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will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the technical realization of the handling of calls originated by a UMTS or GSM mobile subscriber and calls directed to a UMTS or GSM mobile subscriber, up to the point where the call is established. Normal release of the call after establishment is also specified. Trunk Originated call is also modelled.

In the present document, the term MS is used to denote a UMTS UE or GSM MS, as appropriate.

The handling of DTMF signalling and Off-Air Call set-up (OACSU) are not described in the present document.

The details of the effects of UMTS or GSM supplementary services on the handling of a call are described in the relevant 3GPP TS 23.07x, 3GPP TS 23.08x and 3GPP TS 23.09x series of specifications.

The specification of the handling of a request from the HLR for subscriber information is not part of basic call handling, but is required for both CAMEL (3GPP TS 23.078 [12]) and optimal routeing (3GPP TS 23.079 [13]). The use of the Provide Subscriber Information message flow is shown in 3GPP TS 23.078 [12] and 3GPP TS 23.079 [13].

The logical separation of the MSC and VLR (shown in clauses 4, 5 and 7), and the messages transferred between them (described in clause 8) are the basis of a model used to define the externally visible behaviour of the MSC/VLR, which is a single physical entity. They do not impose any requirement except the definition of the externally visible behaviour.

If there is any conflict between the present document and the corresponding stage 3 specifications (3GPP TS 24.008 [26], 3GPP TS 25.413 [27], 3GPP TS 48.008 [2] and 3GPP TS 29.002 [29]), the stage 3 specification shall prevail.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 43.020: "Security related Network Functions".

[2] 3GPP TS 48.008: "Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".

[3] 3GPP TS 52.008: "Telecommunication management; GSM subscriber and equipment trace".

[4] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[5] 3GPP TS 23.003: "Numbering, addressing and identification".

[6] 3GPP TS 23.012: "Location management procedures".

[7] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[8] Void

[9] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[10] 3GPP TS 23.066: "Support of GSM Mobile Number Portability (MNP); Stage 2".

[11] 3GPP TS 23.072: "Call deflection Supplementary Service; Stage2".

[12] 3GPP TS 23.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL); Stage 2".

[13] 3GPP TS 23.079: "Support of Optimal Routeing (SOR); Technical realization; Stage 2".

[14] 3GPP TS 23.081: "Line identification Supplementary Services; Stage 2 ".

[15] 3GPP TS 23.082: "Call Forwarding (CF) Supplementary Services; Stage 2".

[16] 3GPP TS 23.083: "Call Waiting (CW) and Call Hold (HOLD) Supplementary Service; Stage 2".

[17] 3GPP TS 23.084: "Multi Party (MPTY) Supplementary Service; Stage 2".

[18] 3GPP TS 23.085: "Closed User Group (CUG) Supplementary Service; Stage 2".

[19] 3GPP TS 23.086: "Advice of Charge (AoC) Supplementary Service; Stage 2".

[20] 3GPP TS 23.087: "User-to-User Signalling (UUS) Supplementary Service; Stage 2".

[21] 3GPP TS 23.088: "Call Barring (CB) Supplementary Service; Stage 2".

[22] 3GPP TS 23.091: "Explicit Call Transfer (ECT) supplementary service; Stage 2".

[23] 3GPP TS 23.093: "Technical realization of Completion of Calls to Busy Subscriber (CCBS); Stage 2".

[24] 3GPP TS 23.116: "Super-charger technical realization; Stage 2".

[25] 3GPP TS 23.135: "Multicall supplementary service; Stage 2".

[25a] 3GPP TS 23.195: "Provision of UE Specific Behaviour Information to Network Entities".

[26] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[27] 3GPP TS 25.413: "UTRAN Iu interface RANAP signalling".

[28] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[29] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[30] 3GPP TS 29.007: "General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[31] 3GPP TS 29.010: "Information Element Mapping between Mobile Station - Base Station System (MS - BSS) and Base Station System - Mobile-services Switching Centre (BSS - MSC) Signalling Procedures and the Mobile Application Part (MAP)".

[32] 3GPP TS 33.102: "3G Security; Security architecture ".

[33] ITU-T Recommendation Q.761 (1999): " Signalling System No. 7 - ISDN User Part functional description ".

[34] ITU-T Recommendation Q.762 (1999): "Signalling System No. 7 - ISDN User Part general functions of messages and signals".

[35] ITU-T Recommendation Q.763 (1999): "Signalling System No. 7 - ISDN User Part formats and codes".

[36] ITU-T Recommendation Q.764 (1999): " Signalling System No. 7 – ISDN user part signalling procedures".

[37] ITU-T Recommendation Q.850 (05/1998) including Amendment 1 (07/2001): "Usage of cause and location in the Digital Subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN User Part".

[38] 3GPP TS 23.172: "Technical realization of Circuit Switched (CS) multimedia service ; UDI/RDI fallback and service modification; Stage 2".

[39] 3GPP TS 23.067: "enhanced Multi-Level Precedence and Pre-emption service (eMLPP) - Stage 2".

[40] 3GPP TS 23.221: "Technical specification Group Services and System Aspects; Architectural Requirements".

[41] 3GPP TS 29.118: "Mobility Management Entity (MME) - Visitor Location Register (VLR) SGs interface specification".

[42] 3GPP TS 23.272: "Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2".

[43] 3GPP TS 23.007: "Restoration procedures".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

A subscriber: the calling mobile subscriber

B subscriber: the mobile subscriber originally called by the A subscriber

C subscriber: the subscriber to whom the B subscriber has requested that calls be forwarded
The C subscriber may be fixed or mobile.

Location Information: information to define the whereabouts of the MS, and the age of the information defining the whereabouts

PLMN Bearer Capability: information transferred over the UMTS or GSM access interface to define the information transfer capabilities to be used between the MS and the network for a circuit-switched connection

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

A&O	Active & Operative
ACM	Address Complete Message
ANM	ANswer Message
AoC	Advice of Charge
BC	Bearer Capability
BOIC-exHC&BOIZC	Barring of Outgoing International Calls except those directed to the HPLMN Country & Barring of Outgoing InterZonal Calls
BOIZC	Barring of Outgoing InterZonal Calls
BOIZC-exHC	Barring of Outgoing InterZonal Calls except those directed to the HPLMN Country
CCBS	Completion of Calls to Busy Subscriber
CFB	Call Forwarding on Busy
CFNRc	Call Forwarding on mobile subscriber Not Reachable
CFNRy	Call Forwarding on No Reply
CFU	Call Forwarding Unconditional
CLIP	Calling Line Identity Presentation
CLIR	Calling Line Identity Restriction
COLP	COnnected Line identity Presentation
COLR	COnnected Line identity Restriction
CSG	Closed Subscriber Group
CUG	Closed User Group
CW	Call Waiting

FTN	Forwarded-To Number
FTNW	Forwarded-To NetWork
GMSCB	Gateway MSC of the B subscriber
GPRS	General Packet Radio Service
HLC	Higher Layer Compatibility
HLRB	The HLR of the B subscriber
HPLMNB	The HPLMN of the B subscriber
IAM	Initial Address Message
IPLMN	Interrogating PLMN - the PLMN containing GMSCB
IWU	Inter Working Unit
LLC	Lower Layer Compatibility
MO	Mobile Originated
MPTY	MultiParTY
MT	Mobile Terminated
NDUB	Network Determined User Busy
NRCT	No Reply Call Timer
PgA	Paging Area
PLMN BC	(GSM or UMTS) PLMN Bearer Capability
PRN	Provide Roaming Number
PUESBINE	Provision of User Equipment Specific Behaviour Information to Network Entities
SCUDIF	Service Change and UDI/RDI Fallback
SGSN	Serving GPRS support node
SIFIC	Send Information For Incoming Call
SIFOC	Send Information For Outgoing Call
SRI	Send Routeing Information
TO	Trunk Originated
UDUB	User Determined User Busy
UESBI-Iu	User Equipment Specific Behaviour Information over the Iu interface
VLRA	The VLR of the A subscriber
VLRB	The VLR of the B subscriber
VMSCA	The Visited MSC of the A subscriber
VMSCB	The Visited MSC of the B subscriber
VPLMNA	The Visited PLMN of the A subscriber
VPLMNB	The Visited PLMN of the B subscriber

4 Architecture

Clauses 4.1 and 4.2 show the architecture for handling a basic MO call and a basic MT call. A basic mobile-to-mobile call is treated as the concatenation of an MO call and an MT call.

4.1 Architecture for an MO call

A basic mobile originated call involves signalling between the MS and its VMSC via the BSS, between the VMSC and the VLR and between the VMSC and the destination exchange, as indicated in figure 1.

In figure 1 and throughout the present document, the term BSS is used to denote a GSM BSS or a UTRAN, as appropriate.

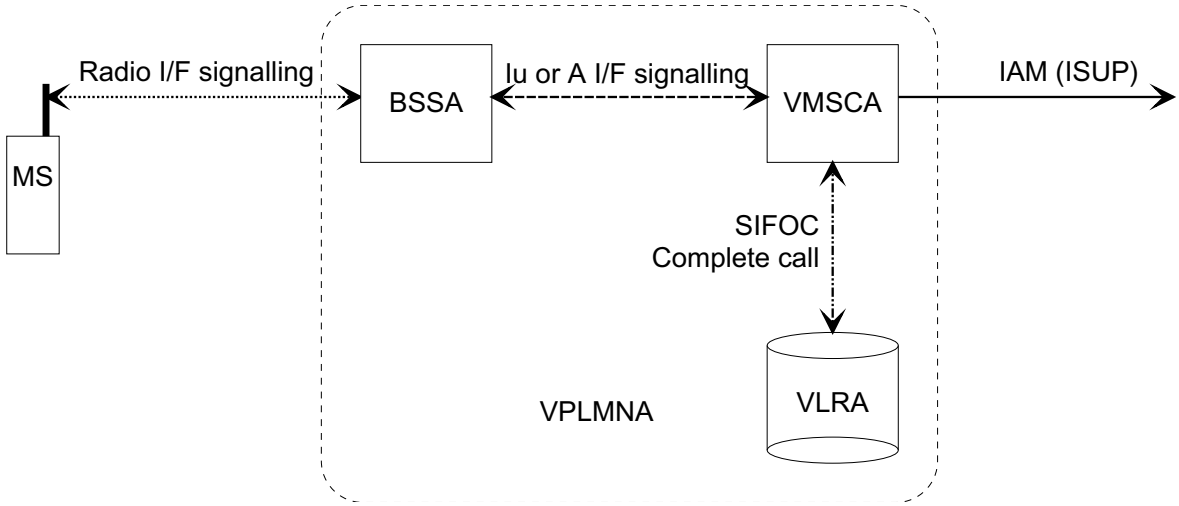


Figure 1: Architecture for a basic mobile originated call

In figure 1 and throughout the present document, the term ISUP is used to denote the telephony signalling system used between exchanges. In a given network, any telephony signalling system may be used.

When the user of an MS wishes to originate a call, the MS establishes communication with the network using radio interface signalling, and sends a message containing the address of the called party. VMSCA requests information to handle the outgoing call (SIFOC) from VLRA, over an internal interface of the MSC/VLR. If VLRA determines that the outgoing call is allowed, it responds with a Complete Call. VMSCA:

- establishes a traffic channel to the MS; and
- constructs an ISUP IAM using the called party address and sends it to the destination exchange.

4.2 Architecture for an MT call

A basic mobile terminated call involves signalling as indicated in figure 2. Communication between VMSCB and the MS is via the BSS, as for the mobile originated case. If VPLMNB supports GPRS and the Gs interface between VLRB and the SGSN is implemented (see 3GPP TS 23.060 [9]) and there is an association between VLRB and the SGSN for the MS, the paging signal towards the MS goes from VMSCB via VLRB and the SGSN to the BSS. The IPLMN, containing GMSCB, is in principle distinct from HPLMNB, containing HLRB, but the practice for at least the majority of current UMTS or GSM networks is that a call to an MS will be routed to a GMSC in HPLMNB.

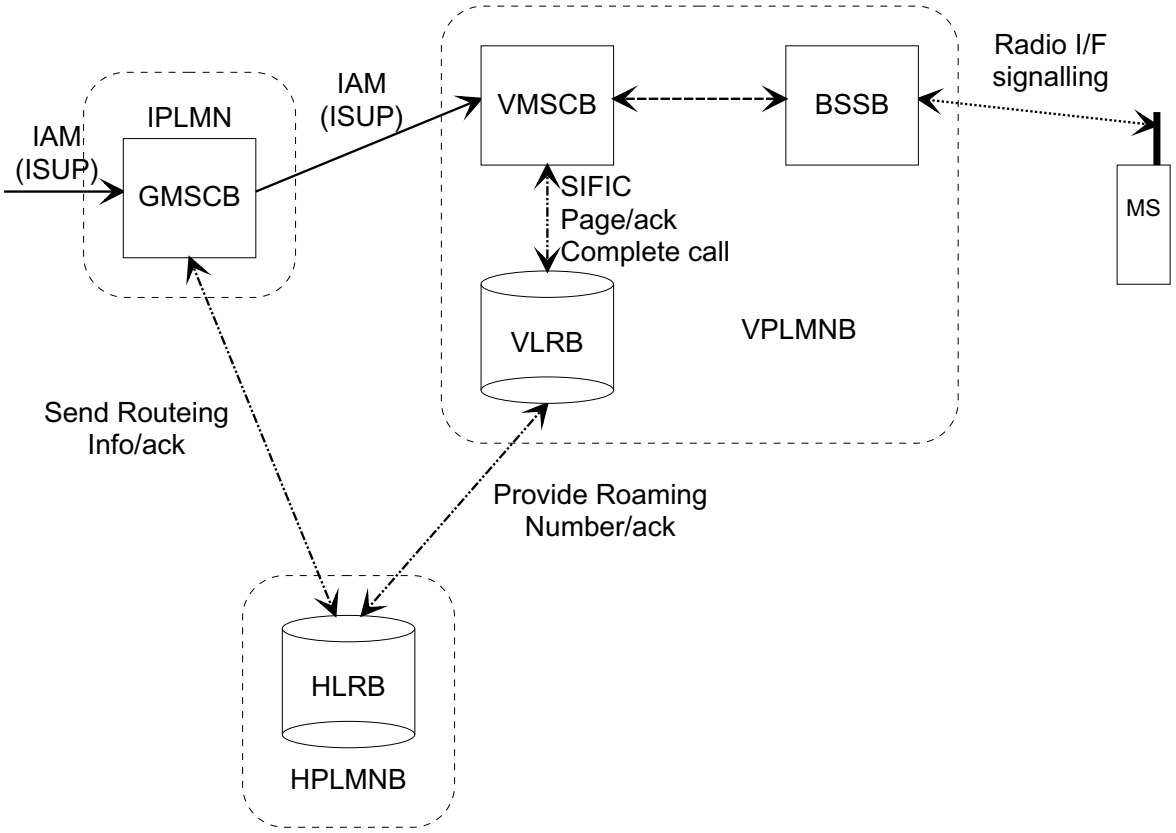


Figure 2: Architecture for a basic mobile terminated call

When GMSCB receives an ISUP IAM, it requests routeing information from HLRB using the MAP protocol. HLRB requests a roaming number from VLRB, also using the MAP protocol, and VLRB returns a roaming number in the Provide Roaming Number Ack. HLRB returns the roaming number to GMSCB in the Send Routeing Info ack. GMSCB uses the roaming number to construct an ISUP IAM, which it sends to VMSCB. When VMSCB receives the IAM, it requests information to handle the incoming call (SIFIC) from VLRB, over an internal interface of the MSC/VLR. If VLRB determines that the incoming call is allowed, it requests VMSCB to page the MS. VMSCB pages the MS using radio interface signalling. When the MS responds, VMSCB informs VLRB in the Page ack message. VLRB instructs VMSCB to connect the call in the Complete call, and VMSCB establishes a traffic channel to the MS.

4.3 Architecture for a TO call

A basic trunk originated call involves signalling between the PSTN and the PLMN's MSC, as indicated in figure x. The originating exchange may also be another MSC of the same or different PLMN.

The MSC may also be connected to PBX but that is outside the scope of this document. In the PBX case same modelling applies but the PBX signalling is different to ISUP.

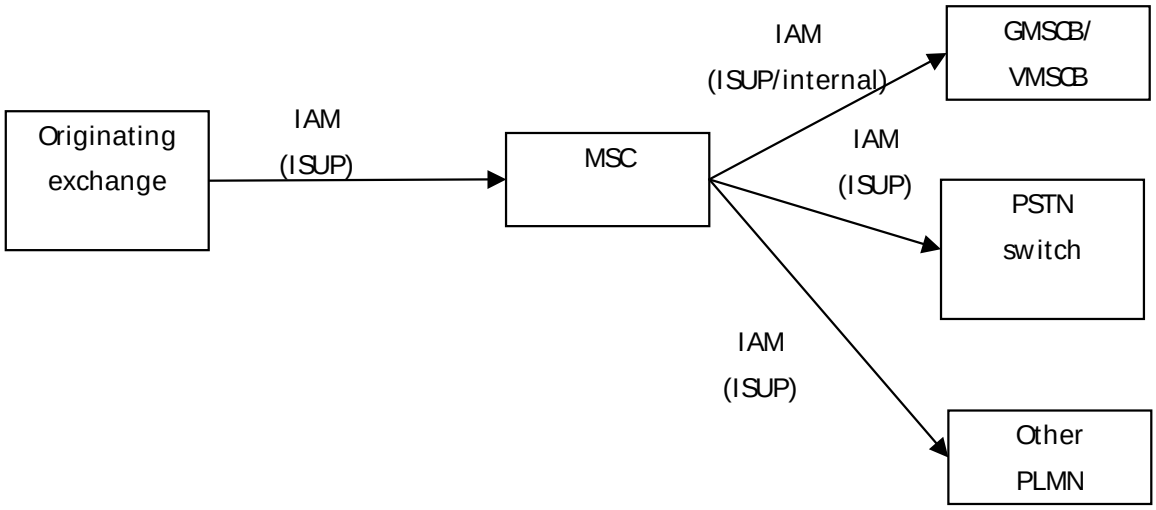


Figure 4.3.1: Architecture for a basic trunk originated call

In figure x and throughout the present document, the term ISUP is used to denote the telephony signalling system used between exchanges. In a given network, any telephony signalling system may be used.

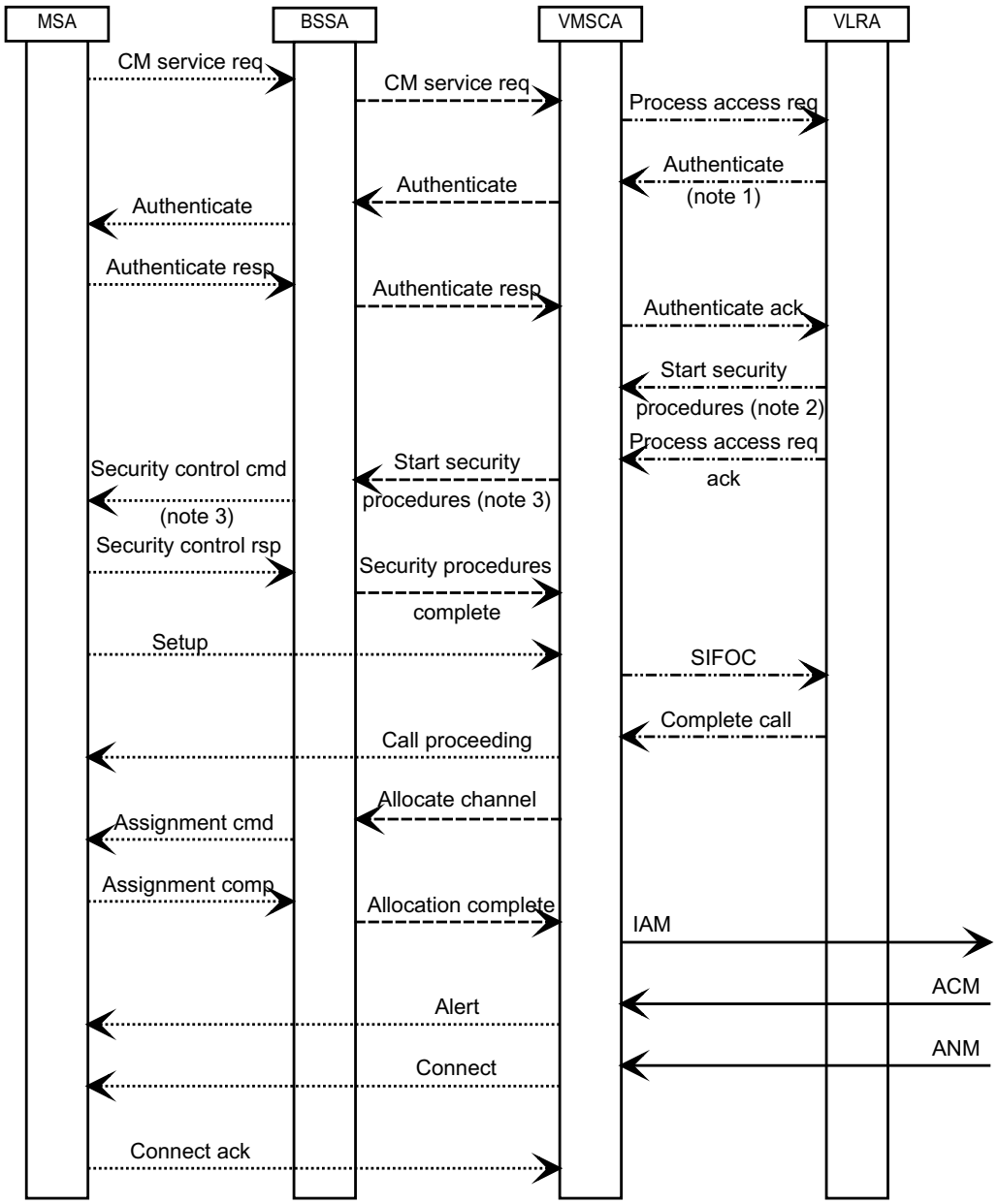
The MSC receives a setup (IAM) message from the originating exchange. The MSC analyses the called party number and routes the call to an appropriate destination. If the called party number is an MSISDN the gateway MSC functionality is activated. If the MSISDN belongs to another PLMN (or is ported out), the call is routed to another PLMN. If the called number is a PSTN number then the call is routed to (appropriate) PSTN operator. There may be other destinations also.

5 Information flows

In this clause and clause 7, the terms "security procedures" and "security control" denote the UMTS ciphering and integrity protection mechanism defined in 3GPP TS 33.102 [32] or the GSM ciphering mechanism defined in 3GPP TS 43.020 [1], as appropriate.

5.1 Information flow for an MO call

An example information flow for an MO call is shown in figure 3; many variations are possible. Signalling over the radio interface between MSA and BSSA or VMSCA is shown by dotted lines; signalling over the Iu interface (for UMTS) or the A interface (for GSM) between BSSA and VMSCA is shown by dashed lines; signalling over the B interface between VMSCA and VLRA is shown by chain lines; and ISUP signalling between VMSCA and the destination exchange is shown by solid lines.



NOTE 1: Authentication may occur at any stage during the establishment of an MO call; its position in this message flow diagram is an example.

NOTE 2: Security procedures may be initiated at any stage after authentication; the position in this message flow diagram is an example.

NOTE 3: If ciphering is not required for a GSM connection, the MSC may send a CM service accept towards the MS; optionally it may instead send a "start ciphering" request indicating that no ciphering is required. This option is not available for a UMTS connection [ffs].

NOTE 4: The network may request the IMEI from the MS, and may check the IMEI, at any stage during the establishment of an MO call, either as part of the procedure to start security procedures or explicitly after security procedures have started; this is not shown in this message flow diagram.

Figure 3: Information flow for a basic mobile originated call

When the user wishes to originate a call, MSA establishes a signalling connection with BSSA, and sends a Connection Management (CM) service request to BSSA, which relays it to VMSCA. VMSCA sends a Process Access Request to VLRA. VLRA may then initiate authentication, as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM. VLRA may also initiate security procedures at this stage, as described in 3GPP TS 33.102 [32] for UMTS 3GPP TS 43.020 [1] for GSM. If the user originates one or more new MO calls in a multicall configuration, MSA sends a CM service request through the existing signalling connection for each new call.

If the MS has performed the Connection Management (CM) service request in a CSG cell, VLRA shall control if the CSG cell is allowed by the CSG subscription data stored in VLRA. If the CSG cell is not allowed, VLRA shall reject the Process Access Request.

If the MS has performed the Connection Management (CM) service request in a hybrid cell, VLRA shall set the CSG membership status in the Process Access Request ack according to the CSG subscription data stored in VLRA.

If VLRA determines that MSA is allowed service, it sends a Process Access Request ack to VMSCA. If VMSCA has received a Start security procedures message from VLRA, the Process Access Request ack message triggers a Start security procedures message towards BSSA; otherwise VMSCA sends a CM Service Accept message towards BSSA.

If BSSA receives a Start security procedures message from VMSCA, it initiates security procedures as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM; when security procedures have been successfully initiated, MSA interprets this in the same way as a CM Service Accept. If security procedures are not required at this stage, BSSA relays the CM Service Accept to MSA.

When MSA has received the CM Service Accept, or security procedures have been successfully initiated, MSA sends a Set-up message containing the B subscriber address via BSSA to VMSCA. MSA also uses the Set-up message to indicate the bearer capability required for the call; VMSCA translates this bearer capability into a basic service, and determines whether an interworking function is required. VMSCA sends to VLRA a request for information to handle the outgoing call, using a Send Info For Outgoing Call (SIFOC) message containing the B subscriber address.

If VLRA determines that the call should be connected, it sends a Complete Call message to VMSCA. VMSCA sends a Call Proceeding message via BSSA to MSA, to indicate that the call request has been accepted, and sends an Allocate channel message to BSSA, to trigger BSSA and MSA to set up a traffic channel over the radio interface. The Call Proceeding message includes bearer capability information if any of the negotiable parameters of the bearer capability has to be changed. When the traffic channel assignment process is complete (indicated by the Allocation complete message from BSSA to VMSCA), VMSCA constructs an ISUP IAM using the B subscriber address, and sends it to the destination exchange.

When the destination exchange returns an ISUP Address Complete Message (ACM), VMSCA sends an Alerting message via BSSA to MSA, to indicate to the calling user that the B subscriber is being alerted.

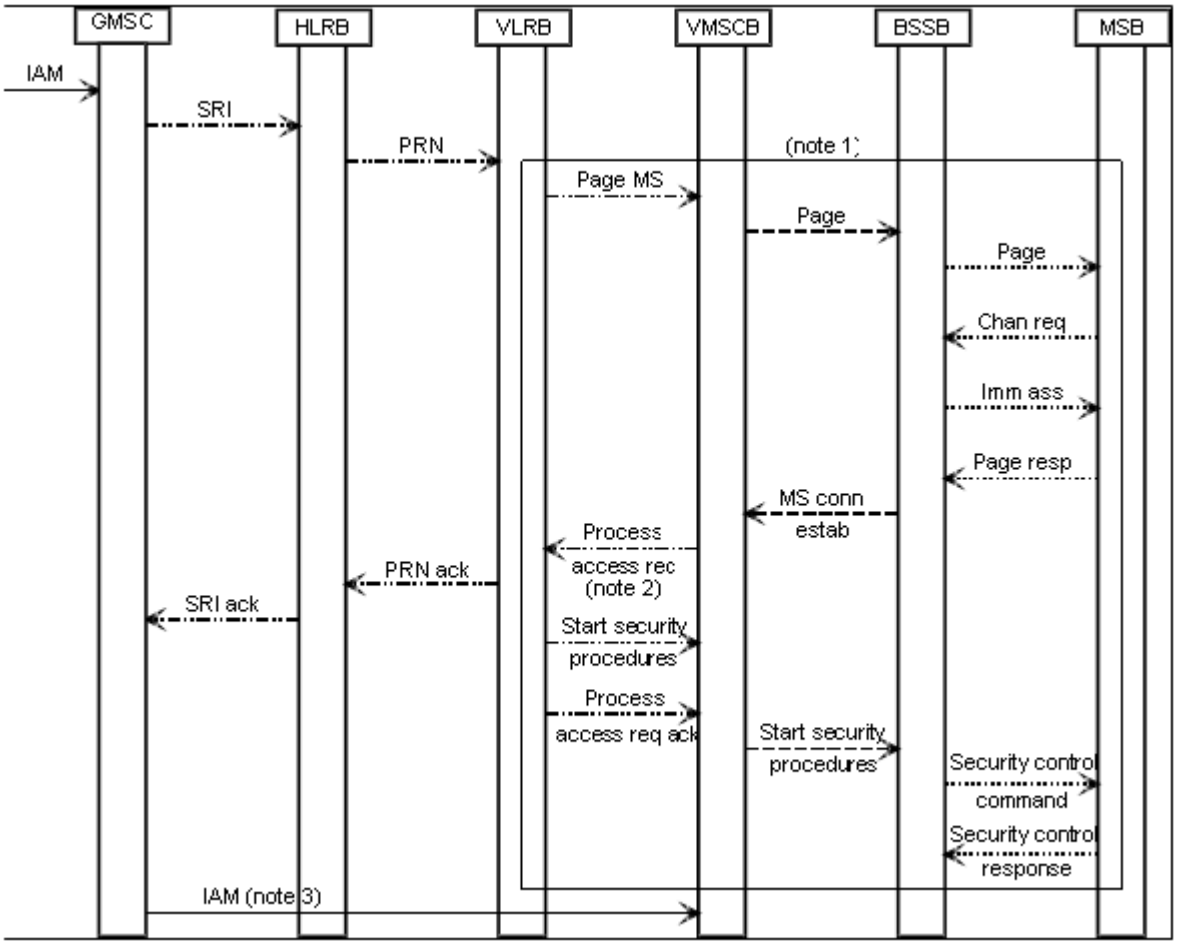
When the destination exchange returns an ISUP ANswer Message (ANM), VMSCA sends a Connect message via BSSA to MSA, to instruct MSA to connect the speech path.

The network then waits for the call to be cleared.

For an emergency call, a different CM service type (emergency call) is used, and the mobile may identify itself by an IMEI. It is a network operator option whether to allow an emergency call when the mobile identifies itself by an IMEI. Details of the handling are shown in clause 7.

5.2 Information flow for retrieval of routeing information for an MT call

The information flow for retrieval of routeing information for an MT call is shown in figure 4. ISUP signalling between the originating exchange and GMSCB, and between GMSCB and VMSCB is shown by solid lines; signalling over the MAP interfaces between GMSCB and HLRB and between HLRB and VLRB, and over the B interface between VLRB and VMSCB is shown by chain lines; signalling over the Iu interface (for UMTS) or the A interface (for GSM) between VMSCB and BSSB is shown by dashed lines; and signalling over the radio interface between BSSB and MSB is shown by dotted lines.



NOTE 1: If pre-paging is used, paging is initiated after VLRB has accepted the PRN message. The paging procedure is described in clause 5.3.

NOTE 2: VMSCB starts the timer for the release of radio resources after it sends the Process Access Request message to VLRB. VMSCB releases the radio resource allocated for the MT call if the timer expires before the IAM is received, and when the MAP RELEASE_RESOURCES message is received from the GMSC.

NOTE 3: If an ISUP REL message is received at the GMSC between sending of SRI and receiving of SRI ack, the GMSC does not send IAM to the VMSC. Instead a MAP Release_Resources message may be sent to the VMSC.

Figure 4: Information flow for retrieval of routeing information for a basic mobile terminated call

When GMSCB receives an IAM, it analyses the called party address. If GMSCB can derive an HLR address from the B party address, it sends a request for routeing information (SRI) to HLRB. If GMSCB supports pre-paging (i.e. it is prepared to wait long enough for the SRI ack to allow pre-paging to be completed), it indicates this by an information element in the SRI message.

HLRB decides whether pre-paging is supported according to the following criteria:

- GMSCB has indicated that it supports pre-paging; and
- HLRB supports pre-paging (i.e. it is prepared to wait long enough for the PRN ack to allow pre-paging to be completed).

HLRB sends a request for a roaming number (PRN) to VLRB; if pre-paging is supported, it indicates this by an information element in the PRN message. If Paging Area function is supported in HLRB then HLRB sends the paging area if stored in HLR. VLRB returns the roaming number in the PRN ack, and HLRB relays the roaming number to GMSCB in the SRI ack. GMSCB constructs an IAM using the roaming number, and sends it to VMSCB.

If the GMSC performs domain selection through HLR interrogation and the HLR supports domain selection functionality, HLRB executes domain selection functionaility. The HLR shall:

- send PRN to VLRB as defined in this section , if the result of domain selection is to handle the call in CS domain; or
- reply with SRI ack without sending PRN to VLRB, if the result of domain selection is to transfer the call from CS domain to IMS domain.

5.2.1 Mobile Terminating Roaming Retry Call after successful Retrieval of Routeing Information

The information flow for mobile terminating roaming retry call after successful retrieval of routeing information is shown in figure 4a. It applies to a mobile terminating call while the called mobile is simultaneously moving from an old to a new MSC, if the GMSC, the HLR and the old terminating VMSC support the MT Roaming Retry procedure.

In that case, upon receipt of:

- an ISUP IAM message which was preceeded by a MAP Cancel Location procedure, or
- a MAP Cancel Location procedure while on-going paging,

the old VMSC shall instruct the GMSC to resume terminating call procedure by sending a MAP Resume Call Handling message. The GMSC shall then release the ISUP connection to the old VMSC, terminate any open CAP dialogue, and retry the terminating call setup towards the new MSC by sending an additional SRI to the HLR. This second SRI request leads to obtaining a roaming number from the new MSC towards which the call can then be delivered (possibly after new CAMEL interactions).

An HLR supporting the "mobile terminating roaming retry" feature shall always send a MAP Cancel Location message message to the old VLR upon receipt of the MAP Update Location from the new VLR. This shall also apply if the HLR and the old VLR support Super-Charger (see 3GPP TS 23.116 [24]), regardless of whether the new VLR indicates or not during the location update procedure that the previous network entity must be notified.

NOTE 1: HLRs compliant with an earlier release of the specification and supporting mobile terminating roaming retry and Super-Charger may not always send a Cancel Location message in a supercharged network. To support mobile terminating roaming retry with such HLR implemenations, the old VLR can start a timer upon receipt of the MAP Send Identification message while on-going paging to trigger the sending of an internal Cancel Location to the old MSC and thus the sending of a MAP Resume Call Handling message by the old MSC to the GMSC after the sending of the MAP Update Location by the new VLR to the HLR.

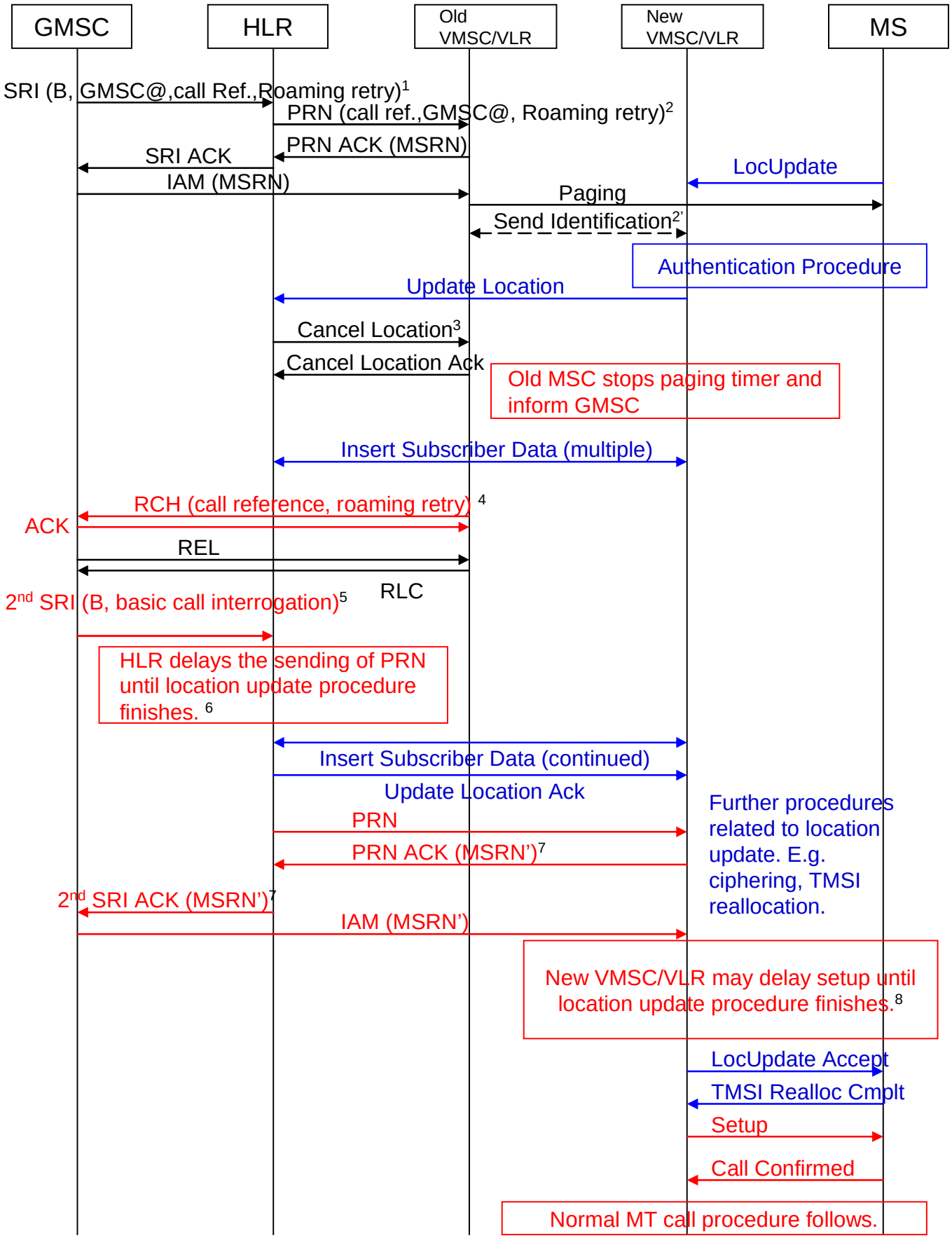

GMSC
HLR
Old VMSC/VLR
New VMSC/VLR
MS
SRI (B, GMSC@,call Ref.,Roaming retry)1
PRN (call ref.,GMSC@, Roaming retry)2
PRN ACK (MSRN)
SRI ACK
LocUpdate
IAM (MSRN)
Paging
Send Identification2'
Authentication Procedure
Update Location
Cancel Location3
Cancel Location Ack
Old MSC stops paging timer and inform GMSC
Insert Subscriber Data (multiple)
RCH (call reference, roaming retry) 4
ACK
REL
RLC
2nd SRI (B, basic call interrogation)5
HLR delays the sending of PRN until location update procedure finishes. 6
Insert Subscriber Data (continued)
Update Location Ack
PRN
PRN ACK (MSRN')7
Further procedures related to location update. E.g. ciphering, TMSI reallocation.
2nd SRI ACK (MSRN')7
IAM (MSRN')
New VMSC/VLR may delay setup until location update procedure finishes.8
LocUpdate Accept
TMSI Realloc Cmplt
Setup
Call Confirmed
Normal MT call procedure follows.

Figure 4a: Information flow for a mobile terminating roaming retry call after successful Retrieval of Routeing Information

1. A GMSC supporting the "mobile terminating roaming retry" feature includes the Call Reference Number, the GMSC address and the MT Roaming Retry Supported IE in the first SRI sent to the HLR.

2. A HLR supporting the "mobile terminating roaming retry" feature includes the Call Reference Number, the GMSC address and the MT Roaming Retry Supported IE in the PRN sent to the MSC/VLR if received in the SRI.

2'. An old VLR supporting the "mobile terminating roaming retry" feature may indicate in the MAP Send Identification response sent to the new VLR whether there is a pending mobile terminating call at the old VLR.

3. Receipt of the MT Roaming Retry Supported IE in the PRN indicates that the GMSC supports the Resume Call Handling procedure and the mobile terminating roaming retry feature. Upon receipt of the ISUP IAM message which was preceeded by a MAP Cancel Location message, or upon receipt of the MAP Cancel Location message while paging, the old MSC/VLR stops paging, if paging was on-going, and if it supports the "mobile terminating roaming retry" feature and did receive the MT Roaming Retry Supported IE in the PRN, sends an RCH message to the GMSC with the MT Roaming Retry IE. The old MSC shall terminate any open CAP dialogue when receiving RCH ACK or ISUP REL message.

4. Upon receipt of the RCH message with the MT roaming retry IE, the GMSC acknowledges the RCH message, releases the call towards the old MSC/VLR, terminates T-CSI dialog with the SCP, if any exists, using T-Abandon EDP, and re-sends a new SRI to the HLR (still a 'basic call' interrogation type) using a new call reference number.

5. To avoid looping, the new SRI shall be sent without the Roaming Retry Supported IE. Furthermore, the GMSC shall use an appropriate high value for the timer supervising receipt of SRI ACK.
   Note that the Suppress T-CSI field is not set since the Mobile Terminating procedure is restarted from the beginning including the handling of CAMEL interaction on T-CSI (this is because T-CSI treatments may end differently if old and new MSCs are not in the same PLMN or in the same geographical area, e.g. different charging rates or regional service subscription).

6. Upon receipt of a SRI request or PRN ack (regardless of the PRN response from the old VLR) during an on-going Update Location procedure, the HLR delays the sending of the PRN to the new VLR till completion of the Update Location procedure.

7. Receipt of the MSRN' from the new MSC/VLR enables the GMSC to relay the call towards the new MSC/VLR.

8. If the IAM message is received before the Location Update procedure is completed with the MS, the new MSC may delay the setup of the call until the completion of the Location Update procedure or start at once the normal terminating call procedure. In the former case, if the Location Update is received with the "follow-on" indication and if the VMSC supports the "follow-on" indication, the incoming IAM may either be handled as a waiting call or forwarded as Busy (CFB), depending on the state of the "follow-on" call and the subscriber's subscription data.
   If no IAM message has been received at the time the Location Update procedure completes, the new MSC may shortly defer the release of the signalling connection with the MS if the old VLR indicated in the MAP Send Identification response that there is a pending mobile terminating call at the old VLR.

NOTE 2: For a CS Fallback mobile terminating call, the new MSC also defers the release of the signalling connection with the MS if the MS includes the "CSMT" flag in the Location Update message (see clause 7.5 of 3GPP TS 23.272 [42]).

Similarly, a HLR supporting the "mobile terminating roaming retry" feature should wait for the completion of any on-going Location Update procedure when processing other terminating requests e.g. MAP-SEND-ROUTING-INFO-FOR-SM, MAP-SEND-ROUTING-INFO-FOR-LCS, MAP-ANY-TIME-INTERROGATION. More generally, this also applies to all TCAP transactions that the HLR may have to open toward a VLR (e.g. USSD, PSI).

5.2.2 Mobile Terminating Roaming Retry Call during Retrieval of Routeing Information

The information flow for mobile terminating roaming retry call during retrieval of routing information is shown in figure 4b. It applies to a mobile terminating call while the called mobile is simultaneously moving from an old to a new

MSC, if the GMSC and the HLR support the MT Roaming Retry procedure. The procedure may e.g. apply during pre-paging if the GMSC, HLR and old MSC/VLR support pre-paging.

In that case, upon receipt of:

- a MAP Cancel Location procedure while on-going pre-paging,

the old VMSC/VLR shall return a PRN negative response to the HLR. If "Suppress T-CSI" was included in the SRI request, the HLR shall relay a SRI negative response with the error "absent subscriber" including the reason "mtRoamingRetry" to the GMSC. If "Suppress T-CSI" was not included in the SRI request, and the called party is roaming to a different MSC/VLR during the PRN procedure, the HLR may either return a SRI negative response with the error "absent subscriber" including the reason "mtRoamingRetry" to the GMSC, or instead delay the sending of a PRN request to the new VLR until completion of the Update Location procedure.

The GMSC shall release the T-CSI dialogue (if existing) and retry the terminating call setup towards the new MSC by sending an additional SRI to the HLR when receiving a SRI negative response with the error "absent subscriber" including the reason "mtRoamingRetry". This second SRI request leads to obtaining a roaming number from the new MSC towards which the call can then be delivered (possibly after new CAMEL interactions).

NOTE 1: If "Suppress T-CSI" was included in the SRI request, the mobile terminating procedure is restarted from the beginning including the handling of CAMEL interaction on T-CSI, because T-CSI treatments can end differently if old and new MSCs are not in the same PLMN or in the same geographical area, e.g. different charging rates or regional service subscription.

An HLR supporting the "mobile terminating roaming retry" feature shall always send a MAP Cancel Location message message to the old VLR upon receipt of the MAP Update Location from the new VLR. This shall also apply if the HLR and the old VLR support Super-Charger (see 3GPP TS 23.116 [24]), regardless of whether the new VLR indicates or not during the location update procedure that the previous network entity must be notified.

NOTE 2: Legacy HLR implementations supporting mobile terminating roaming retry and Super-Charger may not always send a Cancel Location message in a supercharged network. To support mobile terminating roaming retry with such HLR implementations, the old VLR can start a timer upon receipt of the MAP Send Identification message while on-going paging to trigger the sending of an internal Cancel Location to the old MSC and thus the sending of a PRN negative response to the HLR after the sending of the MAP Update Location by the new VLR to the HLR.

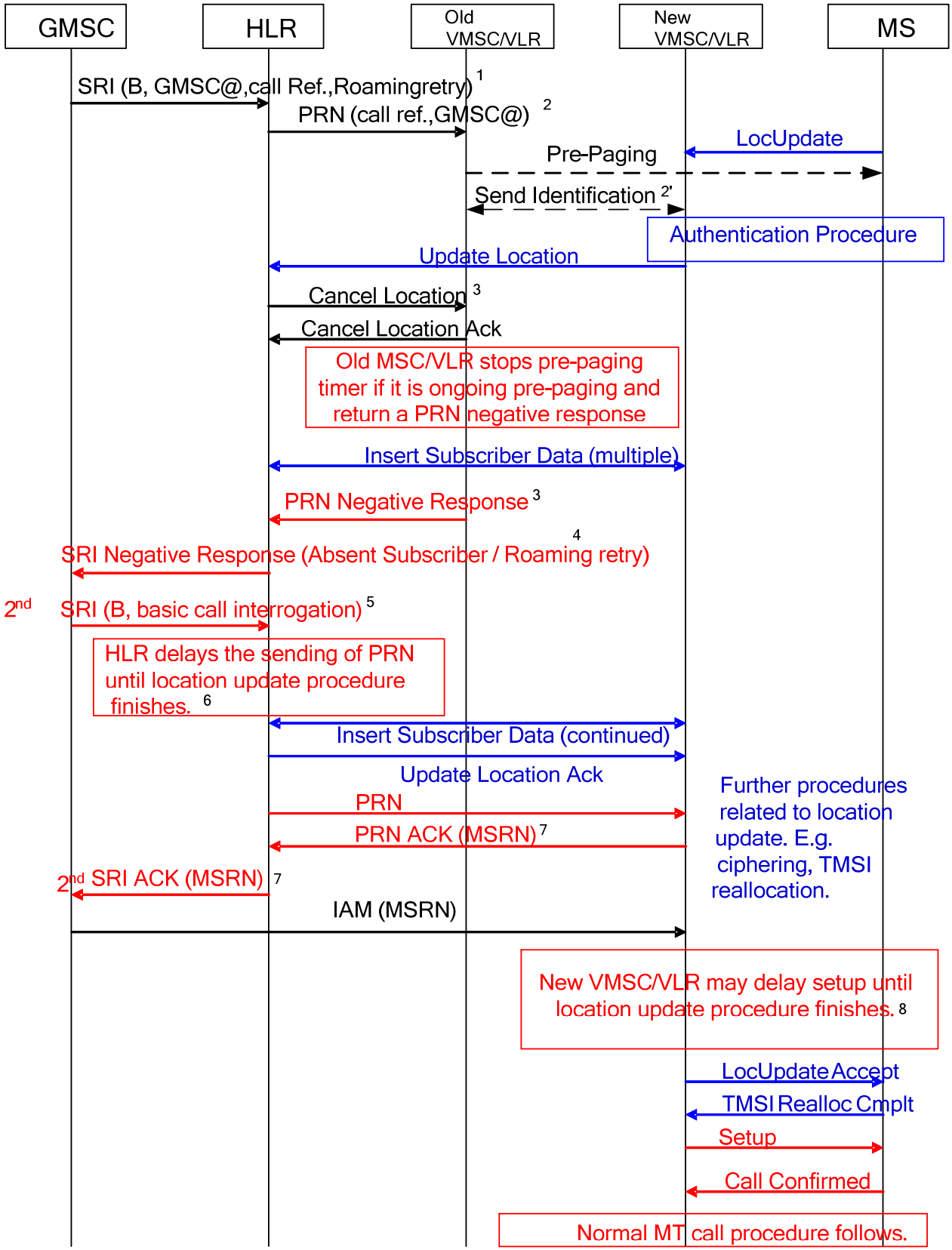


Figure 4b: Information flow for a mobile terminating roaming retry call during Retrieval of Routeing Information

1. A GMSC supporting the "mobile terminating roaming retry" feature includes the Call Reference Number, the GMSC address, and the MT Roaming Retry Supported IE in the first SRI sent to the HLR. The Pre-paging Supported IE is included in the SRI message if the GSMC supports the "Pre-paging" feature.

2. A HLR supporting the "mobile terminating roaming retry" feature includes the Call Reference Number and the GMSC address in the PRN sent to the MSC/VLR if received in the SRI. If GMSC and HLR support the "Pre-paging" feature, the Pre-paging Supported IE is included in the PRN message.

2'. An old VLR supporting the "mobile terminating roaming retry" feature may indicate in the MAP Send Identification response sent to the new VLR whether there is a pending mobile terminating call at the old VLR.

3. Upon receipt of the MAP Cancel Location message while pre-paging, the old MSC/VLR stops pre-paging and sends a PRN negative response message to the HLR. If meanwhile the HLR has received a new Update Location procedure from a new MSC/VLR, the HLR returns a SRI negative response with error "absent subscriber" including the reason "mtRoamingRetry" to the GMSC.

4. Upon receipt of the SRI negative response with error "absent subscriber" including the reason "mtRoamingRetry", the GMSC re-sends a new SRI to the HLR (still a 'basic call' interrogation type) using a new call reference number.

5.-8. See the same procedures from step 5 to step 8 in the figure 4a.

Similarly, a HLR supporting the "mobile terminating roaming retry" feature should wait for the completion of any on-going Location Update procedure when processing other terminating requests e.g. MAP-SEND-ROUTING-INFO-FOR-SM, MAP-SEND-ROUTING-INFO-FOR-LCS, MAP-ANY-TIME-INTERROGATION. More generally, this also applies to all TCAP transactions that the HLR may have to open toward a VLR (e.g. USSD, PSI).

5.2.3 Mobile Terminating Roaming Forwarding Call after successful Retrieval of Routeing Information

The information flow for mobile terminating roaming forwarding (MTRF) call after successful retrieval of routeing information is shown in figure 4c. It applies to a mobile terminating call while the called mobile is simultaneously moving from an old to a new MSC, if the old and the new terminating MSC/VLRs support the MT Roaming Forwarding procedure. The HLR should also support the Mobile Terminating Roaming Forwarding procedure in order to ensure that roaming forwarding can be offered in all scenarios (e.g. in case of IMSI in the LAU Request from UE).

NOTE 1: The full support of MTRF for roaming scenarios requires both home network (HLR) and visited network (VLRs) to support the MTRF procedures and protocol extensions. As deployment scenarios may exist where the home network (HLR) has not been updated to support MTRF the visited network can perform a limited roaming forwarding solution autonomously if the MTRF Supported flag is signalled in the MAP Send Identification message under the conditions defined in this clause.

The new terminating VLR shall include an MTRF Supported flag in the MAP Update Location message sent to the HLR. If the HLR authorises the MTRF call between the old and the new terminating MSCs, the HLR shall include the MTRF Supported And Authorized flag and the new MSC/VLR numbers in the MAP Cancel Location message sent to the old VLR. Otherwise if the HLR disallows the MTRF call between the old and the new terminating MSCs, the HLR shall include the MTRF Supported And Not Authorized flag in the MAP Cancel Location message sent to the old VLR. The new VLR may also signal the MTRF Supported flag and the new MSC/VLR numbers in the MAP Send Identification message to indicate to the old VLR that it supports MTRF.

An HLR supporting the "mobile terminating roaming forwarding" feature shall always send a MAP Cancel Location message message to the old VLR upon receipt of the MAP Update Location from the new VLR. This shall also apply if the HLR and the old VLR support Super-Charger (see 3GPP TS 23.116 [24]), regardless of whether the new VLR indicates or not during the location update procedure that the previous network entity must be notified.

If the old VLR receives a MAP Send Identification message containing the MTRF Supported flag it shall not trigger any MAP Provide Roaming Number request to the new terminating VLR until is has received the MAP Cancel Location message.

Upon receipt of a MAP Cancel Location message while ongoing paging, if either of the following is true:

- the MAP Cancel Location message includes the MTRF Supported And Authorized flag or;

- the MAP Cancel Location message does not include the MTRF Supported And Not Authorized flag and the old VLR has received the MTRF Supported flag earlier in the MAP Send Indentification message,

the old VLR shall send a MAP Provide Roaming Number request (including the MTRF Indicator and the parameters received from the HLR in the MAP Provide Roaming Number) to the new terminating VLR. The new terminating MSC/VLR shall then allocate an MSRN to allow the call to be routed from the old MSC to the new MSC and send it to the old VLR within the MAP Provide Roaming Number response.

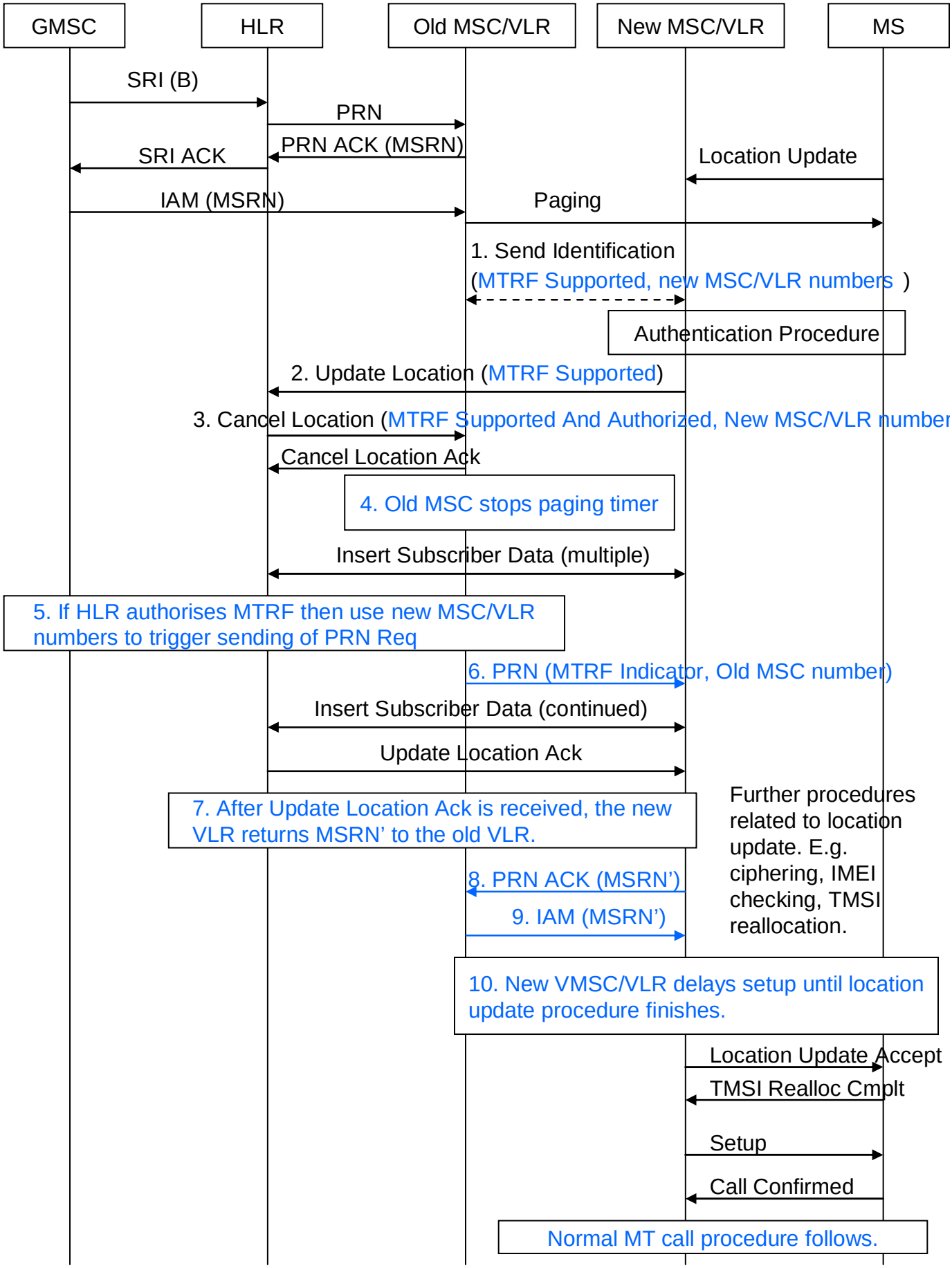

GMSC
HLR
Old MSC/VLR
New MSC/VLR
MS
SRI (B)
PRN
PRN ACK (MSRN)
SRI ACK
Location Update
IAM (MSRN)
Paging
1. Send Identification
(MTRF Supported, new MSC/VLR numbers)
Authentication Procedure
2. Update Location (MTRF Supported)
3. Cancel Location (MTRF Supported And Authorized, New MSC/VLR number
Cancel Location Ack
4. Old MSC stops paging timer
Insert Subscriber Data (multiple)
5. If HLR authorises MTRF then use new MSC/VLR numbers to trigger sending of PRN Req
6. PRN (MTRF Indicator, Old MSC number)
Insert Subscriber Data (continued)
Update Location Ack
7. After Update Location Ack is received, the new VLR returns MSRN' to the old VLR.
Further procedures related to location update. E.g. ciphering, IMEI checking, TMSI reallocation.
8. PRN ACK (MSRN')
9. IAM (MSRN')
10. New VMSC/VLR delays setup until location update procedure finishes.
Location Update Accept
TMSI Realloc Cmplt
Setup
Call Confirmed
Normal MT call procedure follows.

Figure 4c: Information flow for a mobile terminating roaming forwarding call after successful Retrieval of Routeing Information

The sequence follows the normal MT terminating call with the following differences:

1. If the Location Update Request contains a valid TMSI/old LAI (e.g. not after the old VLR restart), a new MSC/VLR supporting the MTRF feature may include the MTRF Supported flag and the new MSC/VLR numbers in the MAP Send Identification to the old VMSC.

   The new VLR shall not include the MTRF Supported flag in the MAP Send Identification message sent to the old VMSC if the Location Update message received from the MS indicates a CS fallback mobile originating call.

   An old VLR supporting the MTRF feature may indicate in the MAP Send Identification response sent to the new VLR whether there is a pending mobile terminating call at the old VLR.

NOTE 2: it is implementation dependent if the new VLR decides to not include the MTRF Supported flag in the MAP Send Identification message sent to the old VMSC if the Location Update message received from the MS contains the "follow-on request pending" flag.

2. A new MSC/VLR supporting the MTRF feature includes the MTRF Supported flag in the MAP Update Location message sent to the HLR, unless the Location Update message received from the MS indicates a CS fallback mobile originating call.

NOTE 3: it is implementation dependent if the new VLR decides to not include the MTRF Supported flag in the MAP Update Location message sent to the HLR if the Location Update message received from the MS contains the "follow-on request pending" flag.

3. Upon receipt of a MAP Update Location including the MTRF Supported flag, an HLR supporting the MTRF feature decides whether to authorise MTRF call between the old and the new MSCs based on roaming agreements with the old and the new MSCs. If MTRF is authorised, the HLR includes the MTRF Supported And Authorized flag and the new MSC/VLR numbers in the MAP Cancel Location message sent to the old VLR. If MTRF is not authorised, the HLR includes the MTRF Supported And Not Authorized flag in the MAP Cancel Location message sent to the old VLR.

4. Upon receipt of a MAP Cancel Location message while on-going paging and if it includes the MTRF Supported And Authorized flag or if the MAP Cancel Location message does include neither the MTRF Supported And Authorized flag nor the MTRF Supported And Not Authorized flag but the old MSC/VLR had received earlier the MTRF Supported flag at step 1, the old MSC/VLR stops paging.

5. If it supports MTRF and decides to apply MTRF based on local operator policy and optionally roaming agreements with the HLR and new MSC for MTRF, it sends a MAP Provide Roaming Number request (including the MTRF Indicator and the parameters received from the HLR in the MAP Provide Roaming Number) to the new terminating VLR.

   If the the MAP Cancel Location message does not include the MTRF Supported And Authorized flag and it did not receive the MTRF Supported flag at step 1 or if the MAP Cancel Location message includes the MTRF Supported And Not Authorized flag, the old MSC/VLR may initiate the MT Roaming Retry procedure as per clause 5.2.1.

   If the old MSC supports both the MT Roaming Retry and the MT Roaming Forwarding procedures, and if the conditions for using these procedures are met, the MSC can decide based on operator policy which procedure to follow.

6. Upon receipt of the MAP Provide Roaming Number Request, the new MSC/VLR may check roaming agreements with the HLR and the old MSC for MTRF.

   The new MSC/VLR may reject the MAP Provide Roaming Number Request with a cause indicating that the subscriber is busy if it has received from the MS a CM Service Request indicating a CS mobile originated call.

   If the new VLR rejects the MTRF request, the new VLR returns a negative response to the old VLR.

   As an option, the new MSC/VLR may check whether it also performs the GMSC function for the call by comparing the GMSC address received in the MAP Provide Roaming Number with its own MSC address. If so,

the GMSC / new MSC/VLR may proceed as shown in figure 4ca to deliver the MT call directly to the UE without further involving the old MSC/VLR.

7. If the new VLR accepts the MAP Provide Roaming Number request, upon successful completion of the MAP Update Location procedure with the HLR, the new MSC/VLR allocates an MSRN to allow the call to be routed from the old MSC to the new MSC. As an implementation option, the new MSC/VLR may allocate an MSRN before completion of the MAP Update Location procedure with the HLR.

8. The new MSC/VLR sends MSRN to the old VLR within the MAP Provide Roaming Number response.

   Upon receipt of the MSRN from the new MSC/VLR, the old MSC/VLR terminates any on-going Camel transaction.

9. Receipt of the MSRN from the new MSC/VLR enables the old MSC to relay the call towards the new MSC.

10. If the IAM message is received before the Location Update procedure is completed with the MS, the new MSC may delay the setup of the call until the completion of the Location Update procedure or start at once the normal terminating call procedure. In the former case, if the Location Update is received with the "follow-on" indication and if the MSC supports the "follow-on" indication, the incoming IAM may either be handled as a waiting call or forwarded as Busy (CFB), depending on the state of the "follow-on" call and the subscriber's subscription data.
    The Location Update Accept message may be sent to the MS at any time after receipt of the MAP Update Location Ack from the HLR, i.e. the location update procedure with the MS is not affected by the MT Roaming Forwarding procedure.

    If no MAP Provide Roaming Number request has been received at the time the Location Update procedure completes, the new MSC may shortly defer the release of the signalling connection with the MS if the old VLR indicated in the MAP Send Identification response that there is a pending mobile terminating call at the old VLR.

NOTE 4: For a CS Fallback mobile terminating call, the new MSC also defers the release of the signalling connection with the MS if the MS includes the "CSMT" flag in the Location Update message (see clause 7.5a of 3GPP TS 23.272 [42]).

The MAP Update Location message and Send Identification message may include the new LMSI allocated by the new terminating MSC/VLR if the MTRF Supported flag is present in those messages. If available, the HLR shall include the new LMSI in the MAP Cancel Location message it sends to the old VLR if the MTRF Supported And Authorized flag is present in this message. If available, the old VLR shall include the new LMSI in the MAP Provide Roaming Number message it sends to the new VLR.

A VLR may also set the MTRF Supported flag in the MAP Update Location message it sends to the HLR upon establishment of an SGs association (see 3GPP TS 23.272 [42]). This enables in particular mobile terminating roaming forwarding calls during the mobile terminated CS service delivery via an alternative MME in MME pool procedure when the new SGs association is established towards a new VLR (see clause 26 of 3GPP TS 23.007 [43]).

The information flow for mobile terminating roaming forwarding (MTRF) call if the GSMC and the new MSC/VLR are the same node and if they support the option (in step 6) to deliver the MT call directly to the UE without further involving the old MSC/VLR is shown in figure 4ca.

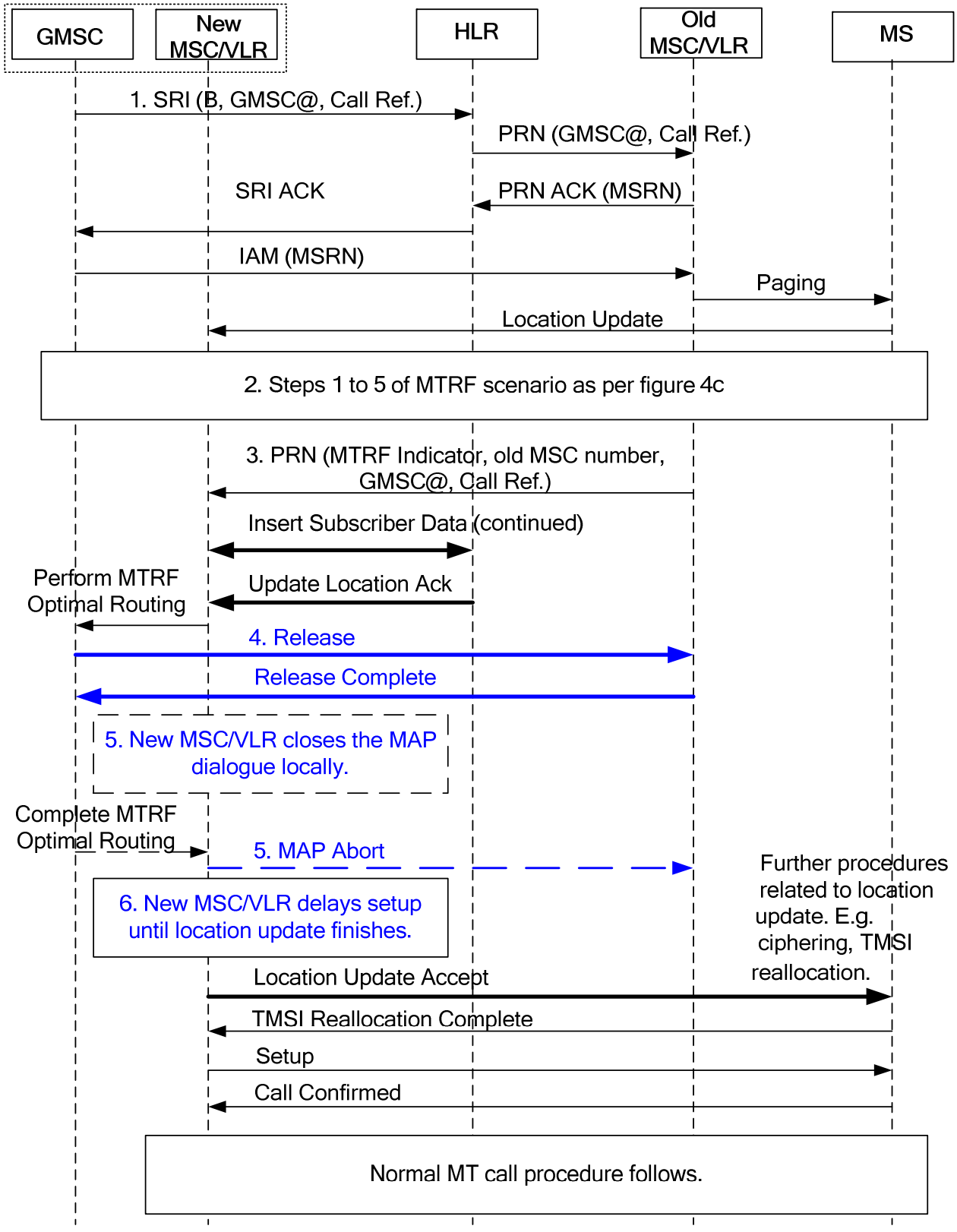


Figure 4ca : Information flow for a mobile terminating roaming forwarding call after successful Retrieval of Routeing Information with MTRF Optimal Routing when the GMSC and the new MSC/VLR are the same node

The sequence follows the normal flow for MTRF call after successful Retrieval of Routeing Information (as specified in figure 4c) with the following differences:

1. The GMSC shall include the GMSC address and the Call reference number used by the GMSC for this call in the MAP Send Routing Information . The HLR shall include these parameters in the MAP Provide Roaming Number if received in the MAP Send Routing Information.

2. Steps 1 to 5 as specified for figure 4c.

3. The new MSC/VLR shall determine that it also performs the GMSC function for the call identified by the Call Reference Number if the GMSC address received in the MAP Provide Roaming Number matches its own MSC address.

4. In that case, the GMSC shall send a Release message to the old MSC/VLR. Upon receipt of this message, the old MSC/VLR shall return a Release Complete message to the GMSC.

5. The new MSC/VLR shall close the MAP Dialogue (initiated in step 3) locally (i.e. MAP-Close service with the release method set to "pre-arranged end"). Alternatively, the new MSC/VLR may send a MAP Abort message to the old MSC/VLR after receiving the Release Complete message. The old MSC/VLR shall release all resources associated to the call (if not already done at step 4).

NOTE 5: The MAP Abort message is sent after receipt of the Release Complete message to avoid the old MSC/VLR initiating a Release procedure towards the GMSC or invoking Call Forwarding upon receipt of the MAP Abort message.6. The new MSC/VLR shall then proceed with the establishment of the MT call without further involving the old MSC/VLR.

NOTE 6: The internal messages between the GMSC and the new MSC/VLR are implementation specific and not further described in 3GPP specifications.

5.2.4 Mobile Terminating Roaming Forwarding Call during Retrieval of Routeing Information

The information flow for mobile terminating roaming forwarding (MTRF) call during retrieval of routeing information is shown in figure 4d. It applies to a mobile terminating call while the called mobile is simultaneously moving from an old to a new MSC, if the old and the new terminating MSC/VLRs support the MT Roaming Forwarding procedure. The HLR should also support the Mobile Terminating Roaming Forwarding procedure in order to ensure that roaming forwarding can be offered in all scenarios (e.g. in case of IMSI in the LAU Request from UE); an HLR that supports Optimal Routeing shall support the requirements defined in this clause to ensure that charging requirements for optimal routeing are never contravened. The procedure may e.g. apply during pre-paging if the GMSC, HLR and old MSC/VLR support pre-paging.

The principles and requirements specified for MT Roaming Forwarding Call after successful Retrieval of Routeing Information (see clause 5.2.3) shall also apply for MT Roaming Forwarding Call during Retrieval of Routeing Information with the following modifications or clarifications.

When an MSRN is retrieved successfully from the new MSC/VLR, the old MSC/VLR shall return the received MSRN within the MAP Provide Roaming Number response to the HLR, which allows the call to be routed from the GMSC to the new MSC.

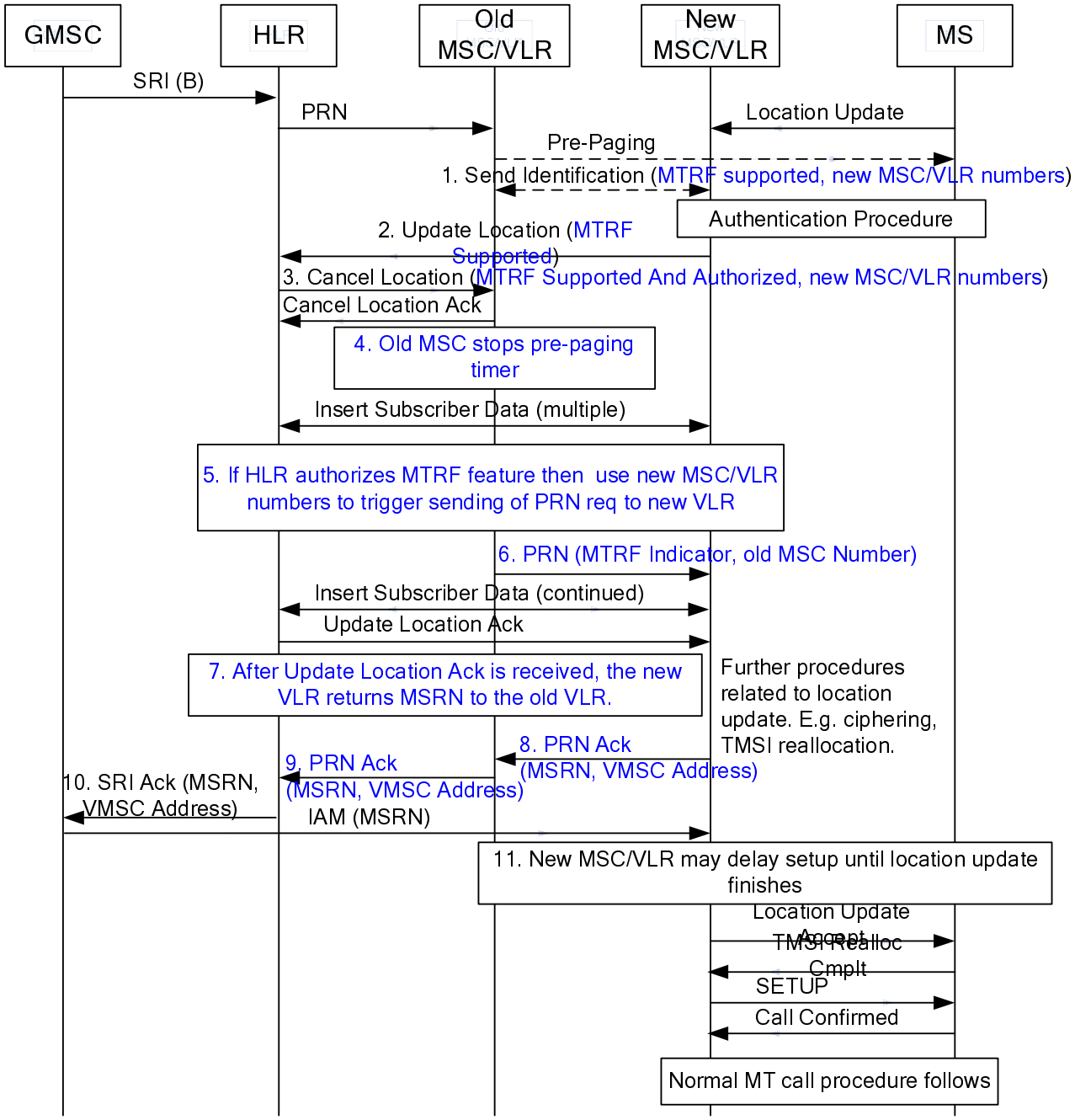


Figure 4d: Information flow for a mobile terminating roaming forwarding call during Retrieval of Routeing Information

The sequence follows the normal MT terminating call with the following differences:

1-2. Same as steps 1 and step 2 in figure 4c.

3. Same as step 3 in figure 4c, with the addition that the HLR shall not authorise MTRF between the old and the new MSCs if routing the call between the GMSC and the new MSC contravenes charging requirements if Optimal Routeing is supported (see 3GPP TS 23.079[13]).

4. Same as step 4 in figure 4c, where the old MSC/VLR stops pre-paging.

5. Same as step 5 in figure 4c.

6. Same as step 6 in figure 4c. If the OR interrogation indicator is received in the PRN request, the new VLR shall return a PRN negative response if it does not support Optimal Routeing (see 3GPP TS 23.079 [13]).

7. Same as step 7 in figure 4c.

8. The new MSC/VLR returns to the old VLR a MAP Providing Roaming Number response including the MSRN, the new VMSC Address, and if the new MSC/VLR supports the MAP Release Resource procedure, the ReleaseResourcesSupported flag.

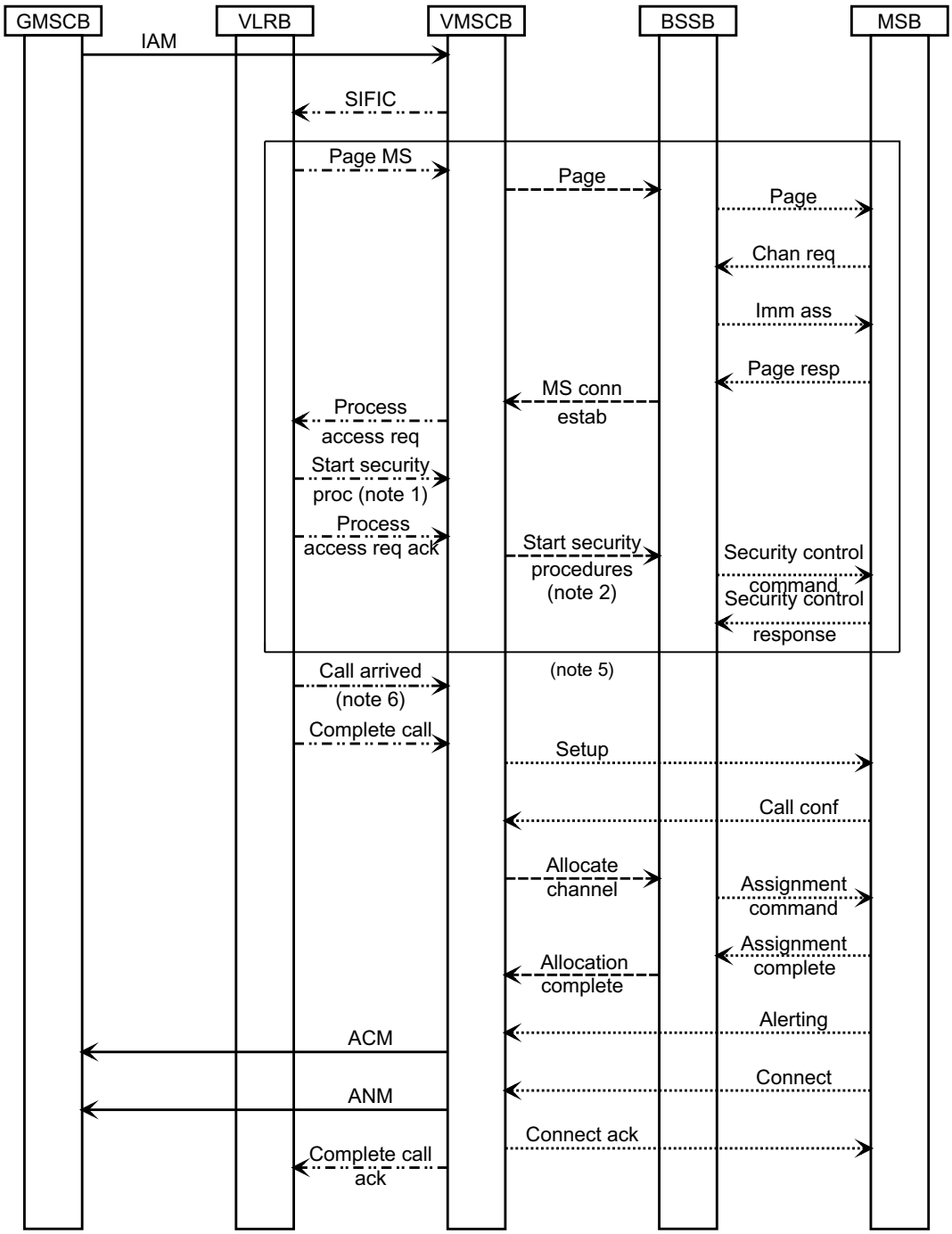
9. Upon receipt of the MSRN from the new VLR, the old VLR returns the PRN Ack to the HLR including the MSRN and the VMSC Address received from the new VLR, and the ReleaseResourcesSupported flag if received from the new MSC/VLR.

10. If the HLR needs to return the VMSC Address to the GMSC (as per the conditions specified in 3GPP TS 29.002 [29]), and if a VMSC Address was received with an MSRN in the PRN Ack, the HLR shall pass in the SRI ack to the GMSC the MSRN and the VMSC Address received in the PRN ack.
Receipt of the MSRN from the HLR enables the GMSC to relay the call towards the new MSC.

11. Same as step 10 in figure 4c.

5.3 Information flow for an MT call

An example information flow for an MT call is shown in figure 5; many variations are possible. ISUP signalling between GMSCB and VMSCB is shown by solid lines; signalling over the B interface between VMSCB and VLRB is shown by chain lines; signalling over the Iu interface (for UMTS) or the A interface (for GSM) between VMSCB and BSSB is shown by dashed lines; and signalling over the radio interface between VMSCB or BSSB and MSB is shown by dotted lines.



NOTE 1: Security procedures may be initiated at any stage after the network has accepted the page response; the position in this message flow diagram is an example.

NOTE 2: If Security procedures are not required, the MSC may send a Start security procedures message indicating that no ciphering is required.

NOTE 3: This message flow diagram assumes that the MS has already been authenticated on location registration. If this is not so (for the first MT call after VLR restoration), the network may initiate authentication after the MS responds to paging.

NOTE 4: The network may request the IMEI from the MS, and may check the IMEI, at any stage after the MS responds to paging, either as part of the procedure to start security procedures or explicitly after security procedures have been started; this is not shown in this message flow diagram.

NOTE 5: If a connection between MSCB and MSB has been established as a result of pre-paging, the paging procedure is not performed.

NOTE 6: If a connection between MSCB and MSB has been established as a result of pre-paging, VLRB sends the Call arrived message to MSCB to stop the guard timer for the release of the radio connection.

Figure 5: Information flow for a basic mobile terminated call

When VMSCB receives an IAM from GMSCB it sends to VLRB a request for information to handle the incoming call, using a Send Info For Incoming Call (SIFIC) message containing the roaming number received in the IAM.

If VLRB recognizes the roaming number, and MSB is allowed service, it sends a request to VMSCB to page MSB. If a radio connection between the network and MSB is already established, VMSCB responds immediately to the page request. If no radio connection exists, VMSCB sends a page request to BSSB, and BSSB broadcasts the page on the paging channel. If VPLMNB supports GPRS and the Gs interface between VLRB and the SGSN is implemented (see 3GPP TS 23.060 [9]) and there is a valid association between VLRB and the SGSN for the MS, the paging signal towards the MS goes from VMSCB via VLRB and the SGSN to the BSS.

If MSB detects the page, it sends a channel request to BSSB, which responds with an immediate assignment command, to instruct MSB to use the specified signalling channel. MSB then sends a page response on the signalling channel; BSSB relays this to VMSCB. VMSCB sends a Process access request message to VLRB to indicate that MSB has responded to paging. VLRB may then initiate authentication, as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM. VLRB may also initiate security procedures at this stage, as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM.

If the MS is paged in a CSG cell, VLRB shall control if the CSG cell is allowed by the CSG subscription data stored in VLRB. If the CSG cell is not allowed, VLRB shall reject the the Process Access Request.

If the MS is paged in a hybrid cell, VLRA shall set the CSG membership status in the Process Access Request ack according to the CSG subscription data stored in VLRA.

VLRB may restore CSG data from CSS for a MT call after a VLRB restart.

If VLRB determines that MSB is allowed service, it sends a Process access request ack to VMSCB. The Process access request ack message triggers a Start security procedures message towards BSSB; if VMSCB has not received a Start security procedures message from VLRB, the Start security procedures message indicates no ciphering.

VLRB then sends a Complete call message to VMSCB. VMSCB sends a Set-up message towards MSB. The Set-up message may include bearer capability information for the call.

When MSB receives the Set-up message from BSSB, it responds with a Call confirmed message. The Call Confirmed message includes bearer capability information if any of the negotiable parameters of the bearer capability has to be changed. When VMSCB receives the Call confirmed message via BSSB, it sends an Allocate channel message to BSSB. BSSB instructs MSB to tune to a traffic channel by sending an Assignment command. When MSB has tuned to the specified traffic channel it responds with an Assignment complete, message, which BSSB relays to VMSCB as an Allocation complete, and sends an Alerting message to indicate that the called user is being alerted. VMSCB sends an ACM to GMSCB, which relays it to the originating exchange.

When the called user answers, MSB sends a Connect message, which BSSB relays to VMSCB. VMSCB:

- responds with a Connect ack message towards MSB;
- sends an ANM to GMSCB, which relays it to the originating exchange;
- sends a Complete call ack to VLRB.

The network then waits for the call to be cleared.

6 Principles for interactions with supplementary services

This clause specifies the principles used to describe the invocation of the GSM or UMTS supplementary services which were standardized when the present document was drafted. Registration, erasure, activation, deactivation and interrogation are call-independent operations; they are therefore outside the scope of the present document. Descriptions may be found in the stage 2 specifications for each supplementary service.

In the modelling used in the present document, each supplementary service which a network entity supports is managed by a supplementary service handler, which handles data in the entity in which it runs. The call handling processes defined in the present document use the data to define the contents of messages to other entities. The basic call handling processes defined in the present document interact with the supplementary service handlers as shown in the SDL

diagrams and the supporting text. If a network entity does not support a supplementary service, it bypasses the interaction with the handler for that supplementary service. Exceptions to this general principle are described later in this clause.

6.1 Call Deflection service (3GPP TS 23.072)

The basic call handling processes ICH_MSC and ICH_VLR interact with the CD supplementary service (3GPP TS 23.072 [11]) as described in clauses 7.3.1 and 7.3.2 respectively.

6.2 Line identification services (3GPP TS 23.081)

6.2.1 Calling Line Identification Presentation (CLIP)

The basic call handling processes ICH_VLR and ICH_MSC interact with the processes CLIP_MAF001 and CLIP_MAF002 (3GPP TS 23.081 [14]) as described in clauses 7.3.1 and 7.3.2.

6.2.2 Calling Line Identification Restriction (CLIR)

The basic call handling processes OCH_MSC and OCH_VLR interact with the processes CLIR_MAF004 and CLIR_MAF003 (3GPP TS 23.081 [14]) as described in clauses 7.1.1 and 7.1.2.

6.2.3 Connected Line Identification Presentation (COLP)

The basic call handling processes OCH_MSC and OCH_VLR interact with the processes COLP_MAF006 and COLP_MAF005 (3GPP TS 23.081 [14]) as described in clauses 7.1.1 and 7.1.2.

The basic call handling processes MT_GMSC and ICH_MSC interact with the process COLP_MAF039 (3GPP TS 23.081 [14]) as described in clauses 7.2.1 and 7.3.1.

6.2.4 Connected Line Identification Restriction (COLR)

The basic call handling processes ICH_VLR and ICH_MSC interact with the processes COLR_MAF040 and COLR_MAF041 (3GPP TS 23.081 [14]) as described in clauses 7.3.2 and 7.3.1.

6.3 Call forwarding services (3GPP TS 23.082)

6.3.1 Call Forwarding Unconditional (CFU)

The basic call handling process SRI_HLR interacts with the process MAF007(3GPP TS 23.082 [15]) as described in clause 7.2.2.

6.3.2 Call Forwarding on mobile subscriber Busy (CFB)

The basic call handling process ICH_VLR interacts with the process MAF008 (3GPP TS 23.082 [15]) as described in clause 7.3.2.

6.3.3 Call Forwarding on No Reply (CFNRy)

The basic call handling process ICH_VLR interacts with the process MAF009 (3GPP TS 23.082 [15]) as described in clause 7.3.2.

6.3.4 Call Forwarding on mobile subscriber Not Reachable (CFNRc)

The basic call handling processes SRI_HLR and ICH_VLR interact with the process MAF010 (3GPP TS 23.082 [15]) as described in clauses 7.2.2 and 7.3.2.

6.4 Call wait (3GPP TS 23.083)

The basic call handling process ICH_VLR interacts with the process MAF013 (3GPP TS 23.083 [16]) as described in clause 7.3.2. Further details of the handling of call waiting are given in clauses 7.3.1 and 7.3.2.

6.5 Call hold (3GPP TS 23.083)

Invocation of call hold before a basic call has been established will be rejected.

The basic call handling processes OCH_MSC and ICH_MSC interact with the procedures Process_Hold_Request and Process_Retrieve_Request as described in clauses 7.1.1 and 7.3.1.

6.6 Multiparty (3GPP TS 23.084)

Invocation of multiparty before a basic call has been established will be rejected.

6.7 Closed user group (3GPP TS 23.085)

The basic call handling process OCH_VLR interacts with the process CUG_MAF014 (3GPP TS 23.085 [18]) as described in clause 7.1.2.

The basic call handling process SRI_HLR interacts with the process CUG_MAF015 (3GPP TS 23.085 [18]) as described in clause 7.2.2.

The interactions between call forwarding and CUG (3GPP TS 23.085 [18]) are handled as described in clause 7.2.2.6.

6.8 Advice of charge (3GPP TS 23.086)

The interactions between Advice of Charge (3GPP TS 23.086 [19]) and MO calls are handled as described in clauses 7.1.1 and 7.1.2.

The interactions between Advice of Charge (3GPP TS 23.086 [19]) and MT calls are handled as described in clauses 7.3.1 and 7.3.2.

6.9 User-to-user signalling (3GPP TS 23.087)

The basic call handling processes OCH_MSC, OCH_VLR, MT_GMSC and ICH_MSC interact with the UUS supplementary service as described in clauses 7.1.1, 7.1.2, 7.2.1 and 7.3.1 respectively.

6.10 Call barring (3GPP TS 23.088)

6.10.1 Barring of outgoing calls

The basic call handling process OCH_VLR interacts with the processes MAF017, MAF018 and MAF020 (3GPP TS 23.088 [21]) as described in clause 7.1.2.

6.10.2 Barring of incoming calls

The basic call handling process SRI_HLR interacts with the processes MAF022, MAF023 and MAF024 (3GPP TS 23.088 [21]) as described in clause 7.2.2.

6.11 Explicit Call Transfer (3GPP TS 23.091)

There is no interaction between Explicit Call Transfer and the basic call handling described in the present document.

6.12 Completion of Calls to Busy Subscriber (3GPP TS 23.093)

The basic call handling processes OCH_MSC, OCH_VLR, MT_GMSC, SRI_HLR, PRN_VLR, ICH_MSC and ICH_VLR interact with the CCBS supplementary service as described in clauses 7.1.1, 7.1.2, 7.2.1, 7.2.2, 7.2.3, 7.3.1 and 7.3.2respectively.

6.13 Multicall (3GPP TS 23.135)

The basic call handling processes OCH_MSC, OCH_VLR, ICH_MSC & ICH_VLR interact with the Multicall supplementary service as described in clauses clauses 7.1.1, 7.1.2, 7.3.1 and 7.3.2respectively.

7 Functional requirements of network entities

The text in this clause is a supplement to the definition in the SDL diagrams; it does not duplicate the information in the SDL diagrams.

The entities described in this clause interwork with other entities over four different types of interface:

- The Iu interface, used to interwork between the MSC and the UTRAN or the UMTS UE;
- The A interface, used to interwork between the MSC and the GSM BSS or the GSM MS;
- The C, D & F interfaces, used to interwork between the MSC & HLR (C), VLR & HLR (D) and MSC & EIR (F);
- Telephony signalling interfaces, used to interwork between an MSC and another exchange.

The protocols used over the Iu interface are RANAP, which is specified in 3GPP TS 25.413 [27], for interworking with the UTRAN and DTAP, which is specified in 3GPP TS 24.008 [26], for interworking with the MS.

The protocols used over the A interface are BSSMAP, which is specified in 3GPP TS 48.008 [2], for interworking with the BSS and DTAP, which is specified in 3GPP TS 24.008 [26], for interworking with the MS.

The protocol used over the C, D & F interfaces is MAP, which is specified in 3GPP TS 29.002 [29].

For the purposes of the present document, the protocol used over telephony signalling interfaces is ISUP, which is specified in ITU-T Recommendations Q.761[33], Q.762 [34], Q.763 [35] and Q.764 [36]; other telephony signalling systems may be used instead.

The present document shows the call handling application processes interworking with a protocol handler for each of the protocols listed above. Each protocol defines supervision timers. If a supervision timer expires before a distant entity responds to a signal, the handling is as defined in the appropriate protocol specification. In general, the protocol handler reports timer expiry to the application as an error condition or negative response. Where a timer is shown in the present document, therefore, it is an **application** timer rather than a **protocol** timer. Interworking with the protocol handlers uses functional signal names which do not necessarily have a one-to-one correspondence with the names of messages used in the protocols.

An MSC which receives an IAM from an originating exchange may react in three different ways:

- It acts as a transit exchange, i.e. it relays the IAM to a destination exchange determined by analysis of the called party address, and thereafter relays other telephony signalling between the originating and destination exchange until the connection is released. This behaviour is not specific to UMTS or GSM;
- It acts as a terminating exchange, i.e. it attempts to connect the call to an MS currently registered in the service area of the MSC;
- It acts as a GMSC, i.e. it interrogates an HLR for information to route the call. If the HLR returns routeing information, the MSC uses the routeing information from the HLR to construct an IAM, which it sends to a destination exchange determined by analysis of the routeing information from the HLR.

Annex A describes the method which the MSC uses to decide how to process the IAM.

The SDL diagrams in this clause show the handling for a number of optional features and services. If the handling consists only of a call to a procedure specific to the feature or service, the procedure call is omitted if the entity does not support an optional feature or service. If the handling consists of more than a call to a procedure specific to the feature or service, the text associated with each SDL diagram specifies the handling which applies if the entity does not support an optional feature or service. For simplicity of description, it is assumed that support for Operator Determined Barring and the Call Forwarding and Call Barring supplementary services is mandatory.

7.1 MO call

7.1.1 Functional requirements of serving MSC

7.1.1.1 Process OCH_MSC

The variable TCH allocated is global data, accessible to the procedure Establish_Originating_TCH_If_Required.

The procedures CCBS_Report_Not_Idle and CCBS_Check_Last_Call are specific to CCBS; they are specified in 3GPP TS 23.093 [23].

7.1.1.2 Procedure Process_Access_Request_MSC

Sheet 1: the processing starting with the input signal "Send UESBI-Iu to Access Network" is specific to PUESBINE. If the MSC does not support PUESBINE, this signal will not be received.

Sheet 1: the task "Convert IMEISV to UESBI" is defined in 3GPP TS 23.195 [25a].

Sheet 2: instead of using the explicit procedure Obtain_IMEI_MSC, the VMSC may encapsulate the request for the IMEI in the Start security procedures message; the BSS relays the response in the Security procedures complete message to the MSC.

Sheet 2: the VMSC maps the negative response received on the B interface to the appropriate reject cause according to the rules defined in 3GPP TS 29.010 [31].

Sheet 2: The Start security procedures message may indicate one of several ciphering algorithms, or (for GSM only) no ciphering.

Sheet 2, sheet 3: At any stage, the MS may terminate the transaction with the network by sending a CM service abort message.

Sheet 2, sheet 3: if the VMSC receives a Set-up message from the MS while the access request is being handled, the message is saved for processing after the access request has been handled.

7.1.1.3 Procedure OG_Call_Setup_MSC

Sheet 1: the variables Alerting sent, MS connected and Reconnect are global data, accessible to the procedures CCBS_Check_OG_Call, CCBS_OCH_Report_Failure, CCBS_OCH_Report_Success, CCBS_Check_If_CCBS_Possible, Send_Alerting_If_Required and Send_Access_Connect_If_Required.

Sheet 1: the variable UUS1 result sent is specific to UUS. This variable is accessible to all UUS specific procedures.

Sheet 1: the procedure UUS_OCH_Check_Setup is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 1: the VMSC converts the PLMN bearer capability negotiated between the VMSC and the MS to a basic service according to the rules defined in 3GPP TS 27.001 [28].

Sheet 1: the procedure CAMEL_N_CSI_CHECK_MSC is specific to CAMEL Phase 3 or later, it is specified in 3GPP TS 23.078 [12].

Sheet 1: the procedure Check_OG_Multicall_MSC is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 1: the variable "On_Hold" is used only if the VMSC supports Call Hold.

Sheet 1, sheet 2, sheet 3, sheet 6: the procedure CCBS_OCH_Report_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1, sheet 2, sheet 6, sheet 7, sheet 9: at any stage after the Set-up has been received, the MS may terminate the transaction with the network by sending a Release transaction request.

Sheet 2, sheet 3, sheet 4, sheet 5, sheet 6, sheet 7, sheet 8, sheet 9: signals are sent to and received from the process Subs_FSM as described in clause 7.4.

Sheet 3: the procedure Set_CLI_Presentation_Indicator_MSC is specific to CLIR. If the VMSC does not support CLIR, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 3: the procedure CAMEL_OCH_MSC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 3: the procedure CAMEL_MO_Dialled_Services is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 3: the procedure CCBS_Check_OG_Call is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. If the VMSC does not support CCBS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 3: the procedure MOBILE_NUMBER_PORTABILITY_IN_OQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 3: the procedure UUS_OCH_Set_Info_In_IAM is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 3: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CCBS_OCH_Report_Success is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 5: the procedure CAMEL_OCH_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 4, sheet 7: the procedures CAMEL_Start_TNRy and CAMEL_Stop_TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 4: the task "UTU2Cnt := 0" is executed only if the VMSC supports UUS

Sheet 4: the procedure CAMEL_OCH_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 5: the procedure CAMEL_OCH_MSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 5: the procedure Set_COLP_Info_MSC is specific to COLP.

Sheet 5: the procedure Handle_AoC_MO_MSC is specific to AoC.

Sheet 5: the task "Store CW treatment indicator for this call if received in SII2" is executed only if the VMSC supports CAMEL phase 3 or later.

Sheet 5: The process CAMEL_OCH_LEG2_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedures CCBS_Check_If_CCBS_Possible and CCBS_Activation_MSC are specific to CCBS; they are specified in 3GPP TS 23.093 [23]. The task "Store CCBS Result" is executed only if the VMSC supports CCBS. If the VMSC does not support CCBS, processing continues from the "CCBS Not Possible" exit of the test "CCBS Result".

Sheet 6, sheet 7: the procedure CAMEL_OCH_MSC_DISC3 is specific to CAMEL Phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 6, sheet 7: the procedure CAMEL_OCH_MSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6, sheet 6: the procedure CAMEL_OCH_MSC1 is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 2 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 6, sheet 7, sheet 9: the processing in the branch beginning with the Int_Release_Call input will occur only if the MSC supports CAMEL.

Sheet 7, sheet 9: the procedure UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 8: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the VMSC supports CAMEL phase 2 or later. The procedure CAMEL_OCH_MSC2 is specified in 3GPP TS 23.078 [12].

Sheet 8: the input signal User To User is specific to UUS; it is discarded if the VMSC does not support UUS.

Sheet 8: the procedures UUS_MSC_Check_UUS2_UUI_to_MS and UUS_MSC_Check_UUS2_UUI_to_NW are specific to UUS; they are specified in 3GPP TS 23.087 [20].

Sheet 9: the procedure CAMEL_OCH_MSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 9: the procedure CAMEL_OCH_MSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 10: the procedure Process_Hold_Request is specific to Call Hold; it is specified in 3GPP TS 23.083[16].

Sheet 10: the procedure Process_Retrieve_request is specific to Call Hold; it is specified in 3GPP TS 23.083[16].

7.1.1.4 Procedure Obtain_IMSI_MSC

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to return its IMSI. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.5 Procedure Authenticate_MSC

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to respond to an authentication request. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.6 Procedure Obtain_IMEI_MSC

The Send IMEI request to the MS specifies the IMEISV as the requested identity.

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to return its IMEI. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.7 Procedure Check_IMEI_MSC

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to return its IMEI. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

The MS may terminate the transaction with the network while the VMSC is waiting for the result of the IMEI check from the EIR. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.8 Procedure Establish_Originating_TCH_If_Required

7.1.1.9 Procedure Set_CLI_Presentation_Indicator_MSC

The MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process CLIR_MAF004. The message is saved for processing after return from the procedure.

7.1.1.10 Procedure Send_Alerting_If_Required

The test "Backward call indicator=no indication" refers to the called party's status field in the backward call indicators parameter of the ISUP Address Complete message which triggered the call of the procedure Send_Alerting_If_Required.

The procedures UUS_MSC_Check_UUS1_UUI and UUS_OCH_Set_Alert_And_Connect_Param are specific to UUS; they are specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

If no useful information would be carried in the Progress message, it is not sent.

7.1.1.11 Procedure Set_COLP_Info_MSC

The MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process COLP_MAF006. The message is saved for processing after return from the procedure.

7.1.1.12 Procedure Send_Access_Connect_If_Required

The test "Acknowledgement required" refers to the result returned by the procedure Handle_AoC_MSC. If the VMSC does not support AoC, processing continues from the "No" exit of the test "Acknowledgement required".

The procedure UUS_OCH_Set_Alert_And_Connect_Param is specific to UUS, it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

If no useful information would be carried in the Facility message, it is not sent.

7.1.1.13 Procedure Handle_AoC_MO_MSC

The charging parameters and the Boolean variable Acknowledgement required are global data which can be read by the parent process.

7.1.1.14 Procedure TCH_Check

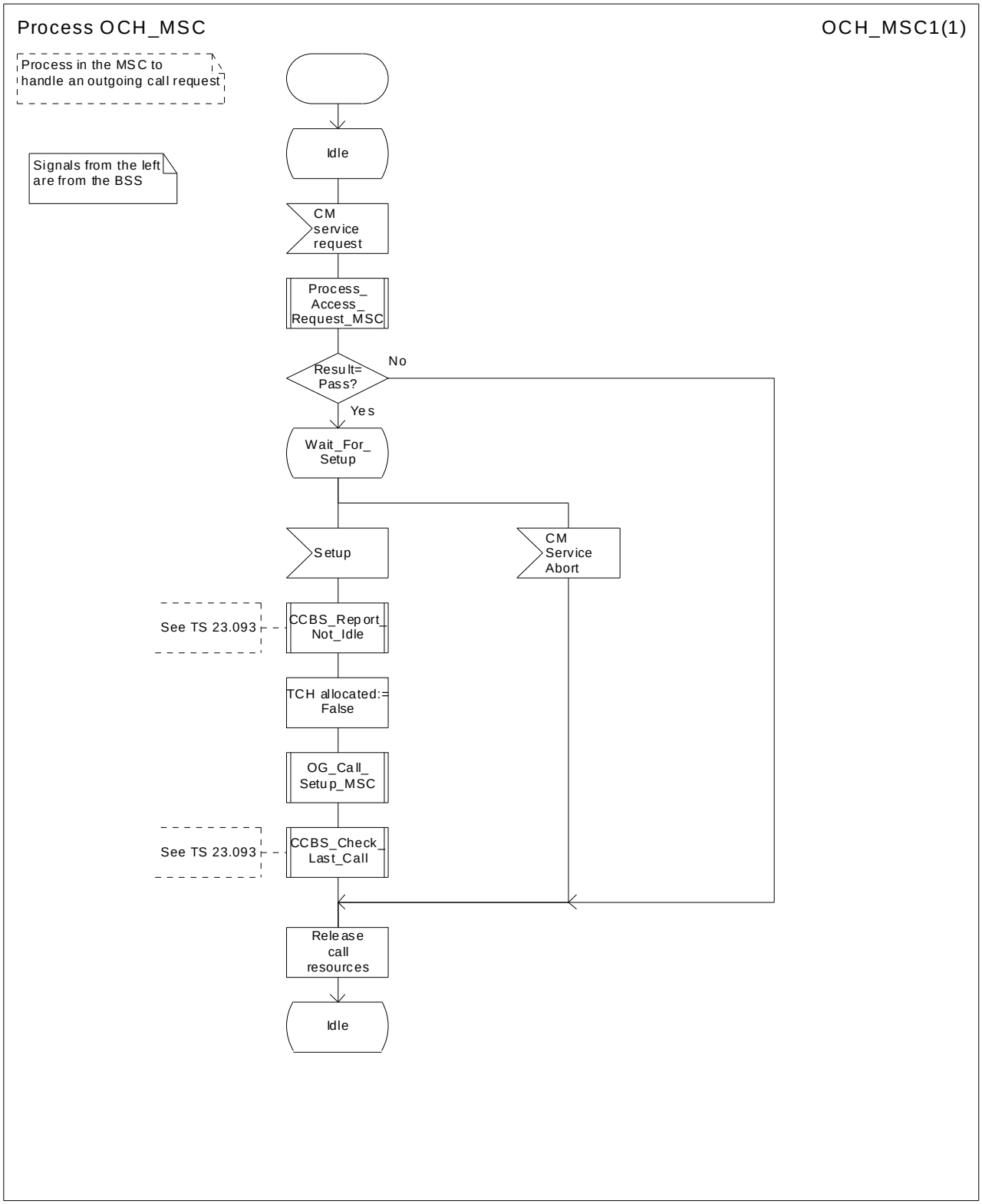


Figure 6: Process OCH_MSC

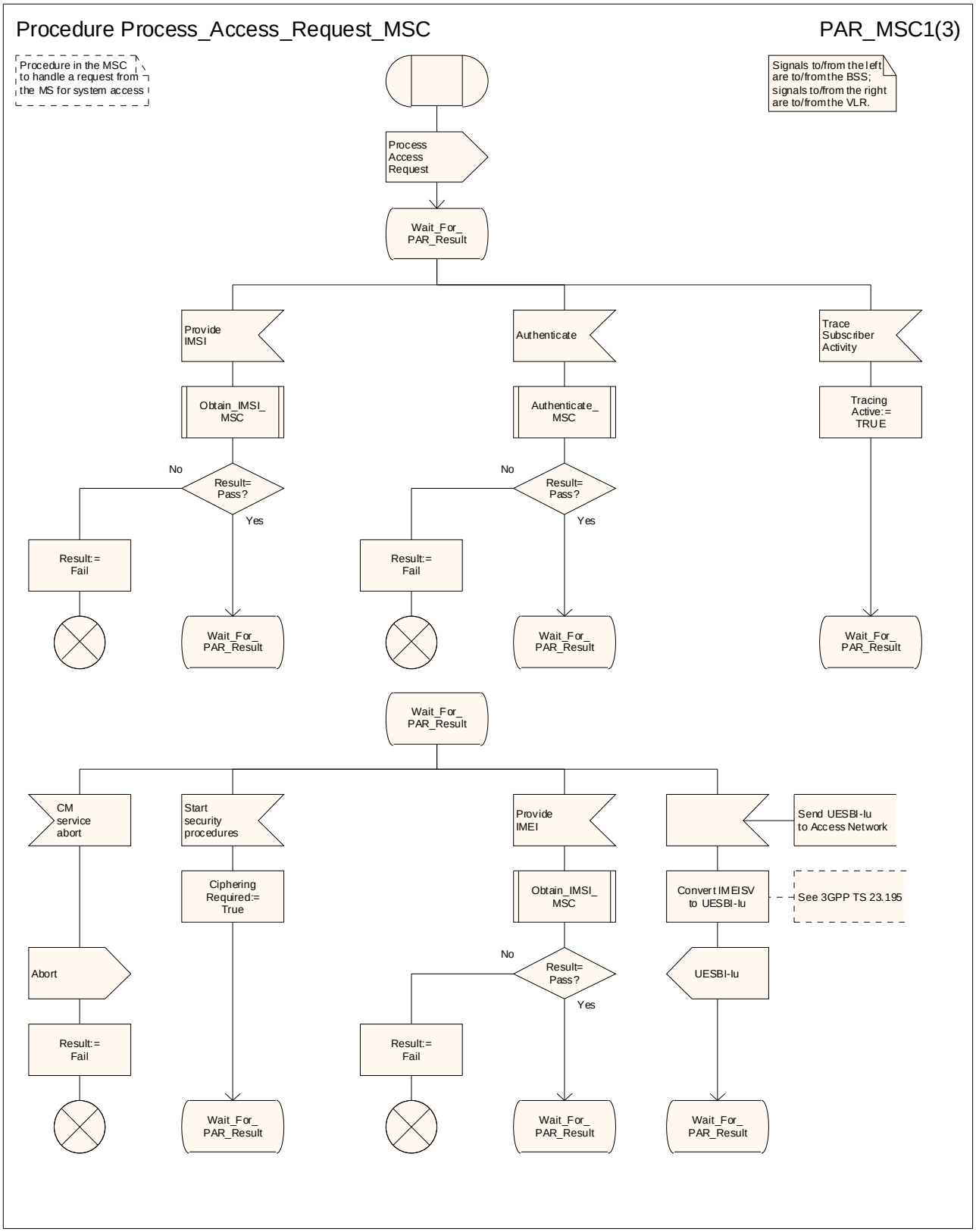


Figure 7a: Procedure Process_Access_Request_MSC (sheet 1)

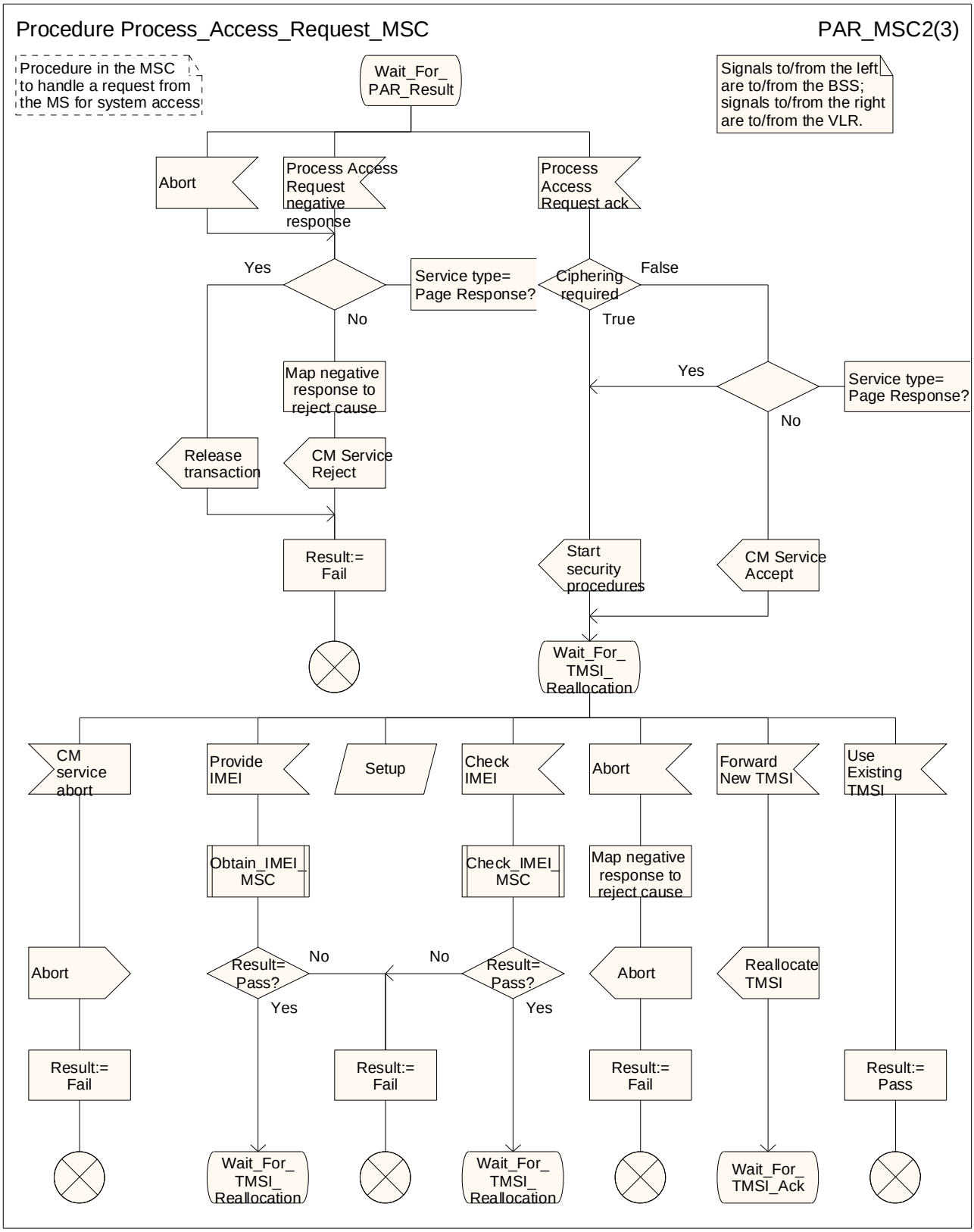


Figure 7b: Procedure Process_Access_Request_MSC (sheet 2)

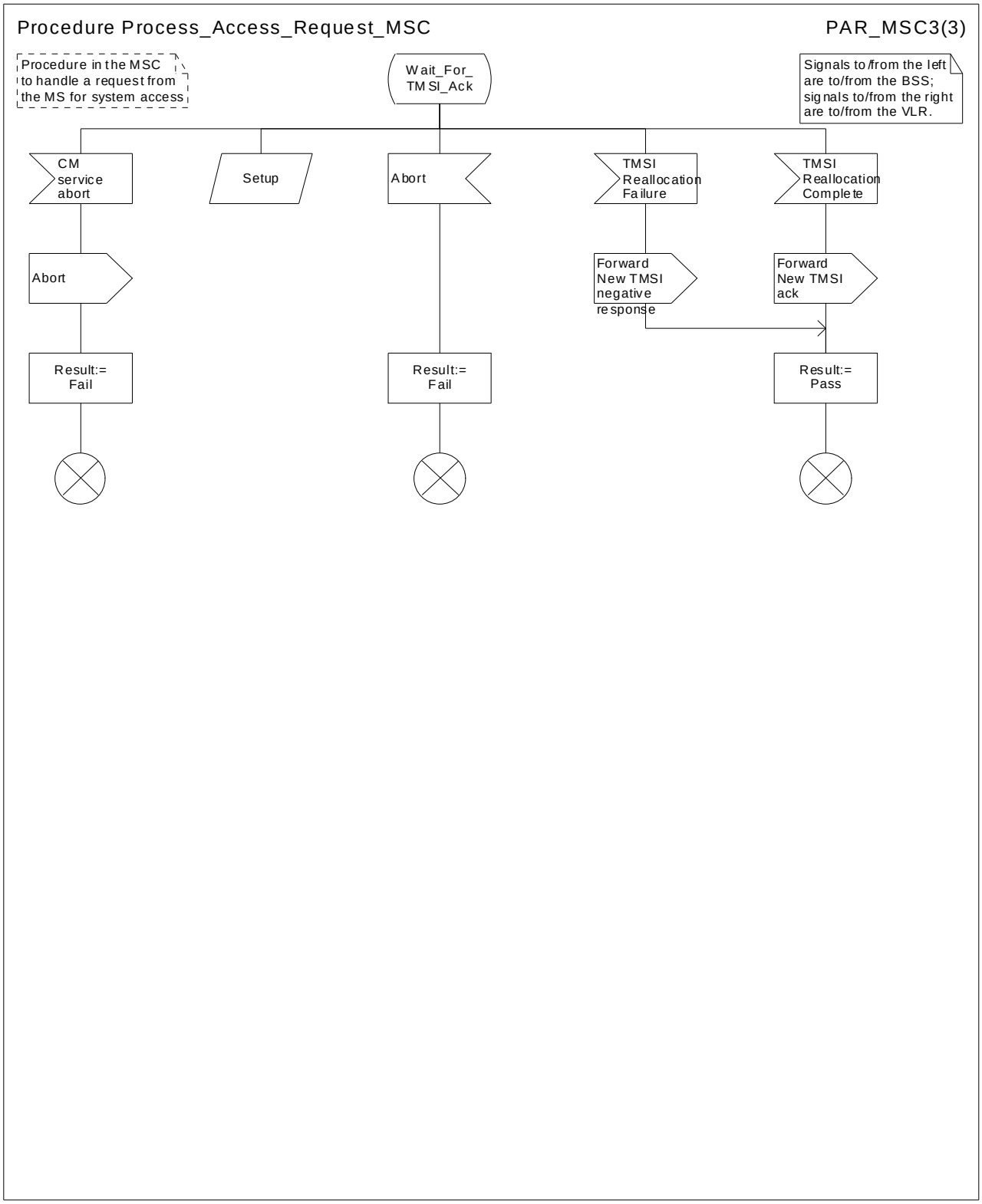


Figure 7c: Procedure Process_Access_Request_MSC (sheet 3)

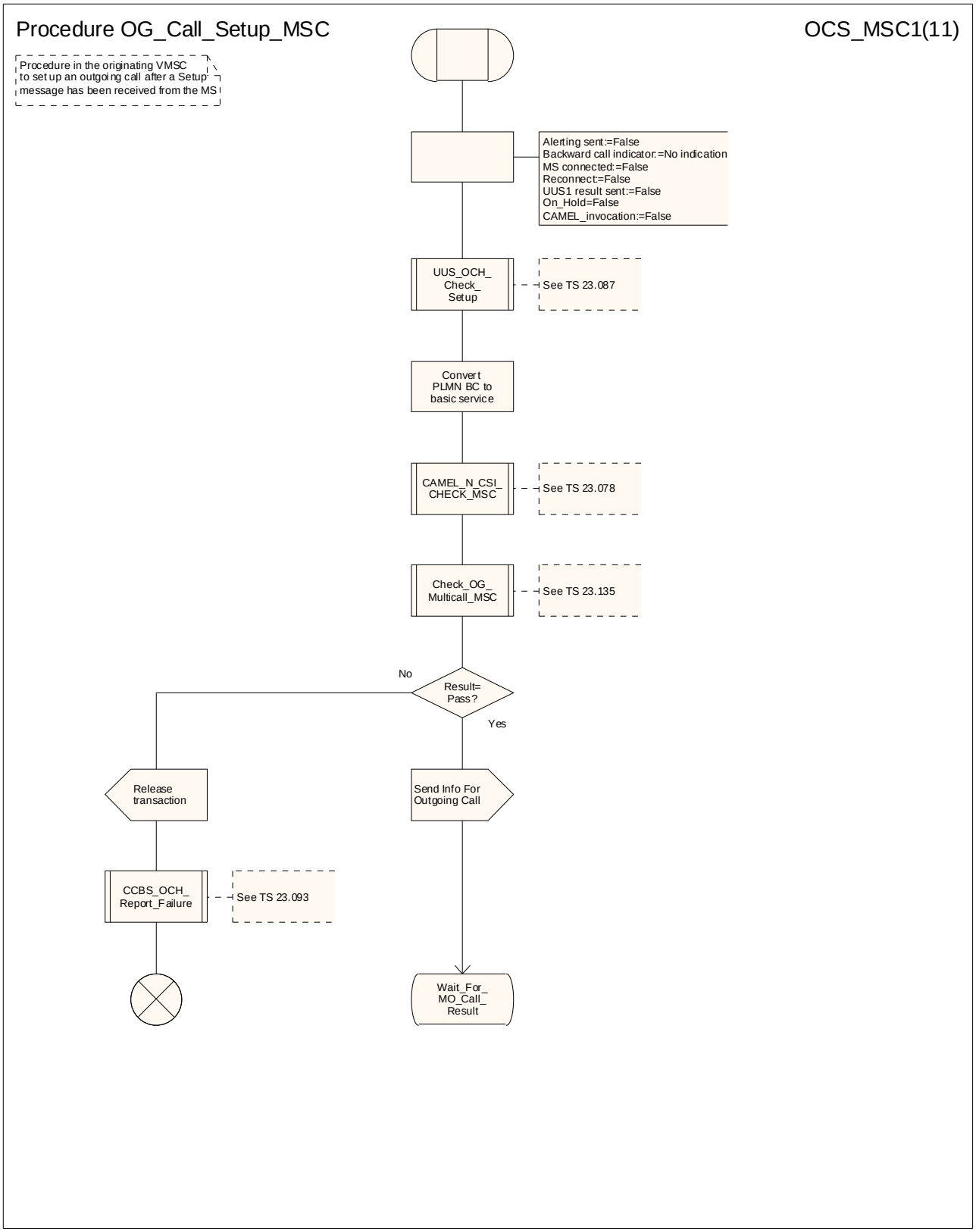


Figure 8a: Procedure OG_Call_Setup_MSC (sheet 1)

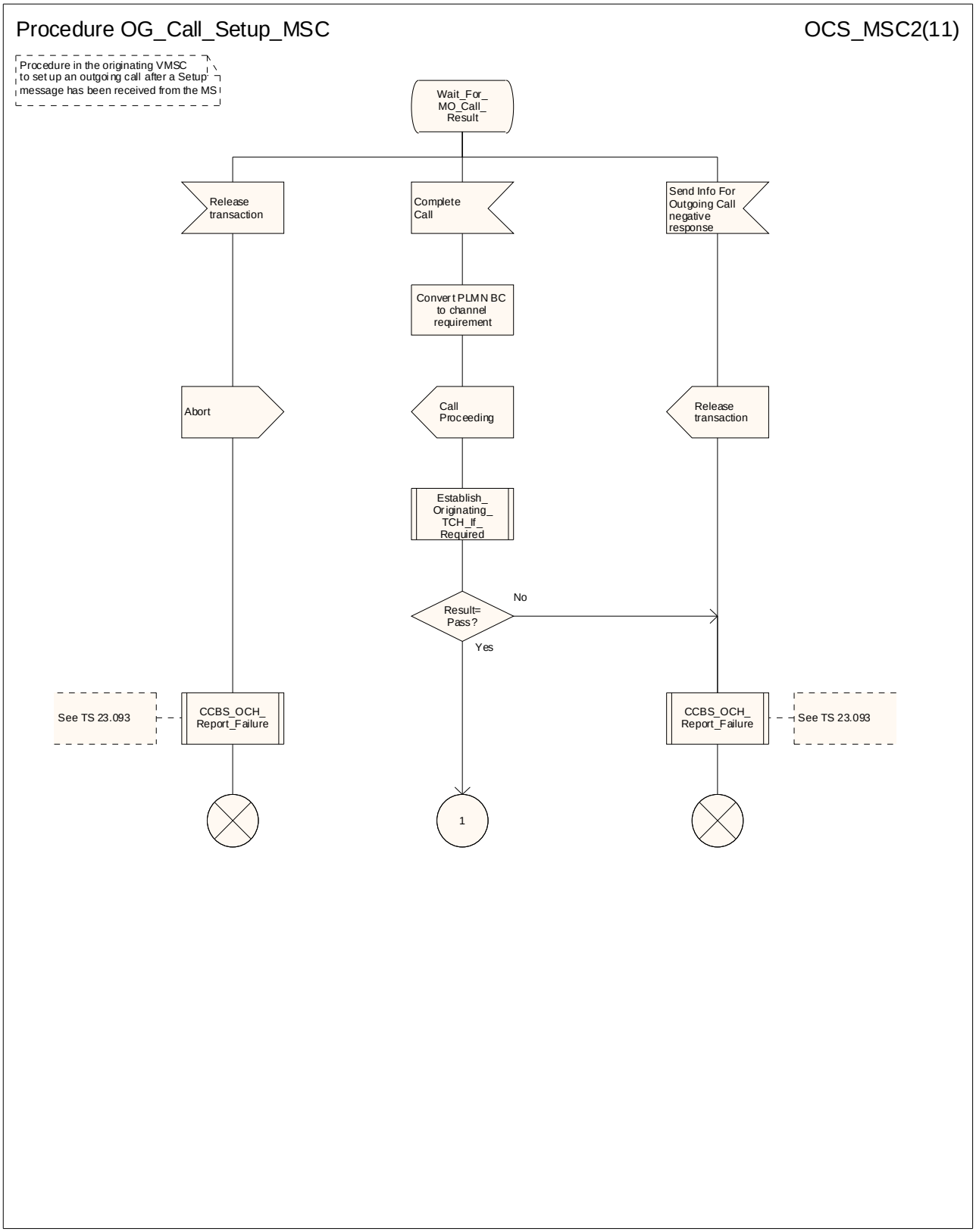


Figure 8b: Procedure OG_Call_Setup _MSC (sheet 2)

