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European Standard (Telecommunications series)

**Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D);
Part 12: Supplementary services stage 3
Sub-part 12: Call Hold (CH)**

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

The present document is a multi-part standard and will consist of the following parts:

Part 1:   "General network design";

Part 2:   "Air Interface (AI)";

Part 3:   "Interworking at the Inter-System Interface (ISI)";

Part 4:   "Gateways basic operation";

Part 5:   "Peripheral Equipment Interface (PEI)";

Part 6:   "Line connected Station (LS)";

Part 7:   "Security";

Part 9:   "General requirements for supplementary services";

Part 10:   "Supplementary services stage 1";

Part 11:   "Supplementary services stage 2";

Part 12:   "Supplementary services stage 3";

Part 13:   "SDL model of the Air Interface (AI)";

Part 14:   "Protocol Implementation Conformance Statement (PICS) proforma specification".

National transposition dates	
Date of adoption of this EN:	5 January 2001
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1 Scope

The present document specifies the stage 3 description of the Supplementary Service Call Hold (SS-HOLD) for the Terrestrial Trunked Radio (TETRA).

SS-HOLD enables a user to interrupt communication on an existing individual call and then subsequently, if desired, re-establish communication.

Man-Machine Interface (MMI) and charging principles are outside the scope of the present document.

Supplementary service specifications are produced in three stages according to the method defined in ITU-T Recommendation I.130 [1]. The stage 1 description specifies the service from the user's point of view (see ETS 300 392-10-12 [7]). The stage 2 description identifies the functional capabilities and the information flows needed to support the service as specified in its stage 1 description (see EN 300 392-11-12 [8]). The present stage 3 description specifies the protocols at the air interface and at the various Inter-System Interfaces (ISI) to support SS-HOLD.

NOTE 1: According to ITU-T Recommendation I.130 [1], the stage 3 description of any telecommunication service addresses the network implementation aspects. Consequently it comprises two steps: the specifications of all protocols at the various reference points involved in any of the service procedures (notably the service operation) are the first step of the stage 3 description, and the specifications of the functions of the corresponding network entities are its second step.

NOTE 2: The latter have not been provided since they can be derived from the specification of the functional entity actions in the stage 2 description.

The present document is applicable to Voice plus Data individual calls; more specifically to the following entities:

- the MS/LSs of the served user and of his distant party; and

- the served user Switching and Management Infrastructure (SwMI) in an individual call.

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 and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies.

[1] ITU-T Recommendation I.130 (1993): "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[2] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

[3] ETSI ETS 300 392-3-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 1: General design".

[4] ETSI EN 300 392-3-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 2: Additional Network Feature Individual Call (ANF-ISIIC)".

[5] ETSI ETS 300 392-3-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 5: Additional Network Feature for Mobility Management (ANF-ISIMM)".

[6]   ETSI ETS 300 392-9: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D);
             Part 9: General requirements for supplementary services".

[7]   ETSI ETS 300 392-10-12: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D);
             Part 10: Supplementary services stage 1; Sub-part 12: Call Hold (CH)".

[8]   ETSI EN 300 392-11-12: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D);
             Part 11: Supplementary services stage 2; Sub-part 12: Call Hold (CH)".

[9]   ETSI ETR 300-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D);
             Designers' guide; Part 5: Guidance on Numbering and addressing".

[10]   ITU-T Recommendation Z.100 (1993): "CCITT Specification and description language (SDL)".

3   Definitions and abbreviations

3.1   Definitions

For the purposes of the present document, the terms and definitions given in ETS 300 392-9 [6] apply with the following modifications:

affected user: other party than the served user in an individual call.

served user: individual subscriber for whom SS-HOLD supplementary service has been subscribed. The served user can thus successfully invoke the supplementary service in an individual call.

NOTE: When the served user has many calls on hold, the served user may be the calling party for some of them and the connected party for the others.

3.2   Abbreviations

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

ANF-ISIGC	Additional Network Feature - Inter-System Interface Group Call
ANF-ISIIC	Additional Network Feature - Inter-System Interface Individual Call
ANF-ISIMM	Additional Network Feature - Inter-System Interface Mobility Management
ANF-ISISS	Additional Network Feature - Inter-System Interface Supplementary Service
HOLD	Call Hold
ISI	Inter-System Interface
ITSI	Individual TETRA Subscriber Identity
LS	Line Station
MS	Mobile Station
PDU	Protocol Data Unit
ROSE	Remote Operation Service Element
SDL	Specification Description Language
SS	Supplementary Service

NOTE: The abbreviation SS is only used when referring to a specific supplementary service (e.g. SS-HOLD).

SSI	Short Subscriber Identity
SwMI	Switching and Management Infrastructure

4   SS-HOLD service description

4.1   General

SS-HOLD enables the served user in an individual call to interrupt that call in putting it on hold, then e.g. to accept another call or place another one, and later to retrieve the call put on hold. The served user may be the calling or the connected user.

This clause describes the SS-HOLD services offered by the Circuit Mode Control Entity (CMCE) at the Supplementary Services service access point (TNSS-SAP) of the TETRA voice plus data layer 3 service boundary in a TETRA Mobile Station (MS) or TETRA Line Station (LS). The SS-HOLD service access point is used in conformance testing as a normative boundary in MSs and LSs.

NOTE: As the present document deals only with SS-HOLD, all the service primitives has been shown without a TNSS-HOLD- prefix e.g. the TNSS-HOLD-INVOKE request is shortened into an INVOKE request.

4.2   SS-HOLD services offered over the TNSS-SAP

NOTE: As man-machine interface or user applications are outside the scope of the present document service primitives are used to define information exchange to and from the standardized part of the MS/LS. Those primitives may be only indirectly accessible.

The SS-HOLD service primitives at the served user MS/LS TNSS-SAP shall be:

-        INTERROGATE request;

-        INTERROGATE ACK indication;

-        INVOKE request;

-        INVOKE confirm;

-        RETRIEVE request;

-        RETRIEVE confirm.

The SS-HOLD service primitives for the affected user at the MS/LS TNSS-SAP shall be:

-        INFORM 1 indication;

-        INFORM 2 indication;

-        INFORM 3 indication.

4.2.1   INFORM 1 indication

The INFORM 1 indication primitive may be sent over the affected user TNSS-SAP by the MS/LS CMCE to the affected user application to inform it that the call in which it is currently participating has (just) been put on hold.

There are no parameters in the INFORM 1 indication primitive.

4.2.2   INFORM 2 indication

The INFORM 2 indication primitive may be sent over the affected user TNSS-SAP by the MS/LS CMCE to the affected user application to inform it that the call in which it is currently participating, which was previously on hold, has (just) been retrieved.

There are no parameters in the INFORM 2 indication primitive.

4.2.3 INFORM 3 indication

The INFORM 3 indication primitive may be sent over the affected user TNSS-SAP by the MS/LS CMCE to the affected user application to inform it that the call in which it is currently participating which was previously on hold has (just) been cleared because the served user has moved into a new area: either

-   in the same SwMI (i.e. the served user has roamed) but that SwMI does not support the SS-HOLD location change procedure; or

-   in a new SwMI (i.e. the served user has migrated) which does not support: either

    -   the SS-HOLD migration procedure; or

    -   SS-HOLD itself.

There are no parameters in the INFORM 3 indication primitive.

4.2.4 INTERROGATE request

The INTERROGATE request primitive shall be sent over the served user TNSS-SAP by the served user application to the MS/LS CMCE to know how many calls are currently still on hold for the served user (i.e. calls previously put on hold by the served user and not retrieved or disconnected).

The INTERROGATE request primitive shall contain the SS-HOLD parameter given in table 1.

Table 1: Parameter for the primitive INTERROGATE request

Parameter	Request
Access priority	O

4.2.5 INTERROGATE ACK indication

The INTERROGATE ACK indication primitive shall be sent over the served user TNSS-SAP by the MS/LS CMCE to the served user application to inform it about the result of a previous INTERROGATE request.

The INTERROGATE ACK indication primitive shall contain the SS-HOLD parameters listed in table 2.

Table 2: Parameters for the primitive INTERROGATE ACK indication

Parameter	Indication
Interrogation result	M
Number of calls still on hold	M
Call reference(s)	M (note 1)
Other party identity	C (note 2)
NOTE 1: There shall be a call reference for each call still on hold.	
NOTE 2: That parameter shall only be present when the reference of the call held corresponds to an individual call. It may be repeated with each such call reference parameter.	

4.2.6 INVOKE request

The INVOKE request primitive shall be sent over the served user TNSS-SAP by the served user application to the MS/LS CMCE to invoke SS-HOLD.

The INVOKE request primitive shall contain the SS-HOLD parameter given in table 3.

Table 3: Parameter for the primitive INVOKE request

Parameter	Request
Access priority	O

4.2.7 INVOKE confirm

The INVOKE confirm primitive shall be sent over the served user TNSS-SAP by the MS/LS CMCE to the served user application to inform it about the result of a previous INVOKE request.

The INVOKE confirm primitive shall contain the SS-HOLD parameters listed in table 4.

Table 4: Parameter for the primitive INVOKE confirm

Parameters	Confirm
Invocation result	M
Invocation failure cause	C (note)
NOTE: Conditional on the invocation result being negative.	

4.2.8 RETRIEVE request

The RETRIEVE request primitive shall be sent over the served user TNSS-SAP by the served user application to the MS/LS CMCE to retrieve a call previously put on hold (by the served user application).

The RETRIEVE request primitive shall contain the SS-HOLD parameters listed in table 5.

Table 5: Parameter for the primitive RETRIEVE request

Parameter	Request
Access priority	O
Call reference	M

4.2.9 RETRIEVE confirm

The RETRIEVE confirm primitive shall be sent over the served user TNSS-SAP by the MS/LS CMCE to the served user application to inform it about the result of a previous RETRIEVE request.

The RETRIEVE confirm primitive shall contain the SS-HOLD parameters listed in table 6.

Table 6: Parameter for the primitive RETRIEVE confirm

Parameters	Confirm
Call reference	M
Retrieval result	M
Retrieval failure cause	C (note)
NOTE: Conditional on the retrieval result being negative.	

4.3 Parameter description

Access priority:

- low priority;

- high priority;

- emergency priority.

The default value for that parameter shall be low priority. The value emergency priority should not be used for that parameter in any primitive.

Call reference: identifies the call in the network where the served user is currently registered.

Interrogation result:

- successful request;

- unsuccessful request.

If the INTERROGATE request has been unsuccessful, one of the following reasons shall be indicated:

- rejected for any reason;

- supplementary service not subscribed to;

- not supported;

- protocol problem.

Invocation result:

- successful request;

- unsuccessful request.

Invocation failure cause:

- rejected for any reason;

- not subscribed;

- maximum number of calls on hold already reached;

- not supported;

- protocol problem.

Those failure causes are sent by the infrastructure (more precisely, by the originating SwMI) to inform the served user who has invoked SS-HOLD that his invocation has failed for one of the following reasons:

- for the failure cause not subscribed: SS-HOLD has not been subscribed to for that user;

- for the failure cause maximum number of calls on hold already reached: SS-HOLD cannot be invoked because there are too many calls still on hold (for the served user);

- for the failure cause not supported: the originating SwMI does not support SS-HOLD;

- for the failure cause protocol problem: e.g. the invocation request has been placed outside of a call, or there has been an erroneous encoding of the invocation request, or transmission.

NOTE 1: Some of the above failure causes are not mutually exclusive of each other. If more than one occurs, only the first one in the above list should be given (so there is no need to repeat the parameter invocation failure cause in the INVOKE indication primitive).

Number of calls still on hold: gives the count of calls previously put on hold by the served user and not cleared.

Other party identity: recalls the identity of the other party in the (individual) call put on hold.

Retrieval result:

- successful request;

- unsuccessful request.

Retrieval failure cause:

- rejected for any reason;

- call already cleared;

- protocol problem.

Those failure causes are sent by the infrastructure (more precisely, by the originating SwMI) to inform the served user who has invoked SS-HOLD that his retrieval request has failed for one of the following reasons:

- for the failure cause call already cleared: the call previously on hold has been cleared in the meantime;

- for the failure cause protocol problem: e.g. there has been an erroneous encoding of the retrieval request, or transmission, or because the call reference in the retrieval request does not correspond to any call previously put on hold by the served user.

NOTE 2: The first cause may occur together with the second one. If this happens, priority should be given to the former (so there is no need to repeat the parameter invocation failure cause in the RETRIEVE indication primitive).

5 Signalling protocol for the support of SS-HOLD

5.1 SS-HOLD operational requirements

5.1.1 Served user MS/LS

The served user MS/LS shall comply with the requirements in clause 14 of EN 300 392-2 [2] which apply to the tele- and bearer-services which it supports. In addition, it shall comply with the call related requirements in clauses 7, 8 and 11 of ETS 300 392-9 [6] which apply to the INVOKE, INVOKE ACK, RETRIEVE and RETRIEVE ACK PDUs (see clauses 5.2.1.3, 5.2.1.4, 5.2.1.8 and 5.2.1.9 for the definition of those PDUs).

If it supports the following optional procedures, the served user MS/LS shall comply with the corresponding call unrelated requirements in clauses 7, 8 and 11 of ETS 300 392-9 [6]:

- for the (SS-HOLD) location change procedure, those which apply for receiving the LOCATION CHANGE PDU (see clause 5.2.1.5 for the definition of that PDU);

- for the interrogation procedure, those which apply to the INTERROGATE and INTERROGATE ACK PDUs (see clauses 5.2.1.1 and 5.2.1.2 for the definition of those PDUs).

5.1.2 Served user SwMI

That SwMI shall support as served user SwMI the served user MS/LS complying with the requirements for individual calls set in clause 5.1.1. It shall also comply with the call related requirements in clause 7 to 11 of ETS 300 392-9 [6] which apply to the INVOKE, INVOKE ACK, RETRIEVE and RETRIEVE ACK PDUs (see clauses 5.2.1.3, 5.2.1.4, 5.2.1.8 and 5.2.1.9 for the definition of those PDUs) and to the sending of notification to the affected user.

If the call is over the ISI, the served user SwMI shall comply with the corresponding ISI requirements for individual calls, set in ETS 300 392-3-2 [4]. In addition, if it supports the optional SS-HOLD migration procedure, the served user SwMI shall comply with the requirements in clauses 10 and 11 of ETS 300 392-9 [6] for sending the MIGRATION PDU and receiving the MIGRATION ACK PDU (see clauses 5.2.1.6 and 5.2.1.7 for the definition of those PDUs).

If it supports the interrogation procedure, that SwMI shall comply with the call unrelated requirements in clauses 7 to 11 of ETS 300 392-9 [6] which apply to the INTERROGATE and INTERROGATE ACK PDUs (see clauses 5.2.1.1 and 5.2.1.2 for the definition of those PDUs).

5.1.3   New served user SwMI

That SwMI shall support the call restoration procedure for the migrating served user MS/LS as set in clause 6.5.2.3 of ETS 300 392-3-2 [4] (for individual calls).

It shall also comply with the call related requirements in clauses 10 and 11 of ETS 300 392-9 [6] for receiving the MIGRATION PDU and sending the MIGRATION ACK PDU (see clauses 5.2.1.6 and 5.2.1.7 for the definition of those PDUs).

Since once the migration procedure is complete, that SwMI becomes the served user SwMI, it shall comply with the other operational requirements set in clause 5.1.2.

5.1.4   Affected user MS/LS

The affected user MS/LS shall comply with the requirements in clause 14 of EN 300 392-2 [2] which apply to the tele- and bearer-services which it supports and which are invoked as individual calls. In addition, it shall comply with clause 7.2.2 of ETS 300 392-9 [6] (for receiving notifications).

5.1.5   Affected user SwMI

That SwMI shall support as affected user SwMI the affected user MS/LS complying with the requirements for individual calls set in clause 5.1.4.

If the call is over the ISI, i.e. the affected user SwMI is different from the served user SwMI, the affected user SwMI shall comply with the corresponding ISI requirements for individual calls, set in ETS 300 392-3-2 [4].

NOTE: The above provisions guarantee that the affected SwMI will be able to relay to the affected user the notifications that it receives from the served user SwMI (carried by ANF-ISIIC).

5.2   Coding requirements

The information contained in the following description tables corresponds to the following keys:

Length: length of the information element or sub-element in bits;

Type: element type (1,2,3) described in clause 14.7 of EN 300 392-2 [2];

C/O/M: conditional/optional/mandatory information in the PDU;

Remark: comment or reference to note(s).

5.2.1   SS-HOLD PDUs

5.2.1.1   INTERROGATE PDU

INTERROGATE PDU may be sent by the served user MS/LS to the served user SwMI.

The served user expects one INTERROGATE ACK PDU as a response.

INTERROGATE PDU shall contain the SS-HOLD information elements listed in table 7.

Table 7: INTERROGATE PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	INTERROGATE

5.2.1.2 INTERROGATE ACK PDU

INTERROGATE ACK PDU is sent by the served user SwMI to the served user MS/LS as a response to a previous interrogation request (sent by the INTERROGATE PDU).

INTERROGATE ACK PDU shall contain the SS-HOLD information elements listed in table 8.

Table 8: INTERROGATE ACK PDU contents

Information element	Length	Type	C/O/M	Remark
SS-Type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	INTERROGATE ACK
Interrogation result	1	1	M	
Interrogation failure cause	1	1	C	Note 1
Number of calls on hold	3	1	M	Note 2
Call identifier	14	1	C	Notes 3 and 4
Address type of affected user	3	1	C	Notes 3, 4 and 5
Affected user SSI	24	1	C	Notes 4 and 6
Affected user extension	24	1	C	Note 7
External number length indicator	5	1	C	Note 8
External subscriber number	variable	1	C	Note 9

NOTE 1: Shall be conditional on the value of the information element interrogation result being equal to 0.
NOTE 2: The value of this information element shall be equal:
- to 0 if the interrogation result is negative; or
- to the number of calls still on hold if the interrogation result is positive.
NOTE 3: Shall be conditional on the value of the information element number of calls on hold being different from 0.
NOTE 4: If present (see note 3), this information element shall be considered as part of a set which shall be repeated as defined by the information element number of calls on hold.
NOTE 5: According to clause 8.4.1 of ETS 300 392-9 [6], the information element address type of affected user shall indicate that the information element affected user extension shall be present whenever the MNI of the served user is different from that of the affected user.
NOTE 6: Shall be conditional on the binary value of the information element address type of affected user being smaller than the binary value 100. It shall then be repeated together with that information element.
NOTE 7: Shall be conditional on the binary value of the information element address type of affected user being equal to the binary values 001 or 011. If present, it shall then be repeated together with that information element.
NOTE 8: Shall be conditional on the value of the information element address type of affected user indicating that the other party on hold is an external user. Its value shall then be equal to N, N being the number of digits of the number (necessarily different from 0) of that external user. If present, it shall then be repeated together with the information element address type of affected user.
NOTE 9: The length in digits of the information element external subscriber number shall be as defined by the information element external number length indicator (see note 8), i.e. this information element shall be conditional on the value of N.

5.2.1.3 INVOKE PDU

INVOKE PDU may be sent by the served user MS/LS to the served user SwMI.

The served user expects one INVOKE ACK PDU as a response.

INVOKE PDU shall contain the SS-HOLD information elements listed in table 9.

Table 9: INVOKE PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	INVOKE

5.2.1.4　INVOKE ACK PDU

INVOKE ACK PDU is sent by the served user SwMI to the served user MS/LS as a response to a previous invocation (sent by the INVOKE PDU).

The served user expects one INVOKE ACK PDU as a response.

INVOKE ACK PDU shall contain the SS-HOLD information elements listed in table 10.

Table 10: INVOKE ACK PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	INVOKE ACK
Invocation result	1	1	M	
Invocation failure cause	2	1	C	Note
NOTE:　　Shall be conditional on the value of the information element invocation result being equal to 0.				

5.2.1.5　LOCATION CHANGE PDU

LOCATION CHANGE PDU may be sent by the served user SwMI when the served user updates his registration with one or more calls on hold and the call identifier value(s) of one or more such calls (on hold) have changed. In the case of roaming (i.e. location change within the same SwMI) it is sent by the served user SwMI; in the case of migration (i.e. registration in a new SwMI), it is sent by the new served user SwMI.

LOCATION CHANGE PDU shall contain the SS-HOLD information elements listed in table 11.

Table 11: LOCATION CHANGE PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	LOCATION CHANGE
Call on hold change	2	1	M	
Number of call identifiers changed	3	1	C	Note 1
Old call identifier	14	1	C	Note 2
New call identifier	14	1	C	Note 2
Number of calls on hold lost	3	1	C	Note 3
Old call identifier	14	1	C	Note 4
NOTE 1:　Shall be conditional on the value of the information element call on hold change indicating that one or more call identifiers of calls on hold have changed.				
NOTE 2:　Shall be repeated as a set as many times as the value of the information element number of call identifiers changed.				
NOTE 3:　Shall be conditional on the value of the information element call on hold change indicating that one or more calls on hold have been lost during the location change procedure.				
NOTE 4:　Shall be repeated as many times as the value of the information element number of calls on hold change lost.				

