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ATIS-1000645.1995(R2013)

B-ISDN Signaling ATM Adaptation Layer – Service Specific Coordination Function for Support of Signaling at the Network Node Interface (SSCF at the NNI)

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ATIS-1000645.1995(R2013), *B-ISDN Signaling ATM Adaptation Layer – Service Specific Coordination Function for Support of Signaling at the Network Node Interface (SSCF at the NNI)*

Is an American National Standard developed by the **Signaling, Architecture, and Control (SAC)** Subcommittee under the **ATIS Packet Technologies and Systems Committee (PTSC)**.

Published by

Alliance for Telecommunications Industry Solutions
1200 G Street, NW, Suite 500
Washington, DC 20005

ANSI®
T1.645-1995 (R2013)

American National Standard
for Telecommunications –

B-ISDN Signaling ATM Adaptation Layer – Service Specific Coordination Function for Support of Signaling at the Network Node Interface (SSCF at the NNI)

Secretariat

Alliance for Telecommunications Industry Solutions

Approved January 3, 1995

American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard T1.645-1995.)

The intent of this standard is to provide a function at the NNI which is used to map the service of the Service Specific Connection Oriented Protocol (SSCOP) to the needs of the NNI layer 3 protocol as described in *American National Standard for Telecommunications – Signaling System No. 7 – Message Transfer Part (MTP*), ANSI T1.111-1992. This function is called the Service Specific Coordination Function (SSCF) for signaling at the NNL.

The ATM Adaptation Layer (AAL) is defined to enhance the services provided by the ATM layer to support the functions required by the next higher layer. One particular type of AAL service is the signaling AAL (SAAL) which comprises AAL functions necessary to support signaling. The structure of the SAAL is defined in *American National Standard for Telecommunications – B-ISDN Signaling ATM adaptation layer – Overview description*, ANSI T1.636-1994.

The SAAL consists of a Segmentation and Reassembly (SAR) function, and a Convergence Sublayer which is specified as two sublayers: a Common Part Convergence Sublayer (CPCS) and a Service Specific Convergence Sublayer (SSCS). The common part protocol is used as a basis for the service specific part for signaling and is defined in *American National Standard for Telecommunications – Broadband ISDN – ATM adaptation layer type 5 common part functions and specification, ANSI* T1.635-1994. The SSCS is functionally divided into two parts: the Service Specific Connection Oriented Protocol (SSCOP), which provides an assured data transfer service and the Service Specific Coordination Function (SSCF). The SSCOP is defined in *American National Standard for Telecommunications – B-ISDN ATM adaptation layer – Service Specific Connection Oriented Protocol (SSCOP)*, ANSI T1.637-1994.

The SSCF at the NNI performs a coordination function between the service required by the signaling layer 3 user and the service provided by the SSCOP. This standard describes for the SSCF at the NNI the mapping of primitives from layer 3 to signals of the SSCOP and vice versa. Similarly, it specifies the exchange of signals between layer management and the SSCF at the NNI.

This standard was developed by Working Group T1S1.5 of Accredited Standards Committee on Telecommunications, T1. Many of T1S1.5's participants are also active participants in similar activities in the ITU. Therefore, this standard is consistent with Draft ITU-T Recommendation Q.2140 – *B-ISDN ATM Adaptation Layer – Service Specific Coordination Function for Signaling at the Network Node Interface (SSCF at NNI)*.

This standard contains 6 annexes. Annex A is normative and is considered part of the standard. Annexes B through F are informative and are not considered part of the standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005.

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American National Standard
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B-ISDN Signaling ATM Adaptation Layer – Service Specific Coordination Function for Support of Signaling at the Network Node Interface (SSCF at the NNI)

1 Scope, purpose, and application

The intent of this standard is to provide a function that is part of the ATM Adaptation Layer for the support of signaling (SAAL) at the Network Node Interface (NNI) of the B-ISDN. This function is used to map the service of the Service Specific Connection Oriented Protocol (SSCOP) of the AAL to the requirements of an SAAL user at the NNI as defined in ANSI T1.111. These requirements cover the needs for signaling between network nodes and networks. This function is called Service Specific Coordination Function (SSCF) for signaling at the NNI.

This standard specifies the Service Specific Coordination Function for support of signaling at the NNI (SSCF at the NNI). It covers the aspects of the SSCF of the complete AAL structure for signaling applications at the NNI defined in ANSI T1.636, and describes the interactions with the level 3 protocol entity for network node signaling defined in ANSI T1.111, layer management defined in ITU-T Recommendation Q.2144, and the Service Specific Connection Oriented Protocol, ANSI T1.637.

This standard is applicable to equipment to be attached to a B-ISDN Network Node Interface when B-ISDN inter-nodal signaling is to be supported.

Although this standard makes reference to MTP-3 (ANSI T1.111) to identify user requirements, this SSCF may be utilized by other protocol entities which are able to rely on the SSCF services specified in this standard.

This standard is based on ITU-T Recommendation Q.2140. Differences with respect to ITU-T Recommendation Q.2140 are described in annex E.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

In addition to the normative references listed below, annex F lists informative references.

ANSI T1.111-1992, *Telecommunications – Signaling System No. 7 – Message Transfer Part (MTP)*

ANSI T1.627-1993, *Telecommunications – Broadband ISDN – ATM layer functionality and specification*

ANSI T1.635-1994, *Telecommunications – Broadband ISDN – ATM adaptation layer type 5 common part functions and specification*

ANSI T1.636-1994, *Telecommunications – B-ISDN signaling ATM adaptation layer – Overview description*

ANSI T1.637-1994, *Telecommunications – B-ISDN ATM adaptation layer – Service Specific Connection Oriented Protocol (SSCOP)*

ITU-T Recommendation X.200 (1994) – *Reference model of Open Systems Interconnection for ITU -T applications*[1)]

ITU-T Recommendation X.210 (1993) – *Open Systems Interconnection layer service definition conventions*[1)]

3 Acronyms

The following acronyms are used throughout this document:

AAL	ATM Adaptation Layer
ALN	Alignment
ANS	Alignment Not Successful
ATM	Asynchronous Transfer Mode
BR	Buffer Release
BSNT	Backward Sequence Number to be Transmitted
CC	Congestion Ceased
CD	Congestion Detected
CES	Connection Endpoint Suffix
CP	Common Part
CPCS	CP Convergence Sublayer
FSNC	Forward Sequence Number of last message signal unit accepted by remote peer
INS	In Service
LM	Layer Management
LPO	Local Processor Outage
LR	Local Release
MAAL	Management ATM Adaptation Layer
MI	Management Initiated
MPS	Management Proving State
MTP	Message Transfer Part (of Signaling System No. 7)
MU	Message Unit
NNI	Network Node Interface
OOS	Out Of Service
PDU	Protocol Data Unit
PDUT	PDU Transmitted
PE	Protocol Error

[1)] Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

PNS	Proving Not Successful
PO	Processor Outage
RN	Retrieval Number
RR	Remote Release
SAAL	Signaling AAL
SAP	Service Access Point
SAR	Segmentation And Reassembly
SD	Sequence Data
SN	Sequence Number
SR	SSCOP Release
SREC	SSCOP Recover
SSCF	Service Specific Coordination Function
SSCOP	Service Specific Connection Oriented Protocol
SSCS	Service Specific Convergence Sublayer
UDR	UNITDATA Received
UNI	User to Network Interface
UPS	User Proving State
UU	User to User
VCI	Virtual Channel Identifier

4 General

The Service Specific Coordination Function (SSCF) specified in this document in conjunction with the Service Specific Connection Oriented Protocol (SSCOP) specified in ANSI T1.637 define the Service Specific Convergence Sublayer (SSCS). The purpose of the Service Specific Coordination Function is to enhance the services of SSCOP to meet the needs of the NNI level 3 protocol. In addition, the SSCF at the NNI provides communication with Layer Management for proper operation of signaling links.

Figure 1 of ANSI T1.636 illustrates the structure of the SAAL at the NNI. It comprises the SSCF at the NNI (this standard), the SSCOP (see ANSI T1.637), the SSCS Layer Management ITU-T Recommendation Q.2144, and the AAL type 5 common part (see ANSI T1.635). One user of this standard is MTP level 3 (see ANSI T1.111). This sublayer (the SSCF at the NNI) has common interfaces with the MTP level 3, the SSCS Layer Management, and the SSCOP.

The definition of the SAAL takes into consideration the principles and terminology of ITU-T Recommendations X.200 and X.210, the reference model and layer service conventions for Open Systems Interconnection (OSI). The SAAL is a protocol which operates at the data link layer of the OSI architecture.

NOTES

1 The ATM layer is currently defined in ANSI T1.627. Level 3 is defined in ANSI T1.111 for the NNI.

2 The term “level 3” is used to indicate the layer above the SAAL, the user of the SAAL services.

5 Services provided by the SAAL at the NNI

The SSCF at the NNI is the uppermost sublayer in the protocol stack for the SAAL at the NNI. By construction, it utilizes the services of the underlying SAAL sublayers, in combination with its own functions, to provide an overall SAAL service to the SAAL user, as described below.

The SAAL at the NNI provides signaling link functions for the transfer of signaling messages over one individual signaling data link. The SAAL functions provide a signaling link for reliable transfer of signaling messages between two signaling points.

A signaling message delivered by the higher levels is transferred over the signaling link in variable length protocol data units (PDUs). For proper operation of the signaling link, the PDU comprises transfer control information in addition to the information content of the signaling message.

The services provided by the SAAL at the NNI include:

a) ***Assured transfer of data***

The SAAL service provides for the transfer of SAAL service user-data on point-to-point ATM connections. Message delimitation and alignment, error detection, and error correction are part of the assured data transfer service of this SAAL. The SAAL supports the transfer of octet aligned SDUs from a minimum of 5 octets up to a maximum of 4096 octets (i.e., maximum information size k in SD PDU). The SAAL service generally relieves the user from dealing with loss, insertion, corruption, and misordering of data that may occur, however, in some cases where errors are not recovered in the ATM adaptation layer, SDUs may be duplicated or lost.

b) ***Transparency of transferred information***

The SAAL service provides for the transparent transfer of SAAL service user-data. It does not restrict the content, format or coding of the information, nor interpret the structure or meaning of the information.

c) ***Establishment and release of SAAL connections for assured transfer of data***

The SAAL service provides for a means to establish and release SAAL connections that operate in the assured mode. An initial alignment procedure may be applied during connection establishment to verify the signaling connection. Depending on the conditions, release of an SAAL connection may result in loss of SAAL user-data.

d) ***SDU retrieval***

The SAAL service makes available to the SAAL service user the means by which the sending SAAL service user may retrieve SDUs already delivered to the SAAL.

e) ***Signaling link error monitoring***

Two signaling link error monitoring functions are provided: one that is employed while a signaling link is in service and which provides one of the criteria for taking the link out of service, and one that is employed when a link is in the proving state of the initial alignment procedure.

f) ***Flow control***

The SAAL service provides, on an implementation dependent basis, indication of local congestion of the signaling link.

6 Functions of the SSCF at the NNI

This clause is provided as an aid to understanding the functions of the SSCF at the NNI. The state transition table (table 6) is the definitive specification of this SSCF. If the following text is found to conflict with clause 12, clause 12 is to be followed. The definitions of the primitives used in the following descriptions of the functions are described in clauses 7, 8, and 9.

6.1 Functions with no peer-to-peer messages

6.1.1 Mapping

This SSCF maps primitives received from the SAAL user to signals defined at the SSCOP upper layer boundary and maps signals received from the SSCOP to primitives implicitly defined at the MTP-3 lower layer boundary.

AAL-MESSAGE_FOR_TRANSMISSION.request maps to AA-DATA.request.
AA-DATA.indication maps to AAL-RECEIVED_MESSAGE.indication.

6.1.2 Local retrieve

The local retrieve function supports the changeover procedure of MTP-3, (see ANSI T1.111). This function accommodates the following primitives at the boundary between SSCF and level 3:

AAL-RETRIEVE_BSNT.request
AAL-BSNT.confirm
AAL-BSNT_NOT_RETRIEVABLE.confirm
AAL-RETRIEVAL_REQUEST_AND_FSNC.request
AAL-RETRIEVED_MESSAGES.indication
AAL-RETRIEVAL_COMPLETE.indication

When MTP-3 issues an AAL-RETRIEVE_BSNT.request, the SSCF ensures that it has processed all AA-DATA.indications from SSCOP. (SSCOP should either be in the *Idle* state or in the process of releasing the connection). SSCF then issues an AAL-BSNT.confirm to MTP-3, with the value of the included BSNT parameter being equal to the value of the SN parameter in the last received AA-DATA.indication.

When MTP-3 issues an AAL-RETRIEVE_REQUEST_AND_FSNC.request to SSCF, SSCF issues an AA-RETRIEVE.request to SSCOP. The retrieval number (RN) parameter in this request is set to the FSNC value received from MTP-3. The SSCOP returns, in order, message units it has received from SSCF in AA-DATA.requests, beginning with the message unit following the one sent in SD PDU with sequence number RN. For cases in which an FSNC value is not obtained from MTP-3, the RN parameter can convey a value of “unknown,” and SSCOP returns only those message units that have not yet been transmitted. Each message unit is contained in an AA-RETRIEVE.indication, which SSCF maps to an AAL-RETRIEVED_MESSAGES.indication to MTP-3 after verifying that the length is larger than 4 octets. When all message units have been returned or when there are no such message units, SSCOP issues an AA-RETRIEVE_COMPLETE.indication. SSCF then issues an AAL-RETRIEVAL_COMPLETE.indication to MTP-3.

6.1.3 Flow control

The SSCF is informed of congestion by an implementation dependent function. The SSCF notifies the SAAL user of the level of congestion via the AAL-LINK_CONGESTED.indication. Four levels of congestion are reported, with the lowest level indicating no congestion. Some guidelines for determining of congestion are given in ANSI T1.111.

It is incumbent upon the SAAL to control its flow of PDUs to the AAL Common Part to avoid unnecessary cell loss. The SAAL should not transfer a PDU to the lower sublayer unless it is assured that the admission policy limitations of the lower sublayer will not be exceeded. The actual method of congestion control is implementation dependent. For example, the interface between sublayers could be modelled as a finite length queue to accomplish this control. The SAAL can thus regulate its flow of PDUs to the lower sublayers based on this information.

6.1.4 Change link status

This SSCF function receives primitives from MTP-3 or signals from SSCOP and maintains local state variables pertaining to the status of the link. It may also in some instances generate primitives to the MTP-3 or signals to the SSCOP. This function accommodates the following primitives: AAL-START.request, AAL-STOP.request, AAL-IN_SERVICE.indication, AAL-OUT_OF_SERVICE.indication, AAL-EMERGENCY.request and AAL-EMERGENCY_CEASED.request.

6.1.5 Reporting to layer management

Upon release of an SSCOP connection, SSCF indicates the reason for the release to layer management in an MAAL-REPORT.indication. The reason is either determined by the SSCF or has been received in the SSCOP-UU parameter of the AA-RELEASE.indication. Other events are also reported to layer management (see clause 9).

6.2 Functions with peer-to-peer messages

Some functions performed by the SSCF utilize peer-to-peer communication. Such communication uses PDU's with a fixed length of four octets. These PDUs may be exchanged using the SSCOP-UU parameter of various AA-ESTABLISH and AA-RELEASE signals or using the MU parameter of the AA-DATA signals. Since the length of all valid MTP-3 PDUs exceeds 4 octets, a simple discrimination based on message length can prevent SSCF PDUs from being delivered inadvertently to MTP-3, either during the normal operation of the link or during message retrieval. When an AA-DATA.indication is received by SSCF and the length of the MU parameter is greater than 4 octets, the contents of the MU parameter are delivered to MTP-3 in an AAL-RECEIVED_MESSAGE.indication primitive. If the length is 4 octets, the contents of the MU parameter are processed within SSCF. If the length is less than 4 octets, the MU is discarded.

6.2.1 Processor outage

The SSCF is notified of a local processor outage or recovery via the signals "MAAL-LOCAL_PROCESSOR_OUTAGE.request" and "MAAL-LOCAL_PROCESSOR_RECOVERED.request". The SSCF maintains an internal flag ("LPO") corresponding to the status of the local processor, LPO can take two values: No local processor outage (in the state table, LPO=0), or local processor outage (LPO=1).

When a local processor outage occurs and the SSCF is in the *In Service/Data Transfer Ready* state, the SSCF issues an AA-RELEASE.request to SSCOP and an AAL-OUT_OF_SERVICE.indication to MTP-3. The SSCOP-UU parameter of the AA-RELEASE.request is used to indicate the Processor Outage to the peer SSCF.

Upon receipt of a status of Processor Outage in the SSCOP-UU parameter of an AA-RELEASE.indication, SSCF issues an AAL-OUT_OF_SERVICE.indication to MTP-3. SSCF also issues an MAAL-REPORT.indication to layer management indicating remote processor outage. SSCF does not maintain any status information regarding remote processor outage.

If the SSCF receives an AAL-START.request during local processor outage, alignment is started normally.

Upon successful completion of proving, if a local processor outage condition exists, SSCF issues an AA-RELEASE.request to SSCOP and an AAL-OUT_OF_SERVICE.indication to MTP-3. The SSCOP-UU parameter of the AA-RELEASE.request is used to indicate the processor outage to the peer SSCF.

6.2.2 Alignment procedure

In establishing a connection for the SAAL user, the SSCF passes through several stages of an alignment procedure. These stages of procedure are as follows: *Out Of Service, Alignment*, *Proving*, *Aligned Ready* and *In Service*. Figure 1 provides an overview of the alignment procedure, including the events which cause the procedure to move to different stages (these events are formally described in later subclauses of this document).

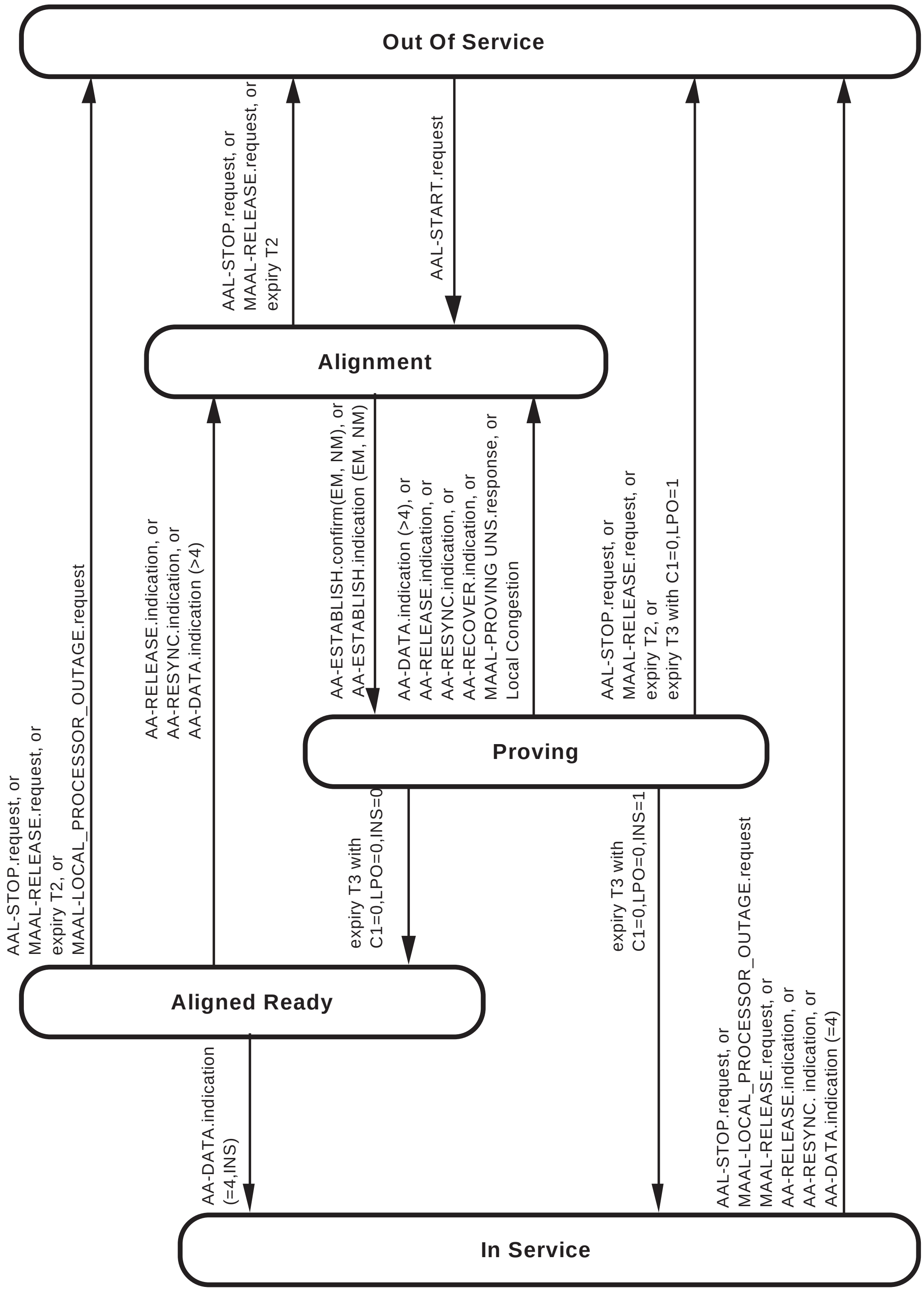


Figure 1 – Overview of the alignment procedure

The alignment procedure can be applied to verify the link quality before it is put into service. The alignment procedure relies upon an error monitoring function in layer management.