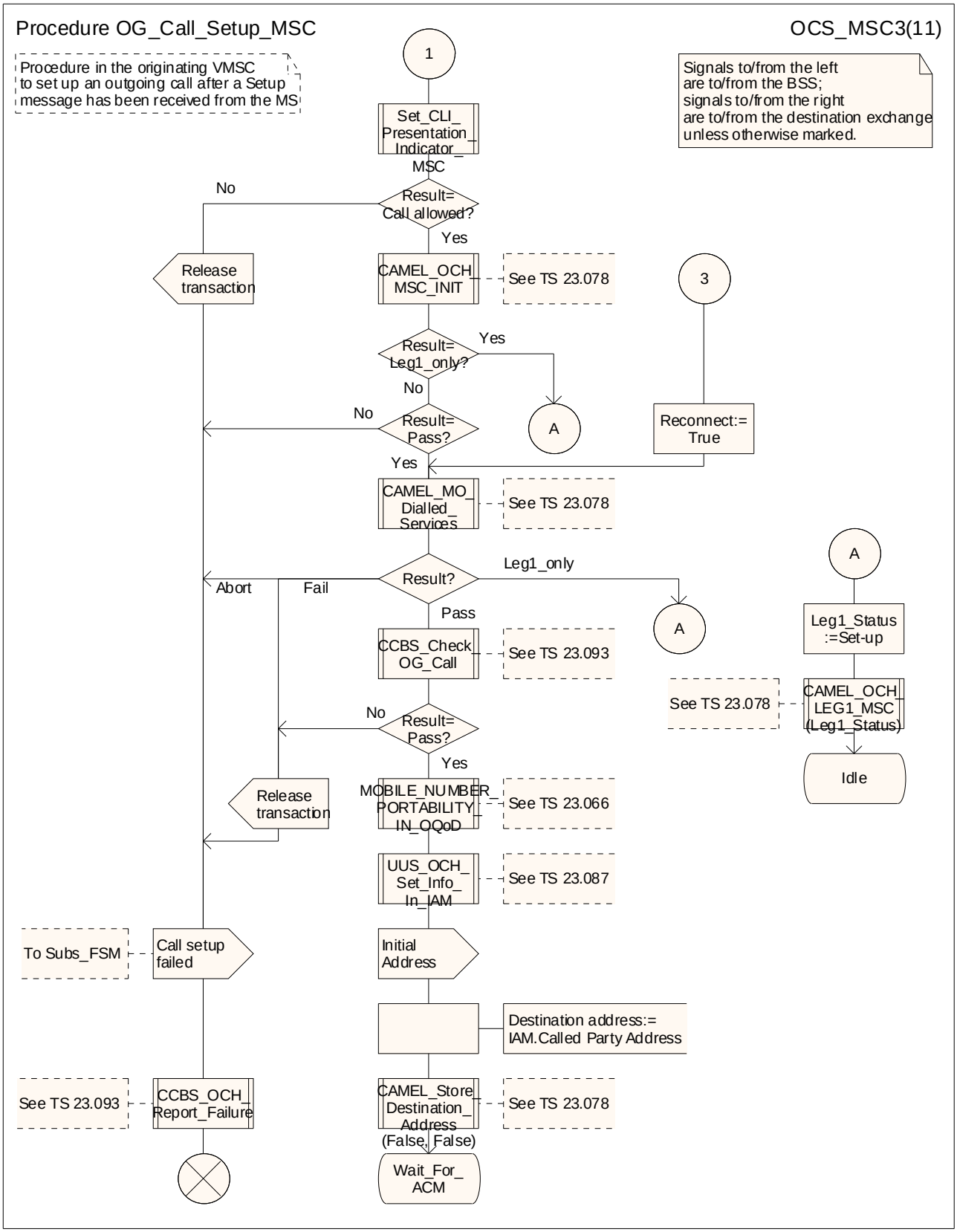


Figure 8c: Procedure OG_Call_Setup _MSC (sheet 3)

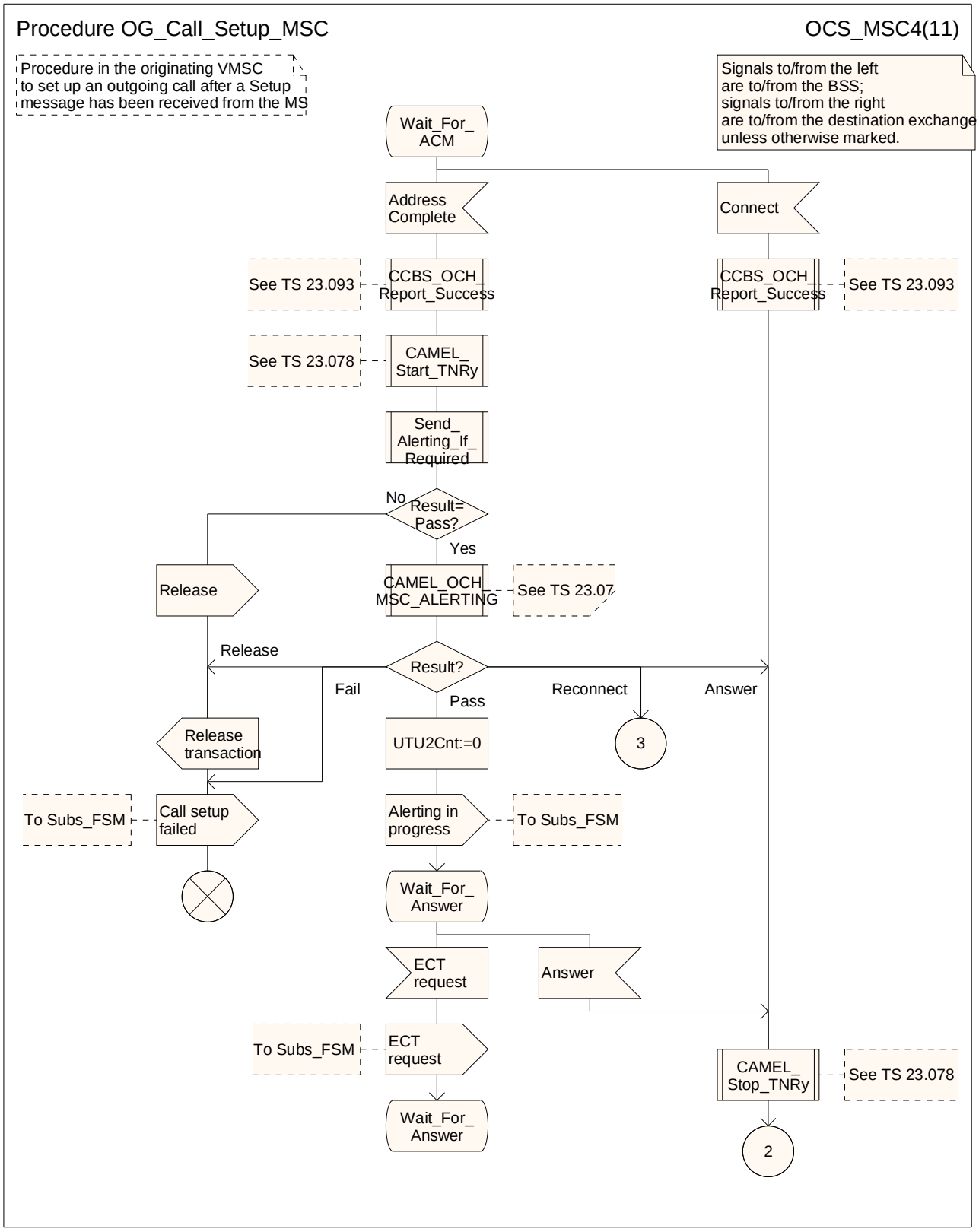


Figure 8d: Procedure OG_Call_Setup _MSC (sheet 4)

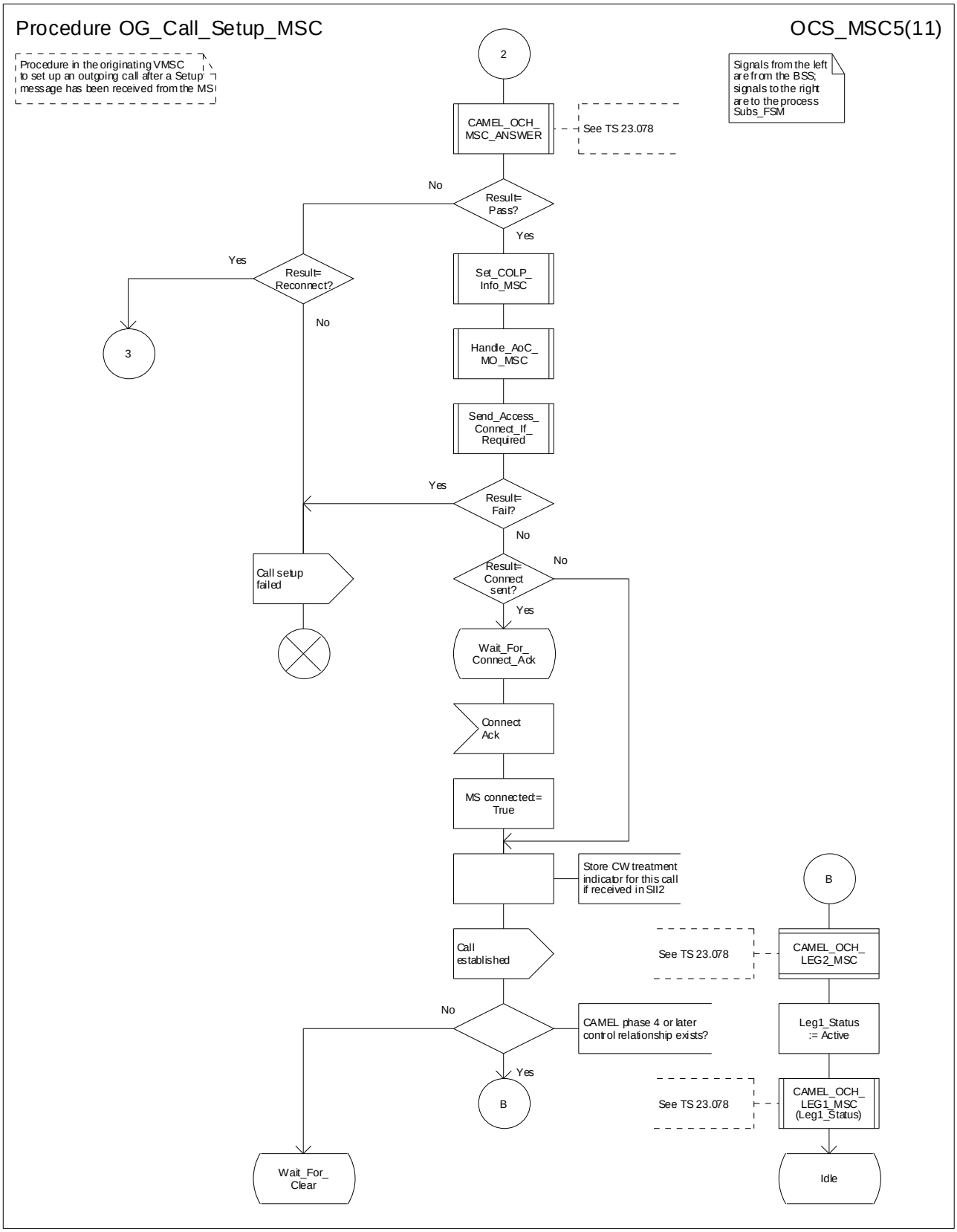


Figure 8e: Procedure OG_Call_Setup _MSC (sheet 5)

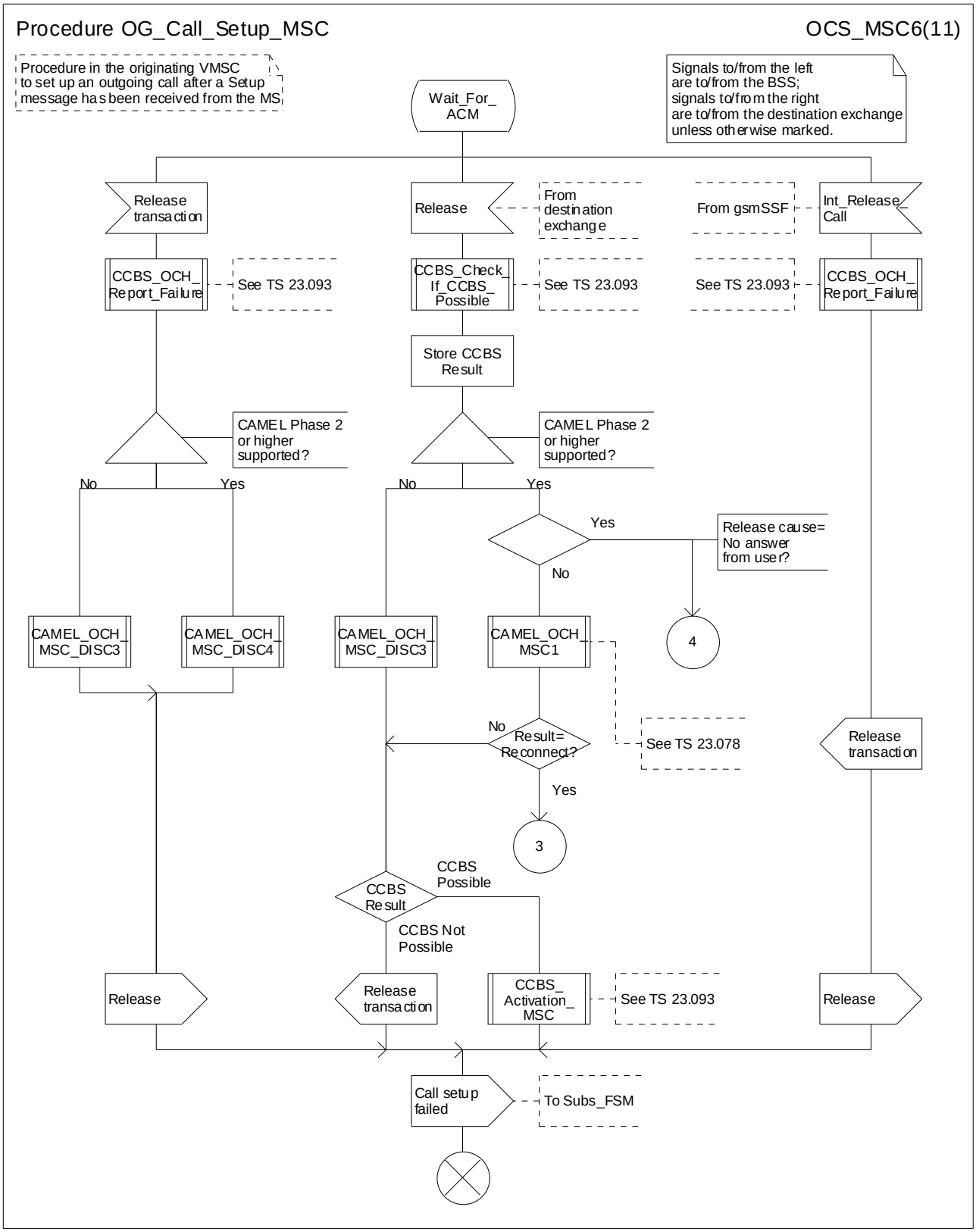


Figure 8f: Procedure OG_Call_Setup _MSC (sheet 6)

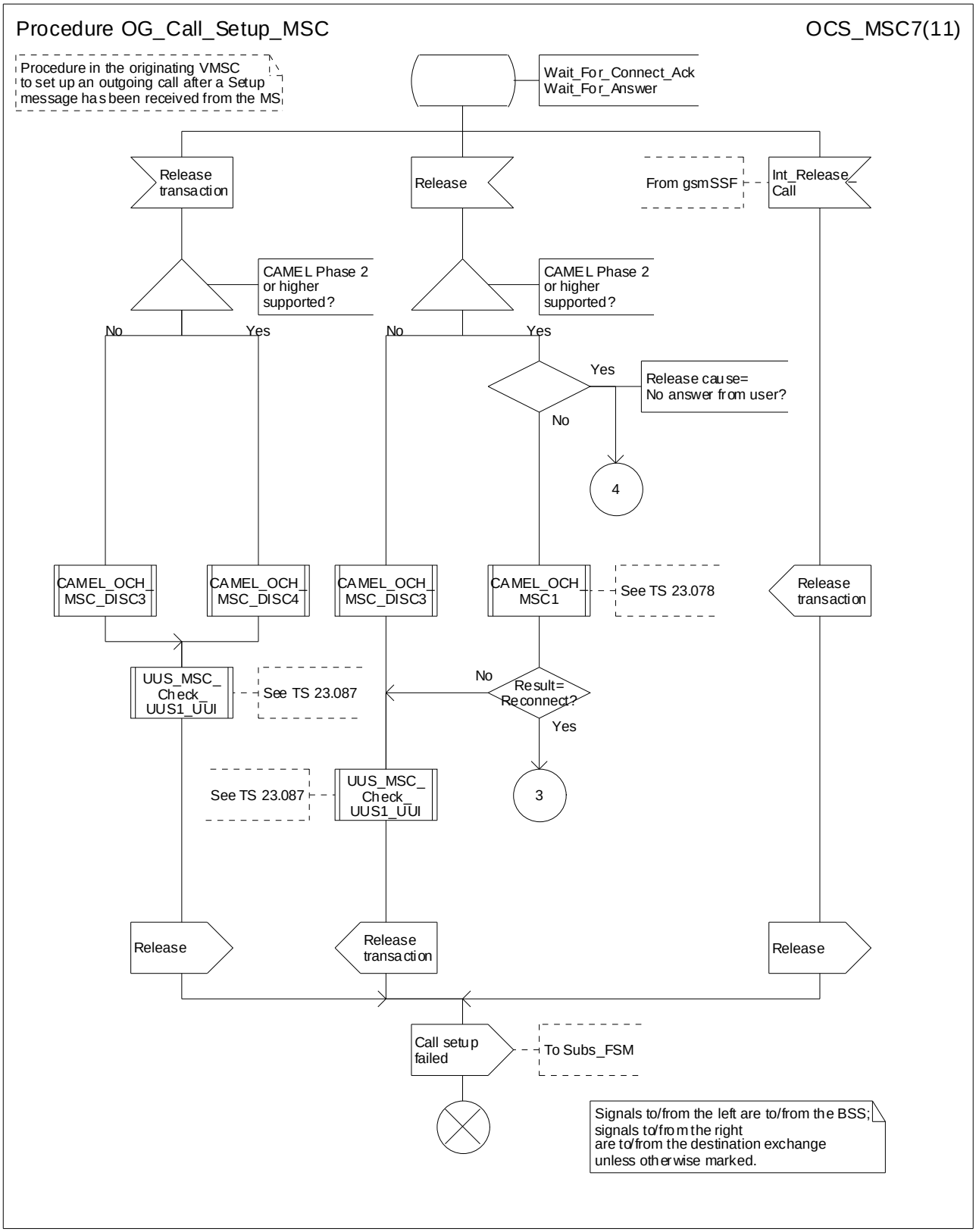


Figure 8g: Procedure OG_Call_Setup _MSC (sheet 7)

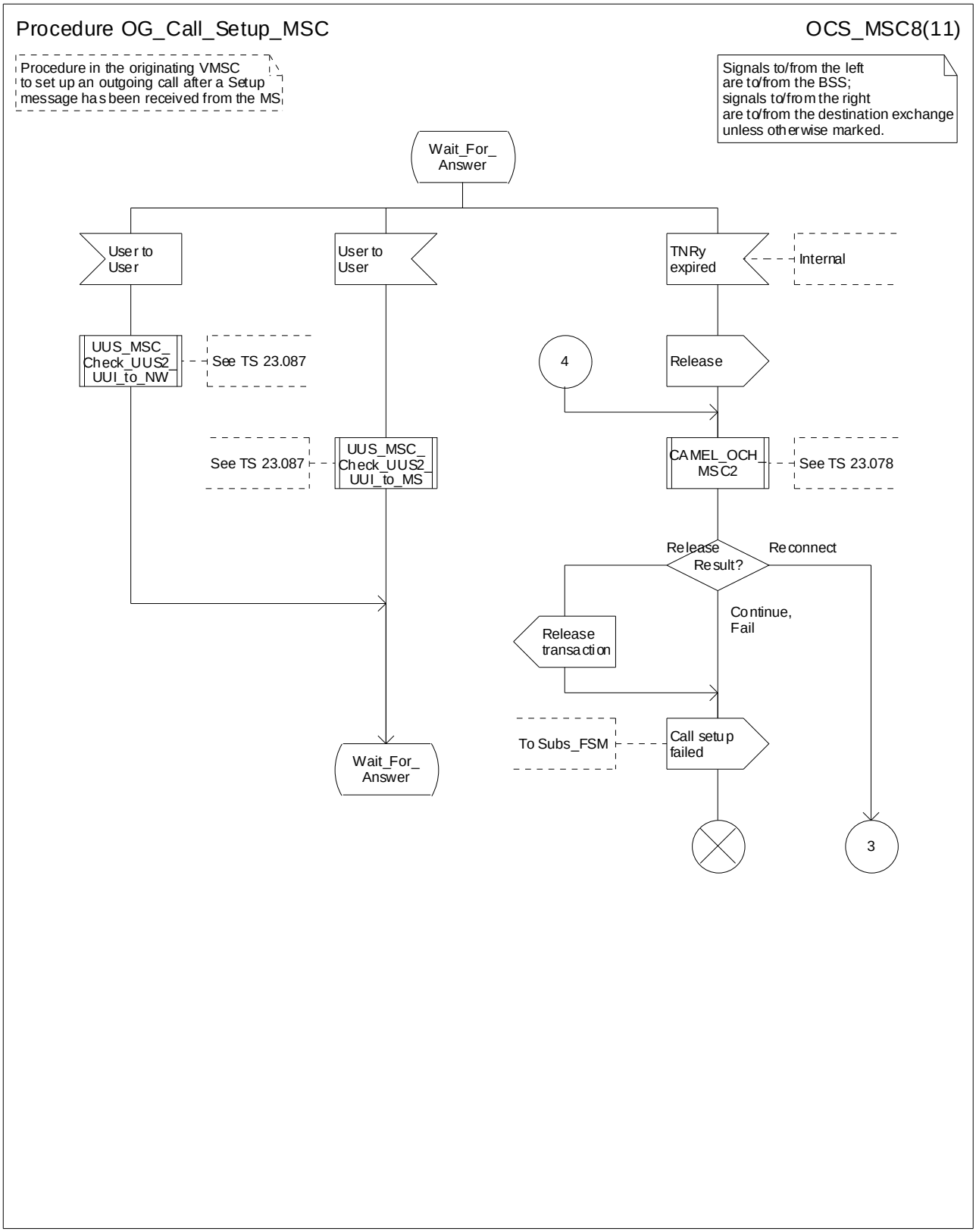


Figure 8h: Procedure OG_Call_Setup _MSC (sheet 8)

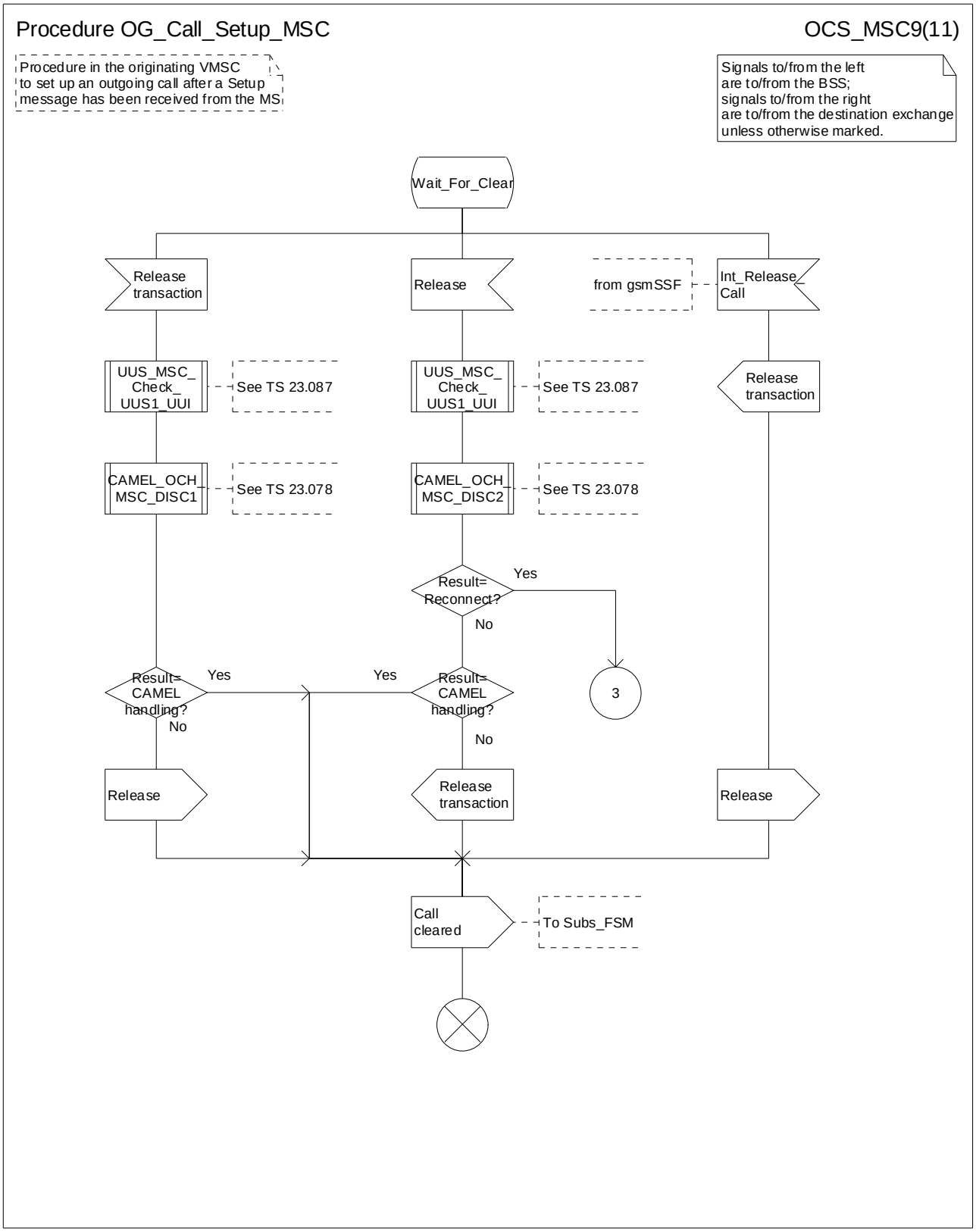


Figure 8i: Procedure OG_Call_Setup _MSC (sheet 9)

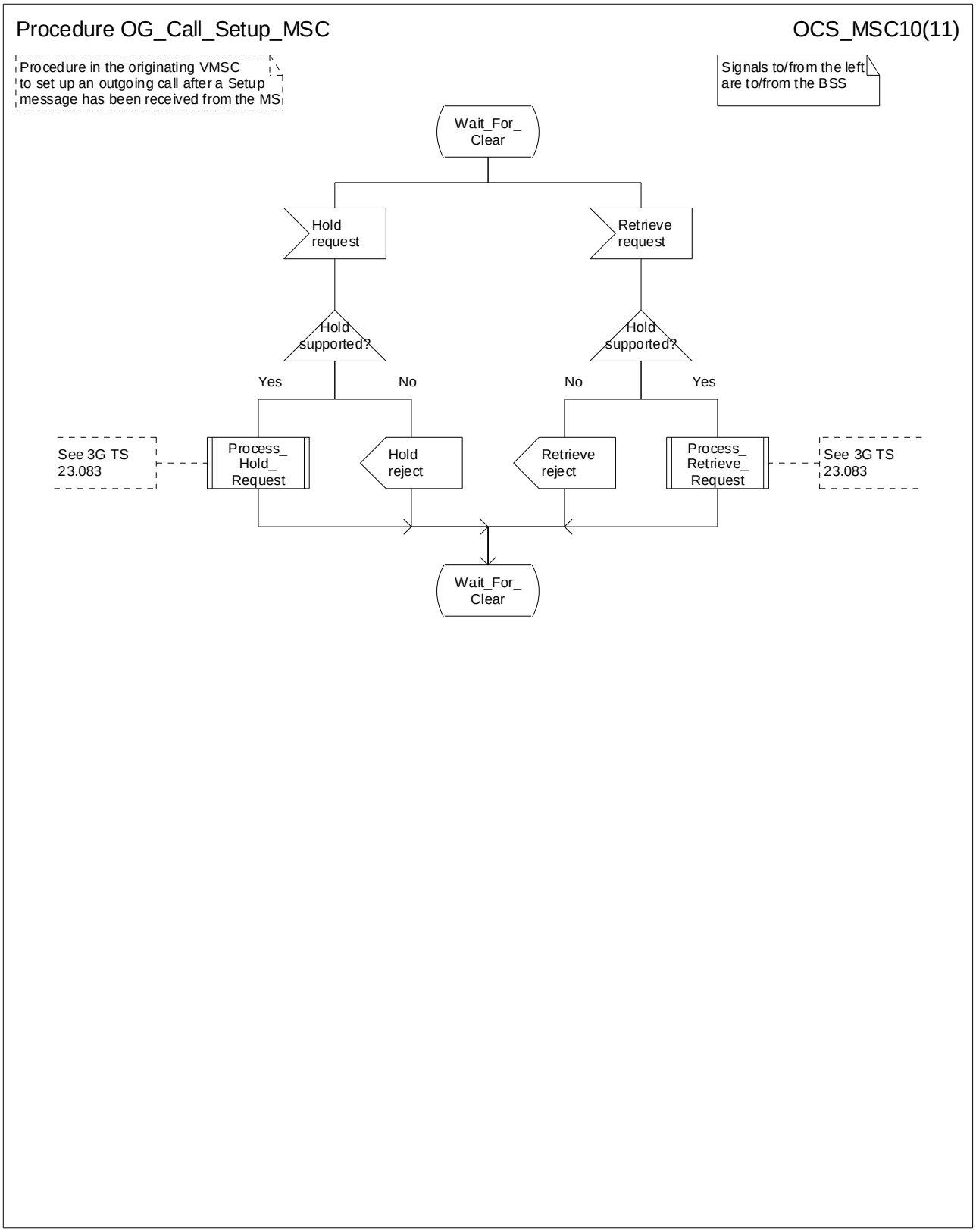


Figure 8j: Procedure OG_Call_Setup _MSC (sheet 10)

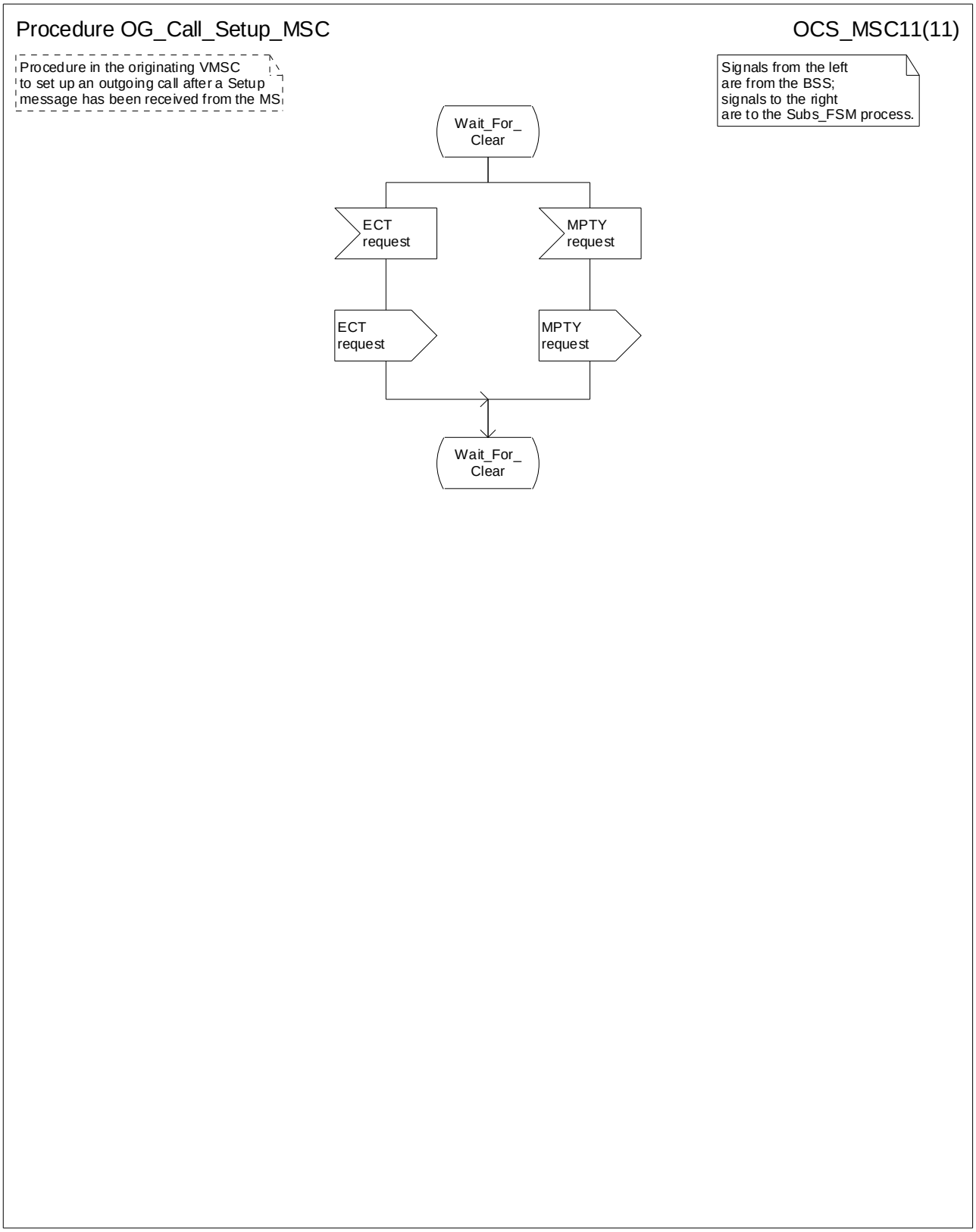


Figure 8k: Procedure OG_Call_Setup _MSC (sheet 11)

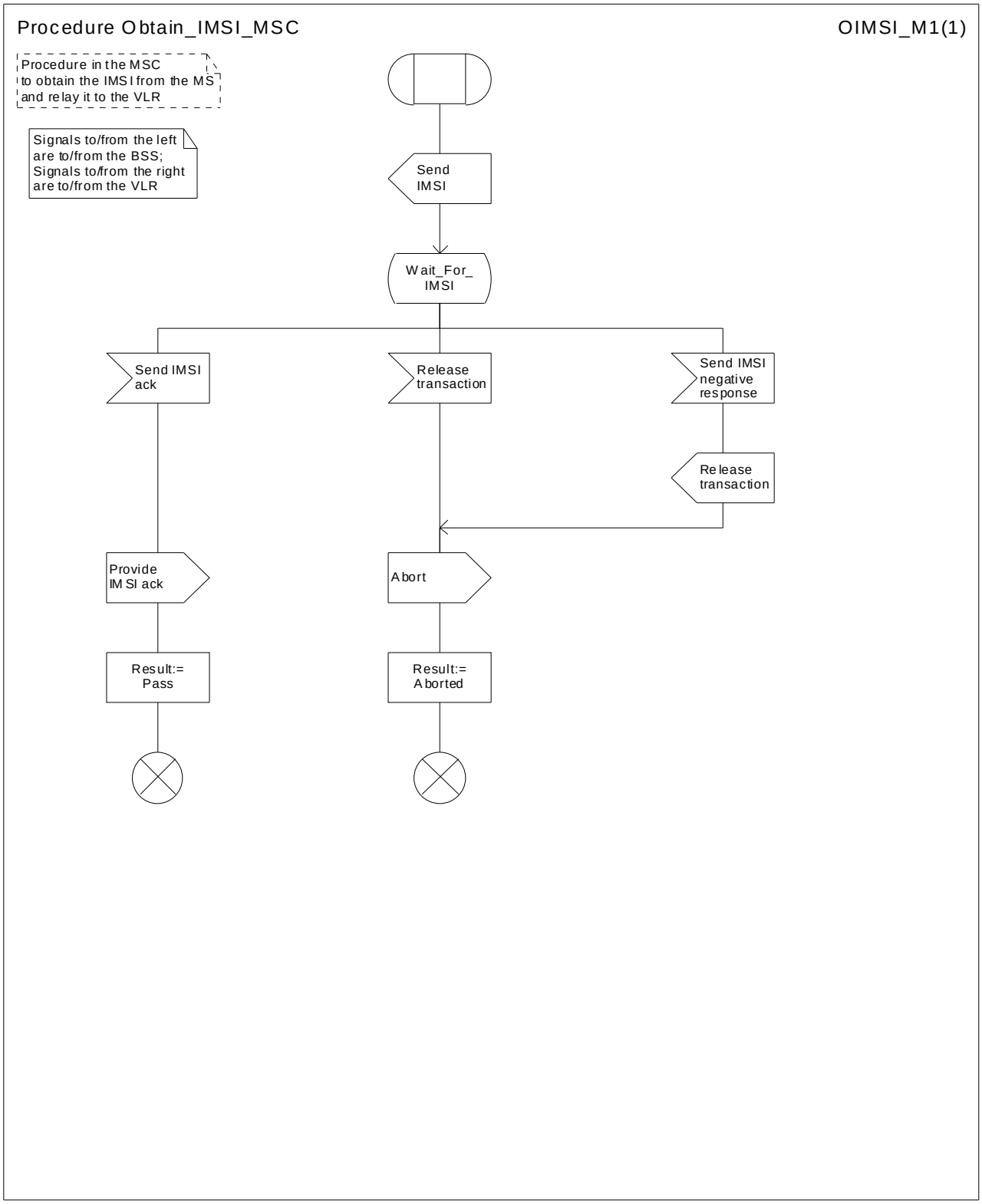


Figure 9: Procedure Obtain_IMSI_MSC

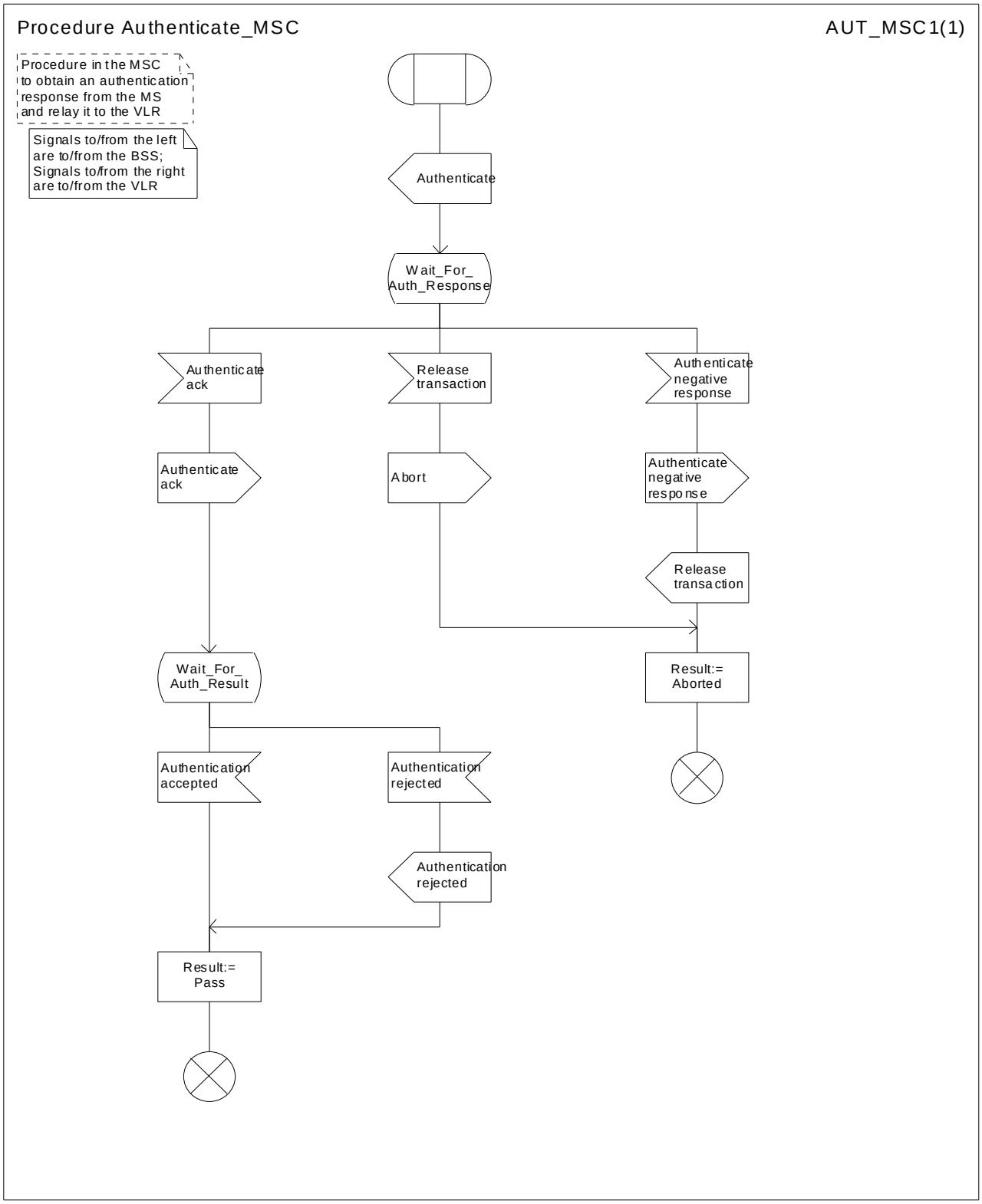


Figure 10: Procedure Authenticate_MSC

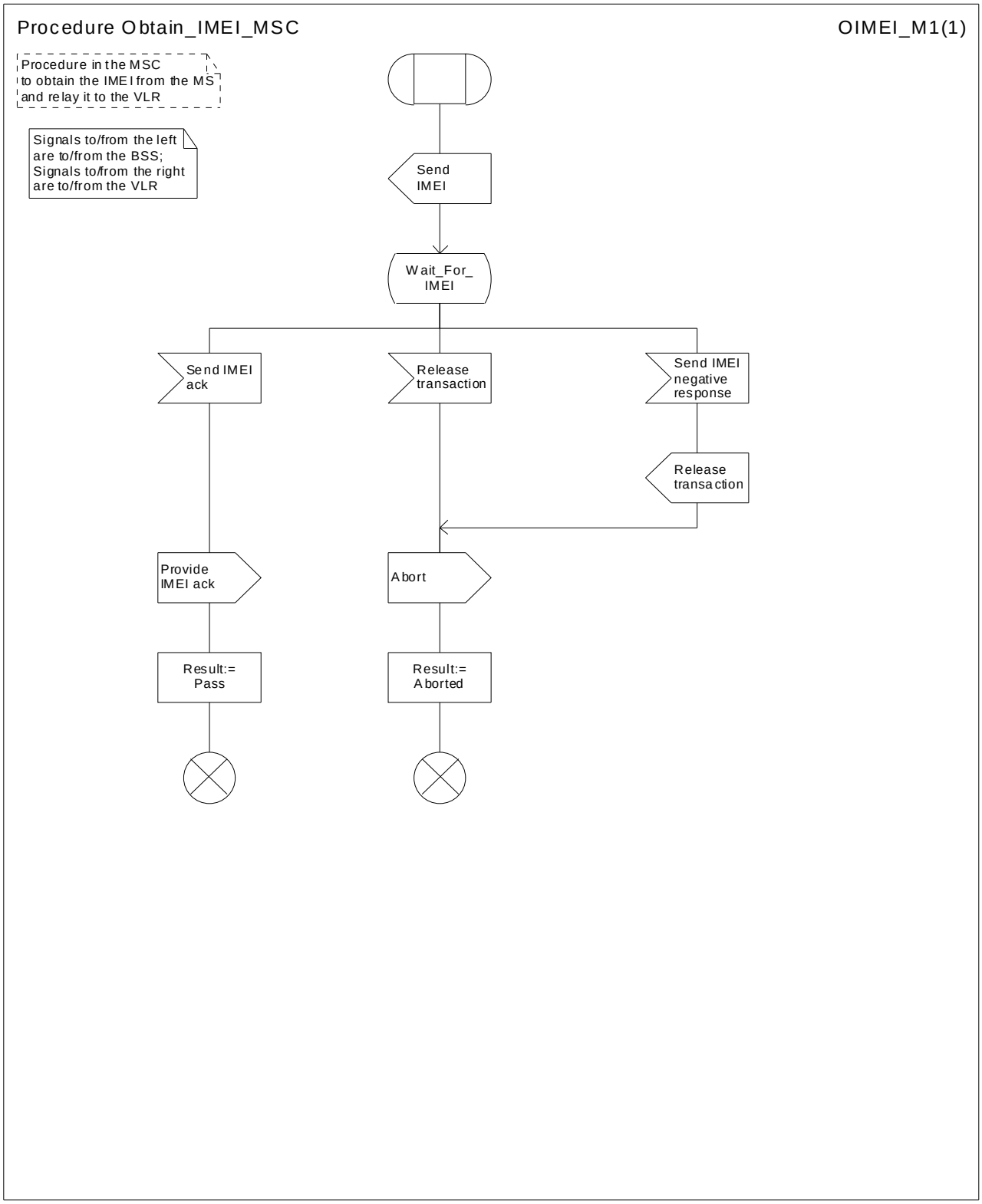


Figure 11: Procedure Obtain_IMEI_MSC

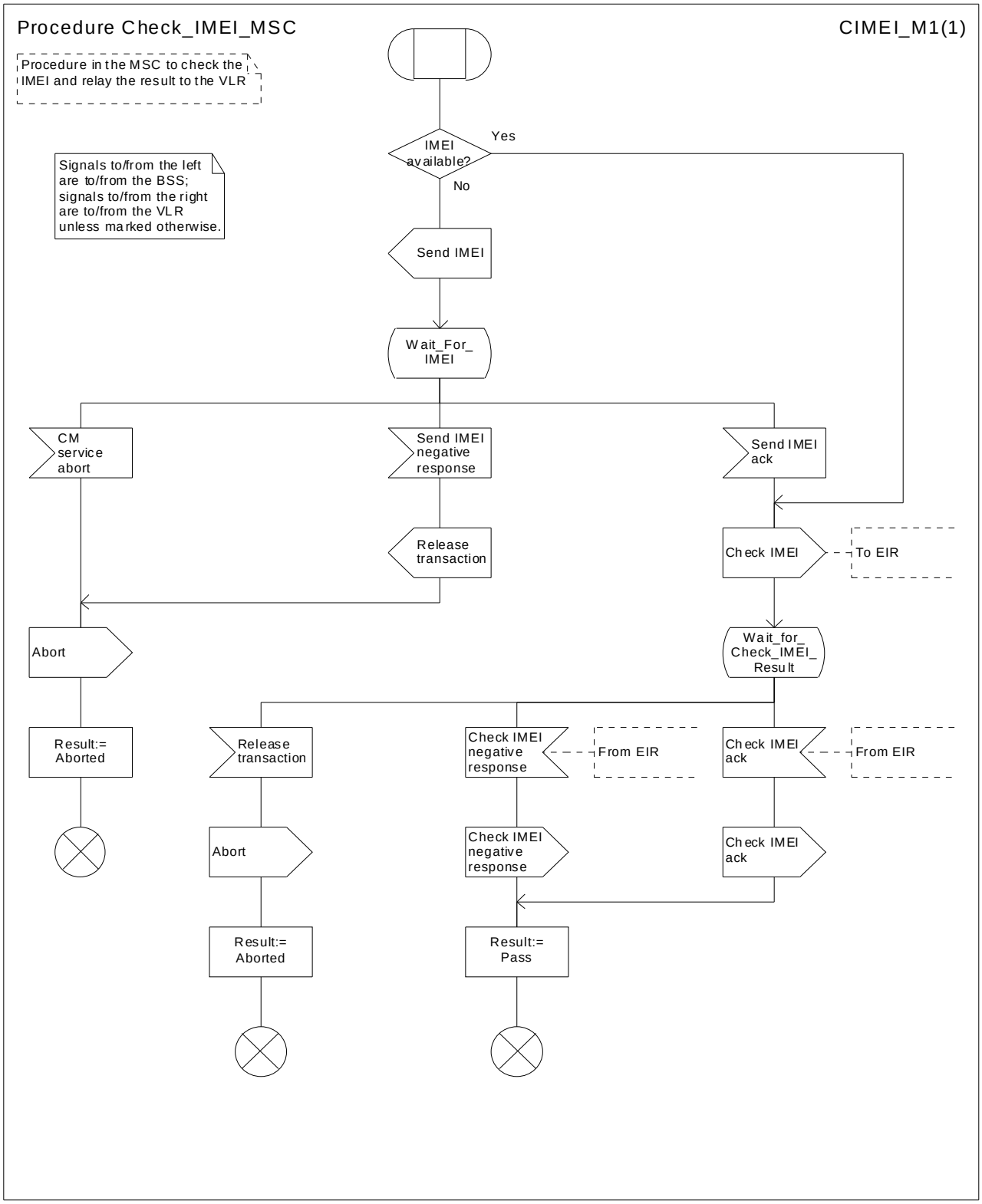


Figure 12: Procedure Check_IMEI_MSC

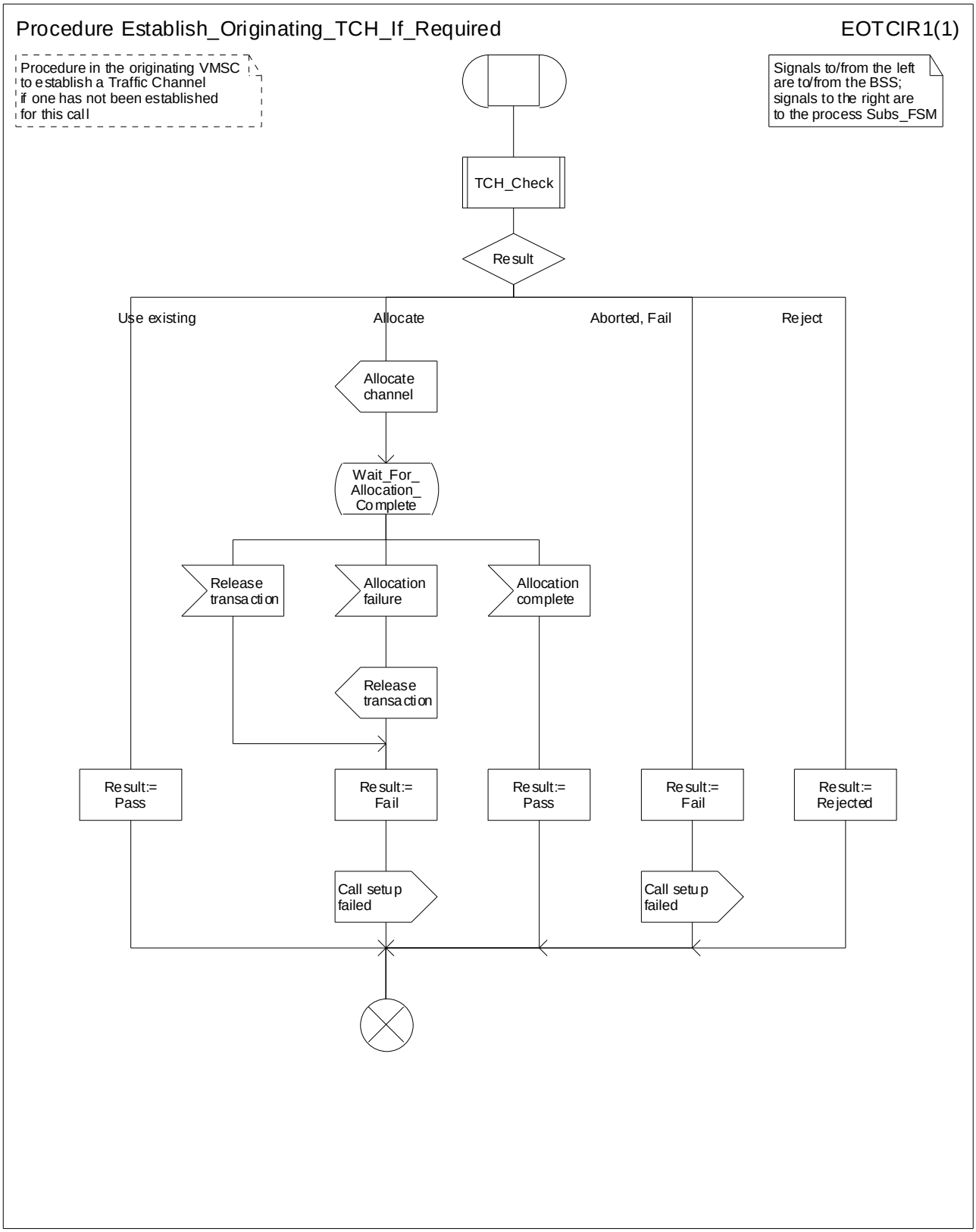


Figure 13: Procedure Establish_Originating_TCH_If_Required

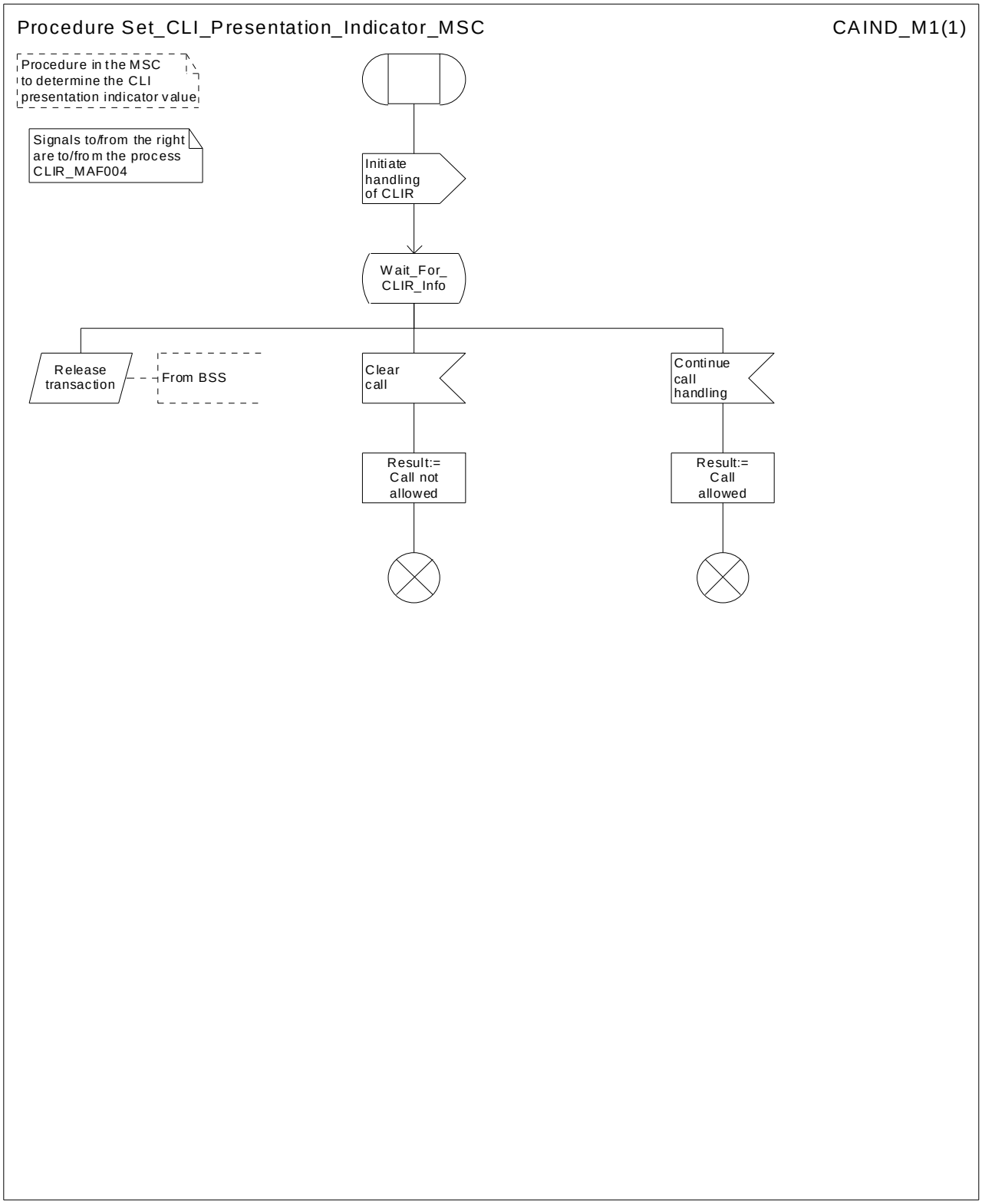


Figure 14: Procedure Set_CLI_Presentation_Indicator_MSC

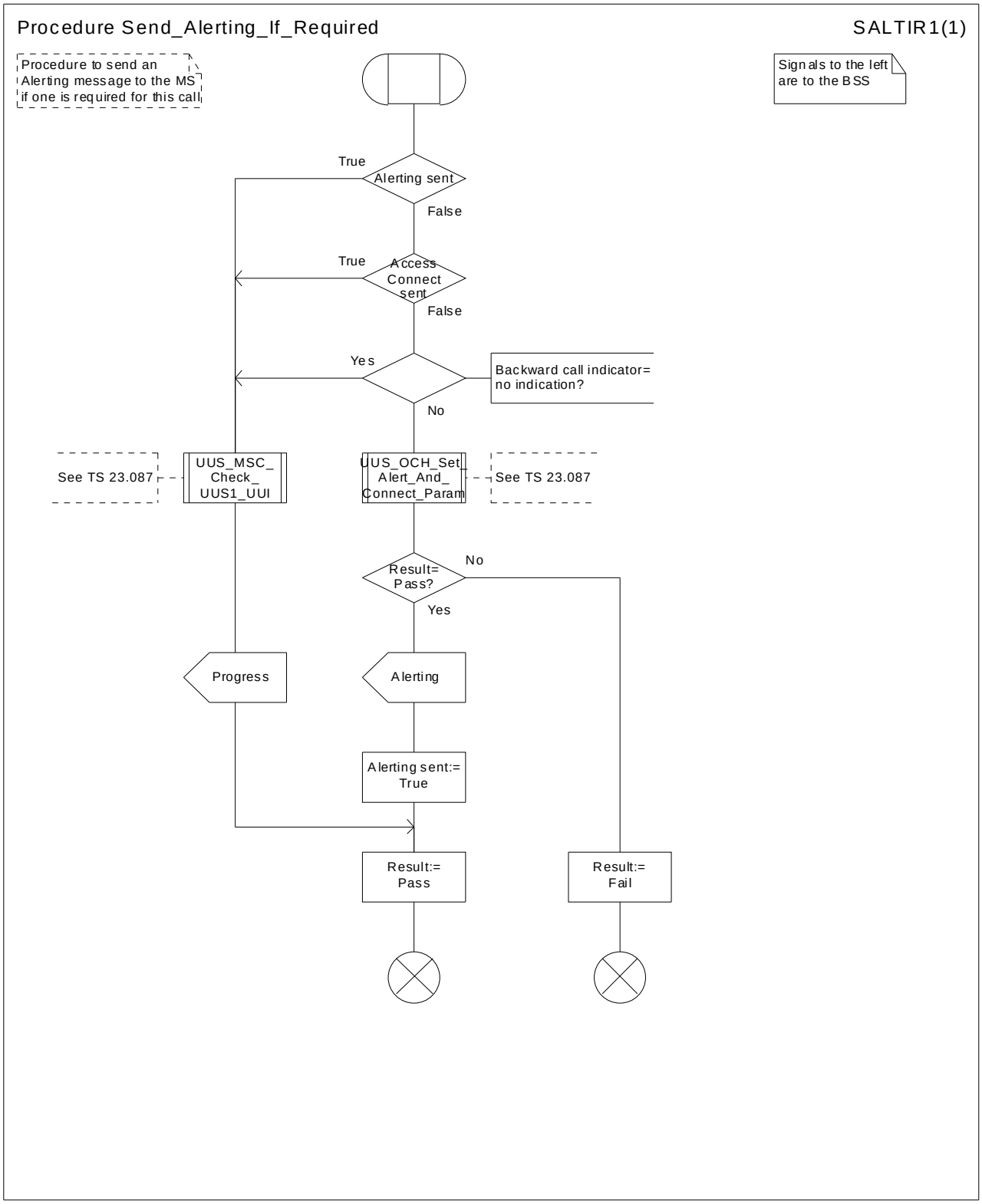


Figure 15: Procedure Send_Alerting_If_Required

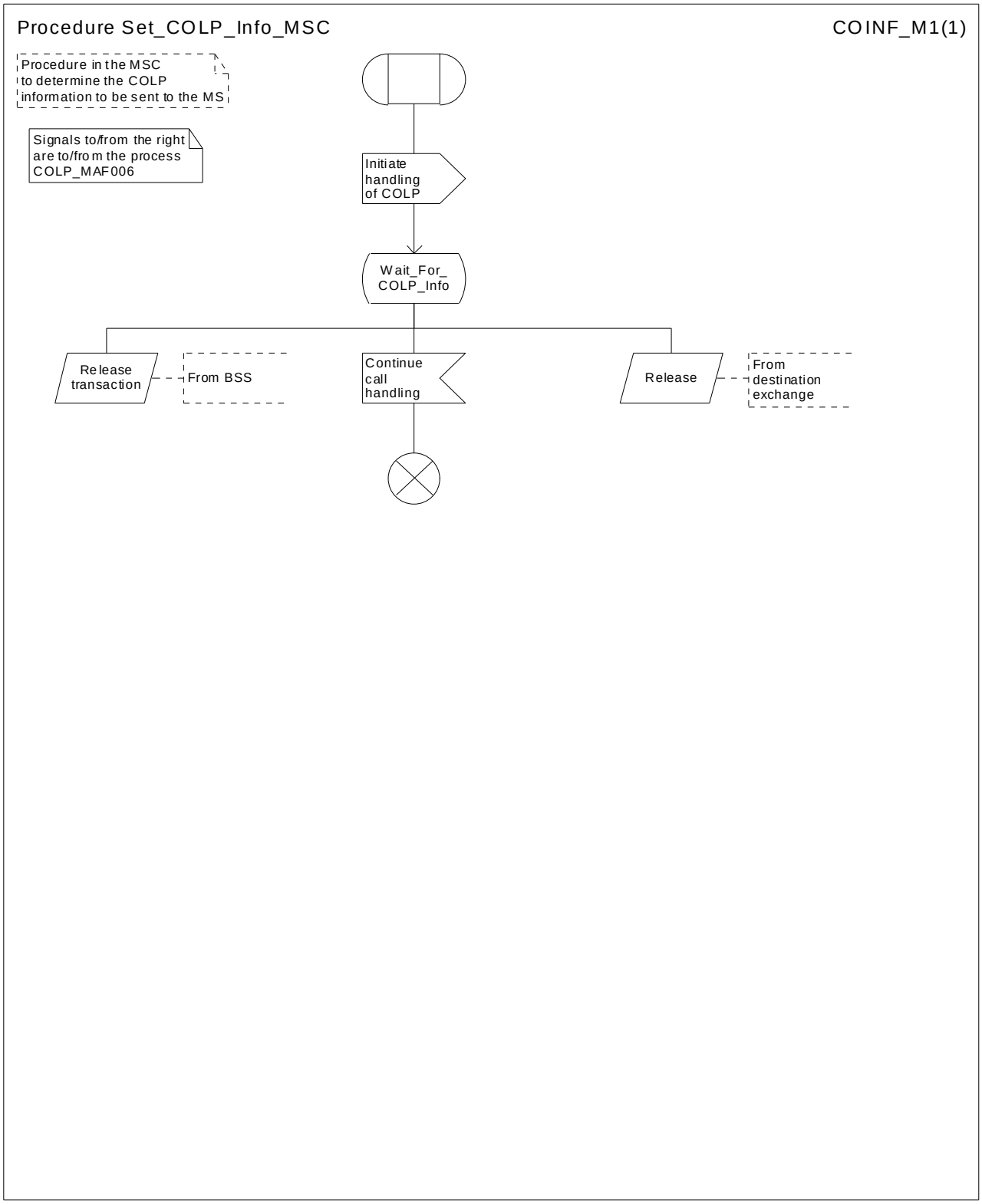


Figure 16: Procedure Set_COLP_Info_MSC

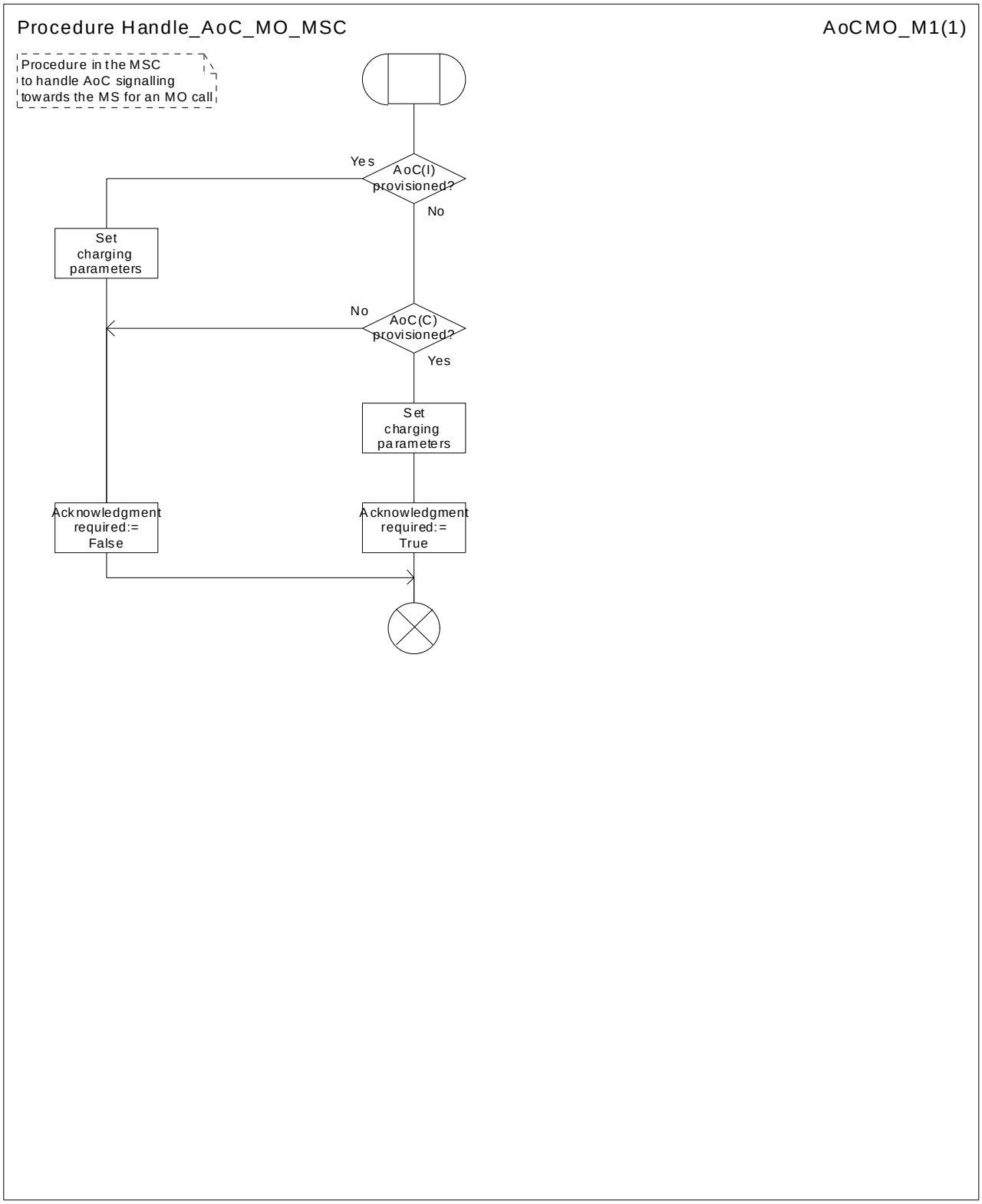


Figure 17: Procedure Handle_AoC_MO_MSC

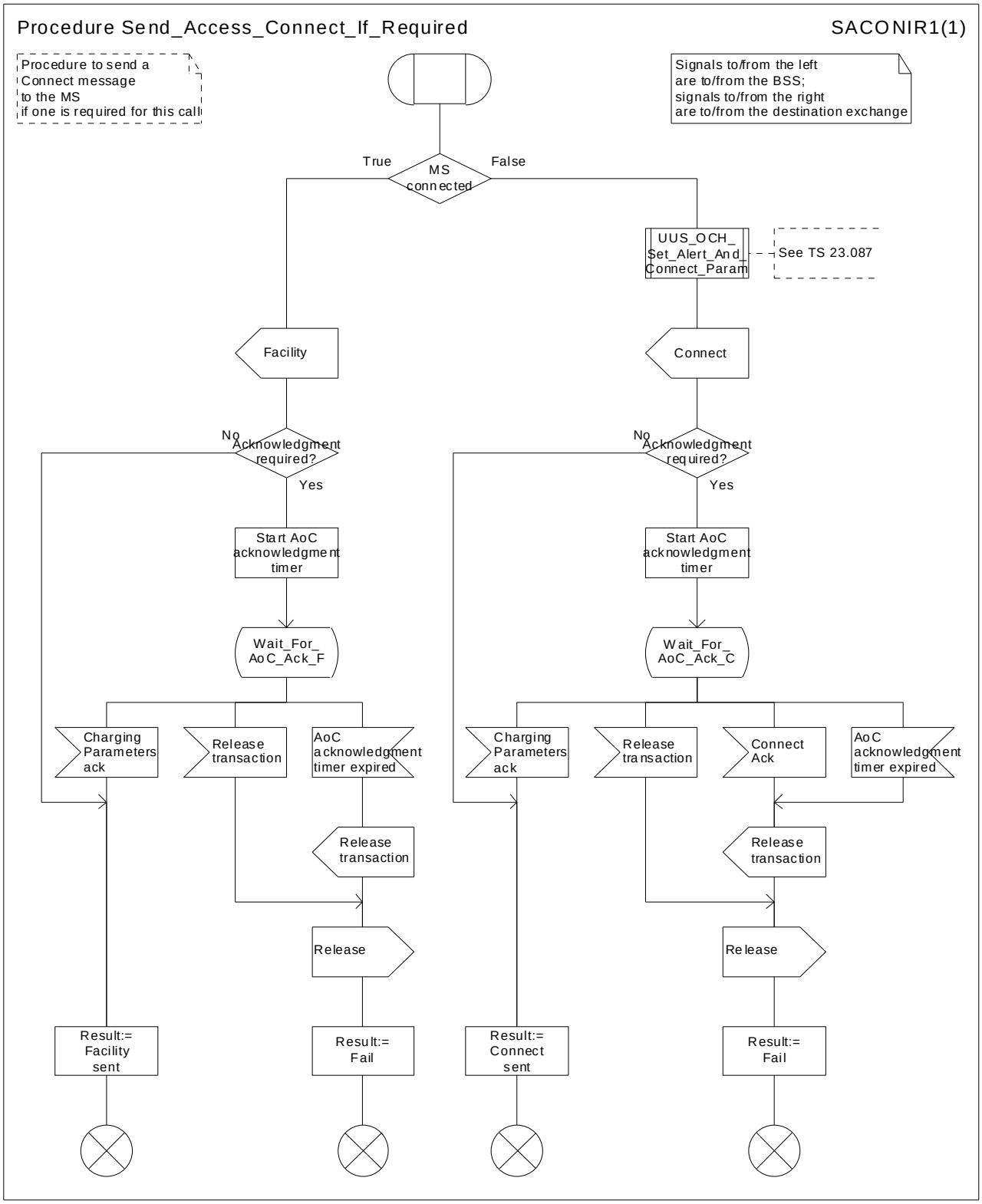


Figure 18: Procedure Send_Access_Connect_If_Required

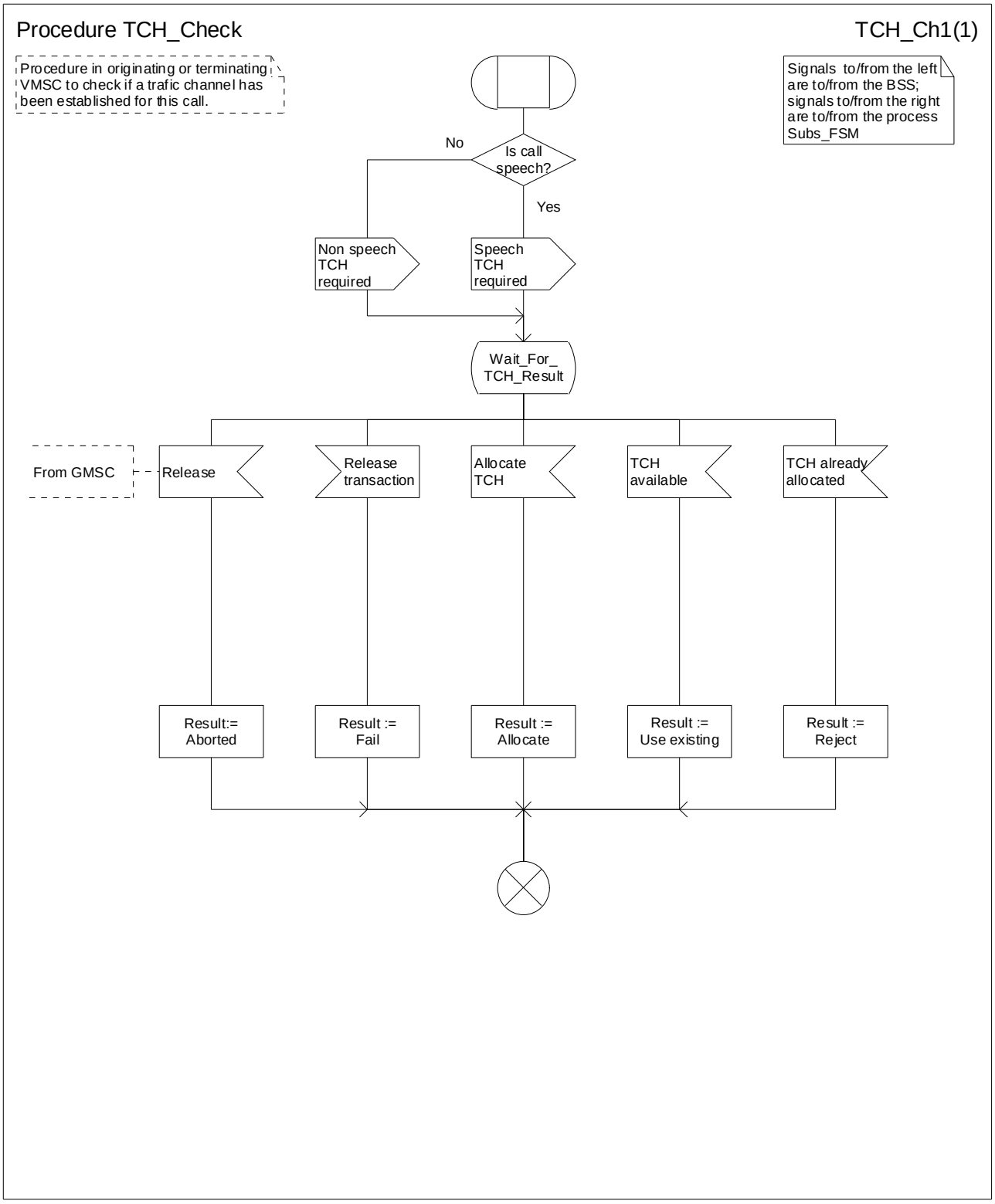


Figure 19: Procedure OCH_VLRTCH_Check

7.1.2 Functional requirements of VLR

7.1.2.1 Process OCH_VLR

7.1.2.2 Procedure Process_Access_Request_VLR

Sheet 1: it is a network operator decision (subject to MoU requirements) how often an MS should be authenticated.

Sheet 1: it is a network operator decision (subject to MoU requirements) how often an MS should be authenticated.

Sheet 2: the process Subscriber_Present_VLR is described in 3GPP TS 29.002 [29].

Sheet 2: it is a network operator decision (subject to MoU requirements) whether a GSM connection should be ciphered. A UMTS connection shall always be ciphered.

Sheet 3: it is a network operator decision (subject to MoU requirements) how often an IMEI should be checked.

Sheet 3, sheet 4, sheet 5: the procedure CCBS_Report_MS_Activity is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 5: it is a network operator decision whether emergency calls are allowed from an ME with no SIM.

7.1.2.3 Procedure OG_Call_Subscription_Check_VLR

Sheet 1: it is an implementation option to carry out the check for operator determined barring of all outgoing calls before the check on provisioning of the requested basic service.

Sheet 1: the procedure Check_OG_Multicall_VLR is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 1: the procedure OG_CUG_Check is specific to CUG. If the VLR does not support CUG, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 1: the procedure Get_LI_Subscription_Info_MO_VLR is specific to CLIR and COLP. If the VLR supports neither CLIR nor COLP, the procedure call is omitted.

Sheet 1: the procedure Get_AoC_Subscription_Info_VLR is specific to AoC.

Sheet 1: the procedure UUS_OCH_Check_Provision is specific to UUS; it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 2: the procedure CAMEL_OCH_VLR is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VLR does not support CAMEL, processing continues from connector 1 to the call to the procedure Check_OG_Barring.

Sheet 2: the negative response "call barred" indicates whether the reason is operator determined barring or supplementary service barring, according to the result returned by the procedure Check_OG_Barring.

7.1.2.4 Procedure Obtain_Identity_VLR

It is a network operator decision whether open (non ciphered) identification of the MS by its IMSI is allowed.

7.1.2.5 Procedure Obtain_IMSI_VLR

7.1.2.6 Procedure Authenticate_VLR

Sheet 1: the number of unused authentication sets which triggers the VLR to request further authentication sets from the HLR is an operator option.

7.1.2.7 Procedure Obtain_Authentication_Sets_VLR

7.1.2.8 Procedure Start_Tracing_VLR

7.1.2.9 Procedure Check_IMEI _VLR

If the response from the EIR to a request to check an IMEI indicates that the ME is:

- in the prohibited list, then service is not granted;
- in the tracking list, then service is granted, but the network operator may decide to initiate tracing;
- in the permitted list, then service is granted.

7.1.2.10 Procedure Obtain_IMEI_VLR

7.1.2.11 Process Fetch_Authentication_Sets_VLR

7.1.2.12 Procedure Check_BAOC

Sheet 1: if the VLR receives an Abort message from the MSC while it is awaiting a response from the process MAF017, the message is saved for handling after return from the procedure.

7.1.2.13 Procedure OG_CUG_Check

If the VLR receives an Abort message from the MSC while it is awaiting a response from the process MAF014, the message is saved for handling after return from the procedure.

7.1.2.14 Procedure Get_LI_Subscription_Info_MO_VLR

If the VLR does not support CLIR, it omits the signal interchange with the process CLIR_MAF003.

If the VLR does not support COLP, it omits the signal interchange with the process COLP_MAF005.

If the VLR receives an Abort message from the MSC while it is awaiting a response from the process CLIR_MAF003 or the process COLP_MAF005, the message is saved for handling after return from the procedure.

7.1.2.15 Procedure Get_AoC_Subscription_Info_VLR

The indicator of whether or not AoC is provisioned is global data which can be read by the parent process.

7.1.2.16 Procedure Check_OG_Barring

Sheet 3: if the VLR receives an Abort message from the MSC while it is awaiting a response from the process MAF018 or MAF020 (see 3GPP TS 23.088 [21]), the message is saved for handling after return from the procedure.

7.1.2.17 Process Update_Location_VLR

The procedure Update_HLR_VLR is described in 3GPP TS 23.012 [6].

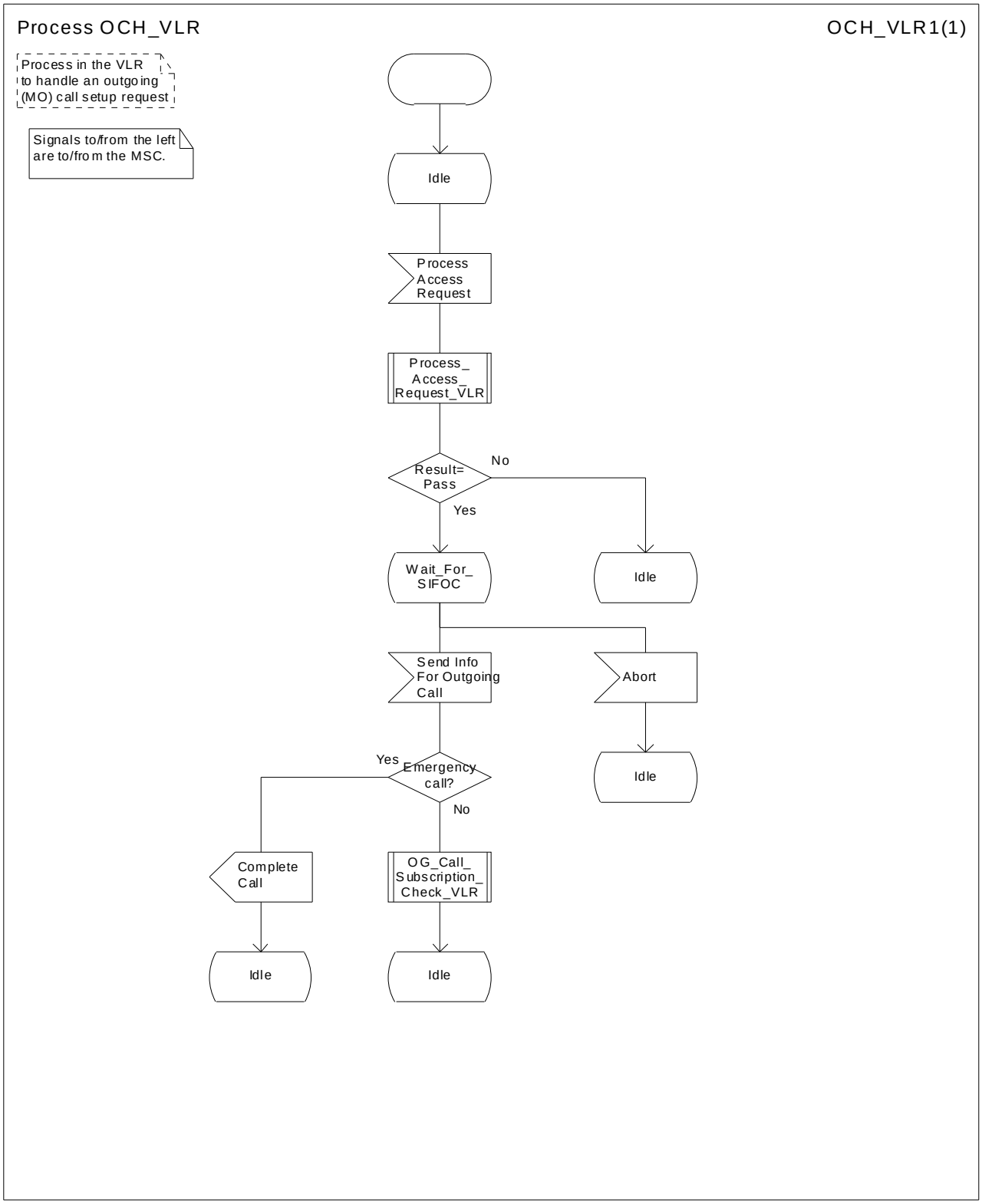


Figure 7.1.2.1: Process OCH_VLR

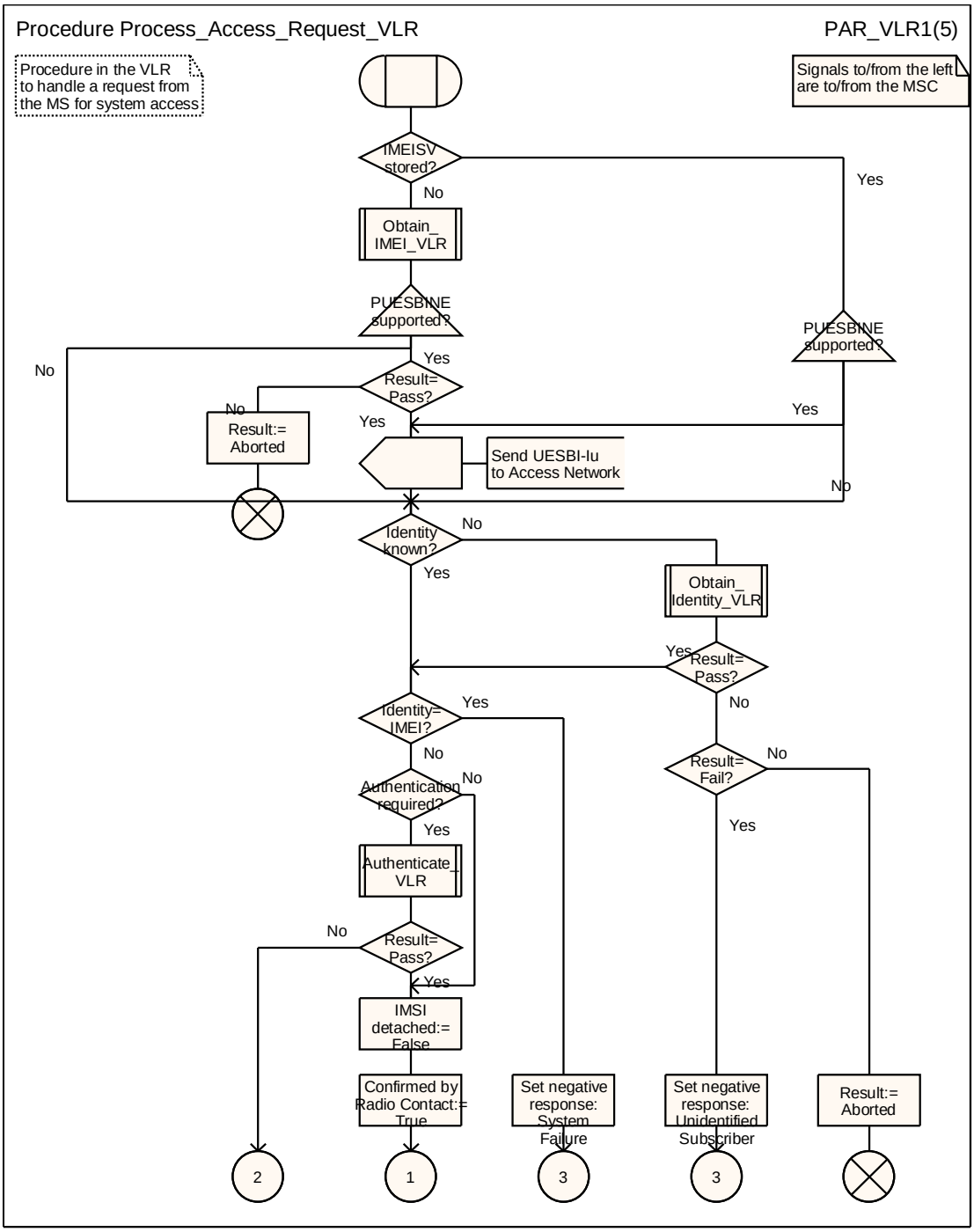


Figure 7.1.2.2a: Procedure Process_Access_Request_VLR (sheet 1)

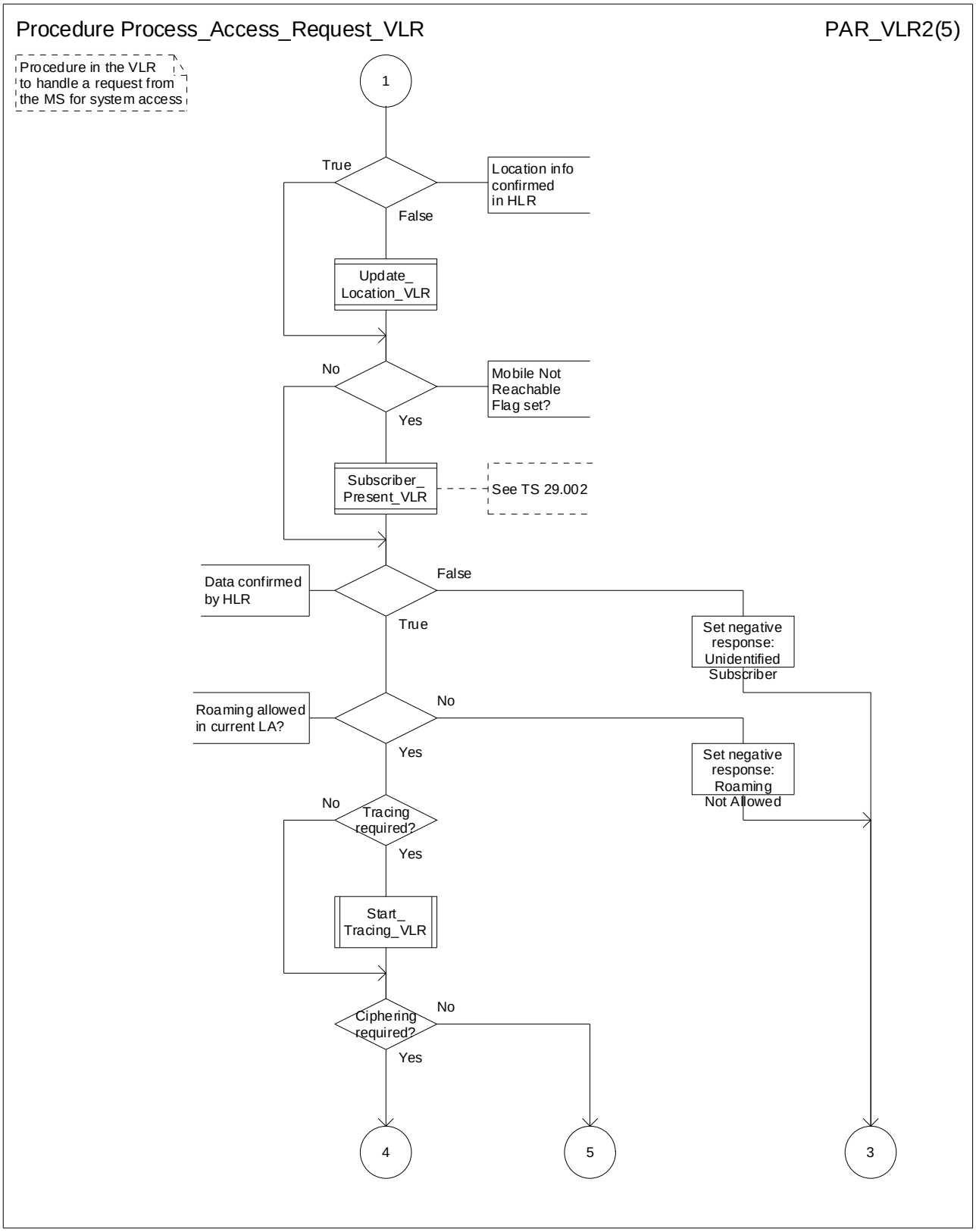


Figure 7.1.2.2b: Procedure Process_Access_Request_VLR (sheet 2)

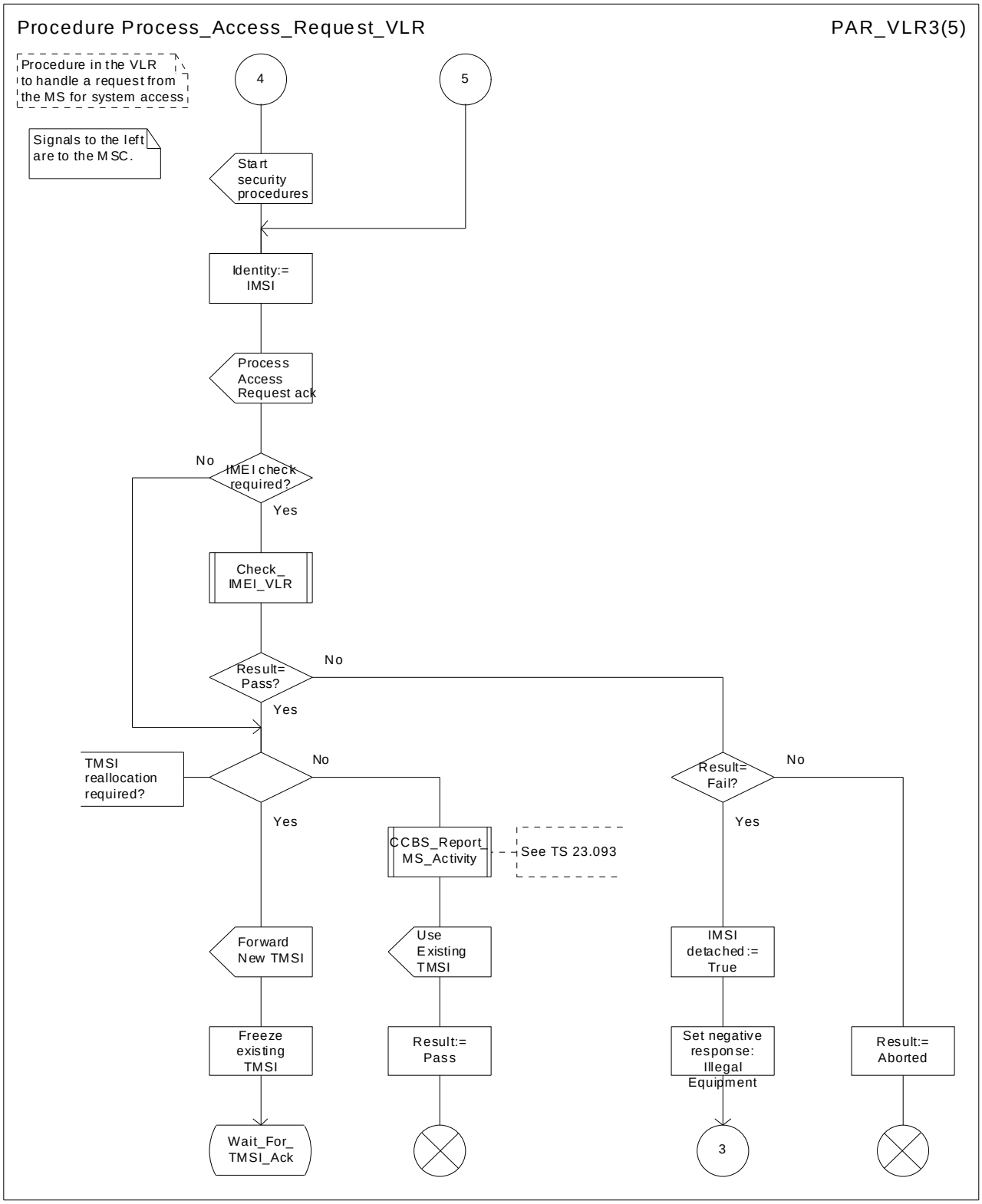


Figure 7.1.2.2c: Procedure Process_Access_Request_VLR (sheet 3)

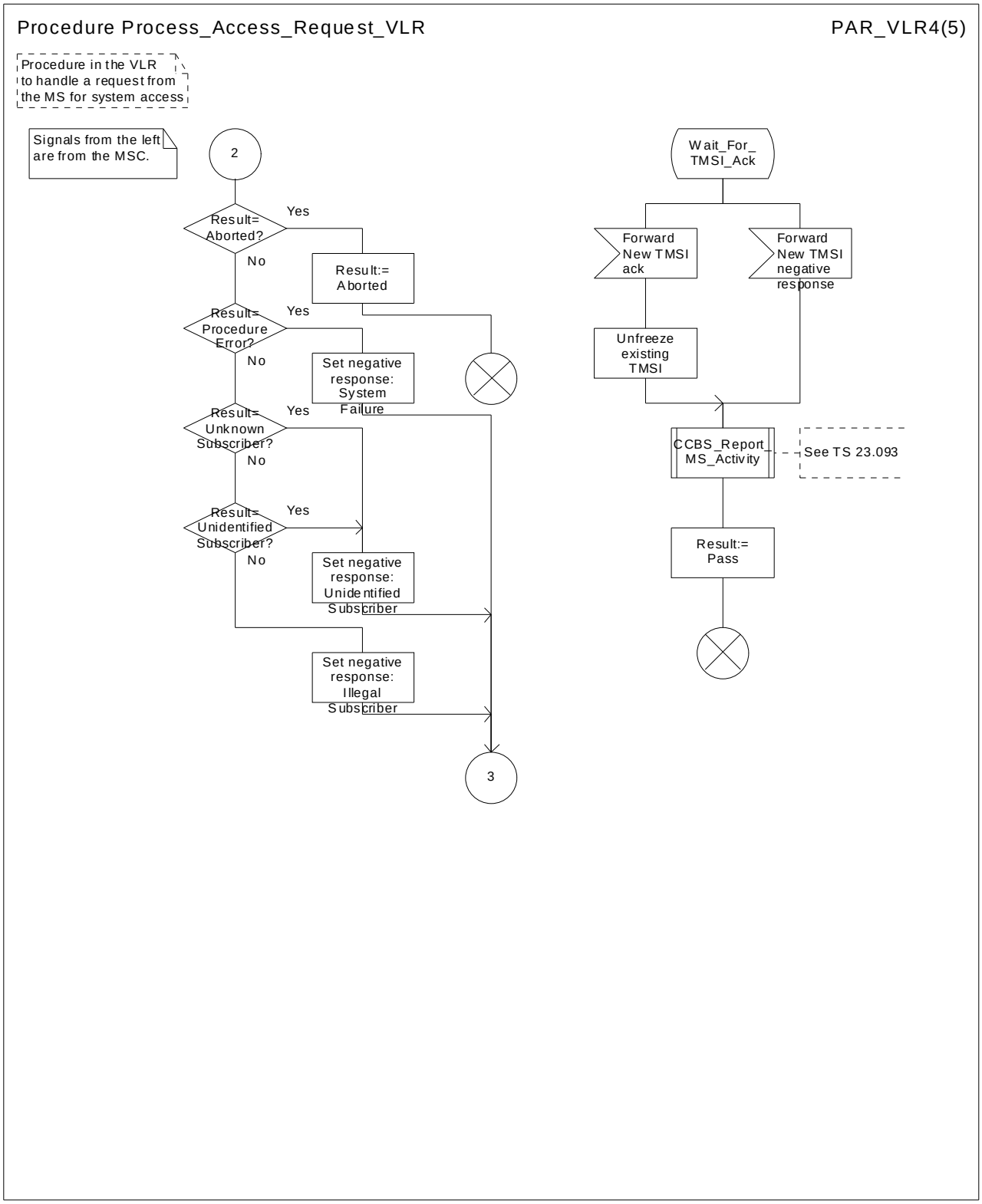


Figure 7.1.2.2d: Procedure Process_Access_Request_VLR (sheet 4)

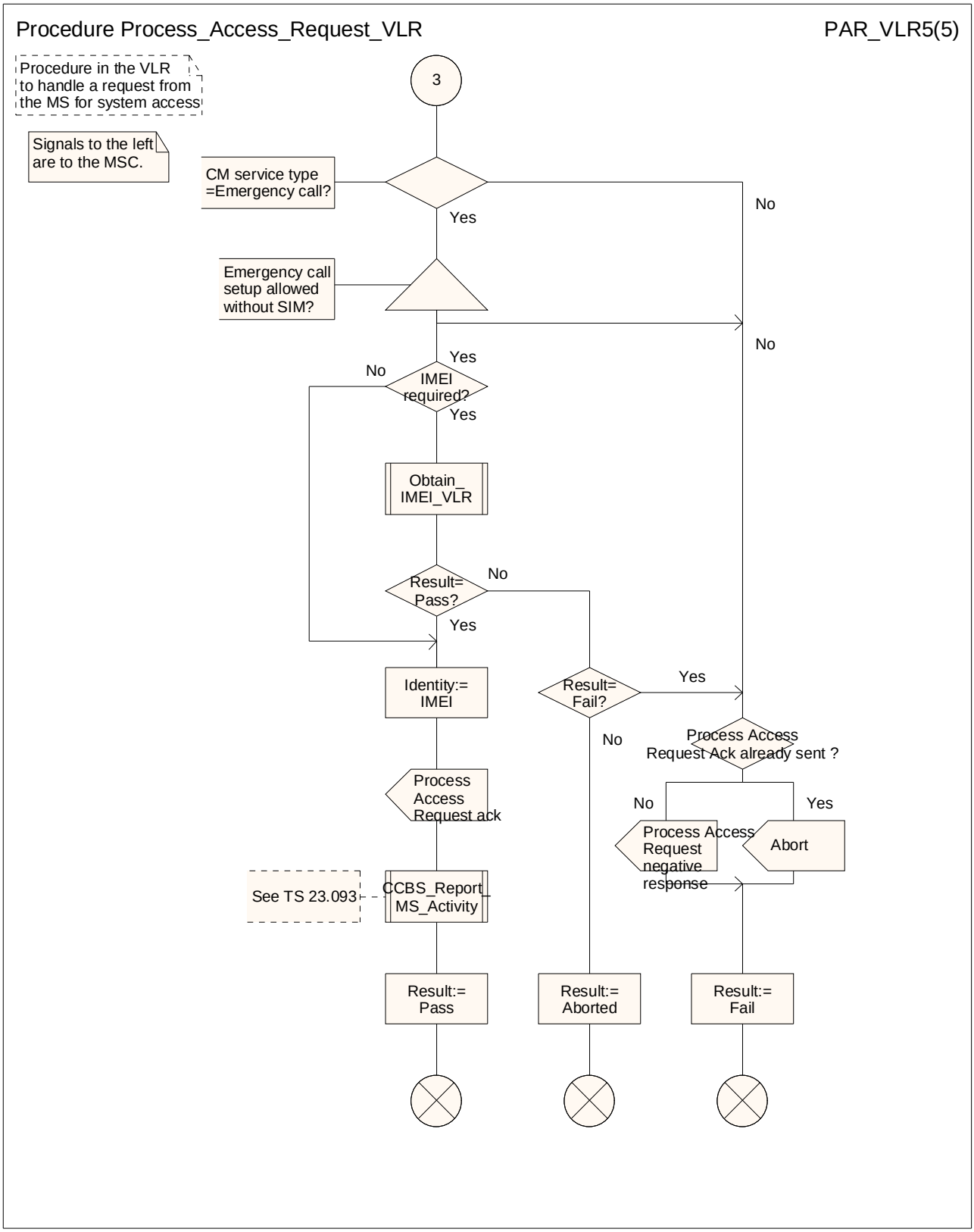


Figure 7.1.2.2e: Procedure Process_Access_Request_VLR (sheet 5)

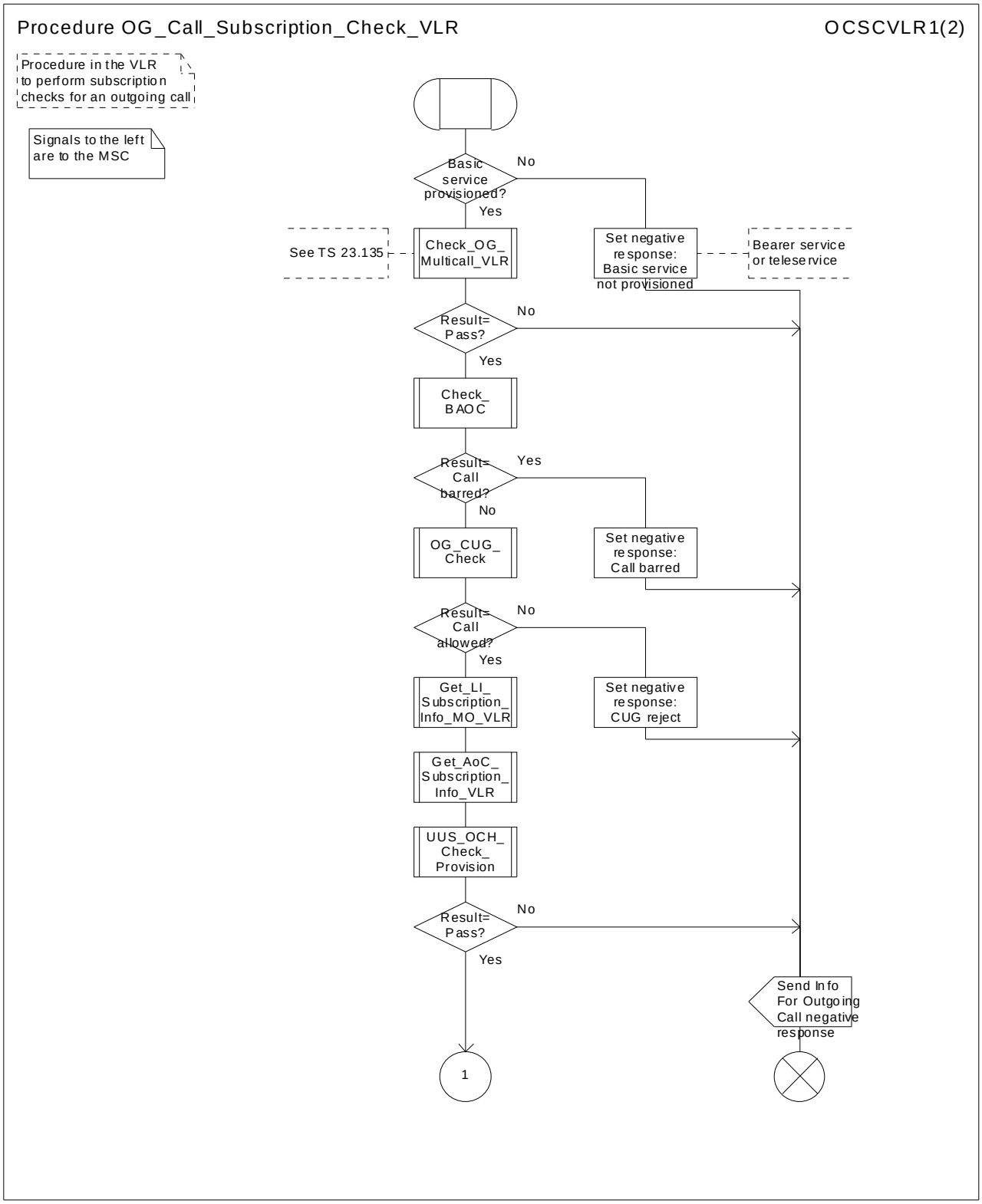


Figure 7.1.2.3a: Procedure OG_Call_Subscription_Check_VLR (sheet 1)

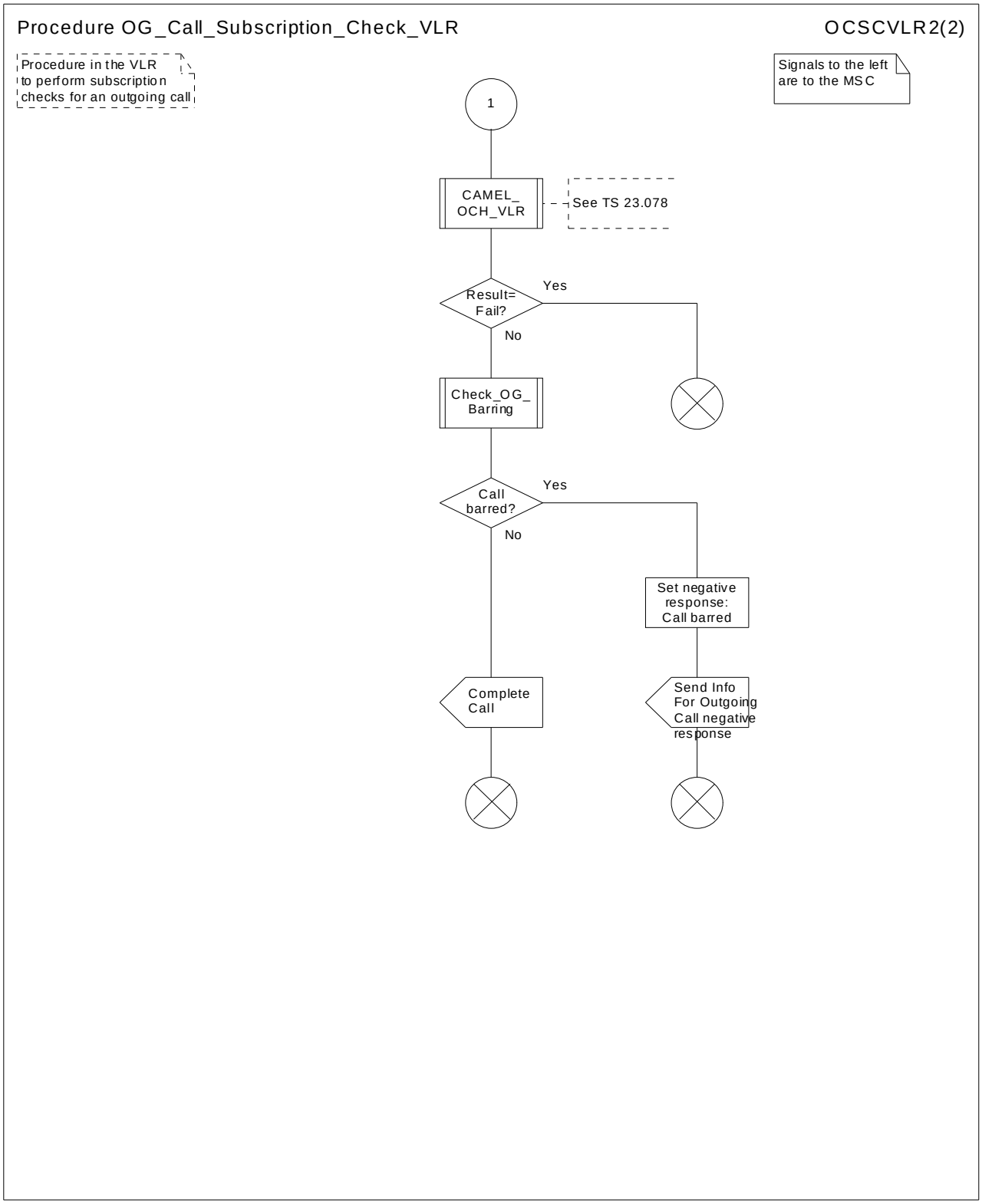


Figure 7.1.2.3b: Procedure OG_Call_Subscription_Check _VLR (sheet 2)

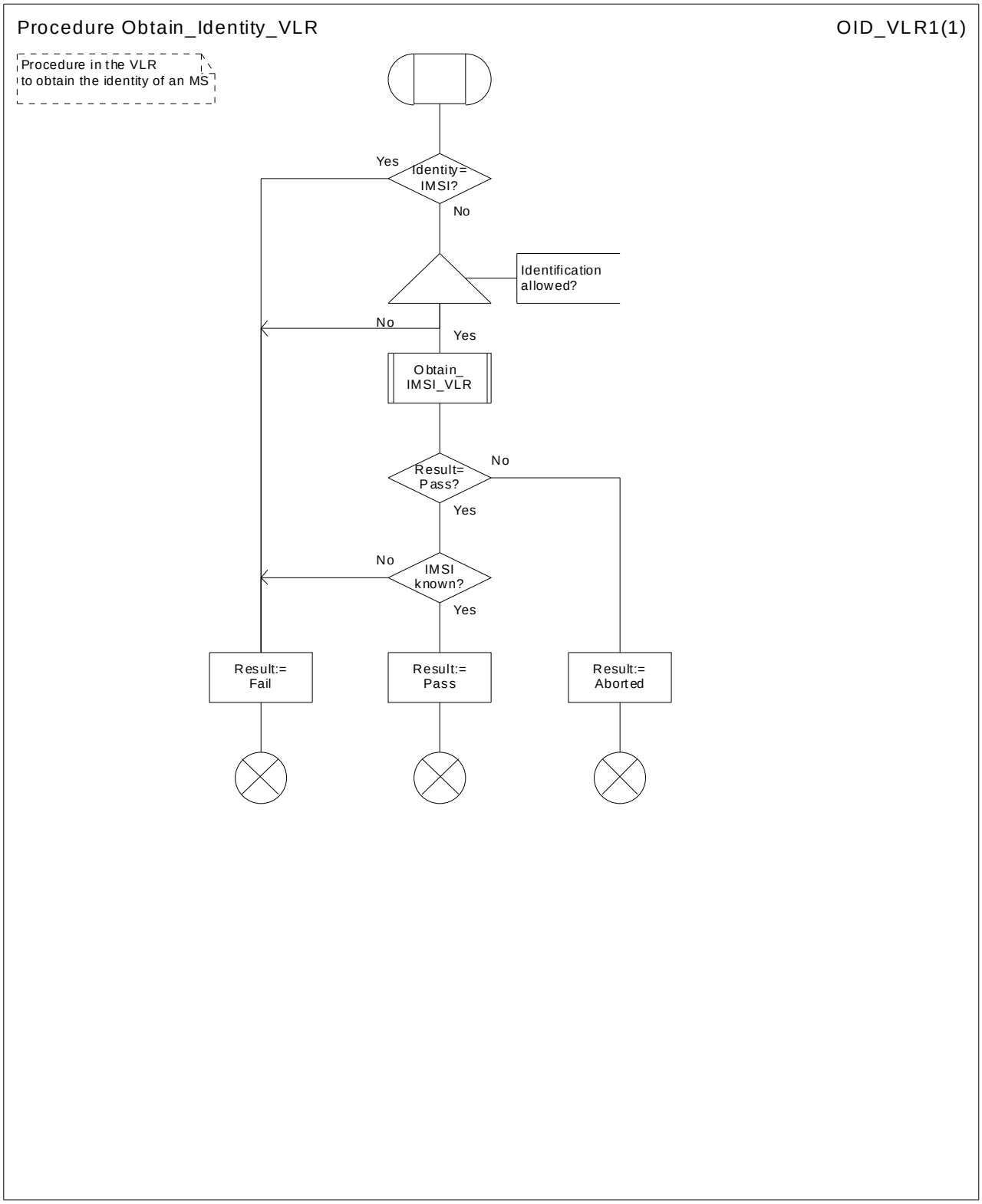


Figure 7.1.2.4: Procedure Obtain_Identity_VLR

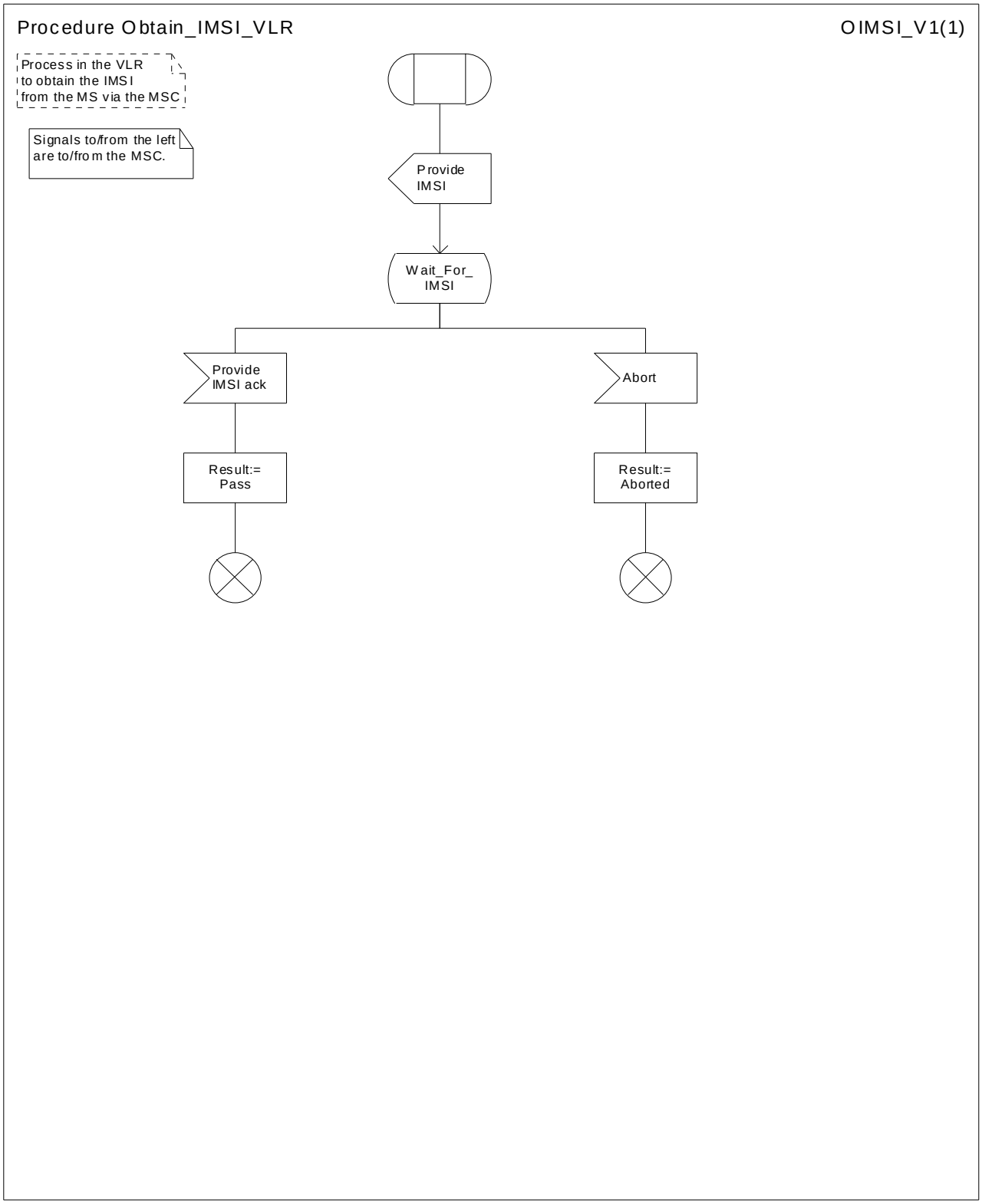


Figure 7.1.2.5: Procedure Obtain_IMSI_VLR

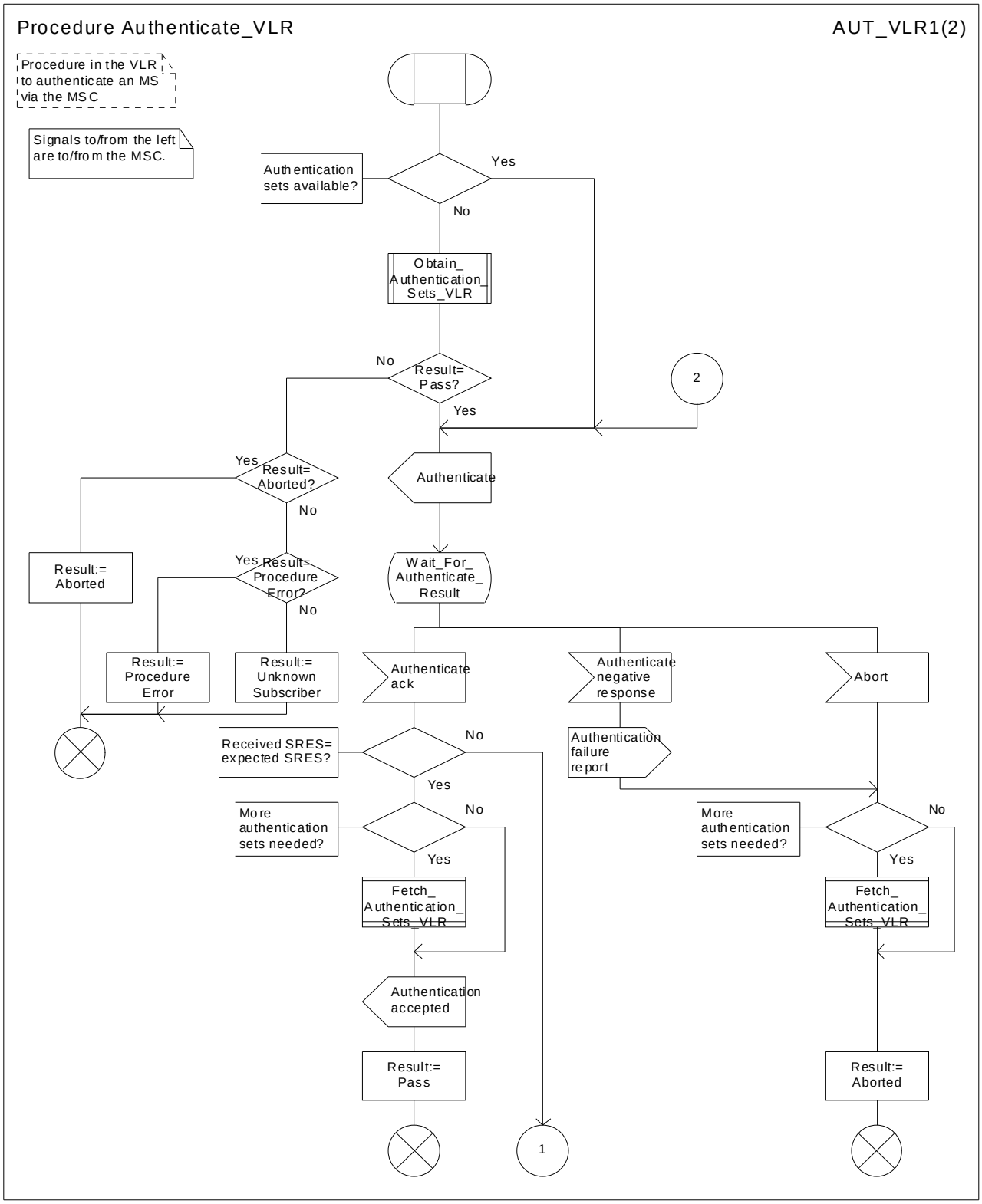


Figure 7.1.2.6a: Procedure Authenticate_VLR (sheet 1)

