ETSI TC SMG

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UPDATE NOTE

Recommendation GSM 09.02 (Phase 1)

Mobile Application Part Specification

- previous released version Jan 1991: 3.8.0
- updated version Jan 1994 : 3.9.0
- updated version Oct 1994 : 3.10.0
- updated version Apr 1995 : 3.11.0

1 Reason for changes

Phase 1 change request (CR 09.02-479) agreed at SMG#14 (Rome) is included. Only updated sheets are provided and reverse pages are provided to ease the updating.

2 Details of change

Change Request	Title	Sections modified	Tdoc SMG
CR 09.02-479 (SMG#14)	Definition of SM-RP-DA	5.13.2.2.1	287/95

Instructions to correct version 3.10.0 are provided, because only correction sheets are provided.

3 Instructions to update GSM Recommendation

To correct Recommendation GSM 09.02 version 3.10.0 please follow the instructions given below.

To delete		To insert	
Page(s)	No of sheets	Page(s)	No of sheets
		Change Control Record	1
1 - 2	1	1 - 2	1
335 - 336	1	335 - 336	1

The version 3.10.0 together with these corrections constitutes version 3.11.0.

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DOCUMENT CHANGE CONTROL RECORD

Recommendation GSM 09.02 (Phase 1)

Mobile Application Part Specification

Released version Jan 1991: 3.8.0
Updated version Jan 1994: 3.9.0
Updated version Oct 1994: 3.10.0
Updated version Apr 1995: 3.11.0

Subject	Decided at	Pages marked	Tdoc SMG	Pages affected
Front sheet		Apr 95		**1** - 2
CR 09.02-479	SMG#14	Apr 95	287/95	335 - **336**

END OF DOCUMENT CHANGE CONTROL RECORD

ETSI/TC SMG

European digital cellular telecommunications system (Phase 1); Mobile Application Part (MAP) Specification Recommendation GSM 09.02

Version : 3.11.0

Date : April 1995

List of contents:

Language of original : English

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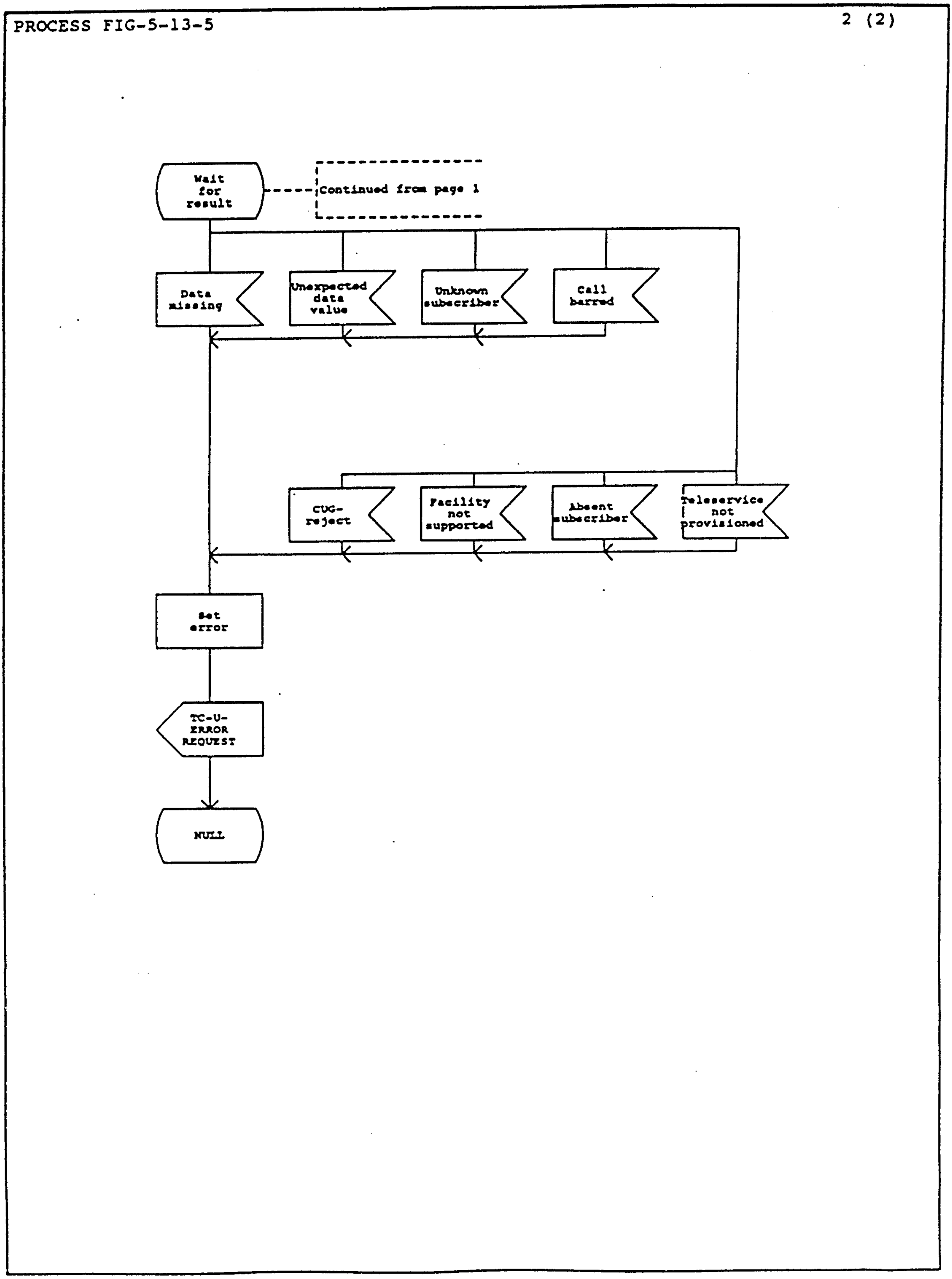
Contents

Figure 5.13.5 (Sheet 2 of 2)
ASE/TCAP Interface procedure in HLR for retrieving short message routing information



5.13.2 Procedure for forwarding of short message

5.13.2.1. General description of the procedure

The procedure is initiated by a GMSC to request the servicing MSC to forward an MS terminated short message to the MS, or by the servicing MSC to request an interworking MSC to forward a MS originated short message to the Service Centre. The procedure is shown in Figure 5.13.6 and consists of the following messages:

- a forward short message message sent from the GMSC to the servicing MSC, or from the servicing MSC to an interworking MSC

- a forwarding acknowledge message or an error message in the return direction.

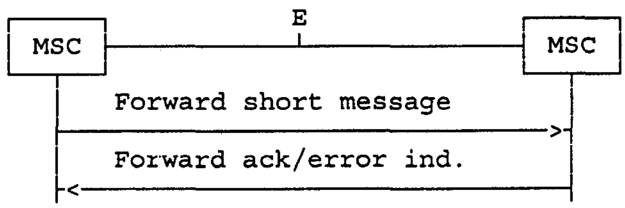


Figure 5.13.6. Forwarding of short message

5.13.2.2 Detailed description of the procedure between a GMSC and the servicing MSC

5.13.2.2.1. Procedure in gateway MSC

The application specific procedure for forwarding a MS terminated short message is shown in Figure 5.13.7.

The procedure is initiated when the short message handling function in the GMSC has obtained the routing information needed to forward a MS terminated short message to the servicing MSC. The GMSC sends a forward short message message containing the destination address SM-RP-DA (either a roaming number or the IMSI), the originating SC-address SM-RP-OA, and the short message SM-RP-UI received from the service centre.

The GMSC will receive one of the following responses:

- a forwarding acknowledge message indicating that the short message has been successfully delivered to the MS. This indication is passed to the SC by the short message handling function in the GMSC.

- a reject indication if the operation has failed due to procedure error, or a timer expiry indication from TCAP. In this case a system failure indication is given to the short message handling function.

- one of the following messages indicating unsuccessful forwarding of the short message:

    - absent subscriber
    - illegal MS
    - unidentified subscriber
    - facility not supported
    - SM delivery failure
    - system failure
    - unexpected data value

ETSI TC SMG

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1. Reason for changes

Phase 1 change request agreed at SMG#09 (Nice) is included. Only updated sheets are provided and reverse pages are provided to ease the updating.

2. Details of change

The frontpage is provided and updated together with the reverse pages.

Change Request	Title	Sections modified	Tdoc SMG
CR 09.02-353r2 (SMG#09)	Transport of BC, HLC & LLC between GMSC, HLR & VLR	6.2.1 6.4.1.2.4 6.4.3.8.9	108/94

Instructions to correct version 3.8.0 are provided, because only correction sheets are provided.

3. Instructions to update GSM Recommendation

To correct Recommendation GSM 09.02 version 3.8.0 please follow the instructions given below.

To delete		To insert	
Page(s)	No of sheets	Page(s)	No of sheets
		Change Control Record	1
1 - 2	1	1 - 2	1
413 - 416	2	413 - 416	2
445 - 446	1	445 - 446	1
473 - 474	1	473 - 474	1

The version 3.8.0 together with these corrections constitutes version 3.9.0.

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ETSI TC SMG

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DOCUMENT CHANGE CONTROL RECORD

Recommendation GSM 09.02

Mobile Application Part Specification

Released version Jan 1991: 3.8.0
Updated version Jan 1994: 3.9.0

Subject	Decided at	Pages marked	Tdoc SMG	Pages affected
Front sheet		Jan 94		1 - 2
CR 09.02-353r2	SMG#09	Jan 94	108/94	413 - 414 415 - 416 445 - 446 473 - 474

END OF DOCUMENT CHANGE CONTROL RECORD

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ETSI/TC SMG

Recommendation GSM 09.02

Mobile Application Part Specification

Version : 3.9.0

Date : January 1994

List of contents:

Language of original : English

Number of pages : 507

TABLE OF CONTENTS

```
-- Call set-up
--
SendInfoForIncomingCall ::= OPERATION
PARAMETER                    SEQUENCE{
        incomingId           CHOICE{
        roamingNumber        [0] IMPLICIT IsdnAddressString,
        imsi                 [1] IMPLICIT IMSI},
        bearerService        [2] IMPLICIT BearerServiceCode OPTIONAL,
        teleservice          [3] IMPLICIT TeleserviceCode OPTIONAL,
        lMsId                [4] IMPLICIT LMsId OPTIONAL,
        dialledNumber        [5] IMPLICIT IsdnAddressString OPTIONAL,
        cug-Interlock        [6] IMPLICIT CUG-Interlock OPTIONAL,
        numberOfForwarding   [7] IMPLICIT NumberOfForwarding OPTIONAL}

ERRORS
        UnallocatedRoamingNumber,
        UnknownSubscriber,
        UnidentifiedSubscriber,
        AbsentSubscriber,
        ImpossibleCallCompletion,
        ForwardingViolation,
        UnexpectedDataValue,
        DataMissing,
        SystemFailure}

LINKED
        CompleteCall,
        ProcessCallWaiting,
        ConnectToFollowingAddress}

--
SendInfoForOutgoingCall ::= OPERATION
PARAMETER           SEQUENCE{
        calledNumber         [0] IMPLICIT IsdnAddressString,
        bearerService        [2] IMPLICIT BearerServiceCode OPTIONAL,
        teleService          [3] IMPLICIT TeleserviceCode OPTIONAL}

ERRORS
        UnknownSubscriber,
        BearerServiceNotProvisioned,
        TeleserviceNotProvisioned,
        CallBarred,
        CUG-Reject,
        DataMissing,
        UnexpectedDataValue,
        SystemFailure}

LINKED
        {CompleteCall}
```

Figure 6.2/5 (Sheet 1 of 3)

ASN.1 Specification of MAP operations types: Call set-up

```
SendRoutingInformation ::= OPERATION
PARAMETER           SEQUENCE{
        msIsdn                  [0] IMPLICIT IsdnAddressString,
        cug-Interlock           [1] IMPLICIT CUG-Interlock OPTIONAL,
        numberOfForwarding      [2] IMPLICIT NumberOfForwarding OPTIONAL,
        networkSignalInfo       [10] IMPLICIT ExternalSignalInfo OPTIONAL}

-- If available from the network the ISDN Bearer Capabilities and the ISDN High Layer
-- Compatibility and Low Layer Compatibility information elements are included in
-- the networkSignalInfo parameter as defined in section 6.4.3.8.9.
-- The information is passed according to the rules specified in GSM 09.07.

RESULT              SEQUENCE{
        imsi                    IMSI,
        routingInfo             CHOICE{
        roamingNumber                       IsdnAddressString,
        forwardingData                      ForwardingData}}

ERRORS
        UnknownSubscriber,
        CallBarred,
        CUG-Reject,
        BearerServiceNotProvisioned,
        TeleServiceNotProvisioned,
        FacilityNotSupported,
        AbsentSubscriber,
        ForwardingViolation,
        SystemFailure,
        DataMissing,
        UnexpectedDataValue}
```

Figure 6.2/5 (Sheet 2 of 3)

ASN.1 Specification of MAP operations types: Call set-up

```
ProvideRoamingNumber ::= OPERATION

PARAMETER            SEQUENCE{
            imsi                      [0] IMPLICIT IMSI,
            mscNumber [1] IMPLICIT IsdnAddressString OPTIONAL,
            msIsdn                    [2] IMPLICIT IsdnAddressString OPTIONAL,
            previousRoamingNumber  [3] IMPLICIT IsdnAddressString OPTIONAL,
            lMsId                     [4] IMPLICIT LMsId OPTIONAL,
            gSM-BearerCapability     [5] IMPLICIT ExternalSignalInfo OPTIONAL,
            networkSignalInfo         [6] IMPLICIT ExternalSignalInfo OPTIONAL}

-- If available from the network the ISDN High Layer Compatibility information element is
-- carried in the networkSignalInfo parameter as shown in section 6.4.3.8.9.
-- The information is passed according to the rules specified in GSM 09.07.

RESULT
            roamingNumber             IsdnAddressString

ERRORS
            {AbsentSubscriber,
            NoRoamingNumberAvailable,
            FacilityNotSupported,
            SystemFailure,
            DataMissing,
            UnexpectedDataValue}
--
CompleteCall ::= OPERATION
PARAMETER            SEQUENCE{
            msIsdn                    [0] IMPLICIT IsdnAddressString,
            category                  [1] IMPLICIT Category OPTIONAL,
            cug-Index                 [2] IMPLICIT CUG-Index OPTIONAL,
            gSM-BearerCapability     [3] IMPLICIT ExternalSignalInfo OPTIONAL,
            noReplyConditionTime     [4] IMPLICIT NoReplyConditionTime OPTIONAL,
            ss-DataList               [5] IMPLICIT SS-DataList OPTIONAL}

ERRORS
            {NoSubscriberReply,
            RadioCongestion,
            BusySubscriber,
            DataMissing,
            UnexpectedDataValue}
--
ConnectToFollowingAddress ::= OPERATION
PARAMETER            SEQUENCE{
            forwardingData            ForwardingData,
            msIsdn                    IsdnAddressString OPTIONAL}
--
ProcessCallWaiting ::= OPERATION
```

Figure 6.2/5 (Sheet 3 of 3)

ASN.1 Specification of MAP operations types: Call set-up

```
-- Paging
--
Page ::= OPERATION
PARAMETER          SEQUENCE{
        imsi                  [0] IMPLICIT IMSI,
        tmsi                  [1] IMPLICIT TMSI OPTIONAL,
        locAreaId             [2] IMPLICIT LocAreaId}


ERRORS
        {AbsentSubscriber,
        UnknownLocArea,
        BusySubscriber,
        SystemFailure,
        UnexpectedDataValue}


--
SearchForMobileSubscriber ::= OPERATION
PARAMETER          SEQUENCE{
        imsi                  IMSI,
        storedLocationArea    CHOICE {
                                      LocAreaId,
                                      NULL}}

RESULT
        currentLocAreaId      LocAreaId


ERRORS
        {AbsentSubscriber,
        BusySubscriber,
        SystemFailure,
        UnexpectedDataValue}

--
```

Figure 6.2/6

ASN.1 Specification of MAP operations types: Paging

AddressString

The type consists of values representing a number used for addressing purposes.

The type can be defined using ASN.1, as follows:

```
AddressString ::= OCTET STRING (SIZE (1..maxAddressLength))
```

where maxAddressLength is an ASN.1 NamedValueand were the "OCTET STRING" is composed of:

a) first octet including a one bit extension indicator, a 3 bits Nature of address indicator and a 4 bits Numbering plan indicator, encoded as follows:

- Bit 8: Extension indicator

0	Extension
1	No extension

- Bit 7-5: Nature of address indicator

000	unknown
001	international number
010	national significant number
011	network specific number
100	dedicated PAD access
101	reserved
110	reserved
111	reserved for extension

- Bit 4-1: Numbering plan indicator, encoded as follows:

0000	unknown
0001	ISDN/Telephony Number Plan (REC E.164)
0010	Spare
0011	Data numbering plan (REC X.121)
0100	Telex numbering plan (REC F.69)
0101	National use
0110	National use
0111	Spare
1000	National numbering plan
1001	Private numbering plan
1111	Reserved for extension

all other values are reserved.

and;

b) following octets representing address signals encoded as a TBCD-STRING parameter.

6.4.1.2.3 IsdnAddressString

This type is a sub-type derived from the AddressString type and is used to represent ISDN numbers.

The type can be defined using ASN.1, as follows:

```
IsdnAddressString ::= AddressString (SIZE (1..10))
```

6.4.1.2.4 ExternalSignalInfo

This data type is defined to allow the Mobile Application Part protocol to carry information elements defined in other Recommendations without any direct reference to their internal structure.

The data type represents any set of information element (including tag and length octets) imported from another signalling protocol. For the user-network protocol, the set of elements may consist of a complete layer 3 message. The protocol to which the information elements belong is indicated by the protocolId element, while the signalling information is contained in the signalInfo element.

The type can be defined using ASN.1, as follows:

```
ExternalSignalInfo ::= SEQUENCE{
                         protocolId   ProtocolId,
                         signalInfo  SignalInfo}

maxExternalInfoLength INTEGER  ::= 200

Signal ::= OCTET STRING (SIZE (1..maxExternalInfoLength))

ProtocolId   ::= ENUMERATED{
                         gsm-0408             (1),
                         gsm-0806             (2),
                         gsm-0808-bssmap      (3),
                         ETS300102-1          (4)}
```

Recommendation GSM 08.06) which is required by the serving BSS to interface properly with the layer-2 on the radio side.

6.4.3.8.2 requestParameters

This identifier refers to a set of subscriber related information requested by a system component.

6.4.3.8.3 sentParameters

This identifier refers to a set of subscriber related information sent by a system component in response to an associated enquiry.

6.4.3.8.4 networkResource

A networkResource identifier refers to a class of network entity.

6.4.3.8.5 traceReference

The traceReference identifier refers to a reference associated to a tracing request. This reference is used by the OMC to identify a specific trace request related to a subscriber.

6.4.3.8.6 cmServiceType

The cmServiceType identifier refers to represent a subscriber service request (eg, call set-up, supplementary service request, short message, ...).

6.4.3.8.7 accessConnectionStatus

The accessConnectionStatus identifier refers to indicate the status of the connection which is established with the mobile subscriber on the radio side.

6.4.3.8.8 traceType

The traceType data type refers to the type of trace associated to a tracing request.

6.4.3.8.9 networkSignalInfo

This parameter is transported as external signal information. The assigned protocol Id shall be ETS 300 102-1.

The network signal information may include a combination of the following information elements as defined in TS GSM 09.07:

- ISDN BC: The tag and length are defined by ETS 300 102-1.
  For the content see GSM 09.07.

- HLC: The tag and length are defined by ETS 300 102-1.
  For the content see GSM 09.07.

- LLC: The tag and length are defined by ETS 300 102-1.
  For the content see GSM 09.07.

When this parameter is used in the SendRoutingInfo operation, the ISDN BC, HLC and LLC shall be included if they are received from the network. When this parameter is used in the ProvideRoamingNumber operation, only the HLC shall be included if it is received from the GMSC.

The information elements are contained in the signalInfo parameter according to the following figure (irrespective of the order).

ISDN BC TAG
LENGTH
CONTENT
HLC TAG
LENGTH
CONTENT
LLC TAG
LENGTH
CONTENT

6.4.3.8.10 accessSignalInfo

This identifier refers to a set of information elements imported from the user-network layer-3 protocol specified in Rec GSM 04.08.

6.4.4 MAP User abort information

MAP user abort information is transferred as the value of the MAP-AbortInformation data type described in the following ASN.1 module described in figure 6.4/12. This data type is mapped onto the UserAbortInformation data type included in the TCAP ABORT message, as defined in Recommendation Q.773. Handling of TC-U-ABORT service is described in section 7.

```
MAP-AbortInformation  DEFINITIONS ::=

BEGIN

IMPORTS
maxSignalInfoLength FROM MAP-Constants;

MAPAbortInformation     ::= SEQUENCE{
                        abortCause ENUMERATED{
                                    unspecifiedReason (0),
                                    versionNotSupported (1),
                                    userResourceLimitation (2),
                                    resourceUnavailableLongTermProblem (3),
                                    resourceUnavailableTemporaryProblem (4),
                                    radioChannelRelease (5),
                                    networkPathRelease (6),
                                    callRelease (7),
                                    associatedProcedureFailed (8),
                                    remoteOperationFailure (9)},
                        additionalInformation OCTET STRING (SIZE(
                                    1..MaxSignalInfoLength))}
                        --
                        -- The internal structure of the OCTET STRING
                        -- is up to the operator

END
```

Figure 6.4/12: ASN.1 Specification of MAP user abort information

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Mobile Application Part Specification

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No changes since the previously distributed version.

ETSI/TC GSM

Title : **Recommendation GSM 09.02**
Mobile Application Part Specification

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1. INTRODUCTION

2. CONFIGURATION OF THE MOBILE NETWORK

3. APPLICATION AND USE OF MAP

4. REQUIREMENTS CONCERNING THE USE OF SCCP AND TCAP

5. MAP PROCEDURES

6. MAP PROTOCOL SPECIFICATIONS

7. MAPPING ON TC SERVICES

1. INTRODUCTION

1.1 Scope

Between the entities of the Public Land Mobile Network there will be a need for an information flow, specific for this system, in order to handle the special behaviour of the roaming Mobile Stations. To transfer this information the Signalling System No 7 specified by CCITT will be applied.

This Recommendation describes the requirements for the signalling system and the procedures needed at the application level in order to fulfil these signalling needs.

Where the term "For further study" (or the abbreviations "FS" or "FFS") is used in this recommendation, this means that this is not relevant for ETSI GSM Phase 1 standard.

1.2 Applicability to GSM

The following procedure is not required in GSM PLMNs:

- Deregistration in the HLR (Para 5.2.3.3.3).

1.3 Abbreviations

The following abbreviations are used in this Recommendation:

AE	Application Entity
ASE	Application Service Element
BSS	Base Station System (BS may be used instead)
EIR	Equipment Identity Register
GMSC	Gateway Mobile-Services Switching Centre
GSM	Groupe Spécial Mobile
HLR	Home Location Register
IMEI	International Mobile Station Equipment Identity
IMSI	International Mobile Subscriber Identity
IWMSC	Interworking Mobile-services Switching Centre
LA	Location Area
MAP	Mobile Application Part
MS	Mobile Station
MSC	Mobile-Services Switching Centre
MSISDN	Mobile Station ISDN Number
MSRN	Mobile Station Roaming Number
PLMN	Public Land Mobile Network
SCCP	Signalling Connection Control Part
SS	Supplementary Services
TC	Transaction Capabilities
TCAP	Transaction Capabilities Application Part
TMSI	Temporary Mobile Station Identity
VLR	Visitor Location Register

2. CONFIGURATION OF THE MOBILE NETWORK

2.1 The entities of the mobile system

To provide the mobile service as it is defined, it is necessary to introduce some specific functions. These functional entities can be implemented in different equipments or gathered. In any case, exchanges of data occur between these entities.

2.1.1 The Home Location Register

This functional entity is a data base in charge of the management of mobile stations. A PLMN may contain one or several HLRs: it depends on the number of mobile subscribers, on the capacity of the equipment and on the organization of the network. All subscription data are stored there. The main information stored there concerns the location of the mobile station in order to be able to route the calls to the subscriber. All the management interventions occur on this data base. This data base is used for routing of calls to mobile stations managed by this HLR. The HLRs have no direct control of MSCs.

Two numbers are attached to each mobile subscription and are stored in the HLR:

- the International Mobile Station Identity (IMSI)
- the Mobile Station International ISDN number (MSISDN)

The data base contains other information such as:

- routing information (e.g. Mobile Station Roaming Number MSRN)
- basic telecommunication services subscription information
- service restrictions (e.g. roaming limitation)
- supplementary services; the tables contain the parameters attached to these services.

The organization of the subscriber data is detailed in Recommendation GSM 03.08.

2.1.2 The Visitor Location Register

A mobile roaming in an MSC area is controlled by the Visitor Location Register in charge of this area. When a mobile appears in a location area it starts a location updating procedure. The MSC in charge of that area notices this registration and transfers to the Visitor Location Register the identity of the location area where the mobile is situated. If this MS is not yet registered, the VLR may allocate a roaming number which will be used to route the calls to this station via the fixed network.

A VLR may be in charge of one or several MSC areas.

The VLR contains also the information needed to handle the calls set up or received by the MSs registered in its data base (for some supplementary services the VLR may have to obtain additional information from the HLR): in its tables the following elements can be found:

- the IMSI
- the Mobile Station International ISDN number
- the Mobile Station Roaming Number, if allocated at location updating.

- the Temporary Mobile Station Identity, if applicable
- the location area where the mobile station has been registered. This data will be used to call the station.
- supplementary service parameters

The information is passed between VLR and HLR by the procedures described in Recommendation GSM 03.12.

The organization of the subscriber data is detailed in Recommendation GSM 03.08.

2.1.3 The Mobile Services Switching Centre

The Mobile Services Switching Centre is an exchange which performs all the switching functions for mobile stations located in a geographical area designated as the MSC area. The main difference between a MSC and an exchange in a fixed network is that the MSC has to take into account the impact of the allocation of radio resources and the mobile nature of the subscribers and has to perform in addition, at least the following procedures:

- procedures required for the location registration (see Recommendation GSM 03.12)
- procedures required for hand-over (see Recommendation GSM 03.09)

2.1.4 The Base Station System

The Base Station System (BSS) is the system of Base Station equipments (tranceivers, controllers, etc...) which is viewed by the MSC through a single interface (interface A) with the functionality as described in Recommendation GSM 08.02.

2.1.5 The Gateway MSC

In the case of incoming calls to the PLMN, if the fixed network is unable to interrogate the HLR, the call is routed to an MSC. This MSC will interrogate the appropriate HLR and then route the call to the MSC where the mobile station is located. The MSC which then performs the routing function to the actual location of the mobile is called the Gateway MSC.

The choice of which MSCs can act as Gateway MSCs is a national matter (e.g. all MSCs or some designated MSCs, ...)

See also Recommendation T/S 43-12.

2.1.6 Equipment Identity Register

This functional unit is a data base in charge of the management of the equipment identities of the mobile stations. See also Recommendation GSM 02.16.

2.2 Configuration of a Public Land Mobile Network

The basic configuration of a Public Land Mobile Network is presented in figure 2.2/1. In this figure the most general solution is described in order to define all the possible interfaces which can be found in any PLMN. The specific implementation in each country may be different: some particular functions may be gathered in the same equipment and then some interfaces may become internal interfaces. In any case the configuration of a PLMN must have no impact on the relationship with the other PLMNs.

In this configuration, all the functions are considered implemented in different equipments. Therefore, all the interfaces are external and need the support of the Mobile Application Part of the signalling system No. 7 to exchange the data necessary to provide the mobile service. From this configuration, all the possible national PLMN organizations can be deduced.

2.3 Interconnection between PLMNs

Since the configuration of a PLMN does not have any impact on other PLMNs, the signalling interfaces specified can be implemented both between the entities within a PLMN and between different PLMNs with or without an intermediate interface equipment which provides a gateway function at the application level. A specific interconnection with a PLMN gateway may appear if the organization of a PLMN does not comply with the specifications: in this particular case the interconnection interface is used to mask, from the remote PLMNs, the national organization which is not in line with the international specifications. The difference in the interface may be found at the lower level (SCCP) since the signalling networks involved in the exchanges of messages are at least independent, with respect to the addressing plans.

2.4 The interfaces within the mobile service

2.4.1 General

The implementation of the mobile service with international roaming implies the exchange of data between the equipments involved in the service. It seems rather logical to use the same network to transfer these data and the call related signalling information. In addition, some of these equipments need to have a signalling interface with the fixed exchanges. The introduction of the No. 7 signalling system and its signalling network in the fixed network will be an opportunity to transfer the data needed to support the mobile service. Where applicable, the No. 7 signalling system should be used to convey the information. To transfer these data, the mobile application will be supported by the Transaction Capabilities Application Part.

2.4.2 Interface between the HLR and the VLR

This interface is used to exchange the data related to the location of the mobile station and to the management of the subscriber. The main service provided to the mobile subscriber is the capability to set-up or to receive calls within the whole service area. To support that purpose the location registers have to exchange data. The VLR informs the HLR on the registration of a mobile station managed by the latter and provides it with the relevant location information . The HLR sends to the VLR all the data needed to support the service to the mobile station. The HLR calls then the previous VLR to inform it that it can cancel the location registration of this station because of the roaming of the mobile.

Exchanges of data may also occur when the mobile subscriber requires a particular service, when he wants to change some data attached to his subscription or when some parameters of the subscription are modified by administrative means.

2.4.3 Interface between the VLR and its associated MSC

The VLR is the location and management data base for the mobile stations roaming in the area controlled by the associated MSC. Whenever the MSC needs data related to a given mobile station currently located in its area, it interrogates the VLR. When a mobile station initiates a location updating procedure with an MSC, the MSC informs its VLR which stores the relevant information in its tables. This procedure occurs whenever a mobile roams to another location area. Also, for instance when a subscriber activates a specific supplementary service or modifies some data attached to a service, the MSC transfer the request to the HLR (via the VLR) which stores these modifications and updates the VLR if required.

2.4.4 Interface between VLRs

When an MS initiates a location updating using TMSI, the VLR can fetch the IMSI and authentication set from the previous VLR.

2.4.5 Interface between the HLR and the MSC

After a call for which the mobile has to be charged, the MSC of this station may send a charging message to the HLR.

When the fixed network is not able to perform the interrogation procedure needed to set-up a call or to forward a short message to a mobile subscriber, the Gateway MSC has to interrogate the HLR of the called subscriber to obtain the roaming number of the called MS (see Recommendation T/S 43-12).

2.4.6 Interface between MSCs

When a mobile station moves from one MSC area to another during a call, a hand-over procedure has to be performed in order to continue the communication. For that purpose the MSCs involved have to exchange data to initiate and then to realize the operation.

This interface is also used to forward short messages.

2.4.7 Interface between the MSC and Base Station Systems

The description of this interface is contained in 08 series of GSM Recommendations.

The BSS-MSC interface will carry information concerning:

- BSS management;
- call handling;
- location management.

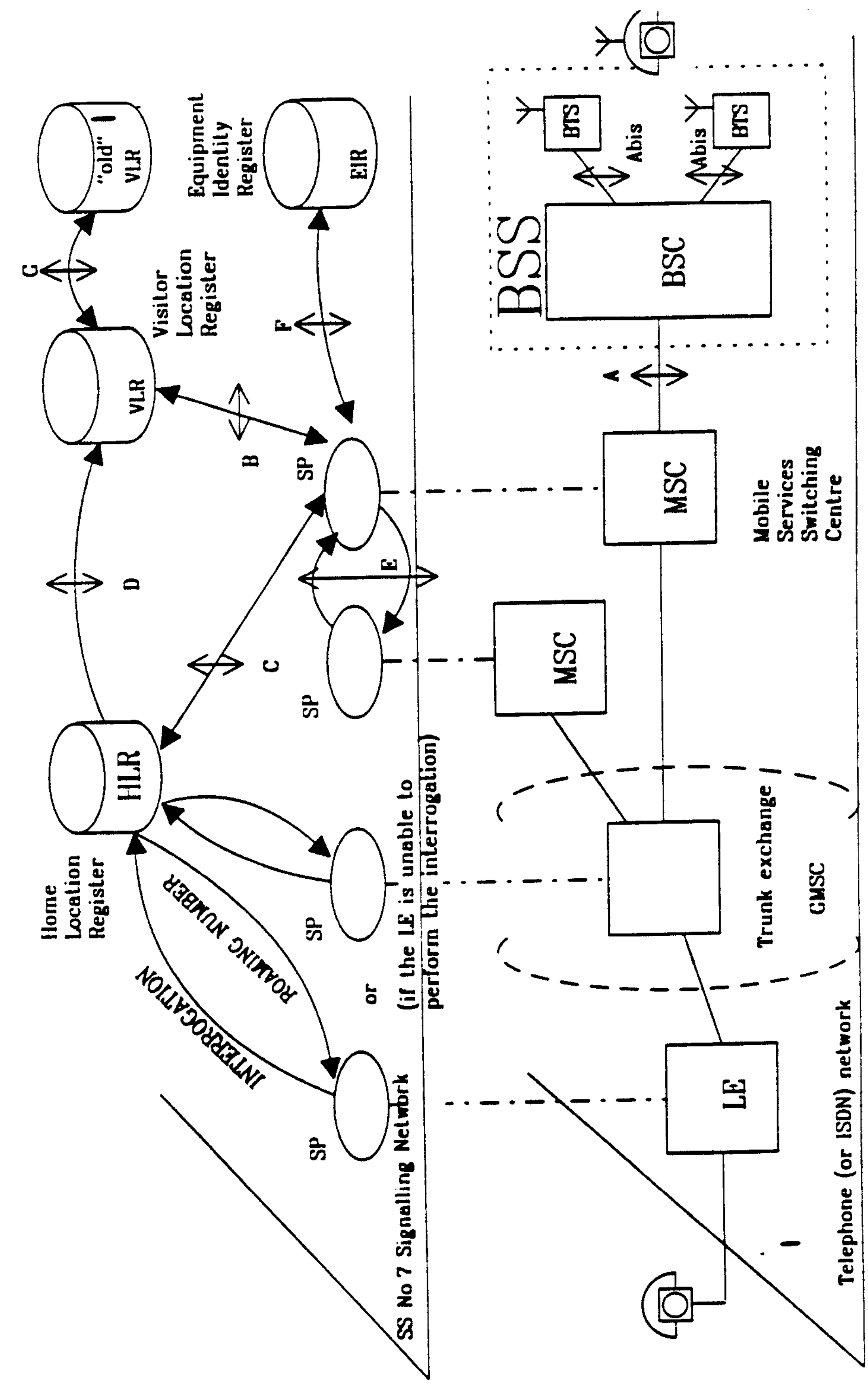
2.4.8 Interface between MSC and EIR:

This interface is used when an MSC wants to check an IMEI.

2.5 Splitting of the data storage

The data attached to each mobile subscriber for management, operation and location are stored in the Location Registers. Some data are duplicated in the HLR and in the VLR, but others may be stored only in one place.

A precise description of the data organization can be found in Recommendation GSM 03.08.



BSS : Base Station System
BSC : Base Station Controller
BTS : Base Tranceiver Station

Figure 2.2/1 Configuration on a PLMN and interfaces

3. APPLICATION AND USE OF MAP

3.1 General

The Mobile Application Part specified here gives the necessary signalling functions required for use of Signalling System No. 7 to provide necessary services such as mobile facilities for voice and non-voice applications in a mobile network. The MAP functions mainly concern the information exchange related to the possibility for a mobile station to roam.

The Mobile Application Part meets all requirements for service features, user facilities and mobile network capabilities for national and international roaming and service provisions.

The Mobile Application Part makes use of services provided by Signalling System No. 7 for the transfer of information between functional units in PLMNs.

3.2 MAP procedures

Most of the following procedures are necessary to allow a mobile subscriber to roam, the whole or parts of the GSM service area.

- Location registration gives the subscriber facilities for receiving and making calls in the whole network.

- Location cancellation of an earlier location registration, e.g. when a new location registration occurs or the subscriber ceases the subscription.

- Deregistration of mobile station initiated by MS.

- Handling of supplementary services allowed for the subscriber, information about relevant parameters may be given as part of location updating procedure.

- Management of subscriber parameters to update home and visitor location registers with regard to changes in subscriber parameters.

- Retrieval of subscriber parameters during a call set up.

- Hand-over which means that a call can be switched over to a better radio channel if the transmission quality drops below a specified level. This radio channel can be controlled by either the same or another MSC (the hand-over can be initiated by the MS or MSC).

- Management of supplementary services procedures.

- Transfer of security related data for authentication and encryption.

- Transfer of charging information between an MSC and the home location register.

- Fault recovery in the network in case of restart with automatic reload in any node involved in the network.

- Procedures to support short message delivery are included in MAP.

- Procedures for MS identification and allocation of TMSI

- Procedures to support subscriber tracing.

- Checking of IMEI

4. REQUIREMENTS CONCERNING THE USE OF SCCP AND TCAP

4.1 Use of SCCP

4.1.1 SCCP Class

MAP will only make use of the connectionless classes (0 or 1) of the SCCP.

4.1.2 Sub-system number

The Application Entities (AEs) defined for MAP consist of several Application Service Elements (ASEs) and are addressed by sub-system numbers (SSNs). The SSN for MAP have been allocated in the SCCP recommendation. The codes in Recommendation T/S 43-03 (SCCP) are:

00000101	for the whole MAP (reserved for possible future use).
00000110	HLR
00000111	VLR
00000100	MSC
00001001	EIR
00001010	is allocated for evolution (possible Authentication centre)

4.1.3 SCCP addressing

4.1.3.1 Introduction

Within the GSM System there will be a need to communicate between entities within the same PLMN and in different PLMN's. Using the Mobile Application Part (MAP) for this function implies the use of Transaction Capabilities (TC) and the Signalling Connection Control Part (SCCP) of CCITT No. 7. The format and coding of address parameters carried by the SCCP for that purpose should comply with recommendation CCITT Q.713 with the following restrictions:

i) Intra-PLMN addressing

- SSN indicator = 1 (MAP SSNs always included)

ii) Inter-PLMN addressing

a) Destinating address

- SSN indicator = 1 (MAP SSN always included)
- Global title indicator = 0100 (Global title includes translation type, numbering plan, encoding scheme and nature of address indicator.)
- The translation type field will be coded "00000000" (Not used.)
- Routing indicator = 0 (Routing on global title)

b) Originating address

- SSN indicator = 1 (MAP SSNs always included)

- Point code indicator = 0

- Global title indicator = 0100 (Global title includes translation type, numbering plan, encoding scheme and nature of address indicator.)

- The translation type field will be coded "00000000" (Not used).

The following sub-sections describe the method of SCCP addressing appropriate for each entity both for the simple intra-PLMN case and where an inter-PLMN communication is required. The following entities are considered:

The Mobile-services Switching Centre (MSC)

The Home location Register (HLR)

The Visitor Location Register (VLR)

The Gateway Mobile-services Switching Centre (GMSC)

The Interworking Mobile-services Switching Centre (IWMSC)

4.1.3.2 The Mobile Switching Centre

There are several cases where it is necessary to address the MSC.

4.1.3.2.1 VLR response message

In this case the MSC will have initiated the dialogue and will have given either a Global Title or a Point Code in the calling address field of the initiating message. A Point Code would be sufficient for addressing as the entities are in the same PLMN.

4.1.3.2.2 HLR response message

In this case the MSC will also have initiated the dialogue. The calling address field of the initiating message will have contained either a Point Code, if the HLR is within the PLMN, or a Global Title, if the HLR is in another PLMN. In either case this is sufficient for addressing.

The Global Title might be the roaming number of the relevant Mobile Station or a service address for an exchange.

4.1.3.2.3 MSC interaction during hand-over

In this case only adjacent or local MSC's will be involved (Inter-PLMN hand-over is not supported) so the Point Code address will be sufficient, or a Global title could be used.

4.1.3.2.4 MSC for short message routing

When a short message has to be routed to a mobile station, the GMSC uses either the MSRN or an MSC identity which comply with E.164 rules. If the exchanges are in the same country, a signalling point code can be used instead.

For MS originating short message, the IWMSC address is derived from the Service Centre address.

4.1.3.3 Home Location Register

There are several cases where the HLR has to be addressed:

4.1.3.3.1 During Call Set up

When a call is initiated the HLR of the called mobile subscriber will be interrogated to discover the whereabouts of the Mobile Station. The addressing required by the SCCP will be derived from the MSISDN number dialled by the calling subscriber. The dialled number will be translated into either a SPC, in the case of local communications within a PLMN, or a Global Title if other networks are involved.(i.e. if the communication is across a PLMN boundary.)

In the case of the calling subscriber being on the fixed network, the interrogation can be initiated from the Gateway MSC of the home PLMN in the general case. If the topology of the network allows it, the interrogation could be initiated from any Signalling Point which has MAP capabilities, e.g. local exchange, outgoing International Switching Centre (ISC) etc.

4.1.3.3.2 Location Updating

When a Mobile Station is turned on in a PLMN, location updating is initiated and the VLR has to communicate with the MS's HLR. The only data for addressing purposes that the VLR has is contained in the IMSI and addressing information for SCCP must be derived from it.

If the HLR is in the same PLMN as the VLR, local translation tables may exist to derive a SPC. For location updating via the international PSTN/ISDN signalling network, the Global title must be derived from the IMSI, using the principles contained in CCITT Recommendation E.214 and the Numbering Plan Indicator (NPI) value referenced by the SCCP recommendations. A summary of the translation from the IMSI (E.212) to Global Title (Described in E.214) is shown below:

E.212 Mobile Country Code translates to E.164 Country Code

E.212 Mobile Network Code translates to E.164 National Destination Code

E.212 Mobile Subscriber Identification Number (MSIN) carried unchanged if within the E.164 number length and terminated by the ST signal. If the Global title is more than 15 digits the number is truncated to 15 by deleting the least significant digits.

This translation will be done at the application level in the VLR. The Global title thus derived will be used to address the HLR. The SCCP calling party address field will be set to the appropriate Global Title for responses from the HLR.

The Global Title can be examined to any depth desired by the fixed network which gives the flexibility to implement physically permanent Gateway MSC's to PLMN's or to directly address the HLR, depending on the topology of the network and the degree of integration of the mobile and fixed network numbering plans. In the outgoing country and the International network, the address can be treated as an ordinary ISDN number.

4.1.3.3.3 VLR requests and responses

In this case a dialogue has already taken place so the VLR will already have stored the SCCP address for the roaming subscribers HLR.

This may be a SPC if it is a communication within one PLMN or it may be a Global title consisting of the MSISDN or the E.164 number allocated to the HLR.

4.1.3.3.4 MSC transactions

In this case, when sending charging information the MSC would request the address of the HLR from the VLR. The MS involved will already have registered in the VLR so the SPC or Global title information for SCCP addressing will be available.

4.1.3.4 VLR transactions

There are several cases when the VLR needs to be addressed:

4.1.3.4.1 Local MSC's transactions

The local MSC when it needs to start a dialogue may know the SPC of the VLR as it is in the same PLMN or a Global Title can be used if appropriate.

4.1.3.4.2 HLR request or response

The HLR will only request information from a VLR if it is aware of the existence of one of its subscribers in that VLR area. This implies that the MS has registered with that VLR and location updating has taken place. Within the location updating message, the VLR would have sent its E.164 service number. This will be used to derive a Global Title or SPC for the communication.

A response from a HLR will be addressed in the same way as the VLR will have sent the appropriate address in the calling party address field.

4.1.3.5 The Gateway MSC

Within one PLMN the Gateway MSC may be addressed using SPC or a Global Title.

In the case of an incoming call to the PLMN, the interrogation of the HLR might be done from the Gateway MSC. In this case the calling party address in the interrogation message would contain the SPC or Global title addressing information to enable the response to be routed correctly. The Global title would be an E.164 number allocated to the Gateway MSC.

4.1.3.6 The Interworking MSC for short message service

The IWMSC is the interface between the mobile network and the network to access to the short message service center. This exchange has an E.164 address known in the HLR or in the MSC. If both entities are is in the same country (i.e. same signalling network) a Signalling Point Code can be used.

4.1.3.7 Summary table

FROM\TO	FIXED NETWORK	HLR	VLR	MSC
FIXED NETWORK	- -	MSISDN	-	-
HOME LOCATION REGISTER	Address given in interro-gation message	-	N: SPC/GT INT: GT given in location updating	N: SPC/GT INT: GT given in the invoke
VISITOR LOCATION REGISTER	-	1)SPC or E.214 2)SPC or E.164 (note 1)	SPC or GT (national only)	SPC or GT (national only)
MOBILE SERVICE SWITCHING CENTRE	-	N:SPC or MSISDN INT:MSISDN	SPC or GT (national only)	N: SPC or GT INT: GT (note 2)

Table 1/ GSM 09.02

N: national
INT: international
GT: Global Title

Note 1: 1) First transaction: correspond to location updating procedure. The VLR has to derive the HLR address from the IMSI of the mobile. The result can be an SPC if both entities are in the same signalling network. If this is not the case, the result will be a Global Title as specified in CCITT Recommendation E.214 (see 3.1.3.3.2 above)

2) For the subsequent transactions, the VLR will use an address given by the HLR at location updating; this address could be either the MSISDN of the subscriber or the HLR number. In the same country, i.e. in the same signalling network, the VLR can use a SPC.

Note 2: Dialogues between MSCs take place when hand-over has to performed and when a short message has to be delivered. In the first case, the transaction is only national.

4.2 Use of TCAP

The Mobile Application part makes use of the services offered by the Transaction Capabilities (TC) of signalling system No. 7. CCITT Blue Book Recommendations Q.771 through Q.775 and T/S 43/BB should be consulted for the full specification of TC.

The OSI Layered reference model (Recommendation X.200) is recognized as a useful tool in defining services and protocol specifications; in this way, the Mobile Application Part can be regarded as including the application process and a part of the layer-7 (i.e, the communication functions) interfacing the Transaction Capabilities Application Part (TCAP).

Transaction Capabilities refers to the protocol structure above the network layer interface (i.e, the SCCP service interface) up to the application layer including common application service elements but not the application specific elements using them. TCAP refers to the part of TC included in the OSI layer-7.

TCAP is structured as a Component sub-layer above a transaction sub-layer. Since only a connectionless service is required, TCAP interfaces directly with the SCCP. The general model is as shown in figure 4.2/1.

The Component sub-layer provides application services for the exchange of protocol data units invoking tasks (operation), and reporting their outcomes (results or errors) plus any non-application specific protocol errors detected by the component sub-layer. The reporting of application specific protocol errors by the user, as distinct from application process errors, is also provided. These services are accessed using the TC-Component handling primitives.

The Transaction sub-layer provides a simple association service over which several related protocol data units can be exchanged. A Transaction termination can be prearranged (no indication provided to the user) or basic (indication provided). These services are accessed through the Component sub-layer using the TC-Dialogue handling primitives.

As a TCAP user, the communication part of the MAP can be modelled by a set of Application Service Elements for each system component consisting of operation, errors and parameters invoked by the processes and sent to the peer entities, using the component sub-layer facilities.

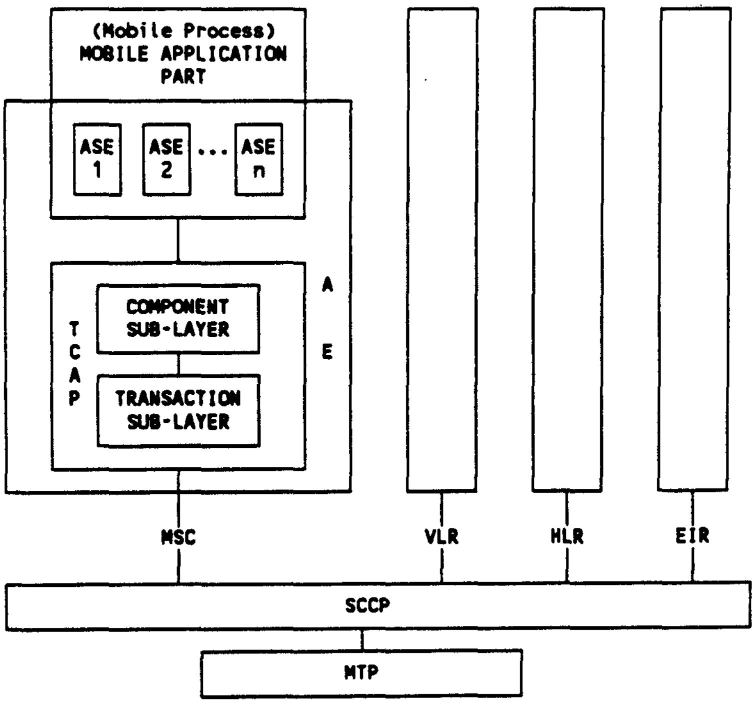


Figure 4.2/1 GSM 09.02
Facilities for supporting the Mobile Application Part in Signalling System No.7.

5 PROCEDURES

5.1 General

5.1.1 Overview of procedures and interfaces

The following procedures are defined below:

- location registration/cancellation (sec. 5.2)
- handling of supplementary services (sec. 5.3)
- retrieval of subscriber parameters during call set-up (sec. 5.4)
- handover (sec. 5.5)
- [illegible]ber management (sec. 5.6)
- operation and maintenance (sec. 5.7)
- fault recovery of location registers (sec. 5.8)
- management of international mobile equipment identities (IMEIs) (sec. 5.9)
- authentication (sec. 5.10)
- management of security related functions (sec. 5.11)
- identity management (sec. 5.12)
- support for short message services (sec. 5.13)
- access request management (sec. 5.14)
- paging and searching for the MS (sec. 5.15)

The procedures are defined for exchange of information between the following system components with interfaces as shown in Figure 5.1.1:

i) between an MSC yand its associated visitor location register (interface B);

ii) between an MSC and a home location register (HLR) (interface C);

iii) between a visitor location register (VLR) and a home location register (HLR) (interface D);

iv) between two MSCs for handover and forwarding of short messages (interface E);

v) between MSCs and EIR (equipment identity register) for management of IMEIs (interface F)

vi) between two VLRs (interface G)

Note: Authentication and security related functions may require the definition of other interfaces.

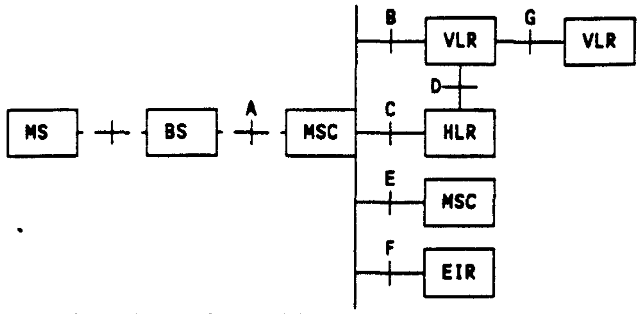


Figure 5.1.1 Interfaces in and between PLMNs for definition of MAP procedures.

MAP may also include procedures for information transfer between MSCs/LRs and operation and maintenance centres. This is regarded to be a national option which is not included in this Recommendation.

In Figure 5.1.I also the interface between the MS and the MSC is shown (interface A). The procedures on interface A are not considered in this Recommendation. However, in order to define the procedures in an MSC, information flows across interface A are shown in terms of abstract interworking messages.

These messages are related to the messages sent on the radio path as defined in Recommendation GSM 09.10. Interface A represents, in an abstract way, the MS-BSS interface defined in Recommendation GSM 04.08 and the BSS-MSC interface defined in Recommendation GSM 08.01.

Note : The following operations may not be implemented in all entities in the network and they may be answered by a REJECT with cause value 'unrecognized operation' :

ForwardShortMessage,
SetMessageWaitingData,
NoteMsPresent,
AlertServiceCenter,
ProcessCallWaiting,
CUGInterlock,
ActivateTraceMode,
DeactivateTraceMode,
SendRoutingInfoForSM.

5.1.2 Specification principles

The procedures are defined using narrative description. In addition, for each procedure two sets of SDL diagrams are provided for clarification:

a) one set describing the application specific protocols between Application Service Element (ASE) peers;

b) one set describing the generation and interpretation of TC primitives, i e the functional procedure across the ASE/TCAP interface.

Figure 5.1.2 shows an example of a simple MAP procedure where only two systems are involved.

The following naming conventions are used in the SDL diagrams in order to make them easily readable:

- signals received from or sent to internal processes are marked with (X)

- messages belonging to the peer-to-peer protocol between ASE peers are written in small letters

- TC primitives are written in capitals.

In the description of the MAP procedures it is assumed that the mobile application:

i) decides whether a procedure is to be performed by using an already existing transaction or by beginning a new transaction;

ii) decides whether the transaction is to be continued or ended at the termination of a procedure. This decision will depend on whether or not an associated procedure requiring the transaction has to be invoked or has been invoked but not terminated.

For the ASE/TCAP interface procedures the dialogue handling primitives, except abort primitives, are not shown in the SDL diagrams.

The primitive name TC-(U-)REJECT INDICATION is used to indicate either a TC-L-REJECT INDICATION primitive, a TC-R-REJECT INDICATION primitive or a TC-U-REJECT INDICATION primitive.

The cause indications that can be contained in TC-(U-)REJECT primitives are given in CCITT Recommendation Q.773.

TC-U-REJECT REQUEST primitives are used by the receiving user to reject an INVOKE component with formal parameter errors (mistyped component). For the MAP procedures no discrimination between various problem codes is shown. The normal operation is that the user receiving the INVOKE component takes no action on it. The user having issued the INVOKE components will abandon the operation and the transaction. Other actions (e g for operation and maintenance) are left to the discretion of the administrations.

Note : TC-(U-)REJECT is not used :

i) if an optional parameter which is required by the context is not included in the INVOKE component. In this casethe return Result Error type Data Missing is used to report the error.

ii) if a parameter in the INVOKE component has a value not allowed by the context. In this case the Return Error type Unexpected Data Value is used.

If a RESULT component is received with parameter errors, the user will generate a reject condition and take actions towards the application process as shown in the specification. The reject condition will normally result in abandoning the operation. In the ASE/TCAP interface procedures it is not shown that a user reject of a RESULT component is actually sent back to the other user (i e the reject timer state is not shown in the SDL diagrams) except in those cases where the reject condition is required to be known for proper follow up activities. User reject of ERROR components is not shown in the procedures.

The primitive name TC-ABORT INDICATION is used as a generic name at the receiving user for both types of abort primitives: TC-U-ABORT and TC-P-ABORT.

TC-U-ABORT REQUEST primitives are used at the sending user when a dialogue by that user is to be terminated for user specific reasons, e g an associated operation has been abnormally terminated, an operation has been invoked for a call and the call is released before the operation has been terminated, a handover is cancelled, etc.

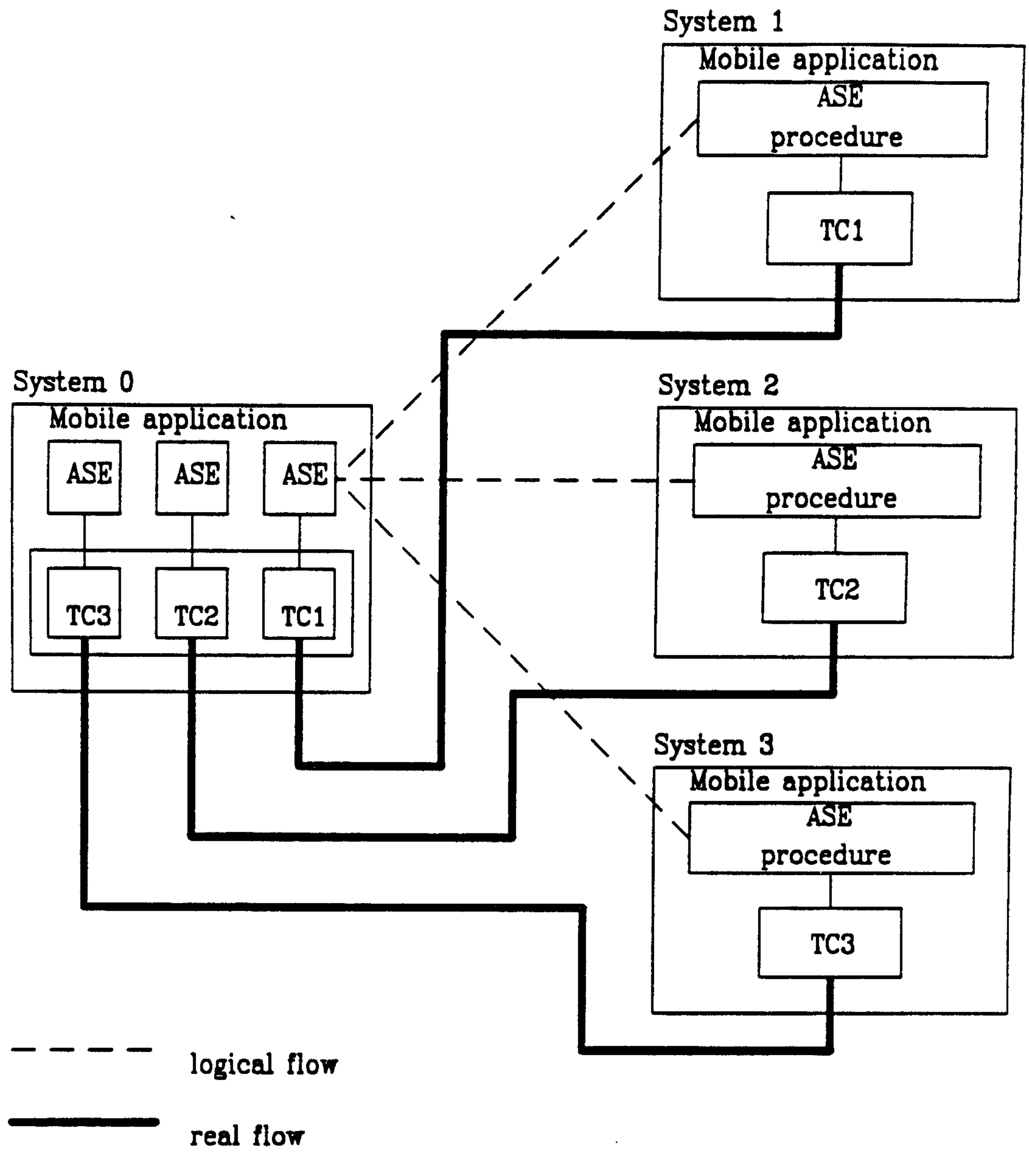


Figure 5.1.2 Logical and real information flows between MAP application entities in two systems.

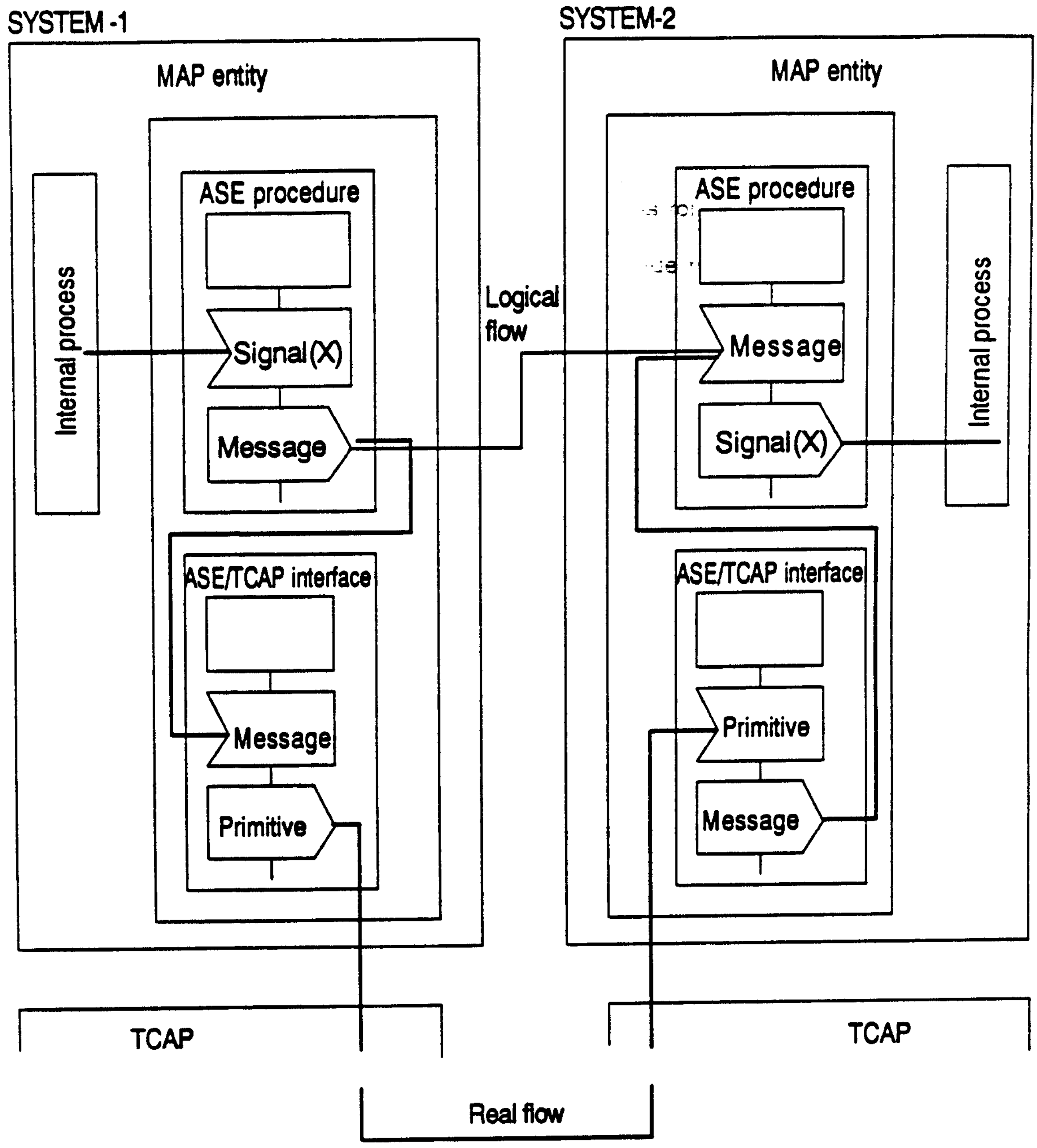


Figure 5.1.3 Logical and real information flows when one ASE procedure interacts with other ASE procedures at different locations.

In some cases (e g handover) a MAP procedure in one system requires interactions with MAP procedures in several other systems. An example of such a configuration is shown in Figure 5.1.3. In this example system 0 operates a procedure which requires simultaneous interactions with three other systems (systems 1, 2 and 3).

For system 0 only one ASE procedure is defined in some cases.In other cases it is more convenient to define one ASE procedure for each operation and assuming that the ASEs of one system interact through an interworking function. However the interactions with the ASEs of the other systems require one ASE/TCAP interface for each interaction (denoted as TC1, TC2 and TC3 in the Figure).

The principles described above will also be apparent from the text and the SDL diagrams associated with each of the procedures.

The description of each procedure is structured in the following way:

i) first, all functional entities and interfaces involved are identified;

ii) second, a general overview of the procedure is given where the main information flows between functional entities are described;

iii) third, a detailed description of the procedures in each functional entity is given using SDL diagrams for clarification.

5.1.3 Distribution of messages at the ASE/TCAP interface

TCAP will not distribute messages (or the associated primitives) to the relevant ASE procedure of MAP. This distribution must take place in the ASE/TCAP interface procedure.

However, since this function is design dependent, it will not be specified in this Recommendation. In the specification of the ASE/TCAP interface procedures it is assumed that this activity has already taken place.

5.1.4 Mapping between MAP procedures and TCAP operations

The mapping between MAP procedures and TCAP operations is given in section 7. In each ASE/TCAP interface procedure the operation name is also given against the TC-INVOKE primitives.

5.2 Location registration/cancellation

5.2.1 Location registration

5.2.1.1 Definition of interfaces for location registration

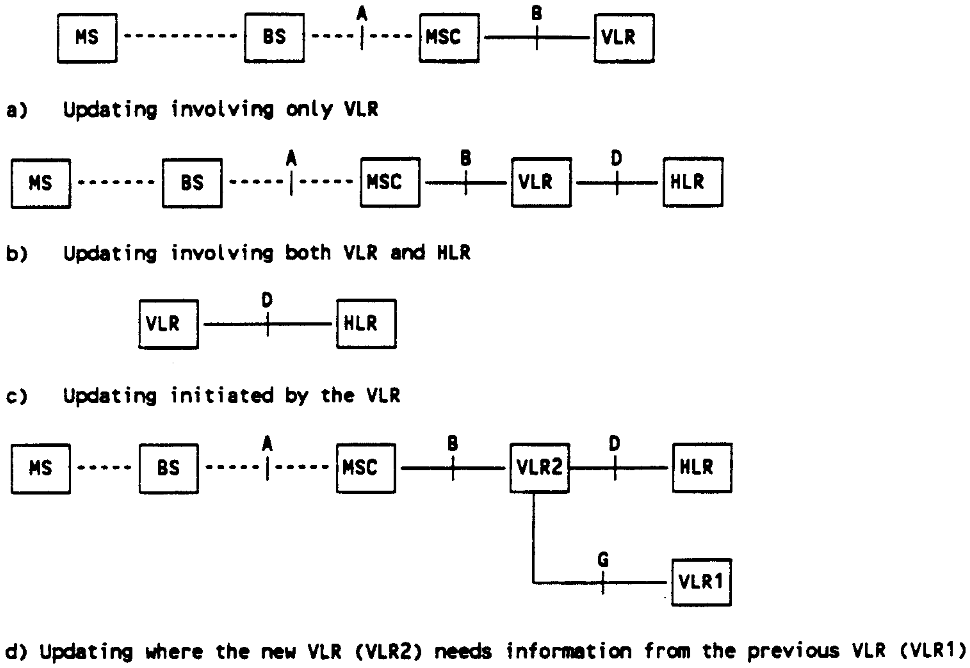


Figure 5.2.1 Interfaces related to location registration

Figure 5.2.1 shows the system components and interfaces involved in the procedure. Four cases are identified:

i) the location registration involves only a location register associated with the MSC (Figure 5.2.1a).

This case applies when the MS initiates a location updating within the area covered by the MSC and new routing information need not be provided to the home location register;

ii) the MS registers in a new visitor location register or between areas of a visitor location register where new routing information has to be provided to the home location register (Figure 5.2.1b);

iii) the visitor location register may initiate location registration (Figure 5.2.1 c) in the following cases

- if the "HLR confirmed indicator" is set to false and the VLR receives an operation indicating that the MS is present (e.g. IMSI attach, outgoing call set-up, operation of a supplementary service),

- the visitor location register has to reallocate mobile station roaming numbers (applies if the mobile station roaming number is allocated at location registration);

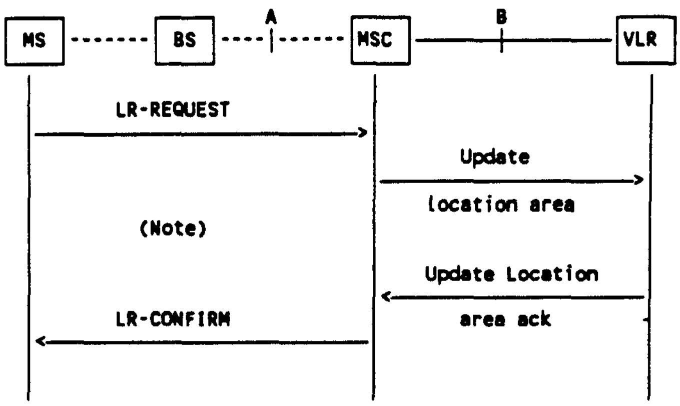
iv) the MS registers in a new visitor location register (VLR2) and identifies itself by the temporary mobile station identity (TMSI) allocated to it in the previous VLR (VLR1). VLR2 must then obtain the IMSI from VLR1 before the HLR can be updated (Figure 5.2.1d)

5.2.1.2 General description of location registration

5.2.1.2.1 Updating involving only the visitor location register

The procedure when initiated by the MS is shown in Figure 5.2.2. The conditions for initiation are defined in Recommendation GSM 03.12.

Receiving a request for location register updating (LR-REQUEST) the MSC sends the update location area message to its associated location register. This message will contain location information as required.



Note: For details of the procedure on the radio path, see Recommendation GSM 04.08. The signals shown here are those generated by the interworking procedure between the MAP application specific entity and the signalling on the radio path.

Figure 5.2.2 Updating involving only the visitor location register.

The location register will analyse the IMSI or TMSI contained in the message, as well as other parameters (see § 6). If the updating is within the area controlled by the location register and no information needs to be provided to the home location register, the visitor location register will return the update location area acknowledge message.

If the updating is unsuccessful, the VLR will return an indication giving the cause for unsuccessful operation.

The MSC will terminate the procedure by signalling on the radio path as defined in Recommendation GSM 04.08 (indicated by the signal LR-CONFIRM in Figure 5.2.2).

5.2.1.2.2 Updating involving both a VLR and an HLR

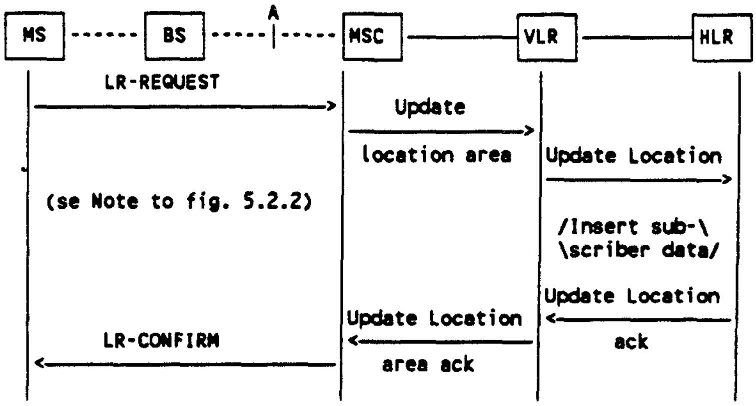


Figure 5.2.3 Updating involving both a VLR and an HLR

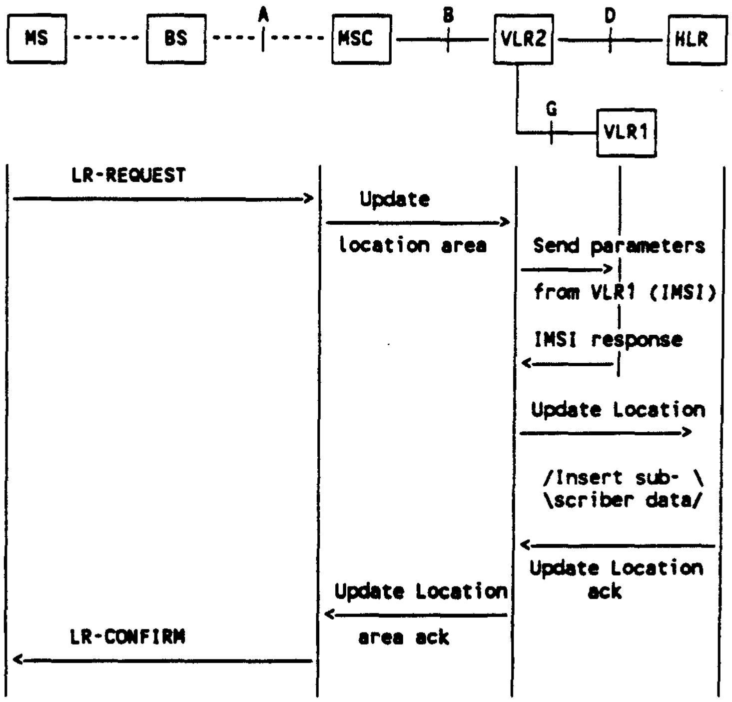


Figure 5.2.4 Updating where the MS identifies itself by using the TMSI allocated to it by the previous VLR (VLR1)

The procedure for location registration is shown in Figures 5.2.3 and 5.2.4.

The procedure on the radio path and the procedure between the MSC and the visitor location register (VLR) are as described in 5.2.1.2.1.

In Figure 5.2.3 the MS identifies itself using the IMSI. Then the new VLR can identify the HLR of the MS directly. In Figure 5.2.4 the MS identifies itself using the TMSI allocated to it in the previous VLR. The LR-REQUEST will also contain a location area identification from which the identity of the previous VLR (VLR1) is derived. The new VLR (VLR2) must then obtain the IMSI by interrogating the previous VLR by sending the MAP message send parameters (IMSI). The previous VLR responds by the message send parameters acknowledge (IMSI response) containing the IMSI and the authentication parameters. If the IMSI response is not received, the new VLR tries to get the IMSI from the MS (5.12, identity management).

When the new VLR has received the IMSI either from the MS or from the previous VLR, the new VLR will send the update location message to the home location register of the MS. This message will contain location information (a combination of mobile station roaming number, MSC number, VLR number, local mobile station identity, depending upon whether call routing information is provided to the HLR at location registration or at incoming call set-up).

If the MS is allowed to roam, the home location register will return the update location acknowledge message (including the HLR number). The information element required by the VLR (category, supplementary services parameters) are provided to the VLR in the operation insert subscriber data of § 5.6.2. The details of this operation are not included in the following description of the location updating procedures.

The visitor location register will send the update location area acknowledge message to the MSC.

If the MS is not allowed to roam, the home location register will mark the MS with a roaming not allowed indicator and return the roaming not allowed message in response to the update location message. The visitor location register will then send the roaming not allowed message to the MSC and delete all MS data. The reason for refusing the location updating is also sent to the MS in the LR-CONFIRM message.

When the roaming not allowed indicator is set and the immediate call forwarding service is not active, the HLR will bar incoming calls to the MS. If the immediate call forwarding service is active, the HLR will forward the call to the required destination. If the MS is making a call when it is in an area into which roaming is not allowed, this will correspond to the case when the MS is not known in the VLR.

5.2.1.2.3 Location register updating initiated by VLR

If the "HLR confirmed indicator" is set to false, the visitor location register may initiate location register updating if the VLR receives an attach IMSI message, a process access request message or a search acknowledge message.

The VLR may also initiate location register updating if the VLR has to reallocate mobile station roaming numbers (only if mobile station roaming numbers are allocated at location registration).

Other cases where the VLR initiates location register updating may be identified in the future.

Note: In these cases the call set-up or operation of the supplementary service is suspended until the updating has been completed.

The procedures for updating the home location register are shown in Figure 5.2.5 and are similar to those described in 5.2.I.2.2 for information exchange between the visitor location register and the home location register.

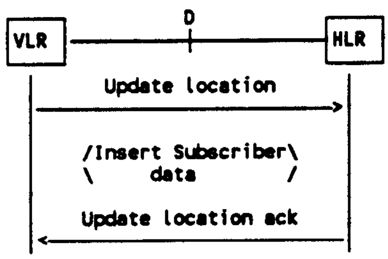


Figure 5.2.5 Updating initiated by VLR

5.2.1.3 Detailed procedures for location registration

5.2.1.3.1 Procedures in the MSC

Figure 5.2.6 shows the application specific procedures and Figure 5.2.7 shows the ASE/TCAP interface procedures. For this purpose the MSC only requires one TC interface, i.e. towards its associated VLR.

The update location area message is sent in a TC-INVOKE REQUEST primitive. Time-out supervision is requested from TCAP (timer T-lau). Timer T-lau must be large enough to allow the VLR to perform all functions as defined in 5.2.1.3.2. The following responses may be received from TCAP:

- TC-RESULT-L INDICATION primitive containing the update location area acknowledge message. This message indicates a successful outcome of the procedure and the roaming allowed indication is returned to the MS (in the LR-CONFIRM (X) message);

- if the update location area acknowledge message contains parameter errors, a reject request is returned and an updating failure indication is provided to the MS;

- TC-L-CANCEL INDICATION primitive which is seen by the ASE as a timer expired message. The indication provided to the MS is updating failure;

- TC-(U-)REJECT INDICATION primitive which is seen by the ASE as a reject indication message containing the cause for rejection as inserted by the VLR or TCAP. The indication updating failure is sent to the MS. As an option the MSC may initiate an alarm condition since the TC-(U-)REJECT INDICATION normally will indicate a protocol error. The MSC should not restart the operation;

- an associated procedure may fail, the MS may release the radio path or the radio path may be interrupted. In such cases the procedure is terminated by a TC-U-ABORT REQUEST primitive, containing the respective abort cause. Similarly, the MSC may receive a TC-ABORT INDICATION primitive. In this case the updating failure indication is provided to the MS;

- a negative result is received in a TC-U-ERROR INDICATION primitive and the actions taken by the MSC are as follows:

  i) roaming not allowed in the new area. This indication is provided to the MS;

  ii) illegal subscriber is received when authentication was performed in conjunction with the location registration and the MS did not pass the authentication check (see § 5.10 for procedures). The condition is shown to the ASE as an illegal MS message and the corresponding information is provided to the MS. Since this case may correspond to fraudulent access from an MS, an alarm condition may be set in the MSC;

  iii) system failure. The updating failure indication is provided to the MS;

  iv) unknown subscriber. This indication is provided to the MS and, as an option, an alarm condition may be set in the MSC;

  v) unknown location area, or unexpected data value. The updating failure indication is provided to the MS. An error condition is set in the MSC since the receipt of these messages may indicate fault conditions in the MSC.

5.2.1.3.2 Procedures in the VLR

The detailed procedures in the VLR are given in Figures 5.2.8, 5.2.9, 5.2.10 and 5.2.11.

The application specific procedure in the VLR associated with the MSC is shown in Figure 5.2.8. When an update location area message is received from the MSC, various decision processes take place:

- if there are parameter errors in the message, a reject indication or the unexpected data value message is returned, as appropriate;
- if the indicated location area is not known in the VLR, the unknown location area message is returned;
- if the MS is already registered in the VLR, i.e. the IMSI or TMSI used is known by the VLR, updating of the HLR needs only take place if the "HLR confirmed indicator" is set to false. Otherwise the update location area acknowledge message is returned to the MSC, after initiation of ciphering and TMSI reallocation, if required;
- if the MS is not registered in the VLR, the VLR can only update the HLR if the update location area message contains enough routing information, i.e. either the IMSI or a TMSI plus the location area identity (LAI) of the previous location area. In the first case the VLR will derive the required routing information for accessing the HLR of the MS. In the latter case the LAI will enable the VLR to derive the address of the previous VLR (VLR1) and to initiate the send parameters operation containing a request for IMSI and authentication parameters. The previous VLR will in response provide the IMSI and the authentication parameters of the MS. If the IMSI is not obtained (receipt of unidentified subscriber, reject or unexpected data value), the new VLR may request the MS to identify itself by using the IMSI. The identification procedure will also be used if the MS identifies itself with a TMSI which is not known in the VLR and for which the address of the previous VLR cannot be derived. If the identification procedure fails for any reason, the system failure message is returned to the MSC;
- authentication may be required during location register updating. If the authentication parameters are not already stored in the VLR, they may be obtained either from the previous VLR or from the HLR depending on whether the MS identified itself by the TMSI or the IMSI. The authentication procedure towards the MSC/MS will take place (state 2 "Wait for authentication"). This procedure is defined in § 5.10 and is only included here to identify which actions need to take place depending on the outcome of the procedure: the illegal MS message is generated if authentication based on IMSI failed or authentication based on TMSI failed and no new attempt based on IMSI is to be performed (Note, for a new attempt based on IMSI, the IMSI is to be obtained from the MS first). The unknown subscriber message is generated if the authentication procedure required an interrogation of the HLR and the HLR reported the unknown subscriber condition. The system failure message is generated if the authentication procedure failed for other reasons (e.g. authentication parameters are not obtained) and the VLR does not support stand alone operation.

The procedure for updating of the HLR is as follows. The VLR first sends the update location message to the HLR. A successful outcome is indicated in the update location acknowledge message. The VLR will then set the "HLR confirmed indicator" to true and send the update location area acknowledge message to the MSC, after initiation of ciphering and TMSI reallocation, if required.

Unsuccessful outcome is indicated in the messages

- roaming not allowed if the MS is not allowed to roam into the area controlled by the VLR. The VLR will not store any information on that MS;

- unknown subscriber if no subscription information on the MS is contained in the HLR. The VLR will then not keep any information on that MS.

The corresponding error messages are sent to the MSC if the MSC initiated the updating.

If the location updating procedure to the HLR fails (receipt of a system failure message, an unexpected data value message, a reject indication, a timer expired indication, or an update location acknowledge message with parameter errors) and the VLR does not support stand alone operation, the system failure message is sent to the MSC. If stand alone operation is supported and "old" MS data are present, the update location area acknowledge message is sent to the MSC, after initiation of ciphering and TMSI reallocation, if required.

The VLR may also return a reject request if there are parameter errors in the message.

Updating of the HLR may also be initiated by other processes in the VLR, e.g. if the mobile station roaming numbers have to be reallocated.

For location updating purposes the VLR must support three MAP interfaces:

- to the MSC (Figure 5.2.9)

- to the HLR (Figure 5.2.l0)

- to the previous VLR (Figure 5.2.ll)

The ASE/TCAP interface procedures are as follows:

At the VLR/MSC interface (Figure 5.2.9) the VLR will receive a TC-INVOKE INDICATION primitive containing the update location area message. Either of the following responses may be received from the application specific procedure of Figure 5.2.8:

- update location area acknowledge message if the updating was successful and the MS is allowed to roam into the area. The message is sent in the TC-RESULT-L REQUEST primitive;

- reject request if procedure errors are discovered in the update location area message. This is sent in a TC-U-REJECT REQUEST primitive;

- other unsuccessful events are returned in TC-U-ERROR REQUEST primitive:

  i) roaming not allowed;
  ii) illegal MS;
  iii) system failure;
  iv) unknown subscriber;
  v) unknown location area;
  vi) unexpected data value.

At the VLR/HLR interface (Figure 5.2.l0) the VLR initiates the operation update location sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-lu. The results of the procedure are as follows:

- the update location acknowledge message is contained in the TC-RESULT-L INDICATION primitive;

- if timer T-lu expires, this is indicated in a TC-L-CANCEL INDICATION primitive;

- if the HLR or TCAP rejects the operation because of procedure errors, the cause is received in a TC-(U)REJECT INDICATION;

- if the updating is unsuccessful, the cause is received in a TC-U-ERROR INDICATION primitive:

  i) unknown subscriber;
  ii) roaming not allowed;
  iii) unexpected data value;
  iv) system failure.

At the VLR/previous VLR (VLR1) interface (Figure 5.2.11) the VLR initiates the operation send parameters (IMSI). VLR1 is requested to provide the IMSI corresponding to the indicated TMSI, and also authentication parameters for that MS. TCAP is requested to supervise the procedure by the timer T-par. The results of the procedure are as follows:

- the send parameters acknowledge (IMSI response) message is contained in a TC-RESULT-L INDICATION primitive. Two cases may occur:

  i) only IMSI
  ii) IMSI + authentication set;

- the TC-L-CANCEL INDICATION primitive is used to indicate expiry of timer T-par;

- the TC-(U-)REJECT INDICATION primitive is used to indicate procedure errors discovered by the previous VLR or TCAP;

- the TC-U-ERROR INDICATION is used to indicate an unsuccessful outcome as follows:

  i) Unidentified subscriber;
  ii) unexpected data value.

5.2.1.3.3 Procedures in the HLR

The procedures are shown in Figures 5.2.12 and 5.2.13.

The application specific procedure for location registration in the HLR is shown in Figure 5.2.12 and is as follows:

- if the MS is unknown in the HLR, the unknown subscriber message is returned;

- if the MS is not allowed to roam into the area controlled by the VLR, the roaming not allowed message is returned. The HLR will set a roaming not allowed indicator which will be used for barring or forwarding of MS terminating calls and initiate the location cancellation procedure of § 5.2.2 towards the previous VLR.

- if the MS is allowed to roam into the area, the update location acknowledge message is returned to the VLR.

- if the message contains parameter or data errors, the HLR ignores the message and returns a reject request or the unexpected data value message depending upon the nature of the error.

In case the MS is known and no parameter or data errors occurred it is checked whether the "SS ind" for the MS is set to false due to restoration of the HLR. In that case, the check SS procedure is invoked.

If the MS is allowed to roam into the area, the subscriber parameters are transferred to the VLR by using the insert subscriber data operation of § 5.6.2. In case of successful parameter transfer, a "MS present" indication is set in order to alert service centers that the MS is available for SMS, and the update location acknowledge message is returned to the VLR. Otherwise, a system failure indication is returned.

If the update location message is received from a new VLR, the HLR will initiate the location cancellation procedure of § 5.2.2 towards the previous VLR.

The ASE/TCAP procedure is contained in Figure 5.2.13. The TC-INVOKE INDICATION primitive will contain the update location message. The results are returned as follows:

- a TC-U-REJECT REQUEST primitive is used to provide the cause if procedure errors are discovered;

- the update location acknowledge message is returned in the TC-RESULT-L REQUEST primitive;

- unsuccessful outcomes are contained in a TC-U-ERROR REQUEST primitive as follows:

  i) unknown subscriber;
  ii) roaming not allowed;
  iii) unexpected data value;
  iv) system failure.

The insert subscriber data operations will use the transaction opened by the update location operation.

5.2.1.3.4 Procedures in the previous VLR (VLR1)

The application specific procedure is shown in Figure 5.2.14.

On receiving the send parameters (IMSI) message the previous VLR will return:

- the send parameters acknowledge (IMSI response) message if the TMSI is valid. This message will also contain authentication parameters if requested by the new VLR;

- the unidentified subscriber message if the TMSI is not allocated in the VLR;

- a reject request or unexpected data value message is sent if the message contains parameter or data errors.

The interface procedure is contained in Figure 5.2.l5. The previous VLR will receive the send parameters (IMSI) message in the TC-INVOKE INDICATION primitive. The results are returned as follows:

- a TC-U-REJECT REQUEST primitive is used to provide the cause if procedure errors are detected;

- the send parameters acknowledge (IMSI response) message is returned in the TC-RESULT-L REQUEST primitive. Two cases may occur:

  i) only IMSI
  ii) IMSI + authentication set;

- unsuccessful outcomes are reported in a TC-U-ERROR REQUEST primitive as follows:

  i) unidentified subscriber;
  ii) unexpected data value.

Figure 5.2.6 (Sheet 1 of 2)

Application specific procedures in MSC for location registration

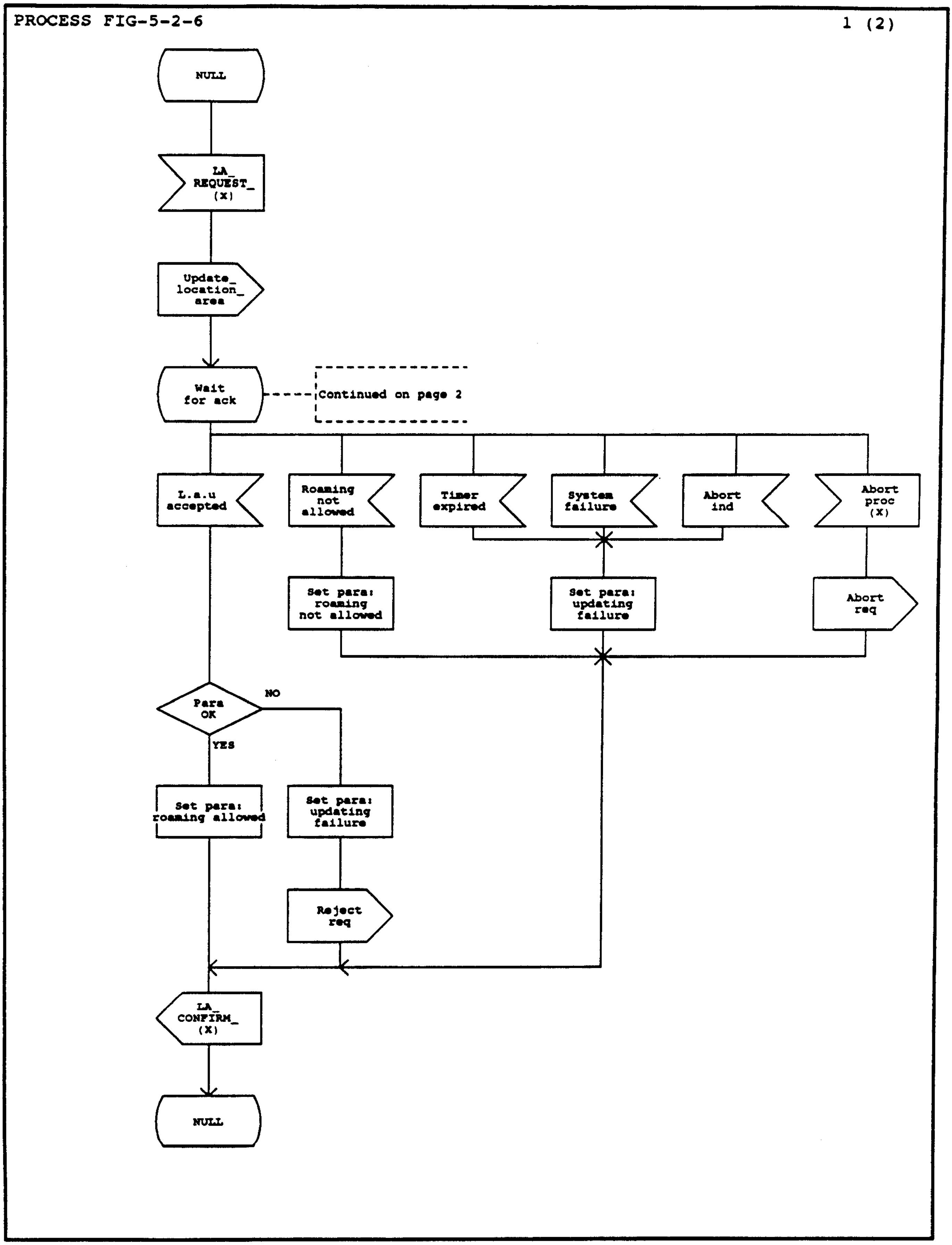


Figure 5.2.6 (Sheet 2 of 2)

Application specific procedures in MSC for location registration

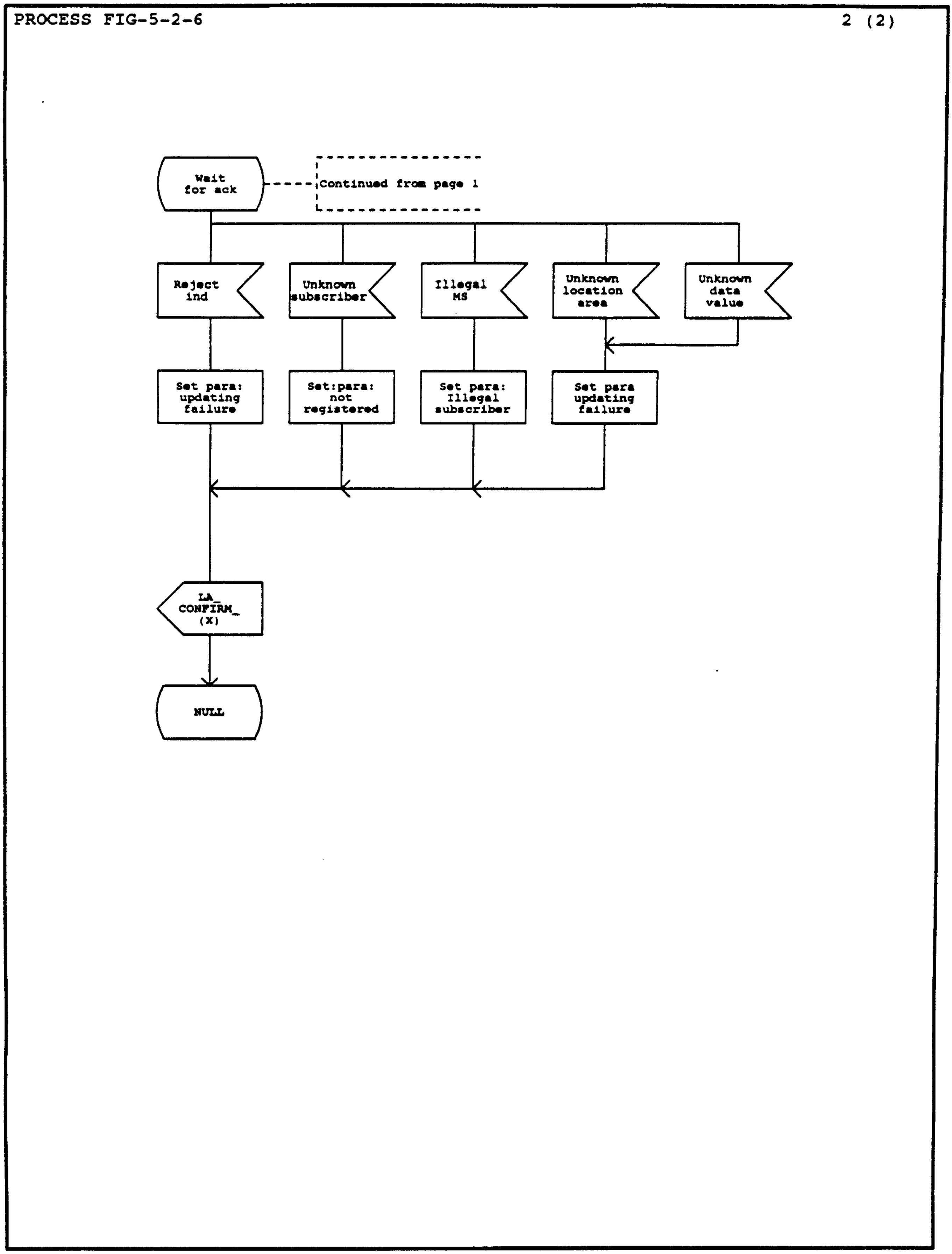


Figure 5.2.7

ASE/TCAP interface procedure in MSC for location registration

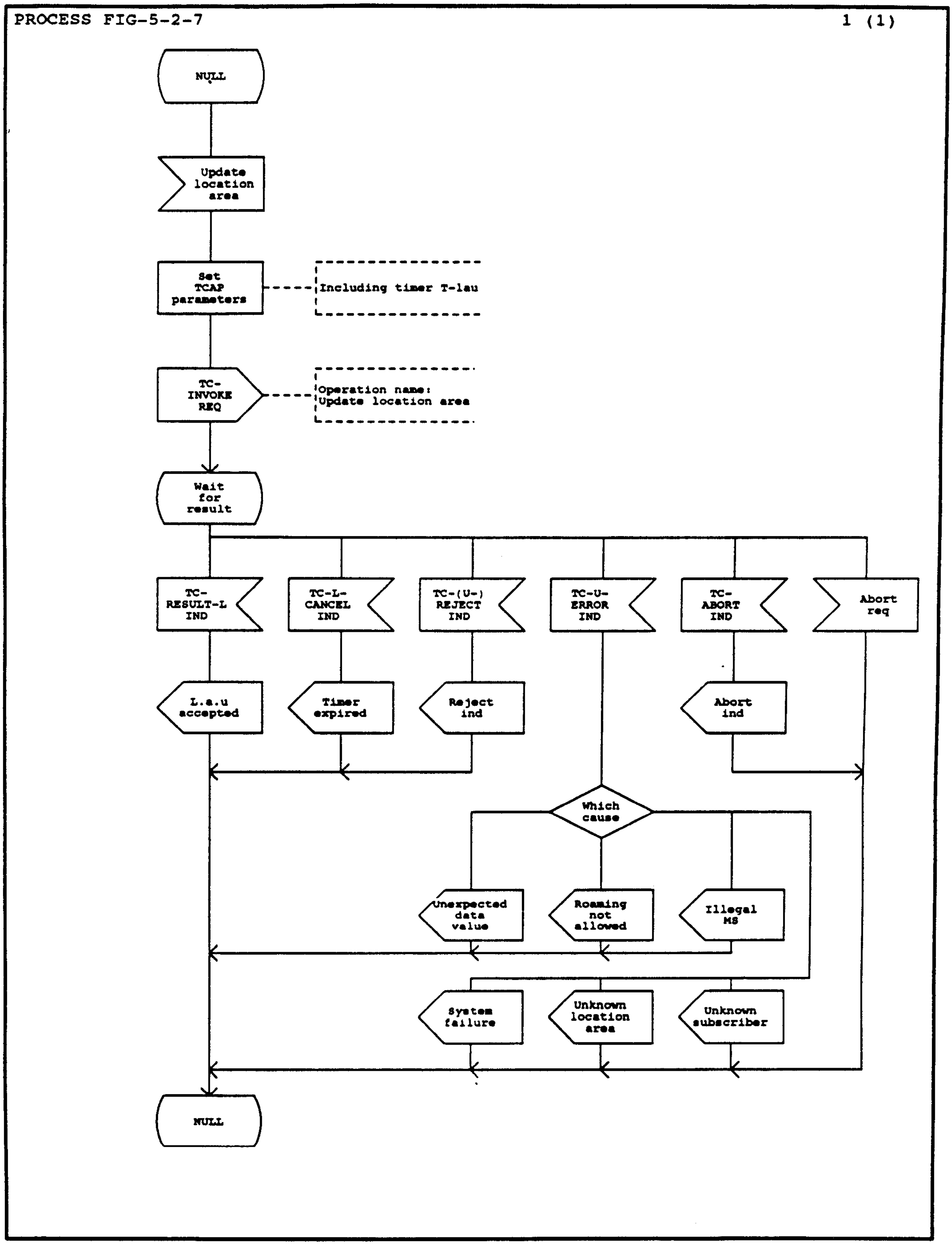


Figure 5.2.8 (Sheet 1 of 5)

Application specific procedures in VLR for location registration

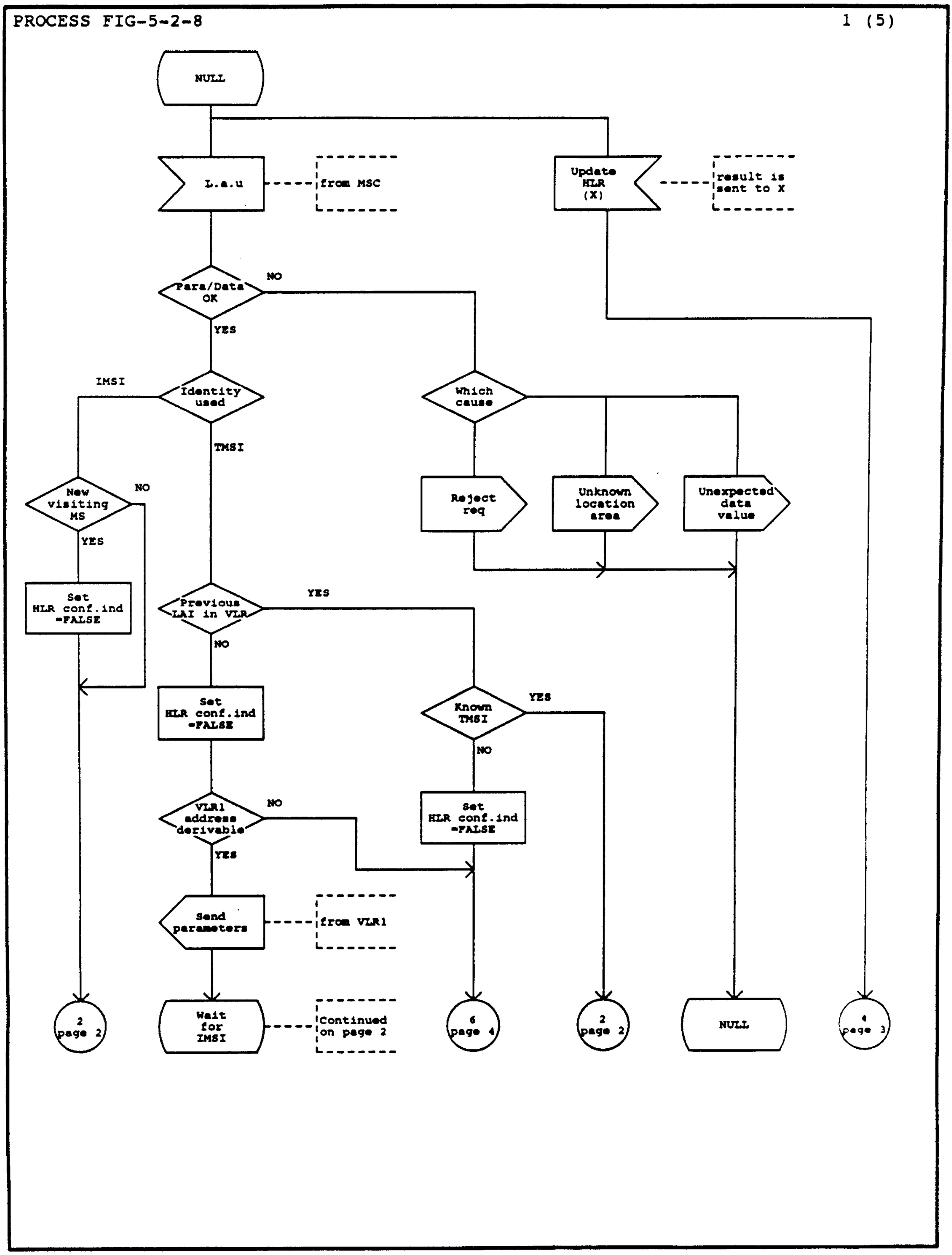


Figure 5.2.8 (Sheet 2 of 5)

Application specific procedures in VLR for location registration

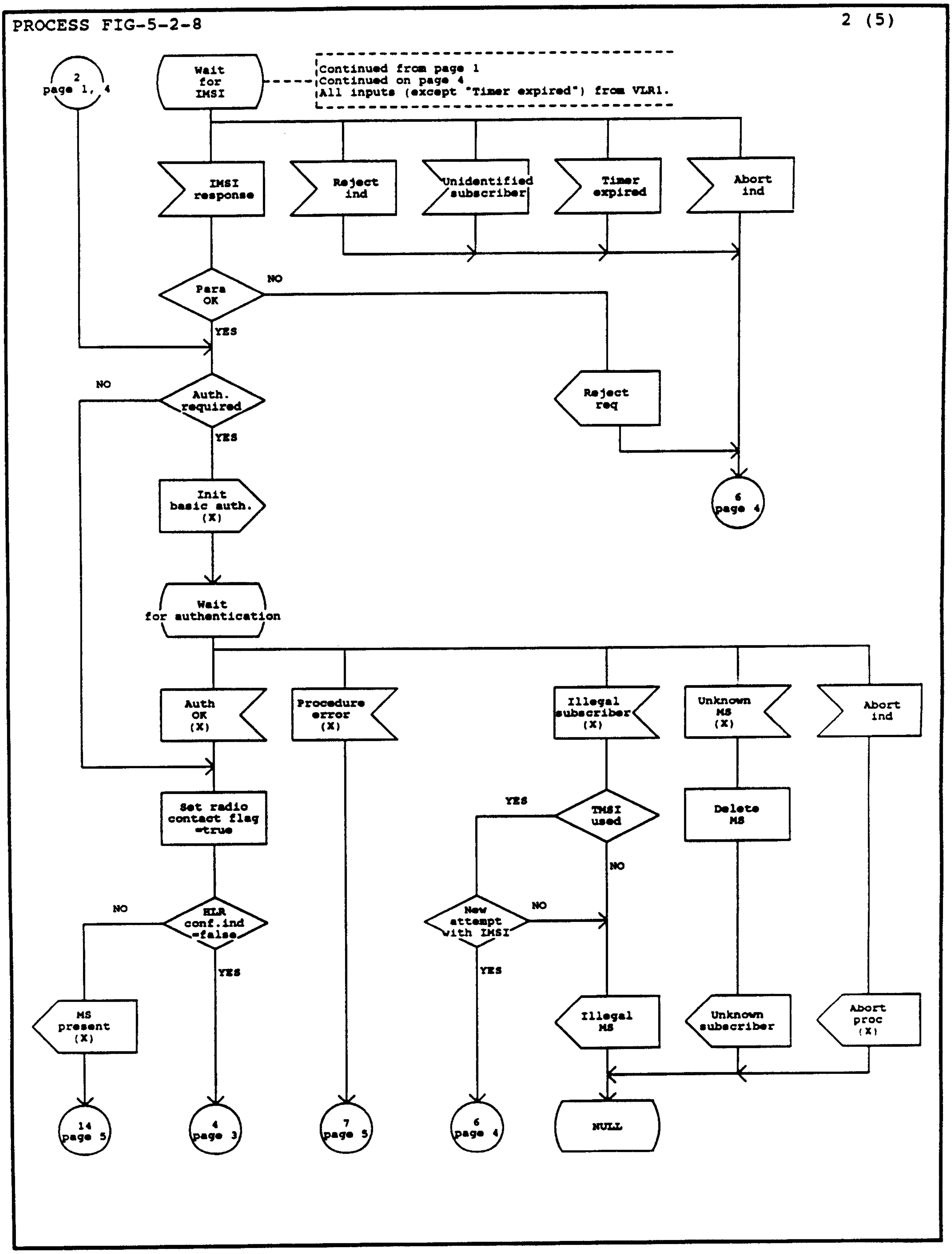


Figure 5.2.8 (Sheet 3 of 5)

Application specific procedures in VLR for location registration

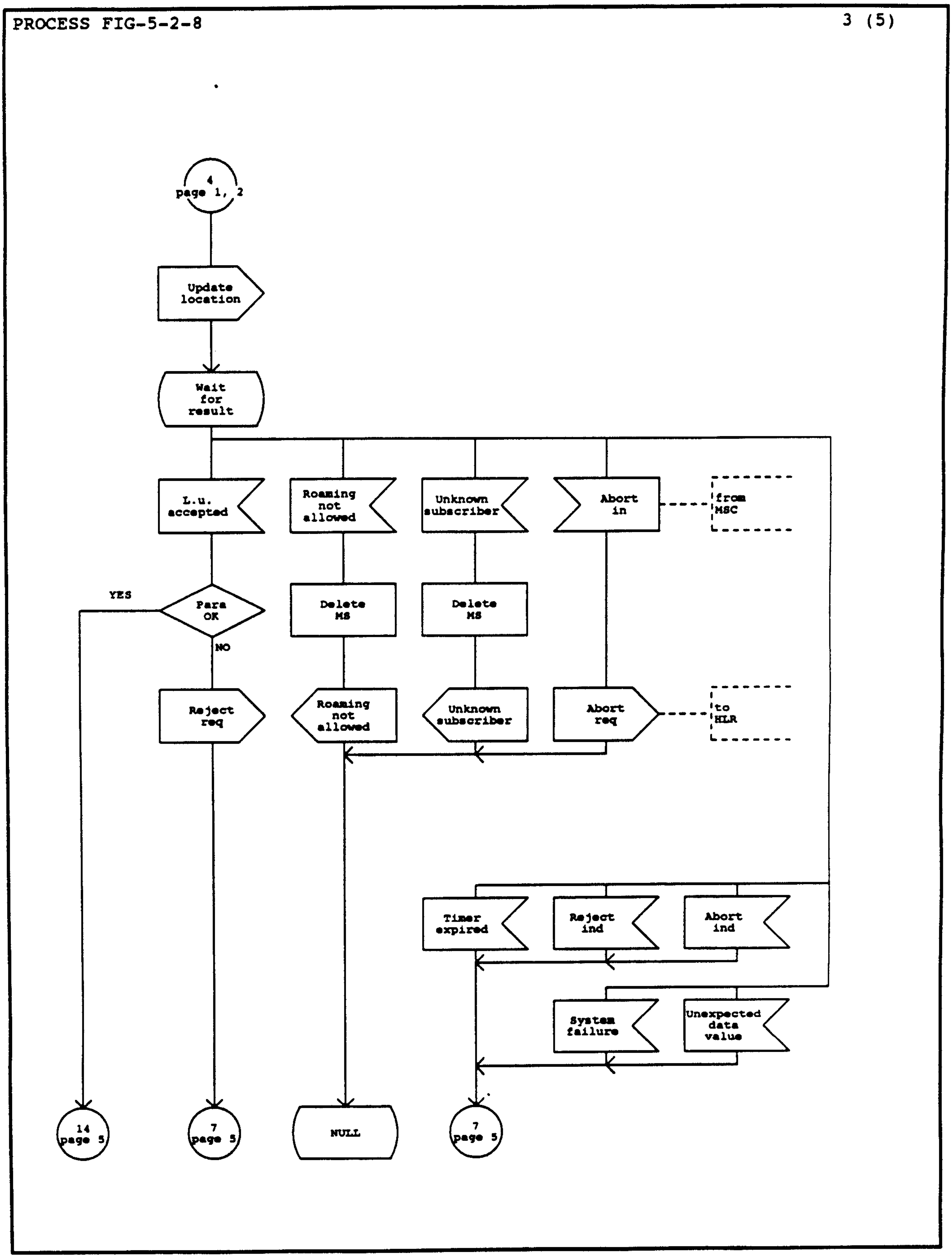


Figure 5.2.8 (Sheet 4 of 5)

Application specific procedures in VLR for location registration

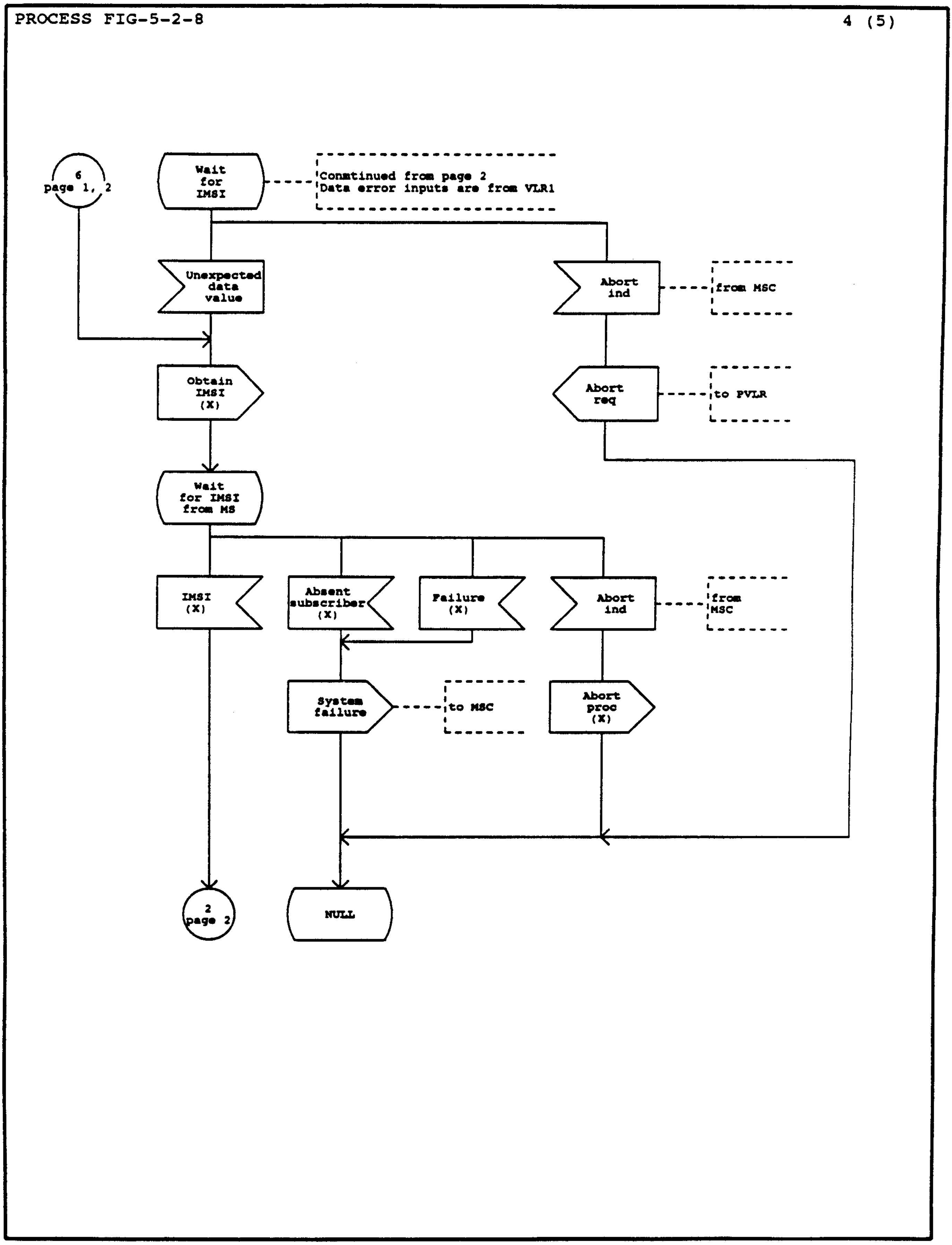


Figure 5.2.8 (Sheet 5 of 5)

Application specific procedures in VLR for location registration

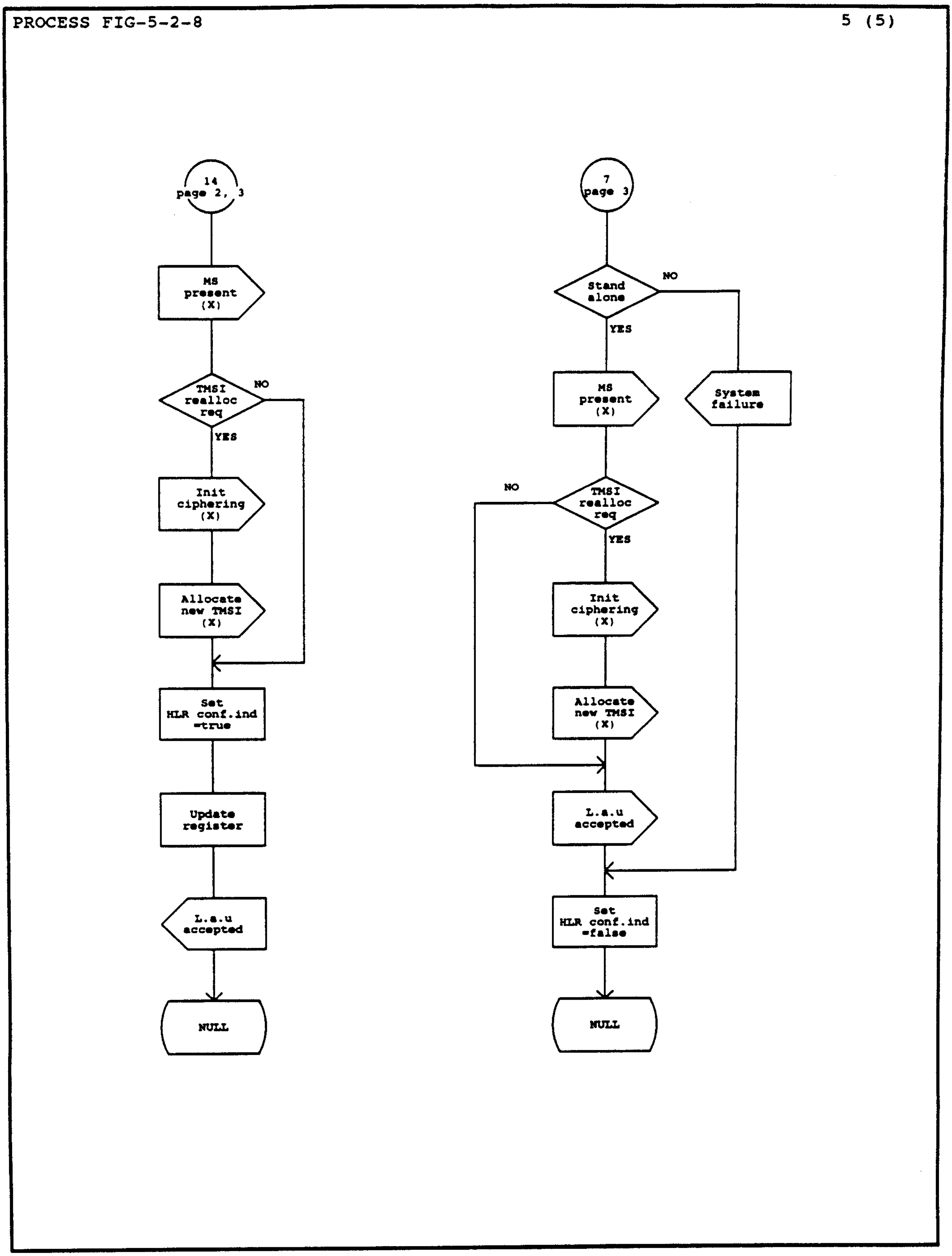


Figure 5.2.9

ASE/TCAP VLR/MSC Interface procedure in VLR for location registration

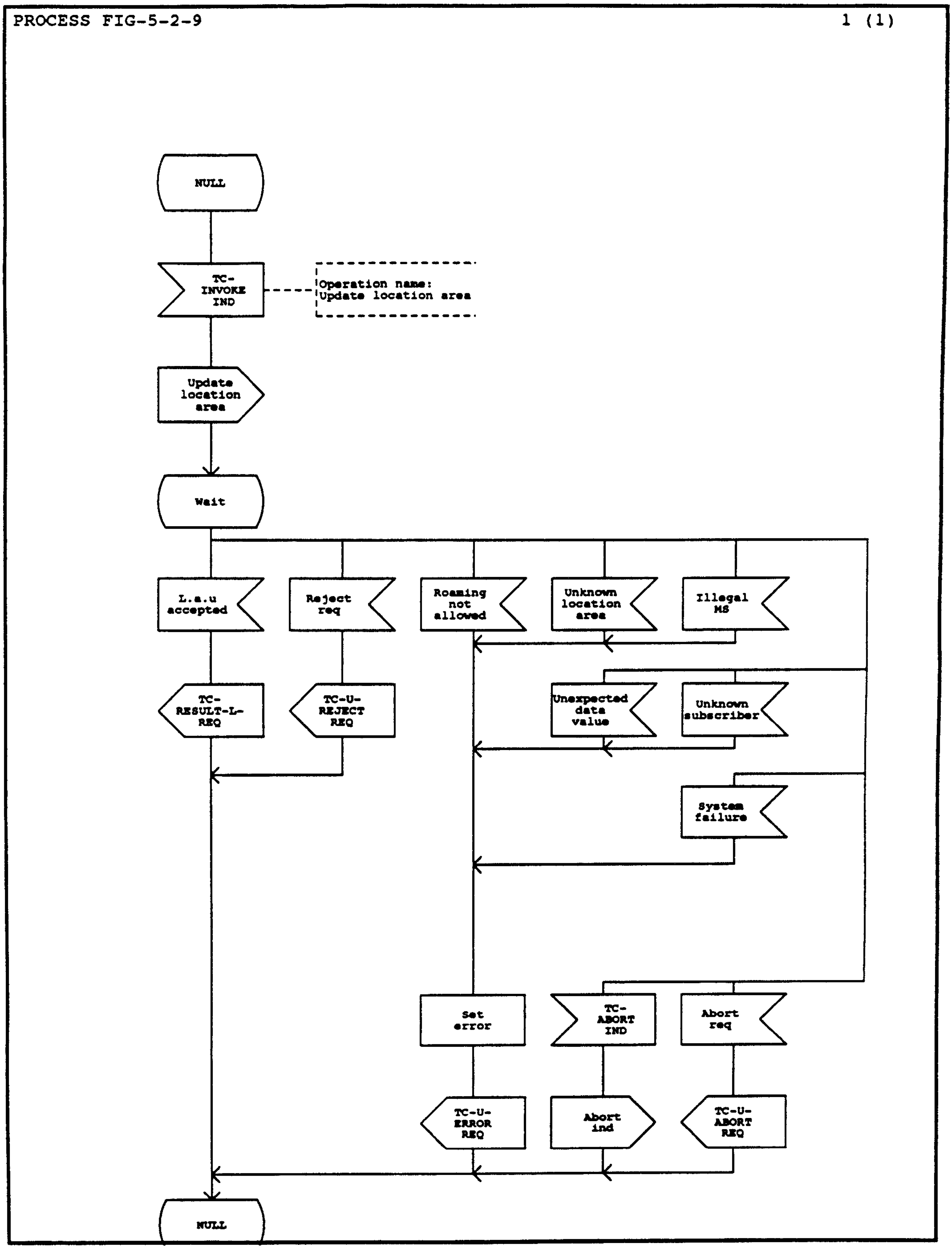


Figure 5.2.10

ASE/TCAP VLR/HLR Interface procedure in VLR for location registration

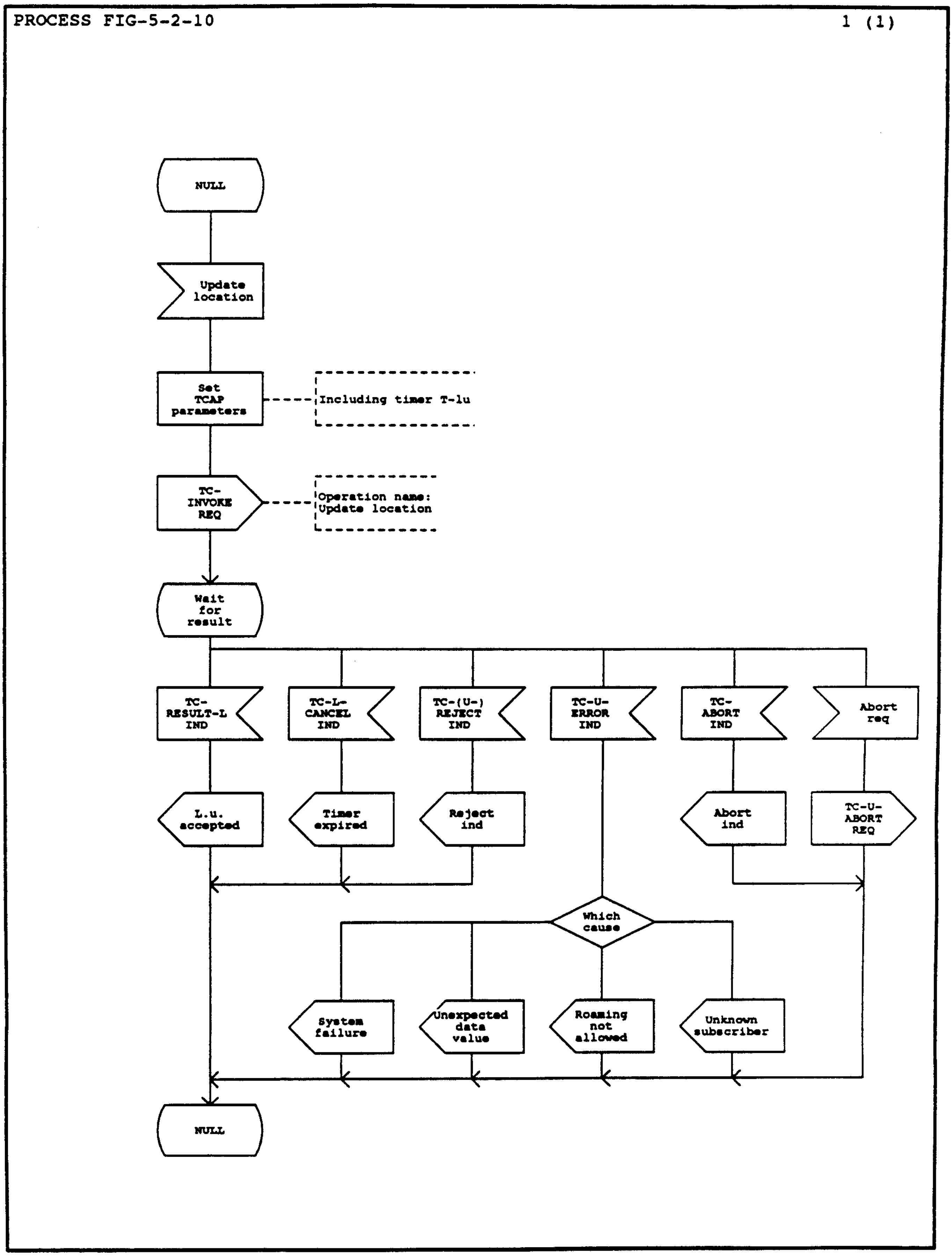


Figure 5.2.11

ASE/TCAP VLR/PREVIOUS VLR Interface procedure in VLR for location registration

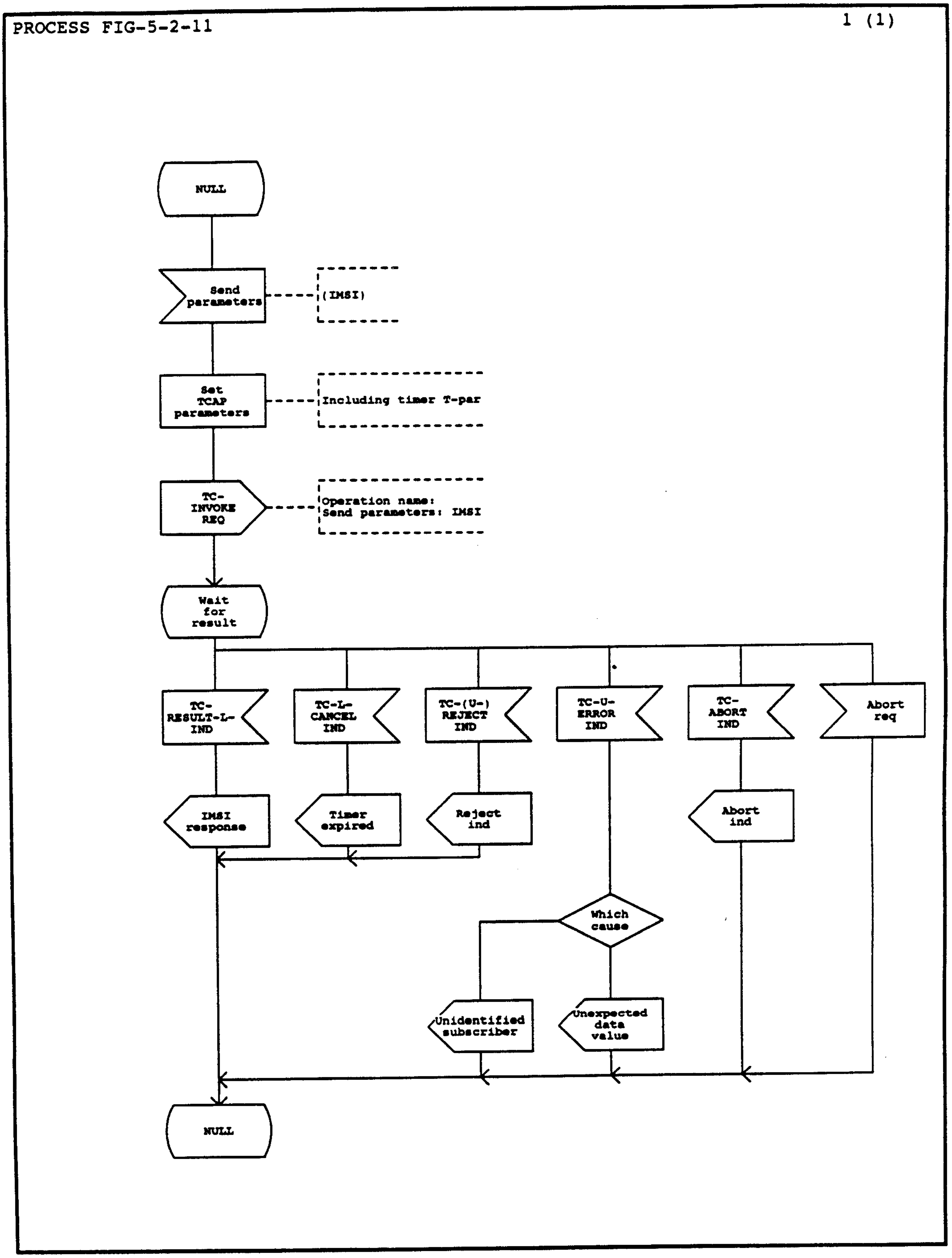


Figure 5.2.12 (Sheet 1 of 2)

Application specific procedures in HLR for location registration

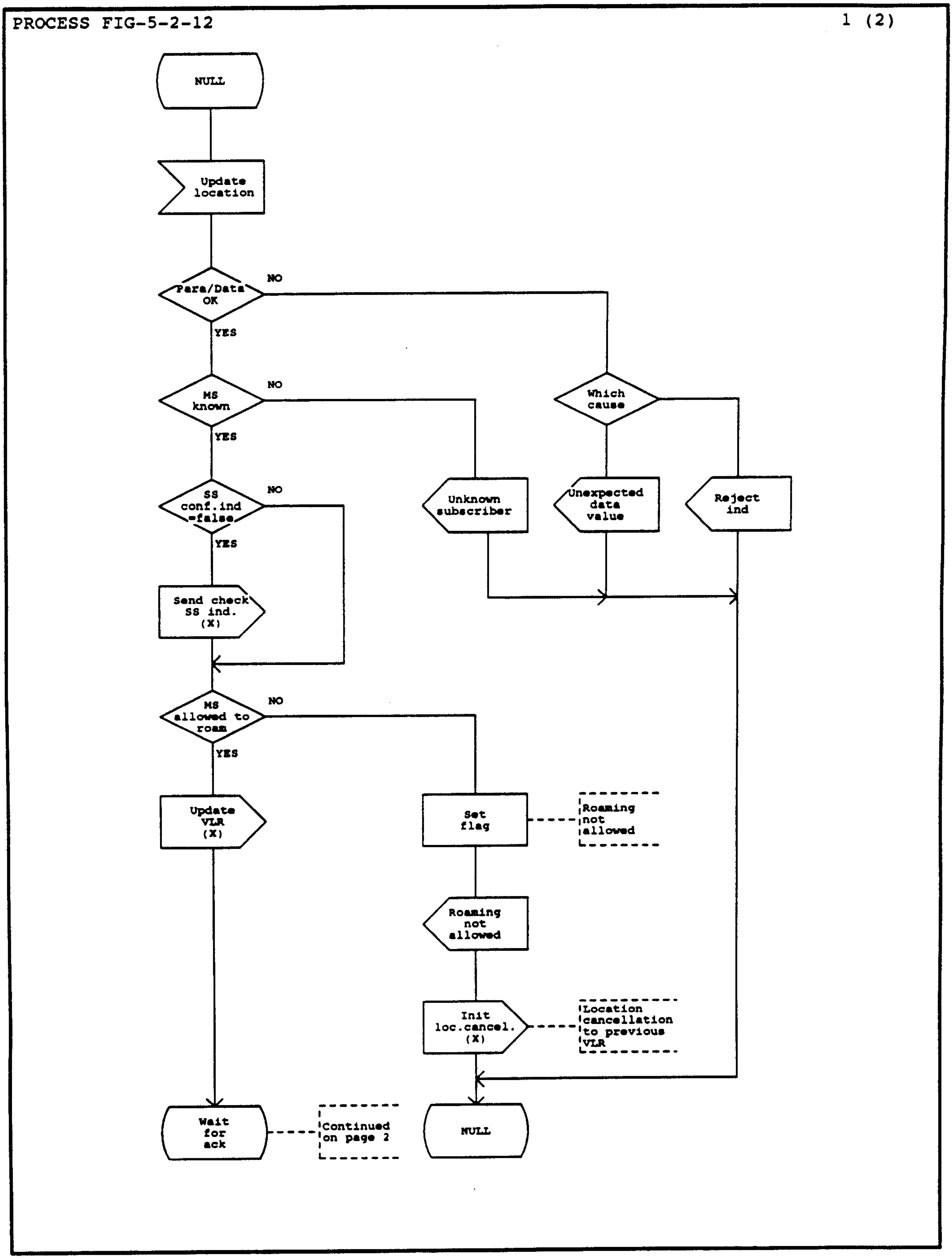


Figure 5.2.12 (Sheet 2 of 2)

Application specific procedures in HLR for location registration

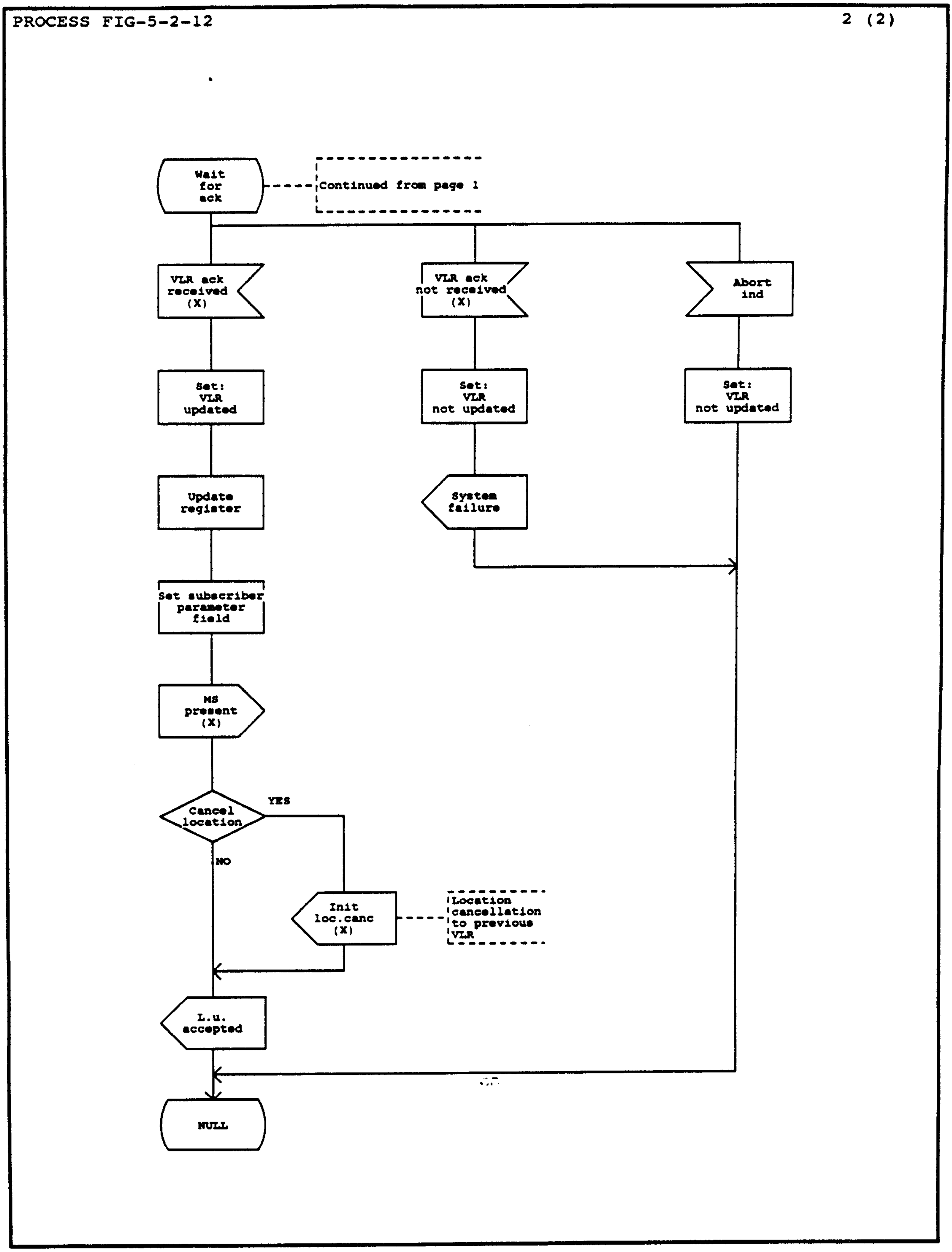


Figure 5.2.13

ASE/TCAP Interface procedure in HLR for location registration

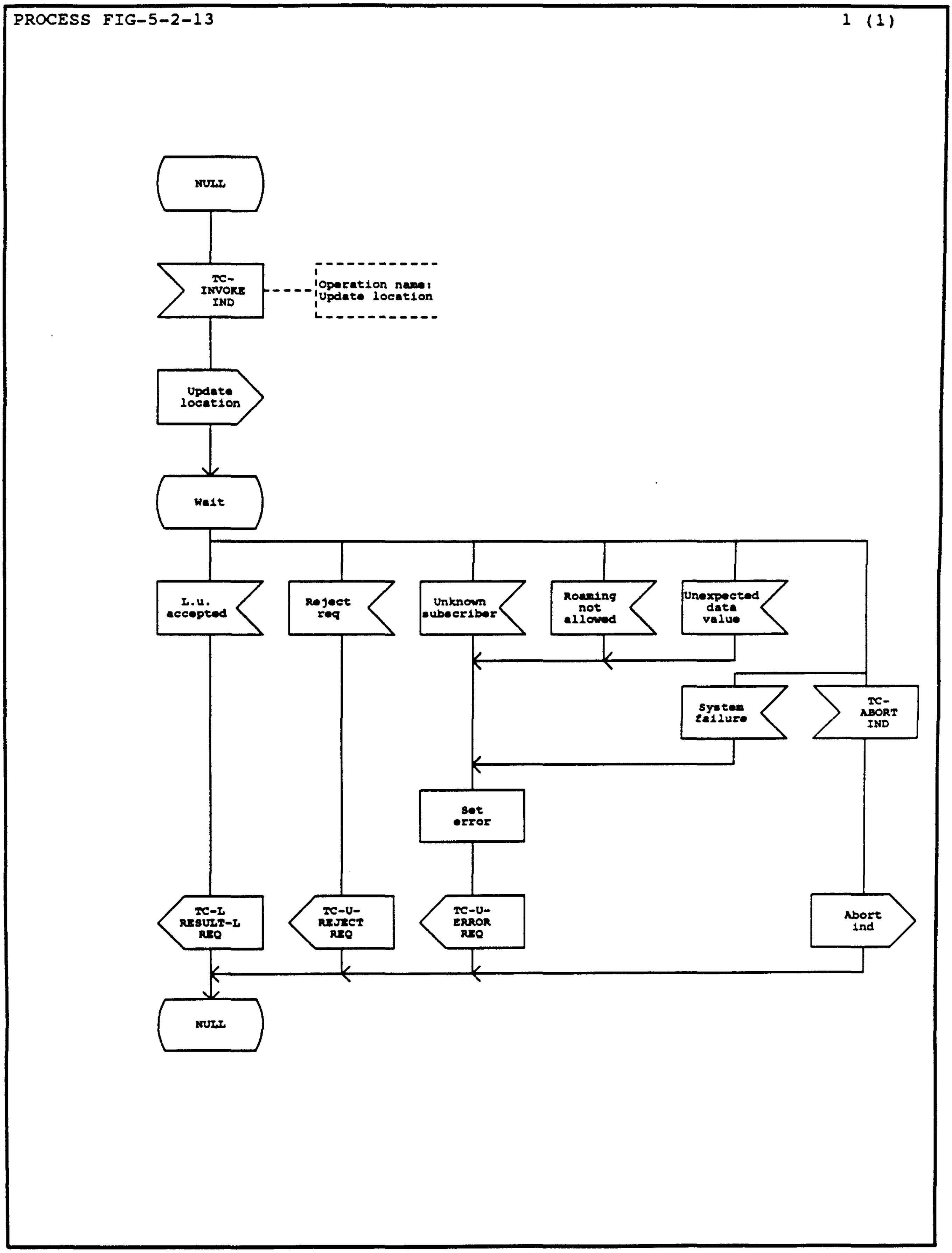


Figure 5.2.14

Application specific procedures in previous VLR (VLR1) for location registration

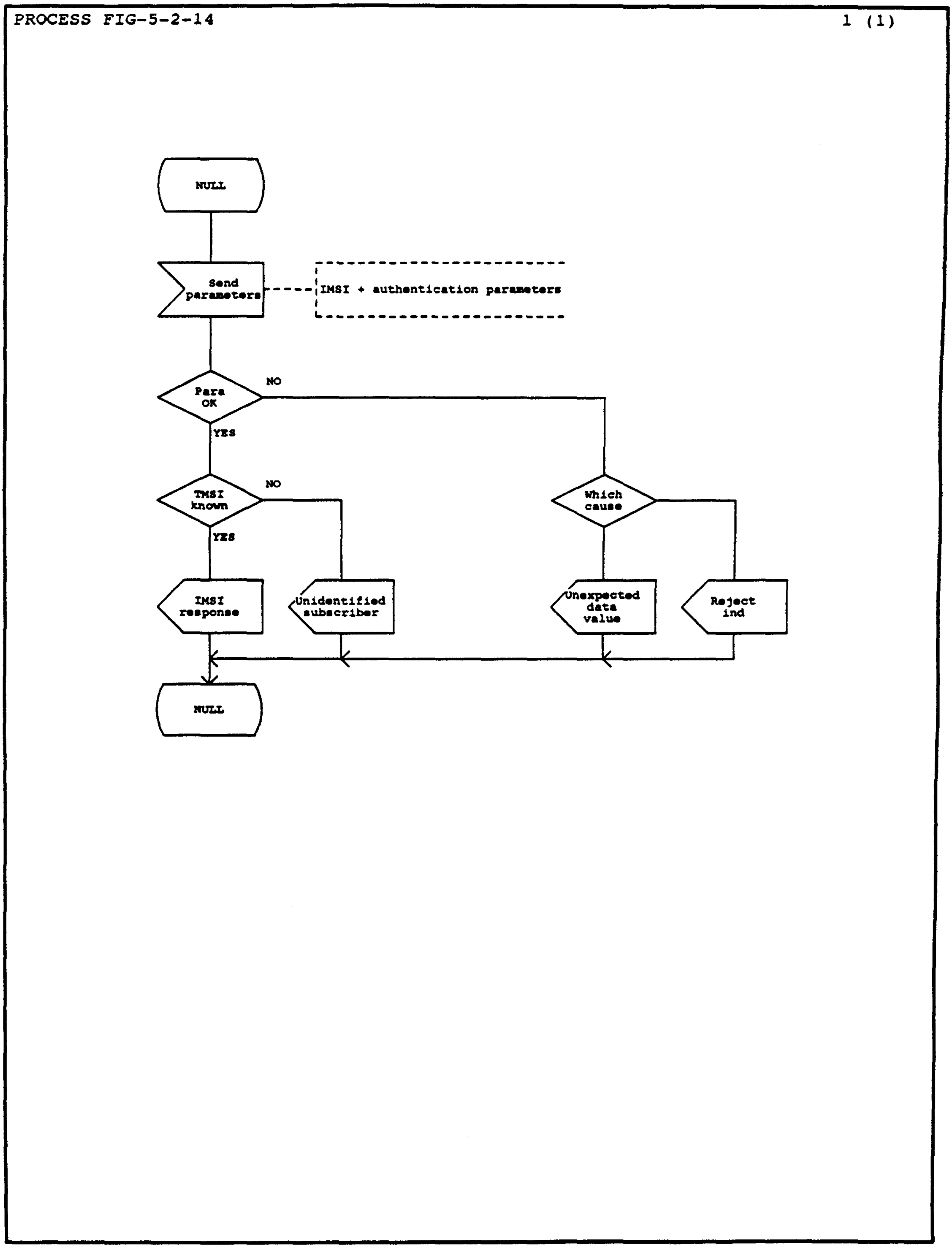
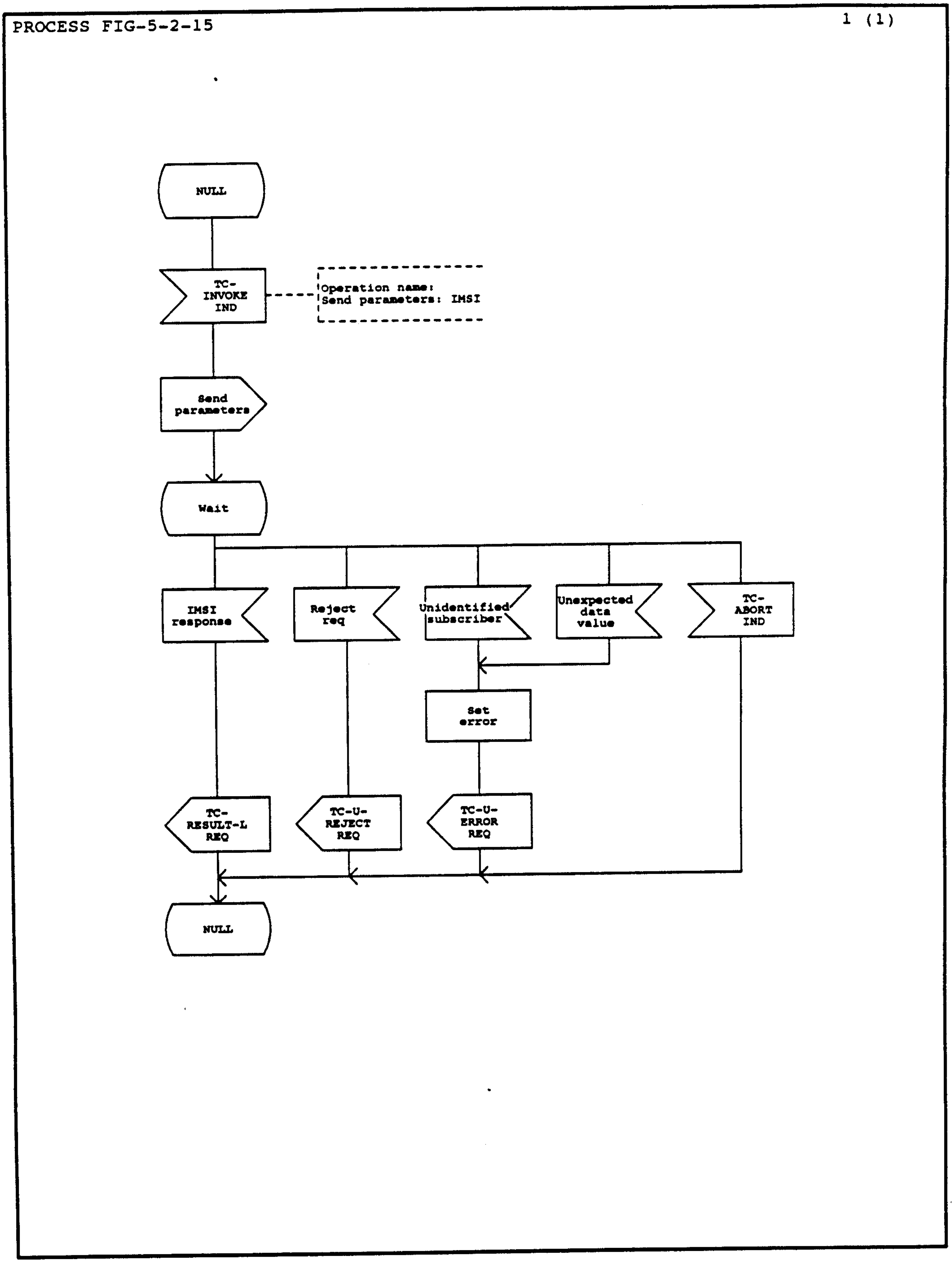


Figure 5.2.15

ASE/TCAP Interface procedure in previous VLR (VLR1) for location registration



5.2.2 Location cancellation

5.2.2.1 Definition of interfaces for location cancellation

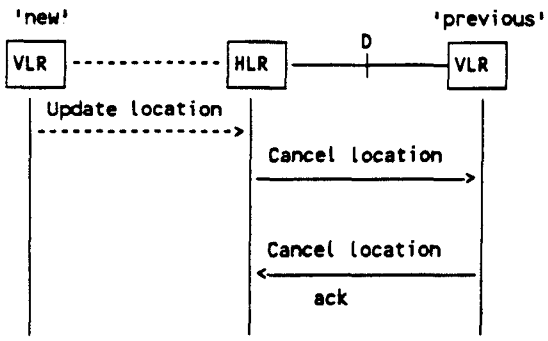


Figure 5.2.16 Interface and procedures for location cancellation.

Figure 5.2.16 shows the functional units and interfaces involved in location cancellation, i.e. home location register (HLR), "previous" visitor location register (VLR) and interface D. A "new" visitor location register may be involved indirectly as shown in the Figure.

5.2.2.2 General description of location cancellation

The purpose of this procedure is to delete a visiting MS from the previous visitor location register when the MS registers with a new visitor location register.

The procedure may also be used if an MS ceases to be a subscriber. The procedure is initiated by the home location register when receiving an update location message from a location register other than that in which the MS was currently located or when the MS is deregistered by some means (e.g. ceases to be a subscriber).

The home location register will then send the cancel location message to the previous visitor location register. The visitor location register receiving this message will return the cancel location acknowledge message and delete the MS from the list of visiting MSs.

Location cancellation is also used if a VLR other than the one contained in the HLR table invokes an MS initiated procedure in the HLR. In this case location cancellation is performed towards the VLR contained in the HLR table.

5.2.2.3 Detailed procedures for location cancellation

5.2.2.3.1 Procedures in the HLR

The application specific procedure of Figure 5.2.17 is initiated by some other event in the HLR represented by the signal initiate location cancellation (X). The initiation conditions are given in 5.2.2.2. The HLR then sends the cancel location message to the previous VLR. Either of the following events may then occur:

- the HLR receives a cancel location acknowledge message from the VLR. This corresponds to successful termination of the procedure;

- the HLR receives an unidentified subscriber message. In this case the procedure is also successfully terminated;

- the HLR receives an indication that the timer has expired or the operation has been rejected, or the unexpected data value message. In this case a message not delivered indication is set in the HLR. The operation must then be repeated at a later time;

- if the cancel location acknowledge message is received with format errors, the message not delivered indication is set and the operation must be repeated at a later time.

The number of repetitions is limited, where the limit is a system parameter fixed by the operator who manages the invoking node.

The ASE/TCAP interface procedure is shown in Figure 5.2.l8. The cancel location message is sent in the TC-INVOKE REQUEST primitive. TCAP is also requested to initiate timer T-lc.

The results received from TCAP can be:

- a TC-RESULT-L INDICATION primitive containing the cancel location acknowledge message;

- a TC-(U-)REJECT INDICATION primitive if the VLR or TCAP rejects the operation because of procedure errors;

- a TC-L-CANCEL INDICATION primitive if timer T-lc expires;

- a TC-U-ERROR INDICATION primitive indicating an unsuccessful outcome as follows

  i) unidentified subscriber;
  ii) unexpected data value.

5.2.2.3.2 Procedures in the VLR

The application specific procedure is contained in Figure 5.2.19 and is as follows.

When receiving a cancel location message the VLR will:

- if the MS is registered in the VLR, the VLR will delete the MS from the register and return the cancel location acknowledge message;

- if the MS is not registered in the VLR, the VLR will return the unidentified subscriber message.

The ASE/TCAP interface procedure is shown in Figure 5.2.20.

The cancel location message is received in a TC-INVOKE INDICATION primitive. The results are returned as follows:

- the cancel location acknowledge message is returned in a TC-RESULT-L REQUEST primitive;

- the TC-U-REJECT REQUEST primitive is used to send the cause if procedure errors are discovered by the VLR;

- unsuccessful events are returned in the TC-U-ERROR REQUEST primitive as follows:

  i) unidentified subscriber;
  ii) unexpected data value.

Figure 5.2.17

Application specific procedures in HLR for location cancellation.

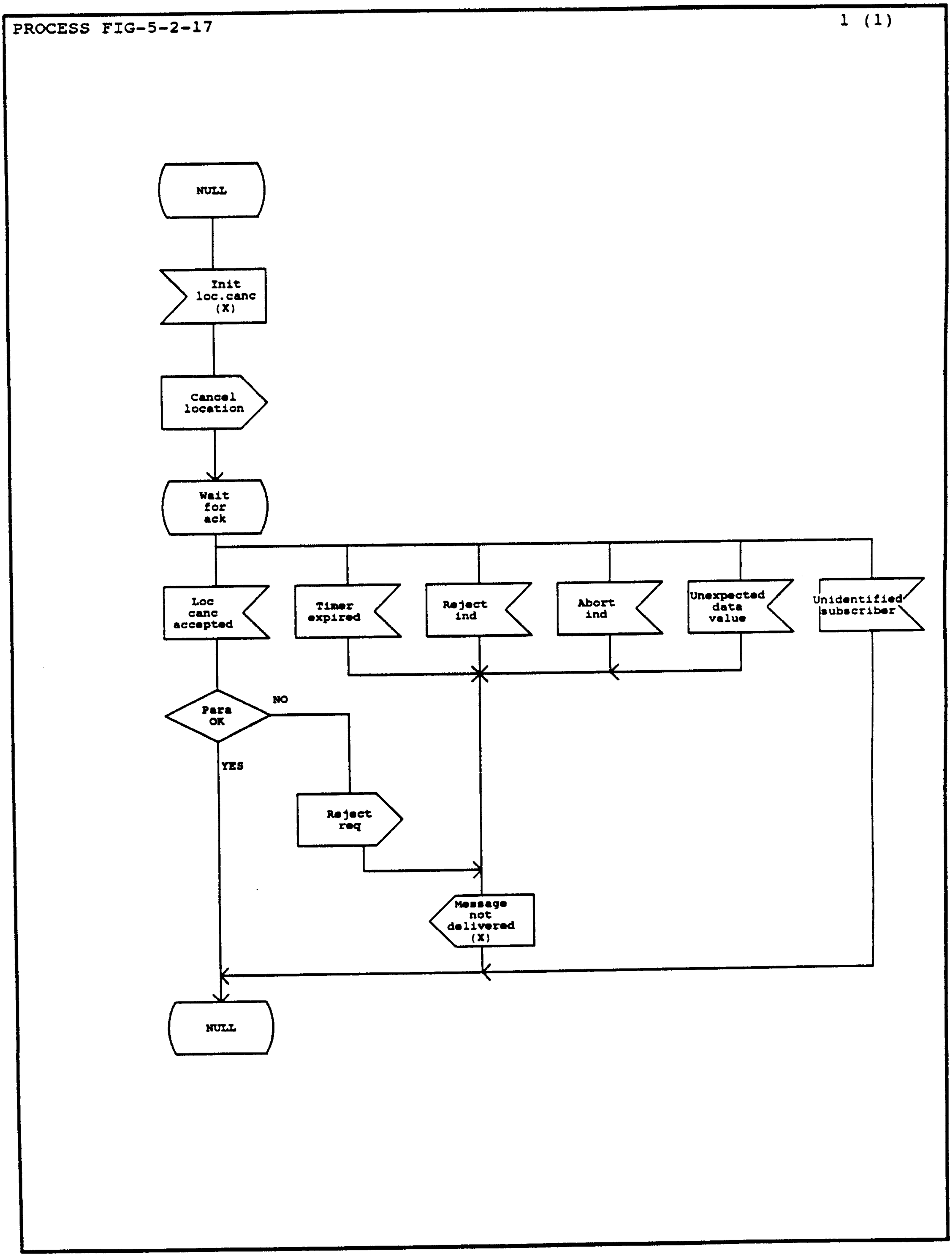


Figure 5.2.18

ASE/TCAP Interface procedure in HLR for location cancellation.

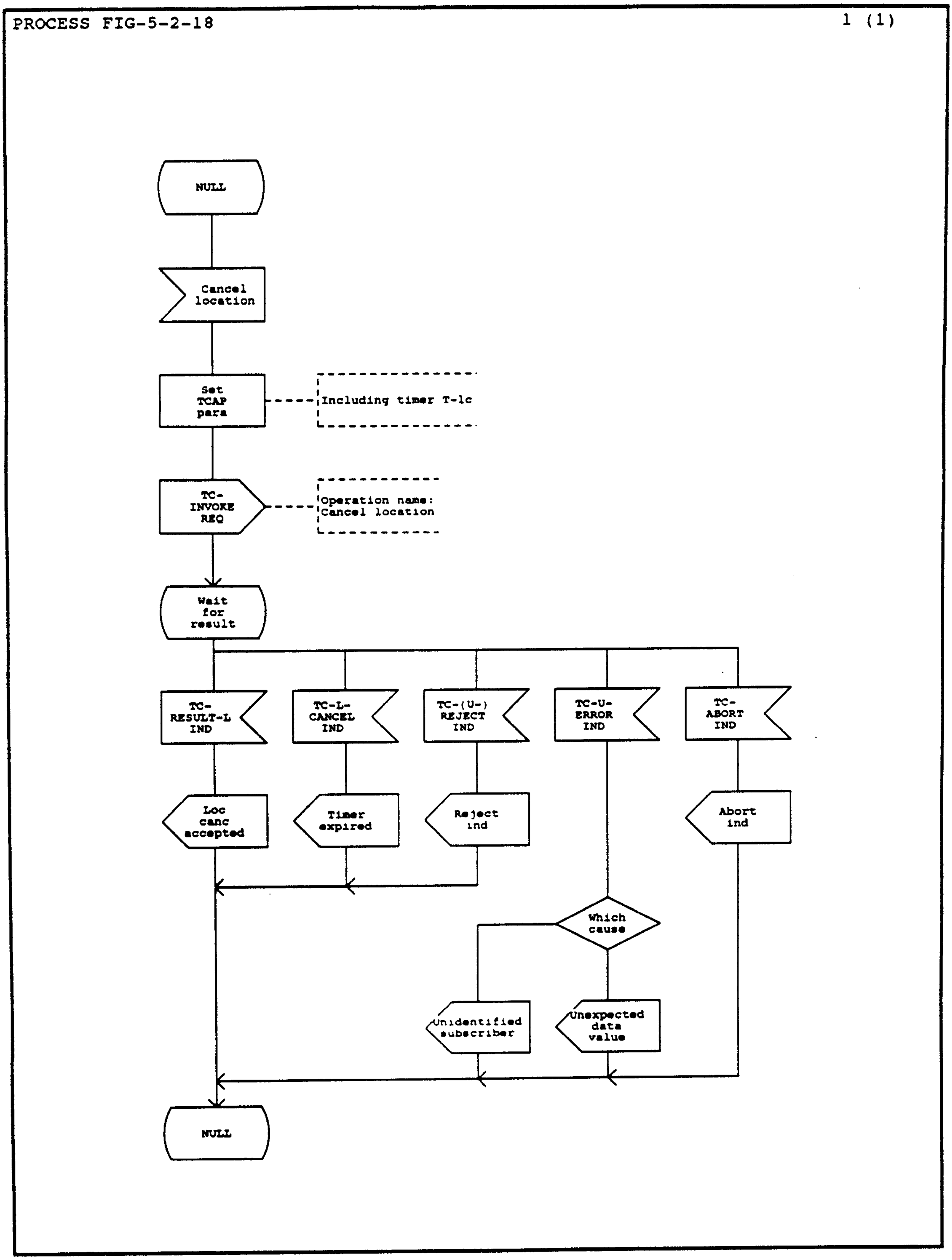


Figure 5.2.19

Application specific procedures in VLR for location cancellation.

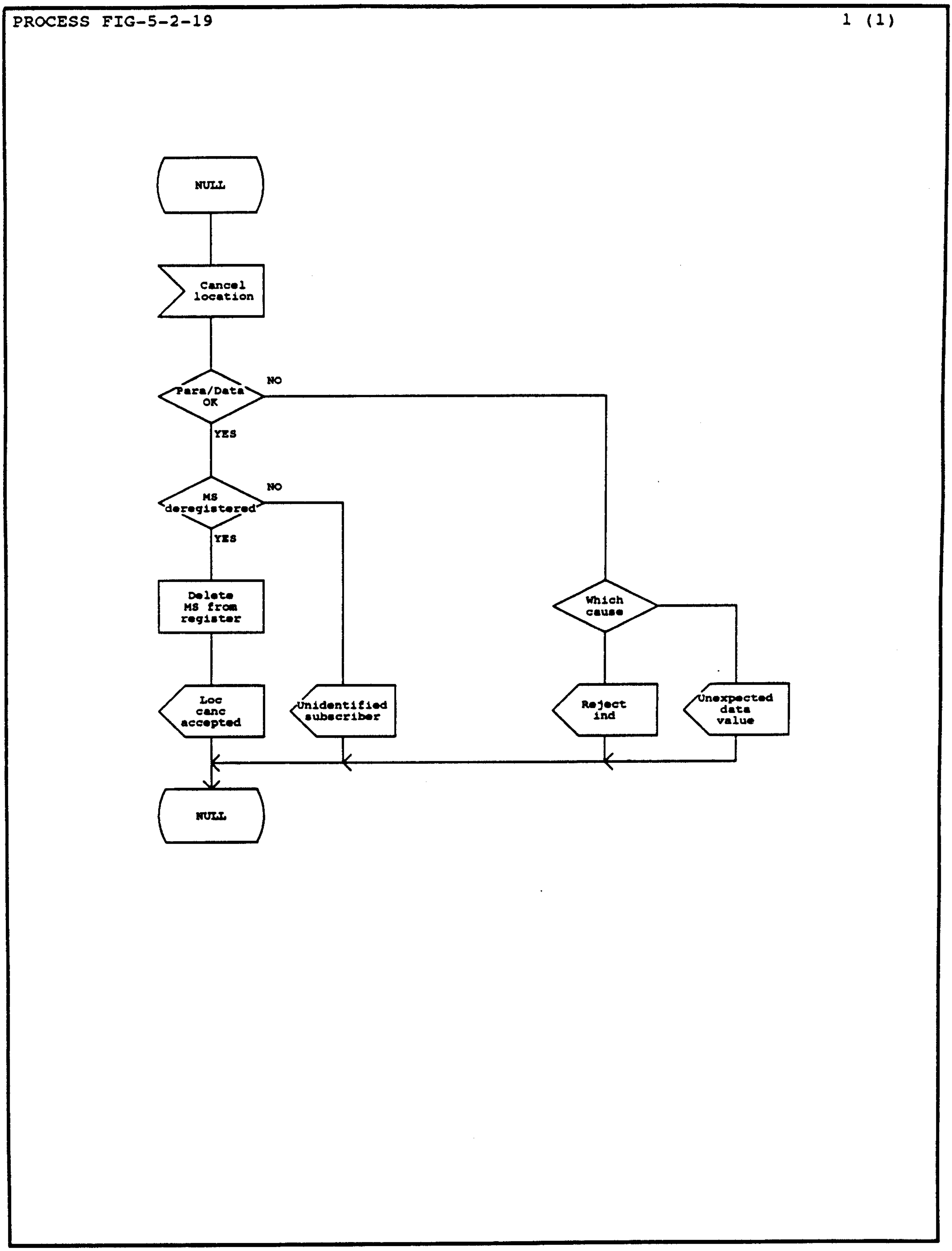
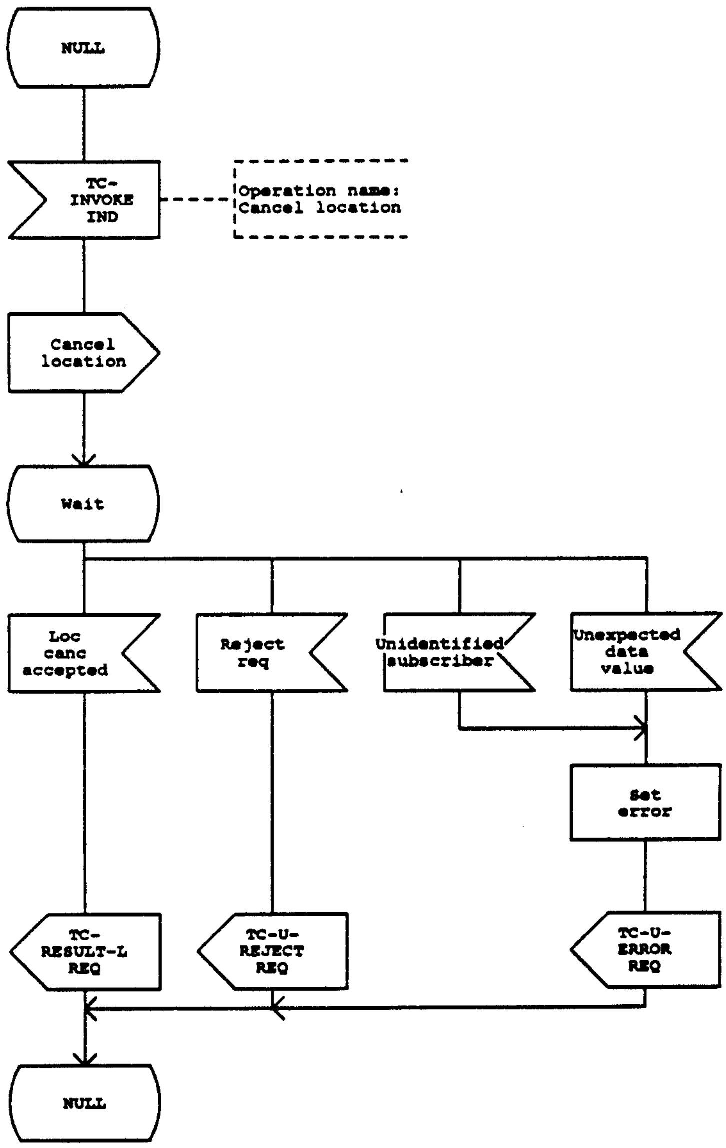


Figure 5.2.20

ASE/TCAP Interface procedure in VLR for location cancellation.

PROCESS FIG-5-2-20 1 (1)



5.2.3 IMSI detach/attach procedures

5.2.3.1 Definition of interfaces for IMSI detach/attach

The interfaces and procedures involved are shown in Figure 5.2.21.

The purpose of the IMSI detach procedure is to enable an MS to indicate to the PLMN that it is about to enter an inactive state. The information is used to reject calls to the MS without sending a paging message on the radio path. The IMSI detached information may either be stored in the VLR and no information being passed to the HLR, or optionally, the HLR may be informed and the IMSI detached flag is then set in the HLR.

The IMSI attach procedure is used by the MS to indicate that it has reentered the active state. The procedure is to be used only when the IMSI detach flag is set in the VLR. If the flag is set in the HLR, reentering of the active state requires a normal location updating from the MS.

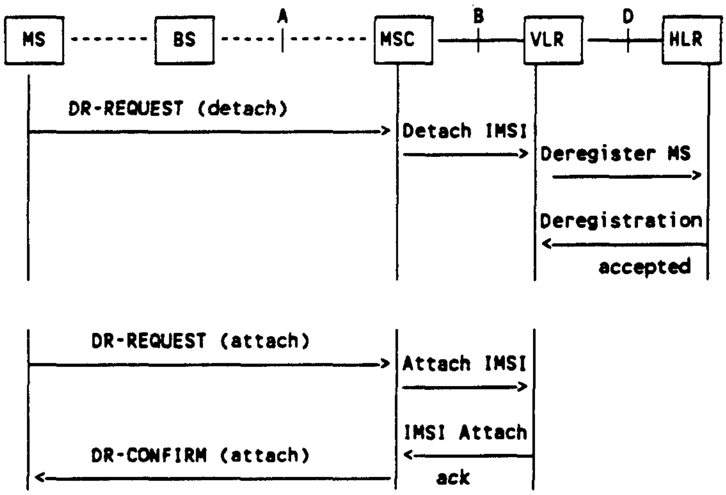


Figure 5.2.21. Interfaces and procedures for IMSI detach/attach.

5.2.3.2 General description of IMSI detach/attach

5.2.3.2.1 IMSI detached flag set in the VLR

When receiving a DR-REQUEST (detach) from the MS, the MSC will send the detach IMSI message to the VLR. This message is not acknowledged since it is likely that an acknowledgement message will not be received by the MS.

The VLR will set an IMSI detached flag and reject incoming calls to the MS as long as the flag is set (or forward the call if the call forwarding on MS not registered service applies).

When receiving a DR-REQUEST (attach) from the MS, the MSC will send the attach IMSI message to the VLR. The VLR will then remove the IMSI detached flag and resume normal call handling for the MS. The VLR returns the attach IMSI acknowledge message to the MSC and the MS is notified by the DR-CONFIRM (attach) message.

5.2.3.2.2 Deregistration flag set in the HLR

When receiving a detach IMSI message from the MSC, the VLR will send the deregister MS message to the HLR and the HLR will return the deregister MS acknowledge message to the VLR.

If the MS is known to the VLR, it should be deleted from the register.

If the deregister MS message is received from a VLR ("new" VLR) other than that in which the MS was originally registered ("previous" VLR), the HLR will initiate the location cancellation procedure of § 5.2.2 towards the previous VLR.

The HLR should set the IMSI detached flag. If the HLR receives an incoming call to the MS and the MS has not activated the call forwarding on MS not registered service, the call should be cleared by an appropriate cause.

Reregistration of the MS will be done by normal location registration.

5.2.3.3 Detailed procedures for IMSI detach/attach

5.2.3.3.1 Procedures in the MSC

The IMSI detach procedure in the MSC is shown in Figures 5.2.22 and 5.2.23.

The MSC sends the detach IMSI message in the TC-INVOKE REQUEST primitive. Since this message is not acknowledged on the component sublayer, the prearranged termination procedure will be used (i.e. by a TC-L-CANCEL INDICATION primitive). If a TC-REJECT INDICATION primitive is received, the procedure is also terminated by reporting the cause to the MAP ASE. The procedure is supervised by timer T-id.

The IMSI attach procedure in the MSC is shown in Figures 5.2.24 and 5.2.25.

The MSC sends the attach IMSI message in the TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-iar. The attach IMSI acknowledge message is received in a TC-RESULT-L INDICATION primitive and negative results are reported in a TC-U-ERROR INDICATION primitive as follows:

- i) unidentified subscriber;
- ii) illegal MS;
- iii) unknown subscriber;
- iv) roaming not allowed;
- v) system failure;
- vi) unexpected data value.

Both positive and negative results are reported to the MS. Expiry of timer T-iar is reported in a TC-L-CANCEL INDICATION. An indication that the procedure failed is sent to the MS.

5.2.3.3.2 Procedures in the VLR

The application specific IMSI detach procedure is given in Figure 5.2.26. Figures 5.2.27 and 5.2.28 contain the ASE/TCAP VLR/MSC interface procedure and the ASE/TCAP VLR/HLR interface procedure, respectively.

The application specific IMSI detach procedure is as follows (Figure 5.2.26). When receiving a detach IMSI message from the MSC, the VLR may proceed as follows:

i) if IMSI detach operation is local in the VLR, the VLR sets an IMSI detached flag;

ii) if the optional facility of deregistration in the HLR is implemented, the VLR sends the deregister MS message to the HLR.

Detach IMSI request messages with parameter errors are ignored by the MAP ASE.

In case ii) the VLR sends the deregister MS message to the HLR. The outcome of this procedure can be as follows:

- if the facility not supported message is received, the VLR will keep the MS in the register and set the IMSI detached flag;

- if either of the messages deregister MS acknowledge, unknown subscriber or absent subscriber is received from the HLR, the VLR will delete the MS and the roaming number (if allocated);

- if failure condition is reported (reject indication, unexpected data value or timer expired), the VLR will block the roaming number (if allocated). Further actions may then be taken at a later time.

The ASE/TCAP MSC/VLR interface procedure (Figure 5.2.27) is simple. The detach IMSI message is received in a TC-INVOKE INDICATION primitive and the MAP ASE does not return any acknowledgement.

The ASE/TCAP VLR/HLR interface procedure for deregistration in the HLR (Figure 5.2.28) is as follows. The deregister MS message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-dr. The outcome of the procedure is as follows:

- the deregister MS acknowledge message is contained in a TC-RESULT-L INDICATION primitive;

- if the operation is rejected by the HLR or TCAP, a TC-(U) REJECT INDICATION primitive will be received indicating the cause;

- if timer T-dr expires, the TC-L-CANCEL INDICATION primitive is received;

- an unsuccessful outcome is reported in a TC-U-ERROR INDICATION primitive as follows:

  i) unknown subscriber;
  ii) absent subscriber;
  iii) facility not supported;
  iv) unexpected data value.

The application specific procedure in the VLR for the IMSI attach procedure is shown in Figure 5.2.29 and the corresponding ASE/TCAP interface procedure is contained in Figure 5.2.30.

When receiving a valid attach IMSI message for an MS which is known by the VLR, the VLR will:

- set the IMSI detached flag to attached;

- set radio confirmed indication to true;

- return the attach IMSI acknowledge message to the MSC.

If the MS identified itself by an unknown TMSI, the VLR will return the unidentified subscriber message to the MSC. If the MS identified itself by an unknown IMSI, the VLR will perform location register updating functions, perform authentication, if required, and update the HLR.

If the station is known in the VLR but the HLR confirmed indicator is set to false, then the VLR will also perform a normal location updating of the HLR.

The VLR will receive the attach IMSI message in a TC-INVOKE INDICATION primitive. If the MS is known in the VLR, the VLR will return the attach IMSI acknowledge message in a TC-RESULT-L REQUEST primitive whether the IMSI detached flag is set or not.

Negative results are returned in a TC-U-ERROR REQUEST primitive with the cause set to indicate either of the following events:

i) unidentified subscriber if the MS identified itself with TMSI not known in the VLR;

ii) illegal MS, unknown subscriber, roaming not allowed or system failure, if a negative outcome is reported in an associated location updating procedure;

iii) unexpected data value if there were data errors in the attach IMSI message.

5.2.3.3.3 Procedures for deregistration in the HLR

The application specific procedure is shown in Figure 5.2.31 and the ASE/TCAP interface procedure is contained in Figure 5.2.32.

The application specific procedure is as follows.

When receiving a deregister MS message from a VLR, the HLR will perform a number of checks:

- if procedure errors are detected, a reject request is returned;
- if data errors are detected, the unexpected data value message is returned;
- if the MS is unknown, the unknown subscriber message is returned;
- if the MS is already deregistered, the absent subscriber message is returned;
- if the HLR does not support deregistration, the facility not supported message is returned.

If none of these conditions apply, the HLR will mark the MS as deregistered and return the deregister MS acknowledge message. If the deregister MS message indicates another VLR than that contained in the subscriber parameter list, the HLR will initiate location cancellation towards the VLR contained in the list.

The ASE/TCAP interface procedure is as follows: The deregister MS message is contained in a TC-INVOKE INDICATION primitive. The result is returned as follows:

- the deregister MS acknowledge message is returned in a TC-RESULT-L REQUEST primitive;
- a reject request is returned in a TC-U-REJECT REQUEST primitive containing the cause;
- an unsuccessful result is returned in a TC-U-ERROR REQUEST primitive as follows:

  i) unknown subscriber;
  ii) absent subscriber;
  iii) facility not supported;
  iv) unexpected data value.

