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13th – 15th December 1999

Agenda item: **5.1.3**

Source: **TSG_N WG1**

Title: **CR001r2 to 23.009 / work item GSM-UMTS interworking**

Introduction:

This document contains **"1"** CRs agreed by **TSG_N WG1** and forwarded to **TSG_N Plenary** meeting **#6** for approval. Due to changes which covers the whole document, a presentation paper for the spec is also attached.

- Presentation of TS 23.009 to TSG.doc
- Table below

Tdoc	Spec	CR	Rev	CAT	Rel.	Old Ver	New Ver	Subject
N1-99E21	23.009	001	2	B	R99	3.0.0	3.1.0	Proposal for updates to 23.009

Presentation of Specification to TSG or WG

Presentation to: **TSG CN Meeting #6**

Document for presentation: **TS 23.009, Version 3.0.0 => 3.1.0**

Presented for: **Approval**

Abstract of document:

The present document contains a detailed description of the handover procedures to be used in PLMNs. The purpose of the handover procedures, as described in this specification, are to ensure that the connection to the Mobile Station (MS) or User Equipment (UE) is maintained as it moves from one cell or radio network to another. The document defines the circuit switched handover functionality based on the service requirements in TS 22.129 [9].

This specification considers the following four cases:

I) Intra-MSC handover.

II) Intra-3G_MSC handover/relocation. This case also includes inter-system handover between RNS and BSS if the 3G_MSC supports the A-interface.

III) Inter-MSC handover, sub-divided into the following three procedures:

a) the Basic Inter-MSC Handover procedure, MSC-A to MSC-B;

b) the Subsequent Inter-MSC Handover procedure, MSC-B to a third MSC, MSC-B';

c) the Subsequent Inter-MSC handback, MSC-B to MSC-A.

IV) Inter-3G_MSC handover/relocation, divided into three further sub-procedures:

a) the Inter-3G_MSC Handover procedure, UMTS to GSM;

b) the Inter-3G_MSC Handover procedure, GSM to UMTS;

c) the Inter-3G_MSC Relocation procedure, 3G_MSC-A to 3G_MSC-B. This procedure can also be combined with a hard change of radio resources (Hard Handover with switch in the core network).

Changes since last presentation to TSG CN Meeting #3:

Added UMTS functionalities as above, New structure, and modernized figures.

Outstanding Issues:

None.

Contentious Issues:

None.

3GPP TSG-N WG1
Bad Aibling, Germany 30. Nov. - 03 Dec. 1999

Document N1-99E21
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

23.009	CR	001r2	Current Version:	3.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG-N #6	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME		UTRAN / Radio	X	Core Network	X

Source:	Ericsson L.M.	**Date:** 30 Nov 1999
Subject:	Introduction of UMTS functionalities in 23.009.	
Work item:	GSM / UMTS Interworking	

Category: *(only one category shall be marked with an X)*			**Release:**	
F	Correction		Phase 2	
A	Corresponds to a correction in an earlier release		Release 96	
B	Addition of feature	X	Release 97	
C	Functional modification of feature		Release 98	
D	Editorial modification		Release 99	X
			Release 00	

Reason for change:	To cover all handover scenarios in both 2G and 3 systems.
Clauses affected:	All

Other specs affected:			
Other 3G core specifications		→ List of CRs:	
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:	

3G TS 23.009 V3.0.0 (1999-05)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Core Network; Handover procedures (3G TS 23.009 version 3.0.0)

The present document has been developed within the 3rd Generation Partnership Project (3GPP ™) and may be further elaborated for the purposes of 3GPP.
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Specifications and reports for implementation of the 3GPP ™ system should be obtained via the 3GPP Organisational Partners' Publications Offices.

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Contents

Foreword 7

1 Scope 8

2 References 9

3 Definitions and abbreviations 13

4 Role, functional composition of MSCs and interfaces for handover 13
4.1 MSC-A 13
4.1.1 Role of MSC-A 13
4.1.2 Functional composition of MSC-A and its interfaces for handover 14
4.2 MSC-B 17
4.2.1 Role of MSC-B 17
4.2.2 Functional composition of MSC-B and its interfaces for handover 18
4.3 3G_MSC-A 20
4.3.1 Role of 3G_MSC-A 20
4.3.2 Functional composition of 3G_MSC-A and its interfaces for handover/relocation 21
4.4 3G_MSC-B 23
4.4.1 Role of 3G_MSC-B 23
4.4.2 Functional composition of 3G_MSC-B and its interfaces for handover/relocation 24

5 Handover initiation conditions 25

6 General description of the procedures for intra - MSC handovers 26
6.1 Procedure for Intra-MSC Handovers 26
6.2 Procedure for Intra-3G_MSC Handovers 28
6.2.1 Intra-3G_MSC Handover from UMTS to GSM 28
6.2.2 Intra-3G_MSC GSM to UMTS Handover 29
6.2.3 Procedure for Intra-3G_MSC SRNS Relocation 31

7 General description of the procedures for inter - MSC handovers 33
7.1 Basic handover procedure requiring a circuit connection between MSC-A and MSC-B 33
7.2 Basic handover procedure not requiring the establishment of a circuit connection between MSC-A and MSC-B 36
7.3 Procedure for subsequent handover requiring a circuit connection between MSC-A and MSC-B 37
7.3.1 Description of subsequent handover procedure i): MSC-B to MSC-A 37
7.3.2 Description of the subsequent handover procedure ii): MSC-B to MSC-B' 38
7.4 Procedure for subsequent handover not requiring a circuit connection between MSC-A and MSC-B 41
7.4.1 Description of the subsequent handover procedure without circuit connection i): MSC-B to MSC-A 42
7.4.2 Description of the subsequent handover procedure without circuit connection ii): MSC-B to MSC-B' 42

8 General Description of the procedures for inter – 3G_MSC handovers 45
8.1 Handover UMTS to GSM 45
8.1.1 Basic Handover procedure requiring a circuit connection between 3G_MSC -A and MSC-B 45
8.1.2 Basic UMTS to GSM Handover procedure not requiring the establishment of a circuit connection between 3G_MSC-A and MSC-B 47
8.1.3 Procedure for subsequent UMTS to GSM handover requiring a circuit connection between 3G_MSC-A and 3G_MSC-B 48
8.1.3.1 Description of subsequent UMTS to GSM handover procedure i): 3G_MSC-B to MSC-A 48
8.1.3.2 Description of subsequent UMTS to GSM handover procedure ii): 3G_MSC-B to MSC-B' 49
8.1.4 Procedure for subsequent UMTS to GSM handover not requiring a circuit connection between 3G_MSC-A and 3G_MSC-B 50
8.1.4.1 Description of subsequent UMTS to GSM handover procedure i): 3G_MSC-B to MSC-A 51
8.1.4.2 Description of the subsequent UMTS to GSM handover procedure without circuit connection ii): 3G_MSC-B to MSC-B' 51
8.2 Handover GSM to UMTS 52
8.2.1 Basic Handover procedure requiring a circuit connection between MSC-A and 3G_MSC-B 53

8.2.2 Basic GSM to UMTS Handover procedure not requiring the establishment of a circuit connection between MSC-A and 3G_MSC-B 54
8.2.3 Procedure for subsequent GSM to UMTS handover requiring a circuit connection between 3G_MSC-A and MSC-B 55
8.2.3.1 Description of subsequent GSM to UMTS handover procedure i): MSC-B to 3G_MSC-A 55
8.2.3.2 Description of subsequent GSM to UMTS handover procedure ii): MSC-B to 3G_MSC-B'' 57
8.2.4 Procedure for subsequent GSM to UMTS handover not requiring a circuit connection between 3G_MSC-A and MSC-B 58
8.2.4.1 Description of subsequent GSM to UMTS handover procedure without circuit connection i): MSC-B to 3G_MSC-A 59
8.2.4.2 Description of subsequent GSM to UMTS handover procedure without circuit connection ii): MSC-B to 3G_MSC-B' 59
8.3 SRNS Relocation 60
8.3.1 Basic relocation procedure requiring a circuit connection between 3G_MSC-A and 3G_MSC-B 61
8.3.2 Basic relocation procedure not requiring the establishment of a circuit connection between 3G_MSC-A and 3G_MSC-B 62
8.3.3 Procedure for subsequent relocation requiring a circuit connection between 3G_MSC-A and 3G_MSC-B 63
8.3.3.1 Description of subsequent relocation procedure i): 3G_MSC-B to 3G_MSC-A 64
8.3.3.2 Description of subsequent relocation procedure ii): 3G_MSC-B to 3G_MSC-B' 65
8.3.4 Procedure for subsequent relocation not requiring a circuit connection between 3G_MSC-A and 3G_MSC-B 66
8.3.4.1 Description of subsequent relocation procedure i): 3G_MSC-B to 3G_MSC-A 67
8.3.4.2 Description of subsequent relocation procedure ii): 3G_MSC-B to 3G_MSC-B'' 67

9 Detailed procedures in MSC-A 68
9.1 BSS/MSC and MS/MSC procedures in MSC-A (functional unit 1) 68
9.2 Call control procedures MSC-A (functional unit 2) 69
9.3 Handover control procedures MSC-A (functional unit 3) 70
9.4 MAP procedures in MSC-A (functional unit 4) 71
9.5 Interworking between Handover control procedures and MAP procedures in MSC-A 71
9.6 Compatibility with GSM Phase 1 71

10 Detailed procedures in MSC-B 72
10.1 BSS/MSC (MS/BSS) procedures MSC-B (functional unit 1) 72
10.2 Call control procedures MSC-B (functional unit 2) 72
10.3 Handover control procedures MSC-B (functional unit 3) 73
10.4 MAP procedures MSC-B (functional unit 4) 74
10.5 Interworking between Handover control procedures and MAP procedures in MSC-B 74
10.6 Compatibility with GSM Phase 1 74

11 Detailed procedures in 3G_MSC-A 74
11.1 RNC/BSC/3G_MSC and UE/MS/3G_MSC procedures in 3G_MSC-A (functional unit 1) 74
11.2 Call control procedures 3G_MSC-A (functional unit 2) 74
11.3 Handover/Relocation control procedures 3G_MSC-A (functional unit 3) 76
11.4 MAP procedures in 3G_MSC-A (functional unit 4) 78
11.5 Interworking between Handover/Relocation control procedures and MAP procedures in 3G_MSC-A 79
11.6 Compatibility with GSM Phase 1 79
11.7 Protocol interworking 79

12 Detailed procedures in 3G_MSC-B 79
12.1 RNC/BSC/3G_MSC (UE/MS/RNC/BSC) procedures in 3G_MSC-B (functional unit 1) 79
12.2 Call control procedures 3G_MSC-B (functional unit 2) 79
12.3 Handover/Relocation control procedures in 3G_MSC-B (functional unit 3) 80
12.4 MAP procedures in 3G_MSC-B (functional unit 4) 82
12.5 Interworking between Handover/Relocation control procedures and MAP procedures in 3G_MSC-B 82
12.6 Compatibility with GSM Phase 1 83
12.7 Protocol interworking 83

13 Subsequent channel assignment using a circuit connection between MSC-A and MSC-B 83
13.1 GSM handover 83
13.2 UMTS to GSM handover 85

13.3 GSM to UMTS handover 86
13.4 SRNS Relocation 86

14Directed retry handover 87

15 SDL diagrams 89

Annex A: Change history 135

History 136

~~Foreword ..... 4~~

~~1 Scope ..... 5~~

~~2 References ..... 6~~

~~3 Definitions and abbreviations ..... 9~~

~~4 Role, functional composition of MSCs and interfaces for handover ..... 9~~
~~4.1 MSC A ..... 9~~
~~4.1.1 Role of MSC A ..... 9~~
~~4.1.2 Functional composition of MSC A and its interfaces for handover ..... 10~~
~~4.2 MSC B ..... 10~~
~~4.2.1 Role of MSC B ..... 10~~
~~4.2.2 Functional composition of MSC B and its interfaces for handover ..... 10~~

~~5 Handover initiation conditions ..... 10~~

~~6 General description of the procedures for intra - MSC handovers ..... 10~~
~~6.1 Procedure for Intra MSC Handovers ..... 10~~

~~7 General description of the procedures for inter - MSC handovers ..... 11~~
~~7.1 Basic handover procedure requiring a circuit connection between MSC A and MSC B ..... 11~~
~~7.2 Basic handover procedure not requiring the establishment of a circuit connection between MSC A and MSC B ..... 12~~
~~7.3 Procedure for subsequent handover requiring a circuit connection between MSC A and MSC B ..... 13~~
~~7.3.1 Description of subsequent handover procedure i): MSC B to MSC A ..... 13~~
~~7.3.2 Description of the subsequent handover procedure ii): MSC B to MSC B' ..... 14~~
~~7.4 Procedure for subsequent handover not requiring a circuit connection between MSC A and MSC B ..... 15~~
~~7.4.1 Description of the subsequent handover procedure without circuit connection i): MSC B to MSC A ..... 15~~
~~7.4.2 Description of the subsequent handover procedure without circuit connection ii): MSC B to MSC B' ..... 16~~

~~8 Detailed procedures in MSC A ..... 16~~
~~8.1 BSS/MSC and MS/MSC procedures in MSC A (functional unit 1) ..... 16~~
~~8.2 Call control procedures MSC A (functional unit 2) ..... 16~~
~~8.3 Handover control procedures MSC A (functional unit 3) ..... 16~~
~~8.4 MAP procedures in MSC A (functional unit 4) ..... 16~~
~~8.5 Interworking between Handover control procedures and MAP procedures in MSC A ..... 16~~
~~8.6 Compatibility with GSM Phase 1 ..... 16~~

~~9 Detailed procedures in MSC B ..... 16~~
~~9.1 BSS/MSC (MS/BSS) procedures MSC B (functional unit 1) ..... 16~~
~~9.2 Call control procedures MSC B (functional unit 2) ..... 16~~
~~9.3 Handover control procedures MSC B (functional unit 3) ..... 16~~
~~9.4 MAP procedures MSC B (functional unit 4) ..... 16~~
~~9.5 Interworking between Handover control procedures and MAP procedures in MSC B ..... 16~~
~~9.6 Compatibility with GSM Phase 1 ..... 16~~

10 Subsequent channel assignment using a circuit connection between MSC-A and MSC-B .....
11 Directed retry handover .....
12 SDL diagrams .....
Annex A: Change history .....
History .....

Foreword

This Technical Specification has been produced by the 3GPP.

This TS provides a mechanism giving reliable transfer of signalling messages within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of this TS, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version 3.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 Indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

The present document contains a detailed description of the handover procedures to be used in ~~GSM~~ PLMNs. The purpose of the handover procedures, as described in this specification, are to ensure that the connection to the Mobile Station (MS) or User Equipment (UE) is maintained as it moves from one ~~Base Station System (BSS) area~~cell or radio network to another. The document defines the circuit switched handover functionality based on the service requirements in TS 22.129 [9].

This specification considers the following four~~two~~ cases:

i) Handover between Base Stations connected to the same MSC, this is termed an Intra-MSC handover.

ii) Handover between Radio Network Subsystems connected to the same 3G_MSC, this is termed an Intra-3G_MSC handover/relocation. This case also includes inter-system handover between RNS and BSS if the 3G_MSC supports the A-interface.

iii) Handover between Base Stations connected to different MSCs, this is termed an Inter-MSC handover. This category can be sub-divided into three further procedures:

a) the Basic Inter-MSC Handover procedure, where the MS is handed over from a controlling MSC (MSC-A) to another MSC (MSC-B);

b) the Subsequent Inter-MSC Handover procedure, where the MS is handed over from MSC-B to a third MSC (MSC-B');

c) the Subsequent Inter-MSC handback, where the MS is handed back from MSC-B to MSC-A.

iv) Handover between Radio Network Subsystems connected to different 3G_MSCs, this is termed an Inter-3G_MSC handover/relocation. This category can be divided into three further sub-procedures:

a) the Inter-3G_MSC Handover procedure from UMTS to GSM, where the UE/MS is handed over from a controlling 3G_MSC (3G_MSC-A) to an MSC (MSC-B);

b) the Inter-3G_MSC Handover procedure from GSM to UMTS, where the UE/MS is handed over from a controlling MSC (MSC-A) to a 3G_MSC (3G_MSC-B);

c) the Inter-3G_MSC Relocation procedure, where the UE is relocated from 3G_MSC-A to 3G_MSC-B. This procedure can also be combined with a hard change of radio resources (Hard Handover with switch in the core network).

The MSC in this category can optionally be a 3G_MSC supporting the A-interface. The three sub-procedures do also cover subsequent handover/relocation to a third MSC-B' or 3G_MSC-B' and subsequent handover/relocation back to MSC-A or 3G_MSC-A.

In both cases i) and iii) the same procedures as defined in the GSM 08.08 [5] and the ~~GSM~~ TS 2~~0~~4.0~~0~~8 [10] shall be used on the A-interface and on the Radio Interface, respectively.

In case ii) the same procedures as defined in the TS 25.413 [11] and the TS 24.008 [10] shall be used on the Iu-interface. If the 3G_MSC in case ii) also supports the A-interface, the GSM 08.08 [5] and the TS 24.008 [10] shall be used on the A-interface.

In case iii) the handover procedures shall transport the A-interface messages between MSC-A and MSC-B described in the Mobile Application Part (MAP), ~~GSM~~ TS 2~~0~~9.0~~0~~2 [12]. ~~The split in functionality between the BSS and MSC is described in the GSM 08 series of Technical Specifications.~~

In case iv) the handover procedures shall transport the A-interface messages between 3G_MSC and MSC described in the Mobile Application Part (MAP), TS 29.002 [12].

In case iv) the relocation procedure shall transport the Iu-interface messages as BSSMAP messages between 3G_MSC-A and 3G_MSC-B described in the Mobile Application Part (MAP), TS 29.002 [12].

The interworking between the ~~GSM~~ TS 2~~0~~9.0~~0~~2 [12] protocol and the GSM 08.08 [5] protocol is described in the GSM 09.10 [8] Technical Specification.

Handovers, which take place on the same MSC are termed Intra-MSC handovers; this includes both Inter-BSS and Intra-BSS handovers.

Handovers, which take place on the same 3G_MSC are termed Intra-3G_MSC handovers; this includes Inter-RNS handovers and optionally RNS to BSS and BSS to RNS handovers.

The present document also covers the requirements for handover in ongoing GSM voice group calls, directed retry and the handover without a circuit connection between MSC-A and MSC-B(U)MSCs. The present document does not consider the case of handovers between radio channels on the same BSS (Intra-BSS handover) or the handover of packet radio services. The Inter-RNS handover case that results in a relocation is covered by this document but not other Inter-RNS or Intra-RNS handover cases.

For voice broadcast calls in GSM, the speaker uses normal point-to-point handover procedures, whilst the listeners use idle mode cell reselection procedures, as for the voice group call listeners.

Voice group calls is only applicable to GSM and handover of voice group calls is therefore only possible in GSM.

Inter-MSC hand-over imposes a few limitations on the system. After inter-MSC hand-over:

- call re-establishment is not supported.

The list of GSM 08.08 [5] features supported during and after Inter-MSC handover is given in GSM 09.08 [7].

In the Inter-MSC handover case, the interworking between a Phase 1 BSSMAP protocol possibly used by one MSC and the Phase 2 BSSMAP protocol used in the Phase 2 MAP protocol on the E-interface is performed by this MSC.

NOTE: The message primitive names used in the SDL diagrams and message flows in this technical specification do not represent the actual messages specified in the GSM or 3GPP stage 3 04 and GSM 08 series or the services specified in the GSM 09 series of technical specifications. The primitive names are only intended to be indicative of their use in this document.

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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 04.01: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface; General aspects and principles".

[3] GSM 04.02: "Digital cellular telecommunications system (Phase 2+); GSM Public Land Mobile Network (PLMN) access reference configuration".

[4] GSM 04.03: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface; Channel structures and access capabilities".

[5] GSM 04.04: "Digital cellular telecommunications system (Phase 2+); layer 1; General requirements".

[6] GSM 04.05: "Digital cellular telecommunications system (Phase 2+); Data Link (DL) layer; General aspects".

[7] GSM 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface; Data Link (DL) layer specification".

[8] GSM 04.07: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3; General aspects".

[9] GSM 04.08: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[10] GSM 04.10: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3; Supplementary services specification; General aspects".

[11] GSM 04.11: "Digital cellular telecommunications system (Phase 2+); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[12] GSM 04.12: "Digital cellular telecommunications system (Phase 2+); Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface".

[13] GSM 04.13: "Digital cellular telecommunications system (Phase 2+); Performance requirements on mobile radio interface".

[14] GSM 04.21: "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[15] GSM 04.22: "Digital cellular telecommunications system (Phase 2+); Radio Link Protocol (RLP) for data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[16] GSM 04.80: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 supplementary services specification; Formats and coding".

[17] GSM 04.81: "Digital cellular telecommunications system (Phase 2+); Line identification supplementary services - Stage 3".

[18] GSM 04.82: "Digital cellular telecommunications system (Phase 2+); Call Forwarding (CF) supplementary services - Stage 3".

[19] GSM 04.83: "Digital cellular telecommunications system (Phase 2+); Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 3".

[20] GSM 04.84: "Digital cellular telecommunications system (Phase 2+); MultiParty (MPTY) supplementary services - Stage 3".

[21] GSM 04.85: "Digital cellular telecommunications system (Phase 2+); Closed User Group (CUG) supplementary services - Stage 3".

[22] GSM 04.86: "Digital cellular telecommunications system (Phase 2+); Advice of Charge (AoC) supplementary services - Stage 3".

[23] GSM 04.88: "Digital cellular telecommunications system (Phase 2+); Call Barring (CB) supplementary services - Stage 3".

[24] GSM 04.90: "Digital cellular telecommunications system (Phase 2+); Unstructured Supplementary Service Data (USSD) - Stage 3".

[25] GSM 05.01: "Digital cellular telecommunications system (Phase 2+); Physical layer on the radio path; General description".

[26] GSM 05.02: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[27] GSM 05.03: "Digital cellular telecommunications system (Phase 2+); Channel coding".

[28] GSM 05.04: "Digital cellular telecommunications system (Phase 2+); Modulation".

[29] GSM 05.05: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception".

[30] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[31] GSM 05.10: "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization".

[32] GSM 05.90: "Digital cellular telecommunications system (Phase 2+); GSM Electro Magnetic Compatibility (EMC) considerations".

[33] GSM 08.01: "Digital cellular telecommunications system (Phase 2+); Base Station System - Mobile services Switching Centre (BSS - MSC) interface; General aspects".

[34] GSM 08.02: "Digital cellular telecommunications system (Phase 2+); Base Station System - Mobile services Switching Centre (BSS - MSC) interface; Interface principles".

[35] GSM 08.04: "Digital cellular telecommunications system (Phase 2+); Base Station System - Mobile services Switching Centre (BSS - MSC) interface; Layer 1 specification".

[36] GSM 08.06: "Digital cellular telecommunications system (Phase 2+); Signalling transport mechanism specification for the Base Station System - Mobile services Switching Centre (BSS - MSC) interface".

[37] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[38] GSM 08.20: "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Base Station System - Mobile services Switching Centre (BSS - MSC) interface".

[39] GSM 08.51: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; General aspects".

[40] GSM 08.52: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Interface principles".

[41] GSM 08.54: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 1 structure of physical circuits".

[42] GSM 08.56: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 2 specification".

[43] GSM 08.58: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 3 specification".

[44] GSM 08.60: "Digital cellular telecommunications system (Phase 2+); Inband control of remote transcoders and rate adaptors for Enhanced Full Rate (EFR) and full rate traffic channels."

[45] GSM 08.61: "Digital cellular telecommunications system (Phase 2+); In band control of remote transcoders and rate adaptors for half rate traffic channels"

[46] GSM 09.01: "Digital cellular telecommunications system (Phase 2+); General network interworking scenarios".

[47] GSM 09.02: "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

[48] GSM 09.03: "Digital cellular telecommunications system (Phase 2+); Signalling requirements on interworking between the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN) and the Public Land Mobile Network (PLMN)".

[49] GSM 09.04: "Digital cellular telecommunications system (Phase 2+); Interworking between the Public Land Mobile Network (PLMN) and the Circuit Switched Public Data Network (CSPDN)".

~~[50] GSM 09.05: "Digital cellular telecommunications system (Phase 2 +); Interworking between the Public Land Mobile Network (PLMN) and the Packet Switched Public Data Network (PSPDN) for Packet Assembly/Disassembly facility access (PAD)".~~

~~[51] GSM 09.06: "Digital cellular telecommunications system (Phase 2+); Interworking between a Public Land Mobile Network (PLMN) and a Packet Switched Public Data Network/Integrated Services Digital Network (PSPDN/ISDN) for the support of packet switched data transmission services".~~

~~[52] GSM 09.07: "Digital cellular telecommunications system (Phase 2+); General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".~~

~~[53] GSM 09.08: "Digital cellular telecommunications system (Phase 2+); Application of the Base Station System Application Part (BSSAP) on the E-interface".~~

~~[54] GSM 09.10: "Digital cellular telecommunications system (Phase 2+); Information element mapping between Mobile Station - Base Station System and BSS - Mobile-services Switching Centre (MS - BSS - MSC); Signalling procedures and the Mobile Application Part (MAP)"~~

~~[55] GSM 09.11: "Digital cellular telecommunications system (Phase 2+); Signalling interworking for supplementary services".~~

~~[56] GSM 09.90: "Digital cellular telecommunications system (Phase 2+); Interworking between Phase 1 infrastructure and Phase 2+ Mobile Stations (MS)".~~

[1~~5~~7] ~~CCITT~~ITU-T Recommendation Q.118: "Special release arrangements".

[2] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[3~~5~~8] GSM 03.68: "Digital cellular telecommunications system (Phase 2+); Voice Group Call Service (VGCS) - Stage 2."

[4] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[5] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[6] GSM 08.58: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 3 specification".

[7] GSM 09.08: "Digital cellular telecommunications system (Phase 2+); Application of the Base Station System Application Part (BSSAP) on the E-interface".

[8] 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)".

[9] TS 22.129: "Handover Requirements between UMTS and GSM or other Radio Systems".

[10] TS 24.008: "Mobile radio interface layer 3 specification".

[11] TS 25.413: "UTRAN Iu interface RANAP signalling".

[12] TS 29.002: "Mobile Application Part (MAP) specification".

[13] TS 25.303: “Interlayer procedures in Connected Mode”

[14] TS 25.331: “RRC Protocol Specification”

3 Definitions and abbreviations

For the purpose of this specification, the following definitions and abbreviations apply:

BSS	Base Station System
BTS	Base Transceiver Station
BSC	Base Station Controller
ISC	International Switching Centre
MS	Mobile Station
MSC	A second generation Mobile Services Switching Centre that only supports the A interface
BSS-A	The BSS from which the MS is being handed over
BSS-B	The BSS to which the MS is being handed over
MSC-A	The controlling MSC on which the call was originally established
MSC-B	The MSC to which the MS is handed over in a Basic Handover
MSC-B'	The MSC to which the MS is handed over in a Subsequent Handover
RNC	Radio Network Controller
RNS	Radio Network Subsystem
UE	A User Equipment is a terminal that supports USIM and the UMTS Uu interface
UE/MS	A terminal that supports USIM, SIM, the Uu interface and the Um interface
3G_MSC	A third generation MSC that supports the Iu interface and optionally the A interface
3G_MSC-A	The controlling 3G_MSC on which the call was originally established
3G_MSC-B	The 3G_MSC to which the UE is handed over in a Basic Handover
3G_MSC-B'	The 3G_MSC to which the UE is handed over in a Subsequent Handover
USIM	UMTS Subscriber Identity Module

Other abbreviations used in the GSM specifications are listed in GSM 01.04 [2].

4 Role, functional composition of MSCs and interfaces for handover

4.1 MSC-A

4.1.1 Role of MSC-A

In the Intra-MSC handover case, the MSC-A (simply termed MSC) controls the call, the mobility manmagement and the radio resources before, during and after an Intra-MSC handover. When BSSAP procedures have to be performed, they are initiated and driven by MSC-A.

In the Inter-MSC handover case, MSC-A is the MSC which controls the call and the mobility management of the Mobile during the call, before, during and after a basic or subsequent handover. When BSSAP procedures related to dedicated resources have to be performed towards the MS, they are initiated and driven by MSC-A. The MSC-A - MSC-B interface works as a MSC - BSS interface for a subset of BSSMAP procedures. These BSSMAP procedures, described in GSM 09.08 [7] are only those related to dedicated resources. The DTAP signalling is relayed transparently by MSC-B between MSC-A and the MS.

During a basic handover, MSC-A initiates and controls all the handover procedure, from its initiation (reception of Handover Required from BSS-A on A-interface) until its completion (reception of Handover Complete from MSC-B on E-interface).

During a subsequent handover back to MSC-A, MSC-A acts as a BSS towards MSC-B, which controls the handover procedure until the termination in MSC-A of the handover radio resources allocation (sending of the Handover Request Acknowledge to MSC-B from MSC-A). Then all handover related messages shall terminate at MSC-A (e.g. Handover Detect/Complete from BSS-B, Handover Failure from BSS-A).

During a subsequent handover to a third MSC, MSC-A works towards MSC-B' as described above in the basic handover paragraph and towards MSC-B as described above in subsequent handover paragraph.

In the Inter-System, inter-MSC handover case, MSC-A is the MSC which controls the call and the mobility management of the Mobile during the call, before, during and after a basic or subsequent handover. When BSSAP procedures related to dedicated resources have to be performed towards the MS, they are initiated and driven by MSC-A. The MSC-A - 3G_MSC-B interface works as a MSC - BSS interface for a subset of BSSMAP procedures. These BSSMAP procedures, described in GSM 09.08 [7] are only those related to dedicated resources. The DTAP signalling is relayed transparently by 3G_MSC-B between MSC-A and the MS.

During a basic inter-system handover, MSC-A initiates and controls all the handover procedure, from its initiation (reception of Handover Required from BSS-A on A-interface) until its completion (reception of Handover Complete from 3G_MSC-B on E-interface).

During a subsequent inter-system handover back to MSC-A, MSC-A acts as a BSS towards 3G_MSC-B, which controls the handover procedure until the termination in MSC-A of the handover radio resources allocation (sending of the Handover Request Acknowledge to 3G_MSC-B from MSC-A). Then all handover related messages shall terminate at MSC-A (e.g. Handover Detect/Complete from BSS-B, Handover Failure from BSS-A).

During a subsequent inter-system handover to a third MSC, MSC-A works towards 3G_MSC-B' as described above in the basic inter-system handover paragraph and towards 3G_MSC-B as described above in subsequent inter-system handover paragraph.

4.1.2 Functional composition of MSC-A and its interfaces for handover

In order to simplify the description of the handover procedures the controlling MSC (MSC-A) can be considered to be composed of five functional units, as shown in figure 1.

Signalling functions

1) BSC/MSC (MS/BSC) Procedures MSC-A. This unit is used to control the signalling between the MSC, BSC and MS. Interface A' is the connection to the old BSC and interface A" is the connection to the new BSC, when an Intra-MSC handover takes place. Interface x represents the interworking connection to the Handover Control Procedures MSC-A.

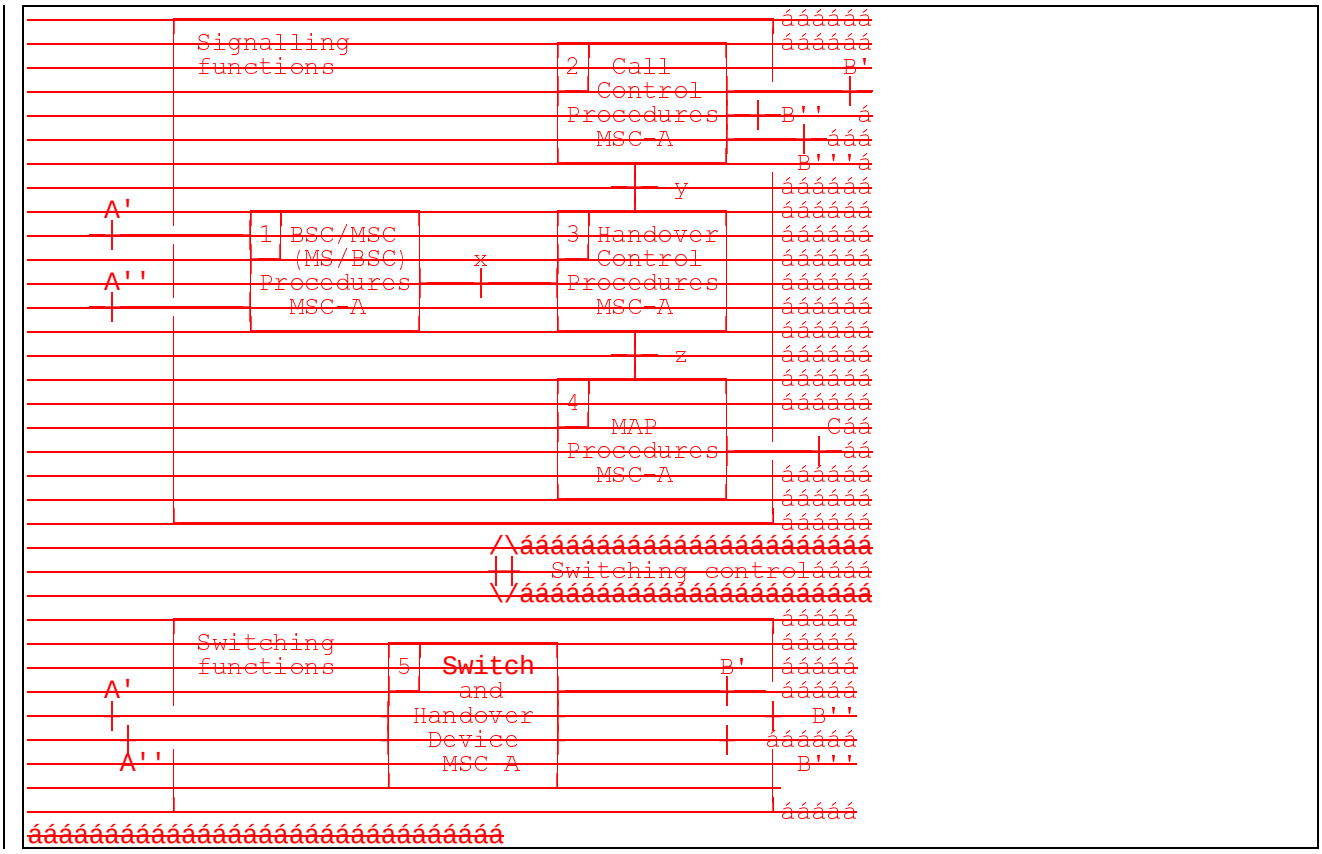
2) Call Control Procedures MSC-A. This unit is used to control the call. Interface B' is used for normal call control procedures. When a Basic handover from MSC-A to MSC-B is to be performed then interface B" is employed to provide a signalling and call control connection to MSC-B. If a Subsequent handover to MSC-B' is to be performed then interface B"' is used. Similarly, when a Basic inter-system handover from MSC-A to 3G_MSC-B is to be performed, then interface B" is employed to provide a signalling and call control connection to 3G_MSC-B. If a subsequent inter-system handover to 3G_MSC-B' is to be performed, then interface B"' is used.

3) Handover Control Procedures MSC-A. This unit provides both the overall control of the handover procedure and interworking between the internal interfaces (x, y and z).

4) MAP Procedures MSC-A. This unit is responsible for controlling the exchange of MAP messages between MSCs during an Inter-MSC handover, or between MSC-A and 3G_MSC-B during an Inter-system Inter-MSC handover. This unit communicates with the Handover Control Procedures MSC-A via interface z.

Switching functions

5) Switch and Handover Device MSC-A. For all calls, except for ongoing voice group calls (see GSM 03.68 [3] for a definition) this unit is responsible for connecting the new path into the network via interface B'. In the case of ongoing voice group calls this unit is responsible for maintaining the connection between the down link group call channels and the active uplink. In specific cases it may be unnecessary to take any explicit action in the MSC concerning the handover device. The handover device interconnections are illustrated in figure 2.



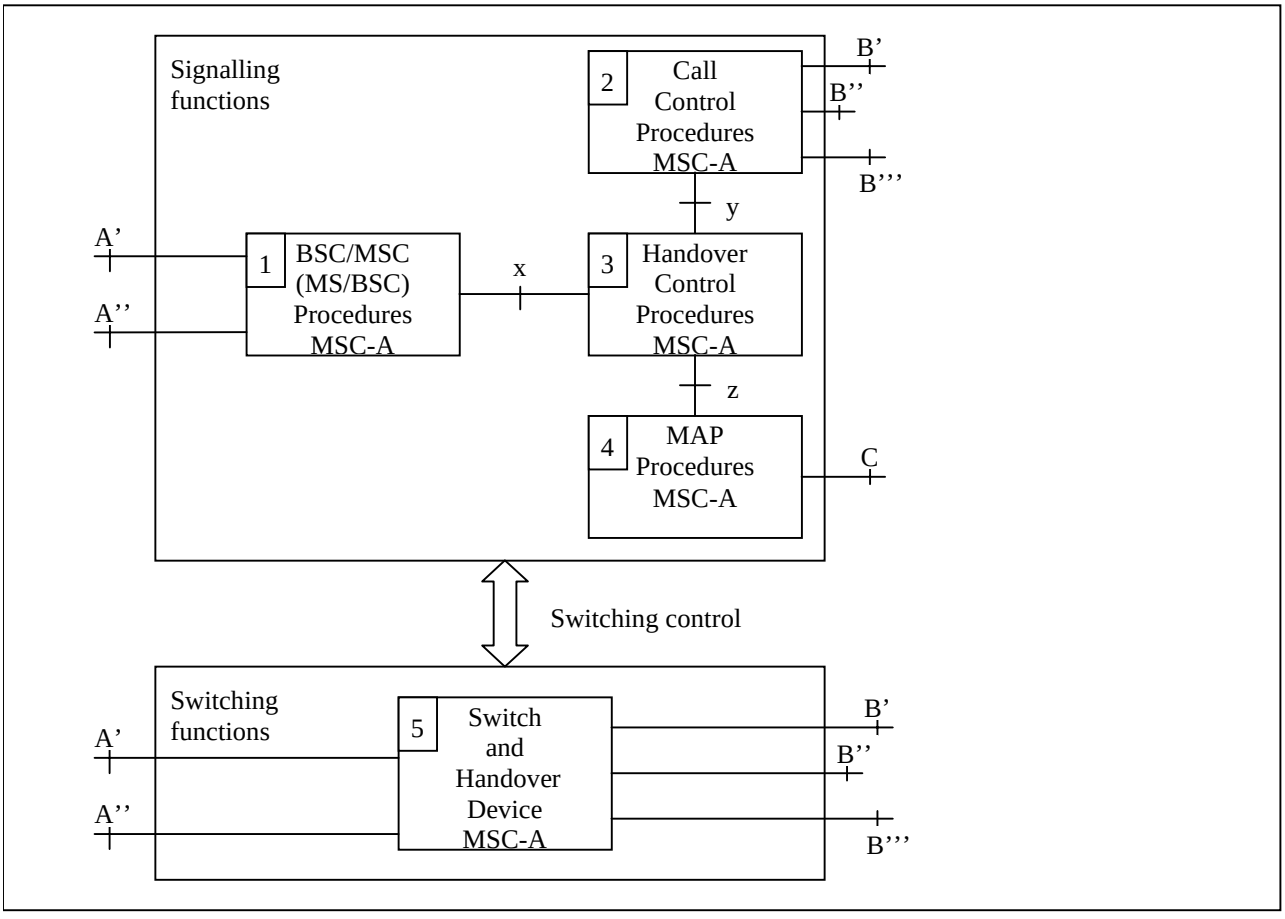


Figure 1: Functional composition of the controlling MSC (MSC-A) for supporting handover

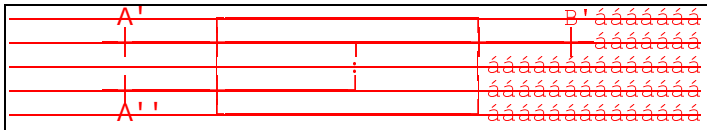
For MS to MS calls in the same MSC the configuration in Figure 2b) applies. In this case interface B" is internal to MSC-A and does not connect to another MSC.

The handover device can either be a three-party bridge or a switching facility without three-party connection capabilities. For a three-party bridge configuration the states of the handover device are as shown in table 1. The three-party configuration exists in the intermediate state. This type of handover device may reduce the interruption time. However, this may require noise reduction if one of the radio channels is unterminated at some time in the intermediate state.

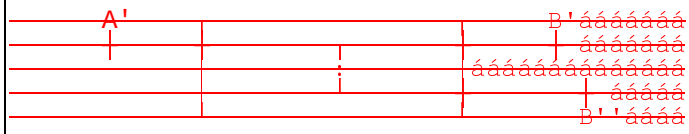
For a handover device consisting of a simple switch there will be no intermediate state.

Table 1: States of the handover device

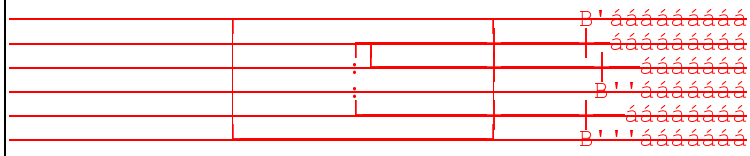
Case	Initial Connection	Intermediate Connection	Resulting Connection	
			Successful Procedure	Unsuccessful Procedure
Fig 2a)	B' to A'	B' to A' and A''	B' to A''	B' to A'
Fig 2b)	B' to A'	B' to A' and B''	B' to B''	B' to A'
Fig 2c)	B' to B''	B' to B''and B'''	B' to B'''	B' to B''



a) Intra-MSC Handover case.

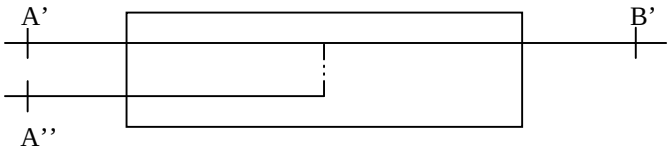


b) Basic Handover case and handover of MS to MS call in the same MSC.

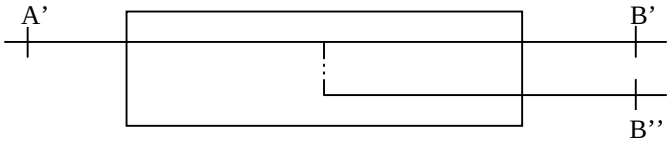


c) Subsequent Handover case

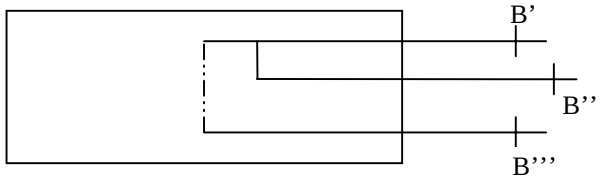
NOTE : In a) and b) A' is released after handover;
In c) B'' is released after handover.



a) Intra-MSC Handover case.



b) Basic Handover case and handover of MS to MS call in the same MSC.



c) Subsequent Handover case

NOTE: In a) and b) A' is released after handover;
In c) B'' is released after handover.

Figure 2: Connections in the handover device (Unit 5)

4.2 MSC-B

4.2.1 Role of MSC-B

In the Intra-MSC handover case, the MSC-B keeps the control of the whole Intra-MSC handover procedure. MSC-A, or 3G MSC-A in the case of a previous inter-system handover, is only notified on the successful completion of the Intra-MSC handover procedure.

In the Inter-MSC handover case, the role of MSC-B (MSC-B') is only to provide radio resources control within its area. This means that MSC-B keeps control of the radio resources connection and release towards BSS-B. MSC-B will do some processing on the BSSMAP information received on the E-interface or A-interface whereas it will relay the DTAP information transparently between A-interface and E-interface. MSC-A initiates and drives a subset of BSSMAP procedures towards MSC-B, while MSC-B controls them towards its BSSs to the extent that MSC-B is responsible for the connections of its BSSs. The release of the dedicated resources between MSC-B and BSS-B is under the ~~responsability~~responsibility of MSC-B and BSS-B, and is not directly controlled by MSC-A. When clearing is to be performed due to information received from BSS-B, MSC-B shall transfer this clearing indication to MSC-A, to clear its connection with BSS-B, to terminate the dialogue with MSC-A through the E-interface, and to release its circuit connection with MSC-A, if any. In the same way, the release of the connection to its BSS-B, is initiated by MSC-B, when the dialogue with MSC-A ends ~~normaly~~normally and a release is received from the circuit connection with MSC-A, if any, or when the dialogue with the MSC-A ends ~~abnormaly~~abnormally.

When a release is received by MSC-B for the circuit connection with MSC-A then MSC-B shall release the circuit connection.

In the Inter-system Inter-MSC handover case, the role of MSC-B (MSC-B') is only to provide radio resources control within its area. This means that MSC-B keeps control of the radio resources connection and release towards BSS-B. MSC-B will do some processing on the BSSMAP information received on the E-interface or A-interface whereas it will relay the DTAP information transparently between A-interface and E-interface. 3G MSC-A initiates and drives a subset of BSSMAP procedures towards MSC-B, while MSC-B controls them towards its BSSs to the extent that MSC-B is

responsible for the connections of its BSSs. The release of the dedicated resources between MSC-B and BSS-B is under the responsibility of MSC-B and BSS-B, and is not directly controlled by 3G_MSC-A. When clearing is to be performed due to information received from BSS-B, MSC-B shall transfer this clearing indication to 3G_MSC-A, to clear its connection with BSS-B, to terminate the dialogue with 3G_MSC-A through the E-interface, and to release its circuit connection with 3G_MSC-A, if any. In the same way, the release of the connection to its BSS-B, is initiated by MSC-B, when the dialogue with 3G_MSC-A ends normally and a release is received from the circuit connection with MSC-A, if any, or when the dialogue with the MSC-A ends abnormally.

When a release is received by MSC-B for the circuit connection with 3G_MSC-A then MSC-B shall release the circuit connection.

4.2.2 Functional composition of MSC-B and its interfaces for handover

The functional composition of an MSC acting as MSC-B is essentially the same as that of MSC-A. However, there are some differences. The functional units are as follows (see figure 3):

Signalling functions

1) BSC/MSC (MS/BSC) Procedures MSC-B. This unit is used to control the signalling between the MSC, BSC and MS. Interface A" is the connection to the new BSC, when an Intra-MSC handover takes place. Interface x represents the interworking connection to the Handover Control Procedures MSC-B.

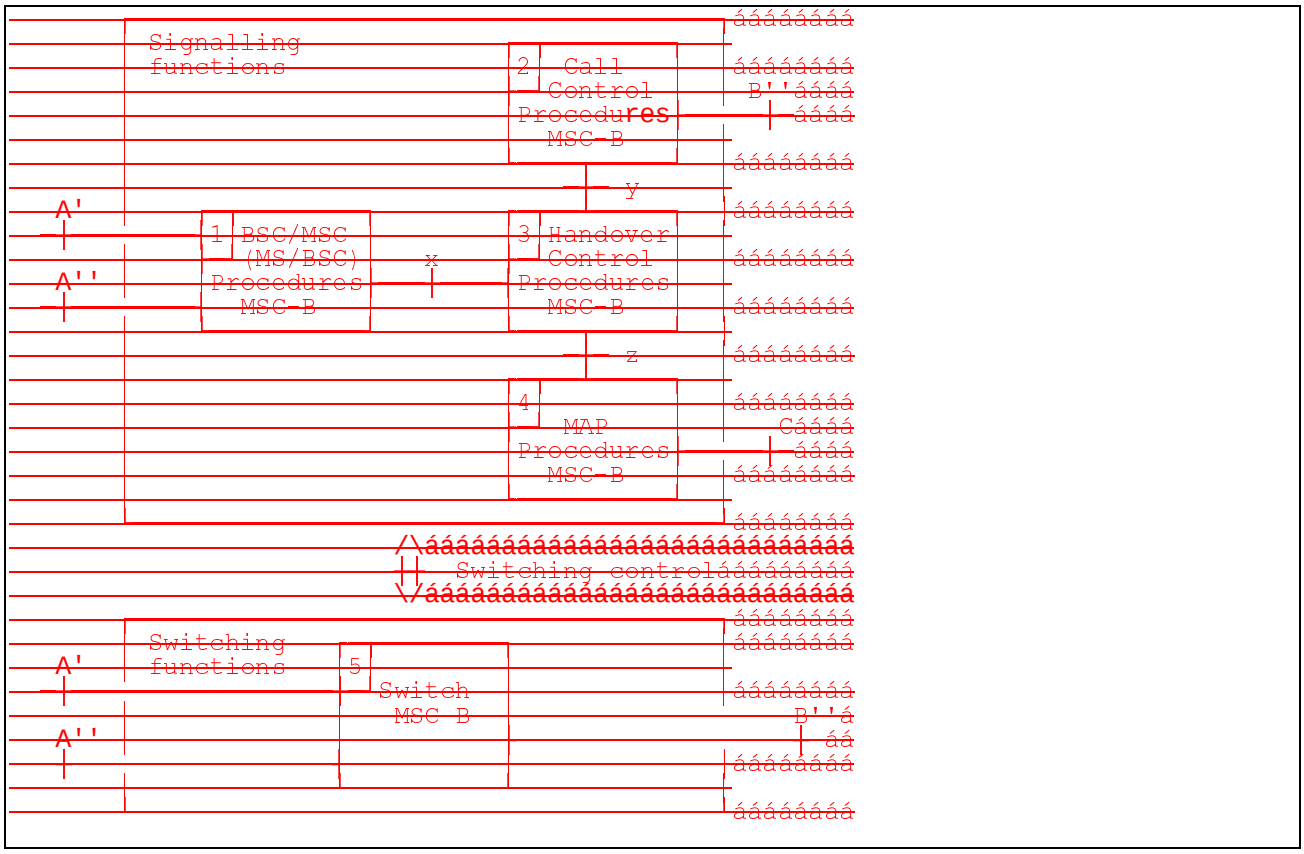
2) Call Control Procedures MSC-B. This unit is used for normal call control and signalling to MSC-A, or 3G_MSC-A in the case of inter-system inter-MSC handover.

3) Handover Control Procedures MSC-B. This unit provides both the overall control of the handover procedure and interworking between the internal interfaces (x, y and z) in MSC-B.

4) MAP Procedures MSC-B. This unit is responsible for controlling the exchange of MAP messages between MSC-A, or 3G_MSC-A, and MSC-B and for signalling to the VLR in MSC-B.

Switching functions

5) Switch MSC-B. For all calls, except ongoing voice group calls (see GSM 03.68 [3] for a definition) this unit is responsible, with BSS-B, for connecting the circuit from MSC-A, or 3G_MSC-A, to BSS-B. This unit may also need to act as a handover device for Intra-MSC handovers controlled by MSC-B. In the case of ongoing voice group calls this unit is responsible for maintaining the connection between the group member currently assigned the uplink and the distribution device. In specific cases it may be unnecessary to take any explicit action in the MSC concerning the handover device.



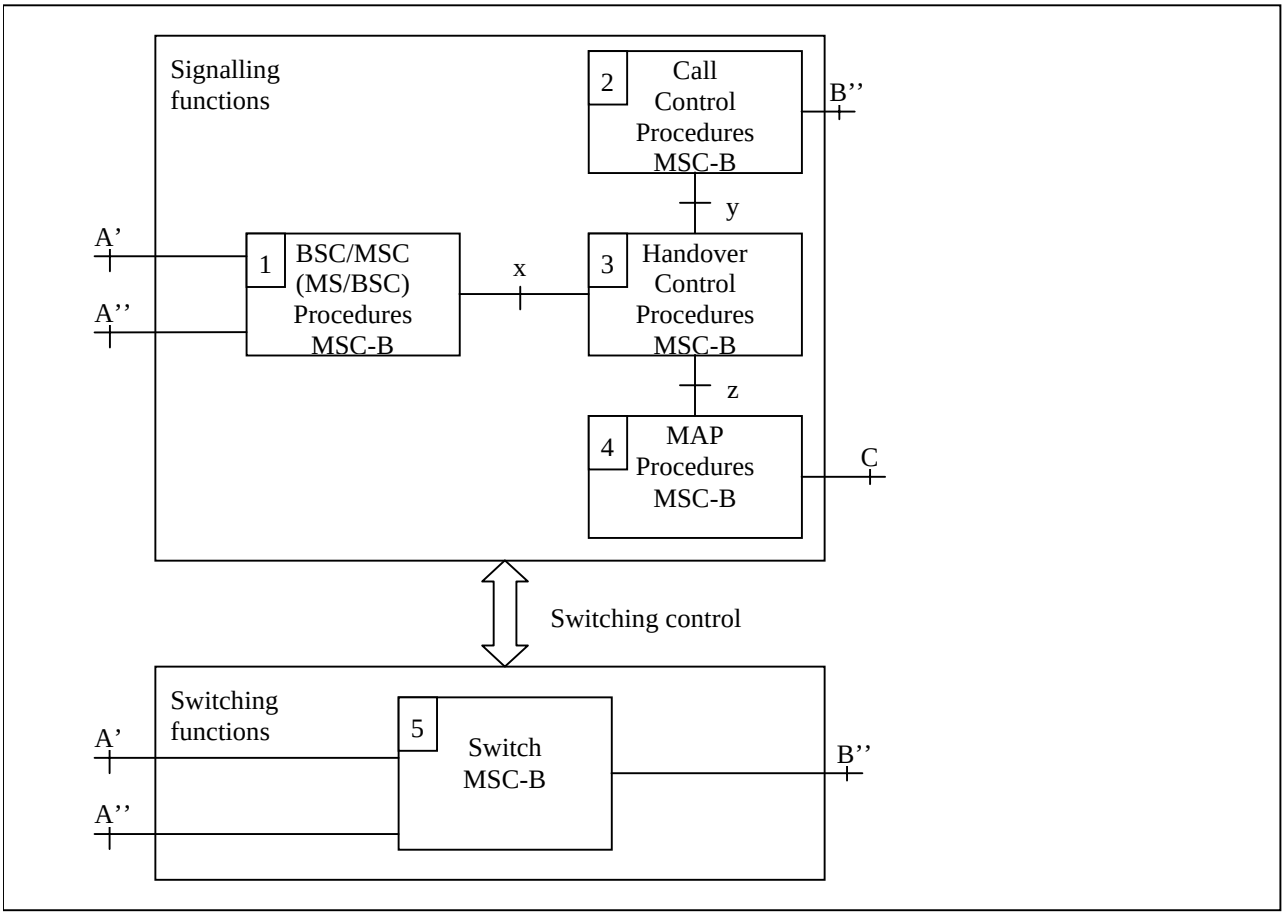


Figure 3: Functional composition of MSC-B for supporting handover

4.3 3G_MSC-A

For roles and functional composition of the 3G_MSC-A working as pure GSM MSC, please see previous chapter ("MSC-A").

4.3.1 Role of 3G_MSC-A

In the Intra-3G_MSC handover/relocation case, the 3G_MSC-A (simply termed 3G_MSC) controls the call, the mobility management and the radio resources before, during and after an Intra-3G_MSC handover/relocation. When RANAP procedures have to be performed, they are initiated and driven by 3G_MSC-A.

In the Inter-3G_MSC handover/relocation case, 3G_MSC-A is the 3G_MSC that controls the call and the mobility management of the UE/MS during the call, before, during and after a basic or subsequent handover/relocation. When RANAP procedures related to dedicated resources have to be performed towards the UE/MS, they are initiated and driven by 3G_MSC-A. The 3G_MSC-A - 3G_MSC-B interface works as a 3G_MSC - BSS interface for the RANAP procedures, sent as BSSMAP procedures. The Direct Transfer signalling is relayed transparently by 3G_MSC-B between 3G_MSC-A and the UE/MS.

During a basic handover/relocation, 3G_MSC-A initiates and controls all the handover/relocation procedure, from its initiation (reception of Relocation Required from RNS-A on Iu-interface) until its completion (reception of Relocation Complete from 3G_MSC-B on E-interface).

During a subsequent handover/relocation back to 3G_MSC-A, 3G_MSC-A acts as an RNS towards 3G_MSC-B, which controls the handover/relocation procedure until the termination in 3G_MSC-A of the handover radio resources allocation (sending of the Relocation Request Acknowledge to 3G_MSC-B from 3G_MSC-A). Then all handover/relocation related messages shall terminate at 3G_MSC-A (e.g. Relocation Detect/Complete from RNS-B, Relocation Failure from RNS-A).

During a subsequent handover/relocation to a third 3G_MSC, 3G_MSC-A works towards 3G_MSC-B' as described above in the basic handover/relocation paragraph and towards 3G_MSC-B as described above in subsequent handover/relocation paragraph.

In the Inter-System, inter-3G_MSC handover case, 3G_MSC-A is the 3G_MSC which controls the call and the mobility management of the UE/MS during the call, before, during and after a basic or subsequent inter-system handover. When BSSAP procedures related to dedicated resources have to be performed towards the UE/MS, they are initiated and driven by 3G_MSC-A. The 3G_MSC-A – MSC-B interface works as a 3G_MSC – BSS interface for a subset of BSSMAP procedures. These BSSMAP procedures described in GSM 09-08 are those related to dedicated resources. The DTAP signalling is relayed transparently by MSC-B between 3G_MSC-A and the UE/MS.

During a basic inter-system handover, 3G_MSC-A initiates and controls all the handover procedure, from its initiation (reception of Relocation Required from RNS-A on Iu-interface) until its completion (reception of Handover Complete from MSC-B on E-interface).

During a subsequent inter-system handover back to 3G_MSC-A, 3G_MSC-A acts as a BSS towards MSC-B, which controls the handover procedure until the termination in 3G_MSC-A of the handover radio resources allocation (sending of the Handover Request Acknowledge to MSC-B from 3G_MSC-A). Then all handover related messages shall terminate at 3G_MSC-A (e.g. Handover Detect/Complete from BSS-B, Relocation Failure from RNS-A).

During a subsequent inter-system handover to a third 3G_MSC, 3G_MSC-A works towards MSC-B' as described above in the basic inter-system handover paragraph and towards 3G_MSC-B as described above in subsequent inter-system handover paragraph.

4.3.2 Functional composition of 3G_MSC-A and its interfaces for handover/relocation

In order to simplify the description of the handover/relocation procedures the controlling 3G_MSC (3G_MSC-A) can be considered to be composed of five functional units, as shown in figure 4.

Signalling functions

1) RNC/BSC/3G_MSC (UE/MS/RNC/BSC) Procedures 3G_MSC-A. This unit is used to control the signalling between the 3G_MSC, RNC or BSC and UE/MS. Interface Iu' is the connection to the old RNC and interface Iu" is the connection to the new RNC, when an Intra-3G_MSC handover takes place. Interface Iu' is the connection to the old RNC and interface A" is the connection to the new BSC, when an Intra-3G_MSC UMTS to GSM handover takes place. Interface A' is the connection to the old BSC and interface Iu" is the connection to the new RNC, when an Intra-3G_MSC GSM to UMTS handover takes place. Interface x represents the interworking connection to the Handover/Relocation Control Procedures 3G_MSC-A.

2) Call Control Procedures 3G_MSC-A. This unit is used to control the call. Interface B' is used for normal call control procedures. When a Basic handover/relocation from 3G_MSC-A to 3G_MSC-B is to be performed then interface B" is employed to provide a signalling and call control connection to 3G_MSC-B. If a Subsequent handover/relocation to 3G_MSC-B' is to be performed then interface B"' is used. Similarly, when a Basic inter-system handover from 3G_MSC-A to MSC-B is to be performed, then interface B" is employed to provide a signalling and call control connection to MSC-B. If a Subsequent inter-system handover to 3G_MSC-B' is to be performed then interface B"' is used.

3) Handover/Relocation Control Procedures 3G_MSC-A. This unit provides both the overall control of the handover/relocation procedure and interworking between the internal interfaces (x, y and z).

4) MAP Procedures 3G_MSC-A. This unit is responsible for controlling the exchange of MAP messages between 3G_MSCs during an Inter-3G_MSC handover/relocation, or between 3G_MSC-A and MSC-B during an Inter-system Inter-3G_MSC handover. This unit communicates with the Handover/Relocation Control Procedures 3G_MSC-A via interface z.

Switching functions

5) Switch and Handover/Relocation Device 3G_MSC-A. For all calls this unit is responsible for connecting the new path into the network via interface B'. In specific cases it may be unnecessary to take any explicit action in the 3G_MSC concerning the handover/relocation device. The handover/relocation device interconnections are illustrated in figure 5.

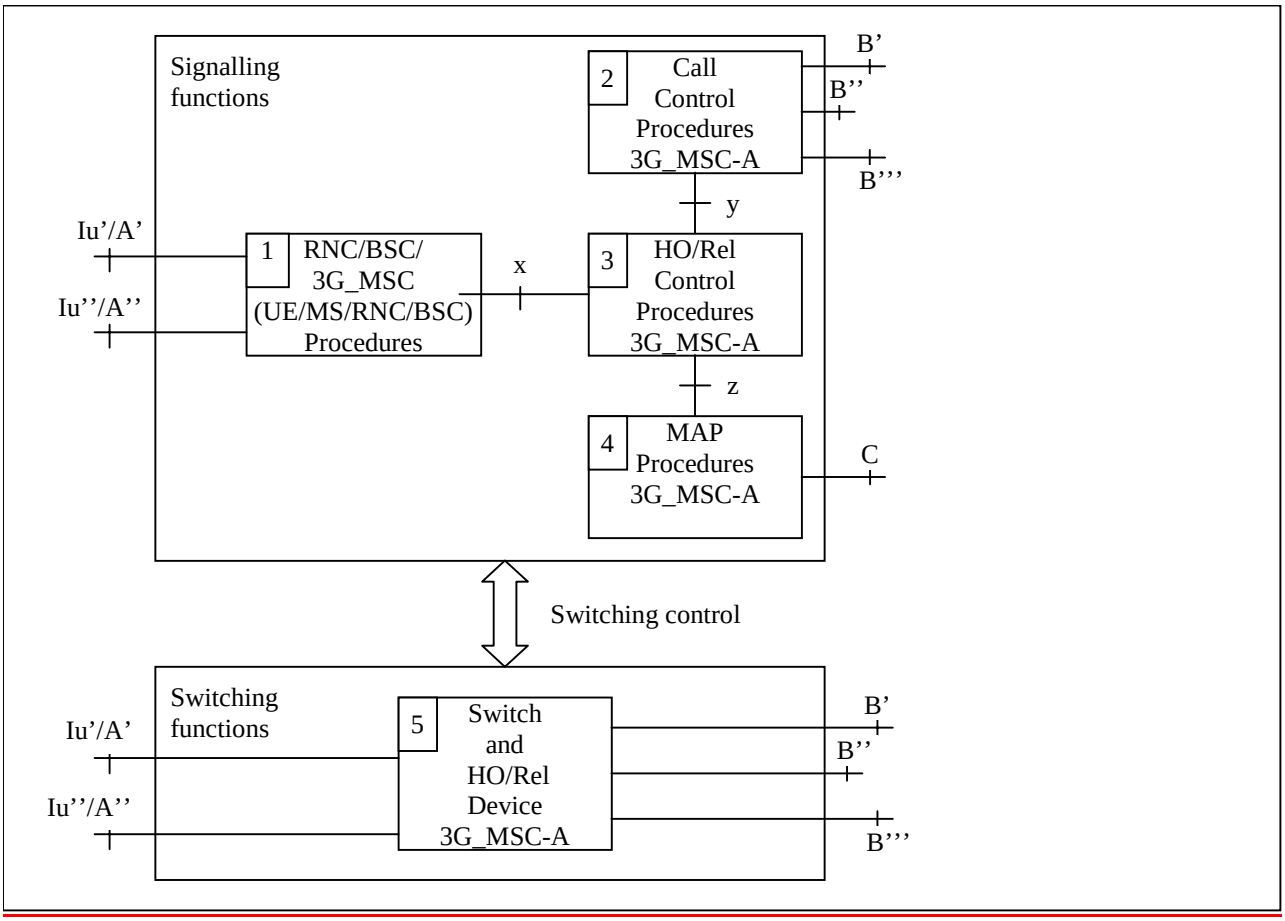


Figure 4: Functional composition of the controlling 3G_MSC (3G_MSC-A) for supporting handover/relocation

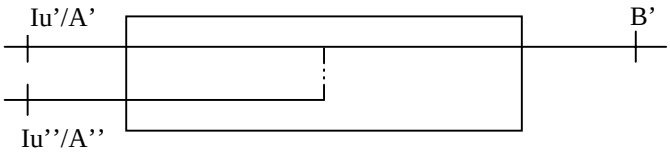
For UE/MS to UE/MS calls in the same 3G_MSC the configuration in Figure 5b) applies. In this case interface B" is internal to 3G_MSC-A and does not connect to another 3G_MSC.

The handover/relocation device can be either a three-party bridge or a switching facility without three-party connection capabilities. For a three-party bridge configuration the states of the handover/relocation device are as shown in table 2. The three-party configuration exists in the intermediate state. This type of handover/relocation device may reduce the interruption time. However, this may require noise reduction if one of the radio channels is unterminated at some time in the intermediate state.

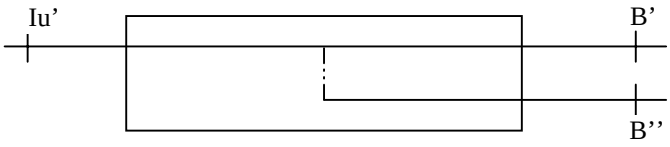
For a handover/relocation device consisting of a simple switch there will be no intermediate state.

Table 2: States of the handover/relocation device

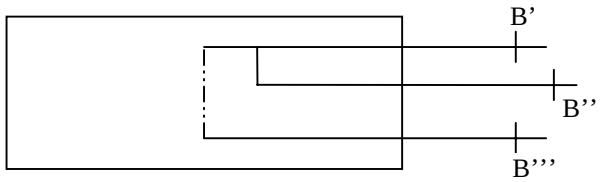
Case	Initial Connection	Intermediate Connection	Resulting Connection	
			Successful Procedure	Unsuccessful Procedure
Fig ya)	B' to Iu'	B' to Iu' and Iu''	B' to Iu''	B' to Iu'
	B' to Iu'	B' to Iu' and A''	B' to A''	B' to Iu'
	B' to A'	B' to A' and Iu''	B' to Iu''	B' to A'
Fig yb)	B' to Iu'	B' to Iu' and B''	B' to B''	B' to Iu'
Fig yc)	B' to B''	B' to B''and B'''	B' to B'''	B' to B''



a) Intra-3G_MSC Handover/Relocation case.



b) Basic Handover/Relocation case and handover/relocation of UE/MS to UE/MS call in the same 3G_MSC.



c) Subsequent Handover/Relocation case

NOTE: In a) and b) Iu' is released after handover/relocation;
In c) B'' is released after handover/relocation.

Figure 5: Connections in the handover/relocation device (Unit 5)

4.4 3G_MSC-B

For roles and functional composition of the 3G_MSC-B working as pure GSM MSC, please see previous chapter ("MSC-B").

4.4.1 Role of 3G_MSC-B

In the Intra-3G_MSC handover/relocation case, the 3G_MSC-B keeps the control of the whole Intra-3G_MSC handover/relocation procedure.

In the Inter-3G_MSC handover/relocation case, the role of 3G_MSC-B (3G_MSC-B') is only to provide radio resources control within its area. This means that 3G_MSC-B keeps control of the radio resources connection and release towards RNS-B. 3G_MSC-B will do some processing on the BSSMAP information received on the E-interface or the RANAP information received on the Iu-interface whereas it will relay the Direct Transfer information transparently between

Iu-interface and E-interface. 3G_MSC-A initiates and drives RANAP procedures as BSSMAP procedures towards 3G_MSC-B, while 3G_MSC-B controls them towards its RNSs to the extent that 3G_MSC-B is responsible for the connections of its RNSs. The release of the dedicated resources between 3G_MSC-B and RNS-B is under the responsibility of 3G_MSC-B and RNS-B, and is not directly controlled by 3G_MSC-A. When clearing is to be performed due to information received from RNS-B, 3G_MSC-B shall transfer this clearing indication to 3G_MSC-A, to clear its connection with RNS-B, to terminate the dialogue with 3G_MSC-A through the E-interface, and to release its circuit connection with 3G_MSC-A, if any. In the same way, the release of the connection to its RNS-B, is initiated by 3G_MSC-B, when the dialogue with 3G_MSC-A ends normally and a release is received from the circuit connection with 3G_MSC-A, if any, or when the dialogue with the 3G_MSC-A ends abnormally.

When a release is received by 3G_MSC-B for the circuit connection with 3G_MSC-A then 3G_MSC-B shall release the circuit connection.

In the Inter-system Inter-3G_MSC handover case, the role of 3G_MSC-B (3G_MSC-B') is only to provide radio resources control within its area. This means that 3G_MSC-B keeps control of the radio resources connection and release towards RNS-B. 3G_MSC-B will do some processing on the BSSMAP information received on the E-interface or the RANAP information received on the Iu-interface whereas it will relay the Direct Transfer information transparently between Iu-interface and E-interface. MSC-A initiates and drives a subset of BSSMAP procedures towards 3G_MSC-B, while 3G_MSC-B controls them towards its RNSs to the extent that 3G_MSC-B is responsible for the connections of its RNSs. The release of the dedicated resources between 3G_MSC-B and RNS-B is under the responsibility of 3G_MSC-B and RNS-B, and is not directly controlled by MSC-A. When clearing is to be performed due to information received from RNS-B, 3G_MSC-B shall transfer this clearing indication to MSC-A, to clear its connection with RNS-B, to terminate the dialogue with MSC-A through the E-interface, and to release its circuit connection with MSC-A, if any. In the same way, the release of the connection to its RNS-B, is initiated by 3G_MSC-B, when the dialogue with MSC-A ends normally and a release is received from the circuit connection with MSC-A, if any, or when the dialogue with the MSC-A ends abnormally.

When a release is received by 3G_MSC-B for the circuit connection with MSC-A then 3G_MSC-B shall release the circuit connection.

4.4.2 Functional composition of 3G_MSC-B and its interfaces for handover/relocation

The functional composition of a 3G_MSC acting as 3G_MSC-B is essentially the same as that of 3G_MSC-A. However, there are some differences. The functional units are as follows (see figure 6):

Signalling functions

1) RNC/BSC/3G_MSC (UE/MS/RNC/BSC) Procedures 3G_MSC-B. This unit is used to control the signalling between the 3G_MSC, RNC, BSC and UE/MS. Interface Iu" is the connection to the new RNC, when an Intra-3G_MSC handover/relocation takes place. Interface Iu' is the connection to the old RNC and interface A" is the connection to the new BSC, when an Intra-3G_MSC UMTS to GSM handover takes place. Interface A' is the connection to the old BSC and interface Iu" is the connection to the new RNC, when an Intra-3G_MSC GSM to UMTS handover takes place. Interface x represents the interworking connection to the Handover/Relocation Control Procedures 3G_MSC-B.

2) Call Control Procedures 3G_MSC-B. This unit is used for normal call control and signalling to 3G_MSC-A or MSC-A in the case of inter-system inter-3G_MSC handover.

3) Handover/Relocation Control Procedures 3G_MSC-B. This unit provides both the overall control of the handover/relocation procedure and interworking between the internal interfaces (x, y and z) in 3G_MSC-B.

4) MAP Procedures 3G_MSC-B. This unit is responsible for controlling the exchange of MAP messages between 3G_MSC-A, or MSC-A, and 3G_MSC-B and for signalling to the VLR in 3G_MSC-B.

Switching functions

5) Switch 3G_MSC-B. For all calls this unit is responsible, with RNS-B, for connecting the circuit from 3G_MSC-A, or MSC-A, to RNS-B. This unit may also need to act as a handover/relocation device for Intra-3G_MSC handovers/relocation controlled by 3G_MSC-B. In specific cases it may be unnecessary to take any explicit action in the 3G_MSC concerning the handover/relocation device.

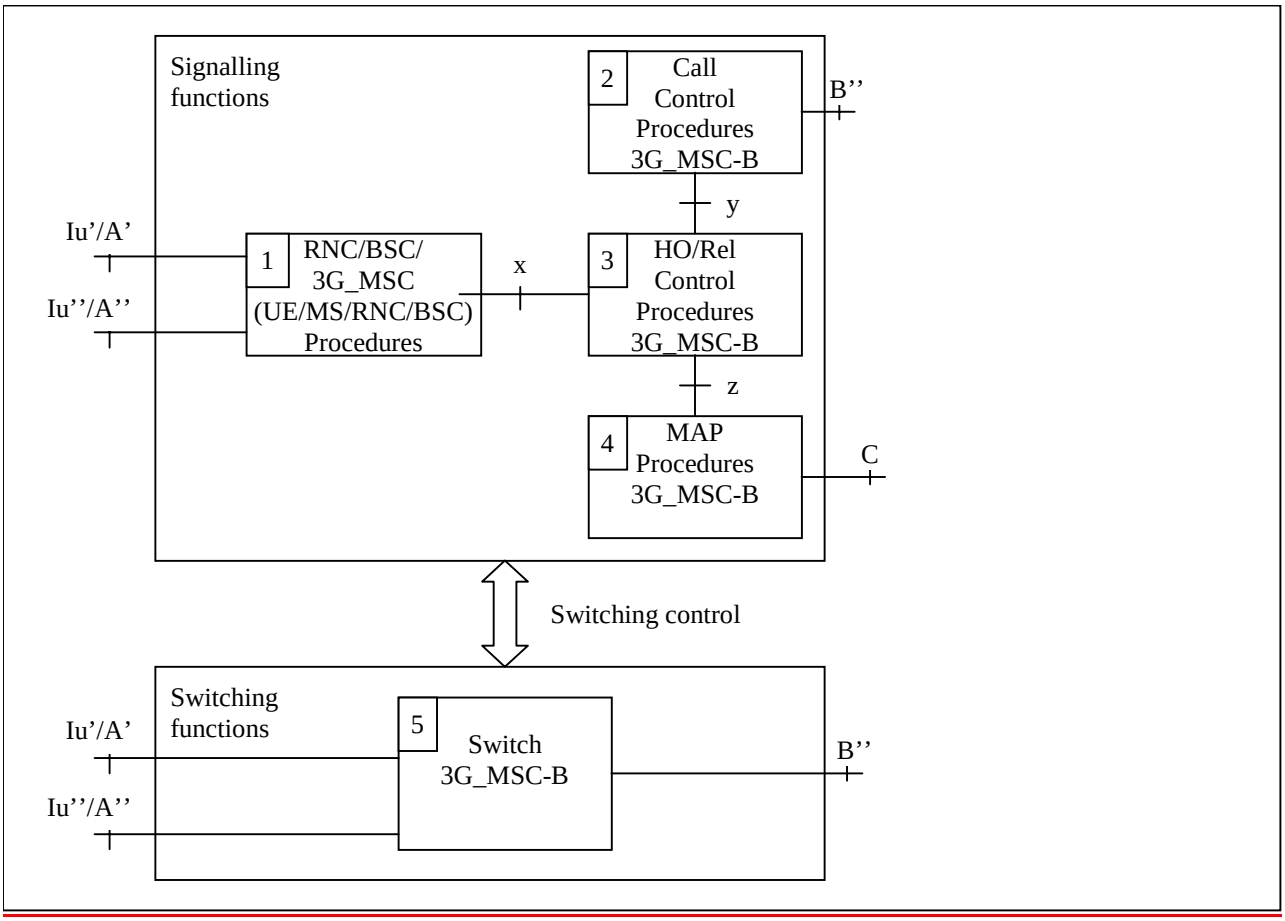


Figure 6: Functional composition of 3G_MSC-B for supporting handover/relocation

5 Handover initiation conditions

Handover may be ~~is~~ initiated by the network based on RF ~~radio subsystem~~ criteria as measured by the MS or the Network (signal level~~RF level~~, Connection quality, power level propagation delay ~~distance~~) as well as ~~network directed~~ traffic criteria (e.g. current traffic loading per cell, interference levels, maintenance requests, etc.).

In order to determine if a handover is required, due to RF criteria, it is typically the MS that shall take radio measurements from neighbouring cells. These measurements are reported to the serving cell on an event driven or regular basis. When a network determines a need for executing a handover the procedures given in GSM 08.08 [5] TS 25.303 [13]~~(stage 2)~~, TS 25.331 [14]~~(stage 3)~~ are followed.

~~Additionally, the handover decision by the network may take into account both the measurement results from the MS and network directed criteria~~.

The ~~same~~ decision process ~~is~~ used to determine when to perform soft handover or hard handover will typically differ. Depending on the support for soft or hard handover ~~both~~ the Intra-MSC and Inter-MSC handover ~~in all the procedures described in this document~~ may differ.

In the case of an ongoing GSM voice group call (see GSM 03.68 [3]) the criteria described above shall only apply to the mobile station currently assigned the uplink and other users with a dedicated connection, no actions shall be taken for the listening users.

6 General description of the procedures for intra - MSC handovers

This section gives a brief overview of the procedures that shall be followed when performing Intra-MSC handovers. Detailed explanation of these procedures can be found in GSM 08.08 [5] and ~~GSM 04.~~TS 24.008 [10].

There are two types of handover that can be considered which involve a BSS and single MSC. These are Internal Handover and External Handover. An Internal Handover is a handover which takes place between channels on a cell or cells controlled by a single BSS, without reference to the MSC, although the MSC maybe informed of its occurrence. This case is not considered in this Technical Specification.

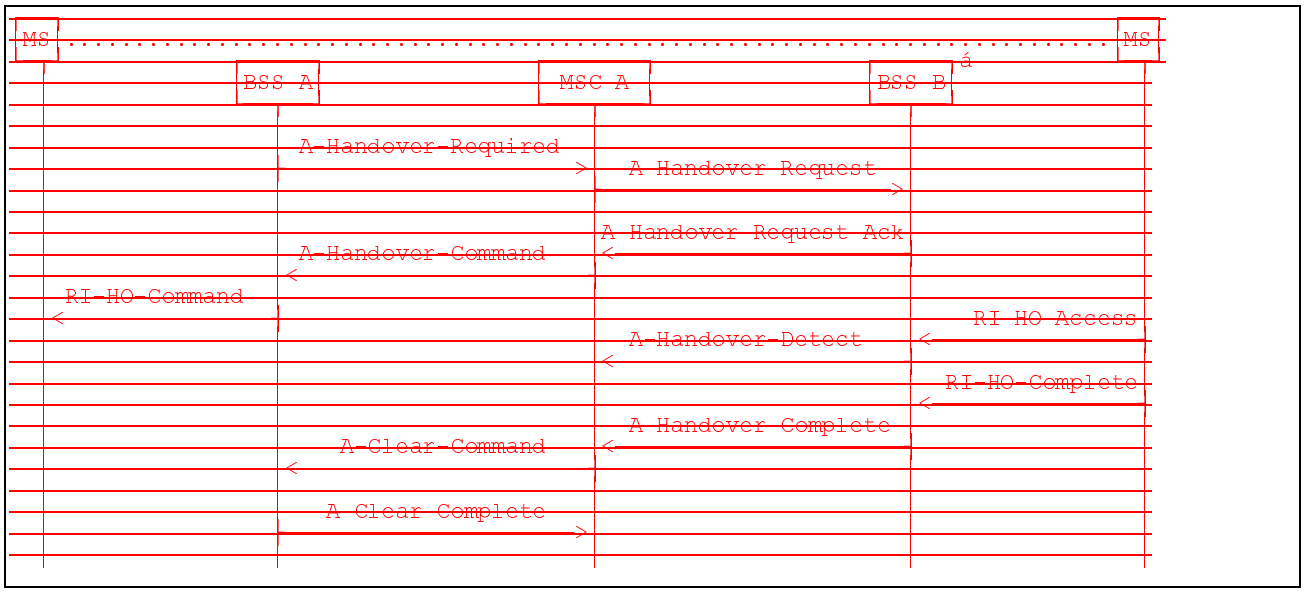
Handovers between channels on the same cell or between cells on the same BSS which are controlled by the MSC are termed External Handovers and use identical procedures to those for Intra-MSC handovers. Only the Intra-MSC handover case will be considered in this Technical Specification.

Handovers from a BSS to an RNS controlled by the same 3G_MSC are intra-3G_MSC GSM to UMTS handovers.
Handovers from an RNS to a BSS controlled by the same 3G_MSC are intra-3G_MSC UMTS to GSM handovers.

There are two types of handover in UMTS: soft handover and hard handover. The first one is fully performed within UTRAN, without involving the core network. The second one may be also performed within UTRAN, or the core network may be involved if the Iur interface between RNSs does not exist. This case of hard handover involving the core network is the only one that is covered in this TS, together with SRNS relocation with Iur interface

6.1 Procedure for Intra-MSC Handovers

The procedure for a successful External Intra-MSC handover is shown in figure 7~~4~~. It is assumed that selection of a candidate MS has already taken place within the BSS based upon the criteria presented in section 5. The exact algorithm, in the BSS, for determining a candidate MS is not addressed in this Technical Specification. The procedures discussed do not make use of the Mobile Application Part (MAP), represented by signalling function 4 in figures 2 and 3. The procedure described in this section covers case i).



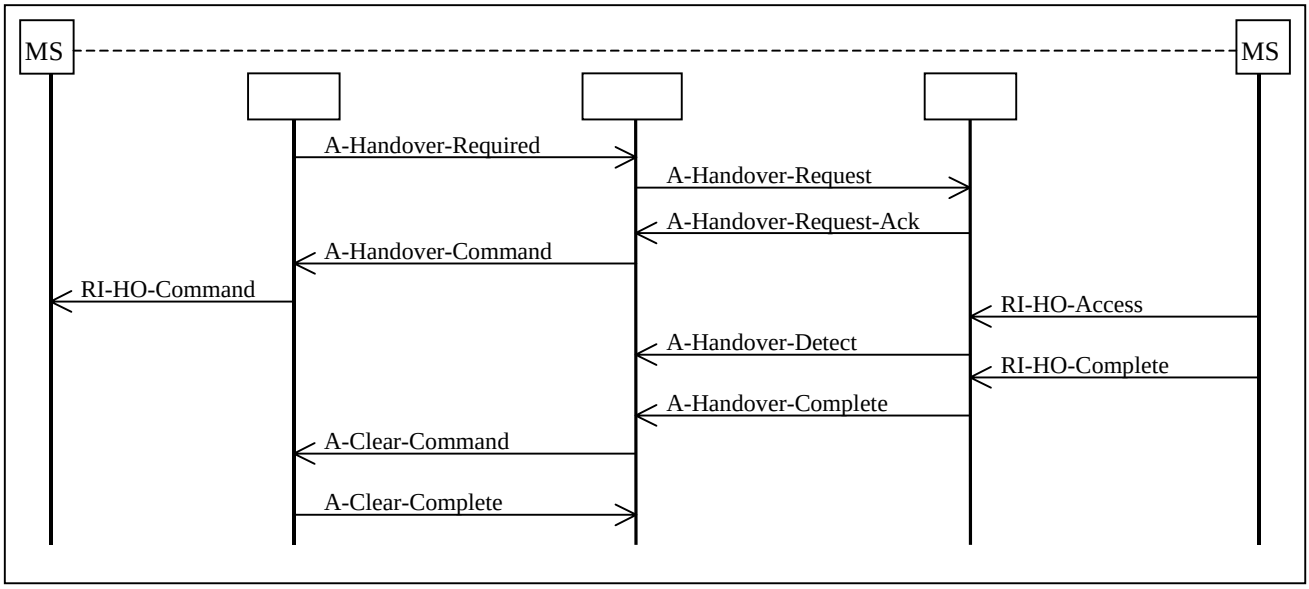


Figure 74: Basic External Intra-MSC Handover Procedure

The successful operation of the procedure is as follows. When the BSS (BSS-A), currently supporting the MS, determines that the MS requires to be handed over it will send an A-HANDOVER-REQUIRED message to the MSC (MSC-A). The A-HANDOVER-REQUIRED message shall contain a list of cells, or a single cell, to which the MS can be handed over. The list of cells shall be given in order of preference based upon operator determined criteria (These criteria are not addressed within this technical specification and are operator dependent). When the MSC-A receives the A-HANDOVER-REQUIRED message it shall begin the process of handing over the MS to a new BSS (BSS-B). (NOTE: BSS-A and BSS-B maybe the same BSS). The MSC-A shall generate an A-HANDOVER-REQUEST message to the selected BSS (BSS-B). When BSS-B receives the A-HANDOVER-REQUEST message it shall take the necessary action to allow the MS to access the radio resource of BSS-B, this is detailed in GSM 08.58 [6] and ~~the~~ in GSM 05.08 [4] ~~series of Technical Specifications~~. The switching of the radio resource through the necessary terrestrial resources is detailed in ~~GSM 04.~~TS 24.008 [10] and GSM 08.08 [5].

Once resource allocation has been completed by BSS-B it shall return an A-HANDOVER-REQUEST-ACK. to MSC-A. When this message is received by MSC-A it shall begin the process of instructing the MS to tune to a new dedicated radio resource. An A-HANDOVER-COMMAND will be sent by the MSC-A to BSS-A. On receipt of the A-HANDOVER-COMMAND message BSS-A will send the radio interface message RI-HANDOVER-COMMAND, containing a Handover Reference number previously allocated by BSS-B, to the MS. The MS will then access the new radio resource using the Handover Reference number contained in the RI-HANDOVER-ACCESS message. The number will be checked by BSS-B to ensure it is as expected and the correct MS has been captured. If this is the correct MS then the BSS-B shall send an A-HANDOVER-DETECT to MSC-A. When the MS is successfully communicating with the BSS-B a RI-HANDOVER-COMPLETE message will be sent by the MS to BSS-B. The BSS-B will then send an A-HANDOVER-COMPLETE message to MSC-A.

NOTE: The A-HANDOVER-REQUEST-ACK from BSS-B contains the complete Radio Interface message that shall be sent by BSS-A to the MS in the RI-HANDOVER-COMMAND, MSC-A transparently passes this radio interface message onto BSS-A.

After MSC-A has received the A-HANDOVER-COMPLETE message from BSS-B it shall begin to release the resources allocated on BSS-A. In figure 74 the resource is released by using the A-CLEAR-COMMAND sequence.

In the case of ongoing GSM voice group calls the clearing of resources on BSS-A shall not be used if the resources are still be used on the down link.

If a failure occurs during the handover attempt, for example A-HANDOVER-FAILURE returned from BSS-A or BSS-B, then MSC-A will terminate the handover to BSS-B. Under these conditions MSC-A may optionally take one of a number of actions:

i) retry the handover to the same cell;

ii) select the next cell from the list contained in the A-HANDOVER-REQUIRED message and attempt a handover to the new cell;

iii) await the next A-HANDOVER-REQUIRED message;

iv) send an A-HANDOVER-REQUIRED-REJECT to BSS-A, if an A-HANDOVER-COMMAND has not already been sent.

The exact action taken is dependent on whether the failure occurs before or after the A-HANDOVER-COMMAND has been sent.

In all cases the existing connection to the MS shall not be cleared.

During the period that the MS is not in communication with the network MSC-A shall queue all appropriate messages. All messages shall be delivered to the MS once communication is resumed . In the case of an Intra-MSC handover on MSC-B then the messages shall be queued by MSC-B.

In the case of ongoing GSM voice group calls if a failure occurs when handing over a user on a dedicated channel then the procedures described above may optionally be applied.

6.2 Procedure for Intra-3G_MSC Handovers

6.2.1 Intra-3G_MSC Handover from UMTS to GSM

The procedure for a successful Intra-3G_MSC handover from UMTS to GSM is shown in figure 8. It is assumed that selection of a candidate UE/MS has already taken place within the RNS based upon the criteria presented in section 5. The exact algorithm, in the RNS, for determining a candidate UE/MS is not addressed in this Technical Specification. The procedures discussed do not make use of the Mobile Application Part (MAP), represented by signalling function 4 in figures 4 and 6. The procedure described in this section covers case ii).

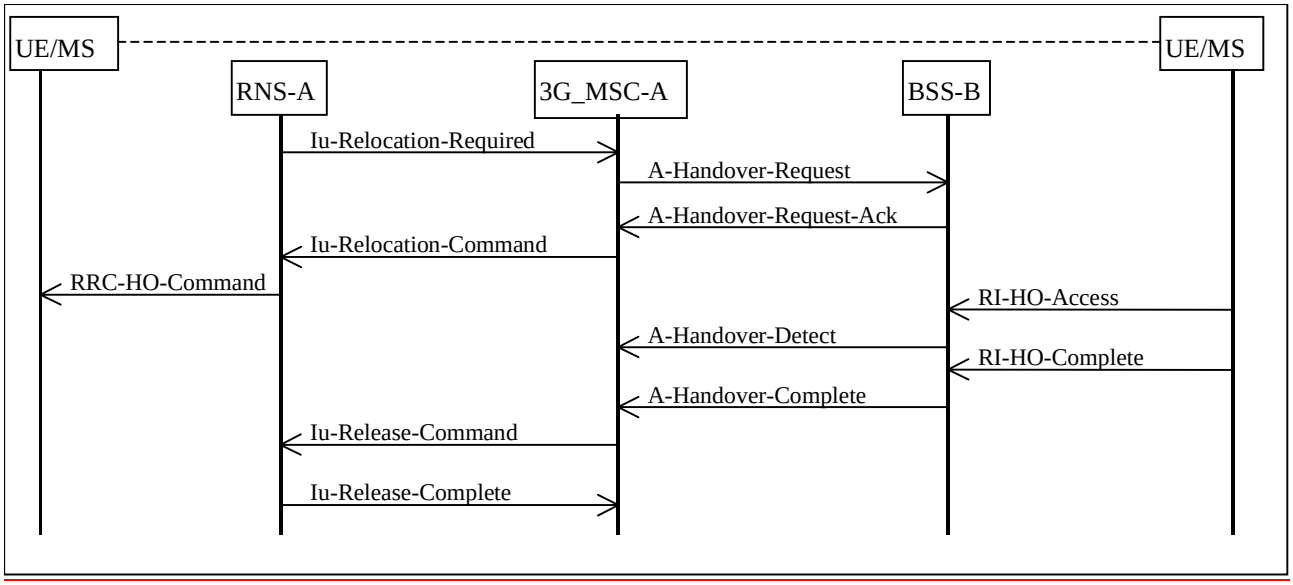


Figure 8: Basic Intra-3G_MSC Handover from UMTS to GSM Procedure

The successful operation of the procedure is as follows. When the RNS (RNS-A), currently supporting the UE/MS, determines that the UE/MS requires to be handed over to GSM it will send an IU-RELOCATION-REQUIRED message to the 3G_MSC (3G_MSC-A). The IU-RELOCATION-REQUIRED message shall contain a single cell, to which the UE/MS can be handed over. When the 3G_MSC-A receives the IU-RELOCATION-REQUIRED message it shall begin the process of handing over the UE/MS to a BSS (BSS-B). The 3G_MSC-A shall generate an A-HANDOVER-REQUEST message to the selected BSS (BSS-B). When BSS-B receives the A-HANDOVER-REQUEST message it shall take the necessary action to allow the UE/MS to access the radio resource of BSS-B, this is detailed in GSM 08.58 [6] and in GSM 05.08 [4]. The switching of the radio resource through the necessary terrestrial resources is detailed in TS 24.008 [10] and GSM 08.08 [5].

Once resource allocation has been completed by BSS-B it shall return an A-HANDOVER-REQUEST-ACK. to 3G_MSC-A. When this message is received by 3G_MSC-A it shall begin the process of instructing the UE/MS to tune to a new dedicated radio resource. An IU-RELOCATION-COMMAND will be sent by the 3G_MSC-A to RNS-A. On receipt of the IU-RELOCATION-COMMAND message RNS-A will send the radio resource control message RRC-HANDOVER-COMMAND, containing a Handover Reference number previously allocated by BSS-B, to the UE/MS. The UE/MS will then access the new radio resource using the Handover Reference number contained in the RI-HANDOVER-ACCESS message. The number will be checked by BSS-B to ensure it is as expected and the correct UE/MS has been captured. If this is the correct UE/MS then the BSS-B shall send an A-HANDOVER-DETECT to 3G_MSC-A. When the UE/MS is successfully communicating with the BSS-B a RI-HANDOVER-COMPLETE message will be sent by the UE/MS to BSS-B. The BSS-B will then send an A-HANDOVER-COMPLETE message to 3G_MSC-A.

NOTE: The A-HANDOVER-REQUEST-ACK from BSS-B contains the complete radio resource control message that shall be sent by RNS-A to the UE/MS in the RRC-HANDOVER-COMMAND, 3G_MSC-A transparently passes this radio interface message onto RNS-A.

After 3G_MSC-A has received the A-HANDOVER-COMPLETE message from BSS-B it shall begin to release the resources allocated on RNS-A. In figure 8 the resource is released by using the IU-RELEASE-COMMAND sequence.

If a failure occurs during the handover attempt, for example A-HANDOVER-FAILURE returned from BSS-B, then 3G_MSC-A will terminate the handover to BSS-B and send an IU-RELOCATION-PREPARATION-FAILURE message to RNS-A.

If RNS-A has decided to cancel the handover, it sends IU-RELOCATION-CANCEL message to 3G_MSC-A. The 3G_MSC-A will then terminate the handover towards BSS-B (if initiated) and send IU-RELOCATION-CANCEL-ACKNOWLEDGE message to RNS-A.

In all cases the existing connection to the UE/MS shall not be cleared except in the case of expiry of the timer for receipt of A-HANDOVER-COMPLETE.

During the period that the UE/MS is not in communication with the network 3G_MSC-A shall queue all appropriate messages. All messages shall be delivered to the UE/MS once communication is resumed. In the case of an Intra-3G_MSC handover from UMTS to GSM on 3G_MSC-B then the messages shall be queued by 3G_MSC-B.

6.2.2 Intra-3G_MSC GSM to UMTS Handover

The procedure for a successful Intra-3G_MSC handover is shown in figure 9. It is assumed that selection of a candidate UE/MS has already taken place within the BSC based upon the criteria presented in section 5. The exact algorithm, in the BSC, for determining a candidate UE/MS is not addressed in this Technical Specification. The procedures discussed do not make use of the Mobile Application Part (MAP), represented by signalling function 4 in figures 4 and 6. The procedure described in this section covers case ii).

In the case of ongoing voice group calls, the handover does not take place since voice group calls are not supported in UMTS.

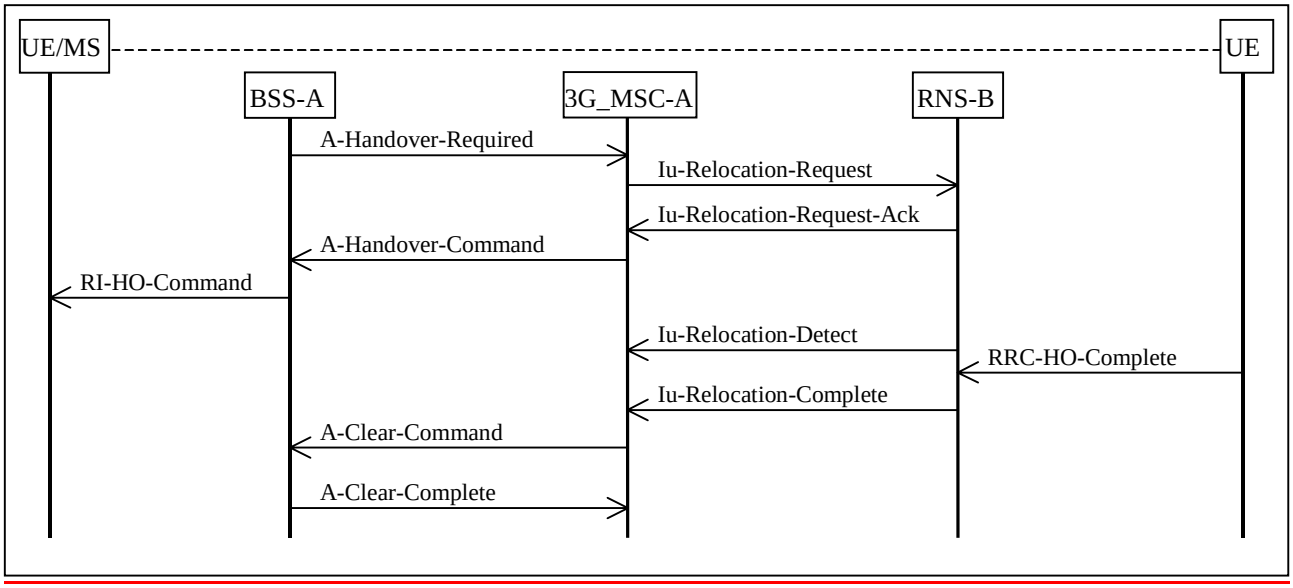


Figure 9: Basic External Intra-3G_MSC GSM to UMTS Handover Procedure

The successful operation of the procedure is as follows. When the BSS (BSS-A), currently supporting the UE, determines that the UE requires to be handed over to UMTS it will send an A-HANDOVER-REQUIRED message to the 3G_MSC (3G_MSC-A). The A-HANDOVER-REQUIRED message shall contain a single cell, to which the UE can be handed over. When the 3G_MSC-A receives the A-HANDOVER-REQUIRED message it shall begin the process of handing over the UE to a new RNS (RNS-B). The 3G_MSC-A shall generate an Iu-RELOCATION-REQUEST message to the selected RNS (RNS-B). When RNS-B receives the Iu-RELOCATION-REQUEST message it shall take the necessary action to allow the UE to access the radio resource of RNS-B, this is detailed in the TS 25.300 series and the TS 25.200 series of Technical Specifications. The switching of the radio resource through the necessary terrestrial resources is detailed in the TS 25.430 series and TS 25.413.

Once resource allocation has been completed by RNS-B, it shall return an Iu-RELOCATION-REQUEST-ACK. to 3G_MSC-A. When this message is received by 3G_MSC-A it shall begin the process of instructing the UE to tune to a new dedicated radio resource. An A-HANDOVER-COMMAND will be sent by the 3G_MSC-A to BSS-A. On receipt of the A-HANDOVER-COMMAND message BSS-A will send the radio interface message RI-HANDOVER-COMMAND. The UE will then access the new radio resource. On detection of the UE, the RNS-B shall send an Iu-RELOCATION-DETECT to 3G_MSC-A. When the UE is successfully communicating with the RNS-B an RRC-HANDOVER-COMPLETE message will be sent by the UE to RNS-B. The RNS-B will then send an Iu-RELOCATION-COMPLETE message to 3G_MSC-A.

NOTE: The Iu-RELOCATION-REQUEST-ACK from RNS-B contains the complete RRC message that shall be sent by BSS-A to the MS in the RI-HANDOVER-COMMAND, 3G_MSC-A transparently passes this radio interface message onto BSS-A.

After 3G_MSC-A has received the Iu-RELOCATION-COMPLETE message from RNS-B, it shall begin to release the resources allocated on BSS-A. In figure 9 the resource is released by using the A-CLEAR-COMMAND sequence.

If a failure occurs during the handover attempt, for example, A-HANDOVER-FAILURE returned from BSS-A or Iu-RELOCATION FAILURE returned from RNS-B, then 3G_MSC-A will terminate the handover to RNS-B. Under these conditions 3G_MSC-A may optionally take one of a number of actions:

i) await the next A-HANDOVER-REQUIRED message;

ii) send an A-HANDOVER-REQUIRED-REJECT to BSS-A, if an A-HANDOVER-COMMAND has not already been sent.

The exact action taken is dependent on whether the failure occurs before or after the A-HANDOVER-COMMAND has been sent.

In all cases the existing connection to the UE shall not be cleared.

During the period that the UE is not in communication with the network 3G_MSC-A shall queue all appropriate messages. All messages shall be delivered to the UE once communication is resumed. In the case of an Intra-3G_MSC GSM to UMTS handover on 3G_MSC-B then the messages shall be queued by 3G_MSC-B.

6.2.3 Procedure for Intra-3G_MSC SRNS Relocation

The procedure for a successful Intra-3G_MSC SRNS Relocation is shown in figures 10 and 11. SRNS Relocation is used to relocate the serving RNS functionality from one RNS to another. The procedure may or may not involve change of the radio resources assigned for the corresponding UE. Whether or not the Relocation includes change of radio resources assigned for the UE does not affect the SRNS Relocation procedure in the Core Network.

It is assumed that selection of a candidate UE has already taken place within RNS based upon the criteria presenting in section 5. The exact algorithm, in RNS, for determining a candidate UE is not addressed in this Technical Specification. The procedure discussed does not make use of the Mobile Application Part (MAP), represented by signalling function 4 in figures 4 and 6. The procedure described in this section covers case ii).

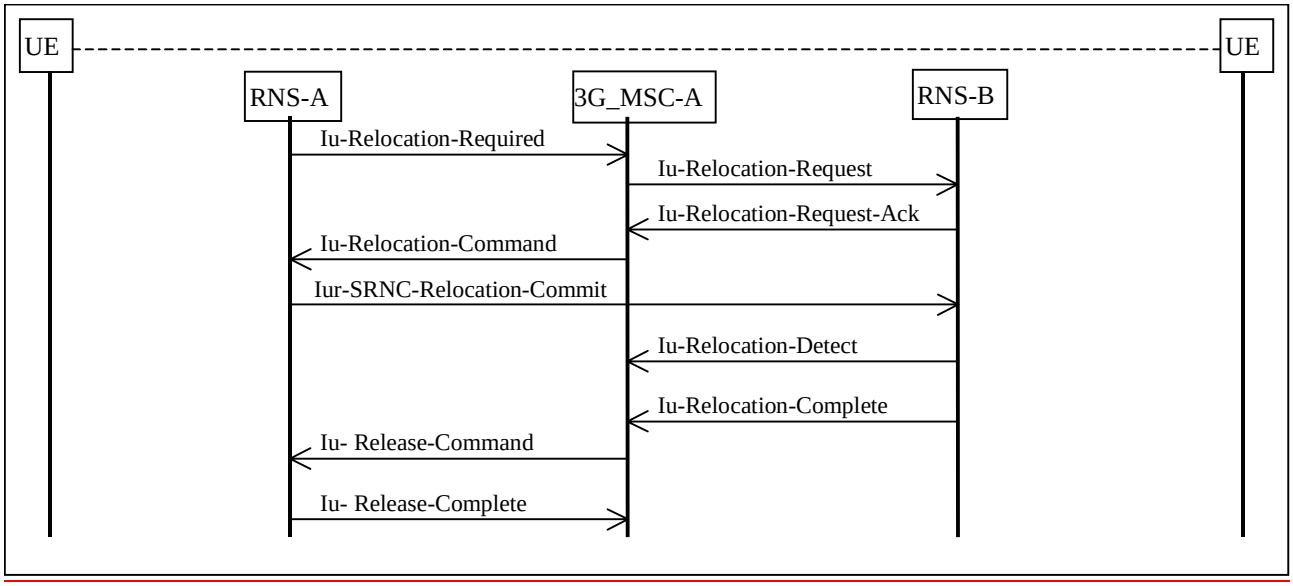


Figure 10 Basic intra-3G_MSC SRNS Relocation Procedure

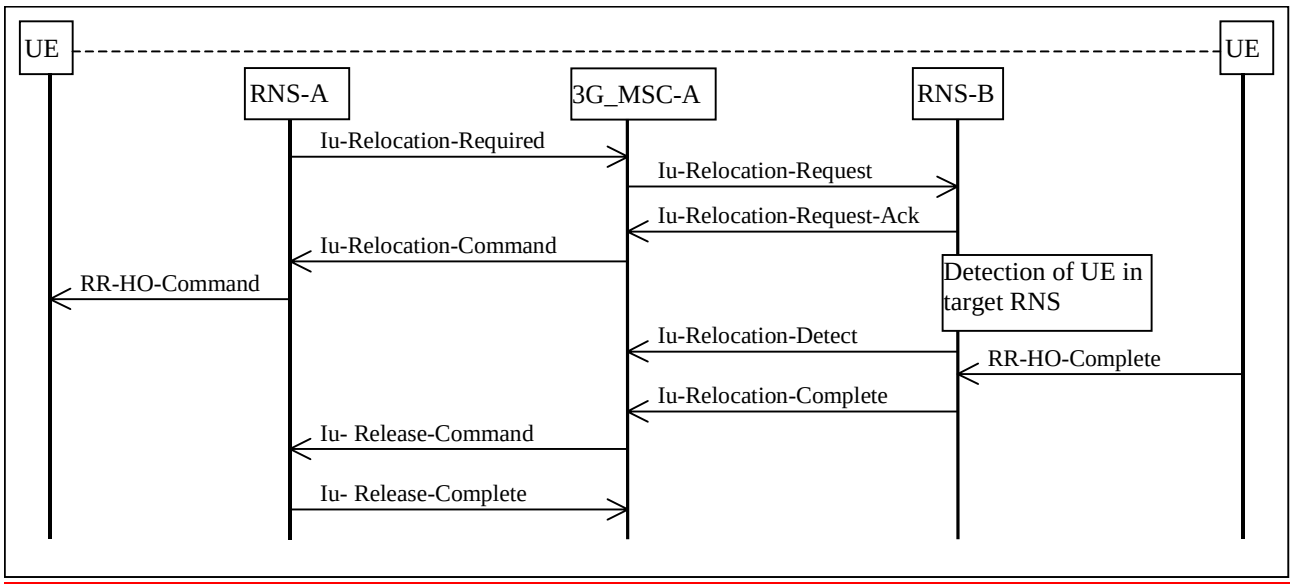


Figure 11 Basic intra-3G_MSC SRNS Relocation Procedure combined with hard change of radio resources (Hard Handover with switch in the Core Network)

The successful operation of the procedure is as follows. When the Serving RNS (RNS-A) makes the decision to perform the SRNS Relocation procedure it will send an IU-RELOCATION-REQUIRED message to the 3G_MSC (3G_MSC-A). The IU-RELOCATION-REQUIRED message shall contain the identifier of the target RNS to which the Relocation is to be performed. When the 3G_MSC-A receives the IU-RELOCATION-REQUIRED message it shall begin the process of relocating the serving RNS functionality to the new RNS (RNS-B). The 3G_MSC-A shall generate an IU-RELOCATION-REQUEST message to the selected RNS (RNS-B). When RNS-B receives the IU-RELOCATION-REQUEST message it shall take the necessary action to establish the new Iu transport bearers for each Radio Access Bearer related to 3G_MSC-A for the UE in question, this is detailed in the TS 25.430 series and TS 25.413 Technical Specification.

Once resource allocation has been completed by RNS-B it shall return an IU-RELOCATION-REQUEST-ACKNOWLEDGE to 3G_MSC-A. When this message is received by 3G_MSC-A, and 3G_MSC-A is ready for the move in Serving RNS functionality, it shall indicate the completion of the preparation phase on the core network side for the SRNS Relocation. An IU-RELOCATION-COMMAND message is sent by 3G_MSC-A to RNS-A. RNS-A acts as follows:

i) If the procedure is a SRNS Relocation without change of radio resources, which means that the Iur interface between RNS-A and RNS-B can be used for the procedure, the RNS-A shall send IUR-SRNS-RELOCATION-COMMIT message to the RNS-B to trigger the Relocation execution. See figure 10.

ii) If the procedure is a SRNS Relocation with change of radio resources, which means that the Iur interface between RNS-A and RNS-B is not used for the procedure, the RNS-A shall trigger the handover procedure on the air interface by sending the RRC-HANDOVER-COMMAND to the UE. The UE will then access the new radio resources. See figure 11.

NOTE: The IU-RELOCATION-REQUEST-ACKNOWLEDGE from RNS-B may optionally contain a transparent container, which is transferred by 3G_MSC-A to the RNS-A using the IU-RELOCATION-COMMAND message.

When the relocation execution trigger is received, RNS-B shall then take the necessary action to assume the role of Serving RNS and shall send an IU-RELOCATION-DETECT message to 3G_MSC-A. When the UE is successfully in communication with the RNS-B, then RNS-B shall send an IU-RELOCATION-COMPLETE message to 3G_MSC-A.

After 3G_MSC-A has received the IU-RELOCATION-COMPLETE message from RNS-B, it shall begin to release the resources associated to the RNS-A. In figures 10 and 11, the resources are released by using the IU-RELEASE-COMMAND sequence.

If a failure occurs during the SRNS Relocation attempt, then 3G_MSC-A will terminate the relocation to RNS-B. For example, if IU-RELOCATION-FAILURE is returned from RNS-B then 3G_MSC-A will terminate the relocation to RNS-B and send IU-RELOCATION-PREPARATION-FAILURE to RNS-A. If IU-RELOCATION-CANCEL is returned from RNS-A, then 3G_MSC-A will terminate the relocation to RNS-B and send IU-RELOCATION-CANCEL-ACKNOWLEDGE to RNS-A.

In all cases the existing connection to the UE shall not be cleared.

During the period that the UE is not in communication with the network, 3G_MSC-A shall queue all appropriate messages. All messages shall be delivered to the UE once communication is resumed. In the case of an Intra-3G_MSC SRNS Relocation (with or without change of radio resources) on 3G_MSC-B, then the messages shall be queued by 3G_MSC-B.

7 General description of the procedures for inter - MSC handovers

The following sections describe two options for the Basic and Subsequent Handover procedures. The first, as described in section 7.1 and 7.3 respectively, provides for a circuit connection between MSC-A and MSC-B. The second, as described in section 7.2 and 7.4 respectively, provides for a Basic and Subsequent Handover without the provision of a circuit connection between MSC-A and MSC-B.

In all the above mentioned sections, the following principles apply:

During the handover resource allocation, only the handover related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08[7] - shall be transferred on the E-interface.

The trace related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - can be sent by the MSC-A on the E-interface after successful handover resource allocation. In the sections 7.1 and 7.2, it is however allowed at basic handover initiation on the E-Interface to transfer one trace related message that is part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - together with the applicable handover related message. The applicable handover related message shall always appear as the first message.

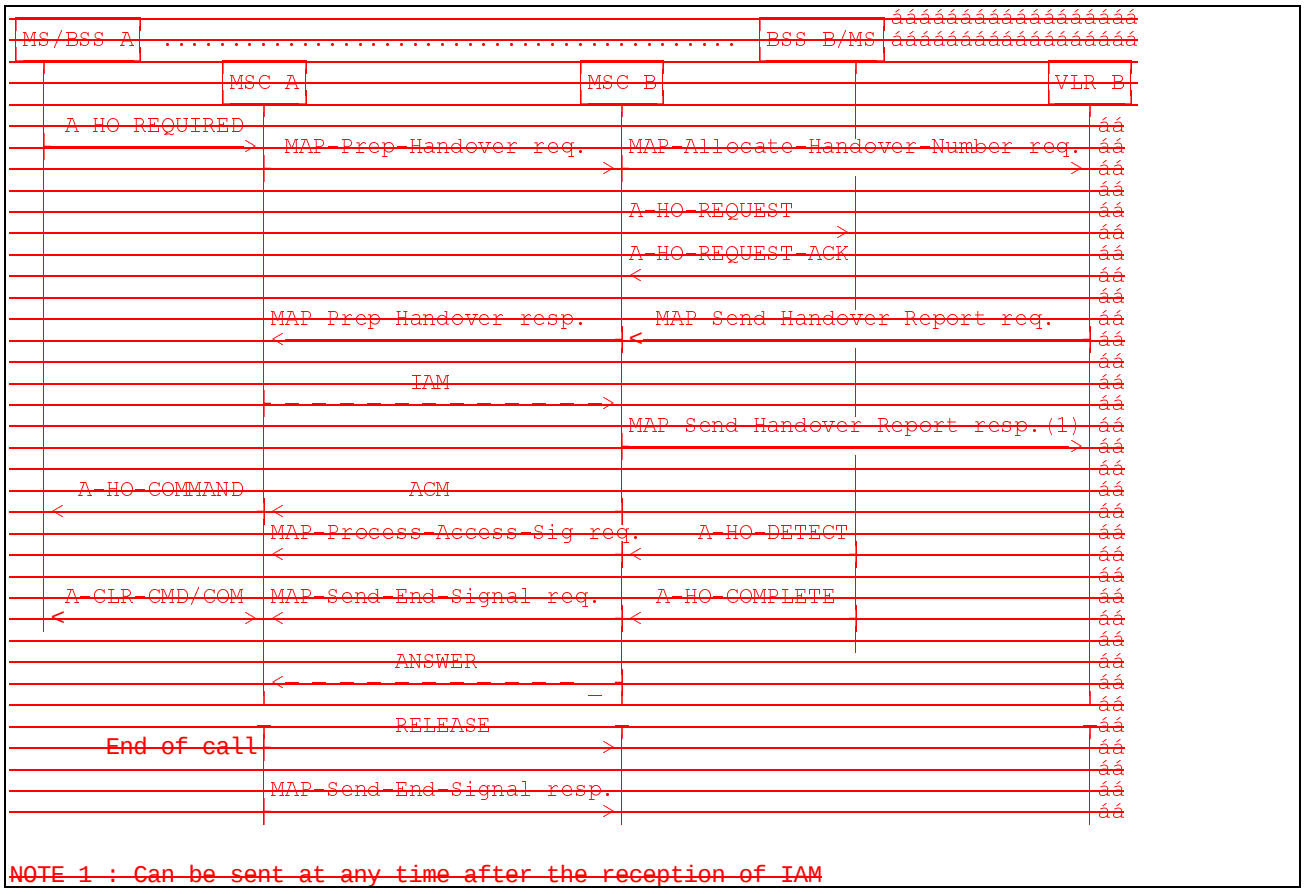
During the handover execution, ie while the MS is not in communication with the network, the MSC-A shall queue all outgoing BSSAP messages until the communication with the MS is resumed.

Finally, during supervision, ie while the MS is not in the area of MSC-A after a successful Inter-MSC handover, the subset of BSSAP procedures and their related messages - as defined in GSM 09.08 [7] - shall apply on the E-Interface.

During the intra-MSC-B handover execution, if any, the MSC-B shall queue all outgoing BSSAP messages until the communication with the MS is resumed.

7.1 Basic handover procedure requiring a circuit connection between MSC-A and MSC-B

The procedure used for successful Inter-MSC Handover is shown in figure 12~~5~~. Initiation of the handover procedure is described in section 5. The procedure described in this section makes use of messages from the Technical Specification GSM 08.08 [5] and of the transport mechanism from the Mobile Application Part (MAP) (Technical Specification ~~GSM 09.~~TS 29.002 [12]). After an Inter-MSC handover further Intra-MSC handovers may occur on MSC-B, these handovers will follow the procedures specified in the previous section.


MS/BSS A
BSS B/MS
MSC A
MSC B
VLR B
A HO REQUIRED
MAP-Prep-Handover req.
MAP-Allocate-Handover-Number req.
A-HO-REQUEST
A-HO-REQUEST-ACK
MAP Prep Handover resp.
MAP Send Handover Report req.
IAM
MAP Send Handover Report resp.(1)
A-HO-COMMAND
ACM
MAP-Process-Access-Sig req.
A-HO-DETECT
A-CLR-CMD/COM
MAP-Send-End-Signal req.
A-HO-COMPLETE
ANSWER
RELEASE
End of call
MAP-Send-End-Signal resp.
NOTE 1 : Can be sent at any time after the reception of IAM

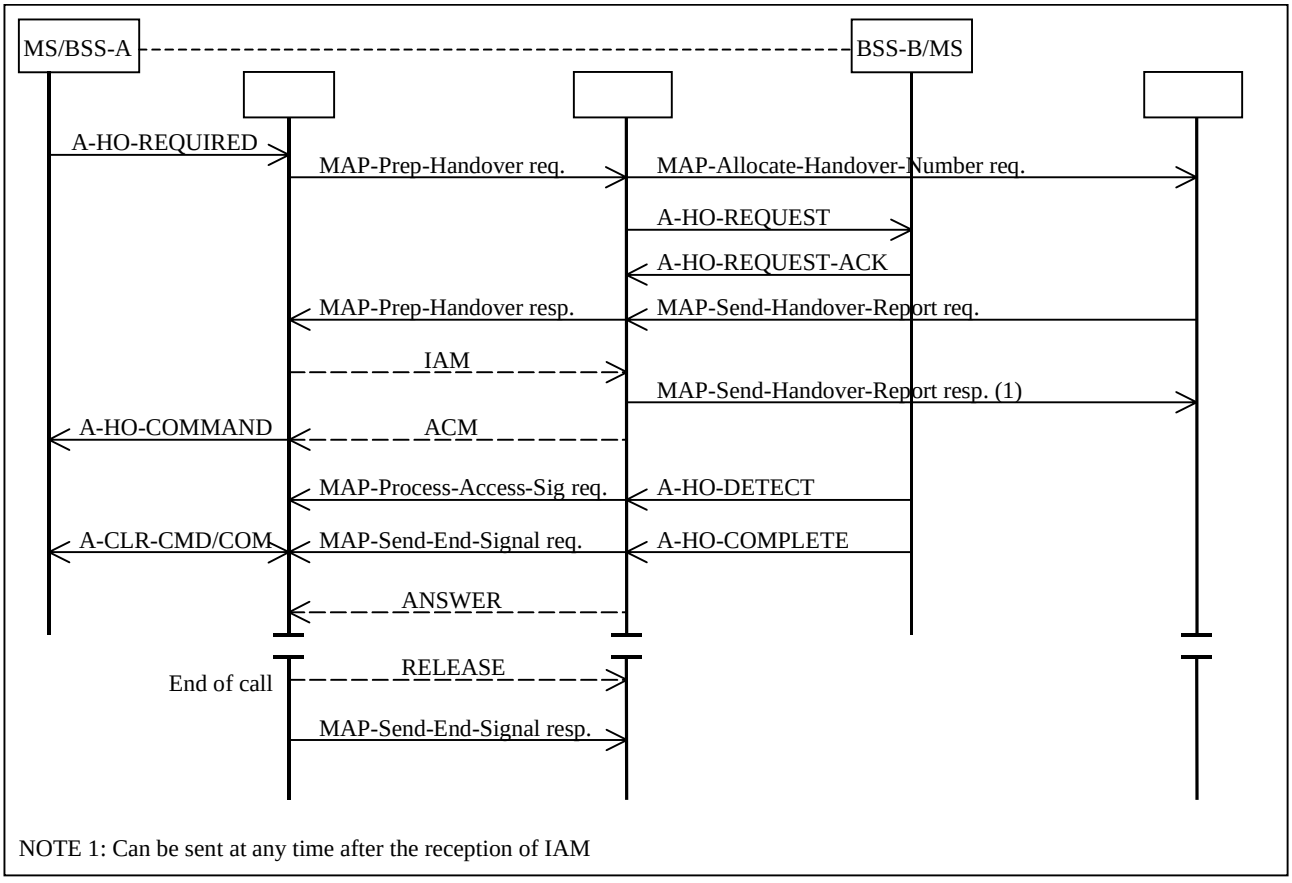

MS/BSS-A
BSS-B/MS
A-HO-REQUIRED
MAP-Prep-Handover req.
MAP-Allocate-Handover-Number req.
A-HO-REQUEST
A-HO-REQUEST-ACK
MAP-Prep-Handover resp.
MAP-Send-Handover-Report req.
IAM
MAP-Send-Handover-Report resp. (1)
A-HO-COMMAND
ACM
MAP-Process-Access-Sig req.
A-HO-DETECT
A-CLR-CMD/COM
MAP-Send-End-Signal req.
A-HO-COMPLETE
ANSWER
End of call
RELEASE
MAP-Send-End-Signal resp.
NOTE 1: Can be sent at any time after the reception of IAM

Figure 125: Basic Handover Procedure requiring a circuit connection

The handover is initiated as described in section 6.1. (This is represented by A-HO-REQUIRED in figure 125. Upon receipt of the A-HO-REQUIRED from BSS-A, MSC-A shall send a MAP-PREPARE-HANDOVER request to MSC-B including a complete A-HO-REQUEST message. (NOTE: MSC-A shall not send further MAP-PREPARE-HANDOVER requests while a MAP-PREPARE-HANDOVER response is pending or before any timeouts). The MAP-PREPARE-HANDOVER request shall carry in the A-HO-REQUEST all information needed by MSC-B for allocating a radio channel, see Technical Specification GSM 08.08 [5]. For compatibility reasons, the MAP-PREPARE-HANDOVER request will also identify the cell to which the call is to be handed over. MSC-B will return the MAP-PREPARE-HANDOVER response after having retrieved a Handover Number from its associated VLR (exchange of the messages MAP-allocate-handover-number request and MAP-send-handover-report request). The Handover Number shall be used for routing the connection of the call from MSC-A to MSC-B. If a traffic channel is available in MSC-B the MAP-PREPARE-HANDOVER response, sent to MSC-A will contain the complete A-HO-REQUEST-ACKNOWLEDGE message received from BSS-B, containing the radio resources definition to be sent by BSS-A to the MS and possible extra BSSMAP information, amended by MSC-B due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface. If the traffic channel allocation is queued by BSS-B, the A-QUEUING-INDICATION may optionaly be sent back to MSC-A. The further traffic channel allocation result (A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. If the traffic channel allocation is not possible, the MAP-PREPARE-HANDOVER response containing an A-HO-FAILURE will be sent to MSC-A. MSC-B will do the same if a fault is detected on the identity of the cell where the call has to be handed over. MSC-B simply reports the events related to the dialogue. It is up to MSC-A to decide the action to perform if it receives negative responses or the operation fails due to the expiry of the MAP-PREPARE-HANDOVER timer.

If an error related to the TCAP dialogue or to the MAP-PREPARE-HANDOVER request is returned from MSC-B, this will be indicated to MSC-A and MSC-A will terminate the handover attempt. MSC-A may retry the handover attempt using the cell identity list, if provided, or may reject the handover attempt towards BSS-A. The existing connection to the MS shall not be cleared.

When the A-HO-REQUEST-ACKNOWLEDGE has been received, MSC-A shall establish a circuit between MSC-A and MSC-B by signalling procedures supported by the network. In figure 125 this is illustrated by the messages IAM (Initial Address Message) and ACM (Address Complete Message) of Signalling System no 7. MSC-B awaits the capturing of the MS (section 6.1) on the radio path when the ACM is sent and MSC-A initiates the handover execution when ACM is received (illustrated by the A-HO-COMMAND and described in the section 6.1).

MSC-B transfers to MSC-A the acknowledgement received from the correct MS (A-HO-DETECT/A-HO-COMPLETE). The A-HO-DETECT, if received, is transferred to MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. The A-HO-COMPLETE, when received from the correct MS, is included in the MAP-SEND-END-SIGNAL request and sent back to MSC-A. The circuit is through-connected in MSC-A when the A-HO-DETECT or the A-HO-COMPLETE is received from MSC-B. The old radio channel is released when the A-HO-COMPLETE message is received from MSC-B. The sending of the MAP-SEND-END-SIGNAL request starts the MAP supervision timer for the MAP dialogue between MSC-A and MSC-B. When the MAP-SEND-END-SIGNAL request including the A-HO-COMPLETE message is received in MSC-A the resources in BSS-A shall be cleared.

In order not to conflict with the PSTN/ISDN signalling system(s) used between MSC-A and MSC-B, MSC-B must generate an answer signal when A-HO-DETECT/COMPLETE is received.

MSC-B shall release the Handover Number when the circuit between MSC-A and MSC-B has been established.

If the circuit between MSC-A and MSC-B cannot be established (e.g. an unsuccessful backward message is received instead of ACM). MSC-A terminates the inter-MSC handover attempt by sending an appropriate MAP message, for example an ABORT. MSC-A may retry the handover at this point, see section 6.1.

MSC-A shall retain overall call control until the call is cleared by the fixed subscriber or the MS and there is no further call control functions to be performed (e.g. servicing waiting calls, echo cancellers).

When MSC-A clears the call to the MS it also clears the call control functions in MSC-A and sends the MAP-SEND-END-SIGNAL response to release the MAP resources in MSC-B.

MSC-A may terminate the procedure at any time by sending an appropriate MAP message to MSC-B. If establishment of the circuit between MSC-A and MSC-B has been initiated, the circuit must also be cleared.

The handover will be aborted by MSC-A if it detects clearing or interruption of the radio path before the call has been established on MSC-B.