In the usual case, the SSCF proves the link, using a proving period (Normal or Emergency) determined by the SAAL user. However, the SAAL layer management can override the usual decision process and force SSCF either to prove or to forgo proving.

The following gives an overview of the alignment process in the case of successful establishment:

Step 1: *Alignment* stage

The SAAL user initiates the procedure (moving from the *Out Of Service* stage to the *Alignment* stage). The SSCF establishes the proving period by examining local state variables pertaining to the management proving status and the user proving status. The SSCF conveys this proving period to its peer by placing an SSCF PDU in the “SSCOP-UU” parameter of its request to establish the link. The SSCF then starts a timer (timer T2), which is the time that the SSCF will wait for alignment to be completed before it terminates the alignment attempt.

Step 2: *Proving* stage

If the SSCF receives confirmation of alignment (notification from SSCOP that the link has been established), the SSCF notifies layer management to begin proving error monitoring. The proving period that must be selected will be based also on the received indication of the peers requested proving interval. The detailed logic of the selection of the proving period is described in clause 12.

The SSCF starts a timer (timer T3), which is the interval between sending of the proving PDUs. This timer should be selected such that proving PDUs are generated at half the nominal rate of the signaling link. An appropriate number of proving PDUs (corresponding to the proving periods) is then sent. A counter (counter C1) is used in clause 12 to describe the appropriate number of proving PDUs to be sent. Timer T3 is restarted after transmission of each proving PDU. Received proving PDUs are discarded.

Step 3: *Aligned Ready* stage

When the appropriate number of proving PDUs has been sent, the SSCF will instruct layer management to stop proving. It will also send an SSCF PDU (INS PDU) to the peer, to indicate that proving has completed. The SSCF waits in the *Aligned Ready* stage of the procedure until it receives a similar INS PDU from the peer. Upon this PDU reception, the alignment procedure completes by moving to the *In Service* stage, and the SSCF notifies both layer management and the user that the link is in service. Alternatively, if the SSCF, before it has completed proving, receives notification that the peer has completed proving, the alignment procedure will bypass the *Aligned Ready* stage upon successful completion of proving and move to the *In Service* stage directly.

6.3 Signaling protocol stack for NNI

Figure 2 relates AAL information flows to the point-to-point signaling virtual channel defined within the ATM layer at the NNI. The figure also depicts how various functional blocks in a protocol stack are related to their “neighbors.”

The properties of figure 2 are:

– for support of signaling there is a one-to-one correspondence between a connection endpoint within the AAL-SAP and a connection endpoint within the ATM-SAP;

– any distribution of information associated with one AAL-connection within the AAL has to be made based on PDU type (bottom up direction) or primitive type (top down direction);

– the connection is available to the AAL user as a point-to-point connection and provides assured information transfer based on AAL-primitives for assured information transfer.

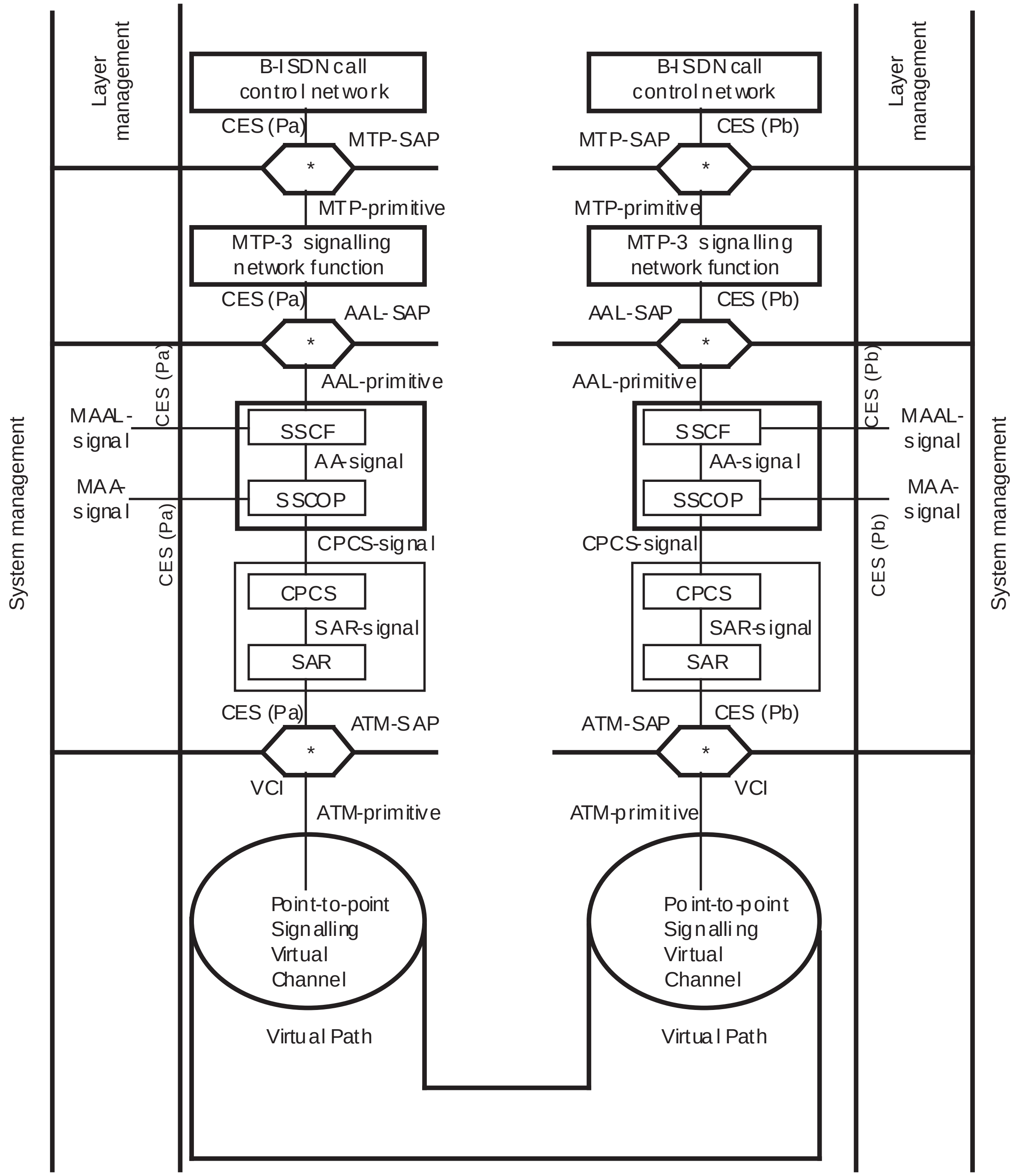


Figure 2 – Signaling protocol stack for NNI

7 Definition of the boundary between the SSCF and Layer 3 at the NNI

7.1 Primitives

These primitives required to support the SAAL user at the NNI are shown in table 1. Their names are consistent with the names of the messages which are exchanged between MTP level 2 and MTP level 3.

Table 1 – Primitives between SAAL and MTP 3

Generic name	Type				Parameters				Message unit contents
	Request	Indica-tion	Response	Confirm	Message Unit	FSNC	BSNT	Congestion Parameter	
AAL-MESSAGE_FOR_TRANSMISSION	X				X				L3 peer-peer message
AAL-RECEIVED_MESSAGE		X			X				L3 peer-peer message
AAL-LINK_CONGESTED		X						X (See note 1)	
AAL-LINK_CONGESTION_CEASED (See note 2)		X							
AAL-EMERGENCY	X								
AAL-EMERGENCY_CEASES	X								
AAL-STOP	X								
AAL-START	X								
AAL-IN_SERVICE		X							
AAL-OUT_OF_SERVICE		X							
AAL-RETRIEVE_BSNT	X								
AAL-RETRIEVAL_REQUEST_AND_FSNC	X					X			
AAL-RETRIEVED_MESSAGES		X			X				Message to be retrieved
AAL-RETRIEVAL_COMPLETE		X							
AAL-BSNT				X			X		
AAL-FLUSH_BUFFERS (See note 3)	X								
AAL-CONTINUE (See note 3)	X								
AAL-BSNT_NOT_RETRIEVABLE				X					

NOTES

1 In North American networks, the AAL-LINK_CONGESTED primitive must indicate one of four levels of congestion, levels 0 through 3, with 0 meaning no congestion.

2 The AAL-LINK_CONGESTION_CEASED primitive is not used in North American networks.

3 If these primitives occur they must be ignored.

The primitives defined in table 1 are used as indicated in table 2.

Table 2 – Use of NNI primitives

Primitive	Operation
AAL-MESSAGE_FOR_TRANSMISSION	Used by AAL user to send data
AAL-RECEIVED_MESSAGE	Used by the AAL to deliver data
AAL-LINK_CONGESTED	Indicates transmitter congestion
AAL-LINK_CONGESTION_CEASED	Indicates congestion has ceased
AAL-EMERGENCY	Request reduction of link proving
AAL-EMERGENCY_CEASES	Return to normal link proving
AAL-STOP	Inhibits peer-to-peer communication
AAL-START	Used to establish communications
AAL-IN_SERVICE	Link available
AAL-OUT_OF_SERVICE	Link not usable
AAL-FLUSH_BUFFERS	Ignored
AAL-CONTINUE	Ignored
AAL-RETRIEVE_BSNT	Requests BSNT to be retrieved
AAL-RETRIEVAL_REQUEST_AND_FSNC	Requests non-acknowledged messages to be delivered
AAL-RETRIEVED_MESSAGES	Delivery of non-acknowledged messages
AAL-RETRIEVAL_COMPLETE	Delivery of non-acknowledged messages completed
AAL-BSNT	Delivery of BSNT value
AAL-BSNT_NOT_RETRIEVABLE	Notifies user that BSNT can not be retrieved

NOTE – In North American networks, the AAL-LINK_CONGESTED primitive must indicate one of four levels of congestion, levels 0 through 3, with 0 meaning no congestion. The AAL-LINK_CONGESTION_CEASED primitive is not used.

7.2 State transition diagram

The NNI-SSCF state transition diagram as seen by the SAAL user is shown in figure 3.

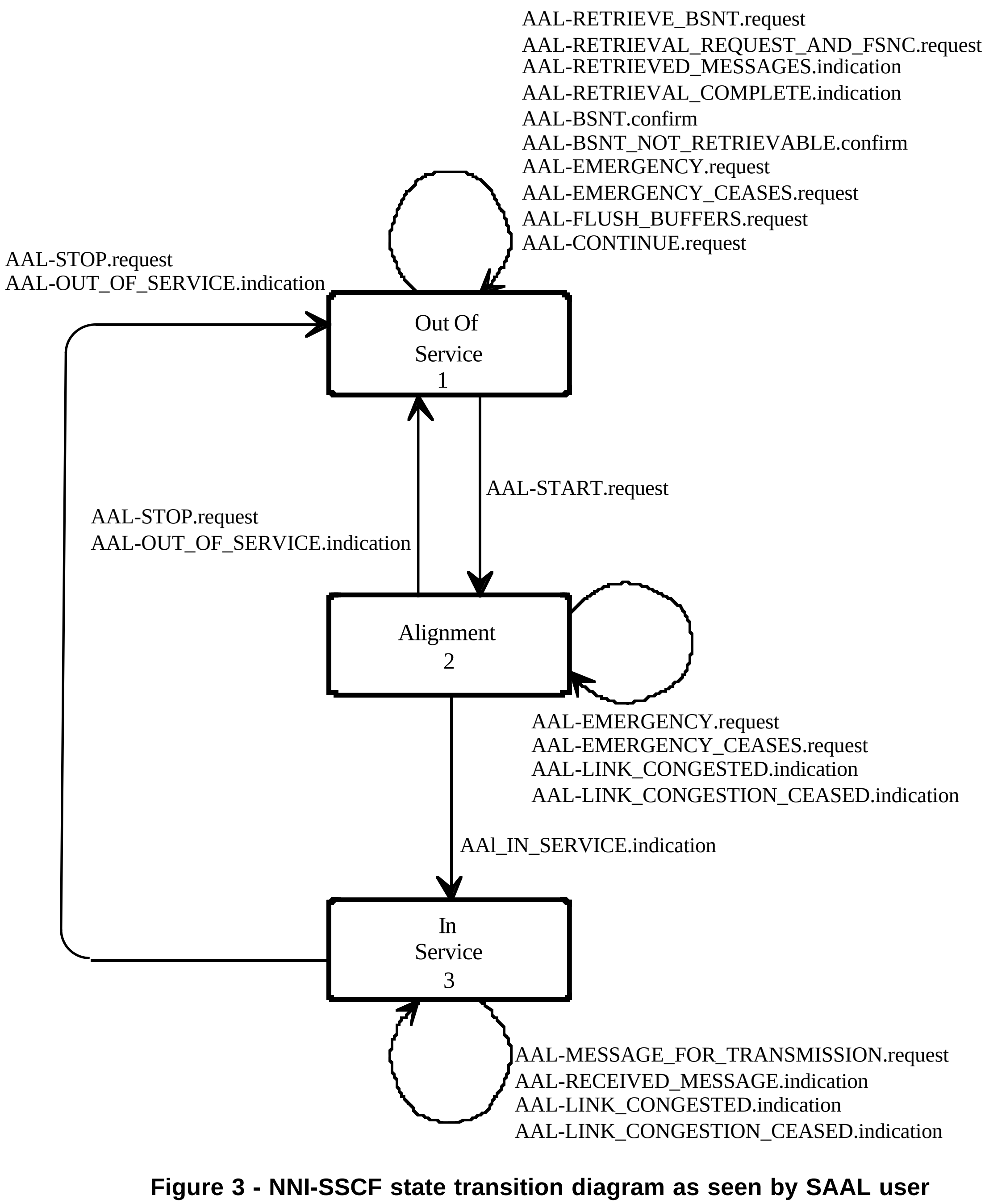


Figure 3 - NNI-SSCF state transition diagram as seen by SAAL user

8 Definition of the boundary between the SSCF at the NNI and the SSCOP

8.1 Repertoire of signals between SSCF and SSCOP

In order to specify the SSCF for the NNI, the signals between SSCF and SSCOP have to be defined. The term “signal” is used instead of “primitive” to reflect the fact that there is no service access point defined between SSCF and SSCOP.

The AA-signals between SSCF and SSCOP at the NNI are defined in table 3:

Table 3 – Signals between SSCF and SSCOP

Functionality	Signal issued by SSCF	Signal issued by SSCOP
Establishment	AA-ESTABLISH.request (SSCOP-UU, BR) AA-ESTABLISH.response (SSCOP-UU, BR)	AA-ESTABLISH.indication (SSCOP-UU) AA-ESTABLISH.confirm (SSCOP-UU)
Assured Data Transfer	AA-DATA.request (MU)	AA-DATA.indication (MU, SN)
Release	AA-RELEASE.request (SSCOP-UU)	AA-RELEASE.indication (SSCOP-UU, Source) AA-RELEASE.confirm (-)
Resynchronisation (See note)		AA-RESYNC.indication (SSCOP-UU)
Data Retrieve	AA-RETRIEVE.request (RN)	AA-RETRIEVE.indication (MU) AA-RETRIEVE_COMPLETE .confirm (-)
Error Recovery	AA-RECOVER.response (-)	AA-RECOVER.indication (-)
Unassured Data Transfer (See note)		AA-UNITDATA.indication (MU)

\- : The signal has no parameter.
NOTE – These are valid signals issued by SSCOP; however, they should never occur in practice.

The definition of these signals is as follows:

a) The AA-ESTABLISH signals are used to establish a point-to-point connection for assured information transfer between peer user entities;

b) The AA-RELEASE signals are used to terminate a point-to-point connection for assured information transfer between peer user entities;

c) The AA-DATA signals are used for the assured point-to-point transfer of SDU’s between peer user entities;

d) The AA-RESYNC.indication signal notifies that the peer users invoked resynchronization of the SSCOP connection. This service is not supported at the NNI;

e) The AA-RECOVER signals are used during recovery from protocol errors;

f) The AA-UNITDATA.indication signal notifies that the peer users invoked point-to-point, unassured transfer of SDU’s between peer user entities. This service is not supported at the NNI;

g) AA-RETRIEVE signals are used to retrieve SDU’s submitted by the user for transmission but not yet released by the transmitter;

h) AA-RETRIEVE_COMPLETE signal is used to indicate that there are no additional SDU’s to be returned to the SSCOP user.

The parameters of the signals between SSCF and SSCOP are also defined in ANSI T1.637; if there is any difference between the two definitions, the one in ANSI T1.637 is definitive. The definition of the parameters is as follows:

– the Message Unit (MU) parameter is used during information transfer to convey a variable-length message. In an AA-DATA.request signal, this parameter is mapped transparently into the Information field of an SSCOP PDU. For AA-DATA.indication and AA-UNITDATA.indication signals, this parameter contains the contents of the Information field of the received SSCOP PDU. The contents of the MU parameter of an AA-UNITDATA.indication are discarded. In AA-RETRIEVE.indication signals, this parameter contains a message unit returned to the SSCF from either the transmitter queue (data not yet sent) or the transmitter buffer. The MU is an integral multiple of one octet;

– the SSCOP User-to-User Information (SSCOP-UU) parameter allows the conveyance of a variable-length user-to-user message during connection control. The SSCOP-UU is an integral multiple of one octet, if it is present. The SSCOP-UU may be null (no data present);

– the Source parameter indicates to the SSCOP user whether the SSCOP layer or the peer SSCOP user originated the connection release. This parameter assumes one of the two values: “SSCOP” or “User”. If “SSCOP” is indicated, the SSCF shall discard the content of the SSCOP-UU parameter, if present;

– the Buffer Release (BR) parameter indicates whether the transmitter may release its buffers upon release of the connection. This parameter also allows for the release of selectively acknowledged messages. A value of “Yes” indicates that the transmission buffer and transmission queue may be released, and a value of “No” indicates that the transmission buffer and transmission queue shall not be released;

– the Sequence Number (SN) parameter indicates the value of the N(S) PDU parameter in an associated received SD PDU which is delivered to SSCF, and is used to support the data retrieval operation;

– the Retrieval Number (RN) is used to support data retrieval. The value RN+1 indicates the value of N(S) for the first SD PDU to be retrieved. A value of “Unknown” indicates that only the not yet transmitted SD PDUs are to be retrieved. A value of “Total” indicates that all the SD PDUs, in both the transmission buffer and the transmission queue, are to be retrieved.

Since the data retrieval service can be utilized by the SAAL user at the NNI, the BR parameter shall be always set to the value “No” by the SSCF at the NNI.

8.2 Sequences of signals between SSCF and SSCOP

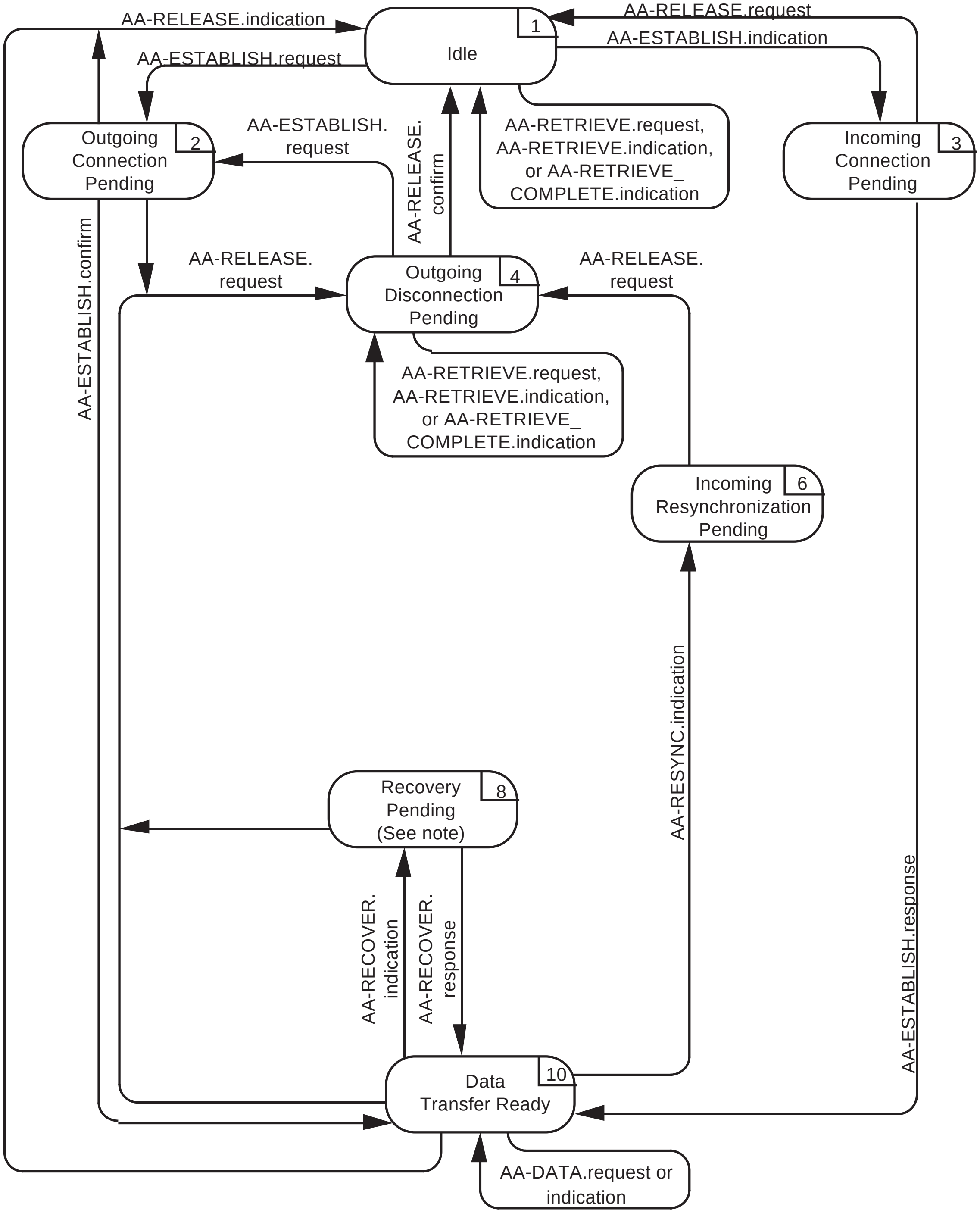
The possible overall sequences of signals between SSCF and SSCOP in relation to a specific connection are defined in the state transition diagram, figure 4. In the diagram:

a) the state numbers and names correspond to SSCOP states;

b) any other signal that is not shown as resulting in a transition (from one state to the same state, or from one state to a different state) is not permitted in that state;

c) it is assumed that the signals passed between SSCOP and an SSCF are coordinated so that collisions do not occur;

d) the *Idle* state (state 1) reflects the absence of a connection. It is the initial and final state of any sequence, and once it has been re-entered, the connection is released.