Figure 5.2.22

Application specific procedures in MSC for IMSI detach procedure

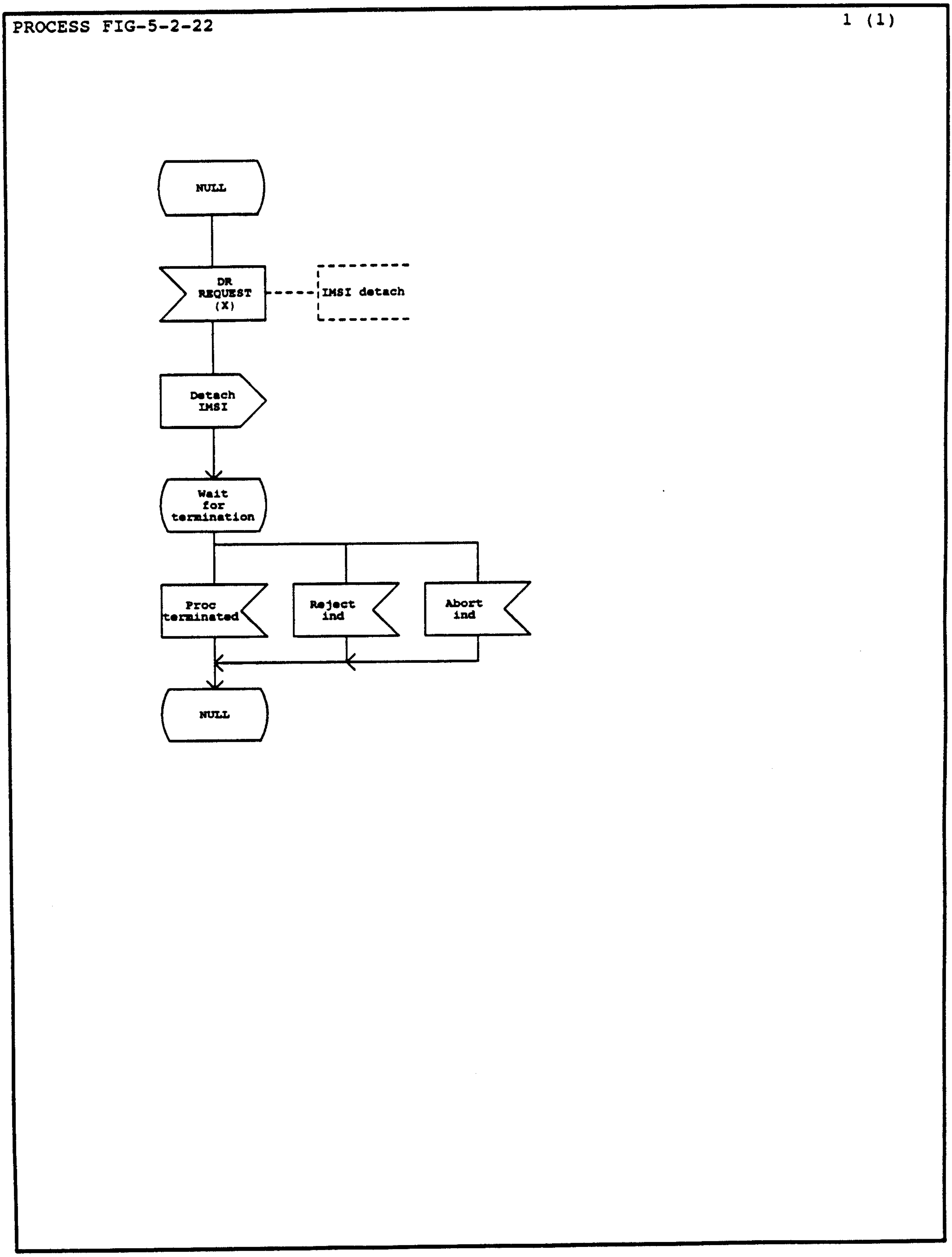


Figure 5.2.23

ASE/TCAP Interface procedure in MSC for IMSI detach procedure

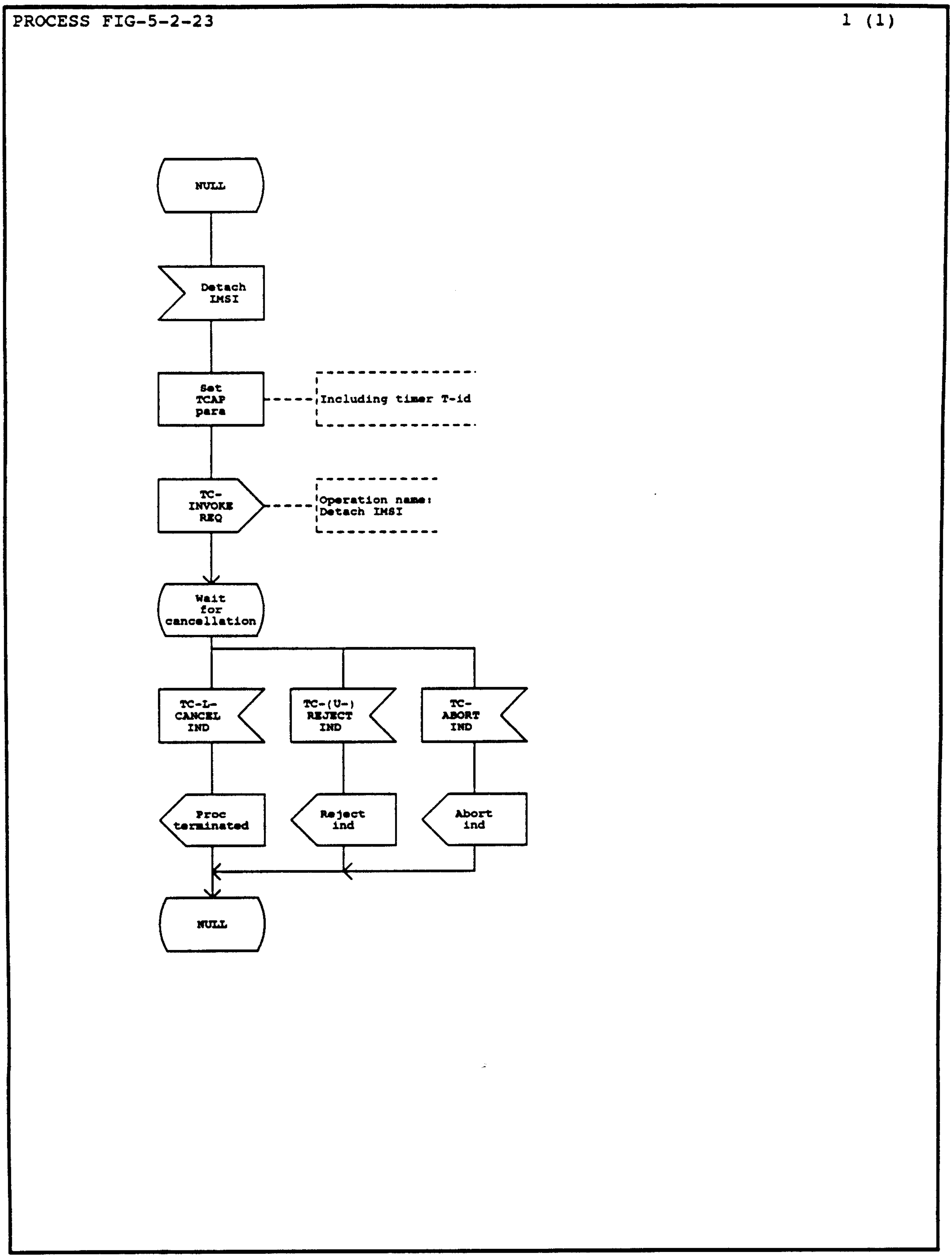


Figure 5.2.24 (Sheet 1 of 2)

Application specific procedures in MSC for IMSI attach procedure

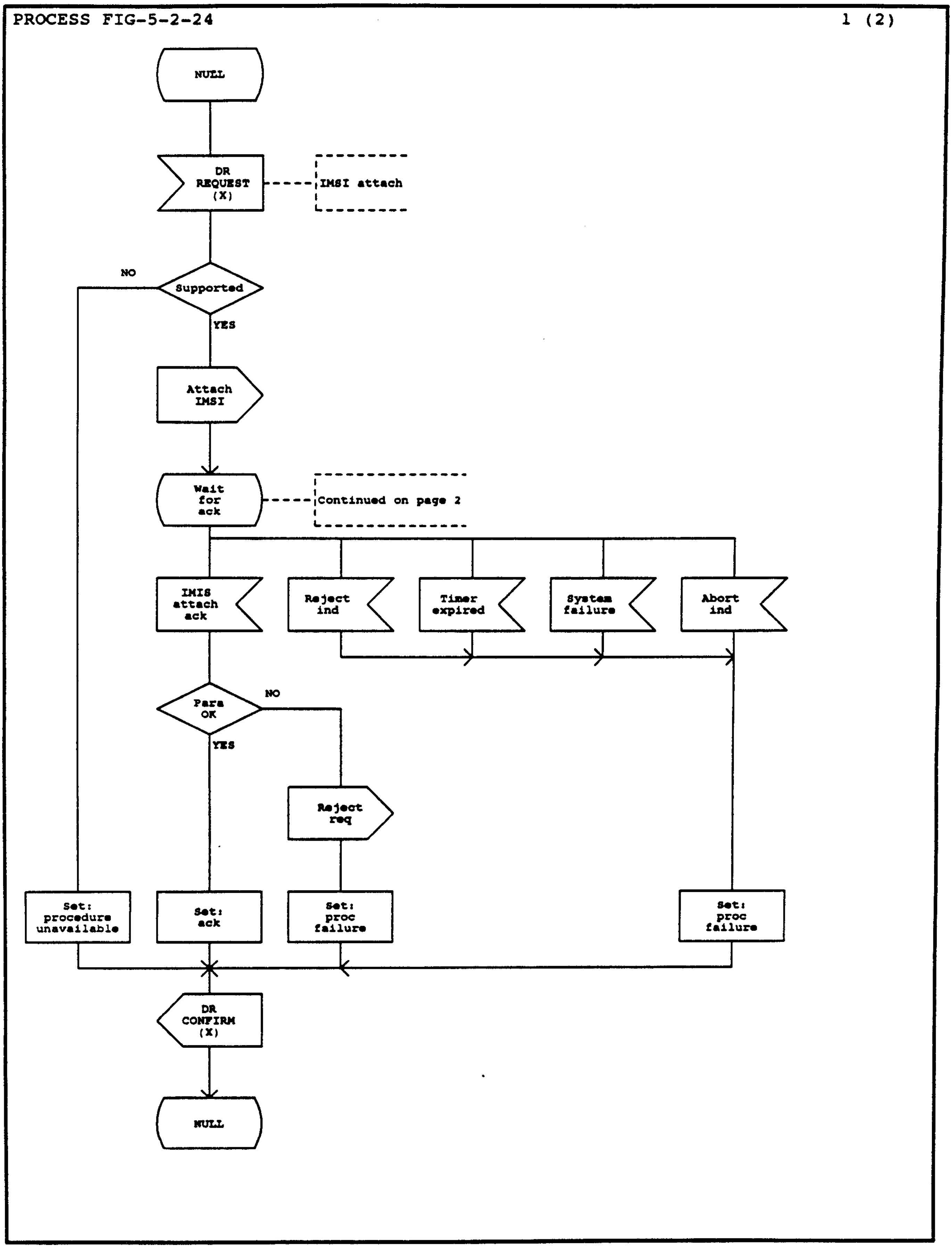


Figure 5.2.24 (Sheet 2 of 2)

Application specific procedures in MSC for IMSI attach procedure

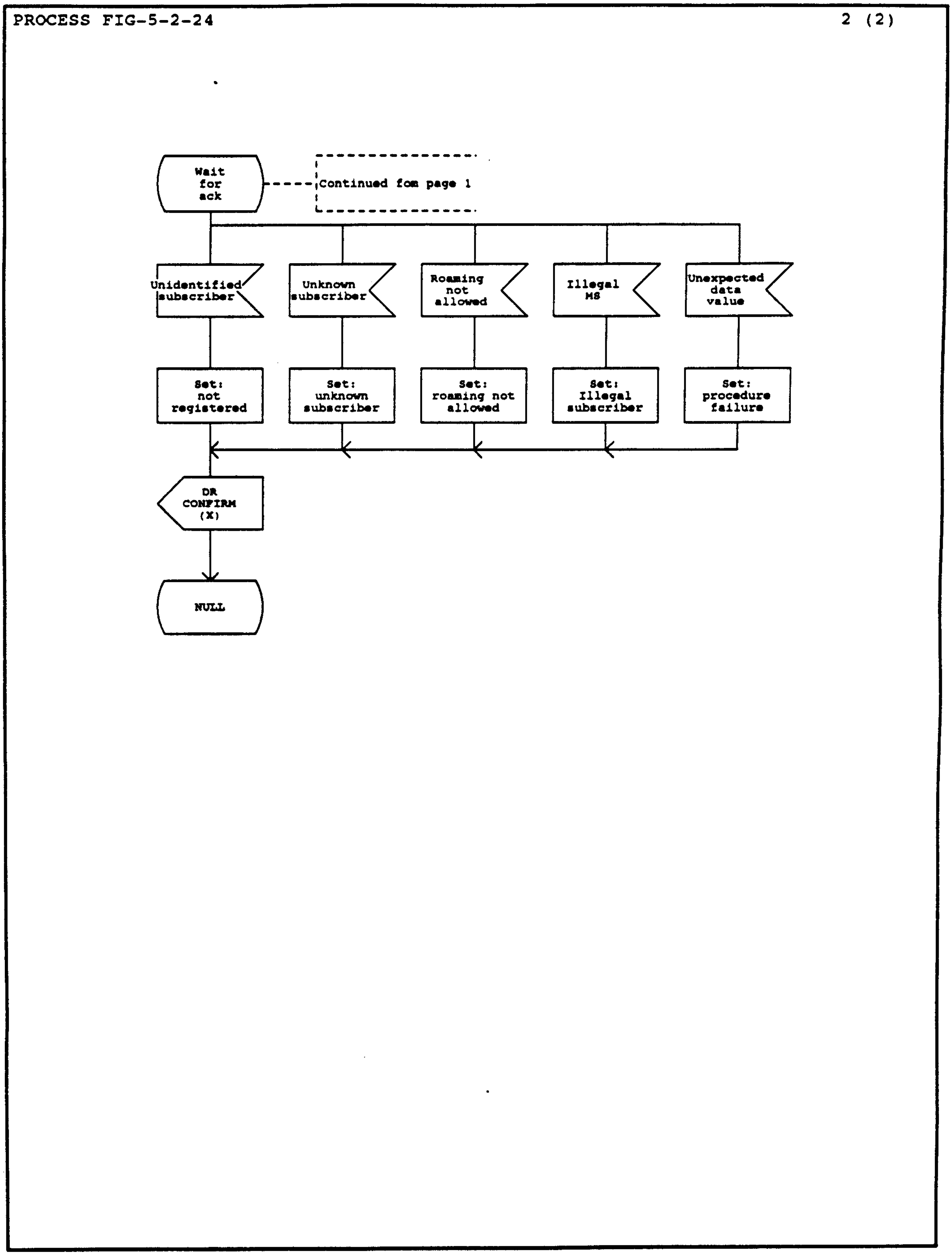


Figure 5.2.25

ASE/TCAP Interface procedure in MSC for IMSI attach procedure

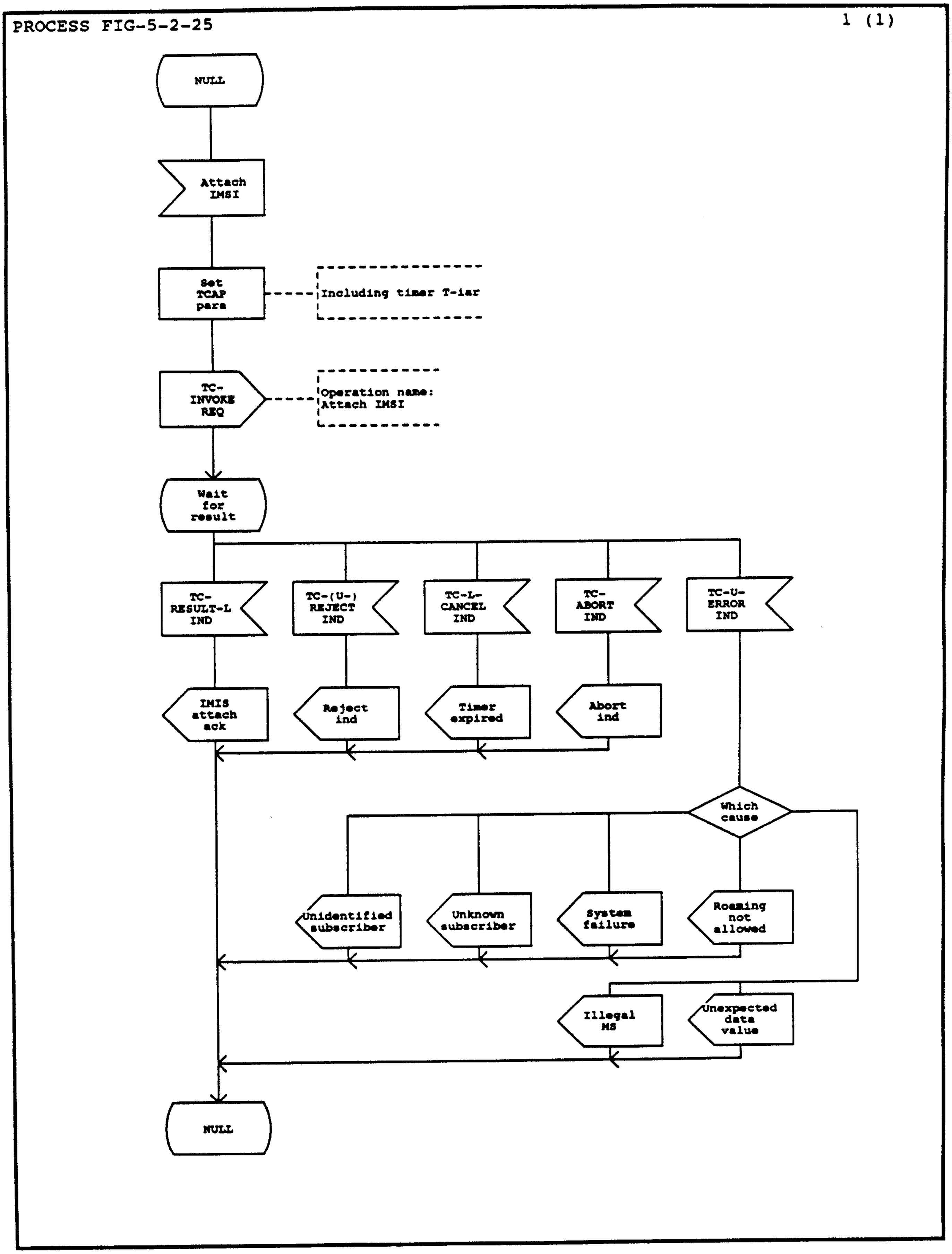


Figure 5.2.26 (Sheet 1 of 2)

Application specific procedures in VLR for IMSI detach procedure

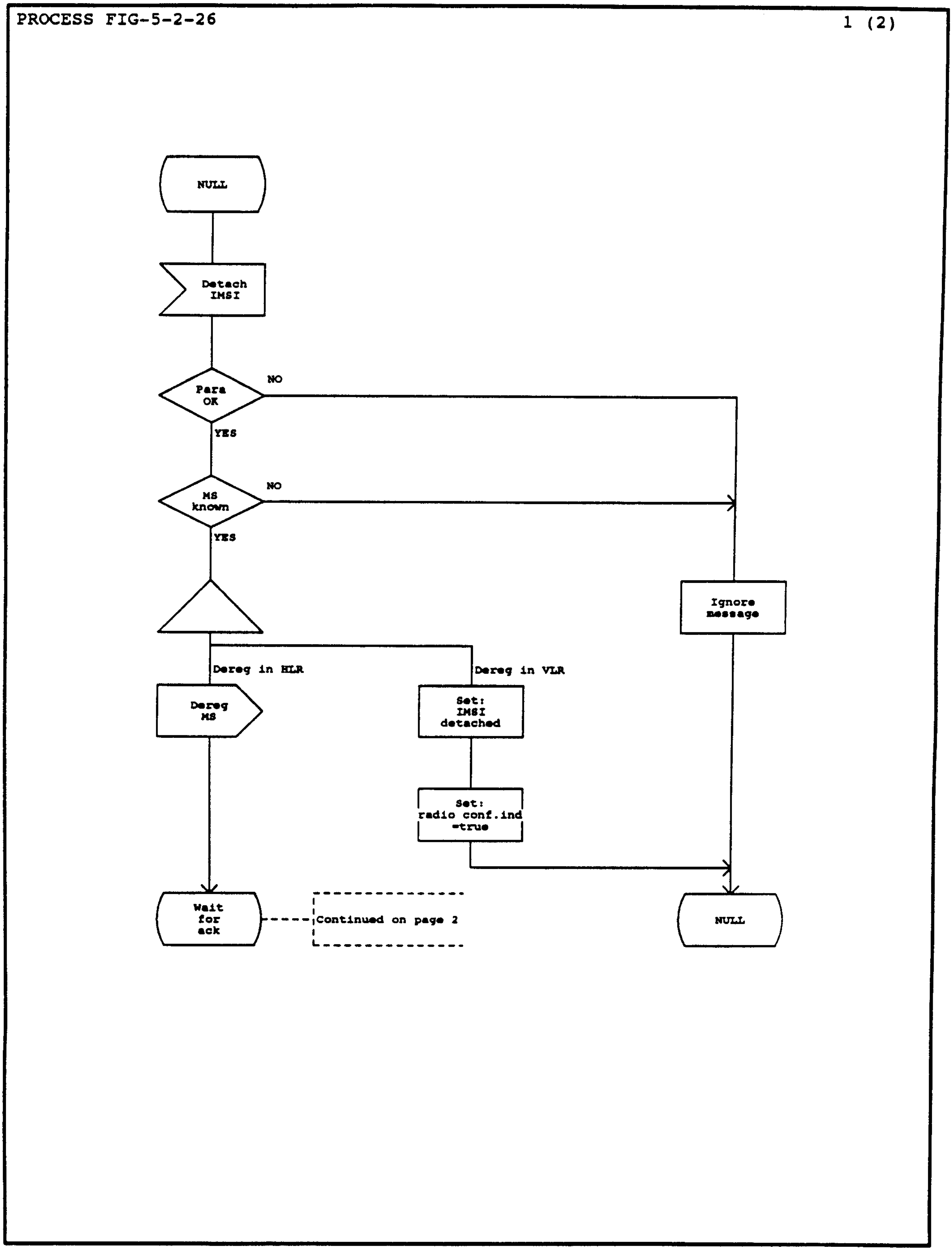


Figure 5.2.26 (Sheet 2 of 2)

Application specific procedures in VLR for IMSI detach procedure

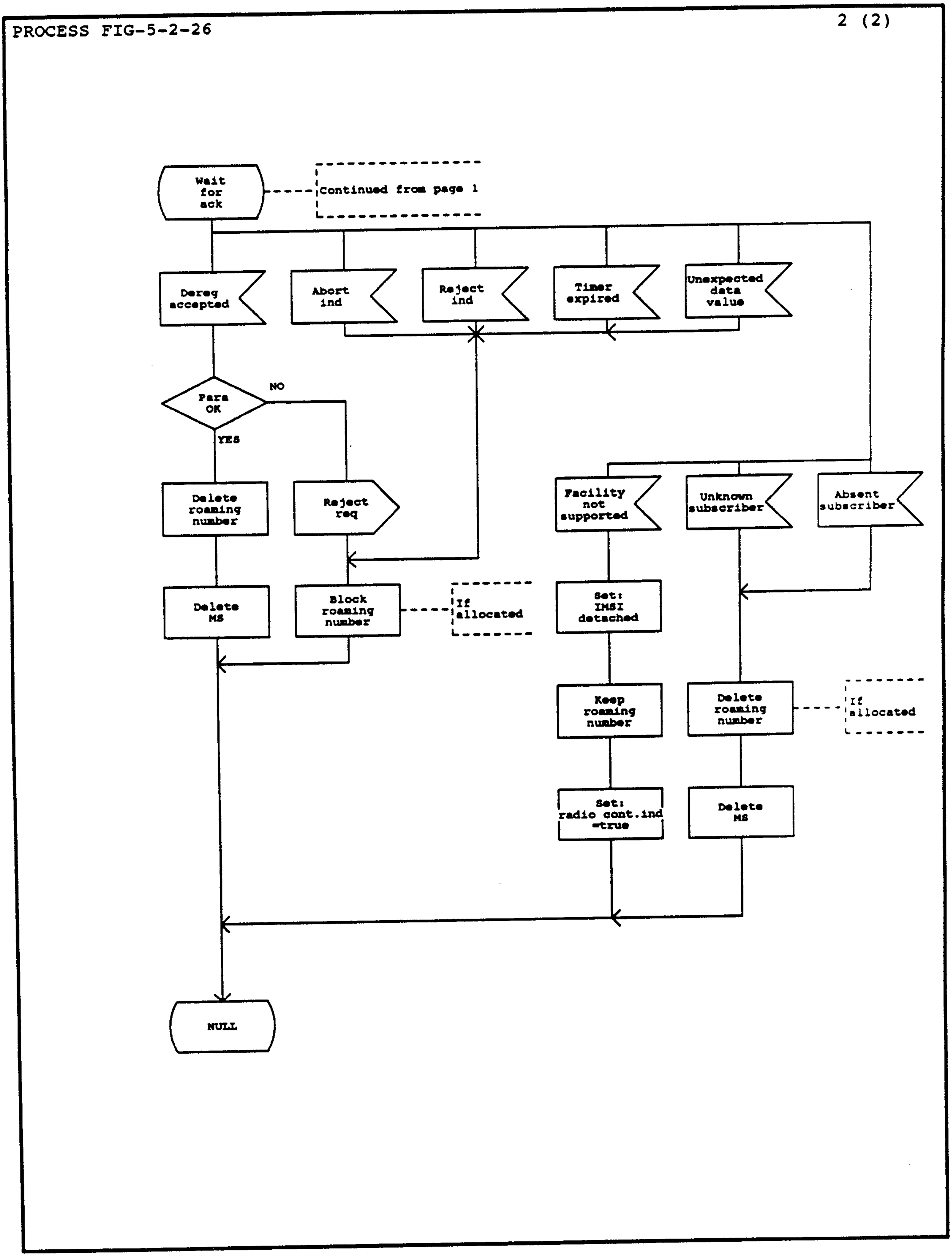


Figure 5.2.27

ASE/TCAP VLR/MSC Interface procedure in VLR for IMSI detach procedure

PROCESS FIG-5-2-27 1 (1)

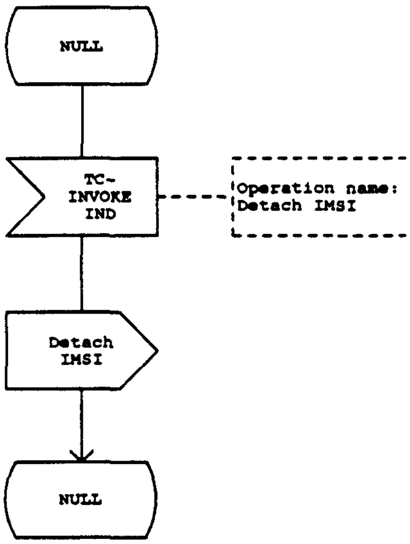


Figure 5.2.28

ASE/TCAP VLR/HLR Interface procedure in VLR for optional deregistration in HLR

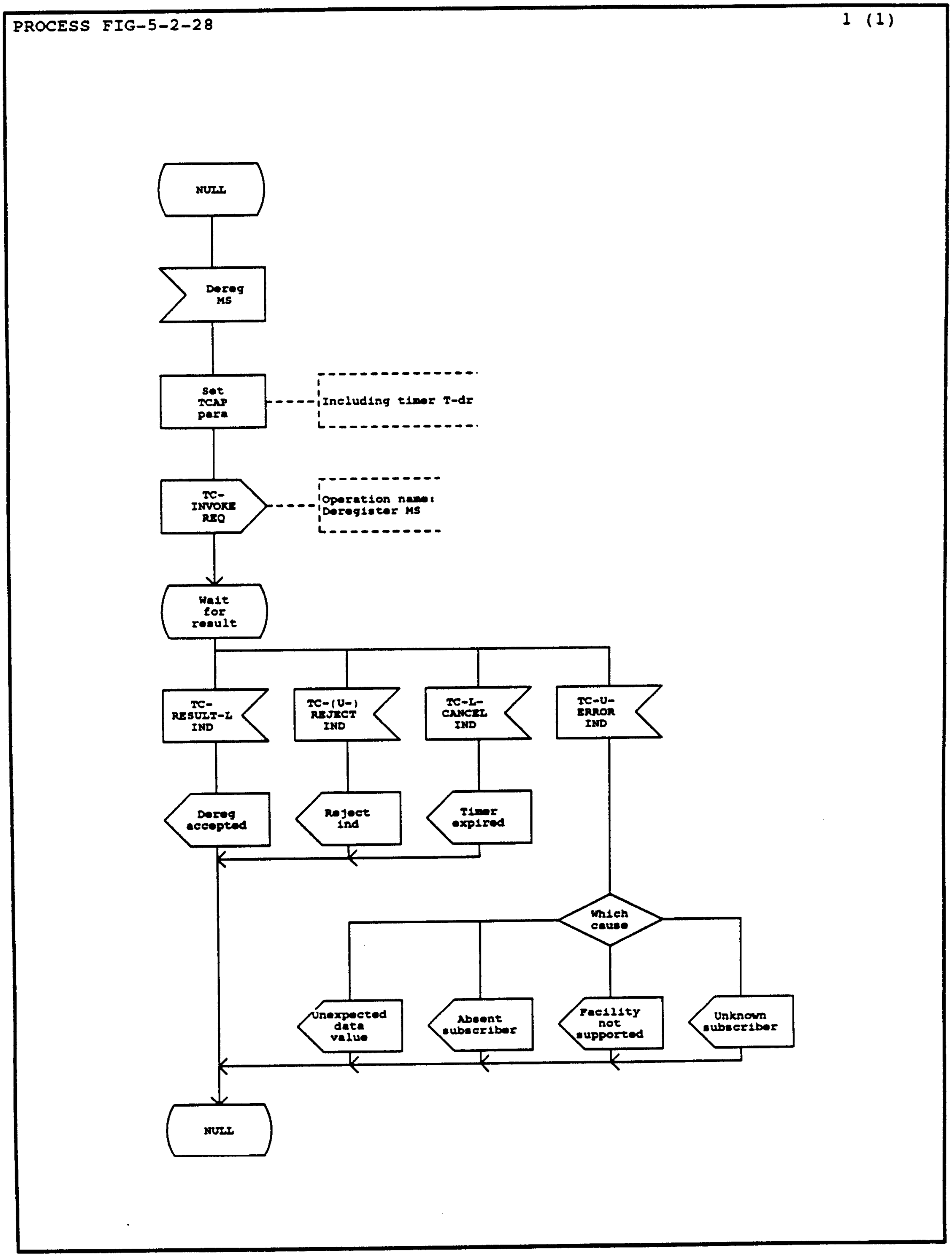


Figure 5.2.29 (Sheet 1 of 3)

Application specific procedures in VLR for IMSI attach procedure

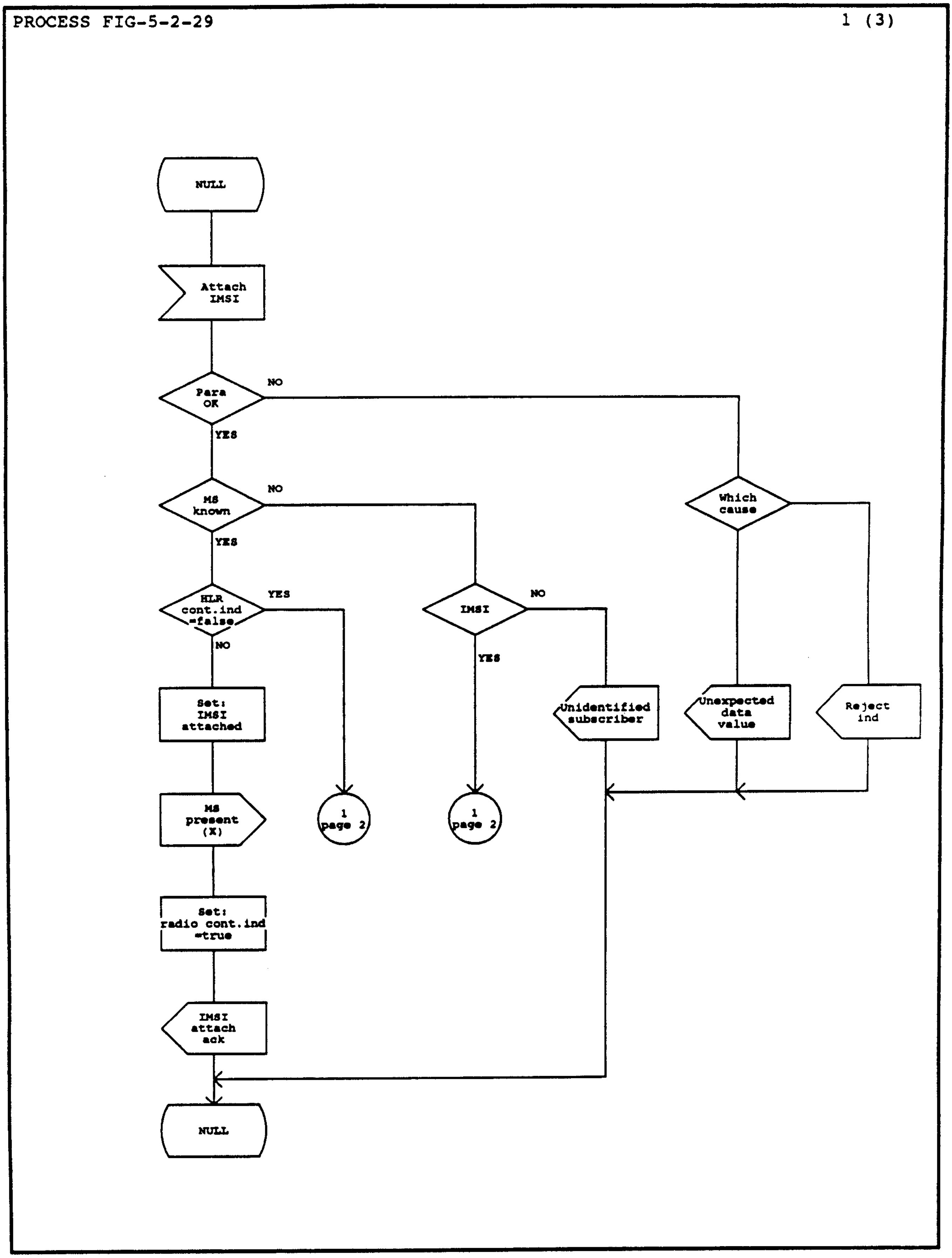


Figure 5.2.29 (Sheet 2 of 3)

Application specific procedures in VLR for IMSI attach procedure

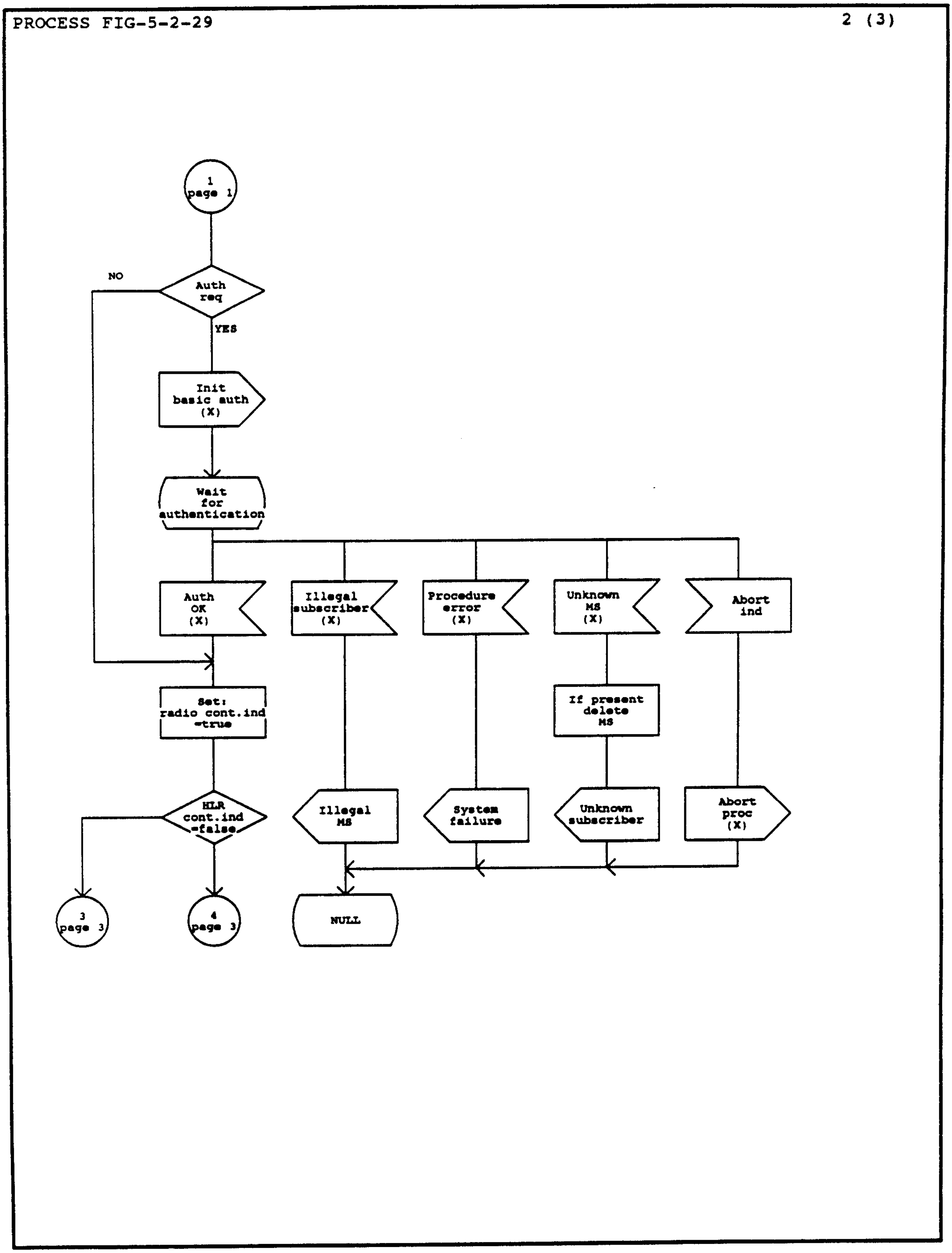


Figure 5.2.29 (Sheet 3 of 3)

Application specific procedures in VLR for IMSI attach procedure

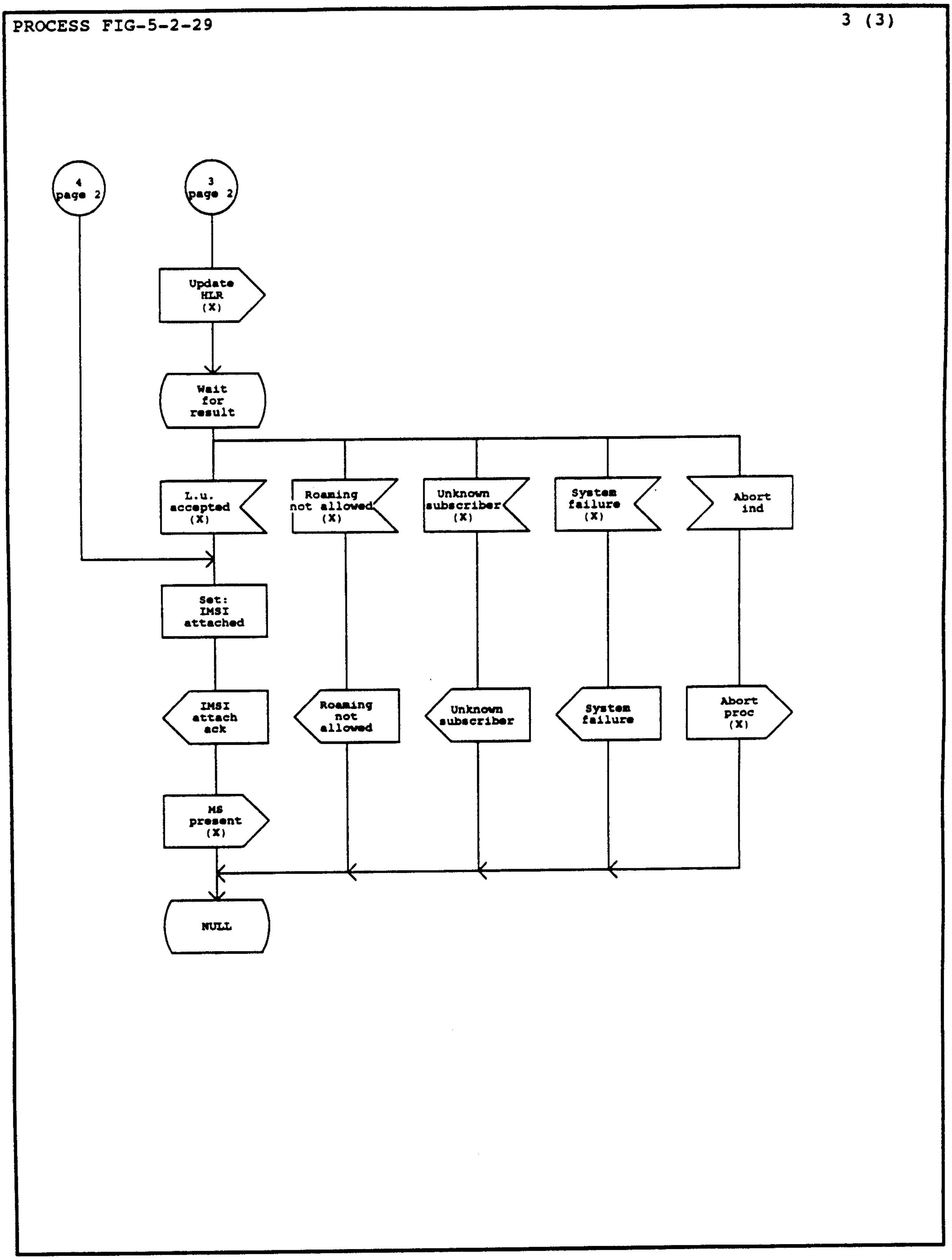


Figure 5.2.30

ASE/TCAP Interface procedure in VLR for IMSI attach procedure

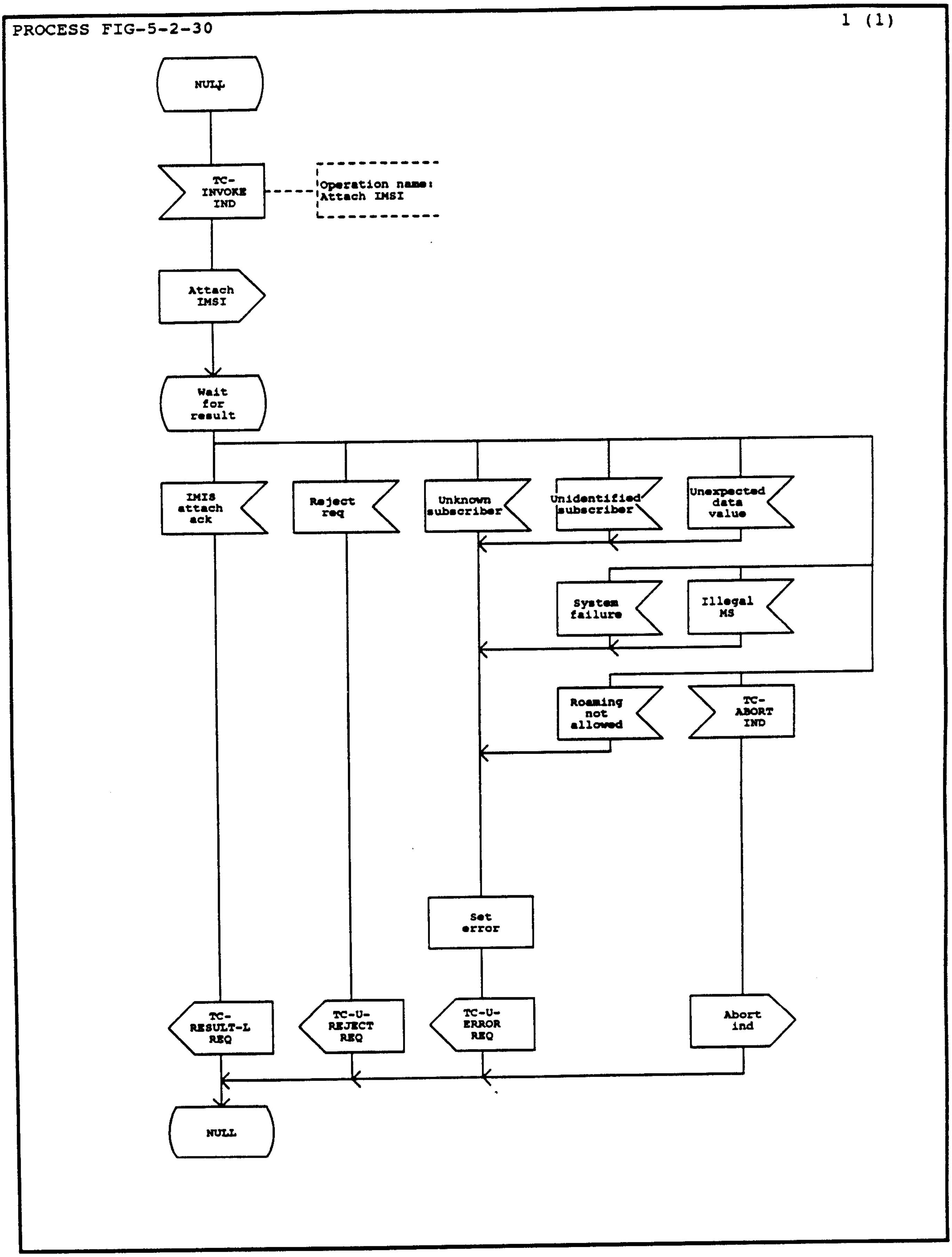


Figure 5.2.31

Application specific procedures in HLR for deregistration

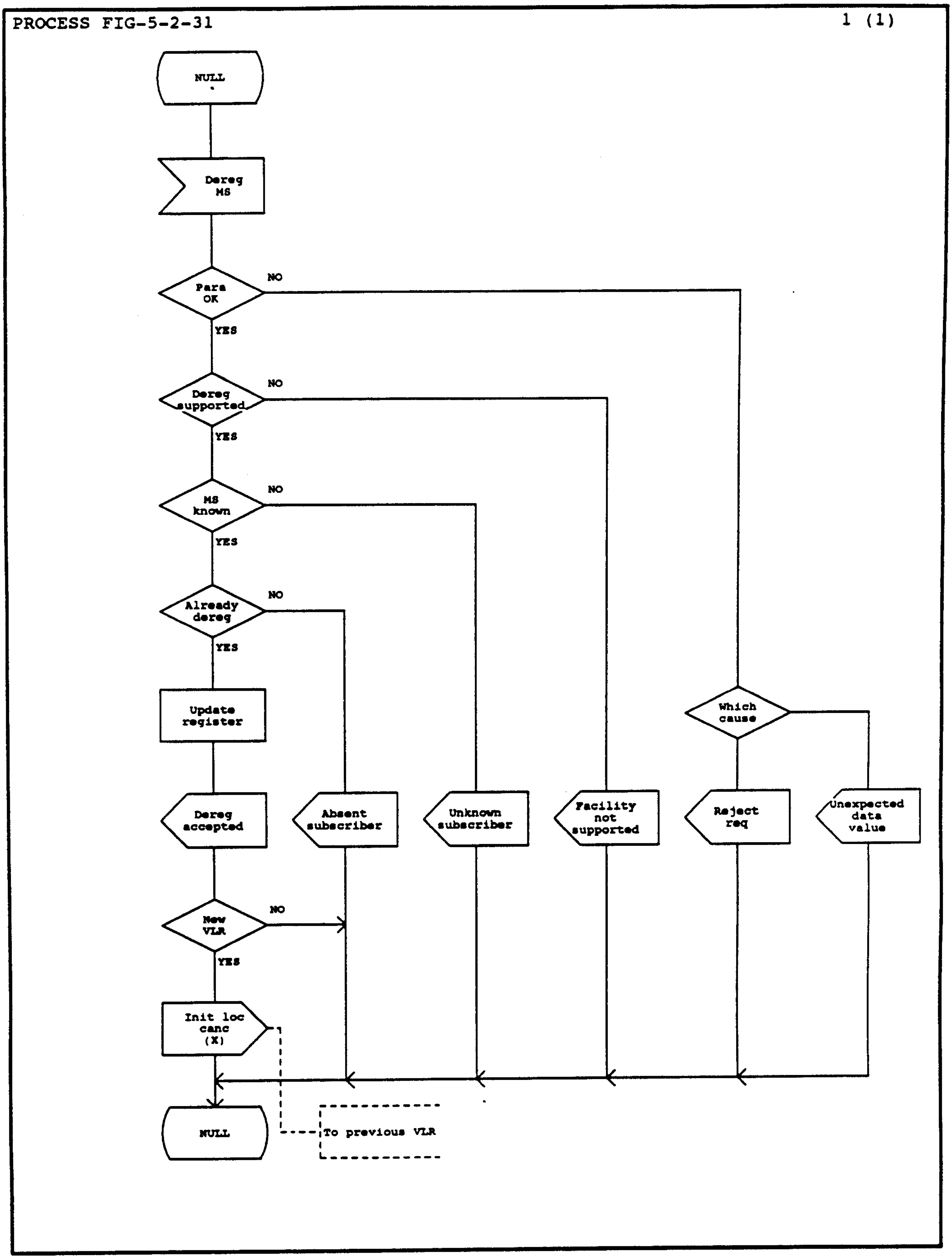
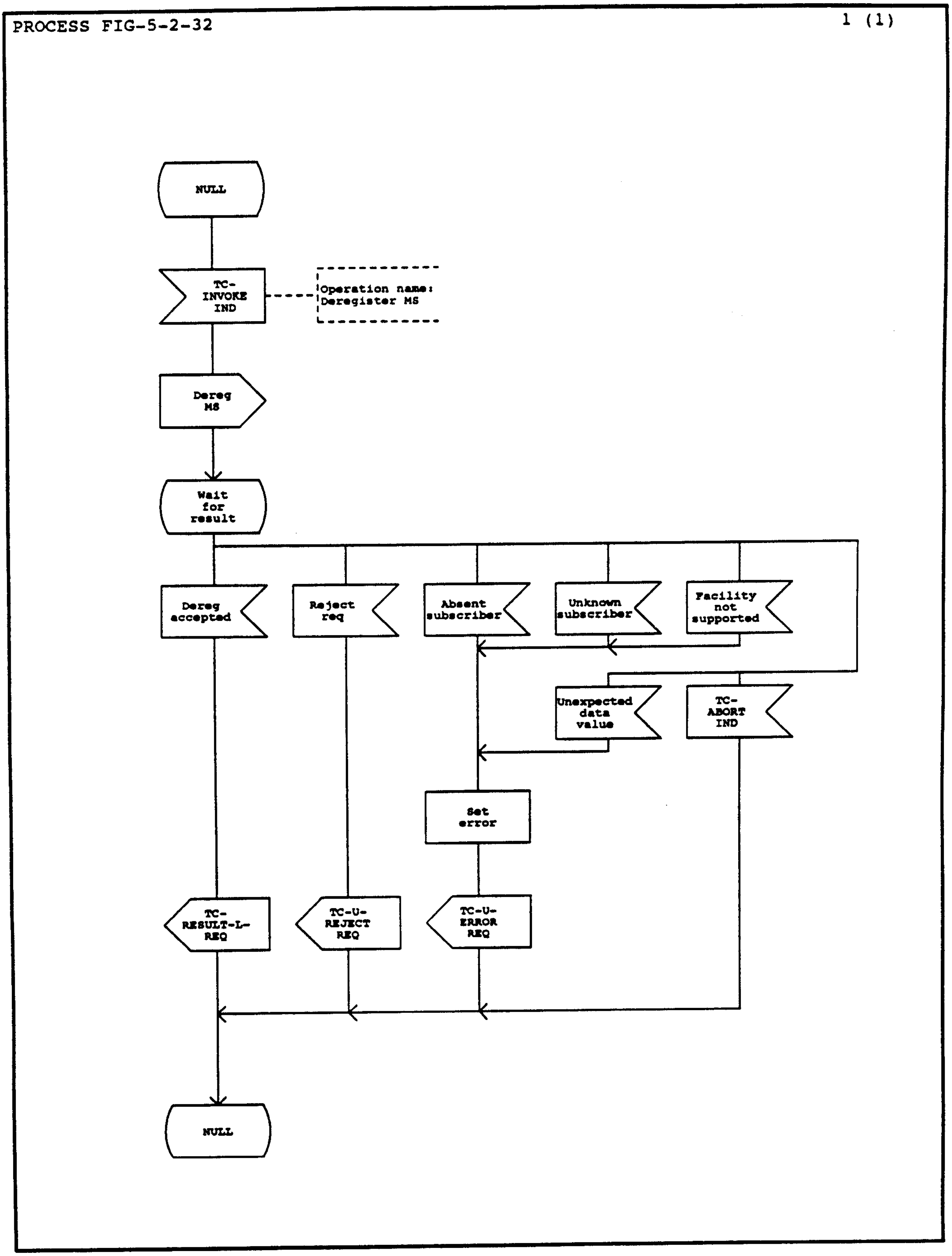


Figure 5.2.32

ASE/TCAP Interface procedure in HLR for deregistration



5.3 Handling of supplementary services

5.3.1 Registration/erasure, activation/deactivation, invocation and interrogation by MS and processing of unstructured SS data

5.3.1.1 Definition of interfaces

a) Procedures involving only the visitor location register associated with the MSC

b) Procedures involving two location registers

Figure 5.3.1 Functional units and interfaces for handling of MS generated supplementary service requests.

Figure 5.3.1 shows the interfaces involved. Several cases are identified as follows:

i) the visitor location register does not require any information from the HLR in order to comply with the request (Figure 5.3.1 a));

ii) the request is first analysed by the visitor location register and the home location register is then interrogated (Figure 5.3.1 b)). This also covers the case where the VLR is transparent to the request from the MS.

The procedures defined below are preceded by the access request procedure of section 5.14.

Handling of supplementary services as part of the call set-up procedure is defined in section 5.4.

See Recommendations in GSM 03.80 series for handling of the various supplementary services.

5.3.1.2 General description of procedures for handling of supplementary services

5.3.1.2.1 List of procedures

There will be separate procedures for each of the following cases:

- activation of supplementary service
- deactivation of supplementary service
- interrogation of supplementary service
- registration of supplementary service
- erasure of supplementary service
- invocation of supplementary service
- process unstructured SS data

However, for the purpose of simplifying the description these procedures are treated together under the generic name "handling of supplementary services". The procedures will differ mainly with regard to reporting negative results.

5.3.1.2.2 Procedures when all the handling functions are in the VLR

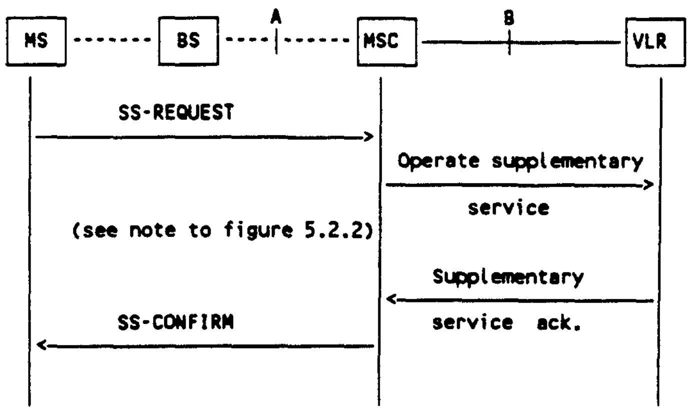


Figure 5.3.2 Procedures for handling of supplementary services in the visitor location register associated with the MSC.

The procedure is initiated by the MS sending a request for supplementary services on the radio path (SS-REQUEST in Figure 5.3.2). This message may contain a request for invocation or interrogation. The MSC then sends the corresponding operate supplementary services message to its associated visitor location register. For each of the procedures invocation or interrogation this corresponds to a distinct message. The location register returns the supplementary services acknowledge message with the fields appropriately set according to the nature of the request and the resulting action on the request (provided, not provided, allowed, not allowed etc), see Recommendations in GSM 03.80 series.

The MSC will send an SS-CONFIRM to the MS with fields set in accordance with the content of the supplementary services acknowledge message.

5.3.1.2.3 Procedures for transitting supplementary services requests via a visitor location register

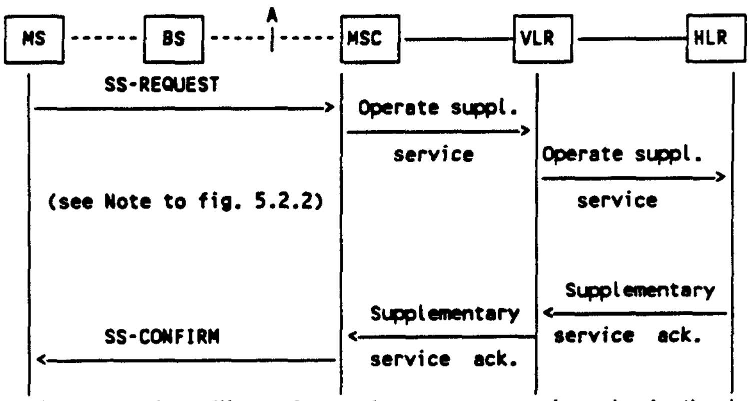


Figure 5.3.3 Procedures for handling of supplementary services by both visitor and home location registers.

Note: The operate supplementary service message is a fully transparent communication between MS and HLR. In case the VLR shall be updated, insert subscriber data is sent to the VLR including the updated parameters, using a separate transaction than the one used for operate supplementary services.

The procedures between the MS and the MSC and between the MSC and the visitor location register are as described in section 5.3.1.2.2. However, in this case the request for supplementary services on the radio path (SS-REQUEST in Figure 5.3.3) may contain a request for registration/erasure, activation/ deactivation, interrogation or processing of unstructured SS data.

If the home location register needs to act upon a supplementary service, or if the supplementary service status needs to be provided to the home location register, or if some parameters related to the services are required from the home location register before actions can be taken by the VLR, the visitor location register will send an operate supplementary services message to the home location register of the MS. There will be one distinct message for each of the procedures listed in section 5.3.1.2.1. However, the invoke supplementary services message will never be sent to the HLR. Every operate supplementary services transaction includes a begin subscriber activity component which is inserted by the VLR when signalling to the HLR, and is included in the first message (operate supplementary services). The begin subscriber activity operation is described in section 5.3.5. The home location register will respond with the supplementary services acknowledge message. This message will contain parameters as requested and also allowed/not allowed information as required. See Recommendation GSM 03.11 for further details.

5.3.1.3 Detailed procedures for handling of supplementary services

5.3.1.3.1 Procedures in the MSC

The application specific procedure is contained in Figure 5.3.4 and the ASE/TCAP interface procedure is contained in Figure 5.3.5. The MSC will receive a request from the MS for some operation of supplementary services (SS-REQUEST (X) in Figure 5.3.4). The MSC will then trigger the interworking application process (operate SS (X)) and wait for the response from the interworking application process (interrogate VLR (X)). The MSC will then send the operate supplementary services (SS) message to its associated VLR. As defined in section 5.3.1.2.1 the operate supplementary services (SS) message is a generic name for several messages.

The MSC will receive either of the following responses:

- a supplementary services (SS) acknowledge message if the operation was successful. The MSC will trigger the interworking application procss (operate SS (X)) and wait for the response from the interworking application process (SS acknowledge (X)). The result will be provided to the MS in the SS-CONFIRM (X) signal;

- a reject indicator if the operation failed because of procedure errors or a timer expired message if the timer in TCAP expired. A failure indication is then inserted in the SS-CONFIRM (X) signal and the interworking application process is informed (procedure aborted (X));

- a negative result where the cause values for each of the operations indicated in section 5.3.1.2.1 are given in section 6 The appropriate cause is inserted in the SS-CONFIRM (X) signal;

- if the MSC receives an abort indication, a failure indication is inserted in the SS-CONFIRM (X) signal and the interworking application process is informed (procedure aborted (X)).

The ASE/TCAP *interface procedure is shown in Figure* 5.3.5. The operate supplementary services (SS) message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the operation by setting timer T-ss. The result is reported as follows:

- a TC-RESULT-L INDICATION primitive contains the supplementary services (SS) acknowledge message;

- expiry of timer T-ss is reported in a TC-L-CANCEL INDICATION primitive;

- negative results as shown in section 6 are reported in a TC-U-ERROR INDICATION primitive.

5.3.1.3.2 Procedures in the VLR

The application specific procedure is contained in Figure 5.3.6. Figures 5.3.7 and 5.3.8 contain the ASE/TCAP interface procedures for the VLR/MSC and VLR/HLR interfaces, respectively.

When receiving an operate supplementary services (SS) message, the request will be provided to the interworking application process in the VLR which is also responsible for supplementary services control (indicated as "operate SS (X)"). If no operation is required in the HLR, the interworking application process will provide either a positive (ack from interworking application process (X)) or negative (negative result, interworking application process (X)) outcome. These results are provided to the MSC in the corresponding MAP messages.

If actions are to be taken in the HLR, the interworking application process will request an operation to be established towards the HLR (interrogate HLR (X)). The VLR will then send the operate supplementary services (SS) message to the HLR and will receive either of the results:

- the supplementary services (SS) acknowledge message containing a positive outcome of the operation. The VLR will then trigger the interworking application process (operate SS(X)) and wait for the response from the interworking application process (SS acknowledge (X)). This information is forwarded to the MSC in a supplementary services (SS) acknowledge message;

- a reject indicator will indicate procedure errors between the VLR and the HLR and a timer expiry message will indicate time-out in TCAP. The transaction with the HLR may also be aborted. These events are sent to the MSC as a system failure message. The interworking application process is informed;

- a negative result as shown in section 6 may also be received. The result is provided to the MSC and to the interworking application process.

If the transaction with the MSC is aborted, the VLR will abort the transaction with the HLR and inform the interworking application process.

The ASE/TCAP interface procedure for the VLR/MSC interface is shown in Figure 5.3.7. The operate supplementary services (SS) message is received in a TC-INVOKE INDICATION primitive. There is one message for each of the operations defined in section 5.3.1.2.1. The results are reported as follows:

- a positive result (supplementary services acknowledge message) is sent in a TC-RESULT-L REQUEST primitive;

- a reject indication (procedure error) is sent in a TC-U-REJECT REQUEST primitive;

- a negative result (as defined in section 6) is sent in a TC-U-ERROR REQUEST primitive.

The ASE/TCAP interface procedure for the VLR/HLR interface is shown in Figure 5.3.8. The operate supplementary services (SS) message is sent in a TC-INVOKE REQUEST primitive (one primitive for each of the operations of section 5.3.1.2.1, with the exception of invocation). TCAP is requested to supervise the procedure by timer T-ss. The outcome of the operation can be as follows:

- a positive result in terms of a supplementary services (SS) acknowledge message is received in a TC-RESULT-L INDICATION primitive;

- expiry of timer T-ss is reported in a TC-L-CANCEL INDICATION primitive;

- procedure failure is reported in a TC-(U-)REJECT INDICATION primitive;

- a negative result of section 6 is reported in a TC-U-ERROR INDICATION primitive.

5.3.1.3.3 Procedures in the HLR

The application specific procedure is given in Figure 5.3.9 and the ASE/TCAP interface procedure is given in Figure 5.3.10.

The application specific procedure is initiated when the HLR receives an operate supplementary services (SS) message from a VLR. The operations on the supplementary services are assumed to be performed by an SS handler function in the HLR not part of the mobile application part. The result (positive: acknowledge from the SS handler (X), or negative: negative result, SS handler (X)) is returned to the VLR.

The ASE/TCAP interface procedure is shown in Figure 5.3.10. The operate supplementary services message is received in a TC-INVOKE INDICATION primitive.

The results are returned as follows:

- a positive result (supplementary services acknowledge) is returned in a TC-RESULT-L REQUEST primitive;

- a reject because of procedure failure is returned in a TC-U-REJECT REQUEST primitive;

- a negative result with cause value as given in section 6 is returned in a TC-U-ERROR REQUEST primitive.

Figure 5.3.4
Application specific procedure in MSC for handling of supplementary services.

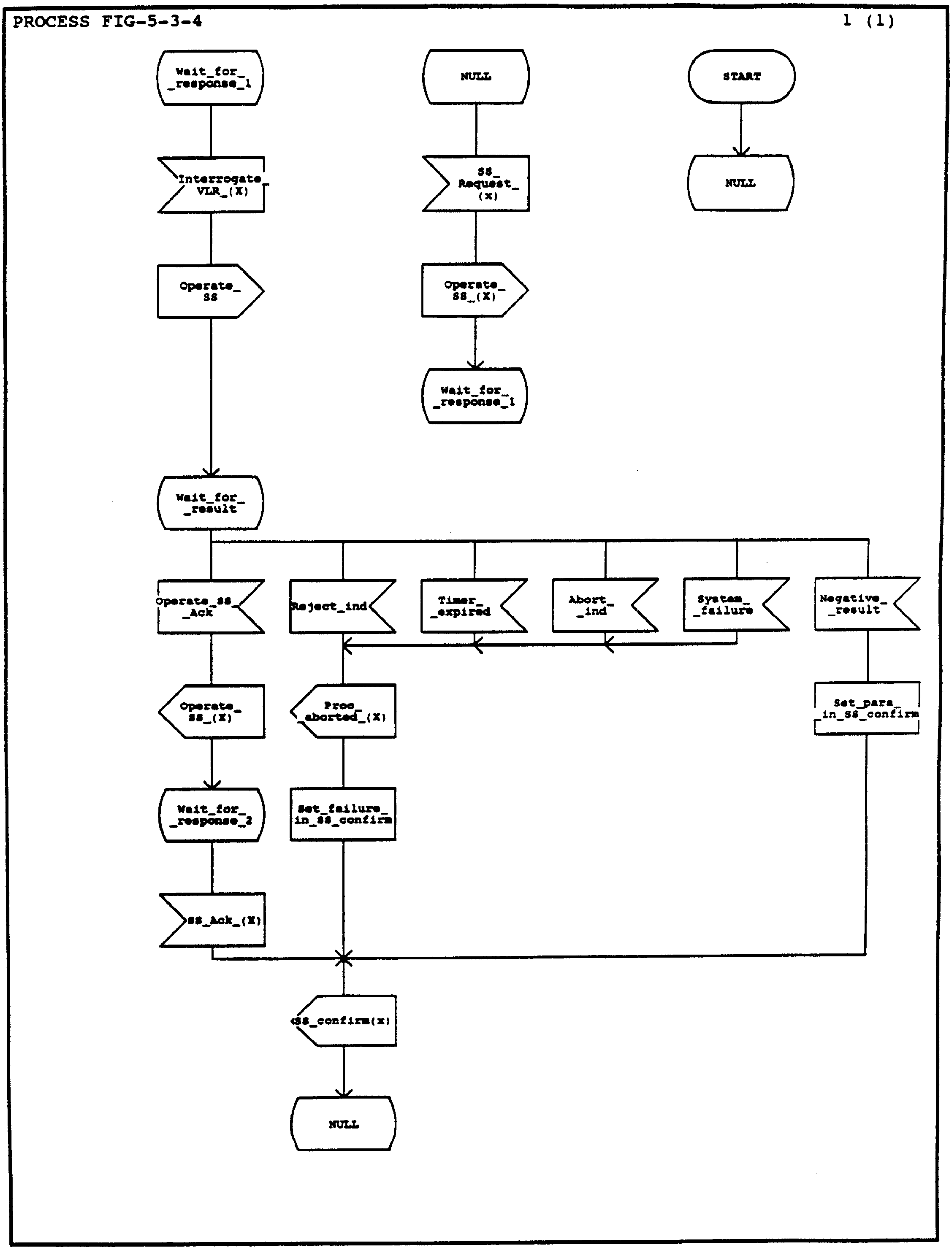


Figure 5.3.5
ASE/TCAP interface procedure in MSC for handling of supplementary services.

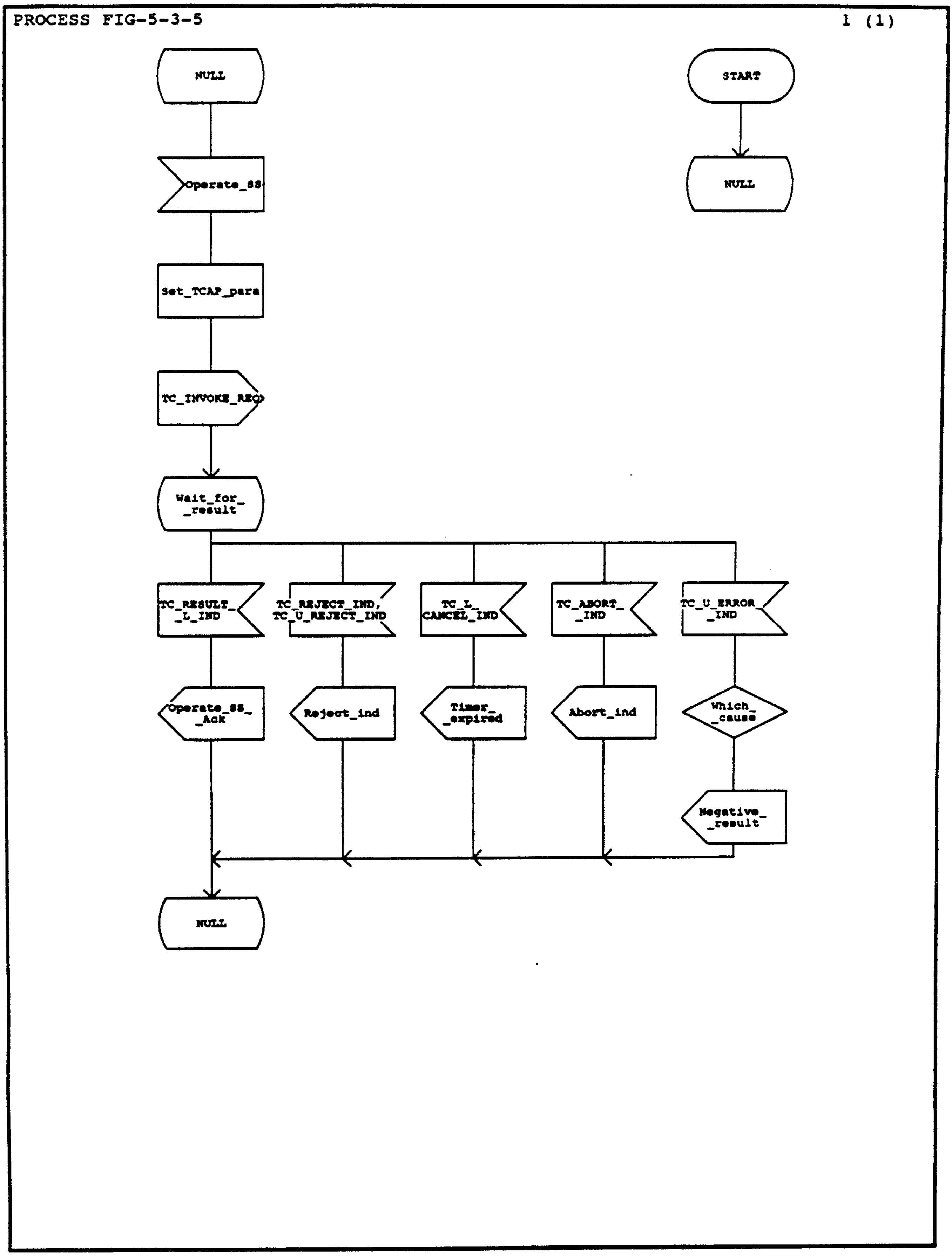


Figure 5.3.6 (Sheet 1 of 2)
Application specific procedures in VLR for handling of supplementary services.

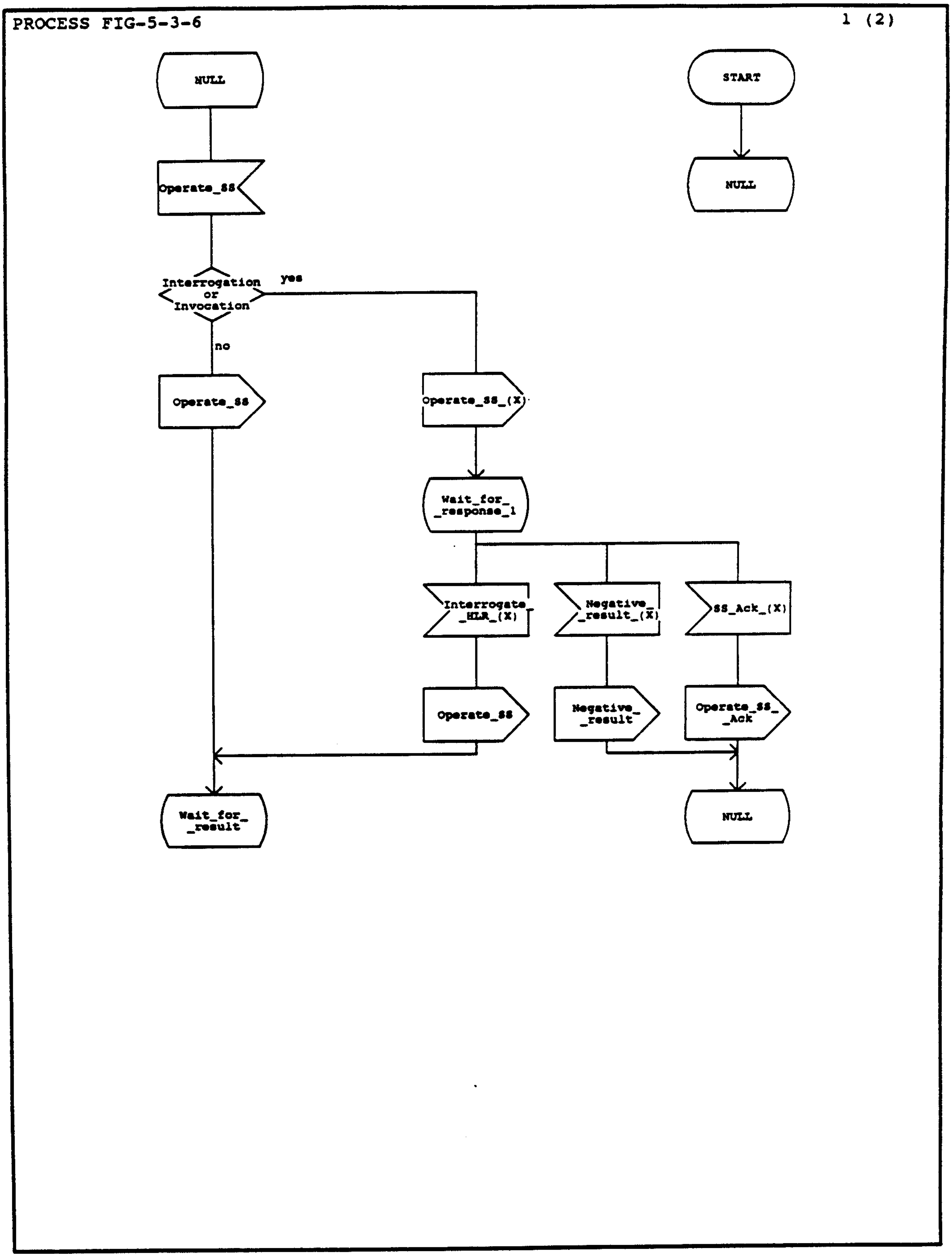


Figure 5.3.6 (Sheet 2 of 2)
Application specific procedures in VLR for handling of supplementary services.

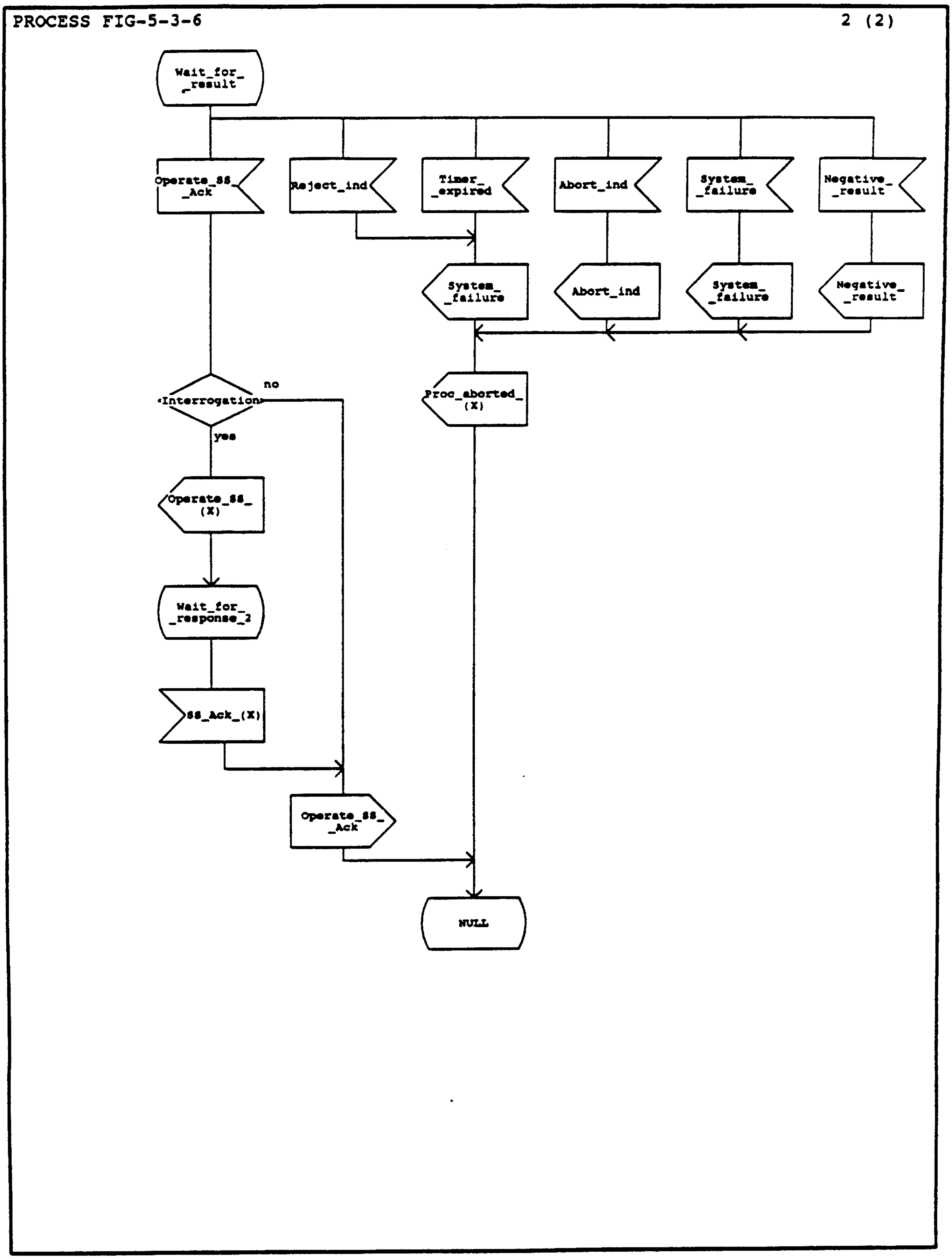


Figure 5.3.7
ASE/TCAP VLR/MSC interface procedure for handling of supplementary services.

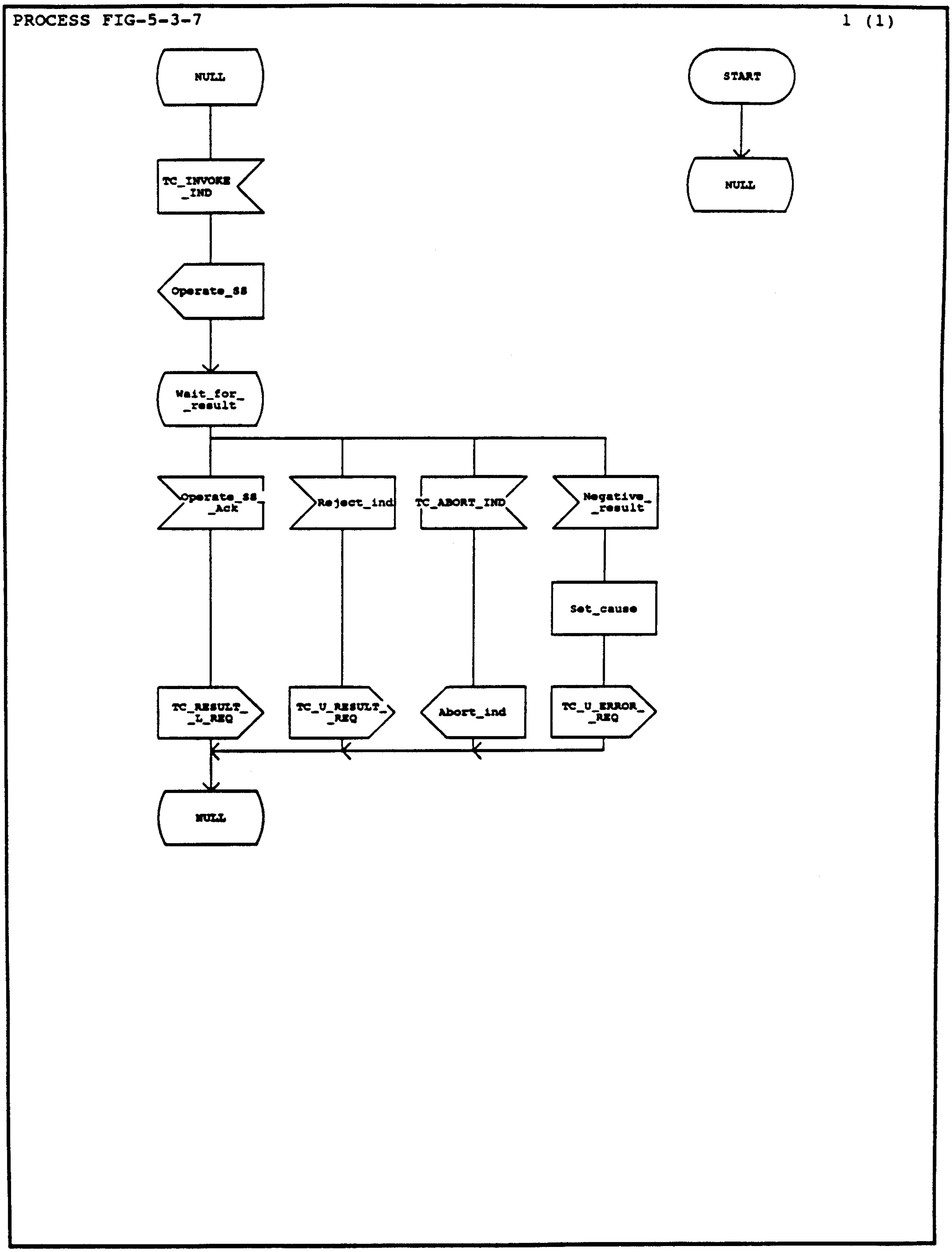


Figure 5.3.8
ASE/TCAP VLR/HLR interface procedure for handling of supplementary services.

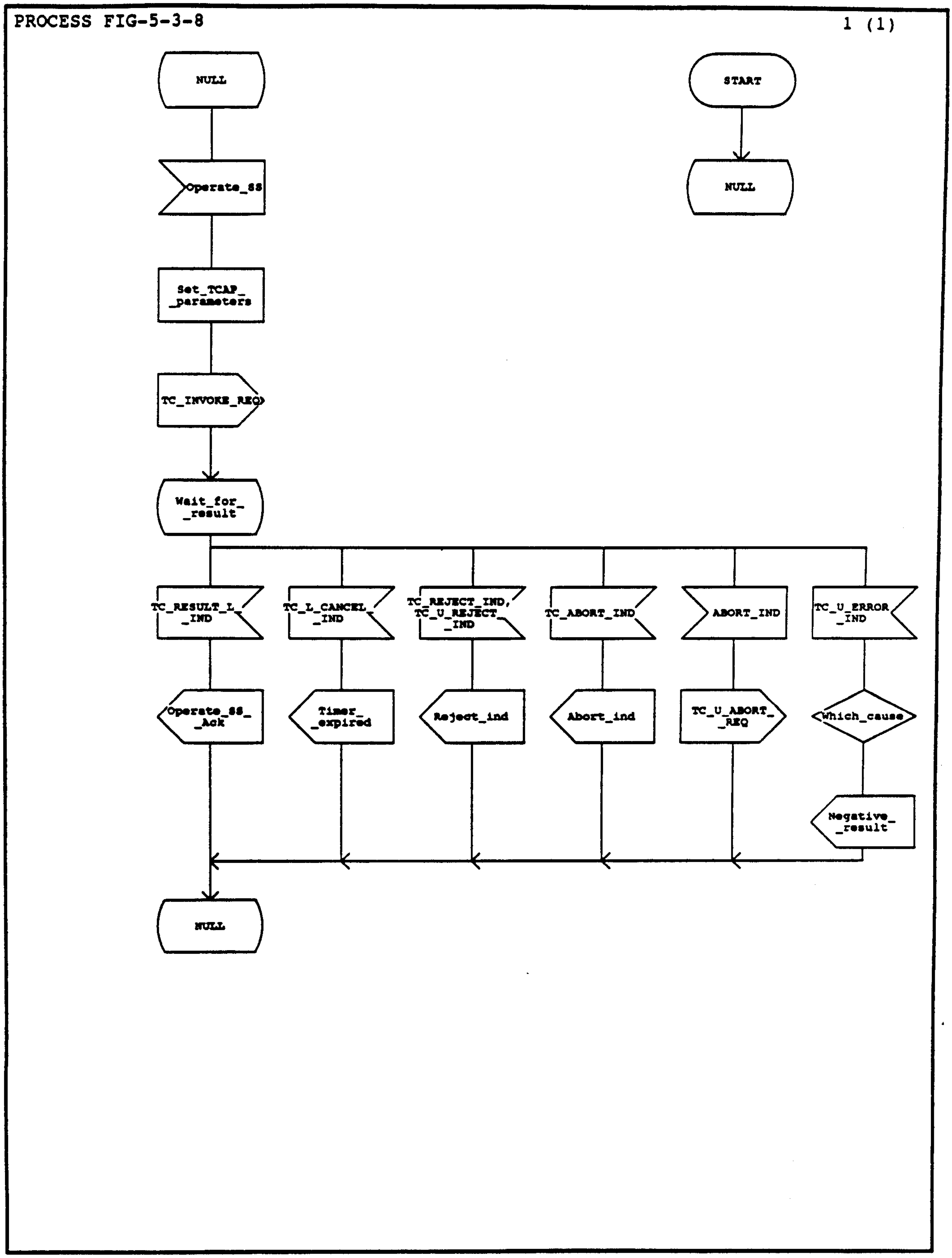


Figure 5.3.9
Application specific procedure in HLR for handling of supplementary services.

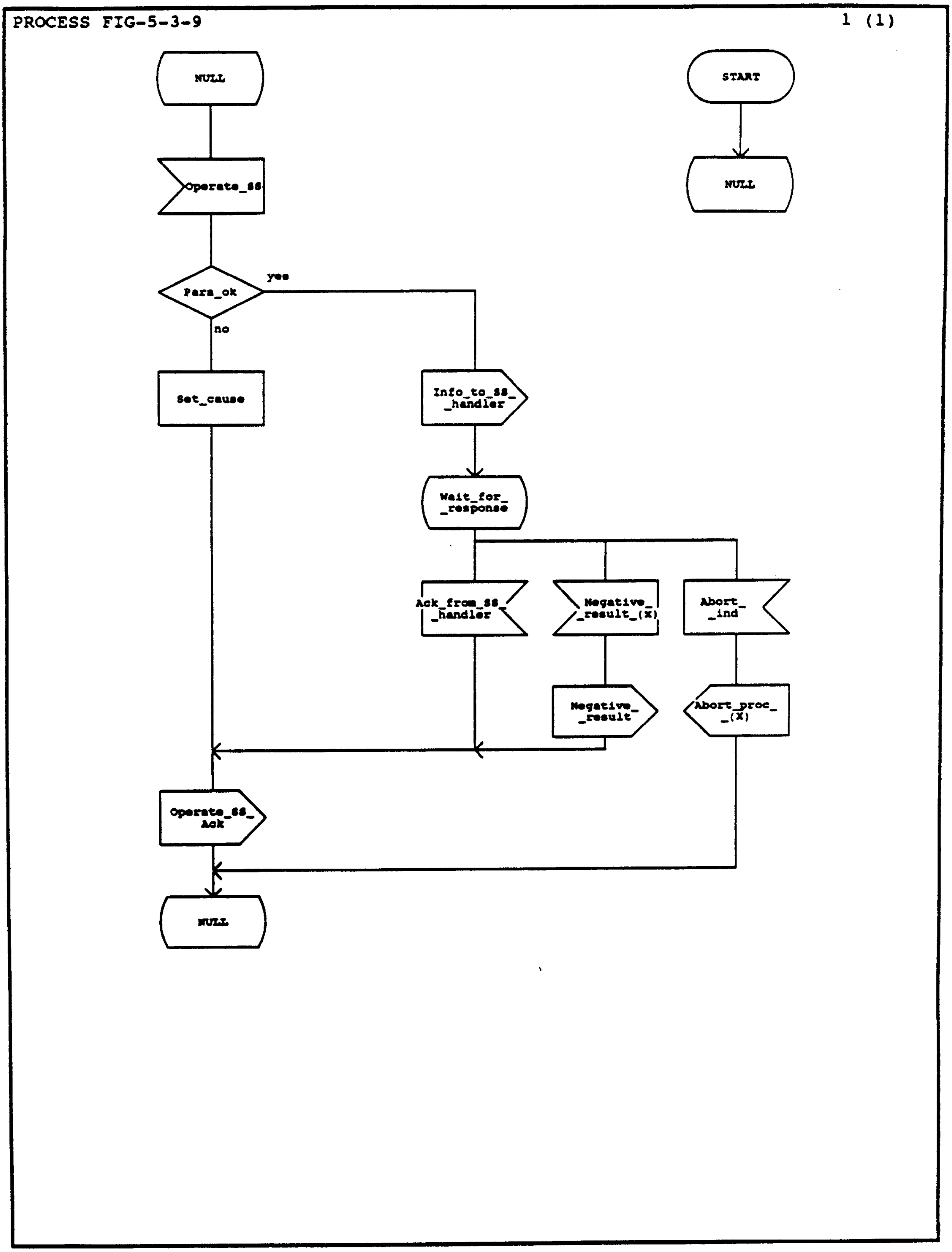
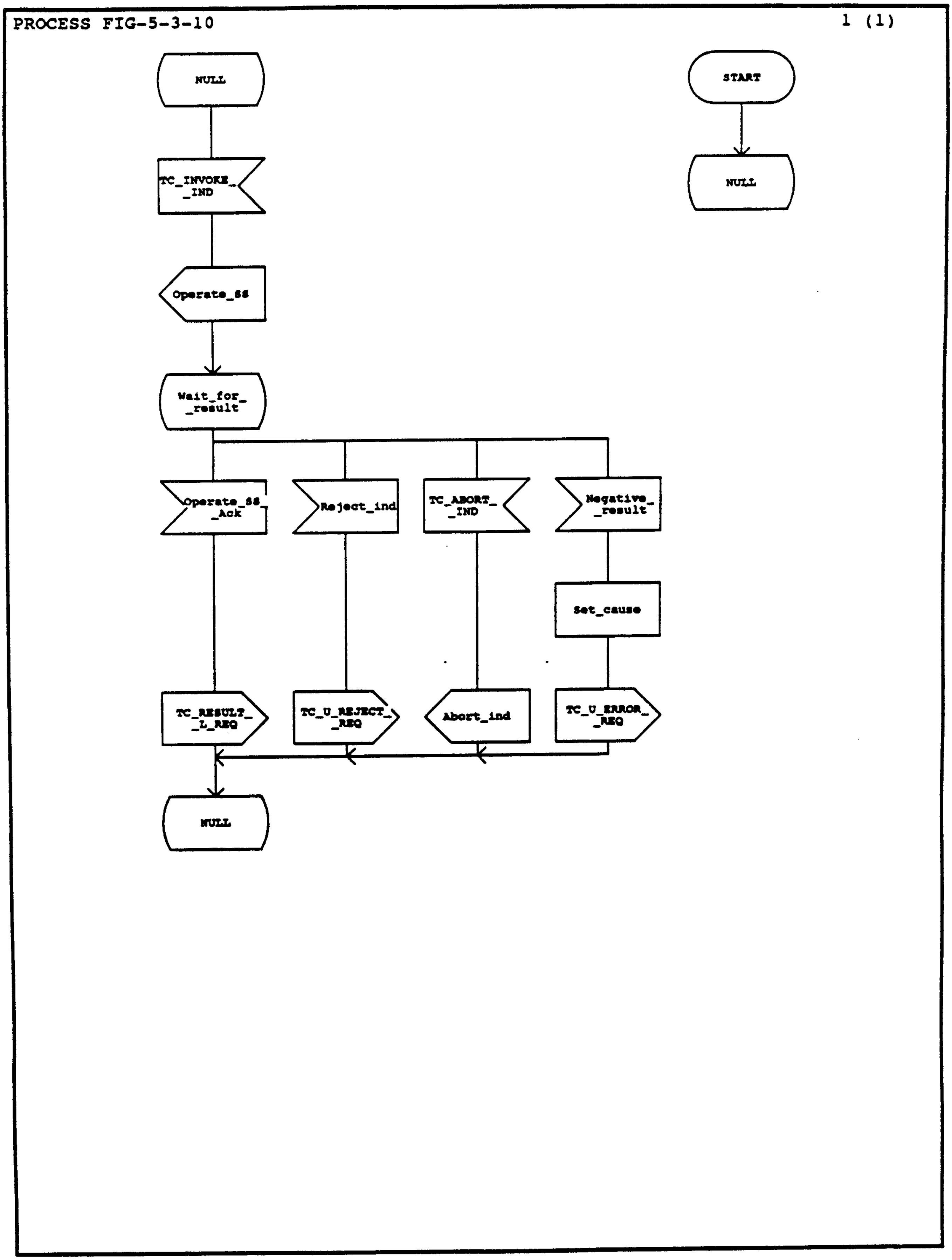


Figure 5.3.10
ASE/TCAP interfac procedure in the HLR for handling of supplementary services.



5.3.2 Notification of supplementary services status

5.3.2.1 Interfaces and general description of procedures

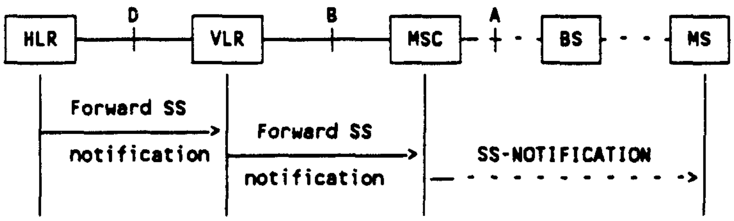


Figure 5.3.11 Interfaces and procedures for notification of supplementary services status.

Figure 5.3.11 shows the general procedures for notification of supplementary services. The procedure is invoked by the HLR if the location register detects that an activation of a supplementary service requires deactivation of another service in order to avoid conflicts in the operation of the two services. The notification is sent in a forward supplementary services notification message. The VLR will relay the message to the MSC.

The notification is passed to the MS in the SS-NOTIFICATION message.

The forward supplementary services notification will only be sent if there exists a connection to the MS at the time when the conflict is detected.

5.3.2.2 Detailed description of the procedure

5.3.2.2.1 Procedure in the HLR when detecting the conflict

The application specific procedure in an HLR detecting a conflict between two or more supplementary services is shown in Figure 5.3.12. The ASE/TCAP interface procedure is shown in Figure 5.3.13.

The HLR will send a forward supplementary services notification message in a TC-INVOKE REQUEST primitive provided that a TCAP transaction for handling supplementary services exists for the MS. The message will contain the new activation status of the supplementary services chosen by the supplementary services handler in order to resolve the conflict.

5.3.2.2.2 Procedures in a VLR relaying the notification

The application specific procedure in the VLR for relaying a forward supplementary services notification is shown in Figure 5.3.14. The ASE/TCAP interface procedure is shown in Figure 5.3.15.

The VLR will receive the forward supplementary services notification message from the HLR in a TC-INVOKE INDICATION primitive. Provided that

- there is no parameter error in the message, and

- a TCAP transaction for handling supplementary services exists to the MSC,

the VLR will forward the same message to the MSC in a TC-INVOKE REQUEST primitive.

5.3.2.2.3 Procedures in the MSC

The application specific procedure in the MSC is shown in Figure 5.3.16 and the ASE/TCAP interface procedure is shown in Figure 5.3.17.

The MSC will receive the forward supplementary services notification message in a TC-INVOKE INDICATION primitive. The MSC will forward the message to the MS provided that:

- there is no parameter error in the message, and
- an MM-connection for supplementary services exists to the MS.

Figure 5.3.12
Application specific procedure in the HLR detecting a possible conflict between supplementary services activation.

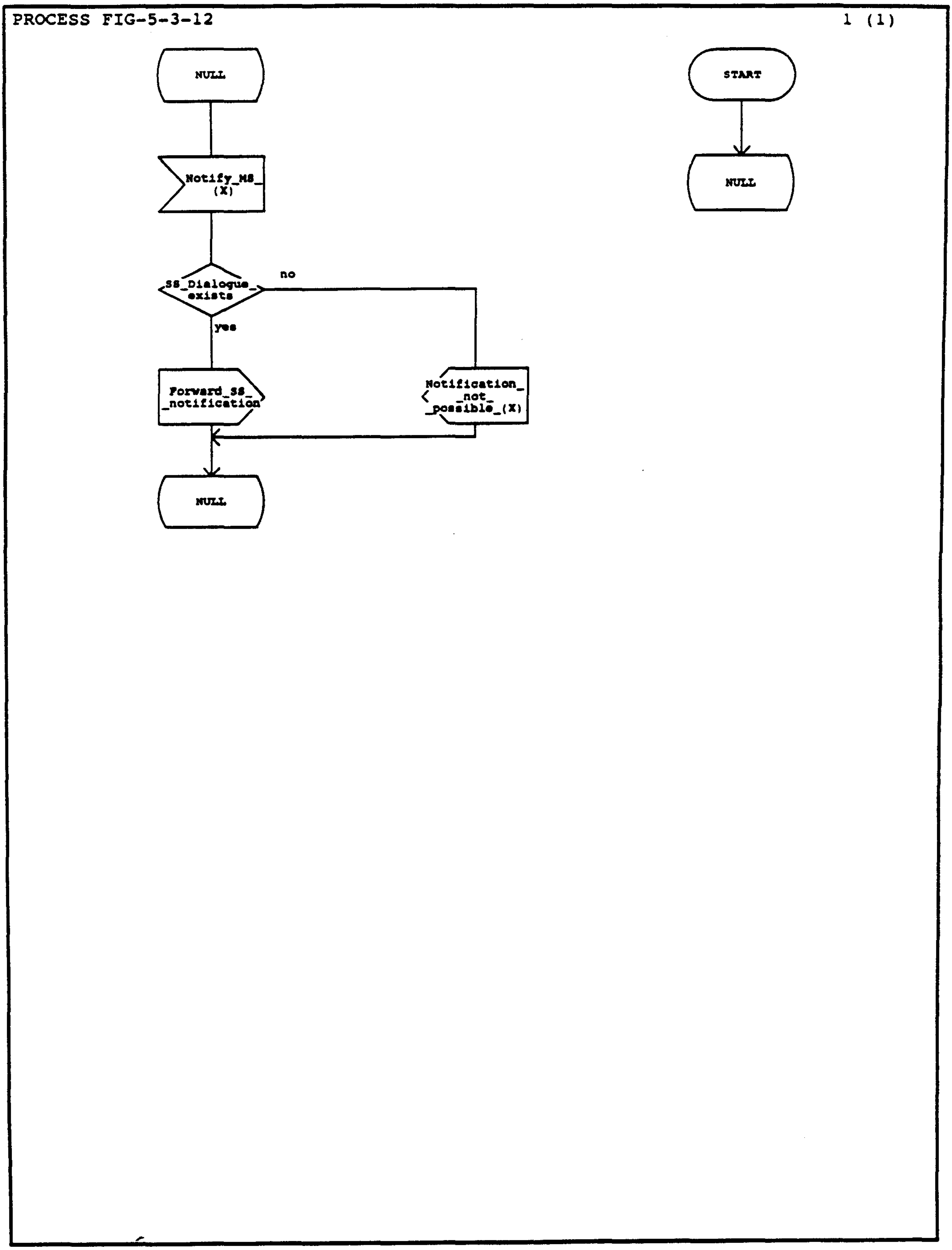


Figure 5.3.13
ASE/TCAP interface procedure in the HLR detecting a possible conflict between supplementary services activation.

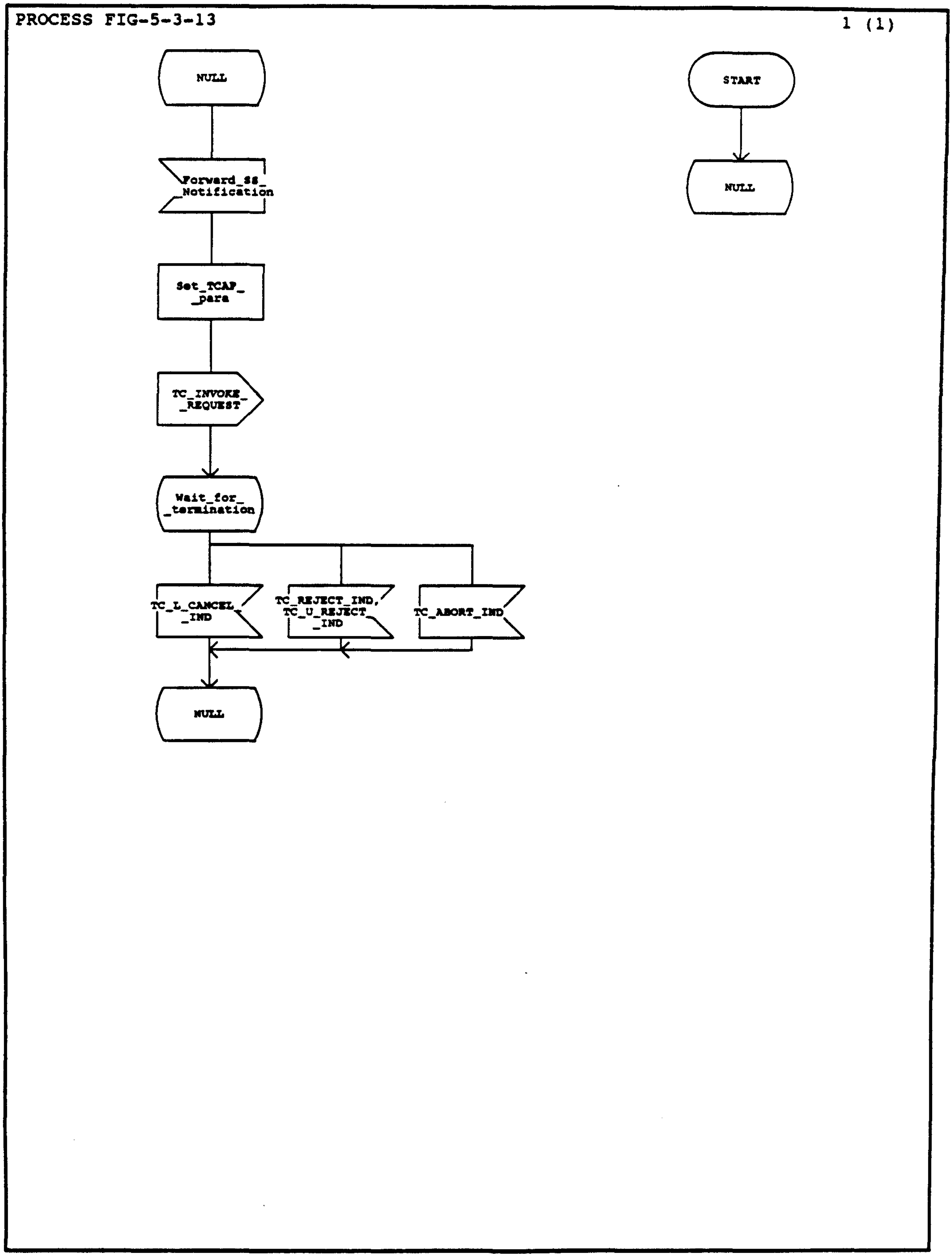


Figure 5.3.14
Application specific procedure in the VLR for relaying the notification.

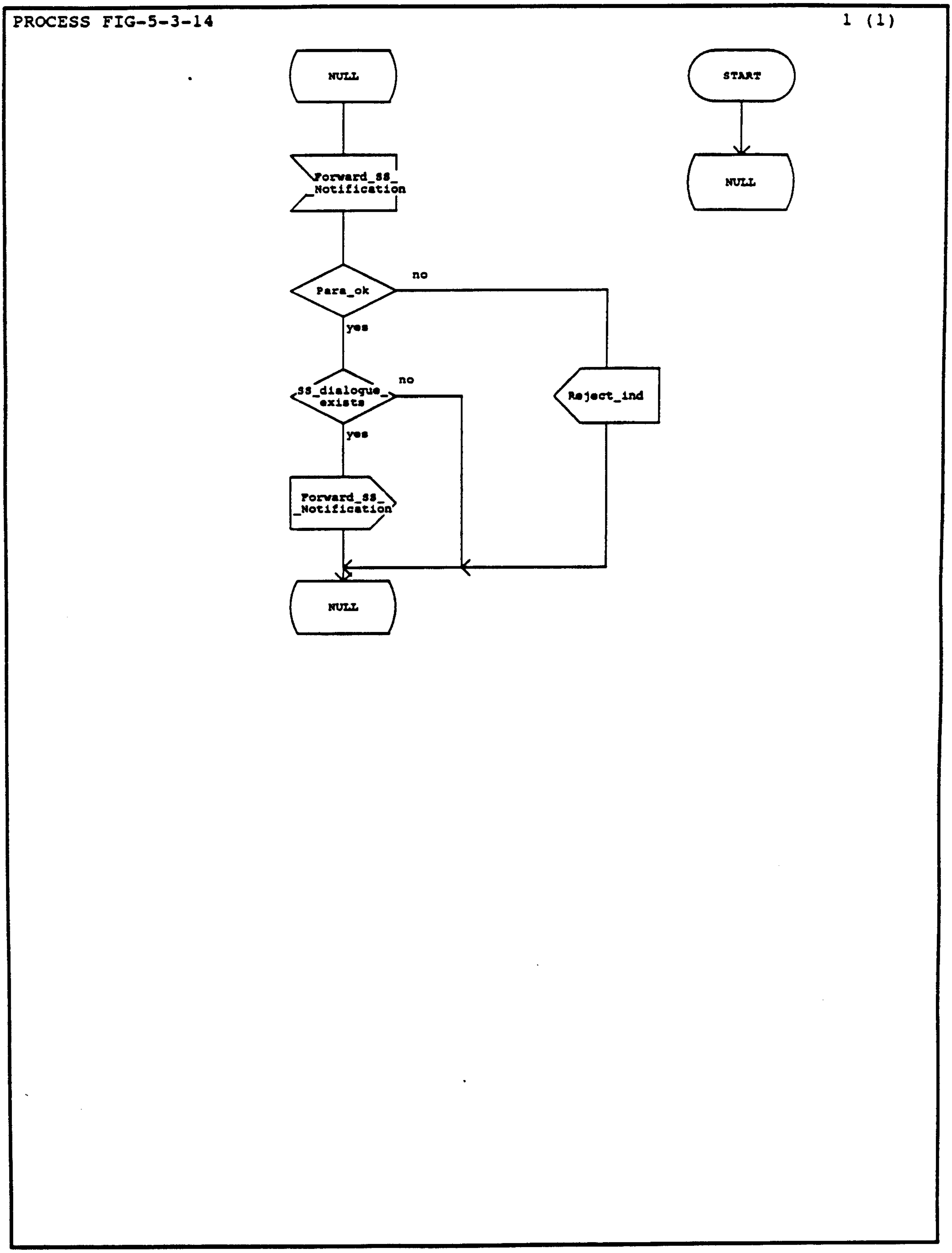


Figure 5.3.15
ASE/TCAP interface procedure in the VLR for relaying the notification.

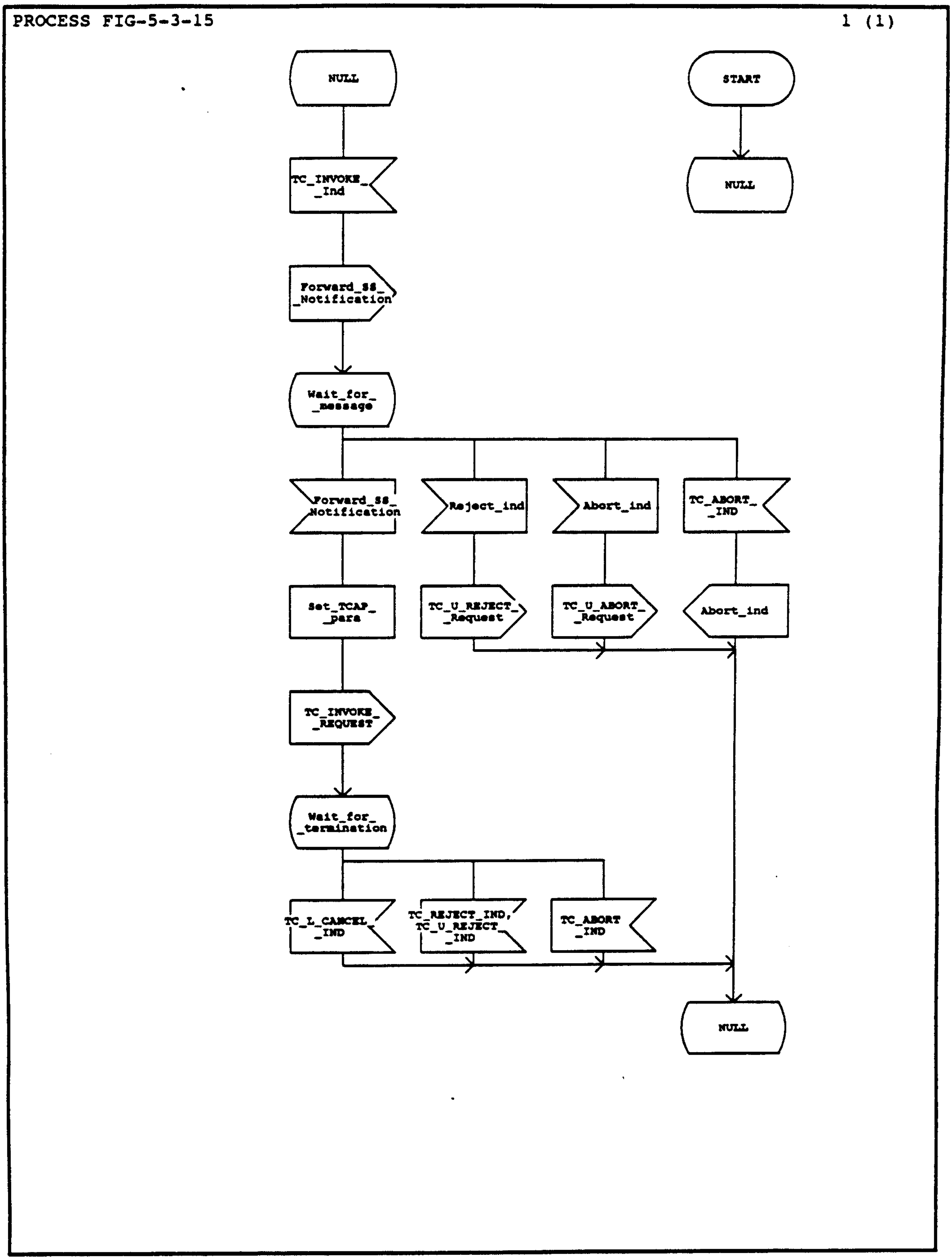


Figure 5.3.16
Application specific procedure in the MSC for relaying the notification to the MS.

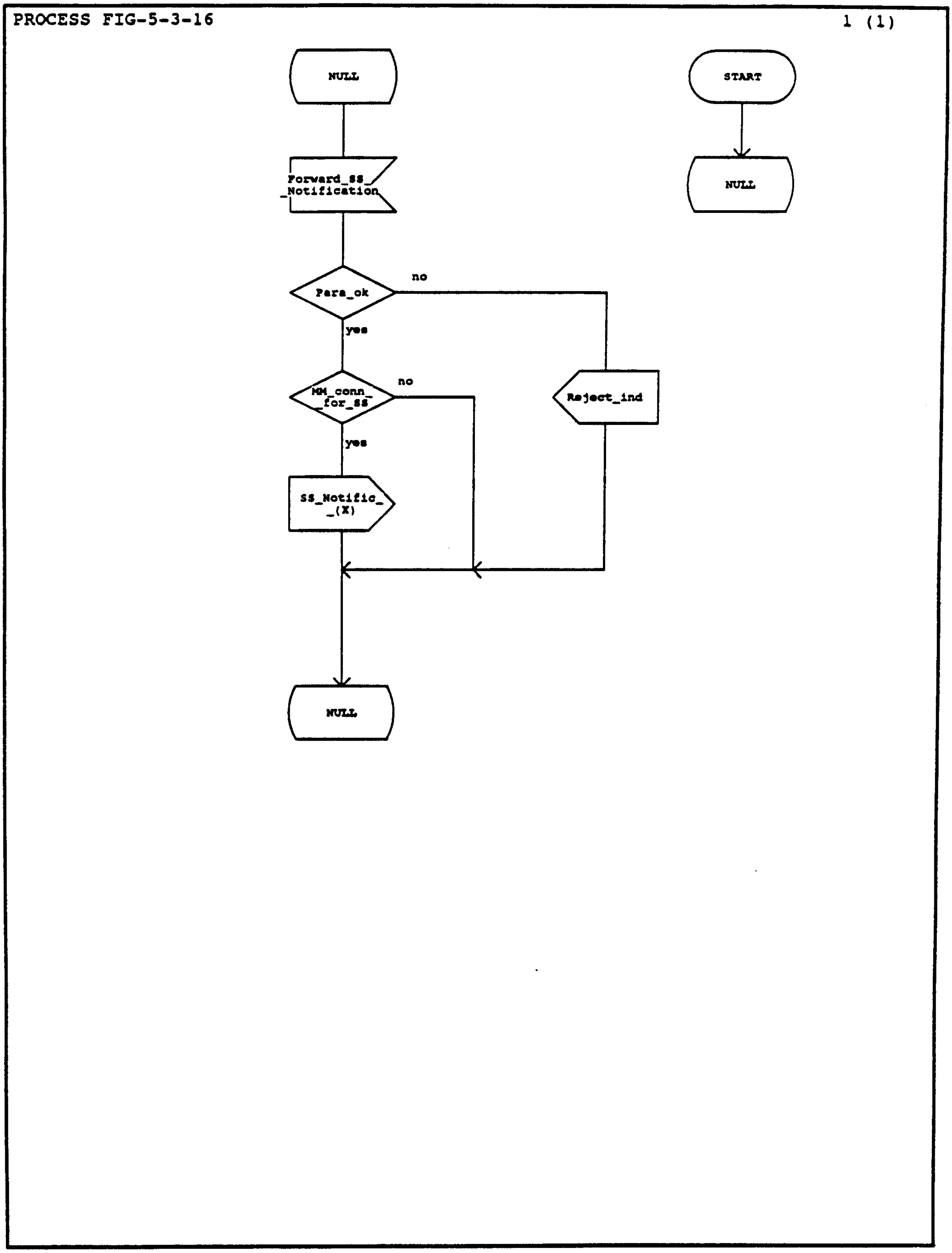
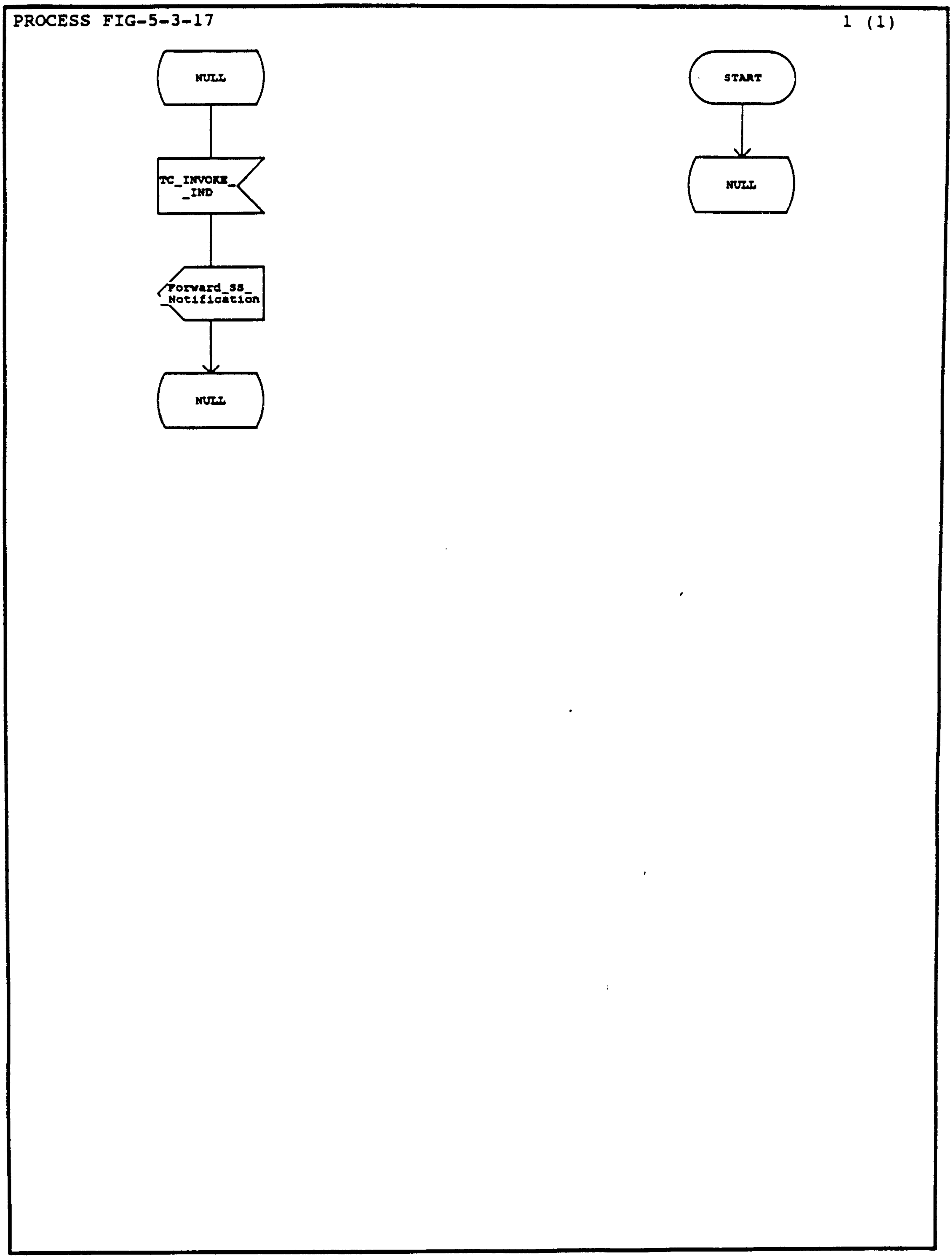


Figure 5.3.17
ASE/TCAP interface procedure in the MSC for relaying the notification to the MS.



5.3.3 Registration of a new password by MS

5.3.3.1 Interfaces and general description of procedures

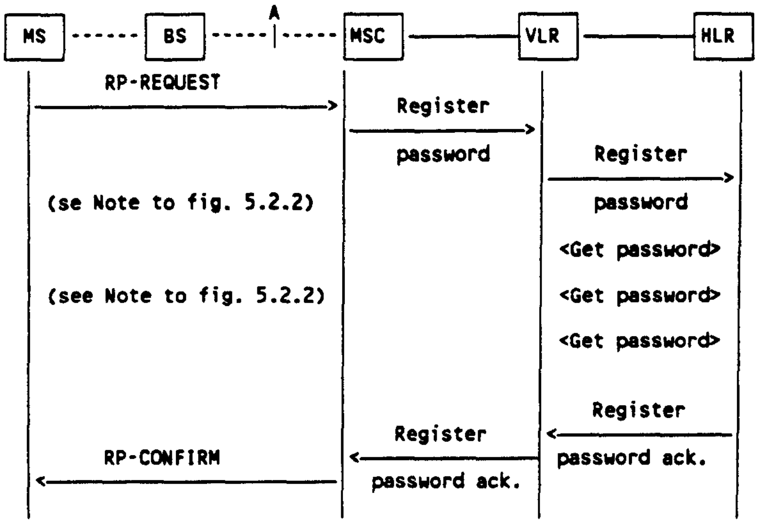


Figure 5.3.18 Interfaces and procedures for registration of a new password.

Figure 5.3.18 shows the general procedures for registration of the new password.

The procedures defined below are preceded by the access request procedure of section 5.14.

The procedure is initiated by the MS sending a request for registration of the new password on the radio path (RP-REQUEST in Figure 5.3.18). The MSC then sends the corresponding register password message to its associated visitor location register. Since the password is handled by the home location register, the visitor location register will send a register password message to the home location register of the MS. Receiving the register password message the HLR initiates the get password procedure (see section 5.3.4) three consecutive times; the first time for checking of the old password, the second time for retrieval of the new password and the third time for verification of the new password. The home location register returns the register password acknowledge message. Receiving the register password acknowledge message the VLR will send the register password acknowledge message to the MSC. The MSC will send a RP-CONFORM to the MS with fields set in accordance with the content of the register password acknowledge message.

5.3.3.2 Detailed procedures for registration of a new password

5.3.3.2.1 Procedures in the MSC

The application specific procedure is contained in Figure 5.3.19 and the ASE/TCAP interface is contained in Figure 5.3.20.

The MSC will receive a request from the MS for registration of the new password (RP-REQUEST (X) in Figure 5.3.19).

The MSC will then send the register password message to its associated VLR.

The MSC will receive either of the following responses:

- a register password acknowledge message if the operation was successful. The result will be provided to the MS in the RP-CONFIRM (X) signal;

- if the register password acknowledge message contains parameter errors, a failure indication is inserted in the RP-CONFIRM (X) signal;

- a reject indicator if the operation failed because of procedure errors or a timer expired message if the timer in TCAP expired. A failure indication is then inserted in the RP-CONFIRM (X) signal;

- negative results may be:

  - negative password check;

  - password registration failure;

  - supplementary service subscription violation;

  - system failure;

  - unexpected data value.

  The appropriate cause is inserted in the RP-CONFIRM (X) signal;

- if the MSC receives an abort indication, a failure indication is inserted in the RP-CONFIRM (X) signal.

The ASE/TCAP interface procedure is shown in Figure 5.3.20. The register password message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the operation by setting timer T-rpw. The result is reported as follows:

- a TC-RESULT-L INDICATION primitive contains the register password acknowledge message;

- a procedure failure is reported in a TC-(U-)REJECT INDICATION primitive;

- expiry of timer T-rpw is reported in a TC-L-CANCEL INDICATION primitive;

- negative results are reported in a TC-U-ERROR INDICATION primitive.

5.3.3.2.2 Procedures in the VLR

The application specific procedure is contained in Figure 5.3.21. Figures 5.3.22 and 5.3.23 contain the ASE/TCAP interfaces for the VLR/MSC and VLR/HLR interfaces, respectively.

When receiving a register password message from the MSC, the VLR first checks whether the register password message contains parameter errors. If parameter errors are detected a reject indication is returned. If no parameter errors are detected, the register password message is sent to the HLR and will receive either of the results:

- the register password acknowledge message containing a positive outcome of the operation. This information is forwarded to the MSC in a register password acknowledge message;

- if the acknowledge message from the HLR contains parameter errors, the information content of the message is discarded and the system failure message is sent to the MSC;

- a reject indicator will indicate procedure errors between the VLR and the HLR and a timer expiry message will indicate time-out in TCAP. The transaction with the HLR may also be aborted. These events are sent to the MSC as a system failure message;

- an error may also be received. This result is provided to the MSC.

If the transaction with the MSC is aborted, the VLR will abort the transaction with the HLR.

The ASE/TCAP interface procedure for the VLR/MSC interface is shown in Figure 5.3.22. The register password message is received in a TC-INVOKE INDICATION primitive. The results are reported as follows:

- a positive result (register password acknowledge message) is sent in a TC-RESULT-L REQUEST primitive;

- a reject indicator (procedure error) is sent in a TC-U-REJECT REQUEST primitive;

- a negative result is sent in a TC-U-ERROR REQUEST primitive.

The ASE/TCAP interface procedure for the VLR/HLR interface is shown in Figure 5.3.23. The register password message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the operation by timer T-rpw. The outcome of the procedure can be as follows:

- a positive result in terms of a register password acknowledge message is received in a TC-RESULT-L INDICATION primitive;

- expiry of timer T-rpw is reported in a TC-L-CANCEL INDICATION primitive;

- procedure failure is reported in a TC-(U-)REJECT INDICATION primitive;

- a negative result is reported in a TC-U-ERROR INDICATION primitive.

5.3.3.2.3 Procedures in the HLR

The application specific procedure is given in Figure 5.3.24 and the ASE/TCAP interface procedure is given in Figure 5.3.25.

The application specific procedure is initiated when the HLR receives a register password message from a VLR. The handling of the passwords is assumed to be performed by a password handler (PW handler) function in the HLR not part of the mobile application part. The result (positive: acknowledge from the PW handler (X), or negative: negative result PW handler (X)) is returned to the VLR.

The ASE/TCAP interface procedure is shown in Figure 5.3.25. The register password message is received in a TC-INVOKE INDICATION primitive.

The results are returned as follows:

- a positive result (register password acknowledge) is returned in a TC-RESULT-L REQUEST primitive;

- a reject because of procedure failure is returned in a TC-U-REJECT REQUEST primitive;

- a negative result with cause value is returned in a TC-U-ERROR primitive.

Figure 5.3.19
Application specific procedure in MSC for registration of a new password.

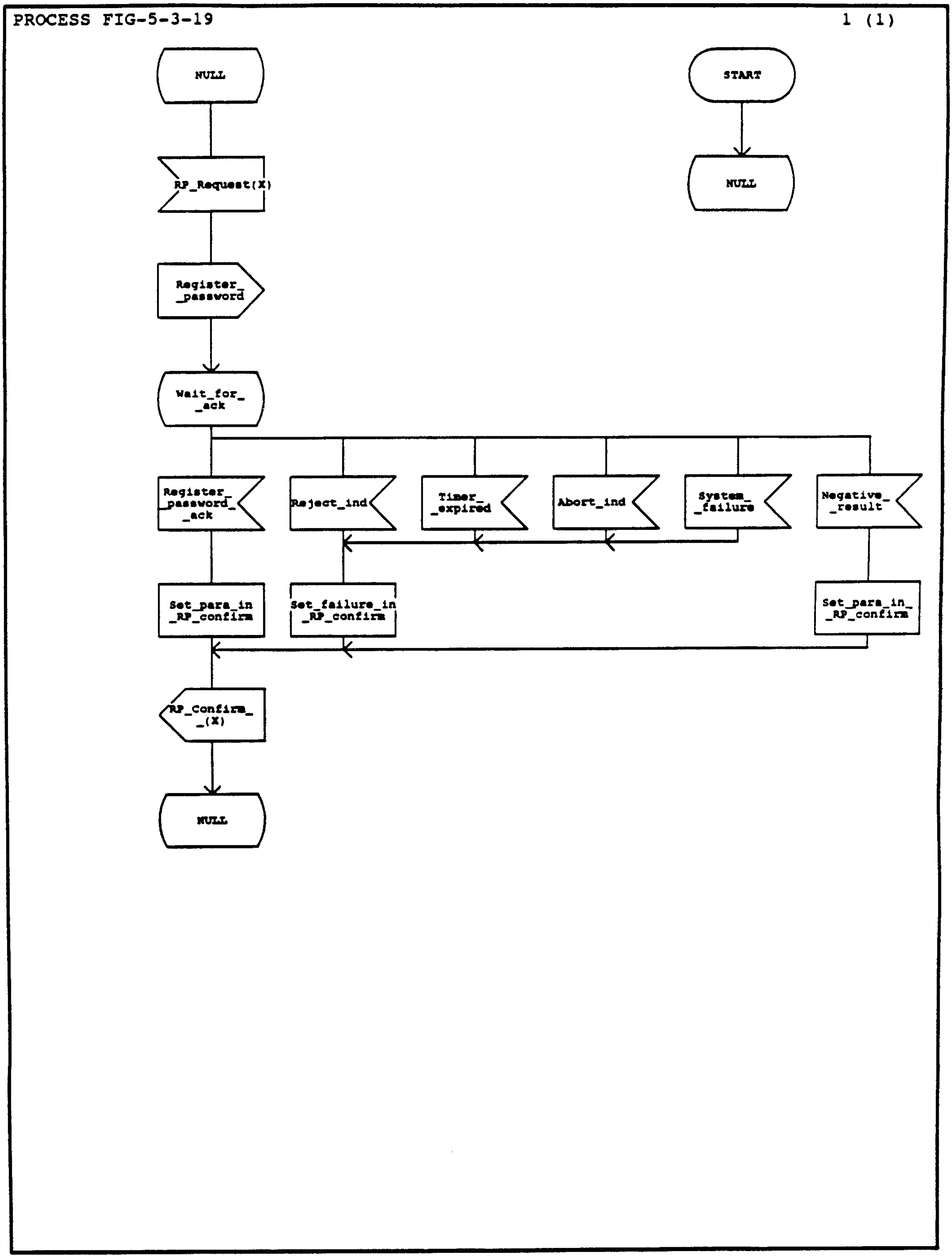


Figure 5.3.20
ASE/TCAP interface procedure in MSC for registration of a new password.

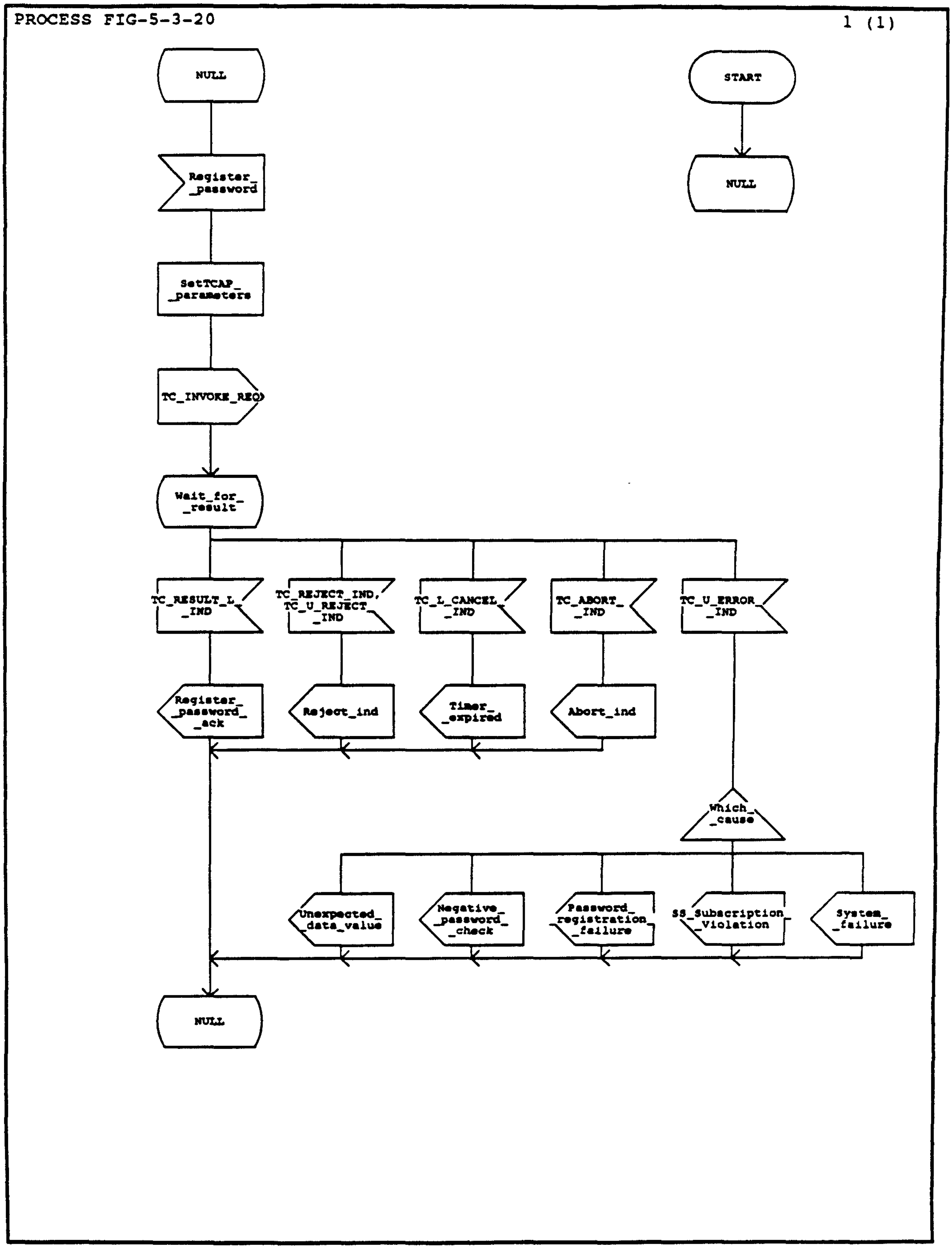


Figure 5.3.21
Application specific procedure in VLR for registration of a new password.

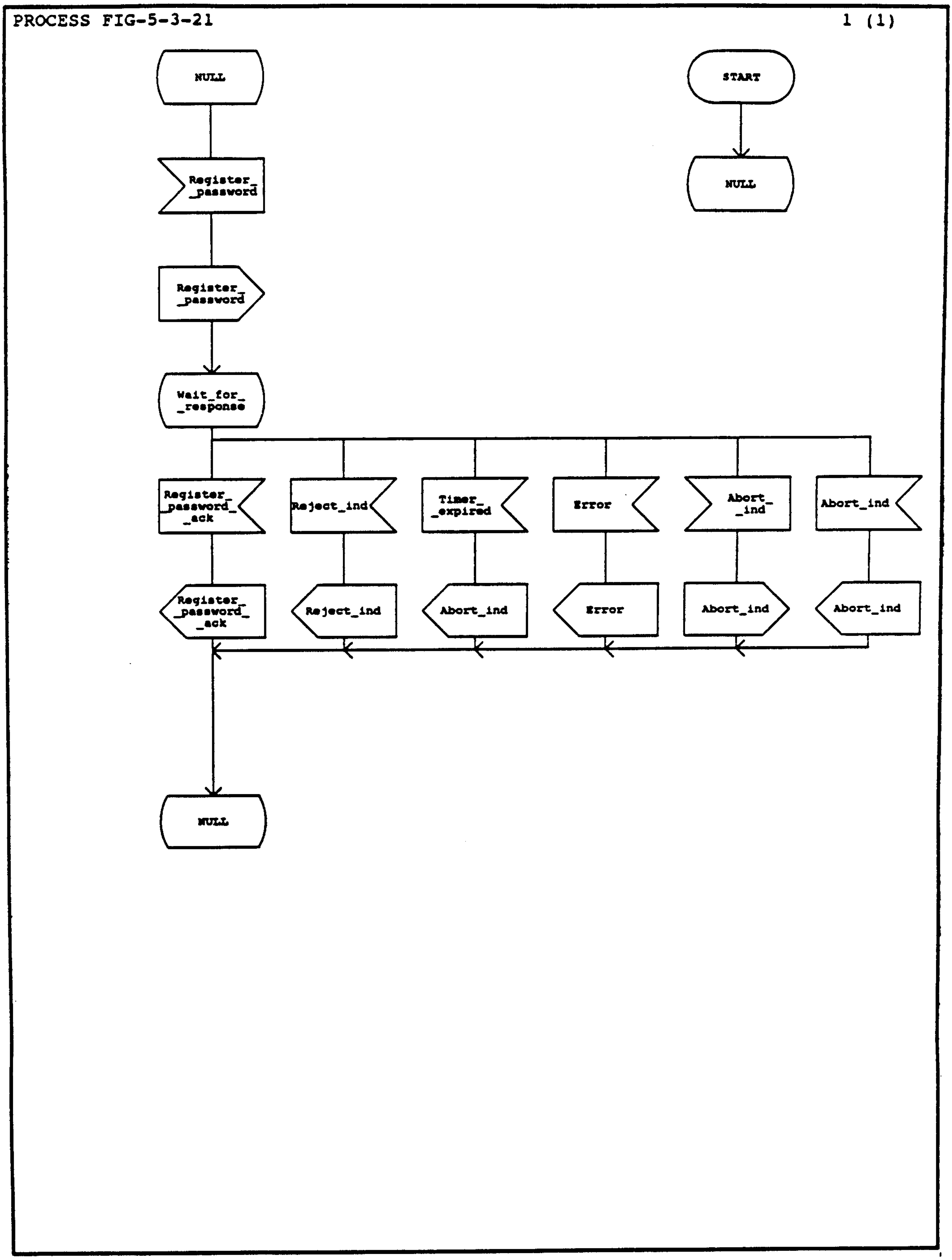


Figure 5.3.22
ASE/TCAP VLR/MSC interface procedure for registration of a new pasword.

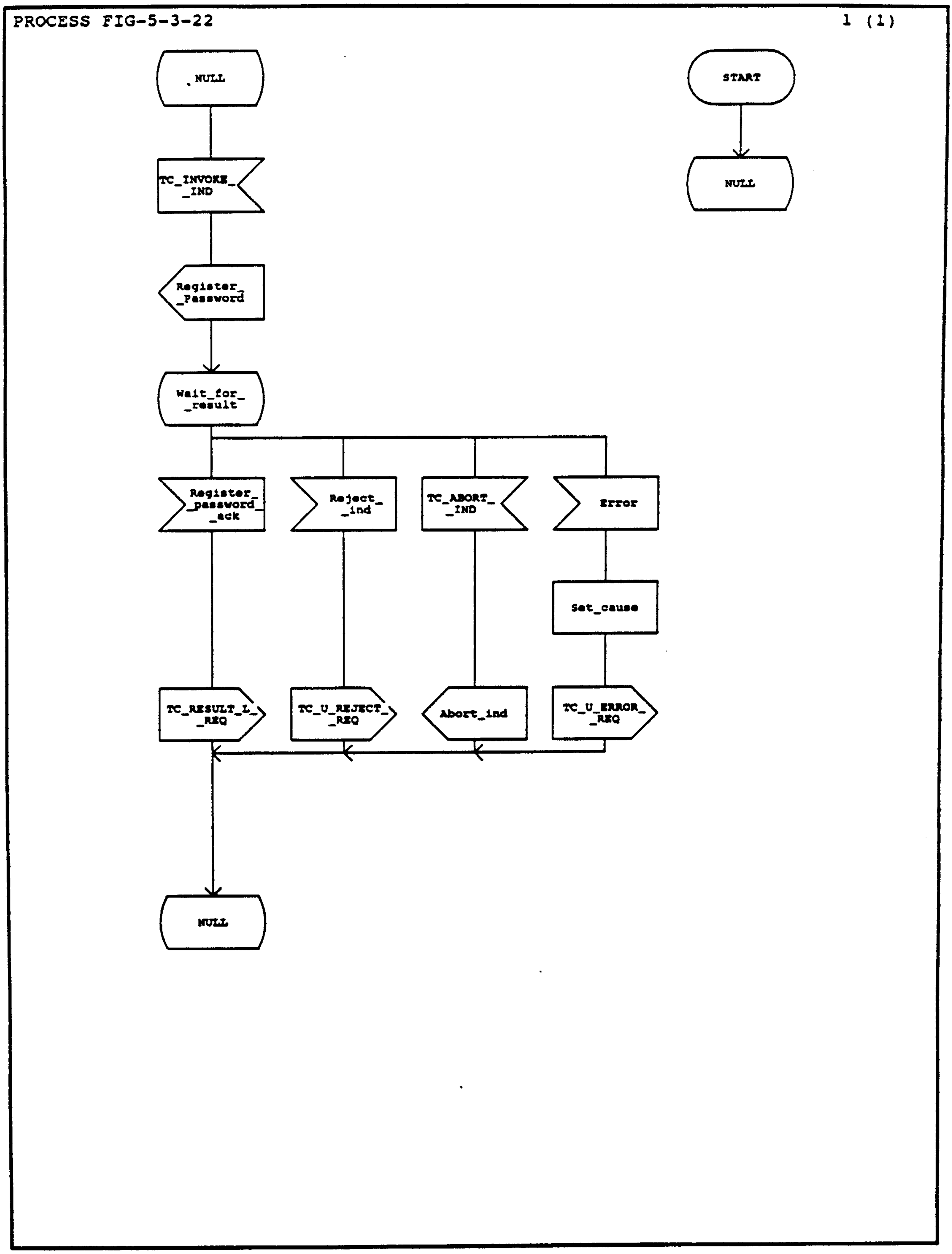


Figure 5.3.23
ASE/TCAP VLR/HLR interface procedure for registration of a new password.

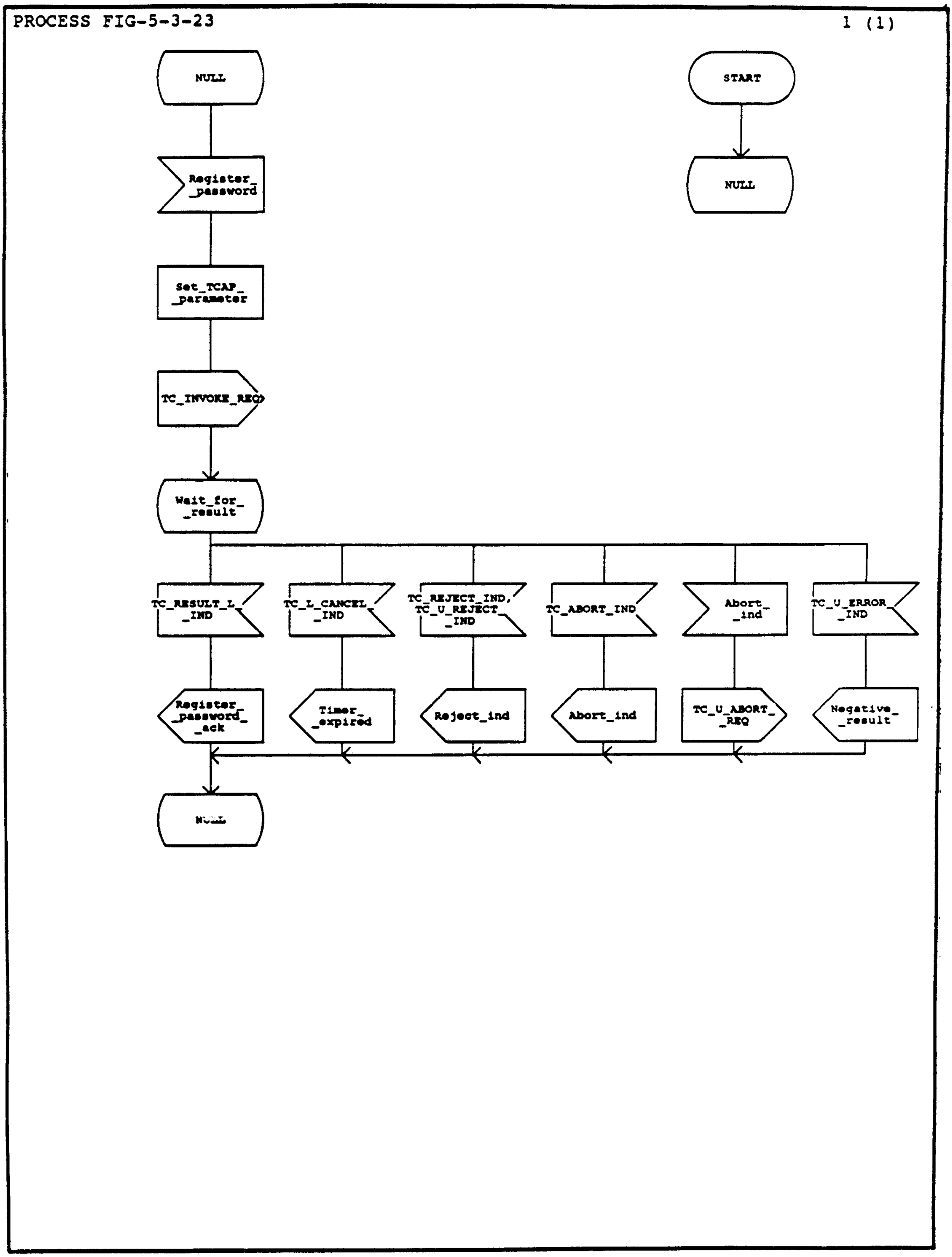


Figure 5.3.24
Application specific procedure in HLR for registration of a new password.

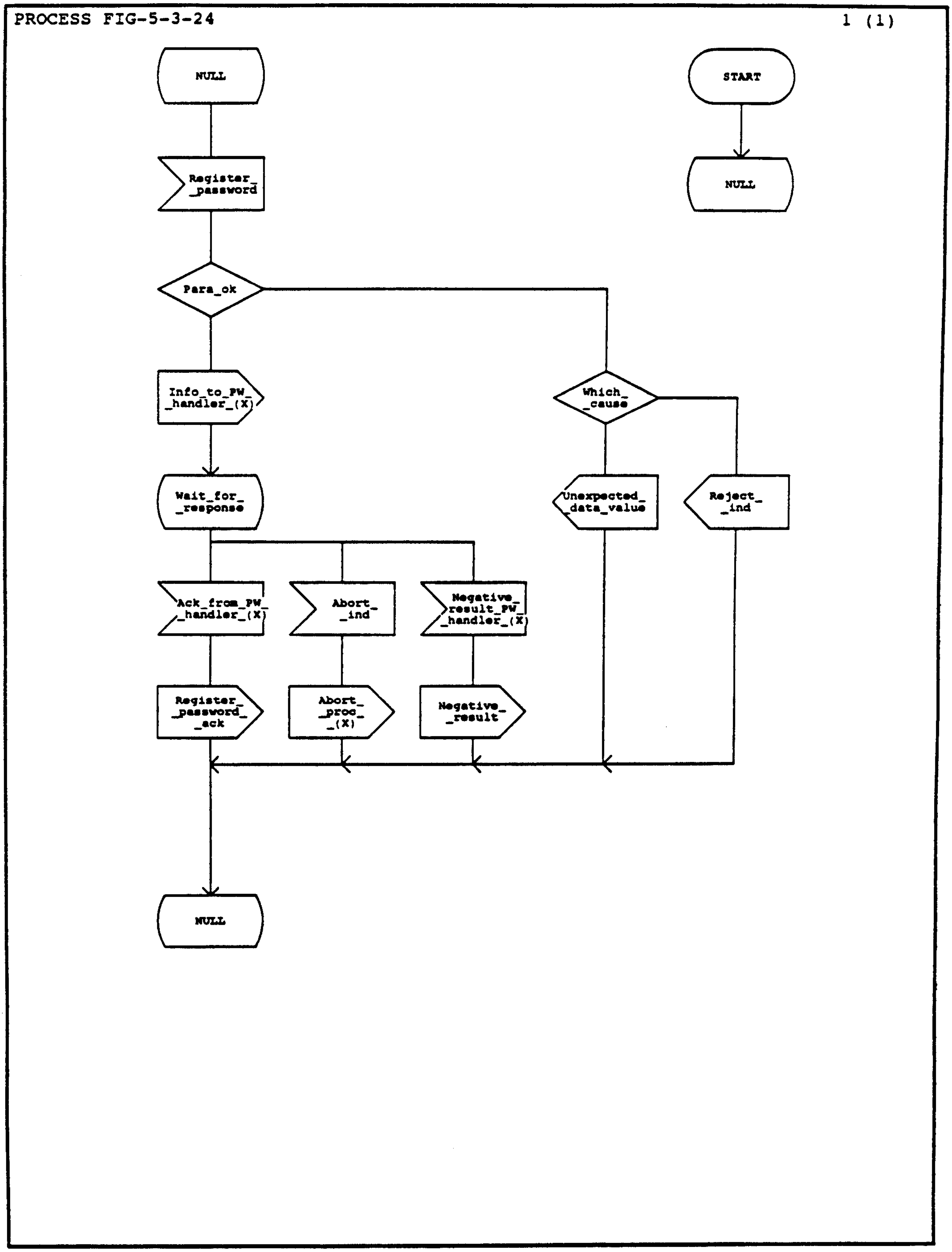
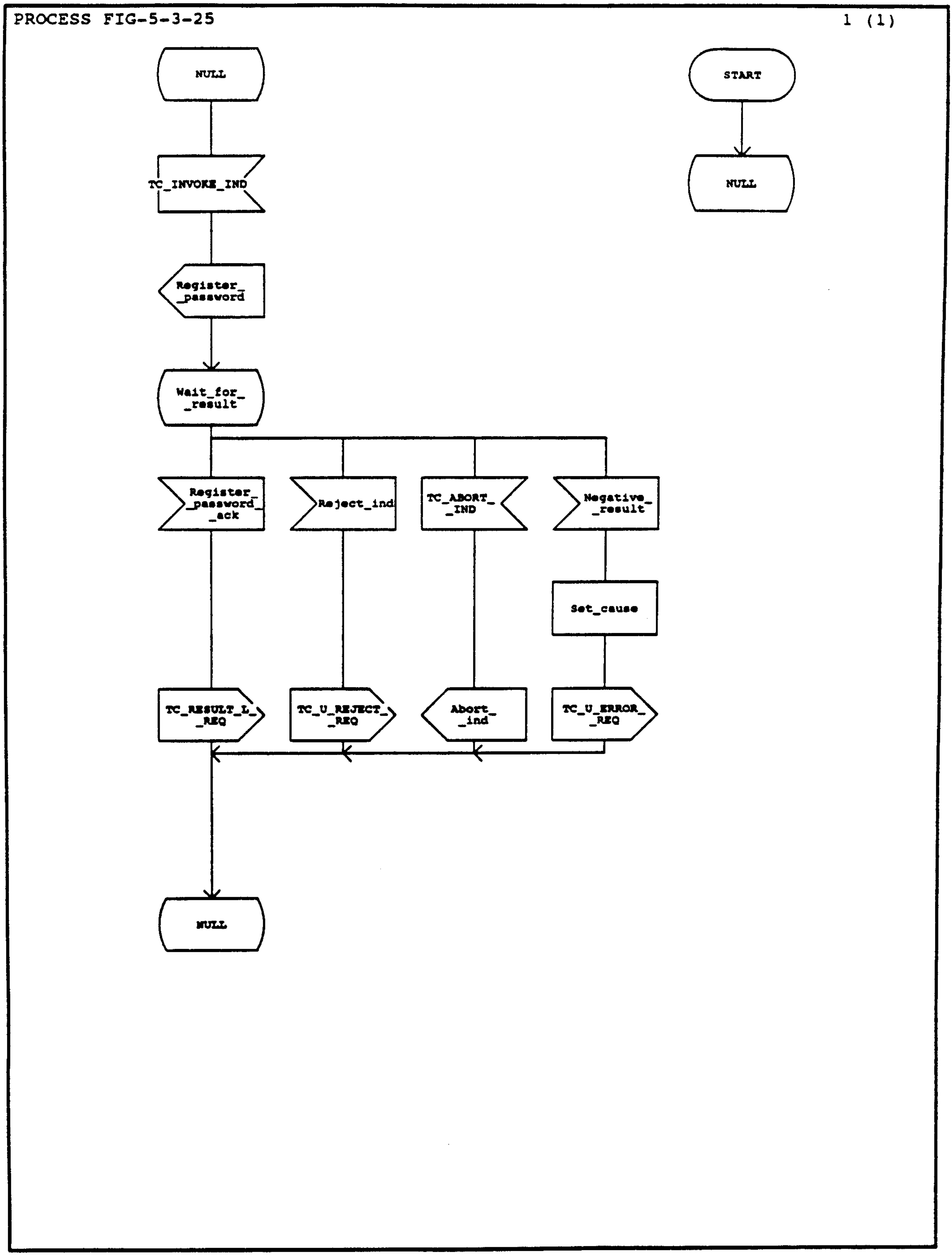


Figure 5.3.25
ASE/TCAP interface procedure in the HLR for registration of a new password.



5.3.4 Checking of the password by the HLR

5.3.4.1 Interfaces and general description

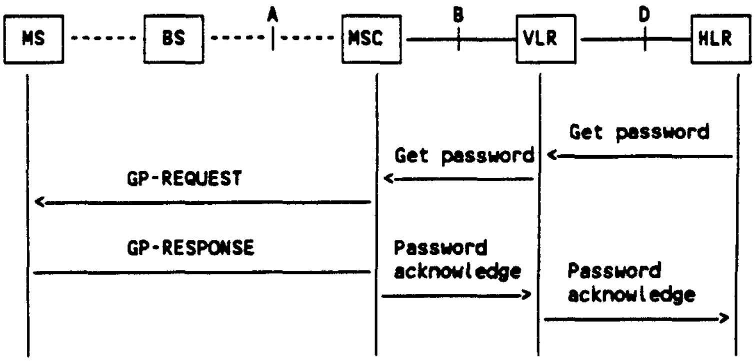


Figure 5.3.26 Interfaces and procedures for checking of the password.

Figure 5.3.26 shows the general procedures for checking of the password.

The procedure is initiated by the HLR when it receives a request from the MS concerning an operation of a supplementary service which requires password checking (e.g. an operation concerning a barring service). The HLR sends the get password message to the VLR. Since the password is to be retrieved from the MS, the VLR will send a get password message to the MSC. The request for the password is forwarded to the MS by the MSC (GP-REQUEST in Figure 5.3.26). The MS returns the password in GP-RESPONSE. The password is forwarded to the HLR by the MSC and the VLR in the password acknowledge message.

5.3.4.2 Detailed procedures for checking of the password

5.3.4.2.1 Procedure in the HLR

The application specific procedure is shown in Figure 5.3.27 and the ASE/TCAP interface procedure is shown in Figure 5.3.28.

The Get Password operation will use the transaction opened by the Supplementary service or Register password operation.

When an indication is given that checking of the password is required, the HLR sends the get password message to the VLR in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-gpw.

Results are received as follows:

- the password acknowledge message is contained in a TC-RESULT-L INDICATION primitive. The password contained in this message is checked with the password stored. If the two passwords match, a password confirmed condition is established. If the two passwords do not match, the negative password check condition is established by the HLR;

- a procedure error is indicated in a TC-(U-)REJECT INDICATION primitive or a TC-ABORT INDICATION primitive. Either of these events are indicated to the password handler (procedure error (X));

- expiry of timer T-gpw (reported in a TC-L-CANCEL INDICATION primitive) is taken as an indication for unsuccessful termination of the procedure.

5.3.4.2.2 Procedures in the VLR

The application specific procedure is contained in Figure 5.3.29. Figures 5.3.30 and 5.3.31 contain the ASE/TCAP interface procedures for the VLR/HLR and VLR/MSC interfaces, respectively.

When receiving a get password message from the HLR, the VLR first checks whether the get password message contains parameter errors. If parameter errors are detected a reject indication is returned. If no parameter errors are detected, the get password message is sent to the MSC and the VLR will receive the password acknowledge message containing a positive outcome of the operation. This information is forwarded to the HLR in a password acknowledge message. The transaction with the MSC may also be aborted. The transaction with the HLR is then also aborted.

The Get Password operation will use the transaction opened by the Supplementary service or Register password operation.

The ASE/TCAP interface procedure for the VLR/HLR interface is shown in Figure 5.3.30. The get password message is received in a TC-INVOKE INDICATION primitive. The results are reported as follows:

- a positive result (password acknowledge message) is sent in a TC-RESULT-L REQUEST primitive;

- a reject indicator (procedure error) is sent in a TC-U-REJECT REQUEST primitive.

The ASE/TCAP interface procedure for the VLR/MSC interface is shown in Figure 5.3.31. The get password message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the operation by timer T-gpw. The outcome of the procedure can be as follows:

- a positive result in terms of a password acknowledge message is received in a TC-RESULT-L INDICATION primitive;

- expiry of timer T-gpw is reported in a TC-L-CANCEL INDICATION primitive;

- procedure failure is reported in a TC-(U-)REJECT INDICATION primitive.

5.3.4.2.3 Procedures in MSC

The application specific procedure is contained in Figure 5.3.32 and the ASE/TCAP interface procedure is contained in Figure 5.3.33.

The MSC will receive the get password message in a TC-INVOKE INDICATION primitive. If parameter errors are detected a reject indication is returned. If no parameter errors are detected, the MSC will initiate retrieval of the password to the MS (illustrated by the GP-REQUEST (X) message). The response from the MS (in the GP-RESPONSE (X) message is returned to the VLR in a TC-RESULT-L REQUEST primitive.

If there is no response from the MS, an abort indication message is returned in a TC-U-ABORT REQUEST primitive.

Procedure errors are indicated in a TC-U-REJECT REQUEST primitive.

Figure 5.3.27
Application specific procedure for password checking procedure in the HLR.

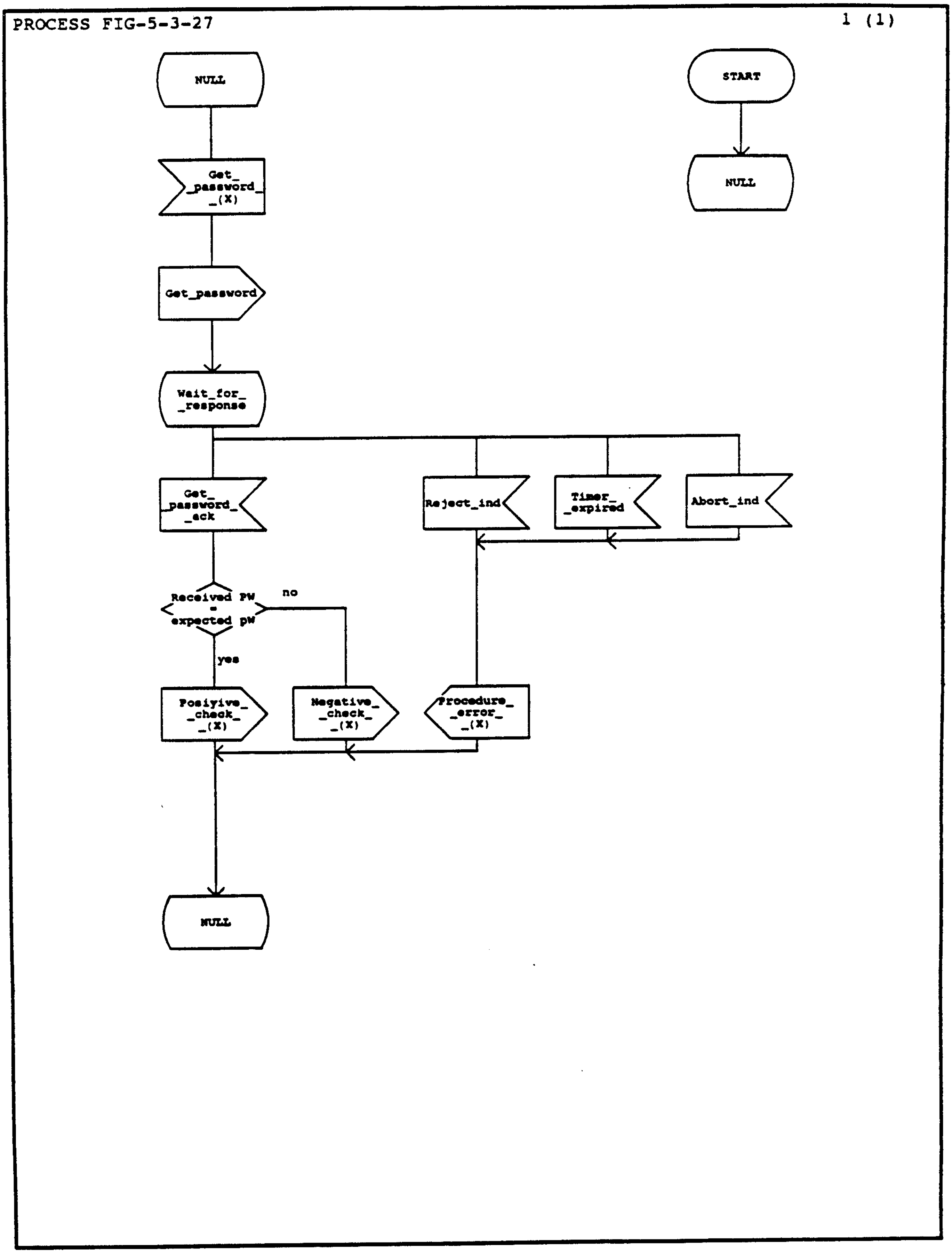


Figure 5.3.28
ASE/TCAP interface procedure for password checking procedure in the HLR.

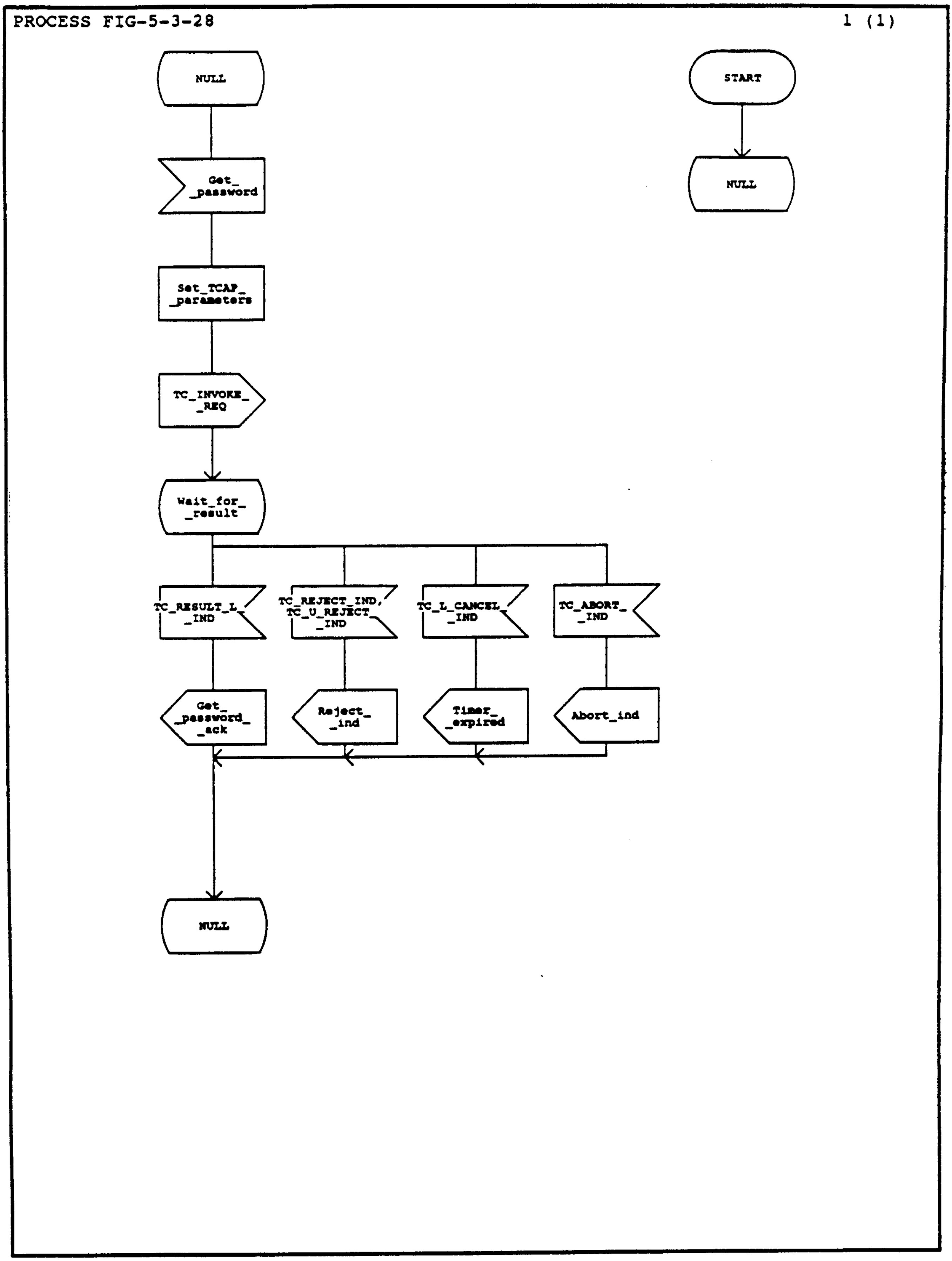


Figure 5.3.29
Application specific procedure for password checking procedure in the VLR.

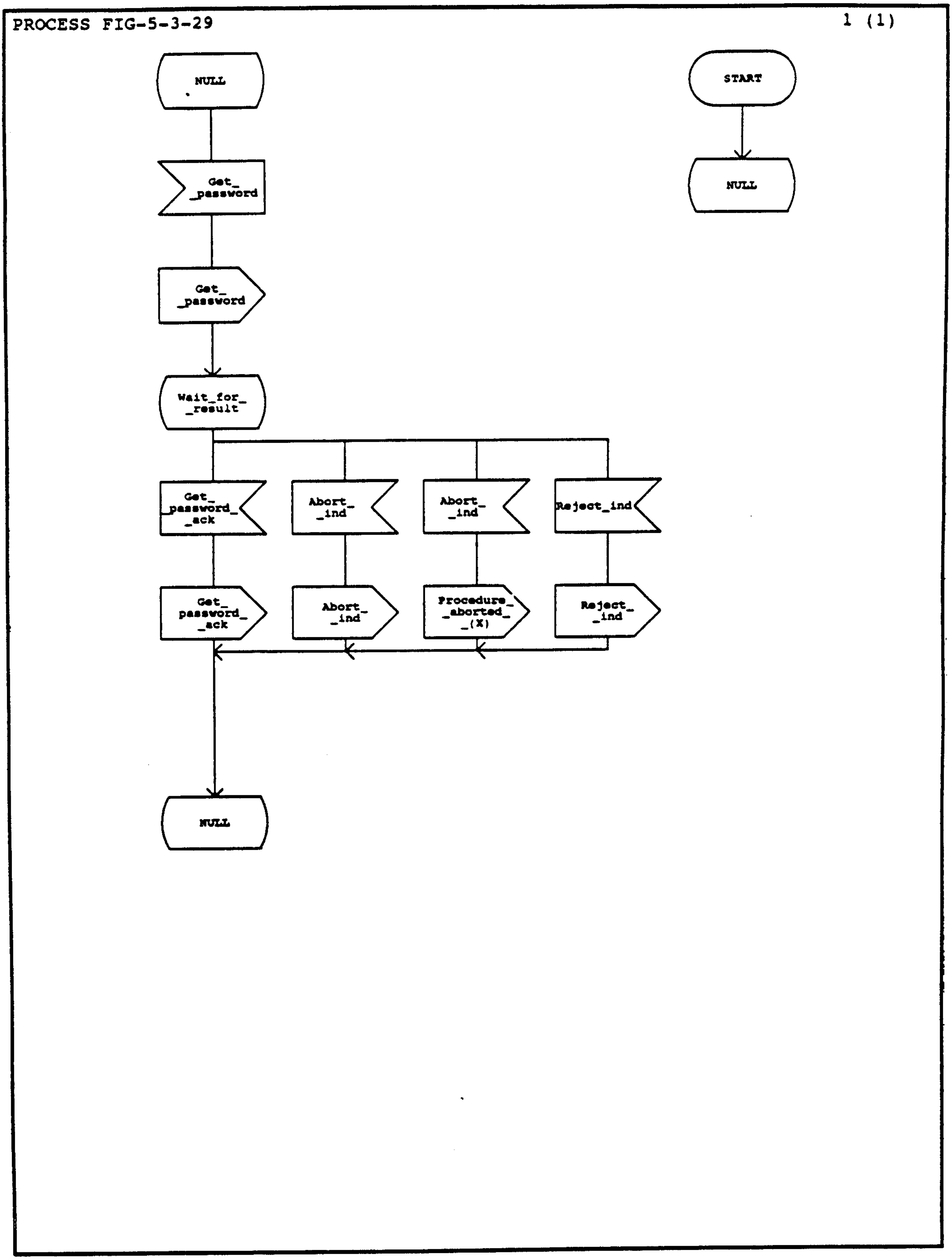


Figure 5.3.30
ASE/TCAP VLR/HLR interface procedure for password checking procedure.

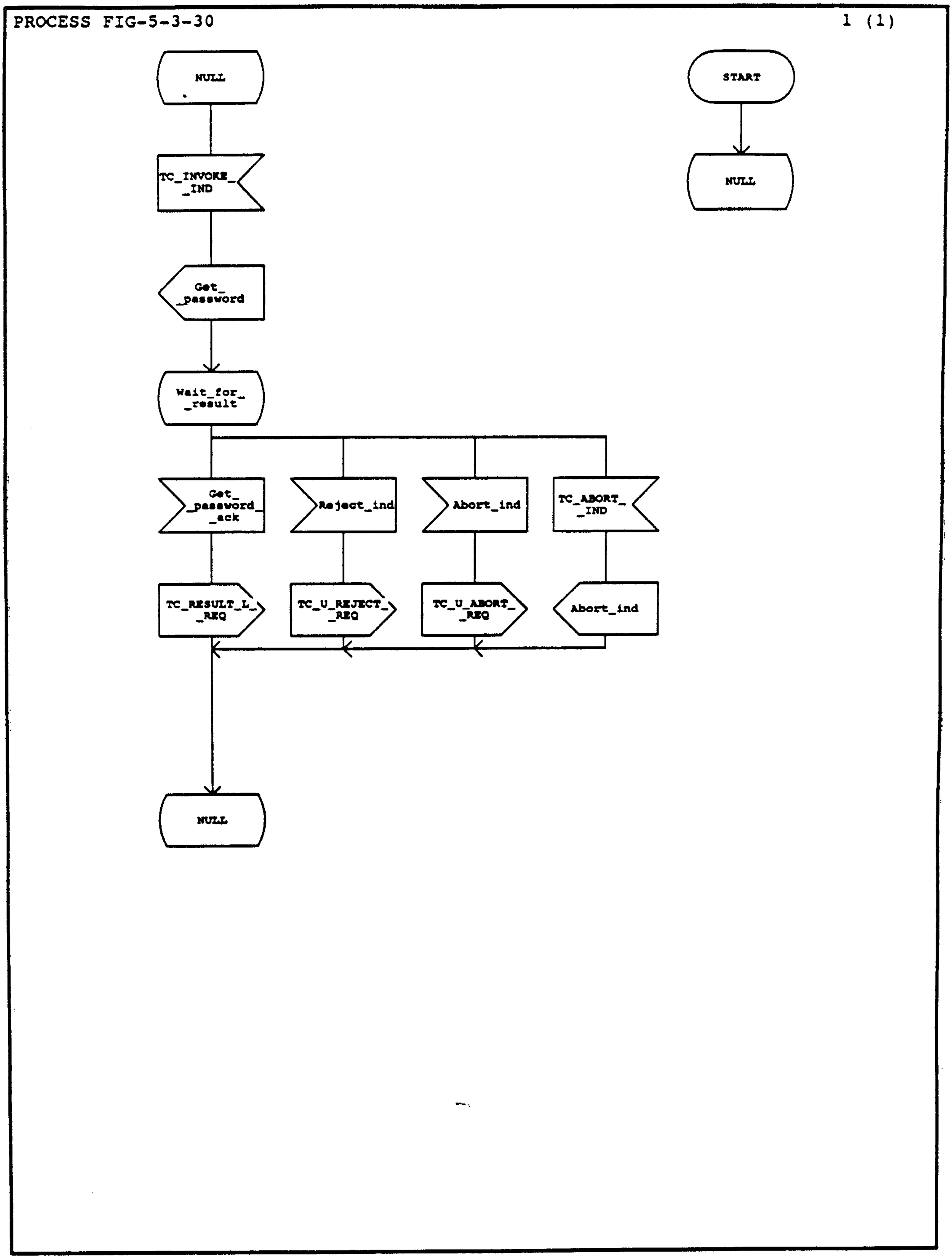


Figure 5.3.31
ASE/TCAP VLR/MSC interface procedure for password checking procedure.

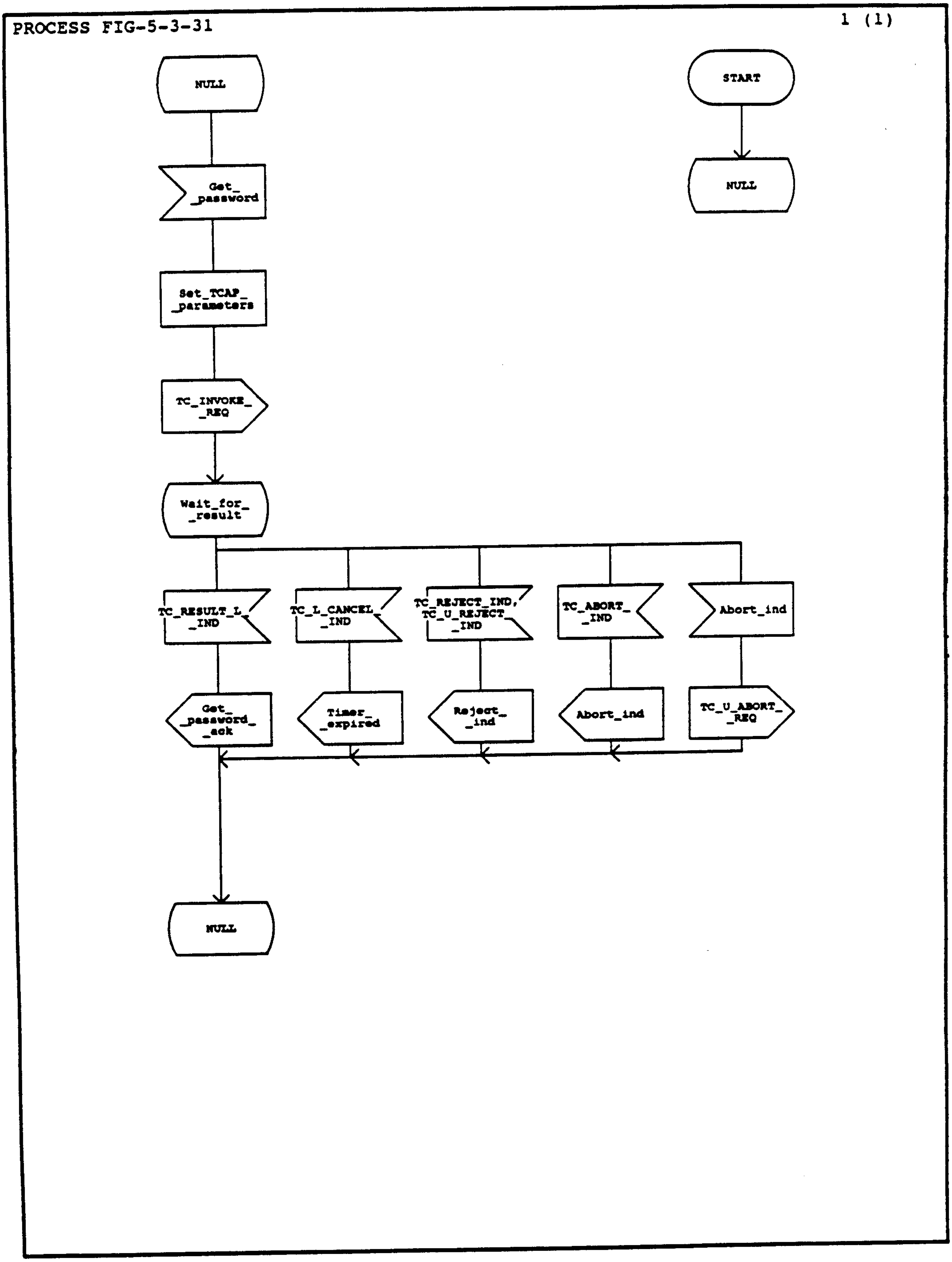


Figure 5.3.32
Application specific procedure for password checking procedure in the MSC.