In the case of migration, the sum of the number of call identifiers changed and of the number of calls on hold lost in the LOCATION CHANGE PDU may be lower than the value of the information element number of calls on hold in the MIGRATION PDUs: e.g. in the case where the new served user SwMI sends the LOCATION CHANGE PDU before the migration procedures have been completed for each call on hold.

5.2.1.6 MIGRATION PDU

MIGRATION PDU may be sent by the old served user SwMI to the new served user SwMI, to inform it that the connection being established by ANF-ISIIC between both SwMIs to prepare call restoration is for a call still on hold for the migrating served user.

MIGRATION PDU shall contain the SS-HOLD information elements listed in table 12.

Table 12: MIGRATION PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	MIGRATION
Number of calls on hold	3	1	M	

NOTE: In the case of migration, there is one migration procedure per call on hold (see clause 5.4.3). The information element number of calls on hold is then necessary for the new served SwMI to know how many migration procedures it may expect to run.

5.2.1.7 MIGRATION ACK PDU

MIGRATION ACK PDU may be sent by the new served user SwMI to the (old) served user SwMI, to acknowledge the reception of the previous MIGRATION PDU.

MIGRATION ACK PDU shall contain the SS-HOLD information elements listed in table 13.

Table 13: MIGRATION ACK PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	MIGRATION ACK

5.2.1.8 RETRIEVE PDU

RETRIEVE PDU is sent by the served user MS/LS to the served user SwMI.

The served user expects one RETRIEVE ACK PDU as a response.

RETRIEVE PDU shall contain the SS-HOLD information elements listed in table 14.

Table 14: RETRIEVE PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	RETRIEVE

5.2.1.9 RETRIEVE ACK PDU

RETRIEVE ACK PDU is sent by the served user SwMI to the served user MS/LS as a response to a previous invocation (sent by the RETRIEVE PDU).

The served user expects one RETRIEVE ACK PDU as a response.

RETRIEVE ACK PDU shall contain the SS-HOLD information elements listed in table 15.

Table 15: RETRIEVE ACK PDU contents

Information element	Length	Type	C/O/M	Remark
SS-type	6	1	M	Defined in ETS 300 392-9 [6]
HOLD PDU type	5	1	M	RETRIEVE ACK
Retrieval result	1	1	M	
Retrieval failure cause	3	1	C	Note
NOTE: Shall be conditional on the value of the information element retrieval result being equal to 0.				

5.2.2 TETRA PDU information element coding

5.2.2.1 Address type of affected user

The information element address type of affected user indicates either the type of address which follows in the PDU or the fact that the presentation of the affected user is restricted due top SS-CLIR. The possible types of address are:

- SSI (only) with no external subscriber number;

- full ITSI with no external subscriber number;

- SSI (only) with external subscriber number;

- full ITSI with external subscriber number.

The information element address type of affected user shall be encoded as defined in table 16.

Table 16: Address type of affected user information element contents

Information element	Length	Value	Remark
Address type of affected user	3	000_2	SSI (only) with no external subscriber number
		001_2	Full ITSI with no external subscriber number
		010_2	SSI (only) with external subscriber number (note)
		011_2	Full ITSI with external subscriber number (note)
		100_2	Reserved
		101_2	Reserved
		110_2	Reserved
		111_2	Identity presentation restricted (SS-CLIR)
NOTE: The corresponding SSI values (whether alone or part of the full ITSI) should then be as defined in clauses 7.8, 7.9 and 7.10 of ETR 300-5 [9].			

5.2.2.2 Affected user extension

The information element affected user extension shall indicate the extended part of the TSI (i.e. the MNI) of the affected user, as defined in table 11 of ETS 300 392-9 [6].

5.2.2.3 Affected user SSI

The information element affected user SSI shall indicate the Short Subscriber Identity (SSI) of the affected user, as defined in table 10 of ETS 300 392-9 [6].

5.2.2.4   Call on hold change

The information element call on hold change shall indicate whether one or more (call) identifiers of calls on hold have changed in the location change procedure and/or whether one or more calls call on hold have been lost during the location change procedure (i.e. because the location change procedure failed, e.g. by lack of resources internal to the served user SwMI, or the call has been cleared on user C side, else because an ISI connection used for the call on hold has been pre-empted).

It shall be encoded in a bit-map manner as defined in table 17.

Table 17: Call on hold change information element contents

Information element	Length	Value (note)	Remark
Call on hold change	2	00_2	No change occurred
		$x1_2$	One or more identifiers of calls on hold changed
		$1x_2$	One or more calls on hold lost
NOTE: The letter x in the values in that column stands for 0 or 1 indifferently.			

5.2.2.5   Call identifier

See table 91 of EN 300 392-2 [2].

5.2.2.6   External number length indicator

See table 17 of ETS 300 392-9 [6], with the restriction that due to the way that information element is used in the present document, its value shall never be equal to 0.

   NOTE: Actually, the external number length indicator is not an information element per se, but it is needed according to the PDU encoding rules defined in clause 14.7 of EN 300 392-2 [2], for encoding the external number digits (the length of which is variable) as "a type 1 element".

5.2.2.7   External subscriber number

See clause 14.8.20 of EN 300 392-2 [2].

5.2.2.8   HOLD PDU type

The information element HOLD PDU type shall indicate the type of the HOLD PDU, as defined in table 18.

Table 18: HOLD PDU type information element contents

Information element	Length	Value	Remark
HOLD PDU type	5	00000_2	See ETS 300 392-9 [6]
		00001_2	See ETS 300 392-9 [6]
		00010_2	See ETS 300 392-9 [6]
		00011_2	See ETS 300 392-9 [6]
		00100_2	See ETS 300 392-9 [6]
		00101_2	INTERROGATE
		00110_2	INTERROGATE ACK
		00111_2	INVOKE
		01000_2	INVOKE ACK
		01001_2	LOCATION CHANGE
		01010_2	MIGRATION
		01011_2	MIGRATION ACK
		01110_2	RETRIEVE
		01111_2	RETRIEVE ACK
		$> 01111_2$	Reserved

5.2.2.9   Interrogation failure cause

The information element interrogation failure cause shall give the reason why the value of the information element interrogation result is equal to 0 in the INTERROGATE ACK PDU. It shall be encoded as defined in table 19.

Table 19: Interrogation failure cause information element contents

Information element	Length	Value	Remark
Interrogation failure cause	1	0	Rejected for any reason
		1	Supplementary service not subscribed for user

5.2.2.10   Interrogation result

The information element interrogation result shall indicate whether the previous interrogation request has been successful or unsuccessful as defined in table 20.

Table 20: Interrogation result information element contents

Information element	Length	Value	Remark
Interrogation result	1	0	Interrogation unsuccessful
		1	Interrogation successful

5.2.2.11   Invocation failure cause

The information element invocation failure cause shall give the reason why the value of the information element retrieval result is equal to 0 in the INVOKE ACK PDU. It shall be encoded as defined in table 21.

Table 21: Invocation failure cause information element contents

Information element	Length	Value	Remark
Invocation failure cause	2	00_2	Rejected for any reason
		01_2	Supplementary service not subscribed for user
		10_2	Reserved
		11_2	Maximum number of calls on hold already reached

5.2.2.12   Invocation result

The information element invocation result shall indicate whether the previous invocation has been successful or unsuccessful as defined in table 22.

Table 22: Invocation result information element contents

Information element	Length	Value	Remark
Invocation result	1	0	Invocation unsuccessful
		1	Invocation successful

5.2.2.13   New/old call identifier

The information element old call identifier shall give the previous reference of the call on hold in the case where that reference has changed or where that call has been lost during the location change procedure. If the call identifier has changed, the information element new call identifier shall then give the new reference of the call. Both information elements shall be encoded as defined in table 91 of EN 300 392-2 [2] (for the information element call identifier).

5.2.2.14   Number of call identifiers changed/ number of calls on hold lost

The information element number of call identifiers changed shall indicate the number of calls still on hold for which the call identifiers have changed and the new call identifiers are given as repeated information elements in the same (LOCATION) PDU.

The information element number of calls on hold lost shall indicate the number of calls lost during the location change procedure (see clause 5.2.2.4) for which the call identifiers are given as repeated information elements in the same (LOCATION) PDU.

Both information elements shall be encoded as the information element number of calls on hold (see table 23).

5.2.2.15   Number of calls on hold

The information element number of calls on hold shall indicate how many calls are on hold for the served user at the time it is sent. It shall be encoded as defined in table 23.

Table 23: Number of calls on hold information element contents

Information element	Length	Value	Remark
Number of calls on hold	3	000_2	No calls still on hold
		001_2	One call still on hold
		$> 001_2$	N calls on hold, N being the value of the information element

5.2.2.16   Retrieval failure cause

The information element retrieval failure cause shall give the reason why the value of the information element retrieval result is equal to 0 in the RETRIEVE ACK PDU. It shall be encoded as defined in table 24.

Table 24: Retrieval failure cause information element contents

Information element	Length	Value	Remark
Retrieval failure cause	3	000_2	Rejected for any reason - the call is retrievable (note 1)
		001_2	Rejected for any reason - the call cannot be retrieved
		010_2	Congestion (note 1)
		011_2	Call identifier no more valid due to location change
		100_2	Call already cleared
		101_2	Unknown call identifier (note 2)
		$> 101_2$	Reserved
NOTE 1: When the served user receives that value as a retrieval failure cause for a given call on hold, it means that if he sends later a new retrieval request for that call, that request may be successful.			
NOTE 2: That value should not be used when the value of the information element call identifier in the corresponding RETRIEVE PDU was that of a call previously put on hold by the served user and cleared since.			

5.2.2.17   Retrieval result

The information element retrieval result shall indicate whether the previous retrieval request has been successful or unsuccessful as defined in table 25.

Table 25: Retrieval result information element contents

Information element	Length	Value	Remark
Retrieval result	1	0	Retrieval unsuccessful
		1	Retrieval successful

5.2.3   Additional coding requirements over the ISI

Except for the SS-HOLD MIGRATION and MIGRATION ACK PDUs (see below), the following shall apply for the PSS1 facility information element carrying an APDU of the ROSE operation used by ANF-ISISS for SS-HOLD PDUs:

- both the sourceEntity and destinationEntity data elements in the Network Facility Extension of this PSS1 information element shall contain the value endPINX;

- no interpretation APDU shall be included in this PSS1 facility information element.

If sent by the old served user SwMI, the SS-HOLD MIGRATION PDU shall be included as an APDU of the ROSE operation used by ANF-ISISS in the same PSS1 facility information element as that carrying the ANF-ISIIC-CALL RESTORE PREPARE PDU, else the ANF-ISIIC-END CALL RESTORE PREPARE PDU or the ANF-ISIIC-PATH RESTORE PREPARE PDU (as a different APDU of the same ROSE operation - used by ANF-ISIIC), itself sent by the old served SwMI to the new served SwMI to prepare call restoration (as if the individual call was ongoing, and not on hold for the migrating served user).

NOTE 1: It may thus happen that the destinationEntity data element in the Network Facility Extension of this PSS1 facility information element contain a value different from endPINX (in the case of call restoration with loop or trombone avoidance - e.g. individual call initially established by forward switching through the called user home SwMI to a user who has migrated and the served user migrates into that SwMI, whether he is user either the calling or the called user).

If sent back by the new served user SwMI, the SS-HOLD MIGRATION ACK PDU, defined in table 13, shall be included as an APDU of the ROSE operation used by ANF-ISISS in the same PSS1 facility information element as that carrying the ANF-ISIIC-CALL RESTORE PREPARED PDU (as a different APDU of the same ROSE operation - used by ANF-ISIIC), sent by the new served SwMI to the old served SwMI to acknowledge one of the following ANF-ISIIC PDUs sent previously for the (individual) call on hold:

- the ANF-ISIIC-CALL RESTORE PREPARE PDU; else

- the ANF-ISIIC-END CALL RESTORE PREPARE PDU or the ANF-ISIIC-PATH CALL RESTORE PREPARE PDU.

NOTE 2: As provided in clause 5.4.3, the SS-HOLD MIGRATION ACK PDU is not sent back when the new served user SwMI does not support the SS-HOLD migration procedure.

5.3   SS-HOLD state definition

5.3.1   States at the served user MS/LS

Two types of state definitions have been identified:

- one for SS-HOLD invocation and operation;

- the other for SS-HOLD interrogation.

5.3.1.1 States for invocation and operation

The following conceptual states have been identified in the served user SwMI for writing the procedures for SS-HOLD invocation and operation:

- idle;

- SS_HOLD_invoked;

- call_on_hold;

- location_change;

- call_retrieve_requested;

- location_change_with_retrieval_to_be_requested;

- call_on_hold_with_retrieval_to_be_reattempted;

- location_change_with_retrieval_requested.

5.3.1.2 State for interrogation

Only one conceptual state has been identified in the served user SwMI for writing the procedures for SS-HOLD interrogation: idle.

5.3.2 States at the served user SwMI

Two types of state definitions have been identified:

- one for SS-HOLD invocation and operation;

- the other for SS-HOLD interrogation.

5.3.2.1 States for invocation and operation

The following conceptual states have been identified in the served user SwMI for writing the procedures for SS-HOLD invocation and operation:

- idle;

- call_on_hold;

- migration;

- waiting_for_call_retrieval;

- waiting_for_path_clearing.

In the case of migration of the served user, only one conceptual state has been identified in the new SwMI for writing the procedures for SS-HOLD invocation and operation before it becomes the served user SwMI: idle.

5.3.2.2 State for interrogation

Only one conceptual state has been identified in the served user SwMI for writing the procedures for SS-HOLD interrogation: idle.

5.3.3   States at the new served user SwMI

Only one conceptual state has been identified in the new served user SwMI for writing the SS-HOLD procedures (i.e. for operation): idle.

NOTE: After the SS-HOLD migration procedure has been completed, the new served user SwMI ceases to exist because: either

-    it has become the served user SwMI, if the SS-HOLD migration procedure has been successful; or

-    the call on hold is cleared, if the SS-HOLD migration procedure has been unsuccessful.

5.3.4   State at the affected user MS/LS

Only one conceptual state has been identified in the affected user MS/LS for writing the SS-HOLD procedures (i.e. for operation): idle.

5.3.5   State at the affected user SwMI

Only one conceptual state has been identified in the affected user SwMI for writing the SS-HOLD procedures (i.e. for operation): idle.

5.4   SS-HOLD signalling procedures

Examples of message sequences are shown in annex A.

5.4.1   Actions at the served user MS/LS

The SDL representation of procedures at the calling user MS/LS is shown in clause B.1 of annex B.

5.4.1.1   Normal procedures

5.4.1.1.1   Invocation and operation

When the served user has invoked SS-HOLD during an individual call, the served user MS/LS shall send the U-INFO PDU (see table 82 of EN 300 392-2 [2]) including the INVOKE PDU, defined in table 9.

The served user MS/LS shall then start the invocation timer and wait for receiving the D-INFO PDU (see table 67 of EN 300 392-2 [2]) including the INVOKE ACK PDU, defined in table 10.

If the invocation timer expires before the served user MS/LS has received either that INVOKE ACK PDU or any call clearing PDU (or primitive), the served user MS/LS shall consider that the invocation has failed. It should reattempt it.

When the served user roams (i.e. changes registered area within the same SwMI) or migrates (registers in a new SwMI) with one or more calls on hold, its MS shall:

-    give the value corresponding to "call restoration roaming location updating" or "call restoration migrating location updating" respectively to the location update type information element (see table 197 of EN 300 392-2 [2]) in the corresponding registration PDU: MM U-LOCATION UPDATE PDU (see table 161 of EN 300 392-2 [2]);

-    start the call_identifier_roaming_change timer in case of roaming, or the call_identifier_migration_change timer in case of migration.

The served user MS may then receive the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the LOCATION CHANGE PDU, defined in table 11. It shall then update accordingly the call identifiers of the calls on hold. If the served user has roamed and his MS has not received that LOCATION CHANGE PDU nor any call clearing PDU (or primitive) when the call_identifier_roaming_change timer expires, that MS shall consider that the call identifiers of the calls on hold have not changed.

To retrieve a call previously put on hold, the served user MS/LS shall send the U-INFO PDU or the
U-TX DEMAND PDU (see tables 82 and 88 of EN 300 392-2 [2] respectively) including the RETRIEVE PDU, defined
in table 14. The value of the information element call identifier in that U-INFO PDU or U-TX DEMAND PDU shall be
the same as in the preceding D-INFO including the INVOKE ACK PDU, defined in table 10, unless that call identifier
has been updated by one or more LOCATION CHANGE PDUs. In the latter case, the served user MS/LS shall use the
call identifier latest update received.

Since the call identifier change will be systematic in case of migration, if the served user decides to retrieve the call on
hold immediately after having registered in the new SwMI, its MS/LS shall delay the sending of the corresponding
RETRIEVE PDU until it has received the LOCATION CHANGE PDU (from the new SwMI), defined in table 11.

The served user MS/LS shall then start the retrieval timer and wait for receiving the D-INFO PDU (see table 67 of
EN 300 392-2 [2]) including the RETRIEVE ACK PDU, defined in table 15. Then the following shall apply for the
possible re-sending of the U-INFO PDU or U-TX DEMAND PDU including the RETRIEVE PDU, defined in table 14,
if the retrieval timer expires before the served user MS/LS has received either that RETRIEVE ACK PDU or any call
clearing PDU (or primitive):

- if the served user has roamed and the served user SwMI has not changed the call identifier of the call on hold, his
  MS should send again that U-INFO PDU or U-TX DEMAND PDU;

- if the served user has roamed or migrated and the call identifier of the call on hold has changed, his MS shall
  send again that U-INFO PDU or U-TX DEMAND PDU, in starting (again) the retrieval timer;

- if the served user has not changed location, it is an implementation matter whether or not that MS/LS will send
  again that U-INFO PDU or U-TX DEMAND PDU.

If that RETRIEVE ACK PDU includes the information element retrieval failure cause (see table 24) with a value
corresponding only to a temporary failure, the served user MS/LS may attempt again to retrieve the call on hold after
some time, in using the repeat timer.

If the served user MS/LS has received that RETRIEVE ACK PDU in the D-RELEASE PDU (see table 68 of
EN 300 392-2 [2]) and the value of the information element retrieval failure cause (see table 24) corresponds to call
identifier no more valid due to location change, that MS/LS should not immediately consider that the call has been
cleared. Instead it should wait for receiving the corresponding LOCATION CHANGE PDU, defined in table 11. Once
it has received it, it may then attempt to retrieve the call on hold in sending the D-INFO PDU (see table 67 of
EN 300 392-2 [2]) including the RETRIEVE ACK PDU, defined in table 15, with the value of the information element
call identifier in that D-INFO PDU being the updated one given by the LOCATION CHANGE PDU.

To clear a call on hold, the served user MS/LS shall use the basic call procedure, as defined in clause 14.5.1.3.1 of
EN 300 392-2 [2].

NOTE: This means that the served user MS/LS will send the U-DISCONNECT PDU with the call identifier of
         the call on hold (i.e. there is no need for that M/LS to have previously retrieved that call).

5.4.1.1.2   Interrogation

The served user MS/LS may support the interrogation procedure. That procedure consists in:

- sending to the served user SwMI the U-FACILITY PDU (see table 4 of ETS 300 392-9 [6]) including the
  INTERROGATE PDU, defined in table 7;

- then waiting for receiving the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the
  INTERROGATE ACK PDU, defined in table 8.

5.4.1.2   Exceptional procedures

5.4.1.2.1   Invocation

The following shall apply when the user has invoked SS-HOLD and when that invocation fails for one of the two following reasons:

- the supplementary service has not been subscribed for him;

- the maximum number of calls put on hold by the served user and not retrieved or cleared has already been reached.

The served user MS/LS shall be given the above reason which applies by the value of the information element invocation failure cause (see table 21) in the INVOKE ACK PDU, defined in table 10, received in the D-INFO PDU (see table 67 of EN 300 392-2 [2]).

NOTE 1: Obviously the two failure reasons mentioned above are mutually exclusive. Thus the case where more than one value of the information element invocation failure cause would be needed is excluded.

NOTE 2: If SS-HOLD invocation by a user fails because the SwMI where that user is registered does not support SS-HOLD, that user will be informed about it according to the procedure defined in clause 11.2.1 of EN 300 392-2 [2].