NOTE – The SSCOP connection endpoint state *Recovery Pending* (state 8) covers the SSCOP states *Recovery Response Pending* (state 8) and *Incoming Recovery Pending* (state 9). Which one of these applies is not visible at the boundary between SSCF and SSCOP. The state *Outgoing Recovery Pending* (state 7) is never visible at the boundary between SSCF and SSCOP.

Figure 4 – State transition diagram for sequences of signals between SSCF and SSCOP

9 Definition of the boundary between the SSCF and the layer management

The signals between SSCF and layer management are defined in table 4.

Table 4 – Signals between SSCF and LM

Signals	Direction
MAAL-PROVING.indication	SSCF to LM
MAAL-STOP_PROVING_.indication	SSCF to LM
MAAL-PROVING_UNSUCCESSFUL.response	LM to SSCF
MAAL-FORCE_PROVING.request	LM to SSCF
MAAL-FORCE_EMERGENCY.request	LM to SSCF
MAAL-CLEAR_FORCE_MODES.request	LM to SSCF
MAAL-RELEASE.request	LM to SSCF
MAAL-LOCAL_PROCESSOR_OUTAGE.request	LM to SSCF
MAAL-LOCAL_PROCESSOR_RECOVERED.request	LM to SSCF
MAAL-REPORT.indication	SSCF to LM

The signals are defined as follows:

"MAAL-PROVING.indication" is used to initiate connection proving.
"MAAL-STOP_PROVING.indication" is used to indicate that the proving procedure has terminated.
"MAAL-PROVING_UNSUCCESSFUL.request" is used to notify SSCF that proving was not successful.
"MAAL-FORCE_PROVING.request" indicates that the layer management requests proving.
"MAAL-FORCE_EMERGENCY.request" indicates that the layer management requests no proving.
"MAAL-CLEAR_FORCE_MODES.request" indicates that the layer management is indifferent which proving mode should be used.
"MAAL-RELEASE.request" is used to release a connection.
"MAAL-LOCAL_PROCESSOR_OUTAGE.request" is used to notify SSCF of local processor outage.
"MAAL-LOCAL_PROCESSOR_RECOVERED.request" is used to notify SSCF that the local processor has recovered.
"MAAL-REPORT.indication" is used to notify layer management of events detected by SSCF. The generic structure for the MAAL-REPORT.indication is:

MAAL-REPORT.indication ("lower boundary conditions," "upper boundary conditions," "reasons in case of exceptional situations"), where,
"lower boundary conditions" can take values LR, RR, SR,-
"upper boundary conditions" can take values ALN, INS, OOS,-
"reasons in case of exceptional situations" can take values: ANS, CC, CD, PE, PDUT, SREC, SSCOP-UU, UDR, -

Key to parameter values:

ALN Alignment
ANS Alignment Not Successful
CC Congestion Ceased
CD Congestion Detected

INS	In Service
LR	Local Release
OOS	Out Of Service
PDUT	PDU Transmitted
PE	Protocol Error
RR	Remote Release
SR	SSCOP Release
SREC	SSCOP Recover
SSCOP-UU	SSCOP User-to-User Information
UDR	UNITDATA Received
–	empty

The parameter values of the MAAL-REPORT.indication and other MAAL-signals provide LM with an unambiguous view of the status of SSCF (see table 6 for applicability of notifications).

10 Protocol elements for peer-to-peer communication

Only one SSCF PDU type is sent between peer NNI SSCFs. It has one information field used to indicate the current status of the sending peer. The format of the SSCF PDU is shown in figure 5.

The SSCF PDU can either be sent as the Message Unit (MU) of an AA-DATA.request signal, or as the SSCOP-UU of an AA-ESTABLISH.request or AA-RELEASE.request signal. All received MUs in AA-DATA.indication signals for which the length equals 4 octets are treated as SSCF PDUs. All received MUs in AA-DATA.indication signals for which the length is greater than 4 octets are treated as user messages.

The Status field is coded as follows:

00000001	Out of Service
00000010	Processor Outage
00000011	In Service
00000100	Normal
00000101	Emergency
00000111	Alignment Not Successful
00001000	Management Initiated
00001001	Protocol Error
00001010	Proving Not Successful

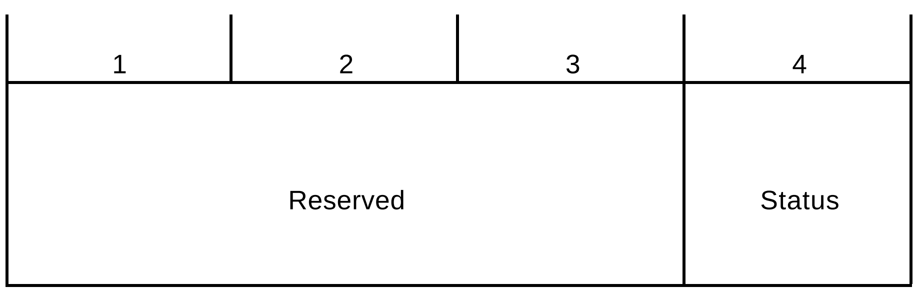


Figure 5 – Format of NNI SSCF PDU

Table 5 – Default values of parameters and timers

Parameter or timer	Default value
SSCOP parameters and timers	
k (Maximum SSCOP SDU size)	4096 octets
j (Maximum SSCOP-UU size)	4 octets
MaxCC	4
MaxPD	500
Timer_CC	200 milliseconds (See note 1)
Timer_KEEP-ALIVE	100 milliseconds
Timer_NO-RESPONSE	1.5 seconds (See note 2)
Timer_POLL	100 milliseconds
Timer_IDLE	100 milliseconds
SSCF parameter and timers	
Timer T1	5 seconds
Timer T2	30 seconds
Timer T3	Such that loading of the signaling link is approximately 50 % of its nominal cell rate
n1	1000

NOTES

1 A value of 700 ms is appropriate for satellite links.

2 Depending on the operating environment, changing this value may improve performance.

3 For Timer_KEEP-ALIVE and Timer_POLL, it does not matter if the first expiry occurs in less time than the stated value, but subsequent expirys shall occur within a nominal tolerance of the stated value.

11 Default parameters and timers

This clause defines the default SSCOP parameters that are used to support signaling. Table 5 summarizes the default protocol parameters. The values are based on a signaling virtual connection operating at 64 kbit/s at the NNI; however, these values provide satisfactory performance over a wider range of operating environments. The appropriate values for parameters and timers are dependent upon the service requirements, link quality, link rate, roundtrip delay, and the size of the resequencing buffer at the receiver: therefore, implementations should be adjustable. At the NNI, the default values for Timer_NO-RESPONSE, Timer_POLL, Timer_KEEP-ALIVE, and Timer_IDLE are driven primarily by the need to detect quickly when a signaling link has failed. If a short Timer_POLL is used, little value is seen for generating additional POLL PDUs through the use of the “MaxPD” parameter, so the default value of MaxPD is set to a value that should never be reached in practice.

The following parameter and timers are used within the SSCF at the NNI:

n1: The number of PDUs sent during normal proving
T1: Time between the link release action and the next link re-establish action during the alignment
T2: Total time SSCF will attempt alignment
T3: Time between proving PDUs

The tolerance of protocol timers is not addressed in this standard.

12 State transition table for the SSCF at the NNI

This clause contains the state transition table of the SSCF at the NNI, shown in table 6. This SSCF provides services at an AAL connection endpoint that are invoked by means of AAL primitives in accordance with the state transition diagram defined in figure 3. The SSCF uses the services provided by the SSCOP sublayer, which are being invoked by means of AA-signals in accordance with the state transition diagram for sequences of signals defined in figure 4 (see note below). The SSCF also interacts with the SSCS Layer Management to invoke and cancel management plane functions.

NOTE – Figure 4 is the subset of figure 2 in ANSI T1.637 which applies between SSCOP and SSCF at NNI.

The SSCF performs primitive-signal mapping by issuing the appropriate primitive (MTP-3 boundary) and/or signal (SSCOP boundary or SSCF LM boundary) as a result of the receipt of a primitive from the service user and/or the receipt of a signal from the service provider (AA-signal from SSCOP or MAAL-signal, respectively). The state transition table is conceptual and does not prevent a designer from partitioning in an implementation. The actions to some events are the same for several states and an implementation may take advantage of this.

The states of the SSCF state machine are numbered such that they reflect the status at the upper, lower and LM boundary of SSCF. These compound state numbers of SSCF at NNI are ordered triples R/S/T where R is upper (see figure 3), S is lower (see figure 4) and T is LM after a sequence of AAL-primitives, AA-signals and MAAL-signals, respectively. The state numbers correspond to:

Upper boundary states	**SSCOP states as perceived by SSCF**	**LM states**
1 Out of Service	1 Idle	1 Out of Service
2 Alignment	2 Outgoing Connection Pending	2 Alignment
3 In Service	3 Incoming Connection Pending	3 Proving
	4 Outgoing Disconnection Pending	4 Aligned Ready
	6 Incoming Resynchronization Pending	5 In Service
	8 Recovery Response Pending	
	10 Data Transfer Ready	

The following states are defined:

1/1/1 *Out Of Service/Idle:* In this state, the connection is idle.

1/4/1 *Out Of Service/Outgoing Disconnection Pending:* In this state the user, or alternatively the layer management, has issued an AAL-STOP.request, or an AA-RELEASE.request, respectively, which caused the SSCF to issue an AA-RELEASE.request, and the SSCF is waiting for a confirmation of the SSCOP connection release, AA-RELEASE.confirm.

2/1/2 *Alignment/Idle:* In this state, the SAAL user requested the SSCF to provide an AAL connection. This request was passed to SSCOP by means of an AA-ESTABLISH.request, but the connection establishment or proving was unsuccessful. SSCF is waiting to reattempt this process. This process will be repeated until a supervisory function indicates that the establishment of an AAL connection is to be abandoned.

2/2/2 *Alignment/Outgoing Connection Pending:* In this state, the user has issued an AAL-START.request, and the SSCF is waiting for a confirmation of SSCOP connection.

2/4/2 *Alignment/Outgoing Disconnection Pending:* In this state the SSCF, or in the case of unsuccessful proving, the Layer Management, requested the release of the SSCOP connection. This request was passed to SSCOP by means of an AA-RELEASE.request, and the SSCF is waiting for a confirmation of the SSCOP connection release, AA-RELEASE.confirm. This state transition within SSCF is not indicated to the SAAL user.

3/10/5 *In Service/Data Transfer Ready:* In this state, the signaling connection is in service and may be used by the user to transfer signaling messages.

2/10/3 *Proving/Data Transfer Ready:* In this state, an SSCOP connection has been established, and SSCS layer management is conducting alignment error rate monitoring to verify the quality of the link.

2/10/4 *Aligned Ready/Data Transfer Ready:* In this state, the SSCF has completed proving and is awaiting an indication from its peer that the signaling link can be put into service.

Table 6 – State transition table for the SSCF at the NNI

State SSCF Timers running Event	*Out Of Service/Idle* 1/1/1	*Out Of Service/ Outgoing Disconnection Pending* 1/4/1	*Alignment/Idle* 2/1/2 T1, T2	*Alignment/ Outgoing Connection Pending* 2/2/2 T2
AAL-START.request	AA-ESTABLISH. request {SSCOP-UU := NM or EM, BR := No} (See note 2) MAAL-REPORT. indication {-,ALN,-} Set T2 2/2/2	AA-ESTABLISH. request {SSCOP-UU := NM or EM, BR := No} (See note 2) MAAL-REPORT. indication {-,ALN,-} Set T2 2/2/2	illegal	illegal
AAL-STOP.request	illegal	illegal	Reset T1, T2 Set UPS = NM MAAL-REPORT. indication {-,OOS,-} 1/1/1	AA-RELEASE.request {SSCOP-UU := OOS} Reset T2 Set UPS = NM MAAL-REPORT. indication {-,OOS,-} 1/4/1
AAL-EMERGENCY. request	Set UPS = EM 1/1/1	Set UPS = EM 1/4/1	Set UPS = EM 2/1/2	Set UPS = EM 2/2/2
AAL-EMERGENCY_ CEASES.request	Set UPS = NM 1/1/1	Set UPS = NM 1/4/1	Set UPS = NM 2/1/2	Set UPS = NM 2/2/2
AAL-MESSAGE_FOR TRANSMISSION. request	illegal	illegal	illegal	illegal
AAL-RETRIEVE_ BSNT.request	IF BSNT available THEN AAL-BSNT.confirm {Parameter Data := BSNT} (See note 4) ELSE AAL-BSNT_NOT_ RETRIEVABLE. confirm 1/1/1	IF BSNT available THEN AAL-BSNT.confirm {Parameter Data := BSNT} (See note 4) ELSE AAL-BSNT_NOT_ RETRIEVABLE. confirm 1/4/1	illegal	illegal
AAL-RETRIEVAL_ REQUEST_AND_ FSNC.request	AA-RETRIEVE. request {RN := Parameter Data} 1/1/1	AA-RETRIEVE. request {RN := Parameter Data} 1/4/1	illegal	illegal
AAL-FLUSH_ BUFFERS.request	1/1/1	1/4/1	illegal	illegal
AAL-CONTINUE. request	1/1/1	1/4/1	illegal	illegal

(continued)

Table 6 *(concluded)*

NOTES

1 The procedure for generating N1 is found in table 7.

2 The rules for generating the SSCOP-UU field are described in table 8.

3 One of four levels of congestion, 0 through 3, is indicated with 0 meaning no congestion.

4 The BSNT is the SN from the AA-DATA.indication most recently received from SSCOP.

5 The detection of local congestion is implementation dependent.

6 Further actions on this event are implementation dependent.

7 The intention of the term "illegal" here is the requirement that state 2/10/3 is not entered while local congestion has not ceased; however, the mechanism to conform to this requirement is implementation dependent.

Table 7 – SSCF decision table for generation of the number of PDUs to be sent to the peer during proving (N1)

Local Mangagement_Proving_Status (MPS)	Local User_Proving_Status (UPS)	Value of SSCOP-UU parameter in AA-ESTABLISH.indication and AA-ESTABLISH.confirm received	Generated value of N1
Emergency	Normal or Emergency	Normal or Emergency	0
Normal	Normal or Emergency	Normal or Emergency	n1
Neutral	Normal	Normal	n1
Neutral	Normal	Emergency	0
Neutral	Emergency	Normal	0
Neutral	Emergency	Emergency	0

Table 8 – SSCF decision table for proving status in SSCOP-UU parameter passed to SSCOP to be conveyed to peer SSCF

Local Mangagement_Proving_Status (MPS)	Local User_Proving_Status (UPS)	Value of SSCOP-UU parameter in AA-ESTABLISH.request and AA-ESTABLISH.response transmitted
Emergency	Normal or Emergency	Emergency
Normal	Normal or Emergency	Normal
Neutral	Normal	Normal
Neutral	Emergency	Emergency

Figure C.1 provides an overview of primitives and signals between the SSCF at the NNI and adjacent functional blocks.

The events shown in table 6 are primitives and signals at the upper and lower boundaries, respectively, and primitives at the boundary with layer management.

The SSCF has four internal flags (INS flag, LPO, MPS, and UPS), which can take the following values:

INS flag: true or false, noted in the table as 1 or 0, respectively;

LPO: true or false, noted in the table as 1 or 0, respectively;

MPS: Normal (NM), Emergency (EM) or Neutral (N);

UPS: Normal (NM) or Emergency (EM);

The initial values of the flags are:

INS flag is undefined;

LPO = false;

UPS = Normal;

MPS = Neutral.

The following points apply throughout the state transition table:

a) If the MAAL-REPORT.indication parameter is listed as “SSCOP-UU”, then the PDU type of the received SSCOP-UU field is transferred to the event specific information parameter of the MAAL-REPORT.indication.

b) The contents of the Reserved field are ignored in received SSCF PDUs.

c) Primitives received from MTP-3 and signals received from SSCOP that are listed as “Illegal” can not happen if the local implementation is correctly implemented. Some of the events identified in table 6 as illegal could be the result of collisions at the boundary between SSCF and SSCOP which, as assumed here, do not occur.

d) If an SAAL, through an implementation dependent process, detects congestion in its own receiver, it may reduce the SSCOP credit (offered window) to reduce the flow of incoming messages. The process by which the SAAL sets the SSCOP window is implementation dependent.

Annex A
(normative)

Protocol Implementation Conformance Statement (PICS) Pro Forma to ANS T1.645-1995[2)]

A.1 General

The supplier of a protocol implementation claiming to conform to this standard, shall complete the following Protocol Implementation Conformance Statement (PICS) pro forma and accompany it by the information necessary to identify fully both the supplier and the implementation. This PICS pro forma applies to the B-ISDN interfaces.

The PICS is a document specifying the capabilities and options which have been implemented, and any features which have been omitted, so that the implementation can be tested for conformance against relevant requirements, and against those requirements only.

This PICS has several uses, the most important are the static conformance review and test case selection in order to identify which conformance tests are applicable to this product.

The PICS pro forma is a document, in the form of a questionnaire, normally designed by the protocol specifier or conformance test suite specifier which, when completed for an implementation or system, becomes the PICS.

This PICS pro forma applies to the B-ISDN SSCF for NNI Signaling and the SSCOP implementation used to support it. Certain mandatory SSCOP functions are not necessary for support of NNI signaling, but may be needed to support other SSCFs. This PICS identifies such mandatory functions as optional for NNI signaling.

Clause A.5 of this document covers the SSCOP Protocol Capabilities, Protocol Data Units, and System Parameters. Clause A.6 covers the SSCOP and SSCF NNI Protocol Capabilities. In B.6, the SSCOP messages and the primitives of the upper boundary of SSCF NNI are the capabilities highlighted.

A.2 Abbreviations and special symbols

CPE Customer Premises Equipment

IUT Implementation Under Test

M Mandatory

N/A Not Applicable

O Optional

O.<n> Optional, but, if chosen, support is required for either at least one or only one of the options in the group labelled by the same numeral <n>

P Prohibited

2) As normative annex A, the PICS proforma is part of American National Standard ANSI T1.645. ANSI T1.645 is subject to copyright held by the Alliance for Telecommunications Industry Solutions (ATIS). However, to encourage and facilitate the PICS proforma use as contained in annex A, permission is granted to reproduce the PICS proforma for its intended purpose and use. This permission is limited to the reproduction of the PICS proforma itself. Requests to reproduce ANSI T1.645 in its entirety or other portions thereof should be referred to ATIS accordingly.

PD	Prefix for the Index number of the Protocol Data Units group
PC	Prefix for the Index number of the Protocol Capabilities group
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation Extra Information for Testing
S.<i>	Supplementary Information number i
SNPC	Prefix for the Index number of the SSCOP-SSCF NNI Protocol Capabilities group
SNSP	SSCF at NNI System parameters group
SP	Prefix for the Index number of the System Parameter group
X.<i>	Exceptional Information number i

A.3 Instructions for completing the PICS pro forma

The main part of the PICS pro forma is a fixed-format questionnaire, divided into three sections. Answers to the questionnaire are to be provided in the right most column, either by simply marking an answer to indicate a restricted choice (such as Yes or No), or by entering a value or a set or range of values.