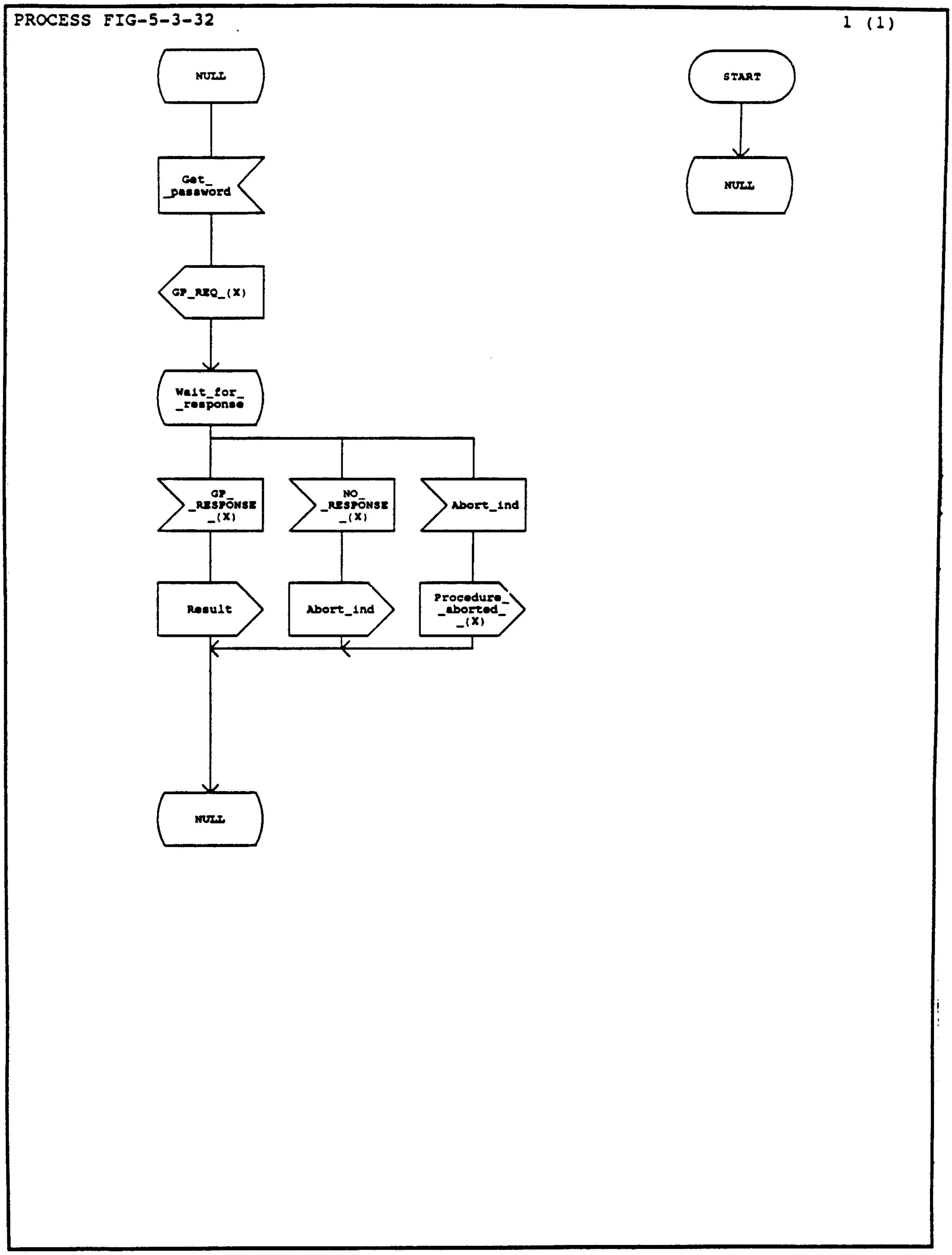
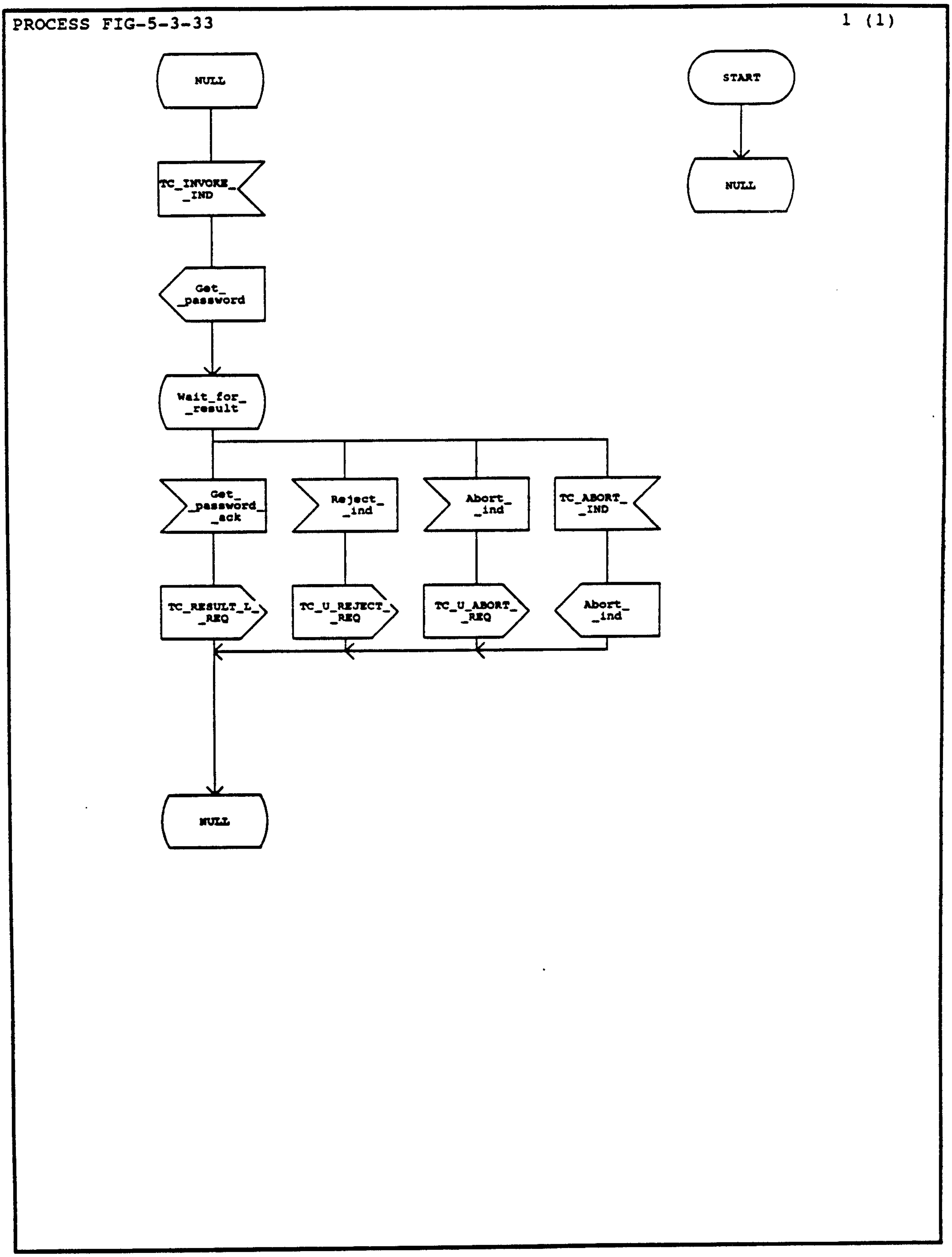


Figure 5.3.33
ASE/TCAP interface procedure for password checking procedure in the MSC.



5.3.5 Begin subscriber activity

5.3.5.1 General description of the procedure

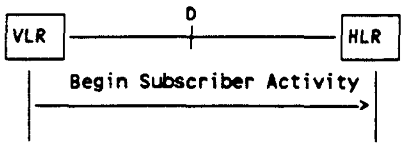


Figure 5.3.34 Procedure for begin subscriber activity

The procedure is shown in Figure 5.3.34. In order to avoid any processing of supplementary services related data units in the VLR, the VLR will insert the invoke component of this operation in the first supplementary services related invoke component in the BEGIN message (in order to insert the IMSI in the first message sent on the VLR-HLR interface). The procedure consists of one message: begin subscriber activity sent from the VLR to the HLR.

5.3.5.2 Detailed description of the procedure

5.3.5.2.1 Procedures in the VLR

The application specific procedure is shown in Figure 5.3.35 and the ASE/TCAP interface procedure is shown in Figure 5.3.36.

The VLR invokes the procedure if one of the following events occur:

- an operate supplementary services message has been received that has to be forwarded to the HLR;

- a register password message has been received.

The VLR sends a begin subscriber activity message containing the IMSI to the HLR. No response is awaited from the HLR.

The begin subscriber activity message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-bsa. The procedure is termianted when a TC-L-CANCEL INDICATION primitive (expiry of timer T-bsa), a TC-(U-)REJECT INDICATION primitive or a TC-ABORT INDICATION primitive is received.

5.3.5.2.2 Procedures in the HLR

The application specific procedure is shown in Figure 5.3.37 and the ASE/TCAP interface procedure is shown in Figure 5.3.38.

If the HLR is in a restoration phase, it may request that the MS checks the status of all its supplementary services. In this case, the check SS procedure of section 5.8 is invoked.

If the request is received from a VLR other than the one contained in the HLR table, the HLR will use the location cancellation procedure of section 5.2.2 towards the VLR contained in the HLR table.

The HLR will receive the begin subscriber activity message in a TC-INVOKE INDICATION primitive.

The HLR checks whether there are parameter errors or data errors in the message.

Figure 5.3.35
Application specific procedure in VLR for begin subscriber activity.

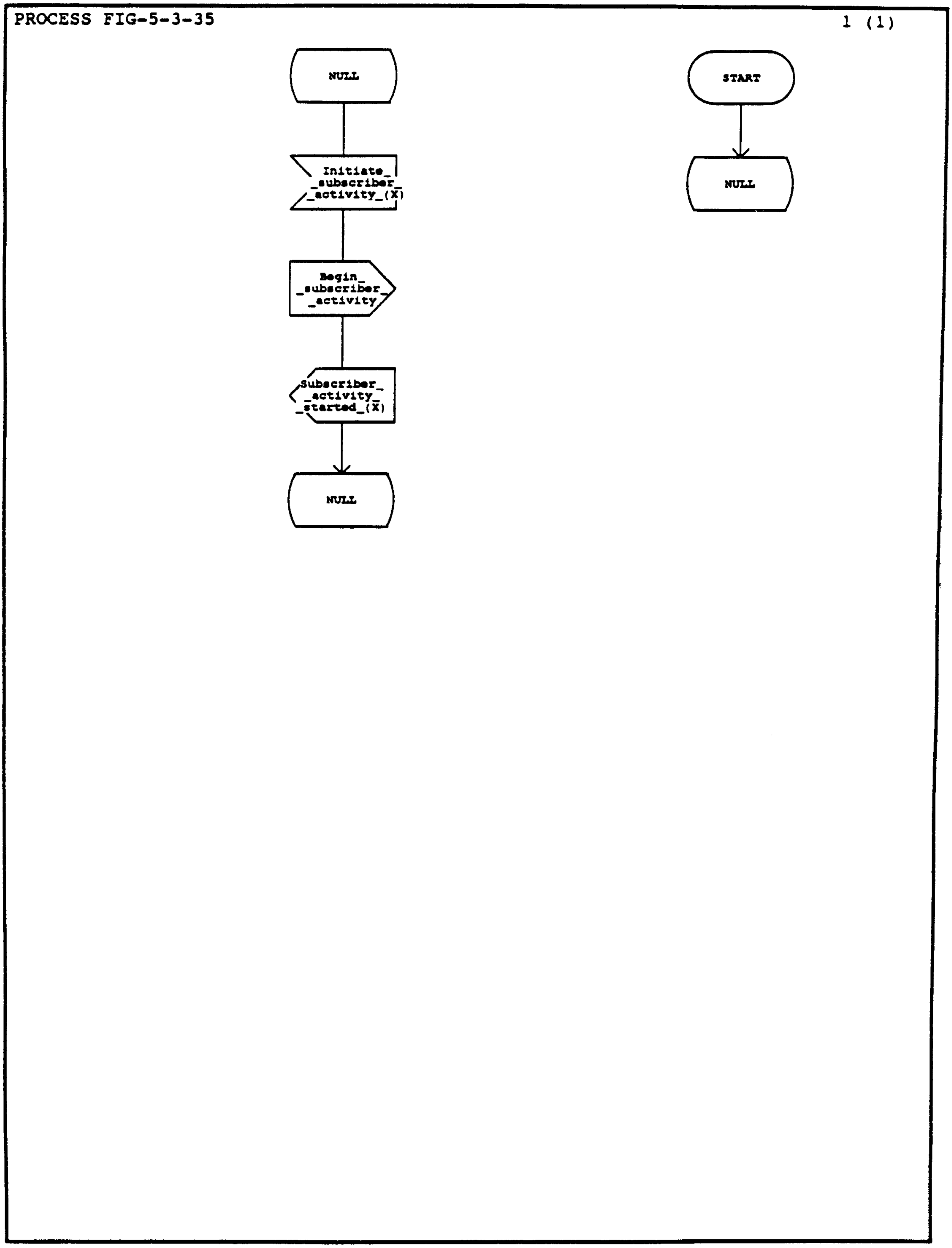


Figure 5.3.36
ASE/TCAP interface procedure in VLR for begin subscriber activity.

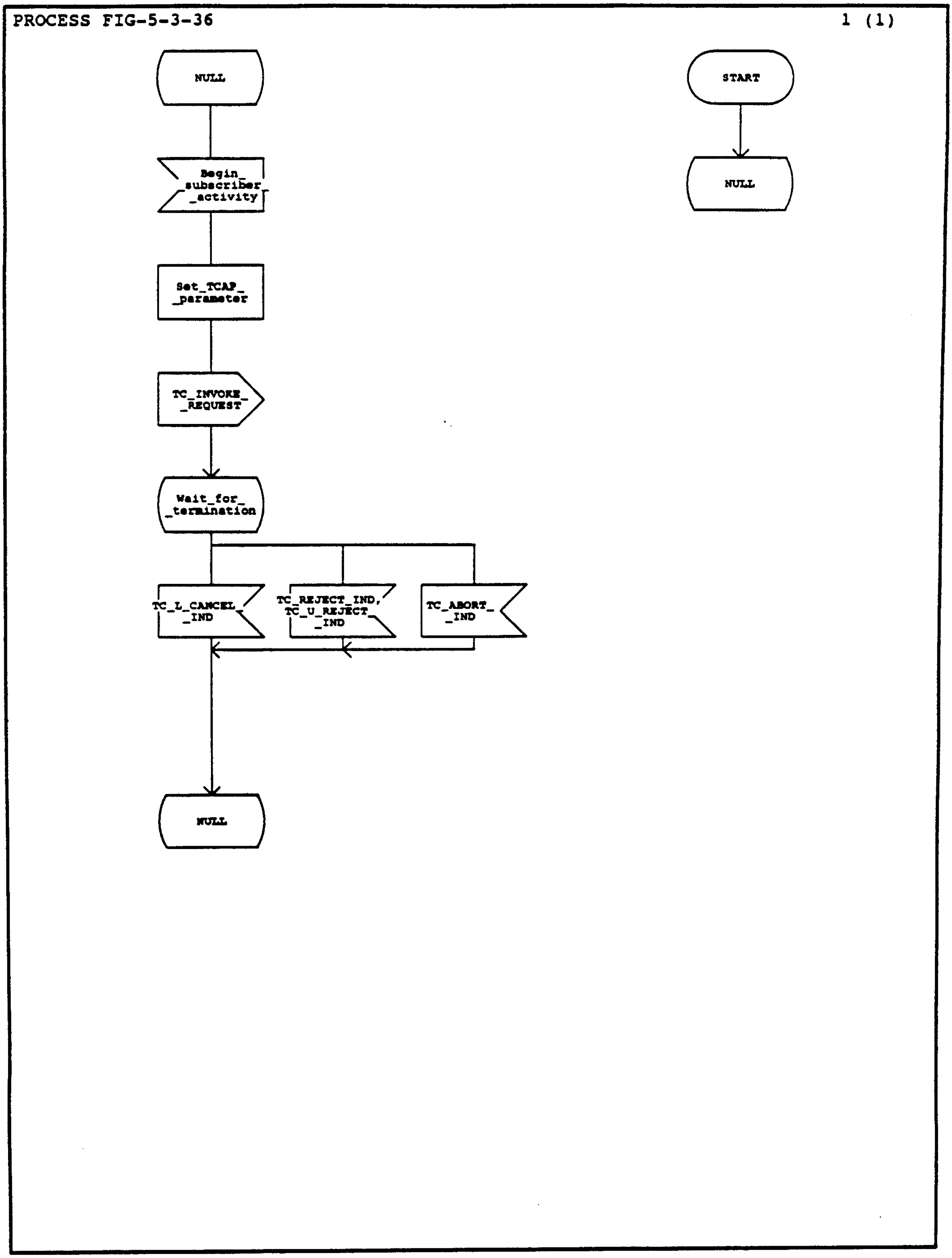


Figure 5.3.37
Application specific procedure in HLR for begin subscriber activity.

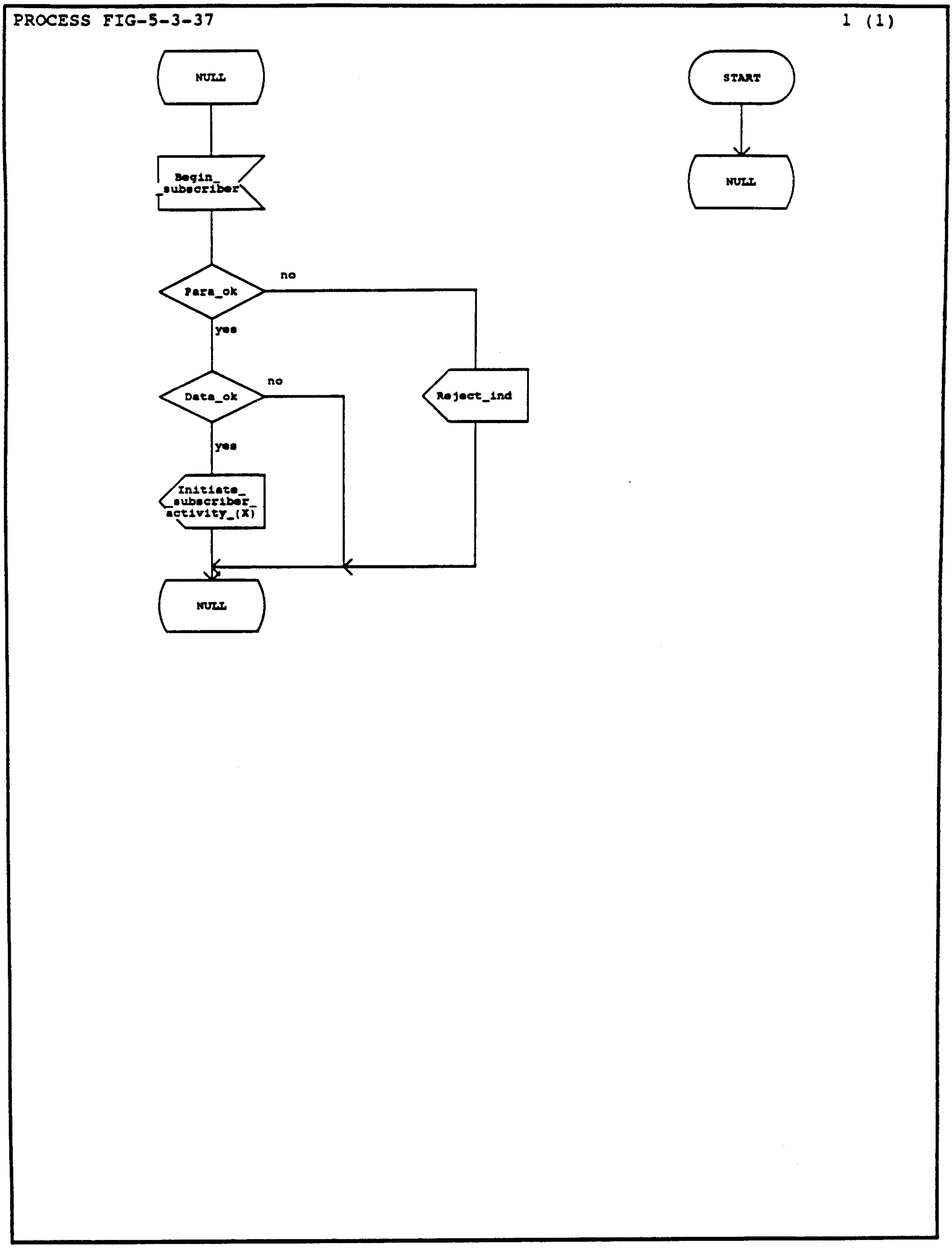
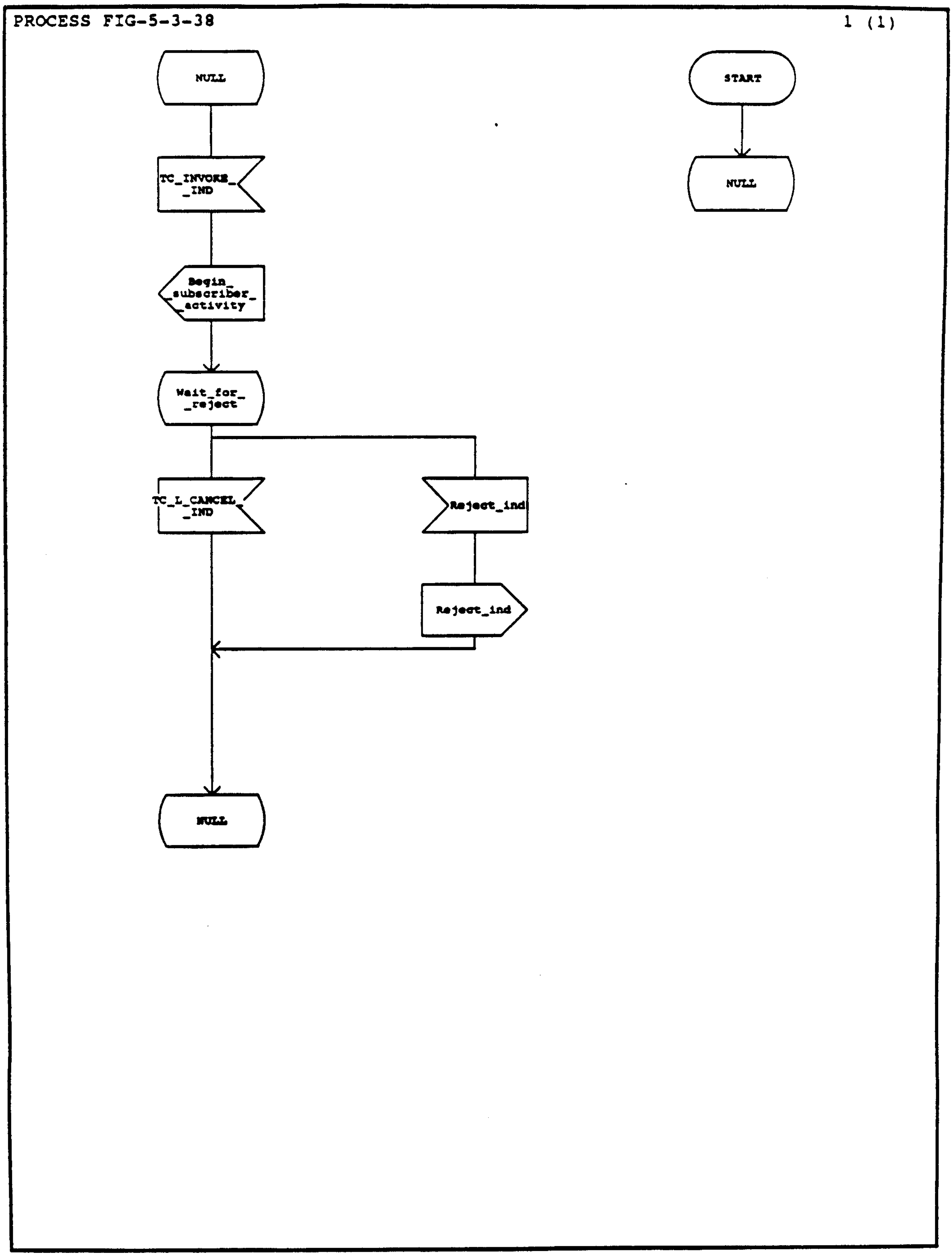


Figure 5.3.38
ASE/TCAP interface procedure in HLR for begin subscriber activity.



5.4 Retrieval of subscriber parameters during call set-up

5.4.1 Definition of interfaces

As shown in Figure 5.4.1 the following cases apply

i) for MS terminating or MS originating calls:

- where the MSC can obtain the required information directly from the visitor location register;

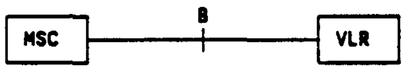
- where the visitor location register has to obtain the information from the home location register after having been interrogated by the MSC;

ii) for MS terminating calls where the MSC (acting as gateway MSC) has to interrogate the home location register in order to obtain routing information.

In ii) two cases apply:

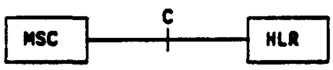
- the HLR contains all the required routing information;

- the HLR must retrieve the routing information from the VLR.



a) Information retrieved directly from the visitor location register

b) Information retrieved from the home location register via the visitor location register



c) Information retrieved directly from the home location register

d) Information retrieved from the visitor location register via the home location register.

Figure 5.4.1 Functional units and interfaces for retrieval of subscriber parameters during call establishment.

5.4.2 General description of procedures

5.4.2.1 Information retrieval for I/C and O/G call set-up

The procedures are shown in Figure 5.4.2 as follows:

- Figure 5.4.2 a) shows the procedure for a successful incoming MS terminated call set-up;

- Figure 5.4.2 b) shows the case for an incoming call when there is no radio contact;
- Figure 5.4.2 c) shows the case when the IMSI detached flag is set in the VLR;
- Figure 5.4.2 d) shows the case where the MS is busy in a call and the busy condition can be established by the MSC;
- Figure 5.4.2 e) shows the case where radio congestion, busy subscriber or no subscriber reply conditions are detected during call set-up at the radio interface;
- Figure 5.4.2 f) shows the procedure for a successful outgoing MS originated call set-up.

Receiving the send information for I/C call set-up message the VLR initiates the page MS procedure or the search for MS procedure (see section 5.15). If the radio contact can be established, the MSC will invoke the process access request procedure as described in s 5.14. Under the control of this procedure, the VLR may initiate the authentication procedure (see section 5.10), and subsequently a ciphering procedure for encryption on the radio path (see section 5.11). If authentication is not performed, or if performed with successful outcome, the VLR sends the complete call message to the MSC with supplementary services information and other requested information for call handling. During the set-up transaction the VLR may reallocate the TMSI to the MS (see section 5.12).This case is shown in Figure 5.4.2 a).

If radio contact cannot be established, the MSC reports this event by an absent subscriber message. Two situations have to be distinguished:

- the call forwarding on no radio contact service is active. The VLR terminates the transaction, sending a connect to following address message to the MSC. The MSC will then forward the call to the given address.
- the call forwarding service is not active. The VLR terminates the transaction by sending the impossible call completion message to the MSC. The MSC then terminates thecall by returning an appropriate information to the network.

This case is shown in Figure 5.4.2 b).

If the IMSI detached flag is set in the VLR, the VLR proceeds as follows:

- if the call forwarding service on IMSI detached is active,the VLR sends a connect to following address message and terminates the transaction. The MSC will then forward the call to the given address.
- if the call forwarding on IMSI detached service is not active, the VLR terminates the transaction by sending the absent subscriber message to the MSC. The MSC then terminates the call by returning the appropriate information to the network.

This case is shown in Figure 5.4.2 c).

When receiving the page MS message or the search for MS message (see 5.15), the MSC will check if the called MS is busy in a call and no further call can be established to that MS. If so, the MSC will return the busy subscriber message to the VLR. The VLR will then:

- if the call forwarding on busy subscriber service is active, the VLR will send the connect to following address message to the MSC. The MSC will then forward the call to the given address;
- if neither the call forwarding on busy subscriber service nor the call waiting service are active, the VLR will return the impossible call completion message to

the MSC. The MSC then terminates the call by returning the appropriate information to the network.

This case is shown in Figure 5.4.2 d).

Unsuccessful call conditions may also be detected after receipt of the complete call message and reported to the VLR by one of the following messages:

- radio congestion of the traffic channel if the traffic channel is allocated when receiving the complete call message and there are no radio resources available at that time;

- busy subscriber message if the busy condition is reported by the MS at call set-up;

- no subscriber reply message if the user at the MS does not answer the call within a predeterminded time.

The VLR will then:

- if the associated call forwarding service (call forwarding on radio congestion, call forwarding on subscriber busy, call forwarding on no reply) is active, the VLR will send the connect to following address message to the MSC. The MSC will then forward the call to the given address;

- if the associated call forwarding service is not active and, in case of subscriber busy, the call waiting service is not active, the VLR will return the impossible call completion message to the MSC. The MSC then terminates the call by returning the appropriate information to the network.

This case is shown in Figure 5.4.2 e).

If the subscriber busy condition applies, the call forwarding on busy subscriber service is not active but the call waiting service is active, then the VLR will return the process call waiting message. The MSC will then insert the required func- tions and procedures for handling the call waiting service.

This case is shown in Figures 5.4.2 d) and e).

Procedures for outgoing calls are shown in Figure 5.4.2 f). When the VLR receives a send information for O/G call set-up message from the MSC, it will, if the call is allowed, return the complete call message containing the requested call hand- ling information.

Prior to sending the send information for O/G call set-up message, the MSC may request initiation of the process access request procedure (see section 5.14), the authentication procedure (see section 5.10) and the ciphering procedure (see section 5.11). The VLR may also reallocate the TMSI to the MS.

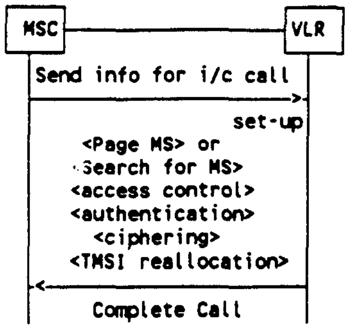


Figure 5.4.2 a) Procedure for a successful incoming MS terminating call set-up

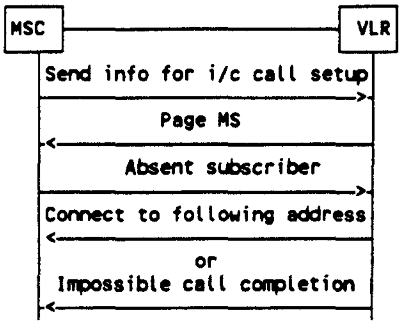


Figure 5.4.2 b) Procedure for an incoming MS terminating call set-up when there is no radio contact.

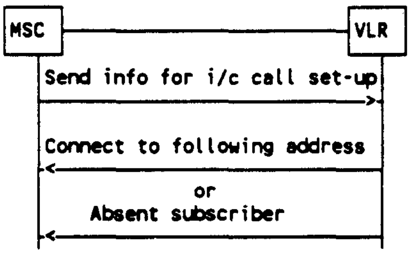


Figure 5.4.2 c) Procedure for an imcoming MS terminating call set-up when the IMSI detached flag is set in the VLR.

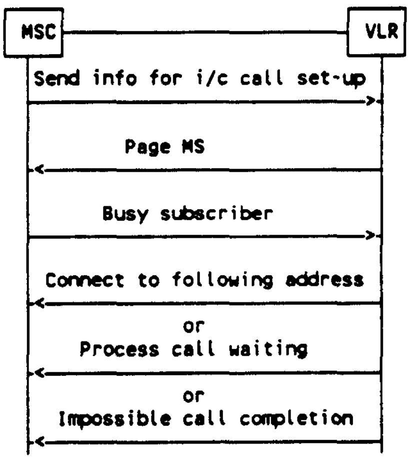
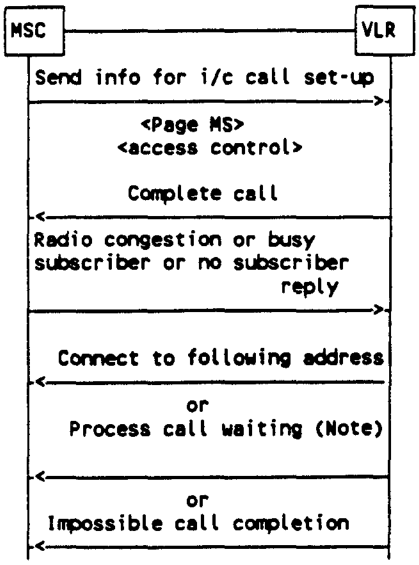


Figure 5.4.2 d) Procedure for an imcoming MS terminating call set-up when the MS is busy.



Note: Only in case of busy subscriber.

Figure 5.4.2 e) Procedures for an incoming MS terminating call set-up when radio congestion, busy subscriber or no reply conditions are detected.

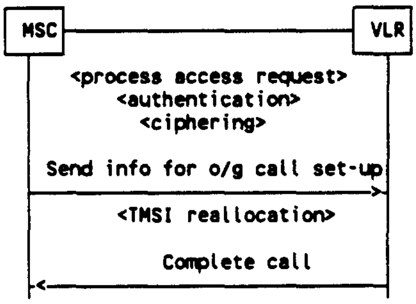


Figure 5.4.2 f) Procedure for a successful outgoing MS originated call set-up.

5.4.2.2 Indirect information retrieval

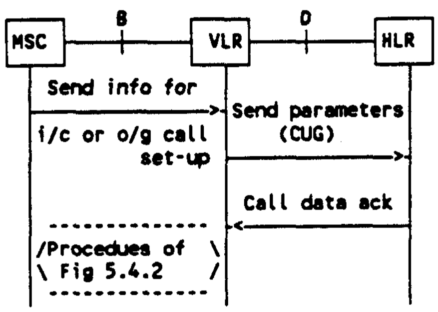
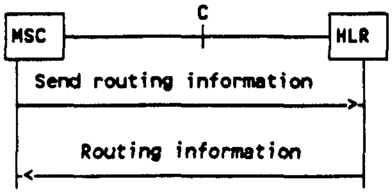


Figure 5.4.3 Procedure for indirect retrieval of CUG information .

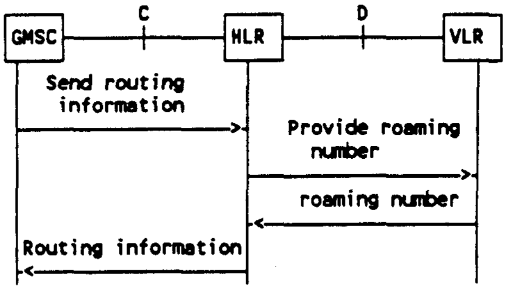
The procedure is shown in Figure 5.4.3 and described in section 5.6.1.

If a call data acknowledge message is not received from the HLR, the VLR will indicate to the MSC that information is not available.

5.4.2.3 Procedure for obtaining routing data



a) MSRN is stored in the HLR.



b) MSRN is obtained from the VLR.

Figure 5.4.4 Procedure for obtaining routing data.

Figure 5.4.4 shows the procedures used by a gateway MSC for obtaining routing data from the HLR. In a) the HLR has all the required information. In b) the MSRN must be retrieved from the VLR. The procedure consists in the exchange of the following messages between the MSC and the HLR:

- send routing information message, and
- routing information acknowledge message.

Note: The same operation may be used by an ISDN exchange for obtaining routing information from the HLR.

The followiwng messages are exchanged between the HLR and the VLR:

- provide roaming number;
- roaming number.

5.4.3 Detailed description of procedures

5.4.3.1 Procedures in the MSC

5.4.3.1.1 MS terminating calls

The application specific procedure is shown in Figure 5.4.5 and the ASE/TCAP interface procedure is shown in Figure 5.4.6.

The MSC sends the send information for I/C call set-up message to the VLR where the mobile station roaming number or the in- ternational mobile staion identity (IMSI) is used to identify the MS. The message will also contain any supplementary ser- vice information required in control functions in the VLR.

In response to the send information for I/C call set-up message, the MSC will receive the outcome of the page MS procedure or the search for MS procedure described in section 5.15. If the radio connection is successfully established or already exists, the MSC will receive the call complete message, which may provide supplementary service information, bearer service information, teleservice information, modem type and category information as required for handling the incoming call. In the successful case the call data is sent to the call handling function. Having succeeded in the establishment of the call, the MSC is informed (indicated by the call connected(X) signal) and the procedure is terminated.

Note: The authentication procedure and the ciphering procedure as described in section 5.10 and section 5.11 respectively, may be performed before the complete call message is received (not shown in Figure 5.4.5). During the call set-up transaction, the VLR may also send a forward TMSI message for allocation of a new TMSI to the MS. Note that the new TMSI has to be sent to the MS after the ciphering procedure has been completed on the radio path.

If a call forwarding condition has been established by the VLR, the MSC will receive a connect to following address message containing a forwarded-to-address. The MSC will then terminate the procedure and set up a connection based on this address.

Unsuccessful events are:

- a reject indication, a timer expired (timer T-ir) or an abort indication in case of procedure failure;
- an absent subscriber message indicating that the IMSI detached flag is set in the VLR. The MSC shall then terminate the call with an appropriate indication provided to the fixed network.
- unallocated roaming number message if the received MSRN is not allocated;
- an unknown subscriber message indicating that the mobile station is unknown in the HLR;
- an unidentified subscriber message if the MS was not identified in the VLR (this case may apply to the short messsage service);
- an impossible call completion message indicating that the call will not be forwarded and shall be released. The information to be provided to the fixed network will be based on which unsuccessful indication was provided as part of the paging procedure, see also section 5.15.
- a forwarding violation message indicating that a call forwarding condition applies but the incoming call has already been forwarded as many times as allowed;
- an unexpected data value message or data missing message if a requested service cannot be operated because of data errors;
- a system failure message indicating an unspecified error condition, e.g. failure of an associated procedure.

The above unsuccessful events are reported to the call handling function so that the call can be terminated by an appropriate indication being provided to the fixed network.

The parameters and data received in the complete call message are checked in the MSC. In case of data error, the appropriate error message is sent to the VLR.

If the call set-up is unsuccessful the MSC will receive either of the following signals from the call control function:

- a radio congestion(X) signal which is reported to the VLR in the radio congestion message;
- a no subscriber answer(X) signal which is reported to the VLR in the no subscriber reply message;
- a busy subscriber(X) signal which is reported to the VLR in the busy subscriber message.

In response to these messages the MSC may receive:

- the connect to following address message. The MSC will then forward the call to the given address;
- the impossible call completion message. The MSC will then release the call with a cause related to the one sent to the VLR;
- the forwarding violation message indicating that a call forwarding condition applies, but the call has already been forwarded as many times as allowed;
- the process call waiting message. The MSC will then insert the necessary functions and procedures for handling the call waiting service.

If the call is released by the calling subscriber or by the network before the connect to following address message, the process call waiting message or the complete call message has been received, the MSC will terminate the procedure towards the VLR by using an abort indication. Expiry of timer T-ir before the connect to following address message, the process call waiting message or the complete call message has been received shall also result in aborting the ongoing transaction and re- lease of the call by an appropriate indication given to the fixed network.

The send information for I/C call set-up message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ir. The complete call, process call waiting and connect to following address messages are received in TC-INVOKE INDICATION primitives.

The following messages are sent in TC-U-ERROR REQUEST primitives:

i) radio congestion
ii) no subscriber reply
iii) busy subscriber
iv) unexpected data value
v) data missing

The following messages are received in TC-U-ERROR INDICATION primitives:

i) unidentified subscriber
ii) impossible call completion
iii) absent subscriber
iv) forwarding violation
v) unexpected data value
vi) data missing
vii) system failure
viii) unknown subscriber
ix) unallocated roaming number.

A TC-(U-)REJECT primitive is used to indicate procedure failure and a TC-L-CANCEL INDICATION primitive indicates expiry oftimer T-ir. An abort condition generated by the MSC is sent in a TC-U-ABORT REQUEST primitive. An abort indication generated by TCAP or the VLR is received in TC-ABORT INDICATION primitives.

5.4.3.1.2 MS originated calls

The application specific procedure is contained in Figure 5.4.7 and the ASE/TCAP interface procedure is contained in Figure 5.4.8.

For an MS originated call the call handling function of the MSC will request MAP to obtain the subscriber parameters required for handling the call. The event is illustrated by the signal obtain subscriber parameters(X). The MSC sends the send information for O/G call set-up message to the VLR. The message will contain service indication, if required and available, and the called number for checking barring conditions. Either of the following may happen:

- if the procedure is successful, the complete call message is received. The message may contain parameters related to the subscription (supplementary services, basic services). These parameters are provided to the call handling function;

- if there is incompatibility with regard to the requested service, the messages bearer service not provisioned or telservice not provisioned are received, and the respective signal bearer service not provisioned(X) or teleservice not provisioned(X) is sent to the call handling function depending on the nature of the incompatibility;

- a reject indication, a timer expired or an abort indication is received if the procedure fails;

- if the MS is barred for this specific outgoing call (supplementary service is active or for administrative reasons), the call barred message with appropriate reason is received;

- if a CUG index provided by the MS is not allocated to that MS, the CUG reject message is received;

- the unknown subscriber message may be received;

- if an associated procedure failed, the system failure message is received from the VLR;

- if there are errors in the data fields, the data missing or unexpected data value message is received.

All the above unsuccessful events are provided to the call handling function so that the call can be terminated by providing the appropriate unsuccessful call indication to the MS.

If the call is released by the calling subscriber before the complete call message has been received, the MSC will terminate the procedure towards the VLR by using an abort indication.

The send information for O/G call set-up message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ir. The complete call message is received in a TC-INVOKE INDICATION primitive. A TC-(U-)REJECT primitive is used to report procedure failure and an abort condition is reported in a TC-ABORT INDICATION primitive. The expiry of the timer T-ir is reported in a TC-L-CANCEL INDICATION primitive.

The following messages are sent in TC-U-ERROR REQUEST primitives:

i) unexpected data value;
ii) data missing.

The following messages are received in TC-U-ERROR INDICATION primitives:

i) unknown subscriber;
ii) system failure;
iii) call barred;
iv) CUG-reject;
v) data missing or unexpected data value;
vi) teleservice not provisioned;
vii) bearerservice not provisioned.

5.4.3.1.3 Retrieval of routing information

The application specific procedure is contained in Figure 5.4.9 and the ASE/TCAP interface procedure is contained in Figure 5.4.10.

The call handling function in the gateway MSC will request MAP to obtain routing information (the obtain routing information (X) signal). The MSC then sends the send routing information message to the HLR of the MS. The message contains the MS ISDN number and any supplementary services information contained in the request from the call handling function. The outcome of the procedure can be as follows:

- if a routing address (either a mobile station roaming number or a forwarded-to number) can be provided, it is included in the routing information acknowledge message. The routing address is provided to the call handling function;

- a procedure failure is reported either as a reject indication or a timer expiry indication. In both cases a call failure indication is provided to the call handling function;

- unsuccessful events are reported in various messages and provided to the call handling function as follows:

  i) unknown subscriber,
  ii) absent subscriber,
  iii) call barred,
  iv) CUG reject,
  v) forwarding violation,
  vi) system failure,
  vii) bearerservice not provisioned,
  viii) teleservice not provisioed,
  ix) facility not supported,
  x) unexpected data value,
  xi) data missing.

The send routing information message is sent in a TC-INVOKE REQUEST primitive. TCAP is also requested to supervise the procedure by timer T-rd. The results are received as follows:

- the routing information acknowledge message is contained in a TC-RESULT-L INDICATION primitive;

- procedure failure is indicated by a TC-(U-)REJECT INDICATION primitive;

- expiry of timer T-rd is reported in a TC-L-CANCEL INDICATION primitive;

- negative results are reported in a TC-U-ERROR INDICATION primitive as follows:

  i) unknown subscriber;
  ii) absent subscriber;
  ii) call barred;
  iv) CUG rejection;
  v) forwarding violation;
  vi) system failure;
  vii) bearer service not provisioned;
  viii) teleservice not provisioned;
  ix) facility not supported;
  x) unexpected data value;
  xi) data missing.

Figure 5.4.5 (Sheet 1 of 5)
Application specific procedure in MSC for retrieval of call data for MS terminating calls.

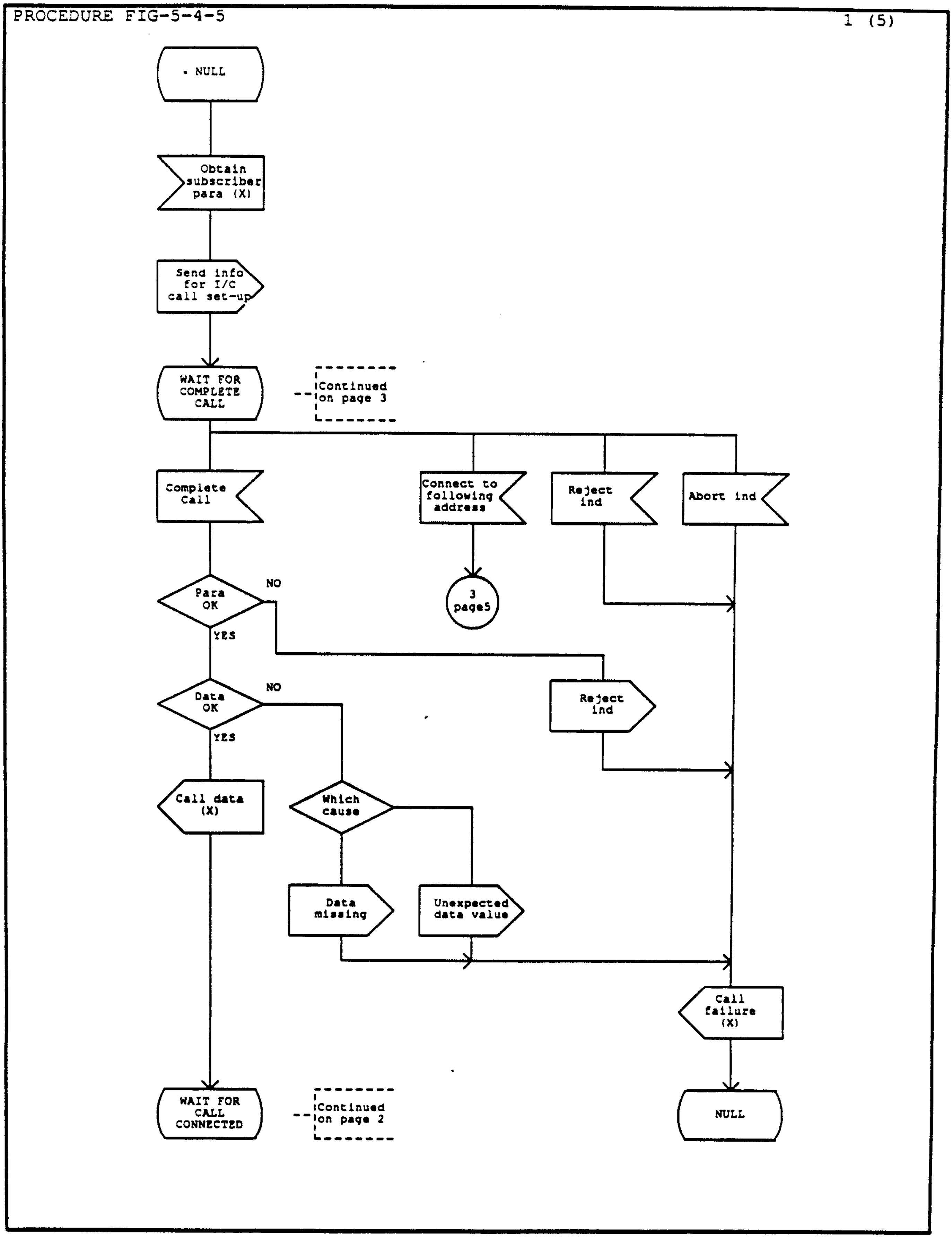


Figure 5.4.5 (Sheet 2 of 5)
Application specific procedure in MSC for retrieval of call data for MS terminating calls.

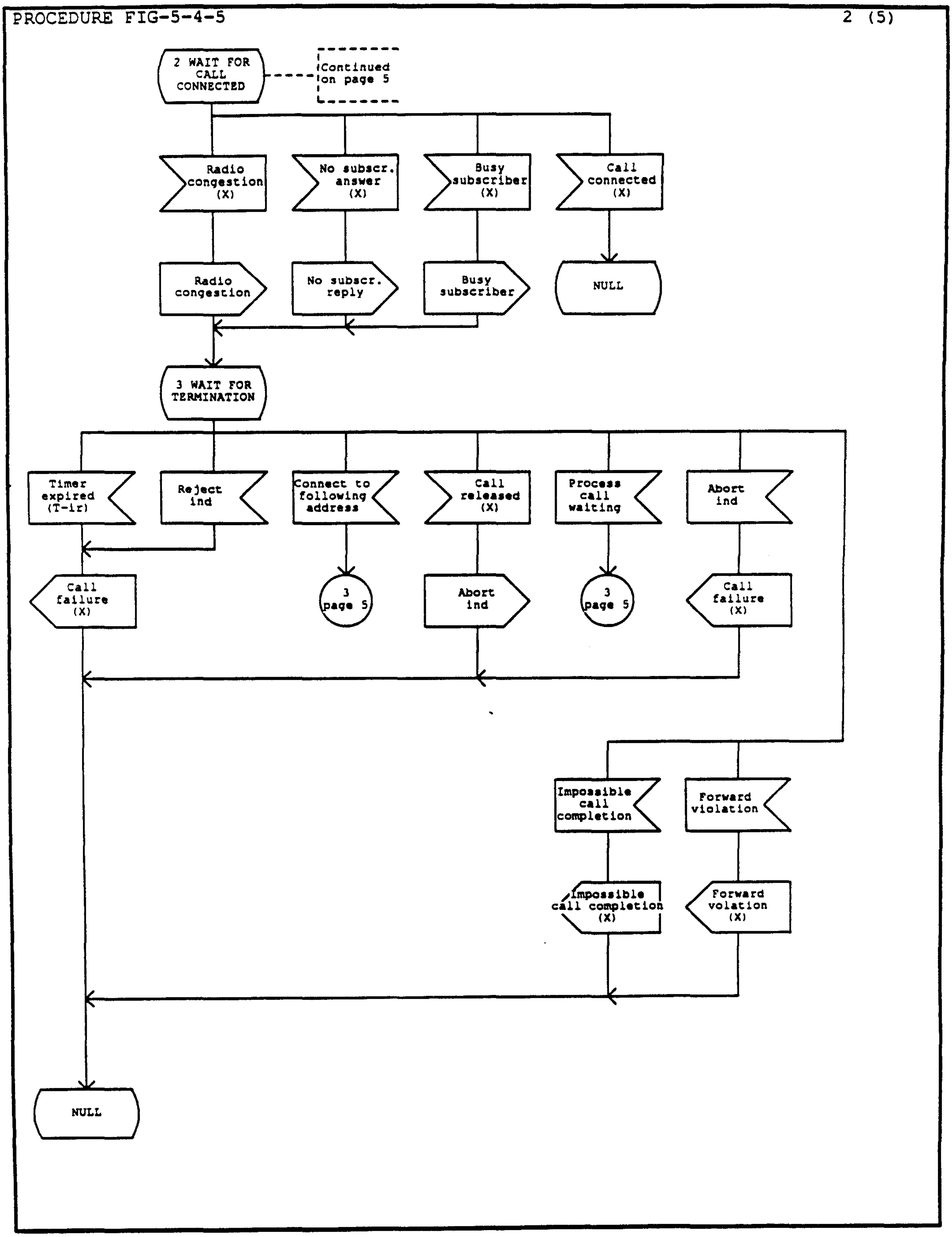


Figure 5.4.5 (Sheet 3 of 5)
Application specific procedure in MSC for retrieval of call data for MS terminating calls.

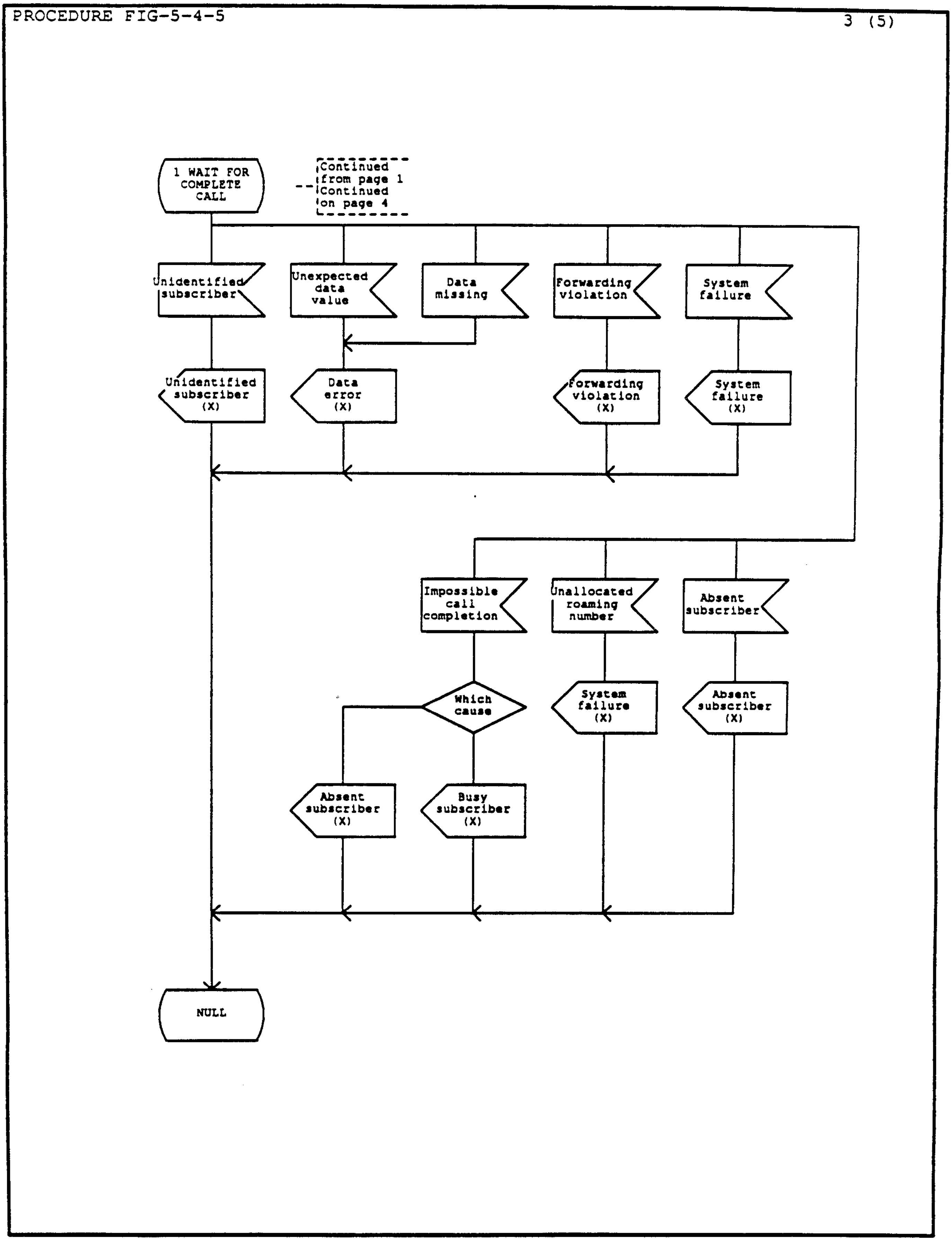


Figure 5.4.5 (Sheet 4 of 5)
Application specific procedure in MSC for retrieval of call data for MS terminating calls.

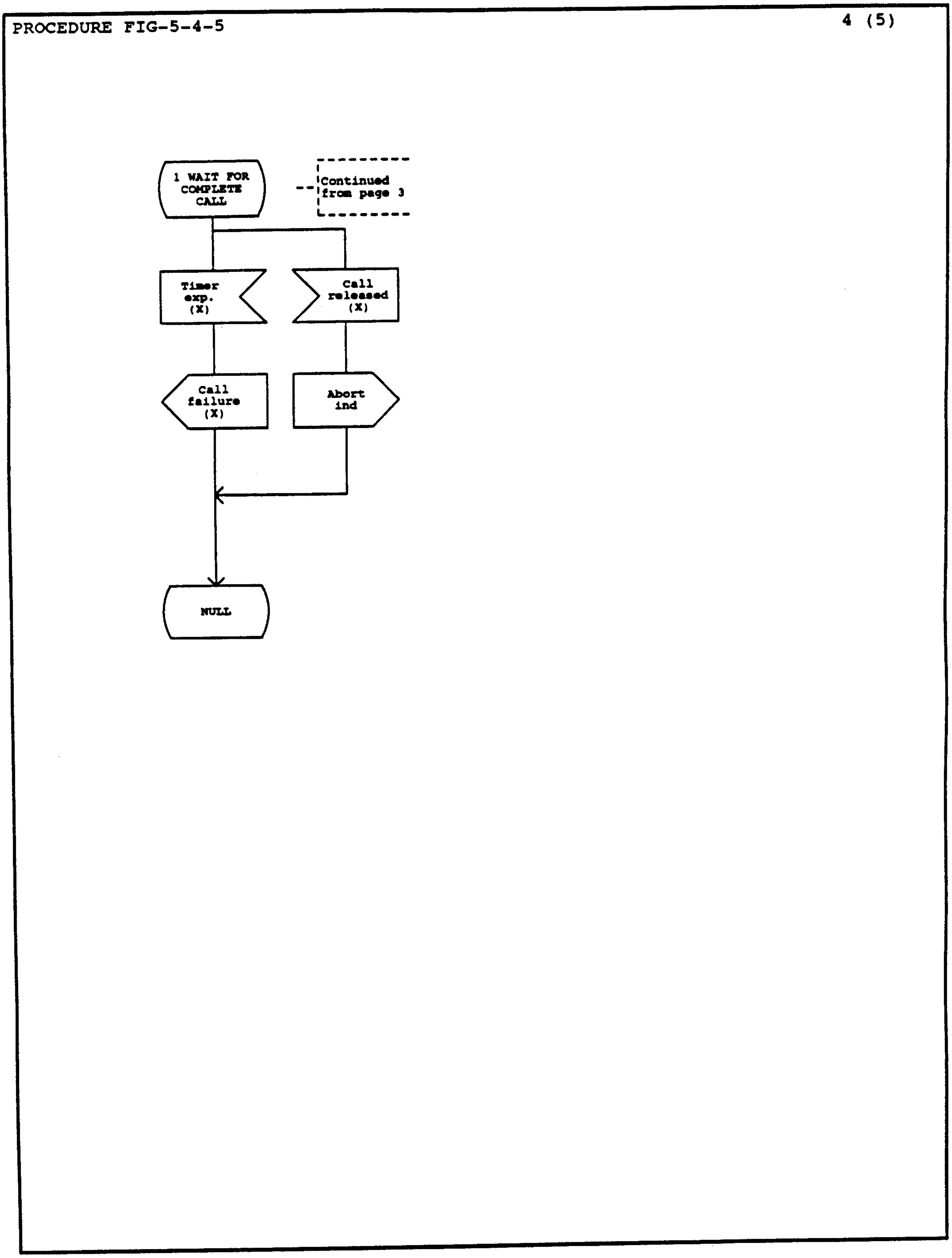


Figure 5.4.5 (Sheet 5 of 5)
Application specific procedure in MSC for retrieval of call data for MS terminating calls.

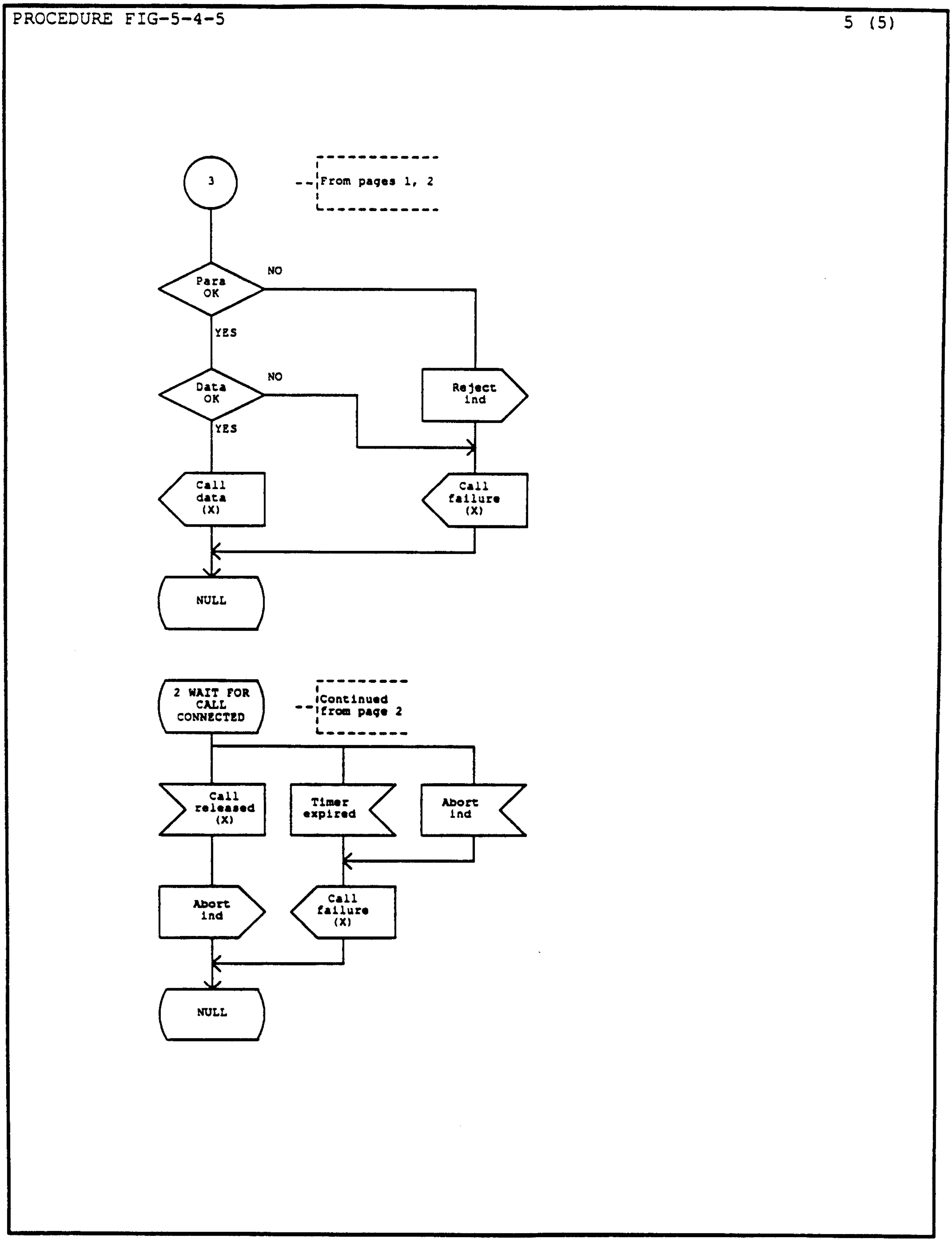


Figure 5.4.6 (Sheet 1 of 3)
ASE/TCAP interface in MSC for retrieval of call data for MS terminating calls.

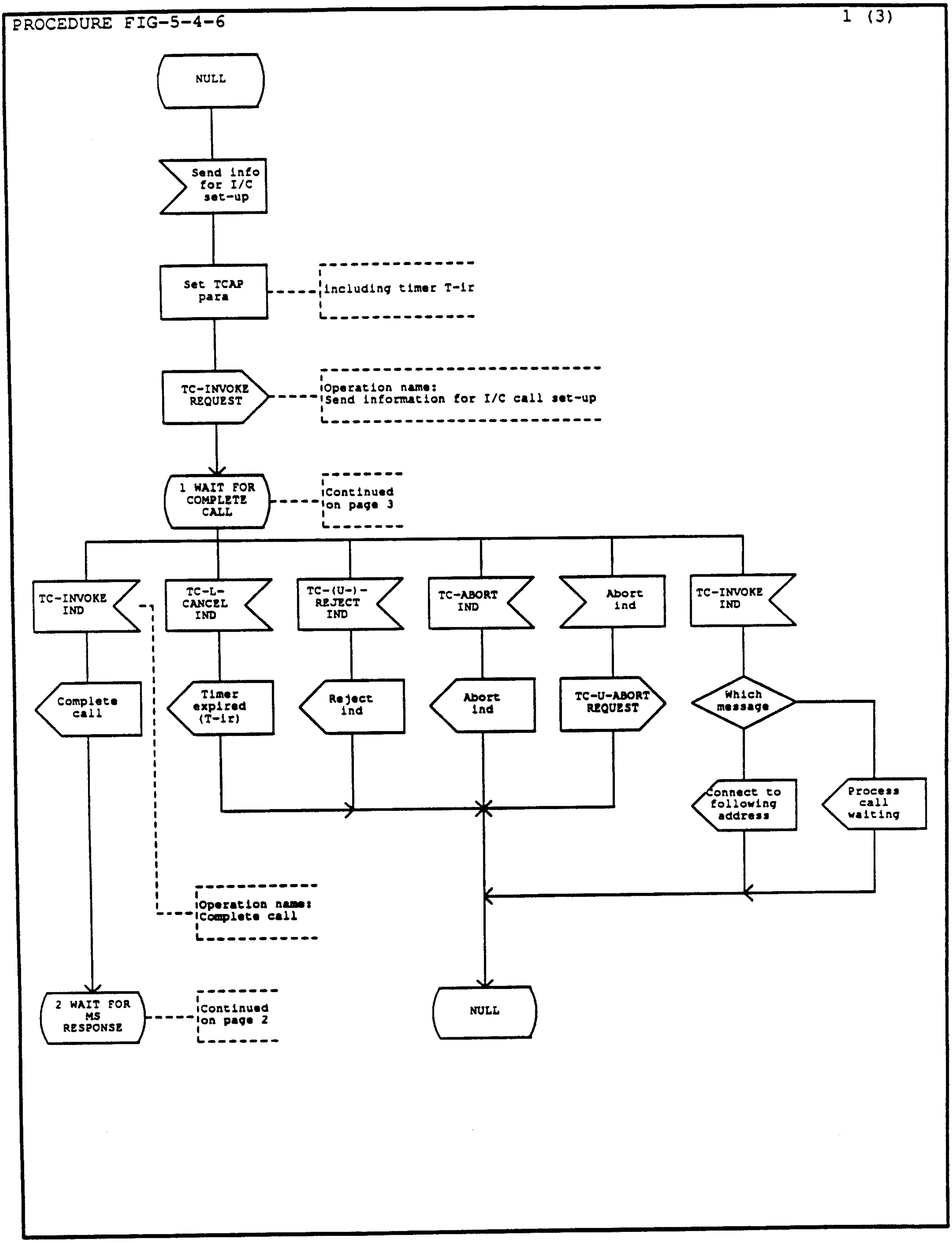


Figure 5.4.6 (Sheet 2 of 3)
ASE/TCAP interface in MSC for retrieval of call data for MS terminating calls.

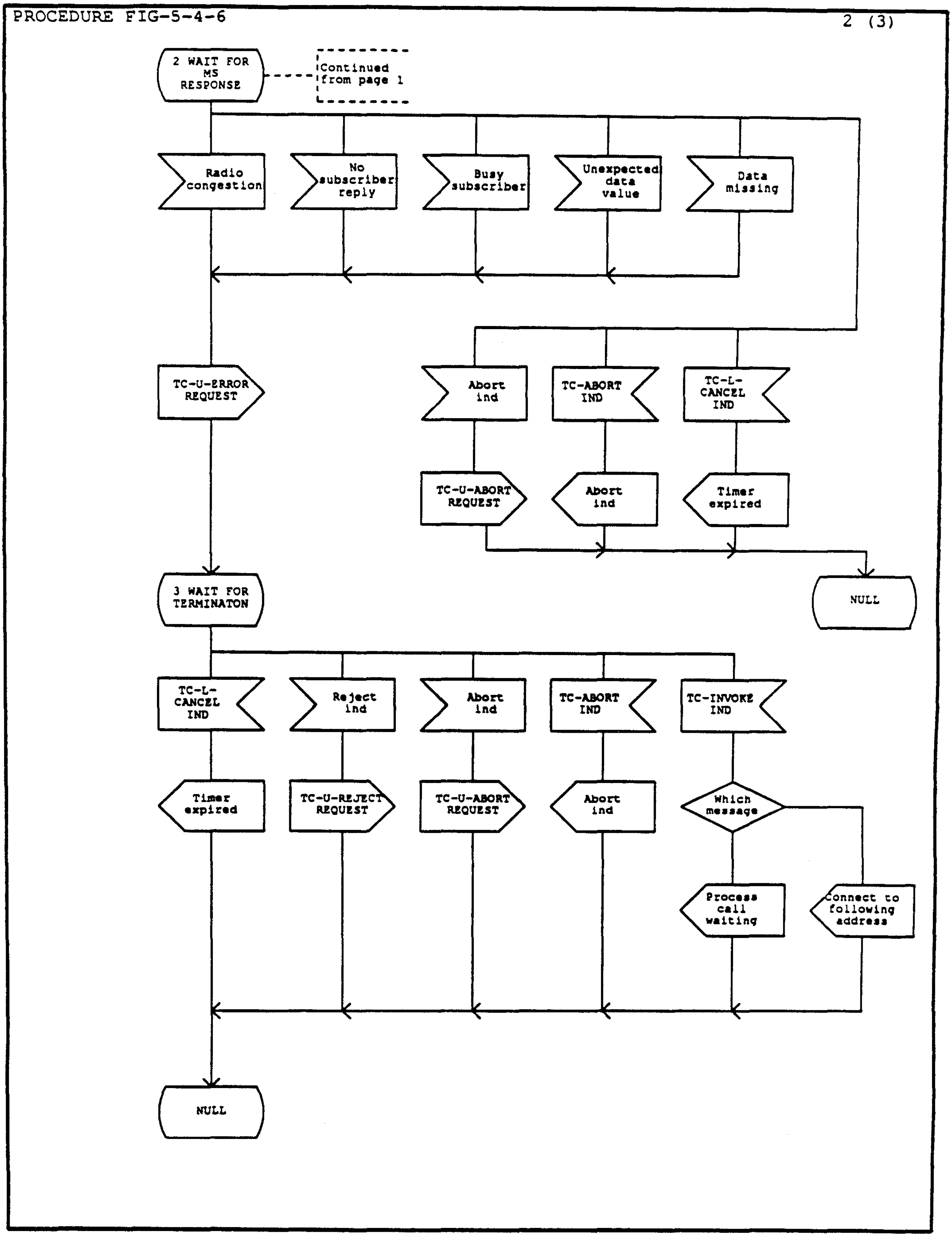


Figure 5.4.6 (Sheet 3 of 3)
ASE/TCAP interface in MSC for retrieval of call data for MS terminating calls.

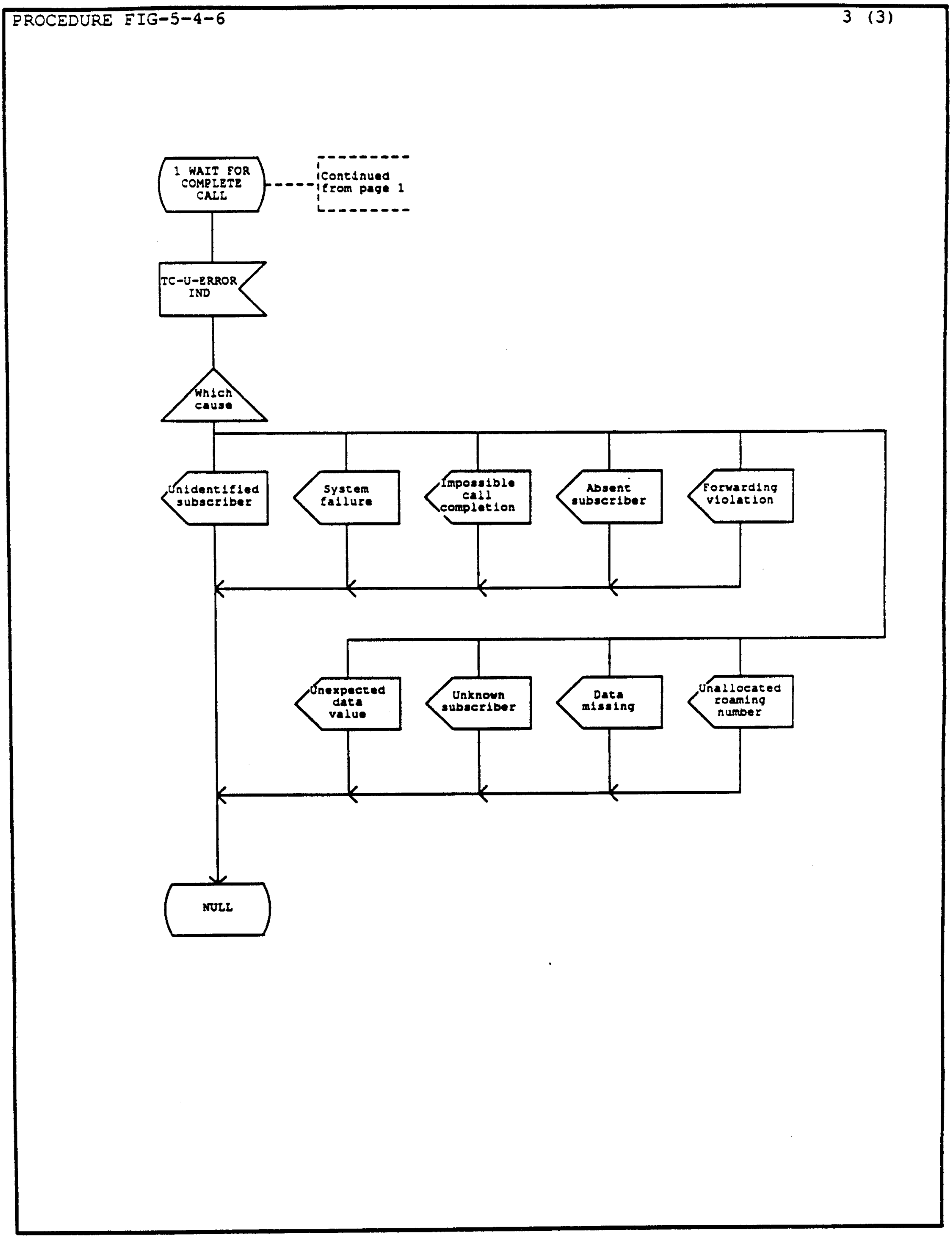


Figure 5.4.7 (Sheet 1 of 2)
Application specific procedure in MSC for retrieval of call data for MS originated calls.

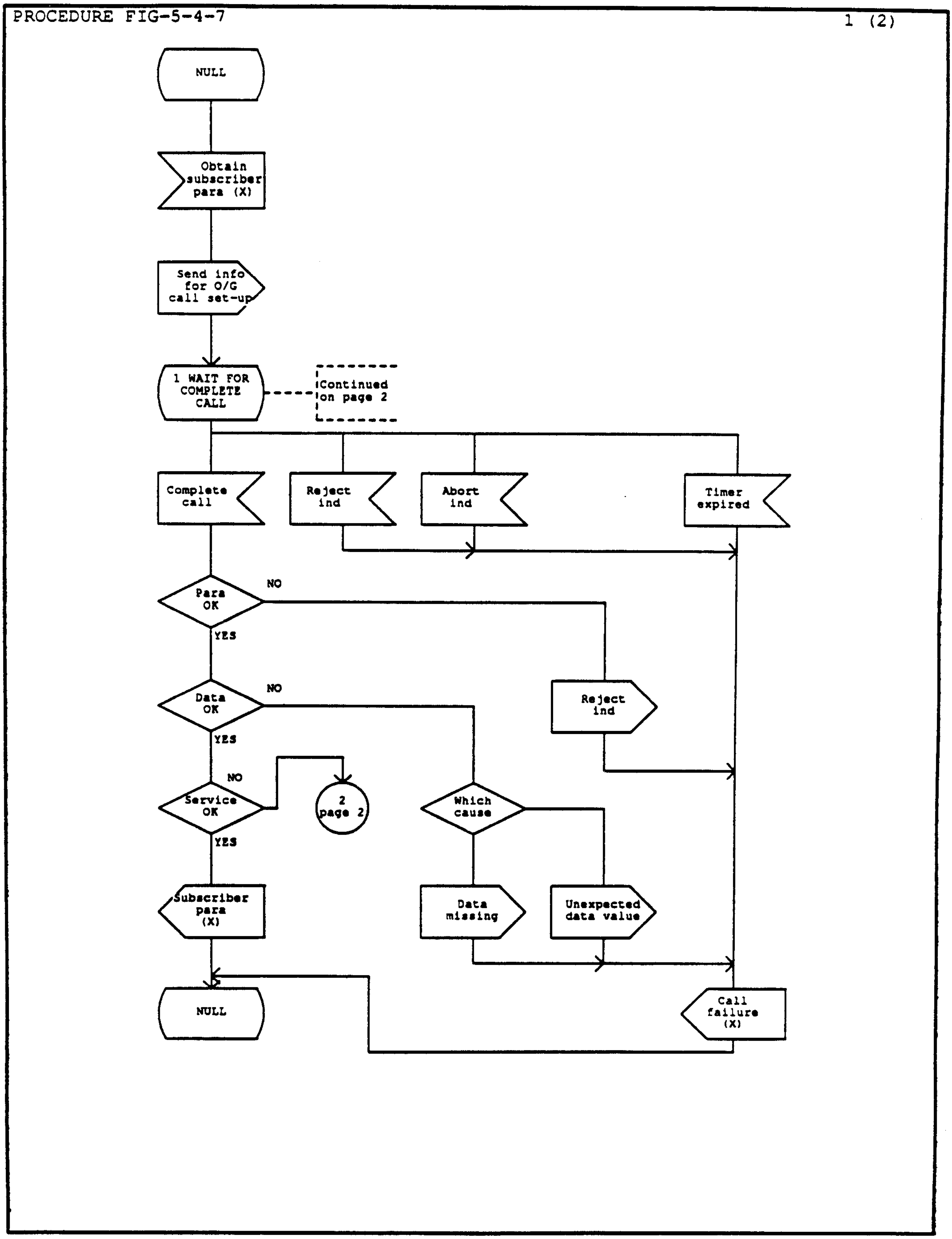


Figure 5.4.7 (Sheet 2 of 2)
Application specific procedure in MSC for retrieval of call data for MS originated calls.

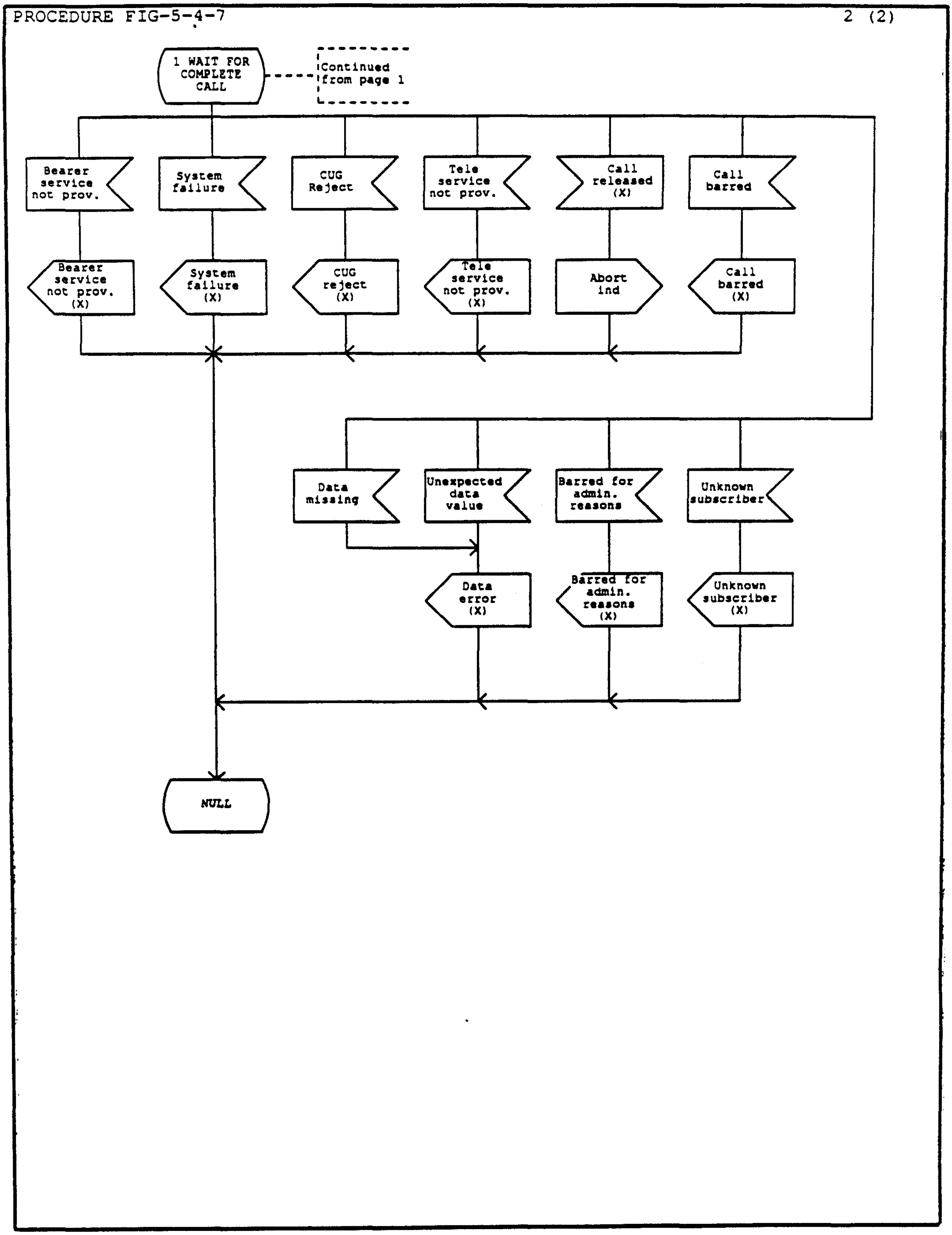


Figure 5.4.8 (Sheet 1 of 2)
ASE/TCAP interface in MSC for retrieval of call data for MS originated calls.

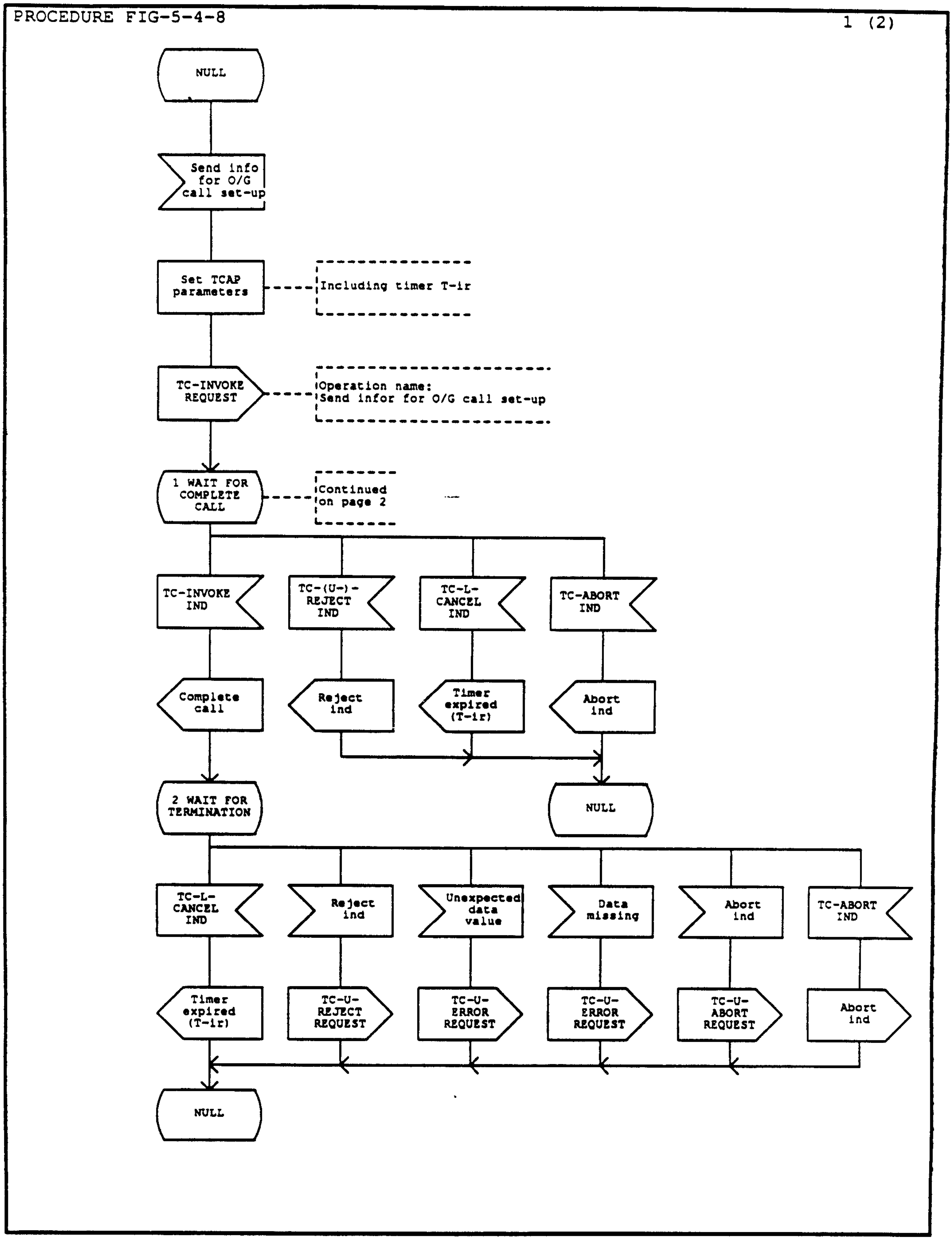


Figure 5.4.8 (Sheet 2 of 2)
ASE/TCAP interface in MSC for retrieval of call data for MS originated calls.

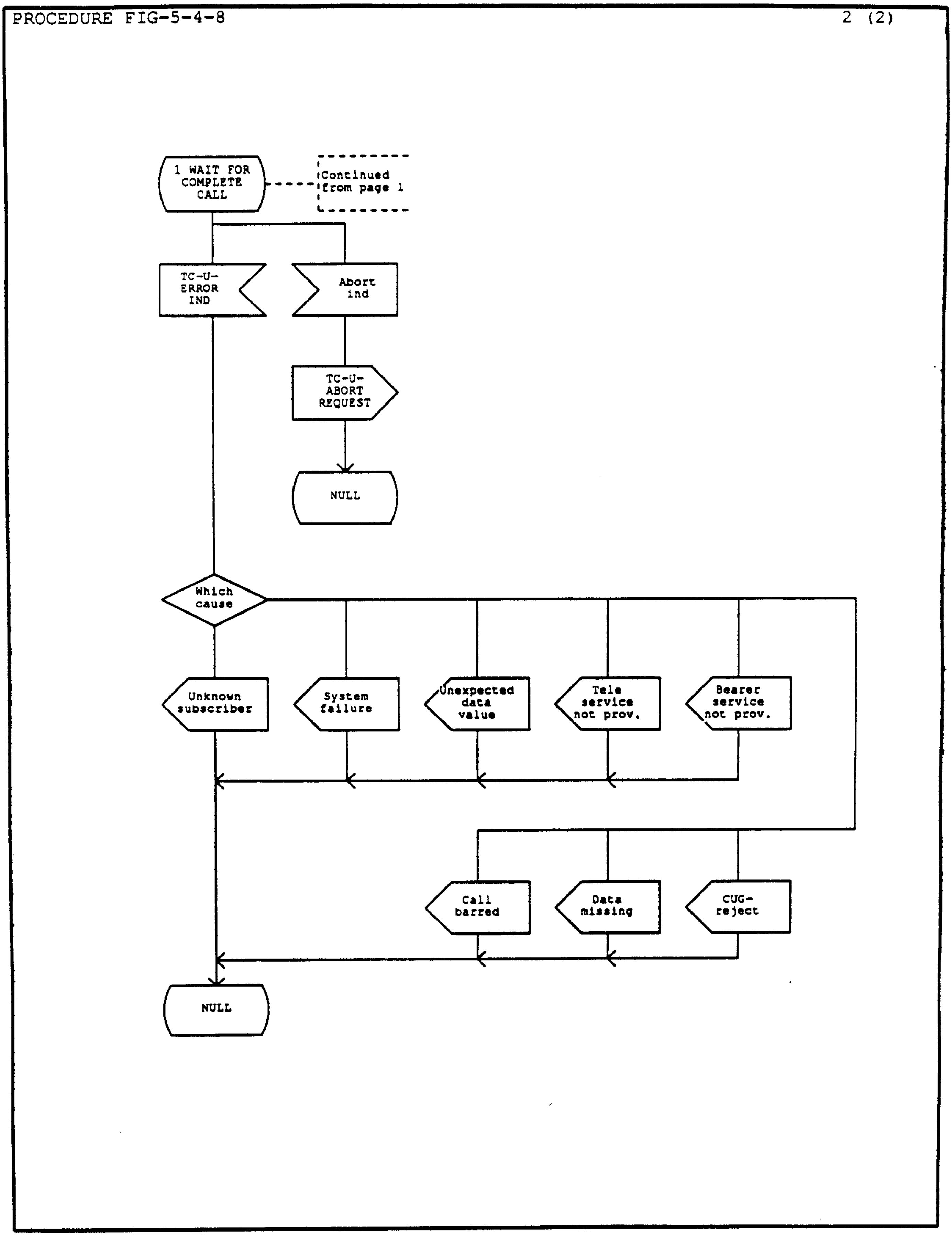


Figure 5.4.9 (Sheet 1 of 2)
Application specific procedure in a gateway MSC for obtaining routing information.

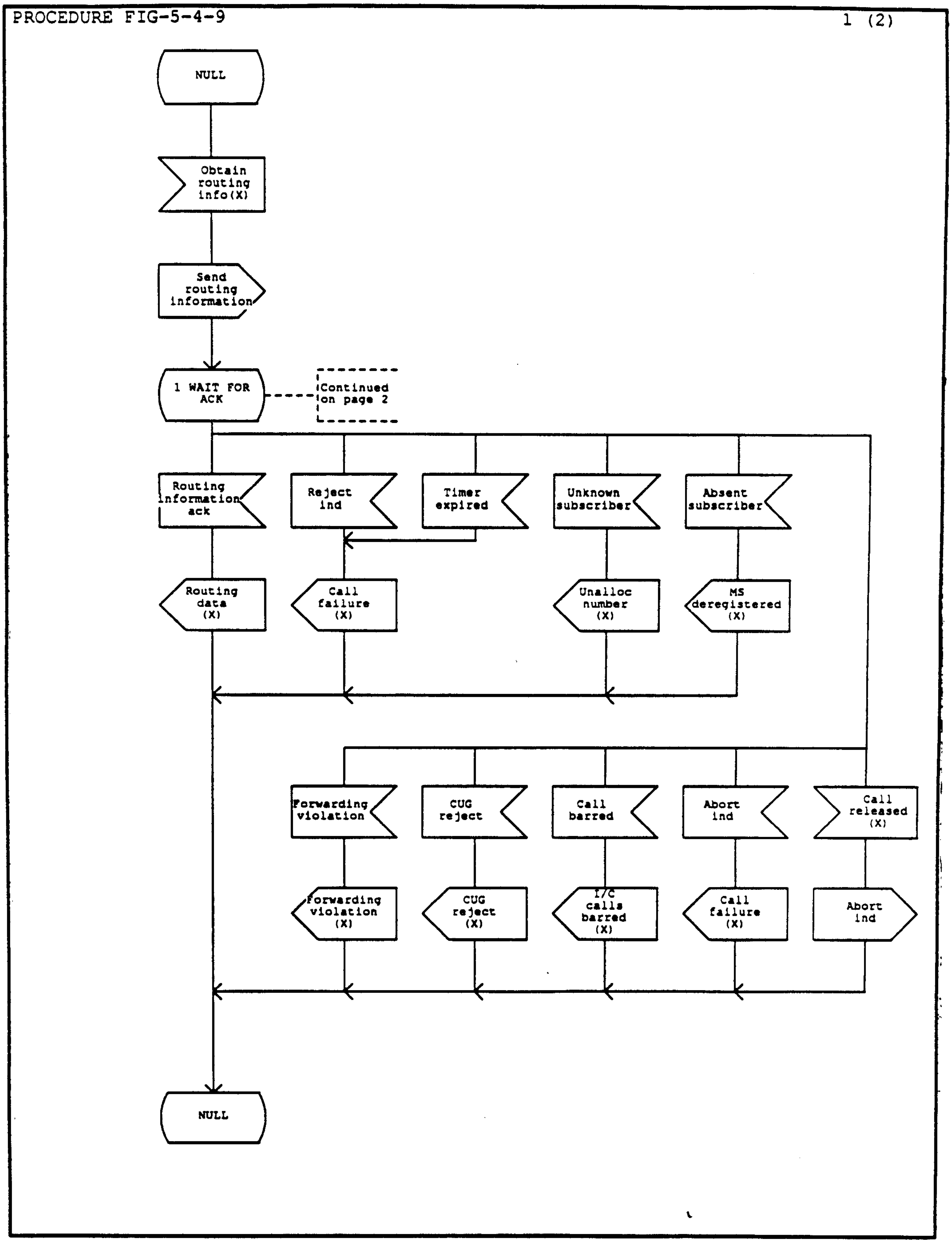


Figure 5.4.9 (Sheet 2 of 2)
Application specific procedure in a gateway MSC for obtaining routing information.

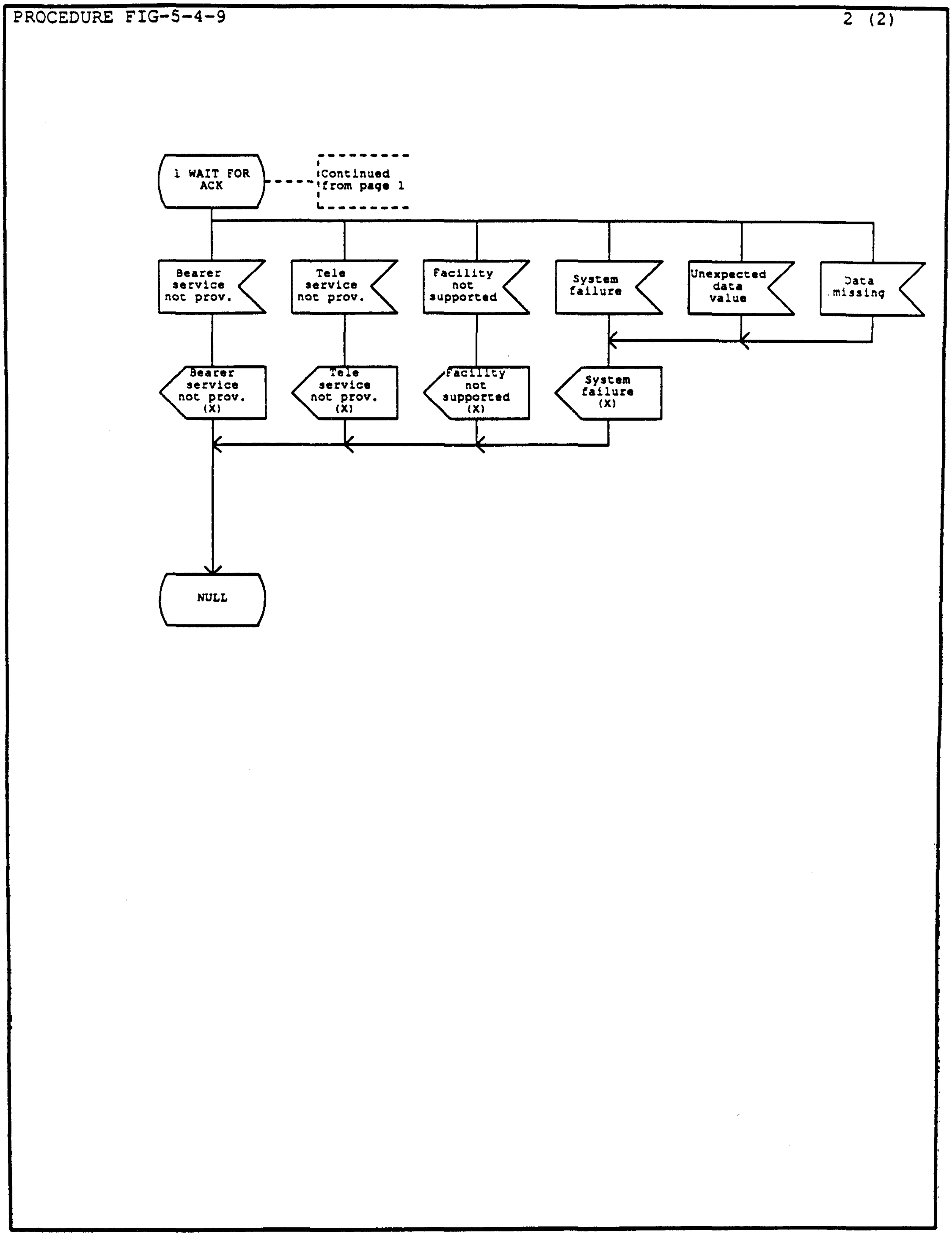


Figure 5.4.10 (Sheet 1 of 2)
ASE/TCAP interface in a gateway MSC for obtaining routing information.

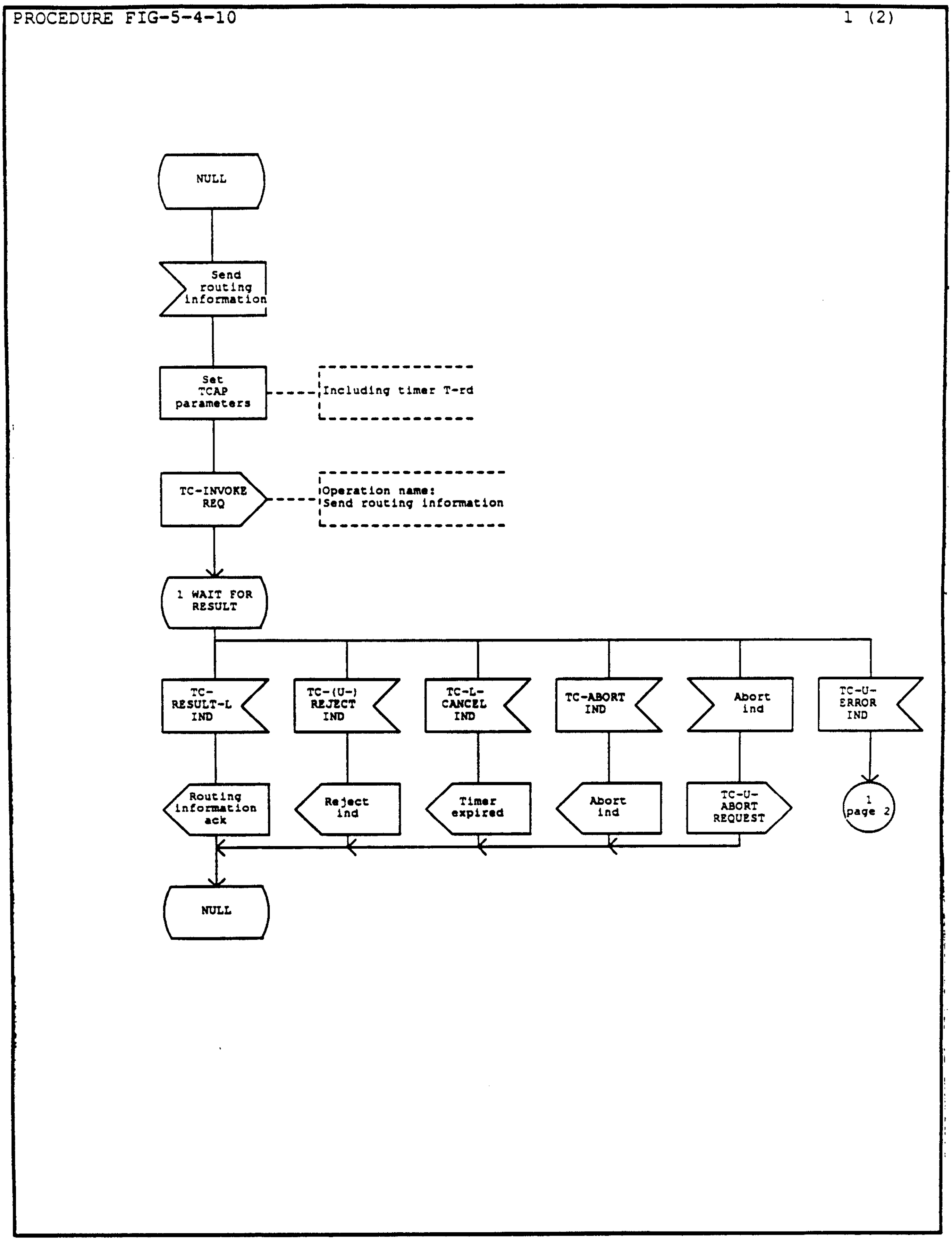
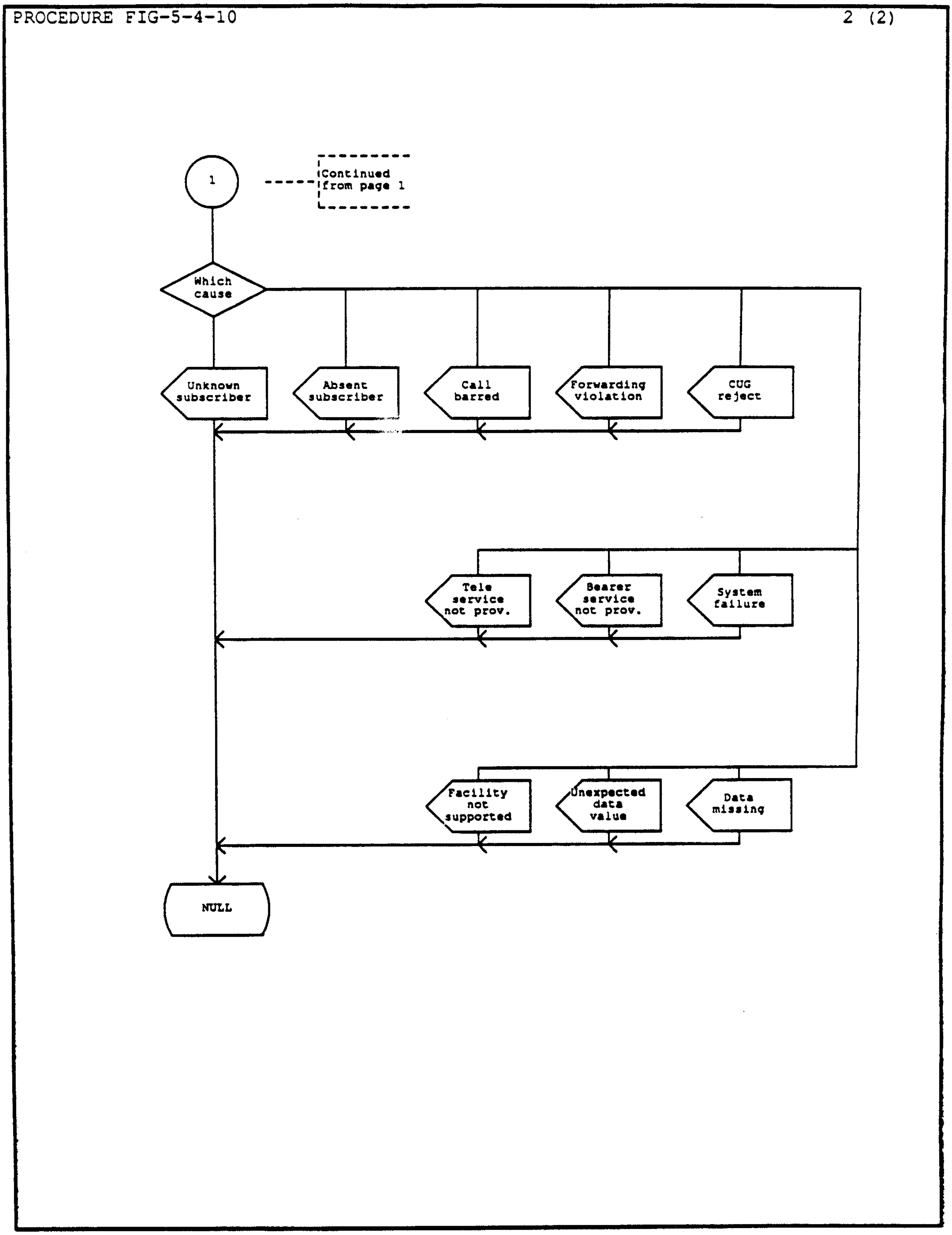


Figure 5.4.10 (Sheet 2 of 2)
ASE/TCAP interface in a gateway MSC for obtaining routing information.



5.4.3.2 Procedures in the VLR

5.4.3.2.1 MS terminating calls

The application specific procedure is shown in Figure 5.4.11 and the ASE/TCAP interface procedure is shown in Figure 5.4.12.

When receiving the send information for I/C call set-up message, the VLR will check the parameters and data in the message and report parameter failure as a reject indication to the MSC. The data failure is reported as an unexpected data value message or a data missing message depending on the nature of the failure. For incoming SMS calls the called MS may be identified by the IMSI. If this IMSI is not included in the VLR table, the unidentified subscriber message is returned. If the MS is identified by an MSRN, and this MSRN is not allocated, the VLR will return the unallocated roaming number message and block the roaming number.

If the IMSI detached flag is set in the VLR and the call forwarding on IMSI detached service is active and the call has not already been forwarded as many times as allowed, a connect to following address message is sent to the MSC. If the call has already been forwarded as many times as are allowed, the forwarding violation message is returned. If the call forwarding on IMSI detached service is not active, an absent subscriber message will indicate to the MSC that the IMSI is detached. If it was a request for SMS call set-up, the message waiting (MW) flag is set.

If the send information for I/C call set-up message has passed all the tests, the VLR will initiate the page MS procedure if the VLR is not in a restoration mode, or the search for MS procedure if the VLR is in a restoration mode and the location data for the called MS has not been confirmed.

If the radio paging procedure or the search for MS procedure and all other procedures invoked (eg authentication procedure) are successful, the process will receive a MS present (x) signal, and the VLR will send a complete call message to the MSC. The complete call message will provide supplementary services information, bearerservice information and category, as required, for handling the incoming call.

During the set-up transaction the VLR may allocate a new TMSI to the MS. This is not shown explicitly in Figure 5.4.11.

Unsuccessful outcome to the page MS procedure or the search for MS procedure or any other procedure invoked (eg authentication procedure) is reported as follows:

- an absent subscriber(X) signal if there is no paging reponse. If the call forwarding on no paging reponse service is active and the call has not already been forwarded as many times as allowed, the VLR will return the connect to following address message. If the service is active and the call has already been forwarded as many times as are allowed, the forwarding violation message is returned. If this supplementary service is not active the impossible call completion message is returned to the MSC. For an incoming short message, the message waiting flag in the VLR is set;

- a busy subscriber(X) signal if the called MS is busy in a call. If the call forwarding on busy subscriber is active and the call has not already been forwarded as many times as allowed and the call is not an SMS call, the VLR will return the connect to following address message. If the call has already been forwarded as many times as are allowed, the forwarding violation message is returned. If this supplementary service is not active and the call waiting service is not active, the impossible call completion message is sent to the MSC. If the call forwarding on busy subscriber service is not active but the call waiting service is active, the process call waiting message is sent to the MSC. For SMS calls to busy subscribers the procedure is terminated in the VLR and no information is sent to the MSC.

- a procedure failure(X) signal which indicates failure in the page MS procedure or search for MS procedure or in any other procedure invoked (eg authentication procedure). A system failure message is sent to the MSC.

Unsuccessful events received from the MSC in response to the sending of the complete call message will be as follows:

- a radio congestion message if the call set-up on the radio path has failed because of radio congestion. If the call forwarding on subscriber not reachable service is active and the call has not been forwarded as many times as allowed, the VLR will return the connect to following address message. If the call has already been forwarded as many times as are allowed, the forwarding violation message is returned. If this supplementary service is not active, the impossible call completion message is sent to the MSC. For a short message, the message waiting flag in the VLR is set.

- a no subscriber reply message if the call set-up has failed because of no subscriber reply. If the call forwarding on no subscriber reply is active and the call has not been forwarded as many times as allowed, the VLR will return the connect to following address message. If the call has already been forwarded as many times as are allowed, the forwarding violation message is returned. If this supplementary service is not active, the impossible call completion message is sent to the MSC. For a short message, the message waiting flag in the VLR is set.

- a busy subscriber message if the call set-up has failed because the subscriber is busy in a call. If the forwarding on busy subscriber service is active and the call has not been forwarded as many times as allowed, the VLR will return the connect to following address message. If the call has already been forwarded as many times as are allowed, the forwarding violation message is returned. If this supplementary service is not active and the call waiting service is not active, the impossible call com- pletion message is sent to the MSC. If the call forwarding on busy subscriber service is not active but the call waiting service is active, the process call waiting message is sent to the MSC. For a short message, the message waiting flag in the VLR is set.

A TC-ABORT primitive may be received at any time during the processing of the call in the VLR. The VLR shall then termi- nate the procedure.

The send information for I/C call set-up message is received in a TC-INVOKE INDICATION primitive. The connect to following address, process call waiting and complete call messages are sent in TC-INVOKE REQUEST primitives. TCAP is requested to supervise these operations by timers T-co, T-pcw and T-cc, respectively.

A reject indication is reported in a TC-U-REJECT REQUEST primitive and expiry of the timers are reported in TC-L-CANCEL INDICATION primitives. An abort condition generated by the VLR is sent in a TC-U-ABORT REQUEST primitive. An abort indication generated by TCAP or the MSC is received in TC-ABORT INDICATION primitives.

The following messages are received in TC-U-ERROR INDICATION primitives:

i) radio congestion,
ii) no subscriber reply,
iii) busy subscriber,
iv) unexpected data value or data missing.

Negative results are reported in a TC-U-ERROR REQUEST primitive:

i) unidentified subscriber,
ii) forwarding violation,
iii) absent subscriber,
iv) unexpected data value,
v) data missing,
vi) system failure,
vii) unknown subscriber,
viii) impossible call completion,
ix) unallocated roaming number.

5.4.3.2.2 MS originated calls

The application specific procedure in the VLR is shown in Figure 5.4.13 and the ASE/TCAP interface procedure is shown in Figure 5.4.14.

Note: Prior to this procedure, the process access request procedure of 5.14 has been performed.

When receiving the send information for O/G call set-up message, the VLR will check the parameters and data in the message and report parameter errors as a reject indication to the MSC. Data errors are reported as an unexpected data value message or a data missing message depending on the nature of the errors. If the MS is barred for administrative reasons (eg a bad payer) the VLR will return the call barred message. The VLR will perform the subscription check. If there is incompatibility with regard to the requested service, either of the messages bearer service not provisioned or teleservice not provisioned is returned to the MSC. The VLR will also check the activation status of the supplementary services. If the calling MS has passed all checks and data is not required from the HLR, the complete call message is sent to the MSC and the procedure is terminated in the VLR. The complete call message may contain parameters related to the subscription, e.g. supplementary services and basic services.

If the barring of all outgoing calls service is active, the VLR will return the call barred message. If a conditional barring of outgoing calls service is active, the VLR will check whether or not calls are barred to the destination address. If so, the call barred message is returned.

If the calling MS is part of a closed user group with restricted outgoing access, the call must pass a CUG test. If the call fails to pass the CUG test (see recommendation GSM 03.11 for conditions) a CUG reject message is reported to the MSC and the procedure is terminated. If the CUG index received from the MS is not known by the VLR, the VLR needs to obtain CUG data from the HLR. In such cases the VLR will send a send parameters message to the HLR requiring all CUG parameters for the MS see section 5.6.1.

At the VLR/MSC interface (Figure 5.4.14) send information for O/G call set-up message is contained in a TC-INVOKE INDICATION primitive. The complete call message is included in TC-INVOKE- REQUEST primitive. TCAP is requested to supervise the procedure by timer T-cc. A reject indication is sent as a TC-U- REJECT REQUEST primitive. An abort indication generated in the MSC or TCAP is received in a TC-ABORT INDICATION primitive. An abort condition generated by the VLR is sent in a TC-U-ABORT REQUEST primitive.

Negative results are sent in a TC-U-ERROR REQUEST primitive as follows:

i) system failure;
ii) call barred;
iii) CUG reject;
iv) data missing;
v) unexpected data value;
vi) unknown subscriber;
vii) teleservice not provisioned;
iix) bearer service not provisioned.

Figure 5.4.11 (Sheet 1 of 4)
Application specific procedure in VLR for retrieval of call data for MS terminating calls.

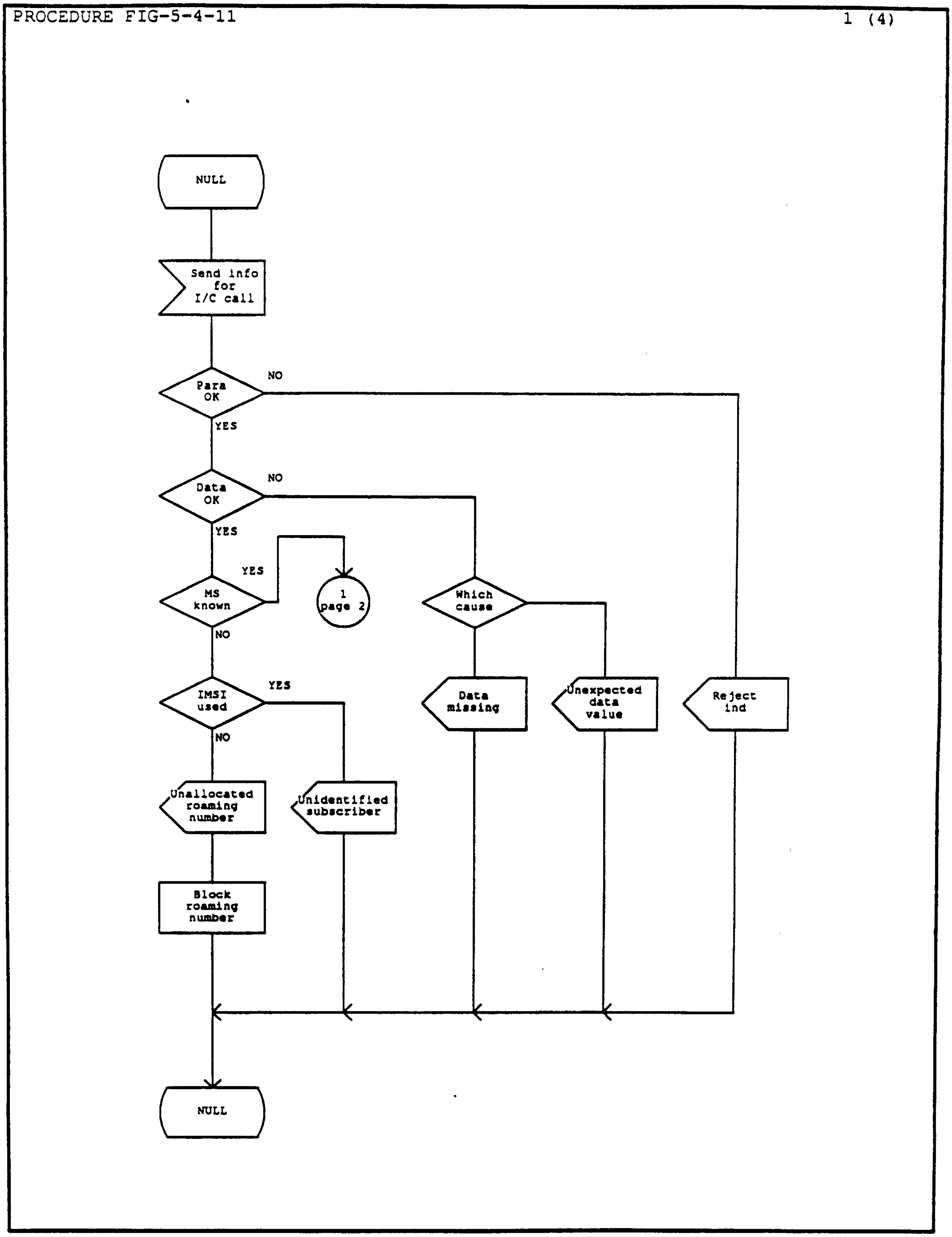


Figure 5.4.11 (Sheet 2 of 4)
Application specific procedure in VLR for retrieval of call data for MS terminating calls.

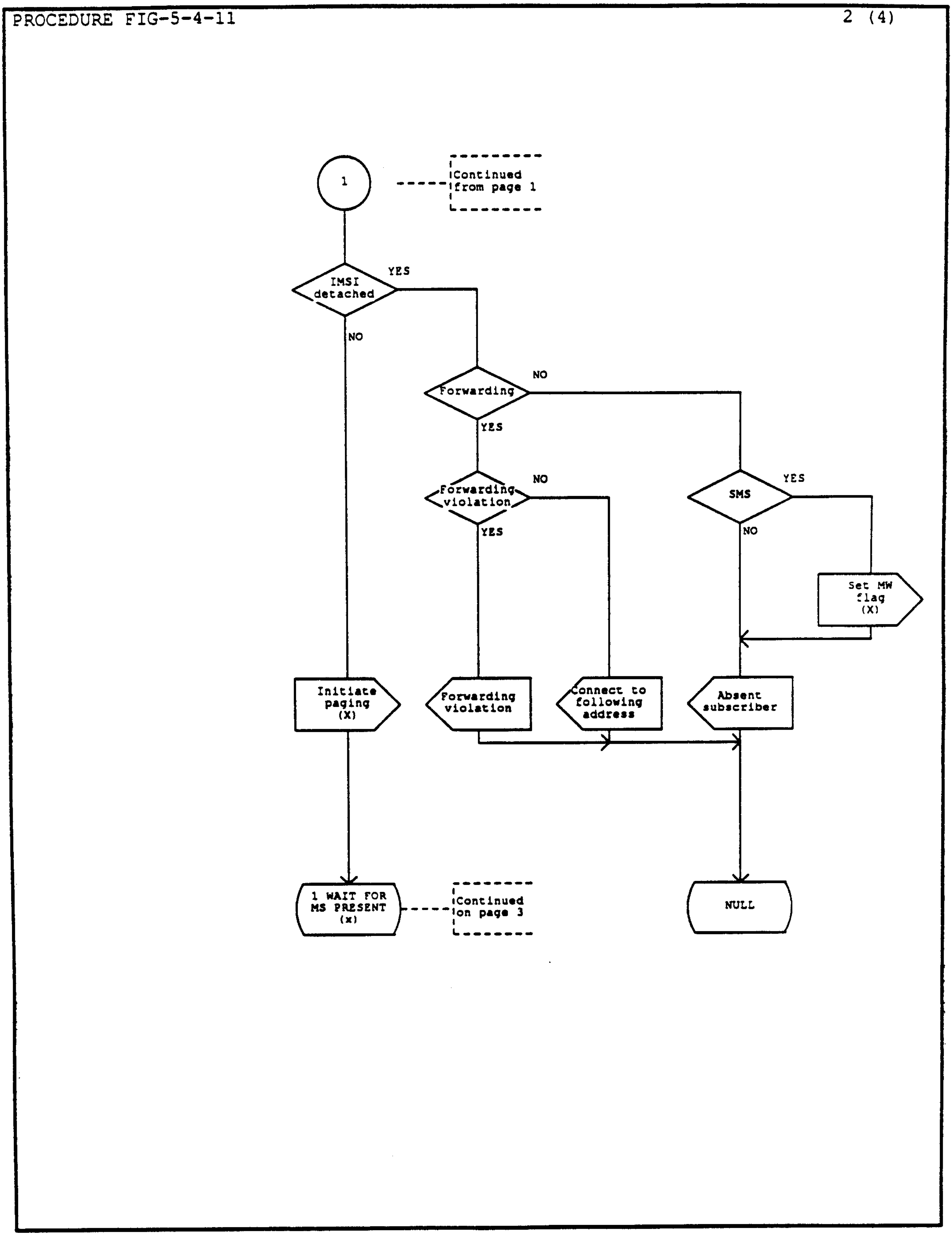


Figure 5.4.11 (Sheet 3 of 4)
Application specific procedure in VLR for retrieval of call data for MS terminating calls.

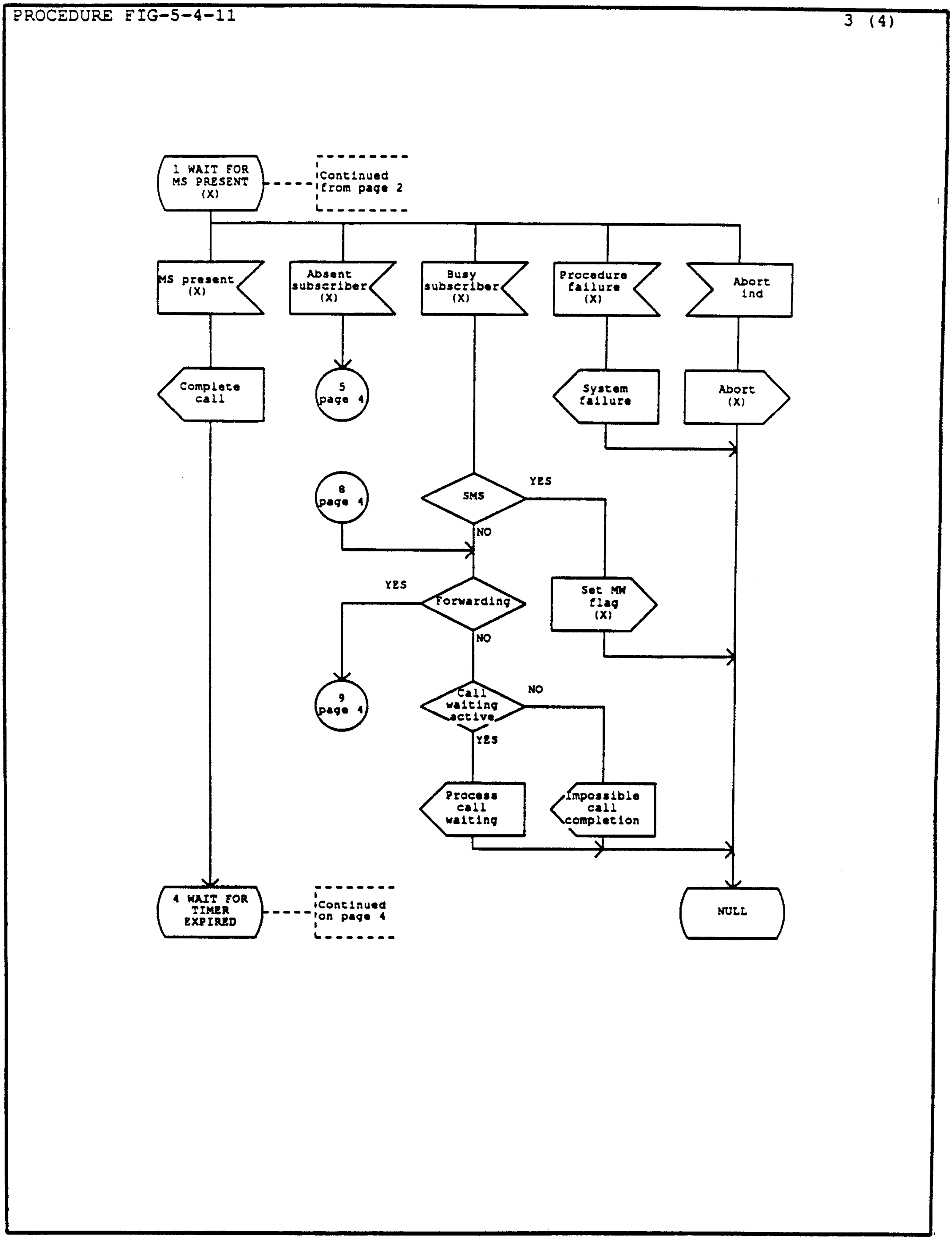


Figure 5.4.11 (Sheet 4 of 4)
Application specific procedure in VLR for retrieval of call data for MS terminating calls.

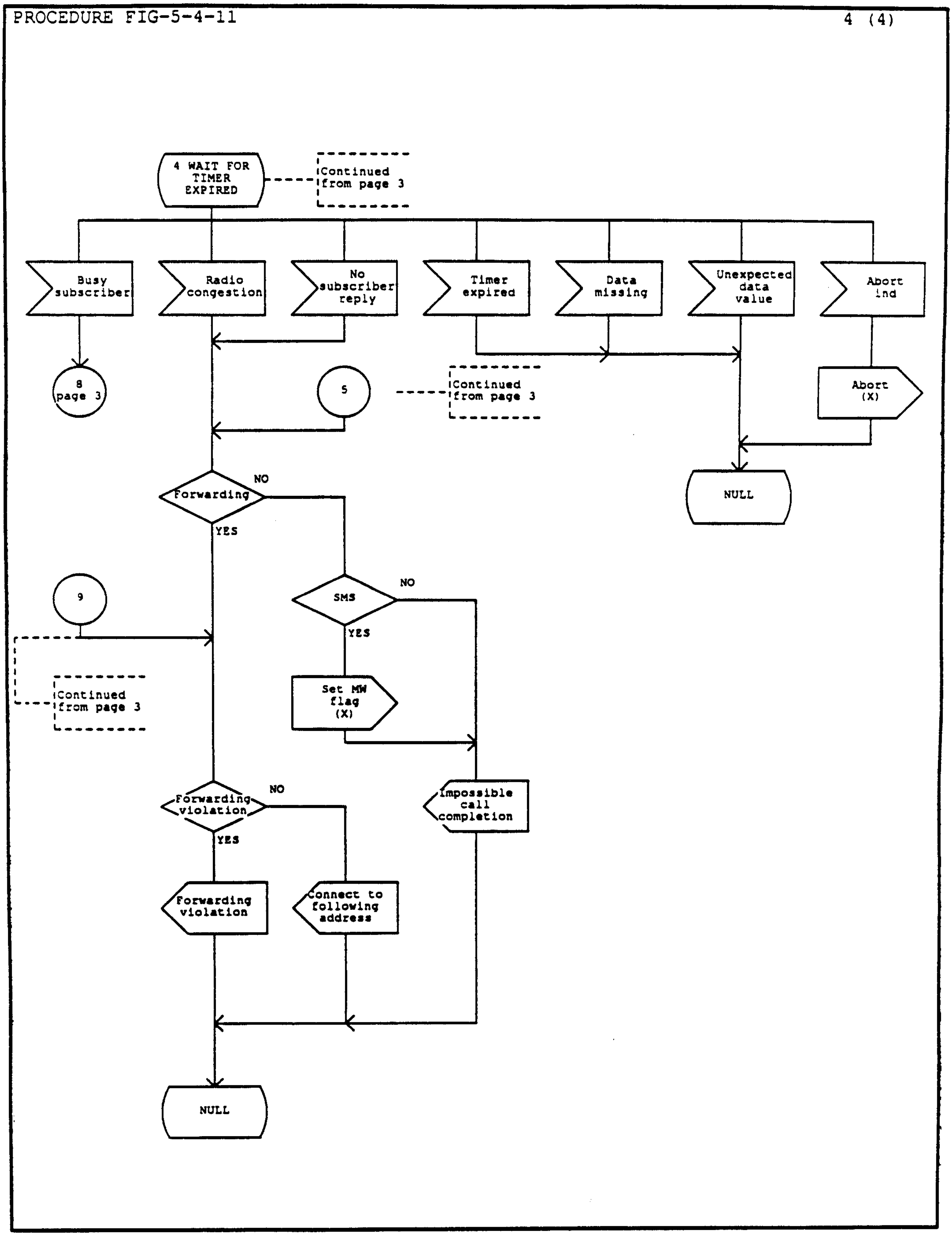


Figure 5.4.12 (Sheet 1 of 3)
ASE/TCAP interface procedure in VLR for retrieval of call data for MS terminating calls.

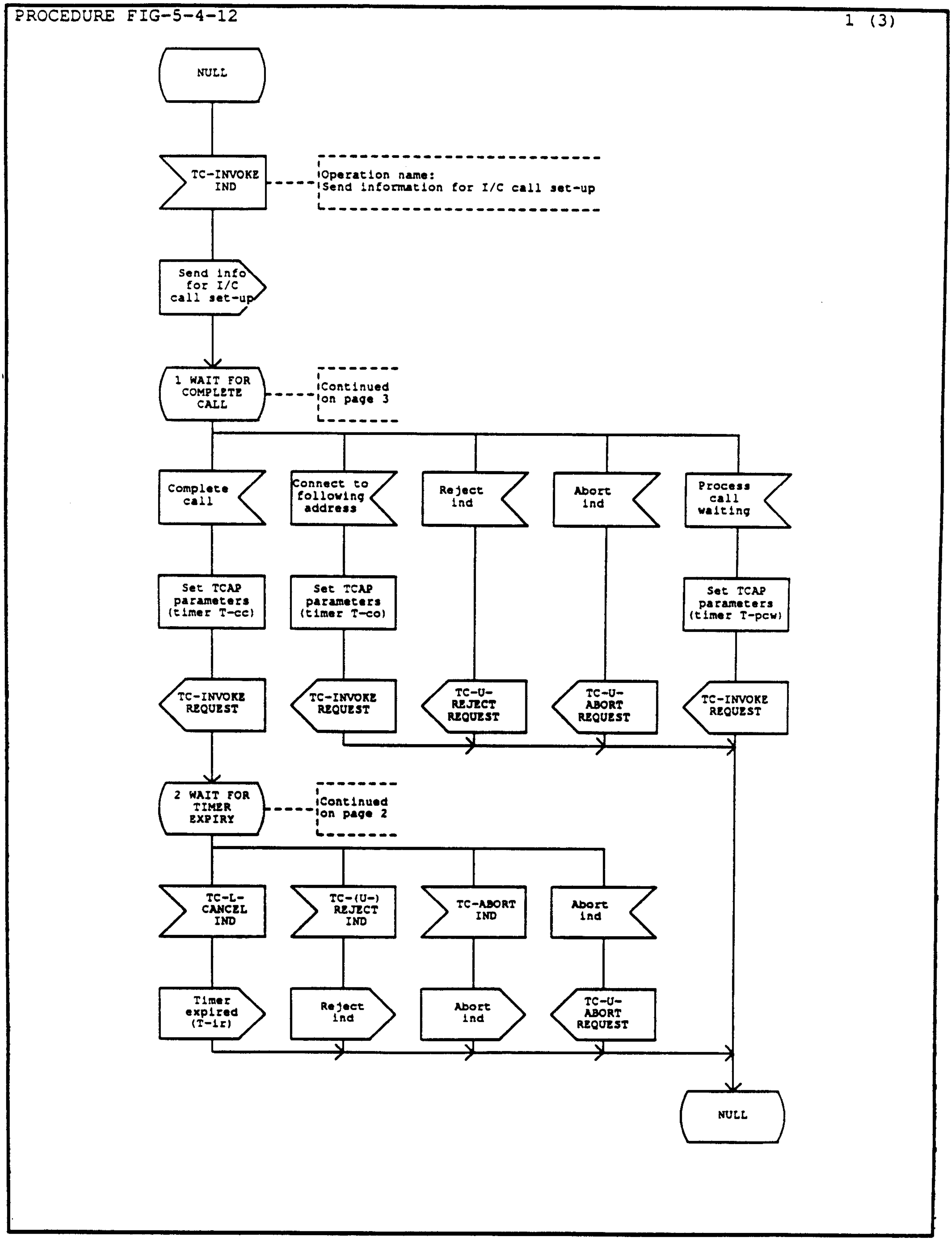


Figure 5.4.12 (Sheet 2 of 3)
ASE/TCAP interface procedure in VLR for retrieval of call data for MS terminating calls.

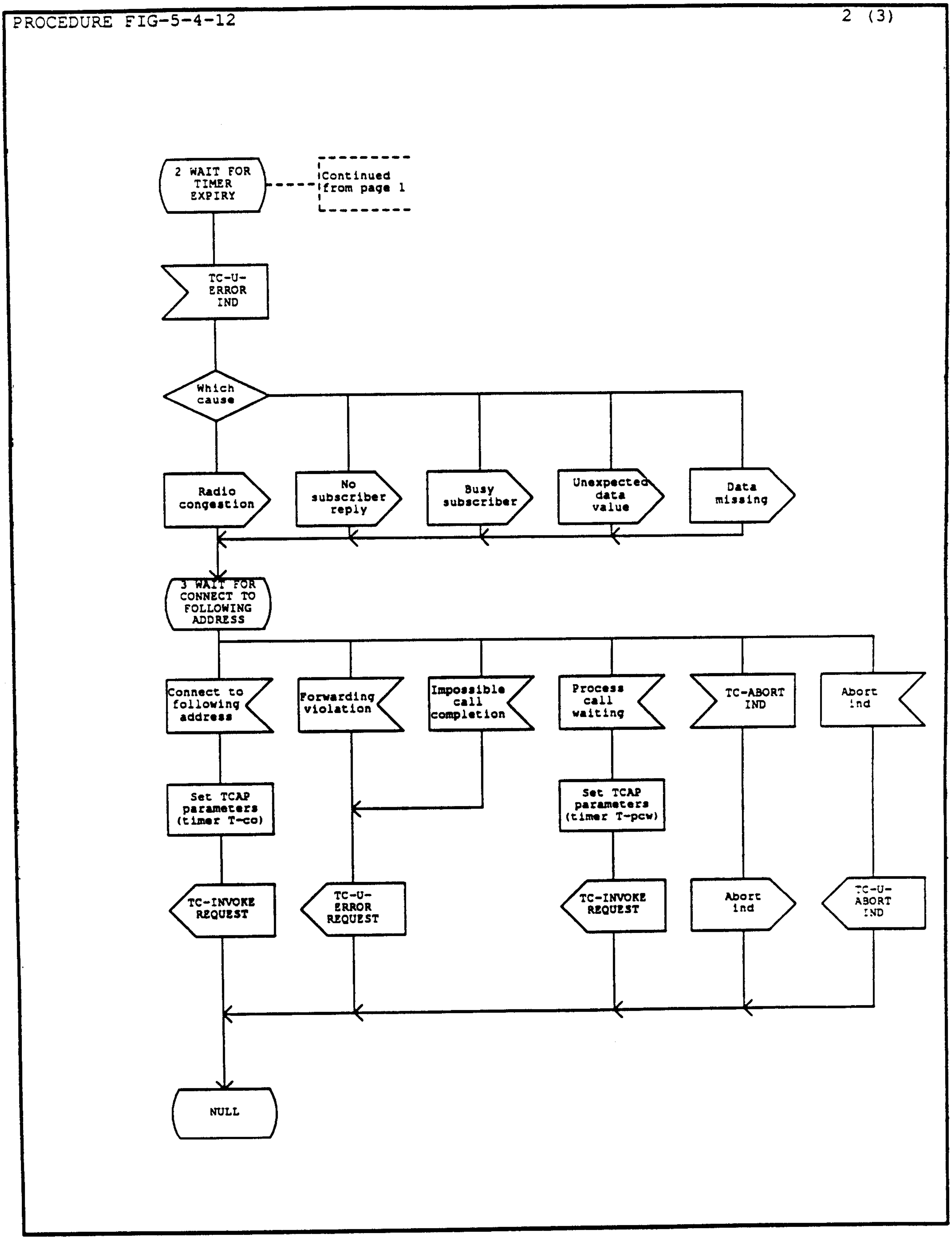


Figure 5.4.12 (Sheet 3 of 3)
ASE/TCAP interface procedure in VLR for retrieval of call data for MS terminating calls.

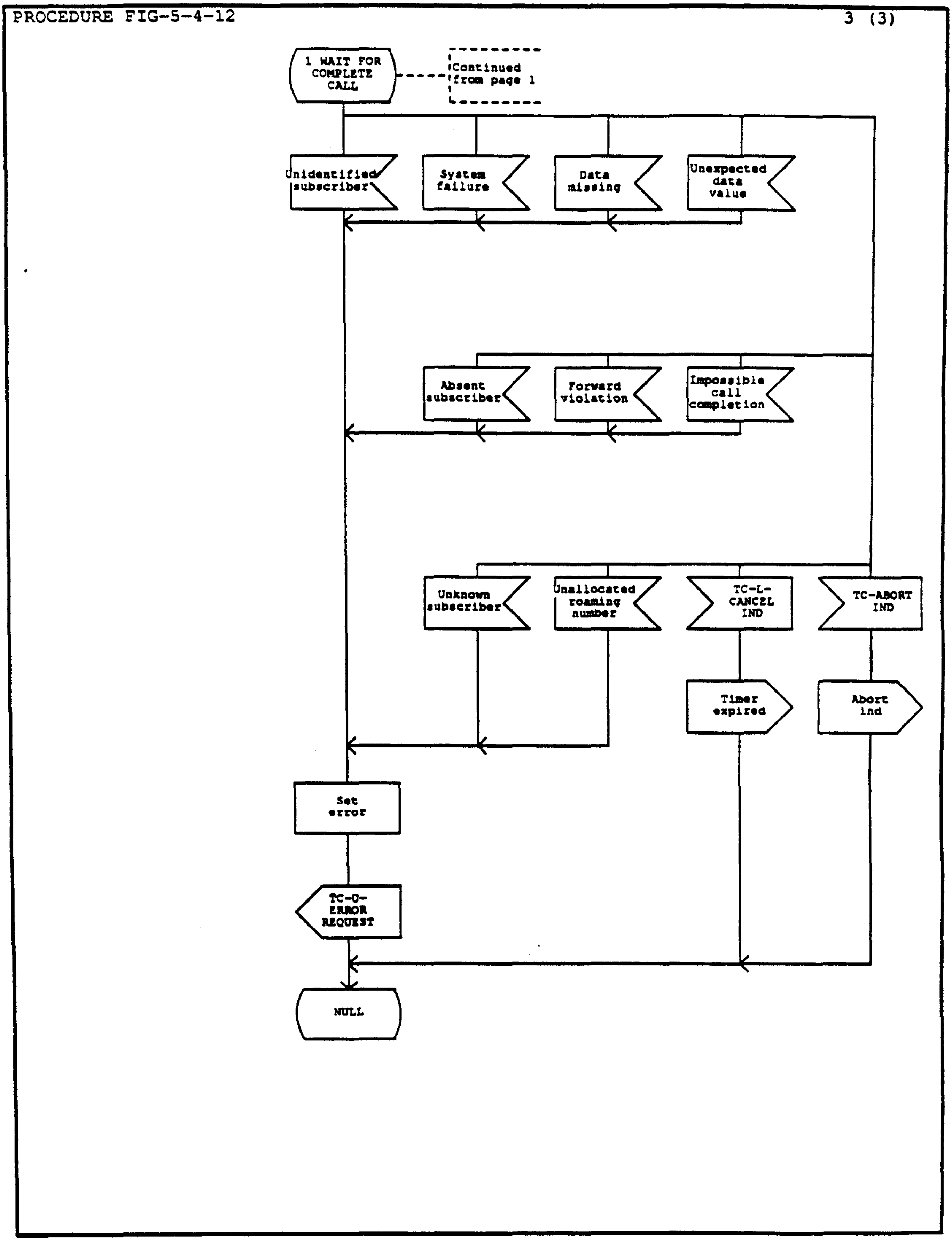


Figure 5.4.13 (Sheet 1 of 3)
Application specific procedure in VLR for retrieval of call data for MS originated calls.

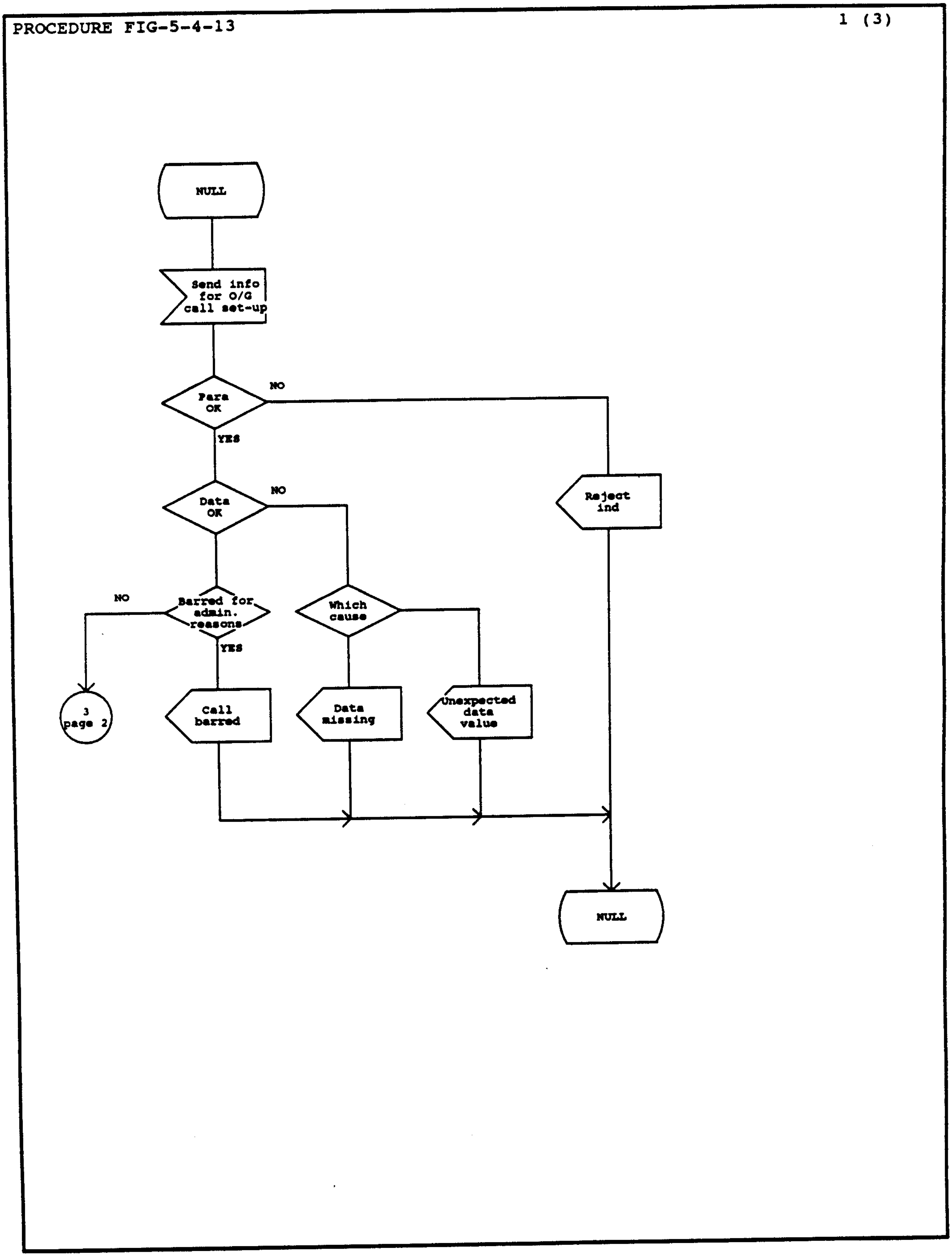


Figure 5.4.13 (Sheet 2 of 3)
Application specific procedure in VLR for retrieval of call data for MS originated calls.

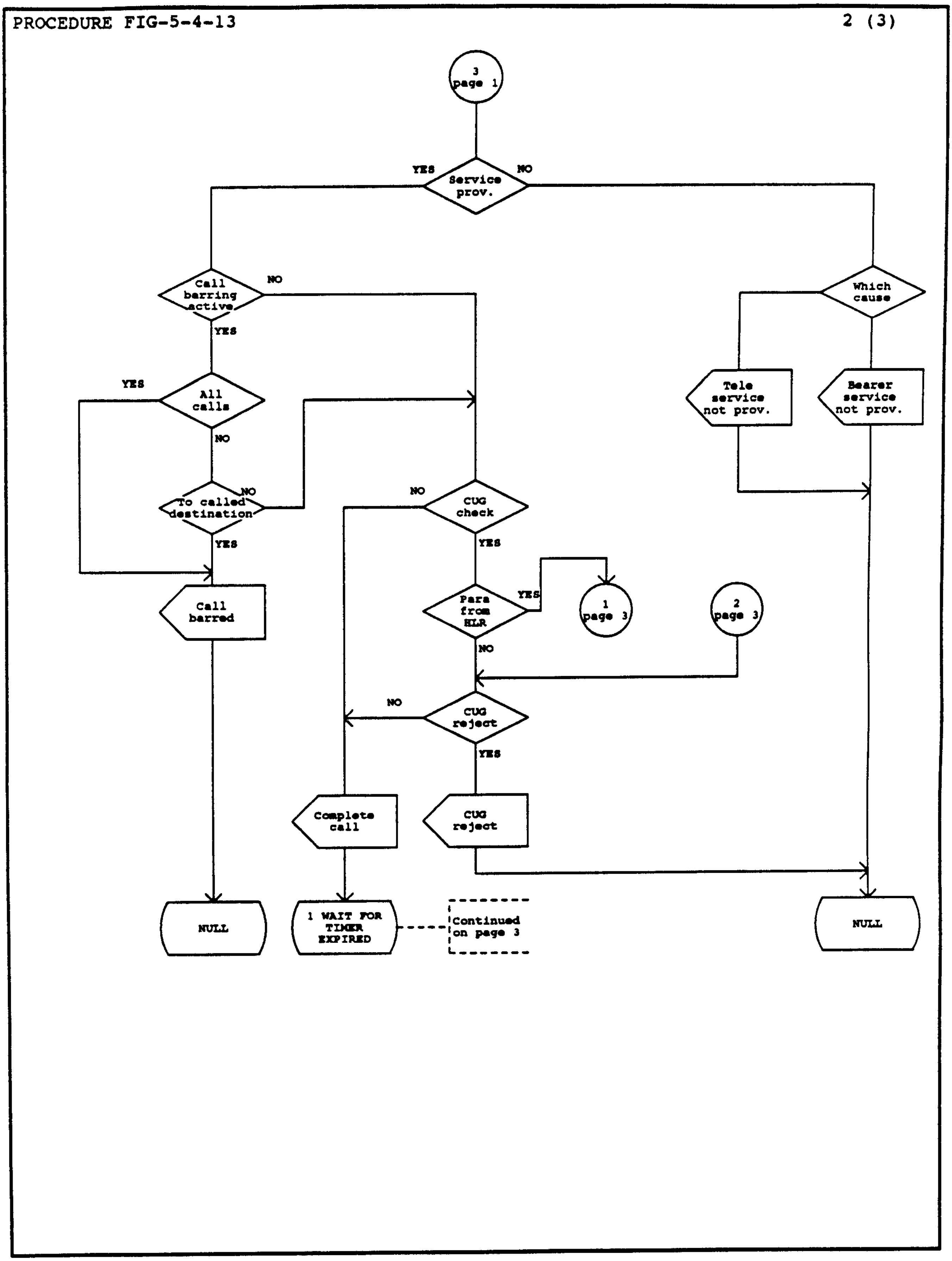


Figure 5.4.13 (Sheet 3 of 3)
Application specific procedure in VLR for retrieval of call data for MS originated calls.

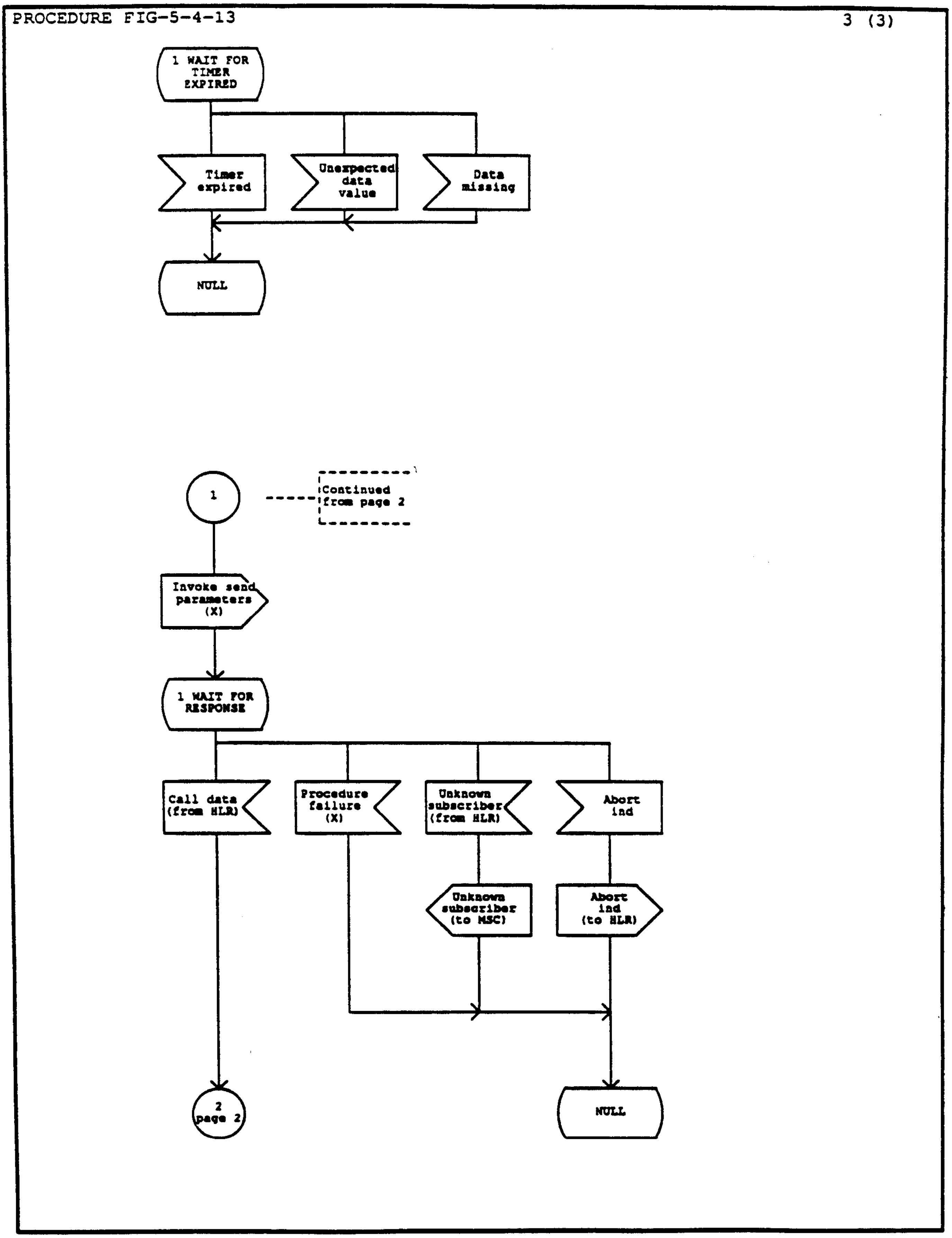


Figure 5.4.14 (Sheet 1 of 2)
ASE/TCAP interface procedure in VLR for retrieval of call data for MS originated calls.

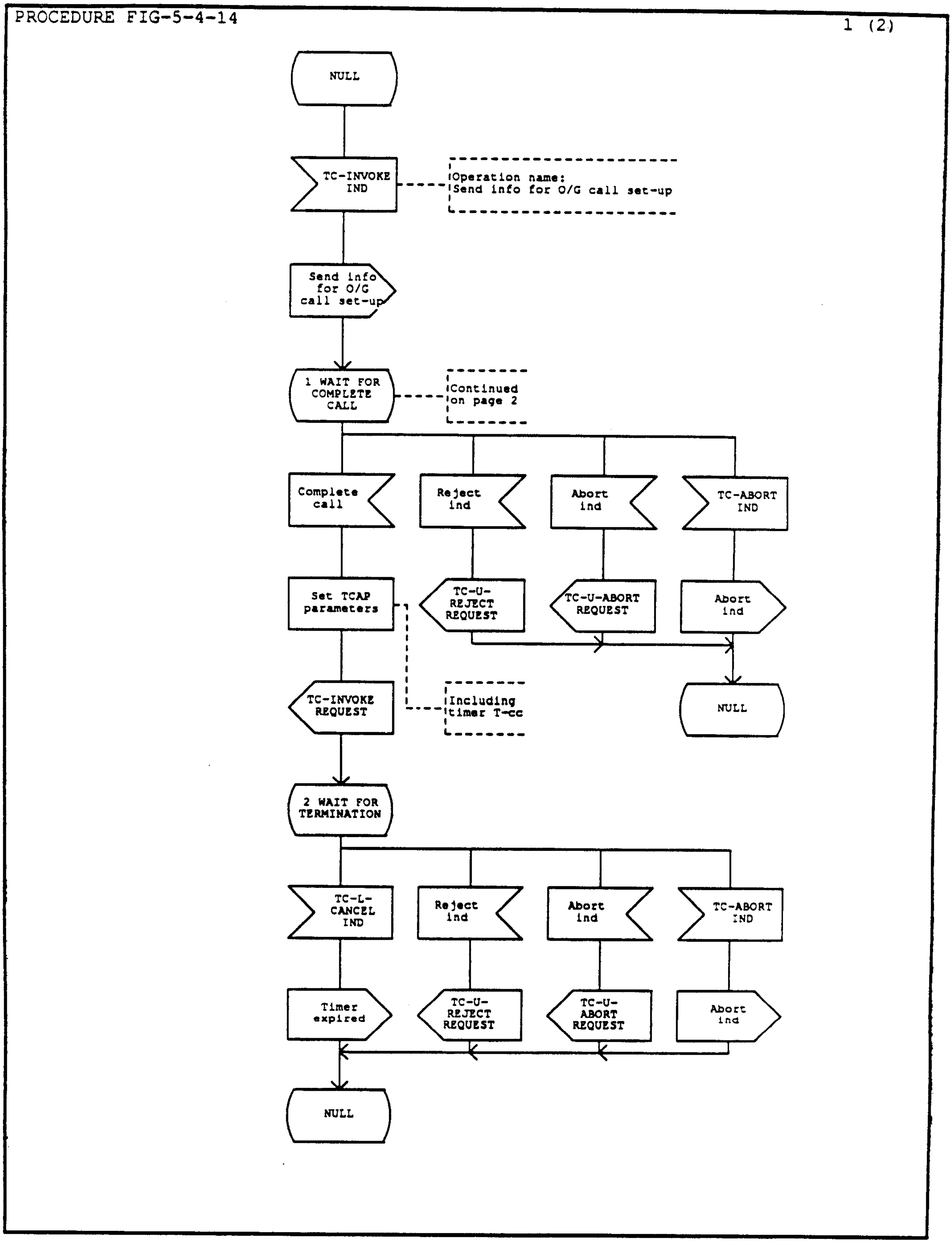
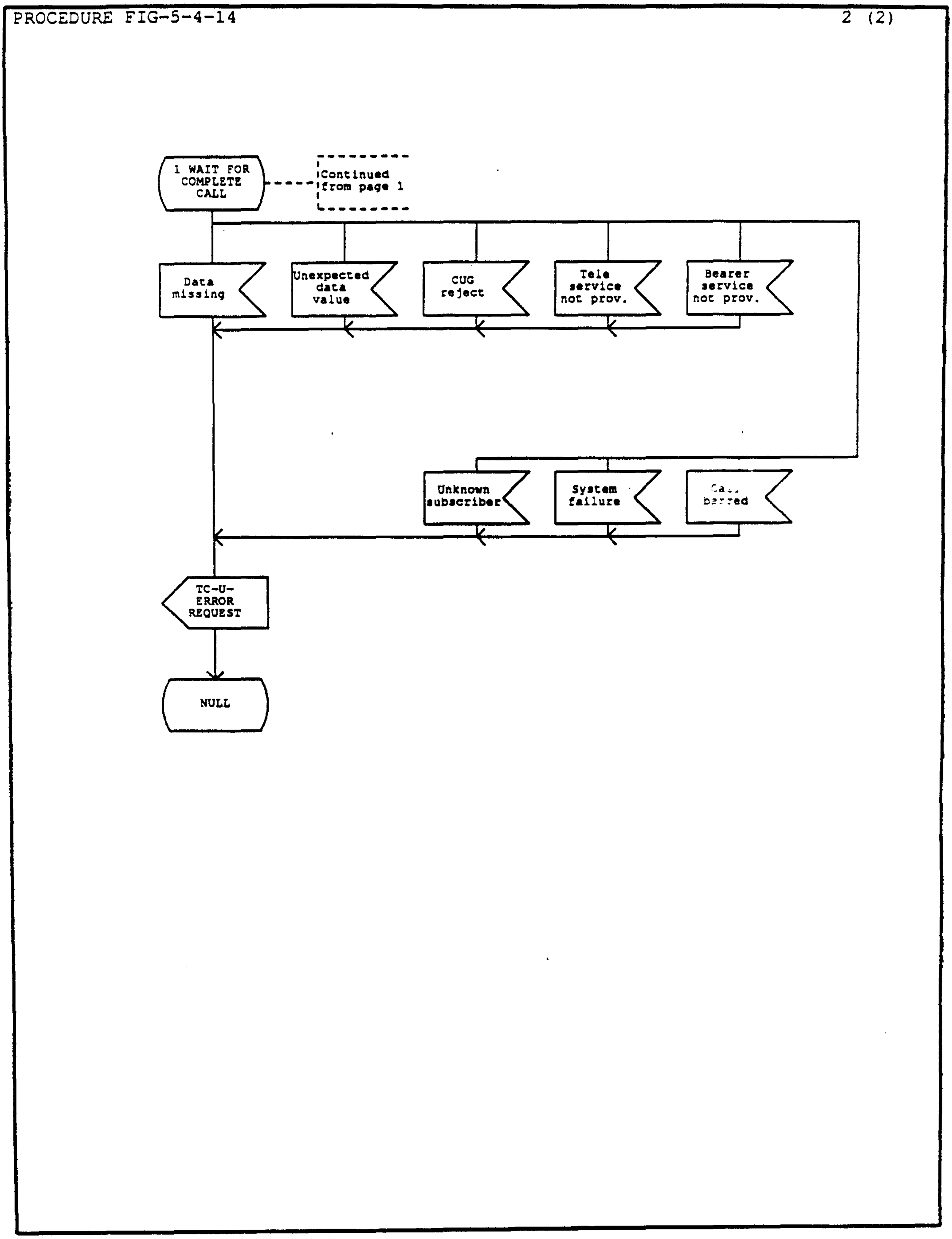


Figure 5.4.14 (Sheet 2 of 2)
ASE/TCAP interface procedure in VLR for retrieval of call data for MS originated calls.



5.4.3.2.3 Roaming number provision

The application specific procedure is contained in Figure 5.4.15, and the ASE/TCAP interface procedure is contained in Figure 5.4.16.

At reception of the provide roaming number message from the HLR, the VLR checks whether or not the IMSI of the mobile station is known in the VLR. If the IMSI is not known, the send parameters message (see section 5.6.1) is sent to the HLR in order to obtain subscriber parameters. The response to this message can be either of the following:

- a call data acknowledge message containing the required information. The VLR associates the MSRN with a service indication if such an indication was contained in the provide roaming number message;
- a reject indication or a negative result. In these cases a system failure message is returned in response to the provide roaming number message.

NOTE: A new transaction is opened for the Send Parameters operation.

If the call data acknowledge message was received, the MS is inserted in the VLR with the radio confirmation indicator set to false. A location updating procedure is later on (preferably after page response) performed with the HLR in order to provide the HLR with either an MSC address or an MSRN. The procedure then proceeds as if the MS would have been known to the VLR at reception of the provide roaming number message.

Alternatively the procedure for retrieving data from the HLR may in the VLR be performed after having provided an MSRN to the HLR, i e in parallel with the call set-up.

If the MS is known in the VLR when receiving the provide roaming number message, the VLR checks the IMSI detached flag for the MS. If the IMSI detached flag is set, the absent subscriber message is returned to the HLR if call forwarding on mobile subscriber not registered shall be performed by the HPLMN.

If the IMSI detached flag was not set or call forwarding on mobile subscriber not registered shall be performed by VPLMN, a roaming number corresponding to the servicing MSC is allocated by the VLR, and the roaming number message is sent to the HLR. The VLR associates the MSRN with a service indication if such an indication was contained in the provide roaming number message. Timer TI is also started. The roaming number will be used to set-up the call to the servicing MSC.

When the send information for I/C call set-up message is received in the VLR, the roaming number allocated for the call will be idle marked in the VLR. If timer TI expires, the roaming number is blocked for some time, in order to ensure that it will not be used as a reference for the wrong call.

Note: Timer TI is not a TCAP timer but an application timer which limits the time of validity of the MSRN. See also Recommendation GSM 03.08.

If no idle roaming number is available in the VLR, the no roaming number available message is sent to the HLR. If the provide roaming number message contains a request for a service that is not supported in the VPLMN, the facility not supported message is returned.

If the message contains parameter or data errors, the HLR ignores the message and returns a reject indication or one of the messages data missing or unexpected data value depending on the nature of the error.

The provide roaming number message is received in a TC-INVOKE-INDICATION primitive. The outcome of the procedure is reported to the HLR as follows:

- the roaming number message is sent in a TC-RESULT-L REQUEST primitive;
- procedure errors are reported in a TC-U-REJECT REQUEST primitive;
- negative results are sent in a TC-U-ERROR REQUEST primitive as follows:

  i) absent subscriber;
  ii) no roaming number available;
  iii) system failure;
  iv) data missing;
  v) unexpected data value;
  vi) facility not supported.

Figure 5.4.15 (Sheet 1 of 2)
Application specific procedure in VLR for roaming number enquiry.

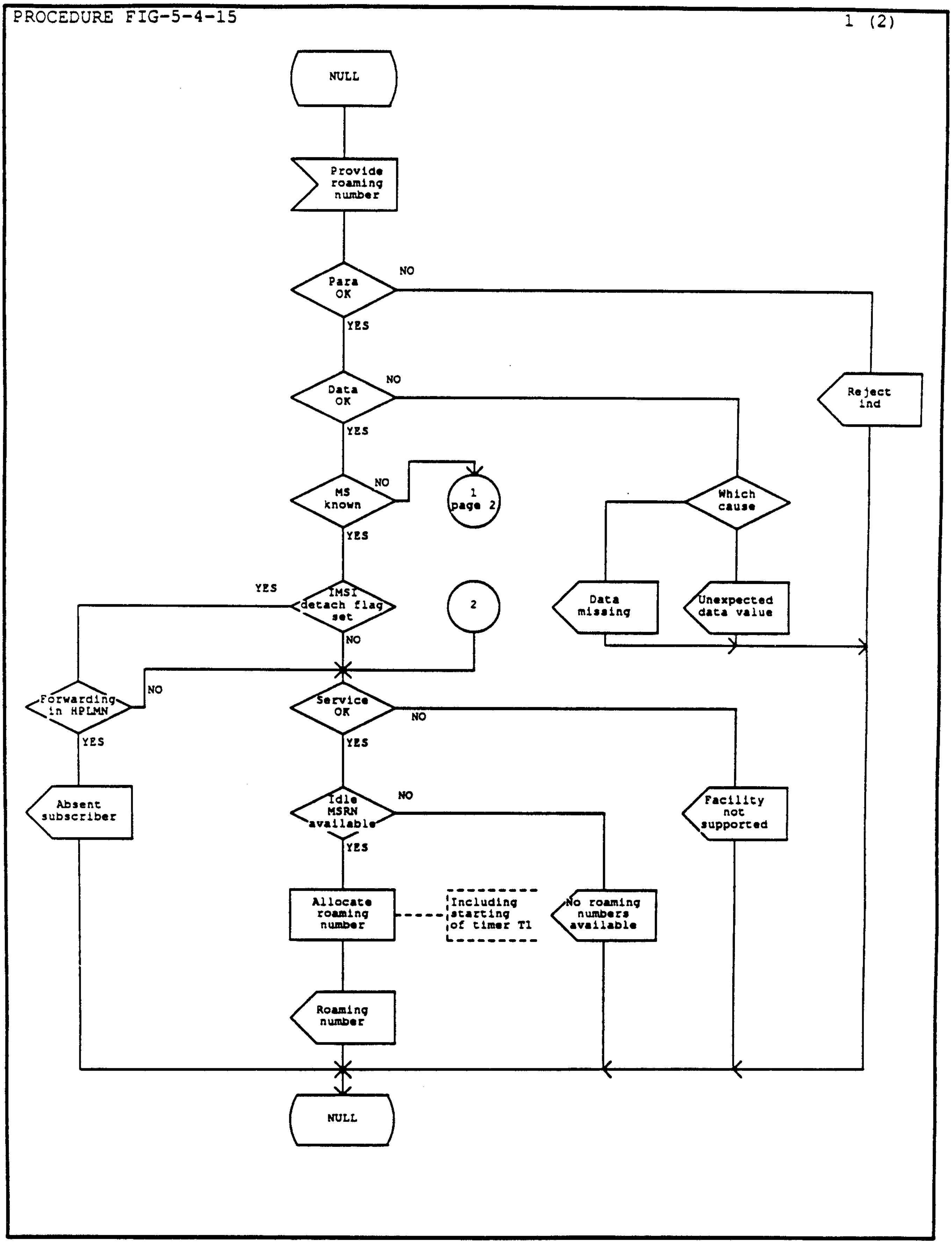


Figure 5.4.15 (Sheet 2 of 2)
Application specific procedure in VLR for roaming number enquiry.

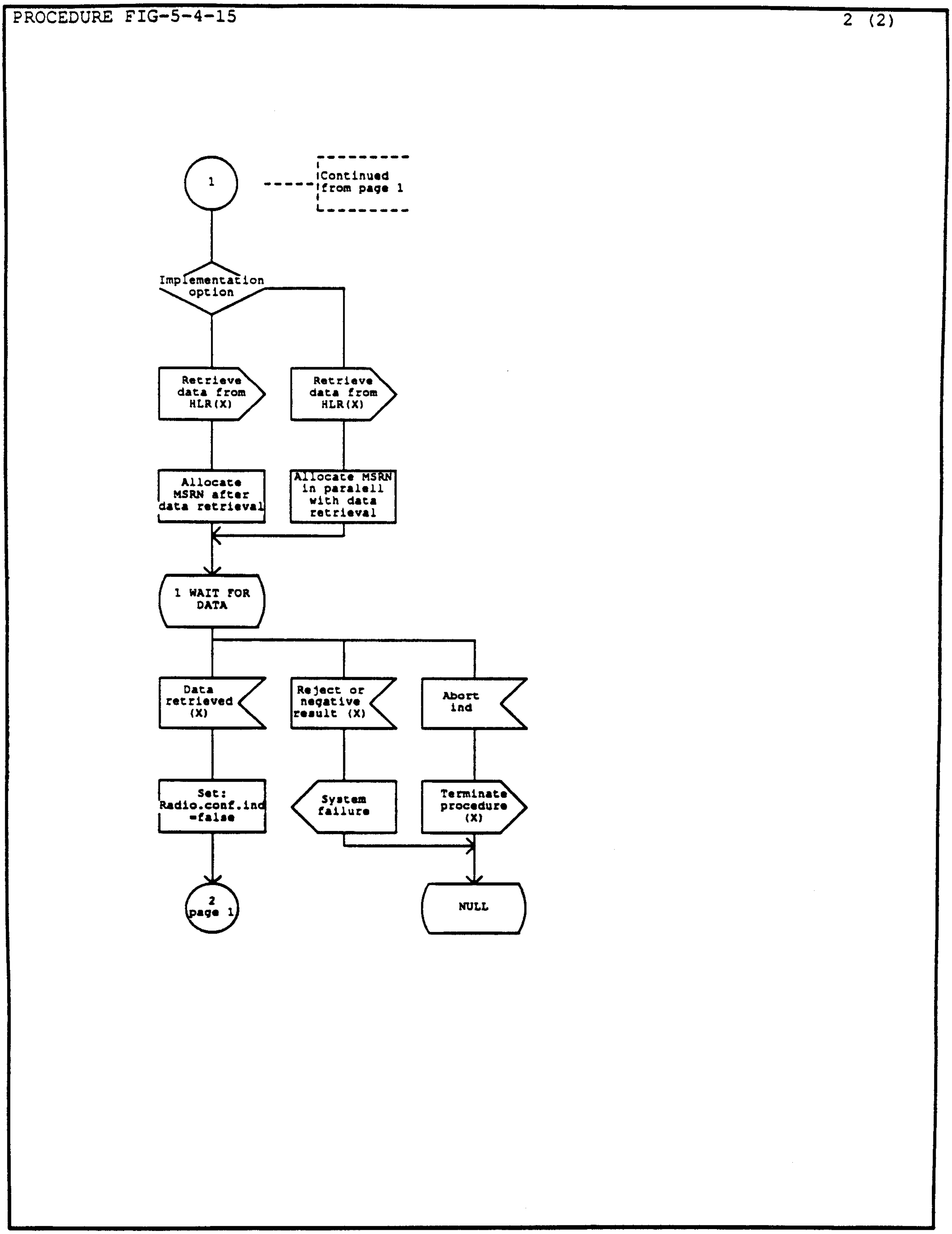
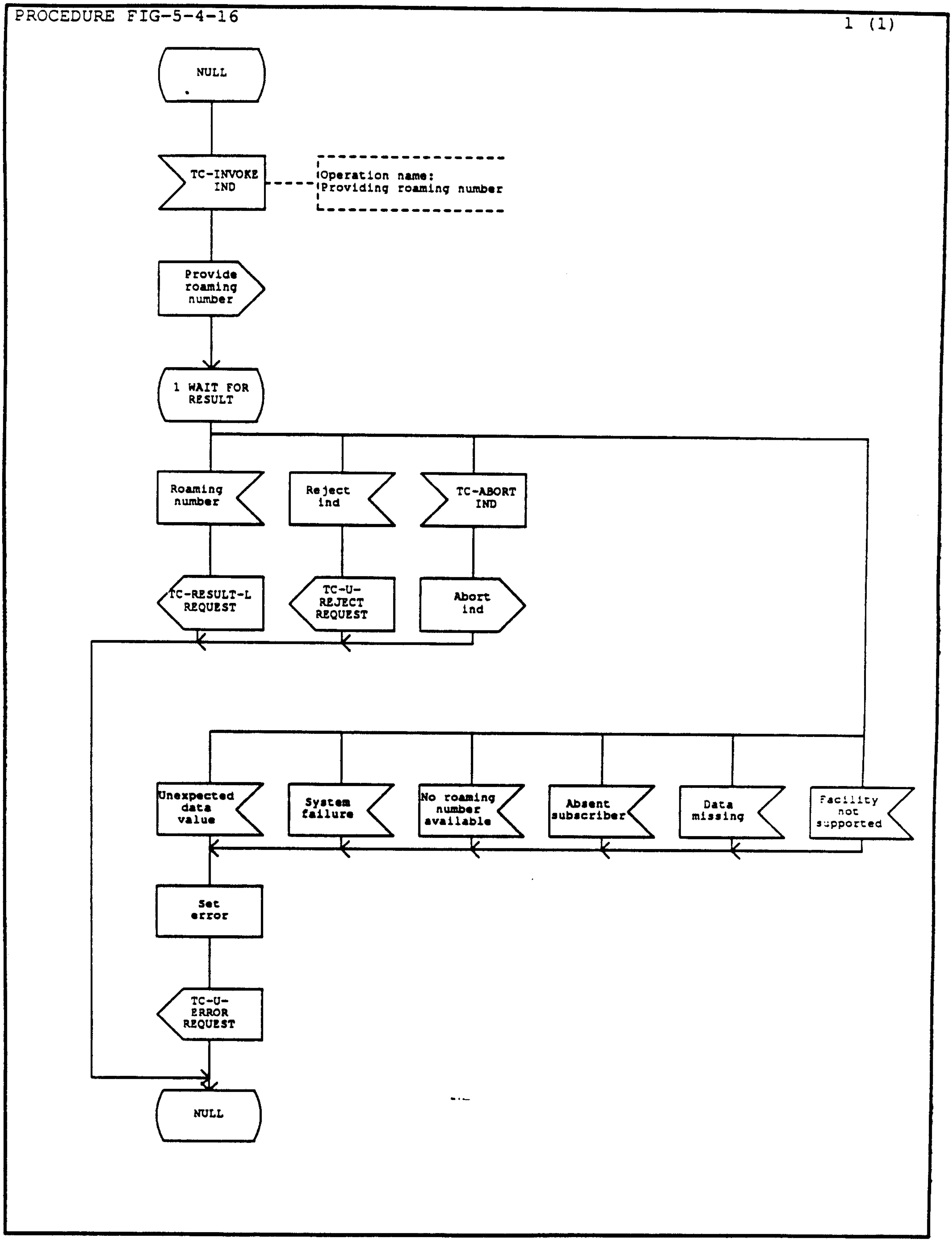


Figure 5.4.16
ASE/TCAP interface procedure in VLR for roaming number enquiry.



5.4.3.3 Procedures in the HLR

5.4.3.3.1 Procedure for retrieval of routing information

The application specific procedure is contained in Figure 5.4.17 and the HLR/MSC ASE/TCAP interface procedure is contained in Figure 5.4.18. The HLR/VLR ASE/TCAP interface procedure is contained in Figure 5.4.19.

When receiving a send routing information message, the HLR will act as follows:

- if the MS is unknown (i e the directory number is not allocated), the unknown subscriber message is returned;
- if the MS is barred for administrative reasons the call barred message is returned;
- if the HLR performs a service subscription check and the call does not pass the check, either the bearer service not provisioned or teleservice not provisioned message is returned;
- if the MS has the unconditional call forwarding service activated and there is no forwarding violation, the forwarded-to-number is returned in a routing information acknowledge message;
- if the MS is deregistered or the roaming not allowed indicator is set and the forwarding on subscriber not reachable service is not active, the absent subscriber message is returned. If the call forwarding on subscriber not reachable service is active and there is no forwarding violation, the forwarded-to-number is returned in a routing information acknowledge message;
- if there is any supplementary service restriction, this will be reported as follows: if the MS belongs to a CUG without incoming access and the call does not pass the CUG check, the CUG reject message is returned; if the MS has the incoming call barred service, the call barred message is returned; if a call forwarding service has been activated by the MS and the incoming call has already been forwarded as many times as are allowed, a forwarding violation message is returned.
- if the message contains parameter or data errors, the HLR ignores the message and returns a reject indication or one of the messages data missing or unexpected data value depending on the nature of the error.

If none of the above cases apply and the MSRN is allocated by the VLR at location updating, the incoming call is a speech or an ISDN call and neither VLR nor HLR has initiated the restoration procedure involving the called mobile subscriber, then the MSRN stored in the HLR may be used for further call routing. In that case, respective routing information ack is returned.

If the MSRN has to be allocated on a per terminating call basis, i e the MSRN has not been provided to the HLR at location updating, or the HLR cannot use a stored MSRN for operational reasons, or the call is non-speech or non-ISDN, or the VLR or HLR has initiated the restoration procedure, then the HLR requests the current VLR to provide a roaming number which shall be used for further call routing. The request is sent in a provide roaming number message. The response from the VLR can be as follows:

- a roaming number is received in the roaming number message. If the message does not contain parameter errors, the routing information acknowledge message is sent to the GMSC;

- if the roaming number message contains parameter errors, the system failure message is sent to the GMSC and a reject message is returned to the VLR;

- if an absent subscriber message is received and the subscriber has the call forwarding on subscriber not reachable service activated, and forwarding violation does not apply, a forwarded-to-number is returned to the GMSC in a routing information acknowledge message. If the call forwarding on subscriber not reachable service is not activated, the absent subscriber message is sent to the MSC. In case of forwarding violation, the forwarding violation message is sent to the GMSC.