5.4.1.2.2   Operation

If the call on hold for which the served user has sent the RETRIEVE PDU, defined in table 14, cannot be retrieved anymore, the served user MS/LS shall be given the above reason which applies by the value of the information element retrieval failure cause (see table 24) in the RETRIEVE ACK PDU, defined in table 15, received in the D-RELEASE PDU (see table 68 of EN 300 392-2 [2]).

NOTE 1: If the served user attempts to retrieve a call on hold after he has roamed or migrated and if his MS receives a generic reject PDU, according to the procedure defined in clause 11.2.1 of ETS 300 392-9 [6], that MS will identify that:

- in case of roaming, i.e. within the same served user SwMI, that SwMI does not support the location change procedure; or

- in case of migration, i.e. into a new served user SwMI, that SwMI does not support: either

- the SS-HOLD migration procedure; or

- SS-HOLD itself.

The served user MS will then consider that the call has been cleared (and send the TNCC-RELEASE indication to the served user application).

After the served user has migrated, if the call_identifier_migration_change timer expires before the served user MS has received the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the LOCATION CHANGE PDU, defined in table 11, the served user MS shall consider that all its calls on hold have been lost.

NOTE 2: Consequently it will send the TNCC-RELEASE indication to the served user application.

5.4.1.2.3   Interrogation

If the served user MS/LS has sent the U-FACILITY PDU (see table 4 of ETS 300 392-9 [6]) including the INTERROGATE PDU and if SS-HOLD has not been subscribed to for that user, it shall receive the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the INTERROGATE ACK PDU, defined in table 8, including the corresponding information element values (see tables 20 and 19).

NOTE: If a SS-HOLD interrogation by a served user fails because the SwMI where he is currently registered (i.e. his served user SwMI) does not support that (optional) procedure, that user will be informed about it according to the procedure defined in clause 11.2.1 of EN 300 392-2 [2].

5.4.2   Actions at the served user SwMI

The SDL representation of procedures at the served user SwMI is shown in clause B.2.

5.4.2.1   Normal procedures

5.4.2.1.1   Operation

5.4.2.1.1.1   Accepting SS-HOLD invocation

When the served user SwMI has received the U-INFO PDU (see table 82 of EN 300 392-2 [2]) including the INVOKE PDU, defined in table 9, the originating SwMI shall identify that the served user has invoked SS-HOLD.

> NOTE 1:   Since node actions are not to be described as part of the protocol, it should be reminded that, according to EN 300 392-11-12 [8], on SS-HOLD stage 2 description, when the served user SwMI has received the U-INFO PDU (see table 82 of EN 300 392-2 [2]) including the INVOKE PDU from the MS/LS of a user, that SwMI will first check whether SS-HOLD has been subscribed for that user.
>
> The case where the result of that check is negative is addressed in clause 5.4.2.2. If that result is positive, the communication channel previously used at the served user MS air interface will be interrupted.

If the served user SwMI accepts the SS-HOLD invocation:

- it shall then send to the served user MS/LS the D-INFO PDU (see table 67 of EN 300 392-2 [2]) including the INVOKE ACK PDU, defined in table 10;

- if the served user SwMI does not coincide with the affected user SwMI (i.e. the call is over the ISI), the served user SwMI shall send in the PSS1 FACILITY message the ANF-ISIIC-INFO DEMAND PDU (see table 42 of ETS 300 392-3-2 [4]) including the notification indicator information element with the value corresponding to call put on hold (see table 3 of ETS 300 392-9 [6]) - notification be delivered to the affected user MS/LS. The value of the information element call status in the ANF-ISIIC- INFO DEMAND PDU shall correspond to call put on hold;

> NOTE 2:   The sending of that notification by the served user SwMI instead of by the affected user SwMI is for the case where the affected user SwMI would not support SS-HOLD.

- if the served user SwMI coincides with the affected user SwMI (i.e. the call is an intra-TETRA call), that SwMI shall send to the affected user MS/LS the notification indicator information element with the value corresponding to call put on hold (see table 3 of ETS 300 392-9 [6]) in the D-INFO PDU (see table 67 of EN 300 392-2 [2]).

5.4.2.1.1.2   Case of roaming with call on hold

If the served user has roamed with one or more calls on hold and if the served user SwMI supports the optional SS-HOLD location change procedure (i.e. the retrieval of calls on hold after such roaming), it shall start the timer Tloc_change and wait for the completion (successful or not) of the location change procedures for all those calls on hold. If such completion occurs before timer Tloc_change expires, the served user SwMI shall send the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the LOCATION CHANGE PDU, defined in table 11, whenever:

- it has changed the call identifier of any call on hold; and/or

- it has lost any call on hold.

5.4.2.1.1.3   Case of migration with call on hold

If the served user migrates into a new SwMI with one or more calls on hold, the served user SwMI may support the SS-HOLD migration procedure.

That procedure consists in invoking ANF-ISISS (see clause 10 of ETS 300 392-9 [6]) to send the MIGRATION PDU, defined in table 12, to that new SwMI together with the ANF-ISIIC-CALL RESTORE PREPARE PDU, else the ANF-ISIIC-END CALL RESTORE PREPARE PDU or the ANF-ISIIC-PATH CALL RESTORE PREPARE PDU (see clause 5.2.3). The served user SwMI shall then wait for receiving back be the MIGRATION ACK PDU, defined in table 13, acknowledging the reception of the previous one, through ANF-ISIIS in a ROSE return result APDU with the same ROSE invoke identifier as that of the ROSE invoke APDU used by ANF-ISISS to convey the original MIGRATION PDU.

> NOTE 1: Since node actions are not to be described as part of the protocol, it should be reminded that, according to EN 300 392-11-12 [8], on SS-HOLD stage 2 description, once the served user SwMI has received that acknowledging MIGRATION ACK PDU, it will transfer the call on hold to the new served user SwMI, in cutting through its user information channel, i.e. its traffic channel, by forward switching.

If the served user SwMI receives the ANF-ISIIC-CALL RESTORATION PDU, else the ANF-ISIIC-PATH CLEARING PDU, from the new served user SwMI before having received that acknowledging MIGRATION ACK PDU (see clause 5.4.3.1), it shall not wait anymore for receiving it.

> NOTE 2: No SS-HOLD timer applies for the reception of the acknowledging MIGRATION PDU after the served user has sent the MIGRATION PDU because the PSS1 timers T303 and T310 apply for the reception of the ANF-ISIIC-PDU together with which the acknowledging MIGRATION ACK PDU is sent (by the new served user SwMI - see clause 5.4.3.1).

If the served user migrates again from the served user SwMI (called $SwMI_1$ hereafter) without having retrieved some calls which were already on hold when he migrated for the first time (after having put them on hold) while he was registered in that SwMI and if that SwMI is on the path of one of those calls before that migration and this has been identified (i.e. $SwMI_1$ has received the ANF-ISIIC-END CALL RESTORE PREPARE PDU or the ANF-ISIIC-PATH RESTORE PREPARE PDU, defined in tables 50 and 51 of ETS 300 392-3-2 [4] respectively, from the then old served user SwMI, called $SwMI_2$), $SwMI_1$ shall send the ANF-ISIIC-PATH CLEARING PDU, defined in table 53 of ETS 300 392-3-2 [4]):

- to $SwMI_2$ if: either

  - $SwMI_1$ had received the ANF-ISIIC-END CALL RESTORE PREPARE PDU and the affected user has not himself migrated into a SwMI identified as being on the path of the original call while the served user was registered in $SwMI_1$; or

  - $SwMI_1$ had received the ANF-ISIIC-PATH RESTORE PREPARE PDU and the affected user has not himself migrated into $SwMI_2$ while the served user was registered in $SwMI_1$ or if he has this has not been identified by the old affected user SwMI;

> NOTE 3: The reason why the path between $SwMI_1$ and $SwMI_2$ may be cleared when $SwMI_1$ is on the path of the call but different from the affected user SwMI (i.e. the other end SwMI) and when the affected user has also migrated into a SwMI on the path of the call but different from $SwMI_2$ is that the specifications of ANF-ISIIC (see clause 6 of ETS 300 392-3-2 [4]) are such that:
>
>   - if the call has not been diverted, that new affected user SwMI on the path of the call can only be $SwMI_1$;
>
>   - if the call has been diverted, the only SwMIs, which the old affected user SwMI may identify as being on the path of the call, are SwMIs on the path between itself and $SwMI_1$ (therefore not on the path between $SwMI_1$ and $SwMI_2$).

  or

- to the old affected user SwMI if $SwMI_1$ had received the ANF-ISIIC-PATH RESTORE PREPARE PDU, if the affected user has himself migrated into $SwMI_2$ while the served user was registered in $SwMI_1$ and if this has been identified by the old affected user SwMI.

> NOTE 4: According to ETS 300 392-3-2 [4], the ANF-ISIIC-PATH CLEARING PDU is sent in the PSS1 DISCONNECT message.

5.4.2.1.1.4   Retrieval

After a call has been put on hold by the served user, the served user SwMI shall wait for receiving the U-INFO PDU or U-TX DEMAND PDU (see table 82 and 88 of EN 300 392-2 [2] respectively) including the RETRIEVE PDU, defined in table 14, unless the served user migrates.

If the served user SwMI accepts that retrieval request:

-   it shall then send to the served user MS/LS one of the following air interface PDUs including the RETRIEVE ACK PDU, defined in table 15:

    -   the D-INFO PDU (see table 67 of EN 300 392-2 [2]), if it had received the corresponding request in the U-INFO PDU; or

    -   the D-TX DEMAND PDU (see table 82 of EN 300 392-2 [2]), if it had received the corresponding request in the U-TX DEMAND PDU;

-   if the served user SwMI coincides with the affected user SwMI (i.e. the call is an intra-TETRA call), that SwMI shall send to the affected user MS/LS the notification indicator information element with the value corresponding to call on hold retrieved (see table 3 of ETS 300 392-9 [6]) in the D-INFO PDU (see table 67 of EN 300 392-2 [2]) or the D-TX GRANTED PDU (see table 74 of EN 300 392-2 [2]) depending on the air interface PDU used by the served user for the corresponding retrieval request;

-   if the served user SwMI does not coincide with the affected user SwMI or if it does this has not been identified (i.e. the call is over the ISI), and if the served user has remained registered in the same SwMI where the call has been put on hold, the served user SwMI shall send one of the following ANF-ISIIC PDUs to the affected user SwMI in the PSS1 FACILITY message:

    -   the ANF-ISIIC-INFO DEMAND PDU (see table 42 of ETS 300 392-3-2 [4]), if the served user has sent the corresponding retrieval request in the U-INFO PDU;

    -   the ANF-ISIIC-TX GRANTED PDU (see table 37 of ETS 300 392-3-2 [4]), if the served user has sent the corresponding retrieval request in the U-TX DEMAND PDU and if he is the calling party in that call (just retrieved); or

    -   the ANF-ISIIC-TX DEMAND PDU (see table 44 of ETS 300 392-3-2 [4]), if the served user has sent the corresponding retrieval request in the U-TX DEMAND PDU and if he is the connected party in that call (just retrieved).

The ANF-ISIIC-INFO DEMAND PDU, ANF-ISIIC-TX GRANTED PDU or ANF-ISIIC-TX DEMAND PDU sent shall include the notification indicator information element with the value corresponding to call on hold retrieved (see table 3 of ETS 300 392-9 [6]) - notification be delivered to the affected user MS/LS; and the value of its information element call status shall indicate that the call is no more on hold, e.g. call on hold retrieved or call is queued.

-   if the served user SwMI does not coincide with the affected user SwMI or if it does this has not been identified (i.e. the call is over the ISI), and if the served user has already migrated since the call has been put on hold, the served user SwMI shall send the ANF-ISIIC-CALL RESTORE PDU (see table 49 of ETS 300 392-3-2 [4]) to the affected user SwMI in the PSS1 FACILITY message.

That PDU shall include the notification indicator information element with the value corresponding to call on hold retrieved (see table 3 of ETS 300 392-9 [6]) - notification be delivered to the affected user MS/LS; and the value of its information element call status shall indicate that the call is no more on hold, e.g. call on hold retrieved or call is queued.

    NOTE 1: See note 2 in clause 5.4.2.1.1.1.

The served user SwMI may also reject the retrieval request but only temporarily. If so, it shall also send the D-INFO PDU (see table 67 of EN 300 392-2 [2]) including the RETRIEVE ACK PDU, defined in table 15, in giving the corresponding value to the information element retrieval failure cause (see table 24).

If the served user has roamed with the call on hold, if the served user SwMI receives the U-INFO PDU (see table 82 of EN 300 392-2 [2]) including the RETRIEVE PDU, defined in table 14, with the value of the information element call identifier in that U-INFO PDU corresponding to the call identifier of the call on hold before roaming (i.e. that value has changed during roaming), and if that SwMI can identify it, it should send (in the D-RELEASE PDU) the RETRIEVE ACK PDU, defined in table 15, with the value of the information element retrieval failure cause (see table 24) corresponding to call identifier no more valid due to location change. It should then also send the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the LOCATION CHANGE PDU, defined in table 11, updating at least the call identifier of that call on hold.

If the served user has already migrated since the call has been put on hold and if the served user SwMI had received the ANF-ISIIC-END CALL RESTORE PREPARE PDU or the ANF-ISIIC-PATH RESTORE PREPARE PDU, defined in tables 50 and 51 of ETS 300 392-3-2 [4] respectively, (i.e. the served user SwMI is on the path of the call on hold before that migration and this has been identified), the served user SwMI shall send the ANF-ISIIC-PATH CLEARING PDU, defined in table 53 of ETS 300 392-3-2 [4]):

- to the old served user SwMI if: either

  - the served user SwMI had received the ANF-ISIIC-END CALL RESTORE PREPARE PDU and the affected user has not himself migrated into a SwMI identified as being on the path of the original call while the served user was registered in the served user SwMI; or

  - the served user SwMI had received the ANF-ISIIC-PATH RESTORE PREPARE PDU and the affected user has not himself migrated into the old served user SwMI while the served user was registered in the served user SwMI or if he has this has not been identified by the old affected user SwMI;

NOTE 2: The reason why the path between the served user SwMI and the old served user SwMI may be cleared when the served user SwMI is on the path of the call but different from the affected user SwMI (i.e. the other end SwMI) and when the affected user has also migrated into a SwMI on the path of the call but different from the old served user SwMI is that the specifications of ANF-ISIIC (see clause 6 of ETS 300 392-3-2 [4]) are such that:

  - if the call has not been diverted, that new affected user SwMI on the path of the call can only be the served user SwMI;

  - if the call has been diverted, the only SwMIs which the old affected user SwMI may identify as being on the path of the call are SwMIs on the path between itself and the served user SwMI (therefore not on the path between the served user SwMI and the old served user SwMI).

  or

- to the old affected user SwMI if the served user SwMI had received the ANF-ISIIC-PATH RESTORE PREPARE PDU, if the affected user has himself migrated into the old served user SwMI while the served user was registered in the served user SwMI and if this has been identified by the old affected user SwMI.

NOTE 3: According to ETS 300 392-3-2 [4], the ANF-ISIIC-PATH CLEARING PDU is sent in the PSS1 DISCONNECT message.

5.4.2.1.2   Interrogation

The served user SwMI may support the interrogation procedure. That procedure consists:

- first in receiving from the served user MS/LS the U-FACILITY PDU (see table 4 of ETS 300 392-9 [6]) including the INTERROGATE PDU, defined in table 7;

- then, if the interrogation request has been successful, in sending the response to the served user MS/LS the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the INTERROGATE ACK PDU, defined in table 8.

5.4.2.2   Exceptional procedures

5.4.2.2.1   Invocation failure

When the served user MS/LS has sent the INVOKE PDU and that invocation fails, the served user SwMI shall send back the INVOKE ACK PDU, defined in table 10, in the D-INFO PDU (see table 67 of EN 300 392-2 [2]), with the value of the information elements:

- invocation result, equal to 0 (see table 22); and

- invocation failure cause giving the corresponding failure cause (see table 21). Such cause may be:

  - the supplementary service has not been subscribed for him;

  - the maximum number of calls put on hold by the served user and not retrieved or cleared has already been reached.

  NOTE: Obviously the two failure reasons mentioned above are mutually exclusive. Thus the case where more than one value of the information element invocation failure cause would be needed is excluded.

5.4.2.2.2   Retrieval failure

When the served user MS/LS has sent the RETRIEVE PDU, and the served SwMI rejects the corresponding retrieval request in considering that the call is definitely lost, the served user SwMI shall send back the D-DISCONNECT or D-RELEASE PDU (see table 65 and 68 of EN 300 392-2 [2]) including the RETRIEVE ACK PDU, defined in table 15, with the value of the information elements:

- retrieval result, equal to 0 (see table 25); and

- retrieval failure cause giving the corresponding failure cause (see table 24). Such cause may be:

  - the call cannot be retrieved due to congestion;

  - the call has already been cleared;

  - the call identifier used in the RETRIEVE PDU either does not exist or does not correspond to a call still on hold for the served user.

  NOTE: See clause 5.4.2.1.1.4 for the case where the call on hold can be retrieved but in using the updated call identifier.

5.4.2.2.3   Location change failure

5.4.2.2.3.1   Partial failure in the case of roaming

If the served user has roamed with one or more calls on hold and if the served user SwMI supports the optional SS-HOLD location change procedure (i.e. the acceptance of calls on hold after such roaming), the served user SwMI shall indicate the number of calls lost during the location change procedure (see clause 5.2.2.9) in the LOCATION CHANGE PDU, defined in table 11, which it sends back to the served user MS.

If the served user SwMI sends that LOCATION CHANGE PDU only when timer Tloc_change expires (i.e. before it has completed the location change procedures for all the calls on hold), in that PDU it shall indicate all calls on hold for which the location change procedures have not yet been completed as calls lost.

5.4.2.2.3.2   Case of migration

In case of migration of the served user with one or more calls on hold, if the served user SwMI does not support the SS-HOLD migration procedure, it shall clear the call(s) on hold with the disconnect cause: served user migration.

Similarly, still in case of migration of the served user with one or more calls on hold, if the served user SwMI has sent the MIGRATION PDU to the new served user SwMI (in case of migration of the served user), it shall clear the call on hold with the disconnect cause (served user migration):

- if it has received back the ROSE ReturnError APDU indicating that the new served user SwMI has rejected the MIGRATION PDU because it does not support:

    - the SS-HOLD migration procedure (see clause 5.4.4.2); or

    - SS-HOLD itself (see case b) in clause 11.1.2 of ETS 300 392-9 [6]);

- if when it receives the ANF-ISIIC-CALL RESTORE PREPARED PDU, defined in table 48 of ETS 300 392-3-2 [4] from the new served user SwMI, it does not receive together with it the MIGRATION ACK PDU back, confirming the reception of the original MIGRATION PDU (see clause 5.4.3.1).

NOTE: Even if it does not support SS-HOLD, according to that clause 11.1.2 of ETS 300 392-9 [6], the new served user SwMI should send the corresponding ROSE ReturnError APDU in the PSS1 DISCONNECT or RELEASE message.

5.4.2.2.4   Interrogation

If the served user SwMI has received the INTERROGATE PDU from the MS/LS of a user and if SS-HOLD has not been subscribed to for that user, it shall include the corresponding information element values (see tables 20 and 19) in the INTERROGATE ACK PDU, defined in table 8. It shall then send that PDU in the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]).

5.4.3   Actions at the new served user SwMI

The new served user SwMI is defined as the SwMI where the served user migrates with one or more calls on hold.

The only actions of the new served user SwMI are when that served user has just migrated into that SwMI. The corresponding SDL representation is shown in clause B.3 of annex B. After those actions are completed, the new served user SwMI ceases to exist because: either

- it has become the served user SwMI (see clause 5.4.3.1); or

- the call on hold is cleared (see clause 5.4.3.2).

5.4.3.1   Normal procedures (migration procedure)

If the served user migrates into the new served user SwMI, that SwMI may support the SS-HOLD migration procedure.

NOTE 1: The support of the migration procedure implies that the new served user SwMI supports the SS-HOLD location change procedure (see clause 5.4.2.1.1.2).

That procedure starts with the reception of the first MIGRATION PDU sent by the present served user SwMI for one call on hold for the (migrating) served user (see clause 5.4.2.1.1.3), through the invoked ANF-ISISS using the ROSE Invoke APDU of the corresponding ROSE operation.

The new served user SwMI shall then start the timer Tloc_change and store the number of calls on hold (as indicated by the value of the information element number of calls on hold in the received MIGRATION PDUs, defined in table 12).