A supplier may also provide additional information, categorized as either Exceptional Information or Supplementary Information (other than PIXIT). When present, each kind of additional information is to be provided as items labelled X.<i> or S.<i> respectively for cross-reference purposes, where <i> is any unambiguous identification for the item. An exception item should contain the appropriate rationale. The Supplementary Information is not mandatory and the PICS is complete without such information. The presence of optional supplementary or exceptional information should not affect test execution, and will in no way affect static conformance verification.

NOTE – Where an implementation is capable of being configured in more than one way, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation’s configuration capabilities, in case this makes for easier or clearer presentation of the information.

A.4 Global statement of conformance

Global statement: The implementation specified in this PICS meets all the mandatory requirements of the referenced standards:

Yes/No

NOTE – Answering “No” to this question indicates non-conformance to this standard. Non-supported mandatory capabilities are to be listed in the PICS below, with an explanation for the abnormal status of the implementation.

The supplier will have fully complied with the requirements for a statement of conformance by completing the statement contained in this subclause. However, the supplier may find it helpful to continue to complete the detailed tabulations in the subclauses which follow.

A.5 SSCOP – ANSI T1.637

A.5.1 Protocol Capabilities (PC) – SSCOP

ITEM #	Protocol Feature	Status	References	Support
PC1	Does IUT support Keep Alive function?	M	T1.637 5.0 e)	Yes:__No:__X:__
PC2	Does IUT support the Local Data Retrieve function?	M	T1.637 5.0 f)	Yes:__No:__X:__
PC3	Does the IUT support SSCOP initiated error recovery due to protocol error?	M	T1.637 5.0 i)	Yes:__No:__X:__
PC4	Does the IUT recognize the following Messages regardless of state?		T1.637 Table 2	
	BGN	M		Yes:__No:__X:__
	BGAK	M		Yes:__No:__X:__
	BGREJ	M		Yes:__No:__X:__
	END	M		Yes:__No:__X:__
	ENDAK	M		Yes:__No:__X:__
	ER	M		Yes:__No:__X__
	ERAK	M		Yes:__No:__X:__
	POLL	M		Yes:__No:__X:__
	STAT	M		Yes:__No:__X:__
	USTAT	M		Yes:__No:__X:__
	RS	O		Yes:__No:__X:__
	RSAK	O		Yes:__No:__X:__
	SD	M		Yes:__No:__X:__
	UD	O		Yes:__No:__X:__
	MD	O		Yes:__No:__X:__
PC5.1	In the absence of protocol error, does the IUT support assured data transfer with sequence integrity?	M	T1.637 5.0 a) h); 7.1 j)	Yes:__No:__X:__
PC5.2	Does IUT support the sending of the Unassured Data PDU?	O	T1.637 5.0 h); 7.1 n)	Yes:__No:__X:__
PC5.3	Does IUT support the sending of the Management Data PDU?	O	T1.637 7.1 o)	Yes:__No:__X:__
PC6.1	Does IUT permit the SSCF to invoke local user initiated resynchronization procedures?	O	T1.637 5.0 g) 8.1.3	Yes:__No:__X:__
PC6.2	Does IUT support remote user initiated resynchronization procedures?	O	T1.637 5.0 g) 8.1.3	Yes:__No:__X:__
PC7	Does IUT support the establishment procedures for an SSCOP connection?	M	T1.637 5.0 g)	Yes:__No:__X:__

ITEM #	Protocol Feature	Status	References	Support
PC8	Does IUT support release procedures for an SSCOP connection?	M	T1.637 5.0 g)	Yes:__No:__X:__
PC9	Does IUT support polling after retransmission?	O	T1.637 SDL Figure 20 (38 of 51)	Yes:__No:__X:__
PC10	Does IUT support the segmenting of STAT PDUs?	M	T1.637 7.2.5	Yes:__No:__X:__
PC11	Can the IUT initiate SSCOP connection?	M	T1.637 5.0 g)	Yes:__No:__X:__
PC12	Can the IUT reject (BGREJ) the establishment of an SSCOP connection from its peer?	M	T1.637 SDL Figure 20 (11 of 51)	Yes:__No:__X:__
PC13	Does IUT support error reporting to layer management?	M	T1.637 5.0 d)	Yes:__No:__X:__
PC14	Does IUT support the Protocol error detection function?	M	T1.637 5.0 i)	Yes:__No:__X:__
PC15	When no SSCOP connection exists, is a connection established only upon receipt of a BGN or a request from the SSCOP user?	M	T1.637 SDL Figure 20 (5, 6 & 7 of 51)	Yes:__No:__X:__
PC16	Does SSCOP permit the conveyance of SSCOP User-to-User Information between user of the SSCOP?	M	T1.637 5.0 g); 6.1.2 b)	Yes:__No:__X:__

A.5.2 SSCOP PDUs – Protocol Data Units (PD)

ITEM #	Protocol Feature	Status	References	Support
Order of Octet Transmission				
PD1	Ascending numerical order	M	T1.637 7.2.1	Yes:__No:__X:__
Field Mapping Convention				
PD2	Lowest bit number = Lowest order value	M	T1.637 7.2.1	Yes:__No:__X:__
PD3	Are PDU formats 32 bit aligned?	M	T1.637 7.2	Yes:__No:__X:__
PD4	Are all reserved bits coded as zeros?	M	T1.637 7.2.3	Yes:__No:__X:__

A.5.3 SSCOP System parameters (SP)

ITEM #	Protocol Feature	Status	References	Support
SP1	Maximum number of transmissions of a BGN, END, ER, or RS PDU (MaxCC)	M	§11; also T1.637 7.7 a)	Yes:__No:__X:_Value:_
SP2	Maximum number of SD PDUS before transmission of a POLL PDU (MaxPD)	M	§11; also T1.637 7.7 b)	Yes:__No:__X:_Value:_
SP3	Maximum number of List Elements in a STAT (MaxSTAT)?	M	T1.637 7.7 c)	Yes:__No:__X_Value:_
SP4	Maximum PDU size	M	T1.637 7.2.4	Yes:__No:__X:_Value:_
SP5	Timer_POLL	M	§11; also T1.637 7.6 a)	Yes:__No:__X:_Value:_
SP6	Timer_KEEP-ALIVE	M	§11; also T1.637 7.6 b)	Yes:__No:__X:_Value:_
SP7	Timer_NO-RESPONSE	M	§11; also T1.637 7.6 c)	Yes:__No:__X:_Value:_
SP8	Timer_IDLE	M	T1.637 7.6 c)	Yes:__No:__X:_Value:_
SP9	Timer_CC	M	§11; also T1.637 7.6 d)	Yes:__No:__X:_Value:_
SP10	What is the maximum size of the SSCOP-UU?	M	§11; also T1.637 6.1.2 b); 7.2.4;	Yes:__No:__X:_Value:_
SP11	Does the IUT support a SSCOP-UU length of at least four octets?	M	§11; also T1.637 6.1.2 b); 7.2.4	Yes:__No:__X:_Value:_

A.6 SSCF at NNI – ANS T1.645

A.6.1 SSCOP-SSCF NNI Protocol Capabilities (SNPC)

This subclause asks questions of the combined SSCOP and SSCF functional block. This subclause is divided into two sections. One is for the establishment and release of an SSCOP connection. The other is for the data transfer. Within these two divisions there are two subdivisions.

These two subdivisions concern the direction of information flow through the combined SSCOP and SSCF functional block. The following convention for terminology should be followed.

The U-NNI represents the upper boundary of the SSCF.

The signals exchanged between the SSCF and the SSCOP are shown in ANSI T1.637 in the PICS questions. These signals do not constrain an implementation.

The SSCOP represents the peer-to-peer messages (e.g., PDUs).

ITEM #	**Protocol Feature**	**Status**	**References**	**Support**
ESTABLISHMENT/RELEASE				
SSCOP -> -> Upper boundary of SSCF NNI (U-NNI)				
SNPC1	After the receipt of an AAL-START request, does the receipt of SSCOP PDU BGN generate [AA-ESTABLSH.indication] AAL-IN_SERVICE.indication (after proving at SSCF) at U-NNI?	M	§12 Table 6	Yes:__No:__X:__
SNPC2	In addition to SNPC1, does SSCOP send PDU BGAK to accept the connection request [AA-ESTABLISH.response]?	M	§12 Table 6	Yes:__No:__X:__
SNPC3	If the IUT is in the *In Service* state, does the receipt of SSCOP END PDU generate [AA-RELEASE.indication] AAL-OUT_OF_SERVICE indication at U-NNI?	M	§12 Table 6	Yes:__No:__X:__
Upper boundary of SSCF NNI (U-NNI) -> -> SSCOP				
SNPC4	Does an AAL-START request [AA-ESTABLISH.request] (U-NNI) generate an SSCOP PDU BGN?	M	§12 Table 6	Yes:__No:__X:__
SNPC5	Does the receipt of an SSCOP BGN or BGAK PDU in response to the sending of an SSCOP BGN PDU generate a AAL-IN_SERVICE.indication [AA-ESTABLISH confirm] at U-NNI (after proving)?	M	§12 Table 6	Yes:__No:__X:__
SNPC6	If an SSCOP connection is present, does an AAL-STOP.request [AA-RELEASE.request] (U-NNI) generate an SSCOP PDU END?	M	§12 Table 6	Yes:__No:__X:__
SNPC6.1	Does IUT permit the SSCF to invoke local user initiated resynchronization procedures?	P	T1.637 5.0 g) 8.1.3	Yes:__No:__X:__

(continued)

ITEM #	Protocol Feature	Status	References	Support
DATA TRANSFER				
SSCOP->->Upper boundary of SSCF NNI (U-NNI)				
SNPC7	If the IUT is in the *In Service* state, does receipt of an in-sequence SSCOP SD PDU generate AAL-Received_Message.indication [AA-DATA indication] at U-NNI?	M	§12 Table 6	Yes:__No:__X:__
Upper boundary of SSCF NNI (U-NNI) -> -> SSCOP				
SNPC8	If the IUT is in the *In Service* state, does an AAL-Message_For_Transmission.request [AA-DATA.request] (U-NNI) generate an SSCOP SD PDU while a connection is established and credit is available?	M	§12 Table 6	Yes:__No:__X:__

A.6.2 SSCF at NNI System parameters (SNSP)

Item #	Protocol Feature	Status	References	Support
SNSP1	Time between the link release action and the next link re-establish action during the alignment (T1)	M	§11	Yes:__No:__X:_Value:_
SNSP2	Total time SSCF will attempt connection establishment (T2)	M	§11	Yes:__No:__X:_Value:_
SNSP3	Time between proving PDUs (T3)	M	§11	Yes:__No:__X:_Value:_
SNSP4	Number of SSCF PDUs sent during proving period (n1)	M	§11	Yes:__No:__X:_Value:_

Annex B
(informative)

Impacts of SAAL on MTP-3

This annex presents the possible impacts on MTP-3 when it is used over SAAL and does not include any protocol specifications.

B.1 Frame format of MTP-3 + B-ISUP message

Figure B.1 illustrates the frame format of MTP-3 and B-ISUP message. All B-ISUP messages over SAAL will be transferred with SIO (service information octet) and a routing label. The same format of SIO (a new code is assigned for B-ISUP) and routing label defined in ANSI T1.111 are also applied in this case. Moreover, the maximum message length of MTP-3 +B-ISUP is allowed up to the maximum length of SAAL when using SAAL.

B.2 Octet transmission order

The AAL SDU received from an AAL user consists of n octets of information, where n is greater than 4 (see figure B.2).

These octets are transmitted across the interface between SSCF and SSCOP in increasing order starting with octet 1 and ending with octet n.

When the SSCF generates a PDU, the following coding conventions shall be used:

– When a field of the PDU is contained within a single octet, the lowest bit number of the field represents the least significant bit;

– When a field of the PDU spans more than one octet, the order of the bit values within each octet progressively increases as the octet number increases; the lowest bit number associated with the field represents the least significant bit.

Figure B.3 is an example to illustrate the above coding conventions. It shows the standard routing label of MTP, which is part of an SAAL PDU.

B.3 Size of FSN in changeover message

Since it has to convey the sequence number of the SSCOP PDUs, the length needs to be no less than SSCOP's sequence number. The default value should be as long as the maximum length of SSCOP's sequence number, i.e., 3 octets.

B.4 Proving ends due to a processor outage condition

In current MTP-2, if a processor outage condition exists when proving is completed, the MTP-2 enters the Aligned/not ready state. In the same circumstances, the SSCF enters the Out of Service state.

B.5 Automatic allocation of signaling data links

Procedures for automatic allocation of signaling data links in an ATM network require further study. At a minimum, the current MTP (ANSI T1.111) messages would have to be enhanced to carry ATM connection identifiers and possibly additional parameters relating to the information rate and quality of service of the ATM connections to be used for signaling.

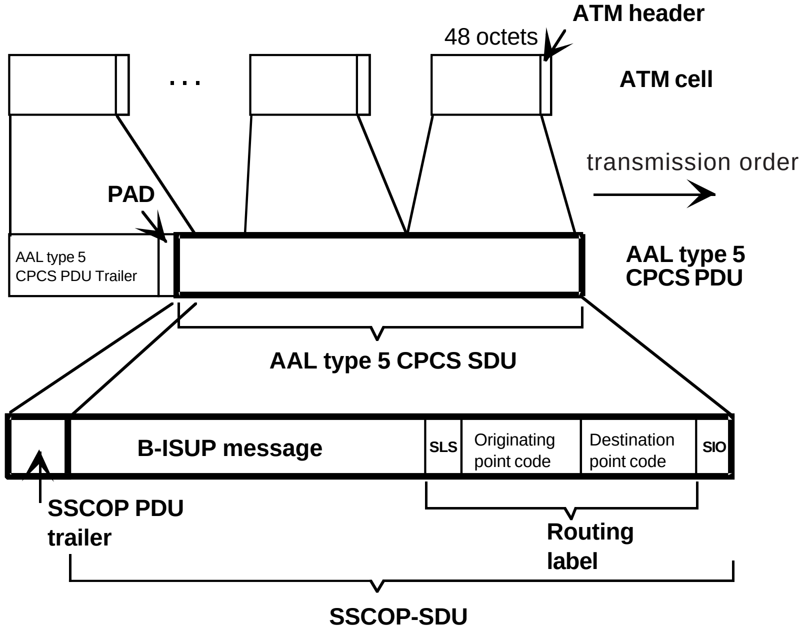


Figure B.1 – Frame format of B-ISUP and MTP-3 over SAAL

8	7	6	5	4	3	2	1	Bit / Octet
								1
								2
. . .								. . .
								n

Figure B.2 – Demonstration of transmission order

8	7	6	5	4	3	2	1	Bit / Octet
MSB			DPC-Network Cluster Member				LSB	1
MSB			DPC- Network Cluster				LSB	2
MSB			DPC- Network Identifier				LSB	3
MSB			OPC- Network Cluster Member				LSB	4
MSB			OPC- Network Cluster				LSB	5
MSB			OPC- Network				LSB	6
MSB			SLS				LSB	7

Figure B.3 – Example of coding conventions

Annex C
(informative)

Example time flow diagrams for connection establishment

NOTE – These sequence charts include a variety of connection establishment flow diagrams indicating the two peer ends but do not include all the possible cases.

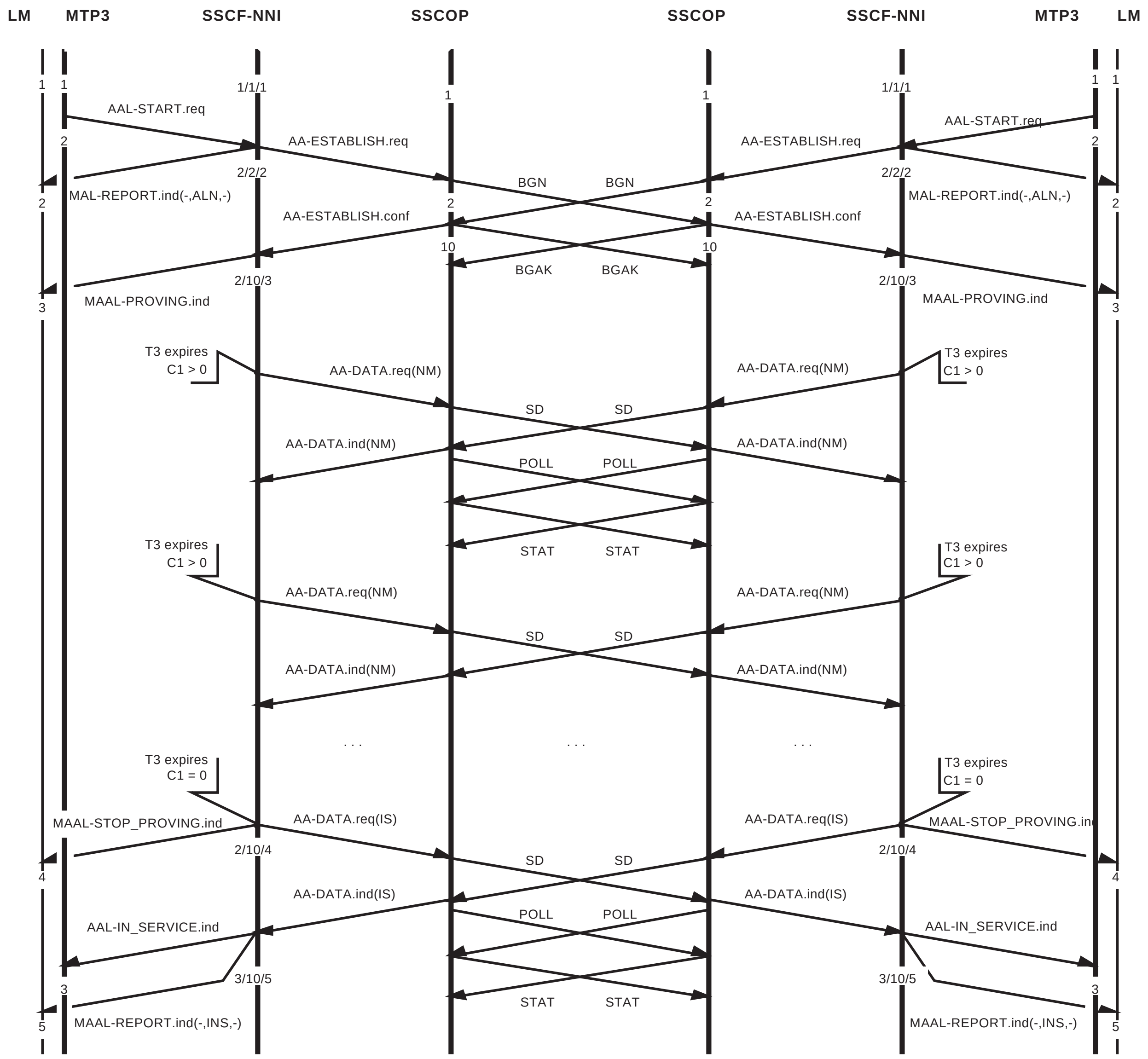


Figure C.1 – Time flow diagram for connection establishment, both UPS = Normal, case 1

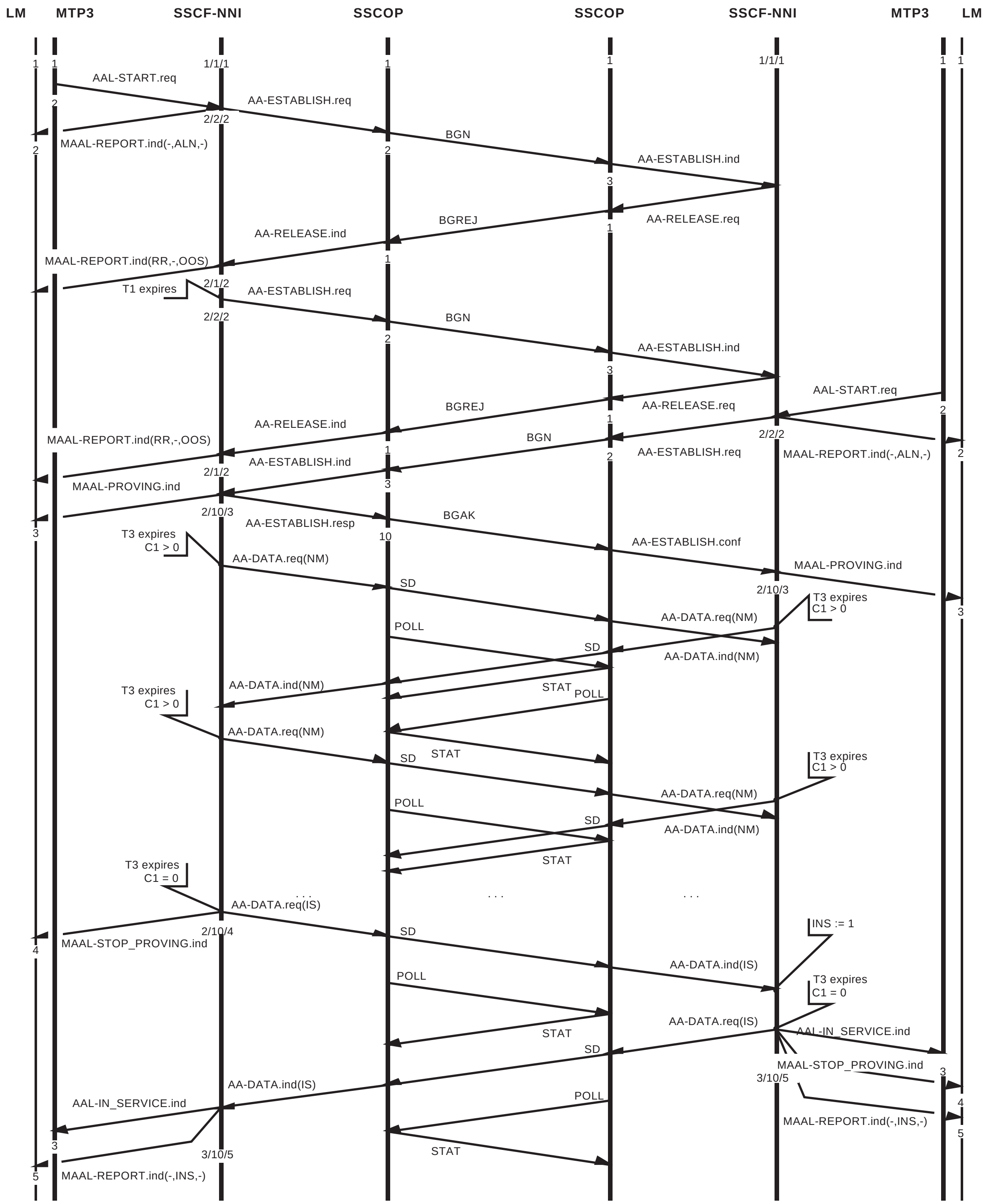


Figure C.2 – Time flow diagram for connection establishment, both UPS = Normal, case 2