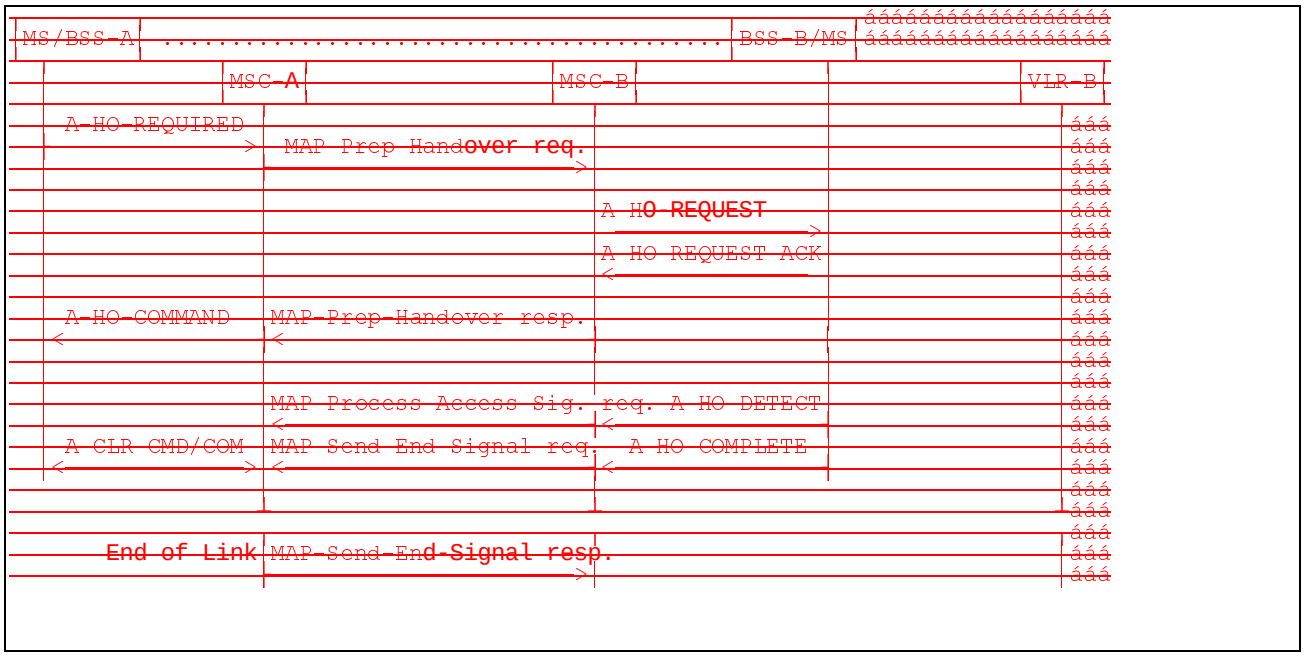
7.2 Basic handover procedure not requiring the establishment of a circuit connection between MSC-A and MSC-B

The basic handover procedures to be used when no circuit connection is required by MSC-A are similar to those described in section 7.1 for circuit switched calls. The main differences to the procedures described in section 7.1 relate to the establishment of circuits between the network entities and the Handover Number allocation.

In the case of ongoing GSM voice group calls the circuit connections are already established therefore the procedures described in this subclause are also applicable. When applied to ongoing voice group calls the clearing of resources on BSS-A shall not be used if the resources are still be used on the down link. Consequently the A-CLEAR-COMMAND message shall not be sent, but an HANDOVER-SUCCEEDED message shall be sent.

In the case of basic handover, MSC-A shall specify to MSC-B that no Handover Number is required in the MAP-PREPARE-HANDOVER request (see TSechnical Specification 2009.002 [12]). As for the basic handover using a circuit connection, the A-HO-REQUEST is transmitted at the same time. Any subsequent Handover Number allocation procedure will not be invoked until the completion of the basic handover procedure (see section: Subsequent Channel Assignment using a circuit connection). MSC-B shall then perform the radio resources allocation as described in section 7.1. The MAP-PREPARE-HANDOVER response shall be returned to MSC-A including either the response of the radio resources allocation request received from BSS-B (A-HO-REQUEST-ACKNOWLEDGE/A-HO-FAILURE with possible extra BSSMAP information. These extra information are amended by MSC-B due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface) or potentially the A-QUEUING-INDICATION . The basic handover procedure will continue as described in section 7.1 except that no circuit connection will be established towards MSC-B.

The relevant case for the basic handover without circuit connection is shown in figure 136. As can be seen the major differences to the equivalent figure 125 is the omission of any circuit establishment messaging and the omission of handover number allocation signalling.



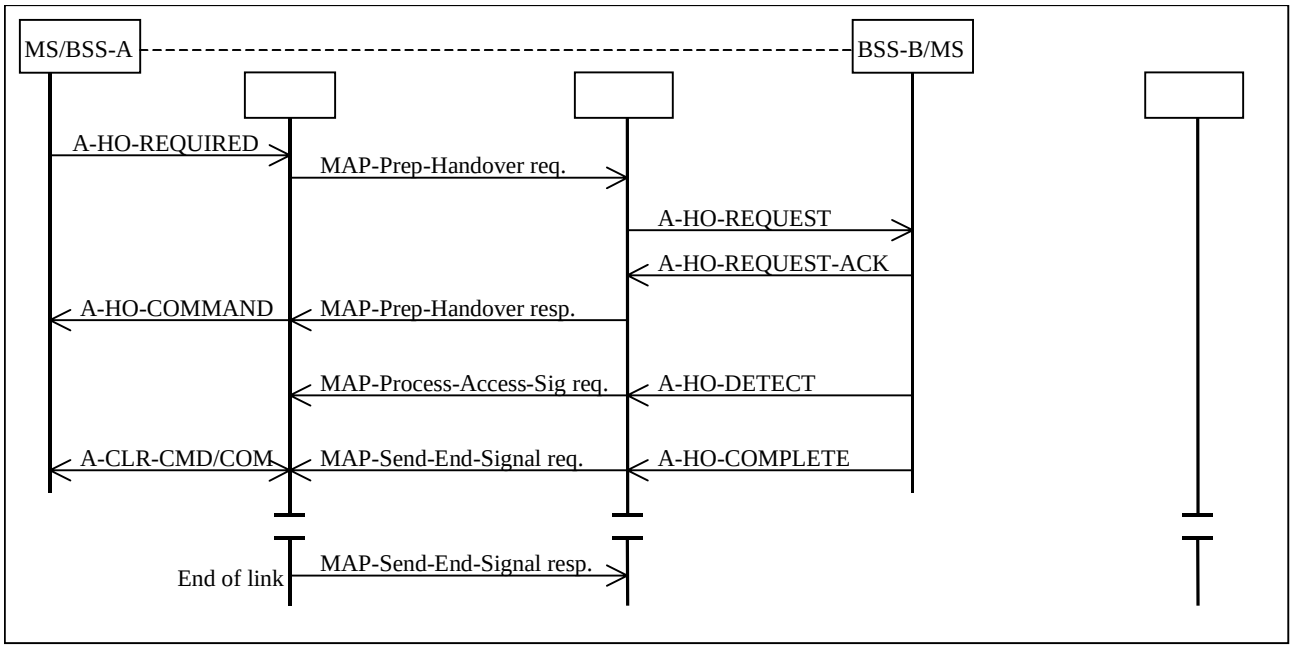


Figure 136: Basic Handover Procedure without circuit connection

7.3 Procedure for subsequent handover requiring a circuit connection between MSC-A and MSC-B

After the call has been handed over from MSC-A to MSC-B, if the MS leaves the area of MSC-B during the same call, subsequent handover is necessary in order to continue the connection.

The following cases apply:

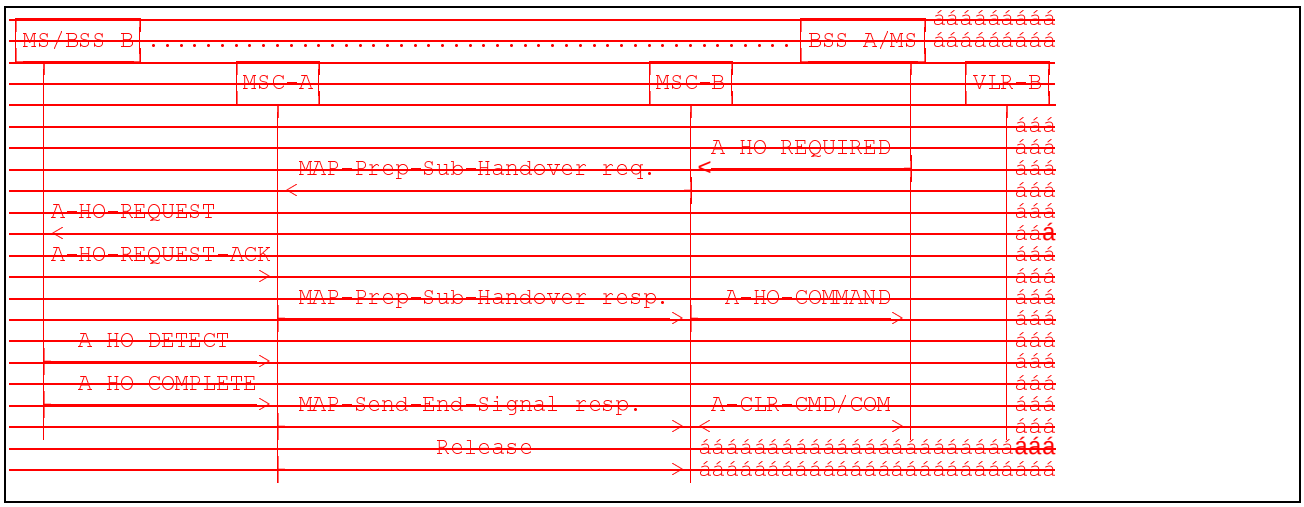
i) the MS moves back to the area of MSC-A;

ii) the MS moves into the area of a third MSC (MSC-B').

In both cases the call is switched in MSC-A; the circuit between MSC-A and MSC-B shall be released after a successful subsequent handover has been performed.

7.3.1 Description of subsequent handover procedure i): MSC-B to MSC-A

The procedure for successful handover from MSC-B back to MSC-A is shown in figure 147.



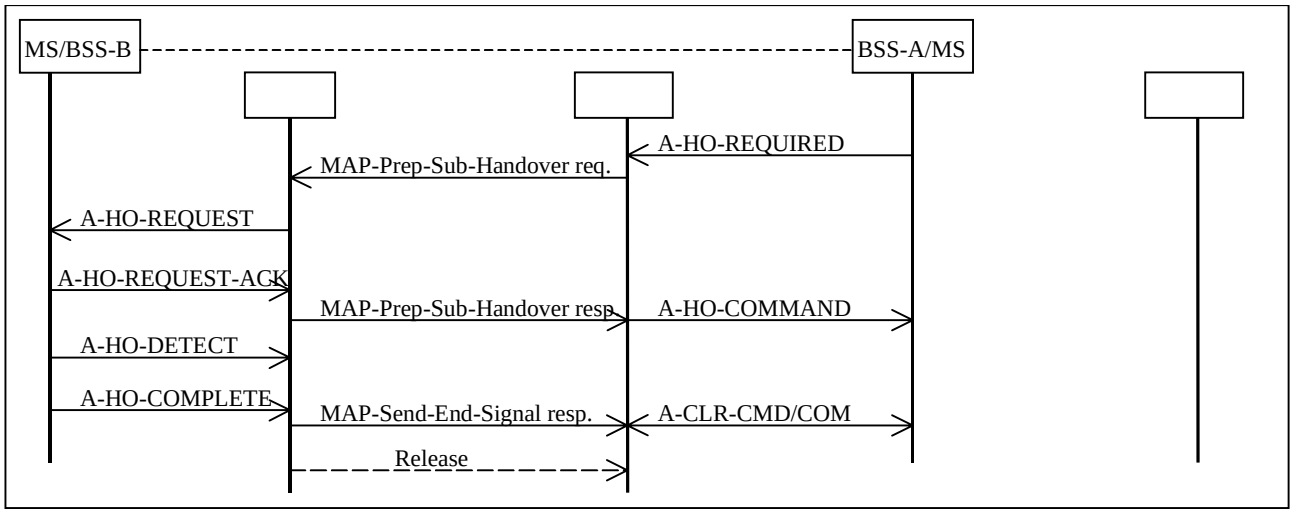


Figure 14~~7~~: Subsequent handover procedure i):successful handover from MSC-B to MSC-A using a circuit connection

The procedure is as follows:

MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to MSC-A indicating the new MSC number(MSC-A number), indicating also the identity of the cell where the call has to be handed over and including a complete A-HO-REQUEST message. (NOTE: MSC-B shall not send further MAP-PREPARE-SUBSEQUENT-HANDOVER requests while a handover attempt is pending or before any timeouts). Since MSC-A is the call controlling MSC, this MSC needs no Handover Number for routing purposes; MSC-A can immediately initiate the search for a free radio channel.

When a radio channel can be assigned, MSC-A shall return in the MAP-PREPARE-SUBSEQUENT-HANDOVER response the complete A-HO-REQUEST-ACKNOWLEDGE message received from the BSS-B and possible extra BSSMAP information, amended by MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface. If the traffic channel allocation is queued by BSS-B, the A-QUEUING-INDICATION may optionaly be sent back to MSC-B. The further traffic channel allocation result (A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to MSC-B using the MAP-FORWARD-ACCESS-SIGNALLING request.If a radio channel cannot be assigned or if a fault is detected on the target cell identity, or the target cell identity in the A-HO-REQUEST is not consistent with the target MSC number, the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing an A-HO-FAILURE message shall be given to MSC-B, in addition MSC-B shall maintain the connection with the MS.

If the procedure in MSC-A is successful then MSC-B can request the MS to retune to the new BSS-B on MSC-A. This is illustrated in figure ~~7~~ 14 by the A-HO-COMMAND message. The operation is successfully completed when MSC-A receives the A-HO-COMPLETE message.

After handover MSC-A shall release the circuit to MSC-B.

MSC-A must also terminate the MAP procedure for the basic handover between MSC-A and MSC-B by sending an appropriate MAP message. MSC-B will clear the resources in BSS-A when the MAP-SEND-END-SIGNAL response is received.

7.3.2 Description of the subsequent handover procedure ii): MSC-B to MSC-B'

The procedure for successful handover from MSC-B to MSC-B' is shown in figure 15~~8~~.

The procedure consists of two parts:

- a subsequent handover from MSC-B back to MSC-A as described in section 7.3.1; and
- a basic handover from MSC-A to MSC-B' as described in section 7.1.

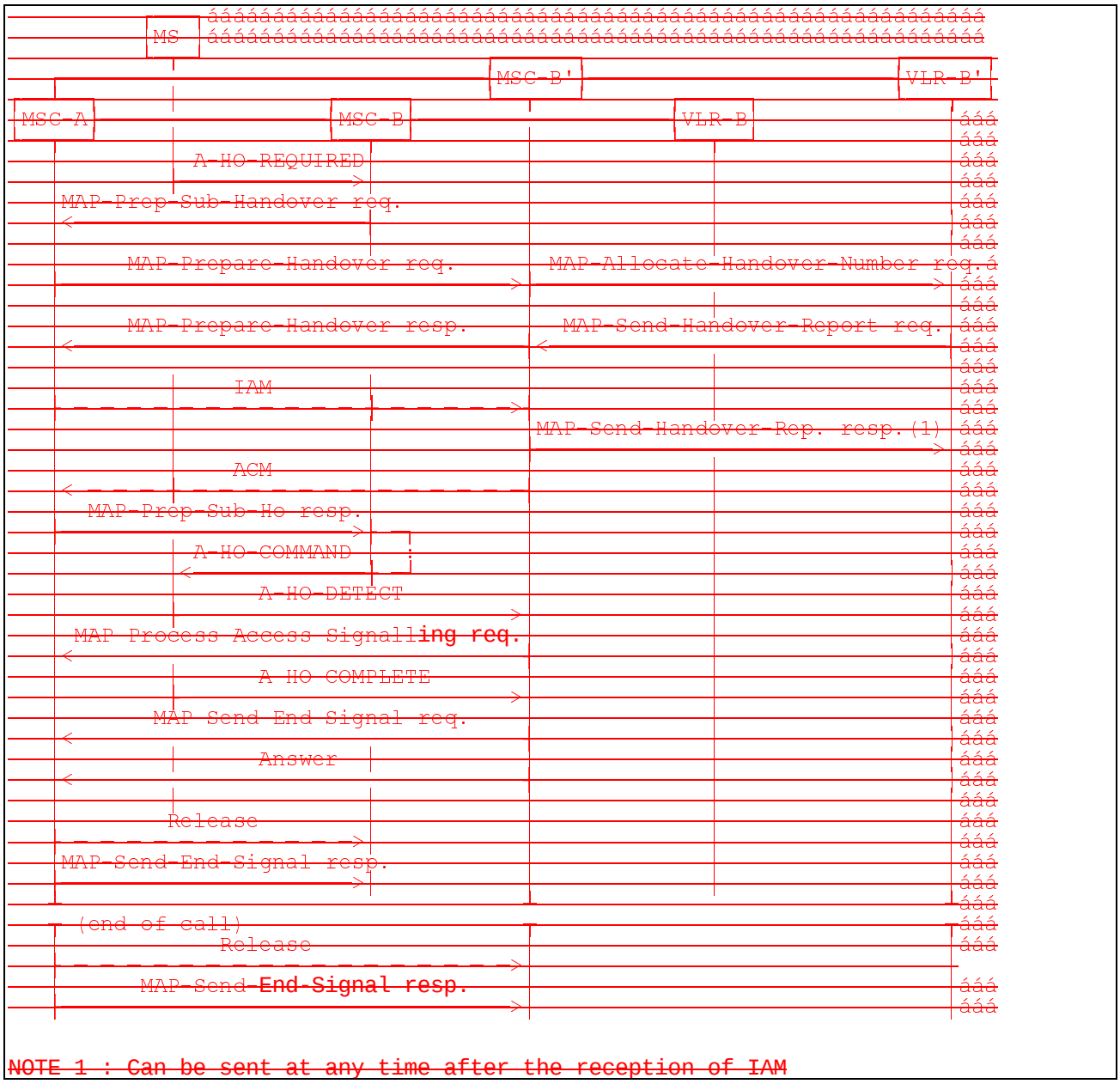
MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to MSC-A indicating a new MSC number (which is the identity of MSC-B'), indicating also the target cell identity and including a complete A-HO-REQUEST, MSC-A then starts a basic handover procedure towards MSC-B'.

When MSC-A receives the ACM from MSC-B', MSC-A informs MSC-B that MSC-B' has successfuly allocated the radio resources on BSS-B' side by sending the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing the complete A-HO-REQUEST-ACKNOWLEDGE received from BSS-B'and possible extra BSSMAP information, amended by MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface between MSC-A and MSC-B' and the BSSMAP protocol carried on the E-interface between MSC-A and MSC-B. Now MSC-B can start the procedure on the radio path.

For MSC-A the handover is completed when it has received the MAP-SEND-END-SIGNAL REQUEST from MSC-B'containing the A-HO-COMPLETE received from the BSS-B'. The circuit between MSC-A and MSC-B is released. MSC-A also sends the MAP-SEND-END-SIGNAL response to MSC-B in order to terminate the original MAP dialogue between MSC-A and MSC-B. MSC-B releases the radio resources when it receives this message.

If the traffic channel allocation is queued by the BSS-B', the A-QUEUING-INDICATION may optionaly be sent back to MSC-B. If no radio channel can be allocated by MSC-B' or no circuit between MSC-A and MSC-B' can be established or a fault is detected on the target cell identity or the target cell identity in the A-HO-REQUEST is not consistent with the target MSC number, MSC-A informs MSC-B by using the A-HO-FAILURE message included in the MAP-PREPARE-SUBSEQUENT-HANDOVER response. MSC-B shall maintain the existing connection with the MS.

When the subsequent handover is completed, MSC-B' is considered as MSC-B. Any further inter-MSC handover is handled as described above for a subsequent handover.


MS
MSC-B'
VLR-B'
MSC-A
MSC-B
VLR-B
A-HO-REQUIRED
MAP-Prep-Sub-Handover req.
MAP-Prepare-Handover req.
MAP-Allocate-Handover-Number req.
MAP-Prepare-Handover resp.
MAP-Send-Handover-Report req.
IAM
MAP-Send-Handover-Rep. resp.(1)
ACM
MAP-Prep-Sub-Ho resp.
A-HO-COMMAND
A-HO-DETECT
MAP Process Access Signalling req.
A HO COMPLETE
MAP Send End Signal req.
Answer
Release
MAP-Send-End-Signal resp.
(end of call)
Release
MAP-Send-End-Signal resp.
NOTE 1 : Can be sent at any time after the reception of IAM

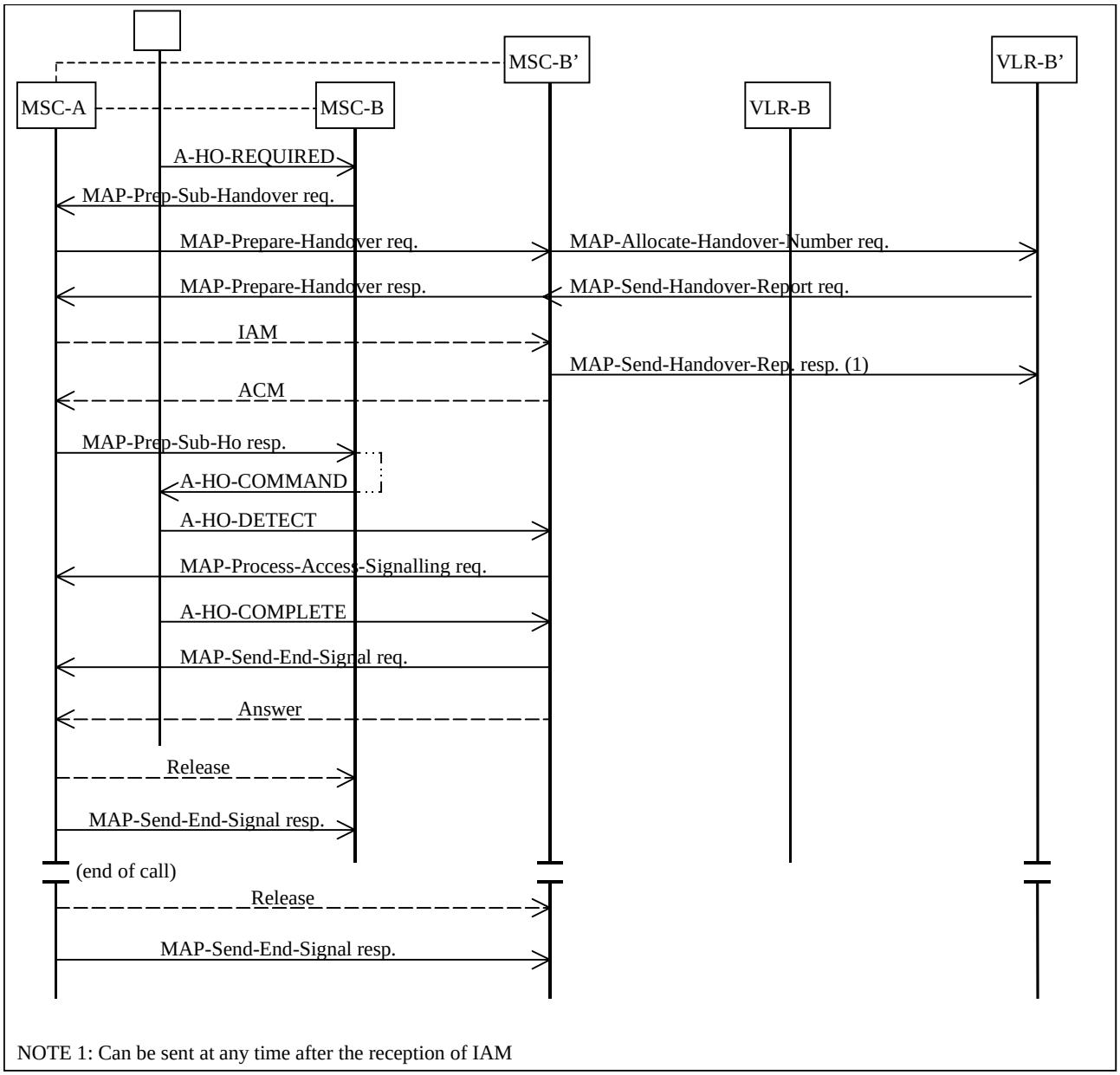


Figure 158: Subsequent handover procedure ii): Successful handover from MSC-B to MSC-B'requiring a circuit connection

7.4 Procedure for subsequent handover not requiring a circuit connection between MSC-A and MSC-B

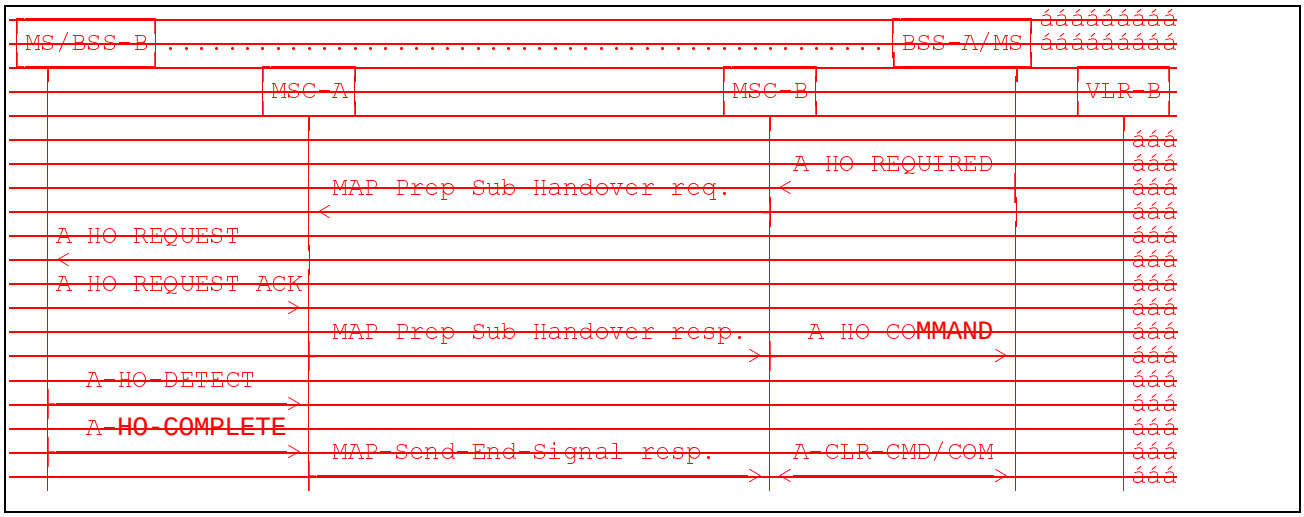
As for the subsequent handover with a circuit connection between MSC-A and MSC-B, the same two cases of subsequent handover apply:

i) the MS moves back to the area of MSC-A;

ii) the MS moves into the area of a third MSC (MSC-B').

7.4.1 Description of the subsequent handover procedure without circuit connection i): MSC-B to MSC-A

The procedure for successful handover from MSC-B back to MSC-A without circuit connection is shown in figure 16~~9~~. The only difference with the figure 14~~7~~, is that no circuit release is needed between MSC-A and MSC-B.



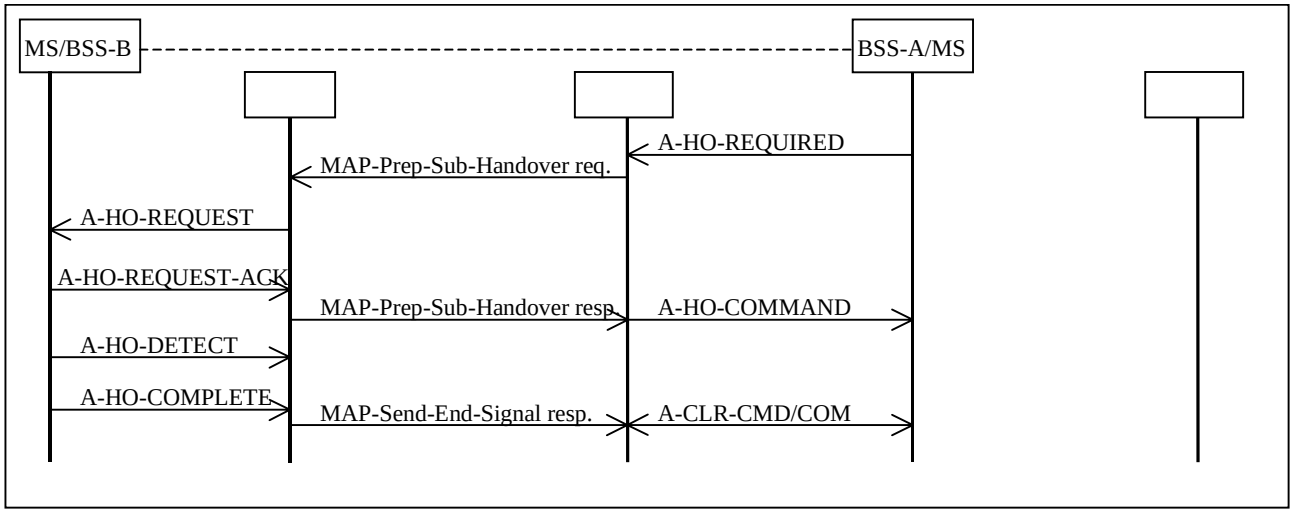


Figure 16~~9~~: Subsequent handover procedure i): Successful handover from MSC-B to MSC-A not requiring a circuit connection

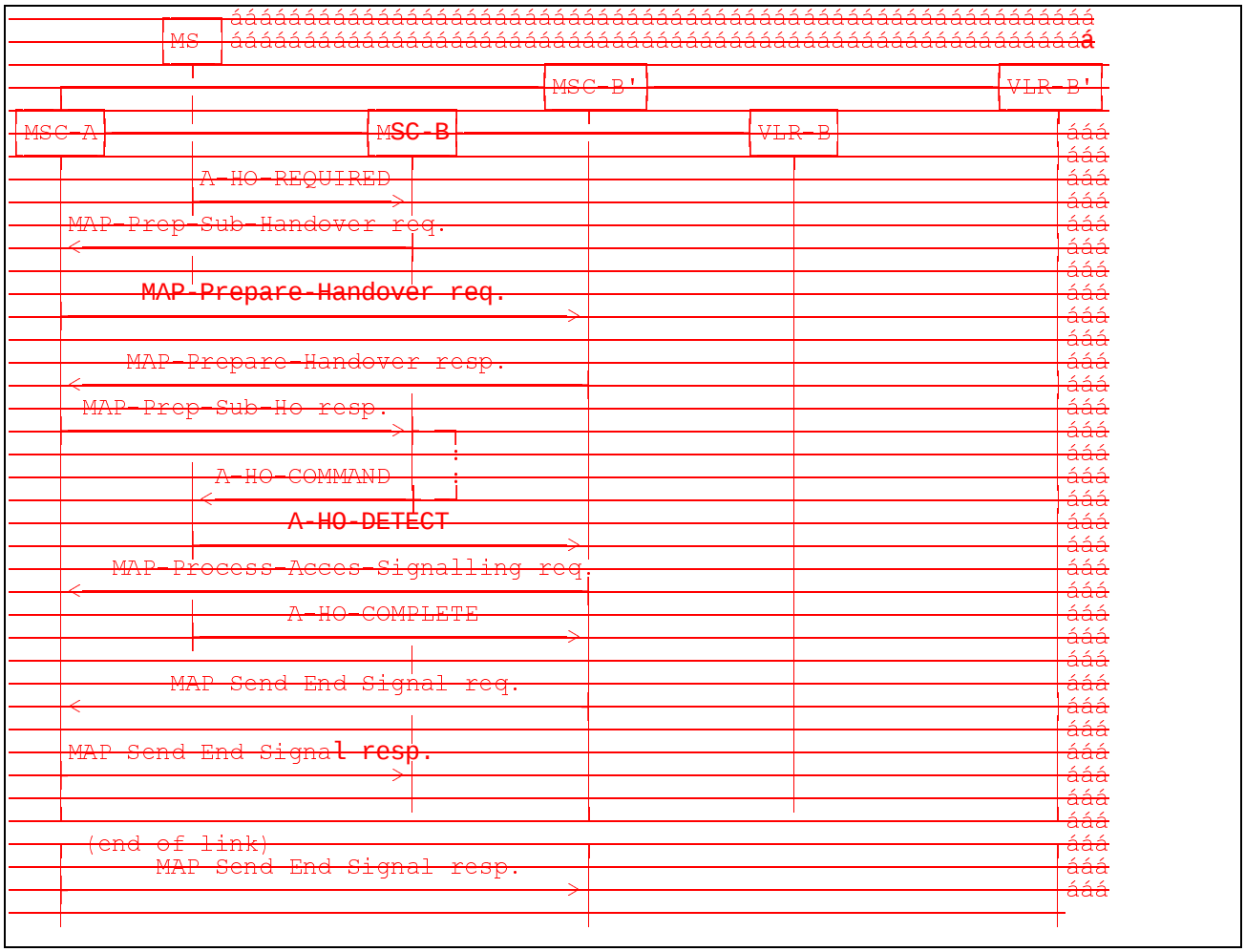
7.4.2 Description of the subsequent handover procedure without circuit connection ii): MSC-B to MSC-B'

The procedure for successful handover from MSC-B to MSC-B' is shown in figure 17~~0~~.

The procedure consists of two parts:

- a subsequent handover from MSC-B back to MSC-A as described in section 7.4.1; and
- a basic handover from MSC-A to MSC-B' as described in section 7.2.

The only difference to the equivalent figure 15~~8~~ is the omission of the circuit and handover number allocation signallings.


MS
MSC-B'
VLR-B'
MSC-A
MSC-B
VLR-B
A-HO-REQUIRED
MAP-Prep-Sub-Handover req.
MAP-Prepare-Handover req.
MAP-Prepare-Handover resp.
MAP-Prep-Sub-Ho resp.
A-HO-COMMAND
A-HO-DETECT
MAP-Process-Access-Signalling req.
A-HO-COMPLETE
MAP Send End Signal req.
MAP Send End Signal resp.
(end of link)
MAP Send End Signal resp.

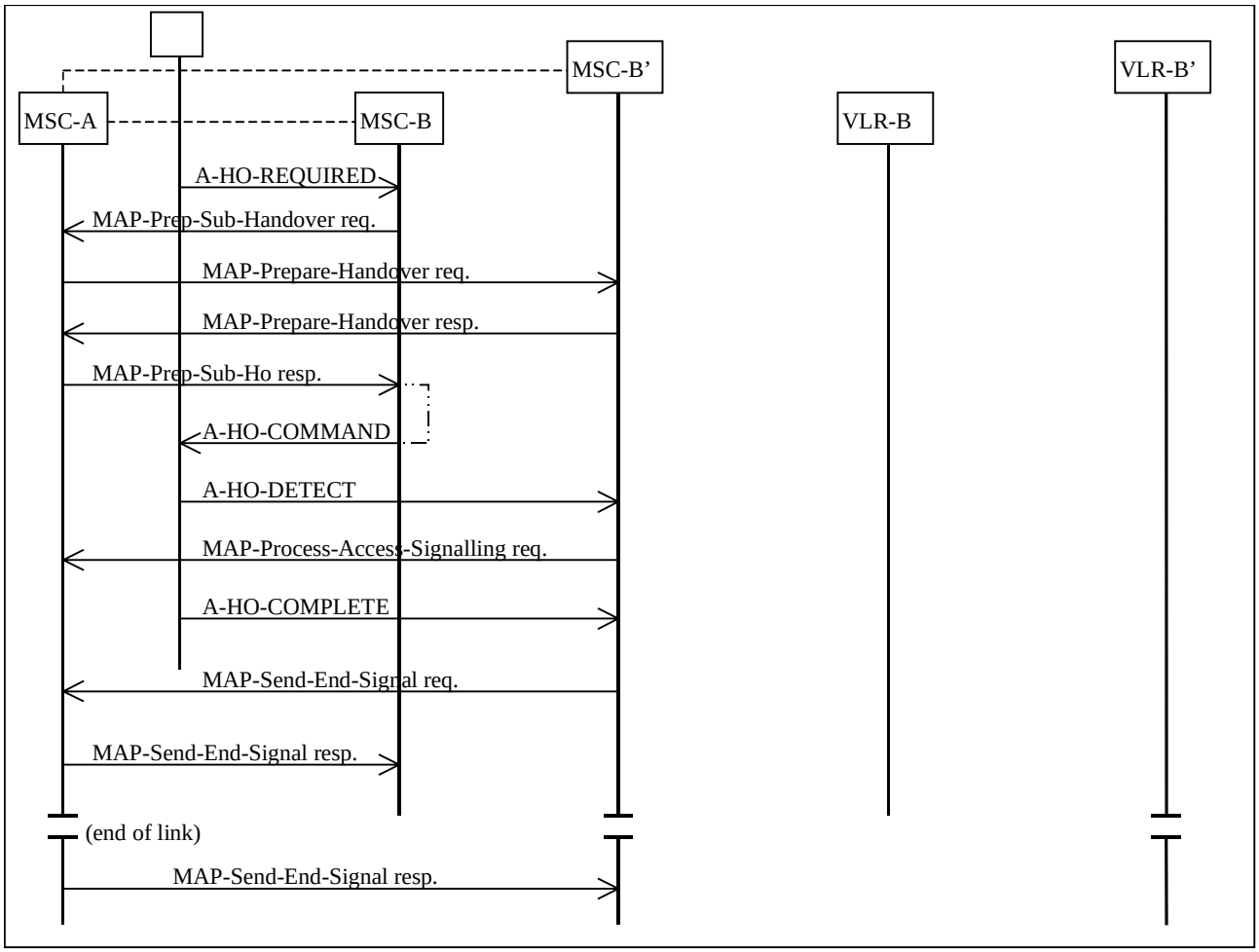


Figure 170: Subsequent handover procedure ii): Successful handover from MSC-B to MSC-B' without circuit connection

8 General Description of the procedures for inter – 3G_MSC handovers

8.1 Handover UMTS to GSM

The following sections describe two options for the Basic and Subsequent UMTS to GSM Handover procedures. The first, as described in section 8.1.1 and 8.1.3 respectively, provides for a circuit connection between 3G_MSC-A and 3G_MSC-B. The second, as described in section 8.1.2 and 8.1.4 respectively, provides for a Basic and Subsequent Handover without the provision of a circuit connection between 3G_MSC-A and 3G_MSC-B. 3G_MSC can also be a pure GSM MSC.

In all the above mentioned sections, the following principles apply:

- During the handover resource allocation, only the handover related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08 - shall be transferred on the E-interface.
- The trace related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08- can be sent by the 3G_MSC-A on the E-interface after successful handover resource allocation. In the sections 8.1.1 and 8.1.2, it is however allowed at basic handover initiation on the E-Interface to transfer one trace related message that is part of the applicable BSSAP subset - as defined in GSM 09.08 - together with the applicable handover related message. The applicable handover related message shall always appear as the first message.
- During the handover execution, i.e. while the UE/MS is not in communication with the network, the 3G_MSC-A shall queue all outgoing BSSAP/Direct Transfer messages until the communication with the UE/MS is resumed.
- Finally, during supervision, i.e. while the UE/MS is not in the area of 3G_MSC-A after a successful Inter-3G_MSC handover, the subset of BSSAP procedures and their related messages - as defined in GSM 09.08 - shall apply on the E-Interface.
- During the intra-3G_MSC -B handover execution, if any, the 3G_MSC -B shall queue all outgoing BSSAP messages until the communication with the UE/MS is resumed.

8.1.1 Basic Handover procedure requiring a circuit connection between 3G_MSC -A and MSC-B

The procedure used for successful Inter-3G_MSC UMTS to GSM Handover is shown in figure 18. Initiation of the UMTS to GSM handover procedure is described in section 5. The procedure described in this section makes use of messages from the Technical Specification GSM 08.08 and of the transport mechanism from the Mobile Application Part (MAP) (Technical Specification GSM 29.002). After an Inter-3G_MSC relocation/handover, Intra-3G_MSC UMTS to GSM handover may occur on 3G_MSC -B, this handover will follow the procedures specified in a previous section.

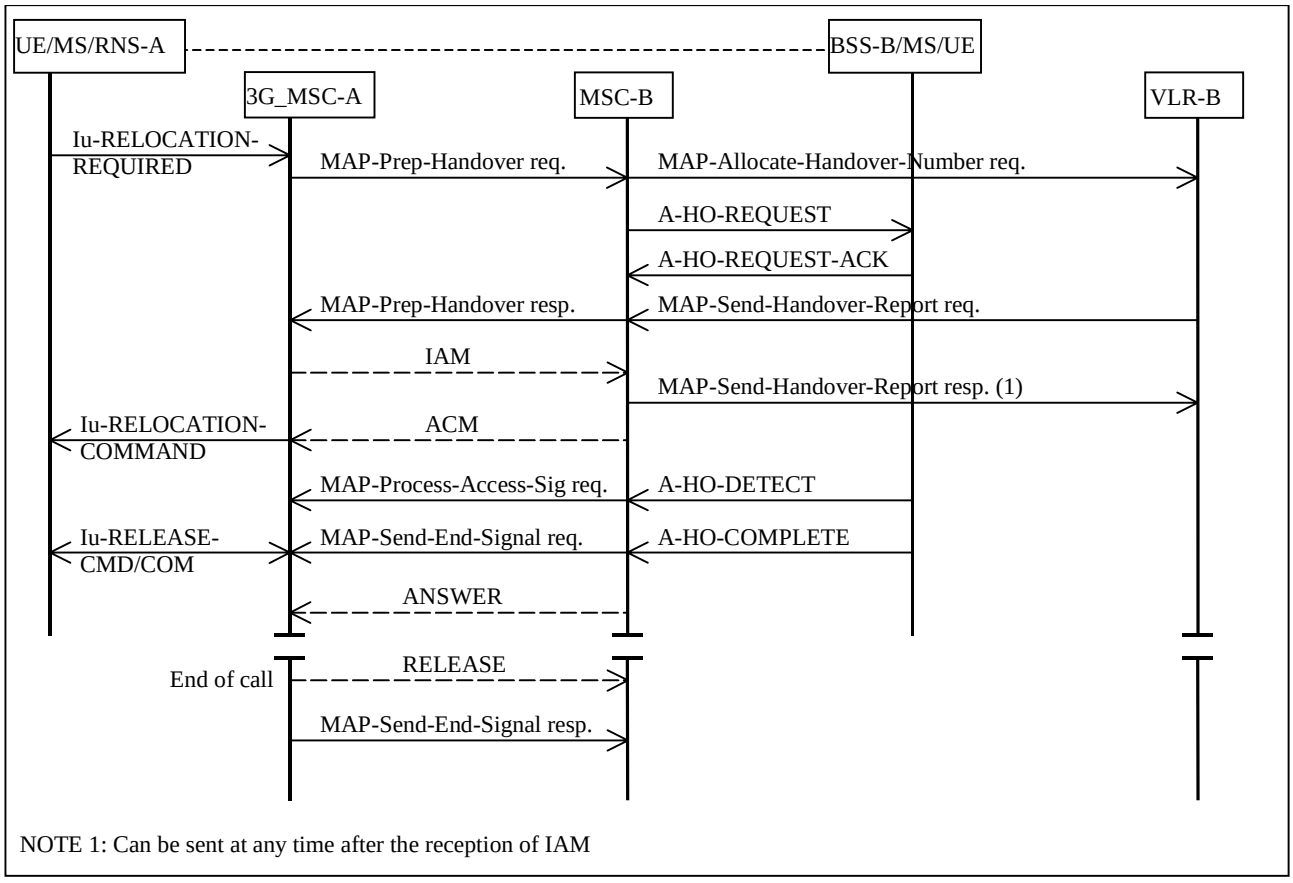


Figure 18: Basic UMTS to GSM Handover Procedure requiring a circuit connection

The UMTS to GSM handover is initiated as described in section 6.2.1. (This is represented by Iu-RELOCATION-REQUIRED in figure 18). Upon receipt of the Iu-RELOCATION-REQUIRED from RNS-A, 3G_MSC -A shall send a MAP-PREPARE-HANDOVER request to MSC-B including a complete A-HO-REQUEST message. (NOTE: 3G_MSC-A shall not send further MAP-PREPARE-HANDOVER requests while a MAP-PREPARE-HANDOVER response is pending or before any timeouts). The MAP-PREPARE-HANDOVER request shall carry in the A-HO-REQUEST all information needed by MSC-B for allocating a radio channel, see Technical Specification GSM 08.08. For compatibility reasons, the MAP-PREPARE-HANDOVER request will also identify the cell to which the call is to be handed over. MSC-B will return the MAP-PREPARE-HANDOVER response after having retrieved a Handover Number from its associated VLR (exchange of the messages MAP-allocate-handover-number request and MAP-send-handover-report request). The Handover Number shall be used for routing the connection of the call from 3G_MSC-A to MSC-B. If a traffic channel is available in MSC-B the MAP-PREPARE-HANDOVER response, sent to 3G_MSC-A will contain the complete A-HO-REQUEST-ACKNOWLEDGE message received from BSS-B, containing the radio resources definition to be sent by RNS-A to the UE/MS and possible extra BSSMAP information, amended by MSC-B due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface. If the traffic channel allocation is queued by BSS-B, the A-QUEUING-INDICATION may optionally be sent back to 3G_MSC-A. The further traffic channel allocation result (A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to 3G_MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. If the traffic channel allocation is not possible, the MAP-PREPARE-HANDOVER response containing an A-HO-FAILURE will be sent to 3G_MSC-A. MSC-B will do the same if a fault is detected on the identity of the cell where the call has to be handed over. MSC-B simply reports the events related to the dialogue. It is up to 3G_MSC-A to decide the action to perform if it receives negative responses or the operation fails due to the expiry of the MAP-PREPARE-HANDOVER timer.

If an error related to the TCAP dialogue or to the MAP-PREPARE-HANDOVER request is returned from MSC-B, this will be indicated to 3G_MSC-A and 3G_MSC-A will terminate the handover attempt. 3G_MSC-A rejects the handover attempt towards RNS-A. The existing connection to the UE/MS shall not be cleared.

When the A-HO-REQUEST-ACKNOWLEDGE has been received, 3G_MSC-A shall establish a circuit between 3G_MSC-A and MSC-B by signalling procedures supported by the network. In figure 18 this is illustrated by the messages IAM (Initial Address Message) and ACM (Address Complete Message) of Signalling System no 7. MSC-B awaits the capturing of the UE/MS (section 6.2.1) on the radio path when the ACM is sent and 3G_MSC-A initiates the UMTS to GSM handover execution when ACM is received (illustrated by the Iu-RELOCATION-COMMAND and described in the section 6.2.1).

MSC-B transfers to 3G_MSC-A the acknowledgement received from the correct UE/MS (A-HO-DETECT/A-HO-COMPLETE). The A-HO-DETECT, if received, is transferred to 3G_MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. The A-HO-COMPLETE, when received from the correct UE/MS, is included in the MAP-SEND-END-SIGNAL request and sent back to 3G_MSC-A. The circuit is through connected in 3G_MSC-A when the A-HO-DETECT or the A-HO-COMPLETE is received from MSC-B. The old radio channel is released when the A-HO-COMPLETE message is received from MSC-B. The sending of the MAP-SEND-END-SIGNAL request starts the MAP supervision timer for the MAP dialogue between 3G_MSC-A and MSC-B. When the MAP-SEND-END-SIGNAL request including the A-HO-COMPLETE message is received in 3G_MSC-A, the resources in RNS-A shall be cleared.

In order not to conflict with the PSTN/ISDN signalling system(s) used between 3G_MSC-A and MSC-B, MSC-B must generate an answer signal when A-HO-DETECT/COMPLETE is received.

MSC-B shall release the Handover Number when the circuit between 3G_MSC-A and MSC-B has been established.

If the circuit between 3G_MSC-A and MSC-B cannot be established, (e.g. an unsuccessful backward message is received instead of ACM), 3G_MSC-A terminates the inter-3G_MSC UMTS to GSM handover attempt by sending an appropriate MAP message, for example an ABORT.

3G_MSC-A shall retain overall call control until the call is cleared by the fixed subscriber or the UE/MS and there is no further call control functions to be performed (e.g. servicing waiting calls, echo cancellers).

When 3G_MSC-A clears the call to the UE/MS it also clears the call control functions in 3G_MSC-A and sends the MAP-SEND-END-SIGNAL response to release the MAP resources in MSC-B.

3G_MSC-A may terminate the procedure at any time by sending an appropriate MAP message to MSC-B. If establishment of the circuit between 3G_MSC-A and MSC-B has been initiated, the circuit must also be cleared.

The UMTS to GSM handover will be aborted by 3G_MSC-A if it detects clearing or interruption of the radio path before the call has been established on MSC-B.

8.1.2 Basic UMTS to GSM Handover procedure not requiring the establishment of a circuit connection between 3G_MSC-A and MSC-B

The basic UMTS to GSM handover procedures to be used when no circuit connection is required by 3G_MSC-A are similar to those described in section 8.1.1 for circuit switched calls. The main differences to the procedures described in section 8.1.1 relate to the establishment of circuits between the network entities and the Handover Number allocation.

In the case of basic UMTS to GSM handover, 3G_MSC-A shall specify to MSC-B that no Handover Number is required in the MAP-PREPARE-HANDOVER request (see Technical Specification 29.002). As for the basic UMTS to GSM handover using a circuit connection, the A-HO-REQUEST is transmitted at the same time. Any subsequent Handover Number allocation procedure will not be invoked until the completion of the basic UMTS to GSM handover procedure (see section: Subsequent Channel Assignment using a circuit connection). MSC-B shall then perform the radio resources allocation as described in section 8.1.1. The MAP-PREPARE-HANDOVER response shall be returned to 3G_MSC-A including either the response of the radio resources allocation request received from BSS-B (A-HO-REQUEST-ACKNOWLEDGE/A-HO-FAILURE with possible extra BSSMAP information. These extra information are amended by MSC-B due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface) or potentially the A-QUEUING-INDICATION . The basic UMTS to GSM handover procedure will continue as described in section 8.1.1 except that no circuit connection will be established towards MSC-B.

The relevant case for the basic UMTS to GSM handover without circuit connection is shown in figure 19. As can be seen the major differences to the equivalent figure 18 is the omission of any circuit establishment messaging and the omission of handover number allocation signalling.

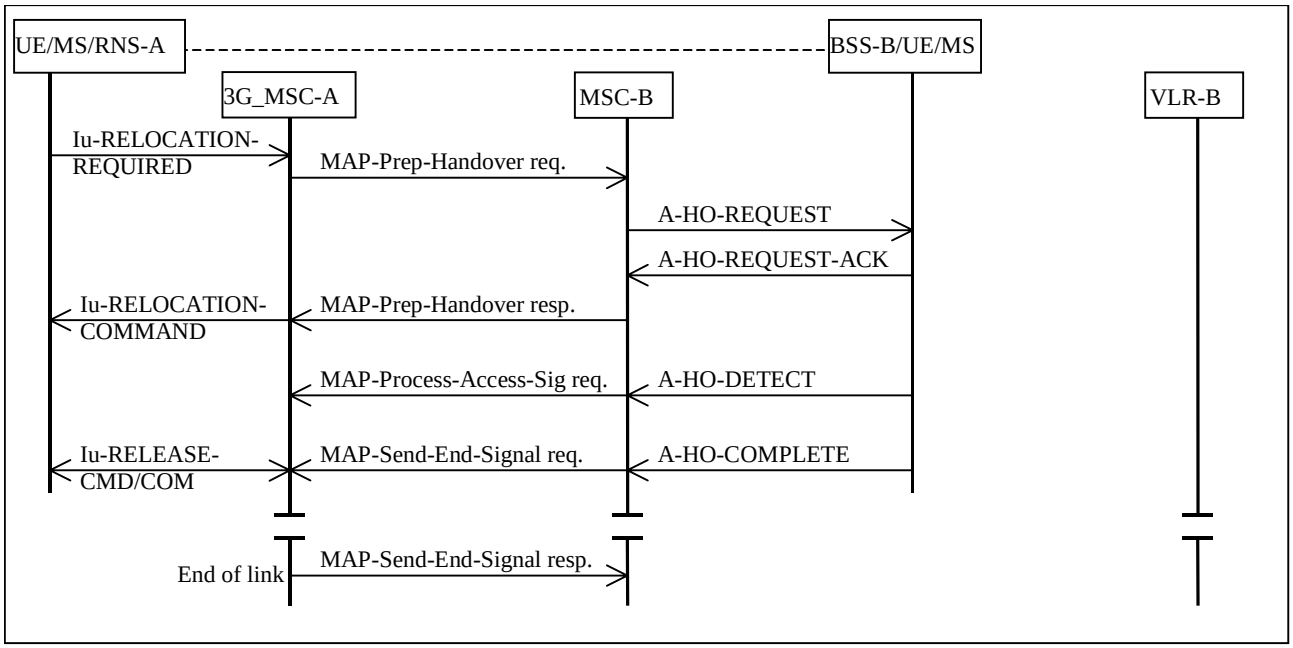


Figure 19: Basic UMTS to GSM Handover Procedure without circuit connection

8.1.3 Procedure for subsequent UMTS to GSM handover requiring a circuit connection between 3G_MSC-A and 3G_MSC-B

After the call has been handed over from 3G_MSC-A to 3G_MSC-B, if the UE/MS leaves the area of 3G_MSC-B during the same call and enters a GSM area, subsequent UMTS to GSM handover is necessary in order to continue the connection.

The following cases apply:

i) the UE/MS moves back to the area of MSC-A;

ii) the UE/MS moves into the area of a third MSC (MSC-B').

In both cases the call is switched in 3G_MSC-A; the circuit between 3G_MSC-A and MSC-B shall be released after a successful subsequent handover has been performed (remember that 3G_MSC-A can be a pure GSM MSC).

8.1.3.1 Description of subsequent UMTS to GSM handover procedure i): 3G_MSC-B to MSC-A

The procedure for successful UMTS to GSM handover from MSC-B back to 3G_MSC-A is shown in figure 20.

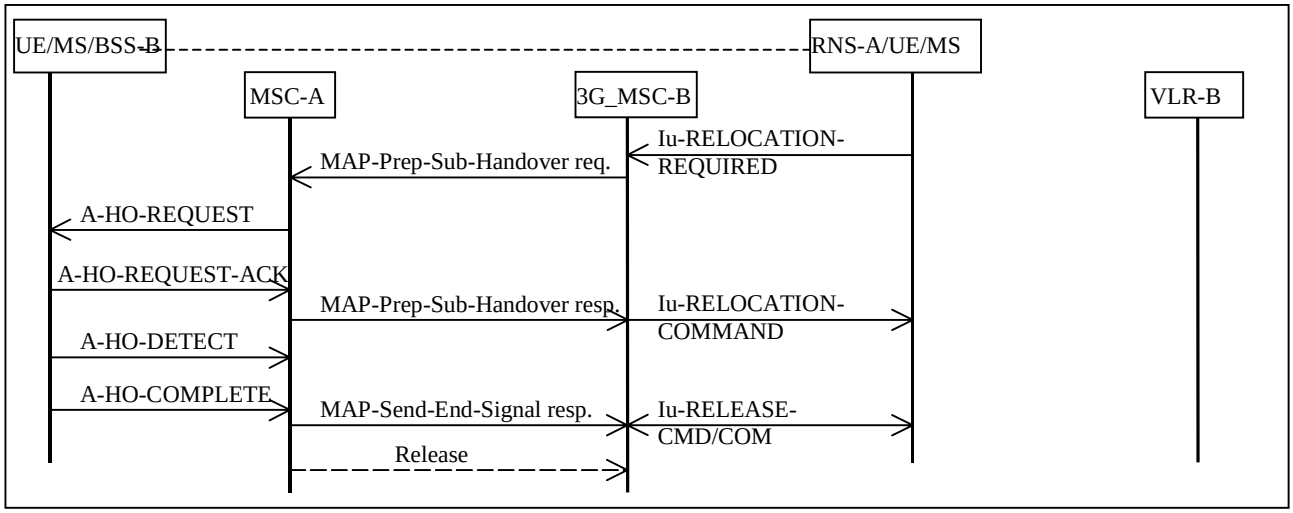


Figure 20: Subsequent UMTS to GSM handover procedure i): successful UMTS to GSM handover from 3G_MSC-B to MSC-A using a circuit connection

The procedure is as follows:

3G_MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to MSC-A indicating the new MSC number (MSC-A number), indicating also the identity of the cell where the call has to be handed over and including a complete A-HO-REQUEST message. (NOTE: 3G_MSC-B shall not send further MAP-PREPARE-SUBSEQUENT-HANDOVER requests while a handover attempt is pending or before any timeouts). Since MSC-A is the call controlling MSC, this MSC needs no Handover Number for routing purposes; MSC-A can immediately initiate the search for a free radio channel.

When a radio channel can be assigned, MSC-A shall return in the MAP-PREPARE-SUBSEQUENT-HANDOVER response the complete A-HO-REQUEST-ACKNOWLEDGE message received from the BSS-B and possible extra BSSMAP information, amended by MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface. If the traffic channel allocation is queued by BSS-B, the A-QUEUING-INDICATION may optionally be sent back to 3G_MSC-B. The further traffic channel allocation result (A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to 3G_MSC-B using the MAP-FORWARD-ACCESS-SIGNALLING request. If a radio channel cannot be assigned or if a fault is detected on the target cell identity, or the target cell identity in the A-HO-REQUEST is not consistent with the target MSC number, the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing an A-HO-FAILURE message shall be given to 3G_MSC-B, in addition 3G_MSC-B shall maintain the connection with the UE/MS.

If the procedure in MSC-A is successful then 3G_MSC-B can request the UE/MS to retune to the new BSS-B on MSC-A. This is illustrated in figure 20 by the Iu-RELOCATION-COMMAND message. The operation is successfully completed when MSC-A receives the A-HO-COMPLETE message.

After UMTS to GSM handover MSC-A shall release the circuit to 3G_MSC-B.

MSC-A must also terminate the MAP procedure for the basic UMTS to GSM handover between MSC-A and 3G_MSC-B by sending an appropriate MAP message. 3G_MSC-B will clear the resources in RNS-A when the MAP-SEND-END-SIGNAL response is received.

8.1.3.2 Description of subsequent UMTS to GSM handover procedure ii): 3G_MSC-B to MSC-B'

The procedure for successful UMTS to GSM handover from 3G_MSC-B to MSC-B' is shown in figure 21.

The procedure consists of two parts:

- a subsequent UMTS to GSM handover from 3G_MSC-B back to 3G_MSC-A as described in section 8.1.3.1 (3G_MSC-A can also be a pure GSM MSC, the procedure is the same in both casess); and

- a basic handover from 3G_MSC-A to MSC-B' as described in section 7.1.

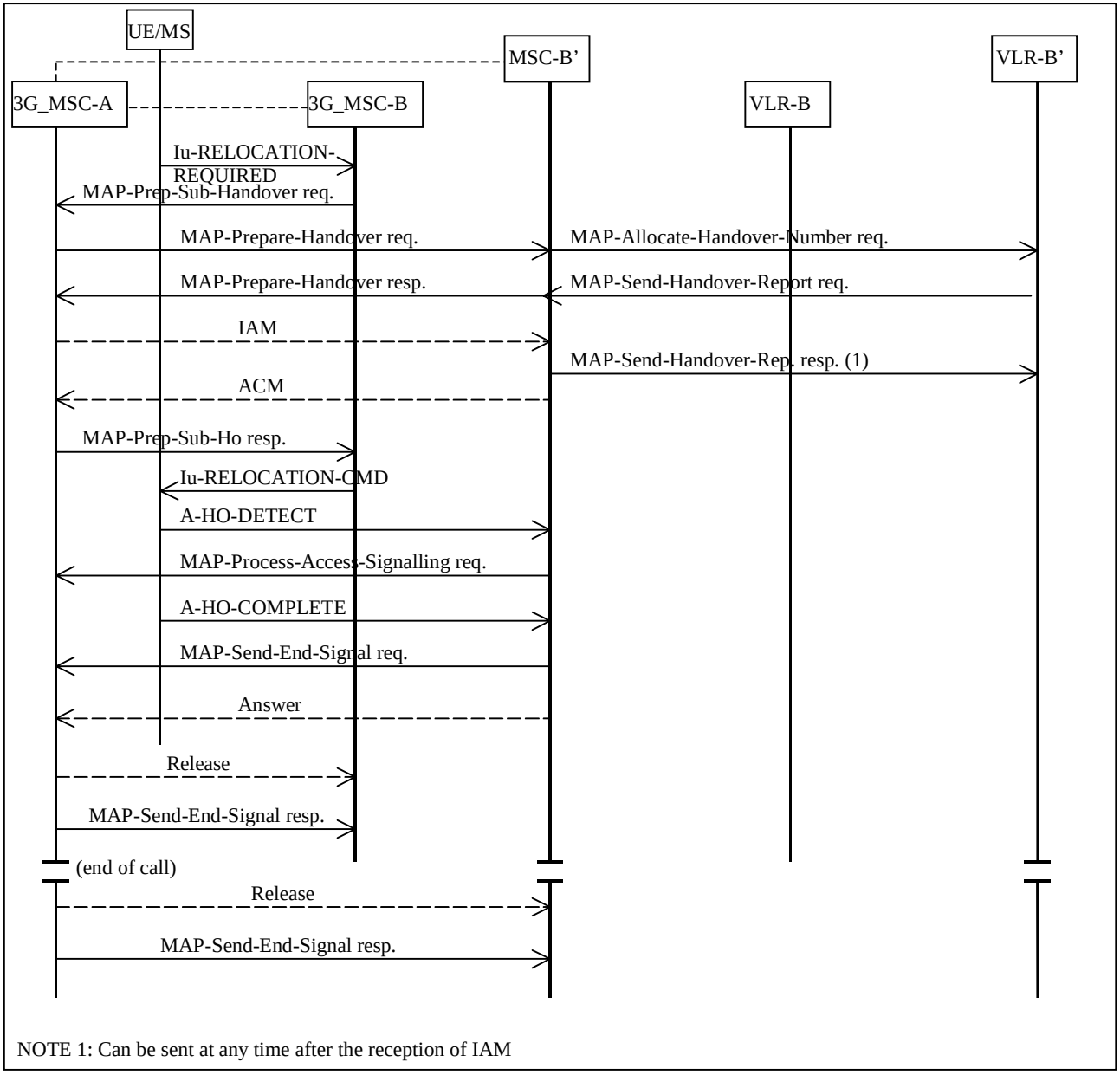
3G_MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to 3G_MSC-A indicating a new MSC number (which is the identity of MSC-B'), indicating also the target cell identity and including a complete A-HO-REQUEST, 3G_MSC-A then starts a basic handover procedure towards MSC-B'.

When 3G_MSC-A receives the ACM from MSC-B', 3G_MSC-A informs 3G_MSC-B that MSC-B' has successfully allocated the radio resources on BSS-B' side by sending the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing the complete A-HO-REQUEST-ACKNOWLEDGE received from BSS-B' and possible extra BSSMAP information, amended by 3G_MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface between 3G_MSC-A and MSC-B' and the BSSMAP protocol carried on the E-interface between 3G_MSC-A and 3G_MSC-B. Now 3G_MSC-B can start the procedure on the radio path.

For 3G_MSC-A the UMTS to GSM handover is completed when it has received the MAP-SEND-END-SIGNAL REQUEST from MSC-B' containing the A-HO-COMPLETE received from the BSS-B'. The circuit between 3G_MSC-A and 3G_MSC-B is released. 3G_MSC-A also sends the MAP-SEND-END-SIGNAL response to 3G_MSC-B in order to terminate the original MAP dialogue between 3G_MSC-A and 3G_MSC-B. 3G_MSC-B releases the radio resources when it receives this message.

If the traffic channel allocation is queued by the BSS-B', the A-QUEUING-INDICATION may optionally be sent back to 3G_MSC-B. If no radio channel can be allocated by MSC-B' or no circuit between 3G_MSC-A and MSC-B' can be established or a fault is detected on the target cell identity or the target cell identity in the A-HO-REQUEST is not consistent with the target MSC number, 3G_MSC-A informs 3G_MSC-B by using the A-HO-FAILURE message included in the MAP-PREPARE-SUBSEQUENT-HANDOVER response. 3G_MSC-B shall maintain the existing connection with the UE/MS.

When the subsequent UMTS to GSM handover is completed, MSC-B' is considered as MSC-B. Any further inter-MSC handover is handled as described earlier for a subsequent handover.



NOTE 1: Can be sent at any time after the reception of IAM

Figure 21: Subsequent handover procedure ii): Successful UMTS to GSM handover from 3G_MSC-B to MSC-B' requiring a circuit connection

8.1.4 Procedure for subsequent UMTS to GSM handover not requiring a circuit connection between 3G_MSC-A and 3G_MSC-B

As for the subsequent UMTS to GSM handover with a circuit connection between 3G_MSC-A and 3G_MSC-B, the same two cases of subsequent handover apply:

i) the UE/MS moves back to the area of MSC-A;

ii) the UE/MS moves into the area of a third MSC (MSC-B').

8.1.4.1 Description of subsequent UMTS to GSM handover procedure i): 3G_MSC-B to MSC-A

The procedure for successful UMTS to GSM handover from 3G_MSC-B back to MSC-A without circuit connection is shown in figure 22. The only difference with the figure 20, is that no circuit release is needed between MSC-A and 3G_MSC-B.

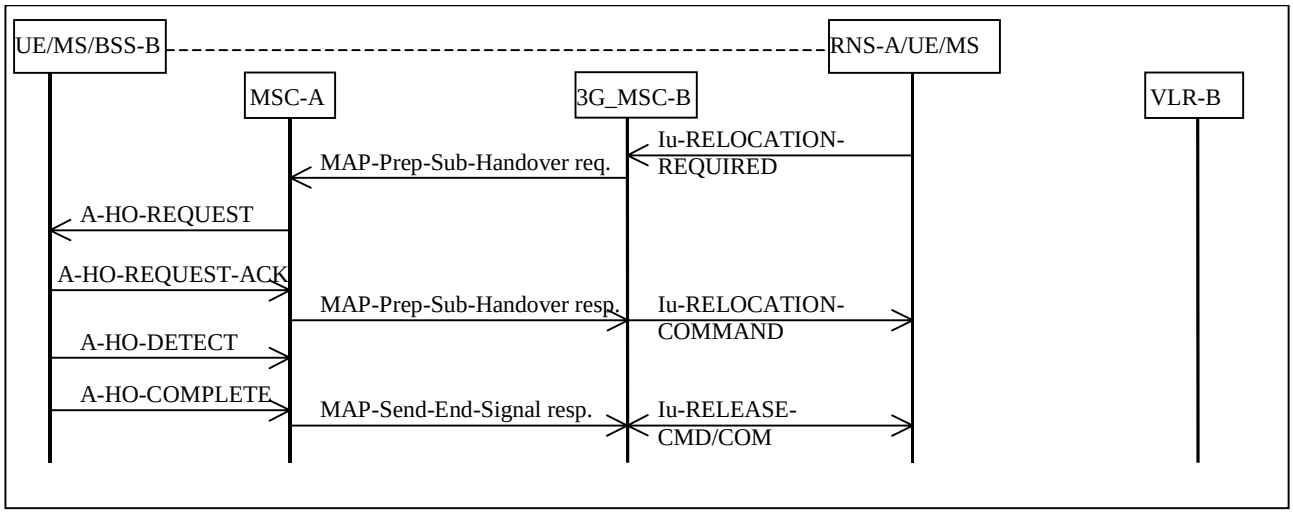


Figure 22: Subsequent UMTS to GSM handover procedure i): Successful UMTS to GSM handover from 3G_MSC-B to MSC-A not requiring a circuit connection

8.1.4.2 Description of the subsequent UMTS to GSM handover procedure without circuit connection ii): 3G_MSC-B to MSC-B'

The procedure for successful UMTS to GSM handover from 3G_MSC-B to MSC-B' is shown in figure 23.

The procedure consists of two parts:

- a subsequent UMTS to GSM handover from 3G_MSC-B back to 3G_MSC-A as described in section 8.1.4.1 (3G_MSC-A can also be a pure GSM MSC, the procedure is the same in both casess); and

- a basic handover from 3G_MSC-A to MSC-B' as described in section 7.2.

The only difference to the equivalent figure 21 is the omission of the circuit and handover number allocation signallings.

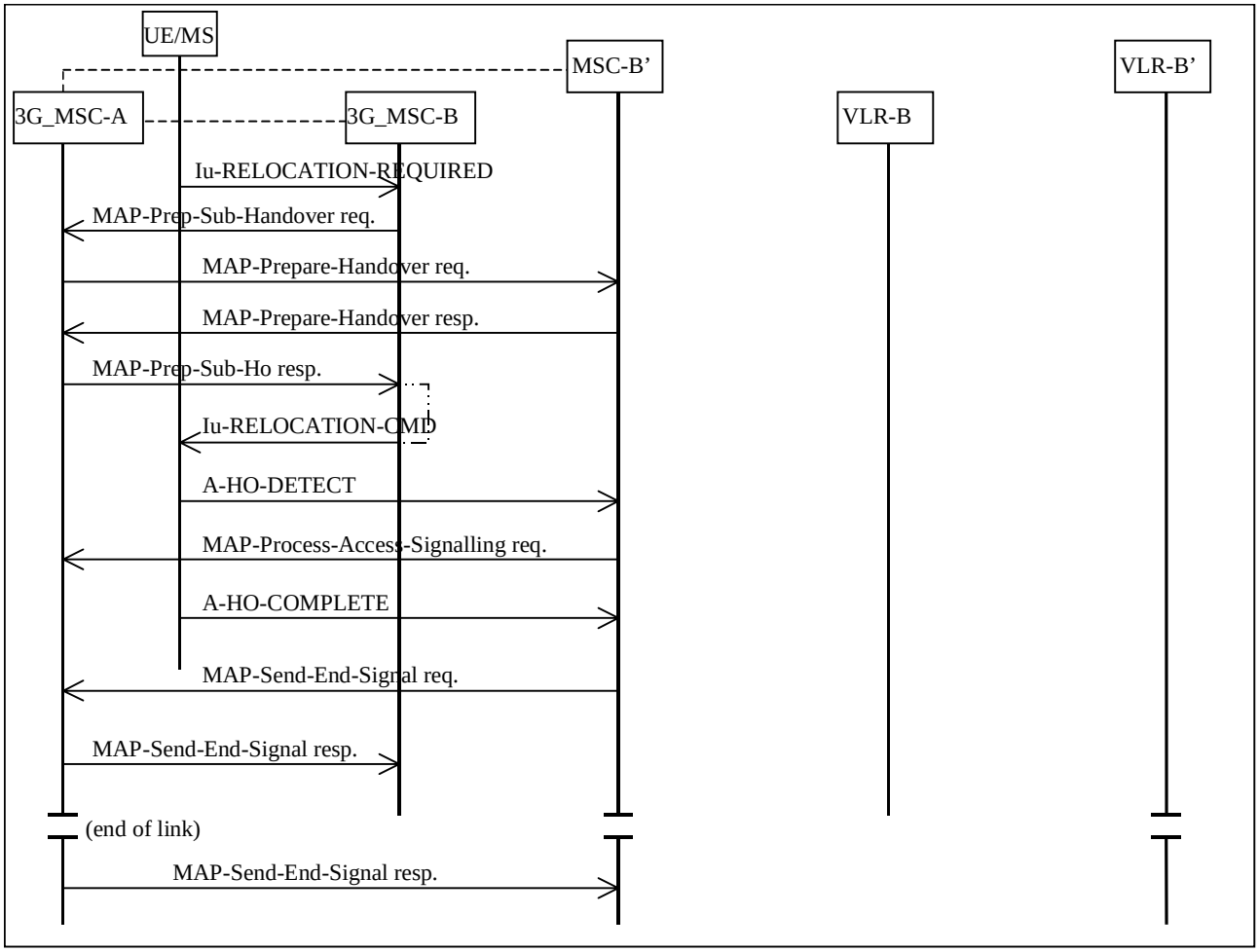


Figure 23: Subsequent UMTS to GSM handover procedure ii): Successful UMTS to GSM handover from 3G_MSC-B to MSC-B' without circuit connection

8.2 Handover GSM to UMTS

The following sections describe two options for the Basic and Subsequent GSM to UMTS Handover procedures. The first, as described in section 8.2.1 and 8.2.3 respectively, provides for a circuit connection between (3G_)MSC-A and (3G_)MSC-B. The second, as described in section 8.2.2 and 8.2.4 respectively, provides for a Basic and Subsequent Handover without the provision of a circuit connection between (3G_)MSC-A and (3G_)MSC-B. In all the above mentioned sections, the following principles apply:

- During the handover resource allocation, only the handover related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - shall be transferred on the E-interface.

- The trace related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - can be sent by the MSC-A on the E-interface after successful handover resource allocation. In the sections 8.2.1 and 8.2.2, it is however allowed at basic handover initiation on the E-Interface to transfer one trace related message that is part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - together with the applicable handover related message. The applicable handover related message shall always appear as the first message.

- During the handover execution, i.e. while the UE/MS is not in communication with the network, the MSC-A shall queue all outgoing BSSAP messages until the communication with the UE/MS is resumed.

- Finally, during supervision, i.e. while the UE/MS is not in the area of MSC-A after a successful Inter-3G_MSC GSM to UMTS handover, the subset of BSSAP procedures and their related messages - as defined in GSM 09.08 [7] - shall apply on the E-Interface.

During the intra-3G_MSC-B GSM to UMTS handover execution, if any, the 3G_MSC-B shall queue all outgoing Direct Transfer messages until the communication with the UE/MS is resumed.

8.2.1 Basic Handover procedure requiring a circuit connection between MSC-A and 3G_MSC-B

The procedure used for successful Inter-3G_MSC Handover from GSM to UMTS is shown in figure 24. Initiation of the GSM to UMTS handover procedure is described in section 5. The procedure described in this section makes use of messages from the Technical Specification GSM 08.08 [5], TS 25.413 [11] and of the transport mechanism from the Mobile Application Part (MAP) (TS 29.002 [12]). After an Inter-3G_MSC handover further Intra-3G_MSC handovers may occur on 3G_MSC-B, these handovers will follow the procedures specified in the previous sections.

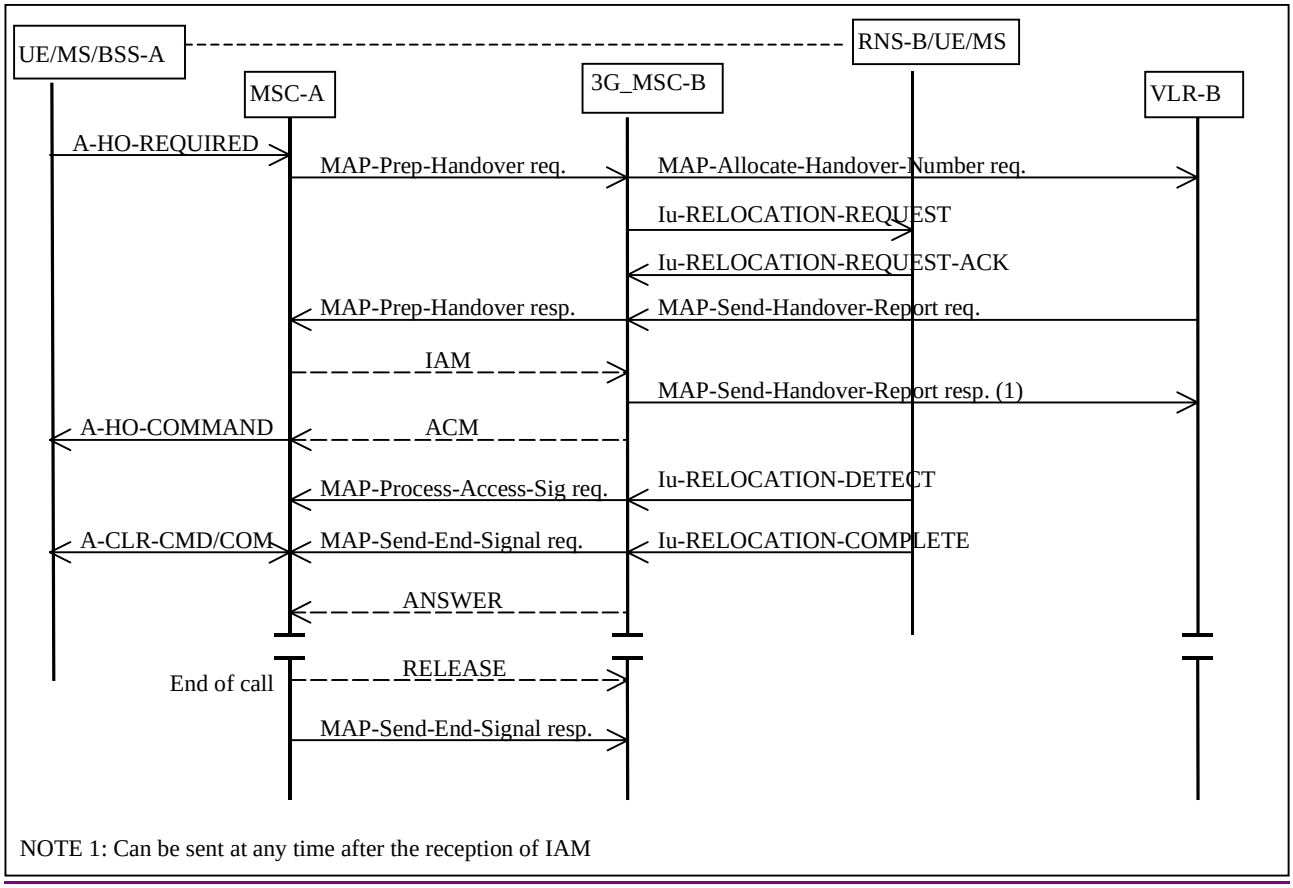


Figure 24: Basic GSM to UMTS Handover Procedure requiring a circuit connection

The GSM to UMTS handover is initiated as described in section 6.2.2. (This is represented by A-HO-REQUIRED in figure 24). Upon receipt of the A-HO-REQUIRED from BSS-A, MSC-A shall send a MAP-PREPARE-HANDOVER request to 3G_MSC-B including a complete A-HO-REQUEST message. (NOTE: MSC-A shall not send further MAP-PREPARE-HANDOVER requests while a MAP-PREPARE-HANDOVER response is pending or before any timeouts). The MAP-PREPARE-HANDOVER request shall carry in the A-HO-REQUEST all information needed by 3G_MSC-B for allocating radio resources in RNS-B, see Technical Specification GSM 08.08 [5]. For compatibility reasons, the MAP-PREPARE-HANDOVER request will also identify the cell to which the call is to be handed over. 3G_MSC-B will return the MAP-PREPARE-HANDOVER response after having retrieved a Handover Number from its associated VLR (exchange of the messages MAP-allocate-handover-number request and MAP-send-handover-report request). The Handover Number shall be used for routing the connection of the call from MSC-A to 3G_MSC-B. If radio resources are available in RNS-B the MAP-PREPARE-HANDOVER response, sent to MSC-A from 3G_MSC-B will contain the complete A-HO-REQUEST-ACK message generated from the Iu-RELOCATION-REQUEST-ACK received from RNS-B, containing the radio resources definition to be sent by BSS-A to the UE/MS. If the radio resource allocation is queued by RNS-B, the A-QUEUING-INDICATION may optionally be sent back to MSC-A. The further radio resource allocation result (A-HO-REQUEST-ACK generated from Iu-RELOCATION-REQUEST-ACK received from RNS-B or

A-HO-FAILURE generated from RELOCATION FAILURE received from RNS-B) will be transferred to MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. If the radio resource allocation is not possible, the MAP-PREPARE-HANDOVER response containing an A-HO-FAILURE will be sent to MSC-A. 3G_MSC-B will do the same if a fault is detected on the identity of the cell where the call has to be handed over. 3G_MSC-B simply reports the events related to the dialogue. It is up to MSC-A to decide the action to perform if it receives negative responses or the operation fails due to the expiry of the MAP-PREPARE-HANDOVER timer.

If an error related to the TCAP dialogue or to the MAP-PREPARE-HANDOVER request is returned from 3G_MSC-B, this will be indicated to MSC-A and MSC-A will terminate the handover attempt. MSC-A shall reject the handover attempt towards BSS-A. The existing connection to the UE/MS shall not be cleared.

When the A-HO-REQUEST-ACK has been received, MSC-A shall establish a circuit between MSC-A and 3G_MSC-B by signalling procedures supported by the network. In figure 24 this is illustrated by the messages IAM (Initial Address Message) and ACM (Address Complete Message) of Signalling System no 7. 3G_MSC-B awaits the capturing of the UE/MS (section 6.2.2) on the radio path when the ACM is sent and MSC-A initiates the handover execution when ACM is received (illustrated by the A-HO-COMMAND and described in the section 6.2.2).

3G_MSC-B transfers to MSC-A the acknowledgement received from the correct UE/MS (A-HO-DETECT/A-HO-COMPLETE). The Iu-RELOCATION-DETECT, if received, is converted to A-HO-DETECT and transferred to MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. The Iu-RELOCATION-COMPLETE, when received from the correct UE/MS, is converted to A-HO-COMPLETE and included in the MAP-SEND-END-SIGNAL request and sent back to MSC-A. The circuit is through-connected in MSC-A when the A-HO-DETECT or the A-HO-COMPLETE is received from 3G_MSC-B. The old radio channel is released when the A-HO-COMPLETE message is received from 3G_MSC-B. The sending of the MAP-SEND-END-SIGNAL request starts the MAP supervision timer for the MAP dialogue between MSC-A and 3G_MSC-B. When the MAP-SEND-END-SIGNAL request including the A-HO-COMPLETE message is received in MSC-A the resources in BSS-A shall be cleared.

In order not to conflict with the PSTN/ISDN signalling system(s) used between MSC-A and 3G_MSC-B, 3G_MSC-B must generate an answer signal when Iu-RELOCATION-DETECT/COMPLETE is received.

3G_MSC-B shall release the Handover Number when the circuit between MSC-A and 3G_MSC-B has been established.

If the circuit between MSC-A and 3G_MSC-B cannot be established (e.g. an unsuccessful backward message is received instead of ACM). MSC-A terminates the inter3G_MSC handover attempt by sending an appropriate MAP message, for example an ABORT.

MSC-A shall retain overall call control until the call is cleared by the fixed subscriber or the UE/MS and there is no further call control functions to be performed (e.g. servicing waiting calls, echo cancellers).

When MSC-A clears the call to the UE/MS it also clears the call control functions in MSC-A and sends the MAP-SEND-END-SIGNAL response to release the MAP resources in 3G_MSC-B.

MSC-A may terminate the procedure at any time by sending an appropriate MAP message to 3G_MSC-B. If establishment of the circuit between MSC-A and 3G_MSC-B has been initiated, the circuit must also be cleared.

The GSM to UMTS handover will be aborted by MSC-A if it detects clearing or interruption of the radio path before the call has been established on 3G_MSC-B.

8.2.2 Basic GSM to UMTS Handover procedure not requiring the establishment of a circuit connection between MSC-A and 3G_MSC-B

The basic GSM to UMTS handover procedures to be used when no circuit connection is required by MSC-A are similar to those described in section 8.2.1 for circuit switched calls. The main differences to the procedures described in section 8.2.1 relate to the establishment of circuits between the network entities and the Handover Number allocation.

In the case of basic GSM to UMTS handover, MSC-A shall specify to 3G_MSC-B that no Handover Number is required in the MAP-PREPARE-HANDOVER request (see TS 29.002 [12]). As for the basic GSM to UMTS handover using a circuit connection, the A-HO-REQUEST is transmitted at the same time. Any subsequent Handover Number allocation procedure will not be invoked until the completion of the basic GSM to UMTS handover procedure (see section: Subsequent Channel Assignment using a circuit connection). 3G_MSC-B shall then perform the radio resources allocation as described in section 8.2.1. The MAP-PREPARE-HANDOVER response shall be returned to MSC-A

including either the translated response of the radio resources allocation request received from RNS-B (A-HO-REQUEST-ACK/A-HO-FAILURE) or potentially the A-QUEUING-INDICATION. The basic GSM to UMTS handover procedure will continue as described in section 8.2.1 except that no circuit connection will be established towards 3G_MSC-B.

The relevant case for the basic GSM to UMTS handover without circuit connection is shown in figure 25. As can be seen the major differences to the equivalent figure 24 are the omission of any circuit establishment messaging and the omission of handover number allocation signalling.

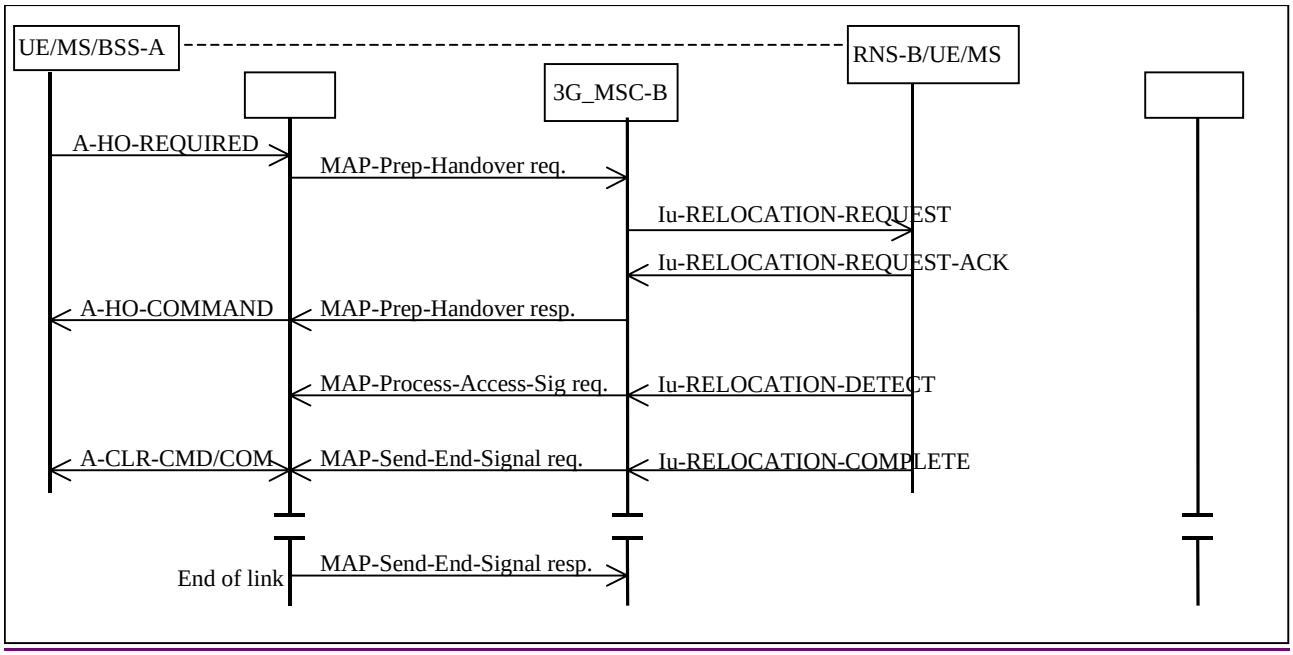


Figure 25: Basic GSM to UMTS Handover Procedure without circuit connection

8.2.3 Procedure for subsequent GSM to UMTS handover requiring a circuit connection between 3G_MSC-A and MSC-B

After the call has been handed over to MSC-B, if the UE/MS leaves the GSM area of MSC-B during the same call and enters a UTRAN area, subsequent GSM to UMTS handover is necessary in order to continue the connection.

The following cases apply:

i) the UE/MS moves back to the area of 3G_MSC-A;

ii) the UE/MS moves into the area of a third 3G_MSC (3G_MSC-B').

In both cases the call is switched in 3G_MSC-A; the circuit between 3G_MSC-A and MSC-B shall be released after a successful subsequent handover has been performed.

8.2.3.1 Description of subsequent GSM to UMTS handover procedure i): MSC-B to 3G_MSC-A

The procedure for successful GSM to UMTS handover from MSC-B back to 3G_MSC-A is shown in figure 26.

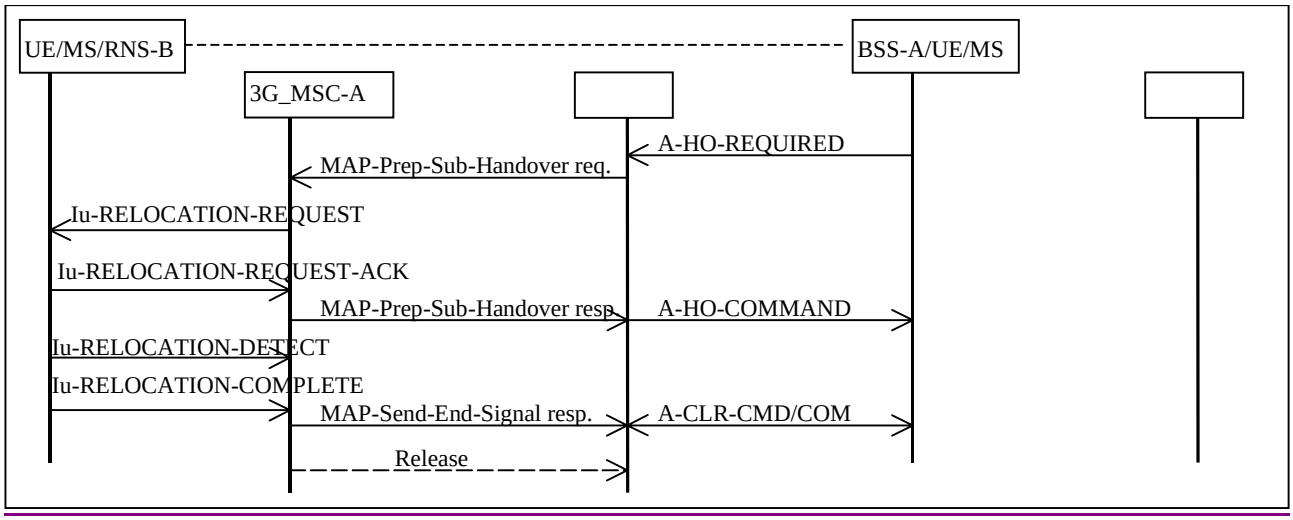


Figure 26: Subsequent GSM to UMTS handover procedure i): successful handover from MSC-B to 3G_MSC-A using a circuit connection

The procedure is as follows:

MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to 3G_MSC-A indicating the new MSC number (3G_MSC-A number), indicating also the identity of the cell where the call has to be handed over and including a complete A-HO-REQUEST message. (NOTE: MSC-B shall not send further MAP-PREPARE-SUBSEQUENT-HANDOVER requests while a handover attempt is pending or before any timeouts). Since 3G_MSC-A is the call controlling MSC, this MSC needs no Handover Number for routing purposes; 3G_MSC-A can immediately initiate the search for free radio resources.

When radio resources can be assigned, 3G_MSC-A shall return in the MAP-PREPARE-SUBSEQUENT-HANDOVER response the complete A-HO-REQUEST-ACK message generated from the Iu-RELOCATION-REQUEST-ACK received from the RNS-B and possible extra BSSMAP information, amended by 3G_MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface and the RANAP protocol used on the Iu-interface. If the radio resource allocation is queued by RNS-B, the A-QUEUING-INDICATION may optionally be sent back to MSC-B. The further radio resource allocation result (A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to MSC-B using the MAP-FORWARD-ACCESS-SIGNALLING request. If radio resources cannot be assigned or if a fault is detected on the target cell identity, or the target cell identity in the A-HO-REQUEST is not consistent with the target MSC number, the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing an A-HO-FAILURE message shall be given to MSC-B, in addition MSC-B shall maintain the connection with the UE/MS.

If the procedure in 3G_MSC-A is successful then MSC-B can request the UE/MS to retune to the new RNS-B on 3G_MSC-A. This is illustrated in figure 26 by the A-HO-COMMAND message. The operation is successfully completed when 3G_MSC-A receives the Iu-RELOCATION-COMPLETE message.

After GSM to UMTS handover 3G_MSC-A shall release the circuit to MSC-B.

3G_MSC-A must also terminate the MAP procedure for the basic handover between 3G_MSC-A and MSC-B by sending an appropriate MAP message. MSC-B will clear the resources in BSS-A when the MAP-SEND-END-SIGNAL response is received.

8.2.3.2 Description of subsequent GSM to UMTS handover procedure ii): MSC-B to 3G_MSC-B''

The procedure for successful GSM to UMTS handover from MSC-B to 3G_MSC-B' is shown in figure 27.

The procedure consists of two parts:

- a subsequent handover from MSC-B back to MSC-A as described in section 7.3.1 (MSC-A can also be a 3G_MSC, the procedure is the same in both cases); and

- a basic GSM to UMTS handover from MSC-A to 3G_MSC-B' as described in section 8.2.1.

MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to MSC-A indicating a new MSC number (which is the identity of 3G_MSC-B'), indicating also the target cell identity and including a complete A-HO-REQUEST, MSC-A then starts a basic handover procedure towards 3G_MSC-B'.

When MSC-A receives the ACM from 3G_MSC-B', MSC-A informs MSC-B that 3G_MSC-B' has successfully allocated the radio resources on RNS-B' side by sending the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing the complete A-HO-REQUEST-ACK generated from the RELOCATION-REQUEST-ACK received from RNS-B' and possible extra BSSMAP information, amended by MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface between MSC-A and 3G_MSC-B' and the BSSMAP protocol carried on the E-interface between MSC-A and MSC-B. Now MSC-B can start the procedure on the radio path.

For MSC-A the handover is completed when it has received the MAP-SEND-END-SIGNAL REQUEST from 3G_MSC-B' containing the A-HO-COMPLETE generated from Iu-RECOLATION COMPLETE received from the RNS-B'. The circuit between MSC-A and MSC-B is released. MSC-A also sends the MAP-SEND-END-SIGNAL response to MSC-B in order to terminate the original MAP dialogue between MSC-A and MSC-B. MSC-B releases the radio resources when it receives this message.

If the radio resource allocation is queued by the RNS-B', the A-QUEUING-INDICATION may optionally be sent back to MSC-B. If no radio resources can be allocated by 3G_MSC-B' or no circuit between MSC-A and 3G_MSC-B' can be established or a fault is detected on the target cell identity or the target cell identity in the A-HO-REQUEST is not consistent with the target MSC number, MSC-A informs MSC-B by using the A-HO-FAILURE message included in the MAP-PREPARE-SUBSEQUENT-HANDOVER response. MSC-B shall maintain the existing connection with the UE/MS.

When the subsequent GSM to UMTS handover is completed, 3G_MSC-B' is considered as 3G_MSC-B. Any further inter-MSC handover is handled as described above for a subsequent handover.

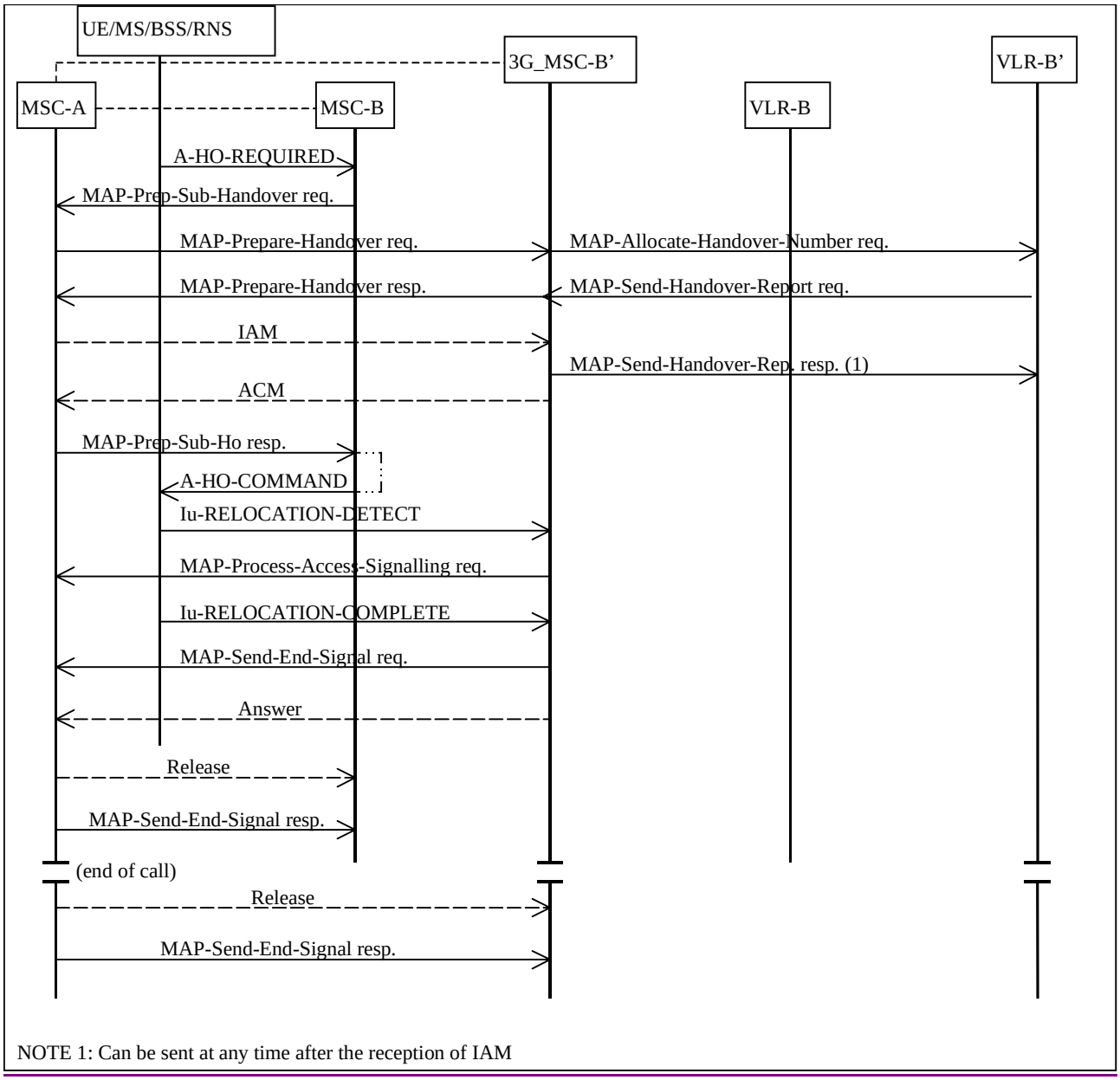


Figure 27: Subsequent GSM to UMTS handover procedure ii): Successful handover from MSC-B to 3G_MSC-B' requiring a circuit connection

8.2.4 Procedure for subsequent GSM to UMTS handover not requiring a circuit connection between 3G_MSC-A and MSC-B

As for the subsequent GSM to UMTS handover with a circuit connection between 3G_MSC-A and MSC-B, the same two cases of subsequent handover apply:

i) the UE/MS moves back to the area of 3G_MSC-A;

ii) the UE/MS moves into the area of a third 3G_MSC (3G_MSC-B').

8.2.4.1 Description of subsequent GSM to UMTS handover procedure without circuit connection i): MSC-B to 3G_MSC-A

The procedure for successful GSM to UMTS handover from MSC-B back to 3G_MSC-A without circuit connection is shown in figure 28. The only difference with the figure 26, is that no circuit release is needed between 3G_MSC-A and MSC-B.

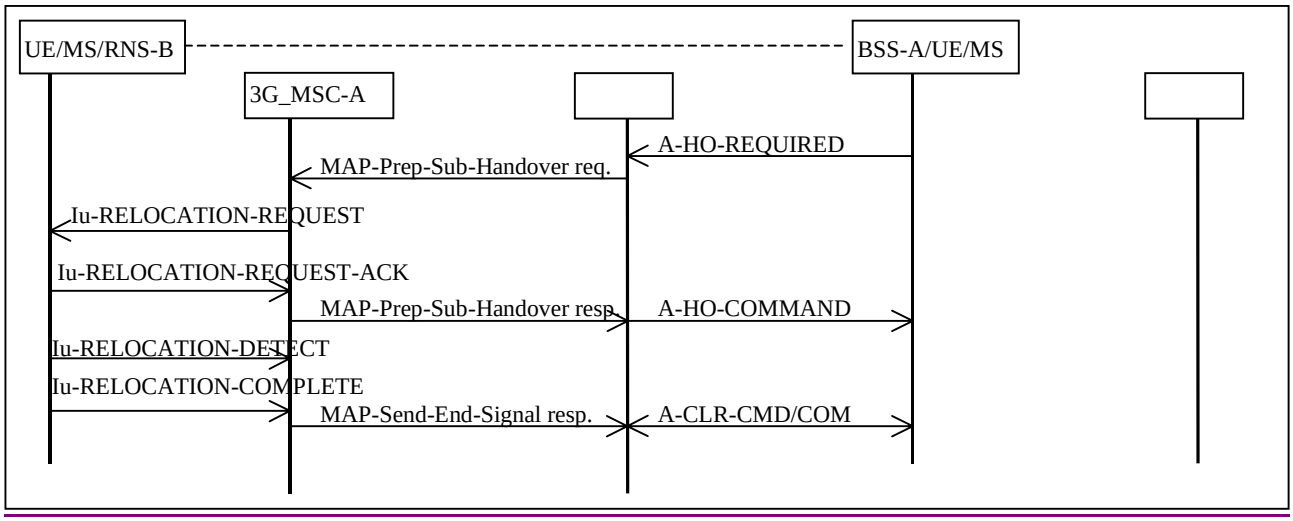


Figure 28: Subsequent GSM to UMTS handover procedure i): Successful handover from MSC-B to 3G_MSC-A not requiring a circuit connection

8.2.4.2 Description of subsequent GSM to UMTS handover procedure without circuit connection ii): MSC-B to 3G_MSC-B'

The procedure for successful GSM to UMTS handover from MSC-B to 3G_MSC-B' is shown in figure 29.

The procedure consists of two parts:

- a subsequent handover from MSC-B back to MSC-A as described in section 7.4.1 (MSC-A can also be a 3G_MSC, the procedure is the same in both cases); and

- a basic GSM to UMTS handover from MSC-A to 3G_MSC-B' as described in section 8.2.2.

The only difference to the equivalent figure 27 is the omission of the circuit and handover number allocation signallings.

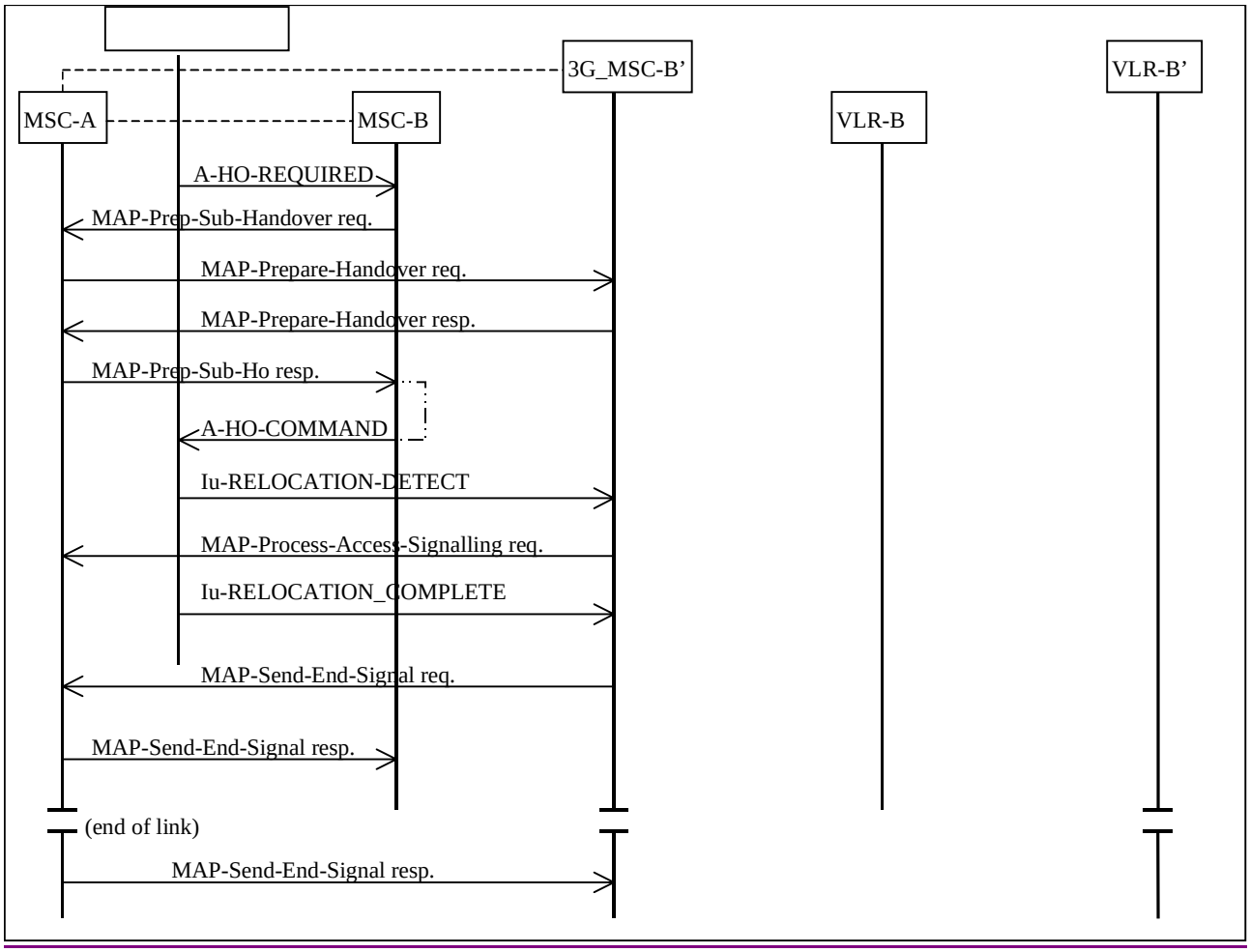


Figure 29: Subsequent GSM to UMTS handover procedure ii): Successful handover from MSC-B to 3G_MSC-B' without circuit connection

8.3 SRNS Relocation

The following sections describe two options for the Basic and Subsequent Relocation procedures. The first, as described in section 8.3.1 and 8.3.3 respectively, provides for a circuit connection between 3G_MSC-A and 3G_MSC-B. The second, as described in section 8.3.2 and 8.3.4 respectively, provides for a Basic and Subsequent Relocation without the provision of a circuit connection between 3G_MSC-A and 3G_MSC-B.

In all the above mentioned sections, the following principles apply:

- During the relocation resource allocation, only the handover related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08[7] - shall be transferred on the E-interface.

- The trace related messages that are part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - can be sent by the 3G_MSC-A on the E-interface after successful relocation resource allocation. In the sections 8.3.1 and 8.3.2, it is however allowed at basic relocation initiation on the E-Interface to transfer one trace related message that is part of the applicable BSSAP subset - as defined in GSM 09.08 [7] - together with the applicable handover related message. The applicable handover related message shall always appear as the first message.

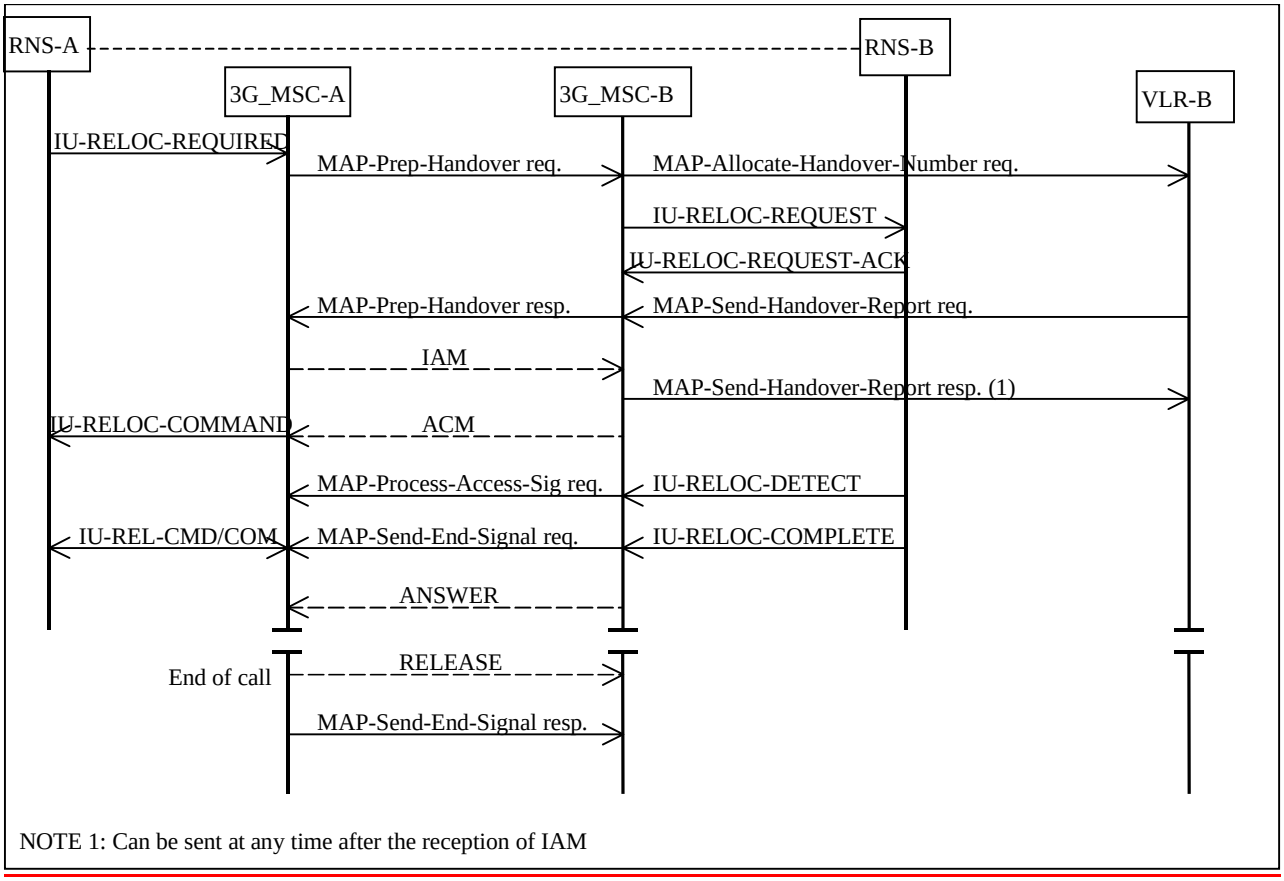
- During the relocation execution, i.e. while the UE is not in communication with the network, the 3G_MSC-A shall queue all outgoing RANAP messages until the communication with the UE is resumed.

- Finally, during supervision, i.e. while the UE is not in the area of 3G_MSC-A after a successful Inter-3G_MSC relocation, the subset of BSSAP procedures and their related messages - as defined in GSM 09.08 [7] - shall apply on the E-Interface.

During the intra-3G_MSC-B relocation execution, if any, the 3G_MSC-B shall queue all outgoing RANAP messages until the communication with the UE is resumed.

8.3.1 Basic relocation procedure requiring a circuit connection between 3G_MSC-A and 3G_MSC-B

The procedure used for successful Inter-3G_MSC SRNS relocation is shown in figure 30. Initiation of the relocation procedure is described in section 5. The procedure described in this section makes use of messages from the Technical Specification GSM 08.08 [5], TS 25.413 [11] and of the transport mechanism from the Mobile Application Part (MAP) (Technical Specification TS 29.002 [12]). After an Inter-3G_MSC SRNS relocation further Intra-3G_MSC relocations may occur on 3G_MSC-B, these relocations will follow the procedures specified in a previous section.



NOTE 1: Can be sent at any time after the reception of IAM

Figure 30: Basic SRNS Relocation Procedure requiring a circuit connection

The relocation is initiated as described in section 6.2.3. (This is represented by IU-RELOC-REQUIRED in figure 30). Upon receipt of the IU-RELOC-REQUIRED from RNS-A, 3G_MSC-A shall send a MAP-PREPARE-HANDOVER request to 3G_MSC-B including a complete A-HO-REQUEST message. (NOTE: 3G_MSC-A shall not send further MAP-PREPARE-HANDOVER requests while a MAP-PREPARE-HANDOVER response is pending or before any timeouts). The MAP-PREPARE-HANDOVER request shall carry in the A-HO-REQUEST all information needed by 3G_MSC-B for allocating radio resources in the case of SRNS relocation without Iur interface, see Technical Specification GSM 08.08 [5]. For compatibility reasons, the MAP-PREPARE-HANDOVER request will also identify the cell to which the call is to be relocated (*the cell id in the MAP message is FFS*). 3G_MSC-B will return the MAP-PREPARE-HANDOVER response after having retrieved a Handover Number from its associated VLR (exchange of the messages MAP-allocate-handover-number request and MAP-send-handover-report request). The Handover Number shall be used for routing the connection of the call from 3G_MSC-A to 3G_MSC-B. If radio resources are available in 3G_MSC-B, the MAP-PREPARE-HANDOVER response sent to 3G_MSC-A will contain the complete A-HO-REQUEST-ACKNOWLEDGE message generated from the IU-RELOC-REQUEST-ACKNOWLEDGE received from RNS-B, containing the radio resources definition to be sent by RNS-A to the UE (in case of relocation without Iur interface) and possible extra BSSMAP information, amended by 3G_MSC-B due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface. If the radio resource allocation is queued by RNS-B, the A-QUEUING-INDICATION may optionally be sent back to 3G_MSC-A.

The further radio resources allocation result (IU-RELOC-REQUEST-ACK or IU-RELOC-FAILURE sent in MAP as A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to 3G_MSC-A using the MAP-PROCESS-ACCESS-SIGNALLING request. If the radio resource allocation is not possible, the MAP-PREPARE-HANDOVER response containing an IU-RELOCATION-FAILURE sent as A-HO-FAILURE will be sent to 3G_MSC-A. 3G_MSC-B will do the same if a fault is detected on the identity of the RNS where the call has to be relocated. 3G_MSC-B simply reports the events related to the dialogue. It is up to 3G_MSC-A to decide the action to perform if it receives negative responses or the operation fails due to the expiry of the MAP-PREPARE-HANDOVER timer.

If an error related to the TCAP dialogue or to the MAP-PREPARE-HANDOVER request is returned from 3G_MSC-B, this will be indicated to 3G_MSC-A and 3G_MSC-A will terminate the relocation attempt. The existing connection to the UE shall not be cleared.

When the A-HO-REQUEST-ACKNOWLEDGE has been received, 3G_MSC-A shall establish a circuit between 3G_MSC-A and 3G_MSC-B by signalling procedures supported by the network. In figure 30 this is illustrated by the messages IAM (Initial Address Message) and ACM (Address Complete Message) of Signalling System no 7. 3G_MSC-B awaits the capturing of the UE (section 6.2.3) on the radio path when the ACM is sent and 3G_MSC-A initiates the relocation execution when ACM is received (illustrated by the IU-RELOC-COMMAND and described in the section 6.2.3).

3G_MSC-B transfers to 3G_MSC-A the acknowledgement received from the correct UE (IU-RELOC-DETECT/IU-RELOC-COMPLETE, sent as A-HO-DETECT/A-HO-COMPLETE). The IU-RELOC-DETECT, if received, is transferred to 3G_MSC-A as A-HO-DETECT using the MAP-PROCESS-ACCESS-SIGNALLING request. The IU-RELOC-COMPLETE, when received from the correct UE, is included in the MAP-SEND-END-SIGNAL request as A-HO-COMPLETE and sent back to 3G_MSC-A. The circuit is through connected in 3G_MSC-A when the A-HO-DETECT or the A-HO-COMPLETE is received from 3G_MSC-B. The old radio resources are released when the A-HO-COMPLETE message is received from 3G_MSC-B. The sending of the MAP-SEND-END-SIGNAL request starts the MAP supervision timer for the MAP dialogue between 3G_MSC-A and 3G_MSC-B. When the MAP-SEND-END-SIGNAL request including the A-HO-COMPLETE message is received in 3G_MSC-A, the resources in RNS-A shall be released.

In order not to conflict with the PSTN/ISDN signalling system(s) used between 3G_MSC-A and 3G_MSC-B, 3G_MSC-B must generate an answer signal when IU-RELOC-DETECT/COMPLETE is received.

3G_MSC-B shall release the Handover Number when the circuit between 3G_MSC-A and 3G_MSC-B has been established.

If the circuit between 3G_MSC-A and 3G_MSC-B cannot be established, (e.g. an unsuccessful backward message is received instead of ACM) 3G_MSC-A terminates the inter-3G_MSC relocation attempt by sending an appropriate MAP message, for example an ABORT.

3G_MSC-A shall retain overall call control until the call is cleared by the fixed subscriber or the UE and there is no further call control functions to be performed (e.g. servicing waiting calls, echo cancellers).

When 3G_MSC-A clears the call to the UE it also clears the call control functions in 3G_MSC-A and sends the MAP-SEND-END-SIGNAL response to release the MAP resources in 3G_MSC-B.

3G_MSC-A may terminate the procedure at any time by sending an appropriate MAP message to 3G_MSC-B. If establishment of the circuit between 3G_MSC-A and 3G_MSC-B has been initiated, the circuit must also be cleared.

The relocation will be aborted by 3G_MSC-A if it detects release or interruption of the radio path before the call has been established on 3G_MSC-B.

8.3.2 Basic relocation procedure not requiring the establishment of a circuit connection between 3G_MSC-A and 3G_MSC-B

The basic SRNS relocation procedures to be used when no circuit connection is required by 3G_MSC-A are similar to those described in section 8.3.1 for circuit switched calls. The main differences to the procedures described in section 8.3.1 relate to the establishment of circuits between the network entities and the Handover Number allocation.

In the case of basic relocation, 3G_MSC-A shall specify to 3G_MSC-B that no Handover Number is required in the MAP-PREPARE-HANDOVER request (see TS 29.002 [12]). As for the basic relocation using a circuit connection, the A-HO-REQUEST is transmitted at the same time. Any subsequent Handover Number allocation procedure will not be

invoked until the completion of the basic relocation procedure (see section: Subsequent Channel Assignment using a circuit connection). 3G_MSC-B shall then perform the radio resources allocation as described in section 8.3.1 if applicable. The MAP-PREPARE-HANDOVER response shall be returned to 3G_MSC-A including either the response of the radio resources allocation request received from RNS-B (IU-RELOC-REQUEST-ACKNOWLEDGE/IU-RELOC-FAILURE sent as A-HO-REQUEST-ACKNOWLEDGE/A-HO-FAILURE with possible extra BSSMAP information. These extra information are amended by 3G_MSC-B due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface) or potentially the A-QUEUING-INDICATION. The basic relocation procedure will continue as described in section 8.3.1 except that no circuit connection will be established towards 3G_MSC-B.

The relevant case for the basic relocation without circuit connection is shown in figure 31. As can be seen the major differences to the equivalent figure 30 are the omission of any circuit establishment messaging and the omission of handover number allocation signalling.

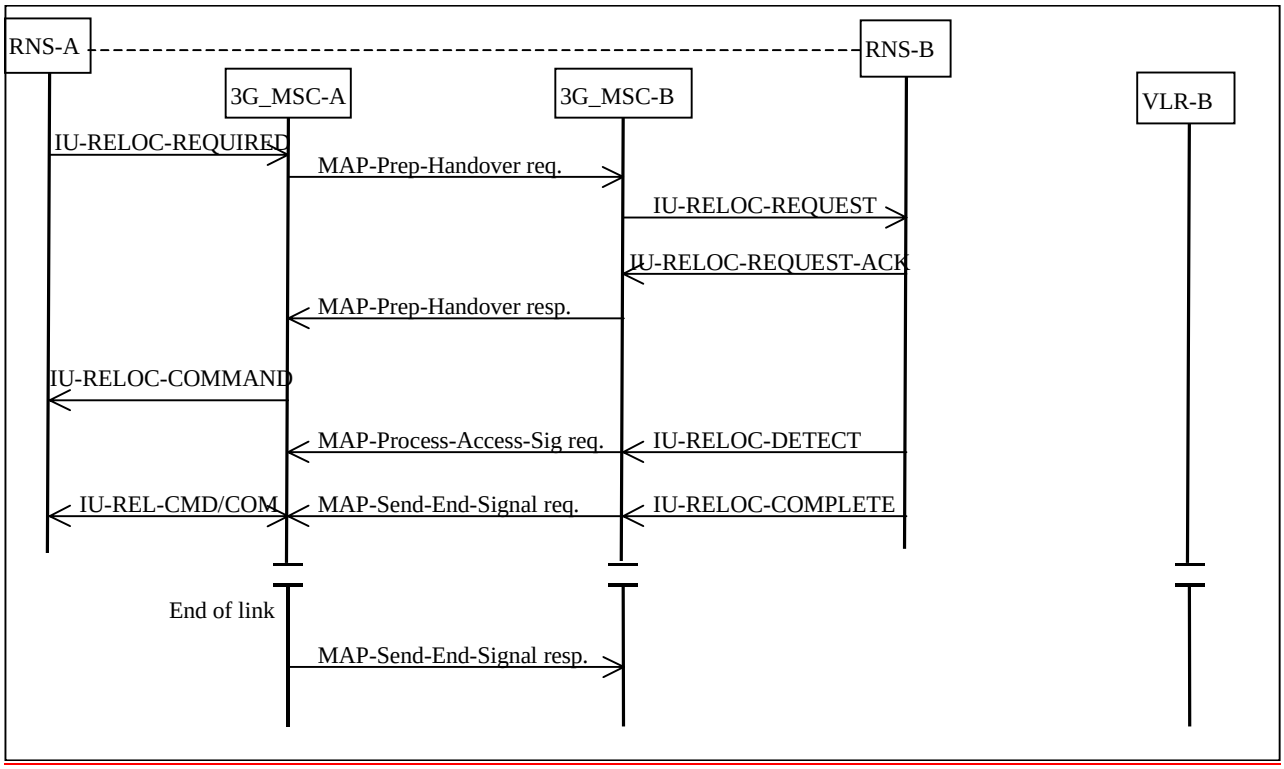


Figure 31: Basic SRNS relocation procedure without a circuit connection

8.3.3 Procedure for subsequent relocation requiring a circuit connection between 3G_MSC-A and 3G_MSC-B

After the call has been relocated from 3G_MSC-A to 3G_MSC-B, if the UE leaves the area of 3G_MSC-B during the same call, subsequent relocation is necessary in order to continue the connection when no Iur interface exists between the involved RNSs, or to optimise the transmission path when the Iur interface is used.

The following cases apply:

i) the UE moves back to the area of 3G_MSC-A;

ii) the UE moves into the area of a third 3G_MSC (3G_MSC-B').

In both cases the call is switched in 3G_MSC-A; the circuit between 3G_MSC-A and 3G_MSC-B shall be released after a successful subsequent relocation has been performed.

8.3.3.1 Description of subsequent relocation procedure i): 3G_MSC-B to 3G_MSC-A

The procedure for successful relocation from 3G_MSC-B back to 3G_MSC-A is shown in figure 32.

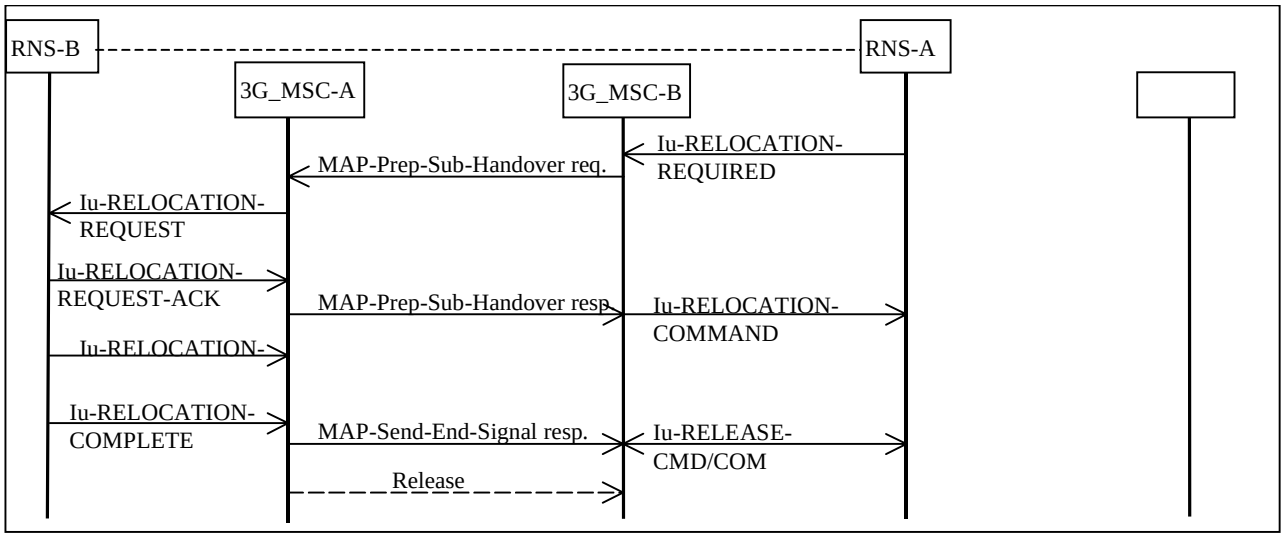


Figure 32: Subsequent relocation procedure i) successful relocation from 3G_MSC-B to 3G_MSC-A using a circuit connection

The procedure is as follows:

3G_MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to 3G_MSC-A indicating the new 3G_MSC number (3G_MSC-A number), indicating also the identity of the cell (*the cell id in the MAP message is FFS*) where the call has to be relocated and including a complete A-HO-REQUEST message. (NOTE: 3G_MSC-B shall not send further MAP-PREPARE-SUBSEQUENT-HANDOVER requests while a relocation attempt is pending or before any timeouts). Since 3G_MSC-A is the call controlling 3G_MSC, this 3G_MSC needs no Handover Number for routing purposes; 3G_MSC-A can immediately initiate the relocation towards the target RNS.

When relocation can be initiated, 3G_MSC-A shall return in the MAP-PREPARE-SUBSEQUENT-HANDOVER response the complete IU-RELOC-REQUEST-ACKNOWLEDGE message received from the RNS-B as A-HO-REQUEST-ACKNOWLEDGE and possible extra BSSMAP information, amended by 3G_MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface and the BSSMAP protocol used on the A-interface. If the radio resource allocation is queued by RNS-B, the A-QUEUING-INDICATION may optionally be sent back to 3G_MSC-B. The further radio resource allocation result (IU-RELOC-REQUEST-ACK or IU-RELOC-FAILURE, sent as A-HO-REQUEST-ACK or A-HO-FAILURE) will be transferred to 3G_MSC-B using the MAP-FORWARD-ACCESS-SIGNALLING request. If a radio resource cannot be assigned or if a fault is detected on the target RNS identity, or the target RNS identity in the A-HO-REQUEST is not consistent with the target 3G_MSC number, the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing an A-HO-FAILURE message shall be given to 3G_MSC-B, in addition 3G_MSC-B shall maintain the connection with the UE.