Depending on whether the served user keeps the call on hold or requests the new served user SwMI to retrieve it as soon as he is registered in that new SwMI, for each MIGRATION PDU received, the following shall apply:

- if the served user keeps the call on hold, the new served user SwMI shall send back the ANF-ISIIC-CALL RESTORE PREPARED PDU, defined in table 48 of ETS 300 392-3-2 [4], to the old served user SwMI; or

- if the served user requests the new served user SwMI to retrieve the call on hold before that SwMI has sent the ANF-ISIIC-CALL RESTORE PREPARED PDU (i.e. as soon as he is registered in that new SwMI):

    - if the new served user SwMI had received the ANF-ISIIC-CALL RESTORE PREPARE PDU, defined in table 47 of ETS 300 392-3-2 [4], it shall send back the ANF-ISIIC-CALL RESTORATION PDU, defined in table 49 of ETS 300 392-3-2 [4], to the old served user SwMI;

    - if the new served user SwMI had received the ANF-ISIIC-PATH RESTORE PREPARE PDU, defined in tables 51 and 50 of ETS 300 392-3-2 [4] respectively and if the affected user has not himself migrated at the same time into the old served user SwMI, the new served user SwMI shall send back the ANF-ISIIC-PATH CLEARING PDU, defined in table 53 of ETS 300 392-3-2 [4], to the old served user SwMI. In addition, it shall send the ANF-ISIIC-CALL RESTORE PDU to the affected user SwMI unless both SwMIs coincide (i.e. the affected user has not himself migrated at the same time into new served user SwMI);

NOTE 2:   The reason why the path between the new served user SwMI and the old served user SwMI may be cleared when the new served user SwMI is on the path of the call but different from the affected user SwMI (i.e. the other end SwMI) and when the affected user has also migrated into a SwMI on the path of the call but different from the old served user SwMI is that the specifications of ANF-ISIIC (see clause 6 of ETS 300 392-3-2 [4]) are such that:

    - if the call has not been diverted, that new affected user SwMI on the path of the call can only be the new served user SwMI;

    - if the call has been diverted, the only SwMIs, which the old affected user SwMI may identify as being on the path of the call, are SwMIs on the path between itself and the new served user SwMI (therefore not on the path between the new served user SwMI and the old served user SwMI).

- if the new served user SwMI had received the ANF-ISIIC-PATH RESTORE PREPARE PDU and if the affected user has himself migrated at the same time into the old served user SwMI, after the new served user SwMI has received the ANF-ISIIC PDU informing it about the corresponding successful call restoration for the affected user, the new served user SwMI shall send back the ANF-ISIIC-CALL RESTORATION PDU to the old served user SwMI.

In addition, the new served user SwMI shall send the ANF-ISIIC-PATH CLEARING PDU to the old affected user SwMI (i.e. the SwMI where the affected user was registered before he migrated);

        or

    - if the new served user SwMI had received the ANF-ISIIC-END CALL RESTORE PREPARE PDU, depending on whether the affected user has himself migrated at the same time or not, it shall send:

        - the ANF-ISIIC-CALL RESTORE PDU to the (current) affected user SwMI if the affected user has himself migrated at the same time;

        - the ANF-ISIIC-PATH CLEARING PDU to the old served user SwMI if either the affected user has not himself migrated at the same time or if he has himself migrated at the same time into a SwMI not identified as being on the path of the call (on hold).

In all above cases where the ANF-ISIIC-CALL RESTORE PDU is sent, that PDU shall include the notification indicator information element with the value corresponding to call on hold retrieved (see table 3 of ETS 300 392-9 [6]) - notification be delivered to the affected user MS/LS.

NOTE 3:   According to ETS 300 392-3-2 [4]:

    - the ANF-ISIIC-CALL RESTORE PREPARED PDU is sent in the PSS1 CONNECT message;

    - the same holds for the ANF-ISIIC-CALL RESTORE PDU when it is sent instead of the ANF-ISIIC-CALL RESTORE PREPARED PDU, which is systematically the case in the present clause;

    - the ANF-ISIIC-PATH CLEARING PDU is sent in the PSS1 DISCONNECT or RELEASE message.

When the new served user SwMI sends the ANF-ISIIC-CALL RESTORE PREPARED PDU (see the above case where the served user does not request immediately the new served user SwMI to retrieve the call on hold), it shall send back together with it the MIGRATION ACK PDU, defined in table 13, to the present served user SwMI. It shall do so in invoking ANF-ISISS to carry it. The invoked ANF-ISISS shall itself be carried in the same PSS1 facility information element as that carrying that ANF-ISIIC PDU (as a different APDU of the same ROSE operation - used by ANF-ISIIC), using the ROSE return result APDU with the same ROSE invoke identifier as that of the ROSE invoke APDU through which the MIGRATION PDU has been received (itself also carried by an invoked ANF-ISISS).

The served user SwMI shall send the D-FACILITY PDU (see clause 7.3 of ETS 300 392-9 [6]) including the LOCATION CHANGE PDU, defined in table 11, to the served user MS when the migration procedures for all the calls on hold (as indicated by the value of the information element number of calls on hold in the received MIGRATION PDUs, defined in table 12) have been completed (successfully or not) if such completion occurs before timer Tloc_change expires.

NOTE 4:   See clause 5.4.3.2 for the case where timer Tloc_change expires before the migration procedures have been completed for all the calls on hold (for the migrating served user).

After the new served user SwMI has sent the LOCATION CHANGE PDU to the served user MS, it shall take over the served user SwMI role shall for the retrieval of the calls on hold or a new migration of the served user.

5.4.3.2   Exceptional procedures

If it does not support the SS-HOLD MIGRATION PDU (i.e. the SS-HOLD migration procedure), the new served user SwMI shall indicate it according to clause 11.1.2 of ETS 300 392-3-1 [3] in sending the corresponding ROSE ReturnError APDU in the case of an individual call on hold, to the present served user SwMI in the PSS1 DISCONNECT or RELEASE message according to clause 8.4.3 of ETS 300 392-3-1 [3].

If timer Tloc_change expires before the migration procedures have been completed for all the calls on hold (as indicated by the value of the information element number of calls on hold in the received MIGRATION PDU, defined in table 12), the new served user SwMI shall send the LOCATION CHANGE PDU, defined in table 11, to the served user MS. That LOCATION CHANGE PDU shall then indicate all calls on hold for which the migration procedures have not yet been completed as calls lost.

NOTE: According to clause 5.4.3.1, the fact that the new served user SwMI has started timer Tloc_change means that it supports the SS-HOLD migration procedure.

5.4.4   Actions at the affected user MS/LS

No specific procedures apply for the affected user MS/LS, beyond those specified in clause 5.1.4.

NOTE: Such procedures result in the affected user MS/LS receiving:

- the notification indicator information element with the value corresponding to call put on hold (see table 3 of ETS 300 392-9 [6]) in the D-INFO PDU when the call is put on hold;

- the notification indicator information element with the value corresponding to call on hold retrieved (see table 3 of ETS 300 392-9 [6]) in the D-INFO PDU when the call on hold is retrieved;

- the disconnect cause with the value corresponding to served user roaming or migration in the D-RELEASE or D-DISCONNECT PDU if:

   - in case of served user roaming, the served user SwMI does not support the location change procedure; or

   - in case of served user migration, the old served user SwMI or the new served user SwMI does not support the SS-HOLD migration procedure.

5.4.5   Actions at the affected user SwMI

When the affected user SwMI is different from the served user SwMI, it shall be ready to receive:

- the ANF-ISIIC-INFO DEMAND PDU (see table 42 of ETS 300 392-3-2 [4]), in the PSS1 FACILITY message, when the served user SwMI has accepted the SS-HOLD invocation. The value of the information element call status in that PDU shall then correspond to call put on hold. In addition, that PDU shall include the notification indicator information element with the value corresponding to call put on hold (see table 3 of ETS 300 392-9 [6]) - notification be delivered to the affected user MS/LS;

NOTE 1: If the affected user is equipped with a MS (and not with a LS), the affected user SwMI may then save the radio resource to that MS as long as the (individual) call is on hold.

- either again the ANF-ISIIC-INFO DEMAND PDU or the ANF-ISIIC-CALL RESTORATION PDU (see table 49 of ETS 300 392-3-2 [4]), in the PSS1 FACILITY message, when the served user SwMI has accepted the retrieval of the call (on hold). The value of the information element call status in those PDUs shall then indicate that the call is no more on hold, e.g. call on hold retrieved or call is queued. In addition, those PDUs shall include the notification indicator information element with the value corresponding to call on hold retrieved (see table 3 of ETS 300 392-9 [6]) - notification be delivered to the affected user MS/LS.

NOTE 2: If the affected user is equipped with a MS (and not with a LS) and if the affected user SwMI had saved the radio resource to that MS when he was on hold, the affected user SwMI will restore them when it receives the INFORM 2 PDU.

NOTE 3: No specific procedures apply for the affected user SwMI for passing the notifications received from the served user SwMI to the affected user MS/LS (when the call is put on hold, and when it is retrieved, later) beyond those specified in clause 5.1.5.

5.5   SS-HOLD impact of interworking with other networks

5.5.1   SS-HOLD impact of interworking with other TETRA networks

The impact on the SS-HOLD call related procedures of interworking with other TETRA networks is limited:

- to the information of the affected user;

- to the case of migration of the served user with a call on hold.

Both have already been taken into account in the preceding clauses (for the served user migration, see clauses 5.2.3, 5.4.2.1 and 5.4.3.1).

The only other SS-HOLD impact of interworking with other TETRA networks is the need to exchange information about SS-HOLD subscription for the served user when that user migrates. It is addressed in clause 5.6.2.2.

5.5.2   SS-HOLD impact of interworking with external networks

The other party in an individual call may be an external user. In such a case it shall be up to the corresponding TETRA gateway to send to the external network the notifications when the call is put on hold and/or when it is retrieved, if such procedure is supported in the external network.

If the external network supports the supplementary service SS-HOLD (as defined in that network), if the external user invokes that supplementary service successfully while participating in an individual call with a TETRA user and if the external network sends notifications to the other party when the call is put on hold and/or when it is retrieved, the following procedures defined in clause 5.4 for informing the TETRA user participating in the call (on hold) shall apply:

-    the served user SwMI procedure, to the SwMI where the corresponding TETRA gateway lies;

-    the affected user MS/LS procedure, to the MS/LS of the TETRA user participating in the call (on hold); and

-    the affected user SwMI procedure, to the SwMI where the TETRA user participating in the call (on hold) is currently registered.

5.6   Protocol interactions between SS-HOLD and other supplementary services and ANFs

5.6.1   Protocol interactions with other supplementary services

No protocol interactions between SS-HOLD and other supplementary services have been identified.

NOTE: Simultaneous conveyance of call unrelated PDUs for SS-HOLD and another supplementary service by the same U- FACILITY PDU, each in accordance with the requirements of its respective stage 3 description standard, does not, on its own, constitute a protocol interaction. The same holds when such PDUs are conveyed by the ANF-ISISS ROSE Invoke APDU, else by the same PSS1 FACILITY message.

5.6.2   Protocol interactions with ANFs

5.6.2.1   Interaction with ANF-ISIGC, ANF-ISIIC and ANF-ISISS

Since SS-HOLD does not apply to group calls, there shall not be any protocol interactions between SS-HOLD and ANF-ISIGC.

The protocol interactions between SS-HOLD and ANF-ISIIC have already been taken into account in clause 5.4.

As to ANF-ISISS, there are no protocol interactions between it and SS-HOLD.

NOTE: The use of ANF-ISISS for conveying call unrelated SS-HOLD PDUs over the ISI has not been considered as a protocol interaction to be addressed in the present document.

5.6.2.2   Interactions with ANF-ISIMM

When the served user migrates into a visited SwMI, the following exchange of information shall be ensured, through ANF-ISIMM (see ETS 300 392-3-5 [5]):

-    the information element basic migration profile (original) in the ANF-ISIMM-PROFILE PDU sent with the value of the profile type information element corresponding to individual subscriber shall indicate that SS-HOLD has been subscribed for the served user;

-    the visited SwMI shall inform the home SwMI whether or not it supports SS-HOLD in the ANF-ISIMM-PROFILE RESPONSE PDU sent back in setting the value of the information element basic migration profile info to 0 (i.e. profile accepted as received).

5.7 SS-HOLD parameter values (timers)

5.7.1 Invocation timer

The invocation timer shall operate at the served user MS/LS (see clause 5.4.1.1.1). Its value shall not be less than 5 seconds.

5.7.2 Retrieval timer

The retrieval timer shall operate at the served user MS/LS (see clause 5.4.1.1.1). Its initial value shall not be less than 5 seconds.

5.7.3 Call_identifier_migration_change timer

The call_identifier_migration_change timer shall operate at the served user MS/LS (see clause 5.4.1.1.1). Its initial value shall not be less than 15 seconds.

5.7.4 Call_identifier_roaming_change timer

The call_identifier_roaming_change timer shall operate at the served user MS/LS (see clause 5.4.1.1.1). Its initial value shall not be less than 10 seconds.

5.7.5 Repeat timer

The repeat timer shall operate at the served user MS/LS (see clause 5.4.1.1.1). Its initial value shall not be less than 5 seconds.
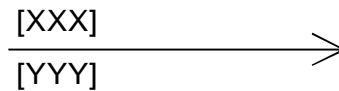
5.7.6 Timer Tloc_change

Timer Tloc_change shall operate at the new served user SwMI (see clause 5.4.3). Its initial value should be smaller than 15 seconds.

Annex A (informative):
Examples of message sequences

This annex describes some typical message flows for SS-HOLD. The following conventions are used in the figures of this annex.

The following notation is used:

$$[XXX] \longrightarrow$$
$$[YYY]$$

where XXX above the arrow refers to a basic call PDU (i.e. either over the air/line station interface or over the ISI), and YYY below the arrow refers:

- to the specific SS-HOLD PDU carried either by that basic call PDU over the air/line station interface, else together with it over the ISI; or

- to the notification indicator information element included in that basic call PDU (both the air/line station interface and the ISI).

If the SS-HOLD PDU is independent of basic call, it is simply shown as:

$$\longrightarrow$$
$$[YYY]$$
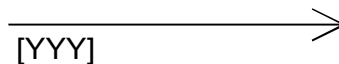
In exceptional operation (i.e. unsuccessful cases), instead of a SS-HOLD PDU, YYY may refer to a ROSE Return Error APDU over the ISI or to a generic SS Reject PDU as defined in table 6 of ETS 300 392-9 [6].

The figures show messages exchanged at the air (or line station) interface via the Circuit Mode Control entities (CMCE - see clause 14 of EN 300 392-2 [2]) and over the ISI by the PSS1 Protocol Control between SwMIs involved in SS-HOLD. Only messages relevant to SS-HOLD are shown.

The Facility information elements containing the ROSE APDUs are not explicitly shown. Information with no impact on SS-HOLD is not shown.

A.1 Example message sequences for successful operation of SS-HOLD

Figures A.1 and A.2 show examples of successful operation of SS-HOLD:

- figure A.1, when the served user has roamed (within the served user SwMI) but not migrated (into a new served user SwMI) after having put the call on hold;

- figure A.2, when the served user has migrated after having put the call on hold.
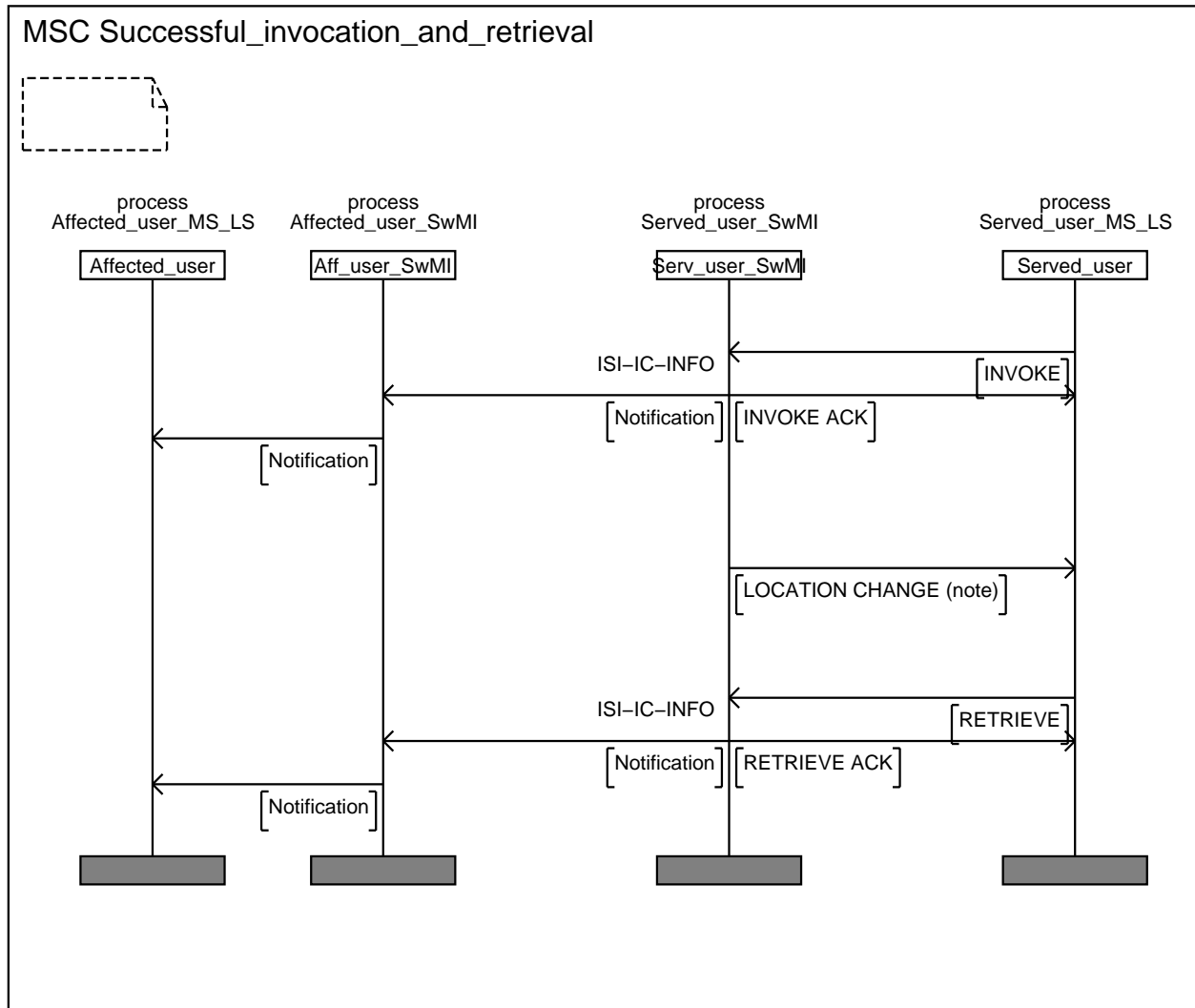
MSC Successful_invocation_and_retrieval

process Affected_user_MS_LS	process Affected_user_SwMI	process Served_user_SwMI	process Served_user_MS_LS
Affected_user	Aff_user_SwMI	Serv_user_SwMI	Served_user

ISI–IC–INFO

[INVOKE]

[Notification] [INVOKE ACK]

[Notification]

LOCATION CHANGE (note)

ISI–IC–INFO

[RETRIEVE]

[Notification] [RETRIEVE ACK]

[Notification]

NOTE: In the case of successful retrieval of the call on hold shown on the figure, the served user SwMI shall send
         the call unrelated LOCATION CHANGE PDU only under the following conditions:
         -    the served user has changed registered area while the call is on hold; and
         -    the served user SwMI has changed the call identifier of the call on hold.

