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B-ISDN ATM ADAPTATION LAYER

B-ISDN ATM ADAPTATION LAYER – SERVICE SPECIFIC COORDINATION FUNCTION FOR SIGNALLING AT THE NETWORK NODE INTERFACE (SSCF AT NNI)

ITU-T Recommendation Q.2140

(Previously “CCITT Recommendation”)

FOREWORD

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NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

SUMMARY

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 signalling AAL (SAAL) which comprises AAL functions necessary to support a signalling. The structure of the SAAL is defined in Recommendation Q.2100 [8].

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 CPCS is defined in clause 6/I.363 [5] and is used as the underlying protocol for the service specific part for signalling. 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 Recommendation Q.2110 [9] and is suitable for use by various SSCFs. This Recommendation specifies the SSCF for signalling at the Network Node Interface (NNI).

The SSCF at the NNI performs a coordination function between the service required by the signalling layer 3 user and the service provided by SSCOP. This Recommendation 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.

Keywords

ATM	Asynchronous Transfer Mode
AAL	ATM Adaptation Layer
B-ISDN	Broadband Integrated Services Digital Network
MTP	Message Transfer Part (of Signalling System No. 7)
NNI	Network Node Interface
SAAL	Signalling AAL
SSCF	Service Specific Coordination Function
SSCOP	Service Specific Connection Oriented Protocol

Recommendation Q.2140

B-ISDN ATM ADAPTATION LAYER – SERVICE SPECIFIC COORDINATION FUNCTION FOR SIGNALLING AT THE NETWORK NODE INTERFACE (SSCF AT NNI)

(Geneva, 1995)

1 Scope

This Recommendation specifies a function that is part of the ATM Adaptation Layer to support signalling (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 Recommendation Q.704 [6]. These requirements cover the needs for signalling between network nodes and networks. This function is called Service Specific Coordination Function (SSCF) for signalling at the NNI.

This Recommendation covers the specification of the SSCF identified in the complete AAL structure for signalling applications at the NNI defined in Recommendation Q.2100 [8], and describes the interactions with the level 3 protocol entity for network node signalling as defined in Recommendation Q.704 [6], layer management defined in Recommendation Q.2144 [7] and the Service Specific Connection Oriented Protocol defined in Q.2110 [9].

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

Although this Recommendation refers to MTP-3 [6] 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 Recommendation.

2 Normative References

The following Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: all users ot this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] CCITT Recommendation X.200 (1988), *Reference model of Open Systems Interconnection for CCITT applications*.

[2] CCITT Recommendation X.210 (1988), *Open Systems Interconnection layer service definition conventions*.

[3] ITU-T Recommendation I.361 (1993), *B-ISDN ATM layer specification*.

[4] ITU-T Recommendation I.150 (1993), *B-ISDN asynchronous transfer mode functional characteristics*.

[5] ITU-T Recommendation I.363 (1993), *B-ISDN ATM Adaptation Layer (AAL) specification*.

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

[7] ITU-T Recommendation Q.2144 (1995), *B-ISDN Signalling ATM adaptation layer – Layer management for the SAAL at the network mode interface*.

[8] ITU-T Recommendation Q.2100 (1994), *B-ISDN Signalling ATM Adaptation Layer (SAAL) overview description*.

[9] ITU-T Recommendation Q.2110 (1994), *B-ISDN ATM adaptation layer – Service Specific Connection Oriented Protocol (SSCOP)*.

[10] CCITT Recommendation X.290 (1992), *OSI conformance testing methodology and framework for protocol recommendations for CCITT applications – General concepts*.

3 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

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 Signalling System No. 7)
MU	Message Unit
NNI	Network Node Interface
OOS	Out Of Service
PDU	Protocol Data Unit
PDUT	PDU Transmitted
PE	Protocol Error
PNS	Proving Not Successful
PO	Processor Outage
RN	Retrieval Number
RR	Remote Release
SAAL	Signalling 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	Work Interface
UPS	User Proving State
UU	User to User
VCI	Virtual Channel Identifier

4 General

The Service Specific Coordination Function (SSCF) specified in this Recommendation in conjunction with the Service Specific Connection Oriented Protocol (SSCOP) specified in Recommendation Q.2110 [9] 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 requirements of the NNI level 3 protocol. In addition the SSCF at the NNI provides communication with Layer Management for proper operation of signalling links.

Figure 1/Q.2100 [8] illustrates the structure of the SAAL at the NNI. It comprises the SSCF at the NNI (this Recommendation), the SSCOP [9], the SSCS Layer Management [7], and the AAL type 5 common part (clause 6 of [5]). One user of this Recommendation is MTP level 3 [6]. This sub-layer (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 Recommendations X.200 [1] and X.210 [2] – 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 Recommendations I.150 [4] and I.361 [3]. Level 3 is defined in Recommendation Q.704 [6] 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 sub-layer in the protocol stack for the SAAL at the NNI. By construction, it utilizes the services of the underlying SAAL sub-layers, 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 signalling link functions for the transfer of signalling messages over one individual signalling data link. The SAAL functions provide a signalling link for reliable transfer of signalling messages between two signalling points.

A signalling message delivered by the higher levels is transferred over the signalling link in variable length Protocol Data Units (PDUs). For proper operation of the signalling link, the PDU comprises transfer control information in addition to the information content of the signalling 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 signalling 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) Signalling link error monitoring

Two signalling link error monitoring functions are provided: one that is employed while a signalling 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 signalling 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 (clause 12) 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 and signals 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 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 [6]. 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. This is indicated to the SAAL user via the primitives AAL-LINK_CONGESTED-indication and AAL-LINK_CONGESTION_CEASED-indication. Some guidelines for determining of congestion are given in 3.8/Q.704 [6].

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 sub-layer unless it is assured that the admission policy limitations of the lower sub-layer will not be exceeded. The actual method of congestion control is implementation dependent. For example, the interface between sub-layers could be modelled as a finite length queue to accomplish this control. The SAAL can thus regulate its flow of PDUs to the lower sub-layers 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 PDUs 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 PDU's 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 subsequent clauses).

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 signalling 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.

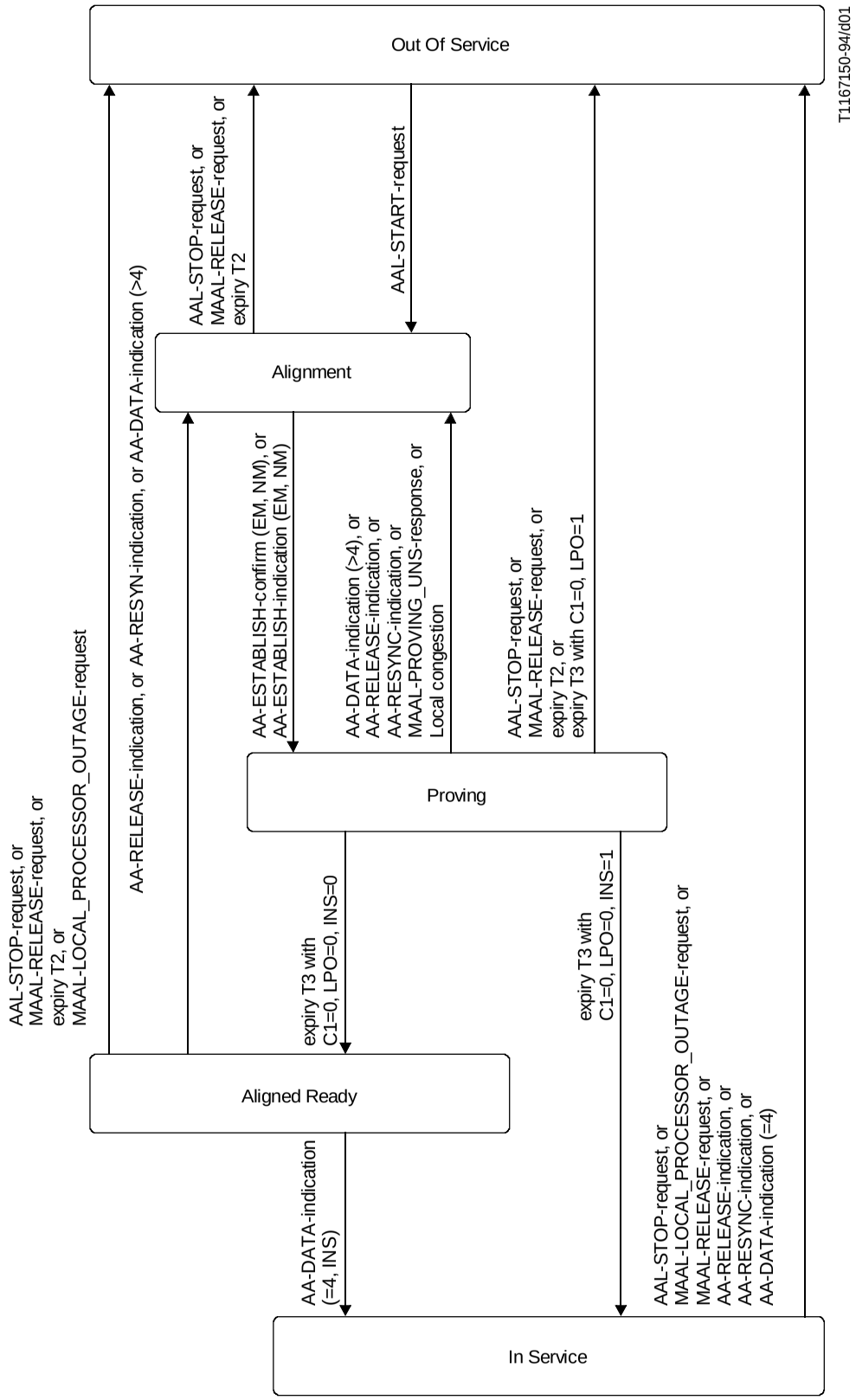


FIGURE 1/Q.2140

Overview of the alignment procedure

6.3 Signalling protocol stack for NNI

Figure 2 relates AAL information flows to the point-to-point signalling 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 "neighbours".

The properties of Figure 2 are:

1) For support of signalling there is a one-to-one correspondence between a connection endpoint within the AAL-SAP and a connection endpoint within the ATM-SAP.

2) 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).

3) 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.