If the procedure in 3G_MSC-A is successful then 3G_MSC-B can request the UE to retune to the new RNS-B on 3G_MSC-A in the case of relocation without Iur interface, or request RNS-B to become serving RNS in the case of relocation with Iur interface. This is illustrated in figure 32 by the IU-RELOC-COMMAND message. The operation is successfully completed when 3G_MSC-A receives the IU-RELOC-COMPLETE message.

After relocation 3G_MSC-A shall release the circuit to 3G_MSC-B.

3G_MSC-A must also terminate the MAP procedure for the basic relocation between 3G_MSC-A and 3G_MSC-B by sending an appropriate MAP message. 3G_MSC-B will release the resources in RNS-A when the MAP-SEND-END-SIGNAL response is received.

8.3.3.2 Description of subsequent relocation procedure ii): 3G_MSC-B to 3G_MSC-B'

The procedure for successful relocation from 3G_MSC-B to 3G_MSC-B' is shown in figure 33.

The procedure consists of two parts:

- a subsequent relocation from 3G_MSC-B back to 3G_MSC-A as described in section 8.3.3.1; and
- a basic handover from 3G_MSC-A to 3G_MSC-B' as described in section 8.3.1.

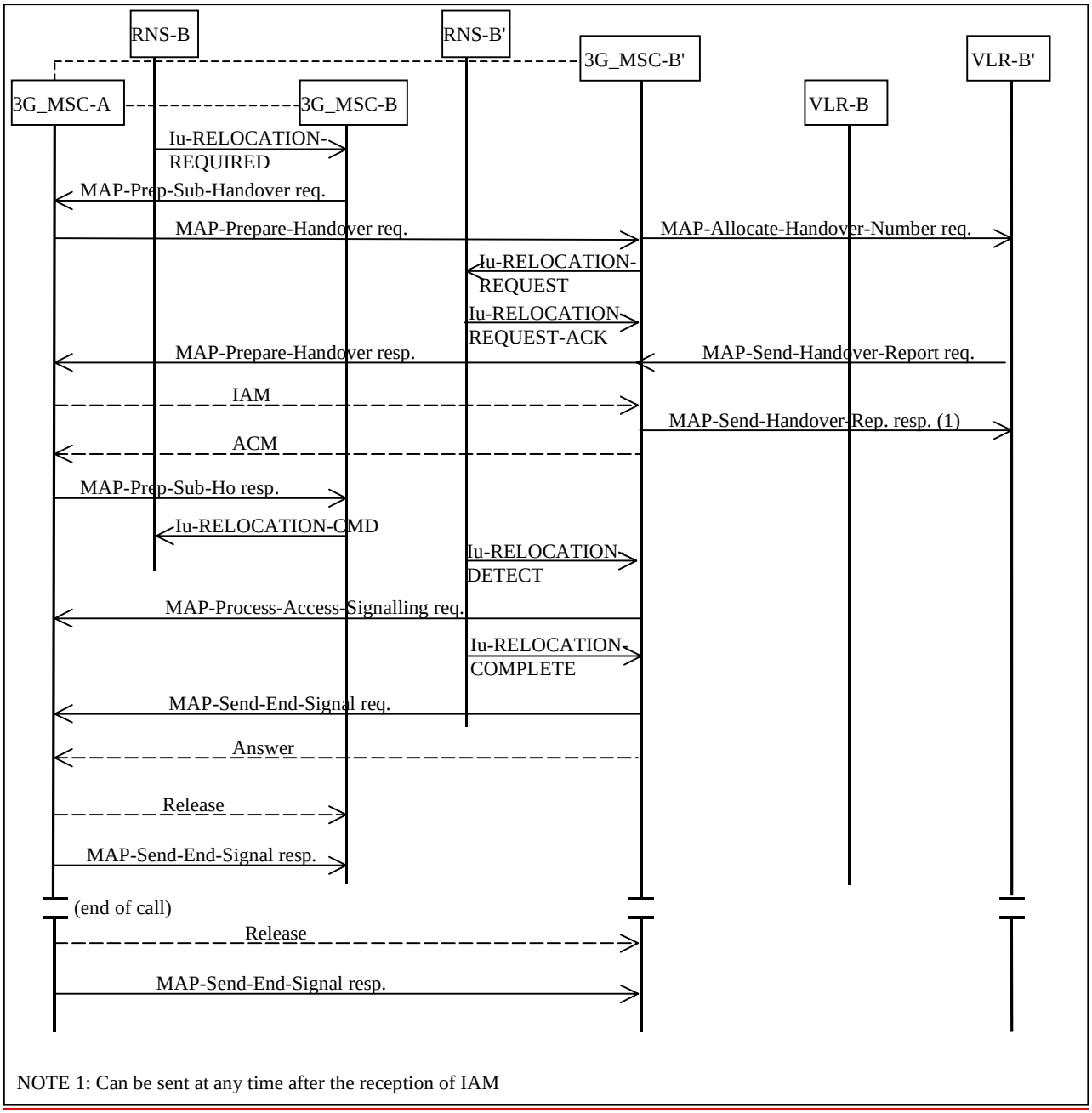
3G_MSC-B sends the MAP-PREPARE-SUBSEQUENT-HANDOVER request to 3G_MSC-A indicating a new 3G_MSC number (which is the identity of 3G_MSC-B'), indicating also the target cell identity (*the cell id in the MAP message is FFS*) and including a complete A-HO-REQUEST, 3G_MSC-A then starts a basic relocation procedure towards 3G_MSC-B'.

When 3G_MSC-A receives the ACM from 3G_MSC-B', 3G_MSC-A informs 3G_MSC-B that 3G_MSC-B' has successfully allocated the radio resources on RNS-B' side by sending the MAP-PREPARE-SUBSEQUENT-HANDOVER response containing the complete IU-RELOC-REQUEST-ACKNOWLEDGE received from RNS-B' as A-HO-REQUEST-ACKNOWLEDGE and possible extra BSSMAP information, amended by 3G_MSC-A due to the possible interworking between the BSSMAP protocol carried on the E-interface between 3G_MSC-A and 3G_MSC-B' and the BSSMAP protocol carried on the E-interface between 3G_MSC-A and 3G_MSC-B. Now 3G_MSC-B can start the procedure on the radio path if needed.

For 3G_MSC-A the relocation is completed when it has received the MAP-SEND-END-SIGNAL REQUEST from 3G_MSC-B'containing the IU-RELOC-COMPLETE received from the RNS-B' as A-HO-COMPLETE. The circuit between 3G_MSC-A and 3G_MSC-B is released. 3G_MSC-A also sends the MAP-SEND-END-SIGNAL response to 3G_MSC-B in order to terminate the original MAP dialogue between 3G_MSC-A and 3G_MSC-B. 3G_MSC-B releases the radio resources when it receives this message.

If the radio resource allocation is queued by the RNS-B', the A-QUEUING-INDICATION may optionally be sent back to 3G_MSC-B. If no radio resource can be allocated by 3G_MSC-B' or no circuit between 3G_MSC-A and 3G_MSC-B' can be established or a fault is detected on the target RNS identity or the target RNS identity in the A-HO-REQUEST is not consistent with the target 3G_MSC number, 3G_MSC-A informs 3G_MSC-B by using the A-HO-FAILURE message included in the MAP-PREPARE-SUBSEQUENT-HANDOVER response. 3G_MSC-B shall maintain the existing connection with the UE.

When the subsequent relocation is completed, 3G_MSC-B' is considered as 3G_MSC-B. Any further inter-3G_MSC relocation is handled as described above for a subsequent relocation.



NOTE 1: Can be sent at any time after the reception of IAM

Figure 33: Subsequent relocation procedure ii) Successful SRNS relocation from 3G_MSC-B to 3G_MSC-B' requiring a circuit connection

8.3.4 Procedure for subsequent relocation not requiring a circuit connection between 3G_MSC-A and 3G_MSC-B

As for the subsequent relocation with a circuit connection between 3G_MSC-A and 3G_MSC-B, the same two cases of subsequent relocation apply:

i) the UE moves back to the area of 3G_MSC-A;

ii) the UE moves into the area of a third 3G_MSC (3G_MSC-B').

8.3.4.1 Description of subsequent relocation procedure i): 3G_MSC-B to 3G_MSC-A

The procedure for successful relocation from 3G_MSC-B back to 3G_MSC-A without circuit connection is shown in figure 34. The only difference with the figure 32 is that no circuit release is needed between 3G_MSC-A and 3G_MSC-B.

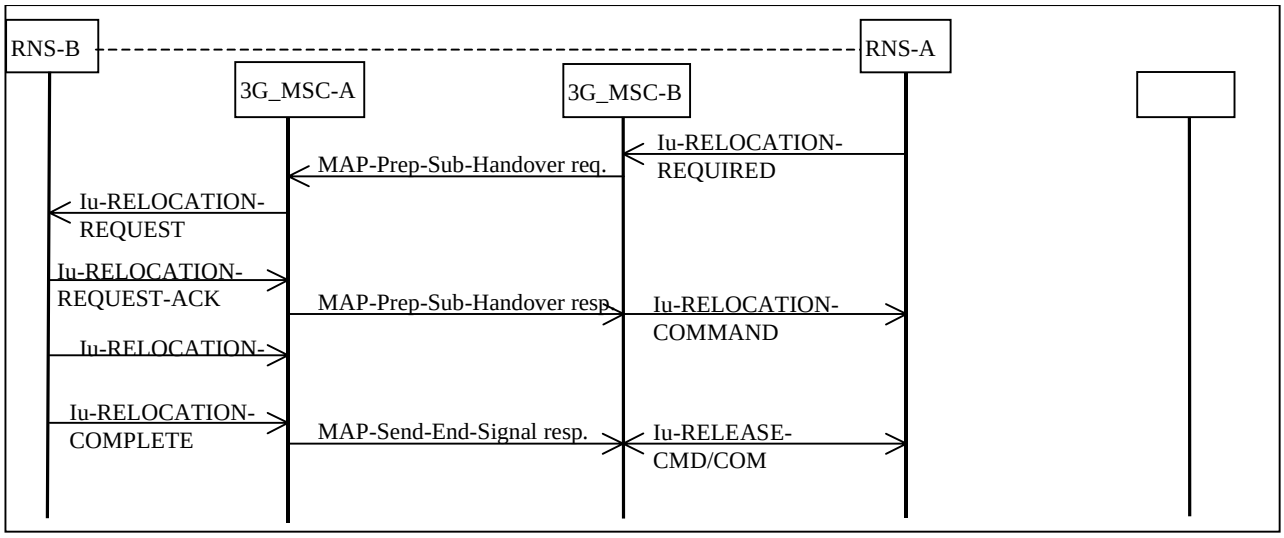


Figure 34: Subsequent relocation procedure i) successful relocation from 3G_MSC-B to 3G_MSC-B not requiring a circuit connection

8.3.4.2 Description of subsequent relocation procedure ii): 3G_MSC-B to 3G_MSC-B''

The procedure for successful relocation from 3G_MSC-B to 3G_MSC-B' is shown in figure 35.

The procedure consists of two parts:

- a subsequent relocation from 3G_MSC-B back to 3G_MSC-A as described in section 8.3.4.1; and
- a basic relocation from 3G_MSC-A to 3G_MSC-B' as described in section 8.3.2.

The only difference to the equivalent figure 33 is the omission of the circuit and handover number allocation signallings.

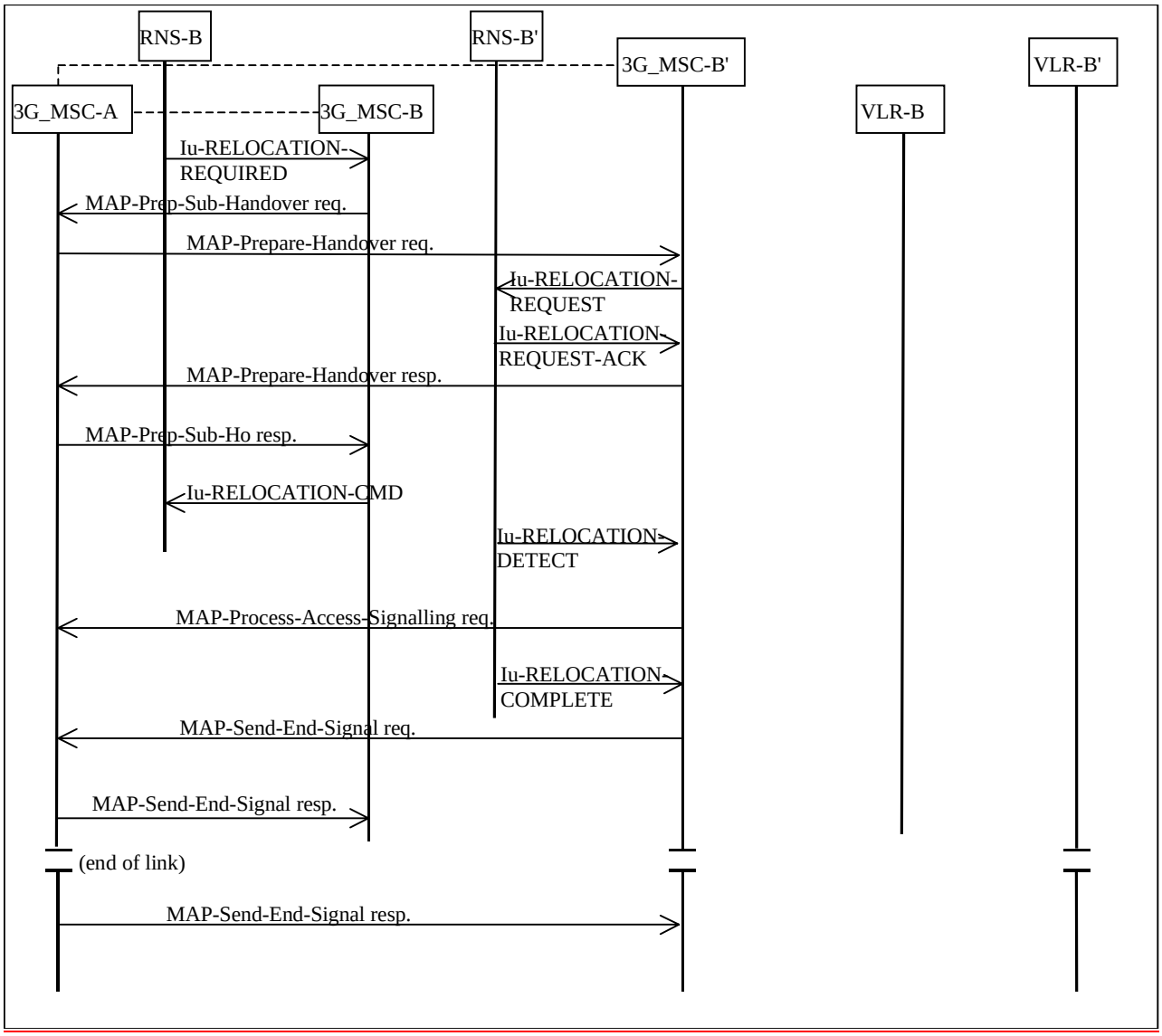


Figure 35: Subsequent relocation procedure ii) Successful SRNS relocation from 3G_MSC-B to 3G_MSC-B' not requiring a circuit connection

98 Detailed procedures in MSC-A

98.1 BSS/MSC and MS/MSC procedures in MSC-A (functional unit 1)

The handover procedures in this functional unit consist of:

i) signalling between the MS and the MSC;

ii) signalling between the BSS and the MSC for access management.

98.2 Call control procedures MSC-A (functional unit 2)

The call control procedures related to handover in MSC-A can be divided into two functional entities:

- the first entity is the call control procedure as part of the normal interworking between the PSTN/ISDN and the PLMN; for an MS originating call MSC-A is the originating exchange, for an MS terminating call MSC-A is the destination exchange.

- the second entity is the call control procedure for the connection between MSC-A and MSC-B in case of a handover from MSC-A to MSC-B. For this call control procedure the following applies:

Call set-up

The connection to MSC-B is set up by procedures relevant to the signalling system used in the PSTN/ISDN to which MSC-A is connected. The call is set up by using the MS Handover Number received from MSC-B as part of the MAP procedure.

The call set-up direction will always be from MSC-A to MSC-B, even when the call was originally established by the MS. Functional unit 2 (see figure 2) should therefore keep information on call set-up direction in order to be able to interpret correctly any clearing signals (see below).

The unit should indicate the address complete condition to functional unit 3 and through-connect without awaiting the answer signal from MSC-B. This applies also to signalling systems where address complete signals are not supported. In such cases an artificial address complete is established by functional unit 2.

Call clearing

Call clearing consists of two parts: after inter-MSC handover, clearing of the MS-BSS connection and clearing of the inter-MSC connection. If a request to release the call is generated by the network while the MS is re-tuning from one BSS to another BSS, then MSC-A shall begin clearing the call to the network and queue the call release to the MS until the MS has resumed communication. This includes the case when MSC-B and/or MSC-B' are involved.

The MAP procedures are used to transfer information between MSC-B and MSC-A in order to maintain full call control within MSC-A. MSC-A determines, based on information received from MSC-B, the appropriate signals (according to TSechnical Specification GSM 02.4.008 [10]) to be sent to the MS, and sends this information to MSC-B.

When MSC-A clears the call to the MS it also clears the call control functions in MSC-B and sends the MAP-SEND-END-SIGNAL response to release the MAP resources in MSC-B. The clearing of the connection is by procedures relevant to the signalling system in the PSTN/ISDN to which MSC-A is connected.

When the Signalling System no 7 ISDN User Part is used, the normal symmetric release procedures apply on both the connection to the fixed network and to MSC-B.

When a signalling system is used without a symmetric release possibility, some notice should be given to the clear-forward and clear-back procedures.

For MS terminating calls the following conditions apply on clear-forward and clear-back:

- when a clear-forward signal is received on interface B' (see figure 1), MSC-A clears the circuit to MSC-B by normal clear-forward procedures.

- when a clear-back signal is received from MSC-B, MSC-A starts normal clear-back procedures towards the fixed network (interface B') and sends the clear-forward signal on interface B" in order to clear the connection with MSC-B.

NOTE: This case corresponds to a fault situation.

For MS originated calls the following applies:

- when MSC-A receives a clear-back signal from MSC-B, this signal must be interpreted as indicating a clear-forward condition. MSC-A then clears both the connection on interface B' (see figure 1) and to MSC-B by normal clear-forward procedures.

NOTE: This case corresponds to a fault situation.

- when MSC-A receives a clear-back signal on interface B', MSC-A should distinguish between national and international connections:

  for international connections where the Q.118 [1] supervision is done in the ISC, MSC-A sends a clear-forward signal on both interface B' to the fixed network and interface B" to MSC-B;

  for national connections or for international connections where the Q.118 [1] supervision is not done in the ISC, a timer is started according to national practice for clear-back supervision and MSC-A proceeds as follows:

  i) if a clear-back signal is received from MSC-B, MSC-A interprets this as indicating a clear-forward condition and proceeds by clearing the connections on interface B' and to MSC-B by normal clear-forward procedures.

  ii) if the timer expires, MSC-A proceeds by normal clear-forward of the connections on interface B' and to MSC-B.

98.3 Handover control procedures MSC-A (functional unit 3)

The procedures of functional unit 3 are given in terms of SDL diagrams in figure 418. To easily distinguish the interface concerned the messages received or sent from this unit are prefixed with either 'MAP' for a MAP message, 'A' for an A-Interface message or 'I' for an ISDN/PSTN message.

The procedures of functional unit 3 include:

i) Initiation. The initiation condition is shown by the signal A-HANDOVER-REQUIRED.

   The diagram also includes queuing when there is no channel available. Calls for which handover has been initiated should be queued with priority higher than normal calls. They should have lower priority than emergency calls.

ii) handover of calls within the area of MSC-A, i.e. handover case i). In this case MSC-A controls the procedures on both the previous and the new radio channel, using signals A-HANDOVER-REQUEST and A-HANDOVER-COMMAND. The handover procedure is completed when A-HANDOVER-COMPLETE is received. If this signal is not received, the radio path and the connection on interface B' are either released or the original connection is maintained.

   In the case of ongoing GSM voice group calls for subsequent users of the VGCS channel uplink the original connection shall always be maintained.

   For handover devices with three-party capabilities the handover device is first set up so that all interfaces A', A" and B' are connected (illustrated by the signal 'set up handover device'). This is done when the Handover Command is sent to the MS . The device is connected in its final position (i.e. A" to B' for case ii)) (illustrated by the signal 'connect handover device') when A-HANDOVER-COMPLETE is received.

iii) handover to MSC-B . This procedure is the one described in sections 7.1. and 7.2. For handover devices with three-party capabilities the handover device is set-up when MSC-A sends the Handover Command to the MS , i.e. the interfaces A', B' and B" are then connected. The device is connected in its final position (i.e. B' to B") when the successful procedure indication is received from functional unit 4.

iv) subsequent handover to MSC-A . The procedure is described in sections 7.3. and 7.4. When a handover to MSC-A indication is received from functional unit 4, the handover device is set up so that interfaces B', B" and A' are connected (for handover devices with three-party capabilities). When A-HANDOVER-COMPLETE is received, the device is connected in its final position (i.e. B' to A').

   If A-HANDOVER-COMPLETE is not received (expiry of timer T104), the handover device releases interface A' and returns to a position where B' and B" are connected.

v) subsequent handover to a third MSC (MSC-B') . The procedure is described in sections 7.3. and 7.4. The handover device is set up in its initial position, (i.e. interconnection of interfaces B', B" and B"') when the connection to MSC-B' has been established. MSC-B is informed via functional unit 4 that the connection has

been established and that the procedure on the radio path can be initiated. The device is connected in its final position (i.e. B' to B"') when a successful procedure indication is received from functional unit 4. MSC-B is informed that all procedures in MSC-B can be terminated (illustrated by the MAP-SEND-END-SIGNAL response). The device returns to the state where B' and B" are connected if the subsequent handover procedure fails.

Timers in MSC-A

The procedures are supervised by timers in order to avoid a deadlock when responses are not received or the procedures fail. The following timers are defined:

T101: this timer supervises the queuing time for a free channel. If T101 expires, a no channel indication is generated, a retry procedure could be applied as described in section 6.1. T101 is set by O&M.

T102: this timer supervises the time for handover completion for handover between BSSs in MSC-A. T102 is set by O&M.

T103: this timer supervises the time between issuing an A-HANDOVER-COMMAND from MSC-A and receiving a successful procedure indication from MSC-B. This timer also supervises the time between sending an A-HO-REQUEST-ACKNOWLEDGE to MSC-B and receiving a successful procedure indication from MSC-B'. If T103 expires, the handover procedure is terminated. T103 is set by O&M.

T104: this timer supervises the time between sending of an A-HO-REQUEST-ACKNOWLEDGE to MSC-B and receiving the A-HANDOVER-COMPLETE from BSS-B on MSC-A. If the timer expires, the new radio channel is released and the existing handover device connection to MSC-B is maintained. T104 is set by O&M.

9~~8~~.4 MAP procedures in MSC-A (functional unit 4)

The MAP procedures for handover are defined in Technical Specification ~~GSM 09.~~TS 29.002 [12]. They include:

- procedures for basic handover;
- procedures for subsequent handover.

These procedures are as outlined in section 7.

9~~8~~.5 Interworking between Handover control procedures and MAP procedures in MSC-A

The interworking between the Handover control procedures and the MAP procedures for handover is defined in Technical Specification GSM 09.10 [8]. It includes:

- interworking at basic handover initiation;
- interworking at subsequent handover completion.

This interworking is not described in this Technical Specification.

9~~8~~.6 Compatibility with GSM Phase 1

If the MSC-A initiates an Inter-MSC handover procedure according to Phase 2 MAP and BSSMAP protocols while using a Phase 1 BSSMAP protocol towards BSS-A, MSC-A has to perform the protocol interworking.

The same holds if a Phase 2 BSSMAP protocol is used between MSC-A and BSS-A and the E-interface supports only Phase 1 protocol.

109 Detailed procedures in MSC-B

109.1 BSS/MSC (MS/BSS) procedures MSC-B (functional unit 1)

The handover procedures in this functional unit consist of:

i) signalling between the MS and the MSC;

ii) signalling between the BS and the MSC for access management.

Signals exchanged with functional unit 3 are indicated in section 109.3 below.

109.2 Call control procedures MSC-B (functional unit 2)

These procedures relate to the call control in MSC-B of the "handover" connection with MSC-A. For these procedures the following apply:

Call set-up

The connection is set up by MSC-A. MSC-B should provide, if possible, the following backward signals:

- signals indicating unsuccessful call set-up and, if possible, the cause of call failure;
- address complete signal;
- answer signal (see NOTE).

NOTE: The answer signal is not related to answering by the MS and it has no meaning in the handover procedure between MSC-A and MSC-B. But after successful handover or successful subsequent channel assignment using a circuit connection between MSC-A and MSC-B this signal is needed for bringing the connection in the answered state in the intermediate PSTN/ISDN exchanges.

There will be no indication that the call applies to a handover. This information has to be derived from the MS Handover Number received during call set-up in relation to the earlier MAP-PREPARE-HANDOVER request/MAP-PREPARE-HANDOVER response procedure between MSC-A and MSC-B.

Call clearing

Call clearing consists of two parts after inter-MSC handover: clearing of the BSS-MS connection and clearing of the inter-MSC connection, this case is only applicable to calls successfully handed over. If a request to release the call is generated by the network while the MS is re-tuning from one BSS to another BSS, then MSC-B shall begin clearing the call to the network and queue the call release to the MS until the MS has resumed communication.

The MAP is used to transfer information between MSC-A and MSC-B in order to make it possible for MSC-B to send the appropriate signals to the MS, specified in TS ~~echnical Specification GSM 04.~~ 24.008 [10], and still leave the call control to MSC-A. MSC-A normally initiates release of the connection between MSC-A and MSC-B. Exceptionally MSC-B is allowed to release the connection if no MAP-SEND-END-SIGNAL response is received, or if the Handover is to be aborted.

When the Signalling System no 7 ISDN User Part is used, the normal symmetric release procedures apply. When a signalling system is used without a symmetric release possibility or a fault condition occurs, the following may apply:

- when MSC-B receives a clear-forward signal from MSC-A, it shall release the radio resources;
- in fault situation eg. machine malfunction or loss of the connection on interface A, MSC-B may send a clear-back signal to MSC-A.

109.3 Handover control procedures MSC-B (functional unit 3)

The procedures of functional unit 3 are given in form of SDL diagrams in figure 429. To easily distinguish the interface concerned the messages received or sent from this unit are prefixed with either 'MAP' for a MAP message, 'A' for an A-Interface message or 'I' for an ISDN/PSTN message. The procedure in functional unit 3 include:

i) handover from MSC-A.

This case is initiated by MSC-A, and includes allocation and establishment of the new radio channel. The procedure is outlined in sections 7.1. and 7.2.

ii) Intra-MSC handovers within the area controlled by MSC-B.

This procedure is the same as that of i) in section 98.3, except that the A-HANDOVER-REQUERED is received by MSC-B.

iii) subsequent handover to another MSC (MSC-A or MSC-B').

The initiation procedure is essentially the same as that of i) of section 98.3. The Handover Command to the MS is now generated by MSC-B after the A-HO-REQUEST-ACKNOWLEDGE is received from MSC-A (via functional unit 4). The procedure is terminated in MSC-B when MSC-B receives a terminate procedure indication from functional unit 4.

Timers in MSC-B

The following procedures are supervised by timers in order to avoid a deadlock when responses are not received or the procedures fail.

The following timers are defined:

T201: this timer supervises the queuing time for a free channel. T201 is set by O&M.

T202: this timer supervises the time for handover completion for handover between BSSs in MSC-B. If T202 expires, the radio path and the connection on interface B' are released. T202 is set by O&M.

T204: this timer supervises the time between sending of address complete message to MSC-A and receiving the A-HANDOVER-COMPLETE from BSS-B on MSC-B. This timer also supervises the time between issuing the handover command to the MS and receiving the MAP-SEND-END-SIGNAL response from MSC-A, for a subsequent handover. In the case of a handover without circuit connection between MSC-A and MSC-B this timer supervises the time between issuing the A-HO-REQUEST-ACKNOWLEDGE to the MSC-A and receiving the A-HANDOVER-COMPLETE from BSS-B on MSC-B. If the timer expires, then any new radio channel is released. T204 is set by O&M.

T210: this timer is used to supervise the time for establishing a circuit connection from MSC-A to MSC-B. When T210 expires, the allocated channel in MSC-B is released. T210 is set by O&M. This timer is not started when MSC-A explicitly indicates that no handover number is needed.

T211: this timer is used to control the time between requesting a subsequent handover (A-HO-REQUEST to the MSC-A) and receiving the response from MSC-A (A-REQUEST-ACKNOWLEDGE/A-HO-FAILURE). If T211 expires, the existing connection with the MS is maintained. T211 is set by O&M.

109.4 MAP procedures MSC-B (functional unit 4)

The MAP procedures for handover are defined in Technical Specification ~~GSM 09.~~TS 29.002 [12]. They include:

- procedures for basic handover;
- procedures for subsequent handover;
- procedures for obtaining the handover number from the VLR.

These procedures are outlined in section 7.

109.5 Interworking between Handover control procedures and MAP procedures in MSC-B

The interworking between the Handover control procedures and the MAP procedures for handover is defined in Technical Specification GSM 09.10 [8]. It includes:

- interworking at basic handover completion;
- interworking at subsequent handover initiation.

This interworking is not described in this Technical Specification.

109.6 Compatibility with GSM Phase 1

If the MSC-B accepts an Inter-MSC handover procedure according to Phase 2 MAP and BSSMAP protocols while using a Phase 1 BSSMAP protocol towards BSS-B, MSC-B has to perform the protocol interworking.

The same holds if a Phase 1 MAP protocol is requested on the E-interface and MSC-B uses a Phase 2 BSSMAP protocol towards BSS-B.

11 Detailed procedures in 3G_MSC-A

For detailed procedures in MSC-A at handover within the GSM network, please see chapter 9 ‘Detailed procedures in MSC-A’.

11.1 RNC/BSC/3G_MSC and UE/MS/3G_MSC procedures in 3G_MSC-A (functional unit 1)

The handover/relocation procedures in this functional unit consist of:

i) signalling between the UE/MS and the 3G_MSC;

ii) signalling between the RNS/BSS and the 3G_MSC for access management.

11.2 Call control procedures 3G_MSC-A (functional unit 2)

The call control procedures related to handover/relocation in 3G_MSC-A can be divided into two functional entities:

- the first entity is the call control procedure as part of the normal interworking between the PSTN/ISDN and the PLMN/UTRAN; for an UE/MS originating call 3G_MSC-A is the originating exchange, for an UE/MS terminating call 3G_MSC-A is the destination exchange.
- the second entity is the call control procedure for the connection between 3G_MSC-A and 3G_MSC-B in case of a handover/relocation from 3G_MSC-A to 3G_MSC-B. For this call control procedure the following applies:

Call set-up

The connection to 3G_MSC-B is set up by procedures relevant to the signalling system used in the PSTN/ISDN to which 3G_MSC-A is connected. The call is set up by using the Handover Number received from 3G_MSC-B as part of the MAP procedure.

The call set-up direction will always be from 3G_MSC-A to 3G_MSC-B, even when the call was originally established by the UE/MS. Functional unit 2 (see figure 5) should therefore keep information on call set-up direction in order to be able to interpret correctly any clearing signals (see below).

The unit should indicate the address complete condition to functional unit 3 and through-connect without awaiting the answer signal from 3G_MSC-B. This applies also to signalling systems where address complete signals are not supported. In such cases an artificial address complete is established by functional unit 2.

Call clearing

Call clearing consists of two parts: after handover/relocation, clearing of the RNS-UE/MS or BSS-UE/MS connection and clearing of the inter-3G_MSC connection. If a request to release the call is generated by the network while the UE/MS is re-tuning from one RNS/BSS to another RNS/BSS, then 3G_MSC-A shall begin clearing the call to the network and queue the call release to the UE/MS until the UE/MS has resumed communication. This includes the case when 3G_MSC-B and/or 3G_MSC-B' are involved.

The MAP procedures are used to transfer information between 3G_MSC-B and 3G_MSC-A in order to maintain full call control within 3G_MSC-A. 3G_MSC-A determines, based on information received from 3G_MSC-B, the appropriate signals (according to TS 24.008 [10]) to be sent to the UE/MS, and sends this information to 3G_MSC-B.

When 3G_MSC-A clears the call to the UE/MS it also clears the call control functions in 3G_MSC-B and sends the MAP-SEND-END-SIGNAL response to release the MAP resources in 3G_MSC-B. The clearing of the connection is by procedures relevant to the signalling system in the PSTN/ISDN to which 3G_MSC-A is connected.

When the Signalling System no 7 ISDN User Part is used, the normal symmetric release procedures apply on both the connection to the fixed network and to 3G_MSC-B.

When a signalling system is used without a symmetric release possibility, some notice should be given to the clear-forward and clear-back procedures.

For UE/MS terminating calls the following conditions apply on clear-forward and clear-back:

- when a clear-forward signal is received on interface B' (see figure 4), 3G_MSC-A clears the circuit to 3G_MSC-B by normal clear-forward procedures.

- when a clear-back signal is received from 3G_MSC-B, 3G_MSC-A starts normal clear-back procedures towards the fixed network (interface B') and sends the clear-forward signal on interface B" in order to clear the connection with 3G_MSC-B.

NOTE: This case corresponds to a fault situation.

For UE/MS originated calls the following applies:

- when 3G_MSC-A receives a clear-back signal from 3G_MSC-B, this signal must be interpreted as indicating a clear-forward condition. 3G_MSC-A then clears both the connection on interface B' (see figure 4) and to 3G_MSC-B by normal clear-forward procedures.

NOTE: This case corresponds to a fault situation.

- when 3G_MSC-A receives a clear-back signal on interface B', 3G_MSC-A should distinguish between national and international connections:

  for international connections where the Q.118 [1] supervision is done in the ISC, 3G_MSC-A sends a clear-forward signal on both interface B' to the fixed network and interface B" to 3G_MSC-B;

for national connections or for international connections where the Q.118 [1] supervision is not done in the ISC, a timer is started according to national practice for clear-back supervision and MSC-A proceeds as follows:

i) if a clear-back signal is received from 3G_MSC-B, 3G_MSC-A interprets this as indicating a clear-forward condition and proceeds by clearing the connections on interface B' and to 3G_MSC-B by normal clear-forward procedures.

ii) if the timer expires, 3G_MSC-A proceeds by normal clear-forward of the connections on interface B' and to 3G_MSC-B.

11.3 Handover/Relocation control procedures 3G_MSC-A (functional unit 3)

The procedures of functional unit 3 are given in terms of SDL diagrams in figure 43. To easily distinguish the interface concerned the messages received or sent from this unit are prefixed with either 'MAP' for a MAP message, 'A' for an A-Interface message, 'I' for an ISDN/PSTN message or ‘Iu’ for an Iu-message.

The procedures of functional unit 3 include:

i) Initiation. The initiation condition is shown by the signal Iu-RELOCATION-REQUIRED or A-HANDOVER-REQUIRED.

The diagram also includes queuing when there is no channel available. Calls for which handover/relocation has been initiated should be queued with priority higher than normal calls. They should have lower priority than emergency calls.

ii) handover/relocation of calls within the area of 3G_MSC-A, i.e. handover/relocation case i).

In the handover/relocation from RNS-A/BSS-A to RNS-B/BSS-B 3G_MSC-A controls the procedures on both the previous and the new radio channel, using signals Iu-RELOCATION-REQUEST/A-HANDOVER-REQUEST and Iu-RELOCATION-COMMAND/A-HANDOVER-COMMAND. The handover/relocation procedure is completed when Iu-RELOCATION-COMPLETE/A-HANDOVER-COMPLETE is received. If this signal is not received, the radio path and the connection on interface B' are either released or the original connection is maintained.

For handover/relocation devices with three-party capabilities the device is first set up so that all interfaces Iu'/A', Iu"/A" and B' are connected (illustrated by the signal 'set up handover device'). This is done when the Relocation Command is sent to serving RNS or Handover Command is sent to the serving BSS. The device is connected in its final position (i.e. Iu’’/ A" to B' for case ii)) (illustrated by the signal 'connect handover device') when Iu-RELOCATION-COMPLETE/A-HANDOVER-COMPLETE is received.

iii) relocation to 3G_MSC-B. This procedure is the one described in sections 8.3.1 and 8.3.2. For handover/relocation devices with three-party capabilities the device is set-up when 3G_MSC-A sends the Relocation Command to the UE, i.e. the interfaces Iu', B' and B" are then connected. The device is connected in its final position (i.e. B' to B") when the successful procedure indication is received from functional unit 4.

iv) UMTS to GSM handover to MSC-B. This procedure is the one described in sections 8.1.1 and 8.1.2. For handover/relocation devices with three-party capabilities the device is set-up when 3G_MSC-A sends the Relocation Command to the serving RNS, i.e. the interfaces Iu', B' and B" are then connected. The device is connected in its final position (i.e. B' to B") when the successful procedure indication is received from functional unit 4.

v) GSM to UMTS handover to 3G_MSC-B. This procedure is the one described in sections 8.2.1 and 8.2.2. For handover/relocation devices with three-party capabilities the device is set-up when MSC-A sends the Handover Command to the serving BSS , i.e. the interfaces A', B' and B" are then connected. The device is connected in its final position (i.e. B' to B") when the successful procedure indication is received from functional unit 4.

vi) subsequent relocation from 3G_MSC-B to 3G_MSC-A. The procedure is described in sections 8.3.3.1 and 8.3.4.1. When a relocation to 3G_MSC-A indication is received from functional unit 4, the handover/relocation device is set up so that interfaces B', B" and Iu' are connected (for devices with three-party capabilities). When Iu-RELOCATION-COMPLETE is received, the device is connected in its final position (i.e. B' to Iu').

If Iu-RELOCATION-COMPLETE is not received (expiry of timer T704), the handover/relocation device releases interface Iu' and returns to a position where B' and B" are connected.

vii) subsequent GSM to UMTS handover from MSC-B to 3G_MSC-A. The procedure is described in sections 8.2.3.1 and 8.2.4.1. When a handover to 3G_MSC-A indication is received from functional unit 4, the handover device is set up so that interfaces B', B" and A' are connected (for handover devices with three-party capabilities). When A-RELOCATION-COMPLETE is received, the device is connected in its final position (i.e. B' to Iu').

If A-RELOCATION-COMPLETE is not received (expiry of timer T504), the device releases interface Iu' and returns to a position where B' and B" are connected.

viii) subsequent UMTS to GSM handover from 3G_MSC-B to MSC-A. The procedure is described in sections 8.1.3.1 and 8.1.4.1. When a handover to MSC-A indication is received from functional unit 4, the handover device is set up so that interfaces B', B" and Iu' are connected (for handover devices with three-party capabilities). When A-HANDOVER-COMPLETE is received, the device is connected in its final position (i.e. B' to A').

If A-HANDOVER-COMPLETE is not received (expiry of timer T304), the device releases interface A' and returns to a position where B' and B" are connected.

ix) subsequent relocation from 3G_MSC-B to a third 3G_MSC (3G_MSC-B'). The procedure is described in sections 8.3.4.2 and 8.3.5.2. The handover/relocation device is set up in its initial position, (i.e. interconnection of interfaces B', B" and B"') when the connection to 3G_MSC-B' has been established. 3G_MSC-B is informed via functional unit 4 that the connection has been established and that the procedure on the radio path can be initiated. The device is connected in its final position (i.e. B' to B"') when a successful procedure indication is received from functional unit 4. 3G_MSC-B is informed that all procedures in 3G_MSC-B can be terminated (illustrated by the MAP-SEND-END-SIGNAL response). The device returns to the state where B' and B" are connected if the subsequent relocation procedure fails.

x) subsequent UMTS to GSM handover from 3G_MSC-B to a third MSC (MSC-B'). The procedure is described in sections 8.1.3.2 and 8.1.4.2. The handover/relocation device is set up in its initial position, (i.e. interconnection of interfaces B', B" and B"') when the connection to MSC-B' has been established. 3G_MSC-B is informed via functional unit 4 that the connection has been established and that the procedure on the radio path can be initiated. The device is connected in its final position (i.e. B' to B"') when a successful procedure indication is received from functional unit 4. 3G_MSC-B is informed that all procedures in 3G_MSC-B can be terminated (illustrated by the MAP-SEND-END-SIGNAL response). The device returns to the state where B' and B" are connected if the subsequent UMTS to GSM handover procedure fails.

xi) subsequent GSM to UMTS handover from MSC-B to a third MSC (3G_MSC-B'). The procedure is described in sections 8.2.3.2 and 8.2.4.2. The handover/relocation device is set up in its initial position, (i.e. interconnection of interfaces B', B" and B"') when the connection to 3G_MSC-B' has been established. MSC-B is informed via functional unit 4 that the connection has been established and that the procedure on the radio path can be initiated. The device is connected in its final position (i.e. B' to B"') when a successful procedure indication is received from functional unit 4. MSC-B is informed that all procedures in MSC-B can be terminated (illustrated by the MAP-SEND-END-SIGNAL response). The device returns to the state where B' and B" are connected if the subsequent GSM to UMTS handover procedure fails.

Timers in 3G_MSC-A.

The procedures are supervised by timers in order to avoid a deadlock when responses are not received or the procedures fail.

The following timers are defined for SRNS Relocation:

T701: this timer supervises the queuing time for a free channel for the relocation inside UMTS. If T701 expires, a no channel indication is generated and 3G_MSC-A will terminate the relocation as described in section 6.2.3. T701 is set by O&M.

T702: this timer supervises the time for relocation completion for relocation between RNSs in 3G_MSC-A. T702 is set by O&M.

T703: this timer supervises the time between issuing an Iu-RELOCATION-COMMAND from 3G_MSC-A and receiving a successful procedure indication from 3G_MSC-B. This timer also supervises the time between sending an A-HANDOVER-REQUEST-ACKNOWLEDGE to 3G_MSC-B and receiving a successful procedure indication from 3G_MSC-B'. If T703 expires, the relocation procedure is terminated. T703 is set by O&M.

T704: this timer supervises the time between sending of an A-HANDOVER-REQUEST-ACKNOWLEDGE to 3G_MSC-B and receiving the Iu-RELOCATION-COMPLETE from RNS-B on 3G_MSC-A. If the timer expires, the new radio channel is released and the existing handover/relocation device connection to 3G_MSC-B is maintained. T704 is set by O&M.

The following timers are defined for UMTS to GSM handover:

T301: this timer supervises the queuing time for a free channel for the UMTS to GSM handover. If T301 expires, a no channel indication is generated and 3G_MSC-A will terminate the handover as described in section 6.2.3. T301 is set by O&M.

T302: this timer supervises the time for UMTS to GSM handover completion for handover from RNS to BSS in 3G_MSC-A. T302 is set by O&M.

T303: this timer supervises the time between issuing an Iu-RELOCATION-COMMAND from 3G_MSC-A and receiving a successful procedure indication from MSC-B. This timer also supervises the time between sending an A-HO-REQUEST-ACKNOWLEDGE to MSC-B and receiving a successful procedure indication from MSC-B'. If T303 expires, the UMTS to GSM handover procedure is terminated. T303 is set by O&M.

T304: this timer supervises the time between sending of an A-HO-REQUEST-ACKNOWLEDGE to MSC-B and receiving the A-HANDOVER-COMPLETE from BSS-B on 3G_MSC-A. If the timer expires, the new radio channel is released and the existing handover device connection to MSC-B is maintained. T304 is set by O&M.

The following timers are defined for GSM to UMTS handover:

T501: this timer supervises the queuing time for a free channel for the GSM to UMTS handover. If T501 expires, a no channel indication is generated and 3G_MSC-A will terminate the handover as described in section 6.2.3. T501 is set by O&M.

T502: this timer supervises the time for GSM to UMTS handover completion for handover from BSS to RNS in 3G_MSC-A. T502 is set by O&M.

T503: this timer supervises the time between issuing an A-HANDOVER-COMMAND from MSC-A and receiving a successful procedure indication from 3G_MSC-B. This timer also supervises the time between sending an A-HANDOVER-REQUEST-ACKNOWLEDGE to 3G_MSC-B and receiving a successful procedure indication from 3G_MSC-B'. If T503 expires, the GSM to UMTS handover procedure is terminated. T503 is set by O&M.

T504: this timer supervises the time between sending of an A-HANDOVER-REQUEST-ACKNOWLEDGE to 3G_MSC-B and receiving the Iu-RELOCATION-COMPLETE from RNS-B on 3G_MSC-A. If the timer expires, the new radio channel is released and the existing handover device connection to MSC-B is maintained. T504 is set by O&M.

11.4 MAP procedures in 3G_MSC-A (functional unit 4)

The MAP procedures for handover/relocation are defined in TS 29.002 [12]. They include:

- procedures for basic handover/relocation;
- procedures for subsequent handover/relocation.

These procedures are as outlined in section 8.

11.5 Interworking between Handover/Relocation control procedures and MAP procedures in 3G_MSC-A

The interworking between the Handover/Relocation control procedures and the MAP procedures for handover/relocation is defined in GSM 29.010 [8]. It includes:

- interworking at basic handover/relocation initiation;
- interworking at subsequent handover/relocation completion.

This interworking is not described in this Technical Specification.

11.6 Compatibility with GSM Phase 1

Interworking with the GSM Phase 1 is not supported.

11.7 Protocol interworking

If the 3G_MSC-A accepts an Inter-3G MSC handover/relocation procedure according to Phase 2 MAP and BSSMAP protocols while using a RANAP protocol towards RNS-A, 3G_MSC-A has to perform the protocol interworking.

The same holds if 3G_MSC-A initiates a subsequent handover/relocation while using a RANAP protocol towards RNS-B.

12 Detailed procedures in 3G_MSC-B

For detailed procedures in 3G_MSC-B at handover within the GSM network, please see chapter 10 'Detailed procedures in MSC-B'.

12.1 RNC/BSC/3G_MSC (UE/MS/RNC/BSC) procedures in 3G_MSC-B (functional unit 1)

The Intra and Inter-3G_MSC handover/relocation procedures in this functional unit consist of:

i) signalling between the UE/MS and the 3G_MSC;

ii) signalling between the RNS/BSS and the 3G_MSC for access management.

Signals exchanged with functional unit 3 are indicated in section 12.3 below.

12.2 Call control procedures 3G_MSC-B (functional unit 2)

These procedures relate to the call control in 3G_MSC-B of the "3G_MSC handover/relocation" connection with 3G_MSC-A. For these procedures the following apply:

Call set-up

The connection is set up by 3G_MSC-A. 3G_MSC-B should provide, if possible, the following backward signals:

- signals indicating unsuccessful call set-up and, if possible, the cause of call failure;
- address complete signal;
- answer signal (see NOTE).

NOTE: The answer signal is not related to answering by the UE/MS and it has no meaning in the 3G_MSC handover/relocation procedure between 3G_MSC-A and 3G_MSC-B. But after successful handover/relocation or successful subsequent channel assignment using a circuit connection between 3G_MSC-A and 3G_MSC-B this signal is needed for bringing the connection in the answered state in the intermediate PSTN/ISDN exchanges.

There will be no indication that the call applies to a 3G_MSC handover/relocation. This information has to be derived from the UE/MS Handover Number received during call set-up in relation to the earlier MAP-PREPARE-HANDOVER request/MAP-PREPARE-HANDOVER response procedure between 3G_MSC-A and 3G_MSC-B.

Call clearing

Call clearing consists of two parts after inter-3G_MSC handover/relocation: clearing of the RNS-UE/MS or the BSS-UE/MS connection and clearing of the inter-3G_MSC connection, these cases are only applicable to calls successfully handed over or relocated. If a request to release the call is generated by the network while the UE/MS is re-tuning from one RNS/BSS to another RNS/BSS, then 3G_MSC-B shall begin clearing the call to the network and queue the call release to the UE/MS until the UE/MS has resumed communication.

The MAP is used to transfer information between 3G_MSC-A and 3G_MSC-B in order to make it possible for 3G_MSC-B to send the appropriate signals to the UE/MS, specified in TS_24.008 [10], and still leave the call control to 3G_MSC-A. 3G_MSC-A normally initiates release of the connection between 3G_MSC-A and 3G_MSC-B. Exceptionally 3G_MSC-B is allowed to release the connection if no MAP-SEND-END-SIGNAL response is received, or if the 3G_MSC Handover/Relocation is to be aborted.

When the Signalling System no 7 ISDN User Part is used, the normal symmetric release procedures apply. When a signalling system is used without a symmetric release possibility or a fault condition occurs, the following may apply:

- when 3G_MSC-B receives a clear-forward signal from 3G_MSC-A, it shall release the radio resources;
- in fault situation e.g. machine malfunction or loss of the connection on interface Iu or interface A, 3G_MSC-B may send a clear-back signal to 3G_MSC-A.

12.3 Handover/Relocation control procedures in 3G_MSC-B (functional unit 3)

The procedures of functional unit 3 are given in form of SDL diagrams in figure 44. To easily distinguish the interface concerned the messages received or sent from this unit are prefixed with either 'MAP' for a MAP message, 'A' for an A-Interface message, ‘Iu’ for an Iu-Interface message or 'I' for an ISDN/PSTN message. The procedure in functional unit 3 include:

i) Inter 3G_MSC handover/relocation from 3G_MSC-A.

This case is initiated by 3G_MSC-A, and includes allocation and establishment of the new radio resources. The procedure is outlined in sections 8.1.1 and 8.1.2. for UMTS to GSM handover, sections 8.2.1 and 8.2.2 for GSM to UMTS handover and sections 8.3.1 and 8.3.2 for relocation.

ii) Intra-3G_MSC UMTS to GSM handovers within the area controlled by 3G_MSC-B.

This procedure is the same as that of ii) in section 11.3, except that the Iu-RELOCATION-REQUERED is received by 3G_MSC-B.

iii) Intra-3G_MSC GSM to UMTS handovers within the area controlled by 3G_MSC-B.

This procedure is the same as that of ii) in section 11.3, except that the A-HANDOVER-REQUERED is received by 3G_MSC-B.

iv) Intra-3G_MSC SRNS Relocation within the area controlled by 3G_MSC-B.

This procedure is the same as that of ii) in section 11.3, except that the Iu-RELOCATION-REQUERED is received by 3G_MSC-B.

v) subsequent handover/relocation to another 3G_MSC (3G_MSC-A or 3G_MSC-B').

The initiation procedure is essentially the same as that of i) of section 11.3. The Handover Command to the BSS or the Relocation Command to the RNS is now generated by 3G_MSC-B after the A-HO-REQUEST-ACKNOWLEDGE is received from 3G_MSC-A (via functional unit 4). The procedure is terminated in 3G_MSC-B when 3G_MSC-B receives a terminate procedure indication from functional unit 4.

Timers in 3G_MSC-B

The following procedures are supervised by timers in order to avoid a deadlock when responses are not received or the procedures fail.

The following timers are defined for UMTS to GSM handover:

T401: this timer supervises the queuing time for a free channel. T401 is set by O&M.

T402: this timer supervises the time for handover completion for UMTS to GSM handover from RNS to BSS in 3G_MSC-B. If T402 expires, the radio path and the connection on interface B' are released. T402 is set by O&M.

T404: this timer supervises the time between sending of address complete message to 3G_MSC-A and receiving the A-HANDOVER-COMPLETE from BSS-B on 3G_MSC-B. This timer also supervises the time between issuing the handover command to the UE/MS and receiving the MAP-SEND-END-SIGNAL response from 3G_MSC-A, for a subsequent handover from UMTS to GSM. In the case of a UMTS to GSM handover without circuit connection between 3G_MSC-A and 3G_MSC-B this timer supervises the time between issuing the A-HO-REQUEST-ACKNOWLEDGE to the 3G_MSC-A and receiving the A-HANDOVER-COMPLETE from BSS-B on 3G_MSC-B. If the timer expires, then any new radio channel is released. T404 is set by O&M.

T410: this timer is used to supervise the time for establishing a circuit connection from 3G_MSC-A to 3G_MSC-B. When T410 expires, the allocated channel in 3G_MSC-B is released. T410 is set by O&M. This timer is not started when 3G_MSC-A explicitly indicates that no handover number is needed.

T411: this timer is used to control the time between requesting a subsequent UMTS to GSM handover (A-HO-REQUEST to the 3G_MSC-A) and receiving the response from 3G_MSC-A (A-HO-REQUEST-ACKNOWLEDGE/A-HO-FAILURE). If T411 expires, the existing connection with the UE/MS is maintained. T411 is set by O&M.

The following timers are defined for GSM to UMTS handover

T601: this timer supervises the queuing time for a free radio resource. T601 is set by O&M.

T602: this timer supervises the time for handover completion for GSM to UMTS handover from BSS to RNS in 3G_MSC-B. If T602 expires, the radio path and the connection on interface B' are released. T602 is set by O&M.

T604: this timer supervises the time between sending of address complete message to 3G_MSC-A and receiving the Iu-RELOCATION-COMPLETE from RNS-B on 3G_MSC-B. This timer also supervises the time between issuing the handover command to the UE/MS and receiving the MAP-SEND-END-SIGNAL response from 3G_MSC-A, for a subsequent handover from GSM to UMTS. In the case of a GSM to UMTS handover without circuit connection between 3G_MSC-A and 3G_MSC-B this timer supervises the time between issuing the A-HO-REQUEST-ACKNOWLEDGE to the 3G_MSC-A and receiving the Iu-RELOCATION-COMPLETE from RNS-B on 3G_MSC-B. If the timer expires, then any new radio resource is released. T604 is set by O&M.

T610: this timer is used to supervise the time for establishing a circuit connection from 3G_MSC-A to 3G_MSC-B. When T610 expires, the allocated radio resource in 3G_MSC-B is released. T610 is set by O&M. This timer is not started when 3G_MSC-A explicitly indicates that no handover number is needed.

T611: this timer is used to control the time between requesting a subsequent GSM to UMTS handover (A-HO-REQUEST to the 3G_MSC-A) and receiving the response from 3G_MSC-A (A-HO-REQUEST-ACKNOWLEDGE/A-HO-FAILURE). If T611 expires, the existing connection with the UE/MS is maintained. T611 is set by O&M.

The following timers are defined for SRNS Relocation

T801: this timer supervises the queuing time for a free radio resource. T801 is set by O&M.

T802: this timer supervises the time for relocation completion for relocation between RNSs in 3G_MSC-B. If T802 expires, the radio path and the connection on interface B' are released. T802 is set by O&M.

T804: this timer supervises the time between sending of address complete message to 3G_MSC-A and receiving the Iu-RELOCATION-COMPLETE from RNS-B on 3G_MSC-B. This timer also supervises the time between issuing the handover command to the UE and receiving the MAP-SEND-END-SIGNAL response from 3G_MSC-A, for a subsequent relocation. In the case of a relocation without circuit connection between 3G_MSC-A and 3G_MSC-B this timer supervises the time between issuing the A-HO-REQUEST-ACKNOWLEDGE to the 3G_MSC-A and receiving the Iu-RELOCATION-COMPLETE from RNS-B on 3G_MSC-B. If the timer expires, then any new radio resource is released. T804 is set by O&M.

T810: this timer is used to supervise the time for establishing a circuit connection from 3G_MSC-A to 3G_MSC-B. When T810 expires, the allocated channel in 3G_MSC-B is released. T810 is set by O&M. This timer is not started when 3G_MSC-A explicitly indicates that no handover number is needed.

T811: this timer is used to control the time between requesting a subsequent relocation (A-HO-REQUEST to the 3G_MSC-A) and receiving the response from 3G_MSC-A (A-HO-REQUEST-ACKNOWLEDGE/A-HO-FAILURE). If T811 expires, the existing connection with the UE is maintained. T811 is set by O&M.

12.4 MAP procedures in 3G_MSC-B (functional unit 4)

The MAP procedures for handover/relocation are defined in TS 29.002 [12]. They include:

- procedures for basic handover/relocation;
- procedures for subsequent handover/relocation;
- procedures for obtaining the handover number from the VLR.

These procedures are outlined in section 8.

12.5 Interworking between Handover/Relocation control procedures and MAP procedures in 3G_MSC-B

The interworking between the Handover/Relocation control procedures and the MAP procedures for handover/relocation is defined in TS 29.010 [8]. It includes:

- interworking at basic handover/relocation completion;
- interworking at subsequent handover/relocation initiation.

This interworking is not described in this Technical Specification.

12.6 Compatibility with GSM Phase 1

GSM phase 1 is not supported.

12.7 Protocol interworking

If the 3G_MSC-B accepts an Inter-3G_MSC handover/relocation procedure according to Phase 2 MAP and BSSMAP protocols while using a RANAP protocol towards RNS-B, 3G_MSC-B has to perform the protocol interworking.

The same holds if 3G_MSC-B initiates a subsequent handover/relocation while using a RANAP protocol towards RNS-A.

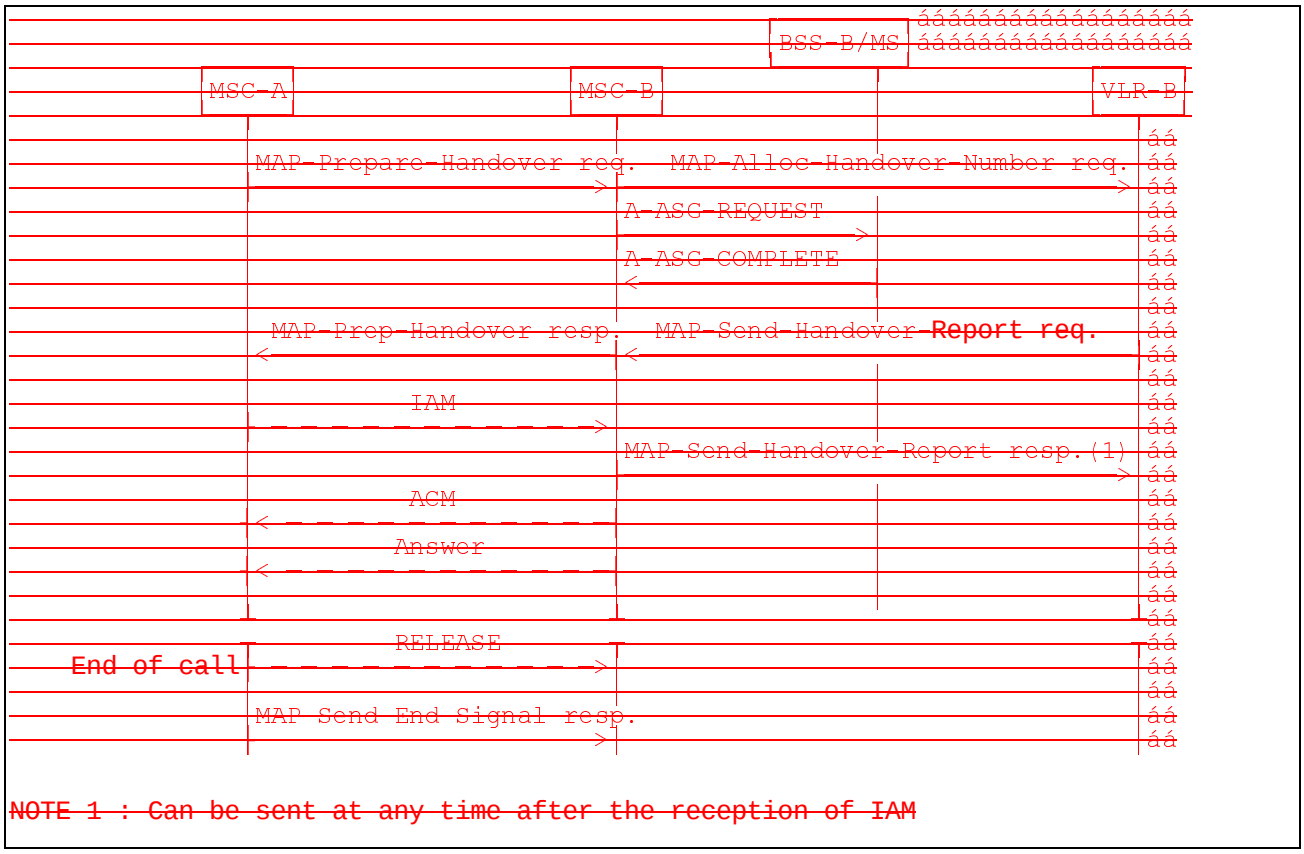
13~~0~~ Subsequent channel assignment using a circuit connection between MSC-A and MSC-B

13.1 GSM handover

If a circuit connection has to be set up (for example for a Mobile Originated or Mobile Terminated Call Establishment) after an Inter-MSC handover without circuit connection, MSC-A shall request a Handover Number using a MAP-PREPARE-HANDOVER request, containing the A-ASSIGNMENT-REQUEST, on the established MAP connection. If MSC-B indicates to MSC-B and to MSC-A that at least one of two procedures assignment or Handover Number allocation can not be completed, then MSC-A shall terminate the circuit establishment attempt. The existing connection to the MS shall be maintained, if possible.

Upon receipt of the MAP-PREPARE-HANDOVER request MSC-B shall perform the requested assignment operation towards the BSS. In addition it shall retrieve a Handover Number from VLR-B. If a failure occurs in the assignment or Handover Number allocation then it shall be reflected in the MAP-PREPARE-HANDOVER response that at least one of these two procedures has not been completed (i.e. either by a MAP-PREPARE-HANDOVER result with the assignment procedure outcome and the Handover Number allocation outcome or by a MAP-PREPARE-HANDOVER error).

When MSC-A receives a successful MAP-PREPARE-HANDOVER response it shall establish a circuit connection to MSC-B by using the appropriate network supported procedures. In figure 36~~11~~ this is indicated by the IAM (Initial Address Message) and ACM (Address Complete Message). MSC-B shall also send the Answer message if appropriate to the signalling system. Upon receipt of the Answer MSC-A shall consider the circuit connection establishment phase complete. If a failure occurs during the cirucit establishment phase then the existing connection to the MS shall be maintained, if possible.



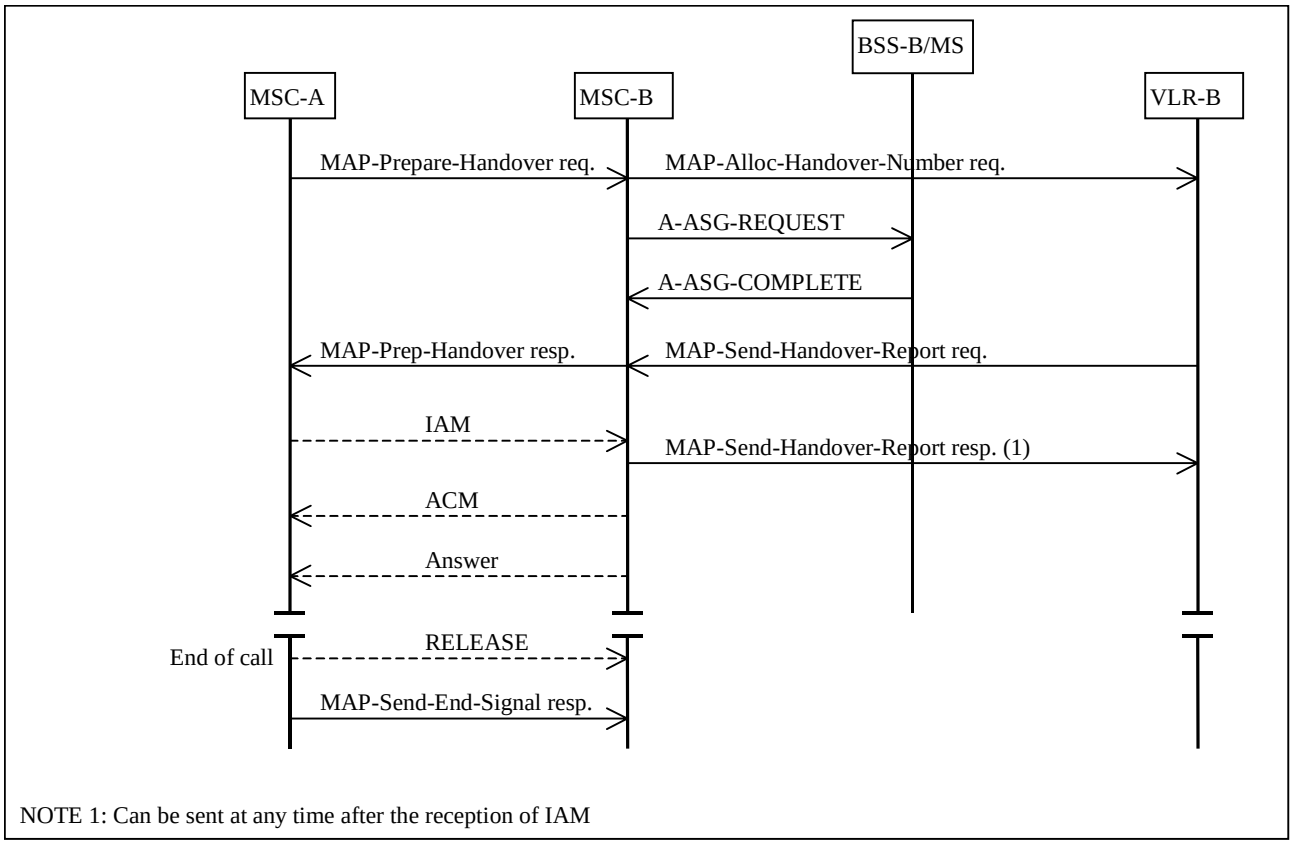


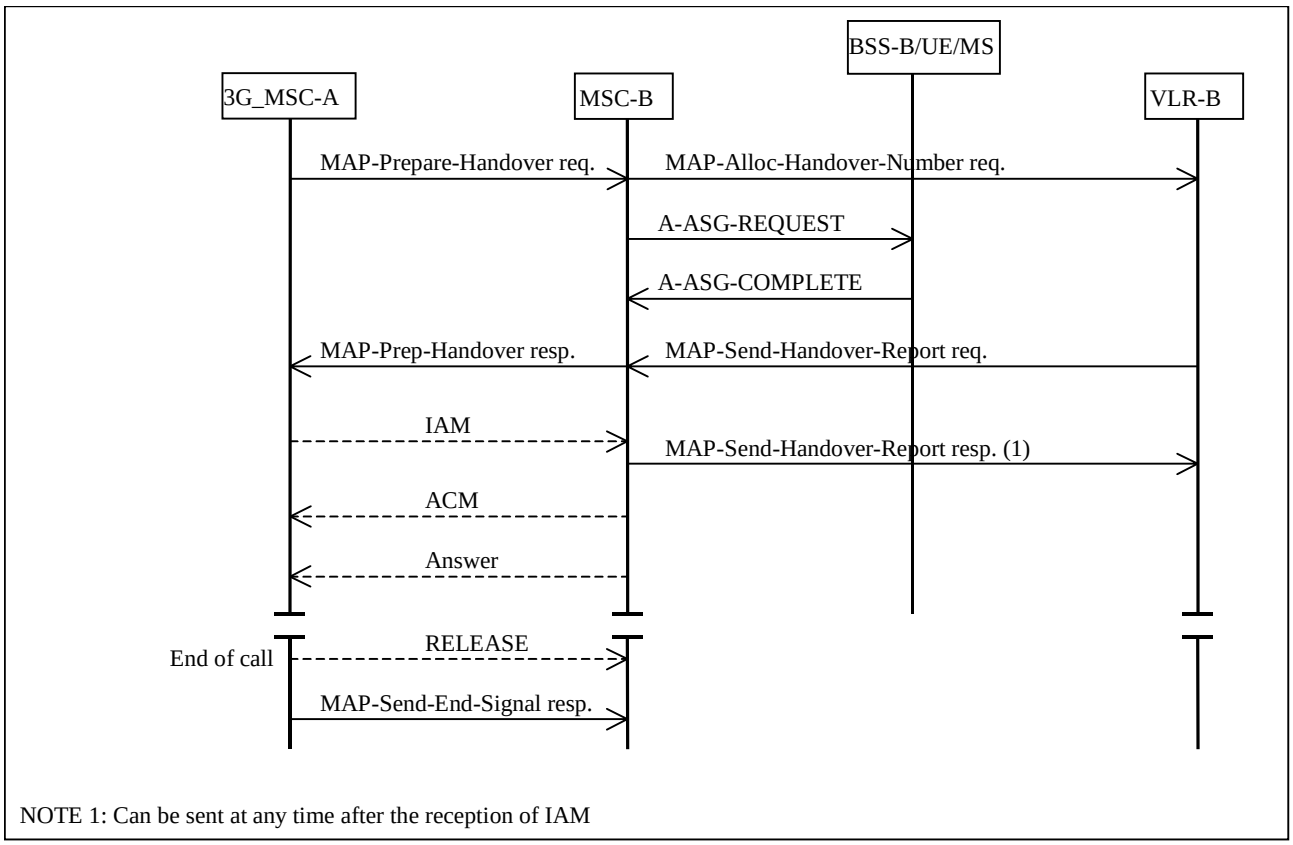
Figure 3611: Successful circuit-switched call establishment after a Basic Handover without circuit connection

13.2 UMTS to GSM handover

If a circuit connection has to be set up (for example for a Mobile Originated or Mobile Terminated Call Establishment) after an Inter-3G_MSC UMTS to GSM handover without circuit connection, 3G_MSC-A shall request a Handover Number using a MAP-PREPARE-HANDOVER request, containing the A-ASSIGNMENT-REQUEST, on the established MAP connection. If MSC-B indicates to MSC-B and to 3G_MSC-A that at least one of two procedures assignment or Handover Number allocation can not be completed, then 3G_MSC-A shall terminate the circuit establishment attempt. The existing connection to the UE/MS shall be maintained, if possible.

Upon receipt of the MAP-PREPARE-HANDOVER request MSC-B shall perform the requested assignment operation towards the BSS. In addition it shall retrieve a Handover Number from VLR-B. If a failure occurs in the assignment or Handover Number allocation then it shall be reflected in the MAP-PREPARE-HANDOVER response that at least one of these two procedures has not been completed (i.e. either by a MAP-PREPARE-HANDOVER result with the assignment procedure outcome and the Handover Number allocation outcome or by a MAP-PREPARE-HANDOVER error).

When 3G_MSC-A receives a successful MAP-PREPARE-HANDOVER response, it shall establish a circuit connection to MSC-B by using the appropriate network supported procedures. In figure 37 this is indicated by the IAM (Initial Address Message) and ACM (Address Complete Message). MSC-B shall also send the Answer message if appropriate to the signalling system. Upon receipt of the Answer 3G_MSC-A shall consider the circuit connection establishment phase complete. If a failure occurs during the circuit establishment phase then the existing connection to the UE/MS shall be maintained, if possible.



NOTE 1: Can be sent at any time after the reception of IAM

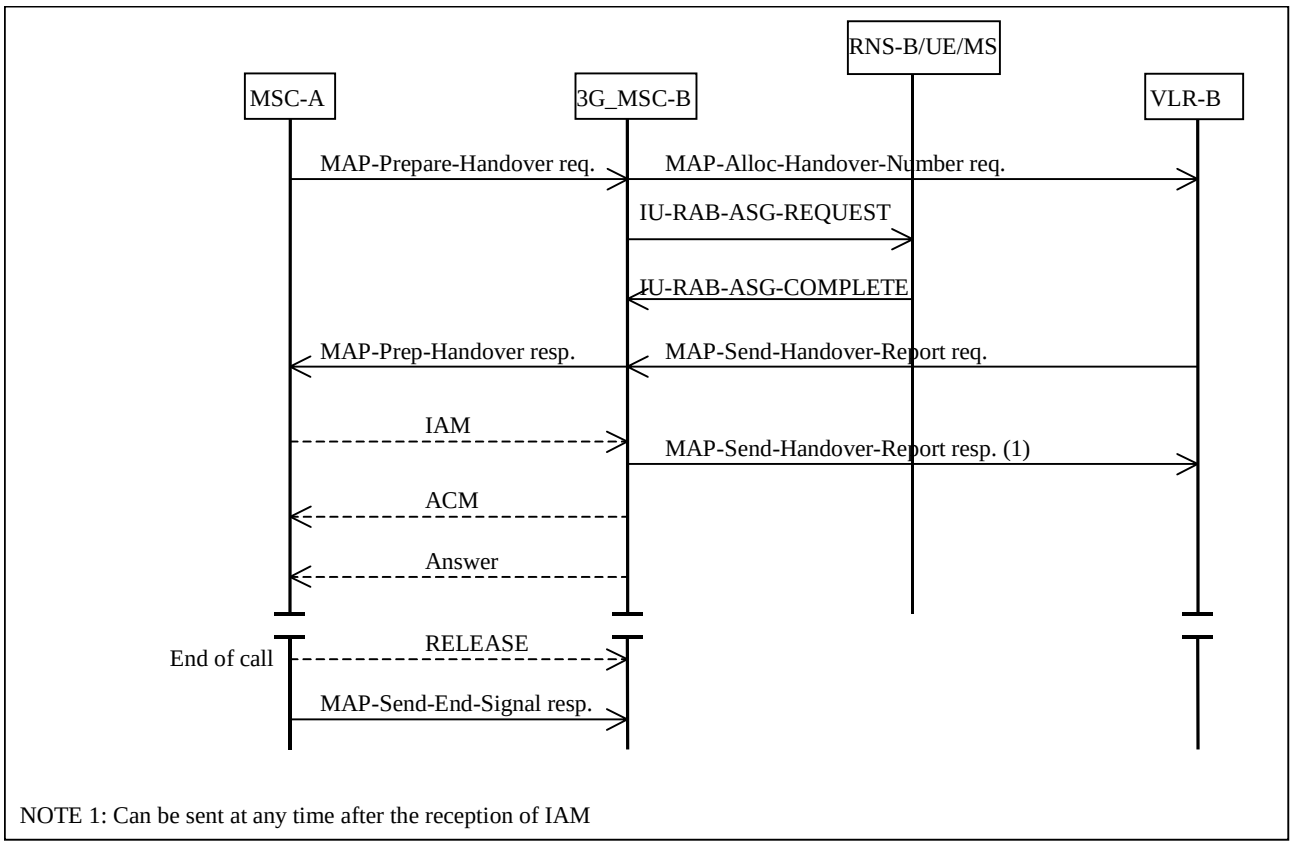
Figure 37: Successful circuit-switched call establishment after a Basic UMTS to GSM Handover without circuit connection

13.3 GSM to UMTS handover

If a circuit connection has to be set up (for example for a Mobile Originated or Mobile Terminated Call Establishment) after an Inter-3G_MSC GSM to UMTS handover without circuit connection, MSC-A shall request a Handover Number using a MAP-PREPARE-HANDOVER request, containing the A-ASSIGNMENT-REQUEST, on the established MAP connection. If 3G_MSC-B indicates to 3G_MSC-B and to MSC-A that at least one of two procedures assignment or Handover Number allocation can not be completed, then MSC-A shall terminate the circuit establishment attempt. The existing connection to the UE/MS shall be maintained, if possible.

Upon receipt of the MAP-PREPARE-HANDOVER request 3G_MSC-B shall perform the requested assignment operation towards the RNS. In addition it shall retrieve a Handover Number from VLR-B. If a failure occurs in the assignment or Handover Number allocation then it shall be reflected in the MAP-PREPARE-HANDOVER response that at least one of these two procedures has not been completed (i.e. either by a MAP-PREPARE-HANDOVER result with the assignment procedure outcome and the Handover Number allocation outcome or by a MAP-PREPARE-HANDOVER error).

When MSC-A receives a successful MAP-PREPARE-HANDOVER response, it shall establish a circuit connection to 3G_MSC-B by using the appropriate network supported procedures. In figure 38 this is indicated by the IAM (Initial Address Message) and ACM (Address Complete Message). 3G_MSC-B shall also send the Answer message if appropriate to the signalling system. Upon receipt of the Answer MSC-A shall consider the circuit connection establishment phase complete. If a failure occurs during the circuit establishment phase then the existing connection to the UE/MS shall be maintained, if possible.



NOTE 1: Can be sent at any time after the reception of IAM

Figure 38: Successful circuit-switched call establishment after a Basic GSM to UMTS Handover without circuit connection

13.4 SRNS Relocation

If a circuit connection has to be set up (for example for a Mobile Originated or Mobile Terminated Call Establishment) after an Inter-3G_MSC relocation without circuit connection, 3G_MSC-A shall request a Handover Number using a

MAP-PREPARE-HANDOVER request, containing the IU-RAB-ASSIGNMENT-REQUEST as A-ASSIGNMENT-REQUEST, on the established MAP connection. If 3G_MSC-B indicates to 3G_MSC-B and to 3G_MSC-A that at least one of two procedures (RAB) assignment or Handover Number allocation can not be completed, then 3G_MSC-A shall terminate the circuit establishment attempt. The existing connection to the UE shall be maintained, if possible.

Upon receipt of the MAP-PREPARE-HANDOVER request, 3G_MSC-B shall perform the requested RAB assignment operation towards the RNS. In addition it shall retrieve a Handover Number from VLR-B. If a failure occurs in the RAB assignment or Handover Number allocation then it shall be reflected in the MAP-PREPARE-HANDOVER response that at least one of these two procedures has not been completed (i.e. either by a MAP-PREPARE-HANDOVER result with the RAB assignment procedure outcome and the Handover Number allocation outcome or by a MAP-PREPARE-HANDOVER error).

When 3G_MSC-A receives a successful MAP-PREPARE-HANDOVER response, it shall establish a circuit connection to 3G_MSC-B by using the appropriate network supported procedures. In figure 39 this is indicated by the IAM (Initial Address Message) and ACM (Address Complete Message). 3G_MSC-B shall also send the Answer message if appropriate to the signalling system. Upon receipt of the Answer 3G_MSC-A shall consider the circuit connection establishment phase complete. If a failure occurs during the circuit establishment phase then the existing connection to the UE shall be maintained, if possible.

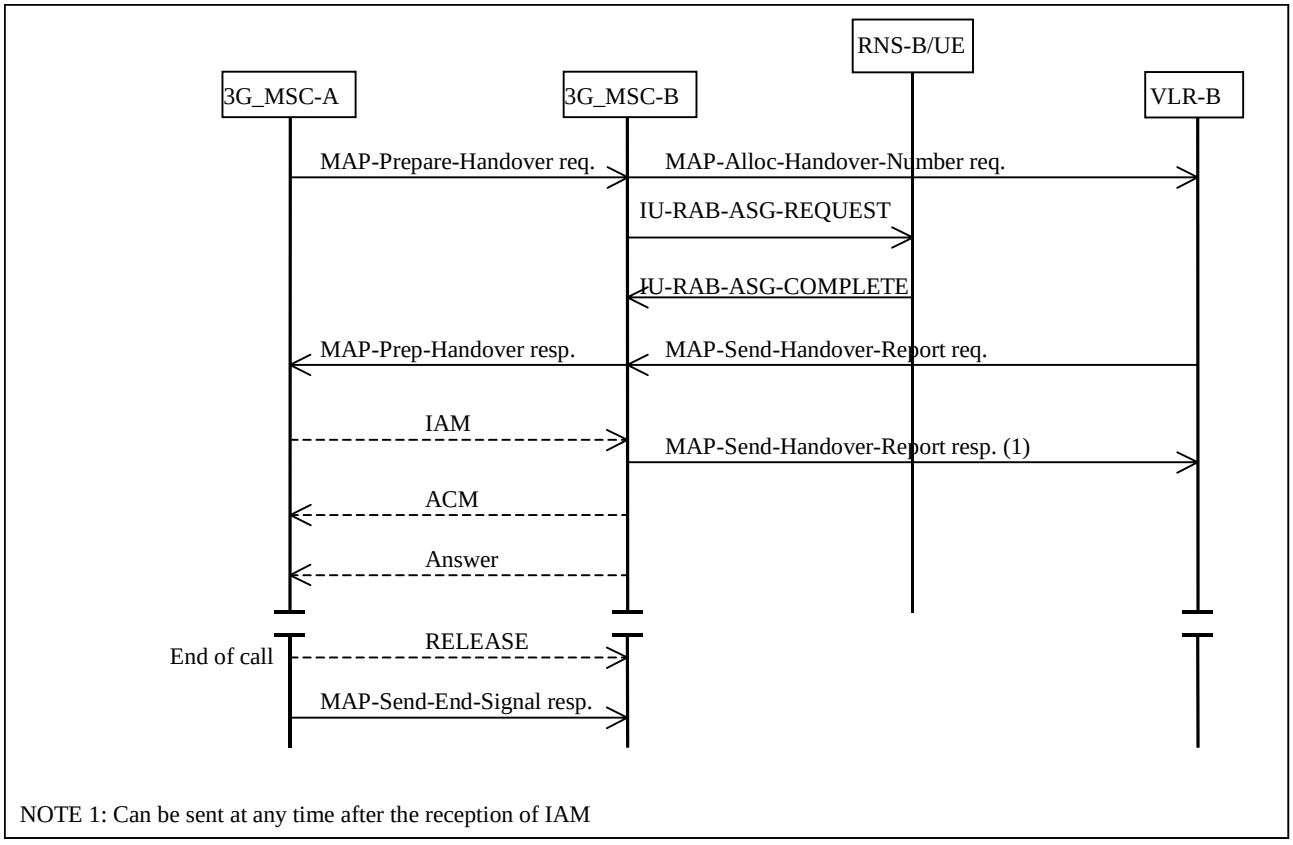


Figure 39: Successful circuit-switched call establishment after a Basic Relocation without circuit connection

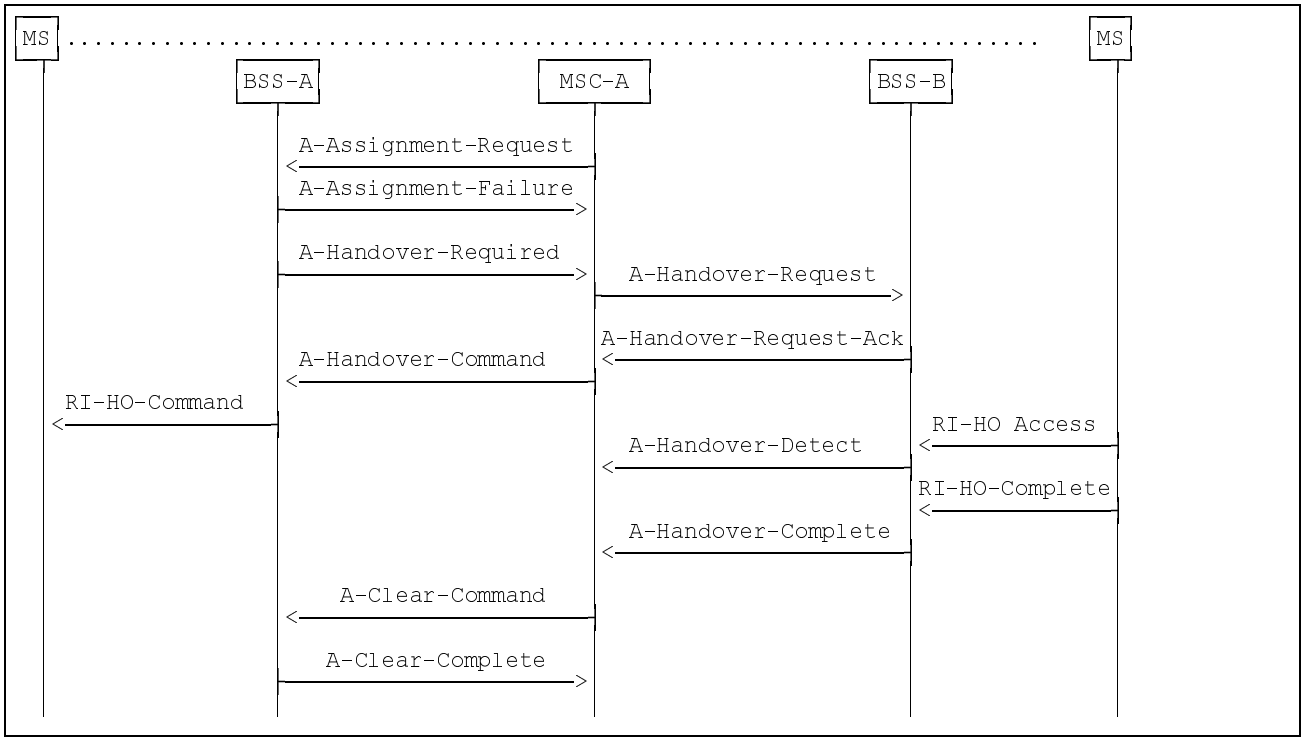
1411 Directed retry handover

[Directed retry in the cases of inter-system handover and SRNS relocation is FFS]

The directed retry procedure allows the network to select the optimum cell for the Mobile Station. The process of directed retry involves the assignment of a Mobile Station to a radio channel on a cell other than the serving cell. This process is triggered by the assignment procedures, as described in GSM 08.08 [5], and employs internal or external handover procedures as described in sections 6 and 7. The successful procedure for a directed retry is as shown in figure 40~~12~~ and as described below.

If during the assignment phase, as represented by the A-ASSIGNMENT-REQUEST message, a handover becomes necessary, due to either radio conditions or congestion, then the Mobile Station may be handed over to a different cell. When the decision has been made to handover the MS the BSS-A may send an A-ASSIGNMENT-FAILURE message, indicating 'directed retry', before sending the A-HANDOVER-REQUIRED message to MSC-A, indicating 'directed retry'. However BSS-A may alternatively send the A-HANDOVER-REQUIRED message, indicating 'directed retry', without sending the A-ASSIGNMENT-FAILURE message. Other cause values may be used instead of “Directed Retry” in the A-HANDOVER-REQUIRED message, this will allow the MSC to take different actions dependent on the received cause. Upon receipt of the A-HANDOVER-REQUIRED message from BSS-A, then MSC-A shall initiate the handover as described in sections 6 and 7. No resources shall be cleared in the MSC-A or BSS-A for this connection.

After receipt of the A-HANDOVER-COMPLETE message from BSS-B the assignment procedure shall be considered to be complete and the resources on BSS-A shall be cleared.



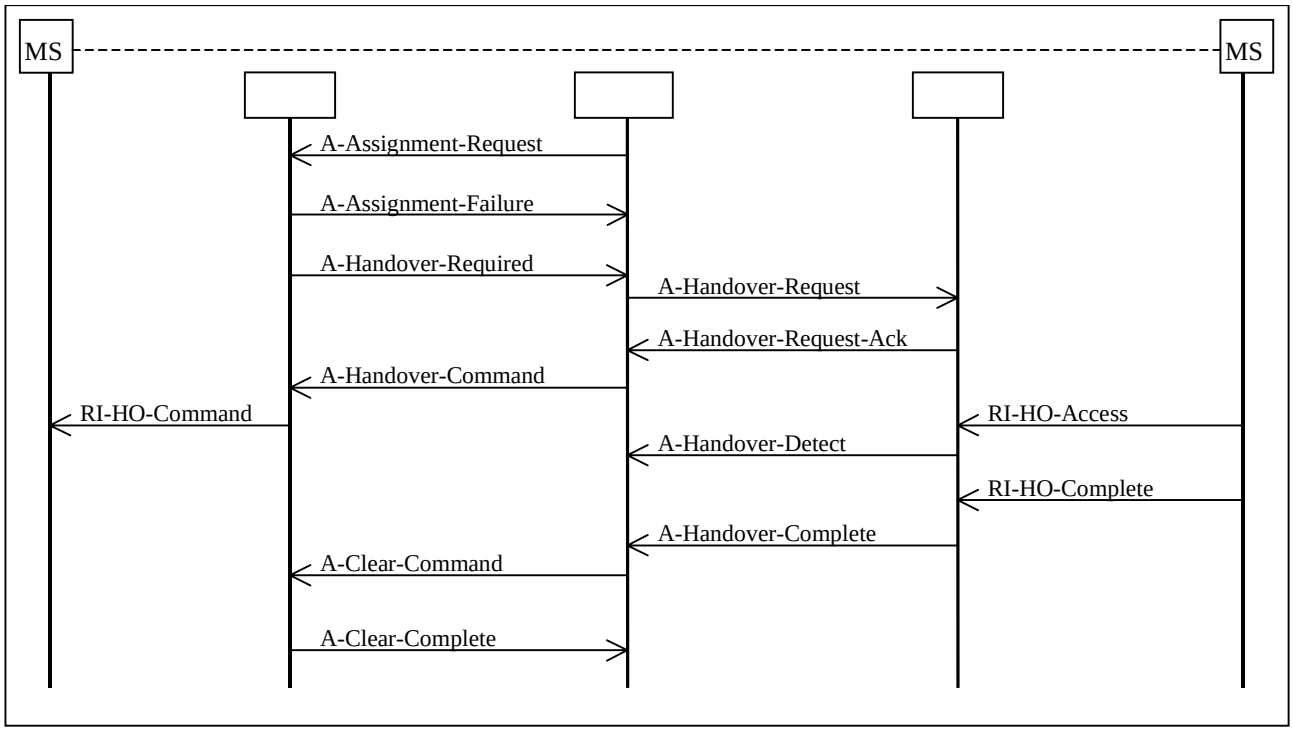


Figure 4012: Example of a Directed Retry Intra-MSC Handover Procedure

If a failure occurs during the handover attempt, for example A-HANDOVER-FAILURE returned from BSS-A or BSS-B, then MSC-A will terminate the handover to BSS-B. Under these conditions MSC-A may optionally take one of a number of actions:

i) retry the handover to the same cell;

ii) select the next cell from the list contained in the A-HANDOVER-REQUIRED message and attempt a handover to the new cell;

iii) send an A-HANDOVER-REQUIRED-REJECT to BSS-A, if an A-HANDOVER-COMMAND has not already been sent;

iv) retry the assignment procedure to BSS-A, if the failure message was returned from BSS-A. This option is additional to those for normal handover;

v) Clear the complete call.

The procedures for Inter-MSC handover are also applicable to the directed retry process. If an Inter-MSC handover is necessary then the assignment process should be considered to have completed successfully upon receipt of the A-HO-COMPLETE included in the MAP-SEND-END-SIGNAL request.

1512 SDL diagrams

NOTE: The message primitive names used in the SDL diagrams and message flows in this technical specification do not represent the actual messages specified in the GSM or 3GPP stage 3 04 and GSM 08 series or the services specified in the GSM 09 series of technical specifications. The primitive names are only intended to be indicative of their use in this document.

SDL Annotation:

The following conventions and abbreviations have been used in the SDLs. Text included in '[]' is used to indicate either, the BSSMAP message (as defined in GSM 09.08 [7]) included in the message, or the transport of a Handover Number.

When traversing the following SDLs it may be possible that resources appear to be released repeatedly, however these operations are only executed once on their first occurrence. Furthermore it maybe that certain messages cannot, in practice, be received in particular states, after specific events have taken place. In general both of the above cases are obvious. This approach has been adopted (in line with other GSM Technical Specifications) in order to reduce the complexity of the SDLs and improve clarity, without reducing the quality of the functional description.

The following abbreviations have been used in the SDLs:

A-HO-REQUEST	A-HANDOVER-REQUEST
A-HO-REQUEST-ACK	A-HANDOVER-REQUEST-ACK.
A-HO-COMPLETE	A-HANDOVER-COMPLETE
A-HO-DETECT	A-HANDOVER-DETECT
A-HO-PERFORMED	A-HANDOVER-PERFORMED
A-ASG-REQUEST	A-ASSIGNMENT-REQUEST
A-ASG-COMPLETE	A-ASSIGNMENT-COMPLETE
A-ASG-FAILURE	A-ASSIGNMENT-FAILURE
MAP-PAS req	MAP-PROCESS-ACCESS-SIGNALLING req.
MAP-FAS req	MAP-FORWARD-ACCESS-SIGNALLING req.

NOTE : The SDL diagrams have been checked for consistency with the allocation of the A interface circuits by the BSC. The conclusion was that SDLs are expressed in general terms, and offer a sufficient latitude of interpretation to be consistent with the allocation of A interface circuits by the BSC.