**Figure A.1: Message sequence for successful invocation and retrieval
with no served user migration**
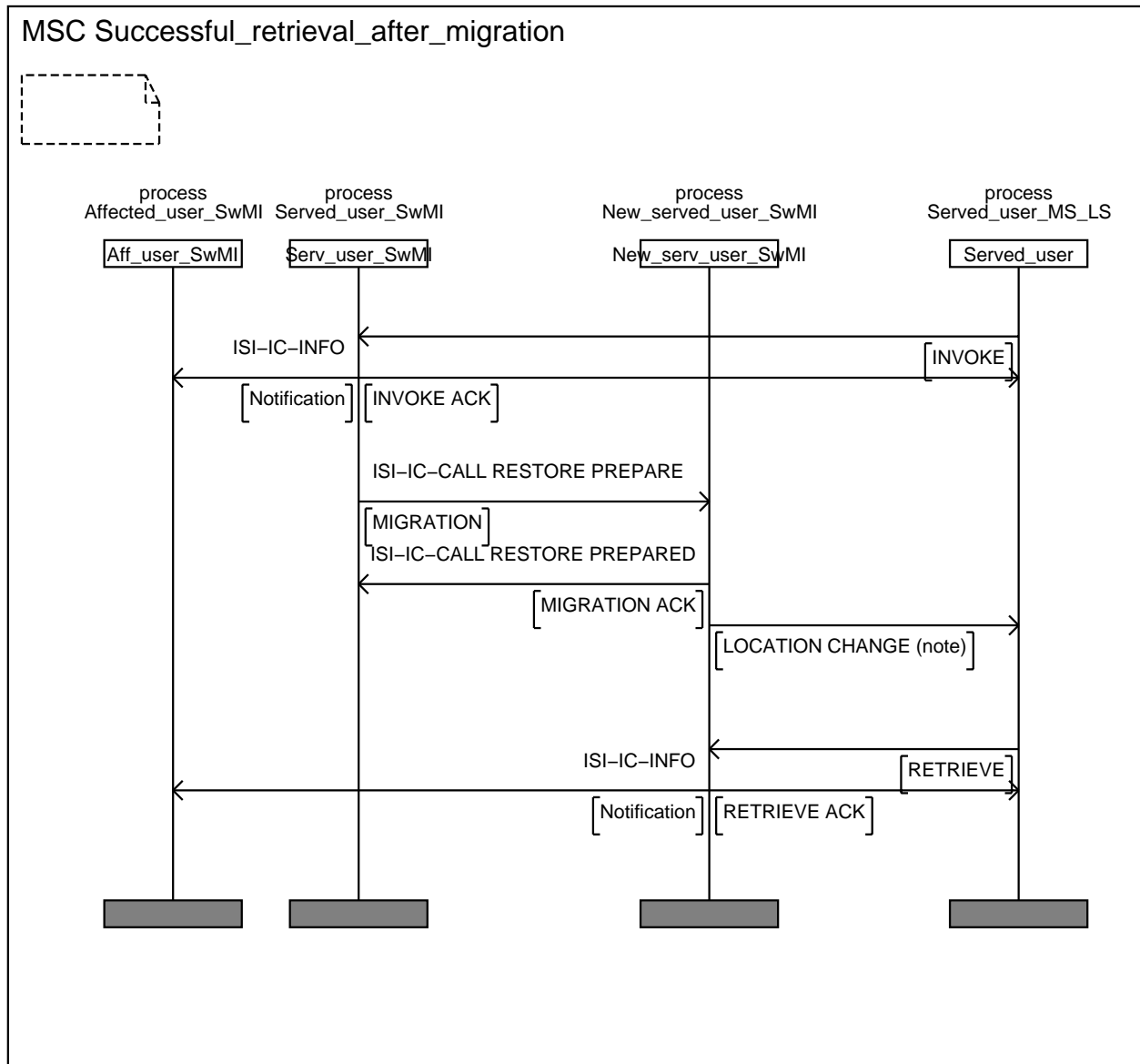
MSC Successful_retrieval_after_migration

NOTE: In the case of successful retrieval of the call on hold shown on the figure, the served user SwMI shall send the call unrelated LOCATION CHANGE PDU only to give the new call identifier of the call on hold (in the new served user SwMI) to the served user MS.

**Figure A.2: Message sequence for successful invocation and retrieval
after served user migration**

A.2 Example message sequences for unsuccessful operation of SS-HOLD

Figures A.3, A.4 and A.5 show examples of unsuccessful operation of SS-HOLD:

- figure A.3, when the SS-HOLD invocation by the served user fails;

- figure A.4, when the call on hold is lost because the served user has roamed after having put the call on hold;

- figure A.5, when the call on hold is lost because the served user has roamed after having put the call on hold and the new served user SwMI does not support the SS-HOLD migration procedure.

MSC Unsuccessful_invocation
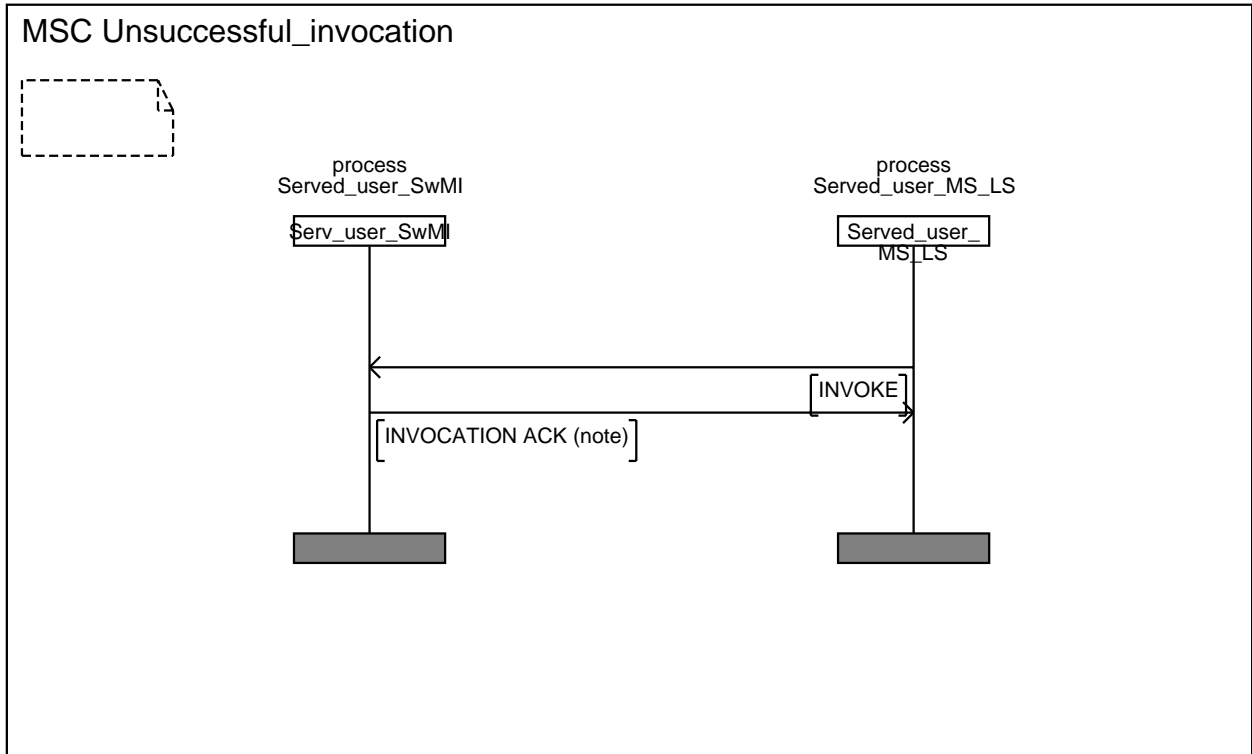
NOTE: In the case of unsuccessful invocation shown on the figure, the INVOKE ACK PDU sent by the served
         user SwMI shall indicate that the invocation attempt has failed.

Figure A.3: Message sequence for unsuccessful invocation

MSC Failed_roaming
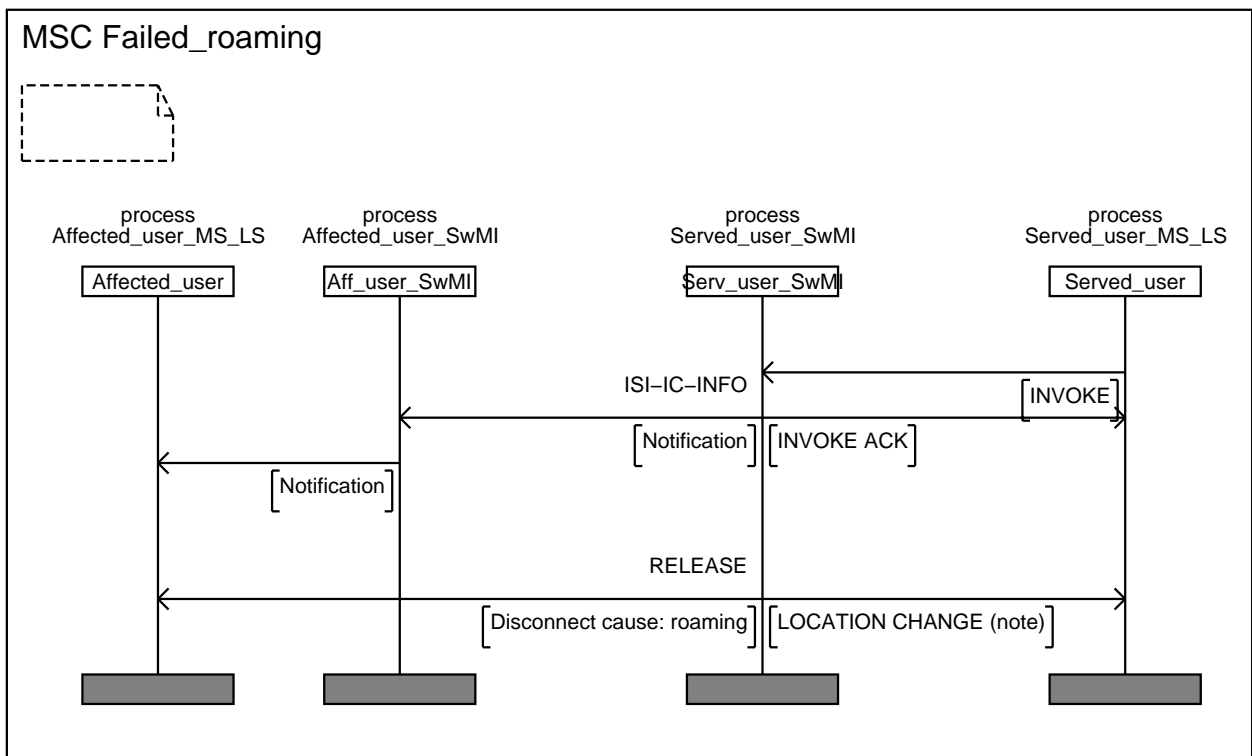
NOTE: In the case of unsuccessful SS-HOLD roaming procedure (shown on the figure), the served user SwMI
         shall send the call unrelated LOCATION CHANGE PDU to indicate to the served user MS that the call on
         hold has been lost due to roaming.

Figure A.4: Message sequence for unsuccessful SS-HOLD roaming procedure

MSC Failed_migration

```
        process              process              process              process
   Affected_user_SwMI    Served_user_SwMI   New_served_user_SwMI   Served_user_MS_LS

    [Aff_user_SwMI]      [Serv_user_SwMI]     [New_serv_user_SwMI]    [Served_user]
```

ISI–IC–INFO

[INVOKE]

[Notification]   [INVOKE ACK]

ISI–IC–CALL RESTORE PREPARE

[MIGRATION]
ISI–IC–CALL RESTORE PREPARED

RELEASE

[ROSE Return Error]

[Disconnect cause: migration]

[RETRIEVE]

[SS Reject]

Figure A.5: Message sequence for unsuccessful SS-HOLD migration procedure

Annex B (informative):
Specification and Description Language (SDL) representation of procedures

The diagrams in this annex use the Specification and Description Language defined in
ITU-T Recommendation Z.100 [10].

The diagrams for MS/LSs and SwMIs represent the behaviour of SS-HOLD supplementary service control entities at those MS/LSs and SwMIs, respectively.

For SS-HOLD protocol at the air interface (or line station interface), in accordance with the protocol model described in clause 14 of EN 300 392-2 [2], the supplementary service control entity at a MS/LS uses the services of the (air/line station interface):
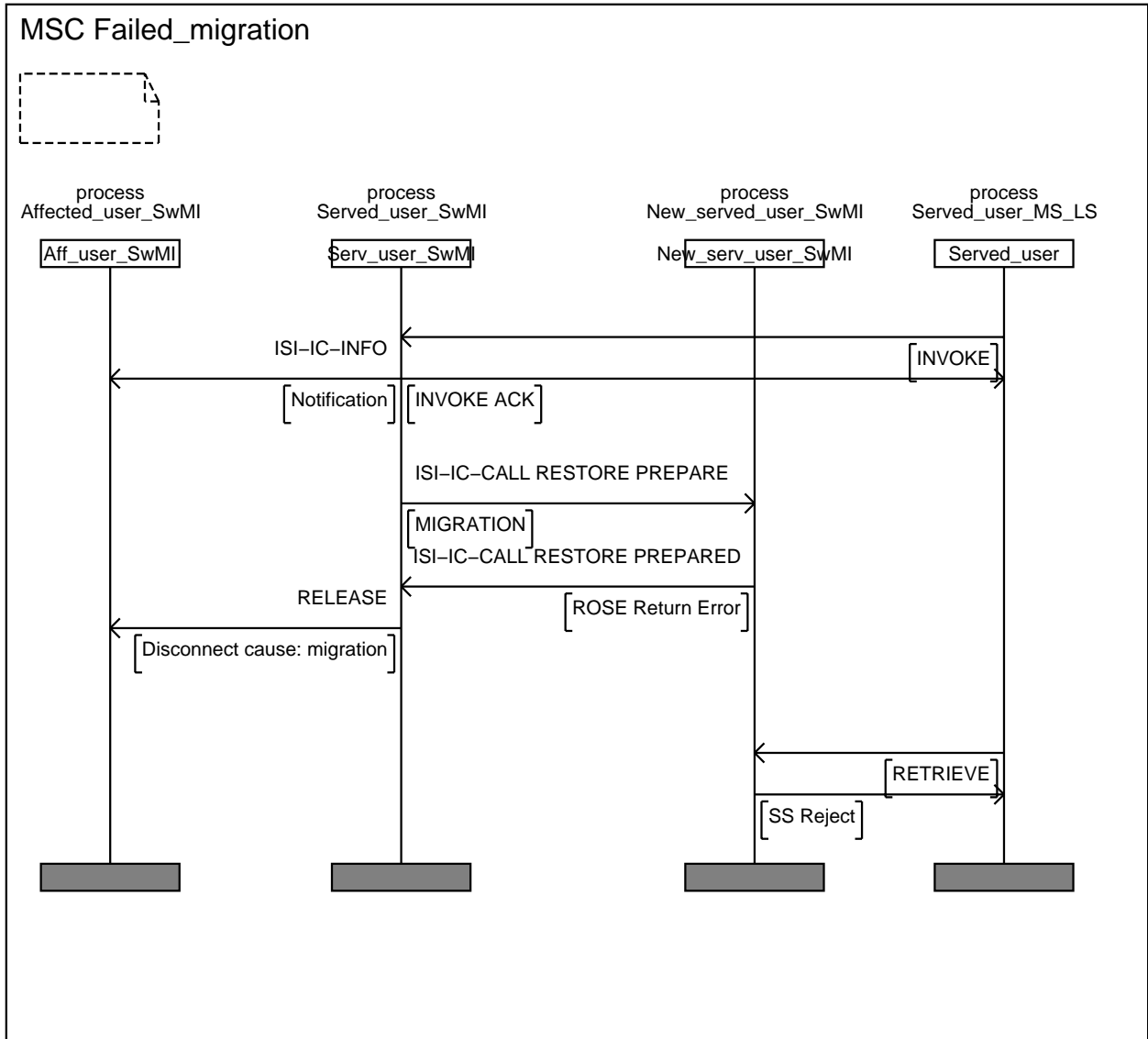
- basic call control, for SS-HOLD invocation and operation procedures;

- U-FACILITY and D-FACILITY PDUs, for SS-HOLD interrogation and/or location change procedures.

The same applies for the supplementary service control entity at the SwMI where the MS/LS subscriber is registered for the corresponding SS-HOLD protocol at the air/line station interface.

For SS-HOLD ISI protocols, in accordance with the protocol model described in clause 8 of ETS 300 392-3-1 [3], the supplementary service control entity (at a SwMI) uses, via the co-ordination function, the services of ANF-ISISS and in addition, for call related procedures, of ANF-ISIIC.

The basic call actions associated with the sending and receiving of the air/line station interface PDUs specified in EN 300 392-2 [2] are deemed to occur. The same applies with the sending and receiving of the ANF-ISIIC PDUs specified in ETS 300 392-3-2 [4].

The suffix PDU has been omitted after the PDU names (e.g. INTERROGATE or INVOKE).

The basic call PDUs at the air interface or at the ISI which do not carry any SS-HOLD information have not been shown on the figures.

B.1   SDL representation of SS-HOLD at the served user MS/LS

Figure B.1 shows the behaviour of an SS-HOLD supplementary service control entity within the served user MS/LS.

Input signals from the right represent air interface PDUs received from the served user SwMI or timer expiry.

Output signals to the right represent air interface PDUs sent to the served user SwMI.

Input signals from the left represent primitives from the served user application.

Output signals to the left represent primitives to the served user application.

Process Served_user_MS_LS   Putting_call_on_hold(7)

HOLD_idle

INVOKE

U–INFO_with_
INVOKE

Start_
invocation_
timer

SS_HOLD_invoked

TNCC_
RELEASE_
request

D–INFO_with_
negative_
INVOKE_ACK

D–INFO_with_
positive_
INVOKE_ACK

D–RELEASE

D–INFO_with_
Reject_
SS_PDU

HOLD_call_on_hold

D–DISCONNECT

Invocation_
time–out

HOLD_idle
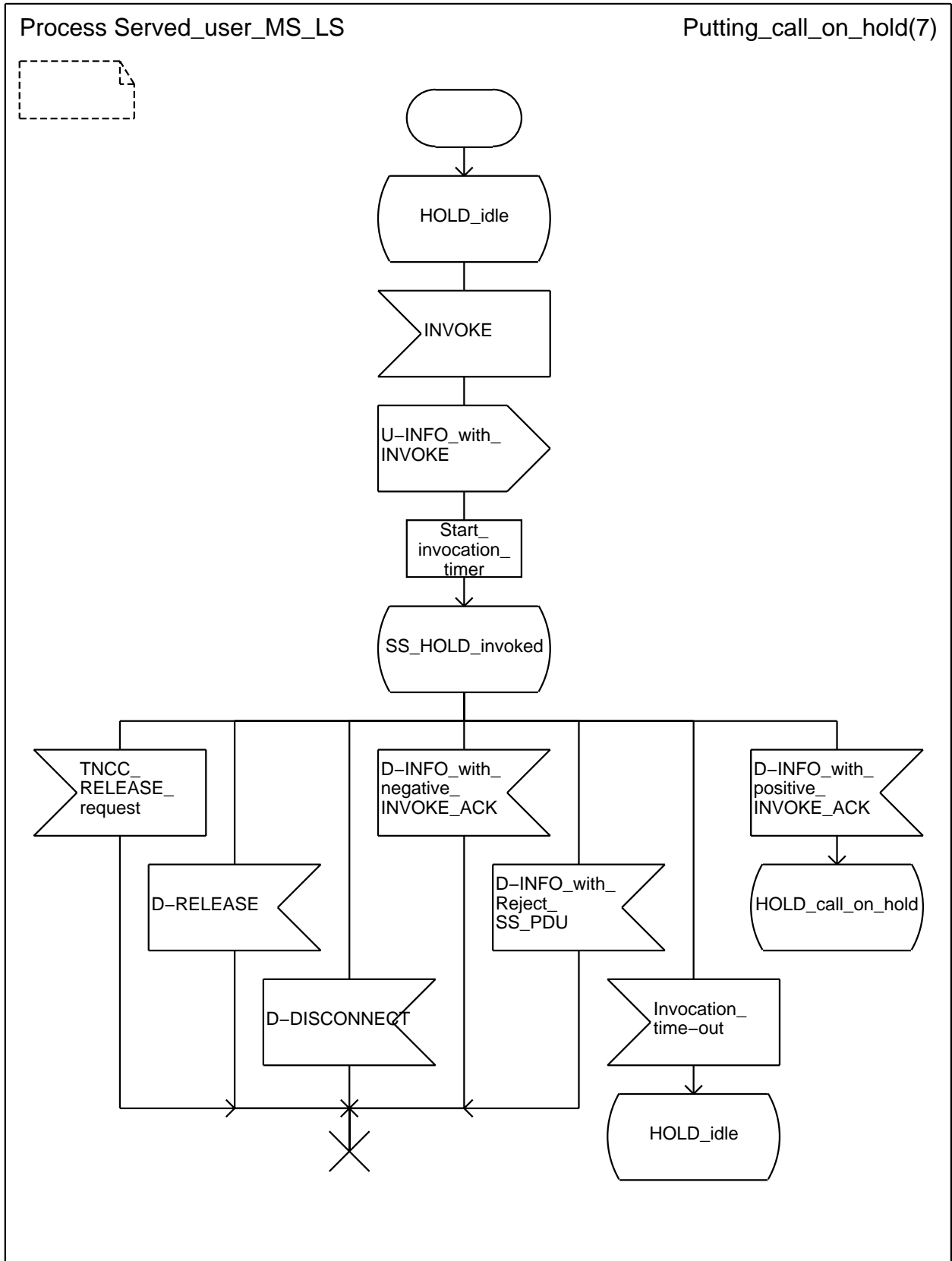
Figure B.1 (sheet 1 of 7): Served user MS/LS SDL - Invocation and beginning of operation

Process Served_user_MS_LS   Call_on_hold(7)