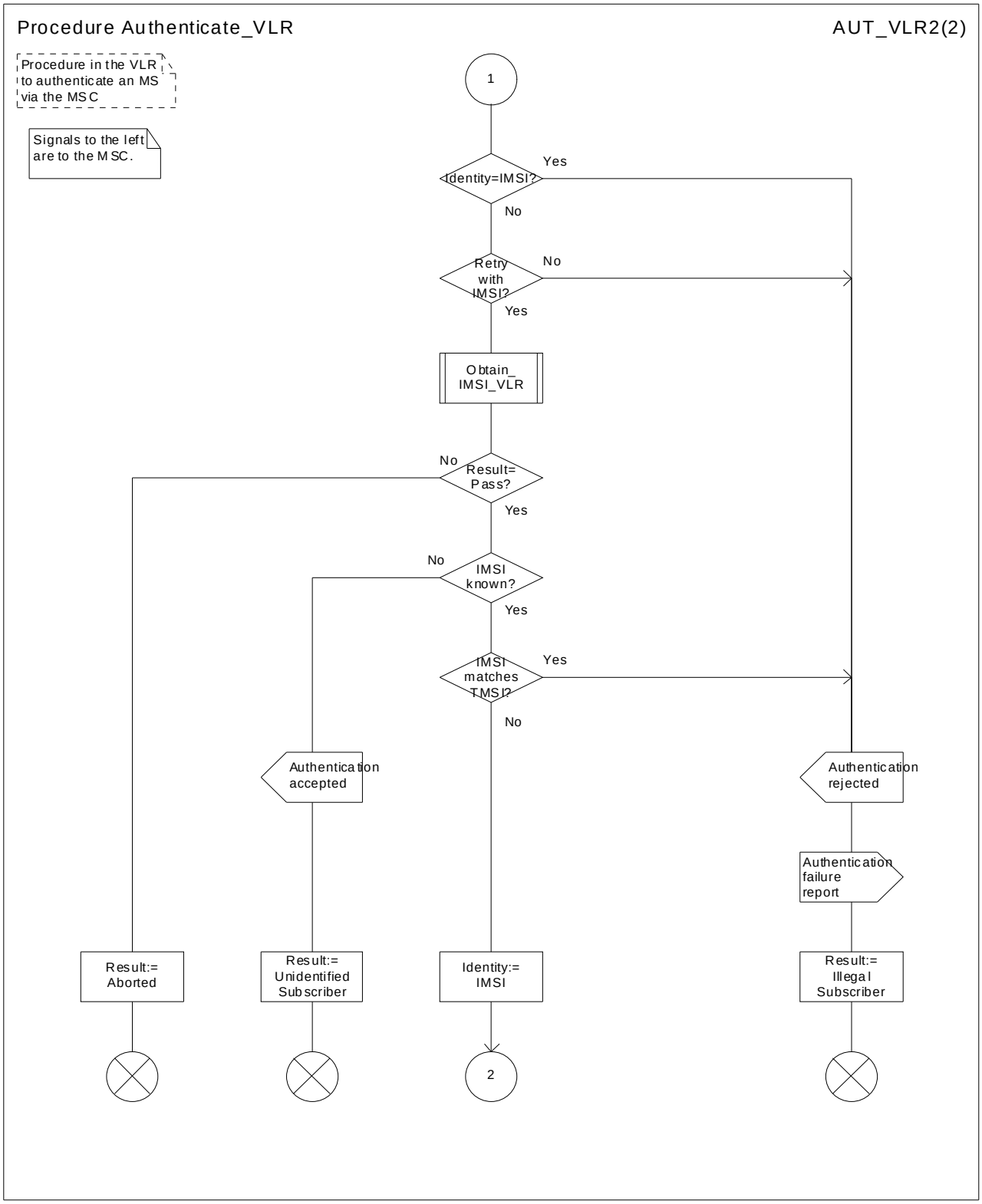


Figure 7.1.2.6b: Procedure Authenticate_VLR (sheet 2)

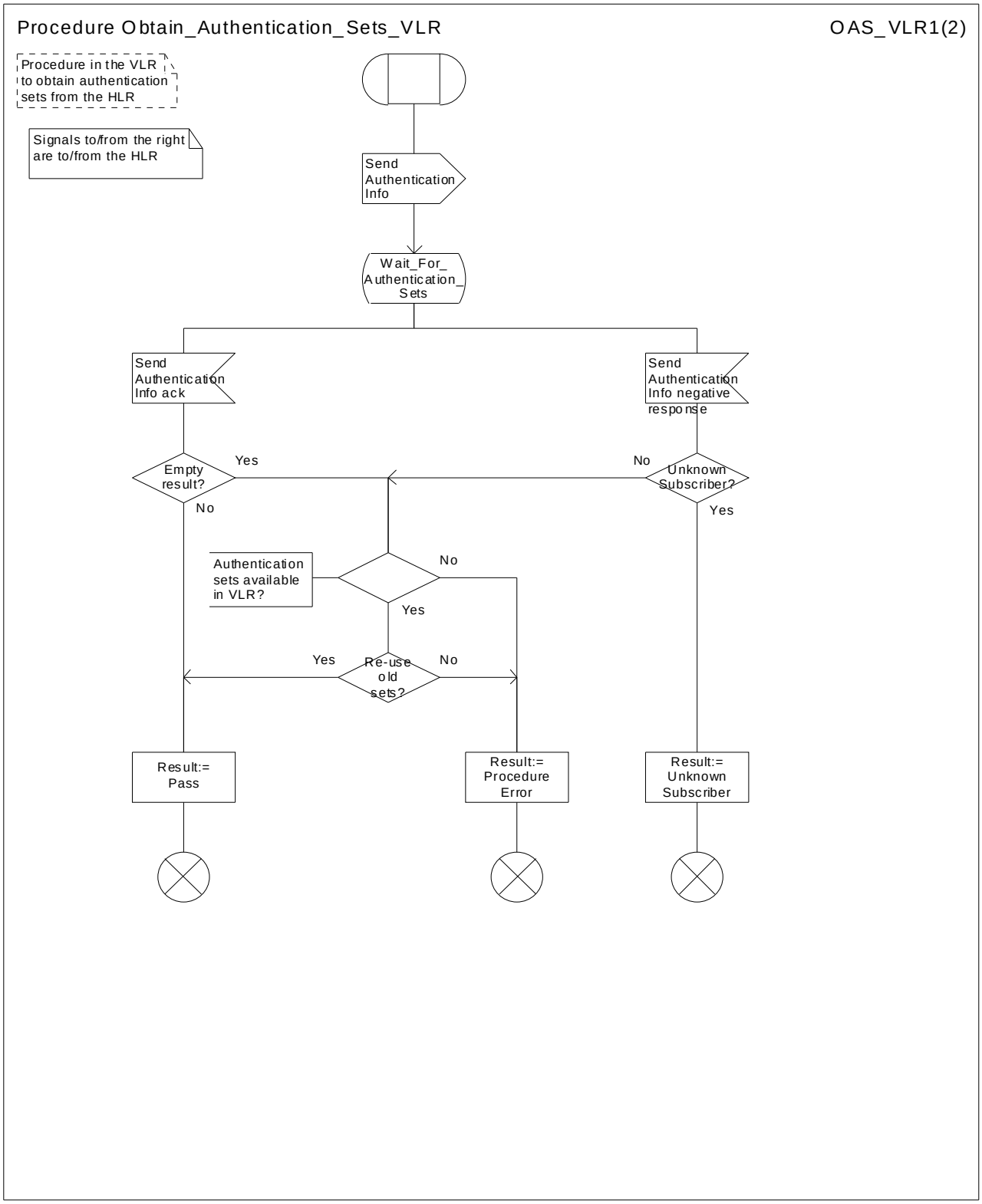


Figure 7.1.2.7a: Procedure Obtain_Authentication_Sets_VLR (sheet 1)

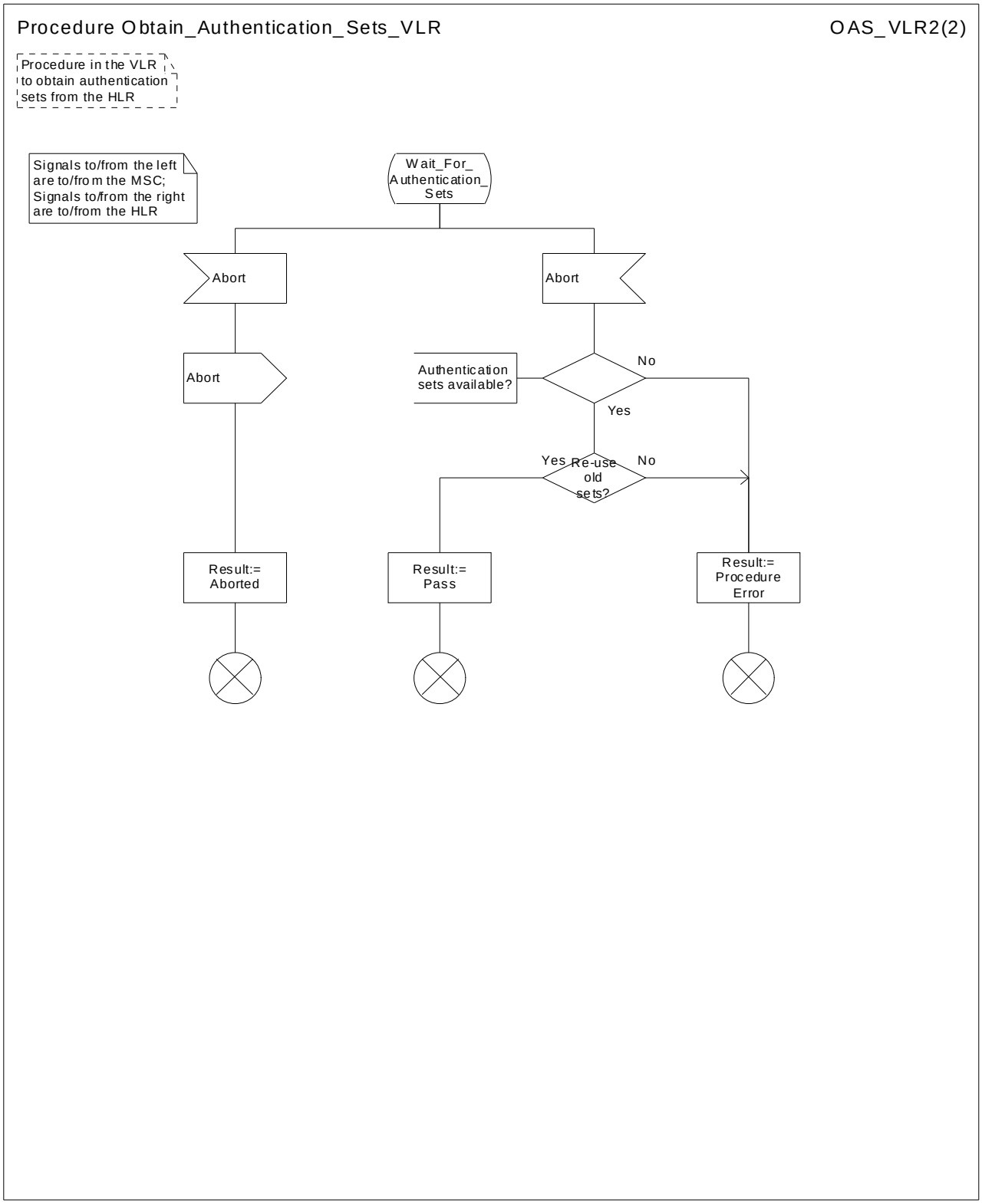


Figure 7.1.2.7b: Procedure Obtain_Authentication_Sets_VLR (sheet 2)

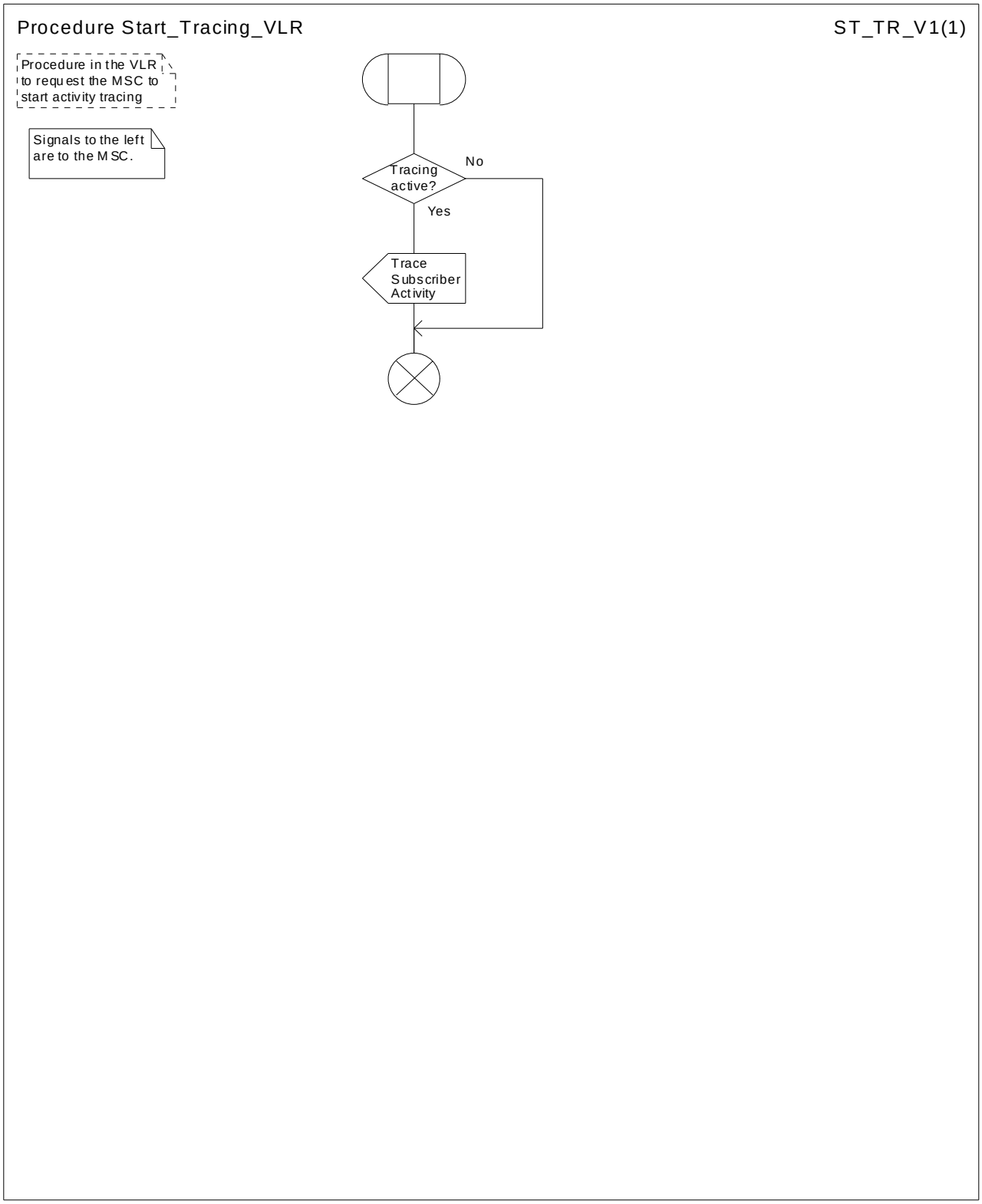


Figure 7.1.2.8: Procedure Start_Tracing_VLR

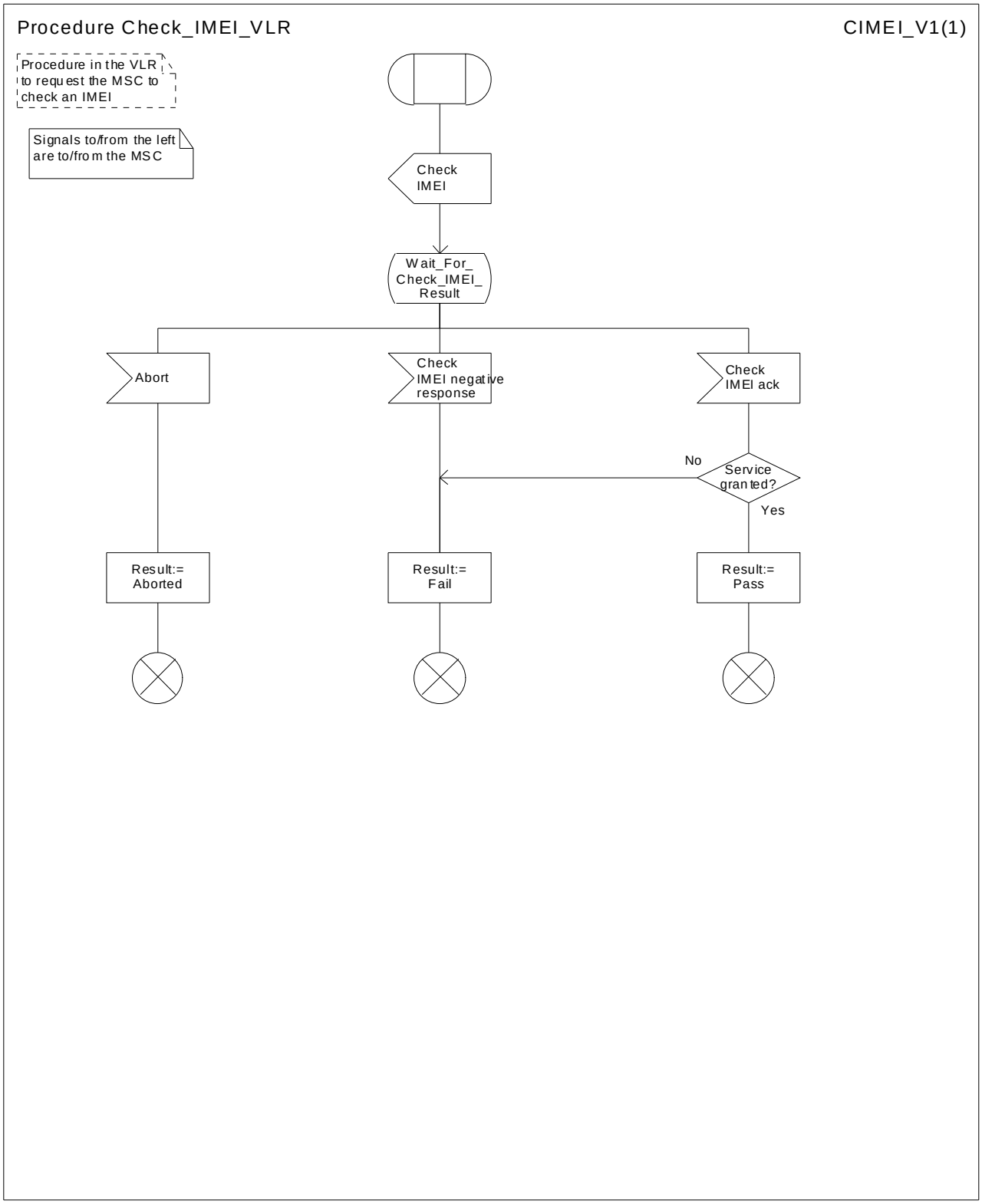


Figure 7.1.2.9: Procedure Check_IMEI_VLR

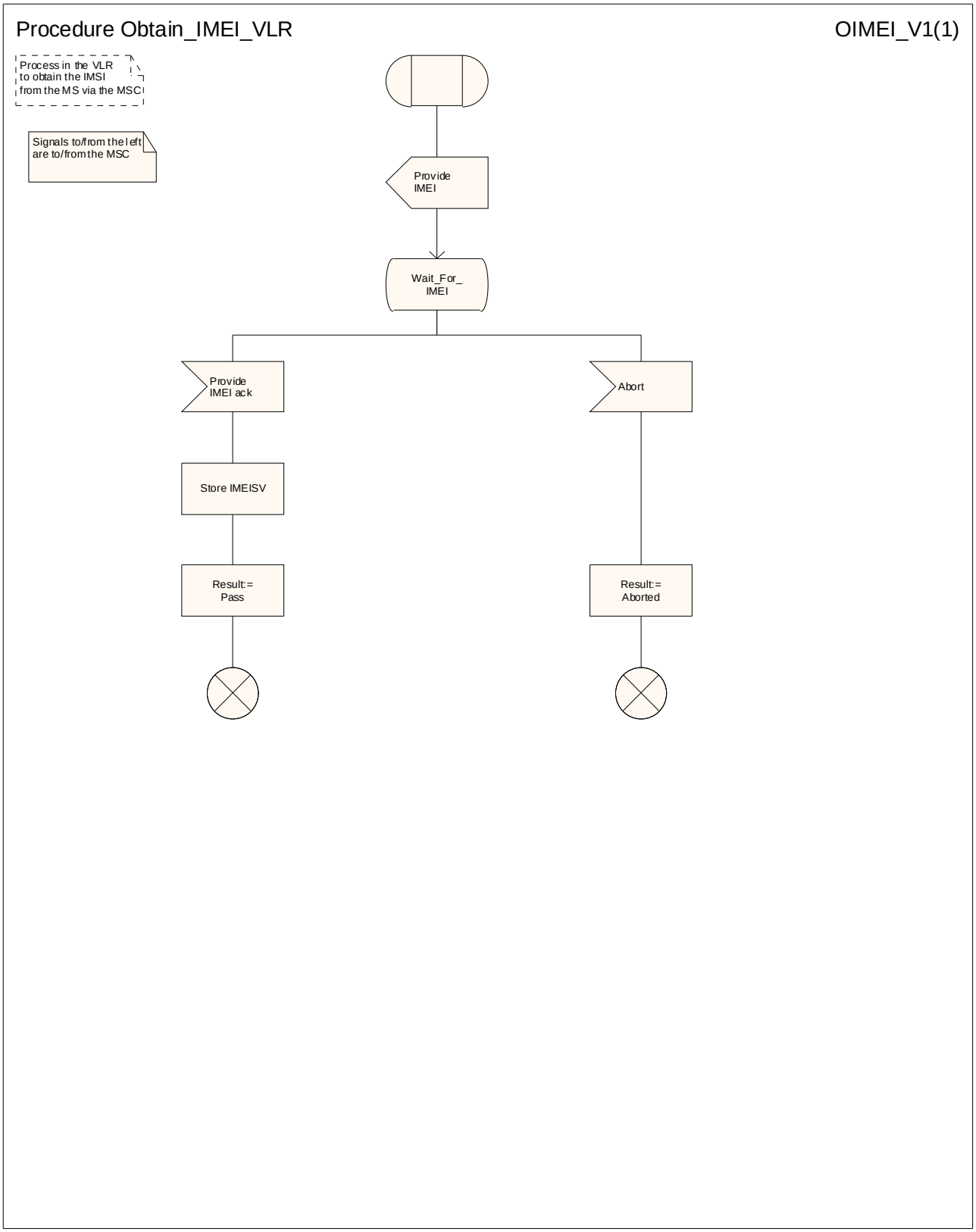


Figure 7.1.2.10: Procedure Obtain_IMEI _VLR

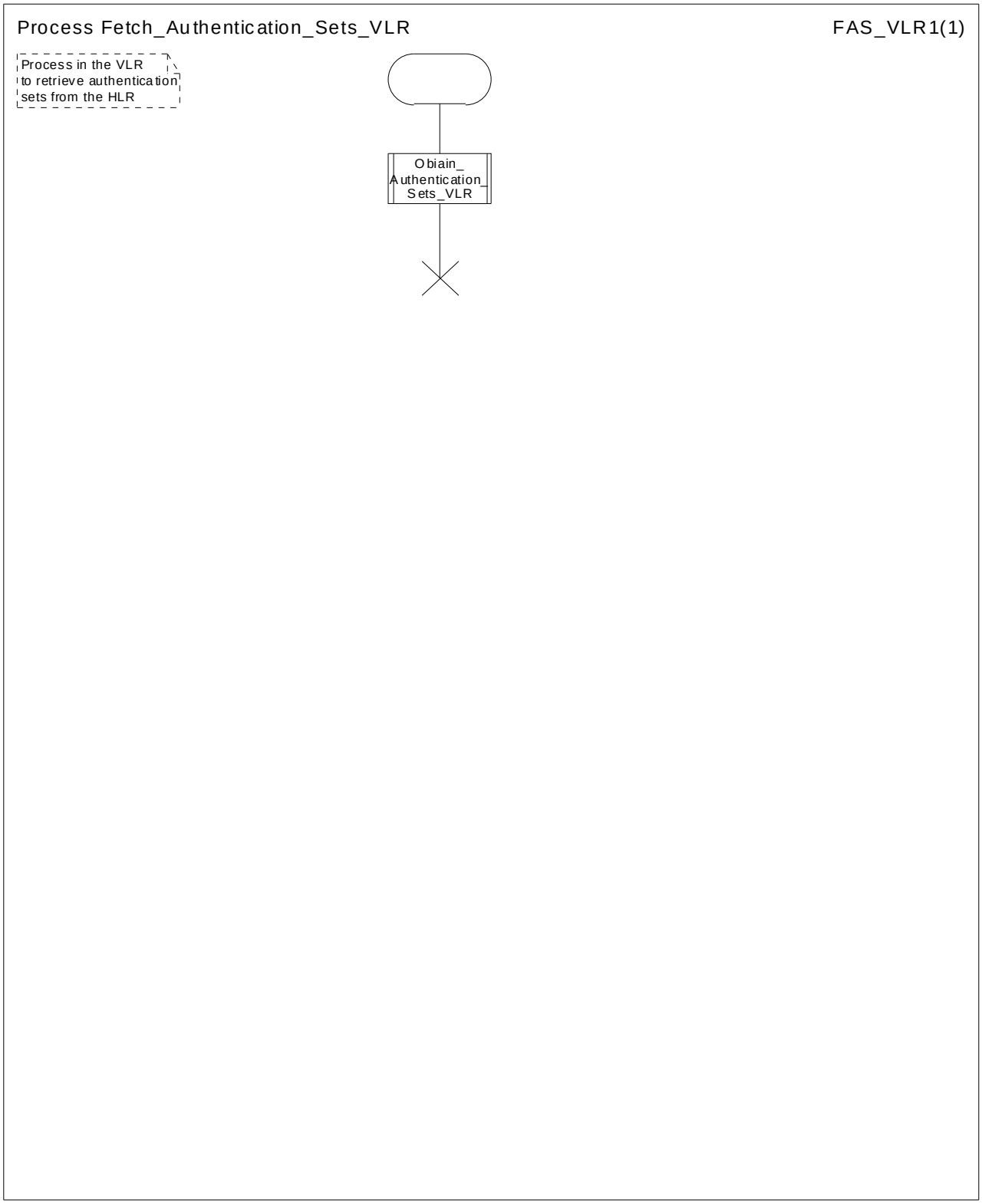


Figure 7.1.2.11: Process Fetch_Authentication_Sets_VLR

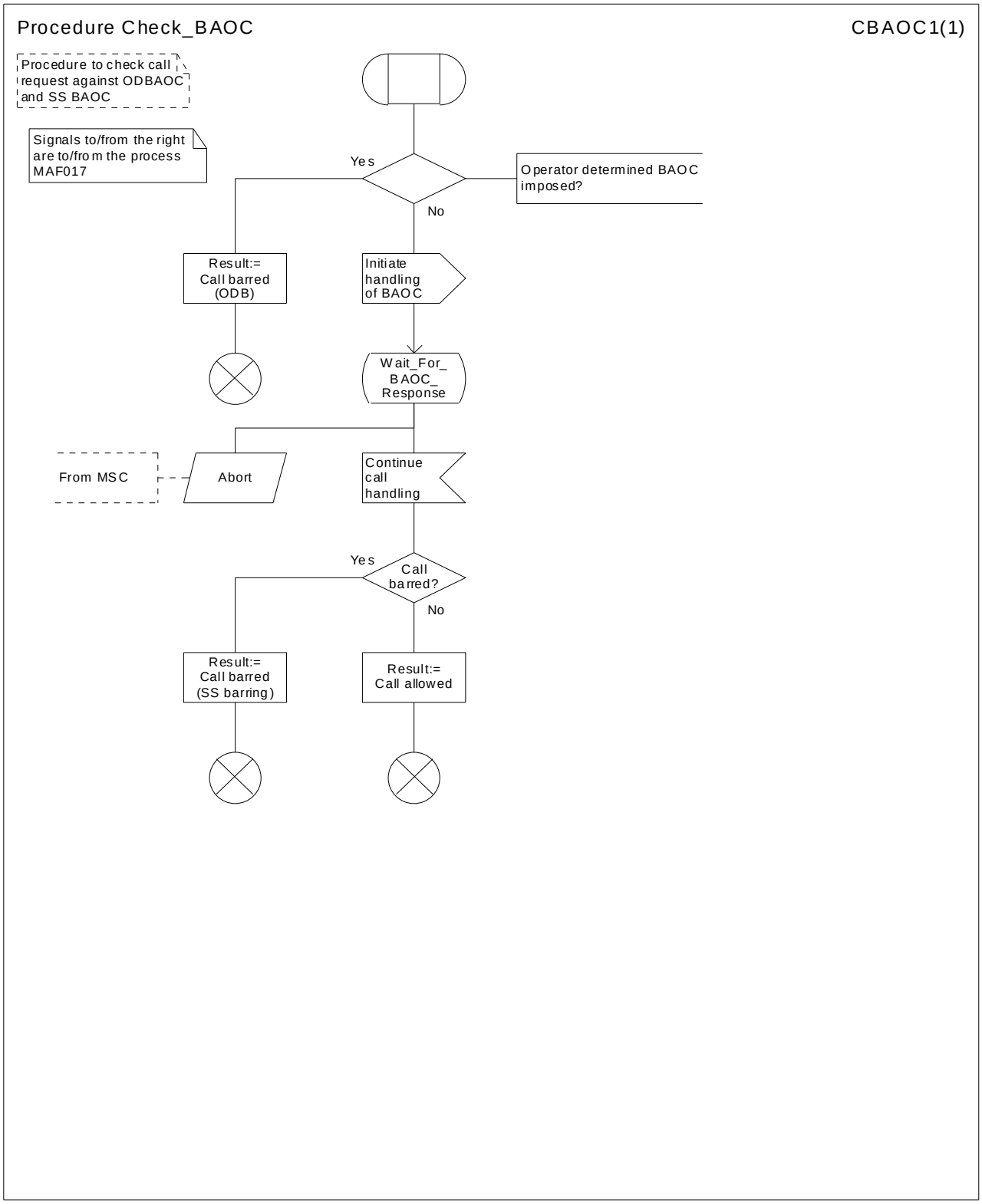


Figure 7.1.2.12: Procedure Check_BAOC

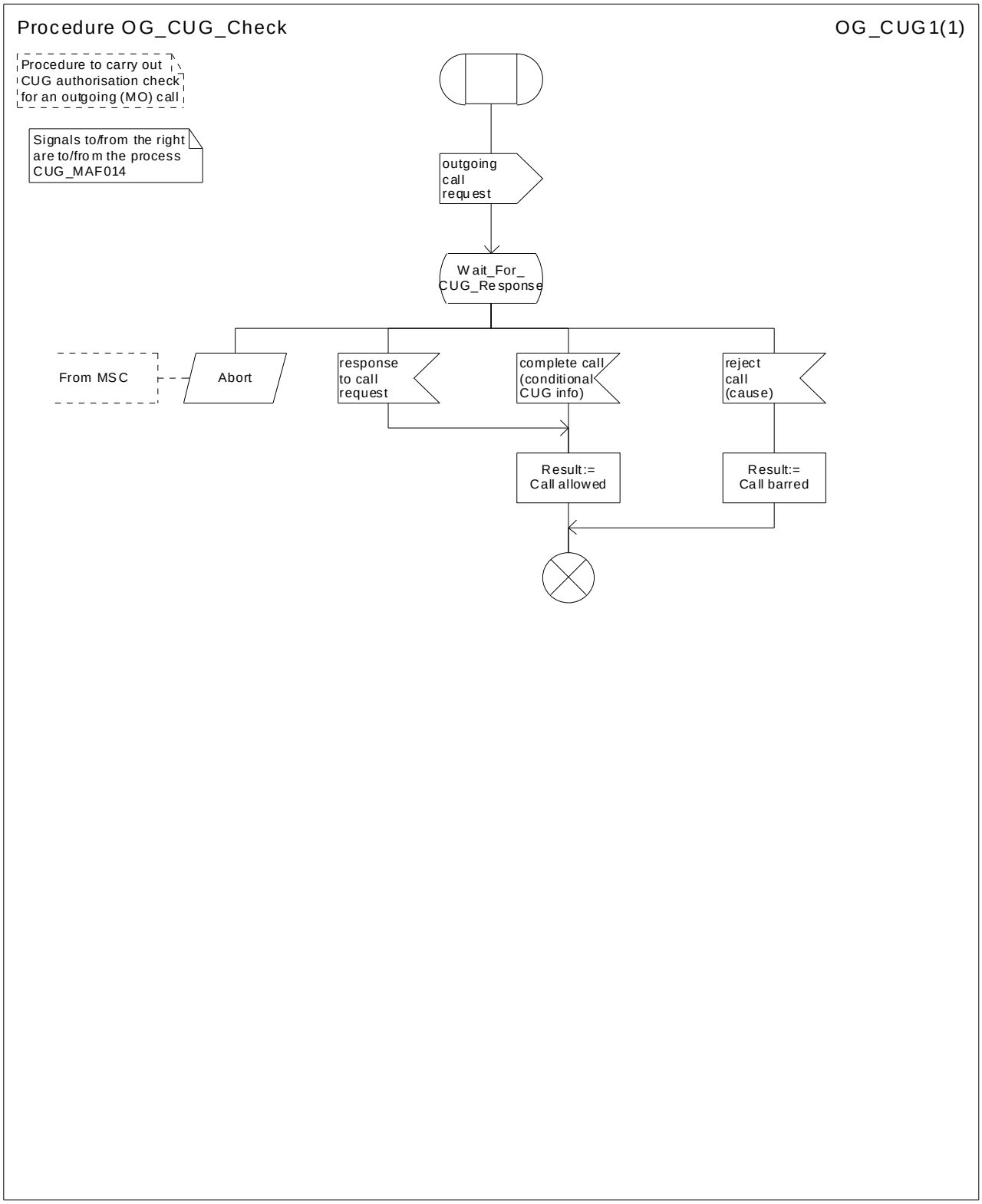


Figure 7.1.2.13: Procedure OG_CUG_Check

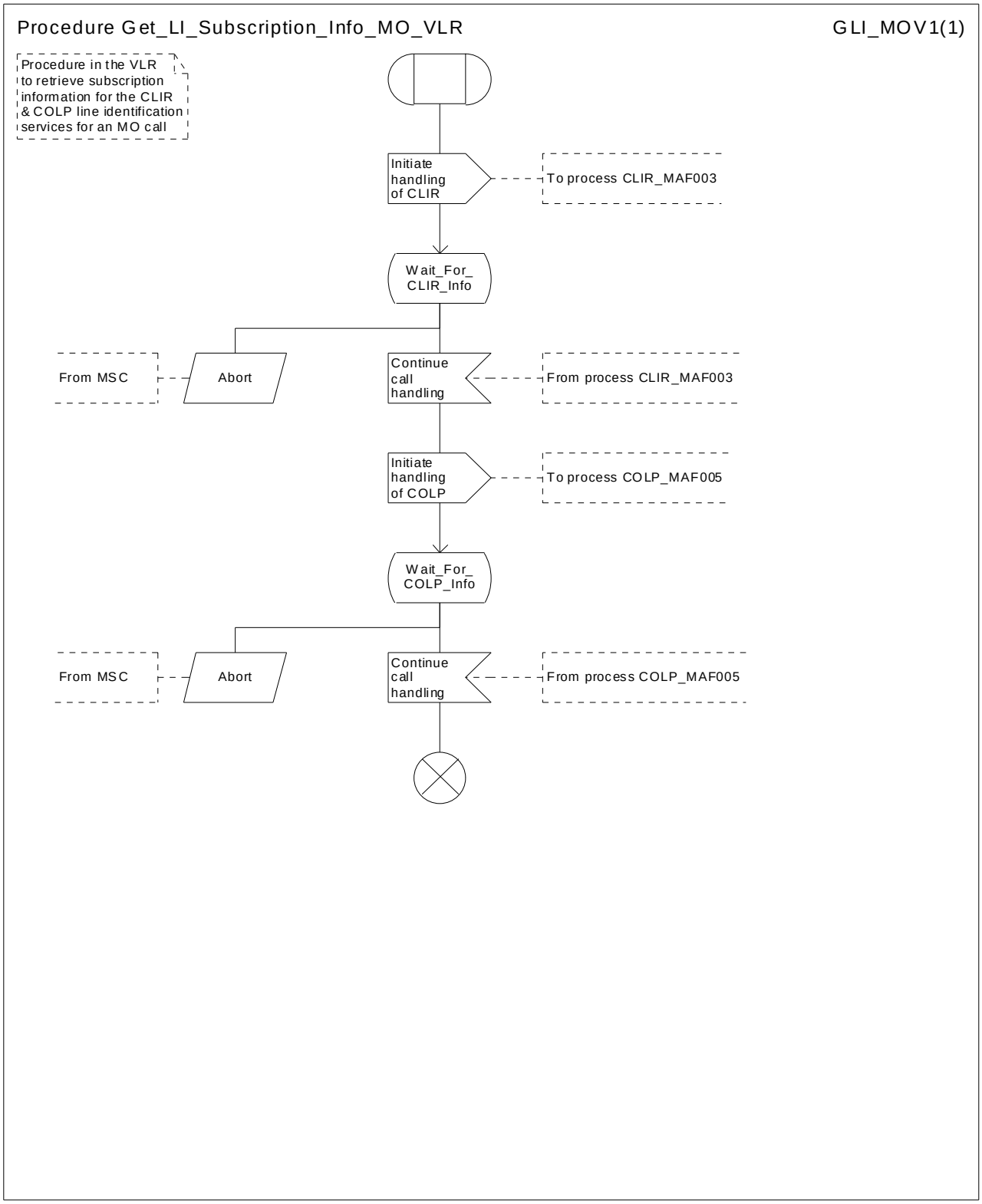


Figure 7.1.2.14: Procedure Get_LI_Subscription_Info_MO_VLR

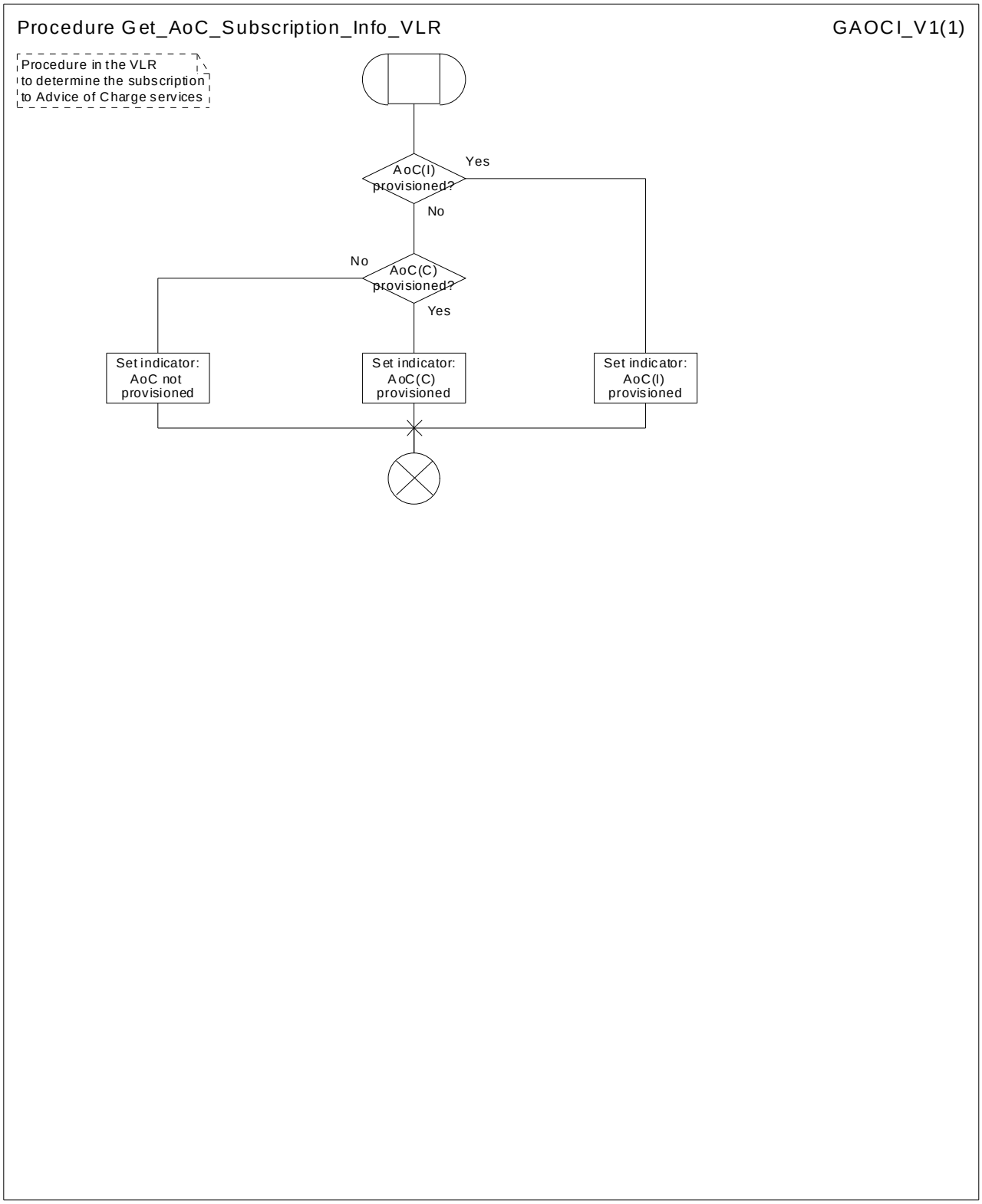


Figure 7.1.2.15: Procedure Get_AoC_Subscription_Info_VLR

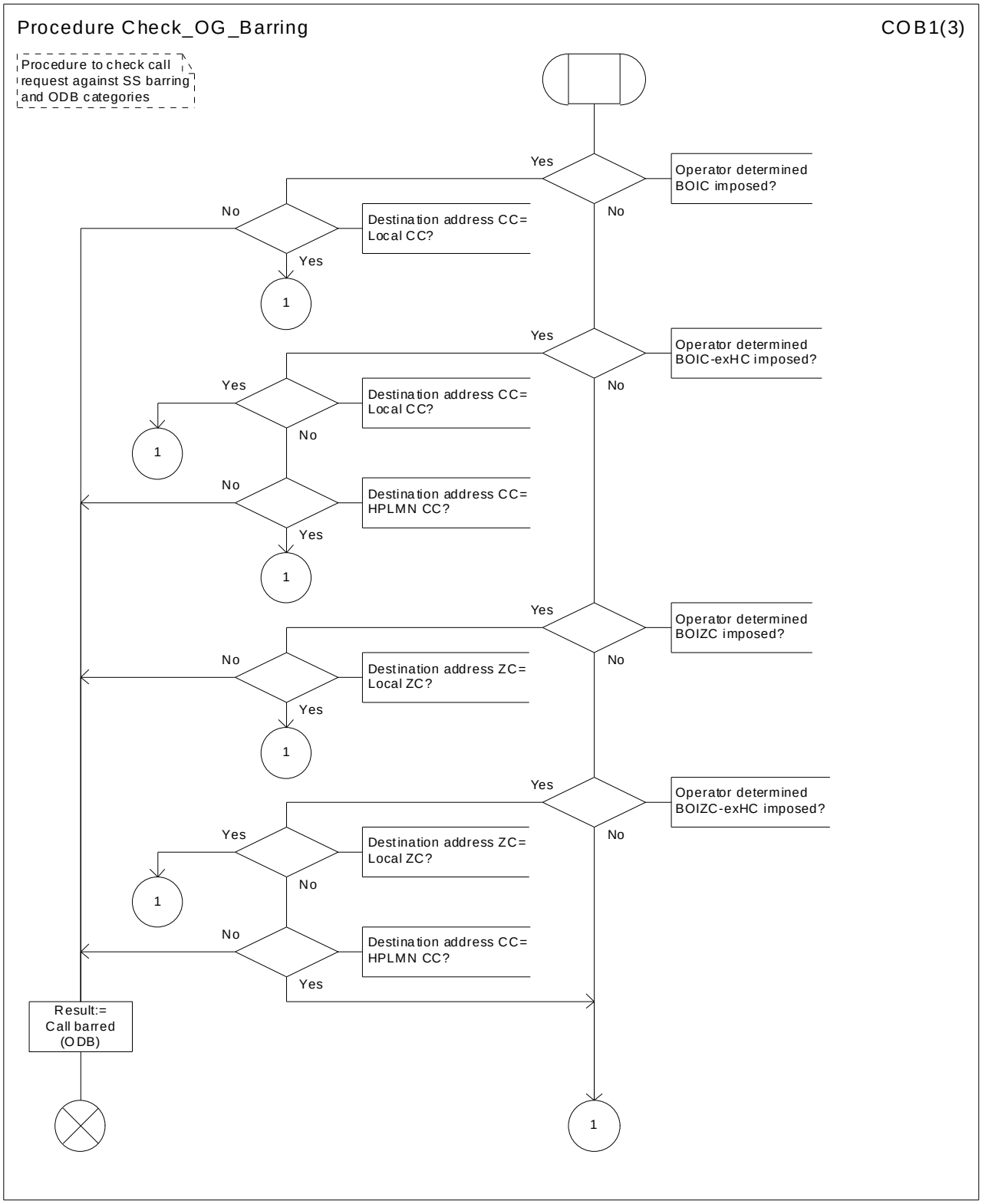


Figure 7.1.2.16a: Procedure Check_OG_Barring (sheet 1)

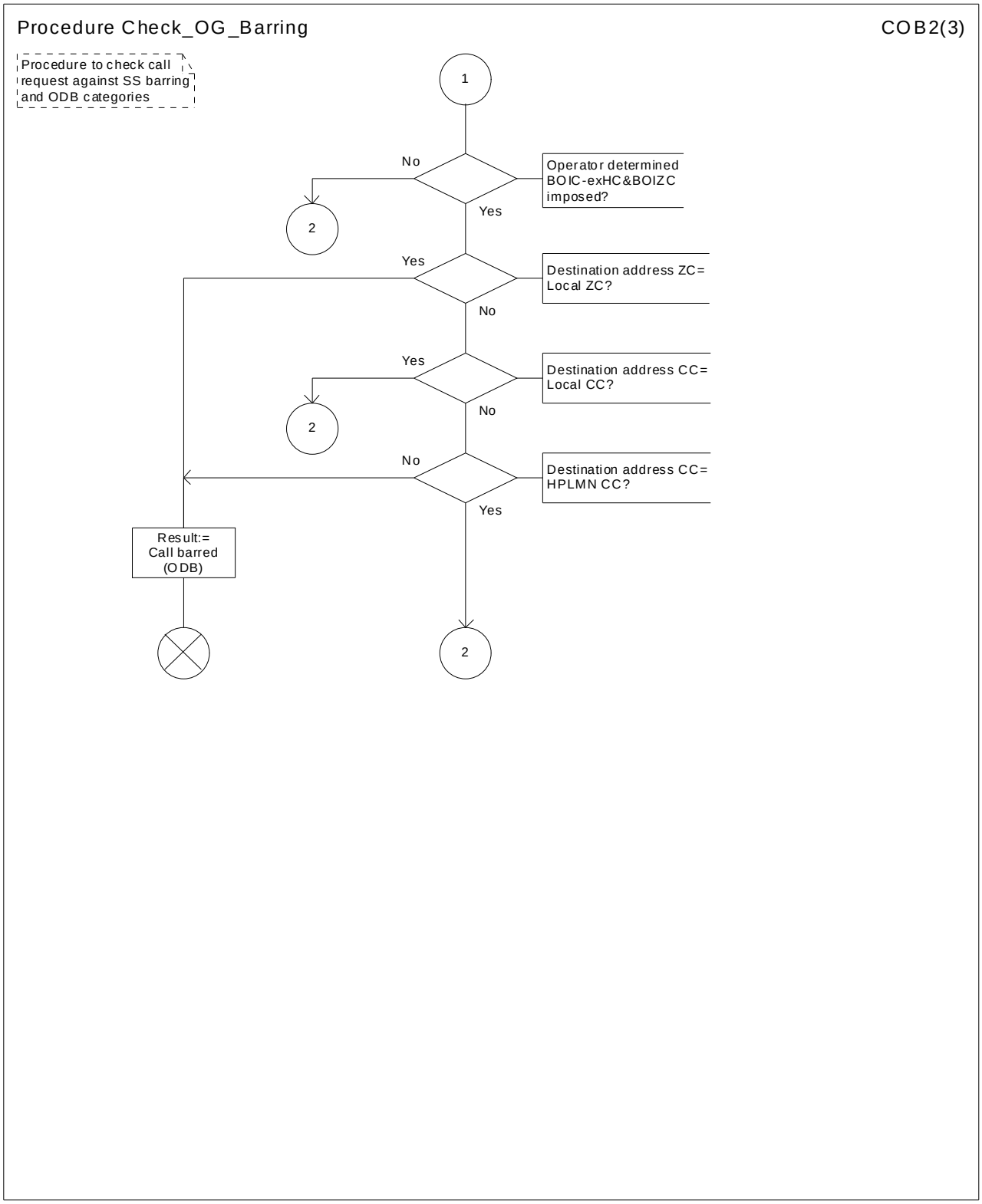


Figure 7.1.2.16b: Procedure Check_OG_Barring (sheet 2)

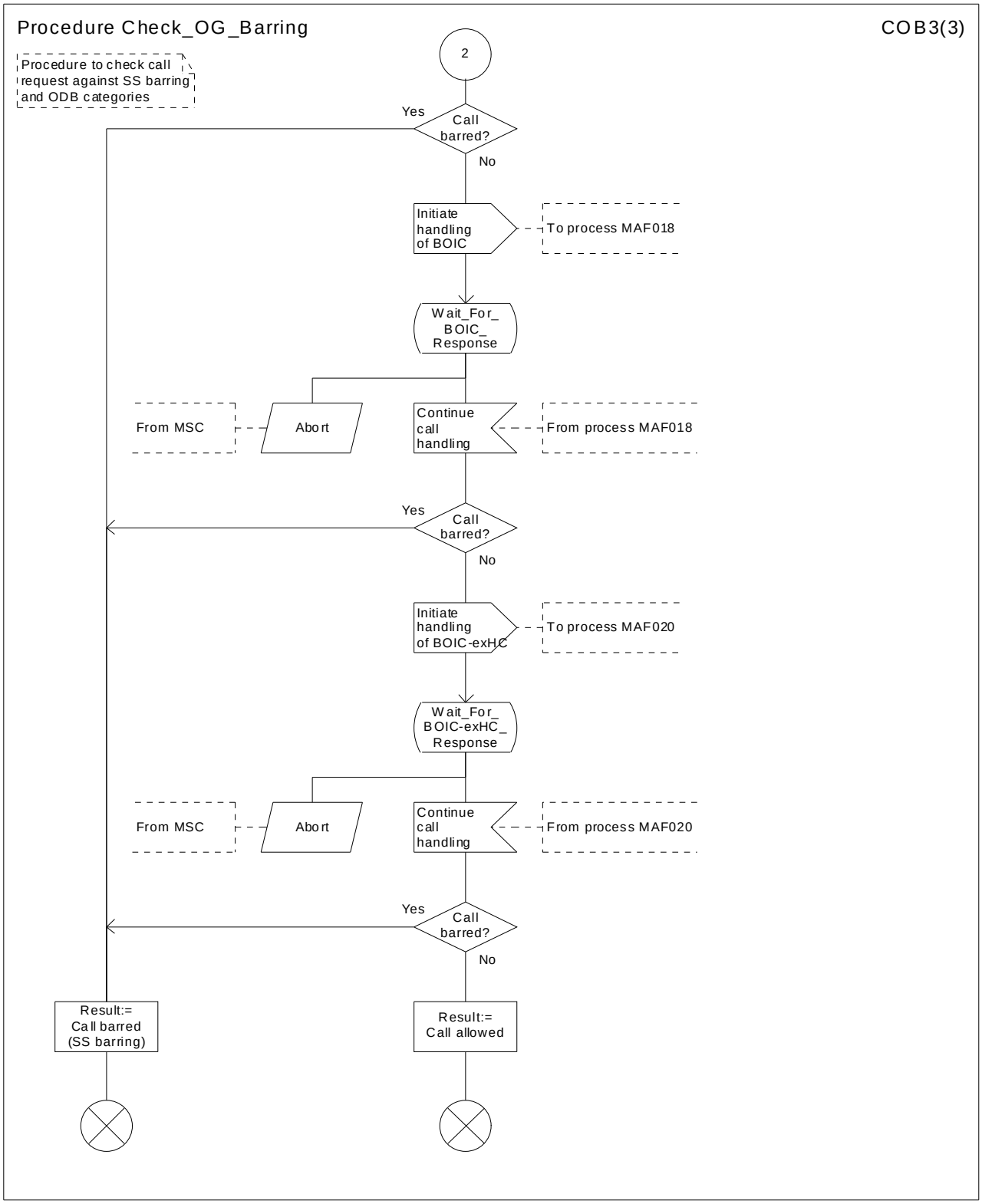


Figure 7.1.2.16c: Procedure Check_OG_Barring (sheet 3)

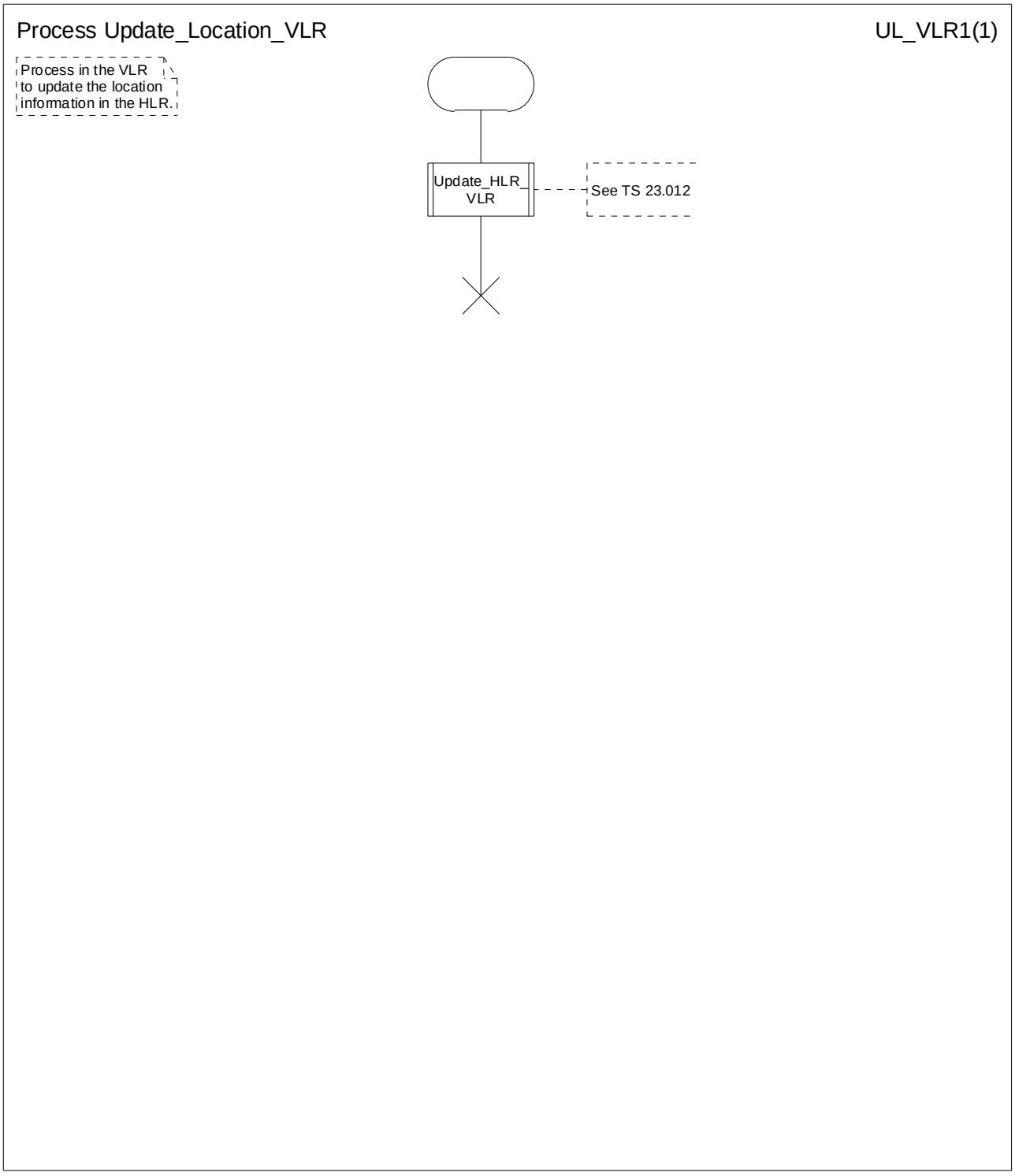


Figure 7.1.2.17: Process Update_Location_VLR

7.2 Retrieval of routeing information for MT call

7.2.1 Functional requirements of GMSC

7.2.1.1 Process MT_GMSC

Sheet 1: the variables ACM sent, Answer sent, Network connect sent, Reconnect and Resume call are global data, accessible to the procedures CCBS_MT_GMSC_Check_CCBS Possible, CCBS_Set_Diagnostic_For_Release, Obtain_Routeing_Address, Send_ACM_If_Required, Send_Answer_If_Required and Send_Network_Connect_If_Required.

Sheet 1: the variable UUS CF interaction is specific to UUS; it is accessible to all UUS specific procedures in the GMSC.

Sheet 1: the procedure MNP_MT_GMSC_Set_MNP_Parameters is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1: the procedure OR_Set_ORA_Parameters is specific to Support of Optimal Routeing; it is specified in 3GPP TS 23.079 [13].

Sheet 1: the procedure CAMEL_Set_ORA_Parameters is specific to CAMEL; it is specified in 3GPP TS 23.078 [12].

Sheet 1: the parameters "Reference address", "OR" and "Own PLMN" are passed to the procedure Obtain_Routeing_Address only if the GMSC supports Optimal Routeing. The parameter "Destination address" is returned by the procedure Obtain_Routeing_Address only if the GMSC supports Optimal Routeing of mobile-to-mobile calls. The Send Routeing Info negative response information element received in the execution of the procedure Obtain_Routeing_Address is global data, available to the parent process.

Sheet 1: the suggested mapping from values of the Send Routeing Info negative response information element to values of the ISUP release cause (see ITU-T Recommendation Q.850 [37]) is shown in table 1. The mapping used is a matter for the network operator, depending on the telephony signalling system used.

Table 1: Suggested mapping of Send Routeing Info (SRI) negative responses to ISUP release causes

SRI negative response	ISUP release cause number	ISUP release cause name
Absent subscriber	20	Subscriber absent
Bearer service not provisioned	57	Bearer capability not authorized
Busy subscriber	17	User busy
Call barred (ODB)	21	Call rejected
Call barred (SS barring)	21	Call rejected
Call barred (ACR)	31	Normal, unspecified (NOTE 2)
CUG reject (Called party SS interaction violation)	21	Call rejected
CUG reject (Incoming calls barred within CUG)	55	Incoming calls barred within CUG
CUG reject (Subscriber not member of CUG)	87	User not member of CUG
CUG reject (Requested basic service violates CUG constraints)	87	User not member of CUG
Data missing	111	Protocol error, unspecified
Facility not supported	69	Requested facility not implemented
Forwarding violation	21	Call rejected
Number changed	22	Number changed
System failure	111	Protocol error, unspecified
Teleservice not provisioned	57	Bearer capability not authorized
Unexpected data value	111	Protocol error, unspecified
Unknown subscriber	1 26	Unallocated (unassigned) number Misrouted call to a ported number (NOTE 1)

NOTE 1: If the Diagnostic parameter indicates "NPDB mismatch", MNP can require a specific ISUP release cause value, according to National Coding Standard, to indicate "Misrouted call to a ported number", depending on national regulations. North American GSM Number Portability (NAGNP) requires the SRI negative response "unknown subscriber" to be treated differently under certain conditions. If the IAM received from the originating exchange contained the HPLMN routing number for NAGNP then the SRI negative response "unknown subscriber" shall be mapped to ISUP release cause number 26 "Misrouted call to a ported number"; under all other conditions the SRI negative response "unknown subscriber" shall be mapped to ISUP release cause number 1 "Unallocated (unassigned) number".

NOTE 2: The GMSC will play an announcement towards the calling user to signal that the call is rejected due to anonymous call rejection and then include cause 24 "call rejected due to feature at destination" in ACM or CPG. See 3GPP TS 23.088 [21].

Sheet 1: it is an operator option whether to send an Address Complete message if the Number Portability Database returns a routeing number. If the GMSC sends an Address Complete message, it shall include the called party's status field of the Backward call indicator set to "no indication".

Sheet 1: the called party address sent in the IAM to the process MT_CF_MSC is the Forwarded-to number received in the Perform Call Forwarding ack.

Sheet 1: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1: it is an operator option whether to send an Address Complete message if the HLR returns forwarding information. If the GMSC sends an Address Complete message, it shall include the called party's status field of the Backward call indicator set to "no indication".

Sheet 1, sheet 8: the process CAMEL_MT_LEG1_GMSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2: the procedures CAMEL_Start_TNRy and CAMEL_Stop_TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 2, sheet 3: the procedure CAMEL_MT_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 2, sheet 3: the procedure CAMEL_MT_GMSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL, processing continues from the "Pass" exit of the test "Result".

Sheet 2, sheet 3: the task "Set destination address parameter" is executed only if the GMSC supports Optimal Routeing of mobile-to-mobile calls.

Sheet 3: the procedure Handle_COLP_Forwarding_Interaction is specific to COLP.

Sheet 4: the input signal Resume Call Handling and all the subsequent processing on this sheet are specific to Support of Optimal Routeing, and will occur only if the GMSC supports Optimal Routeing. The procedure OR_Handle_RCH is specified in 3GPP TS 23.079 [13].

Sheet 4, sheet 6: the procedure CCBS_MT_GMSC_Check_CCBS_Possible is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 5: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the GMSC supports CAMEL phase 2 or later. The procedure CAMEL_MT_GMSC_DISC5 is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CAMEL_MT_GMSC_DISC3 is specific to CAMELphase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedures CAMEL_MT_GMSC_DISC4 and CAMEL_MT_GMSC_DISC6 are specific to CAMEL phase 2 or later, they are specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CCBS_Set_Diagnostic_For_Release is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 6, sheet 7: the processing in the branch beginning with the Int_Release_Call input will occur only if the MSC supports CAMEL.

Sheet 7: the procedure CAMEL_MT_GMSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 7: the procedure CAMEL_MT_GMSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL, processing continues from the "Normal handling" exit of the test "Result?".

Sheet 7: after the GMSC has sent an IAM to the destination VMSC or the forwarded-to exchange (via the process MT_CF_MSC), it acts as a relay for messages received from the originating exchange and the destination VMSC or the process MT_CF_MSC. Any message other than Address Complete, Connect, Answer or Release causes no change of state in the process MT_GMSC.

Sheet 8: the procedure CAMEL_MT_LEG2_GMSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

7.2.1.2 Procedure Obtain_Routeing_Address

Sheet 1: the procedure MOBILE_NUMBER_PORTABILITY_IN_TQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1: the procedure CCBS_MT_GMSC_Check_CCBS_Call is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1: the procedure CLI_MT_GMSC is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14]. This procedure shall also be performed if the GMSC supports the ACR supplementary service.

Sheet 1: for SCUDIF calls, the message Send Routeing Info shall include the ISDN BC of both the preferred and the less preferred service, as specified in 3GPP TS 23.172 [38].

Sheet 1: global flag "Clear MT Roaming Retry IE" is initialized to No at the start of MT_GMSC procedure.

Sheet 1: if Mobile Terminating Roaming Retry is supported, and if no Resume Call Handling message for roaming retry has been received, the GMSC shall include the GMSC address, the call reference number and the MT Roaming Retry Supported IE in the SRI message.

Sheet 2: the procedure SCUDIF_Negative_SRI_Response_Handling is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the GMSC does not support SCUDIF, processing continues from the "Fail" exit of the test "Result".

Sheet 2: the procedure OR_Handle_SRI_Negative_Response is specific to Support of Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the GMSC does not support Optimal Routeing, processing continues from the "No" exit of the test "Result=Pass?".

Sheet 2: the test "Error=Unknown subscriber" refers to the negative response value received from the HLR.

Sheet 2: the procedure MOBILE_NUMBER_PORTABILITY_IN_QoHR is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 3: the procedure SCUDIF_Check_Service_Availability is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the GMSC does not support SCUDIF, processing continues from the "continue" exit of the test "Result ?".

Sheet 3: the procedure CAMEL_MT_GMSC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure SCUDIF_Check_Service_Compatibility is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38].

Sheet 3: sending of "Release Resources" is an implementation option. If support of "Release Resources" by the VMSC is not indicated in Send Routing Info ack, "Release Resources" shall not be sent.

Sheet 4: the procedure SCUDIF_Check_Service_Compatibility is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38].

Sheet 4: the procedure CCBS_MT_GMSC_Check_CCBS_Indicators is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 4: the task "Store Forwarding Interrogation Required indicator" is executed only if the GMSC supports Optimal Routeing.

Sheet 4: The test "MSRN contains a Routeing Number" is executed only if the SRF solution for call related MNP is used. If the SRF solution for call related MNP is not used, processing continues from the "No" exit of the test "MSRN contains a Routeing Number".

Sheet 4: the procedure MNP_MT_GMSC_Check_MNP_Indicators is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 5: the procedure CAMEL_MT_GMSC_Notify_CF is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 2 or later, processing continues from the "Continue" exit of the test "Result".

Sheet 5: the procedure SCUDIF_Check_Service_Compatibility is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38].

Sheet 6: the task "BOR:=OR" is executed only if the GMSC supports Optimal Routeing of mobile-to-mobile calls.

Sheet 6: the procedures CCBS_MT_GMSC_Remove_Indicators_Store_FWT is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 6: the procedure Route_Permitted is specific to Support of Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the GMSC does not support Optimal Routeing, processing continues from the "True" exit of the test "Route permitted".

Sheet 6: the procedure CAMEL_MT_MSC_DISC3 is specific to CAMEL phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CAMEL_MT_GMSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the task "OR:= True" is executed only if the GMSC supports Optimal Routeing of mobile-to-mobile calls.

7.2.1.3 Procedure Send_ACM_If_Required

If no useful information would be carried in the Call Progress message, it is not sent.

7.2.1.4 Procedure Send_Answer_If_Required

If no useful information would be carried in the Call Progress message, it is not sent.

7.2.1.5 Procedure Send_Network_Connect_If_Required

If no useful information would be carried in the Call Progress message, it is not sent.

7.2.1.6 Procedure Handle_COLP_Forwarding_Interaction_MSC

The originating exchange or the destination exchange may release the call while a response is awaited from the process COLP_MAF039. The message is saved for processing after return from the procedure.

7.2.1.7 Procedure Activate_CF_Process

The processing in the branch beginning with the Int_Release_Call input will occur only if the MSC supports CAMEL.

7.2.1.8 Process MT_CF_MSC

Sheet 1: the procedure CAMEL_CF_MSC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 1, sheet 4: the procedure CAMEL_CF_Dialled_Services is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL phase 3 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 1, sheet 3, sheet 4: the procedure CAMEL_OCH_MSC1 is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL phase 2 or later, processing continues from the "Yes" exit of the test "Result=Reconnect?".

Sheet 1: the procedure MOBILE_NUMBER_PORTABILITY_IN_OQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 3: the procedure CAMEL_OCH_MSC_DISC3 is specific to CAMEL phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 3: the procedure CAMEL_OCH_MSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 6: the procedure CAMEL_MT_CF_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2: the procedures CAMEL_Start_TNRy and CAMEL_Stop TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 2: the procedure CAMEL_CF_MSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "Pass" exit of the test "Result?".

Sheet 2: the procedure UUS_MSC_Clear_UUS is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 2: the procedure CAMEL_CF_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specifed in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 3: the procedure CAMEL_Stop_TNRy is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 4: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the GMSC supports CAMEL phase 2 or later. The procedure CAMEL_OCH_MSC2 is specified in 3GPP TS 23.078 [12].

Sheet 5: the procedure CAMEL_OCH_MSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 5: the procedure CAMEL_OCH_MSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "No" exit of the test "Result=Reconnect?" .

Sheet 5: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 5: after the process MT_CF_MSC has sent an IAM to the forwarded-to exchange, it acts as a relay for messages received from the parent process and the forwarded-to exchange. Any message other than Address Complete, Connect, Answer or Release causes no change of state in the process MT_GMSC.

Sheet 6: the process CAMEL_MT_CF_LEG2_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

7.2.1.9 Macro CUG_Support_Check_GMSC

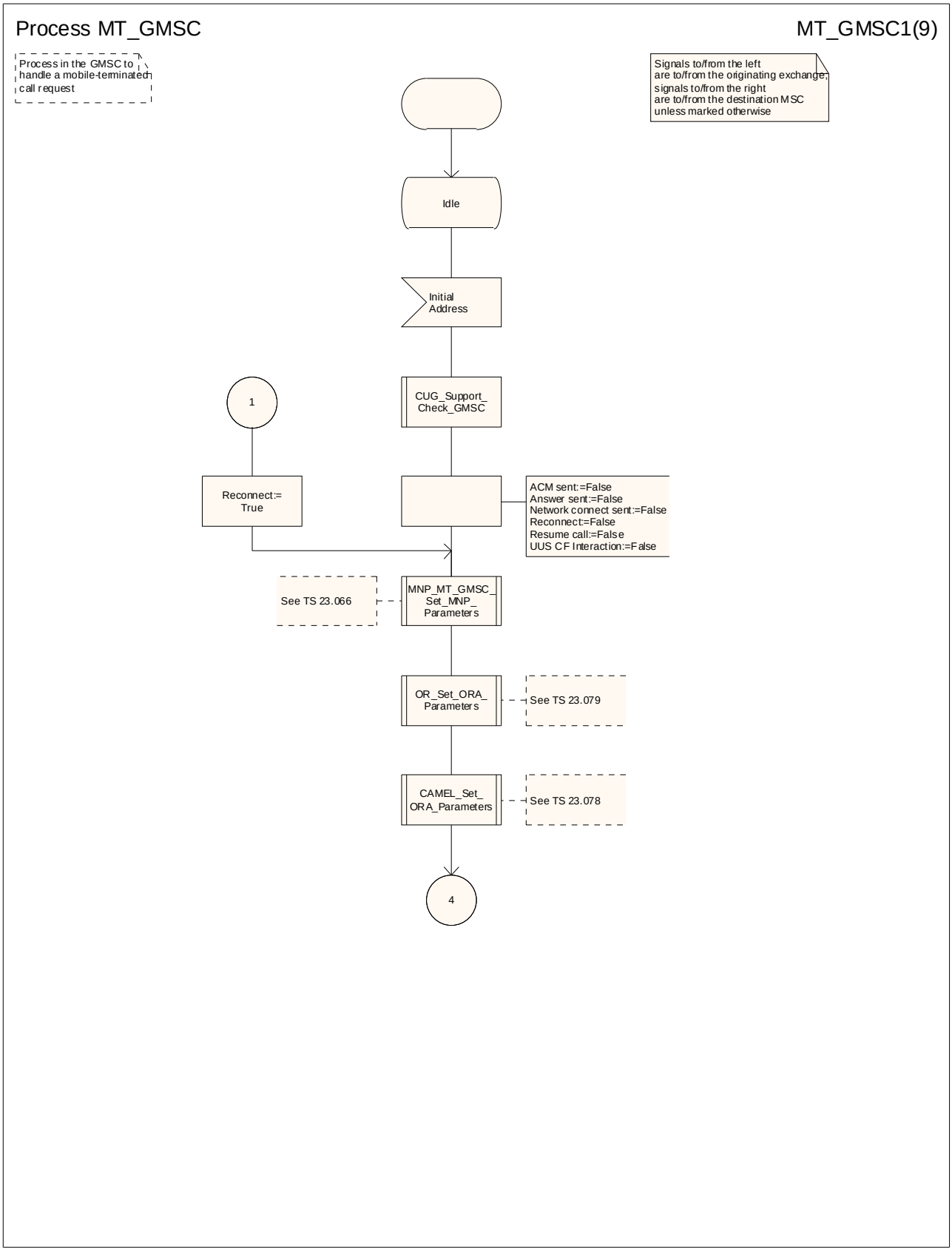


Figure 36a: Process MT_GMSC (sheet 1)

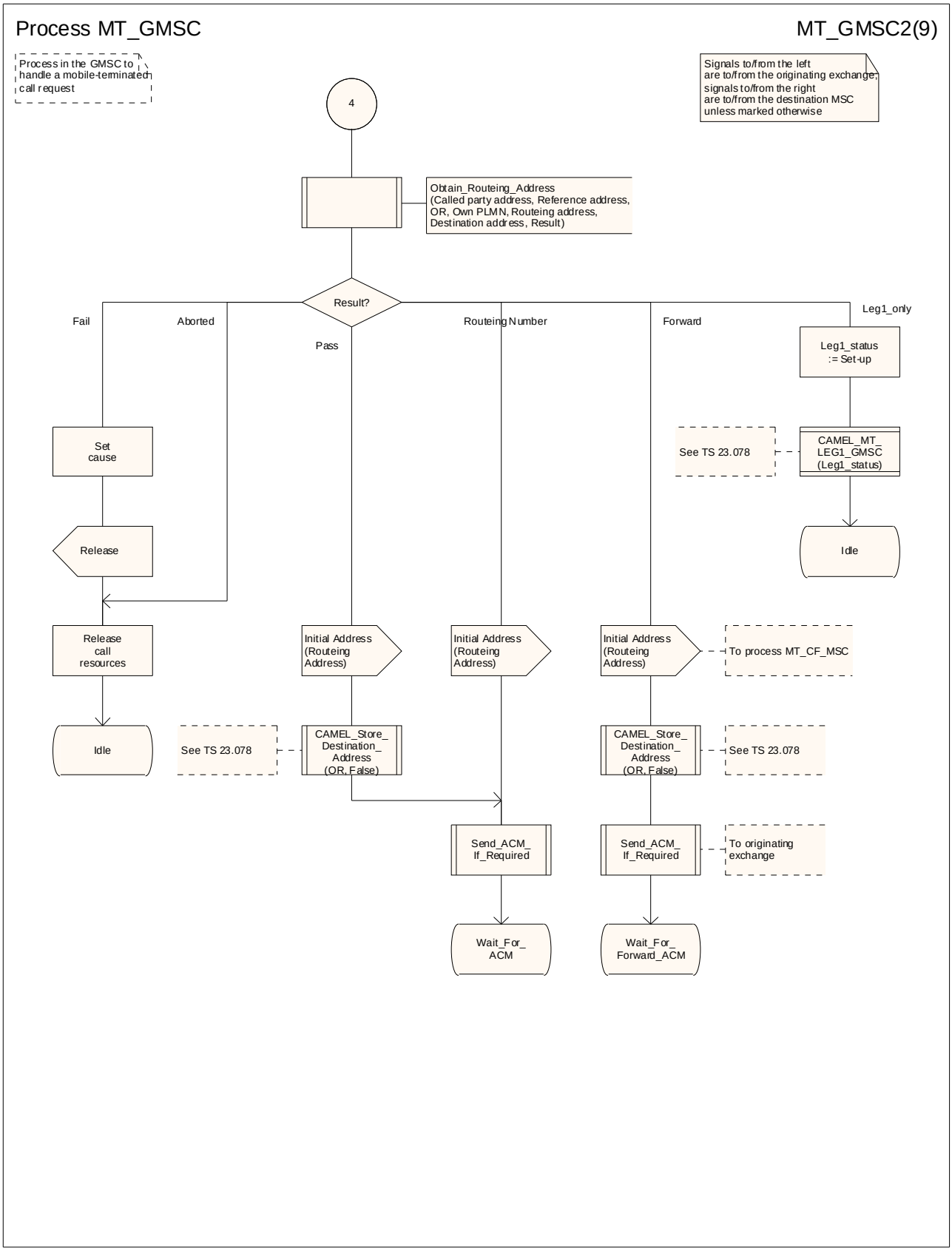


Figure 36b: Process MT_GMSC (sheet 2)

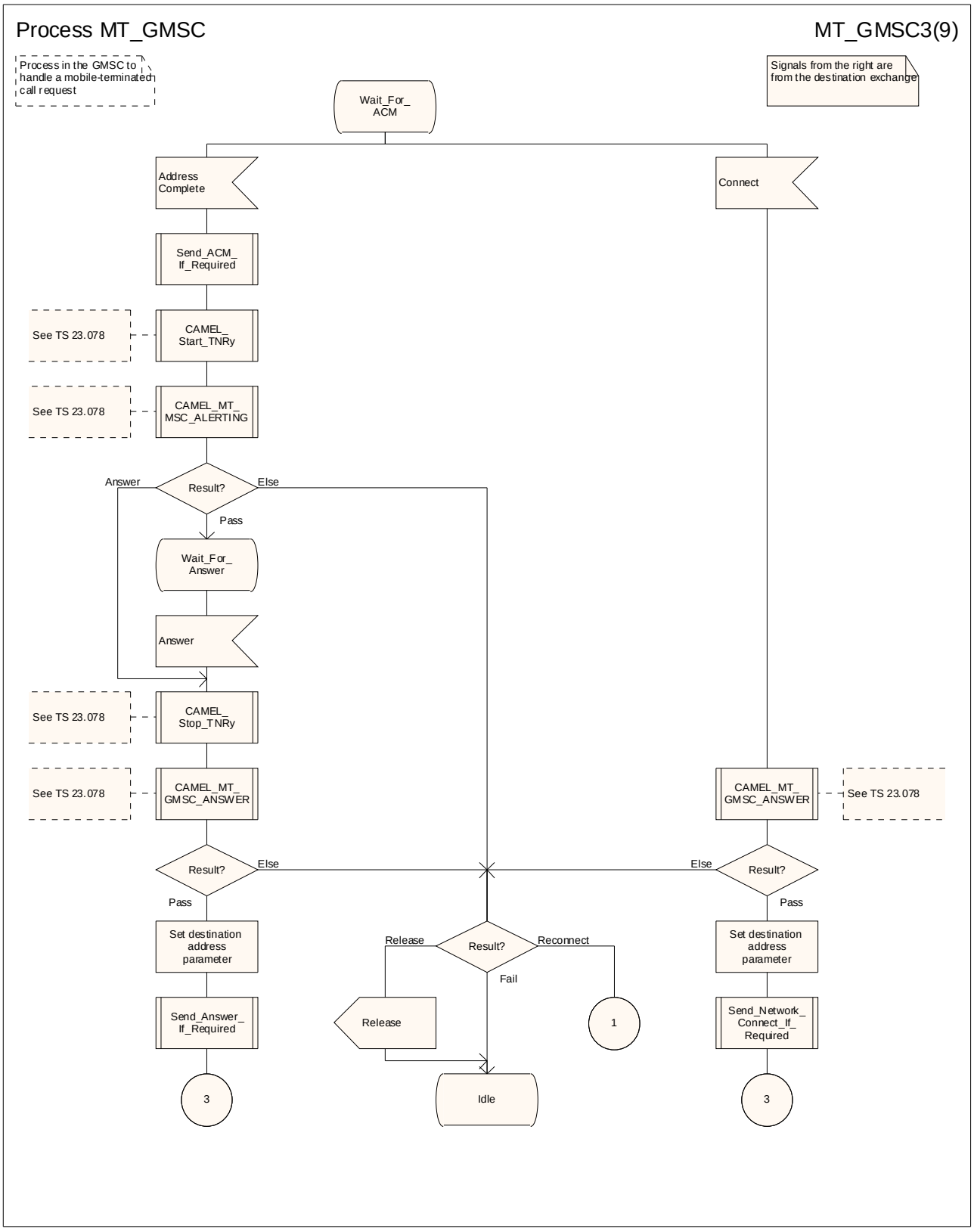


Figure 36c: Process MT_GMSC (sheet 3)

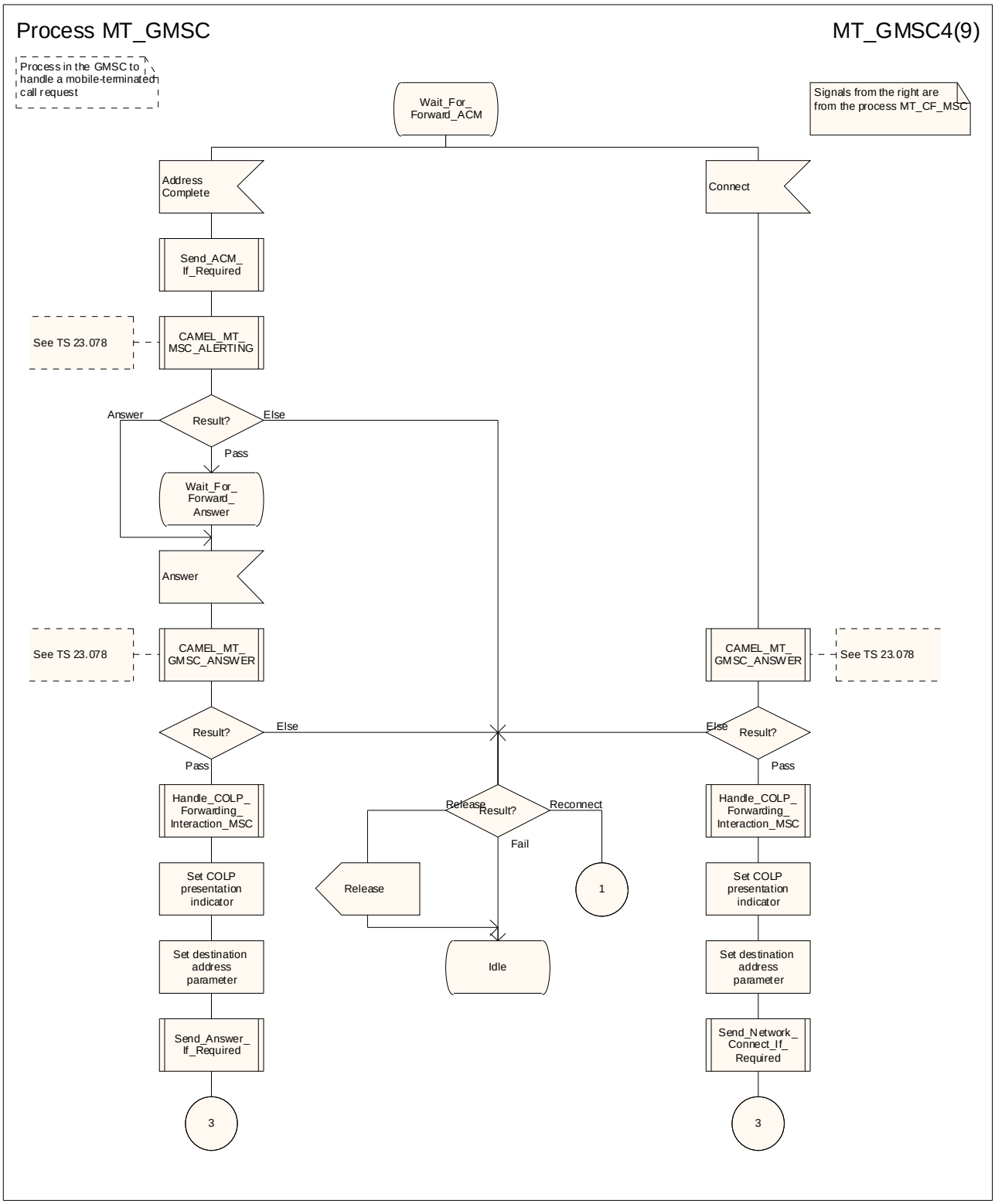


Figure 36d: Process MT_GMSC (sheet 4)

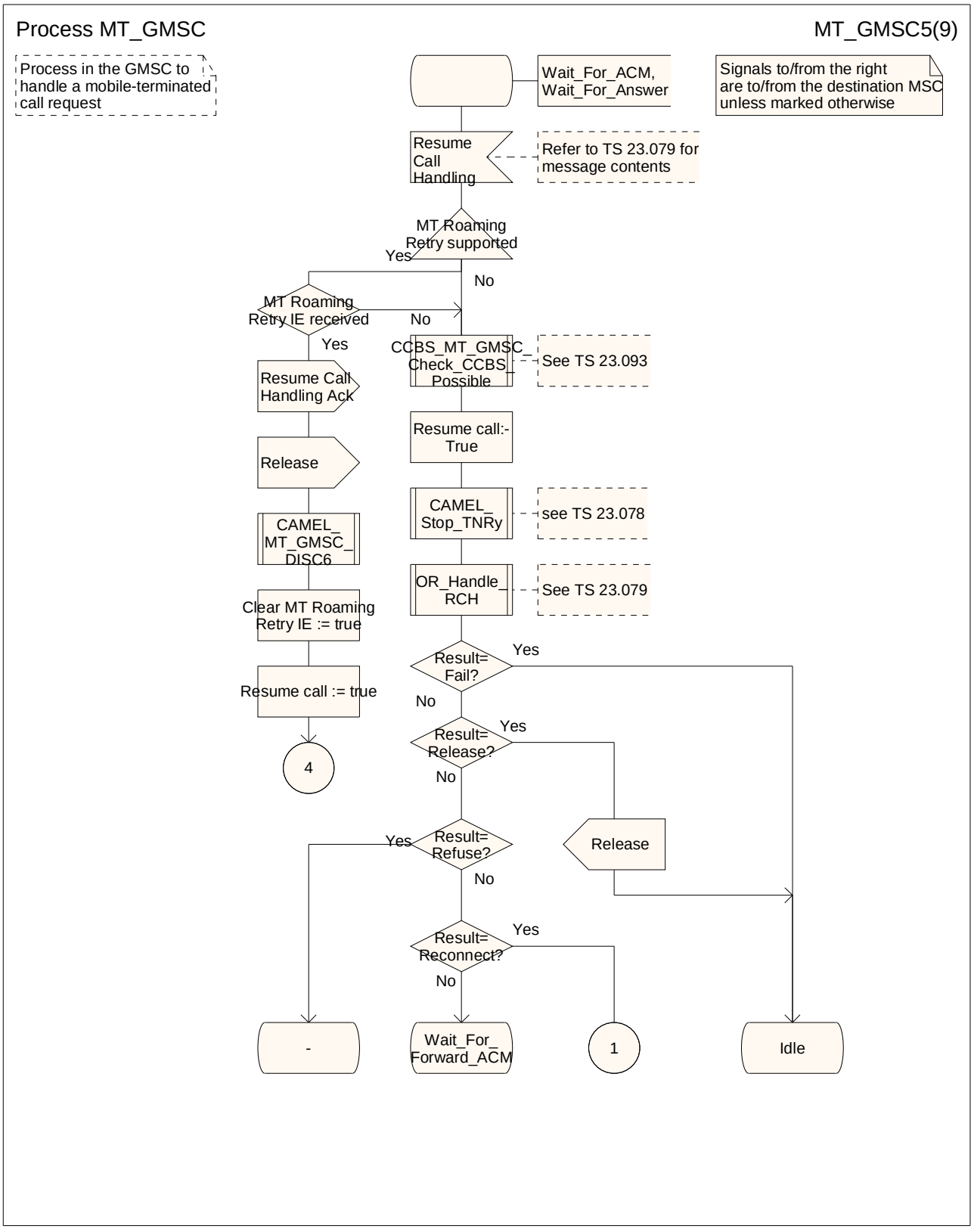


Figure 36e: Process MT_GMSC (sheet 5)

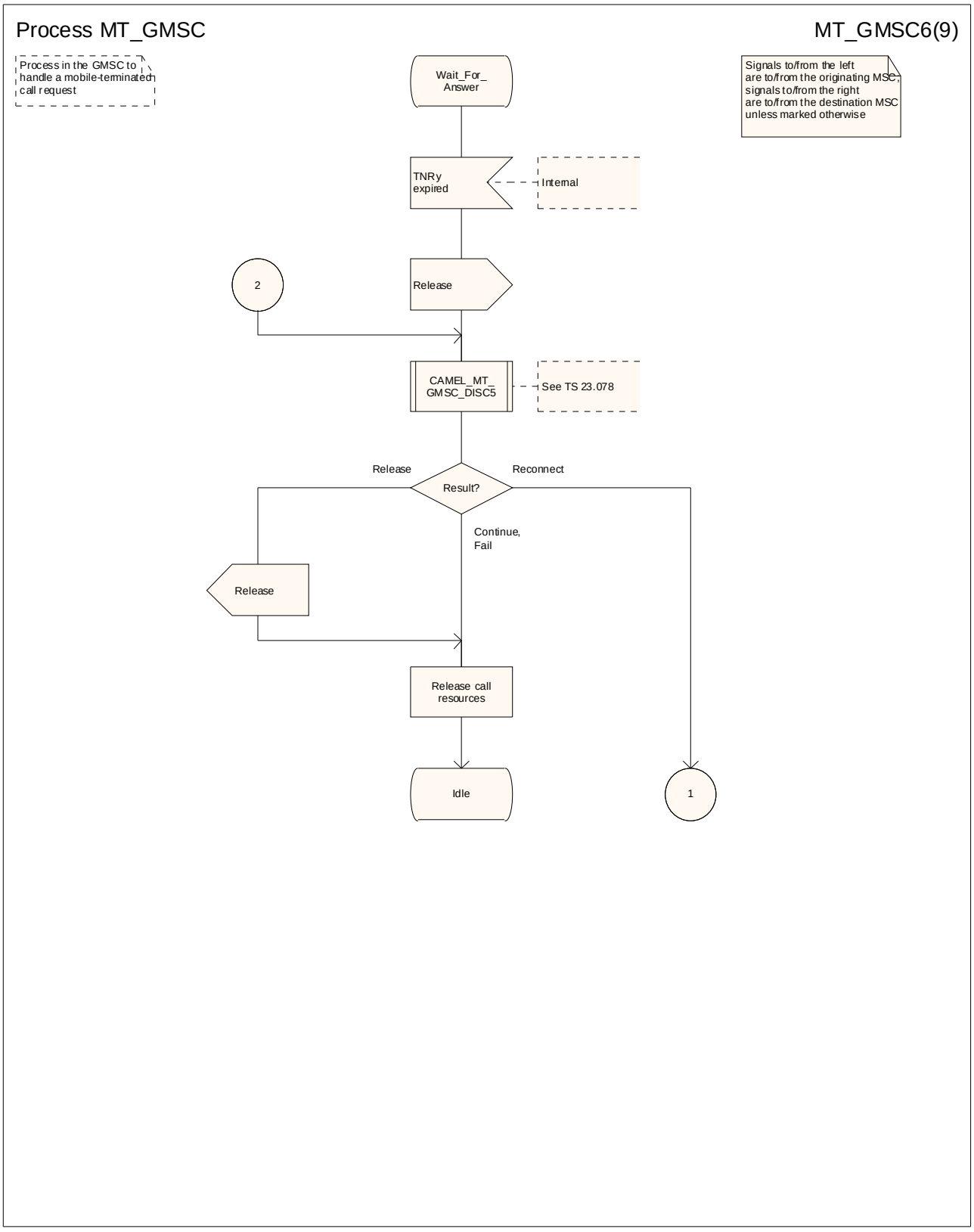


Figure 36f: Process MT_GMSC (sheet 6)

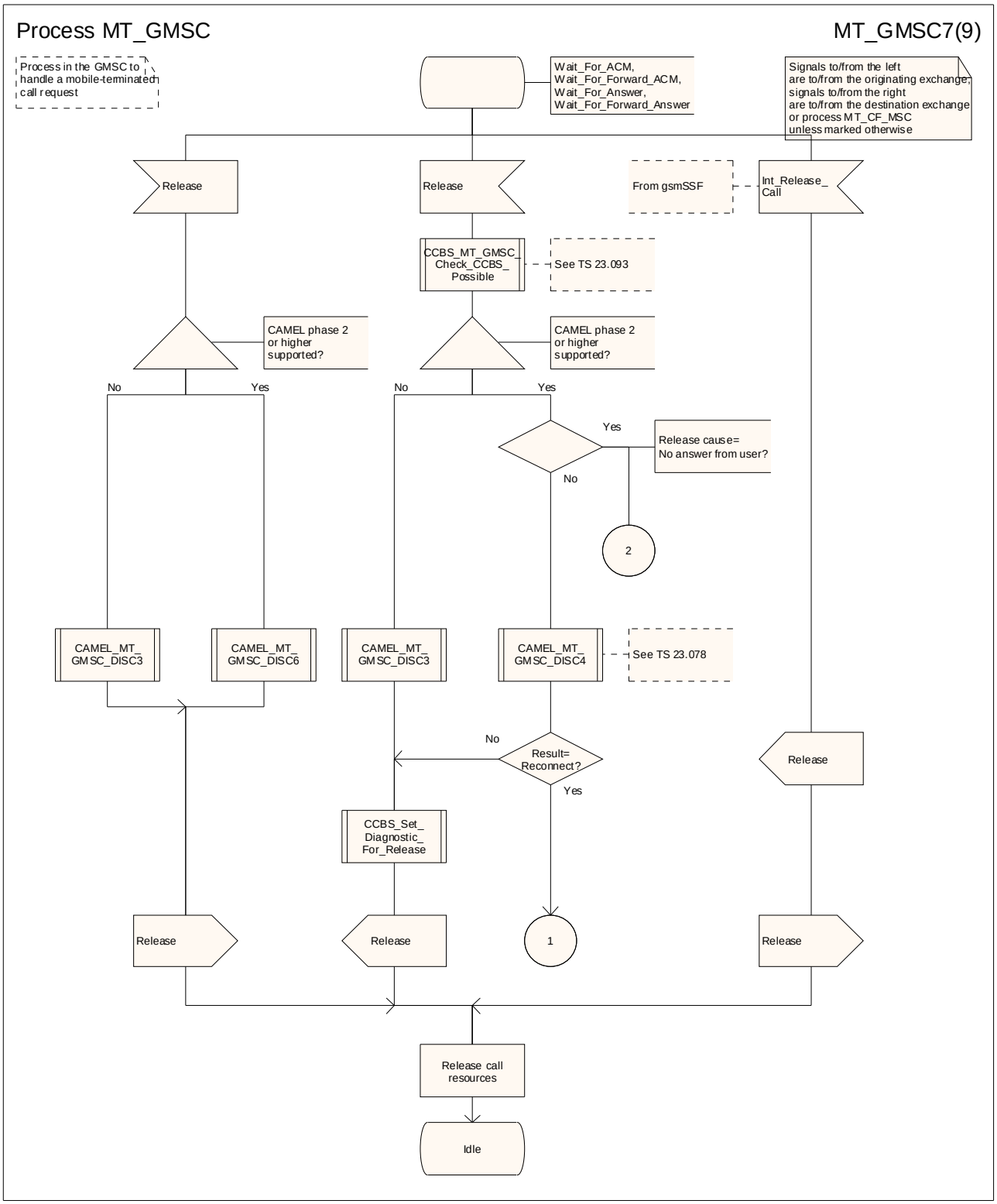


Figure 36g: Process MT_GMSC (sheet 7)

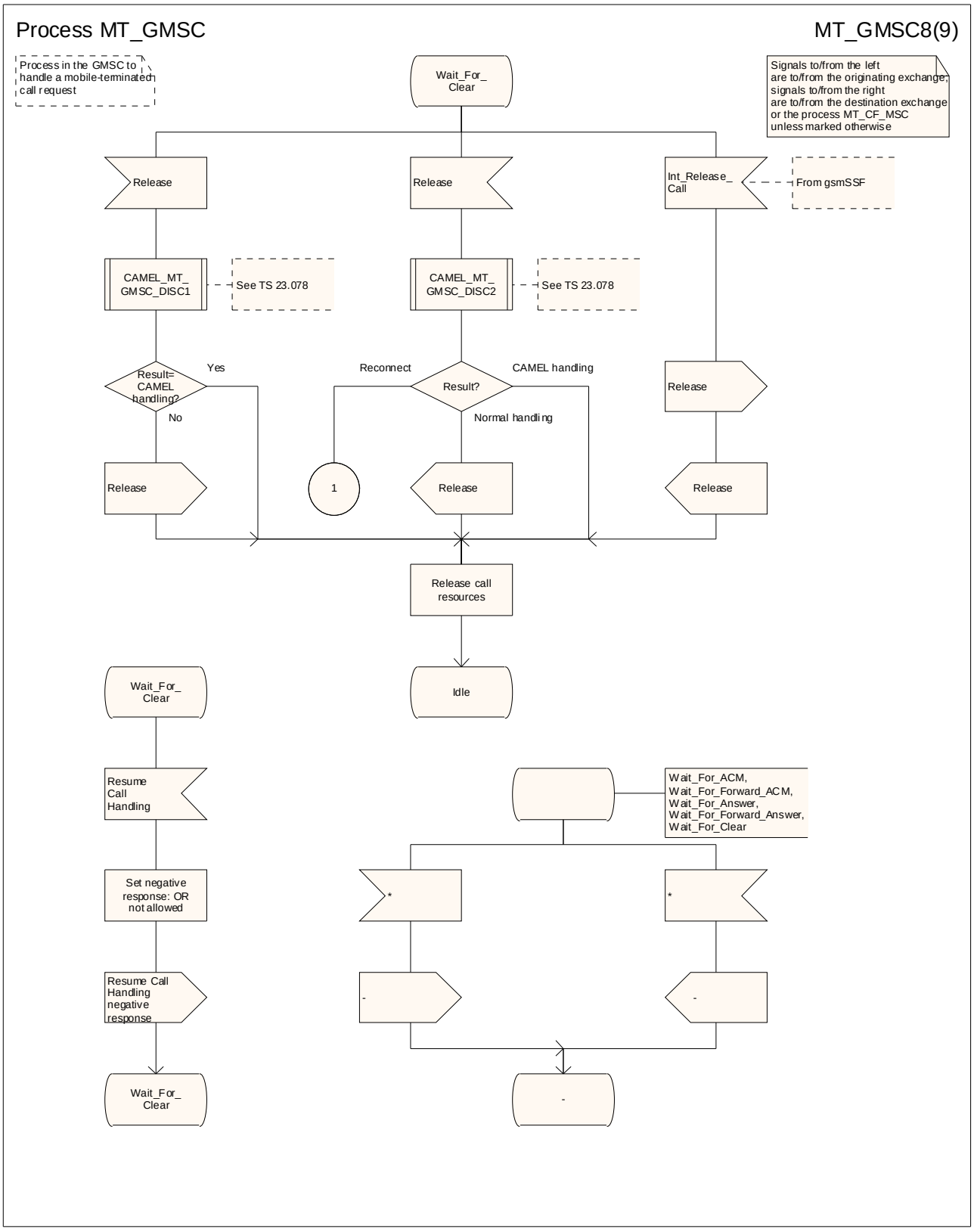


Figure 36h: Process MT_GMSC (sheet 8)

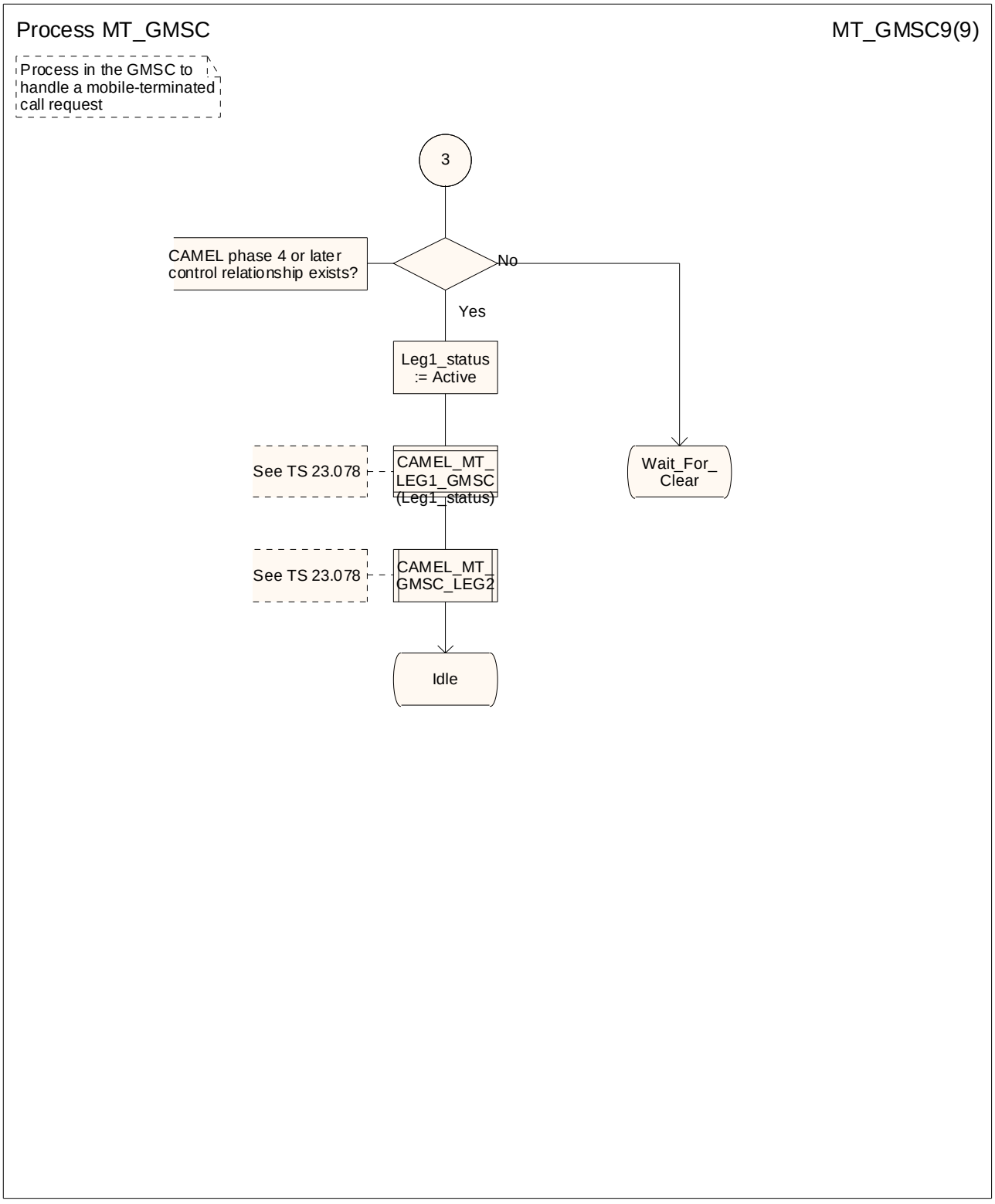


Figure 36i: Process MT_GMSC (sheet 9)

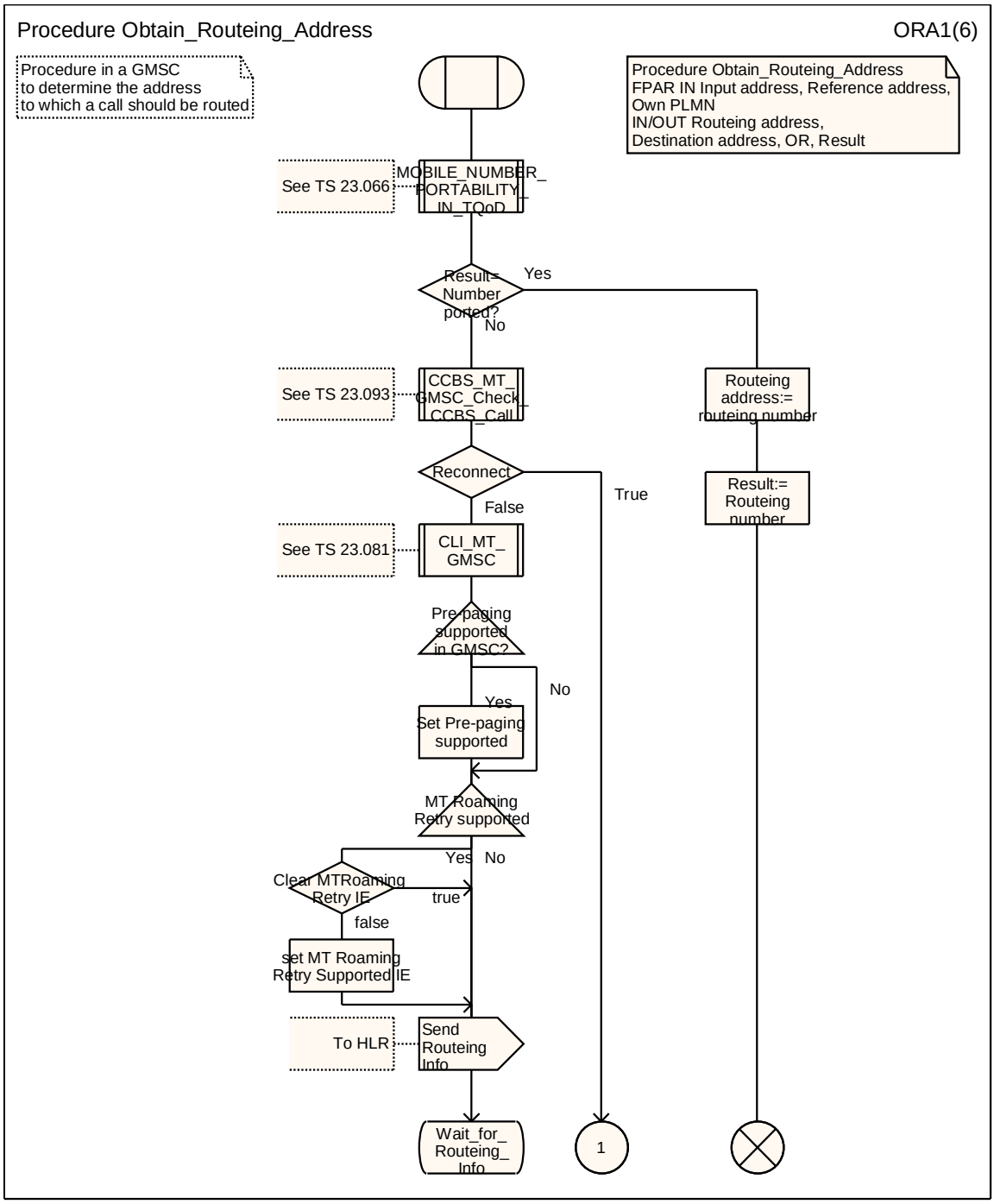


Figure 37a: Procedure Obtain_Routeing_Address (sheet 1)

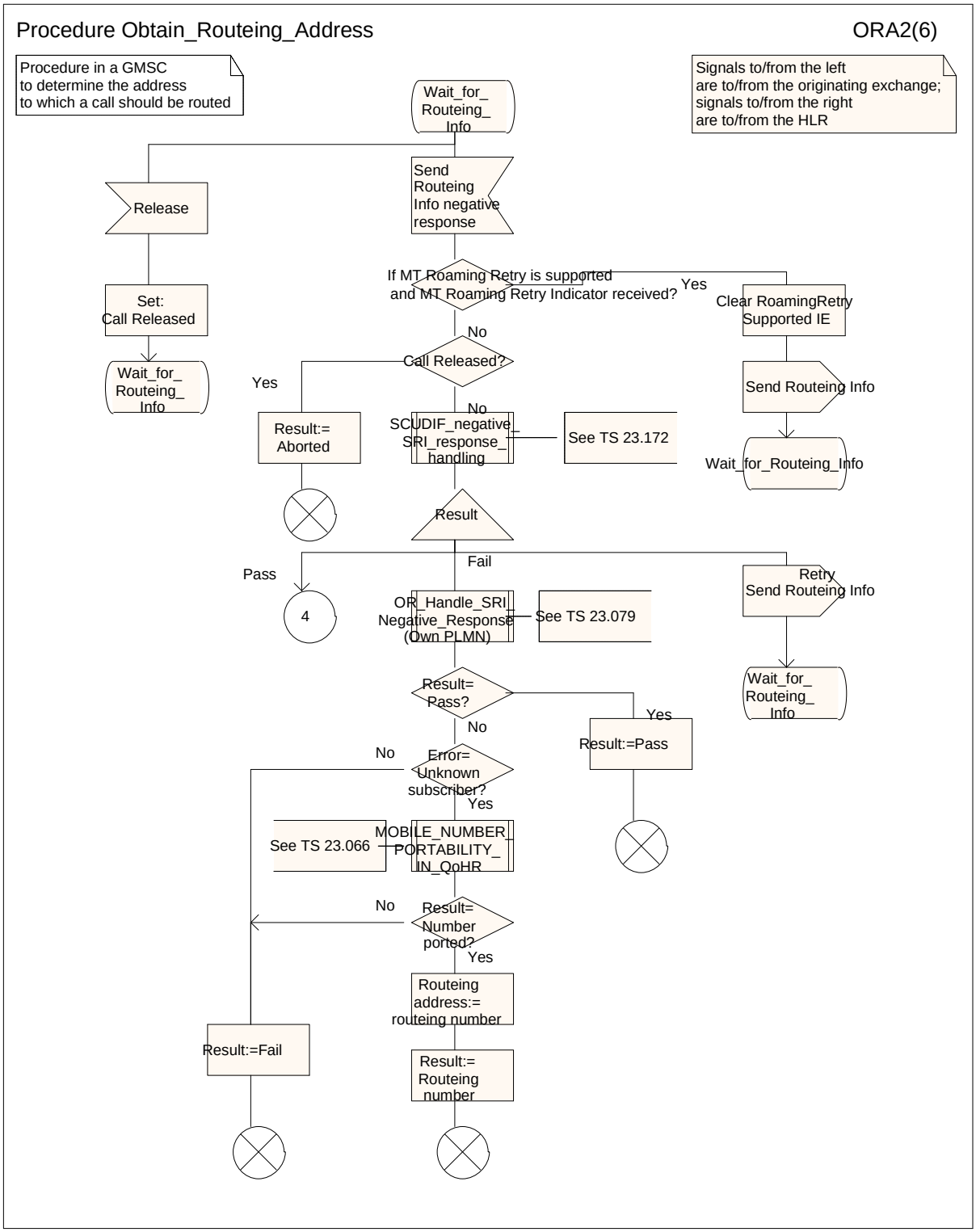


Figure 37b: Procedure Obtain_Routeing_Address (sheet 2)

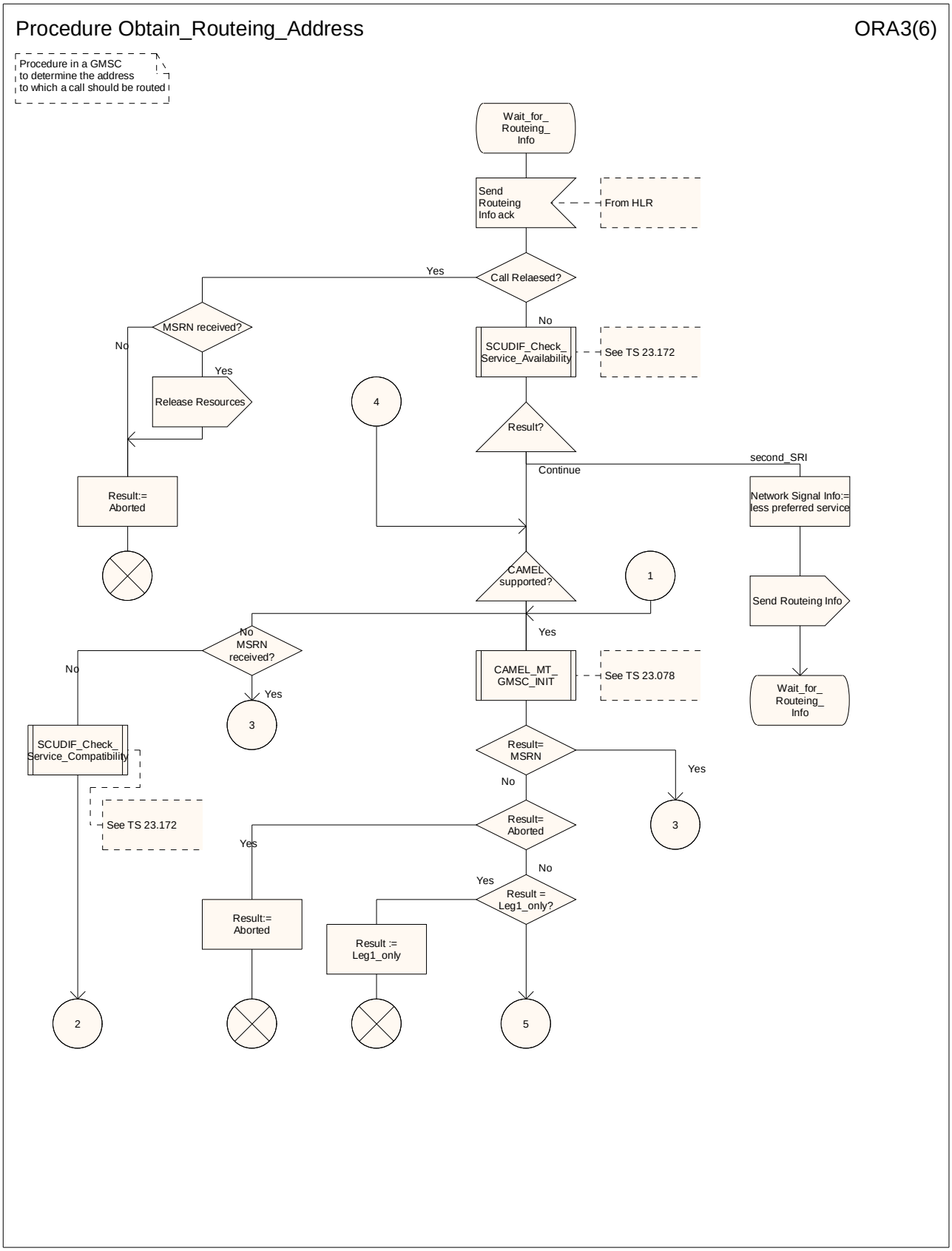


Figure 37c: Procedure Obtain_Routeing_Address (sheet 3)

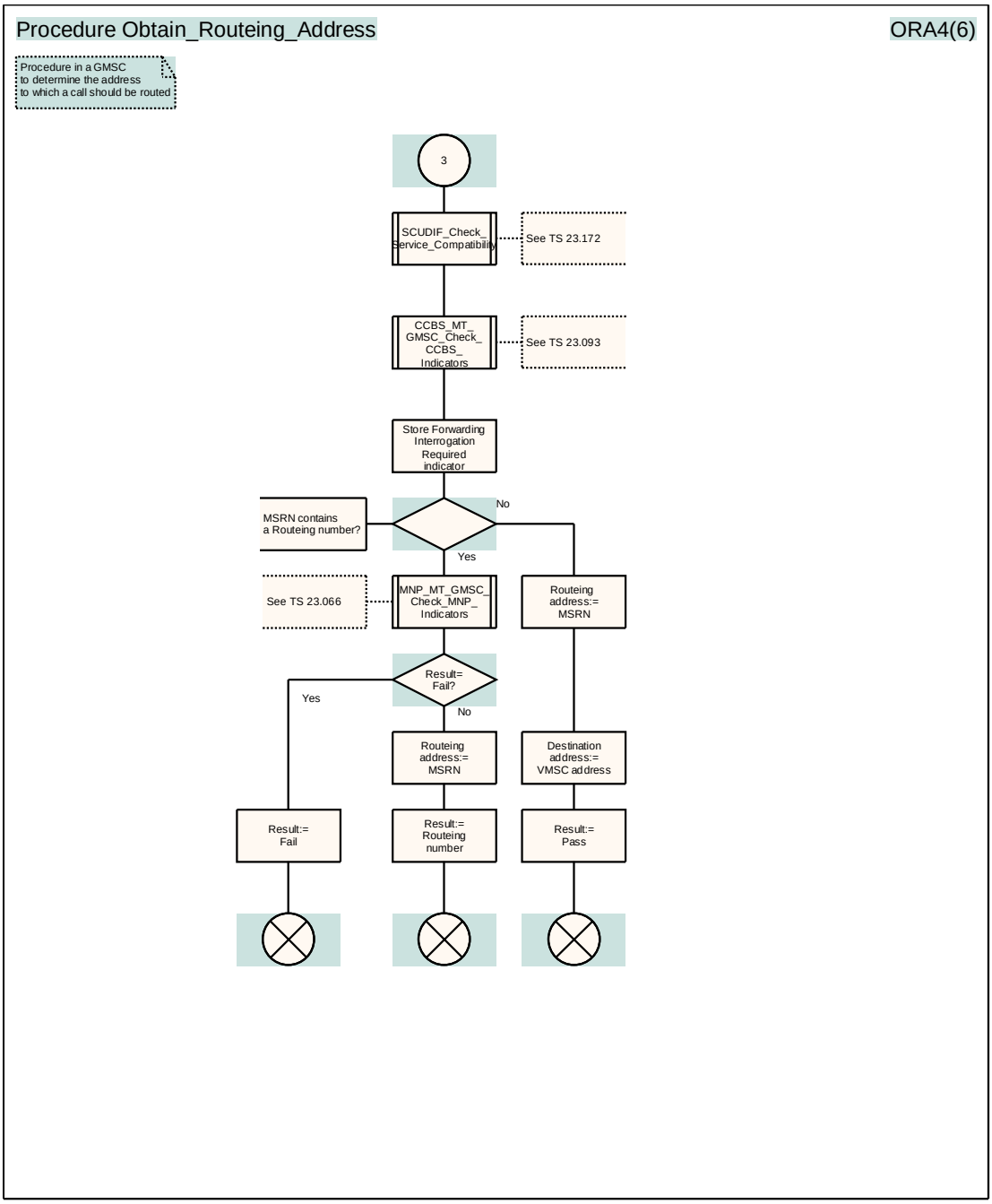


Figure 37d: Procedure Obtain_Routeing_Address (sheet 4)

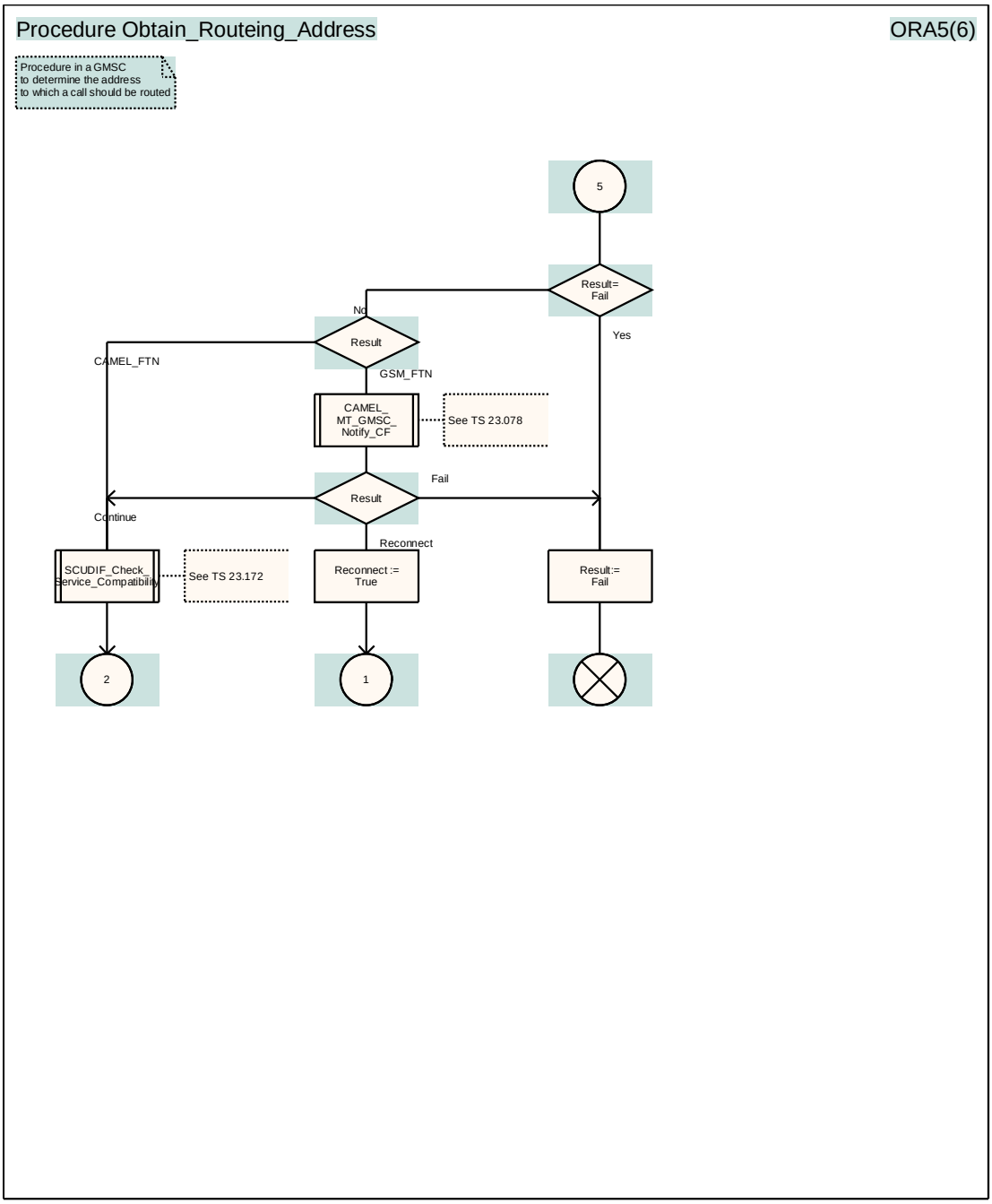


Figure 37e: Procedure Obtain_Routeing_Address (sheet 5)