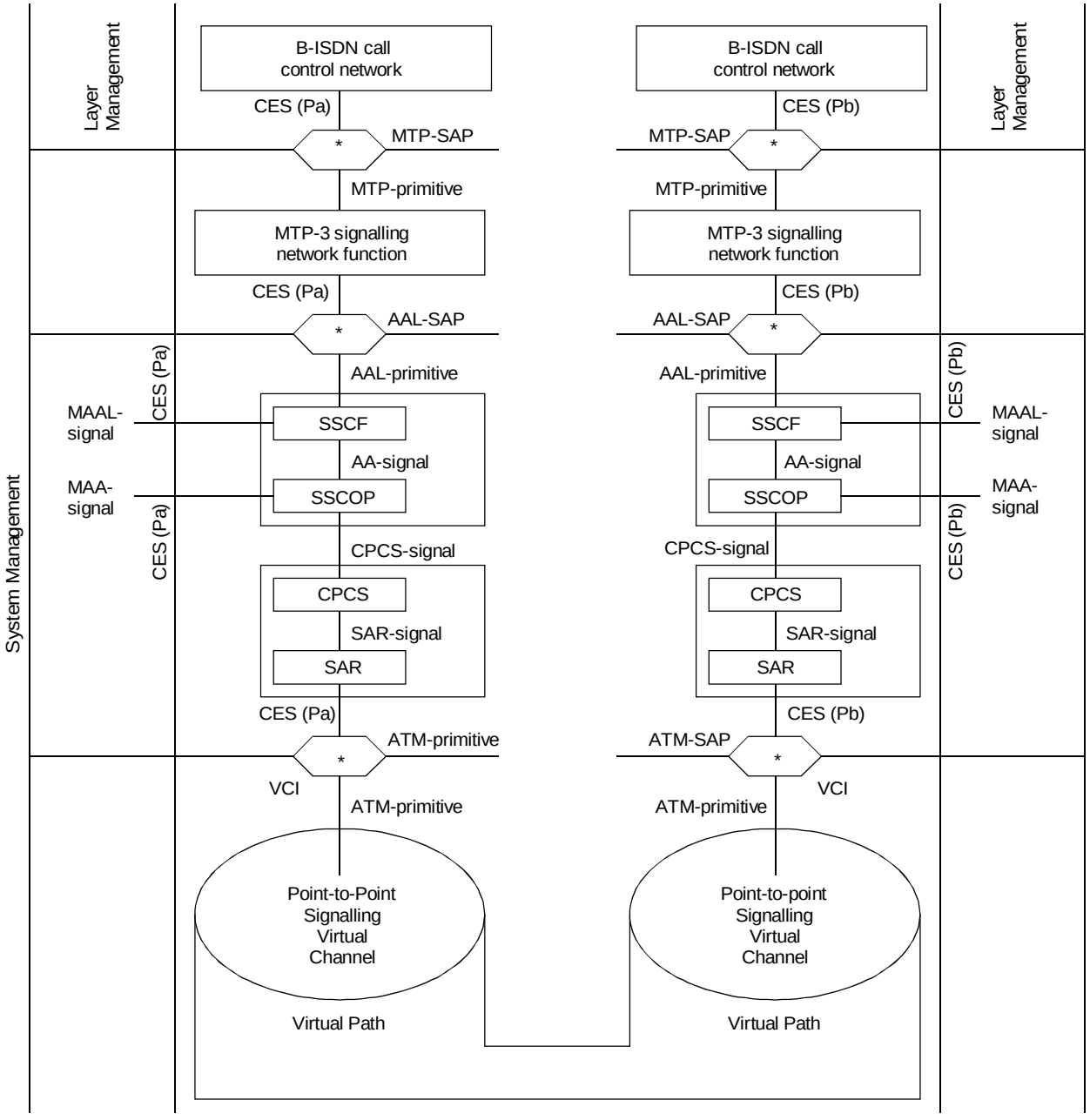


FIGURE 2/Q.2140

Signalling protocol stack for NNI

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

7.1 Primitives

The 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/Q.2140

Primitives between SAAL and MTP 3

Generic name	Type				Parameters				Message unit contents
	Re-quest	Indica-tion	Re-sponse	Confirm	Message unit	FSNC	BSNT	Congestion parameter	
AAL-MESSAGE_FOR_ TRANS-MISSION	X				X				L3 peer-peer message
AAL-RECEIVED_ MESSAGE		X			X				L3 peer-peer message
AAL-LINK_CONGESTED		X						X (Note 1)	
AAL-LINK_CONGES-TION_CEASED (Note 2)		X							
AAL-EMERGENCY	X								
AAL-EMER-GENCY_ 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 (Note 3)	X								
AAL-CONTINUE (Note 3)	X								
AAL-BSNT_ NOT_ RE-TRIEVABLE				X					

NOTES

1 For national options see Recommendation Q.704 [6].

2 Not applicable for all national options, see Recommendation Q.704 [6].

3 If these primitives occur they must be ignored.

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

TABLE 2/Q.2140

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 cannot be retrieved

7.2 State transition diagram

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

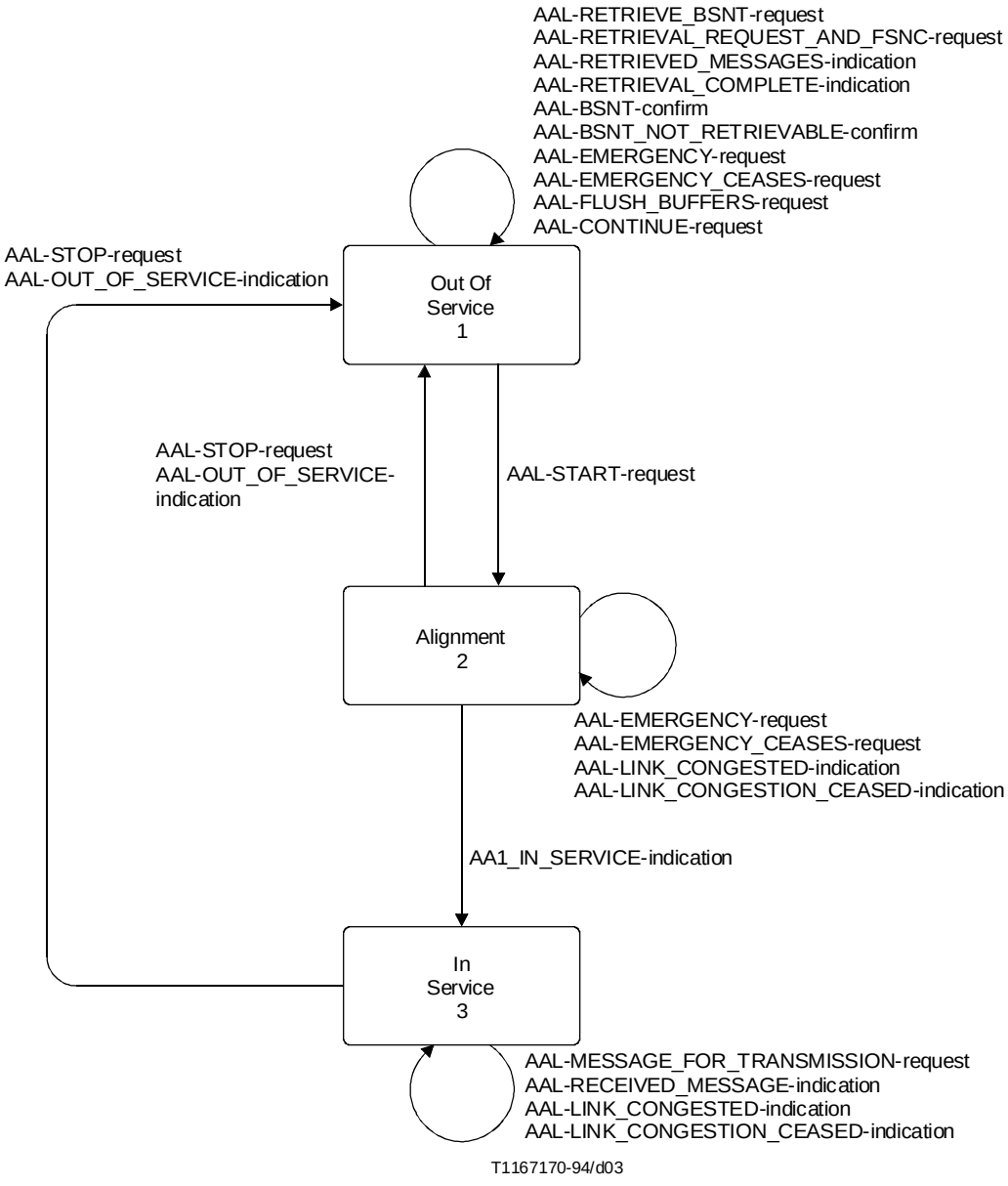


FIGURE 3/Q.2140

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/Q.2140

Signals with allowed parameters between SSCF and SSCOP at the NNI

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 (–)
Resynchronization (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 (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 SDUs 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 SDUs between peer user entities. This service is not supported at the NNI.

g) AA-RETRIEVE signals are used to retrieve SDUs 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 Recommendation Q.2110 [9]; if there is any difference between the two definitions, the one in Recommendation Q.2110 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

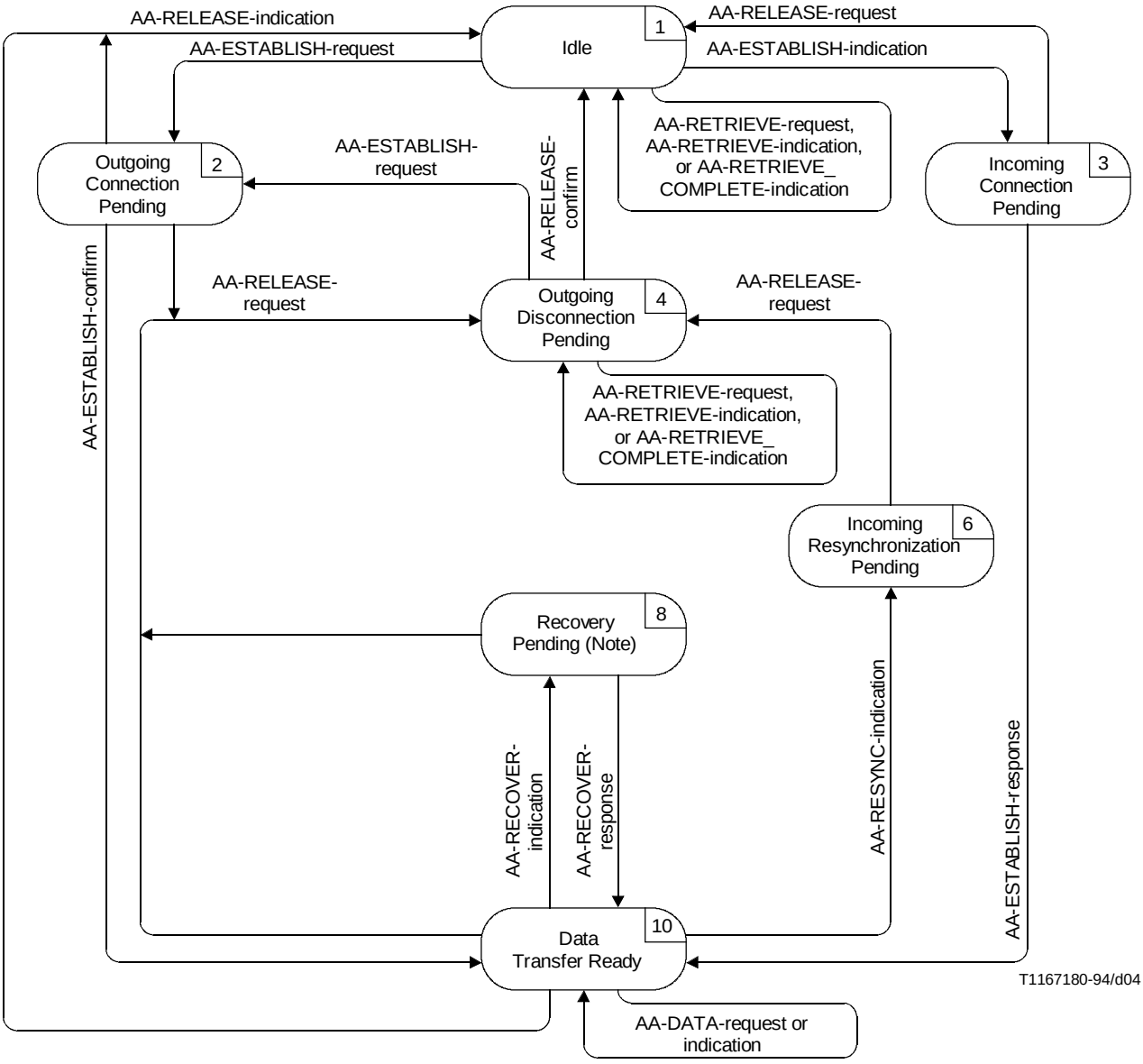
The possible overall sequences of signals between SSCF and SSCOP in relation to a specific connection are defined in the state transition diagram, Figure 4. In the diagram:

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

b) any other signal which 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/Q.2140

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/Q.2140

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.

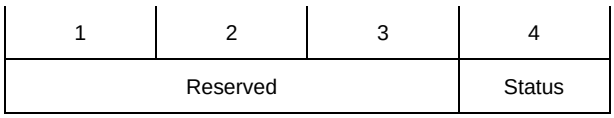


FIGURE 5/Q.2140

Format of NNI SSCF PDU

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

11 Default parameters and timers

This clause defines the default SSCOP parameters that are used to support signalling. Table 5 summarises the default protocol parameters. The values are based on a signalling virtual connection operating at 64 kbits/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, round-trip delay, and the size of the re-sequencing 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 signalling 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 parameters 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 Recommendation.

12 State transition table of 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 which 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 sub-layer, 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). 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/Q.2110 [9] 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.

TABLE 5/Q.2140

Default values of parameters and timers

Parameter or timer	Default value
SSCOP parameter and timers	
k	4096 octets
j	4 octet
MaxCC	4
MaxPD	500
Timer_CC	200 milliseconds (Note 1)
Timer_KEEP-ALIVE	100 milliseconds (Note 3)
Timer_NO-RESPONSE	1.5 seconds (Note 2)
Timer_POLL	100 milliseconds (Note 3)
Timer_IDLE	100 milliseconds
SSCF parameter and timers	
Timer T1	5 seconds
Timer T2	30 seconds
Timer T3	Such that loading of the signalling 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 be 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 expiries shall occur within a nominal tolerance of the stated value.	