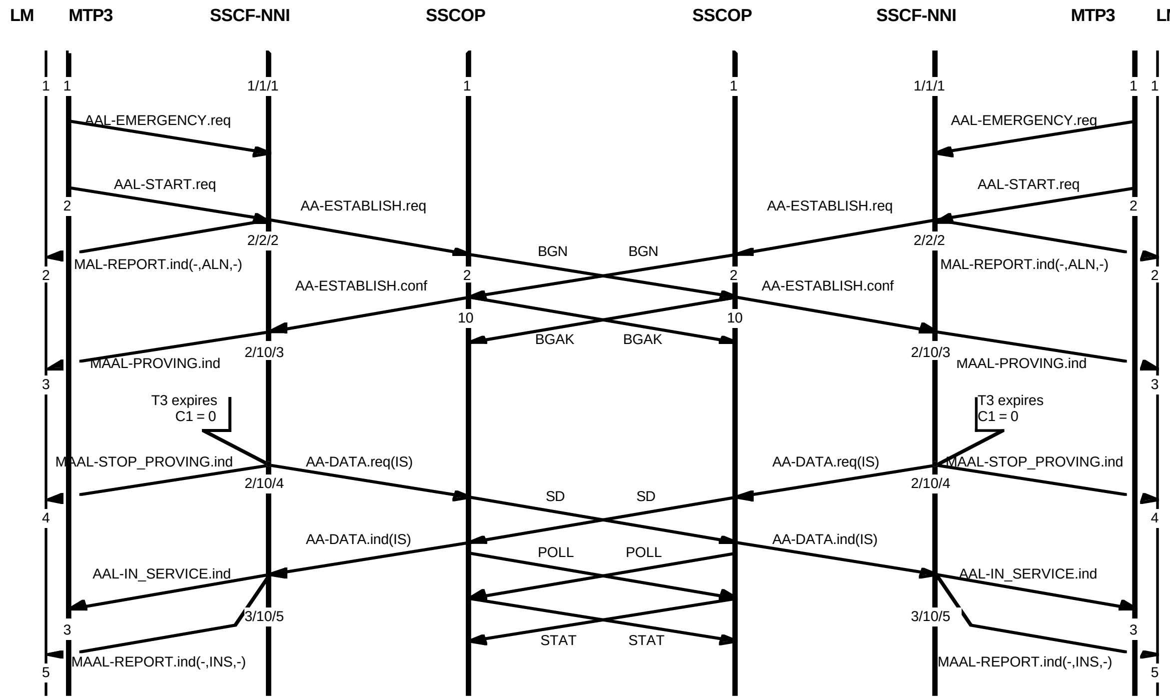


Figure C.3 – Time flow diagram for connection establishment,

Annex D
(informative)

SDL diagrams for the SSCF at the NNI

The purpose of annex D is to provide one example of an SDL representation of the SSCF procedures, to assist in the understanding of this American National Standard. The SDL representation does not constrain the possibility of partitioning in order to implement parallel processing. If there is any difference from the state transition tables in clause 12, table 6, then table 6 takes precedence.

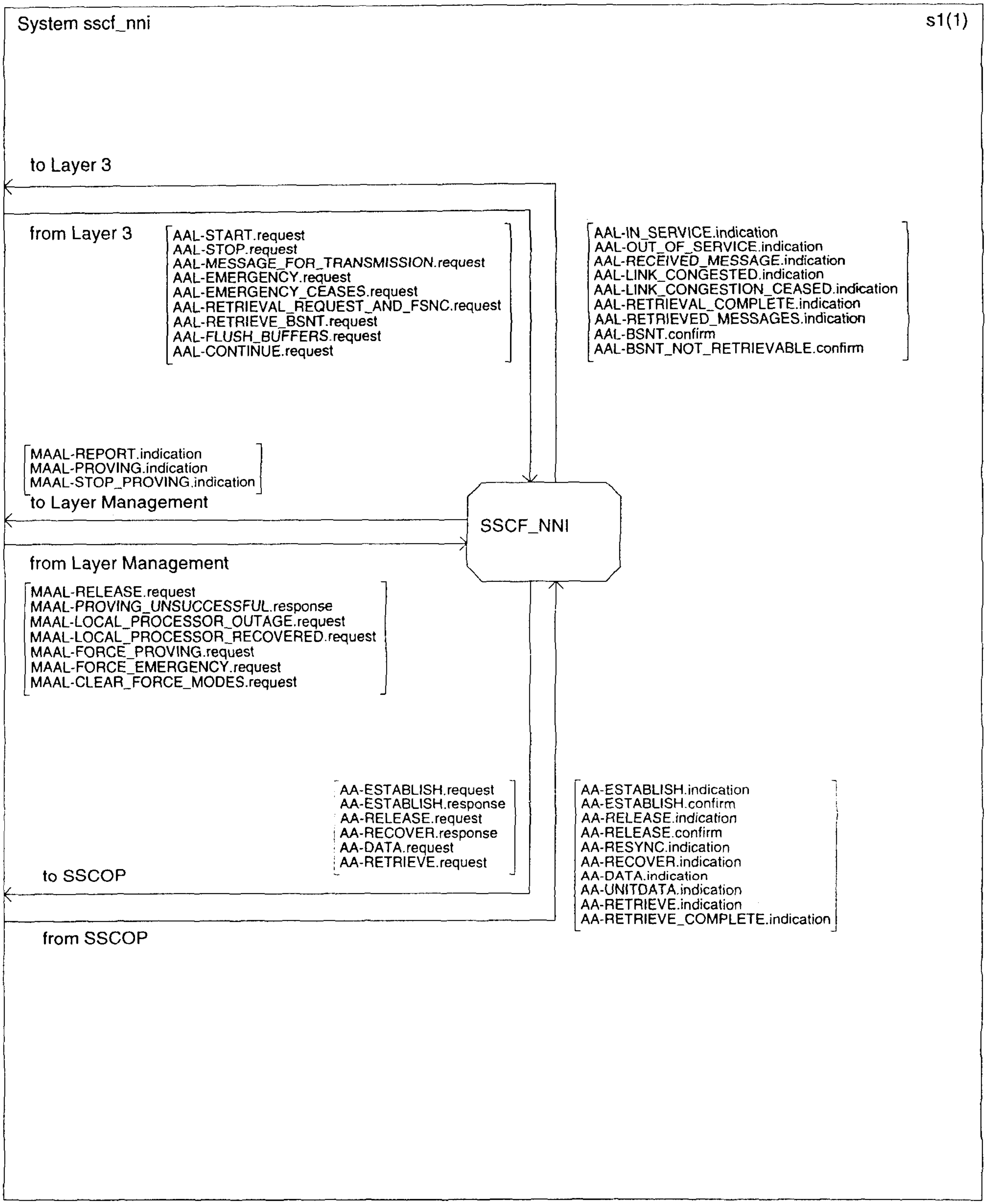


Figure D.1 – System SSCF_NNI SDL diagram

Process SSCF_NNI 01(20)

Note 1:
The procedure for generating N1 is found in Table 7/Q.2140

Note 2:
The rules for generating the SSCOP-UU field is described in Table 8/Q.2140.

Note 3:
"level" is used as part of national options described in Q.704.

Note 4:
The occurrence of the events "Local Congestion" and "Local Congestion ceased" are implementation dependent. The reaction to these events is, where nothing else is specified, implementation dependent. Nevertheless, it is required that state 2/10/3 cannot be entered while local congestion has not ceased.

Note 5:
The BSNT is the SN from the AA-DATA.indication most recently received.

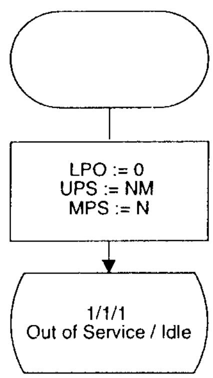


Figure D.2 – Process SSCF_NNI SDL diagram (Part 1 of 20)

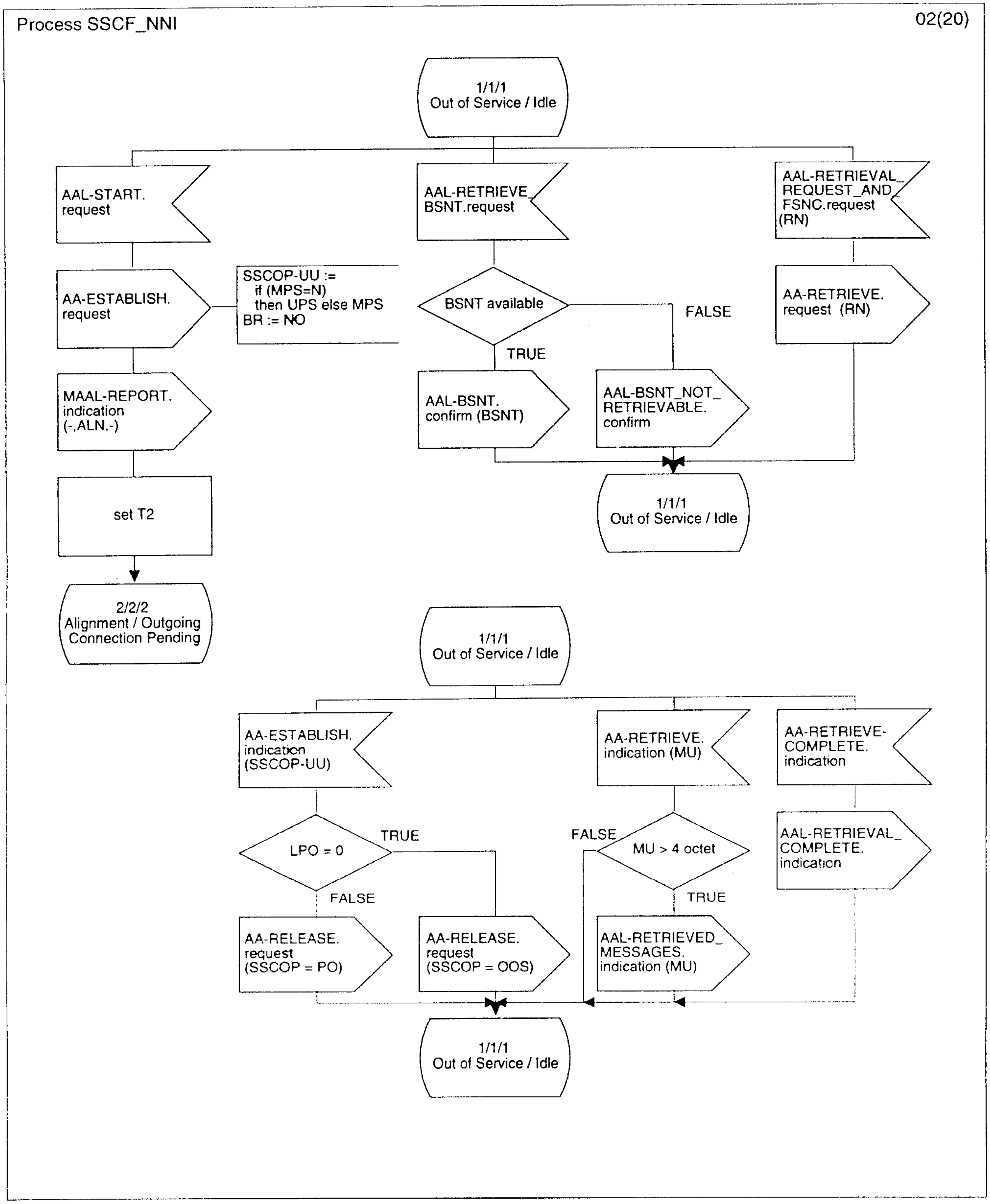


Figure D.2 – Process SSCF_NNI SDL diagram (Part 2 of 20)

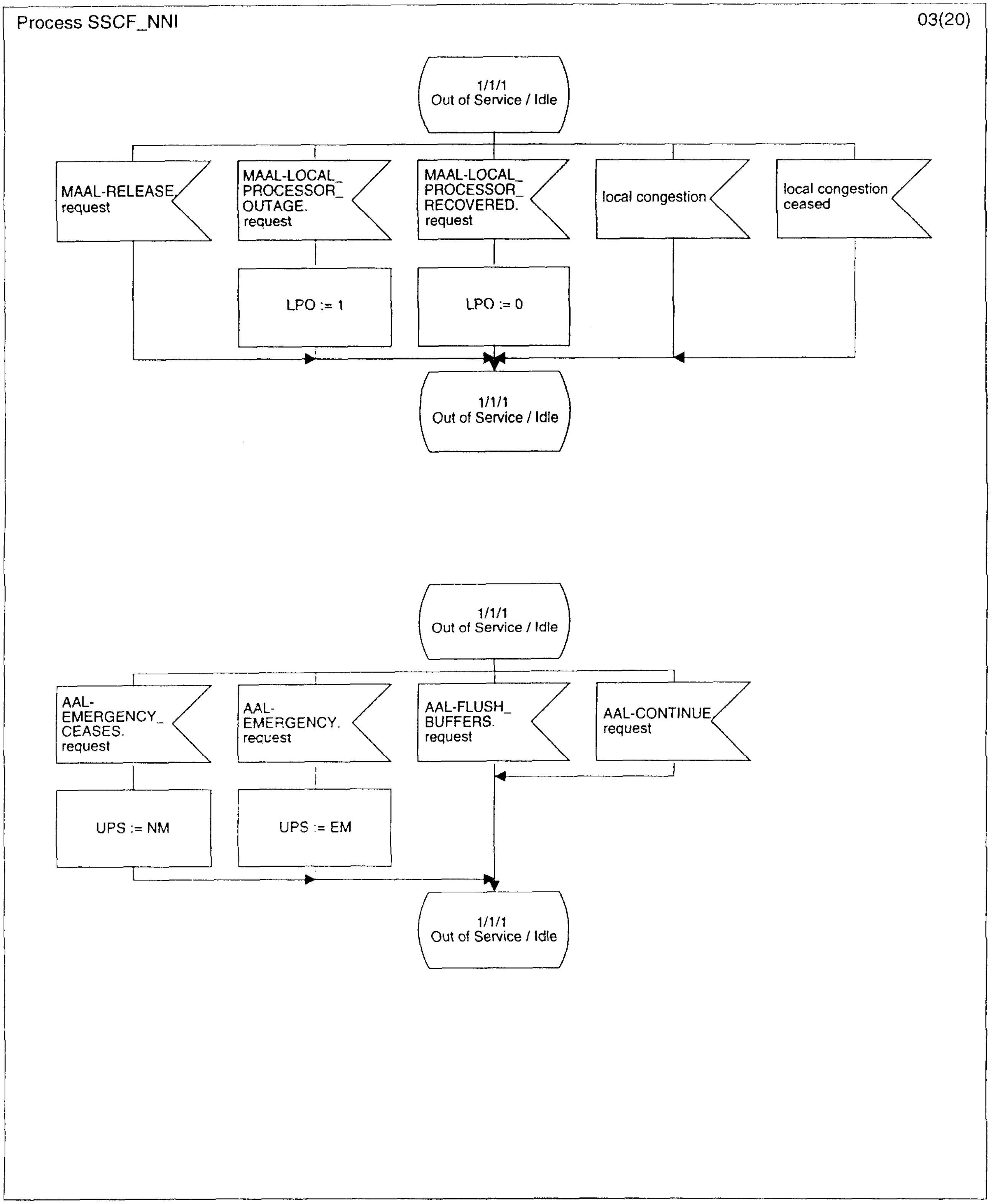


Figure D.2 – Process SSCF_NNI SDL diagram (Part 3 of 20)

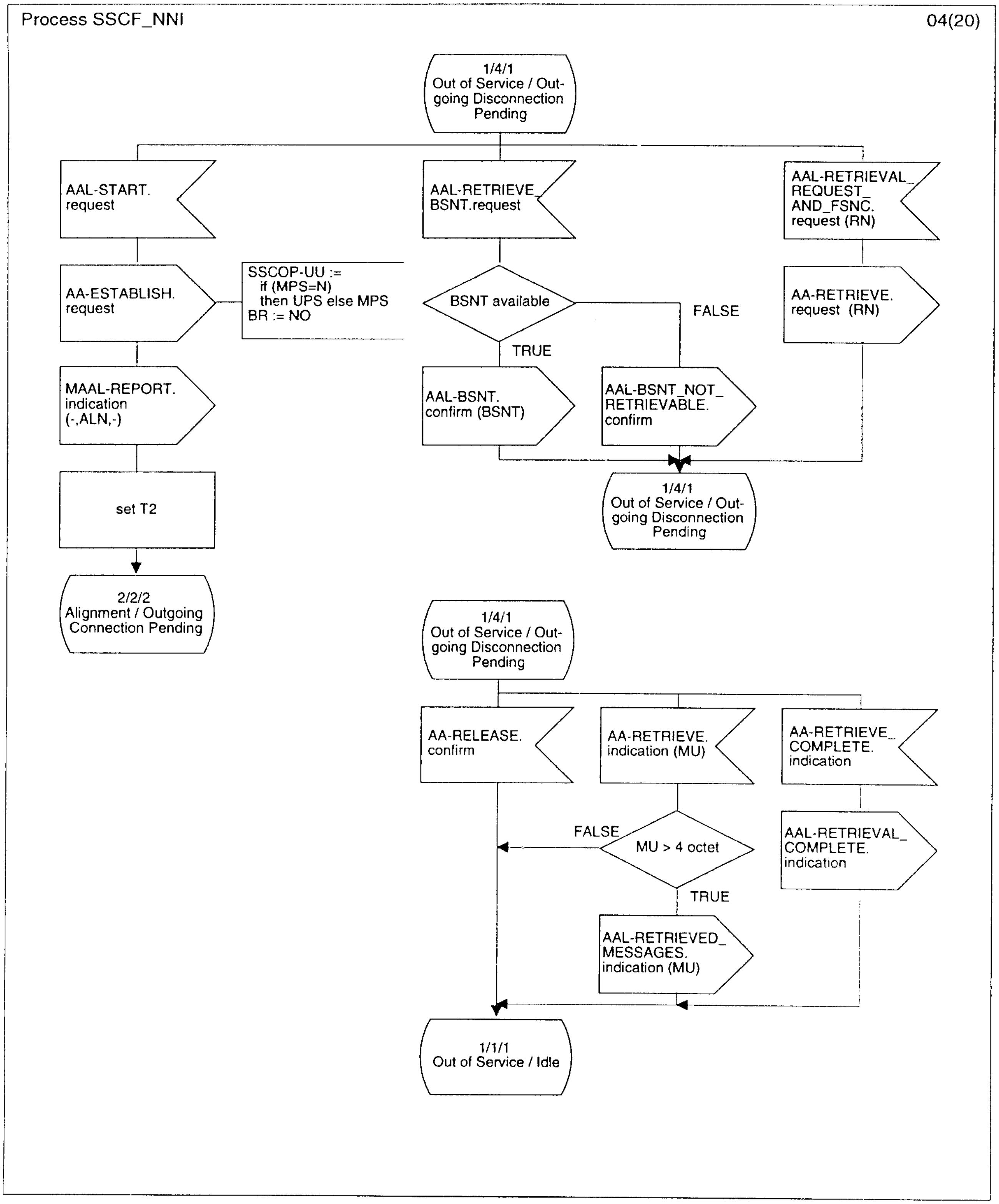


Figure D.2 – Process SSCF_NNI SDL diagram (Part 4 of 20)