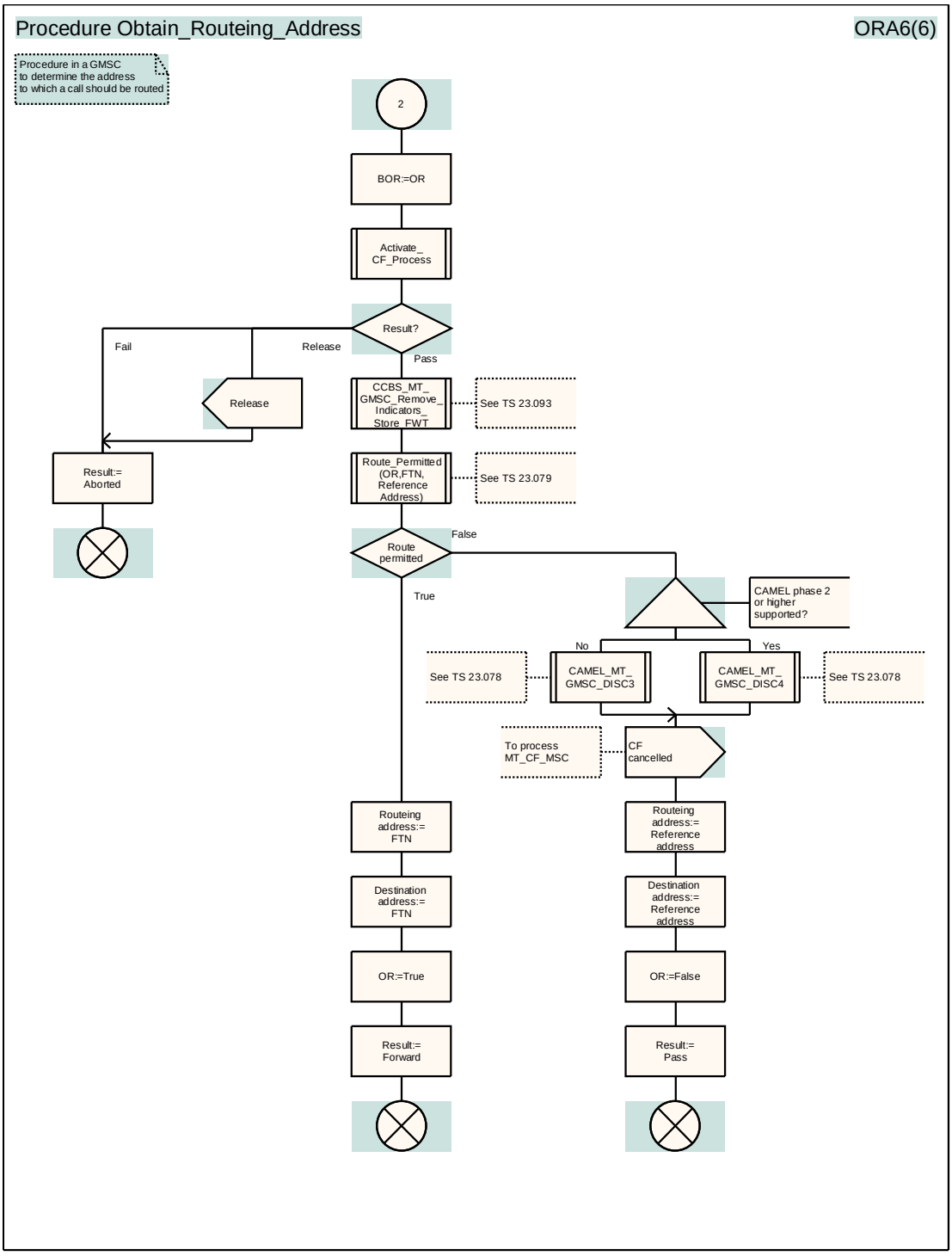


Figure 37f: Procedure Obtain_Routeing_Address (sheet 6)

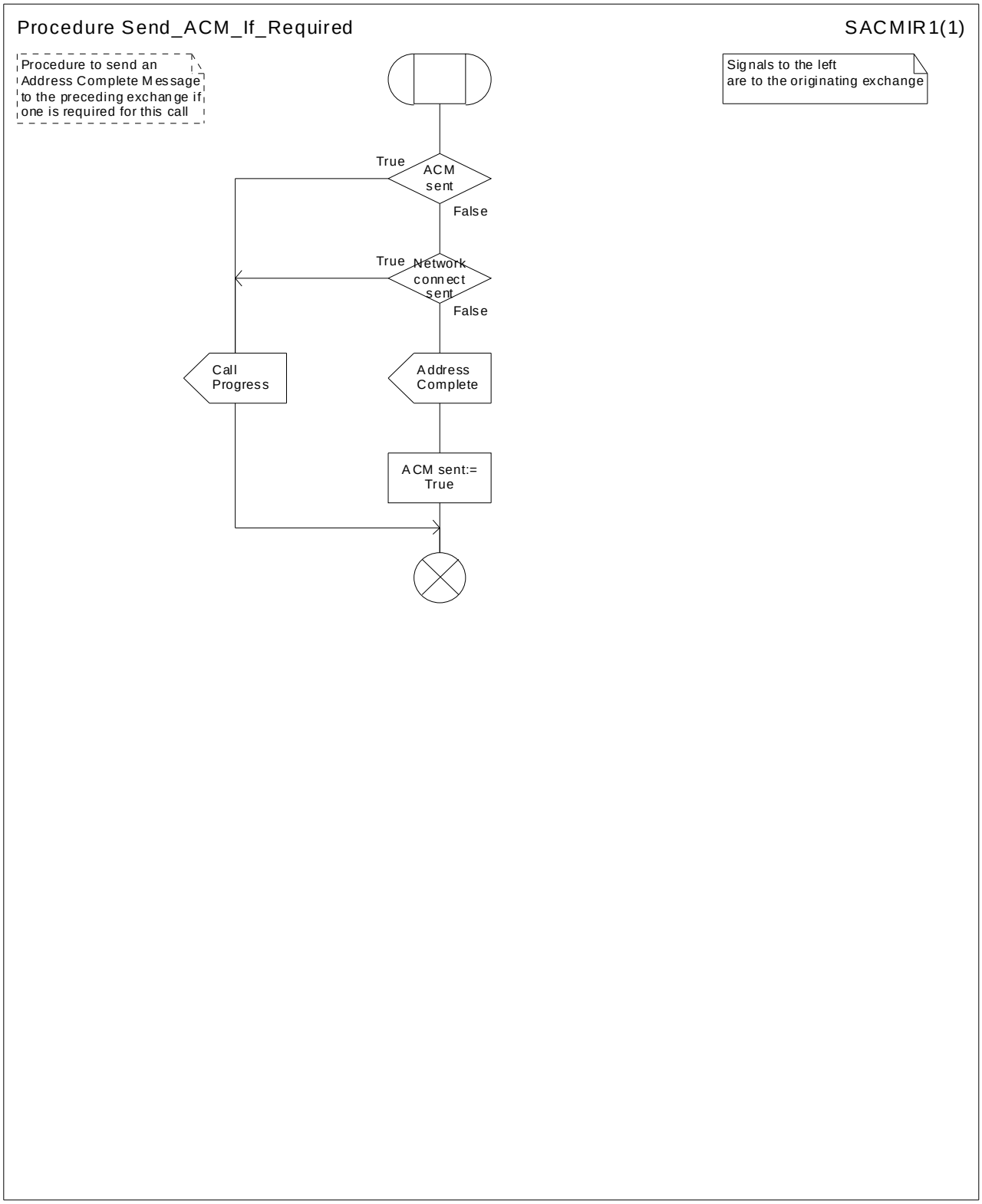


Figure 38: Procedure Send_ACM_If_Required

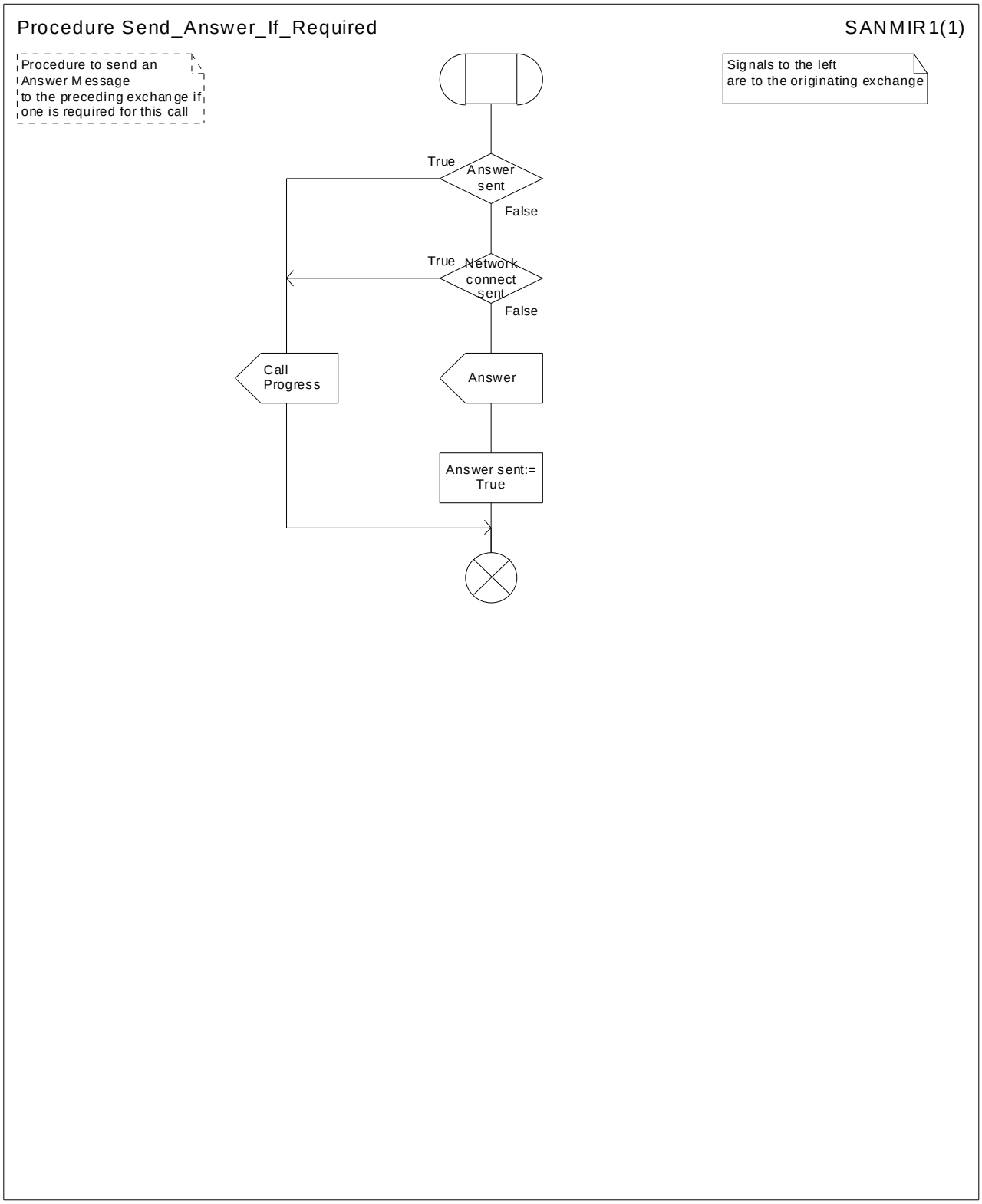


Figure 39: Procedure Send_Answer_If_Required

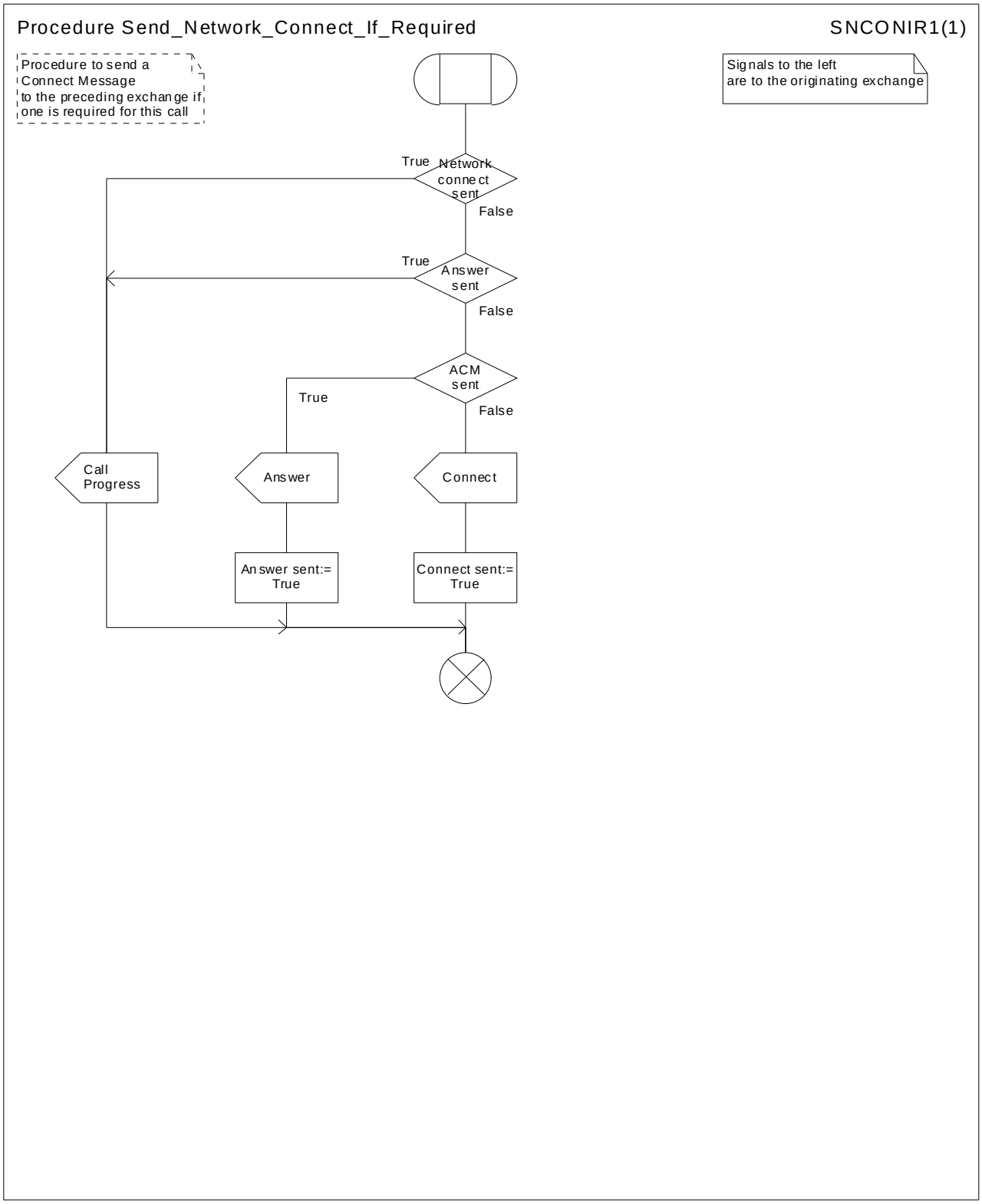


Figure 40: Procedure Send_Network_Connect_If_Required

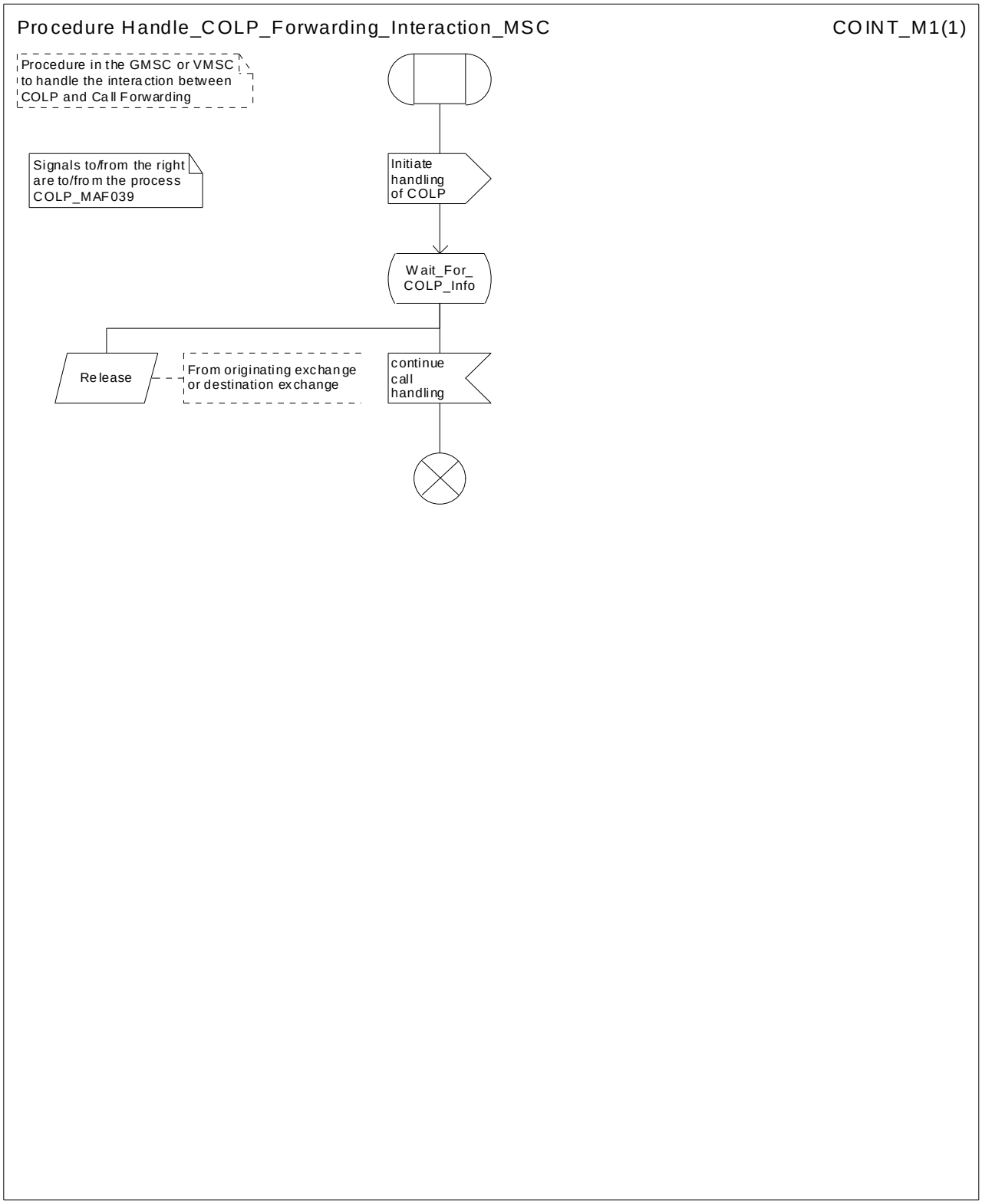


Figure 41: Procedure Handle_COLP_Forwarding_Interaction_MSC

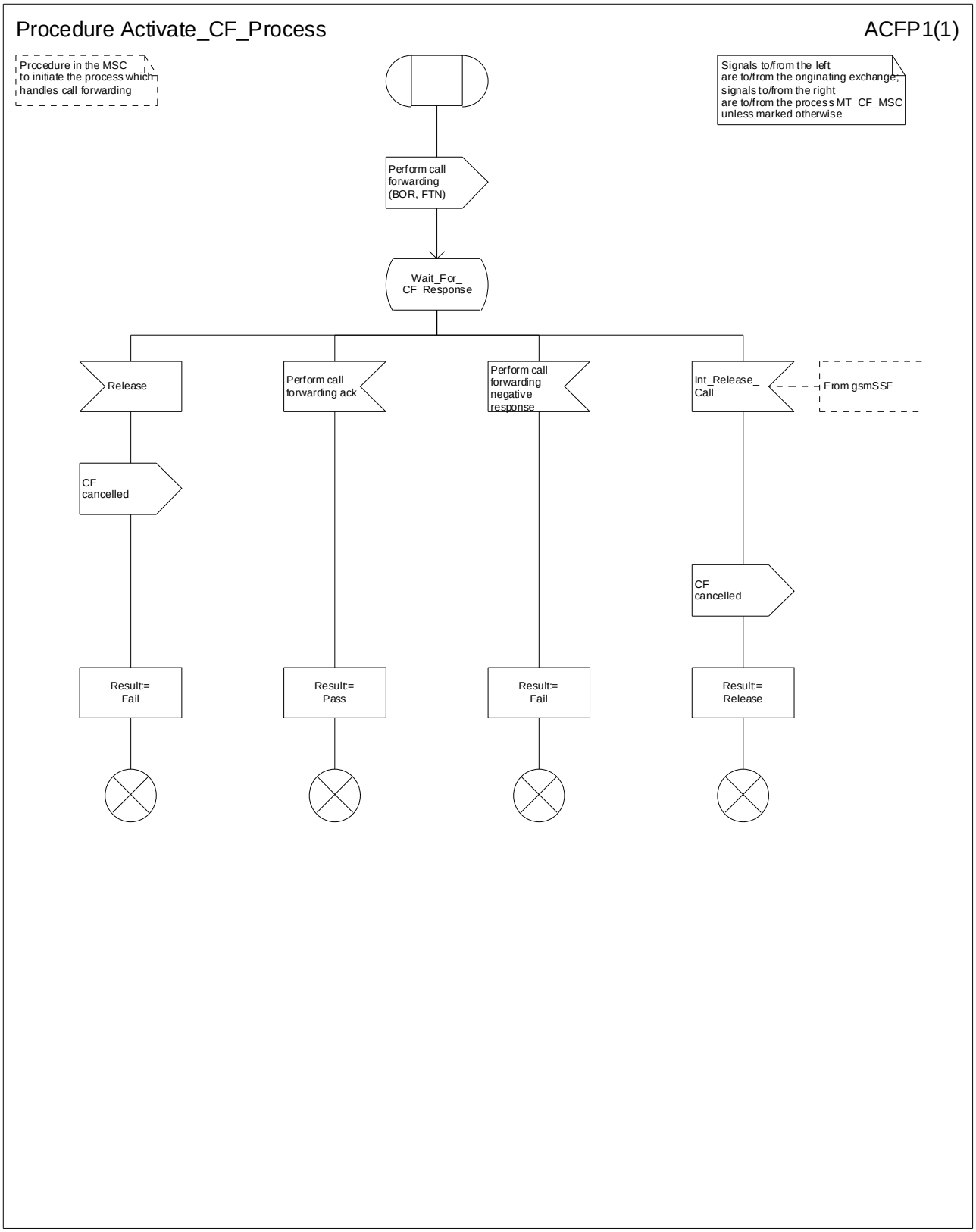


Figure 42: Procedure Activate_CF_Process

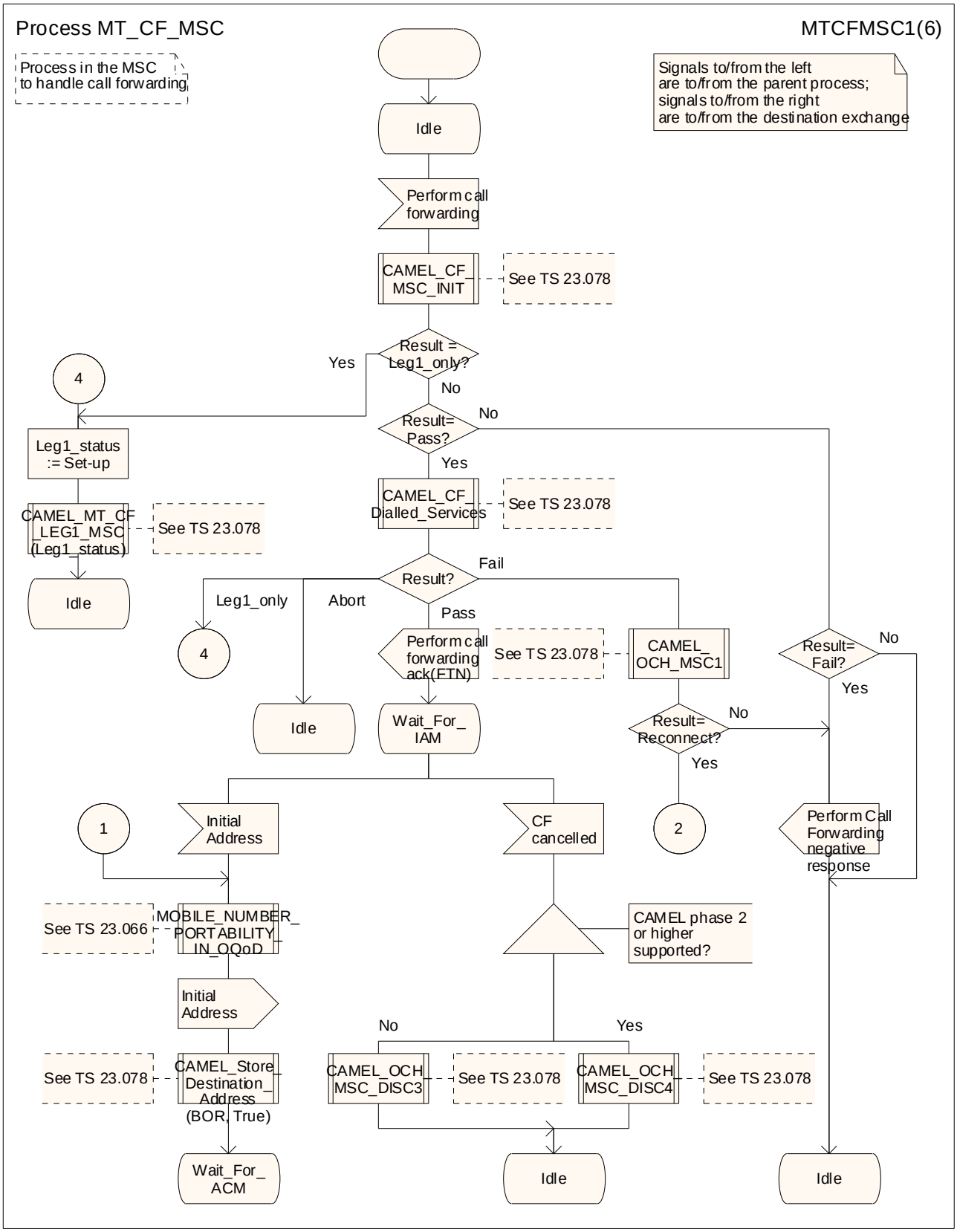


Figure 43a: Process MT_CF_MSC (sheet 1)

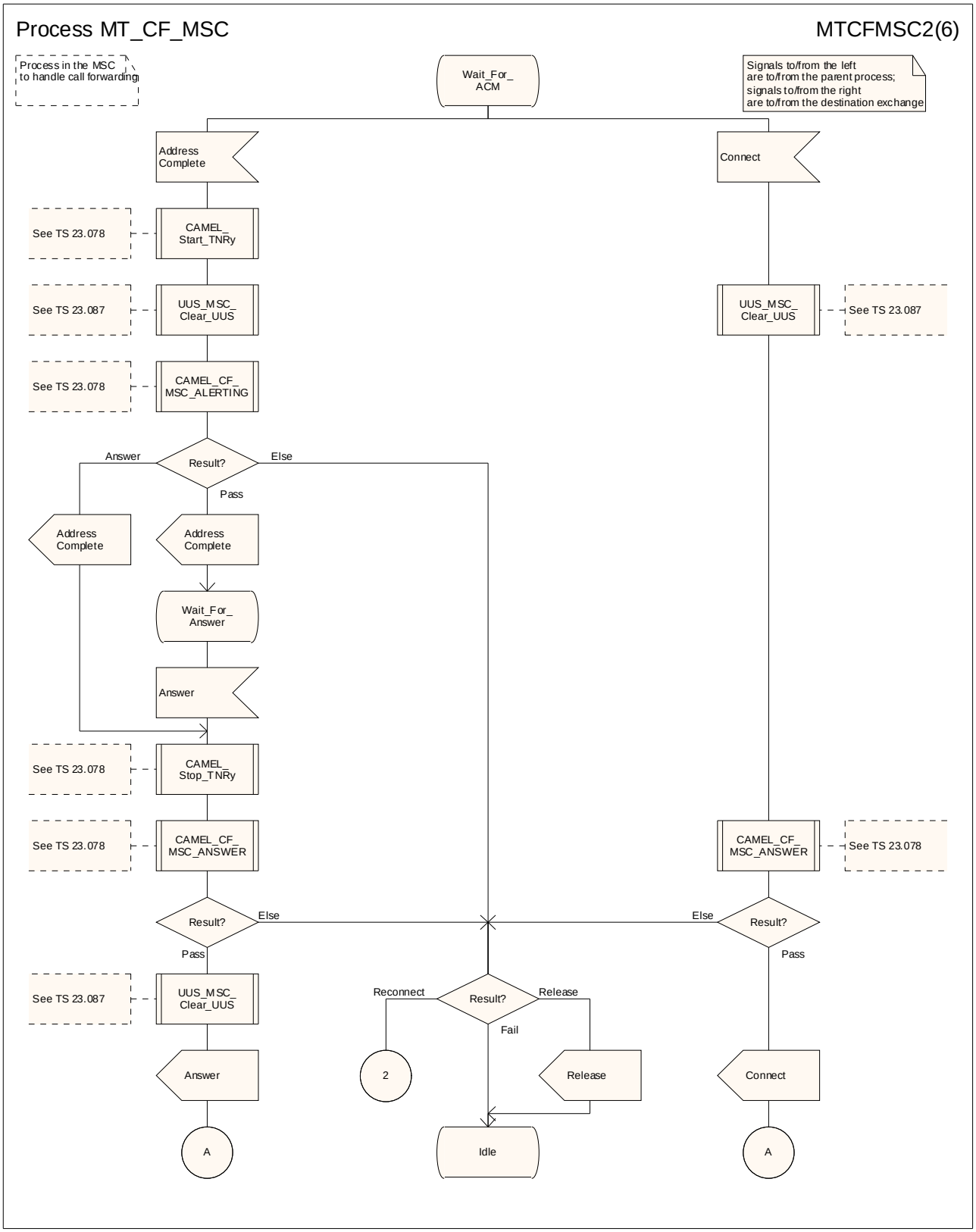


Figure 43b: Process MT_CF_MSC (sheet 2)

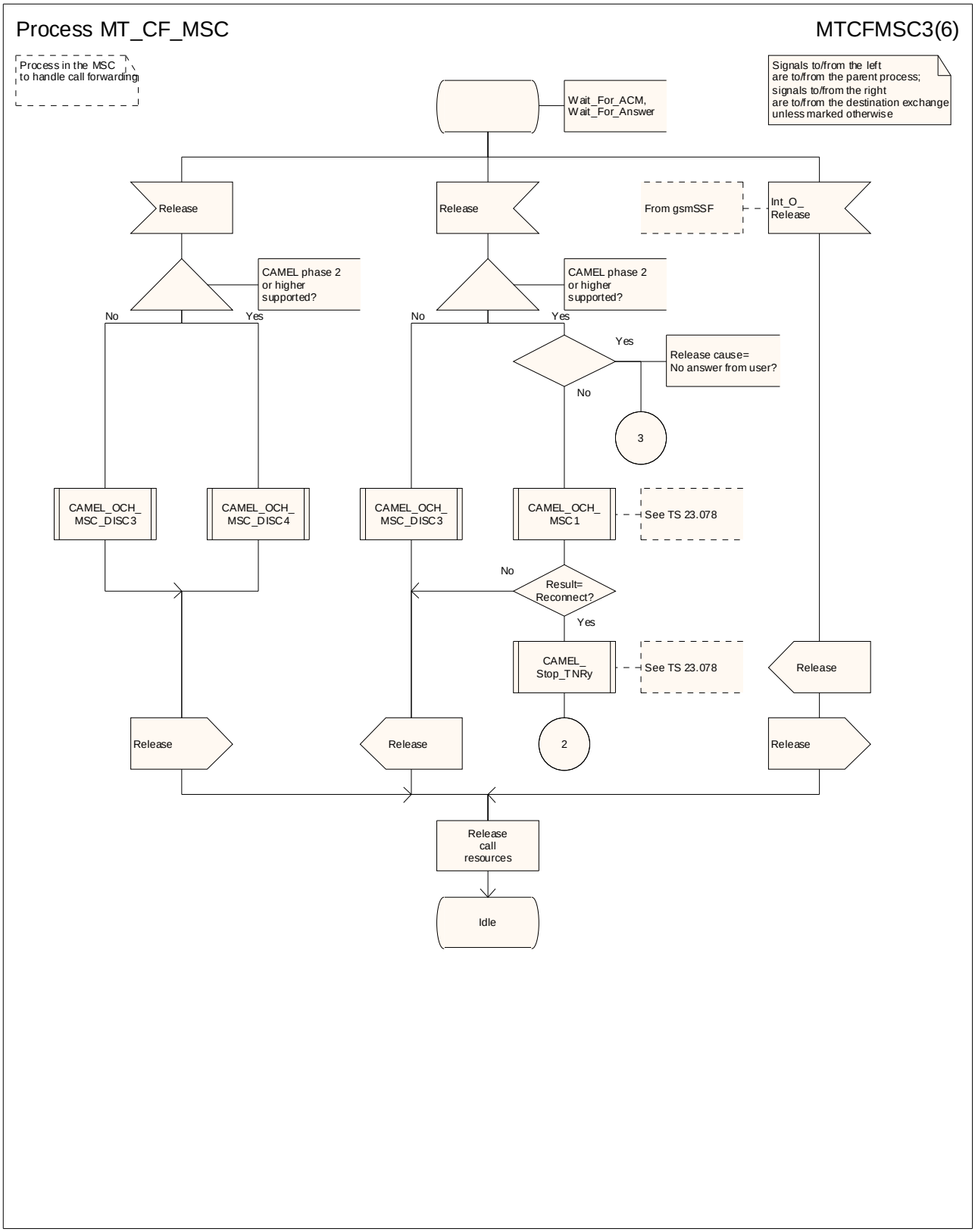


Figure 43c: Process MT_CF_MSC (sheet 3)

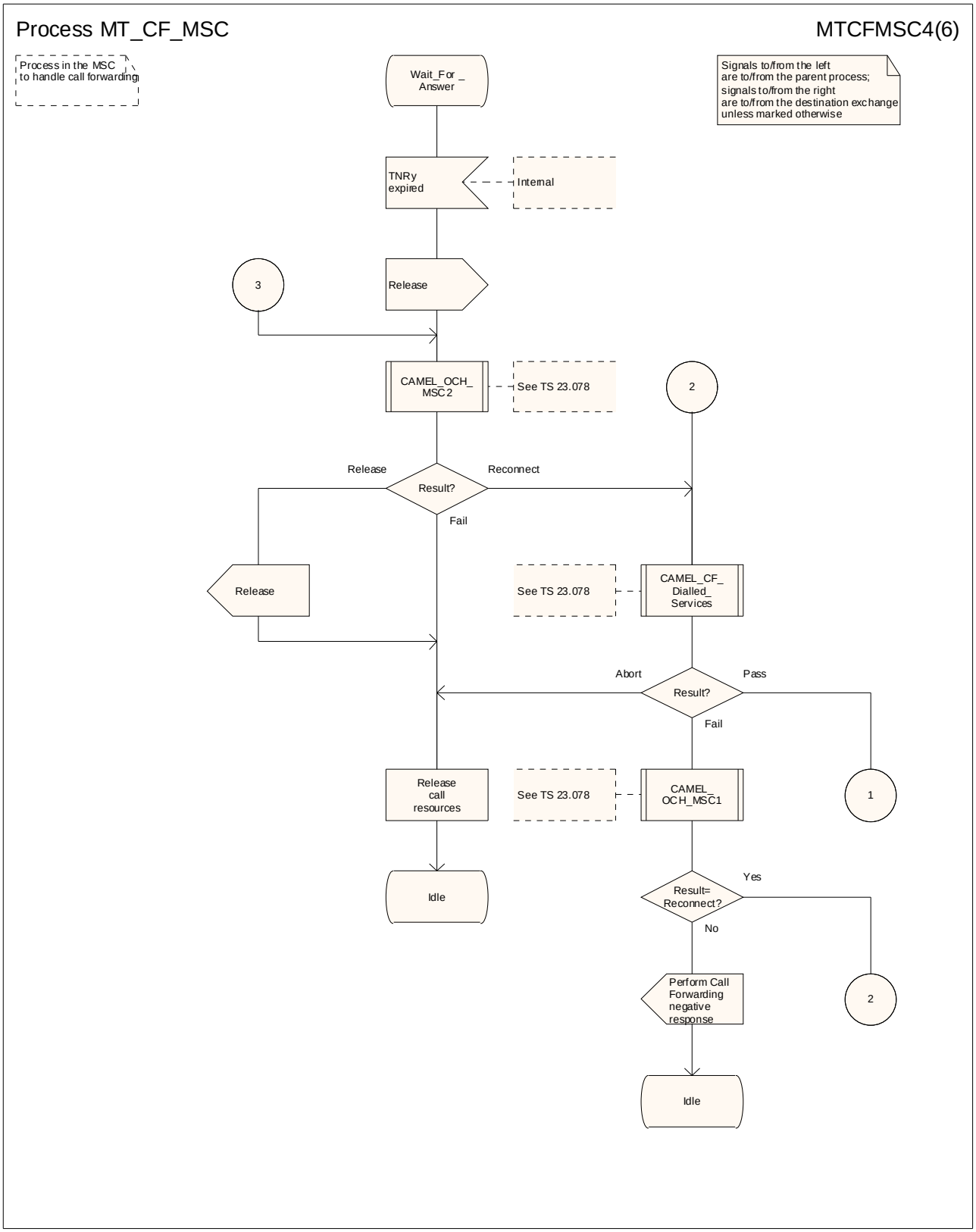


Figure 43d: Process MT_CF_MSC (sheet 4)

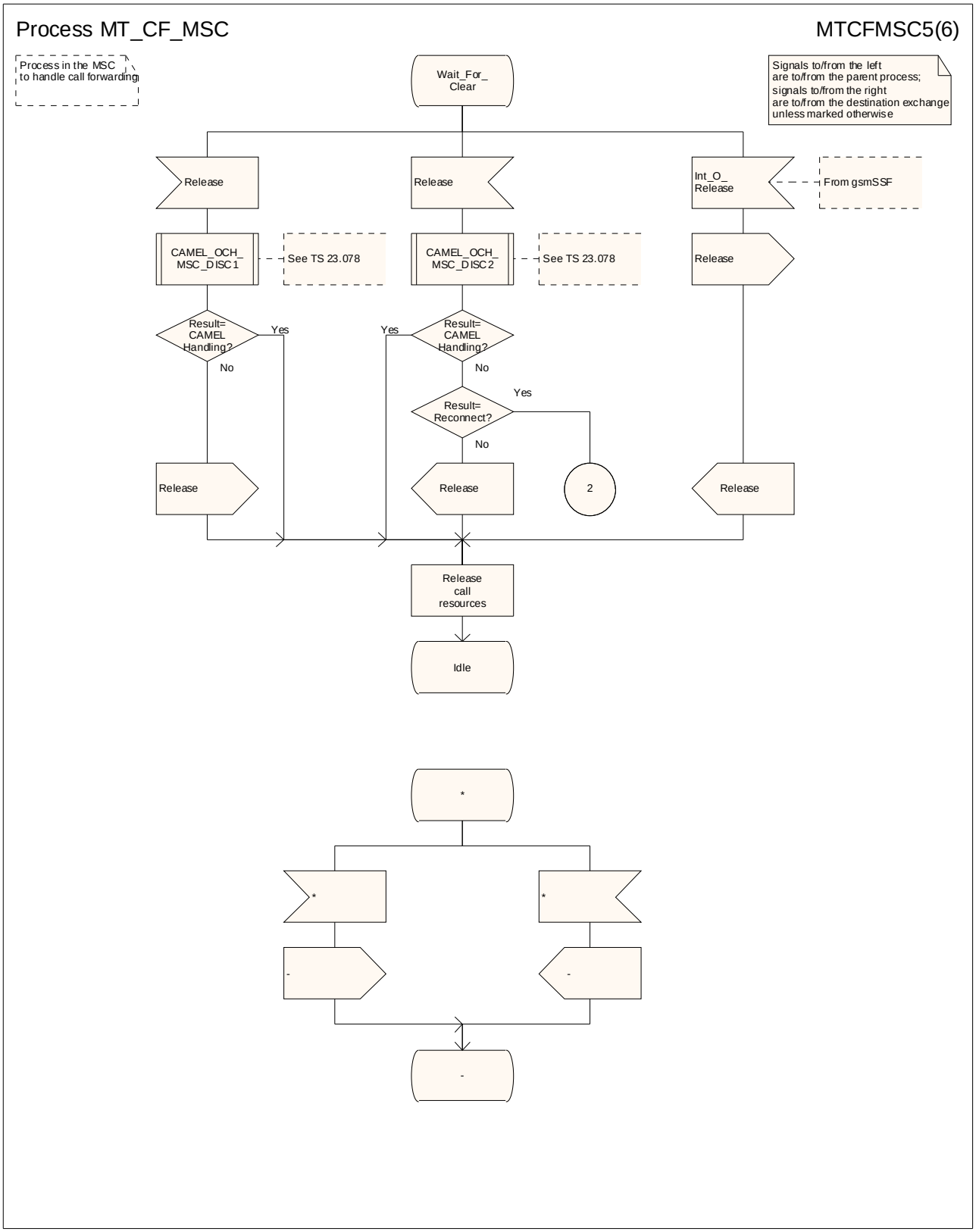


Figure 43e: Process MT_CF_MSC (sheet 5)

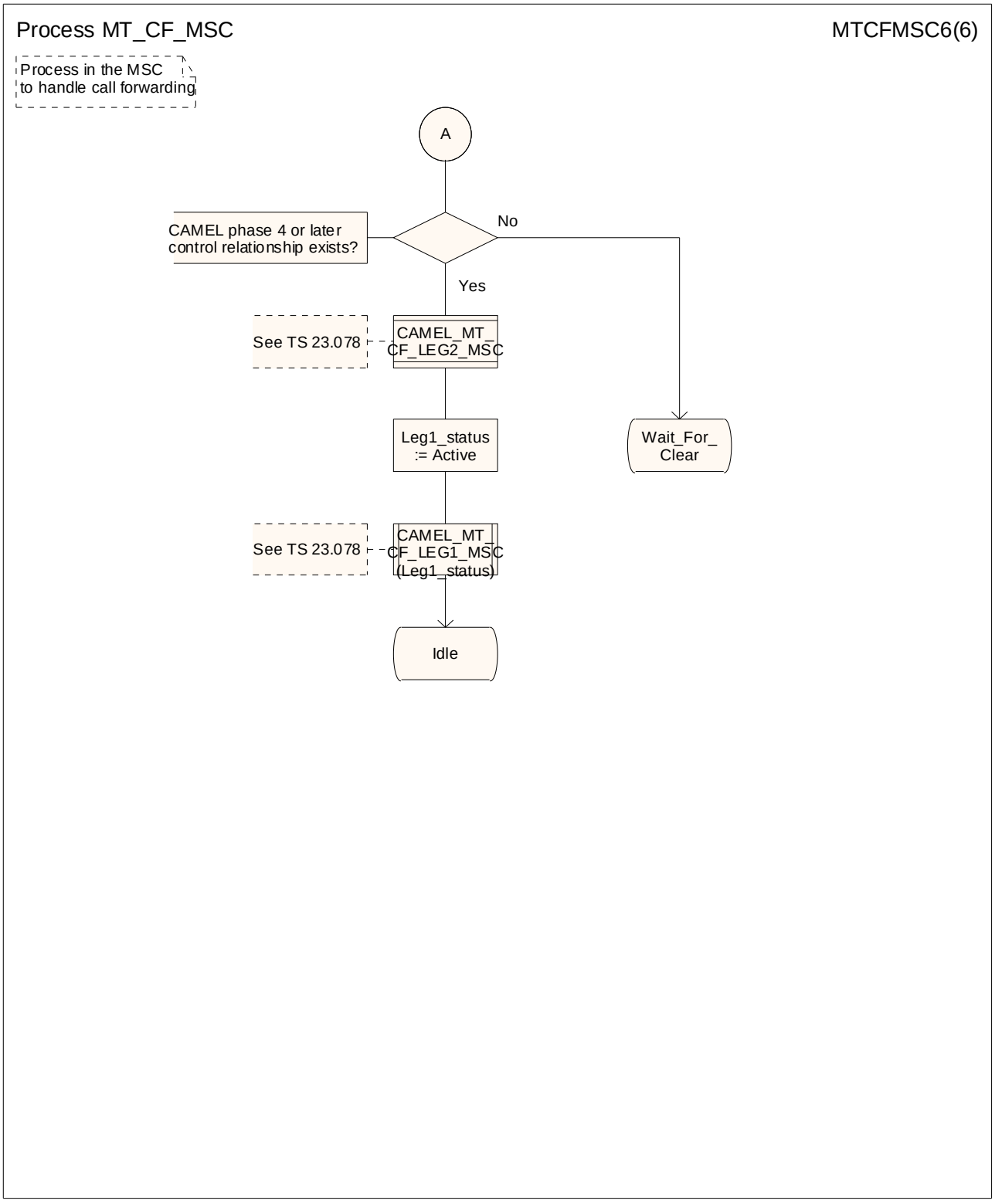


Figure 43f: Process MT_CF_MSC (sheet 6)

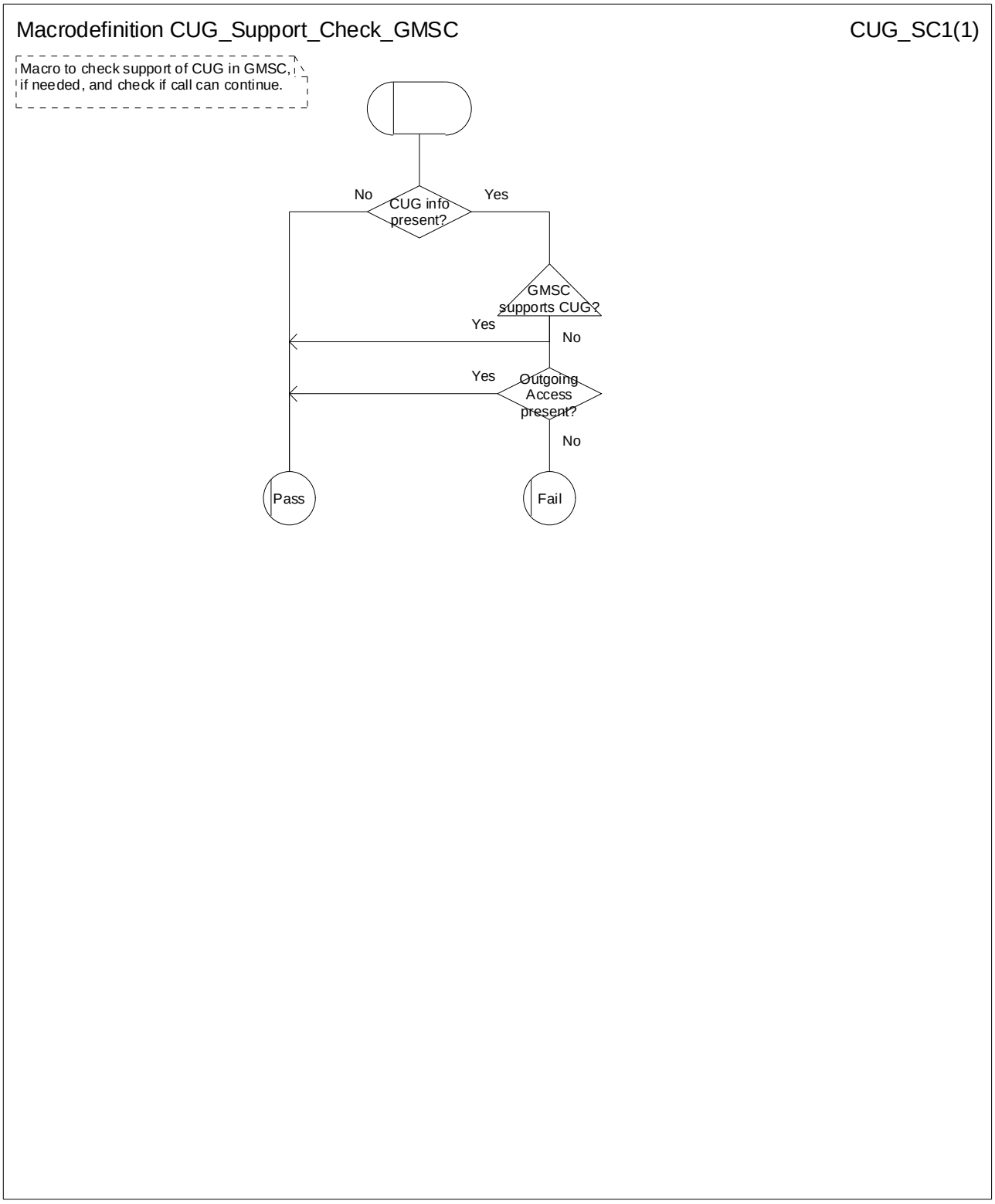


Figure 43bis: Macro CUG_Support_Check_GMSC

7.2.2 Functional requirements of HLR

7.2.2.1 Process SRI_HLR

Sheet 1: the procedures Check_Parameters, Subscription_Check_HLR, SCUDIF_Subscription_Check_HLR, Handle_OR_HLR_CF and CAMEL_HLR_INIT can set the negative response parameter which is used by the process

SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 1: the procedure Handle_OR_HLR_CF is specific to Support of Optimal Routeing; it is specified in 3GPP TS 23.079 [13]. If the HLR does not support Optimal Routeing, processing continues from the "No" exit of the test "Result=Forward?".

Sheet 1: the procedure SCUDIF_Subscription_Check_HLR is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. This procedure gets the result from the Subscription_Check_HLR procedure, and modifies it if needed. If the HLR does not support SCUDIF, the test "Result = Fail ?" applies to the result of the Subscription_Check_HLR procedure.

Sheet 1: the procedure CAMEL_HLR_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the HLR does not support CAMEL, processing continues from the "No" exit of the test"Result=Fail?".

Sheet 2: the procedure First_Forwarding_HLR can set the negative response parameter which is used by the process SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 2: the procedure Domain_Selection_HLR is specific to domain selection for a subscriber who has subscriptions in both the CS and the IMS domain.

NOTE: The domain selection function mentioned in this procedure is service domain selection specified in 3GPP TS 23.221 [40].

Sheet 2: the procedure CAMEL_CSI_Check_HLR is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the HLR does not support CAMEL, processing continues from the "No" exit of the test"Result=CSI active?".

Sheet 2: the procedure SCUDIF_CAMEL_CSI_Check_HLR is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. This procedure gets the result from the CAMEL_CSI_Check_HLR procedure, and modifies it if needed. If the HLR does not support SCUDIF, the test "Result = CSI Active ?" applies to the result of the CAMEL_CSI_Check_HLR procedure. If the HLR does not support CAMEL, processing continues from the "No" exit of the test "Result=CSI active?".

Sheet 2: the test "gsmSCF Initiated Call?" is specific to CAMEL phase 4 or later. If the HLR does not support CAMEL phase 4 or later, processing continues from the "No" exit.

Sheet 2: the test "Suppress CCBS Handling?" is specific to CAMEL phase 4 or later. If the HLR does not support CAMEL phase 4 or later, processing continues from the "No" exit.

Sheet 2: the procedure CCBS_Handling_HLR is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. If the HLR does not support CCBS, processing continues from the "Yes" exit of the test "Result = OK?".

Sheet 3: the procedure OR_HLR_Interrogate_VLR is specific to Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the HLR does not support Optimal Routeing, processing continues from the "No" exit of the test "Result=Forward".

Sheet 3: the procedure SCUDIF_Set_Correct_PLMN_BC is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Set_PLMN_BC" exit of the test "Result ?".

Sheet 3: if the HLR does not support Network Indication of Alerting, the test "Alerting pattern required" and the task "Set Alerting Pattern" are omitted.

Sheet 3: the procedure CLI_HLR_Set_CLI is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 5: the procedure SCUDIF_Check_Second_Service_after_PRN is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "yes" exit of the test "Result = Continue ?".

Sheet 5: the procedure PRN_Error_HLR can set the negative response parameter which is used by the process SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 5: the procedure Forward_CUG_Check is specific to CUG. If the HLR does not support CUG, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 6: the test "Forwarding enquiry" is specific to Support of Optimal Routeing. If the HLR does not support Optimal Routeing, processing continues from the "No" exit of the test.

Sheet 6: the procedure CAMEL_CSI_Check_HLR is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the HLR does not support CAMEL, processing continues from the "No" exit of the test "Result=CSI active?".

Sheet 6: the procedure SCUDIF_CAMEL_CSI_Check_HLR is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. This procedure gets the result from the CAMEL_CSI_Check_HLR procedure, and modifies it if needed. If the HLR does not support SCUDIF, the test "Result = CSI Active ?" applies to the result of the CAMEL_CSI_Check_HLR procedure. If the HLR does not support CAMEL, processing continues from the "No" exit of the test "Result=CSI active?".

Sheet 6: the procedure SCUDIF_Check_Second_Service_before_Negative_Response can set the negative response parameter which is used by the process SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 6: the procedure SCUDIF_Check_Second_Service_before_Negative_Response is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Fail" exit of the test "Result ?".

Sheet 7: the procedures CAMEL_T_CSI_CHECK_HLR and CAMEL_O_CSI_CHECK_HLR are specific to CAMEL; they are specified in 3GPP TS 23.078 [12].

Sheet 7: the procedure CAMEL_D_CSI_CHECK_HLR is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 7: the procedure SCUDIF_Set_Second_Service_when_Forwarded is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Yes" exit of the test "Result = Continue ?".

Sheet 7: the procedure SCUDIF_Check_Second_Service_when_Forwarded is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Yes" exit of the test "Result = Continue ?".

Sheet 7: A HLR implementing the Mobile Terminating Roaming Retry feature (see clause 5.2.1) shall delay the sending of the PRN message till completion of any on-going Location Update procedure.

7.2.2.2 Procedure Check_Parameters

If any parameters required by the rules in clause 8 are missing from the message, the procedure sets the negative response to "Data missing". If any parameter has a value which is not in the set of values expected for the parameter, the procedure sets the negative response to "Unexpected data value".

7.2.2.3 Procedure Subscription_Check_HLR

The HLR derives the possible PLMN bearer capability to populate the parameter in the Provide Roaming Number request according to the rules defined in 3GPP TS 29.007 [30].

If the HLR is able to determine the PLMN bearer capability or equivalent ISDN compatibility information to be sent to the VLR in the Provide Roaming Number request, it applies the corresponding PLMN bearer service or teleservice for handling the call. If the HLR is not able to determine any compatibility information to be sent to the VLR in the Provide Roaming Number request, it applies a default basic service according to the requirements of the operator.

If the HLR receives Send Routeing Information from the gsmSCF and the HLR is not able to determine any compatibility information to be sent to the VLR in the Provide Roaming Number request, then the HLR shall apply basic service TS11.

NOTE The information element "gsmSCF Initiated Call" in Send Routeing Information serves as an indication to the HLR that this Send Routeing Information is sent by the gsmSCF. Refer to 3GPP TS 23.078 [12].

It is an implementation option to carry out the check for operator determined barring of incoming calls before the check on provisioning of the requested basic service.

The test "gsmSCF Initiated Call?" is specific to CAMEL phase 4 or later. If the HLR does not support CAMEL phase 4 or later, processing continues from the "No" exit.

The test "Suppress CUG Handling?" is specific to CAMEL phase 4 or later. If the HLR does not support CAMEL phase 4 or later, processing continues from the "No" exit.

The negative response "Call barred" indicates whether the reason is operator determined barring or supplementary service barring, according to the result returned by the procedure Check_IC_Barring.

The negative response "CUG reject" indicates whether the reason is:

- Incoming calls barred within CUG;
- Requested basic service violates CUG constraints;
- Subscriber not member of CUG;

according to the cause returned by the procedure IC_CUG_Check.

7.2.2.4 Procedure First_Forwarding_HLR

The MS is not reachable if any of the following conditions is satisfied:

- The HLR has no location information for the subscriber.
- The subscriber record is marked as MS purged.
- The subscriber record is marked as MSC area restricted.
- The subscriber record is marked as Roaming Restricted due to Unsupported Feature.
- The subscriber is marked as deregistered because of subscription restrictions on roaming.

7.2.2.5 Procedure PRN_Error_HLR

The procedure CCBS_Report_PRN_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. The procedure does not return a value; the following tests are on the value of the Provide Roaming Number negative response.

The procedure Super_Charged_SRI_Error_HLR is specific to Super-Charger; it is specified in 3GPP TS 23.116 [24]. If the HLR does not support Super-Charger, processing continues from the "No" exit of the test "Result=Purged?".

If the HLR does not support Optimal Routeing, processing starts with the test "Negative response=Facility not supported?".

7.2.2.6 Procedure Forward_CUG_Check

7.2.2.7 Void

7.2.2.8 Procedure Check_IC_Barring

7.2.2.9 Procedure IC_CUG_Check

7.2.2.10 Procedure Handle_CFU

The test "Normal call" refers to the value of the indicator returned by the process MAF007.

The procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

7.2.2.11 Procedure Handle_CFNRc

The test "Mobile subscriber not reachable" refers to the value of the indicator returned by the process MAF010.

The procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

7.2.2.12 Procedure Domain_Selection_HLR

The procedure Domain_Selection_HLR is specific to Domain Selection specified in 3GPP TS 23.221 [40].

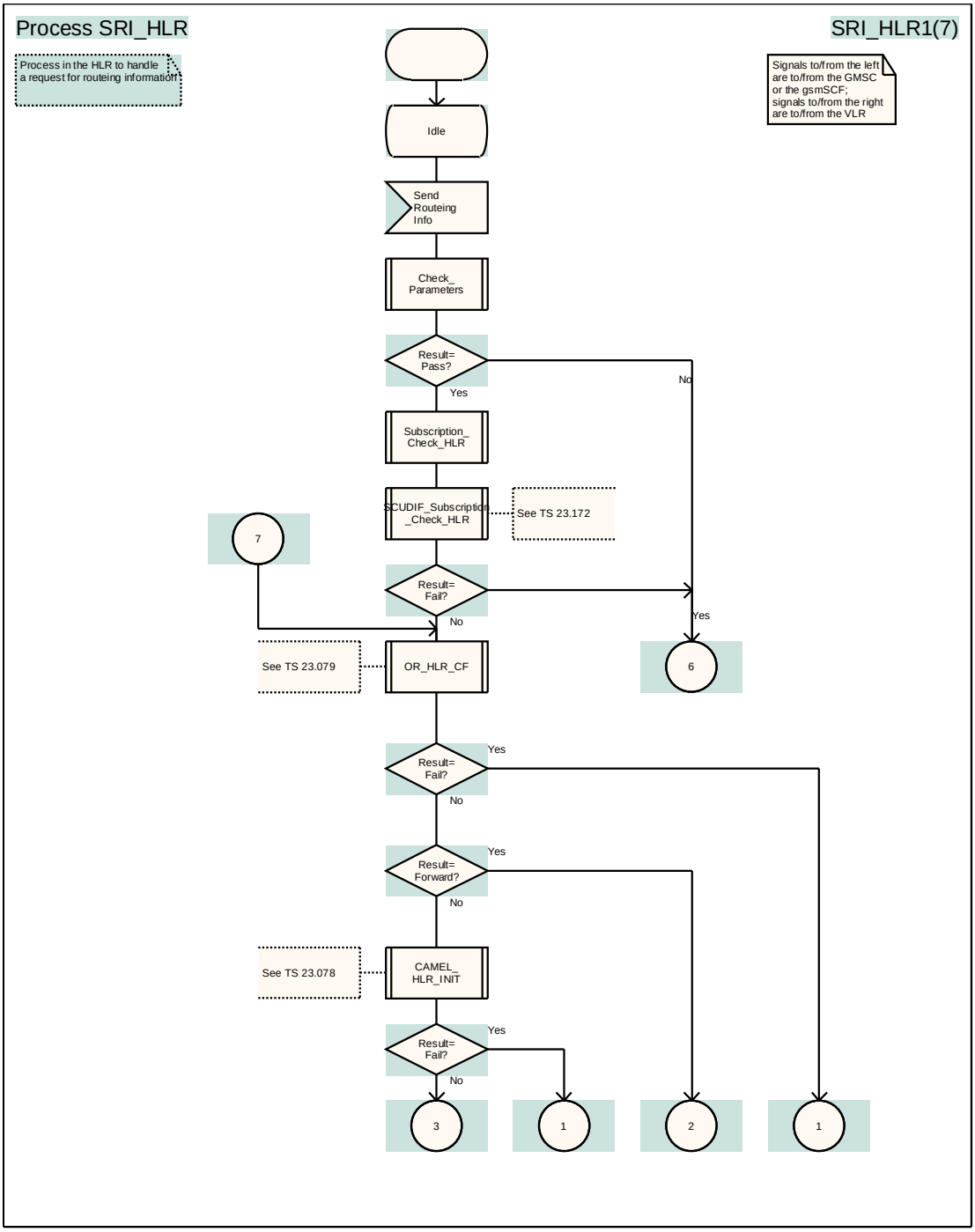


Figure 44a: Process SRI_HLR (sheet 1)

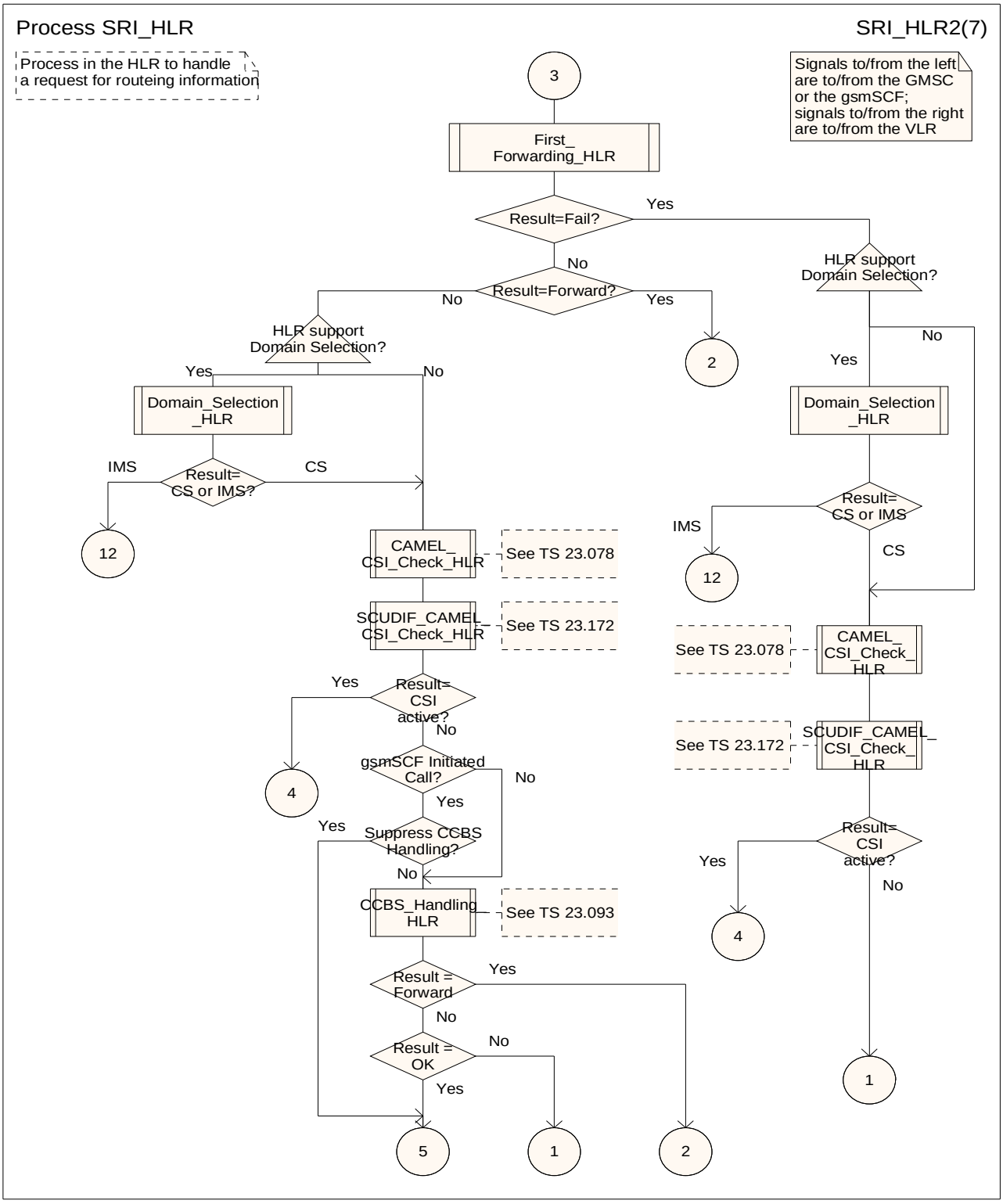


Figure 44b: Process SRI_HLR (sheet 2)

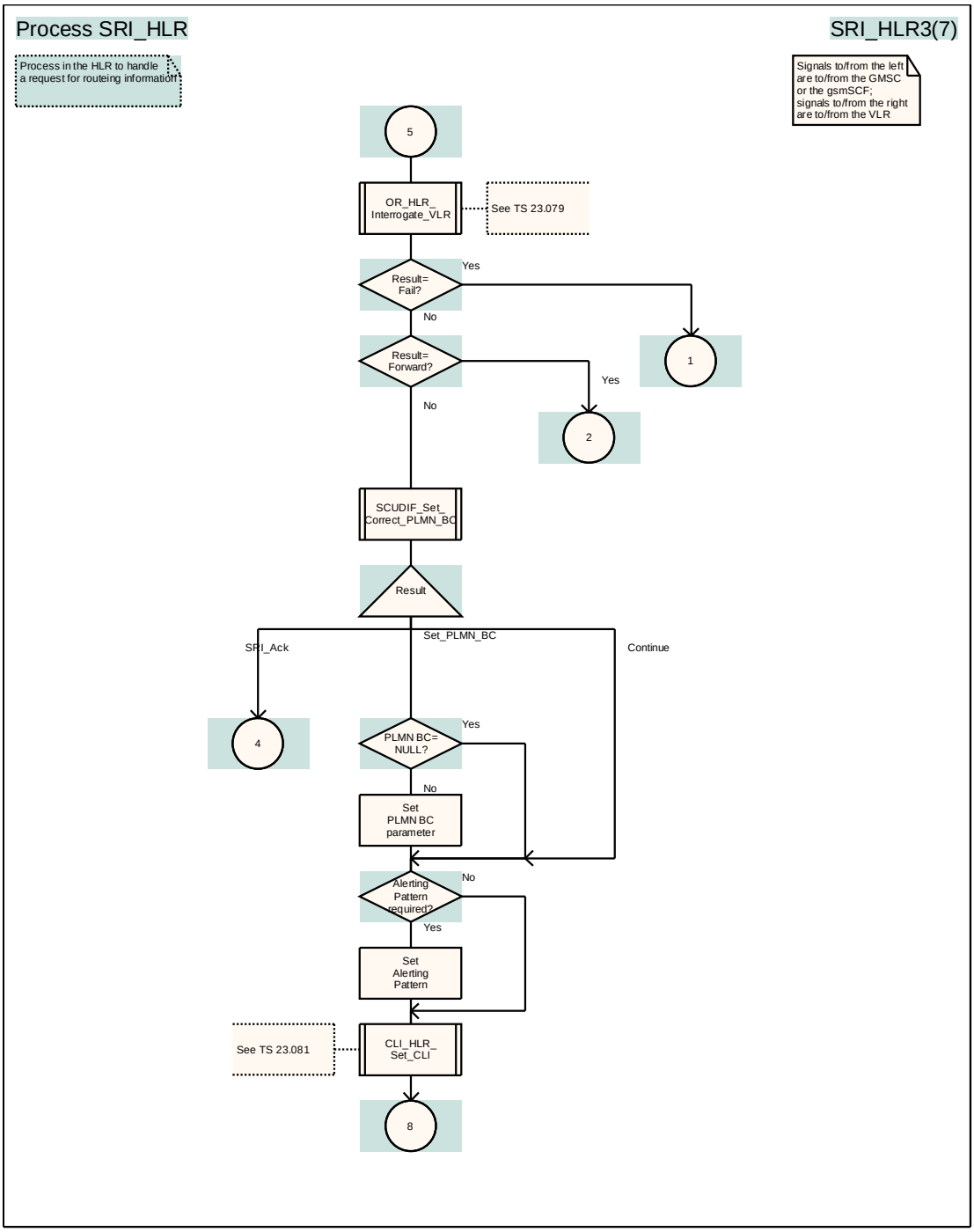


Figure 44c: Process SRI_HLR (sheet 3)

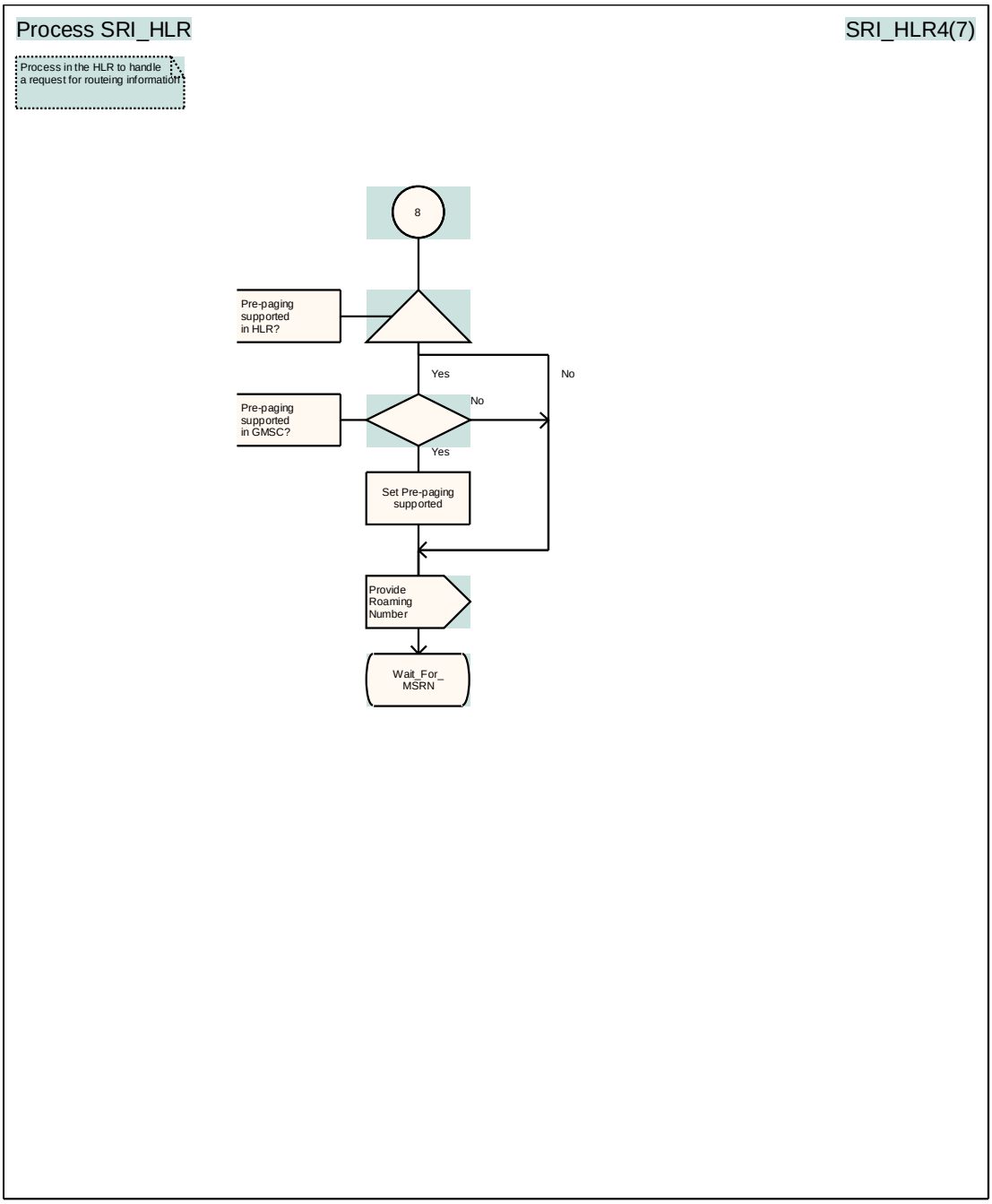


Figure 44d: Process SRI_HLR (sheet 4)

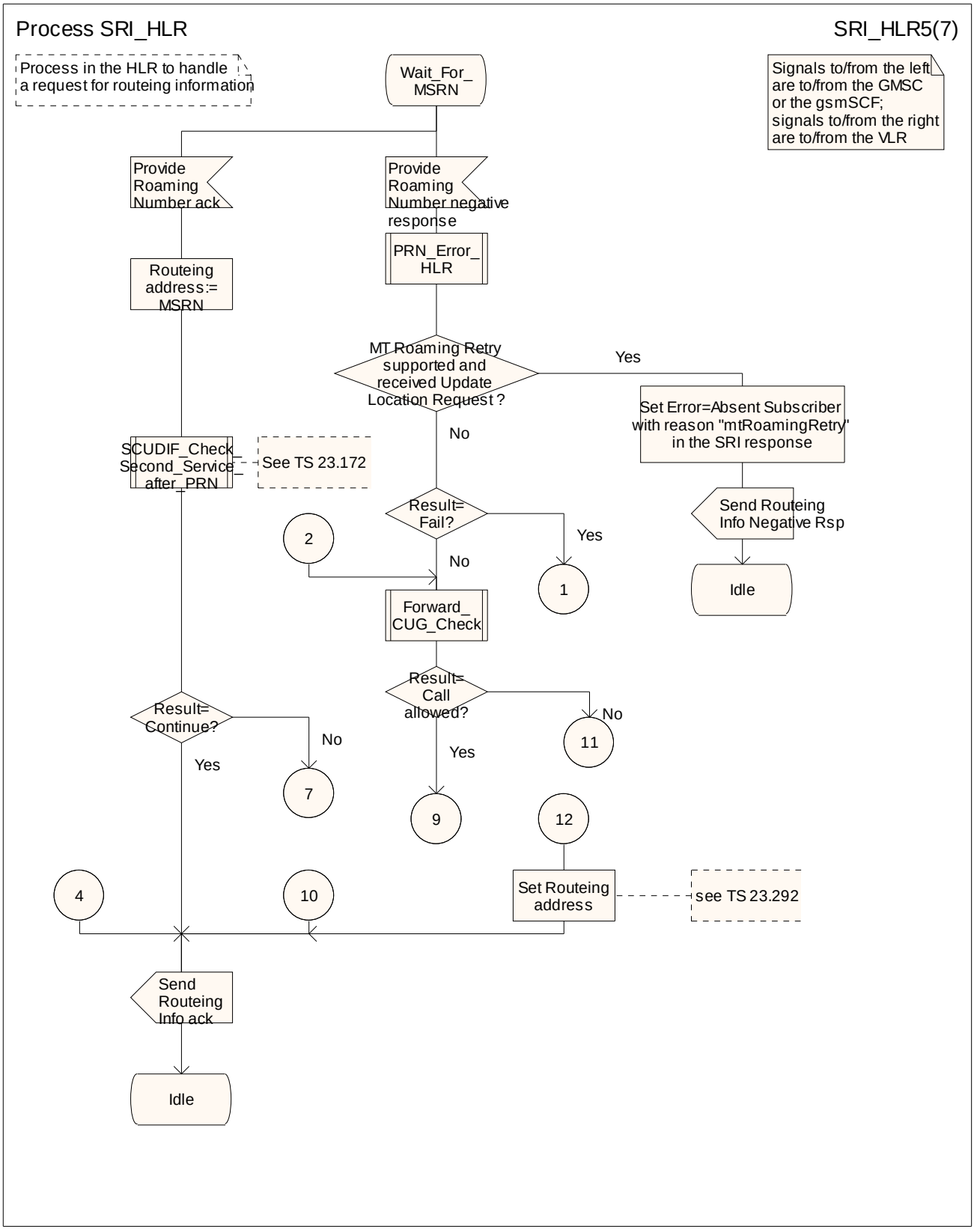


Figure 44e: Process SRI_HLR (sheet 5)

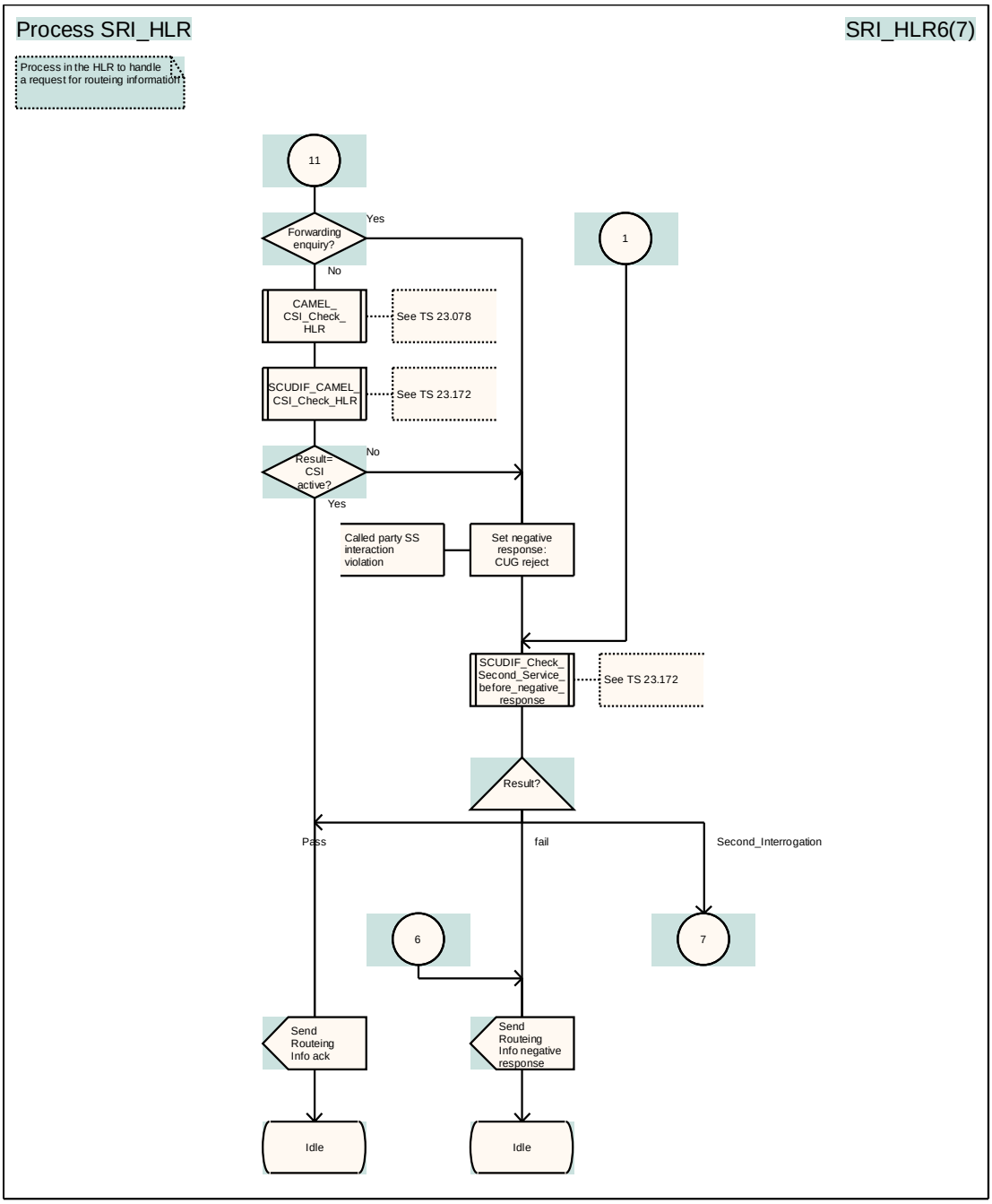


Figure 44f: Process SRI_HLR (sheet 6)

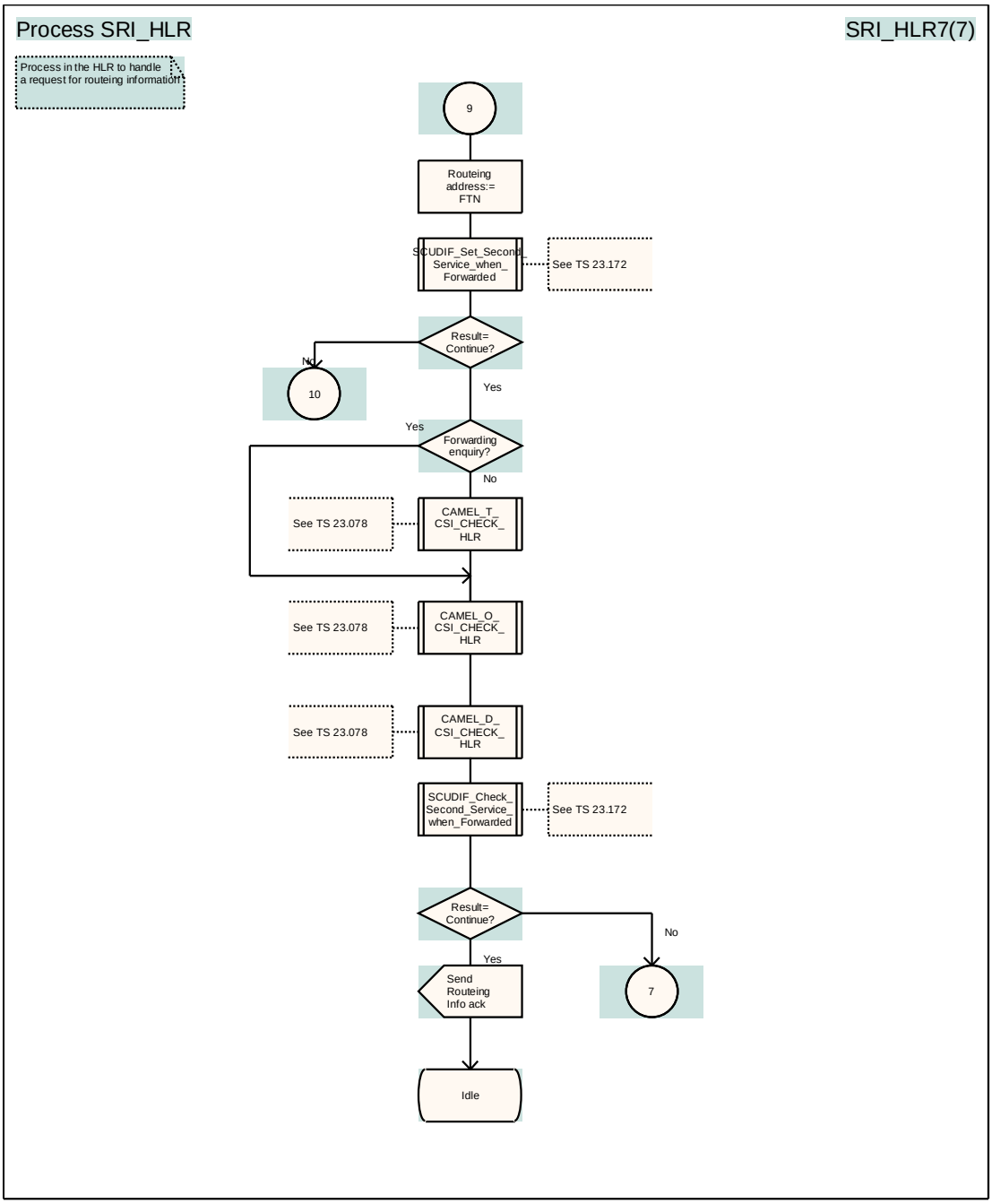


Figure 44g: Process SRI_HLR (sheet 7)

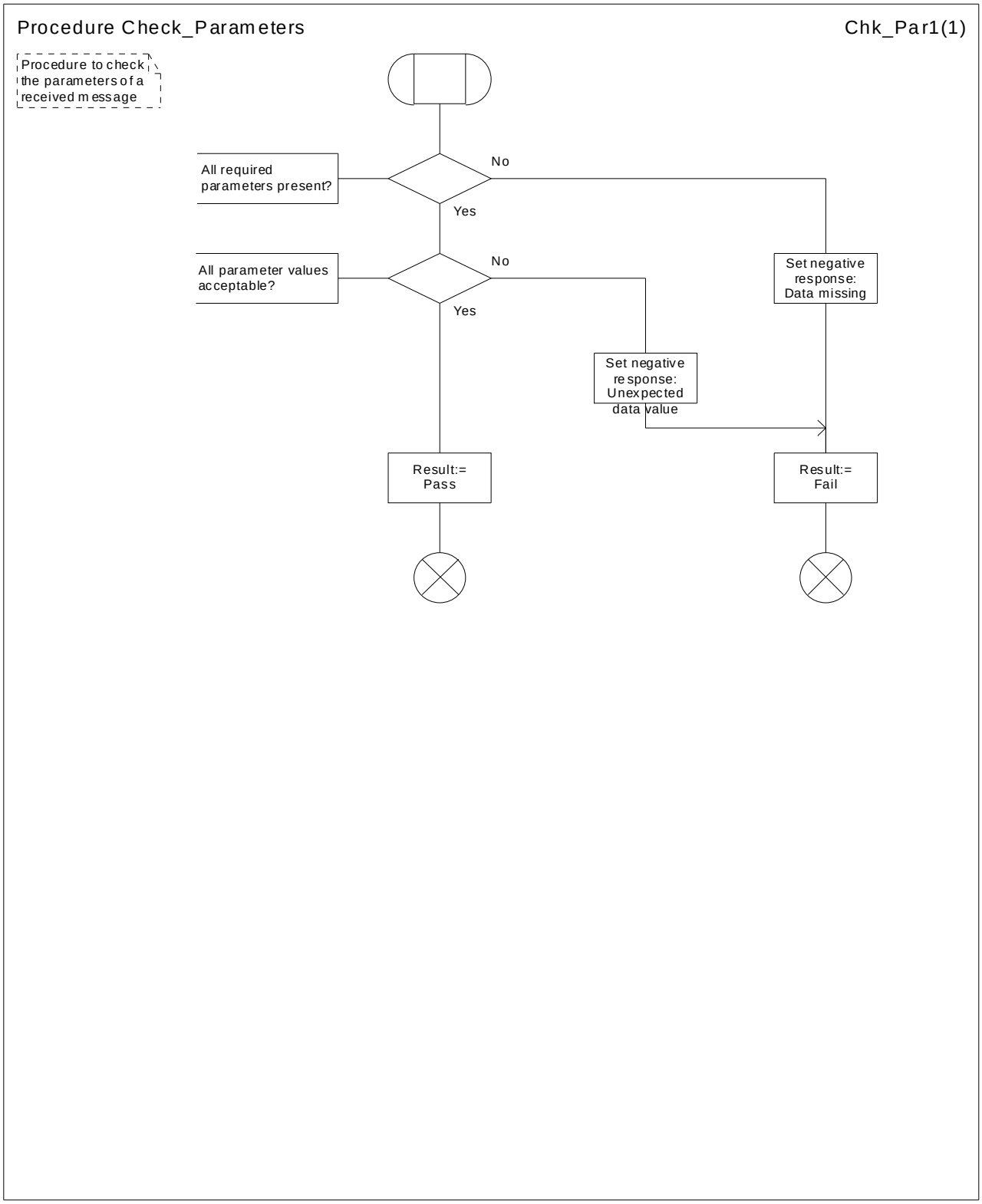


Figure 45: Procedure Check_Parameters

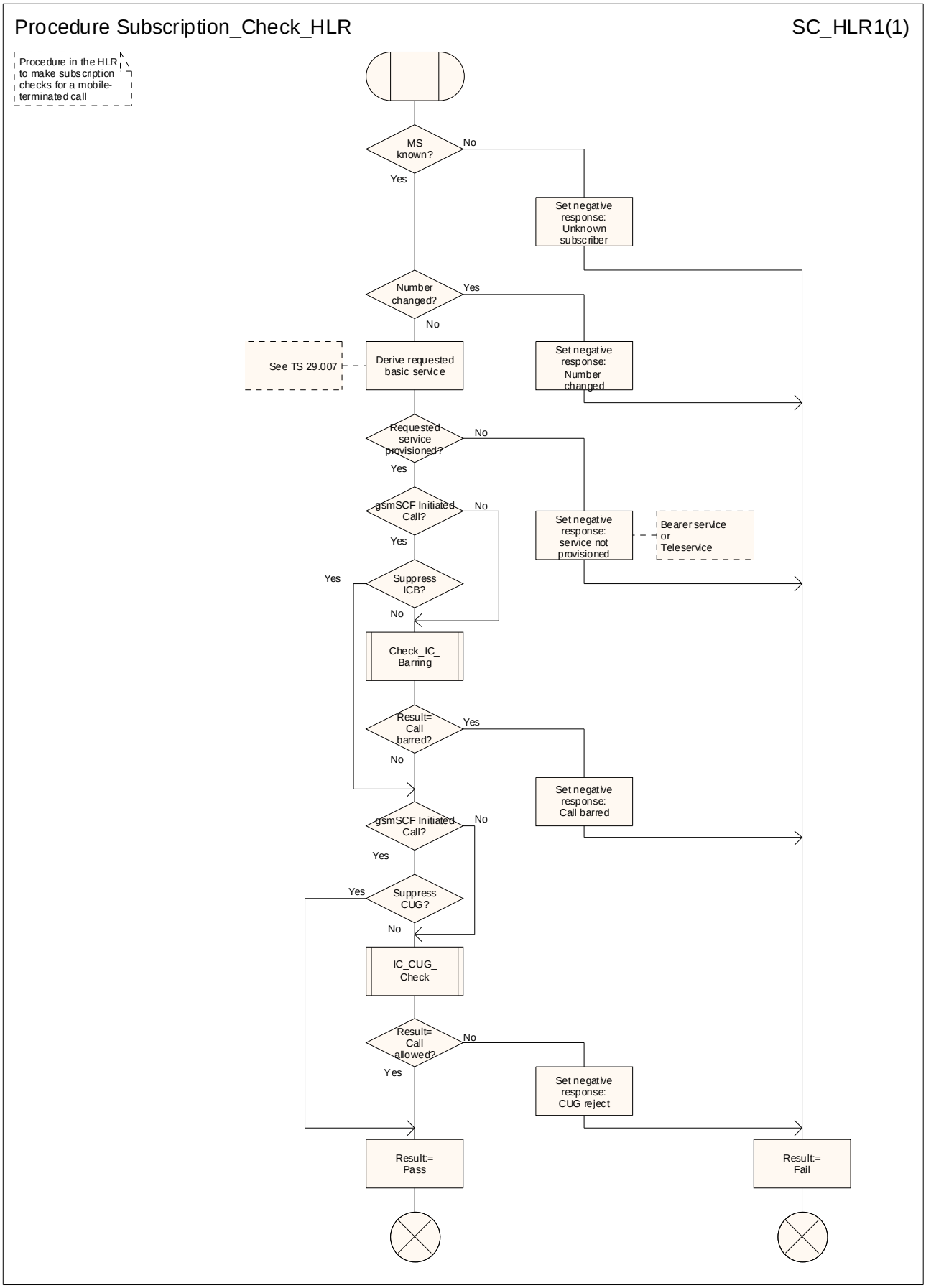


Figure 46: Procedure Subscription_Check_HLR

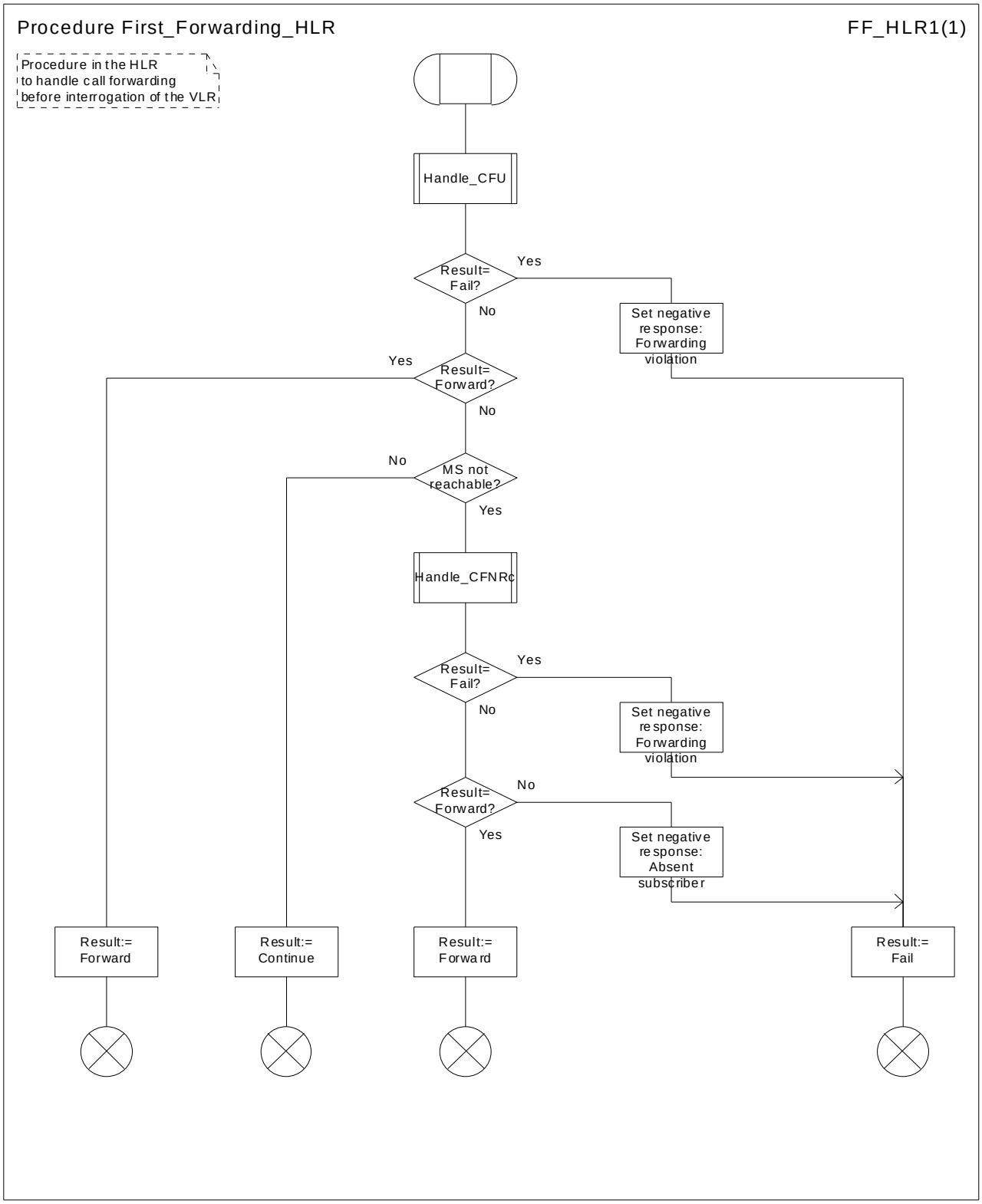


Figure 47: Procedure First_Forwarding_HLR

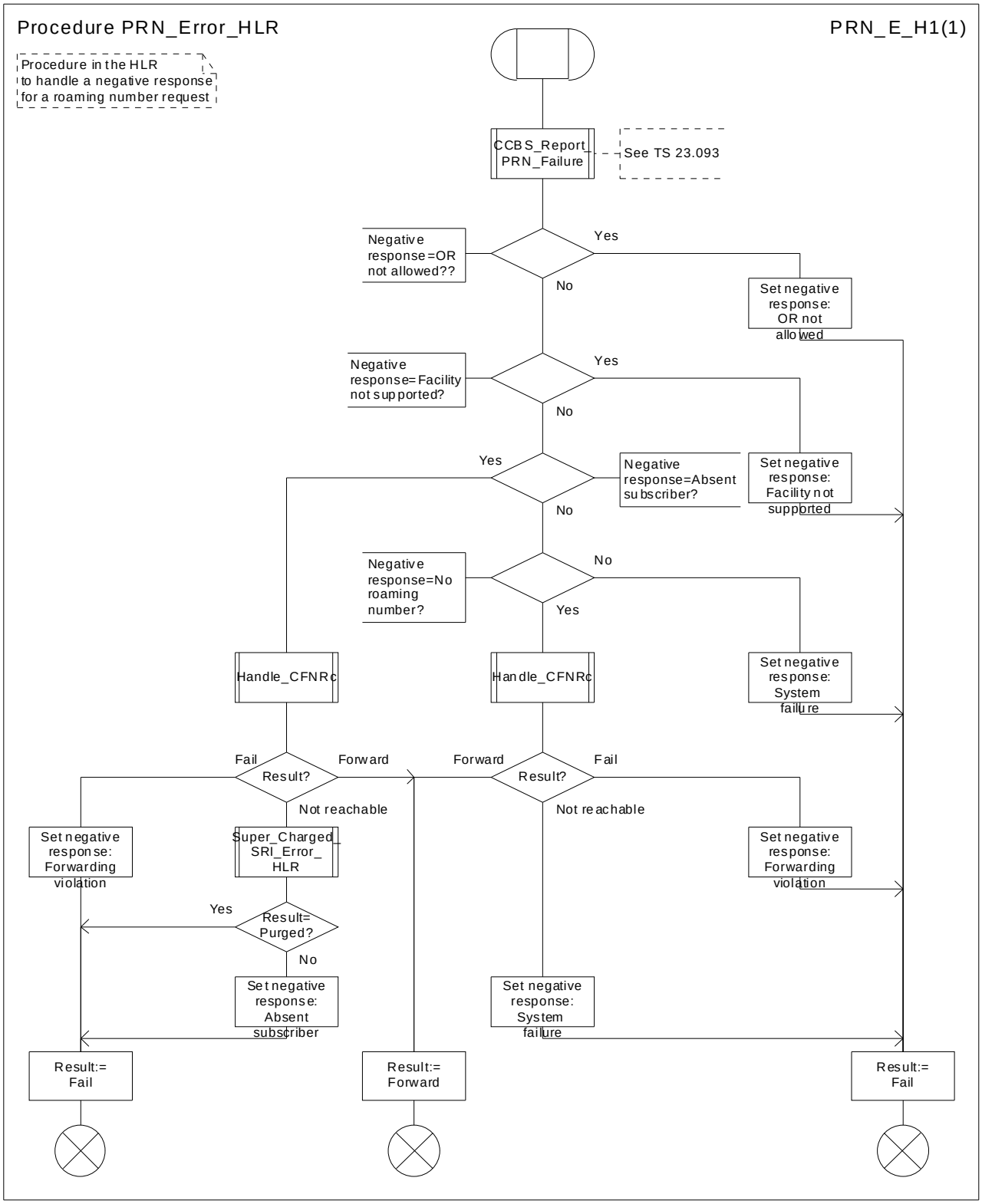


Figure 48: Procedure PRN_Error_HLR

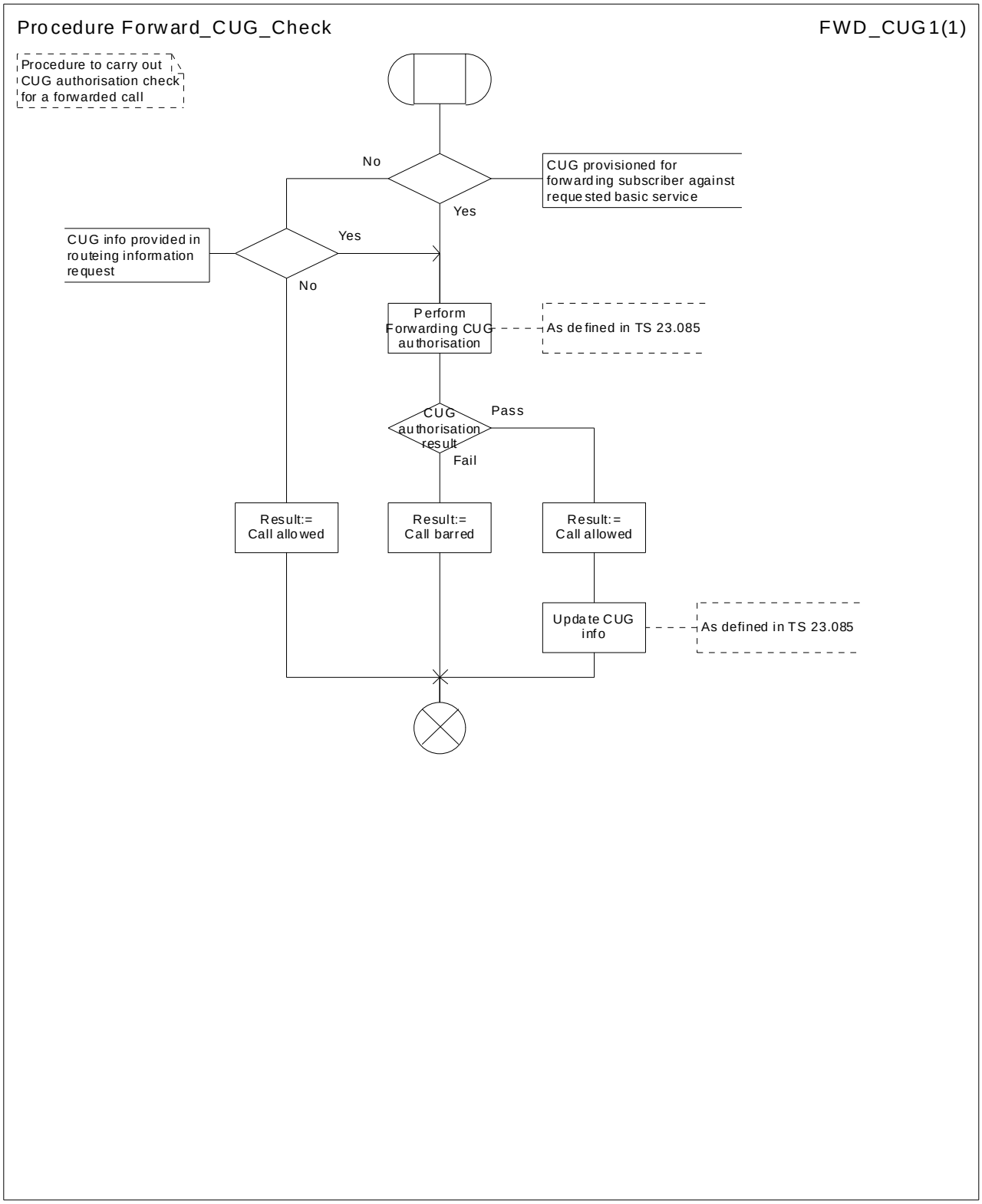


Figure 49: Procedure Forward _CUG_Check

Figure 50: Void

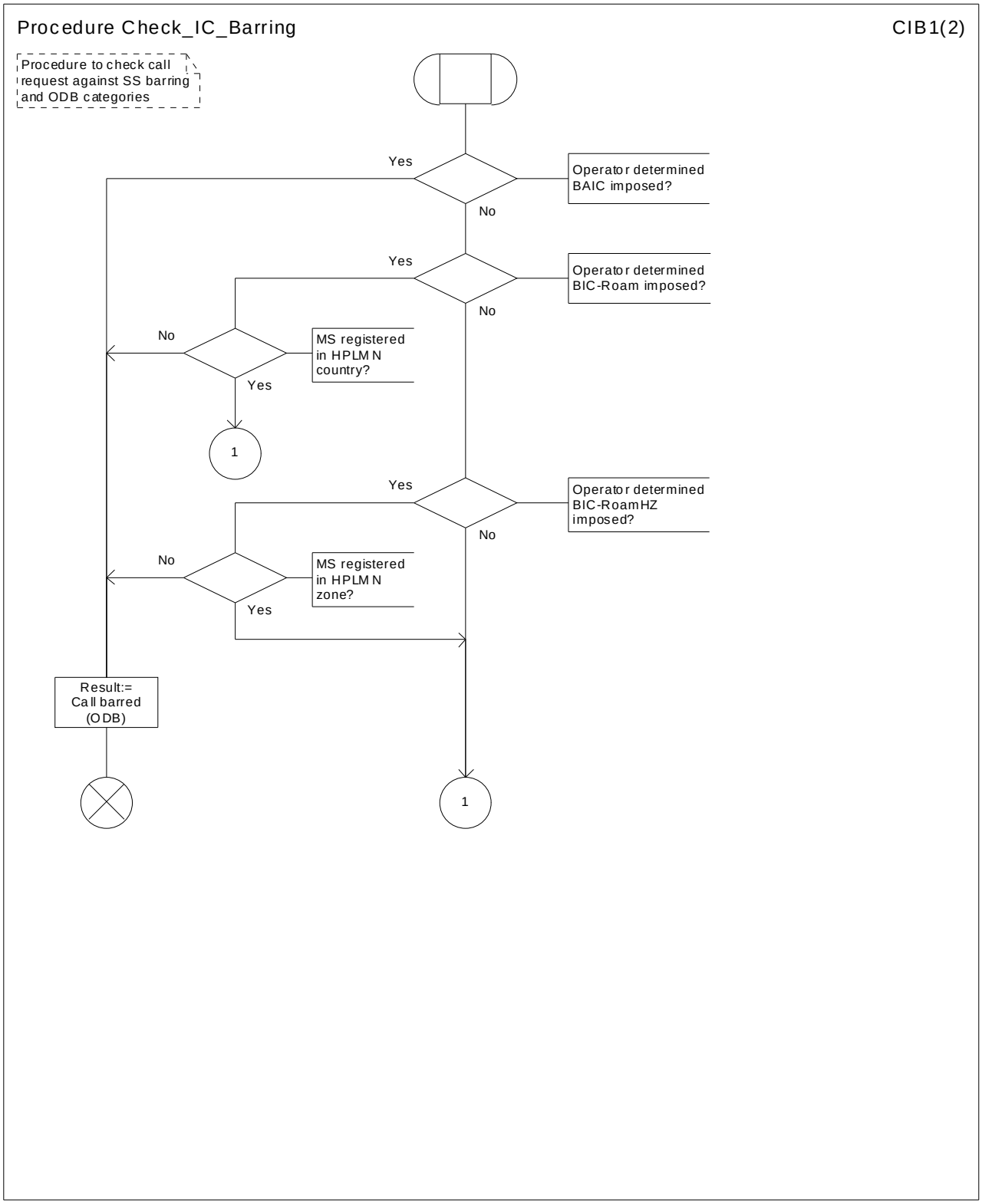


Figure 51a: Procedure Check_IC_Barring (sheet 1)

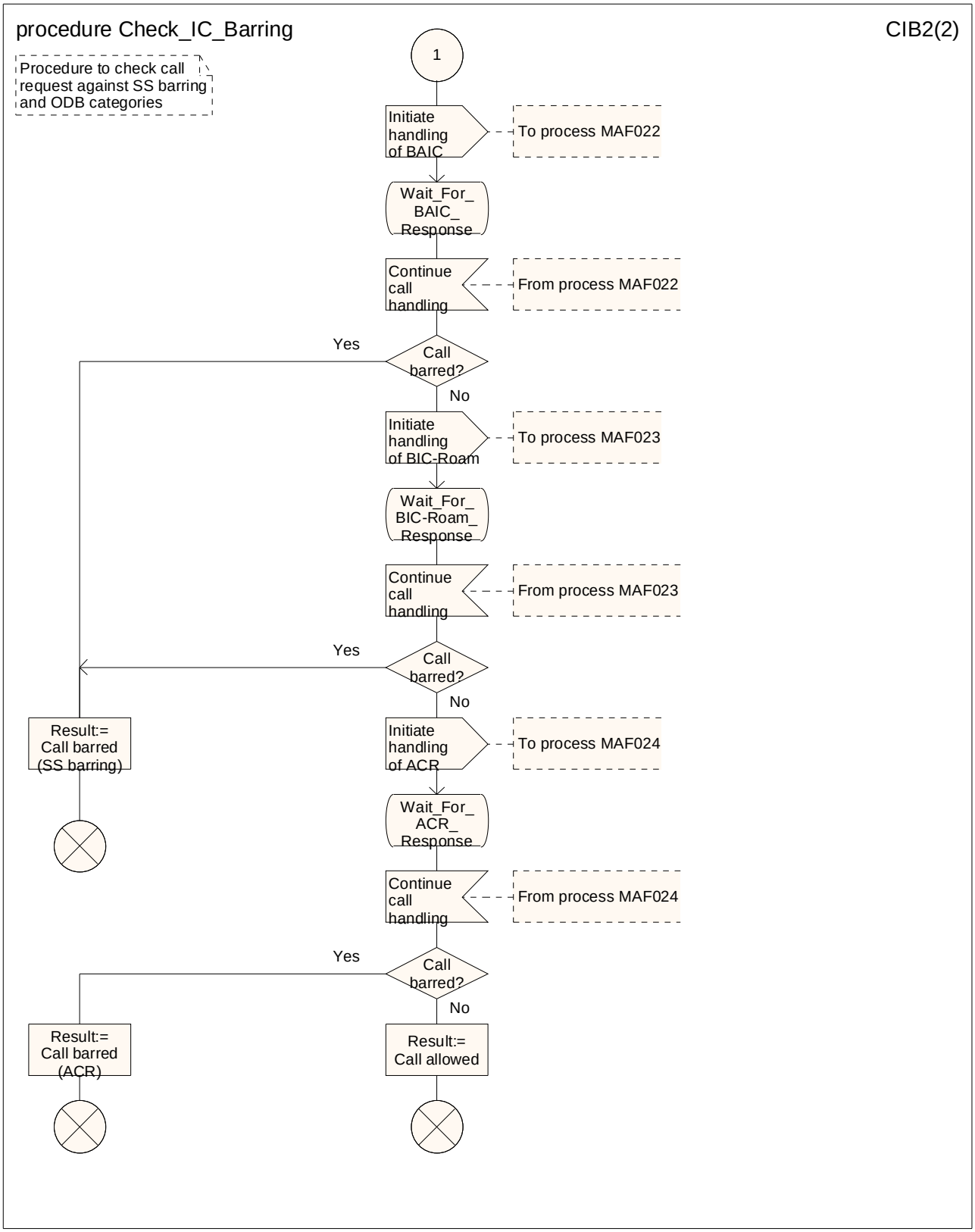


Figure 51b: Procedure Check_IC_Barring (sheet 2)

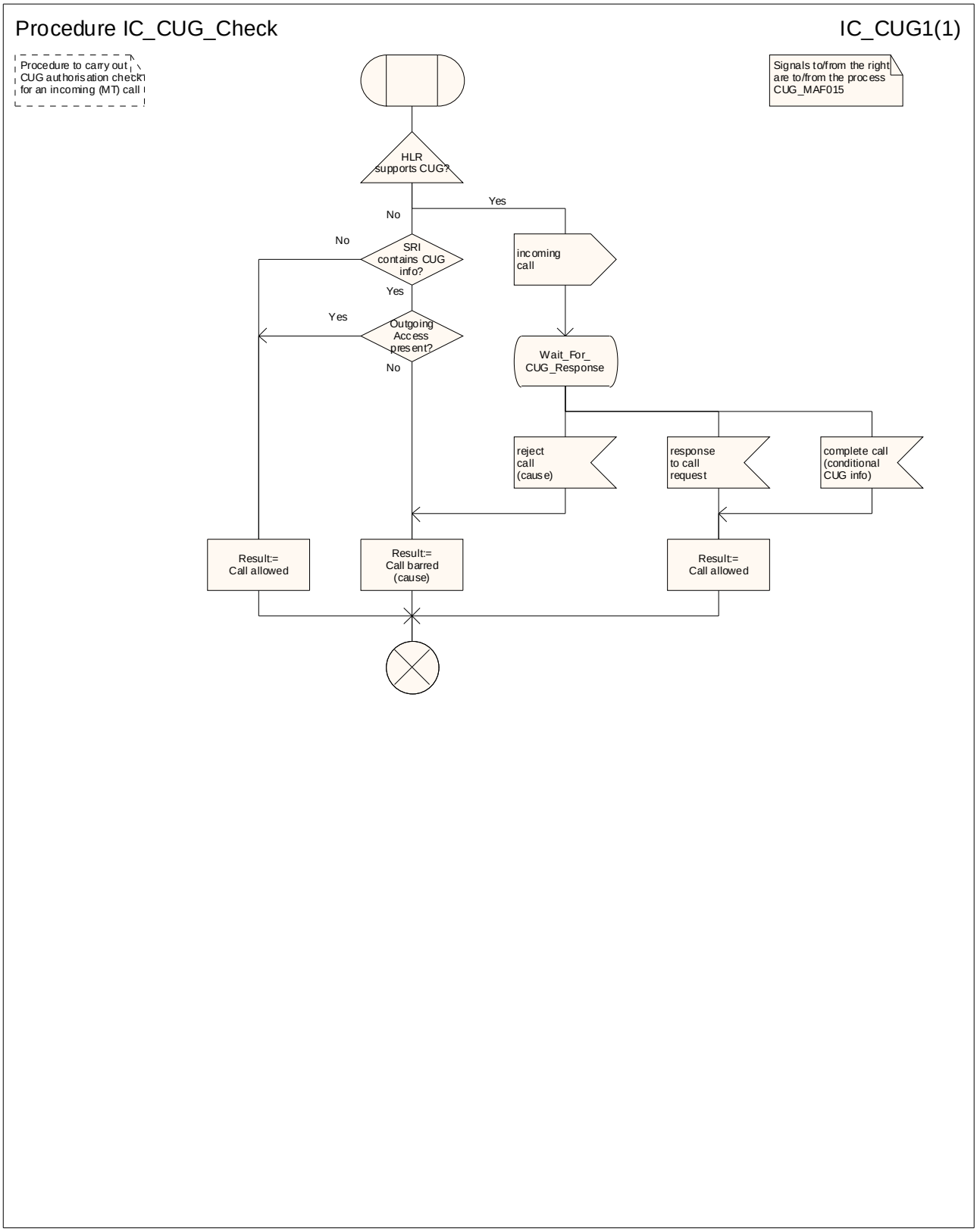


Figure 52: Procedure IC_CUG_Check

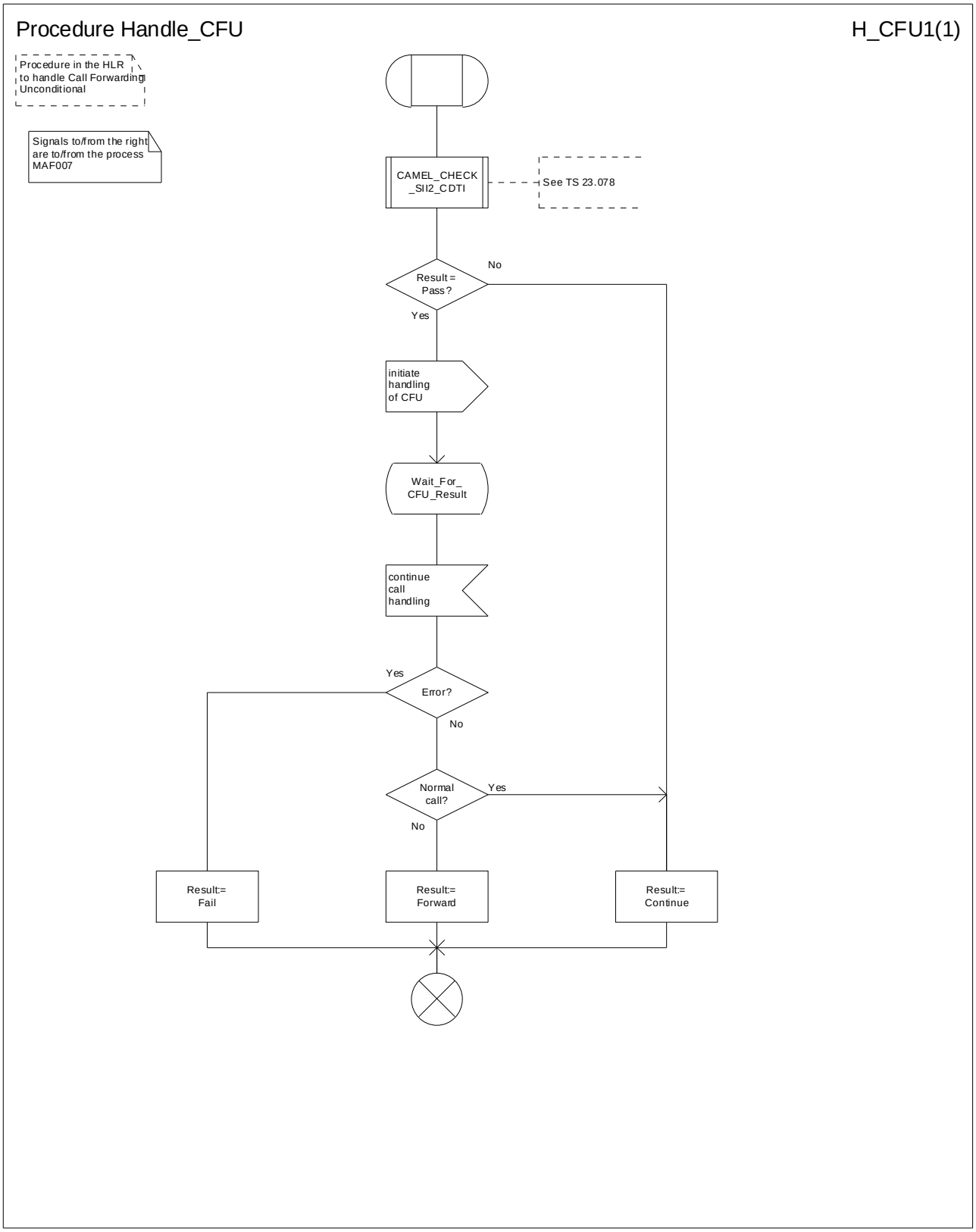


Figure 53: Procedure Handle_CFU

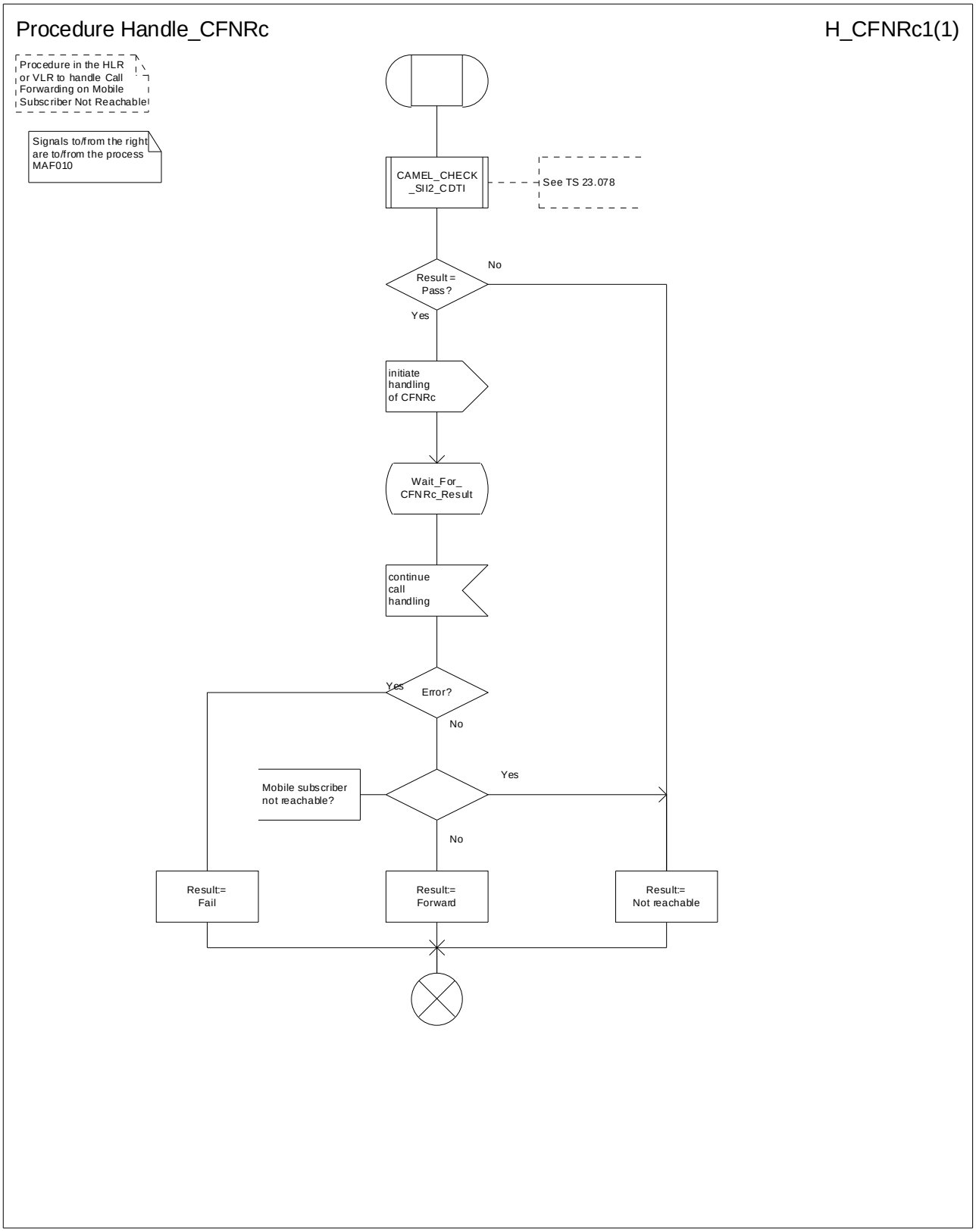


Figure 54: Procedure Handle_CFNRc

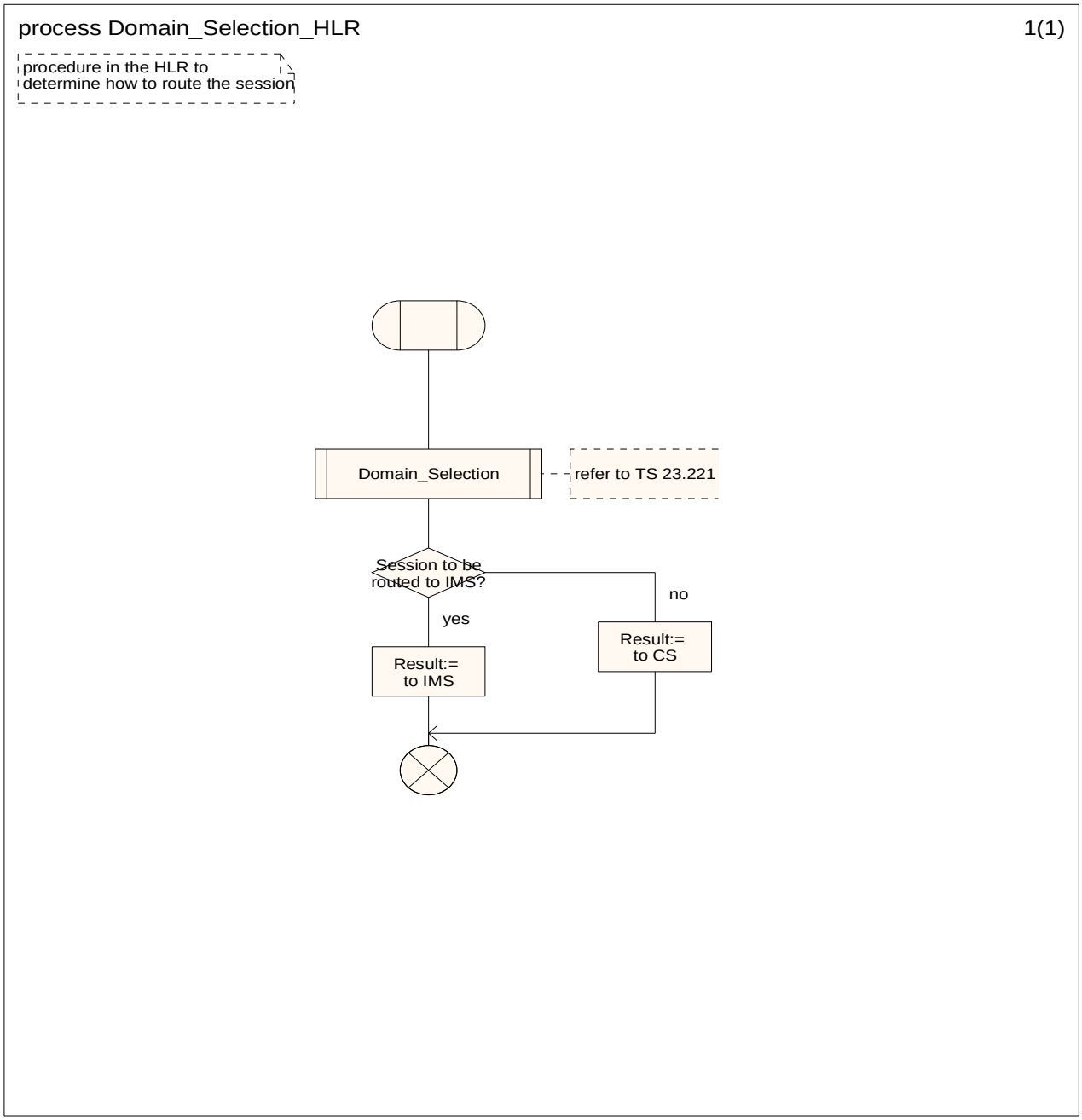


Figure 54A: Process Domain_Selection_HLR

7.2.3 Functional requirements of VLR

7.2.3.1 Process PRN_VLR

Sheet 1: the procedure Check_Parameters is specified in clause 7.2.2.2.