- if a facility not supported message is received, the same message is sent to the GMSC;

- if the no roaming number available message is received, the system failure message is then sent to the GMSC;

- if the unexpected data value or the data missing message is received, the system failure message is sent to the GMSC;

- if there is a timer expiry or a rejection of the message, or if the transaction with the VLR is aborted, the system failure message is sent to the GMSC.

- if a system failure is received, the same message is sent to the GMSC.

At the HLR/GMSC interface the send routing information message is contained in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the routing information acknowledge message is sent in a TC-RESULT-L REQUEST primitive;

- a reject indication is reported in a TC-U-REJECT REQUEST primitive;

- negative results are reported in a TC-U-ERROR REQUEST primitive as follows:

  i) unknown subscriber;
  ii) absent subscriber;
  iii) call barred;
  iv) CUG reject;
  v) forwarding violation;
  vi) system failure;
  vii) bearer service not provisioned;
  viii) teleservice not provisioned;
  ix) facility not supported;
  x) data missing;
  xi) unexpected data value.

At the HLR/VLR interface the provide roaming number message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-prn. The outcome of the procedure could be as follows:

- the roaming number message is contained in a TC-RESULT-L INDICATION primitive;

- procedure failure is indicated in a TC-U-REJECT INDICATION primitive;

- expiry of timer T-prn is reported in a TC-L-CANCEL INDICATION primitive.

- negative results are reported in a TC-U-ERROR INDICATION primitive as follows:

  i) absent subscriber;
  ii) no roaming number available;
  iii) system failure;
  iv) data missing;
  v) unexpected data value;
  vi) facility not supported.

Figure 5.4.17 (Sheet 1 of 3) Application specific procedure in HLR for retrieval of routing information.

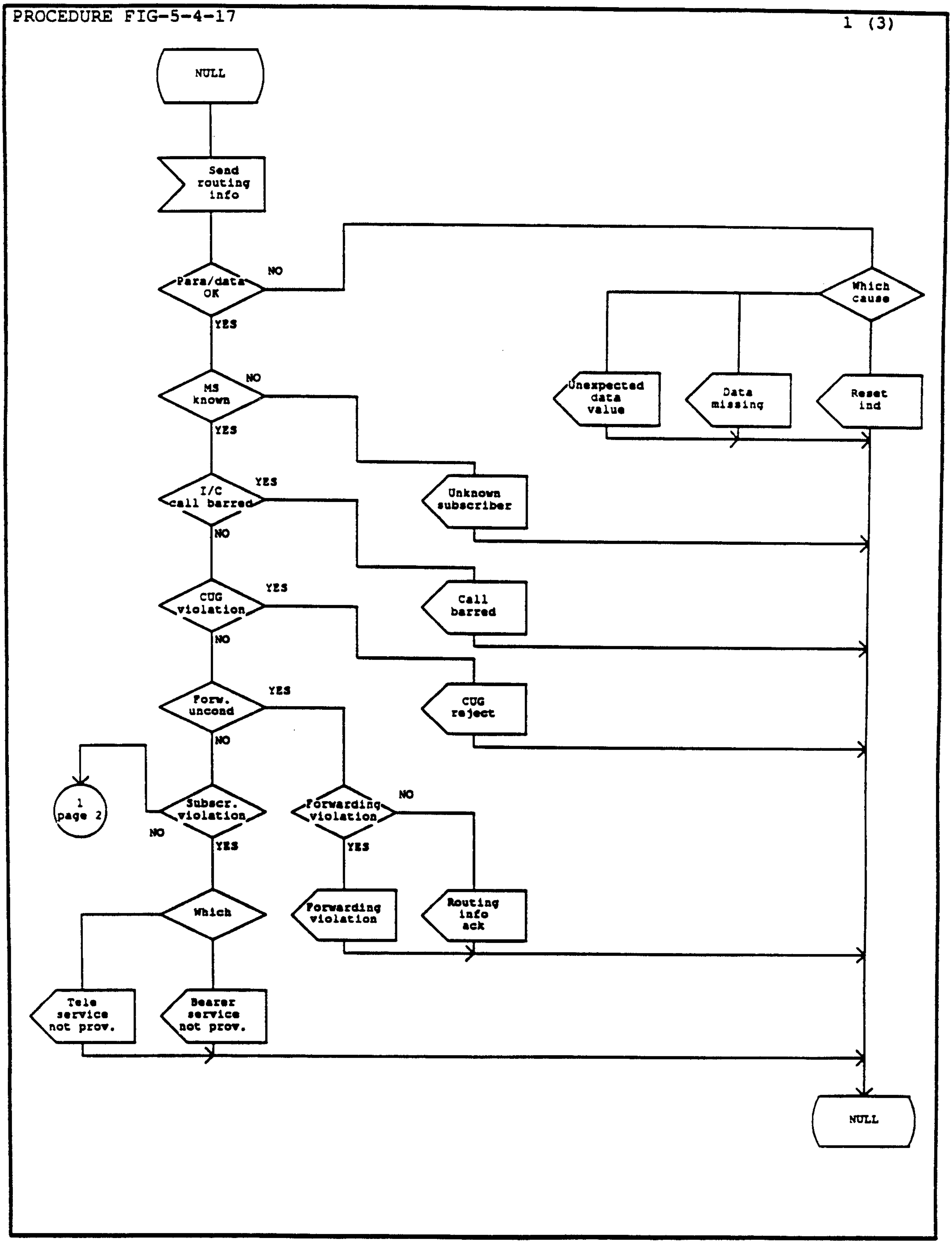


Figure 5.4.17 (Sheet 2 of 3) Application specific procedure in HLR for retrieval of routing information.

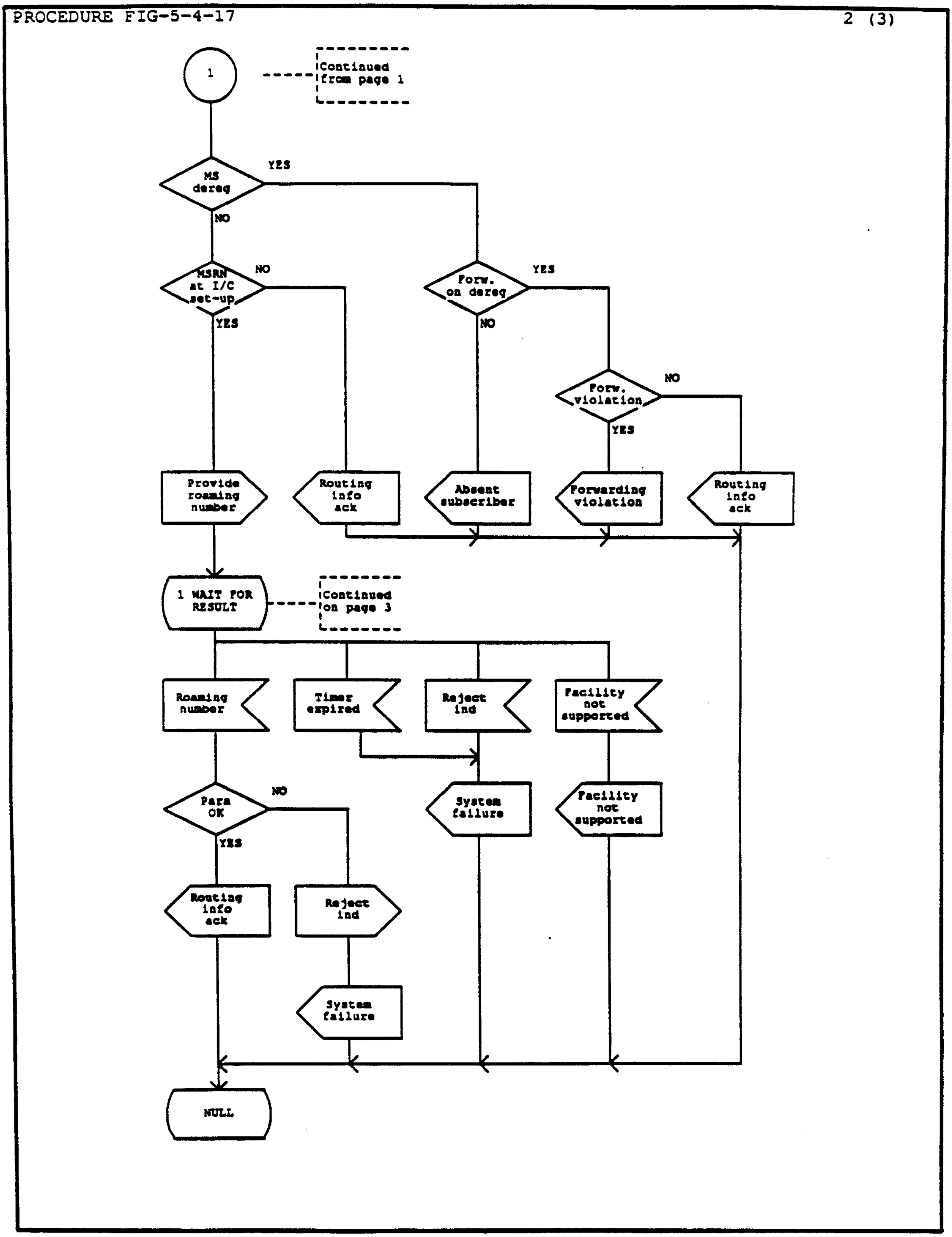


Figure 5.4.17 (Sheet 3 of 3) Application specific procedure in HLR for retrieval of routing information.

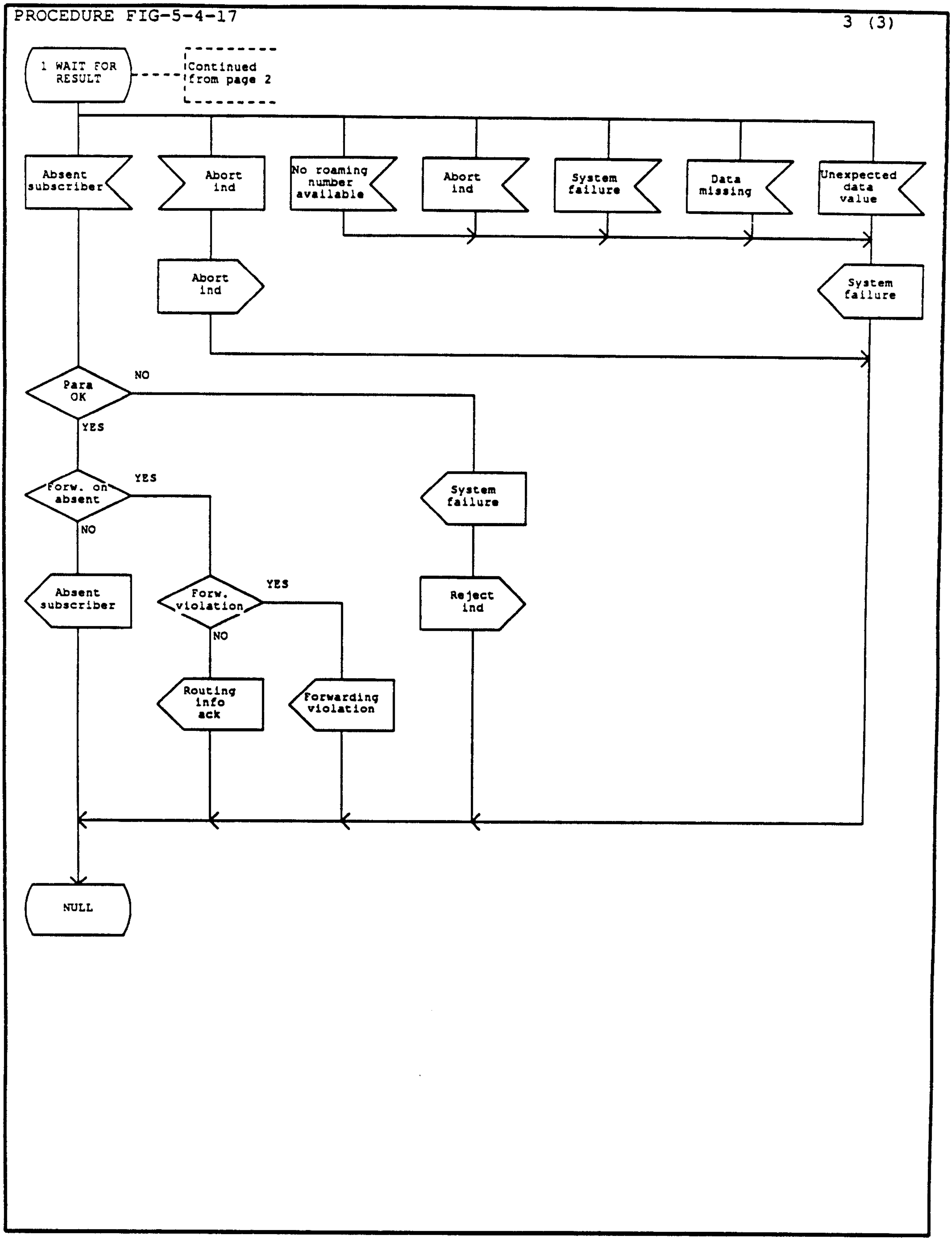


Figure 5.4.18 ASE/TCAP interface procedure in HLR for retrieval of routing information.

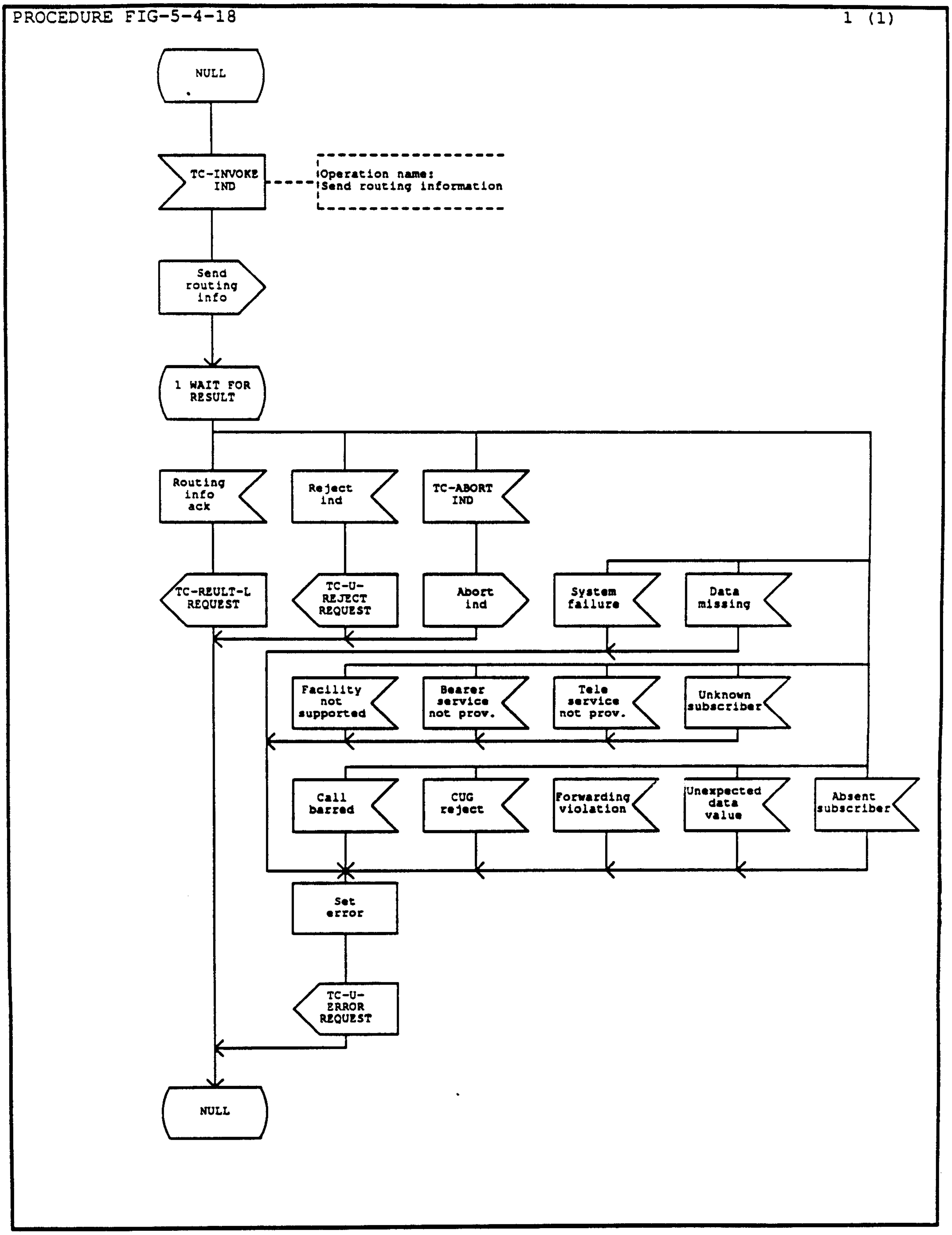
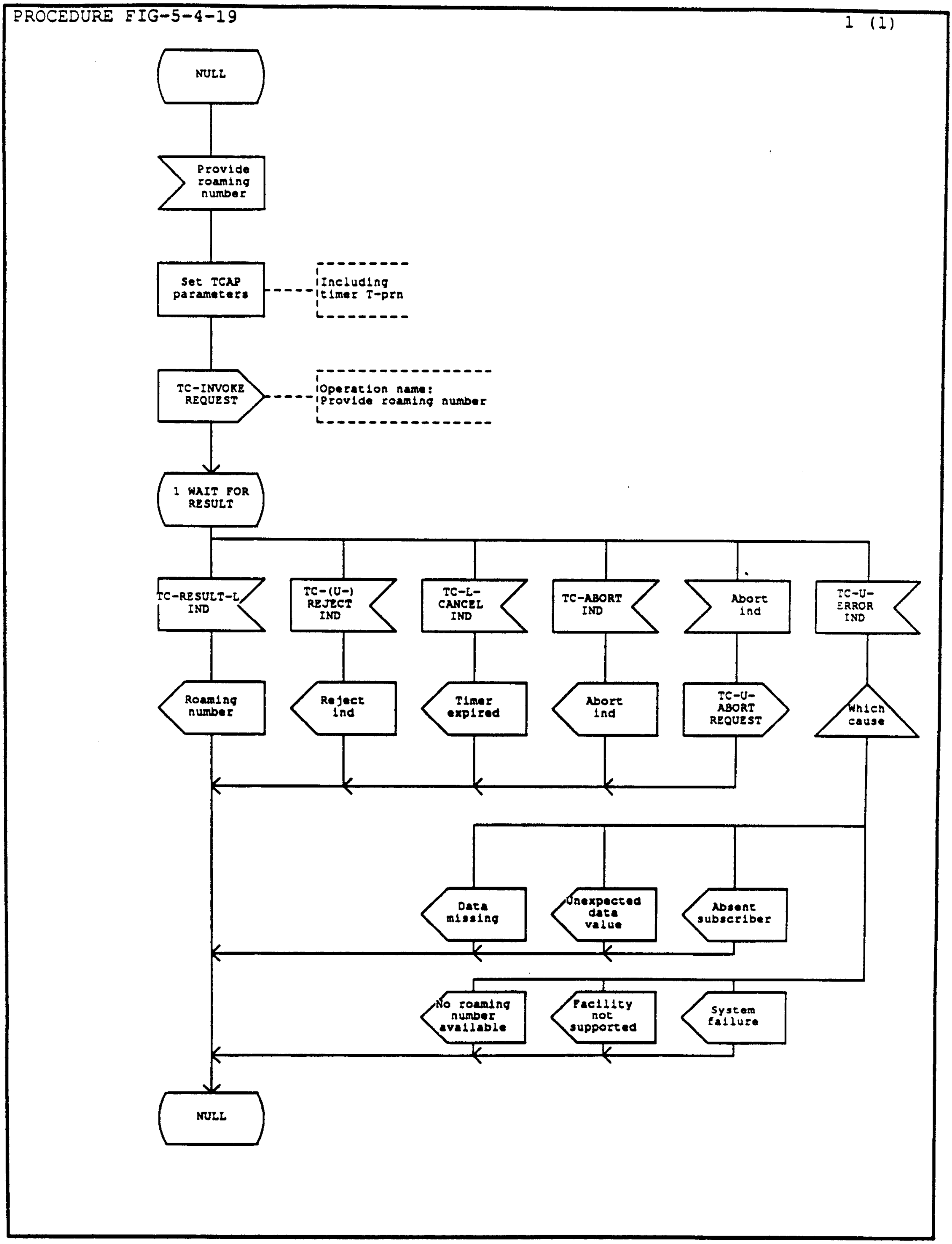


Figure 5.4.19 ASE/TCAP HLR/VLR interface procedure in HLR for retrieval of routing information.



5.5 Handover

5.5.1 Definition of interfaces

Figure 5.5.1 shows the interfaces involved for handover of calls between MSCs. MSC-A is the MSC on which the call was originally established. This MSC is also referred to as the controlling MSC. MSC-B (or MSC-B') is the MSC to which the call is handed over.

Three cases need to be considered

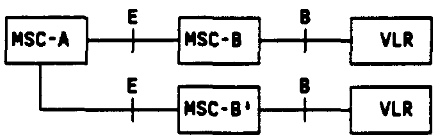
i) handover from MSC-A to MSC-B

ii) subsequent handover from MSC-B to MSC-A

iii) subsequent handover from MSC-B to MSC-B'. After completion of this handover, the connection to MSC-B will be released and MSC-B' will be regarded as the new MSC-B.

These procedures will allow for any sequence of handovers between MSCs.

a) Basic handover procedure MSC-A to MSC-B and subsequent handover procedure MSC-B to MSC-A.



b) Subsequent handover procedure MSC-B to MSC-B'.

Figure 5.5.1 Interface structure for handover

5.5.2 General overview of procedures

5.5.2.1 List of procedures

The following procedures in MAP may be required in order to support all functions associated with handover:

i) basic handover procedure for handover from MSC-A to MSC-B

ii) subsequent handover procedure between MSC-B and MSC-A for handover from MSC-B to MSC-A or from MSC-B to MSC-B'

iii) procedure for forwarding access signalling to the MS

iv) procedure for receiving access signalling from the MS

v) procedure for obtaining handover number.

The detailed procedures for handover are contained in Recommendation GSM 03.09. The description and specification are based on a functional composition of the signalling and call control subsystem of an MSC as shown in Figure 5.5.2.

A more detailed functional composition of MSCs is given in Recommendation GSM 03.09.

The modules are:

Module 1) represents the signalling interface between the MSC and the MS and the BS;

Module 2) represents the signalling interface towards the fixed network;

Module 3) represents the handover control mechanisms in the MSC;

Module 4) represents the MAP interface to other MSCs and to the VLR.

Below only the procedures of functional module 4) are specified. In the SDL diagrams below interworking with other modules are indicated by an <X> following the message name.

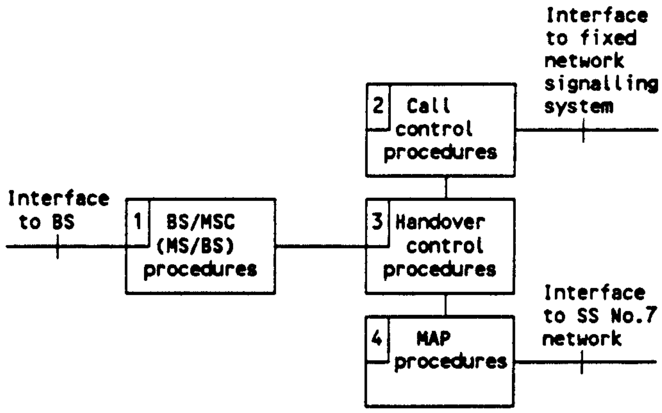


Figure 5.5.2 Functional composition of signalling functions for supporting handover.

5.5.2.2 Basic handover procedure and procedure for requesting handover number

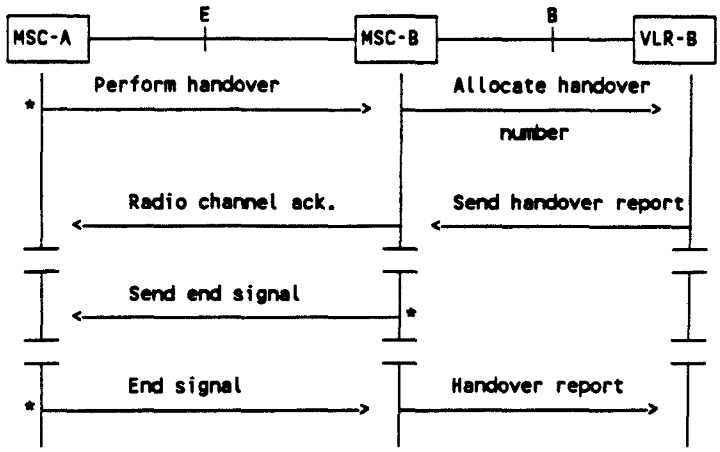
Figure 5.5.3 shows the MAP procedures for successful basic handover from the controlling MSC (MSC-A) to MSC-B. In the Figure only messages in MAP are shown. Messages which are generated by an internal event in the MSC are indicated by an asterisk (*).

The procedure is as follows:

When MSC-A has decided that a call is to be handed over to MSC-B, it sends the message perform handover to MSC-B. This message will contain all information required by MSC-B to allocate a radio channel (e g base station identification, IMSI, and other information related to the call or the radio path). If handover can be performed (i e a radio channel can be assigned within a specified time), MSC-B requests its associated VLR to provide a handover number which can be used for establishing the connection between MSC-A and MSC-B. The interaction with the VLR is done by exchange of the messages allocate handover number and send handover report. MSC-B will return the radio channel acknowledge message to MSC-A when a new radio channel is assigned. The message will contain the new radio channel number, the handover number and other information as specified in section 6. If there is no free radio channel a no traffic channel available indication is given; the handover procedure is then terminated and MSC-A maintains the existing connection with the MS.

If a radio channel has been reserved in MSC-B, MSC-A initiates the establishment of a connection between MSC-A and MSC-B through the fixed network as described in

Recommendation GSM 03.09. The set-up of the radio path then commences as defined in Recommendations GSM 03.09 and 04.08.



*) indicates that the signal is sent as a result of another event in the MSC

Figure 5.5.3 Basic handover procedure; successful handover in MSC-B'.

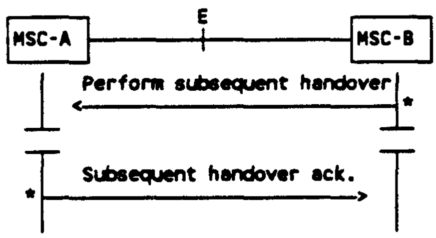
When the radio path has been established on MSC-B, MSC-B indicates this event to MSC-A by sending the send end signal message. MSC-A will then retain the main control of the call until the call clears. When the call is released, MSC-A will inform MSC-B by sending the end signal message.

Note: In order to support the call waiting service, the call clearing instant corresponds to the instant when the last waiting call has been cleared.

When receiving the end signal message, MSC-B sends the handover report message (requesting removal of the handover number) to its associated VLR.

MSC-A may abort the handover procedure at any time (e g if the call clears).

5.5.2.3 Subsequent handover procedure



*) indicates that the signal is sent as a result of another event in the MSC

Figure 5.5.4 Successful subsequent handover.

The procedure is shown in Figure 5.5.4 and is as follows:

When MSC-B decides that the call is to be handed back to MSC-A or to a third MSC (MSC-B'), MSC-B sends the perform subsequent handover message to MSC-A. MSC-A returns the subsequent handover acknowledge message when handover can be performed.MSC-A will also indicate if the handover cannot be performed.

5.5.2.4 Example of the use of the handover procedures

If no subsequent handover takes place after the call has been handed over to MSC-B, only the basic handover procedure will be needed. If, however, a subsequent handover takes place, both the basic handover procedure and the subsequent handover procedure will be required. An example of the overall procedures is shown in Figure 5.5.5.

In the example a basic (or first) handover is made from MSC-A to MSC-B. Then a subsequent handover is made from MSC-B to MSC-B' which in turn makes a subsequent handover back to MSC-A. This example is chosen to illustrate a sequence of handovers as well as the overlapping of operations between various entities. Messages belonging to the same transaction are indicated by a transaction number.

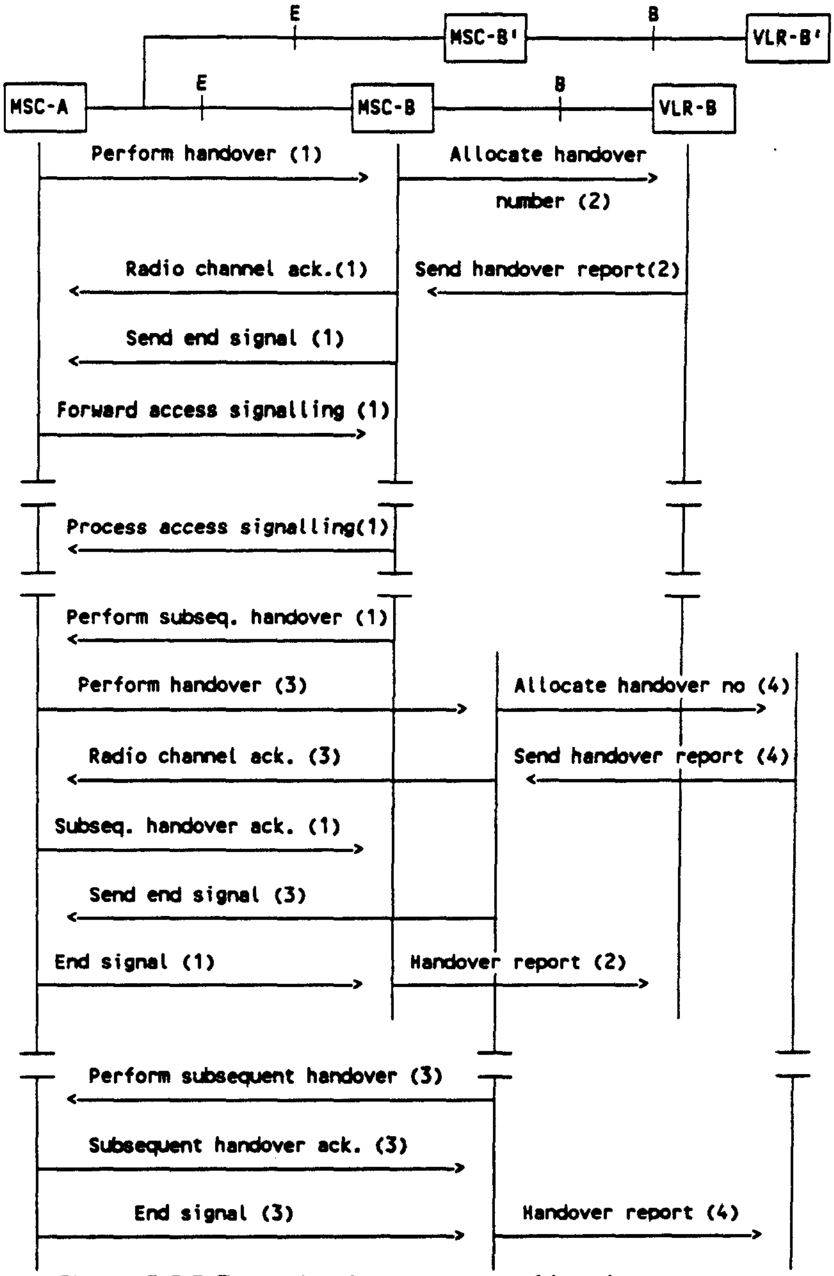


Figure 5.5.5 Example of a sequence of handovers.

First MSC-A requests a handover to MSC-B. This involves a basic handover procedure (transaction 1). The allocation of a handover number in VLR-B is then started (transaction 2).

Any call control, mobility management, supplementary services or SMS information subsequently sent between MSC-A and MSC-B also belongs to transaction 1.

If at some stage MSC-B decides that the call is to be handed over to MSC-B', it starts a subsequent handover procedure which still belongs to transaction 1. MSC-A then initiates a basic handover procedure to MSC-B' (transaction 3), which in turn initiates the allocation of handover number procedure to VLR-B' (transaction 4). Transaction 1 is terminated by an end signal message to MSC-B when the send end signal message is received from MSC-B'. MSC-B can then terminate transaction 2 towards VLR-B.

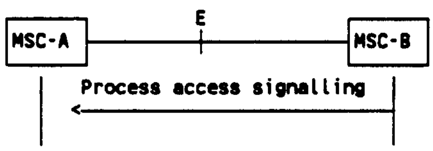
MSC-B' may then at some stage perform further subequent handovers, e g to MSC-A as shown in the Figure (transaction 3). A successful subsequent handover to MSC-A terminates transaction 3 (the end signal message to MSC-B'), which in turn is used to terminate transaction 4 towards VLR-B'.

5.5.2.5 Procedure for receiving access signalling from the MS

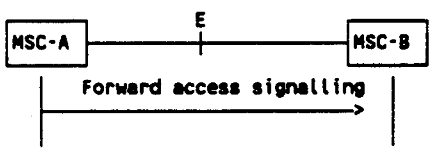
The procedure is shown in Figure 5.5.6 a). If MSC-B receives a request from the MS during the call concerning the operation of a call control, mobility management, short message service management or supplementary services control function (e g a request to pass a facility element), MSC-B maps the information received on the BS/MSC interface into a process access signalling message which is sent to MSC-A. MSC-A does not acknowledge this message. Any response from MSC-A will start a new operation by using the procedure for forwarding access signalling to the MS (5.5.2.6). Some requests may require information retrieval either from the VLR associated with MSC-A or from the HLR of the MS.

5.5.2.6 Procedure for forwarding access signalling to the MS

The procedure is shown in Figure 5.5.6 b). MSC-A may provide call control, mobility management, short message service management or supplementary services control information to the MS by sending a forward access signalling message to MSC-B. MSC-B will not acknowledge the receipt of this message.MSC-B will then forward the required information to the MS. The forward access signalling message is composed in such a way that the information can be passed transparently to the MS. Any response from the MS will start a new independent operation from MSC-B to MSC-A by returning a process access signalling message. The procedure is then as in Figure 5.5.6 a).



a) Procedure for receiving access signalling from the MS.



b) Procedure for providing access signalling to the MS.

Figure 5.5.6 Procedures for access signalling transfer during handover.

5.5.3 Detailed procedures for handover

5.5.3.1 Procedures in MSC-A

5.5.3.1.1 Basic handover procedure

The application specific procedure for basic handover is shown in Figure 5.5.7. The ASE/TCAP interface procedure is shown in Figure 5.5.8.

The handover control function will initiate the basic handover procedure (handover to MSC-B (X) signal). MSC-A then sends the perform handover message to MSC-B. The response can be as follows:

If a radio channel acknowledge message is received without parameter errors, the required information is provided to the handover control function in the connect MSC-B (X) signal. If the message contains parameter errors, the reject indication is sent to MSC-B and the procedure is terminated.

If a timer expired indication is received, a no channel indication is provided to the handover control function and the procedure to MSC-B is aborted.

If a reject indication, a data missing or an unexpected data value message is received, two alternative procedures are indicated:

- MSC-A may either terminate the operation by sending an abort message to MSC-B, or

- retransmit the perform handover message.

Negative results (system failure, unknown BS, invalid target BS, no radio resource available, no handover number available) may also be received. If so, the procedure is terminated and the negative result is provided to the handover control function.

When a radio channel has been allocated in MSC-B, MSC-A waits for the send end signal message. If the parameters in this message are accepted, an indication is provided to the handover control function. In case of parameter errors MSC-A sends a reject indication to MSC-B but does not terminate the procedure since MSC-B may retransmit the message.

An abort indication may also be received. In this case the procedure is terminated.

The procedure is terminated when the ASE receives the send end signal (X) indication from the handover control function. Then the end signal message is sent to MSC-B.

If an abort indication is received in any state, the procedure is terminated.

The perform handover message is sent in a TC-INVOKE REQUEST primitive and the radio channel acknowledge message is received in a TC-RESULT-L INDICATION primitive. The procedure is supervised by timer T-ho. MSC-A may also receive a TC-(U-) REJECT INDICATION primitive, a TC-ABORT INDICATION primitive, a TC-L-CANCEL INDICATION primitive (indicating expiry of timer T-ho) or a TC-U-ERROR INDICATION primitive with cause indications as follows:

i) unknown BS
ii) invalid target BS
iii) no radio resource available
iv) no handover number available
v) data missing
vi) unexpected data value
vii) system failure

An abort indication is sent in a TC-U-ABORT REQUEST primitive.

The send end signal message will be included in a TC-INVOKE-L INDICATION primitive. The end signal message will then be sent as a TC-RESULT-L REQUEST primitive.

Note: In the interval between sending of the perform handover message and sending of the end signal message, the procedures described in 5.5.3.1.2 and 5.5.4 may be required.

5.5.3.1.2 Subsequent handover procedure

The application specific procedure for subsequent handover is shown in Figure 5.5.9 and the corresponding ASE/TCAP interface procedure is shown in Figure 5.5.10.

When receiving a valid perform subsequent handover message, an indication is provided to the handover control function. This indication will include information whether the handover is to MSC-A or to MSC-B'. The result received from the handover function can be:

- send acknowledge (X) which causes the transmission of the subsequent handover acknowledge message;

- a negative result indicating either of the following events: unknown MSC (the subsequent handover is requested to an unidentified or non-existing MSC), unknown BS (the indicated BS does not exist), invalid target BS (handover is not allowed to the indicated BS), unexpected data value or subsequent handover failure (e g no radio channel, mobile station roaming number not allocated or unsuccessful establishment of the connection to MSC-B').

The reject indication will be provided if the subsequent handover request concerns an MS which has no current connections in MSC-A. This is regarded as being part of the parameter checking.

The perform subsequent handover message is received in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the subsequent handover acknowledge message is sent in a TC-RESULT-L REQUEST primitive;

- a reject indication is provided as a TC-U-REJECT REQUEST primitive;

- unsuccessful events are returned in a TC-U-ERROR REQUEST primitive as follows:

  i) unknown BS;
  ii) unknown MSC;
  iii) subsequent handover failure;
  iv) invalid target BS;
  v) unexpected data value.

Figure 5.5.7 (Sheet 1 of 3)
Application specific procedure in MSC-A for basic handover.

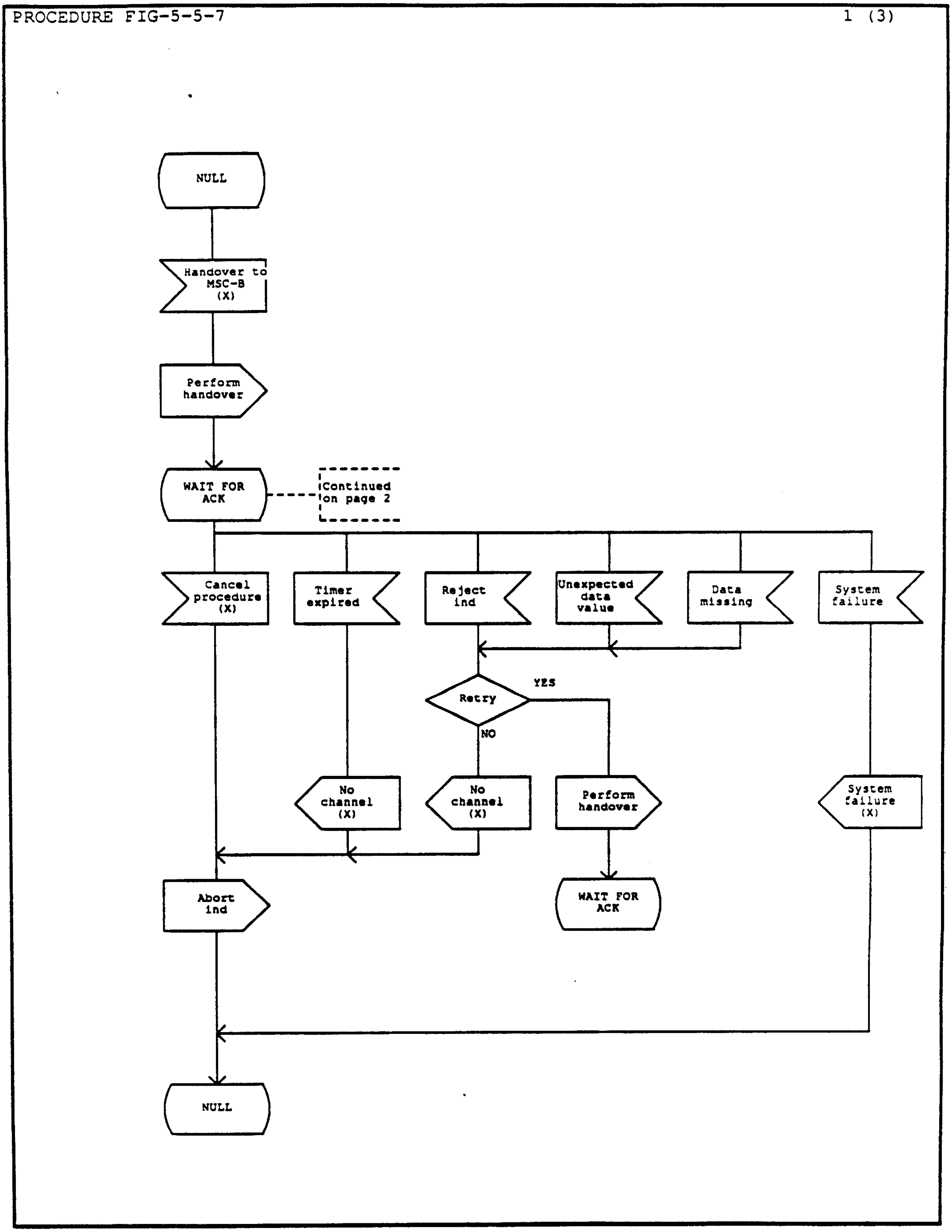


Figure 5.5.7 (Sheet 2 of 3)
Application specific procedure in MSC-A for basic handover.

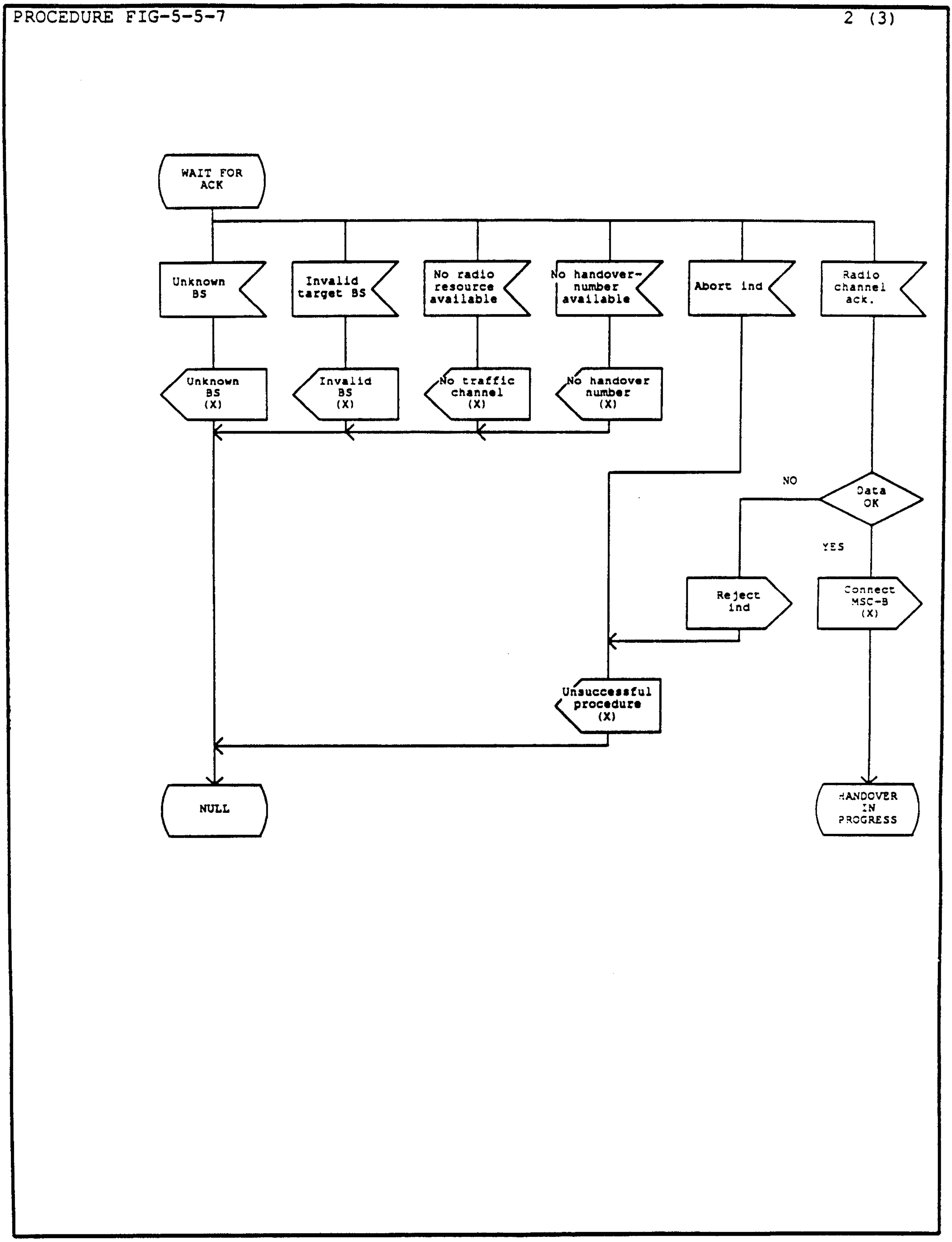


Figure 5.5.7 (Sheet 3 og 3)
Application specific procedure in MSC-A for basic handover.

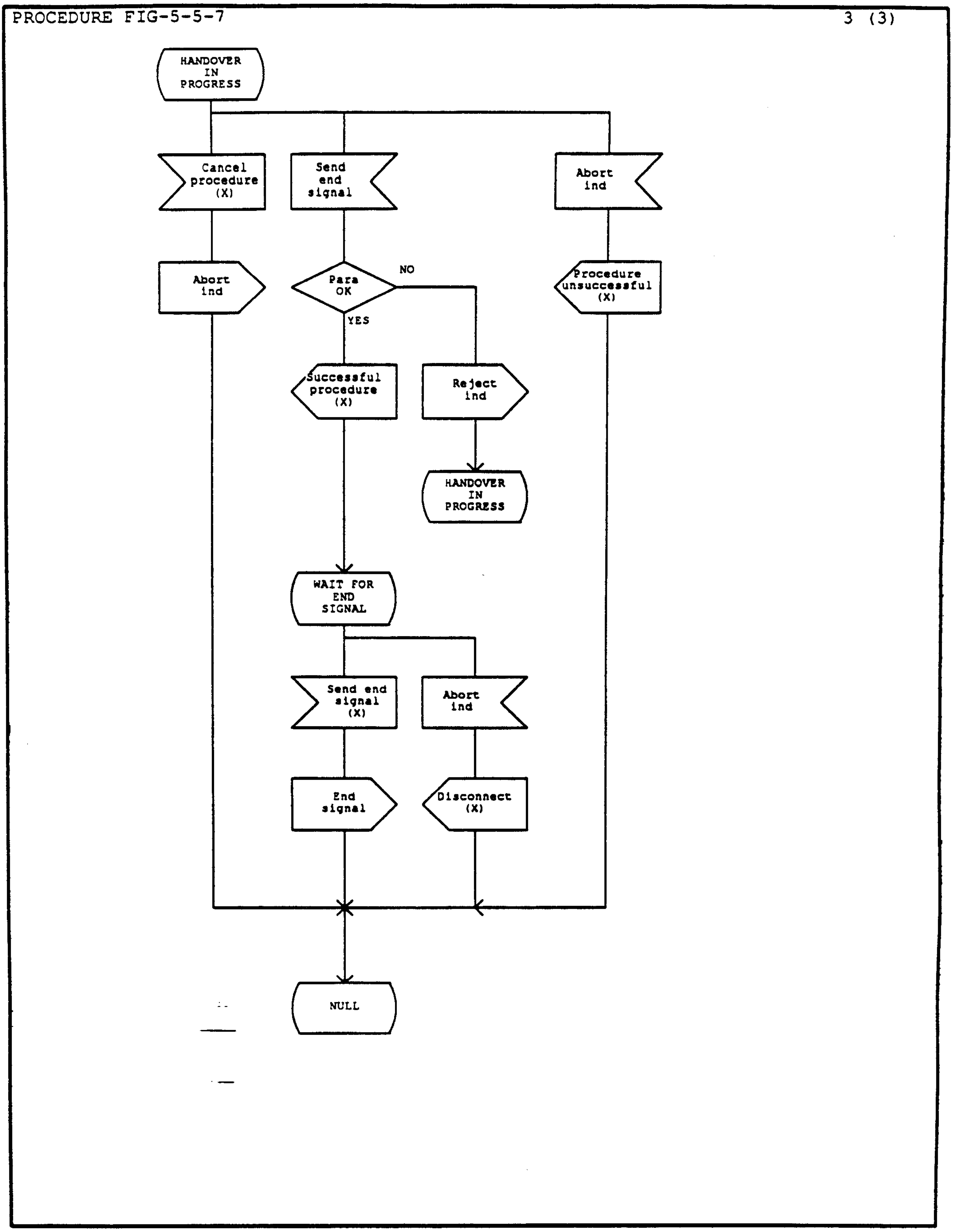


Figure 5.5.8 (Sheet 1 of 3)
ASE/TCAP interface procedure in MSC-A for basic handover.

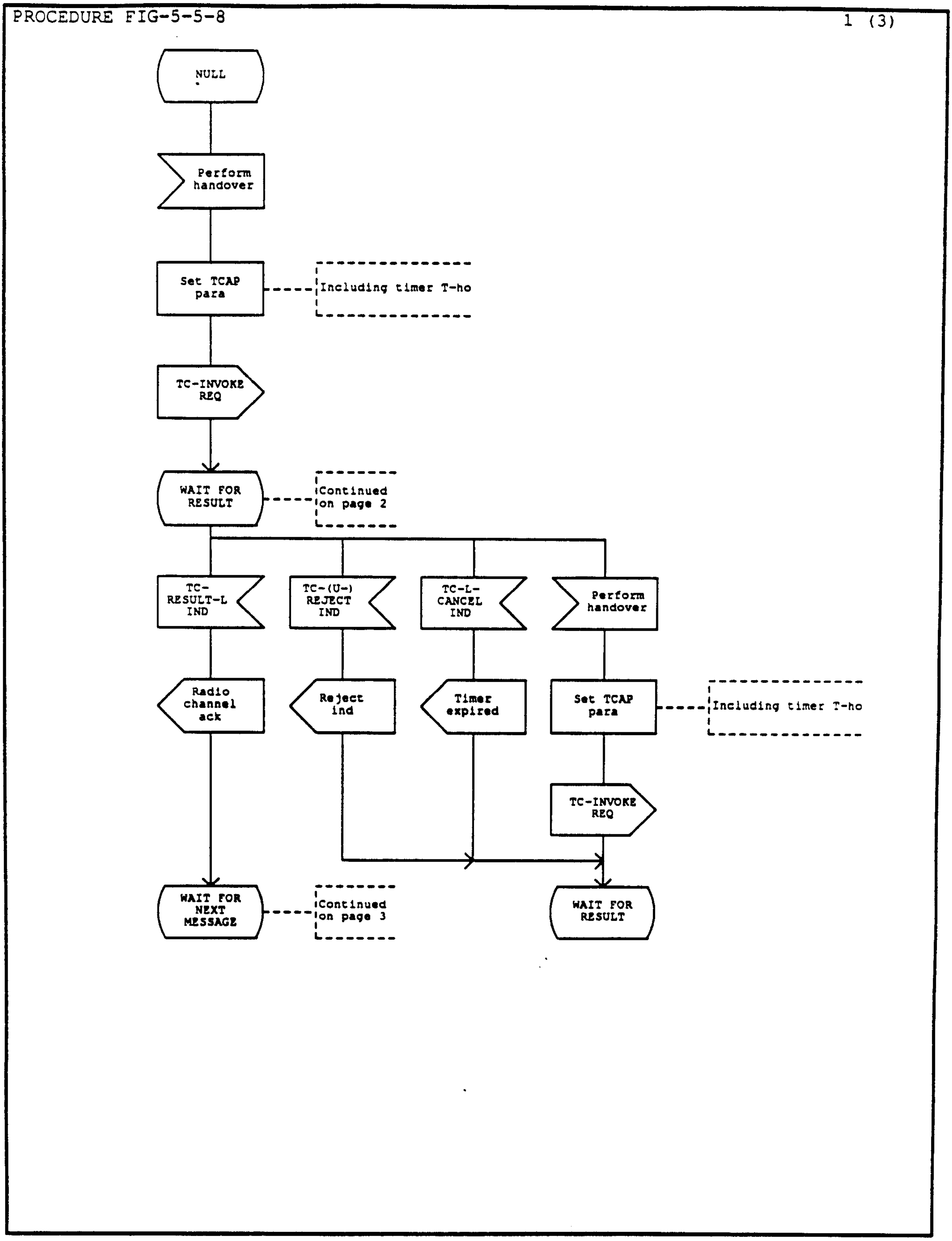


Figure 5.5.8 (Sheet 2 of 3)
ASE/TCAP interface procedure in MSC-A for basic handover

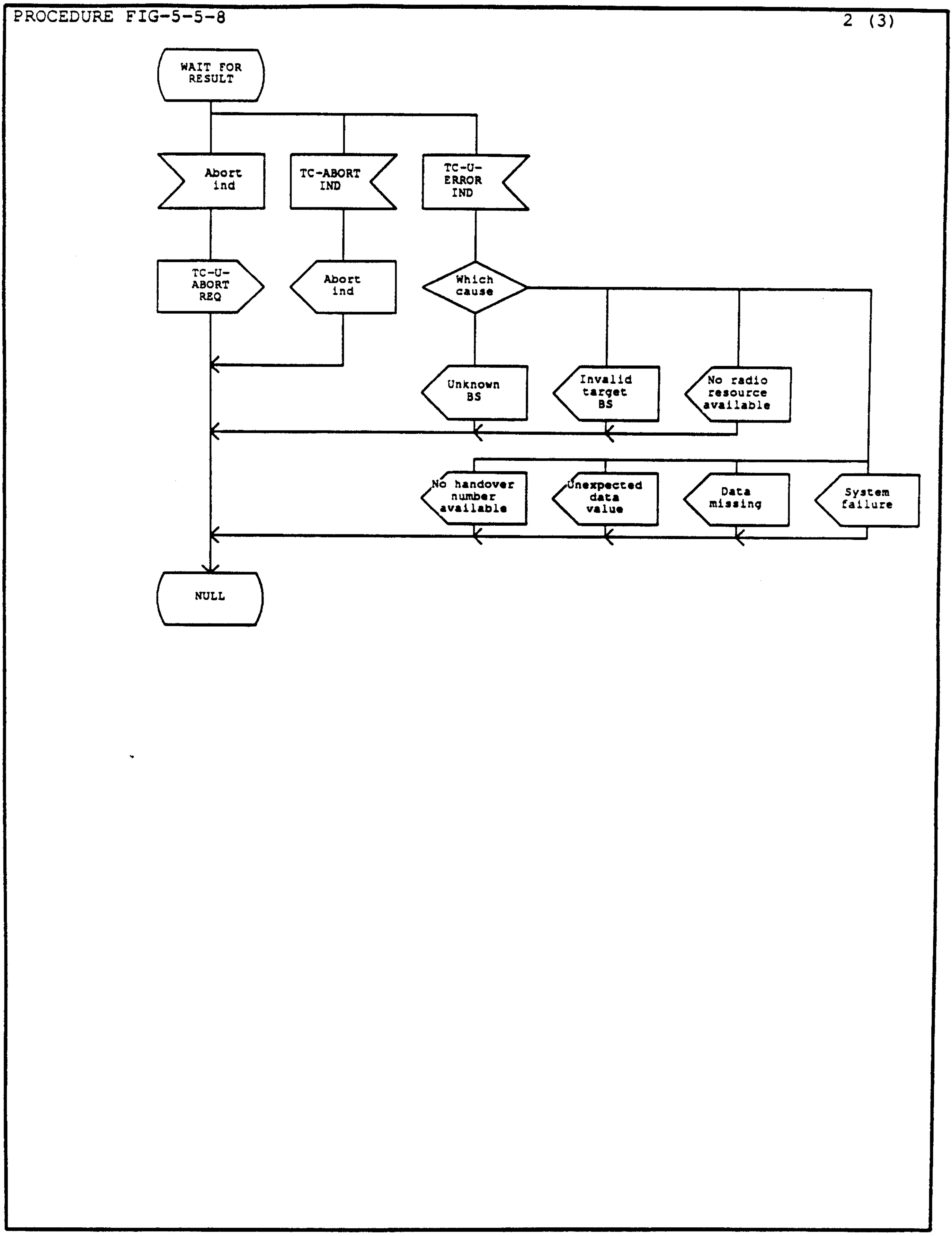


Figure 5.5.8 (Sheet 3 of 3)
ASE/TCAP interface procedure in MSC-A for basic handover.

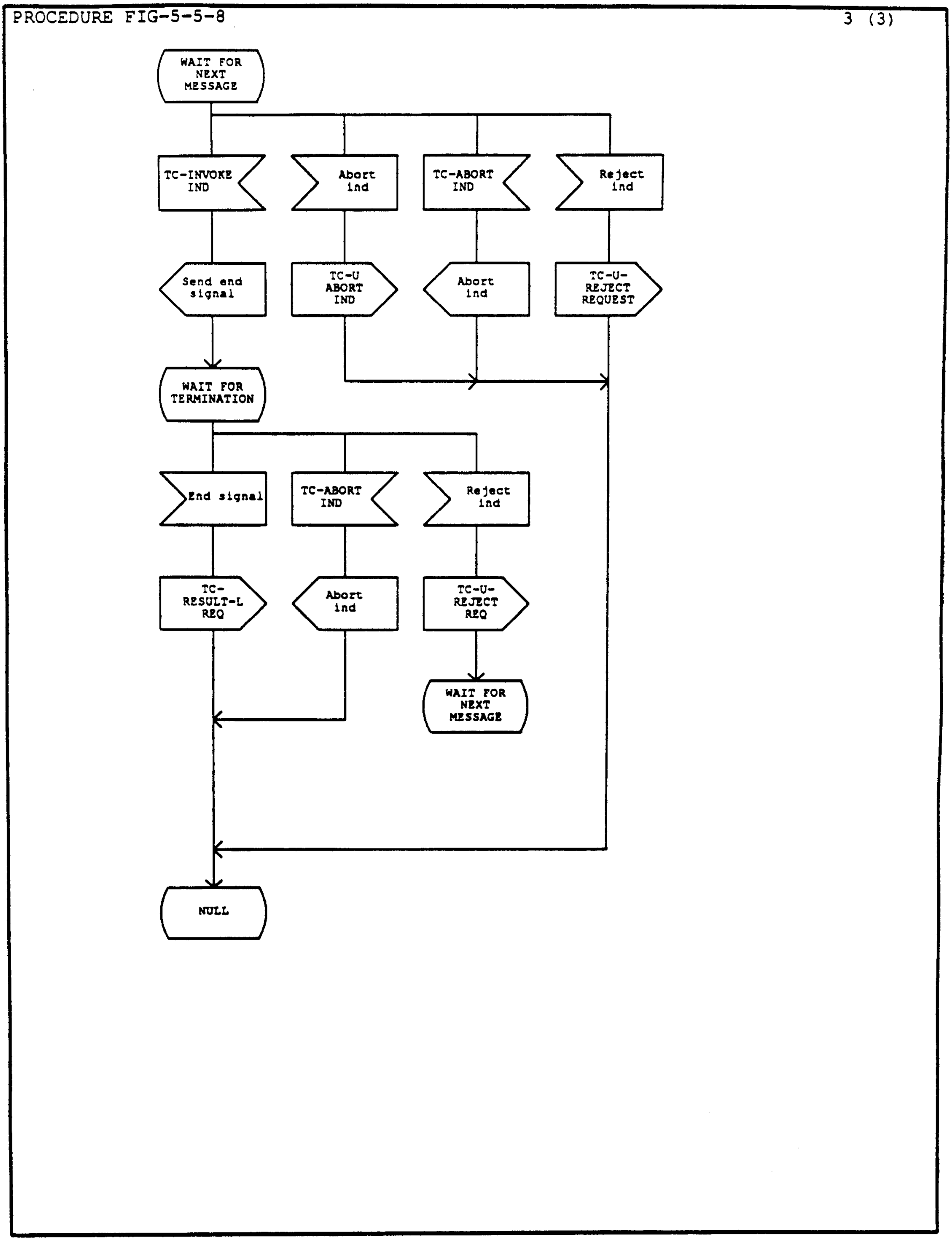


Figure 5.5.9
Application specific procedure in MSC-A for subsequent handover

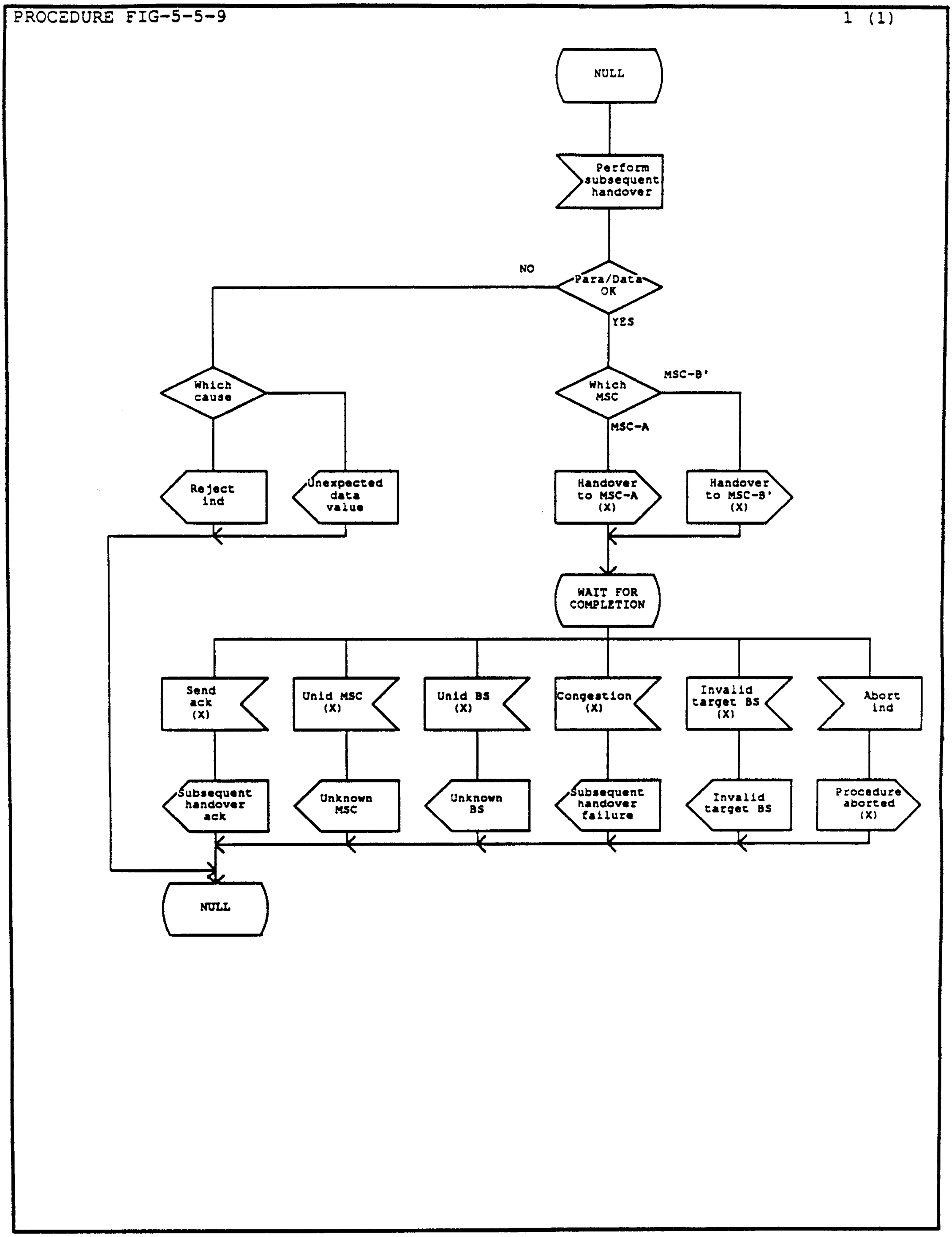
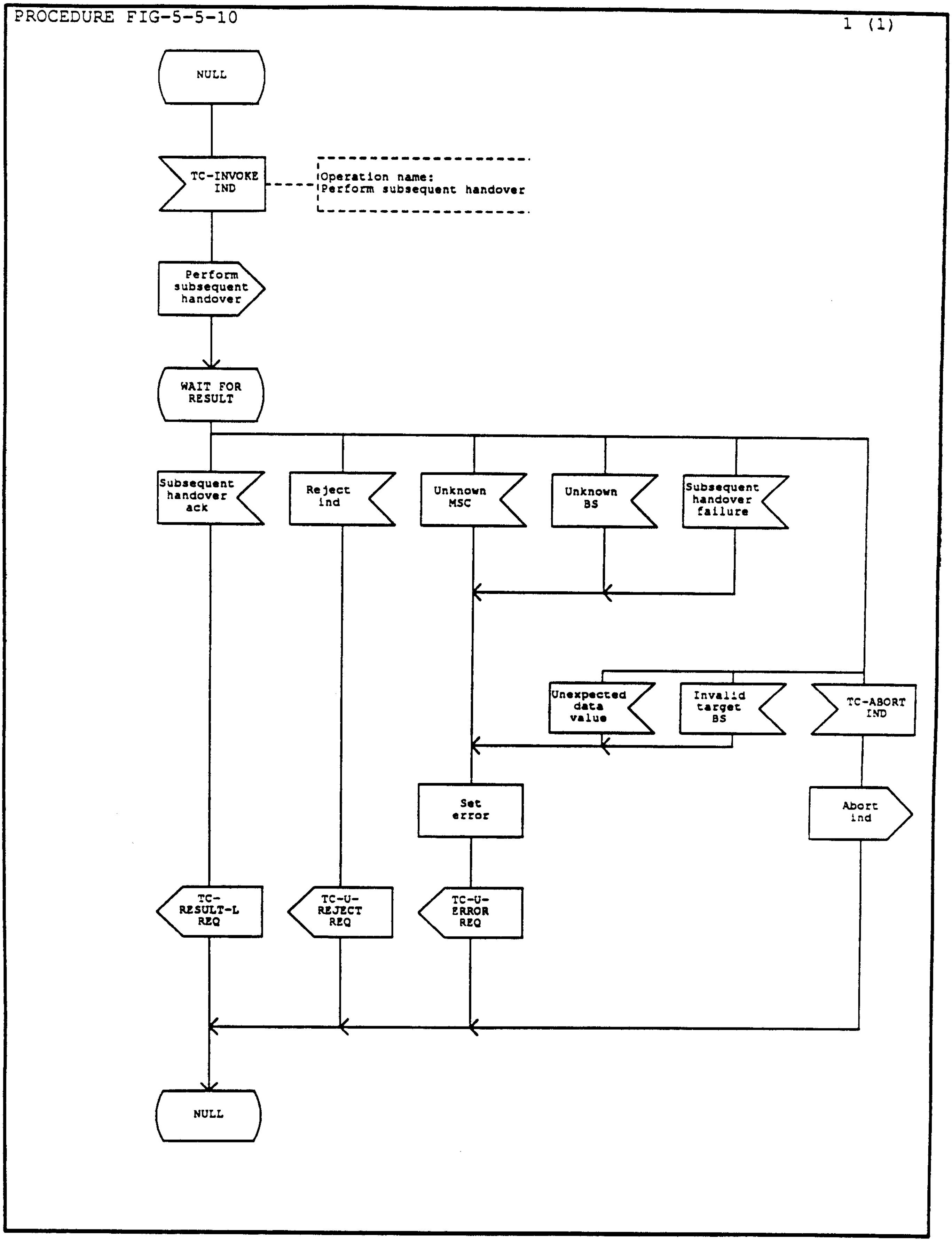


Figure 5.5.10
ASE/TCAP interface procedure in MSC-A for subsequent handover.



5.5.3.2 Procedures in MSC-B

5.5.3.2.1 Basic handover procedure

The application specific procedure is shown in Figure 5.5.11 and the ASE/TCAP interface procedure is contained in Figure 5.5.12.

The application specific procedure is as follows. When a valid perform handover message is received, the handover control function is requested to allocate a radio channel and to initiate allocation of a handover number. The required information is contained in a send acknowledge signal (X) which is sent to MSC-A in a radio channel acknowledge message. Negative results may also be returned as follows:

- unknown BS, i e the BS identity is not used in MSC-B;
- invalid target BS, i e handover is not allowed to the indicated BS;
- no radio resource available, i e the handover cannot be performed because of radio congestion;
- no handover number available, i e handover number cannot be allocated;
- system failure, i e machine malfunction of failure of associated procedure;
- data missing or unexpected data value if data errors are discovered in the perform handover message.

When an indication that the MS has been connected is received from the handover control function, the send end signal message is sent. MSC-B will then wait for the receipt of the end signal message from MSC-A. A timer expiry indication may also be received indicating that the overall control procedure between MSC-A and MSC-B may have failed. The procedure is then terminated.

At any stage MSC-B may receive an abort indication. MSC-B will then terminate the procedure with the appropriate indication provided to the handover control function. The same applies when receiving a reject indication, except in state 3 where the send end signal message is retransmitted.

If there is a connection failure on the radio path or in the connection between MSC-B and MSC-A, MSC-B may abort the transaction.

The perform handover message is contained in a TC-INVOKE INDICATION primitive. The successful result of this invoke (the radio channel acknowledge message) is returned in a TC-RESULT-L REQUEST primitive. Unsuccessful events terminate the procedure and are reported as follows:

- a procedure failure is sent in a TC-U-REJECT REQUEST primitive;
- a negative result is sent in a TC-U-ERROR REQUEST primitive as follows:

  i) unknown BS;
  ii) invalid target BS;
  iii) data missing;
  iv) no radio resource available;
  v) no handover number available;
  vi) unexpected data value.
  vii) system failure.

The send end signal message is returned in a TC-INVOKE-L REQUEST primitive. The procedure is supervised by timer T-es which is required to avoid long term blocking of circuits between MSC-A and MSC-B. If MSC-B is unable to connect the MS, an abort indication is sent in a TC-U-ABORT REQUEST primitive. The end signal message is received in a TC-RESULT-L INDICATION primitive. Expiry of timer T-es is reported in a TC-L-CANCEL INDICATION primitive. TC-ABORT INDICATION primitives may also be received.

An abort indication is received in a TC-U-ABORT INDICATION primitive.

If a TC-(U-)REJECT INDICATION primitive is received in response to the TC-INVOKE-L REQUEST primitive, MSC-B will retransmit the send end signal message as indicated.

5.5.3.2.2 Subsequent handover

The application specific procedure is shown in Figure 5.5.13 and the ASE/TCAP interface procedure is shown in Figure 5.5.14.

The handover control function will request initiation of the procedure. The perform subsequent handover message is sent to MSC-A. This message will contain the identity of the new MSC and the BS to which the call is to be handed over. MSC-B will receive the subsequent handover acknowledge message indicating the new radio channel number if the subsequent handover can be performed. If the handover cannot be performed, MSC-B will receive either of the following messages:

- unknown BS
- unknown MSC
- invalid target BS
- subsequent handover failure
- unexpected data value

If a reject indication or a timer expired indication is received (in TC-(U-)REJECT and TC-L-CANCEL INDICATION primitives, respectively), MSC-B may retransmit the perform subsequent handover message.

The perform subsequent handover message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-sho. The subsequent handover acknowledge message is received in a TC-RESULT-L INDICATION primitive.

Negative results are received in TC-U-ERROR INDICATION primitives as follows:

i) unknown BS;
ii) unknown MSC;
iii) subsequent handover failure;
iv) invalid target BS;
v) unexpected data value.

5.5.3.2.3 Allocation of handover number

The application specific procedure is shown in Figure 5.5.15 and the ASE/TCAP interface procedure is shown in Figure 5.5.16.

The handover control function will request retrieval of the handover number. The allocate handover number message is sent to the VLR. The normal reply from the VLR will be the send handover report message. This message will contain the handover number. Other events may also occur:

- the no handover number available message is received if the VLR cannot allocate a handover number. A no handover number indication is provided to the handover control function and the procedure is terminated;

- the reject indicator is received if the VLR or TCAP detects procedure errors. The reject indication is provided to the handover control function and the procedure is terminated;

- the request may be cancelled by the handover control function, or timer T-ahn may expire. In both cases an abort indication is sent to the VLR;

- the abort indicator is received. In this case the procedure is terminated.

If the send handover report message contains procedure errors, a reject indication is provided to the VLR and the MSC-B sends a no handover number indication to the handover control function.

MSC-B will send the handover report message when requested to do so by the handover control function.

The allocate handover number message is sent in a TC-INVOKE REQUEST primitive and the send handover report message is received in a TC-INVOKE INDICATION primitive. The handover report message is then sent in a TC-RESULT-L REQUEST primitive.

TCAP is requested to supervise the procedure by timer T-ahn.

If T-ahn expires before the send handover report message is received, the procedure is terminated by an abort indication.

If T-ahn expires after the send handover report message has been received, the event is ignored.

Other events are treated as follows:

- a reject indication from the VLR or TCAP is received in a TC-(U-)REJECT INDICATION primitive;

- a negative result is received in a TC-U-ERROR INDICATION primitive as follows:

i) no handover number available;

- a reject indication from MSC-B is sent in a TC-U-REJECT REQUEST primitive;

- an abort indication is sent in a TC-U-ABORT REQUEST primitive;

- an abort indication may be received in a TC-ABORT INDICATION primitive.

Figure 5.5.11 (Sheet 1 of 2)
Application specific procedure in MSC-B for basic handover.

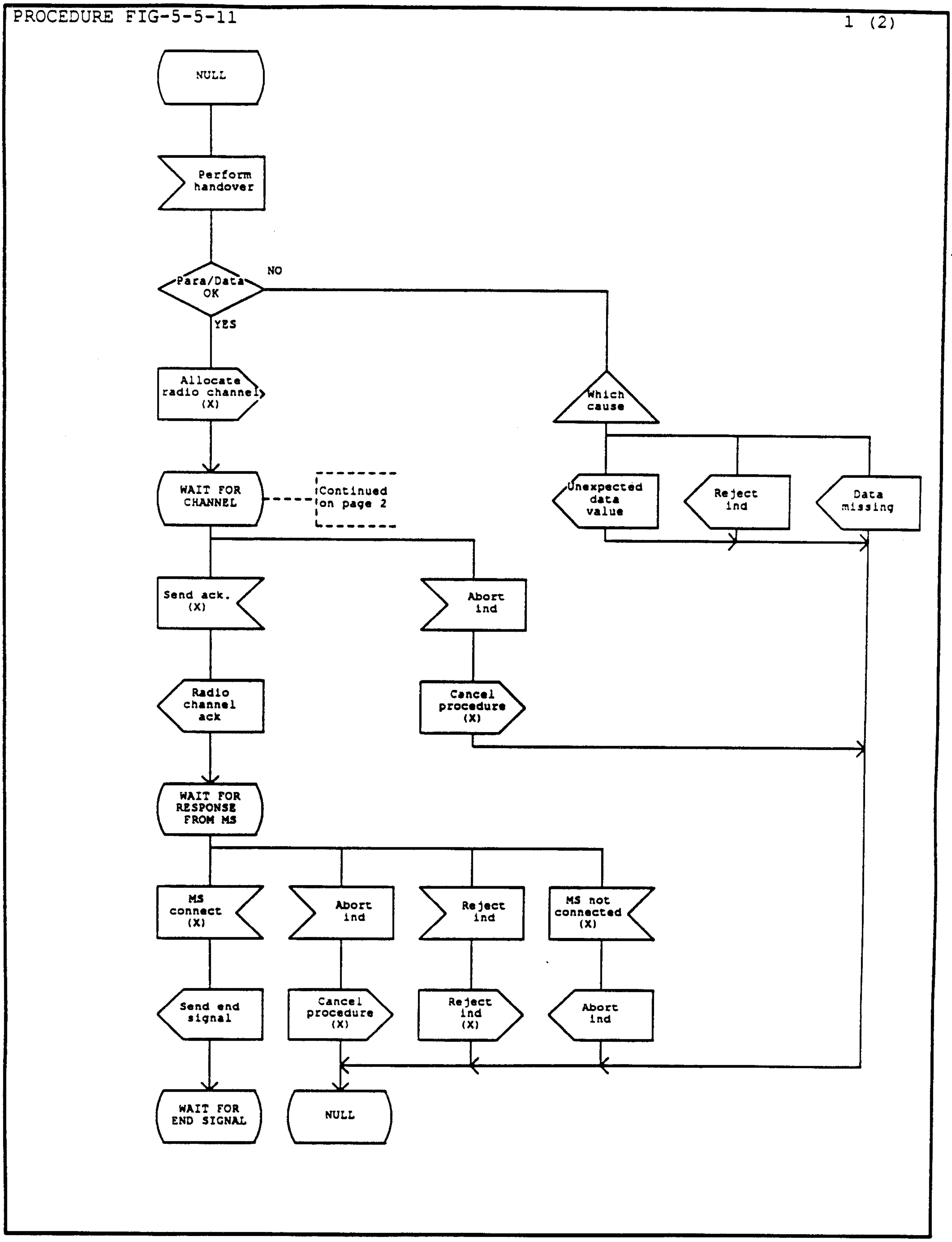


Figure 5.5.11 (Sheet 2 of 2)
Application specific procedure in MSC-B for basic handover.

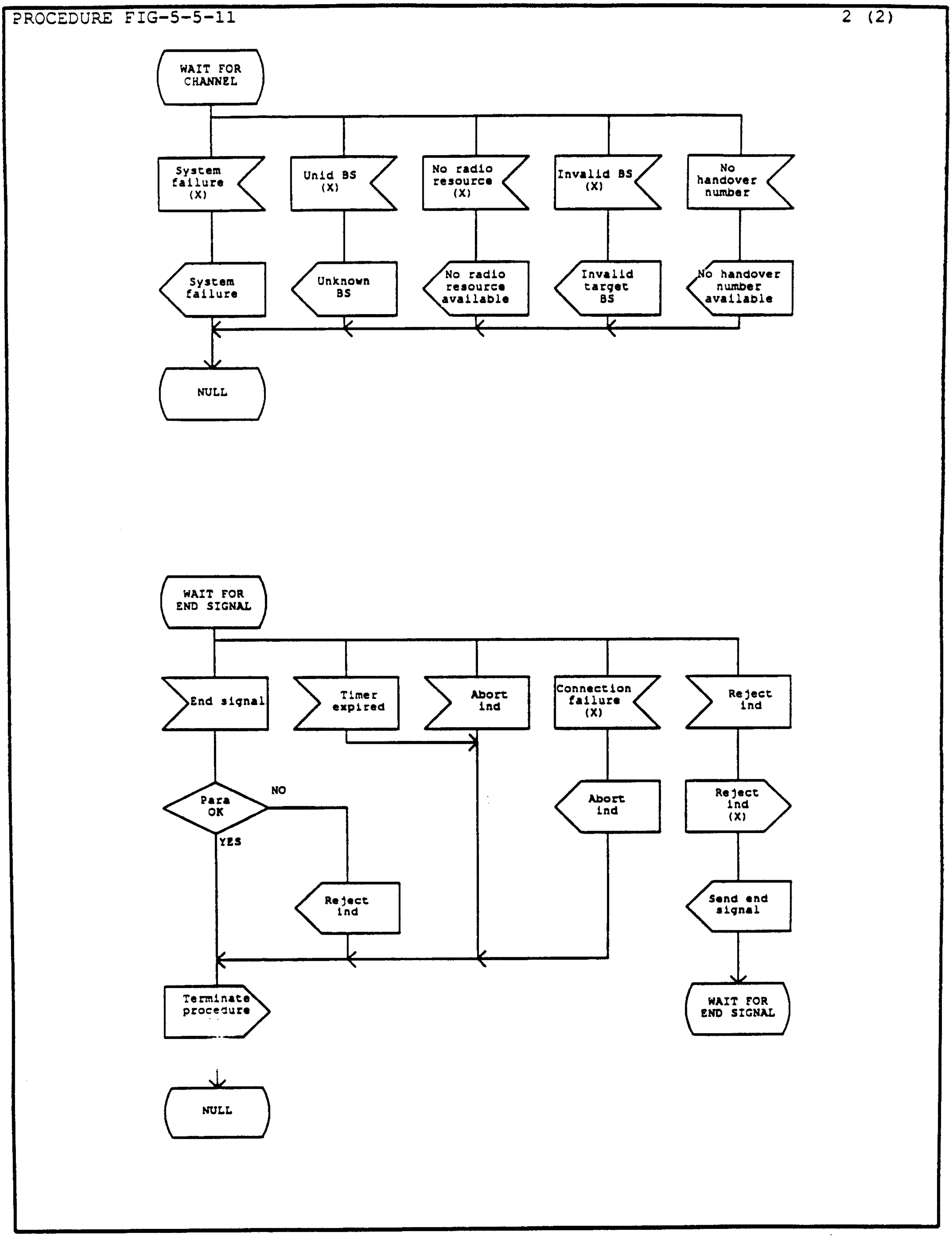


Figure 5.5.12 (Sheet 1 of 2)
ASE/TCAP interface procedure in MSC-B for basic handover.

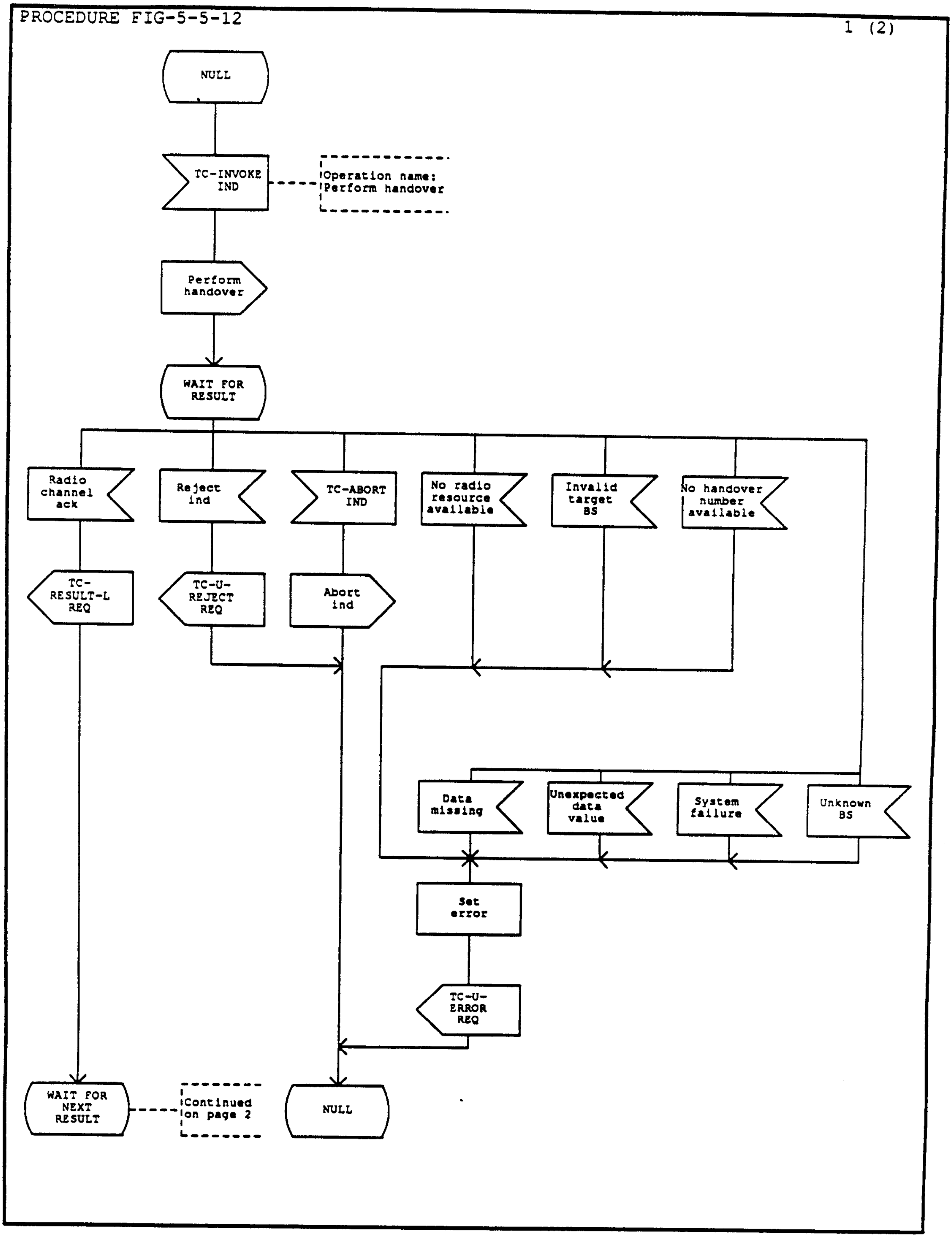


Figure 5.5.12 (Sheet 2 of 2)
ASE/TCAP interface procedure in MSC-B for basic handover.

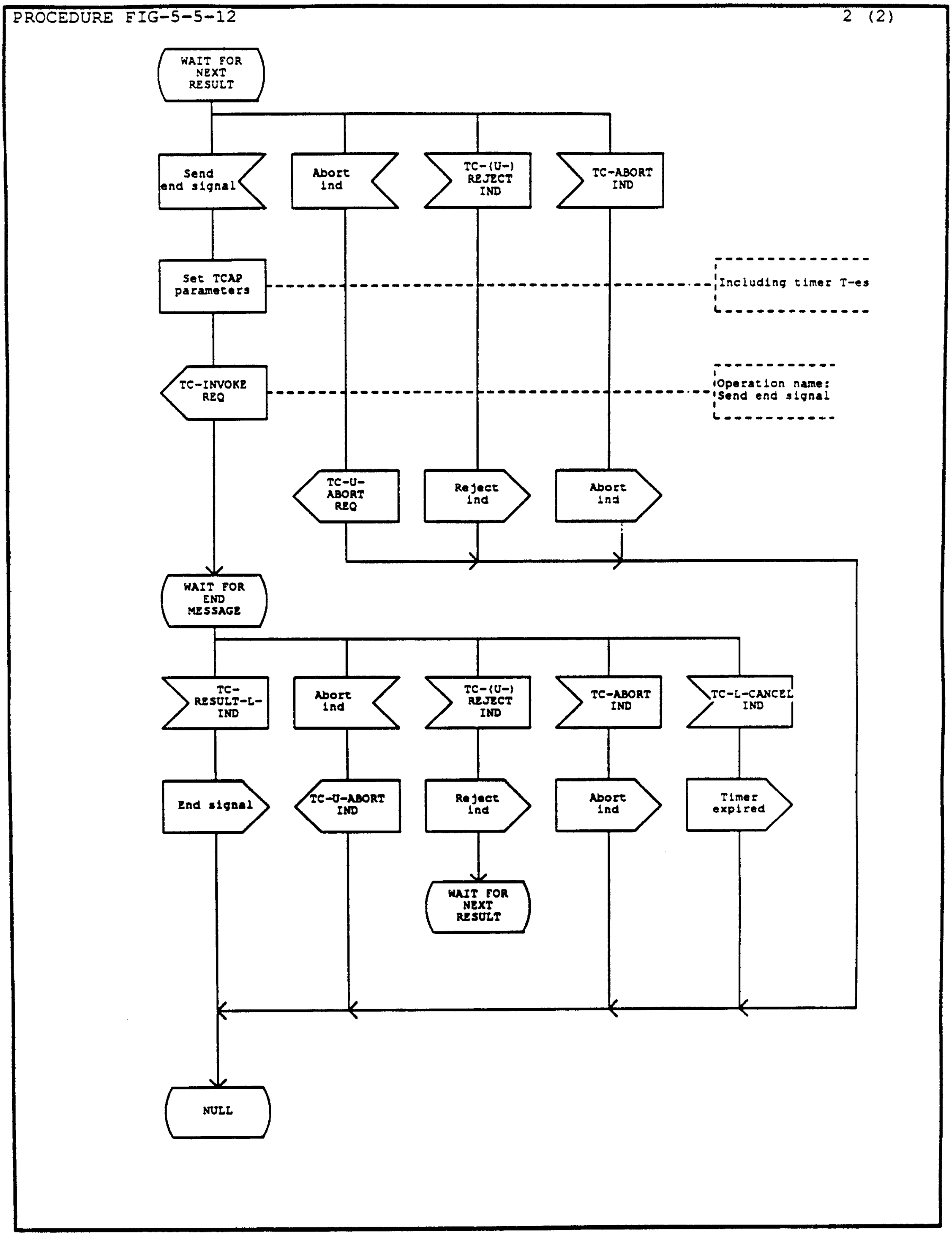


Figure 5.5.13
Application specific procedure in MSC-B for subsequent handover.

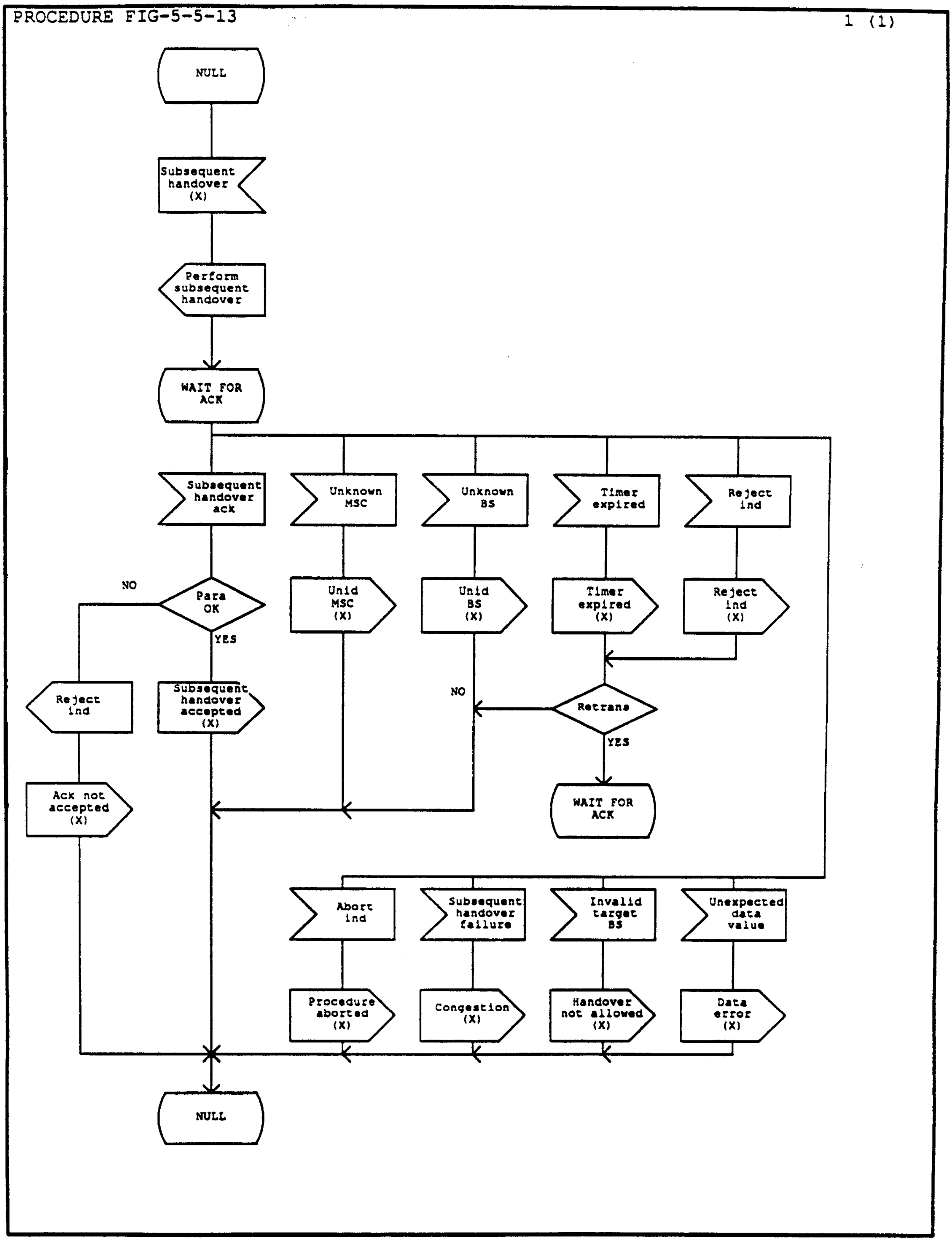


Figure 5.5.14
ASE/TCAP interface procedure in MSC-B for subsequent handover.

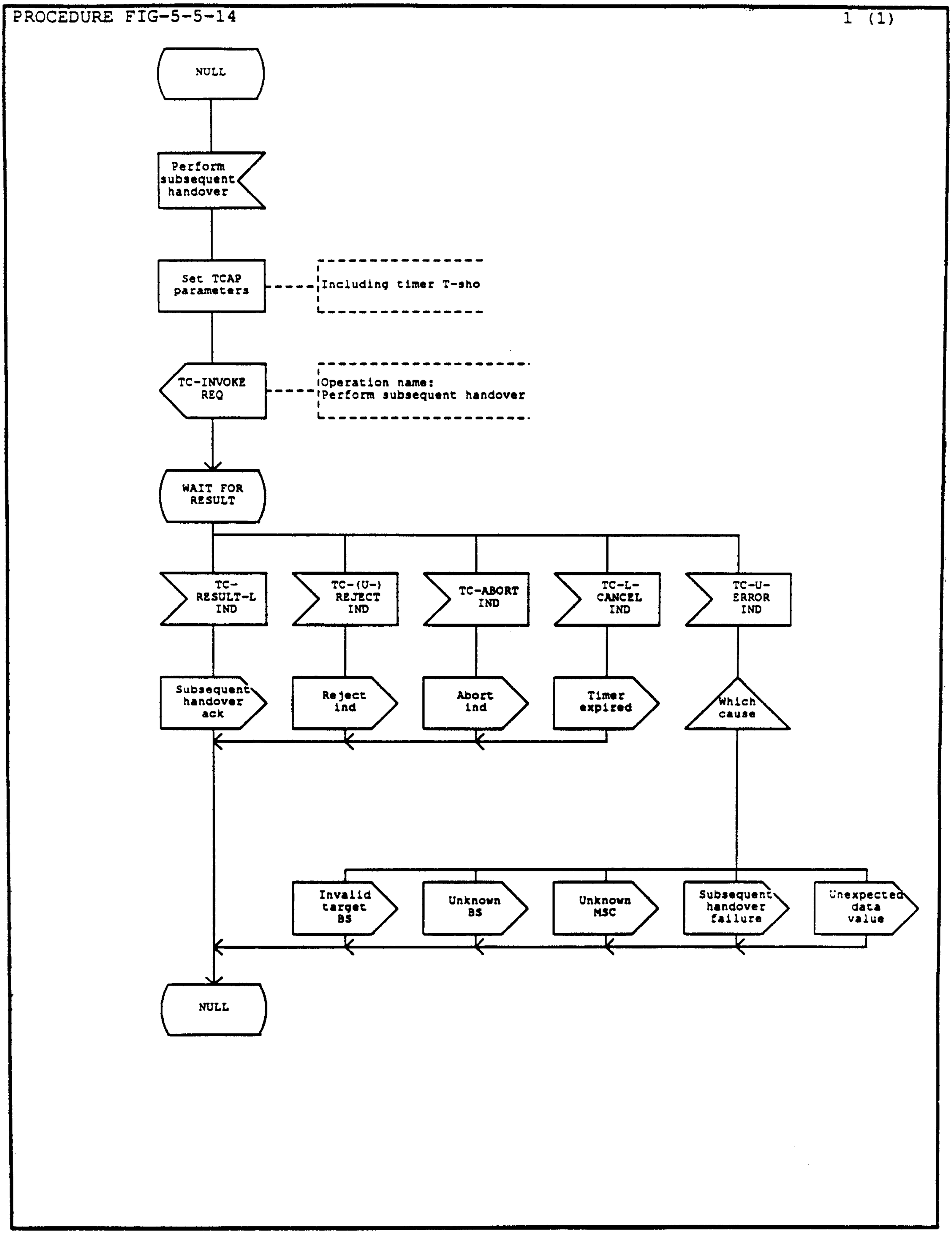


Figure 5.5.15 (Sheet 1 of 2)
Application specific procedure in MSC-B for allocation of handover number.

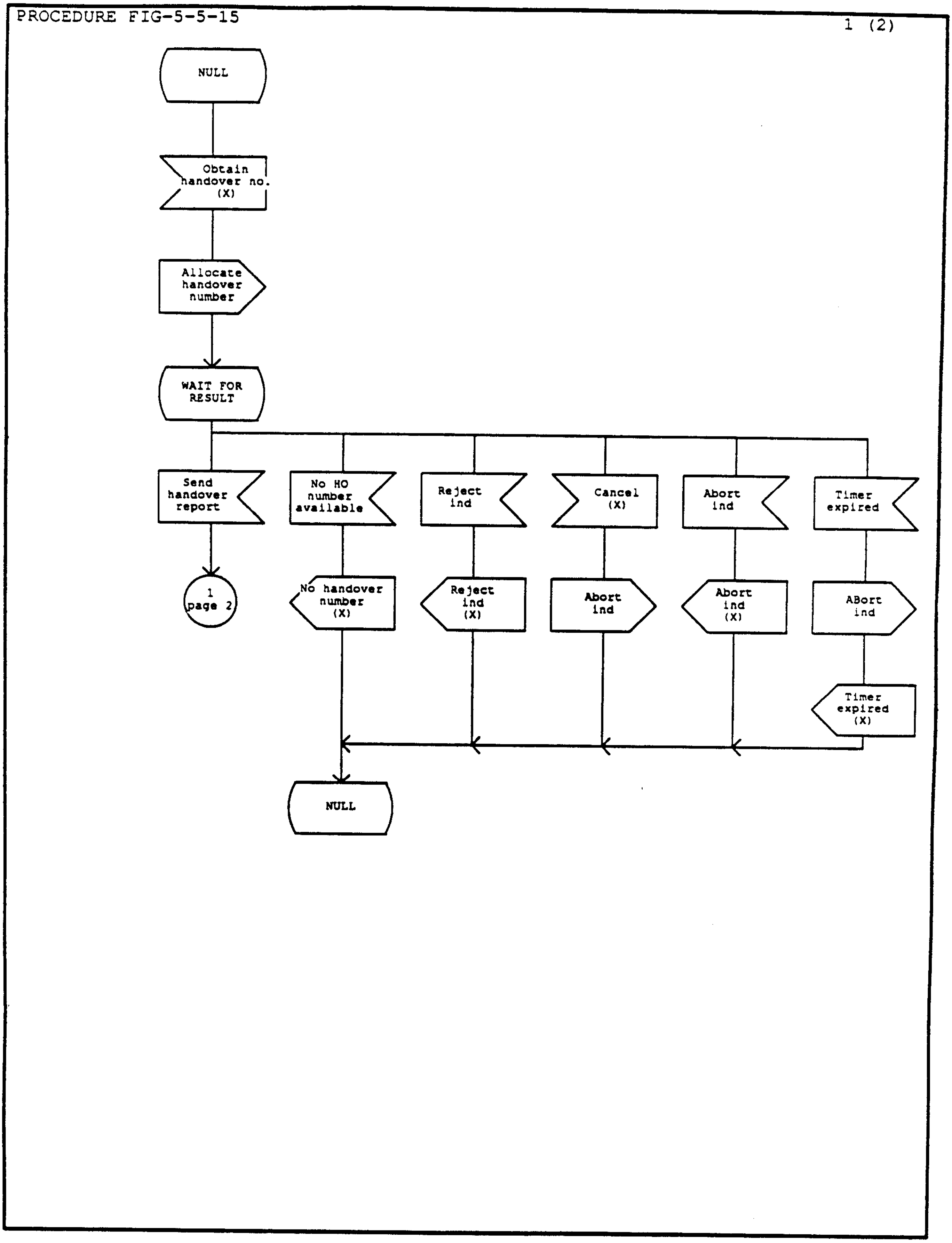


Figure 5.5.15 (Sheet 2 of 2)
Application specific procedure in MSC-B for allocation of handover number.

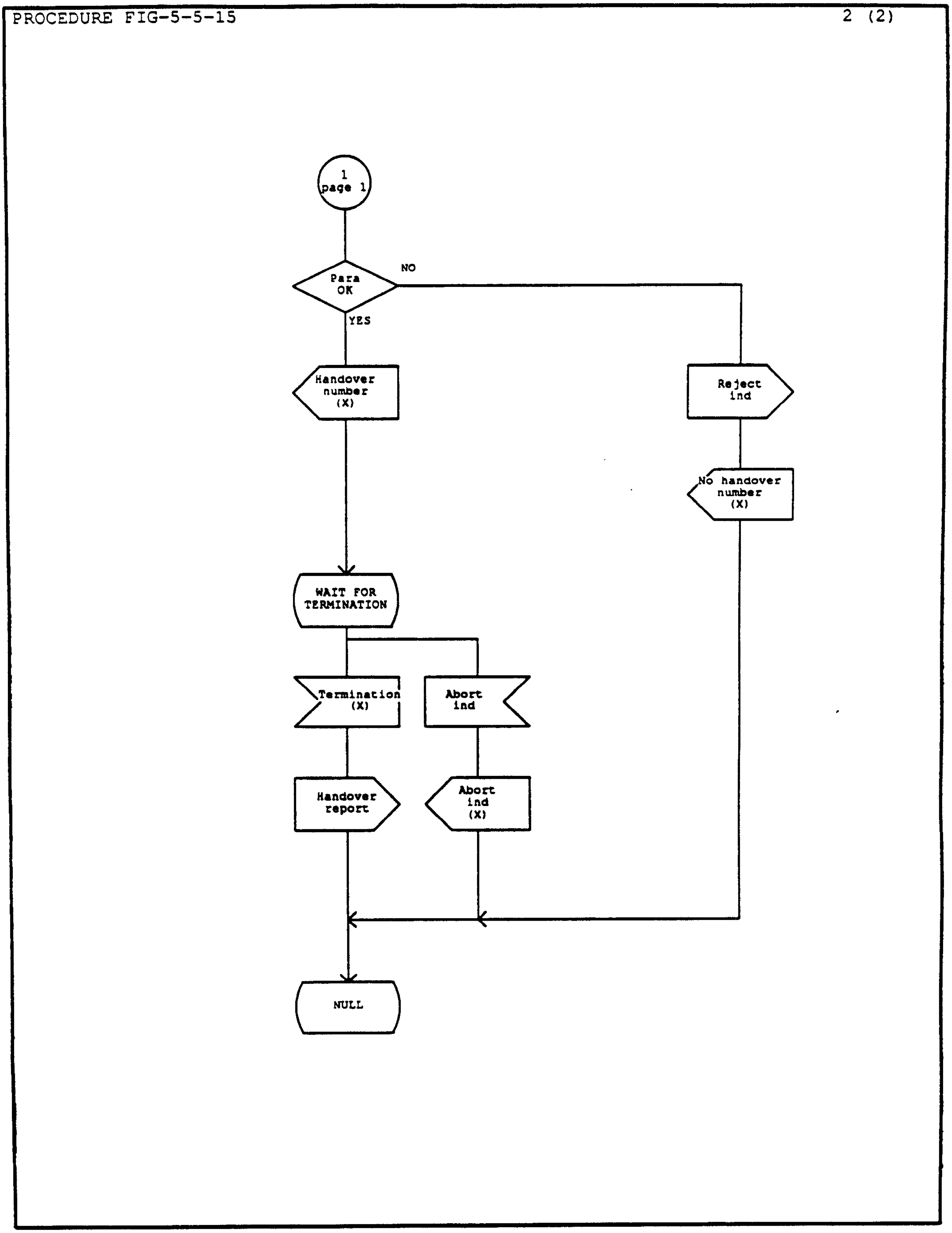


Figure 5.5.16 (Sheet 1 of 2)
ASE/TCAP interface procedure in MSC-B for allocation of handover number.

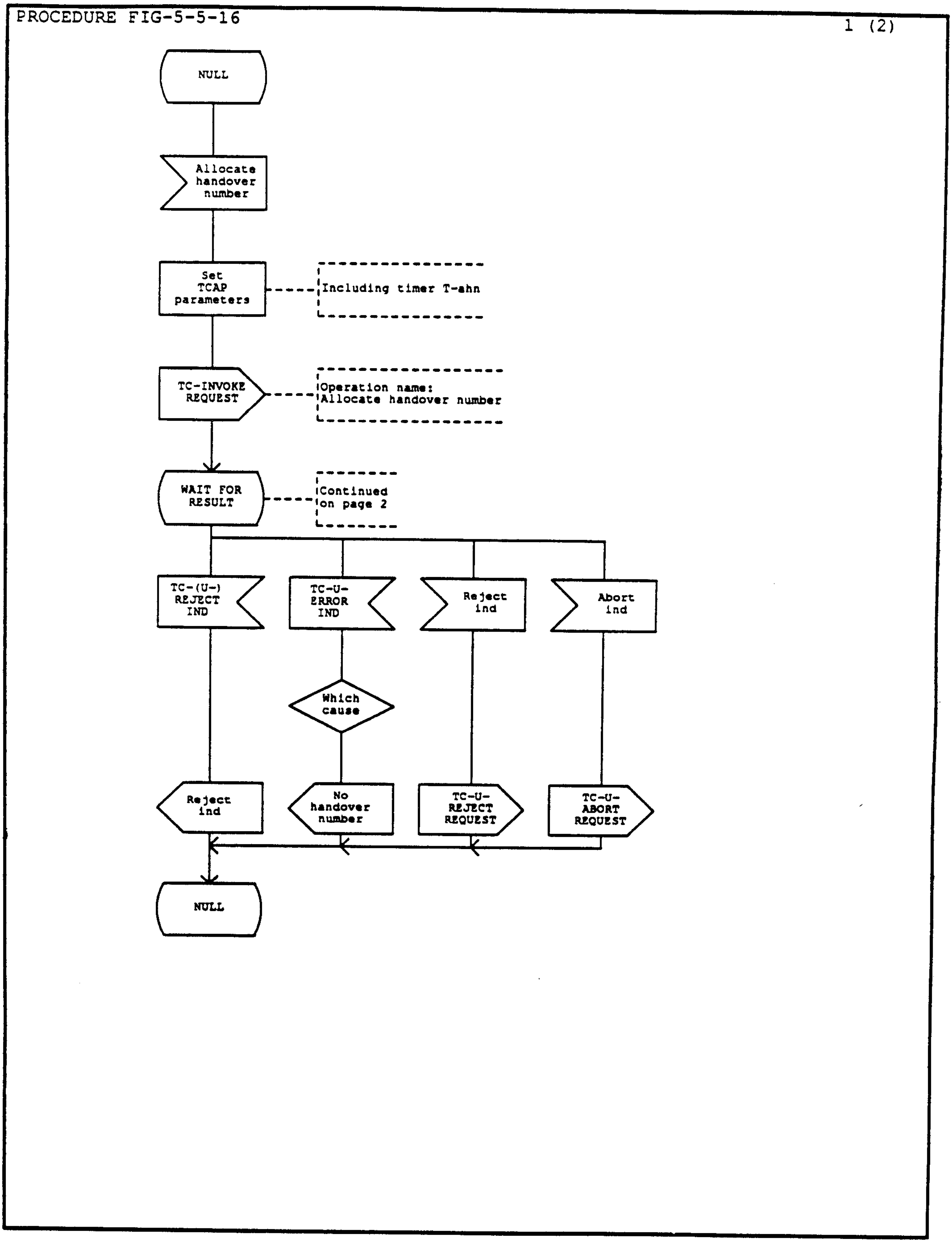
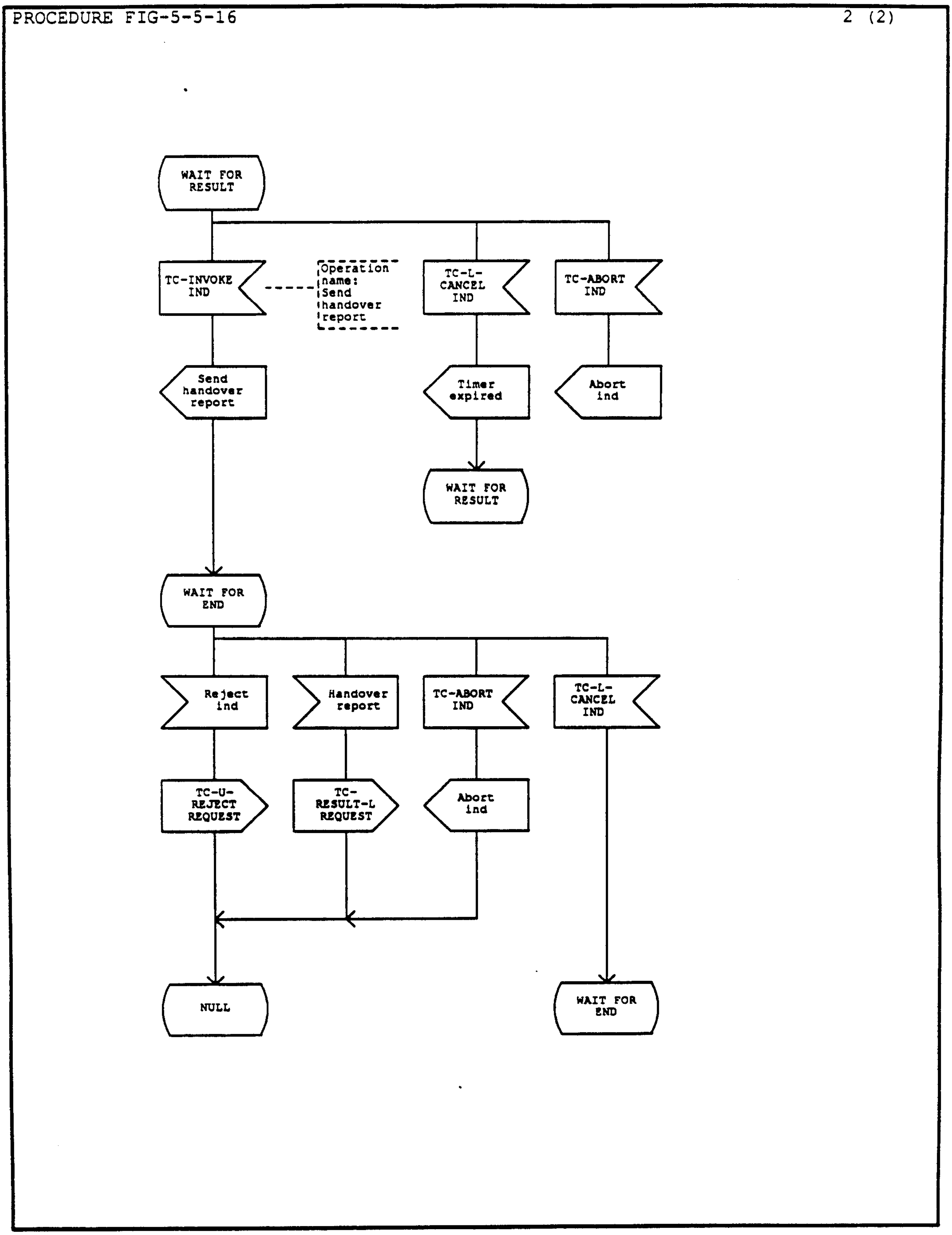


Figure 5.5.16 (Sheet 2 of 2)
ASE/TCAP interface procedure in MSC-B for allocation of handover number.



5.5.3.3 Procedure in VLR for allocation of handover number

The application specific procedure is contained in Figure 5.5.17 and the ASE/TCAP interface procedure is contained in Figure 5.5.18.

When receiving the allocate handover number message the VLR will return:

- a send handover report message if the procedure is successful;
- a no handover number available message if there is no number available;
- a reject indicator if there are parameter errors in the message.

The handover number will be removed if either of the following subsequent messages are received from MSC-B:

- the handover report message;
- a reject indication (reporting parameter error in the send handover report message);
- an abort indication;
- a timer expired indication (timer T-hr).

The allocate handover number message is received in a TC-INVOKE INDICATION primitive and the send handover report message is returned in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-hr. A reject indication is sent in a TC-U-REJECT REQUEST primitive and the no handover number available message is sent in a TC-U-ERROR REQUEST primitive.

An abort indication is received in a TC-U-ABORT INDICATION primitive and a reject indication reporting procedure errors in the send handover report message is received in a TC-(U-) REJECT INDICATION primitive. The timer expired indication is reported in a TC-L-CANCEL INDICATION primitive. A TC-ABORT INDICATION primitive may also be received.

Figure 5.5.17
Application specific procedure in VLR for allocation of handover number.

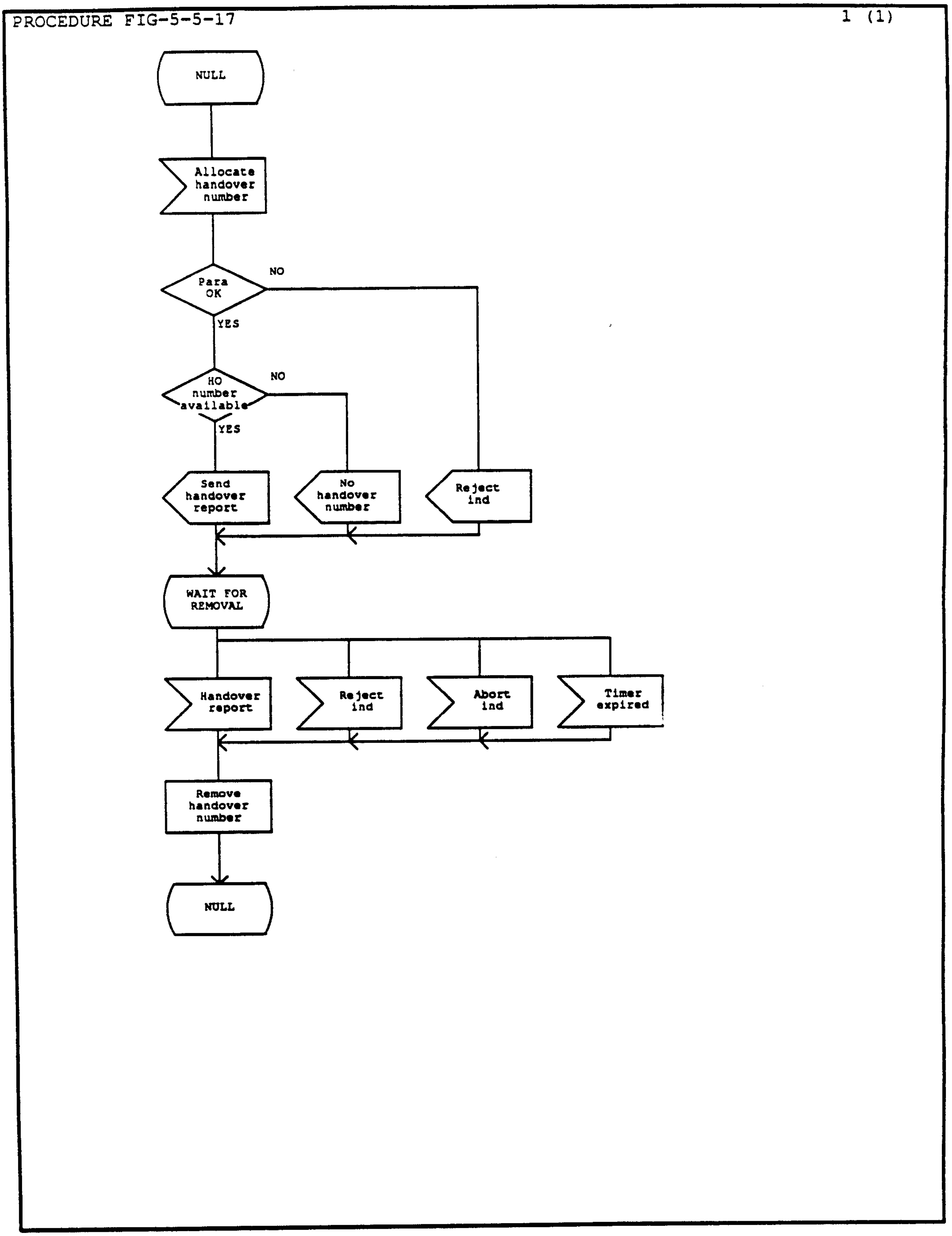
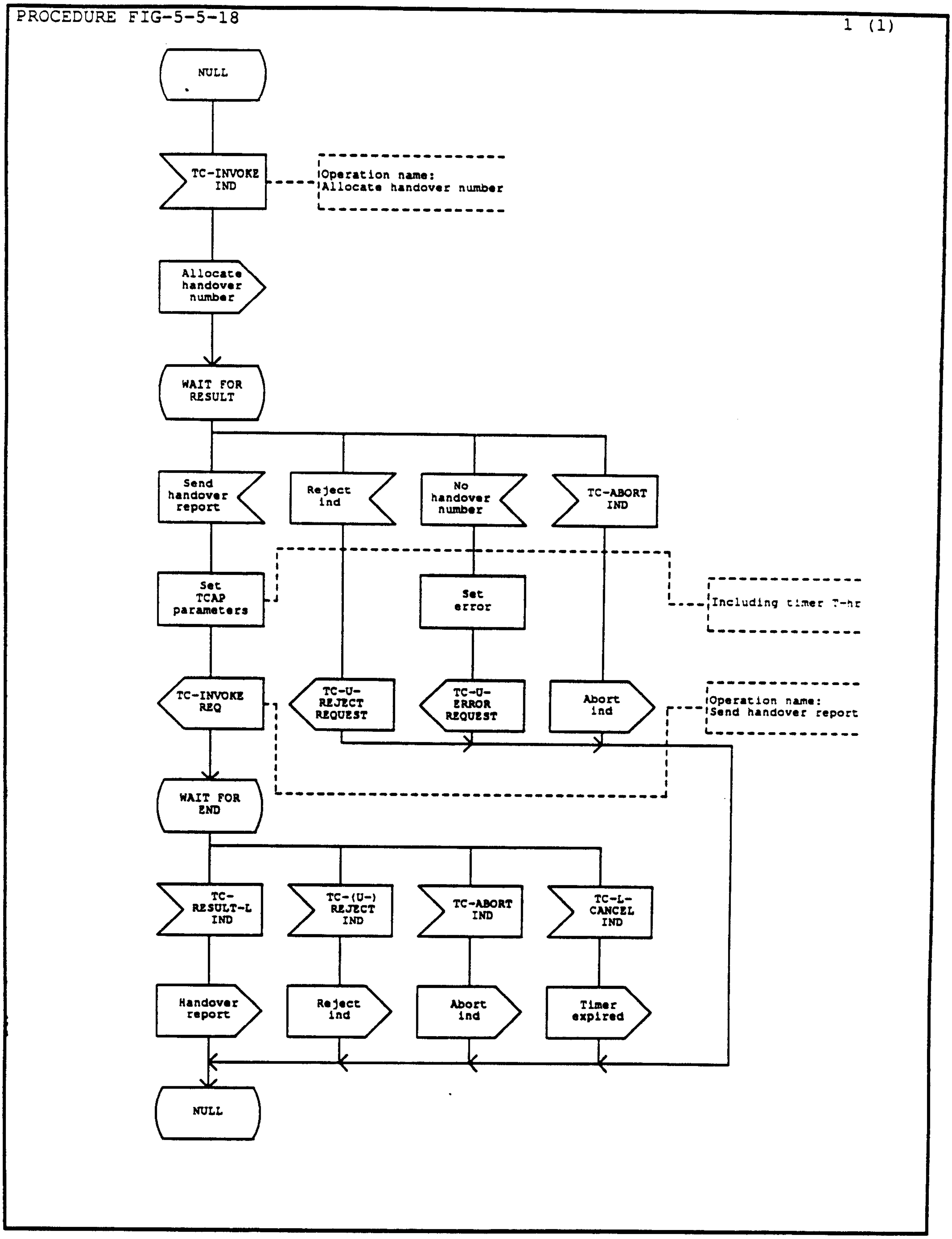


Figure 5.5.18
ASE/TCAP interface procedure in VLR for allocation of handover number.



5.5.4 Detailed procedures for handling of access signalling during handover

5.5.4.1 Procedures for receiving access signalling from the MS

5.5.4.1.1 Procedure in MSC-B

The application specific procedure is shown in Figure 5.5.19 and the ASE/TCAP interface procedure is shown in Figure 5.5.20.

When MSC-B receives an access signalling message from the MS which requires operations in MSC-A, MSC-B sends the process access signalling message to MSC-A provided that a transaction with MSC-A for that MS exists. If a transaction does not exist, an indication is given to the handover control function. The process access signalling message contains the information provided by the MS as received at the BS/MSC-B interface.

MSC-B may receive a reject indicator if the procedure fails. A message un-delivered (X) indication is then provided to the call handling function in MSC-B;

The process access signalling message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ccr. The response is received as follows:

- a TC-(U-)REJECT INDICATION primitive will report on procedure error.

5.5.4.1.2 Procedure in MSC-A

The application specific procedure is shown in Figure 5.5.21 and the ASE/TCAP interface procedure is shown in Figure 5.5.22.

When receiving the process access signalling message from MSC-B, the received data are provided to the handover control function in MSC-A.

The process access signalling message is received in a TC-INVOKE INDICATION primitive.

5.5.4.2 Procedures for forwarding access signalling to the MS

5.5.4.2.1 Procedure in MSC-A

The application specific procedure is shown in Figure 5.5.23 and the ASE/TCAP interface procedure is shown in Figure 5.5.24.

The handover control function will request sending of access signalling to the MS provided that a transaction exists with MSC-B for that MS. If a transaction does not exist, this is indicated to the handover control function. The information is coded in MSC-A in such a way that it can be passed transparently at the BS/MSC interface in MSC-B.

Any response from the MS will be passed to MSC-A by the procedure of 5.5.4.1.

An message undelivered (X) indication is provided to the handover control function if the procedure fails (receiving a reject indication or an abort indication) .

The forward access signalling message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-cci.

5.5.4.2.2 Procedures in MSC-B

The application specific procedure is contained in Figure 5.5.25 and the ASE/TCAP interface procedure is contained in Figure 5.5.26.

When receiving the forward access signalling message, MSC-B will provide the information content to the BS/MSC interface.If the message is delivered to the radio path, the call control information acknowledge message is returned. If the message cannot be delivered, the handover state undetermined is reported to MSC-A. If the MS has released or has initiated release of the radio path, the absent subscriber message is sent.

The forward access signalling message is received in a TC-INVOKE INDICATION primitive.

Figure 5.5.19
Application specific procedure in MSC-B for handling call control requests from the MS.

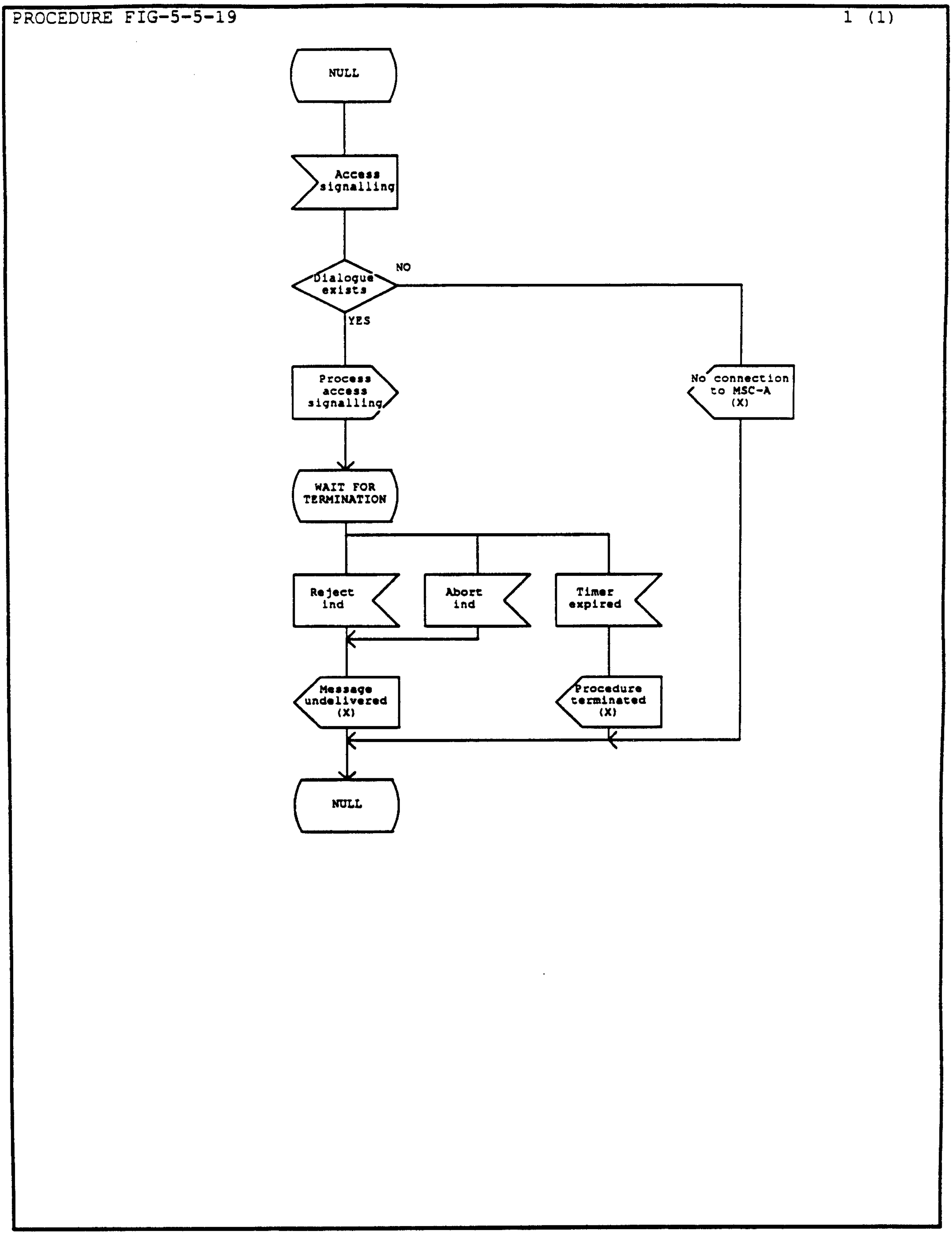


Figure 5.5.20
ASE/TCAP interface procedure in MSC-B for handling of call control requests from the MS.

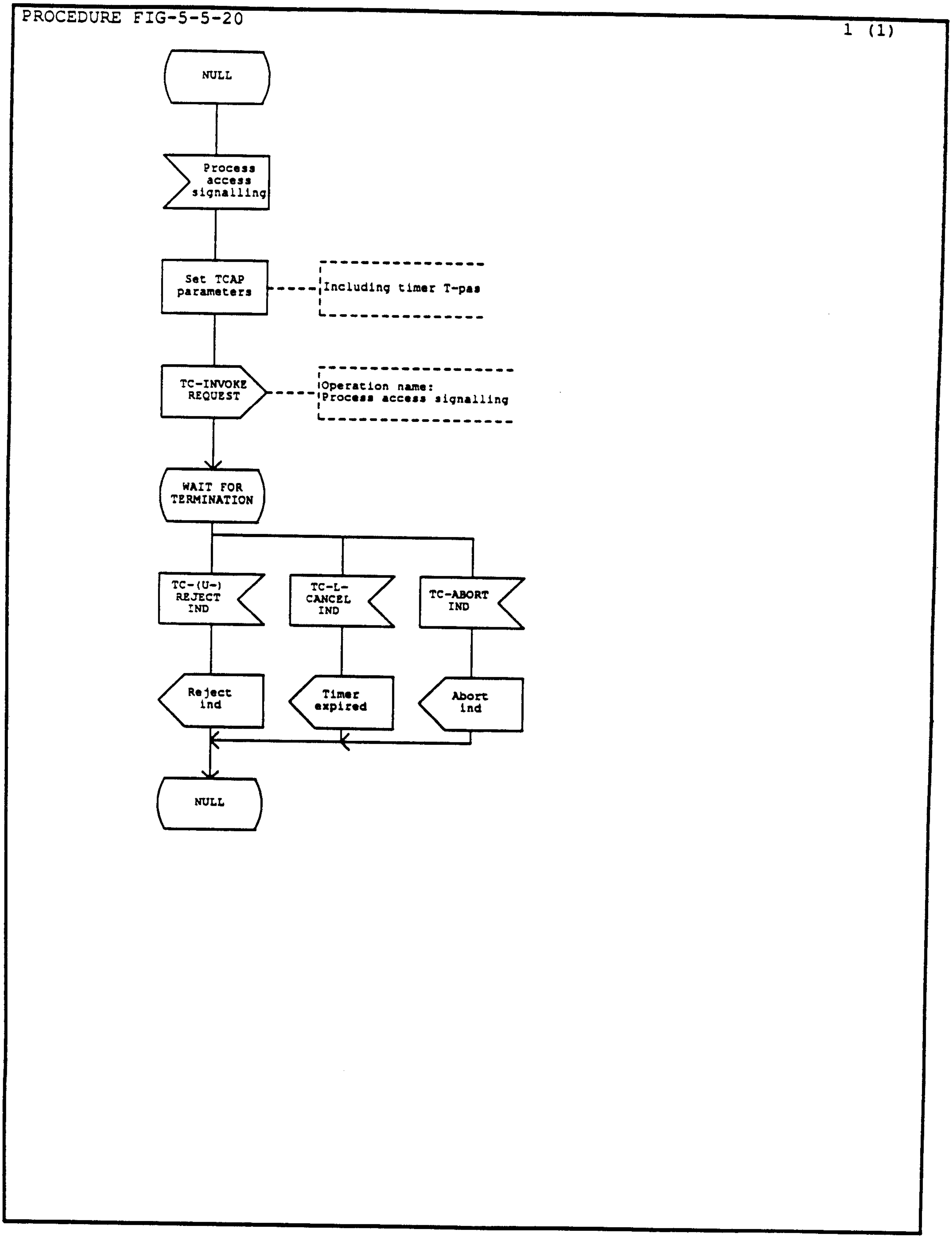


Figure 5.5.21
Application specific procedure in MSC-A for handling of call control requests from the MS.

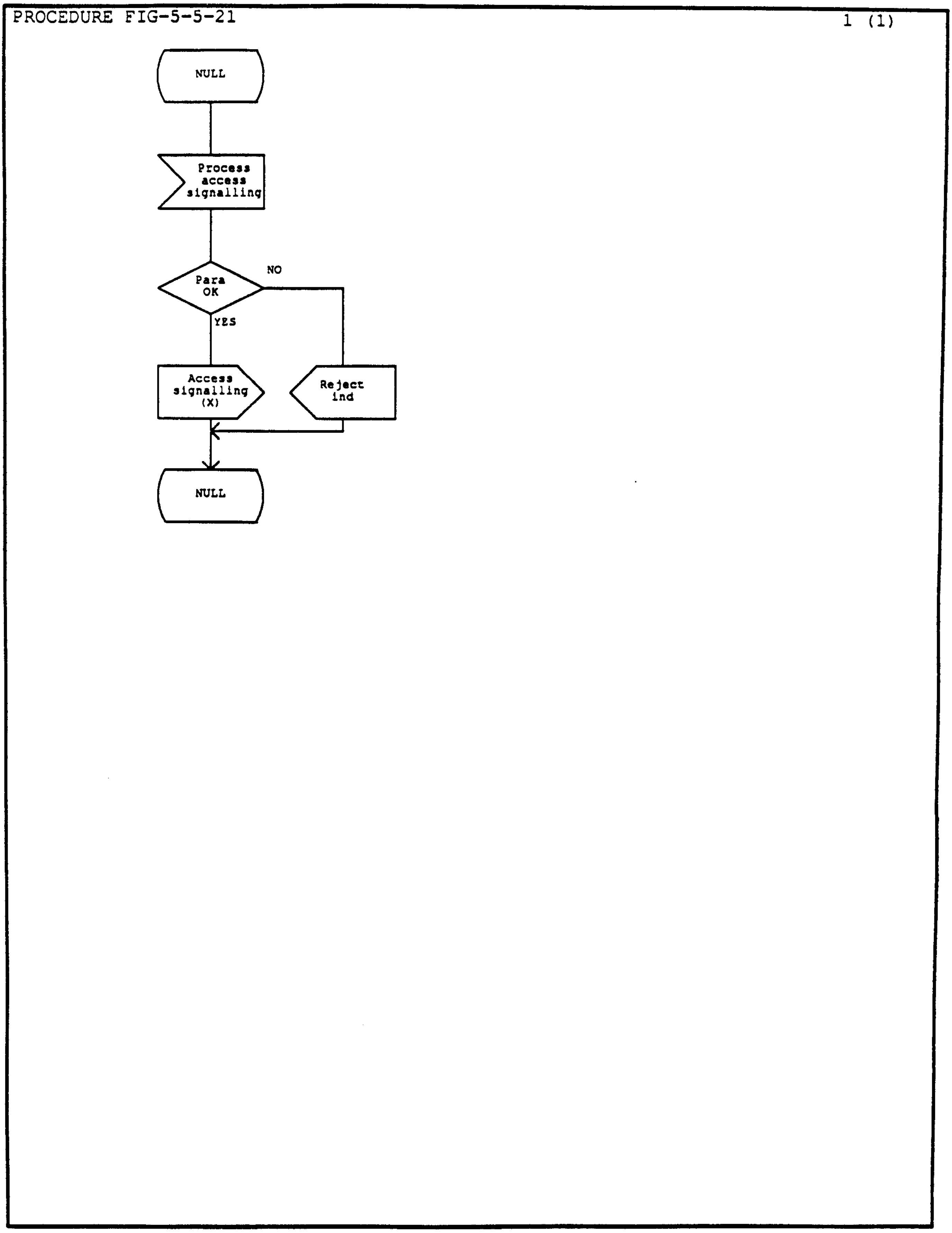


Figure 5.5.22
ASE/TCAP interface procedure in MSC-A for handling of call control request from the MS.

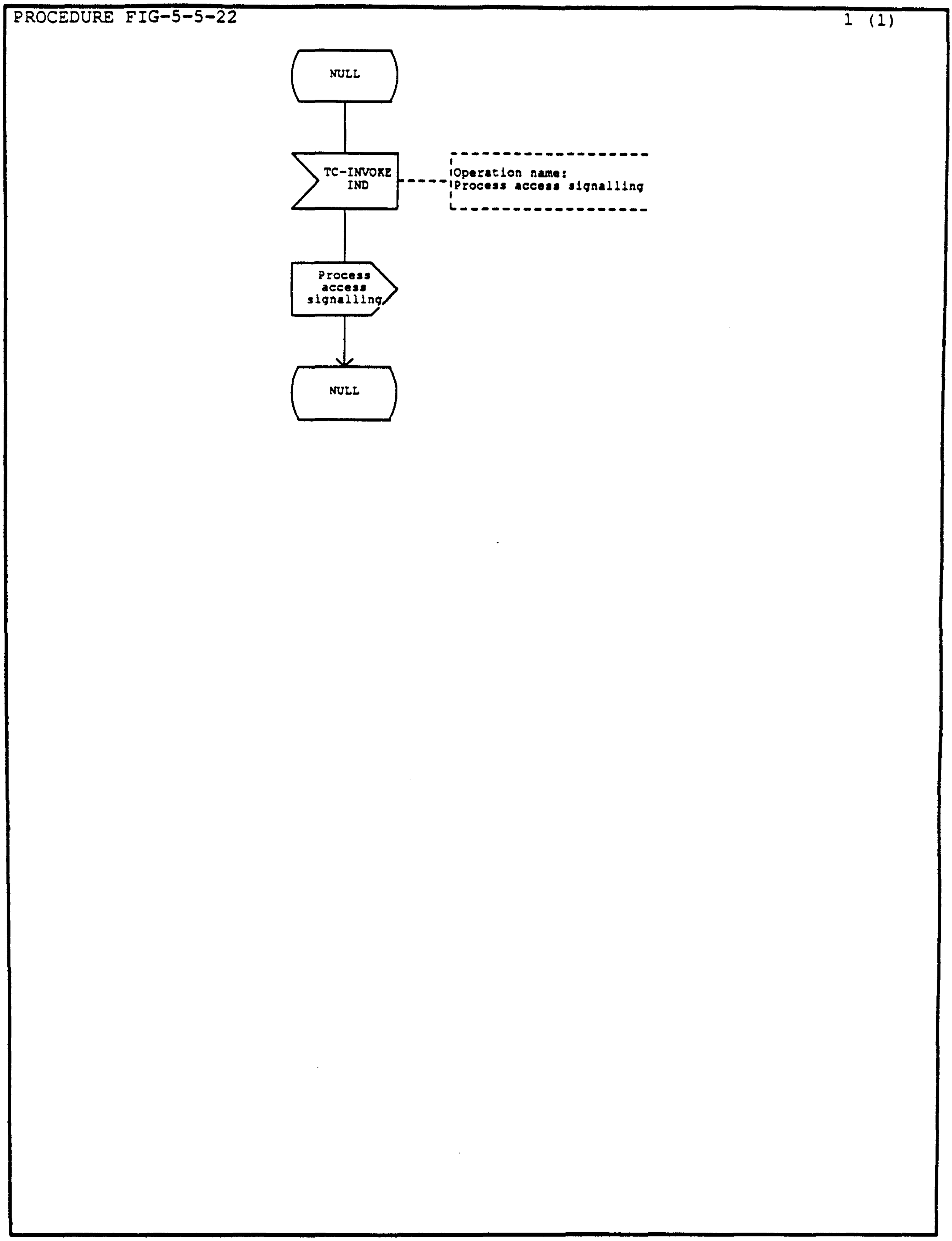


Figure 5.5.23
Application specific procedure in MSC-A for providing call control information to the MS during handover.

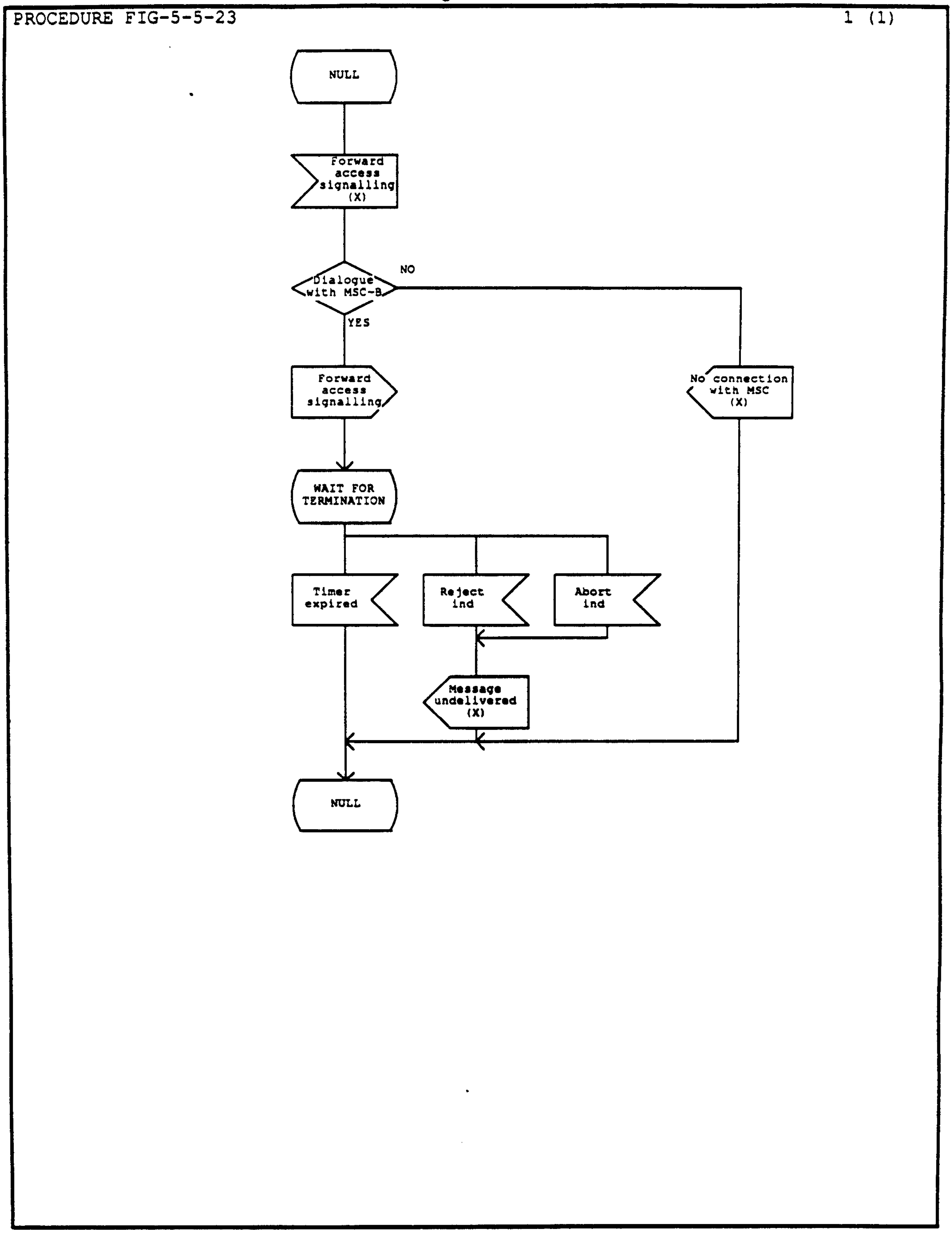


Figure 5.5.24
ASE/TCAP interface procedure in MSC-A for providing call control information to the MS during handover.

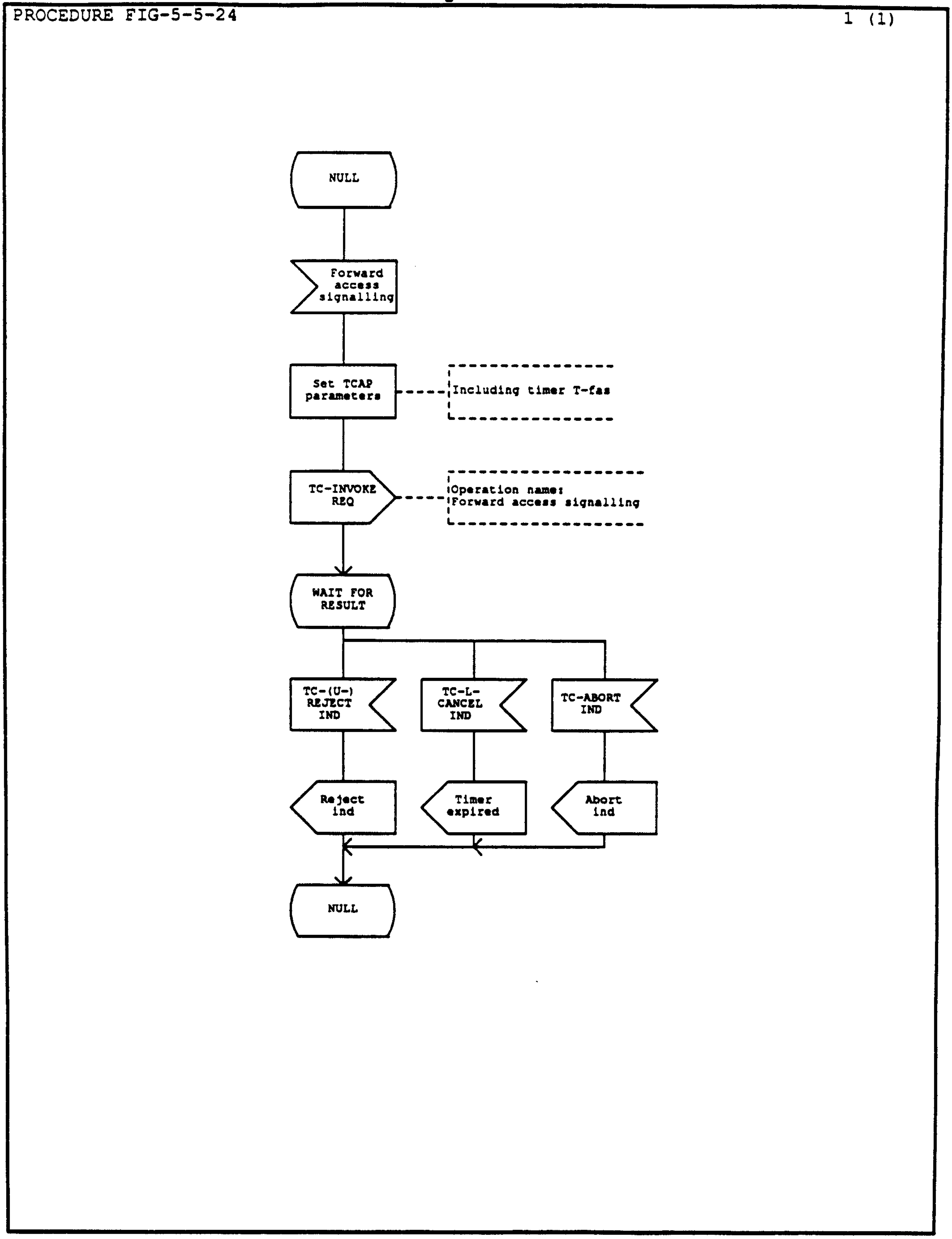


Figure 5.5.25
Application specific procedure in MSC-B for providing call control information to the MS during handover.

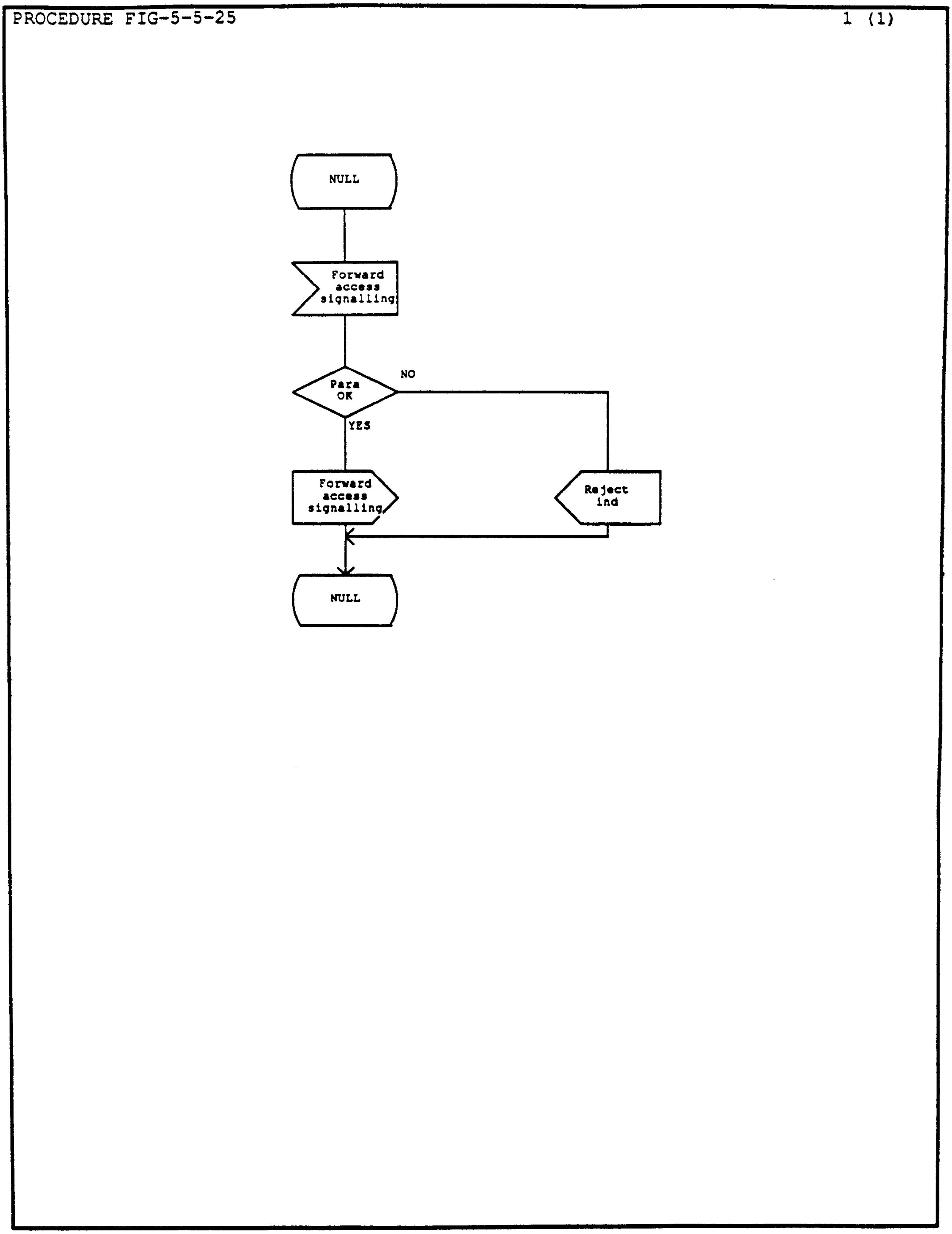
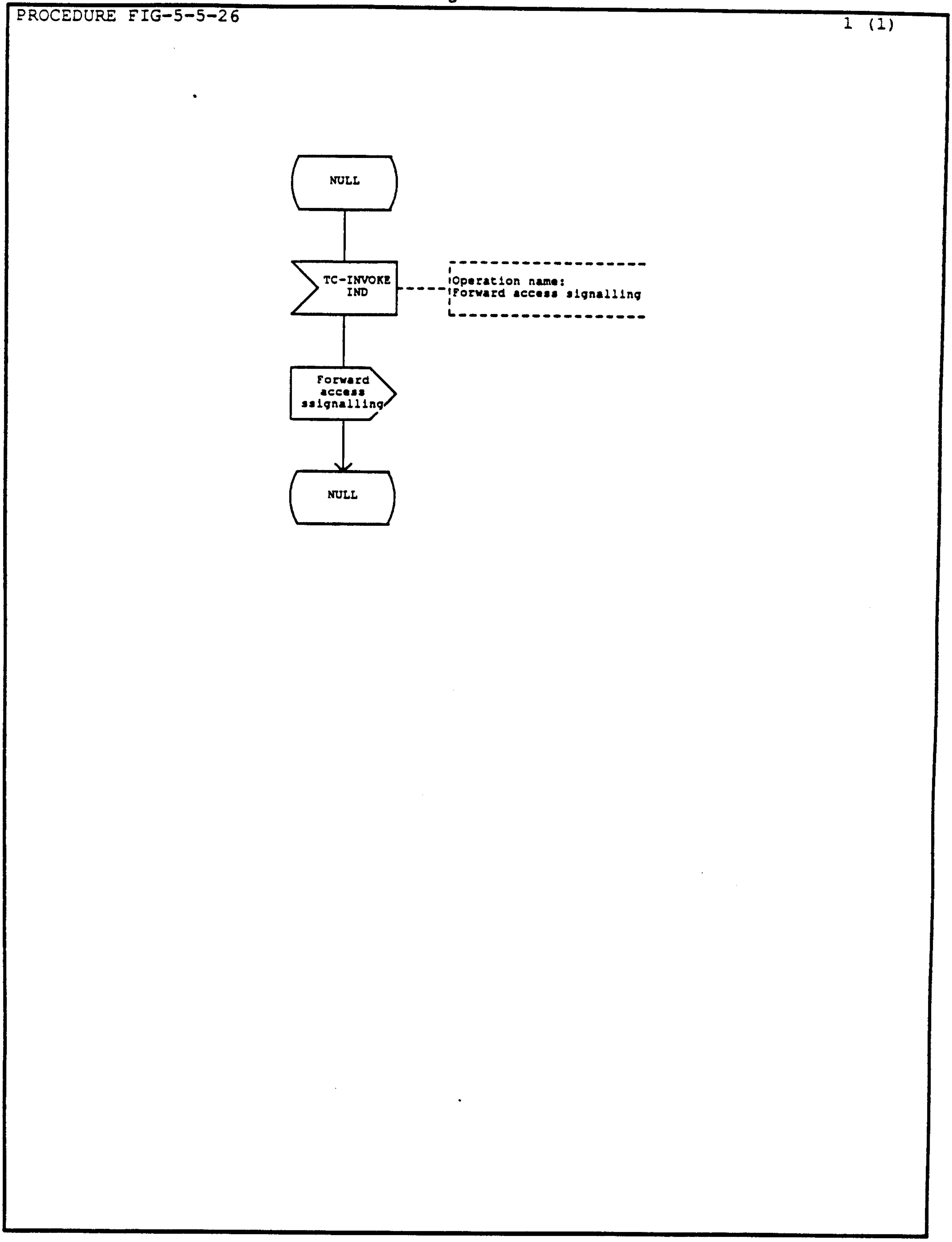


Figure 5.5.26
ASE/TCAP interface procedure in MSC-B for providing call control information to the MS during handover.



5.6 Subscriber management

5.6.1 Retrieval of subscriber data

5.6.1.1 Definition of interfaces

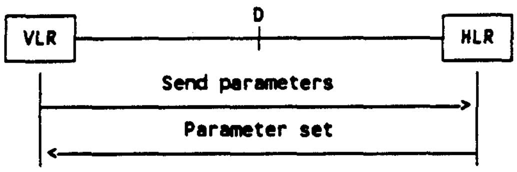
In this category there are three procedures:

i) Subscriber parameter request procedure by which a visitor location register may request the home location register to provide subscriber parameters for a specified MS;

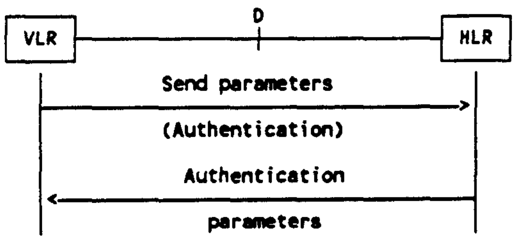
ii) Authentication set request procedure by which a visitor location register may request the home location register to provide authentication sets for a specified MS;

iii) IMSI plus authentication set request procedure by which a visitor location register may request the old visitor location register to provide IMSI plus authentication sets for a specified MS;

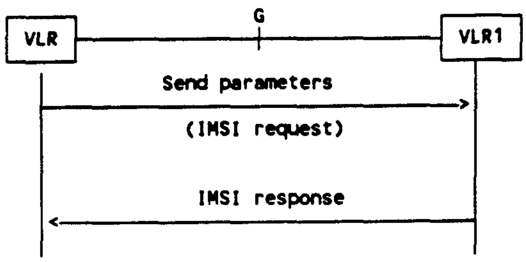
Figure 5.6.1 shows the interfaces and procedures for the three categories defined above.



a) Subscriber parameter request procedure



b) Authentication set request procedure



c) IMSI plus authentication set request procedure

Figure 5.6.1 Interfaces and procedures for location information management.

5.6.1.2 General description of procedures

In the subscriber parameter request procedure the visitor location register sends a send parameters (subscriber parameters) message to the home location register in order to update its database.

The procedure may be used if a VLR receives a request for MSRN for an MS which is not registered in the VLR, in that case all subscriber data for the MS is requested to be retrieved. The procedure may also be used to fetch subscriber data which is not provided to the VLR from the HLR at location updating. The latter case is only applicable for CUG data, and needs further study.

The home location register will return the parameter set message containing the requested parameter set (all subscriber data or CUG information).

The visitor location register may also fetch authentication sets from the home location register. This procedure is described in detail in section 5.10.3.

The visitor location register may also fetch IMSI plus authentication sets from the old visitor location register at location updating. This procedure is described in detail in section 5.2.1.

5.6.1.3 Detailed description of subscriber parameter request

5.6.1.3.1 Procedure in the VLR

The application specific procedure is shown in Figure 5.6.2 and the ASE/TCAP interface procedure is shown in Figure 5.6.3.

The send parameters (subscriber parameters) message is sent to the HLR and TCAP is requested to supervise the procedure by timer T-par. The response to this message is either of the following:

- the parameter set message is received if the MS is known in the HLR;
- a reject indication or timer expired indication reporting procedure error. The message is then undelivered;
- either of the following negative results:
  - i) unknown subscriber. In this case the MS is deleted in the VLR;
  - ii) unexpected data value.

The send parameters (subscriber parameters) message is sent in a TC-INVOKE REQUEST primitive. The outcome of the procedure is received as follows:

- the parameter set message is received in a TC-RESULT-L INDICATION primitive;
- a reject indication is included in a TC-U-REJECT INDICA-TION primitive and a timer expiry is reported by a TC-L-CANCEL INDICATION primitive;
- a negative result is received in a TC-U-ERROR INDICATION primitive as follows:
  - i) unknown subscriber;
  - ii) unexpected data value.

5.6.1.3.2 Procedure in the HLR

The application specific procedure is shown in Figure 5.6.4 and the ASE/TCAP interface procedure is shown in Figure 5.6.5.

When receiving the send parameters (subscriber parameters) message, the HLR acts as follows:

- if the MS is unknown, the unknown subscriber message is returned;
- if there are parameter or data errors in the message, a Reject indication or an Unexpected data value message is returned, respectively;
- if the MS is known in the HLR, the parameter set message is returned with all the requested subscriber parameters included.

The send parameters (subscriber parameters) message is received in a TC-INVOKE REQUEST primitive and the parameter set message is returned in a TC-RESULT-L REQUEST primitive. The reject indication is reported in a TC-U-REJECT REQUEST primitive. Negative results are returned as follows in a TC-U-ERROR REQUEST primitive:

i) unknown subscriber
ii) unexpected data value.

Figure 5.6.2
Application specific procedure in VLR for subscriber parameter request.

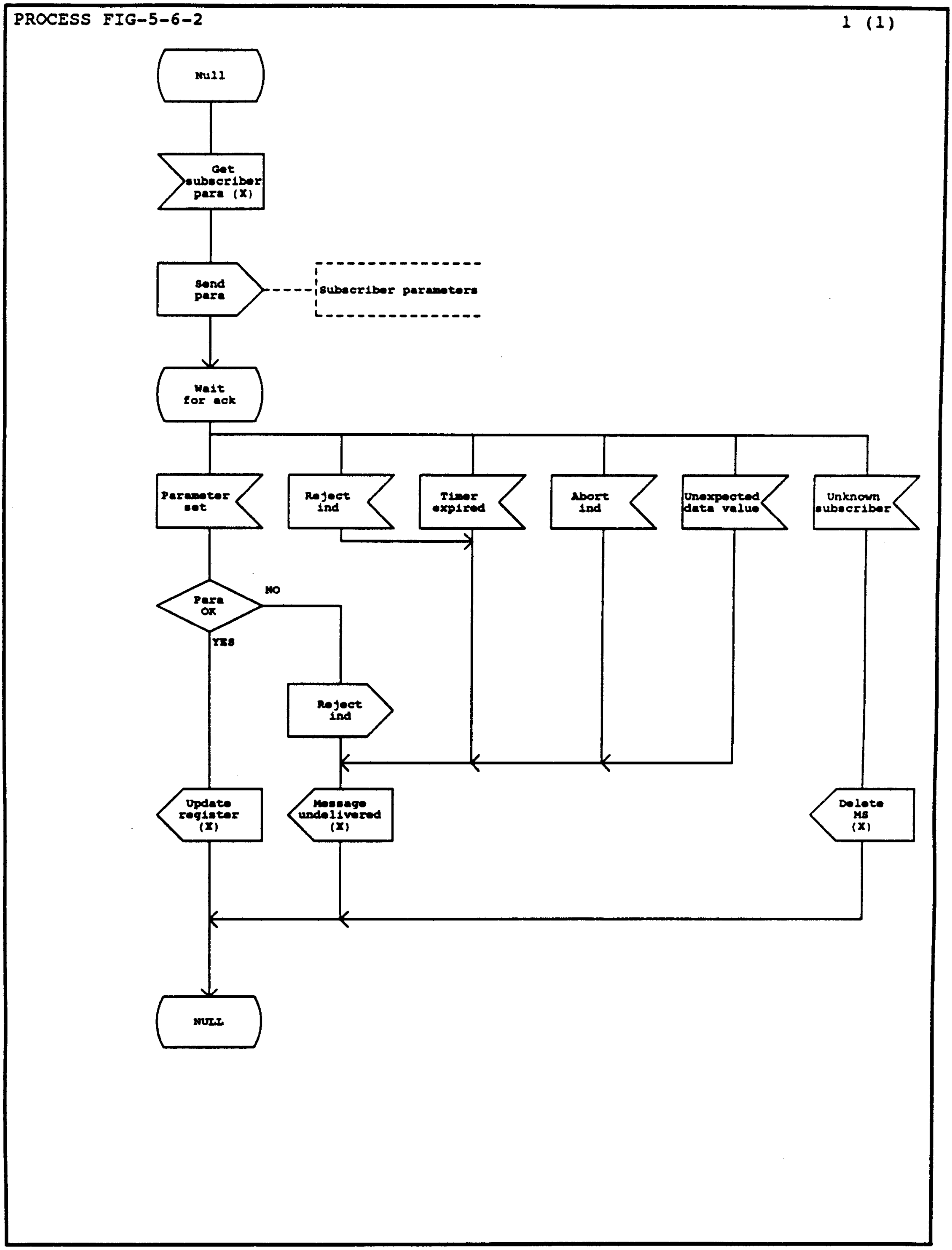


Figure 5.6.3
ASE/TCAP interface procedure in VLR for subscriber parameter request.

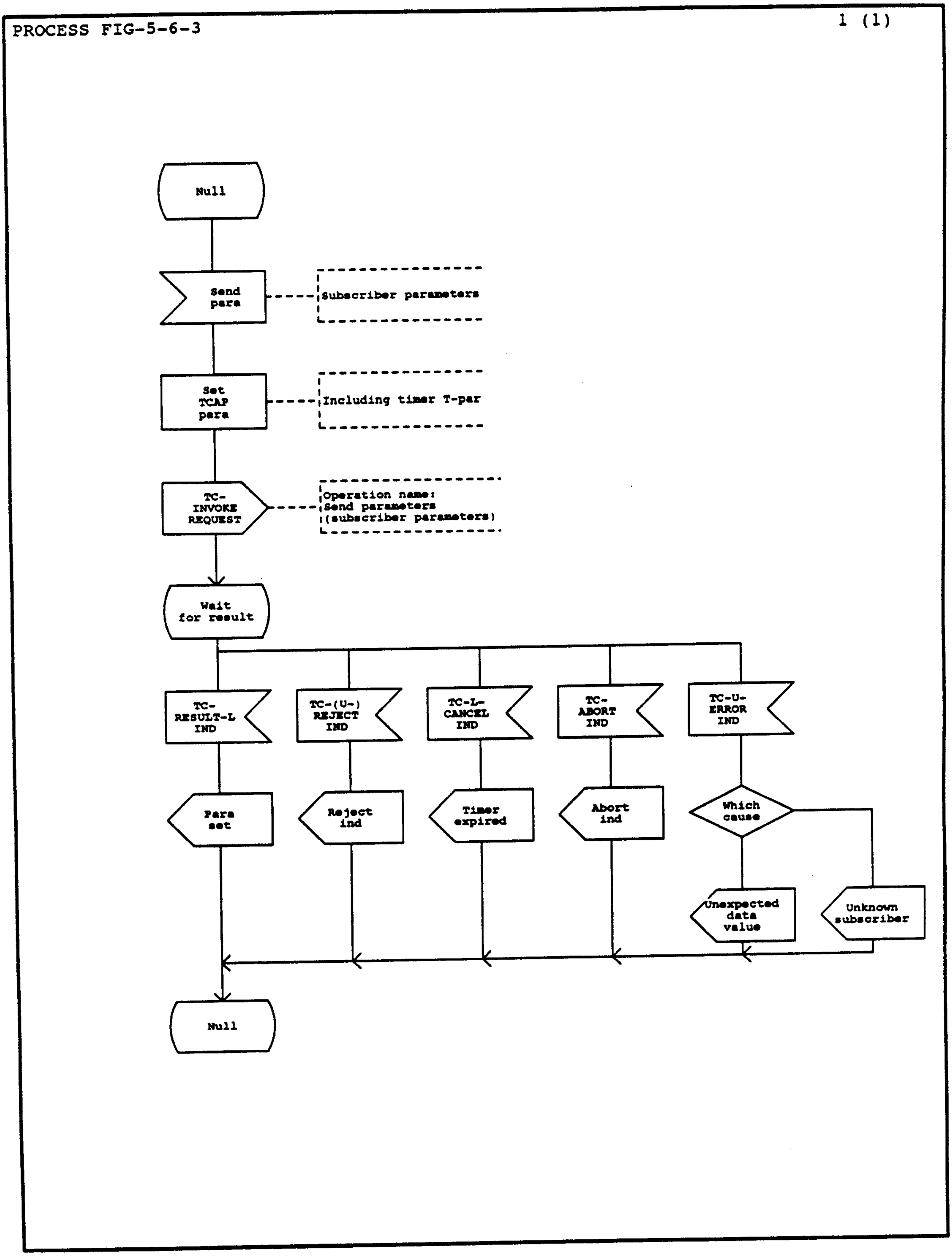


Figure 5.6.4
Application specific procedure in HLR for subscriber parameter request.

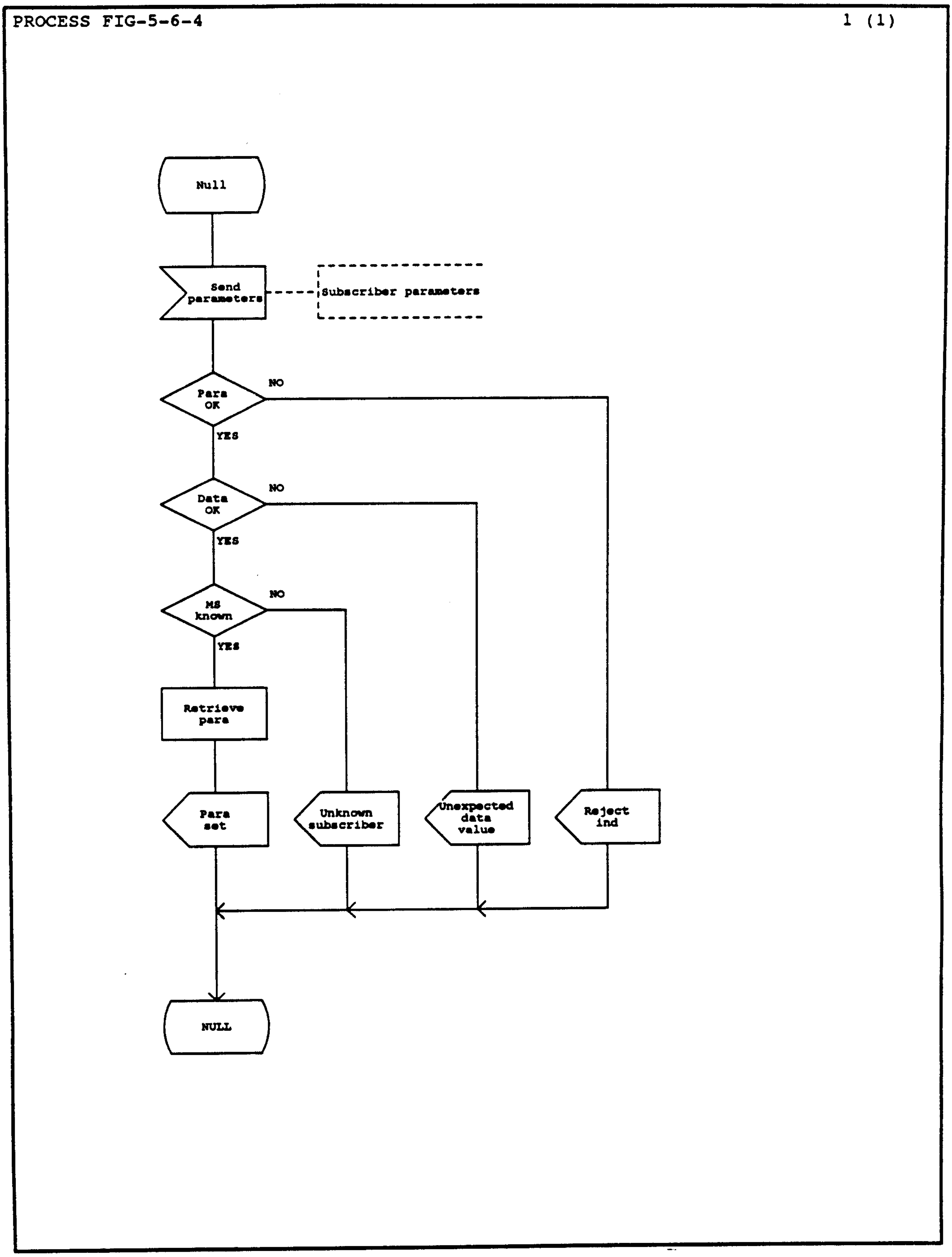
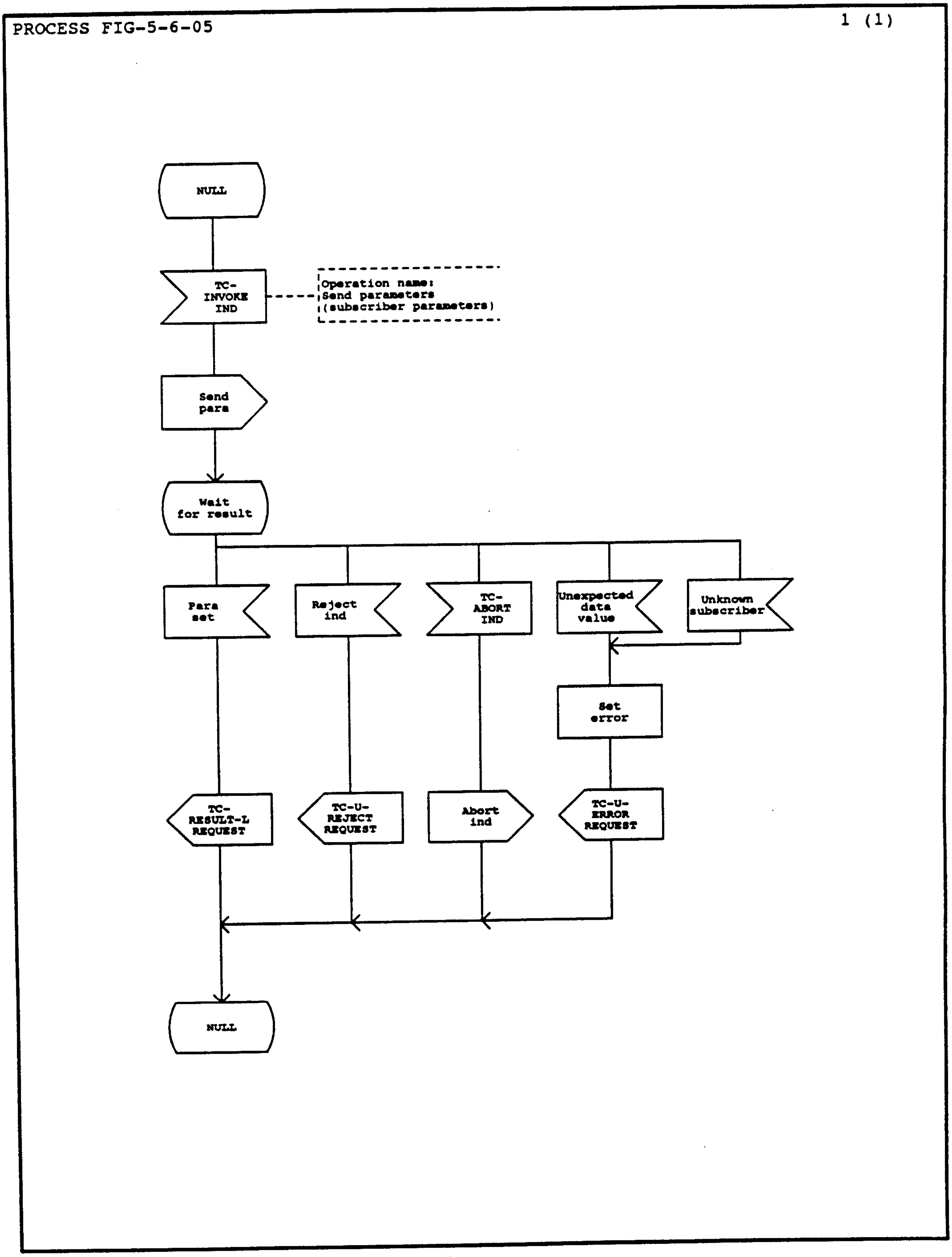


Figure 5.6.5
ASE/TCAP interface procedure in HLR for subscriber parameter request.



5.6.2 Updating of subscriber data in visitor location register

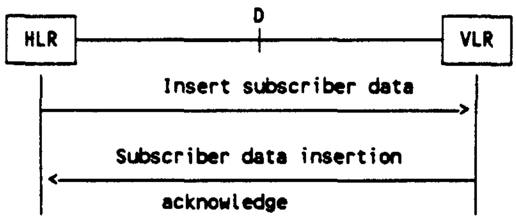
5.6.2.1 Definition of interfaces

There are two ways for an HLR to update a VLR with information regarding subscriber parameters:

i) when subscriber data shall be inserted in VLR, the Insert Subscriber data procedure is used.

ii) when subscriber data shall be removed in VLR, the Delete Subscriber data procedure is used.

Figure 5.6.6 shows the interface for the two procedures defined above.



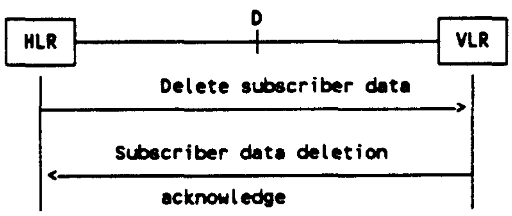
The procedure is used in the following cases:

i) the MS has changed, by administrative means, the subscription of one or more supplementary services, basic services, or changed its subscriber data;

ii) changes has been made to other subscriber parameters of the MS;

iii) the MS has changed, using a supplementary services procedure, data concerning one or more supplementary services, e.g. a forwarded-to number;

iv) to provide subscriber parameters to the VLR at location updating (see also section 5.2.1).



The procedure is used in the following cases:

i) the MS has changed, by administrative means, the subscription of one or more supplementary services or basic services.

Figure 5.6.6 Interface and procedures for updating of subscriber data in visitor location register.

5.6.2.2 General description of procedures

The procedures are shown in Figure 5.6.6 and consists of the exchange of the following messages:

- insert subscriber data message (from home location register),
- subscriber data insertion acknowledge (from visitor location register),
- delete subscriber data message (from home location register),
- subscriber data deletion acknowledge (from visitor location register).

5.6.2.3 Detailed procedures for insert subscriber data

5.6.2.3.1 Procedure in HLR

The application specific procedures are contained in Figure 5.6.7, and the ASE/TCAP interface procedure is contained in Figure 5.6.8.

When a change is made to some subscriber parameters in the HLR (e.g. supplementary services data, subscriber data), due to changes performed by the operator or performed by the MS using a supplementary services procedure, the HLR initiates updating of the VLR (insert subscriber data message). This message will only contain the changed parameters, i.e.only the parameters affected by the change is reported to the VLR.

When receiving an update location message, the HLR will also use the insert subscriber data message to provide all needed subscriber parameters to the VLR. If all information cannot be contained in one message, the HLR will send the remaining parameters in additional insert subscriber data messages, still using the same transaction for all messages.