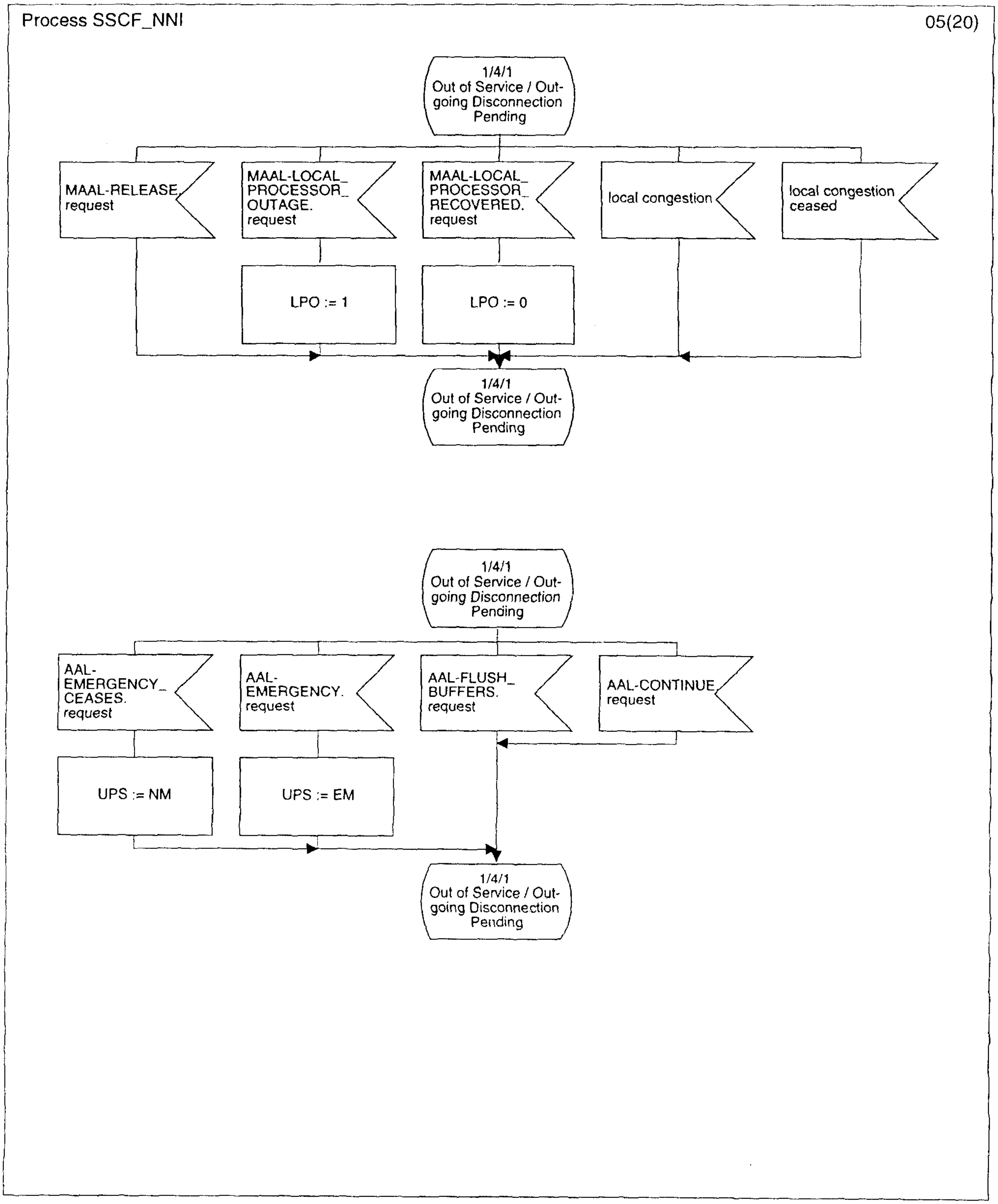


Figure D.2 – Process SSCF_NNI SDL diagram (Part 5 of 20)

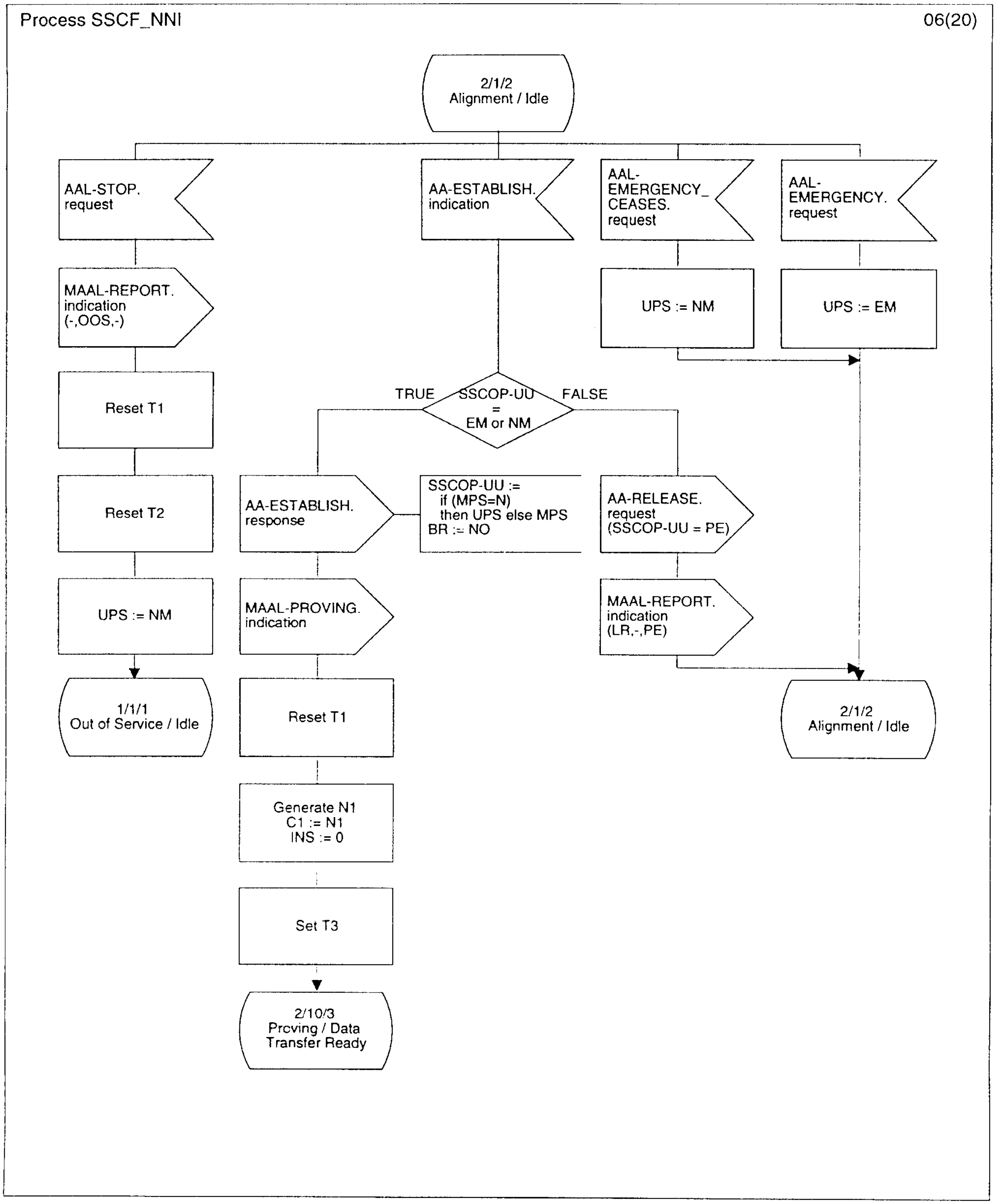


Figure D.2 – Process SSCF_NNI SDL diagram (Part 6 of 20)

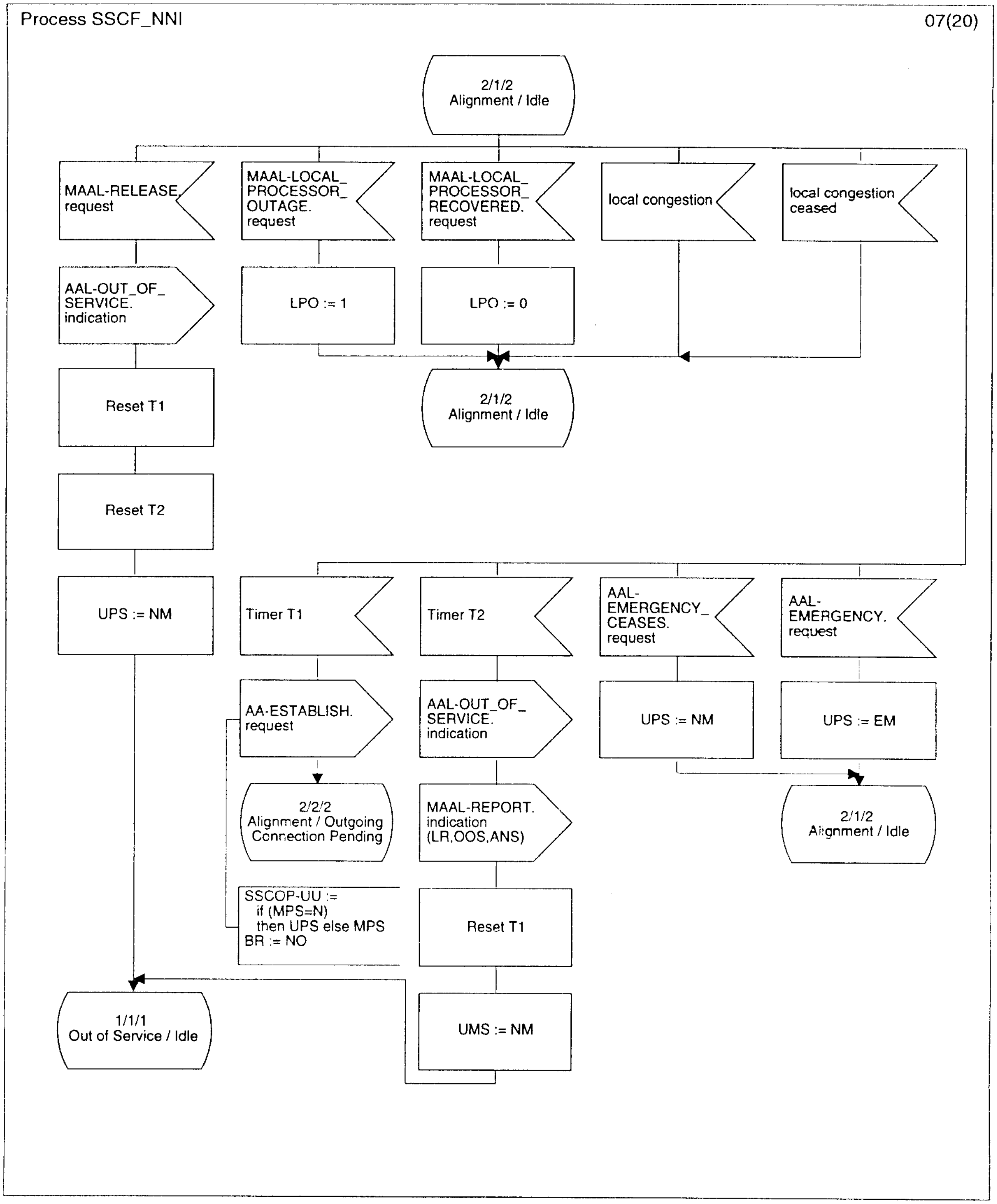


Figure D.2 – Process SSCF_NNI SDL diagram (Part 7 of 20)

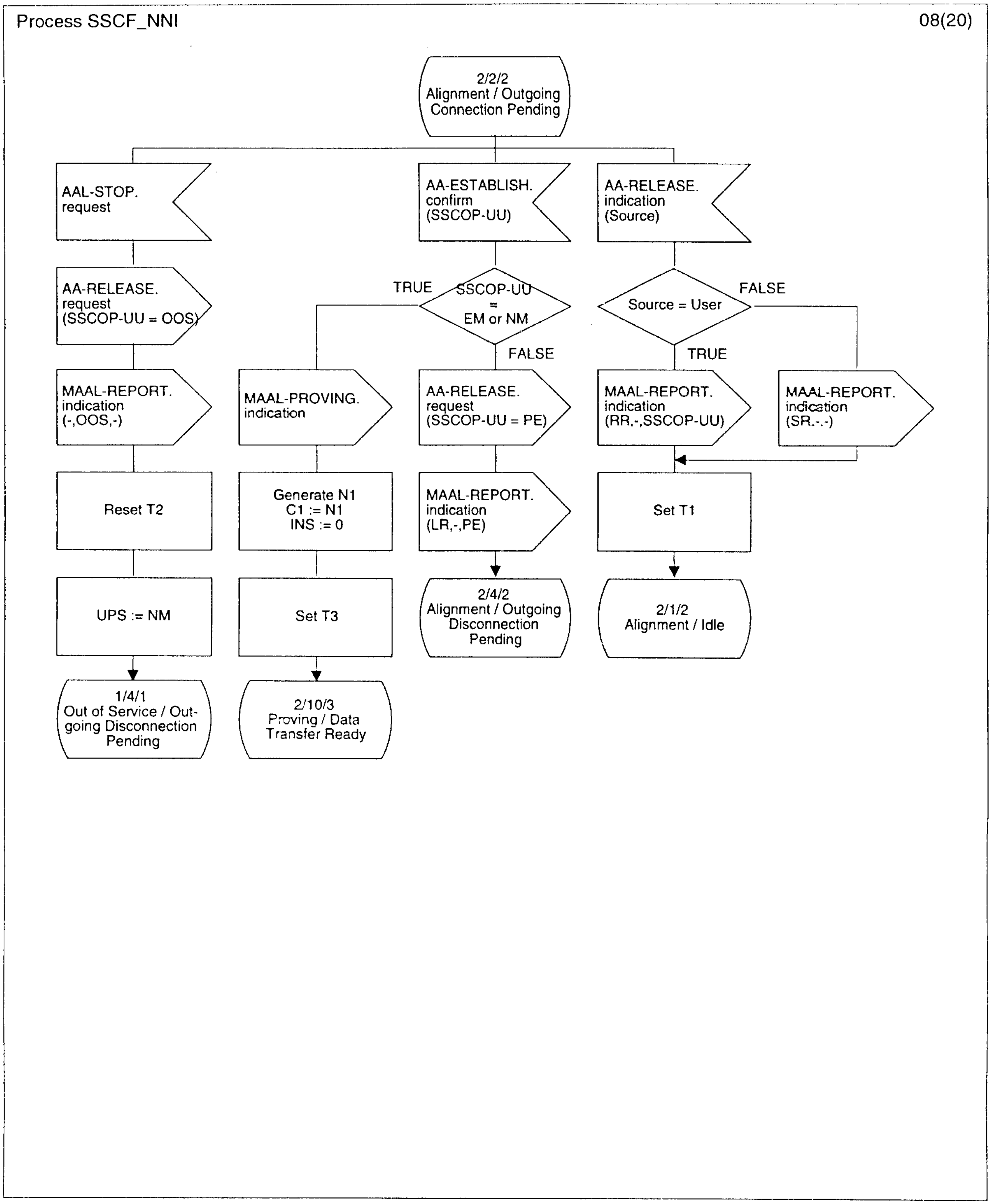


Figure D.2 – Process SSCF_NNI SDL diagram (Part 8 of 20)

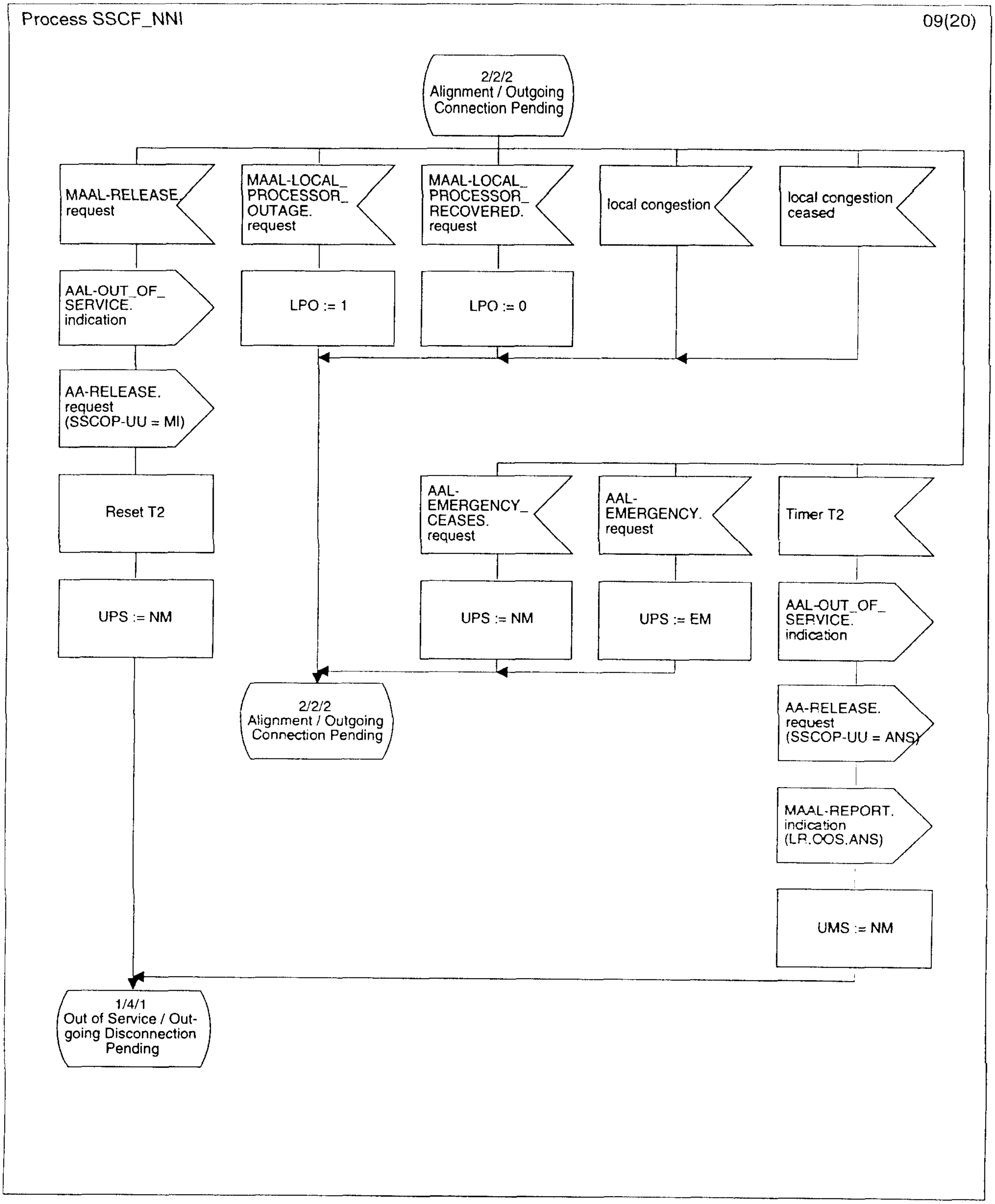


Figure D.2 – Process SSCF_NNI SDL diagram (Part 9 of 20)