Sheet 1: the test "Pre-paging allowed" takes the "yes" exit if:

- the information element "Pre-paging supported" was present in the Provide Roaming Number message; or
- as an operator option, the paging procedure can be completed before the minimum timer value for the Provide Roaming Number operation timer in the HLR has elapsed.

Sheet 1: the procedure Check_Reason_In_Serving_Network_Entity is specific to Super-Charger; it is specified in 3GPP TS 23.116 [24]. If the VLR does not support Super-Charger, processing continues from the "No" exit of the test "Result=Purged?".

Sheet 1: Pre-paging is not applicable if the Provide Roaming Number request includes the MTRF Indicator.

Sheet 2, sheet 3, sheet 6, sheet 7: the procedure CAMEL_SET_SOA is specific to CAMEL; it is specified in 3GPP TS 23.078 [12].

Sheet 2, sheet 3, sheet 6, sheet 7: the task "Store alerting pattern (if received)" is executed only if the VLR supports the feature Network Indication of Alerting.

Sheet 2, sheet 3, sheet 6, sheet 7: the procedure CLI_PRN_VLR is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 2, sheet 3, sheet 6, sheet 7: the procedure CCBS_Handle_PRN is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 2, sheet 4: A VLR not supporting the flag "Subscriber data dormant" shall behave as if this flag is set to false.

Sheet 2: As an implementation option, the VLR may skip the "Authorize_MTRF_VLR" procedure (i.e. assume the result of that procedure takes the "Pass" exit) and allocates an MSRN before the completion of the MAP Update Location procedure with the HLR.

Sheet 3, sheet 4: the number of unused authentication sets which triggers the VLR to request further authentication sets from the HLR is an operator option.

Sheet 3, sheet 4: the process Fetch_Authentication_Sets_VLR is specified in clause 7.1.2.11.

Sheet 4: the procedure Search_For_MS_VLR is specified in clause 7.3.2.3.

Sheet 4: the test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and
- there is an association established for the MS between the MSC/VLR and the SGSN.

Sheet 4: "Location cancelled" cause is set when VMSC receives Cancel Location while paging.

Sheet 6: "Location cancelled with new VLR address" cause is set when VMSC receives Cancel Location with MTRF Supported And Authorized while paging and new MSC/VLR numbers have been received either in the Cancel Location or the Send Identification message.

Sheet 7, sheet 8: the state variables PAR pending, PAR successful and Fatal PAR error are global data, accessible to the matching instance of the process ICH_VLR, which is linked by the MSRN.

Sheet 8: this process communicates with the matching instance of the process ICH_VLR, which is linked by the MSRN.

Sheet 8: the test " Fatal PAR error?" takes the "Yes" exit if:

- the MS failed authentication; or
- the MS failed IMEI checking; or
- the HLR returned an "Unknown subscriber" error;

during the handling of the Process Access Request.

7.2.3.2 Process Restore_Subscriber_Data_VLR

7.2.3.3 Process PSI_VLR

Sheet 1: the procedure Check_Parameters is specified in clause 7.2.2.2. If the HLR requests none of location information subscriber state, MS classmark and IMEI, the VLR treats this as a missing parameter.

Sheet 2: the test "Active retrieval required" takes the "Yes" exit if any one or more of current location, MS classmark or IMEI is indicated in the Provide Subscriber Info request.

7.2.3.4 Procedure Retrieve_Location_Info_VLR

The test "Retrieve location info from SGSN" takes the "Yes" exit if:

- the Gs interface is implemented; and
- there is an association established between the VLR and the SGSN.

The stored location information consists of:

- the service area ID (for UMTS) or cell ID (for GSM) or the tracking area ID and the E-UTRAN cell ID (for E-UTRAN) of the cell in which the MS last established radio contact;
- the location number, geodetic information and geographical information derived from the service area ID or cell ID if the VLR is capable of doing so (the mapping from service area ID or cell ID to location number is network-specific and outside the scope of the UMTS and GSM standards);
- the age of the location information.

The output signal Send MS information towards the SGSN indicates that the required information is mobile location information.

The received location information consists of:

- the service area ID (for UMTS) or cell ID(for GSM) received in the paging response message or in the Send MS Information ack or the tracking area ID and the E-UTRAN cell ID (for E-UTRAN) received in the SGs service request;
- the location number, geodetic information and geographical information derived from the service area ID or cell ID if the VLR is capable of doing so (the mapping from cell ID to location number is network-specific and outside the scope of the UMTS and GSM standards);
- the age of the location information.

The derivation of the location number, geodetic information and geographical information from the received service area ID or cell ID is a VLR operator option (the mapping from service area ID or cell ID to location number is network-specific and outside the scope of the UMTS and GSM standards).

7.2.3.5 Procedure Active_Info_Retrieval_VLR

Sheet 1: the test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and
- the VLR configuration requires paging via the SGSN during VLR restoration.

If the SGs interface is implemented and the conditions for paging over the SGs interface as specified in clause 5.1.2.2 of 3GPP TS 29.118 [41] are fulfilled, the VLR shall send an SGs paging request to the MME. The VLR should indicate the "SMS" service indicator in the SGs paging request if the LocationInformationEPS-Supported flag was received in the Provide Subscriber Information request; otherwise the VLR should indicate the "CS" service indicator. If the VLR indicates the "SMS" service indicator, the VLR should then send an SGs Release Request message to the MME upon receipt of the SGs Service Request message (including the tracking area ID and E-UTRAN cell ID).

The VLR should return in the Provide Subscriber Information response the tracking area ID and E-UTRAN cell ID received from the MME if the LocationInformationEPS-Supported flag was received in the Provide Subscriber Information request and the UE uses the E-UTRAN radio access; otherwise the VLR should return the service area ID (for UMTS) or cell ID (for GSM) received from UTRAN or GERAN.

NOTE: Using the "CS" service indicator leads the UE to fallback to GERAN or UTRAN radio access which can affect on-going PS sessions of the user, e.g. suspend on-going PS sessions if the UE fallbacks to GERAN radio access and Dual Transfer Mode is not supported, and which can cause extra Location Update signalling in the network.

Sheet 2: the output signal Page MS towards the SGSN includes or omits the Location area identity parameter depending on the availability of this information. If it is omitted, the signal Page MS is sent to every SGSN to which the VLR is connected.

The test "Report upon change of service area" takes the yes exit if the MSC has performed the Location Reporting Control procedure with the Request Type IE set to "change of service area" [26].

If the test "Report upon change of service area" takes the no exit, then the MSC shall perform a Location Reporting Control procedure with the Request Type IE set to "Direct".

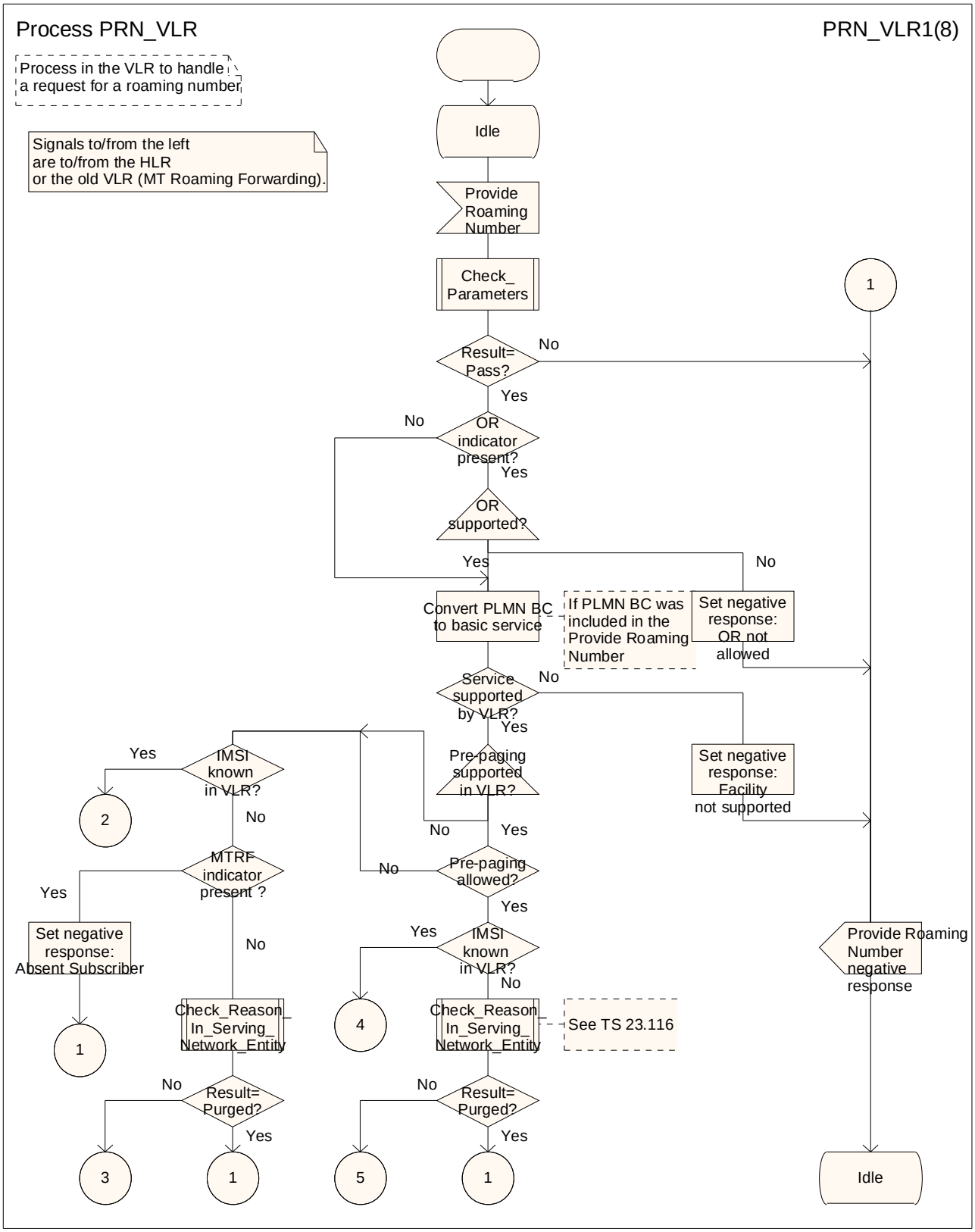


Figure 55a: Process PRN_VLR (sheet 1)

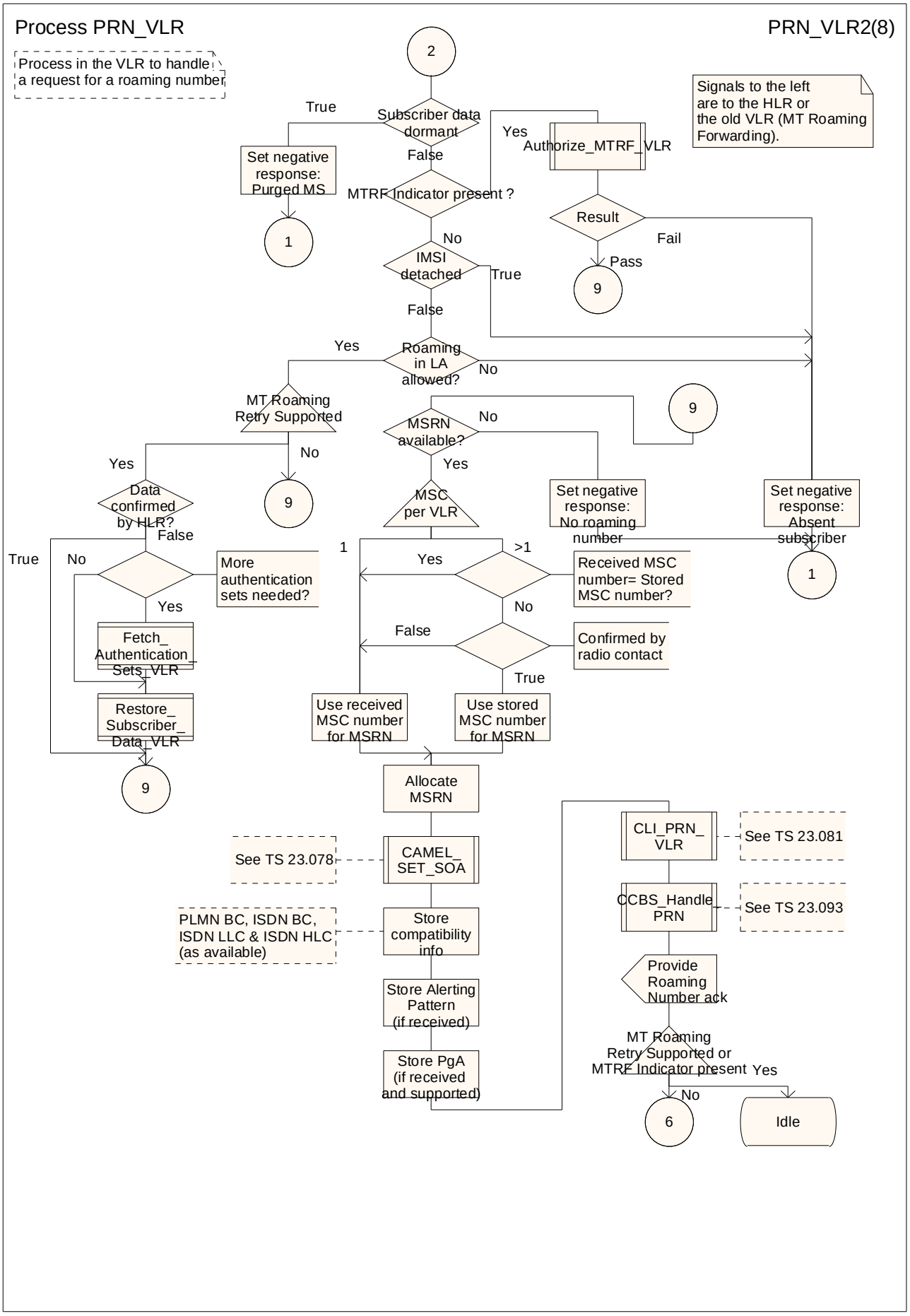

Process PRN_VLR
PRN_VLR2(8)
Process in the VLR to handle a request for a roaming number
Signals to the left are to the HLR or the old VLR (MT Roaming Forwarding).
2
Subscriber data dormant
True
False
Set negative response: Purged MS
1
MTRF Indicator present ?
Yes
Authorize_MTRF_VLR
Result
Fail
Pass
9
No
IMSI detached
True
False
Roaming in LA allowed?
Yes
No
MT Roaming Retry Supported
No
Yes
9
MSRN available?
No
Yes
9
Data confirmed by HLR?
Yes
False
No
True
More authentication sets needed?
Yes
Fetch_ Authentication_ Sets_VLR
Restore_ Subscriber_ Data_VLR
9
MSC per VLR
Set negative response: No roaming number
Set negative response: Absent subscriber
1
1
>1
Yes
Received MSC number= Stored MSC number?
No
False
Confirmed by radio contact
True
Use received MSC number for MSRN
Use stored MSC number for MSRN
Allocate MSRN
See TS 23.078
CAMEL_ SET_SOA
PLMN BC, ISDN BC, ISDN LLC & ISDN HLC (as available)
Store compatibility info
Store Alerting Pattern (if received)
Store PgA (if received and supported)
CLI_PRN_ VLR
See TS 23.081
CCBS_Handle PRN
See TS 23.093
Provide Roaming Number ack
MT Roaming Retry Supported or MTRF Indicator present
Yes
No
6
Idle

Figure 55b: Process PRN_VLR (sheet 2)

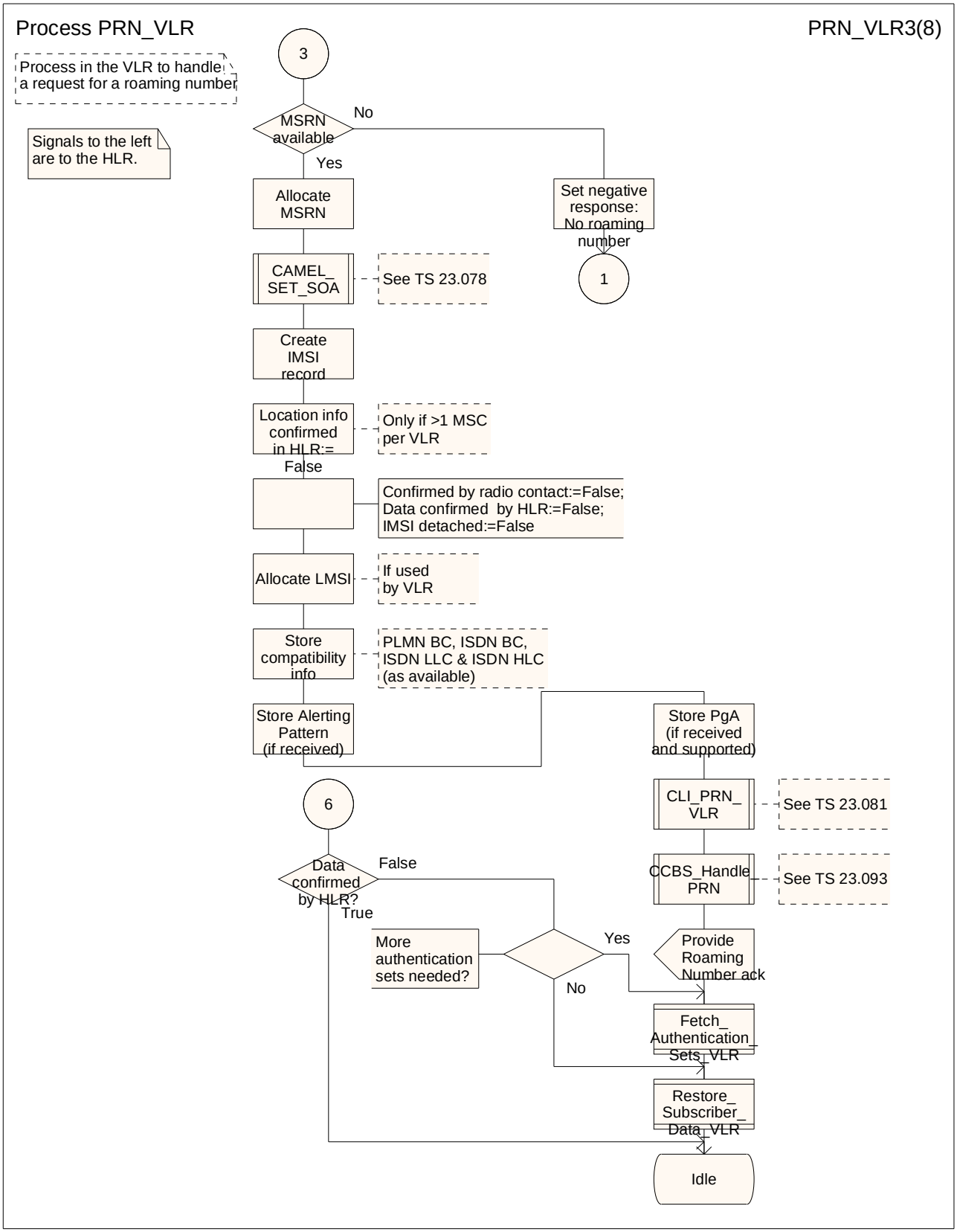


Figure 55c: Process PRN_VLR (sheet 3)

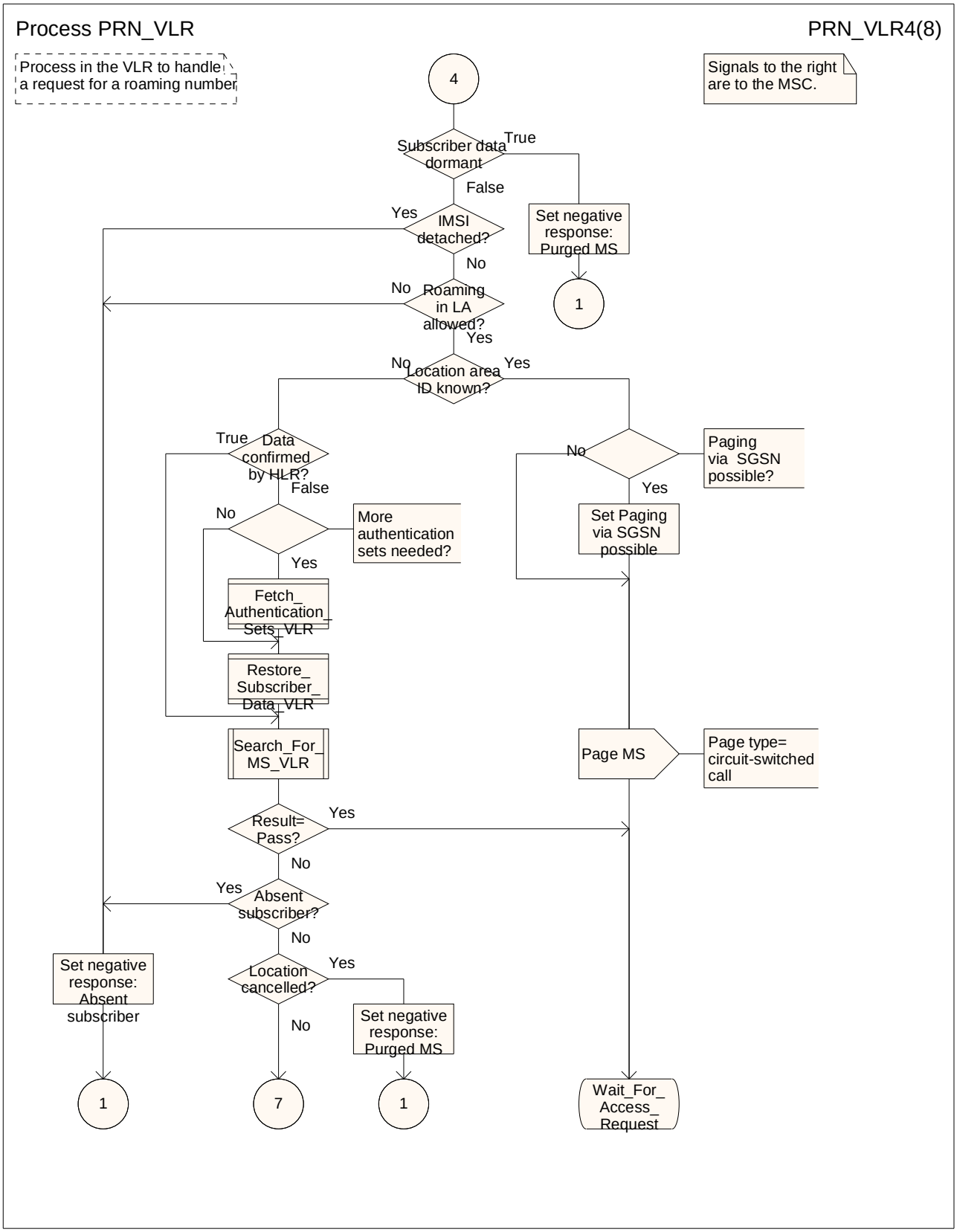


Figure 54d: Process PRN_VLR (sheet 4)

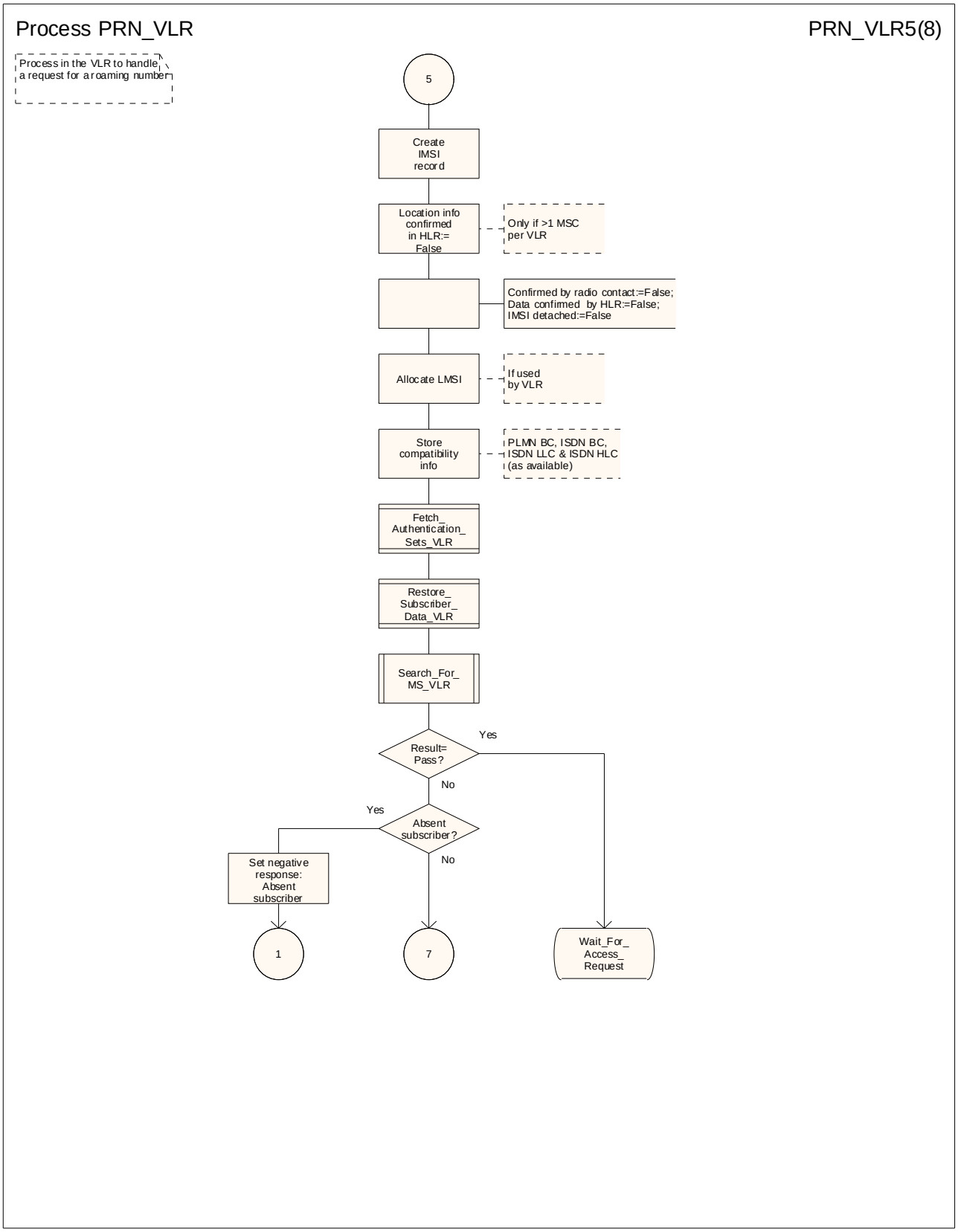


Figure 54e: Process PRN_VLR (sheet 5)

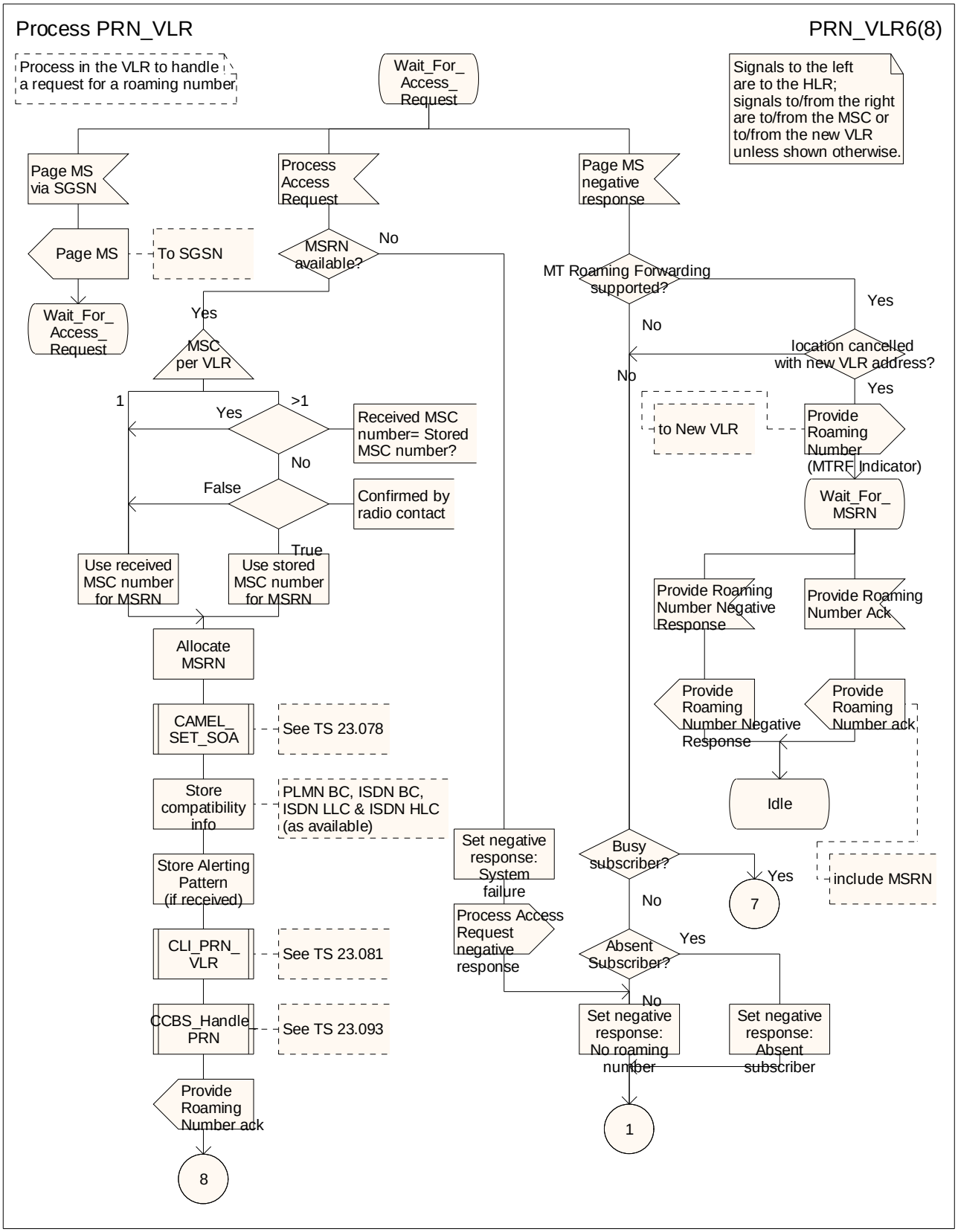


Figure 54f: Process PRN_VLR (sheet 6)

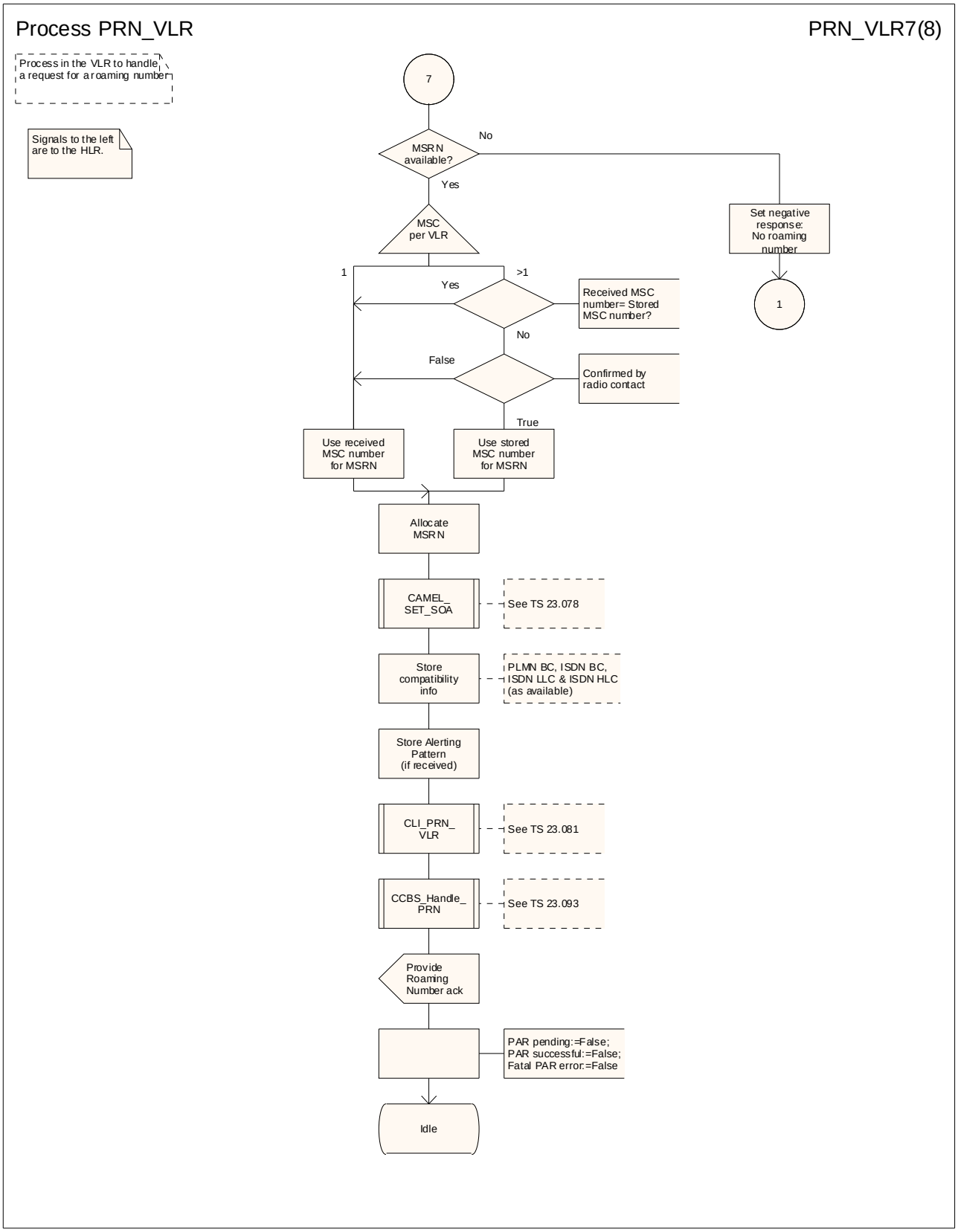


Figure 54g: Process PRN_VLR (sheet 7)

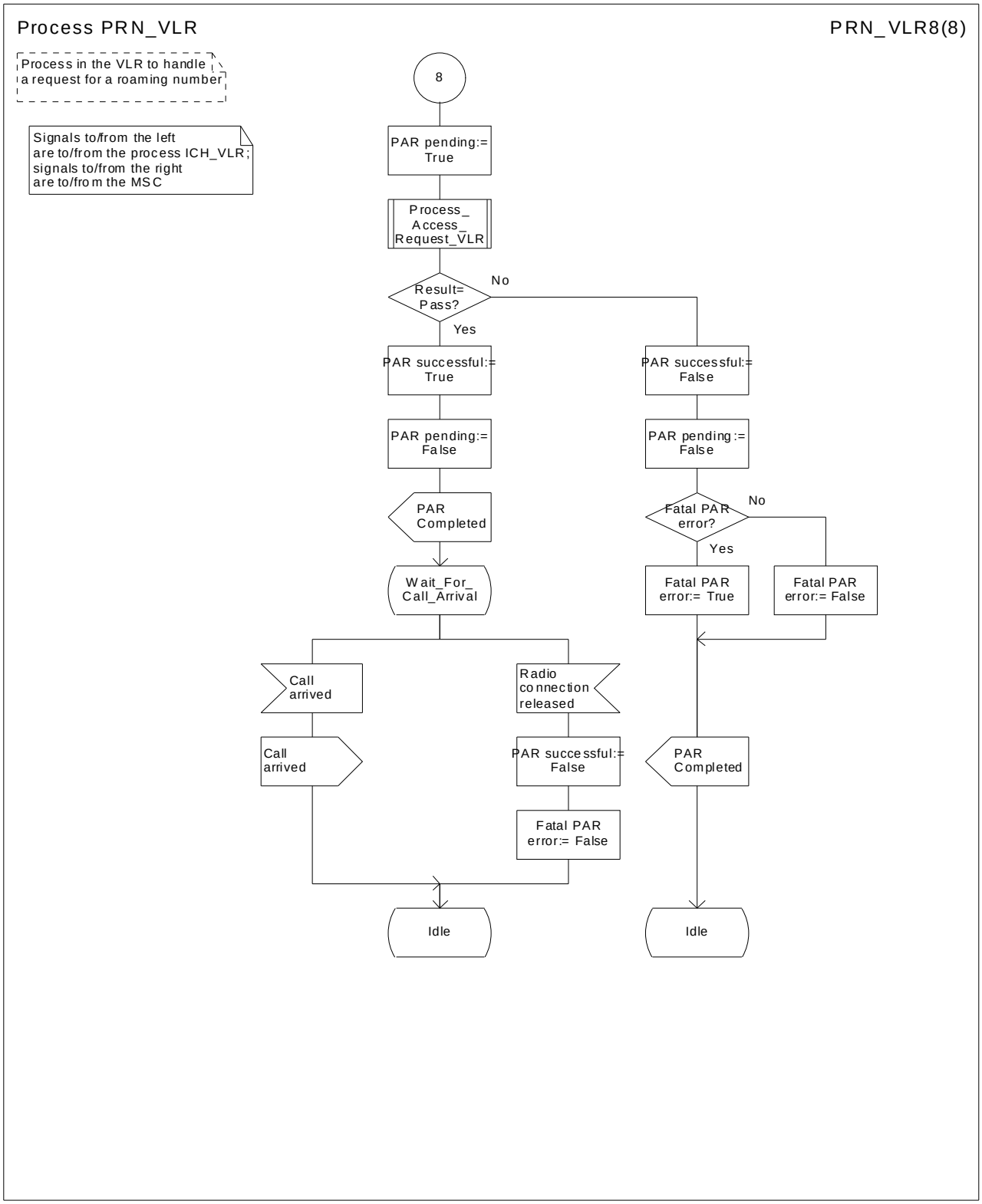


Figure 54h: Process PRN_VLR (sheet 8)

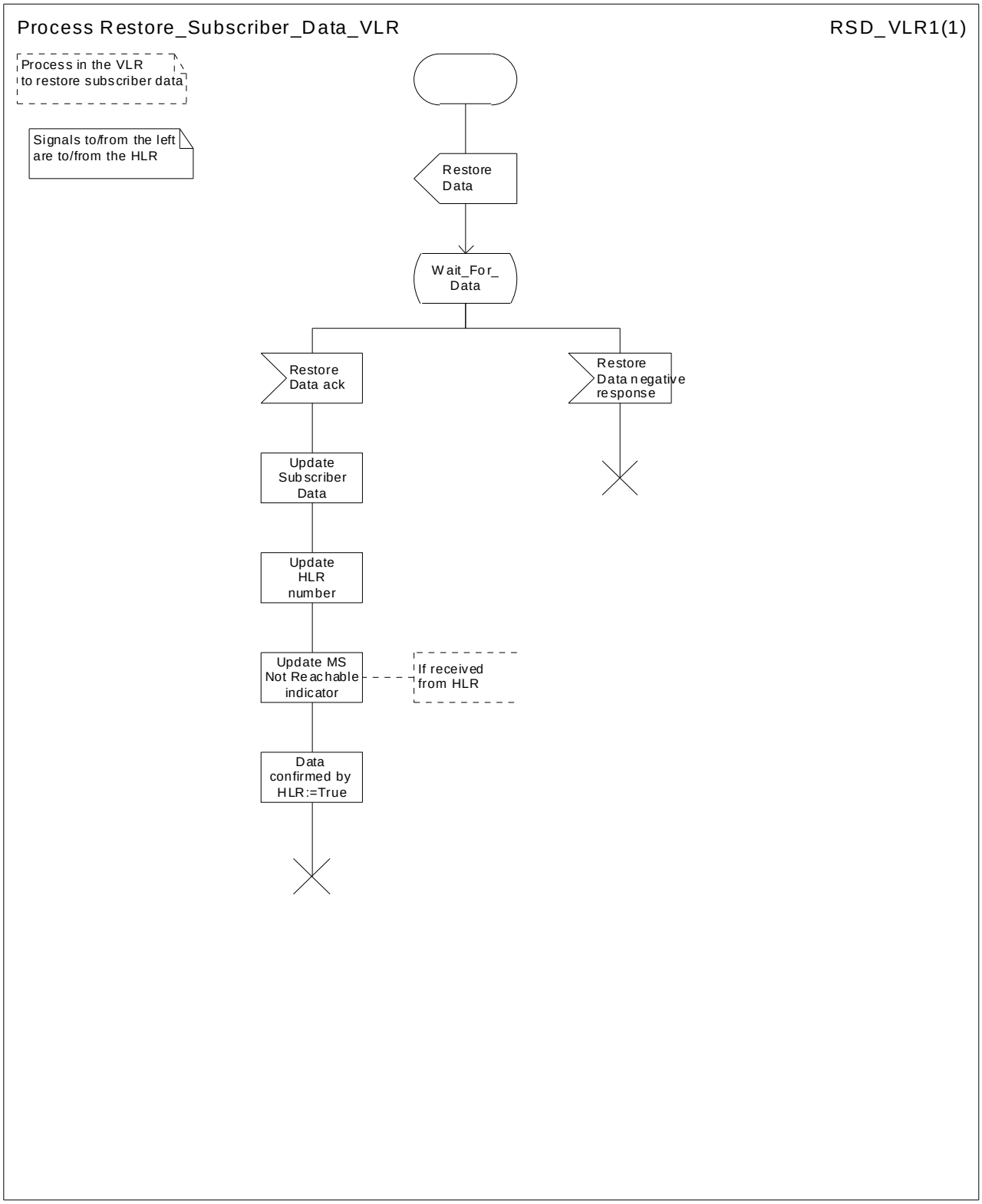


Figure 56: Process Restore_Subscriber_Data_VLR

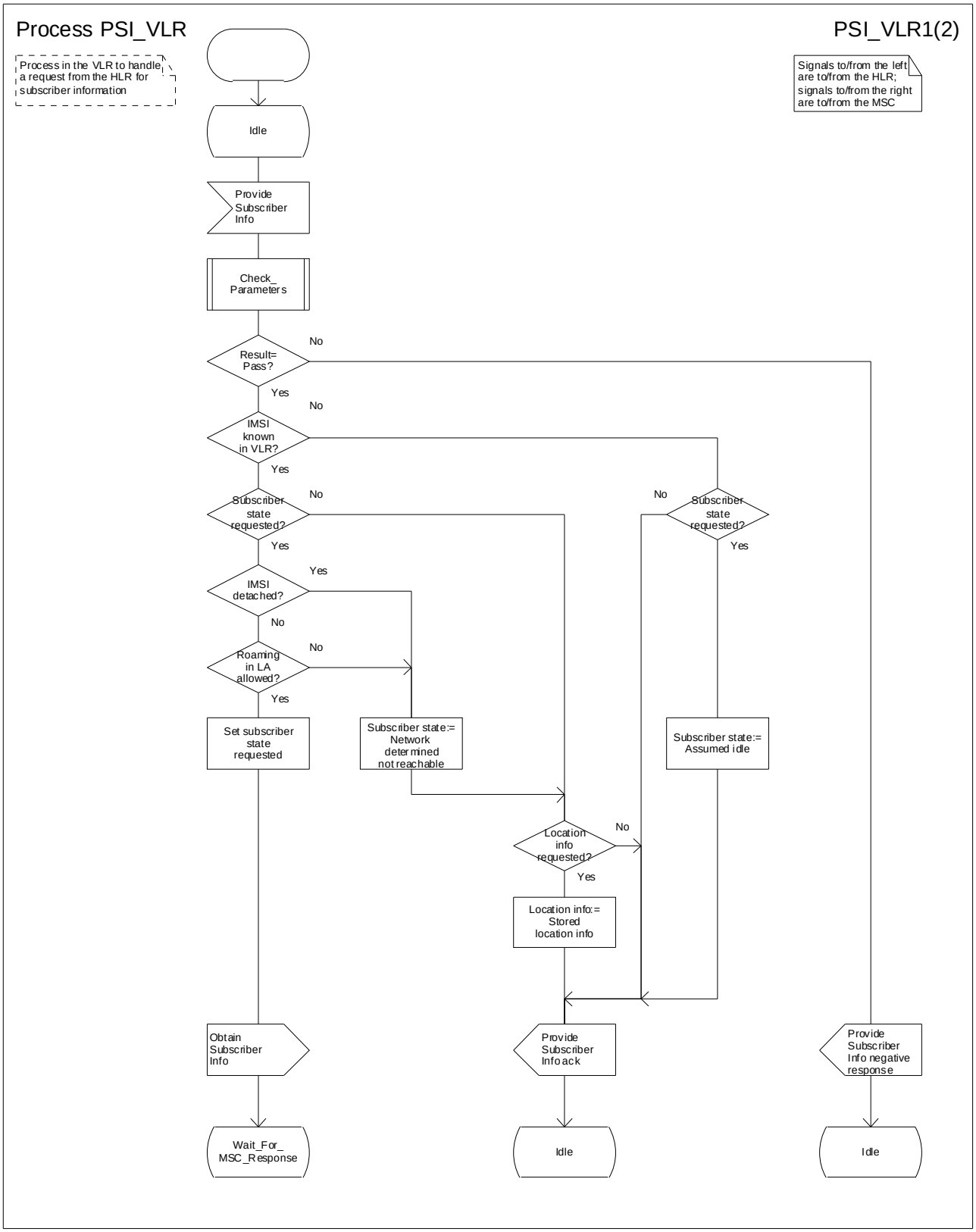


Figure 57a: Process PSI_VLR (sheet 1)

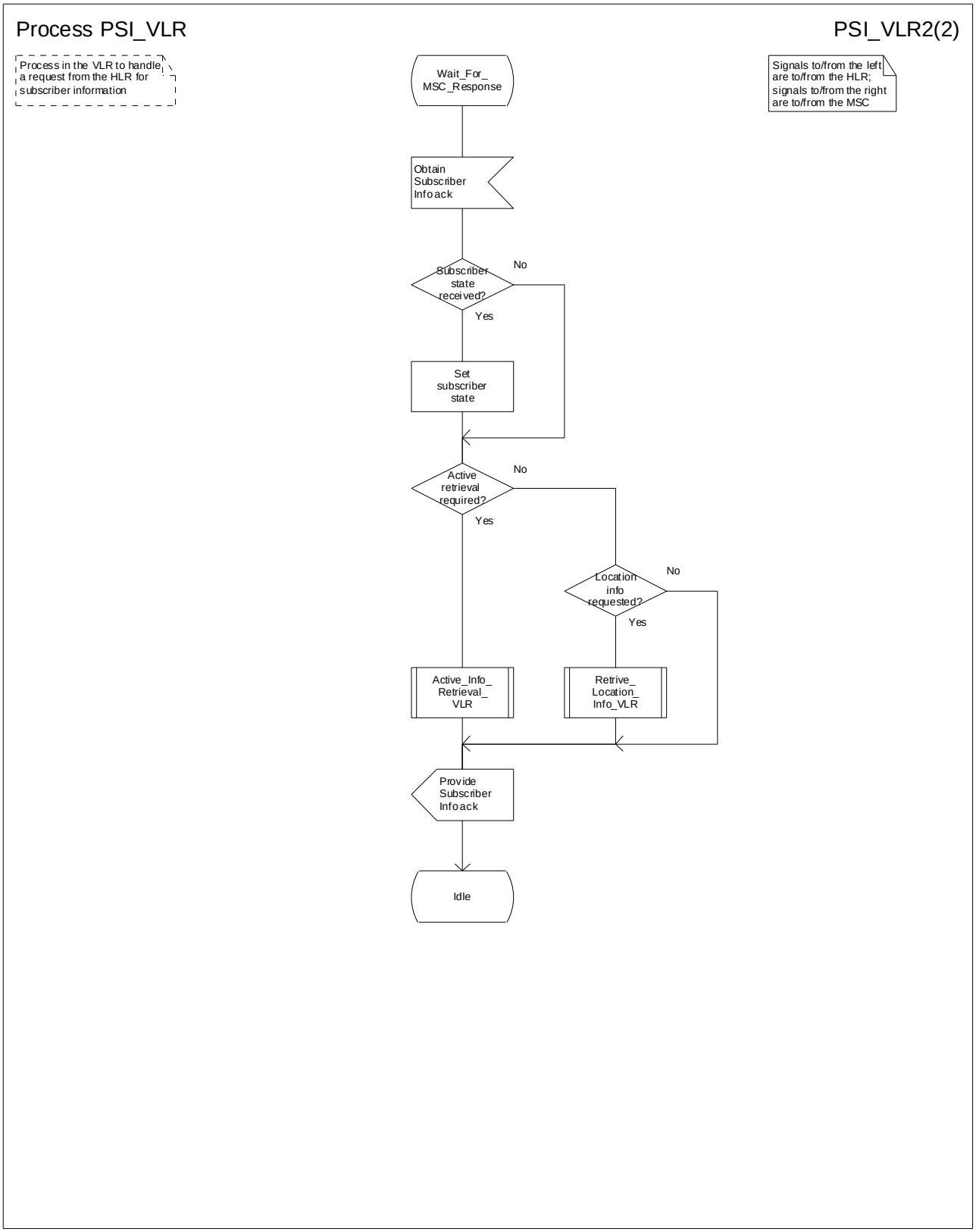


Figure 57b: Process PSI_VLR (sheet 2)

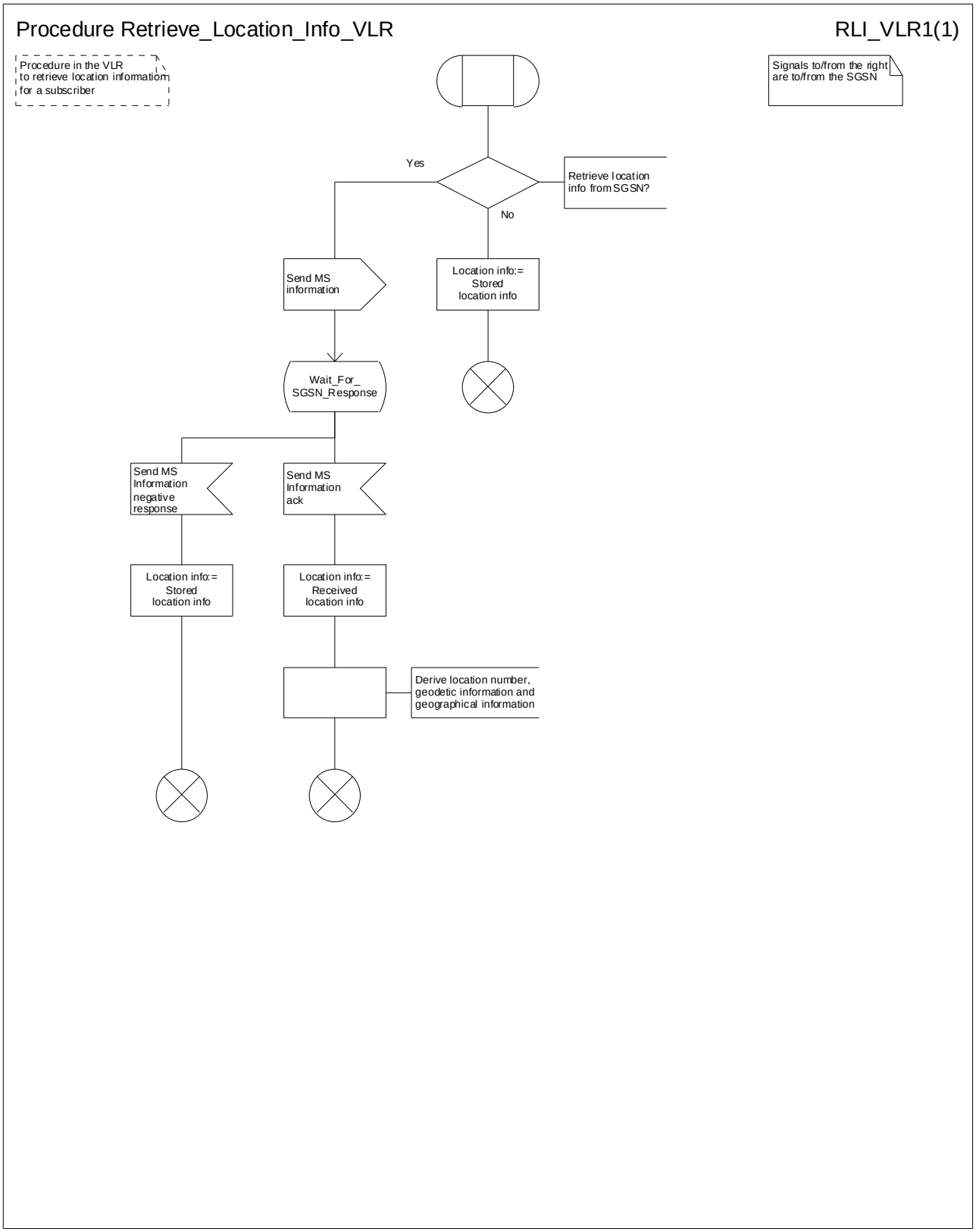


Figure 58: Procedure Retrieve_Location_Info_VLR

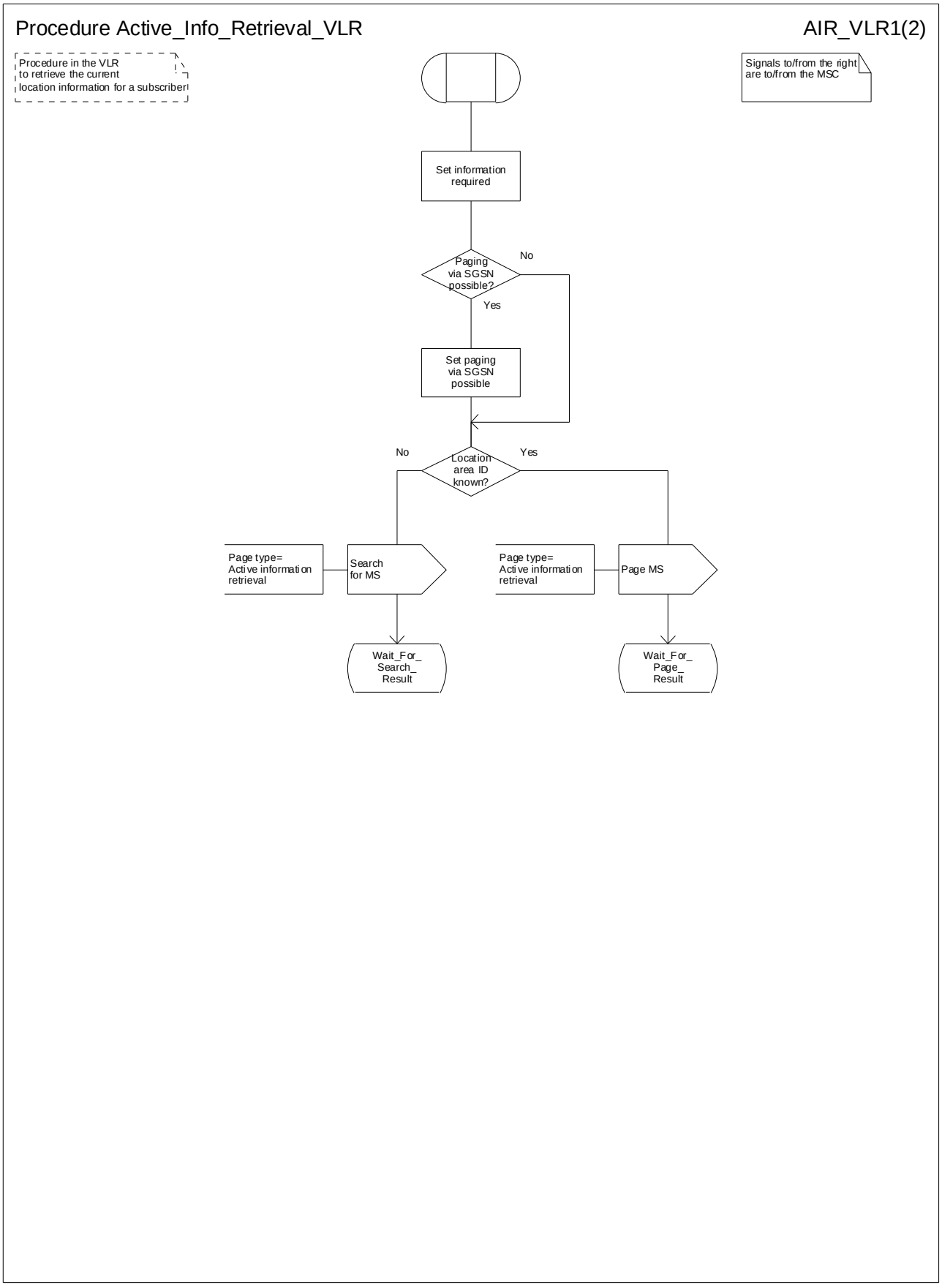


Figure 59a: Procedure Active_Info_Retrieval_VLR

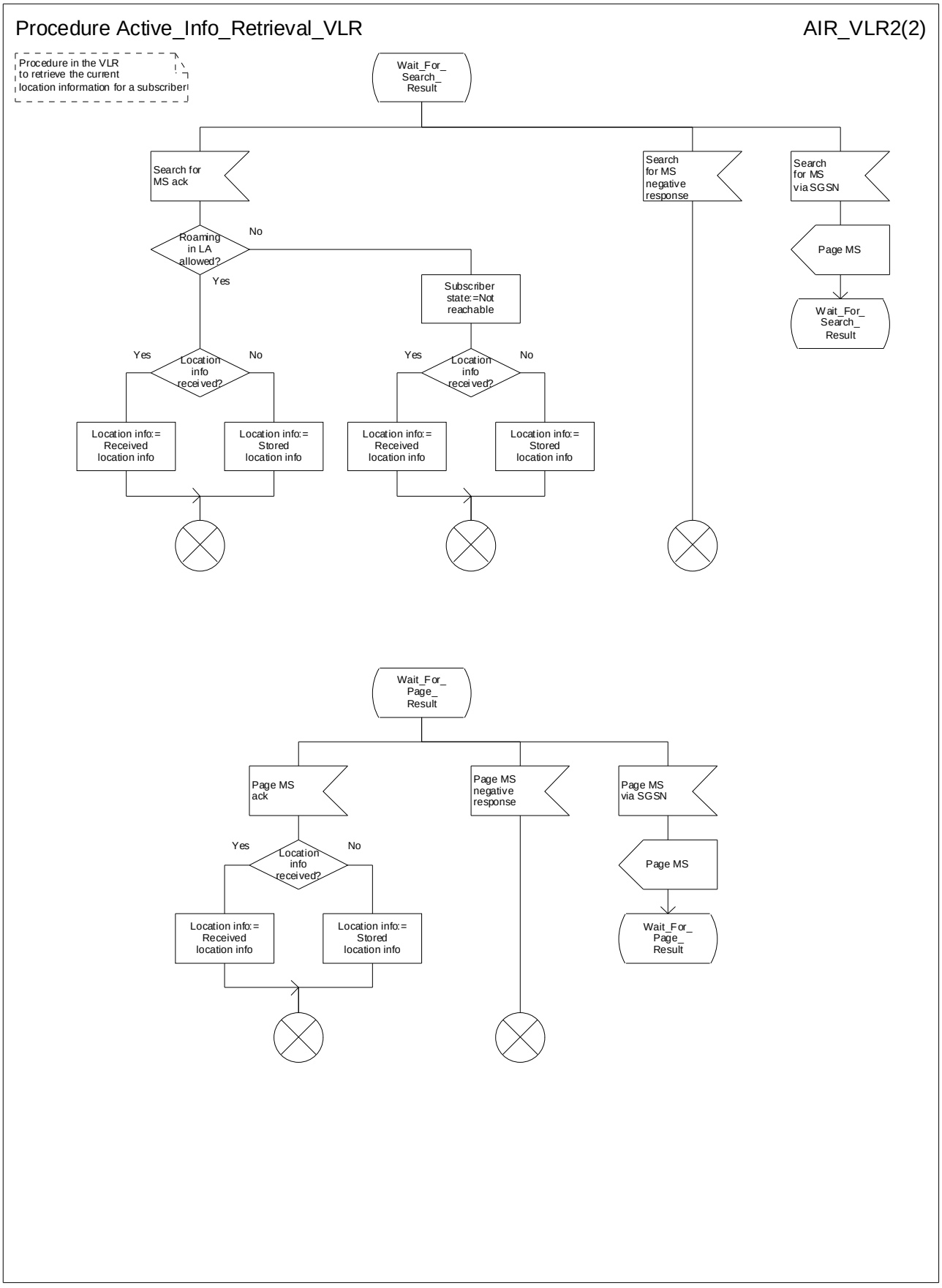


Figure 59b: Procedure Active_Info_Retrieval_VLR (sheet 2)

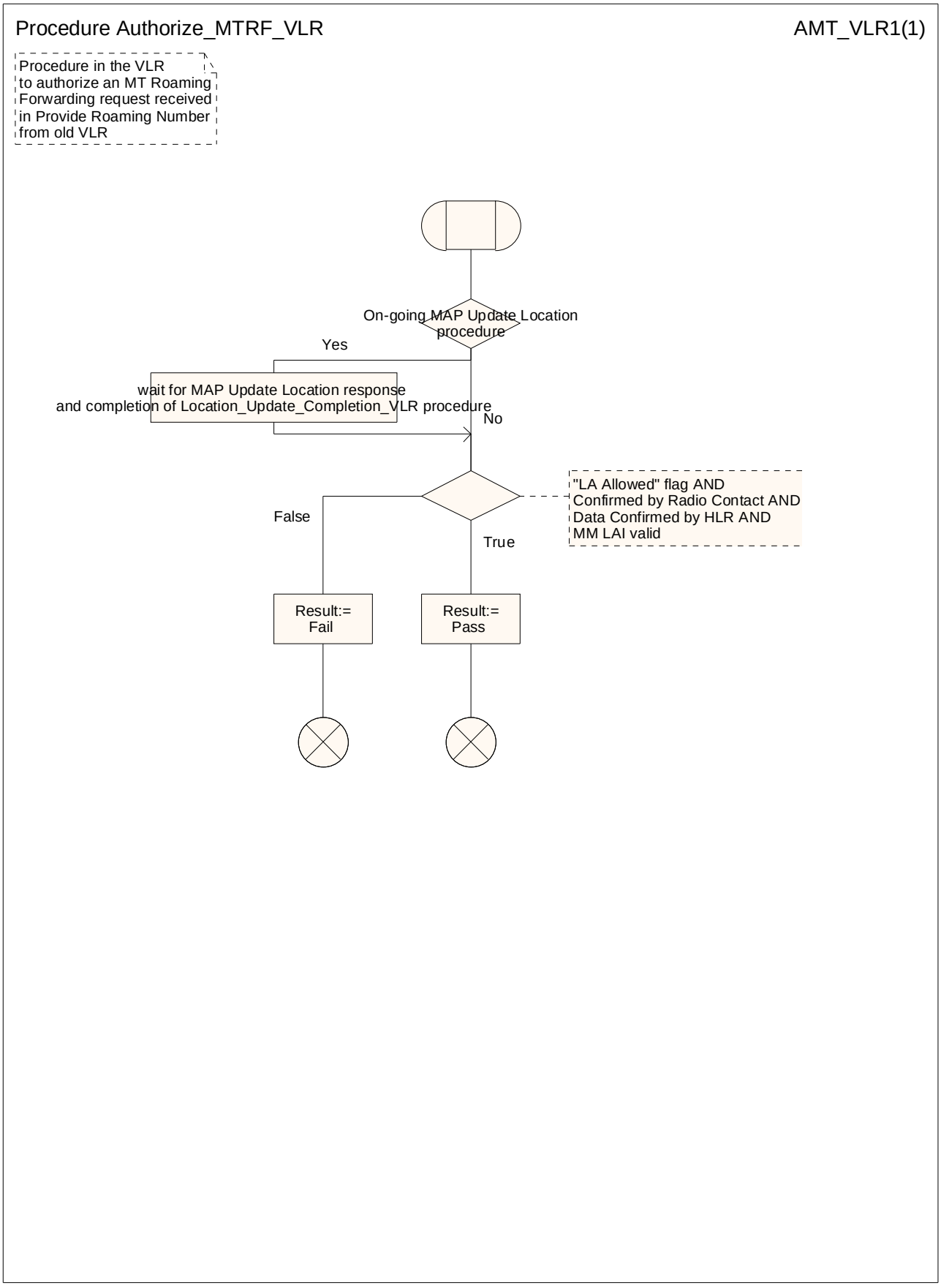


Figure 59b: Procedure Authorize_MTRF_VLR

7.2.4 Functional requirements of MSC

7.2.4.1 Process Prepage_MSC

7.2.4.2 Procedure Prepaging_Page_MS_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "MS busy" takes the "Yes" exit if the MS is engaged on a circuit-switched call.

The signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

7.2.4.3 Prepaging_Search_For_MS_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "MS busy" takes the "Yes" exit if the MS is engaged on a circuit-switched call.

The signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

7.2.4.4 Process OSI_MSC

If the MS is engaged on a circuit-switched call, the state is busy, otherwise assumed idle.

7.2.4.5 Process RCL_MSC

This process runs when the MSC receives a Page MS message or a Search for MS message with a Page type indicating Active Info Retrieval.

7.2.4.6 Procedure Active_Info_Retrieval_Page_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "GSM Access" takes the "Yes" exit if the MS is using a GSM radio access to communicate with the network.

The test "Report on change of service area?" takes the "Yes" exit if the MSC has performed the Location Reporting Control procedure (see 3GPP TS 25.413 [27]) with the Request Type IE set to "Change of service area".

If the test "Report on change of service area?" takes the "No" exit the MSC shall perform a Location Reporting Control procedure with the Request Type IE set to "Direct".

7.2.4.7 Procedure Active_Info_Retrieval_Search_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "GSM Access" takes the "Yes" exit if the MS is using a GSM radio access to communicate with the network.

The test "Report on change of service area?" takes the "Yes" exit if the MSC has performed the Location Reporting Control procedure (see 3GPP TS 25.413 [26]) with the Request Type IE set to "Change of service area".

If the test "Report on change of service area?" takes the "No" exit the MSC shall perform a Location Reporting Control procedure with the Request Type IE set to "Direct".

7.2.4.8 Procedure Retrieve_IMEI_If_Required

If the IMEI is retrieved using an existing connection between the MS and the network (as opposed to a connection which has been set up for active information retrieval), the Release transaction signal is relayed to the MSC process which is supervising the existing connection.

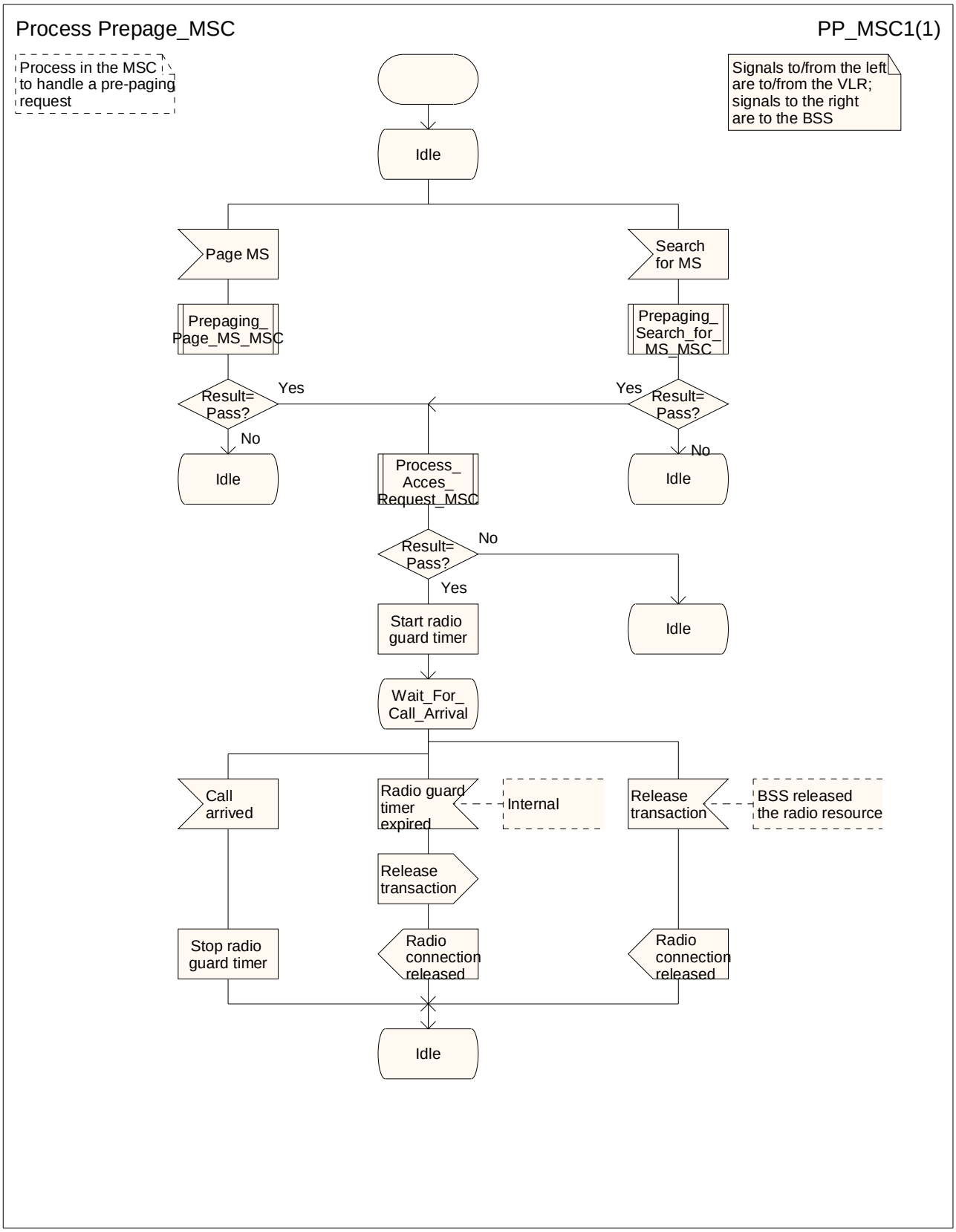


Figure 60: Process Prepage_MSC

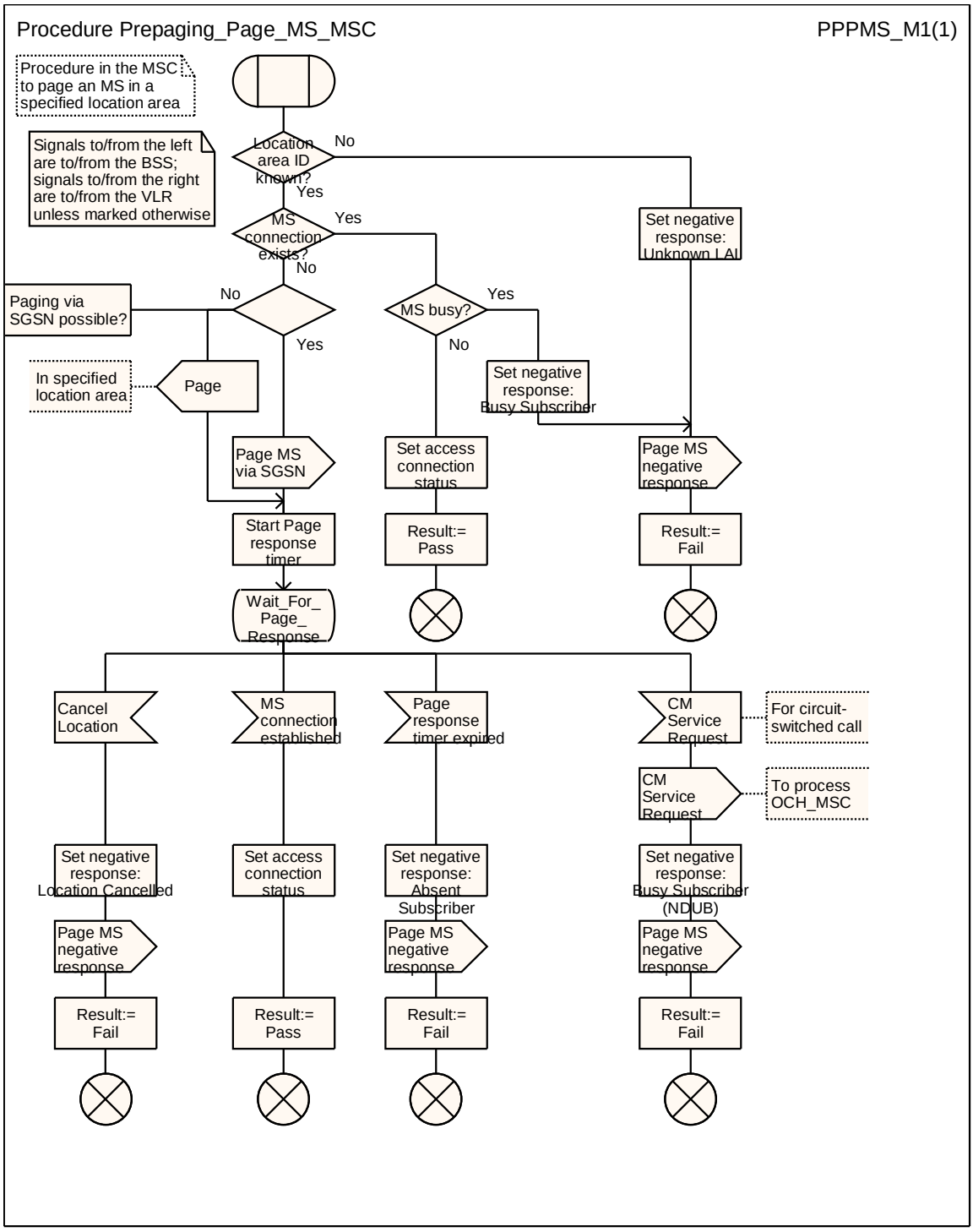


Figure 61: Procedure Prepaging_Page_MS_MSC

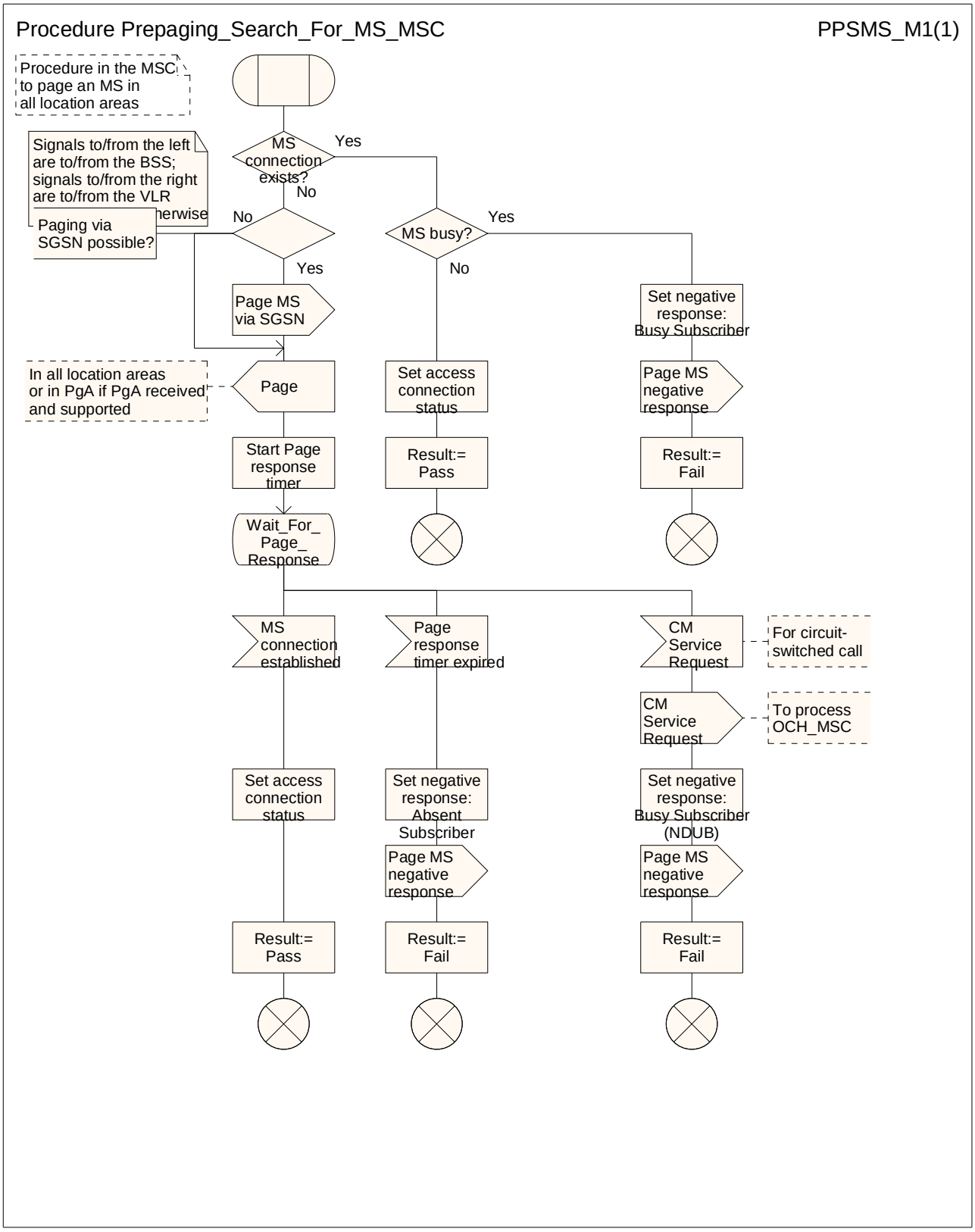


Figure 62: Procedure Prepaging_Search_For_MS_MSC

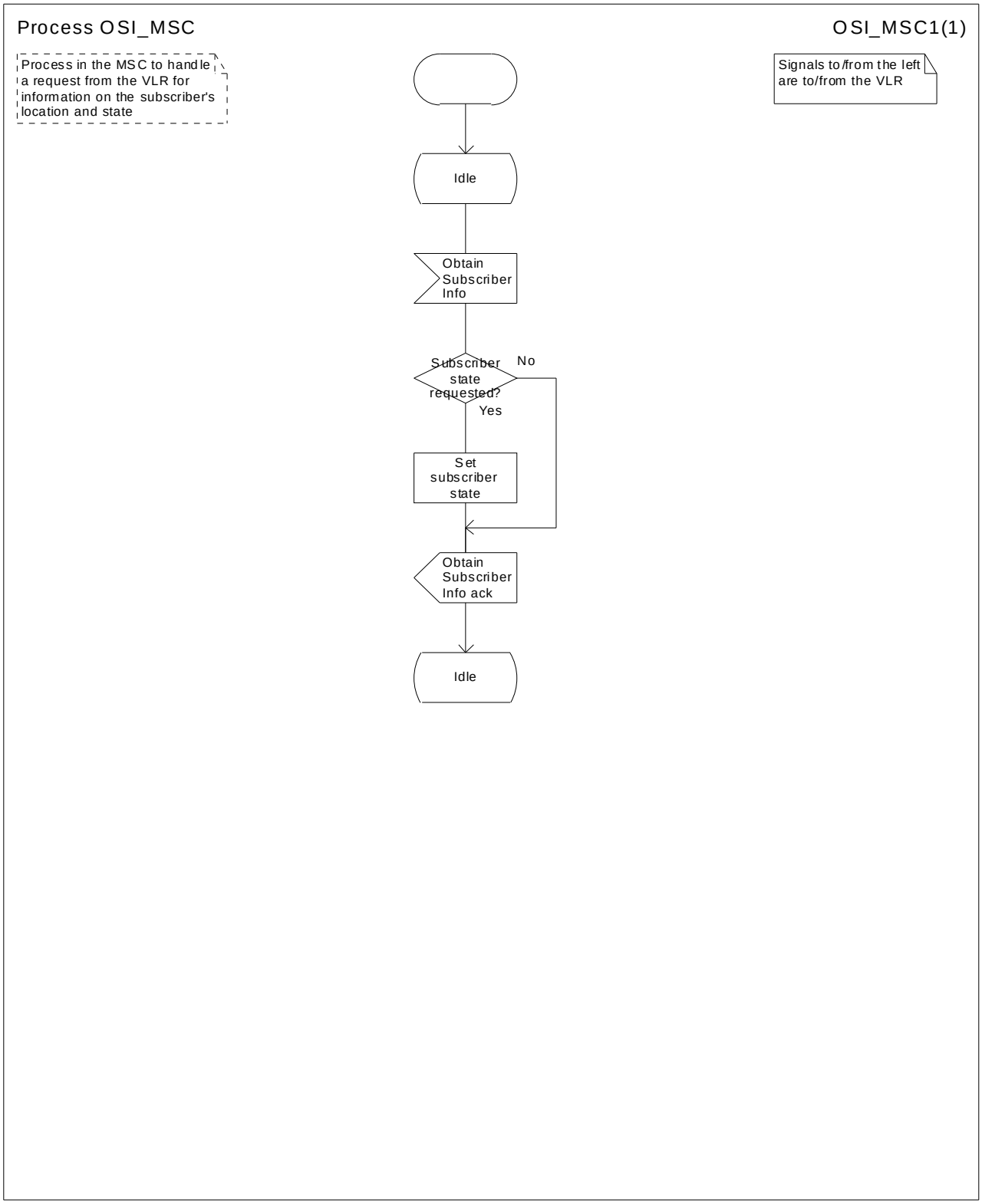


Figure 63: Process OSI_MSC

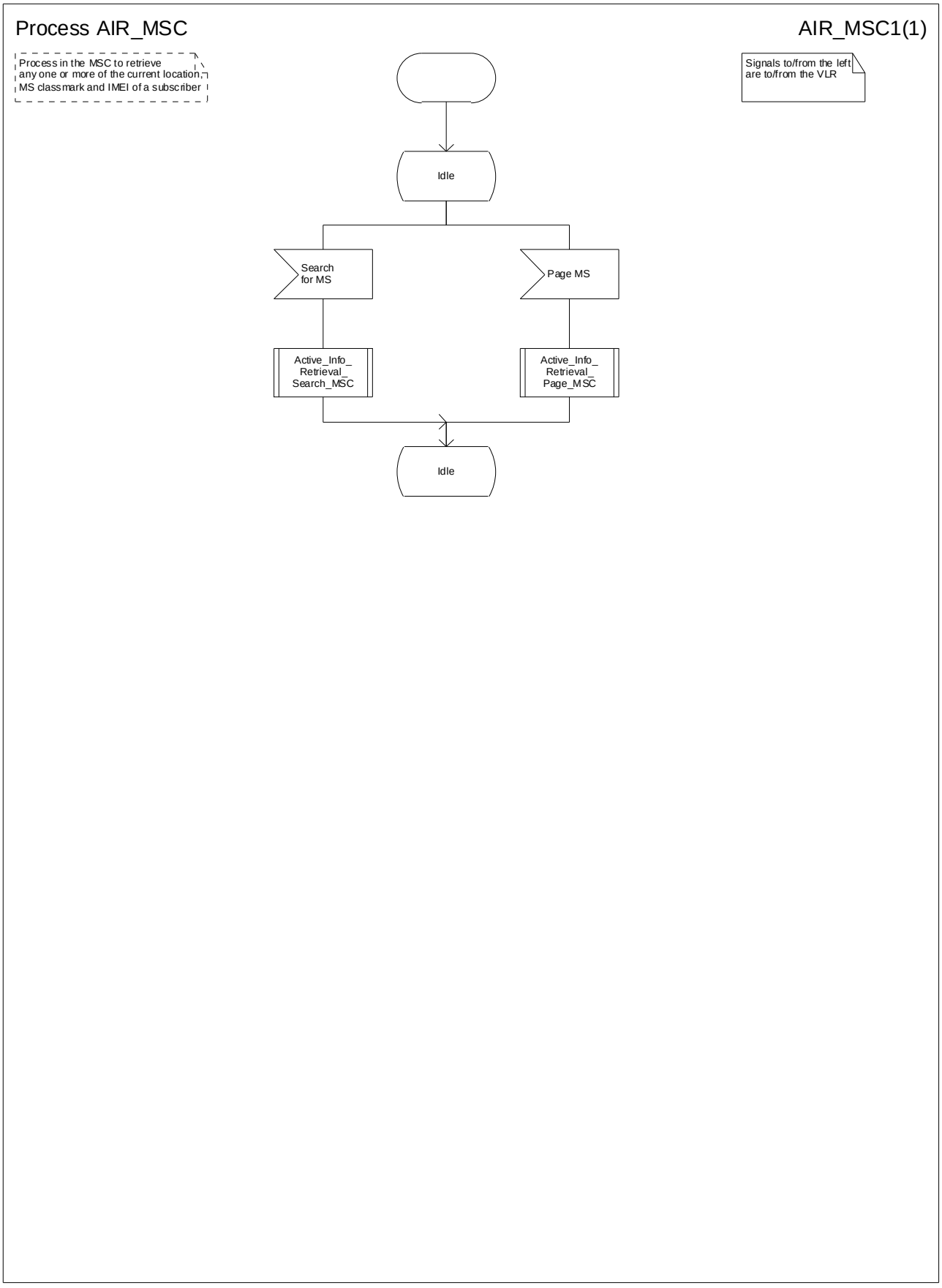


Figure 64: Process AIR_MSC

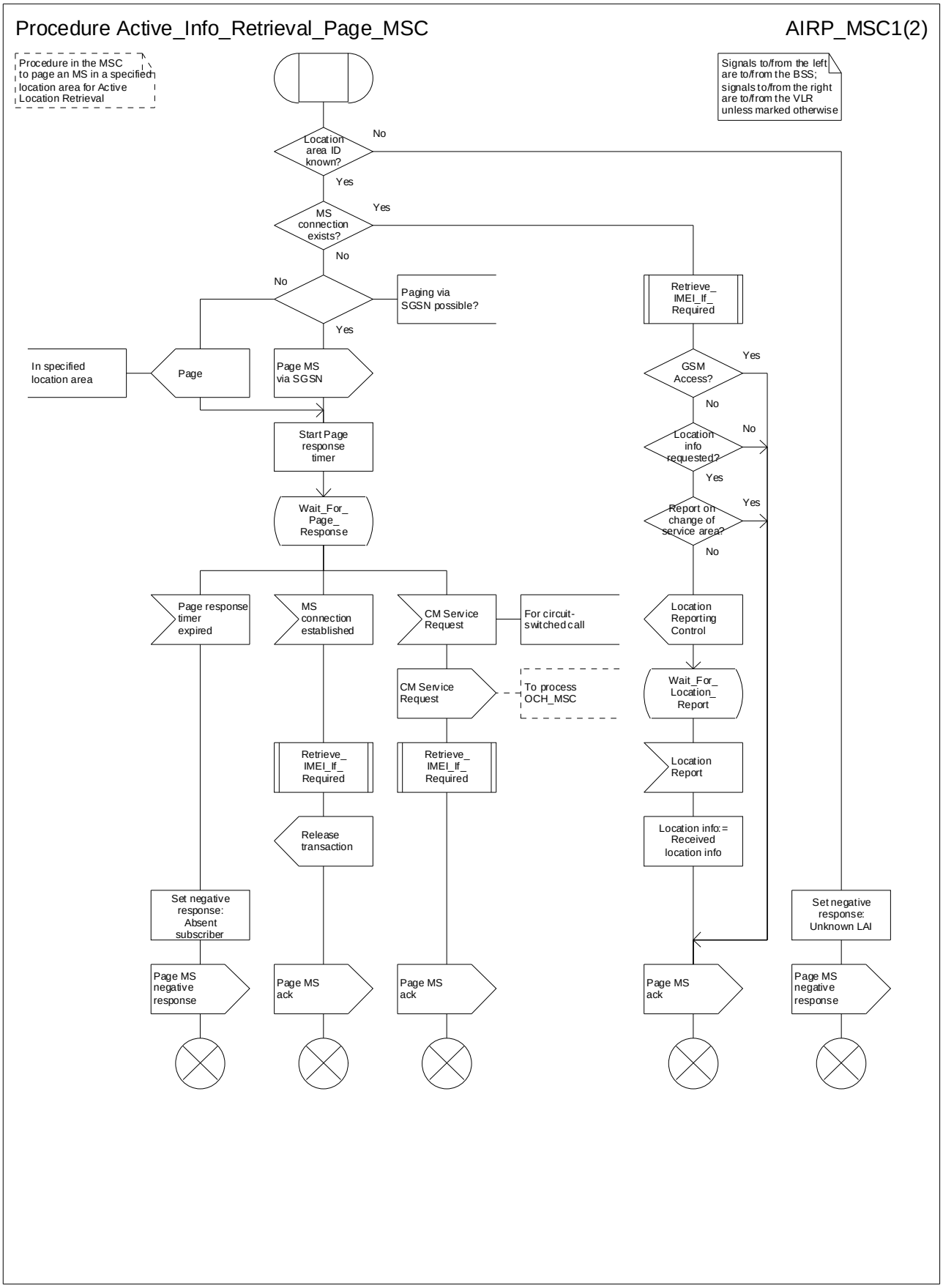


Figure 65: Procedure Active_Info_Retrieval_Page_MSC

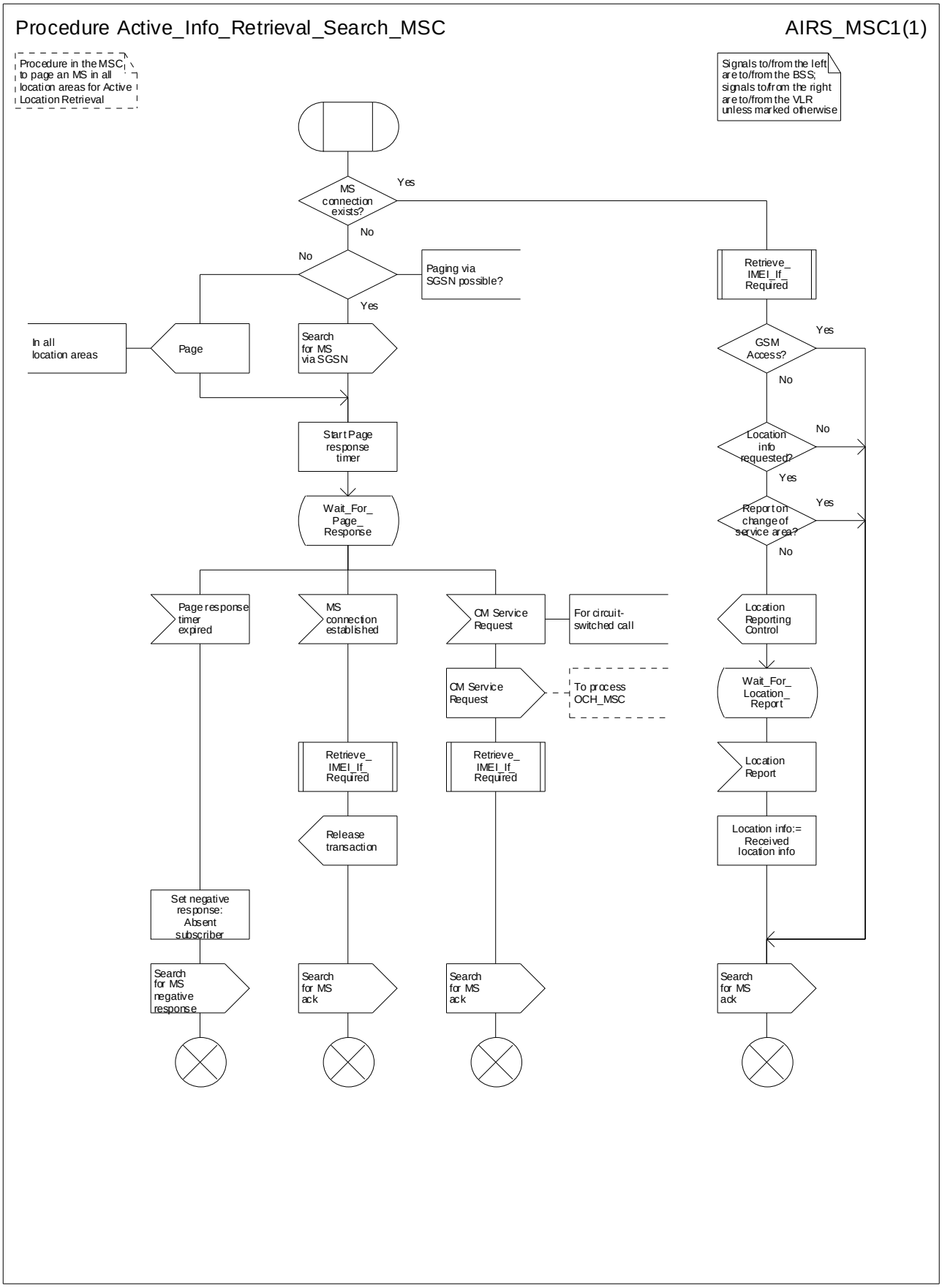


Figure 66: Procedure Active_Info_Retrieval_Search_MSC

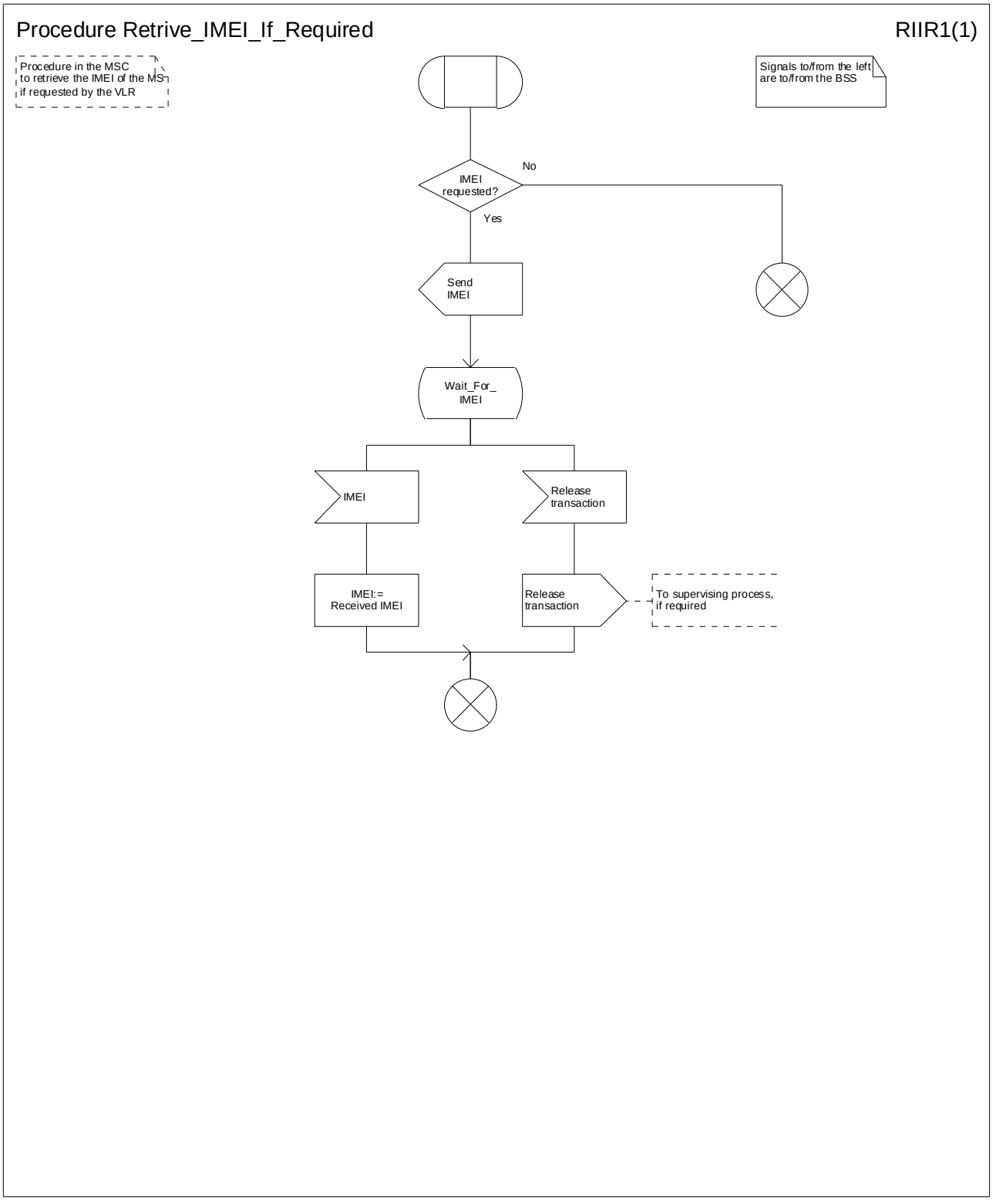


Figure 66bis: Procedure Retrieve_IMEI_If_Required

7.3 MT call

7.3.1 Functional requirements of serving MSC

7.3.1.1 Process ICH_MSC

Sheet 1: the task "Release Resources" refers to any resources that may have been allocated for the call due to Pre-Paging.

Sheet 1: the rules for converting the ISDN BC/LLC/HLC to a bearer service or teleservice are specified in 3GPP TS 29.007 [30].

Sheet 1: the task "Store UUS information (if received)" is executed only if the VMSC supports UUS.

Sheet 1: the variables TCH allocated, ACM sent, Answer sent and Network connect sent are global data, accessible to the procedures Establish_Terminating_TCH_If_Required, Send_ACM_If_Required, Send_Answer_If_Required and Send_Network_Connect_If_Required.

Sheet 1: the variables UUS result sent, UUS1 implicit active, UUS1 explicit active, UUS2 active, UUS3 active and UUS CF interaction are specific to UUS. They are accessible to all UUS specific procedures.

Sheet 1: the handling starting with the input signal "Continue CAMEL handling" is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, this signal will not be received from the VLR.

Sheet 1: the procedure CAMEL_ICH_MSC_INIT is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1: The variable "On_Hold" is used only if the VMSC supports Call Hold.

Sheet 1, sheet 4, sheet 9: the process CAMEL_ICH_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2: the procedure Process_Access_Request_MSC is specified in clause 7.1.1.2.

Sheet 2: the signal input Complete Call will be received in the state Wait_For_Page_Request only if the MSC/VLR supports pre-paging.

Sheet 2, sheet 3: the suggested mapping from values of the Send Info For Incoming Call negative response information element to values of the ISUP release cause (see ITU-T Recommendation Q.850 [37]) is shown in table 2. The mapping used is a matter for the network operator, depending on the telephony signalling system used.

Table 2: Suggested mapping of Send Info For Incoming Call (SIFIC) negative responses to ISUP release causes

SIFIC negative response	ISUP release cause number	ISUP release cause name
Absent subscriber	20	Subscriber absent
Busy subscriber	17	User busy
CUG reject (Called party SS interaction violation)	21	Call rejected
Forwarding violation	21	Call rejected
Impossible call completion	111	Protocol error, unspecified
No subscriber reply	19	No answer from user (user alerted)
System failure	111	Protocol error, unspecified
Unallocated roaming number	111	Protocol error, unspecified

Sheet 2, sheet 3, sheet 6, sheet 8, sheet 10, sheet 12: the procedure CAMEL_MT_GMSC_DISC4 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 2, sheet 5, sheet 8, sheet 10, sheet 11, sheet 12: the procedure CAMEL_MT_GMSC_DISC6 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CAMEL_MT_GMSC_DISC5 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 3: the procedure CD_Reject is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

Sheet 3: the procedure Process_Call_Waiting is specific to Call Waiting; it is specified in 3GPP TS 23.083 [16].

Sheet 3: the task "Store CW treatment indicator for this call if received in SII2" is executed only if the VMSC supports CAMEL phase 3 or later.

Sheet 3: if the VMSC does not support CAMEL phase 3 or later, the procedure Complete_Call_In_MSC and the procedure Process_Call_Waiting will not return a "Reconnect" result.

Sheet 3: the processing in the branch starting with the input signal"Process Call Waiting" is specific to Call Wait. If the VMSC does not support Call Waiting, this signal will not be received from the VLR.

Sheet 3, sheet 10: the procedure CCBS_Set_Diagnostic_For_Release is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 5, sheet 6, sheet 11, sheet 12, sheet 13: the procedure CCBS_Check_Last_Call is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3: the procedure UUS_ICH_Check_Support is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 4: the procedure CAMEL_ICH_LEG2_MSC isspecific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 9: the procedure CAMEL_ICH_LEG2_CF_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 5: the procedure CAMEL_Check_ORLCF_VMSC is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12].

- If the VLR does not support CAMEL or no CAMEL information is available for the subscriber, then ORLCF may take place ('ORLCF' result from CAMEL_Check_ORLCF_VMSC).
- If CAMEL information is available for the subscriber and the GMSC supports the required CAMEL phase, then ORLCF may take place. The Resume Call Handling request shall include the relevant CAMEL information ('ORLCF' result from CAMEL_Check_ORLCF_VMSC).
- If CAMEL information is available for the subscriber but the GMSC does not support the required CAMEL phase, then ORLCF shall not take place ('VMSCCF' result from CAMEL_Check_ORLCF_VMSC).

Sheet 5: the procedure Handle_ORLCF_VMSC is specific to Support of Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the VMSC does not support Optimal Routeing, processing continues from the "Continue" exit of the test "Result?".

Sheet 5, sheet 6, sheet 11: the procedures CD_Failure and CD_Success are specific to Call Deflection; they are specified in 3GPP TS 23.072 [11].

Sheet 5: If MT Roaming Forwarding is supported and the MT Roaming Forwarding Indicator is received from the VLR, the MSC stops any on-going Camel transaction.

Sheet 6: the procedure CAMEL_MT_VMSC_Notify_CF is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6: If the VMSC does not support CAMEL phase 3 or later, processing starts with the possible call of the procedure CCBS_Check_Last_Call.

Sheet 6: The task "set redirection information" includes the mapping of the MSISDN parameter received in the Send Info For Incoming Call ack message to the redirecting number of the IAM message and the setting of the presentation indicator of the redirecting number of the IAM message according to the value of the Redirecting presentation parameter received in the Send Info For Incoming Call ack message.

Sheet 6: it is an operator option whether to send an Address Complete message if the VLR returns forwarding information. If the VMSC sends an Address Complete message, it shall include the called party's status field of the Backward call indicator set to "no indication".

Sheet 6, sheet 8: the procedure Send_ACM_If_Required is specified in clause 7.2.1.3.

Sheet 6: the procedure Activate_CF_Process is specified in clause 7.2.1.7.

Sheet 6: the procedure UUS_ICH_Set_Info_In_IAM is specific to UUS, it is specified in 3GPP TS 23.087 [20].

Sheet 6: the called party address sent in the IAM to the process MT_CF_MSC is the Forwarded-to number received in the Perform Call Forwarding ack.

Sheet 6: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 7: The processing on this sheet is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, the input signal Int_Release Call will not be received.

Sheet 8: the procedure CAMEL_MT_GMSC_ANSWER is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 8: the procedure Handle_COLP_Forwarding_Interaction_MSC is specified in clause 7.2.1.6.

Sheet 8: the procedure Send_Answer_If_Required is specified in clause 7.2.1.4.

Sheet 8: the procedure Send_Network_Connect_If_Required is specified in clause 7.2.1.5.

Sheet 8: the procedure CAMEL_MT_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 10: the procedure CCBS_MT_MSC_Check_Forwarding is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 11: the processing on this sheet is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, the input signal Send Info For MT Reconnected Call ack will not be received.

Sheet 11: the procedure Handle_ORLCF_VMSC is specific to OR; it is specified in 3GPP TS 23.079 [13]. If the VMSC does not support OR, processing continues from the "No" exit of the test "Result = Forwarding Failed?".

Sheet 13, sheet 14: the procedure CAMEL_MT_GMSC_DISC1 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 13, sheet 14: the procedure CAMEL_MT_GMSC_DISC2 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 13: the procedure UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 14: after the VMSC has sent an IAM to the process MT_CF_MSC, it acts as a transparent relay for messages received from the GMSC and the process MT_CF_MSC. Any message other than Address Complete, Connect, Answer or Release causes no change of state in the process ICH_MSC.

Sheet 15: The processing on this sheet is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, the input signal Int_Release Call will not be received.

Sheet 16: the procedure Process_Hold_Request is specific to Call Hold; it is specified in 3GPP TS 23.083[16].

Sheet 16: the procedure Process_Retrieve_request is specific to Call_Hold; it is specified in 3GPP TS 23.083[16].

7.3.1.2 Procedure Page_MS_MSC

Sheet 1: the test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

Sheet 1: for an SMS or SS page, the test "Call still exists" takes the "Yes" exit if the SMS or SS transaction which led to the page still exists.

Sheet 1: the test "SMS or SS page" is not required for the handling of circuit-switched calls, because the VLR will always use a page type of "circuit-switched call", but the more generalized procedure Page_MS_MSC is equally applicable to paging for SMS delivery or network-initiated SS procedures.

Sheet 1: If the MSC supports the option to delay Mobile Terminating CM request during a location update procedure (see 3GPP TS 24.008 [13] clause 4.5.1.3.1 Mobile Terminating CM Activity):

If location update procedure is ongoing for the MS,

If the "follow-on" indicator is received and MSC supports "follow-on" feature, the Page_MS_MSC procedure should return FAIL after sending Page MS negative response (cause Busy Subscriber) to VLR.

Otherwise, the MSC should delay the launching of Page_MS_MSC procedure until the location update procedure ends.

- If the result of location update is successful and location update is not through Gs interface, then Page_MS_MSC procedure returns with PASS.
- If the result of location update is successful and location update is through Gs interface, then Page_MS_MSC continues from the beginning of the procedure.
- If the result of location update is not successful, then the procedure should return FAIL after sending Page MS negative response (cause Absent Subscriber) to VLR.

Sheet 2: the procedure Check_MT_Multicall_MSC is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Not provisioned?".

Sheet 2: the test "Call in set-up" takes the "Yes" exit if the call on which the MS is engaged has not reached the established phase (called party answer).

Sheet 2: the test Call waiting" takes the "Yes" exit if a waiting call has been offered to the subscriber but the outcome of offering the call has not been determined.

Sheet 2: if there is one established call, the negative response Busy Subscriber (More calls possible) includes the basic service which applies for the established call. If there are two or more established calls (the Multicall case), the negative response Busy Subscriber (More calls possible) includes the basic service list which applies for the established calls (See 3GPP TS 23.135 [25]).

Sheet 3: the signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

Sheet 4: A MSC not implementing the MT Roaming Retry feature and the MT Roaming Forwarding feature may not immediately stop paging upon receipt of a Cancel Location message.

7.3.1.3 Procedure Search_For_MS_MSC

Sheet 1: the test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

Sheet 1: for an SMS or SS page, the test "Call still exists" takes the "Yes" exit if the SMS or SS transaction which led to the page still exists.

Sheet 1: the test "SMS or SS page" is not required for the handling of circuit-switched calls, because the VLR will always use a page type of "circuit-switched call", but the more generalized procedure Search_For_MS_MSC is equally applicable to paging for SMS delivery or network-initiated SS procedures.

Sheet 1: If the MSC supports the option to delay the Mobile Terminating CM request during a location update procedure (see 3GPP TS 24.008 [13] clause 4.5.1.3.1 Mobile Terminating CM Activity):

If location update procedure is ongoing for the MS, and if the "follow-on" indicator is received and the MSC supports the "follow-on" feature, the Search_MS_MSC procedure should return FAIL after sending Search MS negative response (cause Busy Subscriber) to VLR.

Otherwise, the MSC should delay the launching of Search_MS_MSC procedure until location update procedure ends.

- If the result of location update is successful and location update is not through Gs interface, then the Search_MS_MSC procedure returns with PASS.
- If the result of location update is successful and location update is through Gs interface, then the procedure continues from the beginning of the Page_MS_MSC procedure.
- If the result of the location update is not successful, then the procedure should return FAIL after sending the Search MS negative response (cause Absent Subscriber) to VLR.

Sheet 2: the procedure Check_MT_Multicall_MSC is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Not provisioned?".

Sheet 2: the test "Call in set-up" takes the "Yes" exit if the call on which the MS is engaged has not reached the established phase (called party answer).

Sheet 2: the test "Call waiting" takes the "Yes" exit if a waiting call has been offered to the subscriber but the outcome of offering the call has not been determined.

Sheet 2: if there is one established call, the negative response Busy Subscriber (More calls possible) includes the basic service which applies for the established call. If there are two or more established calls (the Multicall case), the negative response Busy Subscriber (More calls possible) includes the basic service list which applies for the established calls (See 3GPP TS 23.135 [25]).

Sheet 3: the signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

Sheet 4 : A MSC not implementing the MT Roaming Retry feature and the MT Roaming Forwarding feature may not immediately stop paging upon receipt of a Cancel Location message.

7.3.1.4 Procedure Complete_Call_In_MSC

Sheet 1: the procedure Set_CLIP_Info_MSC is specific to CLIP.

Sheet 1: the VMSC derives the PLMN bearer capability required for the call according to the rules defined in 3GPP TS 29.007 [30].

Sheet 1, sheet 2: the VMSC and the MS may negotiate the bearer capability to be used for the call by the exchange of information in the Set-up and Call Confirmed messages.

Sheet 1: the procedure UUS_ICH_UUS1_Implicit_Active is specific to UUS, it is specified in 3GPP TS 23.087 [20].

Sheet 1: the procedure CCBS_Report_Not_Idle is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 2: the procedure Establish_Terminating_TCH_Multicall is specific to Multicall; it is specified in 3GPP TS 23.135 [25].

Sheet 2: the test "Result=Rejected?" can take the "Yes" exit only if the procedure Establish_Terminating_TCH_Multicall was called.

Sheet 2, sheet 3, sheet 4, sheet 5, sheet 6, sheet 7: the procedure CAMEL_MT_GMSC_DISC4 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 2, sheet 3, sheet 6, sheet 9, sheet 10: the procedure CAMEL_MT_GMSC_DISC6 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2, sheet 5, sheet 9: the procedure CCBS_ICH_MSC_Report_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 5: the procedure CCBS_ICH_MSC_Report_Success is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3: the procedure CAMEL_Start_TNRy is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CAMEL_MT_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 3, sheet 6: the procedure UUS_ICH_Check_Support is specific to UUS, it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 3: the task "UTU2Cnt:=0" is executed only if the VMSC supports UUS.

Sheet 3: the procedure Send_ACM_If_Required is specified in clause 7.2.1.3.

Sheet 3, sheet 6: the procedure Establish_Terminating_TCH_Multicall is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 4, sheet 7: the procedure Handle_AoC_MT_MSC is specific to AoC. If the VMSC does not support AoC, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 4, sheet 7: the procedure CAMEL_MT_GMSC_ANSWER is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 4, sheet 7: the procedure Set_COL_Presentation_Indicator_MSC is specific to COLP.

Sheet 4: the procedure Send_Network_Connect_If_Required is specified in clause 7.2.1.5.

Sheet 5, sheet 11: the processing in the branch starting with the input "CD Request" is specific to Call Deflection; if the VMSC does not support Call Deflection the input is discarded.

Sheet 5, sheet 11: the procedure Handling_CD_MSC is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

Sheet 6: the procedure CAMEL_Stop_TNRy is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 7: the procedure Send_Answer_If_Required is specified in clause 7.2.1.4.

Sheet 8: the input signal "CAMEL TNRy expired" will be received only if the VMSC supports CAMEL phase 3 or later.

Sheet 8, sheet 11: the procedure UUS_ICH_Check_Forwarding is specific to UUS, it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 9, sheet 10: the procedure UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 11: the procedures UUS_MSC_Check_UUS2_UUI_to MS and UUS_MSC_Check_UUS2_UUI_to NW are specific to UUS, they are specified in 3GPP TS 23.087 [20].

Sheet 11: the procedure CD_UUS_Interaction is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

7.3.1.5 Void

7.3.1.6 Procedure Set_CLIP_Info_MSC

The originating exchange may release the call or the MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process CLIP_MAF002. The message is saved for processing after return from the procedure.

7.3.1.7 Void

7.3.1.8 Procedure Establish_Terminating_TCH_If_Required

The procedure TCH_Check is specified in clause 7.1.1.14.

7.3.1.9 Procedure Handle_AoC_MT_MSC

7.3.1.10 Procedure Set_COL_Presentation_Indicator_MSC

The originating exchange may release the call or the MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process COLP_MAF041. The message is saved for processing after return from the procedure.