If the MS is in the VLR, the HLR will receive the subscriber data insertion acknowledge message. However, if the procedure fails (timer expiry, rejection, transaction abort, or receipt of data missing or unexpected data value messages), an indication that the message is undelivered should be stored. The same applies if the acknowledgement message contains parameter errors. The message may then be retransmitted later. If the unidentified subscriber message is received, the HLR should remove the mobile station roaming number (if allocated) and mark the MS as deregistered (indicated by the task: update register (unknown location)).

The insert subscriber data message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-isd. The out come of the procedure is reported as follows:

- the subscriber data insertion acknowledge message is contained in a TC-RESULT-L INDICATION primitive;
- timer expiry (timer T-isd) is reported in a TC-L-CANCEL INDICATION primitive;
- procedure failure is reported in a TC-(U-) REJECT INDICATION primitive;
- the unidentified subscriber message is contained in a TC-U-ERROR INDICATION primitive.
- Data missing and unexpected data value messages are also received in TC-U-ERROR INDICATION primitives.

5.6.2.3.2 Procedure in VLR

The application specific procedures are contained in Figure 5.6.9, and the ASE/TCAP interface procedure is contained in Figure 5.6.10.

When receiving an insert subscriber data message the VLR will update the register if the MS is registered in the VLR. This will be the case even if the VLR receives subscriber data which is not supported by the VLR implementation, but otherwise is formatted correctly.

If the MS is not registered, the VLR will return the unidentified subscriber message. If the message contains parameter or data errors, the VLR ignores the message and returns a reject indication or one of the messages data missing or unexpected data value depending upon the nature of the error.

The insert subscriber data message is received in a TC-INVOKE INDICATION primitive. A TC-RESULT-L REQUEST primitive is used to acknowledge that the VLR has accepted the message and acted upon it.

If the message contains parameter errors, the appropriate indication is returned in a TC-U-REJECT REQUEST primitive. The unidentified subscriber, data missing or unexpected data value message is returned in a TC-U-ERROR REQUEST primitive.

Figure 5.6.7
Application specific procedure in home location register for insertion of subscriber data.

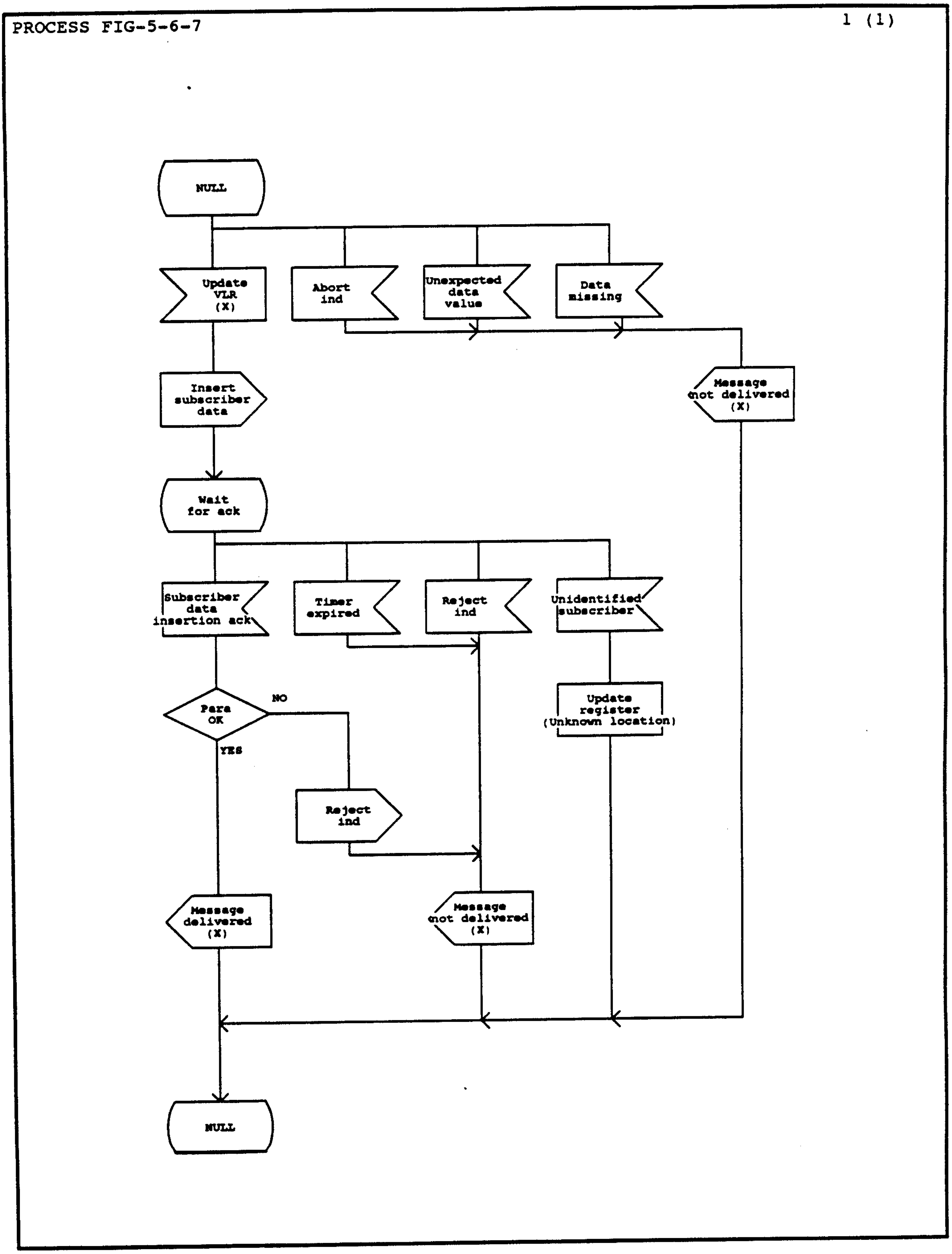


Figure 5.6.8
ASE/TCAP interface procedure in HLR for insertion of subscriber data.

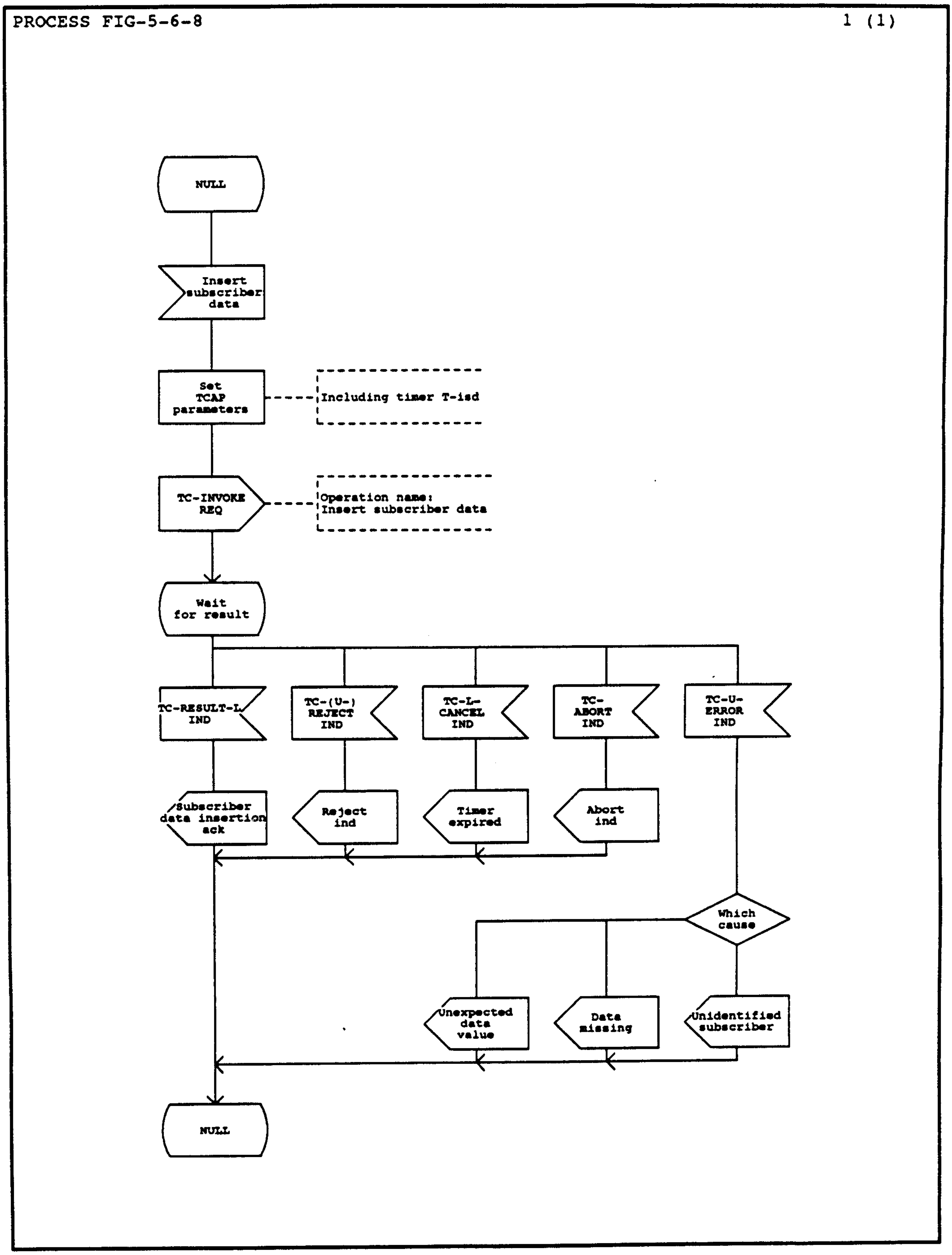


Figure 5.6.9
Application specific procedure in visitor location register for insertion of subscriber data.

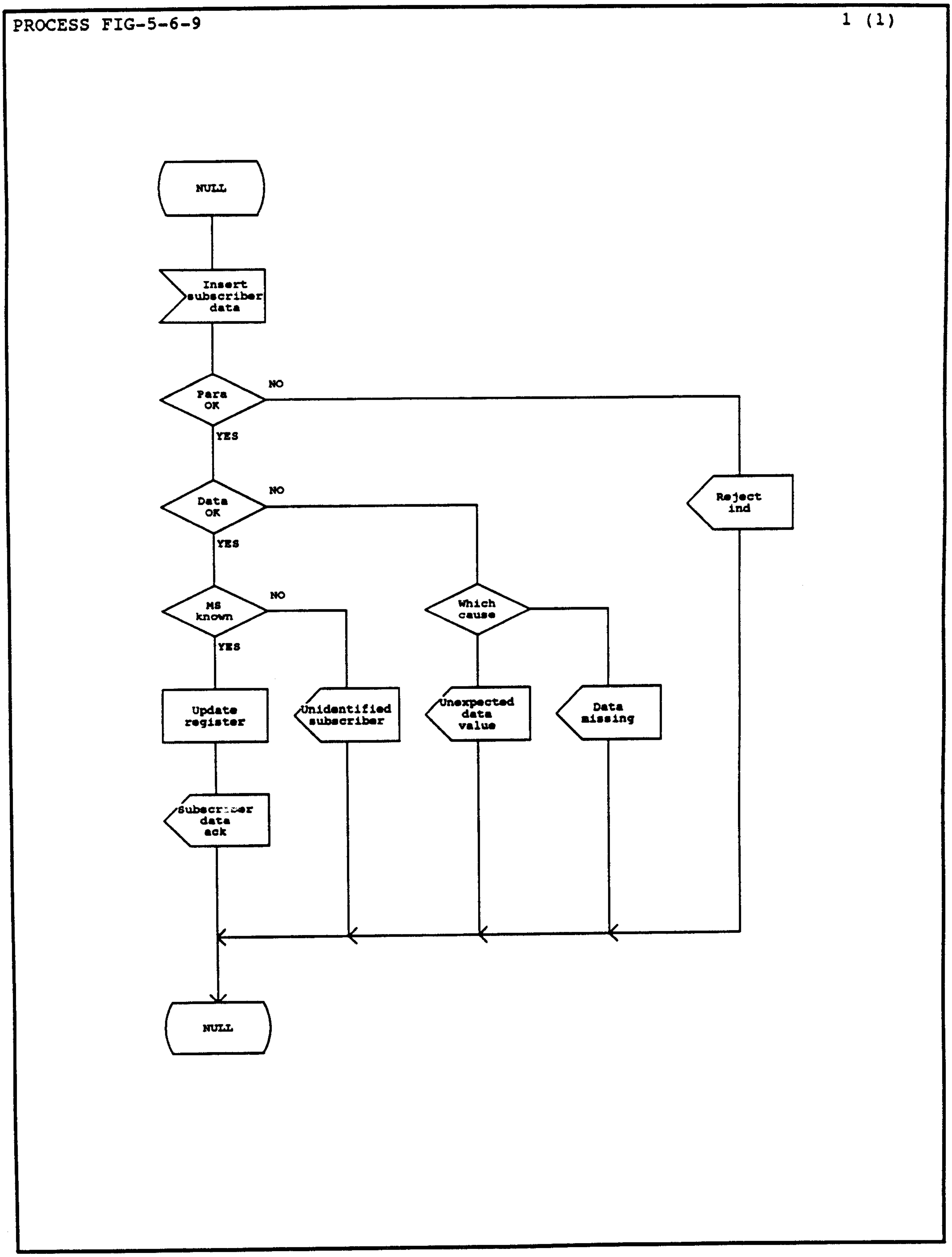
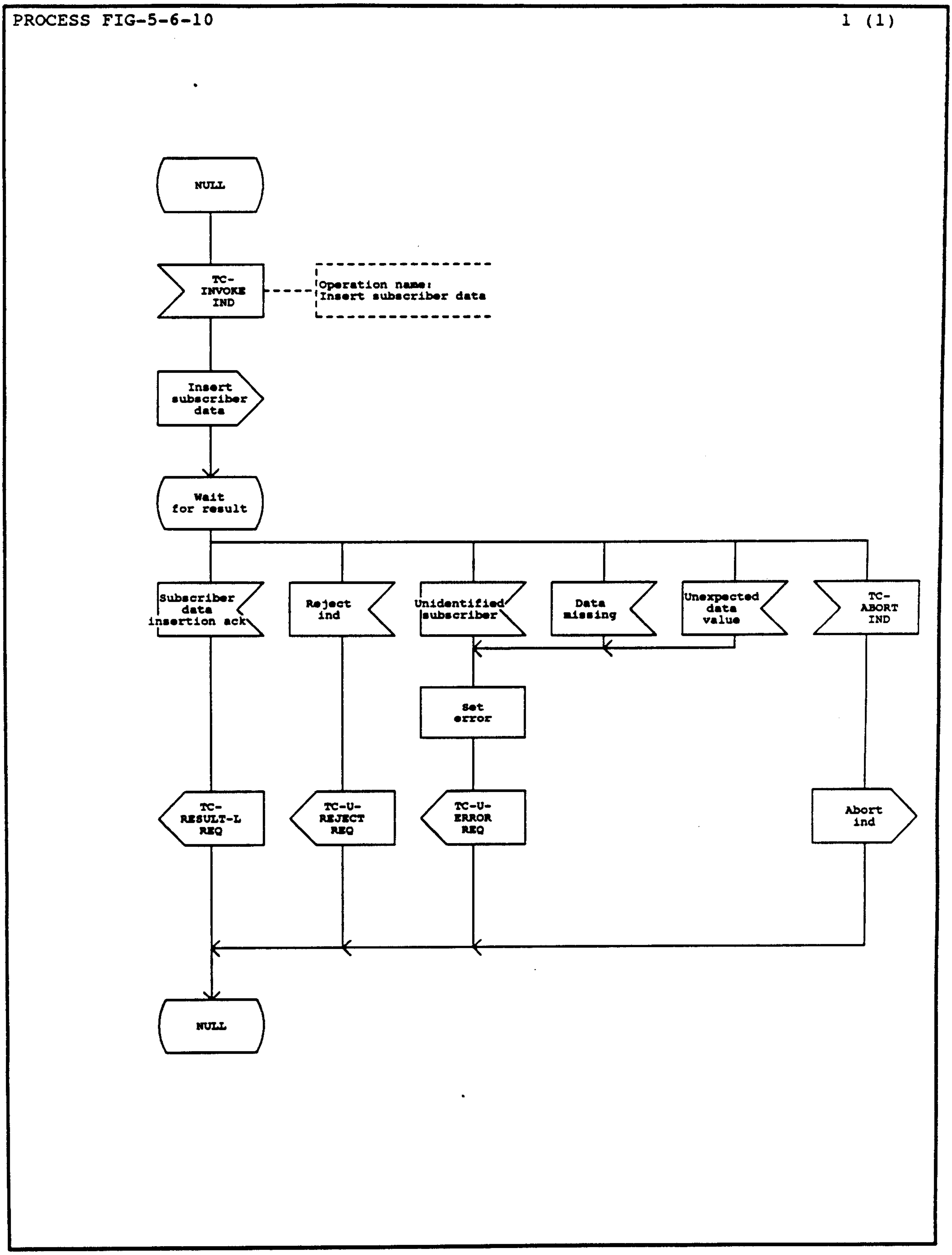


Figure 5.6.10
ASE/TCAP interface procedure in the VLR for insertion of subscriber data.



5.6.2.4 Detailed procedures for delete subscriber data

5.6.2.4.1 Procedure in HLR

The application specific procedures are contained in Figure 5.6.11, and the ASE/TCAP interface procedure is contained in Figure 5.6.12.

When a change is made in HLR which implies deletion of a subscribed service (basic service or supplementary service and the related data), the HLR initiates updating of the VLR with the delete subscriber data message. If all information cannot be contained in one message, the HLR will send the remaining parameters in additional delete subscriber data messages, still using the same transaction for all messages.

If the MS is in the VLR, the HLR will receive the subscriber data deletion acknowledge message. However, if the procedure fails (timer expiry, rejection, transaction abort, or receipt of data missing or unexpected data value messages), an indication that the message is undelivered should be stored. The same applies if the acknowledgement message contains parameter errors. The message may then be retransmitted later. If the unidentified subscriber message is received, the HLR should remove the mobile station roaming number (if allocated) and mark the MS as deregistered (indicated by the task: update register (unknown location)).

The delete subscriber data message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-dsd. The outcome of the procedure is reported as follows:

- the subscriber data deletion acknowledge message is contained in a TC-RESULT-L INDICATION primitive;

- timer expiry (timer T-dsd) is reported in a TC-L-CANCEL INDICATION primitive;

- procedure failure is reported in a TC-(U-)REJECT INDICATION primitive;

- the unidentified subscriber message is contained in a TC-U-ERROR INDICATION primitive.

- Data missing and unexpected data value messages are also received in TC-U-ERROR INDICATION primitives.

5.6.2.4.2 Procedure in VLR

The application specific procedures are contained in Figure 5.6.13, and the ASE/TCAP interface procedure is contained in Figure 5.6.14.

When receiving a delete subscriber data message the VLR will update the register if the MS is registered in the VLR.

If the MS is not registered, the VLR will return the unidentified subscriber message. If the message contains parameter or data errors, the VLR ignores the message and returns a reject indication or one of the messages data missing or unexpected data value depending upon the nature of the error.

The delete subscriber data message is received in a TC-INVOKE INDICATION primitive. A TC-RESULT-L REQUEST primitive is used to acknowledge that the VLR has accepted the message and acted upon it. If the message contains parameter errors, the appropriate indication is returned in a TC-U-REJECT REQUEST primitive. The unidentified subscriber, data missing or unexpected data value message is returned in a TC-U-ERROR REQUEST primitive.

Figure 5.6.11
Application specific procedure in home location register for deletion of subscriber data.

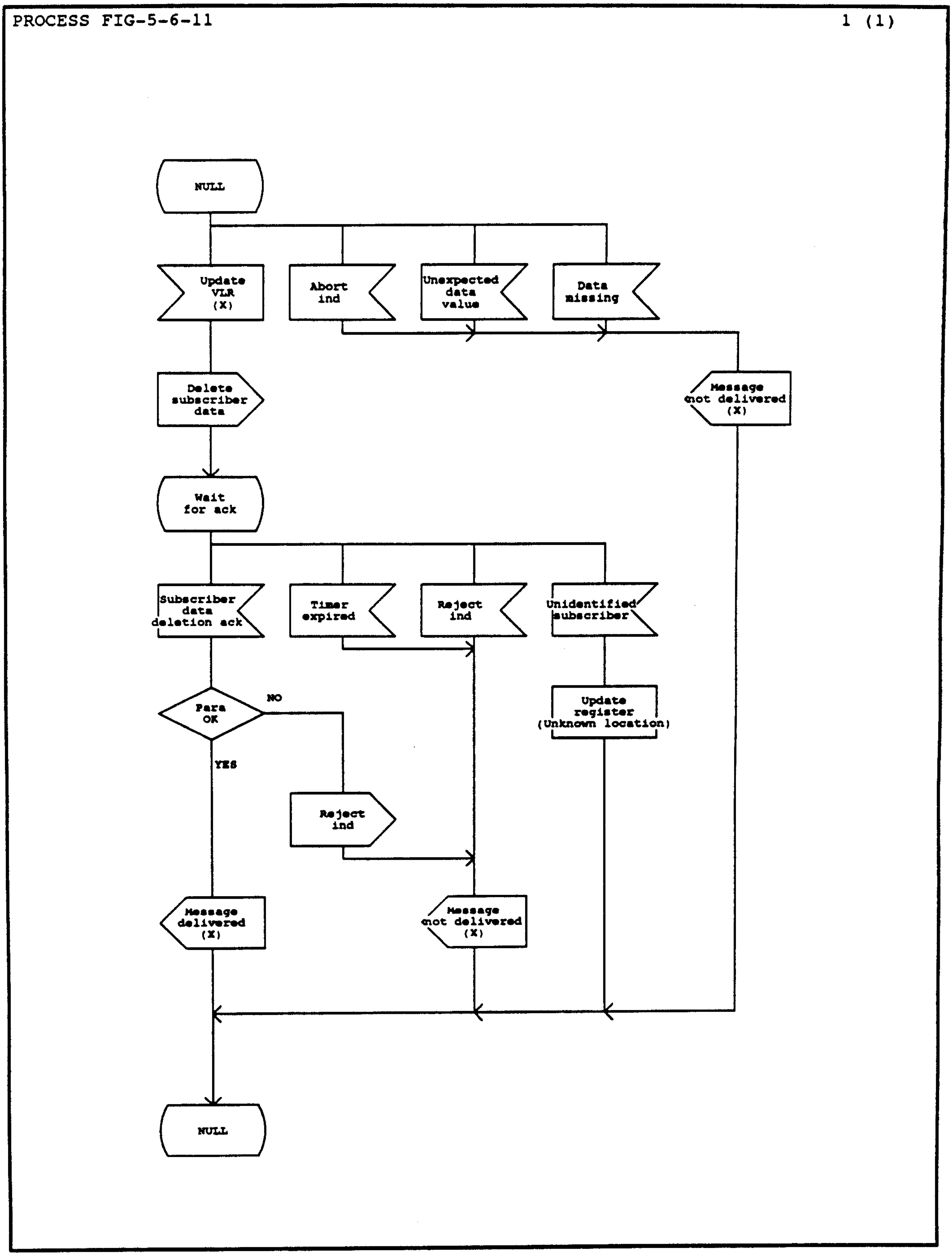


Figure 5.6.12
ASE/TCAP interface procedure in the HLR for deletion of subscriber data.

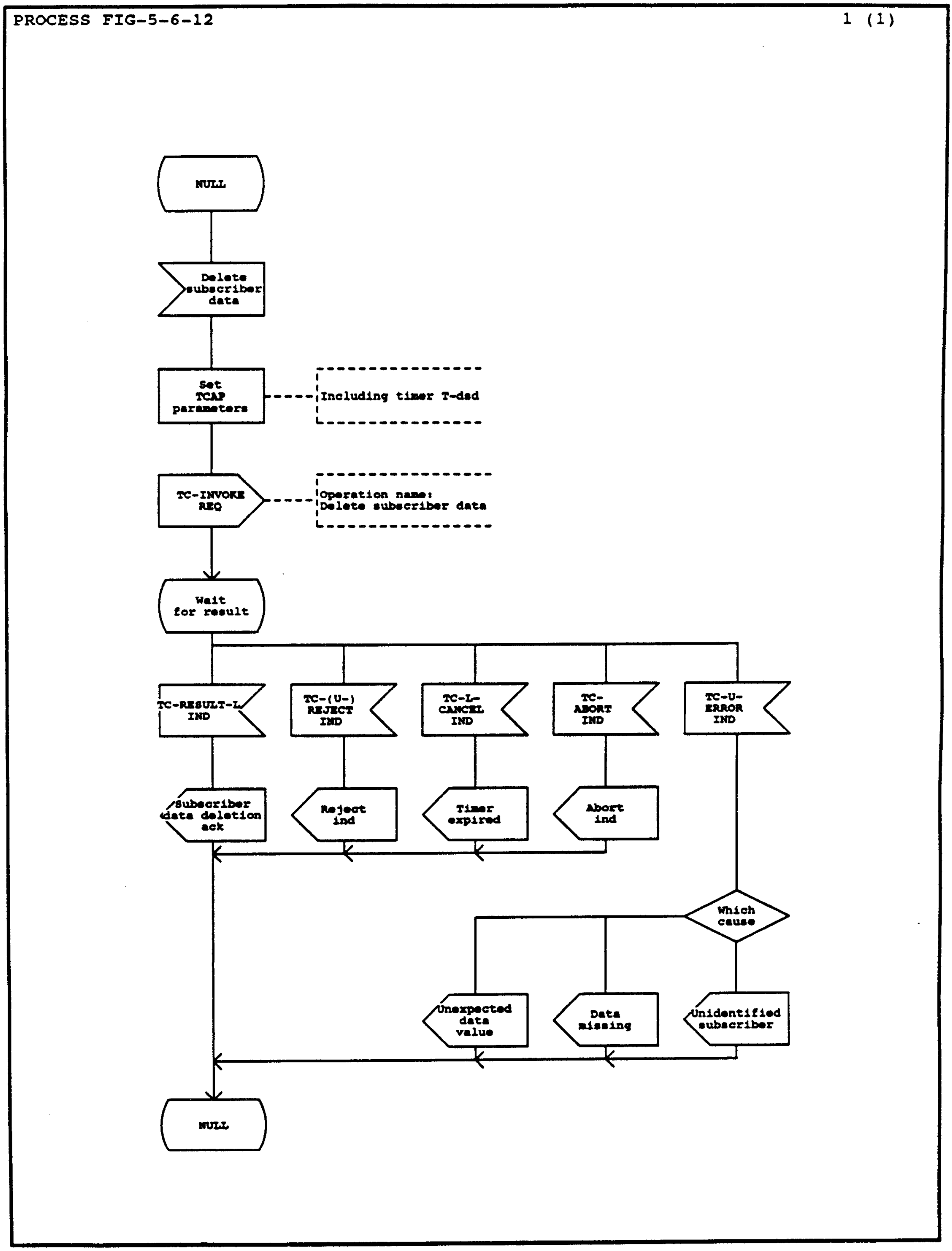


Figure 5.6.13
Application specific procedure in the visitor location register for deletion of subscriber data.

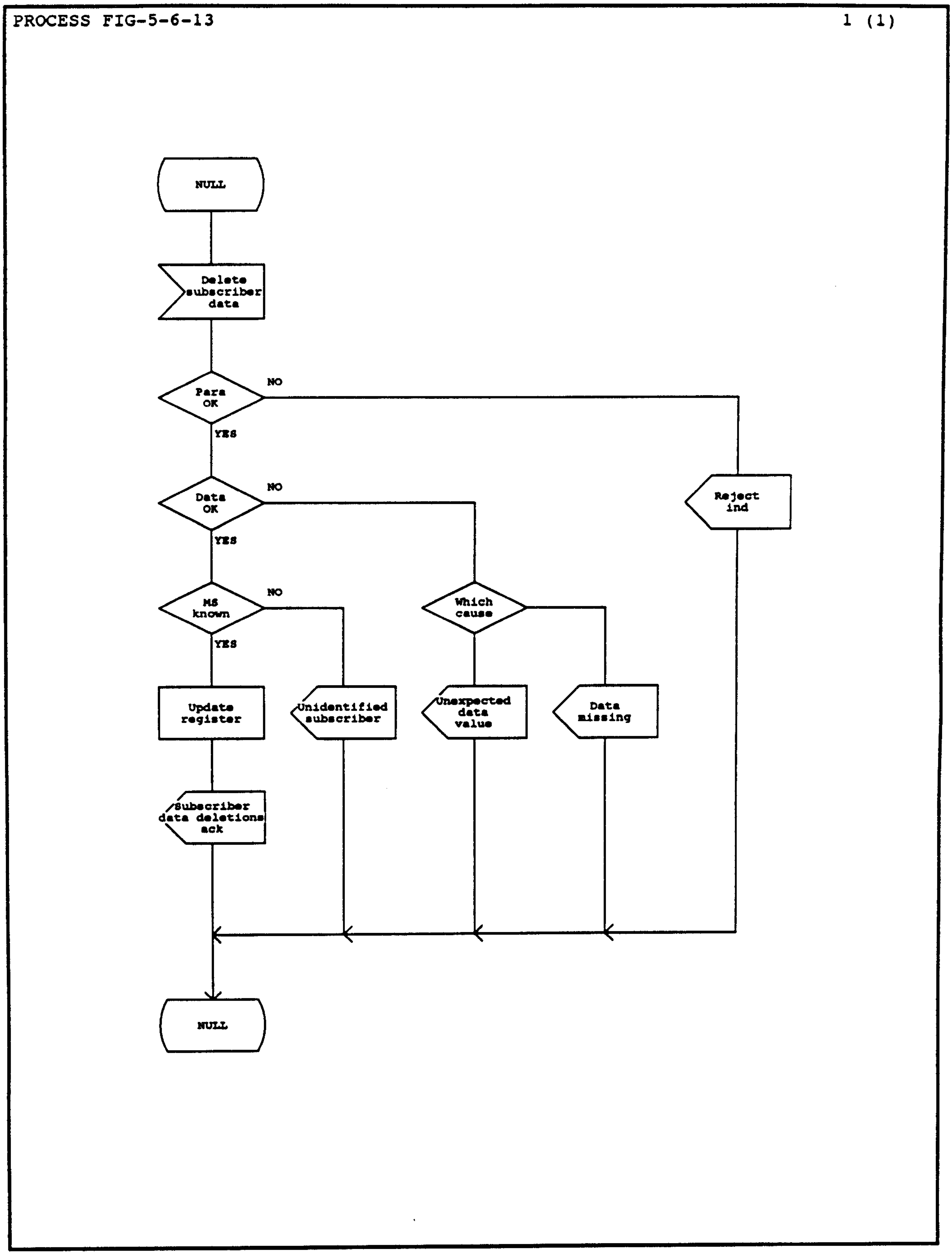
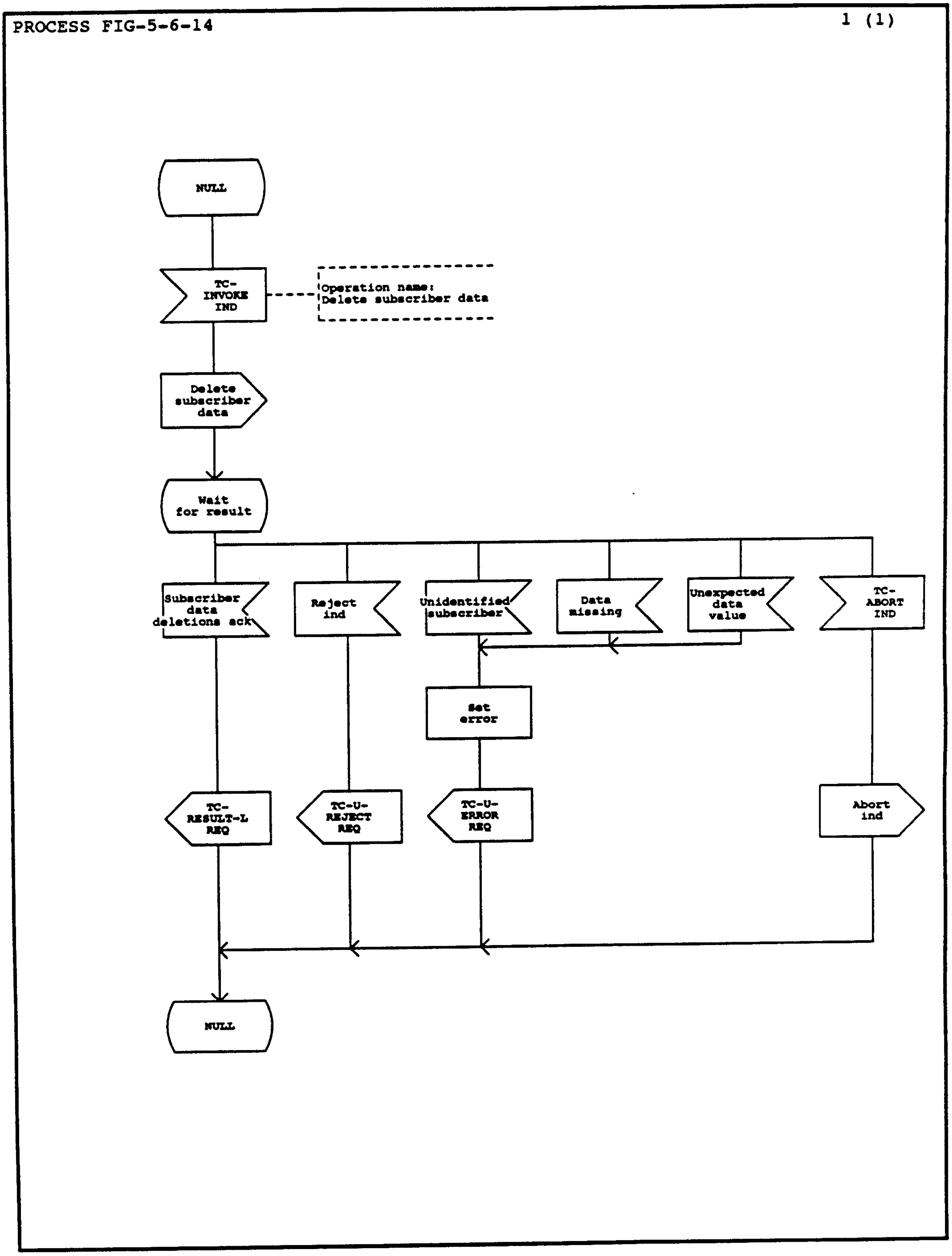


Figure 5.6.14
ASE/TCAP interface procedure in the VLR for deletion of subscriber data.



5.7 Operation and maintenance

5.7.1 Transfer of charging information

5.7.1.1 Definition of interfaces

The charging information related to mobile station originated calls may be transferred from the MSC to the home location register for billing purposes by using MAP (Figure 5.7.1).

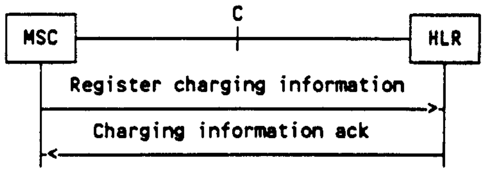


Figure 5.7.1 Interface and procedure for transfer of charging information.

5.7.1.2 General description of procedures

The procedure for transfer of charging information is shown in Figure 5.7.1. At the end of a charged process (e.g. incoming call, outgoing call, supplementary services handling) the MSC will collect all necessary information required by the home location register for billing the mobile station. The information is sent in the register charging information message. The receipt of this message is acknowledged by the charging information acknowledge message. This message will indicate that the charging information is accepted by the home location register. If the information is not accepted, the reason will be reported to the MSC.

5.7.1.3 Detailed description of the procedure for transfer of charging information

5.7.1.3.1 Procedure in the MSC

The application specific procedure is shown in Figure 5.7.2 and the ASE/TCAP interface procedure is shown in Figure 5.7.3.

When sending a register charging information message to the HLR, the following responses can be received in the MSC:

- a charging information acknowledge message indicating that the charging information has been stored in the HLR;
- a reject indicator indicating that the message contained parameter errors. The type of error is indicated to the charging transfer process so that the message may be retransmitted. The reject indication may also be used to indicate that the HLR does not support the procedure;
- a timer expired indication. In this case also the message may be retransmitted. A data not delivered indication is provided to the charging transfer process;
- an unknown subscriber indication. The same indication is provided to the charging transfer process;
- a data missing or unexpected data value message may also be received. The message may then be retransmitted. A procedure error indication is provided to the charging transfer process.

If the charging information acknowledge message contains parameter errors, the MSC returns a reject indication, and informs the charging process that the message may not have been delivered to the HLR. A similar indication is also given to the charging process in case of timer expiry, receipt of a reject indication and dialogue abortion.

The register charging information message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ci. The charging information acknowledge message is received in a TC-RESULT-L INDICATION primitive.

The reject indication and the timer expired indication are received in TC-(U-)REJECT INDICATION and TC-L-CANCEL INDICATION primitives, respectively.

The unknown subscriber, data missing and unexpected data value messages are received in a TC-U-ERROR INDICATION primitive.

A reject condition is sent in a TC-U-REJECT REQUEST primitive.

5.7.1.3.2 Procedure in HLR

The application specific procedure is shown in Figure 5.7.4 and the ASE/TCAP interface procedure is shown in Figure 5.7.5.

When receiving the register charging information message, the HLR will return:

- the charging information acknowledge message if the message is accepted;
- the unknown subscriber message if the MS is not registered in the HLR;
- the data missing and unexpected data value message if the HLR cannot make use of the data in the form they are presented;
- the reject indication if the HLR cannot interpret some parameters or does not support the operation.

The register charging information message is received in a TC-INVOKE INDICATION primitive and the charging information acknowledge message is returned in a TC-RESULT-L REQUEST primitive. The reject indication is sent in a TC-U-REJECT REQUEST primitive and the unknown subscriber, data missing and unexpected data value messages are sent in a TC-U-ERROR REQUEST primitive.

The transaction is kept open until the MSC has been able to return a REJECT, if any, on the charging information acknowledge message. If a reject is received, the HLR should note a possible incompatibility of the charging data contained in the MSC and the HLR.

Figure 5.7.2
Application specific procedures in MSC for sending charging information

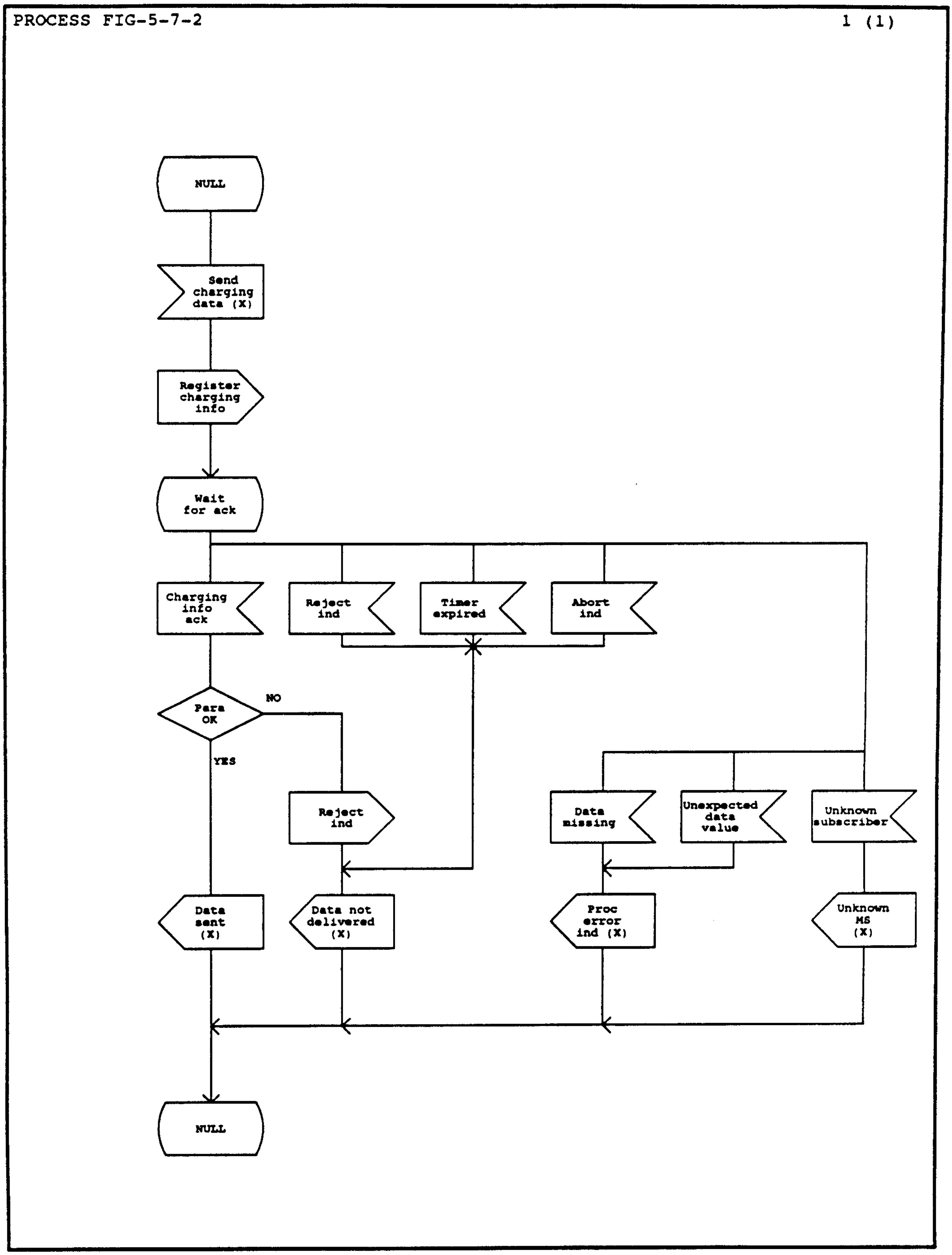


Figure 5.7.3
ASE/TCAP Interface procedure in MSC for sending charging information

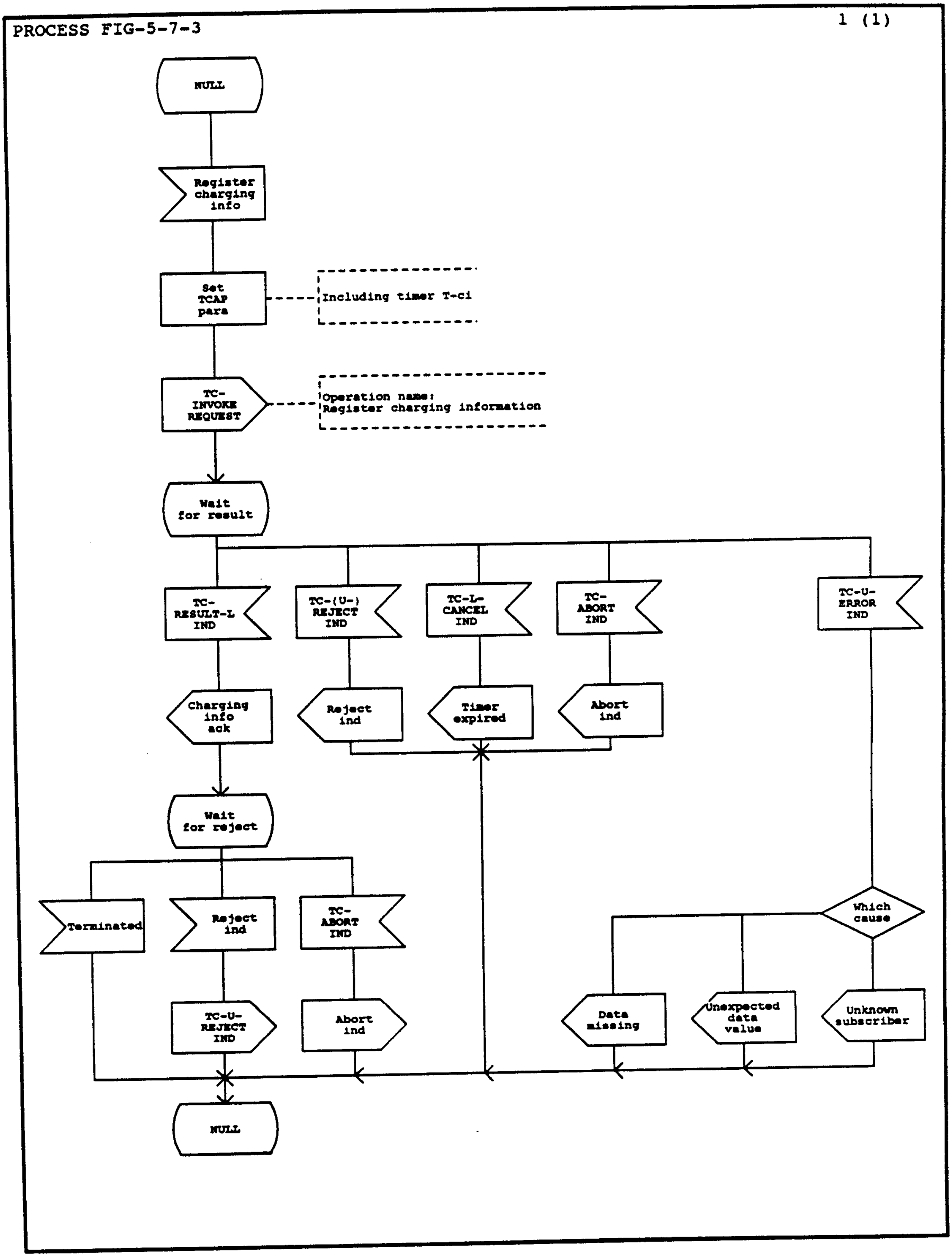


Figure 5.7.4
Application specific procedures in HLR for receiving charging information

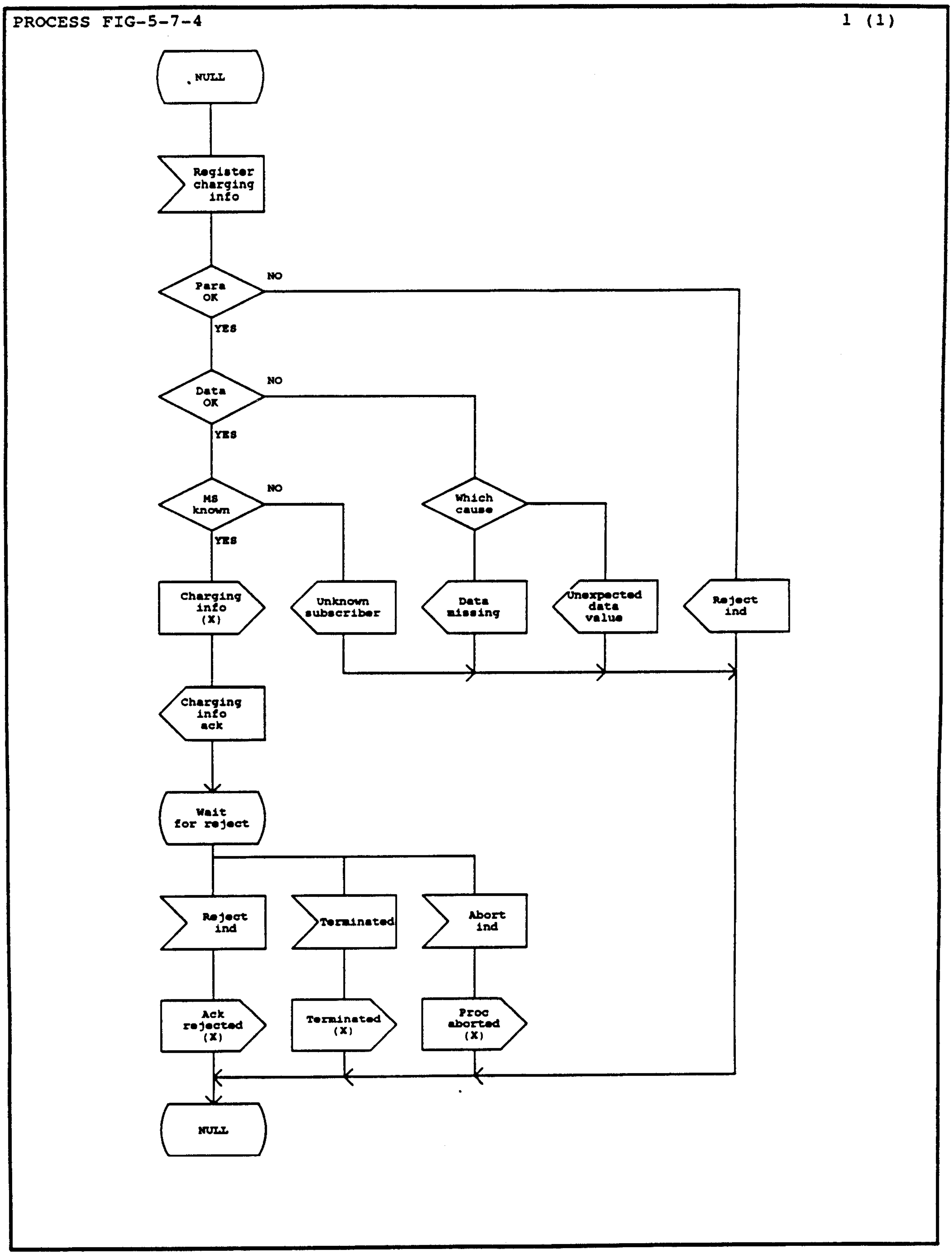
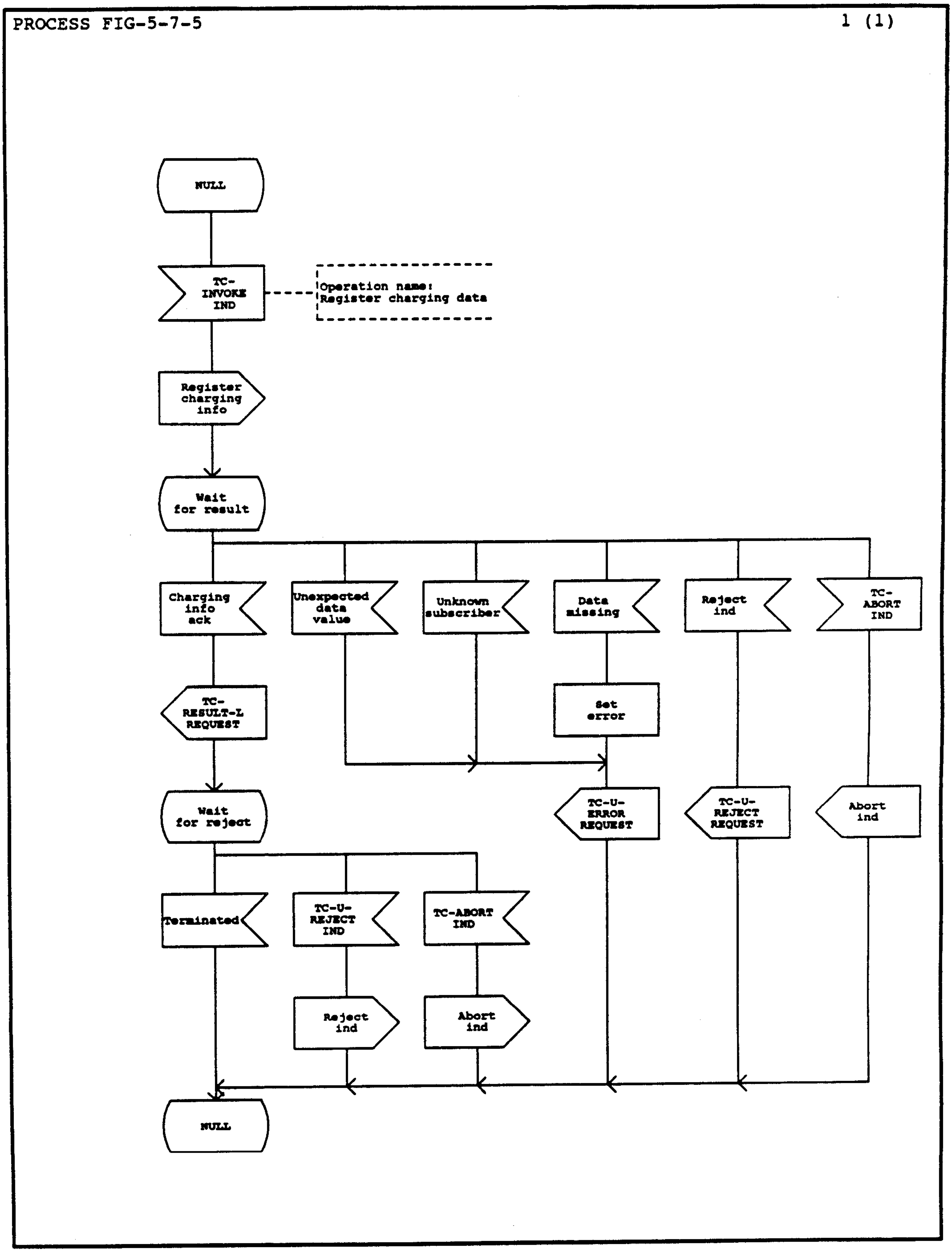


Figure 5.7.5
ASE/TCAP Interface procedure in MSC for receiving charging information



5.7.2 Subscriber tracing procedures

5.7.2.1 Definition of interfaces

Figure 5.7.6 shows the interfaces involved in tracing of subscribers.

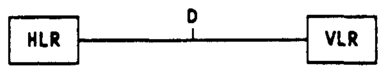
The MSC-A is the MSC on which the call was originally established. The MSC-B is the MSC to which the call is handed over.

Three cases need to be considered :

i) distribution of the trace request between location registers;

ii) distribution of the trace request from the VLR to the MSC;

iii) distribution of the trace request from MSC-A to MSC-B.



a) Distribution of trace request between location registers.

b) Distribution of the trace request from the VLR to the MSC and from MSC-A to MSC-B.

Figure 5.7.6 Interface structure for subscriber tracing

5.7.2.2 General overview of procedures

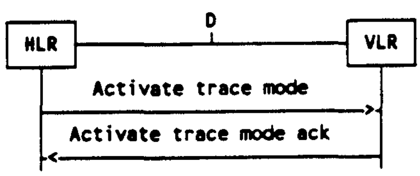
5.7.2.2.1 List of procedures

The following procedures in MAP are required in order to support the functions of subscriber tracing:

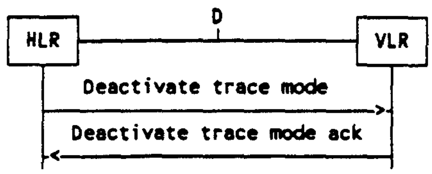
i) procedure for providing a trace request to the VLR (Figure 5.7.7 a);

ii) procedure for trace request cancellation in the VLR (Figure 5.7.7 b);

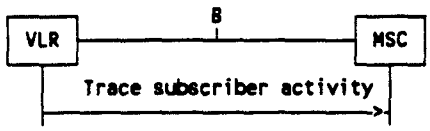
iii) procedure for subscriber tracing at MSCs (Figures 5.7.7 c & d).



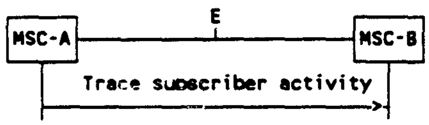
a) Procedure for providing trace request to the VLR.



b) Procedure for trace request cancellation.



c) Procedure for subscriber tracing requested by the VLR of the MSC.



d) Procedure for subscriber tracing requested by MSC-A of MSC-B.

Figure 5.7.7 Procedures for subscriber tracing.

5.7.2.2.2 Procedure for providing a trace request to the VLR

This procedure is used at location updating when the trace mode of a subscriber is set active in the HLR or, as a stand alone procedure, when the subscriber is already registered and the trace mode becomes active in the HLR. The procedure for providing a trace request to the VLR is shown in Figure 5.7.7 a).

The HLR sends the trace request (IMSI, trace reference, trace type and identity of the OMC) to the VLR in the activate trace mode message. The receipt of this message is acknowledged by the activate trace mode acknowledge message. This message will indicate that the trace request is accepted by the VLR. If the request is not accepted, the reason will be reported to the HLR.

5.7.2.2.3 Procedure for trace request cancellation in the VLR

This procedure is used when the trace request of a subscriber is to be cancelled in the VLR. The procedure is shown in Figure 5.7.7 b).

The HLR sends the deactivate trace mode message to the VLR. The VLR will acknowledge with the deactivate trace mode acknowledge message. This message will indicate that the trace request has been deleted by the VLR. If the deactivation is not accepted, the reason will be reported to the HLR.

5.7.2.2.4 Procedure for requesting subscriber tracing at MSCs

This procedure is used when the VLR detects any subscriber related activity for which the trace mode is activated, e.g. receives the process access request. It is also used by the MSC-A when a subscriber with activated trace mode is handed over to the MSC-B. The procedures are shown in Figures 5.7.7 c) and d).

The VLR or MSC-A will generate the trace subscriber activity message. The receiving MSC will send the trace record to the OMC.

5.7.2.3 Detailed description of procedures for subscriber tracing

5.7.2.3.1 Procedures in the HLR

5.7.2.3.1.1 Procedure for providing a trace request

The application specific procedure for providing a trace request is shown in Figure 5.7.8. The ASE/TCAP interface procedure is shown in Figure 5.7.9.

When the HLR observes that the subscriber trace mode becomes active for a subscriber, the HLR will send the activate trace mode message to the VLR where the subscriber is registered to. The activate trace mode message is also used when the mobile subscriber makes a location updating in the area of a new VLR while the subscriber trace mode is active.

When sending an activate trace mode message to the VLR, the following responses can be received in the HLR:

- an activate trace mode acknowledge message indicating that the trace request has been stored in the VLR;

- a reject indication or timer expired indication reporting procedure error. A data not delivered indication is set and the message may be retransmitted;

- a data missing or unexpected data value message may also be received. The message may then be retransmitted;

- an unidentified subscriber indication. Then the HLR should remove the mobile station roaming number if allocated;

- a facility not supported indication. Then the HLR should mark the tracing request as undelivered and the indication is provided to the subscriber tracing process in the HLR;

- a tracing buffer full indication. The same indication is provided to the subscriber tracing process in the HLR.

The activate trace mode message is sent in a TC-INVOKE REQUEST primitive and TCAP is requested to supervise the procedure by timer T-atm. Results are received as follows:

- an activate trace mode acknowledge message is received in a TC-RESULT-L INDICATION primitive;

- procedure errors are indicated in a TC-(U-)REJECT INDICATION primitive;

- expiry of timer T-atm is indicated in a TC-L-CANCEL INDICATION primitive;

- negative results are reported in a TC-U-ERROR INDICATION primitive as follows:

  i) unidentified subscriber,
  ii) facility not supported,
  iii) tracing buffer full,
  iv) data missing,
  v) unexpected data value.

5.7.2.3.1.2 Procedure for trace request cancellation

The application specific procedure for trace request cancellation is shown in Figure 5.7.10. The ASE/TCAP interface procedure is shown in Figure 5.7.11.

When the HLR observes that the trace mode becomes deactive for a subscriber, the HLR will send the deactivate trace mode message to the VLR provided the HLR has not marked the trace mode activation message as undelivered.

When sending a deactivate trace mode message to the VLR, the following responses can be received in the HLR:

- a deactivate trace mode acknowledge message indicating that the trace request has been removed in the VLR;
- a reject indication or timer expired indication reporting procedure error. A data not delivered indication is set and the message may be retransmitted;
- a data missing or unexpected data value message may also be received. The message may then be retransmitted;
- an unidentified subscriber indication. Then the HLR should remove the mobile station roaming number if allocated;
- a facility not supported indication. The same indication is provided to the subscriber tracing process in the HLR.

The deactivate trace mode message is sent in a TC-INVOKE REQUEST primitive and TCAP is requested to supervise the procedure by timer T-dtm. Results are received as follows:

- a deactivate trace mode acknowledge message is received in a TC-RESULT-L INDICATION primitive;
- procedure errors are indicated in a TC-(U-)REJECT INDICATION primitive;
- expiry of timer T-dtm is indicated in a TC-L-CANCEL INDICATION primitive;
- negative results are reported in TC-U-ERROR INDICATION primitive as follows:

  i) unidentified subscriber,
  ii) facility not supported,
  iii) data missing,
  iv) unexpected data value.

5.7.2.3.2 Procedures in the VLR

5.7.2.3.2.1 Procedure for receiving trace requests

The application specific procedure for receiving trace requests is shown in Figure 5.7.12. The ASE/TCAP interface procedure is shown in Figure 5.7.13.

When receiving an activate trace mode message, the VLR will return:

- an activate trace mode acknowledge message if the message is accepted;
- an unidentified subscriber message if the MS is not registered in the VLR;

- a data missing or unexpected data value if the VLR cannot make use of the data in the form they are presented;

- a facility not supported indication if the VLR does not support the subscriber tracing;

- a tracing buffer full indication if the maximum limit of traced subscriber has been exceeded in the VLR.

The activate trace mode message is received in a TC-INVOKE INDICATION primitive and the activate trace mode acknowledge message is returned in a TC-RESULT-L REQUEST primitive. The reject indication is sent in a TC-U-REJECT REQUEST primitive and the unidentified subscriber, data missing, unexpected data value, facility not supported and tracing buffer full are sent in a TC-U-ERROR REQUEST primitive.

5.7.2.3.2.2 Procedure for trace request cancellation

The application specific procedure for trace request cancellation is shown in Figure 5.7.14. The ASE/TCAP interface procedure is shown in Figure 5.7.15.

When receiving a deactivate trace mode message, the VLR will return:

- a deactivate trace mode acknowledge message if the message is accepted;

- an unidentified subscriber message if the MS is not registered in the VLR;

- a data missing or unexpected data value if the VLR cannot make use of the data in the form they are presented;

- a facility not supported indication if the VLR does not support the subscriber tracing.

The deactivate trace mode message is received in a TC-INVOKE INDICATION primitive and the deactivate trace mode acknowledge message is returned in a TC-RESULT-L REQUEST primitive. The reject indication is sent in a TC-U-REJECT REQUEST primitive and the unidentified subscriber, data missing, unexpected data value and facility not supported are sent in a TC-U-ERROR REQUEST primitive.

5.7.2.3.2.3 Procedure for requesting subscriber tracing at MSCs

The application specific procedure for requesting subscriber tracing at MSCs is shown in Figure 5.7.16. The ASE/TCAP interface procedure is shown in Figure 5.7.17.

When the VLR receives a dialog begin request indicating any subscriber related activity from the MSC, the VLR checks whether the trace mode is active for the concerned subscriber. If the trace mode is active the VLR sends to the MSC the trace subscriber activity message. The trace subscriber activity message is always sent in the existing dialog to the MSC in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure to the MSC by timer T-tsa.

5.7.2.3.3 Procedures in the MSC

5.7.2.3.3.1 Procedure for receiving the trace subscriber activity

The application specific procedure for receiving the trace subscriber activity is shown in Figure 5.7.18. The ASE/TCAP interface procedure is shown in figure 5.7.19.

When receiving the trace subscriber activity message, the MSC stores trace reference, trace type and the identity of the OMC in charge of the trace, and the MSC starts to collect the trace information. The trace subscriber activity message may be received either from the VLR or a MSC-A. The MSC will send the trace record to the OMC.

The trace subscriber activity message is received in a TC-INVOKE INDICATION primitive.

5.7.2.3.3.2 Procedure for requesting subscriber tracing at MSC-B

The application specific procedure for requesting subscriber tracing at MSC-B is shown in Figure 5.7.20. The ASE/TCAP interface procedure is shown in Figure 5.7.21.

When the MSC-A performs an inter MSC handover to another MSC (MSC-B), the MSC-A checks whether it has received the trace subscriber activity message from the VLR. If the MSC-A has received the trace subscriber activity message it will forward the same message to the MSC-B. The trace subscriber activity message is always sent in the existing dialog to the MSC-B in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure to the MSC-B by timer T-tsa.

The procedure in the MSC-B is as described in the chapter 5.7.2.3.3.1.

Figure 5.7.8 (Sheet 1 of 2)
Application specific procedures in HLR for requesting subscriber tracing

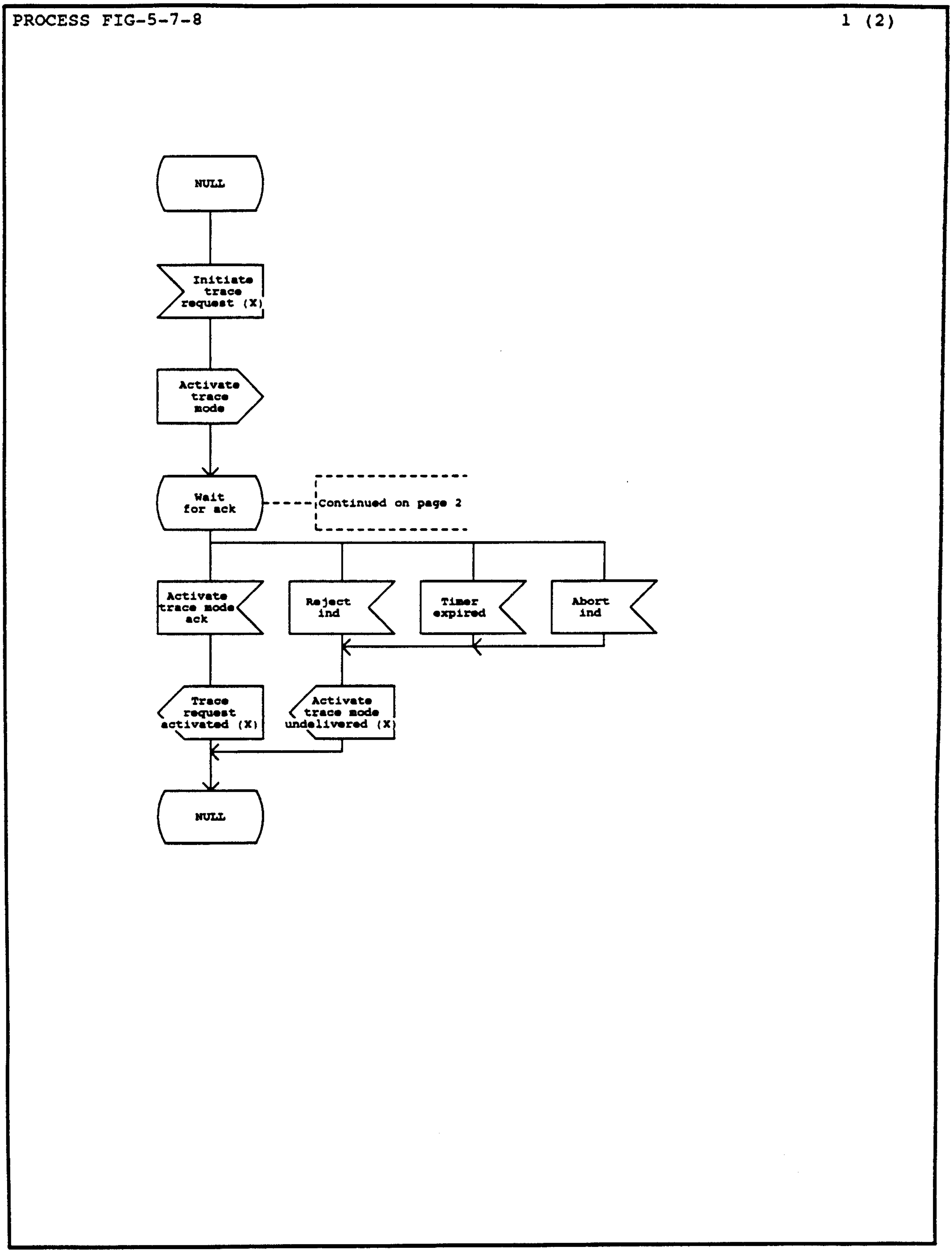


Figure 5.7.8 (Sheet 2 of 2)
Application specific procedures in HLR for requesting subscriber tracing

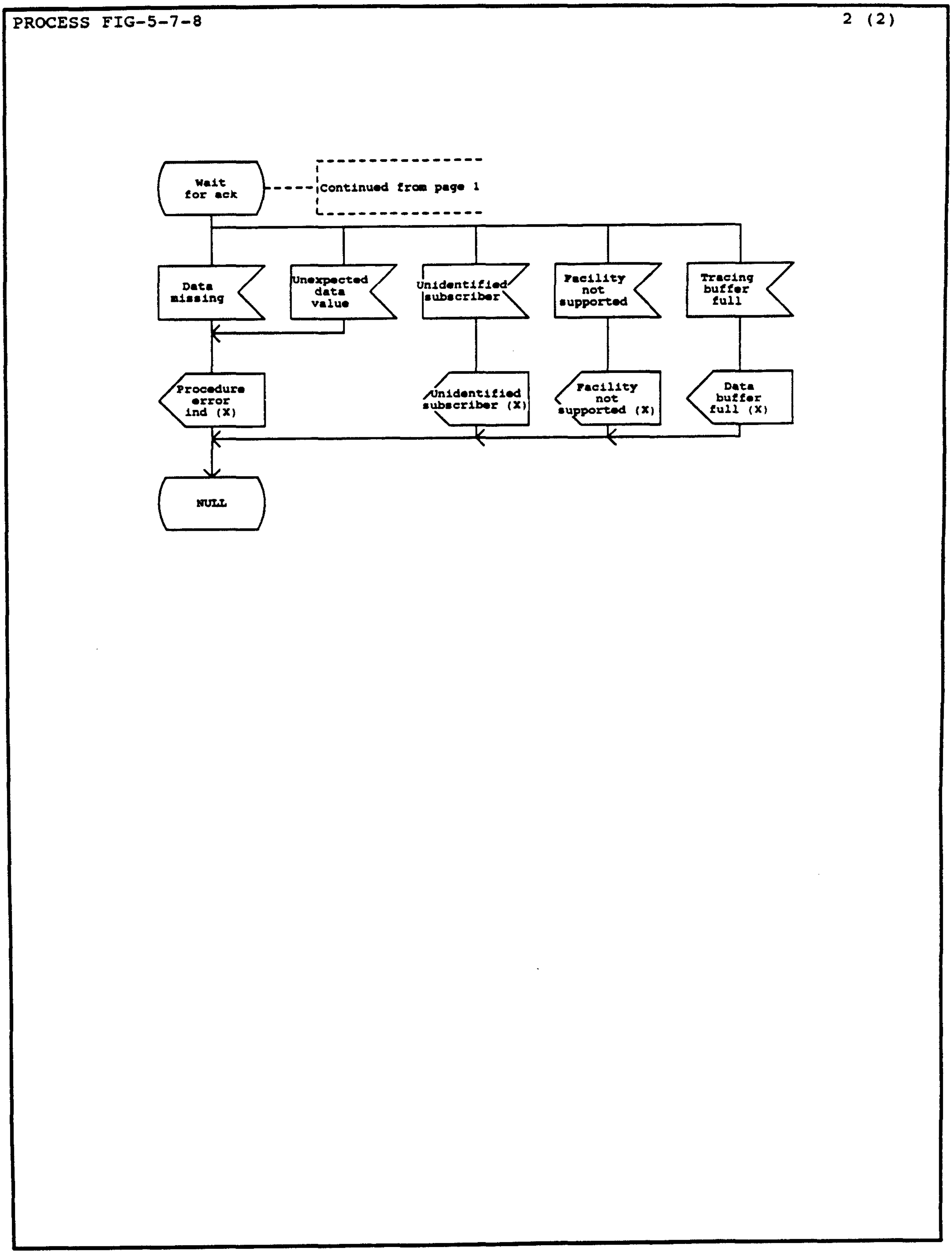


Figure 5.7.9 (Sheet 1 of 2)
ASE/TCAP Interface procedure in HLR for requesting subscriber tracing

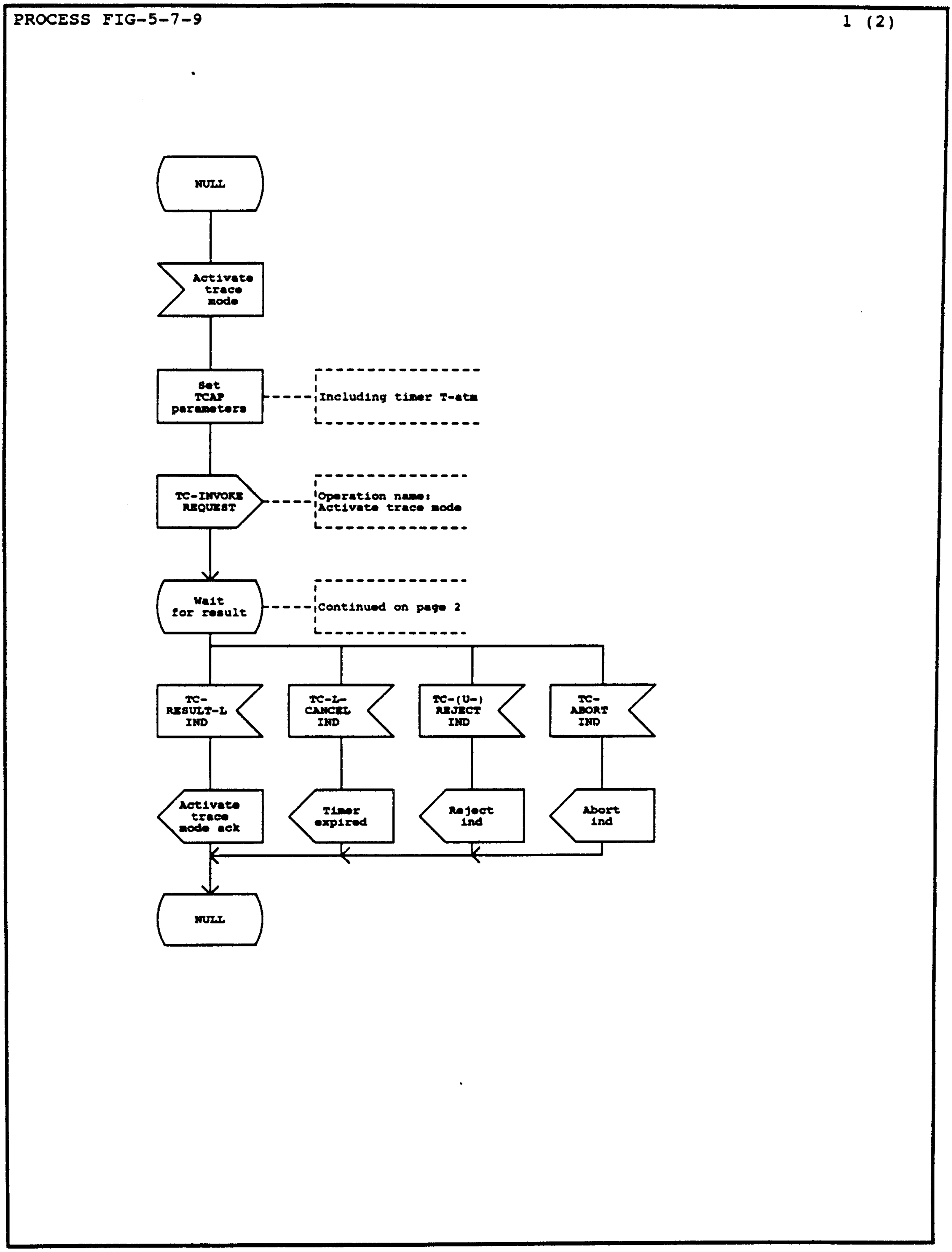


Figure 5.7.9 (Sheet 2 of 2)
ASE/TCAP Interface procedure in HLR for requesting subscriber tracing

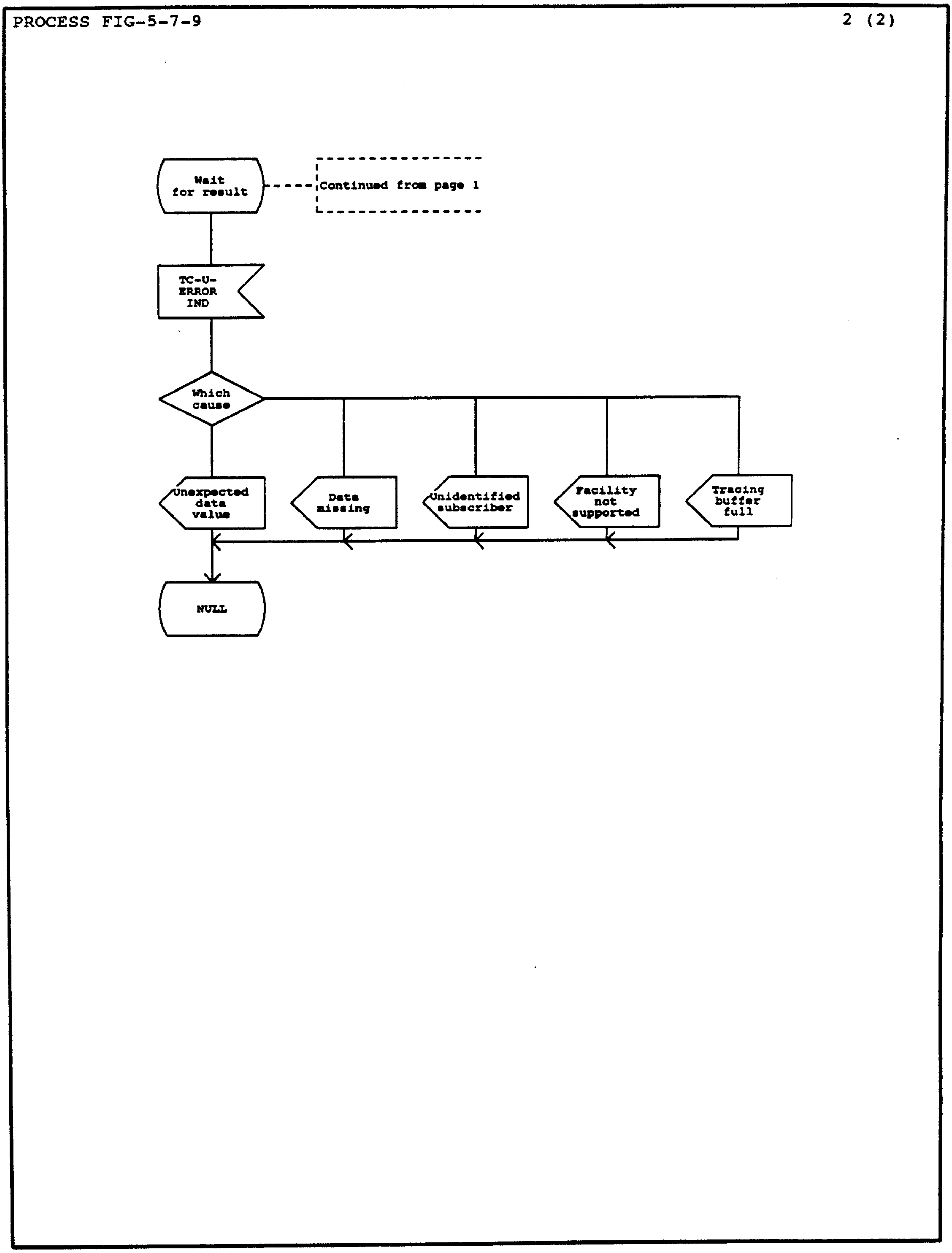


Figure 5.7.10 (Sheet 1 of 2)
Application specific procedures in HLR for trace request cancellation

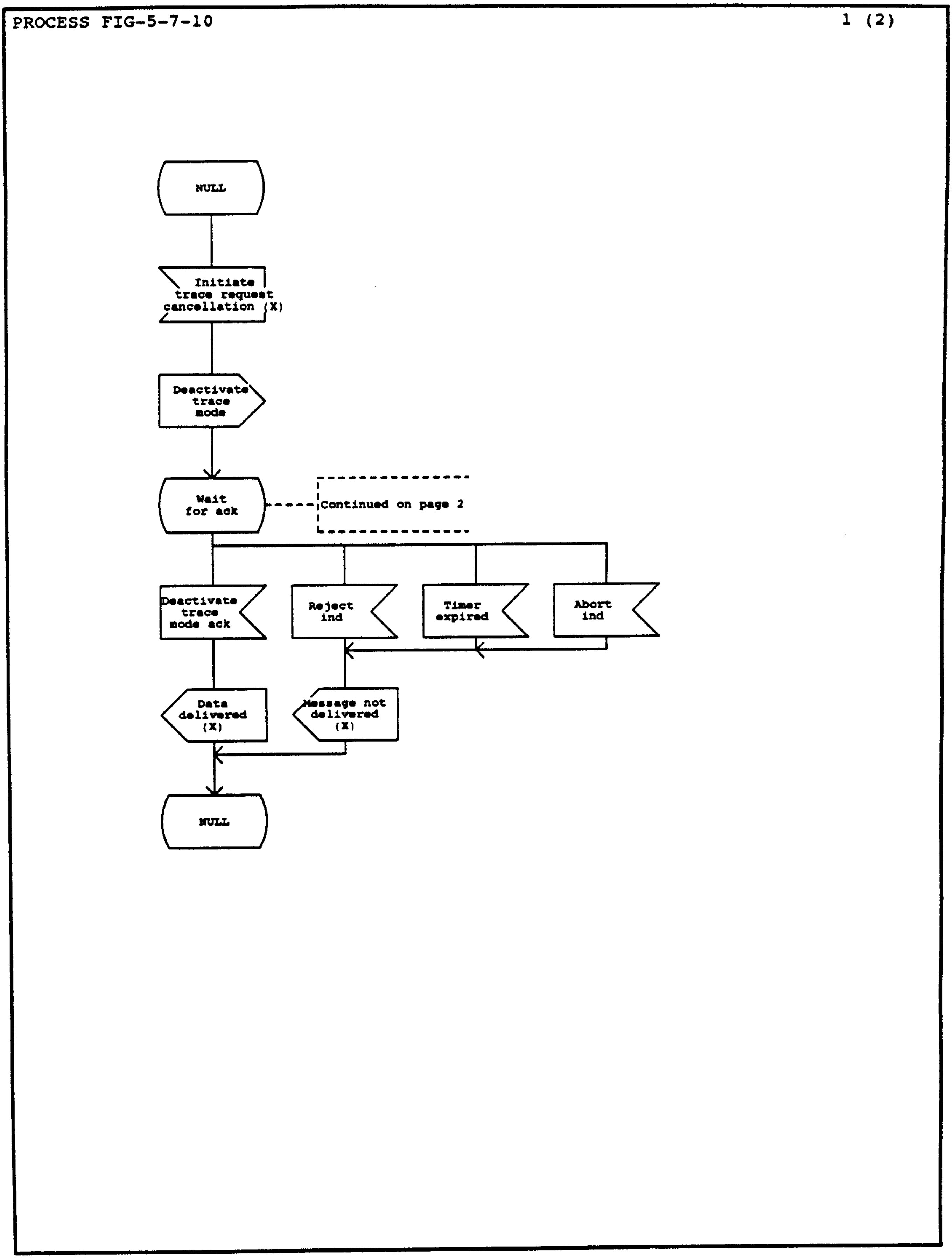


Figure 5.7.10 (Sheet 2 of 2)
Application specific procedures in HLR for trace request cancellation

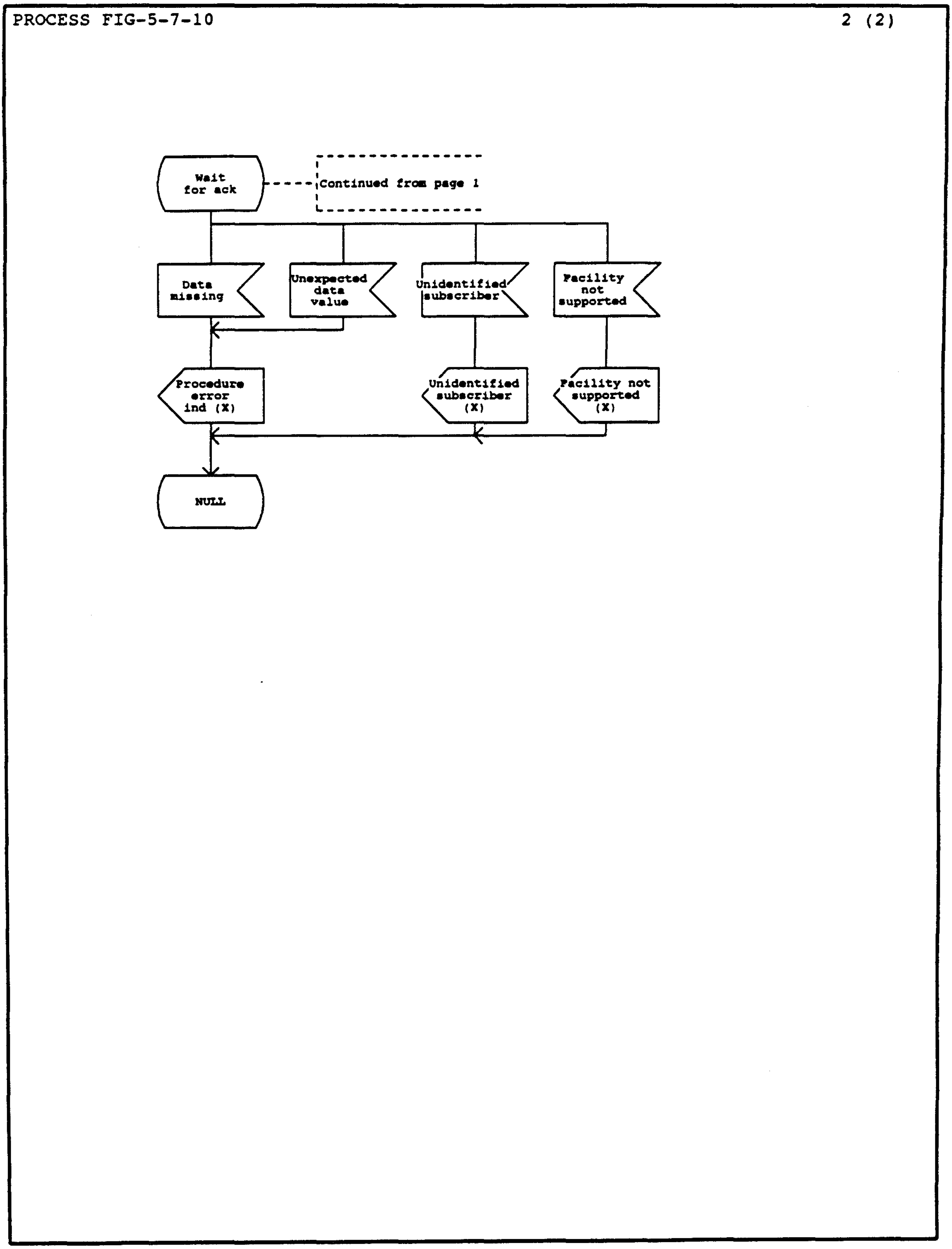


Figure 5.7.11 (Sheet 1 of 2)
ASE/TCAP Interface procedure in HLR for trace request cancellation

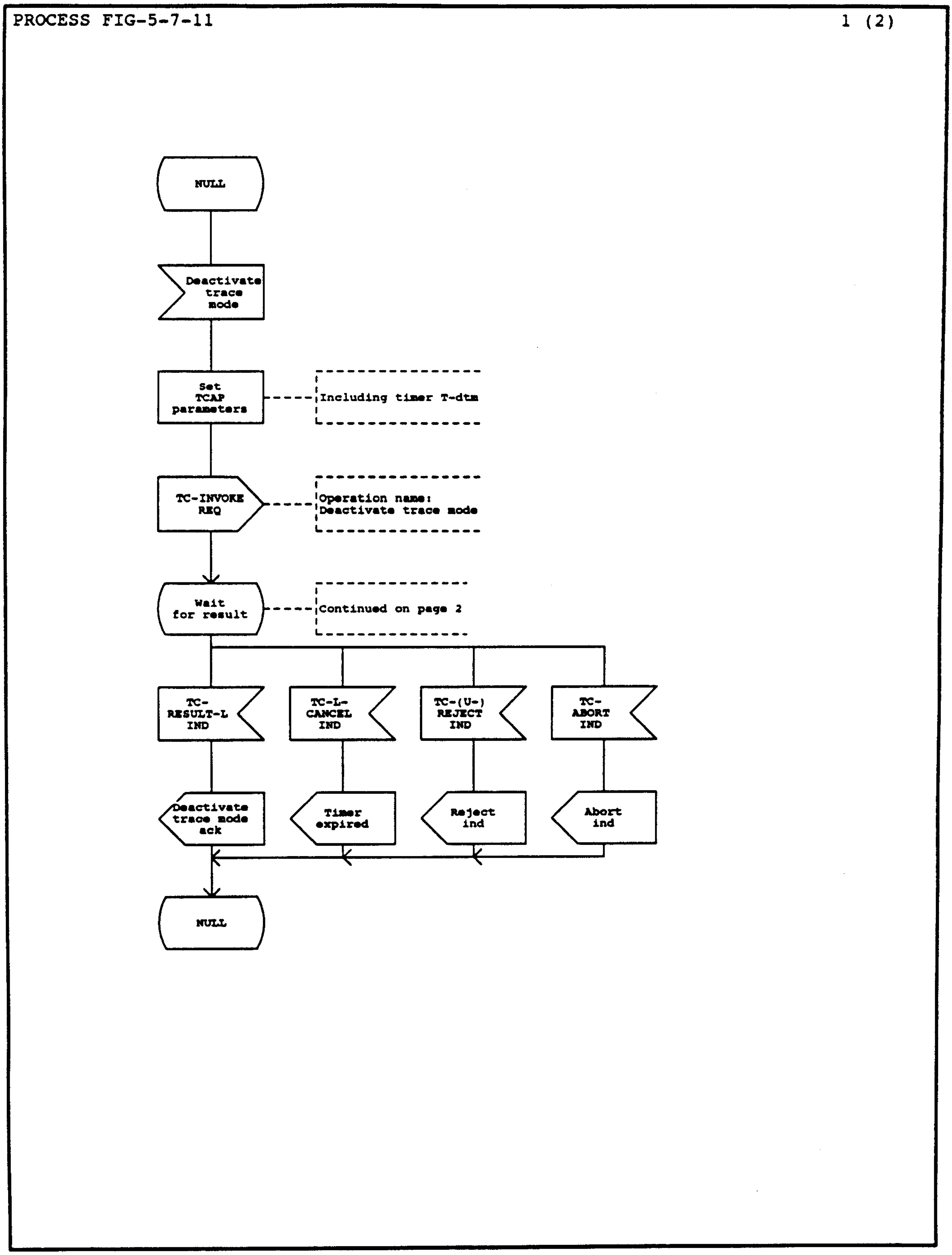


Figure 5.7.11 (Sheet 2 of 2)
ASE/TCAP Interface procedure in HLR for trace request cancellation

PROCESS FIG-5-7-11 2 (2)

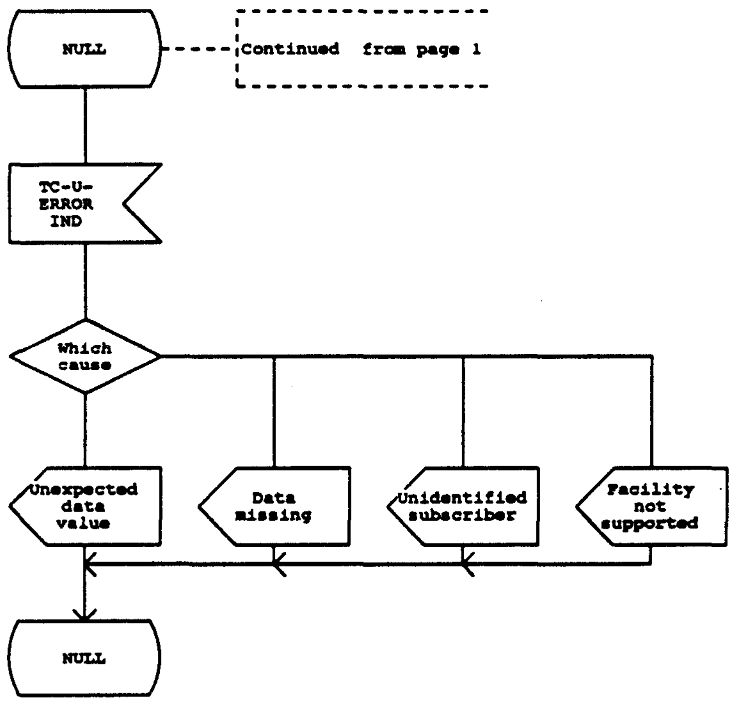


Figure 5.7.12 (Sheet 1 of 2)
Application specific procedures in VLR for receiving trace requests

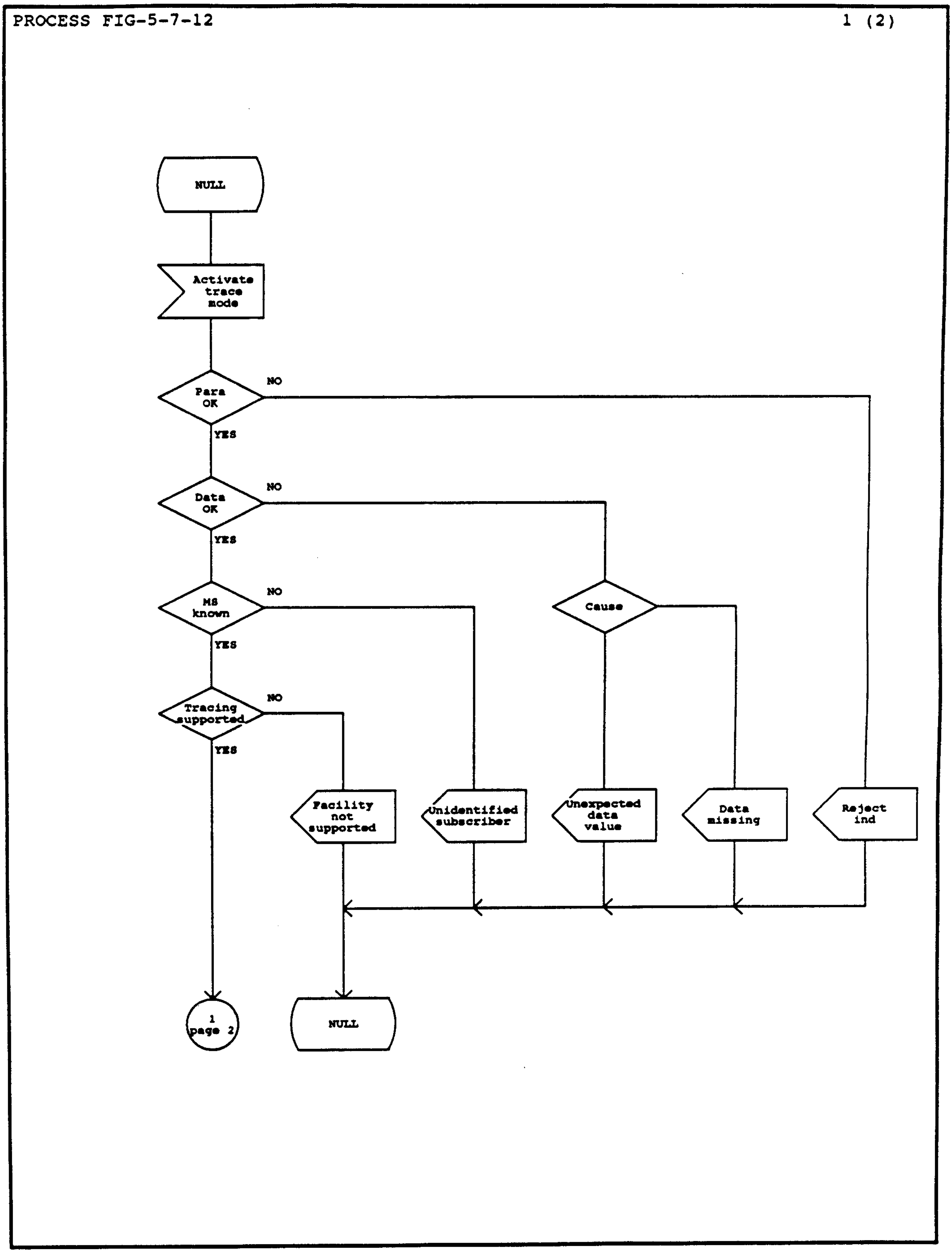


Figure 5.7.12 (Sheet 2 of 2)
Application specific procedures in VLR for receiving trace requests

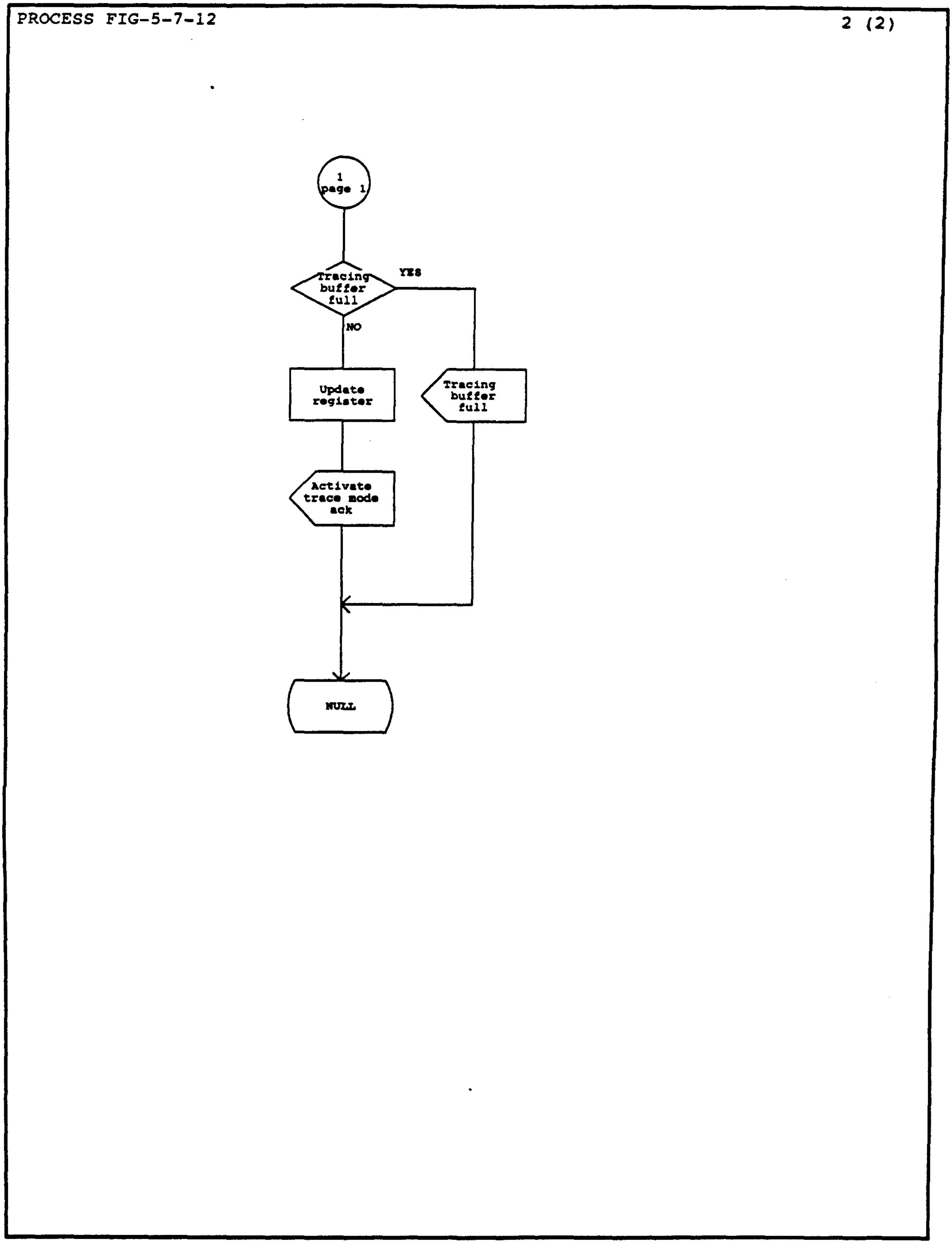


Figure 5.7.13
ASE/TCAP Interface procedure in VLR for receiving trace requests

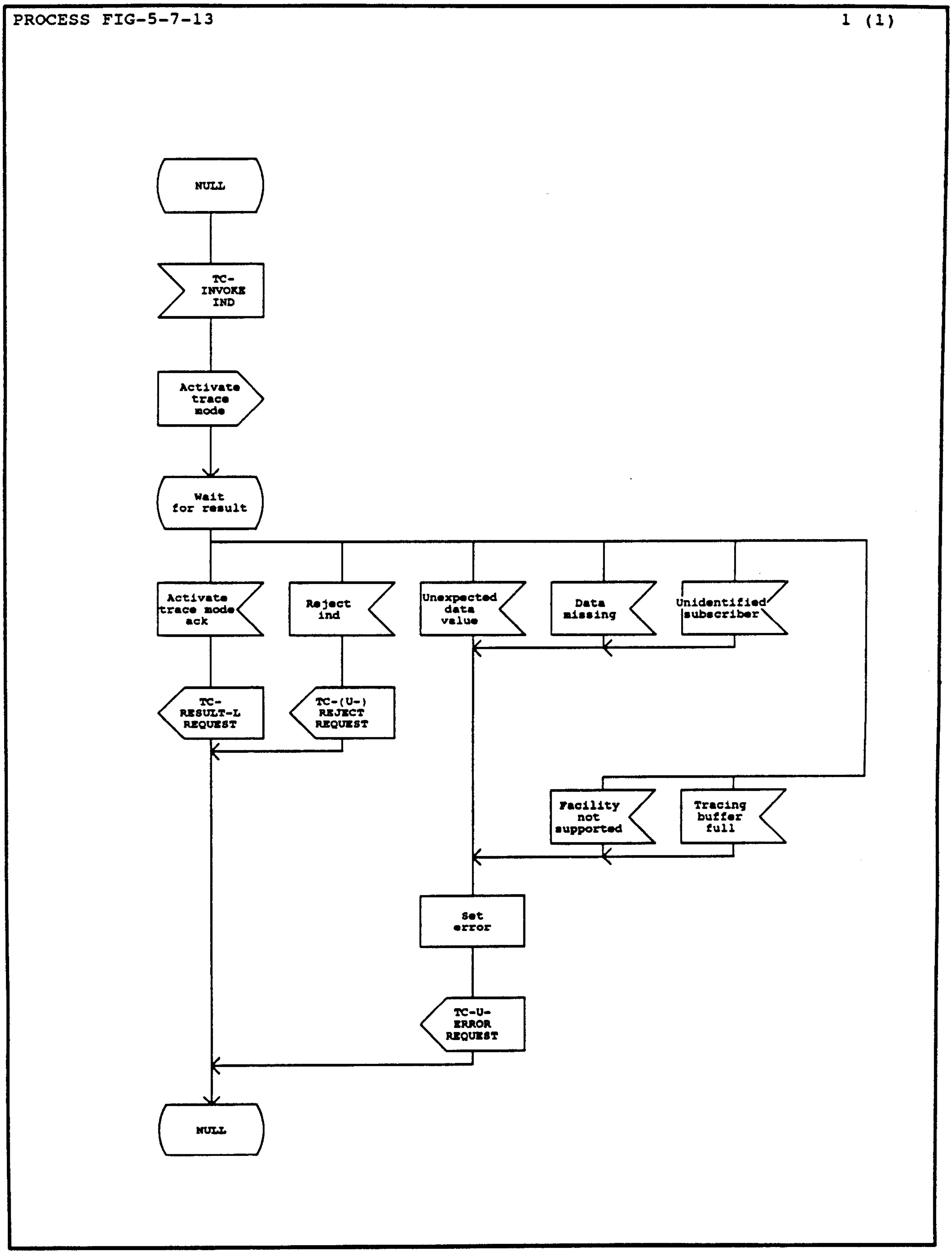


Figure 5.7.14
Application specific procedures in VLR for trace request cancellation

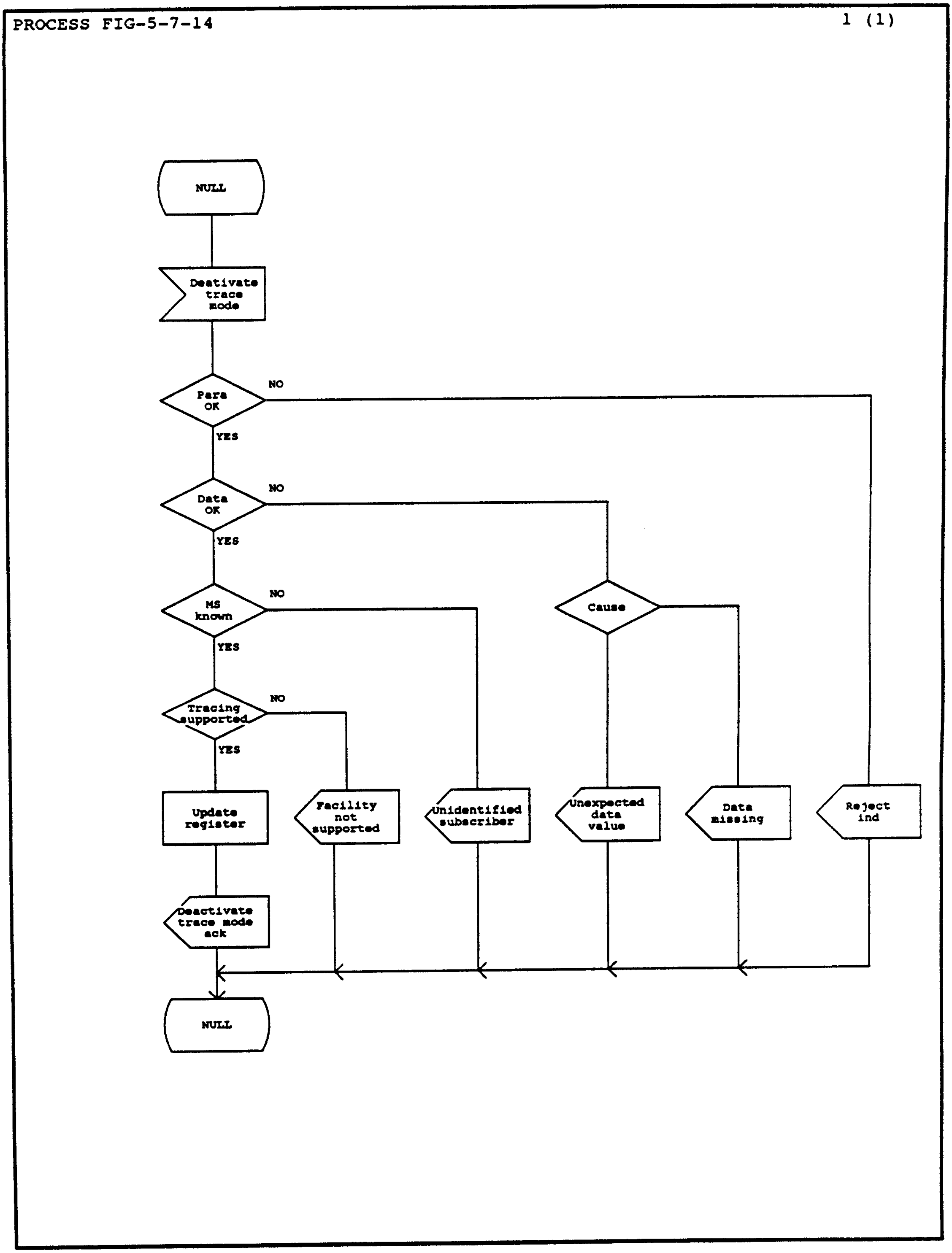


Figure 5.7.15
ASE/TCAP interface procedure in VLR for trace request cancellation

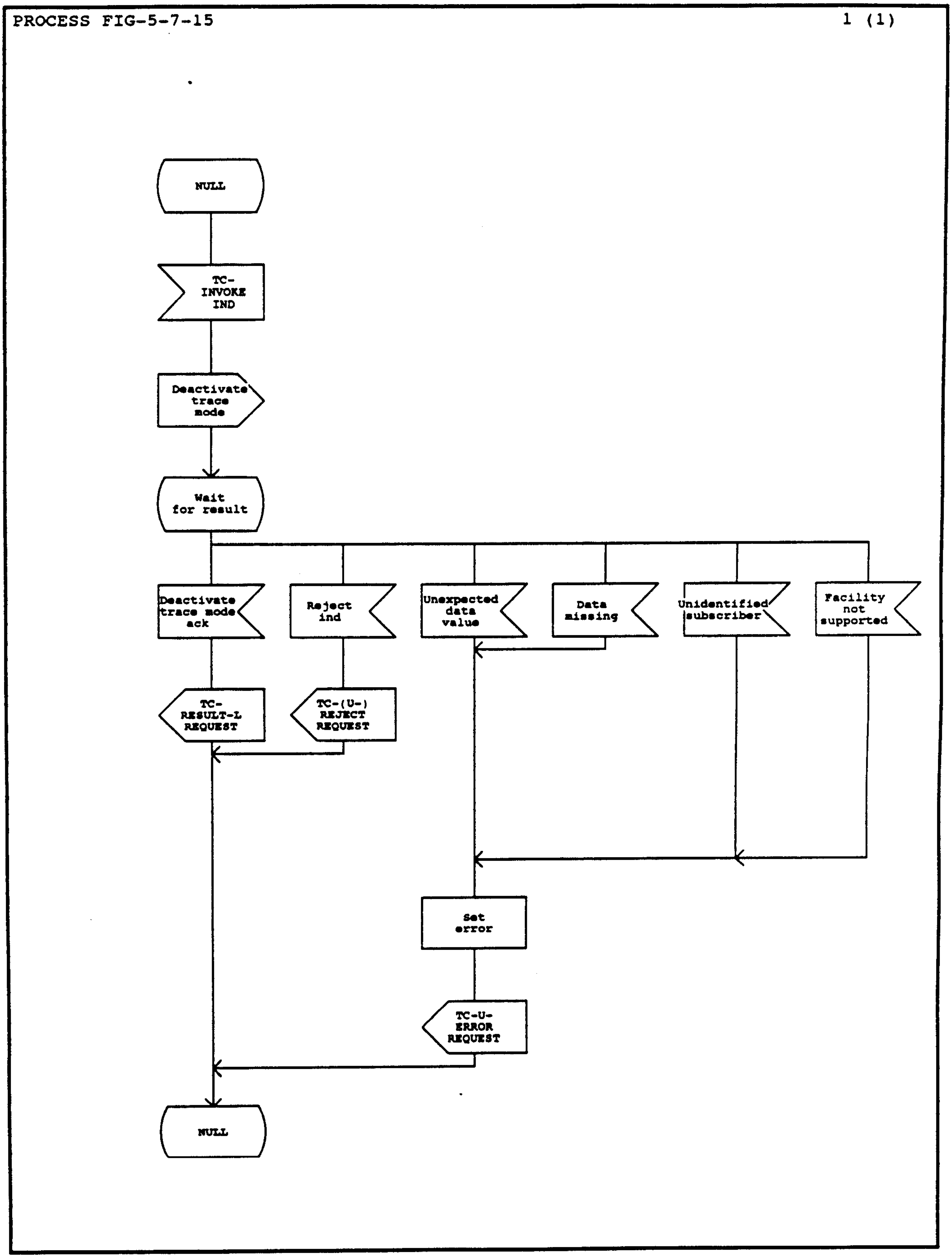


Figure 5.7.16
Application specific procedures in VLR for requesting activity tracing

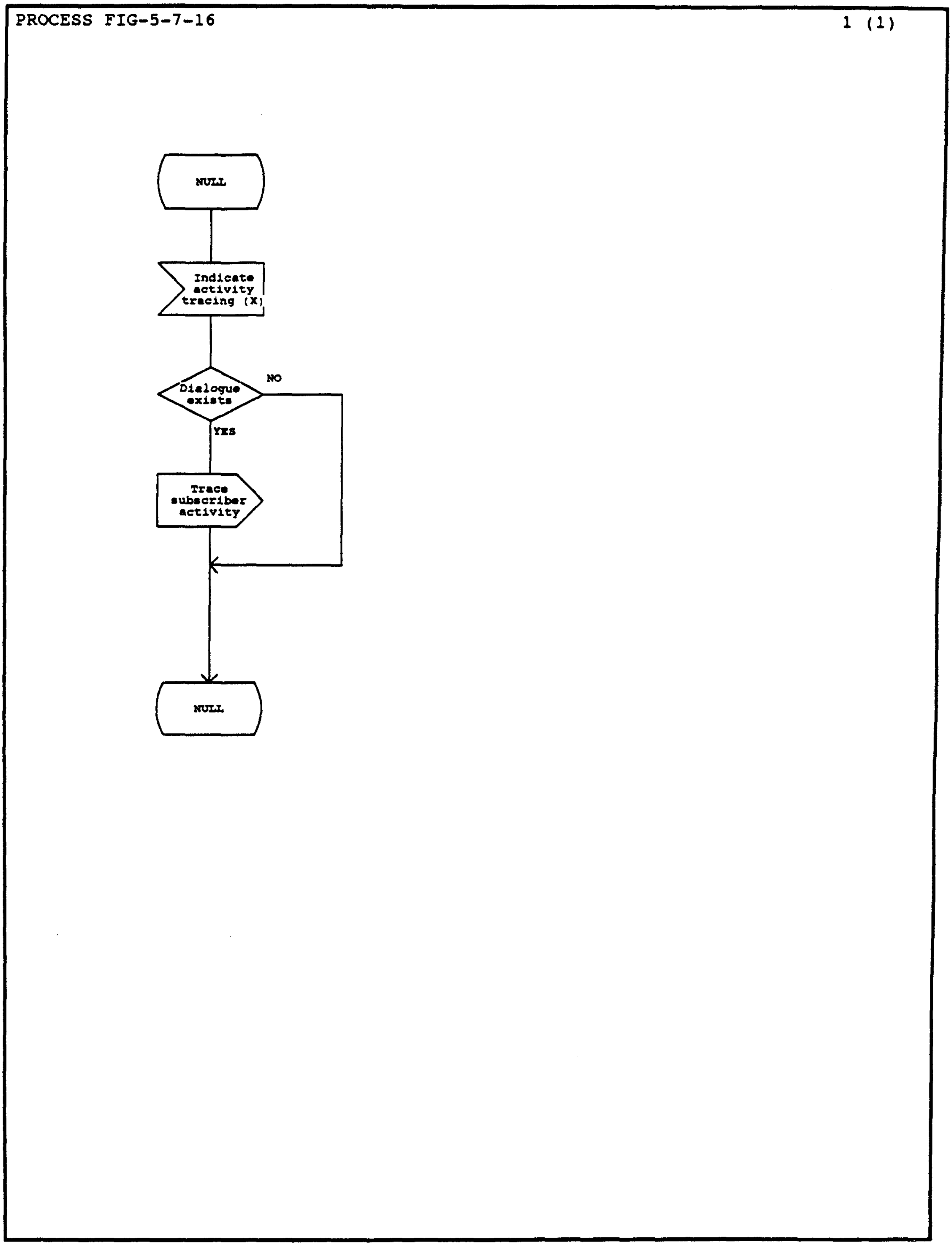


Figure 5.7.17
ASE/TCAP Interface procedure in VLR for requesting activity tracing

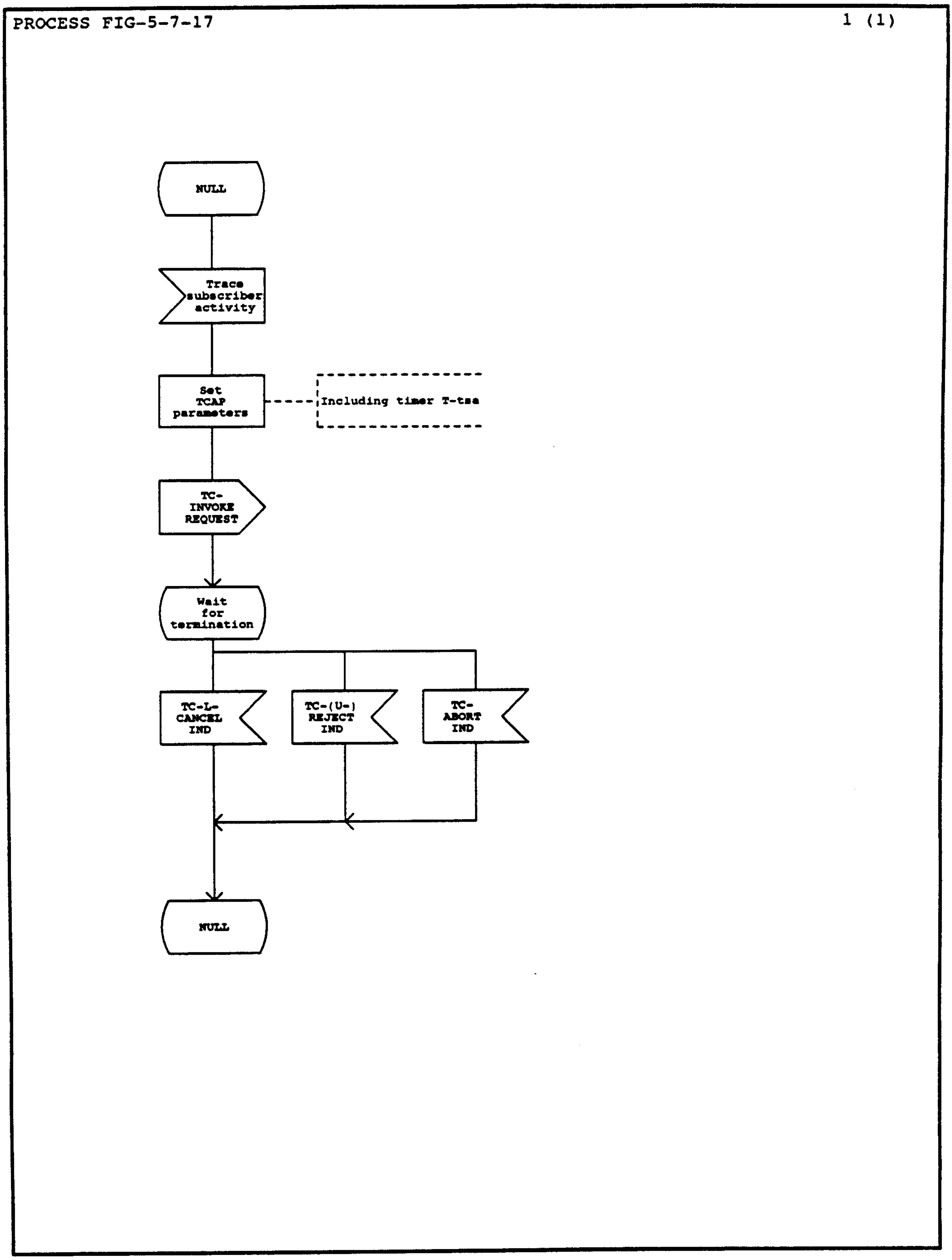


Figure 5.7.18
Application specific procedures in MSC for receiving activity tracing request

PROCESS FIG-5-7-18 1 (1)

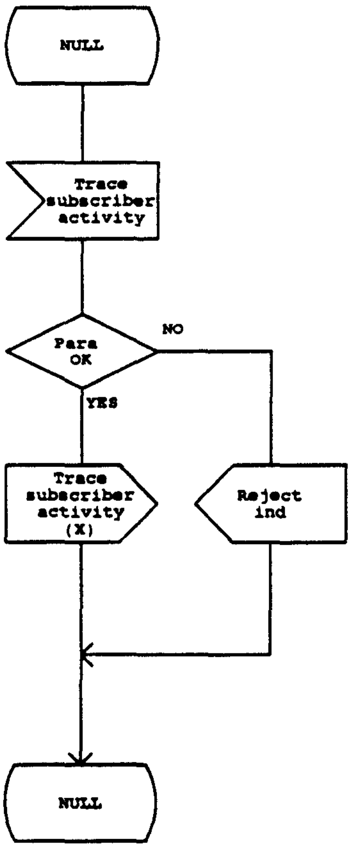


Figure 5.7.19
ASE/TCAP Interface procedure in MSC for receiving activity tracing request

PROCESS FIG-5-7-19 1 (1)

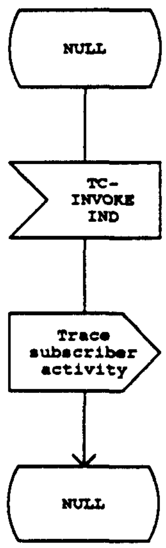


Figure 5.7.20
Application specific procedures in MSC for requesting activity tracing

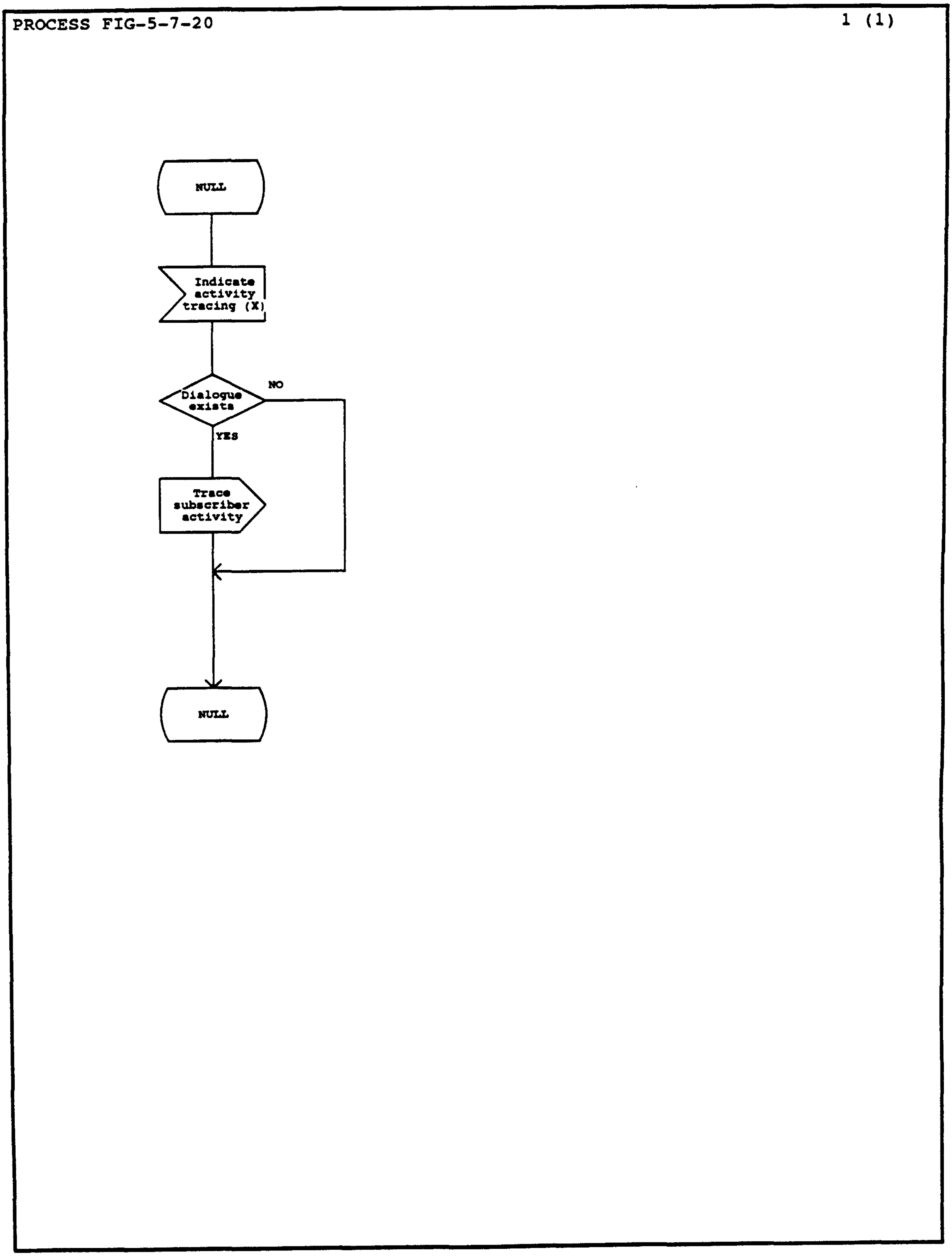
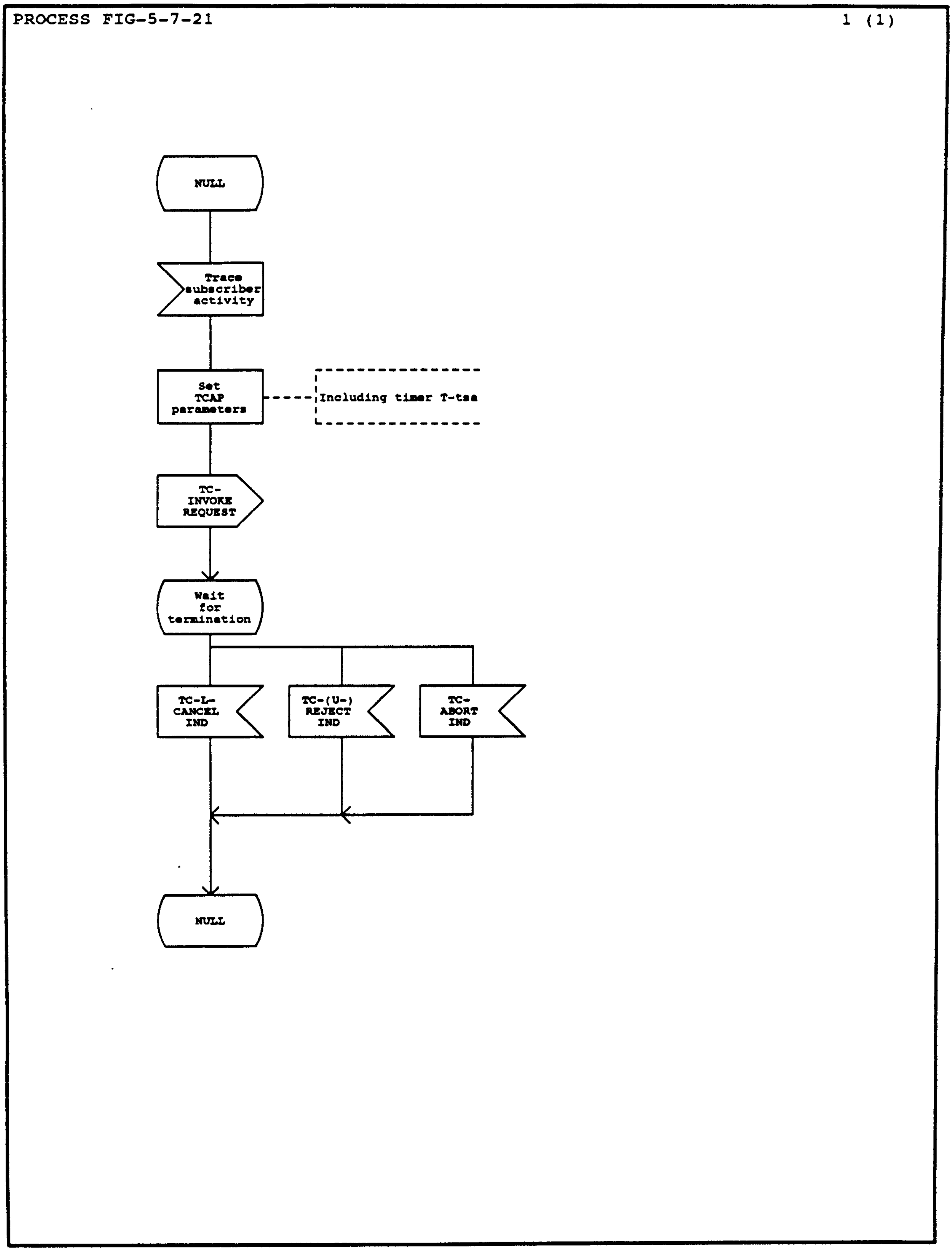


Figure 5.7.21
ASE/TCAP Interface procedure in MSC for requesting activity tracing



5.7.3 Note internal handover

5.7.3.1 General description of the procedures

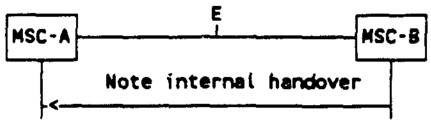


Figure 5.7.22 Procedure for note internal handover

The procedure is shown in figure 5.7.22. It is used by the servicing MSC (MSC-B) to inform the controlling MSC (MSC-A) that a subsequent handover takes place to another BS in the area of MSC-B. The MSC-A uses this information for operation and maintenance purposes. The procedure consists of one message: Note internal handover.

5.7.3.2 Detailed description of the procedures between MSC-A and MSC-B

5.7.3.2.1 Procedure in the controlling MSC (MSC-A)

The application specific and ASE/TCAP interface procedures are shown in Figures 5.7.23 and 5.7.24.

When O&M requires the MSC-B to inform the MSC-A because of the internal handover in the MSC-B, the MSC-A will receive the note internal handover message from the MSC-B in a TC-INVOKE INDICATION primitive. If the message is accepted, the MSC-A sends this information to the O&M process.

5.7.3.2.3 Procedure in the servicing MSC (MSC-B)

The application specific and ASE/TCAP interface procedures are shown in Figures 5.7.25 and 5.7.26.

When the MSC-B has performed a subsequent handover between BSs of the MSC-B, the MSC-B sends the note internal handover message to the MSC-A if the O&M process requests it. The note internal handover message is sent in a TC-INVOKE REQUEST primitive. Implicit termination of the procedure is used by time-out supervision (timer-nho) where the termination of the procedure is indicated by a TC-L-CANCEL INDICATION primitive.

Figure 5.7.23
Application specific procedures in controlling MSC (MSC-A) when receiving note internal handover indication

PROCESS FIG-5-7-23 1 (1)

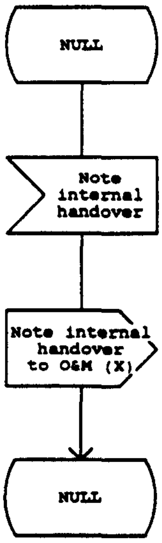


Figure 5.7.24
ASE/TCAP interface procedures in controlling MSC (MSC-A) when receiving note internal handover indication

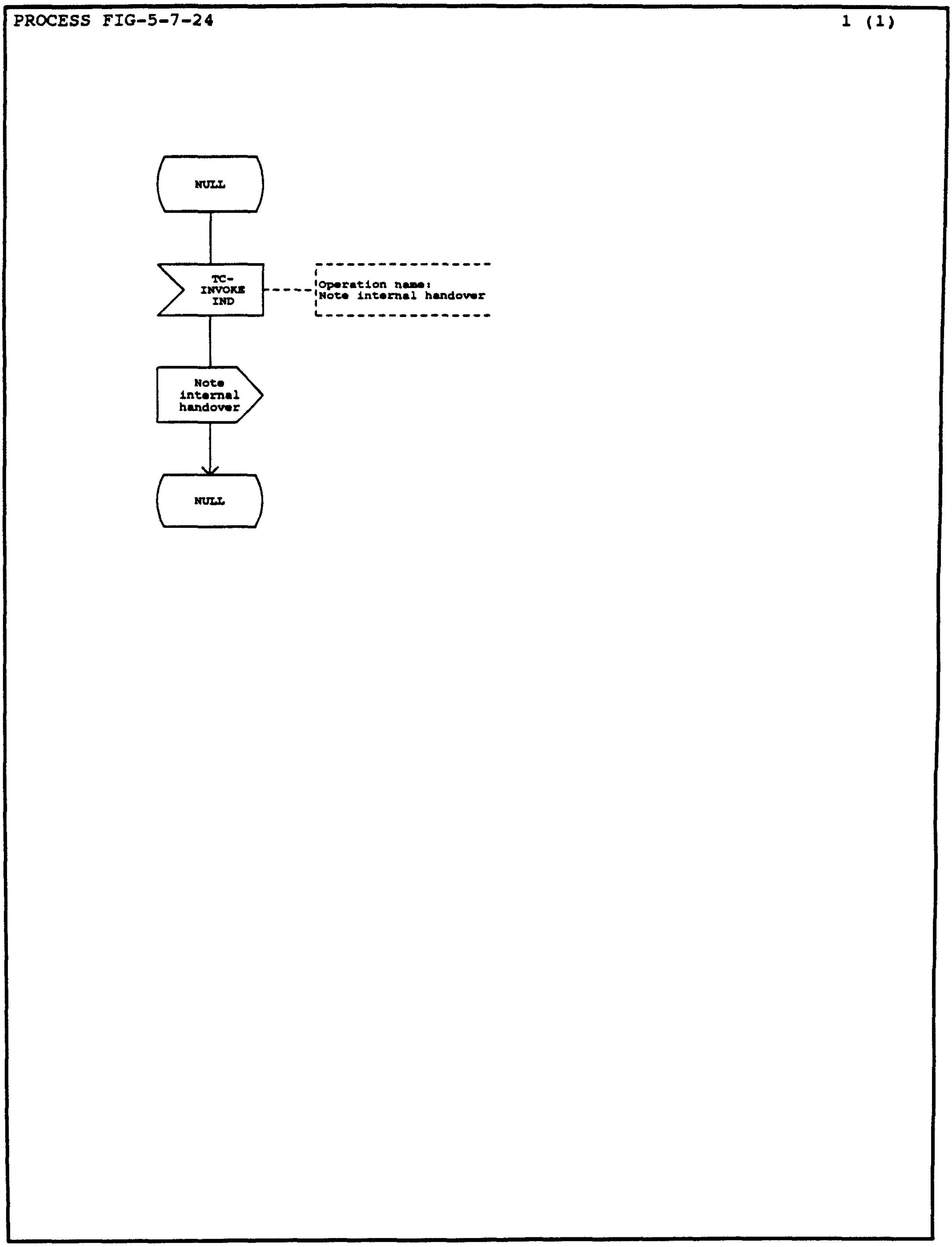


Figure 5.7.25
Application specific procedures in serving MSC (MSC-B) for providing note internal handover indication

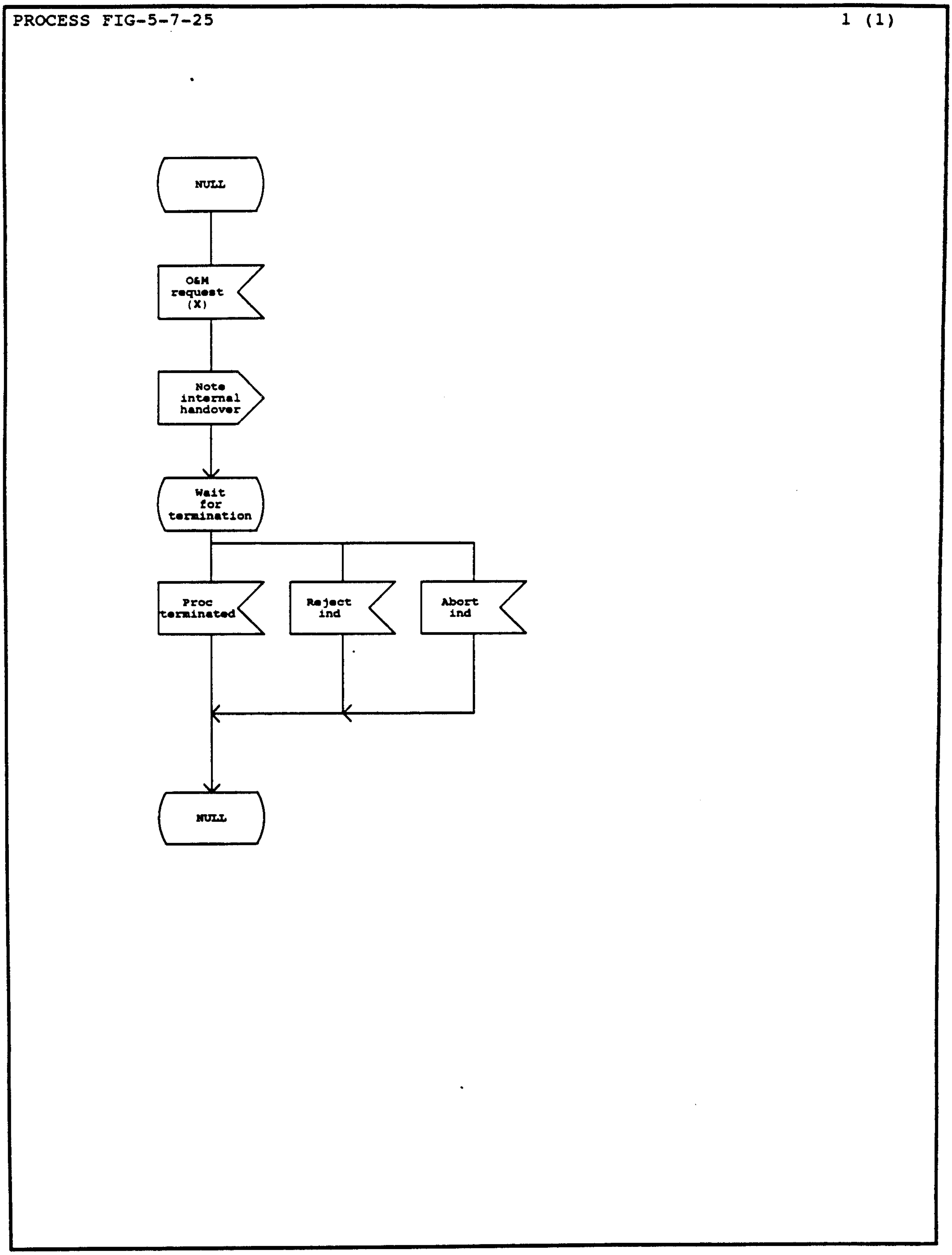
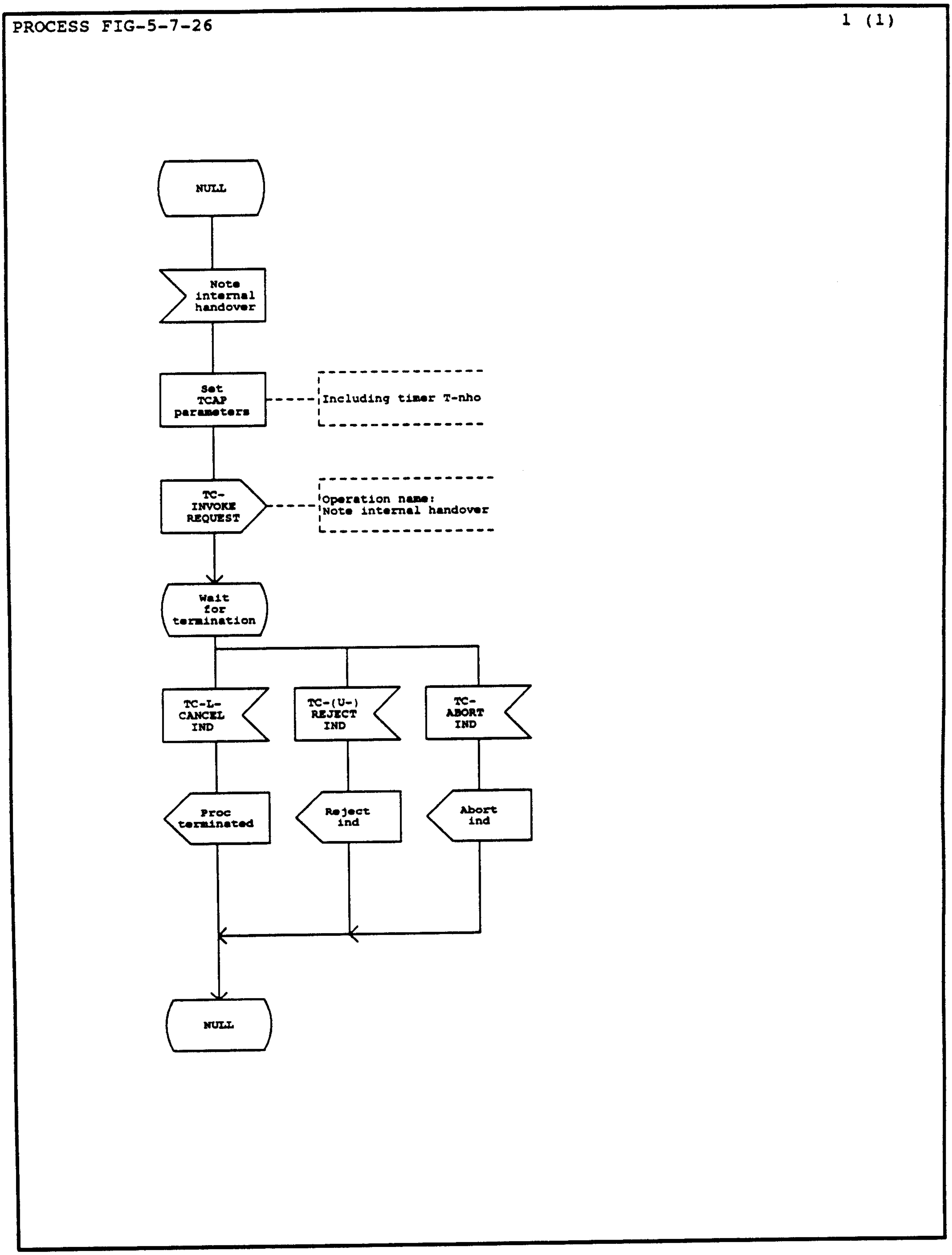


Figure 5.7.26
ASE/TCAP interface procedures in serving MSC (MSC-B) for provding note internal handover indication



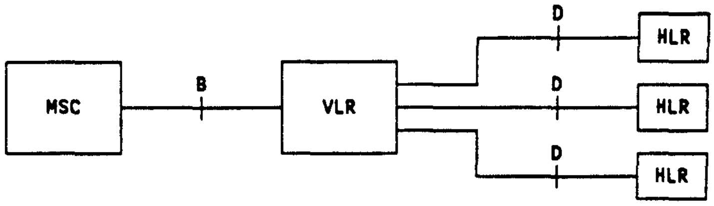
5.8 Fault recovery of location registers

5.8.1 Requirements

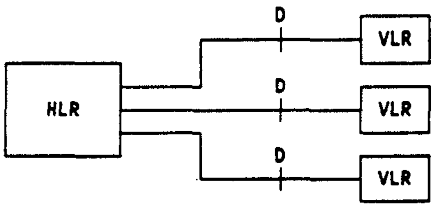
Fault recovery and restoration procedures for location registers are contained in Recommendation GSM 03.07.

Below follows a description of MAP procedures required for this purpose.

5.8.2 Definition of interfaces



a) Interfaces for restoration of VLR



b) Interfaces for restoration of HLR

Figure 5.8.1 Interfaces related to restoration of location registers.

For restoration of the visitor location register interfaces to several home location registers may be involved. The interface to the MSC is also involved (Figure 5.8.1 a)). The procedures across the two types of interfaces are described below.

For restoration of the home location register, interfaces to several visitor location registers may be involved (Figure 5.8.1 b)).

5.8.3 Procedures for restoration of VLR

After a restart, the VLR will send a reset message to the HLRs which may have stored location information previously sent by the VLR, in order to inform them that the location information must be checked prior to establishing calls (see 0 in Figure 5.8.2). When receiving a reset message from a VLR, the HLR will mark all corresponding MSs, derived from the "VLR number" parameter of the reset message.. The first call towards a marked MS will imply a check. This check will be performed by the HLR by using the provide roaming number message. The VLR will also start the restoration timer, delete all TMSI and mark all MSs with two restoration indicators: "not confirmed by radio contact" and "not confirmed by HLR". These flags are removed when a procedure with the relevant entity has taken place.

The procedures involved are shown in Figure 5.8.2 and are as follows:

1) The following MAP messages received from the MSC will indicate that the MS is in the area controlled by the VLR: update location area message, attach IMSI message and process access request message. If authentication is successful, the VLR will remove the indicator "not confirmed by radio contact". If the indicator "not confirmed by HLR" is

set, these messages will also trigger the location updating procedure with the HLR, whose positive answer will remove this indicator.

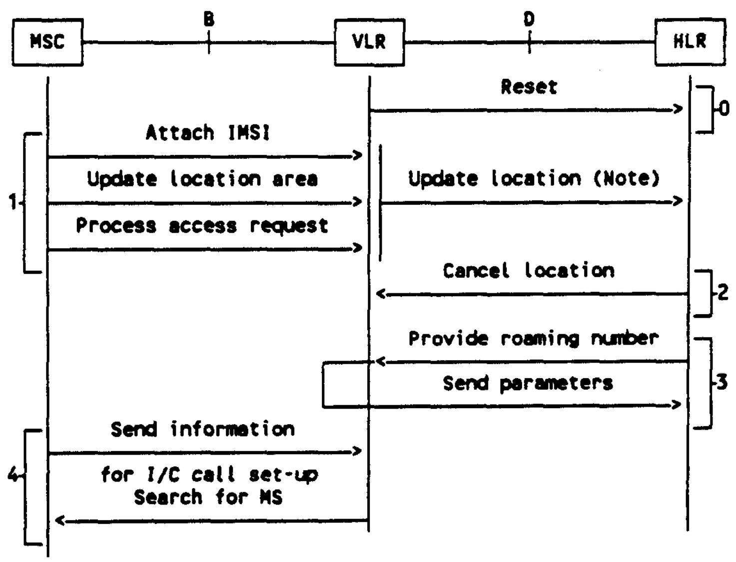
2) Receiving a cancel location message from the HLR enables the VLR to delete the MS, if present.

3) When receiving the provide roaming number message from the HLR for an unidentified MS, the VLR will ask for subscriber parameters with the send parameters message sent to the HLR, prior to replying to the initial message. A positive answer from the HLR will set the indicator "not confirmed by radio contact". For other messages (e g insert subscriber data) the unidentified subscriber message is normally returned. If the MS is already known in the VLR, the standard procedure applies.

4) When receiving a send information for I/C call set-up message concerning an MS terminating call for an MS with the indicator "not confirmed by radio contact" set, but with the indicator "not confirmed by HLR" removed, the VLR sends a search for MS message to the MSC. This message indicates that the MSC may search for the MS on all BSs connected to the MSC (provided that the MSC covers more than one location area). The MSC returns the location information in the search acknowledge message, which removes the indicator "not confirmed by radio contact".

At restoration timer expiry, the VLR deletes all MS records where both the indicators "not confirmed by radio contact" and "not confirmed by HLR" are set.

An overview of the general actions performed by the VLR at restart and at restoration phase time-out is given in Figure 5.8.3 using SDL diagrams. The actions performed for individual procedures are shown in the corresponding SDL diagrams. The actions performed by the HLR when receiving a reset message from a VLR are given in Figure 5.8.4 using SDL diagrams.



Note: After authentication, if performed.

Figure 5.8.2 Procedures related to restoration of VLR.

Figure 5.8.3
Application specific procedures in VLR for restoration of VLR

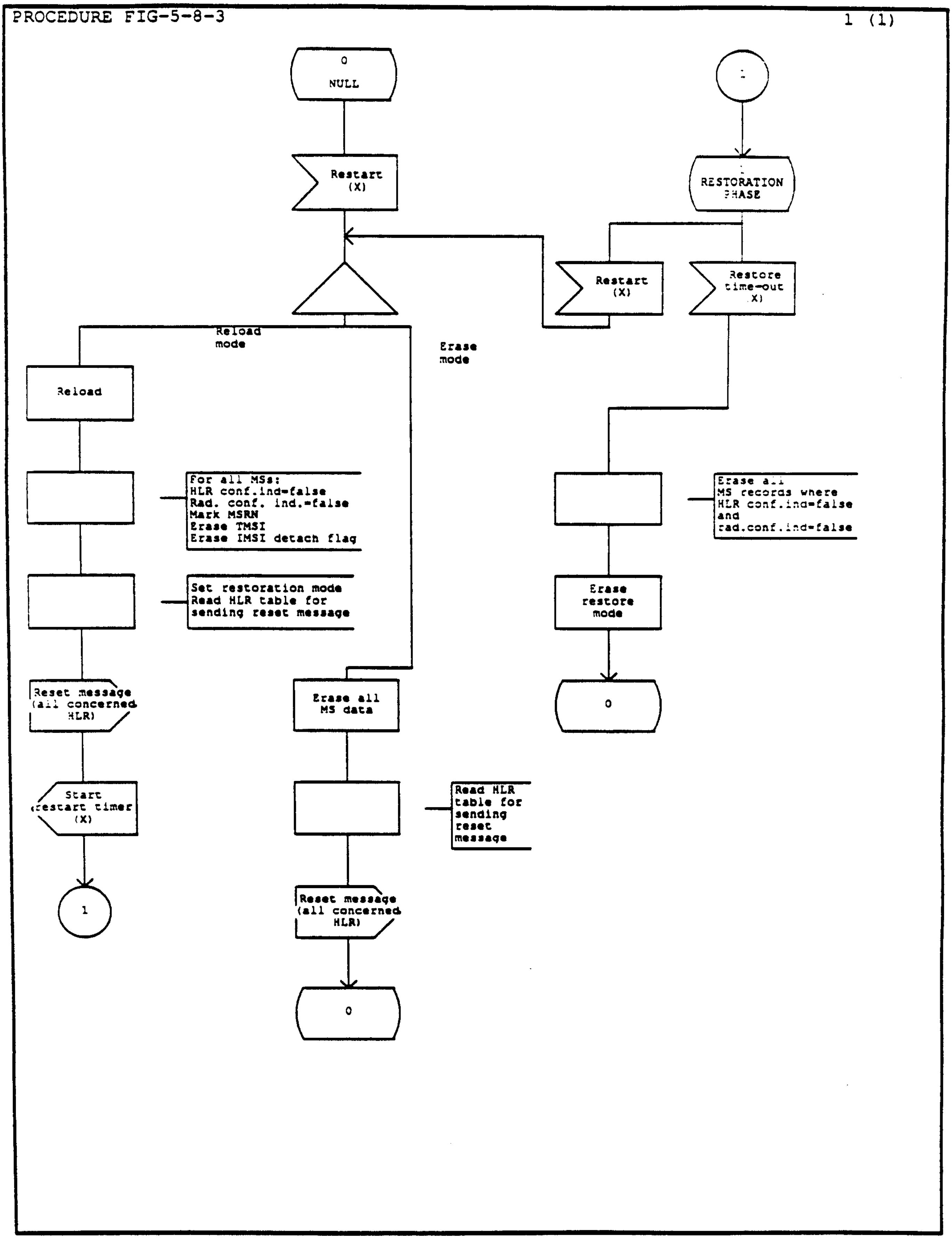
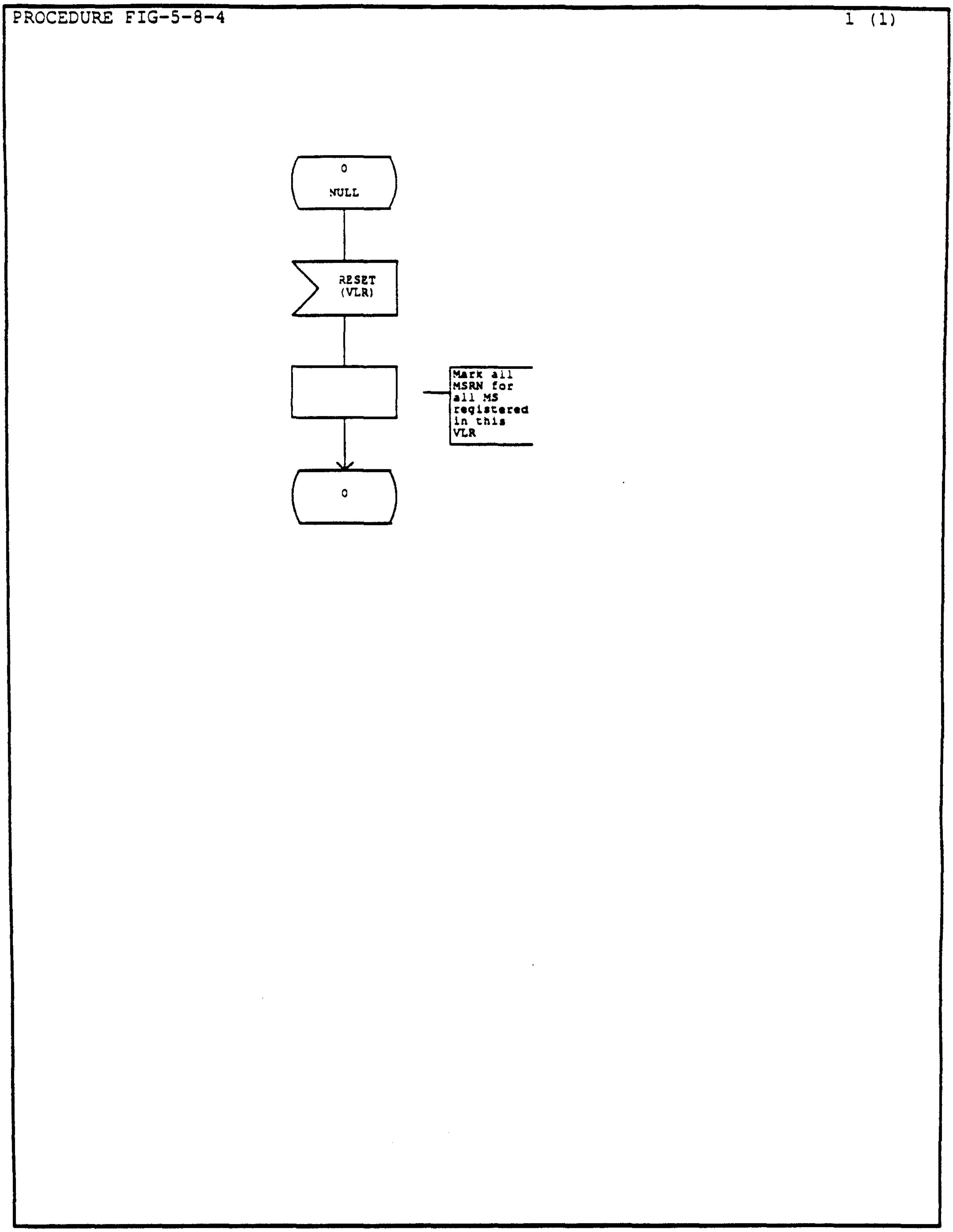


Figure 5.8.4
Application specific procedures in HLR for restoration of VLR



5.8.4 Procedures for restoration of HLR

After a restart, the home location register will send a reset message to the VLRs (see Figure 5.8.5). This corresponds to 0) in Figure 5.8.5. This reset message optionally contains the HLR Identity parameter, or a list of HLR Identities.

When receiving a reset message, the VLR will derive all involved MSs of that HLR either from the HLR Identity (if present), or from the HLR number. The VLR will then mark these MSs with the indicator "not confirmed by HLR". If the VLR receives a message from an MSC indicating radio contact with a concerned MS (i e update location area, process access request, attach IMSI), the VLR will initiate location updating of the HLR. A positive answer from the HLR will remove the indicator "not confirmed by HLR". This corresponds to l) in Figure 5.8.5.

When receiving an update location message from a VLR for an MS whose supplementary services parameters might have been lost since last backup, the HLR will reply to the update location message with a forward check SS indication in addition to the update location accepted message. The indication will be forwarded to the MSC in order to be passed to the MS, so that the mobile subscriber can update the HLR.

When receiving a send routing information message for an MS with a marked roaming number, the HLR will send a provide roaming number message to the VLR, as indicated in 2) of Figure 5.8.5. A positive result will enable the HLR to reply to the interrogating entity, but the provided MSRN should not replace the marked one, which can only be replaced when receiving an update location message.

The procedures outlined above are shown in Figure 5.8.6 and 5.8.7 for the HLR and the VLR, respectively, using SDL description.

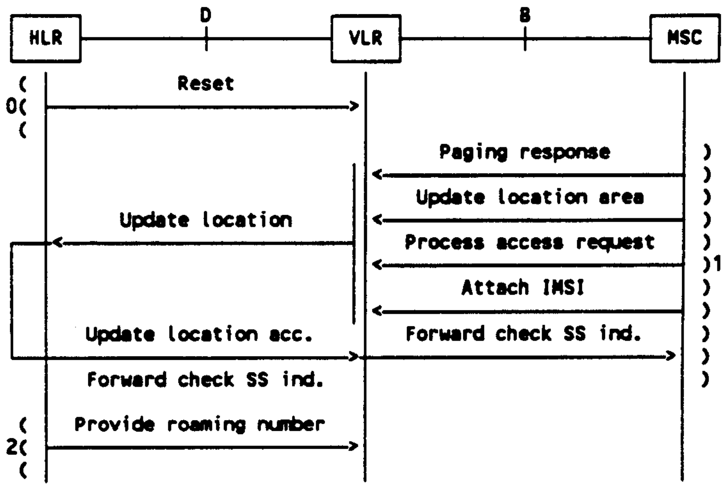


Figure 5.8.5 Procedures related to restoration of HLR.

Figure 5.8.6
Application specific procedures in HLR for restoration of HLR

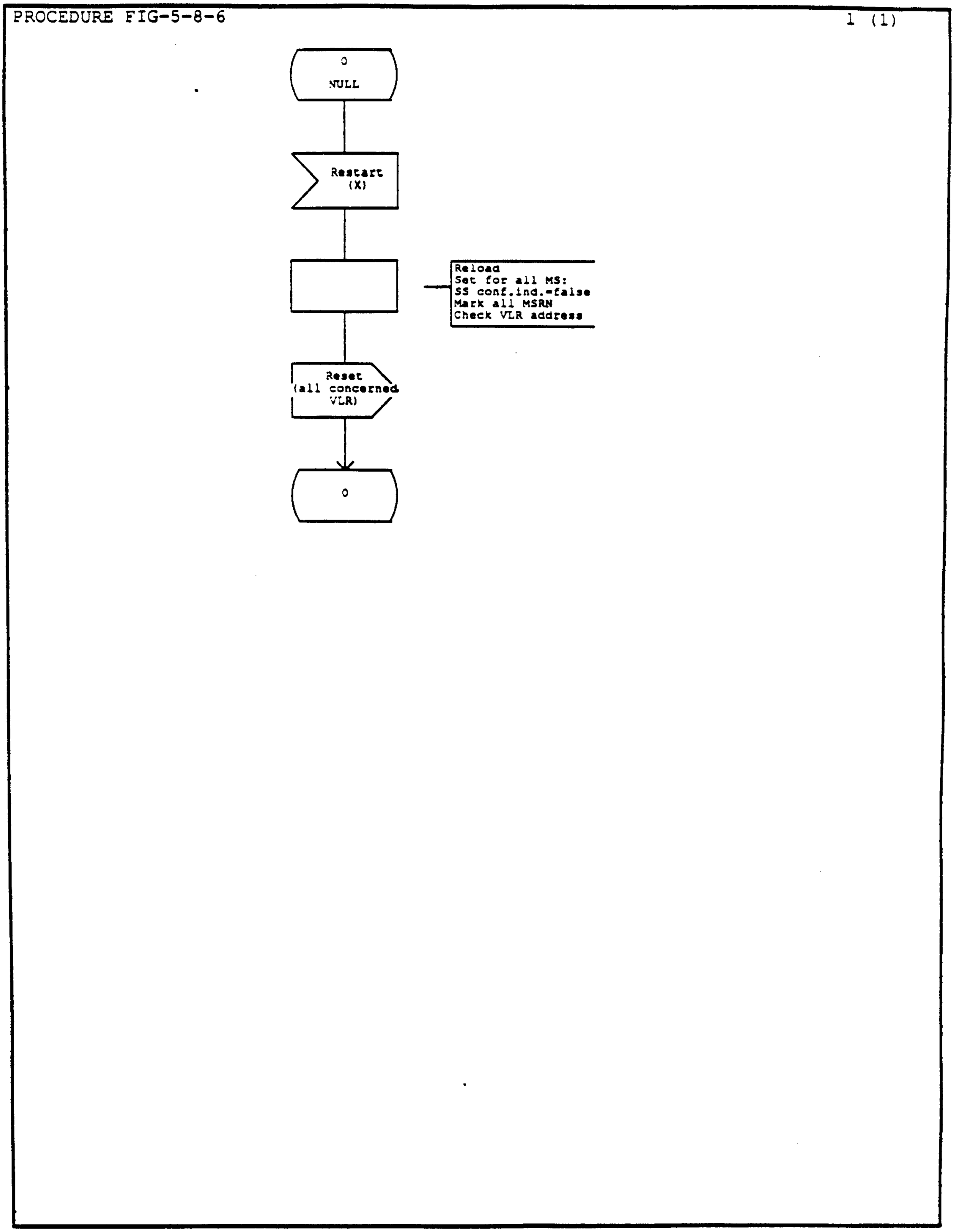
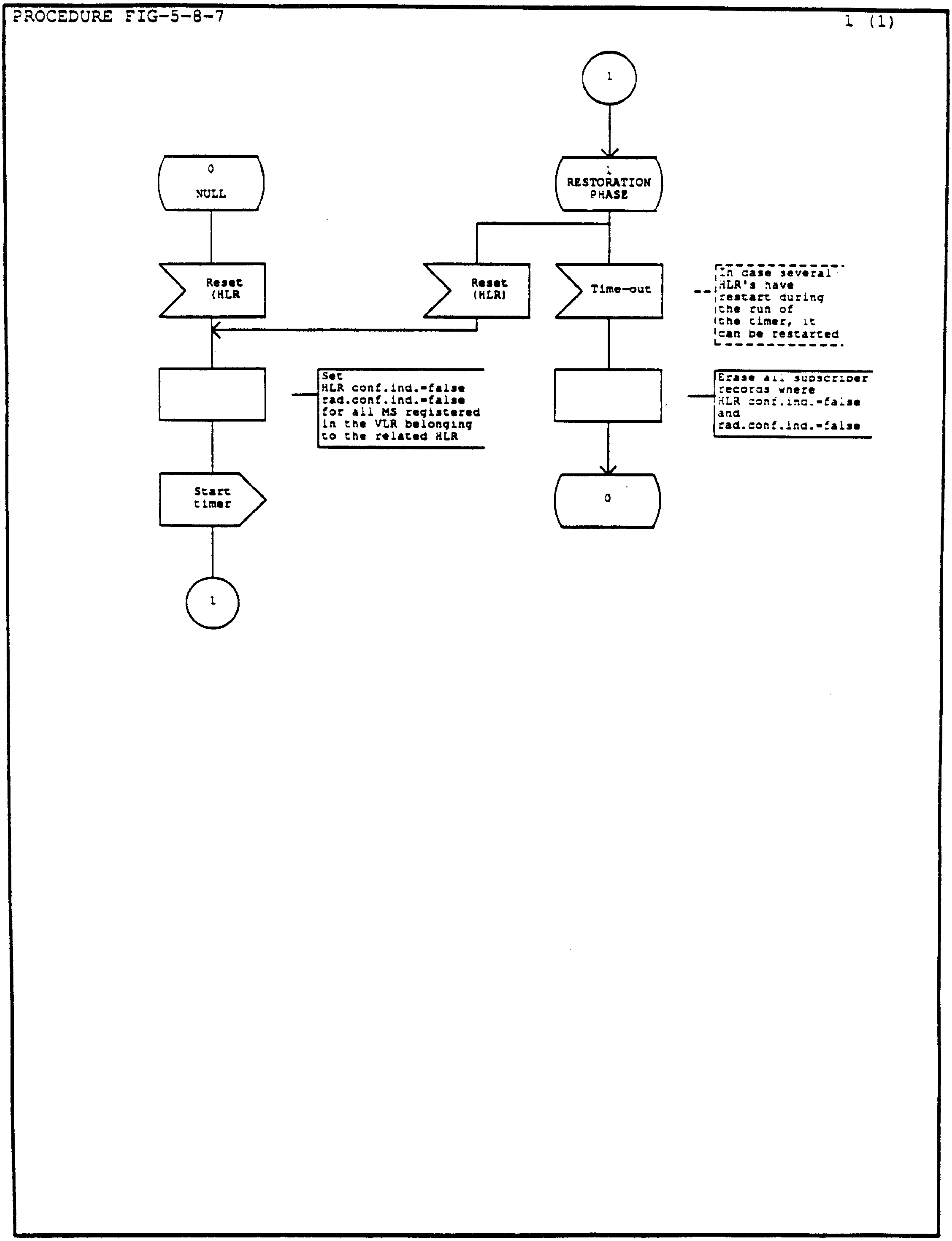


Figure 5.8.7
Application specific procedures in VLR for restoration of HLR



5.8.5 Detailed description of reset procedure

5.8.5.1 Procedure in originating entity (VLR or HLR)

The application specific procedure is shown in Figures 5.8.3 and 5.8.6 and the ASE/TCAP interface procedure is shown in Figure 5.8.8.

The reset message is sent to selected VLRs/HLRs, with one separate transaction for each receiving entity. The reset message is sent in a TC-INVOKE REQUEST primitive with prearranged termination of the procedure. The termination is done by use of timer supervision (T-res) and expiry of the timer indicates the termination of the procedure (TC-L-CANCEL INDICATION primitive).

5.8.5.2 Procedure in receiving entity (HLR or VLR)

The application specific procedure is shown in Figures 5.8.4 and 5.8.7 and the ASE/TCAP interface procedure is shown in Figure 5.8.9. The receiving entity will receive the reset message in the TC-INVOKE INDICATION primitive. An internal operation in the receiving location register will then take place in order to mark the MSs of the originating location register.

Figure 5.8.8
ASE/TCAP interface procedure in the entity originating a reset procedure.

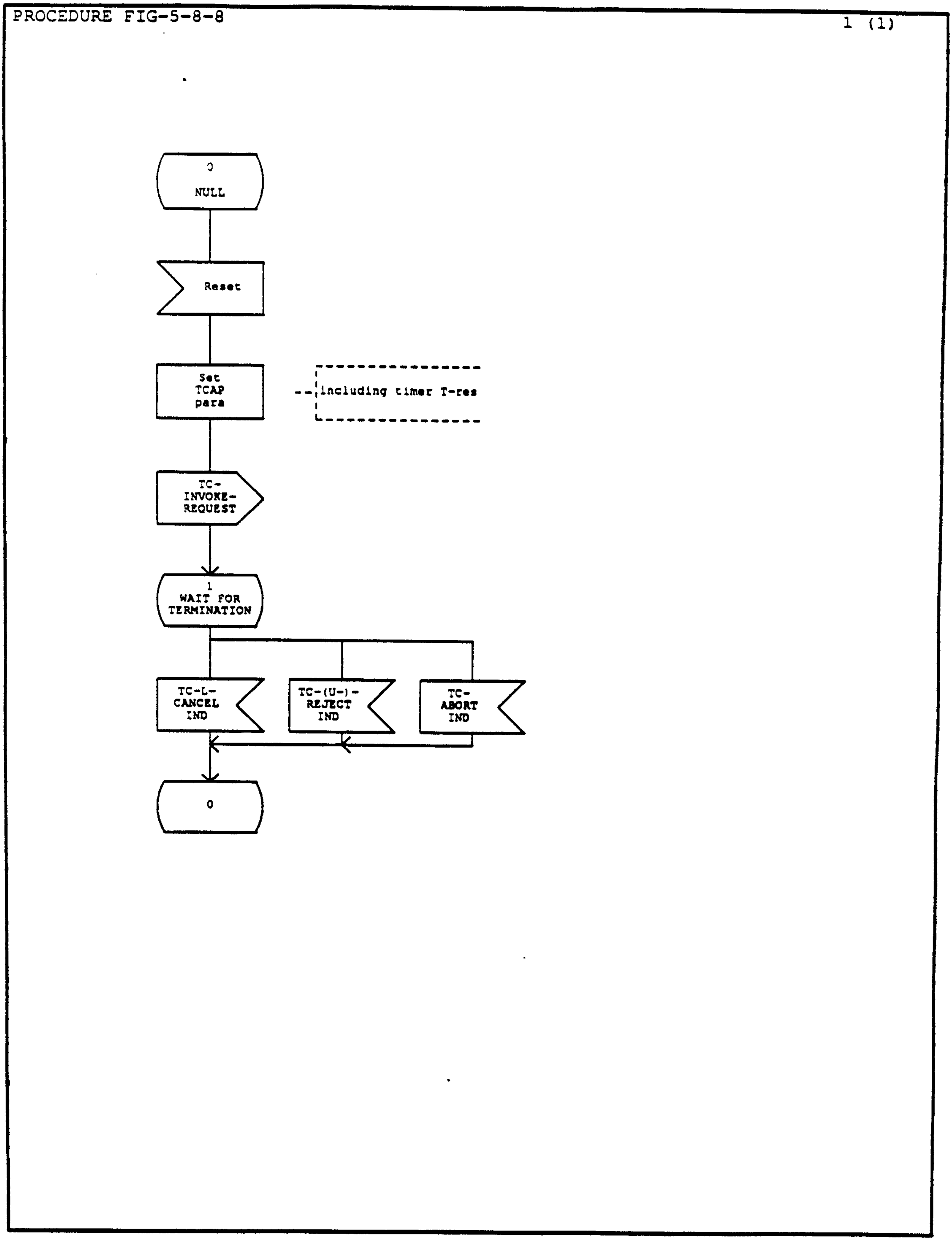
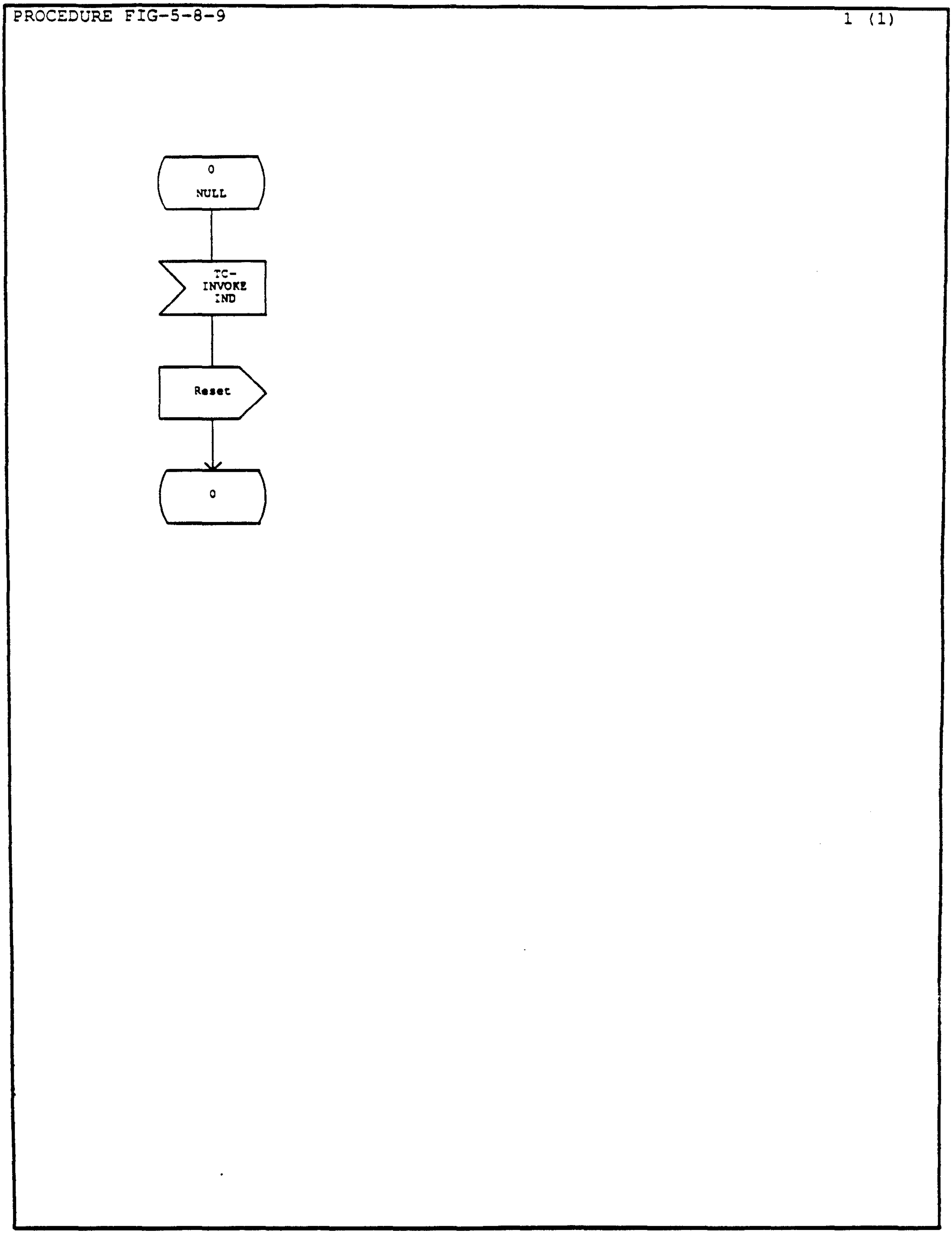


Figure 5.8.9
ASE/TCAP interface procedure in the entity receiving a reset message.



5.8.6 Procedure for checking supplementary services

5.8.6.1 General description of the procedure

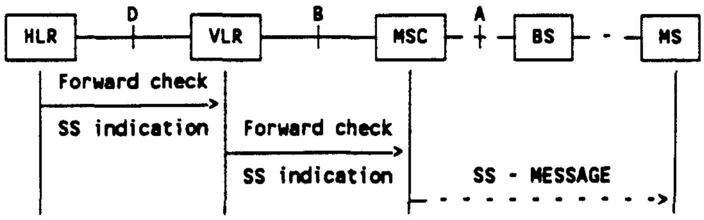


Figure 5.8.10 Procedure for checking supplementary services

The procedure is invoked by the HLR if it is in a restoration mode and it receives a request for location updating or an operation on a supplementary service and the MS has subscription for supplementary services requiring subscriber activation/ deactivation.

The message forward check SS indication is sent to the VLR and the VLR forwards the same message to the MSC. The supplementary services check indication is then sent to the MS (SS-MESSAGE in the Figure). The message does not contain any specific supplementary services information, but is an indication to the user at the MS that the activation status of supplementary services may not be correct in the network. The user may then check the status of the services or activate/deactivate/register/erase them, as required.

5.8.6.2 Detailed description of the procedure in the HLR

The application specific procedure and the ASE/TCAP interface procedure are shown in Figures 5.8.11 and 5.8.12, respectively. When an application process in the HLR indicates that the user should be notified that the status of supplementary services should be checked, the HLR sends the forward check SS indication message in a TC-INVOKE REQUEST primitive to the VLR provided that a dialogue with the VLR exists already for the MS concerned. TCAP is requested to supervise the procedure by timer T-fcs.

5.8.6.3 Detailed description of the procedure in the VLR

The application specific procedure in the VLR is shown in Figure 5.8.13. The ASE/TCAP interface procedures towards the HLR and the MSC are shown in Figures 5.8.15 and 5.8.12, respectively.

The VLR will send the forward check SS indication to the MSC when that message is received from the HLR provided that the received message does not contain parameter errors and that a dialogue with the MSC exists already for the MS concerned. The VLR takes no other actions on the message. The forward check SS indication message is received in a TC-INVOKE INDICATION primitive and sent to the MSC in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure to the MSC by timer T-fcs.

5.8.6.4 Detailed description of the procedure in the MSC

The application specific procedure in the MSC is shown in Figure 5.8.14 and the ASE/TCAP interface procedure is shown in Figure 5.8.15.

When receiving a forward check SS indication in a TC-INVOKE INDICATION primitive without parameter errors, the MSC will forward an indicator to the MS provided that a radio connection exists to the MS.

Figure 5.8.11
Application specific procedure in HLR for forwarding check SS indication.