HOLD_call_on_hold

D–DISCONNECT

TNCC_
RELEASE_
request

TNMM_
REGISTRATION_
request

RETRIEVE

D–RELEASE

Migration?   Yes

U–INFO_with_
RETRIEVE

No

Start_call_
identifier_
migration_
change_timer

Start_call_
identifier_
roaming_
change_timer

Start_
retrieval_timer

HOLD_location_
change

Call_retrieve_
requested

Call_identifier_
migration_
change_time–out

D–INFO_with
LOCATION_
CHANGE

Call_identifier_
roaming_
change_time–out

RETRIEVE

TNCC_
RELEASE_
request

Call_cleared?   Yes

HOLD_location_
change_with_
retrieval_to_be_
requested

No

TNCC_
RELEASE_
indication

Update_call_
identifier_of_
call_on_hold_
if_changed

HOLD_call_on_hold

Figure B.1 (sheet 2 of 7): Served user MS/LS SDL - Call on hold

Process Served_user_MS_LS   Retrieval_requested_during_location_change(7)
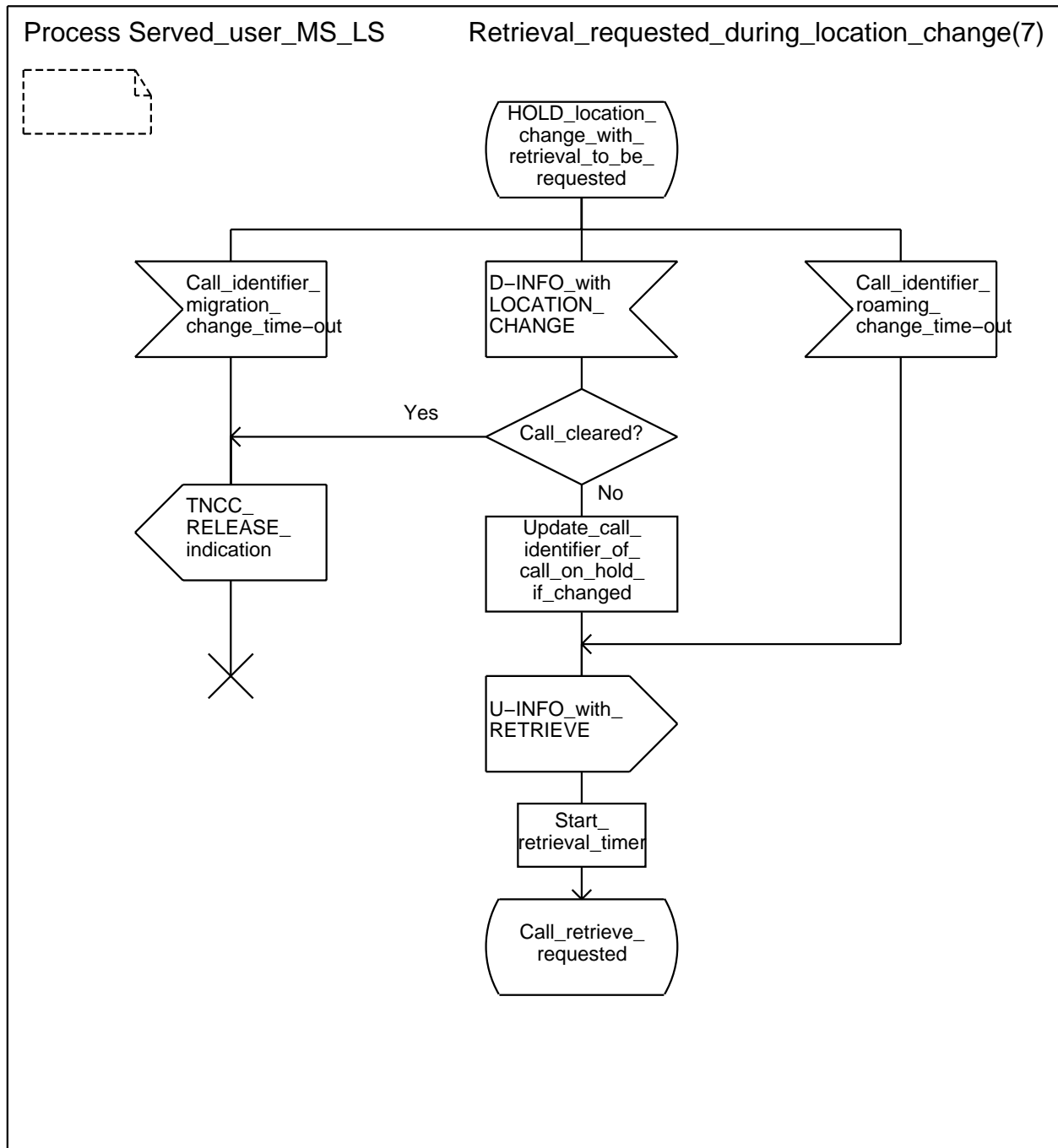
Figure B.1 (sheet 3 of 7): Served user MS/LS SDL - Retrieve primitive received during roaming or migration

Figure B.1 (sheet 4 of 7): Served user MS/LS SDL - Call on hold retrieval

NOTE: By lack of space, the possibility for the served user SwMI to clear the call on hold by sending the D-RELEASE PDU has not been shown.
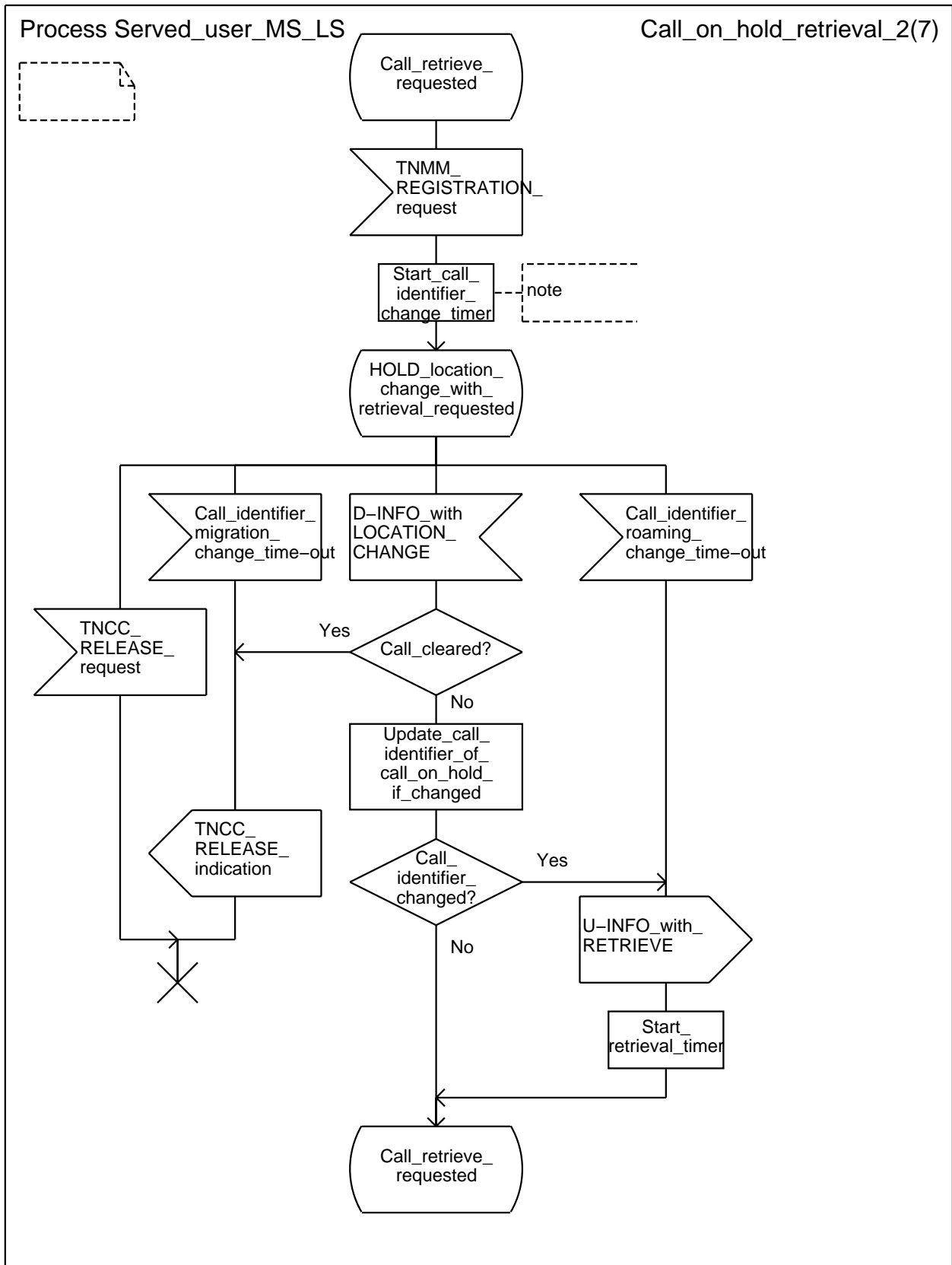
NOTE: The timer called "call_identifier_change" stands for the two timers call_identifier_roaming_change and call_identifier_migration_change, depending on whether the served user has roamed or migrated - since by lack of space, it has not been possible to show those two different timers (as on sheet 2).

Figure B.1 (sheet 5 of 7): Served user MS/LS SDL - Roaming or migration after retrieval request

ETSI
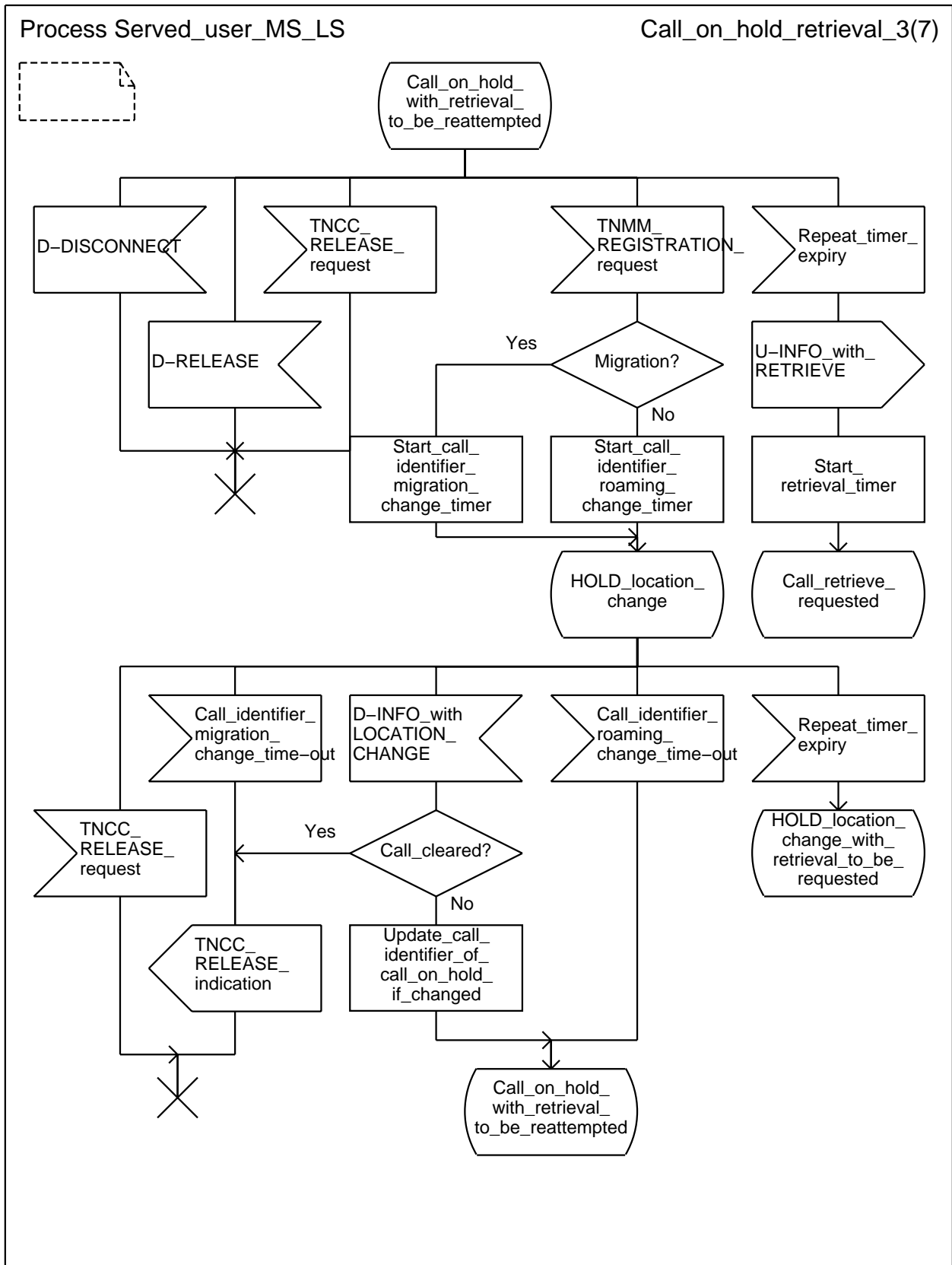
Figure B.1 (sheet 6 of 7): Served user MS/LS SDL - Repetition of retrieval request

Process Served_user_MS_LS   Interrogation(7)

Idle

TNSS_HOLD_
INTERROGATE_
request

U_FACILITY_
with_INTERROGATE

Idle

D_FACILITY_
with_
INTERROGATE_ACK

D_FACILITY_
with_Reject_
SS_PDU

TNSS_HOLD_
INTERROGATE_
ACK_indication

TNSS_Reject_
indication

–

Figure B.1 (sheet 7 of 7): Served user MS/LS SDL - Interrogation

B.2   SDL representation of SS-HOLD at the served user SwMI

Figure B.2 shows the behaviour of an SS-HOLD supplementary service control entity within the served user SwMI.

The meaning of the input signals from the right and of the output signals to the right is different for the various sheets of figure B.2:

- on sheet 1 of figure B.2, the INFO PDU including the hold notification is: either

    - the (air interface) D-INFO PDU, sent to the affected user, if he is registered in the served user SwMI (i.e. case of intra-TETRA call); or

    - the ANF-ISIIC-INFO DEMAND PDU, sent to the affected user SwMI, otherwise.

- on sheet 3 of figure B.2:

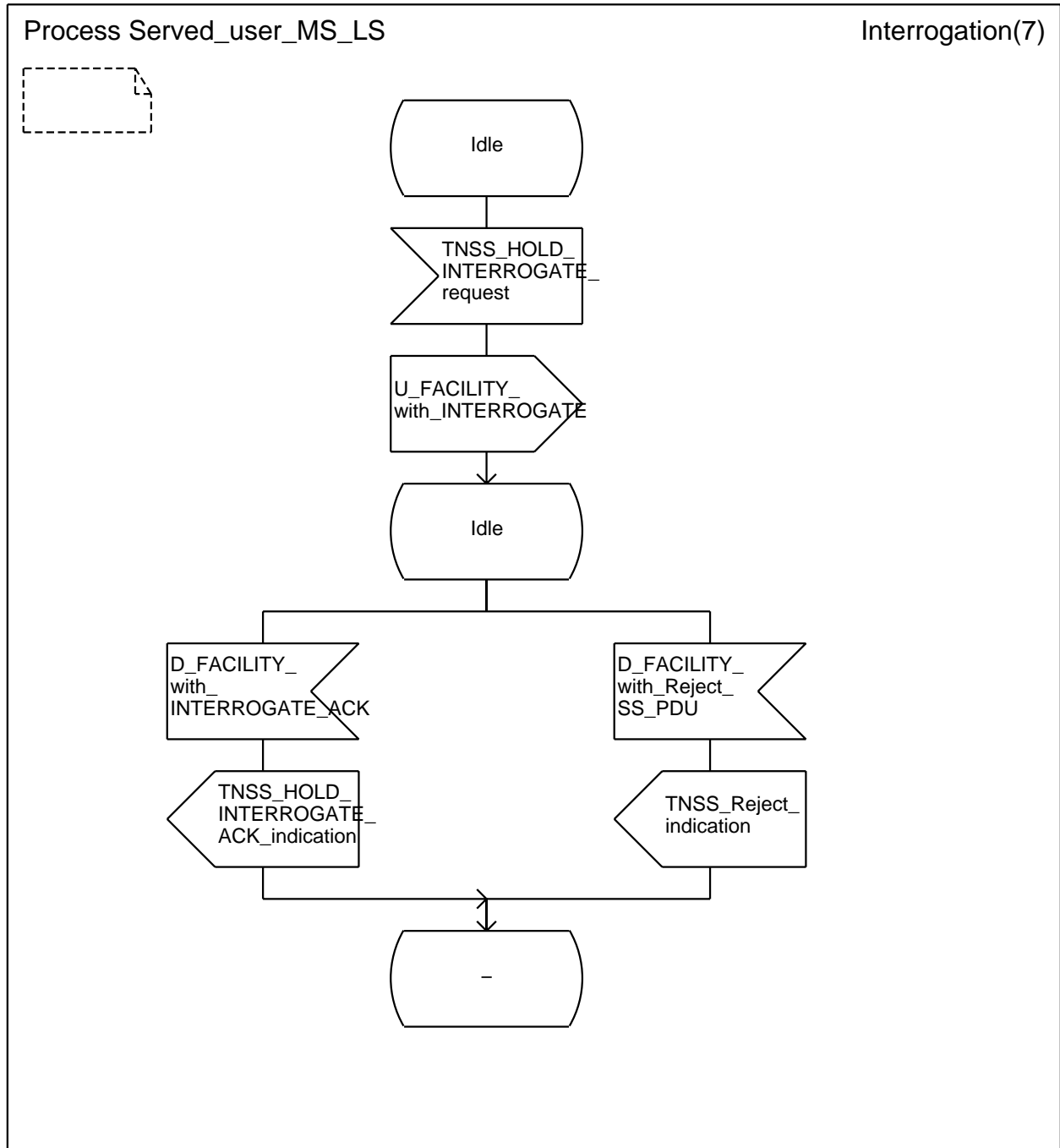   - the primitive informing the served user SwMI about the served user migration is received from its mobility management entity (itself informed through ANF-ISIMM);

    - the MIGRATION PDU is sent to the new served user SwMI, and the MIGRATION ACK PDU, received from that SwMI.

- on sheet 4 of figure B.2:

    - all input signals from the right are received from the new served user SwMI: the MIGRATION ACK PDU, the two ANF-ISIIC-CALL RESTORATION PDUs and the ANF-ISIIC-PATH CLEARING PDU;

    - the only output signal to the right, i.e. the ANF-ISIIC-PATH CLEARING PDU, is sent to the previous served user SwMI if the served user migrates again with the call still on hold and the then old served user SwMI (i.e. to which the SDL diagram refers) is on the path of the call before the previous migration of the served user and that situation has been identified.

- on sheet 5 of figure B.2, the following basic call clearing PDUs are sent when the served user SwMI detects that the migration procedure has failed: either

    - the D-RELEASE PDU, to the affected user, if that user is registered in the served user SwMI (i.e. case of intra-TETRA call); or

    - the ANF-ISIIC-DISCONNECT PDU, to the affected user SwMI, otherwise.

- on sheet 6 of figure B.2, the basic call DISCONNECT PDU is: either

    - the U-DISCONNECT PDU, received from the affected user, if he is registered in the served user SwMI; or

    - the ANF-ISIIC-DISCONNECT PDU, received from the affected user SwMI, otherwise.

Similarly the D-INFO PDU including the retrieval notification is sent to the affected user if he is registered in the served user SwMI INFO PDU, or the ANF-ISIIC-INFO DEMAND or the ANF-ISIIC-CALL RESTORATION PDU including the retrieval notification is sent to the affected user SwMI, otherwise.

The ANF-ISIIC-PATH CLEARING PDU is sent to the old served user SwMI if the new served user SwMI is on the path of the call before the served user migration and that situation has been identified.

Input signals from the left represent PDUs received from the served user MS/LS.