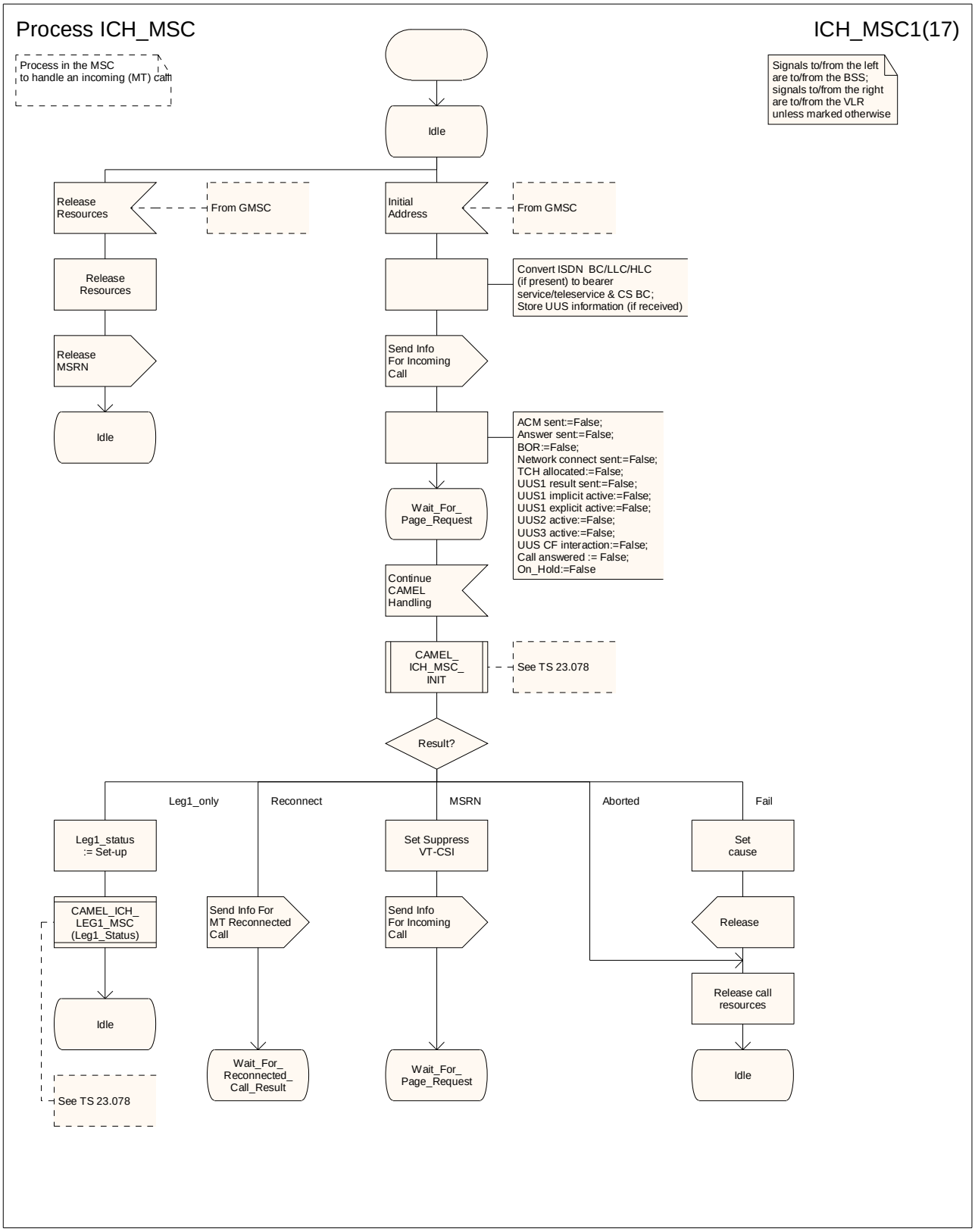


Figure 67a: Process ICH_MSC (sheet 1)

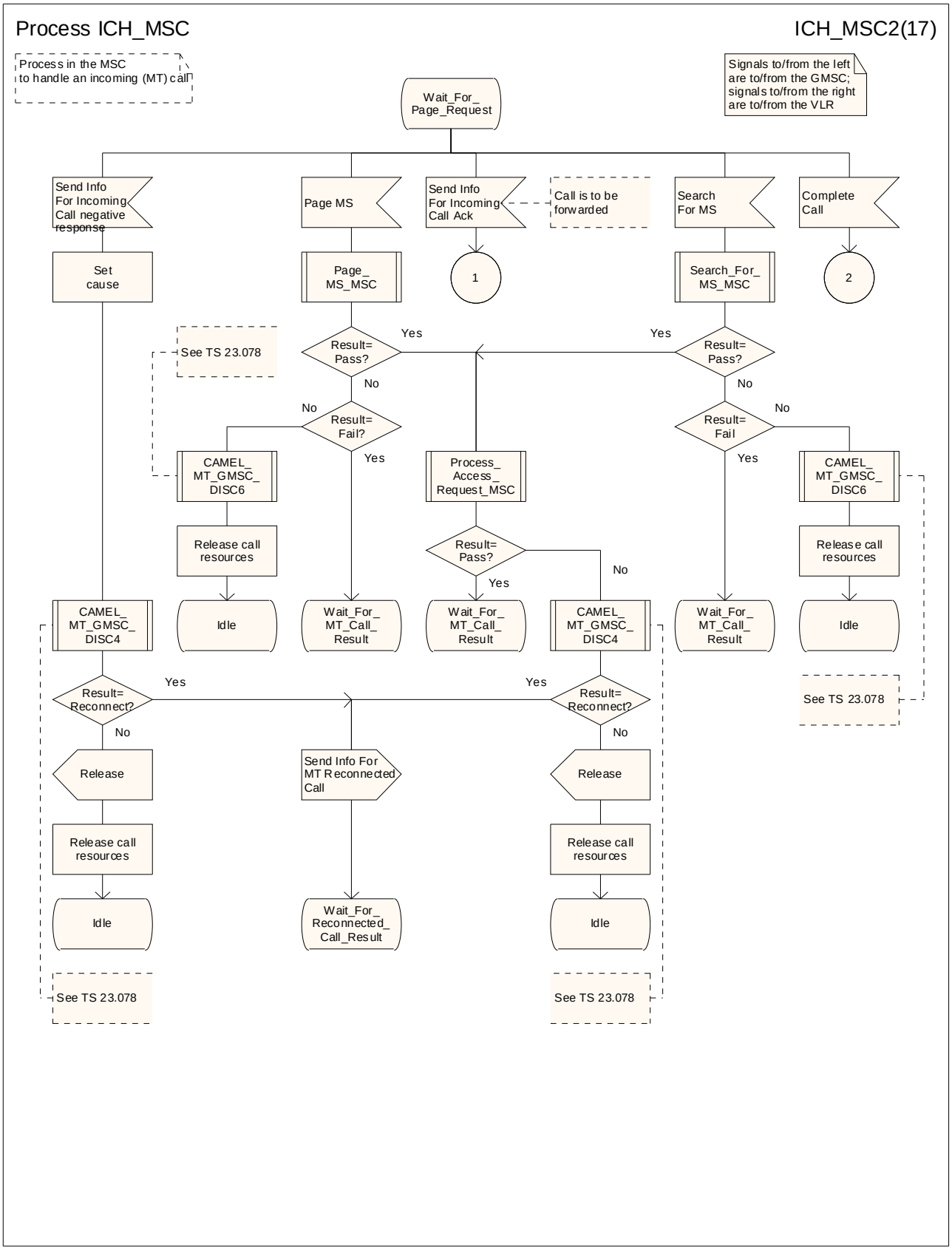


Figure 67b: Process ICH_MSC (sheet 2)

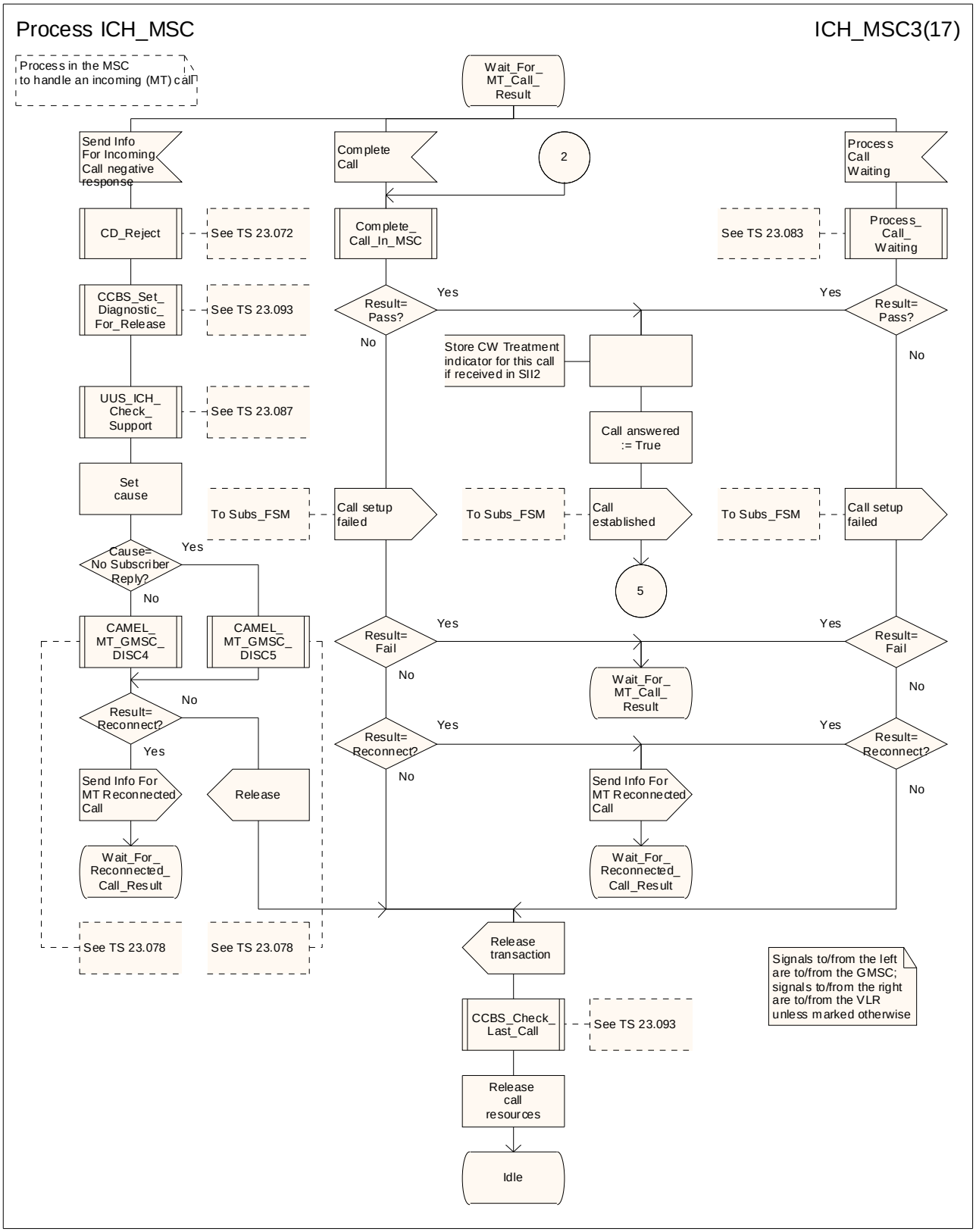


Figure 67c: Process ICH_MSC (sheet 3)

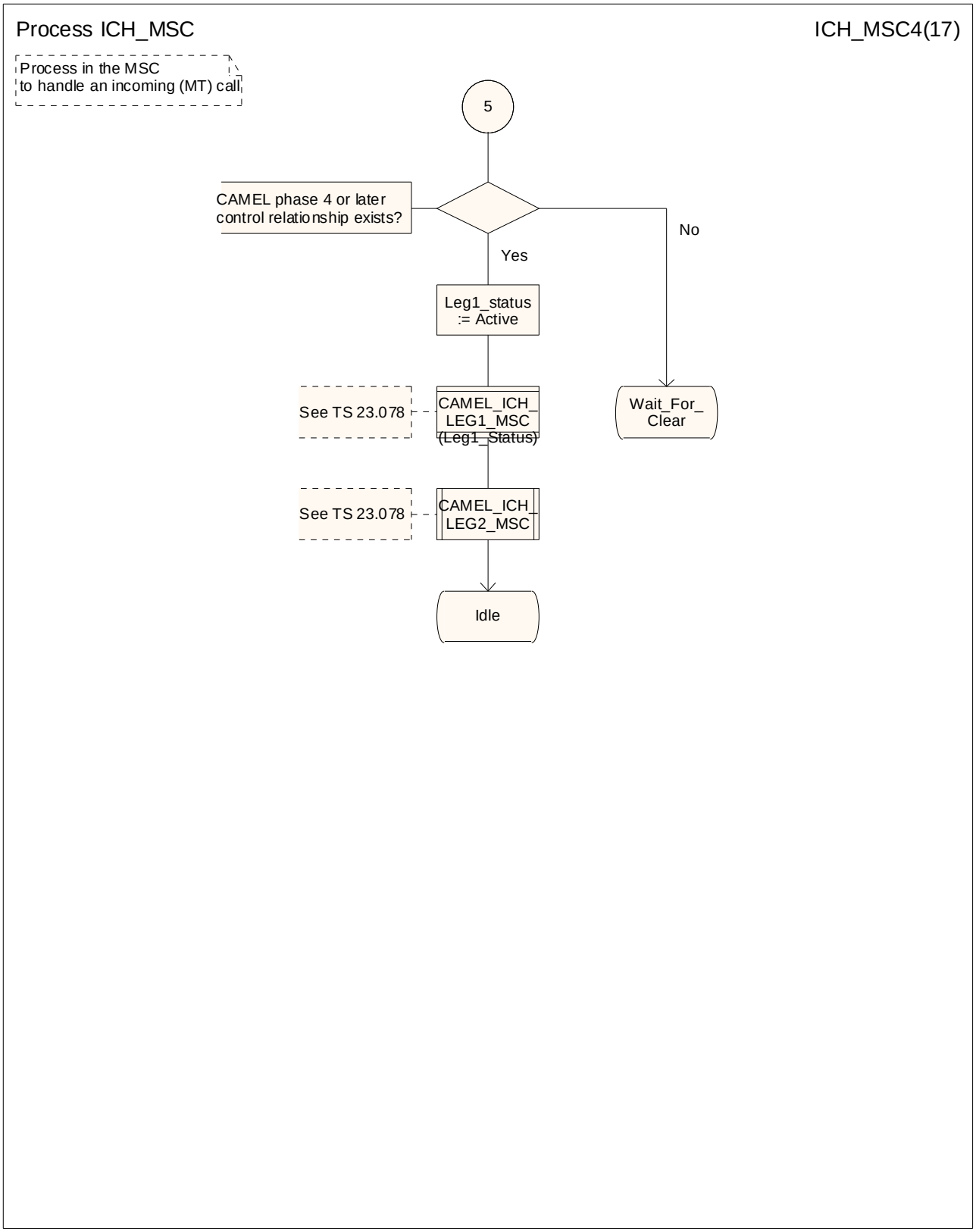


Figure 67d: Process ICH_MSC (sheet 4)

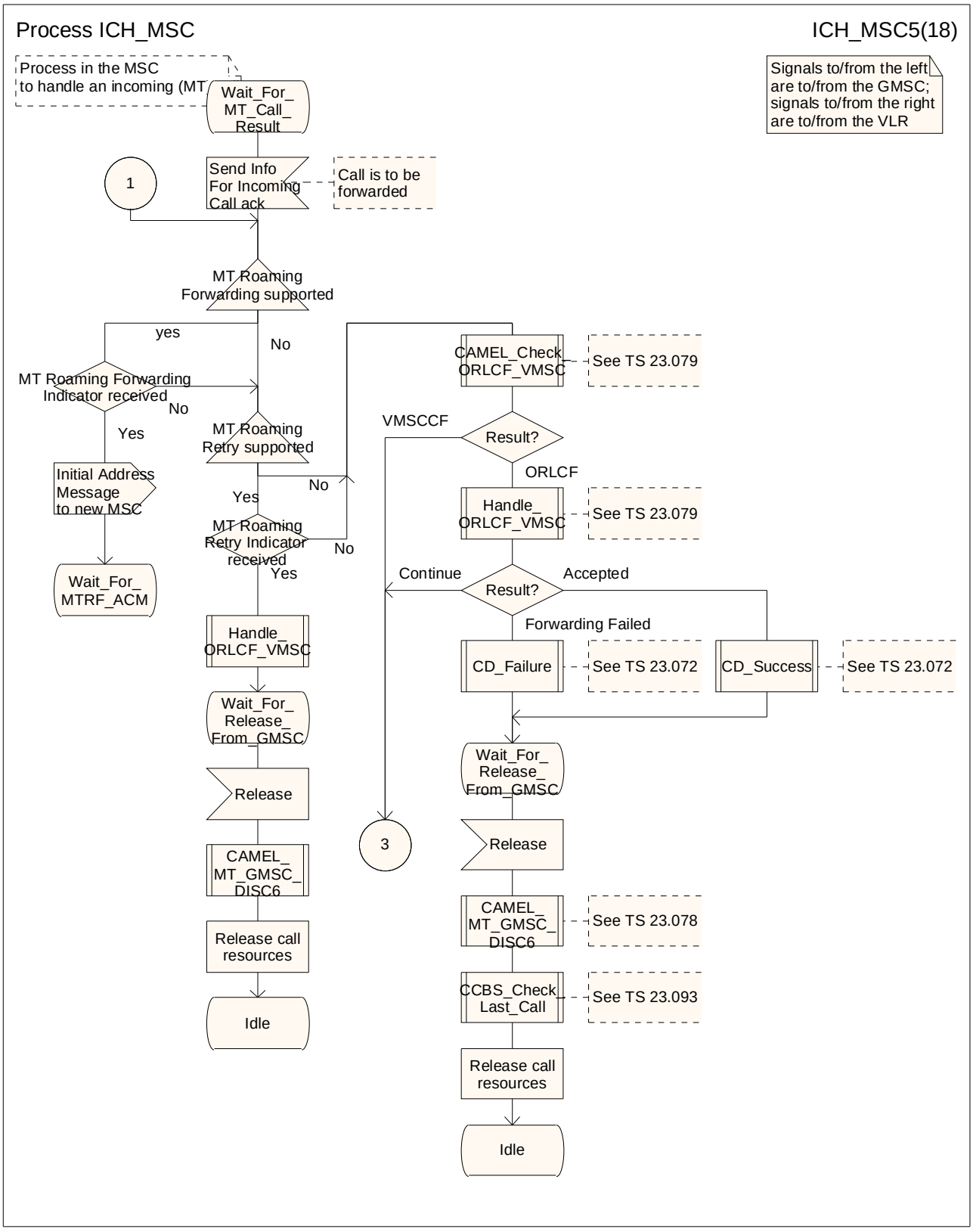


Figure 67e: Process ICH_MSC (sheet 5)

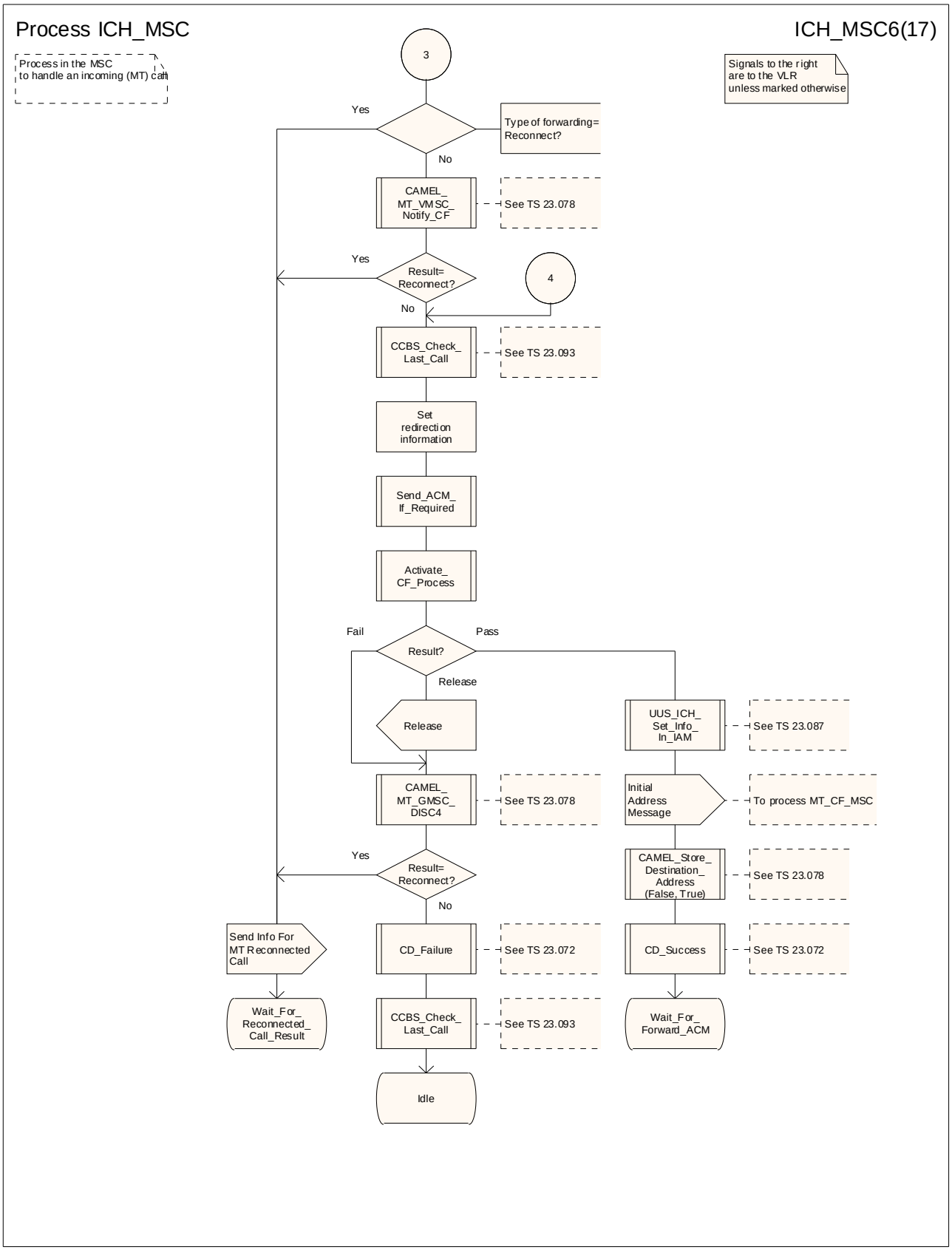


Figure 67f: Process ICH_MSC (sheet 6)

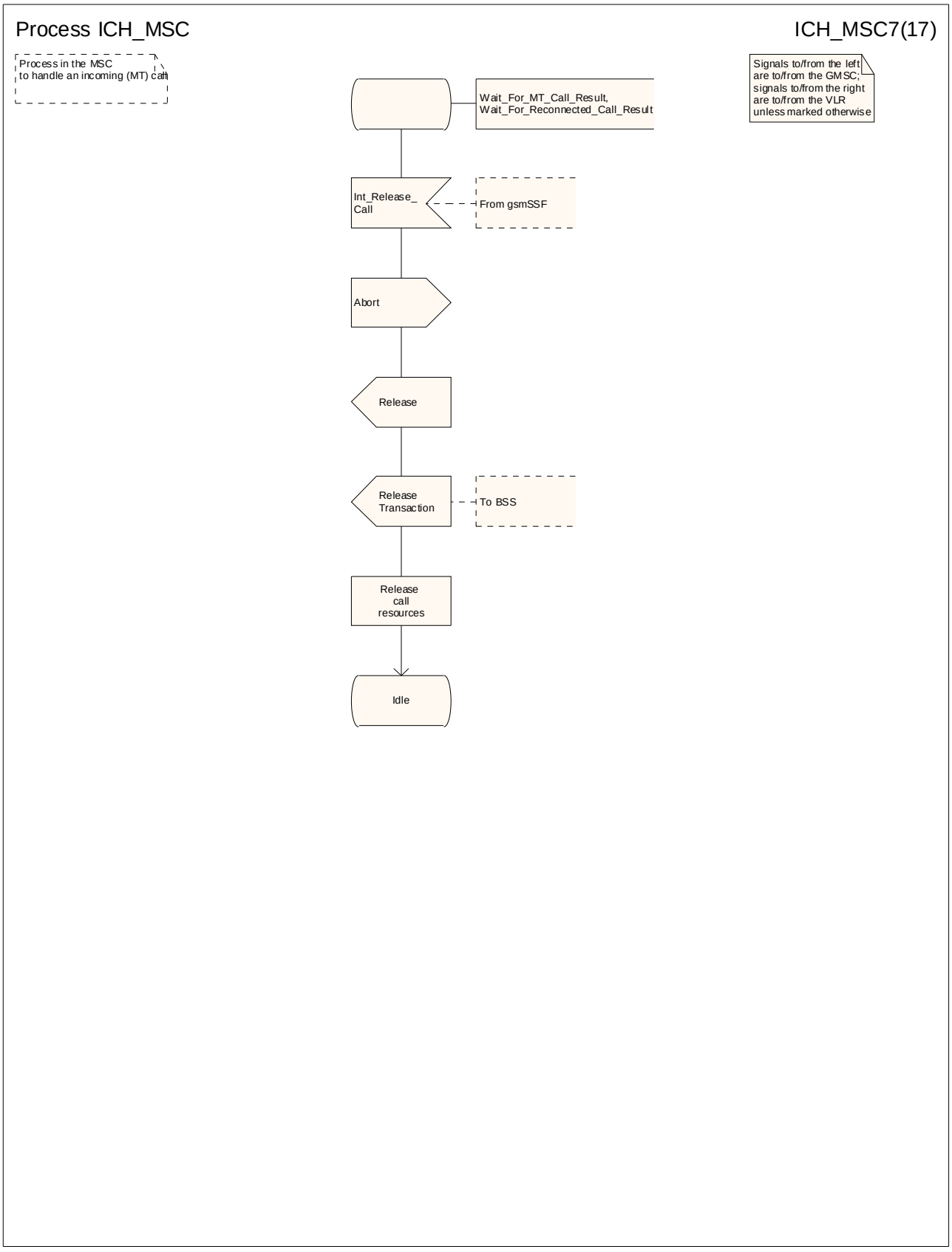


Figure 67g: Process ICH_MSC (sheet 7)

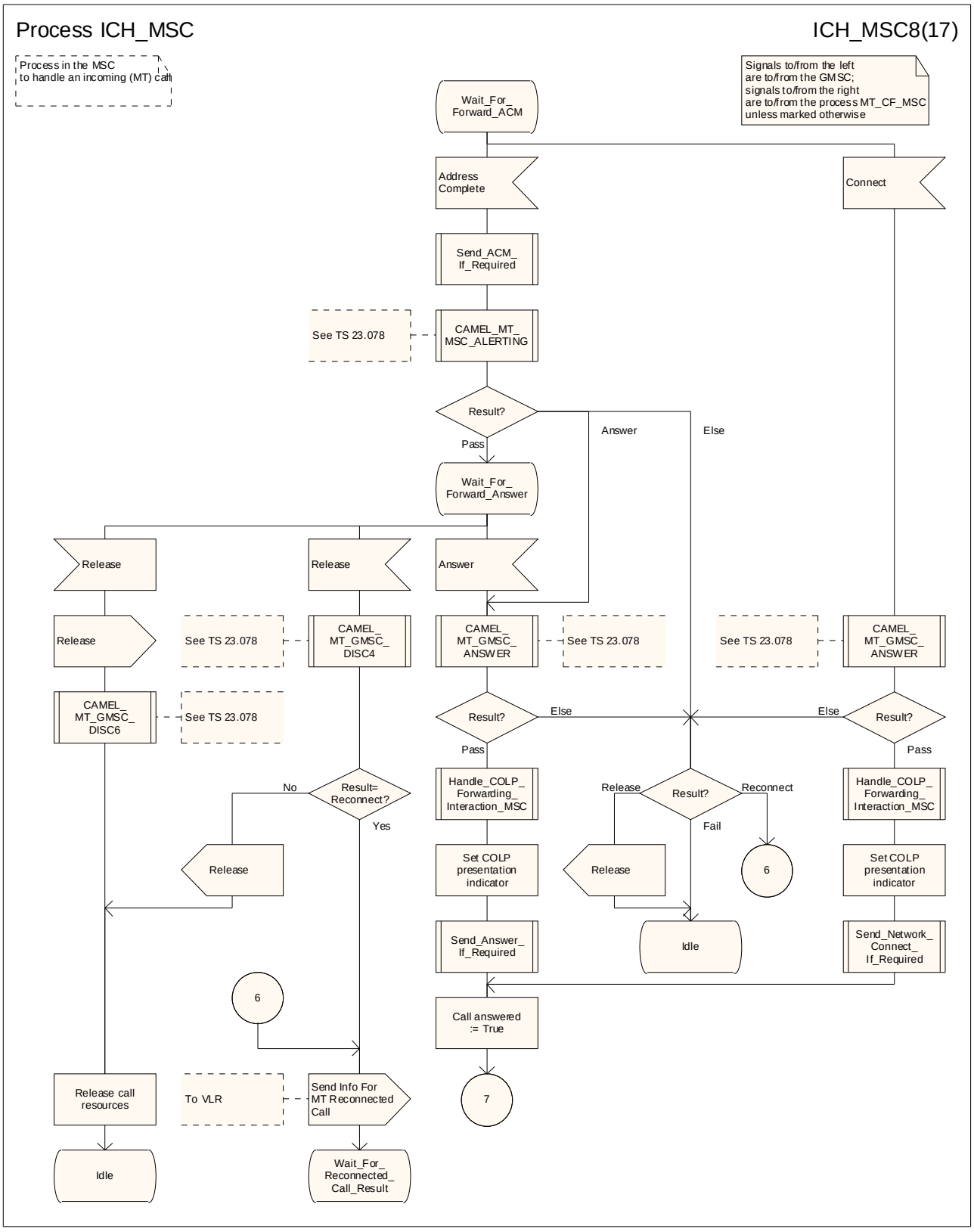


Figure 67h: Process ICH_MSC (sheet 8)

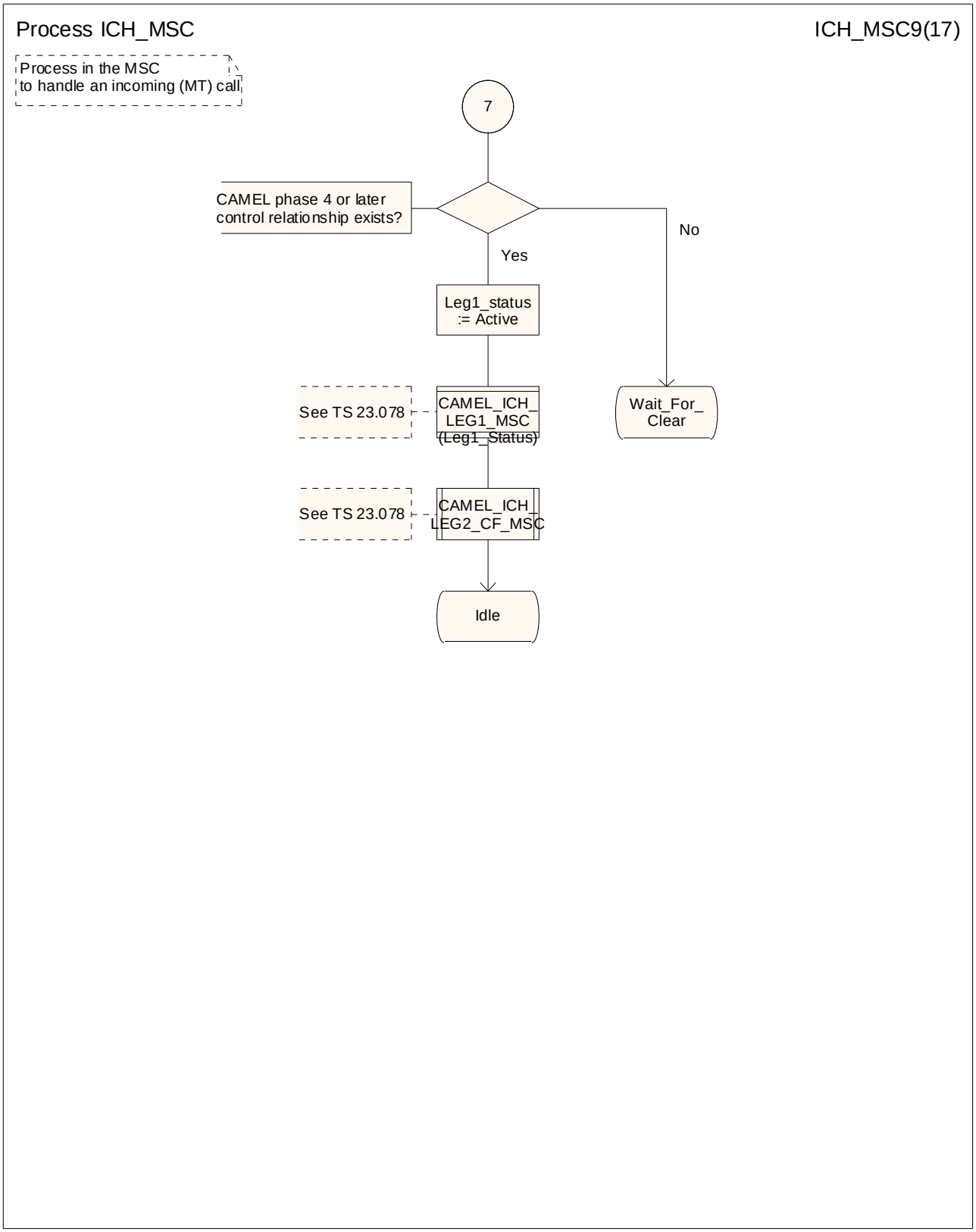


Figure 67i: Process ICH_MSC (sheet 9)

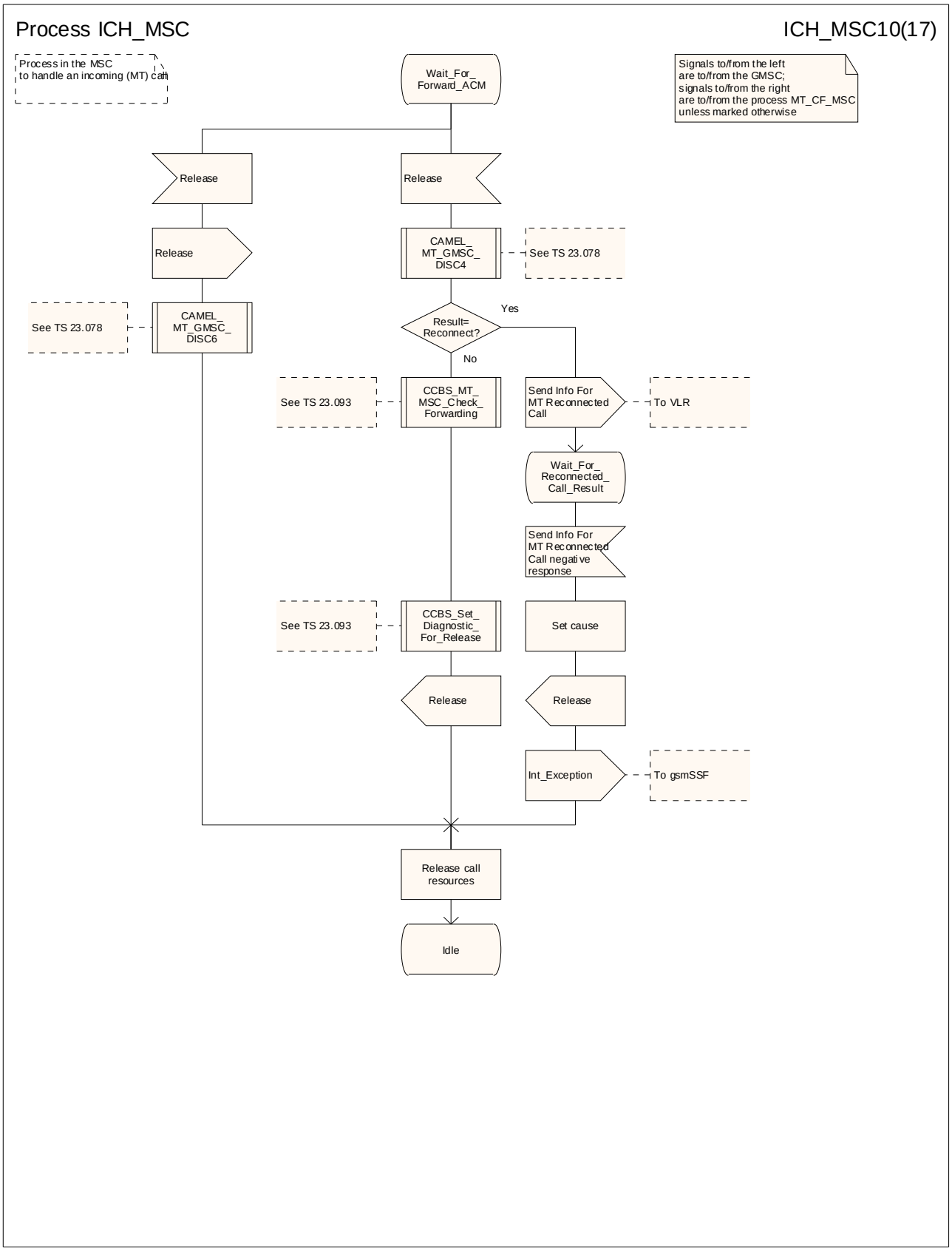


Figure 67j: Process ICH_MSC (sheet 10)

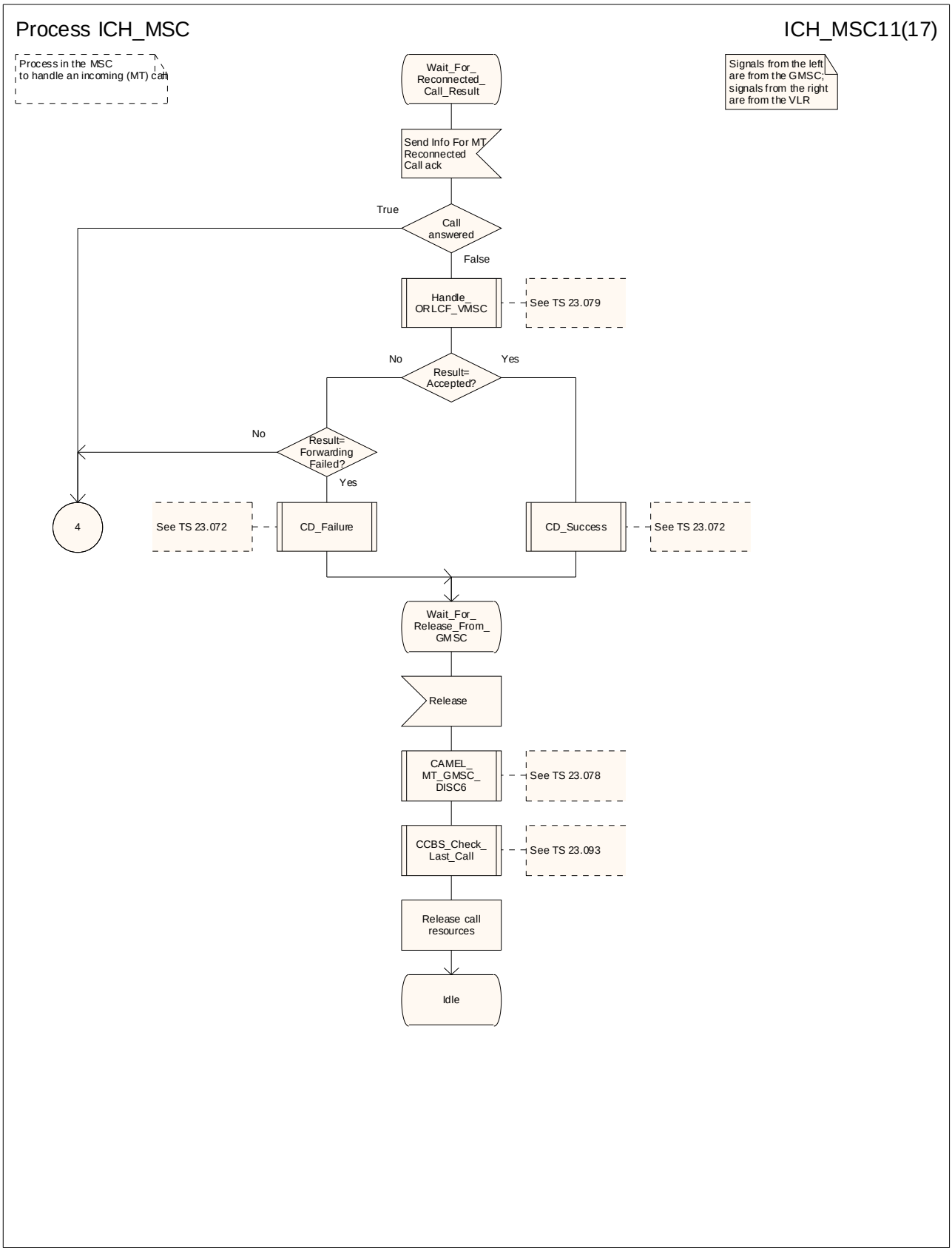


Figure 67k: Process ICH_MSC (sheet 11)

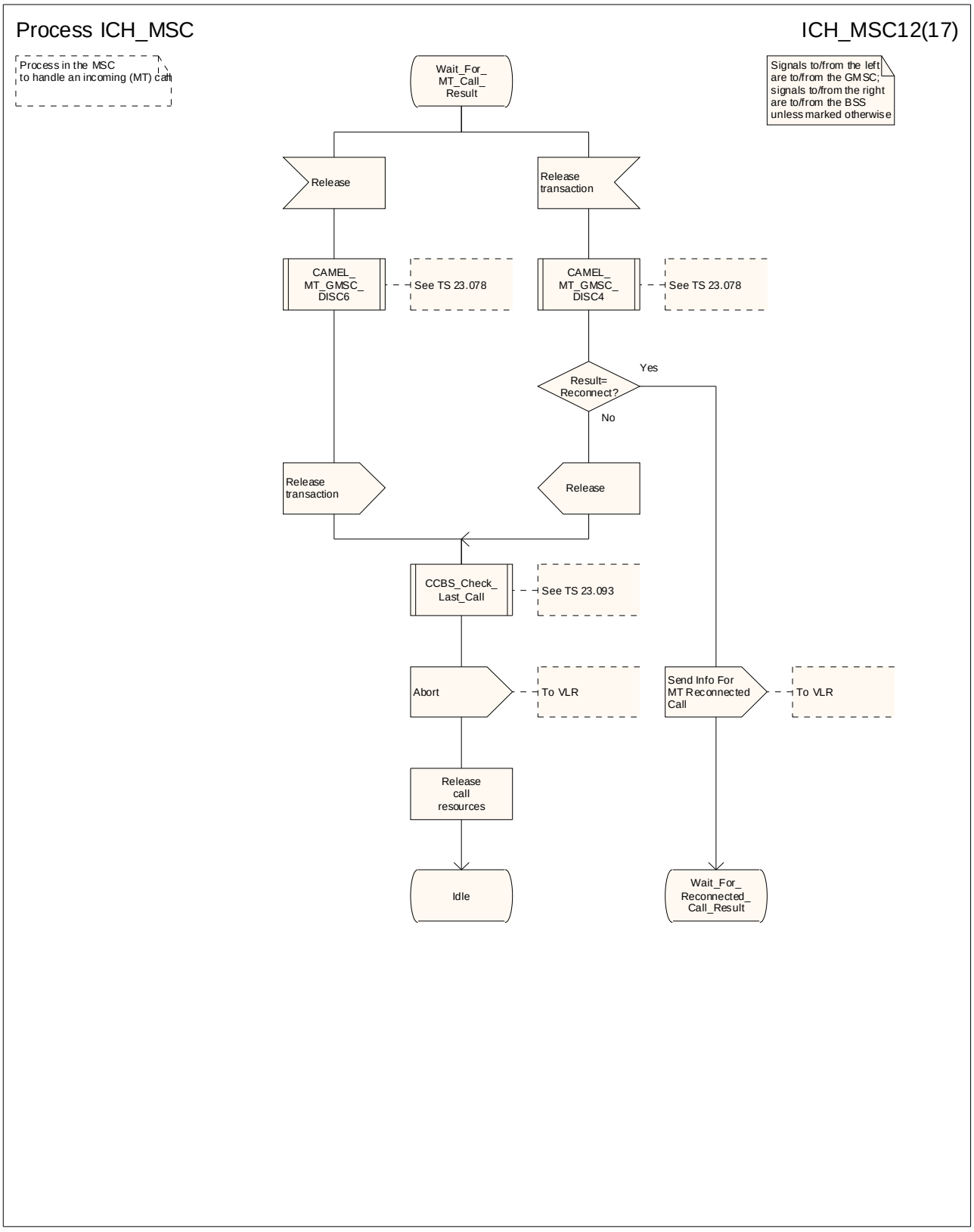


Figure 67l: Process ICH_MSC (sheet 12)

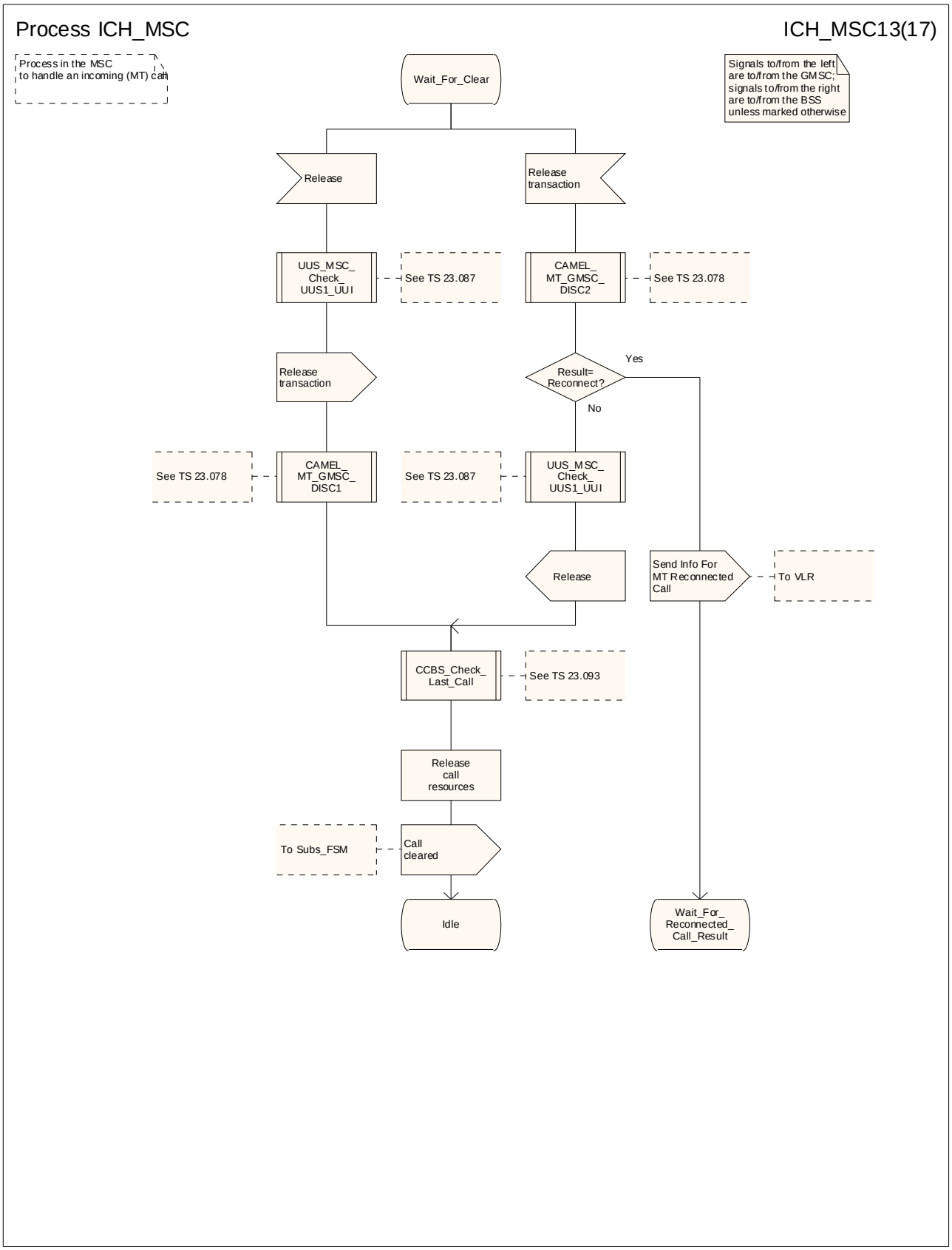


Figure 67m: Process ICH_MSC (sheet 13)

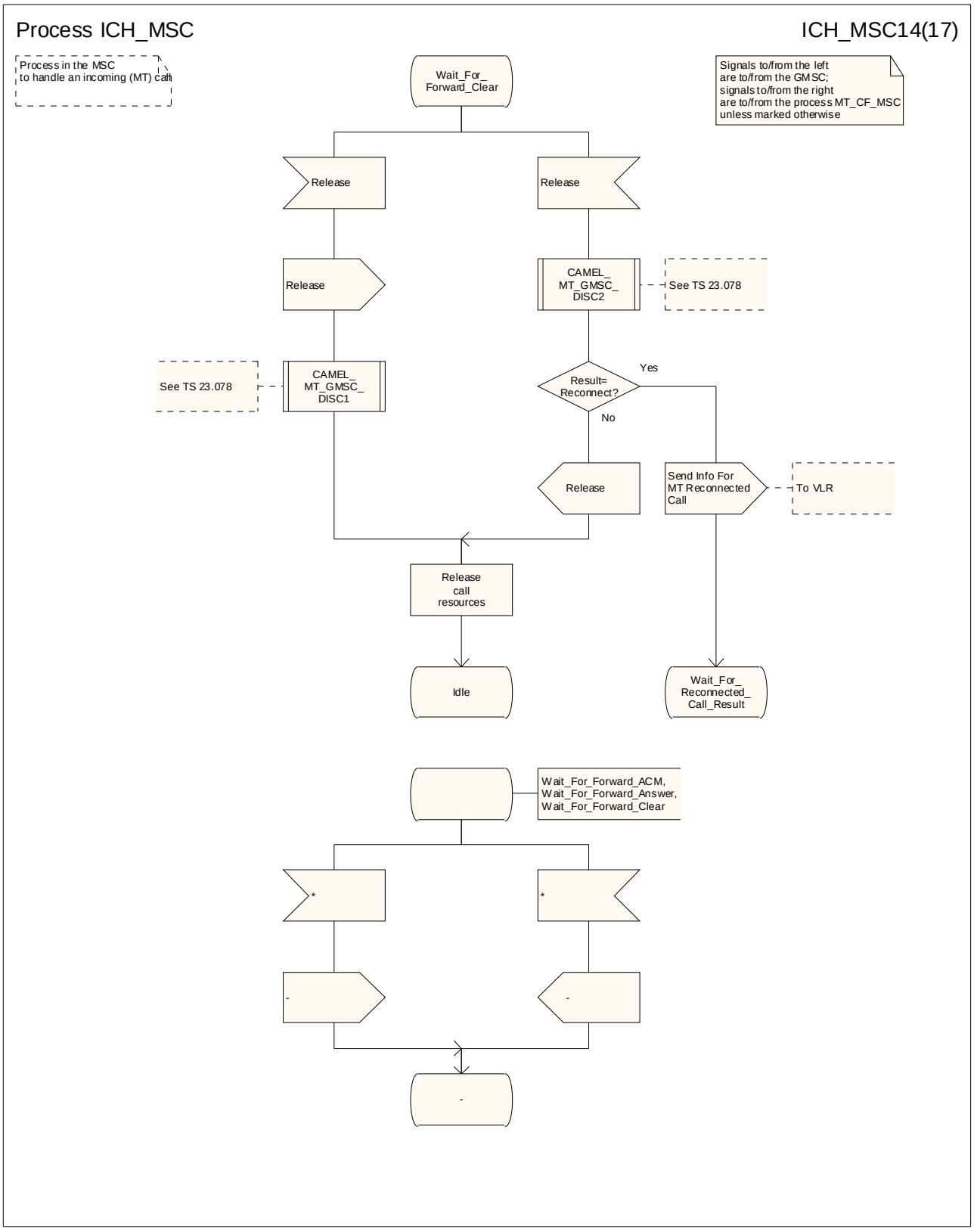


Figure 67n: Process ICH_MSC (sheet 14)

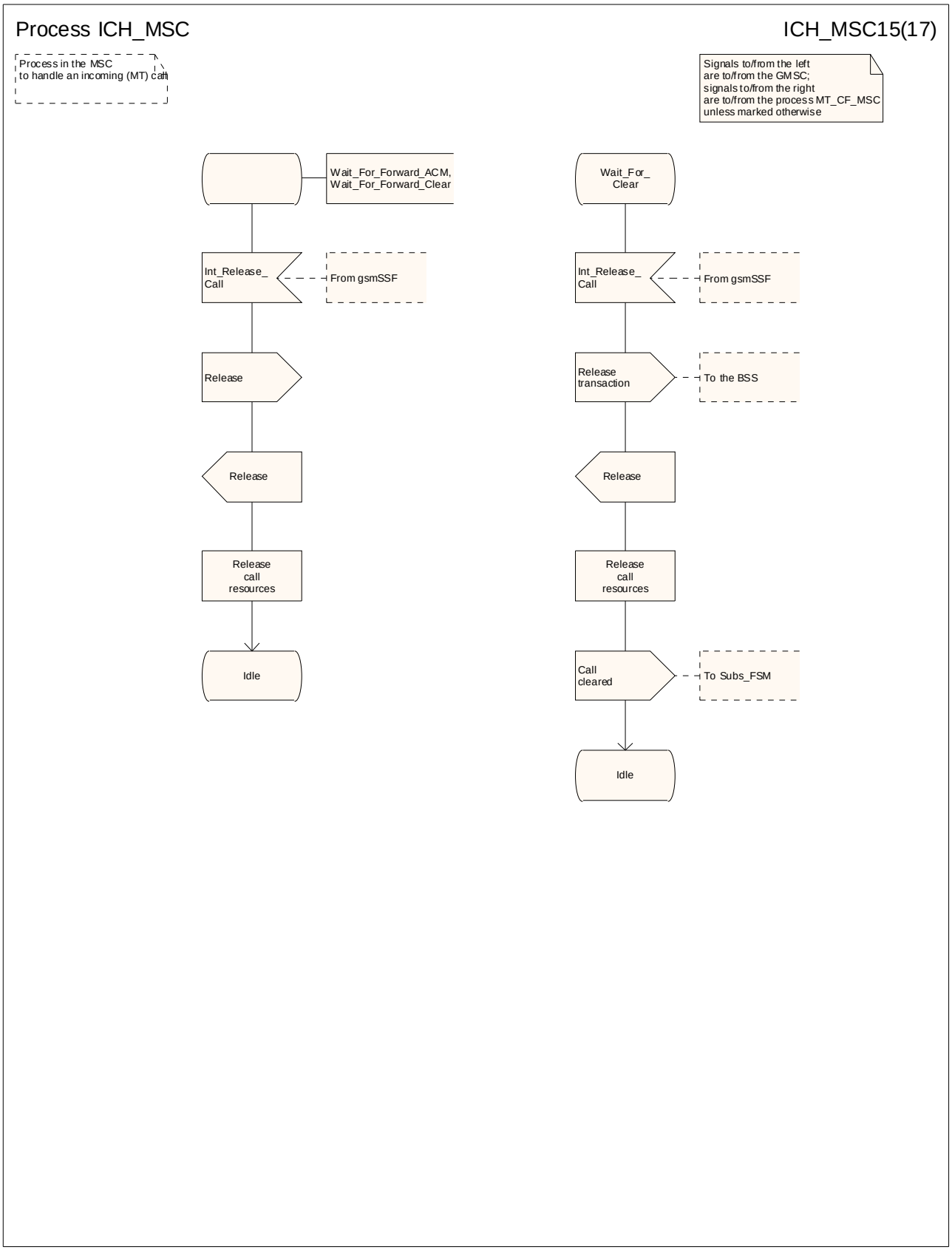


Figure 67o: Process ICH_MSC (sheet 15)

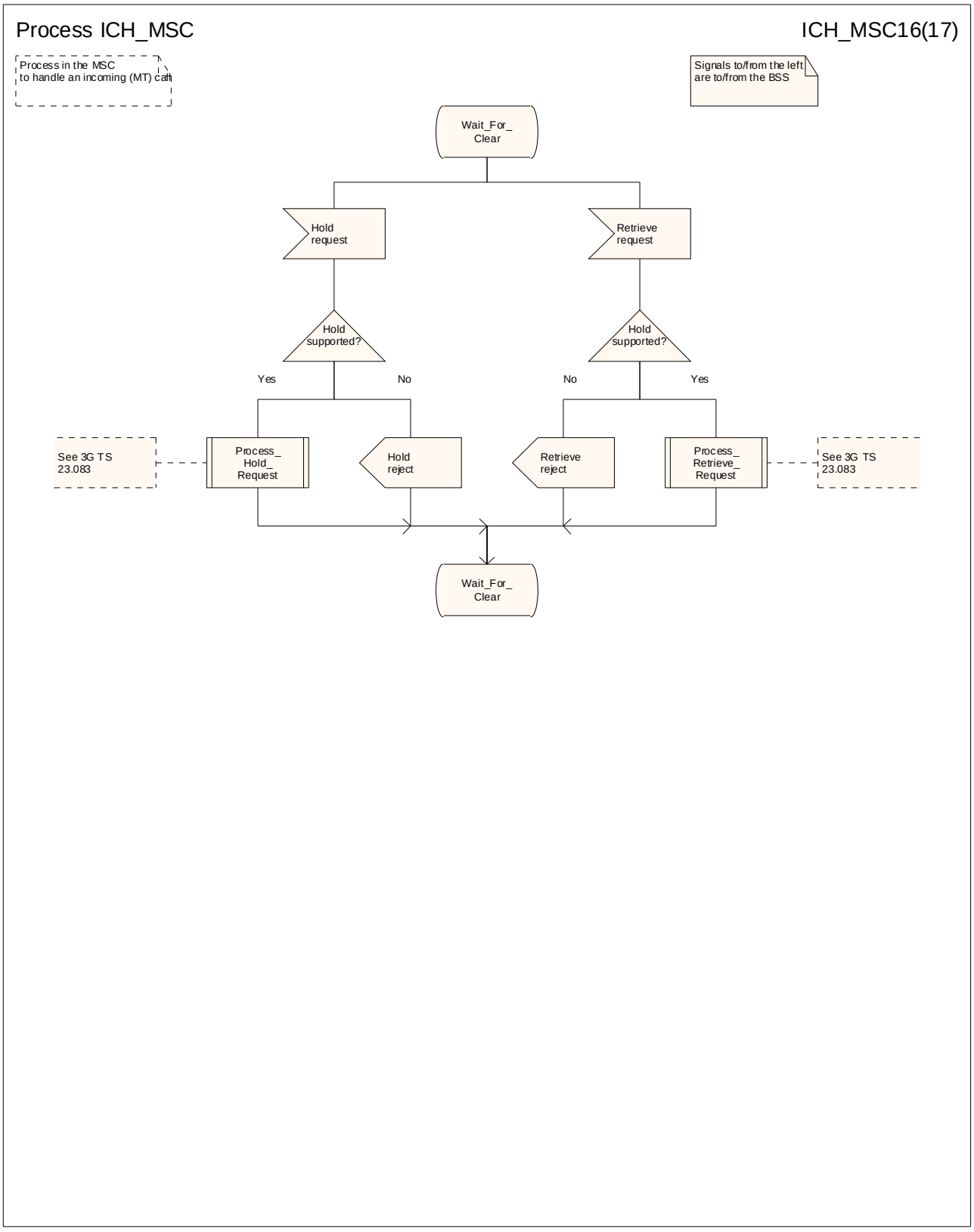


Figure 67p: Process ICH_MSC (sheet 16)

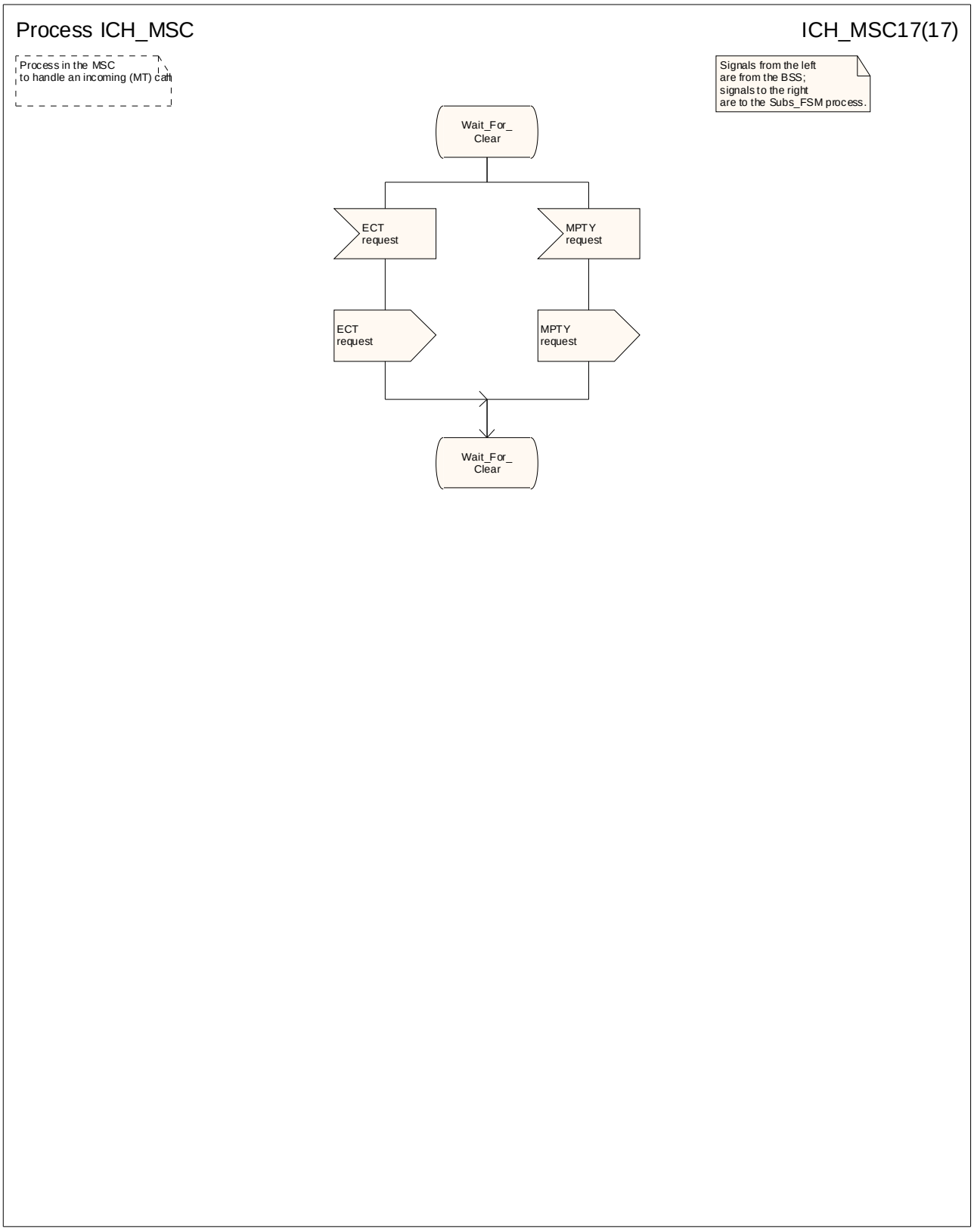


Figure 67q: Process ICH_MSC (sheet 17)

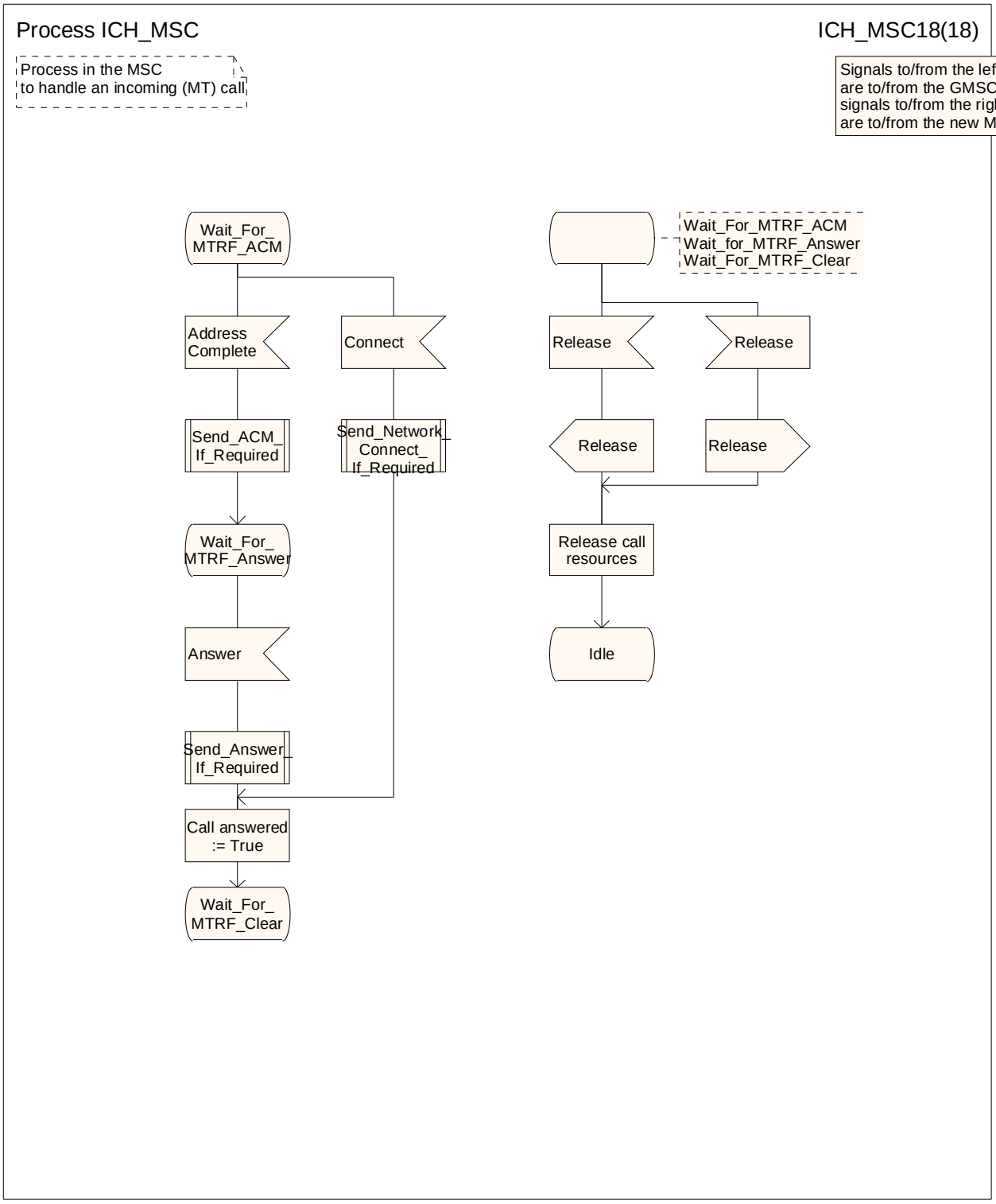


Figure 67r: Process ICH_MSC (sheet 18)

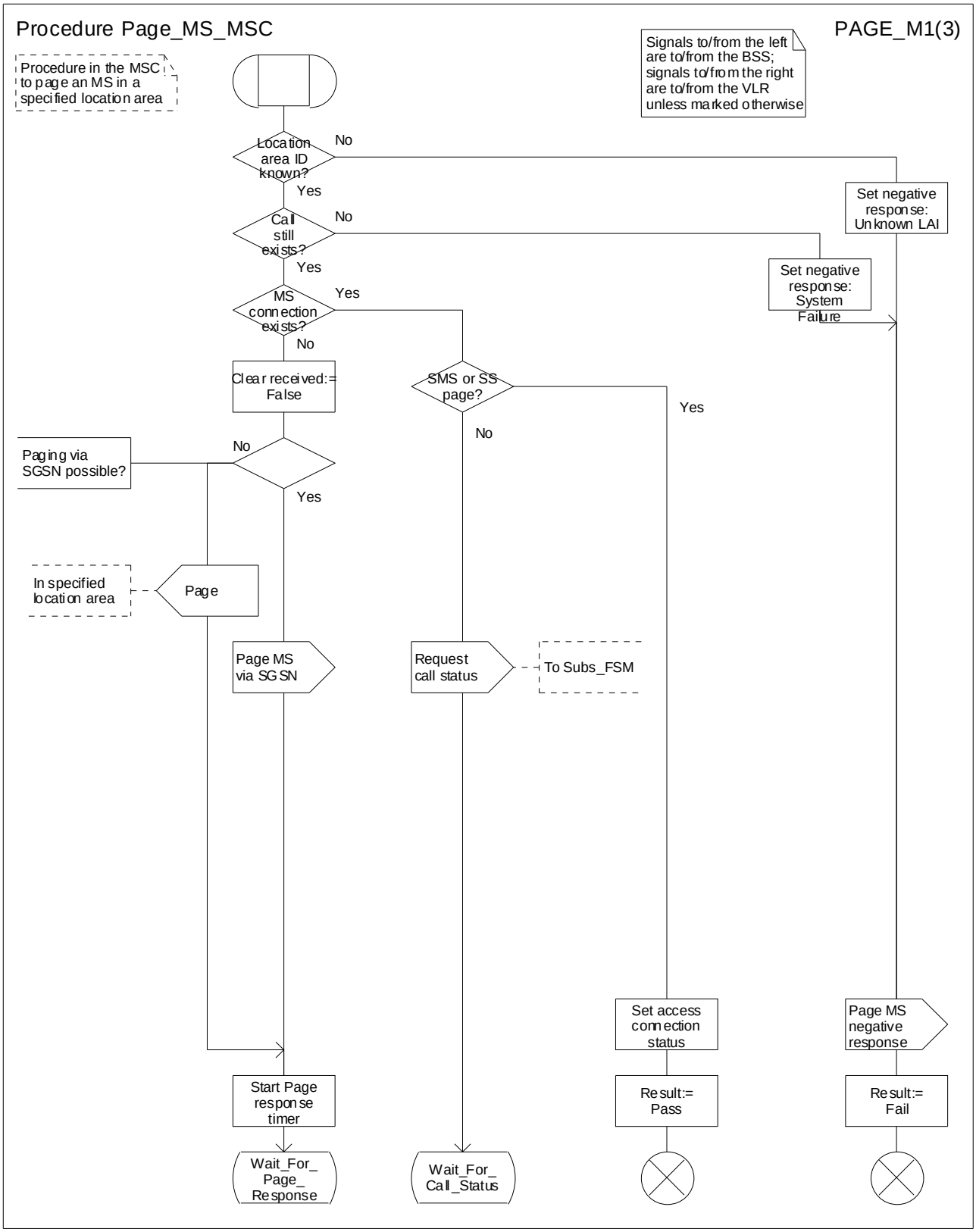


Figure 68a: Procedure Page_MS_MSC (sheet 1)

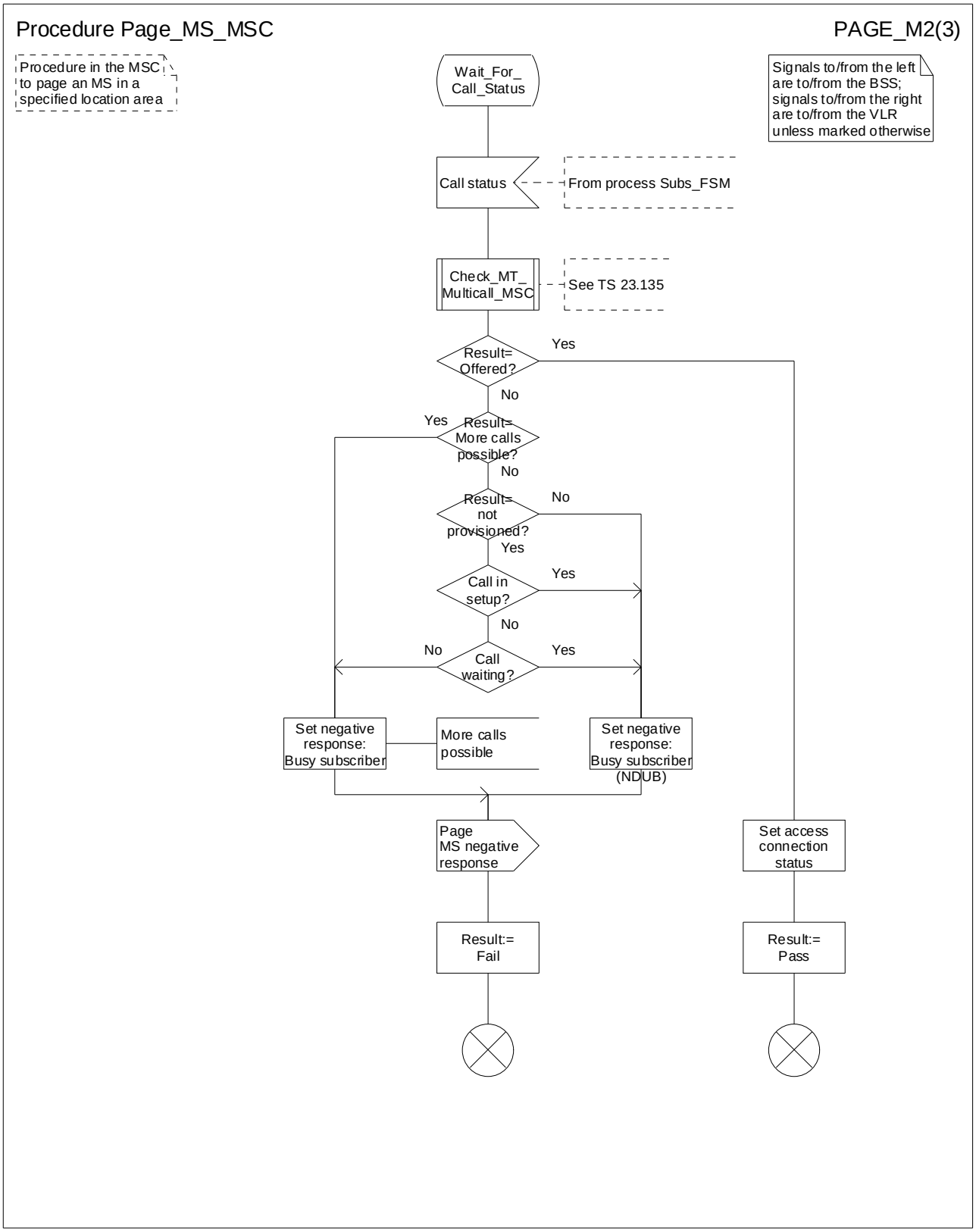


Figure 68b: Procedure Page_MS_MSC (sheet 2)

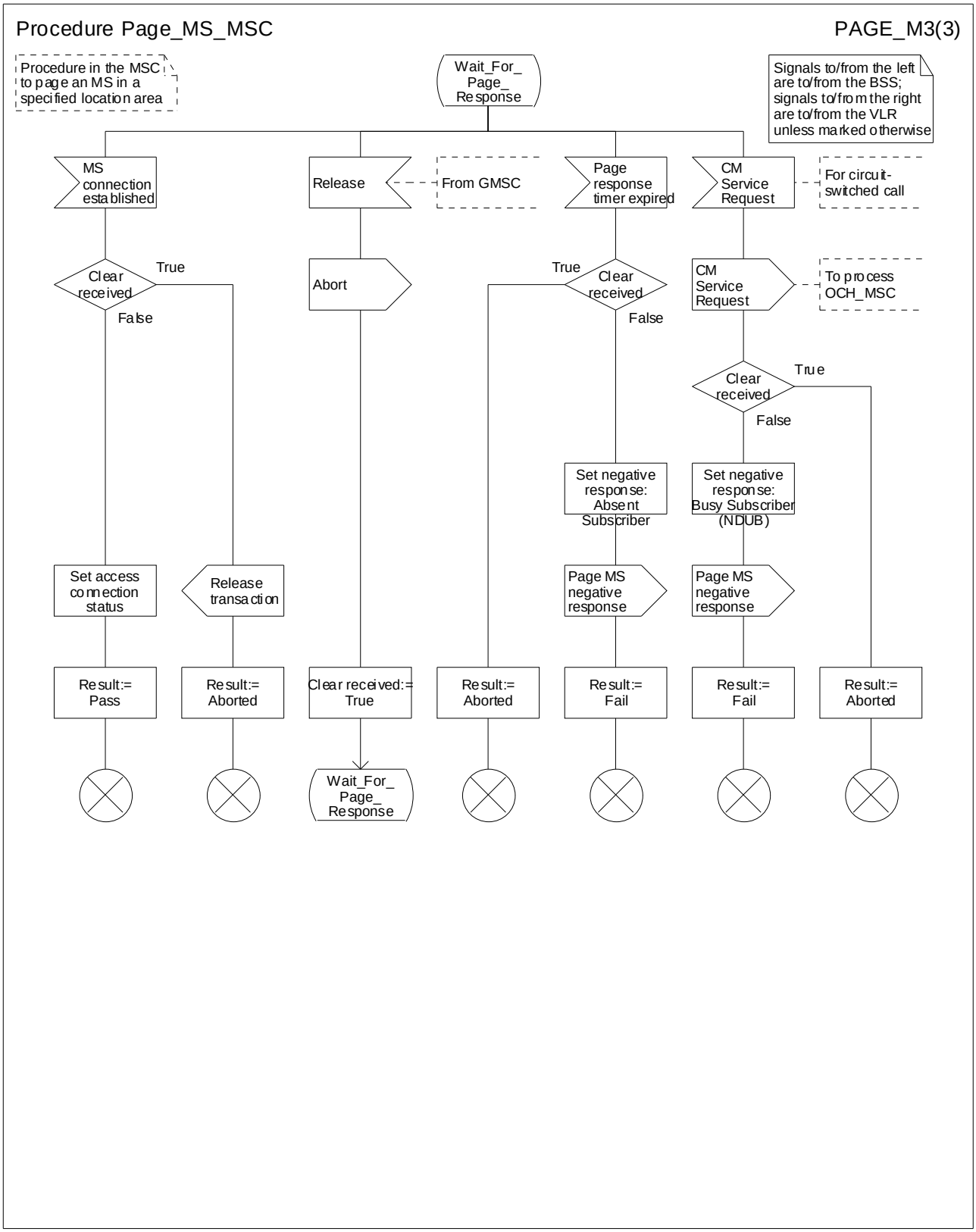


Figure 68c: Procedure Page_MS_MSC (sheet 3)

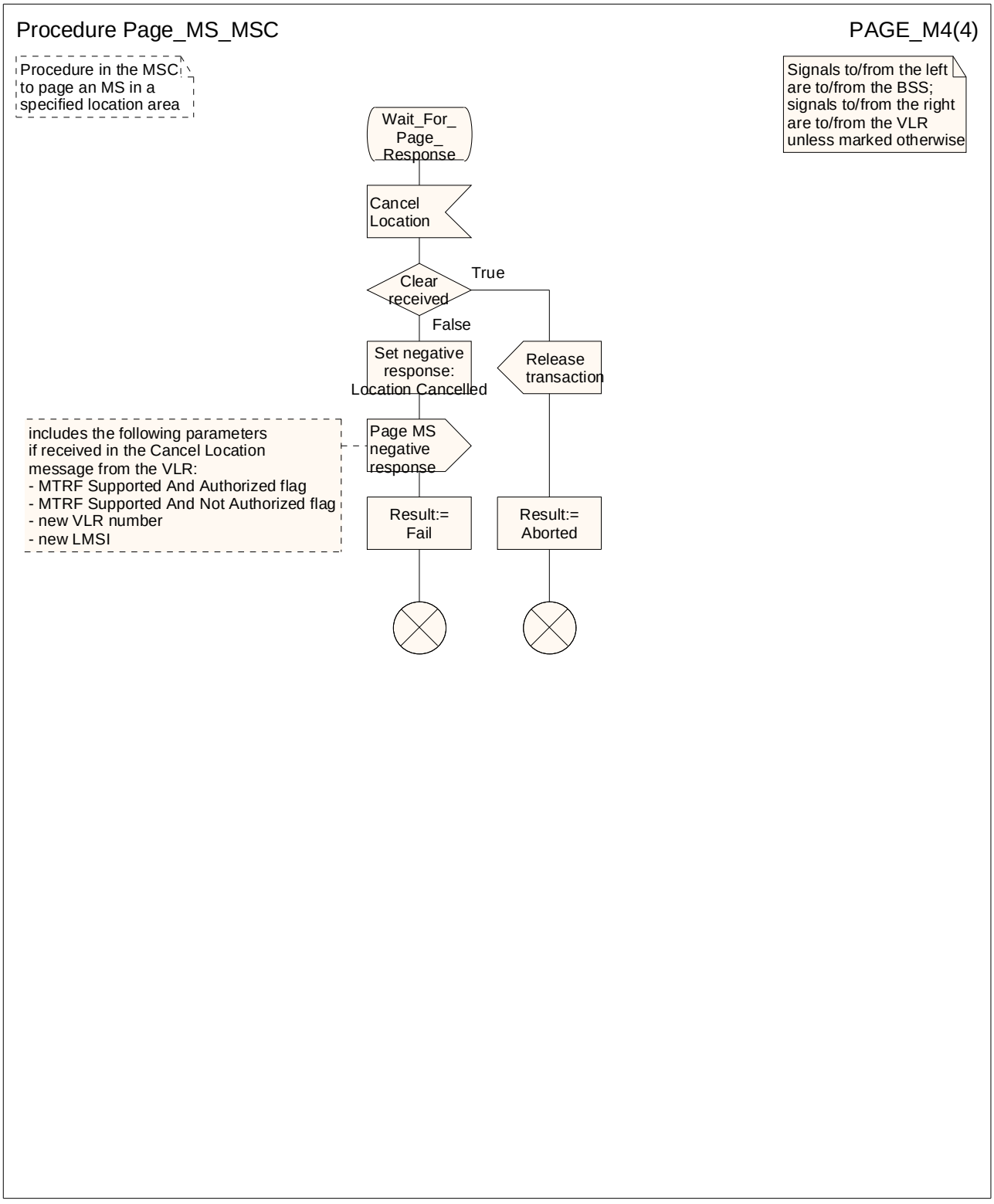


Figure 68d: Procedure Page_MS_MSC (sheet 4)

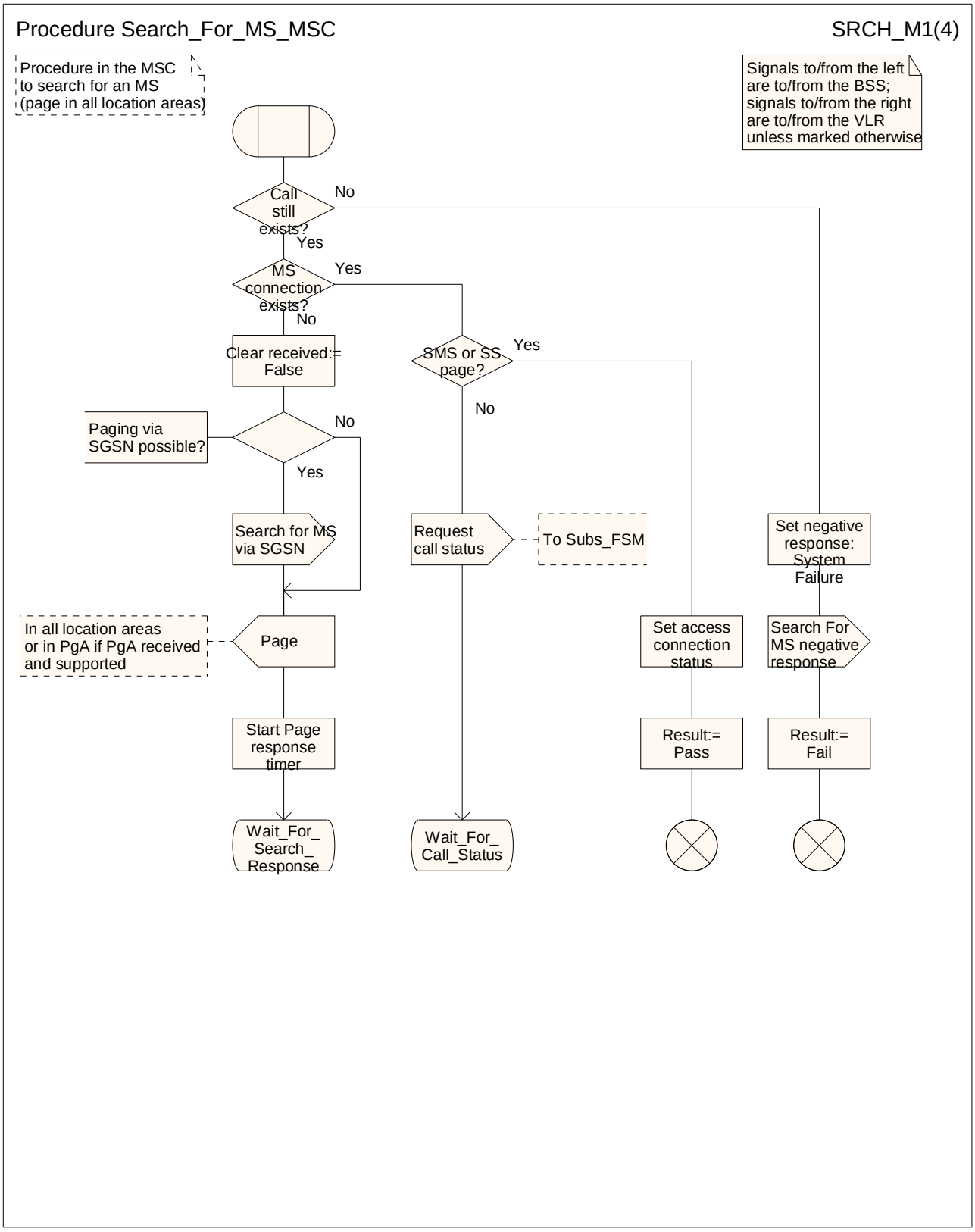


Figure 69a: Procedure Search_For_MS_MSC (sheet 1)

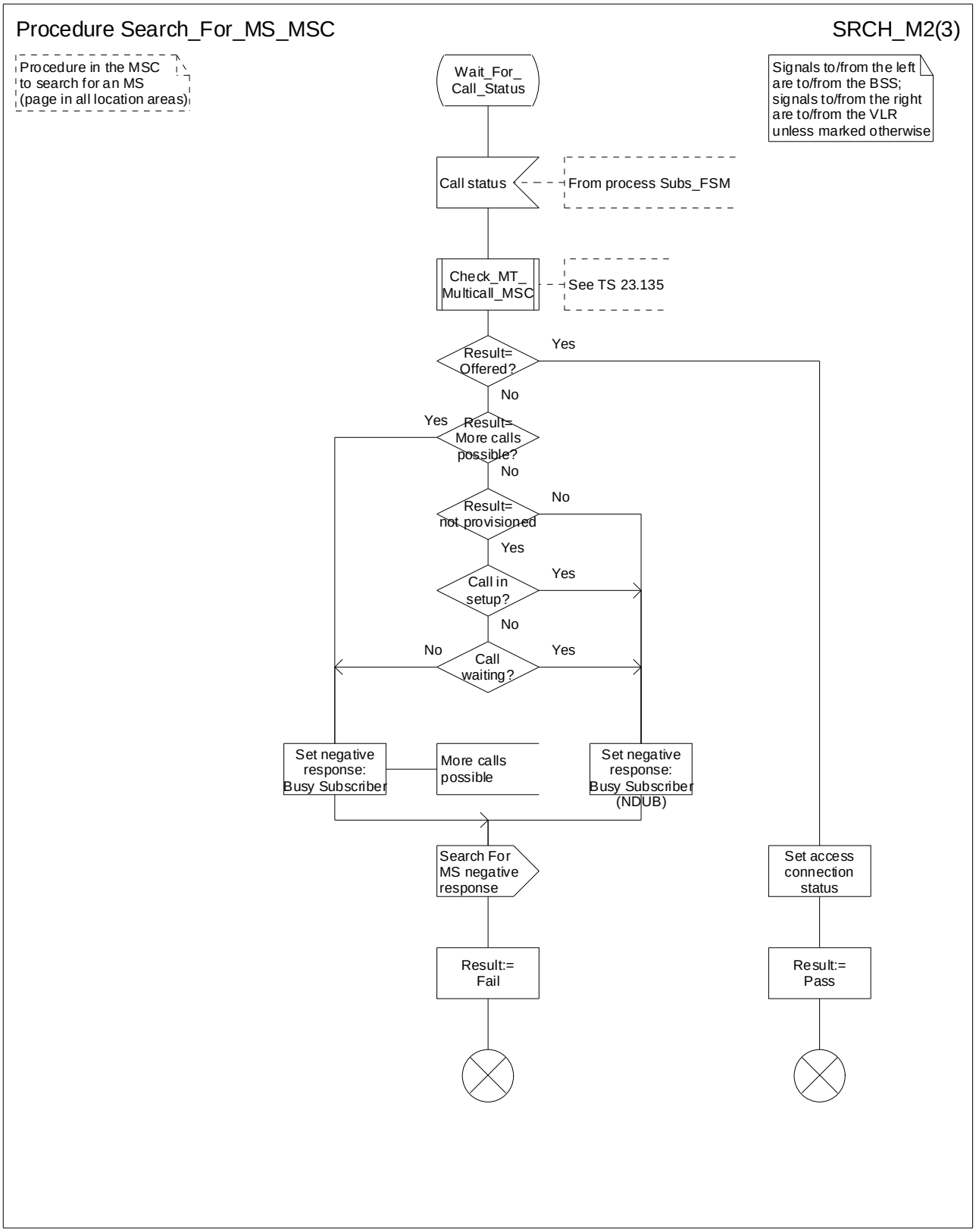


Figure 69b: Procedure Search_For_MS_MSC (sheet 2)

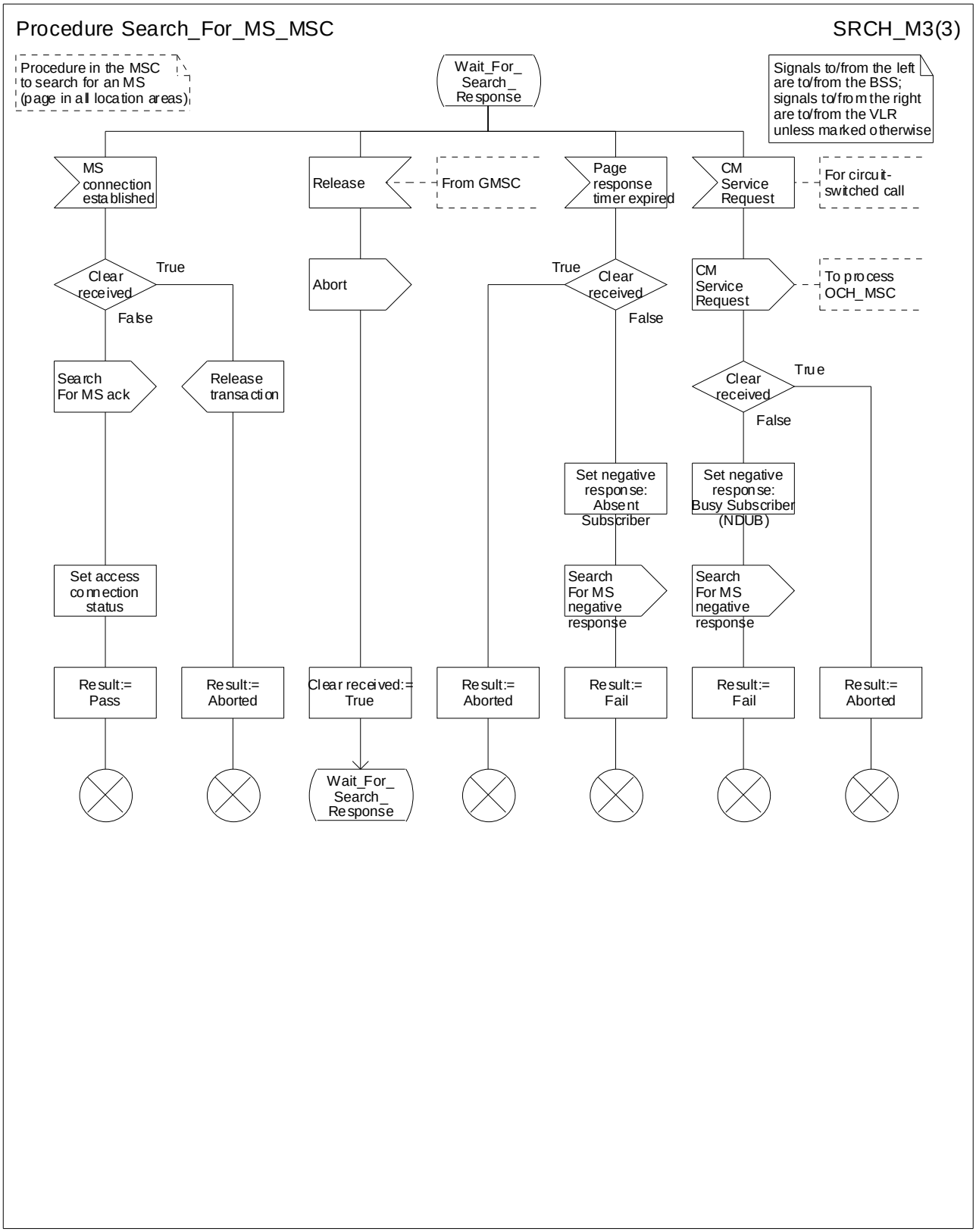


Figure 69c: Procedure Search_For_MS_MSC (sheet 3)

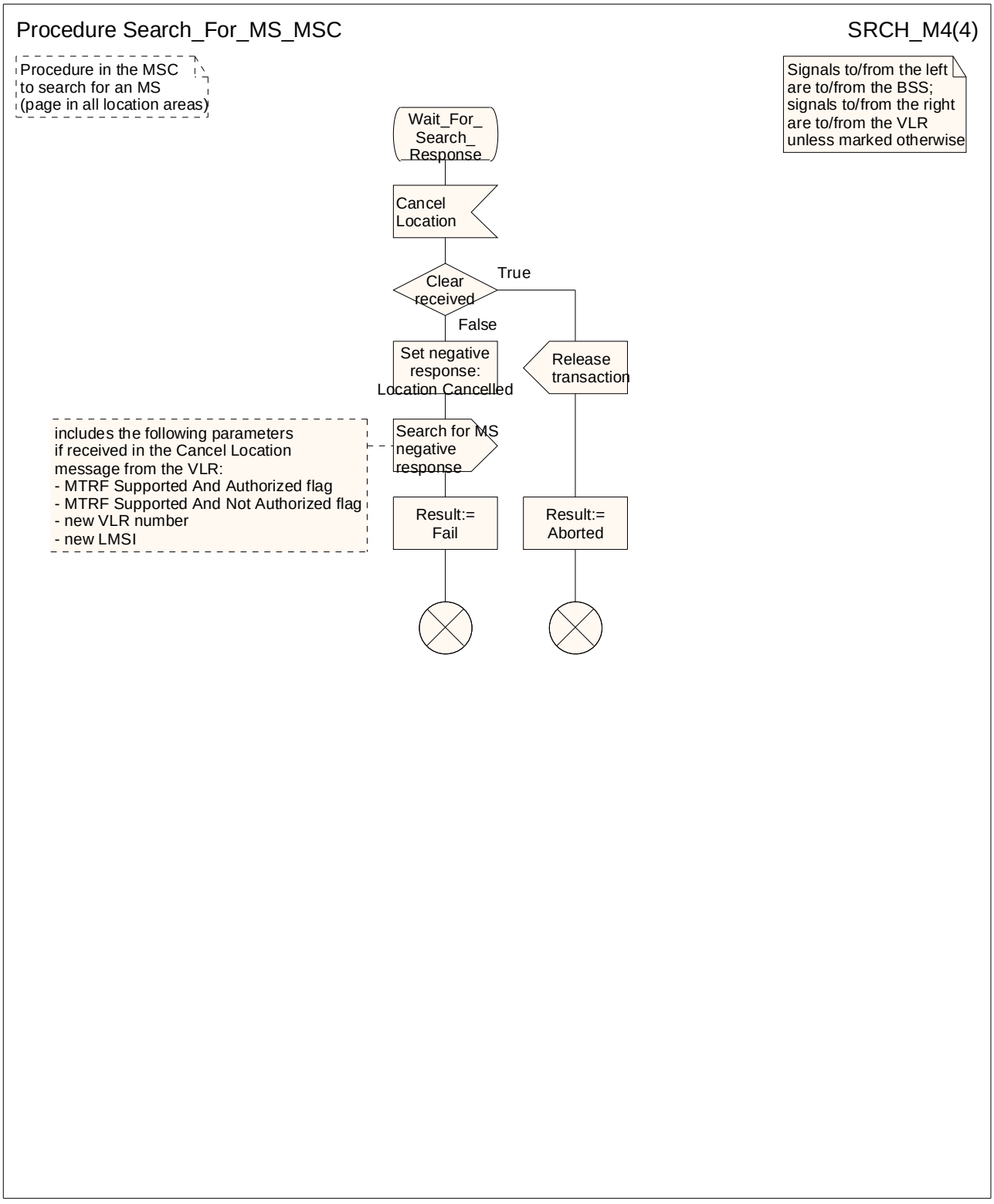


Figure 69d: Procedure Search_For_MS_MSC (sheet 4)

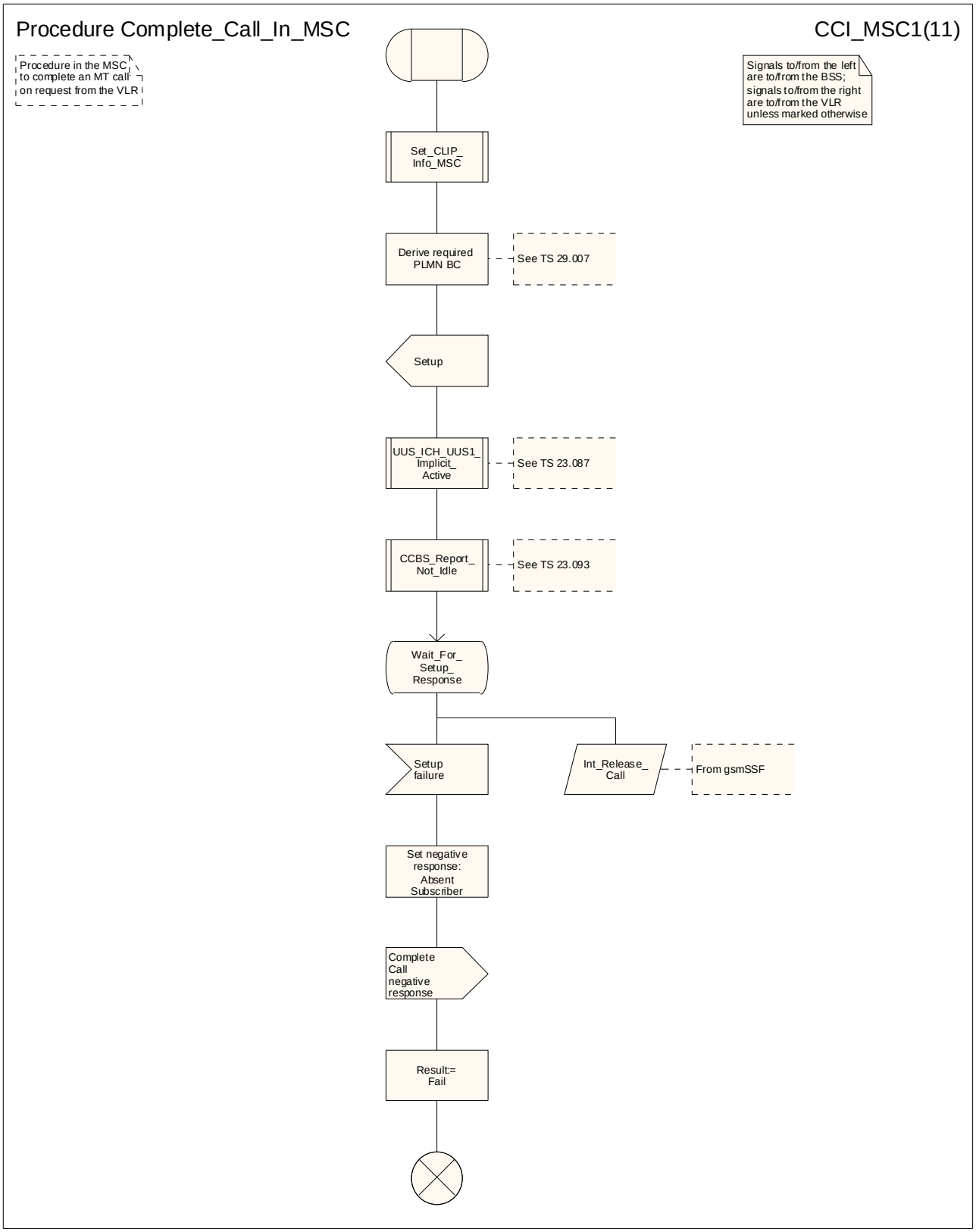


Figure 70a: Procedure Complete_Call_In_MSC (sheet 1)

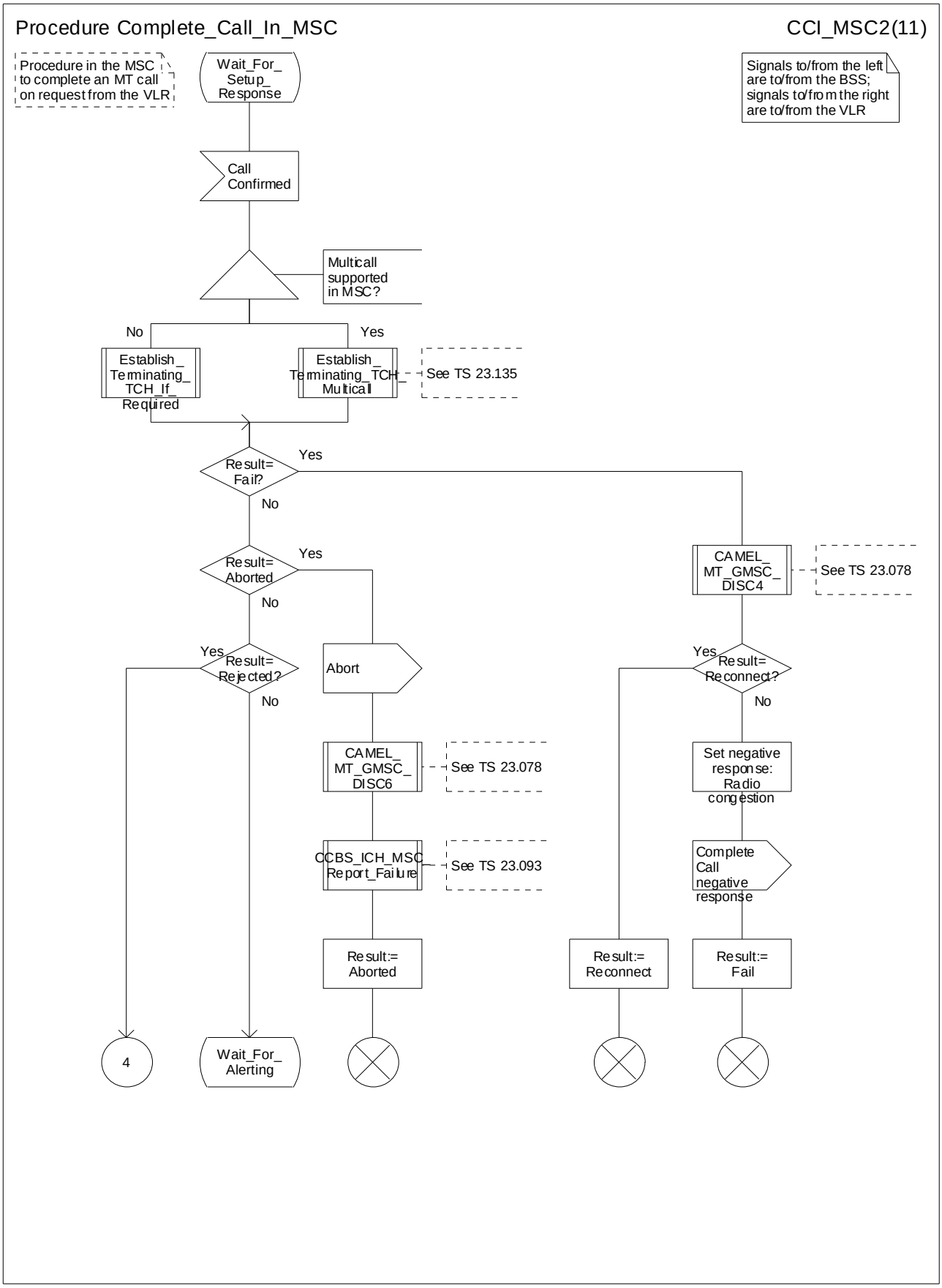


Figure 70b: Procedure Complete_Call_In_MSC (sheet 2)

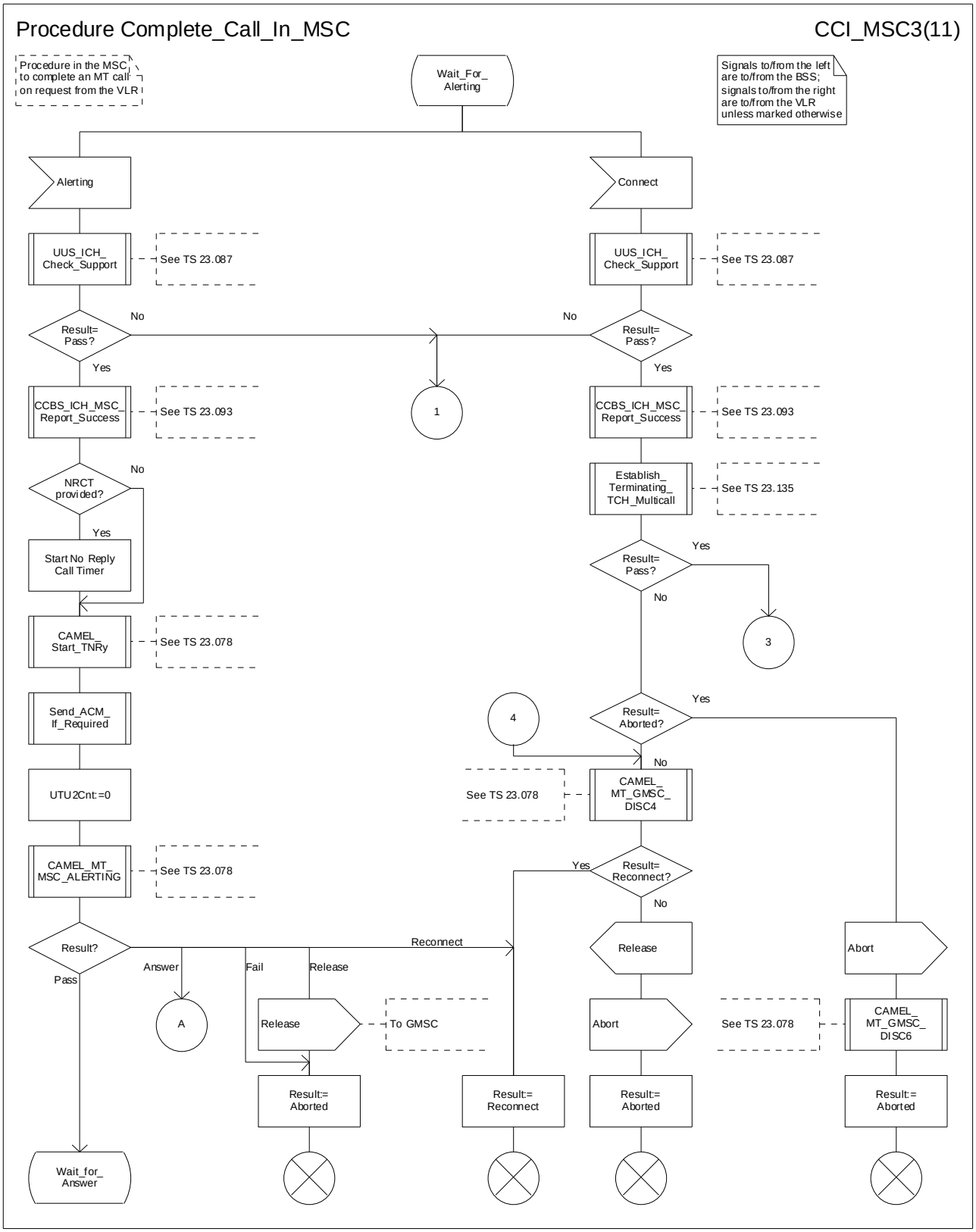


Figure 70c: Procedure Complete_Call_In_MSC (sheet 3)

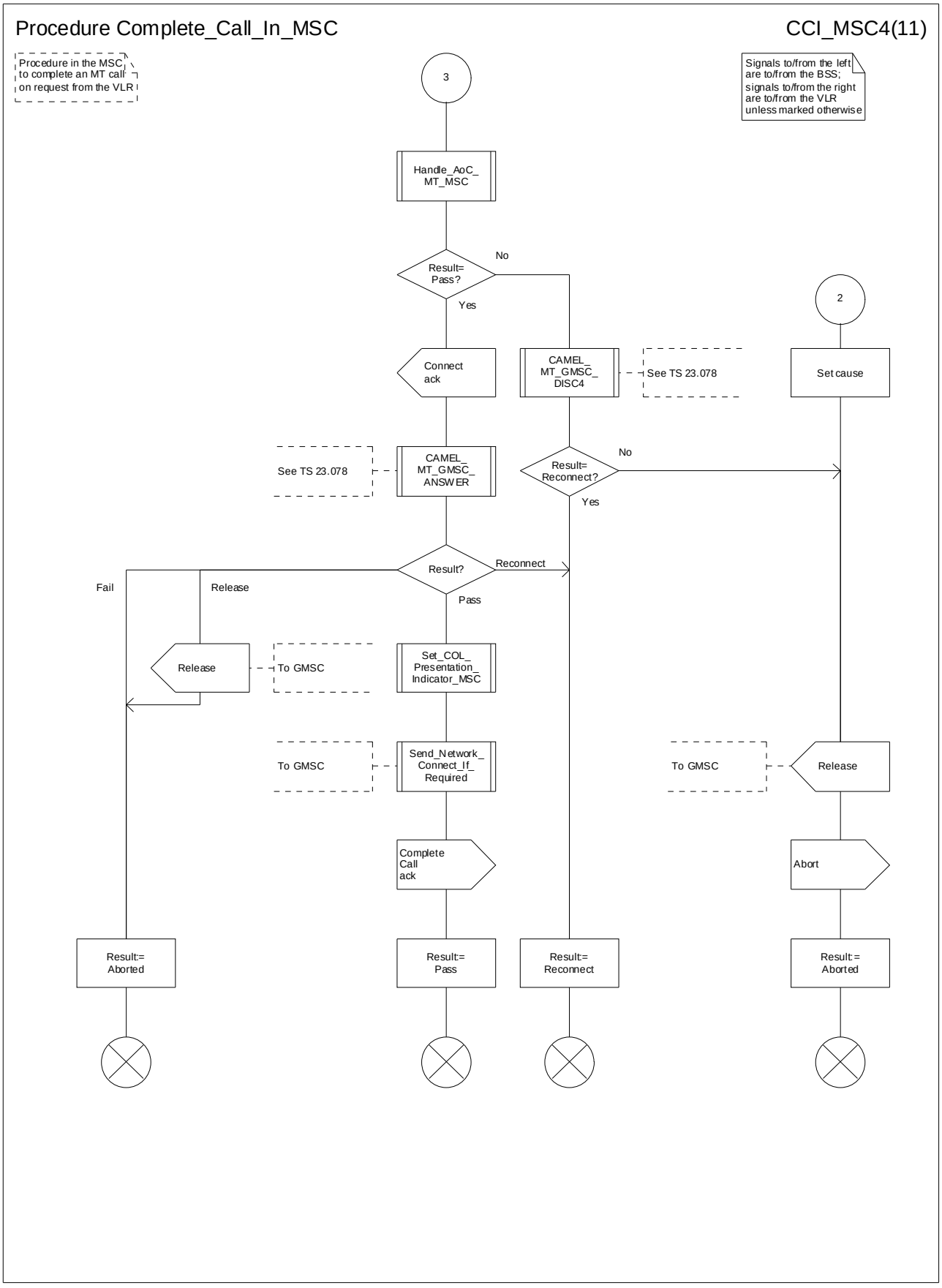


Figure 70d: Procedure Complete_Call_In_MSC (sheet 4)

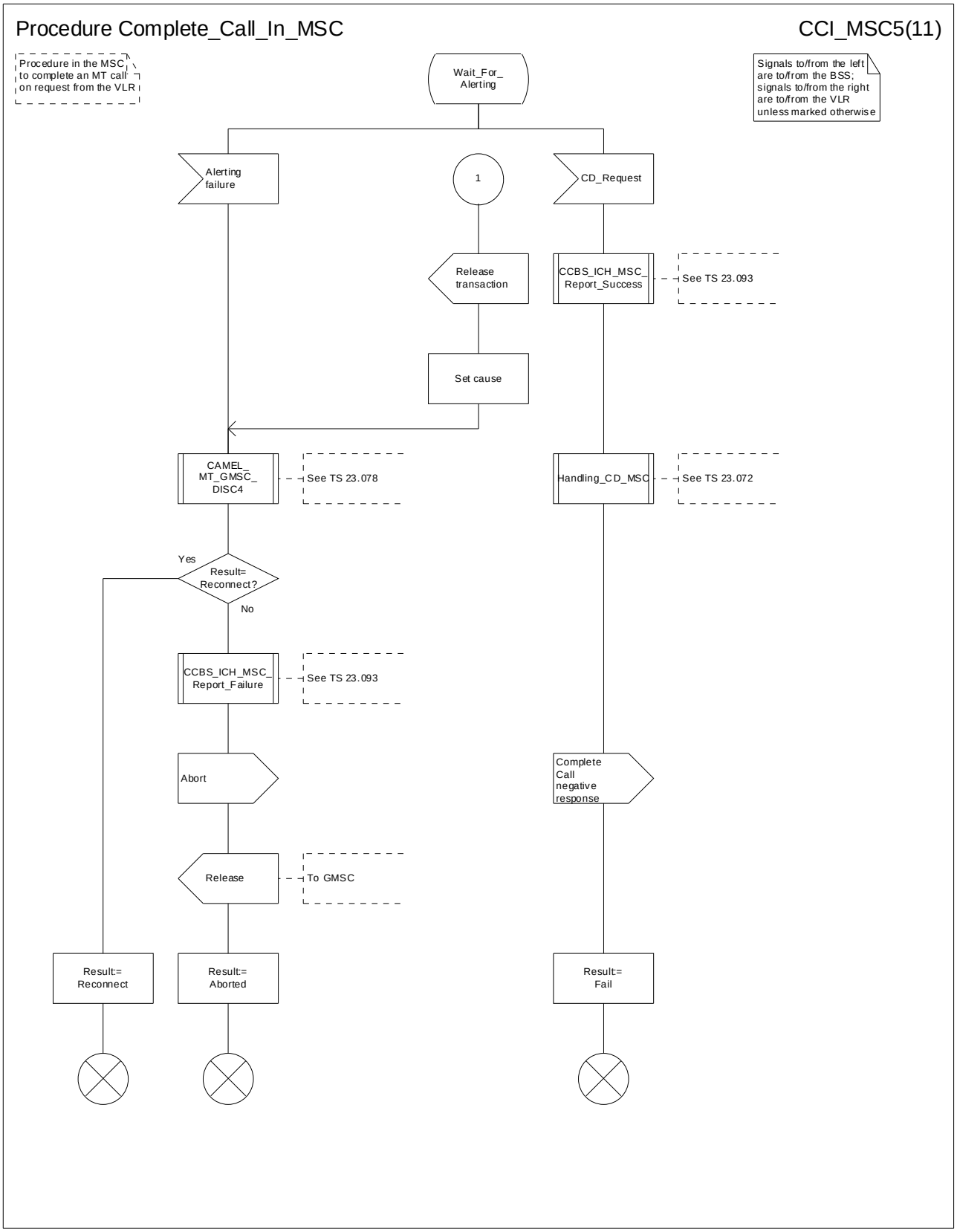


Figure 70e: Procedure Complete_Call_In_MSC (sheet 5)

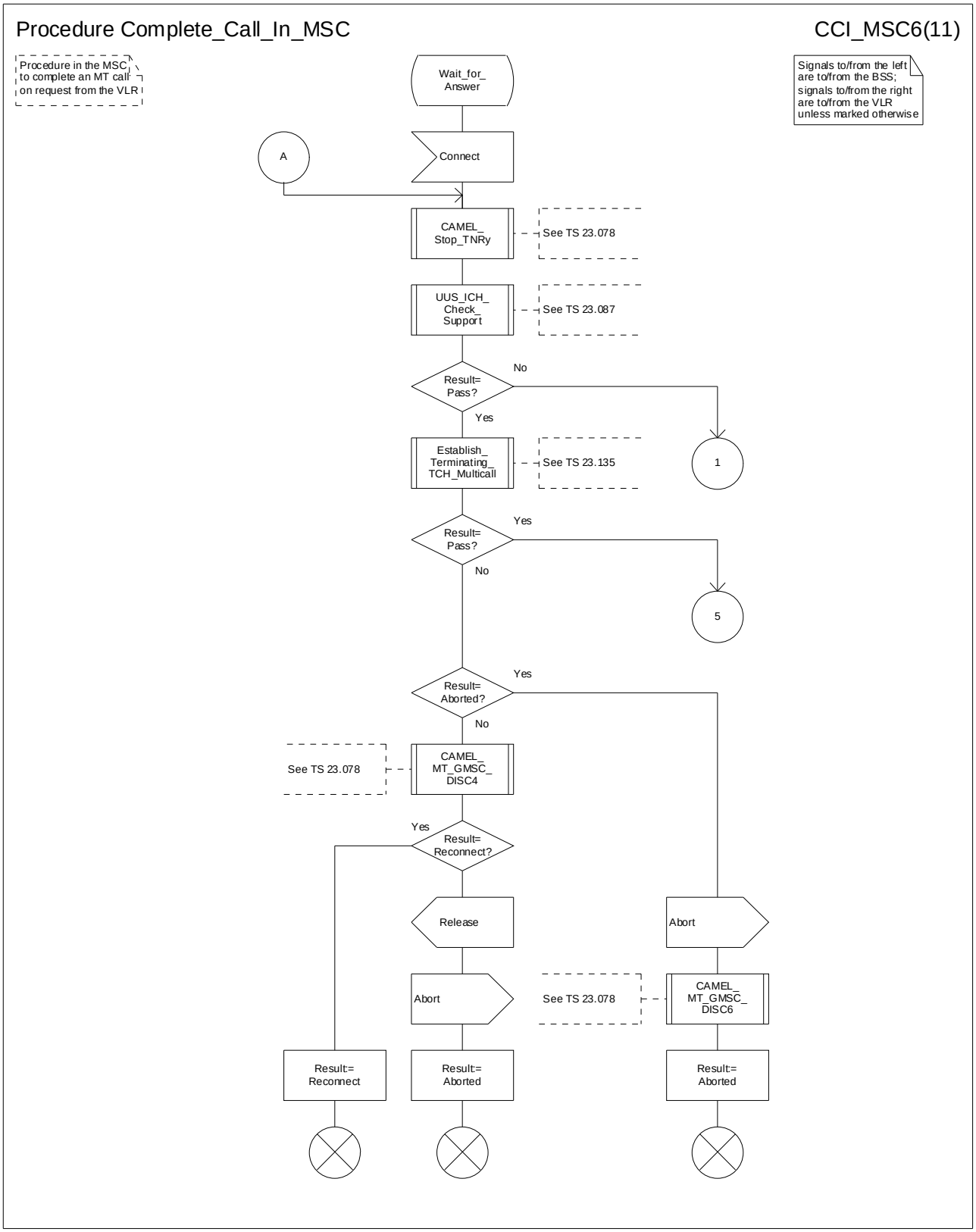


Figure 70f: Procedure Complete_Call_In_MSC (sheet 6)

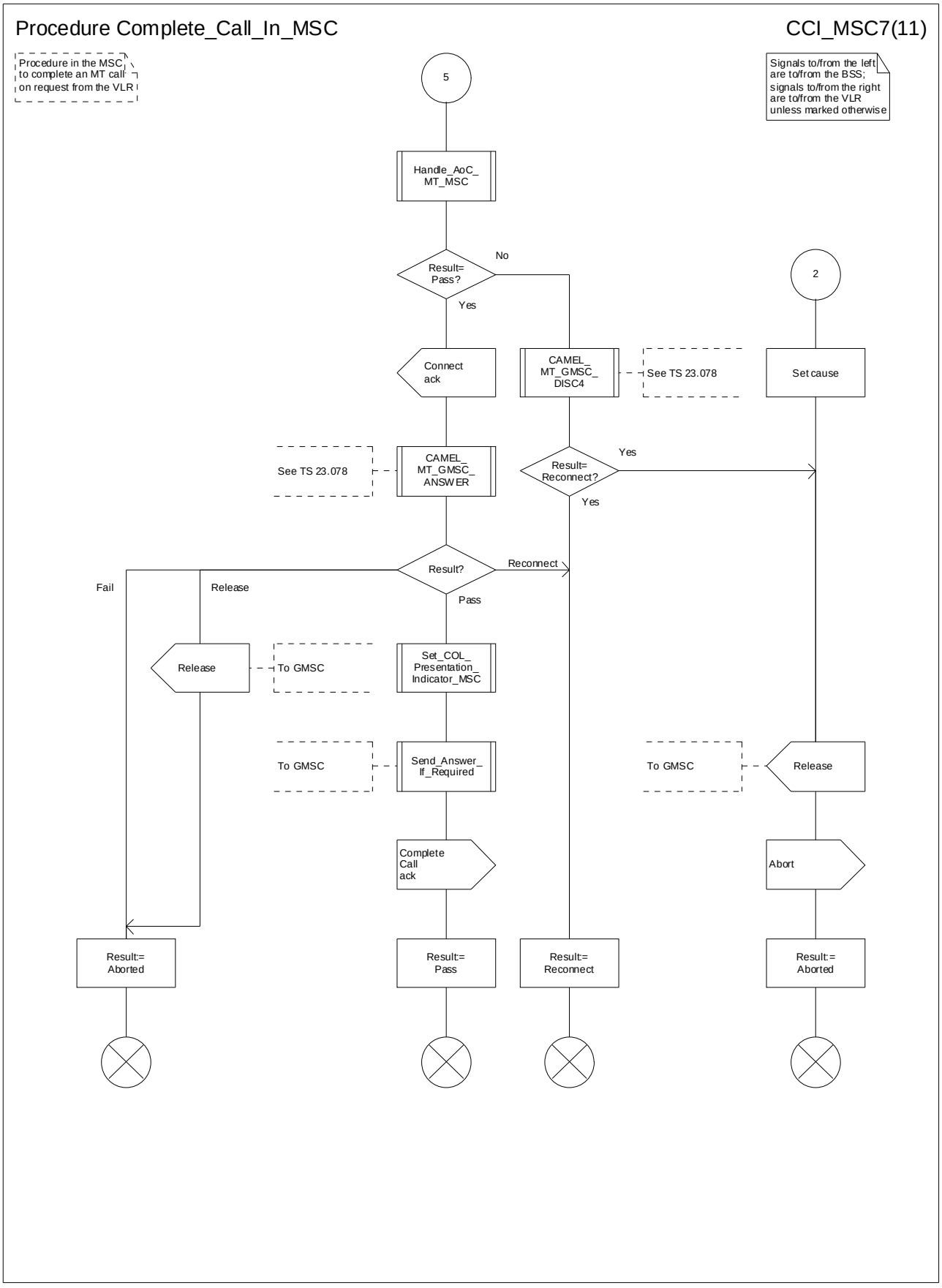


Figure 70g: Procedure Complete_Call_In_MSC (sheet 7)

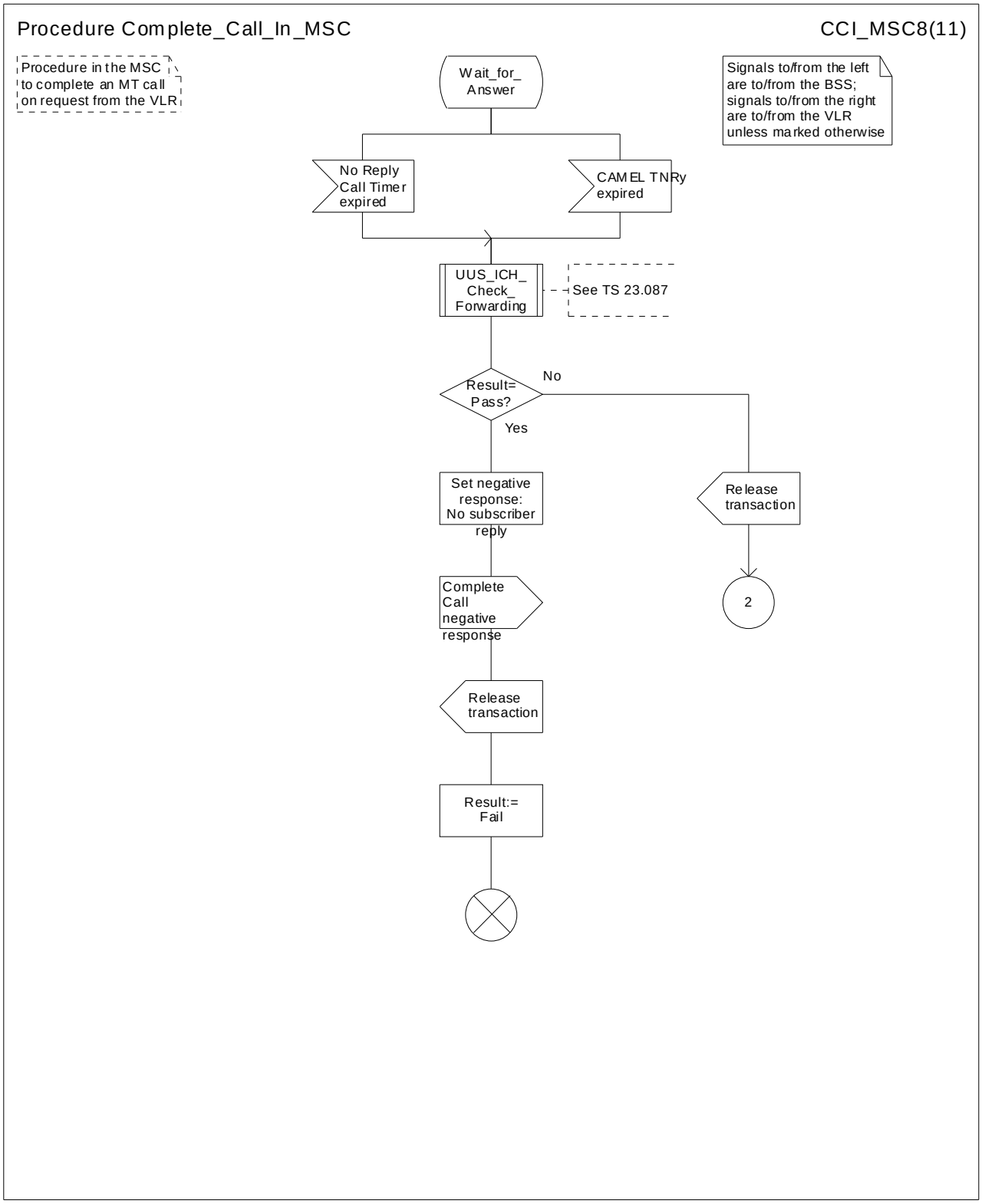


Figure 70h: Procedure Complete_Call_In_MSC (sheet 8)