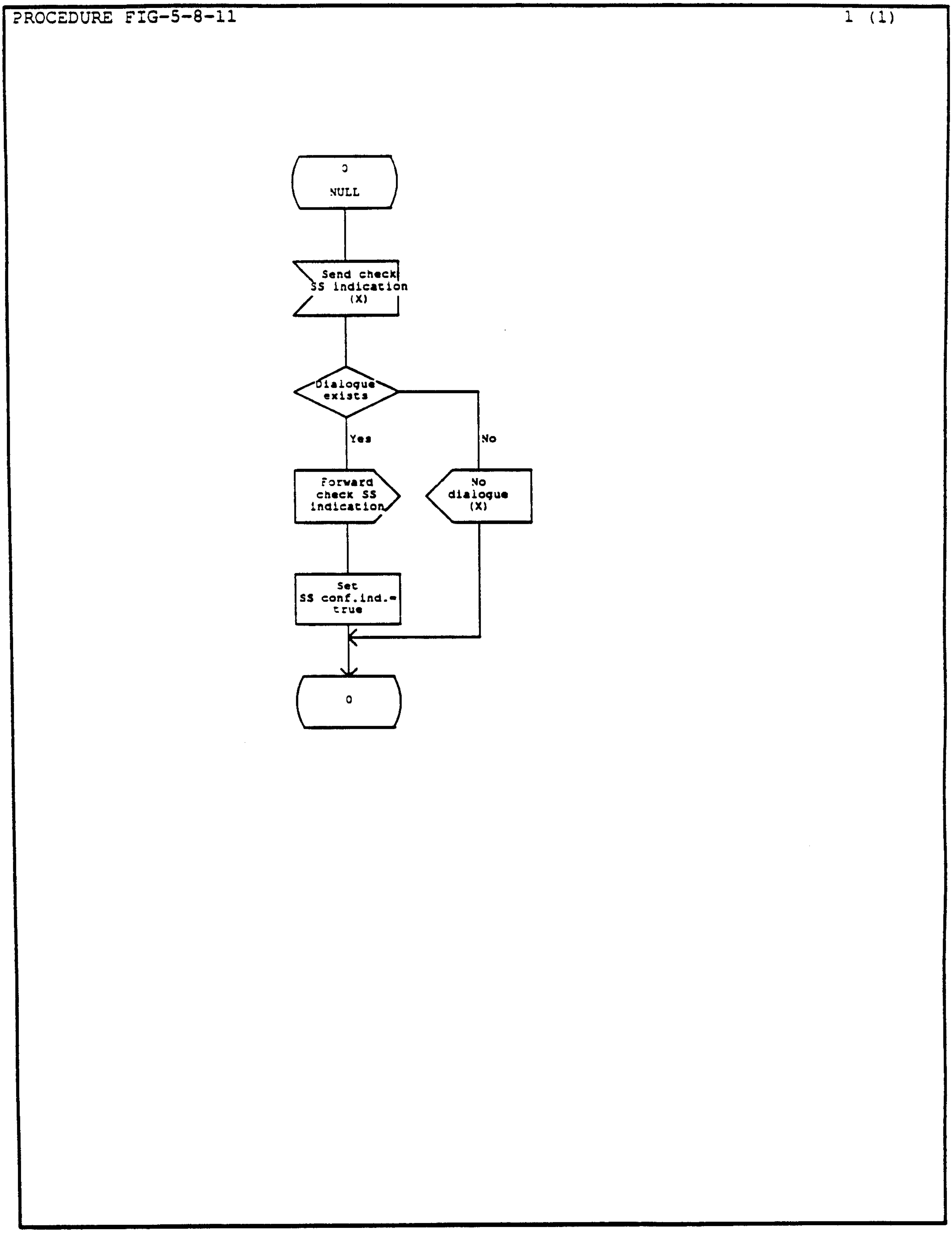


Figure 5.8.12
ASE/TCAP interface procedure in the HLR and the VLR for forwarding check SS indication.

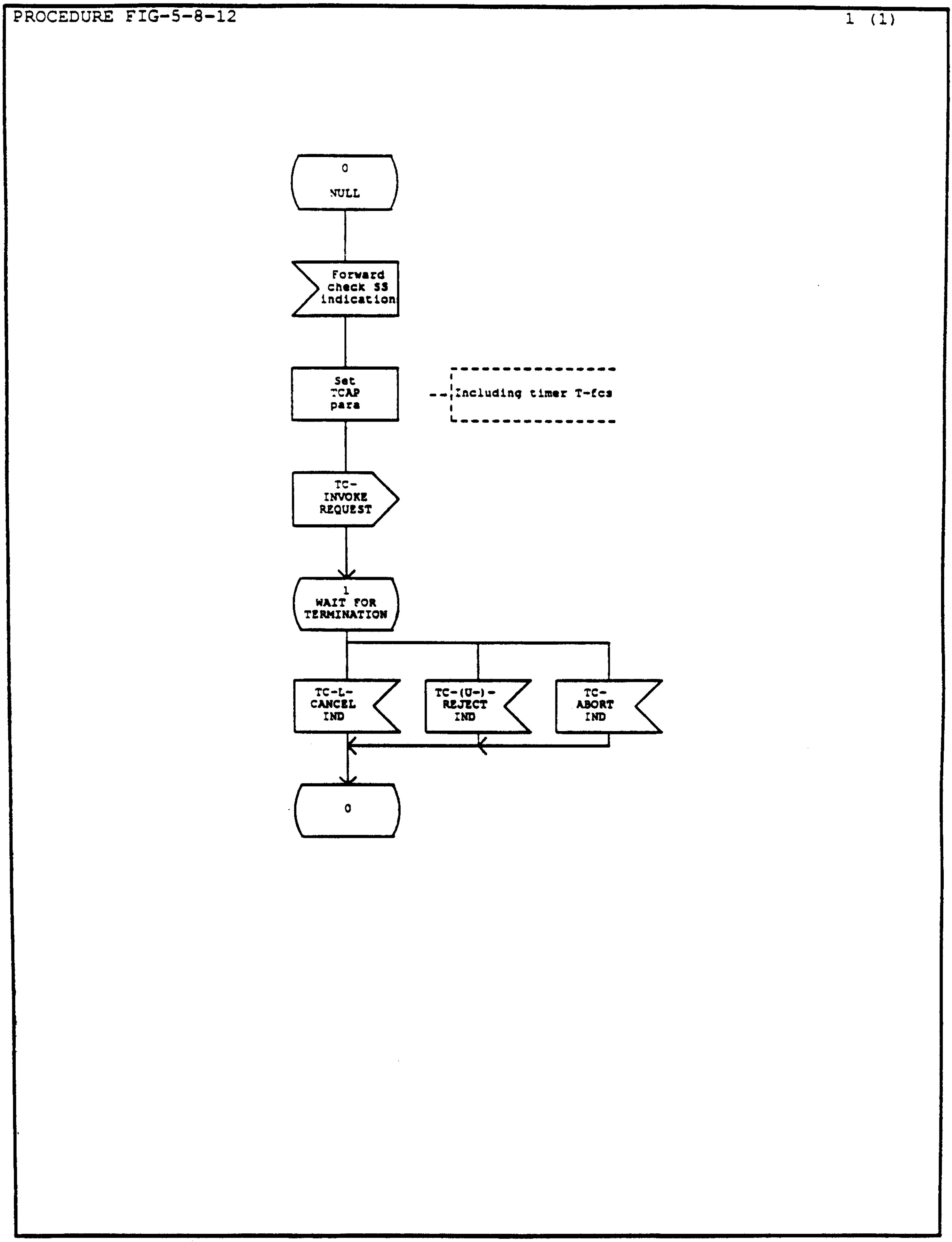


Figure 5.8.13
Application specific procedure in the VLR for forwarding check SS indication.

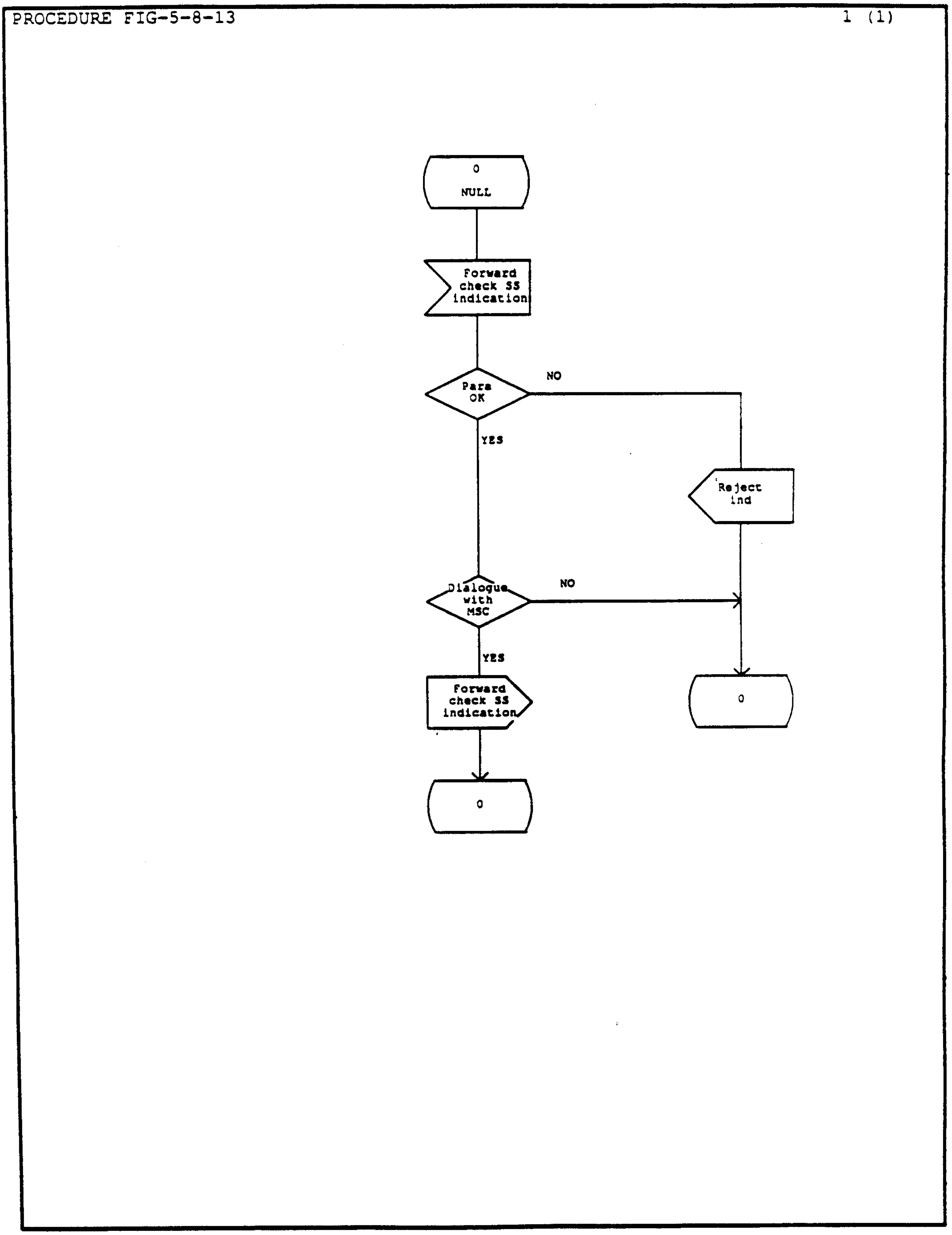


Figure 5.8.14
Application specific procedure in the MSC for forwarding check SS indication to the MS.

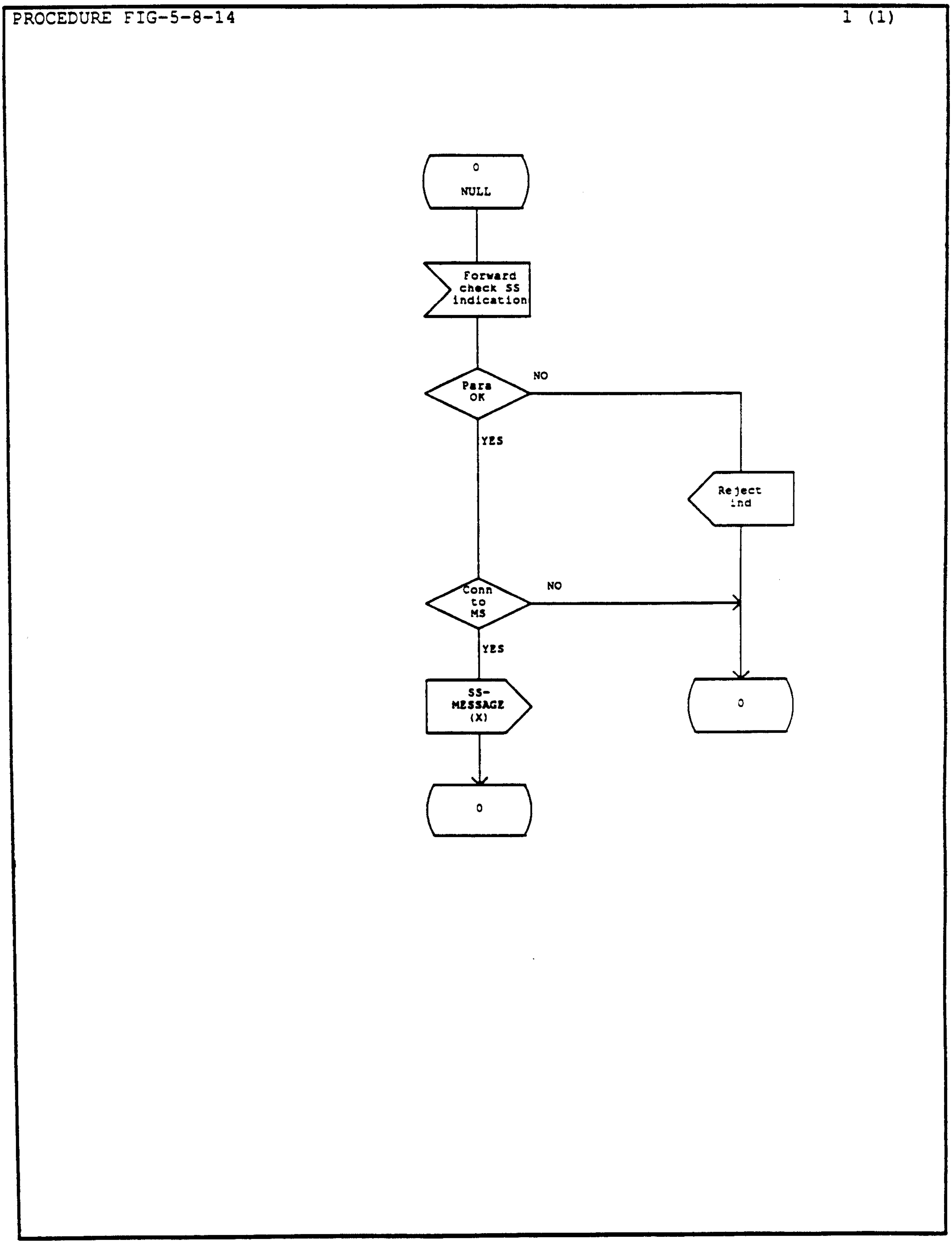
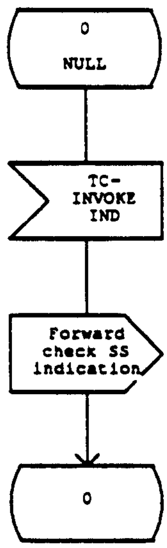


Figure 5.8.15
ASE/TCAP interface procedure in the VLR and the MSC for receiving a forward check SS indication message.

PROCEDURE FIG-5-8-15 1 (1)



5.9 Management of international mobile equipment identities

5.9.1 Definition of interfaces

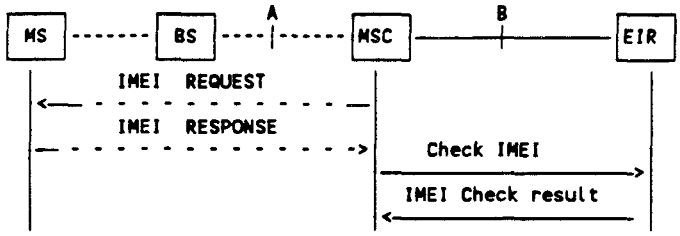


Figure 5.9.1 Interface and procedures for checking the equipment identity (IMEI)

The international mobile equipment identities (IMEI) are stored in a functional unit denoted equipment identity register (EIR). MSCs may interface the register by use of MAP (interface F) as shown in Figure 5.9.1.

5.9.2 General description of procedures

The procedure is shown in Figure 5.9.1. It is initiated by the MSC requesting an MS to provide its IMEI by signalling procedures on the radio path. When the IMEI is received in the MSC, the MSC sends a check IMEI message to the EIR.

The EIR responds by returning a IMEI check result message. The further actions taken by the MSC depend on the result received from the EIR.

5.9.3 Detailed description of the IMEI management procedure

5.9.3.1 Procedure in the MSC

The application specific procedure is contained in Figure 5.9.2 and the ASE/TCAP interface procedure is contained in Figure 5.9.3.

When an IMEI is to be checked, the MSC sends the check IMEI message to the equipment identity register (EIR) in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-cim.

The IMEI check result is received in a TC-RESULT-L INDICATION primitive. If the IMEI is not known in the EIR, the message Unknown equipment will be received in a TC-U-ERROR INDICATION primitive.

5.9.3.2 Procedure in the EIR

The application specific procedure is contained in Figure 5.9.4 and the ASE/TCAP interface procedure is contained in Figure 5.9.5.

The EIR will receive the check IMEI message in a TC-INVOKE INDICATION primitive. If the IMEI is not in the list contained in the EIR, the Unknown equipment message is returned in a TC-U-ERROR REQUEST primitive. If the IMEI is contained in the list, the information contained in the list (see section 6) is returned in a TC-RESULT-L REQUEST primitive.

Figure 5.9.2
Application specific procedure in MSC for checking IMEI

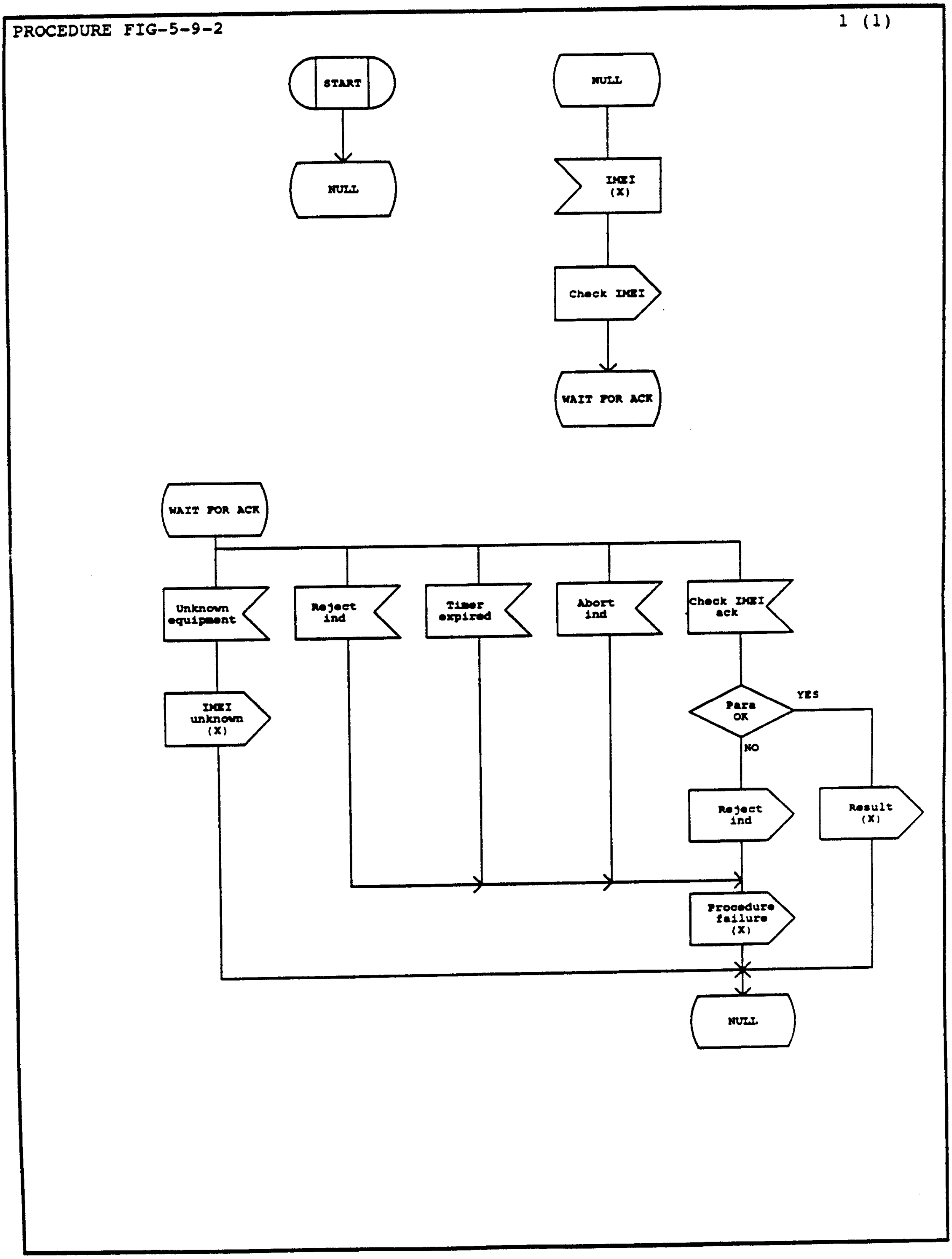


Figure 5.9.3
ASE/TCAP interface procedure in MSC for checking IMEI

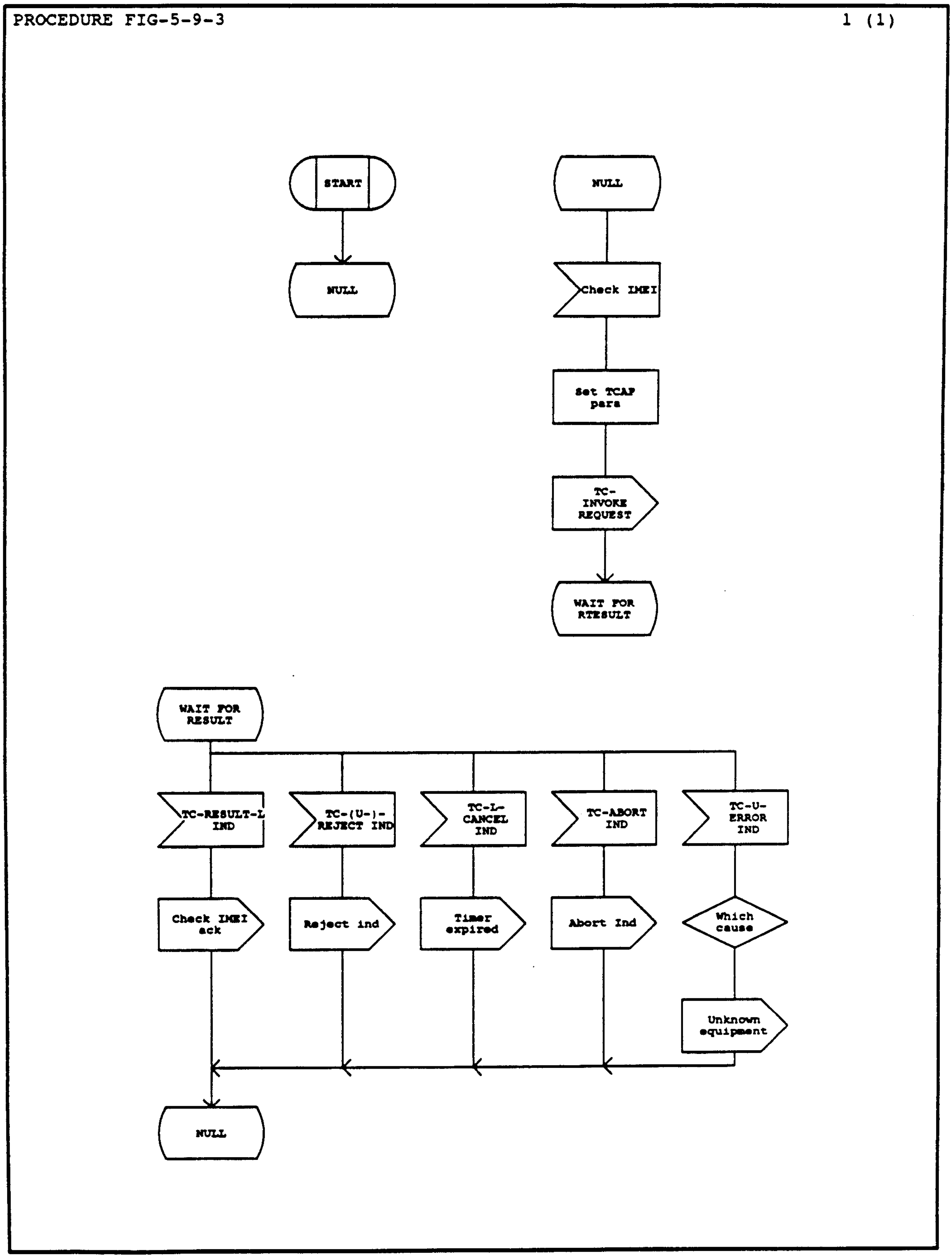


Figure 5.9.4
Application specific procedure in EIR for checking IMEI

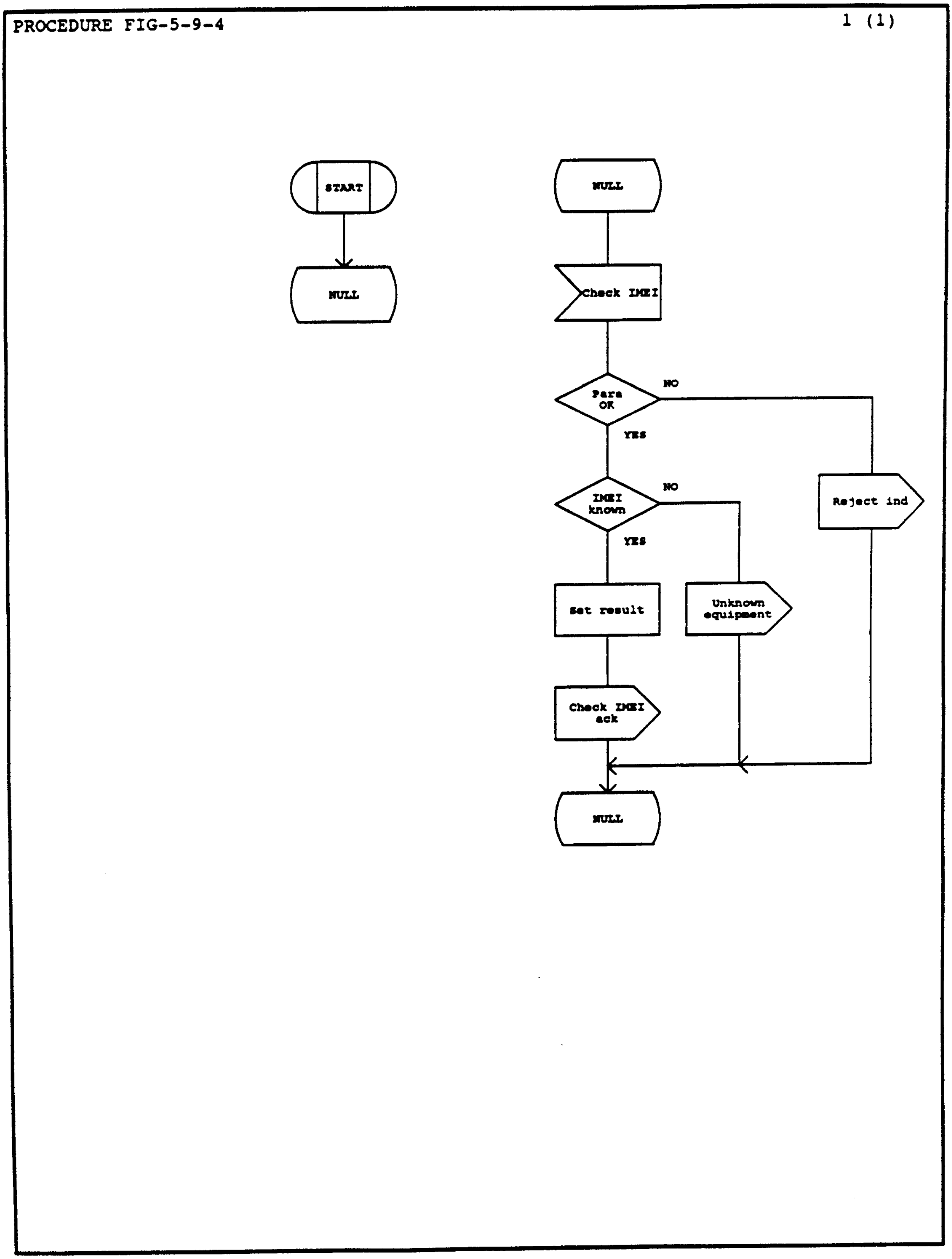
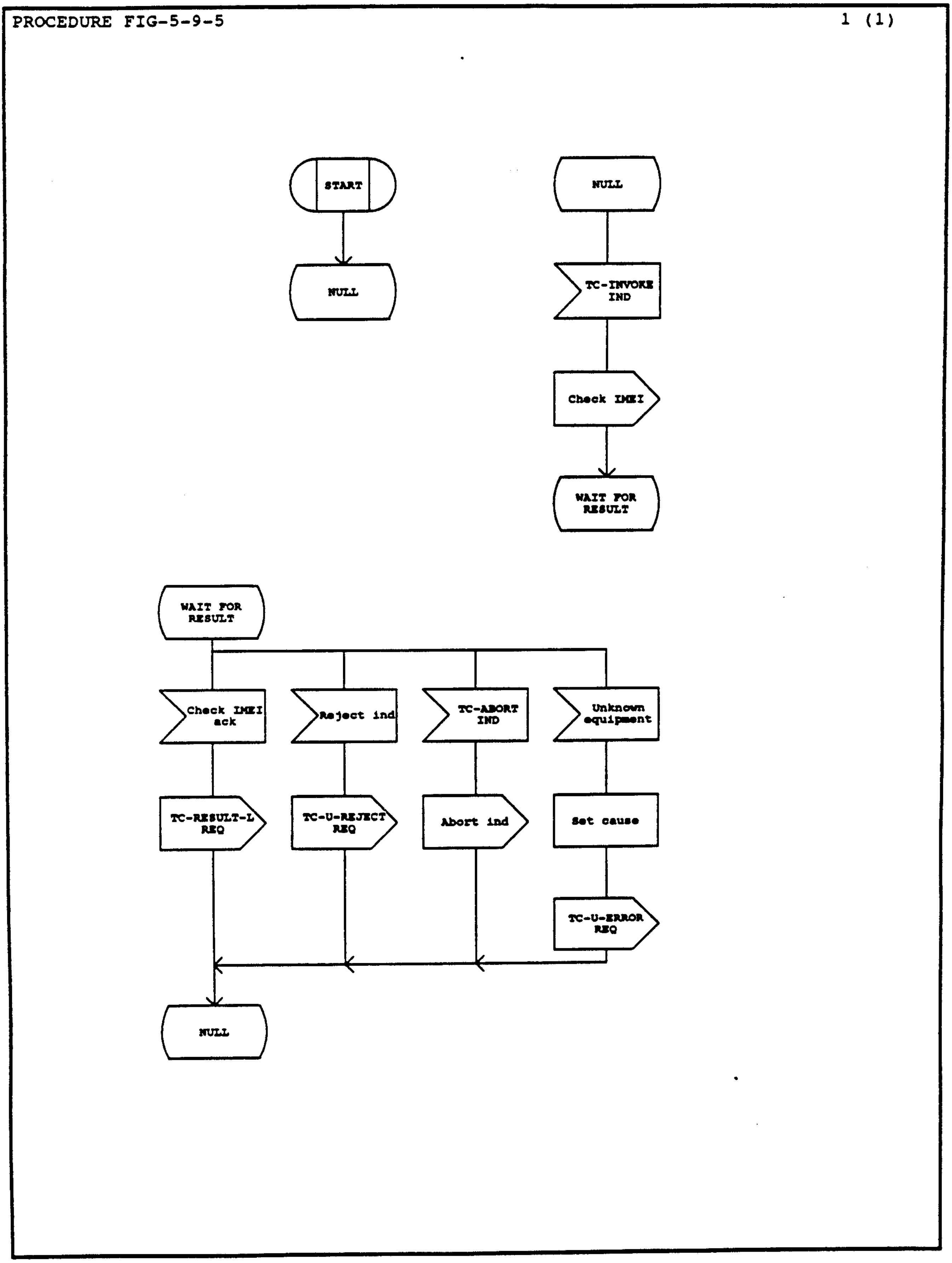


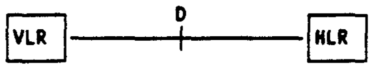
Figure 5.9.5
ASE/TCAP interface procedure in EIR for checking IMEI



5.10 Authentication

5.10.1 Definition of Interfaces

a) Interfaces for basic authentication procedures



b) Interface for obtaining authentication parameters from HLR

c) Interface for obtaining authentication parameters from previous VLR (VLR1)

Figure 5.10.1 Interfaces related to authentication.

Figure 5.10.1 shows the interfaces and system components involved in authentication of mobile stations. The various cases are:

i) the interface for the basic authentication procedure where the authentication check is done by the VLR for authentication at call set-up, location registration and operation of supplementary services (Figure 5.10.1 a));

ii) the interface between the VLR and the HLR for transfer of authentication parameters to the VLR (Figure 5.10.1 b));

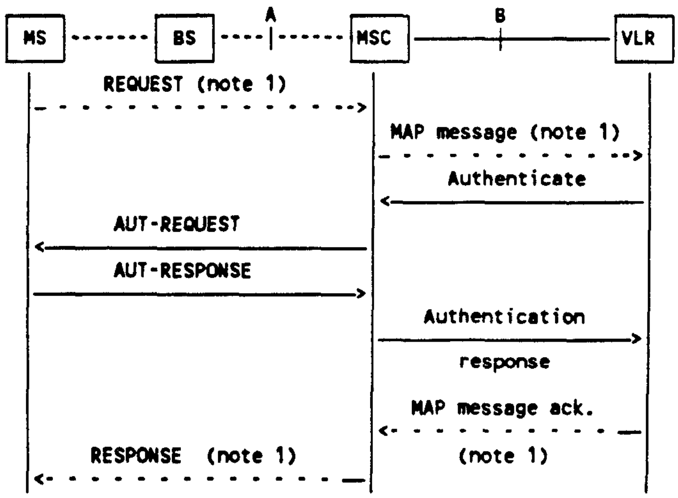
iii) the interface between the new VLR (VLR1) and the previous VLR (VLR2) for transfer of authentication parameters at location registration (Figure 5.10.1 c));

5.10.2 Basic authentication procedure

5.10.2.1 General description of the procedure

The procedure is shown in Figure 5.10.2.

The procedure is initiated when the VLR receives a MAP message from the MSC concerning a location registration, call set-up, operation of a supplementary service or a request from the MSC for initiating authentication . If the MS is unknown to the VLR, the VLR may obtain authentication parameters from the HLR by the procedure described in section 5.10.3 or from the previous VLR by the procedure described in section 5.10.4.



Note 1: REQUEST, RESPONSE, MAP message and MAP message ack indicate a message associated with call set-up, location registration, operation of a supplementary service or any other event requiring authentication.

Figure 5.10.2 Basic authentication procedure.

The VLR performs the authentication by sending the authenticate message to the MSC. This message contains the authentication parameter RAND (see Recommendation GSM 03.20). The parameter RAND is then sent to the MS in the AUT-REQUEST message. The MS responds by returning the parameter SRES (see Recommendation GSM 03.20) in the AUT-RESPONSE message. SRES is then sent to the VLR in the authentication response message for authenticity checking.

The authenticity of the MS is established by the VLR.

A negative authentication check result, indicating an illegal subscriber, is returned as part of the procedure that initiated the authentication procedure.

5.10.2.2 Detailed description of the basic authentication procedure

5.10.2.2.1 Procedure in the VLR

The application specific procedure is shown in Figure 5.10.3 and the ASE/TCAP interface procedure is shown in Figure 5.10.4.

When an indication is given that authentication is required, the VLR checks if either the authentication key (Ki) or a (RAND, SRES) set is available. If this is not the case, the VLR first obtains the required authentication parameters by using the procedure of section 5.10.3. If this procedure is unsuccessful, the authentication procedure is terminated.

If the authentication parameters are available in the VLR or obtained as described above, the VLR sends the authenticate message to the MSC in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-aut. Results are received as follows:

- the authentication response message is contained in a TC-RESULT-L INDICATION primitive. The SRES contained in this message is checked with the SRES stored or calculated in the VLR. If the two SRESs match, an authentication confirmed condition is established. If the two SRESs do not match, the illegal subscriber condition is established by the VLR;

- a procedure error is indicated in a TC-(U-)REJECT INDICATION primitive or a TC-ABORT INDICATION primitive. Either of these events are indicated to the authentication check mechanism (procedure error (X));

- expiry of timer T-aut (reported in a TC-L-CANCEL INDICATION primitive) is taken as an indication for unsuccessful termination of the procedure.

At the end of the authentication procedure, the VLR will request more authentication parameters, if required.

5.10.2.2.2 Procedures in the MSC

The application specific procedure is contained in Figure 5.10.5 and the ASE/TCAP procedure is contained in Figure 5.10.6.

The MSC will receive the authenticate message in a TC-INVOKE INDICATION primitive. If there is no parameter errors, the MSC will initiate the authentication of the MS (illustrated by the AUT-REQ (X) message). The response from the MS (in the AUT-RESPONSE (X) message) is returned to the VLR in a TC-RESULT-L REQUEST primitive.

If there is no response from the MS, an abort indication message is returned in a TC-U-ABORT REQUEST primitive.

Procedure errors are indicated in a TC-U-REJECT REQUEST primitive.

Figure 5.10.3 (Sheet 1 of 2)
Application specific procedure for the basic authentication procedure in the VLR.

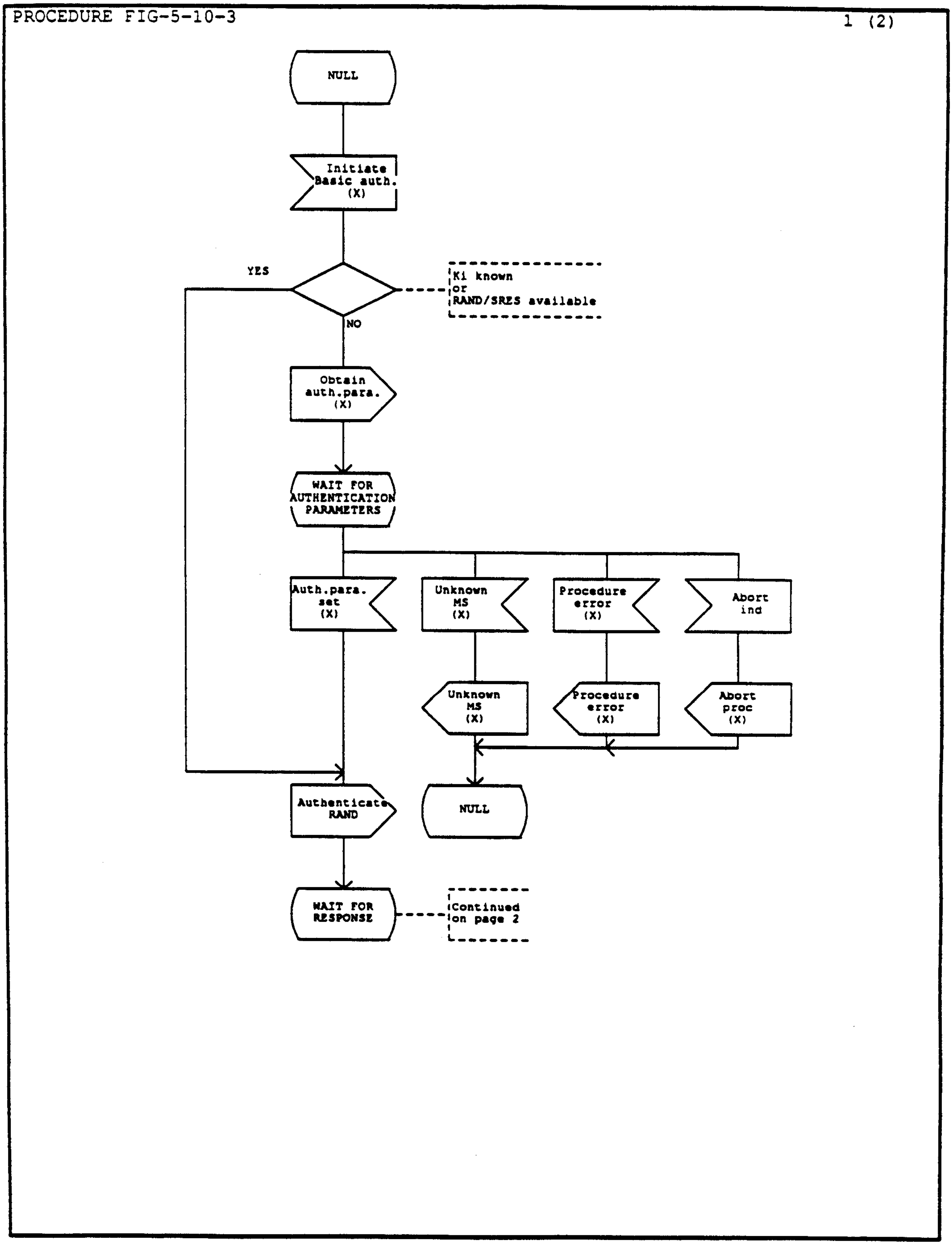


Figure 5.10.3 (Sheet 2 of 2)
Application specific procedure for the basic authentication procedure in the VLR.

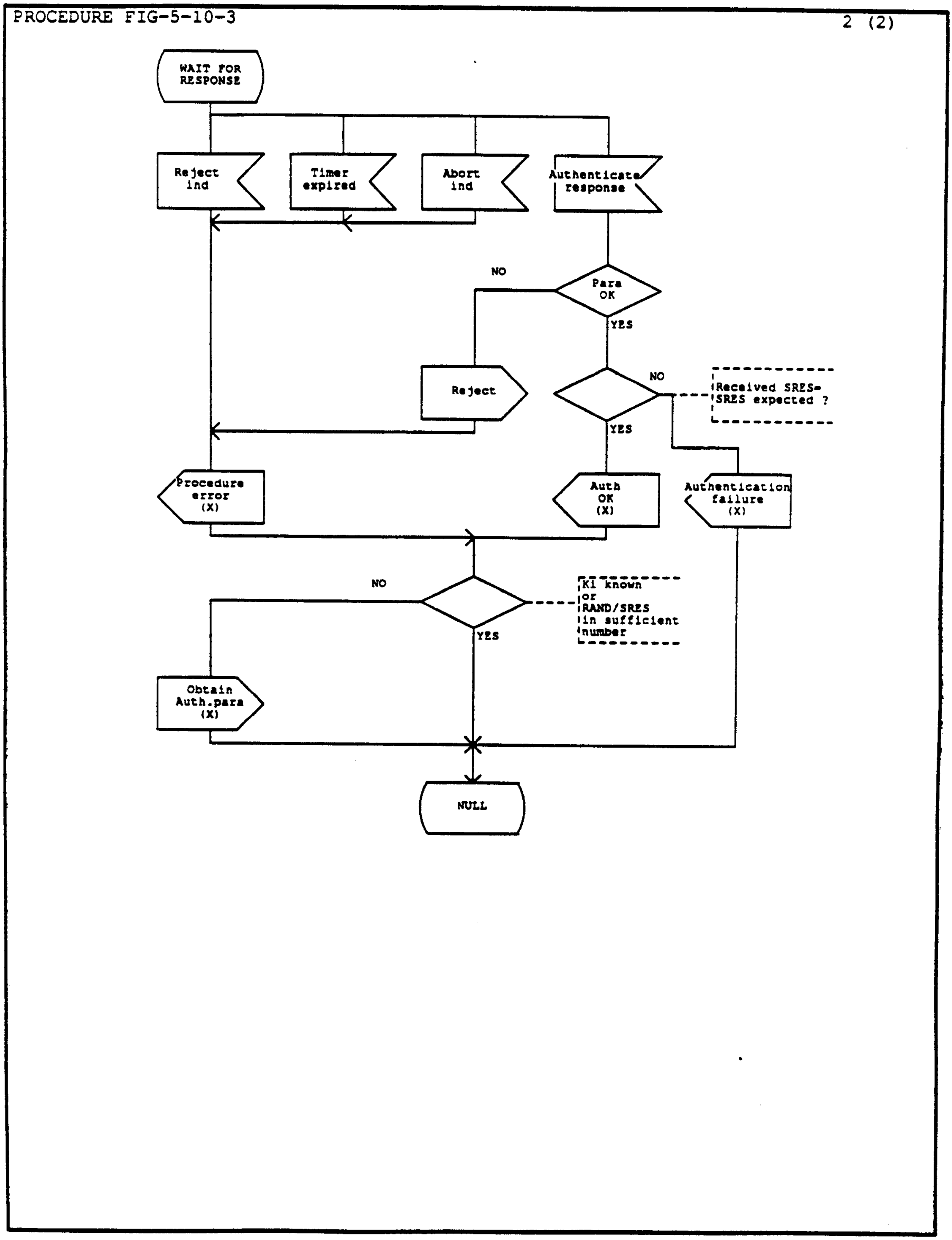


Figure 5.10.4
ASE/TCAP interface procedure for the basic authentication procedure in VLR.

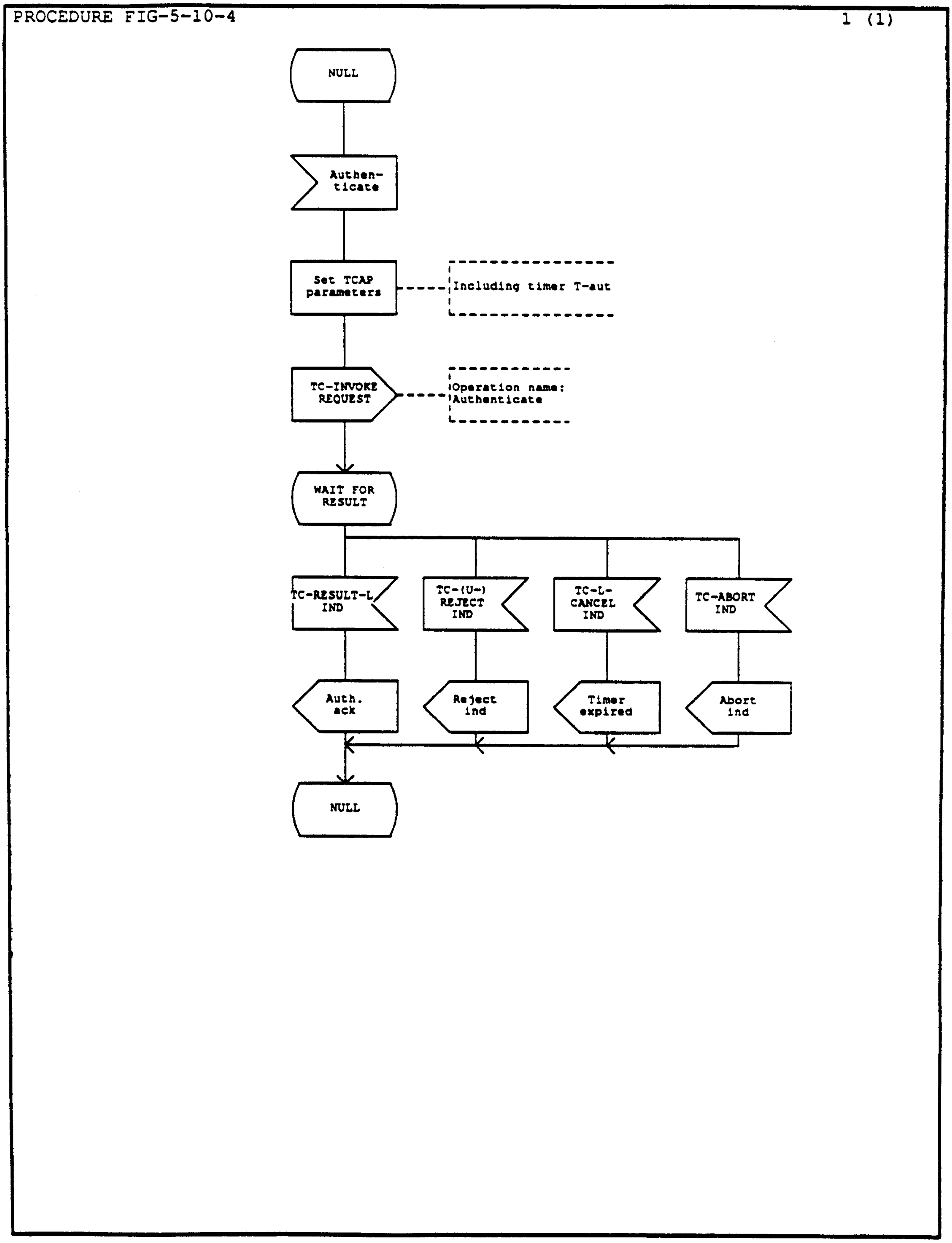


Figure 5.10.5
Application specific procedure for the basic authentication procedure in the MSC.

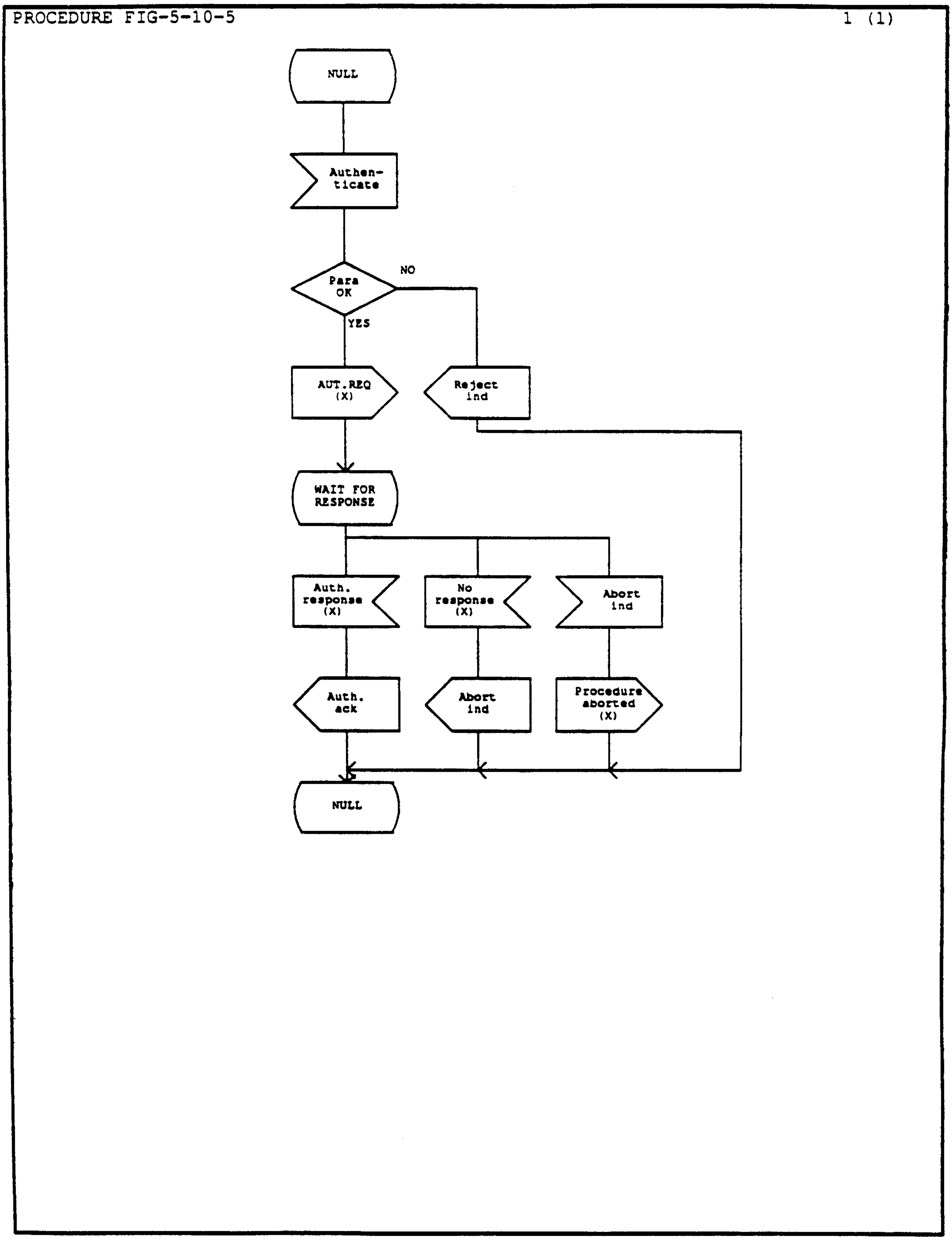
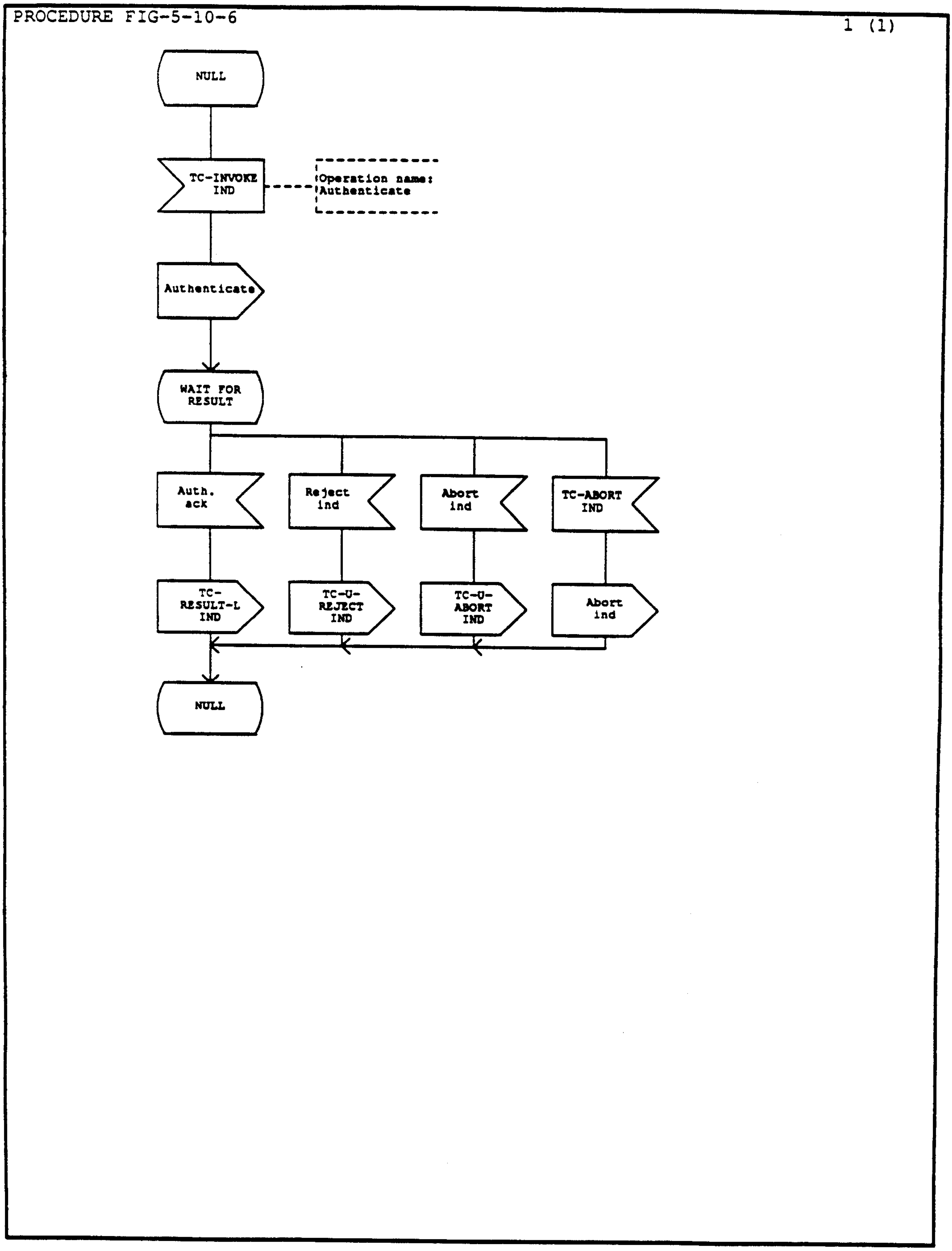


Figure 5.10.6
ASE/TCAP procedure for the basic authentication procedure in the MSC.



5.10.3 Procedure for transferring authentication parameters from HLR to VLR

5.10.3.1 General description of the procedure

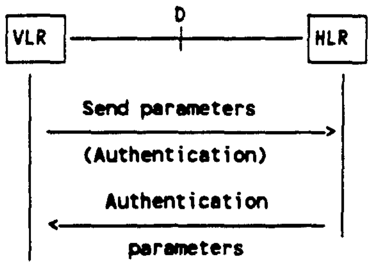


Figure 5.10.7 Procedure for tranferring authentication parameters from HLR to VLR

In accordance with Recommendation GSM 03.20 the VLR may be provided with either of the following authentication information:

i) the authentication key

ii) a set of RAND/SRES/Kc vectors (see Recommendation GSM 03.20 for definitions)

Method ii) is always used when the VLR and the HLR are in different PLMNs.

The procedure is shown in Figure 5.10.7 and consists in the exchange of the messages send parameters (authentication) and authentication parameters.

5.10.3.2 Detailed description of the procedure

5.10.3.2.1 Procedure in the VLR

The application specific procedure is shown in Figure 5.10.8 and the ASE/TCAP interface procedure is shown in Figure 5.10.9.

The authentication management entity in the VLR will indicate that authentication parameters are required (the obtain authentication parameters (X) signal). The indication may also include the type of parameters that are required, see section 5.10.3.1. This may also be default in the PLMN, e g method ii) is always used; or method i) is used if the HLR and the VLR is in the same PLMN and method ii) is used if the request is to an HLR of another PLMN.

TCAP is requested to supervise the procedure by timer T-par.

The send parameters (authentication) message is sent in a TC-INVOKE REQUEST primitive. Results are received as follows:

- the authentication parameters message is received in a TC-RESULT-L INDICATION primitive. The authentication parameters are provided to the authentication management of the VLR;

- expiry of timer T-par is indicated in a TC-L-CANCEL INDICATION primitive. A procedure error indication is provided to the authentication management;

- procedure errors are indicated in a TC-(U-)REJECT INDICATION primitive. A procedure error indication is provided to the authentication management;

- negative results are reported in a TC-U-ERROR INDICATION primitive as follows:

  i) unknown subscriber. The same indication is given to the authentication management.

  ii) unexpected data value. A procedure error indication is provided to the authentication management.

Figure 5.10.8
Application specific procedure in VLR for obtaining authentication parameters from HLR.

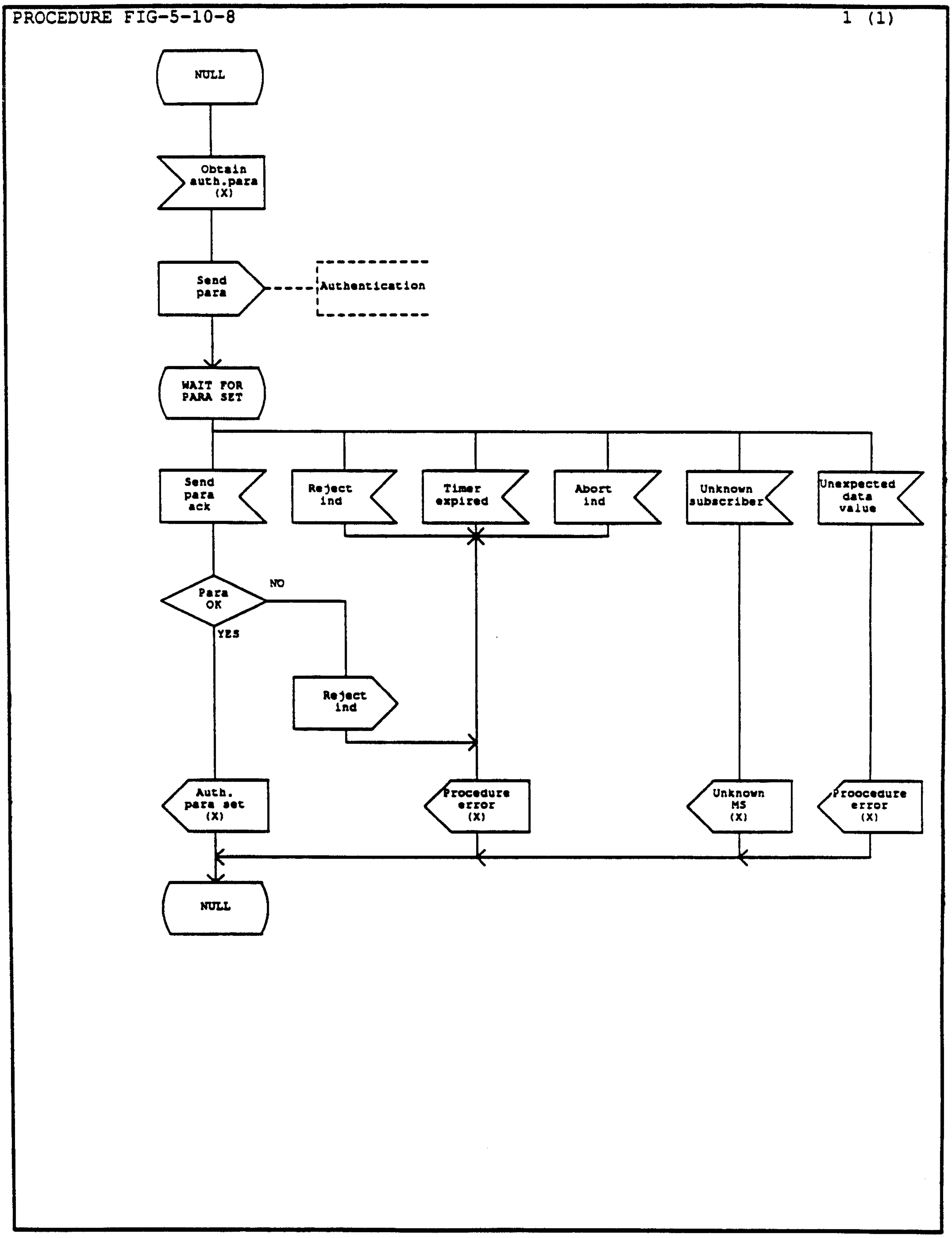
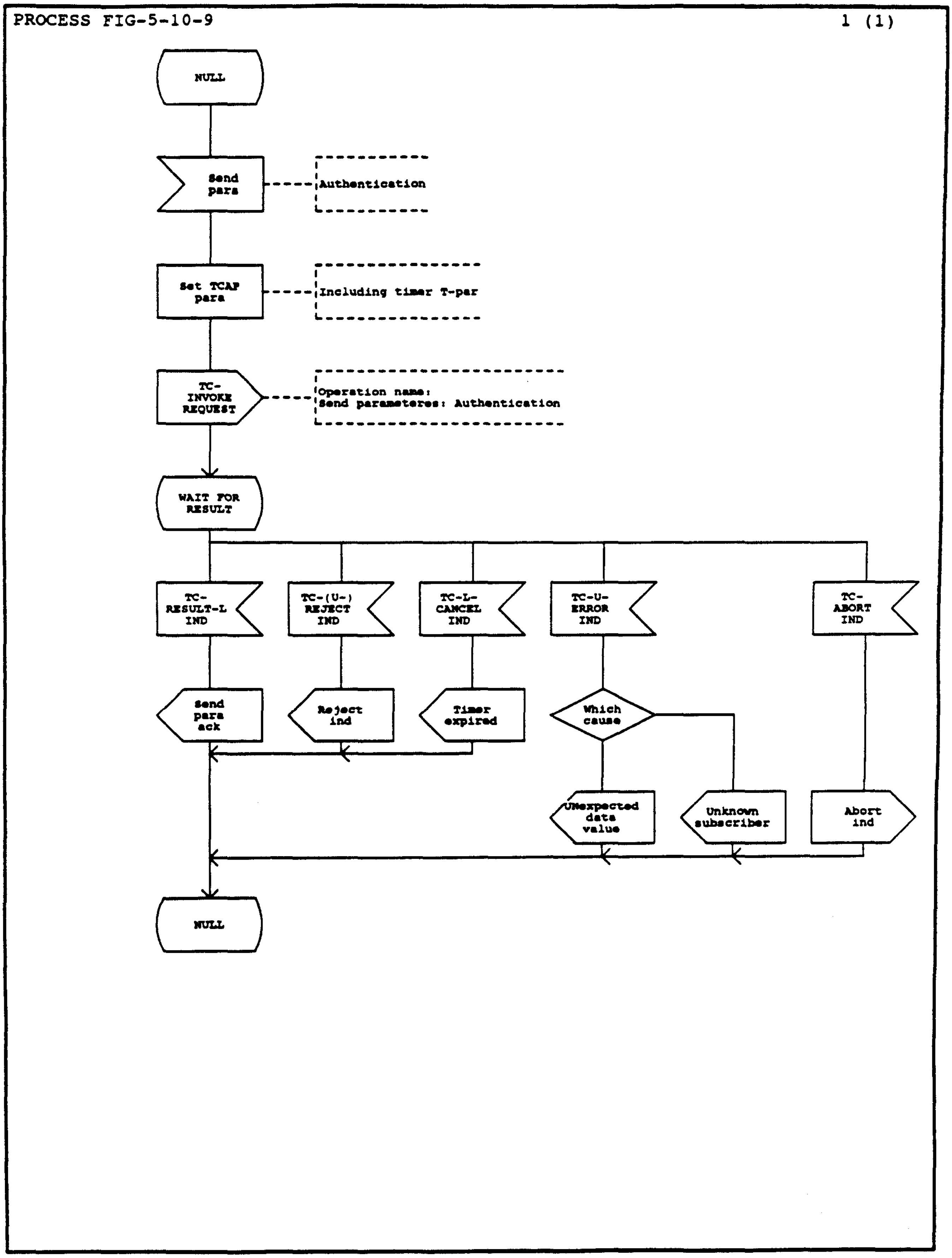


Figure 5.10.9
ASE/TCAP interface procedure in VLR for obtaining authentication parameters from HLR.



5.10.3.2.2 Procedures in the HLR

The application specific procedure is shown in Figure 5.10.10 and the ASE/TCAP interface procedure is shown in Figure 5.10.11.

The send parameters (authentication) message is received in a TC-INVOKE INDICATION primitive. The HLR will perform analysis and return results as follows:

- the authentication parameters message will be returned in a TC-RESULT-L REQUEST primitive. This message will contain either the authentication key or a set of RAND/SRES/Kc vectors, see section 5.10.3.1. In case this message contains a set of RANS/SRES/Kc vectors, the number of vectors to be returned will be determined by the HLR;

- if the MS is not known in the HLR, the unknown subscriber message is returned in a TC-U-ERROR REQUEST primitive;

- the unexpected data value message is returned in a TC-U-ERROR REQUEST.

Figure 5.10.10
Application specific procedure in HLR for providing authentication parameters to VLR.

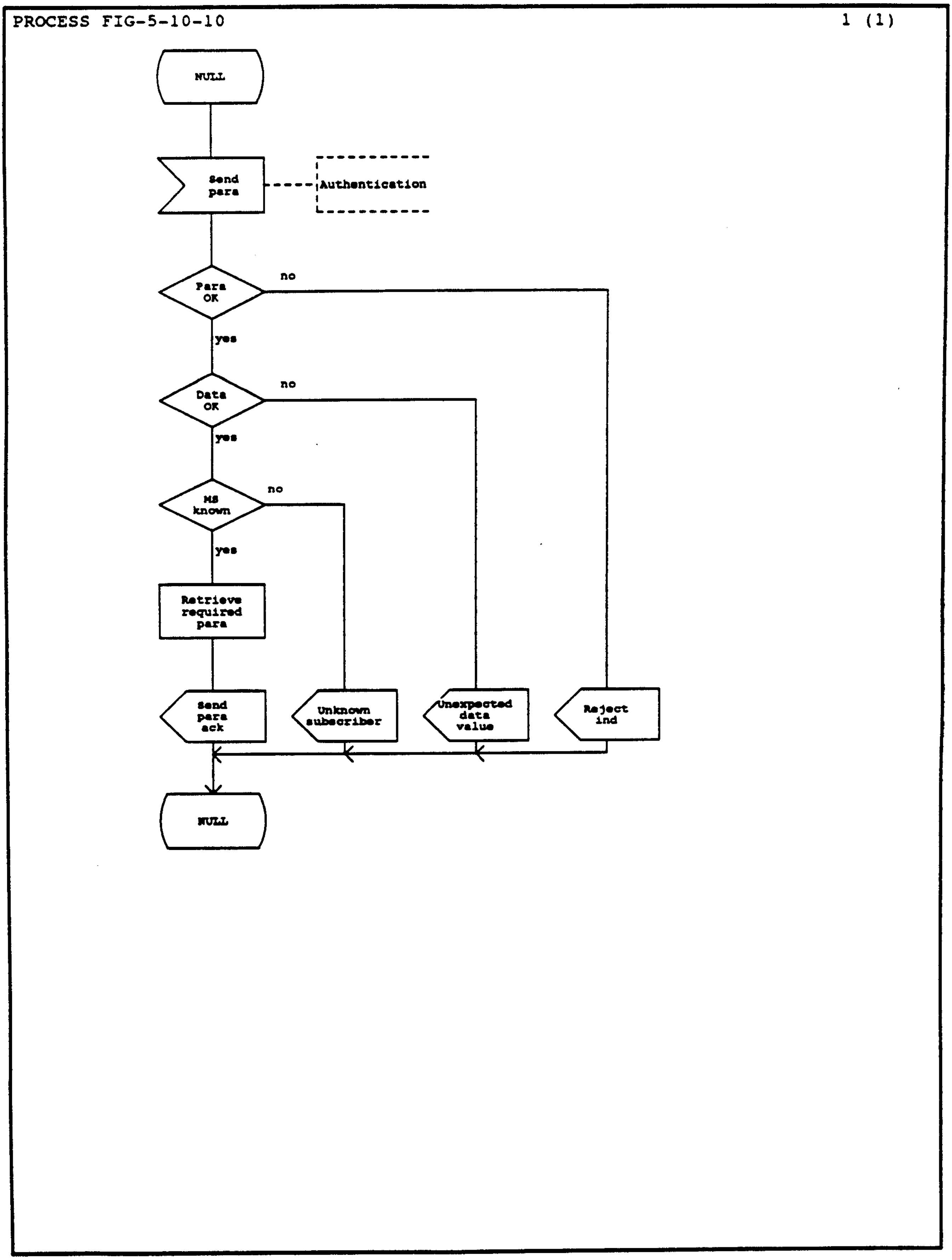
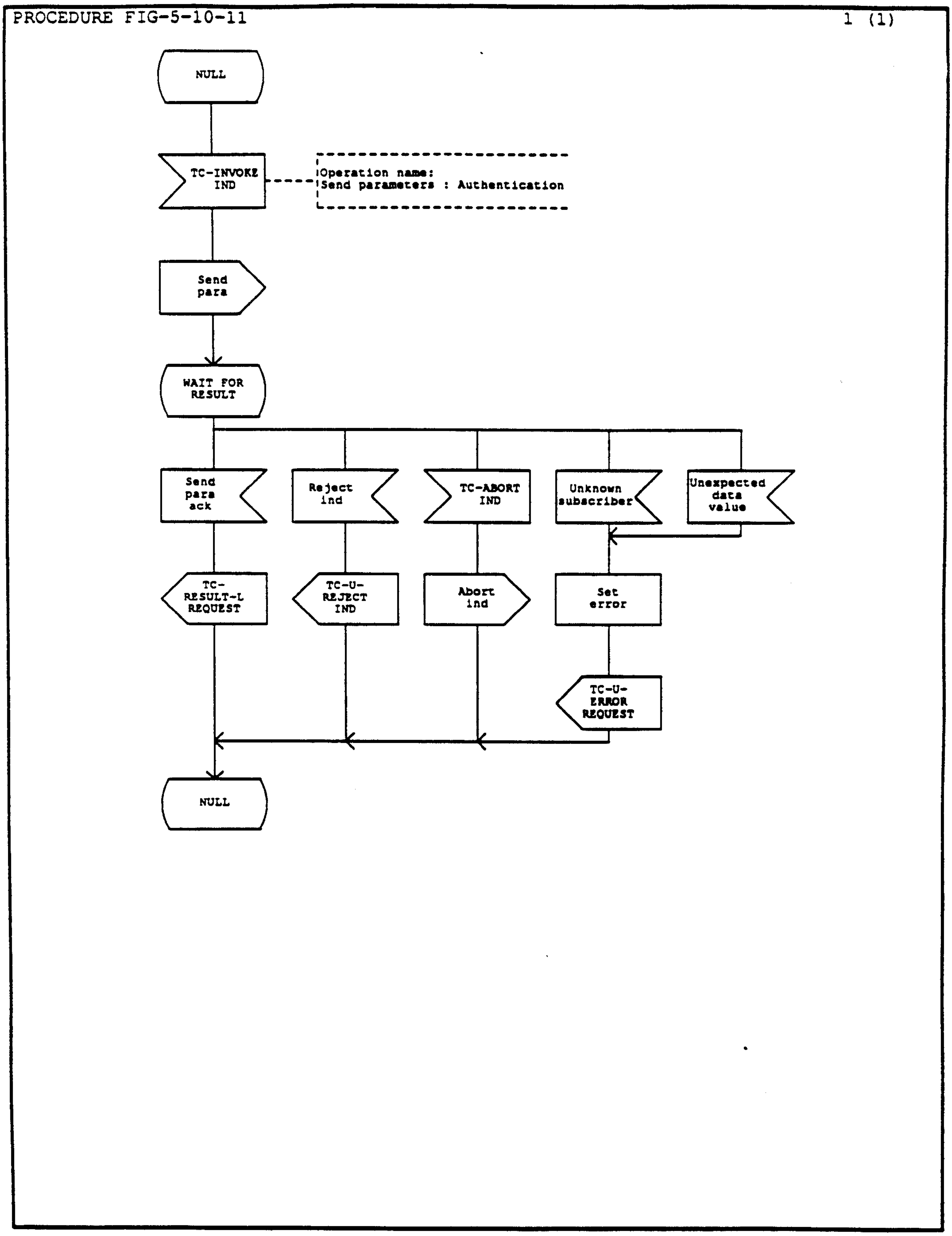


Figure 5.10.11
ASE/TCAP interface procedure in HLR for providing authentication parameters to VLR.



5.10.4 Procedure for obtaining authentication parameters from the previous VLR

Authentication parameters are obtained from the previous VLR by the send parameters operation described in section 5.2.1.3. The authentication parameters are then contained in the IMSI response message. If the message does not contain authentication parameters then the VLR will use the procedure of section 5.10.3 to obtain them from the HLR.

5.11 Management of security related functions

5.11.1 Initiation of ciphering

5.11.1.1 General description of the procedure

The interface and the procedure for initiation of ciphering are shown in Figure 5.11.1.

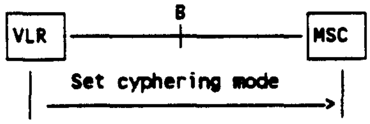


Figure 5.11.1 Interface and procedure for initiation of ciphering.

The procedure is initiated by the VLR as a result of another procedure requiring that information is to be sent on the radio path in encrypted form (e g , at call set-up, for transfer of user data, at reallocation of TMSI, at handling of supplementary services).

The message set ciphering mode is sent by the VLR to the MSC and it contains either the ciphering key to be used and the algorithm identifier identifying the user data encryption algorithm to be used or an indication that ciphering shall not take place.

The choice between the two modes of operation is made by the VLR on operational, technical or regulatory grounds.

If a procedure normally requiring ciphering (e g , call establishment, reallocation of TMSI, forwarding of a short message) is invoked and an existing ciphered connection can be used, then the ciphering procedure is not invoked by the VLR. The condition that a ciphered connection exists is indicated by the MSC in an associated operation.

5.11.1.2 Detailed procedures in the VLR

The application specific procedure and the ASE/TCAP interface procedure are shown in Figures 5.11.2 and 5.11.3, respectively.

The VLR will send the set ciphering mode message in a TC-INVOKE REQUEST primitive. The procedure is supervised by timer T-sc. The procedure is terminated when a TC-L-CANCEL INDICATION primitive (expiry of timer T-sc), a TC-(U-)REJECT INDICATION primitive or a TC-ABORT INDICATION primitive is received.

5.11.1.3 Detailed procedures in the MSC

The application specific procedure and the ASE/TCAP interface procedure are shown in Figures 5.11.4 and 5.11.5, respectively.

The MSC will receive the set ciphering mode message in a TC-INVOKE INDICATION primitive.

If there are no parameter errors or data errors in the message, the MSC will use the information contained in the message to choose the required cipher mode and, if present, provide the encryption key to the BSS.

Figure 5.11.2 Application specific procedure in VLR for initiating ciphering.

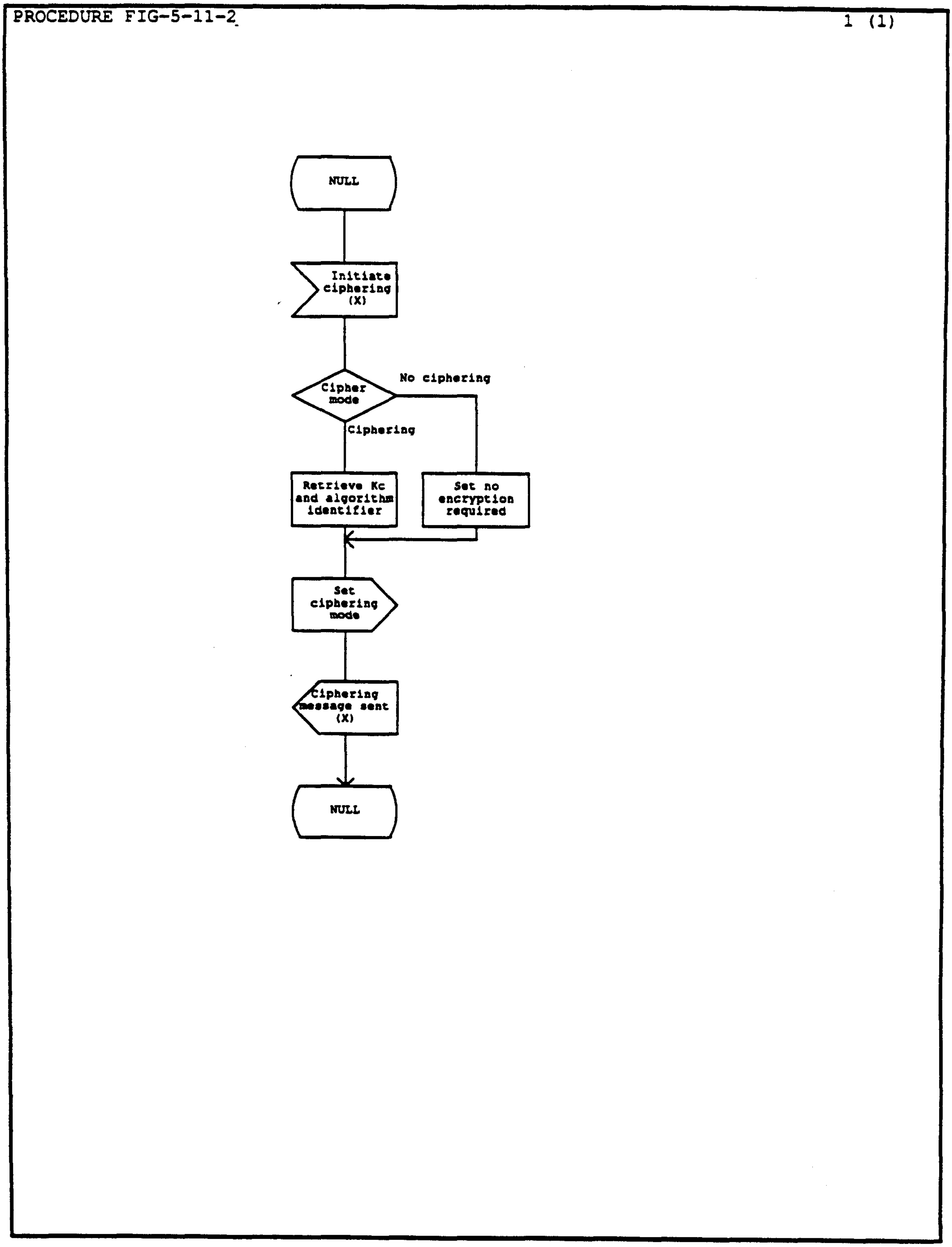


Figure 5.11.3 ASE/TCAP interface procedure in VLR for initiating ciphering.

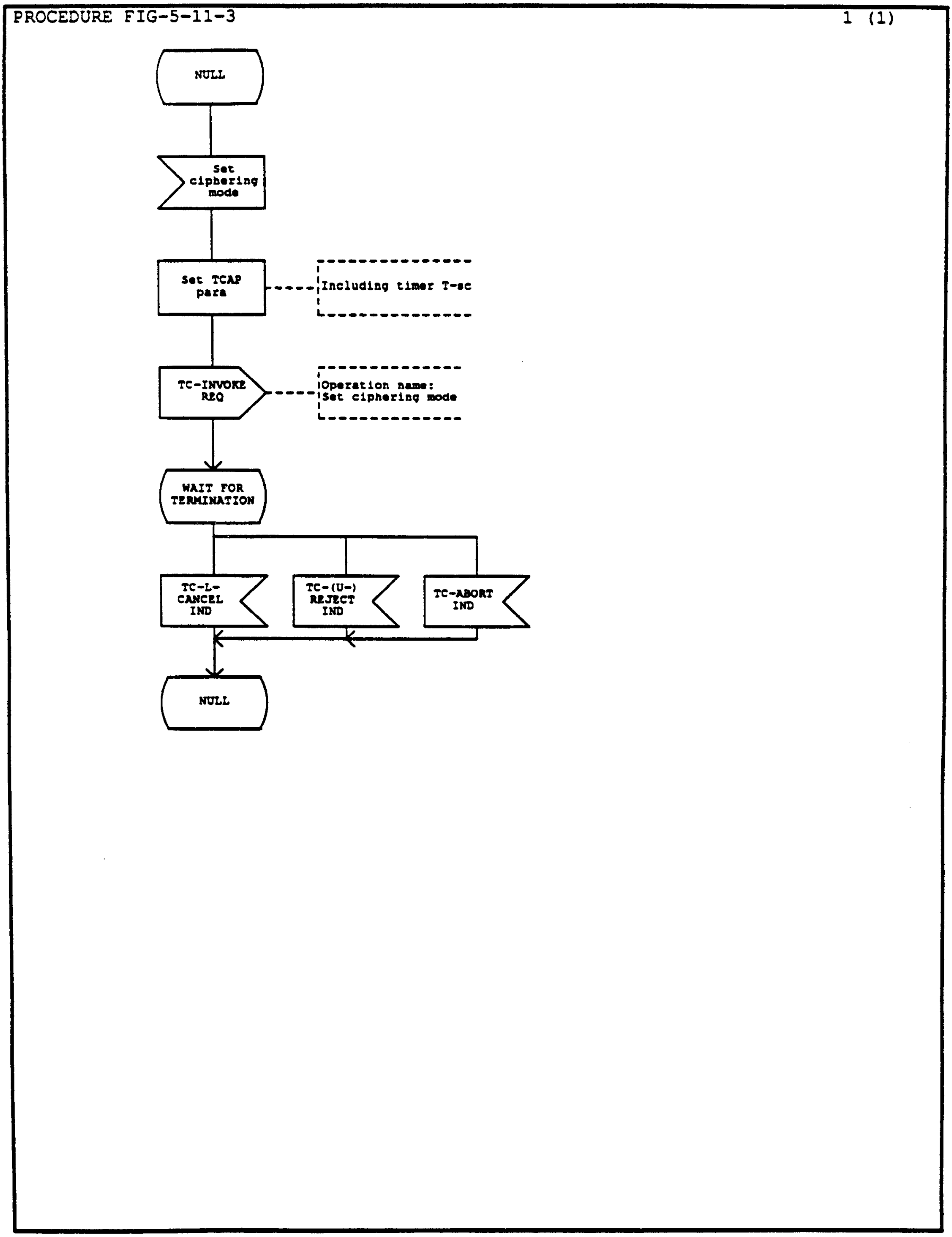


Figure 5.11.4 Application specific procedure in MSC for initiation of ciphering.

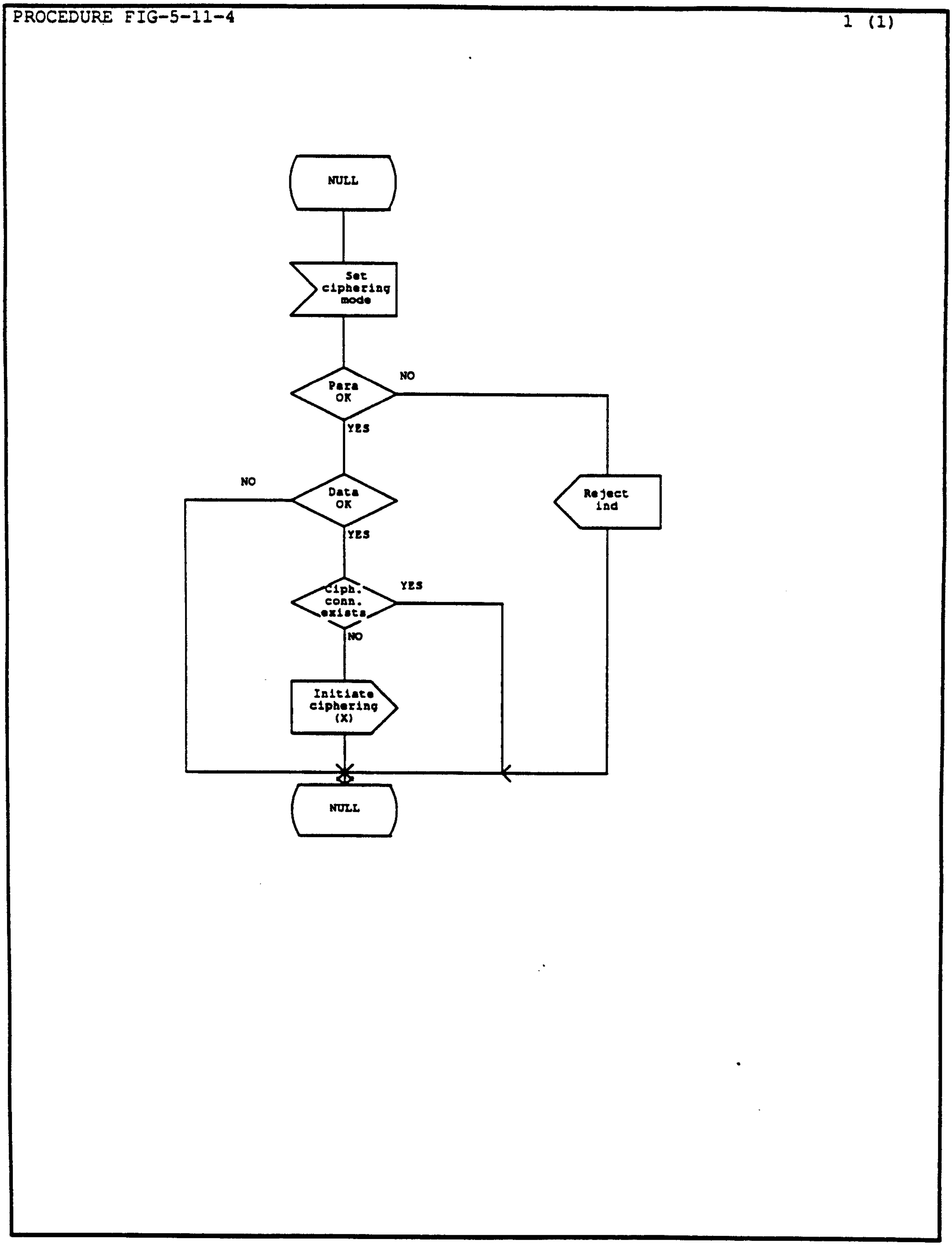
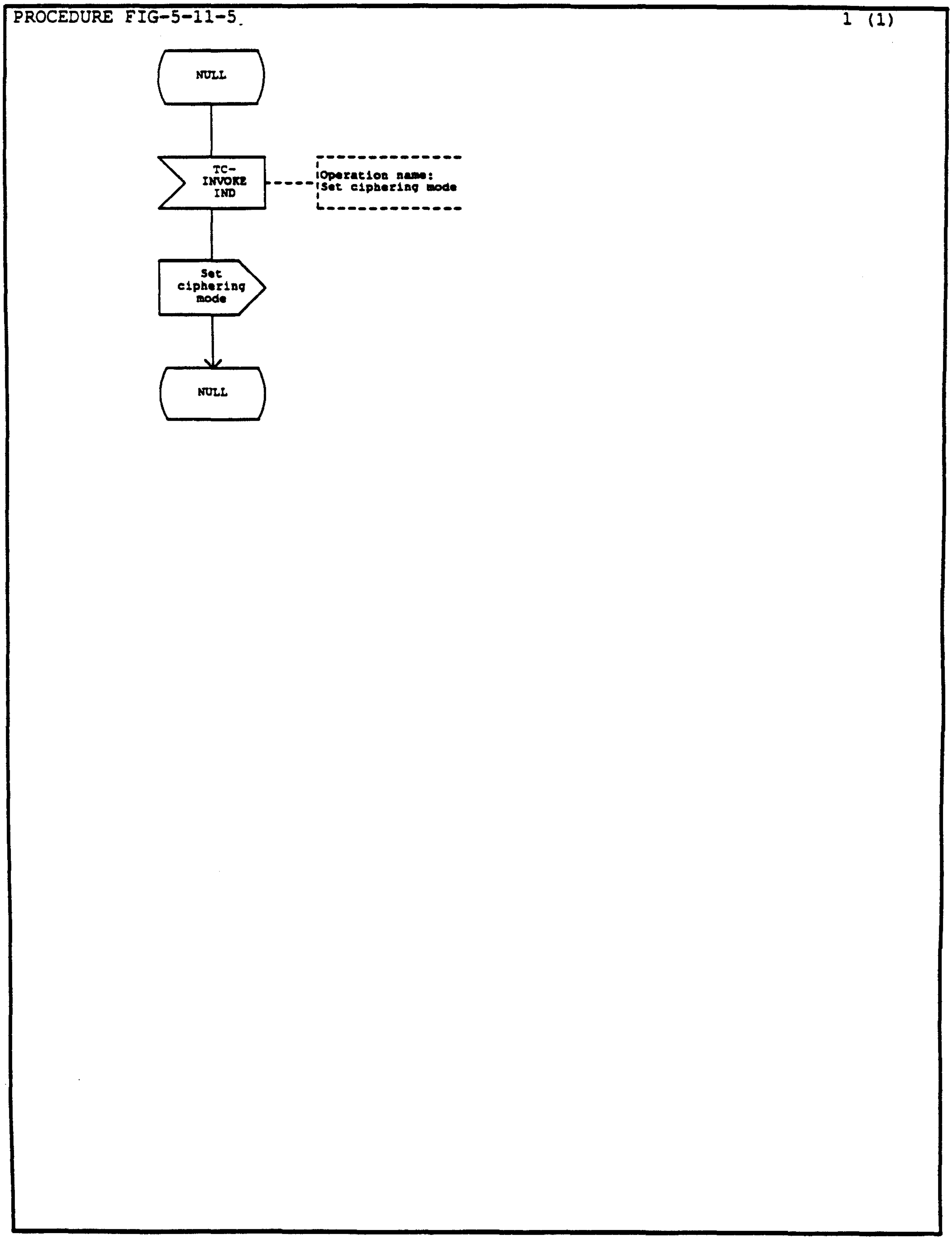


Figure 5.11.5 ASE/TCAP interface procedure in MSC for initiation of ciphering.



5.12 Identity management

5.12.1 Identity request procedure

5.12.1.1 Definition of interfaces

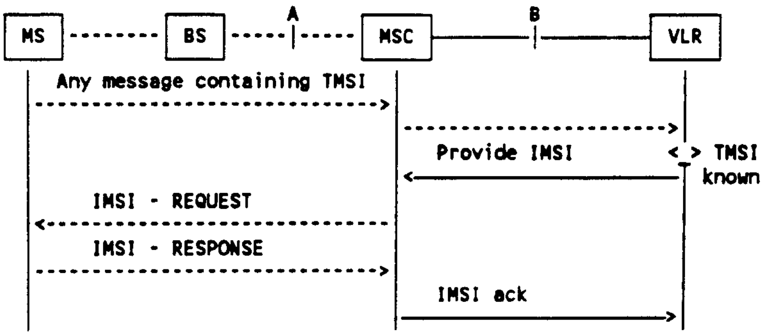


Figure 5.12.1 Interface and procedure for identity request.

The procedure is shown in Figure 5.12.1. When the VLR receives a TMSI from an MS which is not allocated to any MS, the VLR may request open identification of the MS by sending the provide IMSI message to the MSC. The MS will then send its IMSI which is passed to the VLR in the IMSI acknowledge message.

The procedure may be activated at outgoing call set-up, at location updating or at handling of supplementary services.

5.12.1.2 Detailed procedures in VLR

The application specific procedure is shown in Figure 5.12.2 and the ASE/TCAP procedure is shown in Figure 5.12.3.

The procedure is initiated when the VLR needs open identification of the MS. The provide IMSI message is sent to the MSC in a TC-INVOKE-REQUEST primitive. The IMSI acknowledge message is received in a TC-RESULT-L INDICATION primitive. TCAP is requested to supervise the procedure by timer T-pi. The IMSI is then provided to the application procedure that requested open identification.

If a TC-(U-)REJECT, TC-ABORT or TC-L-CANCEL INDICATION primitive is received, a failure indication is provided to the application process.

An absent subscriber message may be received in a TC-U-ERROR INDICATION primitive. The absent subscriber indication is provided to the application process.

5.12.1.3 Detailed procedure in MSC

The application specific procedure is shown in Figure 5.12.4 and ASE/TCAP procedure is shown in Figure 5.12.5.

The MSC will receive the provide IMSI message in a TC-INVOKE INDICATION primitive. The message is passed to the application process. The result received from the application process may be:

i) that IMSI is obtained, i e the MS responds. Then the IMSI acknowledge message is returned in a TC-RESULT-L REQUEST primitive;

ii) that the MS does not respond. Then the absent subscriber message is returned in a TC-U-ERROR REQUEST primitive.

Figure 5.12.2
Application specific procedure in VLR for obtaining IMSI from the MS.

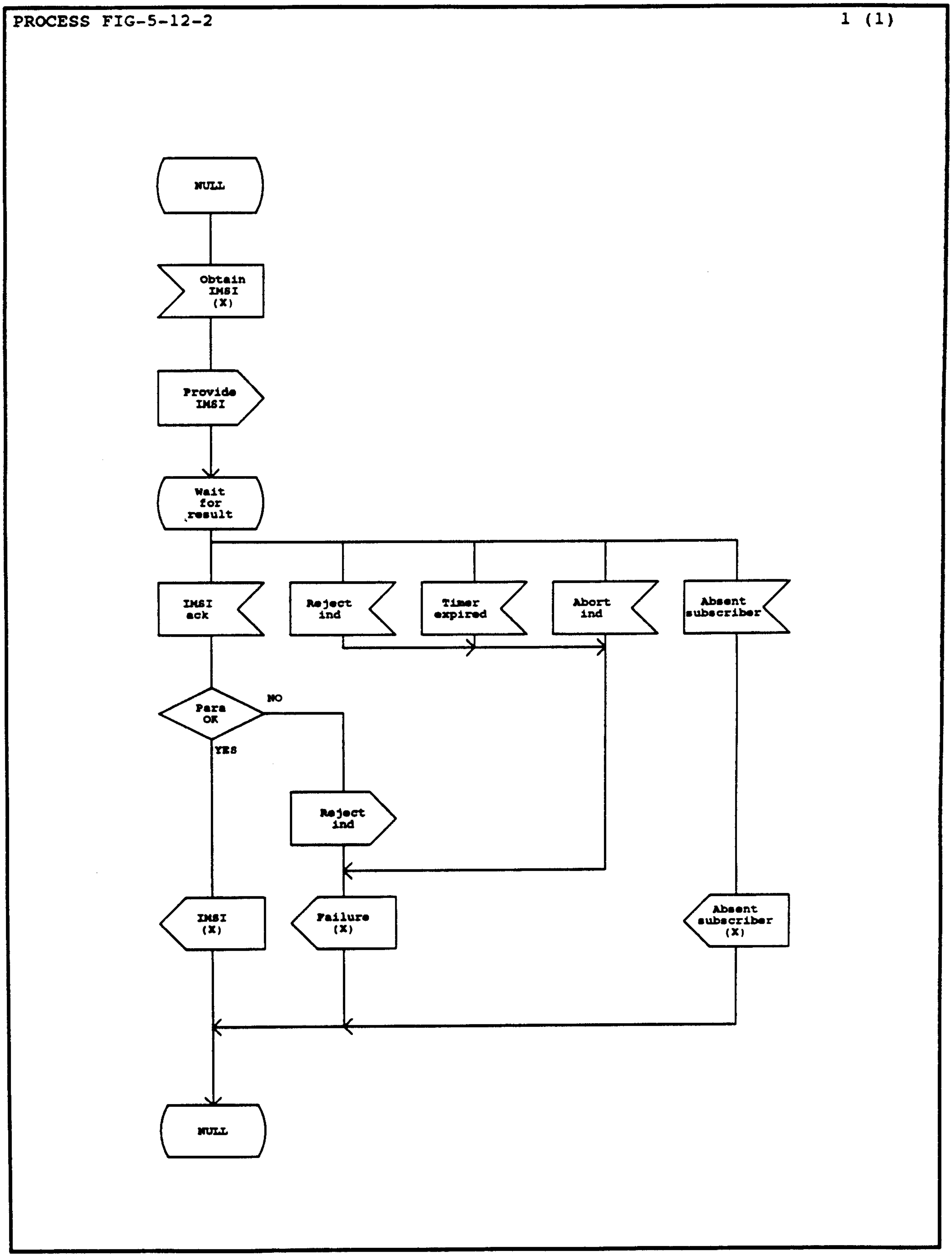


Figure 5.12.3
ASE/TCAP interface procedure in VLR for obtaining IMSI from the MS.

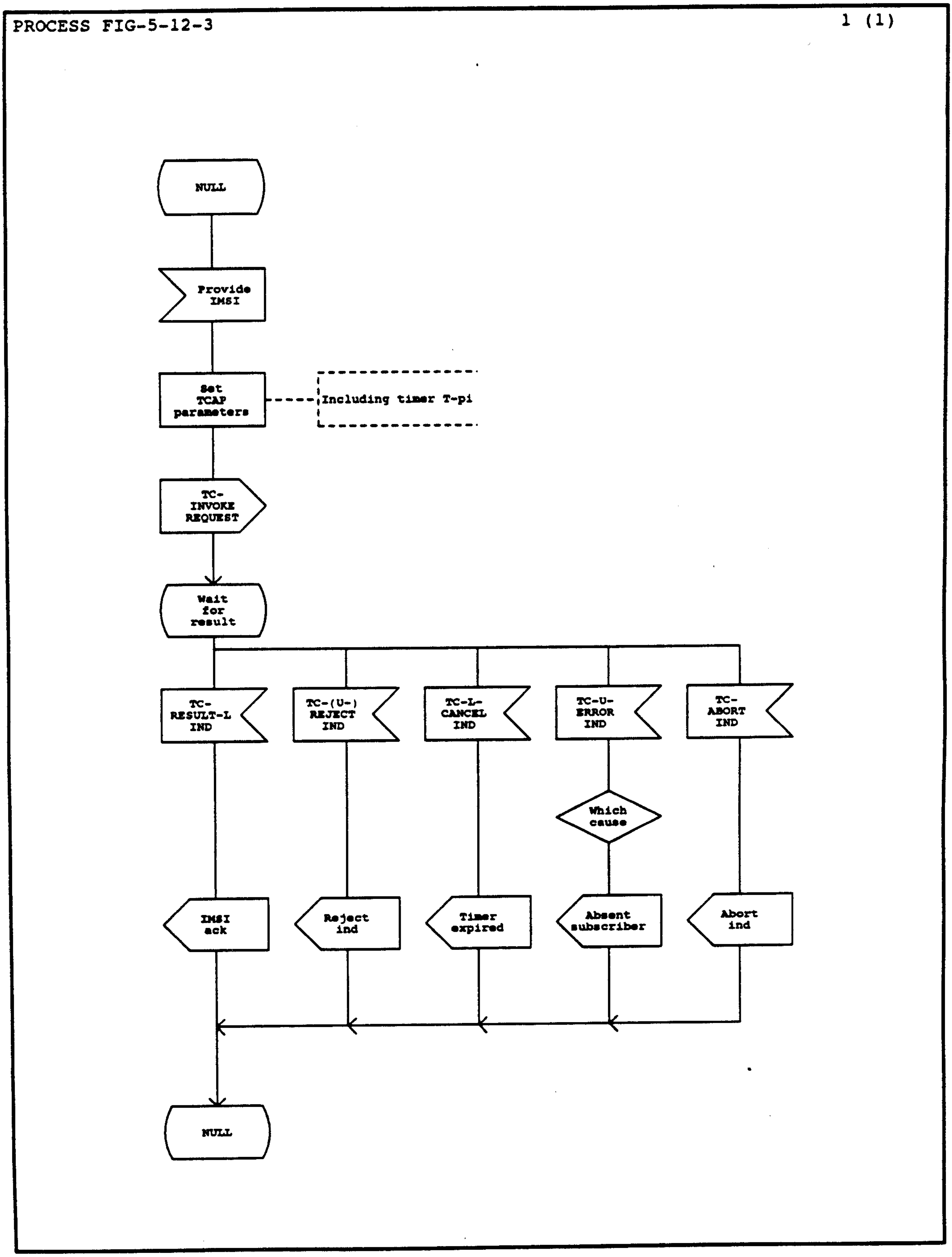


Figure 5.12.4
Application specific procedure in MSC for obtaining IMSI from the MS.

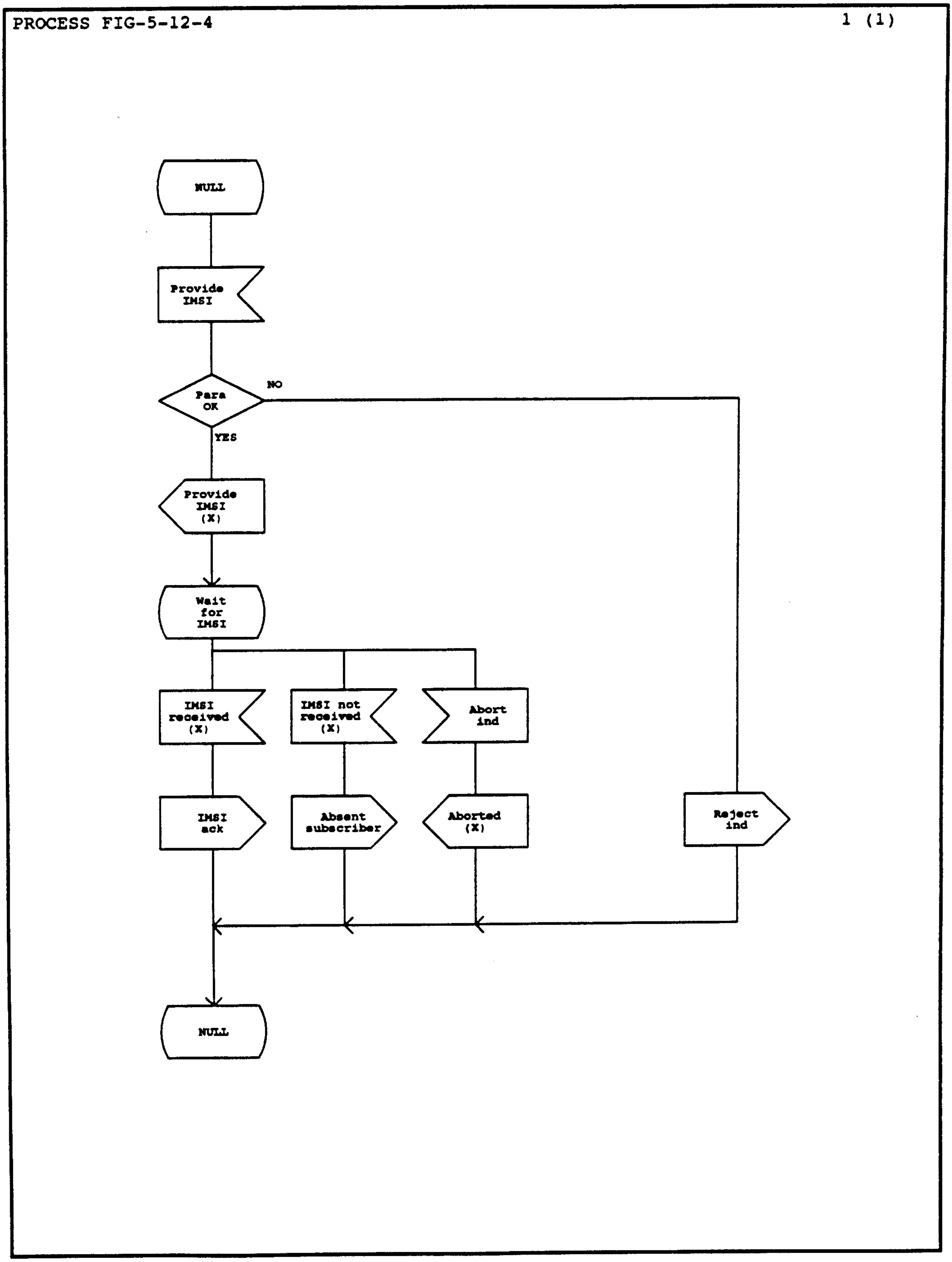
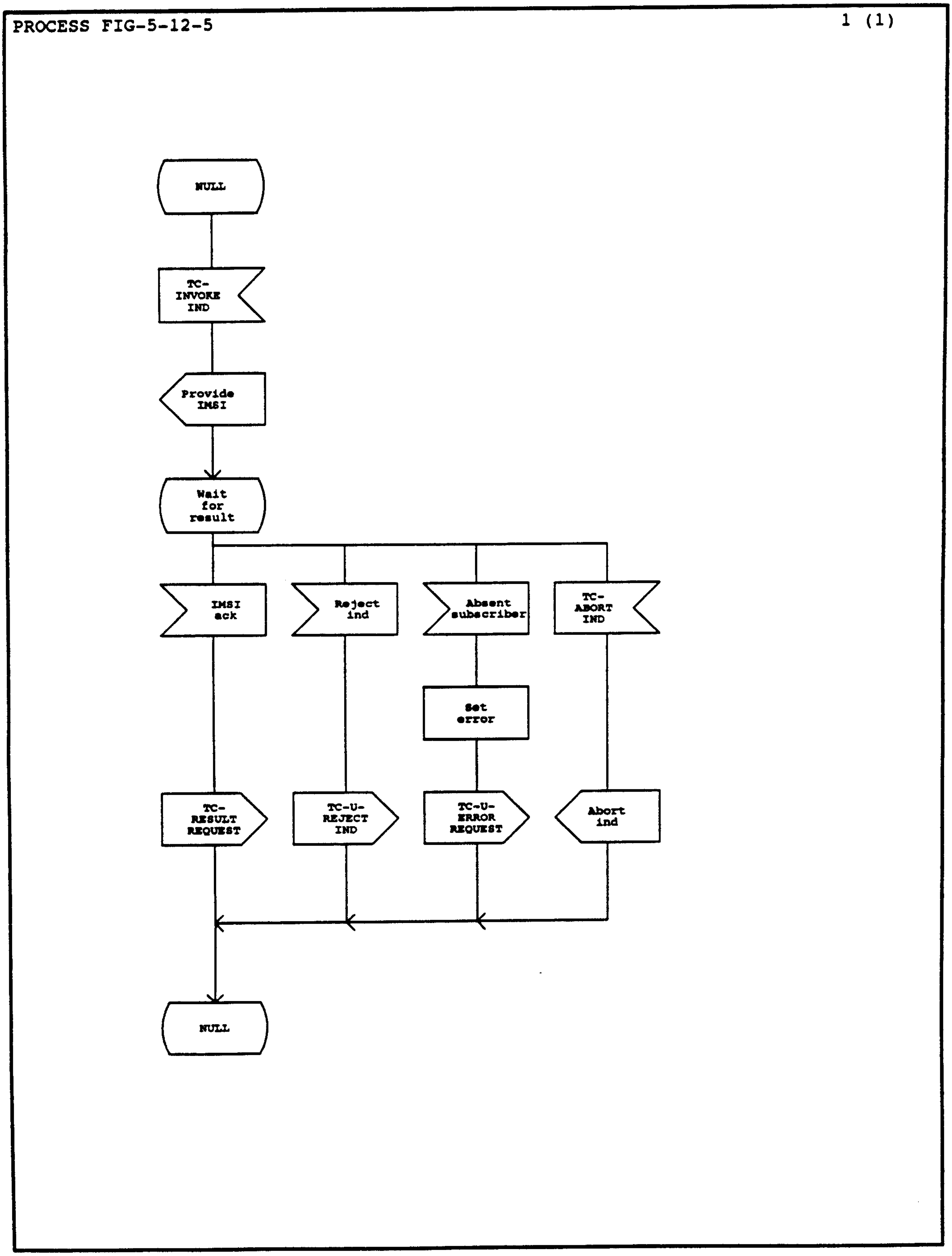


Figure 5.12.5
ASE/TCAP interface procedure in MSC for obtaining IMSI from the MS.



5.12.2 Reallocation of TMSI

5.12.2.1 Definition of interfaces

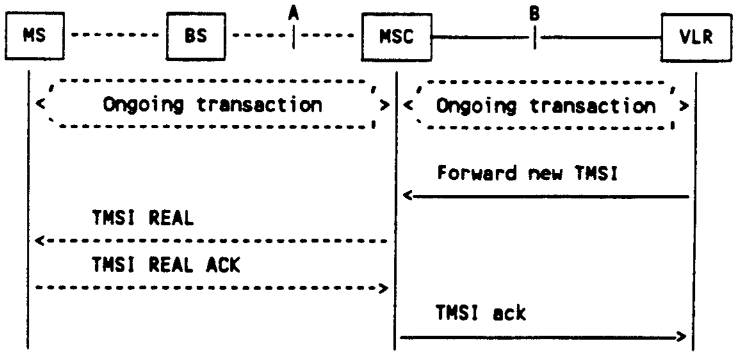


Figure 5.12.6 Interfaces and procedures for reallocation of TMSI.

The procedure is shown in Figure 5.12.6. During an ongoing transaction (call set-up, location updating, supplementary services operation) the VLR may decide to reallocate the TMSI. The VLR will then send the forward new TMSI message to the MSC. This initiates the reallocation procedure on the radio path (TMSI REAL/TMSI REAL ACKNOWLEDGE signals). The acknowledgement from the MS is returned to the VLR in the TMSI acknowledge message.

5.12.2.2 Detailed procedures in VLR

Figures 5.12.7 and 5.12.8 show the application specific and the ASE/TCAP interface procedures in the VLR, respectively.

The forward new TMSI message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ft.

The TMSI acknowledge message is received in a TC-RESULT-L INDICATION primitive. The acknowledge message is used in the VLR to establish the association between TMSI and IMSI.

If a provider abort indication (received in a TC-P-ABORT INDICATION primitive) is received or if timer T-ft expires (indicated by a TC-L-CANCEL INDICATION primitive), the VLR should set a flag indicating that the TMSI may not have been received by the MS.

If a TC-(U-)REJECT INDICATION primitive or TC-U-ABORT INDICATION primitive is received, the VLR will interpret this as an indication that the TMSI has not been sent to the MS.

5.12.2.3 Detailed procedures in the MSC

Figures 5.12.9 and 5.12.10 show the application specific and the ASE/TCAP interface procedure in the VLR, respectively.

The forward new TMSI message is received in a TC-INVOKE INDICATION primitive. The MSC will send the new TMSI to the MS. When the MS acknowledges the receipt of the new TMSI, the TMSI acknowledge message is returned in a TC-RESULT-L REQUEST primitive.

If there are parameter errors in the forward new TMSI message, the MSC will report this in a TC-U-REJECT REQUEST primitive.

If there is no connection to the MS when the forward new TMSI message is received, the MSC returns a TC-U-ABORT REQUEST primitive.

Figure 5.12.7
Application specific procedure in the VLR for TMSI reallocation.

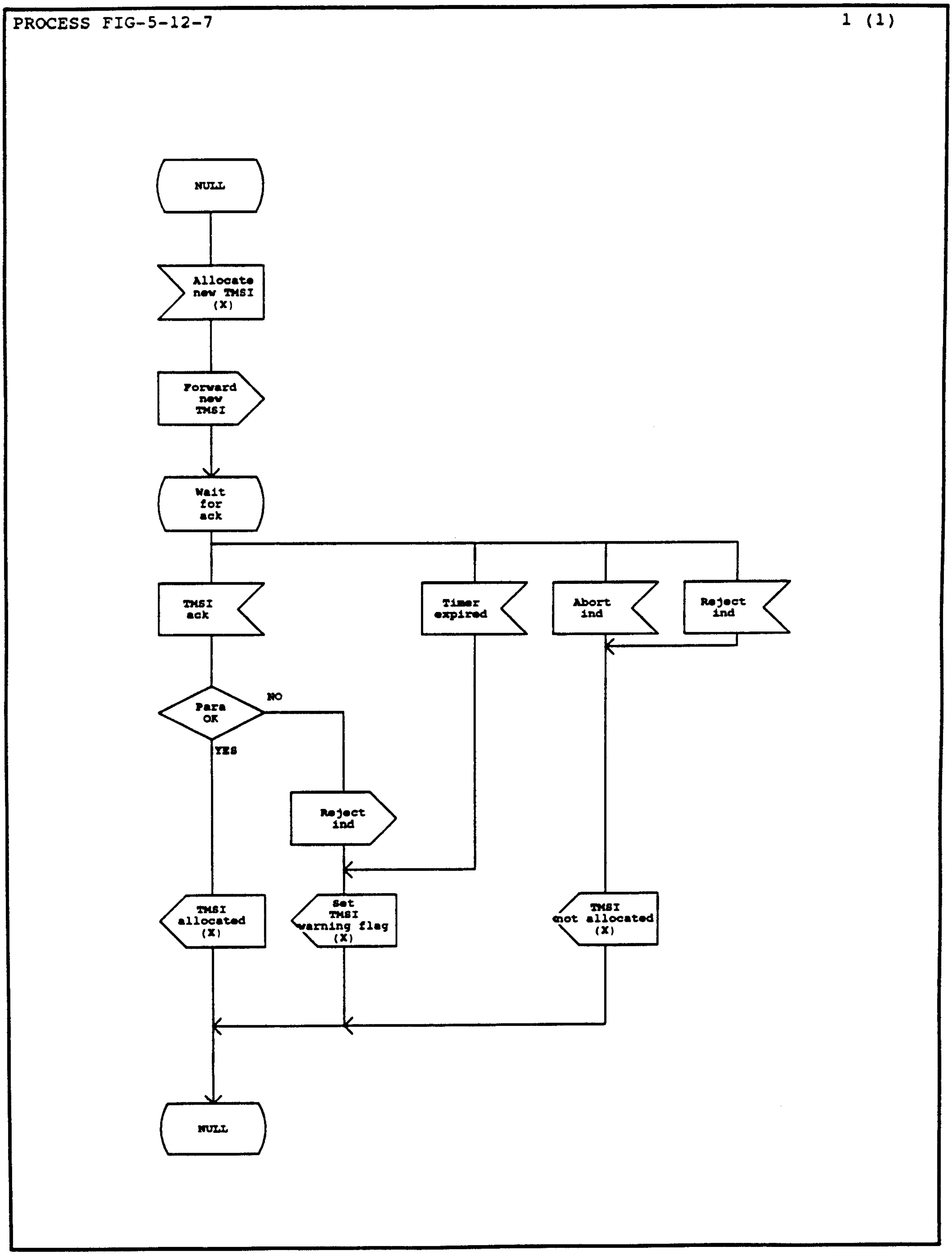


Figure 5.12.8
ASE/TCAP interface in VLR for TMSI reallocation.

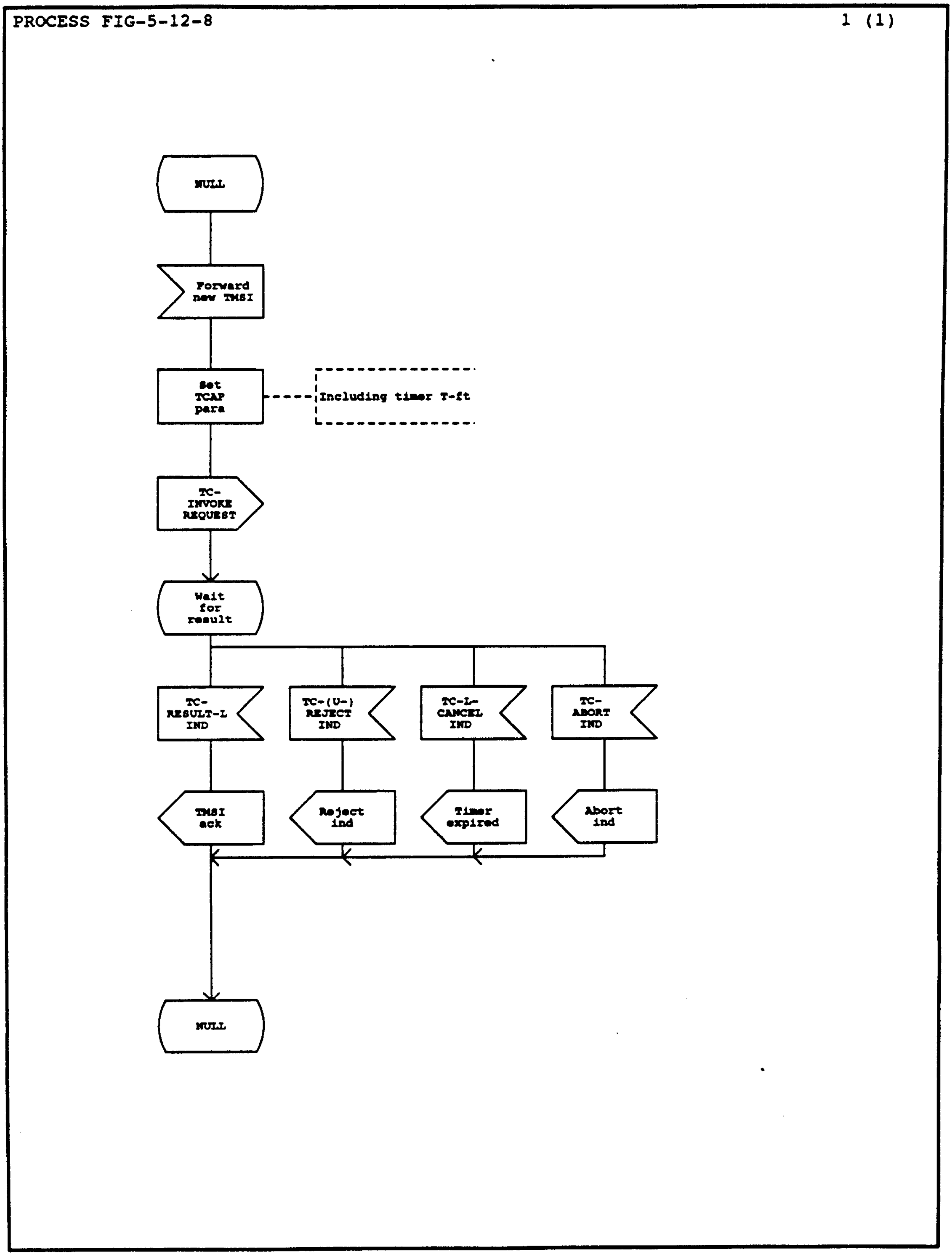


Figure 5.12.9
Application specific procedure in MSC for TMSI reallocation.

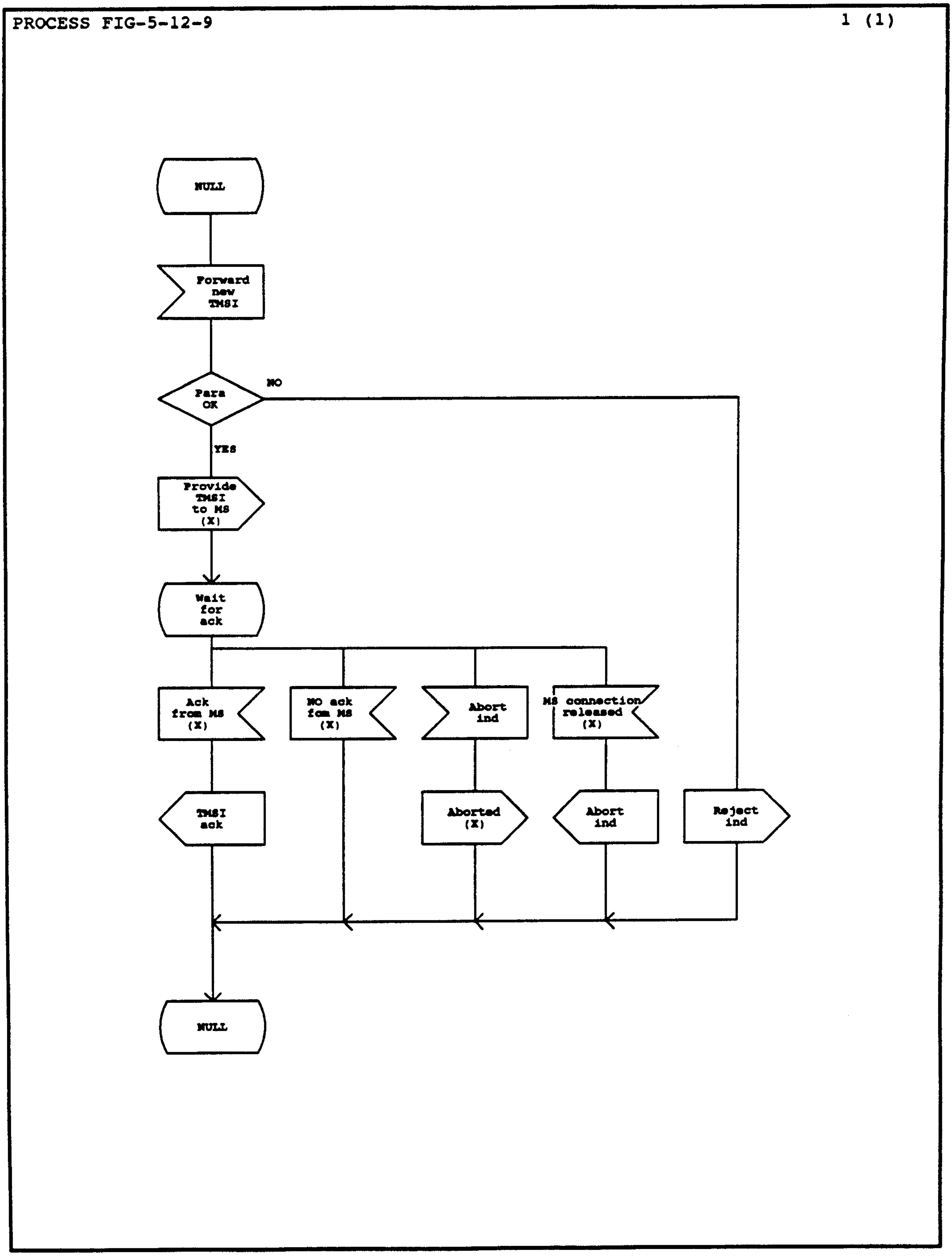
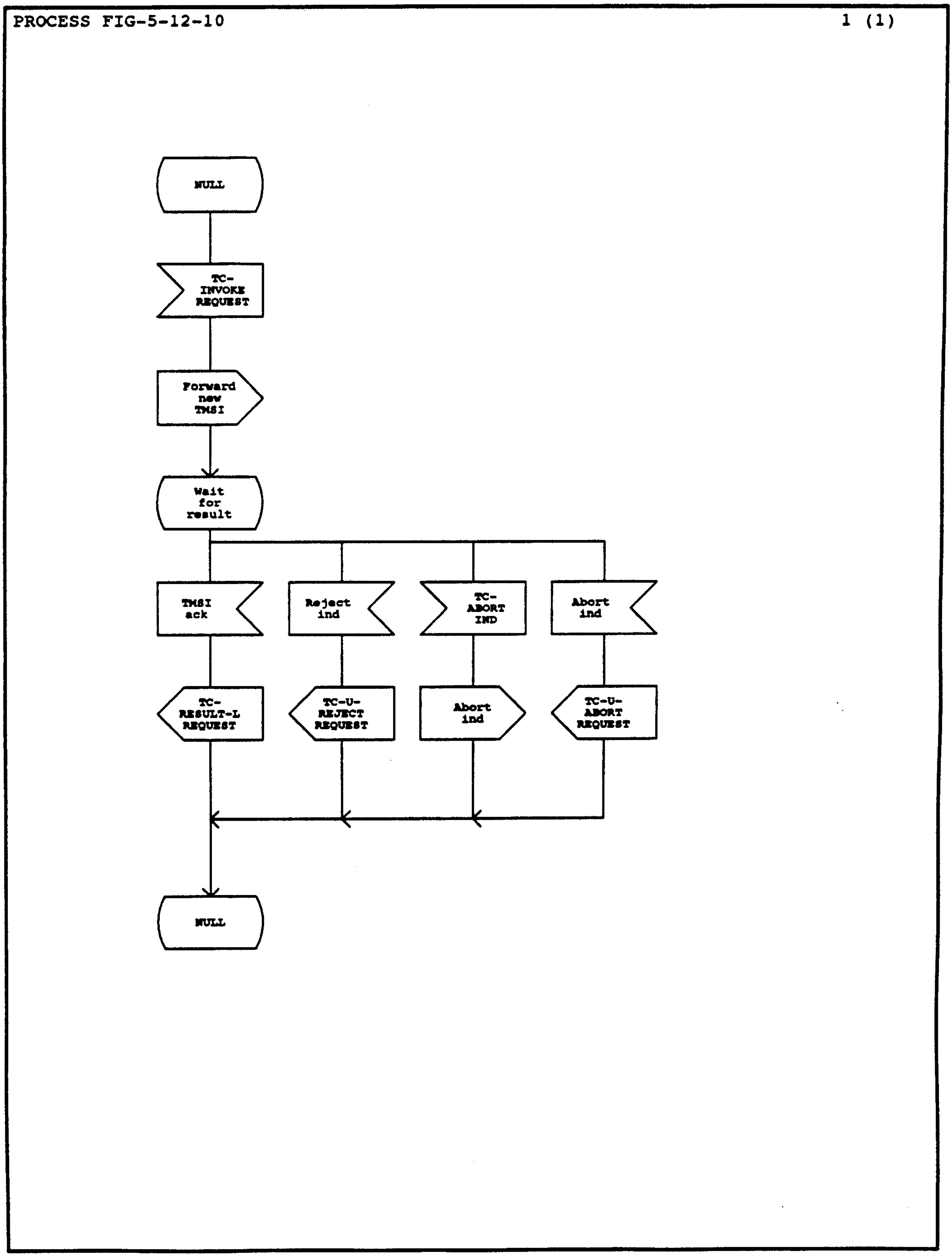


Figure 5.12.10
ASE/TCAP interface procedure in MSC for TMSI reallocation.



5.13 Procedures for supporting short message services

5.13.1 Procedure for retrieving short message routing information

5.13.1.1 General description of the procedure

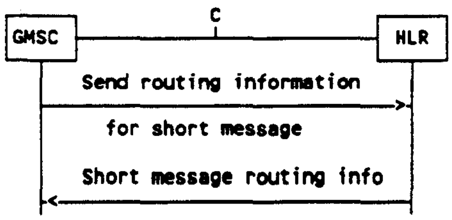


Figure 5.13.1. Interrogation for routing information for the short message service

Figure 5.13.1 shows the procedure used by a gateway MSC to obtain routing information for mobile terminated short message transfer. The procedure consists of the exchange of the messages:

- send routing information for short message

and

- short message routing information.

5.13.1.2 Detailed description of the procedure

5.13.1.2.1 Procedure in the gateway MSC

The application specific procedure in the GMSC is shown in Figure 5.13.2, and the ASE/TCAP interface procedure is shown in Figure 5.13.3.

The short message handling function of the GMSC will request routing information when a mobile terminated short message is received from a Service Centre (SC). The GMSC sends the message send routing information for short message to the HLR of the MS. The message contains the MS directory number (i.e.MSIsdn), the priority indication SM-RP-PRI and the address of the source SC. It may also contain supplementary services parameters such as CUG index and CUG interlock code. The outcome of the procedure is one of the following:

- a short message routing information message containing following parameters:
- either a routing address (roaming number or servicing MSC address together with IMSI and optionally also LMsId)
- a Message Waiting Data Set indication.

The parameters are passed to the short message handling function.

- an unsuccessful event indication comprising of various messages:

  - unknown subscriber
  - absent subscriber containing the MWD set parameter
  - teleservice not provisioned
  - call barred
  - CUG reject
  - facility not supported
  - unexpected data value
  - data missing.

  Unexpected data value and data missing are reported as system failure to the short message handling function, all other indications are passed unchanged.

- a procedure failure either as a rejection from HLR or timer expiry. This is indicated as a system failure to the short message handling function.

The message send routing information for short message is sent in a TC-INVOKE REQUEST primitive, and TCAP is requested to supervise the procedure by timer T-smr. The outcome is received as follows:

- the short message routing information message is contained in a TC-RESULT-L INDICATION primitive.

- rejection is indicated by a TC-(U)-REJECT INDICATION primitive

- expiry of timer T-smr is reported in a TC-L-CANCEL INDICATION primitive

- negative results are reported in a TC-U-ERROR INDICATION primitive

5.13.1.2.2 Procedure in HLR

The application specific procedure is shown in Figure 5.13.4, and the ASE/TCAP procedure is contained in Figure 5.13.5.

When receiving a send routing information for short message message the HLR checks that the necessary parameters and data are present in the message. The priority parameter (SM-RP-PRI) is processed as follows:

- if the priority is low and the Message Waiting Data (MWD) contains one or more SC-addresses, an absent subscriber message is returned. The SC-address given in the request will be included in the MWD if possible. The absent subscriber message contains the parameter MWD set indicating whether or not the SC-address has been included in the MWD.

- if the priority is low, and if the MWD is empty, the routing information is retrieved as described below.

- if the priority is high, the routing information is retrieved as described below.

The appropriate routing information is included in a short message routing information message as follows:

- if a roaming number is available it will be provided to the GMSC.

- if an MSC-address is present, it will be returned to the GMSC together with the IMSI and optionally also a LMsId.

The short message routing information message contains also the MWD set parameter indicating whether or not the SC-address is already contained in the MWD.

If the MS is unknown, i.e. it cannot be identified from the MSIsdn number given, an unknown subscriber message is returned.

If the MS is deregistered or the roaming not allowed flag is set, i.e. no routing information is available, the SC-address is included in the MWD (if possible) and the absent subscriber message is returned.

If there is any supplementary service restrictions, it will be reported as follows:

- if the short message transfer will be in contradiction with the call barring conditions registered in the HLR, a call barred message is returned

- if the CUG-check is negative, a CUG reject message is returned.

If the mobile subscription identified by the given MSIsdn number does not comprise MT short message service, a teleservice not provisioned message is returned.

If the location registration of the MS shows that the visited PLMN does not support the MT short message service, a facility not supported message is returned.

If insufficient or invalid data content is detected, an unexpected data value message or a data missing message is returned.

The send routing information for short message message is received in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the short message routing information message is sent in a TC-RESULT-L REQUEST primitive

- a reject indication is reported in a TC-U-REJECT REQUEST primitive

- negative results are reported in a TC-U-ERROR REQUEST primitive.

Figure 5.13.2 (Sheet 1 of 2)
Application specific procedures in GMSC for retrieving short message routing information

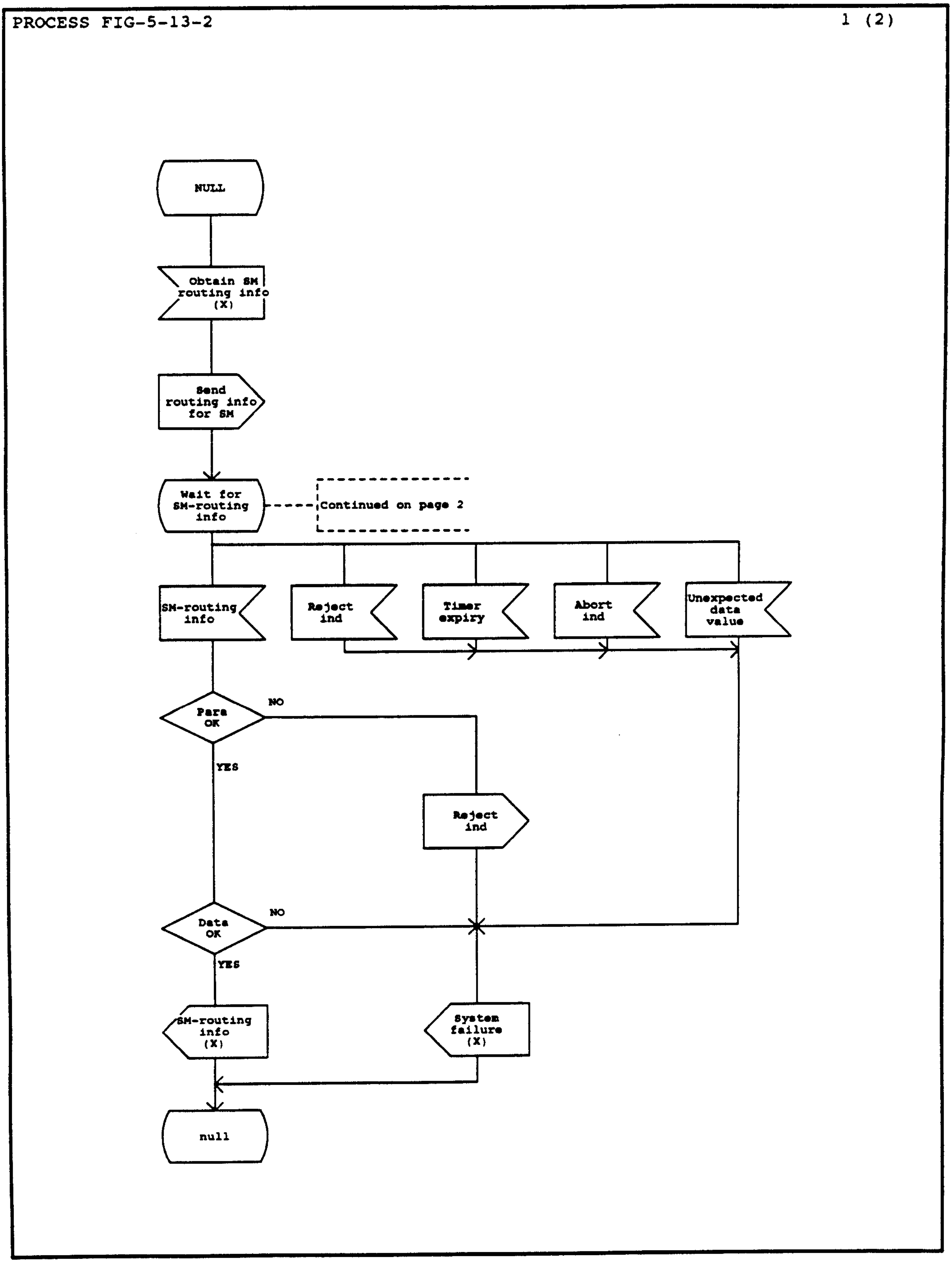


Figure 5.13.2 (Sheet 2 of 2)
Application specific procedures in GMSC for retrieving short message routing information

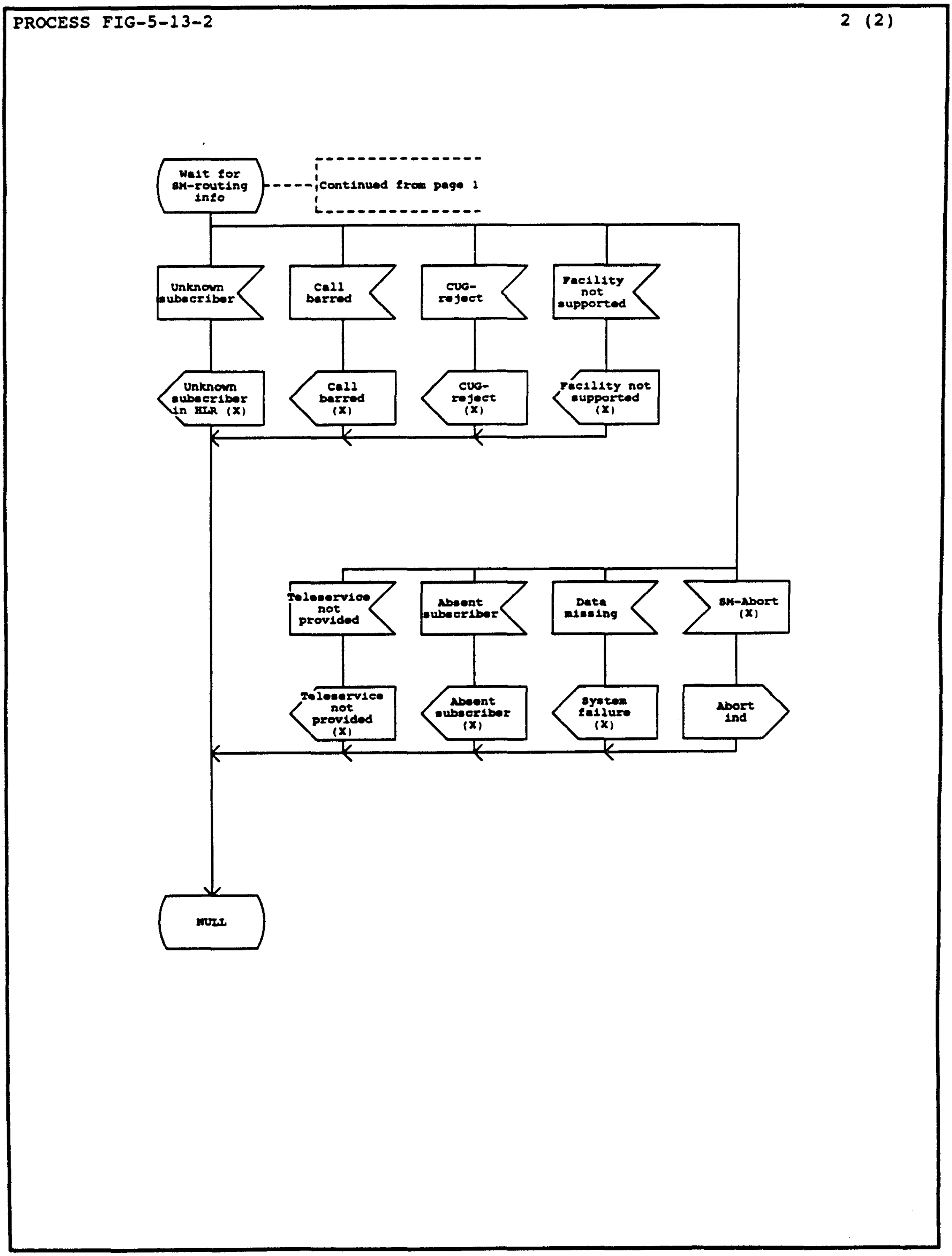


Figure 5.13.3 (Sheet 1 of 2)
ASE/TCAP Interface procedure in GMSC for retrieving short message routing information

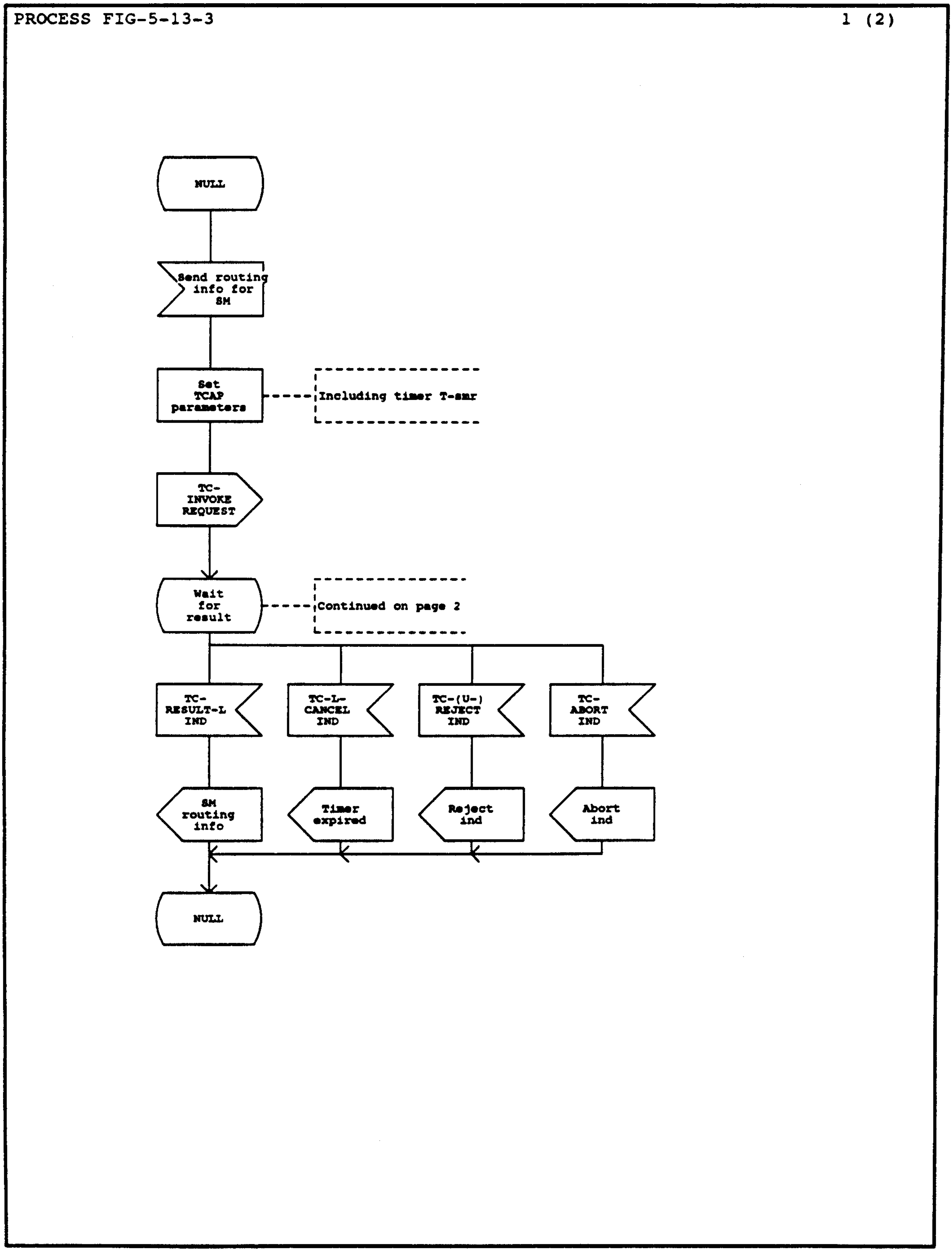


Figure 5.13.3 (Sheet 2 of 2)
ASE/TCAP Interface procedure in GMSC for retrieving short message routing information

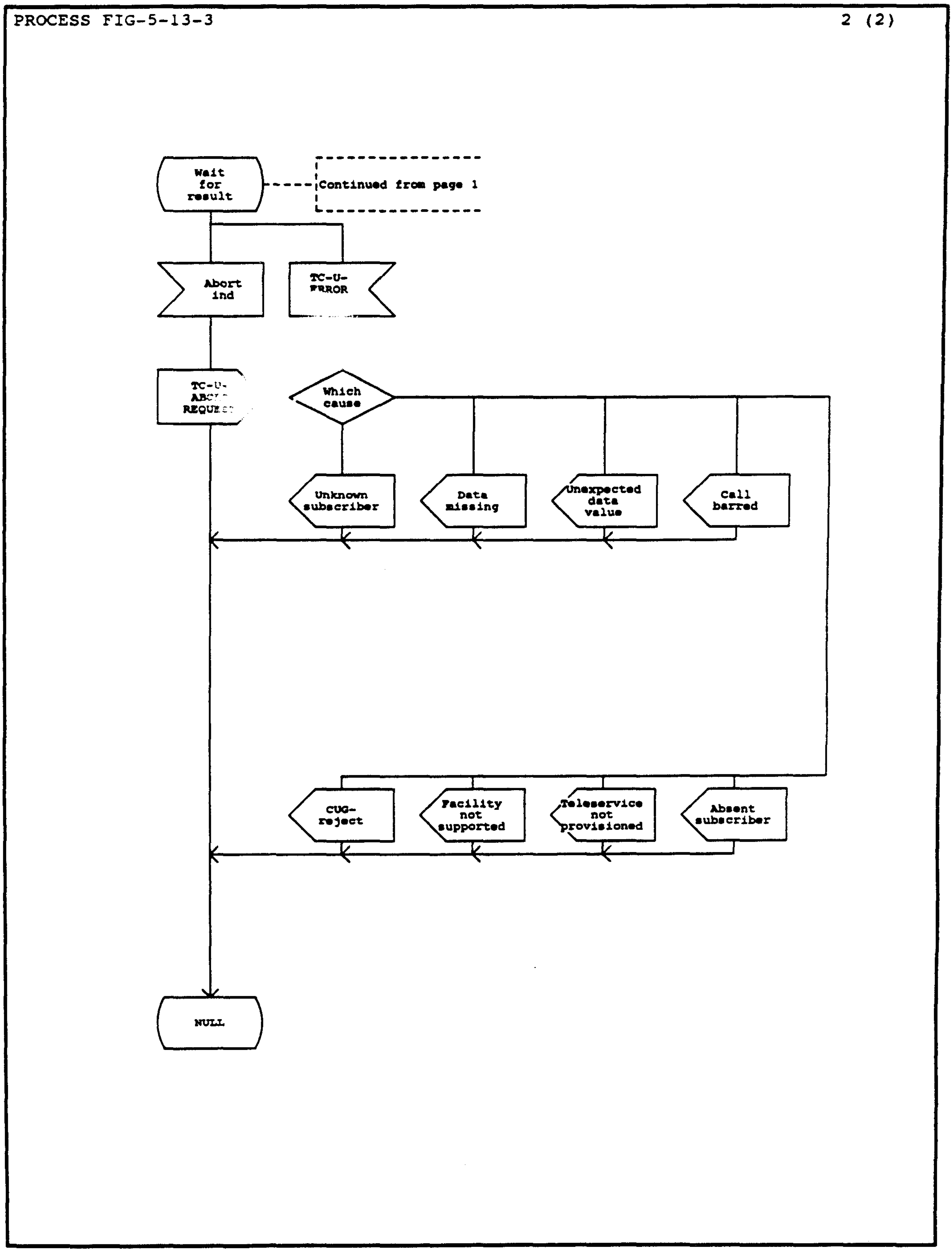


Figure 5.13.4 (Sheet 1 of 3)
Application specific procedures in HLR for retrieving short message routing information

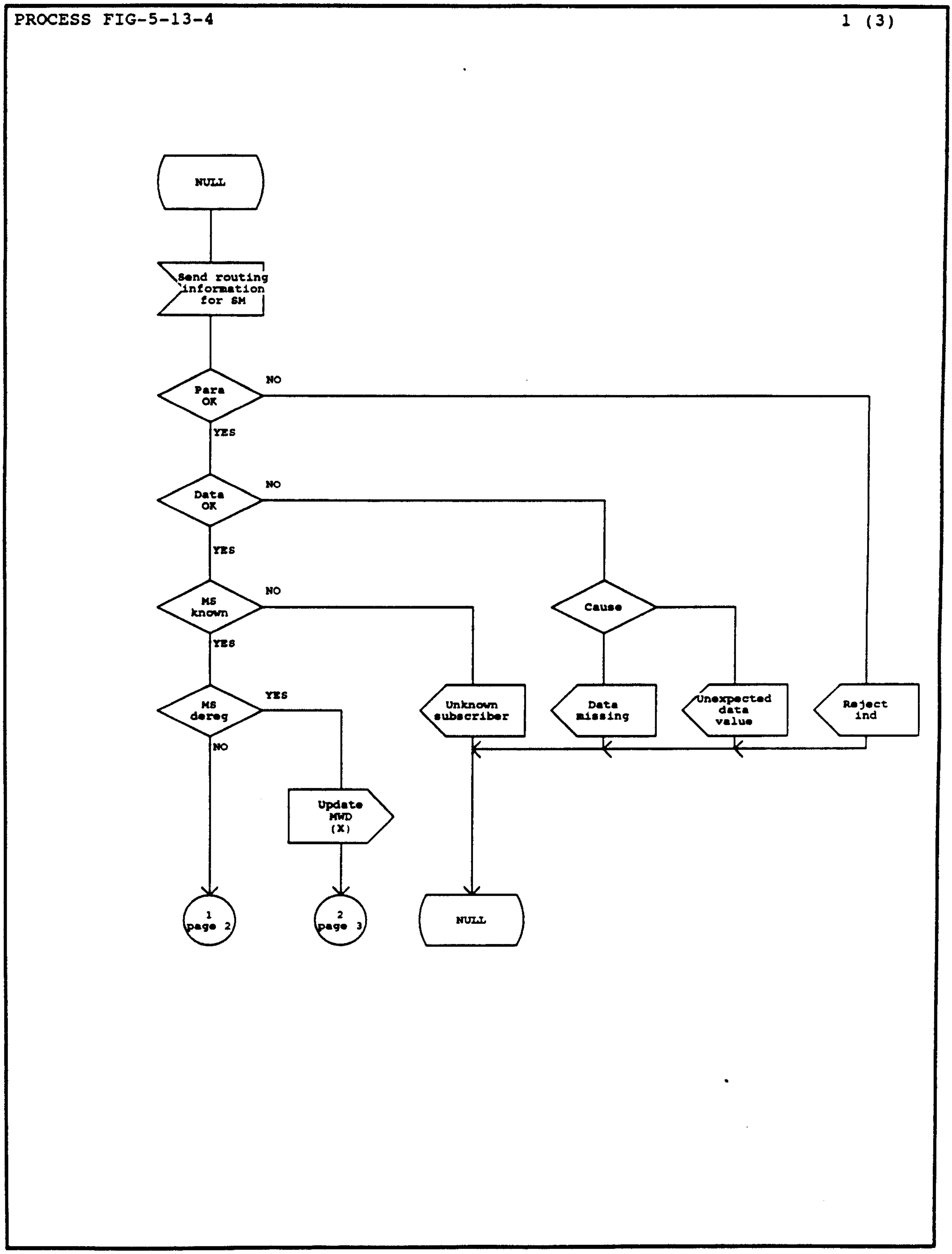


Figure 5.13.4 (Sheet 2 of 3)
Application specific procedures in HLR for retrieving short message routing information

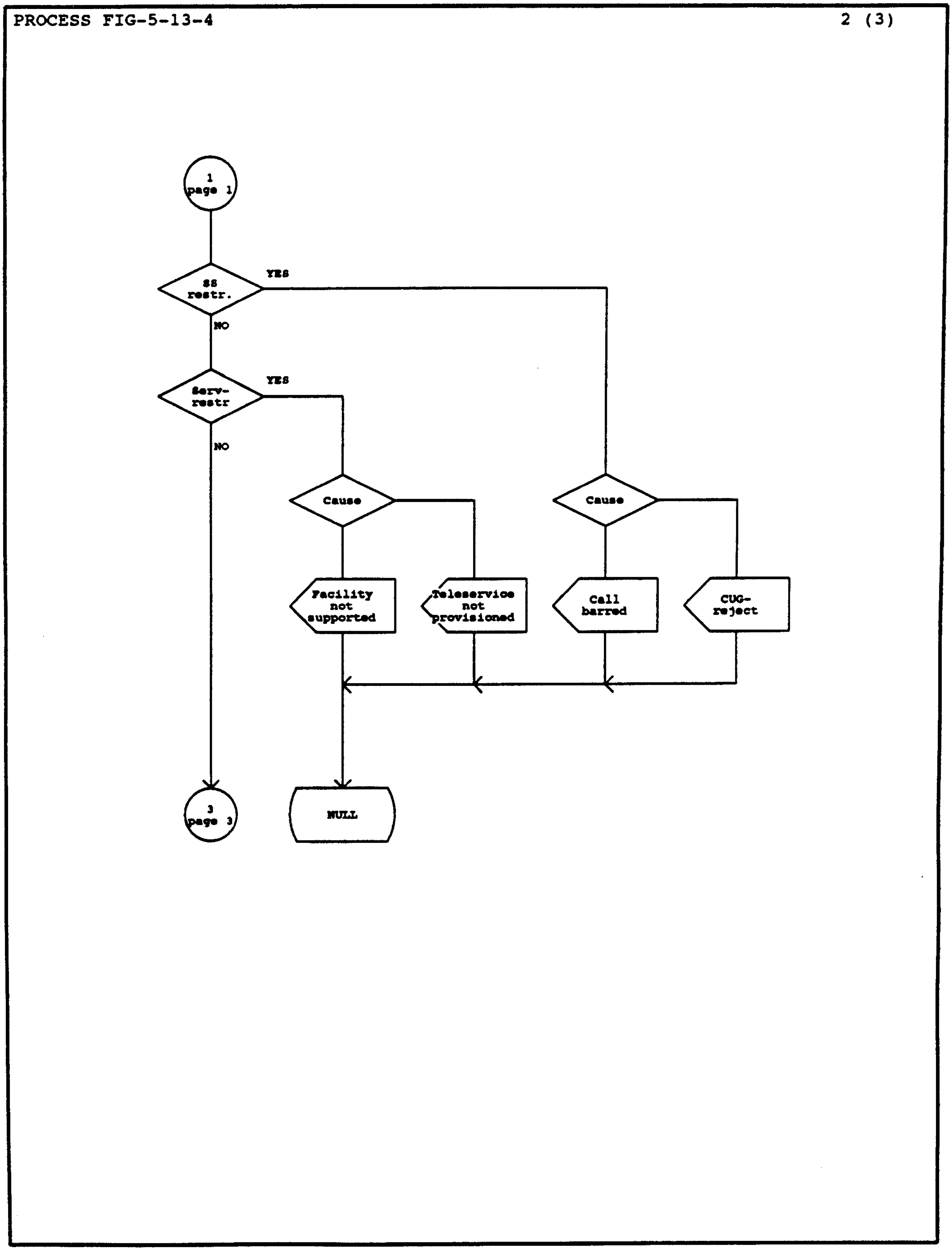


Figure 5.13.4 (Sheet 3 of 3)
Application specific procedures in HLR for retrieving short message routing information

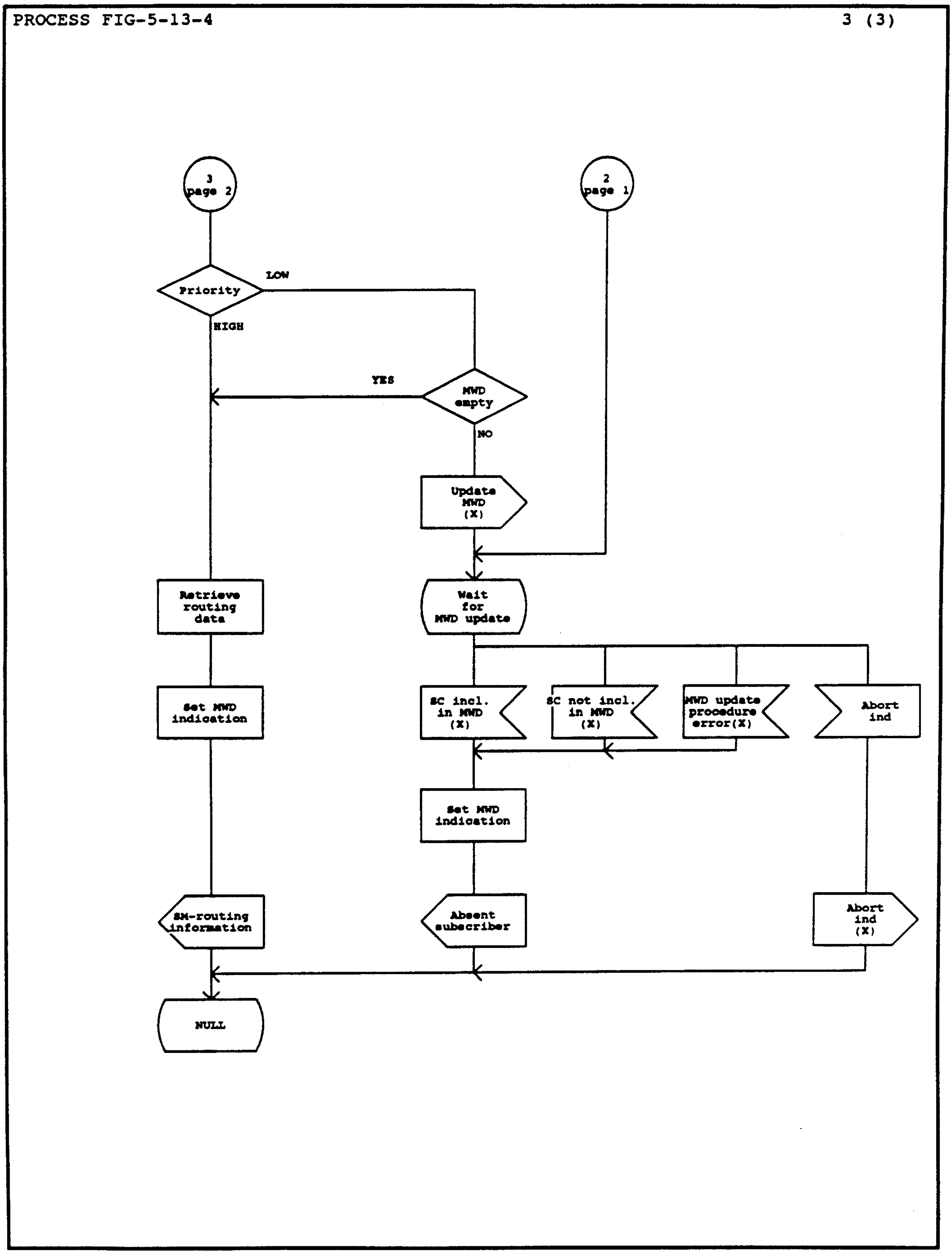


Figure 5.13.5 (Sheet 1 of 2)
ASE/TCAP Interface procedure in HLR for retrieving short message routing information

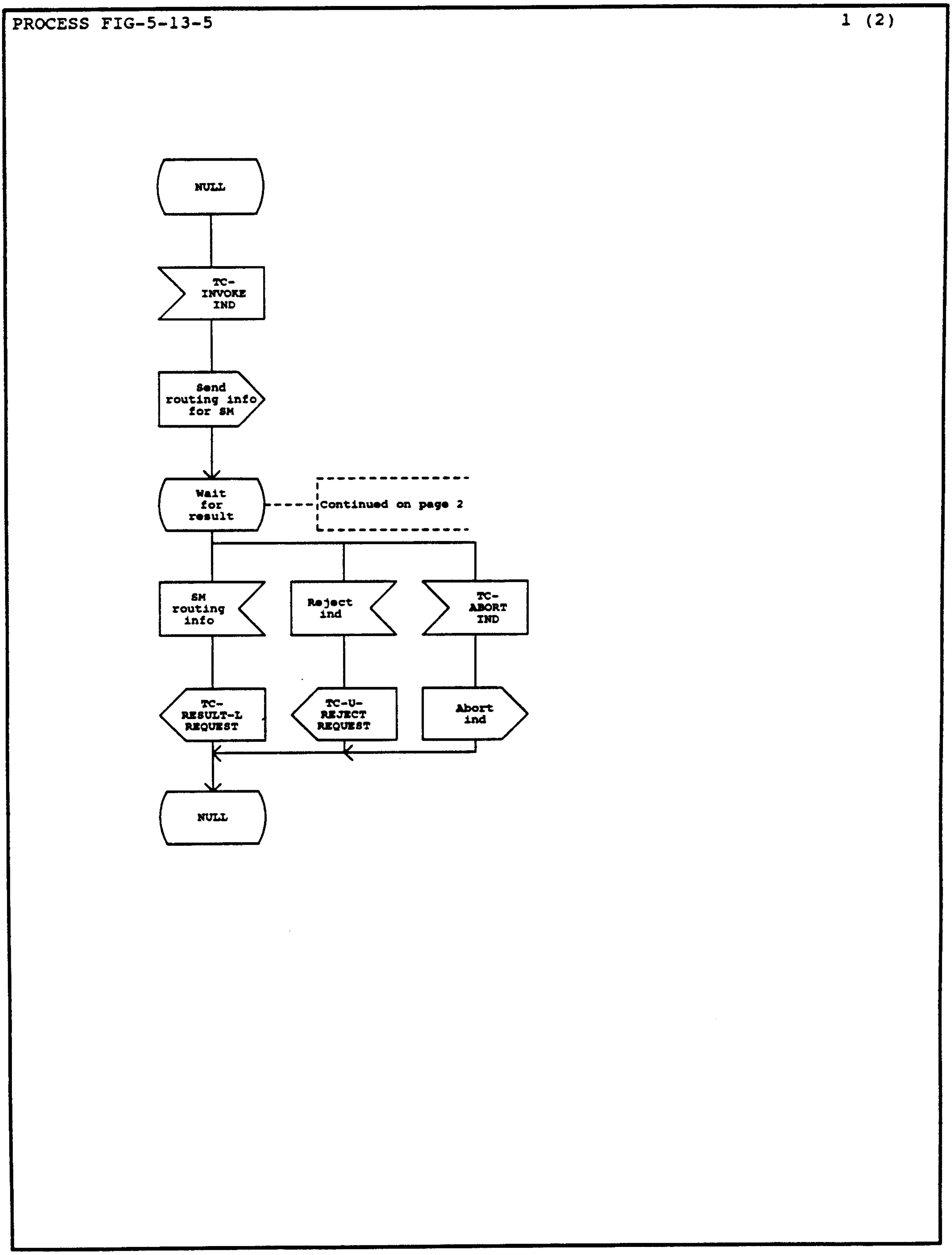
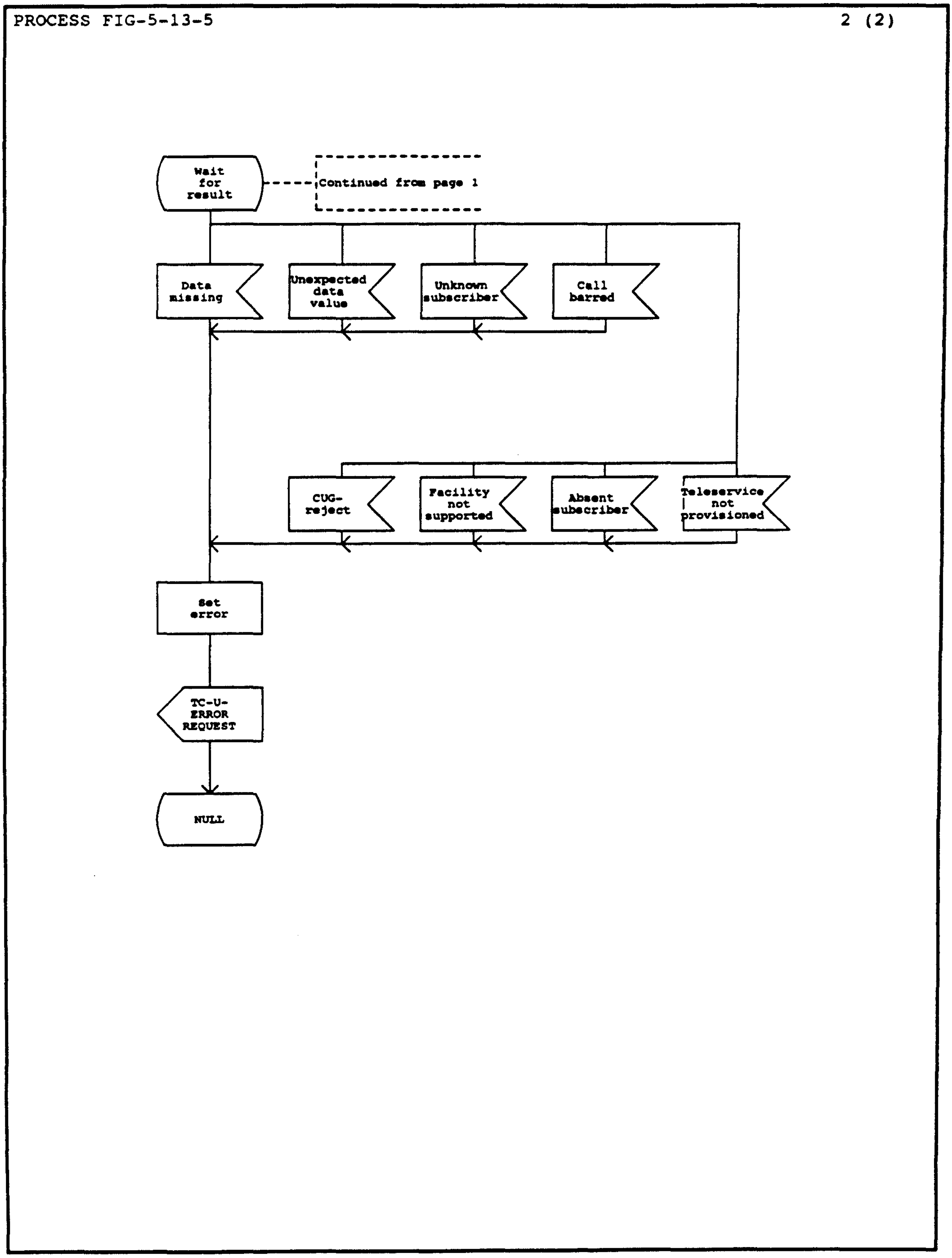


Figure 5.13.5 (Sheet 2 of 2)
ASE/TCAP Interface procedure in HLR for retrieving short message routing information



5.13.2 Procedure for forwarding of short message

5.13.2.1. General description of the procedure

The procedure is initiated by a GMSC to request the servicing MSC to forward an MS terminated short message to the MS, or by the servicing MSC to request an interworking MSC to forward a MS originated short message to the Service Centre. The procedure is shown in Figure 5.13.6 and consists of the following messages:

- a forward short message message sent from the GMSC to the servicing MSC, or from the servicing MSC to an interworking MSC
- a forwarding acknowledge message or an error message in the return direction.

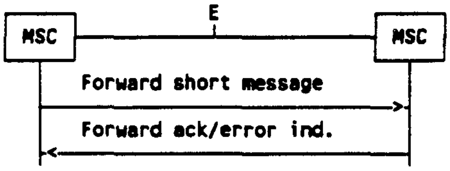


Figure 5.13.6. Forwarding of short message

5.13.2.2 Detailed description of the procedure between a GMSC and the servicing MSC

5.13.2.2.1. Procedure in gateway MSC

The application specific procedure for forwarding a MS terminated short message is shown in Figure 5.13.7.

The procedure is initiated when the short message handling function in the GMSC has obtained the routing information needed to forward a MS terminated short message to the servicing MSC. The GMSC sends a forward short message message containing the destination address SM-RP-DA (either a roaming number or the IMSI, possibly together with the LMsId), the originating SC-address SM-RP-OA, and the short message SM-RP-UI received from the service centre.

The GMSC will receive one of the following responses:

- a forwarding acknowledge message indicating that the short message has been successfully delivered to the MS. This indication is passed to the SC by the short message handling function in the GMSC.
- a reject indication if the operation has failed due to procedure error, or a timer expiry indication from TCAP. In this case a system failure indication is given to the short message handling function.
- one of the following messages indicating unsuccessful forwarding of the short message:
    - absent subscriber
    - illegal MS
    - unidentified subscriber
    - facility not supported
    - SM delivery failure
    - system failure
    - unexpected data value

Unexpected data value, unidentified subscriber are all indicated as system failure to the short message handling entity of the GMSC. The others are indicated unchanged.

The ASE/TCAP interface procedure is shown in Figure 5.13.8. The forward short message message is sent in a TC-INVOKE REQUEST primitive, and TCAP is requested to supervise the operation by the timer T-fsm. The result is reported as follows:

- a TC-RESULT-L INDICATION primitive contains the forwarding acknowledge message
- a procedure failure is reported in a TC-(U)-REJECT INDICATION primitive
- expiry of timer T-fsm is reported in a TC-L-CANCEL INDICATION primitive
- negative results as described above are reported in a TC-U-ERROR INDICATION primitive

5.13.2.2.2. Procedure in the servicing MSC

The application specific procedure for MS terminated short message transfer in the servicing MSC is shown in Figure 5.13.9.

When receiving a forward short message message the servicing MSC invokes the send information for incoming call set up operation towards the VLR. Depending on the response from this external procedure, the MSC will forward the message to the MS or send an error indication back to the GMSC.

The following responses may be received from the procedure towards the VLR:

- complete call, indicating that the MS has been successfully paged, authentication is done and ciphering mode is set. The forwarding of the short message to MS is then initiated.
- absent subscriber, indicating either that the IMSI detached flag is set or that there is no paging response from the MS.
- illegal MS, indicating that the authentication check is not passed.
- unidentified subscriber, indicating that the given MS identification (roaming number or IMSI) is not recognised in the VLR.
- unknown subscriber, indicating that the MS is unknown in the HLR.
- facility not supported, indicating that the VPLMN does not support mobile terminated short message service.
- system failure, indicating that an associated procedure has failed.

All the negative responses from the procedure towards the VLR are sent to the GMSC unchanged, except the unknown subscriber indication which is sent as a system failure message.

If invalid data content is detected, an unexpected data value message is returned to the GMSC.

If forwarding to the MS is initiated, the servicing MSC awaits the result of that procedure before one of the following responses is sent back to the GMSC:

- a forwarding acknowledge message if the short message has been successfully delivered to the MS

- an SM delivery failure message containing a parameter indicating either of the following: the MS has no MT short message transfer capability, there is an MS protocol error or the MS memory capacity is exceeded

- a system failure message if the delivery procedure is aborted.

The ASE/TCAP interface procedure is shown in Figure 5.13.10.

The forward short message message is received in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the forwarding acknowledge message is sent in a TC-RESULT-L REQUEST primitive

- a reject indication is reported in a TC-U-REJECT REQUEST primitive

- negative results are reported in a TC-U-ERROR REQUEST primitive.

5.13.2.3. Detailed description of the procedure between the servicing MSC and an interworking MSC (MS originating short message)

5.13.2.3.1. Procedure in the servicing MSC

The application specific procedure is shown in Figure 5.13.11.

The short message handling function of the servicing MSC will request forwarding towards a Service Centre when an MS originated short message is received. The servicing MSC then initiates the send information for outgoing call set-up procedure, and awaits the outcome of that procedure. If the call is allowed, the forward short message message is sent to the IWMSC.

The forward short message message contains the following parameters: An SM-RP-DA containing the destination Service Centre address, an SM-RP-UI including the MS originated short message and an SM-RP-OA containing the MSIsdn number (obtained from the VLR).

When the forward short message message is sent, the servicing MSC will receive one of the following responses from IWMSC:

- a forwarding acknowledge message indicating that the short message has been successfully delivered to the Service Centre. The indication is given to the short message handling function.

- one of the following error messages:

- SM delivery failure, for which a corresponding indication is given to the short message handling function.

- unexpected data value for which a system failure indication is given to the short message handling function.

- system failure if the connection to the Service Centre cannot be established, for which a corresponding indication is given to the short message handling function.

- a procedure failure either as a rejection from the IWMSC or timer expiry. This is indicated to the short message handling function as system failure.

The ASE/TCAP interface procedure is shown in Figure 5.13.12.

The forward short message message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the operation by timer T-fsm. The result of the operation is reported as follows:

- a TC-RESULT-L INDICATION primitive contains the forwarding acknowledge message

- a reject condition is reported in a TC-(U)-REJECT INDICATION primitive

- expiry of timer T-fsm is reported in a TC-L-CANCEL INDICATION primitive

- negative results as described above are reported in a TC-U-ERROR INDICATION primitive.

5.13.2.3.2. Procedure in the IWMSC

The application specific procedure is shown in Figure 5.13.13.

When a forward short message message is correctly received, the Interworking MSC invokes forwarding of the short message to the service centre by an external procedure. The outcome of that procedure is awaited before a response is given back to the servicing MSC:

- if an SC acknowledgement is received, a forwarding acknowledge message is sent back to the servicing MSC

- if the SC is not identified, the SM delivery failure message is returned to the servicing MSC

- if the short message cannot be forwarded to the Service Centre or the procedure towards the Service Centre fails for some reason, a system failure message is sent to the servicing MSC.

If parameter errors are detected by the IWMSC, a reject indication is given to TCAP.

If invalid data content is detected, an unexpected data value message is returned to the GMSC.

The ASE/TCAP interface procedure is shown in Figure 5.13.14.

The forward short message message is received in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the forwarding acknowledge message is sent in a TC-RESULT-L REQUEST primitive

- a reject indication is reported in a TC-U-REJECT REQUEST primitive

- negative results are reported in a TC-U-ERROR REQUEST primitive.