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 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 signalling connection is in service and may be used by the user to transfer signalling 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 signalling link can be put into service.

Figure III.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:

1) 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.

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

3) Primitives received from MTP-3 and signals received from SSCOP that are listed as “Illegal” cannot 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.

4) 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.

TABLE 6/Q.2140

State transition table for 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} (Note 2) MAAL-REPORT-indication {-,ALN,-} Set T2 2/2/2	AA-ESTABLISH-request {SSCOP-UU := NM or EM, BR := No} (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} (Note 4) else AAL-BSNT_NOT_RETRIEVABLE-confirm 1/1/1	IF BSNT available then AAL-BSNT-confirm {Parameter Data := BSNT} (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

TABLE 6/Q.2140 *(continuation)*

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
AA-ESTABLISH-indication with SSCOP-UU = EM, NM	IF (LPO = 0) then AA-RELEASE-request {SSCOP-UU := OOS} else AA-RELEASE-request {SSCOP-UU := PO} 1/1/1	Illegal	AA-ESTABLISH-response {SSCOP-UU := NM or EM, BR := No} (Note 2) MAAL-PROVING-indication Reset T1 (Note 1) Generate N1 Set C1 = N1 Set T3, Reset INS flag 2/10/3	Illegal
AA-ESTABLISH-indication with SSCOP-UU = others	IF (LPO = 0) then AA-RELEASE-request {SSCOP-UU := OOS} else AA-RELEASE-request {SSCOP-UU := PO} 1/1/1	Illegal	AA-RELEASE-request {SSCOP-UU := PE} MAAL-REPORT-indication {LR,-,PE} 2/1/2	Illegal
AA-ESTABLISH-confirm with SSCOP-UU = EM, NM	Illegal	Illegal	Illegal	MAAL-PROVING-indication Generate N1 Set C1 = N1 Set T3 (Note 1) Reset INS flag 2/10/3
AA-ESTABLISH-confirm with SSCOP-UU = others	Illegal	Illegal	Illegal	AA-RELEASE-request {SSCOP-UU := PE} MAAL-REPORT-indication {LR,-,PE} 2/4/2
AA-RELEASE-indication with Source = User	Illegal	Illegal	Illegal	MAAL-REPORT-indication {RR,-,SSCOP-UU} Set T1 2/1/2
AA-RELEASE-indication with Source = SSCOP	Illegal	Illegal	Illegal	MAAL-REPORT-indication {SR,-,-} Set T1 2/1/2
AA-RELEASE-confirm	Illegal	1/1/1	Illegal	Illegal
AA-DATA-indication with MU > 4 octets	Illegal	Illegal	Illegal	Illegal
AA-DATA-indication with MU = 4 octets and PDU type = INS	Illegal	Illegal	Illegal	Illegal

TABLE 6/Q.2140 *(continuation)*

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
AA-DATA-indication with MU = 4 octets and PDU type = NM	Illegal	Illegal	Illegal	Illegal
AA-DATA-indication with MU < 4 octets or (PDU type _ NM, or INS)	Illegal	Illegal	Illegal	Illegal
AA-RESYNC.-indication	Illegal	Illegal	Illegal	Illegal
AA-RECOVER-indication	Illegal	Illegal	Illegal	Illegal
AA-UNITDATA-indication	MAAL-REPORT-indication {-,-,UDR} 1/1/1	MAAL-REPORT-indication {-,-,UDR} 1/4/1	MAAL-REPORT-indication {-,-,UDR} 2/1/2	MAAL-REPORT-indication {-,-,UDR} 2/2/2
AA-RETRIEVE-indication	IF MU > 4 octets then AAL-RETRIEVED_ MESSAGES-indication {Parameter Data := MU} else Discard MU 1/1/1	IF MU > 4 octets then AAL-RETRIEVED_ MESSAGES-indication {Parameter Data := MU} else Discard MU 1/4/1	Illegal	Illegal
AA-RETRIEVE_ COMPLETE-indication	AAL-RETRIEVAL_ COMPLETE-indication 1/1/1	AAL-RETRIEVAL_ COMPLETE-indication 1/4/1	Illegal	Illegal
MAAL-PROVING_ UNSUCCESSFUL-response	Illegal	Illegal	Illegal	Illegal
MAAL-RELEASE-request	1/1/1	1/4/1	AAL-OUT_OF_ SERVICE-indication Reset T1, T2 Set UPS = NM 1/1/1	AA-RELEASE-request {SSCOP-UU := MI} AAL-OUT_OF_SERVICE-indication Reset T2 Set UPS = NM 1/4/1
MAAL-LOCAL_ PROCESSOR_ OUTAGE-request	Set LPO = 1 1/1/1	Set LPO = 1 1/4/1	Set LPO = 1 2/1/2	Set LPO = 1 2/2/2

TABLE 6/Q.2140 *(continuation)*

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
MAAL-LOCAL_ PROCESSOR_ RECOVERED-request	Set LPO = 0 1/1/1	Set LPO = 0 1/4/1	Set LPO = 0 2/1/2	Set LPO = 0 2/2/2
MAAL-FORCE_ PROVING-request	Set MPS = NM 1/1/1	Set MPS = NM 1/4/1	Set MPS = NM 2/1/2	Set MPS = NM 2/2/2
MAAL-FORCE_ EMERGENCY-request	Set MPS = EM 1/1/1	Set MPS = EM 1/4/1	Set MPS = EM 2/1/2	Set MPS = EM 2/2/2
MAAL-CLEAR_FORCE_ MODES-request	Set MPS = N 1/1/1	Set MPS = N 1/4/1	Set MPS = N 2/1/2	Set MPS = N 2/2/2
Local Congestion (Note 5)	Implementation dependent (Note 6) 1/1/1	Implementation dependent (Note 6) 1/4/1	Implementation dependent (Note 6) 2/1/2	Implementation dependent (Note 6) 2/2/2
Local Congestion Ceased (Note 5)	Implementation dependent (Note 6) 1/1/1	Implementation dependent (Note 6) 1/4/1	Implementation dependent (Note 6) 2/1/2	Implementation dependent (Note 6) 2/2/2
T1 expires	Illegal	Illegal	AA-ESTABLISH-request {SSCOP-UU := NM or EM, BR := No} (Note 2) 2/2/2	Illegal
T2 expires	Illegal	Illegal	AAL-OUT_OF_ SERVICE-indication MAAL-REPORT-indication {LR,OOS,ANS} Reset T1 Set UPS = NM 1/1/1	AA-RELEASE-request {SSCOP-UU := ANS} AAL-OUT_OF_ SERVICE-indication MAAL-REPORT-indication {LR,OOS,ANS} Set UPS = NM 1/4/1
T3 expires and C1 > 0	Illegal	Illegal	Illegal	Illegal
T3 expires and C1 = 0	Illegal	Illegal	Illegal	Illegal
AAL-START-request	Illegal	Illegal	Illegal	Illegal

TABLE 6/Q.2140 *(continuation)*

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-STOP-request	MAAL-REPORT-indication {-,OOS,-} Reset T2 Set UPS = NM 1/4/1	AA-RELEASE-request {SSCOP-UU := OOS} MAAL-REPORT-indication {LR,OOS,-} Set UPS = NM 1/4/1	AA-RELEASE-request {SSCOP-UU := OOS} MAAL-REPORT-indication {LR,OOS,-} MAAL-STOP_PROVING-indication Reset T2,T3 Set UPS = NM 1/4/1	AA-RELEASE-request {SSCOP-UU := OOS} MAAL-REPORT-indication {LR,OOS,-} Reset T2 Set UPS = NM 1/4/1
AAL-EMERGENCY-request	Set UPS = EM 2/4/2	Illegal	Set UPS = EM 2/10/3	Set UPS = EM 2/10/4
AAL-EMERGENCY_CEASES-request	Set UPS = NM 2/4/2	Illegal	Set UPS = NM 2/10/3	Set UPS = NM 2/10/4
AAL-MESSAGE_FOR_TRANSMISSION-request	Illegal	AA-DATA-request {MU := Parameter Data} MAAL-REPORT-indication {-,-,PDUT} 3/10/5	Illegal	Illegal
AAL-RETRIEVE_BSNT-request	Illegal	Illegal	Illegal	Illegal
AAL-RETRIEVAL_REQUEST_AND_FSNC-request	Illegal	Illegal	Illegal	Illegal
AAL-FLUSH_BUFFERS-request	Illegal	Illegal	Illegal	Illegal
AAL-CONTINUE-request	Illegal	Illegal	Illegal	Illegal
AA-ESTABLISH-indication with SSCOP-UU = EM, NM	Illegal	Illegal	Illegal	Illegal
AA-ESTABLISH-indication with SSCOP-UU = others	Illegal	Illegal	Illegal	Illegal
AA-ESTABLISH-confirm with SSCOP-UU = EM, NM	Illegal	Illegal	Illegal	Illegal

TABLE 6/Q.2140 *(continuation)*

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
AA-ESTABLISH-confirm with SSCOP-UU = others	Illegal	Illegal	Illegal	Illegal
AA-RELEASE-indication with Source = User	Illegal	AAL-OUT_OF_SERVICE-indication MAAL-REPORT-indication {RR,-,SSCOP-UU} Set UPS = NM 1/1/1	MAAL-REPORT-indication {RR,-,SSCOP-UU} MAAL-STOP_PROVING-indication Set T1 Reset T3 2/1/2	MAAL-REPORT-indication {RR,-,SSCOP-UU} Set T1 2/1/2
AA-RELEASE-indication with Source = SSCOP	Illegal	AAL-OUT_OF_SERVICE-indication MAAL-REPORT-indication {SR,OOS,-} Set UPS = NM 1/1/1	MAAL-REPORT-indication {SR,-,-} MAAL-STOP_PROVING-indication Set T1 Reset T3 2/1/2	MAAL-REPORT-indication {SR,-,-} Set T1 2/1/2
AA-RELEASE-confirm	Set T1 2/1/2	Illegal	Illegal	Illegal
AA-DATA-indication with MU > 4 octets	Illegal	AAL-RECEIVED_MESSAGE-indication {Parameter Data := MU} 3/10/5	MAAL-REPORT-indication {LR,-,PE} AA-RELEASE-request {SSCOP-UU := PE} MAAL-STOP_PROVING-indication Reset T3 2/4/2	AA-RELEASE-request {SSCOP-UU := PE} MAAL-REPORT-indication {LR,-,PE} 2/4/2
AA-DATA-indication with MU = 4 octets and PDU type = INS	Illegal	AA-RELEASE-request {SSCOP-UU := PE} AAL-OUT_OF_SERVICE-indication MAAL-REPORT-indication {LR,OOS,PE} Set UPS = NM 1/4/1	Set INS flag 2/10/3	AAL-IN_SERVICE-indication MAAL-REPORT-indication {-,INS,-} Reset T2 3/10/5
AA-DATA-indication with MU = 4 octets and PDU type = NM	Illegal	AA-RELEASE-request {SSCOP-UU := PE} AAL-OUT_OF_SERVICE-indication MAAL-REPORT-indication {LR,OOS,PE} Set UPS = NM 1/4/1	2/10/3	2/10/4