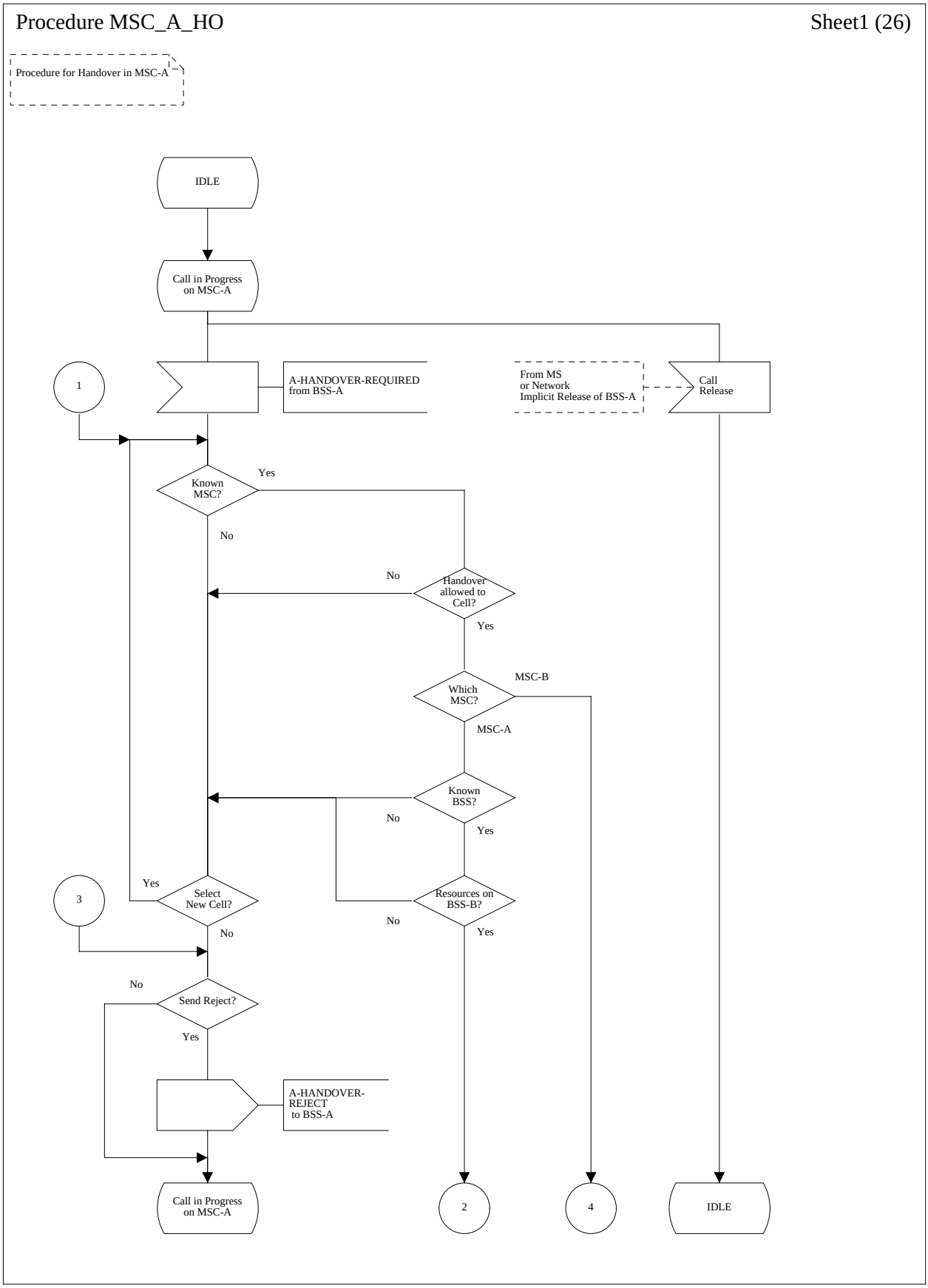


Figure 41~~13~~ (Sheet 1 of 26): Handover control procedure in MSC-A

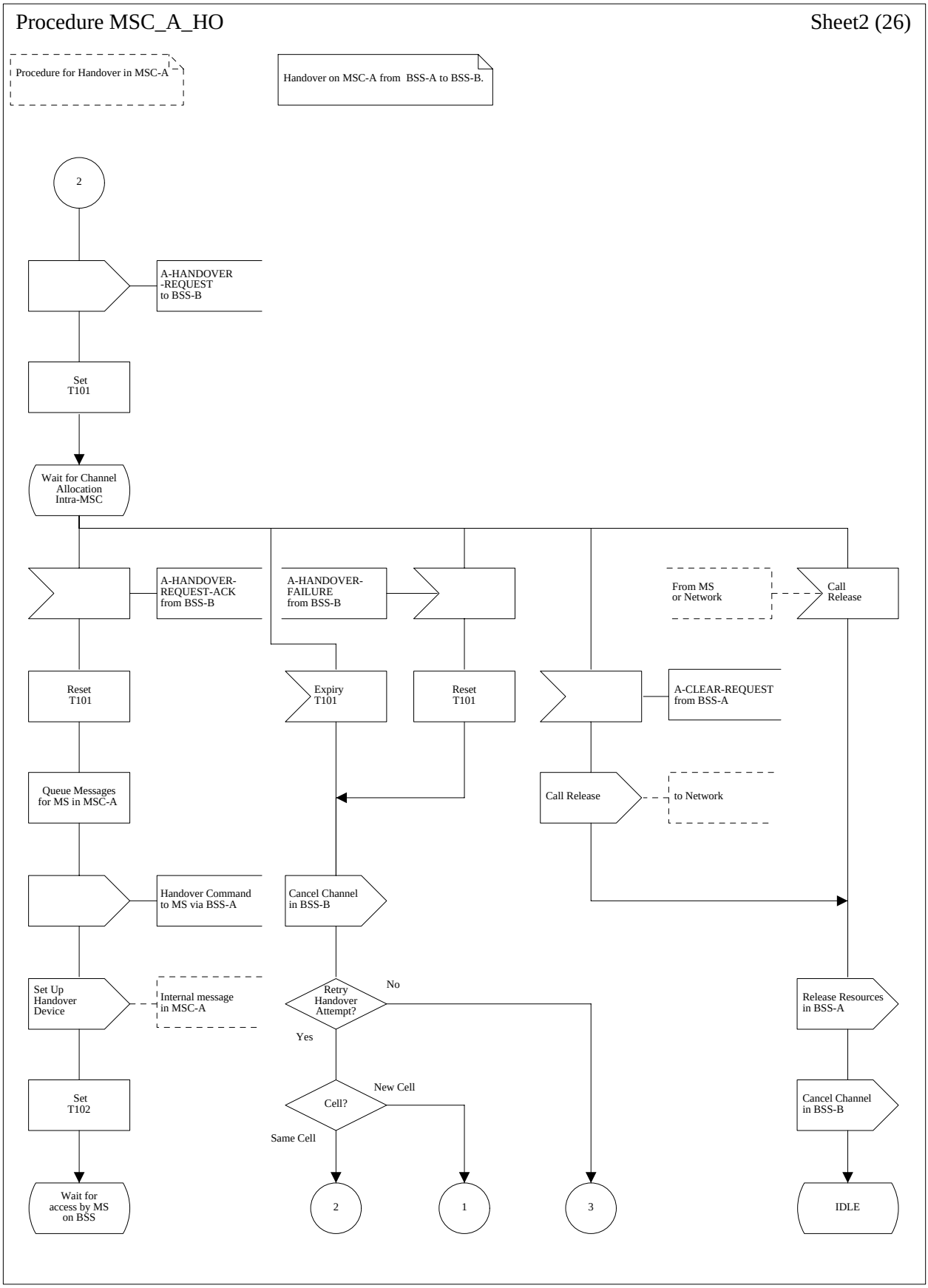


Figure 41~~13~~ (Sheet 2 of 26): Handover control procedure in MSC-A

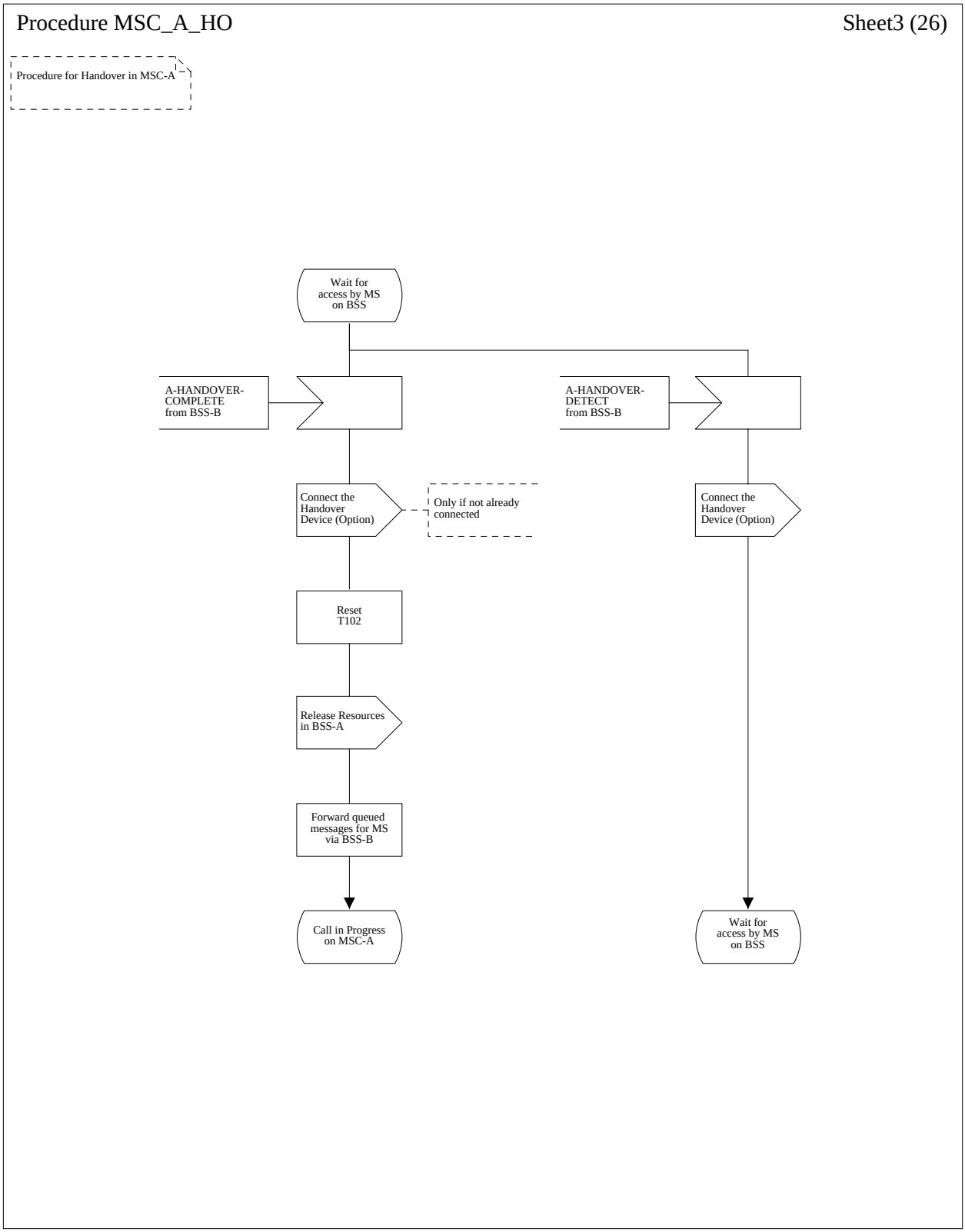


Figure 41~~13~~ (Sheet 3 of 26): Handover control procedure in MSC-A

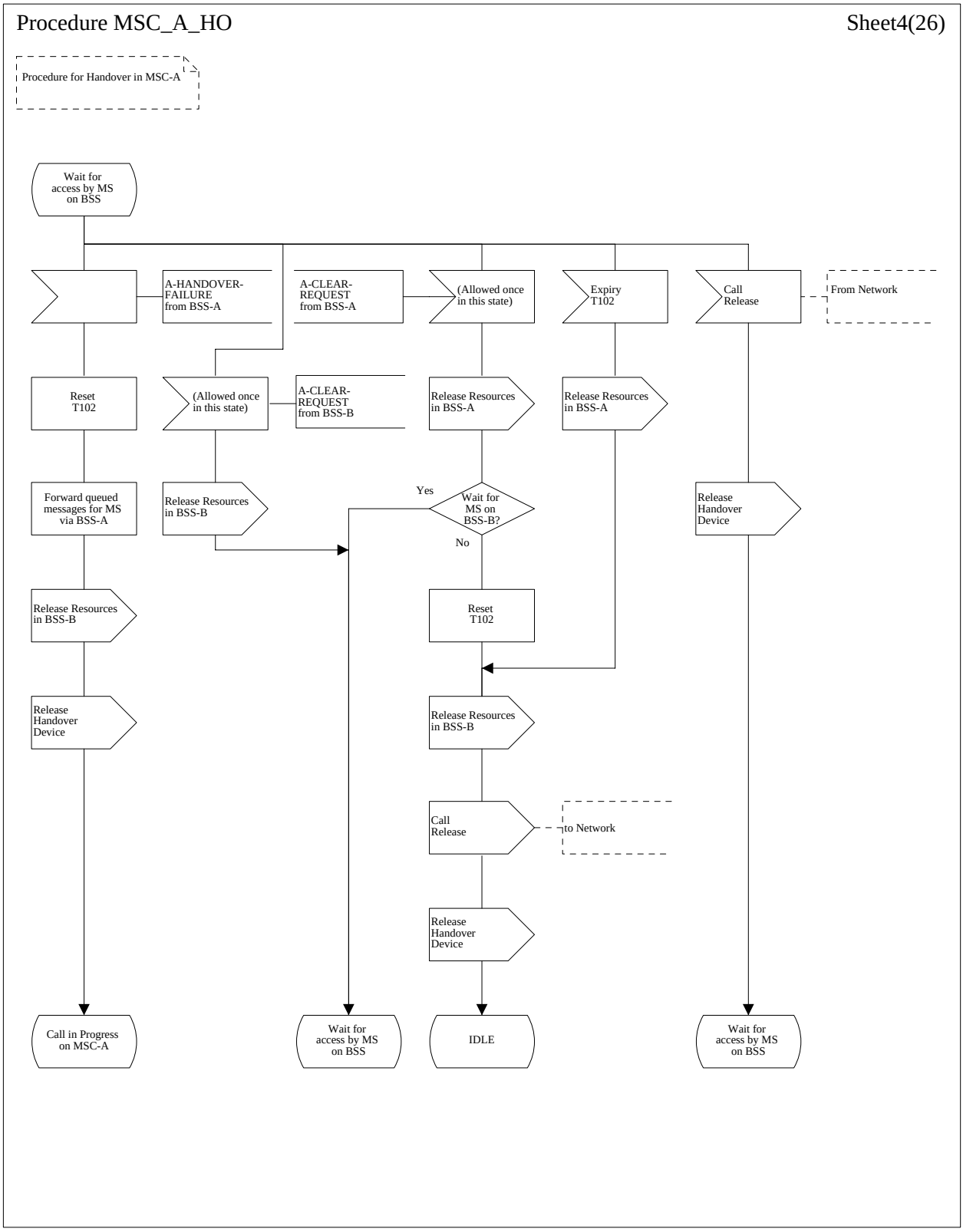


Figure 41~~13~~ (Sheet 4 of 26): Handover control procedure in MSC-A

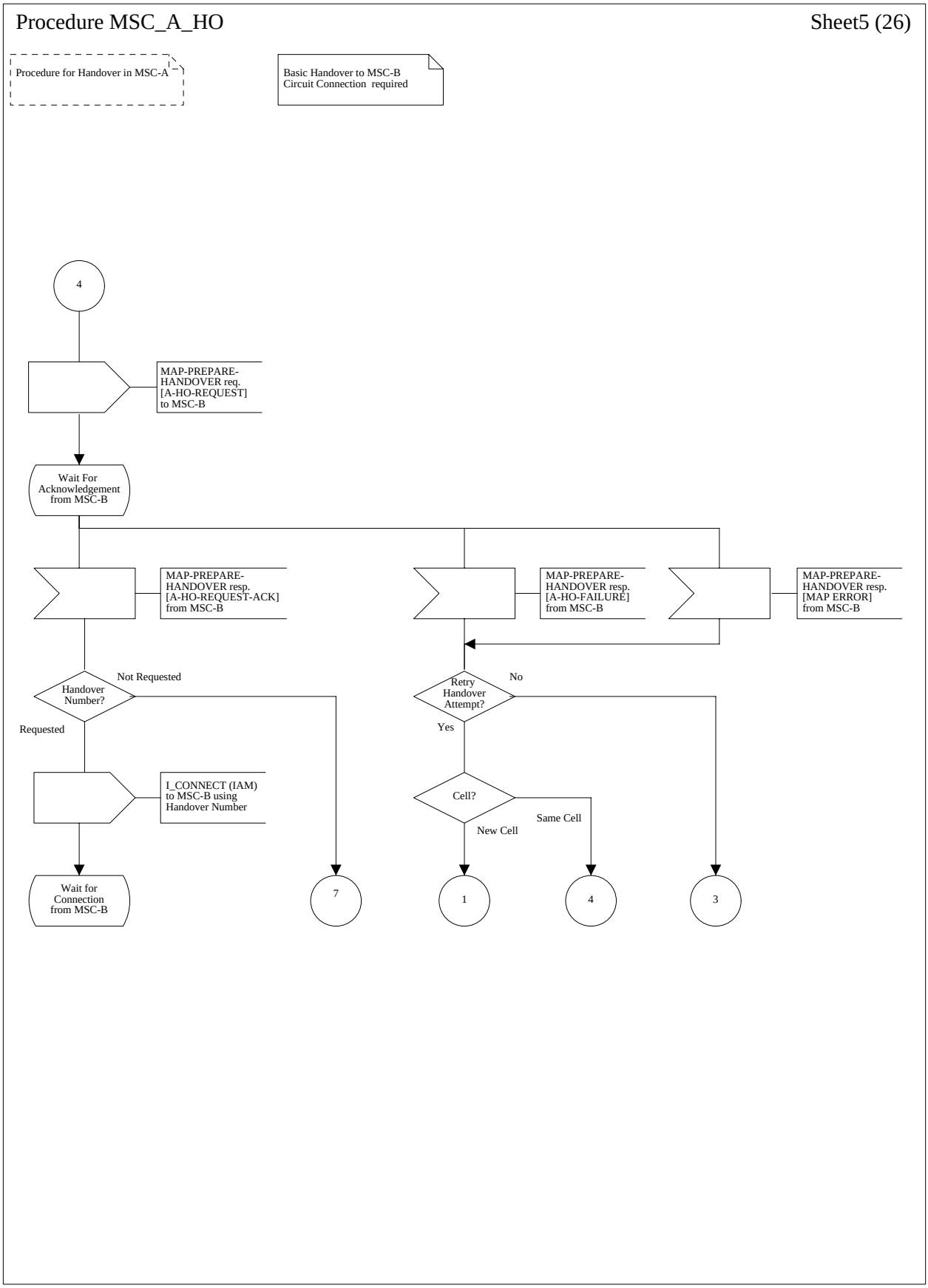


Figure 41~~13~~ (Sheet 5 of 26): Handover control procedure in MSC-A

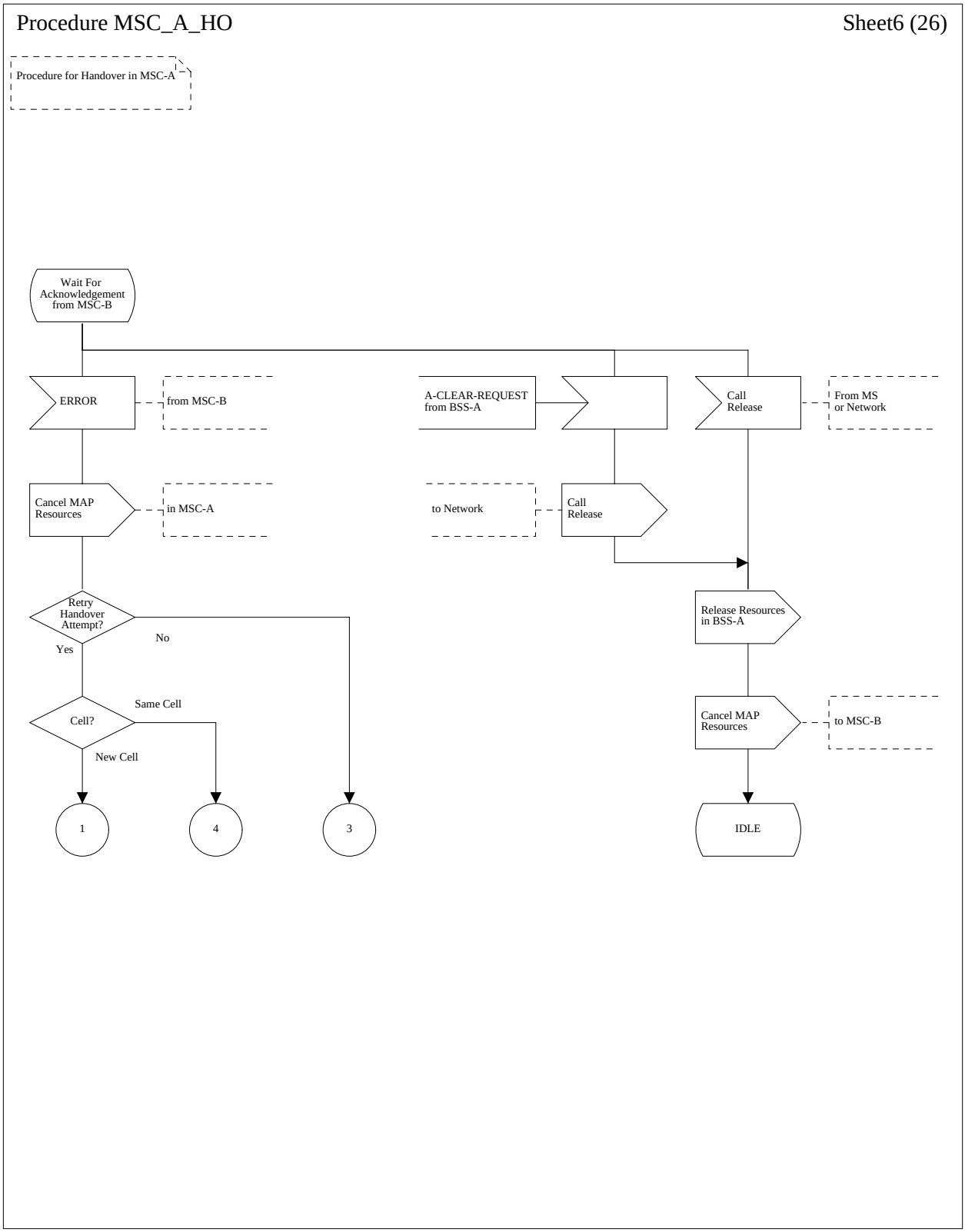


Figure 41~~13~~ (Sheet 6 of 26): Handover control procedure in MSC-A

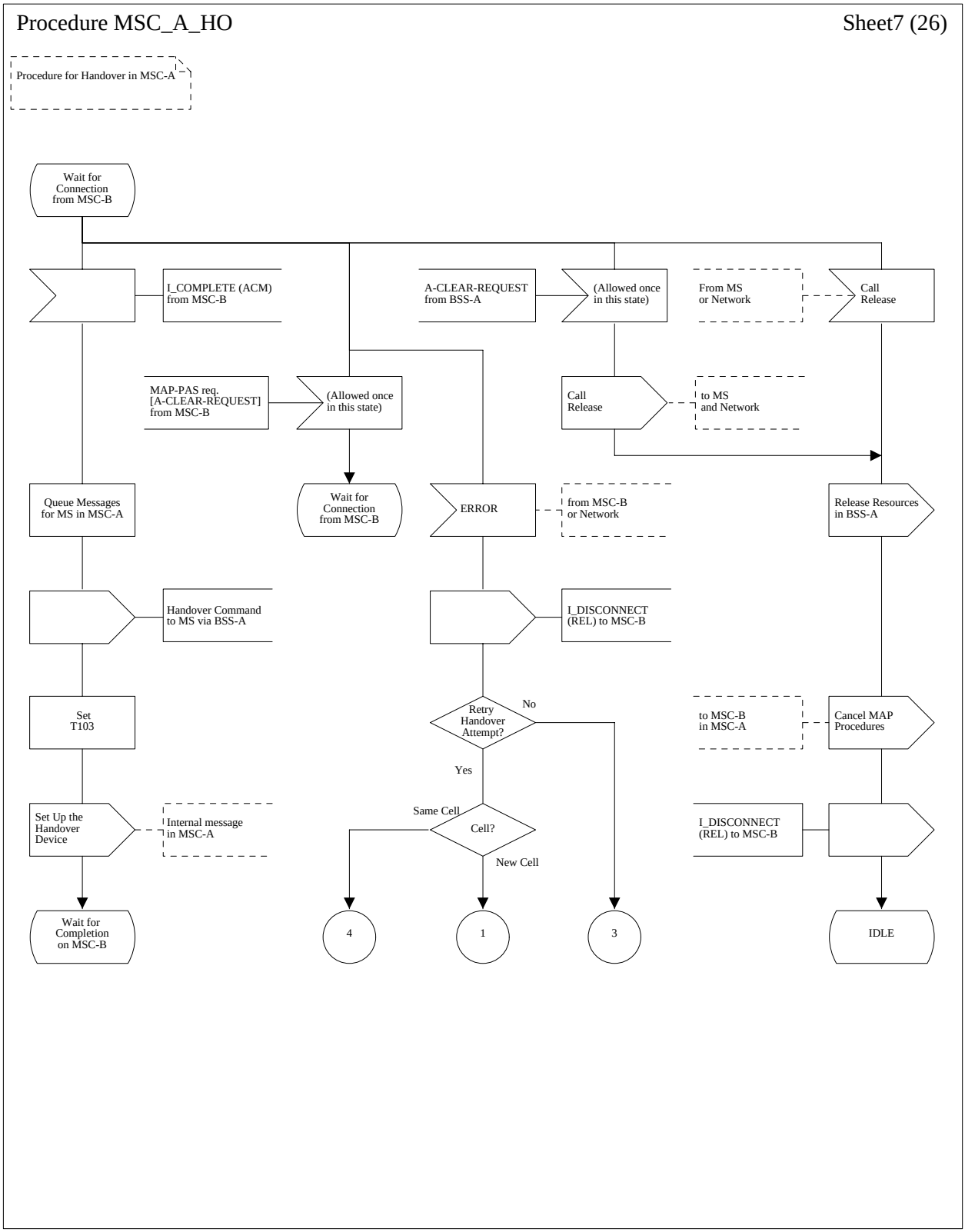


Figure 41~~13~~ (Sheet 7 of 26): Handover control procedure in MSC-A

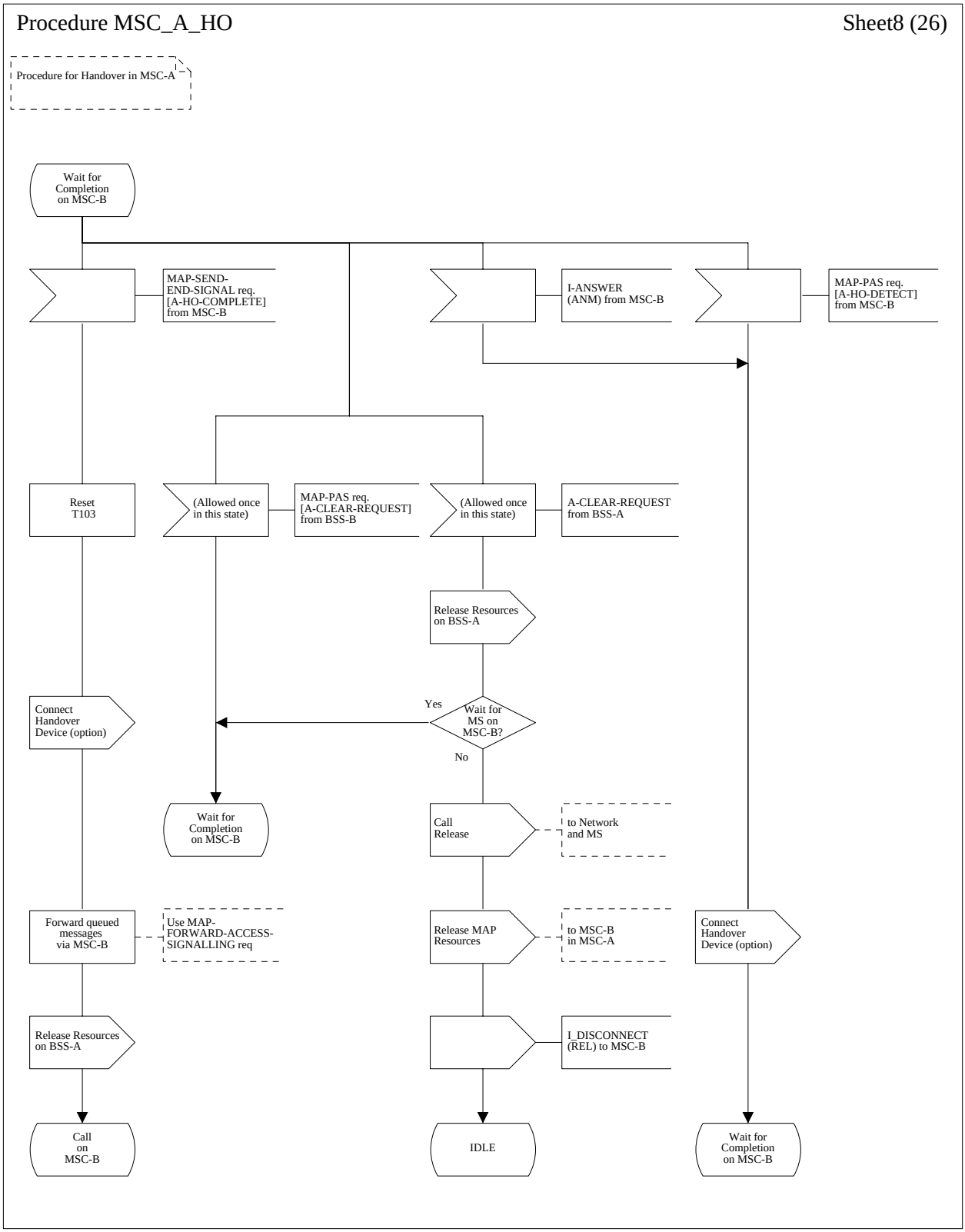


Figure 41~~13~~ (Sheet 8 of 26): Handover control procedure in MSC-A

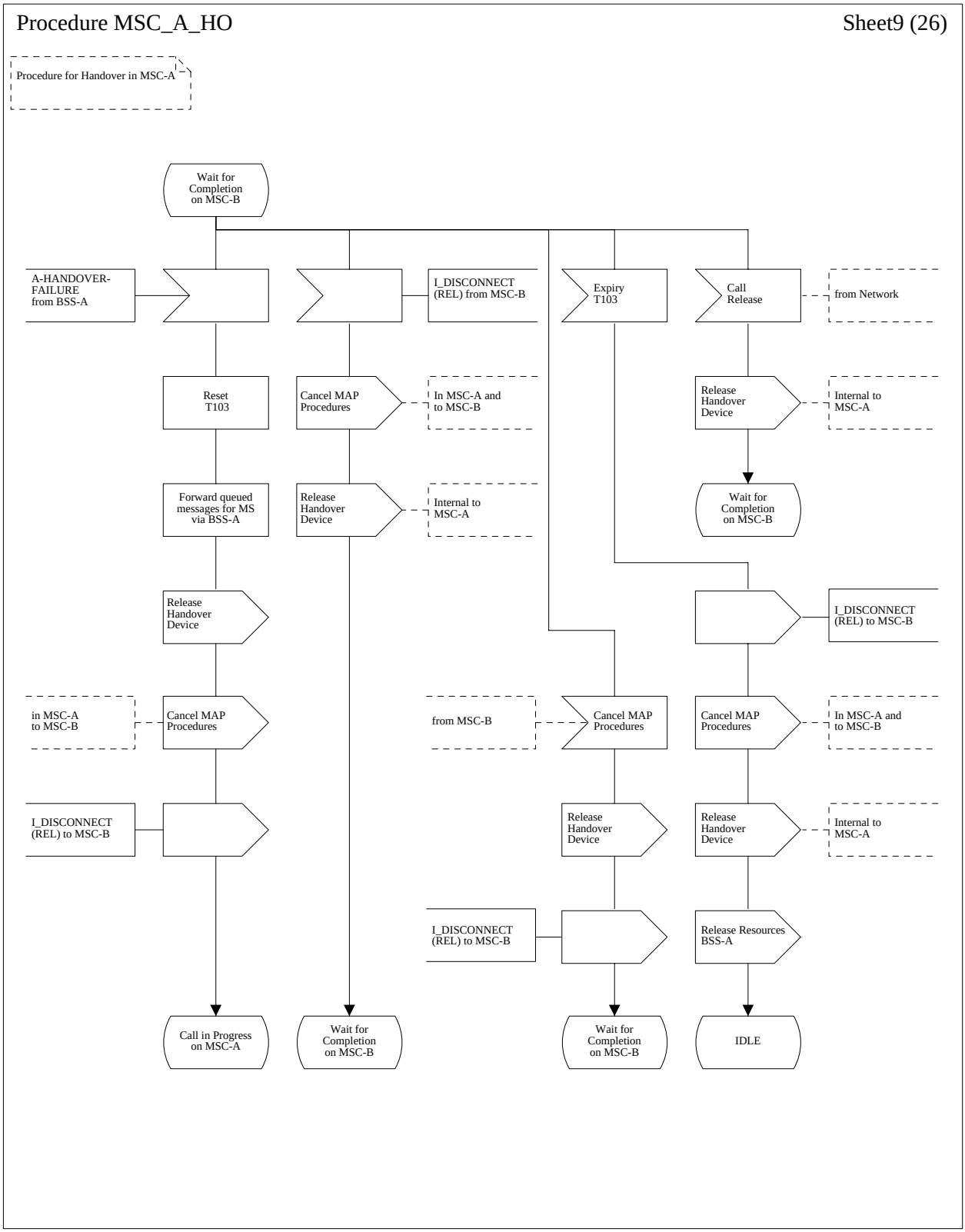


Figure ~~13~~41 (Sheet 9 of 26): Handover control procedure in MSC-A

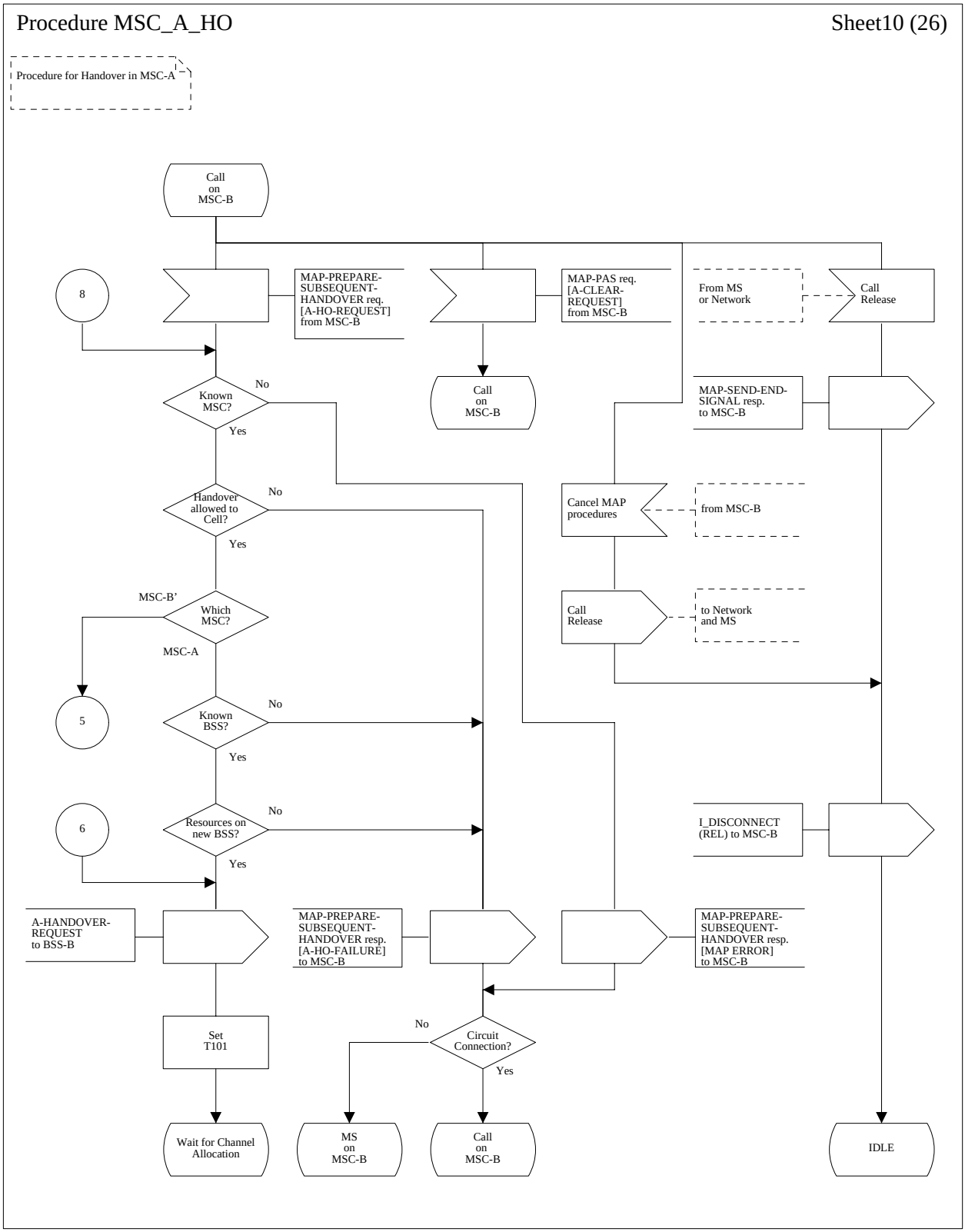


Figure 4113 (Sheet 10 of 26): Handover control procedure in MSC-A

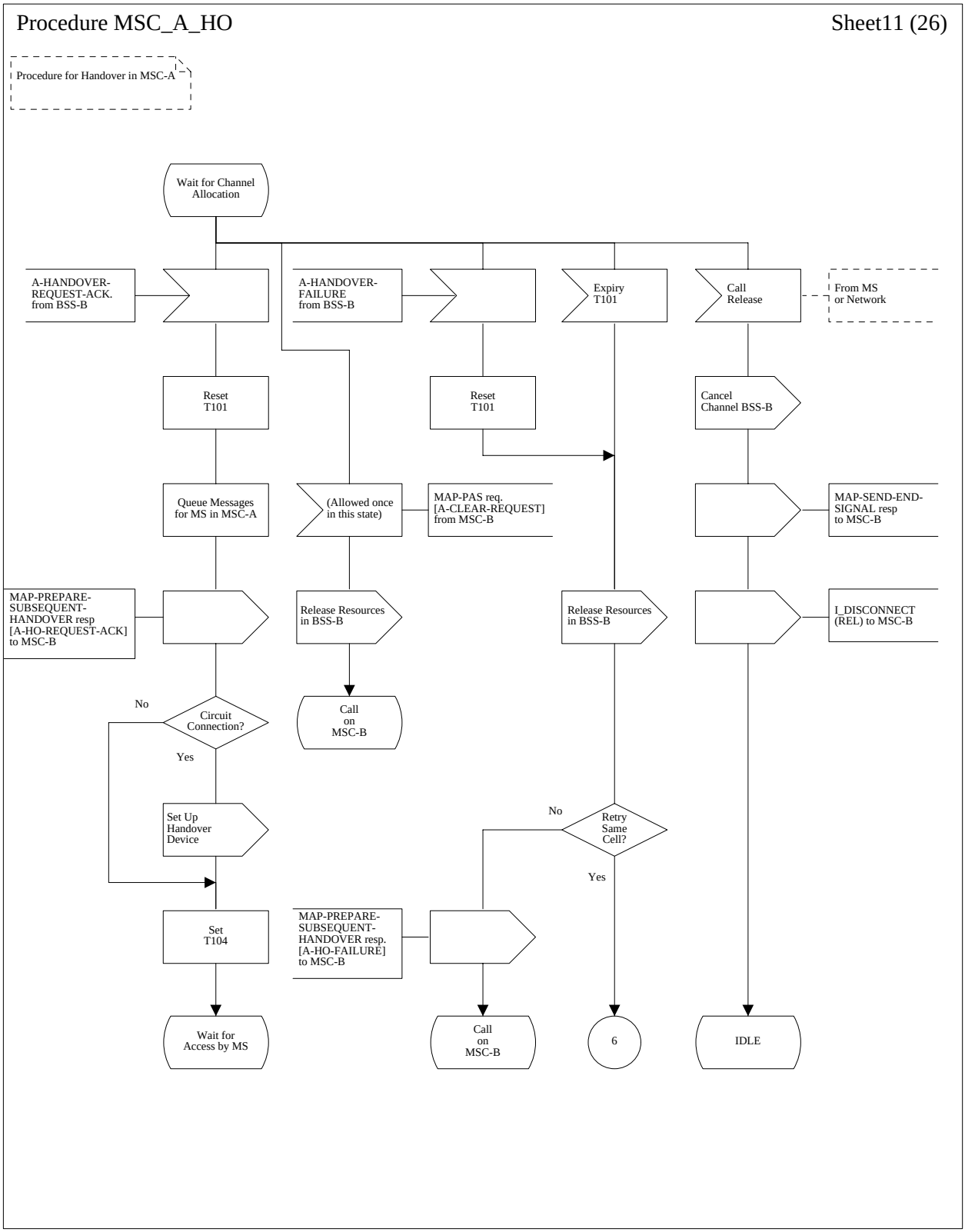


Figure 4113 (Sheet 11 of 26): Handover control procedure in MSC-A

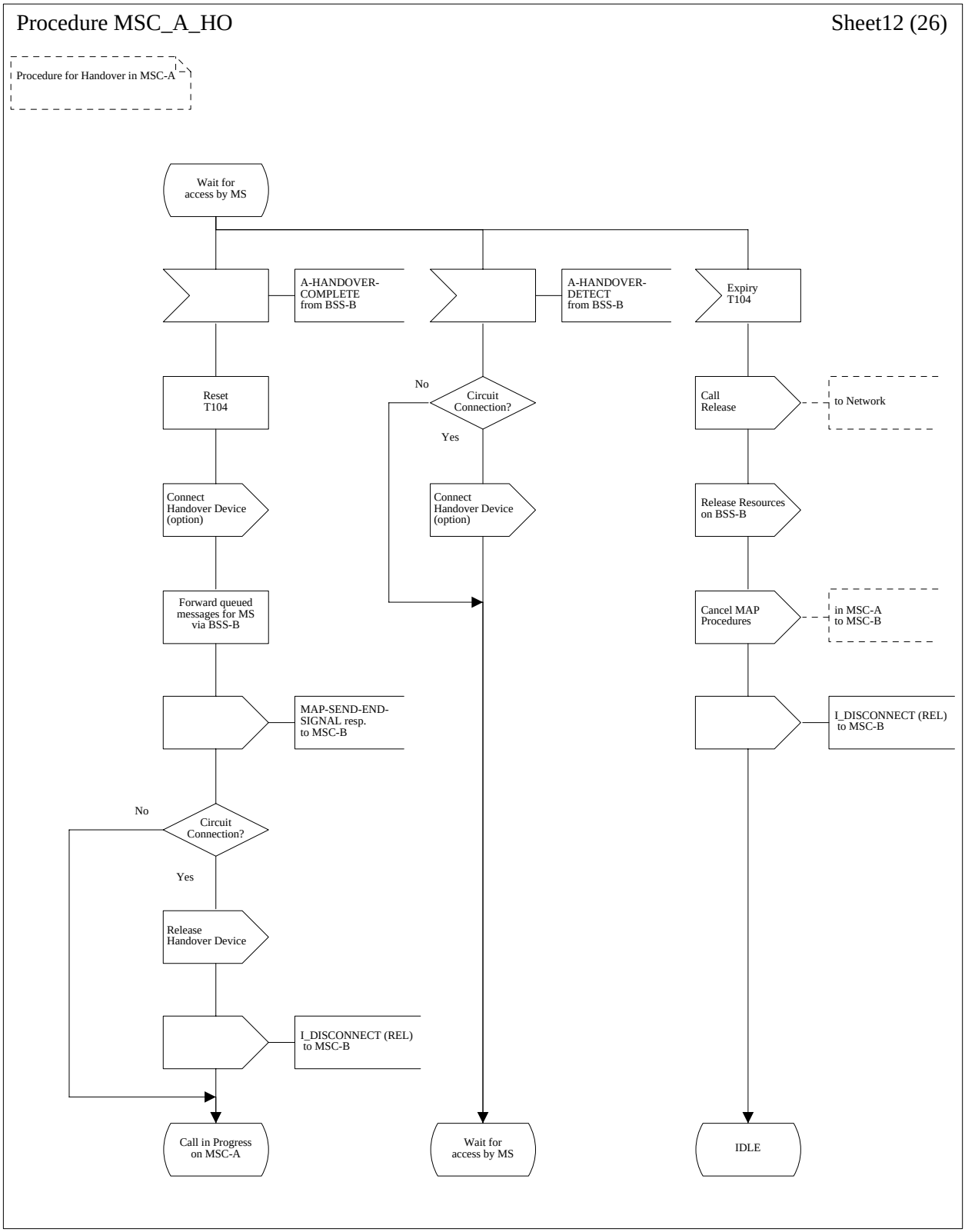


Figure 4113 (Sheet 12 of 26): Handover control procedure in MSC-A

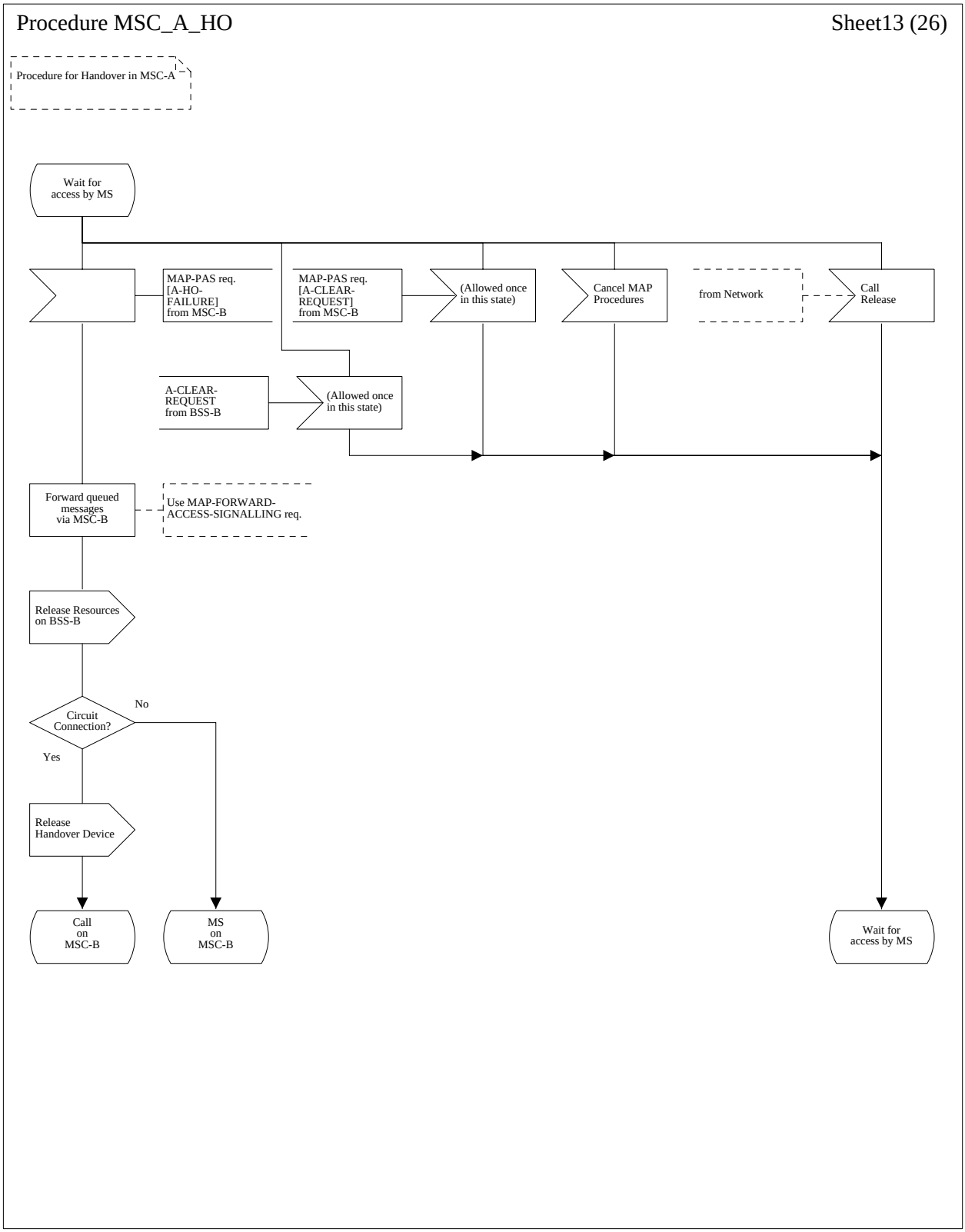


Figure 4113 (Sheet 13 of 26): Handover control procedure in MSC-A

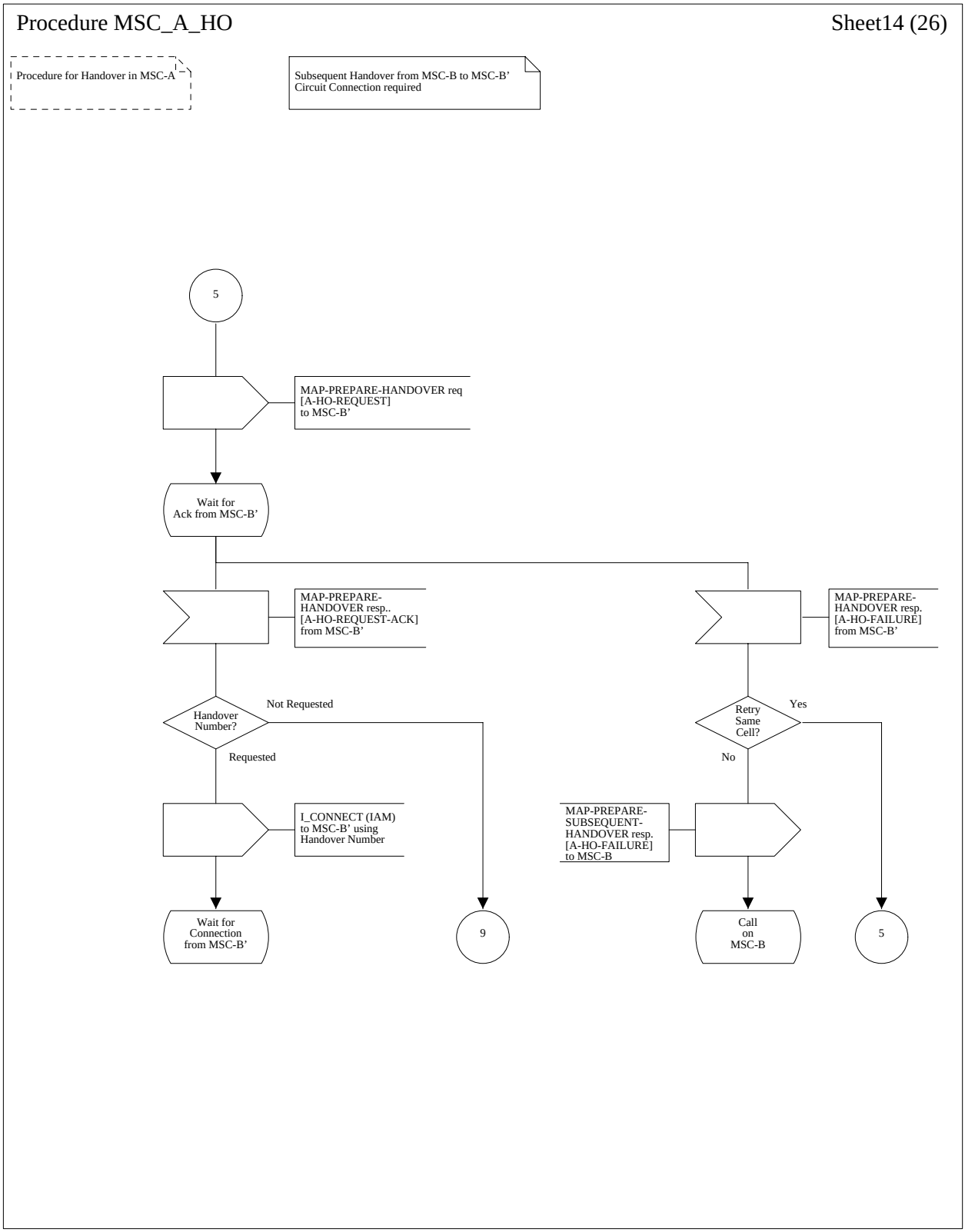


Figure 4113 (Sheet 14 of 26): Handover control procedure in MSC-A

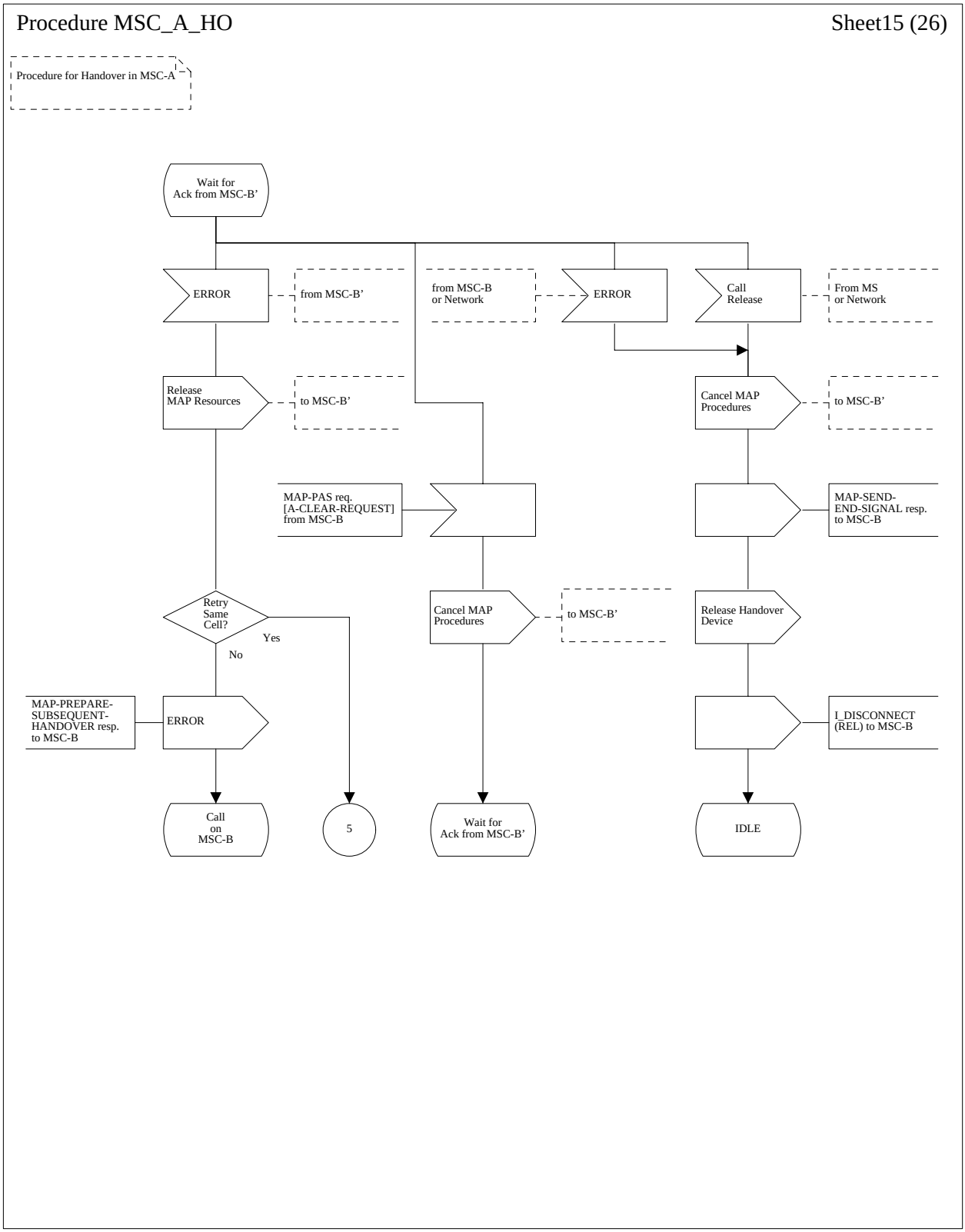


Figure 4113 (Sheet 15 of 26): Handover control procedure in MSC-A

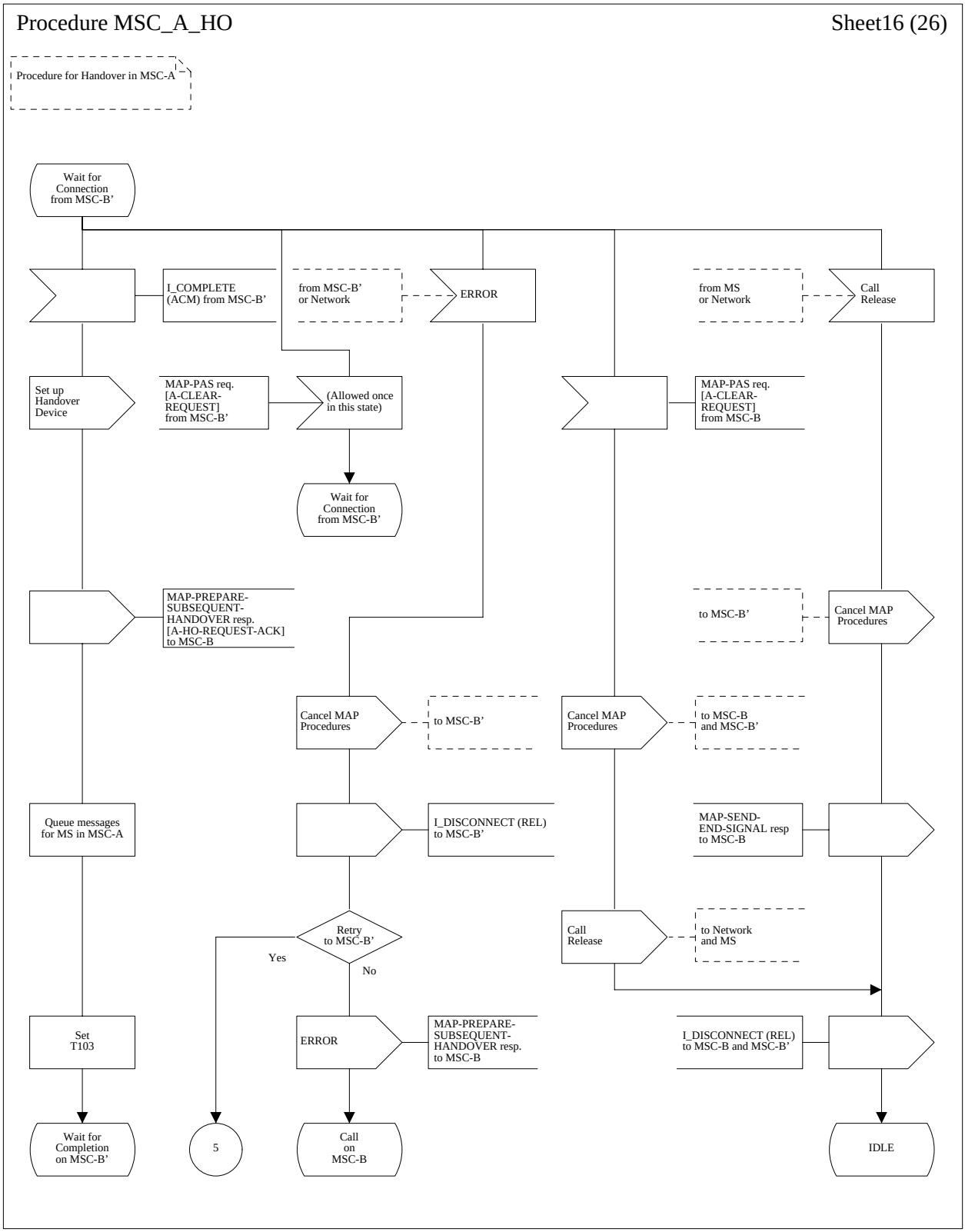


Figure 4113 (Sheet 16 of 26): Handover control procedure in MSC-A

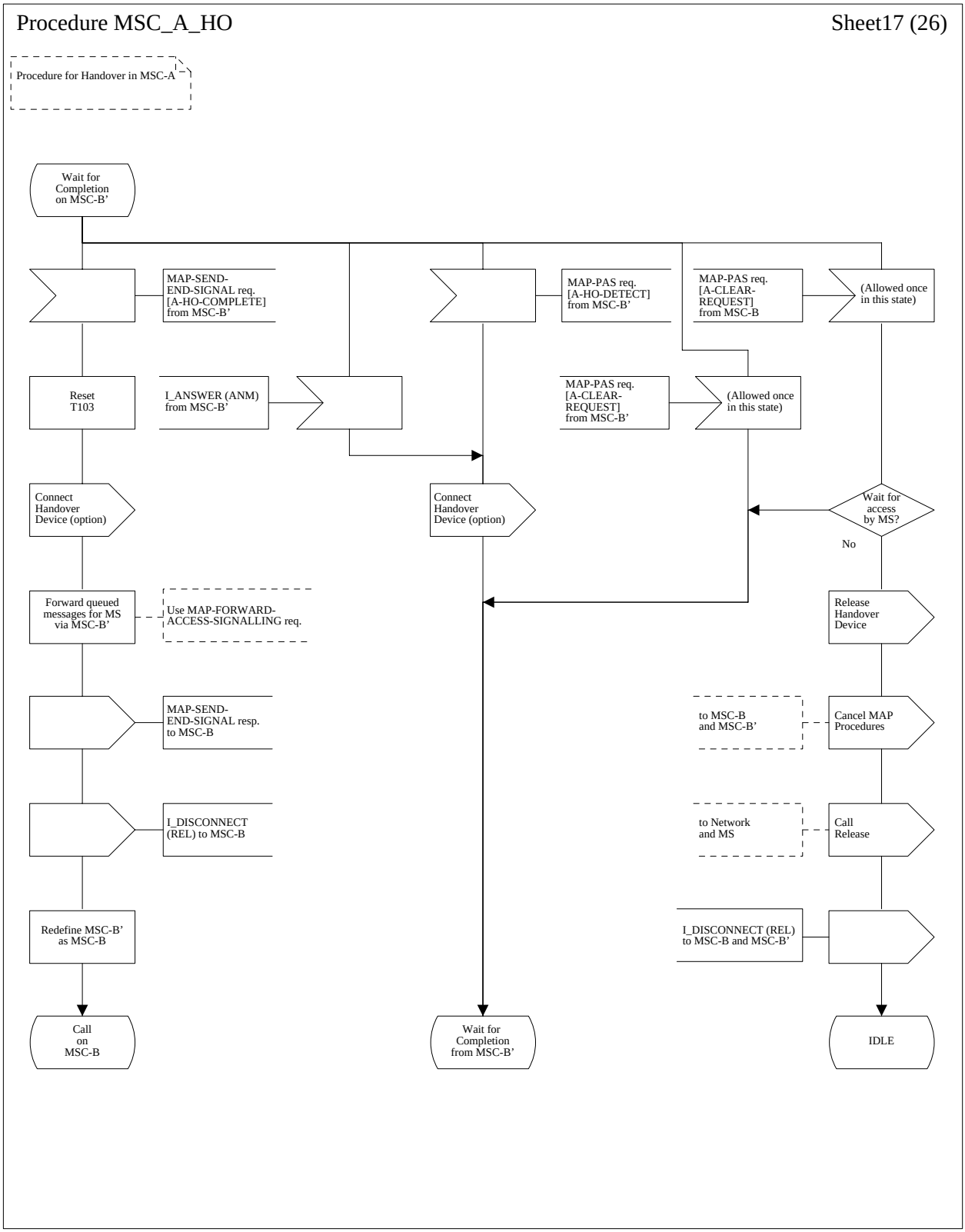


Figure 4113 (Sheet 17 of 26): Handover control procedure in MSC-A

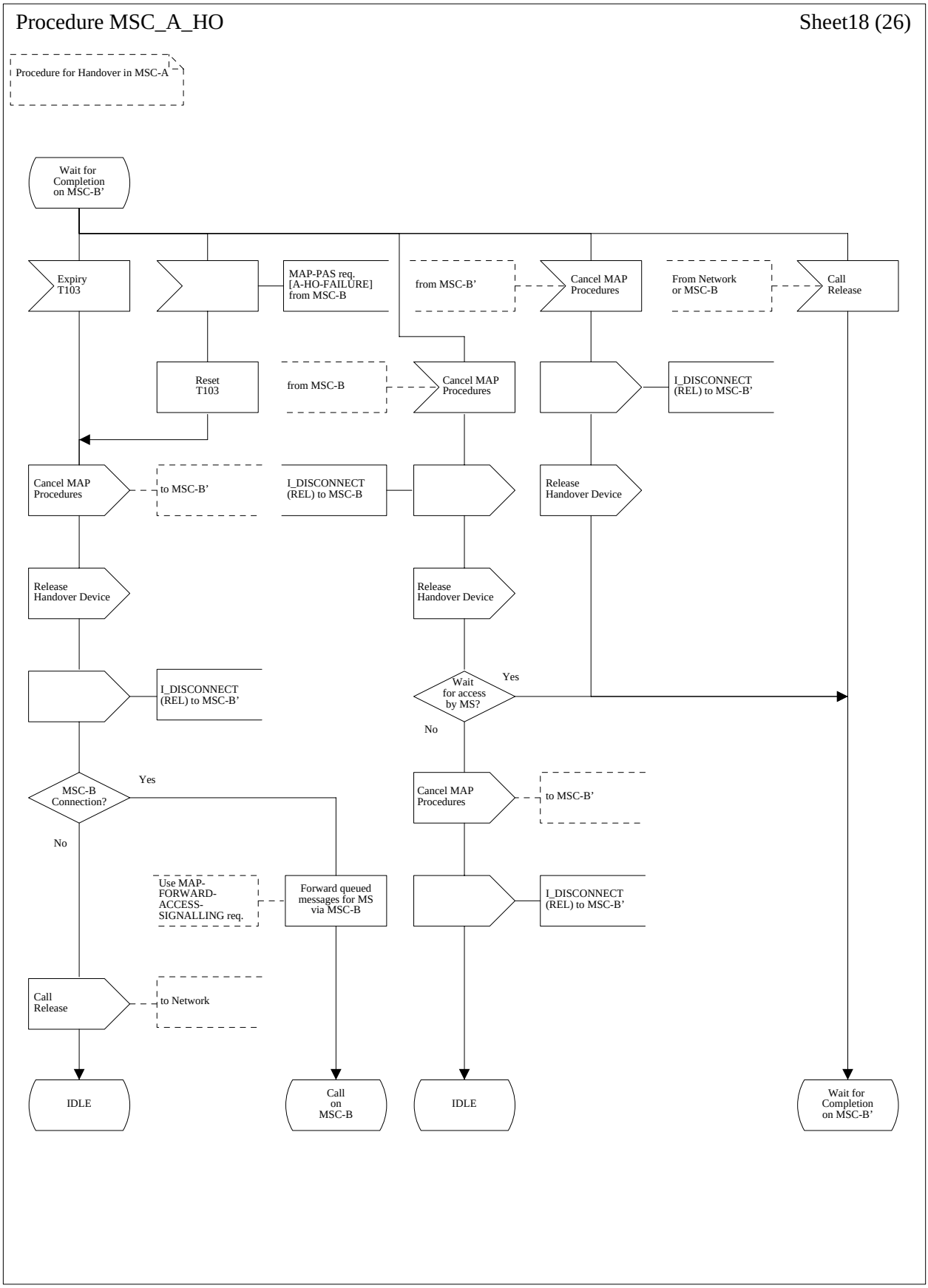


Figure 4113 (Sheet 18 of 26): Handover control procedure in MSC-A

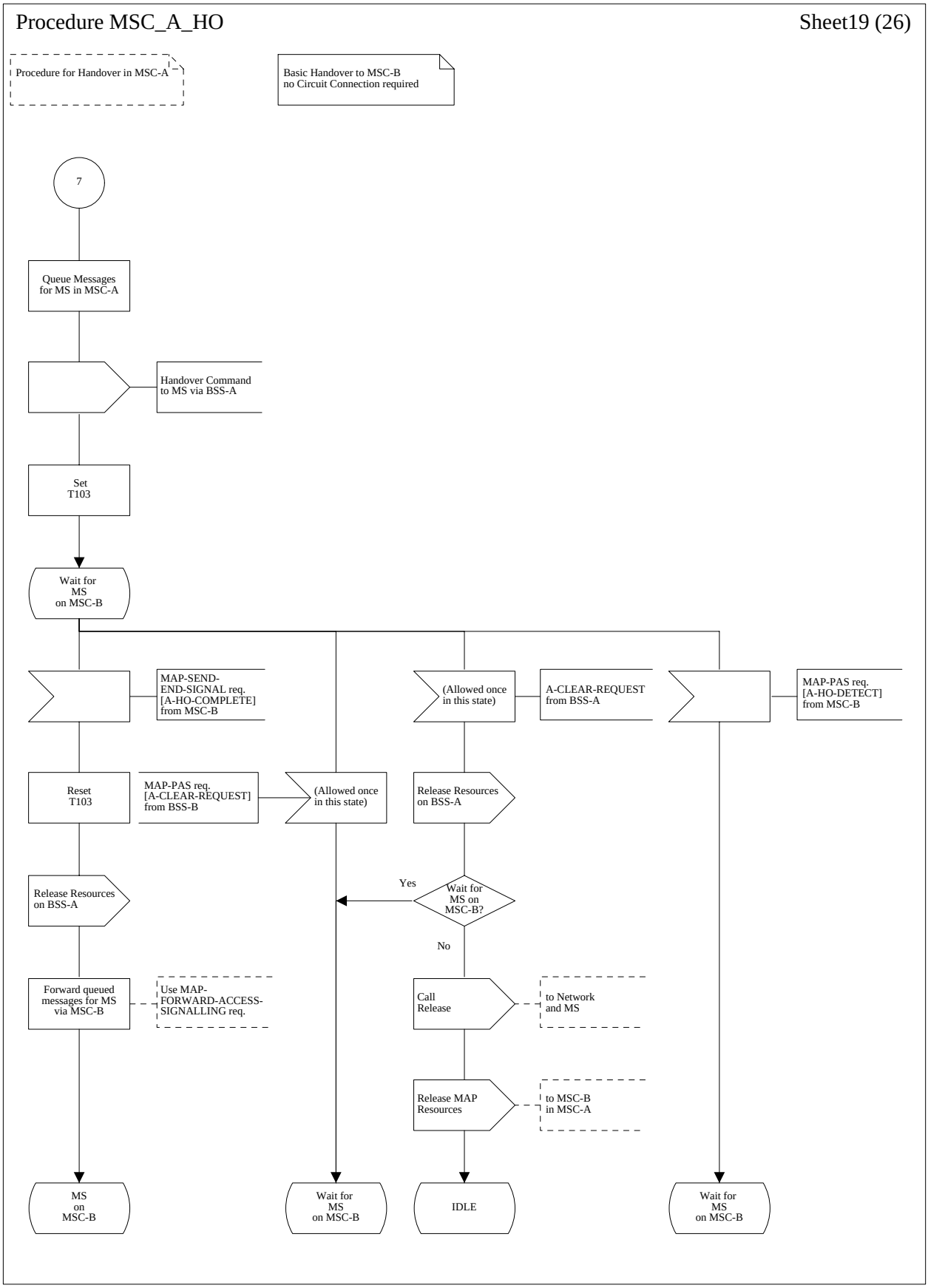


Figure 41~~13~~ (Sheet 19 of 26): Handover control procedure in MSC-A

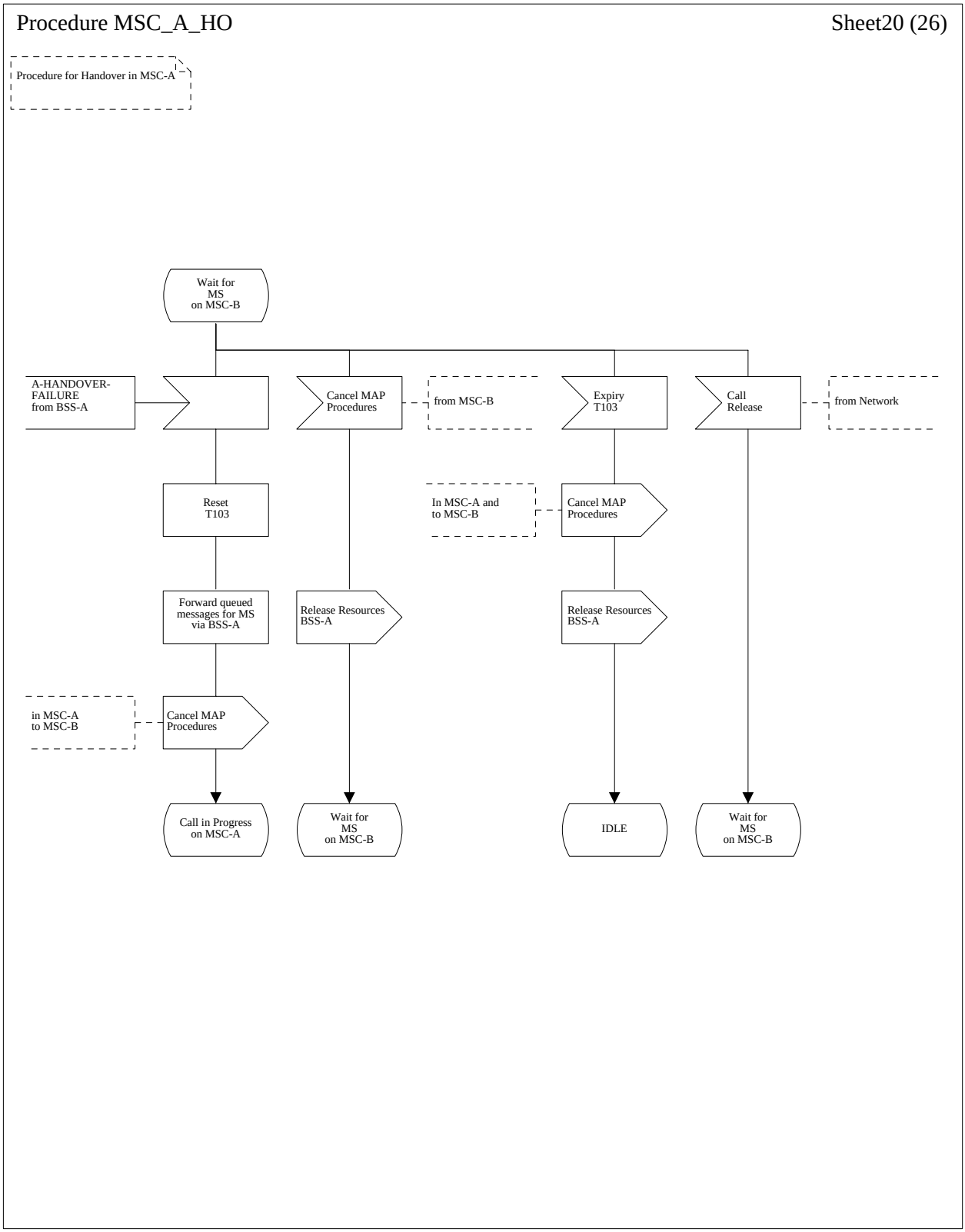


Figure 41~~13~~ (Sheet 20 of 26): Handover control procedure in MSC-A

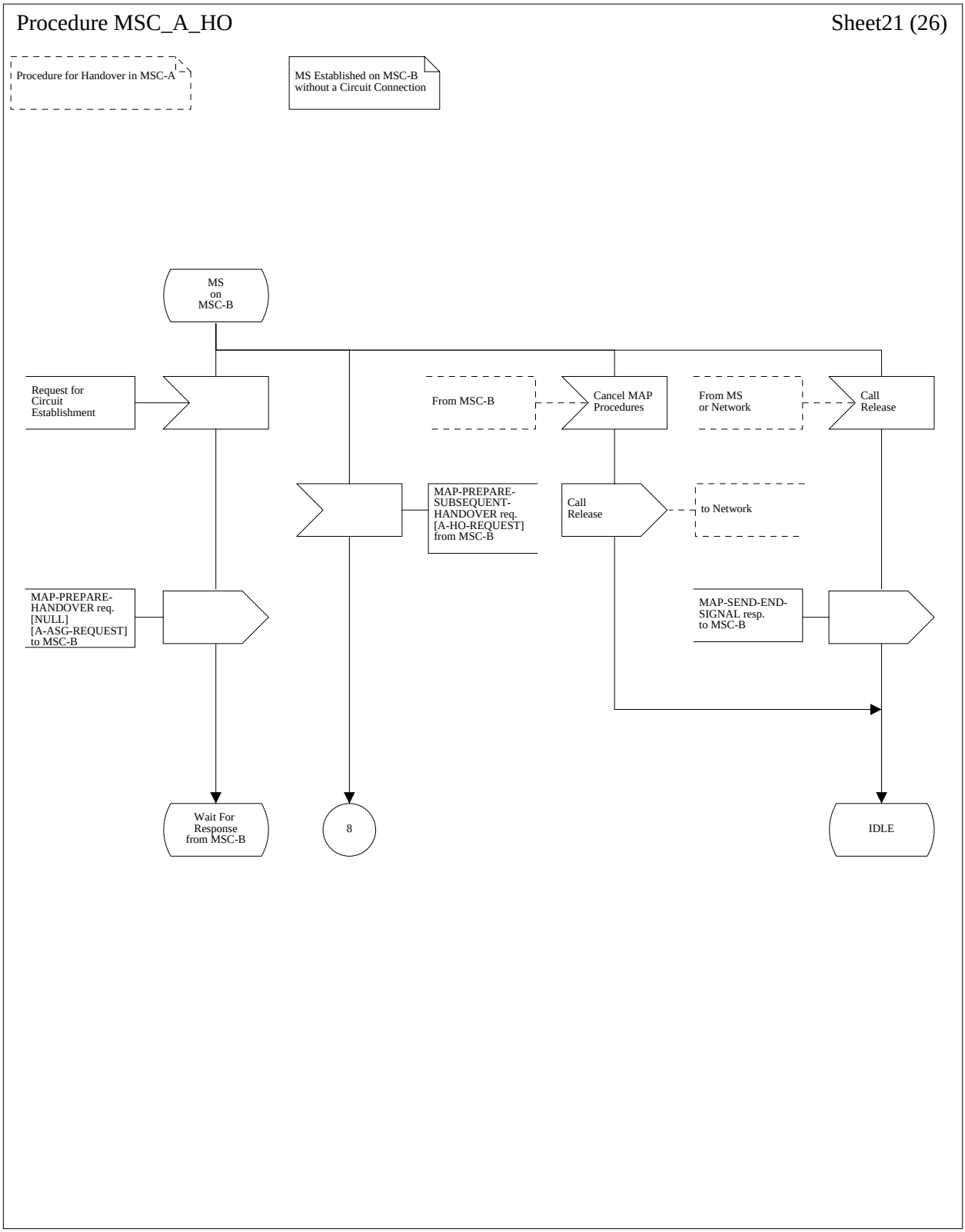


Figure 4113 (Sheet 21 of 26): Handover control procedure in MSC-A

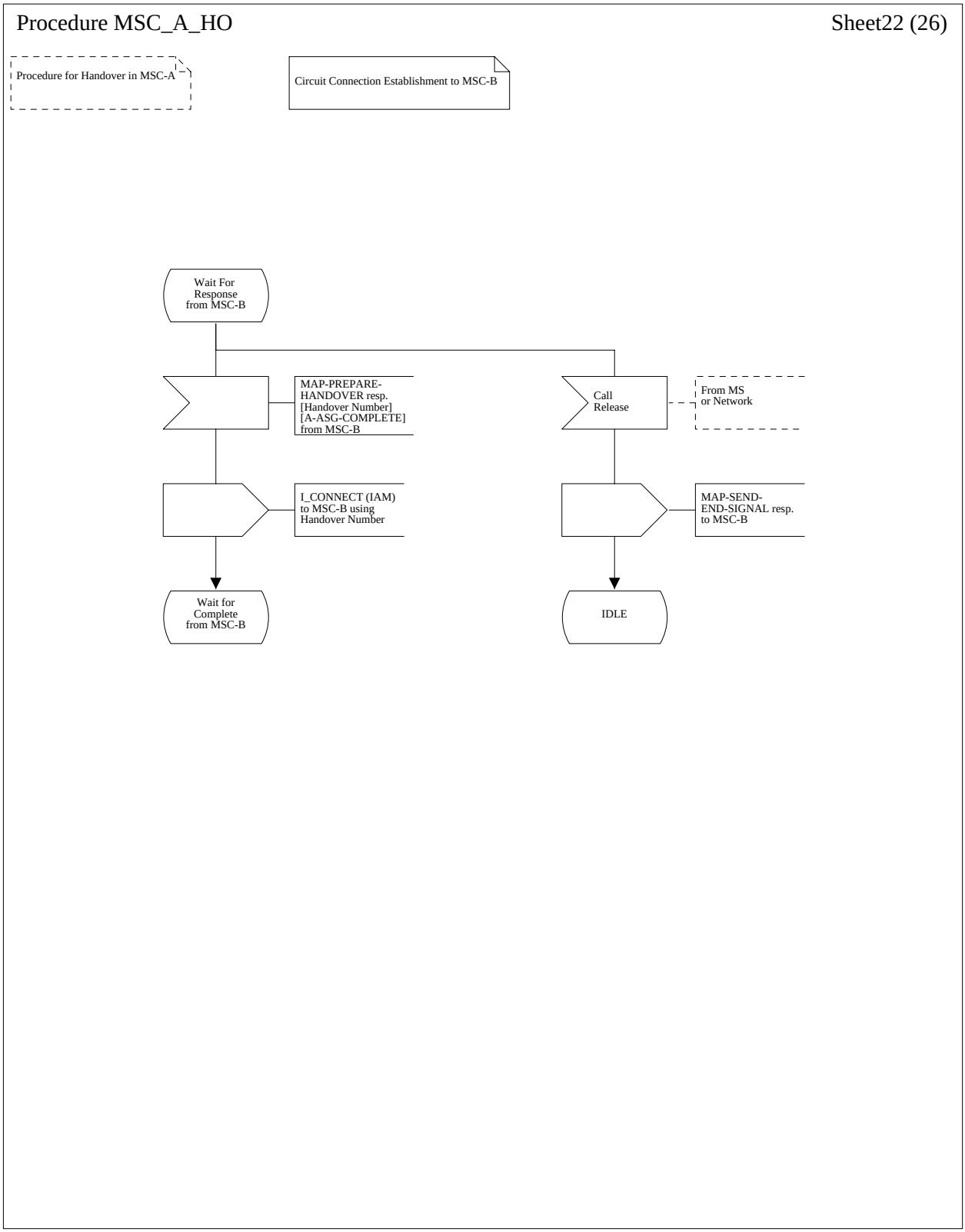


Figure 41~~13~~ (Sheet 22 of 26): Handover control procedure in MSC-A

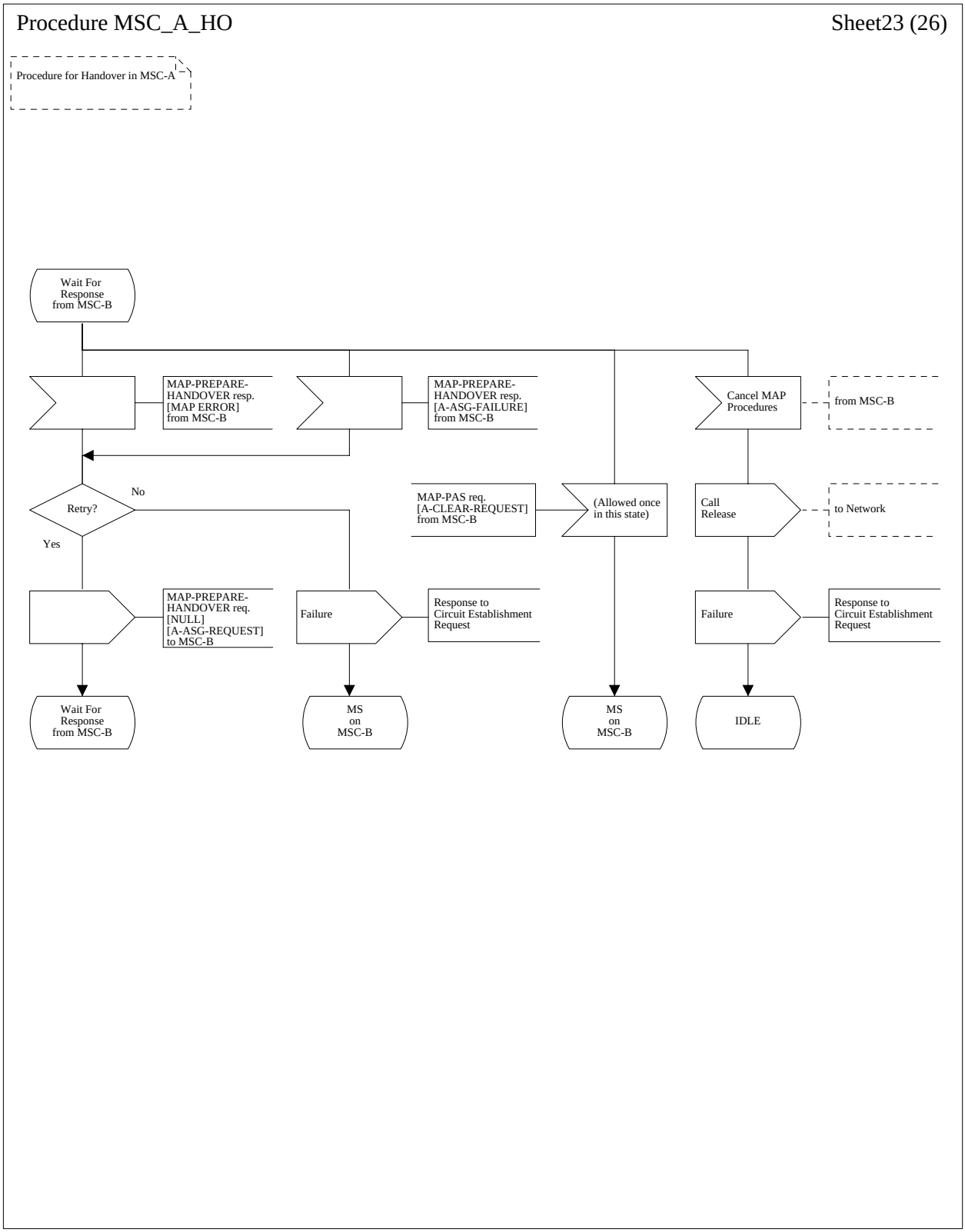


Figure 4113 (Sheet 23 of 26): Handover control procedure in MSC-A

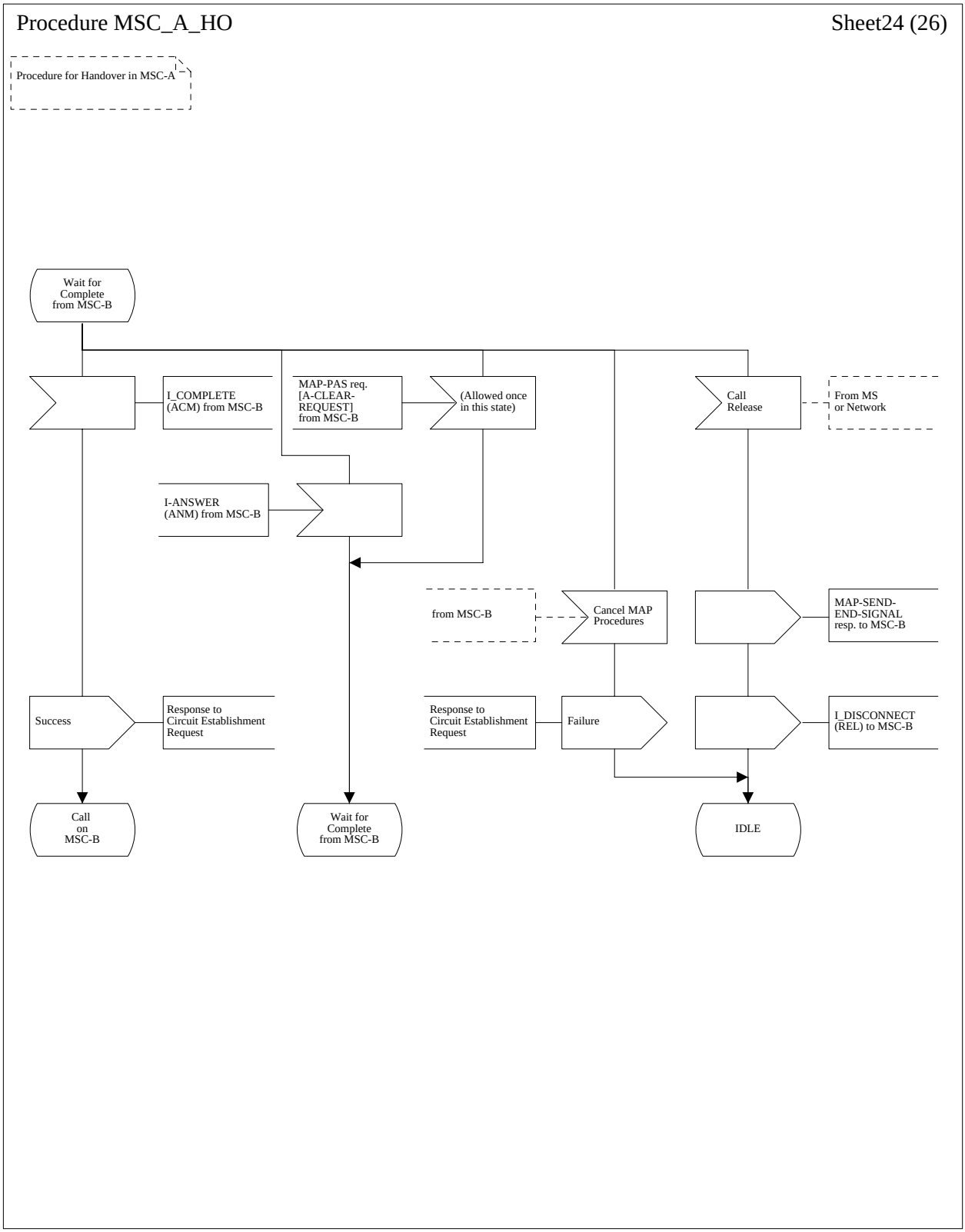


Figure 4113 (Sheet 24 of 26): Handover control procedure in MSC-A

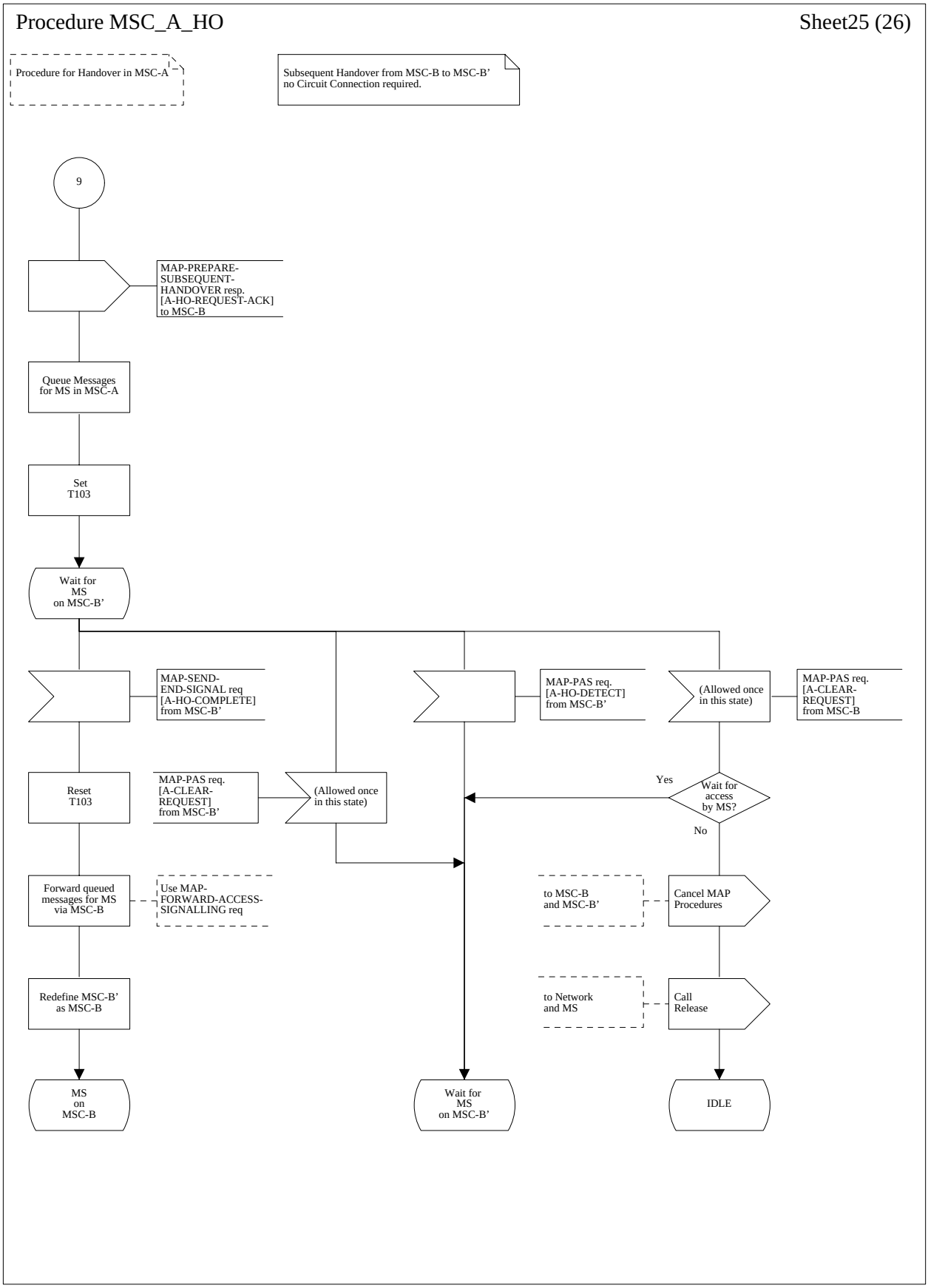


Figure 41~~13~~ (Sheet 25 of 26): Handover control procedure in MSC-A

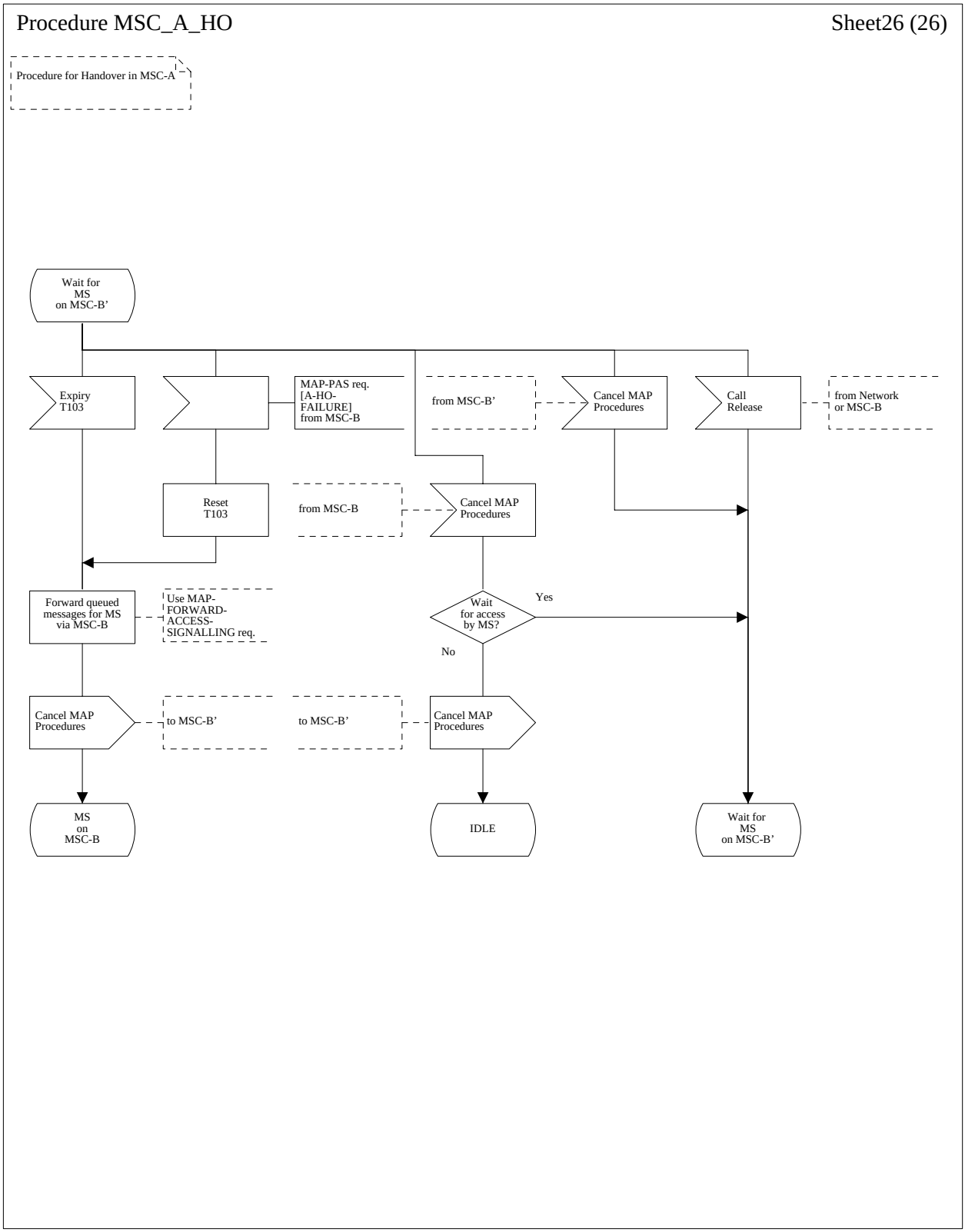


Figure 4113 (Sheet 26 of 26): Handover control procedure in MSC-A

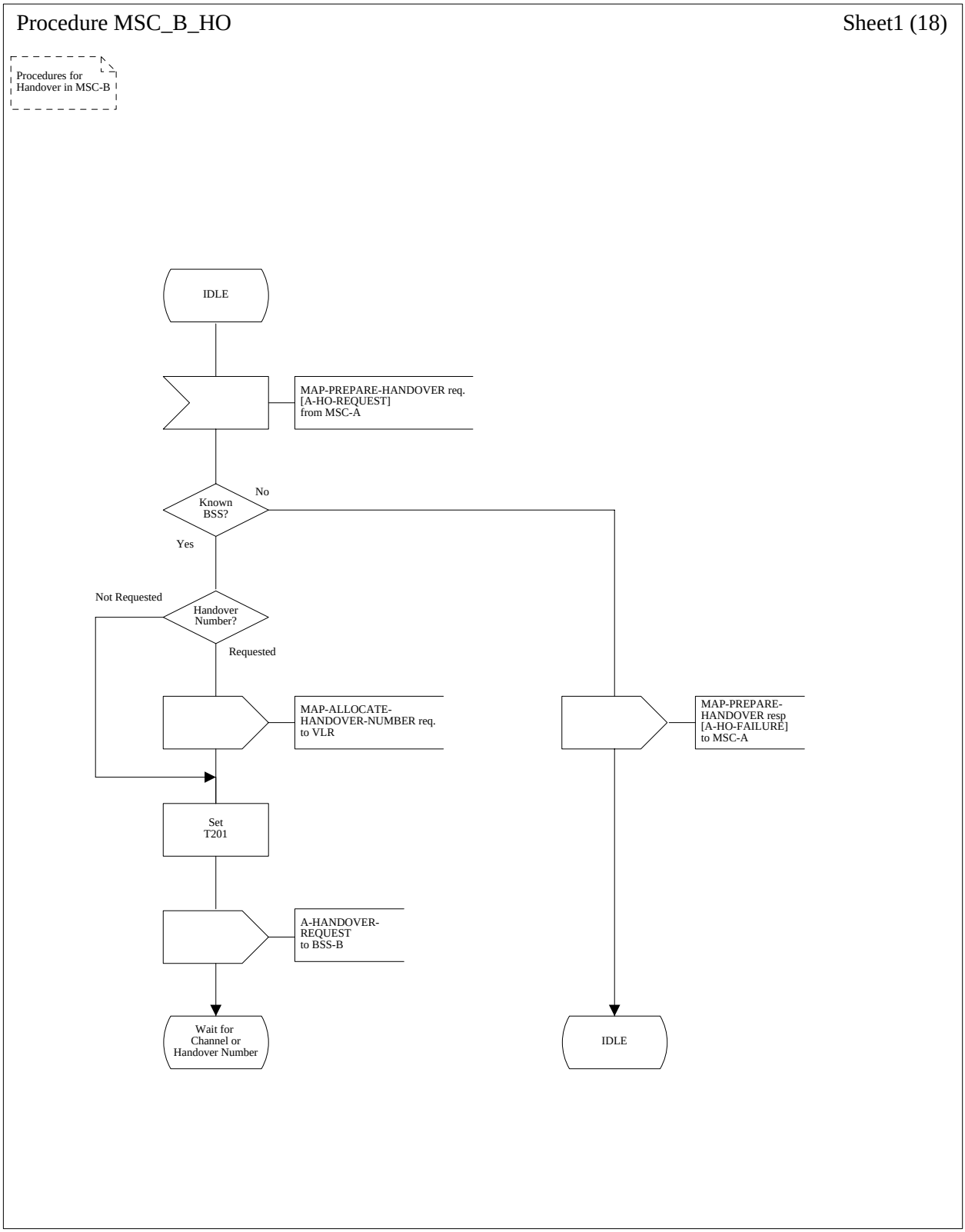


Figure 4214 (Sheet 1 of 18): Handover control procedure in MSC-B

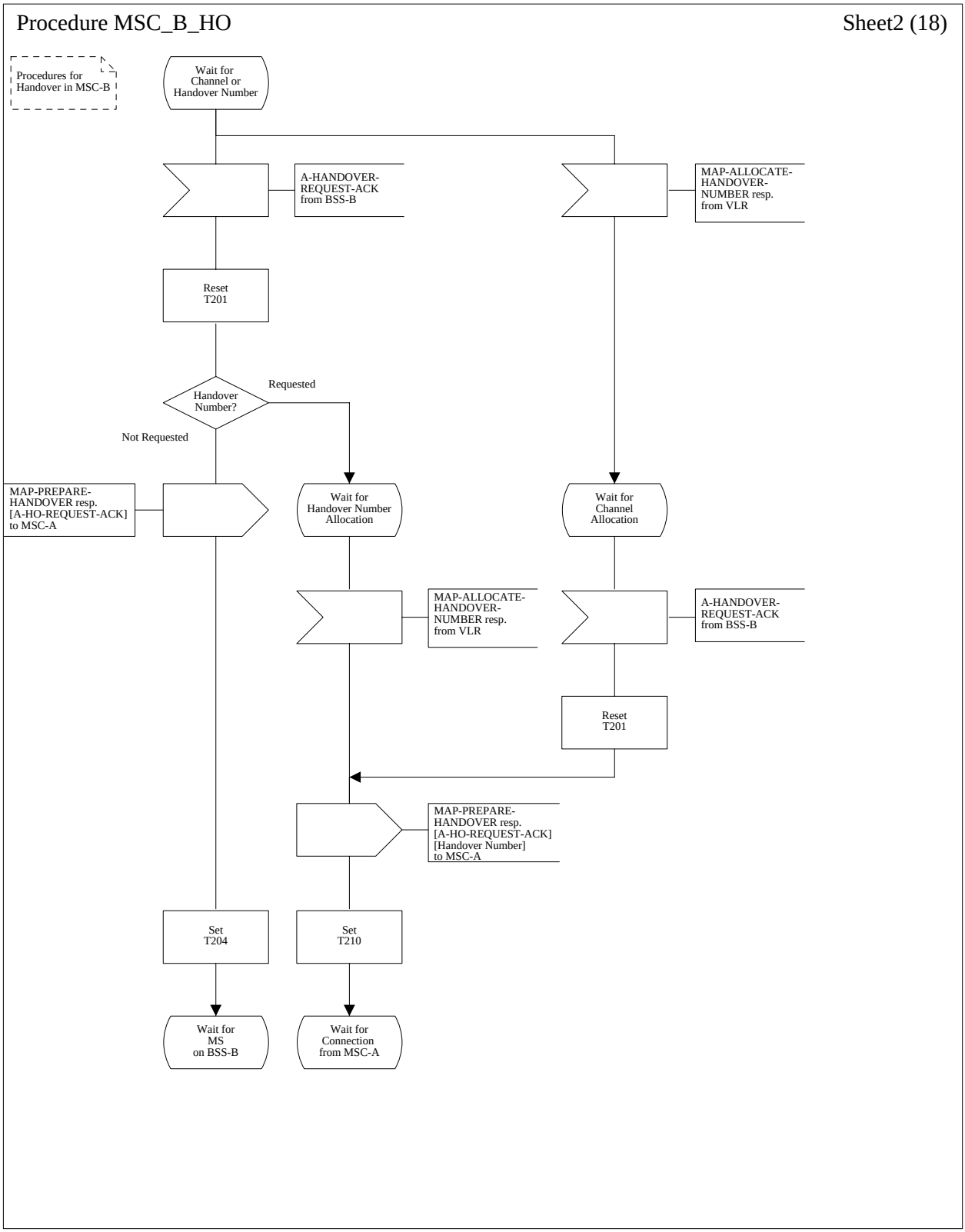


Figure 4214 (Sheet 2 of 18): Handover control procedure in MSC-B

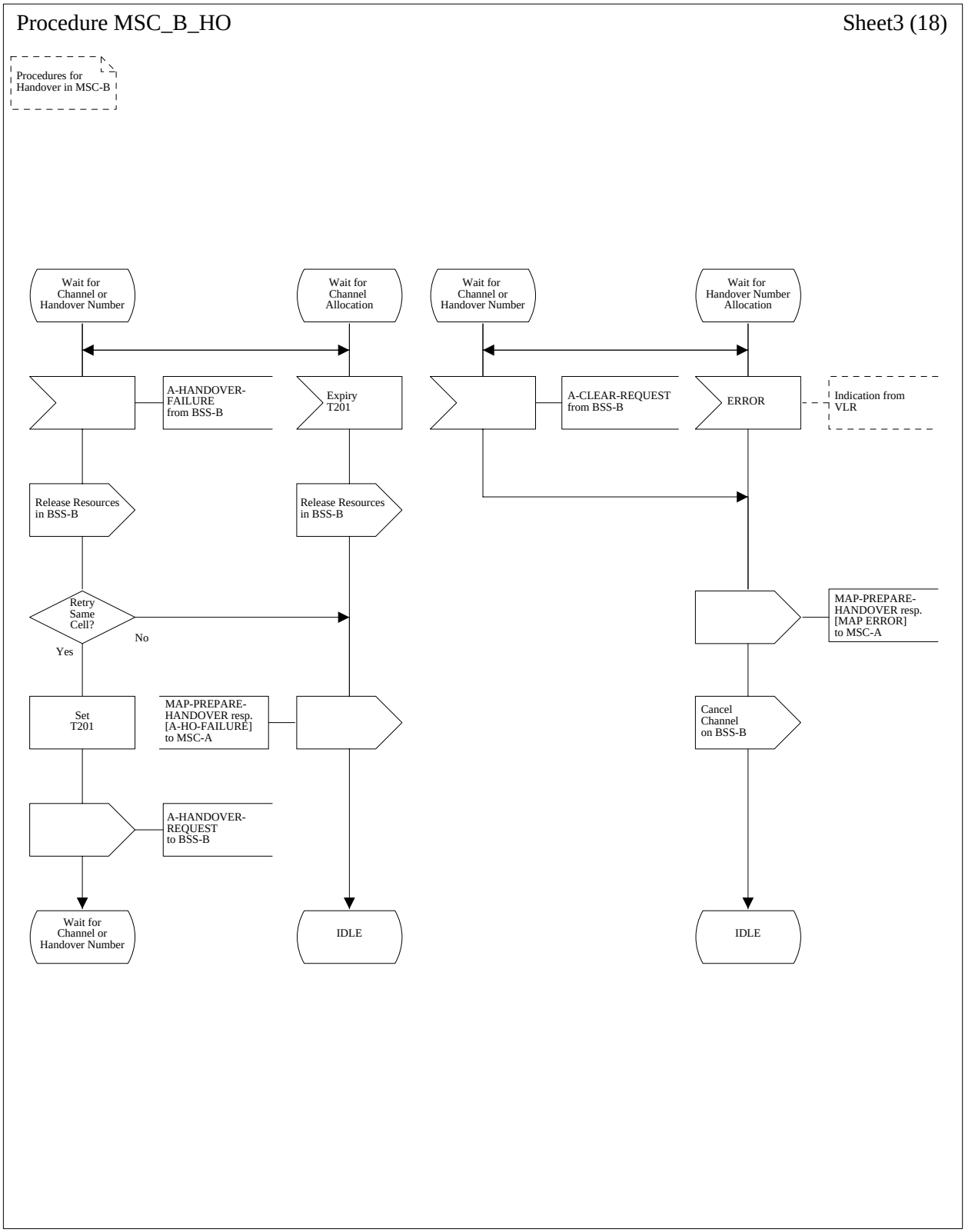


Figure 4214 (Sheet 3 of 18): Handover control procedure in MSC-B

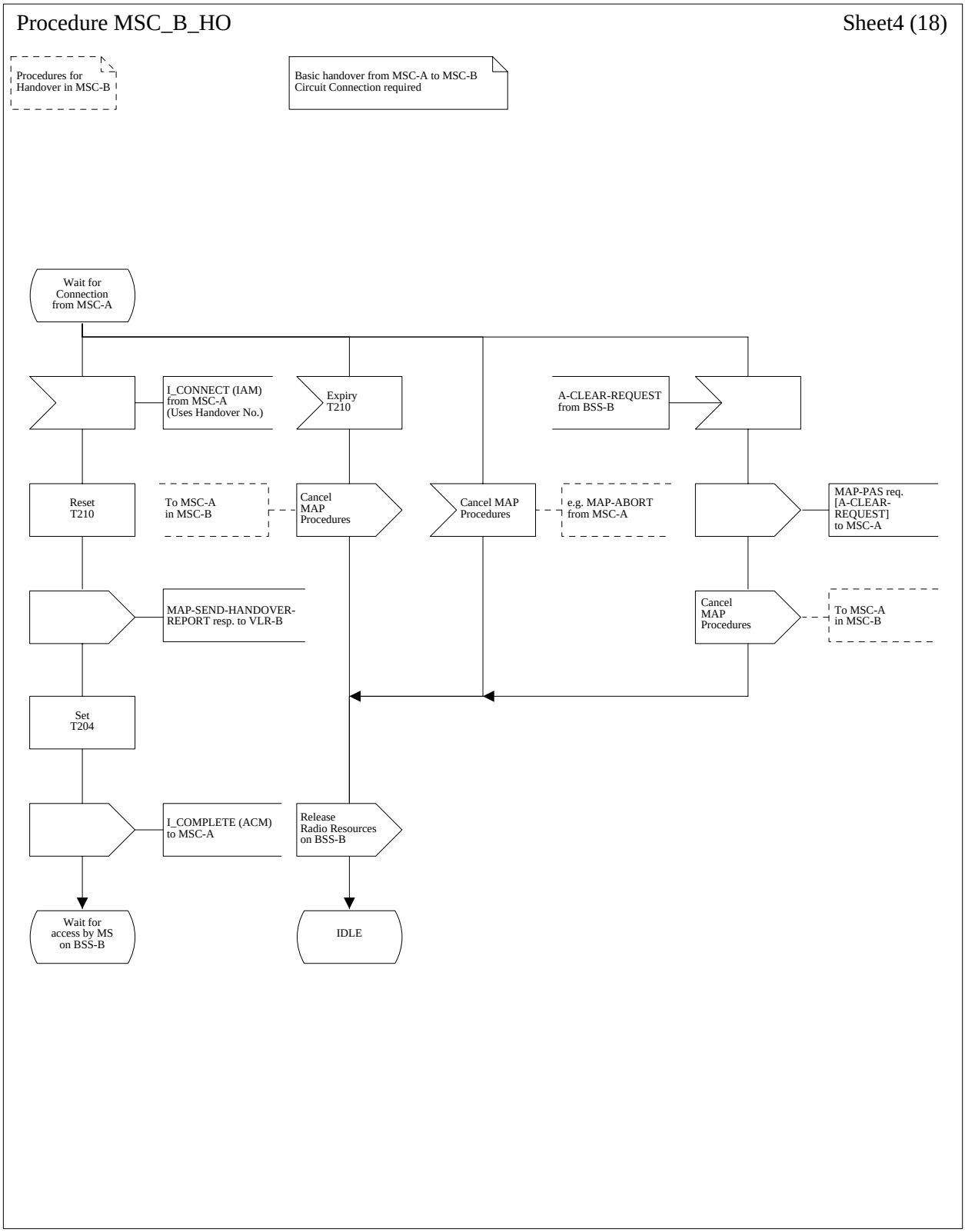


Figure 4214 (Sheet 4 of 18): Handover control procedure in MSC-B

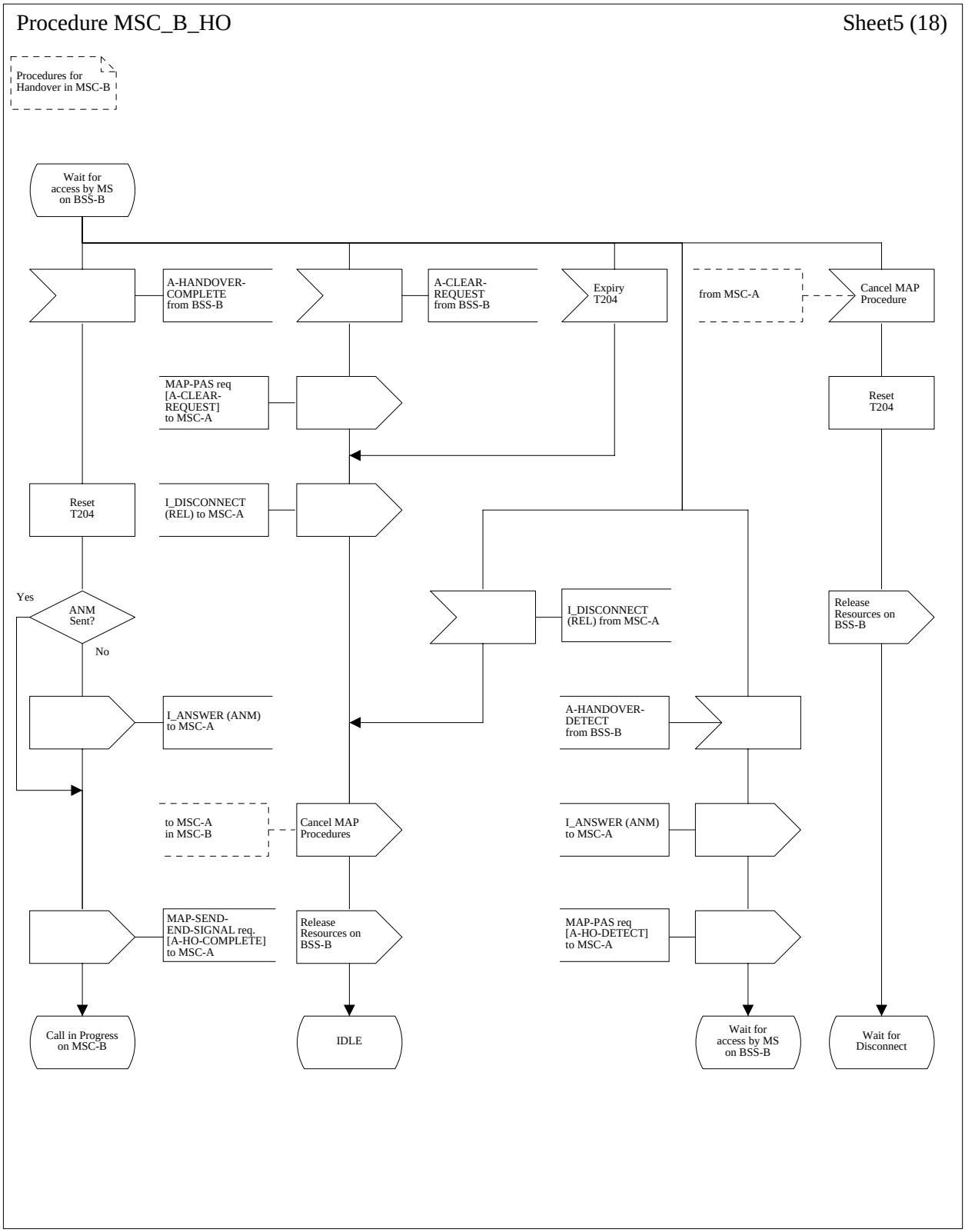


Figure 4214 (Sheet 5 of 18): Handover control procedure in MSC-B

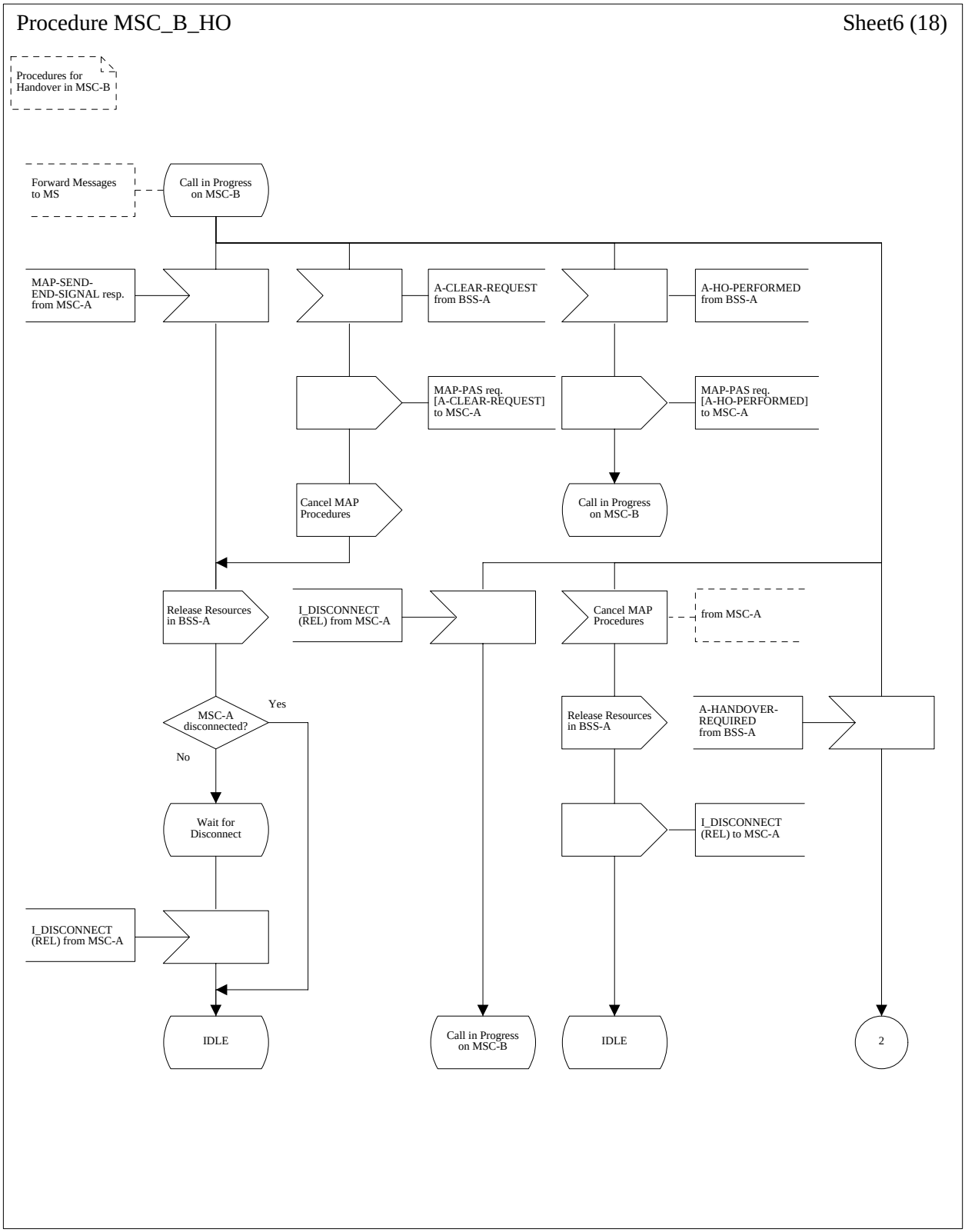


Figure 4214 (Sheet 6 of 18): Handover control procedure in MSC-B

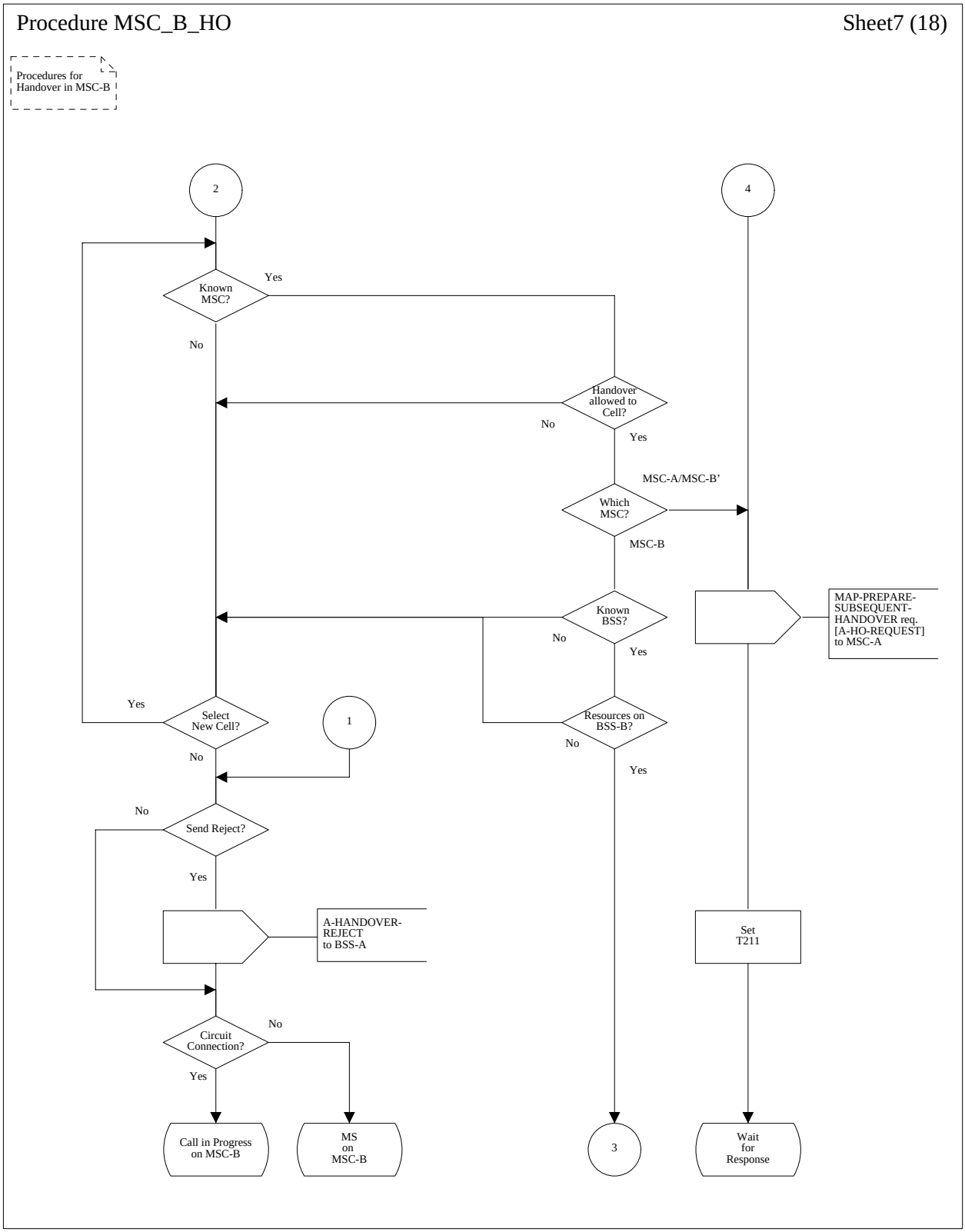


Figure 4214 (Sheet 7 of 18): Handover control procedure in MSC-B

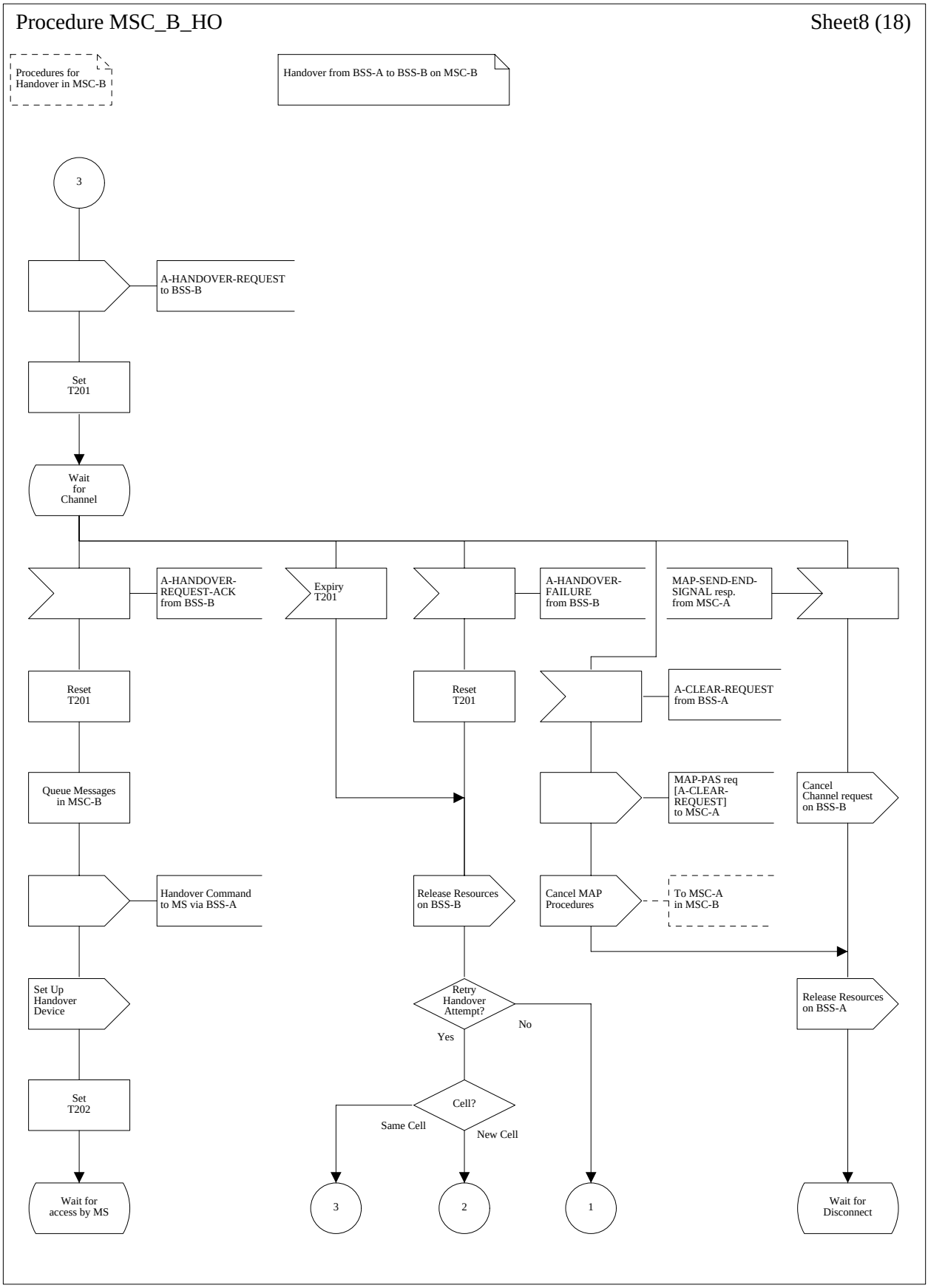


Figure 42~~1~~4 (Sheet 8 of 18): Handover control procedure in MSC-B

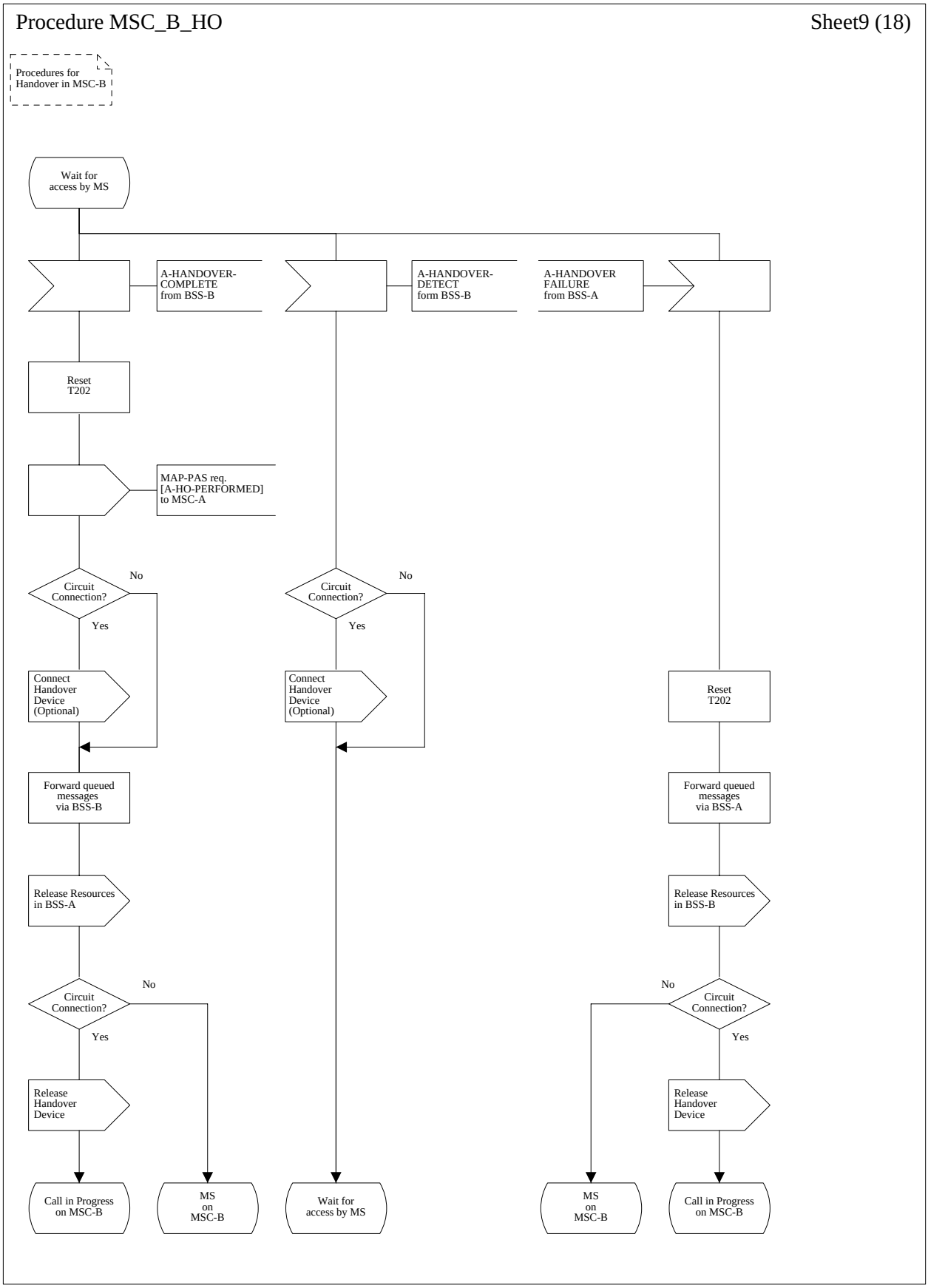


Figure 4214 (Sheet 9 of 18): Handover control procedure in MSC-B

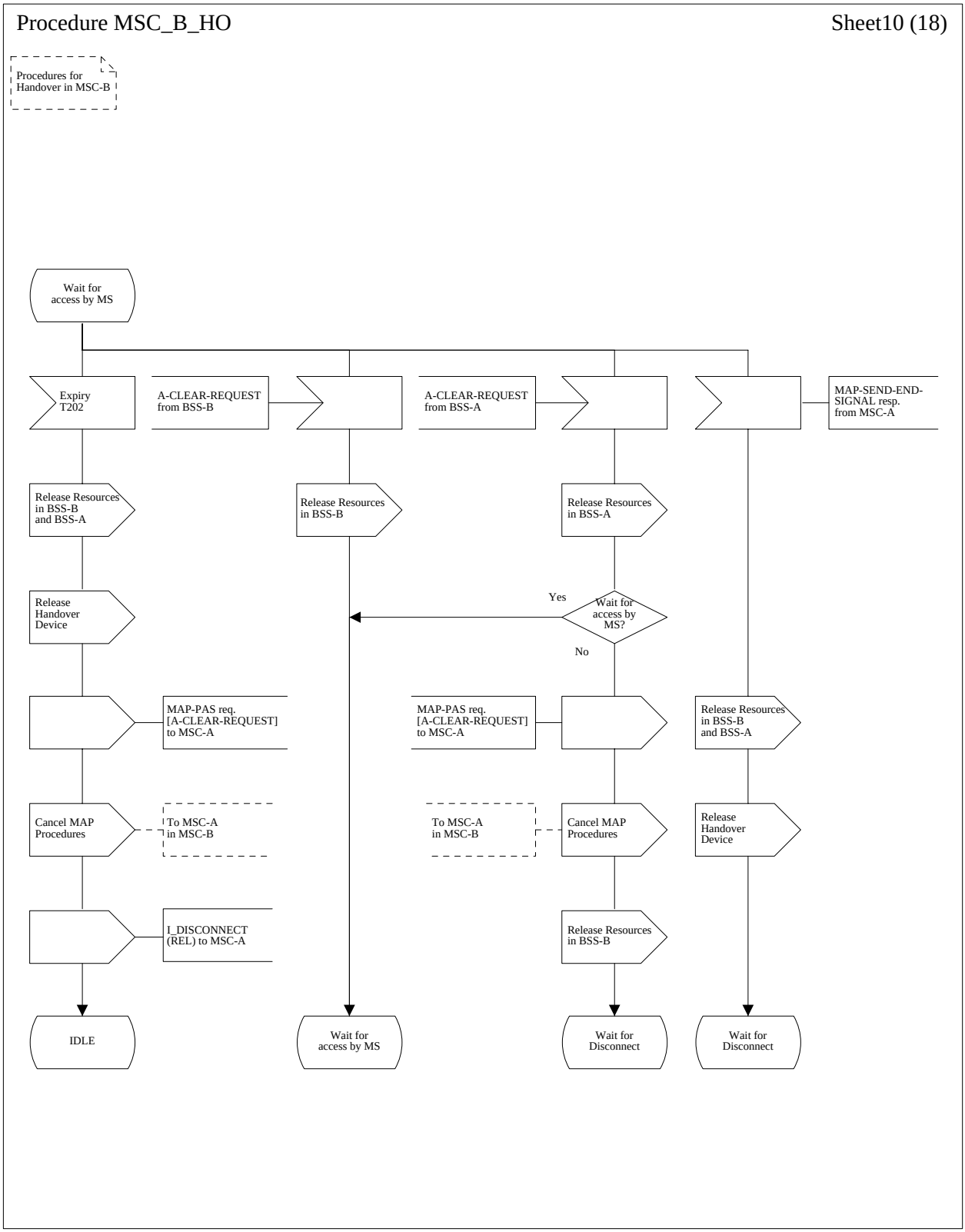


Figure 4214 (Sheet 10 of 18): Handover control procedure in MSC-B

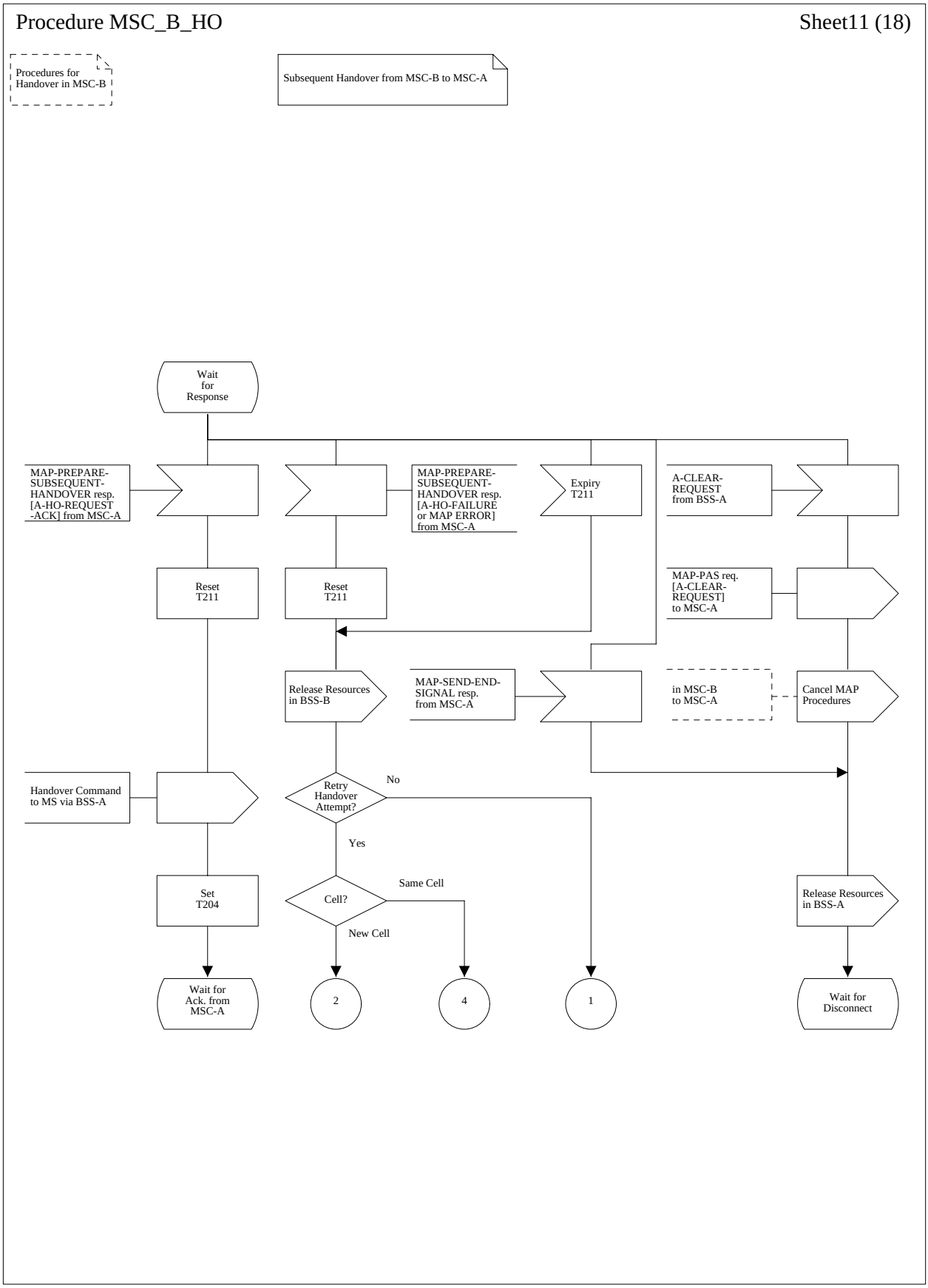


Figure 4214 (Sheet 11 of 18): Handover control procedure in MSC-B

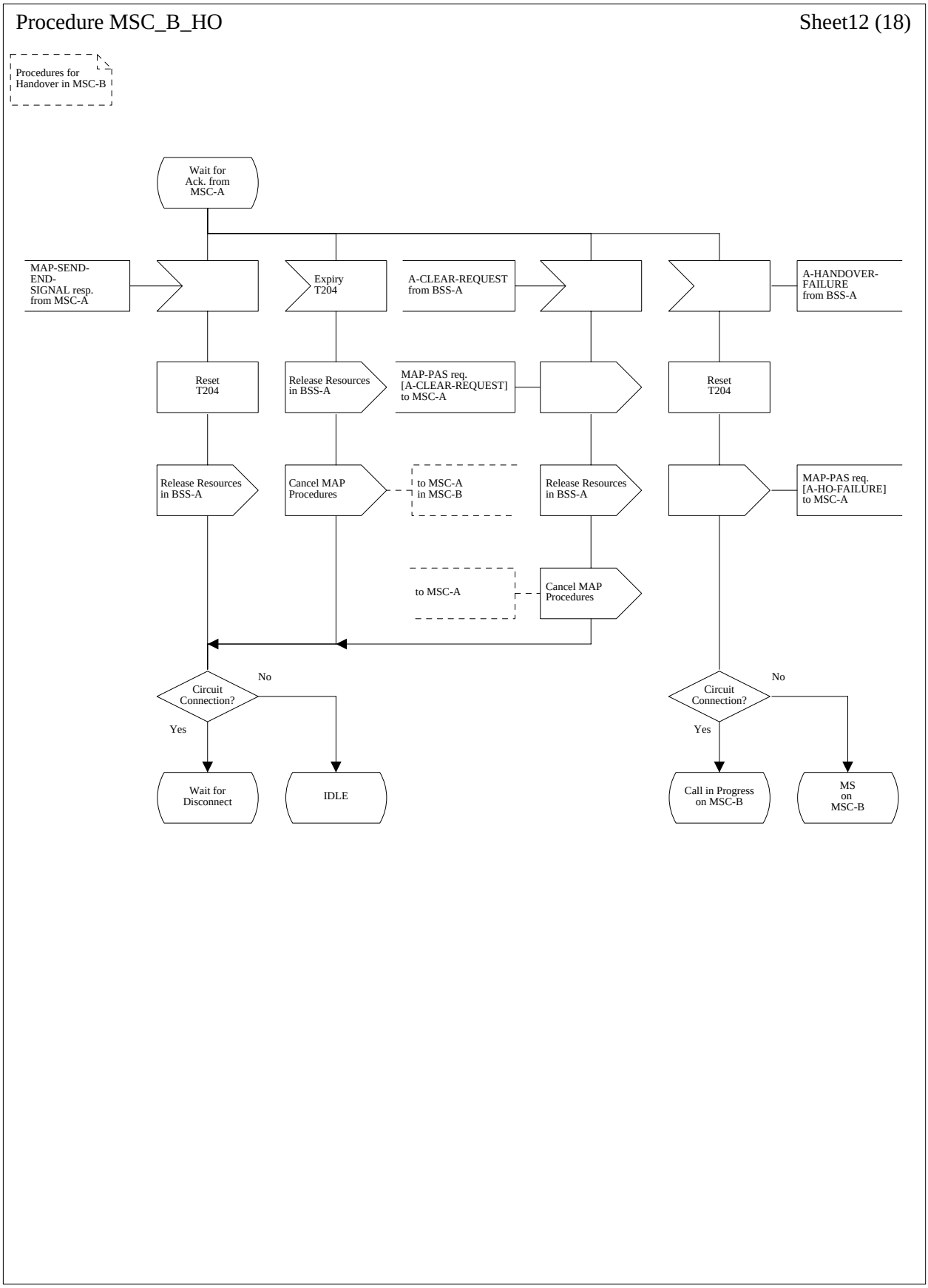


Figure 4214 (Sheet 12 of 18): Handover control procedure in MSC-B

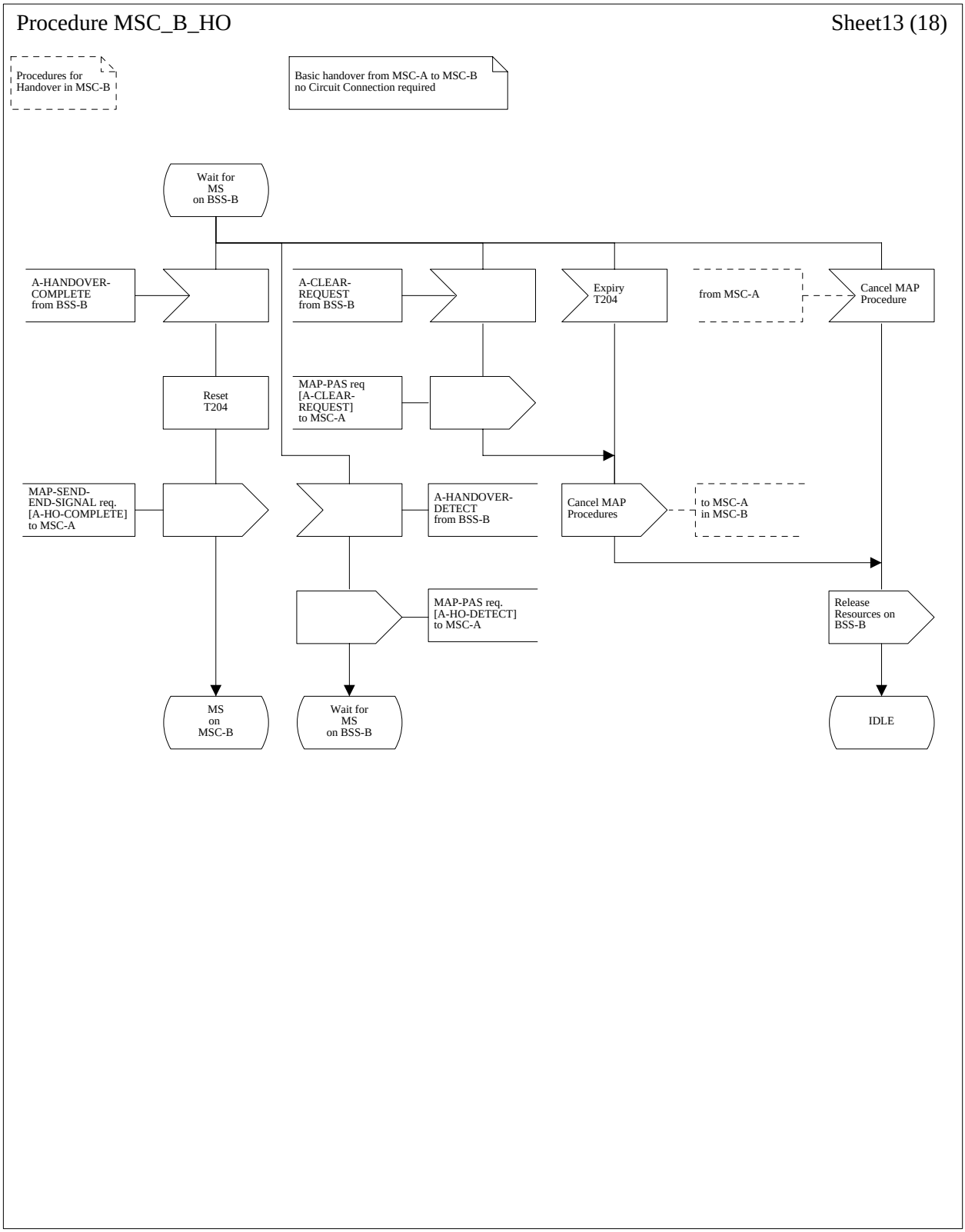


Figure 4214 (Sheet 13 of 18): Handover control procedure in MSC-B

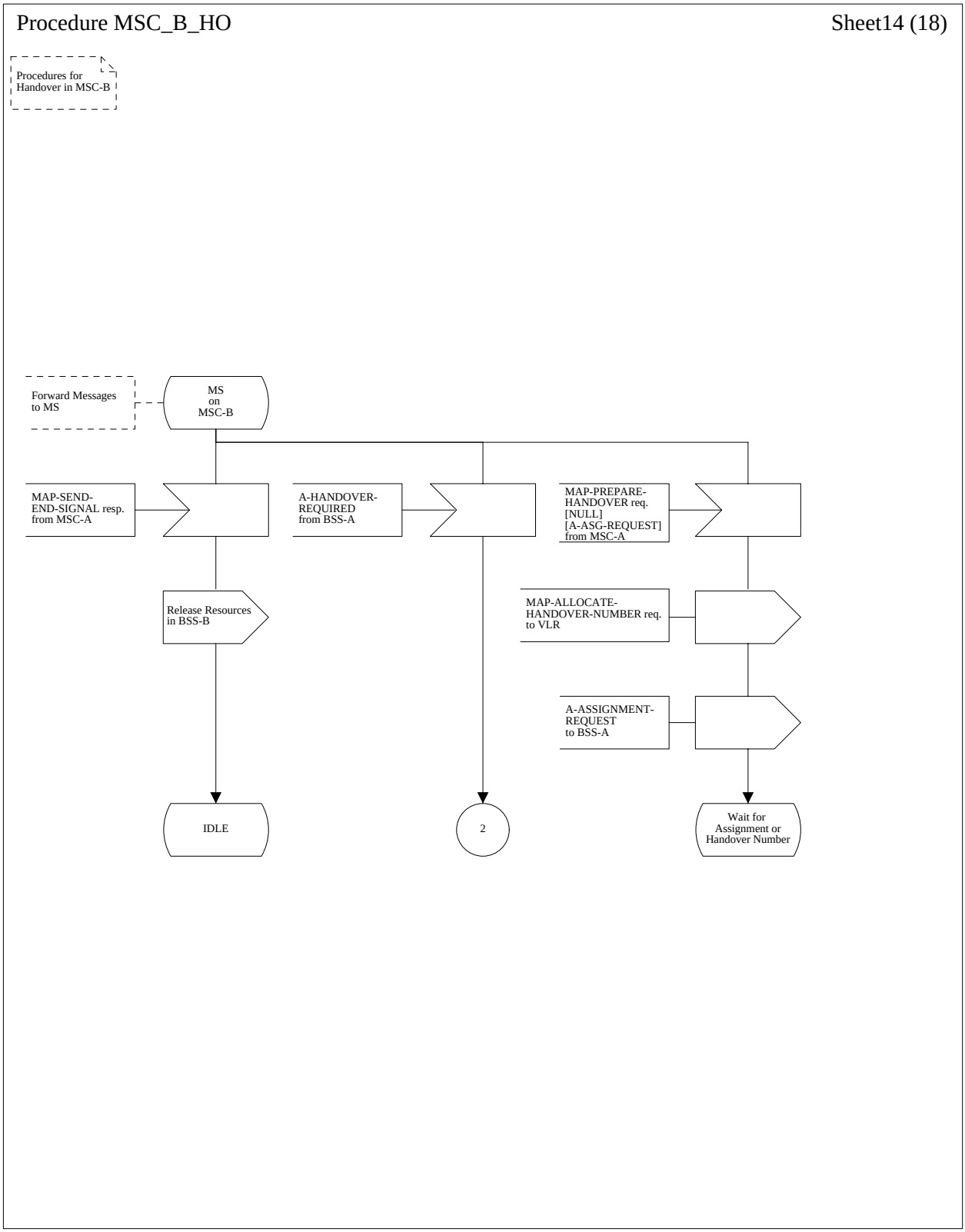


Figure 4214 (Sheet 14 of 18): Handover control procedure in MSC-B

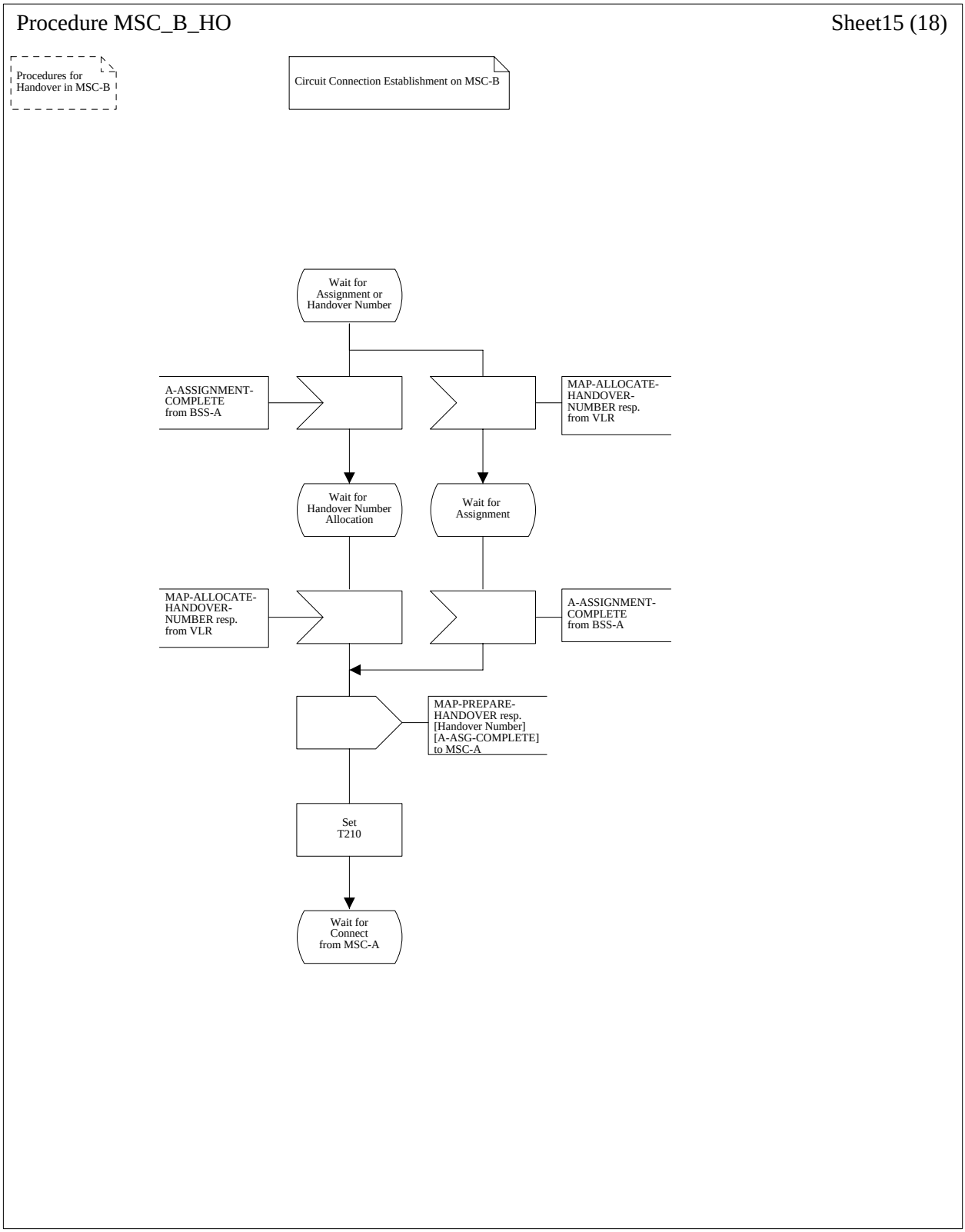


Figure 4214 (Sheet 15 of 18): Handover control procedure in MSC-B

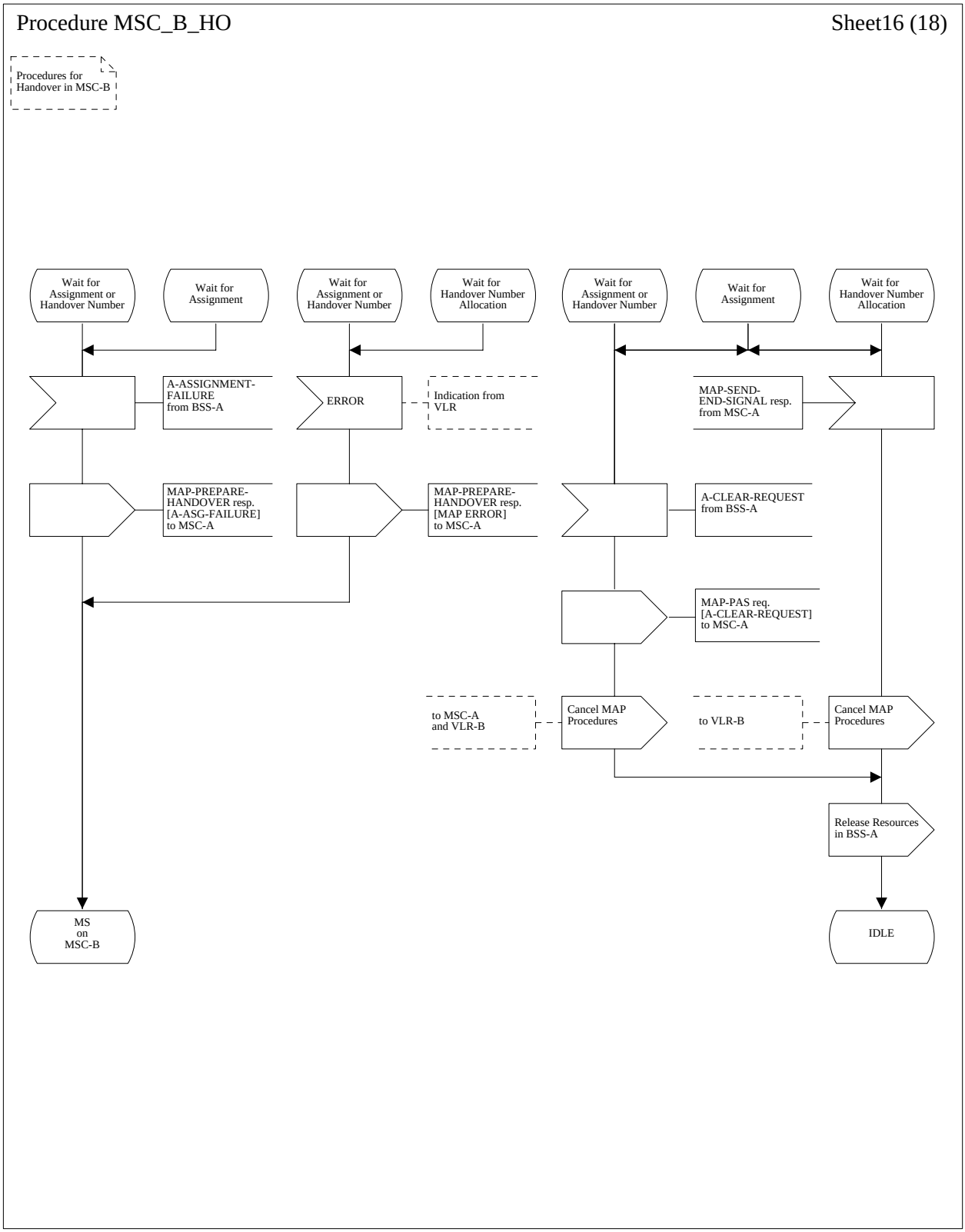


Figure 4214 (Sheet 16 of 18): Handover control procedure in MSC-B

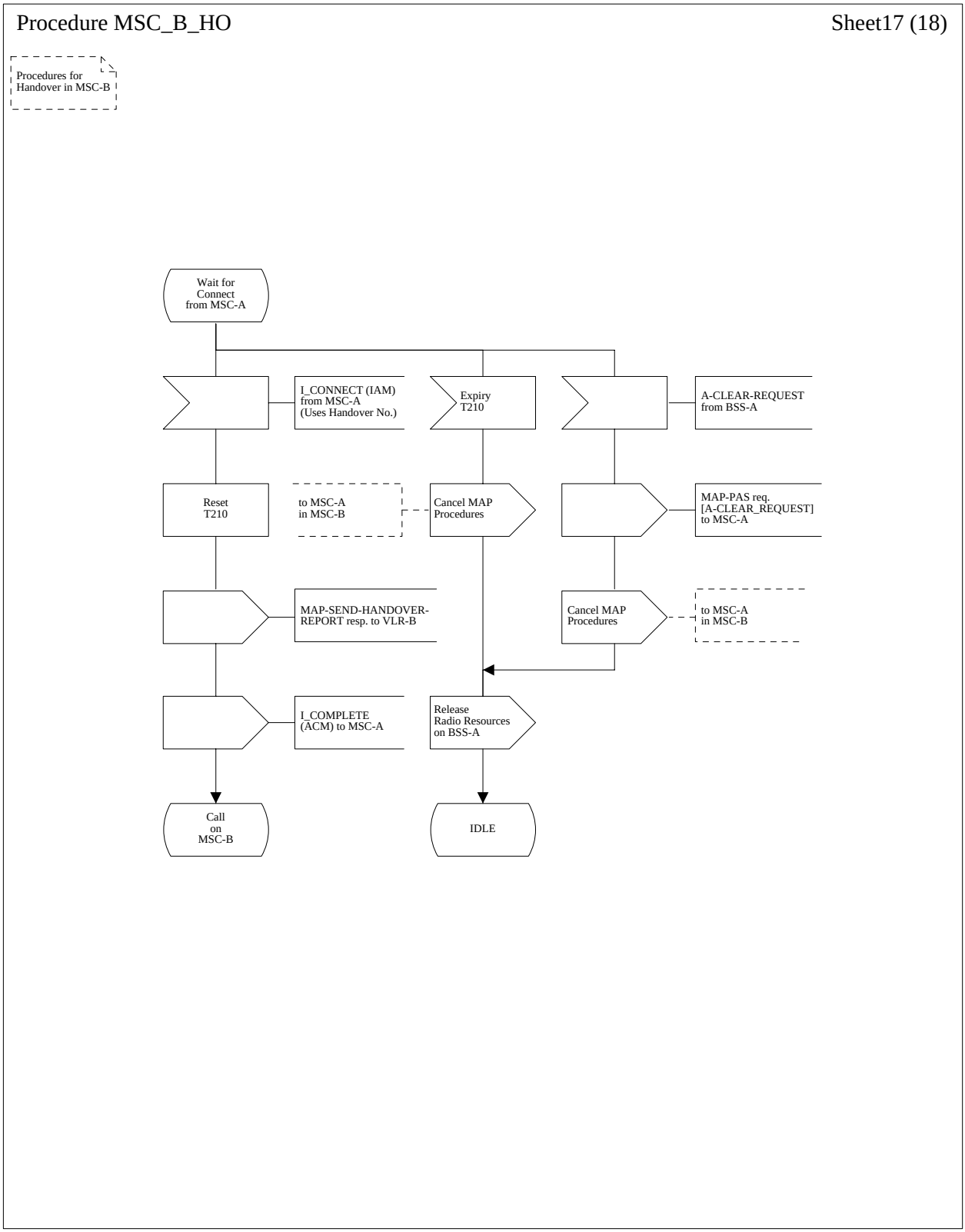


Figure 4214 (Sheet 17 of 18): Handover control procedure in MSC-B

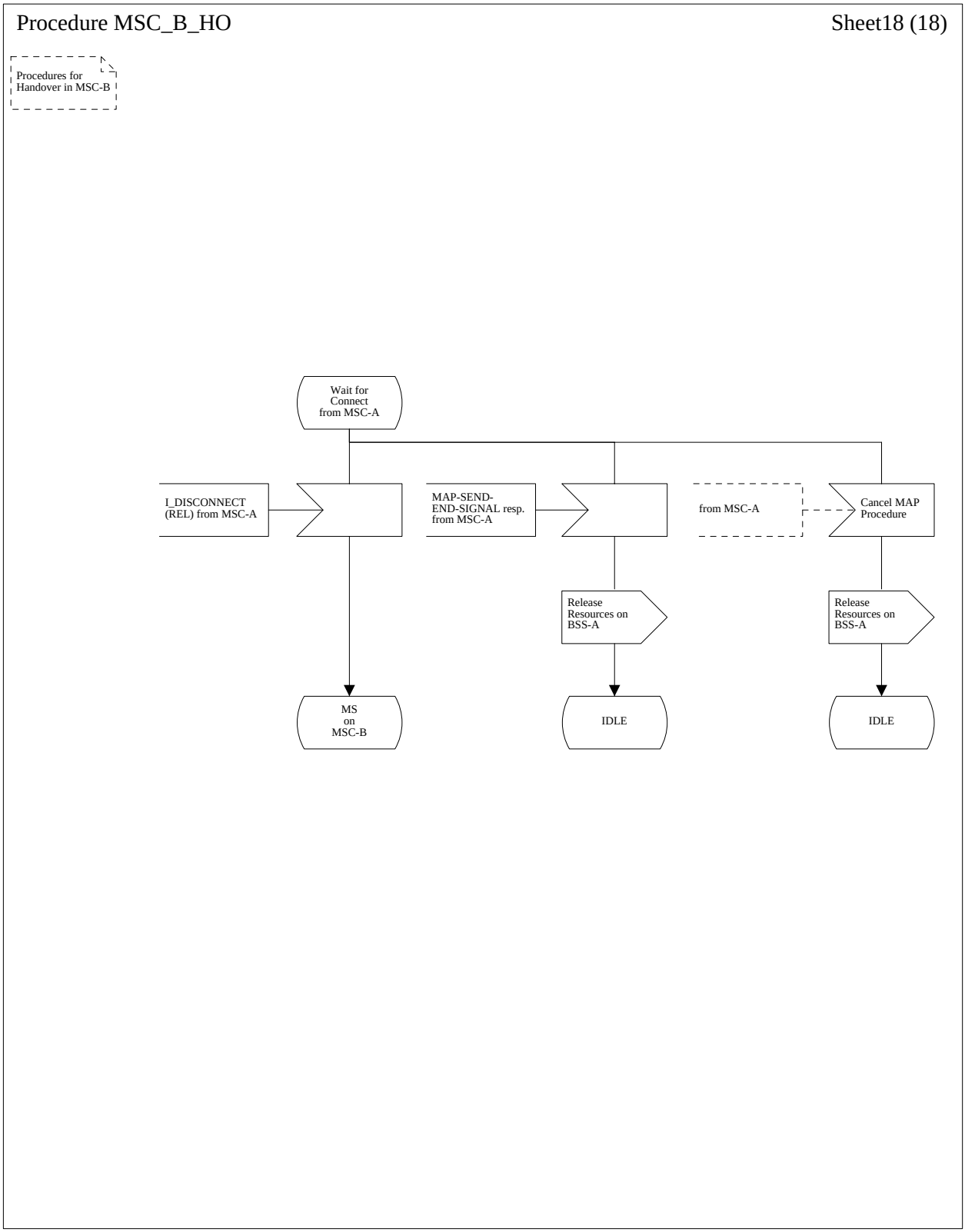


Figure 4214 (Sheet 18 of 18): Handover control procedure in MSC-B

Annex A:
Change history

Change history						
TSG CN#	**Spec**	**Version**	**CR**	**<Phase>**	**New Version**	**Subject/Comment**
Apr 1999	GSM 03.09	6.0.0				Transferred to 3GPP CN1
CN#03	23.009				3.0.0	Approved at CN#03

History

Document history		
V3.0.0	May 1999	Approved at TSGN #3. Under TSG TSG CN Change Control.