Output signals to the left represent PDUs sent to the served user MS/LS.
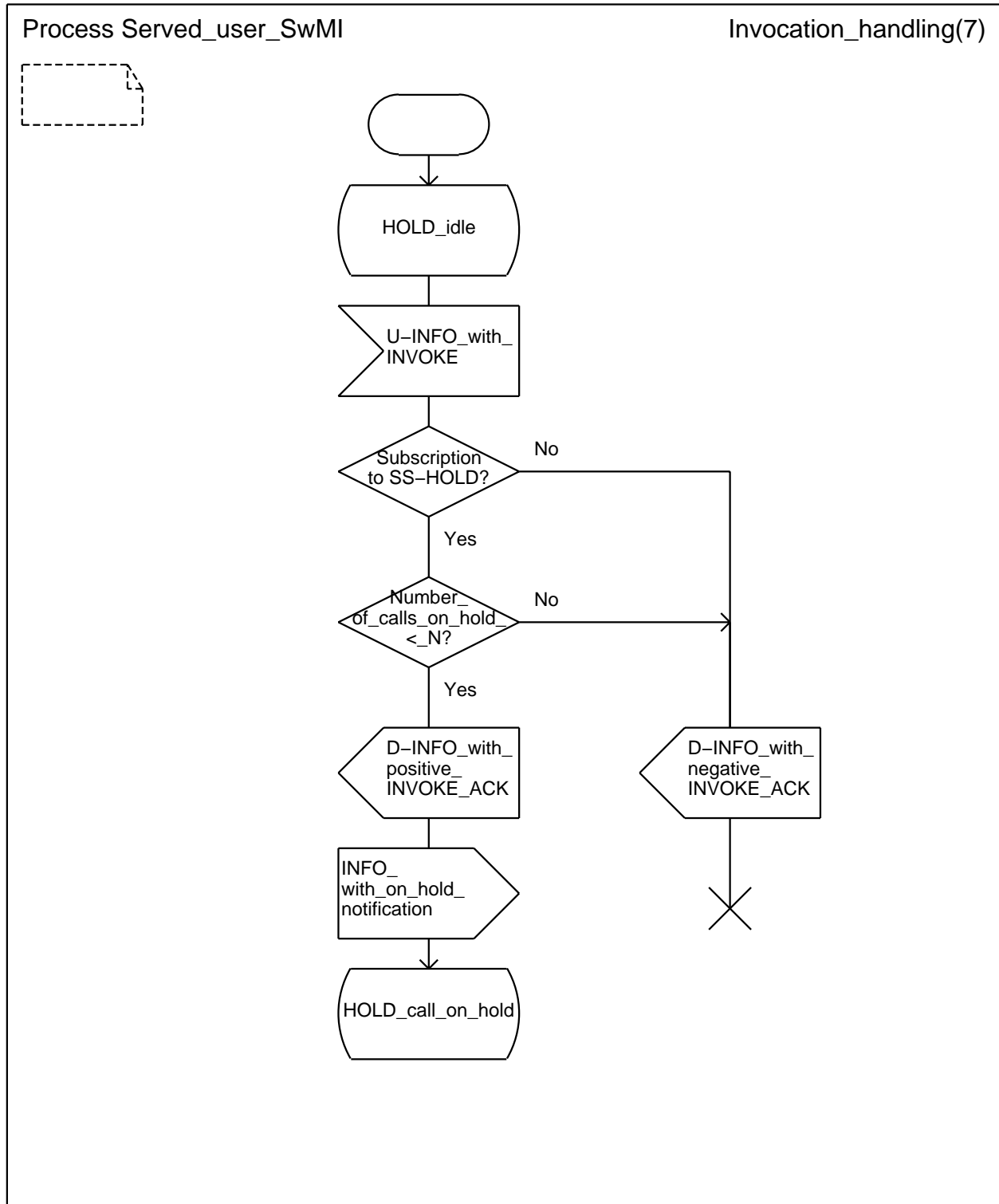
NOTE: The value of the information element call status in the ISI-INFO or the ISI-CALL RESTORATION PDU shall correspond to call put on hold.

Figure B.2 (sheet 1 of 7): Served user SwMI SDL - Invocation handling

Process Served_user_SwMI   Roaming_operation(7)

HOLD_call_on_hold

Location update
type = call
restoration
roaming location
updating

MM_LOCATION_
UPDATE_
with_call

Location_
change_procedure
supported?

No

Yes

D−FACILITY_
with_LOCATION_
CHANGE

D−FACILITY_
with_Reject_
SS_PDU

–
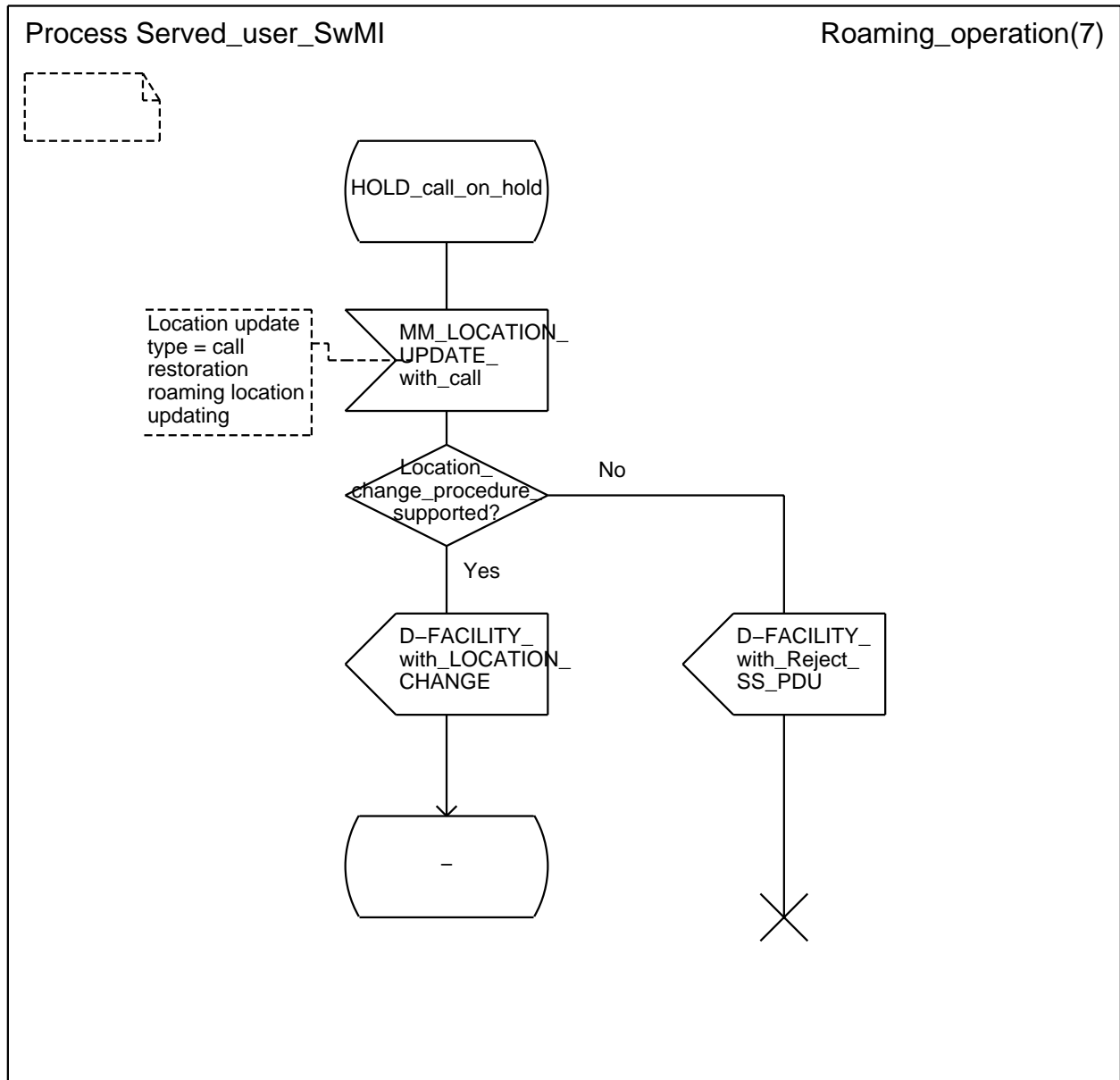
Figure B.2 (sheet 2 of 7): Served user SwMI SDL - Roaming

Process Served_user_SwMI   MIgration_operation_start(7)

HOLD_call_on_hold

Migration   Through
                             ANF−ISIMM

MIGRATION_   To new served
(note)   user SwMI
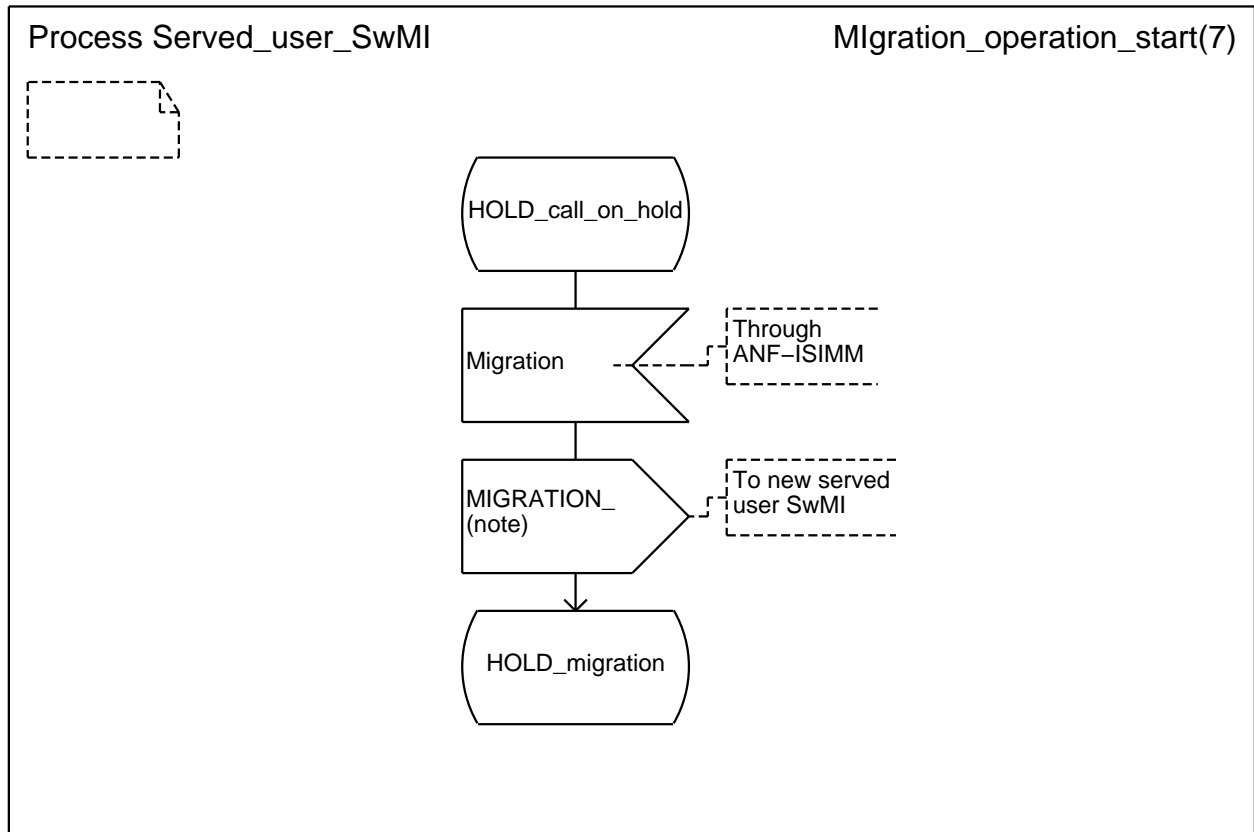
HOLD_migration

NOTE: The various ANF-ISIIC PDUs with which the (SS-HOLD) MIGRATION PDU shall possibly be sent have not
         been shown on the figure.

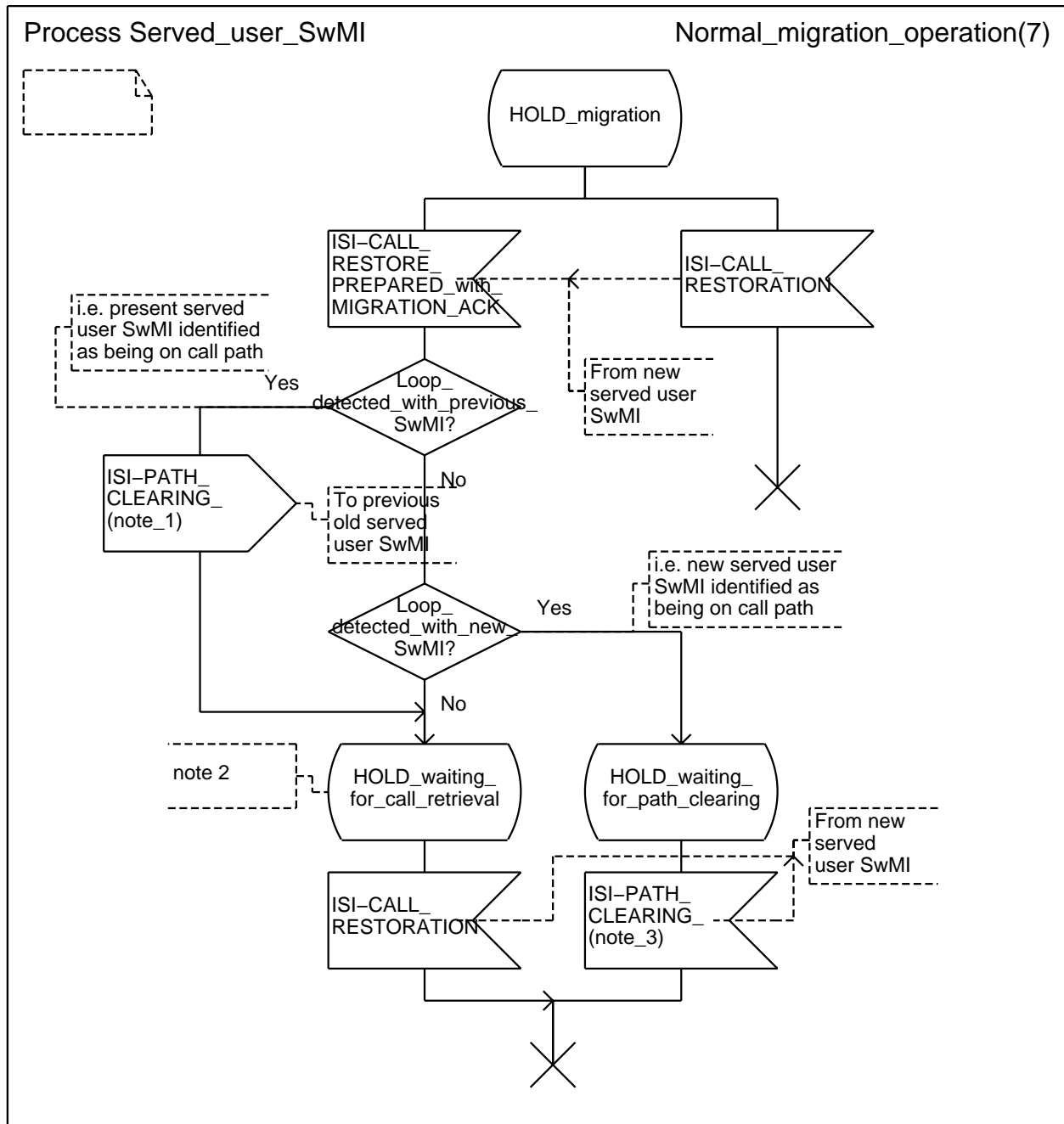**Figure B.2 (sheet 3 of 7): Served user SwMI SDL - Migration**

Process Served_user_SwMI   Normal_migration_operation(7)

NOTE 1: The case where the affected user has migrated into a SwMI also on the path of the call between the previous migration of the served user and the new one and where the served user SwMI is informed about that situation has not been taken into account.

NOTE 2: If the served user has migrated into SwMI$_1$ on the path of the call with a call on hold and migrates again into a new SwMI with that call still on hold (i.e. without having retrieved it or lost it), the way ANF-ISIIC has been specified does not allow SwMI$_1$ to identify the situation where that new SwMI would also be on the path of the call, even if that call had been established with one or more call diversions. This is why the test on the loop detection with the new SwMI is by-passed if the served user has already sent the ANF-ISIIC-PATH CLEARING PDU to the previous served user SwMI.

NOTE 3: The case where the affected user has migrated into a SwMI also on the path of the call between the served user migration and the retrieval of the call on hold and where the served user SwMI is informed about that situation has not been taken into account.

Figure B.2 (sheet 4 of 7): Served user SwMI SDL - Migration procedure (continued)

Process Served_user_SwMI   Exceptional_migration_operation(7)

HOLD_migration

ROSE_error_
or_reject_
APDU

From new
served user
SwMI

Affected_
user_in_same_
SwMI?

No

Yes

D–RELEASE_
with_cause_
served_user_
migration

To affected
user

ISI–DISCONNECT

To affected
user SwMI
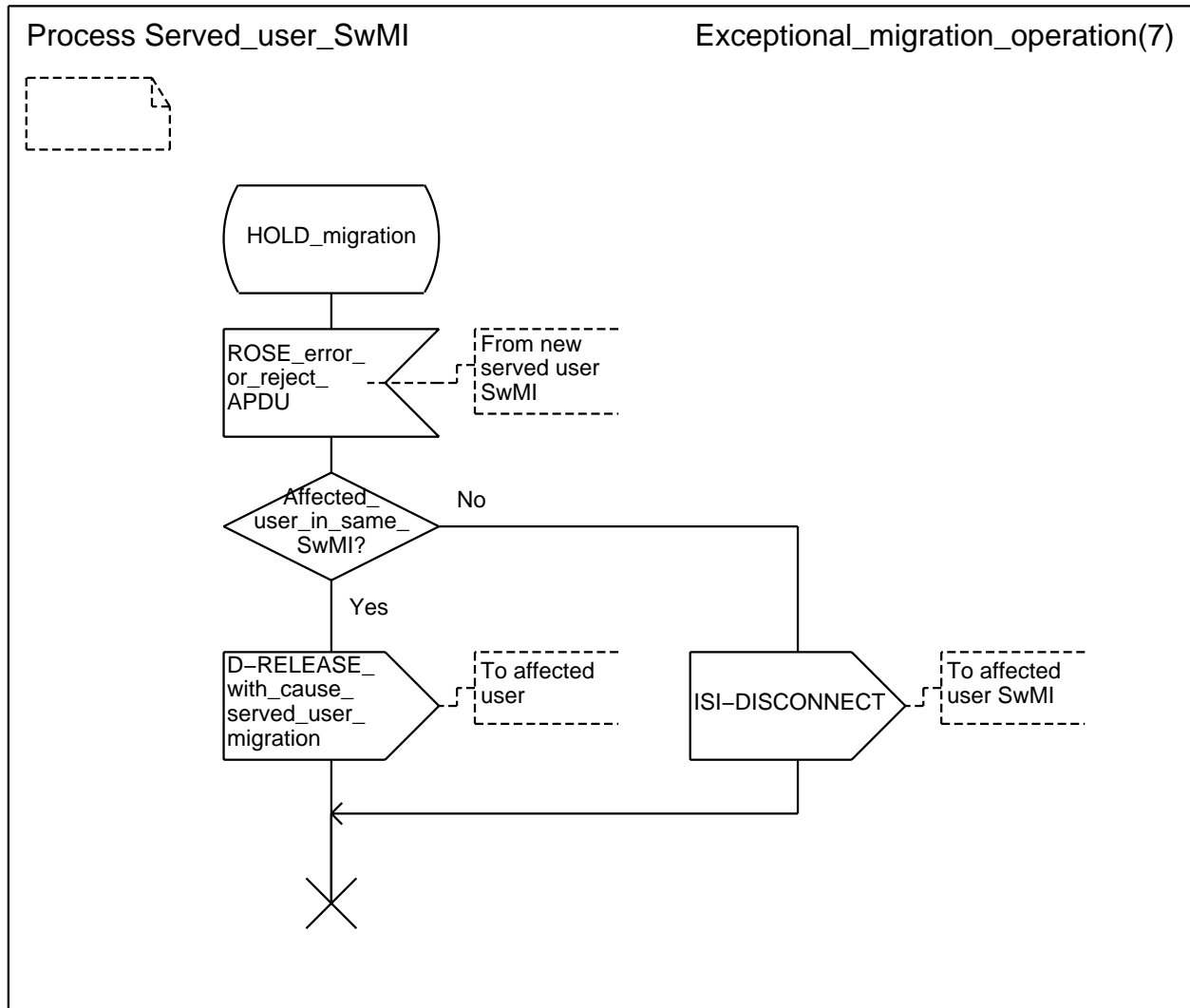
Figure B.2 (sheet 5 of 7): Served user SwMI SDL - Migration procedure (end)