TABLE 6/Q.2140 *(continuation)*

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
AA-DATA-indication with MU < 4 octets or (PDU type _ NM, or INS)	Illegal	3/10/5	2/10/3	2/10/4
AA-RESYNC.-indication	Illegal	AA-RELEASE-request {SSCOP-UU := PE} AAL-OUT_OF_ SERVICE-indication MAAL-REPORT-indication {LR,OOS,PE} Set UPS = NM 1/4/1	MAAL-REPORT-indication {LR,-,PE} AA-RELEASE-request {SSCOP-UU := PE} MAAL-STOP_ PROVING-indication Reset T3 2/4/2	MAAL-REPORT-indication {LR,-,PE} AA-RELEASE-request {SSCOP-UU := PE} 2/4/2
AA-RECOVER-indication	Illegal	AA-RECOVER-response {-} MAAL-REPORT-indication {-,-,SREC} 3/10/5	MAAL-REPORT-indication {LR,-,PE} AA-RELEASE. request {SSCOP-UU := PE} MAAL-STOP_ PROVING-indication Reset T3 2/4/2	AA-RECOVER-response {-} MAAL-REPORT-indication {-,-,SREC} 2/10/4
AA-UNITDATA-indication	MAAL-REPORT-indication {-,-,UDR} 2/4/2	MAAL-REPORT-indication {-,-,UDR} 3/10/5	MAAL-REPORT-indication {-,-,UDR} 2/10/3	MAAL-REPORT-indication {-,-,UDR} 2/10/4
AA-RETRIEVE-indication	Illegal	Illegal	Illegal	Illegal
AA-RETRIEVE_ COMPLETE-indication	Illegal	Illegal	Illegal	Illegal
MAAL-PROVING_ UNSUCCESSFUL-response	Illegal	Illegal	AA-RELEASE-request {SSCOP-UU := PNS} Reset T3 2/4/2	Illegal
MAAL-RELEASE-request	AAL-OUT_OF_ SERVICE-indication Reset T2 Set UPS = NM 1/4/1	AA-RELEASE-request {SSCOP UU := MI} AAL-OUT_OF_ SERVICE-indication Set UPS = NM 1/4/1	AA-RELEASE-request {SSCOP-UU := MI} AAL-OUT_OF_ SERVICE-indication Reset T2, T3 Set UPS = NM 1/4/1	AA-RELEASE-request {SSCOP-UU := MI} AAL-OUT_OF_ SERVICE-indication Reset T2 Set UPS = NM 1/4/1

TABLE 6/Q.2140 *(continuation)*

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
MAAL-LOCAL_ PROCESSOR_ OUTAGE-request	Set LPO = 1 2/4/2	Set LPO = 1 AA-RELEASE-request {SSCOP-UU := PO} AAL-OUT_OF_ SERVICE-indication Set UPS = NM 1/4/1	Set LPO = 1 2/10/3	Set LPO = 1 AA-RELEASE-request {SSCOP-UU := PS} AAL-OUT_OF_ SERVICE-indication Set UPS = NM Reset T2 1/4/1
MAAL-LOCAL_ PROCESSOR_ RECOVERED-request	Set LPO = 0 2/4/2	Illegal	Set LPO = 0 2/10/3	Illegal
MAAL-FORCE_ PROVING-request	Set MPS = NM 2/4/2	Set MPS = NM 3/10/5	Set MPS = NM 2/10/3	Set MPS = NM 2/10/4
MAAL-FORCE_ EMERGENCY-request	Set MPS = EM 2/4/2	Set MPS = EM 3/10/5	Set MPS = EM 2/10/3	Set MPS = EM 2/10/4
MAAL-CLEAR_ FORCE_MODES-request	Set MPS = N 2/4/2	Set MPS = N 3/10/5	Set MPS = N 2/10/3	Set MPS = N 2/10/4
Local Congestion (Note 5)	Implementation dependent (Note 6) 2/4/2	AAL-LINK_CONGESTED-indication {level} (Note 3) MAAL-REPORT-indication {-,-,CD} 3/10/5	AA-RELEASE-request {SSCOP-UU := PNS} MAAL-REPORT-indication {LR,-,CD} MAAL-STOP_ PROVING-indication Reset T3 2/4/2	AAL-LINK_CONGESTED-indication {level} (Note 3) MAAL-REPORT-indication {-,-,CD} 2/10/4
Local Congestion Ceased (Note 5)	MAAL-REPORT-indication {-,-,CC} 2/4/2	AAL-LINK_CONGESTION_ CEASED-indication MAAL-REPORT-indication {-,-,CC} 3/10/5	Illegal (Note 7)	AAL-LINK_ CONGESTION_ CEASED-indication MAAL-REPORT-indication {-,-,CC} 2/10/4
T1 expires	Illegal	Illegal	Illegal	Illegal
T2 expires	AAL-OUT_OF_ SERVICE-indication MAAL-REPORT-indication {-,OOS,ANS} Set UPS = NM 1/4/1	Illegal	MAAL-REPORT-indication {LR,OOS,ANS} MAAL-STOP_ PROVING-indication AAL-OUT_OF_ SERVICE-indication AA-RELEASE-request {SSCOP-UU := ANS} Reset T3 Set UPS = NM 1/4/1	MAAL-REPORT-indication {LR,OOS,ANS} AAL-OUT_OF_ SERVICE-indication AA-RELEASE-request {SSCOP-UU := ANS} Set UPS = NM 1/4/1

TABLE 6/Q.2140 *(end)*

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
T3 expires and C1 > 0	Illegal	Illegal	AA-DATA-request {MU := NM} Decrement C1 Set T3 2/10/3	Illegal

T3 expires and
C1 = 0
	Illegal	Illegal	If (LPO = 0 & INS flag = 0)
			then
			MAAL-STOP_ PROVING-indication
			AA-DATA-request
			{MU := INS}
			2/10/4
			
			If (LPO = 0 & INS flag = 1)
			then
			MAAL-STOP_ PROVING-indication
			AA-DATA-request
			{MU := INS}
			MAAL-REPORT-indication {-,INS,-}
			AAL-IN_SERVICE-indication
			Reset T2
			3/10/5
			
			If (LPO = 1)
			then
			AA-RELEASE-request
			{SSCOP-UU := PO}
			AAL-OUT_OF_ SERVICE-indication
			MAAL-REPORT-indication {LR,OOS,-}
			MAAL-STOP_ PROVING-indication
			Reset T2
			Set UPS = NM
			1/4/1
				Illegal

NOTES

1 The procedure for generating N1 is found in Table 7 below.

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

3 "level" is used as part of national options described in Q.704 [6].

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/Q.2140

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

Local Management_ 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/Q.2140

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

Local Management_ 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

Annex A

Protocol Implementation Conformance Statement (PICS) pro forma to Recommendation Q.2140[1)]

(This annex forms an integral part of this Recommendation)

A.1 General

The supplier of a protocol implementation claiming to conform to this Recommendation, 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 Signalling and the SSCOP implementation used to support it. Certain mandatory SSCOP functions are not necessary for support of NNI signalling, but may be needed to support other SSCFs. This PICS identifies such mandatory functions as optional for NNI signalling.

Subclause A.5 of this Recommendation covers the SSCOP Q.2110 Protocol Capabilities, Protocol Data Units, and System Parameters. Subclause A.6 covers the SSCOP Q.2110 and SSCF NNI Q.2140 Protocol Capabilities. In subclause A.6, the SSCOP messages and the primitives of the upper boundary of SSCF NNI are the capabilities highlighted.

A.2 Abbreviations and special symbols

For the purposes of this Recommendation, the following abbreviations are used:

CPE Customer Premises Equipment

IUT Implementation Under Test

The references noted in the reference column are from Recommendation Q.2110 [9], unless preceded by this Recommendation. Once this Recommendation appears in the referenced cell, all following references are from this Recommendation (i.e. Recommendation Q.2140).

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.

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1) Copyright release for PICS pro formas – Users of this Recommendation may freely reproduce the PICS pro forma in this annex, so that it may be used for its intended purpose and may further publish the completed PICS.

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 Recommendation. 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 section. However, the supplier may find it helpful to continue to complete the detailed tabulations in the sections which follow.

A.5 SSCOP – Recommendation Q.2110 [9]

A.5.1 Protocol Capabilities (PC) – SSCOP

Item No.	Protocol feature	Status	References	Support
PC1	Does the ITU support Keep Alive function?	M	Q.2110, 5 e)	Yes:_No:_X:_
PC2	Does the ITU support the Local Data Retrieve function?	M	Q.2110, 5 f)	Yes:_No:_X:_
PC3	Does the ITU support SSCOP initiated error recovery due to protocol error?	M	Q.2110, 5 i)	Yes:_No:_X:_
PC4	Does the ITU recognize the following Messages regardless of state? BGN BGAK BGREJ END ENDAK ER ERAK POLL STAT USTAT RS RSAK SD UD MD	 M M M M M M M M M M O O M O O	Table 2/Q.2110	 Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_ Yes:_No:_X:_
PC5.1	In the absence of protocol error, does the ITU support assured data transfer with sequence integrity?	M	Q.2110, 5 a) h); 7.1 j)	Yes:_No:_X:_
PC5.2	Does the ITU support the sending of the Unassured Data PDU?	O	Q.2110, 5 h); 7.1 n)	Yes:_No:_X:_
PC5.3	Does the ITU support the sending of the Management Data PDU?	O	Q.2110, 7.1 o)	Yes:_No:_X:_
PC6.1	Does the ITU permit the SSCF to invoke local user initiated resynchronization procedures?	O	Q.2110, 5 g); 8.1.3/Q.2110	Yes:_No:_X:_
PC6.2	Does the ITU support remote user initiated resynchronization procedures?	O	Q.2110, 5 g); 8.1.3/Q.2110	Yes:_No:_X:_

Item No.	Protocol feature	Status	References	Support
PC7	Does the ITU support the establishment procedures for an SSCOP connection?	M	Q.2110, 5 g)	Yes:_No:_X:_
PC8	Does the ITU support release procedures for an SSCOP connection?	M	Q.2110, 5 g)	Yes:_No:_X:_
PC9	Does the ITU support polling after retransmission?	M	Q.2110 SDL Figure 20 (sheet 38 of 51)	Yes:_No:_X:_
PC10	Does the ITU support the segmenting of STAT PDUs?	M	7.2.5/Q.2110	Yes:_No:_X:_
PC11	Can the ITU initiate SSCOP connection?	M	Q.2110, 5 g)	Yes:_No:_X:_
PC12	Can the ITU reject (BGREJ) the establishment of an SSCOP connection from its peer?	M	Q.2110 SDL Figure 20 (sheet 11 of 51)	Yes:_No:_X:_
PC13	Does the ITU support error reporting to layer management?	M	Q.2110, 5 d)	Yes:_No:_X:_
PC14	Does the ITU support the Protocol error detection function?	M	Q.2110, 5 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	Q.2110 SDL Figure 20 (sheets 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	Q.2110, 5 g); 6.1.2 b)/Q.2110	Yes:_No:_X:_

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

Item No.	Protocol feature	Status	References	Support
Order of octet transmission				
PD1	Ascending numerical order	M	7.2.1/Q.2110	Yes:_No:_X:_
Field Mapping Convention				
PD2	Lowest bit number = Lowest order value	M	7.2.1/Q.2110	Yes:_No:_X:_
PD3	Are PDU formats 32 bit aligned?	M	7.2/Q.2110	Yes:_No:_X:_
PD4	Are all reserved bits coded as zeros?	M	7.2.3/Q.2110	Yes:_No:_X:_

A.5.3 SSCOP System Parameters (SP)

Item No.	Protocol feature	Status	References	Support
SP1	Maximum number of transmissions of a BGN, END or RS PDU (MaxCC)	M	Q.2110, 7.7 a); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP2	Maximum number of SD PDUs before transmission of a POLL PDU (MaxPD)	M	Q.2110, 7.7 b); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP3	Maximum number of List Elements in a STAT (MaxSTAT)	M	Q.2110, 7.7 c)	Yes:_No:_X:_Value:_
SP4	Maximum PDU size	M	7.2.4/Q.2110	Yes:_No:_X:_Value:_
SP5	Timer_POLL	M	Q.2110, 7.6 a); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP6	Timer_KEEP-ALIVE	M	Q.2110, 7.6 b); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP7	Timer_NO-RESPONSE	M	Q.2110, 7.6 c); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP8	Timer_IDLE	M	Q.2110, 7.6 c); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP9	Timer_CC	M	Q.2110, 7.6 d); clause 11/Q.2140	Yes:_No:_X:_Value:_
SP10	What is the maximum size of the SSCOP-UU?	M	Q.2110, 6.1.2 b); 7.2.4/Q.2110; clause 11/Q.2140	Yes:_No:_X:_Value:_
SP11	Does the ITU support a SSCOP-UU length of at least four octets?	M	Q.2110, 6.1.2 b); 7.2.4/Q.2110; clause 11/Q.2140	Yes:_No:_X:_Value:_

A.6 SSCF at NNI – Recommendation Q.2140

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

This subclause asks questions of the combined SSCOP and SSCF functional block. This section 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 [9] in the PICS questions. These signals do not constrain an implementation.