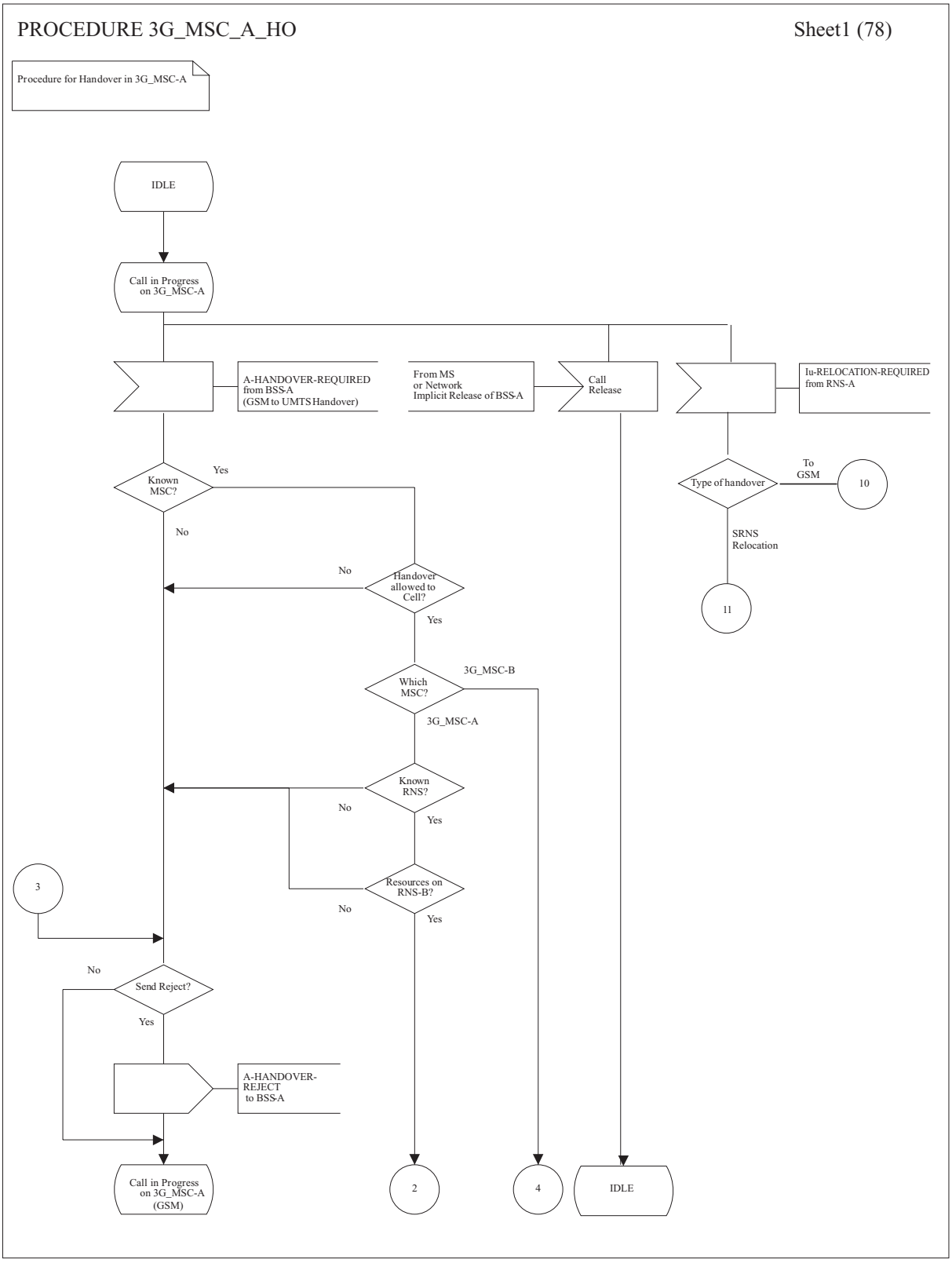


Figure 43 (Sheet 1 of 78): Handover control procedure in 3G_MSC-A

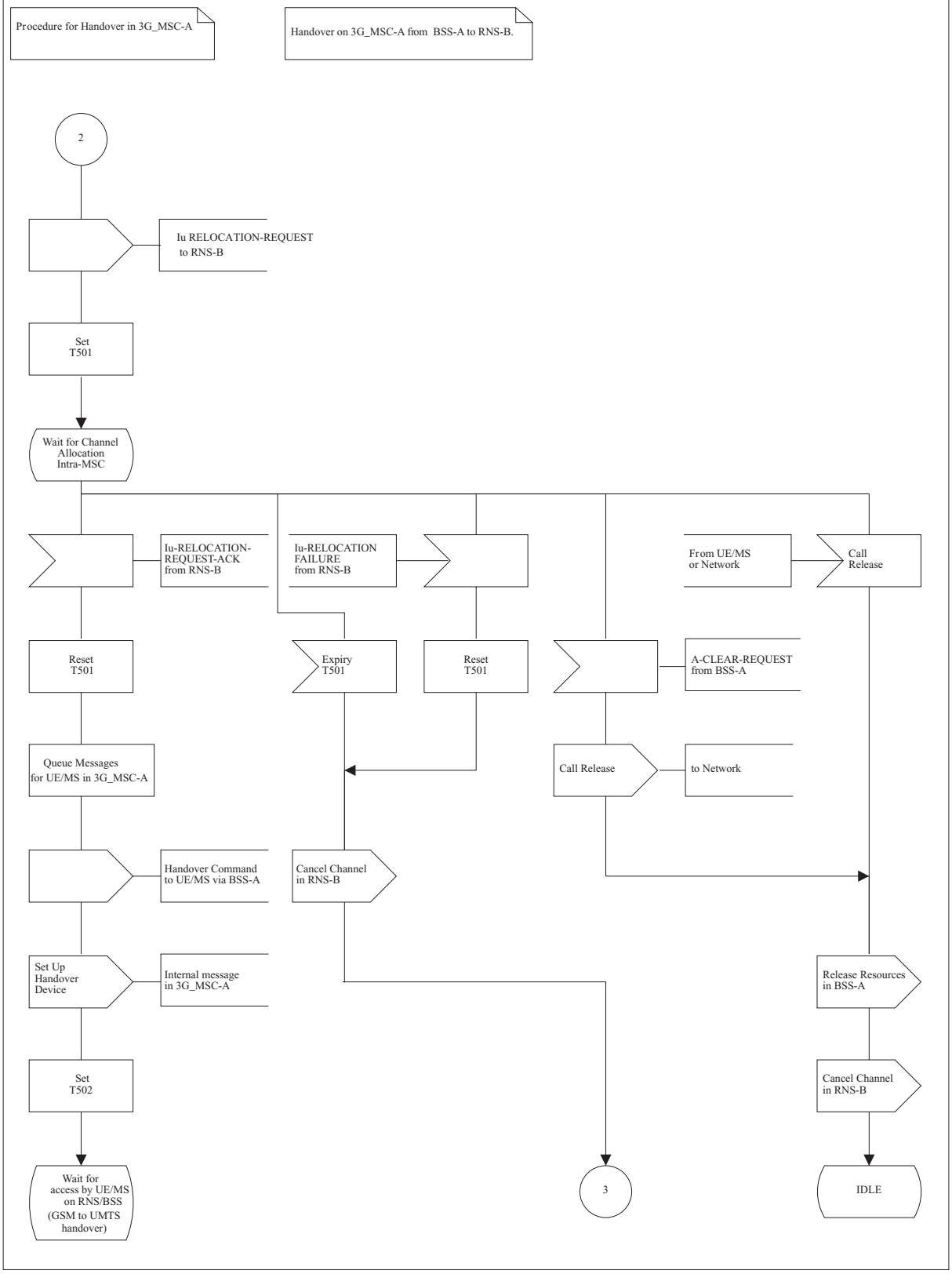


Figure 43 (Sheet 2 of 78): Handover control procedure in 3G_MSC-A

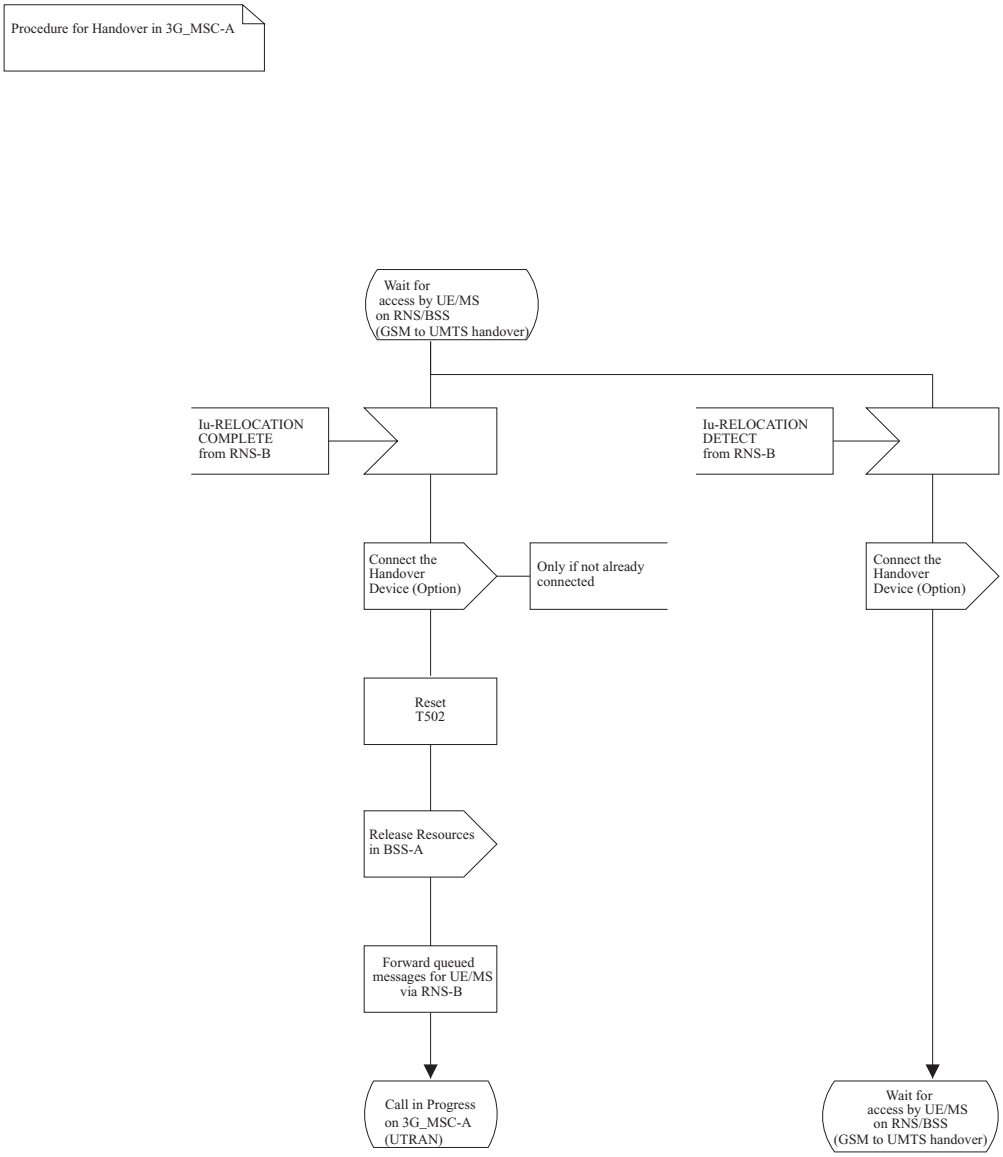


Figure 43 (Sheet 3 of 78): Handover control procedure in 3G_MSC-A

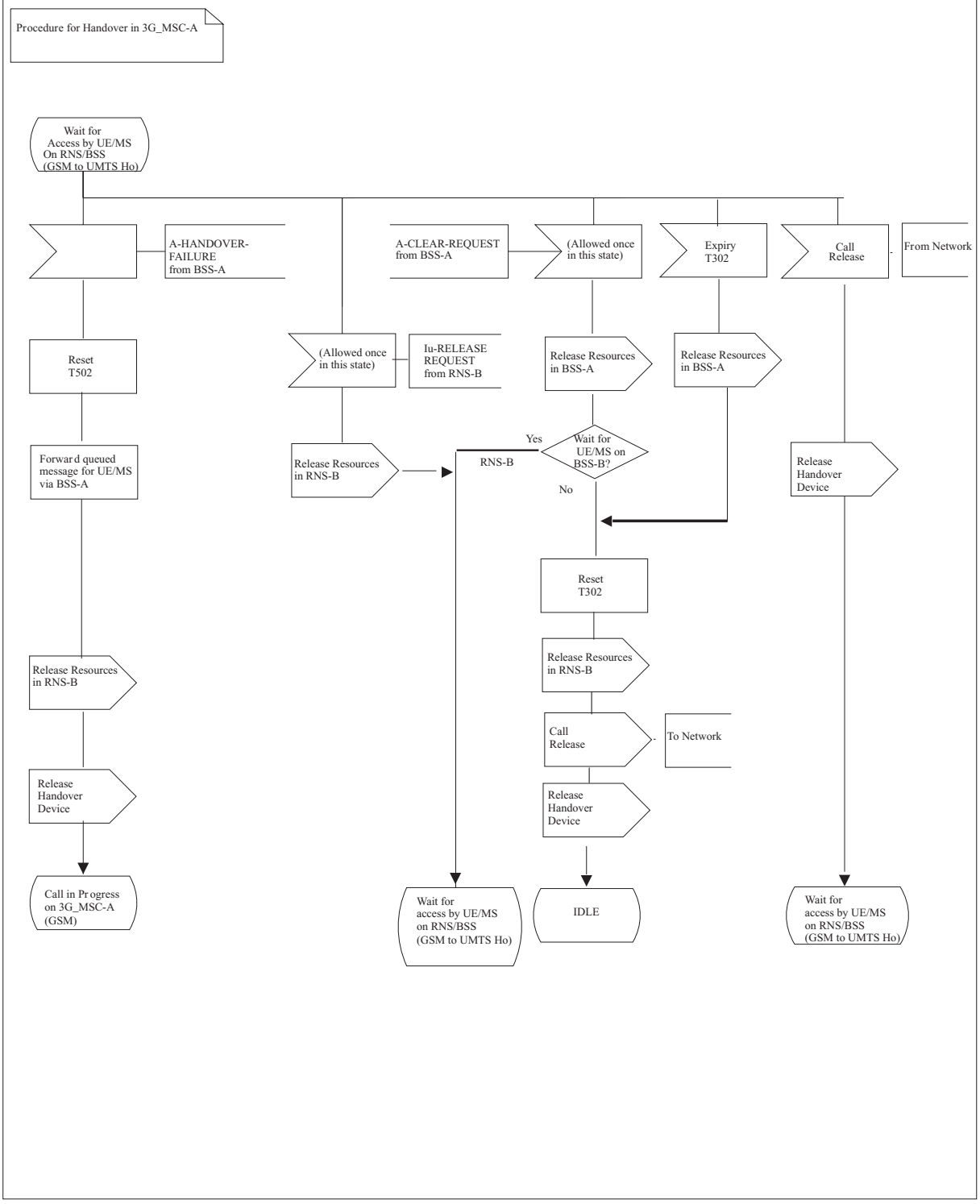


Figure 43 (Sheet 4 of 78): Handover control procedure in 3G_MSC-A

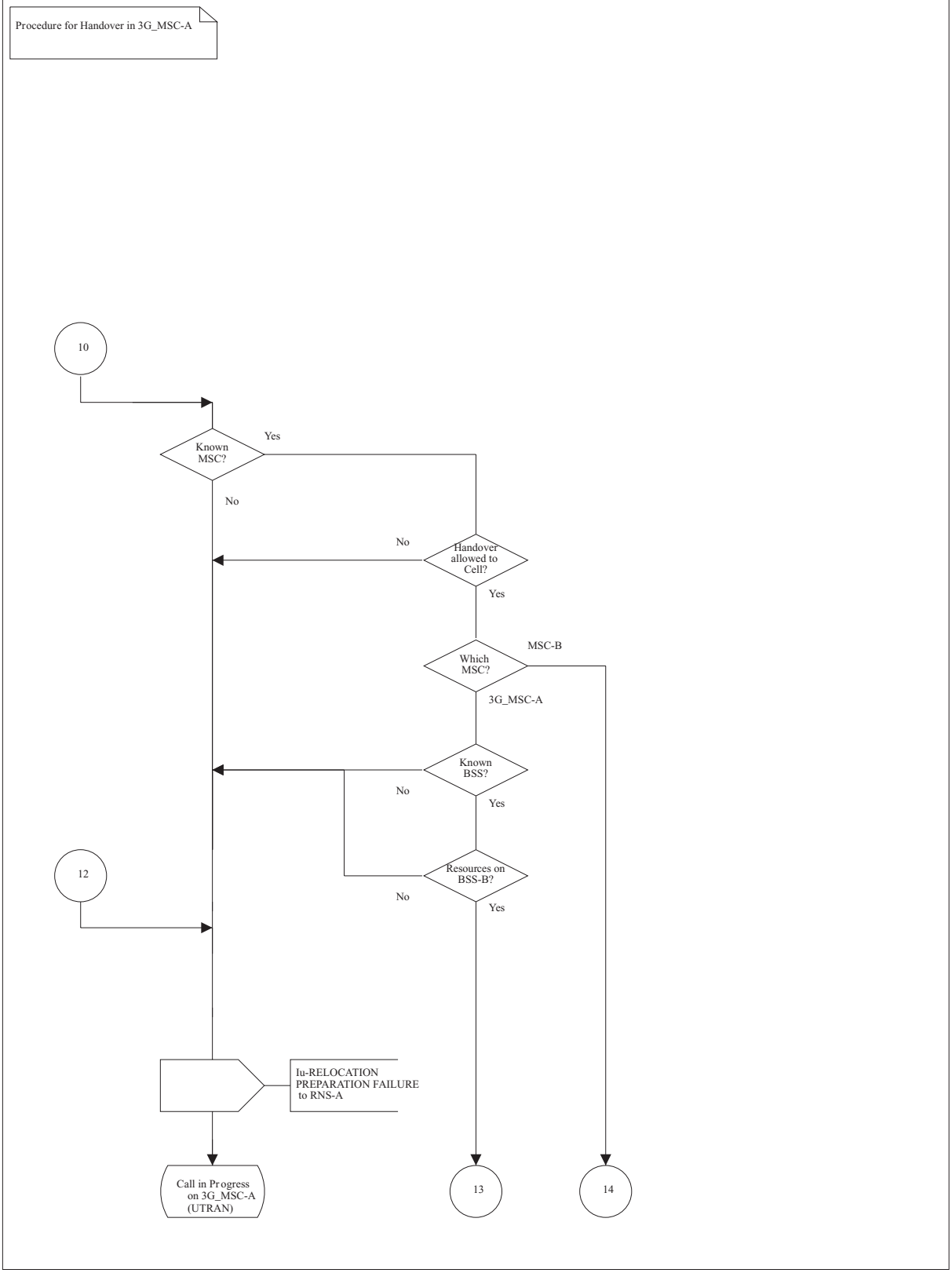


Figure 43 (Sheet 5 of 78): Handover control procedure in 3G_MSC-A

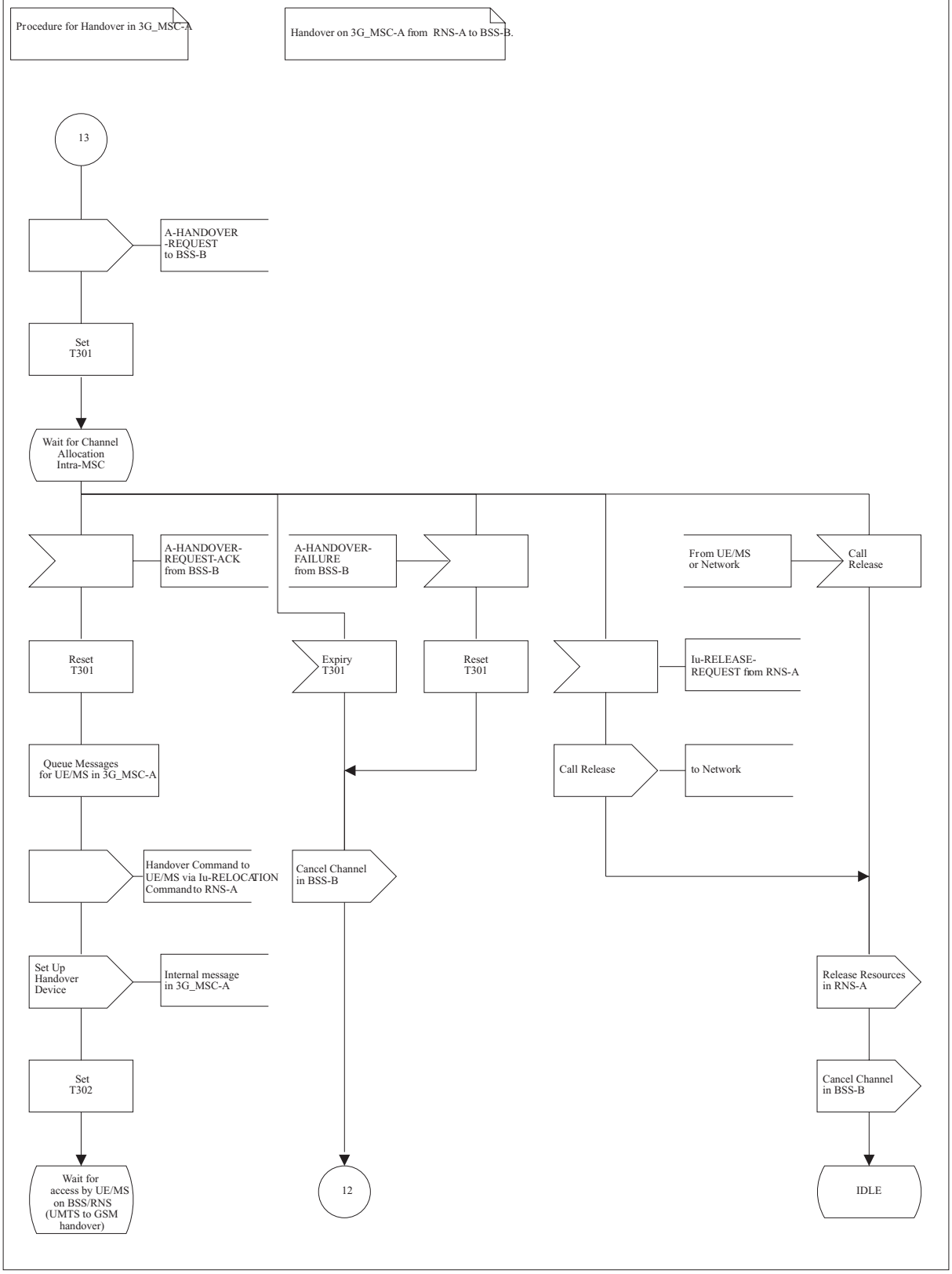


Figure 43 (Sheet 6 of 78): Handover control procedure in 3G_MSC-A

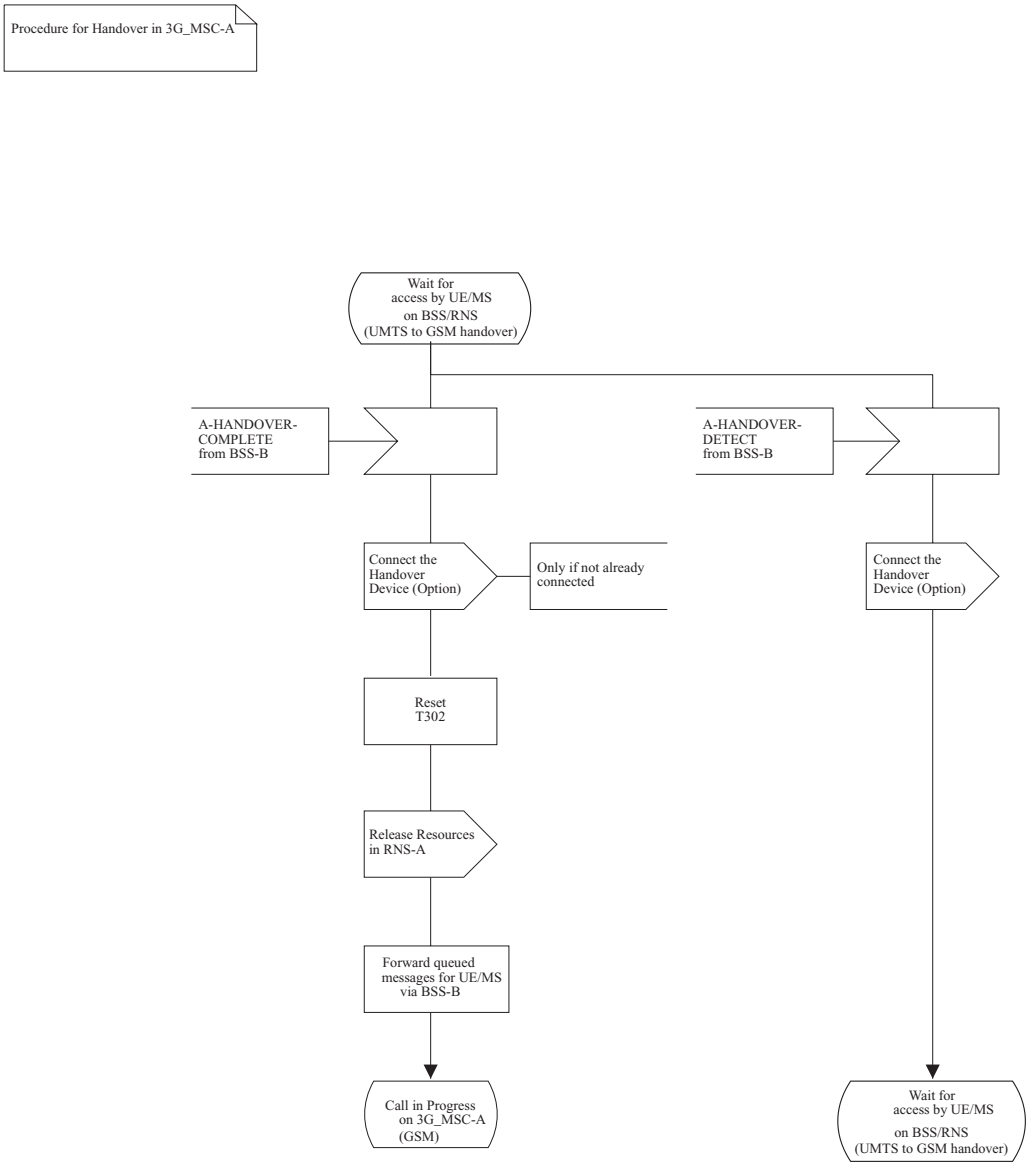


Figure 43 (Sheet 7 of 78): Handover control procedure in 3G_MSC-A

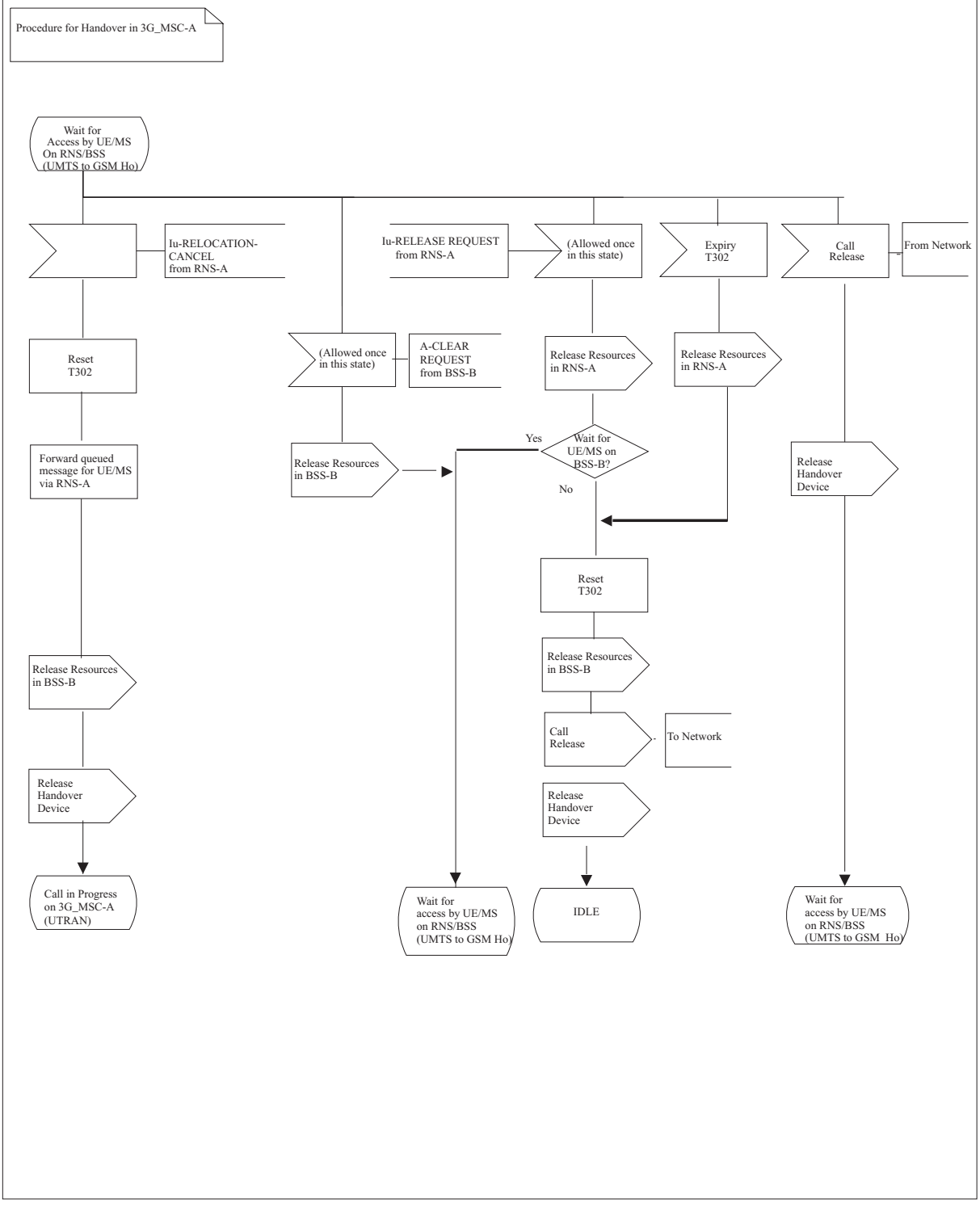


Figure 43 (Sheet 8 of 78): Handover control procedure in 3G_MSC-A

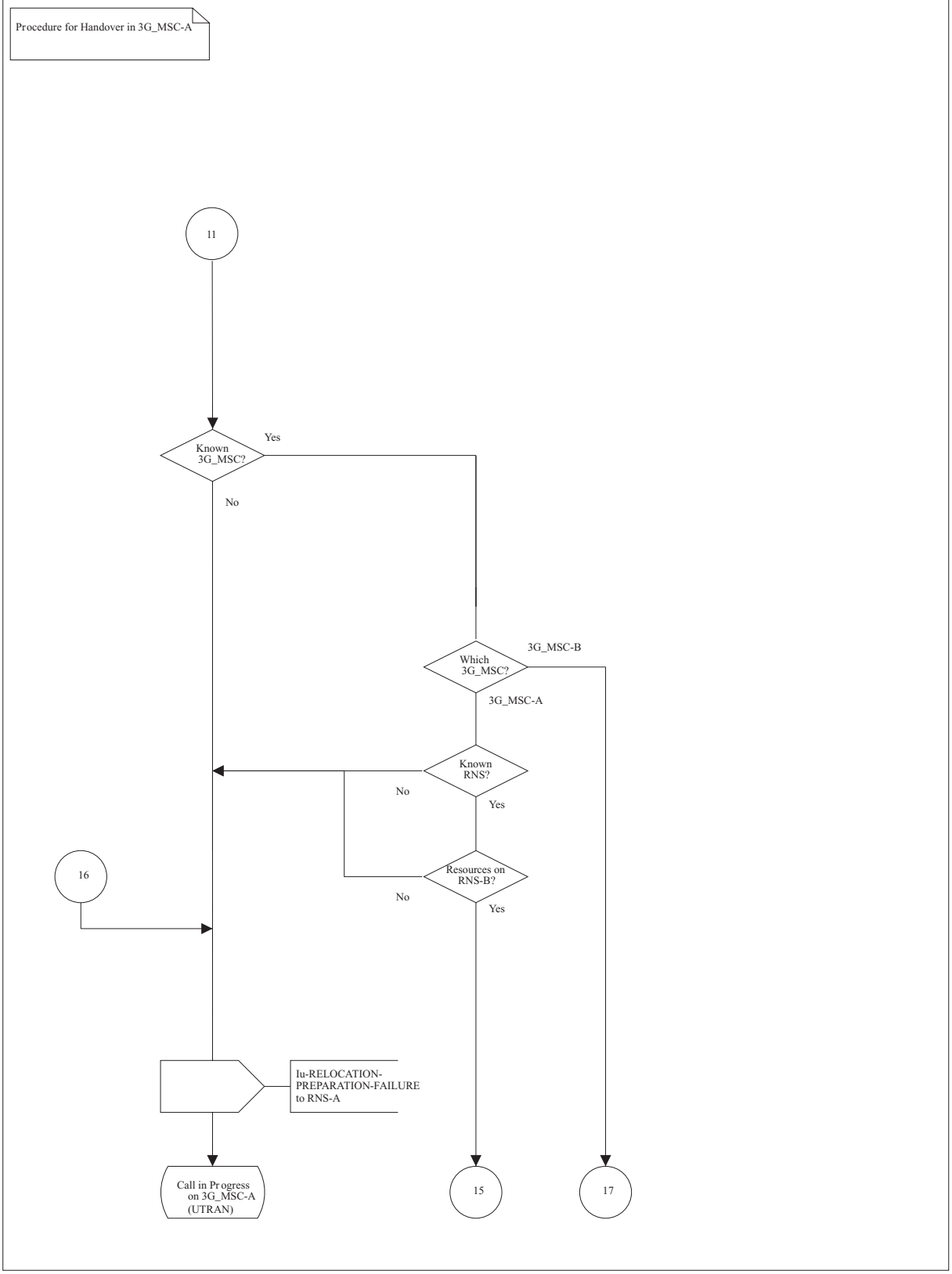


Figure 43 (Sheet 9 of 78): Handover control procedure in 3G_MSC-A

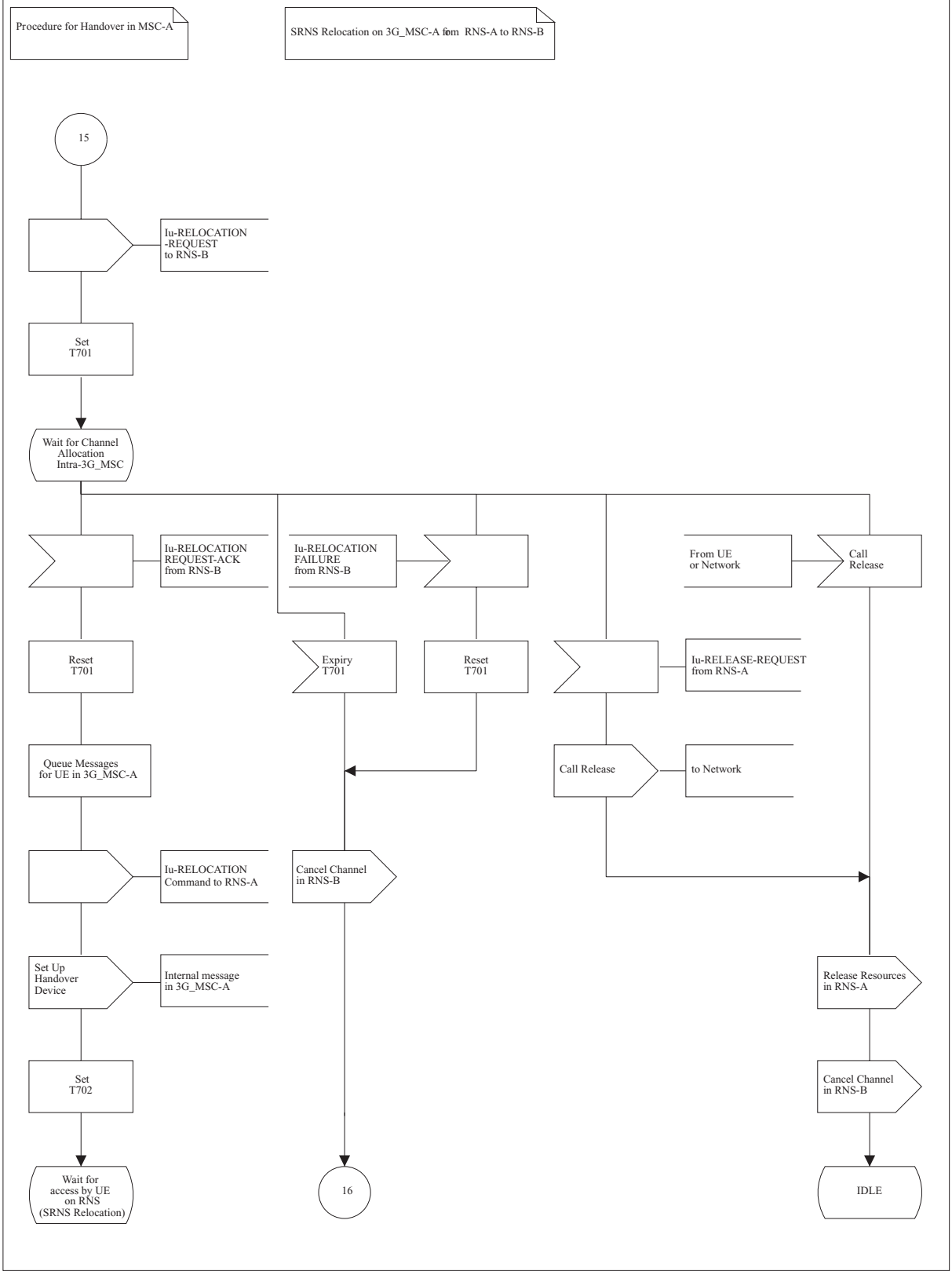


Figure 43 (Sheet 10 of 78): Handover control procedure in 3G_MSC-A

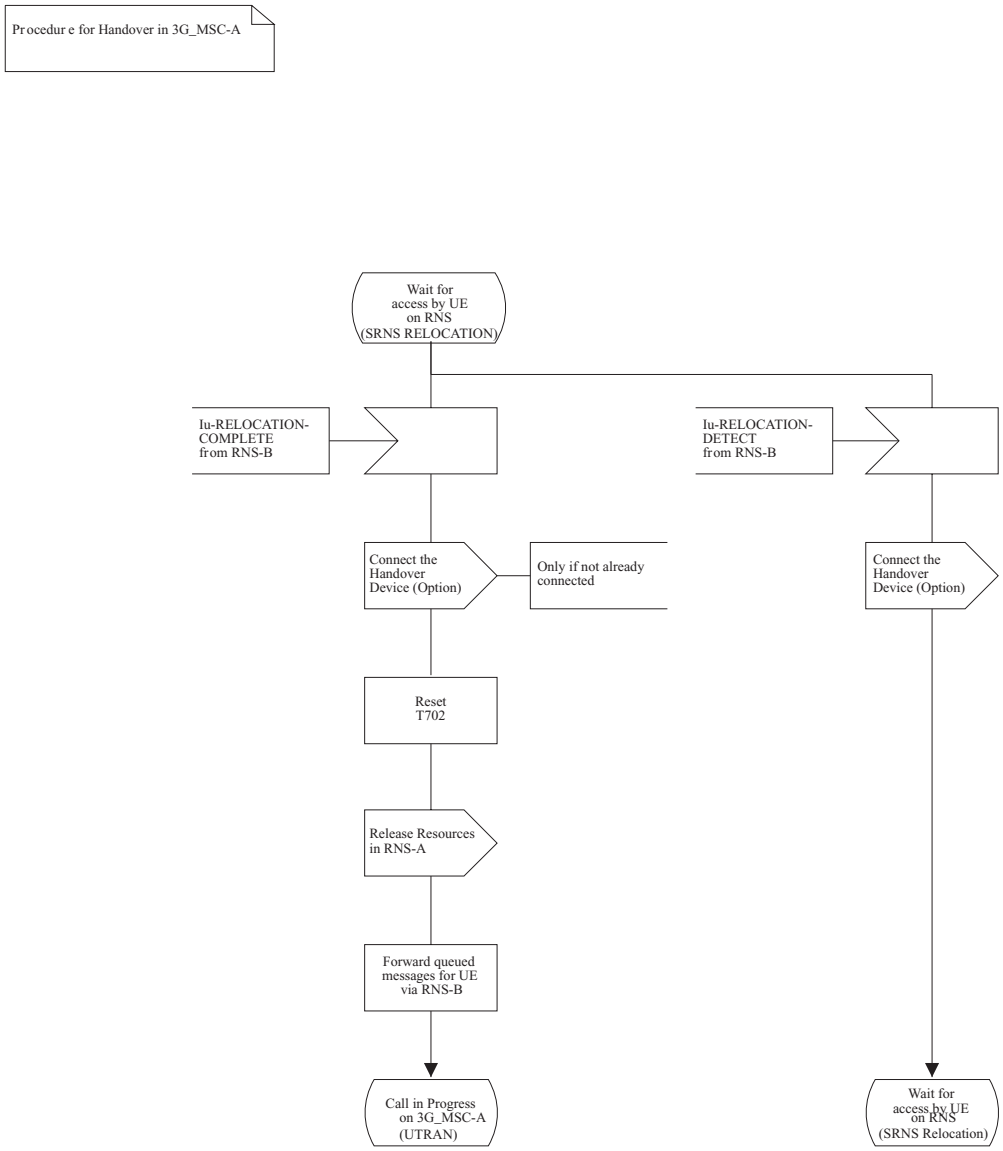


Figure 43 (Sheet 11 of 78): Handover control procedure in 3G_MSC-A

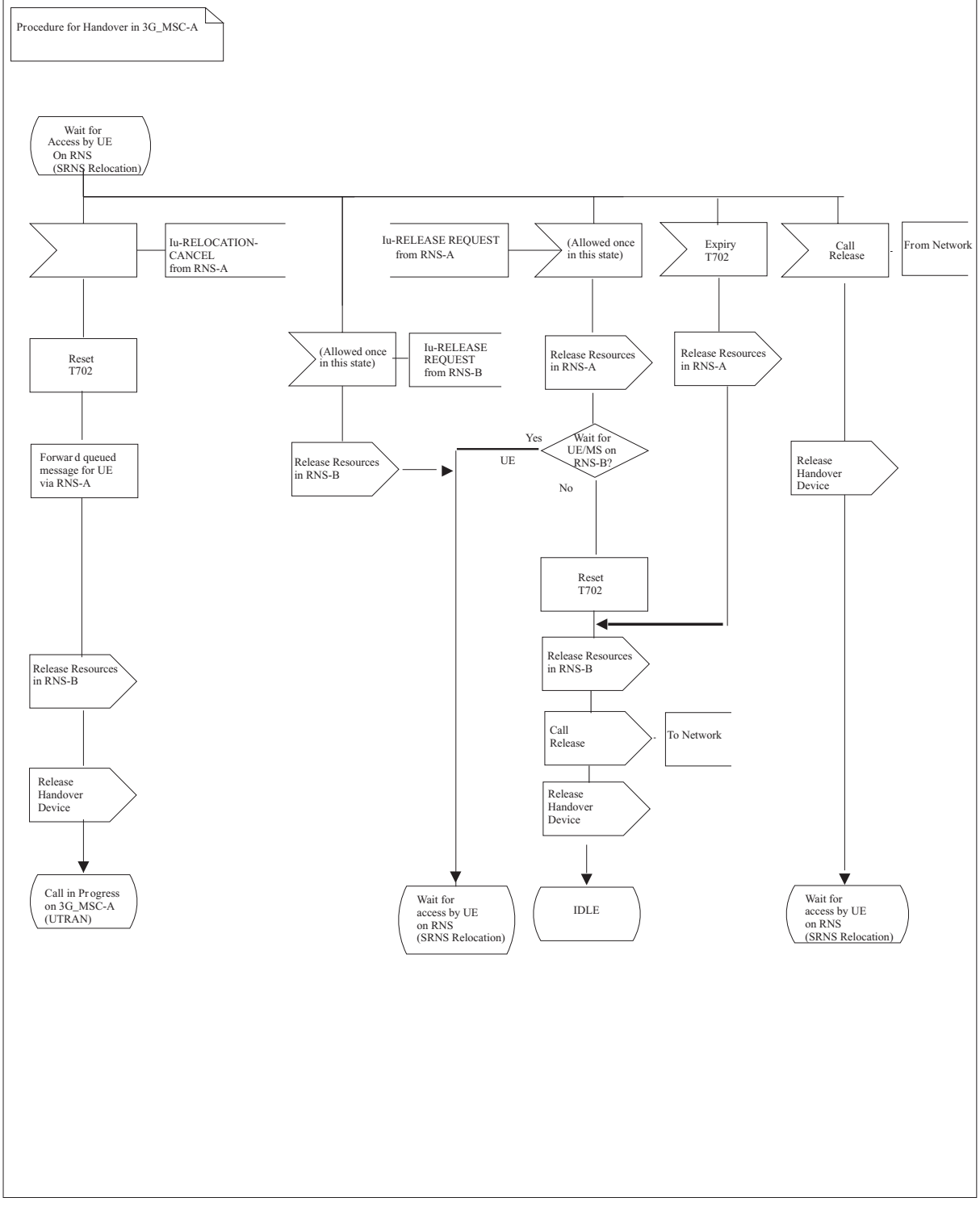


Figure 43 (Sheet 12 of 78): Handover control procedure in 3G_MSC-A

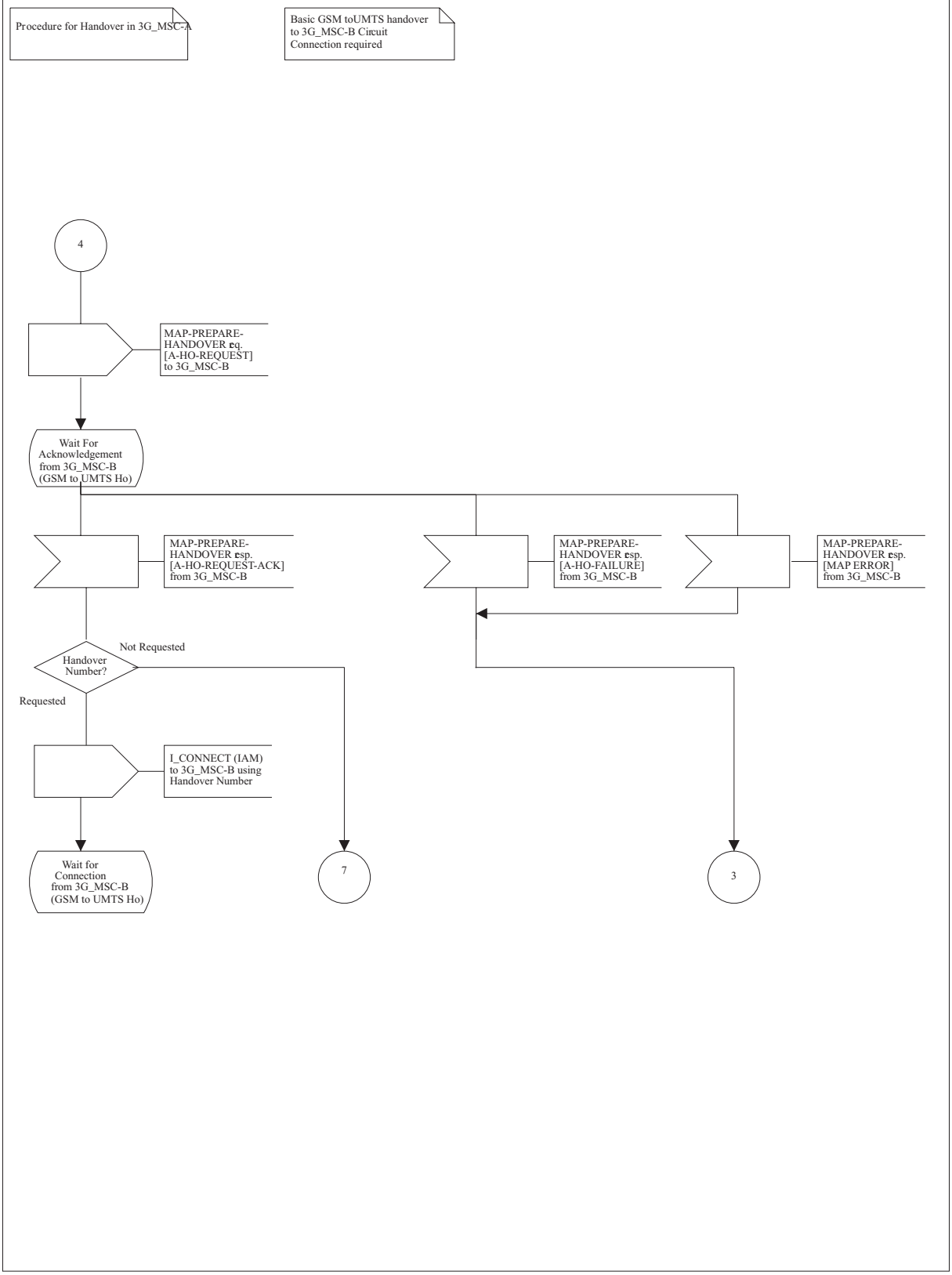


Figure 43 (Sheet 13 of 78): Handover control procedure in 3G_MSC-A

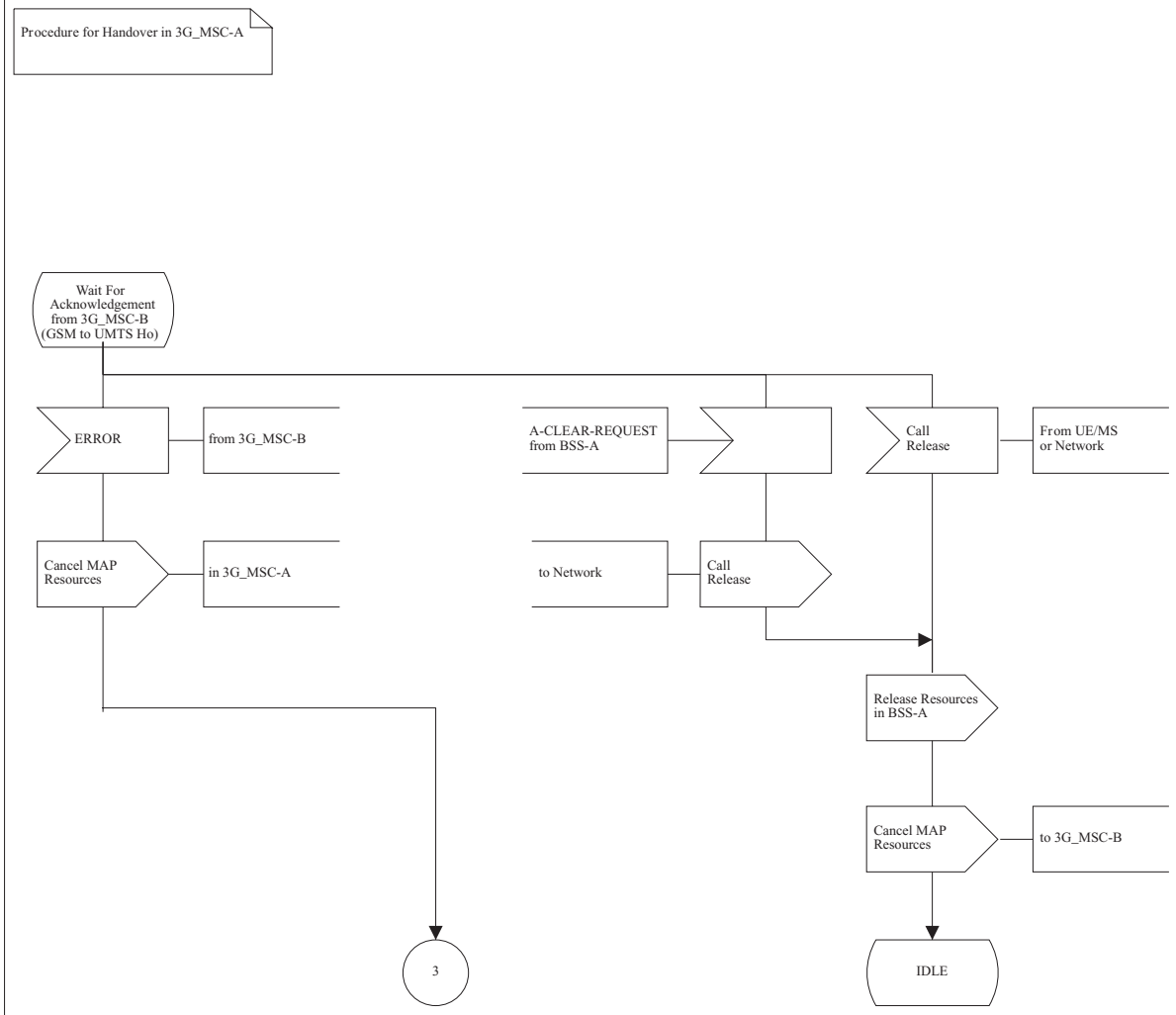


Figure 43 (Sheet 14 of 78): Handover control procedure in 3G_MSC-A

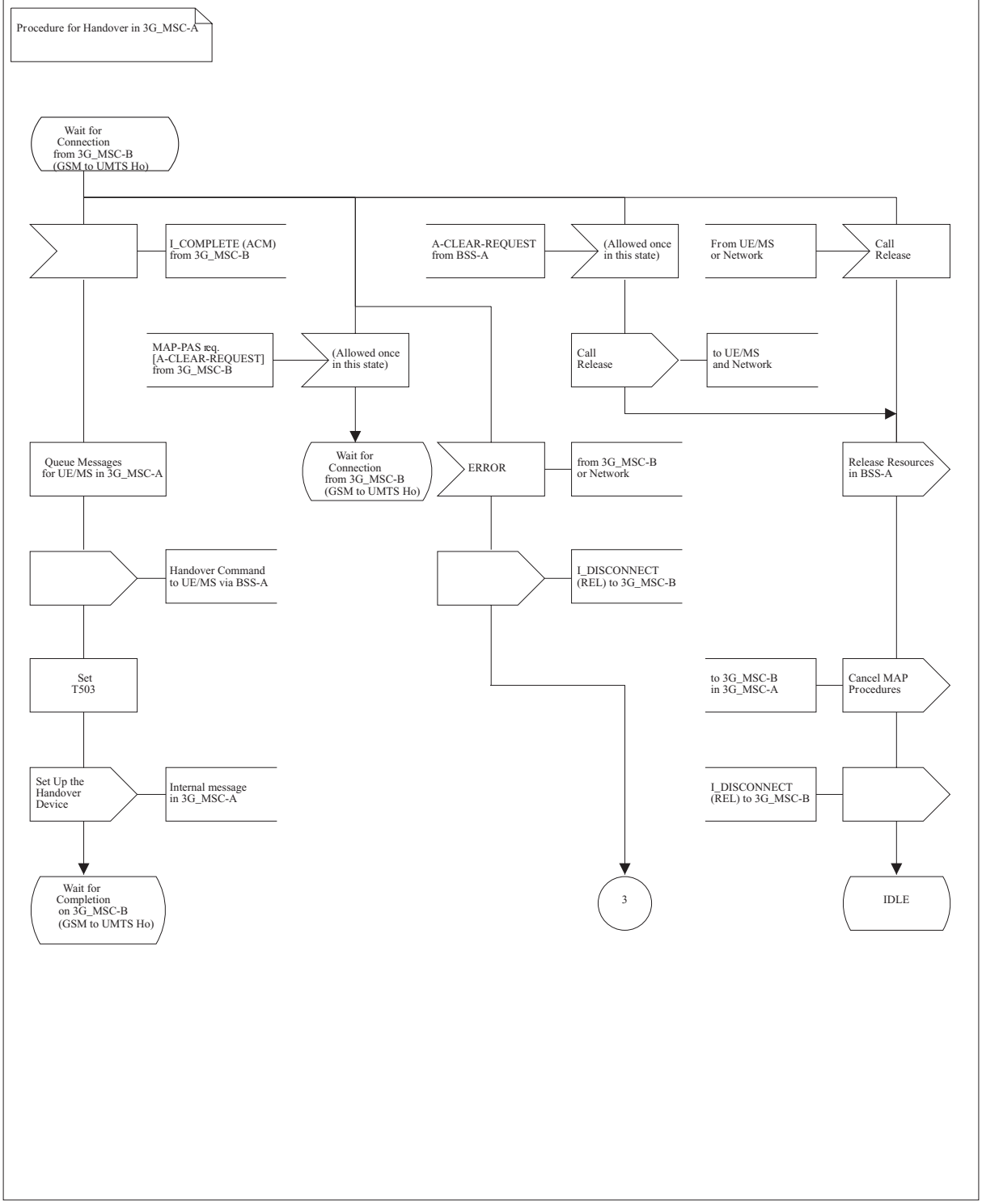


Figure 43 (Sheet 15 of 78): Handover control procedure in 3G_MSC-A

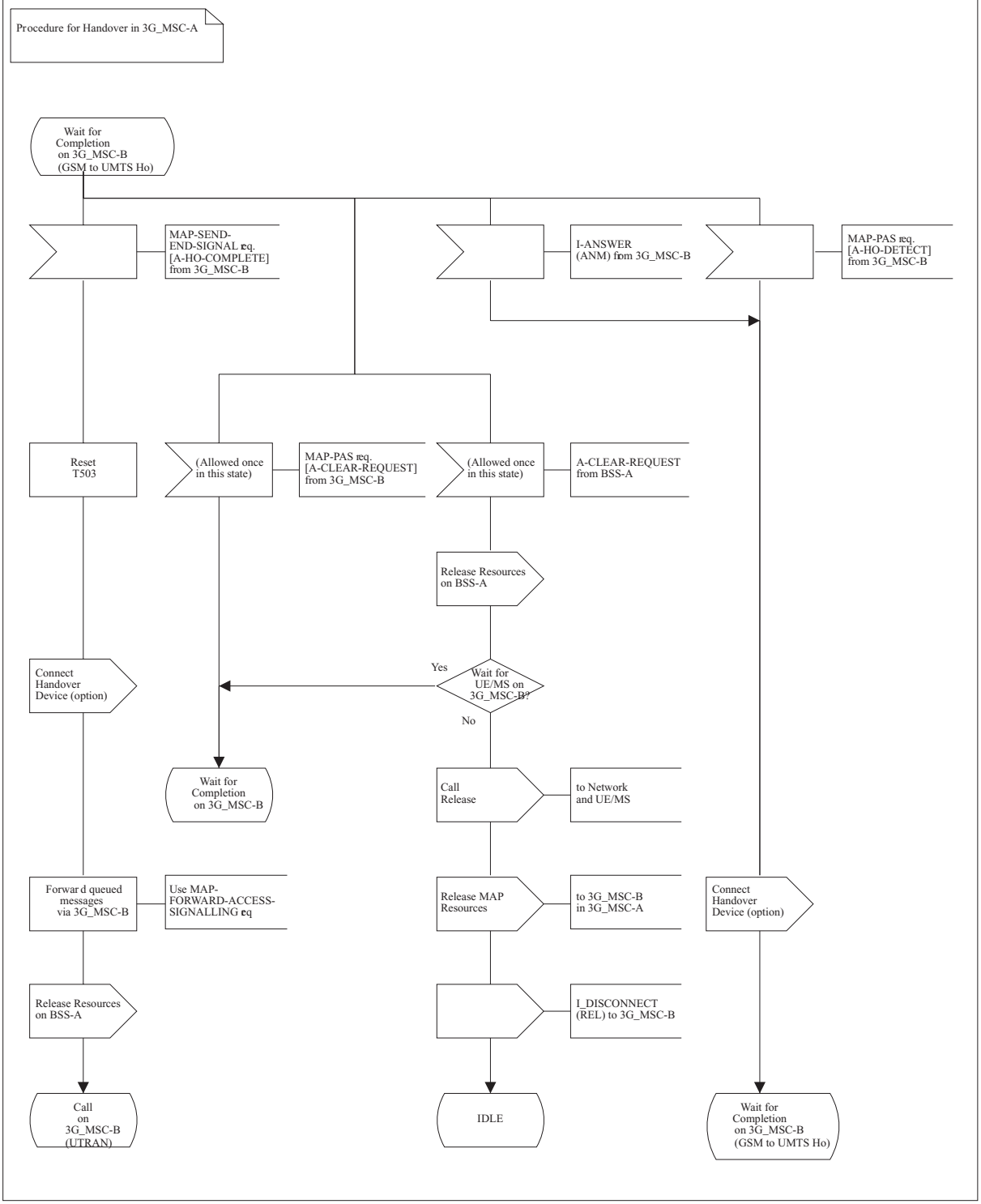


Figure 43 (Sheet 16 of 78): Handover control procedure in 3G_MSC-A

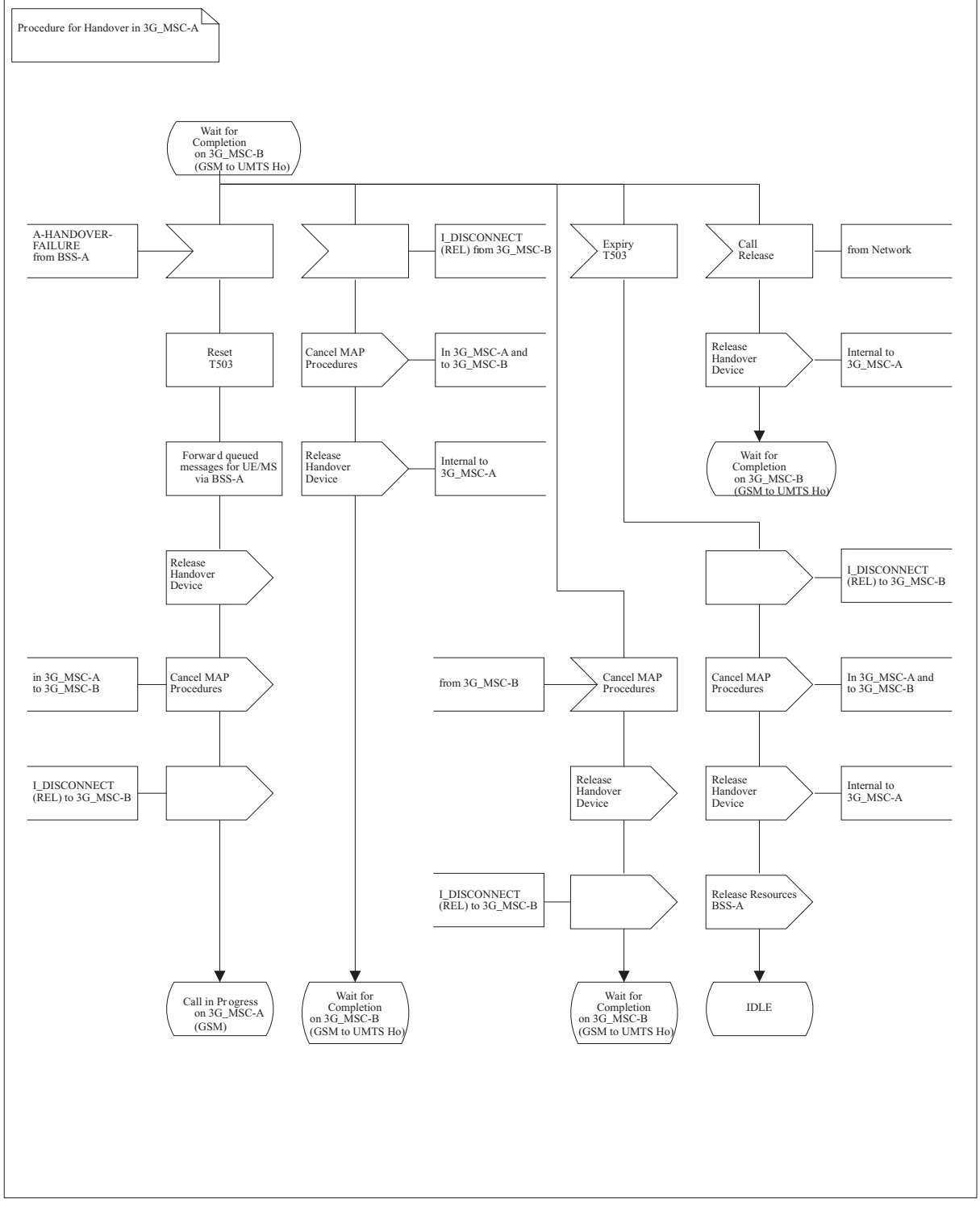


Figure 43 (Sheet 17 of 78): Handover control procedure in 3G_MSC-A

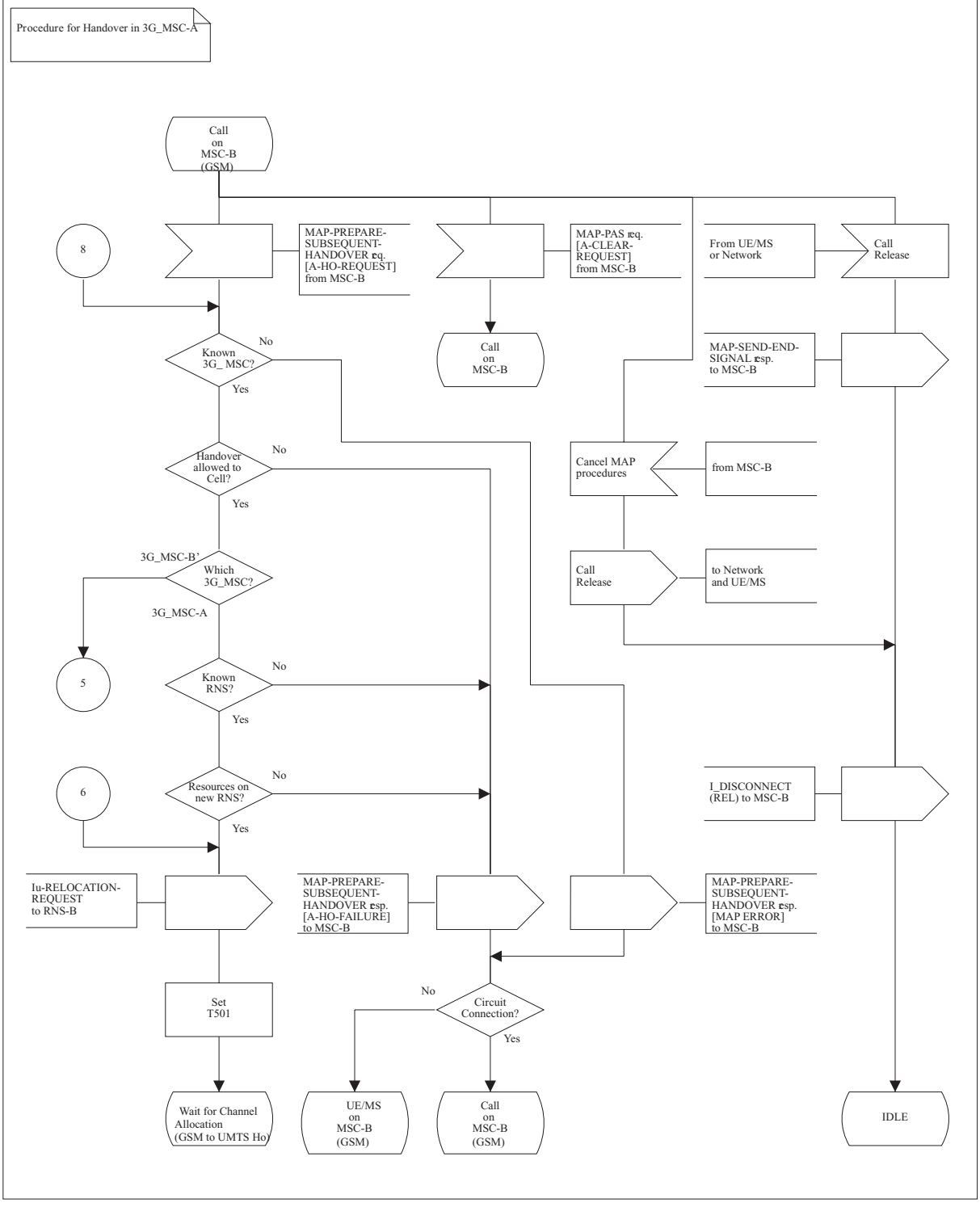


Figure 43 (Sheet 18 of 78): Handover control procedure in 3G_MSC-A

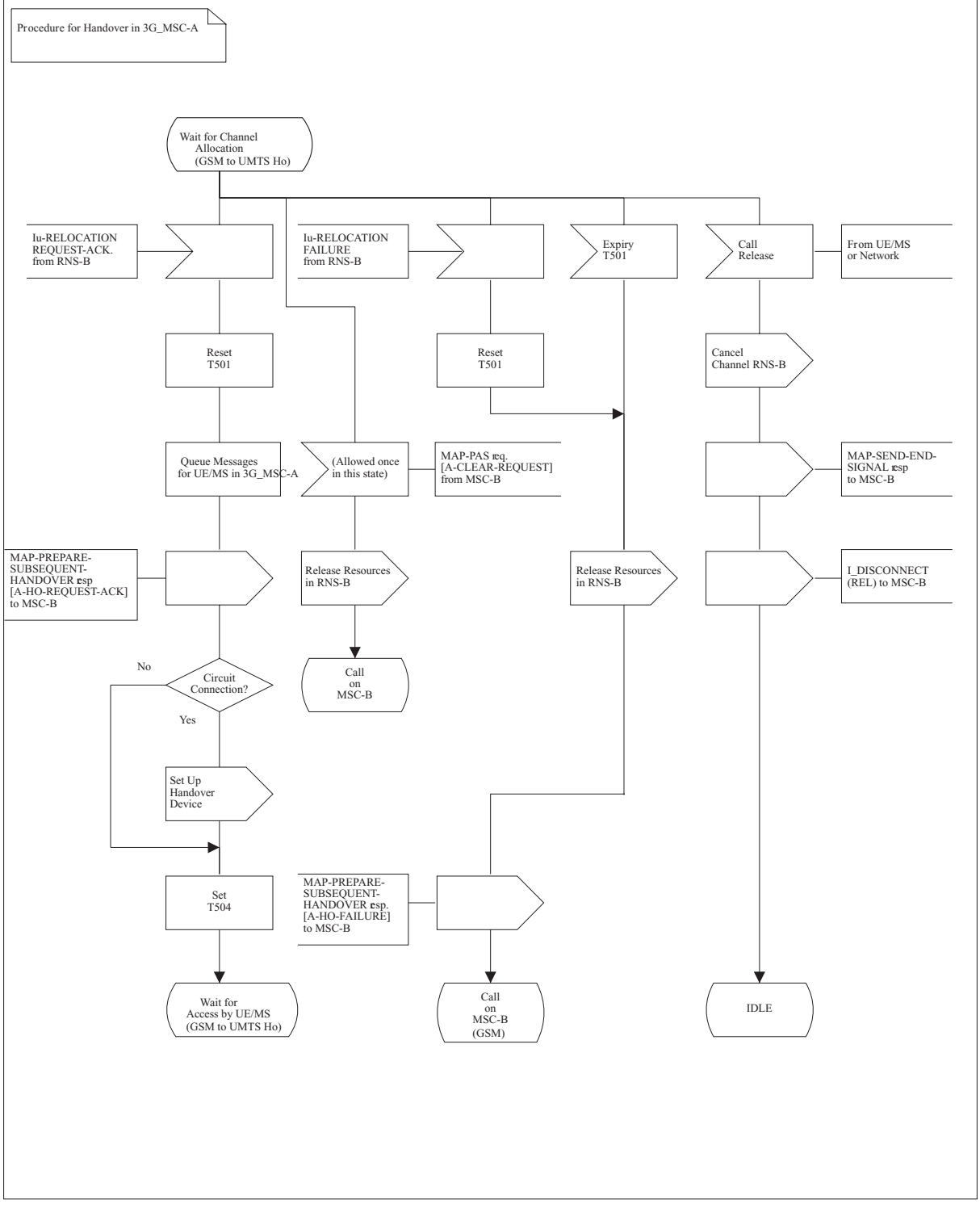


Figure 43 (Sheet 19 of 78): Handover control procedure in 3G_MSC-A

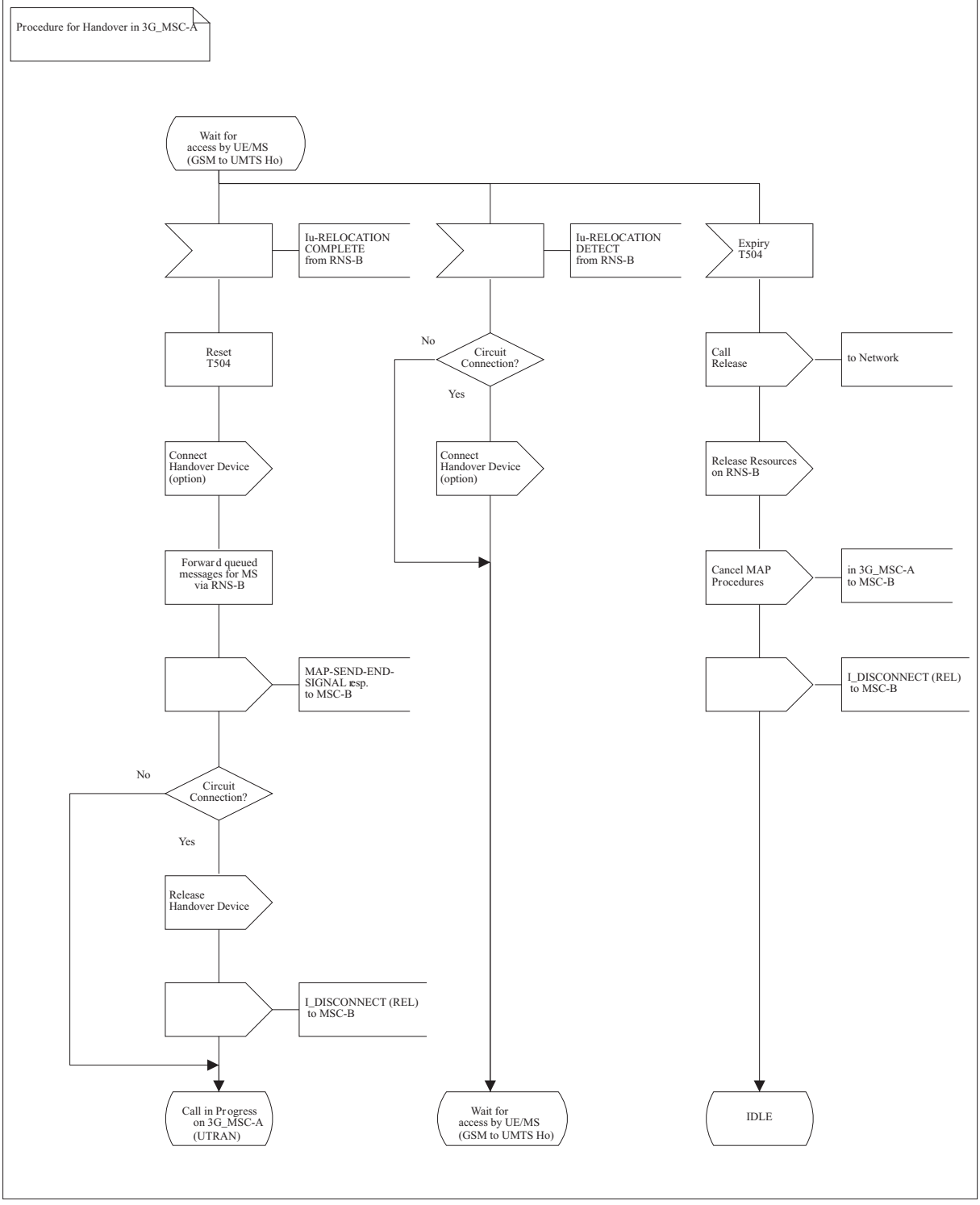


Figure 43 (Sheet 20 of 78): Handover control procedure in 3G_MSC-A

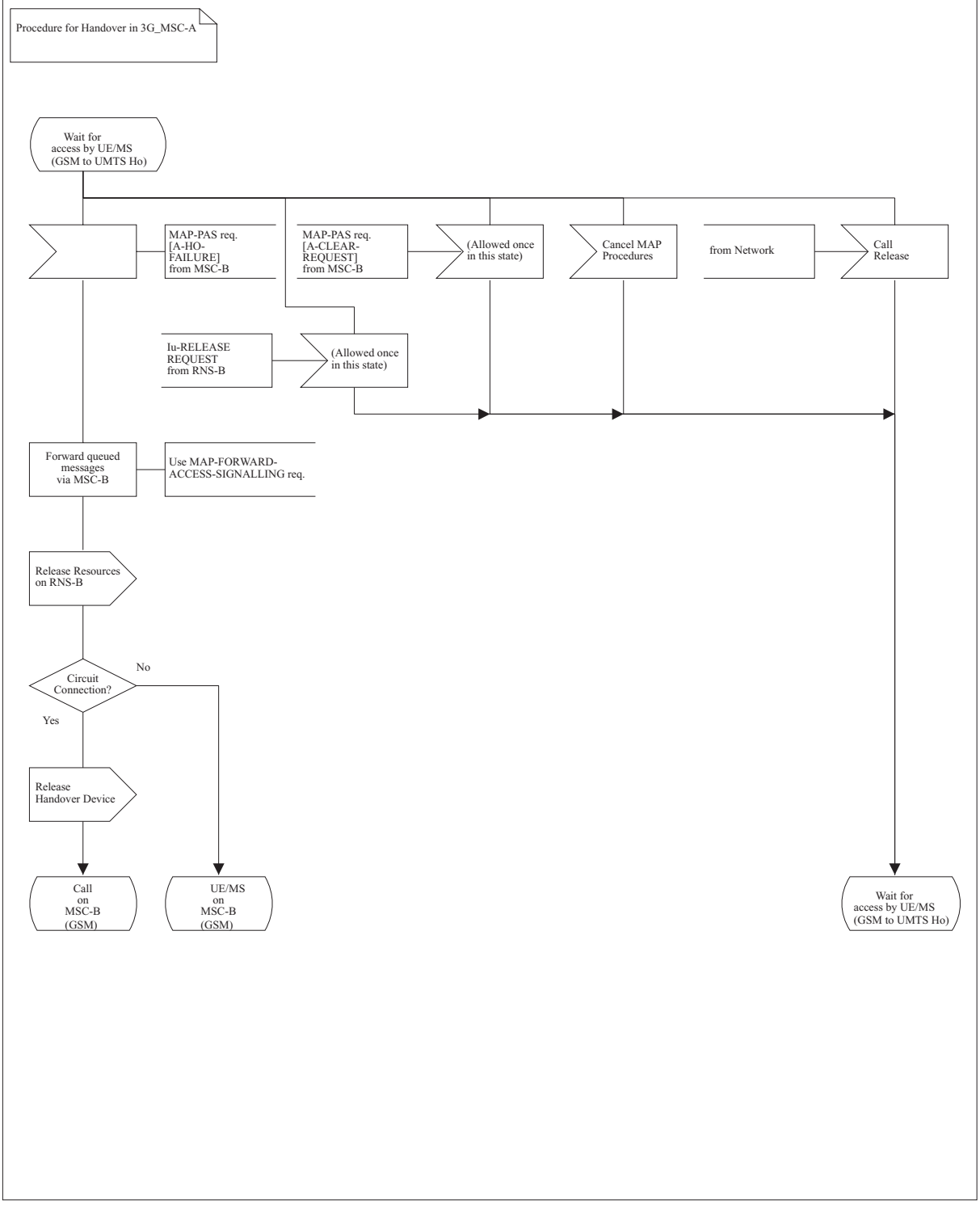


Figure 43 (Sheet 21 of 78): Handover control procedure in 3G_MSC-A

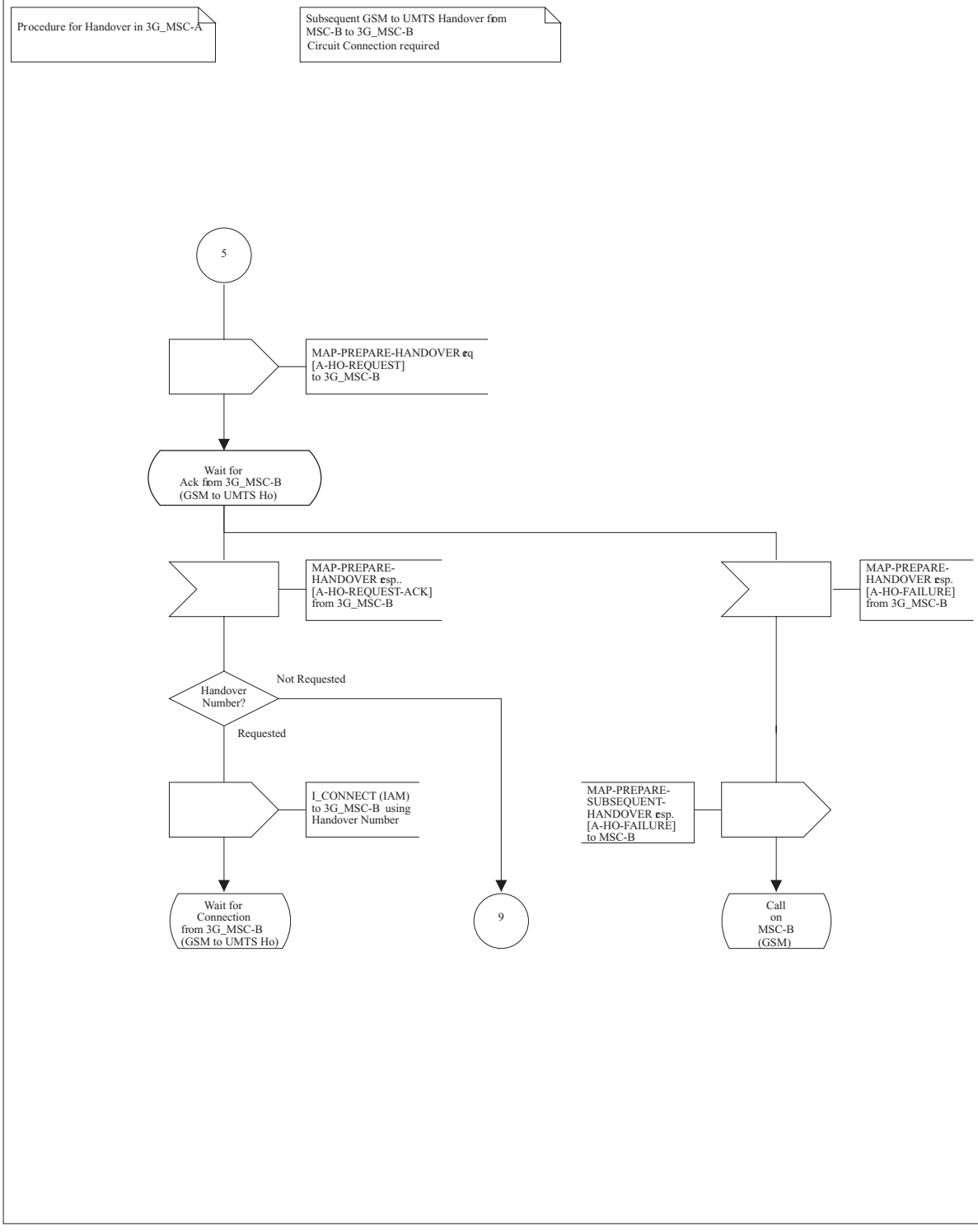


Figure 43 (Sheet 22 of 78): Handover control procedure in 3G_MSC-A

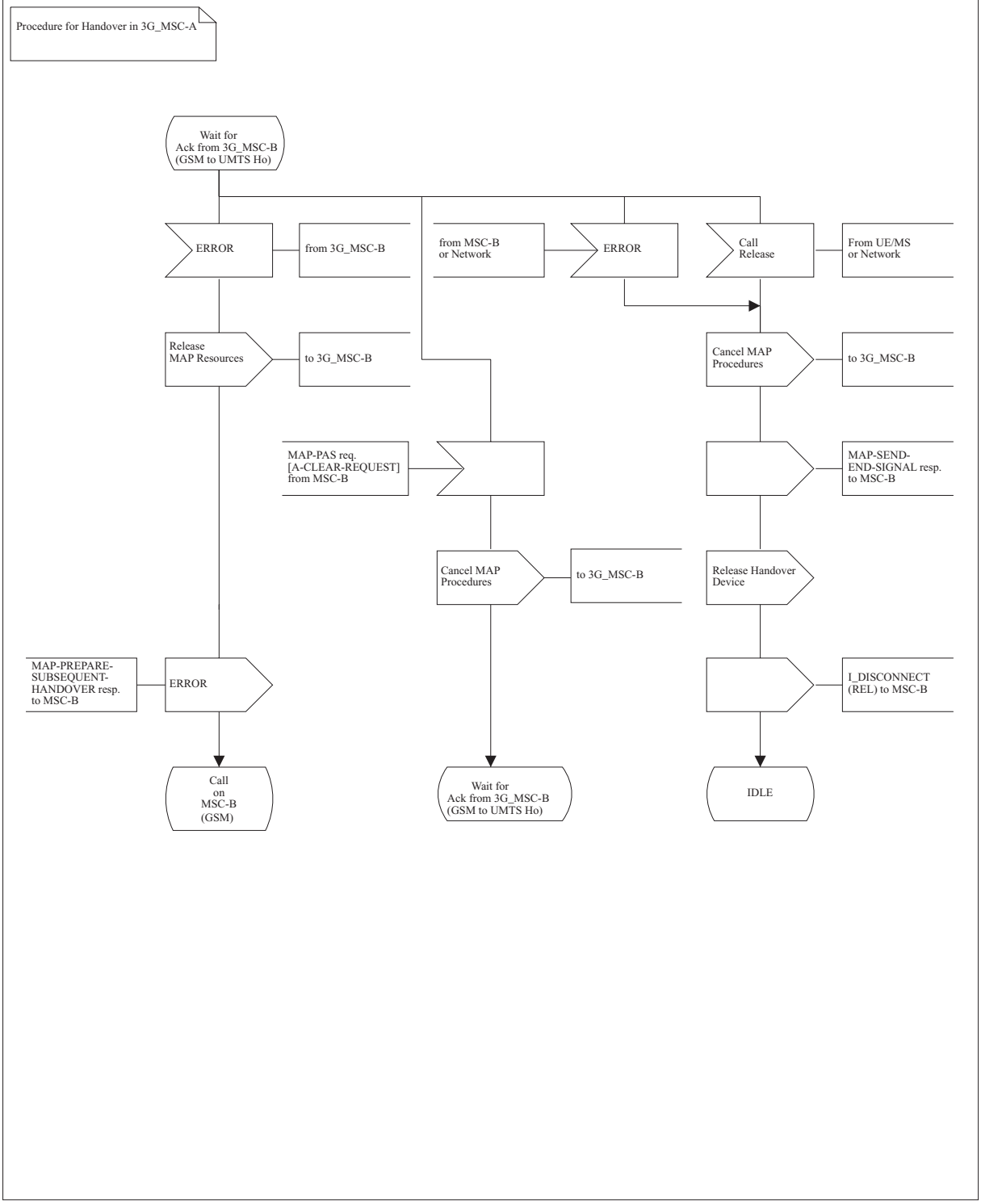


Figure 43 (Sheet 23 of 78): Handover control procedure in 3G_MSC-A

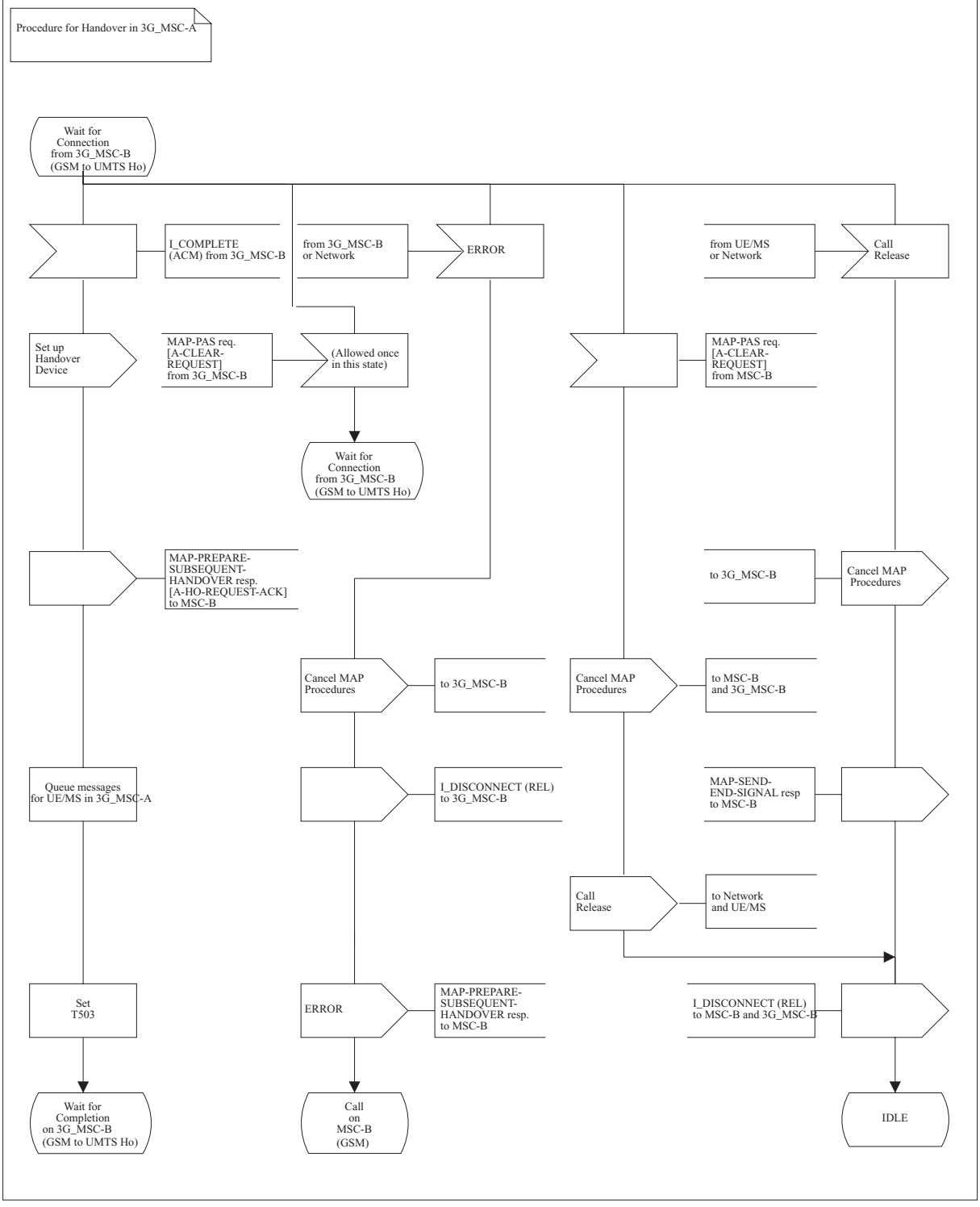


Figure 43 (Sheet 24 of 78): Handover control procedure in 3G_MSC-A

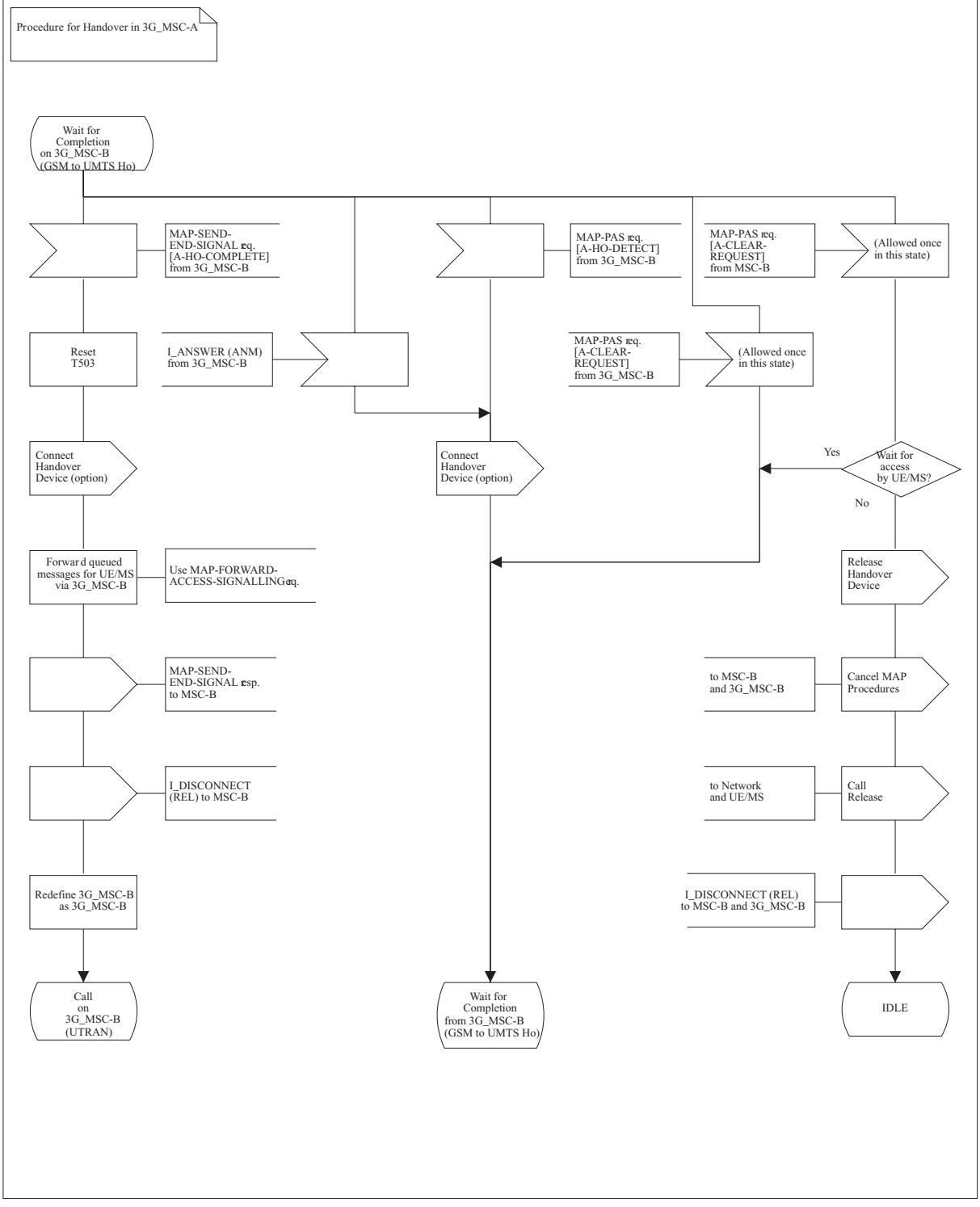


Figure 43 (Sheet 25 of 78): Handover control procedure in 3G_MSC-A

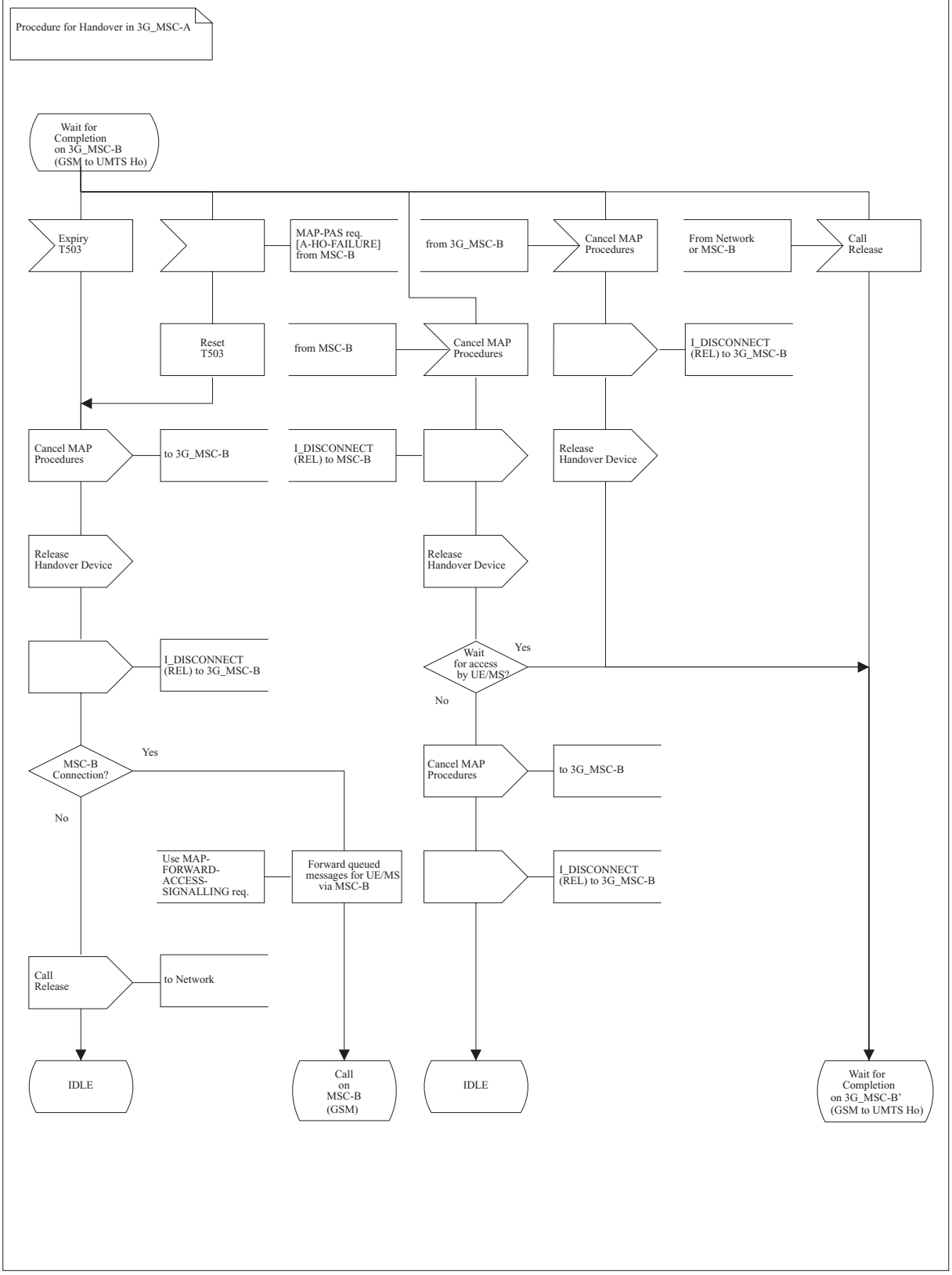


Figure 43 (Sheet 26 of 78): Handover control procedure in 3G_MSC-A

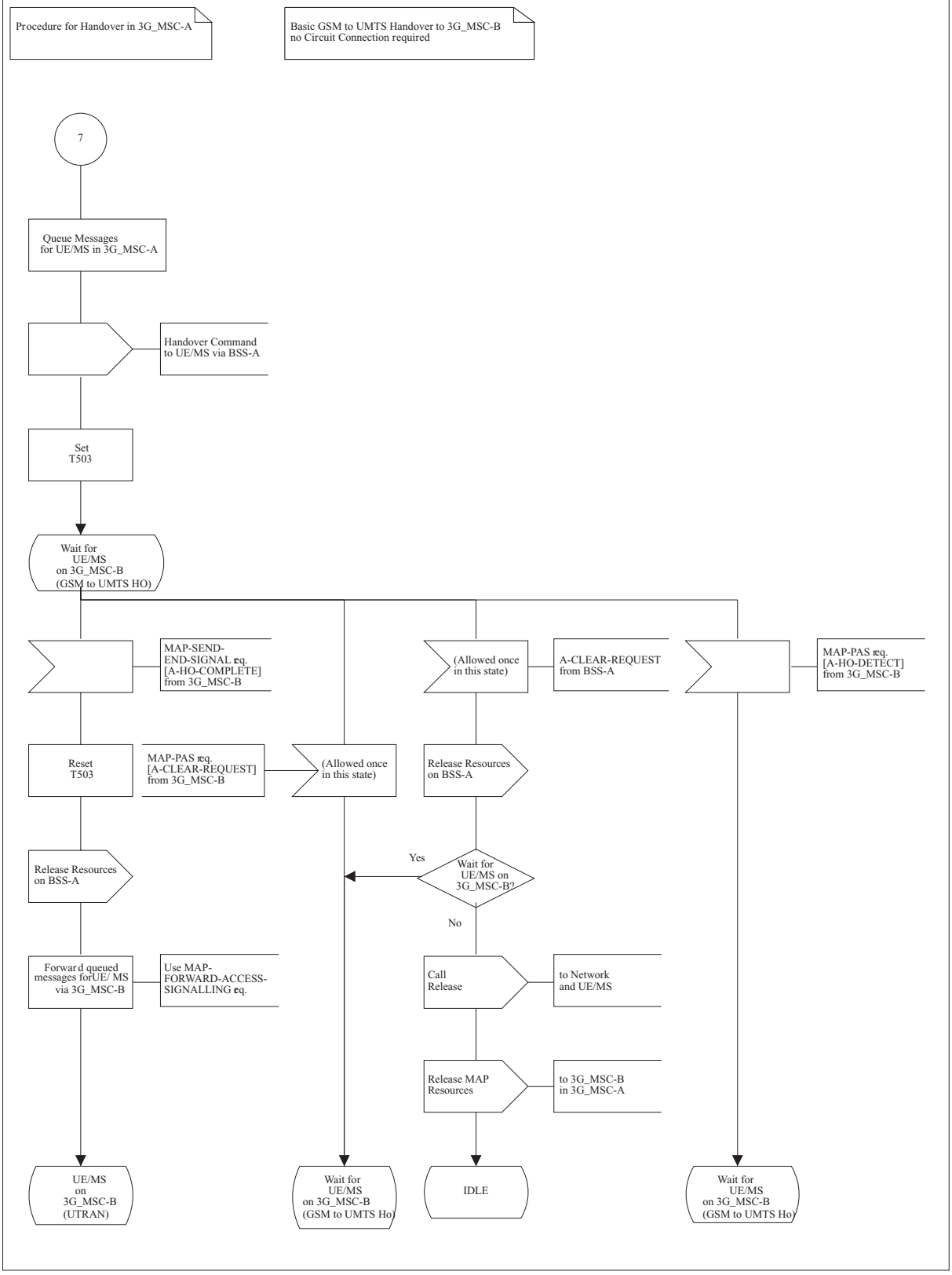


Figure 43 (Sheet 27 of 78): Handover control procedure in 3G_MSC-A

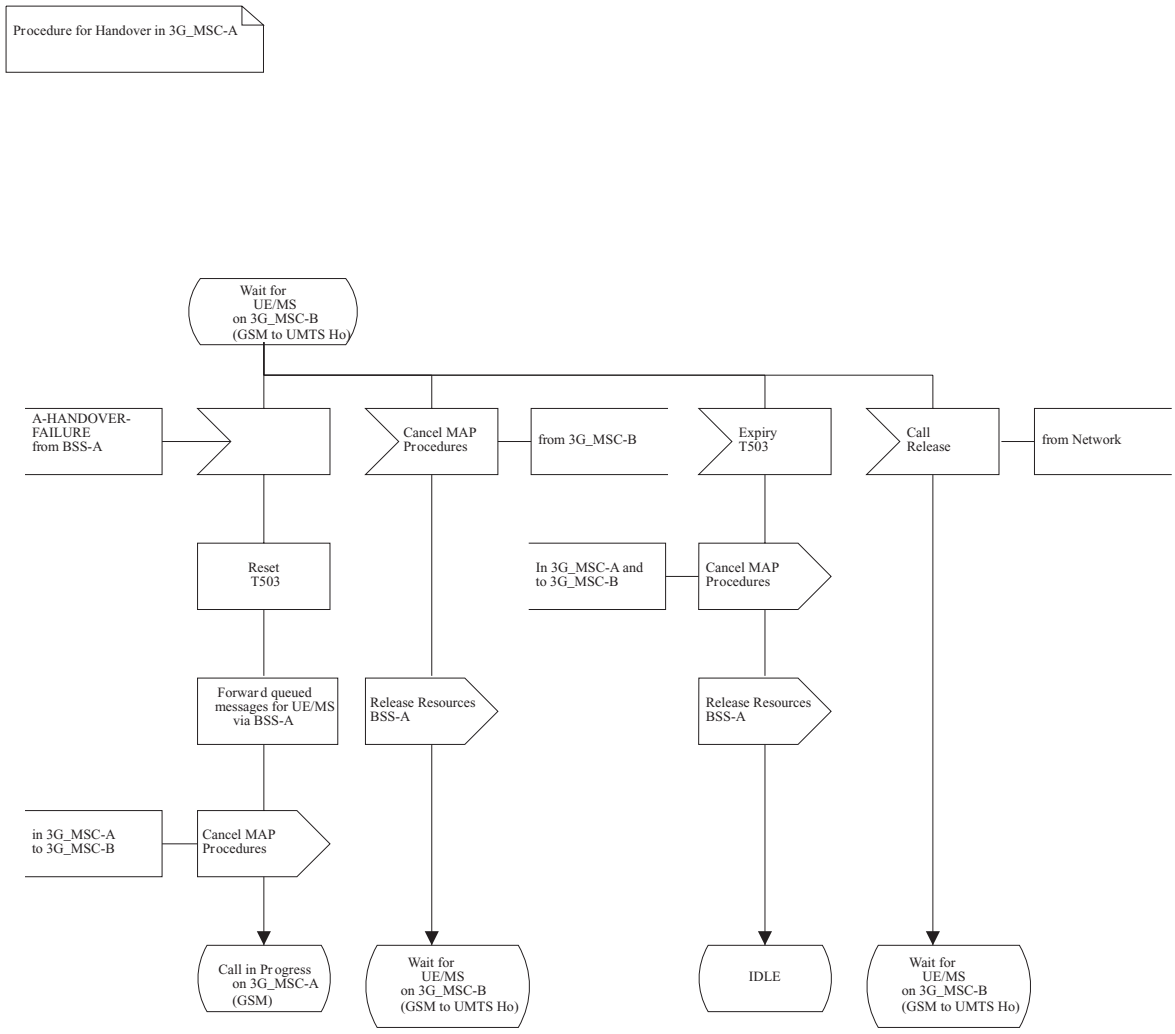


Figure 43 (Sheet 28 of 78): Handover control procedure in 3G_MSC-A

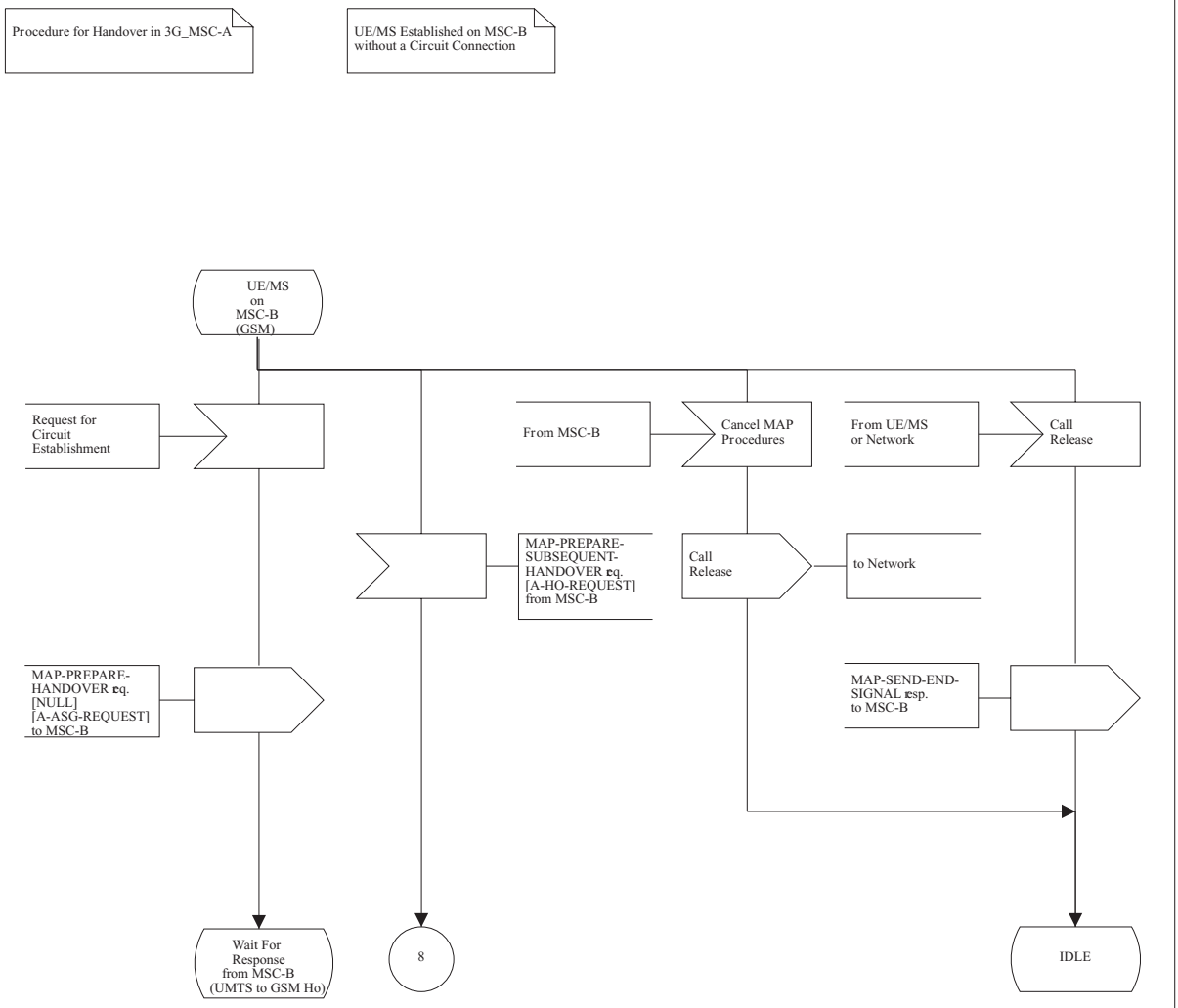


Figure 43 (Sheet 29 of 78): Handover control procedure in 3G_MSC-A

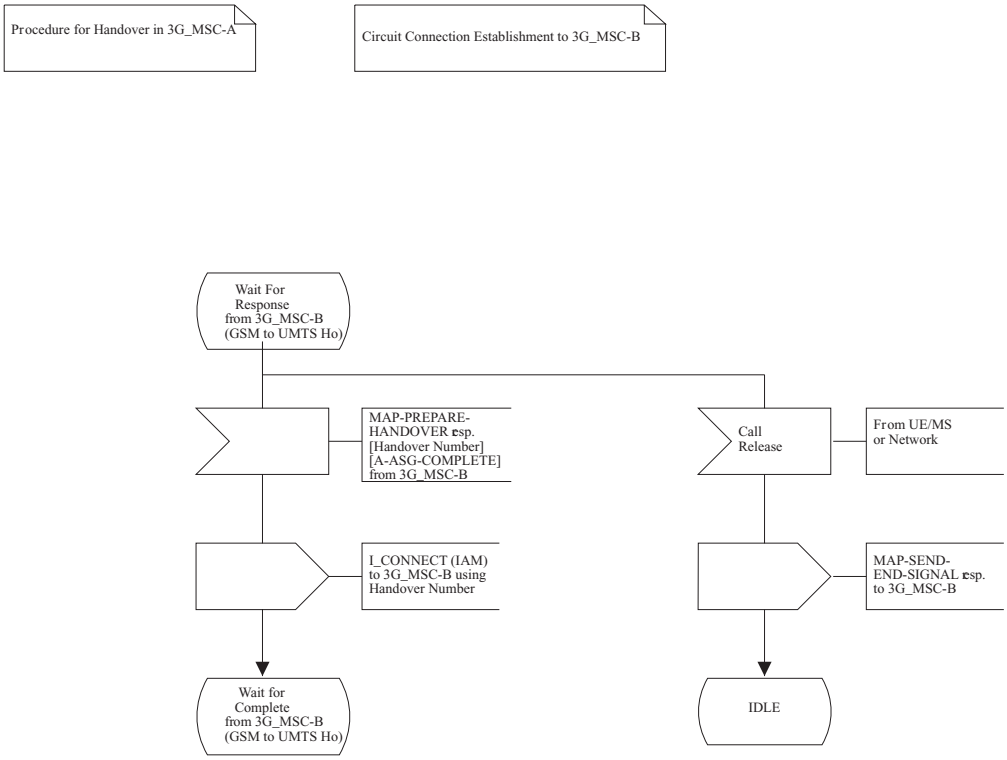


Figure 43 (Sheet 30 of 78): Handover control procedure in 3G_MSC-A

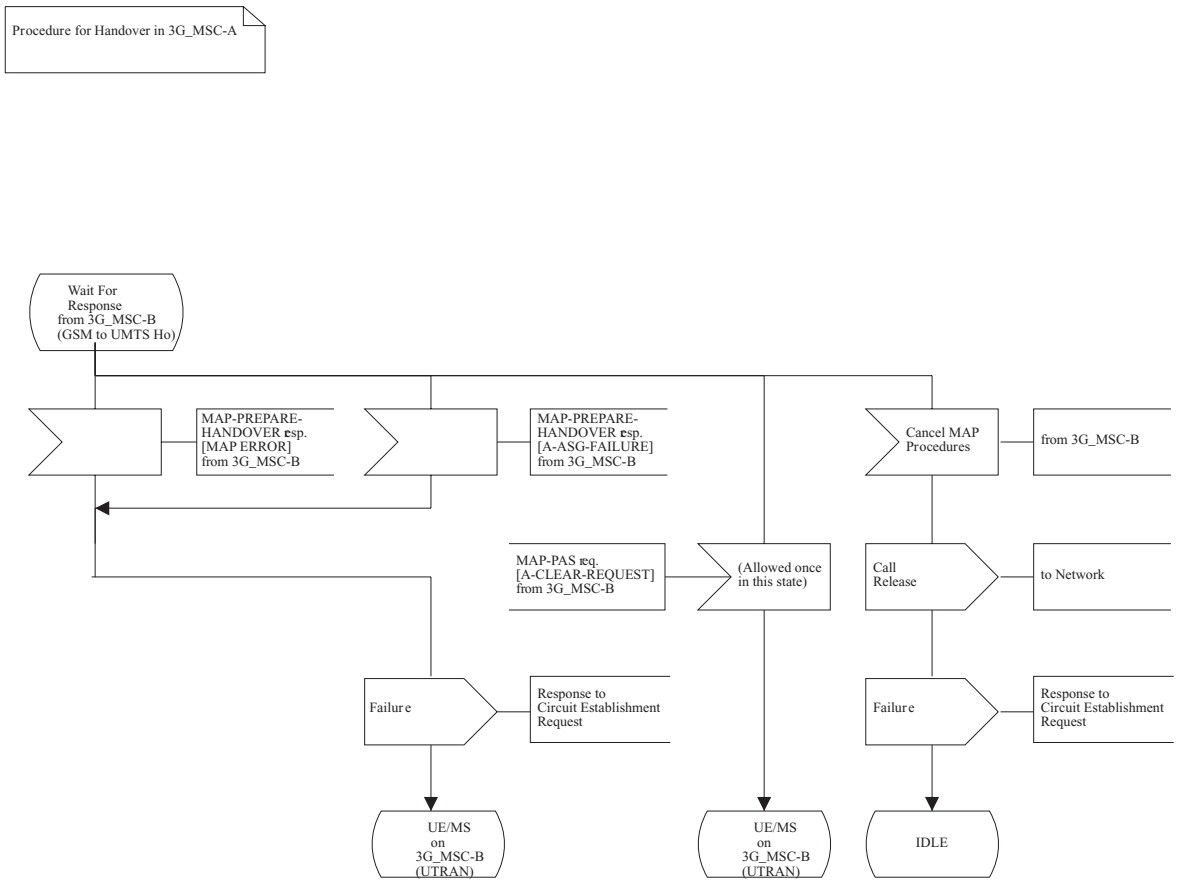


Figure 43 (Sheet 31 of 78): Handover control procedure in 3G_MSC-A

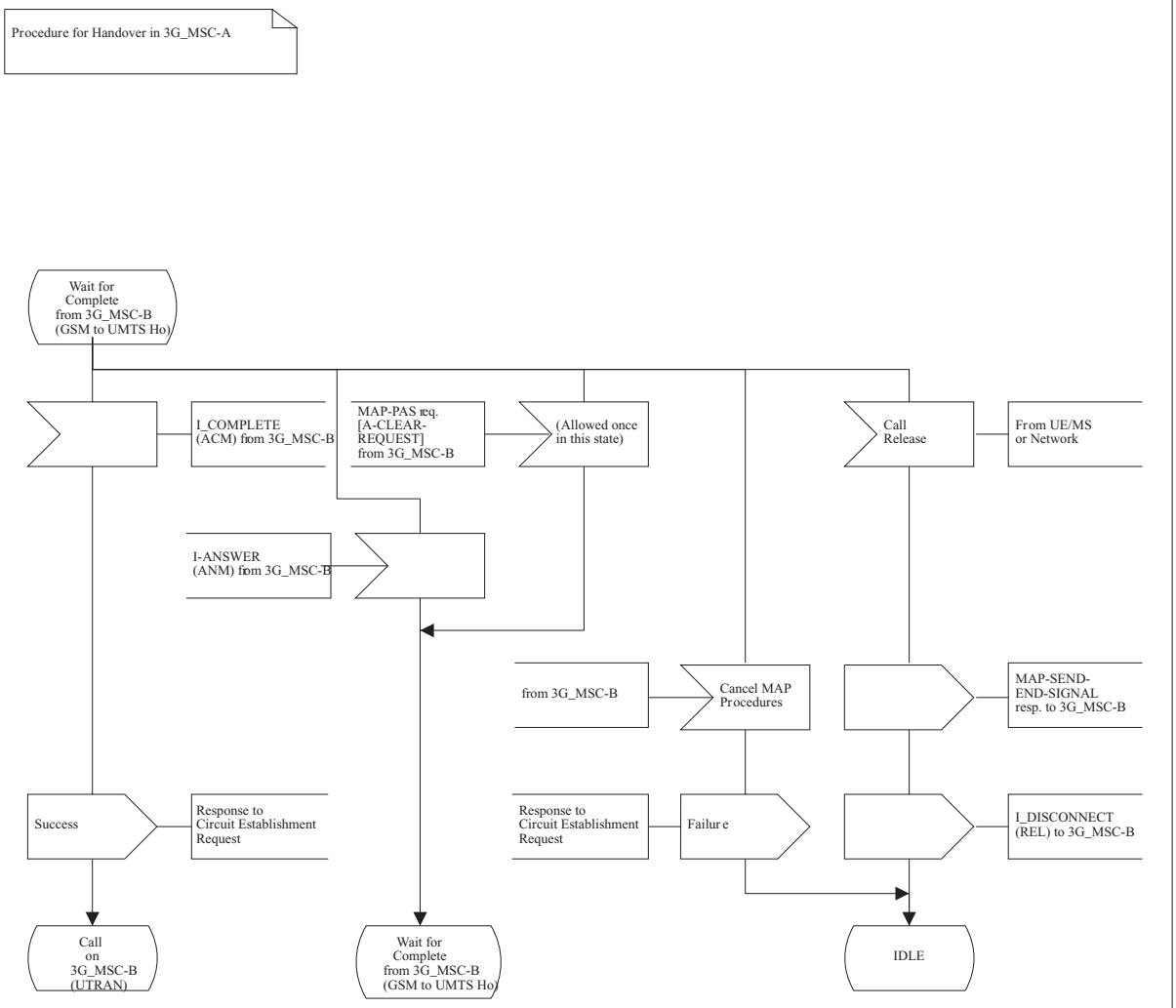


Figure 43 (Sheet 32 of 78): Handover control procedure in 3G_MSC-A

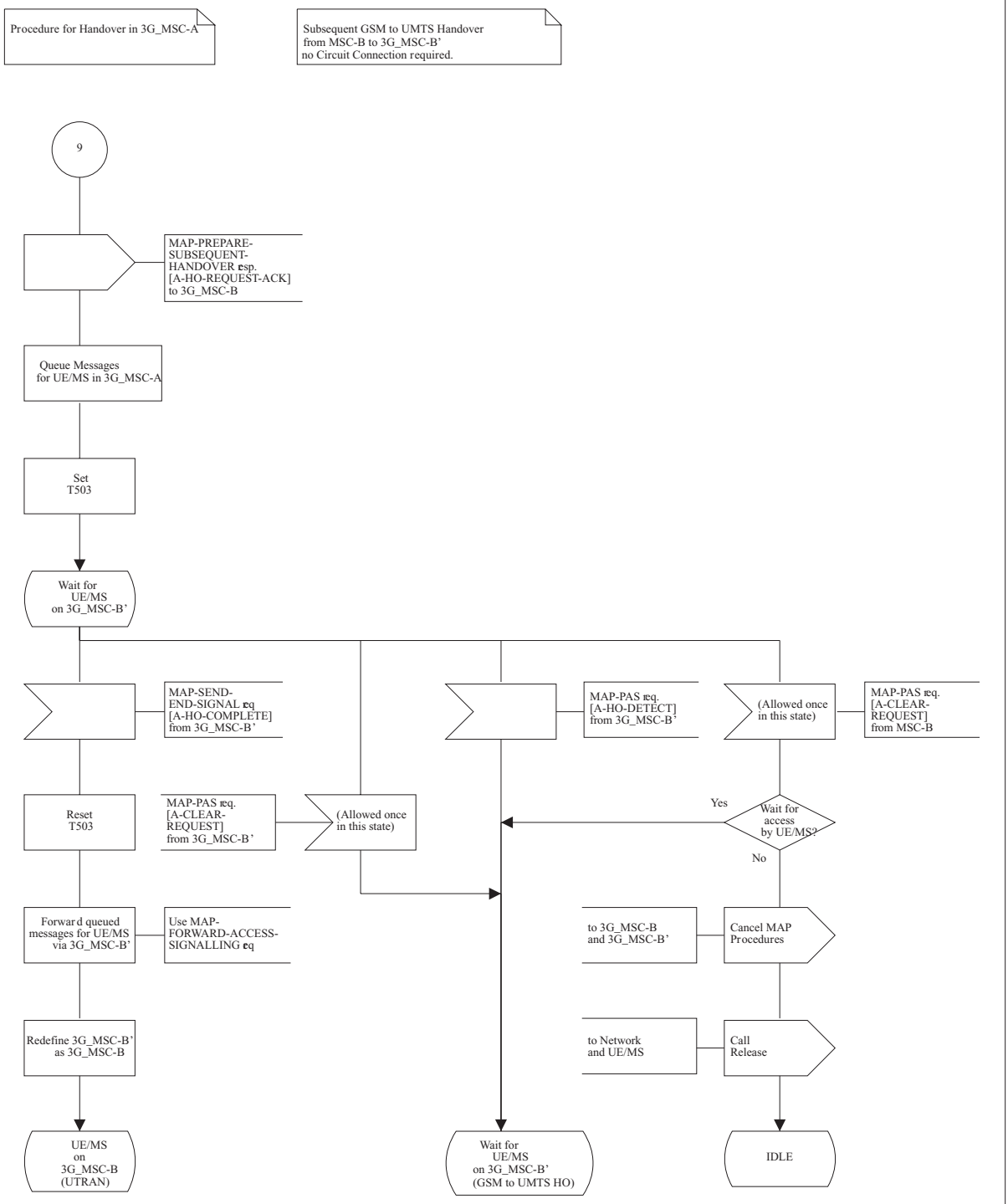


Figure 43 (Sheet 33 of 78): Handover control procedure in 3G_MSC-A