Process Served_user_SwMI   Retrieval_operation(7)
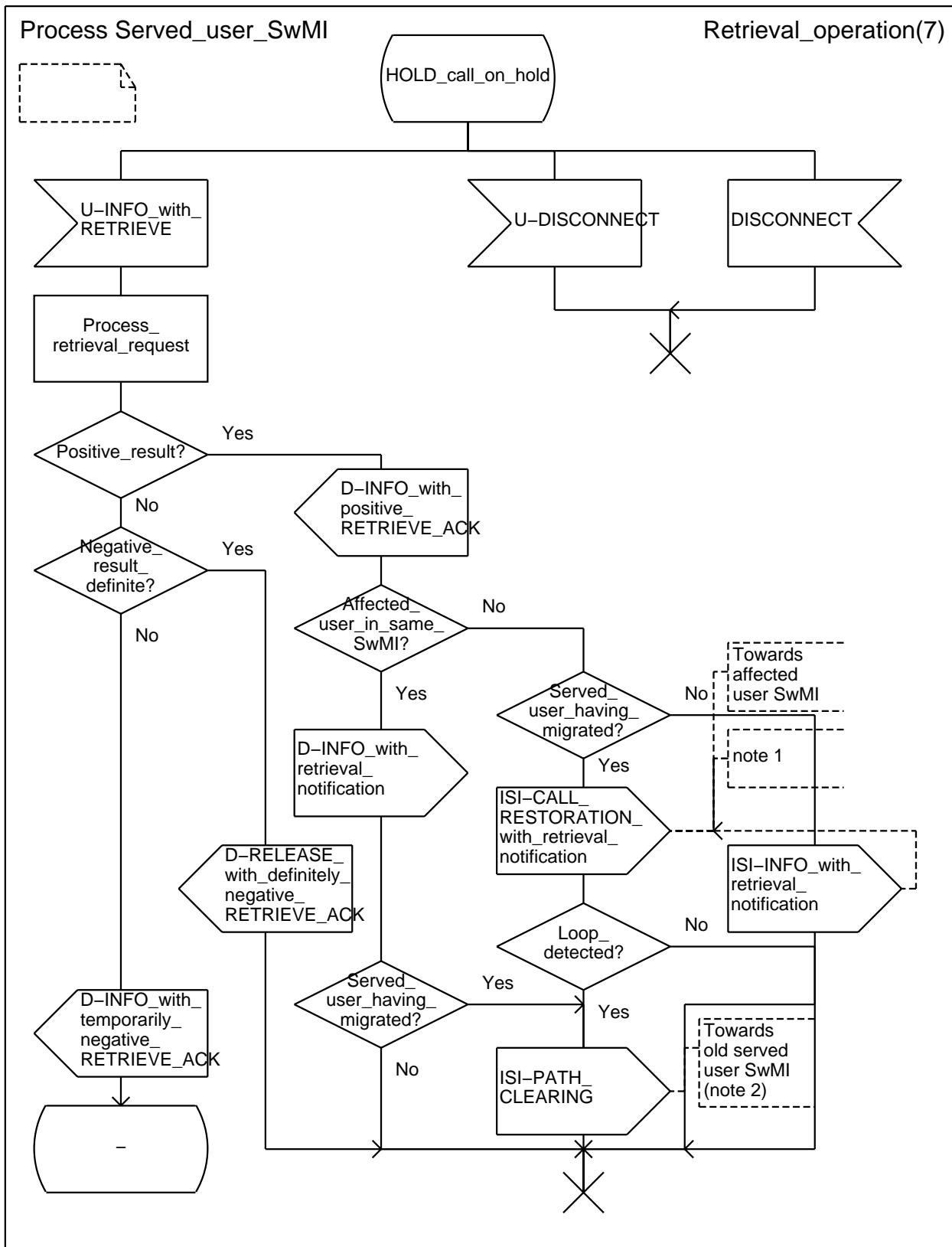
NOTE 1: The value of the information element call status in the ISI-INFO or the ISI-CALL RESTORATION PDU shall indicate that the call is no more on hold.

NOTE 2: The case where the affected user has migrated into a SwMI also on the path of the call between the served user migration and the retrieval of the call on hold and where the served user SwMI is informed about it has not been taken into account.

Figure B.2 (sheet 6 of 7): Served user SwMI SDL - Retrieval

Process Served_user_SwMI   Interrogation_process(7)
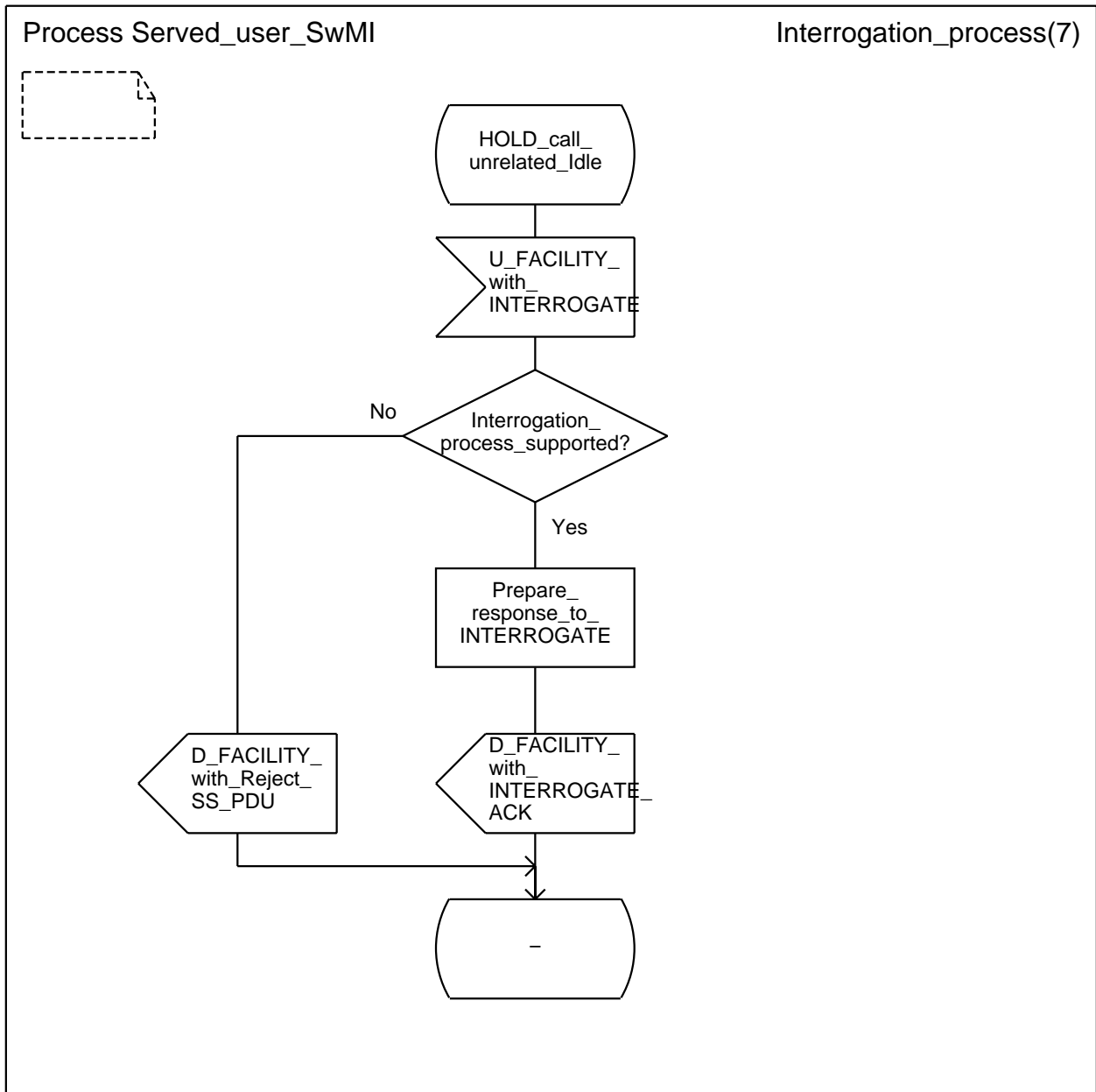

Figure B.2 (sheet 7 of 7): Served user SwMI SDL - Interrogation

B.3 SDL representation of SS-HOLD at the new served user SwMI

Figure B.3 first shows how the new served user SwMI SDL process is created, then it shows the behaviour of the supplementary service control entity specific to the new served user SwMI.

Input signals from the right represent either a PDU received from the old served user SwMI or expiry of the timer for answering the served user request for new call identifiers.

The output signal to the right represents a PDU sent to the old served user SwMI.

Input signals from the left represent a PDU received from the served user MS/LS.

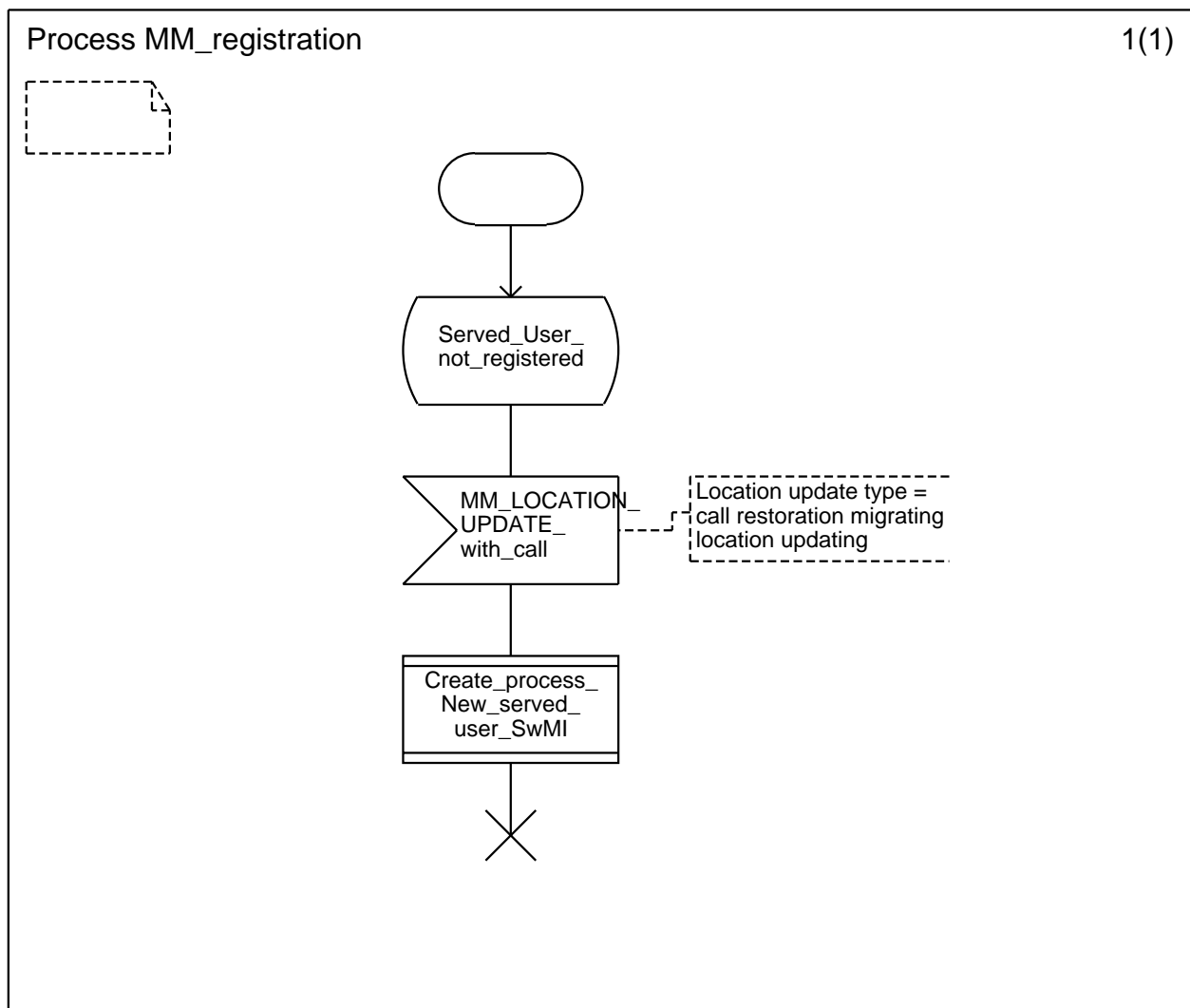The output signal to the left represents a PDU sent to the served user MS/LS.

Figure B.3 (sheet 1 of 3): New served user SwMI SDL - SDL process creation

Process New_served_user_SwMI   1(1)

Reset_n_to_1

HOLD_Idle

Tloc_change_
timer_expiry

MIGRATION_
(note)

No   n_=_1?

Yes

Start_
Tloc_change_
timer

Store_N,
the_number_of_
calls_on_hold

Migration_
procedure

n_=_n+1

Yes   n_>_N?

No

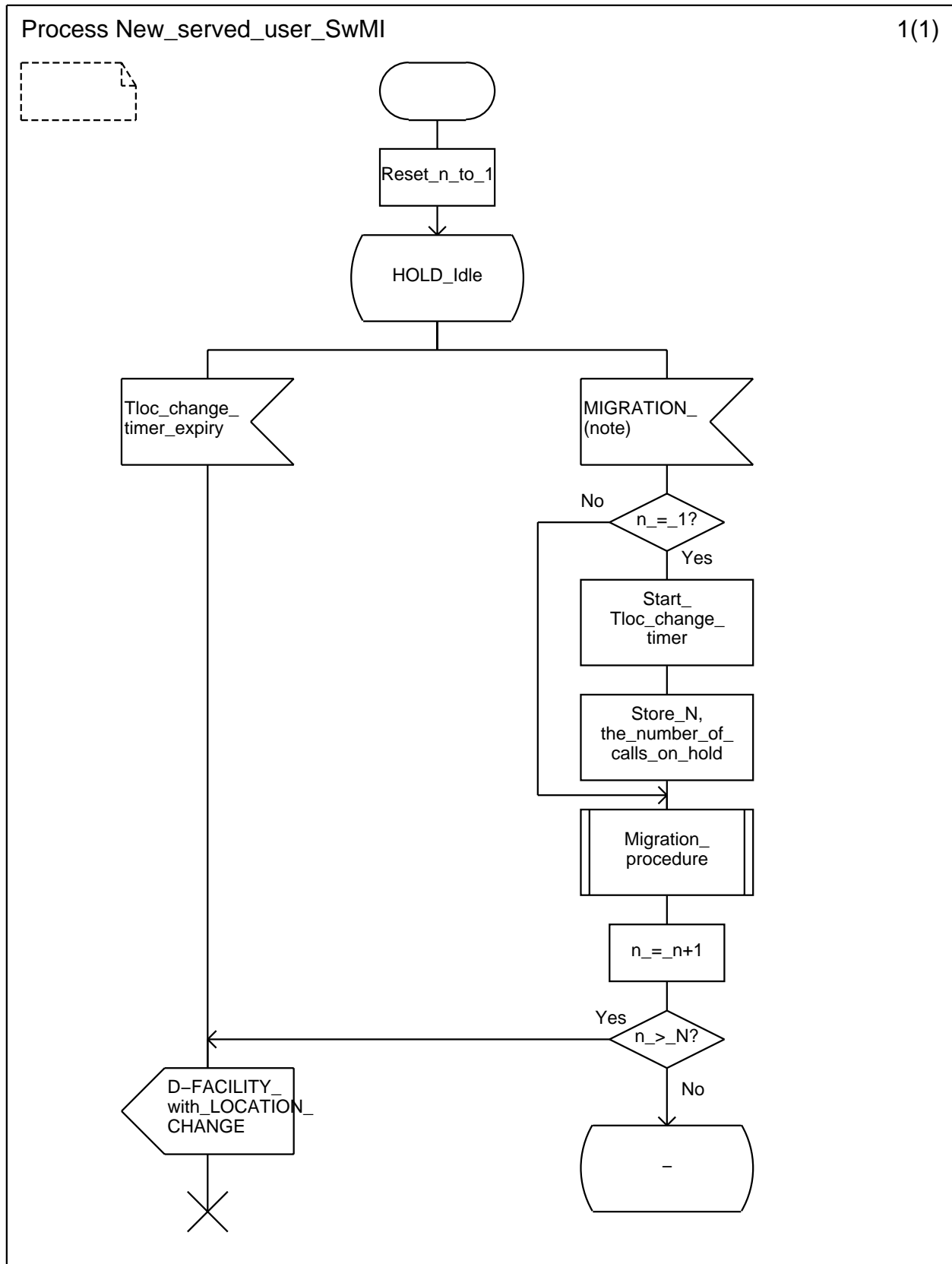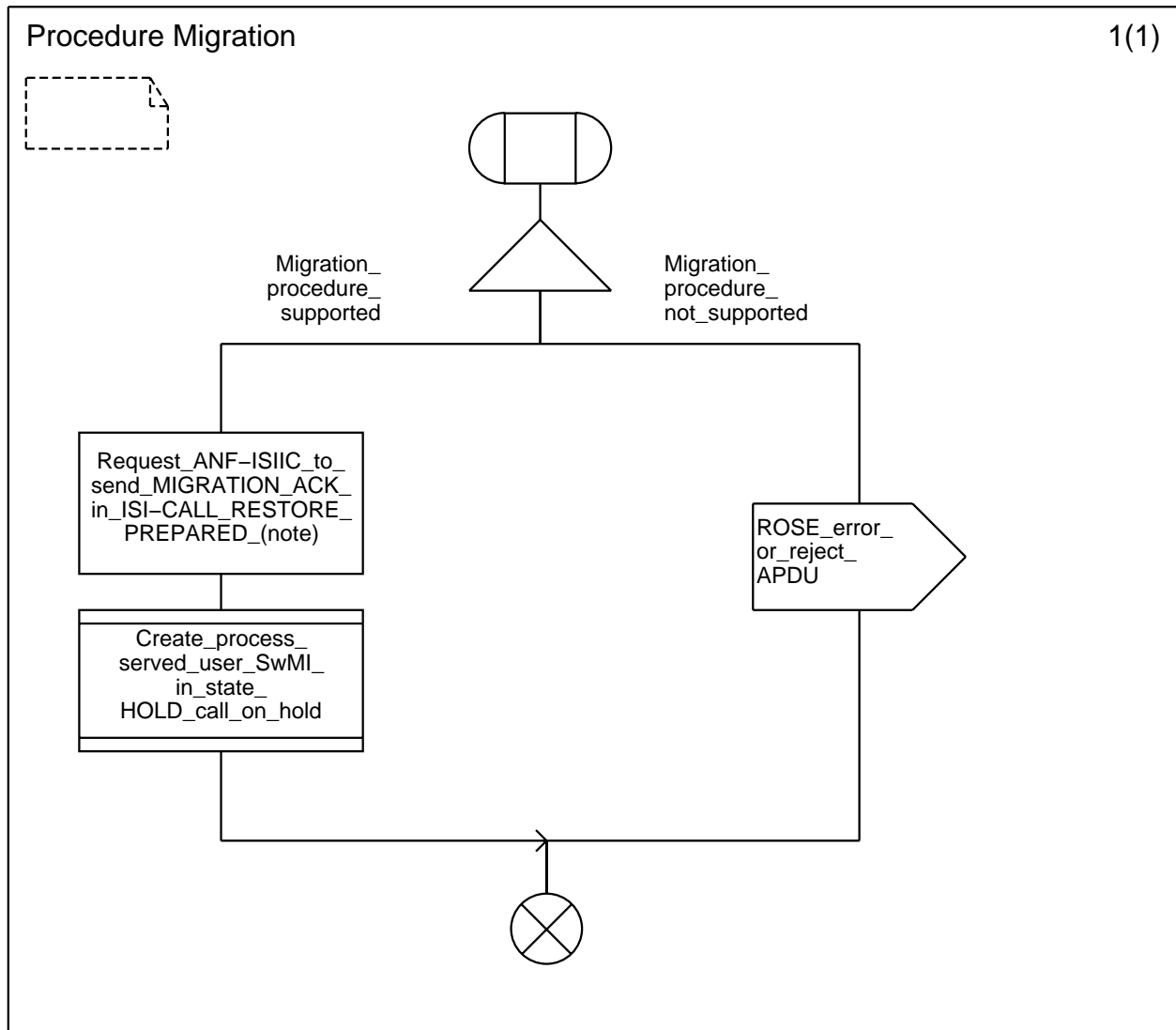D−FACILITY_
with_LOCATION_
CHANGE

−

Figure B.3 (sheet 2 of 3): New served user SwMI SDL - Overall

NOTE: ANF-ISIIC may delay the sending of the ANF-ISIIC-CALL RESTORE PREPARED PDU by a few seconds. If the served user decides to retrieve the call on hold during that time (in sending the RETRIEVE PDU), ANF-ISIIC may skip the sending of the ANF-ISIIC-CALL RESTORE PREPARED PDU in sending directly the ANF-CALL RESTORATION PDU. In such a case, the MIGRATION ACK PDU will not be sent.

Figure B.3 (sheet 3 of 3): New served user SwMI SDL - MIGRATION PDU reception follow-up

History

Document history				
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	November 2000	Converted from ETS to EN between Public Enquiry and Vote		
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