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

Item No.	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 BGN PDU generate [AA-ESTABLISH-indication] AAL-IN_SERVICE-indication (after proving at SSCF) at U-NNI?	M	Clause 12/Q.2140, Table 6	Yes:_No:_X:_
SNPC2	In addition to SNPC1, does SSCOP send BGAK PDU to accept the connection request [AA-ESTABLISH-response]?	M	Clause 12/Q.2140, Table 6	Yes:_No:_X:_
SNPC3	If the ITU 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	Clause 12/Q.2140, 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 BGN PDU?	M	Clause 12/Q.2140, 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	Clause 12/Q.2140, 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 END PDU?	M	Clause 12/Q.2140, Table 6	Yes:_No:_X:_
SNPC6.1	Does the ITU permit the SSCF to invoke local user initiated resynchronization procedures?	P	Q.2110, 5 g); Table 6/Q.2140, 8.1.3/Q.2110	Yes:_No:_X:_

Item No.	Protocol feature	Status	References	Support
DATA TRANSFER				
SSCOP → → Upper boundary of SSCF NNI (U-NNI)				
SNPC7	If the ITU 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	Clause 12/Q.2140, Table 6	Yes:_No:_X:_
Upper boundary of SSCF NNI (U-NNI) → → SSCOP				
SNPC8	If the ITU 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	Clause 12/Q.2140, Table 6	Yes:_No:_X:_

A.6.2 SSCF at NNI System Parameters (SNSP)

Item No.	Protocol feature	Status	References	Support
SNSP1	Time between the link release action and the next link re-establish action during the alignment (T1)	M	Clause 11/Q.2140	Yes:_No:_X:_Value:_
SNSP2	Total time SSCF will attempt connection establishment (T2)	M	Clause 11/Q.2140	Yes:_No:_X:_Value:_
SNSP3	Time between proving PDUs (T3)	M	Clause 11/Q.2140	Yes:_No:_X:_Value:_
SNSP4	Number of SSCF PDUs send during proving period (n1)	M	Clause 11/Q.2140	Yes:_No:_X:_Value:_

Appendix I

Impacts of SAAL on MTP-3

(This appendix does not form an integral part of this Recommendation)

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

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

Figure I.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 Recommendations Q.703 and Q.704 [6] 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.

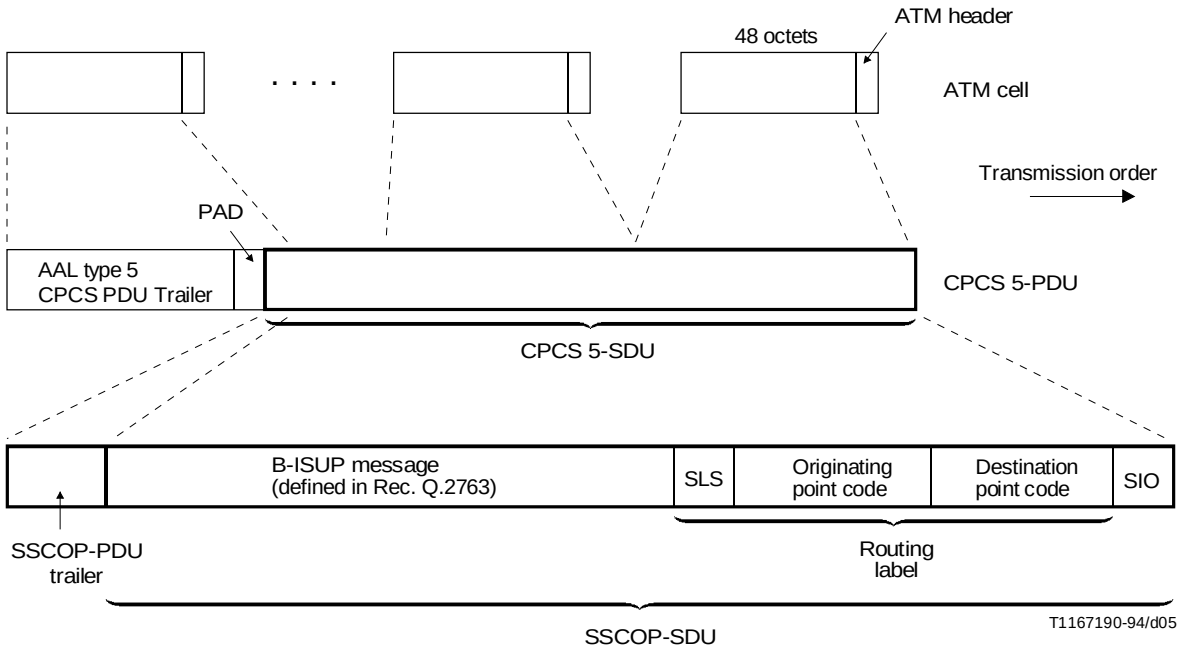

FIGURE I.1/Q.2140

Frame format of B-ISUP and MTP-3 over SAAL

I.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 I.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.

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

FIGURE I.2/Q.2140

Demonstration of transmission order

Figure I.3 is an example to illustrate the above coding conventions. It shows the standard routing label of the Q.704, which is part of an SAAL PDU.

8	7	6	5	4	3	2	1	Bit Octet
DPC.1							LSB	1
OPC.1 LSB		MSB		DPC.2				2
OPC.2								3
MSB	SLS		LSB	MSB		OPC.3		4

FIGURE I.3/Q.2140

Example of coding conventions

I.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.

I.4 Proving ends due to a processor outage condition

In the 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.

I.5 Automatic allocation of signalling data links

Procedures for automatic allocation of signalling data links in an ATM network require further study. At a minimum, the current Q.704 [6] 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 signalling.

Appendix II

Example time flow diagrams for connection establishment

(This appendix does not form an integral part of this Recommendation)

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. The MTP-3 and local Layer Management (LM) on a single end are shown on the same single line. (See Figures II.1 to II.3.)