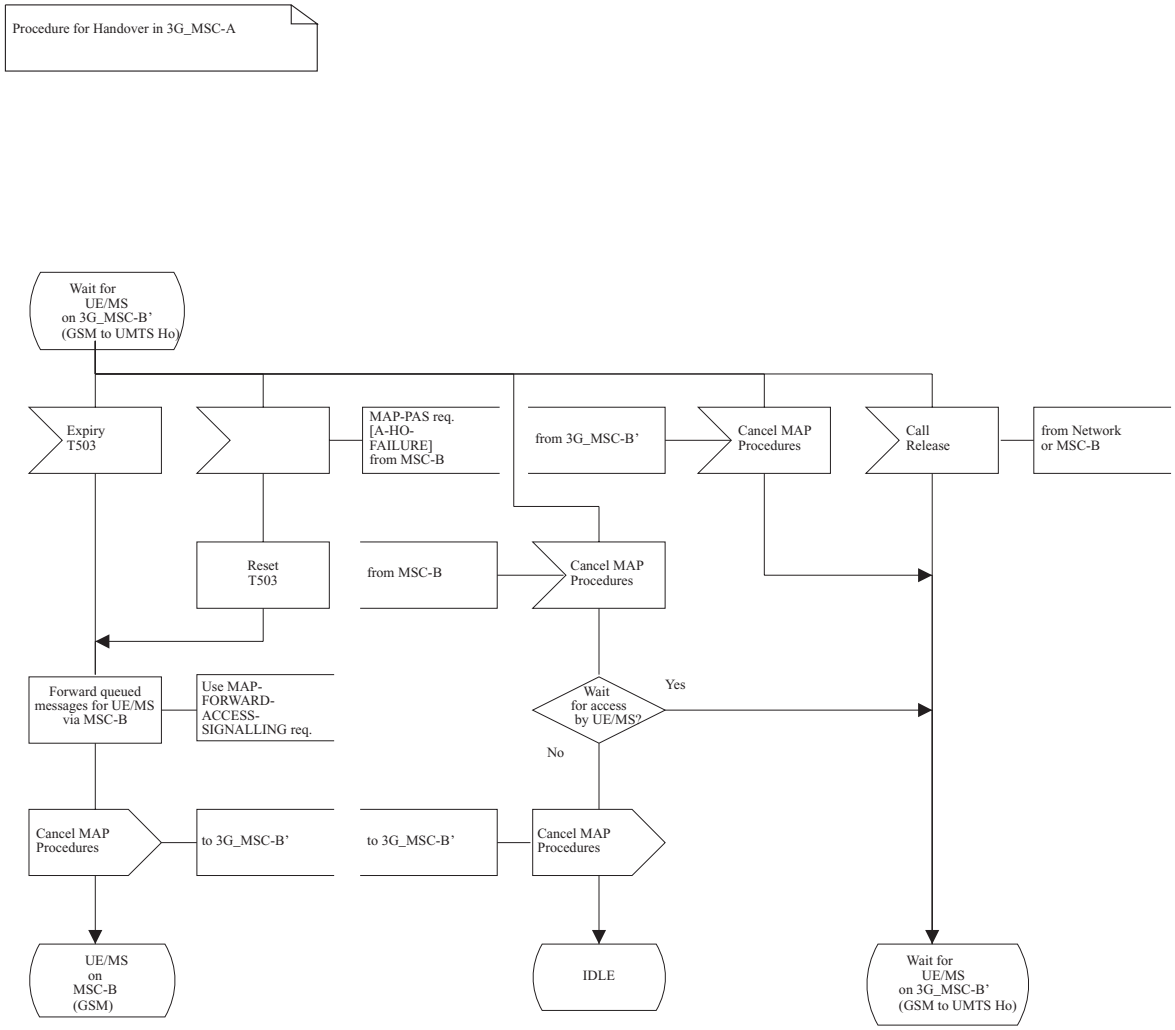


Figure 43 (Sheet 34 of 78): Handover control procedure in 3G_MSC-A

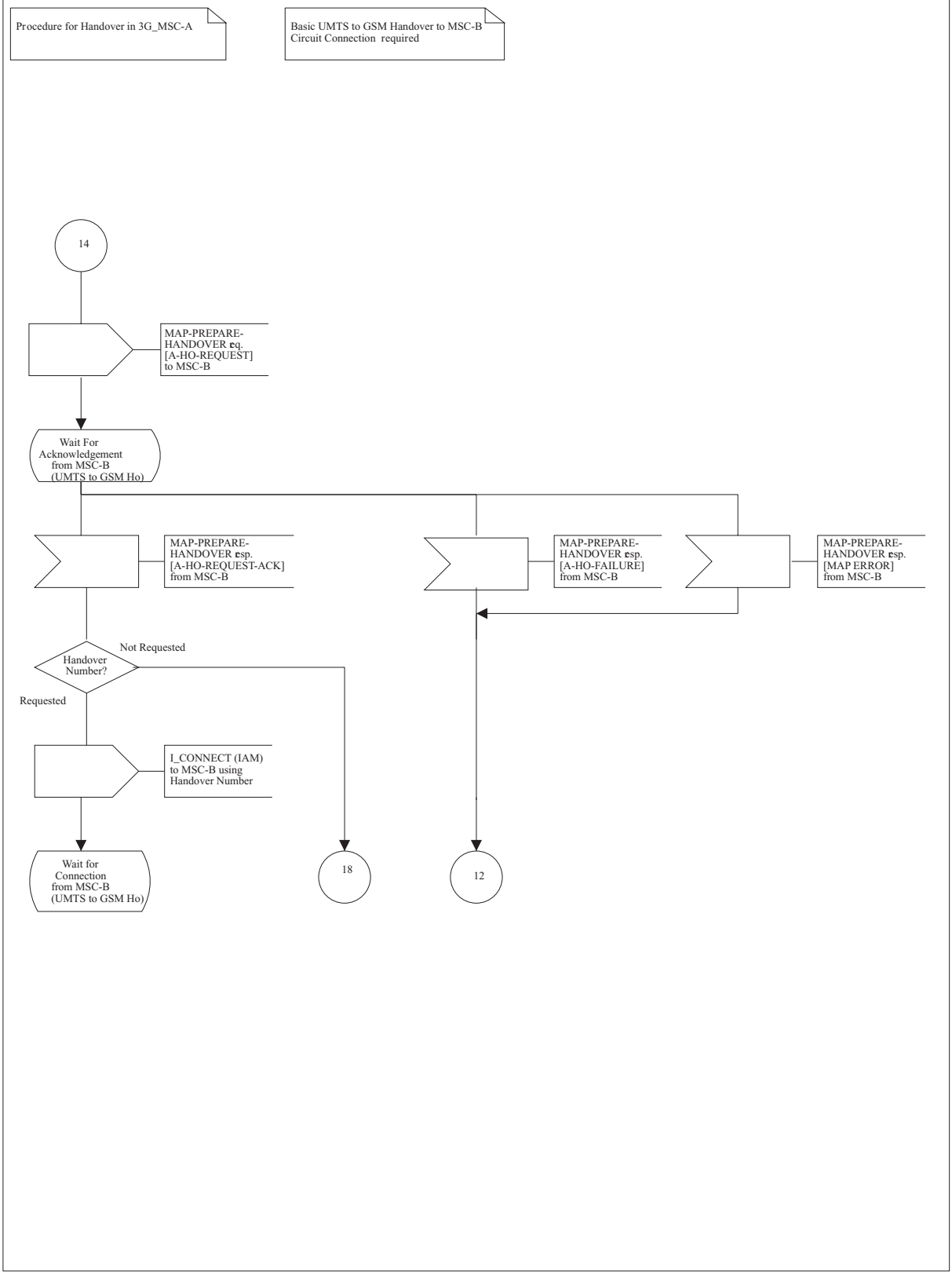


Figure 43 (Sheet 35 of 78): Handover control procedure in 3G_MSC-A

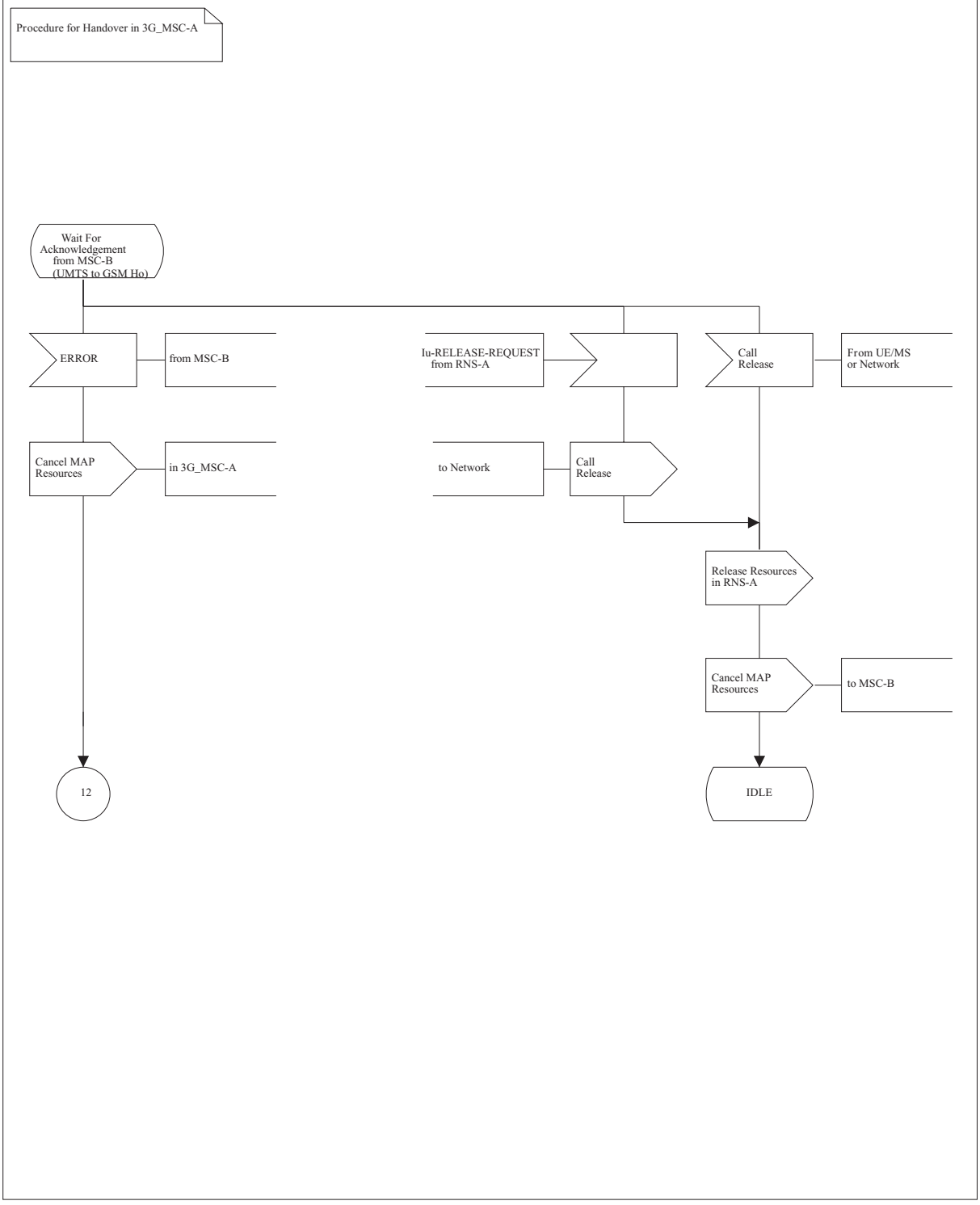


Figure 43 (Sheet 36 of 78): Handover control procedure in 3G_MSC-A

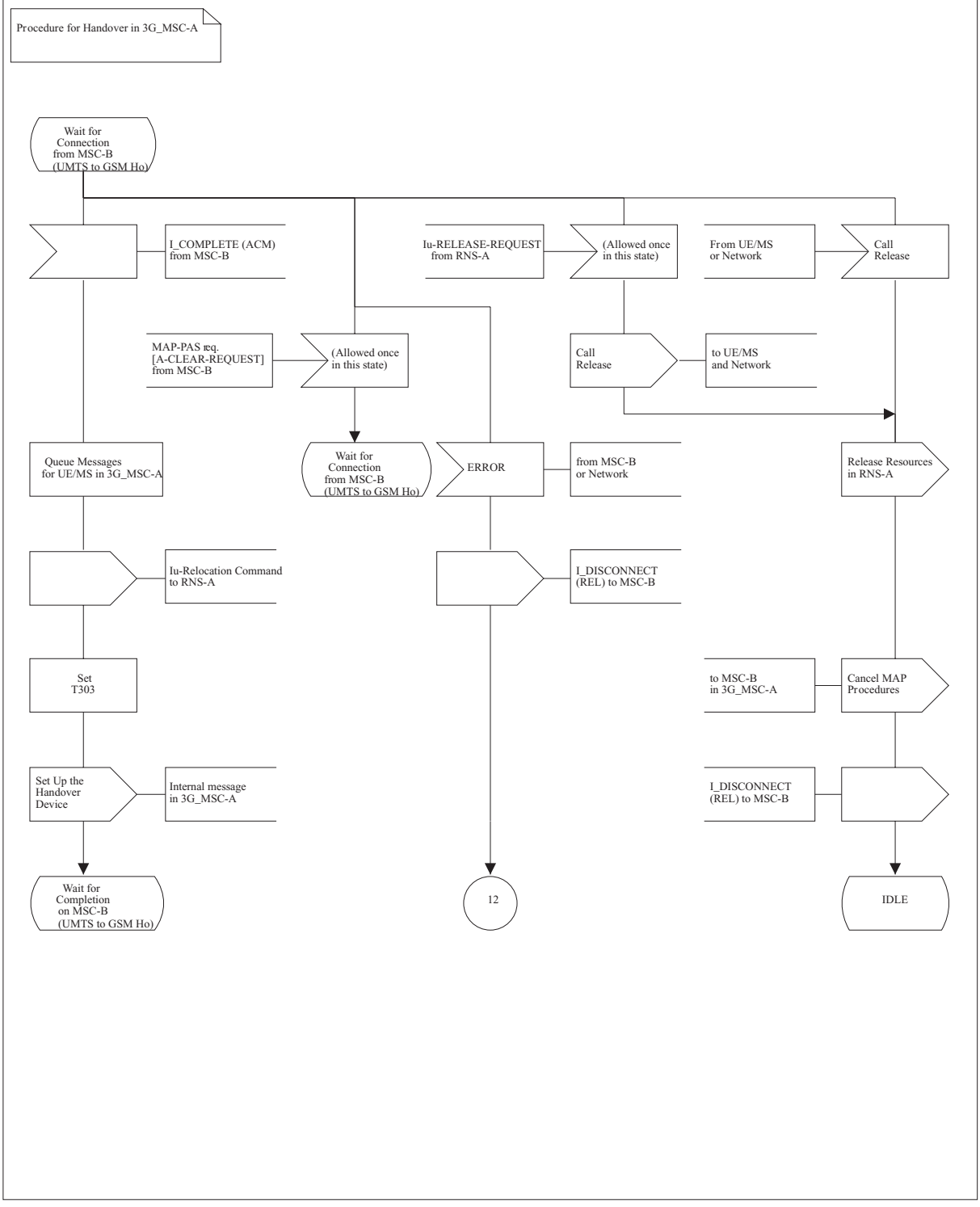


Figure 43 (Sheet 37 of 78): Handover control procedure in 3G_MSC-A

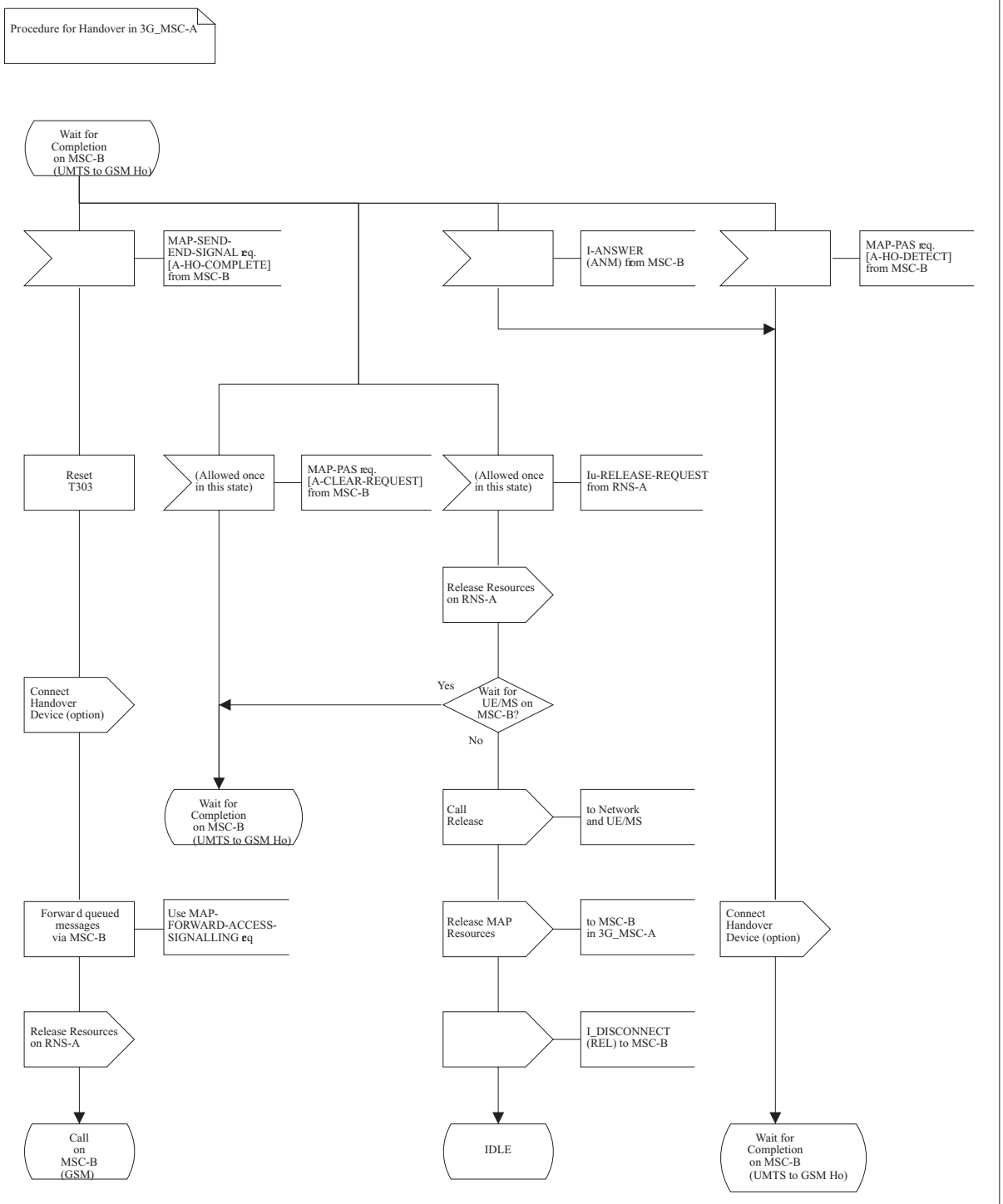


Figure 43 (Sheet 38 of 78): Handover control procedure in 3G_MSC-A

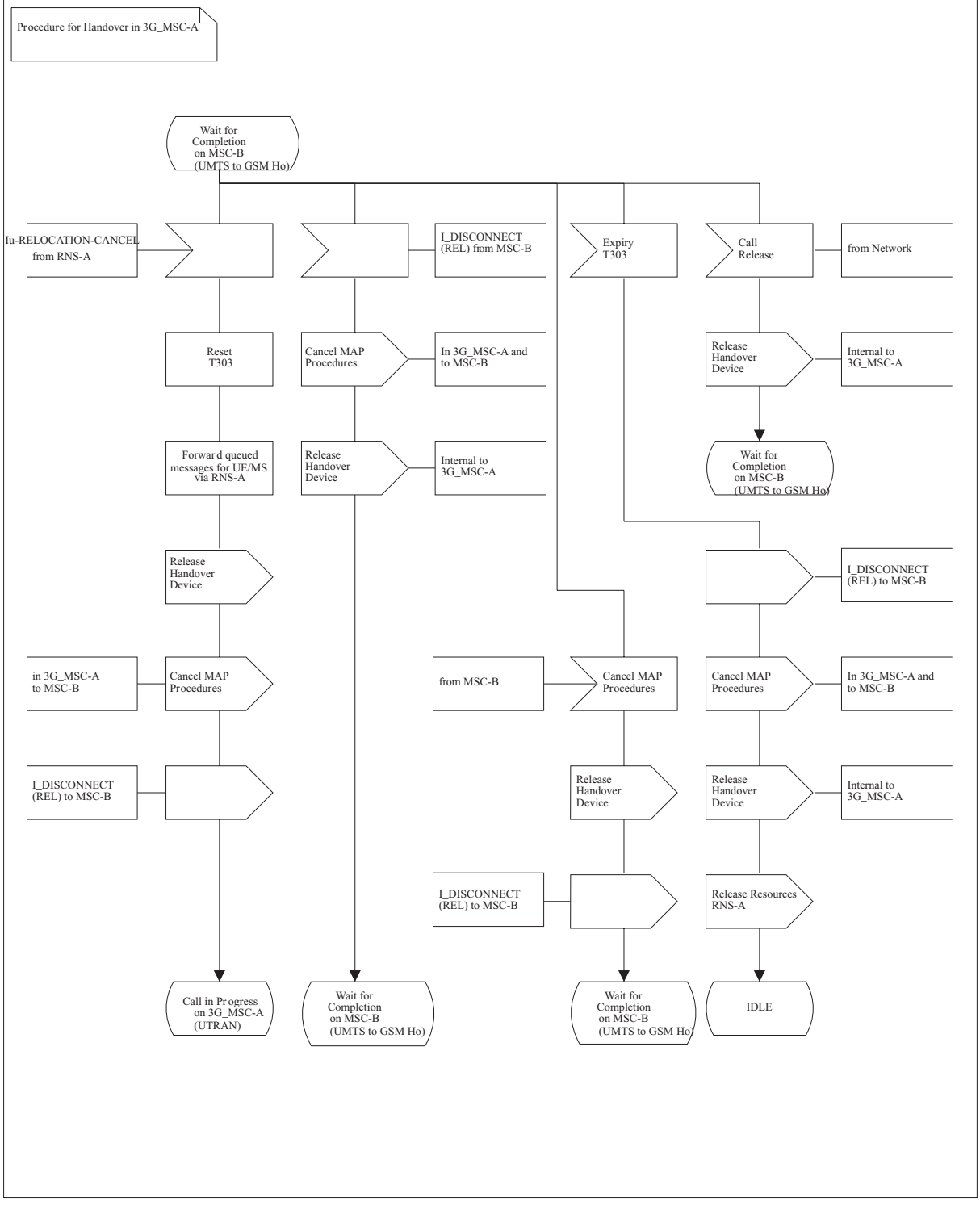


Figure 43 (Sheet 39 of 78): Handover control procedure in 3G_MSC-A

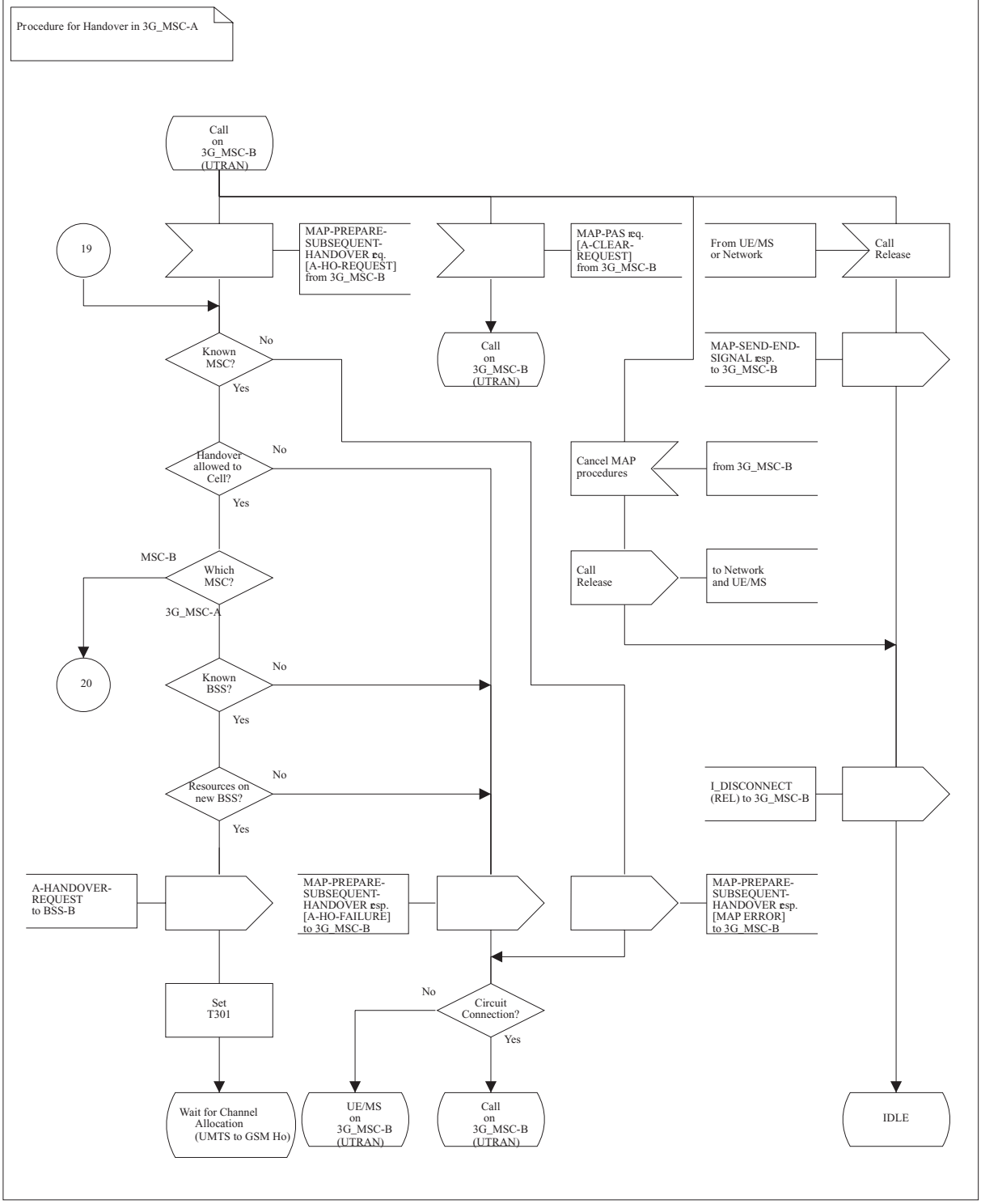


Figure 43 (Sheet 40 of 78): Handover control procedure in 3G_MSC-A

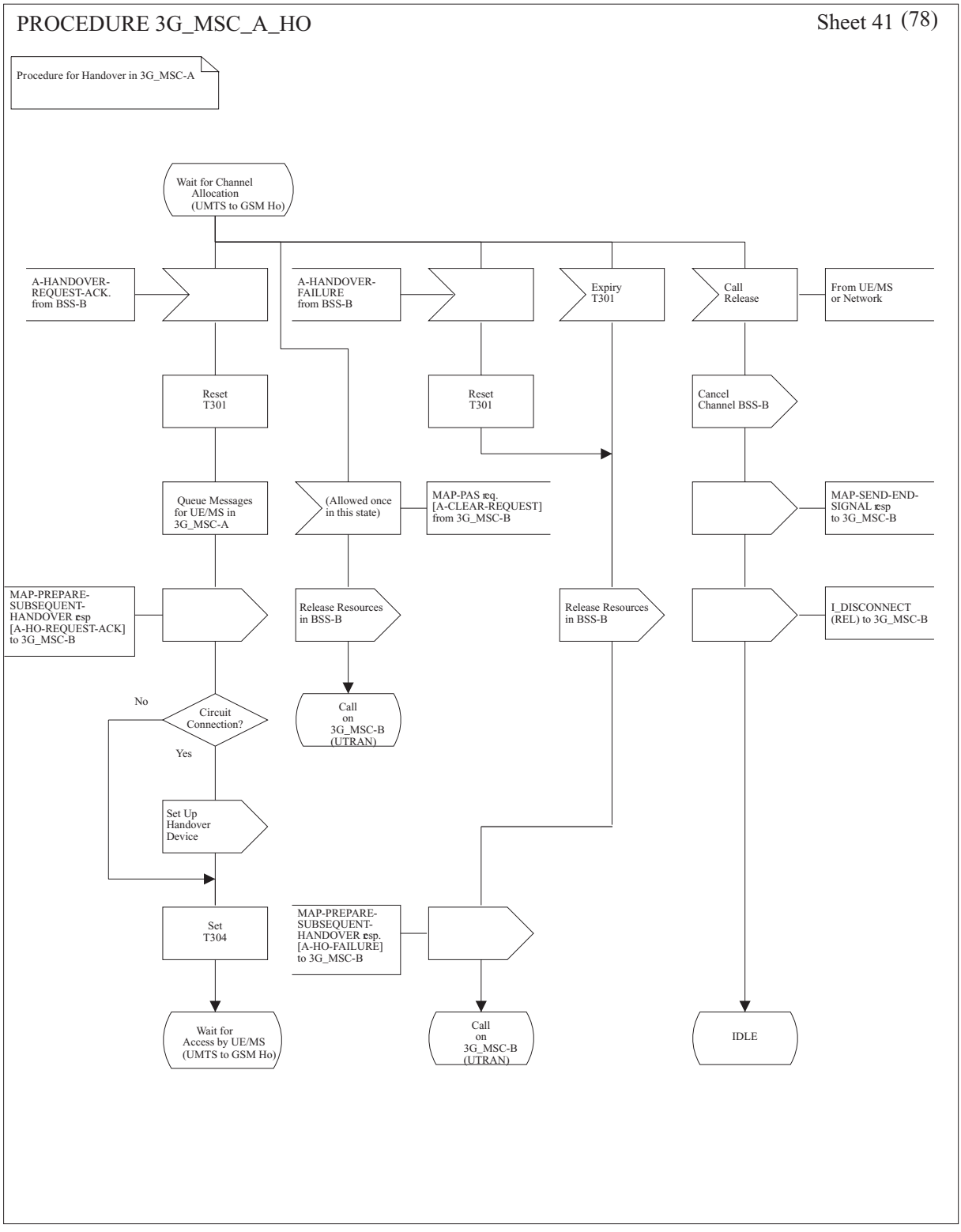


Figure 43 (Sheet 41 of 78): Handover control procedure in 3G_MSC-A

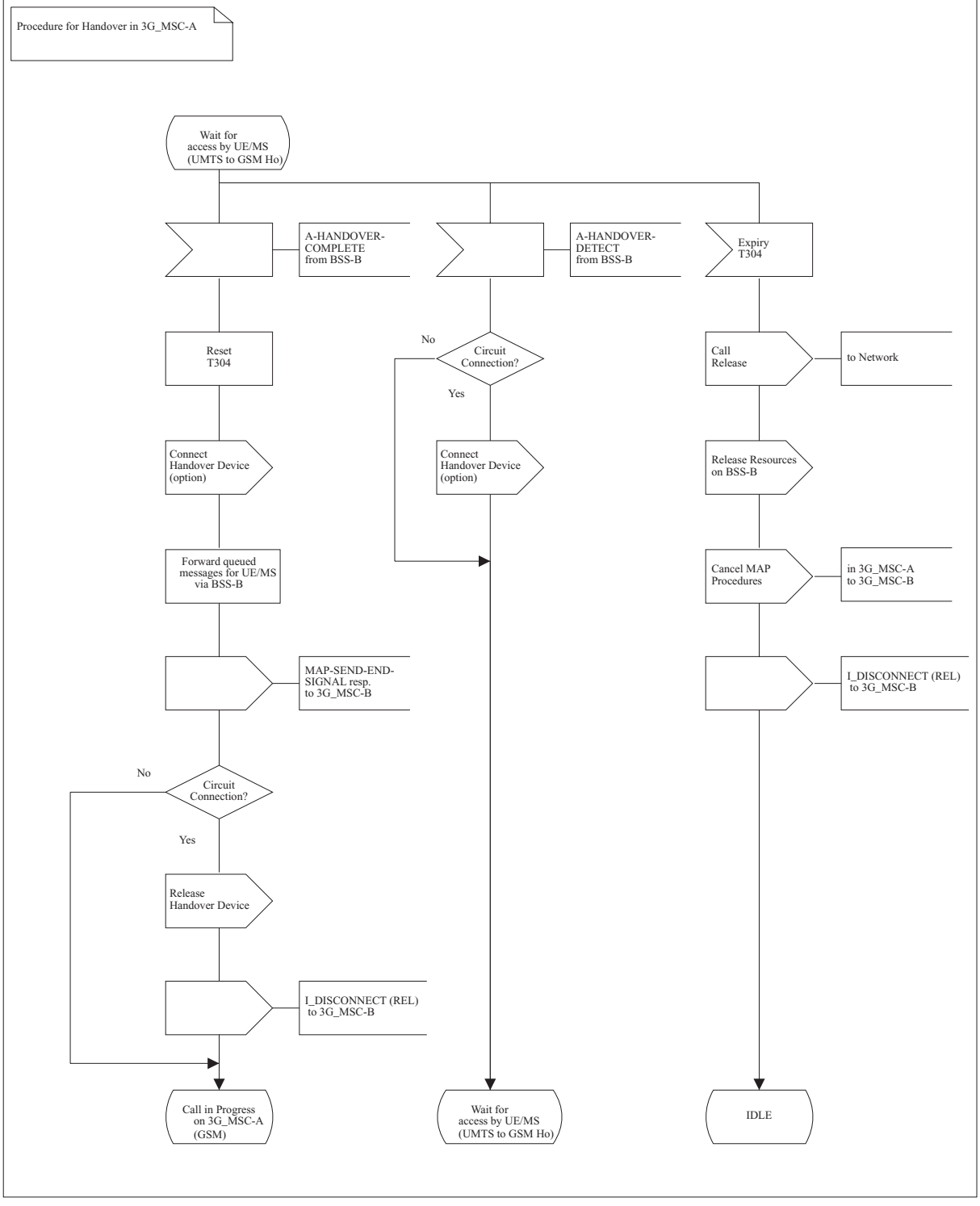


Figure 43 (Sheet 42 of 78): Handover control procedure in 3G_MSC-A

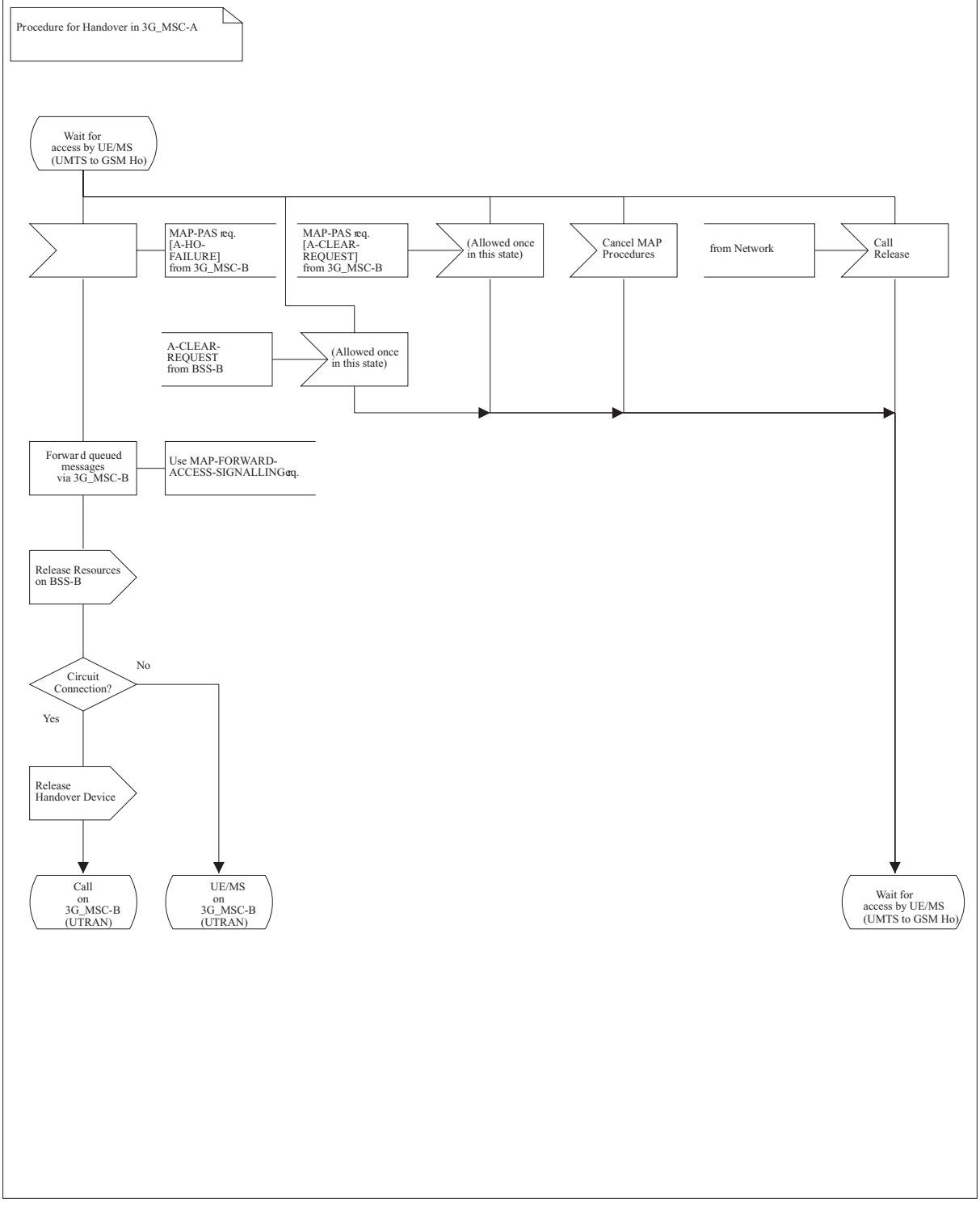


Figure 43 (Sheet 43 of 78): Handover control procedure in 3G_MSC-A

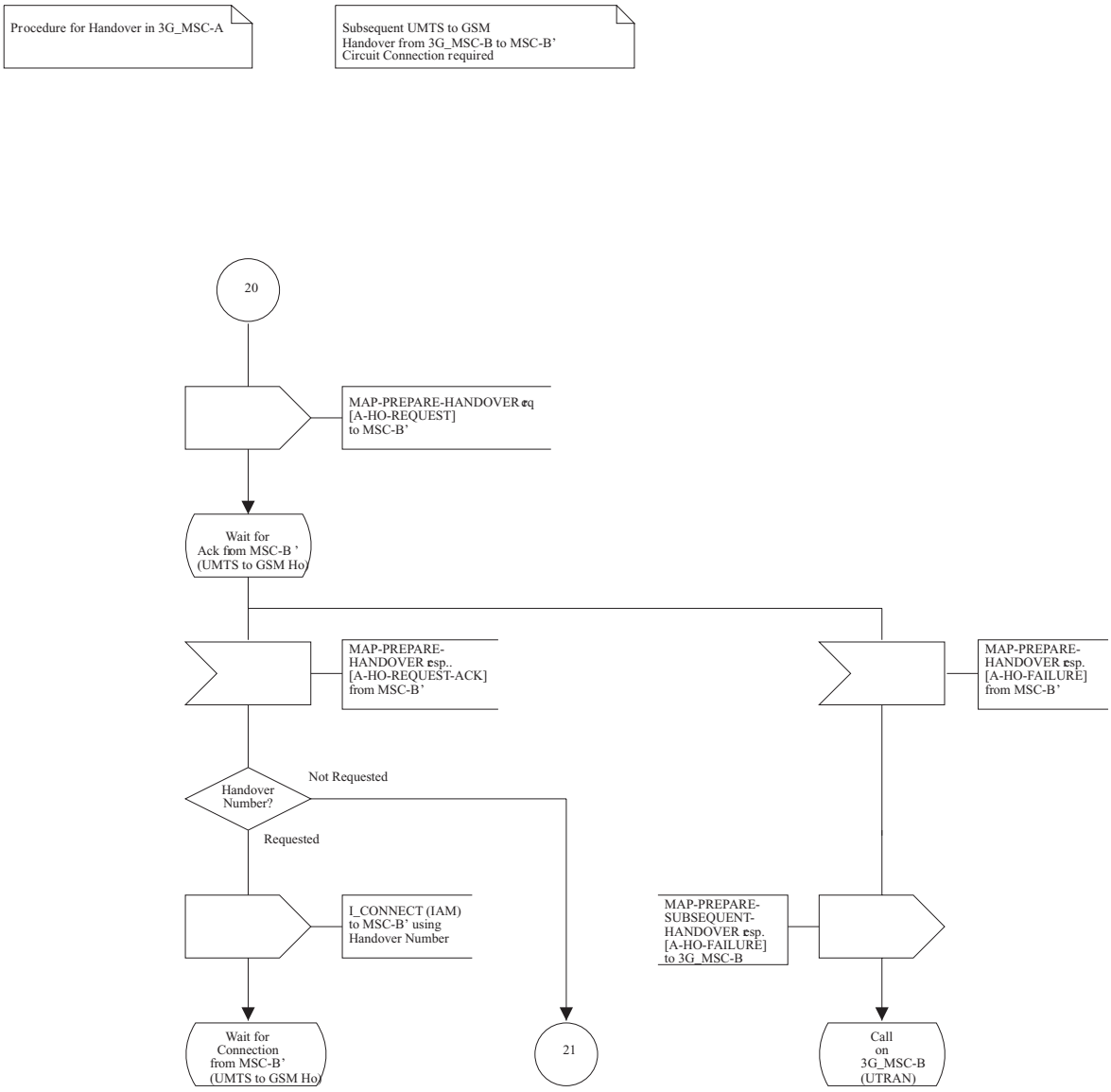


Figure 43 (Sheet 44 of 78): Handover control procedure in 3G_MSC-A

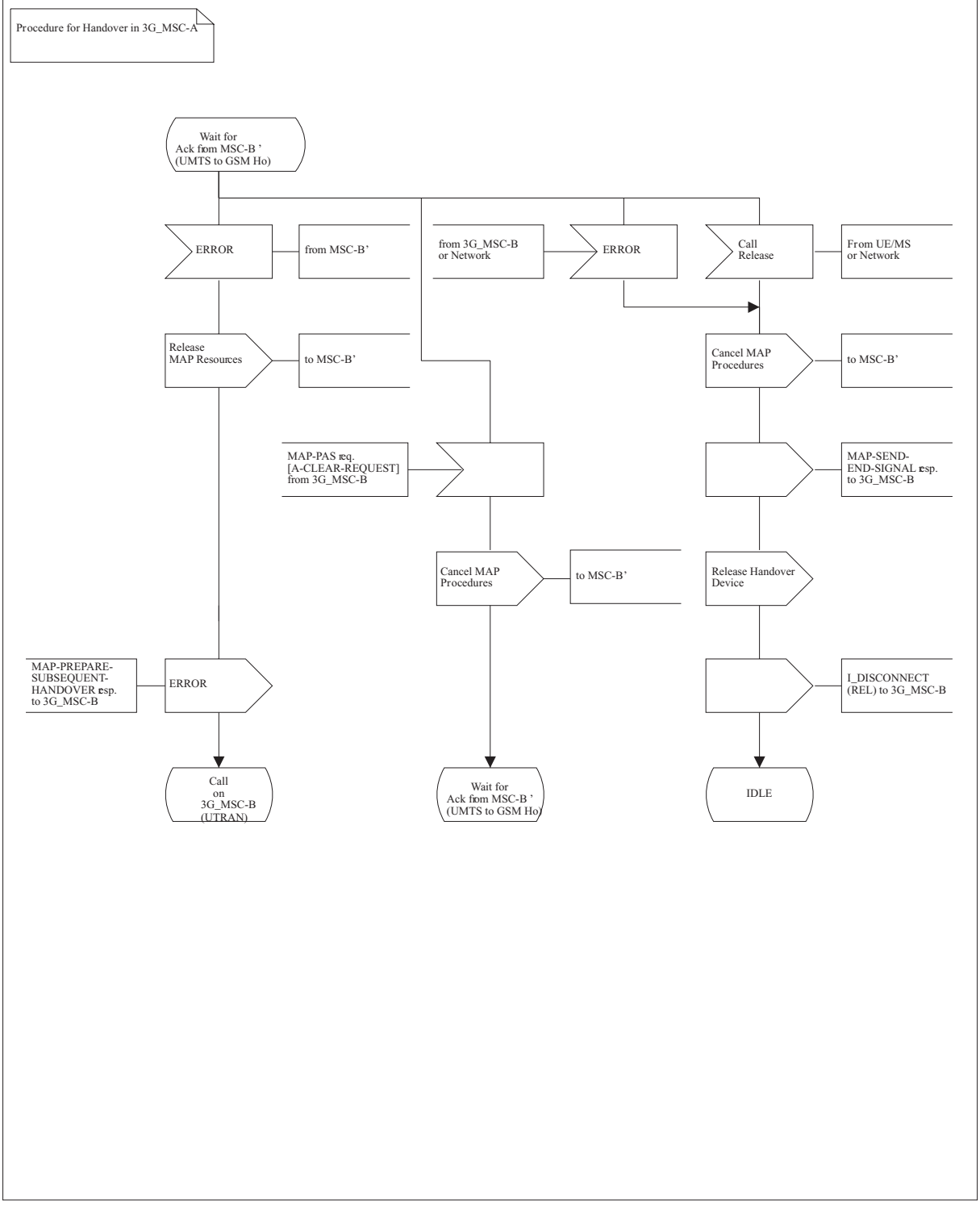


Figure 43 (Sheet 45 of 78): Handover control procedure in 3G_MSC-A

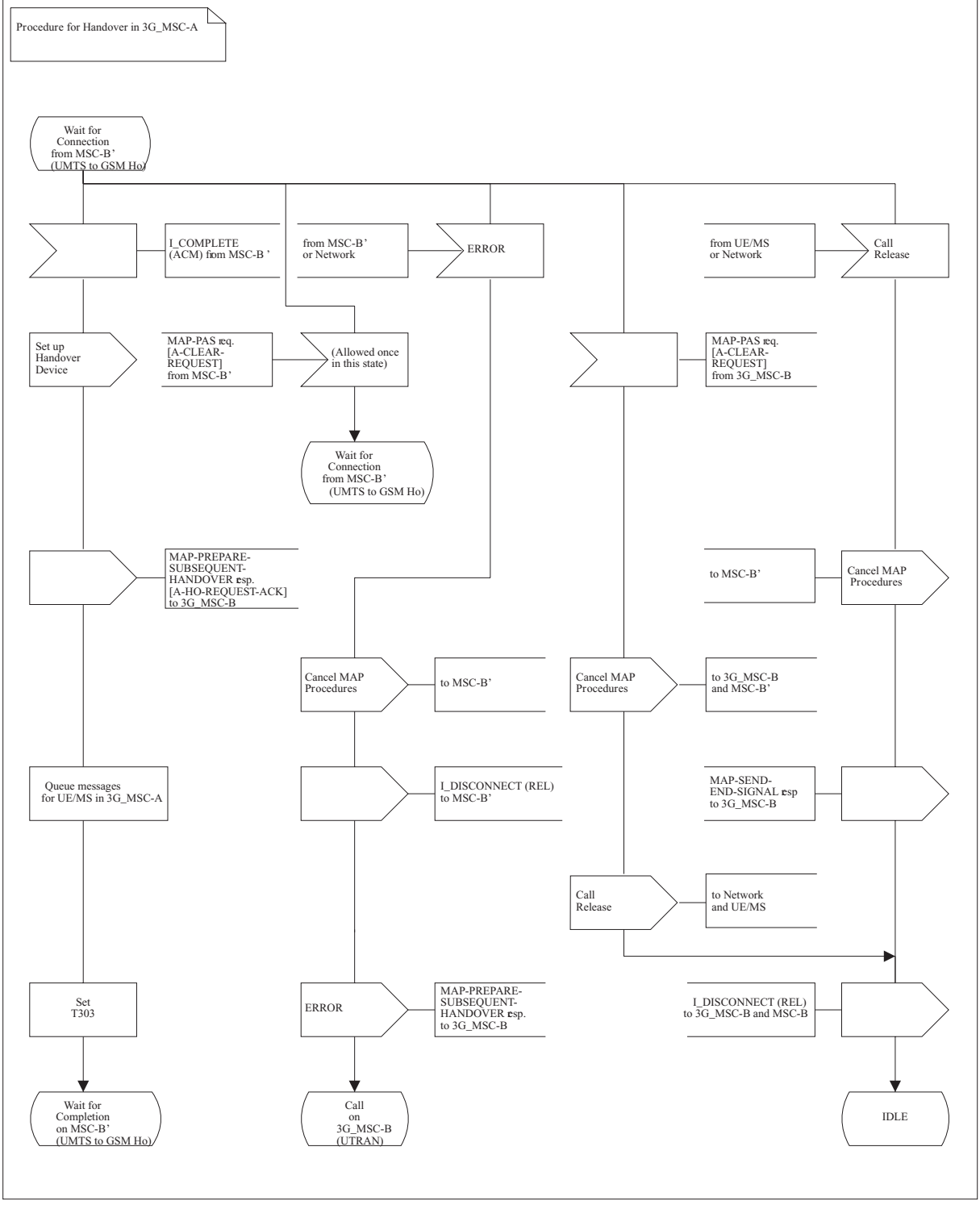


Figure 43 (Sheet 46 of 78): Handover control procedure in 3G_MSC-A

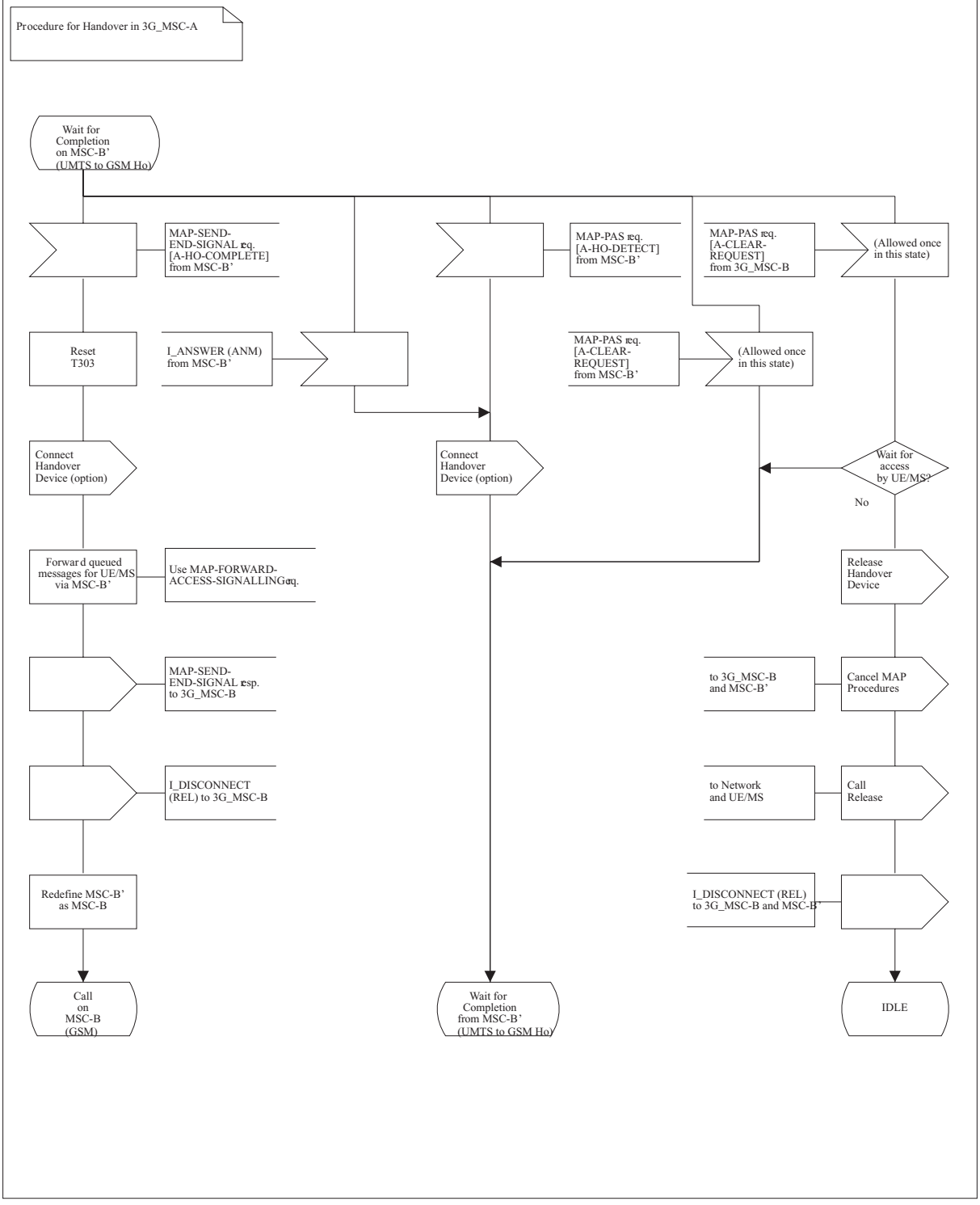


Figure 43 (Sheet 47 of 78): Handover control procedure in 3G_MSC-A

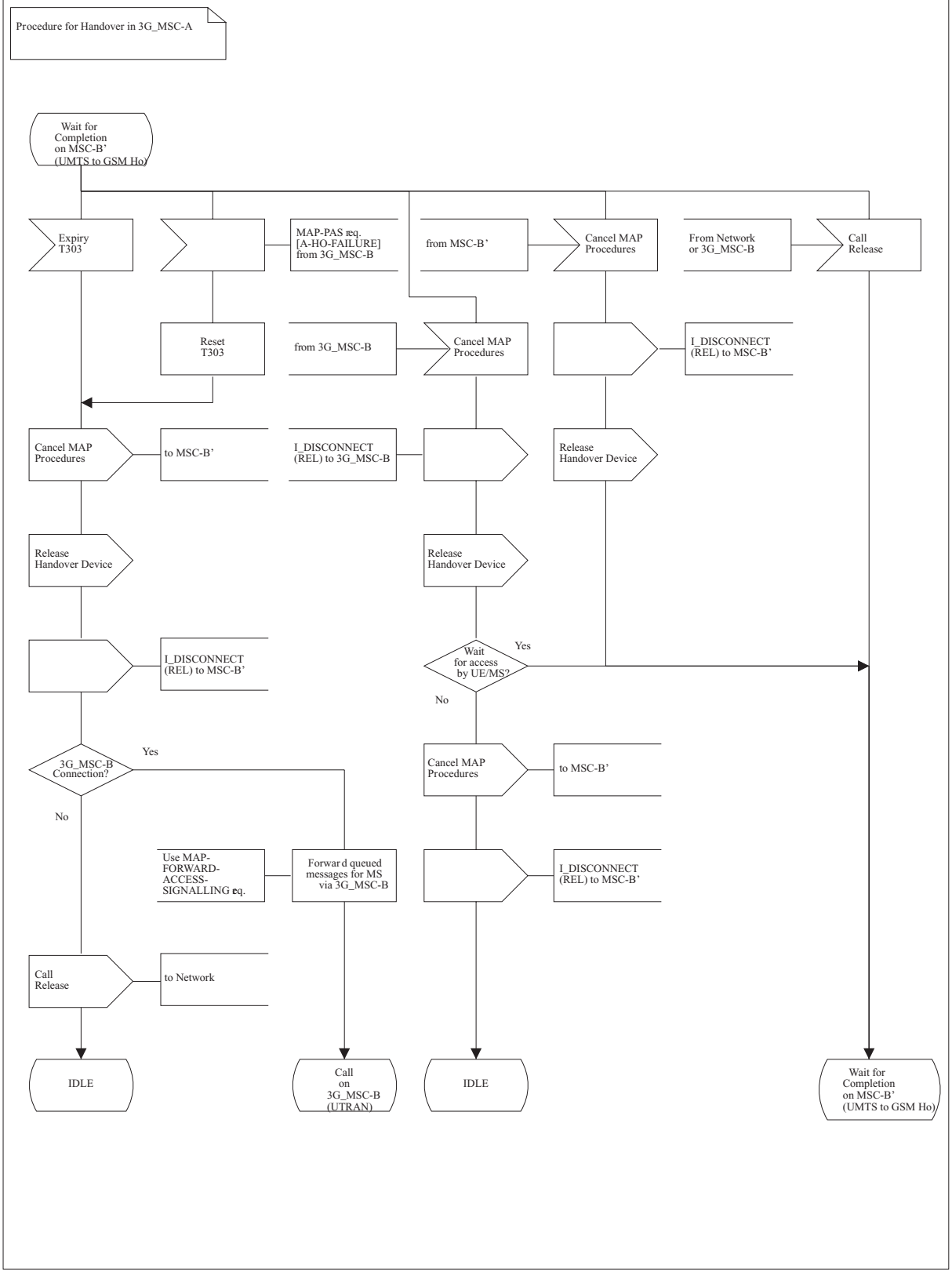


Figure 43 (Sheet 48 of 78): Handover control procedure in 3G_MSC-A

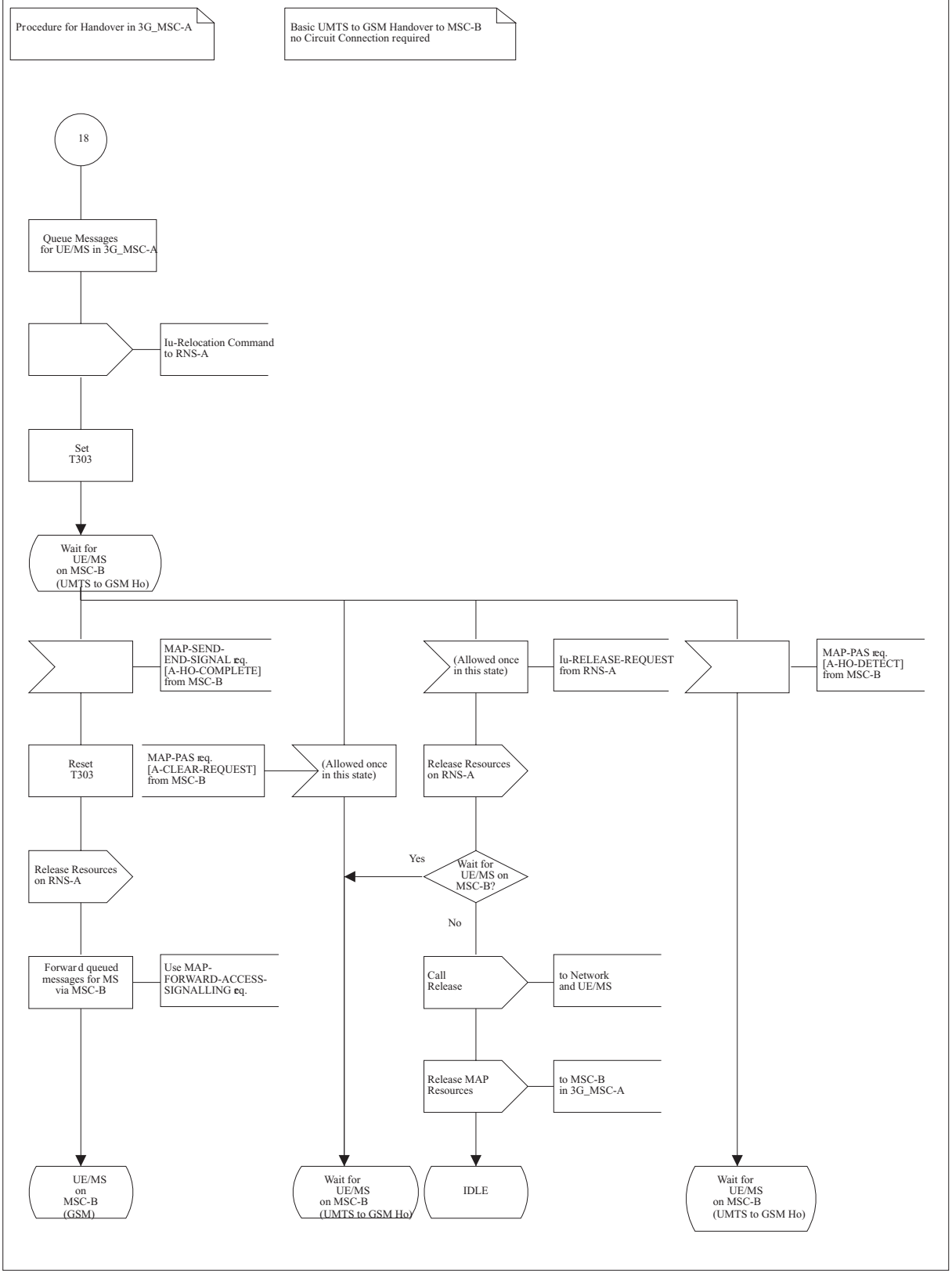


Figure 43 (Sheet 49 of 78): Handover control procedure in 3G_MSC-A

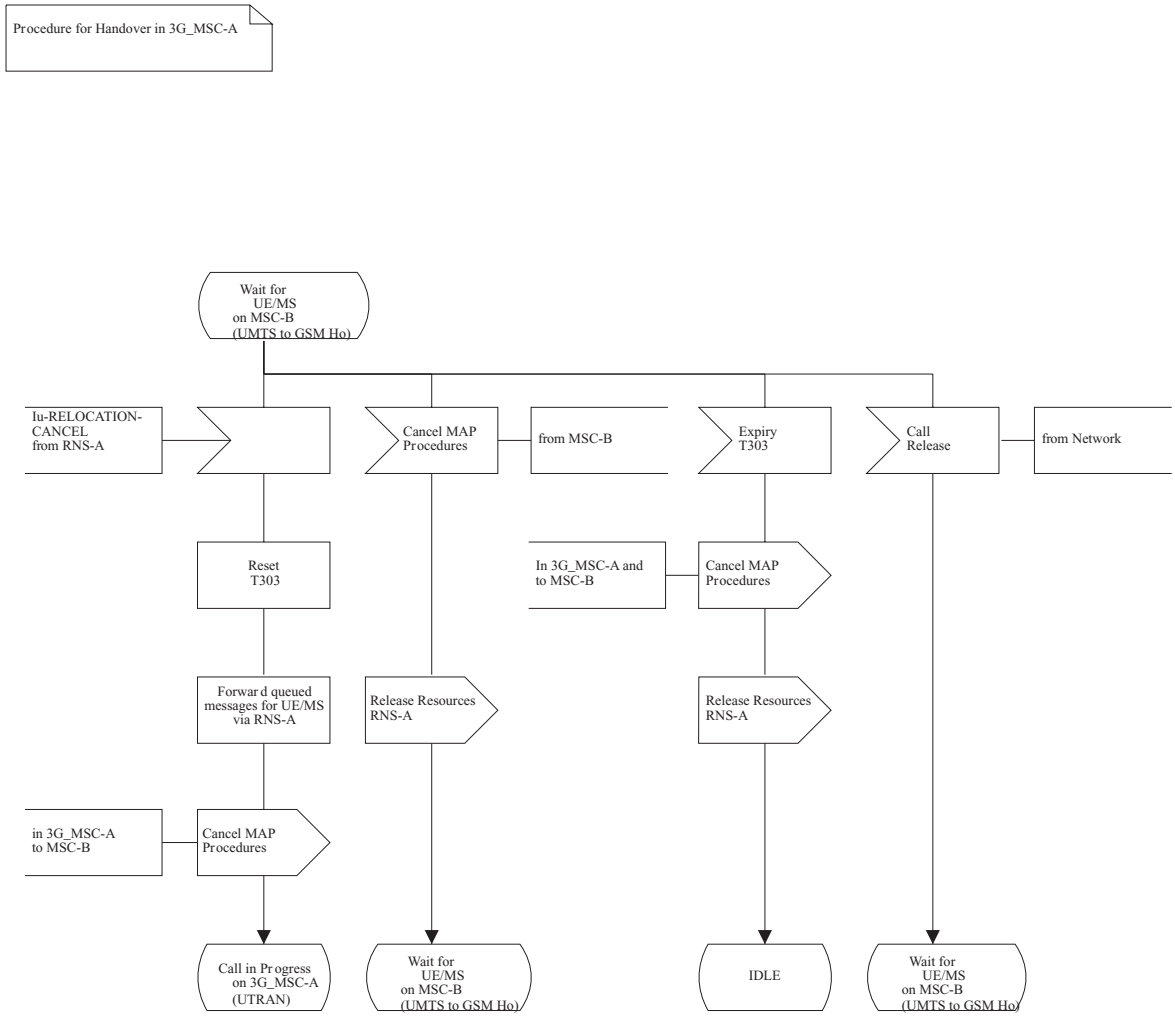


Figure 43 (Sheet 50 of 78): Ha ndover control procedure in 3G_MSC-A

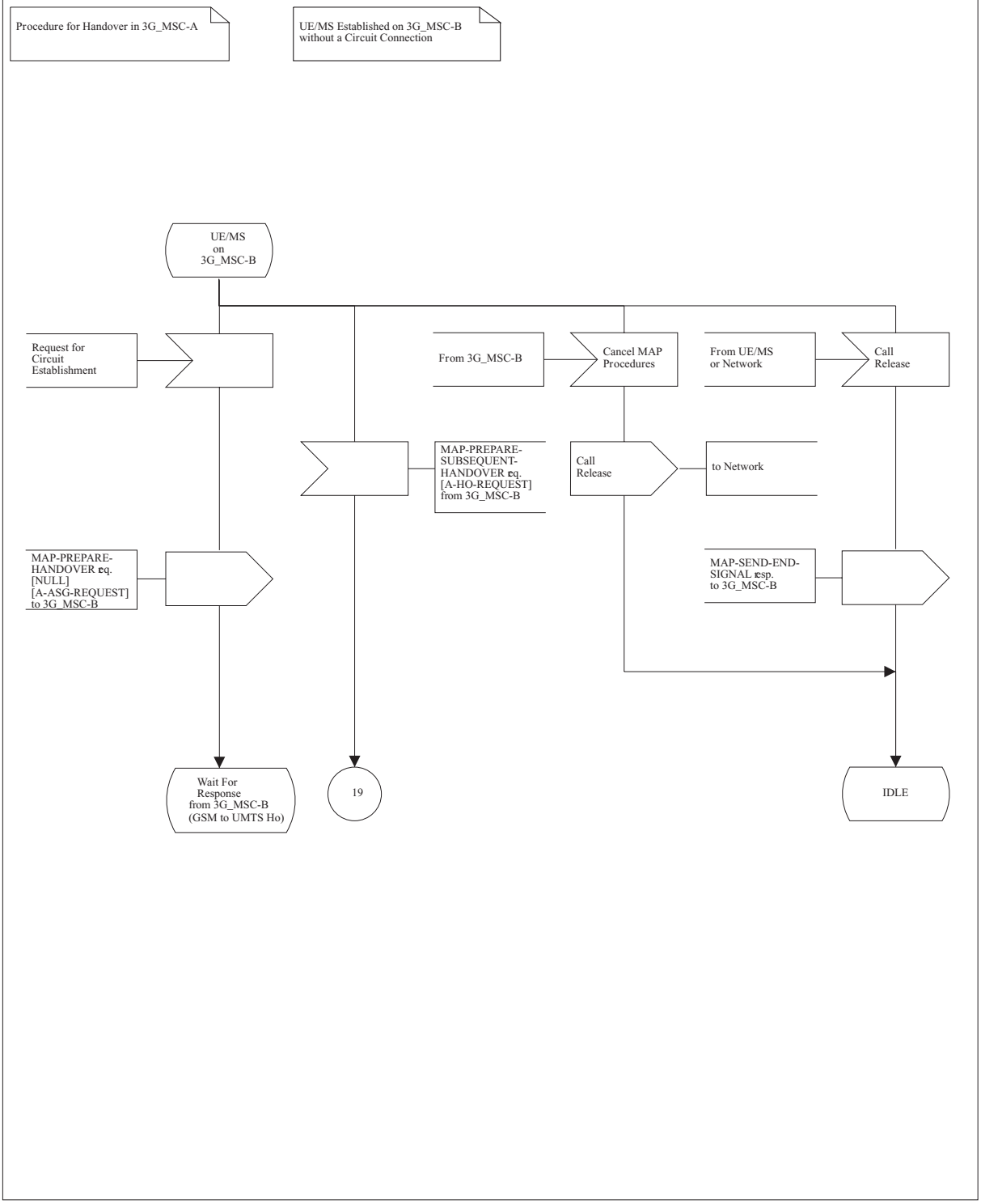


Figure 43 (Sheet 51 of 78): Handover control procedure in 3G_MSC-A

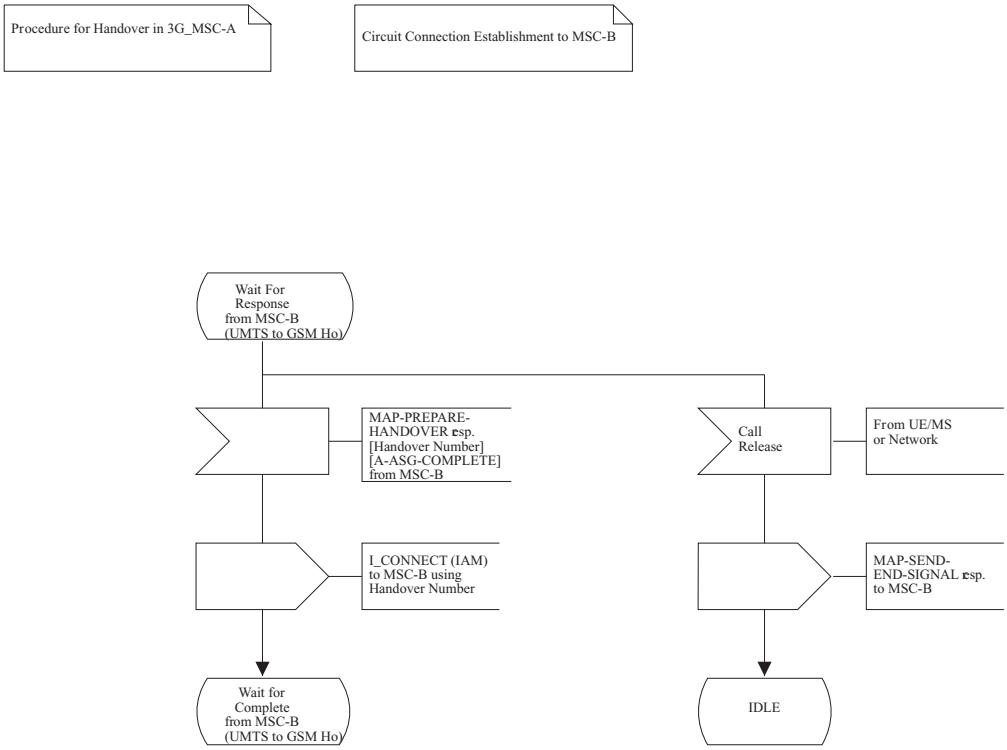


Figure 43 (Sheet 52 of 78): Handover control procedure in 3G_MSC-A

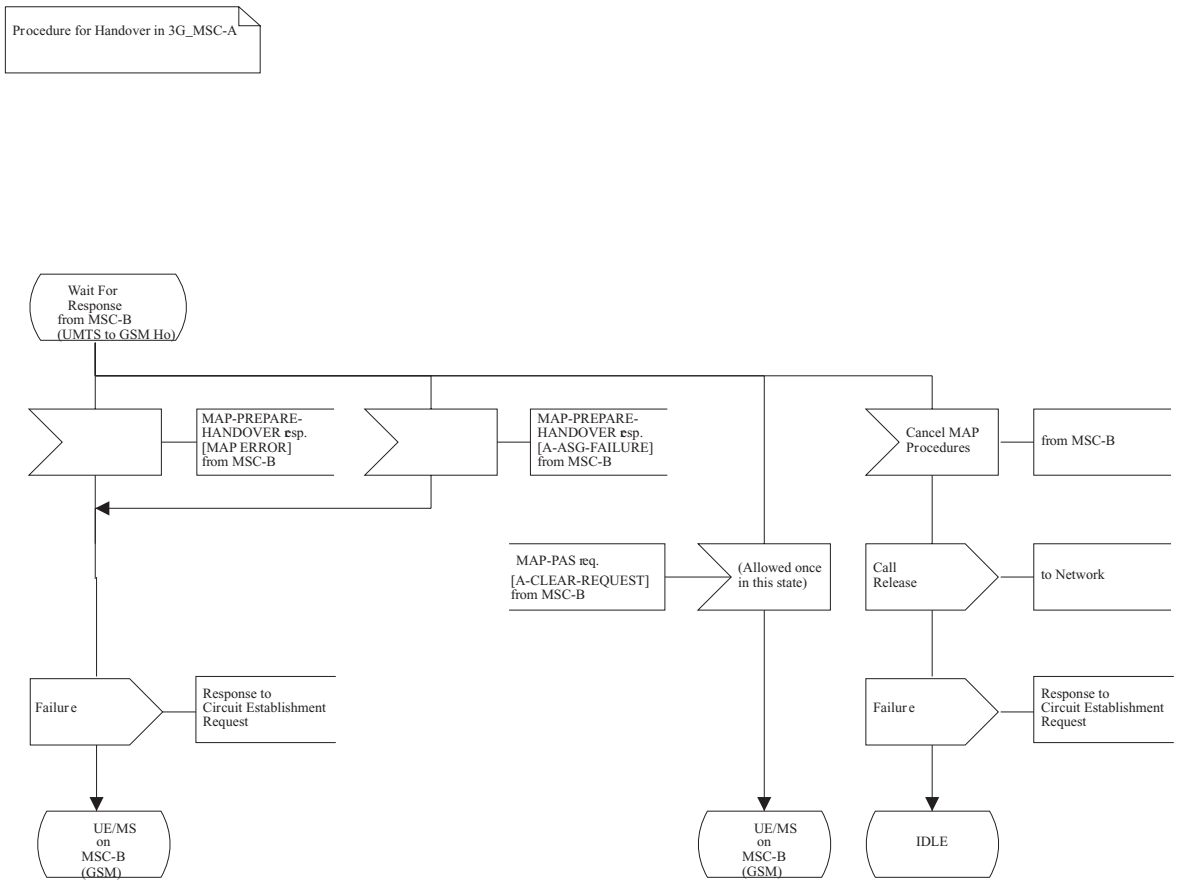


Figure 43 (Sheet 53 of 78): Handover control procedure in 3G_MSC-A

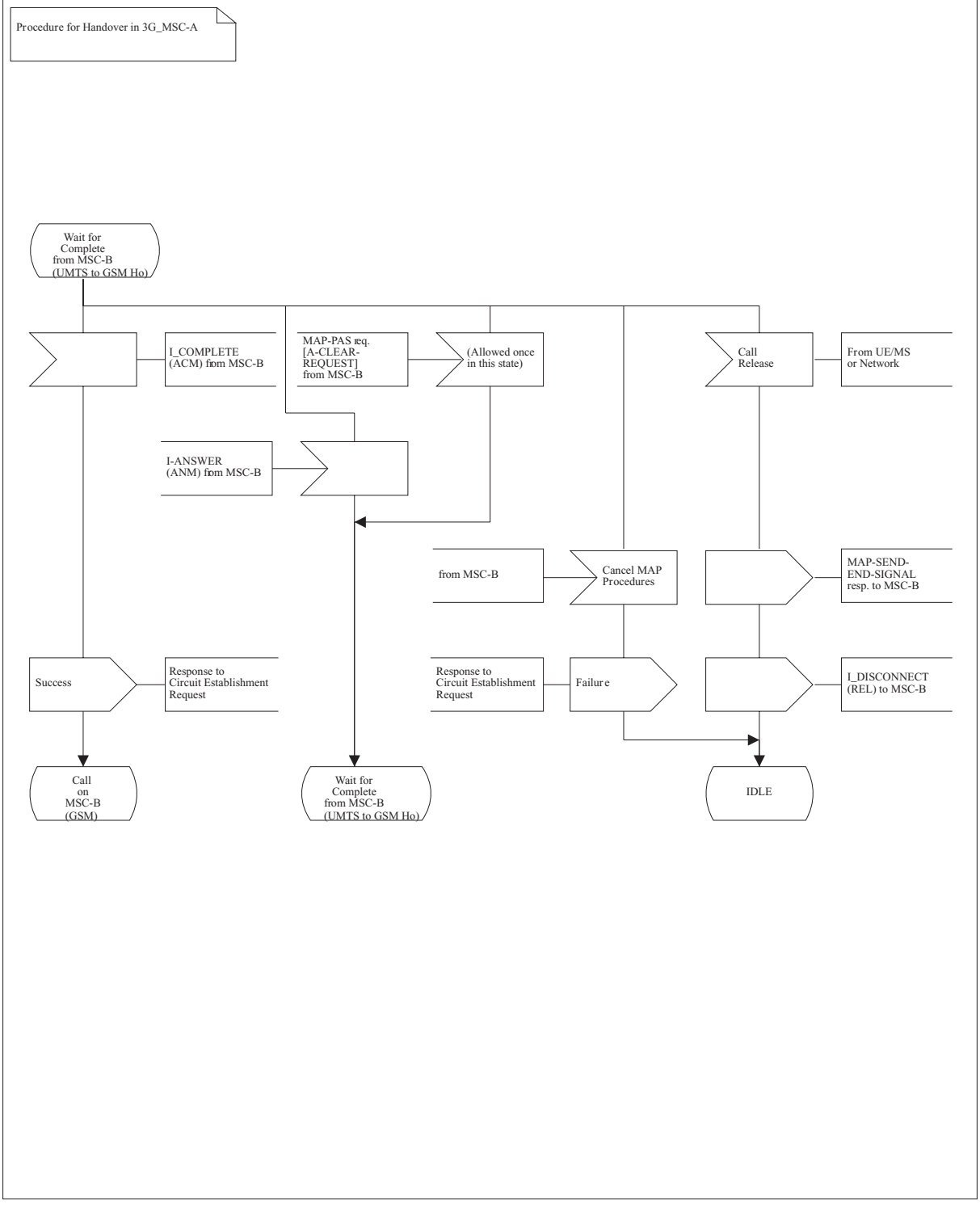


Figure 43 (Sheet 54 of 78): Handover control procedure in 3G_MSC-A

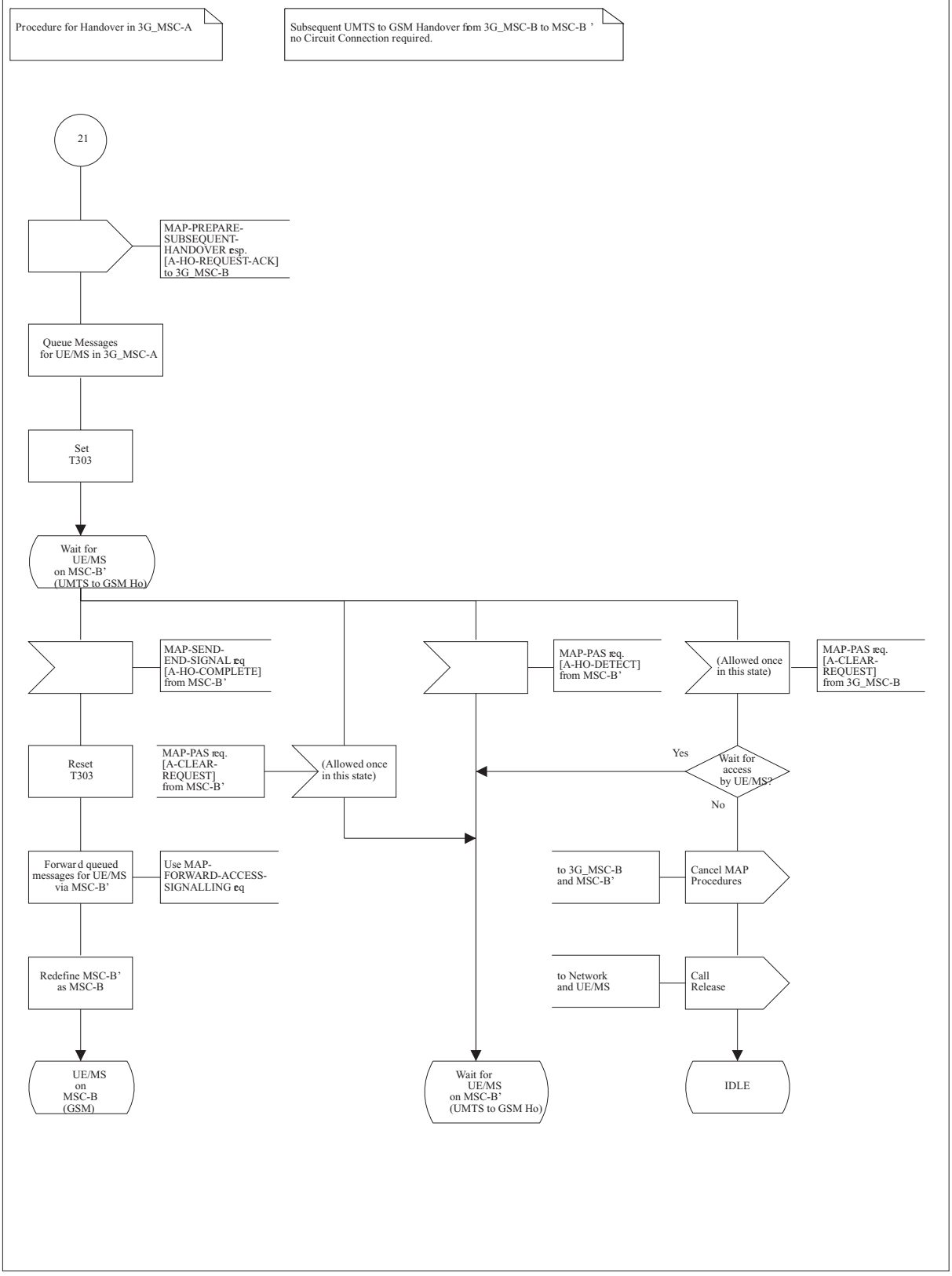


Figure 43 (Sheet 55 of 78): Handover control procedure in 3G_MSC-A

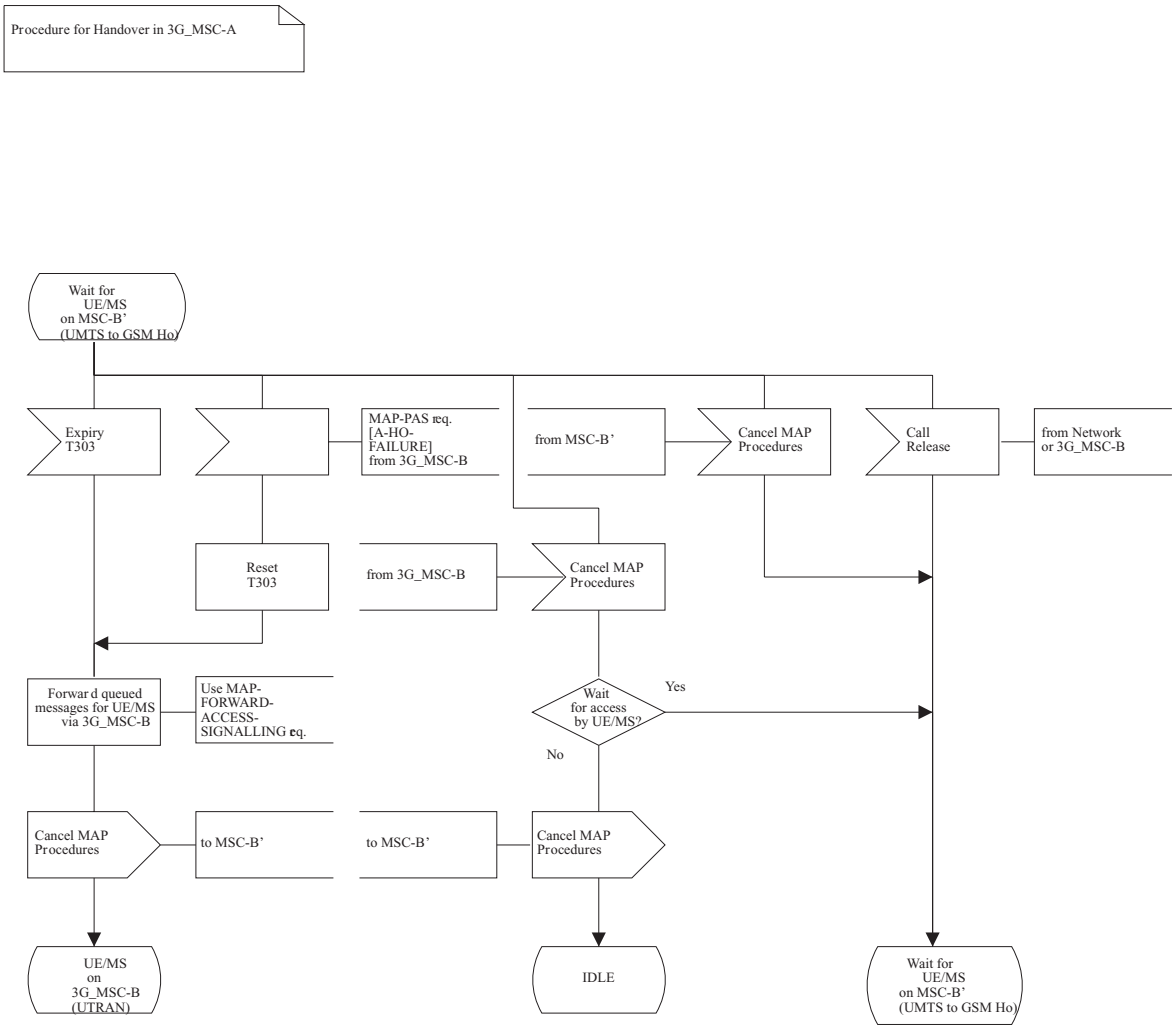


Figure 43 (Sheet 56 of 78): Handover control procedure in 3G_MSC-A

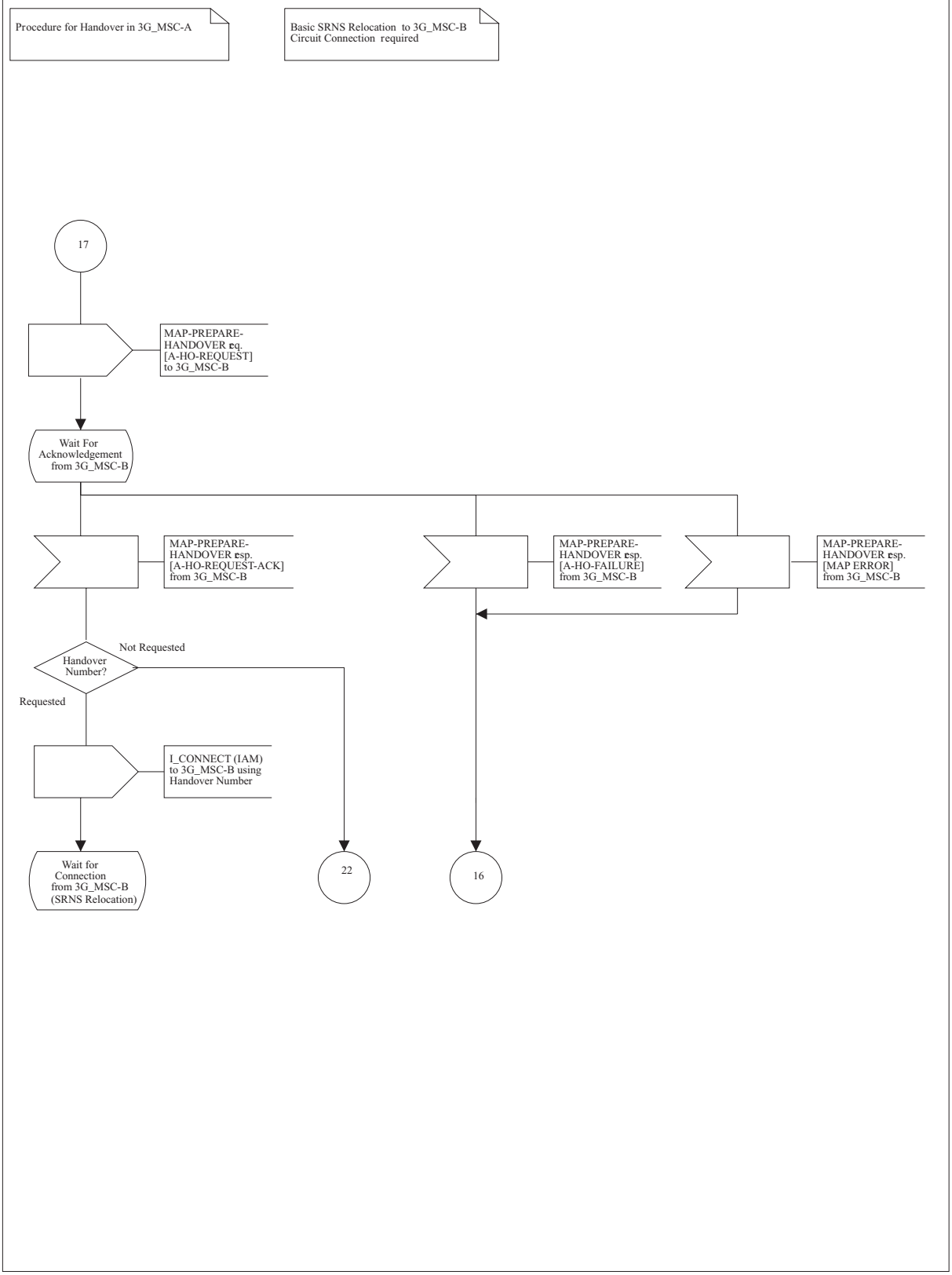


Figure 43 (Sheet 57 of 78): Handover control procedure in 3G_MSC-A

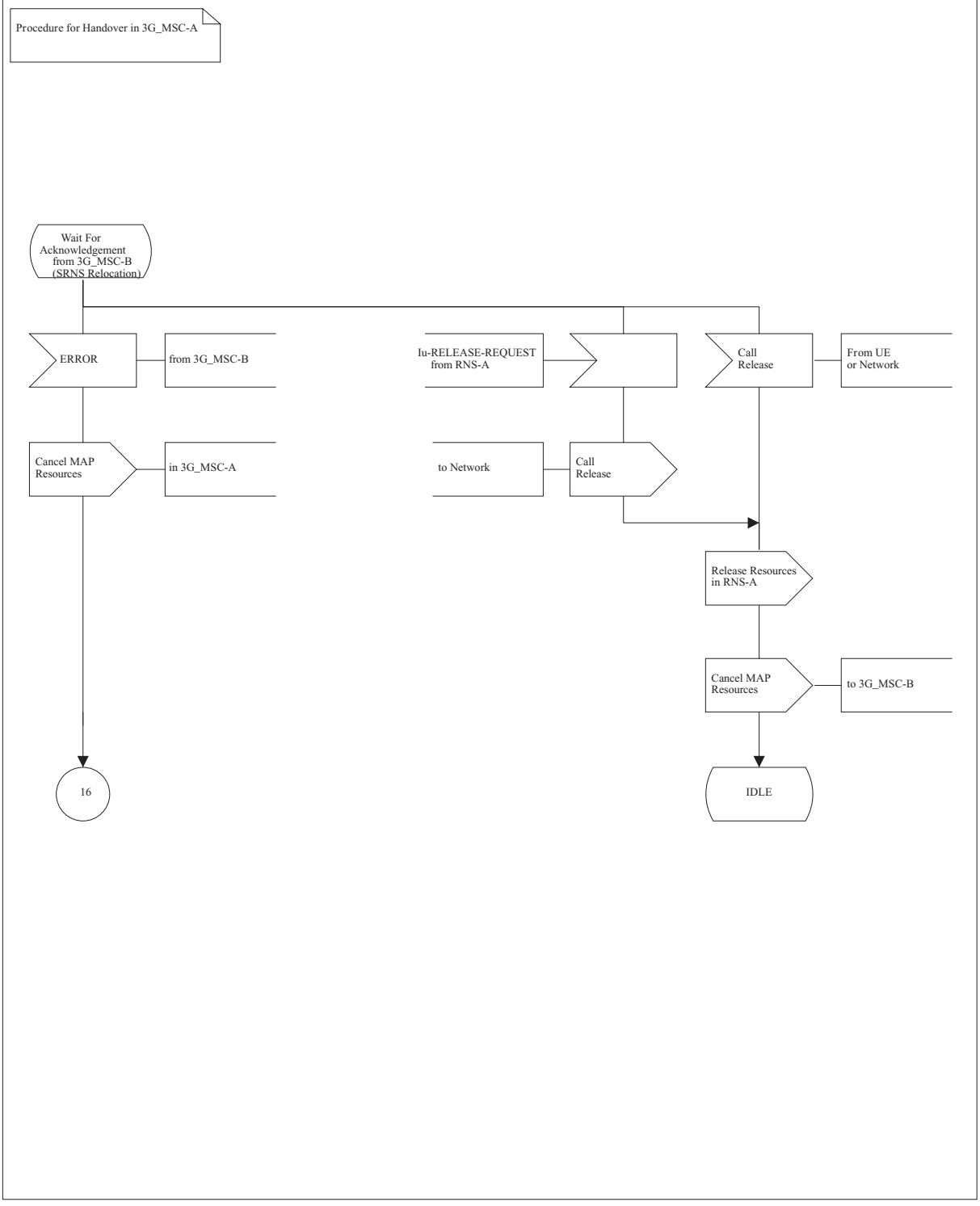


Figure 43 (Sheet 58 of 78): Handover control procedure in 3G_MSC-A

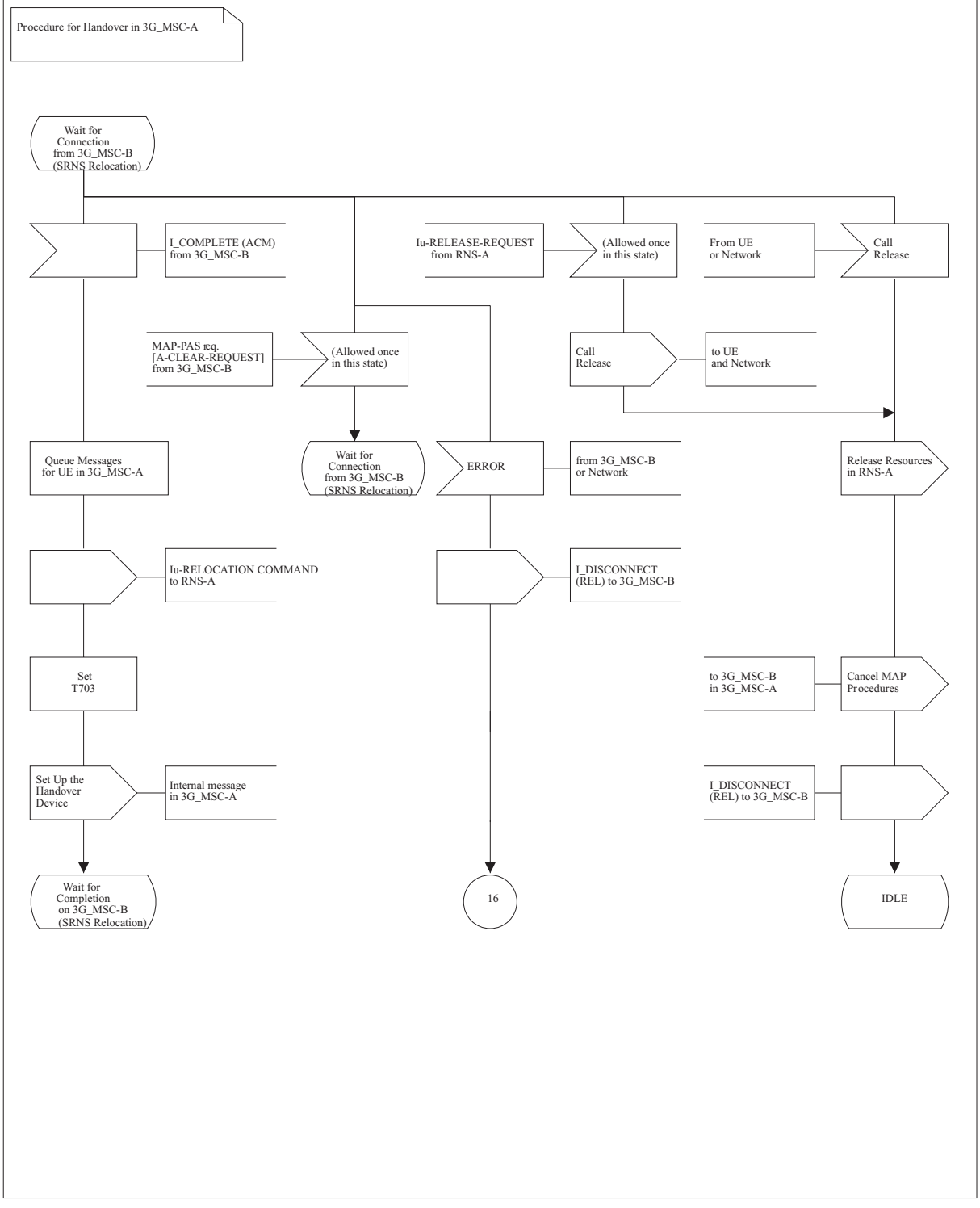


Figure 43 (Sheet 59 of 78): Handover control procedure in 3G_MSC-A

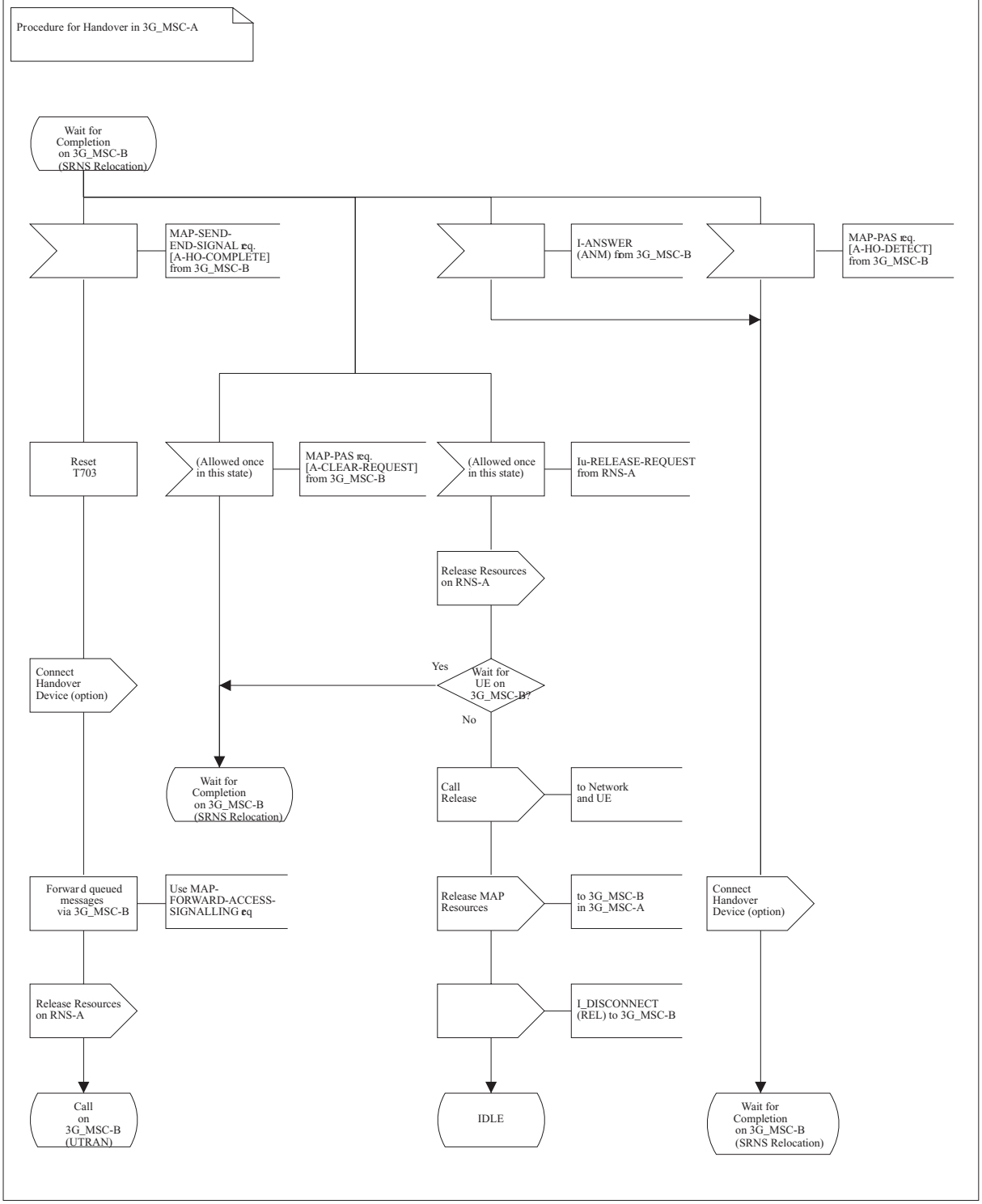


Figure 43 (Sheet 60 of 78): Handover control procedure in 3G_MSC-A

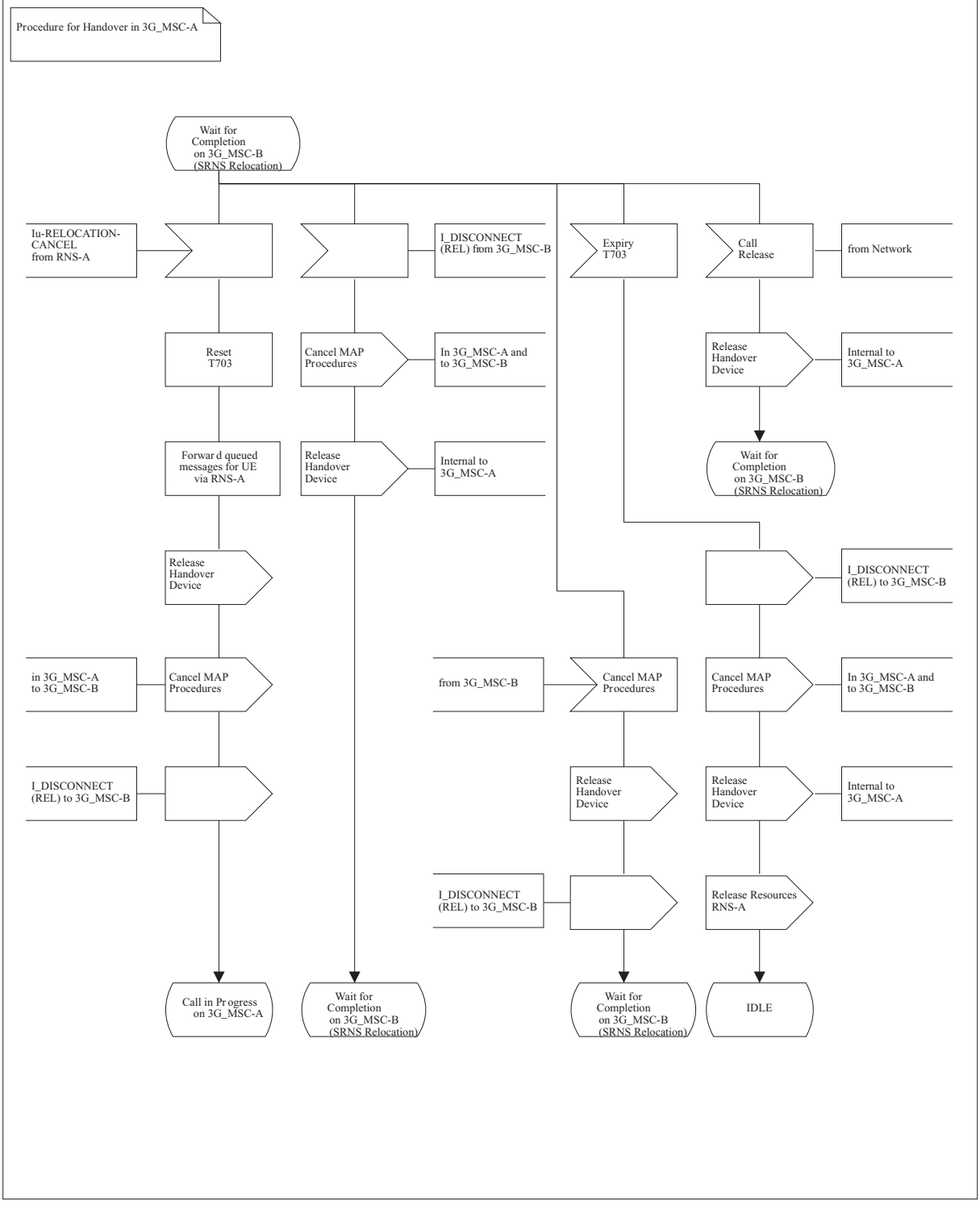


Figure 43 (Sheet 61 of 78): Handover control procedure in 3G_MSC-A

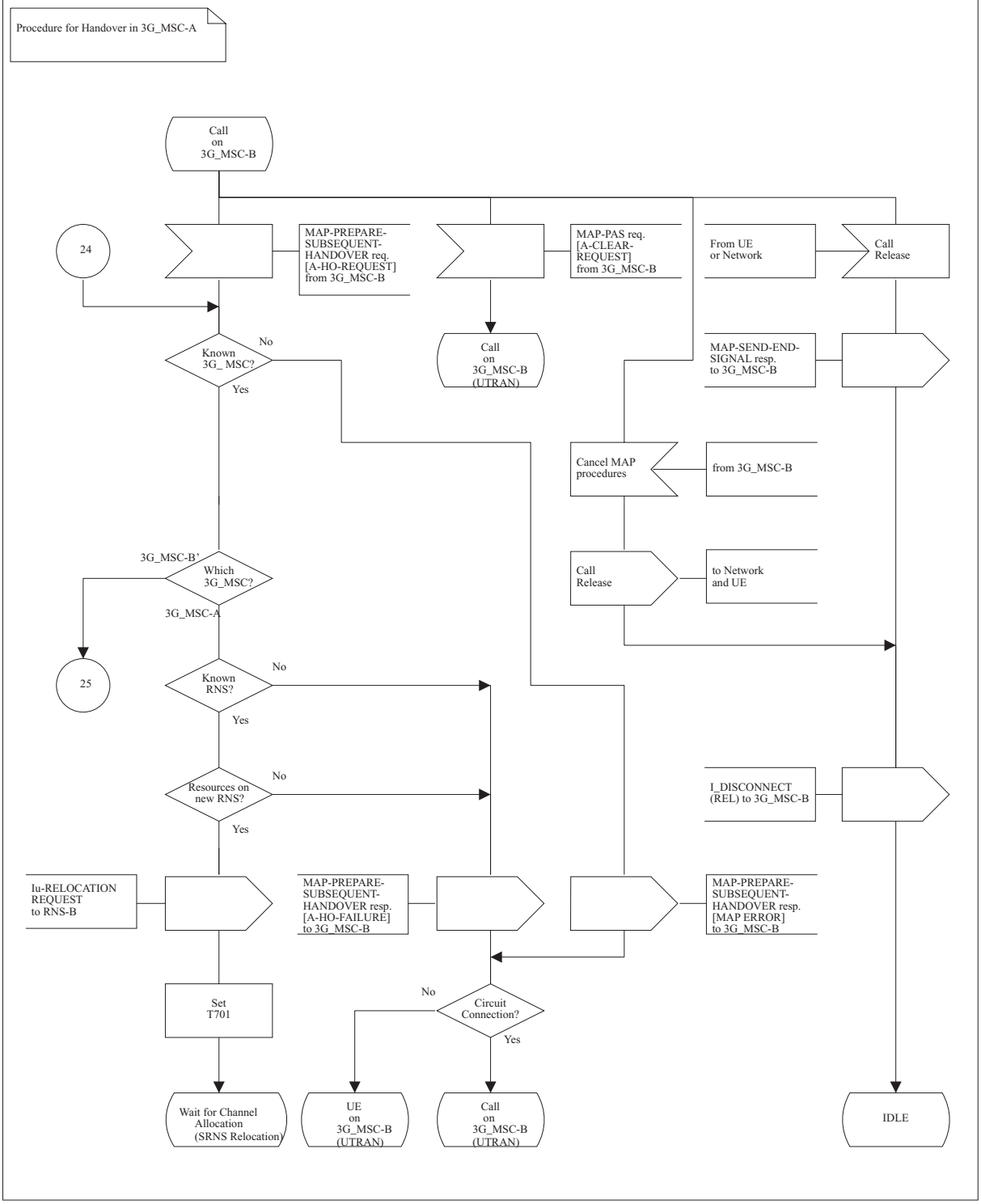


Figure 43 (Sheet 62 of 78): Handover control procedure in 3G_MSC-A

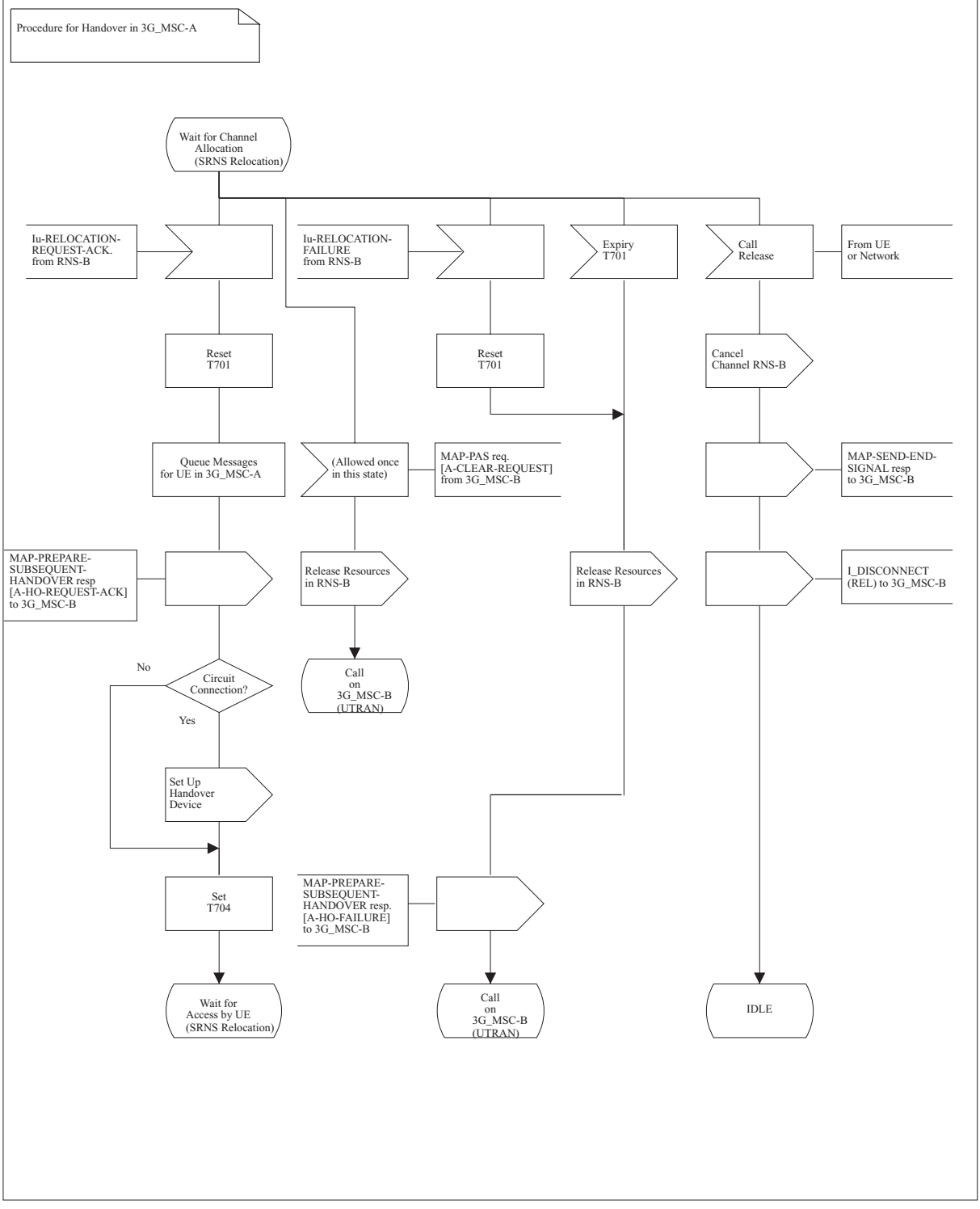


Figure 43 (Sheet 63 of 78): Handover control procedure in 3G_MSC-A

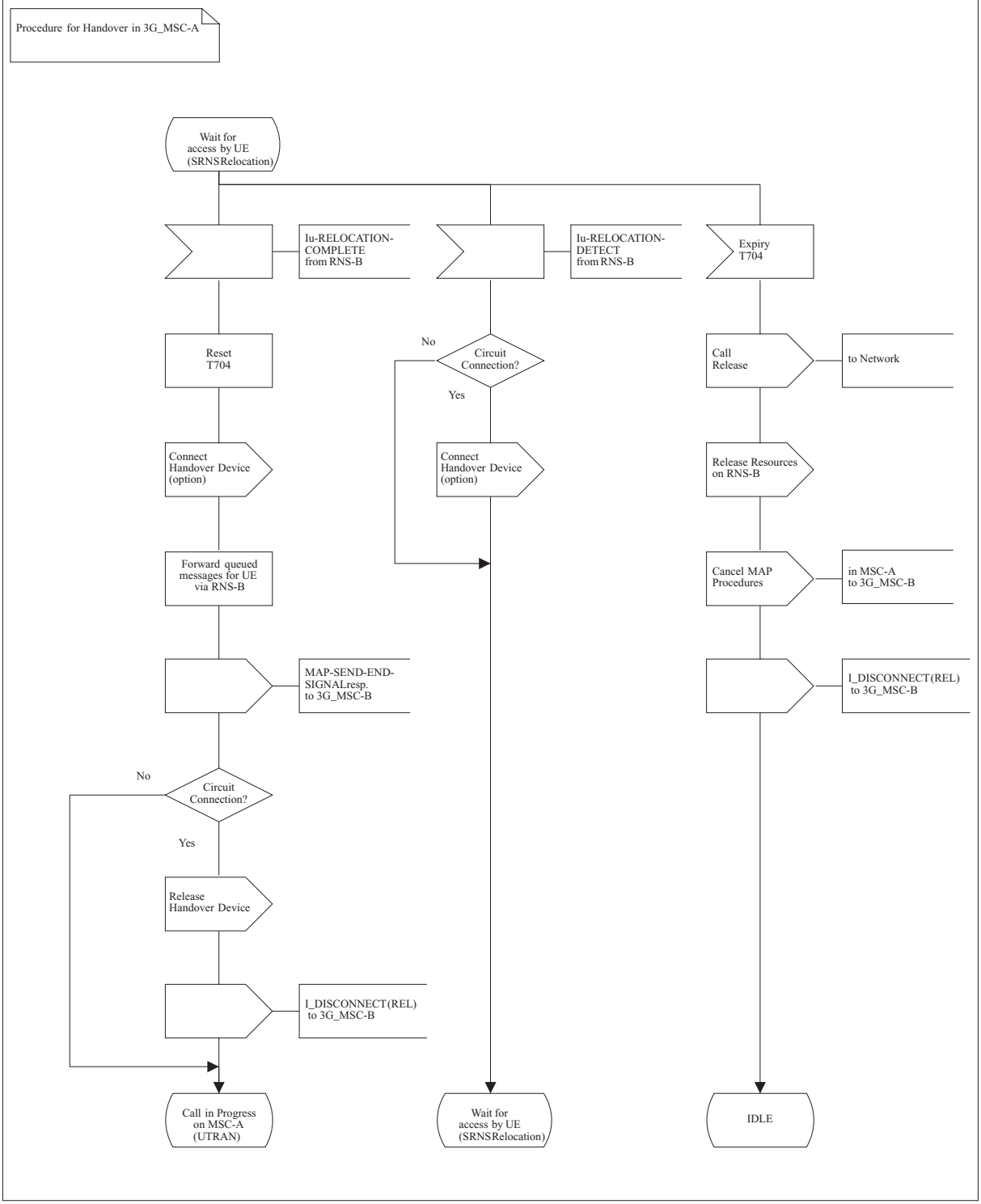


Figure 43 (Sheet 64 of 78): Handover control procedure in 3G_MSC-A

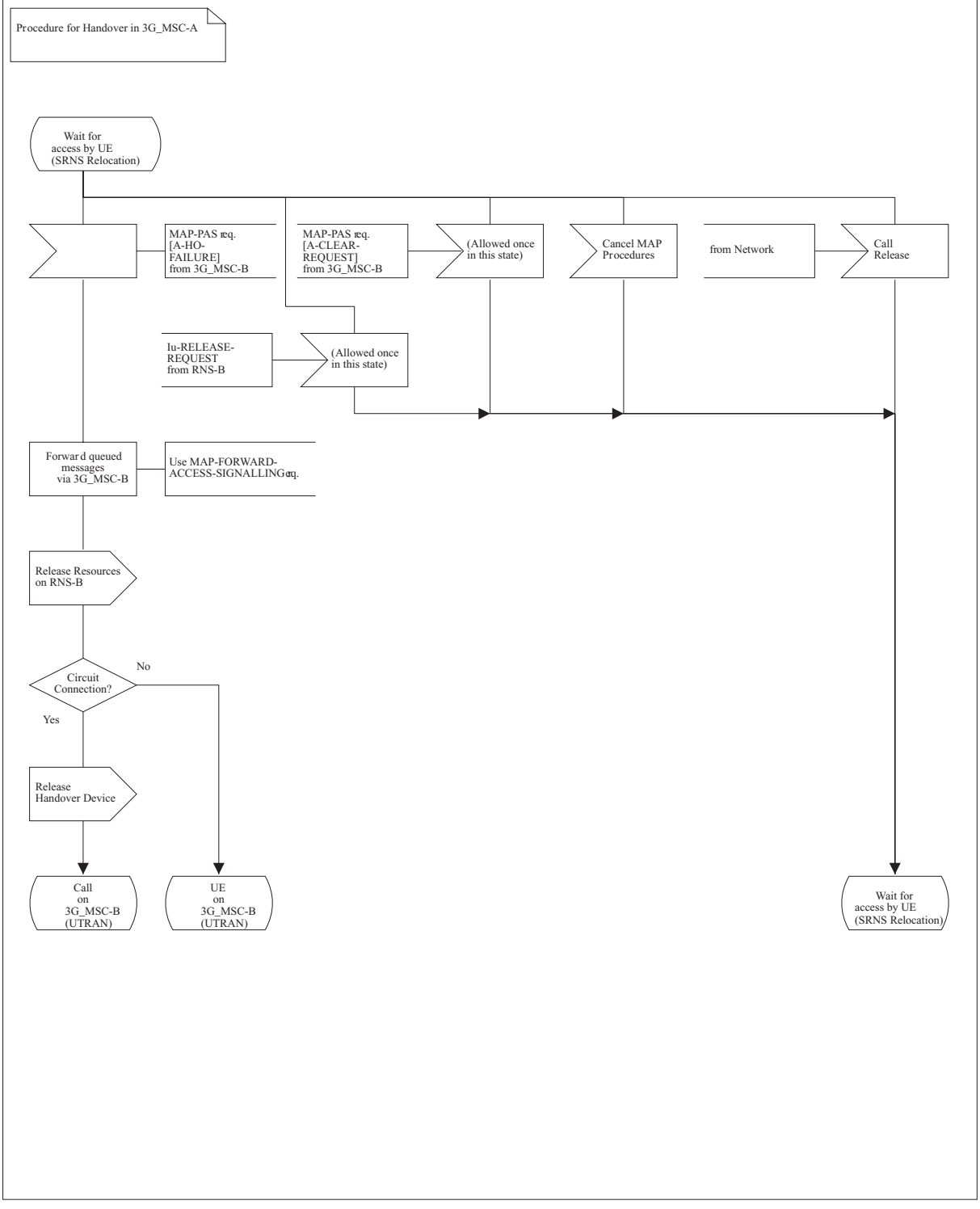


Figure 43 (Sheet 65 of 78): Handover control procedure in 3G_MSC-A

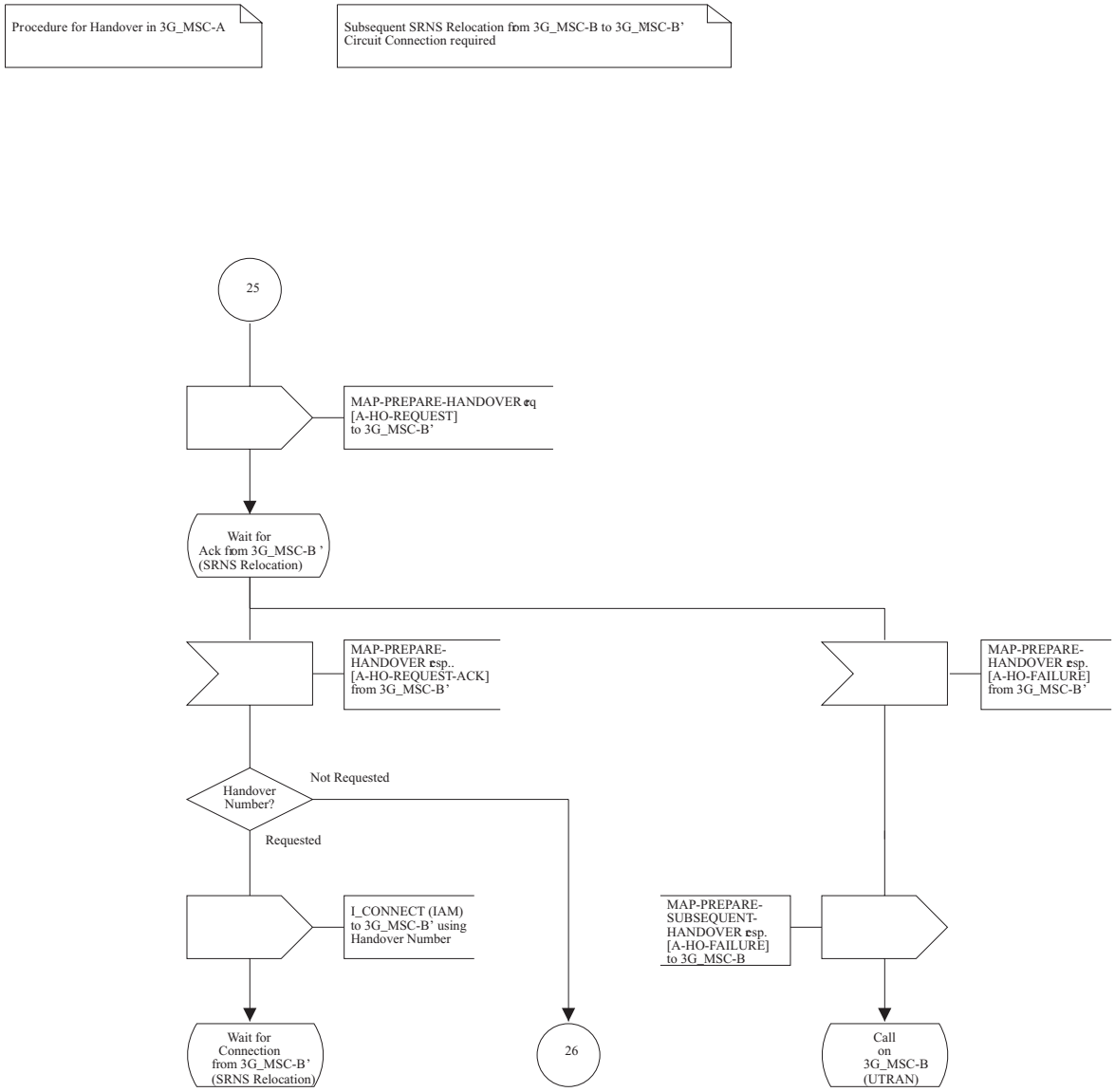


Figure 43 (Sheet 66 of 78): Handover control procedure in 3G_MSC-A