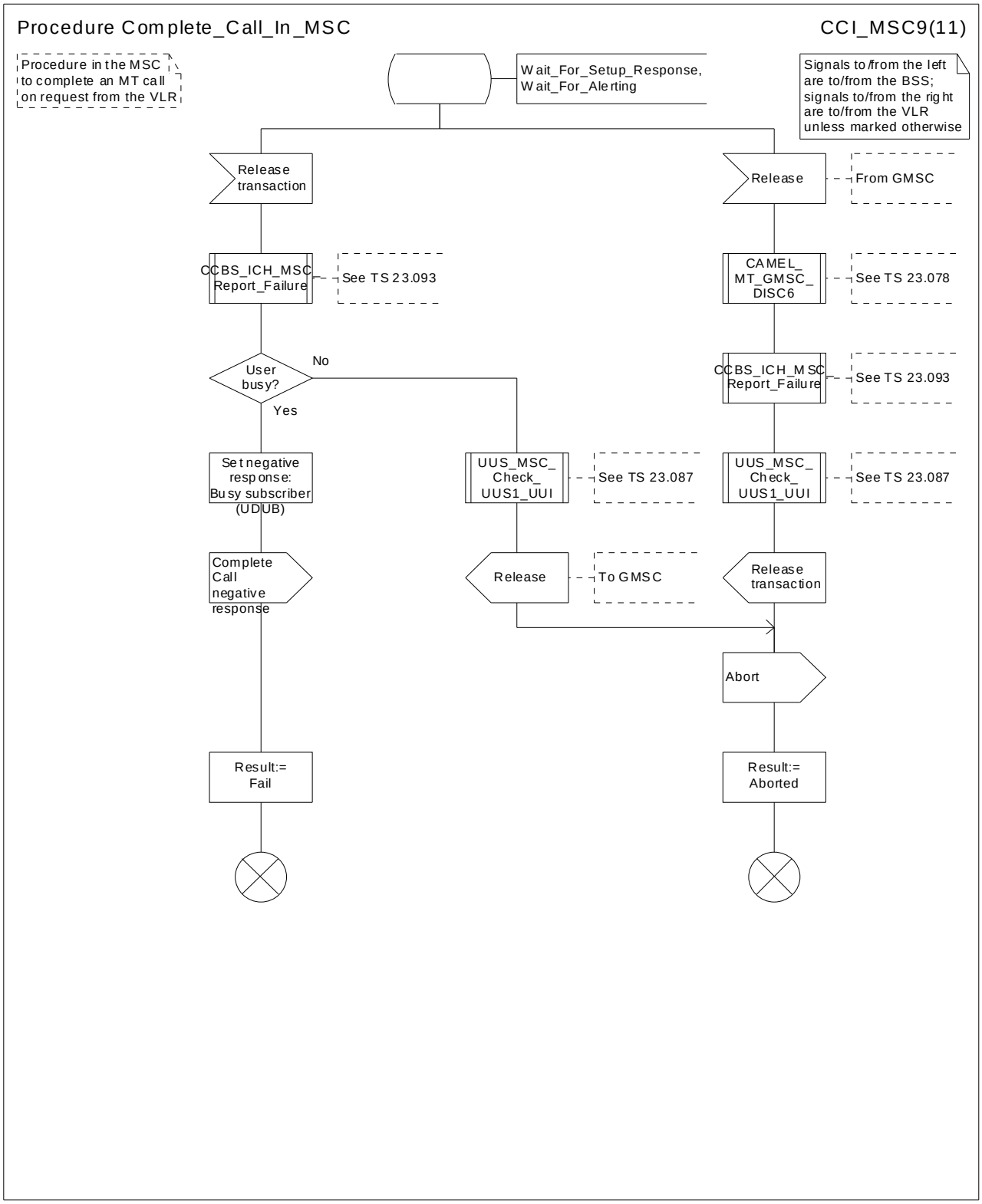


Figure 70i: Procedure Complete_Call_In_MSC (sheet 9)

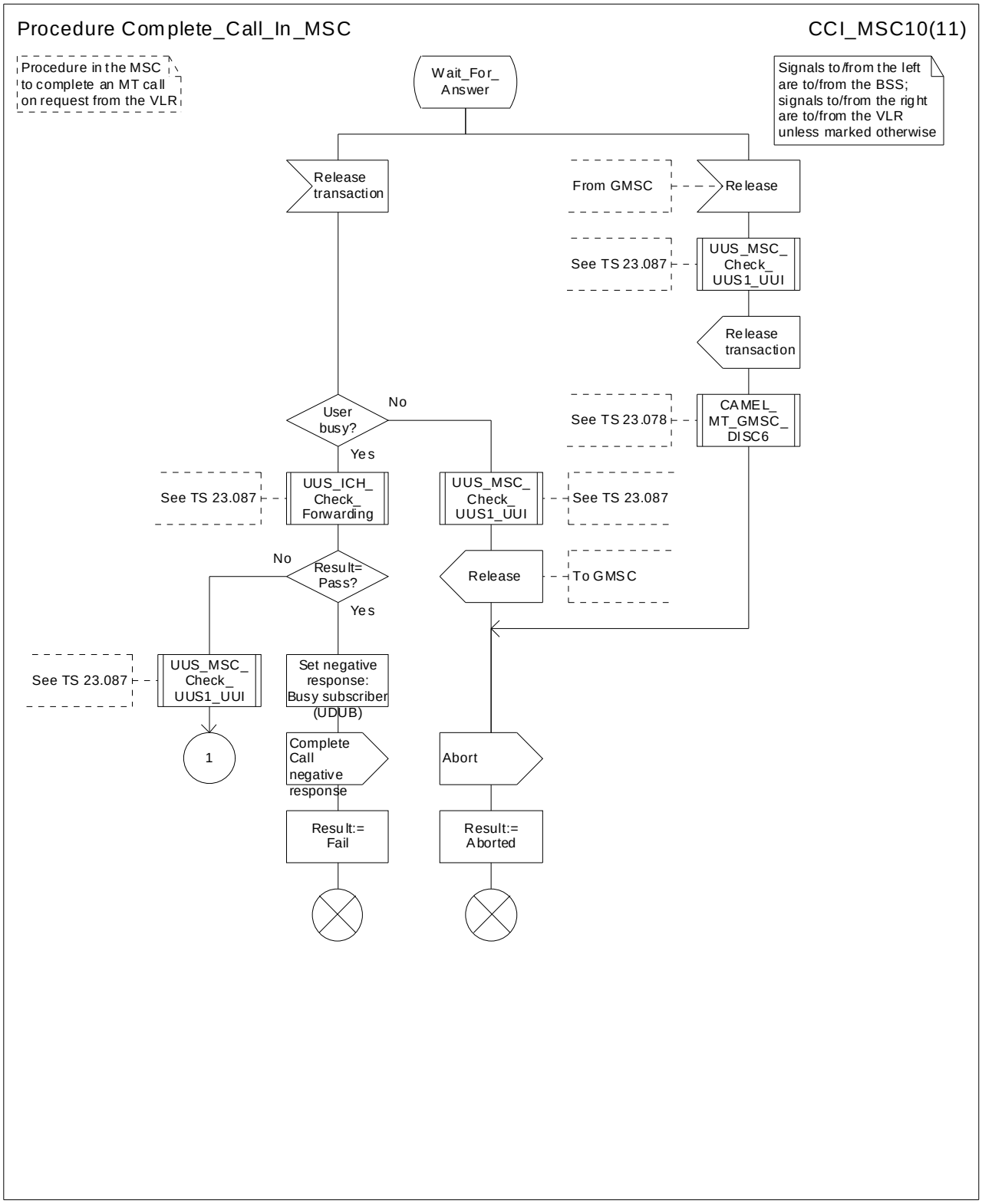


Figure 70j: Procedure Complete_Call_In_MSC (sheet 10)

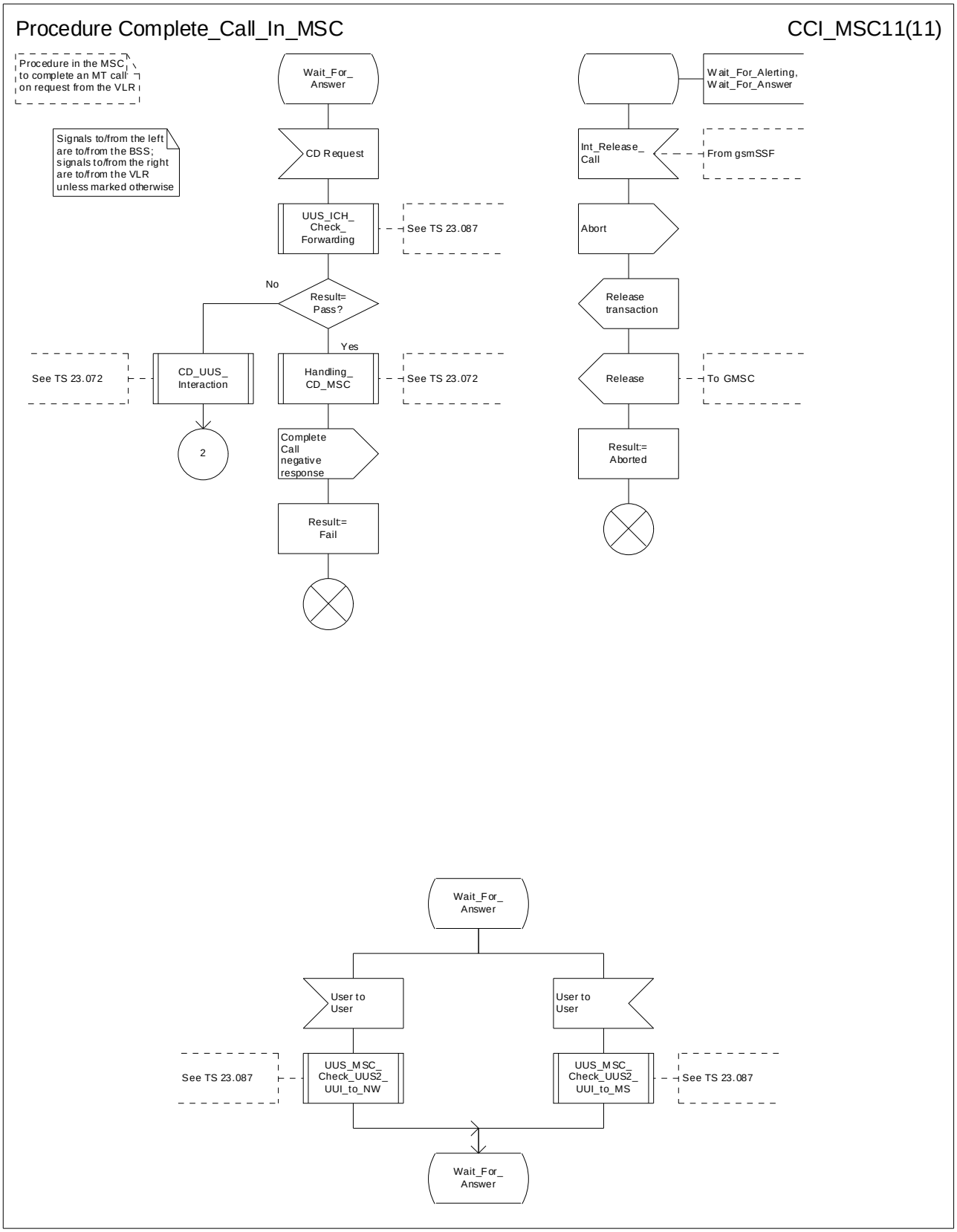


Figure 70k: Procedure Complete_Call_In_MSC (sheet 11)

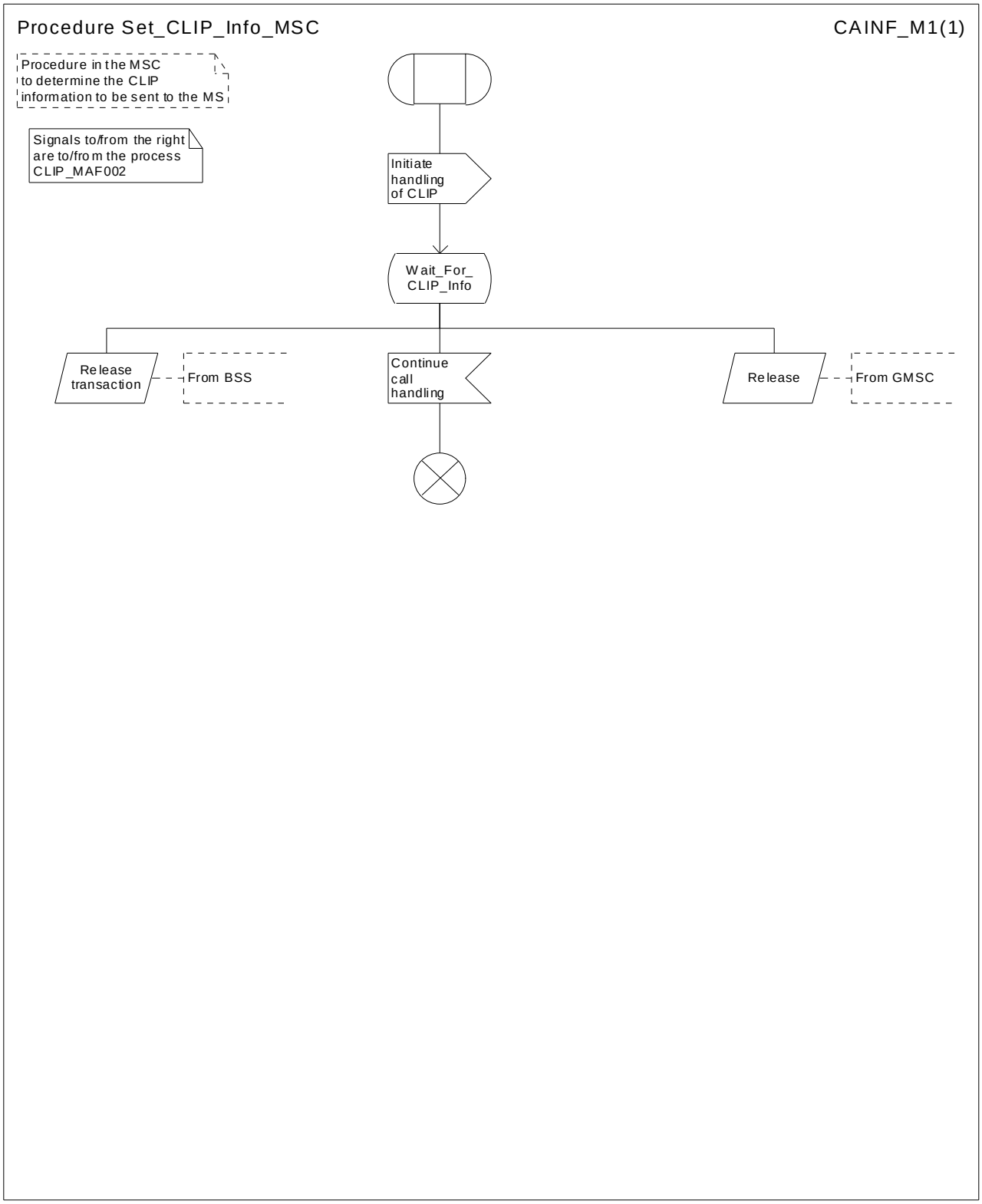


Figure 71: Procedure Set_CLIP_Info_MSC

Figure 72: Void

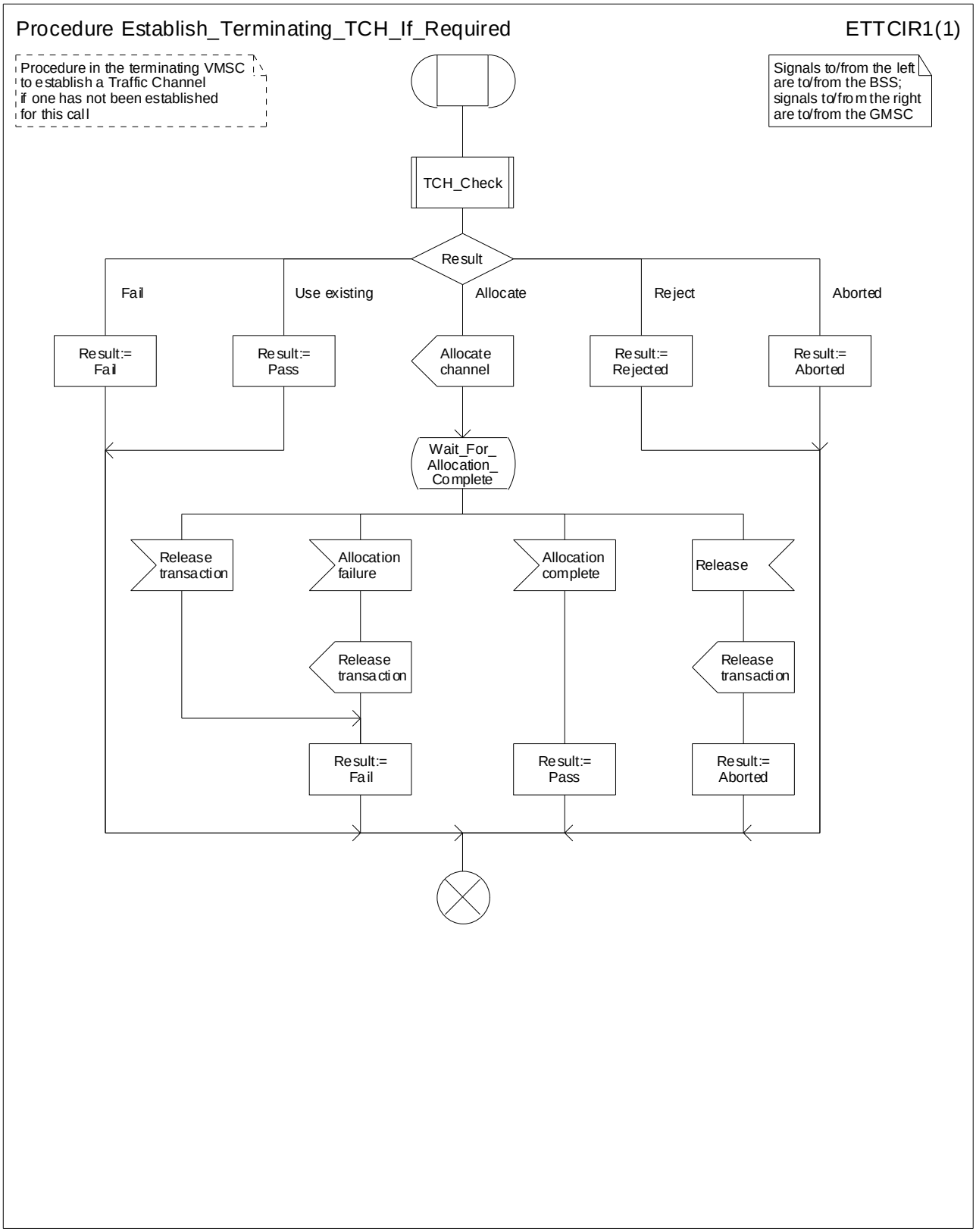


Figure 73: Procedure Establish_Terminating_TCH_If_Required

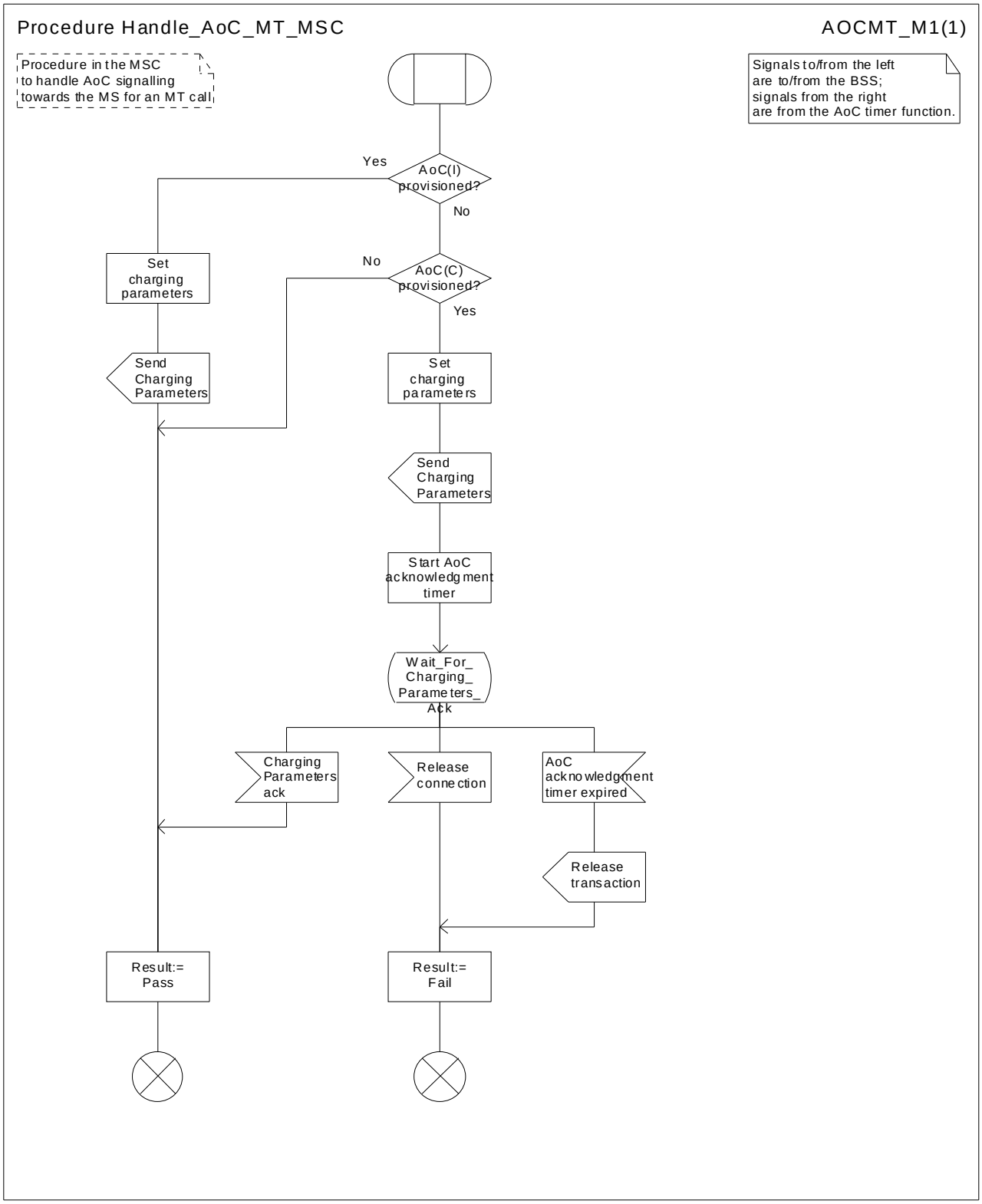


Figure 74: Procedure Handle_AoC_MT_MSC

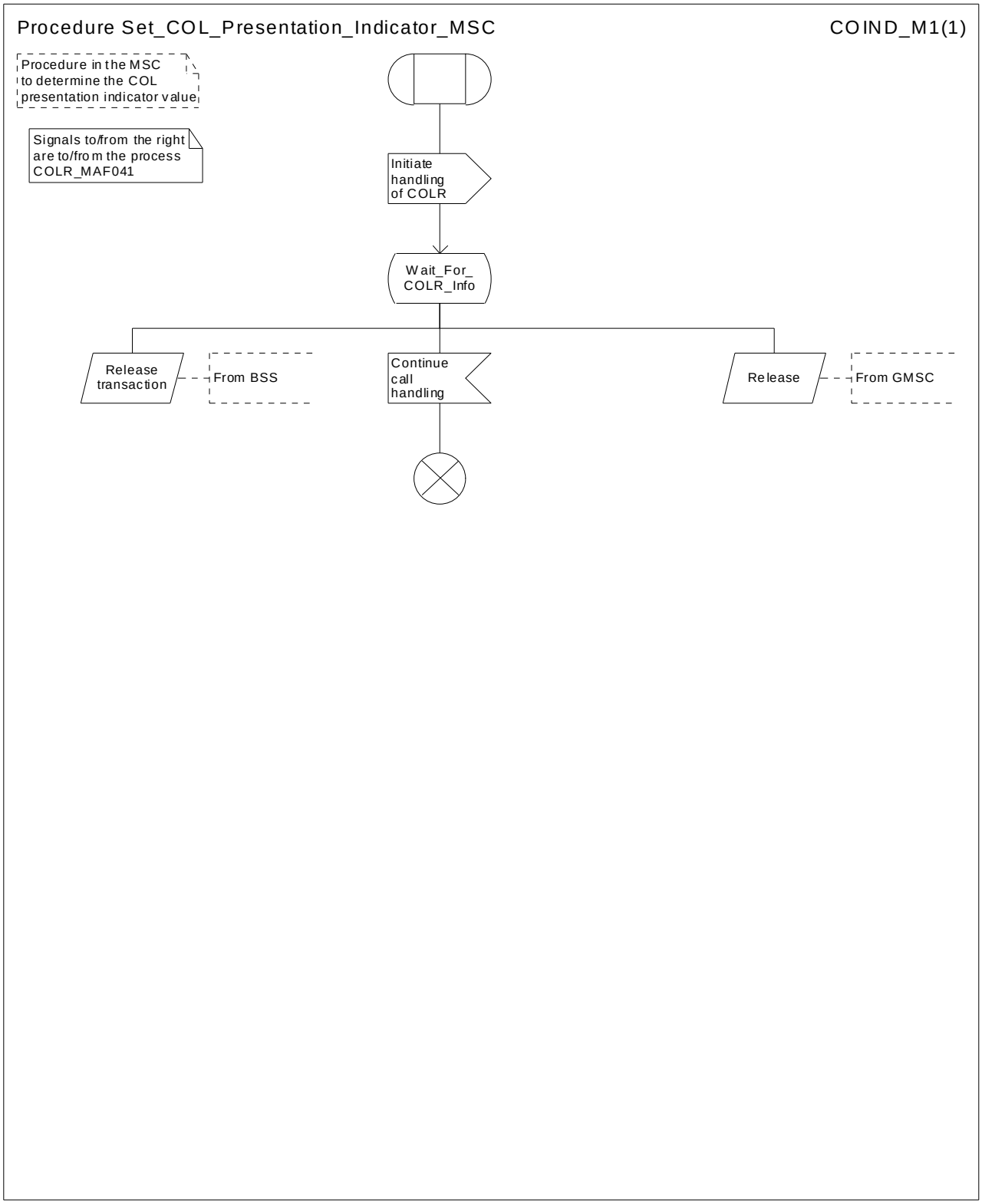


Figure 75: Procedure Set_COL_Presentation_Indicator MSC

7.3.2 Functional requirements of VLR

7.3.2.1 Process ICH_VLR

Sheet 1: if the MSRN received in the Send Info For Incoming Call is not allocated or there is no IMSI record for the IMSI identified by the MSRN or the MS is marked as "Subscriber data dormant" (e.g. due to super-charger), this is treated as an unknown MSRN.

Sheet 1: MT roaming retry is not triggered for an incoming call that arrives at the old VLR after the receipt of the MAP Send Identification request from the new VLR but before the receipt of the MAP Cancel Location from the HLR. The "Cancel Location received" flag enables to differentiate for a subscriber whose subscriber data is dormant whether a Cancel Location has been received or not from the HLR.

Sheet 1: the procedure CAMEL_ICH_VLR is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VLR does not support CAMEL phase 3 or later, processing continues from the possible call of the procedure CCBS_ICH_Set_CCBS_Call_Indicator. .

Sheet 1: If the MSRN is not allocated, "GMSC supports MT Roaming Retry" takes "No" exit.

Sheet 1: If no IMSI record is found, the " Subscriber data dormant" check takes the "False" exit.

Sheet 1: A VLR not supporting the flag "Subscriber data dormant" shall behave as if the flag is set to false.

Sheet 1: the procedure CCBS_ICH_Set_CCBS_Call_Indicator is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1: the VLR derives the basic service required for the call according to the rules defined in 3GPP TS 29.007 [30].

Sheet 1, sheet 2, sheet 5: the procedure CCBS_ICH_VLR_Report_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1, sheet 3: the procedure CCBS_ICH_Report_Not_Reachable is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 2: this process communicates with the matching instance of the process PRN_VLR, which is linked by the MSRN.

Sheet 2: the test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and
- there is an association established for the MS between the MSC/VLR and the SGSN.

Sheet 3: the test "NDUB?" takes the "Yes" exit if the Page MS negative response or the Search for MS negative response had the value Busy Subscriber (NDUB).

Sheet 3: the procedure Get_CW_Subscription_Info_VLR is specific to Call Waiting. If the VLR does not support Call Waiting, processing continues from the "No" exit of the test "CW available?".

Sheet 3: the procedure Get_CW_Subscription_Info_Multicall_VLR is specific to Multicall; it is specified in 3GPP TS 23.135 [34]. If the VLR does not support both Multicall and Call Waiting, processing continues from the "No" exit of the test "CW available?".

Sheet 3: the VLR uses the basic service returned in the Page MS negative response or the Search for MS negative response Busy Subscriber (More calls possible) to determine whether call waiting is available.

Sheet 3: the procedure Get_LI_Subscription_Info_MT_VLR is specific to CLIP and COLR. If the VLR supports neither CLIP nor COLR, the procedure call is omitted.

Sheet3: the procedure Get_AoC_Subscription_Info_VLR is specific to AoC; it is specified in clause 7.1.2.15.

Sheet 3 sheet 6: the procedure CLI_ICH_VLR_Add_CLI is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 3: the procedure CCBS_ICH_Handle_NDUB is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. If the VLR does not support CCBS, processing continues from the "Forward" exit of the test "Result".

Sheet 3: the procedure Process_Access_Request_VLR is specified in clause 7.1.2.2.

Sheet 3: the output signal Page MS towards the SGSN includes the Location area identity parameter.

Sheet 3: if the VLR does not support CUG, handling continues from the "No" exit of the test "CUG info present?".

Sheet 3: the "MT Roaming Forwarding Supported" check takes the "Yes" exit if both the MSC and the VLR support that feature. If both the MT Roaming Retry and the MT Roaming Forwarding procedures are supported, and if the conditions for using these procedures are met, the VLR can decide based on operator policy which procedure to follow.

Sheet 3: MT Roaming Forwarding is possible towards the new VLR if the conditions defined in clause 5.2.3 are fulfilled. If so, the old VLR sends a MAP Provide Roaming Number request to the new VLR whose address was received in the MAP Cancel Location message or the MAP Send Identification message. In addition to the requirements specified in clause 10.2.3 of 3GPP TS 29.002 [29], the MAP Provide Roaming Number request shall not include the "OR Interrogation" parameter when being sent as part of the MT Roaming Forwarding call after successful retrieval of routeing information procedure.

Sheet 4, sheet 6: the procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

Sheet 5, sheet 6: the procedure CD_Authorization is specific to Call Deflection, it is specified in 3GPP TS 23.072 [11]. If the VLR does not support Call Deflection, processing continues from the "Yes" exit of the test "Result=Aborted?".

Sheet 5, sheet 6: the procedure CCBS_ICH_Handle_UDUB is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 6: the test "NDUB?" is executed only if the VLR supports CCBS. If the VLR does not support CCBS, processing continues from connector 5.

Sheet 7: the procedure CCBS_ICH_Set_CCBS_Target is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 7: the procedure Handle_CFNRc is specified in clause 7.2.2.11.

Sheet 8: the procedure Forward_CUG_Check is specific to CUG; it is specified in clause 7.2.2.6. If the VLR does not support CUG, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 8: the procedures CAMEL_O_CSI_Check_VLR, and CAMEL_D_CSI_Check_VLR are specific to CAMEL phase 3 or later; they are specified in 3GPP TS 23.078 [12].

7.3.2.2 Void

7.3.2.3 Procedure Search_For_MS_VLR

The test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and
- the VLR configuration requires paging via the SGSN during VLR restoration.

The output signal Page MS towards the SGSN omits the Location area identity parameter. It is sent to every SGSN to which the VLR is connected.

7.3.2.4 Procedure Get_CW_Subscription_Info_VLR

The VMSC may abort the transaction with the VLR while a response is awaited from the process MAF013. The message is saved for processing after return from the procedure.

7.3.2.5 Procedure Get_LI_Subscription_Info_MT_VLR

The VMSC may abort the transaction with the VLR while a response is awaited from the process CLIP_MAF001 or the process COLR_MAF040. The message is saved for processing after return from the procedure.

7.3.2.6 Procedure Handle_CFB

The test "Normal call busy" refers to the value of the indicator returned by the process MAF008.

The procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

7.3.2.7 Procedure Handle_CFNRy

The test "Normal call" refers to the value of the indicator returned by the process MAF009.

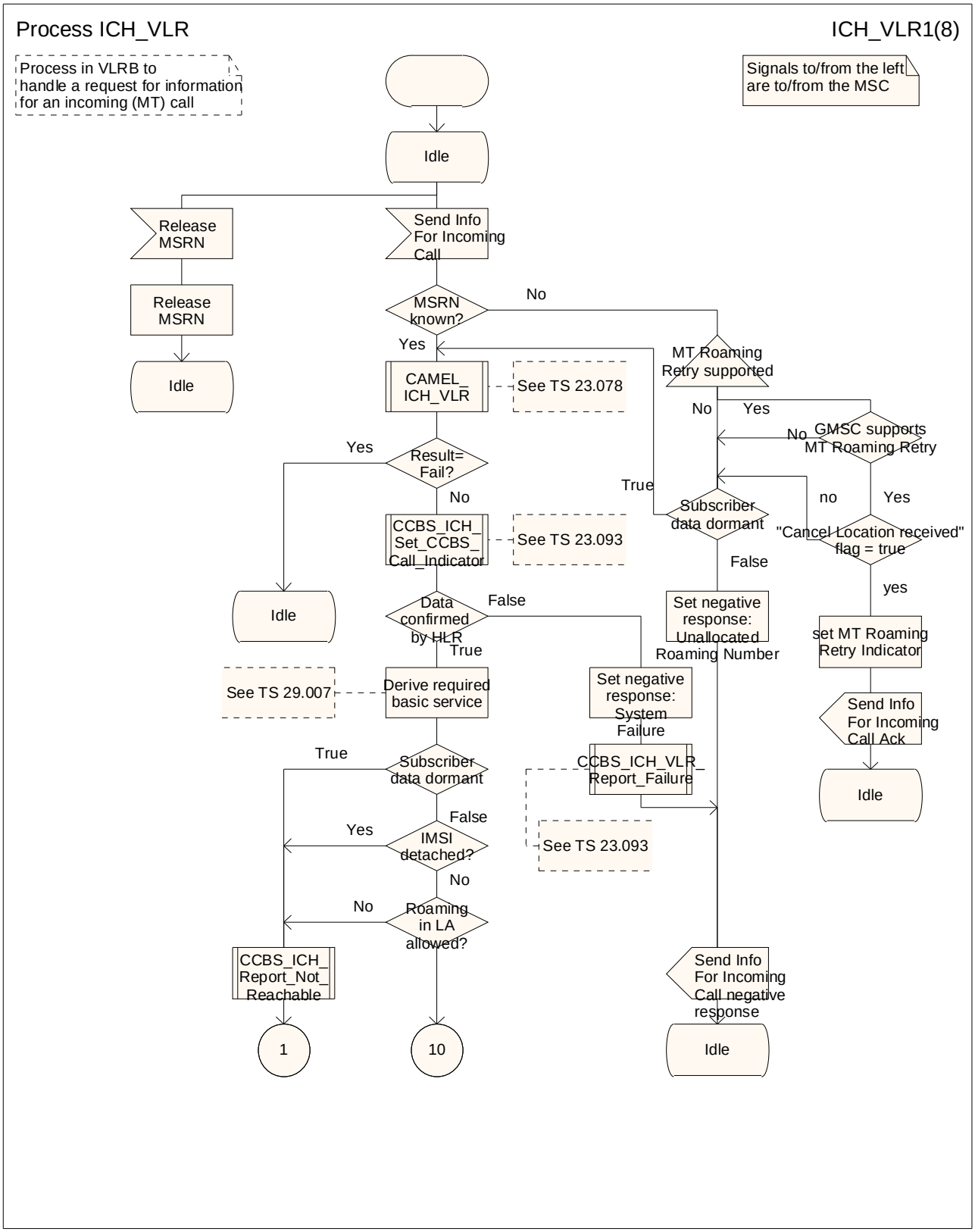


Figure 76a: Process ICH_VLR (sheet 1)

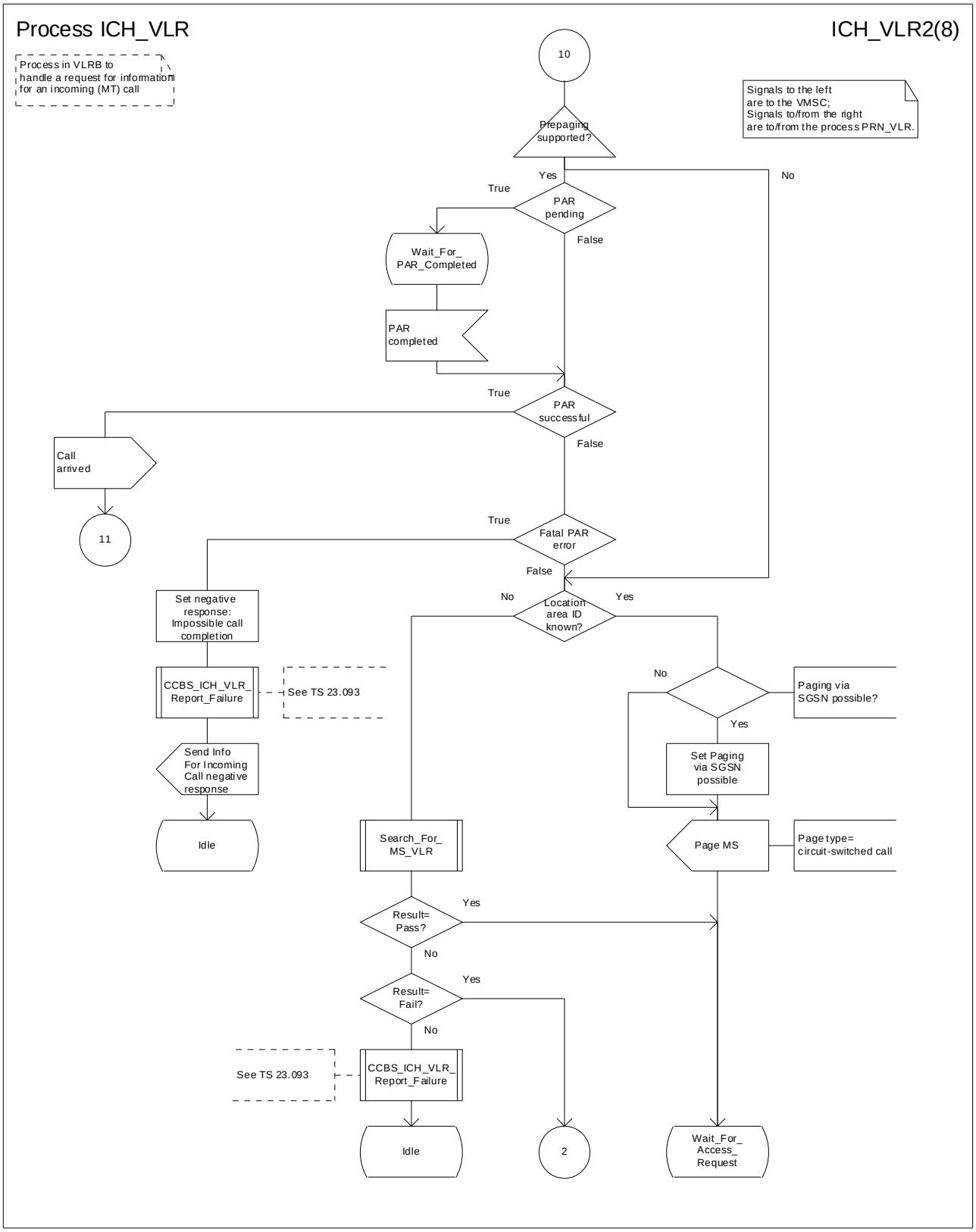


Figure 76b: Process ICH_VLR (sheet 2)

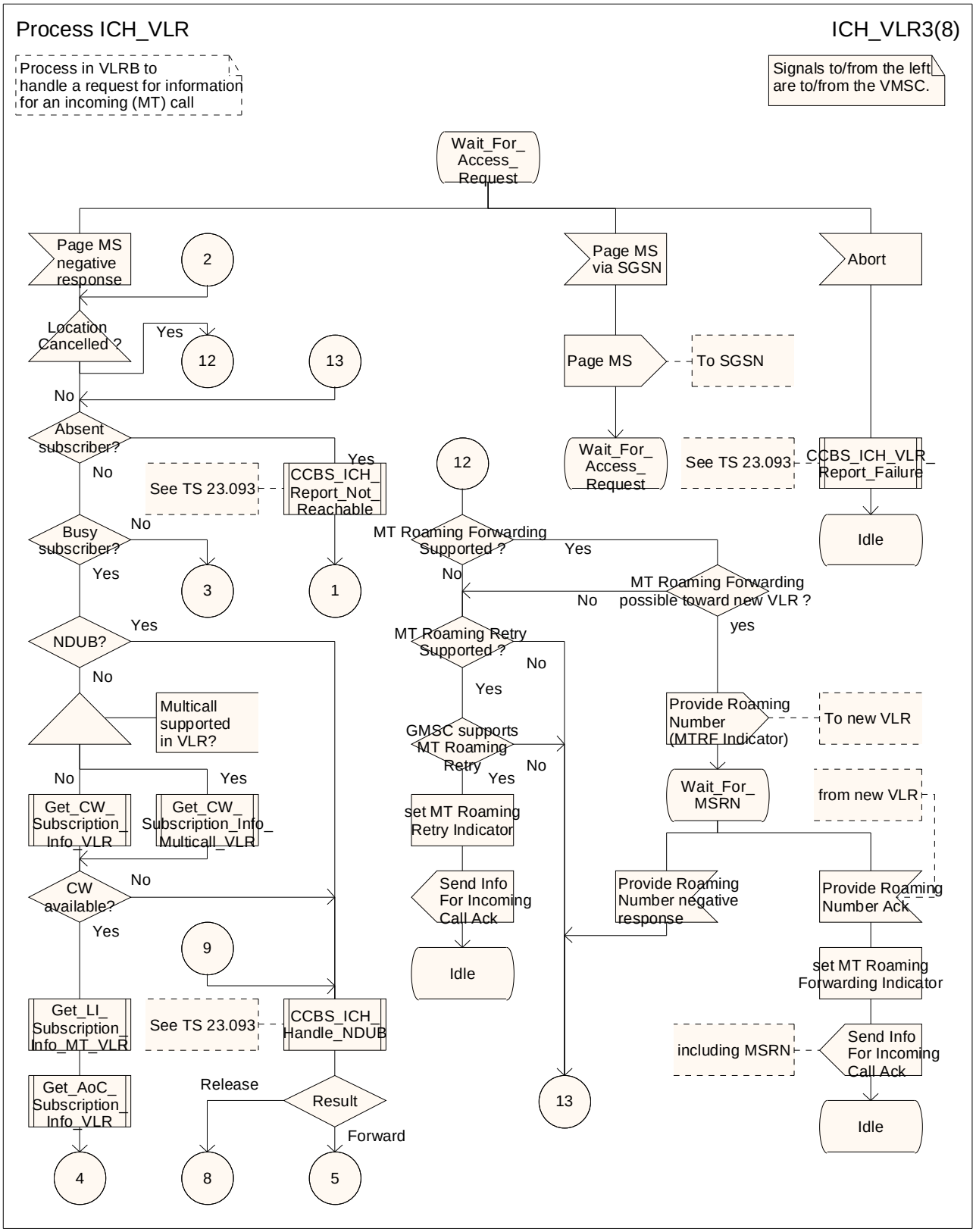


Figure 76c: Process ICH_VLR (sheet 3)

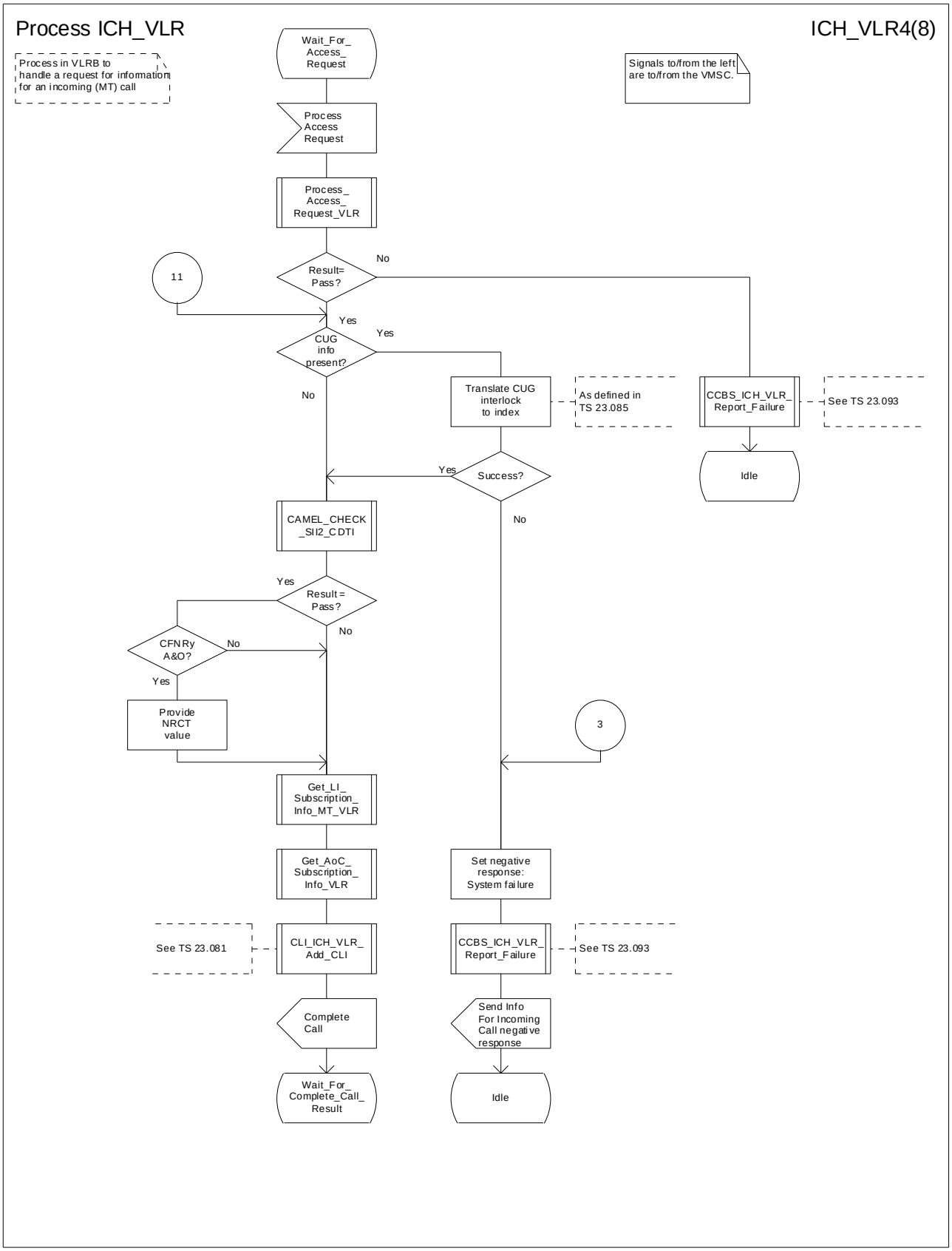


Figure 76d: Process ICH_VLR (sheet 4)

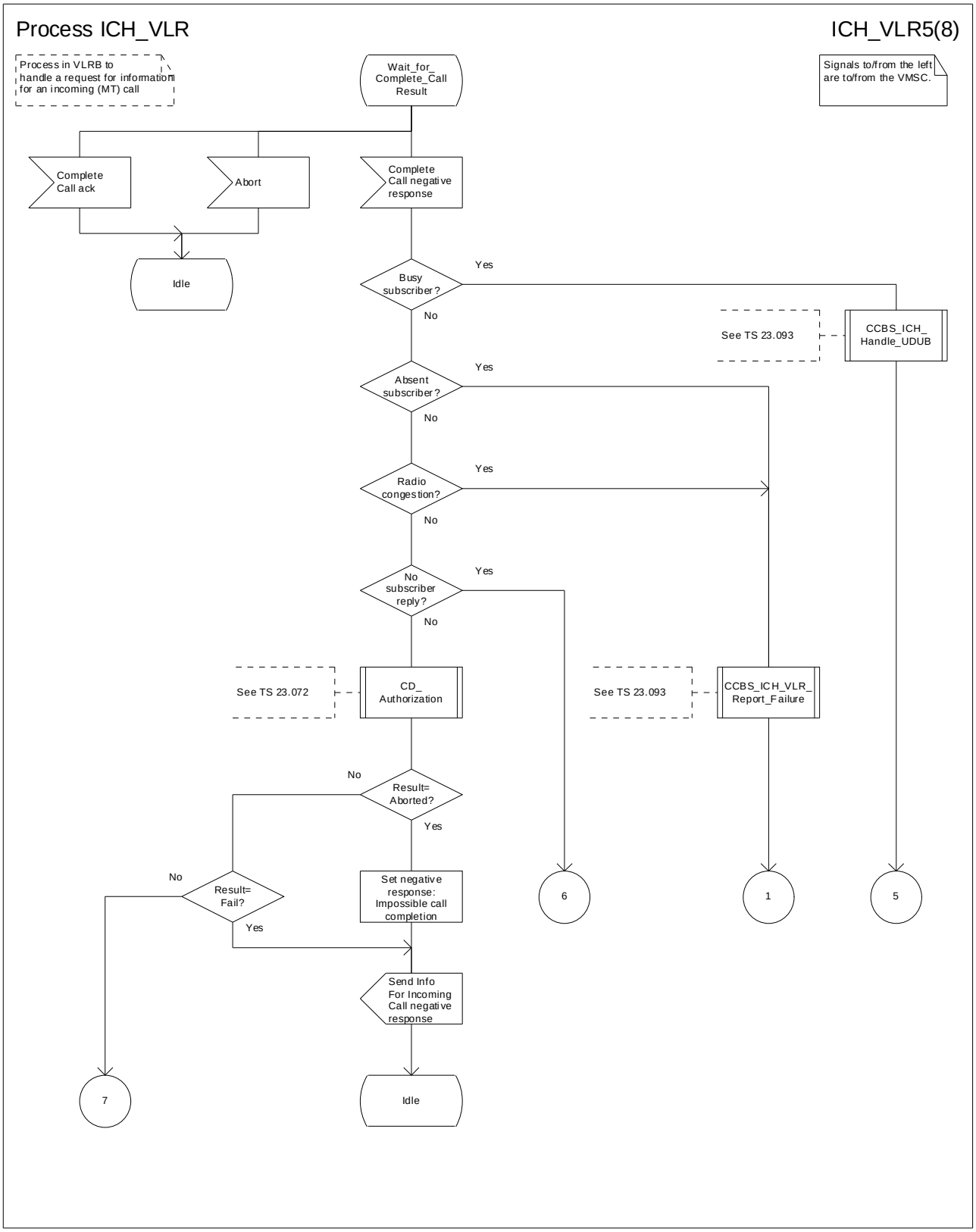


Figure 76e: Process ICH_VLR (sheet 5)

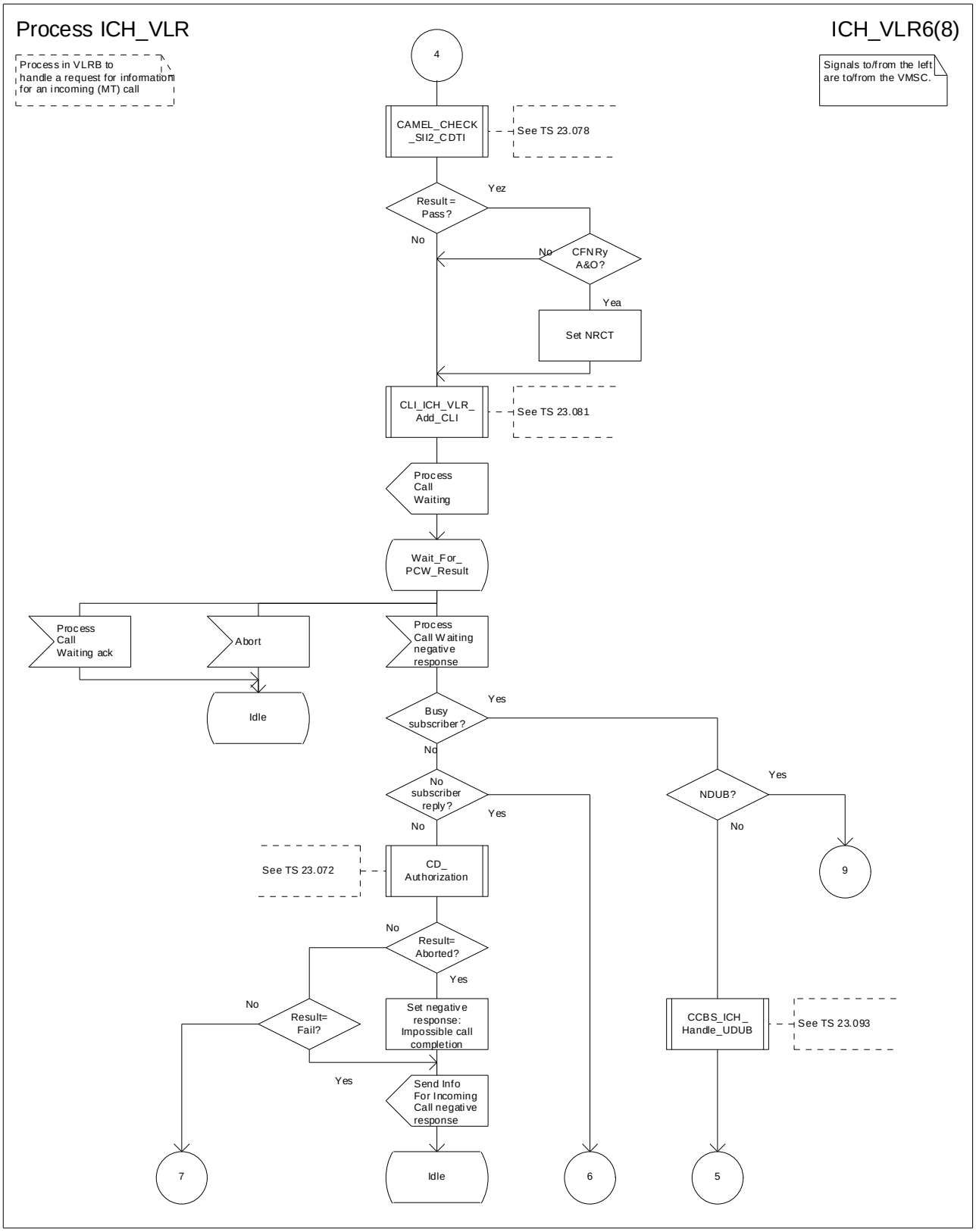


Figure 76f: Process ICH_VLR (sheet 6)

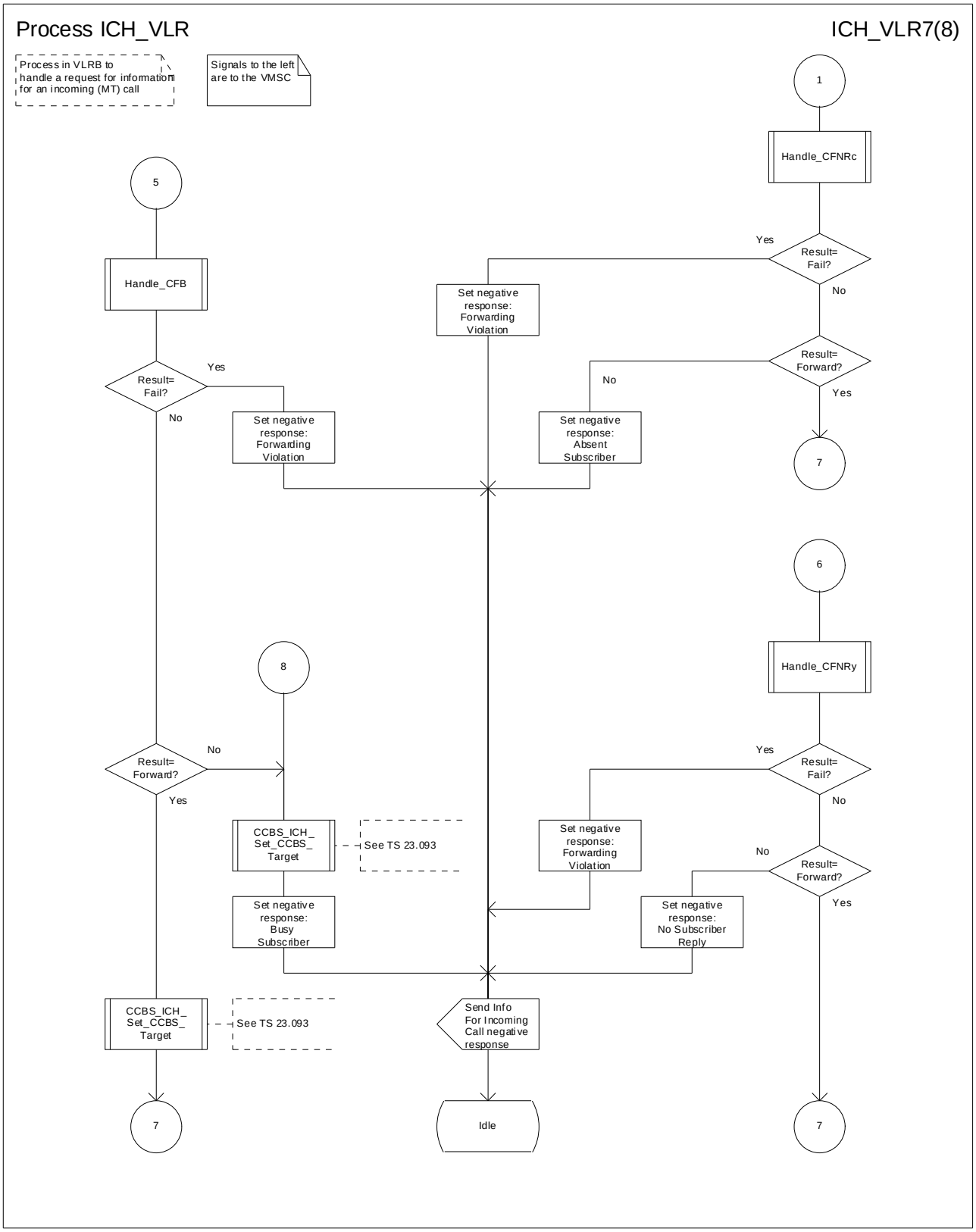


Figure 76g: Process ICH_VLR (sheet 7)

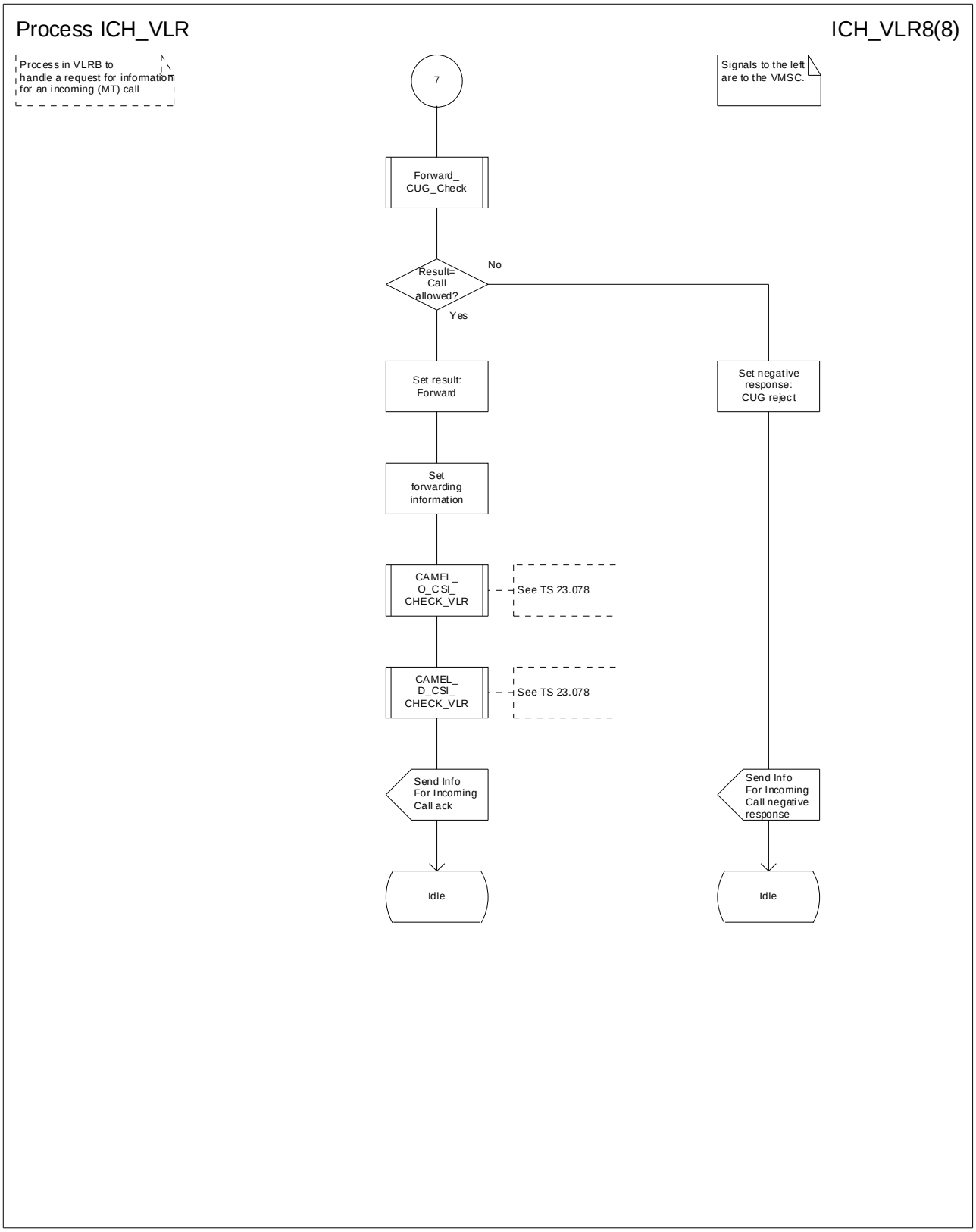


Figure 76h: Process ICH_VLR (sheet 8)

Figure 77: Void

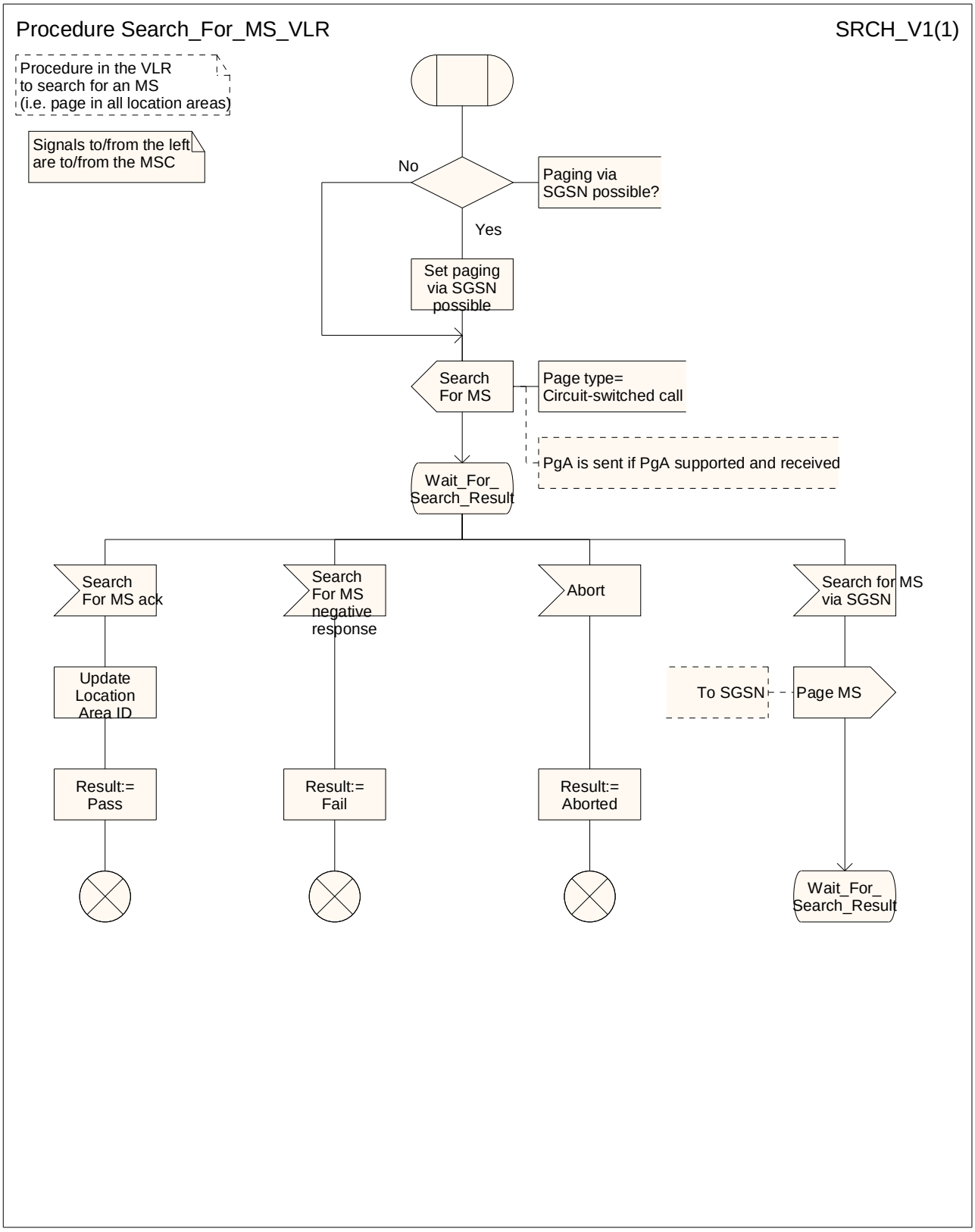


Figure 78: Procedure Search_For_MS_VLR

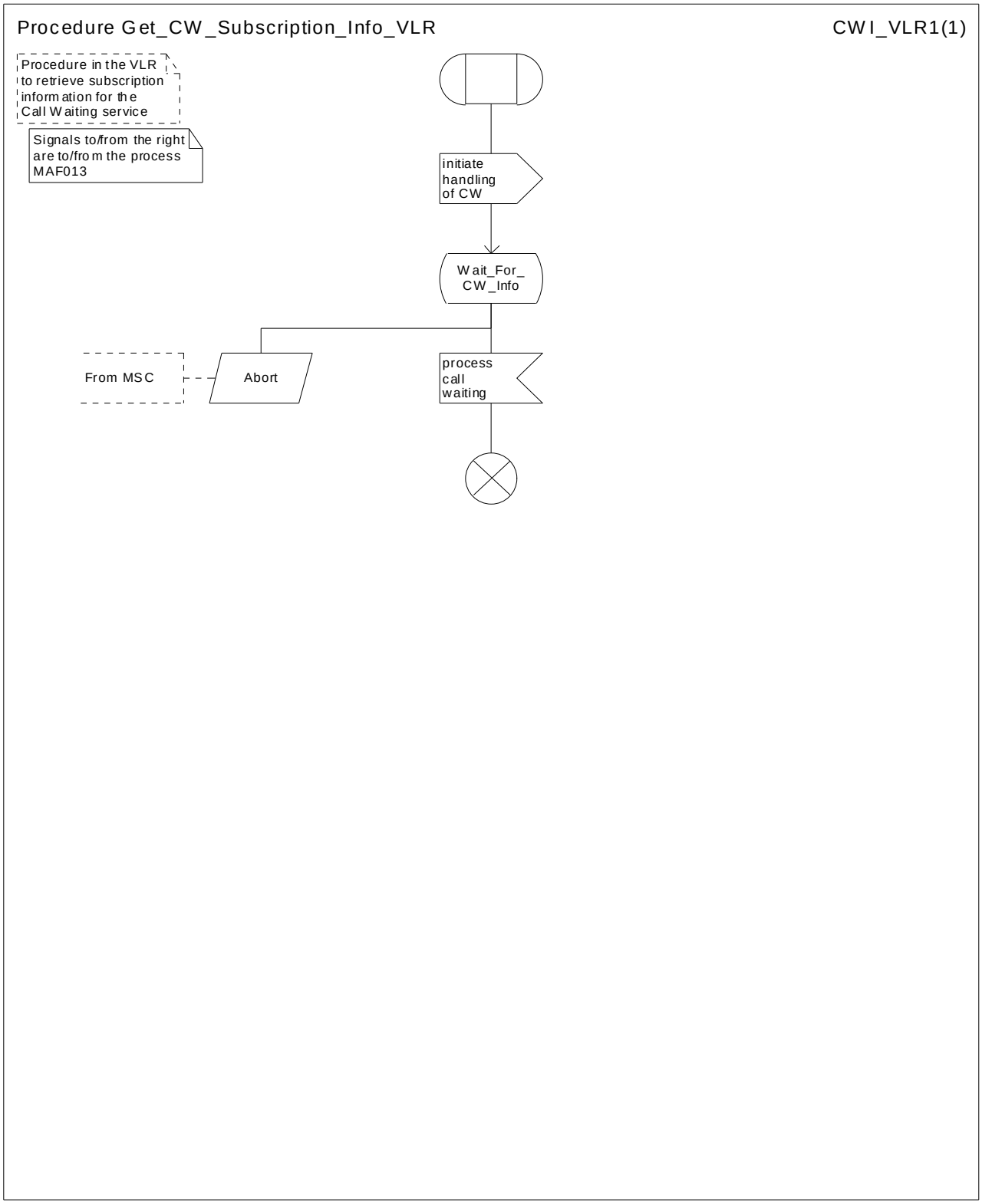


Figure 79: Procedure Get_CW_Subscription_Info_VLR

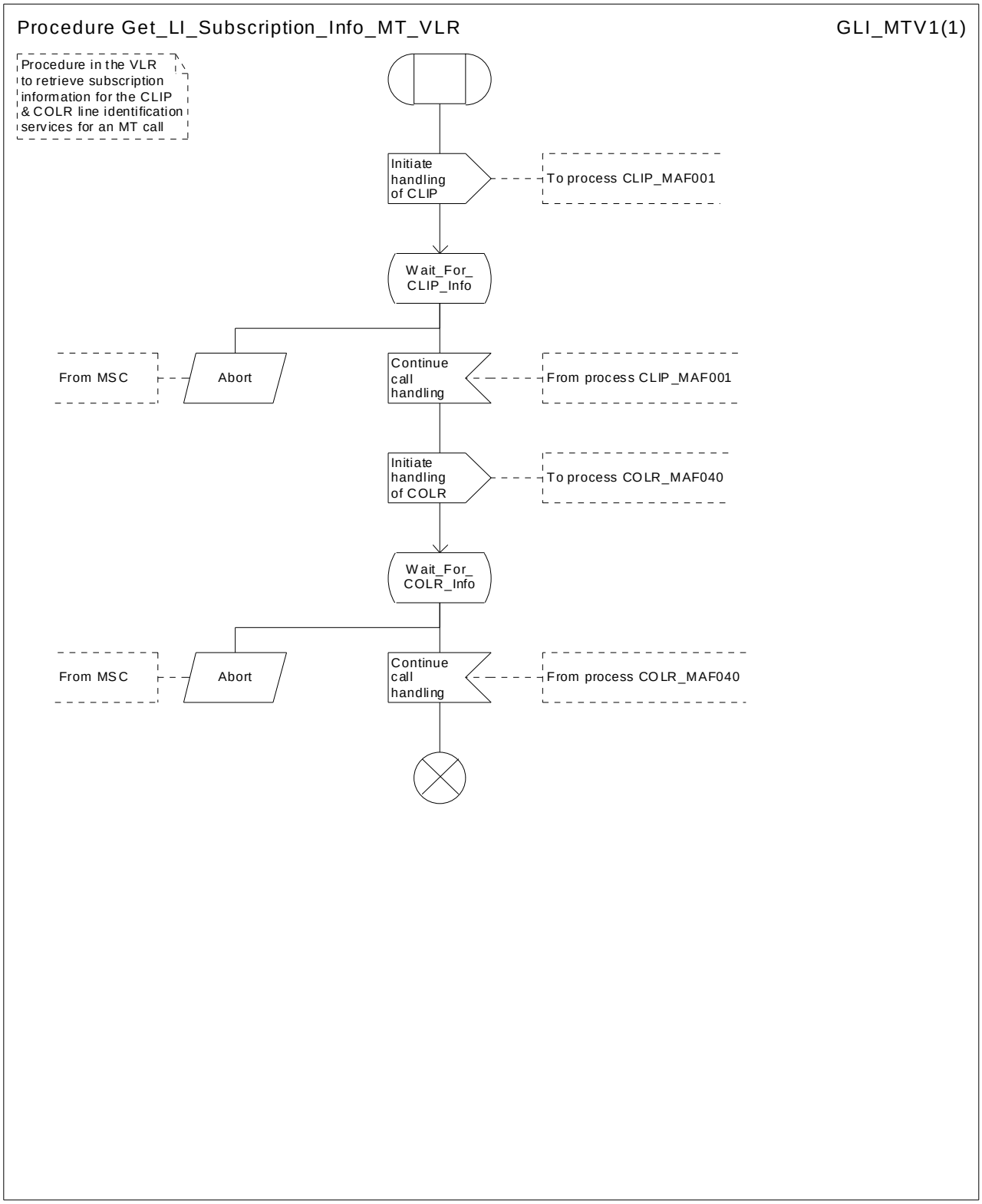


Figure 80: Procedure Get_LI_Subscription_Info_MT_VLR

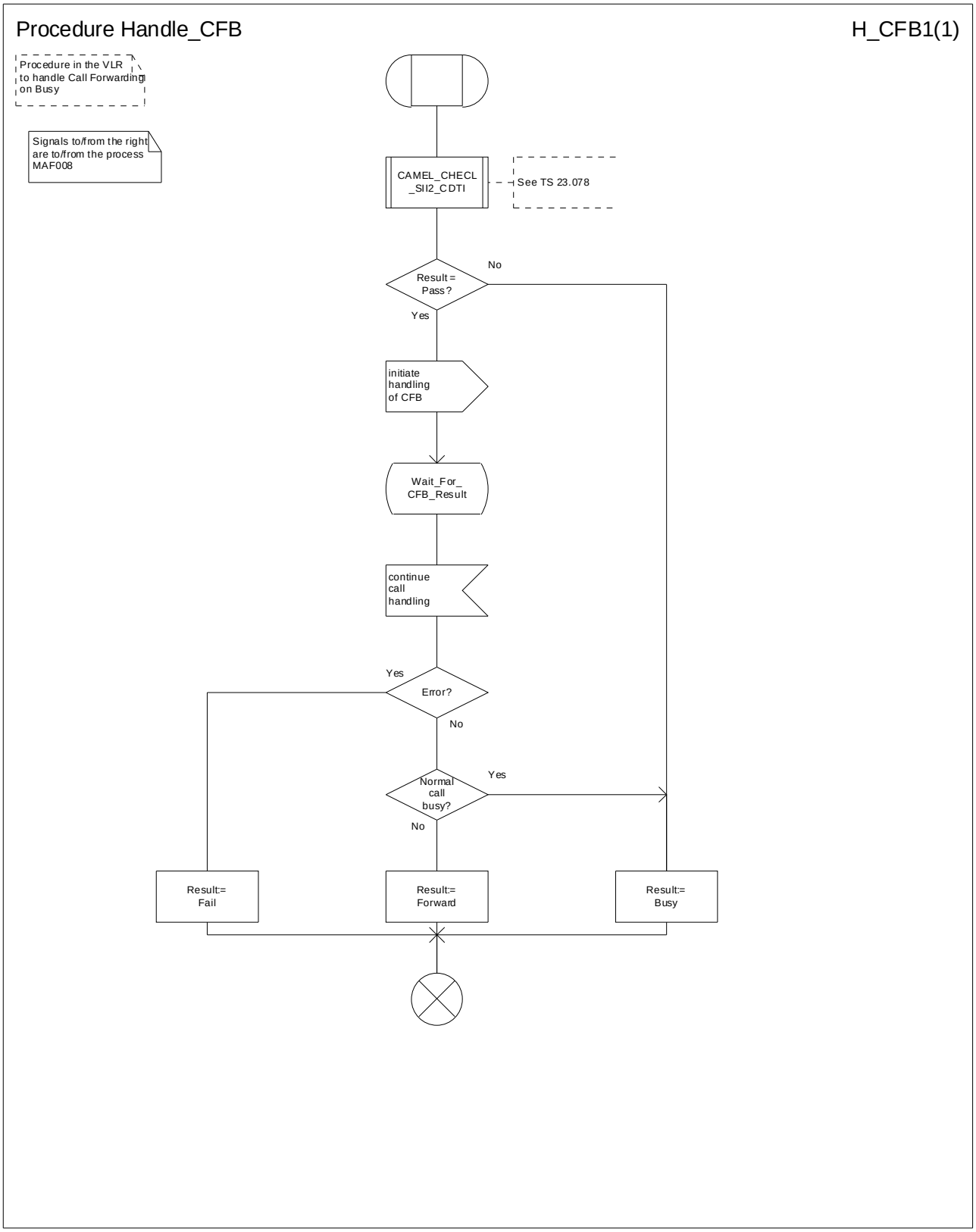


Figure 81: Procedure Handle_CFB

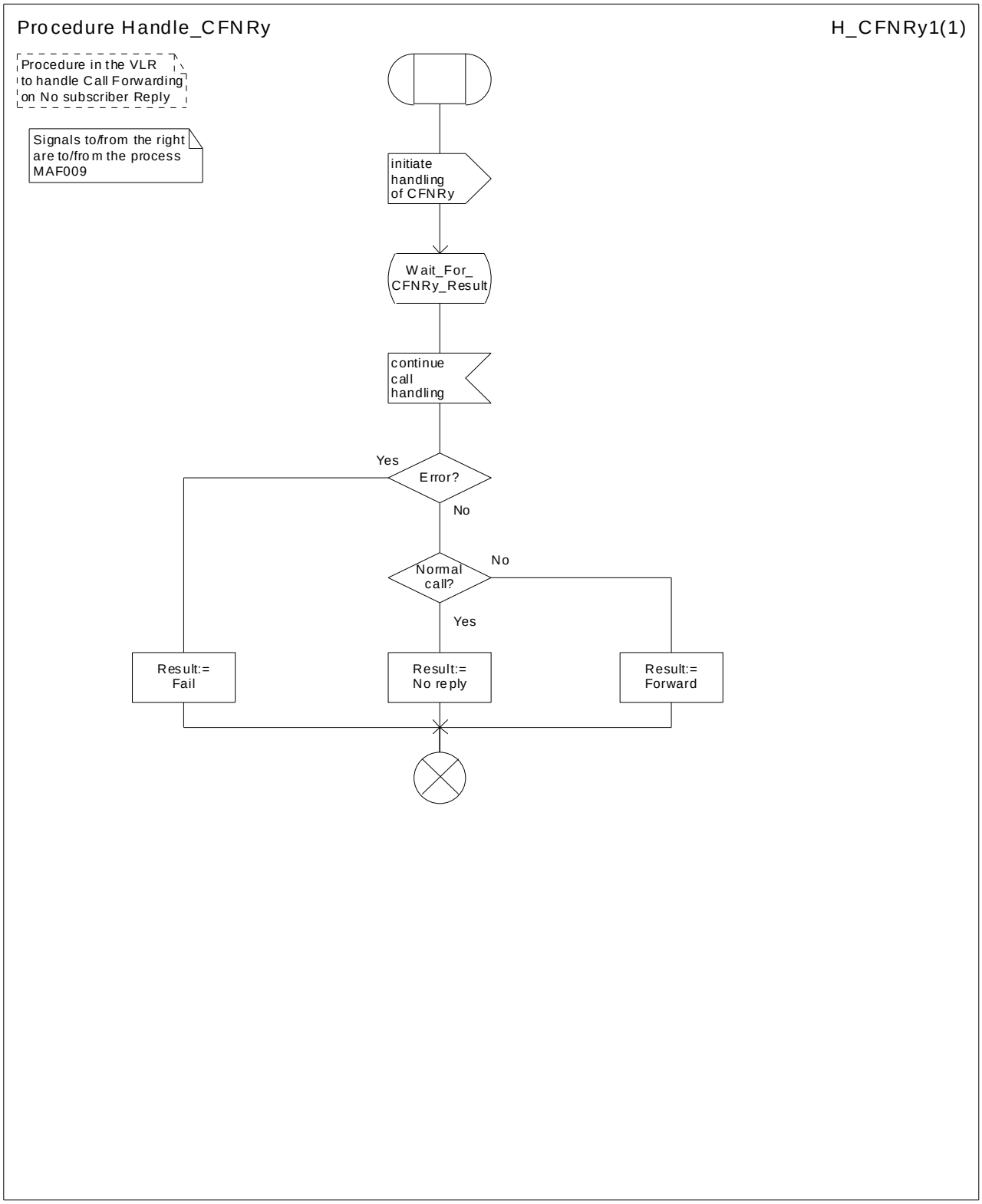


Figure 82: Procedure Handle_CFNRy

7.4 Subs_FSM

7.4.1 Functional requirements of serving MSC

7.4.1.1 Process Subs_FSM

One instance of the process Subs_FSM runs for each subscriber who is involved in at least one call. It monitors the state of any ongoing calls for that subscriber. The individual call control processes OCH_MSC and ICH_MSC submit supplementary service requests received from the MS to the process Subs_FSM, which then responds appropriately.

The process Subs_FSM interacts with the processes OCH_MSC and ICH_MSC as specified in clauses 7.1.1 and 7.3.1.

Sheet 5, sheet 6, sheet 7, sheet 8, sheet 9, sheet 11, sheet 12, sheet 15: processing on this page will occur only if the VMSC supports HOLD.

Sheet 8: the procdure Handle_MPTY is specific to MPTY; it is specified in 3GPP TS 23.084 [17].

Sheet 8: the procedure Handle_ECT_Active is specific to ECT; it is specified in 3GPP TS 23.091 [22].

Sheet 10: processing on this page will occur only if the VMSC supports Multicall.

Sheet 12: the procedure Handle_ECT_Alerting is specific to ECT; it is specified in 3GPP TS 23.091 [22].

Sheet 13, sheet 14: processing on this page will occur only if the VMSC supports both HOLD and Multicall.

7.4.1.1.1 Macro Check_Ongoing_Calls

7.4.1.1.2 Macro Update_Non_Speech_Calls_Status

7.4.1.1.3 Macro Increment_Call_Counter

7.4.1.1.4 Macro Decrement_Call_Counter

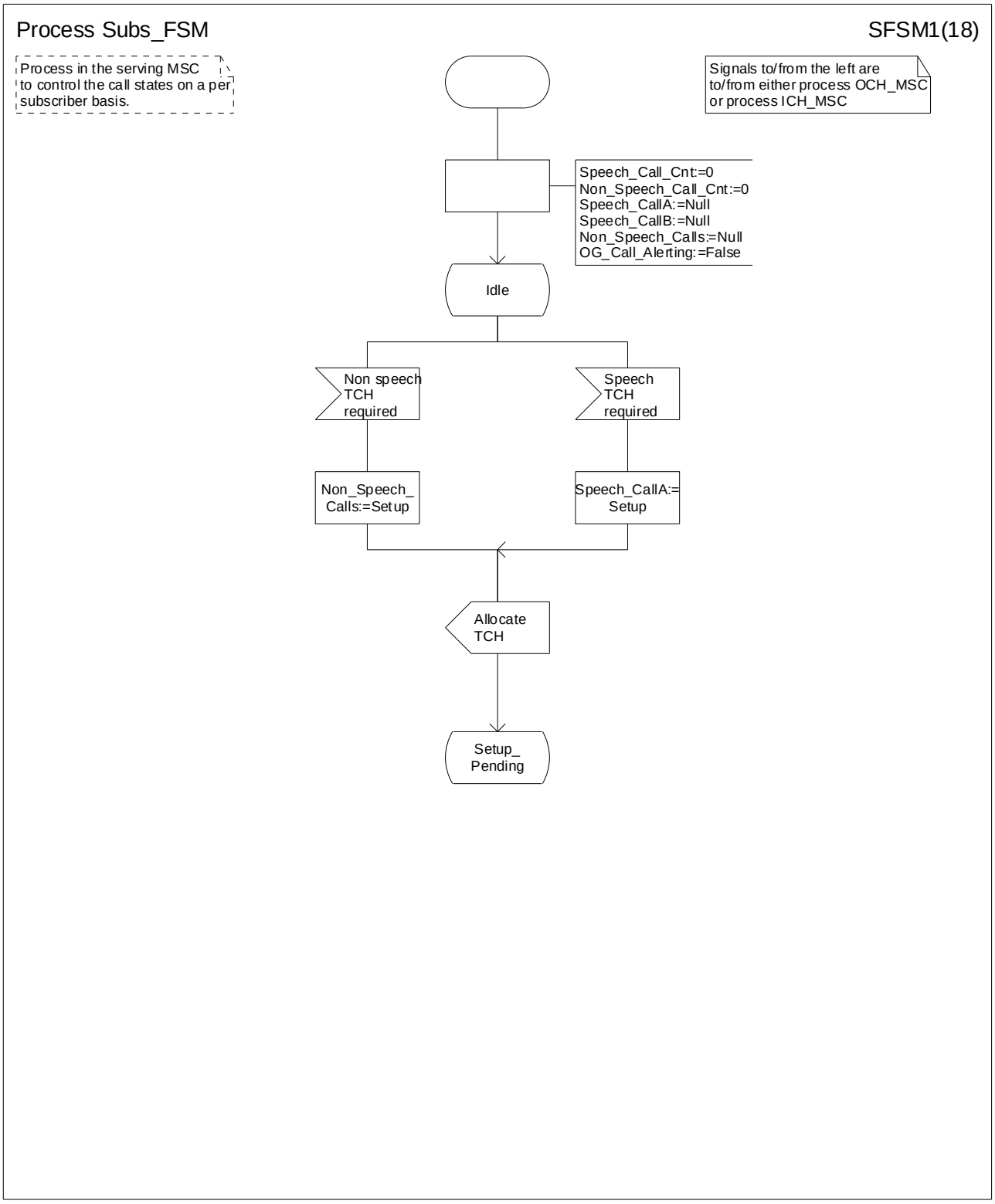


Figure 83a: Process Subs_FSM (sheet 1)

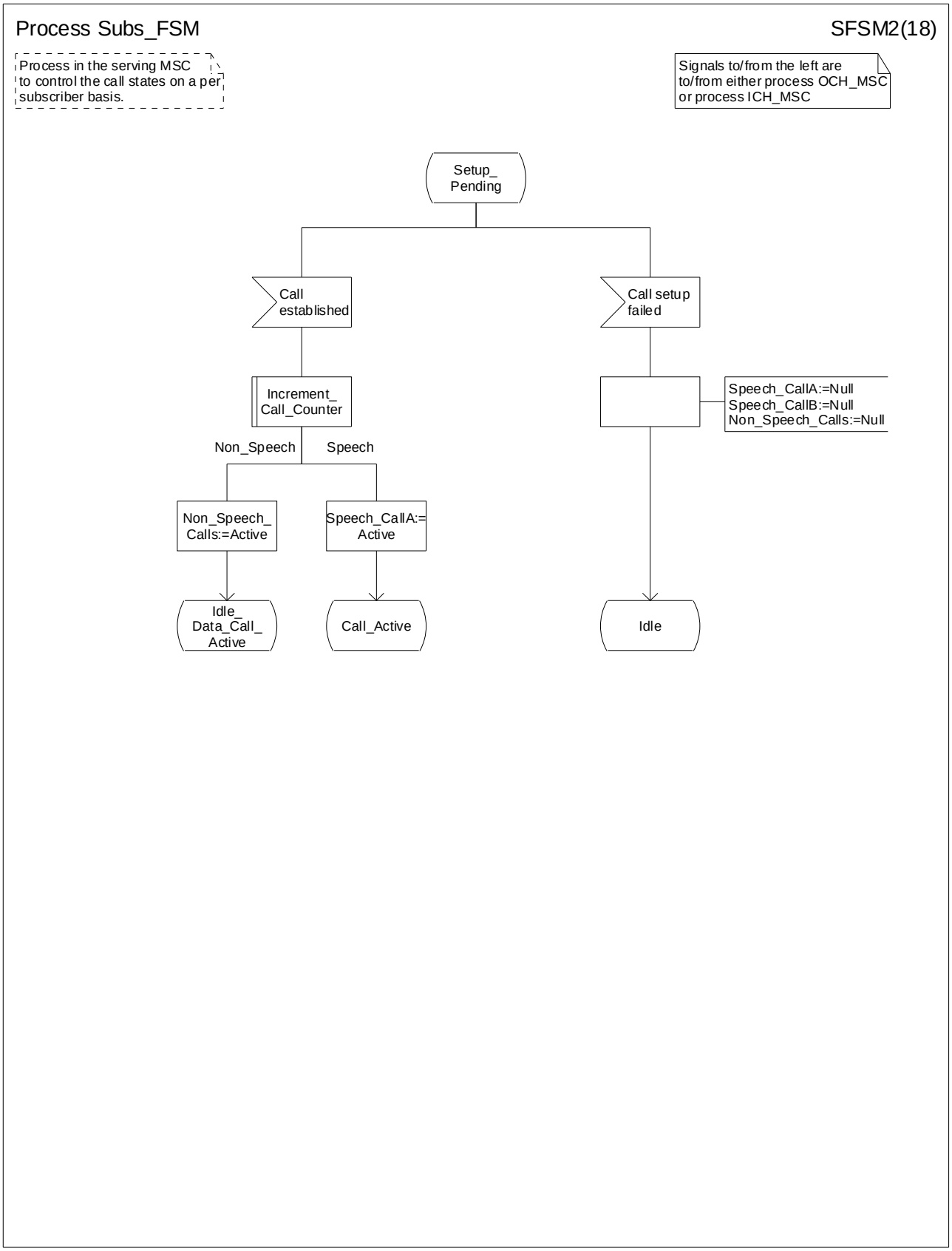


Figure 83b: Process Subs_FSM (sheet 2)

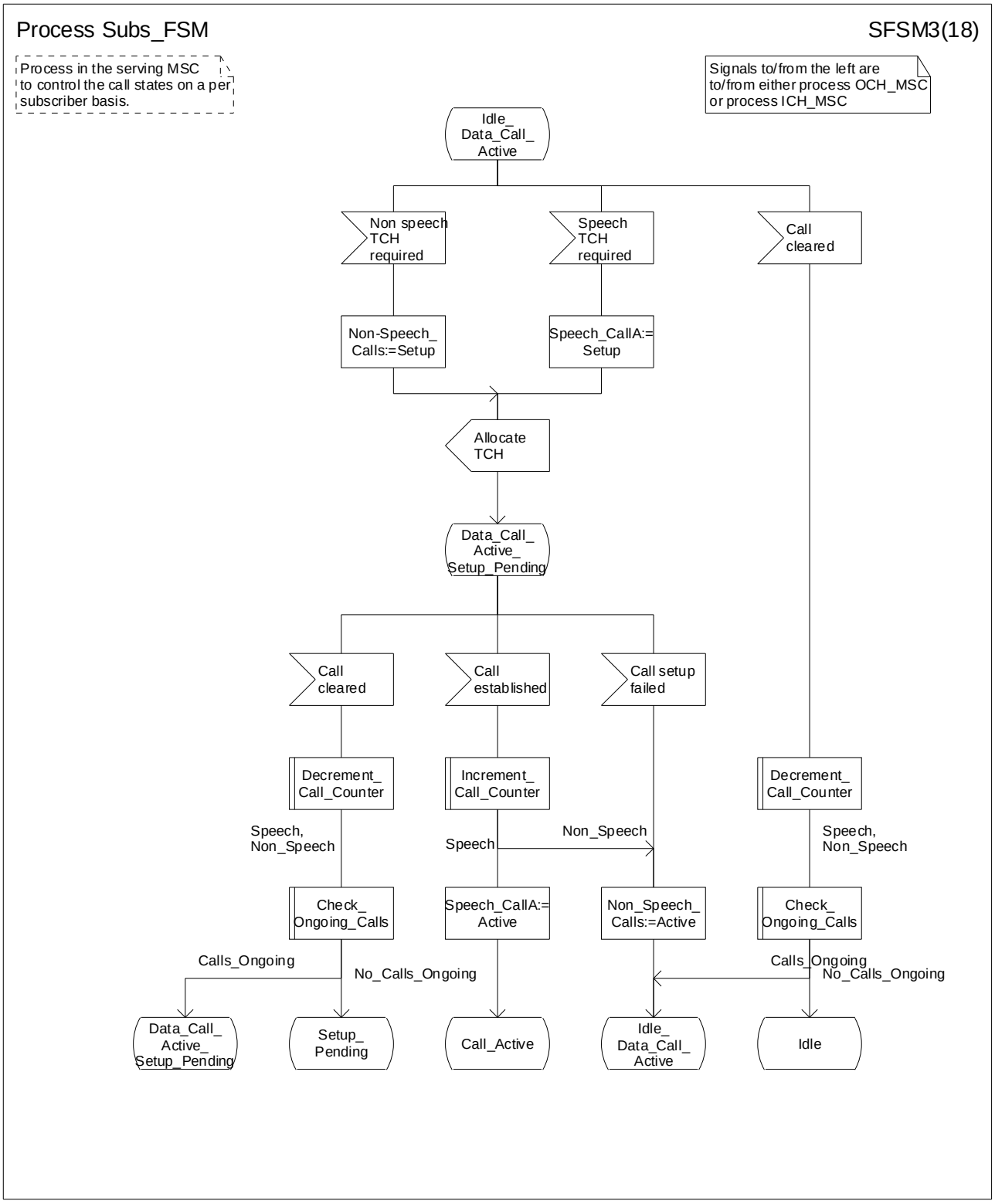


Figure 83c: Process Subs_FSM (sheet 3)

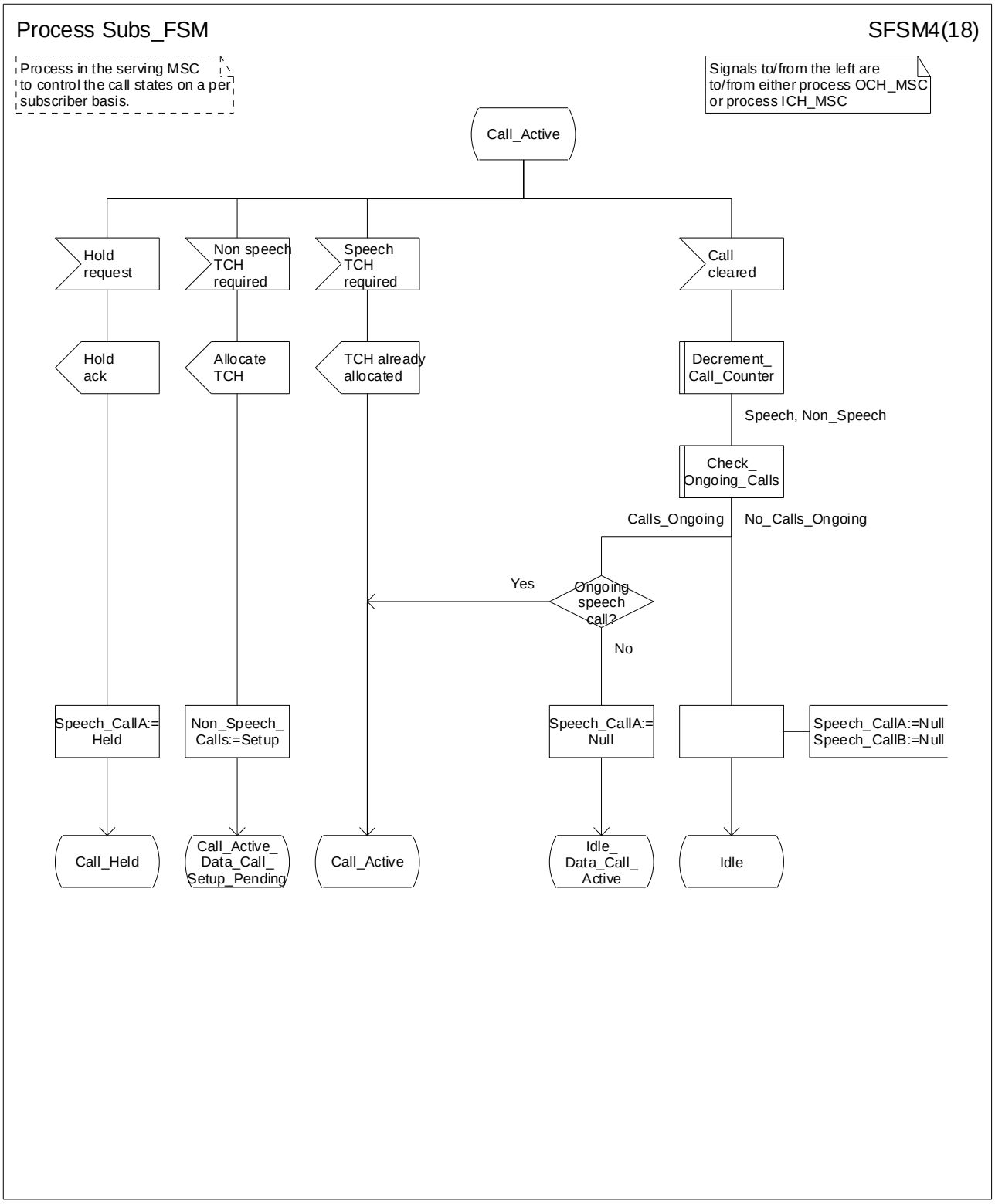


Figure 83d: Process Subs_FSM (sheet 4)

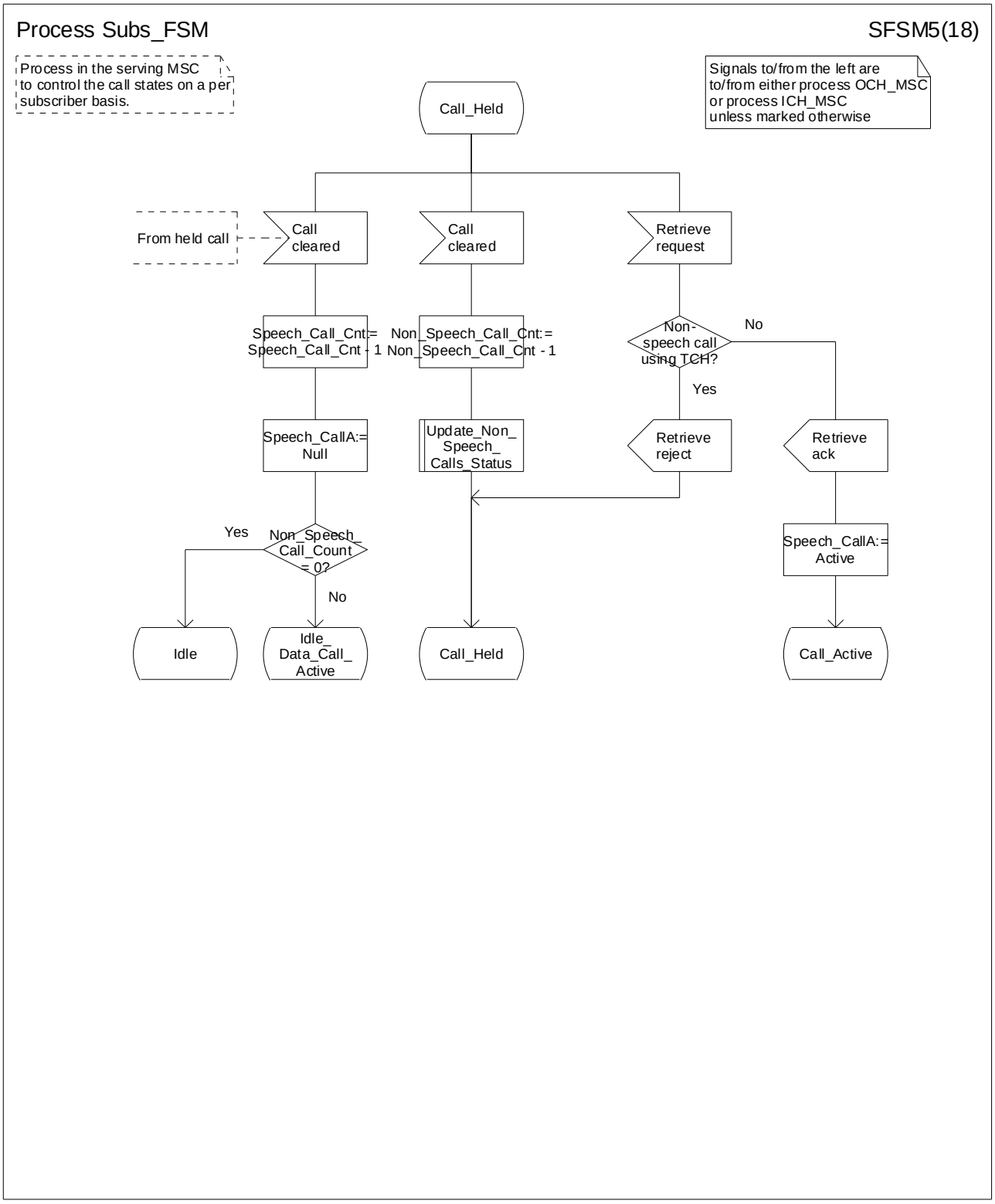


Figure 83e: Process Subs_FSM (sheet 5)

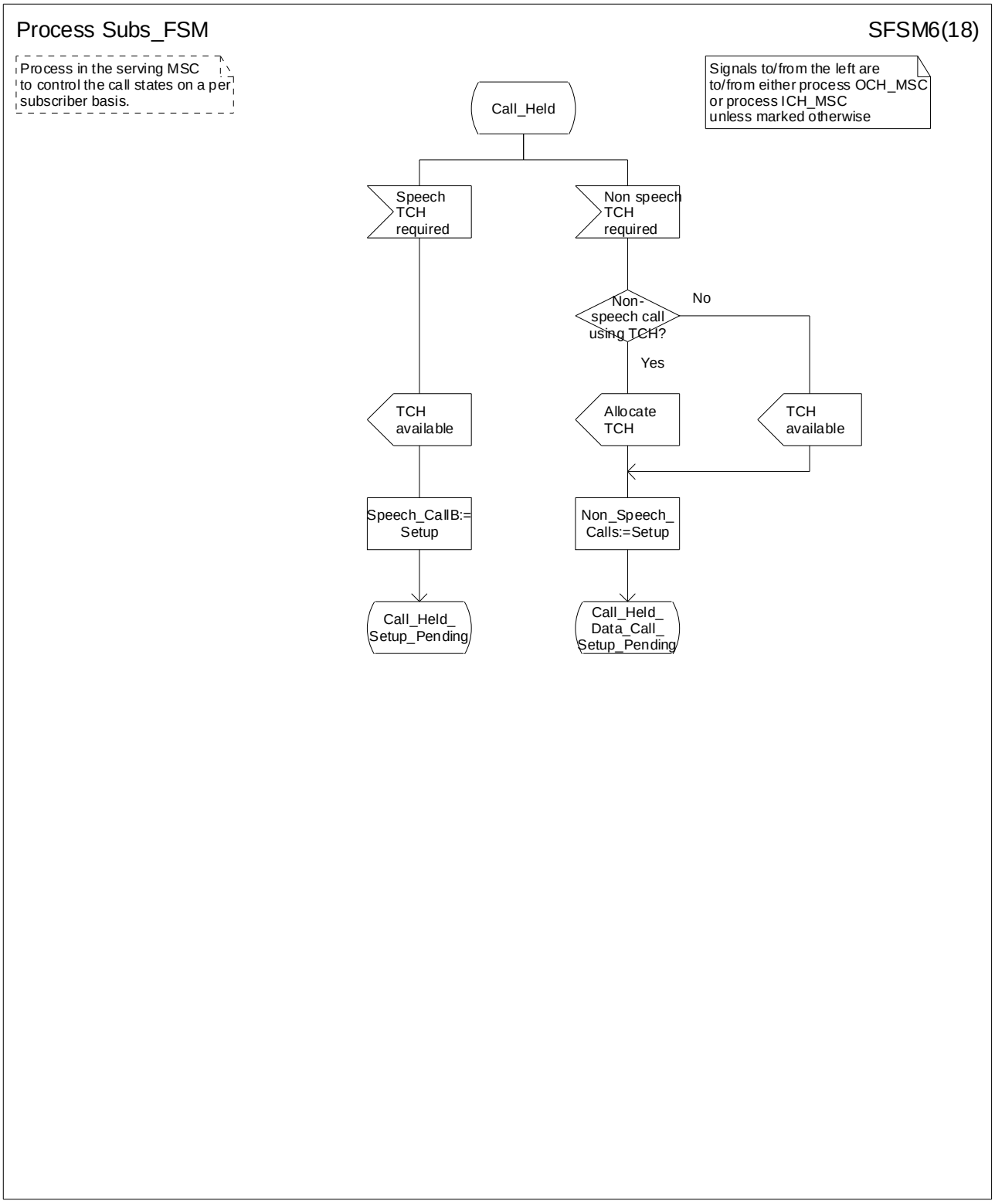


Figure 83f: Process Subs_FSM (sheet 6)

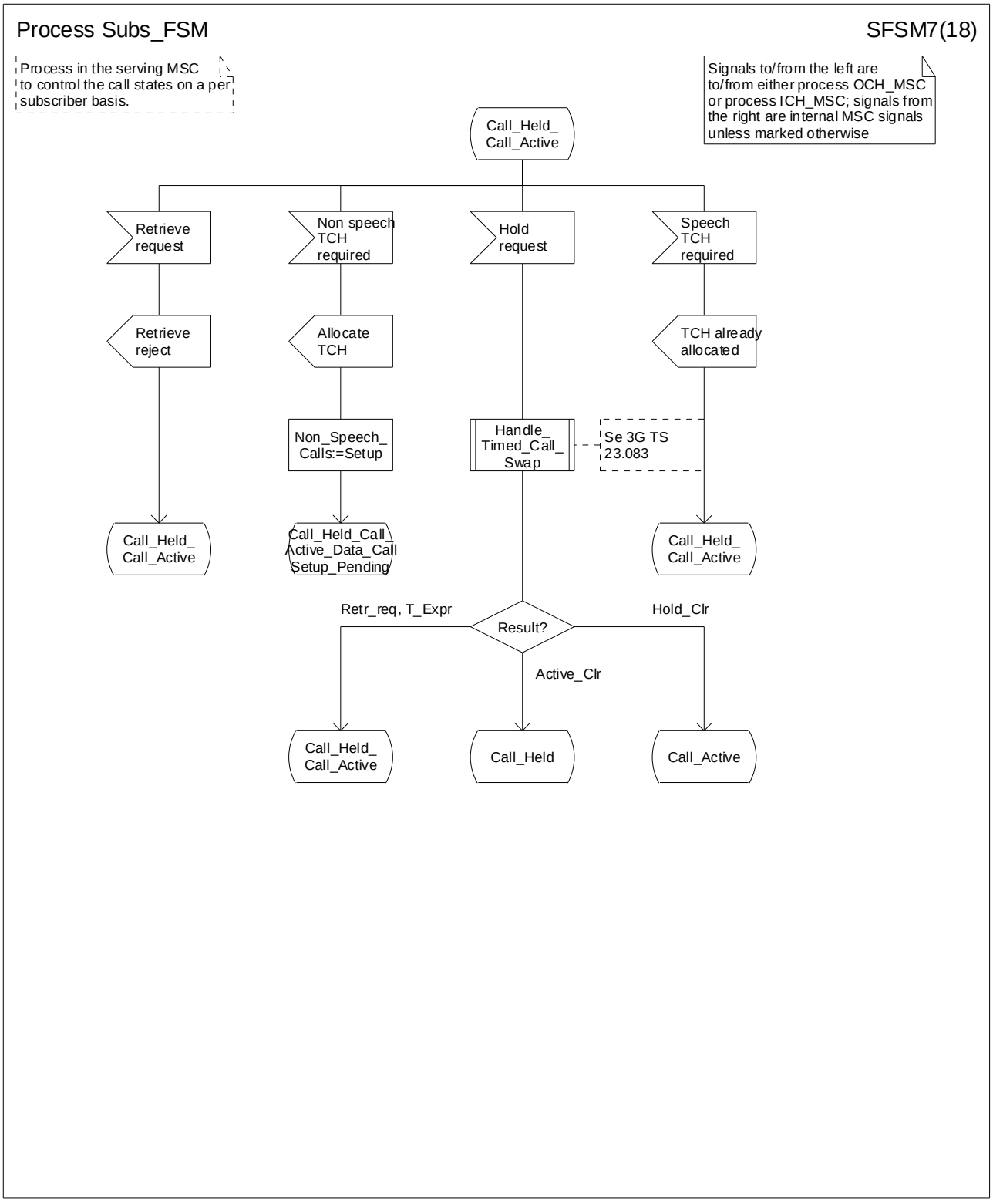


Figure 83g: Process Subs_FSM (sheet 7)

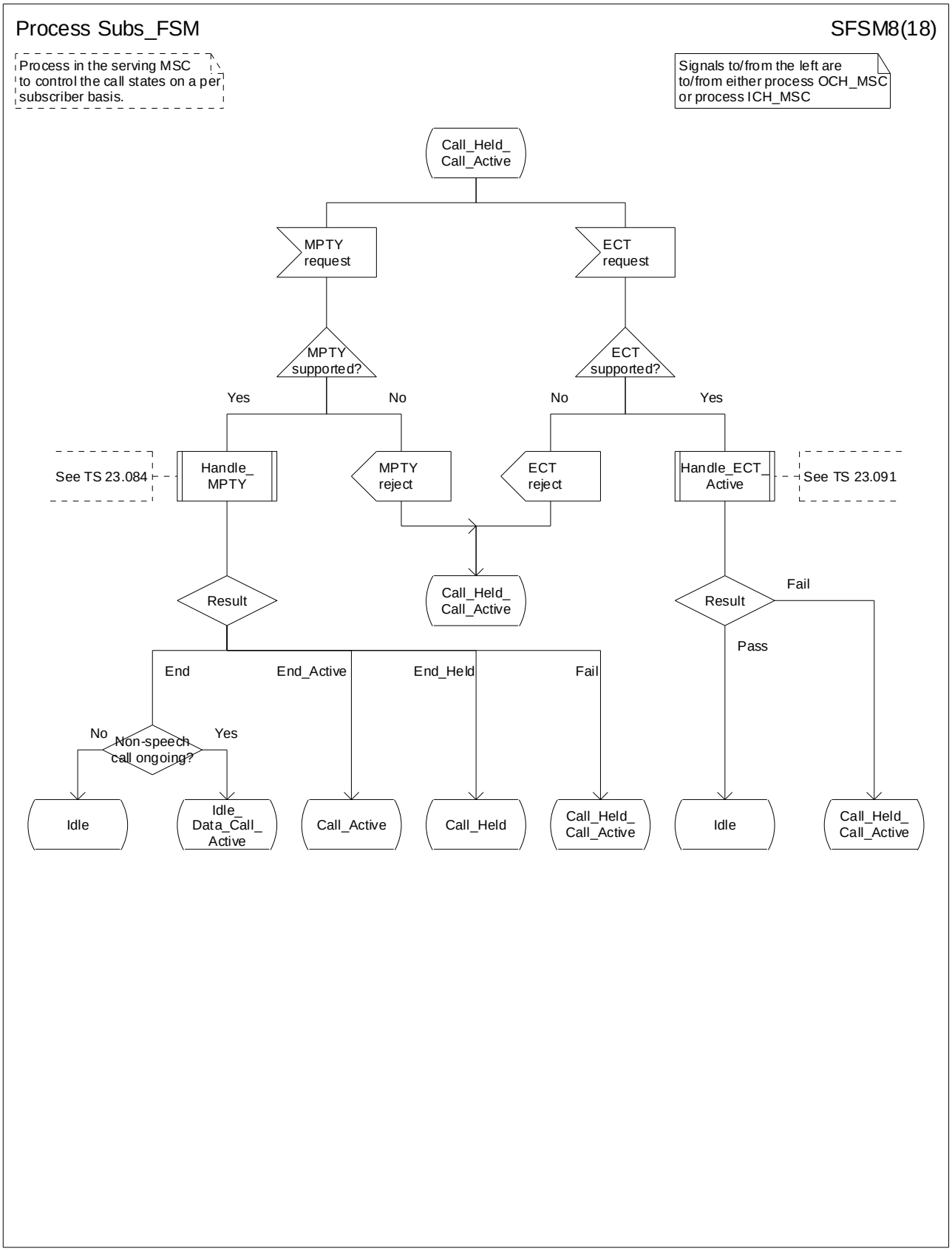


Figure 83h: Process Subs_FSM (sheet 8)

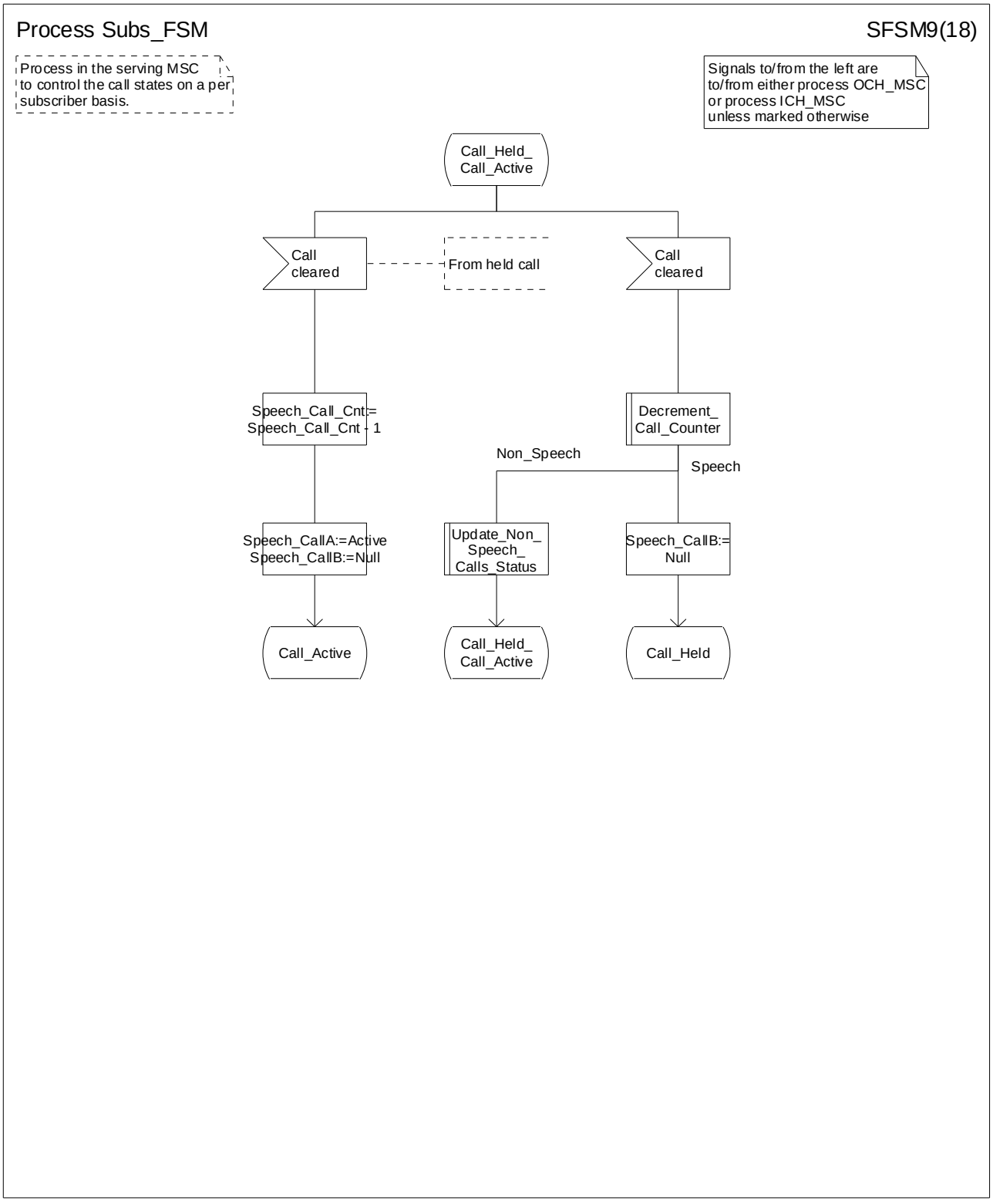


Figure 83i: Process Subs_FSM (sheet 9)

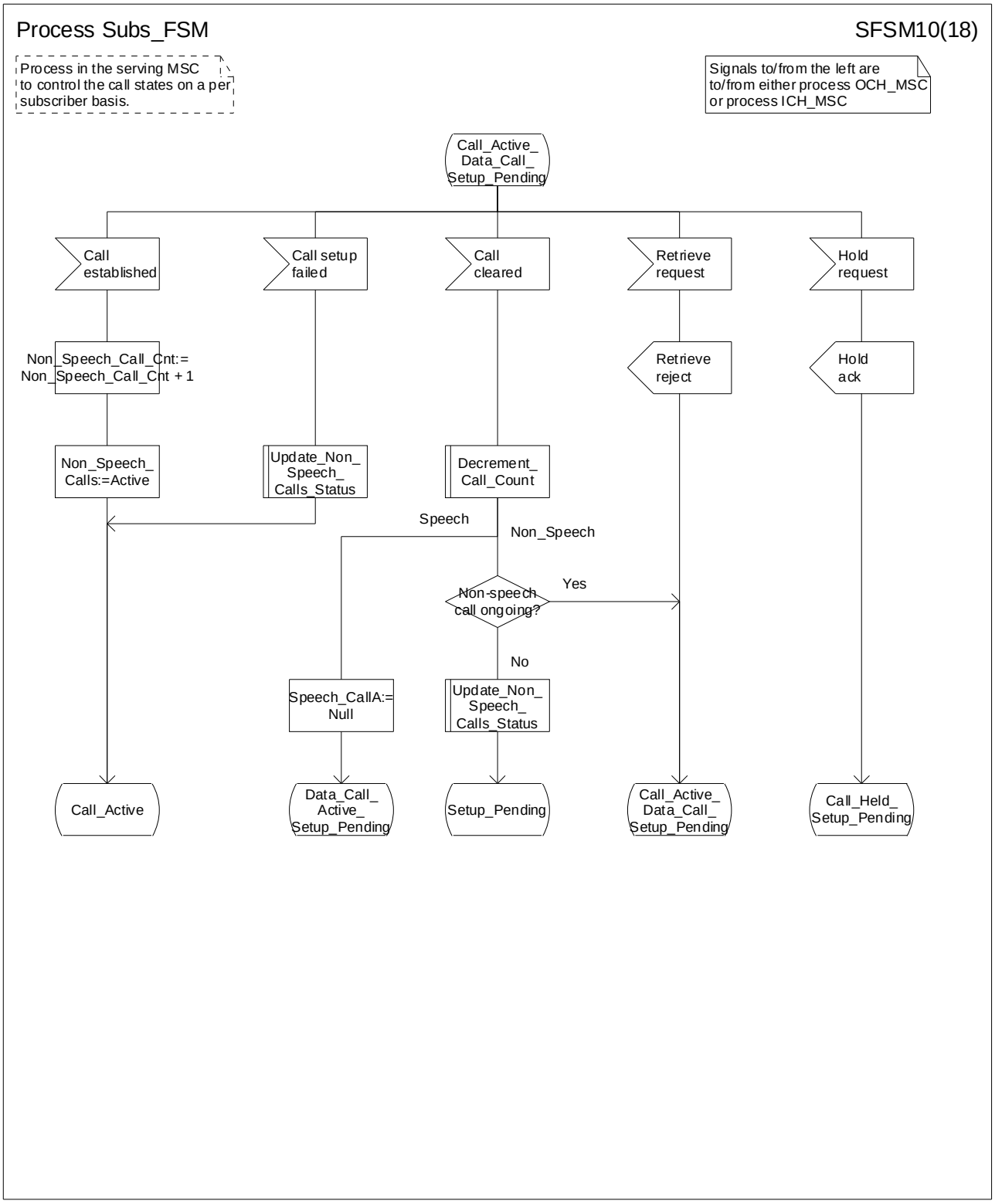


Figure 83j: Process Subs_FSM (sheet 10)

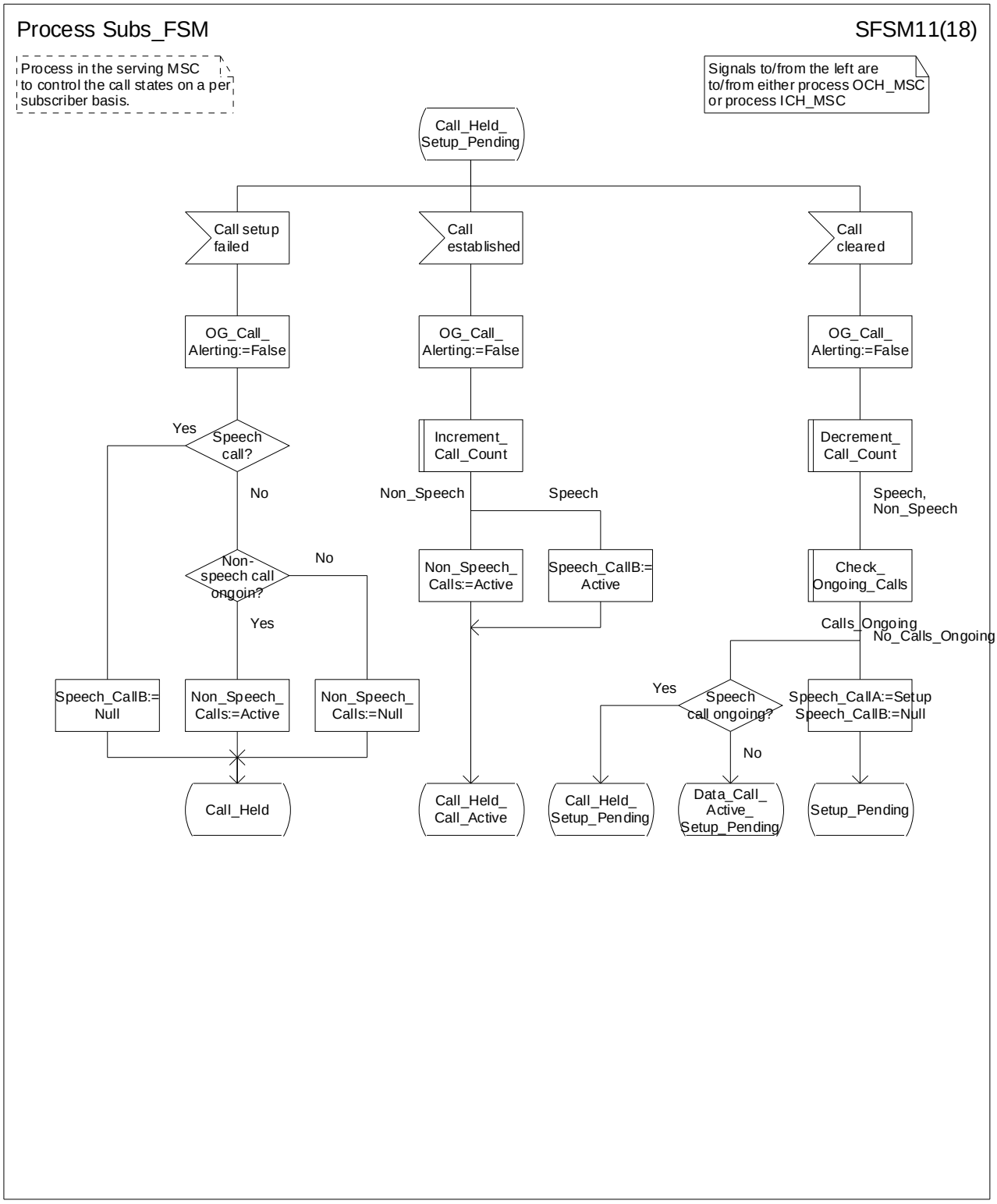


Figure 83k: Process Subs_FSM (sheet 11)