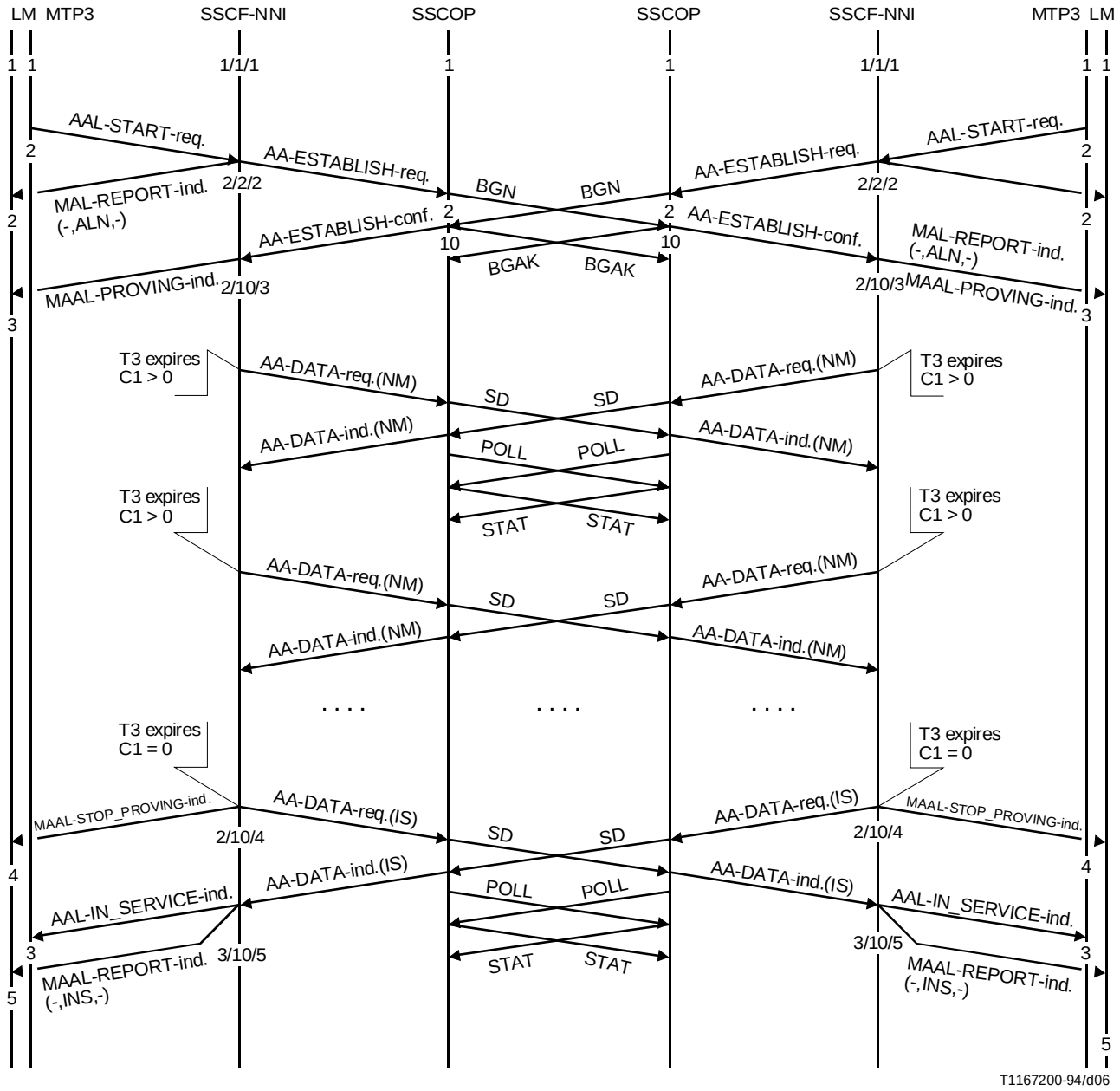

FIGURE II.1/Q.2140

Time flow diagram for connection establishment
Both UPS = Normal, Case 1

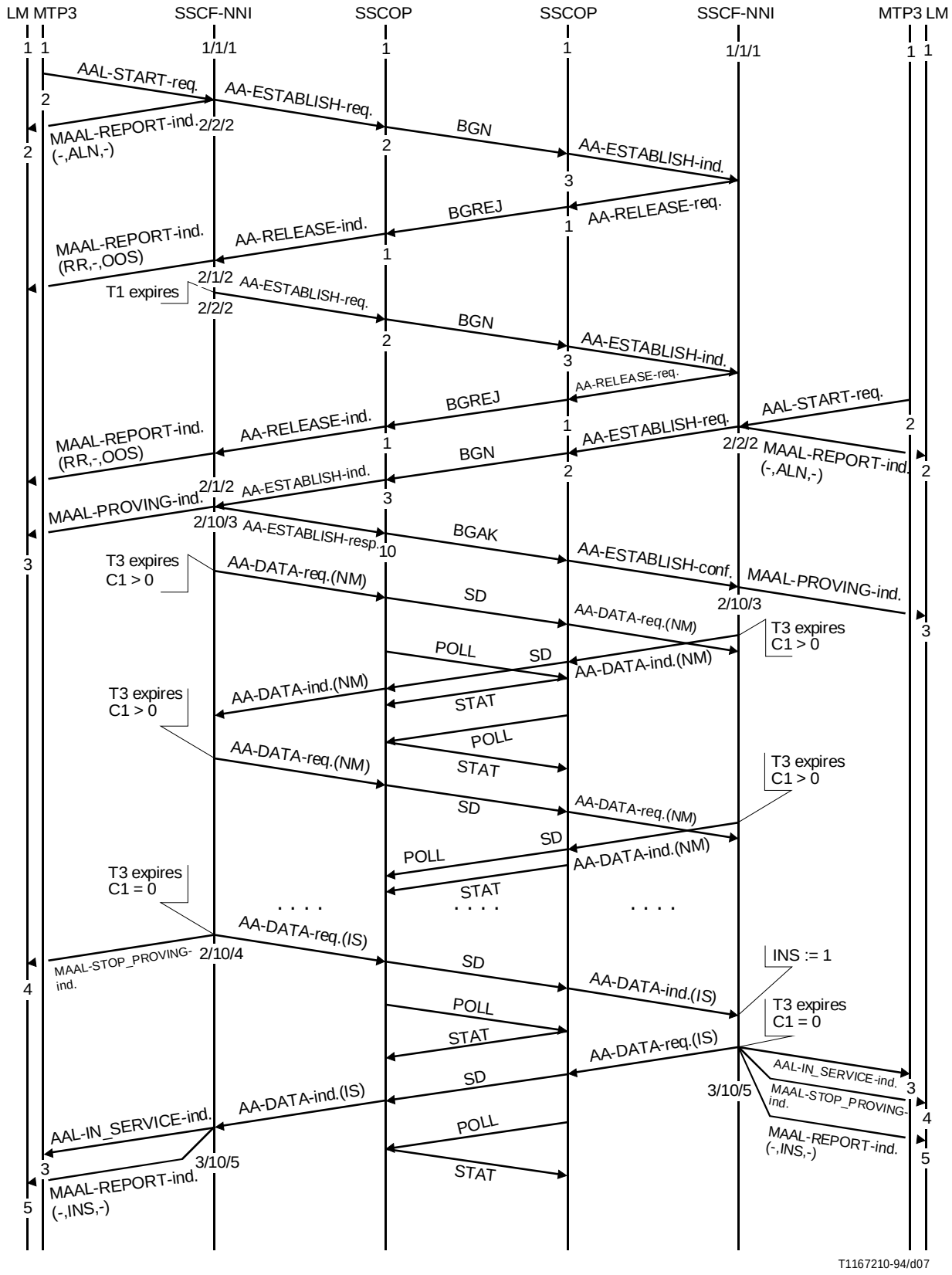

FIGURE II.2/Q.2140

Time flow diagram for connection establishment
Both UPS = Normal, Case 2

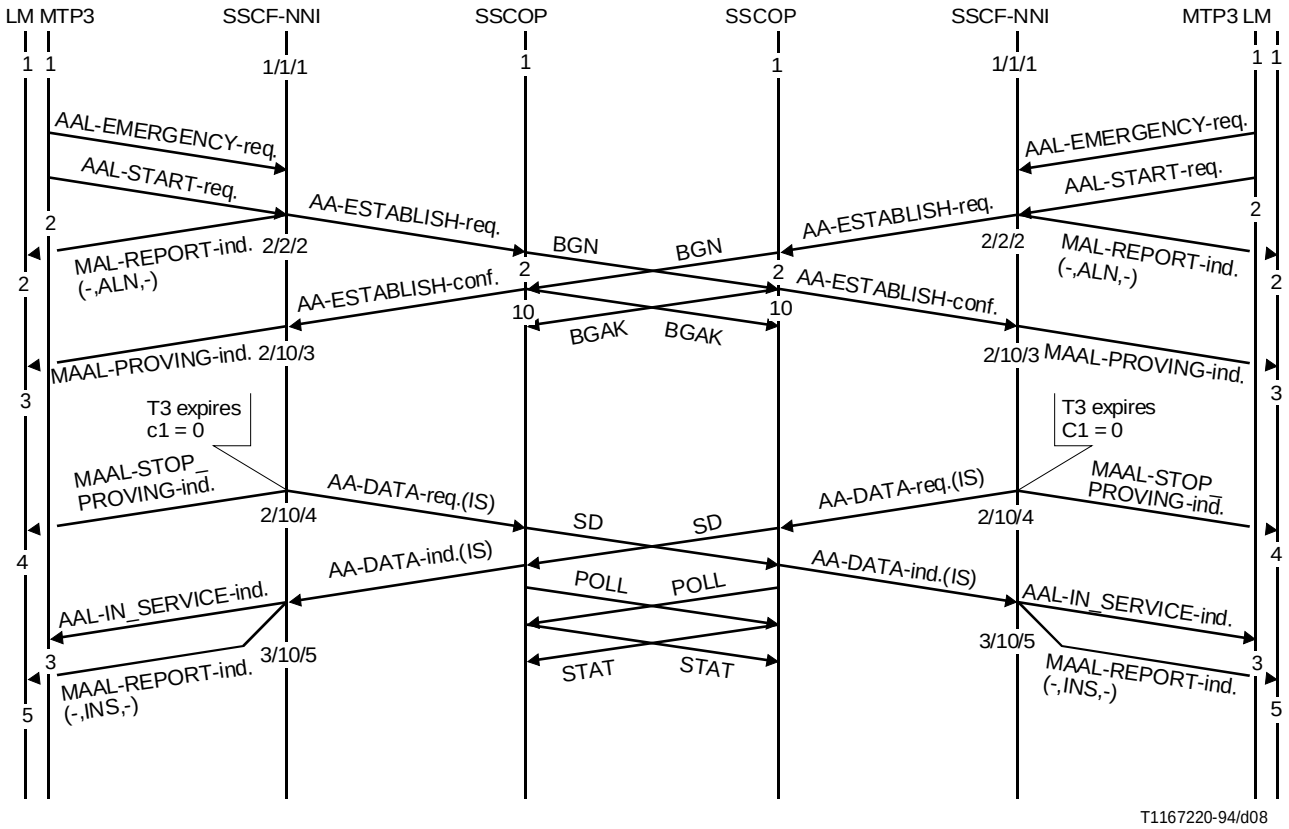

FIGURE II.3/Q.2140

Time flow diagram for connection establishment
Both UPS = Emergency, Case 1

Appendix III

SDL Diagrams for the SSCF at the NNI

(This appendix does not form an integral part of this Recommendation)

The purpose of this appendix is to provide one example of an SDL representation of the SSCF procedures, to assist in the understanding of this Recommendation. The SDL representation does not constrain implementations from exploiting the full potential inherent in this highly parallel and fast environment. If there is any difference from the state transition tables in clause 12 (see Table 6), Table 6 takes precedence. (See Figures III.1 and III.2.)