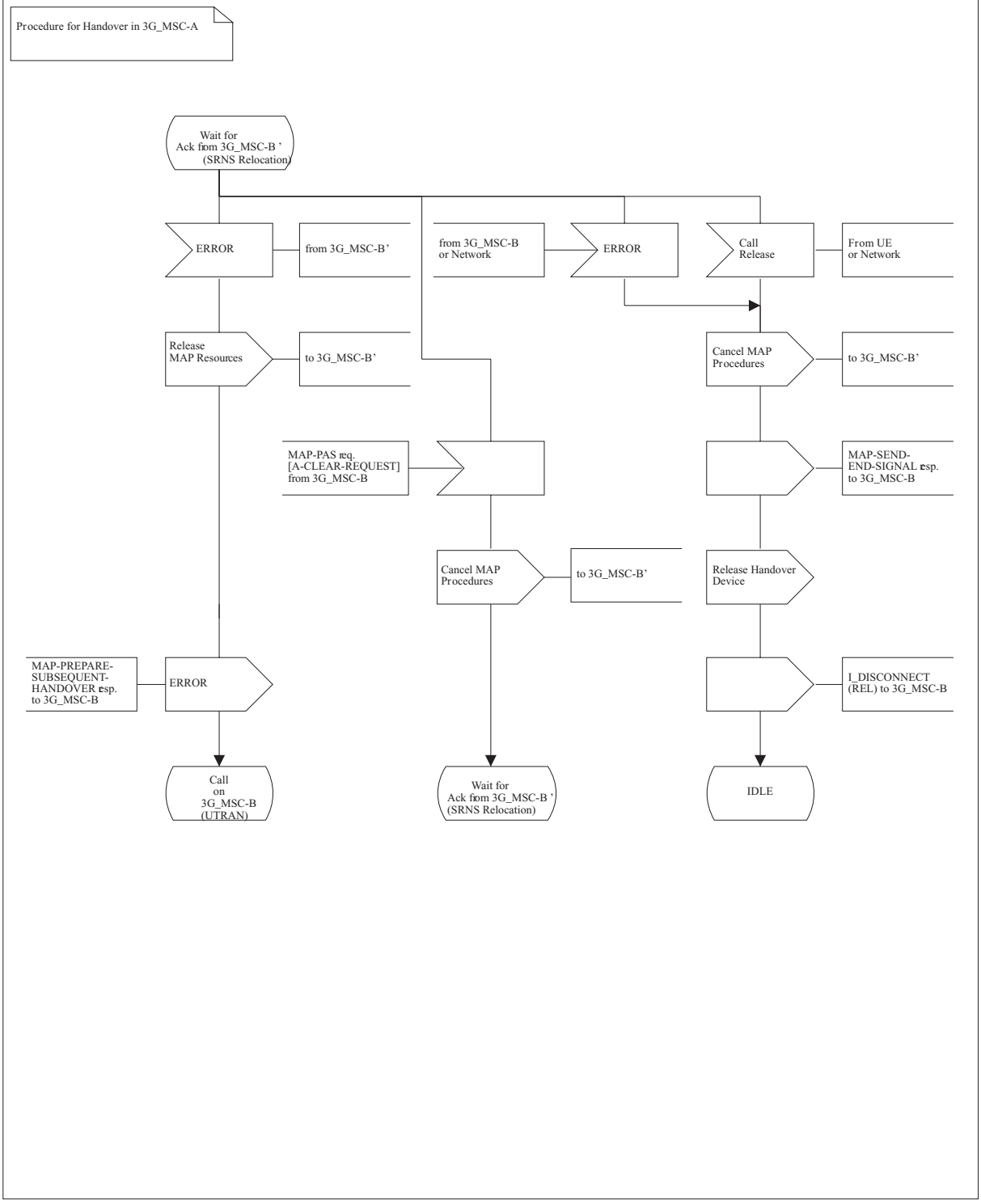


Figure 43 (Sheet 67 of 78): Handover control procedure in 3G_MSC-A

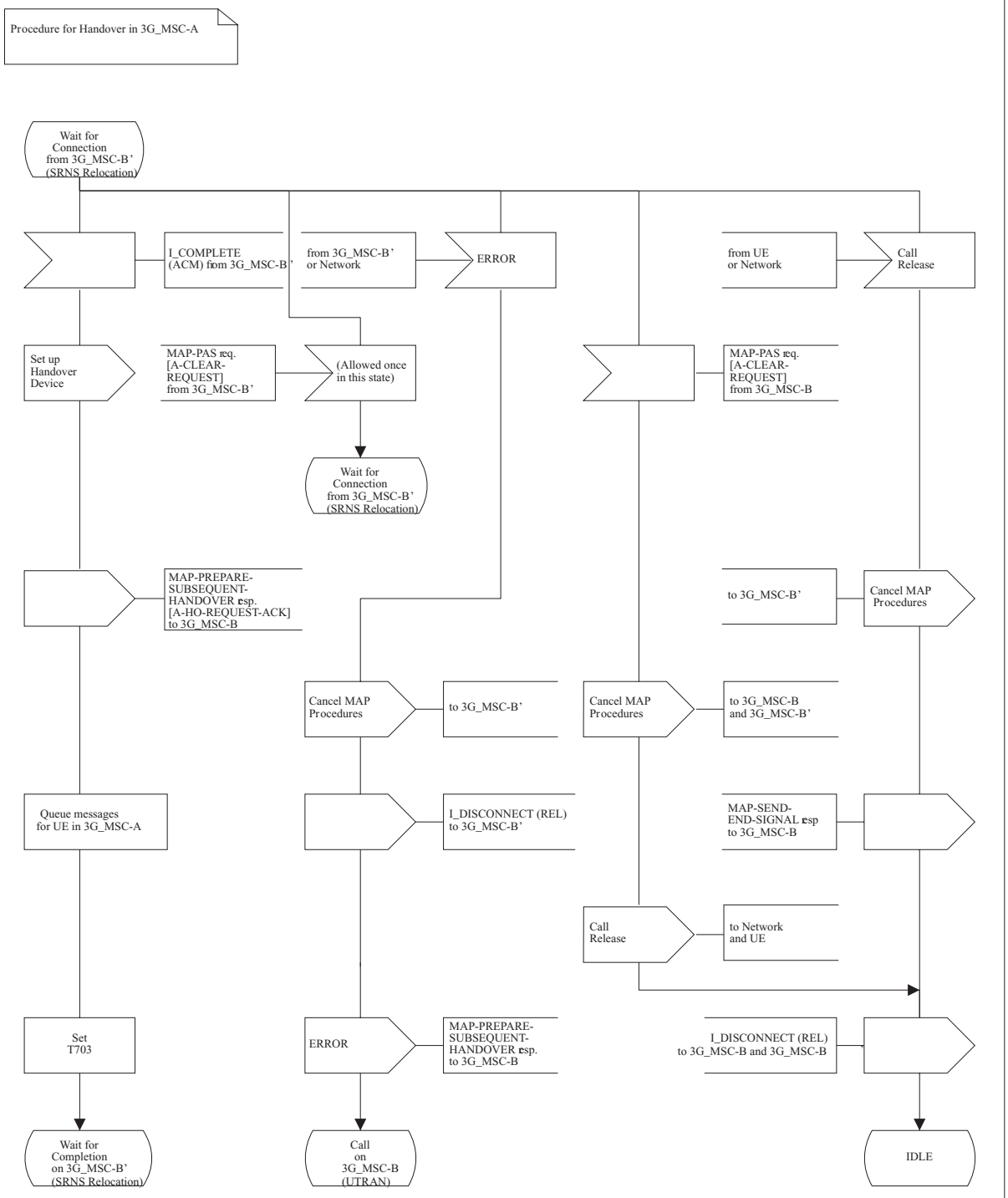


Figure 43 (Sheet 68 of 78): Handover control procedure in 3G_MSC-A

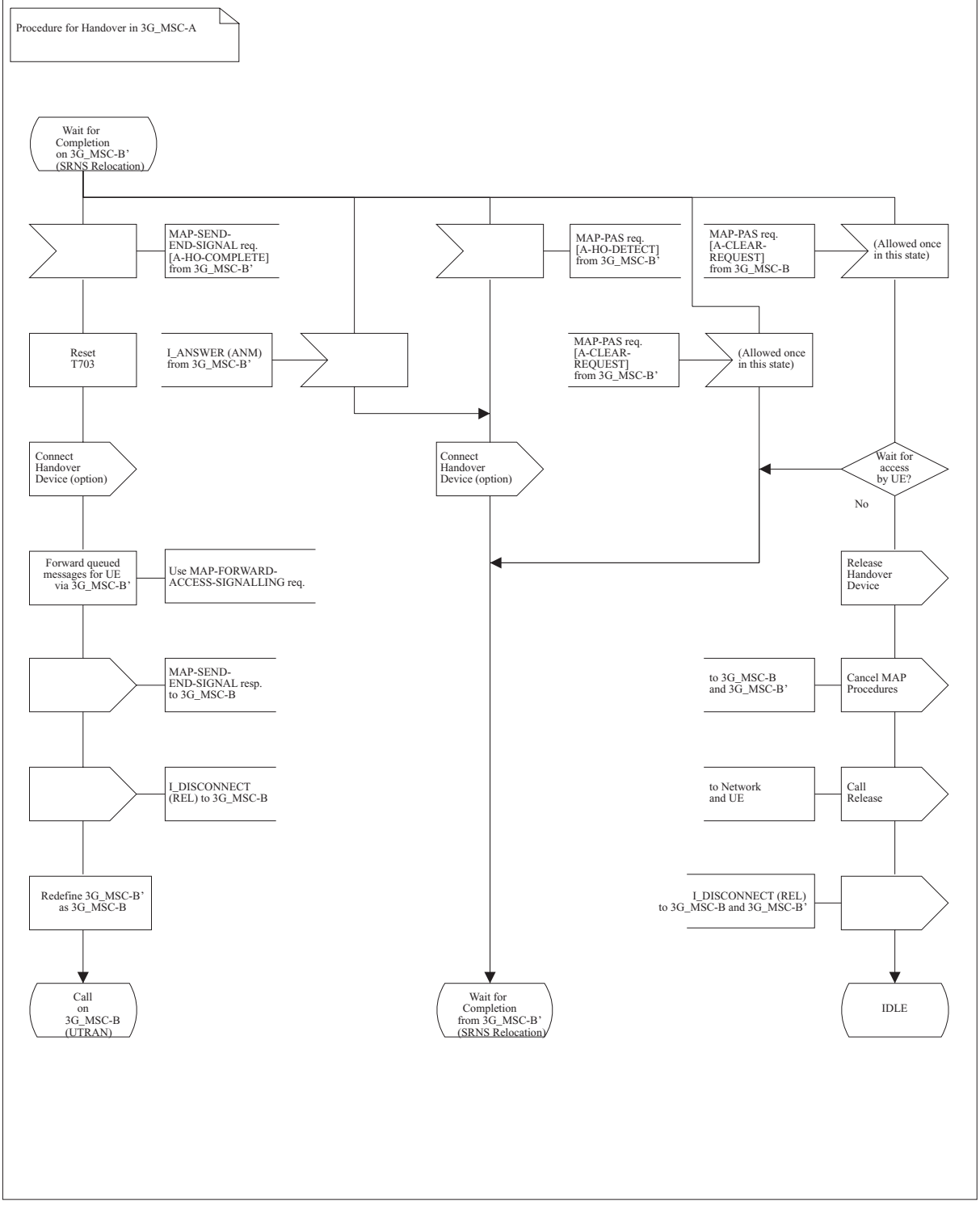


Figure 43 (Sheet 69 of 78): Handover control procedure in 3G_MSC-A

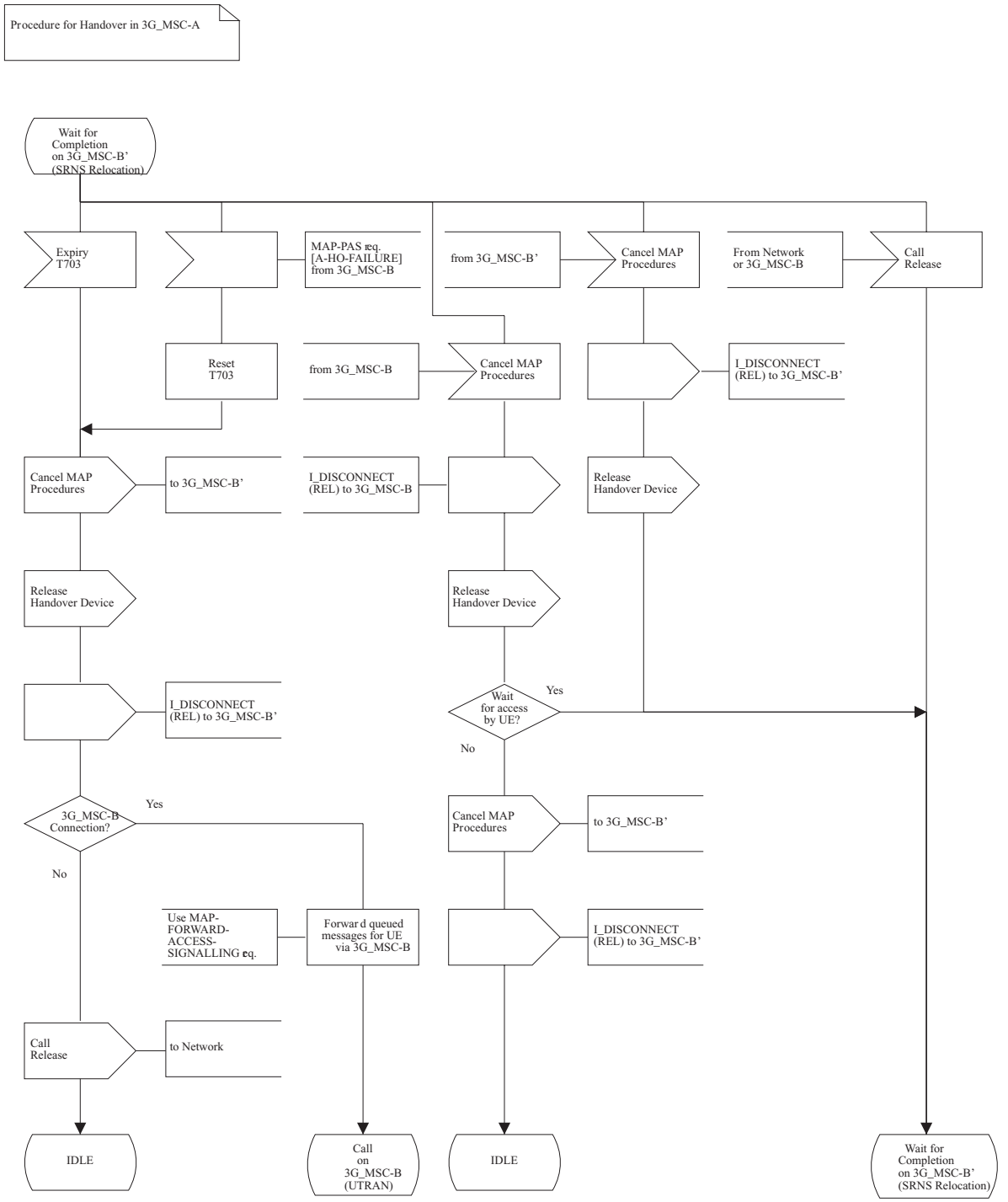


Figure 43 (Sheet 70 of 78): Handover control procedure in 3G_MSC-A

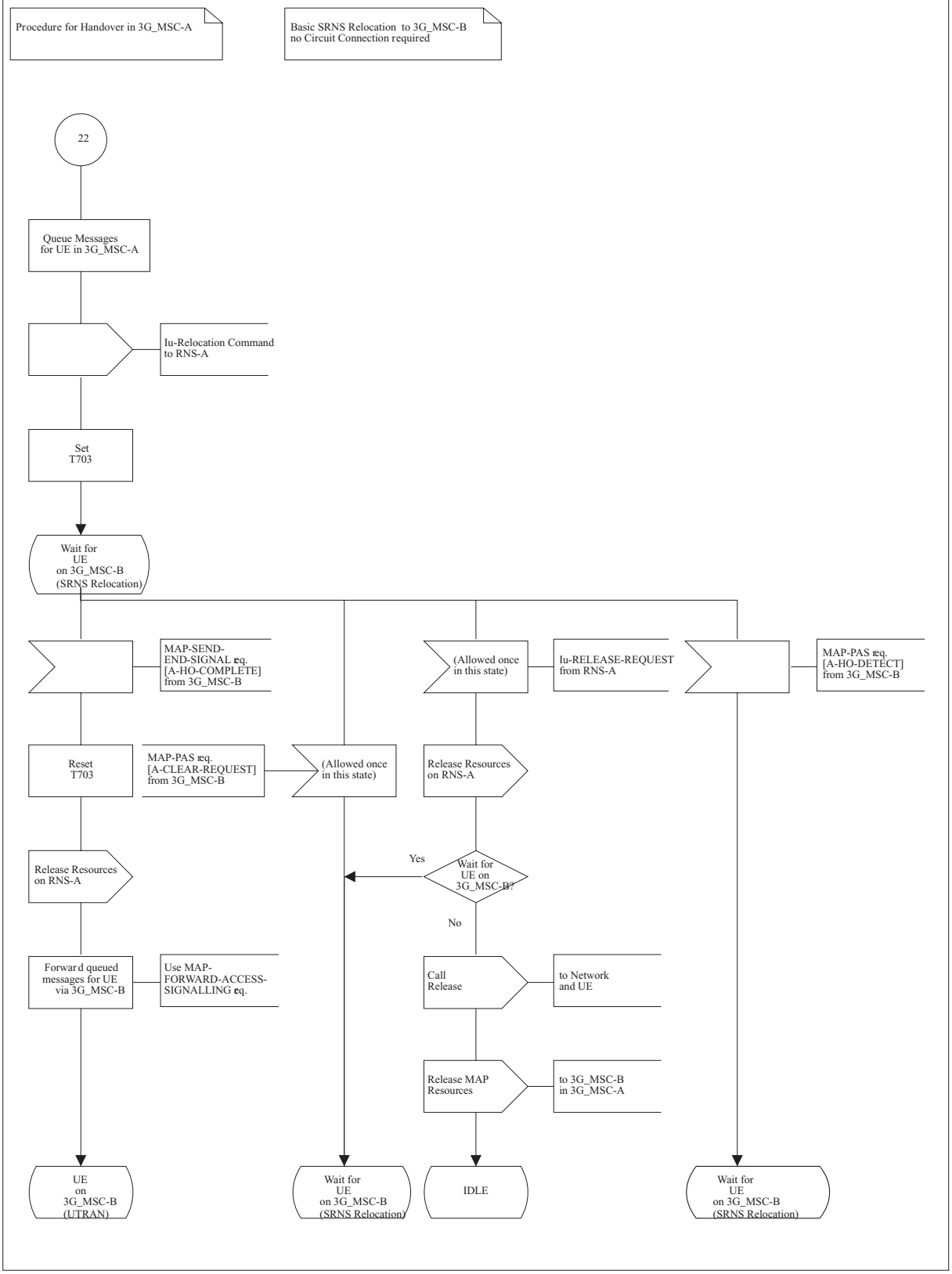


Figure 43 (Sheet 71 of 78): Handover control procedure in 3G_MSC-A

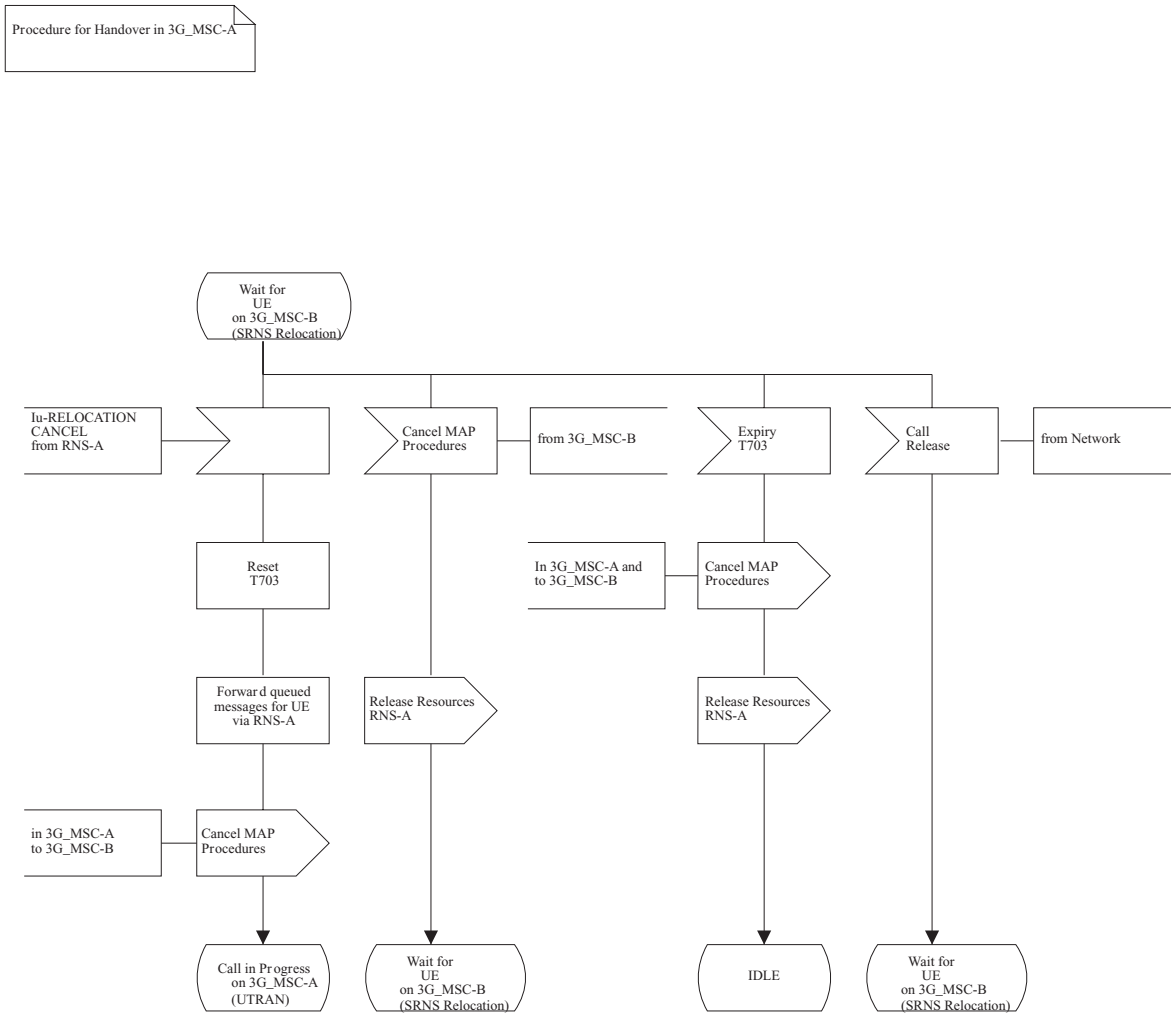


Figure 43 (Sheet 72 of 78): Handover control procedure in 3G_MSC-A

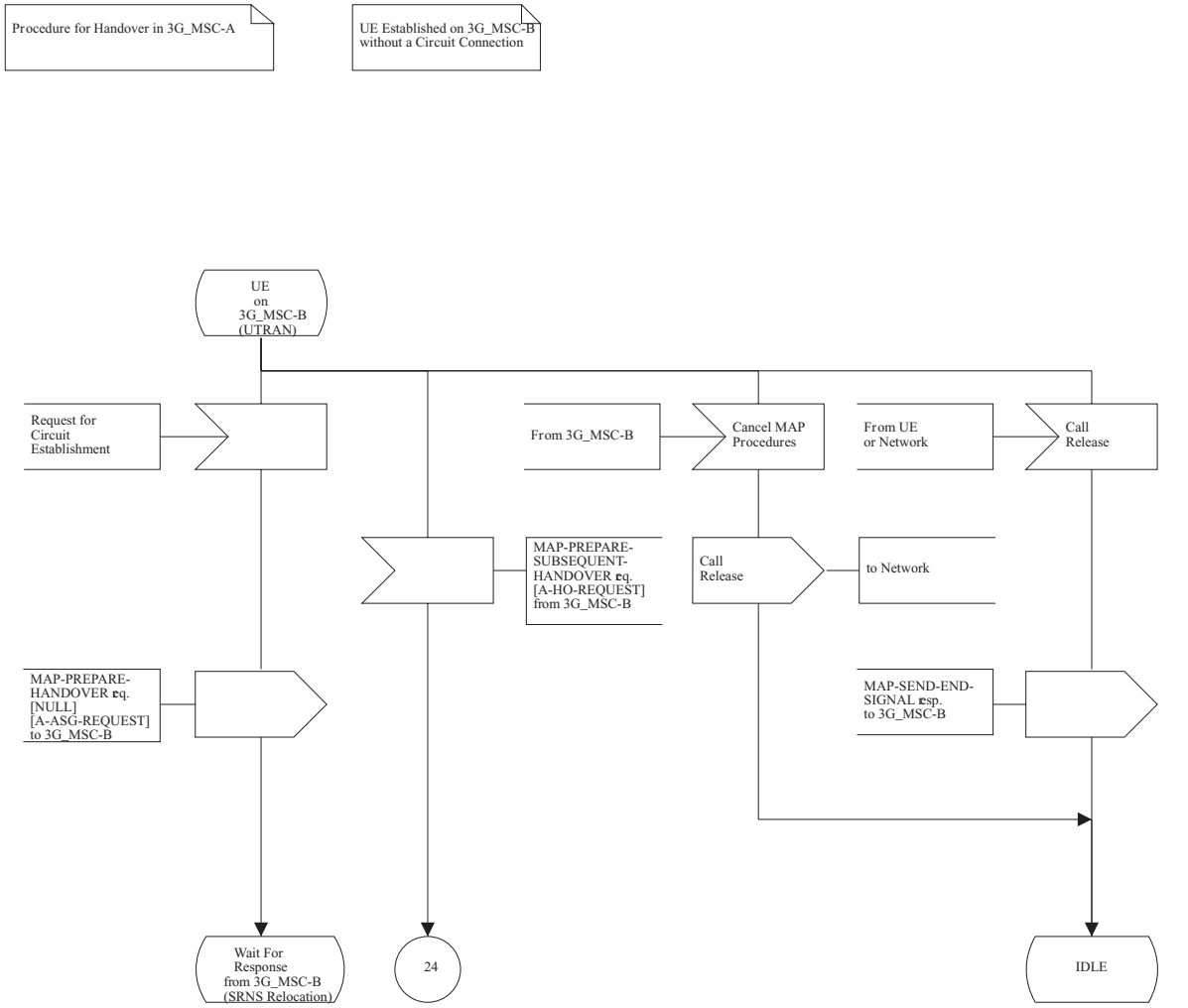


Figure 43 (Sheet 73 of 78): Handover control procedure in 3G_MSC-A

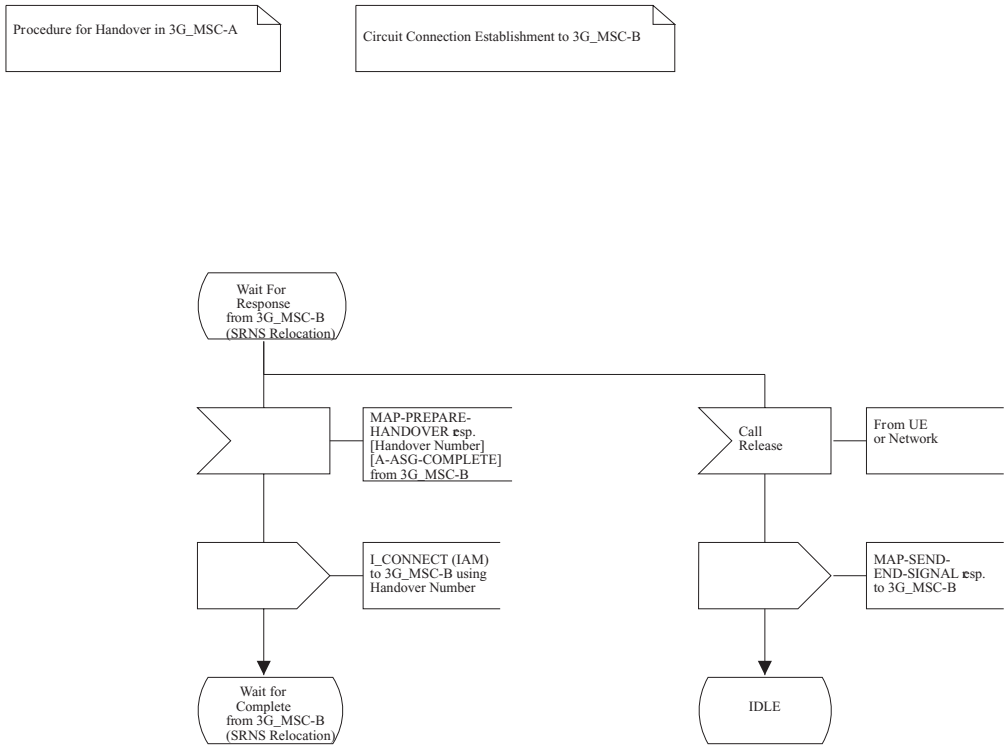


Figure 43 (Sheet 74 of 78): Handover control procedure in 3G_MSC-A

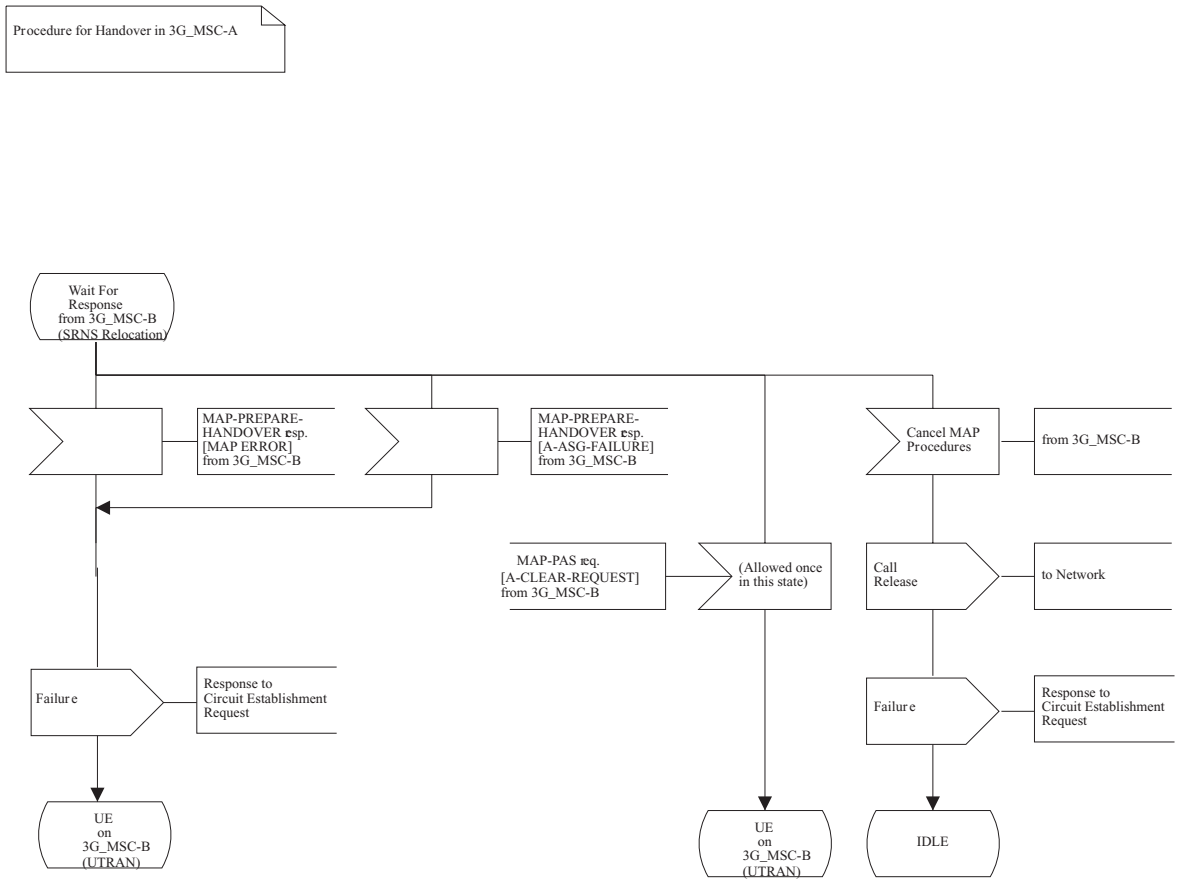


Figure 43 (Sheet 75 of 78): Handover control procedure in 3G_MSC-A

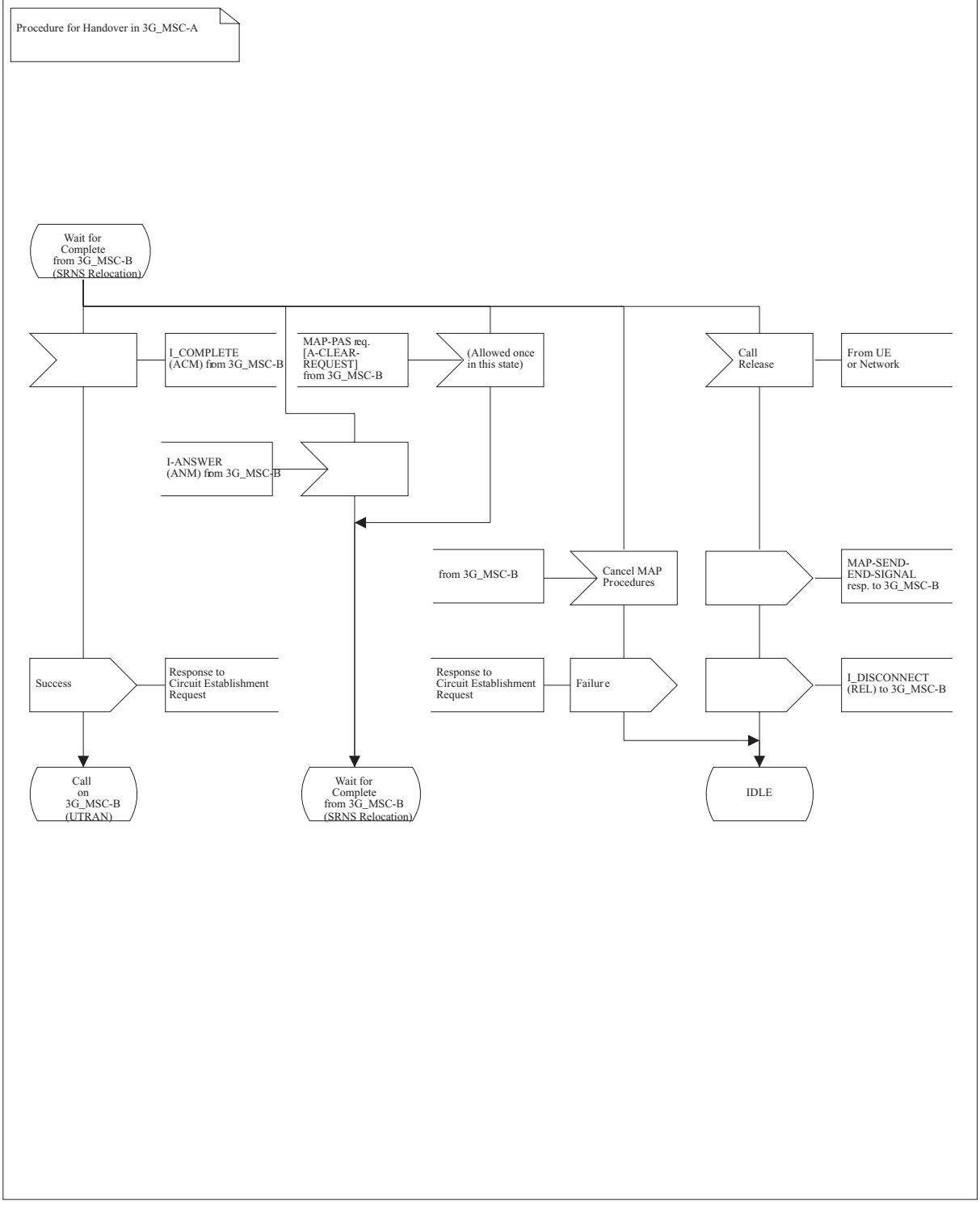


Figure 43 (Sheet 76 of 78): Handover control procedure in 3G_MSC-A

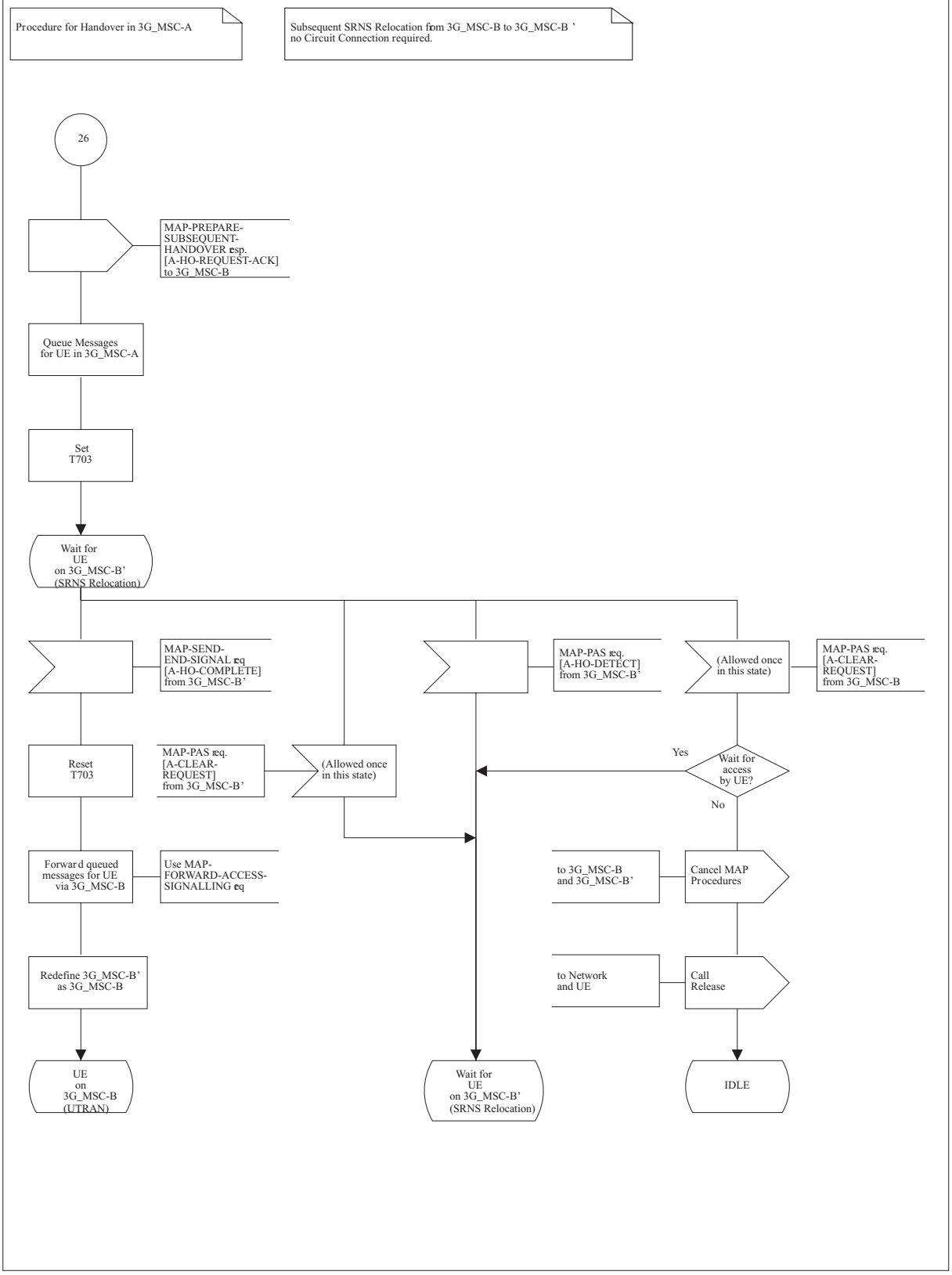


Figure 43 (Sheet 77 of 78): Handover control procedure in 3G_MSC-A

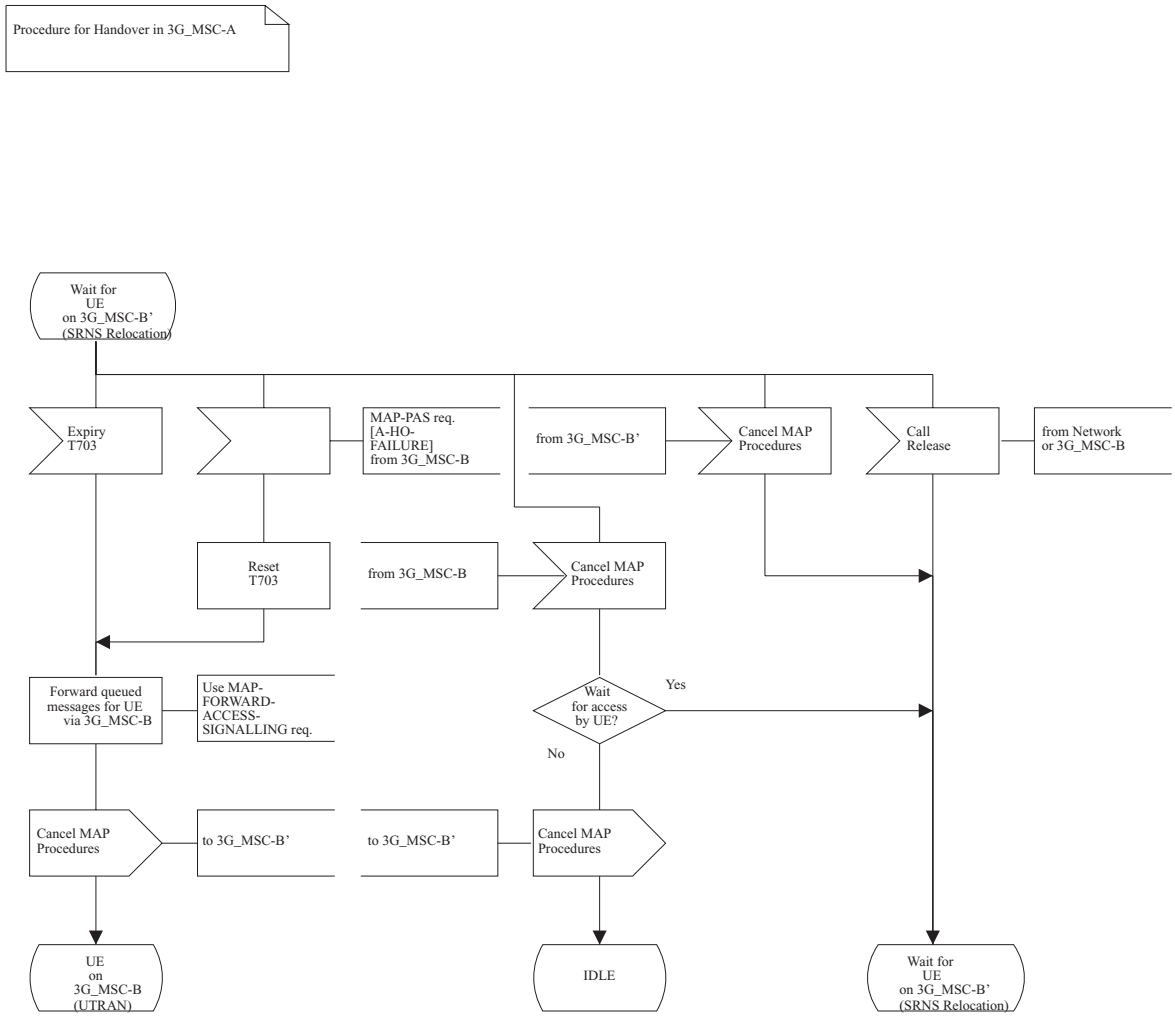


Figure 43 (Sheet 78 of 78): Handover control procedure in 3G_MSC-A

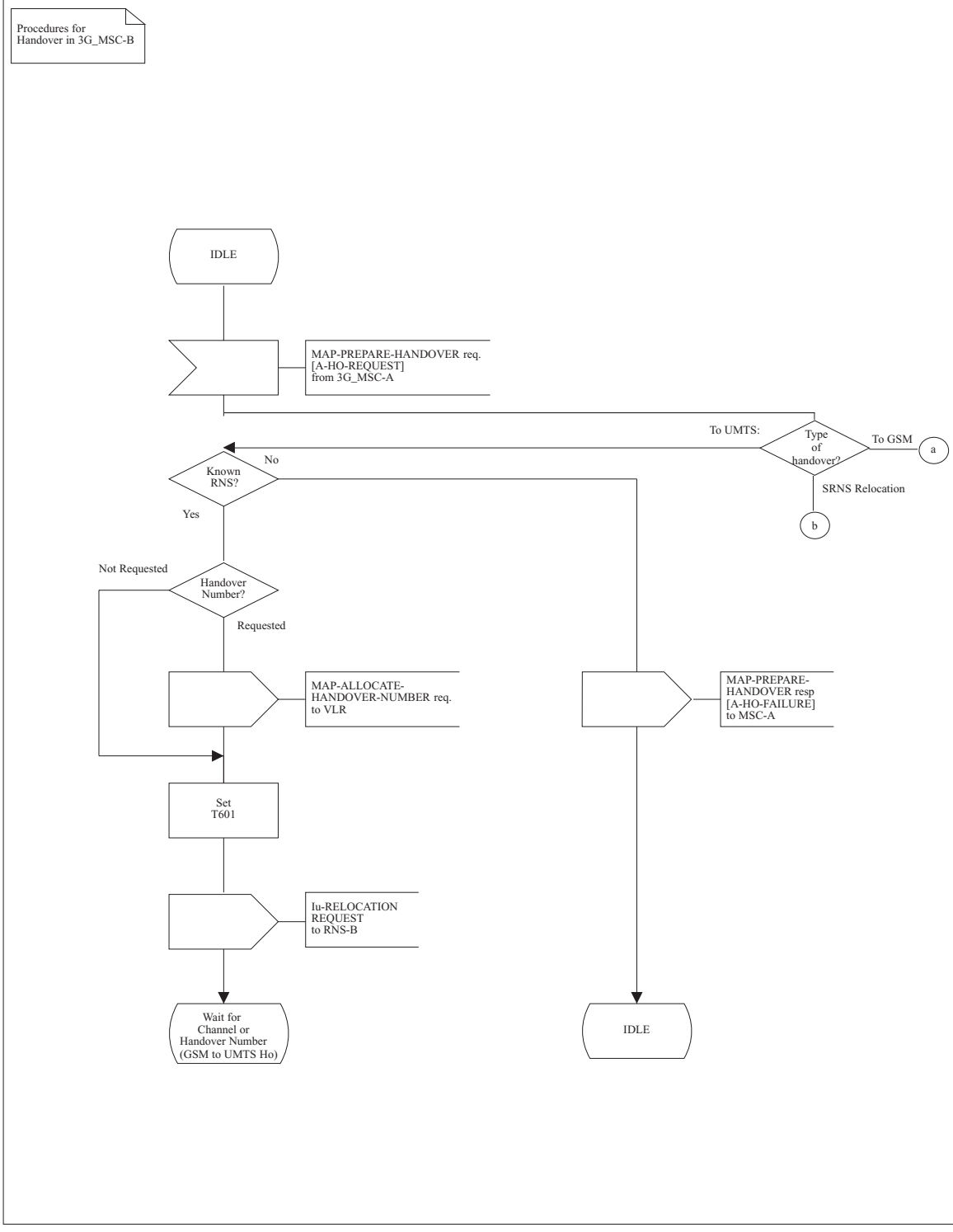


Figure 44 (Sheet 1of 54): Handover control procedure in 3G_MSC-B

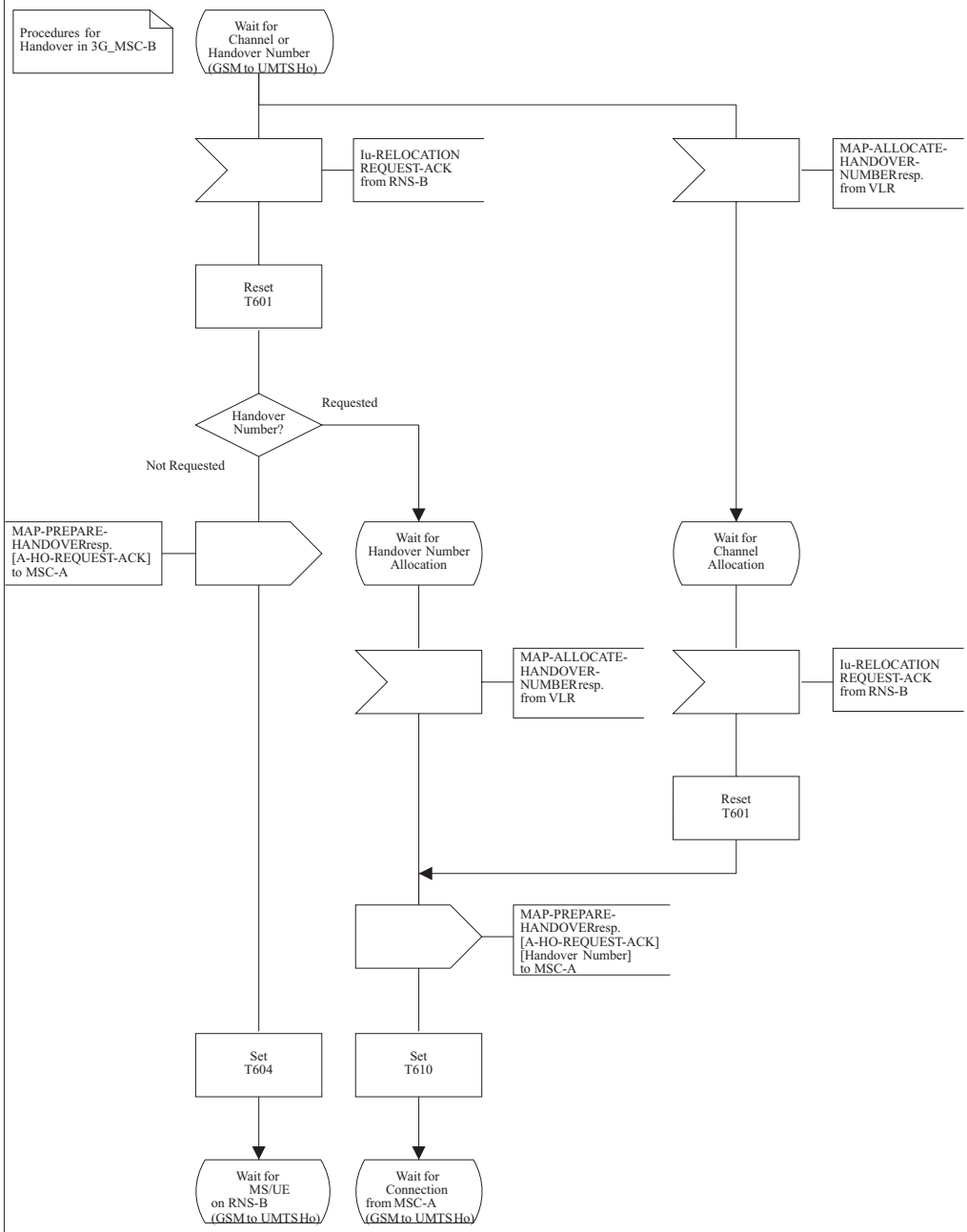


Figure 44 (Sheet 2 of 54): Handover control procedure in 3G_MSC-B

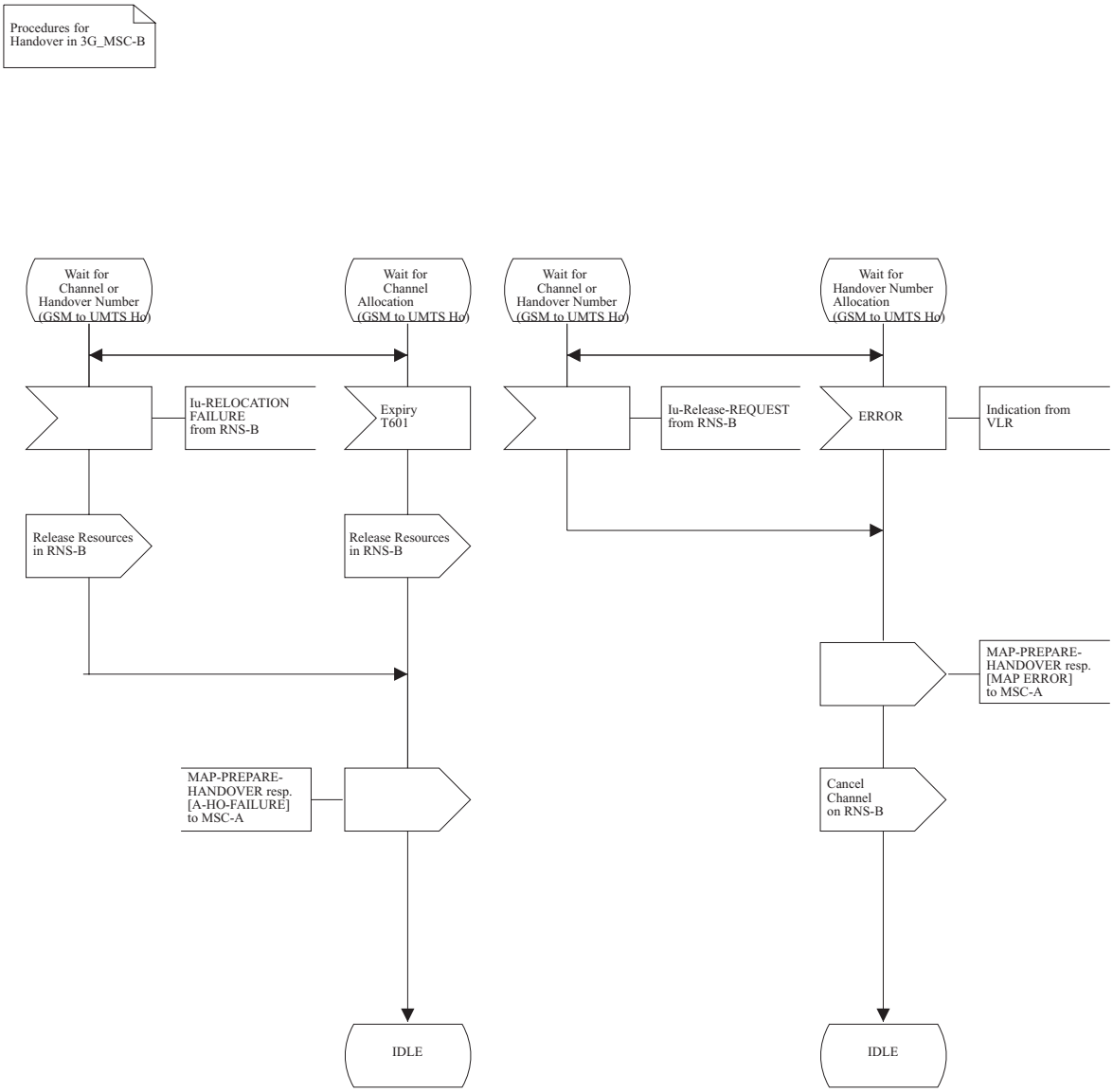


Figure 44 (Sheet 3 of 54): Handover control procedure in 3G_MSC-B

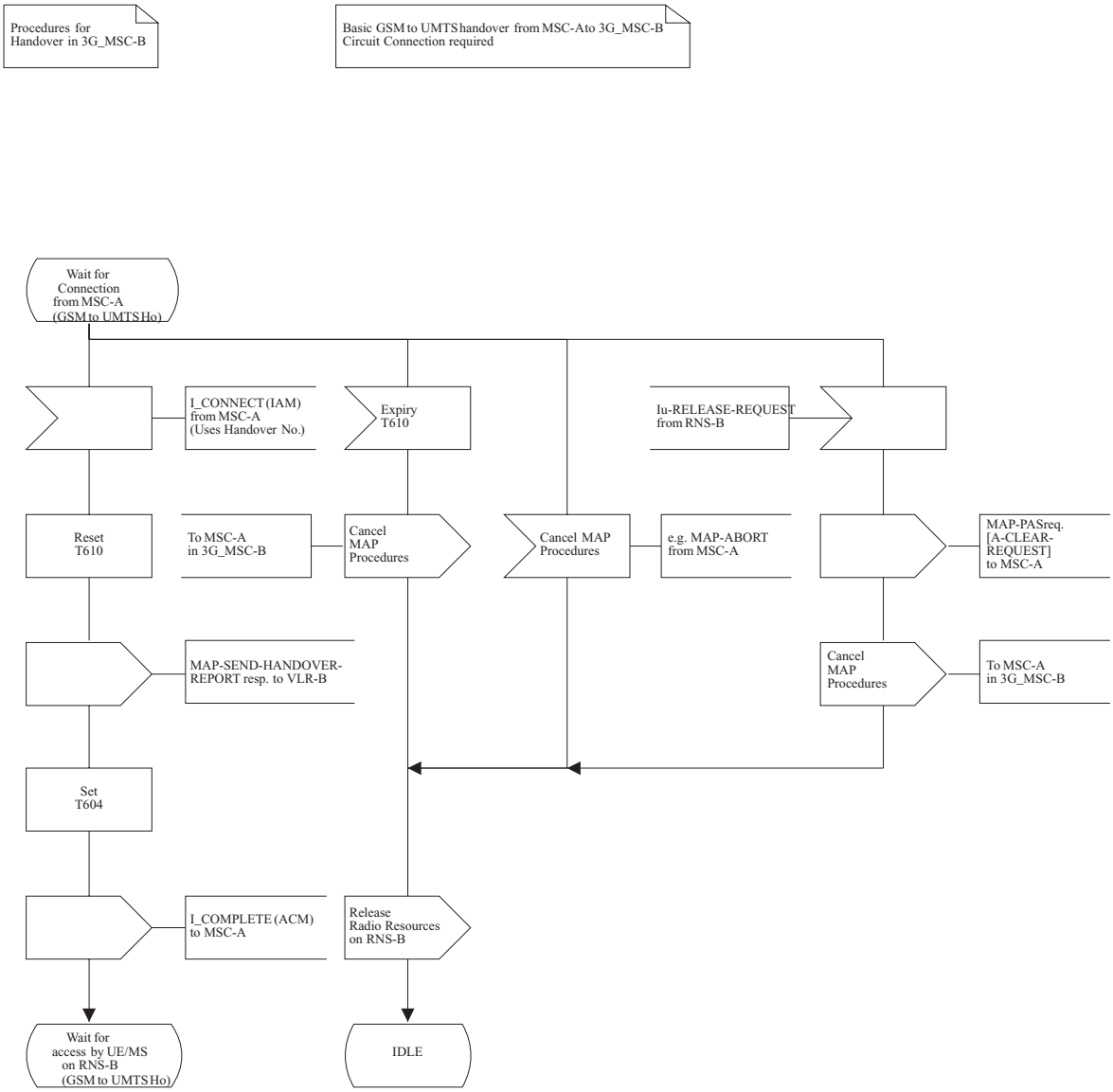


Figure 44 (Sheet 4 of 54): Handover control procedure in 3G_MSC-B

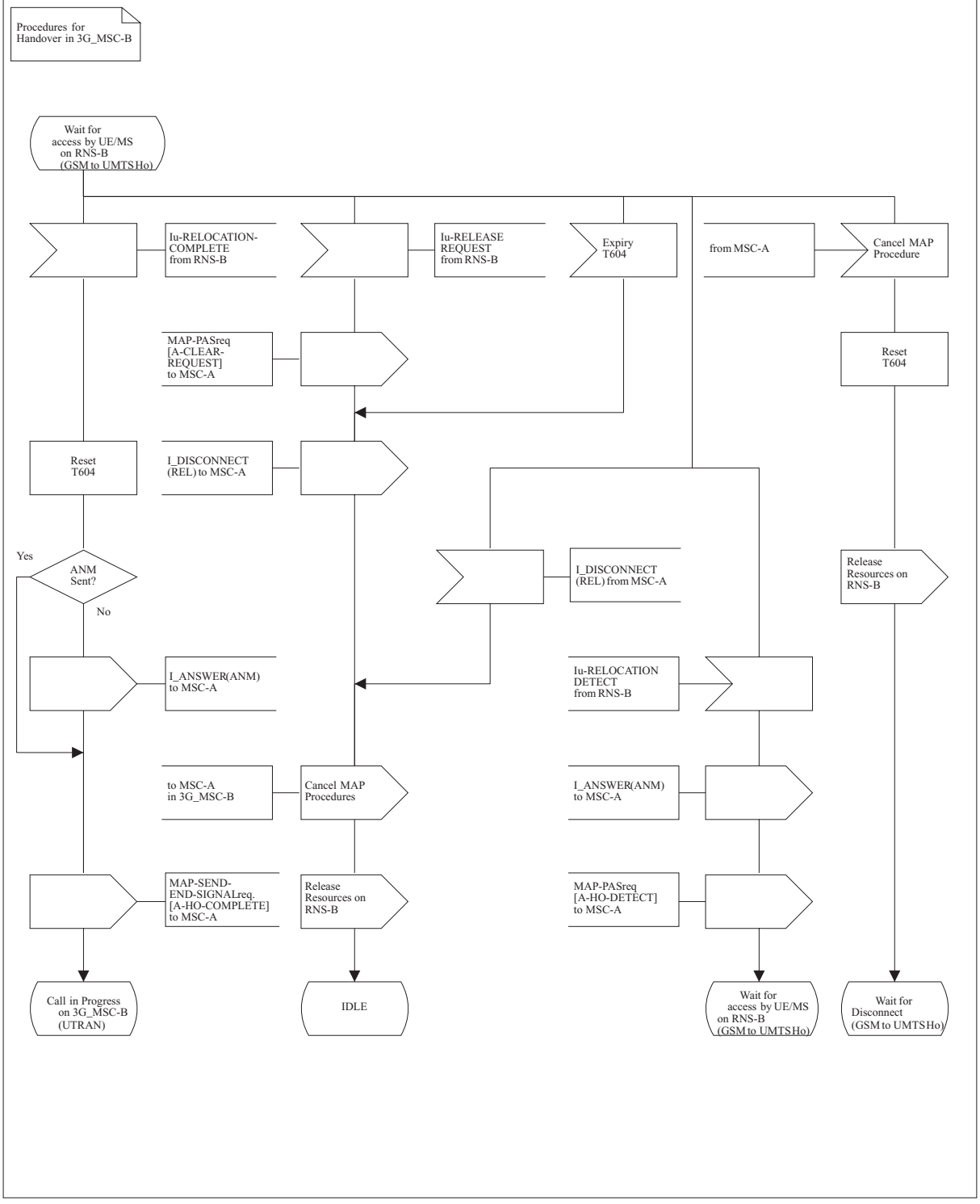


Figure 44 (Sheet 5 of 54): Handover control procedure in 3G_MSC-B

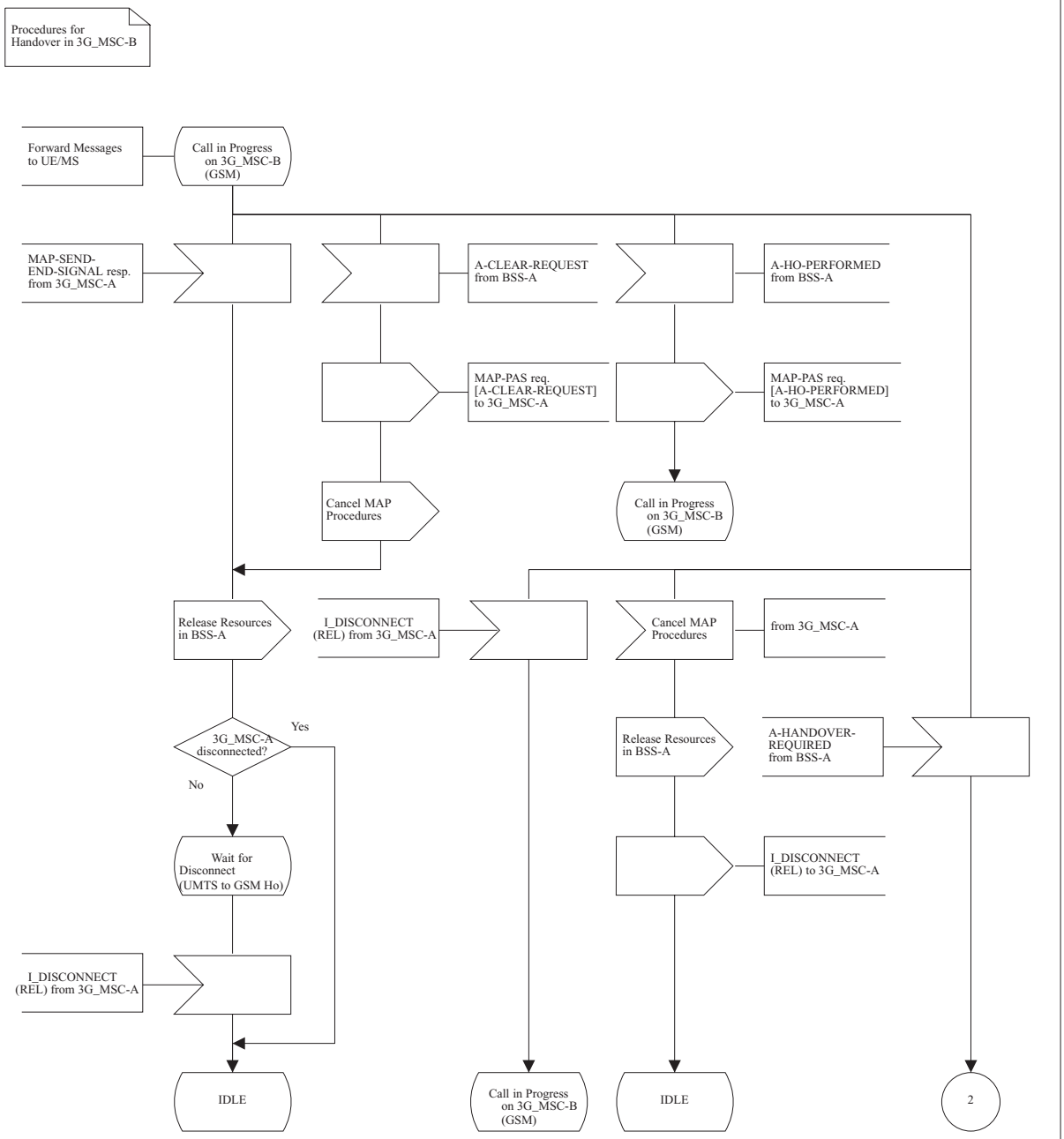


Figure 44 (Sheet 6 of 54): Handover control procedure in 3G_MSC-B

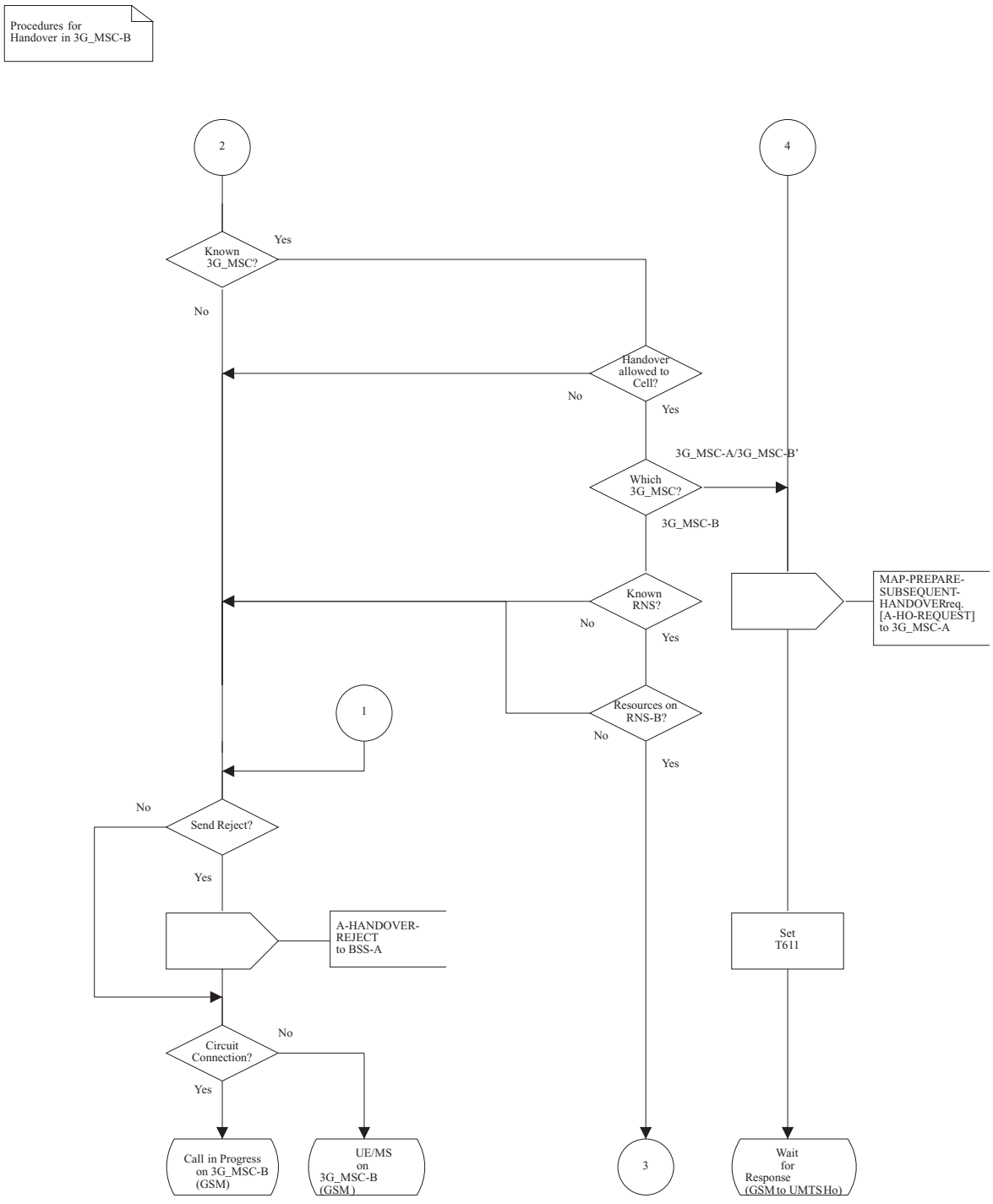


Figure 44 (Sheet 7 of 54): Handover control procedure in 3G_MSC-B

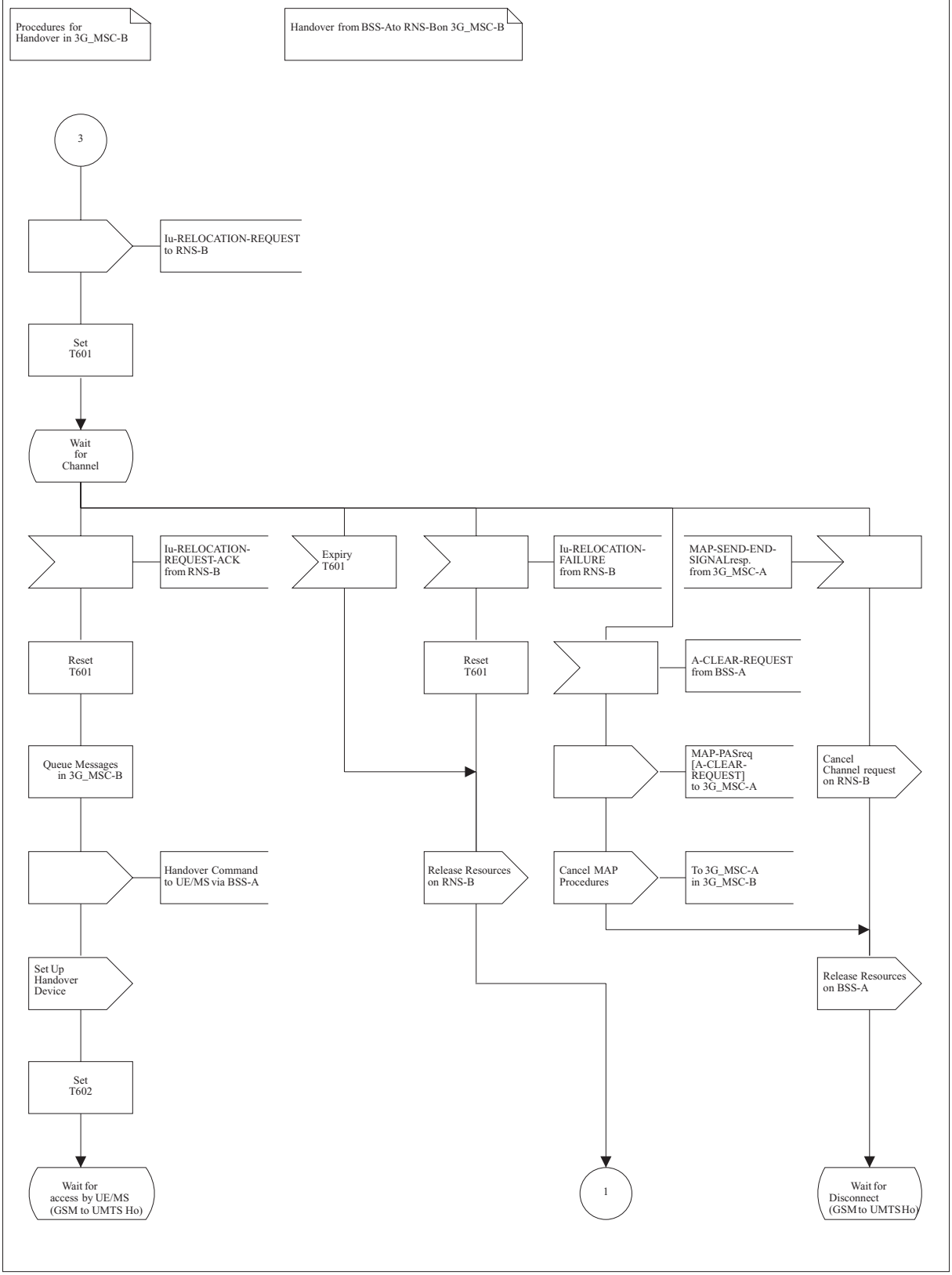


Figure 44 (Sheet 8 of 54): Handover control procedure in 3G_MSC-B

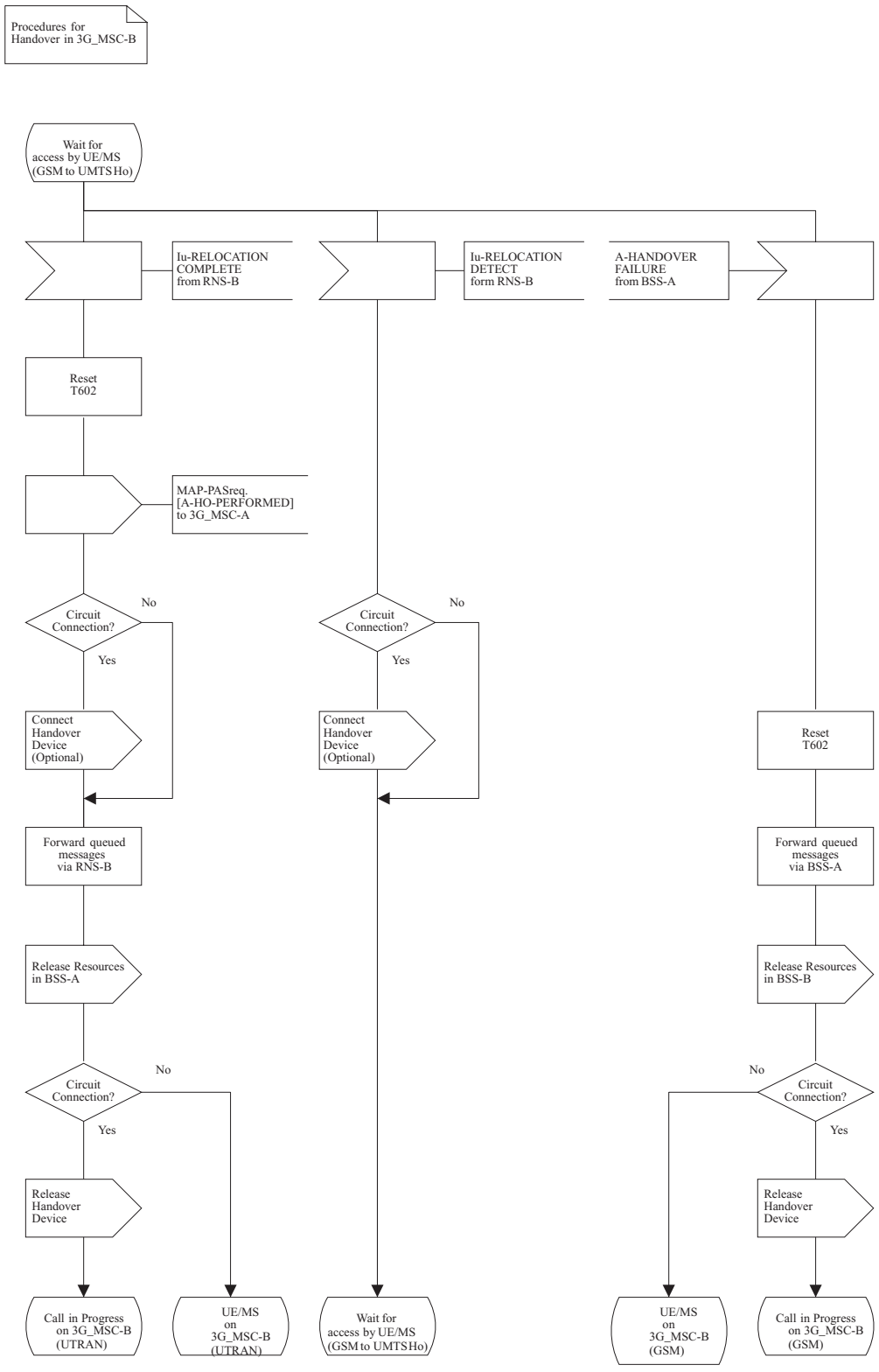


Figure 44 (Sheet 9 of 54): Handover control procedure in 3G_MSC-B

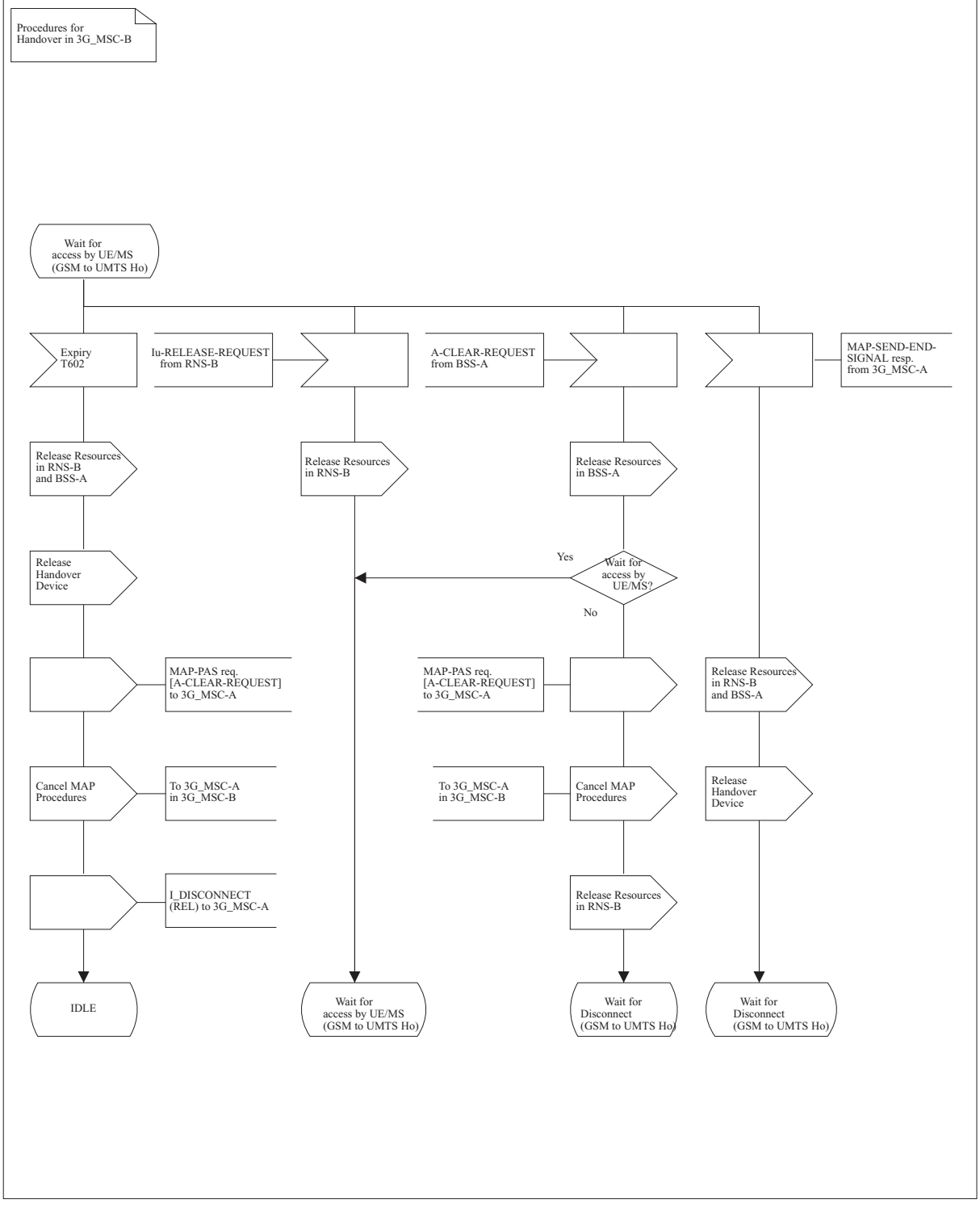


Figure 44 (Sheet 10 of 54): Handover control procedure in 3G_MSC-B

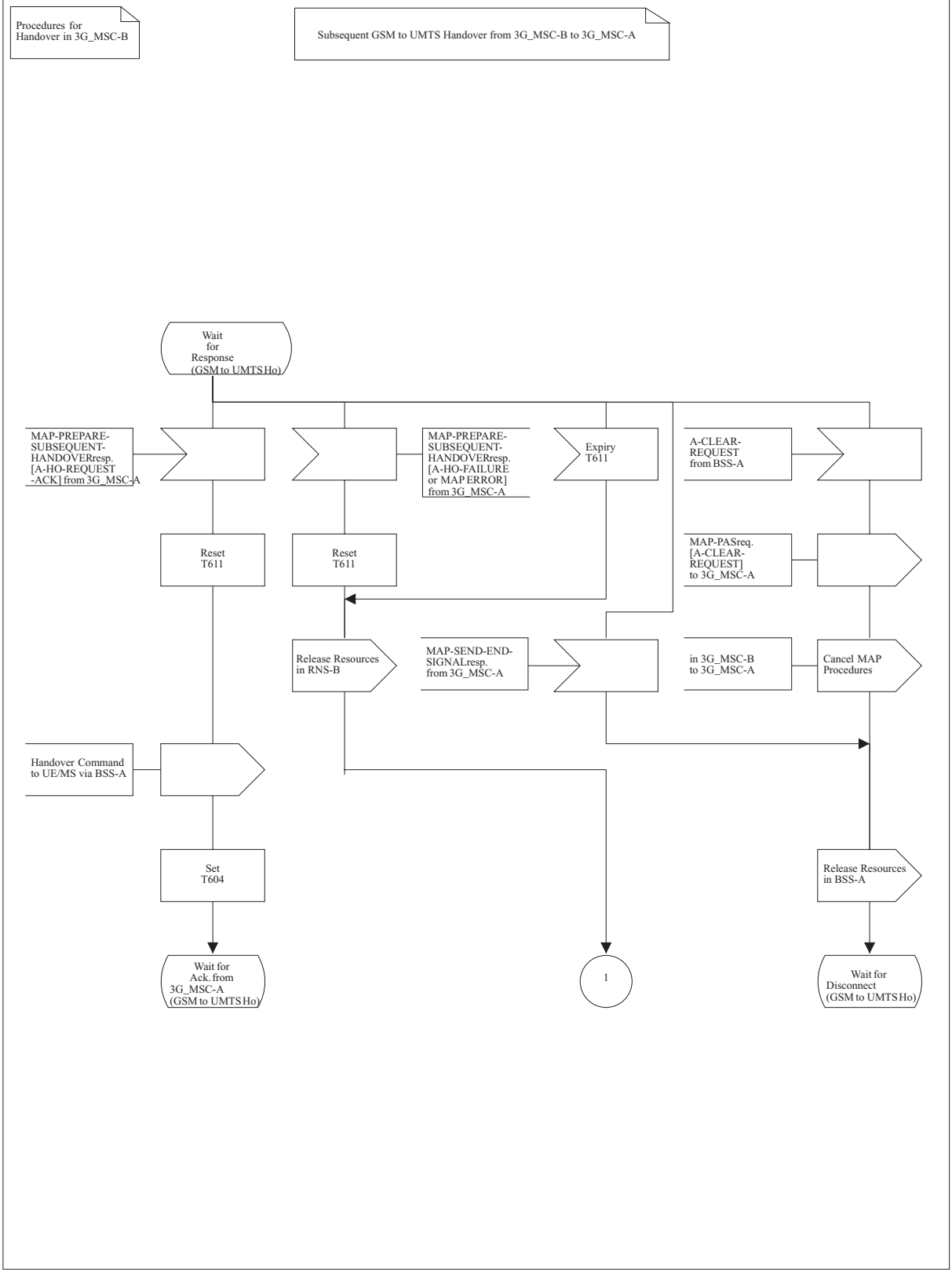


Figure 44 (Sheet 11 of 54): Handover control procedure in 3G_MSC-B

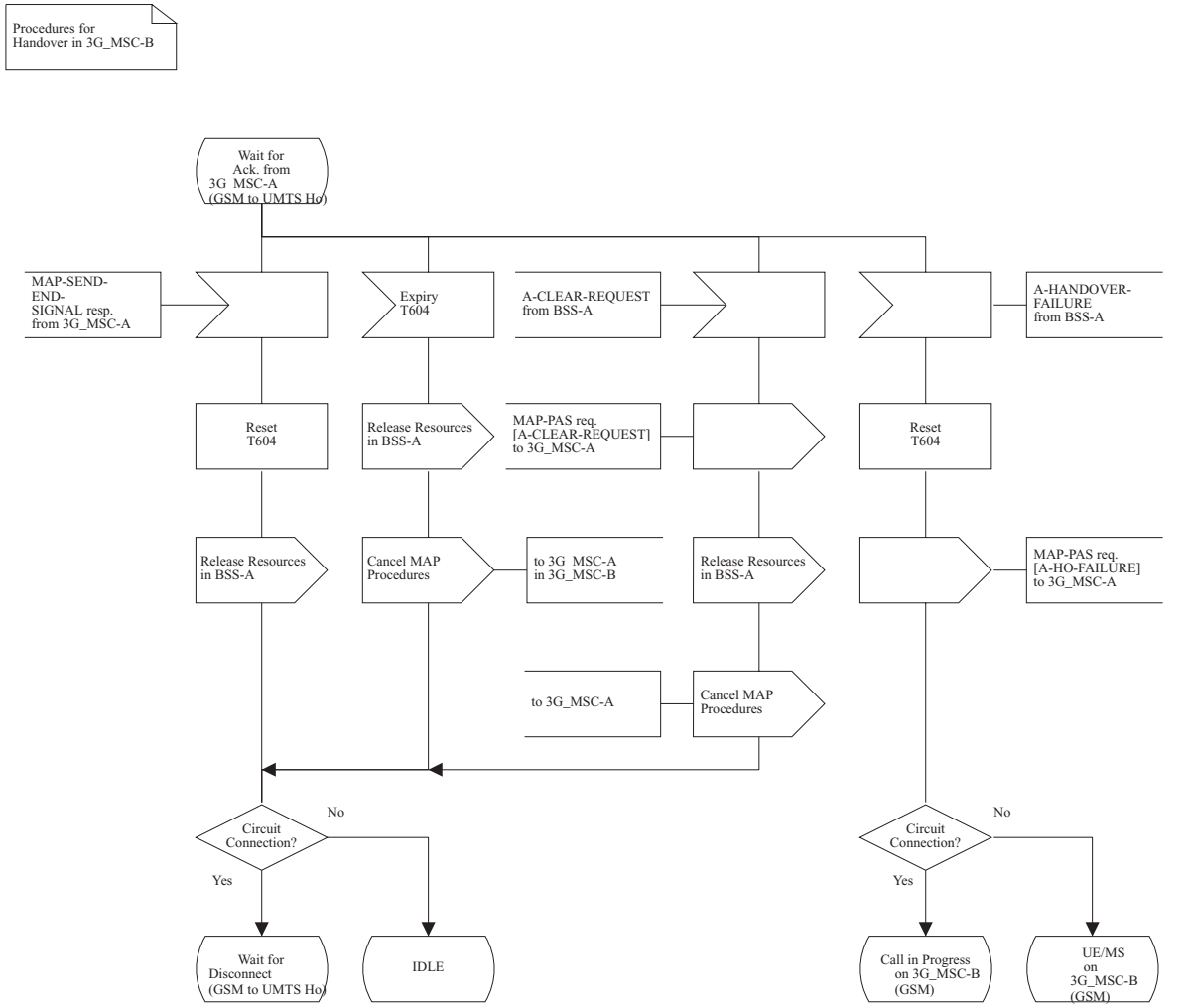


Figure 44 (Sheet 12 of 54): Handover control procedure in 3G_MSC-B

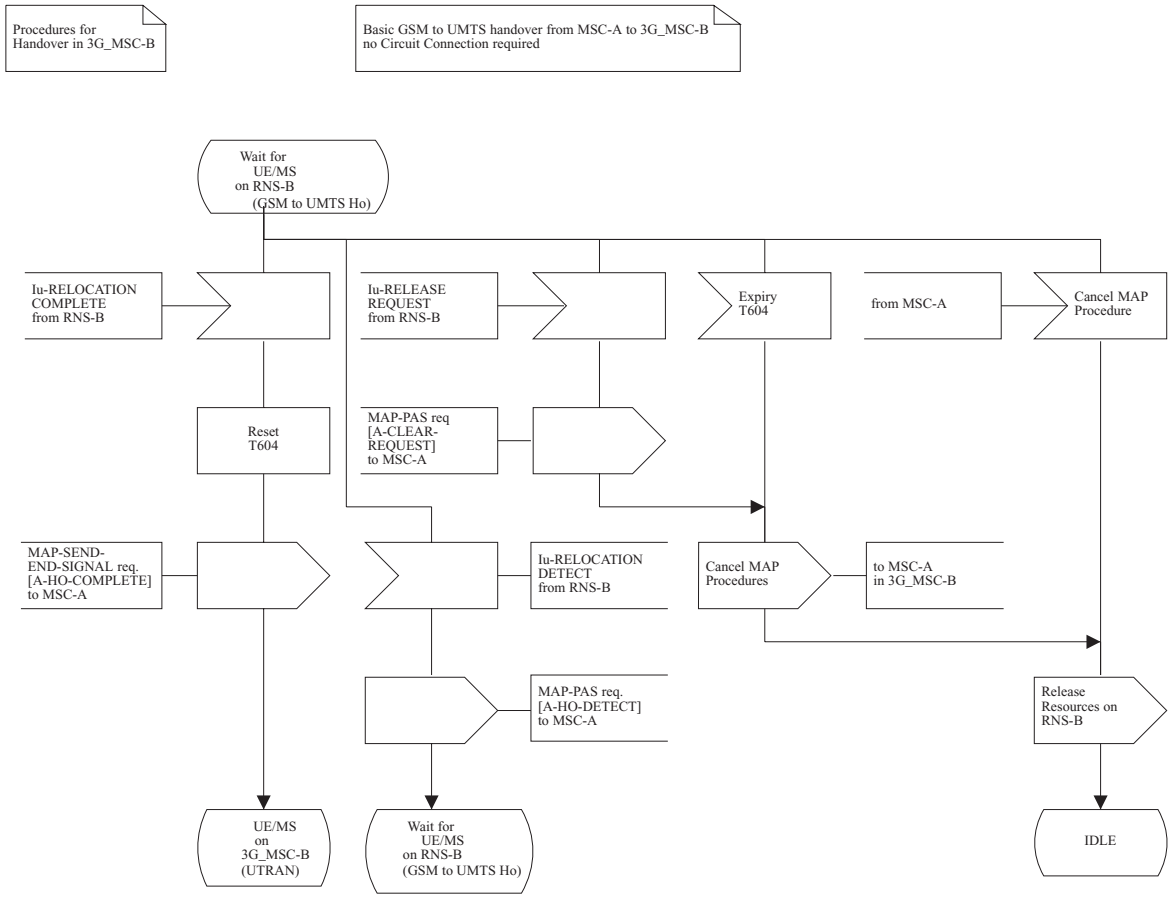


Figure 44 (Sheet 13 of 54): Handover control procedure in 3G_MSC-B

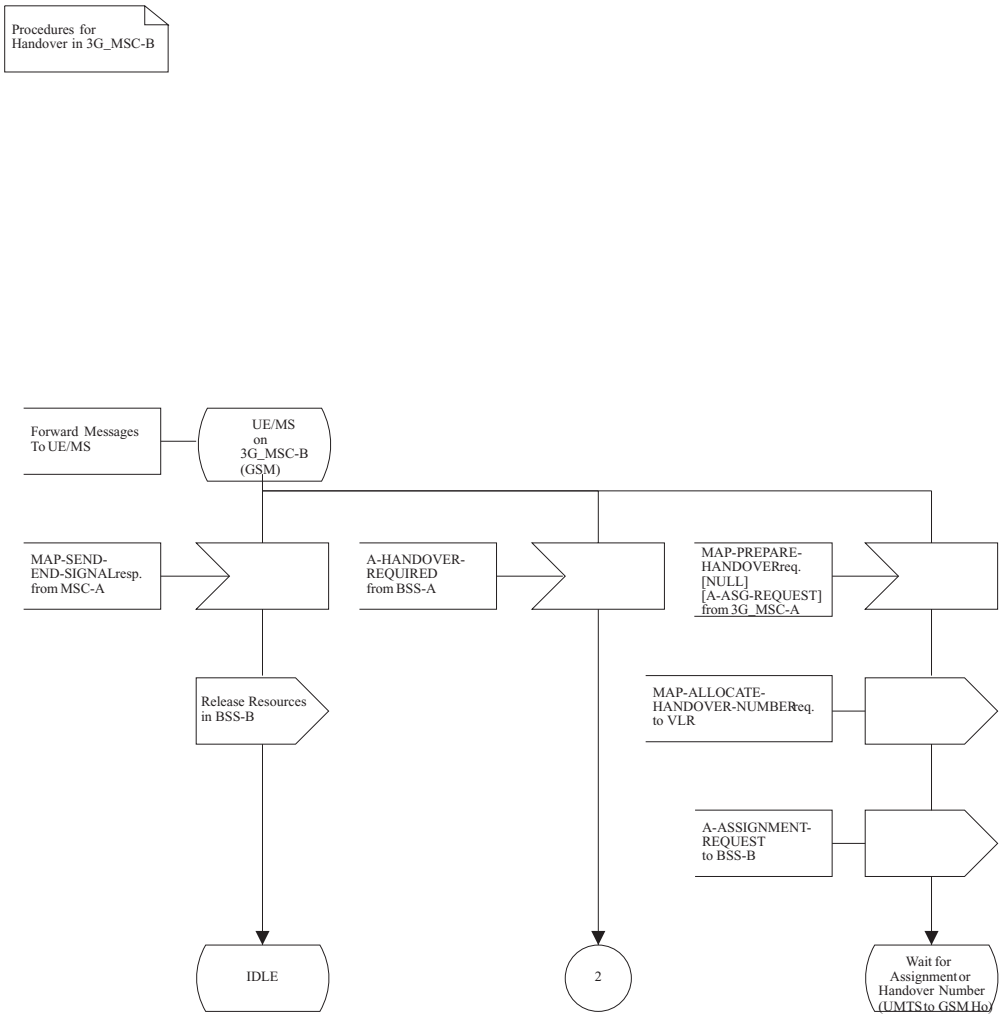


Figure 44 (Sheet 14 of 54): Handover control procedure in 3G_MSC-B

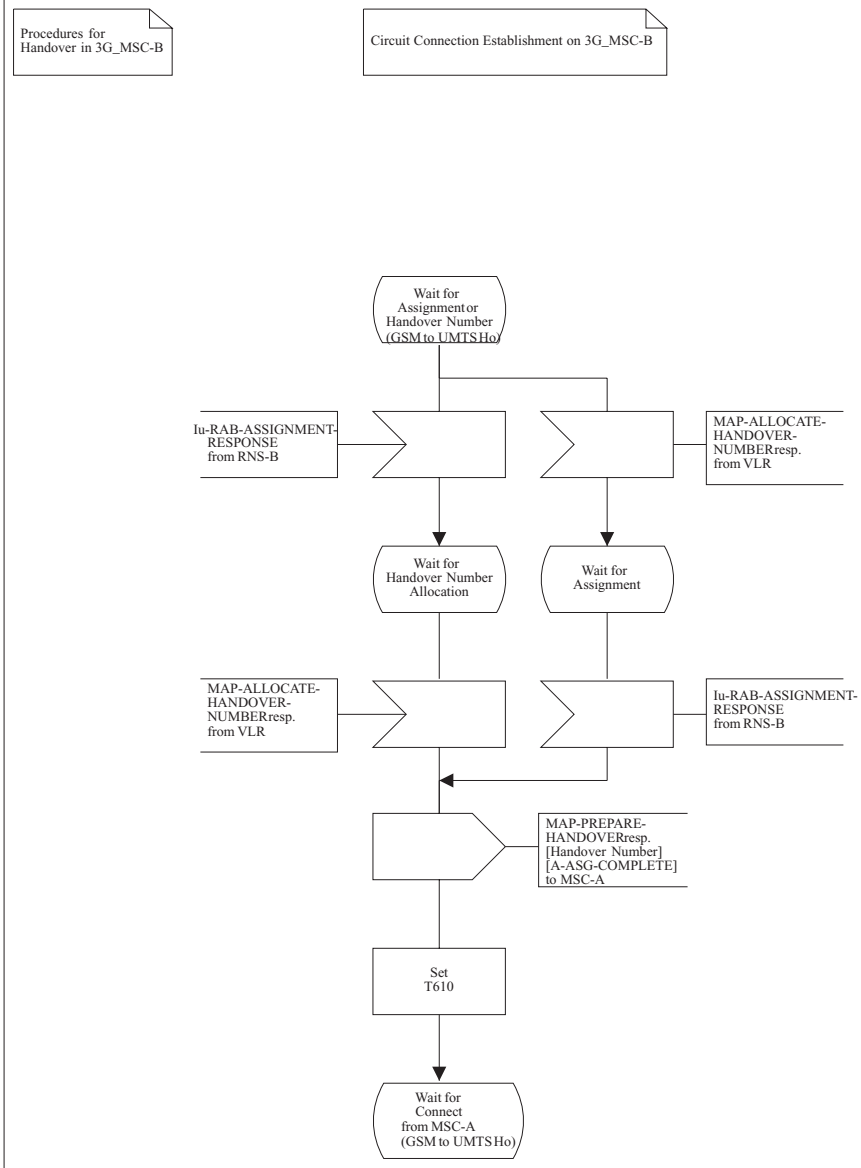


Figure 44 (Sheet 15 of 54): Handover control procedure in 3G_MSC-B

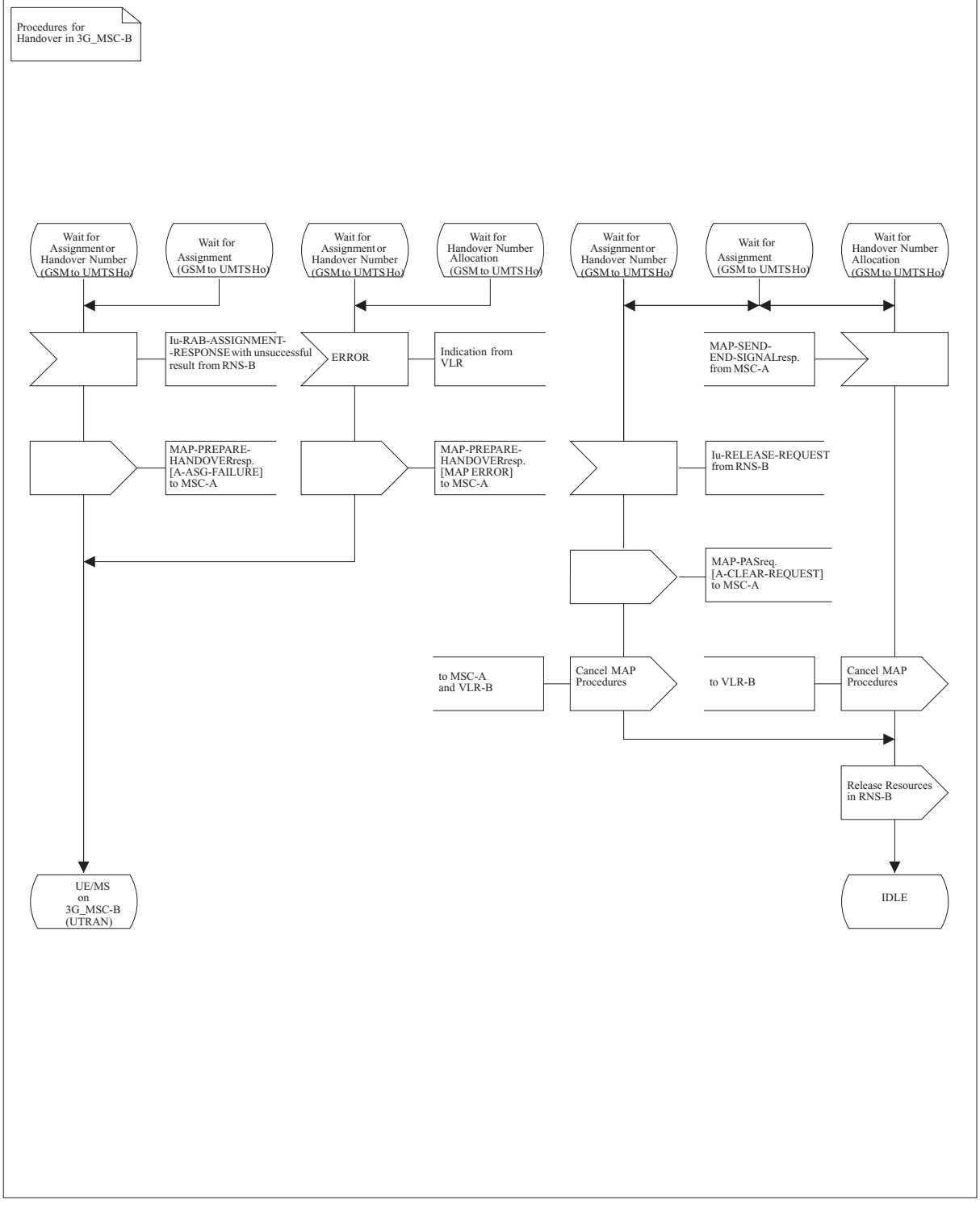


Figure 44 (Sheet 16 of 54): Handover control procedure in 3G_MSC-B

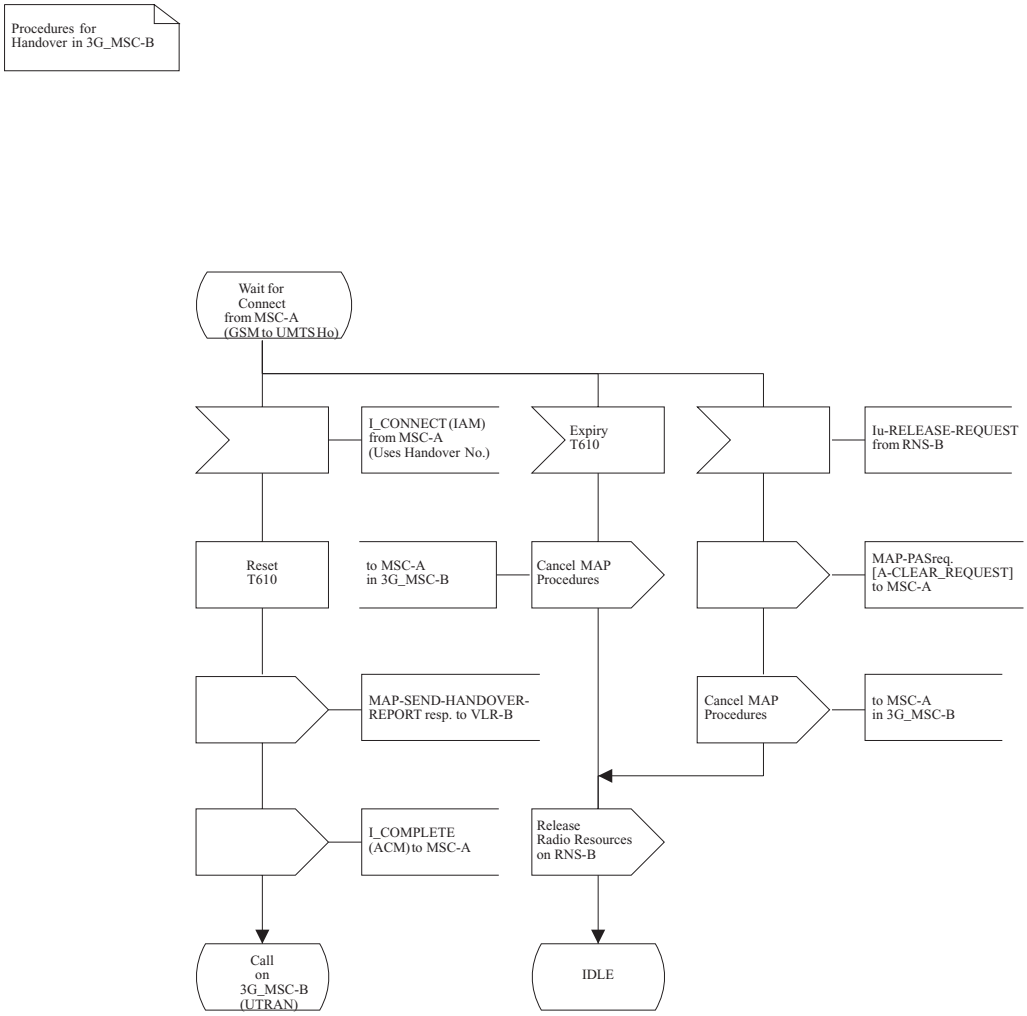


Figure 44 (Sheet 17 of 54): Handover control procedure in 3G_MSC-B

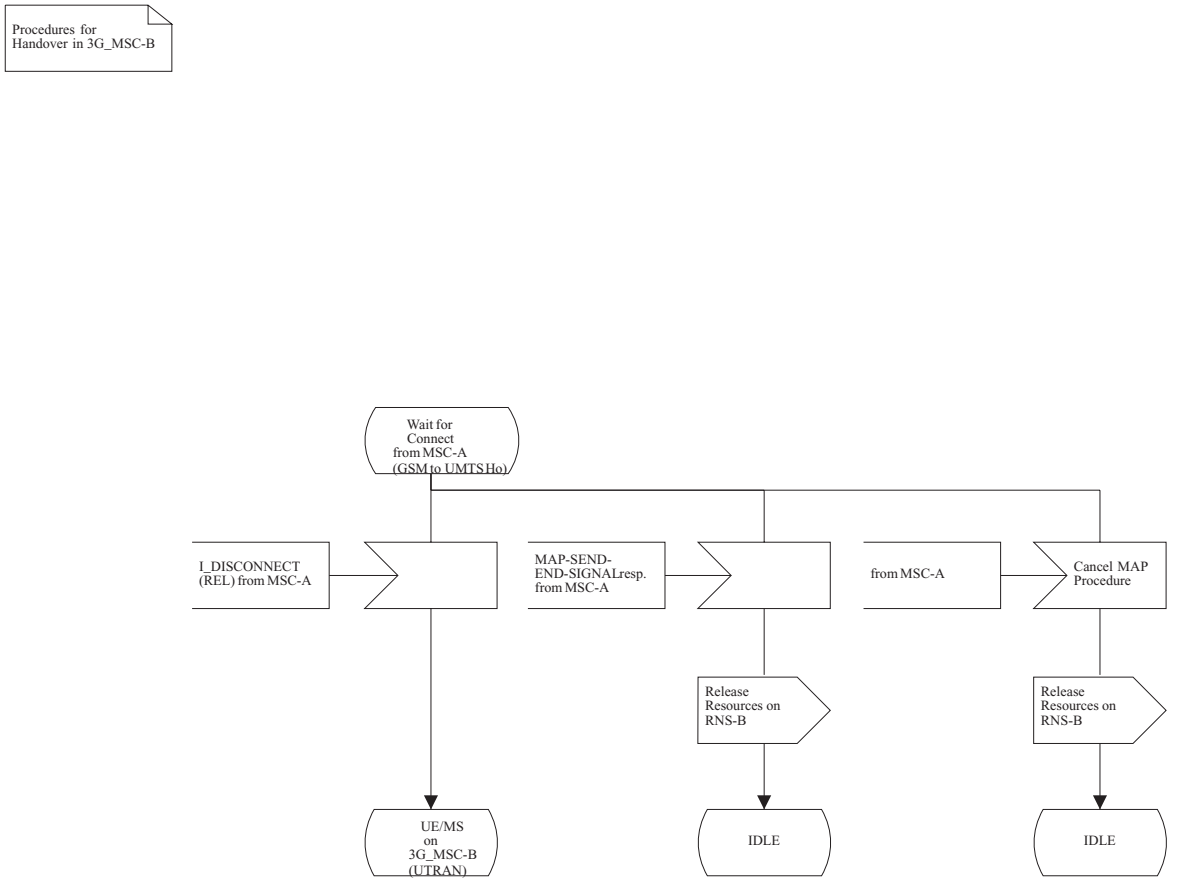


Figure 44 (Sheet 18 of 54): Handover control procedure in 3G_MSC-B

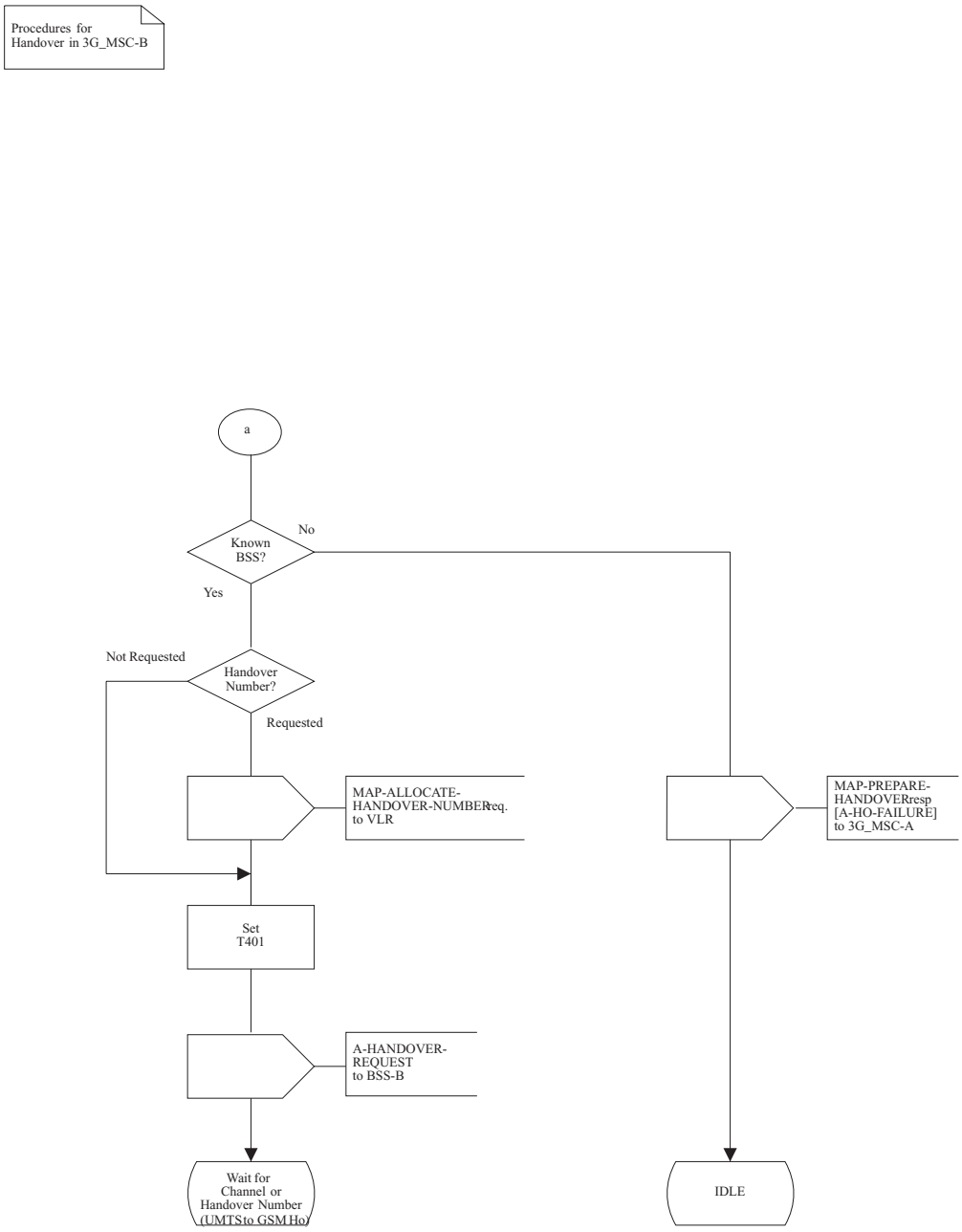


Figure 44 (Sheet 19 of 54): Handover control procedure in 3G_MSC-B

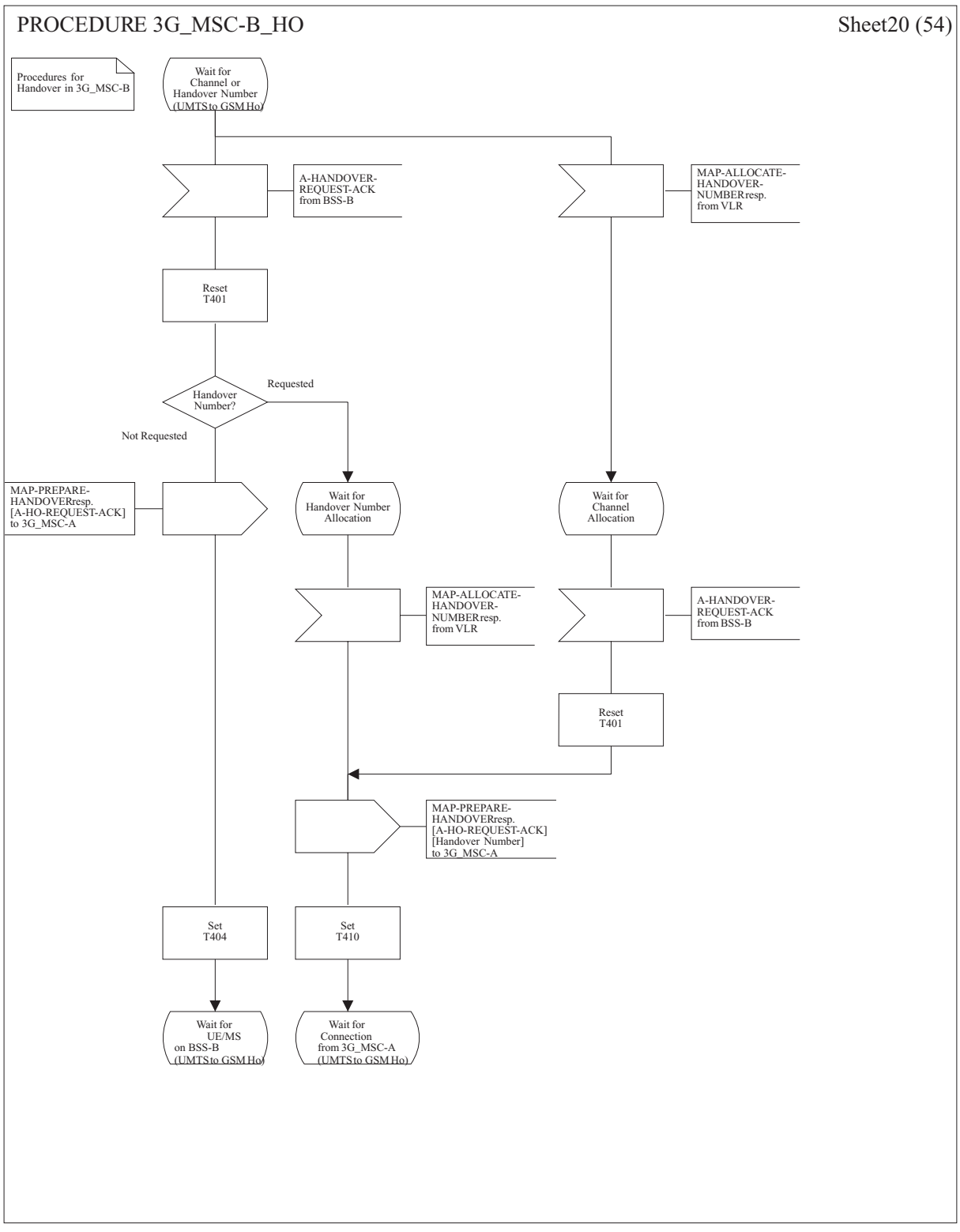


Figure 44 (Sheet 20 of 54): Handover control procedure in 3G_MSC-B

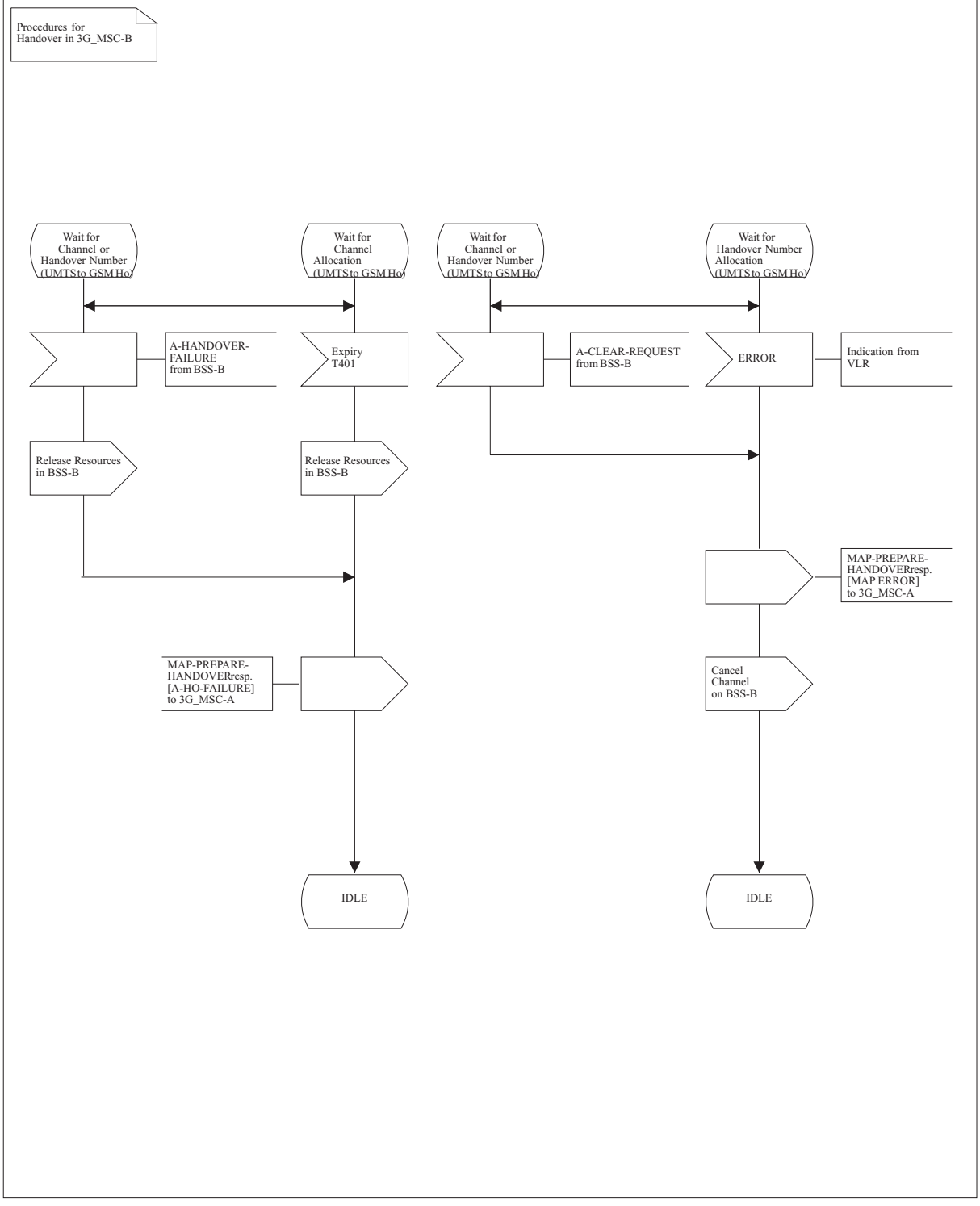


Figure 44 (Sheet 21 of 54): Handover control procedure in 3G_MSC-B