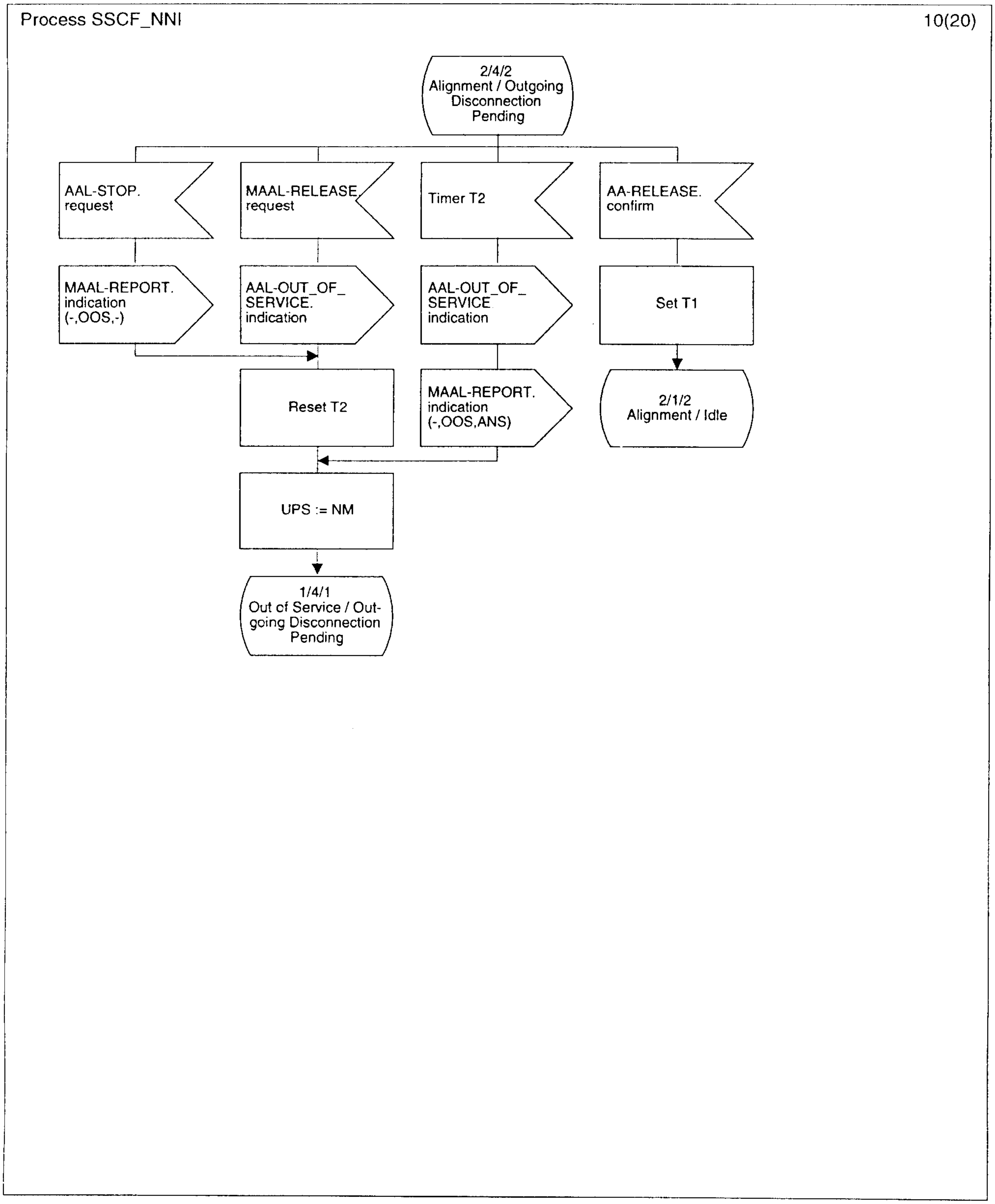


Figure D.2 – Process SSCF_NNI SDL diagram (Part 10 of 20)

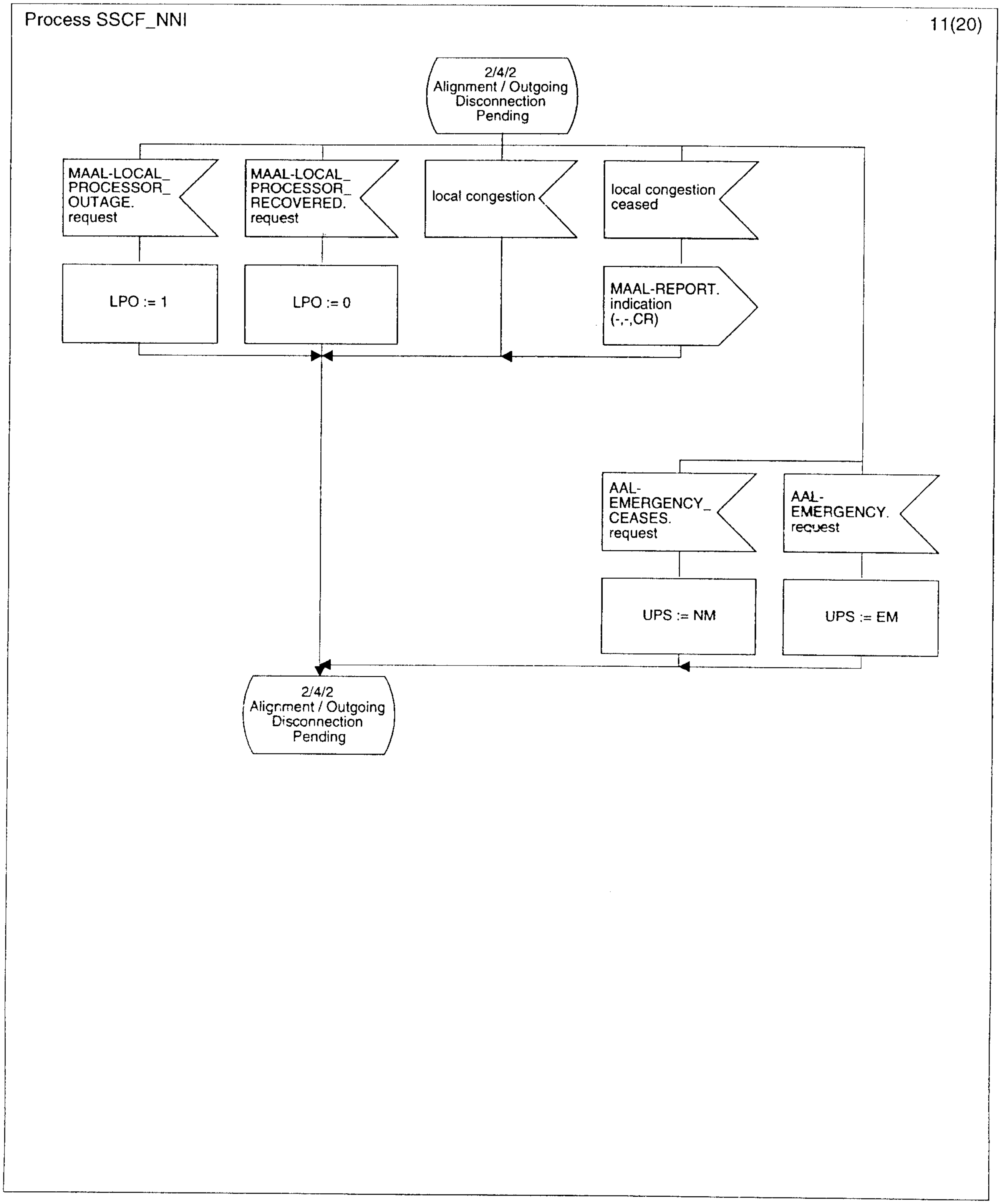


Figure D.2 – Process SSCF_NNI SDL diagram (Part 11 of 20)

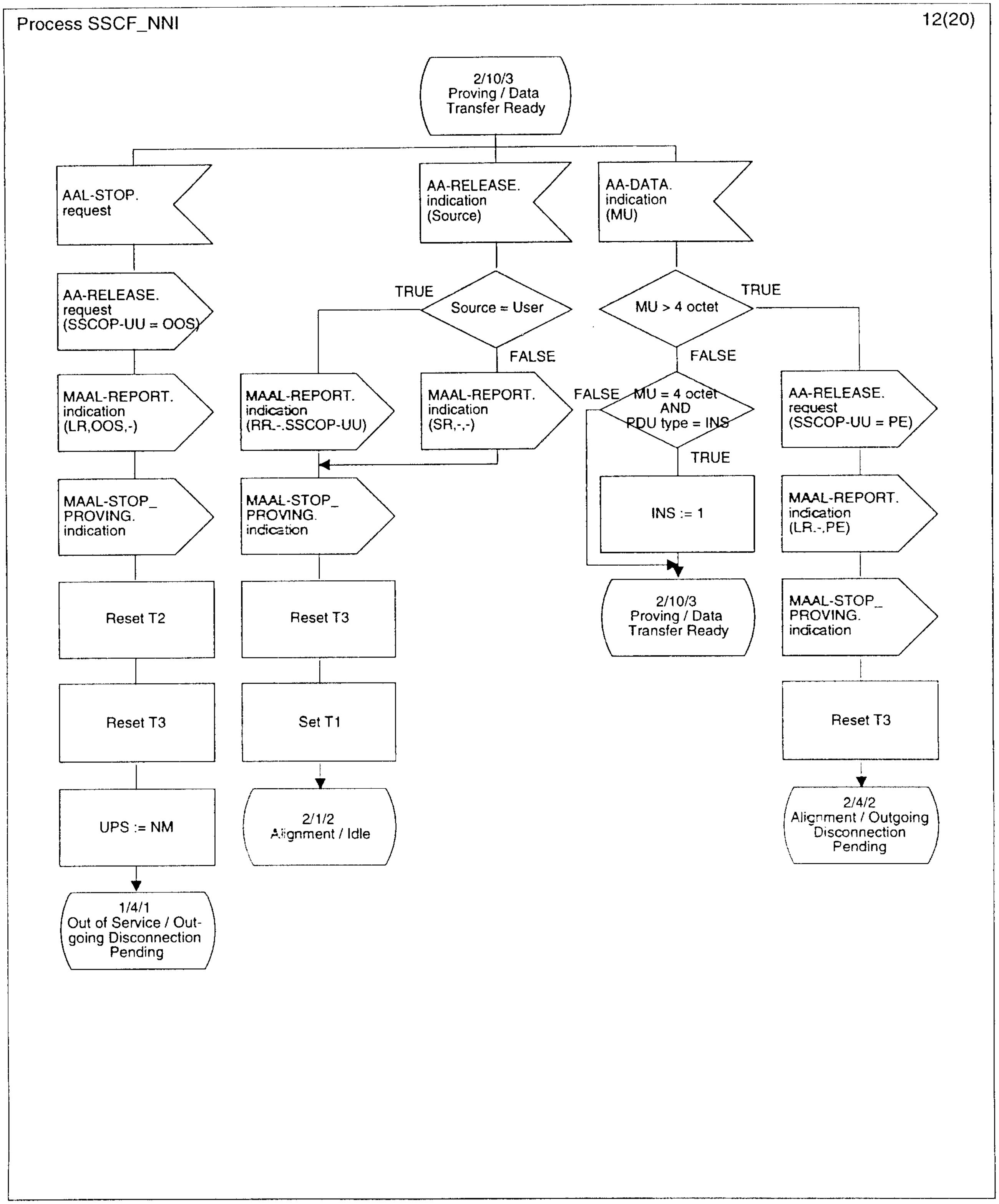


Figure D.2 – Process SSCF_NNI SDL diagram (Part 12 of 20)

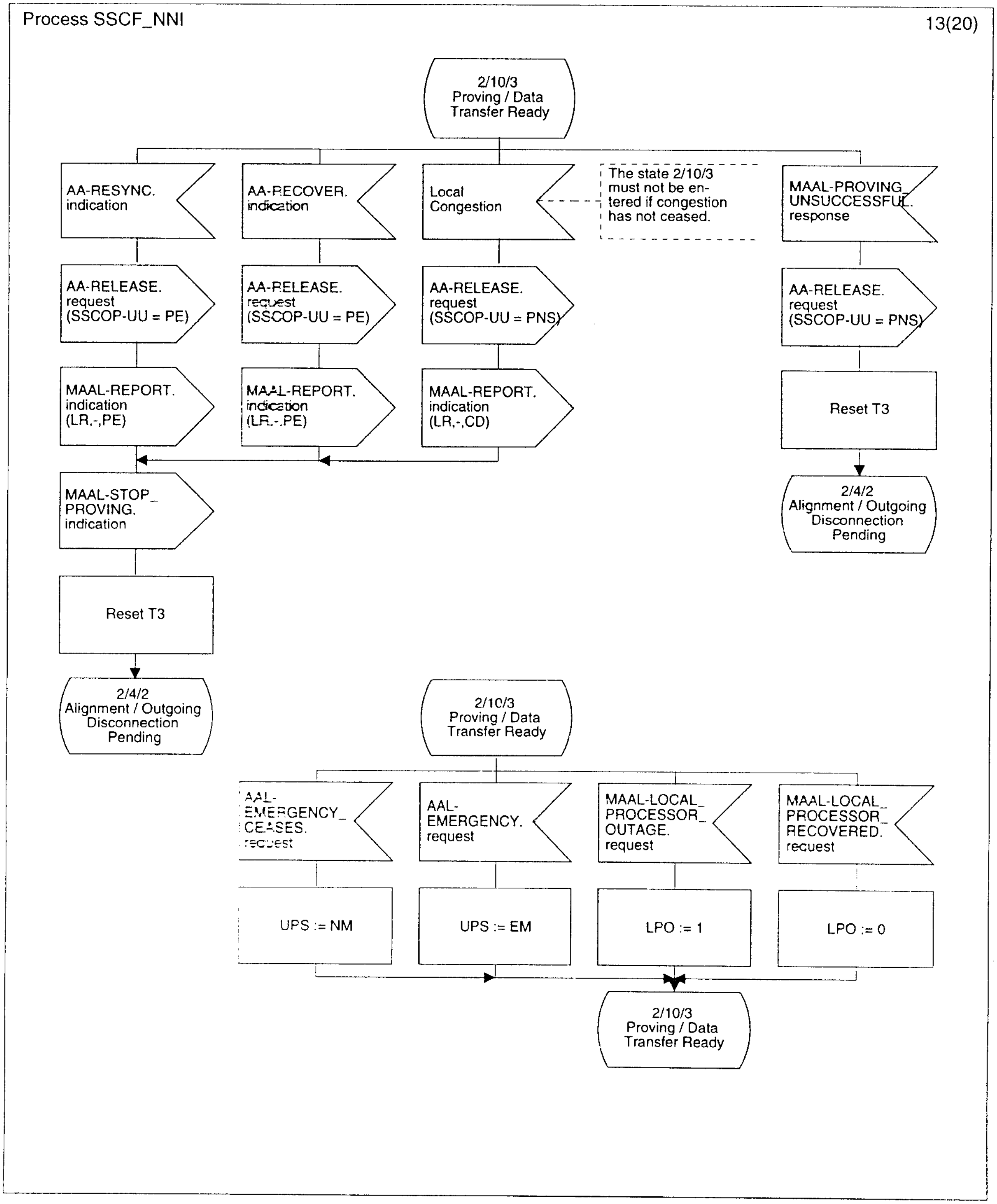


Figure D.2 – Process SSCF_NNI SDL diagram (Part 13 of 20)

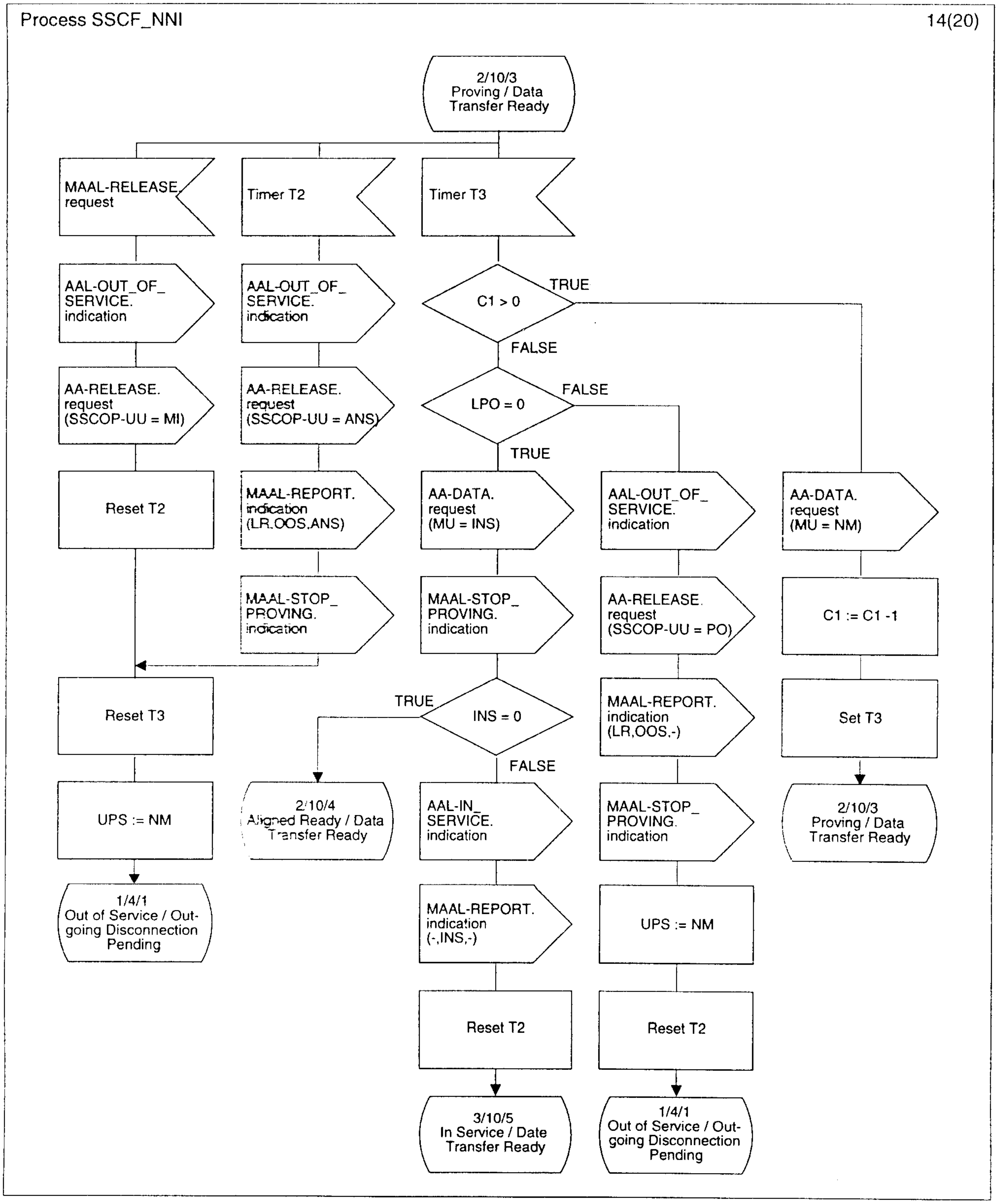


Figure D.2 – Process SSCF_NNI SDL diagram (Part 14 of 20)

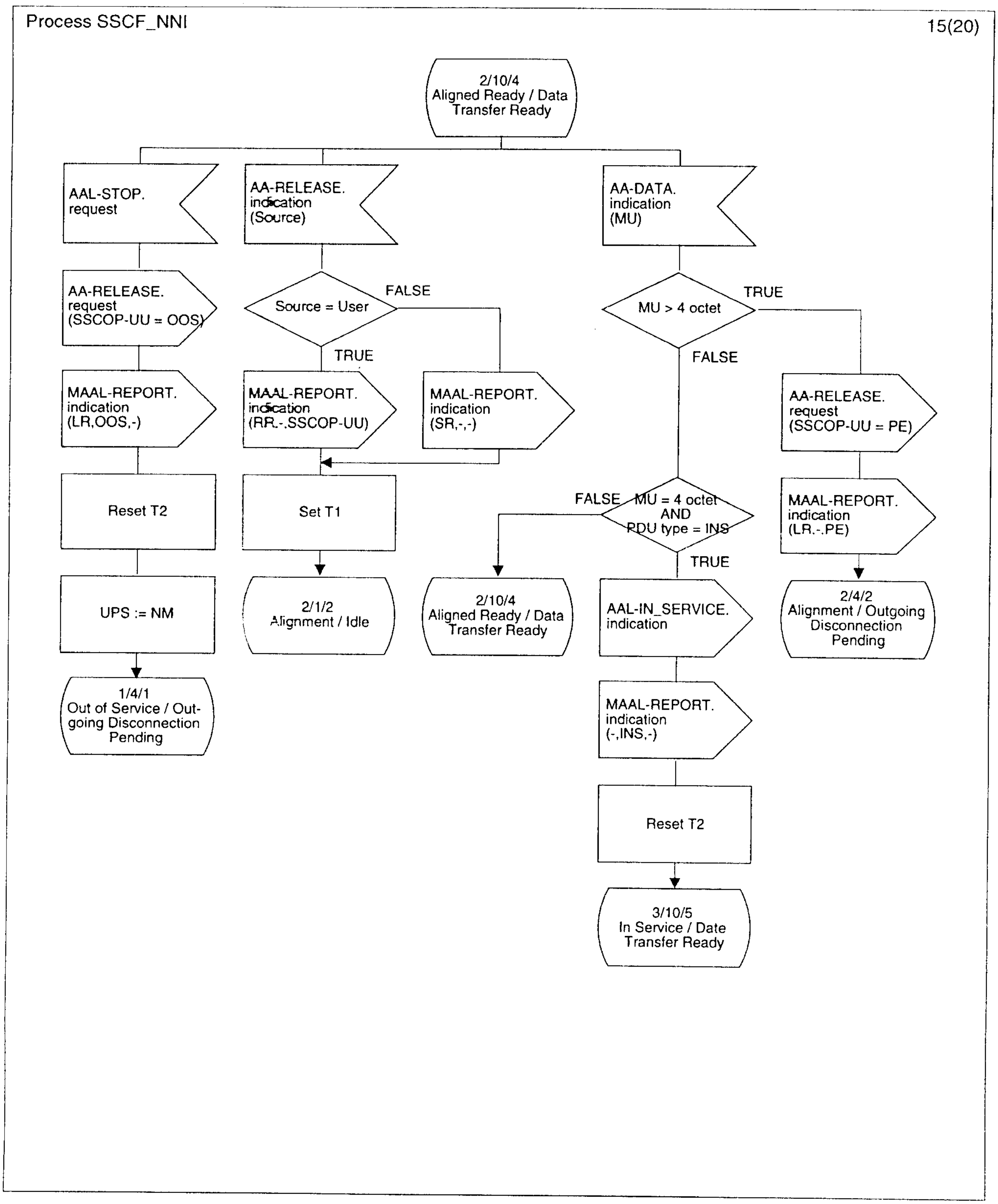


Figure D.2 – Process SSCF_NNI SDL diagram (Part 15 of 20)