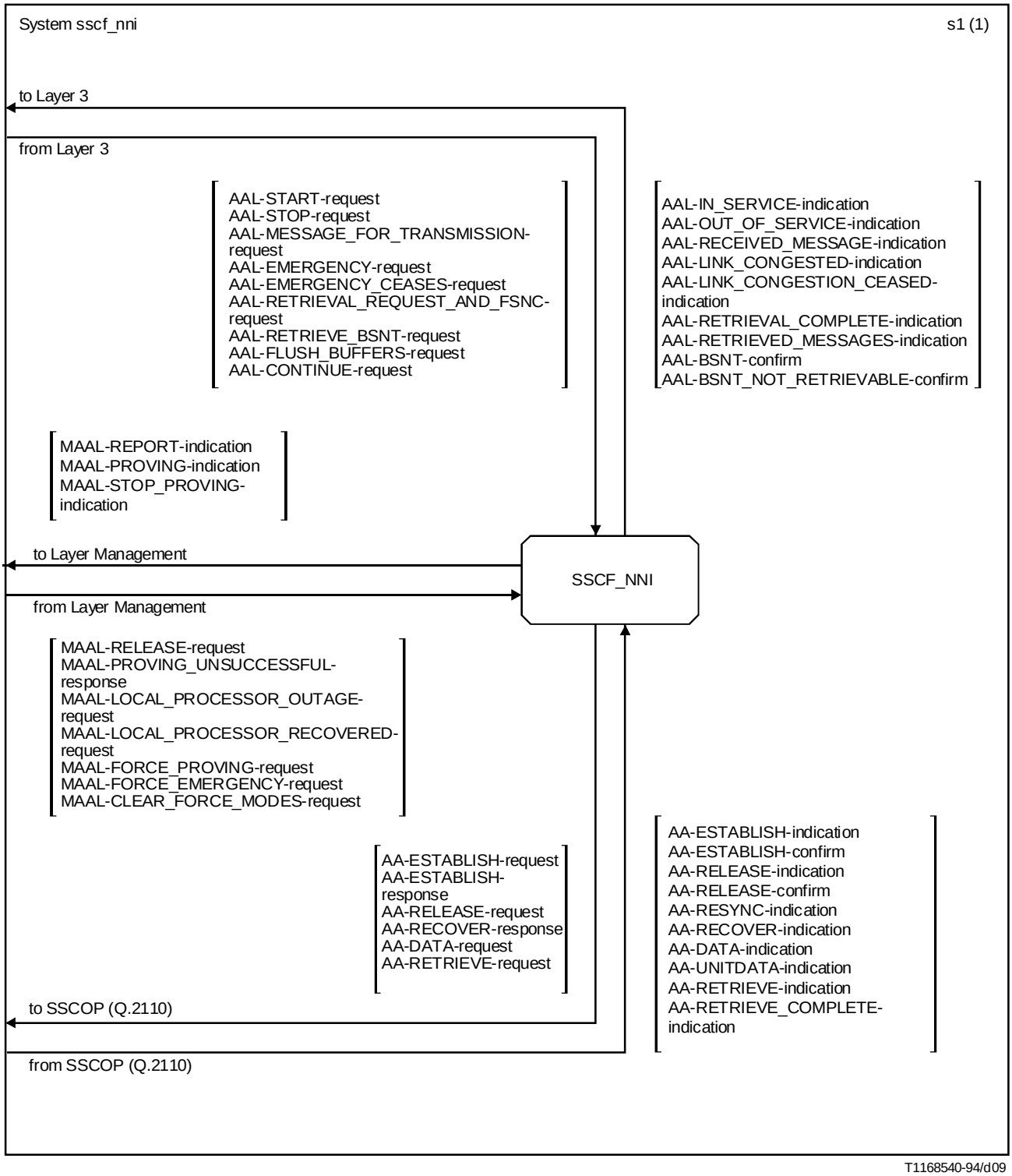

FIGURE III.1/Q.2140

System SSCF_NNI SDL diagram

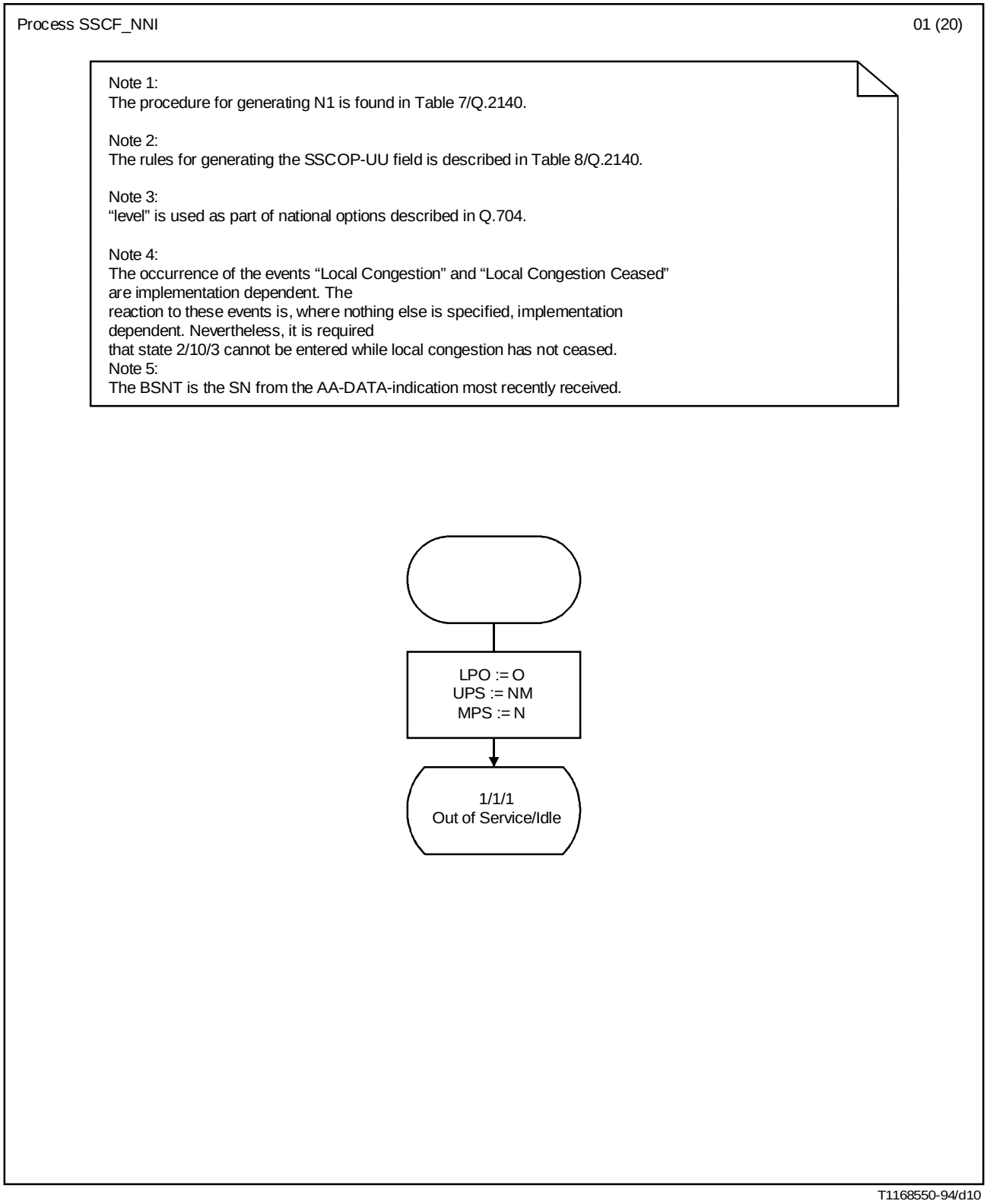

FIGURE III.2/Q.2140 *(sheet 1 of 20)*

Process SSCF_NNI SDL diagram

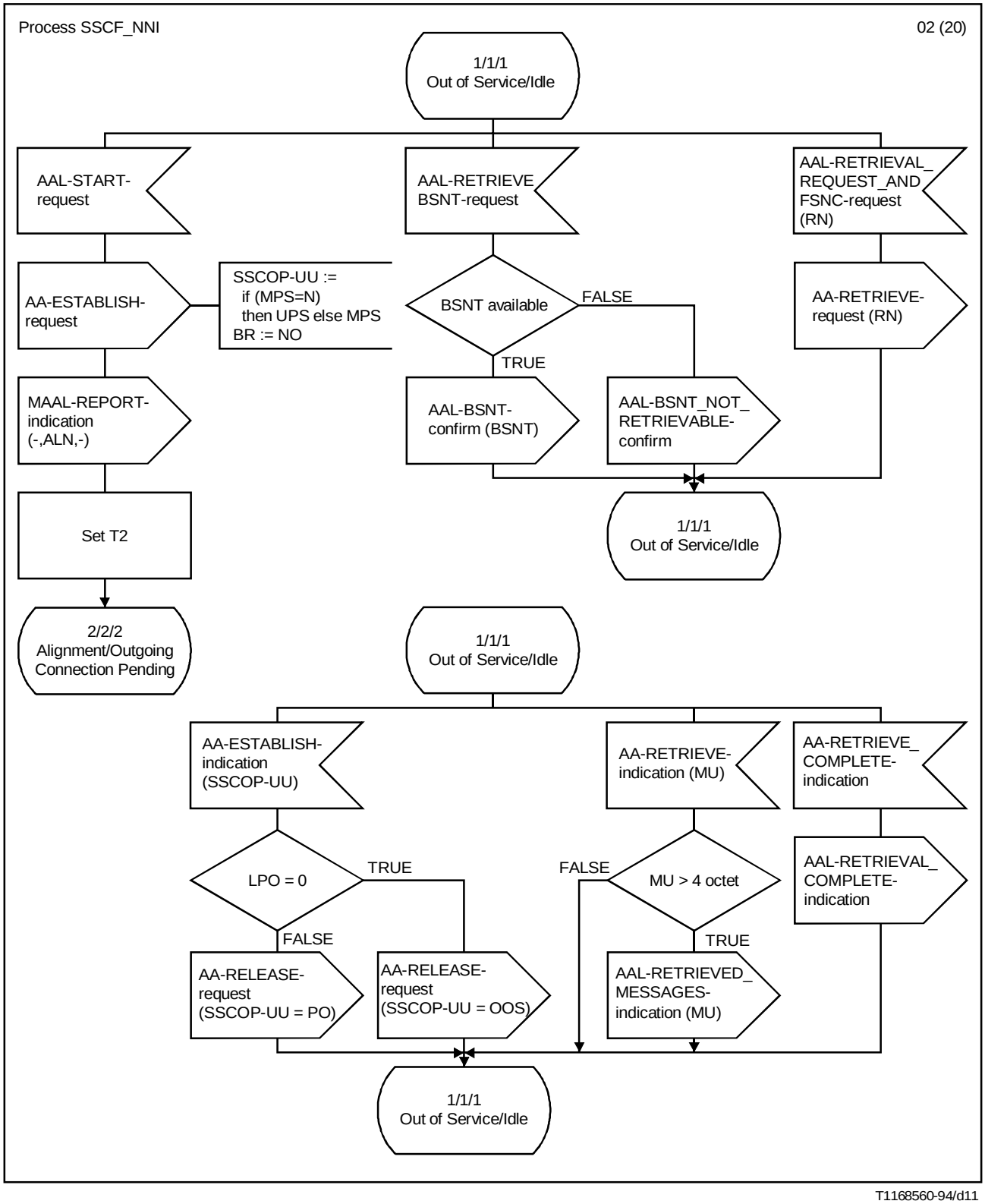

FIGURE III.2/Q.2140 *(sheet 2 of 20)*

Process SSCF_NNI SDL diagram

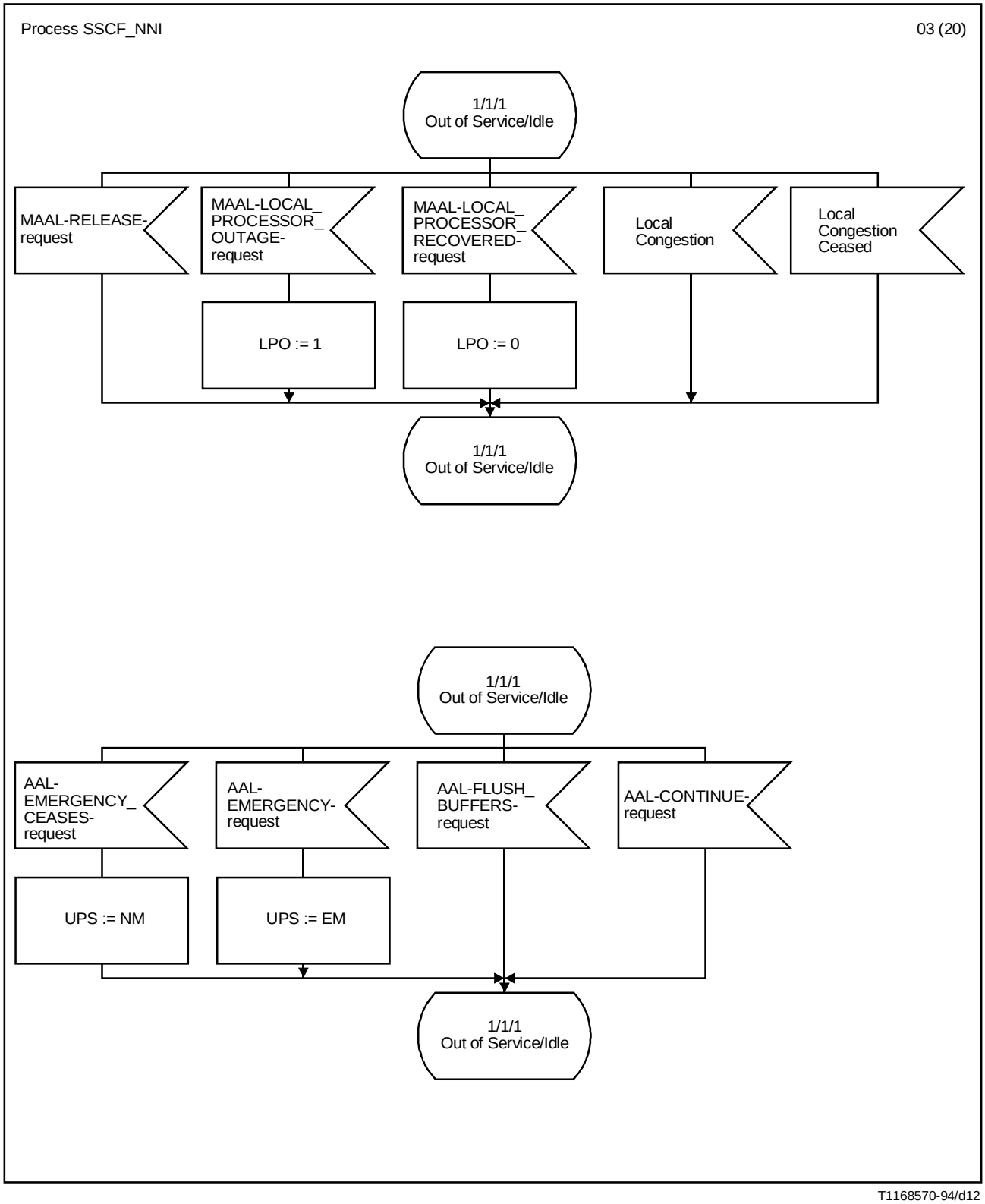

FIGURE III.2/Q.2140 *(sheet 3 of 20)*

Process SSCF_NNI SDL diagram