Figure 5.13.7 (Sheet 1 of 2)
Application specific procedures in GMSC for forwarding MS terminated short message to serving MSC

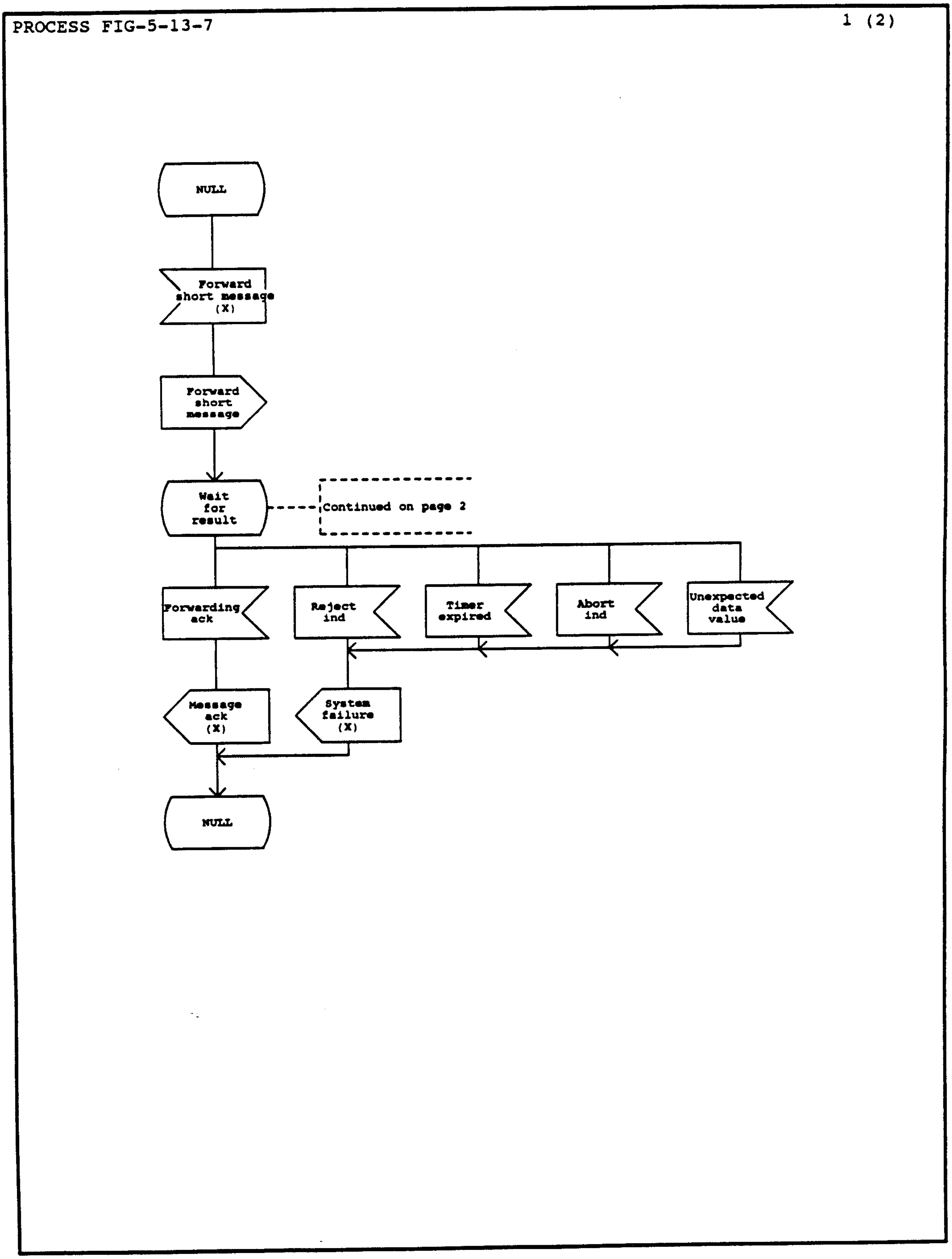


Figure 5.13.7 (Sheet 2 of 2)
Application specific procedures in GMSC for forwarding MS terminated short message to serving MSC

PROCESS FIG-5-13-7 2 (2)

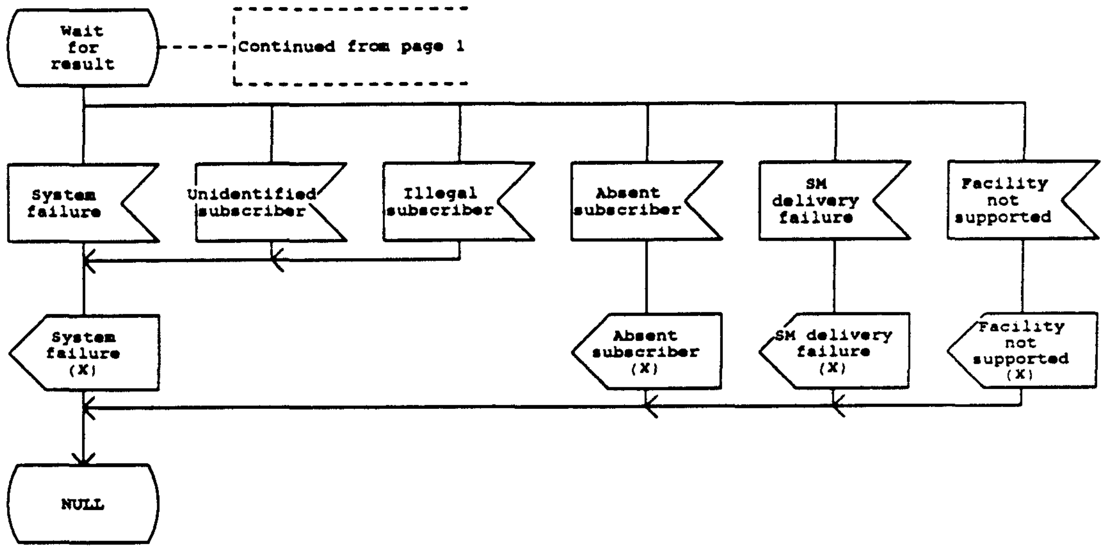


Figure 5.13.8 (Sheet 1 of 2)
ASE/TCAP interface procedure in GMSC for forwarding MS terminated short message to serving MSC

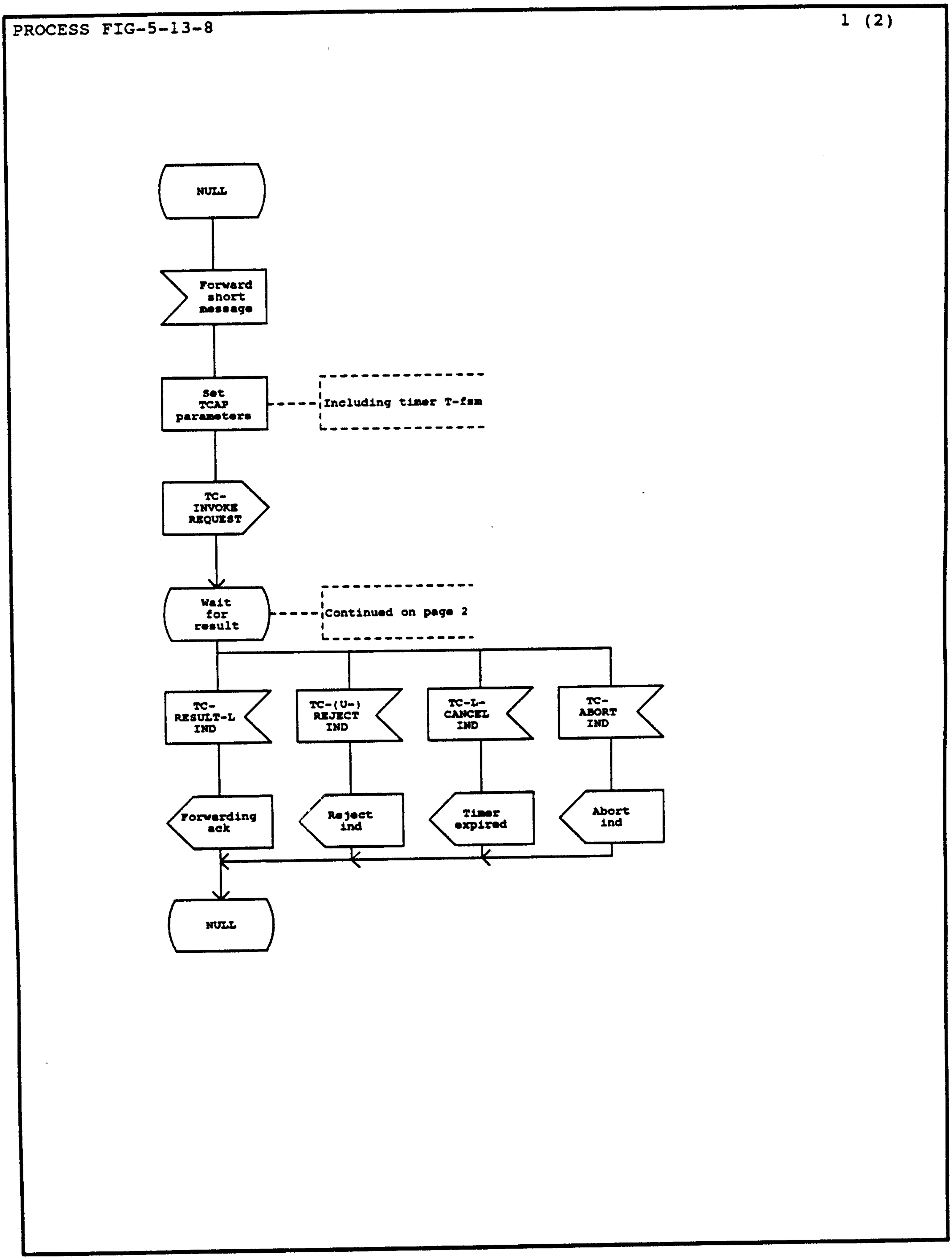


Figure 5.13.8 (Sheet 2 of 2)
ASE/TCAP interface procedure in GMSC for forwarding MS terminated short message to serving MSC

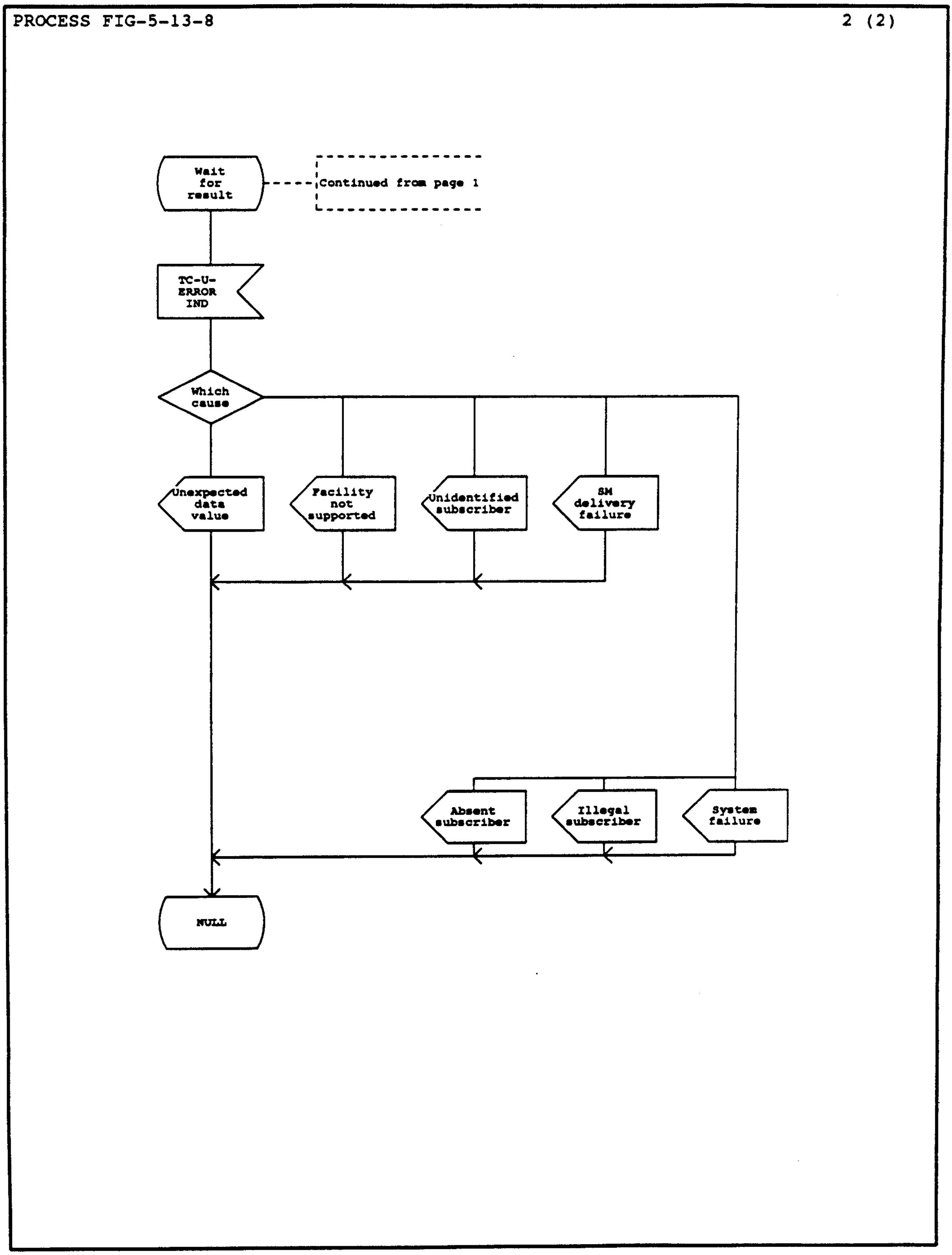


Figure 5.13.9 (Sheet 1 of 2)
Application specific procedures in serving MSC for forwarding MS terminated short message to serving MSC

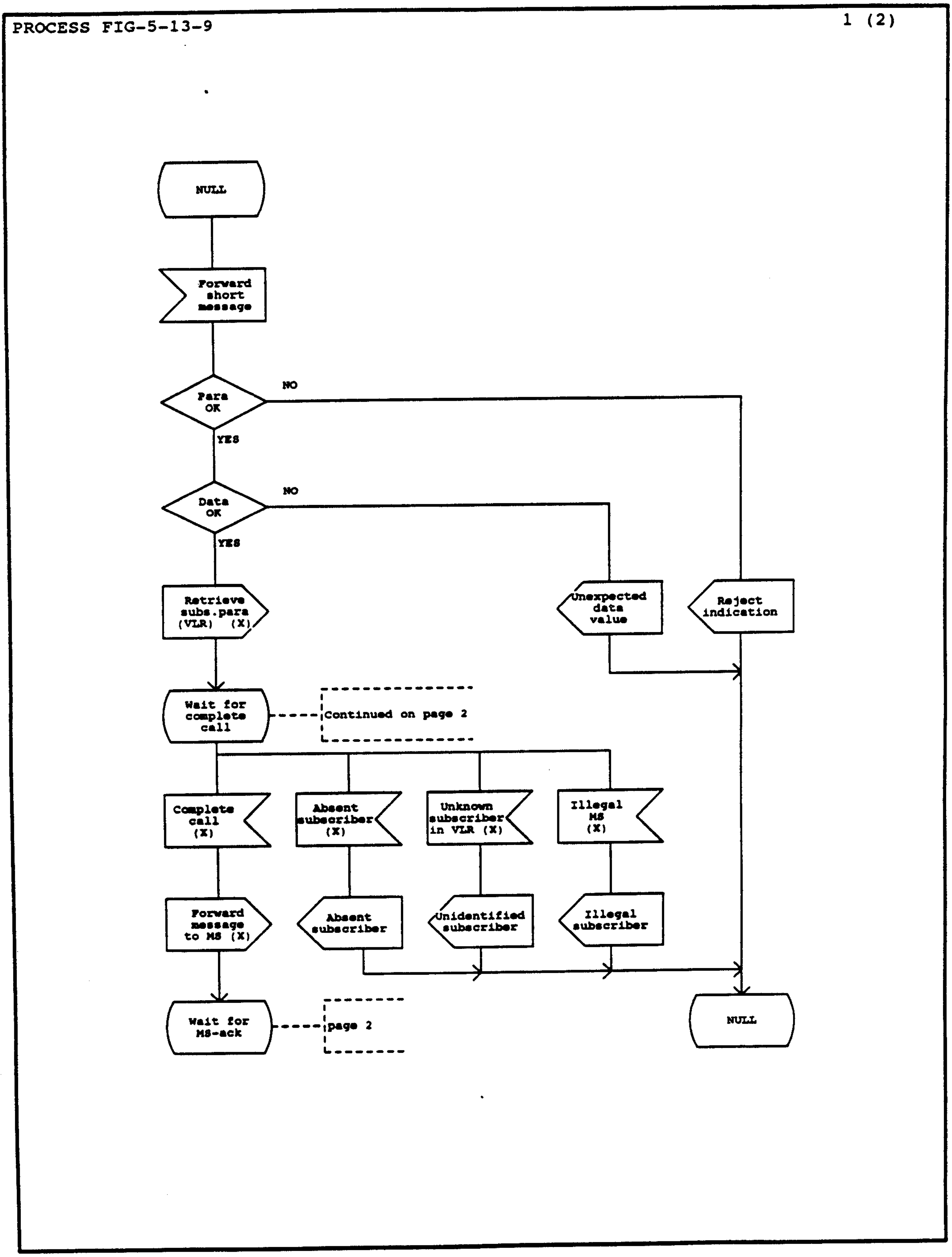


Figure 5.13.9 (Sheet 2 of 2)
Application specific procedures in serving MSC for forwarding MS terminated short message to serving MSC

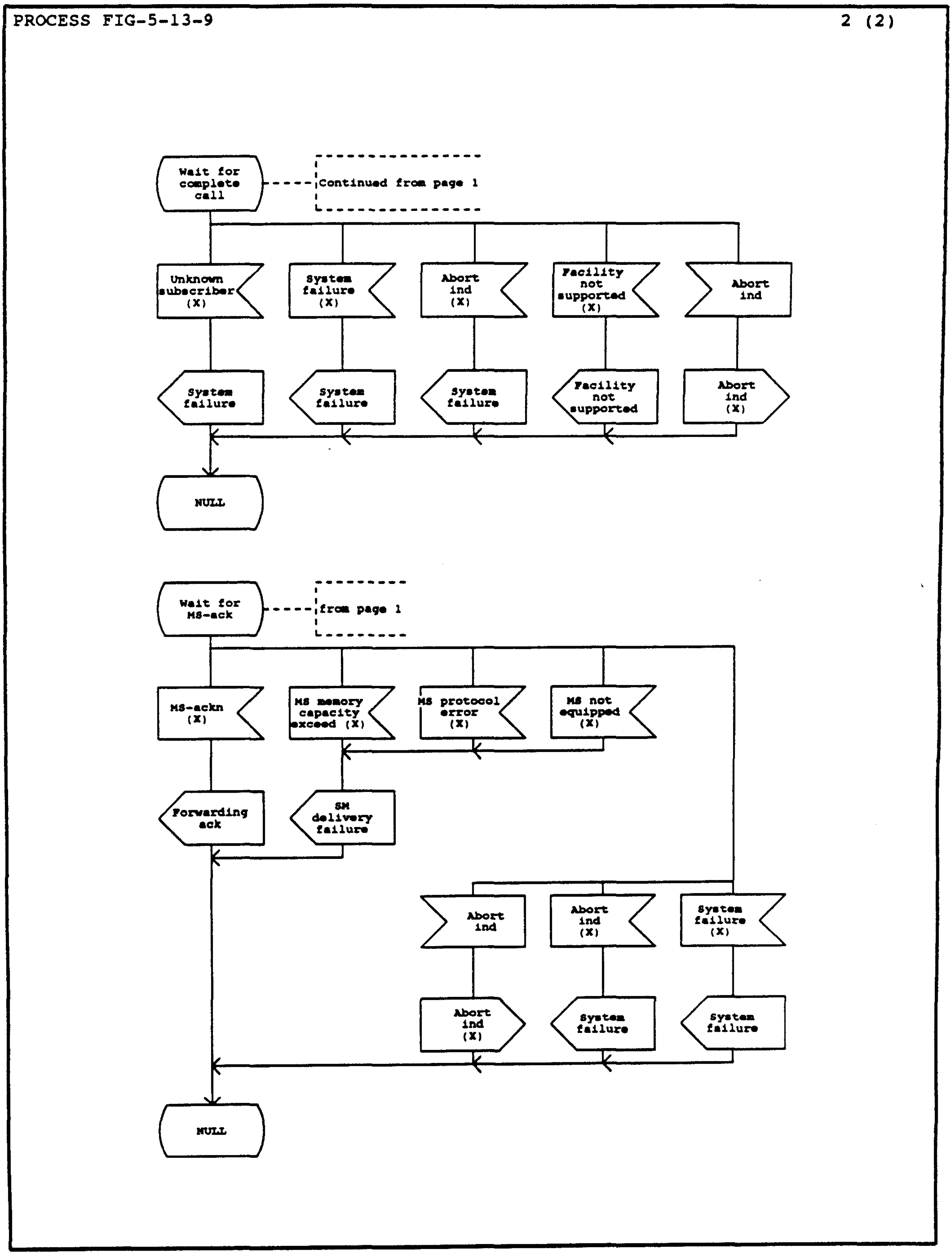


Figure 5.13.10 (Sheet 1 of 2)
ASE/TCAP interface procedure in serving MSC for forwarding MS terminated short message to serving MSC

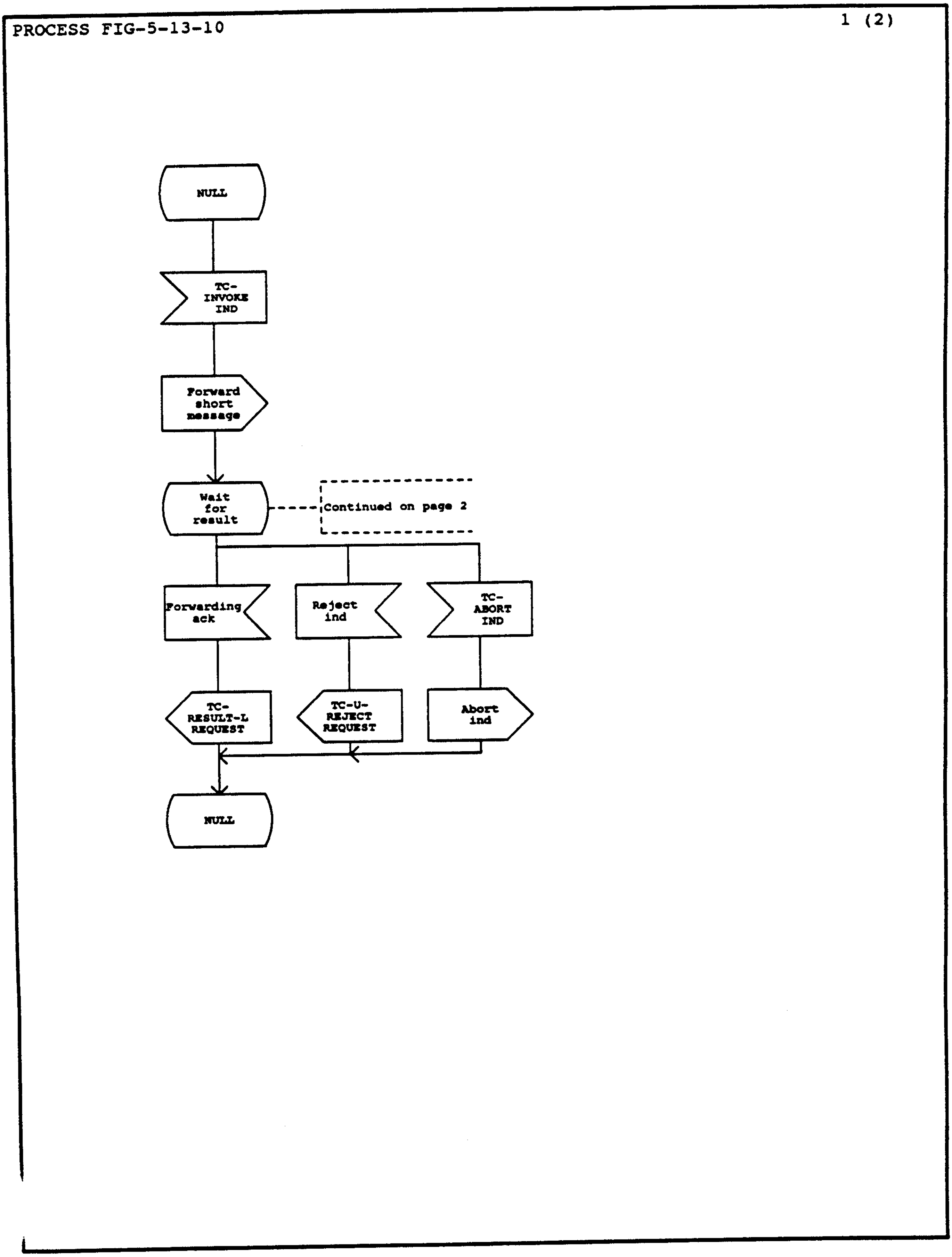


Figure 5.13.10 (Sheet 2 of 2)
ASE/TCAP interface procedure in serving MSC for forwarding MS terminated short message to serving MSC

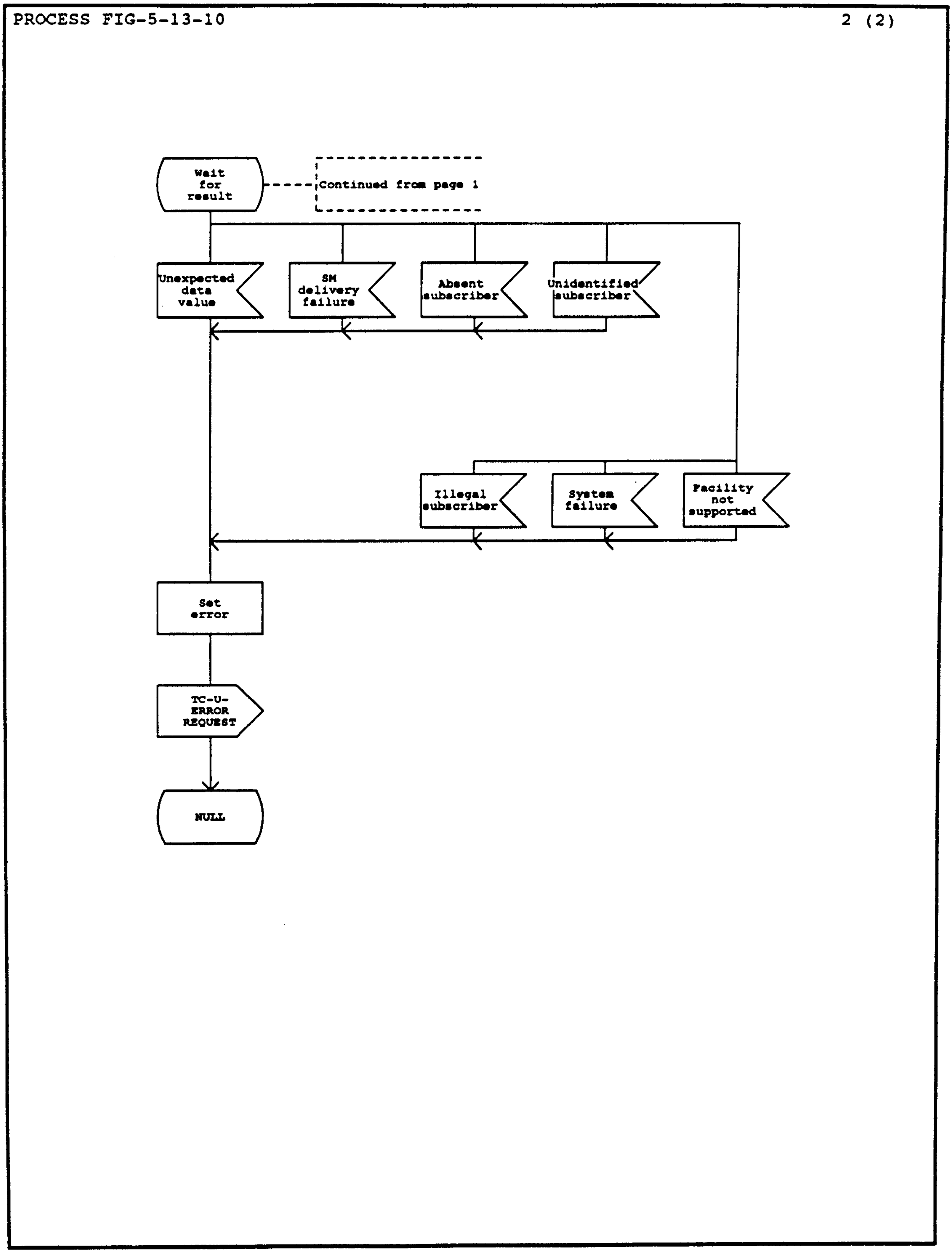


Figure 5.13.11
Application specific procedures in serving MSC for forwarding MS originated short message to IWMSC

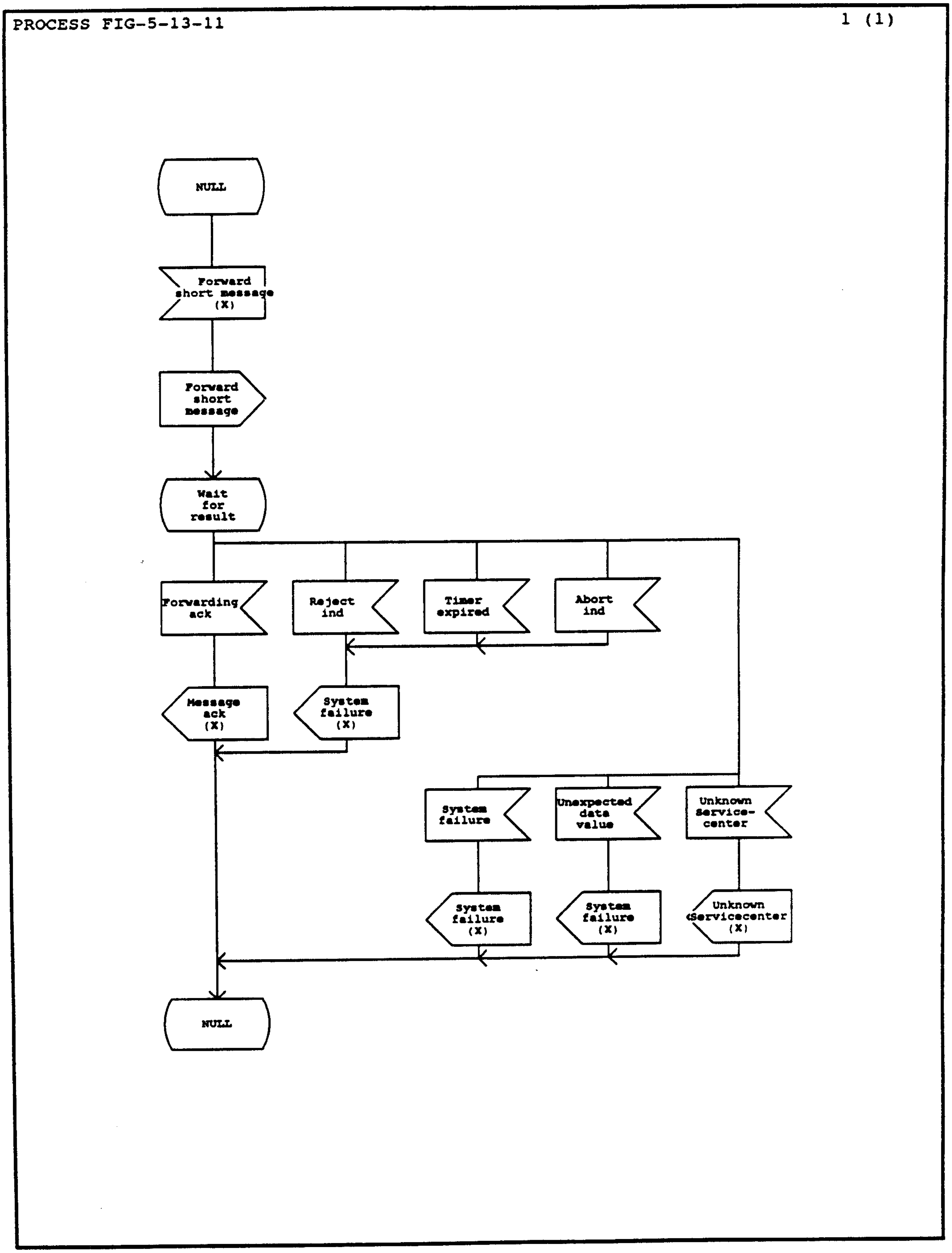


Figure 5.13.12
ASE/TCAP interface procedure in serving MSC for forwarding MS originated short message to IWMSC

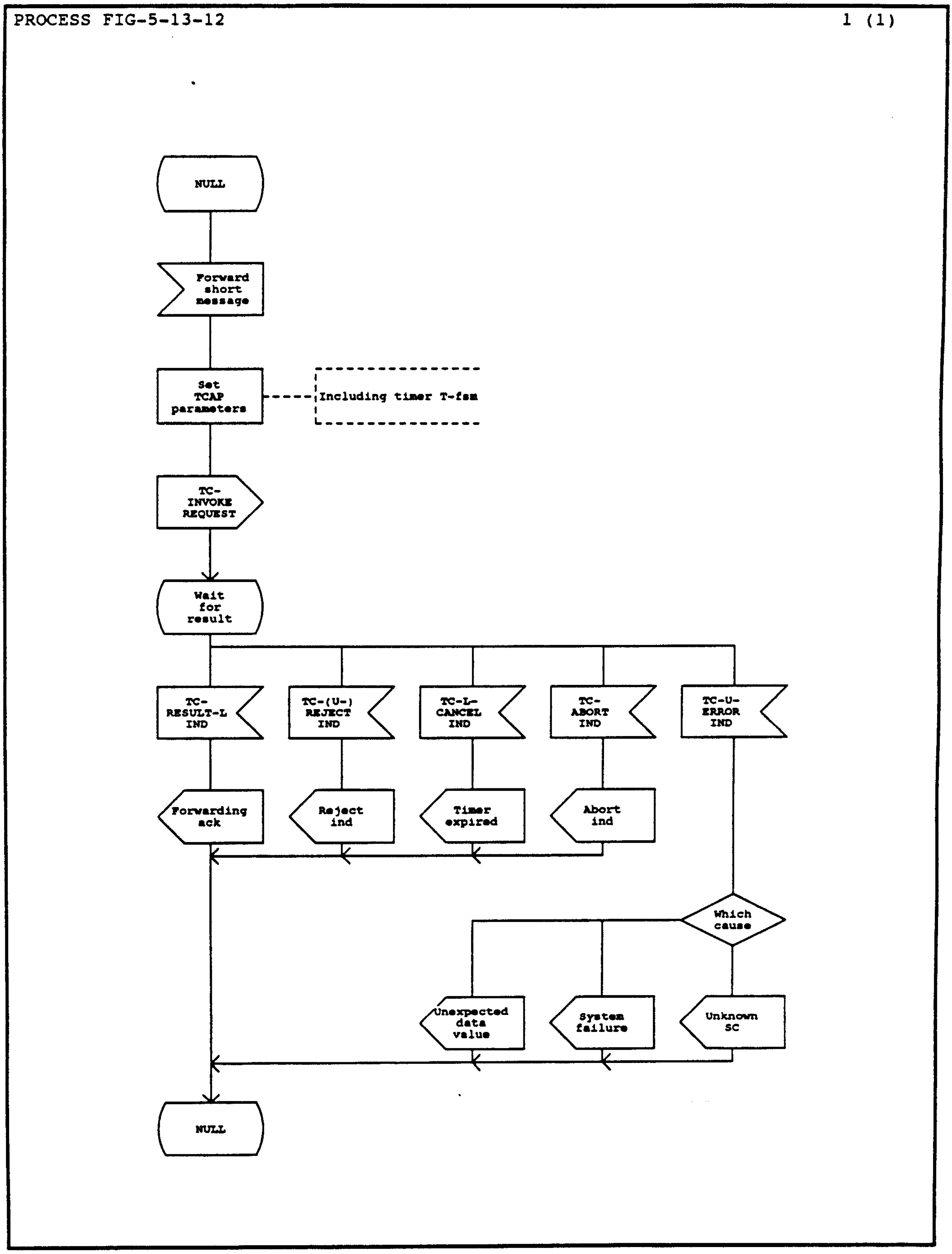


Figure 5.13.13
Application specific procedures in IWSC for forwarding MS originated short message to SC

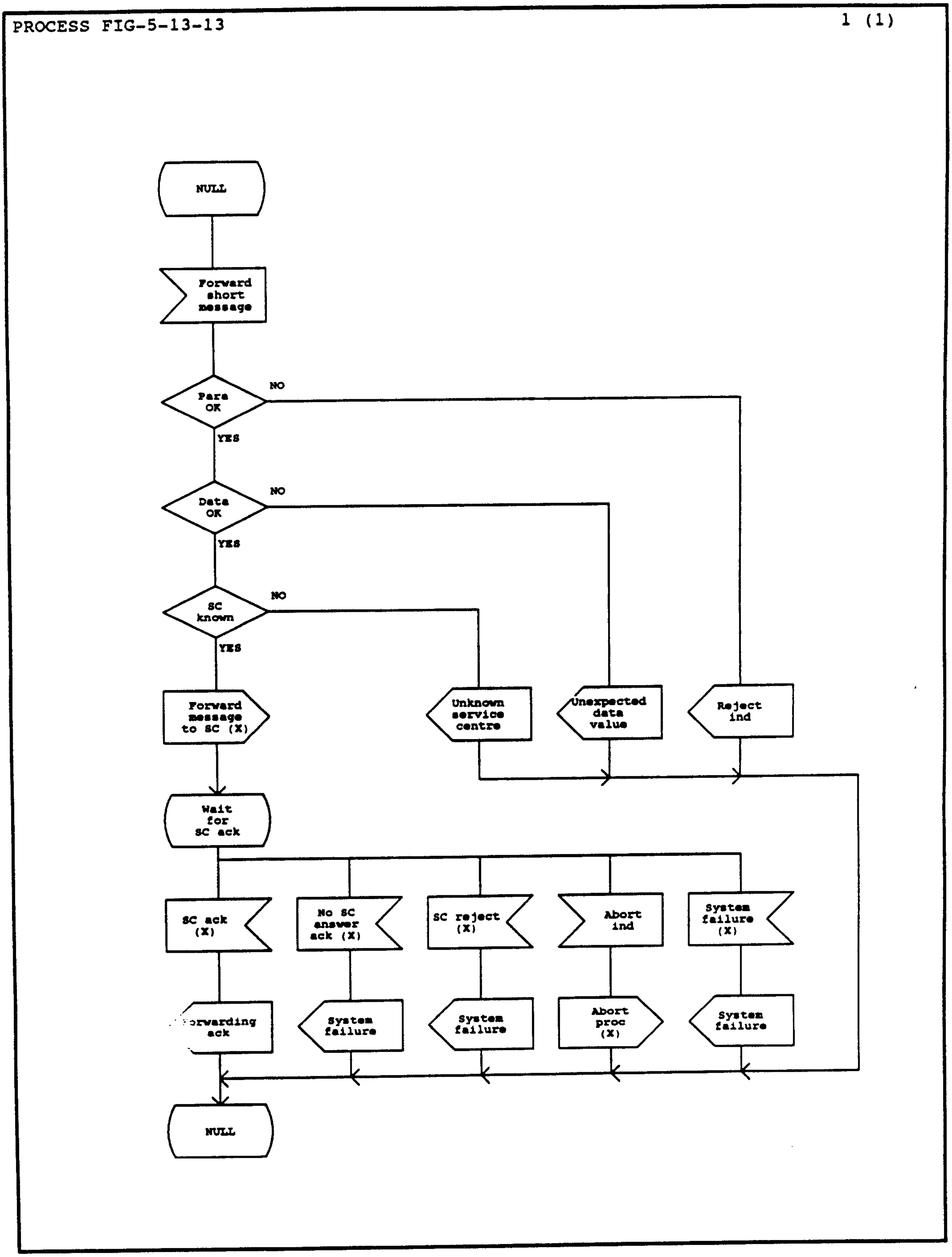
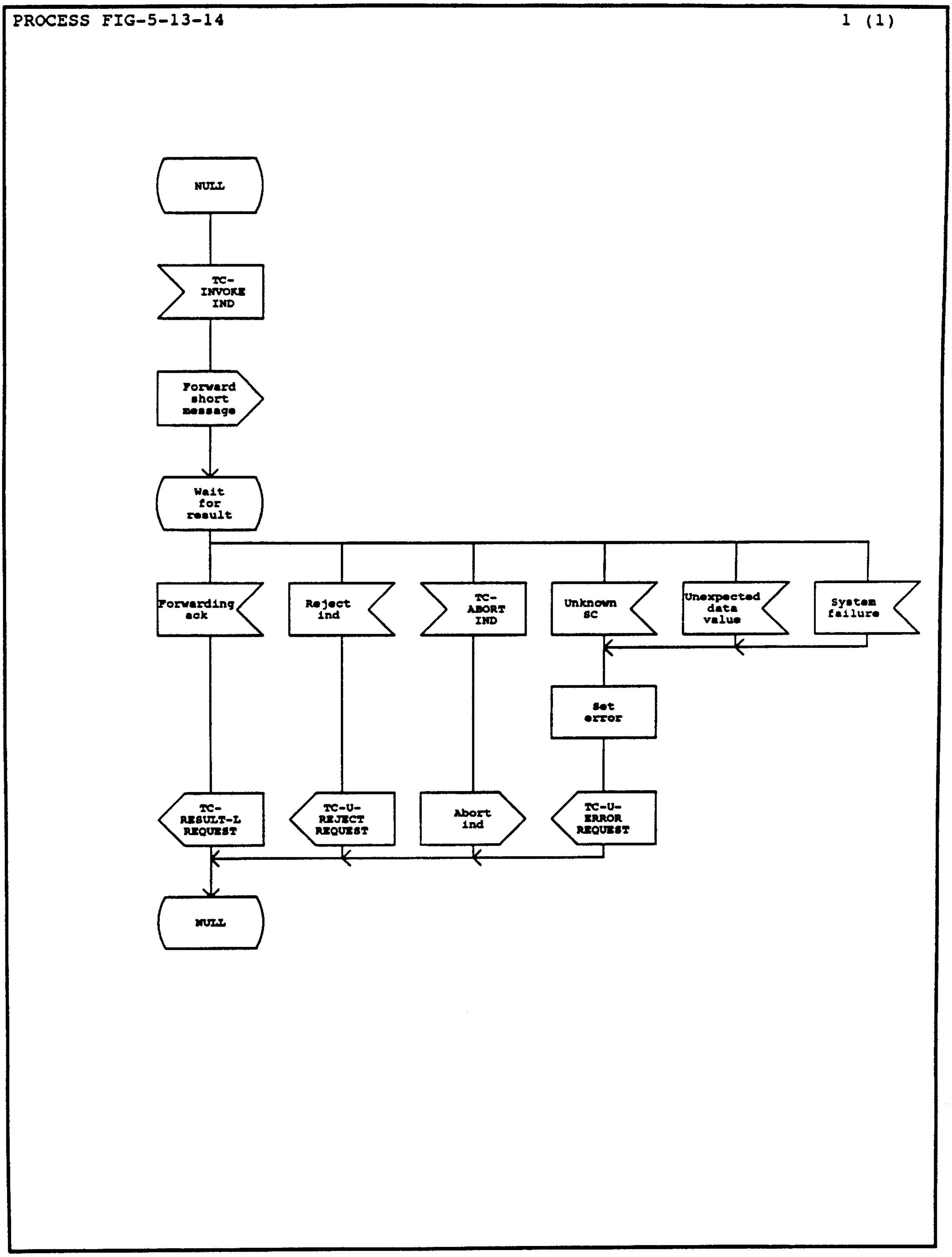


Figure 5.13.14
ASE/TCAP interface procedure in IWMSC for forwarding MS originated short message to SC



5.13.3. Procedure for setting Message Waiting Data in HLR

5.13.3.1. General description of the procedure

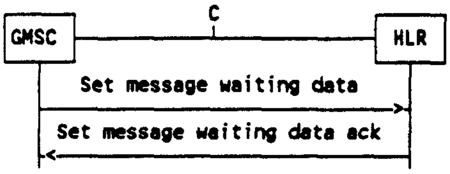


Figure 5.13.15. Procedure for setting Message Waiting Data in the HLR

Figure 5.13.15 shows the procedure used by a gateway MSC to request inclusion of a Service Centre address in the Message Waiting Data in the HLR. The procedure consists of the exchange of the messages:

- set MWD and
- set MWD ack or an error message

5.13.3.2 Detailed description of the procedure

5.13.3.2.1 Procedure in GMSC

The application specific procedure is shown in Figure 5.13.16.

The GMSC invokes the procedure if an absent subscriber indication is received from the servicing MSC during a forward short message procedure for an MS terminating short message, and the MWD-set parameter received from the HLR at routing information retrieval shows that the SC-address is not already included in the MWD.

The GMSC sends a set MWD message containing the MSIsdn number and the Service Centre address to the HLR. One of the following responses will be received:

- a set MWD ack message indicating successful outcome of the procedure. This is indicated to the short message handling function for further indication towards the Service Centre
- a message waiting list full message,
- an unknown subscriber message,
- an unexpected data value message,

For all these messages a system failure indication is given to the short message handling function

- a procedure failure either as a rejection from the HLR or timer expiry. This is indicated as a system failure to the short message handling function.

The procedure towards the Service Centre may also be aborted. If so the operation towards the HLR is also aborted.

The ASE/TCAP interface procedure is shown in Figure 5.13.17.

The set MWD message is sent in TC-INVOKE REQUEST primitive, and TCAP is requested to supervise the operation by timer T-smf. The result is received as follows:

- the set MWD ack message is contained in a TC-RESULT-L INDICATION primitive.
- a reject condition is indicated by a TC-(U)-REJECT INDICATION primitive
- expiry of timer T-smf is reported in a TC-L-CANCEL INDICATION primitive
- negative results are reported in a TC-U-ERROR INDICATION primitive.

An abortion of the procedure to the SC is sent to the HLR in a TC-U-ABORT REQUEST primitive.

5.13.3.2.2 Procedure in the HLR

The application specific procedure is shown in Figure 5.13.18.

When a set MWD message for a recognised MS is correctly received by the HLR, the given Service Centre address is included in the Message Waiting Data if possible, and a set MWD ack message is returned.

If the MSIsdn number provided is not recognised, an unknown subscriber message is returned to the GMSC.

If inclusion of the SC address in the MWD is not possible, a message waiting list full message is returned to the GMSC.

If parameter errors or other procedure errors are detected by the HLR, a reject indication is given to TCAP.

If invalid data content is detected, an unexpected data value message is returned to the GMSC.

The ASE/TCAP interface procedure is shown in Figure 5.13.19.

The set MWD message is received in a TC-INVOKE INDICATION primitive. The outcome of the procedure is reported as follows:

- the set MWD ack message is sent in a TC-RESULT-L REQUEST primitive
- a reject indication is reported in a TC-U-REJECT REQUEST primitive
- negative results are reported in a TC-U-ERROR REQUEST primitive.

Figure 5.13.16
Application specific procedures in GMSC for setting Message Waiting Data in HLR.

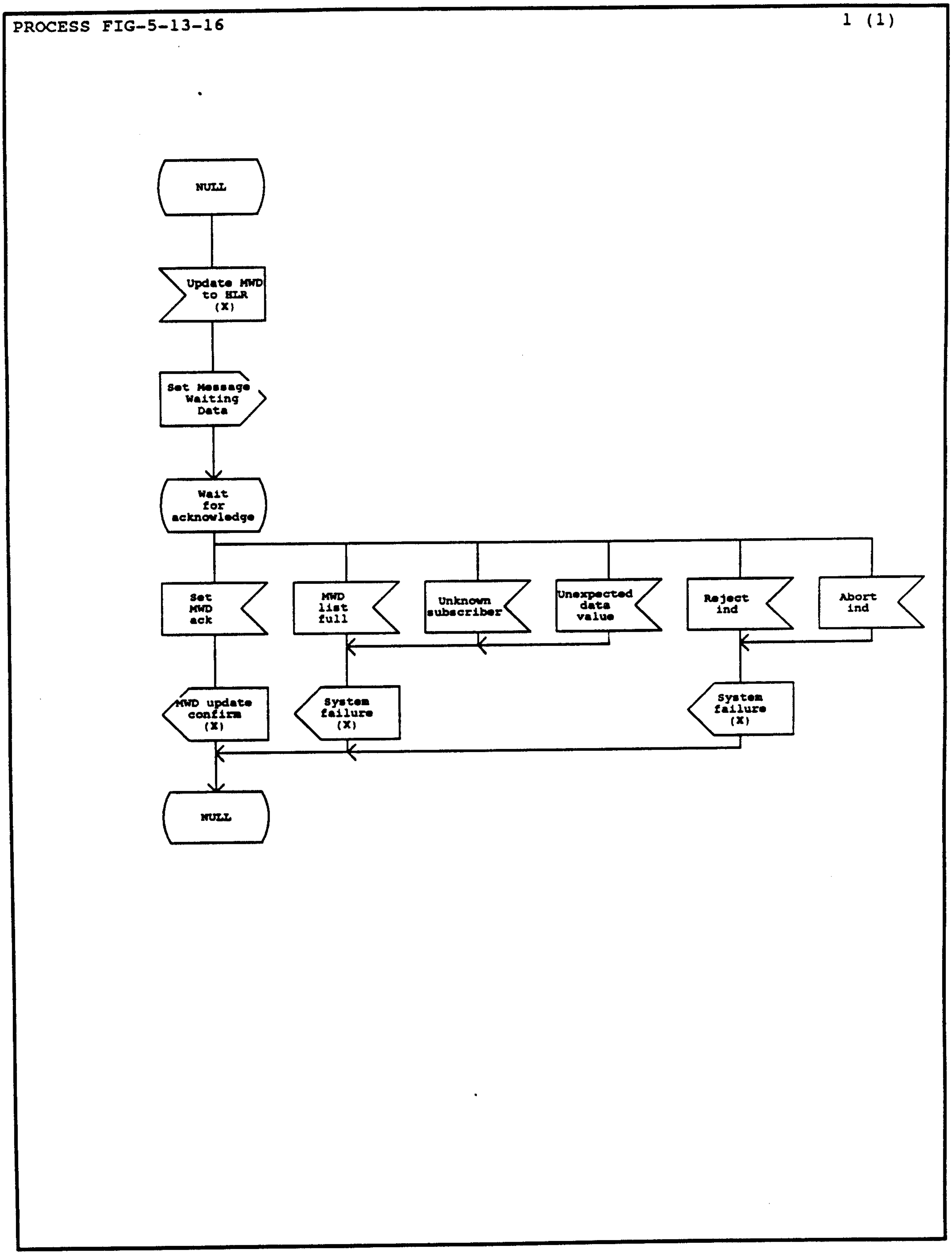


Figure 5.13.17
ASE/TCAP Interface procedures in GMSC for setting Message Waiting Data in HLR.

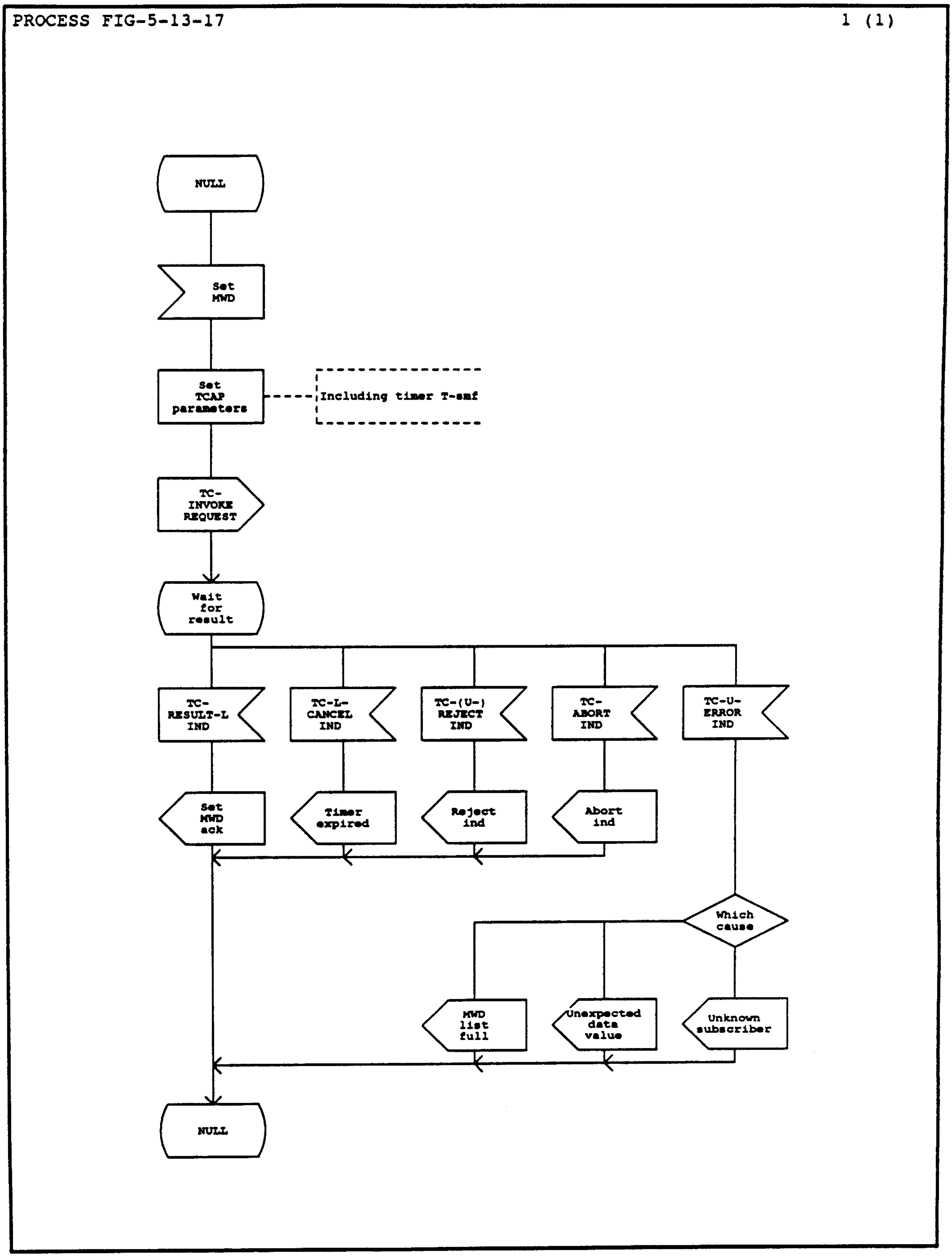


Figure 5.13.18
Application specific procedures in HLR for setting Message Waiting Data

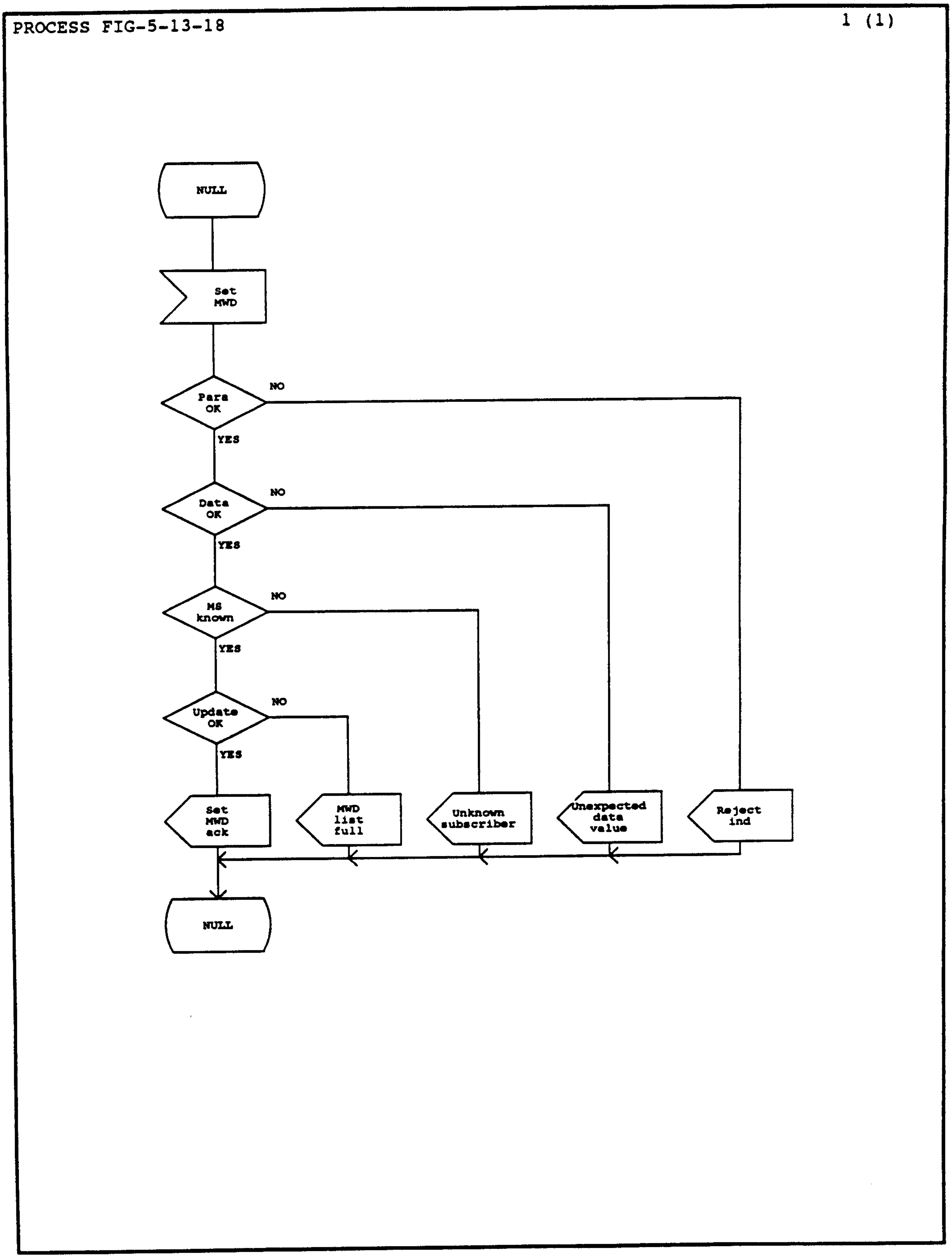
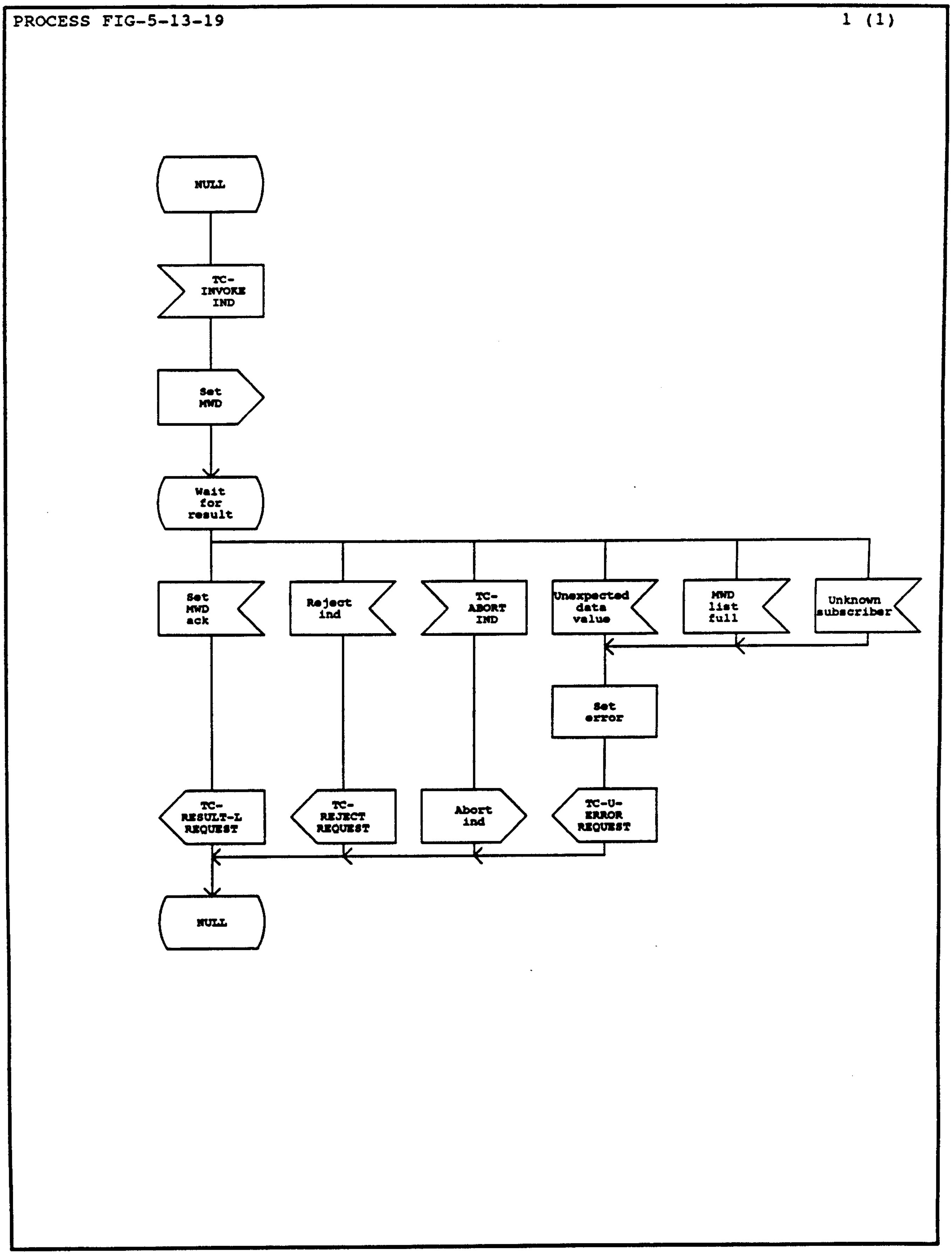


Figure 5.13.19
ASE/TCAP Interface procedures in HLR for setting Message Waiting Data



5.13.4 Procedure for MS present indication VLR-HLR

5.13.4.1 General description of the procedure

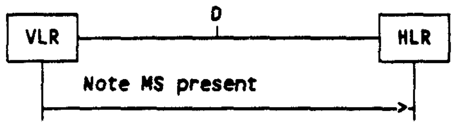


Figure 5.13.20 Procedure for MS present indication

The procedure is shown in Figure 5.13.20. It is used by a VLR to inform the HLR that the MS may be reachable again, so that the HLR may alert the Service Centres contained in the Message Waiting Data. The procedure consists of one message: Note MS present sent from the VLR to the HLR.

5.13.4.2 Detailed description of the procedure

5.13.4.2.1 Procedure in the VLR

The application specific procedure is shown in Figure 5.13.21 and the ASE/TCAP interface procedure is shown if Figure 5.13.22.

The VLR invokes the procedure if the Message Waiting Flag is TRUE and one of the following events occur:

- an process access request procedure has been started and the MS is recognised
- an attach IMSI procedure is successfully completed
- an update location area procedure is successfully completed
- a page or search for mobile subscriber operation is successfully completed.

The VLR sends a note MS present message containing the IMSI to the HLR, and sets the Message Waiting Flag to FALSE. No response is awaited from the HLR.

The note MS present message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-nmp.

5.13.4.2.2 Procedure in HLR

The application specific procedure is shown in Figure 5.13.23 and the ASE/TCAP interface procedure is shown in Figure 5.13.24.

When a note MS present message is correctly received by the HLR, the alert Service Centre procedure is invoked if the Message Waiting Data is not empty. The note MS present message is received in a TC-INVOKE INDICATION primitive.

Figure 5.13.21
Application specific procedures in VLR for providing MS-present indication to the VLR.

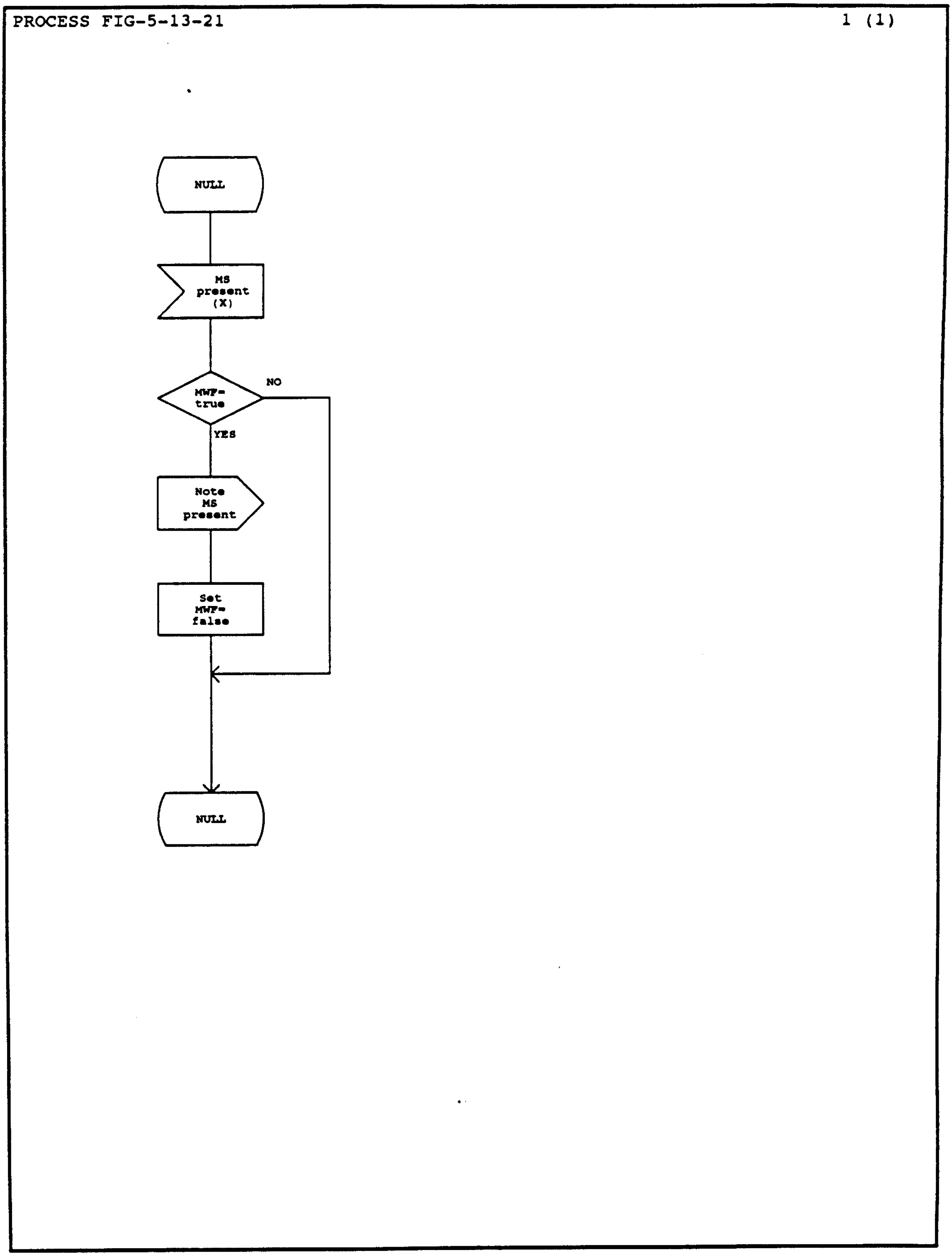


Figure 5.13.22
ASE/TCAP Interface procedures in VLR for providing MS-present indication to the VLR.

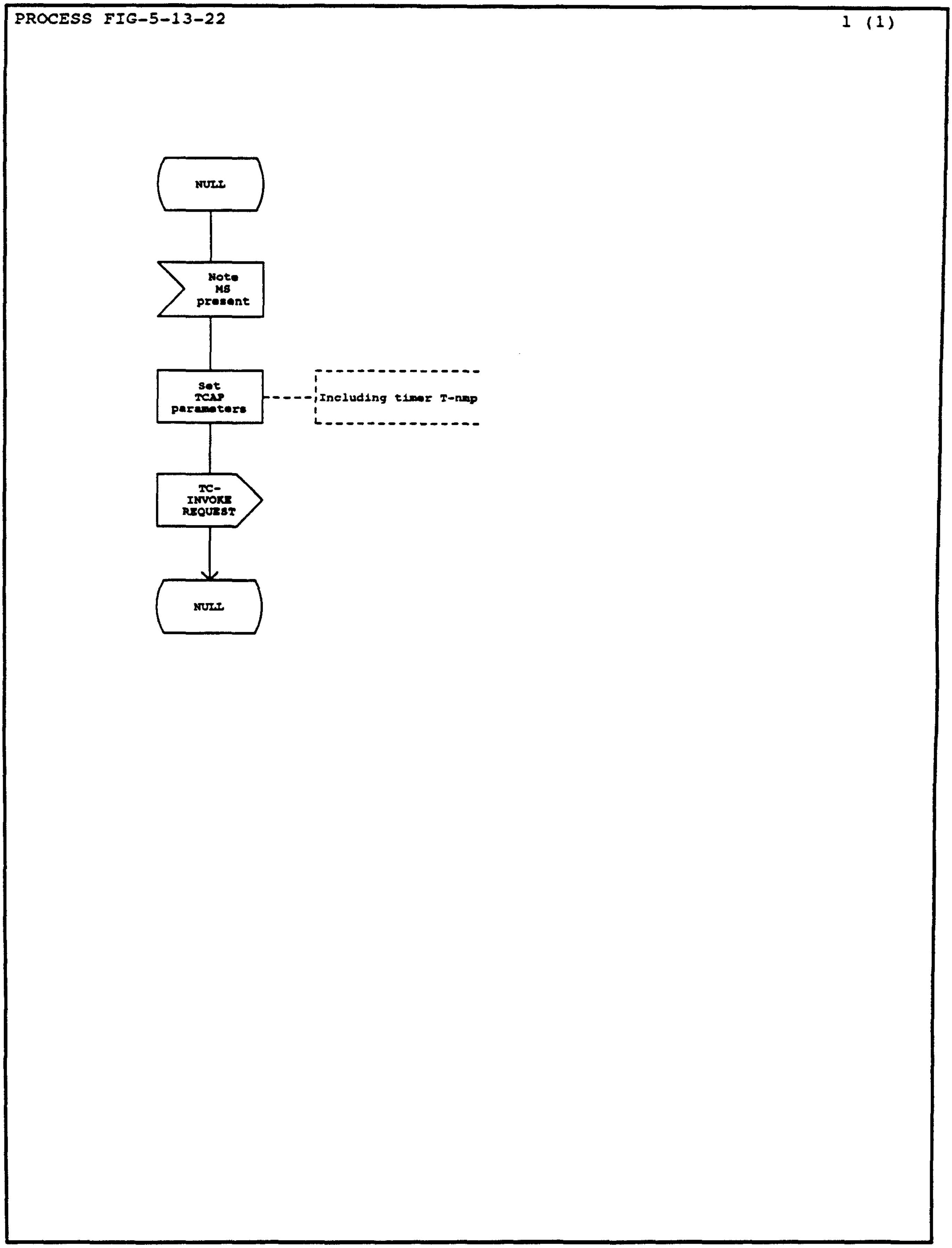


Figure 5.13.23
Application specific procedures in HLR when receiving an MS-present indication

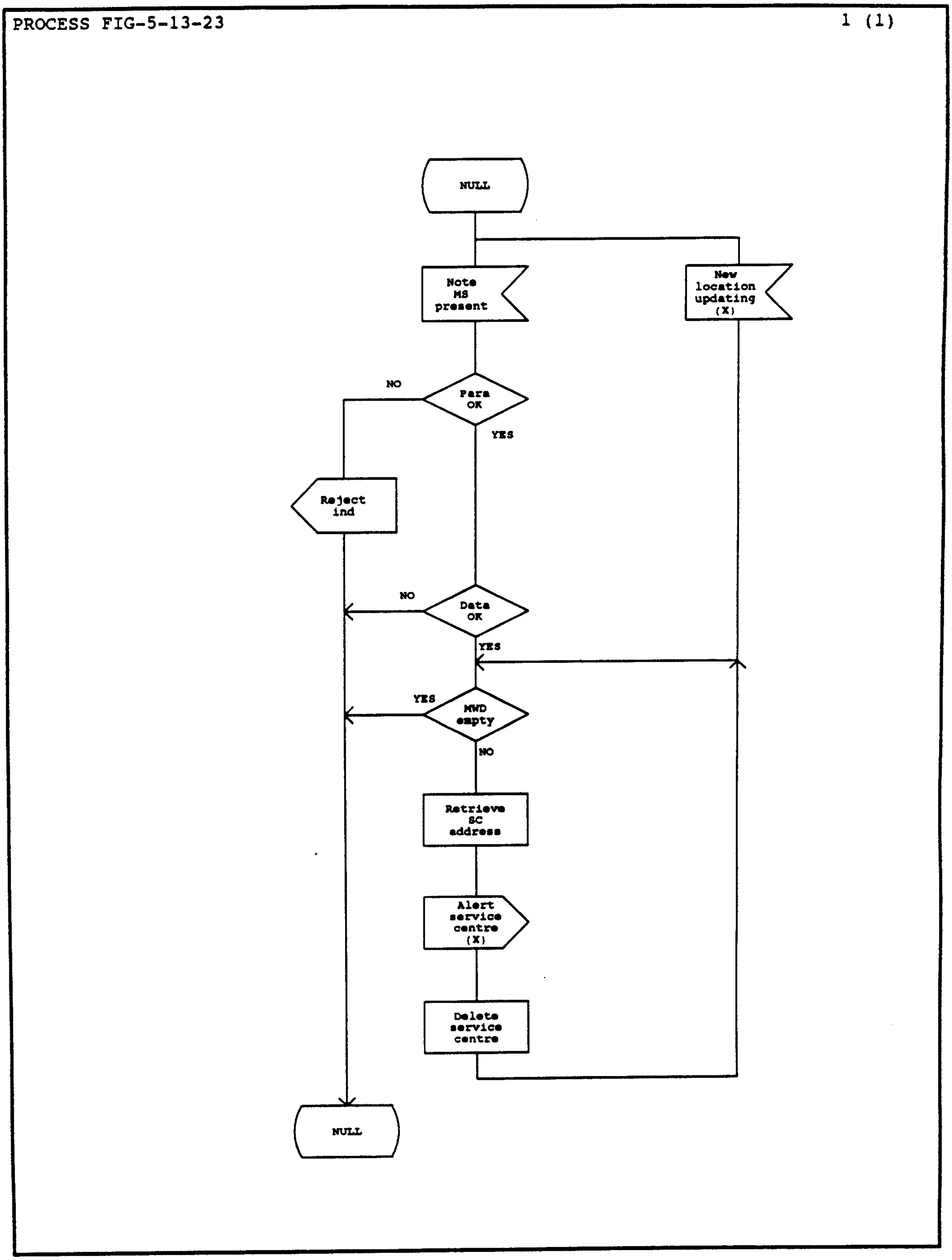
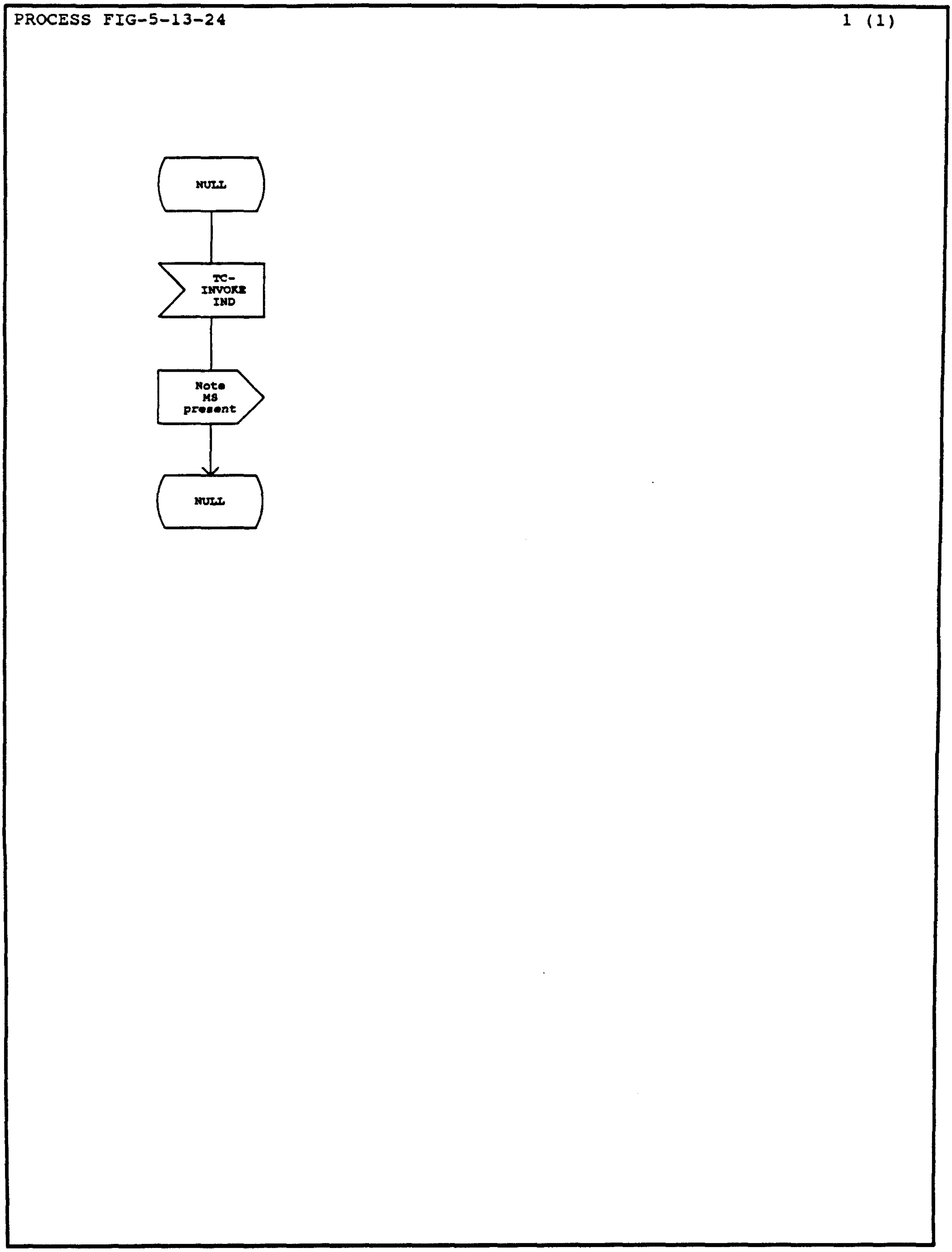


Figure 5.13.24
ASE/TCAP Interface procedures in HLR when receiving an MS-present indication



5.13.5 Procedure for alerting service centre

5.13.5.1 General description of the procedure

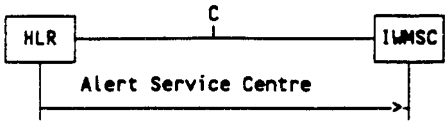


Figure 5.13.25. Procedure for alerting Service Centre.

The procedure is shown in Figure 5.13.25. It is used by an HLR to request an Interworking MSC to inform a Service Centre that a mobile subscriber is again available. It consists of one message: Alert Service Centre sent from the HLR to the IWMSC.

5.13.5.2 Detailed description of the procedure

5.13.5.2.1 Procedure in HLR

The application specific procedure is shown in Figure 5.13.26 and the ASE/TCAP interface procedure is shown in Figure 5.13.27.

The procedure is invoked by the HLR if the MWD contains one or more SC addresses at the following events:

- a note MS present indication is received from a VLR

- an update location procedure has been successfully completed.

An alert Service Centre message is sent for each SC-address contained in the MWD. The message contains the MSIsdn number and the Service Centre address. The MWD entries are deleted when the message is sent. No response is awaited from the IWMSC.

The alert Service Centre message is sent in a TC-INVOKE REQUEST primitive, and TCAP is requested to supervise the procedure by timer T-asc.

5.13.5.2.2 Procedure in IWMSC

The application specific procedure is shown in Figure 5.13.28, and the ASE/TCAP interface procedure is shown in Figure 5.13.29.

When an alert Service Centre message is correctly received by the IWMSC, the IWMSC will forward the alerting to the given Service Centre if possible. No response is given back to the HLR.

The alert Service Centre message is received in a TC-INVOKE INDICATION primitive.

Figure 5.13.26
Application specific procedure in HLR for alerting the Service Center

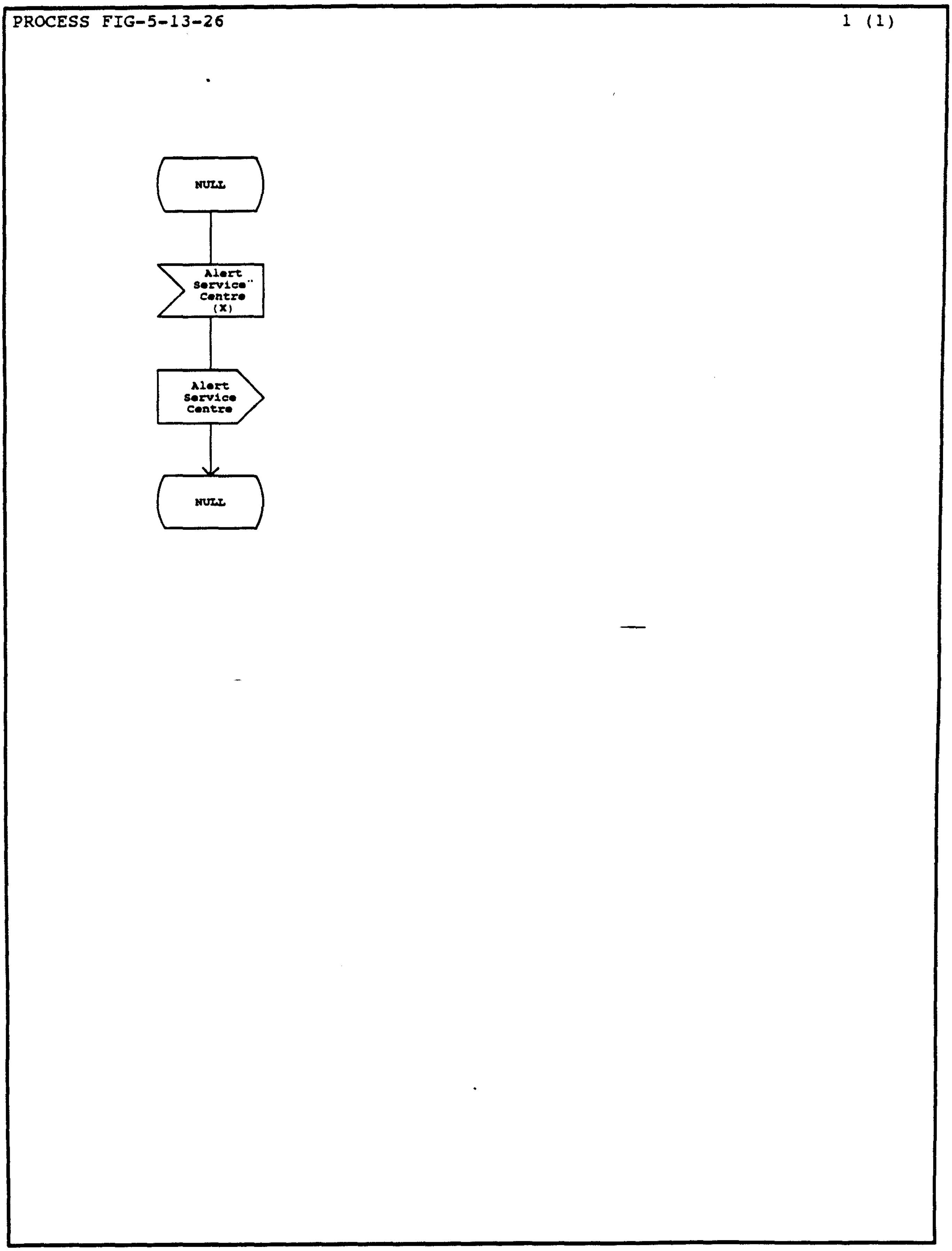


Figure 5.13.27
ASE/TCAP Interface procedure in HLR for alerting the Service Center

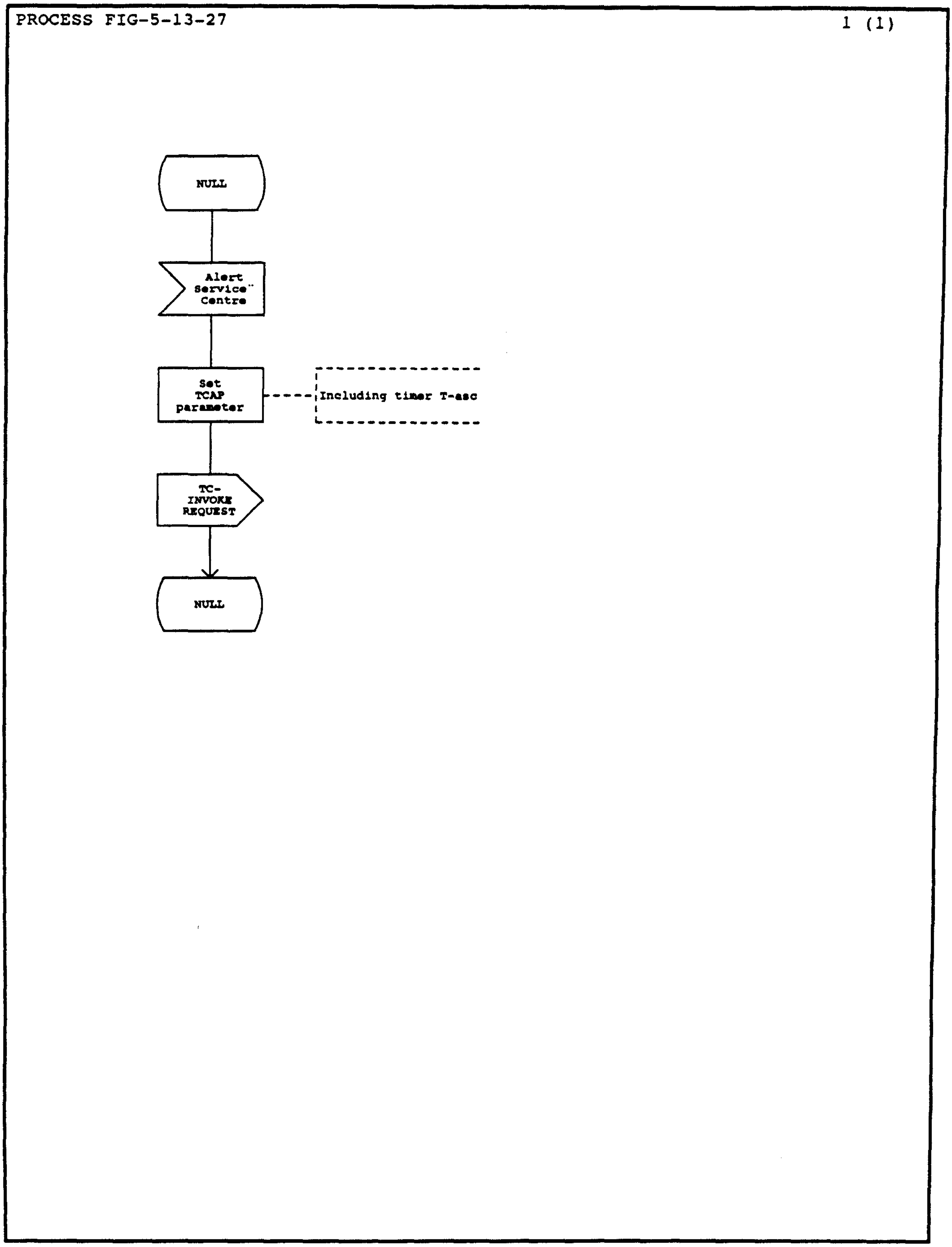


Figure 5.13.28
Application specific procedure in IWMSC for alerting the Service Center

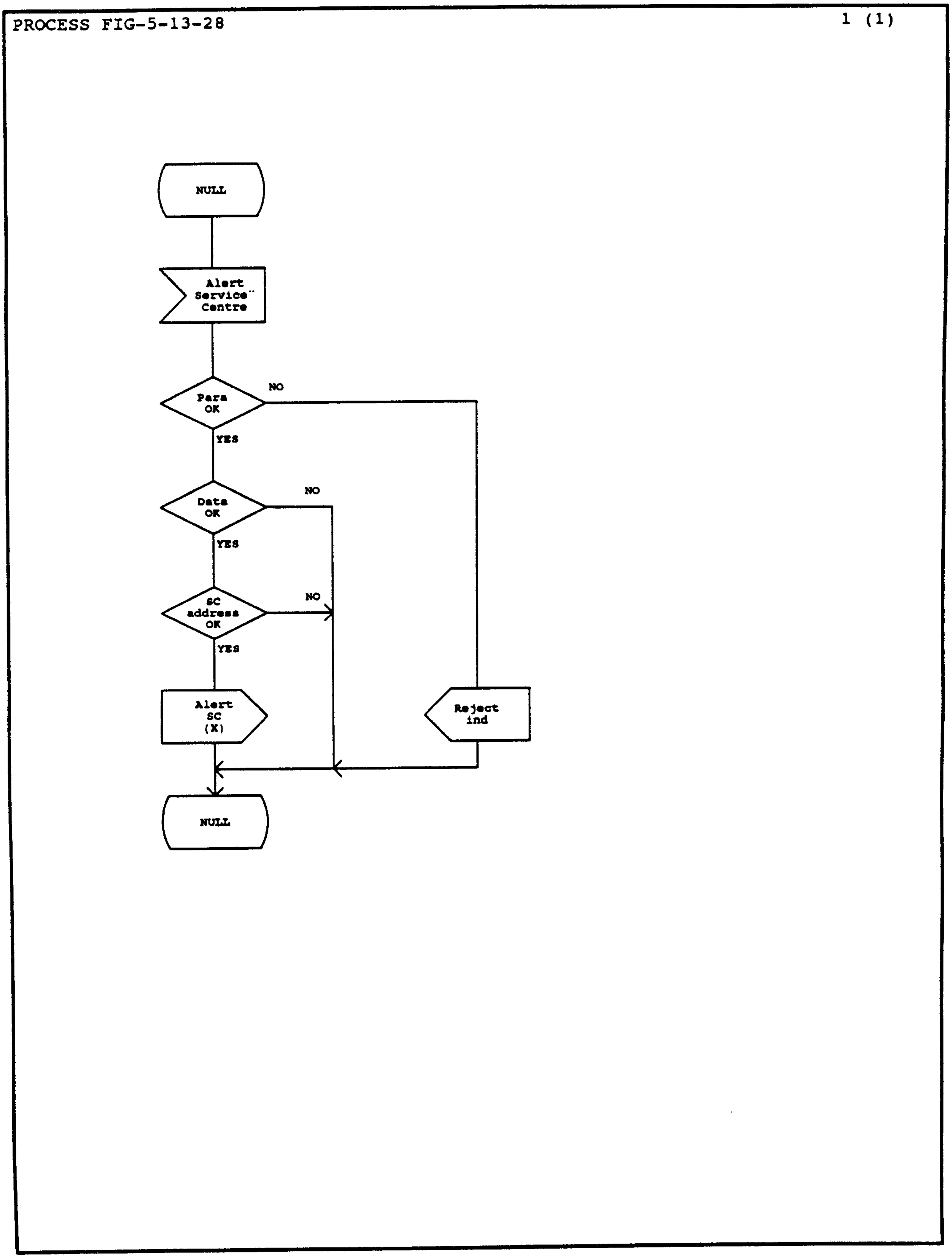
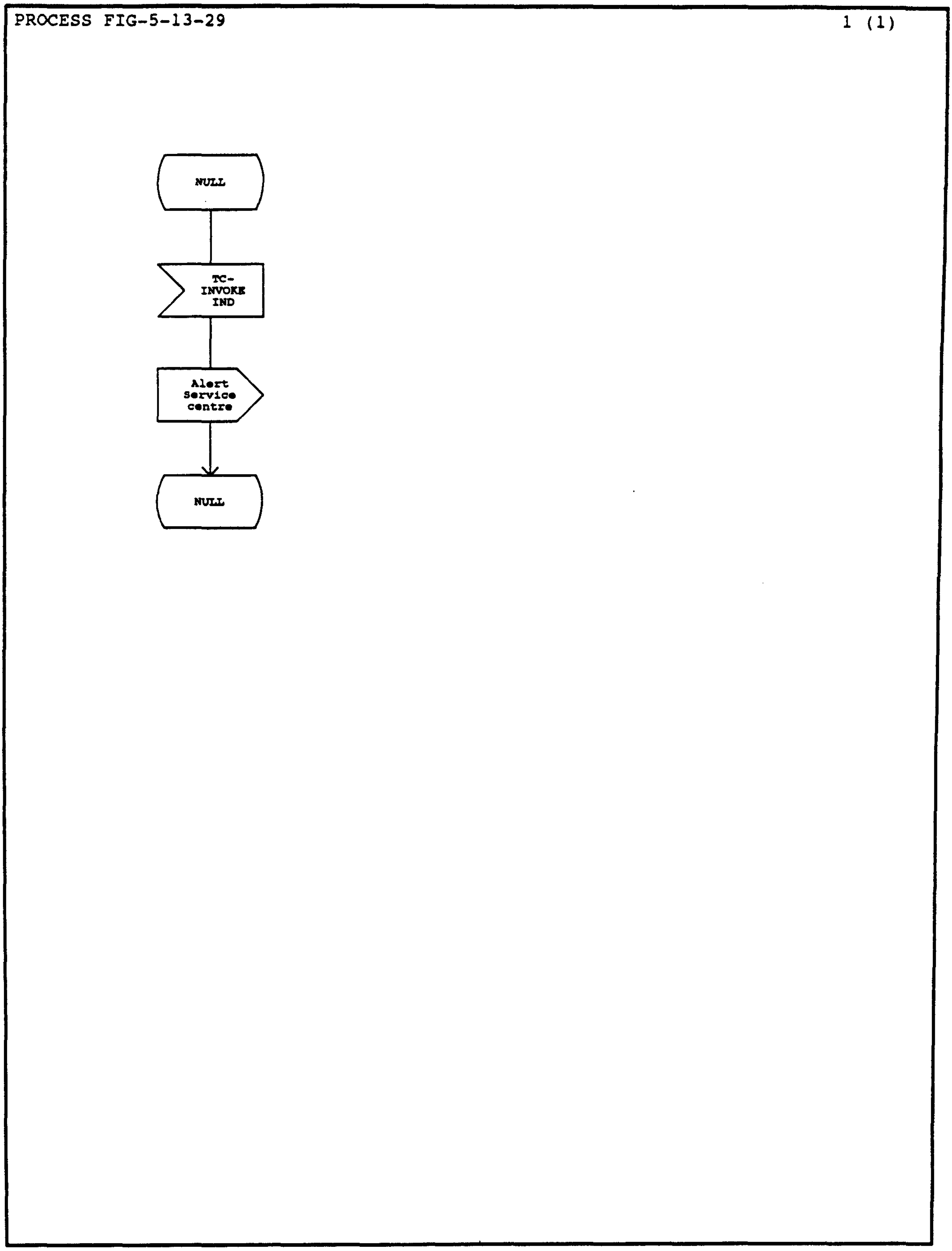


Figure 5.13.29
ASE/TCAP Interface procedure in IWMSC for alerting the Service Center



5.14 Access management procedures

5.14.1 General description of access management procedures

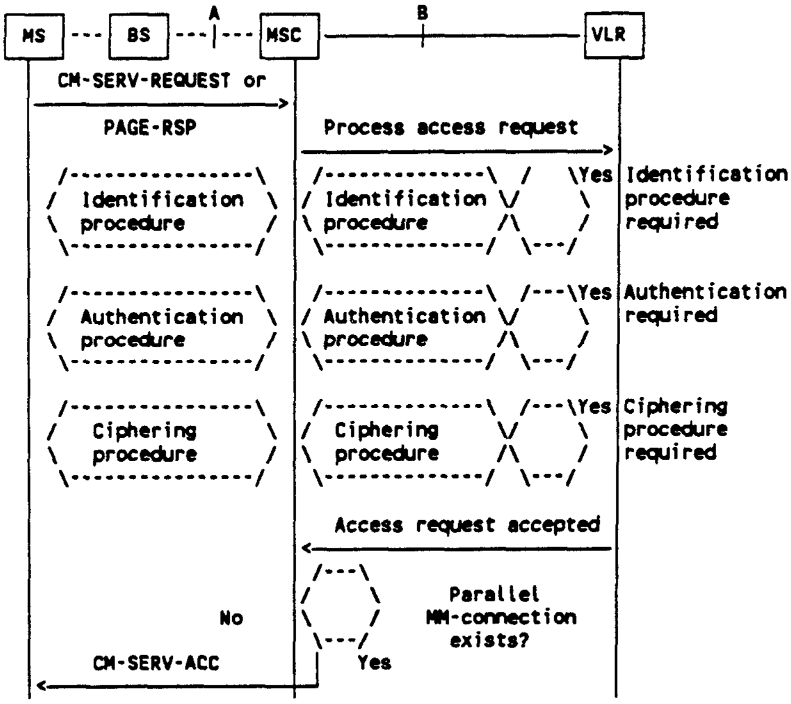


Figure 5.14.1 Interfaces and procedures for processing access management.

The procedure for processing access requests from MSs is shown in Figure 5.14.1. The procedure is initiated by the MS using the CM-SERV-REQ message or the PAGE RESP message on the radio path. The CM-SERV-REQ message contains the nature of request, e g:

- outgoing circuit switched call set-up;
- operation of a supplementary service;
- transmission of a short message.

For an incoming call set-up the nature of request is derived from the PAGE-RESP message.

The service request is sent to the VLR in a process access request message. The message contains the access connection status parameter. The access connection status parameter is set to the following:

- the status of the RR-connection is set to the fixed value "RR-connection established";
- "ciphering mode off" if
  - i) the MM-connection is established on a new RR-connection;
  - ii) the MM-connection is established on an existing RR- connection but ciphering has not been applied;
- "ciphering mode on" if the MM-connection is established on an existing RR-connection for which ciphering has been applied;

- "MM-connection authenticated" if the MM-connection is established on an existing RR-connection and the MS has already been authenticated;

- "MM-connection not authenticated" if:

    i) the MM connection is established on an existing RR-connection but the MS has not been authenticated;

    ii) the MM connection is established on a new RR-connection.

The VLR will use this information in order to determine which additional procedures need to be invoked. These are:

- the identification procedure if the MS identified itself with an unallocated TMSI;

- the authentication procedure if the MS has not been authenticated already and authentication is required for that type of access request. Authentication may also be required in order to establish a common ciphering key in the network and the MS independently of previous authentications, e g if the ciphering key sequence number contained in the process access request message cannot be relied upon or if the method of using ciphering key sequence number is not implemented in the network or if that facility is temporarily out of order;

- ciphering procedure if ciphering is not applied already and ciphering is required for the requested service.

The VLR indicates acceptance of the access request by returning the access request accepted message. This message is sent after successful outcome of the above procedures, if invoked.

When receiving the message, the MSC will

i) send the CM-SERV-ACC message to the MS if a parallel MM-connection exists and the CMServiceType is not Mobile Terminating Call;

ii) not send any message to the MS if this is the first MM-connection or the CMServiceType is Mobile Terminating Call.

Note: The CM-service acceptance is then reported in the ciphering procedure on the radio path.

5.14.2 Detailed description of the procedure in the MSC

The application specific procedure is shown in Figure 5.14.2 and the ASE/TCAP interface procedure is shown in Figure 5.14.3.

When receiving the CM-SERV-REQ or PAGE-RESP (indicated as invoke access request (x)) from the MS, the MSC will send the process access request message to the VLR with the Access Connection Status parameter taking values in accordance with the principles outlined in $ 5.14.1. The MSC will also keep internal variables concerning connection ciphered/connection not ciphered and MS authenticated/MS not authenticated. These are required for handling of parallel MM-connections.

The process access request message is sent in a TC-INVOKE REQUEST primitive and TCAP is requested to supervise the procedure by timer T-prq.

If the MS releases the radio connection before a response has been received from the VLR, the MSC aborts (TC-U-ABORT REQUEST) the dialogue with the VLR.

Other events are:

- expiry of timer T-prq (reported in a TC-L-CANCEL INDICATION primitive), receipt of a reject indication (TC-(U-) REJECT INDICATION) or abortion of the dialogue (TC-ABORT INDICATION). In these cases the procedure is terminated and a system failure indication is provided to the radio interface;

- receipt of the system failure, unknown subscriber, or unexpected data value message. The system failure indication is provided to the radio interface;

- receipt of the illegal subscriber message. The illegal subscriber indication is provided to the radio interface;

- receipt of the unidentified subscriber message. The unknown MS indication is provided to the radio interface;

- receipt of the access request accepted message. If the message contains parameter errors, the system failure (X) signal is provided to the radio interface. If the message is received without errors, the MSC sends the CM-SERV-ACC signal to the radio interface if a parallel MM connection exists on the radio interface and CMServiceType is not Mobile Terminating Call.

The messages system failure, unknown subscriber, unexpected data value, illegal MS and unidentified subscriber are received in TC-U-ERROR INDICATION primitives.

The access request accepted message is received in a TC-RESULT-L INDICATION primitive.

5.14.3 Detailed description of the procedure in the VLR

The application specific procedure is shown in Figure 5.14.4 and the ASE/TCAP interface procedure is shown in Figure 5.14.5.

When receiving a process access request message, the VLR acts as follows:

- if the message contains parameter or data errors, a reject indication or an unexpected data value message is returned to the MSC;

- if the MS identifies itself by an IMSI which is not known in the VLR, the unidentified subscriber message is returned;

- if the MS identifies itself with an unallocated TMSI, the VLR may either return the unidentified subscriber message or request open identification of the MS. In the latter case, any failure of that procedure is reported to the MSC by using the system failure message. If the received IMSI is unknown in the VLR, the unidentified subscriber message is sent to the MSC;

- if the MS is known in the VLR and the IMSI detached flag is set, the IMSI detached flag is removed;

- the VLR may initiate authentication based on the criteria given in $ 5.14.1. Any failure of the authentication procedure, except illegal subscriber and unknown subscriber, is reported to the MSC in a system failure message. If the outcome of the authentication procedure indicates illegal subscriber, the VLR will return the illegal MS message if the authentication was based on knowledge of the IMSI. If it was based on the TMSI, the VLR may decide to request open identification of the MS and then perform a new authentication procedure. An unknown subscriber indication is sent as an unknown subscriber message to the MSC;

- if the MS passes the authentication procedure, or that procedure was not performed, the VLR will decide if the ciphering procedure is to be initiated based on the criteria given in $ 5.14.1;

- the VLR will then set the radio confirmed indicator to true, indicate to the application that the MS is present (see 5.13 for how this indication is used for the short message service, 5.4 for how it is used for Mobile Terminating Calls) and return the access request accepted message to the MSC.

The VLR may also decide to reallocate the TMSI. If so, this procedure should use the same dialogue as the one used for the access management procedure.

The process access request message is received in a TC-INVOKE INDICATION primitive. The access request accepted message is sent in a TC-RESULT-L REQUEST primitive.

The messages system failure, unknown subscriber, data missing, unexpected data value, illegal subscriber and unidentified subscriber are sent in TC-U-ERROR REQUEST primitives. A reject indication is sent in a TC-U-REJECT REQUEST primitive.

Figure 5.14.2 (sheet 1 of 2)
Application specific procedure in MSC for access management.

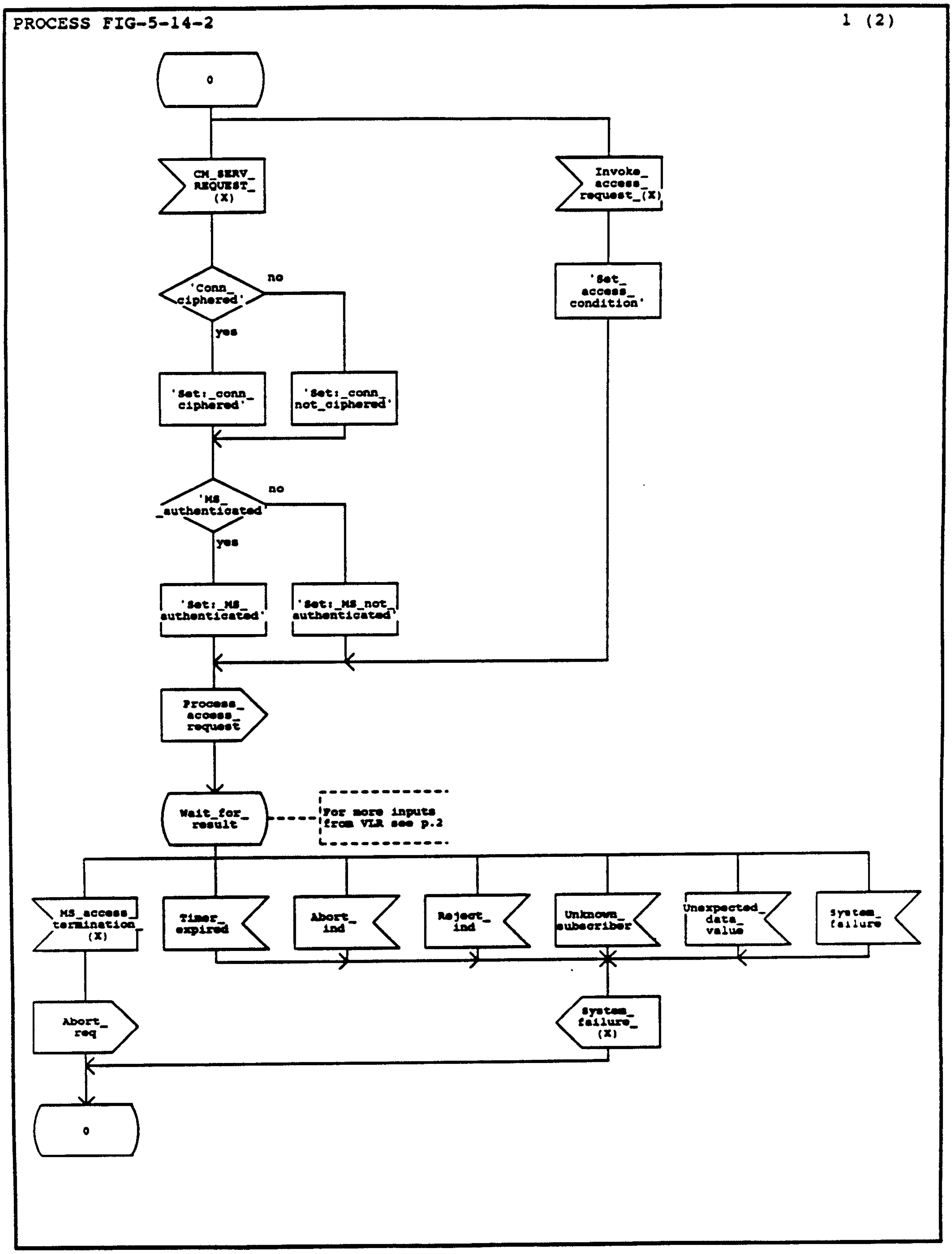


Figure 5.14.2 (sheet 2 of 2)
Application specific procedure in MSC for access management.

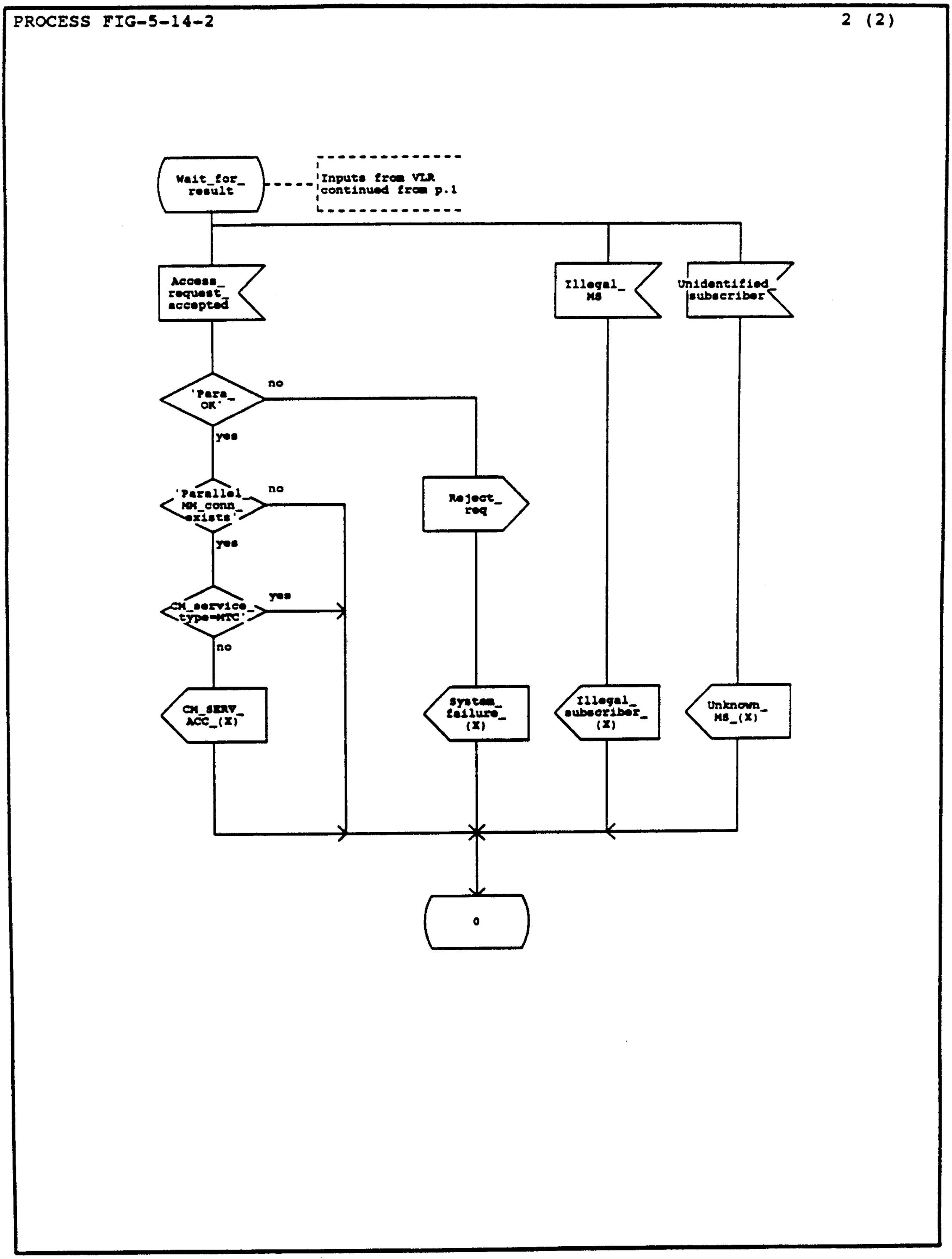


Figure 5.14.3
ASE/TCAP interface procedure in MSC for access management.

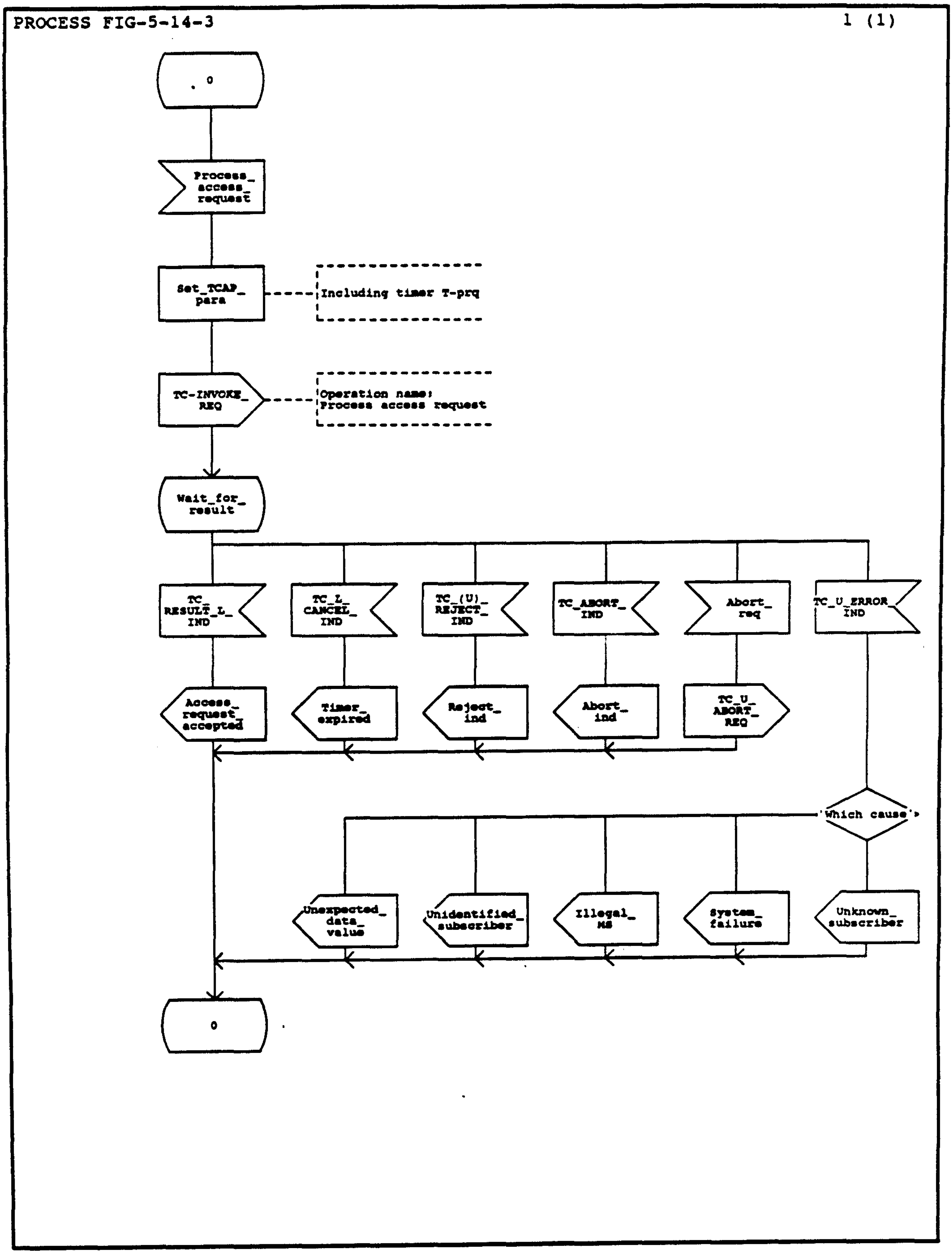


Figure 5.14.4 (sheet 1 of 3)
Application specific procedure in VLR for access management.

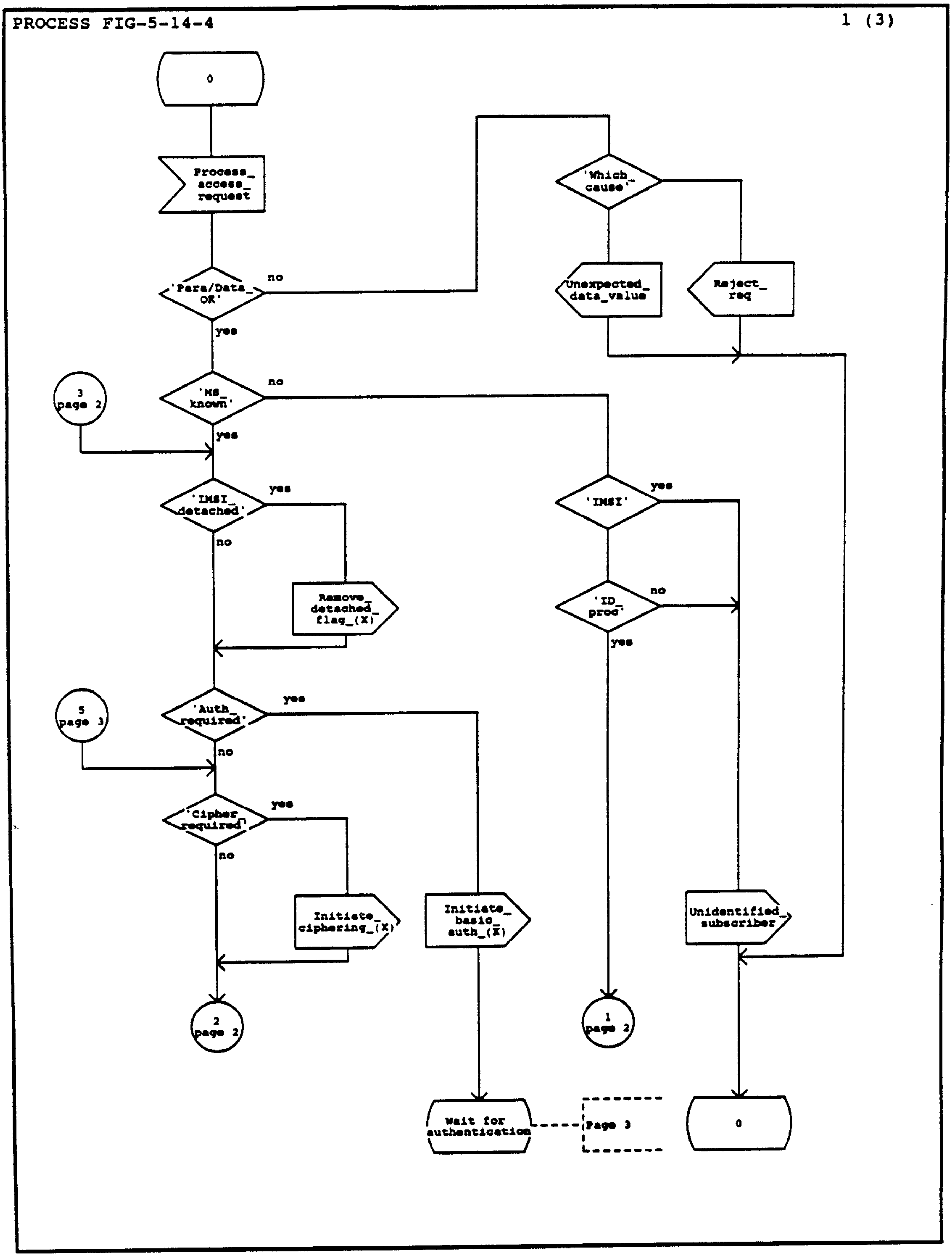


Figure 5.14.4 (sheet 2 of 3)
Application specific procedure in VLR for access management.

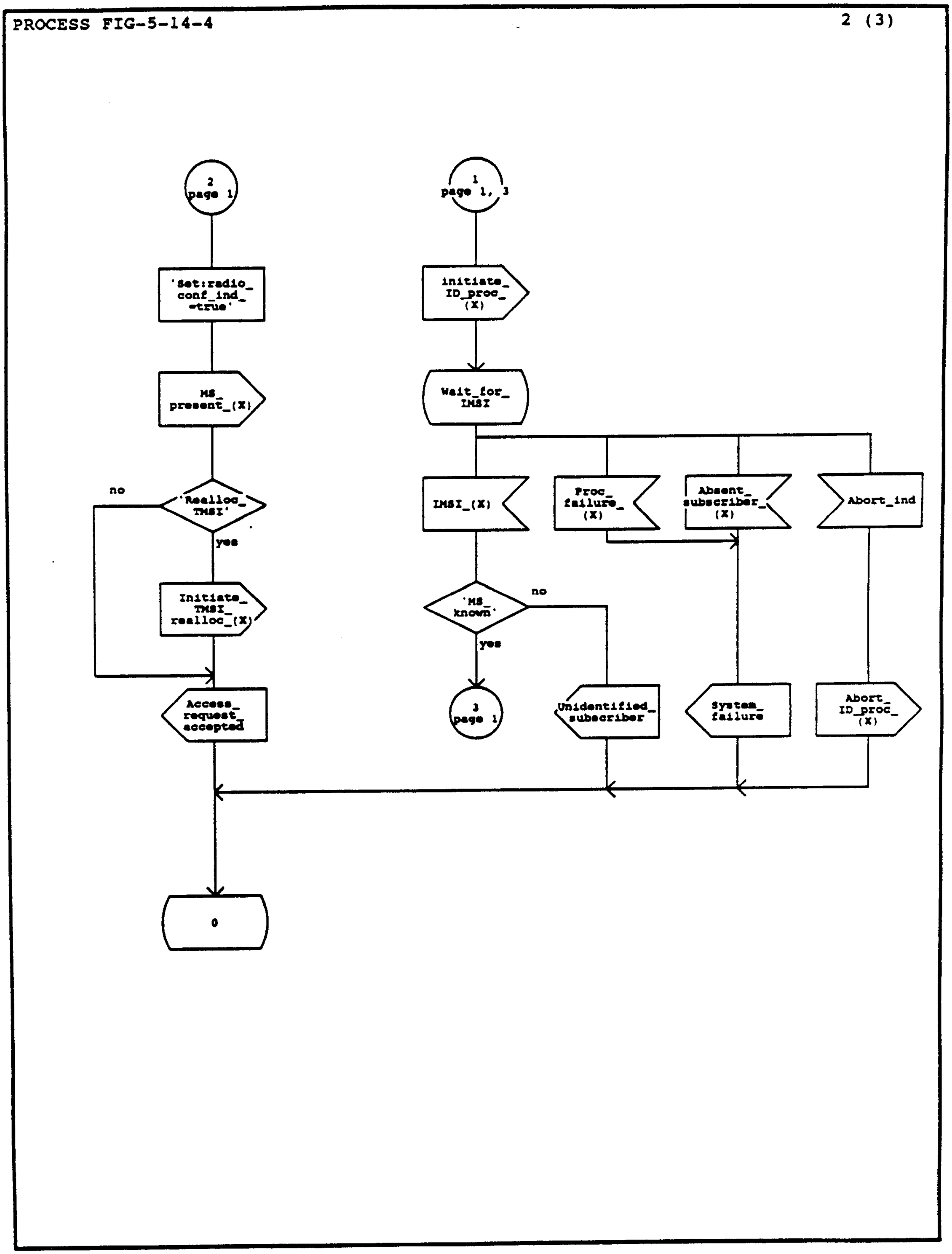


Figure 5.14.4 (sheet 3 of 3)
Application specific procedure in VLR for access management.

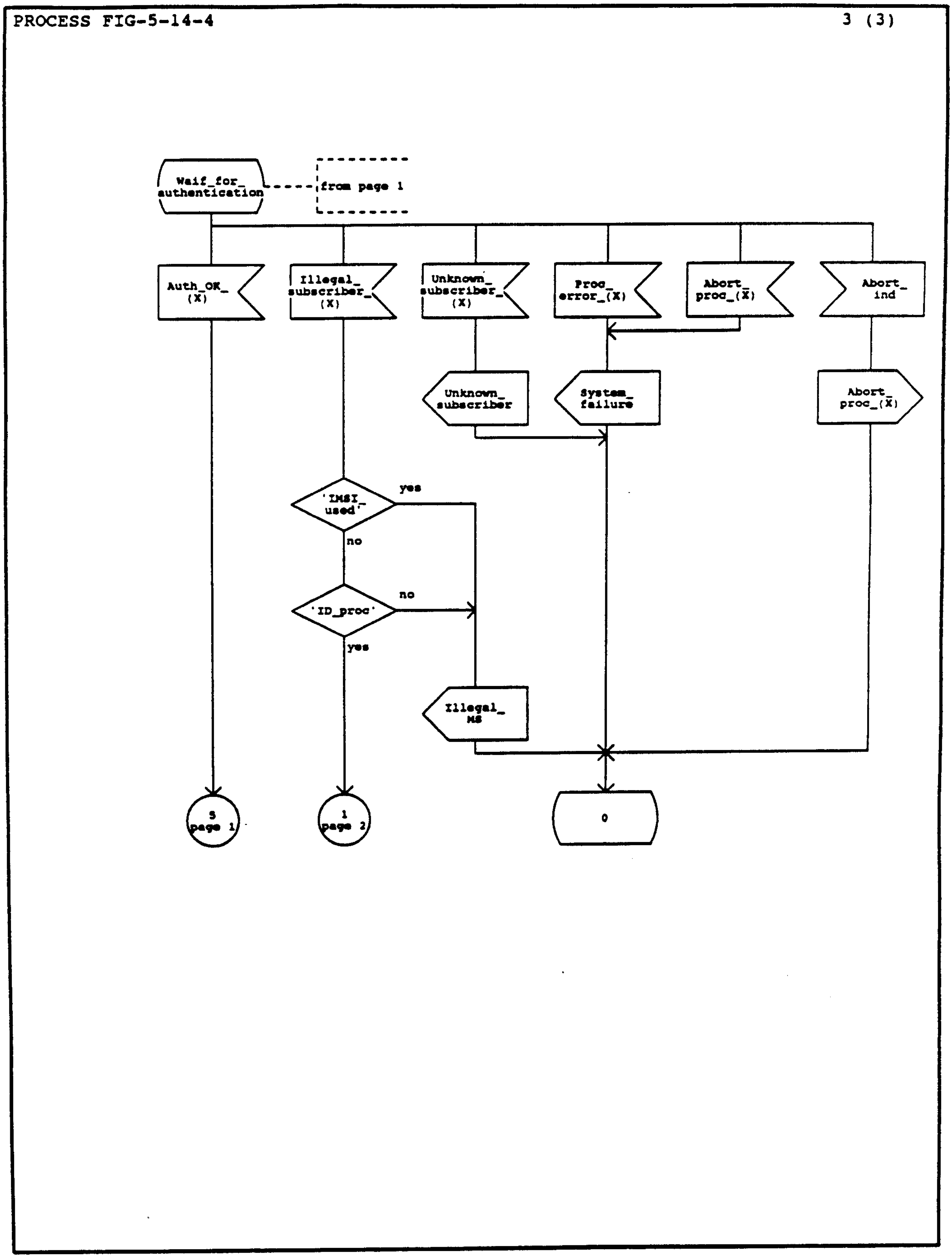
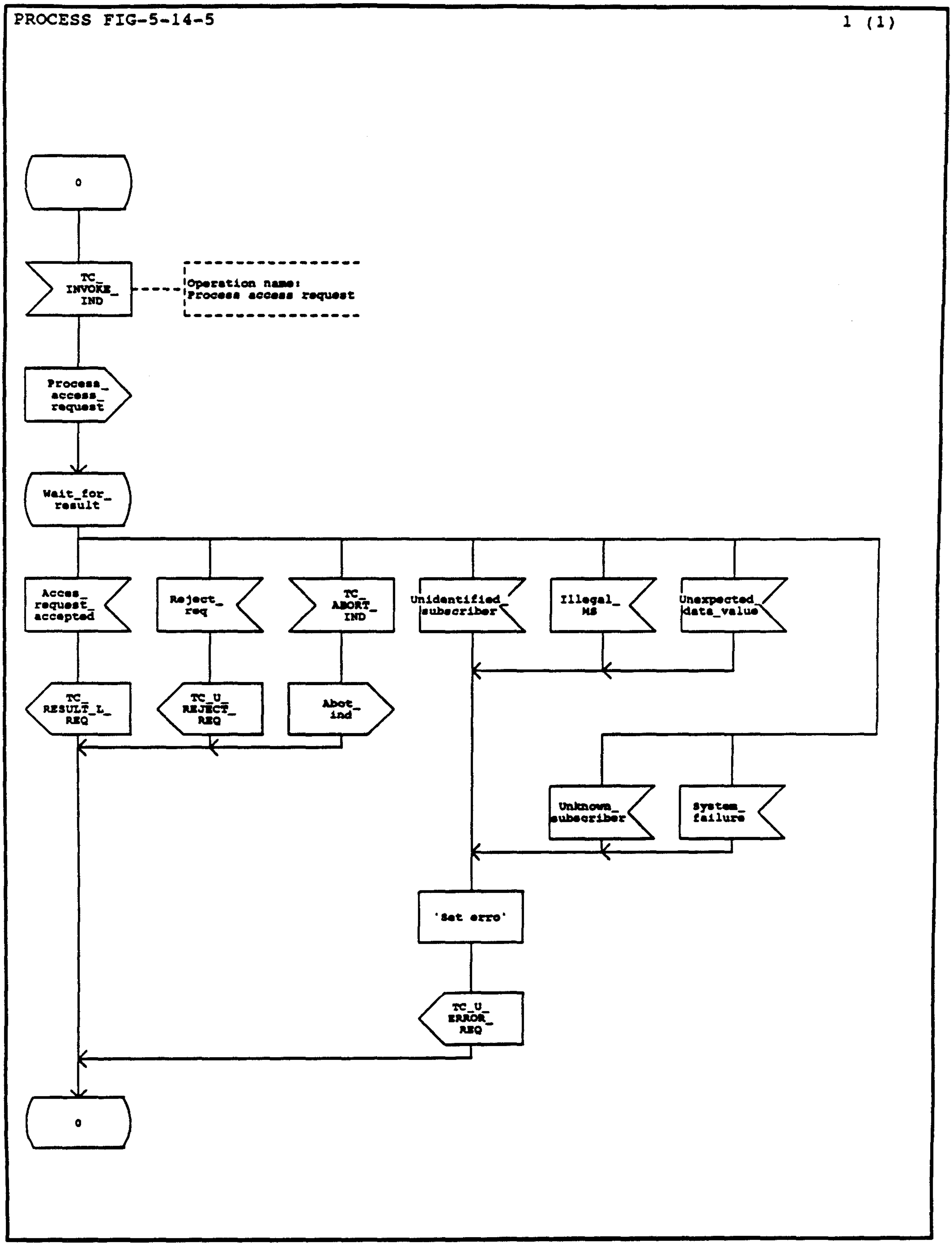


Figure 5.14.5
ASE/TCAP interface procedure in VLR for access management.



5.15 Search and paging procedures

5.15.1 General description of search and paging procedures

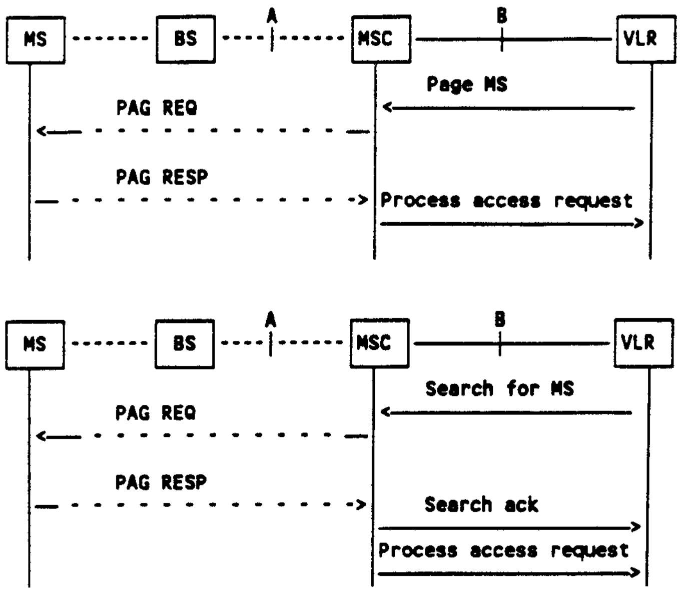


Figure 5.15.1 Interface and procedures for searching and paging.

The procedures for paging and searching are shown in Figure 5.15.1. The page MS procedure is used when the VLR is not in a restoration mode and there is an incoming call for an MS.

The search for MS procedure is used for incoming calls when the VLR is in a restoration phase.

For further details concerning the use of the page MS and search for MS procedures for incoming call set-up, see 5.4.

When an MS is to be paged, the VLR sends the page MS or search for MS message to the MSC. If paging is required on the radio path (see 5.15.3 for details), the message PAG-REQ is sent to the MS. The MS responds by a PAG-RESP message and the MSC invokes the process access management procedure (see 5.15.3 for details).

If the search for MS was sent, the VLR will also receive the search acknowledge message indicating the LAI of the area in which the MS responded.

5.15.2 Detailed description of the procedures in the VLR

5.15.2.1 Paging procedure

The application specific procedure is shown in Figure 5.15.2. and the ASE/TCAP interface procedure is shown in Figure 5.15.3.

If the VLR is not in a restoration phase, the VLR will send the page MS message to the MSC.

If the MS is successfully paged, the access request management procedure is initiated.

If a reject indication, an unexpected data value message,a system failure message or an unknown location area message is received, the system failure indica- tion is given to the call handling process.

If an absent subscriber message or a busy subscriber message is received, the same indication is given to the call handling process.

Expiry of timer T-pa is taken as successful termination of the procedure.

The application in the VLR may also abort the procedure, e g if an associated procedure is aborted. The procedure may also be aborted by TCAP or by the MSC.

The treatment of successful and unsuccessful events by the call handling process is given in 5.4.

The page MS message is sent in a TC-INVOKE REQUEST primitive.

TCAP is requested to supervise the procedures by timer T-pa.

A TC-L-CANCEL INDICATION primitive reports timer expiry (T-pa) and a reject condition is reported in a TC-(U-)REJECT INDICATION primitive.

The messages system failure, busy subscriber, absent subscriber, unknown location area, and unexpected data value are received in TC-U-ERROR INDICATION primitives.

An abort condition is sent in a TC-U-ABORT REQUEST primitive.

5.15.2.2 Search procedure

The application specific procedure is shown in Figure 5.15.4 and the ASE/TCAP interface procedure is shown in Figure 5.15.5.

If the VLR is in a restoration phase, the VLR will send the search for MS message to the MSC.

If the MS is successfully paged, the VLR will receive the search for MS message from the MSC. This message will contain the LAI of the area in which the MS responded. Subsequently, the access management procedure will be invoked by the MSC.

If the acknowledgement message is received with parameter errors, a system failure indication is provided to the call handling process.

If a reject indication, a timer expiry indication (T-sms), an unexpected data value message,or a system failure message is received, the system failure indication is given to the call handling process.

If an absent subscriber message or a busy subscriber message is received, the same indication is given to the call handling process.

The application in the VLR may also abort the procedure, e g if an associated procedure is aborted. The procedure may also be aborted by TCAP or by the MSC.

The treatment of successful and unsuccessful events by the call handling process is given in 5.4.

The search for MS message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedures by timer T-sms.

The search acknowledge message is received in a TC-RESULT-L INDICATION primitive. A TC-L-CANCEL INDICATION primitive reports timer expiry (T-sms) and a reject condition is reported in a TC-(U-)REJECT INDICATION primitive.

The messages system failure, busy subscriber, absent subscriber,and unexpected data value are received in TC-U-ERROR INDICATION primitives.

An abort condition is sent in a TC-U-ABORT REQUEST primitive.

5.15.3 Detailed description of the procedures in the MSC

5.15.3.1 Paging procedure

The application specific procedure is shown in Figure 5.15.6 and the ASE/TCAP interface procedure is shown in Figure 5.15.7.

When receiving a page MS message the MSC will:

- if there are parameter errors in the received message, return a reject indication to the VLR and send a call failure indication to the call handling function;

- if there are data errors, return an unexpected data value message to the VLR and send a call failure indication to the call handling function;

- if the location area identity contained in the page MS message is not allocated to any location area of the MSC, the MSC will return the unknown location area message to the VLR and send a call failure indication to the call handling function;

- if there is no call associated with the received page MS message, a system failure message is returned to the VLR.

Note: This may correspond to the case where the incoming call has been released but where the dialogue with the VLR for that call has not been aborted.

If the call exists in the call handling process and there is no existing RR-connection with the called MS, the MSC will request paging to be performed on the radio path.

If the MS responds, the MSC will report successful paging and establishment of an RR-connection as follows:

- set the access connection status parameter to:

    - "no RR-connection" indicating that the RR-connection did not exist when the page MS message was received,

    - "not authenticated"

    - "ciphering mode off"

- invoke the process access request procedure.

If the MS does not respond, the absent subscriber message is returned to the VLR. If the incoming call is released by the calling subscriber or by the network, the dialogue with the VLR is aborted. If the dialogue with the VLR is aborted by the VLR or by TCAP, a call failure indication is given to the call handling function.

If an RR-connection already exists to the called MS when the page MS message is received and the call is forwarding of a short message, the MSC will:

- set the access connection status parameter to:

  - "RR-connection established" indicating that there was an RR-connection to the called MS at receipt of the page MS message,
  - "cipher mode on"/"cipher mode off" depending upon whether or not the existing RR-connection is ciphered,
  - "authenticated"/"not authenticated" depending upon whether or not the MS was authenticated when the existing RR-connection was established;

- invoke the process access request procedure.

If an RR-connection already exists to the called MS when the page MS message is received and the call is not related to forwarding of a short message, the MSC will:

- if the busy condition can be established by the MSC, return the busy subscriber message to the VLR;
- if the busy condition cannot be established by the MSC, invoke the process access request procedure with the access connection status parameter set to:
  - "RR-connection established"
  - "cipher mode on"/"cipher mode off" depending upon whether or not the existing RR-connection is ciphered,
  - "authenticated"/"not authenticated" depending upon whether or not the MS was authenticated when the existing connection was established.

The page MS message is received in a TC-INVOKE INDICATION primitive.

A reject condition is sent in a TC-U-REJECT REQUEST primitive, an abort condition is sent in a TC-U-ABORT REQUEST primitive and the messages absent subscriber, unknown location area, system failure, busy subscriber and unexpected data value are sent in a TC-U-ERROR REQUEST primitive.

5.15.3.2 Search procedure

The application specific procedure is shown in Figure 5.15.8 and the ASE/TCAP interface procedure is shown in Figure 5.15.9.

When receiving a search for MS message the MSC will:

- if there are parameter errors in the received message, return a reject indication to the VLR and send a call failure indication to the call handling function;
- if there are data errors, return an unexpected data value message to the VLR and send a call failure indication to the call handling function;
- if there is no call associated with the received search for MS message, a system failure message is returned to the VLR.

Note: This may correspond to the case where the incoming call has been released but where the dialogue with the VLR for that call has not been aborted.

If the call exists in the call handling process and there is no existing RR-connection with the called MS, the MSC will request searching to be performed on the radio path, using the LAI supplied in the 'Search for MS' message. If the LAI is null, the MSC will page all areas.

If the MS responds, the MSC will report successful paging and establishment of an RR-connection as follows:

- set the access connection status parameter to:
  - "no RR-connection" indicating that the RR-connection did not exist when the search for MS message was received,
  - "not authenticated"
  - "ciphering mode off"
- return the search acknowledge message with the LAI of the area in which the MS responded;
- invoke the process access request procedure.

If the MS does not respond, the absent subscriber message is returned to the VLR. If the incoming call is released by the calling subscriber or by the network, the dialogue with the VLR is aborted. If the dialogue with the VLR is aborted by the VLR or by TCAP, a call failure indication is given to the call handling function.

If an RR-connection already exists to the called MS when the search for MS message is received and the call is forwarding of a short message, the MSC will:

- set the access connection status parameter to:
  - "RR-connection established" indicating that there was an RR-connection to the called MS at receipt of the search for MS message,
  - "cipher mode on"/"cipher mode off" depending upon whether or not the existing RR-connection is ciphered,
  - "authenticated"/"not authenticated" depending upon whether or not the MS was authenticated when the existing RR-connection was established;
- return the search acknowledge message with the LAI included to the VLR;
- invoke the process access request procedure.

If an RR-connection already exists to the called MS when the search for MS message is received and the call is not related to forwarding of a short message, the MSC will:

- if the busy condition can be established by the MSC, return the busy subscriber message to the VLR;
- if the busy condition cannot be established by the MSC, return the search acknowledge message with the LAI included;
- set the access connection status parameter to:
  - "RR-connection established"

- "cipher mode on"/"cipher mode off" depending upon whether or not the existing RR-connection is ciphered,
- "authenticated"/"not authenticated" depending upon whether or not the MS was authenticated when the existing connection was established;

- invoke the process access request procedure.

The search for MS message is received in a TC-INVOKE INDICATION primitive and the search acknowledge message is returned in a TC-RESULT-L REQUEST primitive..

A reject condition is sent in a TC-U-REJECT REQUEST primitive, an abort condition is sent in a TC-U-ABORT REQUEST primitive and the messages absent subscriber, system failure, busy subscriberand unexpected data value are sent in a TC-U-ERROR REQUEST primitive.

Figure 5.15.2 (sheet 1 of 2)
Application specific procedure in VLR for page MS.

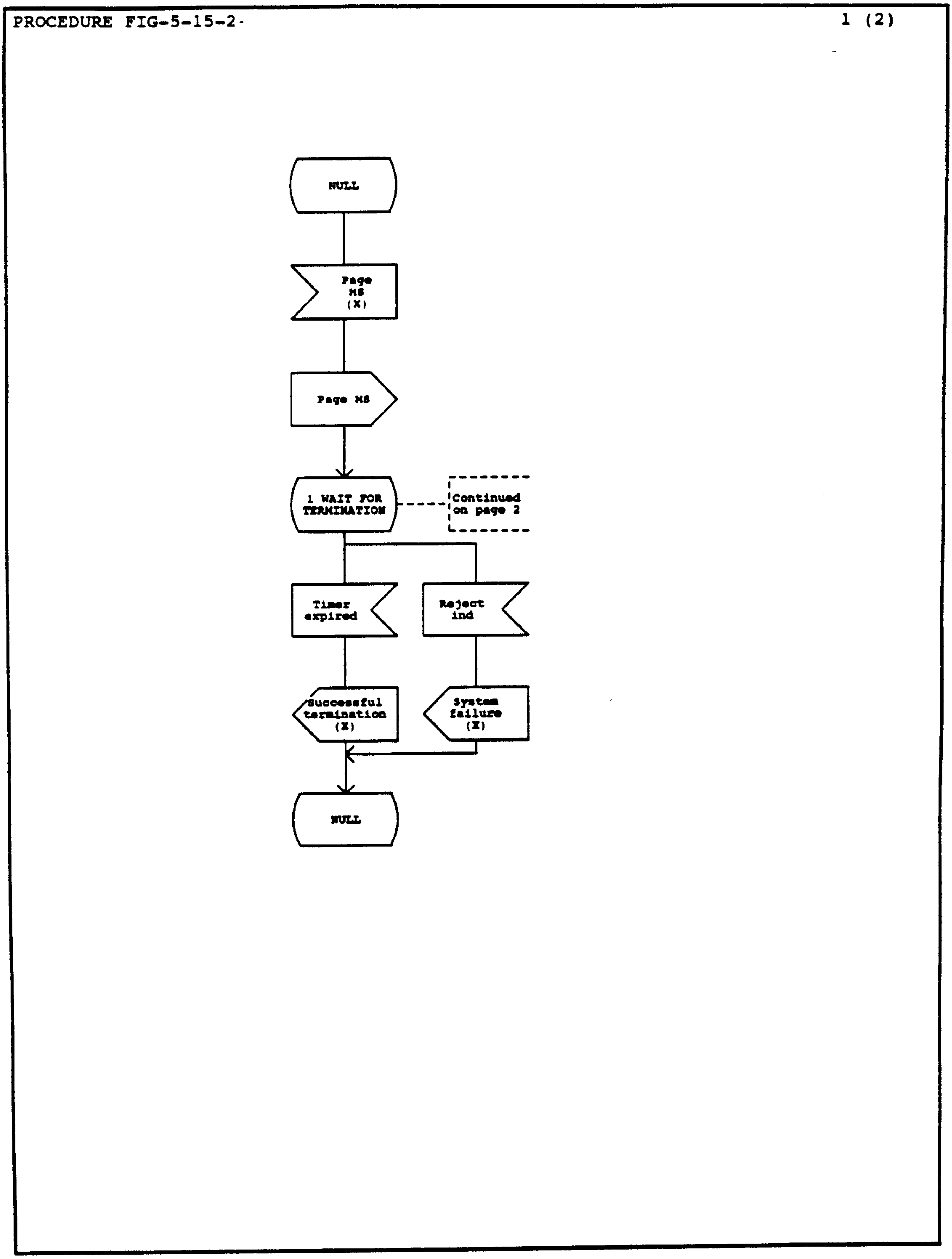


Figure 5.15.2 (sheet 2 of 2)
Application specific procedure in VLR for page MS.

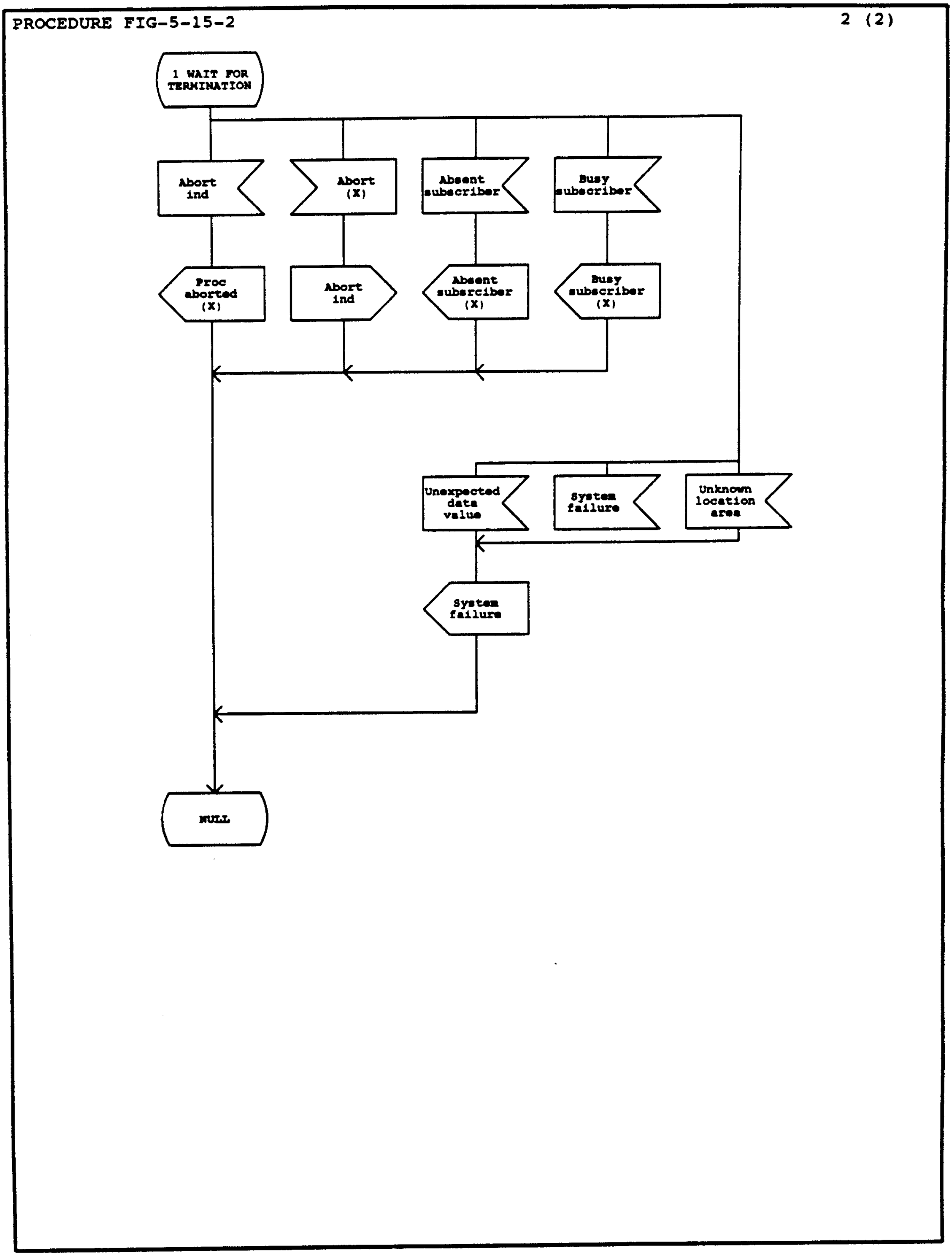


Figure 5.15.3 (sheet 1 of 2)
ASE/TCAP interface procedure in VLR for page MS.

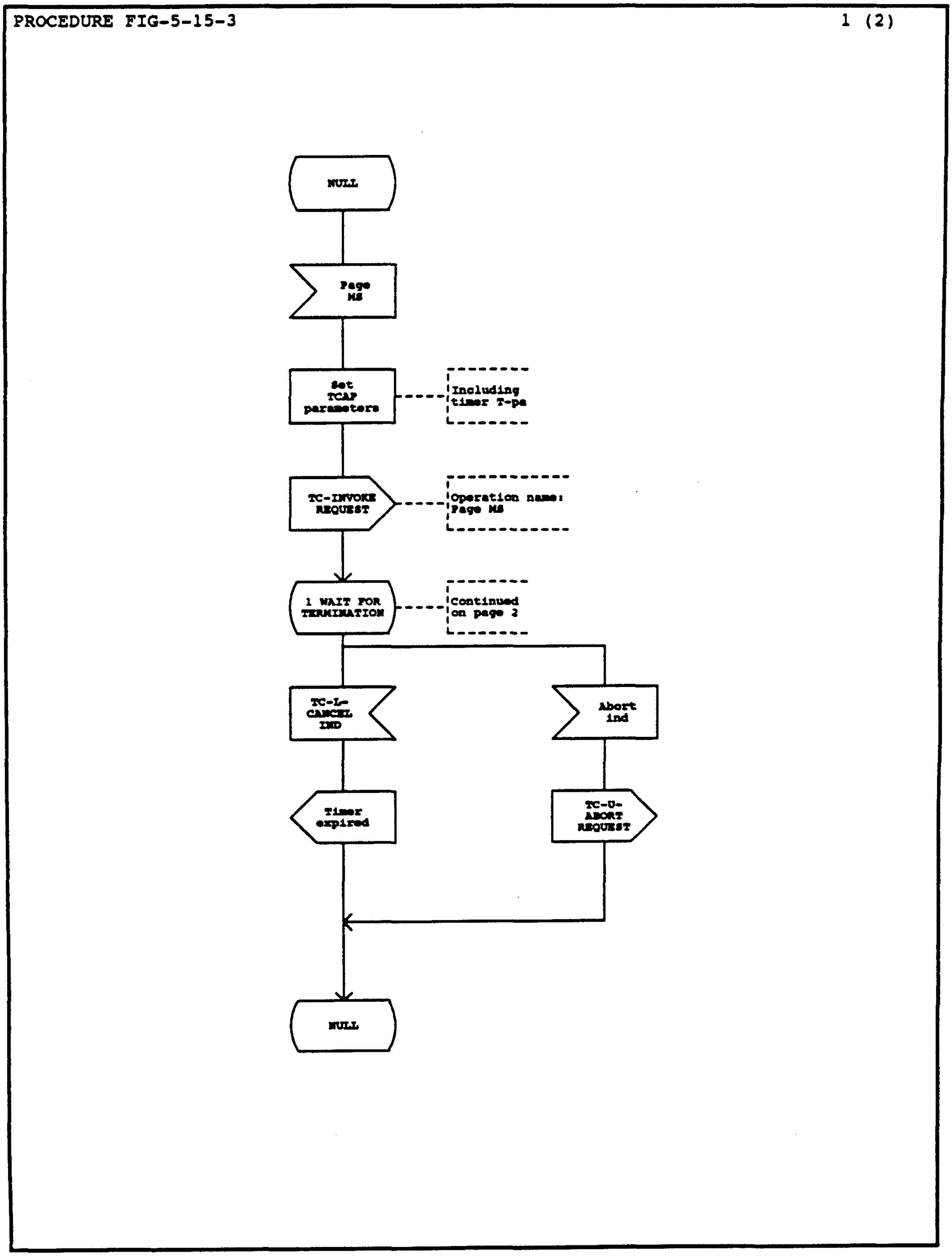


Figure 5.15.3 (sheet 2 of 2)
ASE/TCAP interface procedure in VLR for page MS.

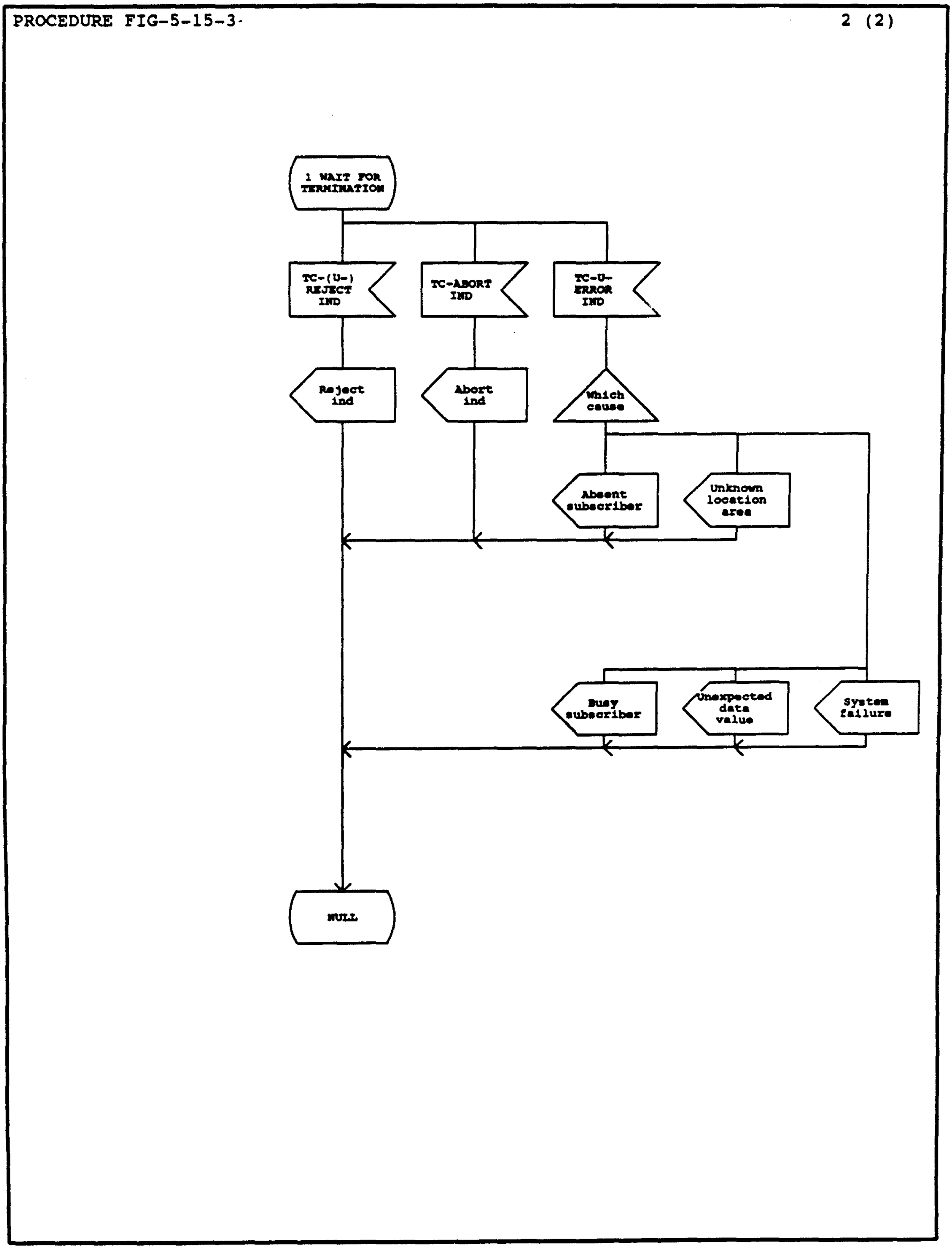


Figure 5.15.4 (sheet 1 of 2)
Application specific procedure in VLR for search for MS.

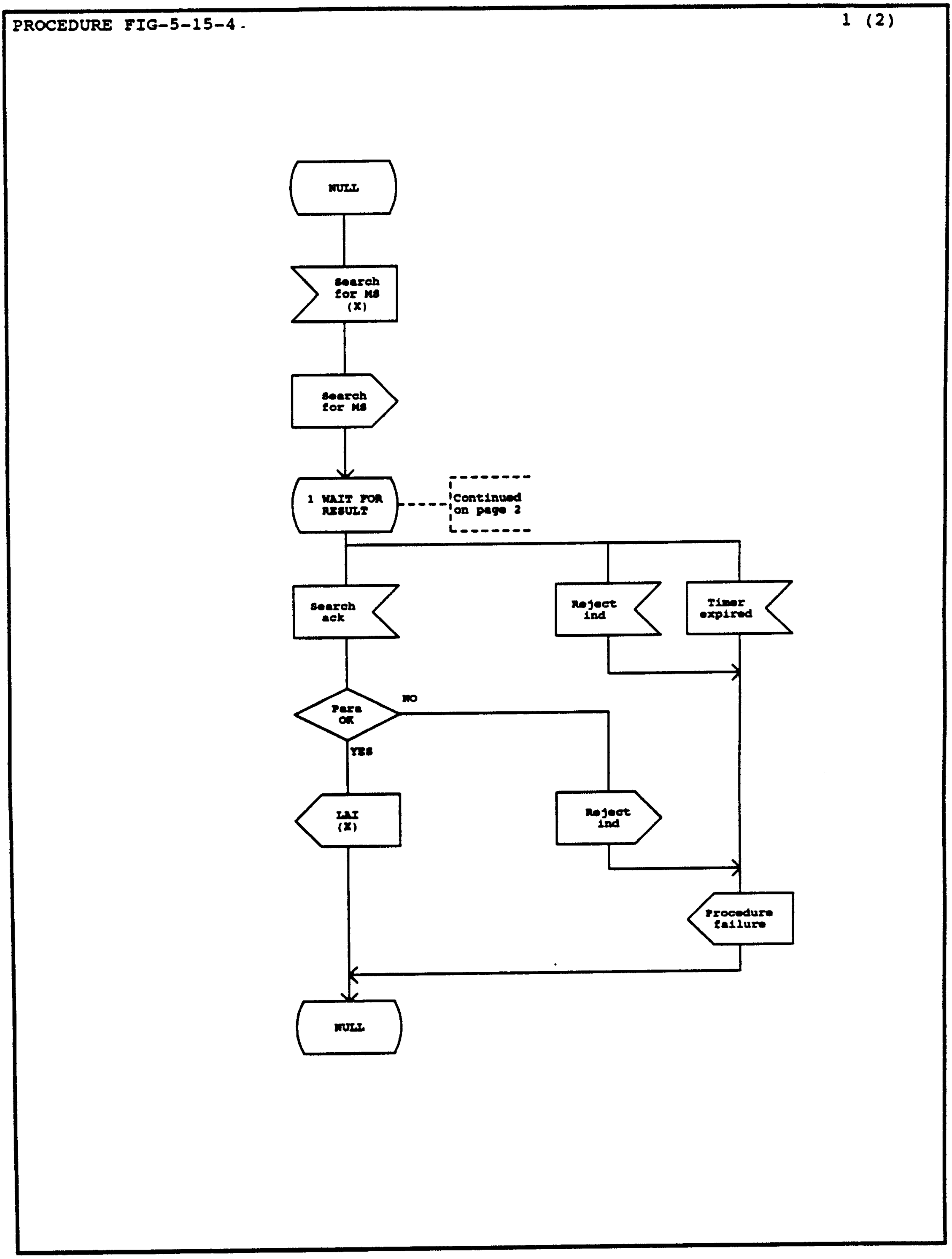


Figure 5.15.4 (sheet 2 of 2)
Application specific procedure in VLR for search for MS.

PROCEDURE FIG-5-15-4 2 (2)

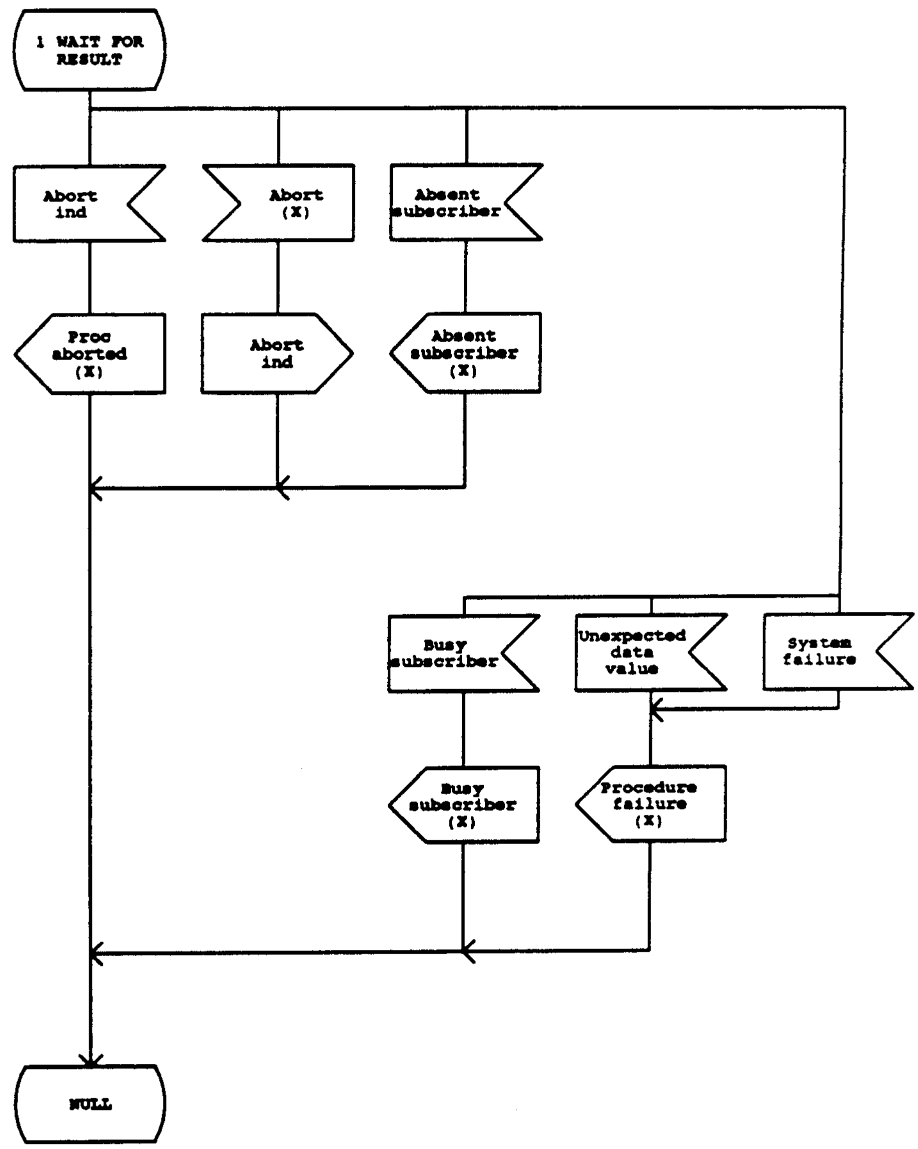


Figure 5.15.5 (sheet 1 of 2)
ASE/TCAP interface procedure in VLR for search for MS.

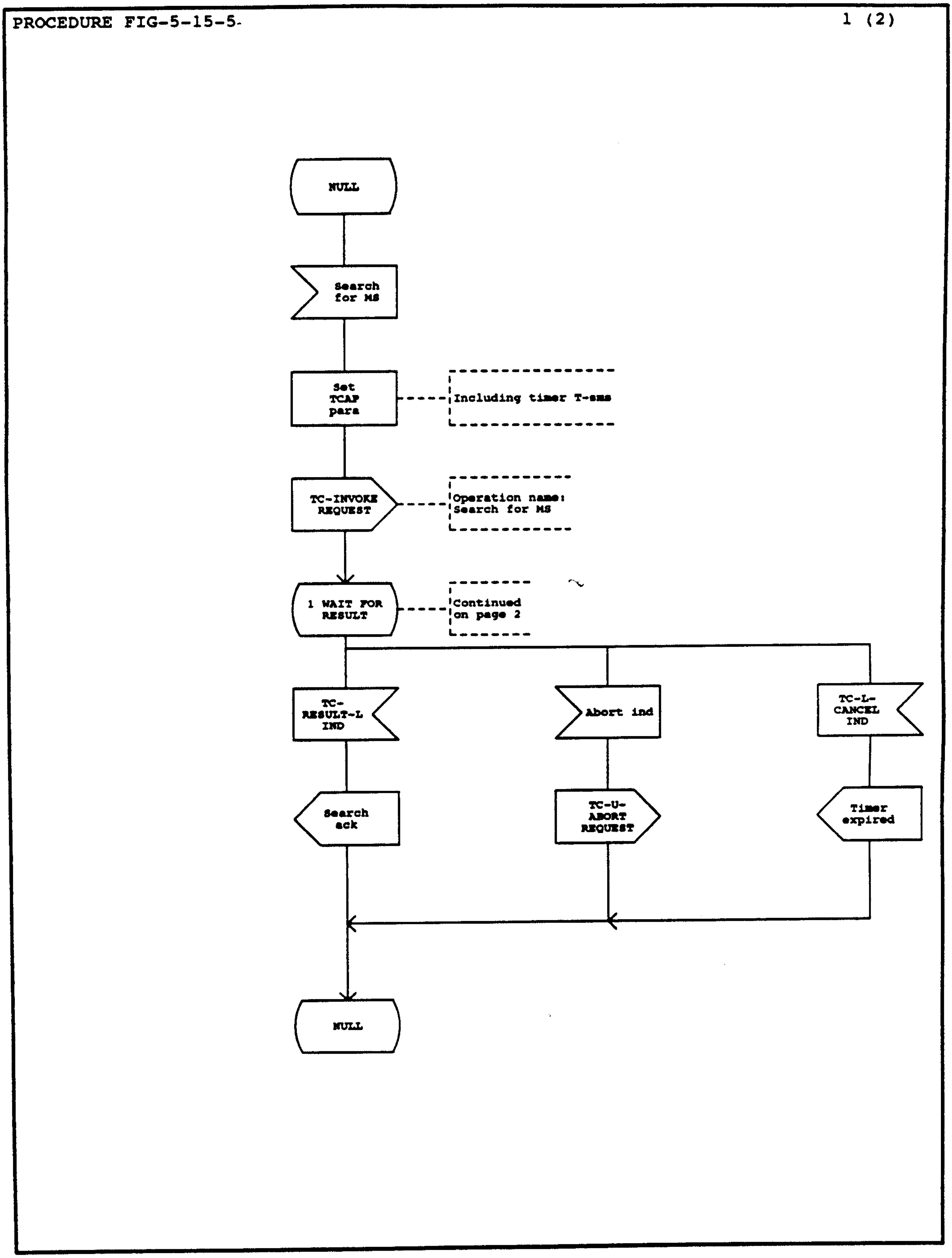


Figure 5.15.5 (sheet 2 of 2)
ASE/TCAP interface procedure in VLR for search for MS.

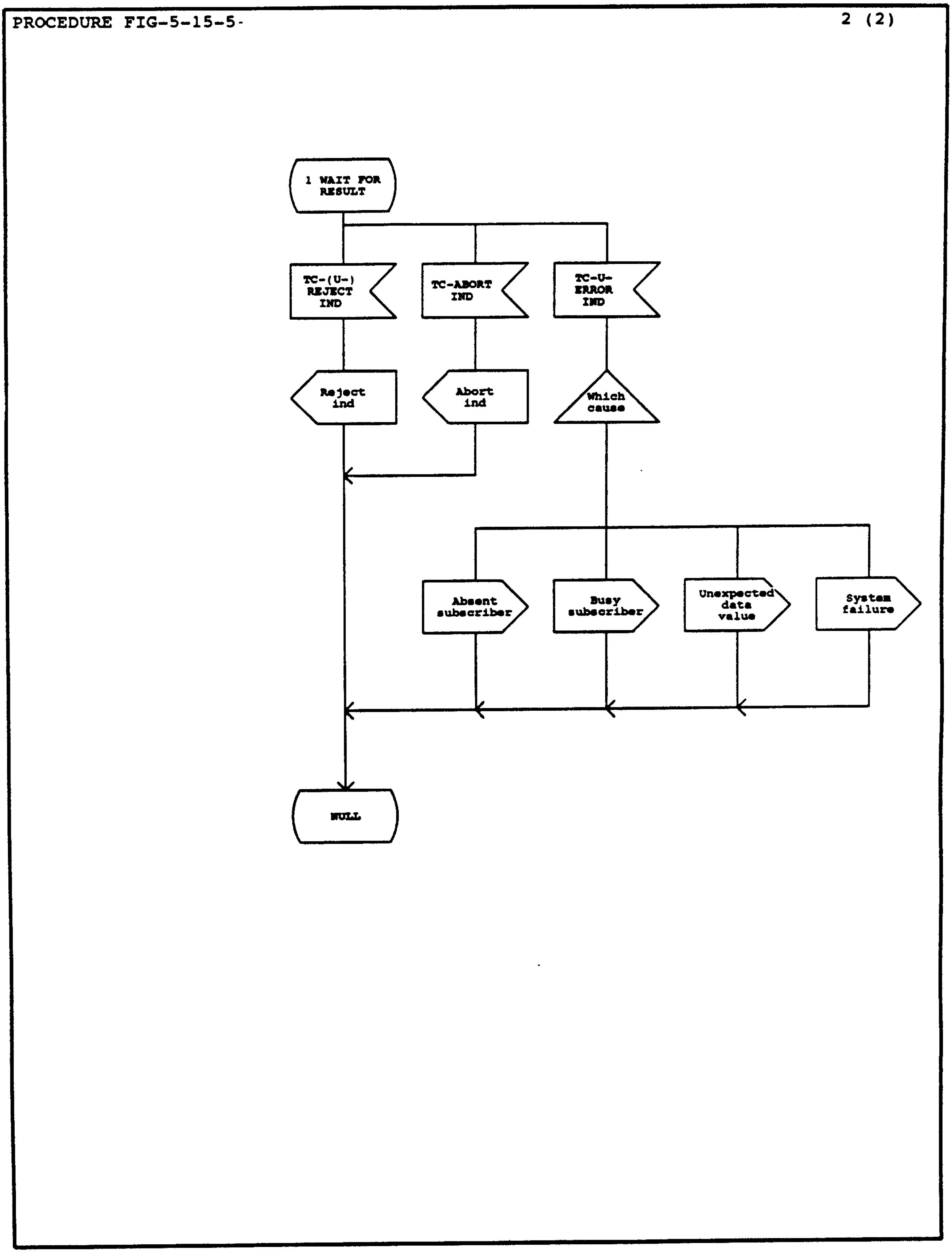


Figure 5.15.6 (sheet 1 of 3)
Application specific procedure in MSC for page MS.

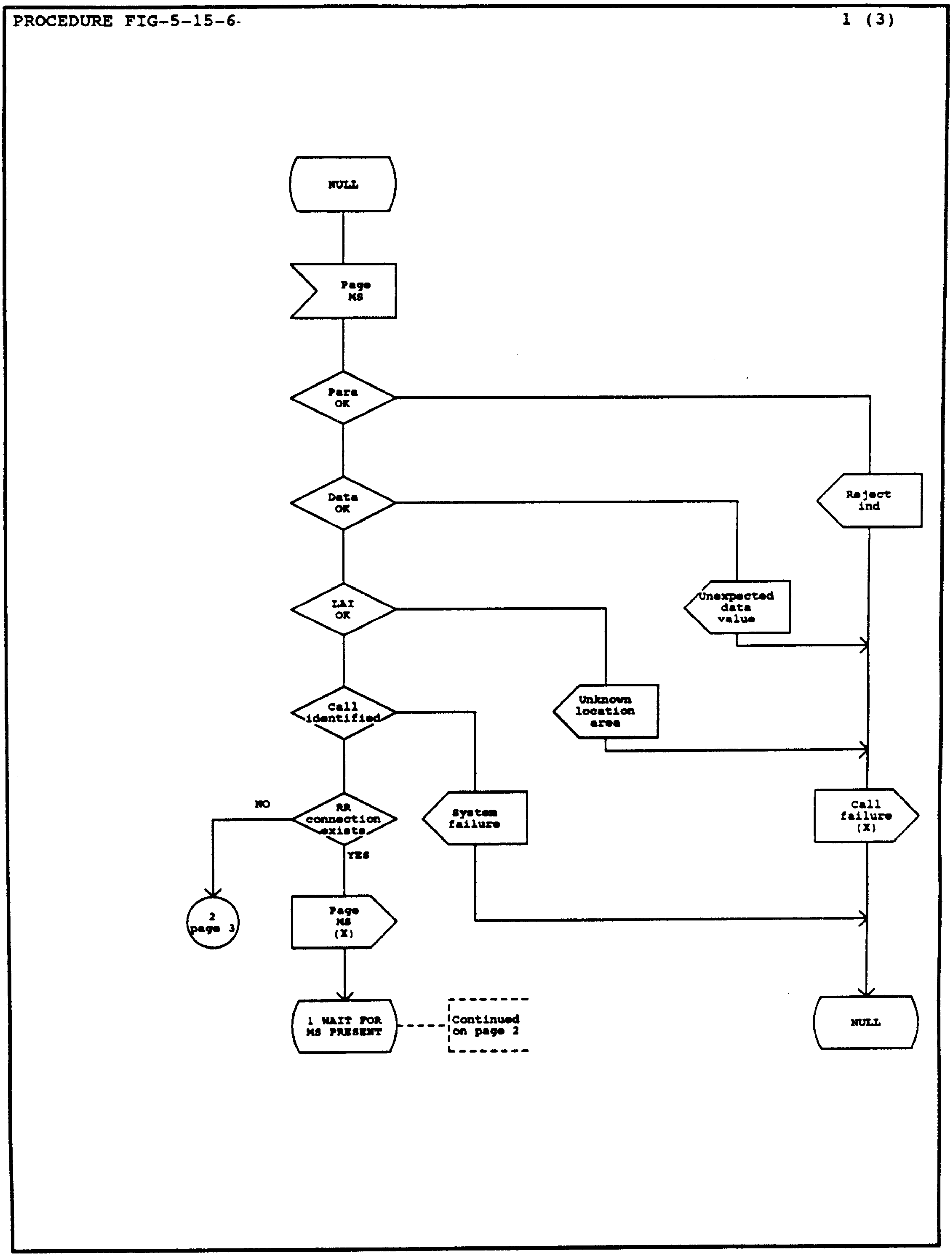


Figure 5.15.6 (sheet 2 of 3)
Application specific procedure in MSC for page MS.

PROCEDURE FIG-5-15-6. 2 (3)

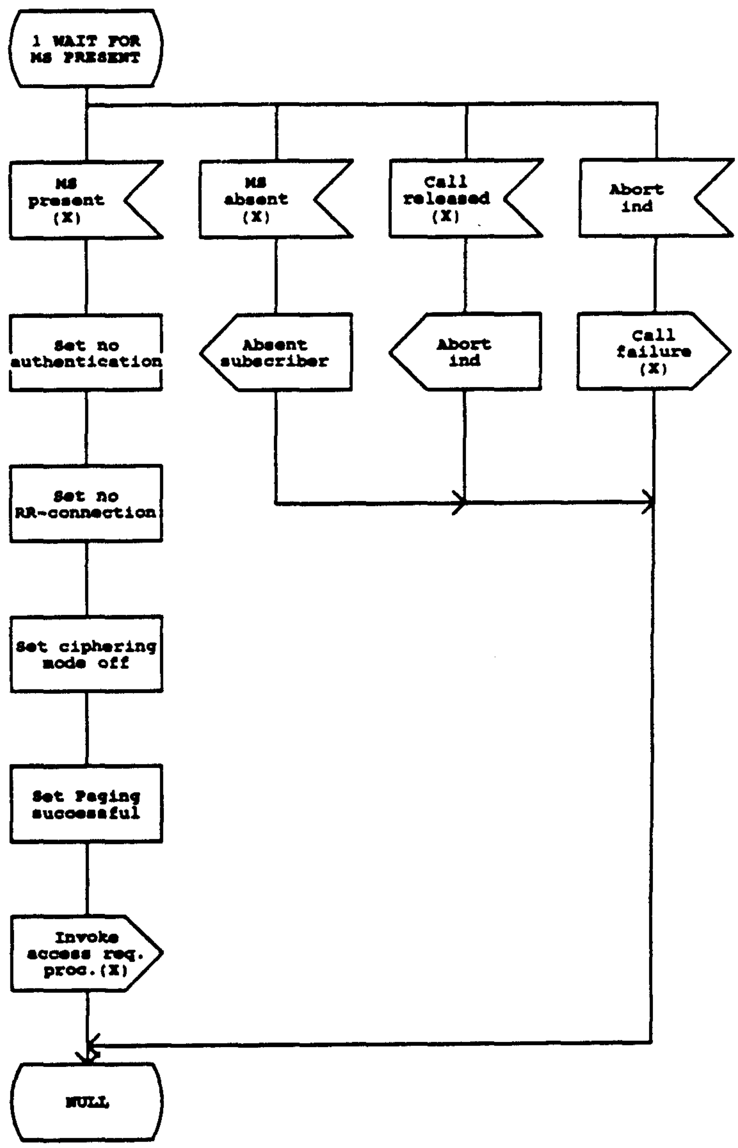


Figure 5.15.6 (sheet 3 of 3)
Application specific procedure in MSC for page MS.