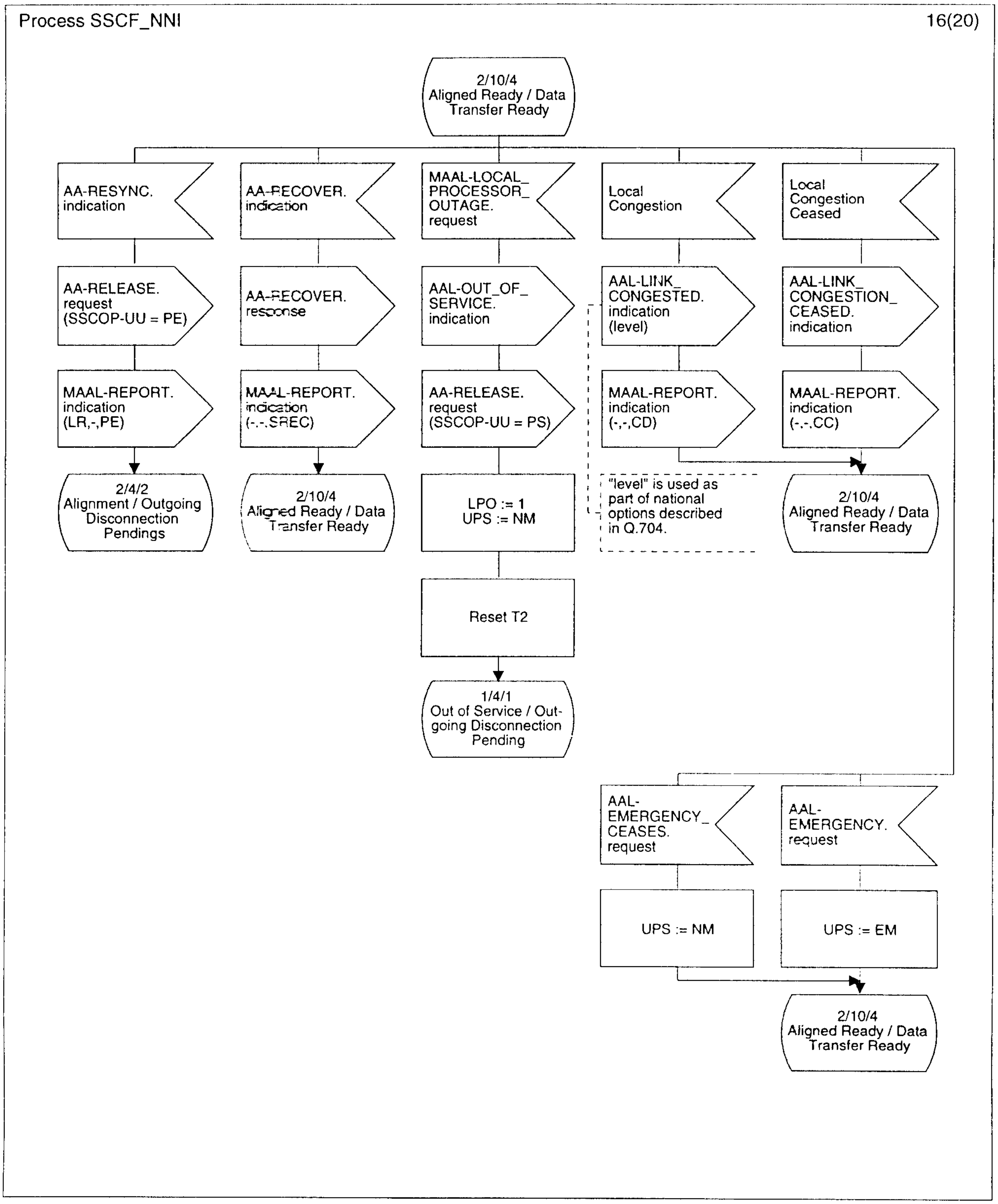


Figure D.2 – Process SSCF_NNI SDL diagram (Part 16 of 20)

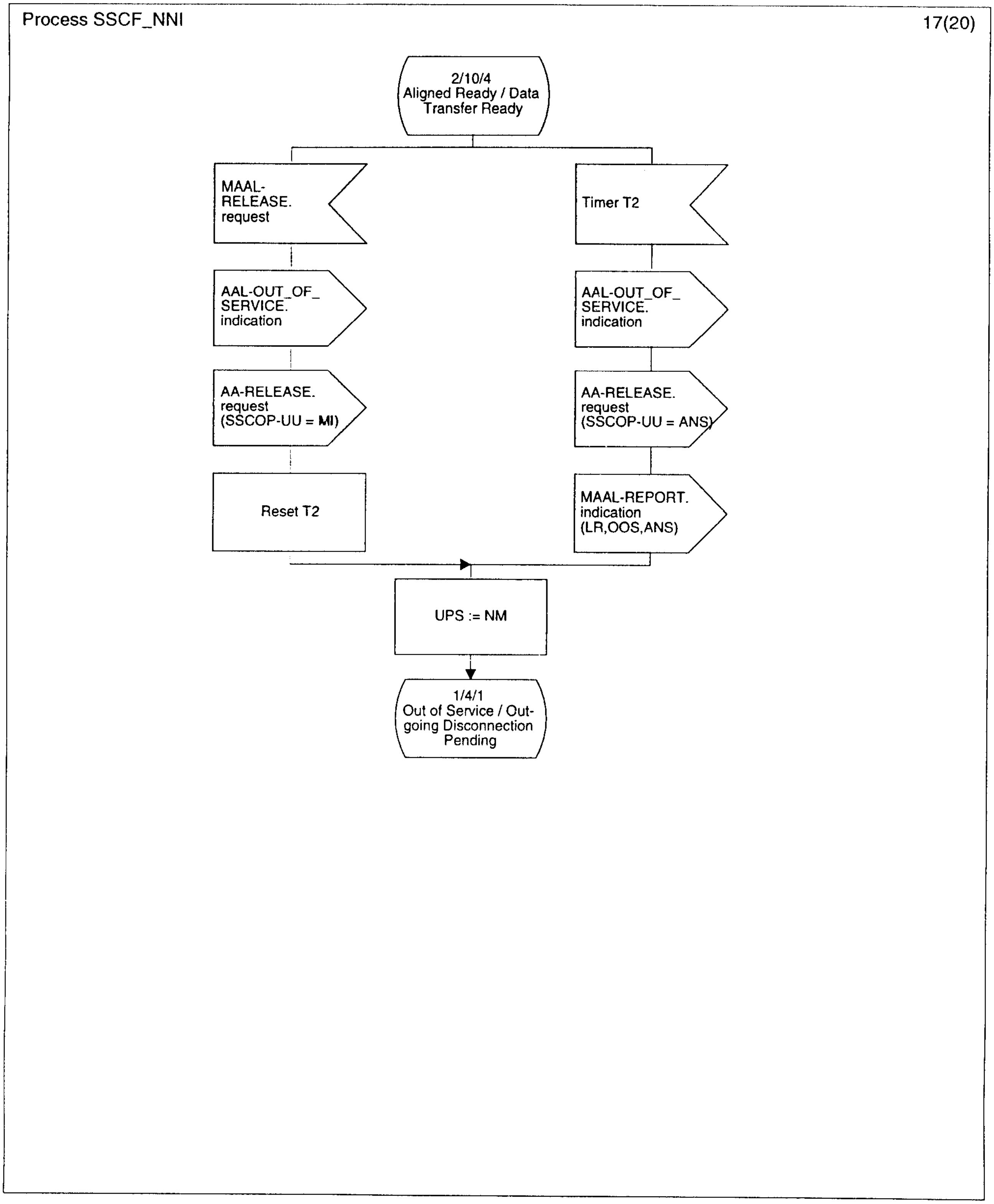


Figure D.2 – Process SSCF_NNI SDL diagram (Part 17 of 20)

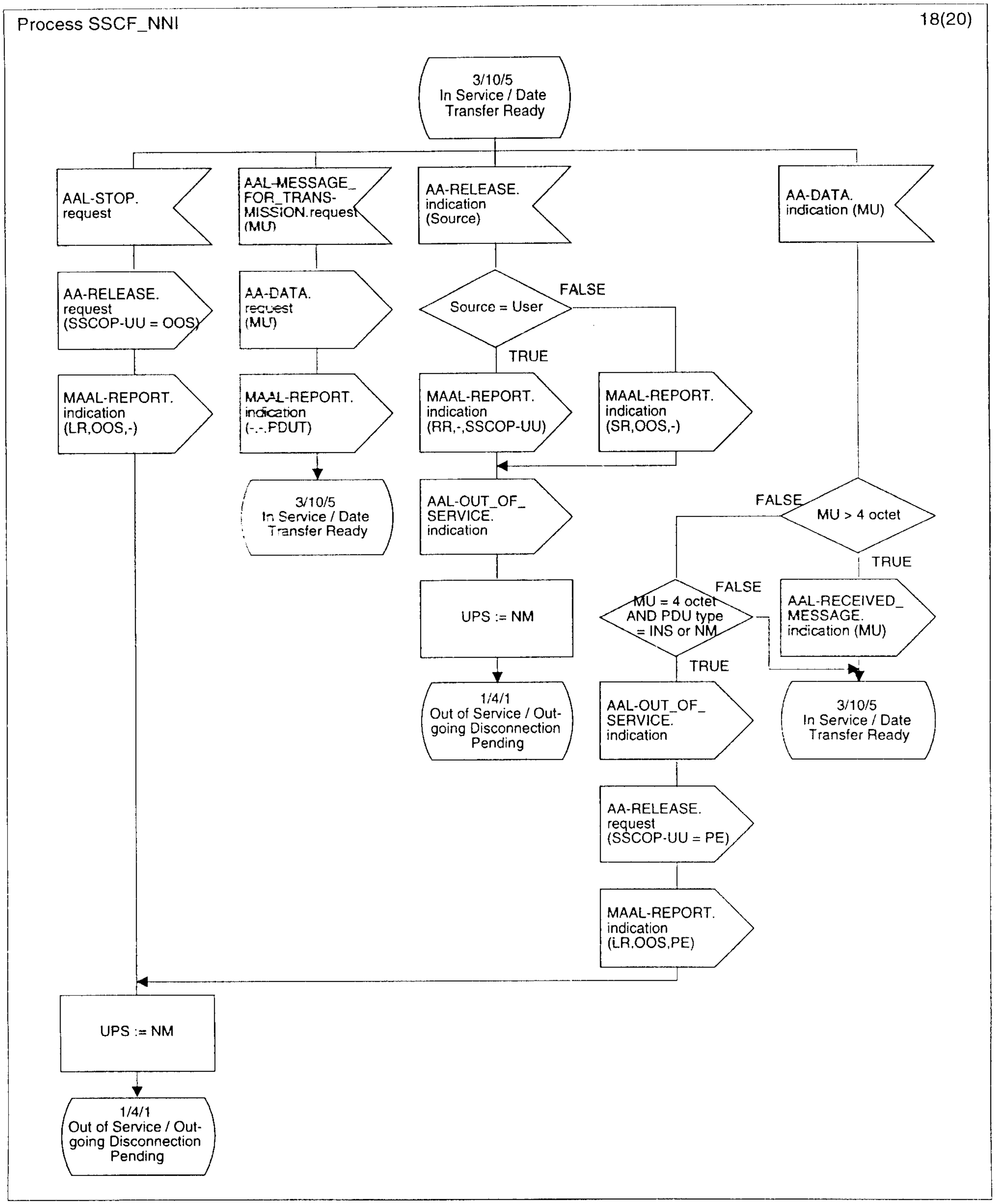


Figure D.2 – Process SSCF_NNI SDL diagram (Part 18 of 20)

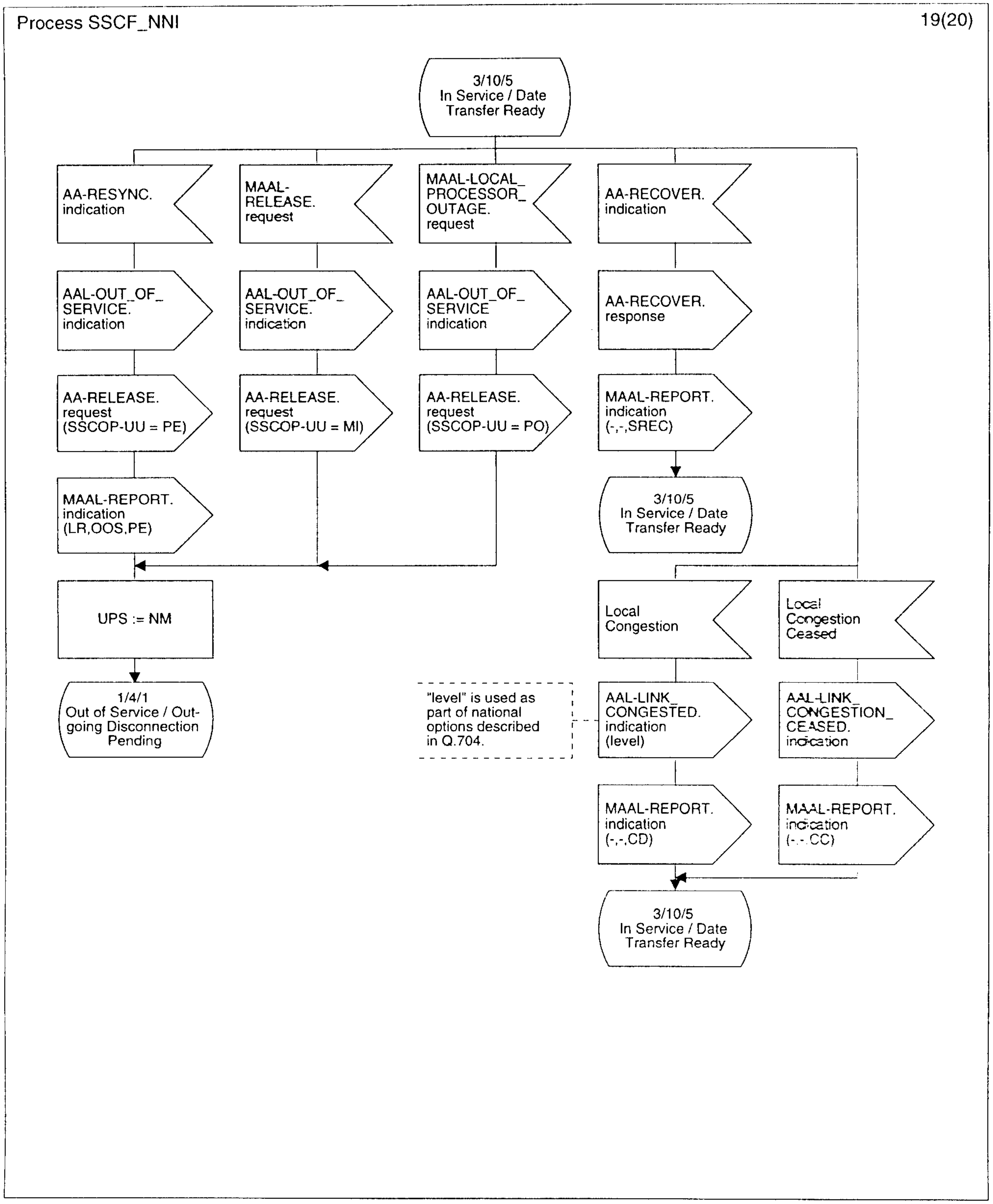


Figure D.2 – Process SSCF_NNI SDL diagram (Part 19 of 20)

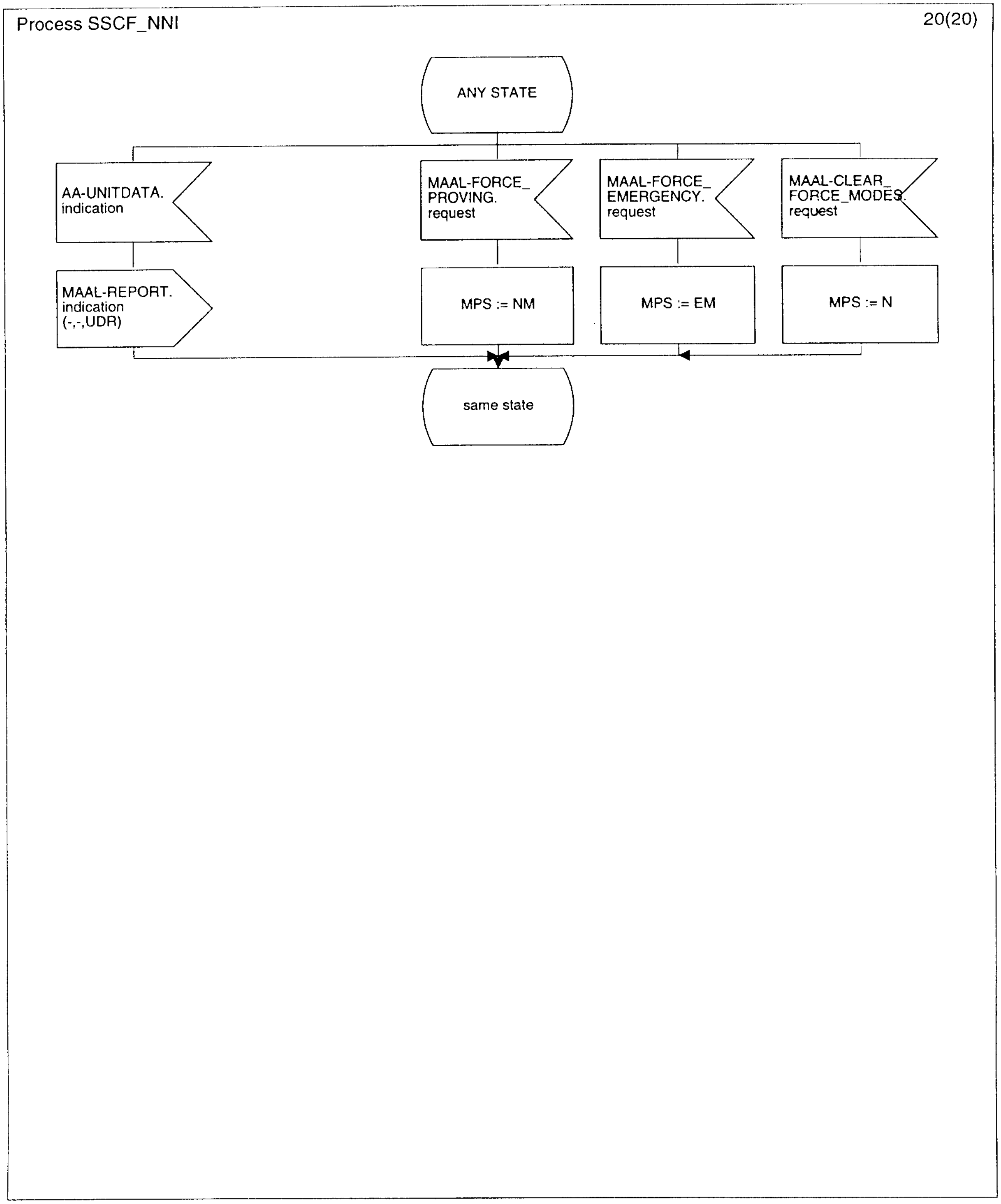


Figure D.2 – Process SSCF_NNI SDL diagram (Part 20 of 20)

Annex E
(informative)

Differences between this standard and ITU-T Recommendation Q.2140

Certain aspects of Signaling System No. 7 are unique to North America. This annex identifies specific differences between this standard and ITU-T Recommendation Q.2140.

a) *Clause 2 and throughout the document:* The references to all ITU-T Recommendations for which an American National Standard exists on the same topic have been replaced by references to the appropriate American National Standards.

b) *Subclauses 6.1.3 and 7.1, and clause 12:* The use of AAL-LINK_CONGESTED and AAL-LINK_CONGESTION_CEASED primitives is different. In North American networks, the AAL-LINK_CONGESTED primitive must indicate one of four levels of congestion, levels 0 through 3, with 0 meaning no congestion. The AAL-LINK_CONGESTION_CEASED primitive is not used. These differences are reflected in the text in 6.1.3, the notes to table 1 and table 2, and in clause 12, table 6 (note 3 to table 6, and the event “Local Congestion Ceased” which occurs while in state 3/10/5).

c) *Annex B:* The ANSI T1.111 routing label replaces the ITU-T Recommendation Q.704 routing label in figure B.3.

Annex F
(informative)

Bibliography

ITU-T Recommendation Q.704 (1993) – *Signalling System No. 7 – Signalling network functions and messages*[1)]

Draft ITU-T Recommendation Q.2140 – *B-ISDN ATM Adaptation Layer – Service Specific Coordination Function for Signaling at the Network Node Interface (SSCF at NNI)*[3)]

Draft ITU-T Recommendation Q.2144 – *B-ISDN ATM Adaptation Layer SSCS Layer Management at the NNI*[3)]

[3)] Contact the secretariat for more recent information on this document.