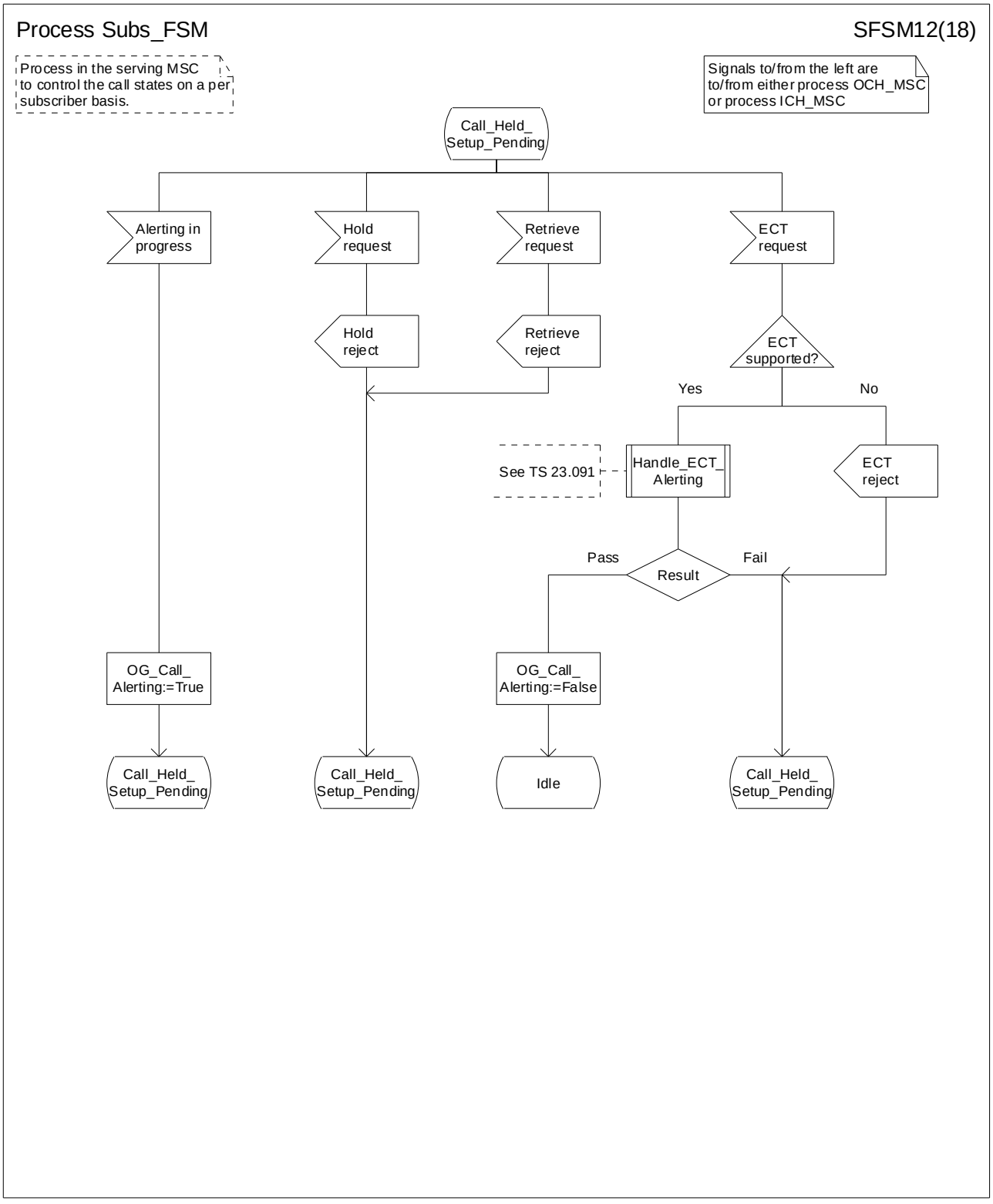


Figure 84l: Process Subs_FSM (sheet 12)

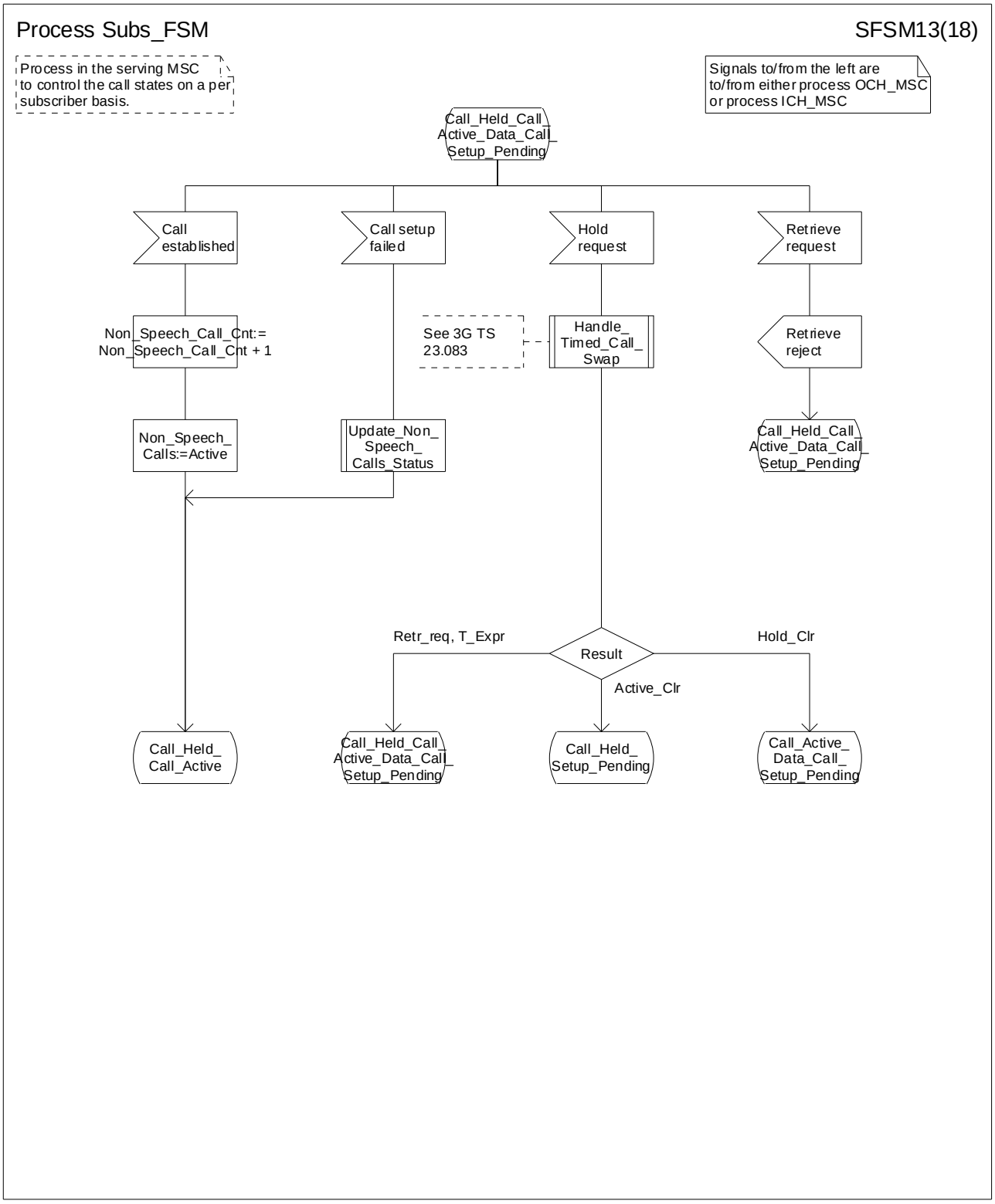


Figure 84m: Process Subs_FSM (sheet 13)

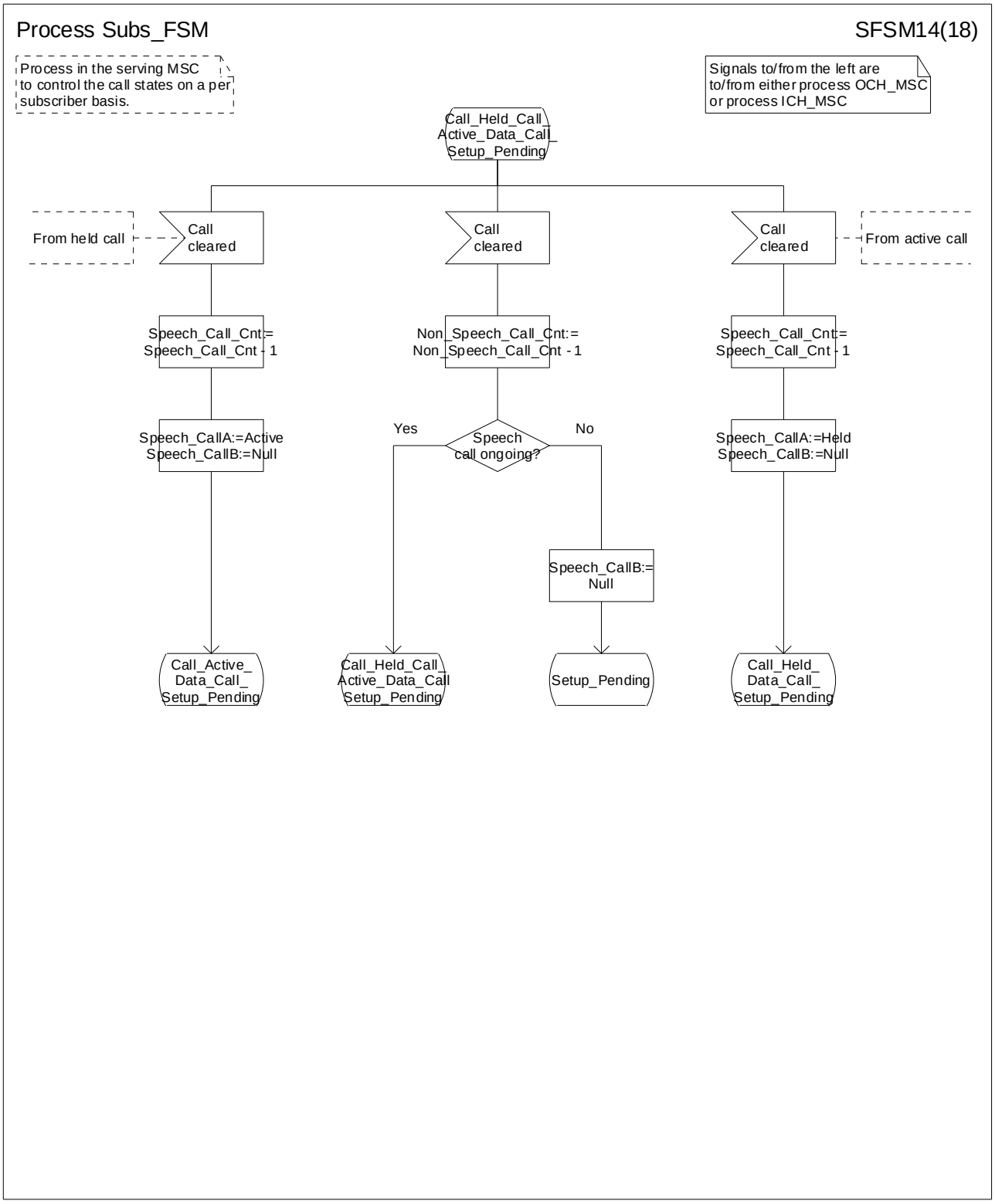


Figure 84n: Process Subs_FSM (sheet 14)

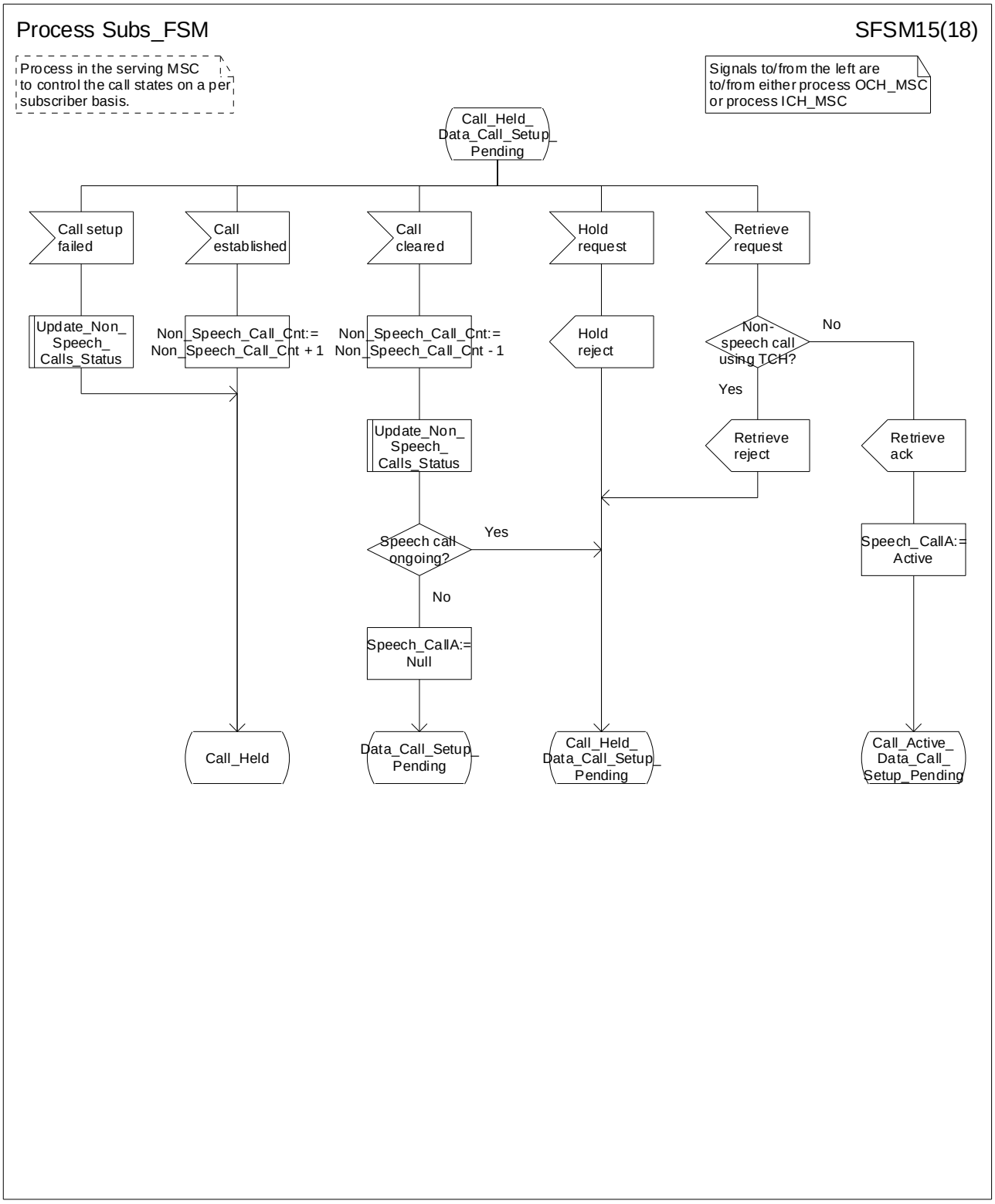


Figure 84o: Process Subs_FSM (sheet 14)

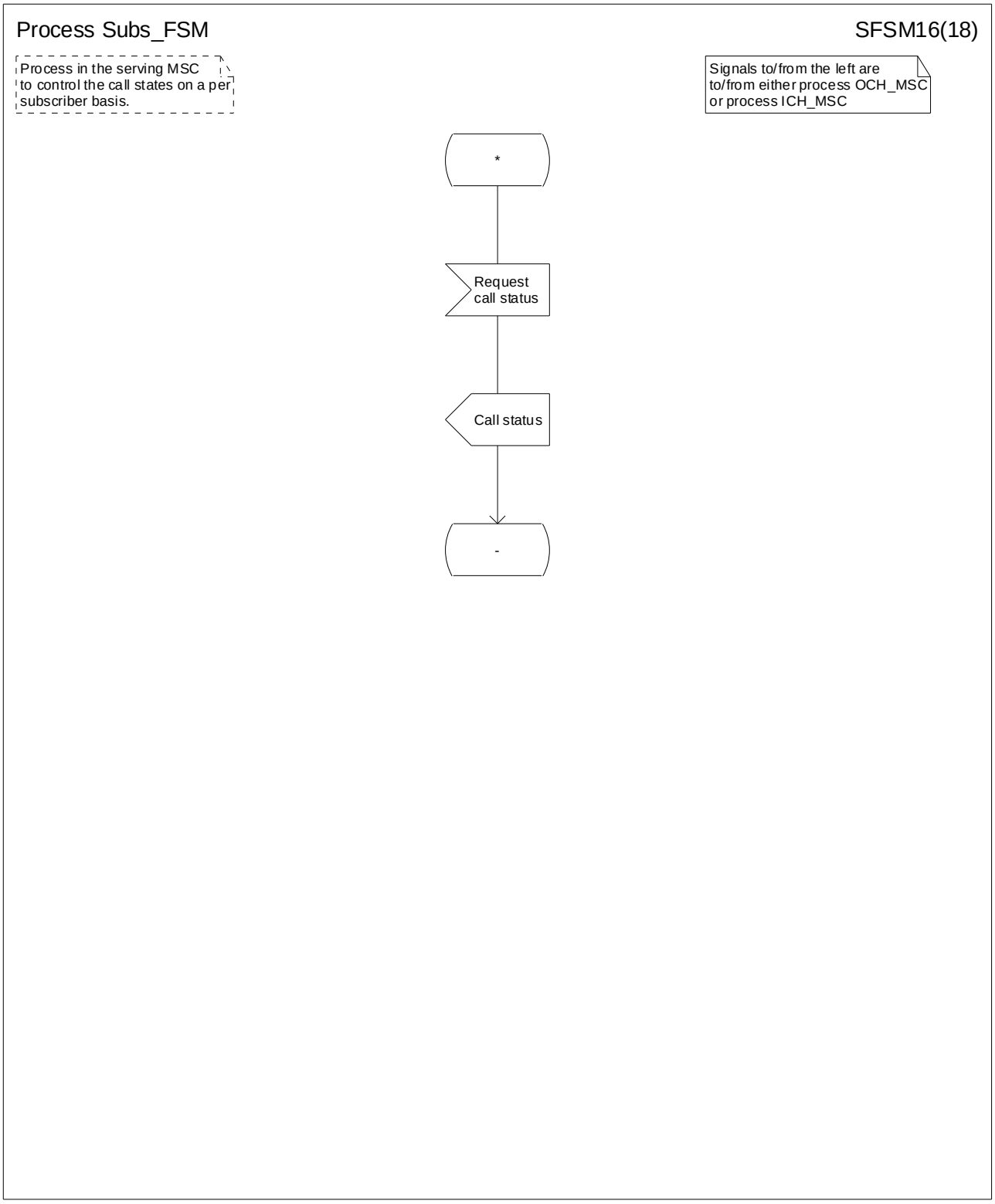


Figure 84p: Process Subs_FSM (sheet 14)

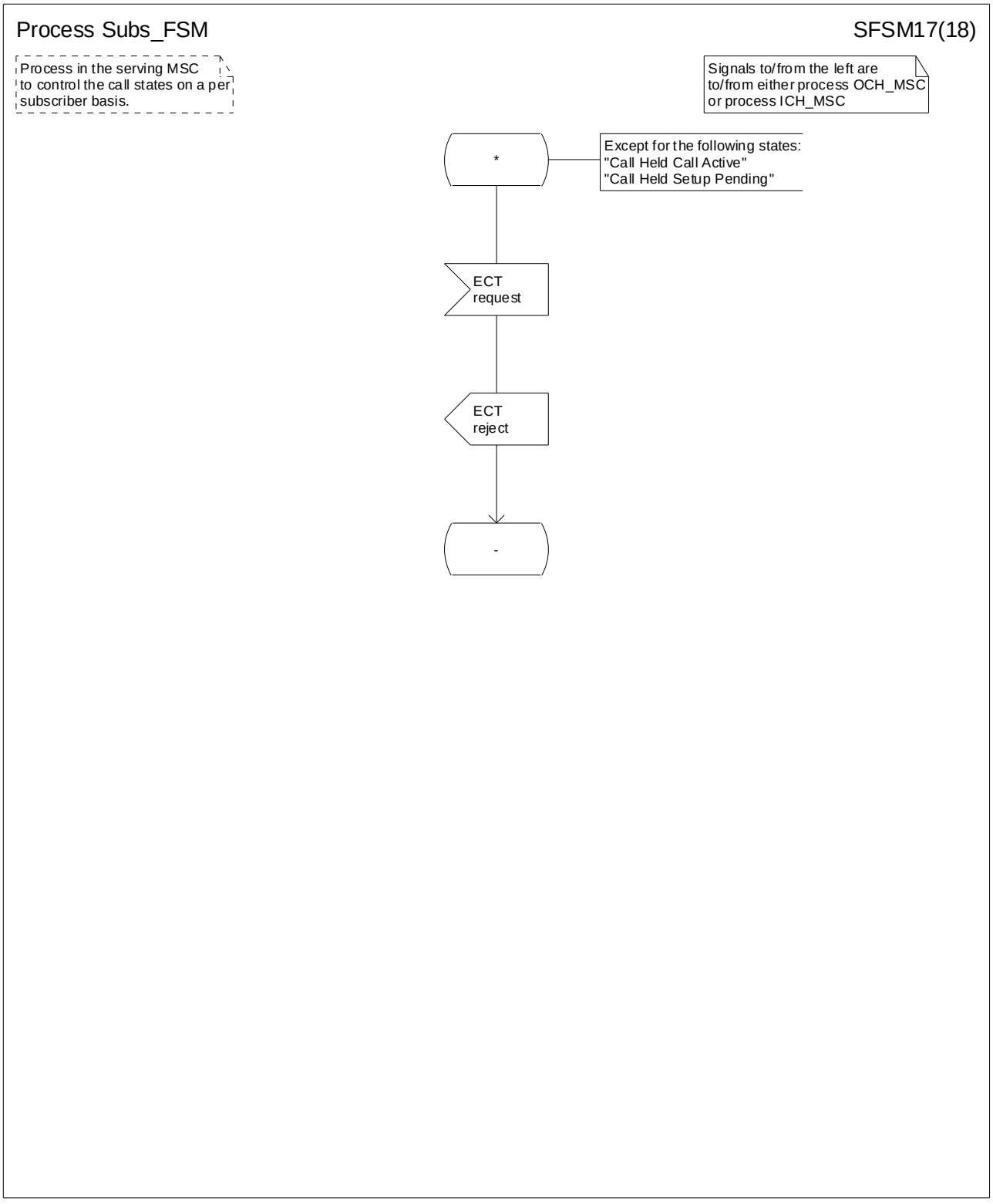


Figure 84q: Process Subs_FSM (sheet 14)

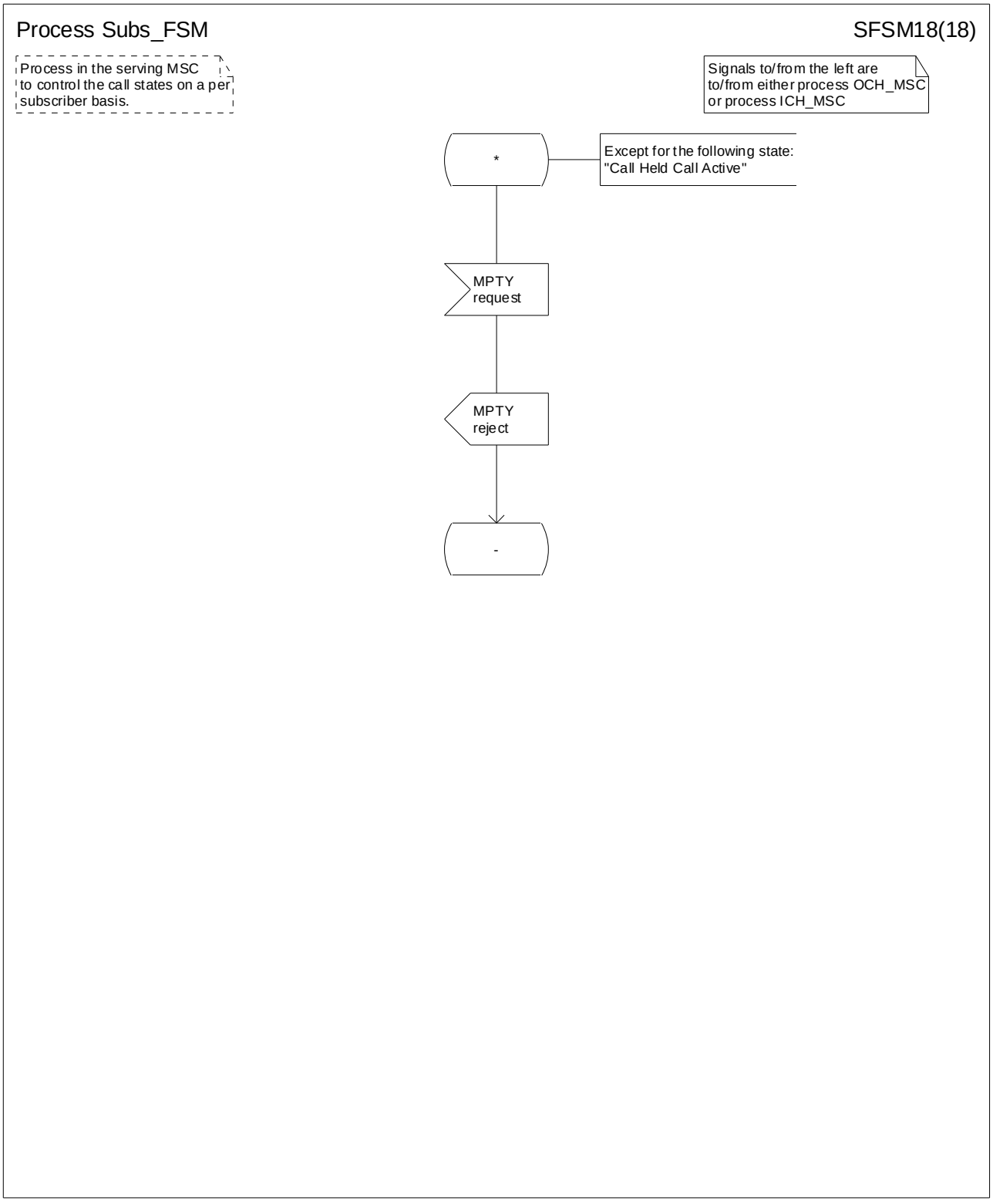


Figure 84r: Process Subs_FSM (sheet 14)

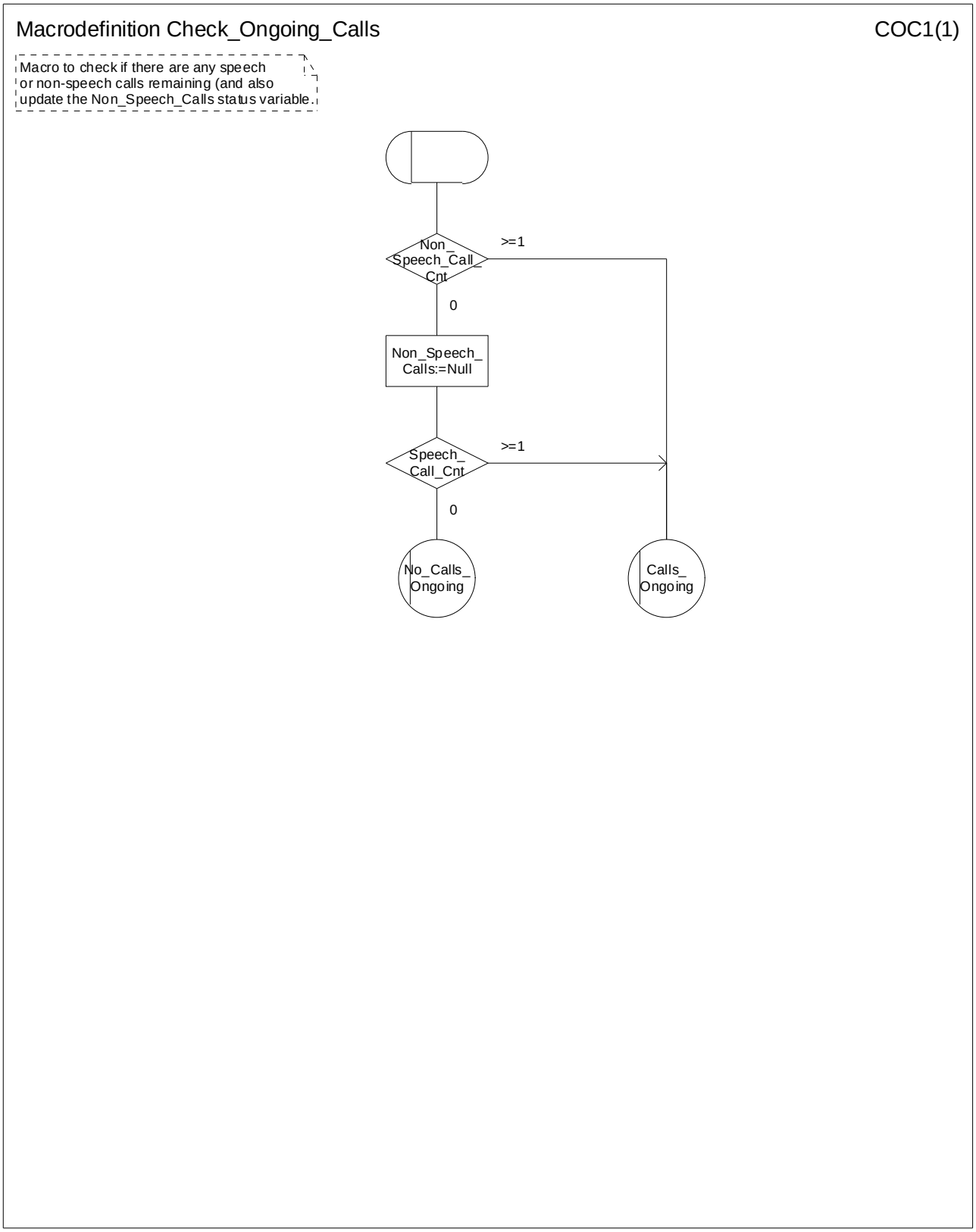


Figure 85: Macro Check_Ongoing_Calls

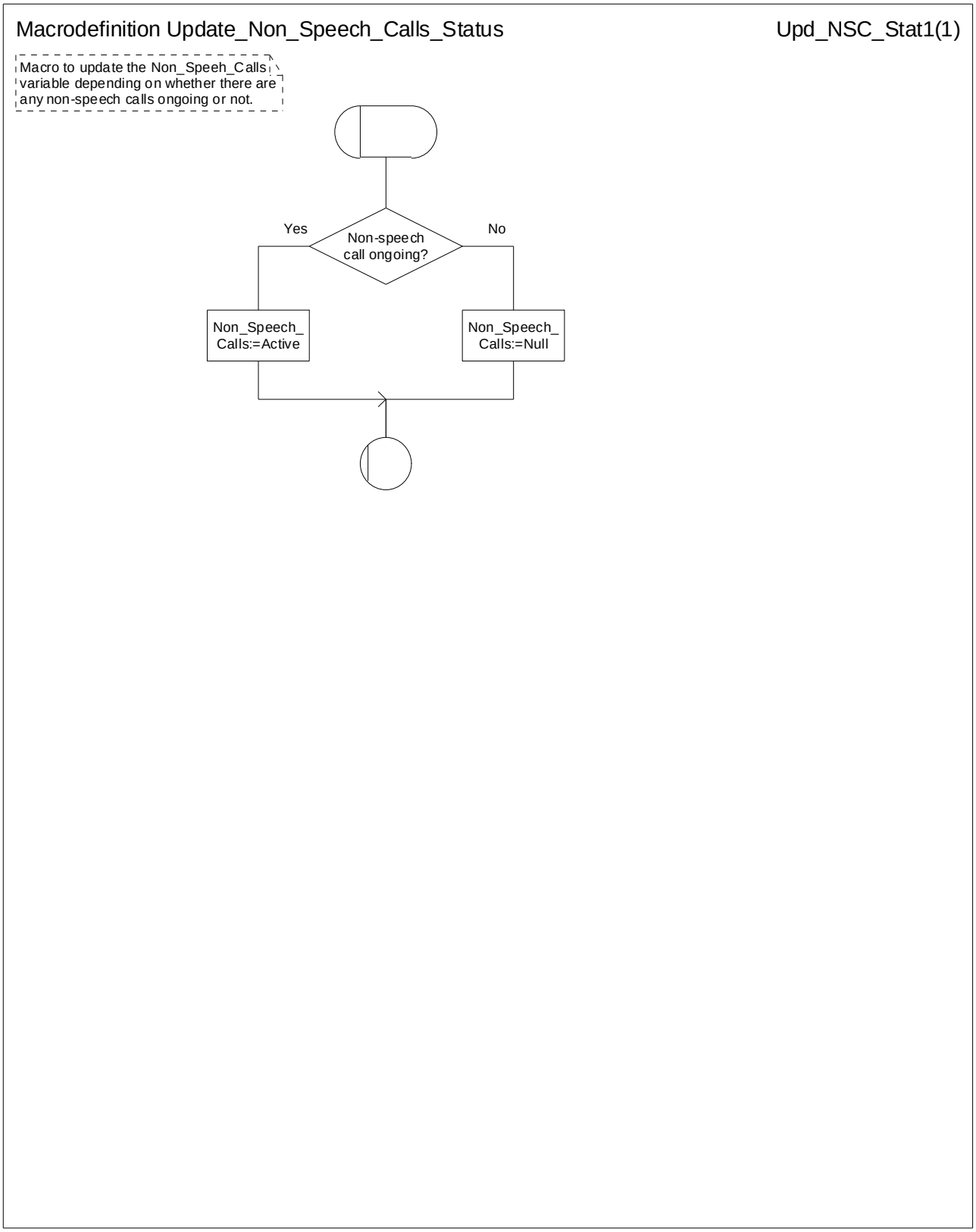


Figure 86: Macro Update_Non_Speech_Calls_Status

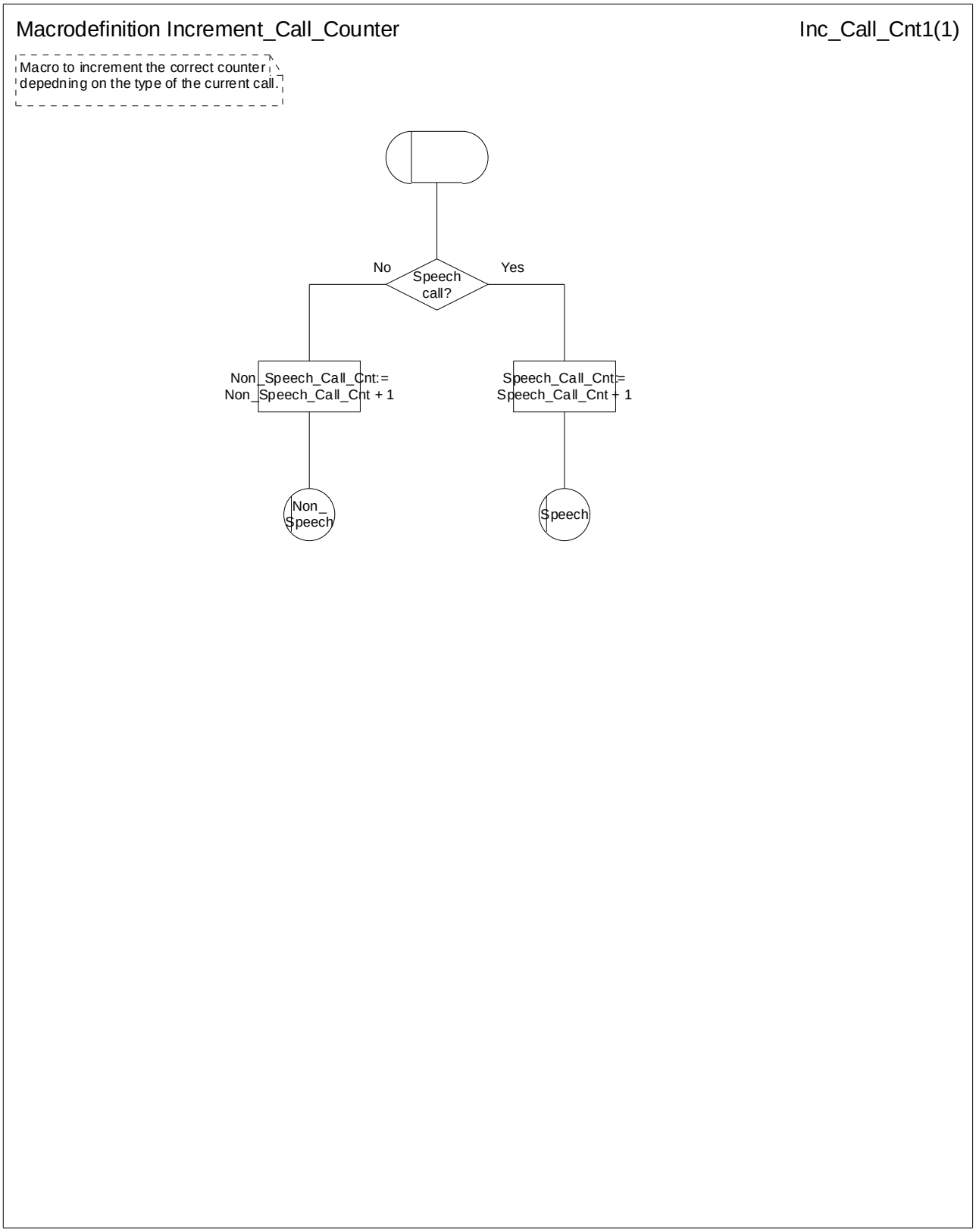


Figure 87: Macro Increment_Call_Counter

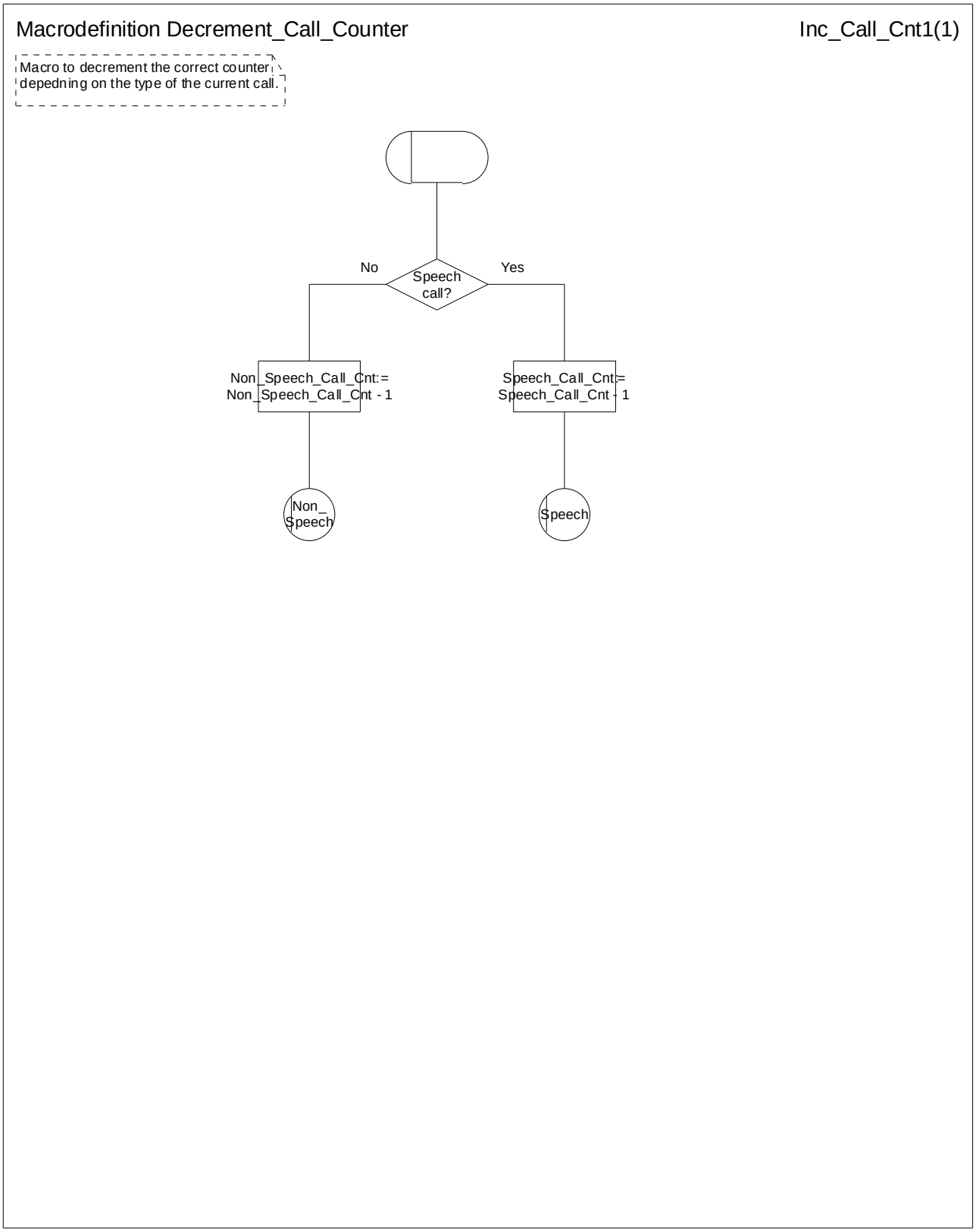


Figure 88: Macro Decrement_Call_Counter

7.5 TO call

7.5.1 Functional requirements of inter-connecting MSC

7.5.1.1 Process TO_MSC

Sheet 1: the procedure CAMEL_TOC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "Pass" exit of the test "Result=?". The procedure call formal parameter "First" or "NotFirst" indicates whether the procedure was called earlier in the same call.

Sheet 1, sheet 4: the procedure CAMEL_TOC_Dialled_Services is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL trunk triggering, processing continues from the "Pass" exit of the test "Result?". The procedure call formal parameter "First" or "NotFirst" indicates whether the procedure was called earlier in the same call.

Sheet 1: the procedure MOBILE_NUMBER_PORTABILITY_IN_OQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1, sheet 2, sheet 3: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 4: the procedure CAMEL_OCH_MSC_DISC3 is specific to CAMEL phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet2, sheet 4: the procedure CAMEL_OCH_MSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 7: the procedure CAMEL_MT_CF_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 2: The variable "Return_Place" indicates at which detection point the additional digit collection is.

Sheet 1, sheet 2: The "inter-digit timer" is a MSC internal timer to wait for additional dialling from the incoming side. At the expiry of the timer, the MSC/gsmSSF may report digits to the gsmSCF (if the event detection point is armed). This timer is used for the SDL modelling purposes only and it may not present the actual implementations.

Sheet 2: "Number_of_Digits" is the Collected_Info specific reporting criterion. The gsmSCF specifies the criterion. The process CS_gsmSSF sends the parameter to the TO_MSC process.

Sheet 2: "ST digit" is the ISUP value for a digit indicating that the Called Party Number is complete.

Sheet 3: the procedures CAMEL_Start_TNRy and CAMEL_Stop TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CAMEL_CF_MSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "Pass" exit of the test "Result?".

Sheet 3: the procedure UUS_MSC_Clear_UUS is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 3: the procedure CAMEL_CF_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specifed in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 4: the procedure CAMEL_Stop_TNRy is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 4: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 5: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the GMSC supports CAMEL phase 2 or later. The procedure CAMEL_OCH_MSC2 is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CAMEL_OCH_MSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 6: the procedure CAMEL_OCH_MSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "No" exit of the test "Result=Reconnect?" .

Sheet 6: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 6: after the process TO_MSC has sent an IAM to the forwarded-to exchange, it acts as a relay for messages received from the parent process and the forwarded-to exchange.

Sheet 7: the process CAMEL_MT_CF_LEG2_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

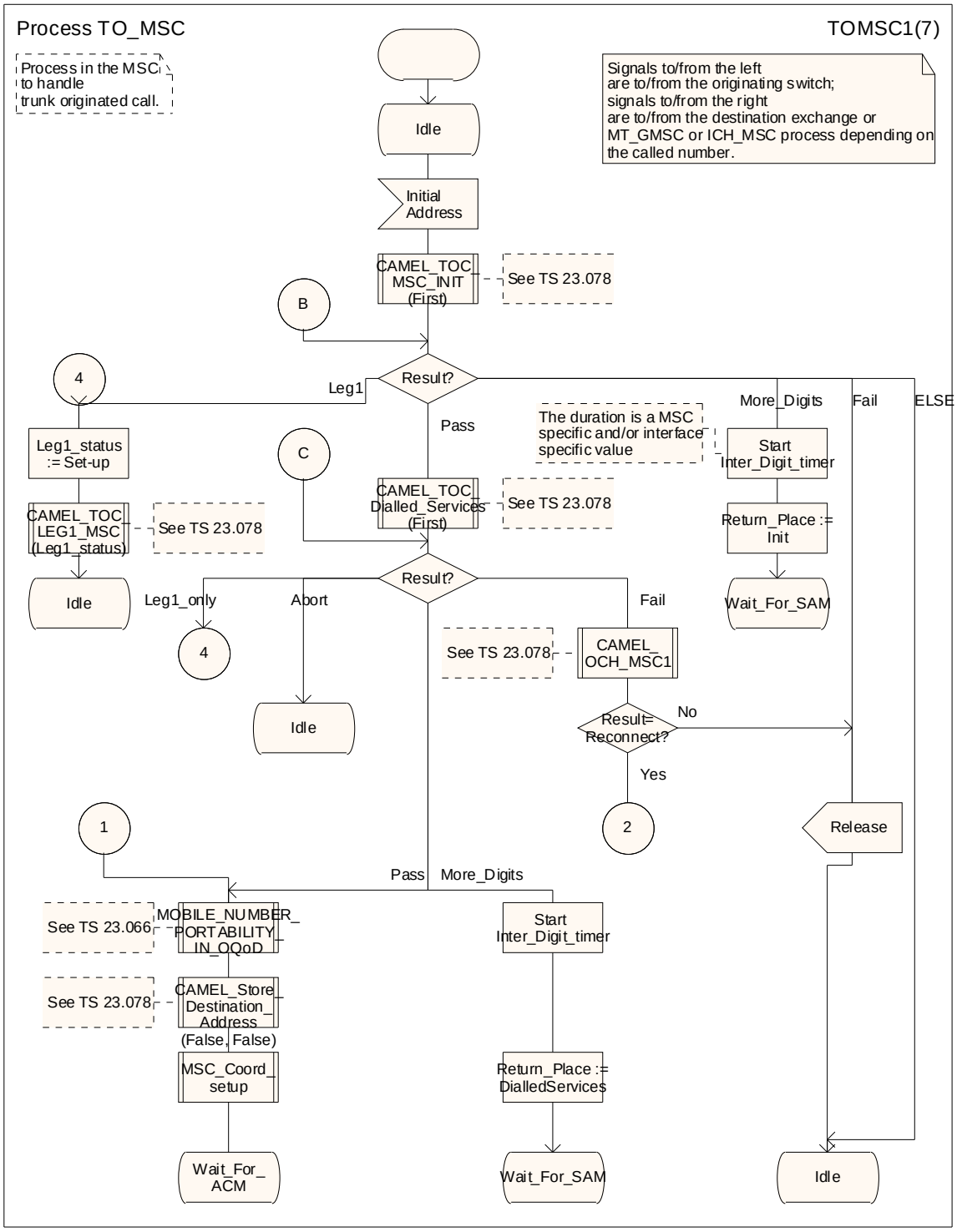


Figure 7.5.1a: Process TO_MSC (sheet 1)

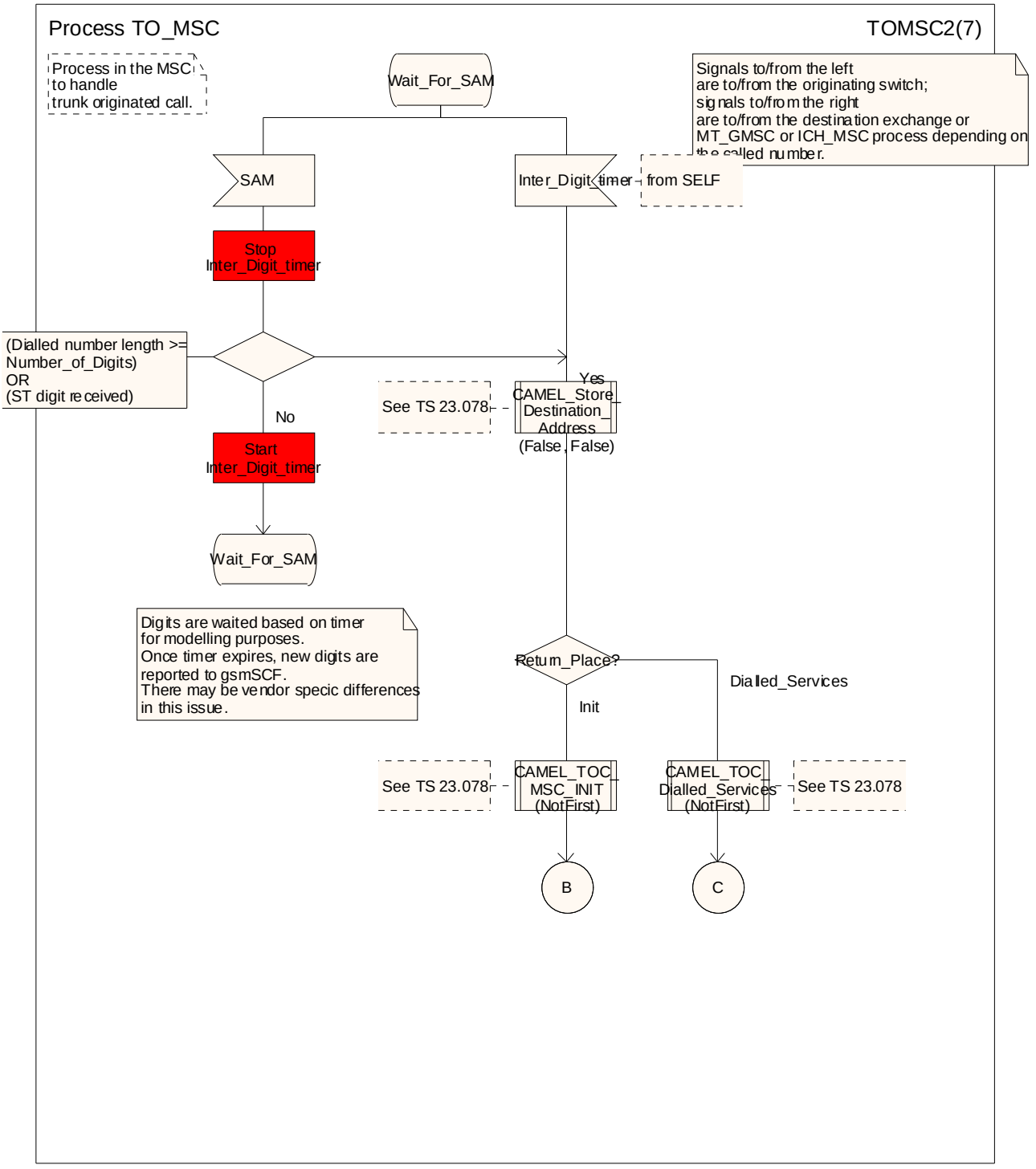


Figure 7.5.1b: Process TO_MSC (sheet 2)

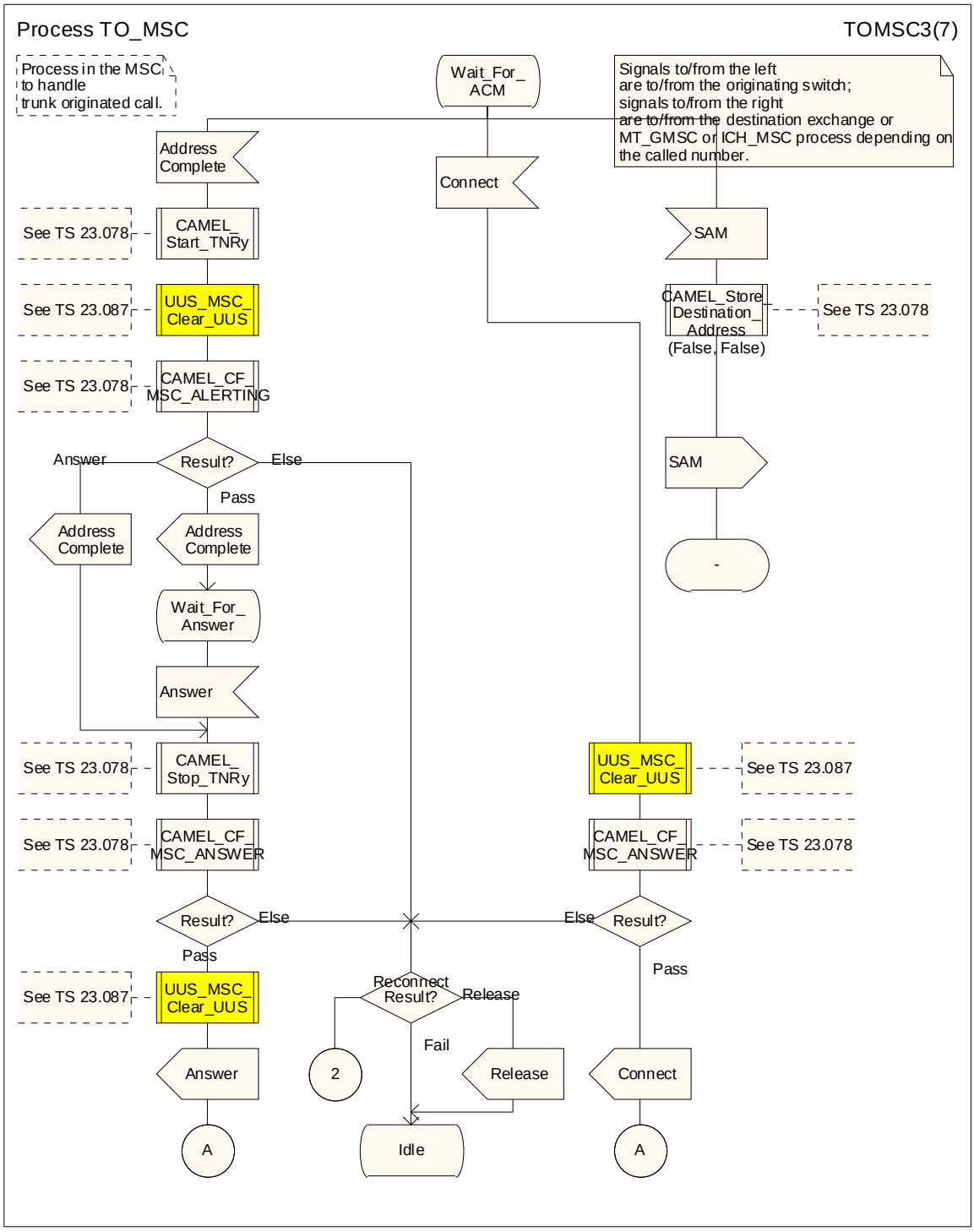


Figure 7.5.1c: Process TO_MSC (sheet 3)

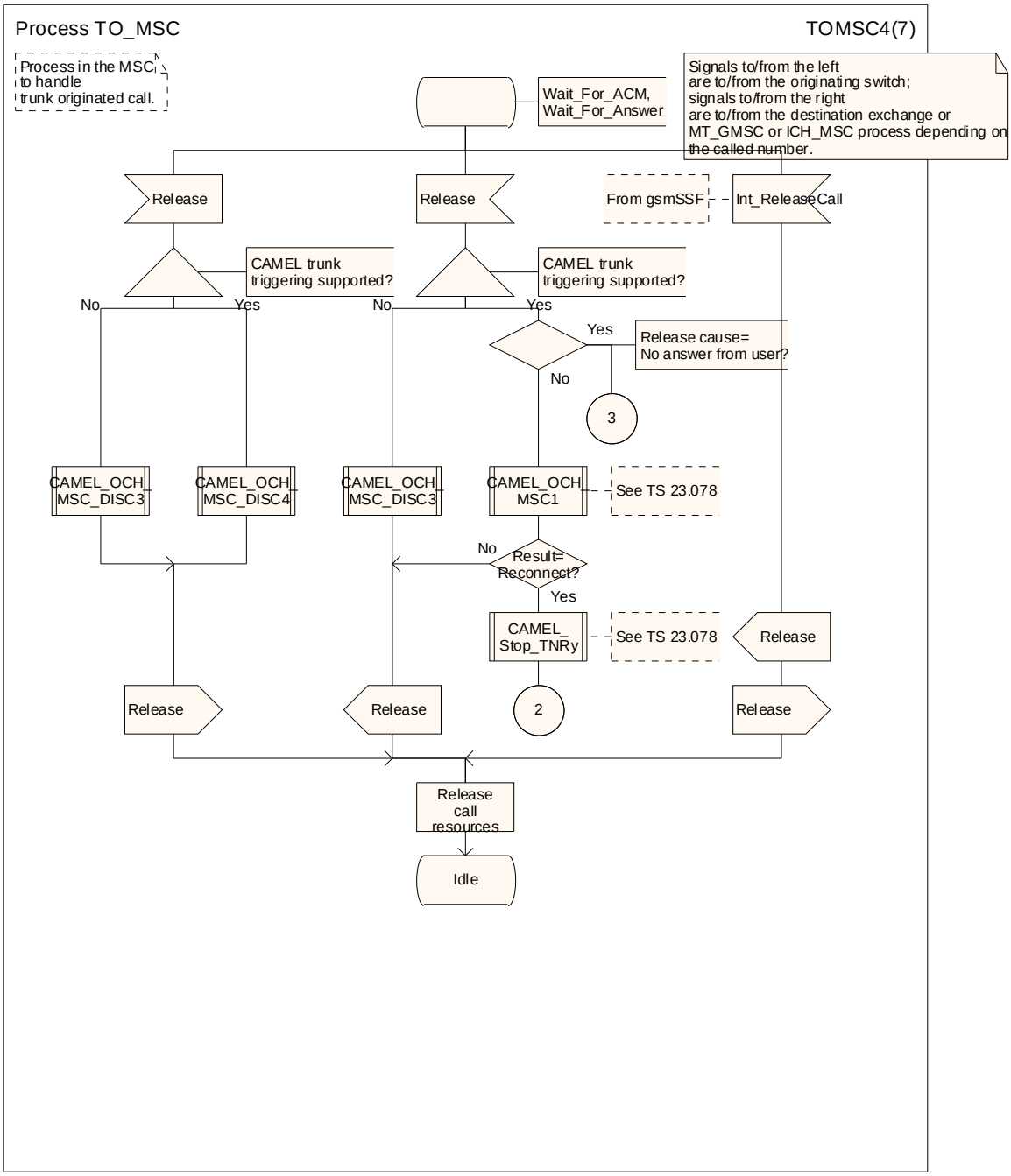


Figure 7.5.1d: Process TO_MSC (sheet 4)

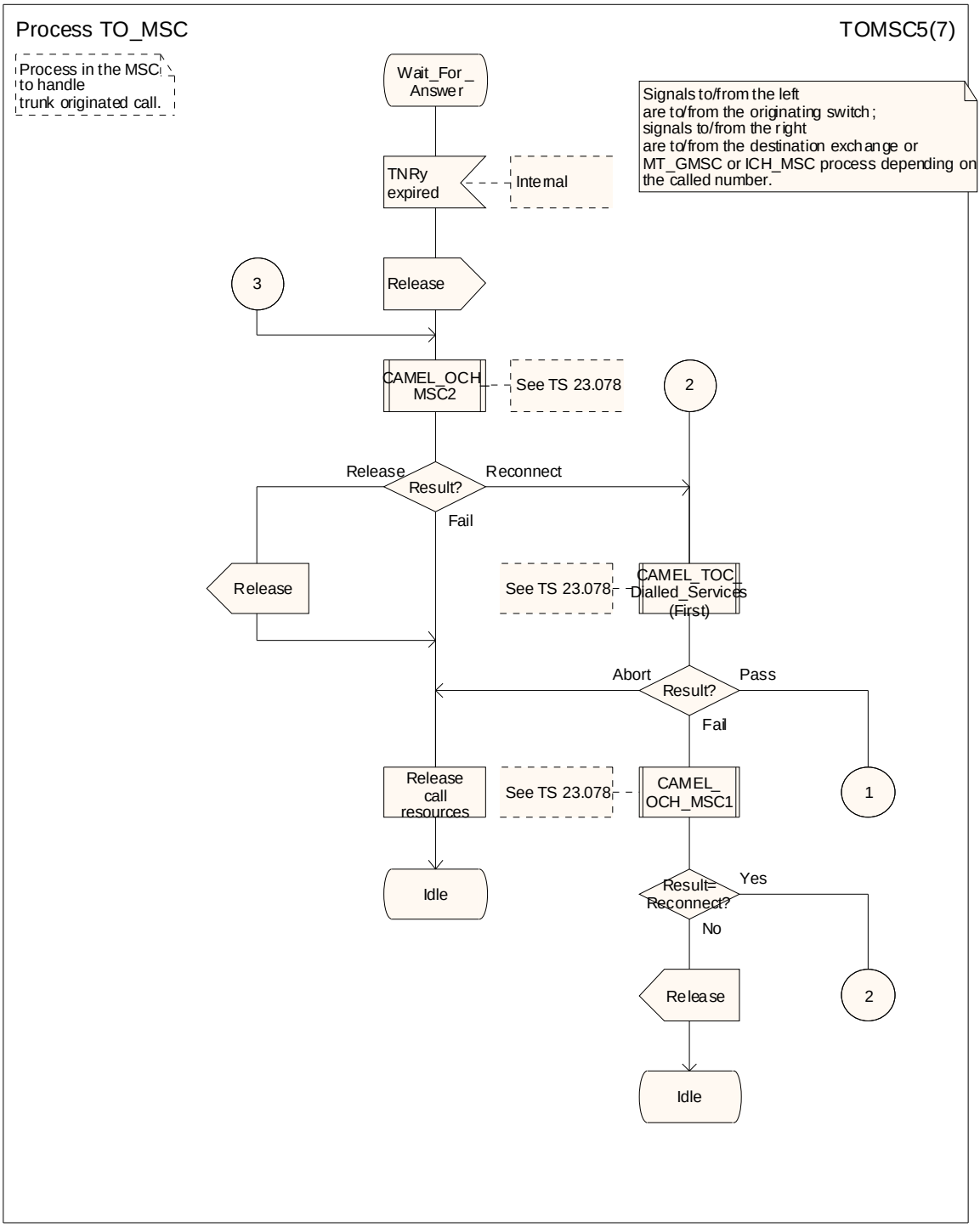


Figure 7.5.1e: Process TO_MSC (sheet 5)

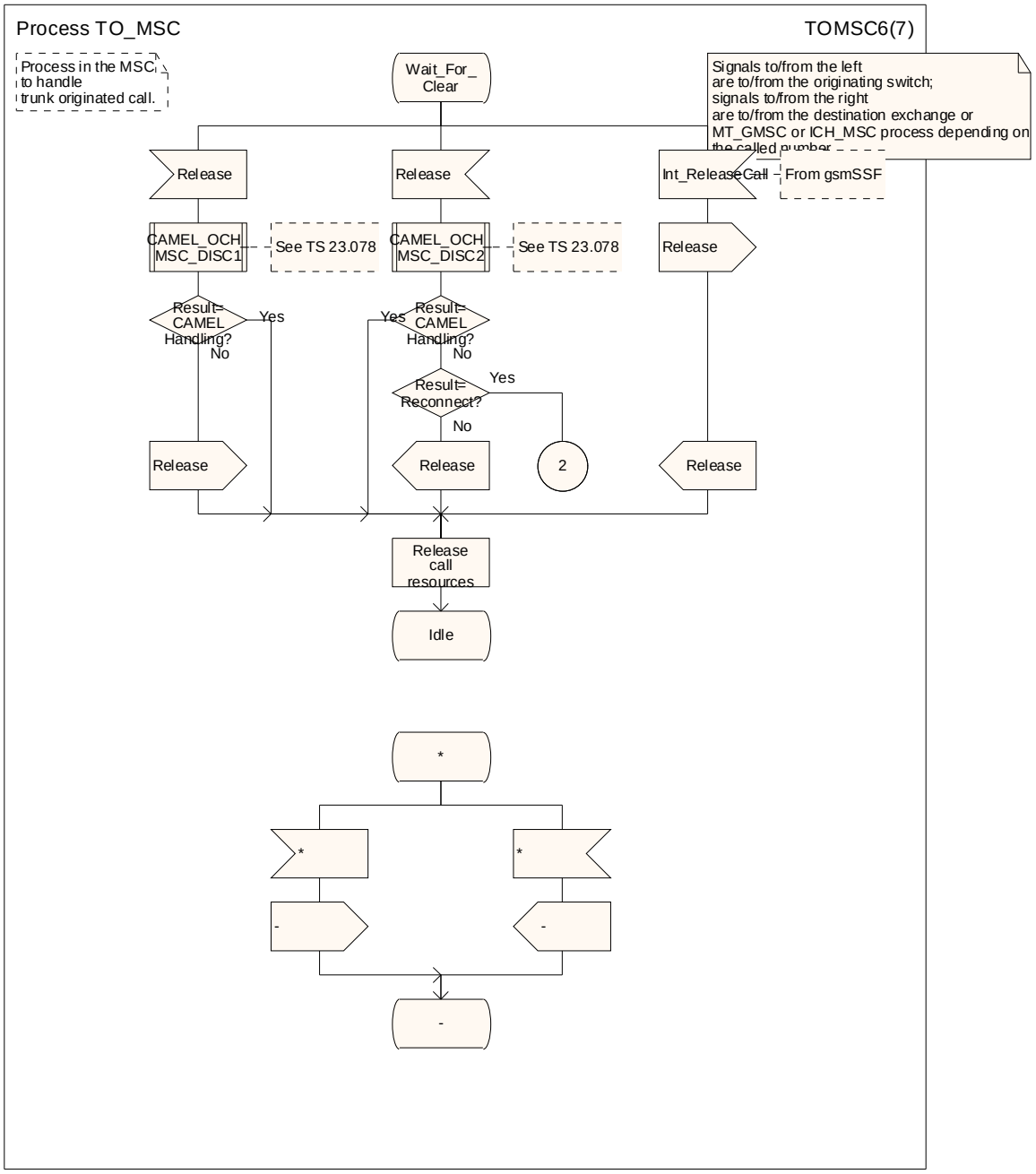


Figure 7.5.1f: Process TO_MSC (sheet 6)

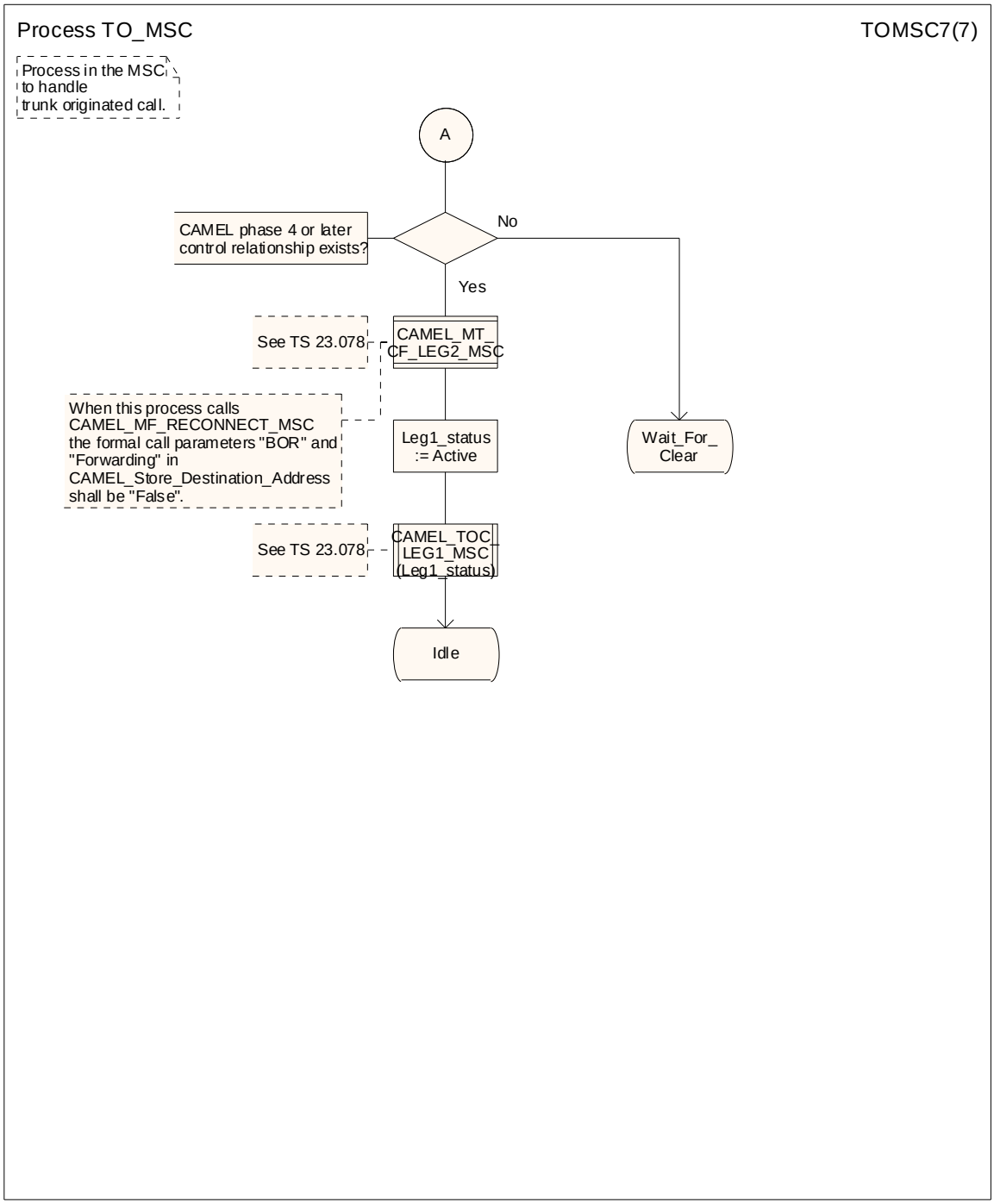


Figure 7.5.1g: Process TO_MSC (sheet 7)

8 Contents of messages

This clause specifies the content of each message shown in clauses 5 and 7, except for the following messages, which are not specific to call handling:

On the D interface (VLR-HLR):

- Abort;
- Activate Trace Mode;
- Authentication Failure Report;

- Insert Subscriber Data;
- Send Authentication Info;
- Send Authentication Info ack;
- Send Authentication Info negative response;

In the tables which follow, information elements are shown as mandatory (M), conditional (C) or optional (O). A mandatory information element shall always be present. A conditional information element shall be present if certain conditions are fulfilled; if those conditions are not fulfilled it shall be absent. An optional element may be present or absent, at the discretion of the application at the sending entity.

Some messages which are defined in this clause are used for other services or features. The specifications (referred to below as "derived specifications") for those services or features may simply refer to the present document for the definition of the message; in this case the requirements for the presence of each information element are as defined in this clause. If the specification for a service or feature requires information elements in a message additional to those specified in this clause, the requirements for the presence of the additional information elements are specified in the relevant specification. If the specification for a service or feature has different requirements for the presence of an information element in a message which is specified in this clause, then the following principles apply:

- If the information element is shown as mandatory in this clause, it shall always be present.
- If the information element is shown as conditional or optional in this clause, but mandatory in the derived specification, it shall always be present in the context of the service or feature defined in the derived specification.
- If the information element is shown as conditional or optional in this clause, and the conditions in the derived specification require the information element to be present, it shall be present even if the conditions in this clause do not require it to be present.

8.1 Messages on the B interface (MSC-VLR)

8.1.1 Abort

The following information element is required:

Information element name	Required	Description
Abort reason	M	Indicates the reason for the procedure being aborted.

8.1.2 Authenticate

The following information elements are required for authentication of a UMTS UE:

Information element name	Required	Description
RAND(I)	M	Random number challenge to be sent to the MS (3GPP TS 33.102 [32])
AUTN(I)	M	Authentication token to be sent to the MS (3GPP TS 33.102 [32])

The following information elements are required for authentication of a GSM MS:

Information element name	Required	Description
RAND	M	Random number challenge to be sent to the MS (3GPP TS 43.020 [1])
CKSN	M	Cipher key sequence number to be sent to the MS (3GPP TS 43.020 [1])

8.1.3 Authenticate ack

The following information element is required for authentication of a UMTS UE:

Information element name	Required	Description
RES(I)	M	Result returned by the MS (3GPP TS 33.102 [32])

The following information element is required for authentication of a GSM MS:

Information element name	Required	Description
SRES	M	Signature result returned by the MS (3GPP TS 43.020 [1])

8.1.4 Authenticate negative response

The negative response information element can take the following value:

- wrong network signature.

8.1.5 Call arrived

This message contains no information elements.

8.1.6 Check IMEI

This message contains no information elements.

8.1.7 Check IMEI ack

The following information element is required:

Information element name	Required	Description
Equipment status	M	Indicates whether the ME is in the permitted list, tracking list or prohibited list

8.1.8 Check IMEI negative response

The negative response information element can take the following values:

- System failure;
- Unknown equipment.

8.1.9 Complete Call

The following information elements are required:

Information element name	Required	Description
MSISDN	C	MSISDN of the MS for which the Complete Call is sent. Shall be present for an ordinary MO call, for an MT call and for an emergency call when the MS is registered in the VLR; otherwise shall be absent.
IMEI	C	IMEI of the mobile for which the Complete Call is sent. Shall be present for an emergency call when the mobile is identified only by its IMEI; otherwise shall be absent.
Category	C	Category of the MS for which the Complete Call is sent. Shall be present for an ordinary MO call and for an emergency call when the MS is registered in the VLR; otherwise shall be absent.
PLMN bearer capability	C	Shall be present for an MT call according to the rules defined in 3GPP TS 29.007 [30].
ISDN bearer capability	C	Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.
ISDN low layer compatibility	C	Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.
ISDN high layer compatibility	C	Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.
CLIP provision	C	Indicates that CLIP is provisioned. Shall be present for an MT call if CLIP is provisioned; otherwise shall be absent.
CLIR override provision	C	Indicates that the CLIR override subscription option of CLIP is provisioned. Shall be present for an MT call if CLIP is provisioned with the CLIR override subscription option and the MS is registered in the HPLMN country; otherwise shall be absent.
CLIR provision	C	Indicates that CLIR is provisioned. Shall be present for an MO call if CLIR is provisioned; otherwise shall be absent.
CLIR mode	C	Indicates the mode in which CLIR is provisioned: permanent, temporary (default presentation allowed) or temporary (default presentation restricted). Shall be present for an MO call if CLIR is provisioned; otherwise shall be absent.
COLP provision	C	Indicates that COLP is provisioned. Shall be present for an MO call if COLP is provisioned; otherwise shall be absent.
COLR override provision	C	Indicates that the COLR override subscription option of COLP is provisioned. Shall be present for an MO call if COLP is provisioned with the COLR override subscription option and the MS is registered in the HPLMN country; otherwise shall be absent.
COLR provision	C	Indicates that COLR is provisioned. Shall be present for an MT call if COLR is provisioned; otherwise shall be absent.
No Reply Condition Timer	C	Value of timer to be used to determine the No subscriber reply condition. Shall be present for an MT call if the Call Forwarding on No Reply service is active and operative; otherwise shall be absent.
CUG index	C	For the definition of this IE, see 3GPP TS 23.085 [18]. May be present (as a network operator option) for an ordinary MO call if the call is a CUG call; shall be present for an MT call if the call is a CUG call; otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present for an ordinary MO call if the call is a CUG call; otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present for an ordinary MO call if the call is a CUG call with outgoing access; otherwise shall be absent.
Advice of Charge provision	C	Indicates whether Advice of Charge (Information) or Advice of Charge (Charging) is provisioned. Shall be present for an ordinary MO call or an MT call if Advice of Charge is provisioned; otherwise shall be absent.
Alerting Pattern	C	Shall be present for an MT call if it was received in the Provide Roaming Number and if the feature is supported by the MSC/VLR; otherwise shall be absent.

Information element name	Required	Description
NAEA preferred Carrier Id	O	The preferred carrier identity identifying the carrier to be used to route the interexchange call if the call requires routing via an interexchange carrier. This parameter may be included at the discretion of the VLR operator.

8.1.10 Complete Call ack

This message contains no information elements.

8.1.11 Complete Call negative response

The negative response information element can take the following values:

- Absent subscriber;
- Busy subscriber;
- No subscriber reply;
- Radio congestion.

8.1.12 Forward New TMSI

The following information element is required:

Information element name	Required	Description
TMSI	M	TMSI to be sent to the MS.

8.1.13 Forward New TMSI ack

This message contains no information elements.

8.1.14 Forward New TMSI negative response

The negative response information element can take the following value:

- TMSI reallocation failure.

8.1.15 Obtain Subscriber Info

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS for which information is required.
Subscriber state requested	C	Indicates that the VLR requires state information for the MS. Shall be present if state information is required; otherwise shall be absent.

8.1.16 Obtain Subscriber Info ack

The following information elements are required:

Information element name	Required	Description
Subscriber state	C	Indicates whether the MS is busy (i.e. engaged on a circuit-switched call) or assumed idle. Shall be present if the VLR requested state information; otherwise shall be absent.

8.1.17 Page MS

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
Location area ID	M	Location area in which the MS is to be paged.
Page type	M	Indicates whether the paging is for a circuit-switched call, MT SMS delivery, SS activity or Active Location Retrieval.
Requested information	C	Indicates the information requested by the VLR – one or more of: - Location; - MS classmark; - IMEI. Shall be present if the Page type is Active Information Retrieval; otherwise shall be absent.
Paging via SGSN possible	C	Indicates that paging via the SGSN is possible. Shall be present if the VLR determines that the MS can be paged via the SGSN; otherwise shall be absent.
TMSI	O	TMSI to be broadcast to identify the MS.
Call Priority	O	This parameter indicates the eMLPP priority of the call (see 3GPP TS 23.067 [39]). This parameter should be present if the VLR supports the eMLPP feature and if the Call Priority was received in the MAP_PROVIDE_ROAMING_NUMBER request or in the MAP PROVIDE_SUBSCRIBER_INFO request.

8.1.18 Page MS ack

The following information elements are required:

Information element name	Required	Description
Location area ID	M	Location area in which the MS responded to the page.
Serving cell ID	M	Identity of the cell in which the served subscriber is located. Shall be present if the MS uses GSM radio access; otherwise shall be absent.
Service area ID	C	Service area identity of the cell in which the served subscriber is located. Shall be present if the MS uses UMTS radio access; otherwise shall be absent.
MS classmark	M	MS classmark 2 as defined in 3GPP TS 24.008 [26].
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5]. Shall be present if the IMEI was requested in the Page MS message and the MSC retrieved it from the MS; otherwise shall be absent.

8.1.19 Page MS negative response

The negative response information element can take the following values:

- Absent subscriber;
- Busy subscriber (More calls possible);

- Busy subscriber (NDUB);
- System failure;
- Unknown location area ID.

The Page MS negative response Busy subscriber (More calls possible) also indicates the basic service which applies for the established call.

8.1.20 Page MS via SGSN

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
eMLPP priority	O	Circuit-switched paging priority.
TMSI	O	TMSI to be broadcast to identify the MS.
Channel type	O	Type of channel required for the call.

8.1.21 Process Access Request

The following information elements are required:

Information element name	Required	Description
CM service type	M	Indicates the type of access required: normal MO call, emergency call or page response. Other values (short message service and SS request) defined for this IE are not considered in the present document.
Access connection status	M	Indicates whether or not the connection to the MS is ciphered and whether or not it is authenticated.
Current location area ID	M	Identity of the location area from which the access request was received.
Service area ID	C	Identity of the service area (for UMTS access) in use by the served subscriber. Shall be present for UMTS access; otherwise shall be absent.
Serving cell ID	C	Identity of the cell (for GSM access) in use by the served subscriber. Shall be present for GSM access; otherwise shall be absent.
IMSI	C	IMSI of the MS requesting the access. For normal MO call or page response, one of IMSI or TMSI shall be present. For emergency call, one of IMSI, TMSI or IMEI shall be present.
TMSI	C	TMSI of the MS requesting the access. For normal MO call or page response, one of IMSI or TMSI shall be present. For emergency call, one of IMSI, TMSI or IMEI shall be present.
IMEI	C	IMEI of the MS requesting the access. For normal MO call or page response, one of IMSI or TMSI shall be present. For emergency call, one of IMSI, TMSI or IMEI shall be present.
CKSN	C	Cipher key sequence number of the MS requesting the access. Shall be present if TMSI is present; otherwise shall be absent.
CSG Id	C	Identifier of the closed subscriber group. Shall be present if the serving cell is a CSG cell or a hybrid cell.
Cell Access Mode	C	Indicates that the serving cell operates in Hybrid Access mode. Shall be present if the serving cell is a Hybrid cell.

8.1.22 Process Access Request ack

The following information elements are required:

Information element name	Required	Description
IMSI	C	IMSI of the MS requesting the access. For normal MO call or page response, shall be present. For emergency call, one of IMSI or IMEI shall be present.
IMEI	C	IMEI of the MS requesting the access. For normal MO call or page response, shall be absent. For emergency call, one of IMSI or IMEI shall be present.
MSISDN	O	MSISDN of the MS requesting the access.
CSG Membership Status	C	Indicates the Membership status of the UE to a particular CSG. Shall be present if the serving cell is a Hybrid cell.

8.1.23 Process Access Request negative response

The negative response information element can take the following values:

- Roaming not allowed;
- System failure;
- Unidentified subscriber;
- Illegal equipment;
- Illegal subscriber;
- Not authorized for this CSG.

8.1.24 Process Call Waiting

The following information elements are required:

Information element name	Required	Description
MSISDN	M	MSISDN of the MS for which the Process Call Waiting is sent.
PLMN bearer capability	C	Shall be present according to the rules defined in 3GPP TS 29.007 [30].
ISDN bearer capability	C	Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.
ISDN low layer compatibility	C	Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.
ISDN high layer compatibility	C	Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.
CLIP provision	C	Indicates that CLIP is provisioned. Shall be present if CLIP is provisioned; otherwise shall be absent.
CLIR override provision	C	Indicates that the CLIR override subscription option of CLIP is provisioned. Shall be present if CLIP is provisioned with the CLIR override subscription option and the MS is registered in the HPLMN country; otherwise shall be absent.
COLR provision	C	Indicates that COLR is provisioned. Shall be present if COLR is provisioned; otherwise shall be absent.
No Reply Condition Timer	C	Value of timer to be used to determine the No subscriber reply condition. Shall be present if the Call Forwarding on No Reply service is active and operative; otherwise shall be absent.
CUG index	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the waiting call is a CUG call; otherwise shall be absent.
Advice of Charge provision	C	Indicates whether Advice of Charge (Information) or Advice of Charge (Charging) is provisioned. Shall be present if Advice of Charge is provisioned; otherwise shall be absent.

8.1.25 Process Call Waiting ack

This message contains no information elements.

8.1.26 Process Call Waiting negative response

The negative response information element can take the following values:

- Busy subscriber (UDUB);
- Busy subscriber (NDUB);
- No subscriber reply.

8.1.27 Provide IMEI

This message contains no information elements.

8.1.28 Provide IMEI ack

The following information element is required:

Information element name	Required	Description
IMEI	M	IMEISV (as defined in 3GPP TS 23.003 [5]) of the ME involved in the access request.

8.1.29 Provide IMSI

This message contains no information elements.

8.1.30 Provide IMSI ack

The following information element is required:

Information element name	Required	Description
IMSI	M	IMSI of the MS involved in the access request.

8.1.31 Radio connection released

This message contains no information elements.

8.1.32 Search For MS

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged in all location areas.
Page type	M	Indicates whether the paging is for a circuit-switched call, MT SMS delivery, SS activity or Active Location Retrieval.
Requested information	C	Indicates the information requested by the VLR – one or more of: - Location; - MS classmark; - IMEI. Shall be present if the Page type is Active Information Retrieval; otherwise shall be absent.
Paging via SGSN possible	C	Indicates that paging via the SGSN is possible. Shall be present if the VLR determines that the MS can be paged via the SGSN; otherwise shall be absent.
TMSI	O	TMSI to be broadcast to identify the MS.
Paging area	O	May be present if the Paging type is circuit switched call, if the Paging Area function is supported and if the paging area is available; otherwise it shall be absent. It indicates the set of Location Areas in which the MS is to be paged on the A interface if Location area ID is not known in VLR.
Call Priority	O	This parameter indicates the eMLPP priority of the call (see 3GPP TS 23.067 [39]). This parameter should be present if the VLR supports the eMLPP feature and if the Call Priority was received in the MAP_PROVIDE_ROAMING_NUMBER request or in the MAP PROVIDE_SUBSCRIBER_INFO request.

8.1.33 Search For MS ack

The following information element is required:

Information element name	Required	Description
Location area ID	M	Location area in which the MS responded to the page.
Serving cell ID	C	Identity of the cell in which the served subscriber is located. Shall be present if the MS uses GSM radio access; otherwise shall be absent.
Service area ID	C	Service area identity of the cell in which the served subscriber is located. Shall be present if the MS uses UMTS radio access; otherwise shall be absent.
MS classmark	M	MS classmark 2 as defined in 3GPP TS 24.008 [26].
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5]. Shall be present if the IMEI was requested in the Page MS message and the MSC retrieved it from the MS; otherwise shall be absent.

8.1.34 Search For MS negative response

The negative response information element can take the following values:

- Absent subscriber;
- Busy subscriber (More calls possible);
- Busy subscriber (NDUB);
- System failure.

The Search For MS negative response Busy subscriber (More calls possible) also indicates the basic service which applies for the established call.

8.1.35 Search for MS via SGSN

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
eMLPP priority	O	Circuit-switched paging priority.
TMSI	O	TMSI to be broadcast to identify the MS.
Channel type	O	Type of channel required for the call.

8.1.36 Send Info For Incoming Call

The following information elements are required:

Information element name	Required	Description
MSRN	M	Mobile Station Roaming Number received in the IAM.
Bearer service	C	Bearer service required for the MT call. Shall be present if the MSC was able to derive a bearer service from ISDN BC/LLC/HLC information received in the IAM; otherwise shall be absent.
Teleservice	C	Teleservice required for the MT call. Shall be present if the MSC was able to derive a teleservice from ISDN BC/LLC/HLC information received in the IAM; otherwise shall be absent.
Dialled number	C	Number dialled by the calling subscriber. Shall be present if it was received in the IAM; otherwise shall be absent.
Number of forwarding	C	Number of times the incoming call has already been forwarded. Shall be present if it was received in the IAM; otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the IAM; otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the IAM; otherwise shall be absent.
MT Roaming Forwarding Supported	C	Indication that the MSC supports the MT Roaming Forwarding feature. Shall be present if the MSC supports that feature, otherwise shall be absent.

8.1.37 Send Info For Incoming Call ack

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the B subscriber.
Forwarded-to number	C	E.164 number of the C subscriber. Shall be present if the call is to be forwarded other than for MT roaming retry reason.
Forwarding reason	C	Indication of why the call has been forwarded (on call deflection, on mobile subscriber busy, on mobile subscriber not reachable or on no subscriber reply). Shall be present if the call is to be forwarded other than for MT roaming retry reason.
Notification to calling party	C	Indication of whether the calling party is to be notified that the call has been forwarded. Shall be present if the call is to be forwarded other than for MT roaming retry reason.
Notification to forwarding party	C	Indication of whether the forwarding party is to be notified that the call has been forwarded. Shall be present if the call is to be forwarded on mobile subscriber busy or on no subscriber reply; otherwise shall be absent.
Forwarded-to subaddress	C	Subaddress of the C subscriber (see 3GPP TS 23.003 [5]). Shall be present if a forwarded-to subaddress is stored in the VLR in association with the forwarded-to number; otherwise shall be absent.
Redirecting presentation	C	Indication of whether the MSISDN of B subscriber shall be presented to the C subscriber. Shall be present if the call is to be forwarded, otherwise shall be absent.
MSISDN	C	E.164 number which identifies the B subscriber. It will be used to create the redirecting number presented to the C subscriber. Shall be present if the call is to be forwarded, otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the VLR has determined that the forwarded call is to be treated as a CUG call in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the VLR has determined that the forwarded call is to be treated as a CUG call with outgoing access in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
NAEA preferred Carrier Id	O	The preferred carrier identity identifying the carrier to be used to route the interexchange call if the forwarded call requires routing via an interexchange carrier. This parameter may be included at the discretion of the VLR operator.
MT Roaming Retry Indicator	C	Indication that the call is forwarded for MT roaming retry. All other forwarding parameters are not relevant if this IE is present.
MT Roaming Forwarding Indicator	C	Indication that the call is forwarded for MT Roaming Forwarding. All other forwarding parameters are not relevant if this IE is present.
MSRN for MT Roaming Forwarding	C	Mobile Station Roaming Number received in the MAP PROVIDE ROAMING NUMBER response from the new VLR. Shall be present if the MT Roaming Forwarding Indicator is present, otherwise shall be absent.

8.1.38 Send Info For Incoming Call negative response

The negative response information element can take the following values:

- Absent subscriber;
- Busy subscriber;
- CUG reject (Called party SS interaction violation);
- Forwarding violation;

- Impossible call completion;
- No subscriber reply;
- System failure;
- Unallocated roaming number;

8.1.39 Send Info For Outgoing Call

The following information elements are required:

Information element name	Required	Description
Called number	M	E.164 number of the call destination.
Bearer service	C	Bearer service required for the MO call, derived from the PLMN bearer capability information received in the set-up request from the MS. One of bearer service or teleservice shall be present.
Teleservice	C	Teleservice required for the MO call, derived from the PLMN bearer capability information received in the set-up request from the MS or from the emergency set-up request from the MS. One of bearer service or teleservice shall be present.
CUG index	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the set-up request from the MS.
Suppress preferential CUG	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the set-up request from the MS.
Suppress CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the set-up request from the MS.

8.1.40 Send Info For Outgoing Call negative response

The negative response information element can take the following values:

- Bearer service not provisioned;
- Call barred (Operator determined barring);
- Call barred (Supplementary service barring);
- CUG reject (Inconsistent access information - index incompatible with basic service);
- CUG reject (Inconsistent access information - no CUG selected);
- CUG reject (Outgoing calls barred within the CUG);
- CUG reject (Unknown CUG index);
- Teleservice not provisioned.

8.1.40A Send UESBI-Iu to Access Network

The following information element is required:

Information element name	Required	Description
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5].

8.1.41 Start security procedures

The following information elements are required for a UMTS connection:

Information element name	Required	Description
CK	M	Ciphering key to be used to cipher communication over the radio link (see 3GPP TS 33.102 [32]).
IK	M	Integrity key to be used to verify the integrity of messages transferred over the radio link (see 3GPP TS 33.102 [32]).

The following information elements are required for a GSM connection:

Information element name	Required	Description
Ciphering mode	M	Indicates whether ciphering of the radio connection is required, and if so which ciphering algorithm is to be used.
Kc	C	Ciphering key to be used if ciphering of the radio connection is required. Shall be present if the ciphering mode indicates that ciphering of the radio connection is required, otherwise shall be absent.

8.1.42 Trace subscriber activity

The following information elements are required:

Information element name	Required	Description
Trace reference	M	Reference number to be included with tracing reports which the VMSC sends to the OMC
Trace type	M	For the definition of this IE, see 3GPP TS 52.008 [3]

8.1.43 Use existing TMSI

This message contains no information elements.

8.1.44 Release MSRN

The following information elements are required:

Information element name	Required	Description
MSRN	M	Mobile Station Roaming Number received with the message RELEASE RESOURCES.

8.2 Messages on the C interface (MSC-HLR)

8.2.1 Send Routeing Info

The following information elements are required:

Information element name	Required	Description
MSISDN	M	MSISDN of the B subscriber (see 3GPP TS 23.003 [5]).
Alerting Pattern	C	Shall be present if received in a Connect operation from the gsmSCF; otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the GMSC received it in the IAM and the GMSC supports CUG, otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the GMSC received it in the IAM and the GMSC supports CUG, otherwise shall be absent.
Number of forwarding	C	Number of times the incoming call has already been forwarded. Shall be present if it was received in the IAM; otherwise shall be absent.
ISDN BC	C	ISDN bearer capability. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.
ISDN LLC	C	ISDN lower layer compatibility. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.
ISDN HLC	C	ISDN higher layer compatibility. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.
Pre-paging supported	C	Shall be present if the GMSC supports pre-paging, otherwise shall be absent.
Call Priority	O	This parameter indicates the eMLPP priority of the call (see 3GPP TS 23.067 [39]). This parameter should be present if the GMSC supports the eMLPP feature and if the call is an eMLPP call. The eMLPP priority levels A and B shall be mapped to the Call priority level 0.

8.2.2 Send Routeing Info ack

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the B subscriber (see 3GPP TS 23.003 [5]).
Roaming number	C	E.164 number required to route the call to VMSCB (see 3GPP TS 23.003 [5]). Shall be present if the HLR received it in the Provide Roaming Number ack and the call is not subject to early CF, otherwise shall be absent.
Forwarded-to number	C	E.164 number of the C subscriber. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
Forwarded-to subaddress	C	Subaddress of the C subscriber (see 3GPP TS 23.003 [5]). Shall be present if the HLR has determined that the call is to be forwarded and a forwarded-to subaddress is stored in the HLR in association with the forwarded-to number, otherwise shall be absent.
Notification to calling party	C	Indication of whether the calling party is to be notified that the call has been forwarded. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
Forwarding reason	C	Indication of why the call has been forwarded (unconditionally or on mobile subscriber not reachable). Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
Redirecting presentation	C	Indication of whether the MSISDN of B subscriber shall be presented to the C subscriber. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
MSISDN	C	E.164 number which identifies the B subscriber (basic MSISDN). It will be used to create the redirecting number presented to the C subscriber. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the HLR has determined that the call is to be treated as a CUG call in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the HLR has determined that the call is to be treated as a CUG call with outgoing access in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
NAEA preferred Carrier Id	O	The preferred carrier identity identifying the carrier to be used to route the interexchange call if the call requires routing via an interexchange carrier. This parameter may be included at the discretion of the HLR operator.

8.2.3 Send Routeing Info negative response

The negative response information element can take the following values:

- Absent subscriber;
- Bearer service not provisioned;
- Call barred (Operator determined barring);
- Call barred (Supplementary service barring);
- Call barred (Anonymous Call Rejection);
- CUG reject (Called party SS interaction violation);
- CUG reject (Incoming calls barred within CUG);

- CUG reject (Requested basic service violates CUG constraints);
- CUG reject (Subscriber not member of CUG);
- Data missing;
- Facility not supported;
- Forwarding violation
- Number changed;
- System Failure;
- Teleservice not provisioned;
- Unexpected data value;
- Unknown subscriber.

8.3 Messages on the D interface (VLR-HLR)

8.3.1 Provide Roaming Number

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the B subscriber (see 3GPP TS 23.003 [5]).
MSC number	M	E.164 number which identifies VMSCB (see 3GPP TS 23.003 [5]).
MSISDN	O	E.164 number which identifies the B subscriber. It shall be present if the following 3 conditions are all satisfied: 1. the MSISDN is different from the basic MSISDN; 2. the subscriber has VT-CSI stored in HLR; 3. the VLR has indicated support for CAMEL Phase 3 or later. It may be present if the HLR requires it to be included in the call data record.
LMSI	C	Local Mobile Subscriber Identity. Shall be present if the LMSI was sent to HLRB at location updating.
PLMN bearer capability	C	Information to define the PLMN bearer capability required for the call. For alternate speech/facsimile group 3 calls this information element shall contain one PLMN bearer capability, as specified in 3GPP TS 29.007 [30]. May be present if the HLR can determine the required PLMN bearer capability from ISDN compatibility information received in the Send Routeing Info message, or from the MSISDN if a multi-numbering scheme is used; otherwise shall be absent. If the ISDN BC and ISDN LLC IEs are present, the PLMN bearer capability IE shall be absent.
ISDN BC	C	ISDN bearer capability. May be present if the HLR received it in the Send Routeing Info message, otherwise shall be absent. If the PLMN bearer capability IE is present, the ISDN BC IE shall be absent.
ISDN LLC	C	ISDN lower layer compatibility. May be present if the HLR received it in the Send Routeing Info message, otherwise shall be absent. If the PLMN bearer capability IE is present, the ISDN LLC IE shall be absent.
ISDN HLC	C	ISDN higher layer compatibility. Shall be present if the HLR received it in the Send Routeing Info message, otherwise shall be absent.
Alerting Pattern	C	Shall be present if the HLR has determined an alerting category or an alerting level for the MT call configuration; otherwise shall be absent.
Pre-paging supported	C	Shall be present if the HLR has determined that pre-paging is supported in the GMSC and the HLR, otherwise shall be absent.
Paging area	O	Shall be present if the Paging Area function is supported and if the paging area is stored in HLR (see 3GPP TS 23.012); otherwise it shall be absent. It indicates the set of Location Areas in which the MS is to be paged on the A interface if Location area ID is not known in VLR.
Call Priority	O	This parameter indicates the eMLPP priority of the call (see 3GPP TS 23.067 [39]). This parameter should be present if the HLR supports this parameter and if the Call Priority was received in the MAP_SEND_ROUTING_INFORMATION request.

8.3.2 Provide Roaming Number ack

The following information element is required:

Information element name	Required	Description
Roaming number	M	E.164 number required to route the call to VMSCB (see 3GPP TS 23.003 [5]).

8.3.3 Provide Roaming Number negative response

The negative response information element can take the following values:

- Absent subscriber;
- Data missing;
- Facility not supported;
- No roaming number available;
- OR not allowed;
- Unexpected data value.

8.3.4 Provide Subscriber Info

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the subscriber for whom information is requested (see 3GPP TS 23.003 [5]).
LMSI	C	Local Mobile Subscriber Identity. Shall be present if the LMSI was sent to the HLR at location updating.
Requested information	M	Indicates which of the following information the HLR requires: - location information; - subscriber state; - IMEI (with software version); - MS classmark.
Active location retrieval requested	C	Indicates that the HLR requires active location retrieval. Shall be absent if the requested information does not indicate that the HLR requires location information.
Location Information in EPS Supported	C	Indicates by its presence that Location Information in EPS is supported. Shall be absent if the requested information does not indicate that the HLR requires location information. Shall be present if the Provide Subscriber Info message is triggered by the receipt of a Any Time Interrogation Request that includes the same IE. May be present otherwise, if the HLR requires location information and the requesting entity in the HPLMN (e.g. gsmSCF) is known to support Location Information in EPS.
Call Priority	O	Indicates the eMLPP priority of the call (see 3GPP TS 23.067 [39]). Should be present if the HLR supports this parameter and if the Call Priority was received in the MAP_SEND_ROUTING_INFORMATION request.

8.3.5 Provide Subscriber Info ack

The following information elements are required:

Information element name	Required	Description
Location information	C	Information to define the location of the MS: see definition in clause 8.3.5.1. Shall be present if location information was requested and is available; otherwise shall be absent.
Subscriber state	C	Indicates whether the MS is busy (i.e. engaged on a circuit-switched call), network determined not reachable (IMSI detached or roaming in a prohibited location area) or assumed idle. Shall be present if subscriber state was requested; otherwise shall be absent.
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5]. Shall be present if the IMEI was requested, otherwise shall be absent.
MS classmark	C	MS classmark 2 as defined in 3GPP TS 24.008 [26]. Shall be present if the MS classmark was requested, otherwise shall be absent.

8.3.5.1 Location information

The compound information element Location information consists of the following subordinate information elements:

Information element name	Required	Description
Location number	C	For a definition of this information element, see ITU-T Recommendation Q.763 [35]. Shall be present if the VLR can derive it from the stored service area identity (for UMTS) or cell global identity (for GSM) or location area identity; otherwise shall be absent. The mapping from service area identity or cell ID and location area to location number is network-specific and outside the scope of the UMTS and GSM standards.
Service area ID	C	Service area identity of the cell in which the MS is currently in radio contact or in which the MS was last in radio contact. Shall be present if the MS uses UMTS radio access and the subscriber record is marked as confirmed by radio contact; otherwise shall be absent. See clause 7.2.3.5.
Cell ID	C	Cell global identity of the cell in which the MS is currently in radio contact or in which the MS was last in radio contact. Shall be present if the MS uses GSM radio access and the subscriber record is marked as confirmed by radio contact; otherwise shall be absent. See clause 7.2.3.5.
Geographical information	C	For a definition of this information element, see 3GPP TS 23.032 [7] . Shall be present if the VLR can derive it from the stored service area identity, cell global identity or location area identity; otherwise shall be absent.
Geodetic information	C	This information element corresponds to the Calling Geodetic Location defined in ITU-T Recommendation Q.763 [35]. Shall be present if the VLR can derive it from the stored service area identity, cell global identity or location area identity; otherwise shall be absent.
VLR number	O	E.164 number which identifies the VLR (see 3GPP TS 23.003 [5]). If the HLR receives it from the VLR it shall ignore it.
Age of location information	C	Measured in minutes. Shall be present if available in the MSC/VLR; otherwise shall be absent.
Current Location Retrieved	C	Shall be present when location information was obtained after a successful paging procedure for Active Location Retrieval.
E-UTRAN Cell ID	C	E-UTRAN cell global identity of the cell in which the MS is currently in radio contact or in which the MS was last in radio contact. Shall be present if the MS uses E-UTRAN radio access and the subscriber record is marked as confirmed by radio contact; otherwise shall be absent. See clause 7.2.3.5.
Tracking area ID	C	Tracking area identity of the cell in which the MS is currently in radio contact or in which the MS was last in radio contact. Shall be present if the MS uses E-UTRAN radio access; otherwise shall be absent. See clause 7.2.3.5.

8.3.6 Provide Subscriber Info negative response

The negative response information element can take the following values:

- Data missing;
- Unexpected data value.

8.3.7 Restore Data

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the subscriber for whom data are to be restored (see 3GPP TS 23.003 [5]).
LMSI	O	LMSI of the subscriber for whom data are to be restored (see 3GPP TS 23.003 [5]). May be included if required by the requesting VLR.

8.3.8 Restore Data ack

The following information elements are required:

Information element name	Required	Description
HLR number	M	E.164 number which identifies the HLR (see 3GPP TS 23.003 [5]).
MS not reachable flag	C	Indicates whether the VLR should notify the HLR when the MS next establishes radio contact. Shall be present if the corresponding indicator is set in the HLR record for the subscriber; otherwise shall be absent.

8.3.9 Restore Data negative response

The negative response information element can take the following values:

- System failure;
- Unknown subscriber.

8.4 Messages on the F interface (MSC-EIR)

8.4.1 Check IMEI

The following information element is required:

Information element name	Required	Description
IMEI	M	IMEI of the ME whose status is to be checked (see 3GPP TS 23.003 [5]).

8.4.2 Check IMEI ack

The following information element is required:

Information element name	Required	Description
Equipment status	M	Indicates whether the ME is in the permitted list, tracking list or prohibited list

8.4.3 Check IMEI negative response

The negative response information element can take the following value:

- Unknown equipment.

8.5 Messages on the MSC internal interface

This interface can carry ISUP messages received from the process MT_GMSC or the process ICH_MSC and to be forwarded to a destination exchange, and ISUP messages received from the destination exchange and to be forwarded to the process MT_GMSC or the process ICH_MSC. In addition, it carries the following inter-process messages.

8.5.1 CF cancelled

This message contains no information elements.

8.5.2 Perform Call Forwarding

The following information element is required:

Information element name	Required	Description
Forwarded-to number	M	E.164 number of the C subscriber.
OR call	M	Indicates whether the call which is to be forwarded was subject to basic OR as specified in 3GPP TS 23.079 [13]

8.5.3 Perform Call Forwarding ack

The following information element is required:

Information element name	Required	Description
Forwarded-to number	M	E.164 number of the C subscriber. Note: this number may be different from the Forwarded-to number received in the Perform Call Forwarding, as a result of CAMEL handling.

8.5.4 Perform Call Forwarding negative response

The negative response information element can take the following value:

- Call forwarding failed.

8.6 Messages on the VLR internal interface

This interface carries messages between corresponding instances of the processes PRN_VLR and ICH_VLR. The correlation between the process instances is done by the MSRN.

8.6.1 Call arrived

This message contains no information elements.

8.6.2 PAR completed

This message contains no information elements.

8.7 Messages on the Gs interface

8.7.1 Page MS

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
eMLPP priority	C	Circuit-switched paging priority. Shall be present if it was received in the Page MS via SGSN request or Search for MS via SGSN request; otherwise shall be absent.
TMSI	C	TMSI to be broadcast to identify the MS. Shall be present if it was received in the Page MS via SGSN request or Search for MS via SGSN request; otherwise shall be absent.
Location area identity	C	Location area identity of the location area where the mobile is registered, according to the subscriber data in the VLR. Shall be present if the VLR can supply it; otherwise shall be absent.
Channel type	C	Type of channel required for the call. Shall be present if it was received in the Page MS via SGSN request or Search for MS via SGSN request; otherwise shall be absent.

8.7.2 Send MS information

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS for which information is required.
Information requested	M	Information required for the specified MS.

8.7.3 Send MS information ack

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS for which information is required.
Service area ID	C	Service area ID (for UMTS access) of the cell in which the MS last established radio contact. Shall be present if the MS uses UMTS access; otherwise shall be absent.
Cell ID	C	Cell ID (for GSM access) of the cell in which the MS last established radio contact. Shall be present if the MS uses GSM access; otherwise shall be absent.
Location information age	M (note)	Time in minutes since the MS last established a radio transaction
NOTE: Although they are optional in the protocol, these IEs are mandatory in this context.		

8.7.4 Send MS information negative response

The negative response information element can take the following value:

- No response from SGSN.

8.8 Messages on the E interface (GMSC-VMSC)

8.8.1 Release Resources

The following information elements are required:

Information element name	Required	Description
MSRN	M	Mobile Station Roaming Number.

Annex A (informative): Handling of an IAM at an MSC

An MSC which receives an IAM from an originating exchange may react in three different ways:

- It acts as a transit exchange, i.e. it relays the IAM to a destination exchange determined by analysis of the called party address, and thereafter relays other telephony signalling between the originating and destination exchange until the connection is released. This behaviour is not specific to UMTS or GSM.

- It acts as a terminating exchange, i.e. it attempts to connect the call to an MS currently registered in the service area of the MSC.

- It acts as a GMSC, i.e. it interrogates an HLR for information to route the call. If the HLR returns routeing information, the MSC uses the routeing information from the HLR to construct an IAM, which it sends to a destination exchange determined by analysis of the routeing information from the HLR.

Sheet 1: when the MSC co-ordinating setup procedure has decided whether the MSC is to act as a terminating VMSC, a GMSC or a transit exchange, it forwards the IAM to an idle instance of the appropriate process.

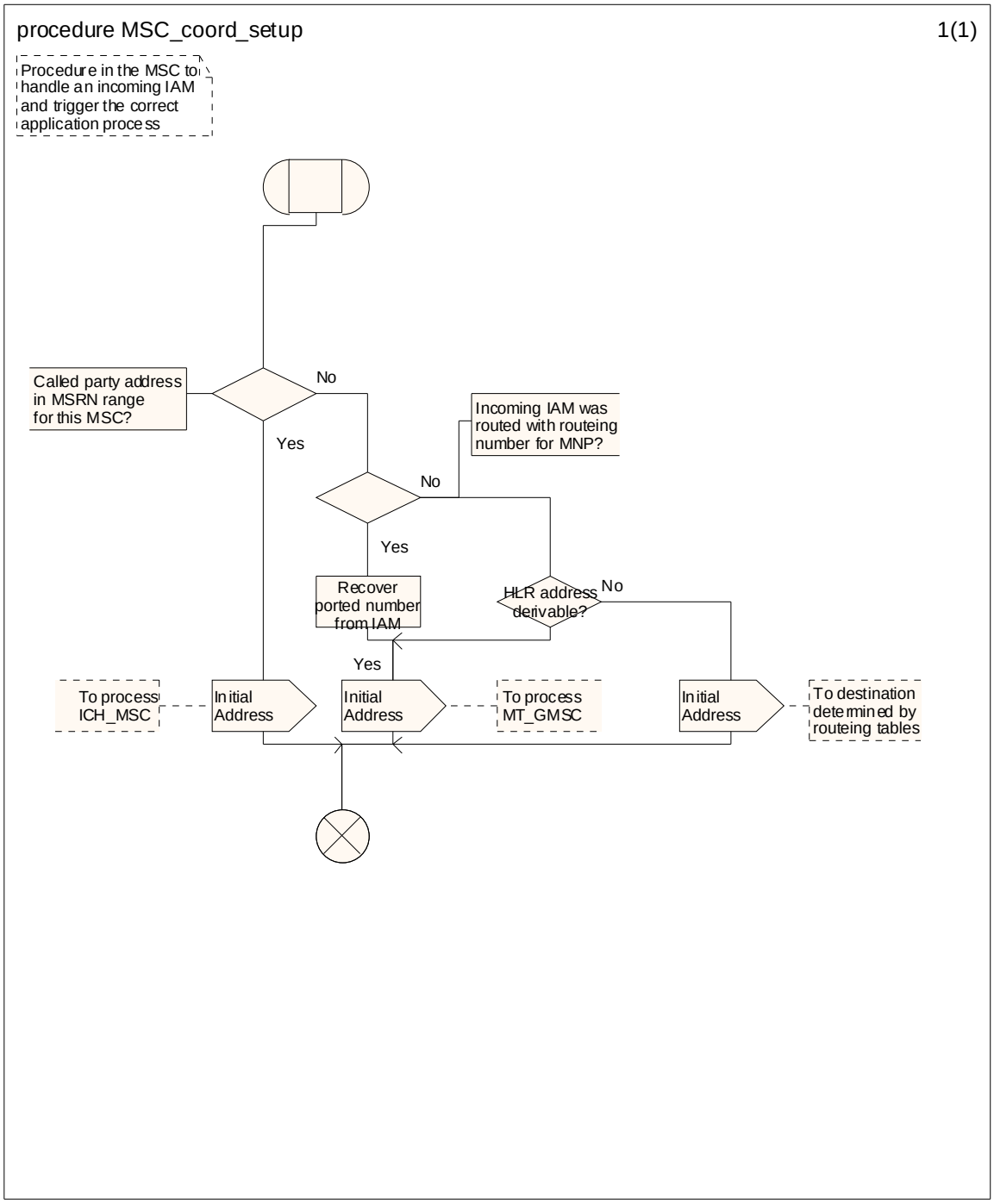


Figure 84a: Process MSC_Coord (sheet 1)

Annex B (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
Apr 1999	Apr 1999					Transferred to 3GPP CN1	
CN#03	CN#03					Approved at CN#03	3.0.0
CN#04	CN#04		001			Notification of Call Forwarding to the gsmSCF	3.1.0
CN#05	CN#05		002	4		Addition of the description for Pre-Paging	3.2.0
CN#05	CN#05		006			Removal of TDP criteria from Resume Call Handling	3.2.0
CN#05	CN#05		007	1		GMSC CAMEL phases in Provide Roaming Number	3.2.0
CN#05	CN#05		023			Separation of success & failure cases for OR of late call forwarding	3.2.0
CN#05	CN#05		024			Notification of Call Forwarding to the gsmSCF before activating call forwarding process	3.2.0
CN#06	CN#06		004	2		Introduction of the Super-Charger Concept in TS 23.018	3.3.0
CN#06	CN#06		027	3		Introduction of CAMEL Phase 3	3.3.0
CN#07	CN#07		025	7		Addition of the description for Multicall	3.4.0
CN#07	CN#07		026	2		Alternative solution for ALR	3.4.0
CN#07	CN#07		030			Correction of the SDL diagrams for Pre-paging	3.4.0
CN#07	CN#07		032	1		Inclusion of D-CSI check in HLR/VLR	3.4.0
CN#07	CN#07		033			Initialization of Backward Call indicator	3.4.0
CN#07	CN#07		034			Correction of the result of the procedure CAMEL_ICH_MSC_INIT	3.4.0
CN#07	CN#07		037			Clarification of N-CSI in Core NW	3.4.0
CN#07	CN#07		039	2		Replacement of references to GSM with references to UMTS	3.4.0
CN#07	CN#07		043	1		Clarification of NPDB error detection and MNP specific call handling	3.4.0
CN#07	CN#07		044			Setting the Destination Address for MO calls	3.4.0
CN#07	CN#07		047			O-CSI and D-CSI checks for ORLCF calls	3.4.0
CN#07	CN#07		048			Correction of CF Notification	3.4.0
CN#07	CN#07		049			Introduction of Authentication Failure Report	3.4.0
CN#07	CN#07		050	3		ISUP release cause value	3.4.0
CN#08	CN#08		045	1		Correction of CAMEL Incoming Call Handling	3.5.0
CN#08	CN#08		051	4		Improvement of Active Retrieval of Location Information procedure	3.5.0
CN#08	CN#08		052	2		North American Service Provider Number Portability impacts for MNP	3.5.0
CN#09	CN#09		053			Correction of connector numbering in process ICH_MSC	3.6.0
CN#09	CN#09		054			Correction of the SDL diagram for Pre-paging	3.6.0
CN#09	CN#09		056			Correction to process ICH_VLR	3.6.0
CN#09	CN#09		057	3		Handling of the Call Diversion Treatment Indicator	3.6.0
CN#09	CN#09		059	1		Modifications to procedure obtain routeing address.	3.6.0
CN#09	CN#09		060			Corrections to process ICH_VLR	3.6.0
CN#09	CN#09		061	2		Update of CAMEL references	3.6.0
CN#09	CN#09		063	1		Correction of procedure Obtain_Routeing_Address for the reconnect case	3.6.0
CN#09	CN#09		055	4		Inclusion of call hold in basic call handling.	4.0.0
CN#10	CN#10		064			Tidying up of Process Subs_FSM and inter-process signals	4.1.0
CN#11	CN#11		065			Incorporation of MPTY and ECT into the Subs_FSM process	4.2.0
CN#11	CN#11		067			Removal of CW descriptions	4.2.0
CN#11	CN#11		069			Paging not via the SGSN correction	4.2.0
CN#12	CN#12		074			Initialization of variable to monitor activation of CSI's	4.3.0
CN#12	CN#12		072			Handling of MultiCall in MPTY procedure	5.0.0
CN#13	CN#13		077			Addition of missing process Update_Location_VLR	5.1.0
CN#13	CN#13					Editorial clean up	5.1.0
CN#14	CN#14		081			Handling of Reconnect on Leg2 Disconnect	5.2.0
CN#14	CN#14		091	2		Corrections in the ATI mechanism description	5.2.0
CN#15	CN#15		082	2		Introduction of CAMEL Phase 4	5.3.0
CN#15	CN#15		088	2		Handling of CUG calls in non-supporting networks	5.3.0
CN#15	CN#15		093	1		MSISDN in Provide Roaming Number in case of MSP	5.3.0
CN#15	CN#15		098			Correction on the Active Location Retrieval description	5.3.0
CN#15	CN#15		100	1		Transferring the MS classmark & IMEI to the gsmSCF	5.3.0
CN#17	CN#17		109	1		Determining the basic service for MT calls	5.4.0
CN#17	CN#17		110			Minor corrections to Process ICH_MSC	5.4.0
CN#17	CN#17		111			Setting of Leg1_Status variable	5.4.0

CN#18	CN#18		112	1		Clarification of requirements for the presence of IEs in messages	5.5.0
CN#19	CN#19		118			Correction in the ATI mechanism description	5.6.0
CN#20	CN#20		115	2		Stopping No_Answer timer in the case of forwarding notification	5.7.0
CN#20	CN#20		122			Release Result from CAMEL_MT_GMSC_Notify_CF	5.7.0
CN#20	CN#20		124			Addition of procedure to retrieve UE-specific behaviour data	5.7.0
CN#21	CN#21		128			Corrections to "Early UE" handling	5.8.0
CN#21	CN#21		133			HLR Interrogation for SCUDIF calls	5.8.0
CN#21	CN#21		132			Removal of SIWF material	6.0.0
CN#22	CN#22		126	1		Collective CR for Rel-6 Enhanced Dialled Services	6.1.0
CN#22	CN#22		135			Incorrect implementation of CR 133	6.2.0
CN#22	CN#22		137			Default Basic Service for gsmSCF-initiated calls	6.2.0
CN#25	CN#25		141	1		Pre-Paging Resource Optimization	6.3.0
CN#25	CN#25		143	1		Add "CAMEL_Stop_TNRy"in Procedure OG_Call_Setup _MSC (sheet 4)	6.3.0
CN#27	CN#27		144			Management Based Activation Impacts	6.4.0
CT#28	CT#28		145	1		Trunk Originated CAMEL triggering - SDLs	7.0.0
CT#29	CT#29		146			Trunk Originated CAMEL: Inter-digit timer stop/reset SDL correction	7.1.0
CT#30	CT#30		0147			Incorrect References	7.2.0
CT#33	CT#33		0150			Correction to the IC_CUG_Check Procedure	7.3.0
CT#34	CT#34		0155			Optional Suppress Terminating Services Bit String in SRI	7.4.0
CT#36	CT#36		0157	4		Mobile Termination whilst the MS is moving to another MSC	7.5.0
CT#36	CT#36		0159			PLMN BC in PRN for alternate speech/fax - alignment with TS 29.007	7.5.0
CT#37	CT#37		0160			Procedure Check_OG_Barring	7.6.0
			0162			Missing SRIack negative response to ISUP release cause mapping in GMSC	
CT#40	CT#40		0163	2		Paging optimization with A/Iu flex	8.0.0
CT#41	CT#41		0164r1	1		eMLPP Priority in MAP SRI, PRN and PSI request	8.1.0
CT#42	CT#42					Copyright Notification updated	8.1.1
CT#45	CT#45		0166			PSI negative response	8.2.0
CT#46	CT#46		-			Update to Rel-9 version (MCC)	9.0.0
CT#47	CT#47		0167	4		Mobile Termination on Pre-paging whilst the MS is moving to another MSC	9.1.0
CT#49	CT#49		0168r2	2		SRI Negative Response Error	9.2.0
CT#49	CT#49		0170			Correction for SMS via SGs charging	9.2.0
						History table version numbers corrected	9.2.1
CT#50	CT#50		0171			MT Roaming Retry	10.0.0
CT#51	CT#51		0174	2		Mobile Terminating Roaming Forwarding	10.1.0
CT#51	CT#51		0173			MT Roaming Retry and Super Charger	10.1.0
CT#52	CT#52		0180			Paging optimization with A/Iu flex	10.2.0
CT#52	CT#52		0175	3		Mobile Terminating Roaming Forwarding for Pre-paging	10.2.0
CT#52	CT#52		0176			New LMSI handling for MTRF	10.2.0
CT#52	CT#52		0177	1		SDL changes for MTRF after retrieval of routeing information	10.2.0
CT#52	CT#52					Editorial correction of overlapping CRs C4-111418 and C4-111415 implementation after CT#52. 5.2.4 was re-numbered as figure 4d in order to align with previous figure number in serction 5.2.3.	10.2.1
CT#53	CT#53		0181	1		Addition of Anonymous Call Rejection in the CS domain	11.0.0
CT#53	CT#53		0182	2		HLR/HSS domain selection function alignment with Stage 2 requirement	11.0.0
CT#54	CT#54		0188	1		Provide Subscriber Information handling for UE under LTE	11.1.0
CT#54	CT#54		0183	1		Cause code mapping	11.1.0
CT#54	CT#54		0185			CSG access control in CS domain	11.1.0
CT#55	CT#55		0189	4		Termination of VT-CSI Dialogue during MTRR and MTRF Procedures	11.2.0
CT#56	CT#56		0190	1		MTRF upon establishment of SGs association	11.3.0
CT#56	CT#56		0191	1		Clause number correction on MTRF	11.3.0
CT#59	CT#59		0195	3		MTRF for normal 2G and 3G MT call	11.4.0
CT#59	CT#59		0193	1		MTRR for normal 2G/3G MT call	12.0.0
CT#59	CT#59		0196	1		MTRF for normal 2G and 3G MT call	12.0.0

CT#60	CT#60		0197	+		MM Abort intead of CM Service Reject after CM service acceptance	12.1.0
CT#61	CT#61		0198	2		MTRF Optimal Routing when the GMSC and new MSC/VLR are the same node	12.2.0
CT#70	CT#70		-	+		Update to Rel-13 version (MCC)	13.0.0
2017-03	CT#77		-	+		Update to Rel-14 version (MCC)	14.0.0
2018-06	CT#83		-	+		Update to Rel-15 version (MCC)	15.0.0
2020-07	CT#88e		-	+		Update to Rel-16 version (MCC)	16.0.0
2021-03	CT#91e	CP-210027	0201	-		Inclusive language review related to EIR responses	17.0.0
2024-03	CT#103		-	+		Update to Rel-18 version (MCC)	18.0.0

History

Document history		
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