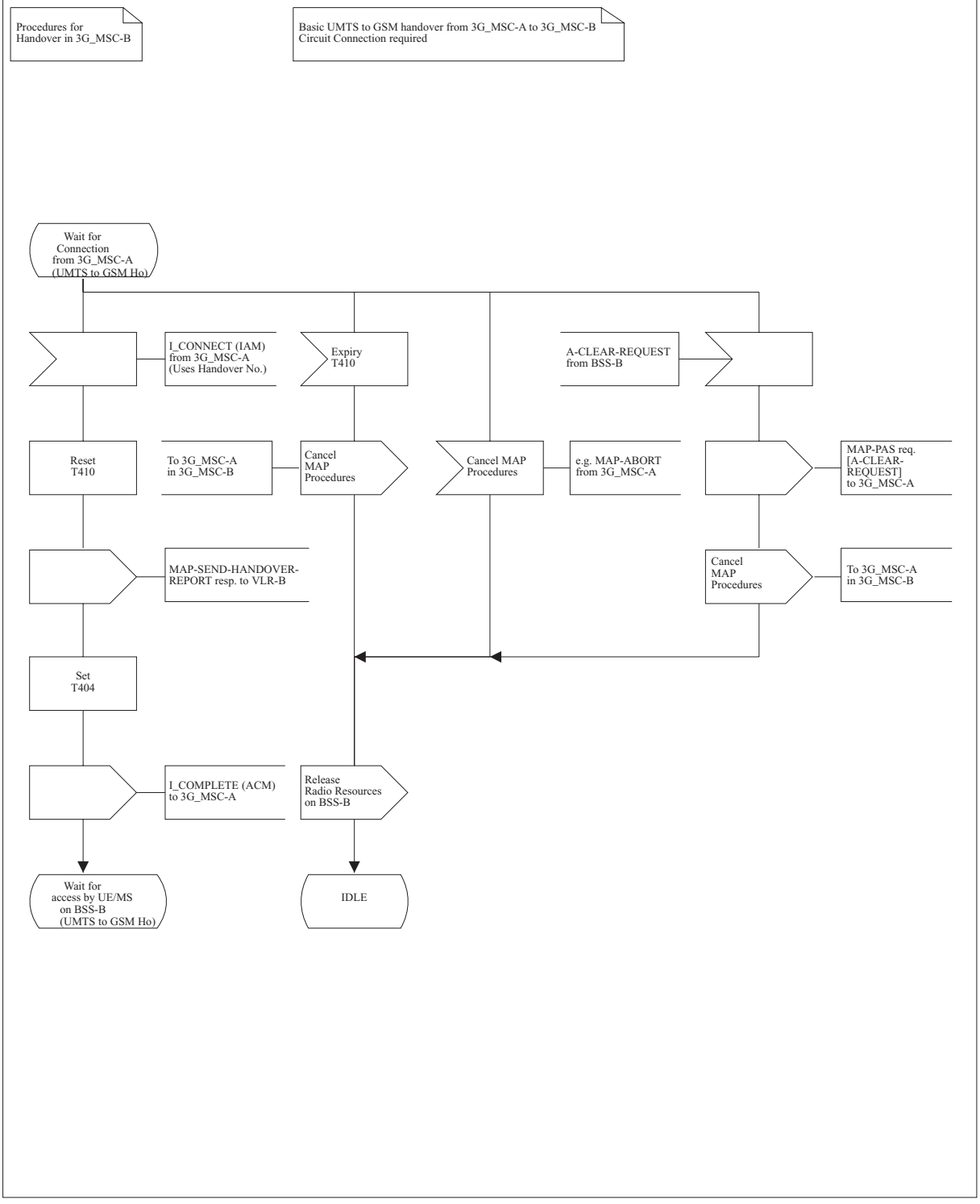


Figure 44 (Sheet 22 of 54): Handover control procedure in 3G_MSC-B

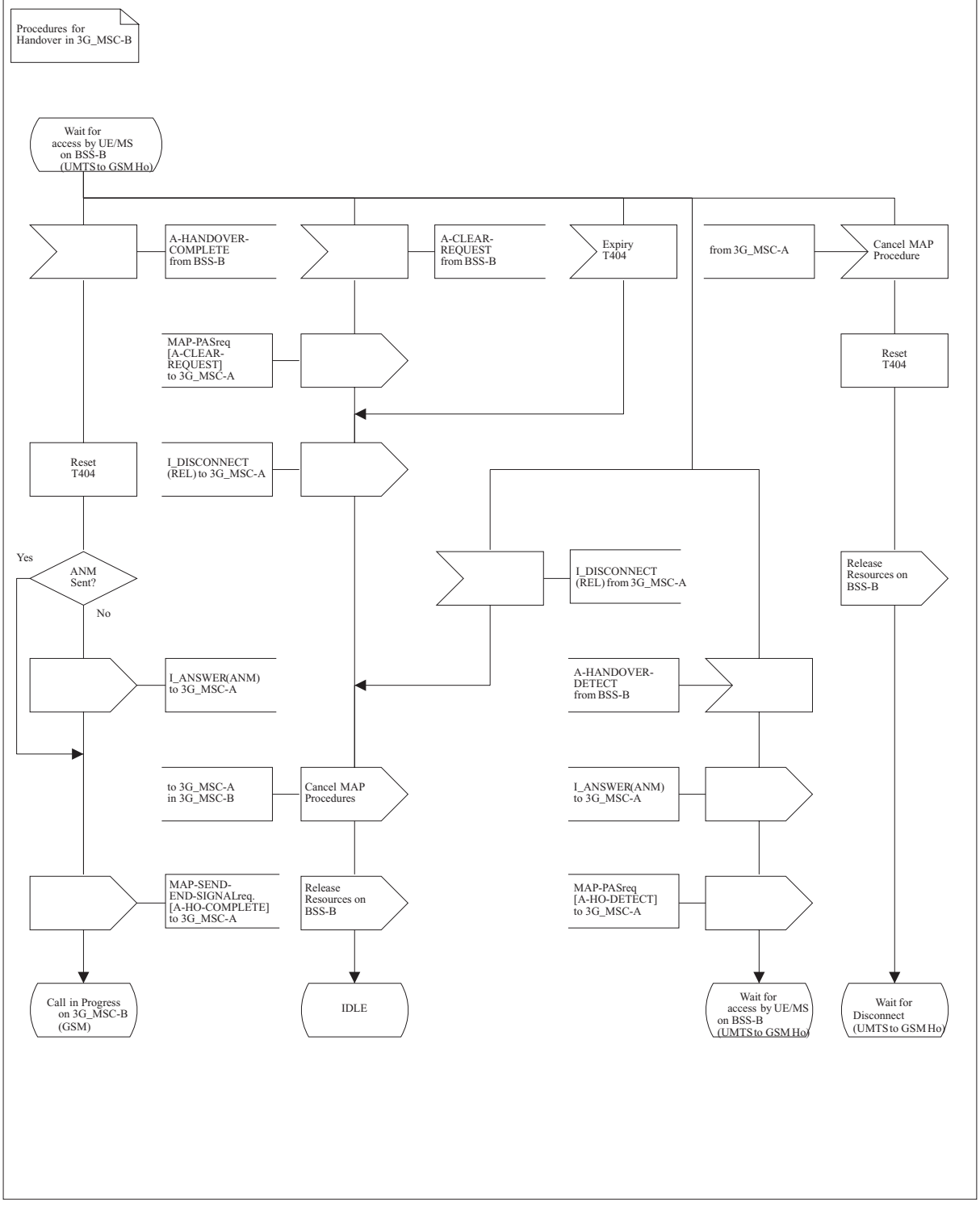


Figure 44 (Sheet 23 of 54): Handover control procedure in 3G_MSC-B

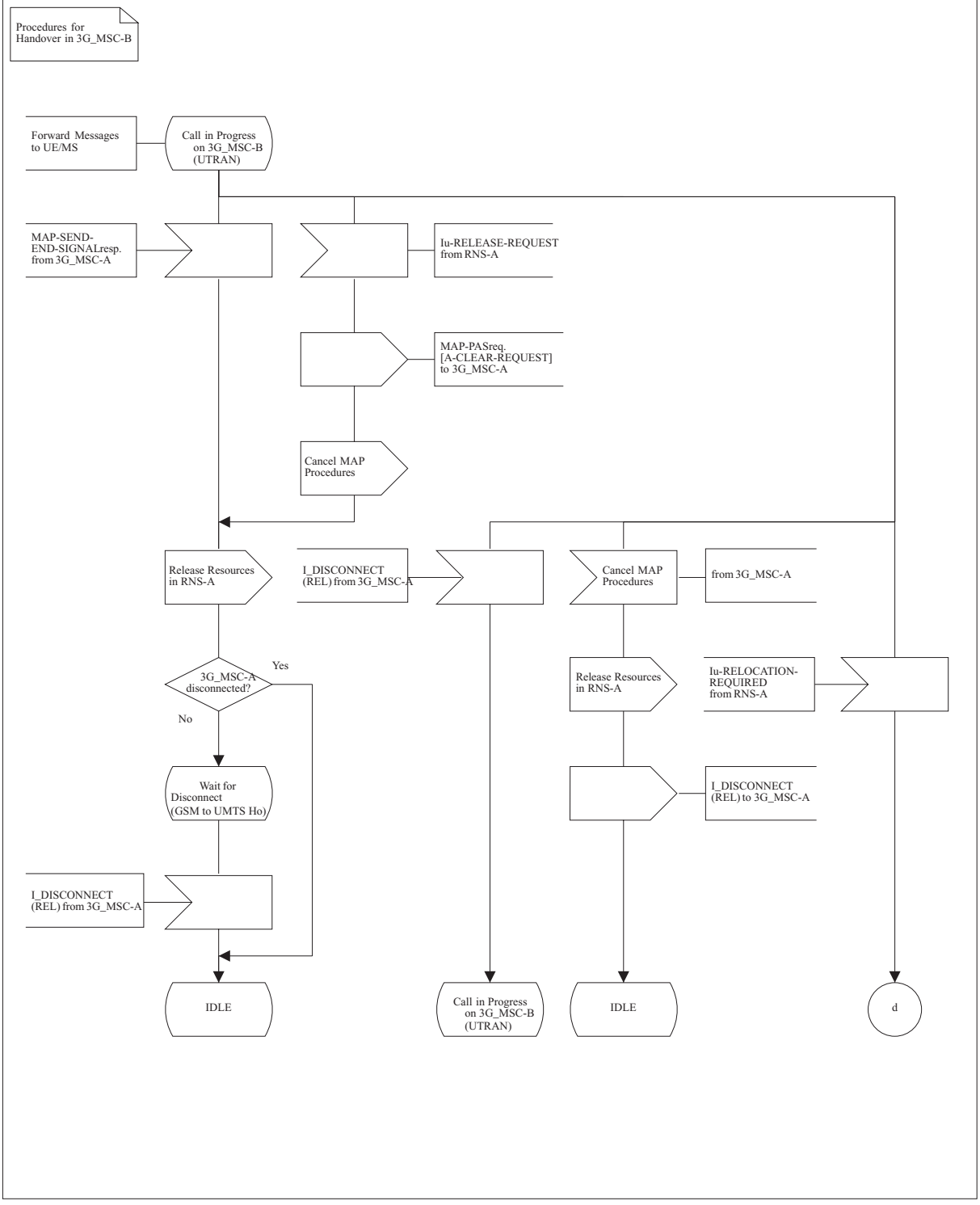


Figure 44 (Sheet 24 of 54): Handover control procedure in 3G_MSC-B

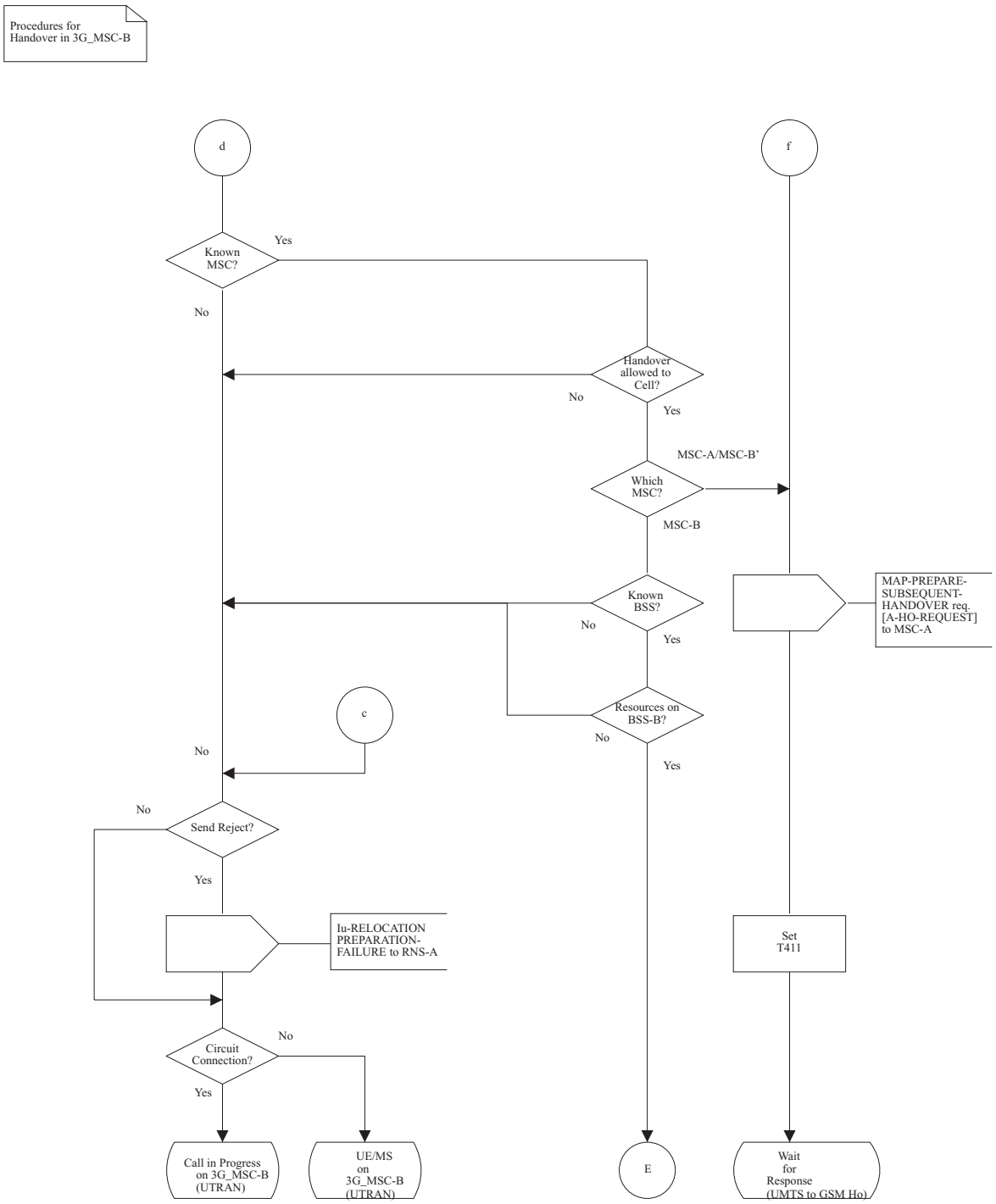


Figure 44 (Sheet 25 of 54): Handover control procedure in 3G_MSC-B

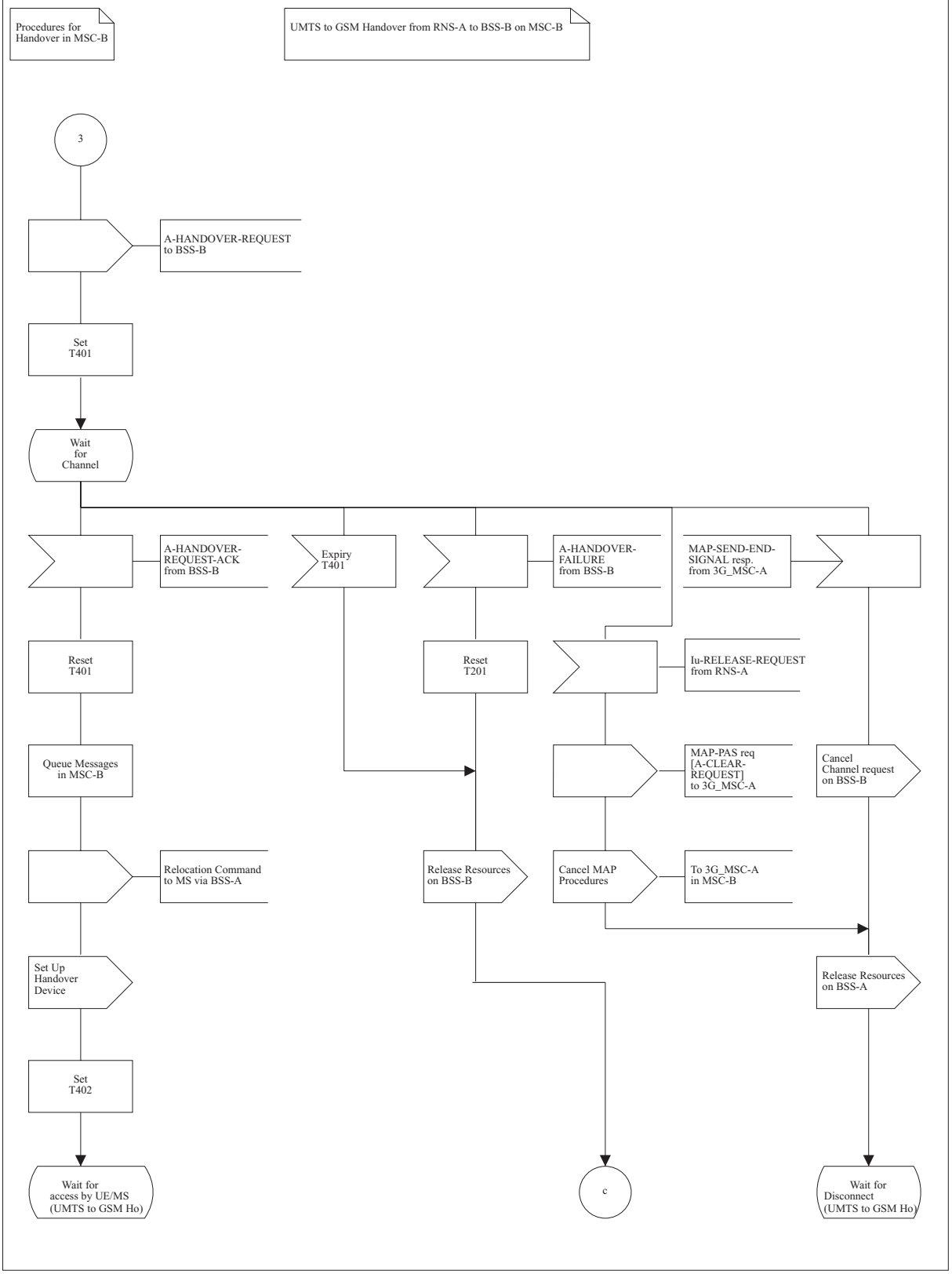


Figure 44 (Sheet 26 of 54): Handover control procedure in 3G_MSC-B

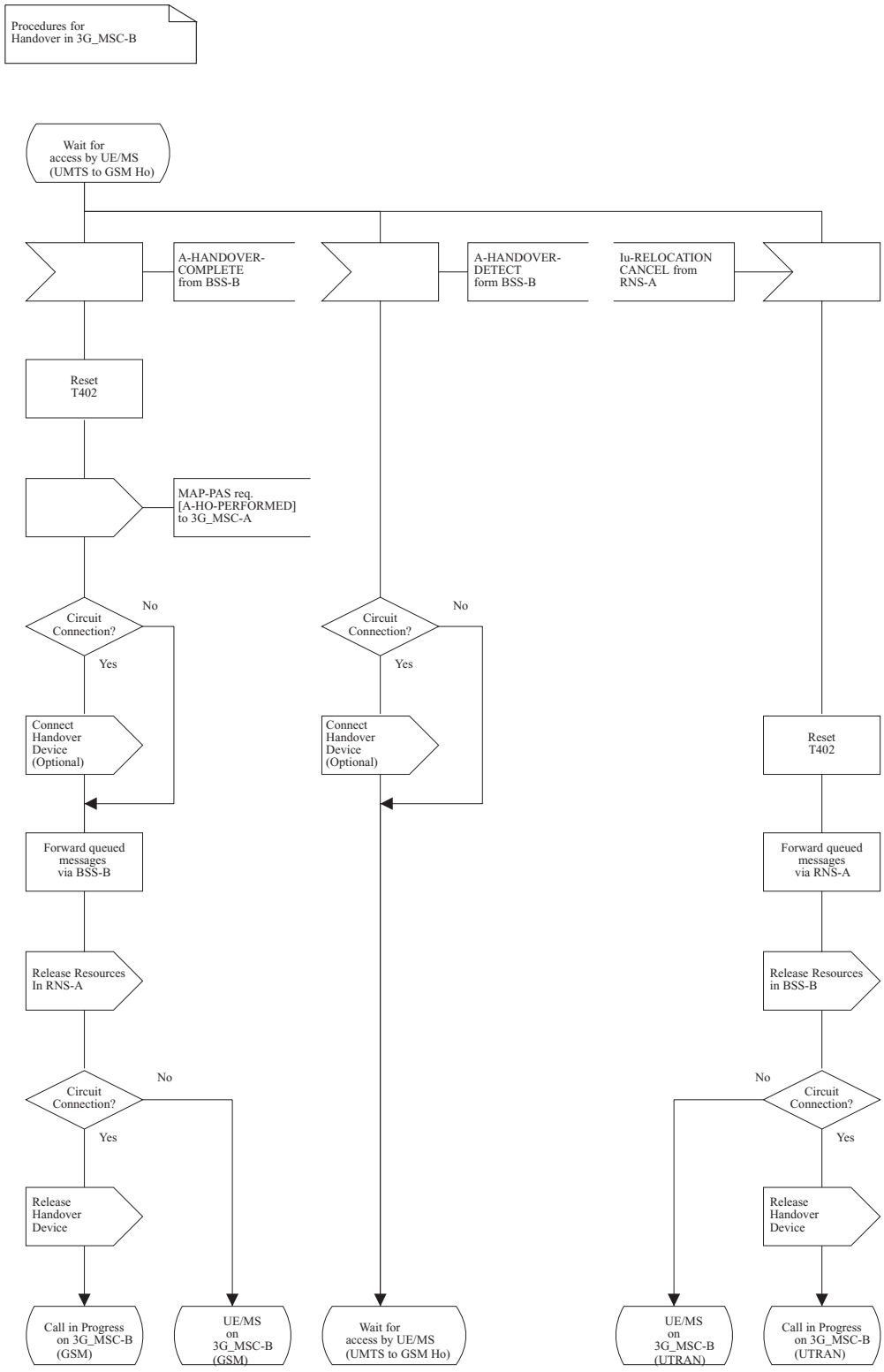


Figure 44 (Sheet 27 of 54): Handover control procedure in 3G_MSC-B

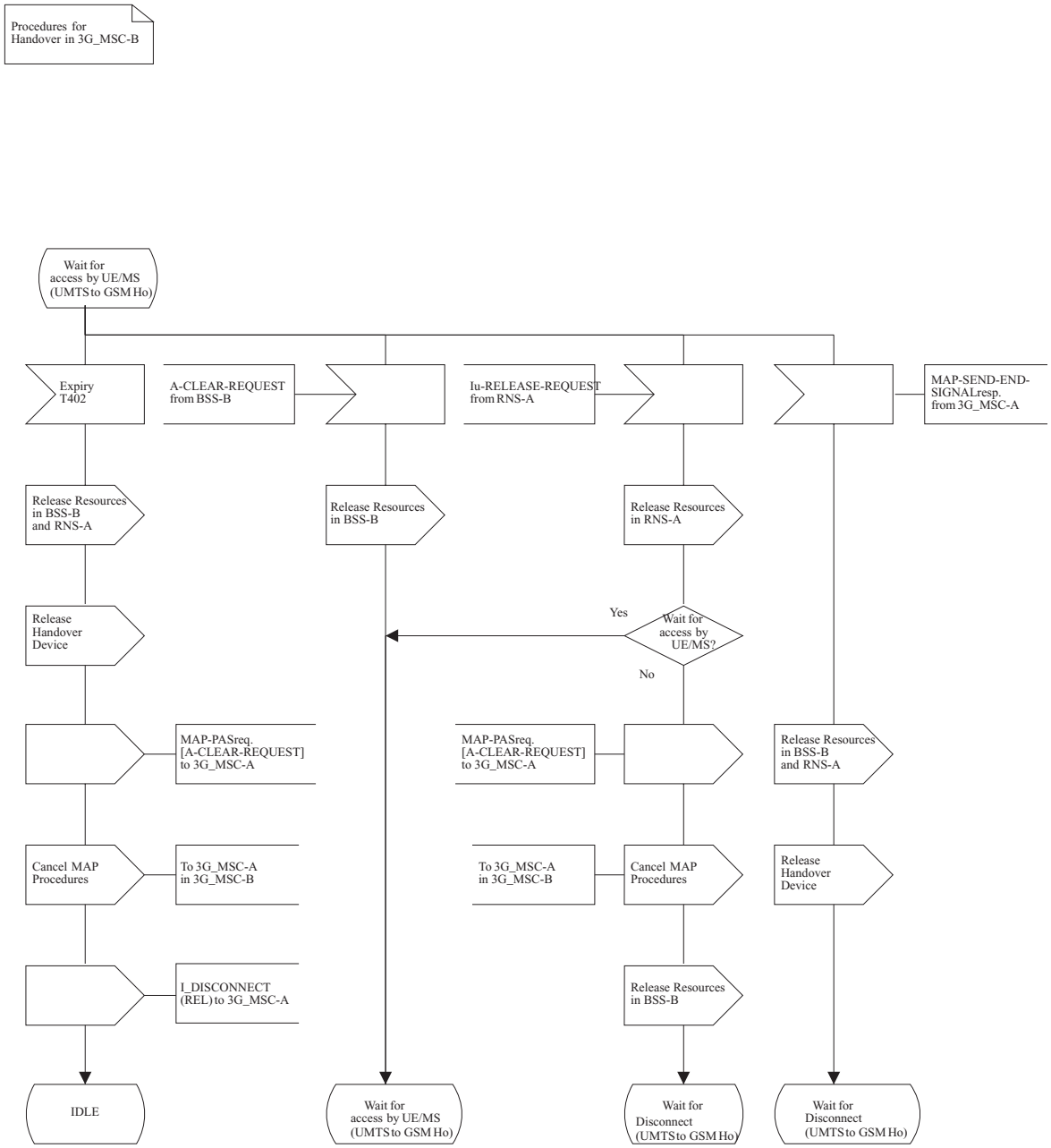


Figure 44 (Sheet 28 of 54): Handover control procedure in 3G_MSC-B

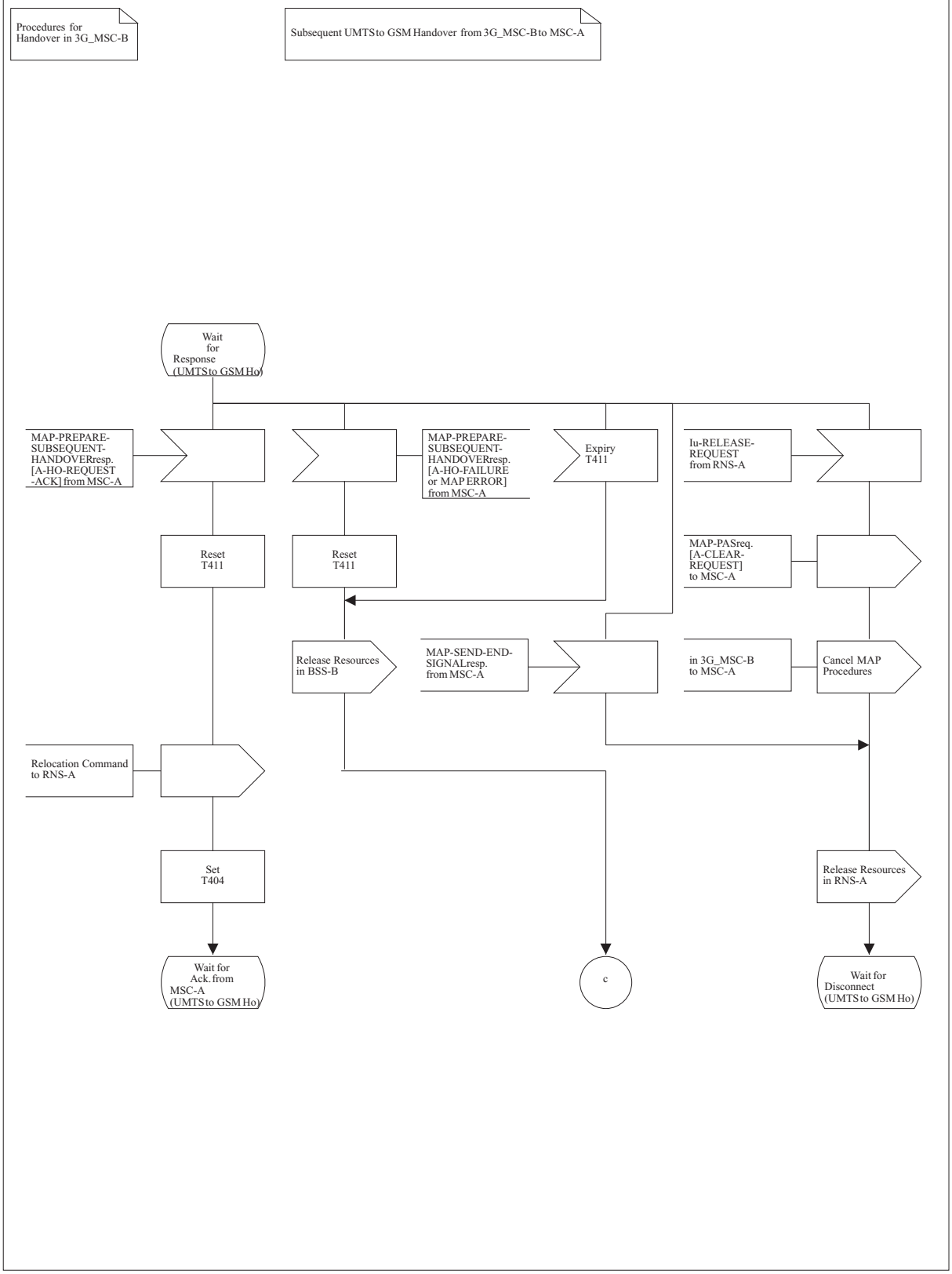


Figure 44 (Sheet 29 of 54): Handover control procedure in 3G_MSC-A

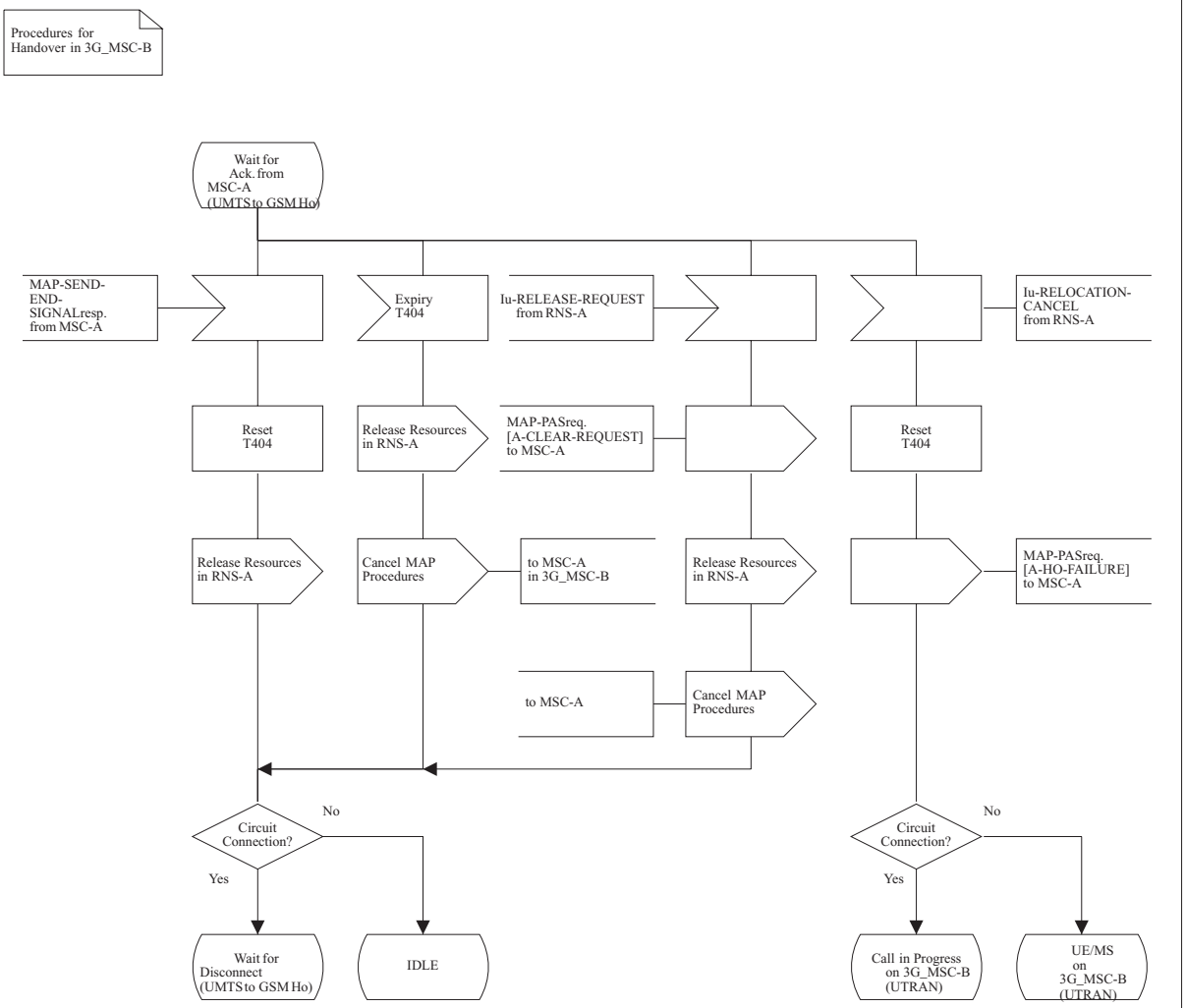


Figure 44 (Sheet 30 of 54): Handover control procedure in 3G_MSC-B

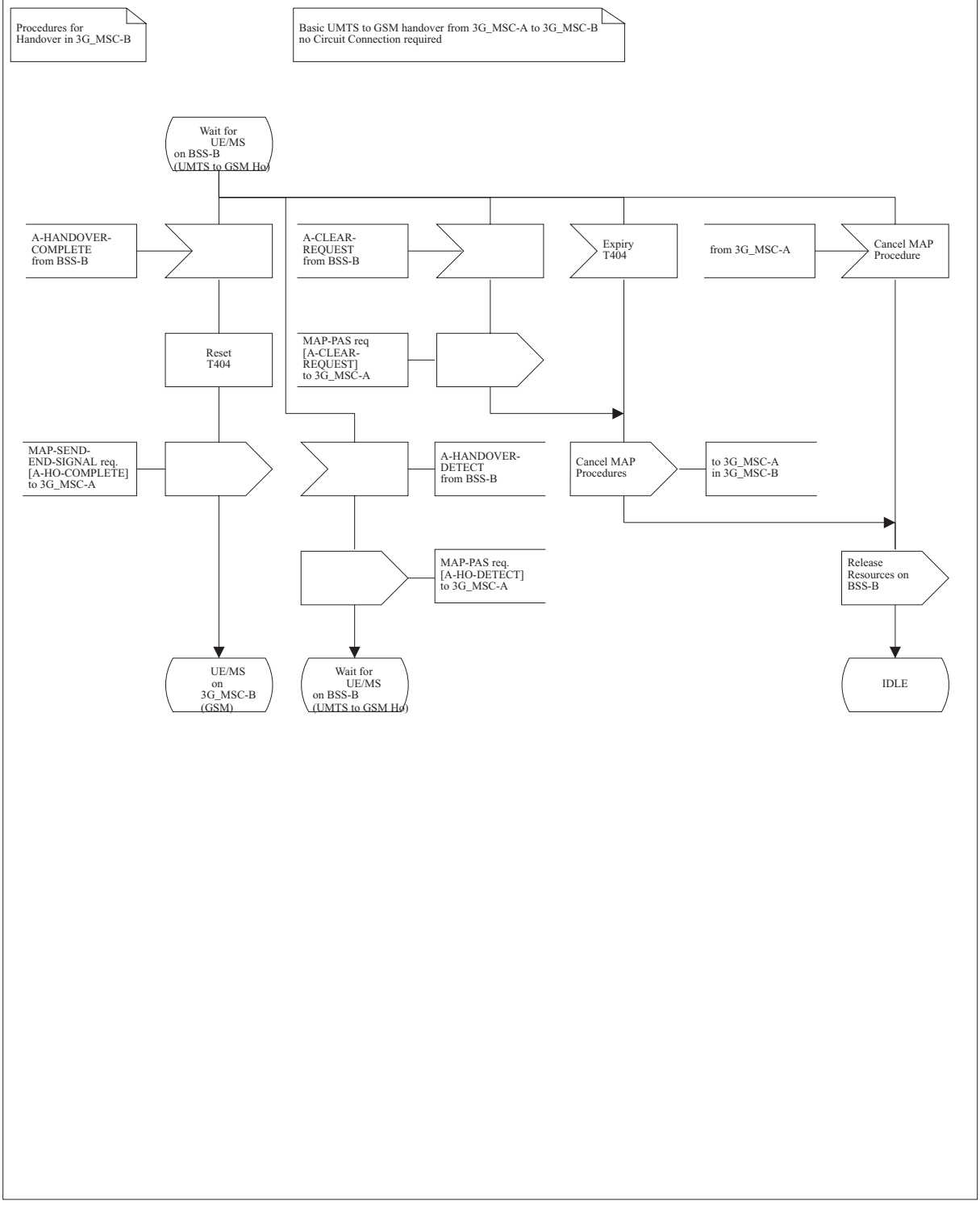


Figure 44 (Sheet 31 of 54): Handover control procedure in 3G_MSC-B

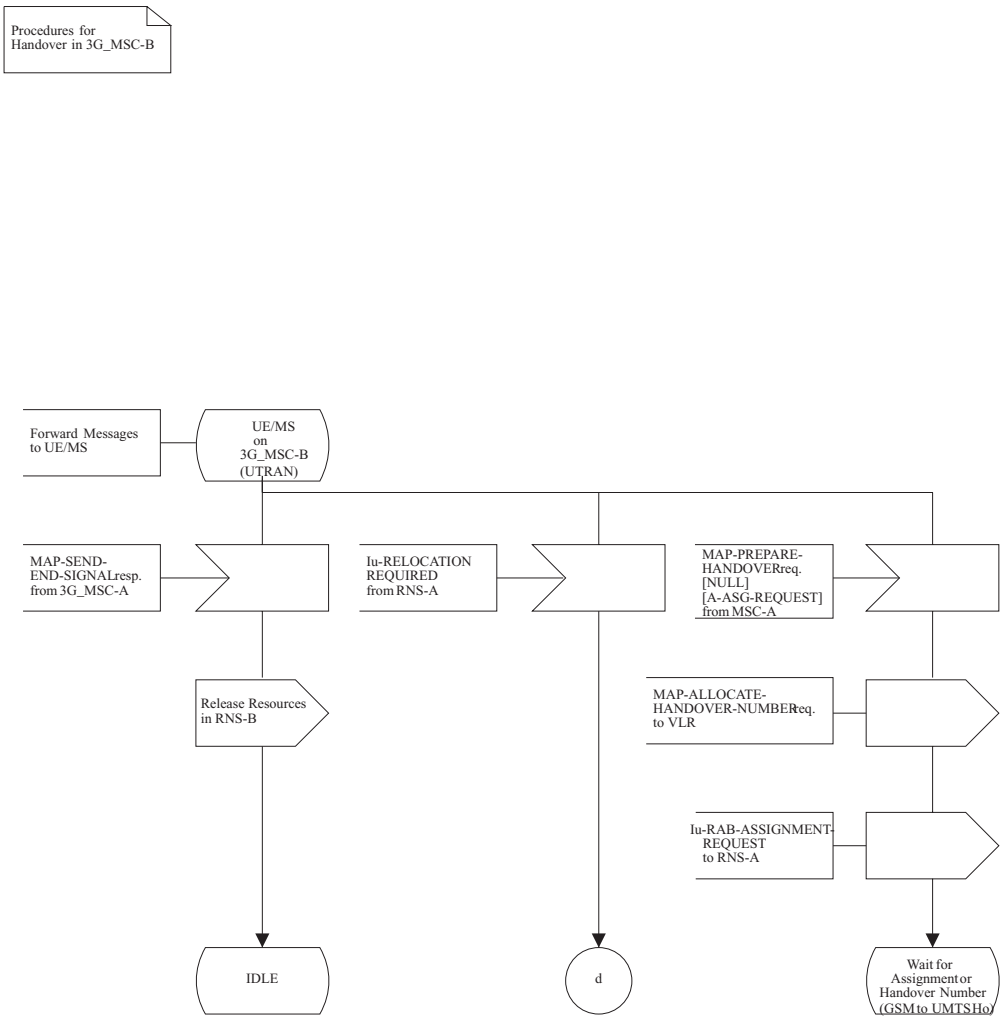


Figure 44 (Sheet 32 of 54): Handover control procedure in 3G_MSC-B

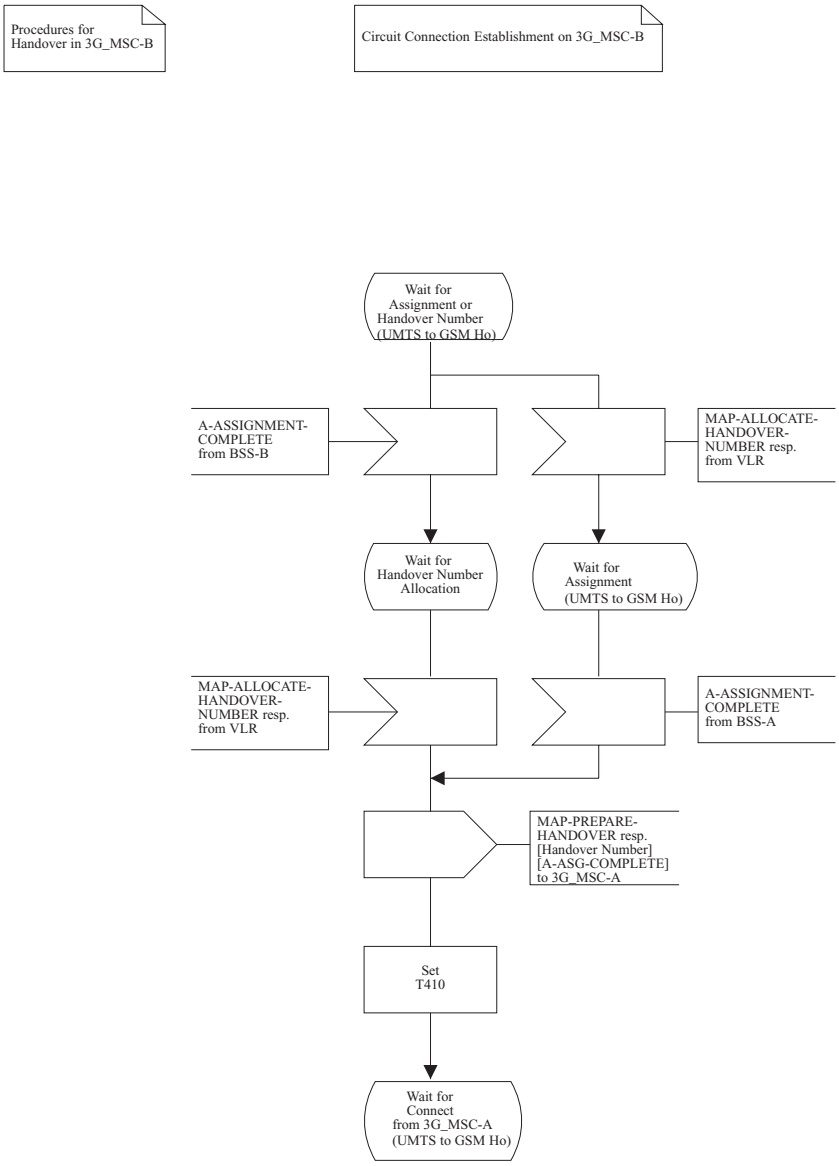


Figure 44 (Sheet 33 of 54): Handover control procedure in 3G_MSC-B

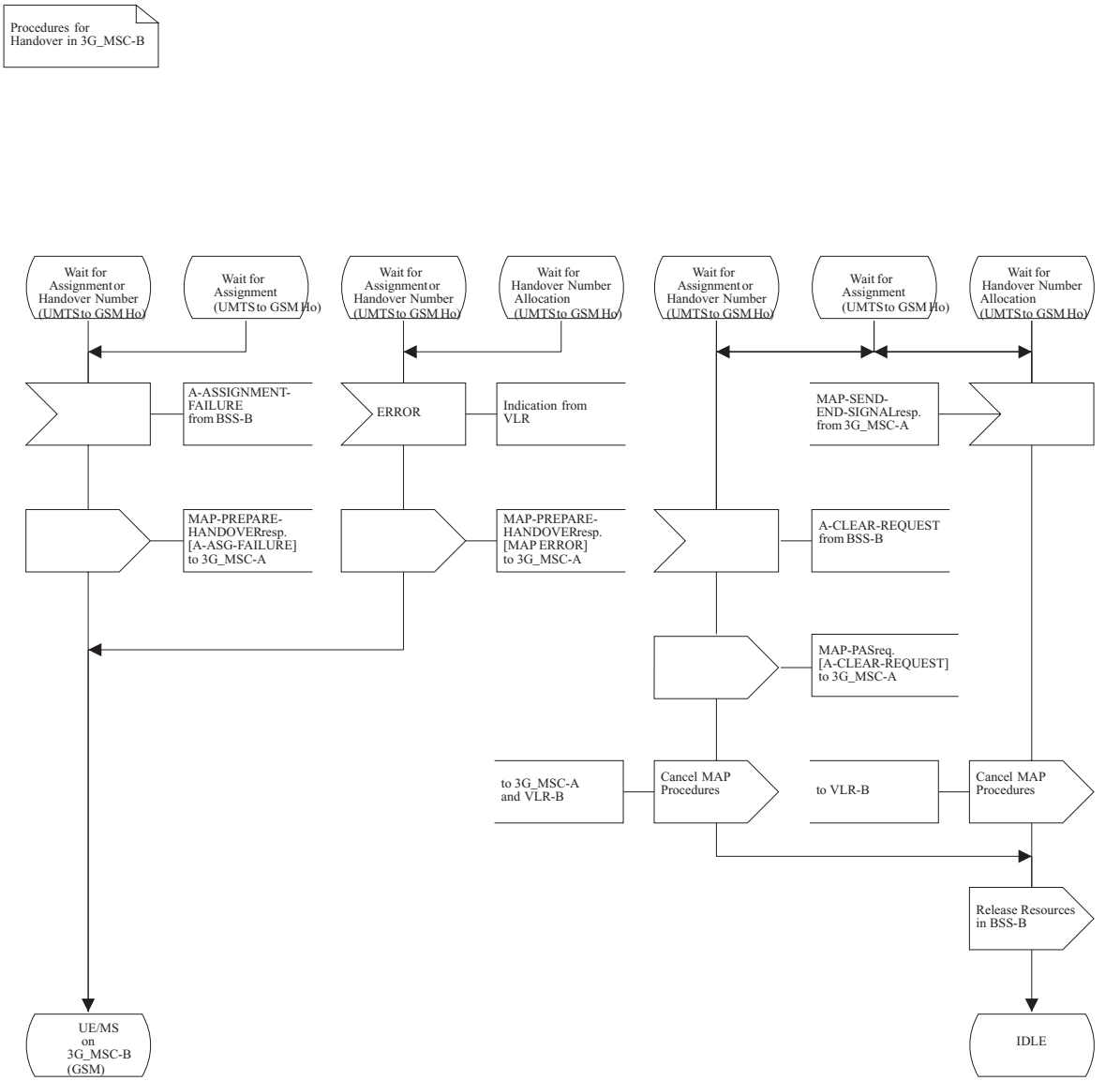


Figure 44 (Sheet 34 of 54): Handover control procedure in 3G_MSC-B

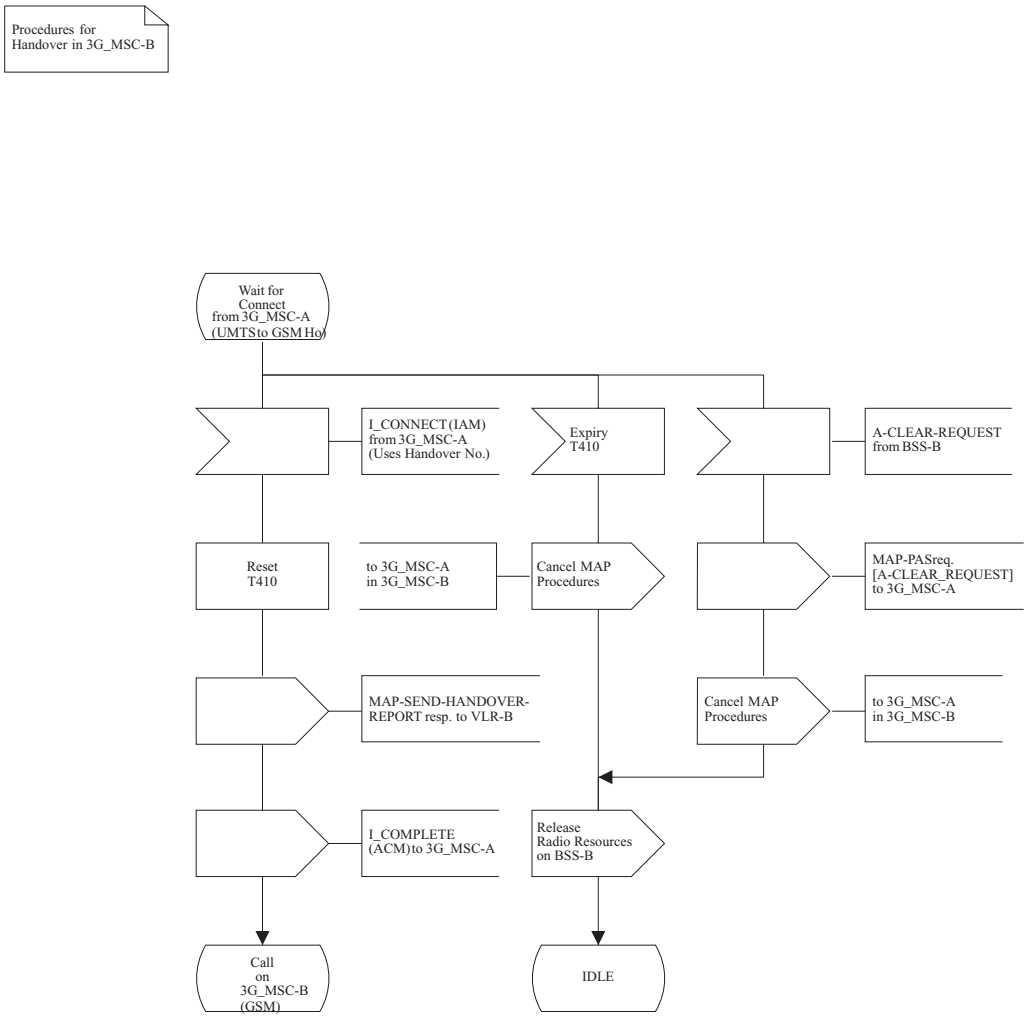


Figure 44 (Sheet 35 of 54): Handover control procedure in 3G_MSC-B

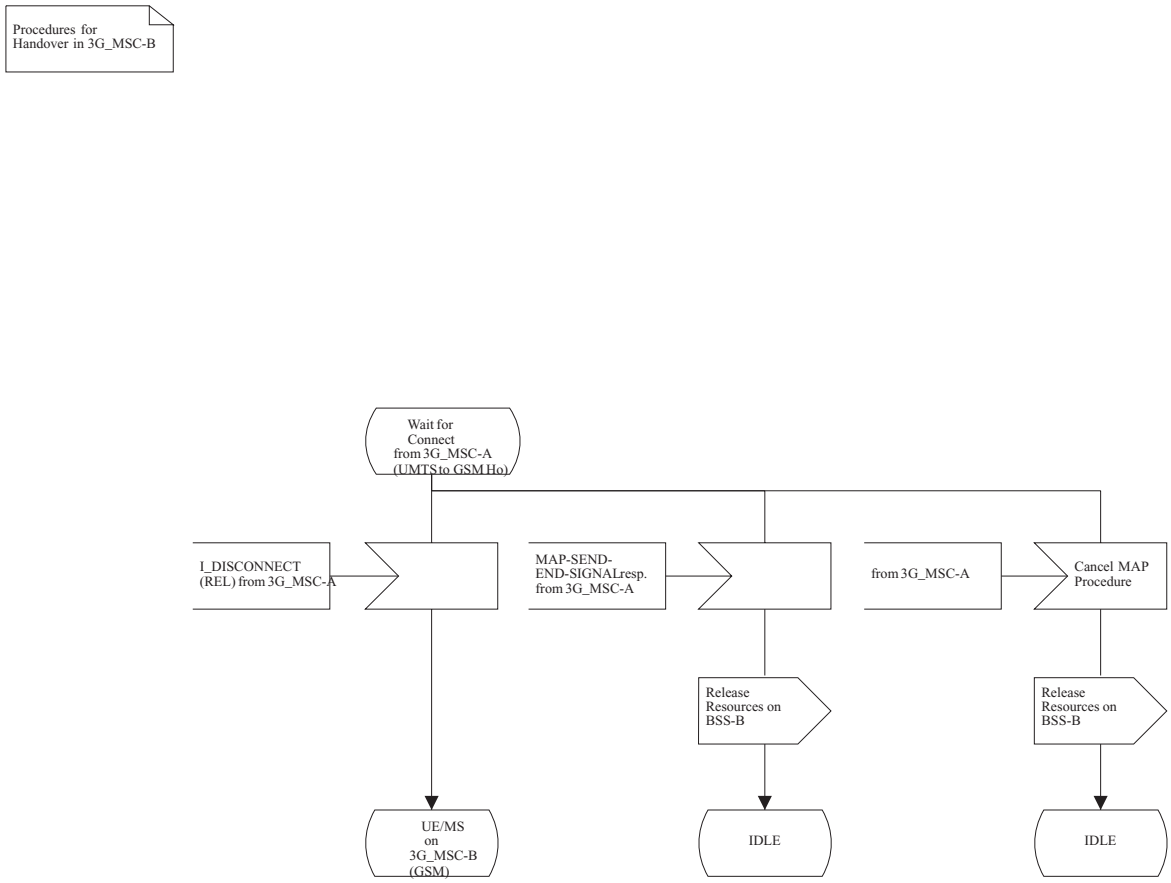


Figure 44 (Sheet 36 of 54): Handover control procedure in 3G_MSC-B

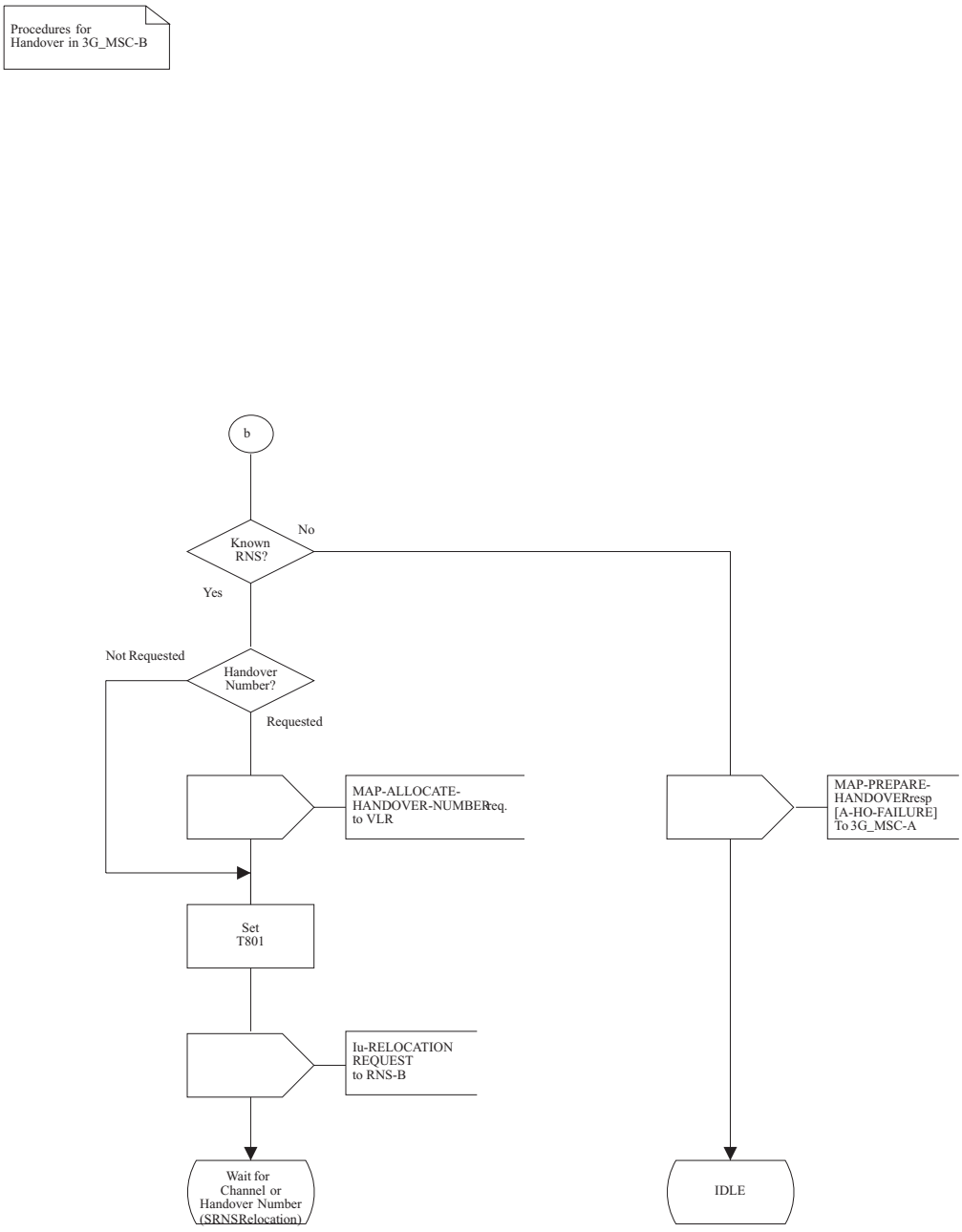


Figure 44 (Sheet 37 of 54): Handover control procedure in 3G_MSC-B

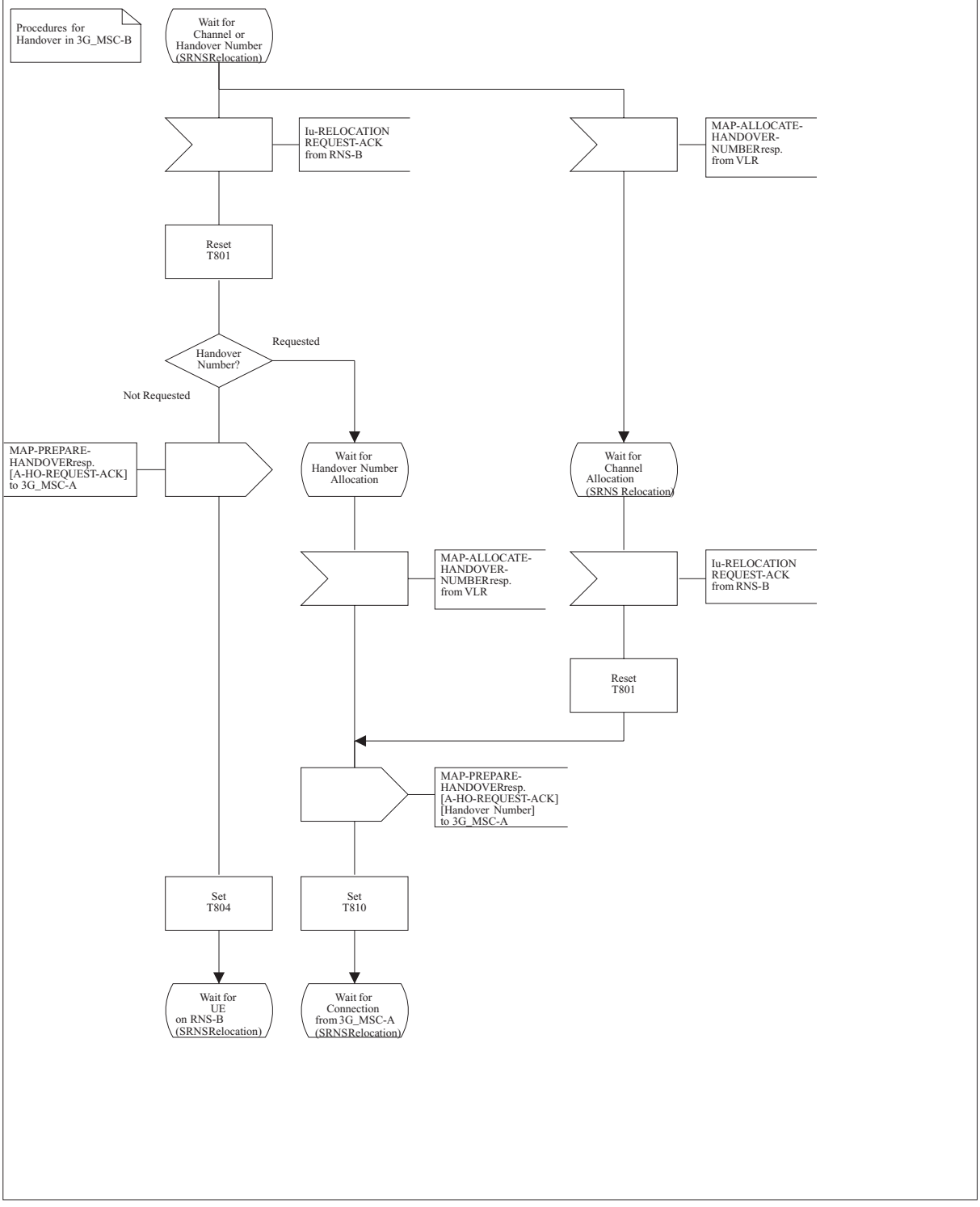


Figure 44 (Sheet 38 of 54): Handover control procedure in 3G_MSC-B

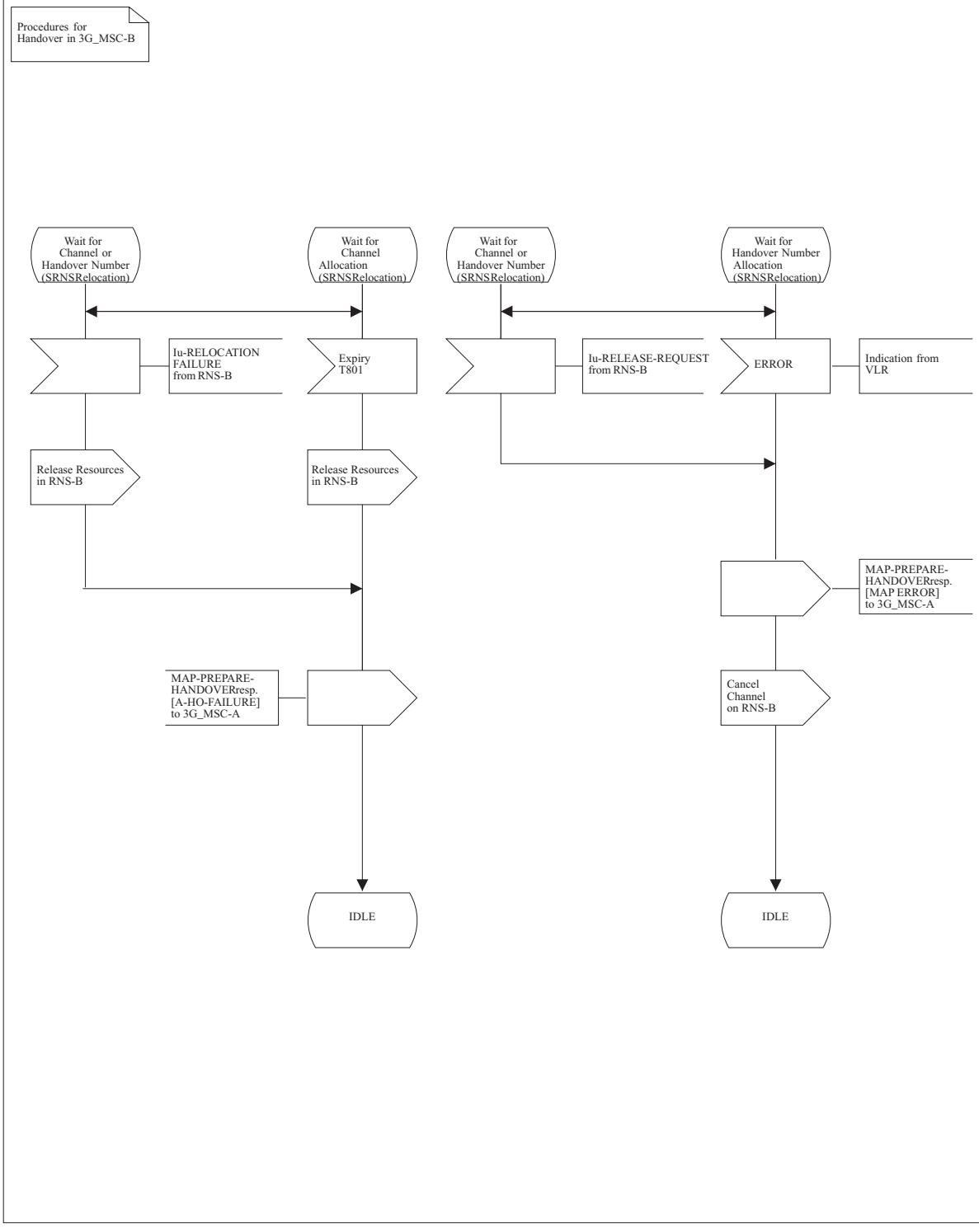


Figure 44 (Sheet 39 of 54): Handover control procedure in 3G_MSC-B

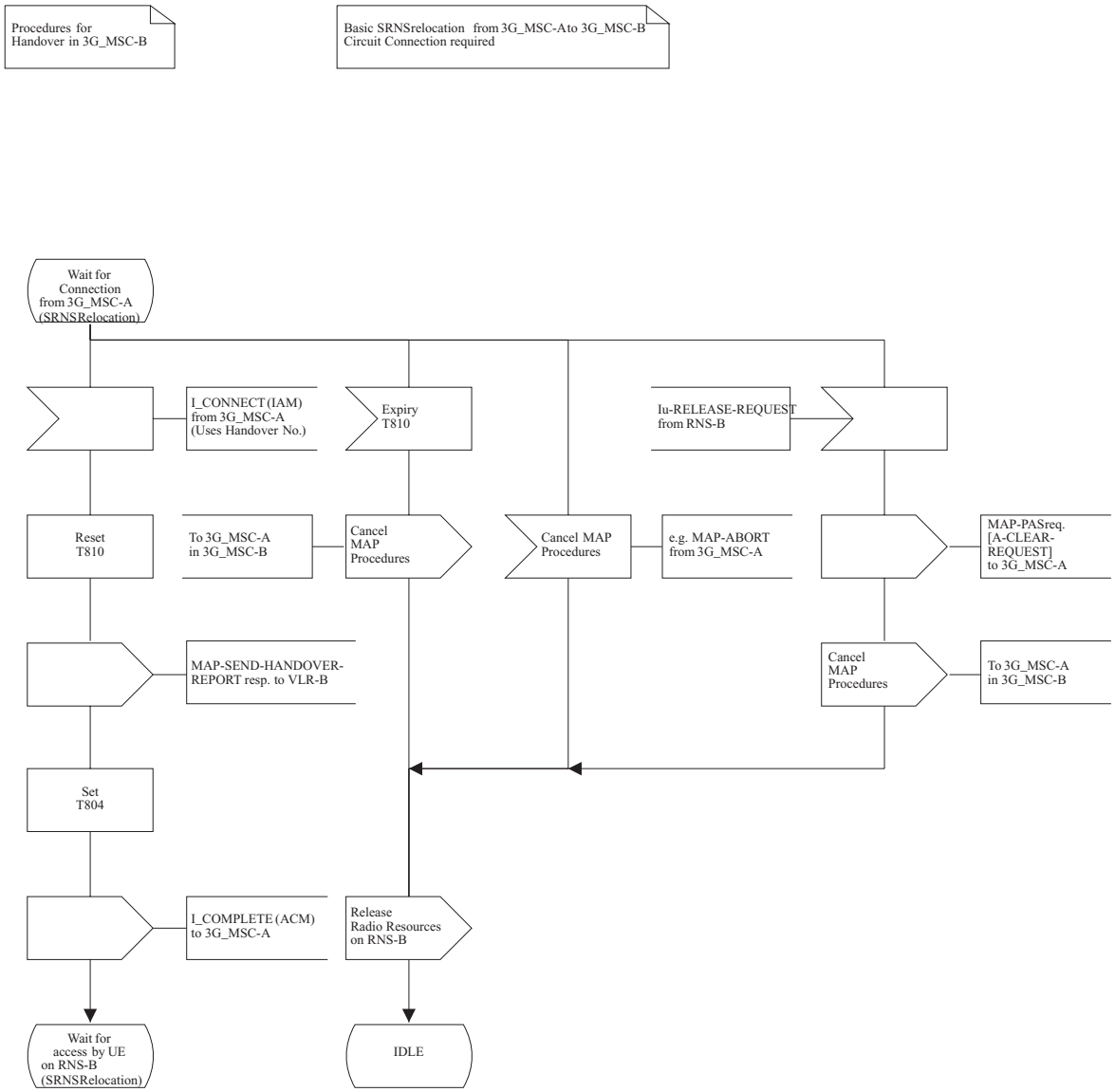


Figure 44 (Sheet 40 of 54): Handover control procedure in 3G_MSC-B

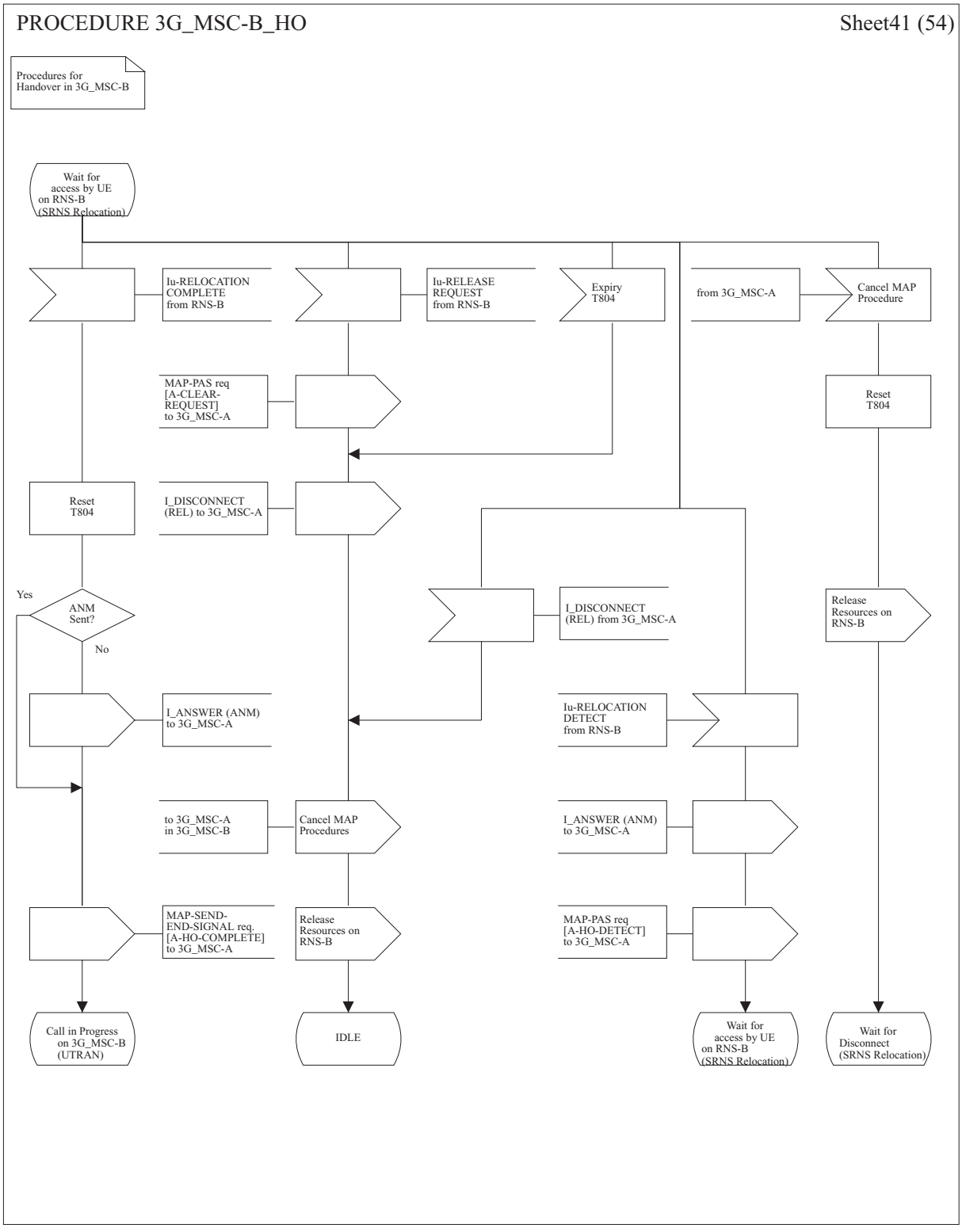


Figure 44 (Sheet 41 of 54): Handover control procedure in 3G_MSC-B

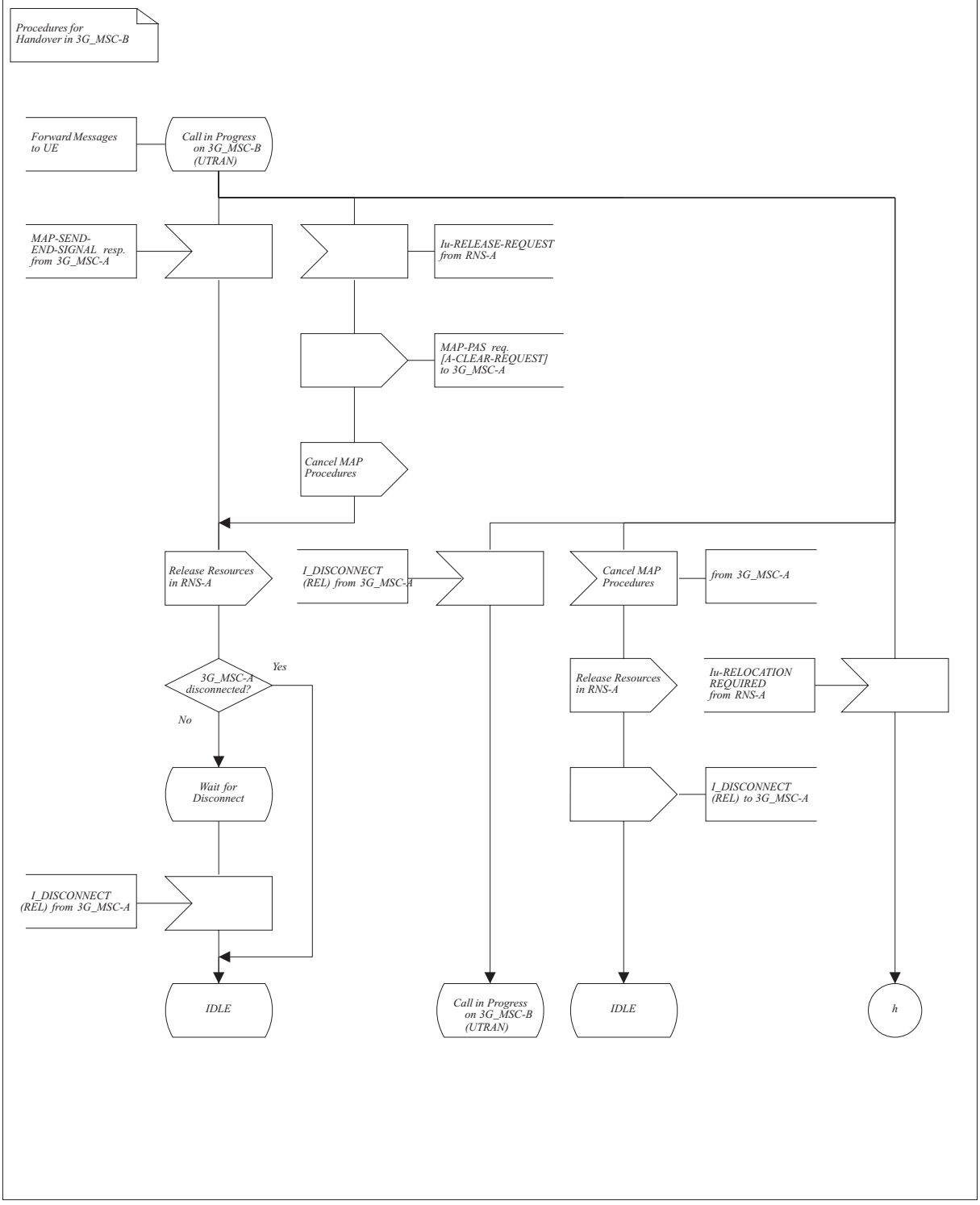


Figure 44 (Sheet 42 of 54): Handover control procedure in 3G_MSC-B

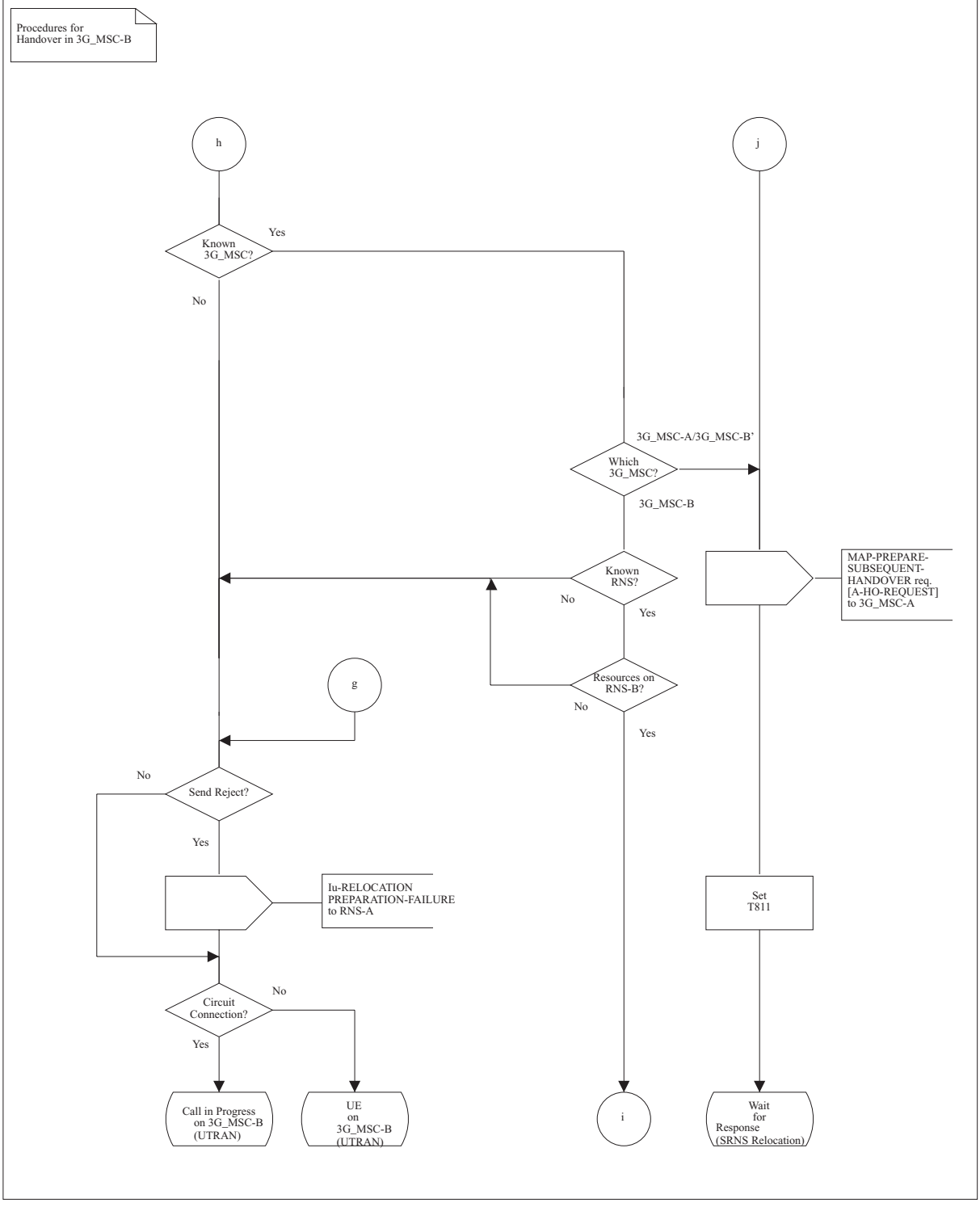


Figure 44 (Sheet 43 of 54): Handover control procedure in 3G_MSC-B

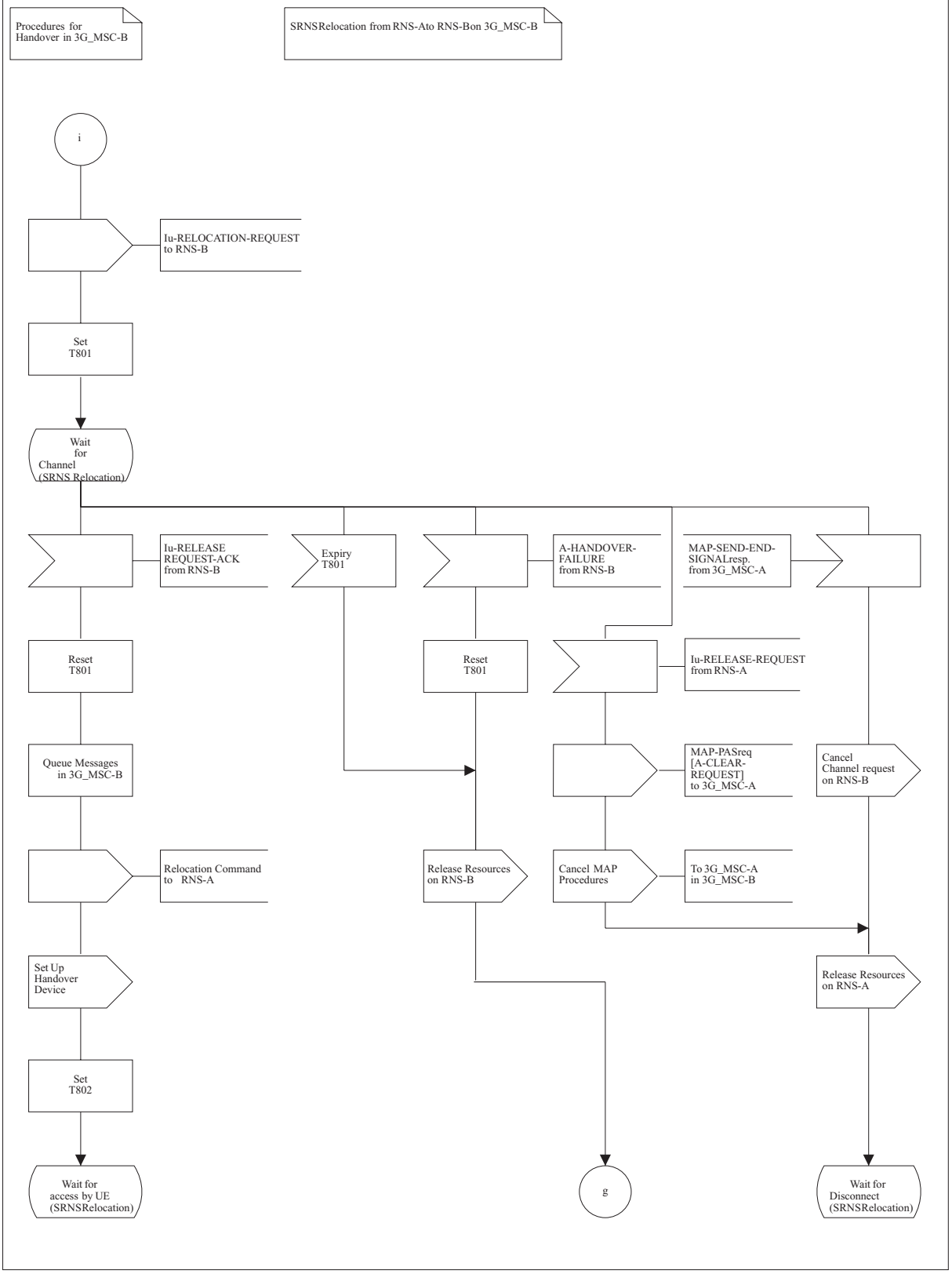


Figure 44 (Sheet 44 of 54): Handover control procedure in 3G_MSC-B

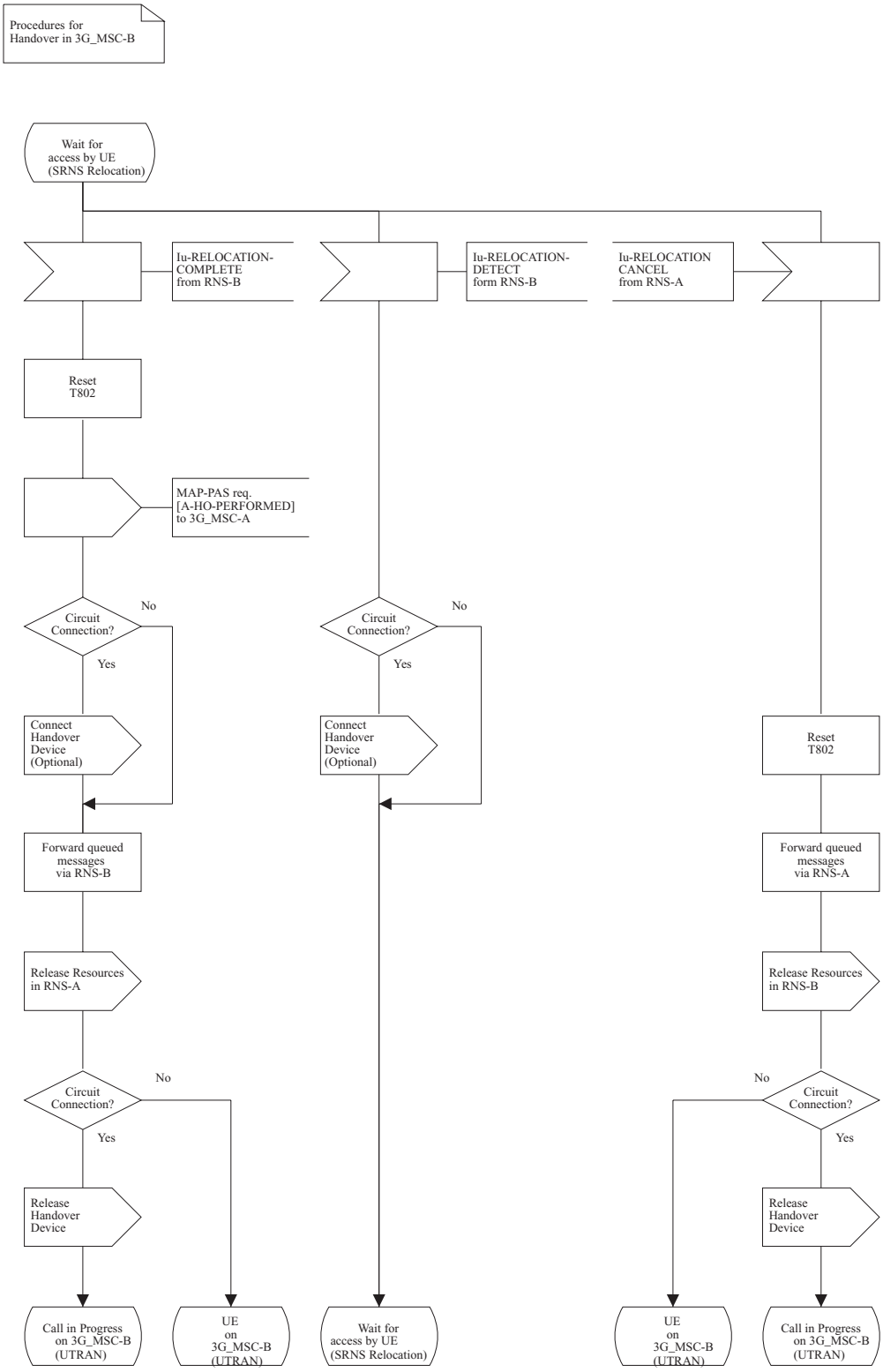


Figure 44 (Sheet 45 of 54): Handover control procedure in 3G_MSC-B

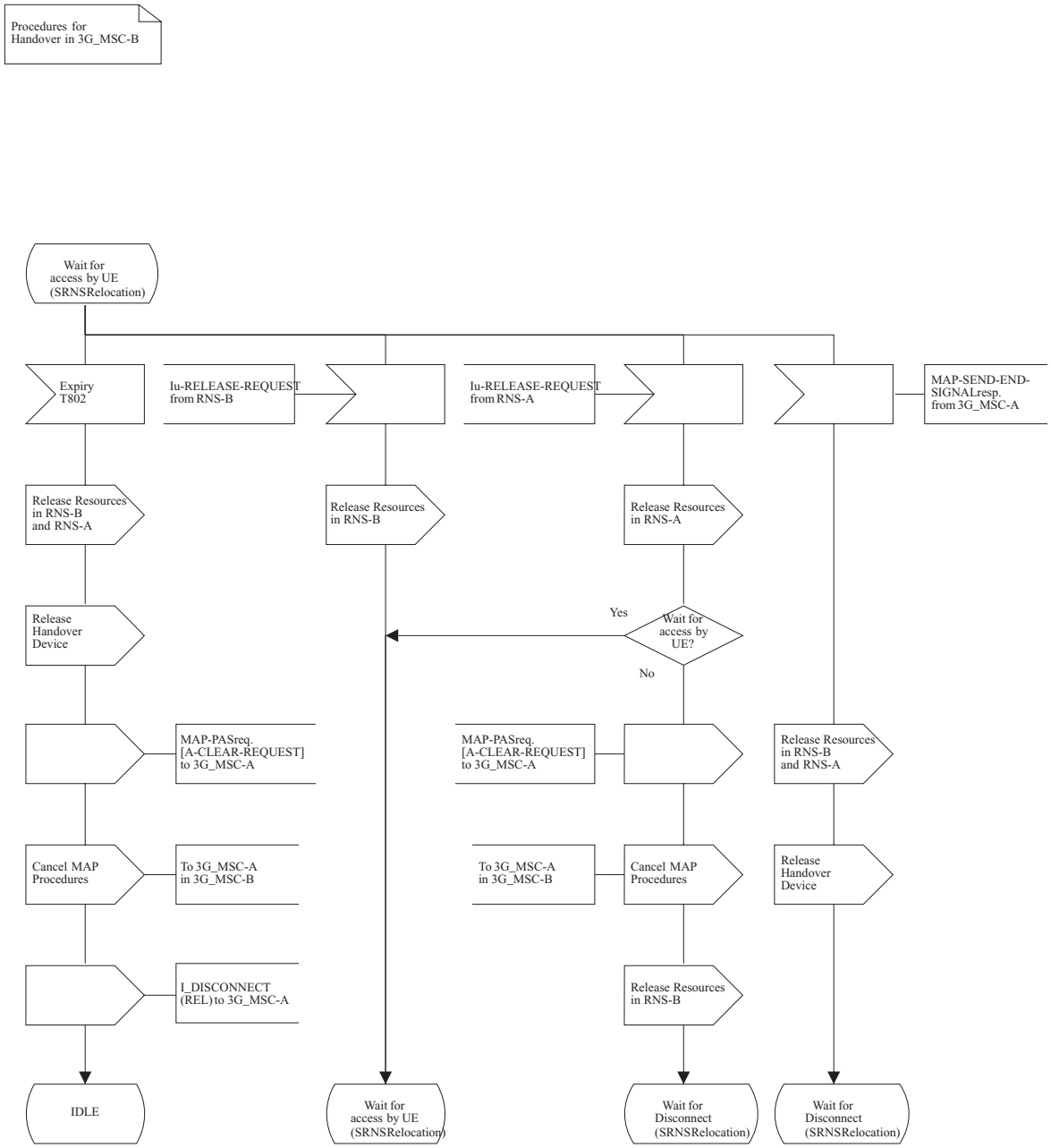


Figure 44 (Sheet 46 of 54): Handover control procedure in 3G_MSC-B

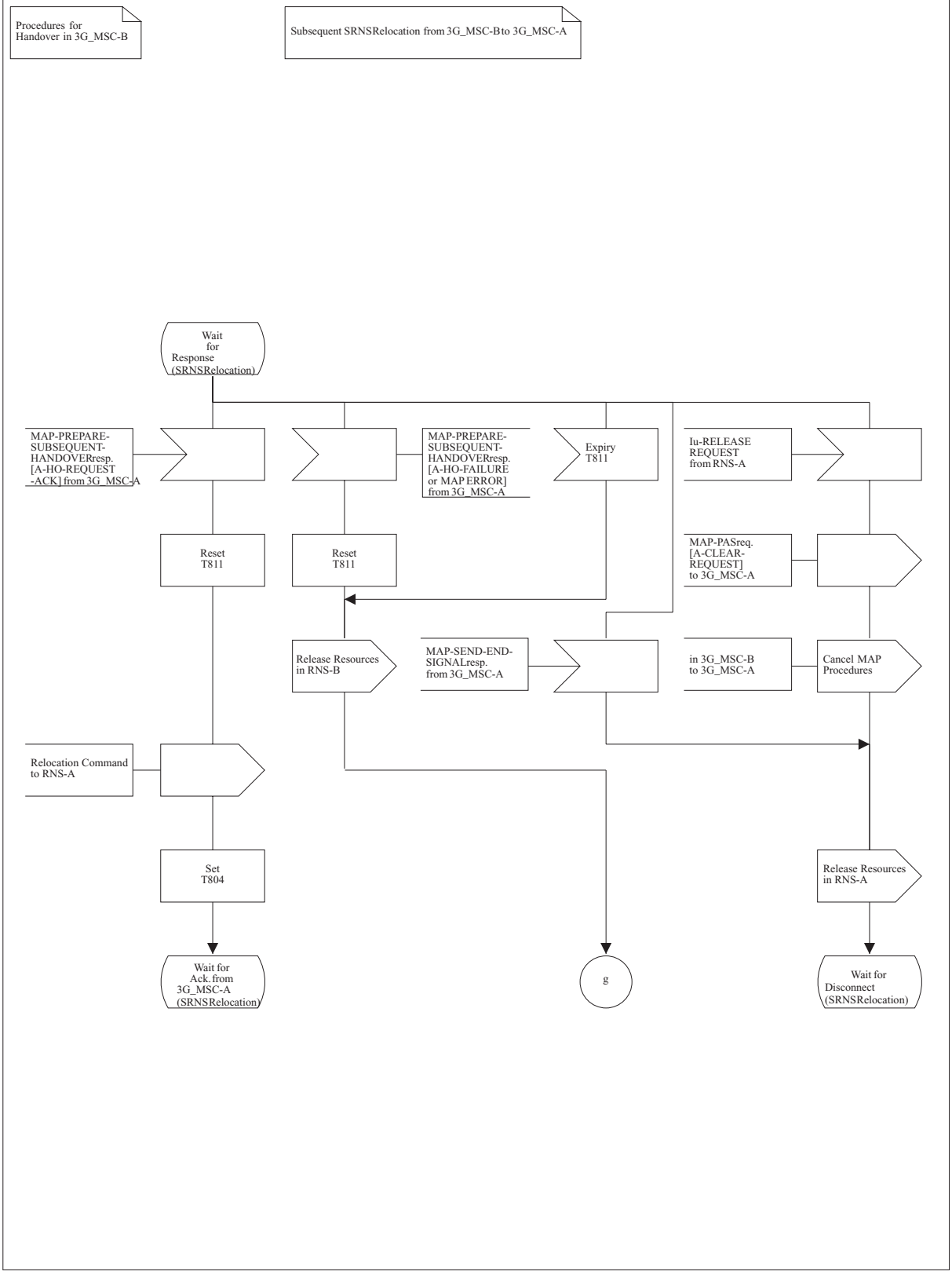


Figure 44 (Sheet 47 of 54): Handover control procedure in 3G_MSC-B

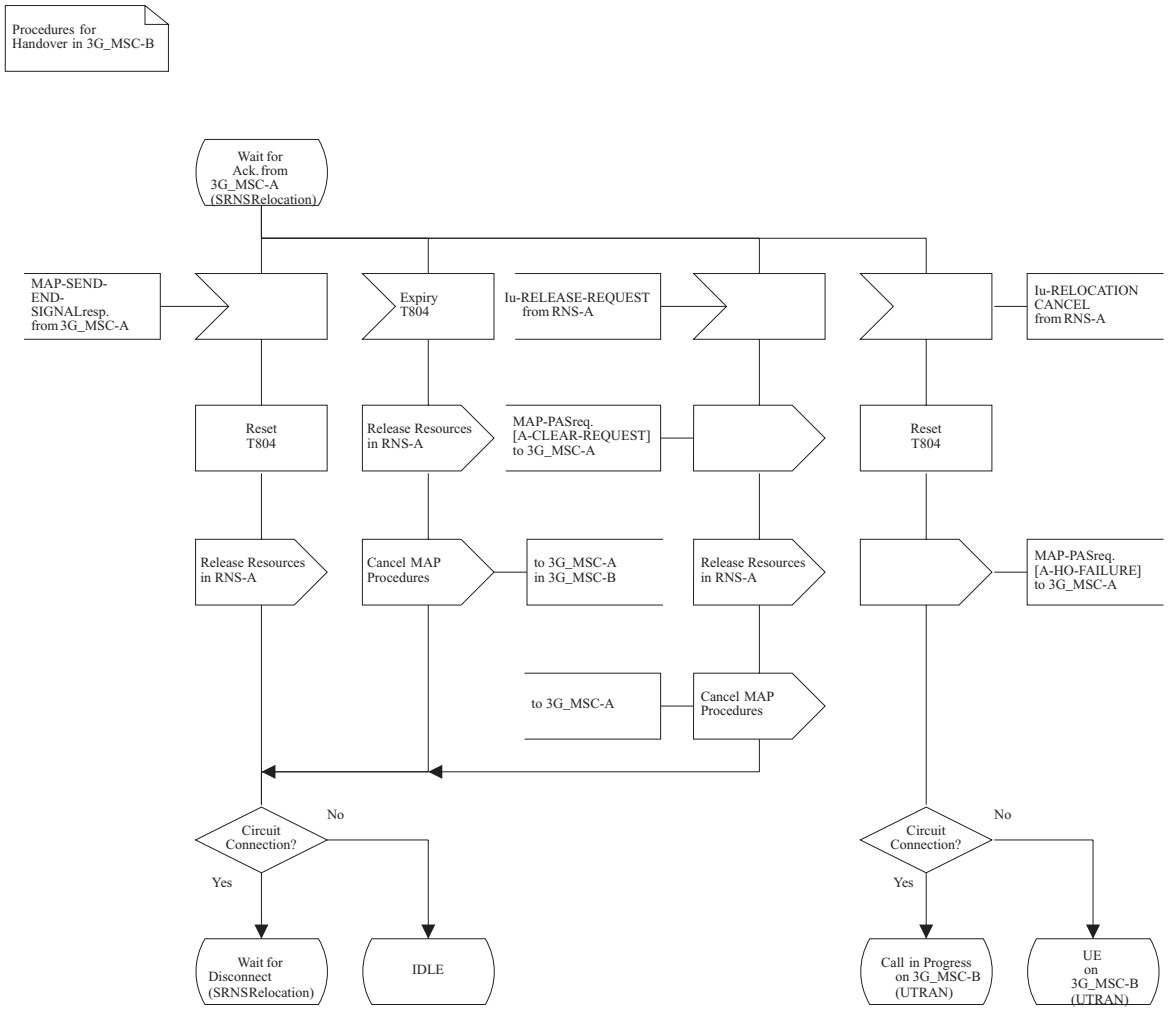


Figure 44 (Sheet 48 of 54): Handover control procedure in 3G_MSC-B

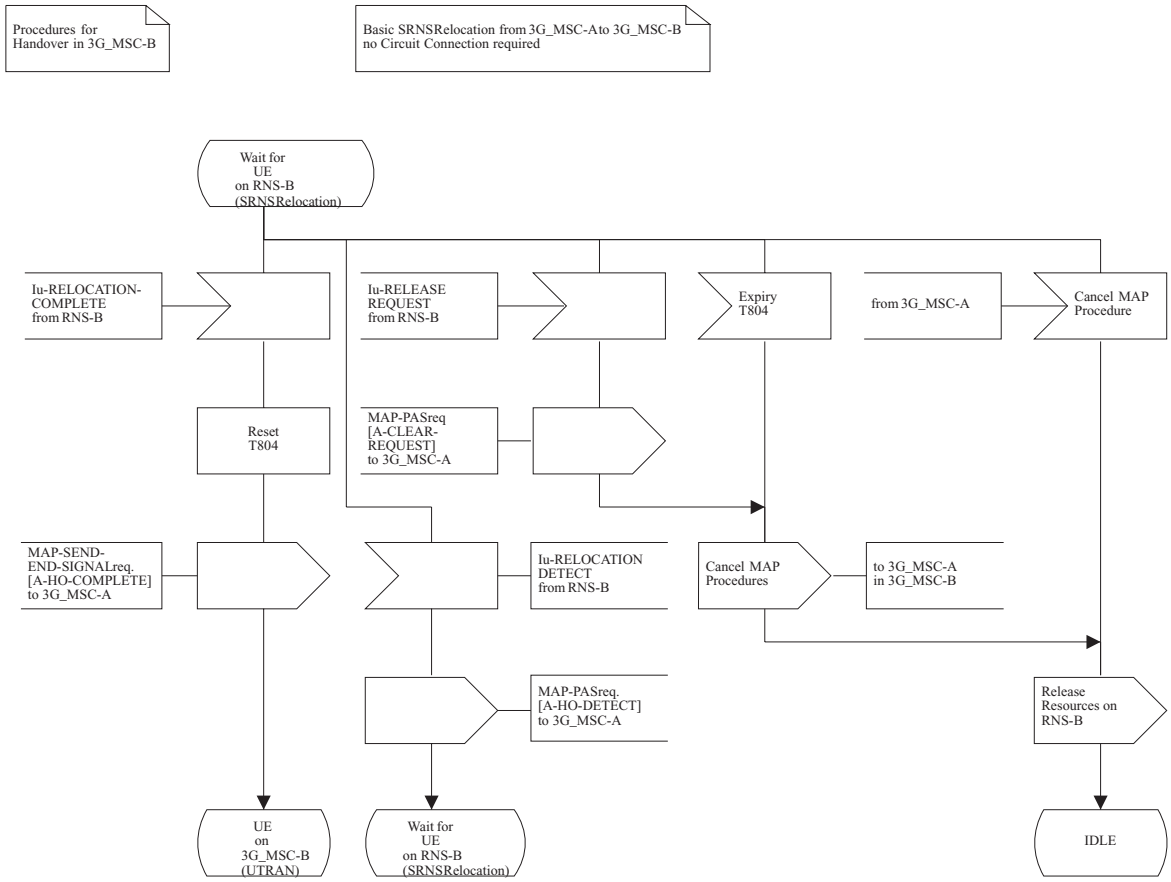


Figure 44 (Sheet 49 of 54): Handover control procedure in 3G_MSC-B

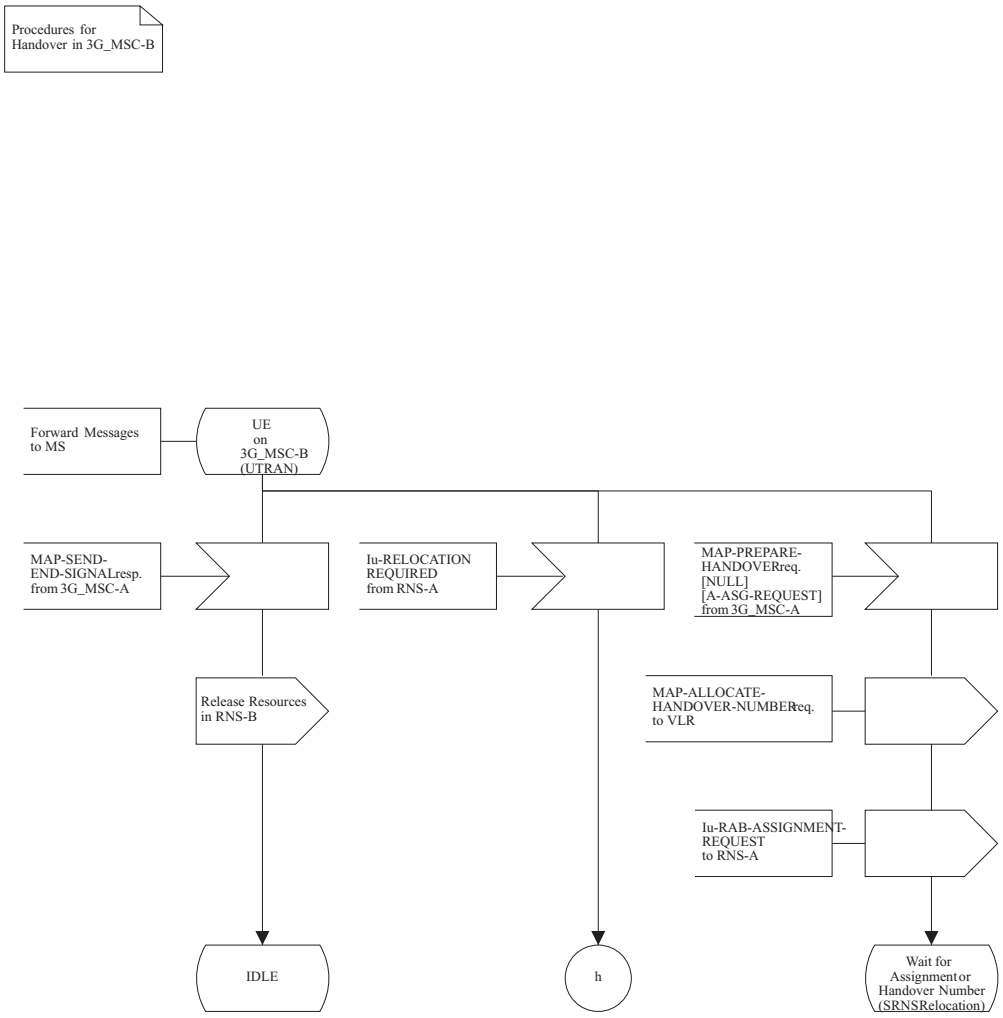


Figure 44 (Sheet 50 of 54): Handover control procedure in 3G_MSC-B

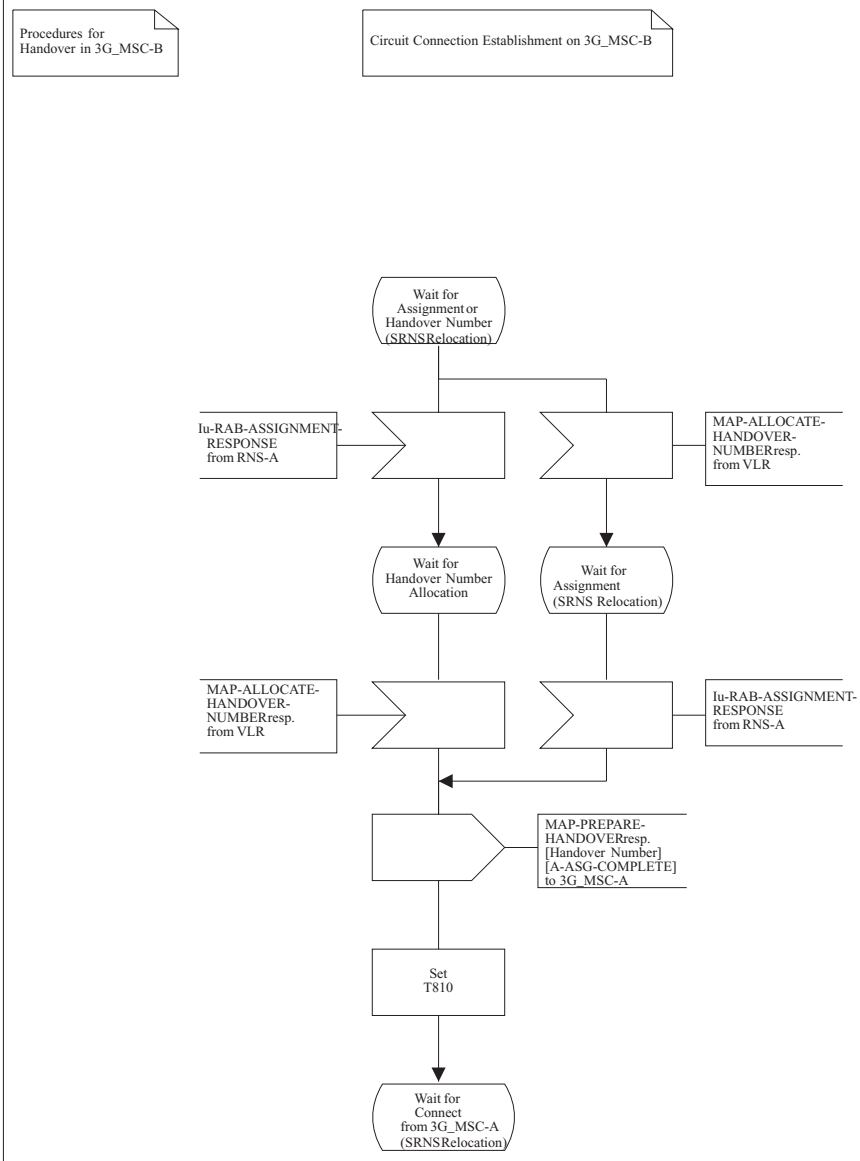


Figure 44 (Sheet 51 of 54): Handover control procedure in 3G_MSC-B

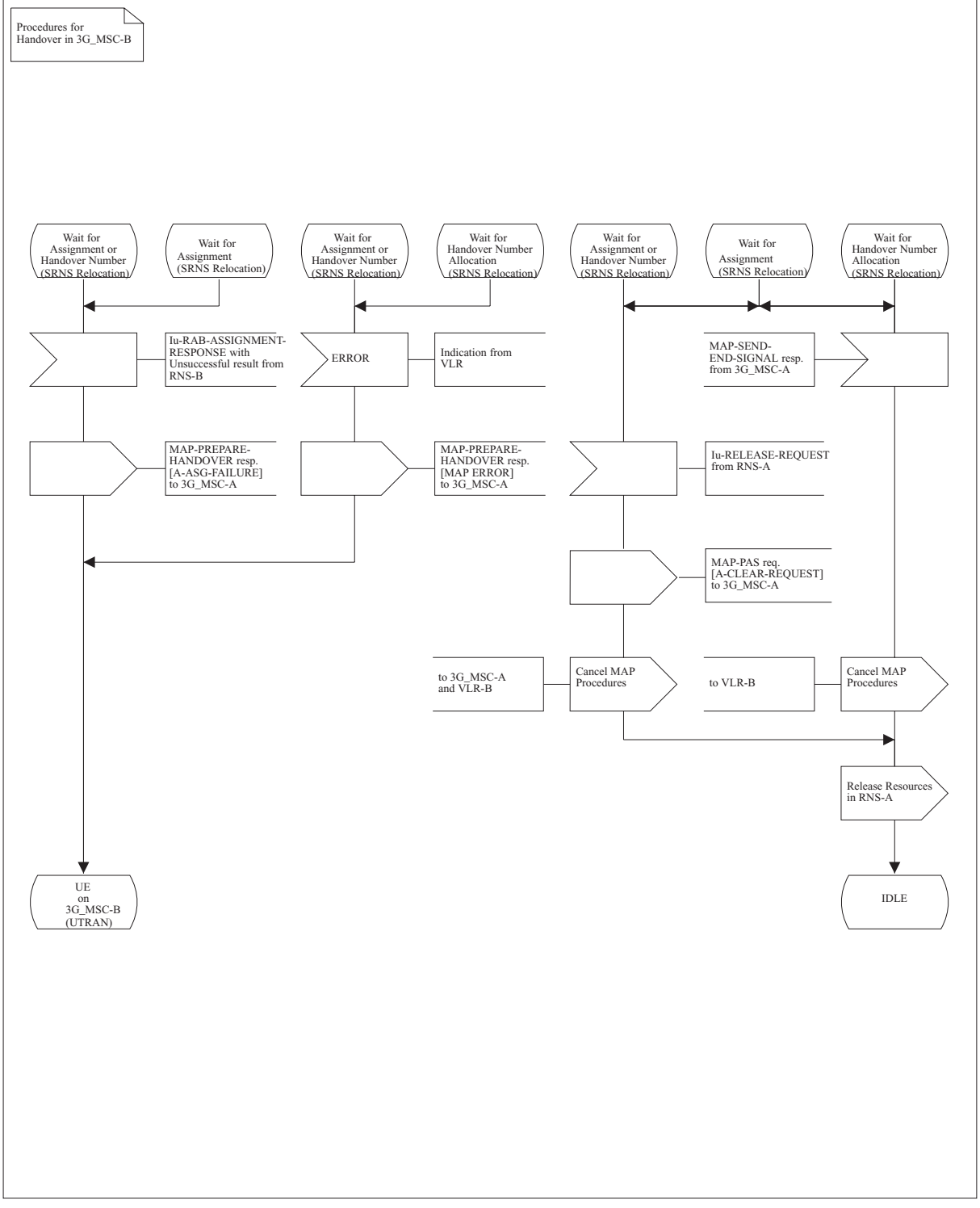


Figure 44 (Sheet 52 of 54): Handover control procedure in 3G_MSC-B

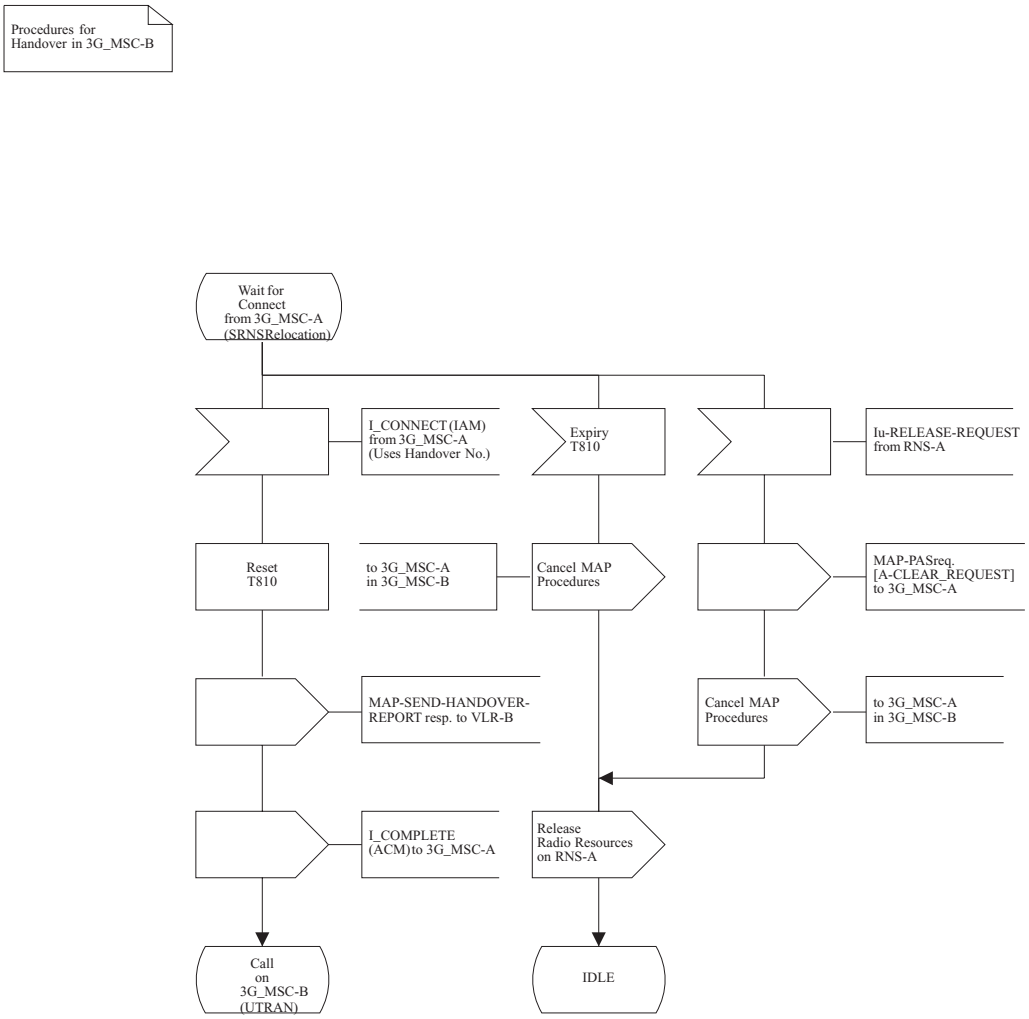


Figure 44 (Sheet 53 of 54): Handover control procedure in 3G_MSC-B

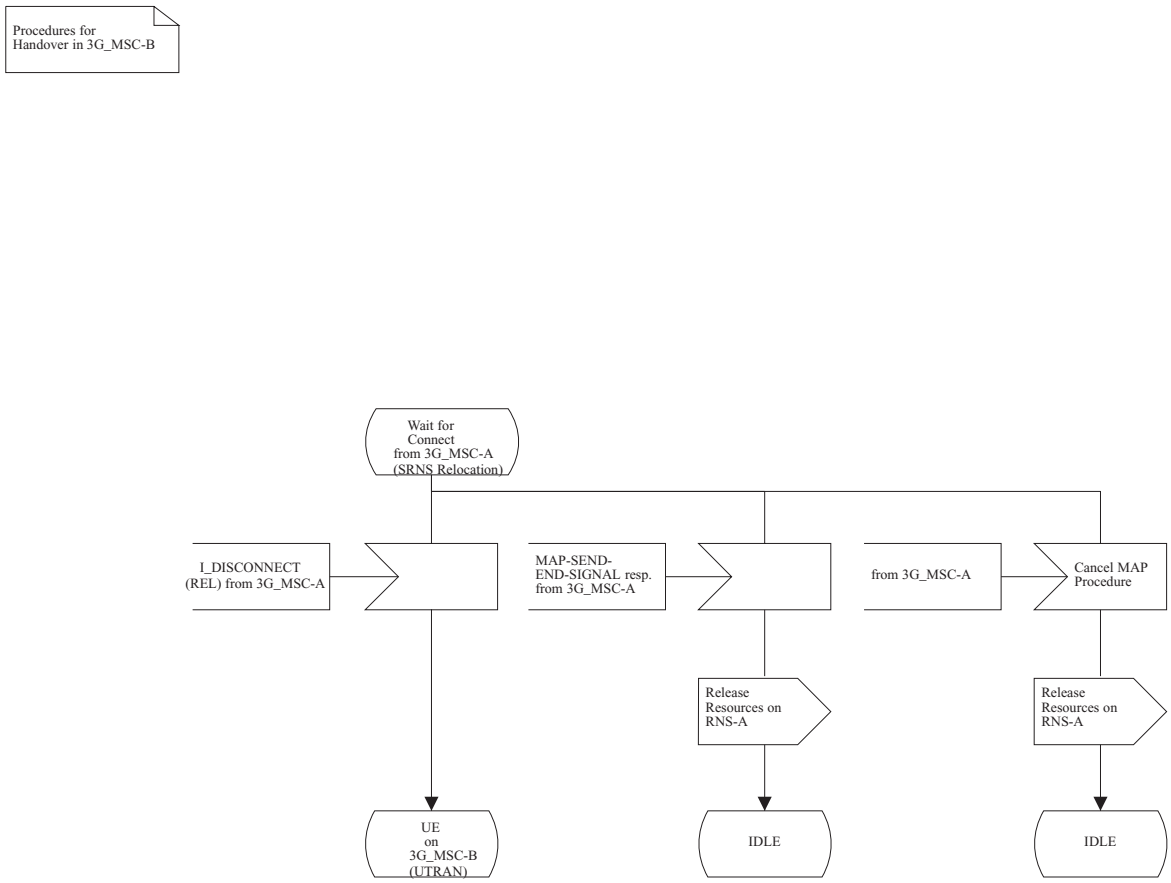


Figure 44 (Sheet 54 of 54): Handover control procedure in 3G_MSC-B