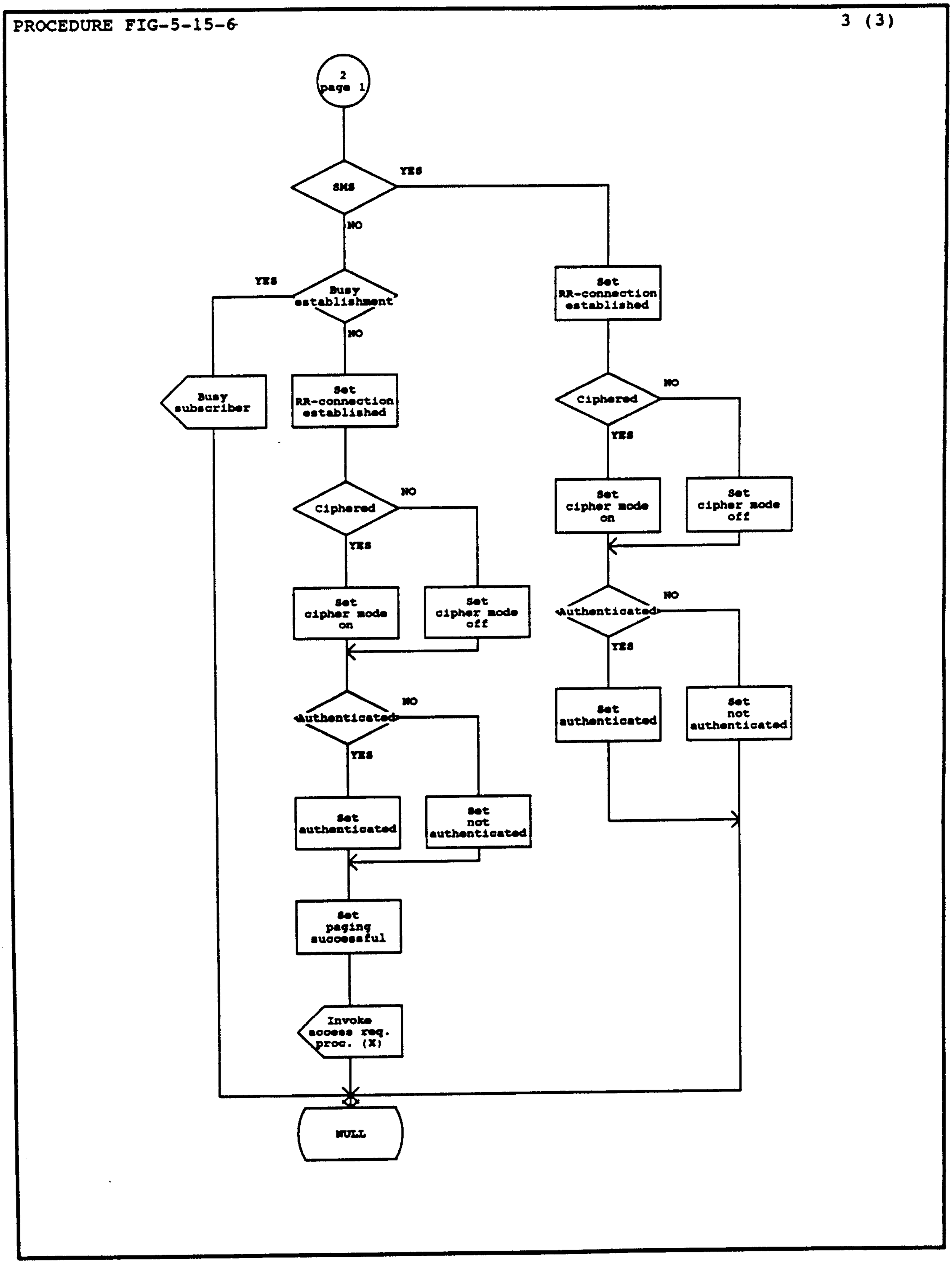


Figure 5.15.7 (sheet 1 of 2)
ASE/TCAP interface procedure in MSC for page MS.

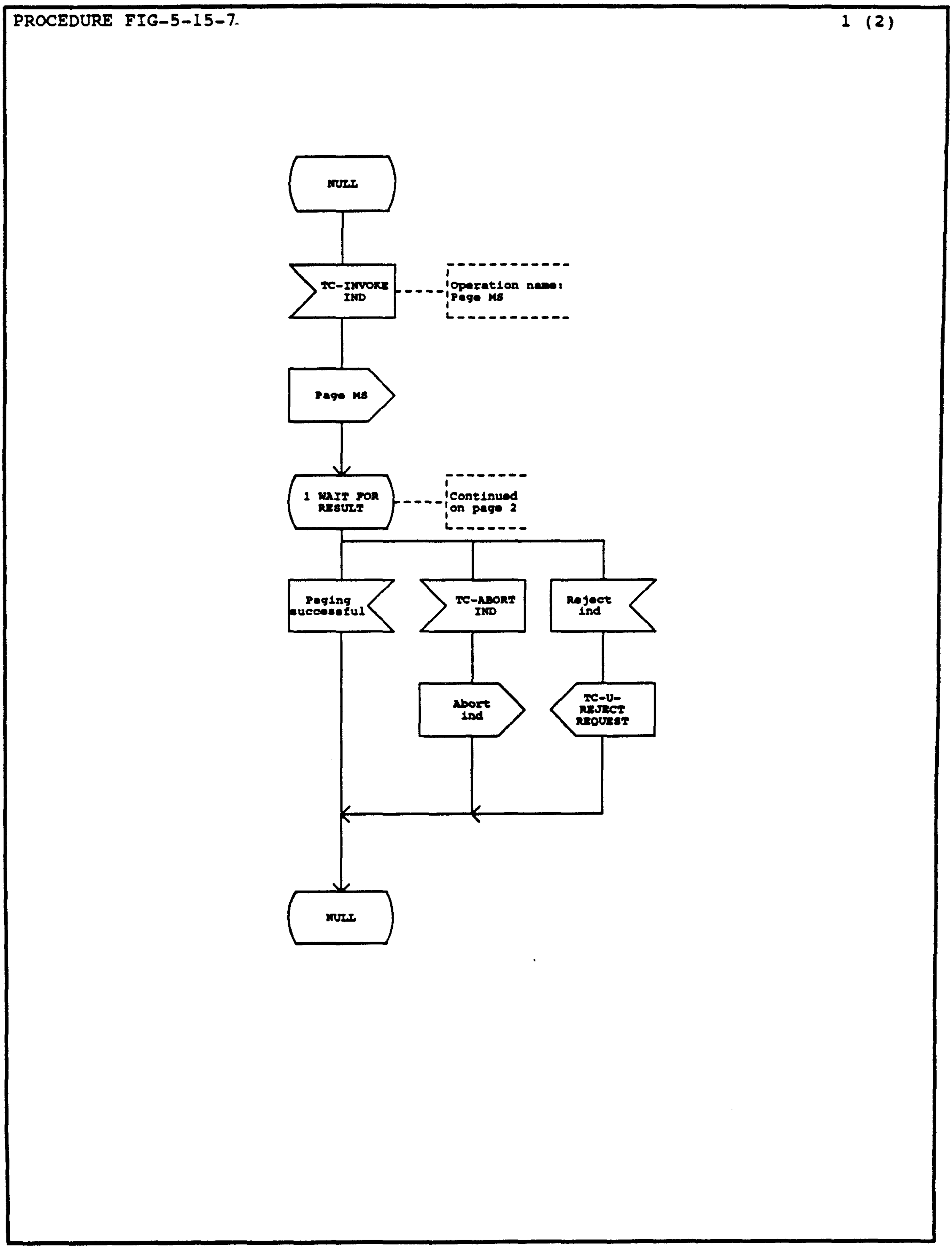


Figure 5.15.7 (sheet 2 of 2)
ASE/TCAP interface procedure in MSC for page MS.

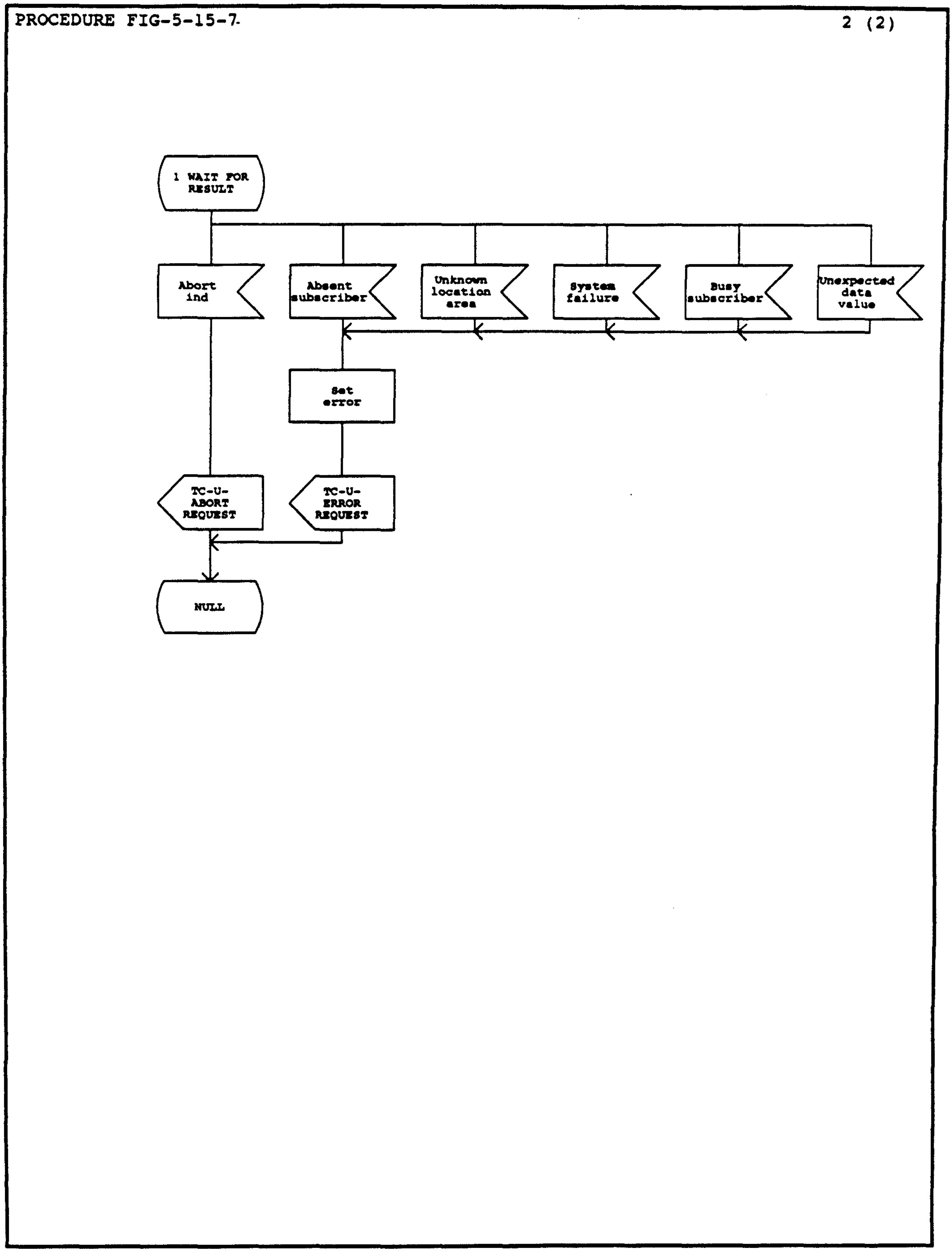


Figure 5.15.8 (sheet 1 of 3)
Application specific procedure in MSC for search for MS.

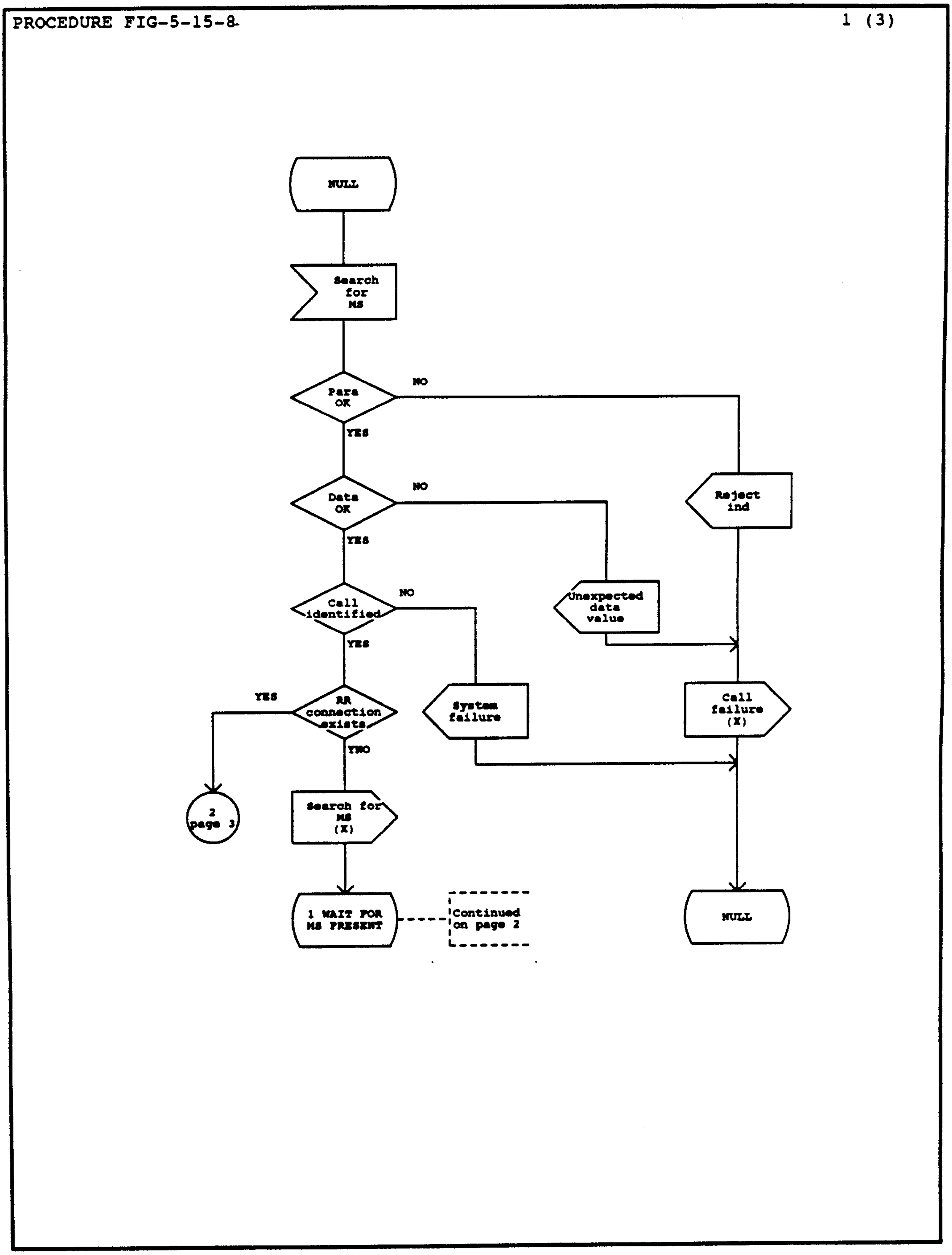


Figure 5.15.8 (sheet 2 of 3)
Application specific procedure in MSC for search for MS.

PROCEDURE FIG-5-15-8 2 (3)

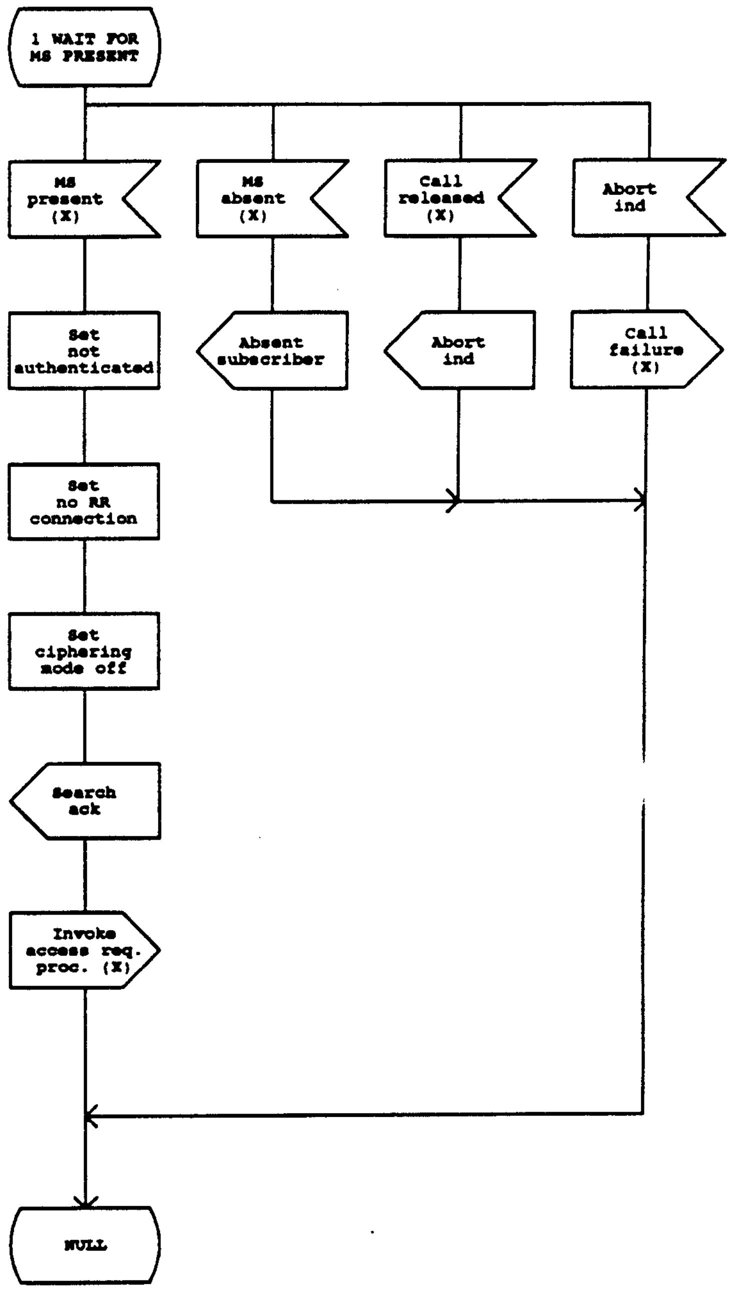


Figure 5.15.8 (sheet 3 of 3)
Application specific procedure in MSC for search for MS.

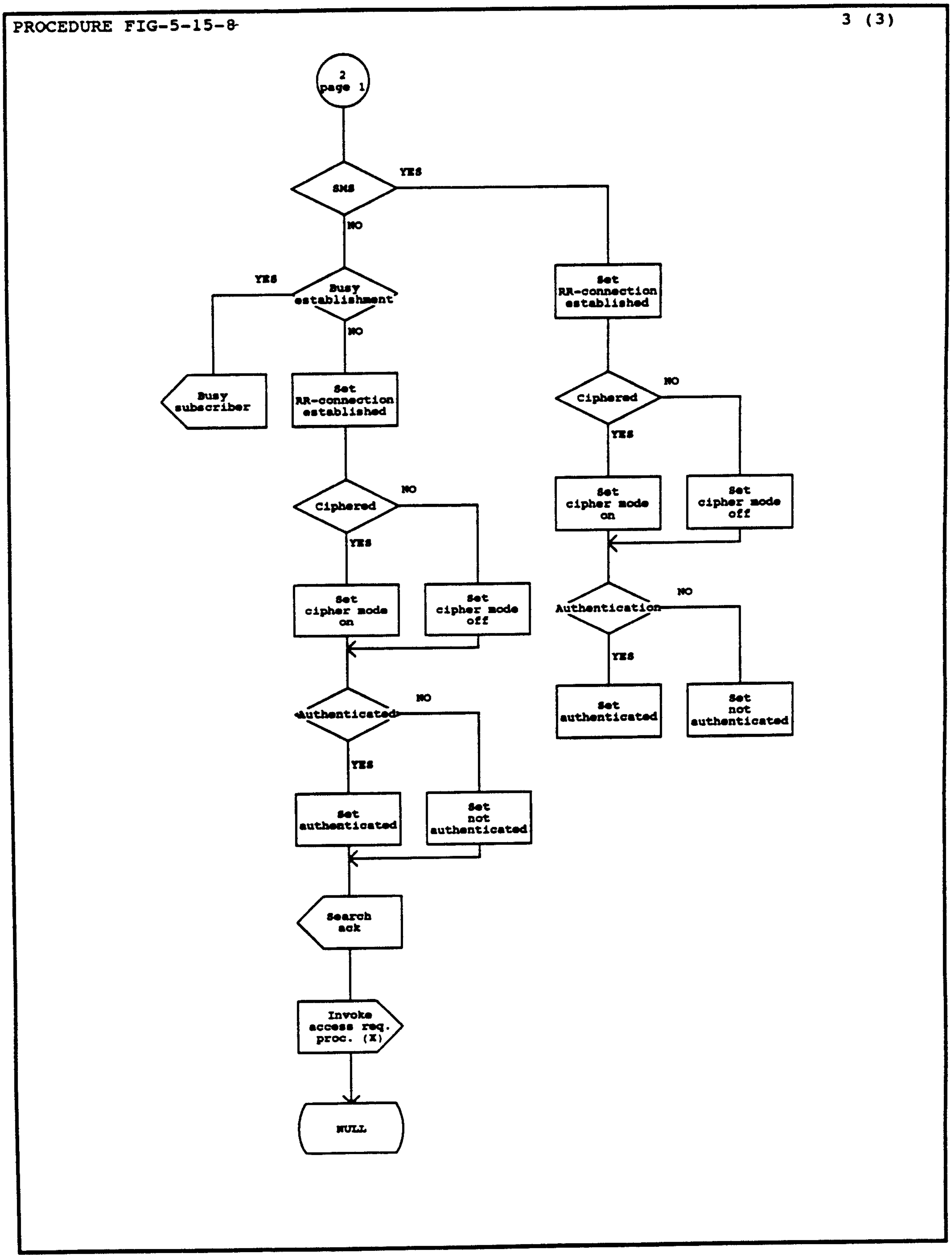


Figure 5.15.9 (sheet 1 of 2)
ASE/TCAP interface procedure in MSC for search for MS.

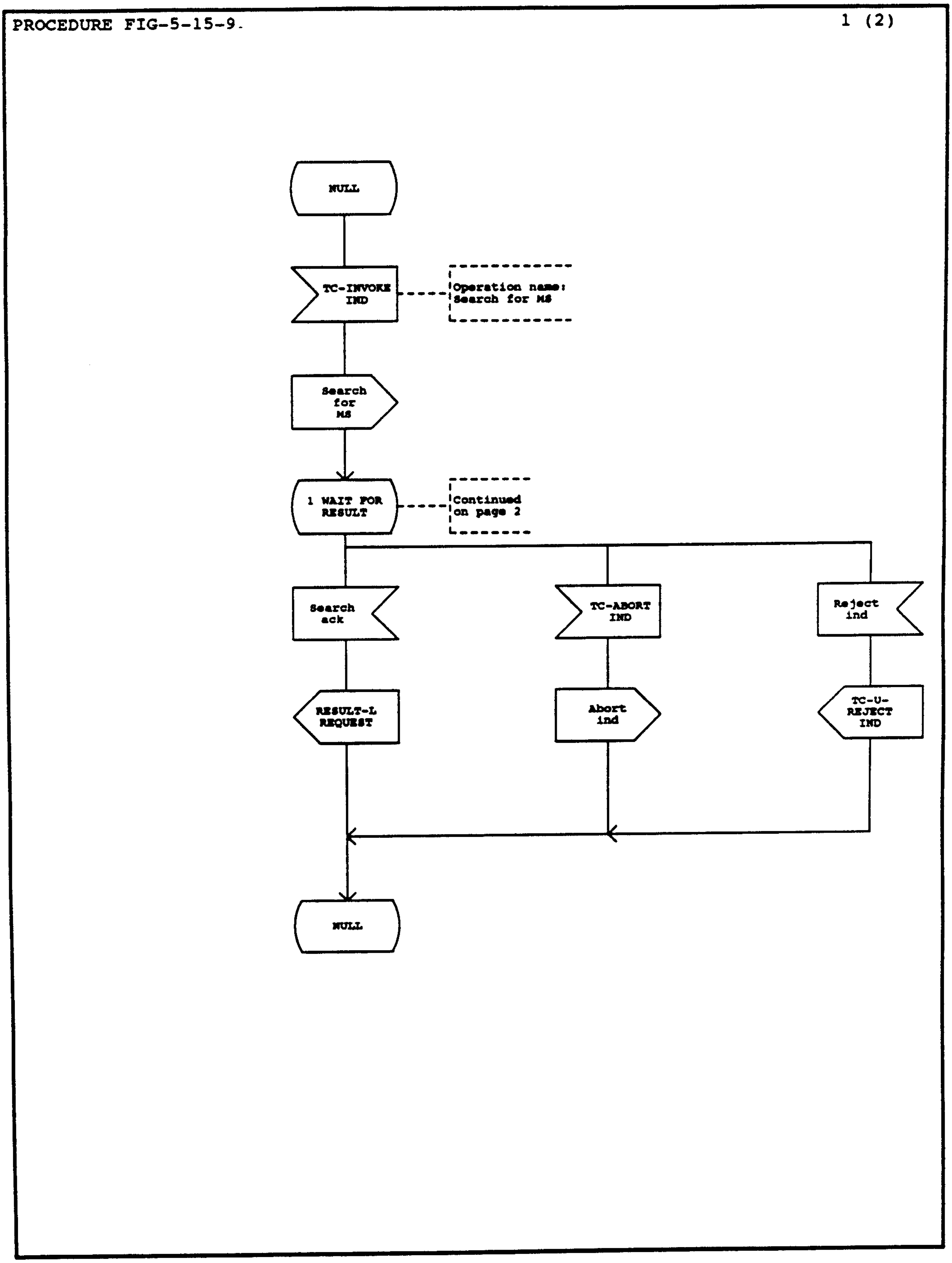
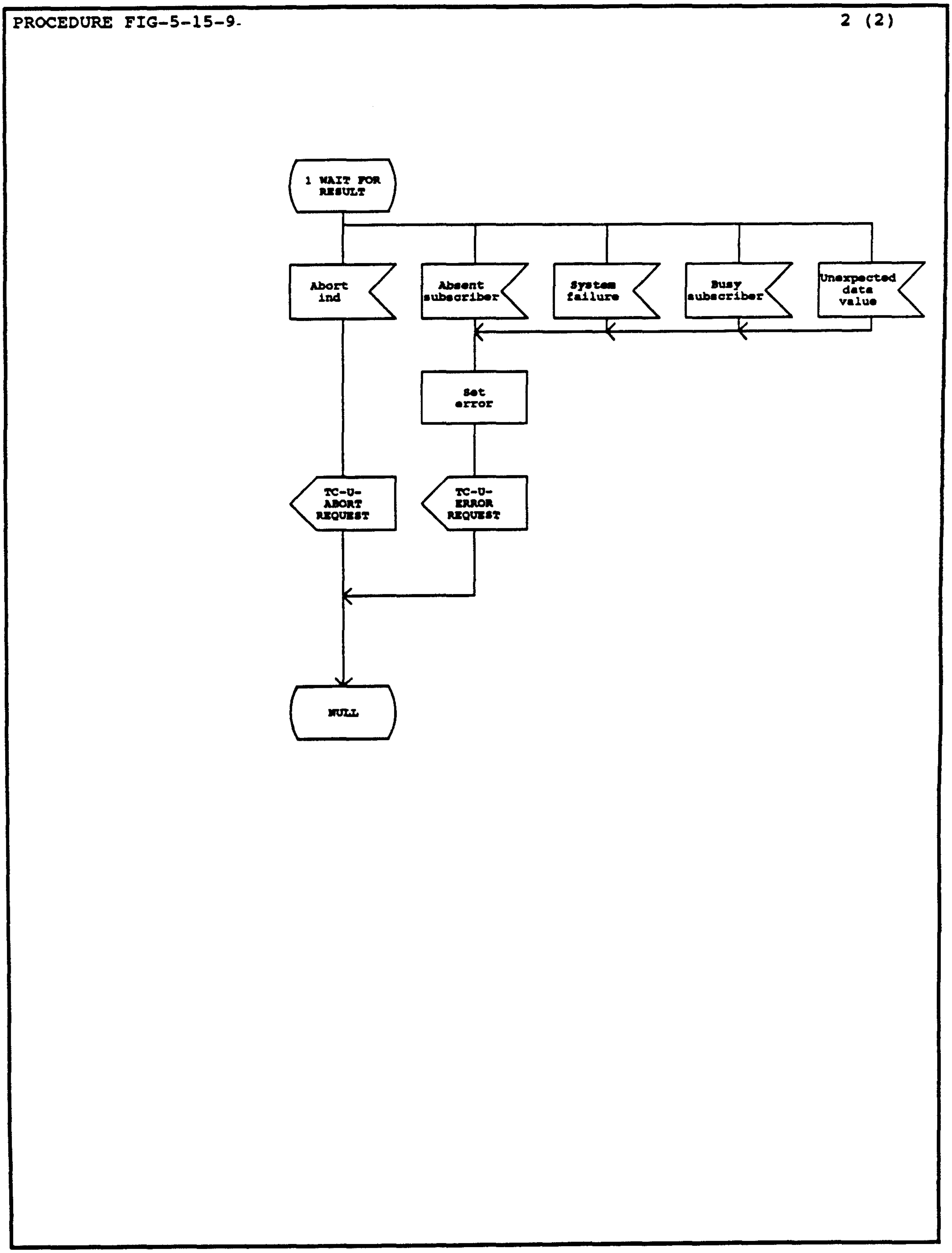


Figure 5.15.9 (sheet 2 of 2)
ASE/TCAP interface procedure in MSC for search for MS.



6. MAP Protocol specifications

6.1 General

This section specifies the abstract syntax for the Mobile Application Part protocol using the Abstract Syntax Notation One (ASN.1), defined in Recommendation CCITT X.208.

The mapping of OPERATION and ERROR to TCAP components is defined in Recommendation CCITT Q.773. The mapping with TCAP dialogue service is context dependent and is described in section 7.

The encoding rules which are applicable to the defined abstract syntax are the Basic Encoding Rules for Abstract Syntax Notation One, defined in Recommendation CCITT X.209 with the folowing exceptions:

- ad X.209 12.1:
  The encoding of an octetstring value shall be primitive .

- ad X.209 6.3.3:
  For the definite form, the length octets shall consist of one or more octets, and shall represent the number of octets in the contents using the short form (6.3.3.1) if the actual length is less than 128 and the long form (6.3.3.2) if the actual length is greater or equal 128.

- ad X.209 6.3.3.2:
  In the long form, it is not allowed to use more length octets than the minimum necessary.

For each MAP parameter which has to be transferred by a MAP Protocol Data Unit (MAP message), there is a PDU field (an ASN.1 NamedType) whose ASN.1 identifier has the same name that the corresponding parameter, except for the differences required by the ASN.1 notation (blanks between words are removed, the first letter of the first word is lower-case and the first letter of the following words are capitalized (e.g "no reply condition time" is mapped to "noReplyConditionTime"). In addition some words may be abbreviated as follows:

info	= information
id	= identity
suppl	= supplementary
ms	= mobile subscriber
ss	= supplementary services
sm	= short message
cug	= closed user group

The ASN.1 data type which follows the keywords "PARAMETER" or "RESULT" (for OPERATION and ERROR) is always optional from a syntactic point of view. However, except specific mention, it has to be considered as mandatory from a semantic point of view.

When a mandatory element is missing in any component or inner data structure, a reject component is returned (if the dialogue still exist). The problem cause to be used is "Mistyped parameter". When an optional element is missing in an invoke component or in an inner data structure while it is required by the context, an error component is returned; the associated type of error is DataMissing.

Information element or set of information elements (messages) transparently carried in the Mobile Application Part but defined in other recommendations are handled in one of the following ways:

i) The contents of the information element (without the octets encoding the identifier and the length in the recommendation where it is defined) are carried as the value of an ASN.1 NamedType derived from the OCTET STRING data type.

ii) The complete information element (including the octets encoding the identifier and the length in the recommendation where it is defined) and the identity of the associated protocol are carried as the value of the ExternalSignalInfo data type defined in this recommendation.

6.2 Operations types

6.2.1 Operations types ASN.1 specification

The ASN.1 specification of the operation types required for the Mobile Application Part is provided in the single ASN.1 module "MAP-Operations" described in figure 6.2/1 to 6.2/14.

```
MAP-Operations DEFINITIONS ::=

BEGIN

EXPORTS

-- exports operations types

-- Location management
UpdateLocationArea, UpdateLocation, CancelLocation, DetachIMSI, AttachIMSI,
DeregisterMobileSubscriber,

-- Subscriber data management
InsertSubscriberData, DeleteSubscriberData, SendParameters,

-- Supplementary Services Handling
RegisterSS, EraseSS, ActivateSS,
DeactivateSS, InterrogateSS, InvokeSS, ForwardSsNotification,
RegisterPassword, GetPassword, ProcessUnstructuredSsData,

-- Call set-up
SendInfoForIncomingCall, SendInfoForOutgoingCall,
SendRoutingInformation,ProvideRoamingNumber, CompleteCall,
ConnectToFollowingAddress, ProcessCallWaiting,

-- Paging
 Page, SearchForMobileSubscriber,

-- Handover
 PerformHandover, SendEndSignal,
PerformSubsequentHandover, AllocateHandoverNumber,
SendHandoverReport,ProcessAccessSignalling,
ForwardAccessSignalling,

-- Charging
RegisterChargingInformation,

-- Fault recovery
Reset, ForwardCheckSsIndication,

-- Tracing
ActivateTraceMode, DeactivateTraceMode, TraceSubscriberActivity,
NoteInternalHandover,
```

Figure 6.2/1 (Sheet 1 of 2)

ASN.1 Specification of MAP operations types: Imports and Exports

```
-- Equipment management
CheckIMEI,

-- Authentication and security
Authenticate, ProvideIMSI, ForwardNewTMSI, SetCipheringMode,

-- Short messages
SendRoutingInfoForSM, ForwardShortMessage, SetMessageWaitingData, NoteMSPresent,
AlertServiceCentre,

-- Access request
ProcessAccessRequest, BeginSubscriberActivity;


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

-- imports data types

AddressString, IsdnAddressString, ExternalSignalInfo,
IMSI, TMSI, SubscriberId, IMEI, LMsId, LocAreaId, GlobalCellId,
LocationInfo, HlrList, Category, EquipStatus, BasicServiceList,
BasicServiceCode, BearerServiceCode, TeleserviceCode,
SubscriberData, SS-Information, SS-DataList, SS-Code,
SS-CodeList, SS-Status, SS-Notification, Password, ChannelType,
NoReplyConditionTime, UserToUserServiceIndicator,
CUG-Index, CUG-Interlock, NumberOfConferees, NumberOfForwarding, ForwardingData,
ForwardingFeatureList, ForwardingOptions, ClassmarkInformation, HandoverType,
HandoverPriority, CallReference, CallType, CallDateTime, CallStatus, CallDuration,
PacketDataVolume, ChargingUnit, Charge, SS-ChargingInfo,
TraceReference, TraceType, NetworkResource, CmServiceType,
AccessConnectionStatus, Rand, Sres,CipheringMode, Kc, CKSN,
SS-UserData, RequestParameters, SentParameters, SM-RP-OA,
SM-RP-DA, SM-RP-UI, GuidanceInfo FROM MAP-DataTypes

-- imports errors types

UnknownSubscriber, UnknownBaseStation, UnknownMSC,
UnknownLocArea, UnidentifiedSubscriber,
UnallocatedRoamingNumber, UnknownEquipment,
RoamingNotAllowed, IllegalMS, BearerServiceNotProvisioned,
TeleserviceNotProvisioned, InsufficientBearerCapabilities,
CallBarred, ForwardingViolation, CUG-Reject, IllegalSS-Operation,
SS-ErrorStatus, SS-NotAvailable, SS-SubscriptionViolation,
SS-Incompatibility, InvalidTargetBaseStation,
NoRadioResourceAvailable, NoHandoverNumberAvailable,
SubsequentHandoverFailure, AbsentSubscriber, BusySubscriber,
NoSubscriberReply, RadioCongestion, ImpossibleCallCompletion,
SystemFailure, DataMissing, UnexpectedDataValue,
PasswordRegistrationFailure, NegativePasswordCheck,
NoRoamingNumberAvailable, TracingBufferFull, FacilityNotSupported, SM-DeliveryFailure,
MessageWaitingListFull FROM MAP-Errors;
```

Figure 6.2/1 (Sheet 2 of 2)

ASN.1 Specification of MAP operations types: Imports and Exports

```
-- operation types definitions
-- Location management operations

UpdateLocationArea ::= OPERATION
PARAMETER            SEQUENCE{
          subscriberId          SubscriberId,
          previousLocAreaId     CHOICE{
                                          LocAreaId,
                                          NULL},
          targetLocAreaId       LocAreaId,
          cksn                  CKSN }

RESULT

ERRORS
          {UnknownSubscriber,
          UnknownLocArea,
          RoamingNotAllowed,
          IllegalMS,
          SystemFailure,
          UnexpectedDataValue}

--
UpdateLocation ::= OPERATION
PARAMETER            SEQUENCE{
          imsi                  IMSI,
          locationInfo          LocationInfo,
          vlrNumber             IsdnAddressString,
          lmsId                 [10] IMPLICIT LMsId OPTIONAL}

RESULT
          hlrNumber             IsdnAddressString

ERRORS
          {UnknownSubscriber,
          RoamingNotAllowed,
          SystemFailure,
          UnexpectedDataValue}

--
CancelLocation ::= OPERATION
PARAMETER            CHOICE{
          imsi                  IMSI,
                                SEQUENCE{
          imsi                            IMSI,
          lMsId                           LMsId}}

RESULT

ERRORS
          {UnidentifiedSubscriber,
          UnexpectedDataValue}
```

Figure 6.2/2 (Sheet 1 of 2)

ASN.1 Specification of MAP operations types: Location management

```
--
DetachIMSI ::= OPERATION
PARAMETER
          subscriberId            SubscriberId

--
AttachIMSI ::= OPERATION
PARAMETER
          subscriberId            SubscriberId

RESULT

ERRORS
          {UnknownSubscriber,
          UnidentifiedSubscriber,
          IllegalMS,
          RoamingNotAllowed,
          SystemFailure,
          UnexpectedDataValue}

--
DeregisterMobileSubscriber ::= OPERATION
PARAMETER
          imsi                    IMSI

RESULT

ERRORS
          {AbsentSubscriber,
          UnknownSubscriber,
          FacilityNotSupported,
          UnexpectedDataValue}
```

Figure 6.2/2 (Sheet 2 of 2)

ASN.1 Specification of MAP operations types: Location management

```
-- Subscriber data management

InsertSubscriberData ::= OPERATION
PARAMETER            SEQUENCE{
          imsi                  [0] IMPLICIT IMSI OPTIONAL,
                                COMPONENTS OF SubscriberData}

RESULT

ERRORS
          {UnidentifiedSubscriber,
          DataMissing,
          UnexpectedDataValue}

--
DeleteSubscriberData ::= OPERATION
PARAMETER            SEQUENCE{
          imsi                  [0] IMPLICIT IMSI,
          basicService          [1] IMPLICIT BasicServiceList OPTIONAL,
          ss-Code               [2] IMPLICIT SS-CodeList OPTIONAL}

RESULT

ERRORS
          {UnidentifiedSubscriber,
          DataMissing,
          UnexpectedDataValue}


--
SendParameters ::= OPERATION
PARAMETER            SEQUENCE{
          subscriberId          SubscriberId,
          requestParameters     RequestParameters}

RESULT
          sentParameters        SentParameters
          -- optional (nothing is returned, if the requested
          -- parameters are not available or do not exist)

ERRORS
          {UnknownSubscriber,
          UnidentifiedSubscriber,
          UnexpectedDataValue}
```

Figure 6.2/3 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Subscriber data management

```
-- Supplementary services handling
--
RegisterSS ::= OPERATION
PARAMETER          SEQUENCE{
         ss-Code                 SS-Code,
         basicService            BasicServiceCode OPTIONAL,
         forwardedToNumber       [4] IMPLICIT IsdnAddressString OPTIONAL,
         noReplyConditionTime    [5] IMPLICIT NoReplyConditionTime OPTIONAL}

RESULT
         ss-Information          SS-Information -- optional

ERRORS
         {UnknownSubscriber,
         IllegalSS-Operation,
         SS-ErrorStatus,
         SS-NotAvailable,
         BearerServiceNotProvisioned,
         TeleServiceNotProvisioned,
         SS-SubscriptionViolation,
         SS-Incompatibility,
         NegativePasswordCheck,
         UnexpectedDataValue,
         DataMissing,
         SystemFailure}


--
EraseSS ::= OPERATION
PARAMETER          SEQUENCE{
         ss-Code                 SS-Code,
         basicService            BasicServiceCode OPTIONAL}

RESULT
         ss-Information          SS-Information -- optional

ERRORS
         {UnknownSubscriber,
         NegativePasswordCheck,
         IllegalSS-Operation,
         SS-ErrorStatus,
         SS-SubscriptionViolation,
         UnexpectedDataValue,
         SystemFailure}
```

Figure 6.2/4 (Sheet 1 of 4)

ASN.1 Specification of MAP operations types: Supplementary services handling

```
--
ActivateSS ::= OPERATION
PARAMETER           SEQUENCE{
        ss-Code                 SS-Code,
        basicService            BasicServiceCode OPTIONAL}

RESULT
        ss-Information          SS-Information -- optional

ERRORS
        {UnknownSubscriber,
        NegativePasswordCheck,
        IllegalSS-Operation,
        SS-ErrorStatus,
        SS-NotAvailable,
        SS-SubscriptionViolation,
        SS-Incompatibility,
        UnexpectedDataValue,
        SystemFailure}

--
DeactivateSS ::= OPERATION
PARAMETER           SEQUENCE{
        ss-Code                 SS-Code,
        basicService            BasicServiceCode OPTIONAL}


RESULT
        ss-Information          SS-Information -- optional

ERRORS
        {UnknownSubscriber,
        IllegalSS-Operation,
        SS-ErrorStatus,
        SS-SubscriptionViolation,
        NegativePasswordCheck,
        UnexpectedDataValue,
        SystemFailure}
```

Figure 6.2/4 (Sheet 2 of 4)

ASN.1 Specification of MAP operations types: Supplementary services handling

```
--
InterrogateSS ::= OPERATION
PARAMETER            SEQUENCE{
        ss-Code                  SS-Code,
        basicService             BasicServiceCode OPTIONAL}

RESULT               CHOICE{
        ss-Status                [0] IMPLICIT SS-Status,
        forwardedToNumber        [1] IMPLICIT IsdnAddressString,
        activesBasicServices     [2] IMPLICIT BasicServiceList,
        forwardingFeatureList    [3] IMPLICIT ForwardingFeatureList}


ERRORS
        {UnknownSubscriber,
        NegativePasswordCheck,
        IllegalSS-Operation,
        SS-NotAvailable,
        UnexpectedDataValue,
        SystemFailure}

--
InvokeSS ::= OPERATION
PARAMETER            SEQUENCE{
        ss-Code                  SS-Code,
        basicService             BasicServiceCode OPTIONAL,
        userToUserServiceIndicator        [4] IMPLICIT UserToUserServiceIndicator
OPTIONAL,
        cug-Index                [5] IMPLICIT CUG-Index OPTIONAL,
        numberOfConferees        [6] IMPLICIT NumberOfConferees OPTIONAL}

RESULT
        cug-Interlock            CUG-Interlock -- optional


ERRORS
        {IllegalSS-Operation,
        SS-ErrorStatus,
        SS-NotAvailable,
        SS-SubscriptionViolation,
        SS-Incompatibility,
        CUG-Reject,
        DataMissing,
        UnexpectedDataValue,
        SystemFailure}
```

Figure 6.2/4 (Sheet 3 of 4)

ASN.1 Specification of MAP operations types: Supplementary services handling

```
--
ForwardSsNotification ::= OPERATION
PARAMETER           SEQUENCE{
        imsi                [0] IMPLICIT IMSI OPTIONAL,
        ss-Code             [1] IMPLICIT SS-Code OPTIONAL,
        teleservice         [2] IMPLICIT TeleserviceCode OPTIONAL,
        bearerService       [3] IMPLICIT BearerServiceCode OPTIONAL,
        ss-Status           [4] IMPLICIT SS-Status OPTIONAL,
        ss-Notification     [5] IMPLICIT SS-Notification OPTIONAL}

--
RegisterPassword ::= OPERATION

PARAMETER
        ss-Code             SS-Code

RESULT
        newPassword         Password

ERRORS
        {NegativePasswordCheck,
        PasswordRegistrationFailure,
        SS-SubscriptionViolation,
        UnexpectedDataValue,
        SystemFailure}

LINKED
        {GetPassword}

--
GetPassword ::= OPERATION
PARAMETER
        guidanceInfo        GuidanceInfo

RESULT
        currentPassword     Password

--
ProcessUnstructuredSsData ::= OPERATION
PARAMETER
        ss-UserData         SS-UserData

RESULT
        ss-UserData         SS-UserData -- optional

ERRORS
        {UnexpectedDataValue,
        SystemFailure}
        -- UnexpectedDataValue is used when data from MS does not correspond
        -- to any service implemented in HLR
```

Figure 6.2/4 (Sheet 4 of 4)

ASN.1 Specification of MAP operations types: Supplementary services handling

```
-- Call set-up
--
SendInfoForIncomingCall ::= OPERATION
PARAMETER               SEQUENCE{
        incomingId          CHOICE{
        roamingNumber       [0] IMPLICIT IsdnAddressString,
        imsi                [1] IMPLICIT IMSI},
        bearerService       [2] IMPLICIT BearerServiceCode OPTIONAL,
        teleservice         [3] IMPLICIT TeleserviceCode OPTIONAL,
        lMsId               [4] IMPLICIT LMsId OPTIONAL,
        dialledNumber       [5] IMPLICIT IsdnAddressString OPTIONAL,
        cug-Interlock       [6] IMPLICIT CUG-Interlock OPTIONAL,
        numberOfForwarding  [7] IMPLICIT NumberOfForwarding OPTIONAL}

ERRORS
        UnallocatedRoamingNumber,
        UnknownSubscriber,
        UnidentifiedSubscriber,
        AbsentSubscriber,
        ImpossibleCallCompletion,
        ForwardingViolation,
        UnexpectedDataValue,
        DataMissing,
        SystemFailure}

LINKED
        CompleteCall,
        ProcessCallWaiting,
        ConnectToFollowingAddress}

--
SendInfoForOutgoingCall ::= OPERATION
PARAMETER           SEQUENCE{
        calledNumber        [0] IMPLICIT IsdnAddressString,
        bearerService       [2] IMPLICIT BearerServiceCode OPTIONAL,
        teleService         [3] IMPLICIT TeleserviceCode OPTIONAL}

ERRORS
        UnknownSubscriber,
        BearerServiceNotProvisioned,
        TeleserviceNotProvisioned,
        CallBarred,
        CUG-Reject,
        DataMissing,
        UnexpectedDataValue,
        SystemFailure}

LINKED
        {CompleteCall}
```

Figure 6.2/5 (Sheet 1 of 3)

ASN.1 Specification of MAP operations types: Call set-up

```
SendRoutingInformation ::= OPERATION
PARAMETER           SEQUENCE{
         msisdn                [0]  IMPLICIT IsdnAddressString,
         cug-Interlock         [1]  IMPLICIT CUG-Interlock OPTIONAL,
         numberOfForwarding    [2]  IMPLICIT NumberOfForwarding OPTIONAL,
         networkSignalInfo     [10] IMPLICIT ExternalSignalInfo OPTIONAL}

-- If available from the network the  ISDN Bearer Capabilities
-- the ISDN High Layer Compatibility and Low Layer Compatibility
-- information elements, are concatenated and included as the
-- value of the networkSignalInfo element

RESULT              SEQUENCE{
         imsi                  IMSI,
         routingInfo           CHOICE{
         roamingNumber                     IsdnAddressString,
         forwardingData                    ForwardingData}}

ERRORS
         UnknownSubscriber,
         CallBarred,
         CUG-Reject,
         BearerServiceNotProvisioned,
         TeleServiceNotProvisioned,
         FacilityNotSupported,
         AbsentSubscriber,
         ForwardingViolation,
         SystemFailure,
         DataMissing,
         UnexpectedDataValue}
```

Figure 6.2/5 (Sheet 2 of 3)

ASN.1 Specification of MAP operations types: Call set-up

```
ProvideRoamingNumber ::= OPERATION

PARAMETER          SEQUENCE{
        imsi                      [0] IMPLICIT IMSI,
        mscNumber                 [1] IMPLICIT IsdnAddressString OPTIONAL,
        msIsdn                    [2] IMPLICIT IsdnAddressString OPTIONAL,
        previousRoamingNumber     [3] IMPLICIT IsdnAddressString OPTIONAL,
        lMsId                     [4] IMPLICIT LMsId OPTIONAL,
        gSM-BearerCapability      [5] IMPLICIT ExternalSignalInfo OPTIONAL,
        networkSignalInfo         [6] IMPLICIT ExternalSignalInfo OPTIONAL}

-- If available from the network the ISDN High Layer Compatibility information element is,
-- included as the value of the networkSignalInfo element

RESULT
        roamingNumber             IsdnAddressString

ERRORS
        {AbsentSubscriber,
        NoRoamingNumberAvailable,
        FacilityNotSupported,
        SystemFailure,
        DataMissing,
        UnexpectedDataValue}
--
CompleteCall ::= OPERATION
PARAMETER          SEQUENCE{
        msIsdn                    [0] IMPLICIT IsdnAddressString,
        category                  [1] IMPLICIT Category OPTIONAL,
        cug-Index                 [2] IMPLICIT CUG-Index OPTIONAL,
        gSM-BearerCapability      [3] IMPLICIT ExternalSignalInfo OPTIONAL,
        noReplyConditionTime      [4] IMPLICIT NoReplyConditionTime OPTIONAL,
        ss-DataList               [5] IMPLICIT SS-DataList OPTIONAL}

ERRORS
        {NoSubscriberReply,
        RadioCongestion,
        BusySubscriber,
        DataMissing,
        UnexpectedDataValue}
--
ConnectToFollowingAddress ::= OPERATION
PARAMETER          SEQUENCE{
        forwardingData            ForwardingData,
        msIsdn                    IsdnAddressString OPTIONAL}
--
ProcessCallWaiting ::= OPERATION
```

Figure 6.2/5 (Sheet 3 of 3)

ASN.1 Specification of MAP operations types: Call set-up

```
-- Paging
--
Page ::= OPERATION
PARAMETER            SEQUENCE{
        imsi                     [0] IMPLICIT IMSI,
        tmsi                     [1] IMPLICIT TMSI OPTIONAL,
        locAreaId                [2] IMPLICIT LocAreaId}


ERRORS
        {AbsentSubscriber,
        UnknownLocArea,
        BusySubscriber,
        SystemFailure,
        UnexpectedDataValue}


--
SearchForMobileSubscriber ::= OPERATION
PARAMETER            SEQUENCE{
        imsi                     IMSI,
        storedLocationArea       CHOICE {
                                          LocAreaId,
                                          NULL}}

RESULT
        currentLocAreaId         LocAreaId


ERRORS
        {AbsentSubscriber,
        BusySubscriber,
        SystemFailure,
        UnexpectedDataValue}

--
```

Figure 6.2/6 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Paging

```
-- Handover

PerformHandover ::= OPERATION
PARAMETER          SEQUENCE{
        targetCellId            GlobalCellId,
        servingCellId           GlobalCellId,
        channelType             ChannelType,
        classmarkInformation    ClassmarkInformation,
        handoverPriority        [11] IMPLICIT HandoverPriority OPTIONAL,
        kc                      [12] IMPLICIT Kc OPTIONAL}

RESULT             SEQUENCE{
        handoverNumber          IsdnAddressString,
        accessSignalInfo        ExternalSignalInfo}
        -- protocolId for ExternalSignalInfo
        -- should indicate "gsm-04.08-version1"

ERRORS
        {UnknownBaseStation,
        InvalidTargetBaseStation,
        NoRadioResourceAvailable,
        NoHandoverNumberAvailable,
        SystemFailure,
        UnexpectedDataValue}


--
SendEndSignal ::= OPERATION

RESULT


--
PerformSubsequentHandover ::= OPERATION
PARAMETER          SEQUENCE{
        targetCellId            GlobalCellId,
        servingCellId           GlobalCellId,
        targetMscNumber         IsdnAddressString,
        classmarkInformation    [10] IMPLICIT ClassmarkInformation OPTIONAL}

RESULT
        accessSignalInfo        ExternalSignalInfo
-- protocolId should indicate "gsm-04.08-version1"}


ERRORS
        {UnknownBaseStation,
        InvalidTargetBaseStation,
        UnknownMSC,
        SubsequentHandoverFailure,
        UnexpectedDataValue}
```

Figure 6.2/7 (Sheet 1 of 2)

ASN.1 Specification of MAP operations types: Handover

```
--
AllocateHandoverNumber ::= OPERATION

ERRORS
        {NoHandoverNumberAvailable}

LINKED
        {SendHandoverReport}


--
SendHandoverReport ::= OPERATION
PARAMETER
        handoverNumber          IsdnAddressString

RESULT


--
ProcessAccessSignalling ::= OPERATION
PARAMETER
        bss-APDU                ExternalSignalInfo
-- protocolId should indicate "gsm-0806-version1"



--
ForwardAccessSignalling ::= OPERATION
PARAMETER
        bss-APDU                ExternalSignalInfo
-- protocolId should indicate "gsm-0806-version1"
```

Figure 6.2/7 (Sheet 2 of 2)

ASN.1 Specification of MAP operations types: Handover

```
-- Charging
--
RegisterChargingInformation ::= OPERATION
PARAMETER            SEQUENCE{
           msisdn                  IsdnAddressString,
           mscNumber               IsdnAddressString,
           imsi                    IMSI,
           callReference           CallReference,
           callType                CallType,
           callStatus              CallStatus,
           callDateTime            CallDateTime,
           callDuration            CallDuration,
           bearerServiceCode       [10] IMPLICIT BearerServiceCode OPTIONAL,
           teleserviceCode         [11] IMPLICIT TeleserviceCode OPTIONAL,
           calledNumber            [12] IMPLICIT IsdnAddressString OPTIONAL,
           callingNumber           [13] IMPLICIT IsdnAddressString OPTIONAL,
           packetDataVolume        [14] IMPLICIT PacketDataVolume OPTIONAL,
           chargingUnit            [15] IMPLICIT ChargingUnit OPTIONAL,
           charge                  [16] IMPLICIT Charge OPTIONAL,
           ss-ChargingInfo         [17] IMPLICIT SS-ChargingInfo OPTIONAL}

RESULT

ERRORS
           {UnknownSubscriber,
           DataMissing,
           UnexpectedDataValue}
```

Figure 6.2/8 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Charging

```
-- Fault recovery
--
Reset ::= OPERATION
PARAMETER              SEQUENCE{
          networkResource          NetworkResource,
          originatingEntityNumber          IsdnAddressString,
          hlrId                    HlrList OPTIONAL}


--

ForwardCheckSsIndication ::= OPERATION
```

Figure 6.2/9 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Fault recovery

```
-- Tracing
--
ActivateTraceMode ::= OPERATION
PARAMETER           SEQUENCE{
          imsi                    [0] IMPLICIT IMSI OPTIONAL,
          traceReference          [1] IMPLICIT TraceReference ,
          traceType               [2] IMPLICIT TraceType,
          omcId                   [3] IMPLICIT AddressString OPTIONAL}

RESULT


ERRORS
          {UnidentifiedSubscriber,
          FacilityNotSupported,
          TracingBufferFull,
          SystemFailure,
          DataMissing,
          UnexpectedDataValue}

--
DeactivateTraceMode ::= OPERATION
PARAMETER           SEQUENCE{
          imsi                    [0] IMPLICIT IMSI OPTIONAL,
          traceReference          [1] IMPLICIT TraceReference}

RESULT

ERRORS
          {UnidentifiedSubscriber,
          FacilityNotSupported,
          SystemFailure,
          DataMissing,
          UnexpectedDataValue}


--
TraceSubscriberActivity ::= OPERATION
PARAMETER           SEQUENCE{
          imsi                    [0] IMPLICIT IMSI OPTIONAL,
          traceReference          [1] IMPLICIT TraceReference,
          traceType               [2] IMPLICIT TraceType,
          omcId                   [3] IMPLICIT AddressString OPTIONAL,
          callReference           [4] IMPLICIT CallReference OPTIONAL}

--
NoteInternalHandover ::= OPERATION

PARAMETER           SEQUENCE{
          handoverType            HandoverType,
          targetCellId            [1] IMPLICIT GlobalCellId OPTIONAL,
          channelId               [2] IMPLICIT ExternalSignalInfo OPTIONAL}
```

Figure 6.2/10 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Tracing

```
-- Equipment management
--
CheckIMEI ::= OPERATION
PARAMETER
        imei                    IMEI

RESULT
        equipStatus             EquipStatus

ERRORS
        {UnknownEquipment,
        SystemFailure,
        UnexpectedDataValue}
```

Figure 6.2/11 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Equipment management

```
-- Authentication and security
--
Authenticate ::= OPERATION
PARAMETER               SEQUENCE{
        rand                    Rand,
        cksn                    CKSN}

RESULT
        sres                    Sres

--
ProvideIMSI ::= OPERATION

RESULT
        imsi                    IMSI

ERRORS
        {AbsentSubscriber}
```

Figure 6.2/12 (Sheet 1 of 2)

ASN.1 Specification of MAP operations types: Authentication and security

```
--
ForwardNewTMSI ::= OPERATION
PARAMETER
          tmsi                    TMSI

RESULT

--
SetCipheringMode ::= OPERATION
PARAMETER           SEQUENCE{
          cipheringMode           CipheringMode,
          kc                      Kc OPTIONAL}
-- Kc should be included when cipheringMode indicates
-- that ciphering must be performed
```

Figure 6.2/12 (Sheet 2 of 2)

ASN.1 Specification of MAP operations types: Authentication and security

```
-- Short messages

SendRoutingInfoForSM ::= OPERATION
PARAMETER           SEQUENCE{
          msisdn                  [0] IMPLICIT IsdnAddressString,
          sm-RP-PRI               [1] IMPLICIT BOOLEAN,
          serviceCentreAddress    [2] IMPLICIT AddressString,
          cug-Interlock           [3] IMPLICIT CUG-Interlock OPTIONAL,
          teleserviceCode         [5] IMPLICIT TeleserviceCode OPTIONAL}

RESULT              SEQUENCE{
          imsi                    IMSI,
                                  CHOICE{
                                              [0] IMPLICIT SEQUENCE{
          locationInfo                                  LocationInfo,
          lMsId                                         LMsId OPTIONAL},
          forwardingData                      [1] IMPLICIT ForwardingData},
          mwd-Set                             [2] IMPLICIT BOOLEAN OPTIONAL}

ERRORS
          {UnknownSubscriber,
          CallBarred,
          CUG-Reject,
          TeleServiceNotProvisioned,
          AbsentSubscriber,
          FacilityNotSupported,
          SystemFailure,
          DataMissing,
          UnexpectedDataValue}
```

Figure 6.2/13 (Sheet 1 of 2)

ASN.1 Specification of MAP operations types: Short messages

```
--
ForwardShortMessage ::= OPERATION
PARAMETER          SEQUENCE{
        sm-RP-DA             SM-RP-DA,
        sm-RP-OA             SM-RP-OA,
        sm-RP-UI             SM-RP-UI}

RESULT

ERRORS
        {UnidentifiedSubscriber,
        AbsentSubscriber,
        FacilityNotSupported,
        IllegalMS,
        SystemFailure,
        UnexpectedDataValue,
        SM-DeliveryFailure}

--
SetMessageWaitingData ::= OPERATION
PARAMETER          SEQUENCE{
        msisdn               IsdnAddressString,
        serviceCentreAddress AddressString}

RESULT


ERRORS
        {UnknownSubscriber,
        MessageWaitingListFull,
        UnexpectedDataValue}


--
NoteMSPresent ::= OPERATION

PARAMETER
        imsi                 IMSI


--
AlertServiceCentre ::= OPERATION
PARAMETER          SEQUENCE{
        msisdn               IsdnAddressString,
        serviceCentreAddress AddressString}
```

Figure 6.2/13 (Sheet 2 of 2)

ASN.1 Specification of MAP operations types: Short messages

```
-- Access request
--
ProcessAccessRequest ::= OPERATION
PARAMETER          SEQUENCE{
        subscriberId                        SubscriberId,
        cmServiceType                       CmServiceType,
        accessConnectionStatus              AccessConnectionStatus,
        cksn                                CKSN}

RESULT             SEQUENCE{
        imsi                    IMSI,
        msisdn                  IsdnAddressString OPTIONAL}

ERRORS
        {IllegalMS,
        UnknownSubscriber,
        UnidentifiedSubscriber,
        SystemFailure,
        UnexpectedDataValue }


--
BeginSubscriberActivity ::= OPERATION
PARAMETER          SEQUENCE{
        imsi                                IMSI,
        originatingEntityNumber             IsdnAddressString}



END   -- End of operation types definitions --
```

Figure 6.2/14 (Sheet 1 of 1)

ASN.1 Specification of MAP operations types: Access request

6.2.2 Operations types description

For each operation type this section provides a brief prose description and indicates the system components involved by the associated invocation procedure.

6.2.2.1 Location management

6.2.2.1.1 Update location area

Direction: (MSC —> VLR)

This operation type is invoked by a MSC to request its associated VLR for location area updating.

6.2.2.1.2 Update location

Direction: (VLR —> HLR)

This operation type is invoked by a VLR to update location information in the HLR of a mobile subscriber.

6.2.2.1.3 Cancel location

Direction: (HLR —> VLR)

This operation type is invoked by a HLR to request a VLR to delete a mobile subscriber from the list of visitors.

6.2.2.1.4 Detach IMSI

Direction (MSC —> VLR)

This operation type is invoked by a MSC to request its associated VLR to set an IMSI detach flag for a given mobile subscriber.

6.2.2.1.5 Attach IMSI

Direction: (MSC —> VLR)

This operation type is invoked by a MSC to request its associated VLR to remove the IMSI Detach flag for a given mobile subscriber.

6.2.2.1.6 Deregister mobile subscriber

Direction: (VLR —> HLR)

This operation type is invoked by a VLR to request the HLR to mark a mobile subscriber as deregistered.

6.2.2.2 Subscriber data mangement

6.2.2.2.1 Insert subscriber data

Direction: (HLR —> VLR)

This operation type is invoked by a HLR to transfer to the VLR various data related to a visitor subscriber (directory number, category, subscription information, supplementary service parameters, ...). This operation type can be invoked at location updating or after in a stand alone procedure, if any change or addition has to be reported to the VLR. When the information to be transferred cannot be carried in a single message due to the length limitations at the network layer, the information is segmented at the process level and this operation type is invoked several times. If a basic service or a supplementary service is not supported in the visited network, no reject condition and no error are reported.

6.2.2.2.2 Delete subscriber data

Direction: (HLR ---> VLR)

This operation type is invoked by a HLR to delete information from a subscriber record in a VLR. To delete the information related to a basic service or a supplementary service , the parameters types included in the invoke component are respectivly, basicService and ss-Code .

6.2.2.2.3 Send parameters

Direction: (VLR ---> HLR, VLR ---> VLR)

This operation type is invoked by a VLR to request a location register for one or several parameters related to a subscriber.

6.2.2.3 Supplementary service handling

6.2.2.3.1 Register supplementary service

Direction: (MSC --> VLR, VLR --> HLR)

This operation type is invoked by a network component to register data related to a supplementary service. When no BasicService parameter is provided, the registration applies to all provisioned basic services.

6.2.2.3.2 Erase supplementary service

Direction: (MSC --> VLR, VLR --> HLR)

This operation type is invoked by a network component to erase data related to a supplementary service. When no BasicService parameter is provided, the erasure applies to all provisioned basic services.

6.2.2.3.3 Activate supplementary service

Direction: (MSC --> VLR, VLR --> HLR)

This operation type is invoked by a network component to activate a supplementary service. When no basicService parameter is provided, the activation applies to all provisioned services basic. If this activation causes the deactivation of other supplementary services, this indication is provided by sending an invoke component for the Forward SS notification operation.

6.2.2.3.4 Deactivate supplementary service

Direction: (MSC --> VLR, VLR --> HLR)

This operation type is invoked by a network component to deactivate a supplementary service. When no basicService parameter is provided, the deactivation applies to all provisioned basic services.

6.2.2.3.5 Interrogate supplementary service

Direction: (MSC --> VLR, VLR --> HLR)

This operation type is invoked by a network component to retrieve information related to a supplementary service. When no basicService parameter is provided, the interrogation applies to all provisioned basic services.

6.2.2.3.6 Invoke supplementary service

Direction: (MSC --> VLR)

This operation type is invoked by a MSC to request its associated VLR for supplementary service invocation. If the supplementary service involved in the request is not provisioned, not registered or not active, the ss-ErrorStatus is returned with the corresponding ss-Status parameter value.

6.2.2.3.7 Forward supplementary service notification

Direction: (HLR ---> VLR,VLR ---> MSC)

This operation type is invoked by a location register to request the forwarding of a supplementary service notification towards a mobile subscriber.

6.2.2.3.8 Register password

Direction: (MSC --- VLR, VLR ---> HLR)

This operation type is invoked by an MS to register a new password related to the management by the subscriber himself of subscription data in the HLR. The operation type "Register password" will be successful if the subscriber can provide the old password, the new password and the new password again as results of 3 subsequent operations "Get password".

6.2.2.3.9 Get password

Direction: (HLR ---> VLR, VLR ---> MSC)

This operation type is invoked by the network to request a password from the mobile subscriber. It may be used to allow the registration of a new password or the management of subscription data by the subscriber himself (e.g. modification of call barring activation status).

6.2.2.3.10 Process unstructured supplementary service data

Direction: (MSC ---> VLR, VLR ---> HLR)

This operation type is invoked by a MSC or a VLR to relay unstructured information in order to allow end to end SS operation type between the MS and the HLR following specific rules (e.g embedding of keypad commands).

6.2.2.4 Call set-up

6.2.2.4.1 Send information for incoming call

Direction: (MSC ---> VLR)

This operation type is invoked by a MSC receiving an incoming call (call to mobile subscriber) to request the VLR for guidance.

6.2.2.4.2 Send information for outgoing call

Direction: (MSC ---> VLR)

This operation type is invoked by a MSC which has to handle an outgoing call set-up request (call from mobile subscriber) to retrieve the required informations from the VLR. If supplementary services are invoked at call setup, the associated information (ie, included in the Facility information element) is sent in the invoke component of the invoke supplementary service operation. The two invoke components can be grouped in the same message.

6.2.2.4.3 Send routing information

Direction: (GMSC ---> HLR)

This operation type is invoked by a gateway MSC to perform the interrogation of the HLR in order to route a call towards a mobile subscriber.

6.2.2.4.4 Provide roaming number

Direction: (HLR ---> VLR)

This operation type is invoked by a HLR to request a VLR to send back a roaming number in order to route a call to a mobile subscriber.

6.2.2.4.5 Complete call

Direction: (VLR ---> MSC)

This operation type is used by a VLR to request the MSC to set up a call to/from a mobile subscriber. In case of incoming call unsuccessful establishment is reported to the VLR as an error to the operation.

6.2.2.4.6 Connect to following address

Direction: (VLR ---> MSC)

This operation type is invoked by a VLR to request the MSC to connect a call to the indicated address.

6.2.2.4.7 Process call waiting

Direction: (VLR --> MSC)

This operation type is invoked by a VLR to request a MSC to perform a call waiting procedure.

6.2.2.5 Paging

6.2.2.5.1 Page

Direction: (VLR -> MSC)

This operation type is used by a VLR to request the MSC to page a mobile subscriber, in the indicated location area.

6.2.2.5.2 Search for mobile subscriber

Direction: (VLR ---> MSC)

This operation type is invoked by a VLR to request a MSC to search for a mobile subscriber. The stored location area identity must be sent in the invoke component; if this data is not available, a NULL parameter is used and the MSC page the MS in all the location area it controls.

6.2.2.6 Handover

6.2.2.6.1 Perform handover

Direction: (MSC-A ---> MSC-B)

This operation type is invoked by a MSC to request an other MSC (target MSC) to trigger an handover procedure.

6.2.2.6.2 Send end signal

Direction: (MSC-B —> MSC-A)

This operation type is invoked by MSC-B to requests MSC-A to send the end signal when their association can be released.

6.2.2.6.3 Perform subsequent handover

Direction: (MSC-B —> MSC-A)

This operation type is invoked by a serving MSC to request the call controlling MSC trigger a subsequent handover procedure with a third MSC (The new MSC can be MSC-A).

6.2.2.6.4 Allocate handover number

Direction: (MSC —> VLR)

This operation type is invoked by a MSC where a call has to be handed over, to request its associated VLR for an handover number.

6.2.2.6.5 Send handover report

Direction: (VLR —> MSC)

This operation type is invoked by a VLR after receiving a handover number request to request a MSC to send an handover report in order to remove the handover number.

6.2.2.6.6 Process access signalling

Direction: (MSC-B —> MSC-A)

This operation type is invoked by MSC-B, after a handover procedure, to transfer signalling information from the mobile subscriber to MSC-A. The MSC-B is transparent to the information included in the Bss-APDU parameter.

6.2.2.6.7 Forward access signalling

Direction: (MSC-A —> MSC-B)

This operation type is invoked by MSC-A, after a handover procedure to request MSC-B to forward signalling information to the MS. The MSC-B is transparent to the information included in the Bss-APDU parameter.

6.2.2.7 Charging

6.2.2.7.1 Register charging information

Direction: (MSC —> HLR)

This operation type is invoked by a MSC to transmit the charging information to the HLR.

6.2.2.8 Fault recovery

6.2.2.8.1 Reset

Direction: (HLR —> VLRs, VLR —> HLRs)

This operation type is invoked by a location register, after a restart, to indicate to other LRs that a failure occurred. For HLR restart, the range of IMSI which are affected by the restart procedure, can be specified sending a set of Hlrld parameters, to identify one or several sub-units of the HLR.

6.2.2.8.2 Forward check supplementary service indication

Direction: (HLR —> VLR, VLR –> MSC)

This operation type is used to request a VLR or a MSC to forward a check supplementary service indication to a mobile subscriber. This operation type is invoked first by the HLR and then by the VLR when a transaction is open with the MSC.

6.2.2.8.3 Tracing

6.2.2.8.4 Activate trace mode

Direction: (HLR —> VLR)

This operation type is invoked by a HLR entity in order to indicate to a VLR that the activities related to a subscriber have to be traced. The trace mode is set active as soon as the invoke component is received and remains active until the VLR receives a deactivateTraceMode invoke indication or the location is cancelled.

6.2.2.8.5 Deactivate trace mode

Direction: (HLR —> VLR)

This operation type is invoked by a HLR entity in order to request a VLR to stop to trace a subscriber.

6.2.2.8.6 Trace subscriber activity

Direction: (MSC-A —> MSC-B), (VLR —> MSC)

This operation type is invoked by a VLR or a MSC in order to request a MSC to trace the current subscriber related activity and to report the recorded information to the OMC.

6.2.2.8.7 Note Internal Handover

Direction: (MSC-B —> MSC-A)

This operation type is invoked by a MSC-B to inform MSC-A that a handover has been performed within the area controlled by MSC-B.

6.2.2.9 Equipment management

6.2.2.9.1 Check IMEI

Direction: (MSC —> EIR)

This operation type is invoked by a MSC to request the EIR to check the equipment identity used by a mobile subscriber.

6.2.2.9.2 Authentication and security

6.2.2.9.3 Authenticate

Direction: (VLR –> MSC)

This operation type is invoked by a VLR to request a subscriber for authentication.

6.2.2.9.4 Provide IMSI

Direction: (VLR —> MSC)

This operation type is invoked by a VLR to request a mobile subscriber to identify itself by the IMSI. This operation type is always invoked during a running transaction.

6.2.2.9.5 Forward new TMSI

Direction: (VLR —> MSC)

This operation type is invoked by a VLR to reallocate the TMSI of a mobile subscriber via the MSC.

6.2.2.9.6 Set ciphering mode

Direction: (VLR —> MSC)

This operation type is invoked by a VLR to request a MSC to set the ciphering mode and to start the ciphering procedure if applicable.

6.2.2.10 Short messages

6.2.2.10.1 Send routing information for short message

Direction: (GMSC —> HLR)

This operation type is invoked by a gateway MSC to perform the interrogation of the HLR in order to get routing information related to a mobile subscriber.

6.2.2.10.2 Forward short message

Direction: (MSC —> MSC)

This operation type is invoked by a GMSC to request a VMSC to forward a mobile destinating short message or by a VMSC to request an IWMSC to forward a mobile originating short message.

6.2.2.10.3 Set message waiting data

Direction: (GMSC —> HLR)

This operation type is invoked by a GMSC to request a HLR to add a service centre address in the Message Waiting Data..

6.2.2.10.4 Note MS present

Direction: (VLR —> HLR)

This operation type is invoked by a VLR to inform a HLR that a mobile subscriber becomes reachable.

6.2.2.10.5 Alert service centre

Direction: (HLR —> IWMSC)

This operation type is used by a HLR to request an IWMSC to inform a service centre that a mobile subscriber becomes available.

6.2.2.11 Access request

6.2.2.11.1 Process access request

Direction: (MSC --> VLR)

This operation type is invoked by a MSC to request its associated VLR to initiate the possible security procedures required before handling an access request from a mobile subscriber.

6.2.2.11.2 Begin subscriber activity

Direction: (VLR ---> HLR)

This operation type is invoked by a VLR in order to indicate to a HLR that a one or several operations invoked by a subscriber will be forwarded during the associated ongoing dialogue.

6.3 Errors types

6.3.1 Errors types ASN.1 specification

The ASN.1 specification of the errors types required for the Mobile Application Part is provided in the single ASN.1 module "MAP-errors" described in Figure 6.3/1.

```
MAP-Errors DEFINITIONS ::=

BEGIN


EXPORTS
UnknownSubscriber, UnknownBaseStation,UnknownMSC,
UnknownLocArea, UnidentifiedSubscriber,
UnallocatedRoamingNumber, UnknownEquipment, RoamingNotAllowed,
IllegalMS, BearerServiceNotProvisioned,
TeleserviceNotProvisioned, InsufficientBearerCapabilities,
CallBarred, ForwardingViolation, CUG-Reject,
IllegalSS-Operation, SS-ErrorStatus, SS-NotAvailable,
SS-SubscriptionViolation, SS-Incompatibility, FacilityNotSupported, InvalidTargetBaseStation,
NoRadioResourceAvailable, NoHandoverNumberAvailable,
SubsequentHandoverFailure,
AbsentSubscriber, BusySubscriber, NoSubscriberReply,
RadioCongestion, ImpossibleCallCompletion, SM-DeliveryFailure,
MessageWaitingListFull, SystemFailure, DataMissing,
UnexpectedDataValue, PasswordRegistrationFailure,
NegativePasswordCheck, NoRoamingNumberAvailable,
TracingBufferFull;

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

SS-Code, SS-CodeList, SS-Status, SS-SubscriptionOption, BasicServiceCode,
NetworkResource FROM MAP-DataTypes;


-- error types definitions

UnknownSubscriber ::= ERROR

UnknownBaseStation ::= ERROR

UnknownMSC ::= ERROR

UnknownLocArea ::= ERROR
```

Figure 6.3/1 (Sheet 1 of 4)

ASN.1 Specification of MAP errors types

```
UnidentifiedSubscriber ::= ERROR

UnallocatedRoamingNumber ::= ERROR

UnknownEquipment ::= ERROR

RoamingNotAllowed ::= ERROR

IllegalMS ::= ERROR

BearerServiceNotProvisioned ::= ERROR

TeleServiceNotProvisioned ::= ERROR

InsufficientBearerCapabilities ::= ERROR

CallBarred ::= ERROR
PARAMETER
        cause ENUMERATED {
                barringServiceActive (0),
                operatorBarring (1)} -- optional

--
ForwardingViolation ::= ERROR

--
CUG-Reject ::= ERROR
PARAMETER
        cause ENUMERATED {
                incomingCallBarred(0),
                nonCUGmember (1)} -- optional

--
IllegalSS-Operation ::= ERROR

--
SS-ErrorStatus ::= ERROR
PARAMETER
        ss-Status    SS-Status -- optional

--
SS-NotAvailable ::= ERROR

SS-SubscriptionViolation ::= ERROR
PARAMETER
        ss-SubscriptionOption SS-SubscriptionOption -- optional
```

Figure 6.3/1 (Sheet 2 of 4)

ASN.1 Specification of MAP errors types

```
--
SS-Incompatibility ::= ERROR
PARAMETER                    SEQUENCE{
          ss-Code            [1] IMPLICIT SS-Code OPTIONAL,
          basicService       BasicServiceCode OPTIONAL,
          ss-Status          [4] IMPLICIT SS-Status OPTIONAL} -- optional

--
FacilityNotSupported ::= ERROR

--
InvalidTargetBaseStation ::= ERROR

NoRadioResourceAvailable ::= ERROR

NoHandoverNumberAvailable ::= ERROR


SubsequentHandoverFailure ::= ERROR


AbsentSubscriber ::= ERROR
PARAMETER
          mwd-Set            BOOLEAN -- optional

BusySubscriber ::= ERROR

NoSubscriberReply ::= ERROR

RadioCongestion ::= ERROR

ImpossibleCallCompletion ::= ERROR
PARAMETER
          activeSupplServices    SS-CodeList -- optional

SM-DeliveryFailure ::= ERROR
PARAMETER
          cause ENUMERATED {memoryCapacityExceeded (0),
                    msProtocolError (1),
                    msNotEquiped (2),
                    unknownServiceCentre (3),
                    scCongestion (4),
                    invalidSmeAddress (5),
                    msNotScSubscriber (6)}

MessageWaitingListFull ::= ERROR
```

Figure 6.3/1 (Sheet 3 of 4)

ASN.1 Specification of MAP errors types

```
--
SystemFailure ::= ERROR
PARAMETER           NetworkResource -- optional

DataMissing ::= ERROR

UnexpectedDataValue ::= ERROR

PasswordRegistrationFailure ::= ERROR
PARAMETER
          diagnostic  ENUMERATED{undetermined (0),
                      invalidFormat (1),
                      newPasswordsMismatch (2)}


NegativePasswordCheck ::= ERROR

NoRoamingNumberAvailable ::= ERROR

TracingBufferFull ::= ERROR


END  -- End of error types definitions
```

Figure 6.3/1 (Sheet 4 of 4)

ASN.1 Specification of MAP errors types

6.3.2 Errors types description

For each error type this section provides a brief prose description.

6.3.2.1 Identification and numbering

6.3.2.1.1 UnknownSubscriber

This error is returned by a location register, when it is requested to perform an operation concerning an unknown subscriber (ie, the IMSI or the directory number is not allocated to a subscriber).

6.3.2.1.2 UnknownBaseStation

This error is returned by an MSC when it is requested to perform an operation concerning an unknown base station.

6.3.2.1.3 UnknownMSC

This error is returned by an MSC when it is requested to perform an operation concerning an unknown MSC.

6.3.2.1.4 UnknownLocArea

This error is returned by a network entity when its is requested to perform an operation related to an unknown location area.

6.3.2.1.5 UnidentifiedSubscriber

This error is returned by a VLR, in response to an operation related to a subscriber not registered in its data base (ie, the IMSI is not known).

6.3.2.1.6 UnallocatedRoamingNumber

This error is returned by a VLR when it receives a request concerning a roaming number that is not allocated.

6.3.2.1.7 UnknownEquipment

This error is returned by an EIR when it is requested for the status of a non registered equipment.

6.3.2.2 Subscription

6.3.2.2.1 RoamingNotAllowed

This error is returned by a location register when it is requested to update the location of a subscriber, roaming out of the area covered by its subscription.

6.3.2.2.2 IllegalMS

This error is returned by a VLR when the procedure cannot be achieved because the mobile subscriber has not been authenticated.

6.3.2.2.3 BearerServiceNotProvisioned

This error is returned by a location register when it is requested for call set-up information related to a non provisioned bearer service.

6.3.2.2.4 TeleserviceNotProvisioned

This error is returned by a location register when it is requested for call set-up information related to a non provisioned teleservice.

6.3.2.2.5 InsufficientBearerCapabilties

This error is returned by a visitor location register, when it is requested for call set-up information while the bearer capabilities of the mobile station are not sufficient to establish the associated call.

6.3.2.3 Supplementary services

6.3.2.3.1 CallBarred

This error is returned by a location register when a switching centre wants to set-up a call which fulfil the barring condtions attached to the subscriber. A parameter indicating whether this error is due to an active barring supplementary service or due to operator decision may also be provided.

6.3.2.3.2 ForwardingViolation

This error is returned by a location register when it is requested for routing information while the maximum number of forwarding is reached.

6.3.2.3.3 CUG-Reject

This error is reported by a location register to indicate that the call does not pass the CUG check or that the CUG barring conditions are transgressed. A cause parameter can be included and indicates the follwing situations:

- Incoming call barred
- non CUG member

6.3.2.3.4 IllegalSS-Operation

This error is returned by a location register when it is requested to perform an illegal operation on a supplementary service (eg registration request for a service which must be registered by the administration).

6.3.2.3.5 SS-ErrorStatus

This error is returned by a location register when it is requested to perform an operation which is not compatible with the current status of the relevant supplementary service. The current status is given as parameter.

6.3.2.3.6 SS-NotAvailable

This error is returned by a visitor location register when it is requested to activate a supplementary service which is not available in the visited area.

6.3.2.3.7 SS-SubscriptionViolation

This error is returned by a location register when it is requested to activate a supplementary service, transgressing the subscription restrictions. The the transgressed option may be sent as parameter.

6.3.2.3.8 SS-Incompatiblity

This error is returned by a location register when it is requested for a supplementary service operation incompatible with the status of an other supplementary service or with the teleservice or bearer service for which the operation is requested. The code and the status of the relevant service are possibly sent as parameters.

6.3.2.3.9 FacilityNotSupported

This error is returned by a location register receiving a request about a facility which is not supported in the PLMN.

6.3.2.4 Handover

6.3.2.4.1 InvalidTargetBaseStation

This error is returned by a MSC, when it is requested to perform a handover on an invalid base station.

6.3.2.4.2 NoRadioResourceAvailable

This error is returned by a MSC, when the radio path cannot be established because of congestion.

6.3.2.4.3 NoHandoverNumberAvailable

This error is returned by a VLR or a MSC, when no handover number can be allocated.

6.3.2.4.4 SubsequentHandoverFailure

This error is returned by a call control MSC to indicate to MSC-B that the handover procedure with MSC-B' failed.

6.3.2.5 Call set-up

6.3.2.5.1 NoRoamingNumberAvailable

This error is returned by a VLR when it is requested to allocate a roaming number, while all the possible numbers are already in use.

6.3.2.5.2 AbsentSubscriber

This error is returned by any network entity requested to perform an operation concerning a subscriber which is deregistered, detached or not reachable. A parameter indicating whether or not the message waiting data flag has been set may be provided.

6.3.2.5.3 BusySubscriber

This error is returned by a MSC to indicate that a call cannot be established because the called subscriber is busy.

6.3.2.5.4 NoSubscriberReply

This error is returned by a MSC when a call cannot be established because the called subscriber does not reply.

6.3.2.5.5 RadioCongestion

This error is returned by an MSC when a call cannot be established because of radio congestion (eg, no traffic channel available).

6.3.2.5.6 ImpossibleCallCompletion

This error is returned by a VLR when a call can neither be established nor forwarded. The list of active supplementary services may be included as parameter (e.g for call completion on busy subscriber) .

6.3.2.6 Short messages

6.3.2.6.1 SM-DeliveryFailure

This error is used to report a failure for short message delivery. A cause parameter is included in the component and indicates the following situations:

- Memory capacity exceeded
- MS protocol error
- MS not equiped
- Unknown Service Centre
- SC Congestion
- Invalid SME Address
- MS is not a SC subscriber

6.3.2.6.2 MessageWaitingListFull

This error is returned by a HLR when when it cannot update the message waiting list because, the maximum number of SC addresses which can be stored is reached.

6.3.2.7 Generic errors

6.3.2.7.1 SystemFailure

This error is returned by any system entity, when it cannot perform an operation because of the failure of another entity.

6.3.2.7.2 DataMissing

This error is returned by any entity when when an Optional parameter is missing in an invoke component or in an inner data structure, while it is required by the context of the request.

6.3.2.7.3 UnexpectedDataValue

This error is returned by any entity when it receives a parameter with an unexpected value, without type violation.

6.3.2.8 Password handling

6.3.2.8.1 PasswordRegistrationFailure

This error is returned when a password registration procedure fails because of abnormal subscriber inputs. A more specific diagnostic may be passed as error parameter and indicates situations such as:

- invalid password format

- new passwords mismatch

6.3.2.8.2 NegativePasswordCheck

This error is returned to indicate the negative result of a password check because the subscriber has not provided the required password or has provided a password which does not match the valid one.

6.3.2.9 Tracing

6.3.2.9.1 TracingBufferFull

This error is reported by a VLR to indicate that subscriber tracing cannot be achieve because the tracing capacity is exceeded.

6.4 Data types and identifiers

6.4.1 Common rules

6.4.1.1 General

The data types used in MAP protocol specifications are described in the ASN.1 module provided in section 6.4.2, while section 6.4.3 provides an overview of the identifiers used in MAP ASN.1 specifications

Since size constraints are subject to modifications named values have been defined in the following module for the upper boundaries of the value ranges associated to several sub-type specifications. These named values are exported from this module and imported in the modules defining the data types and the operation types.

```
MAP-Constants DEFINITIONS ::=

BEGIN

EXPORTS

maxSignalInfoLength,
maxNumberOfTeleServices ,
maxNumberOfBearerServices,
maxNumberOfSupplServices,

maxNumberOfCUG,
maxNumberOfBasicServices,
maxNumberOfForwardingFeatures,
maxNumberOfCallBarringFeatures,
maxNumberOfHlrId,
maxPacketDataVolume,
maxNumberOfChargingUnit,
maxCallDuration,
maxAddressLength,
maxNumberOfSentParameters;

-- value assignement

maxSignalInfoLength INTEGER ::= 200
-- this NamedValue represent the theoretical maximum number
-- of octets which available to carry a single data type, without
-- requiring segmentation to cope with the network layer service.
-- However the actual maximum size available for a data type
-- may be lower, especially when other information elements have
-- to be included in the same component
```

Figure 6.4/1 (Sheet 1 of 2)

ASN.1 Specification of MAP constants

```
-- value assignment continuation

maxNumberOfTeleservices             INTEGER ::=  20
maxNumberOfBearerServices           INTEGER ::=  50
maxNumberOfSupplServices            INTEGER ::=  30

maxNumberOfCUG                      INTEGER ::=  10
maxNumberOfBasicServices            INTEGER ::=  70
maxNumberOfForwardingFeatures       INTEGER ::=  13
maxNumberOfCallBarringFeatures      INTEGER ::=  13
maxNumberOfHlrId                    INTEGER ::=  50
maxPacketDataVolume                 INTEGER ::= 100
maxNumberOfChargingUnit             INTEGER ::= 16777215
maxCallDuration                     INTEGER ::= 16777215
maxAddressLength                    INTEGER ::=  20

maxNumberOfSentParameters           INTEGER ::=  10
-- this named value should correspond to the maximum of
-- the maxNumberOfCUG and the maximum number of authentication
-- set which may be returned by a HLR plus 1.
END
```

Figure 6.4/1 (Sheet 2 of 2)

ASN.1 Specification of MAP constants

6.4.1.2 Basic data types

In addition to the builtin types defined in Recommendation X.208, the following basic types are defined: to represent address information.

6.4.1.2.1 TBCD-STRING type

This type shall be referenced by the name

TBCD-STRING

This type consists of values representing several digits from 0 through 9.

This type can be defined using ASN.1,as follows:

```
TBCD-STRING ::= OCTET STRING
```

The "OCTET STRING" contains the digits 0 through 9, two digits per octet, each digit encoded 0000 to 1001, 1111 used as filler when there is an odd number of digit..

Bit 4 to 1 of octet n encoding digit 2(n-1) +1

Bit 8 to 5 of octet n encoding digit 2n

6.4.1.2.2 AddressString type

This type shall be referenced by the name

The type consists of values representing a number used for addressing purposes.

The type can be defined using ASN.1, as follows:

```
AddressString ::= OCTET STRING (SIZE (1..maxAddressLength))
```

where maxAddressLength is an ASN.1 NamedValueand were the "OCTET STRING" is composed of:

a) first octet including a one bit extension indicator, a 3 bits Nature of address indicator and a 4 bits Numbering plan indicator, encoded as follows:

- Bit 8: Extension indicator

0	Extension
1	No extension

- Bit 7-5: Nature of address indicator

000	unknown
001	international number
010	national significant number
011	network specific number
100	dedicated PAD access
101	reserved
110	reserved
111	reserved for extension

- Bit 4-1: Numbering plan indicator, encoded as follows:

0000	unknown
0001	ISDN/Telephony Number Plan (REC E.164)
0010	Spare
0011	Data numbering plan (REC X.121)
0100	Telex numbering plan (REC F.69)
0101	National use
0110	National use
0111	Spare
1000	National numbering plan
1001	Private numbering plan
1111	Reserved for extension

all other values are reserved.

and;

b) following octets representing address signals encoded as a TBCD-STRING parameter.

6.4.1.2.3 IsdnAddressString

This type is a sub-type derived from the AddressString type and is used to represent ISDN numbers.

The type can be defined using ASN.1, as follows:

```
IsdnAddressString ::= AddressString (SIZE (1..10))
```

6.4.1.2.4 ExternalSignalInfo

This data type is defined to allow the Mobile Application Part protocol to carry information elements defined in other Recommendations without any direct reference to their internal structure.

The data type represents any set of information element (including tag and length octets) imported from another signalling protocol. For the user-network protocol, the set of elements may consist of a complete layer 3 message. The protocol to which the information elements belong is indicated by the protocolId element, while the signalling information is contained in the signalInfo element.

The type can be defined using ASN.1, as follows:

```
ExternalSignalInfo ::=  SEQUENCE{
                        protocolId   ProtocolId,
                        signalInfo  SignalInfo}

maxExternalInfoLength INTEGER  ::= 200

Signal ::= OCTET STRING (SIZE (1..maxExternalInfoLength))

ProtocolId    ::= ENUMERATED{
                        gsm-0408              (1),
                        gsm-0806              (2),
                        gsm-0808-bssmap       (3),
                        isup-Q763             (4)}
```

6.4.2 ASN.1 data types

The abstract specification of the data types used in Operations and Errors specifications is provided in the following ASN.1 module "MAP-DataTypes" described in figure 6.4/2 to 6.4/N.

```
MAP-DataTypes   DEFINITIONS ::=

BEGIN

-- exports all data types defined in this module

IMPORTS
-- imports upper boundaries for data types

maxSignalInfoLength, maxNumberOfTeleServices,
maxNumberOfBearerServices, maxNumberOfSupplServices,
maxNumberOfCUG, maxNumberOfBasicServices,
maxNumberOfForwardingFeatures, maxNumberOfCallBarringFeatures,
maxNumberOfHlrId, maxPacketDataVolume,
maxNumberOfChargingUnit, maxCallDuration,
maxAddressLength, maxNumberOfSentParameters
FROM MAP-Constants;

-- common data types

TBCD-STRING          ::= OCTET STRING
                     -- digits 0 through 9, two digits per octet,
                     -- each digit encoded 0000 to 1001,
                     -- 1111 used as filler when there is an odd number of digit.

AddressString        ::= OCTET STRING (SIZE (1..maxAddressLength))
                     -- see internal description in section 6.4.1

IsdnAddressString              ::= AddressString (SIZE (1..10))

ExternalSignalInfo             ::= SEQUENCE{
                               protocolId   ProtocolId,
                               signalInfo   SignalInfo}

SignalInfo           ::= OCTET STRING (SIZE (1..maxSignalInfoLength))

ProtocolId           ::= ENUMERATED{
                     gsm-0408            (1),
                     gsm-0806            (2),
                     gsm-0808-bssmap     (3),
                     isup-Q763           (4)}
```

Figure 6.4/2 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: common data types

```
-- data types for numbering and identification

IMSI        ::= TBCD-STRING (SIZE (2..8))
                    -- MCC, MNC, MSIN concatenated in this order

TMSI        ::= OCTET STRING (SIZE (1..4))


SubscriberId        ::= CHOICE {
                    imsi        [0] IMPLICIT IMSI,
                    tmsi        [1] IMPLICIT TMSI}

--
IMEI        ::= TBCD-STRING (SIZE (8))
                    -- Internal Structure
                    -- Type Approval Code : 6 digits
                    -- manufacturer place : 2 digits
                    -- individual serial number : 6 digits
                    -- unassigned : 1 digit

LocAreaId           ::= OCTET STRING (SIZE (2..5))
                    -- Octets coded according to
                    -- Recommendation GSM 04.08
                    -- Internal structure
                    -- Mobile Country Code : 3 digits according to Rec E.212
                    --                     : 1 filler (1111)
                    -- Mobile Network Code: 2 digits  according to Rec E.212
                    -- Location Area Code  : 2 octets  according to GSM 04.08

LocationInfo        ::= CHOICE {
                    roamingNumber       [0] IMPLICIT IsdnAddressString,
                    mscNumber           [1] IMPLICIT IsdnAddressString}

HlrId       ::= IMSI
                    -- leading digits of IMSI

HlrList     ::= SEQUENCE
                        SIZE(1.. maxNumberOfHlrId) OF HlrId


LMsId       ::= OCTET STRING (SIZE (4))


GlobalCellId        ::= OCTET STRING (SIZE (5..7))
                    -- Octets coded according to
                    -- Recommendation GSM 04.08
                    -- Internal structure
                    -- Mobile Country Code : 3 digits according to Rec E.212
                    --                     : 1 filler (1111)
                    -- Mobile Network Code: 2 digits  according to Rec E.212
                    -- Location Area Code  : 2 octets (LAC) according
                    -- to GSM 04.08
                    -- Cell identity       : 2 octets (CI)  according to GSM 04.08
```

Figure 6.4/3 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: numbering and identification

```
-- data types for subscriber management

--
Category            ::= OCTET STRING (SIZE (1))
                    -- internal structure defined in CCITT Rec Q.763

EquipStatus         ::= ENUMERATED {
                    white-listed (0),
                    black-listed (1),
                    grey-listed  (2)}

BearerServiceCode            ::= OCTET STRING (SIZE (1))
                    -- Internal structure according to table 6.4/1
                    -- BIT 8 Transparency indicator (if applicable)
                    --     0 transparent
                    --     1 non transparent

                    -- BIT 7654  Bearer service group
                    --    0001 3.1 kHz ex PLMN
                    --    0010 Circuit data asynchronous
                    --    0011 Circuit data synchronous
                    --    0100 PAD access c.d.a
                    --    0101 Packet data synchrounous
                    --    0110 Alternate speech/c.d.a
                    --    0111 Alternate speech c.d.s
                    --    1000 Speech followed by data c.d.a
                    --    1001 Speech followed by data c.d.s
                    --    1111 12.6 kb/s unrestricted digital

                    -- BIT 321  Rate (when applicable)
                    --    000 Any
                    --    001 300-300 b/s
                    --    010 1200-1200b/s
                    --    011 1200-75b/s
                    --    100 2400-2400b/s
                    --    101 4800-4800b/s
                    --    110 9600-9600b/s


                    -- Bits 321 = 000 can be used to refer to all
                    -- the bearer services of the corresponding group.
                    -- Value "00000000" can be used to refer to all the defined
                    -- bearer services.
                    -- For the codes referring to a group or all bearer services
                    -- the Transparency Indicator is not applicable and has to be set to "0"

BearerServiceList ::= SEQUENCE
                      SIZE(1 .. maxNumberOfBearerServices)
                      OF BearerServiceCode
```

Figure 6.4/4 (Sheet 1 of 2)

ASN.1 Specification of MAP data types: subscriber management

BearerServiceCode

7564321	Meaning
0000000	All bearer services
0001000	3.1 Khz group
0001001	3.1 Khz ex PLMN
0001010	alternate/speech
0001011	speech followed by 3.1 Khz
0010000	Data c.d.a
0010001	Data c.d.a 300b/s
0010010	Data c.d.a 1200b/s
0010011	Data c.d.a 1200-75b/s
0010100	Data c.d.a 2400b/s
0010101	Data c.d.a 4800b/s
0010110	Data c.d.a 9600b/s
0011000	Data c.d.s
0011010	Data c.d.s 1200b/s
0011100	Data c.d.s 2400b/s
0011101	Data c.d.s 4800b/s
0011110	Data c.d.s 9600b/s
0100000	PAD access c.d.a
0100001	PAD access c.d.a 300b/s
0100010	PAD access c.d.a 1200b/s
0100011	PAD access c.d.a 1200-75b/s
0100100	PAD access c.d.a 2400b/s
0100101	PAD access c.d.a 4800b/s
0100110	PAD access c.d.a 9600b/s
0101000	Data p.d.s
0101100	Data p.d.s 2400b/s
0101101	Data p.d.s 4800b/s
0101110	Data p.d.s 9600b/s
0110000	Alternate speech/ data c.d.a
0111000	Alternate speech/data c.d.s
1000000	Speech followed by data c.d.a
1001000	Speech follwoed by data c.d.s
1111000	12 kb/s Unrestricted Digital

Table 6.4/1

TeleServiceCode

Contents	Meaning
00000000	All teleservices
00010000	Speech transmission
00010001	Telephony
00010010	Emergency calls
00100000	Short messages services
00100001	Short message MT/PP
00100010	Short message MO/PP
00110000	Data MHS
00110001	Advanced MHS access
01000000	Videotex access services
01000001	Videotex access profile 1
01000010	Videotex access profile 2
01000011	Videotex access profile 3
01010000	Teletex service
01010001	Teletex CS
01010010	Teletex PS
01100000	Facsimile
01100001	Facsimile Group 3 and alternate speech
01100010	Automatic Facimile Group 3

Table 6.4/2

```
TeleserviceCode     ::= OCTET STRING (SIZE (1))
                    -- Internal structure according to table 6.4/2
                    -- Bit 8-5 encode the teleservice group

                    -- Bit 4-1 = 0000 can be used to refer to all the
                    -- teleservices  of the corresponding group.
                    -- Value "00000000" can be used to refer to all the defined
                    -- teleservices

TeleserviceList     ::= SEQUENCE
                       SIZE(1 .. maxNumberOfTeleservices)
                       OF TeleserviceCode


BasicServiceCode ::= CHOICE {
                    bearerService          [2] IMPLICIT BearerServiceCode,
                    teleservice            [3] IMPLICIT TeleserviceCode}

BasicServiceList    ::= SEQUENCE
                       SIZE(1 .. maxNumberOfBasicServices)
                       OF BasicServiceCode

--
SubscriberStatus    ::= ENUMERATED{
                    serviceGranted          (0),
                    operatorOGCallBarring  (1)}
```

Figure 6.4/4 (Sheet 2 of 2)

ASN.1 Specification of MAP data types: subscriber management

SS-Code

Contents	Meaning
00010001	Calling number identification presentation
00010010	Calling number identification restriction
00010011	Called number identification presentation
00010100	Called number identification restriction
00010101	Malicious call identification
00100001	Call forwarding unconditional
00101000	All conditional forwarding services
00101001	Call forwarding on mobile subscriber busy
00101010	Call forwarding on no reply
00101011	Call forwarding on subscriber not reachable
00110001	Call transfer
00110010	Mobile access hunting
01000001	Call waiting
01000010	Call hold
01000011	Completion of calls to busy subscribers
01010001	Three party service
01010010	Conference calling
01100001	Closed user groupe
01110001	Advice of charge
01110010	Freephone service
01110011	Reverse charging
10000001	User to user signalling
10010001	Barring of outgoing calls
10010010	Barring of all outgoing calls
10010011	Barring of all outgoing international calls
10010100	Barring of all OG international non-HPLMN directed calls
10011001	Barring of incoming calls
10011010	Barring of all incoming calls
10011011	Barring of all IC calls when outside HPLMN

Table 6.4/3

```
-- Data types for supplementary services

SS-Code             ::= OCTET STRING (SIZE(1))
                    -- internal strucure according to
                    -- table 6.4/3
                    -- Bit 8-5
                    -- 0001 Number Identification services
                    -- 0010 Forwarding services
                    -- 0011 Call offering services
                    -- 0100 Call completion services
                    -- 0101 Multi-party services
                    -- 0110 Community of interest services
                    -- 0111 Charging services
                    -- 1000 Additional information transfer services
                    -- 1001 Call restriction services
                    -- Bit 4-1 = 0000 can be use to refer to
                    -- a group of supplementary services
                    -- eg, "00100000" can be used to refer to all
                    -- forwarding services
                    -- "00101000" can be used to refer to all
                    -- conditional forwarding services
                    -- "00000000" can be used to refer to all
                    -- supplementary services

SS-CodeList         ::= SEQUENCE
                        SIZE(1 .. maxNumberOfSupplServices)
                        OF SS-Code


SS-Status           ::= OCTET STRING (SIZE (1))
                    -- Bit 8-4 Unused
                    -- Bit 3   Provision indicator
                    --     0 : Not provisioned
                    --     1 : Provisioned
                    -- Bit 2   Registration indicator (if applicable)
                    --     0 : Not Registered
                    --     1 : Registered
                    -- Bit 1   Activation indicator (if applicable)
                    --     0 : Not Active
                    --     1 : Active

SS-Information      ::= CHOICE{
                    forwardingInfo      [0] IMPLICIT ForwardingInfo,
                    callBarringInfo     [1] IMPLICIT CallBarringInfo,
                    cug-Information     [2] IMPLICIT CUG-Information,
                    ss-Data             [3] IMPLICIT SS-Data}

SS-InfoList         ::= SEQUENCE
                        SIZE(1 .. maxNumberOfSupplServices)
                        OF SS-Information
```

Figure 6.4/5 (Sheet 1 of 4)

ASN.1 Specification of MAP data types: supplementary services

```
--
SS-Data ::= SEQUENCE{
        ss-Code                  SS-Code,
        ss-Status                [4] IMPLICIT SS-Status OPTIONAL,
        ss-SubscriptionOption    SS-SubscriptionOption OPTIONAL}


SS-DataList          ::= SEQUENCE
                         SIZE(1 .. maxNumberOfSupplServices)
                         OF SS-Data


SS-Request           ::= ENUMERATED{
                     registration (0),
                     erasure (1),
                     activation (2),
                     deactivation(3),
                     interrogation (4),
                     invoke (5)}


SS-SubscriptionOption        ::= CHOICE{
        perCallBasis                       [5] IMPLICIT BOOLEAN,
        notificationToHeldRetrievedParty   [6] IMPLICIT BOOLEAN,
        userToUserServiceIndicator         [7] IMPLICIT UserToUserServiceIndicator,
        maximumConfereesNumber             [8] IMPLICIT MaximumConfereesNumber,
        huntGroupAccessSelectionOrder      [9] IMPLICIT HuntGroupAccessSelectionOrder}


ForwardingOptions            ::= OCTET STRING (SIZE(1))
                     -- Bit 8-7  Notification to forwarding party
                     --         00  No notification
                     --         01  notification with calling number identity
                     --         10  notification without calling number identity
                     -- Bit 6-5  Notification to calling party
                     --         00 No notification
                     --         01 Notification with forwarded-to number
                     --         10 Notification without forwarded-to number


UserToUserServiceIndicator           ::= OCTET STRING (SIZE(1))
                     -- Bit 8   : service 1
                     -- Bit 7   : service 2
                     -- Bit 6   : service 3
                     -- Bit 5-1 : Reserved
                     -- Bit 8 to 6 coded "1" if the service
                     -- is available to the subscriber


MaximumConfereesNumber               ::= INTEGER (1..10)
```

Figure 6.4/5 (Sheet 2 of 4)

ASN.1 Specification of MAP data types: supplementary services

```
HuntGroupAccessSelectionOrder ::= ENUMERATED{
                    random      (0),
                    sequential  (1)}


NoReplyConditionTime        ::= INTEGER (5..30)


NumberOfConferees           ::= INTEGER (1..10)


CUG-Facilities      ::=  OCTET STRING (SIZE (1))
                    -- Bit 8-3 000000 (Unused)
                    -- Bit 2-1
                    --   00 CUG only facilities
                    --   01 CUG with outgoing access
                    --   10 CUG with incoming access
                    --   11 CUG with both outgoing and incoming access

CUG-Interlock       ::= OCTET STRING (SIZE (4))
                    -- Internal structrure defined in Rec CCITT Q.763

CUG-Index           ::=  OCTET STRING (SIZE (1))
                    -- Internal structrure defined in Rec CCITT Q.763

CUG-Options         ::=  OCTET STRING (SIZE (1))
                    -- BIT 8-4 00000 (Unused)
                    -- BIT 3 preferential CUG indicator
                    -- 0 no preferential
                    -- 1 preferential CUG
                    -- BIT 2 barring of incoming calls within the CUG
                    -- 0 no barring
                    -- 1 barring
                    -- BIT 1 barring of outgoing calls within the CUG
                    -- 0 no barring
                    -- 1 barring

CUG-Feature         ::= SEQUENCE {
        cug-interlock           CUG-Interlock,
        cug-Index               CUG-Index,
        cug-Options             CUG-Options,
        ss-Status               SS-Status}


CUG-FeatureList ::=             SEQUENCE SIZE (
                    1..maxNumberOfCUG) OF CUG-Feature
```

Figure 6.4/5 (Sheet 3 of 4)

ASN.1 Specification of MAP data types: supplementary services

```
CUG-Information ::= SEQUENCE{
        cug-Facilities          CUG-Facilities,
                                CHOICE{
        cug-Feature                     [0] IMPLICIT CUG-Feature,
        cug-FeatureList                 [1] IMPLICIT CUG-FeatureList}}
                -- the first alternative of the choice should be used
                -- for the preferred CUG.

--
ForwardingInfo ::= SEQUENCE{
        ss-Code                 SS-Code OPTIONAL,
        forwardingFeatureList   ForwardingFeatureList}

ForwardingData ::= SEQUENCE{
        forwardedToNumber       [5] IMPLICIT IsdnAddressString,
        forwardingOptions       [6] IMPLICIT ForwardingOptions OPTIONAL}


ForwardingFeature               ::= SEQUENCE {
        basicService            BasicServiceCode OPTIONAL,
        ss-Status               [4] IMPLICIT SS-Status,
        forwardedToNumber       [5] IMPLICIT IsdnAddressString OPTIONAL,
        forwardingOptions       [6] IMPLICIT ForwardingOptions OPTIONAL,
        noReplyConditionTime    [7] IMPLICIT NoReplyConditionTime  OPTIONAL}

ForwardingFeatureList           ::= SEQUENCE SIZE (1.. maxNumberOfForwardingFeatures)
                                        OF ForwardingFeature

CallBarringInfo ::= SEQUENCE {
        ss-Code     SS-Code,
        callBarringFeatureList  CallBarringFeatureList}

CallBarringFeature              ::= SEQUENCE{
        basicServiceCode        BasicServiceCode OPTIONAL,
        ss-Status               [4] IMPLICIT SS-Status }

CallBarringFeatureList          ::= SEQUENCE SIZE (1.. maxNumberOfCallBarringFeatures)
                                        OF CallBarringFeature

SubscriberData ::= SEQUENCE{
        msisdn                          [1] IMPLICIT IsdnAddressString OPTIONAL,
        category                        [2] IMPLICIT Category OPTIONAL,
        subscriberStatus                [3] IMPLICIT SubscriberStatus OPTIONAL,
        bearerServiceList               [4] IMPLICIT BearerServiceList OPTIONAL,
        teleserviceList                 [6] IMPLICIT TeleserviceList OPTIONAL,
        provisonedSupplServices         [7] IMPLICIT SS-InfoList OPTIONAL}
```

Figure 6.4/5 (Sheet 4 of 5)

ASN.1 Specification of MAP data types: supplementary services

```
SS-Notification     ::= OCTET STRING (SIZE (1))
                    -- 1 bit per defined indication

Password            ::= CHOICE {
                    PrintableString (SIZE(4..8)),
                    NumericString (FROM (
                    "0" | "1" | "2" | "3" | "4" |
                    "5" | "6" | "7" | "8" | "9") |
                    SIZE(4))}
                    -- only the second form is used for GSM systems.

GuidanceInfo        ::=  ENUMERATED{
                    guidance0 (0),
                    guidance1 (1),
                    guidance2 (2),
                    guidance3 (3),
                    guidance4 (4)}

                    -- the identifiers used in this description represent
                    -- the information which has to be delivered to the subscriber
                    -- according to table 6.4/4.
                    -- How this information is really delivered to the subscriber
                    -- (display, annoucement, ...) is not part of this specification.

SS-UserData         ::= IA5String (SIZE (1.. maxSignalInfoLength))
```

Figure 6.4/5 (Sheet 5 of 5)

ASN.1 Specification of MAP data types: supplementary services

number	Information to be provided
guidance0	enter password
guidance1	enter new password
guidance2	enter new password again
guidance3	bad password try again
guidance4	bad password format try again

Table 6.4/4

```
-- Data types for call parameters

CallReference        ::= OCTET STRING (SIZE (1..3))

CallType             ::= ENUMERATED{
                     incomingCall          (0),
                     forwardedCallPortion  (1),
                     reroutedCallPortion   (2),
                     outgoingCall          (3),
                     ss-Request            (4)}

SS-ChargingData      ::= SEQUENCE {
          ss-Code    [1] IMPLICIT SS-Code,
          ss-Request [2] IMPLICIT SS-Request,
          charge     [3] IMPLICIT Charge OPTIONAL}

SS-ChargingInfo      ::= SEQUENCE
                         SIZE(1..maxNumberOfSupplServices)
                         OF SS-ChargingData

CallDuration         ::= INTEGER (0..maxCallDuration)

CallDateTime         ::= GeneralizedTime (SIZE (14 .. 24))
                     -- local time and time differential
                     -- to UTC time

PacketDataVolume             ::= INTEGER (1..maxPacketDataVolume)

Charge   ::= INTEGER (1.. maxNumberOfChargingUnit)

ChargingUnit         ::= ENUMERATED {
                     specialDrawingRights (0)}

CallStatus           ::= ENUMERATED
                     {undetermined                          (0),
                     successfulNormalTermination            (1),
                     successfulAbnormalTermination          (2),
                     forwarded                              (4),
                     forwardedWithAbnormalTermination       (5),
                     rerouted                               (6),
                     reroutedWithAbnormalTermination        (7),
                     unsuccessfulNoRadioContact             (8),
                     unsuccessfulNoResponse                 (9),
                     unsuccessfulBusySubscriber             (10),
                     unsuccessfulSystemFailed               (11),
                     unsuccessfulSusbcriptionViolation      (12),
                     unsuccessfulUnsupportedFacility        (13)}

NumberOfForwarding           ::= INTEGER (1..5)
```

Figure 6.4/6 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: call set-up

```
-- Data types for radio parameters

ChannelType          ::= OCTET STRING (SIZE (1..10))
                     -- Concatenation of
                     -- Speech data indicator
                     -- Channel rate
                     -- Speech encoding algorithm/ data rate
                     -- + transparency indicator
                     -- as defined in Recommendation GSM 08.08


ClassmarkInformation        ::= OCTET STRING (SIZE (1..2))
                     -- classmark information element type 1 or 2
                     -- contents as defined in Recommendation 08.08


HandoverPriority     ::= OCTET STRING (SIZE (1))
                     -- internal structure defined in Recommendation GSM 08.08



HandoverType         ::= ENUMERATED
                     {interBSS (0),
                      intraBSS (1)}
```

Figure 6.4/7 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: handover

```
-- Data types for security procedures

AuthenticationSet ::= SEQUENCE {
        rand        Rand,
        sres        Sres,
        kc          Kc}

Rand      ::= OCTET STRING (SIZE (16))

Sres      ::= OCTET STRING (SIZE (4))

Kc        ::= OCTET STRING (SIZE (8))

Ki        ::= OCTET STRING (SIZE (16))

CKSN      ::= OCTET STRING (SIZE (1))
                    -- bits 8-4 unused
                    -- bits 3-1 coded as specified in recommendation GSM 04.08

CipheringMode   ::= ENUMERATED{
                    noEncryption (1),
                    version1-GSM (2)}
```

Figure 6.4/8 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: authetication and security

```
-- Data types for short message services

SM-RP-DA          ::= CHOICE{
        imsi                    [0] IMPLICIT IMSI,
        lMsId                   [1] IMPLICIT LMsId,
        roamingNumber           [3] IMPLICIT IsdnAddressString,
        serviceCentreAddress    [4] IMPLICIT AddressString}


SM-RP-OA          ::= CHOICE{
        msIsdn                  [2] IMPLICIT IsdnAddressString,
        serviceCentreAddress    [4] IMPLICIT AddressString}


SM-RP-UI          ::= OCTET STRING (SIZE (1..maxSignalInfoLength))
```

Figure 6.4/9 (Sheet 1 of 1)
ASN.1 Specification of MAP data types: short messages

```
-- fault recovery, call tracing

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

TraceType         ::= INTEGER{
                  allEvents (0),
                  onlyCalls (1),
                  eventSet1 (2),
                  eventSet254 (255)}
                  (0..255)
                  -- Identifiers eventSet1 to eventSet254 corresponds to
                  -- sets of events pre-defined by each operator.

NetworkResource   ::= ENUMERATED
                  {pLMN              (0),
                  hLR                (1),
                  vLR                (2),
                  previous-VLR       (3),
                  controlling-MSC    (4),
                  vMSC               (5),
                  eIR                (6),
                  radioSubSystem     (7)}
```

Figure 6.4/10 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: fault recovery, call tracing

```
-- other data types

RequestParameter            ::= ENUMERATED{
                        request-IMSI                    (0),
                        request-AuthenticationSet       (1),
                        request-SubscriberData          (2),
                        request-CUG-Information         (3),
                        request-Ki                      (4)}

RequestParameters           ::= SEQUENCE SIZE (1..2) OF RequestParameter

SentParameter       ::= CHOICE{
        imsi                    [0] IMPLICIT IMSI,
        authenticationSet       [1] IMPLICIT AuthenticationSet,
        susbcriberData          [2] IMPLICIT SubscriberData,
        cug-information         [3] IMPLICIT CUG-Information,
        ki                      [4] IMPLICIT Ki}


SentParameters      ::= SEQUENCE
                          SIZE(1..maxNumberOfSentParameters)
                          OF SentParameter


CmServiceType       ::= ENUMERATED{
                        mobileOriginatingCall                       (1),
                        emergencyCallEstablishment                  (2),
                        shortMessageService                         (4),
                        ss-request                                  (8),
                        mobileOriginatingCallRe-establishment       (9),
                        mobileTerminatingCall                       (10)}

-
AccessConnectionStatus      ::= OCTET STRING (SIZE (1))
                        -- Bit 8-4 Reserved
                        -- Bit 3
                        --     0 No RR- connection
                        --     1 RR-connection established
                        -- Bit 2
                        --     0 Ciphering mode off
                        --     1 Ciphering mode on
                        -- Bit 1
                        --     0 MM-connection existing and authenticated
                        --     1 MM-connection existing and not authenticated

END -- End of data types specifications
```

Figure 6.4/11 (Sheet 1 of 1)

ASN.1 Specification of MAP data types: miscellaneous

6.4.3 Identifiers definitions

The parameters which are described in the following sub-sections correspond to the identifiers used in operation and errors types definitions.

For each identifier, it is generally possible to derive an identifier which reprents a list of the information elemnts reprsented by this identifier. The resulting identifier is formed by the previous indentifier concatenated with the characters "List" (e.g the identifier for a list of callBarringData elements is callBarringDataList)

6.4.3.1 Numbering and Identification parameters

6.4.3.1.1 subscriberId

The *subscriberId* identifier is used to represent the identify the subscriber, it can refer to the IMSI or the TMSI.

6.4.3.1.2 imsi

The imsi identifier refers to the International Mobile subscriber Identity. The structure of this idenity is defined in GSM Recommendation 03.03.

6.4.3.1.3 tmsi

The tmsi identifier refers to the Temporary Mobile Subscriber Identity.

6.4.3.1.4 imei

The imei identifier refers to the International Mobile Station Equipment Identity. The structure of this identity is as follows:

Internal Structure :	
Type Approval Code :	6 digits
manufacturer place :	2 digits
individual serial number :	6 digits
unassigned :	1 digit

6.4.3.1.5 previousLocAreaId

The previousLocAreaId identifier refers to the identify of the current location area where a subscriber is roaming.

6.4.3.1.6 storedLocAreaId

The storedLocAreaId identifier refers to the location area identify which is stored in the network for a given subscriber.

6.4.3.1.7 targetLocAreaId

The targetLocAreaId identifier refers to the identity of the location area in which a mobile subscriber wants to roam.

6.4.3.1.8 targetCellId

The targetCellId identifier refers to the identity of the cell on which a call has to be handed over.

6.4.3.1.9 servingCellId

The servingCellId identifier refers to the identity of the serving cell.

6.4.3.1.10 originatingEntityNumber

This identifier refers to an application level identification of a system component, which is currently its associated ISDN number.

6.4.3.1.11 mscNumber

The mscNumber identifier refers to the ISDN number of a Mobile-services Switching Centre.

6.4.3.1.12 targetMscNumber

The targetMscId identifiers refers to the ISDN number of a MSC on which a call has to be handed over.

6.4.3.1.13 hlrNumber

The hlrNumber identifier refers to the ISDN number of a home location register.

6.4.3.1.14 vlrNumber

The vlrNumber identifier refers to the ISDN number of a visitor location register.

6.4.3.1.15 hlrId

The hlrId identifier refers to the identity of a Home Location Register based on a E.212 number (using the leading digits of the IMSI which are managed by this entity). Logical sub-units can also be identified by adding part of the digits of the corresponding MSIN.

6.4.3.1.16 lMsId

The lMsId identifier refers to an internal identity, allocated by the VLR to every registered mobile subscriber. This information is included, if received, in the messages destinated to the VLR, when no roaming number is present.

6.4.3.1.17 msisdn

This identifier refers to the ISDN number of the mobile subscriber (MS ISDN number) accoring to CCITT Recommendation E213.

6.4.3.1.18 omcId

The omcId identifier refers to the identify of an operation and maintenance centre.

6.4.3.1.19 roamingNumber

The roamingNumber identifier refers to a mobile subscriber roaming number, as defined in recommendation E.213.

6.4.3.1.20 previousRoamingNumber

The previousRoamingNumber identifier refers to the roaming number which is stored in a HLR which request the VLR for a new one.

6.4.3.1.21 locationInfo

The locationInfo identifier refers to the information which is provided by the mobile network to indicate the location of a mobile subscriber. It can be either a roaming number or the isdn number of the serving MSC.

6.4.3.1.22 routingInfo

The routingInfo identifiers refers to the information returned by the mobile network in response to an interrogation procedure. It can be either a roaming number or a forwarded-to number.

6.4.3.1.23 incomingId

The incomingId identifier refers to the identity which is used to access the VLR for incoming call set-up. It is either a roaming number or an IMSI.

6.4.3.1.24 handoverNumber

The handoverNumber identifier refers to a number used to route a call between MSC during handover.

6.4.3.1.25 forwardedToNumber

The forwardedToNumber identifier refers to an address where the calls are forwarded to.

6.4.3.1.26 calledNumber

The calledNumber identifier refers to a number called by the mobile subscriber.

6.4.3.1.27 callingNumber

The callingNumber identifier refers to a calling party address.

6.4.3.1.28 dialledNumber

The dialledNumber identifier refers to the number dialled by the calling party to reach a mobile subscriber. It is one of the msisdn allocated to this subscriber.

6.4.3.2 Subscriber management parameters

6.4.3.2.1 category

This identifier refers to the subscriber category as defined in CCITT Recommendation Q.763.

6.4.3.2.2 subscriberData

This identifier refers to all the data attached to a subscriber which have to be known in the VLR (directory number, subscription information, supplementary service information, ...)

6.4.3.2.3 equipStatus

The equipStatus identifier refers to the status of a mobile equipment.

6.4.3.2.4 bearerService

This identifier refers to a bearer service or a group of bearer services.

6.4.3.2.5 teleService

This identifier refers to a teleservice or a group of teleservices.

6.4.3.2.6 basicService

This parameter type refers to a basic service (teleservice or bearer service) involved in call or supplementary service handling.

6.4.3.2.7 activeBasicServices

This identifier refers to a list of basic services for which a supplementary service is active.

6.4.3.2.8 gsm-BearerCapability

This identifierr refers to the GSM bearer capability information element defined in Recommendation GSM 04.08.

6.4.3.2.9 subscriberStatus

This identifier refers to the subscriber status which indicates whether or not calls are barred by the operator.

6.4.3.3 Supplementary services parameters

6.4.3.3.1 ss-Information

The s-Information identifier refers to all the information related to a supplementary service.

6.4.3.3.2 ss-Code

The SS-Code identifier refers to the code which identify a supplementary service or a group of supplementary services.

6.4.3.3.3 activeSupplServices

The activeSupplServices represent a list of active supplementary services.

6.4.3.3.4 ss-Status

The ss-Status identifier refers to the status of a supplementary service.

6.4.3.3.5 ss-Data

The ss-Data identifier refers to a set of infromation related to a supplementary service restricted to the supplementary service code, the ss-Status and its associated subscription options.

6.4.3.3.6 provisionedSupplServices

This identifier refers to all the information related to the supplementary services available to a mobile subscriber.

6.4.3.3.7 ss-Request

The ss-request identifier refers to the nature of a supplementary service request.

6.4.3.3.8 ss-SubscriptionOption

This identifier refers to a subscription option attached to a supplementary service.

6.4.3.3.9 forwardingOptions

The ForwardingOptions identifier refers to a set of subscription options related to forwarding services. These options are described in Recommendation GSM 02.82.

6.4.3.3.10 perCallBasis

This subscription option is defined in GSM Rec 02.81

6.4.3.3.11 notificationToHeldRetrievedParty

This subscription option is defined in GSM Rec 02.82.

6.4.3.3.12 userToUserServiceIndicator

This subscription option is defined in GSM Rec 02.87.

6.4.3.3.13 maximumConfereesNumber

This subscription option is defined in GSM Rec 02.84.

6.4.3.3.14 huntGroupeAccessSelectionOrder

This subscription option is defined in GSM Rec 02.82.

6.4.3.3.15 noReplyConditionTime

This identifier refers to a no reply condition time for call forwarding on no reply service.

6.4.3.3.16 numberOfConferees

This identifier refers to the number of conferees requested by the mobile subscriber.

6.4.3.3.17 cug-Information

This identifier refers to all the information related to the CUG supplementary service (cug-facilities and cug-feature for each CUG).

6.4.3.3.18 cug-Feature

This identifier refers to the information related to a particular CUG (interlock code, index, options and status).

6.4.3.3.19 cug-Facilities

This identifier refers to the general subscription options related to the CUG service.

- CUG only facilities
- CUG with outgoing access
- CUG with incoming access
- CUG with both outgoing and incoming access

6.4.3.3.20 cug-Interlock

A cug-Interlock identifier refers to the interlock code of a CUG, as defined in Recommendation CCITT Q.763.

6.4.3.3.21 cug-Index

A CUG-Index identifier represnts the index of a CUG, as defined in recommendation CCITT Q.763.

6.4.3.3.22 cug-Options

This identifier refers to the subscription options attached to a particular CUG.

- preferential CUG indicator
- barring of incoming calls within the CUG
- barring of outgoing calls within the CUG

6.4.3.3.23 forwardingInfo

The forwardingInfo identifier refers to a sequence of information attached to a call forwarding supplementary service (the ss-Code and if required, a forwardingFeature parameter for each specific basic service).

6.4.3.3.24 forwardingFeature

The forwardingFeature identifier refers to a sequence of information attached to a call forwarding supplementary service for a specific basic service (ss-Status, forwardingOptions and if applicable forwrdedToNumber and noReplyConditionTime). If no basicService parameter is provided in such a sequence, the forwardingFeature identifier applies to all the basic services.

6.4.3.3.25 forwardingData

The forwardingData identifers refers to the data required by the network to invoke a call forwarding procedure (i.e forwarded-to number and associated subscription options).

6.4.3.3.26 callBarringInfo

The callBarringInfo identifier refers to a sequence of information attached to a call barring supplementary service. When the supplementary service status depends on the basic service callBarringFeature parameter is provided for a specific basic service.

6.4.3.3.27 CallBarringFeature

The CallBarringFeature identifier refers to the association between the status of a call barring supplementary service and a basic service.

6.4.3.3.28 ss-Notification

This identifier refers to one or several supplementary service notifications which have to be forwarded to a subscriber.

6.4.3.3.29 currentPassword

This identifier refers to a password used by the subscriber for supplementary service control.

6.4.3.3.30 newPassword

This identifier refers to a new password provided by the subscriber during a password modification procedure.

6.4.3.3.31 guidanceInfo

This identifier refers to the guidance information which is delivered to a subscriber which is requested to provide a password. The following information can be passed to the subscriber:

- enter password
- enter new password
- enter new password again
- bad password try again
- bad password format try again

6.4.3.3.32 ss-UserData

This identifier refer to a set of information which alows end to end operation of supplementary service according specific operator rules.

6.4.3.4 Call parameters

6.4.3.4.1 callReference

The callReference identifier refers to a call reference allocated by a call control MSC.

6.4.3.4.2 callType

This identifier refers to the reason of a charging message.

- Incoming call
- Forwarded call portion
- Rerouted call portion
- Outgoing call
- Handling of supplementary service

6.4.3.4.3 ss-ChargingDataInfo

This identifier refers to a set of parameters required to charge a subscriber for the use of a supplementary service during a call (ss-Request, ss-Code and charge).

6.4.3.4.4 ss-ChargingData

This identifier refers to the set of information required to charge a subscriber for all supplementary service used during a call.

6.4.3.4.5 callDuration

The callDuration identifier refers to a call duration (in seconds)

6.4.3.4.6 callDateTime

The CallDateTime identifier refers to the date and time of a call termination, even when the call is only a supplementary service request.

6.4.3.4.7 packetDataVolume

This identifier refers to a volume of data tranferred by a mobile subscriber, expressed in Kilobit.

6.4.3.4.8 charge

The Charge identifier refers to an amount of charges, expressed in the unit specified by the associated ChargingUnit parameter.

6.4.3.4.9 chargingUnit

This identifier refers to a charging unit.

6.4.3.4.10 callStatus

This identifier refers to indicate the status of a call described in a charging record.

- Undetermined
- Successful with normal termination
- Successful with abnormal termination
- Spare
- Forwarded
- Forwarded with abnormal termination
- Rerouted
- Rerouted with abnormal termination
- Unsuccessful due to no radio contact
- Unsuccessful due to no response
- Unsucessful due to busy subscriber
- Unsuccessful due to system failure
- Unsuccessful due to subscription violation
- Unsuccessful due to not supported facility

6.4.3.4.11 numberOfForwarding

This identifier refers to the number of times that a call has been forwarded.

6.4.3.5 Radio parameters

6.4.3.5.1 channelType

The channelType identifier refers to all the information required by a BSS to determine a type of radio resource to allocate.

6.4.3.5.2 classmarkInformation

The classmarkInformation identifier refers to represent classmark information required for handover procedure and defined in Recommendation GSM 04.08.

6.4.3.5.3 handoverPriority

The handoverPriority identifier refers to the priority level of an handover request.

6.4.3.5.4 handoverType

The handoverType identifier refers to the type of handover which may occur within the area controlled by an MSC.

6.4.3.6 Authentication Parameters

6.4.3.6.1 authenticationSet

This identifier refers to a set of authentication parameters related to a subscriber (rand, sres and kc). Generally several sets are transmitted.

6.4.3.6.2 rand

The rand identifier refers to a random number used for authentication procedures.

6.4.3.6.3 sres

The sres identifier refers to a response to an authentication request.

6.4.3.6.4 kc

The kc identifier refers to a key used for ciphering purpose.

6.4.3.6.5 ki

The ki identifier refers to an authentication key for a the mobile subscriber.

6.4.3.6.6 cksn

This identifier refers to a ciphering key sequence number.

6.4.3.6.7 cipheringMode

This identifier refers to the ciphering mode which is associated with a radio link (no ciphering or ciphering algorithm identification).

6.4.3.7 Short Message services parameters

6.4.3.7.1 sm-RP-DA

The sm-RP-DA identifier refers to a destination address used by the short message service relay sub-layer protocol.

6.4.3.7.2 sm-RP-OA

The sm-RP-OA identifier refers to an originating address used by the short message service relay sub-layer protocol.

6.4.3.7.3 mwd-Set

The mwd-Set identifier refers to a parameter used by the the short message service relay sub-layer protocol to indicate whether or not the address of the originator SC is already contained in the Mobile Waiting Data.

6.4.3.7.4 sm-RP-UI

The sm-RP-UI parameter type refers to the user data field carried by the short message service relay sub-layer protocol.

6.4.3.7.5 sm-RP-PRI

The sm-RP-PRI identifier refers to a priority request parameter used by the short message service relay sub-layer protocol to indicate whether or not a short message transfer should be stopped if a SC address is already contained in the Mobile Waiting Data.

6.4.3.7.6 serviceCentreAddress

The serviceCentreAddress identifier refers to the network address of a short message service centre.

6.4.3.8 Others

6.4.3.8.1 bss-APDU

This identifier refers to a set of information exchanged between a call control MSC and a mobile subscriber which has been handed over MSC-B. Such a parameter fits into the user data field of the Network Protocol Data Units (NPDUs) of the BSS/MSC interface. These user data consist of DTAP messages including the Data Link Connection Identifier (DLCI) parameter (See

Recommendation GSM 08.06) which is required by the serving BSS to interface properly with the layer-2 on the radio side.

6.4.3.8.2 requestParameters

This identifier refers to a set of subscriber related information requested by a system component.

6.4.3.8.3 sentParameters

This identifier refers to a set of subscriber related information sent by a system component in response to an associated enquiry.

6.4.3.8.4 networkResource

A networkResource identifier refers to a class of network entity.

6.4.3.8.5 traceReference

The traceReference \identifier refers to a reference associated to a tracing request. This reference is used by the OMC to idenitify a specific trace request related to a subscriber.

6.4.3.8.6 cmServiceType

The cmServiceType identifier refers to represent a subscriber service request (eg, call setup, supplementary service request, short message, ...).

6.4.3.8.7 accessConnectionStatus

The accessConnectionStatus identifier refers to indicate the status of the connection which is established with the mobile subscriber on the radio side.

6.4.3.8.8 traceType

The traceType data type refers to the type of trace associated to a tracing request.

6.4.3.8.9 networkSignalInfo

This identifier refers to a set of information element imported from the ISDN Signalling User Part specified in Rec CCITT Q.763.

6.4.3.8.10 accessSignalInfo

This identifier refers to a set of information elements imported from the user-network layer-3 protocol specified in Rec GSM 04.08.

6.4.4 MAP User abort Information

MAP user abort information is transferred as the value of the MAP-AbortInformation data type described in the following ASN.1 module described in figure 6.4/12. This data type is mapped onto the UserAbortInformation data type included in the TCAP ABORT message, as defined in Recommendation Q.773. Handling of TC-U-ABORT service is described in section 7.

```
MAP-AbortInformation  DEFINITIONS ::=
BEGIN

IMPORTS
maxSignalInfoLength FROM MAP-Constants;

MAPAbortInformation          ::= SEQUENCE{
                    abortCause ENUMERATED{
                              unspecifiedReason (0),
                              versionNotSupported (1),
                              userResourceLimitation (2),
                              resourceUnavailableLongTermProblem (3),
                              resourceUnavailableTemporaryProblem (4),
                              radioChannelRelease (5),
                              networkPathRelease (6),
                              callRelease (7),
                              associatedProcedureFailed (8),
                              remoteOperationFailure (9)},
                    additionalInformation OCTET STRING (SIZE(
                              1..MaxSignalInfoLength))}
                    --
                    -- The internal structure of the OCTET STRING
                    -- is up to the operator

END
```

Figure 6.4/12 (Sheet 1 of 1)

ASN.1 Specification of MAP user abort information

6.5 Operations and errors implementation

For the actual implementation of MAP, operations and errors have to be defined by value. The following ASN.1 module described in figure 6.5/1, imports operations and errors types from the ASN1. module described in sections 6.2 and 6.3 and defines operations by allocating them a local value.

In addition, the following sections identify which operations have to be implemented in each system component and to which type of functional interface(s) they apply.

The functional interfaces are referred to as in section 5 of this recommendation.

- S indicates that the operation is invoked by the entity
- R indicates that the operation has to be performed by the entity.
- Both indicates that the operation can be invoked or performed by the entity.

```
MAP-Protocol DEFINITIONS ::=

BEGIN
IMPORTS

-- Imports operation types

-- Location management
UpdateLocationArea, UpdateLocation, CancelLocation,
DetachIMSI, AttachIMSI, DeregisterMobileSubscriber,

-- Data management
SendParameters, InsertSubscriberData, DeleteSubscriberData,

-- Supplementary Services Handling
RegisterSS, EraseSS, ActivateSS,
DeactivateSS, InterrogateSS, InvokeSS, ForwardSsNotification,
RegisterPassword, GetPassword, ProcessUnstructuredSsData,

-- Call set-up
SendInfoForIncomingCall, SendInfoForOutgoingCall,
SendRoutingInformation,ProvideRoamingNumber,
CompleteCall, ConnectToFollowingAddress, ProcessCallWaiting

-- Paging
 Page, SearchForMobileSubscriber,

-- Handover
 PerformHandover, SendEndSignal,
PerformSubsequentHandover, AllocateHandoverNumber, SendHandoverReport,
ProcessAccessSignalling, ForwardAccessSignalling, NoteInternalHandover,
```

Figure 6.5/1 (Sheet 1 of 6)

ASN.1 Specification of MAP protocol

```
-- Charging
RegisterChargingInformation,

-- Restoration
Reset, ForwardCheckSsIndication,

-- Authentication and security
 Authenticate, ProvideIMSI,
ForwardNewTMSI, SetCipheringMode,


-- Equipment management
CheckIMEI,

-- Short messages
SendRoutingForShortMsg, ForwardShortMessage, SetMessageWaitingData,
NoteMSPresent, AlertServiceCentre,

-- Tracing
ActivateTraceMode, DeactivateTraceMode, TraceSubscriberActivity,

-- Others
ProcessAccessRequest
BeginSubscriberActivity
FROM MAP-Operations

-- imports error types

UnknownSubscriber, UnknownBaseStation,UnknownMSC,
UnknownLocArea, UnidentifiedSubscriber,
UnallocatedRoamingNumber, UnknownEquipment, RoamingNotAllowed,
IllegalMS, BearerServiceNotProvisioned,
TeleserviceNotProvisioned, InsufficientBearerCapabilities,
CallBarred, ForwardingViolation, CUG-Reject,
IllegalSS-Operation, SS-ErrorStatus, SS-NotAvailable,
SS-SubscriptionViolation, SS-Incompatibility, FacilityNotSupported, InvalidTargetBaseStation,
NoRadioResourceAvailable,
NoHandoverNumberAvailable,
SubsequentHandoverFailure,  AbsentSubscriber,
BusySubscriber, NoSubscriberReply, RadioCongestion,
ImpossibleCallCompletion, SM-DeliveryFailure, MessageWaitingListFull, SystemFailure,
DataMissing,
UnexpectedDataValue, PasswordRegistrationFailure,
NegativePasswordCheck, NoRoamingNumberAvailable,
TracingBufferFull
FROM MAP-Errors;
```

Figure 6.5/1 (Sheet 2 of 6)

ASN.1 Specification of MAP protocol

```
-- allocation of local value to operations

updateLocationArea UpdateLocationArea ::= 1

updateLocation UpdateLocation ::= 2

cancelLocation CancelLocation ::= 3

provideRoamingNumber ProvideRoamingNumber ::= 4

detachIMSI DetachIMSI ::= 5

attachIMSI AttachIMSI ::= 6

insertSubscriberData InsertSubscriberData ::= 7

deleteSubscriberData DeleteSubscriberData ::= 8

sendParameters SendParameters ::= 9

registerSS RegisterSS ::= 10

eraseSS EraseSS ::= 11

activateSS ActivateSS ::= 12

deactivateSS DeactivateSS ::= 13

interrogateSS InterrogateSS ::= 14

invokeSS InvokeSS ::= 15

forwardSsNotification ForwardSsNotification ::= 16

registerPassword RegisterPassword ::= 17

getPassword GetPassword ::= 18

processUnstructuredSsData ::= 19

sendInfoForIncomingCall SendInfoForIncomingCall ::= 20

sendInfoForOutgoingCall SendInfoForOutgoingCall ::= 21

sendRoutingInformation SendRoutingInformation ::= 22

completeCall CompleteCall ::= 23

connectToFollowingAddress ConnectToFollowingAddress ::= 24

processCallWaiting ProcessCallWaiting ::= 25
```

Figure 6.5/1 (Sheet 3 of 6)

ASN.1 Specification of MAP protocol

```
page Page ::= 26

searchForMobileSubscriber SearchForMobileSubscriber ::= 27

performHandover PerformHandover ::= 28

sendEndSignal SendEndSignal ::= 29

performSubsequentHandover PerformSubsequentHandover ::= 30

allocateHandoverNumber AllocateHandoverNumber ::= 31

sendHandoverReport SendHandoverReport ::= 32

processAccessSignalling ProcessAccessSignalling ::= 33

forwardAccessSignalling ForwardAccessSignalling ::= 34

noteInternalHandover NoteInternalHandover ::= 35

registerChargingInformation RegisterChargingInformation ::= 36

reset Reset ::= 37

forwardCheckSsIndication ForwardCheckSsIndication ::= 38

authenticate Authenticate ::= 39

provideIMSi ProvideIMSI ::= 40

forwardNewTMSI ForwardNewTMSI ::= 41

setCipheringMode SetCipheringMode ::= 42

checkIMEI CheckIMEI ::= 43

sendRoutingInfoForSM SendRoutingInfoForSM ::= 45

forwardShortMessage ForwardShortMessage ::= 46

setMessageWaitingData SetMessageWaitingData ::= 47

noteMSPresent NoteMsPresent ::= 48

alertServiceCentre AlertServiceCentre ::= 49

activateTraceMode ActivateTraceMode ::= 50

deactivateTraceMode DeactivateTraceMode ::= 51

traceSubscriberActivity TraceSubscriberActivity ::= 52
```

Figure 6.5/1 (Sheet 4 of 6)

ASN.1 Specification of MAP protocol

```
processAccessRequest ProcessAccessRequest ::= 53

beginSubscriberActivity BeginSubscriberActivity ::= 54

--
-- allocation of local value to errors

unknownSubscriber UnknownSubscriber ::= 1

unknownBaseStation UnknownBaseStation ::= 2

unknownMSC UnknownMSC ::= 3

unknownLocArea UnknownLocArea ::= 4

unidentifiedSubscriber UnidentifiedSubscriber ::= 5

unallocatedRoamingNumber UnallocatedRoamingNumber ::= 6

unknownEquipment UnknownEquipment ::= 7

roamingNotAllowed RoamingNotAllowed ::= 8

illegalMS IllegalMS ::= 9

bearerServiceNotProvisioned BearerServiceNotProvisioned ::= 10

teleServiceNotProvisioned TeleServiceNotProvisioned ::= 11

insufficientBearerCapabilities InsufficientBearerCapabilities ::= 12

callBarred CallBarred ::= 13

forwardingViolation ForwardingViolation ::= 14

cug-Reject CUG-Reject ::= 15

illegalSS-Operation IllegalSS-Operation ::= 16

ss-ErrorStatus SS-ErrorStatus ::= 17

ss-NotAvailable SS-NotAvailable ::= 18

ss-SubscriptionViolation SS-SubscriptionViolation ::= 19

ss-Incompatibility SS-Incompatibility ::= 20

facilityNotSupported FacilityNotSupported ::= 21

invalidTargetBaseStation InvalidTargetBaseStation  ::= 23
```

Figure 6.5/1 (Sheet 5 of 6)

ASN.1 Specification of MAP protocol

```
noRadioResourceAvailable NoRadioResourceAvailable ::= 24

noHandoverNumberAvailable NoHandoverNumberAvailable ::= 25

subsequentHandoverFailure SubsequentHandoverFailure ::= 26

absentSubscriber AbsentSubscriber ::= 27

busySubscriber BusySubscriber ::= 28

noSubscriberReply NoSubscriberReply ::= 29

radioCongestion RadioCongestion ::= 30

impossibleCallCompletion ImpossibleCallCompletion ::= 31

sm-DeliveryFailure SM-DeliveryFailure ::= 32

MessageWaitingListFull ::= 33

systemFailure SystemFailure ::= 34

dataMissing DataMissing ::= 35

unexpectedDataValue UnexpectedDataValue ::= 36

passwordRegistrationFailure PasswordRegistrationFailure :: 37

negativePasswordCheck NegativePasswordCheck ::= 38

noRoamingNumberAvailable NoRoamingNumberAvailable ::= 39

tracingBufferFull TracingBufferFull ::= 40


END
```

Figure 6.5/5 (Sheet 6 of 6)

ASN.1 Specification of MAP protocol

6.5.1 Operations for MSC

OPERATION	Interface	S/R
activateSS	B	S
alertServiceCentre	C	R
allocateHandoverNumber	B	S
attachIMSI	B	S
authenticate	B	R
checkIMEI	F	S
completeCall	B	R
connectToFollowingAddress	B	R
deactivateSS	B	S
detachIMSI	B	S
eraseSS	B	S
forwardAccessSignalling	E	Both
forwardcheckssindication	B	R
forwardNewTMSI	B	R
forwardShortMessage	E	Both
forwardSsNotification	B	R
getPassword	B	R
interrogateSS	B	S
invokeSS	B	S
noteInternalHandover	E	Both
page	B	R
performHandover	E	Both
performSubsequentHandover	E	Both
processAccessRequest	B	S
processAccessSignalling	E	Both
processCallWaiting	B	R
processUnstructuredSsData	B	S
provideIMSI	B	R
registerChargingInformation	C	S
registerPassword	B	S
registerSS	B	S
searchForMobileSubscriber	B	R
sendEndSignal	E	Both
sendHandoverReport	B	R
sendInfoForIncomingCall	B	S
sendInfoForOutgoingCall	B	S
sendarameters	B	S
sendRoutingInfoForSM	C	S
sendRoutingInformation	C	S
setCipheringMode	B	R
setMessageWaitingData	C	S
traceSubscriberActivity	B,E	Both
updateLocationArea	B	S

6.5.2 Operations for VLR

OPERATION	Interface	S/R
activateSS	D,B	Both
activateTraceMode	D	R
allocateHandoverNumber	B	R
attachIMSI	B	R
authenticate	B	S
beginSubscriberActivity	B,D	S
cancelLocation	D	R
completeCall	B	S
connectToFollowingAddress	B	S
deactivateSS	D,B	Both
deactivateTraceMode	D	R
deleteSubscriberData	D	R
deregisterSS	D	S
detachIMSI	B	R
eraseSS	D,B	Both
forwardCheckSsIndication	B,D	Both
forwardNewTMSI	B	S
forwardSsNotification	D,B	Both
getPassword	B,D	Both
insertSubscriberData	D	R
interrogateSS	D,B	Both
invokeSS	B	R
noteMsPresent	D	S
updateLocationArea	B	R
page	B	S
processaccessrequest	B	R
processCallWaiting	B	S
processUnstructuredSsData	B,D	Both
provideIMSI	B	S
provideRoamingNumber	D	R
registerPassword	B,D	Both
registerSS	D,B	Both
reset	D	Both
searchForMobileSubscriber	B	S
sendHandoverReport	B	S
sendInfoForIncomingCall	B	R
sendInfoForOutgoingCall	B	R
sendParameters	B,D,G	Both
setCipheringMode	B	S
traceSubscriberActivity	B	S
updatelocation	D	S

6.5.3 Operations for HLR

OPERATION	Interface	S/R
activateSS	D	R
activateTraceMode	D	S
alertServiceCentre	C	S
beginSubscriberActivity	D	R
cancelLocation	D	S
deactivateSS	D	R
deactivateTraceMode	D	S
deleteSubscriberData	D	S
deregisterMobileSubscriber	D	R
eraseSS	D	R
forwardcheckssindication	D	S
forwardSsNotification	D	S
getPassword	D	S
insertSubscriberData	D	S
interrogateSS	D	R
noteMsPresent	D	R
updatelocation	D	R
processUnstructuredSsData	D	R
provideRoamingNumber	D	S
registerChargingInformation	C	R
registerPassword	D	R
registerSS	D	R
reset	D	Both
sendRoutingInfoForSM	C	R
sendRoutingInformation	C	R
setMessageWaitingData	C	R

6.5.4 Operations for EIR

OPERATION	Interface	S/R
Check IMEI	F	R

6.6 Timers in MAP procedures

The following timers are used in the Mobile Application Part ASEs specifications:

OPERATION	Timer	Location	Value
activateSS	T-ss	VLR,MSC	m
activateTraceMode	T-atm	HLR	m
alertServiceCentre	T-asc	HLR	s
allocateHandoverNumber	T-ahn	MSC-B	s
attachIMSI	T-iar	MSC	s
authenticate	T-aut	VLR	s
beginSubscriberActivity	T-bsa	VLR	m
cancelLocation	T-lc	HLR	m
checkIMEI	T-cim	MSC	m
completeCall	T-cc	VLR	m
connectToFollowingAddress	T-co	VLR	s
deactivateSS	T-ss	VLR,MSC	m
deactivateTraceMode	T-dtm	HLR	m
deleteSubscriberData	T-dsd	HLR	m
deregisterMobileSubscriber	T-dr	VLR	m
detachIMSI	T-id	MSC	s
eraseSS	T-ss	VLR,MSC	m
forwardAccessSignalling	T-fas	MSC-A	s
forwardcheckssindication	T-fcs	HLR	s
forwardNewTMSI	T-ft	VLR	s
forwardShortMessage	T-fsm	MSC	m
forwardSsNotification	T-fsn	HLR,VLR	m
getPassword	T-gpw	MSC,VLR	m
insertSubscriberData	T-isd	HLR	m
interrogateSS	T-ss	VLR,MSC	m
invokeSS	T-ss	MSC	m
noteInternalHandover	T-nho	MSC-B	s
noteMsPresent	T-nmp	VLR	s
updateLocationArea	T-lau	MSC	m

OPERATION	Timer	Location	Value
page	T-pa	VLR	m
performHandover	T-ho	MSC-A	s
performSubsequentHandover	T-sho	MSC-B	m
processAccessRequest	T-prq	MSC	m
processAccessSignalling	T-pas	MSC-B	s
processCallWaiting	T-pcw	VLR	s
processUnstructuredSsData	T-pud	MSC,VLR	m
provideIMSI	T-pi	VLR	s
provideRoamingNumber	T-prn	HLR	m
registerChargingInformation	T-ci	MSC	m
registerPassword	T-rpw	MSC,VLR	m
registerSS	T-ss	VLR,MSC	m
reset	T-res	HLR,VLR	m
searchForMobileSubscriber	T-sr	VLR	m
sendEndSignal	T-es	MSC-B	l
sendHandoverReport	T-hr	VLR-B	l
sendInfoForIncomingCall	T-ir	MSC	m
sendInfoForOutgoingCall	T-ir	MSC	m
sendParameters	T-par	VLR	m
sendRoutingInfoForSM	T-smr	GMSC	m
sendRoutingInformation	T-rd	GMSC	m
setCipheringMode	T-sc	VLR	s
setMessageWaitingData	T-mwd	GMSC	s
traceSubscriberActivity	T-tsa	MSC,VLR	s
updateLocation	T-lu	VLR	m

Timers value :

s	=	from 5 seconds to 10 seconds
m	=	from 15 seconds to 30 seconds
l	=	from 28 hours to 38 hours

Overview of figures for ASN.1 Specifications

MAP Operations and errors types

MAP Data types

7. Mapping on TC SERVICES

7.1 General rules

7.1.1 Notation and conventions

MAP messages are conveyed by TCAP Application Protocol Data Units. The following sections describe their mapping onto component sub-layer primitives.

To simplify the notation, Dialogue IDs, addresses, are not indicated in the primitives descriptions. Only the generic name of the primitives is provided. It is assumed that the request primitive is issued by the sending TC-user, while the corresponding indication primitive is issued by the receiving component sub-layer of the destination entity.

Messages related to optional or operator dependent features (eg, authentication, forwarding of new TMSI, ...) are shown with an <OPTIONAL> indication.

Error messages are shown in the descriptions only when the error situation does not imply the termination of the transaction.

For several procedures, the interface description shows a choice between a TC-End and a TC-Continue request primitive to trigger a message sending. The TC-End primitive is used only when no pending operation exists (i.e, no outcome is expected from the responding entity and no outcome has to be provided to it.

The return result component of the ForwardNewTMSI operation can be sent at any time before the end of the transaction, the order shown in the following descriptions is not significant. If no pending operation exists, this component can be sent using a TC-End request primitive.

The TC-Result-NL primitives are not shown in this section; however this type of primitives can be issued by any user, when a result has to be segmented. This situation may occur only for the outcome of the sendParameters operation.

7.1.2 Component grouping

The procedures are generally described with one component per message, however the grouping facility provided by TCAP can be used in the following situations (assuming that the maximum size of messages is not exceeded):

- The invoke components of the ForwardCheckSsIndication operation and ForwardSupplementaryServiceNotification operation can be grouped with the return result component of all supplementary service handling operations, with the return result of the updateLocation and updateLocationArea operations, with the invokeComponent of the completeCall, processCallWaiting, forwardNewTMSI, setCiphering operations, and with the return result component of the processAccessRequest. As a radio contact must exist, the TC-Invoke request primitive for the ForwardCheckSsIndication ForwardSupplementaryServiceNotification operations must be passed first.

- The invoke component of the SetCipheringMode operation can be grouped with the return result component of the processAccessRequest operation. As the order is significant the TC-Invoke request primitive related to the invoke component of the SetCipheringMode operation must be passed first.

- The invoke component of the SetCipheringMode operation can be grouped with the invoke component of the ForwardNewTMSI operation, the return result component of the processAccessRequest operation or with the return result component of the UpdateLocationArea operation. As the order is significant, the TC-invoke primitive related to SetCipheringMode must always be passed first.

- The invoke component of the InvokeSS operation can be grouped with the invoke component of the SendInfoforOutgoingCall operation.

- The invoke components of the activateTraceMode and deactivateTraceMode operations can be grouped with the invoke components of the insertSubscriberData and deleteSubscriberData operations.

- The return result components of the activateTraceMode and deactivateTraceMode operations can be grouped with the retrurn result components of the insertSubscriberData and deleteSubscriberData operations.

- The invoke component of the traceSubscriberActivity operation can be grouped with the invoke component of the page operation, with the return result component of the processAccessRequest operation or with the invoke component of the performHandover operation.

The invoke component of the beginSubscriberActivity operation must be grouped with the invoke component of the associated supplementary service related operation.

7.1.3 Dialogue user abort

7.1.3.1 General

In any system component, the MAP may decide to abort a dialogue at any time for two kinds of reasons:

- Immediately after the reception of a TC-BEGIN indication primitive to reject the implicit dialogue establishment request. This situation occurs mainly for reason such as version incompatibility, resource limitation, ...

- Abort of an established dialogue because an unexpected situation occurs and makes impossible or useless to pursue the application procedure supported by this dialogue.

In both cases an abort cause is generally provided by the MAP as user abort information. Depending on the implementation and on the cause value, additional information can also be provided.

The possible user abort causes identified for the Mobile Application Part are described in the following sections:

7.1.3.2 unspecifiedReason

This cause is used when the reason does not pertain to the list identified in this section.

7.1.3.3 versionNotSupported

This cause is used when the responding TC-user identifies that the transaction is related to a version which is not supported by the node. The absence of version information in a MAP message will implicitly indicate that the message belongs to the first version. How version information will be carried for subsequent version is not specified and depends on the evolution of TCAP specifications. However, the presence of unrecognized information element carried in the TCAP transaction portion, before the component portion should not result in a transaction abort by TCAP with the cause "incorrectTransactionPortion". The information should be transparently passed to the TC-User as an implementation dependent mechanism (e.g user data filed in the TC-BEGIN ind primitive). The MAP should then abort the dialogue with the reason "versionNotSuported". Since no indication concerning the supported versions will be provided, the originating node will consider that only version 1 is supported.

7.1.3.4 userResourceLimitation

This cause is used when sufficient resources are not available at the user level to handle a new dialogue.

7.1.3.5 resourceUnavailableLongTermProblem

This cause is used when sufficient resources are not available at the user level to handle a new dialogue and that this situation is likely to last for a long period of time.

7.1.3.6 resourceUnavalbleTemporaryProblem

This cause is used when sufficient resource are temporary not available at the user level to handle a new dialogue.

7.1.3.7 radioChannelRelease

This cause is used during an established dialogue which requires a radio contact with a subscriber, when the radio channel connection is released while this situation is not specified as a possible outcome of any pending operation.

7.1.3.8 networkRelease

This cause is used during an established dialogue which requires the existence of a bearer connection in the network, when this connection is released while this situation is not specified as a possible outcome of any pending operation.

7.1.3.9 callRelease

This cause is used when aborting an established dialogue which is related to a call (i.e, a subscriber activity) in case of unexpected call termination (i.e, which is not specified as the possible outcome of an operation).

7.1.3.10 associatedProcedureFailed

This cause is used when aborting an established dialogue in case of failure (including abnormal termination) of an associated procedure when this situation is not handled as the possible outcome of any pending operation.

7.1.3.11 abnormalDialogue

This cause is used when aborting an established dialogue, because the component flow exchanged during this dialogue does not conform to the associated procedure while the situation cannot be covered by the reject mechanism, e.g: expected invoke component not received, unexpected (non linked-to) operation invoke component received , ...)

7.1.3.12 RemoteOperationFailure

This cause is used when aborting an established dialogue, because the failure of an operation invocation procedure makes (i.e time-out situation for a class 1 operation) makes impossible or useless to pursue this dialogue.

7.2 Mapping of messages onto TC primitives

7.2.1 TC interface for location area updating procedure

Update Location Area Message (MSC --> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	updateLocationArea
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Authentication Request message (VLR ---> MSC) <OPTIONAL>

Component Handling Primitive :	TC-Invoke
Operation :	authenticate
Invoke-ID :	j
Dialogue Handling Primitive :	TC-Continue

Authentication Response Message (MSC ---> VLR) <OPTIONAL>

Component Handling Primitive :	TC-Result-L
Invoke-ID :	j
Dialogue Handling Primitive :	TC-Continue

Set ciphering mode message (VLR ---> MSC)

Component Handling Primitive :	TC-Invoke
Operation :	setCipheringMode
Invoke-ID :	l
Dialogue Handling Primitive :	TC-Continue

Forward new TMSI message (VLR ---> MSC) <OPTIONAL>

Component Handling Primitive :	TC-Invoke
Operation :	forwardNewTMSI
Invoke-ID :	k
Dialogue Handling Primitive :	TC-Continue

Location Area Updating Accepted Message (VLR ---> MSC)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive:	TC-End or TC-Continue [1]

TMSI Acknowledgment Message (MSC ---> VLR) <OPTIONAL>

Component Handling Primitive :	TC-Result-L
Invoke-ID :	k
Dialogue Handling Primitive :	TC-End

[1]Note: If TMSI reallocation is used, the invoke component of the forwardNewTMSI operation is grouped with the return result component of the updateLocationArea operation and sent in a CONTINUE message, else the VLR terminates the transaction with the return result component of the updateLocationArea operation.

7.2.2 TC interface for location updating procedure between VLR and HLR

Update Location Message (VLR ---> HLR)

Component Handling Primitive : TC-Invoke
Operation : updateLocation
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Insert Subscriber Data message (HLR ---> VLR) [2]

Component Handling Primitive : TC-Invoke
Operation : insertSubscriberData
Invoke-ID : k
Dialogue Handling Primitive: TC-Continue

Subscriber data acknowledge message (VLR ---> HLR) [2]

Component Handling Primitive : TC-Result-L
Invoke-ID : k
Dialogue Handling Primitive: TC-CONTINUE

Location Updating Accepted Message (HLR ---> VLR)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive: TC-END

7.2.3 TC interface for IMSI enquiring procedure

IMSI Enquiry Message (VLR ---> VLR)

Component Handling Primitive: TC-Invoke
Operation : sendParameters
--- requested parameters
Invoke-ID : i
--- IMSI
--- AuthenticationSet OPTIONAL
--- Ki OPTIONAL
Dialogue Handling Primitive : TC-Begin

IMSI Response Message (VLR ---> VLR)

Component Handling Primitive: TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-End

[2] This message can be repeated several times, if all the subscriber data cannot be transferred in a single message. Since invocations are independent from each over, it is not necessary to wait for the acknowledgment of such a message before issuing a subsequent one.

7.2.4 TC Interface for location cancellation procedure

Cancel Location Message (HLR —> VLR)

Component Handling Primitive:	TC-Invoke
Operation :	cancelLocation
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Location Cancellation Accepted Message (VLR —> HLR)

Component Handling Primitive:	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.5 TC Interface for IMSI-Attach/Detach procedures

Detach IMSI Message (MSC —> VLR)

Component Handling Primitive:	TC-Invoke
Operation :	detachIMSI
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin (Pre-arranged release)

Attach IMSI Message (MSC —> VLR)

Component Handling Primitive:	TC-Invoke
Operation :	attachIMSI
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

IMSI Attach Acknowledgment Message (VLR —> MSC)

Component Handling Primitive:	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.6 TC Interface for deregistration procedure

Deregister Mobile Subscriber Message (VLR —> HLR)

Component Handling Primitive:	TC-Invoke
Operation :	deregisterMobileSubscriber
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Deregistration Accepted Message (HLR —> VLR)

Component Handling Primitive:	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.7 TC interface for subscriber data updating procedure

Insert subscriber data Message (HLR —> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	insertSubscriberData
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin or TC-Continue [3]

Subscriber data acknowledge message (VLR —> HLR) [3]

Component Handling Primitive:	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-CONTINUE

Updating terminated indication (HLR —> VLR) [4]

Component Handling Primitive:	none
Dialogue Handling Primitive :	TC-END

7.2.8 TC interface for subscriber data deletion

Delete Subscriber Data Message (HLR —> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	deleteSubscriberData
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Delete Subscriber Data Acknowledgment Message (VLR —> HLR)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.9 TC interface for handling of supplementary services with VLR

Process access request message (MSC —> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	processAccessRequest
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Authentication request Message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive :	TC-Invoke
Operation :	authenticate
Invoke-ID :	j
Dialogue Handling Primitive :	TC-Continue

---

[3] This message can be repeated several times, if all the subscriber data cannot be transferred in a single message. Once the first invocation has been acknowledged, it is not necessary to wait for the acknowledgment of an invoke message before sending another one . Subsequent invocations are sent in a continue message.

[4] This message is sent when all the required invoked components of the insertSubscriberData operation have been sent and acknowledged.

Authentication Response message (MSC —> VLR) <OPTIONAL>

Component Handling Primitive : TC-Result-L
Invoke-ID : j
Dialogue Handling Primitive : TC-Continue

Set ciphering mode message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : setCipheringMode
Invoke-ID : l
Dialogue Handling Primitive : TC-Continue

Access request accepted message (VLR —> MSC)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-Continue

Forward new TMSI message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive : TC-Invoke
Operation : forwardNewTMSI
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

TMSI Acknowledgment Message (MSC —> VLR) <OPTIONAL>

Component Handling Primitive : TC-Result-L
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

Operate Supplementary Services to VLR Message (MSC —> VLR)

Component Handling Primitive: TC-Invoke
Operation : CHOICE {
registerSS,
eraseSS,
activateSS,
deactivateSS,
interrogateSS,
invokeSS,
processUnstructuredSsData}
Invoke-ID : i
Dialogue Handling Primitive : TC-Continue

Supplementary Services Acknowledge Message (VLR —> MSC)

Component Handling Primitive: TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.10 TC interface for handling of supplementary services with HLR

When the message regards several supplementary services the originating part sends as many component handling primitives as supplementary services it wants to handle.

Operate Supplementary Service to HLR Message (VLR ---> HLR)

Component Handling Primitive : TC-Invoke
Operation : BeginSubscriberActivity
Invoke-ID : j
Component Handling Primitive : TC-Invoke
Operation : CHOICE {
registerSS,
eraseSS,
activateSS,
deactivateSS,
interrogateSS,
processUnstructuredSsData}
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Supplementary Services Acknowledge Message (HLR ---> VLR)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.11 TC Interface for MS originating call setup

Process access request message (MSC ---> VLR)

Component Handling Primitive : TC-Invoke
Operation : processAccessRequest
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Authentication request Message (VLR ---> MSC) <OPTIONAL>

Component Handling Primitive : TC-Invoke
Operation : authenticate
Invoke-ID : j
Dialogue Handling Primitive : TC-Continue

Authentication Response message (MSC ---> VLR) <OPTIONAL>

Component Handling Primitive : TC-Result-L
Invoke-ID : j
Dialogue Handling Primitive : TC-Continue

Set ciphering mode message (VLR ---> MSC)

Component Handling Primitive : TC-Invoke
Operation : setCipheringMode
Invoke-ID : l
Dialogue Handling Primitive : TC-Continue

Access request accepted message (VLR ---> MSC)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-Continue

Forward new TMSI message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive : TC-Invoke
Operation : forwardNewTMSI
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

TMSI Acknowledgment Message (MSC —> VLR) <OPTIONAL>

Component Handling Primitive : TC-Result-L
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

Send Information for O/G Call Set-up Message (MSC —> VLR)[1]

Component Handling Primitive : TC-Invoke
Operation : sendInfoForOutgoingCall
Invoke-ID : l
Dialogue Handling Primitive : TC-Continue

Complete call message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : completeCall
Linked-Id : l
Invoke-ID : p
Dialogue Handling Primitive : TC-Continue
<Prearranged termination>

7.2.12 TC interface for MS terminating call setup

7.2.12.1 Successful establishment

Send Information for I/C Call Set-up Message (MSC —> VLR)

Component Handling Primitive : TC-Invoke
Operation : sendInfoForIncomingCall
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Page message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : page
Invoke-ID : t
Dialogue Handling Primitive : TC-Continue

Process Access Request message (MSC — VLR)

Component Handling Primitive : TC-Invoke
Operation : processAccessRequest
Invoke-ID : z
Dialogue Handling Primitive : TC-Continue

Authentication request message (VLR — MSC) <OPTIONAL>

Component Handling Primitive :	TC-Invoke
Operation :	authenticate
Invoke-ID :	k
Dialogue Handling Primitive :	TC-Continue

Authentication response message (VLR — MSC) <OPTIONAL>

Component Handling Primitive :	TC-Result-L
Invoke-ID :	k
Dialogue Handling Primitive :	TC-Continue

Set ciphering mode message (VLR —> MSC)

Component Handling Primitive :	TC-Invoke
Operation :	setCipheringMode
InvokeId :	n
Dialogue Handling Primitive :	TC-Continue

Access request accepted message (VLR —> MSC)

Component Handling Primitive :	TC-Result-L
InvokeId :	z
Dialogue Handling Primitive :	TC-Continue

Forward new TMSI message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive :	TC-Invoke
Operation :	forwardNewTMSI
Invoke-ID :	l
Dialogue Handling Primitive :	TC-Continue

TMSI Acknowledgment Message (MSC —> VLR) <OPTIONAL>

Component Handling Primitive :	TC-Result-L
Invoke-ID :	l
Dialogue Handling Primitive :	TC-Continue

Complete call message (VLR —> MSC)

Component Handling Primitive :	TC-Invoke
Operation :	completeCall
Invoke-ID :	u
Linked-Id :	i
Dialogue Handling Primitive :	TC-Continue <prearranged termination>

7.2.12.2 Busy subscriber / No paging response

Send Information for I/C Call Set-up Message (MSC —> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	sendInfoForIncomingCall
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Page message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : page
Invoke-ID : t
Dialogue Handling Primitive : TC-Continue

error message (MSC —> VLR)

Component Handling Primitive : TC-U-ERROR
Error : CHOICE{
busySubscriber ,
absentSubscriber }
Invoke-ID : t
Dialogue Handling Primitive : TC-Continue

Connect to following address message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : connectToFollowingAddress
Invoke-ID : k
Linked-Id : i
Dialogue Handling Primitive : TC-End
or

Process Call waiting message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : processCallWaiting
Invoke-ID : s
Linked-Id : i
Dialogue Handling Primitive : TC-End
or

Error message (VLR —> MSC)

Component Handling Primitive : TC-U-Error
Error : impossibleCallCompletion
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.12.3 Detached subscriber

Send Information for I/C Call Set-up Message (MSC —> VLR)

Component Handling Primitive : TC-Invoke
Operation : sendInfoForIncomingCall
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Connect to following address message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : connectToFollowingAddress
Invoke-ID : k
Linked-ID : i
Dialogue Handling Primitive : TC-End
or

Absent subscriber message (VLR —> MSC)

Component Handling Primitive : TC-U-Error
Error : absentSubscriber
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.12.4 No subscriber reply / radio congestion

Send Information for I/C Call Set-up Message (MSC —> VLR)

Component Handling Primitive : TC-Invoke
Operation : sendInfoForIncomingCall
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Page message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : page
Invoke-ID : t
Dialogue Handling Primitive : TC-Continue

Process access request message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : processAccessRequest
Invoke-ID : z
Dialogue Handling Primitive : TC-Continue

Authentication request message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive : TC-Invoke
Operation : authenticate
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

Authentication response message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive : TC-Result-L
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

Set ciphering mode message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : setCipheringMode
InvokeId : n
Dialogue Handling Primitive : TC-Continue

Access request accepted message (VLR —> MSC)

Component Handling Primitive : TC-Result-L
InvokeId : z
Dialogue Handling Primitive : TC-Continue

Forward new TMSI message (VLR —> MSC) <OPTIONAL>

Component Handling Primitive :	TC-Invoke
Operation :	forwardNewTMSI
Invoke-ID :	I
Dialogue Handling Primitive :	TC-Continue

TMSI Acknowledgment Message (MSC —> VLR) <OPTIONAL>

Component Handling Primitive :	TC-Result-L
Invoke-ID :	I
Dialogue Handling Primitive :	TC-Continue

Complete call message (VLR —> MSC)

Component Handling Primitive :	TC-Invoke
Operation :	completeCall
Invoke-ID :	u
Linked-ID :	i
Dialogue Handling Primitive :	TC-Continue

Error message (MSC —> VLR)

Component Handling Primitive :	TC-U-ERROR
Error :	CHOICE{ nosubscriberReply, radioCongestion}
Invoke-ID :	u
Dialogue Handling Primitive :	TC-Continue

Connect to following address message (VLR —> MSC)

Component Handling Primitive :	TC-Invoke
Operation :	connectToFollowingAddress
Invoke-ID :	k
Dialogue Handling Primitive :	TC-End

or

Error message (VLR —> MSC)

Component Handling Primitive :	TC-U-Error
Error :	CHOICE{ impossibleCallCompletion, forwardingViolation}
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.13 TC Interface for indirect information retrieval during call set-up

Call Data Request Message (VLR —> HLR)

Component Handling Primitive :	TC-Invoke
Operation :	sendParameters
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Call Data Acknowledge Message (HLR —> VLR)	
Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.14 TC Interface for obtaining routing data

Send Routing Information Message (GMSC —> HLR)	
Component Handling Primitive :	TC-Invoke
Operation :	sendRoutingInformation
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Routing Information Acknowledge Message (HLR —> GMSC)	
Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.15 TC Interface for roaming number enquiry

Provide roaming number message (HLR —> VLR)	
Component Handling Primitive:	TC-Invoke
Operation :	provideRoamingNumber
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Roaming number acknowledgment message (VLR —> HLR)	
Component Handling Primitive:	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.16 TC Interface for handover procedures between MSCs

When the messages within a transaction are not correlated at the component layer, the order shown in this section is not significant.

Perform Handover Message (MSC-A —> MSC-B)	
Component Handling Primitive :	TC-Invoke
Operation :	performHandover
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Radio Channel Acknowledgement Message (MSC-B —> MSC-A)	
Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Continue

Send End Signal Message (MSC-B —> MSC-A)

Component Handling Primitive : TC-Invoke
Operation : sendEndSignal
Invoke-ID : k
Dialogue Handling Primitive : TC-Continue

Process Access Signalling (MSC-B —> MSC-A) [5]

Component Handling Primitive : TC-invoke
Operation : processAccessSignalling
Invoke-ID : t
Dialogue Handling Primitive : TC-Continue

Forward Access Signalling Message (MSC-A —> MSC-B) [5]

Component Handling Primitive : TC-invoke
Operation : forwardAccessSignalling
Invoke-ID : l
Dialogue Handling Primitive : TC-Continue

Perform Subsequent Handover Message (MSC-B —> MSC-A) [6]

Component Handling Primitive : TC-invoke
Operation : performSubsequentHandover
Invoke-ID : m
Dialogue Handling Primitive : TC-Continue

Subsequent handover acknowledge message (MSC-A —> MSC-B) [6]

Component Handling Primitive : TC-Result-L
Invoke-ID : m
Dialogue Handling Primitive : TC-Continue

Note internal handover message (MSC-B —>MSC-A) [7]

Component Handling Primitive : TC-Invoke
Operation : noteInternalHandover
Invoke-ID : n
Dialogue Handling Primitive : TC-Continue

5: These messages (and acknowledgements) do not exist in all the handover transactions and are used to transfer information between the call control MSC and the MS. MSC-2 is transparent to the parameter sequence which is passed on the BS/MSC interface as Application protocol data unit. MSC-2 is also transparent to the possible parameter sequence included in a return result component.

6: These messages exist only if a subsequent handover is needed during the communication, the request may be sent at any moment between the successful handover message and the end signal, then another transaction is opened between MSC-A and MSC-B'.

7: This message exists only if an internal handover takes place in MSC-B and indication to MSC-A is required.

End signal message (MSC-A --->MSC-B)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	k
Dialogue Handling Primitive :	TC-End

Handover cancellation message (MSC-A ---> MSC-B) [8]

Dialogue Handling Primitive :	TC-U-Abort
Reason :	According to CCITT Rec Q.773

7.2.17 TC Interface for handover number allocation procedure

Allocate Handover Number Message (MSC-B ---> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	allocateHandoverNumber
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Send Handover Report Message (VLR ---> MSC-B)

Component Handling Primitive :	TC-Invoke
Operation :	sendHandoverReport
Invoke-ID :	j
Linked-ID :	i
Dialogue Handling Primitive :	TC-Continue

Handover Report Message (MSC-B ---> VLR)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	j
Dialogue Handling Primitive :	TC-End

7.2.18 TC Interface for charging information transfer procedure

Register Charging Information message (MSC ---> HLR)

Component Handling Primitive :	TC-invoke
Operation :	registerChargingInformation
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Charging information accepted message (HLR ---> MSC)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Continue
	<Prearranged release>

[8]: This message abort the transaction and may be sent at every moment before successful handover message.

7.2.19 TC Interface for reset procedures

Reset message (HLR —> VLRs), (VLR —> HLRs)

Component Handling Primitive :	TC-Invoke
Operation :	reset
Dialogue Handling Primitive :	TC-Begin
	<Pre-arranged release>

7.2.20 TC Interface for trace mode activation

Activate trace mode Message (HLR —> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	activateTraceMode
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Activate trace mode acknowledgment Message (VLR —> HLR)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.21 TC Interface for trace mode deactivation

Deactivate trace mode Message (HLR —> VLR)

Component Handling Primitive :	TC-Invoke
Operation :	deactivateTraceMode
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Deactivate trace mode acknowledgment Message (VLR —> HLR)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.22 TC Interface for equipment identity check procedure

Check IMEI message (MSC —> EIR)

Component Handling Primitive :	TC-invoke
Operation :	checkIMEI
Invoke-ID :	i
Dialogue Handling Primitive :	TC-Begin

Result check IMEI message (EIR —> MSC)

Component Handling Primitive :	TC-Result-L
Invoke-ID :	i
Dialogue Handling Primitive :	TC-End

7.2.23 TC interface for retrieval of authentication parameters

Authentication Information Request message (VLR —> HLR)

Component Handling Primitive : TC-Invoke
Operation : sendParameters
— Requested Parameters
— = AuthenticationSet
— and/or Ki
Invoke-ID : I
Dialogue Handling Primitive : TC-Begin

Authentication Information acknowledgement (HLR —> VLR)

Component Handling Primitive : TC-Result
Invoked-ID : I
Dialogue Handling Primitive : TC-End

7.2.24 TC interface for procedure with IMSI request

Any begin message (eg: update location area) (MSC —> VLR)

Component Handling Primitive : TC-Invoke
Operation : (eg updateLocationArea)
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Provide IMSI message (VLR —> MSC)

Component Handling Primitive : TC-Invoke
Operation : provideIMSI
Invoke-ID : j
Dialogue Handling Primitive : TC-Continue

IMSI provided message (MSC —> VLR)

Component Handling Primitive : TC-Result-L
Invoke-ID : j
Dialogue Handling Primitive : TC-Continue

Next MAP message (VLR —> MSC)

7.2.25 TC interface for obtaining short message routing data

Send short message routing information Message (GMSC —> HLR)

Component Handling Primitive : TC-Invoke
Operation : sendRoutingInfoForShortMessage
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Short message routing information acknowledge Message (HLR —> GMSC)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.26 TC Interface for short message waiting data setting

Set message waiting data Message (GMSC ---> HLR)

Component Handling Primitive : TC-Invoke
Operation : setMessageWaitingData
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Message waiting data acknowledgment message (HLR ---> GMSC)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.27 TC Interface for MS present Indication

Note MS present Message (VLR ---> HLR)

Component Handling Primitive : TC-Invoke
Operation : noteMsPresent
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin
<Prearranged termination>

7.2.28 TC Interface for service centre alerting

Alert service centre Message (HLR ---> IWMSC)

Component Handling Primitive : TC-Invoke
Operation : alertServiceCentre
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin
<Prearranged termination>

7.2.29 TC Interface for short message forwarding

Forward short message Message (GMSC ---> MSC, MSC ---> IWMSC)

Component Handling Primitive : TC-Invoke
Operation : forwardShortMessage
Invoke-ID : i
Dialogue Handling Primitive : TC-Begin

Forwarding acknowledgment message (MSC ---> GMSC, IWMSC ---> MSC)

Component Handling Primitive : TC-Result-L
Invoke-ID : i
Dialogue Handling Primitive : TC-End

7.2.30 TC interface for abnormal situation in any MAP procedure

Any Error or Refused Message	
Component Handling Primitive :	TC-U-Error
Error :	ErrorMacro according to the situation
Invoke-ID :	Invoke-Id of the correlated operation
Dialogue Handling Primitive :	TC-End or TC-Continue [9]

Any Reject Message	
Component Handling Primitive :	TC-U-Reject or TC-Reject
Invoke-ID :	Invoke-Id of the relevant component
Problem Code :	According to the situation (See CCITT REC Q.773)
Dialogue Handling Primitive :	TC-End

Any User cancellation procedure message	
Dialogue Handling Primitive :	TC-U-Abort
Reason :	According to CCITT Rec Q.773

[9]: TC-Continue can be used when the success of the correlated invoke is not required to continue the transaction.