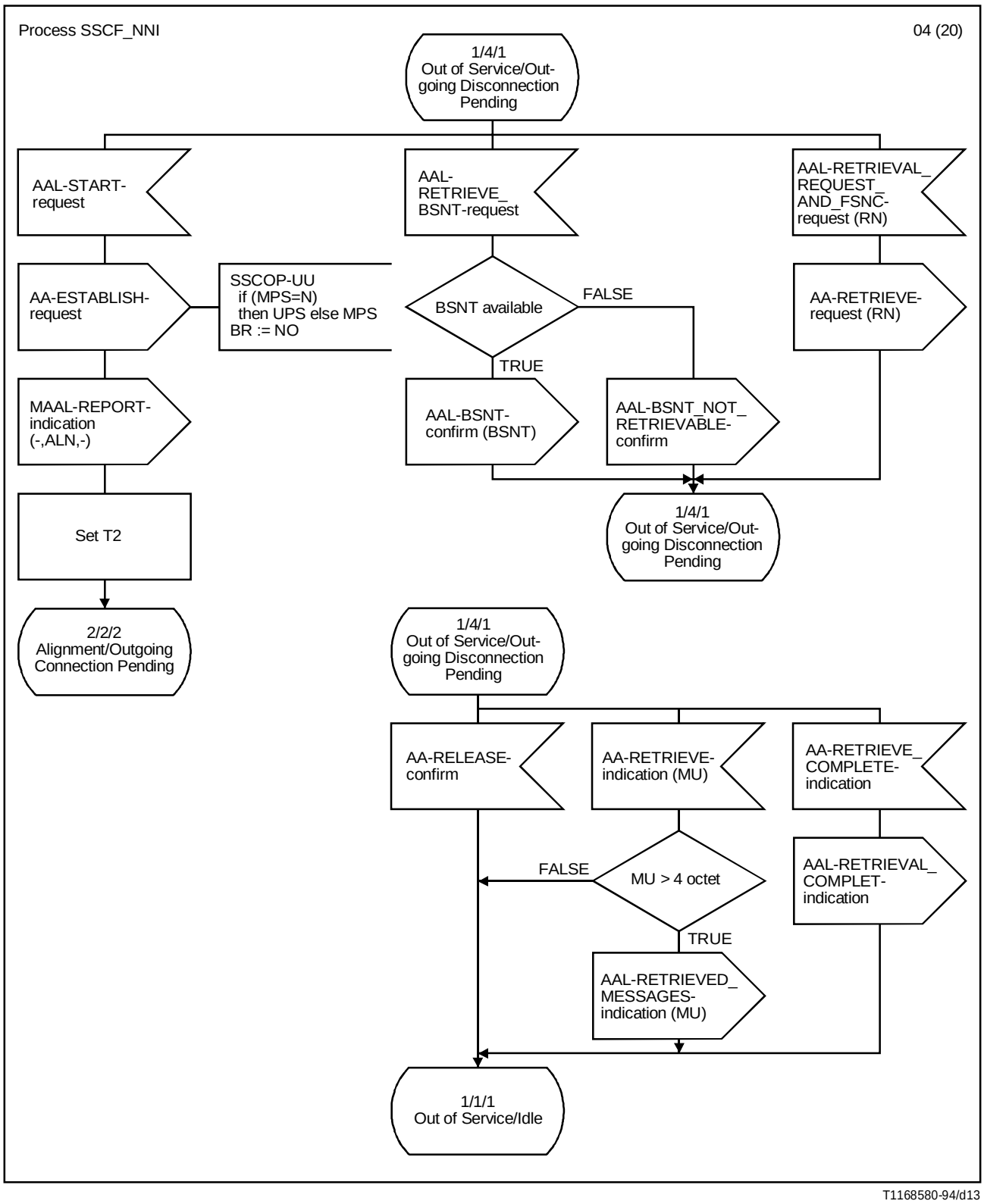

FIGURE III.2/Q.2140 *(sheet 4 of 20)*

Process SSCF_NNI SDL diagram

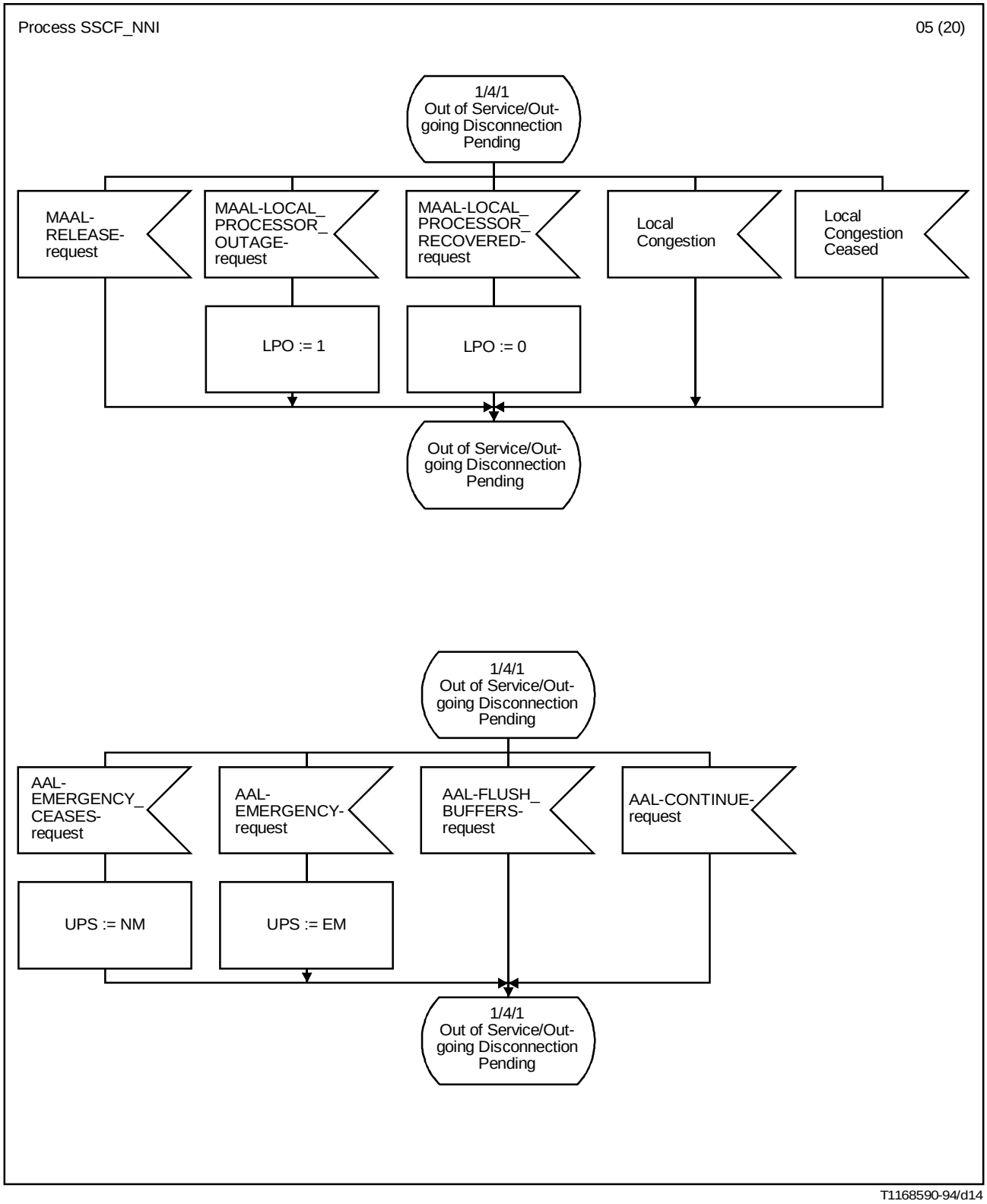

FIGURE III.2/Q.2140 *(sheet 5 of 20)*

Process SSCF_NNI SDL diagram

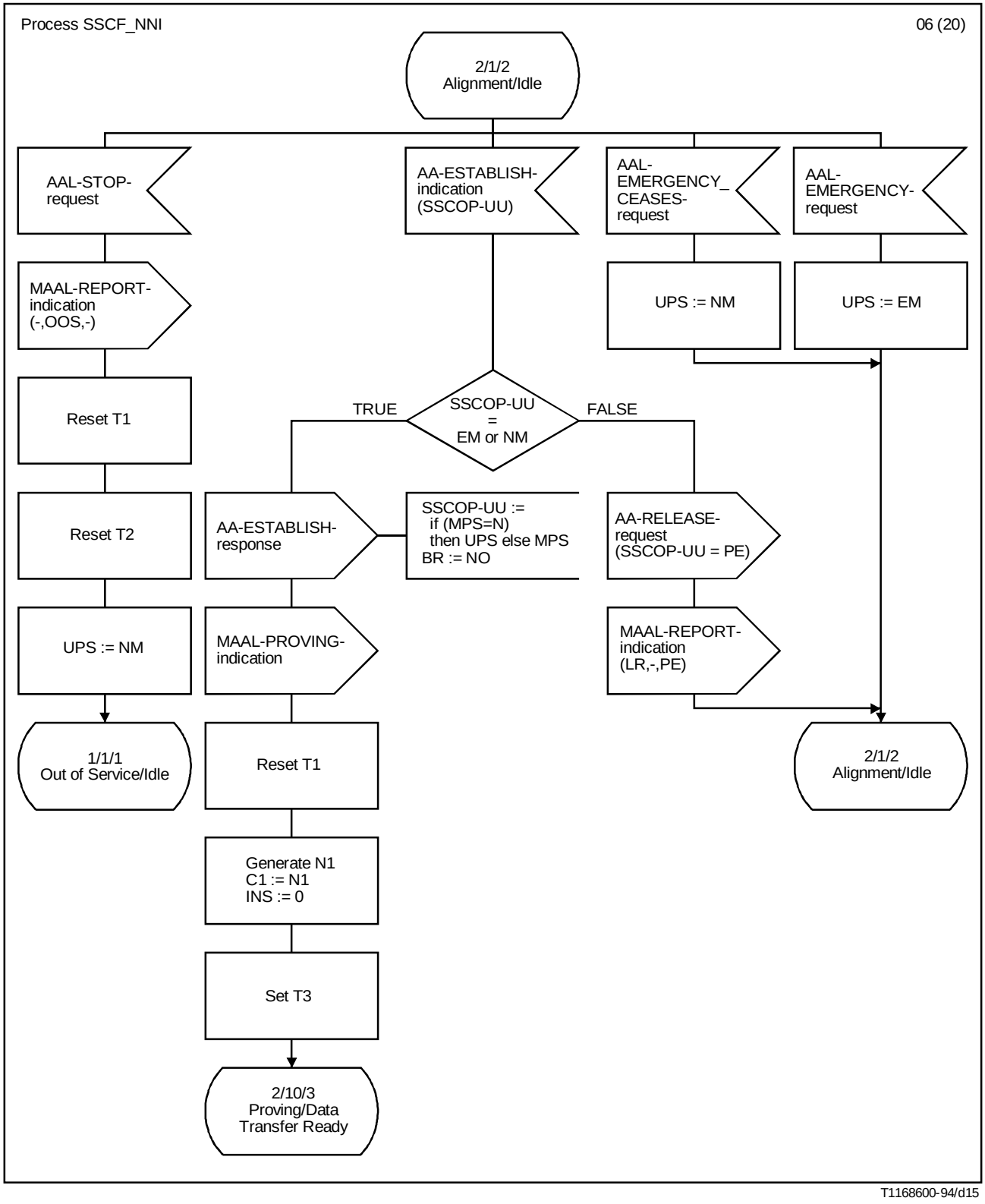

FIGURE III.2/Q.2140 *(sheet 6 of 20)*

Process SSCF_NNI SDL diagram

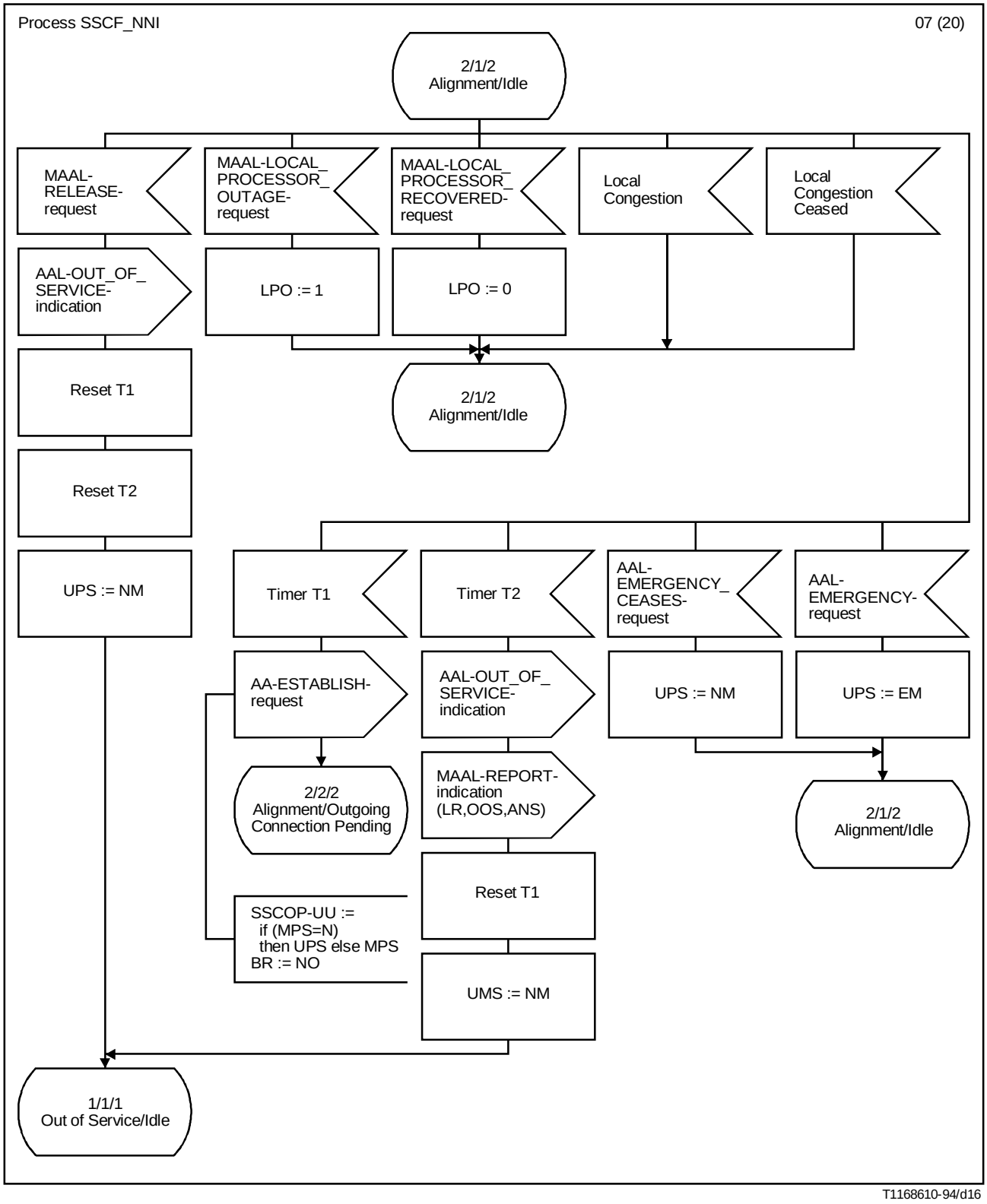

FIGURE III.2/Q.2140 *(sheet 7 of 20)*

Process SSCF_NNI SDL diagram

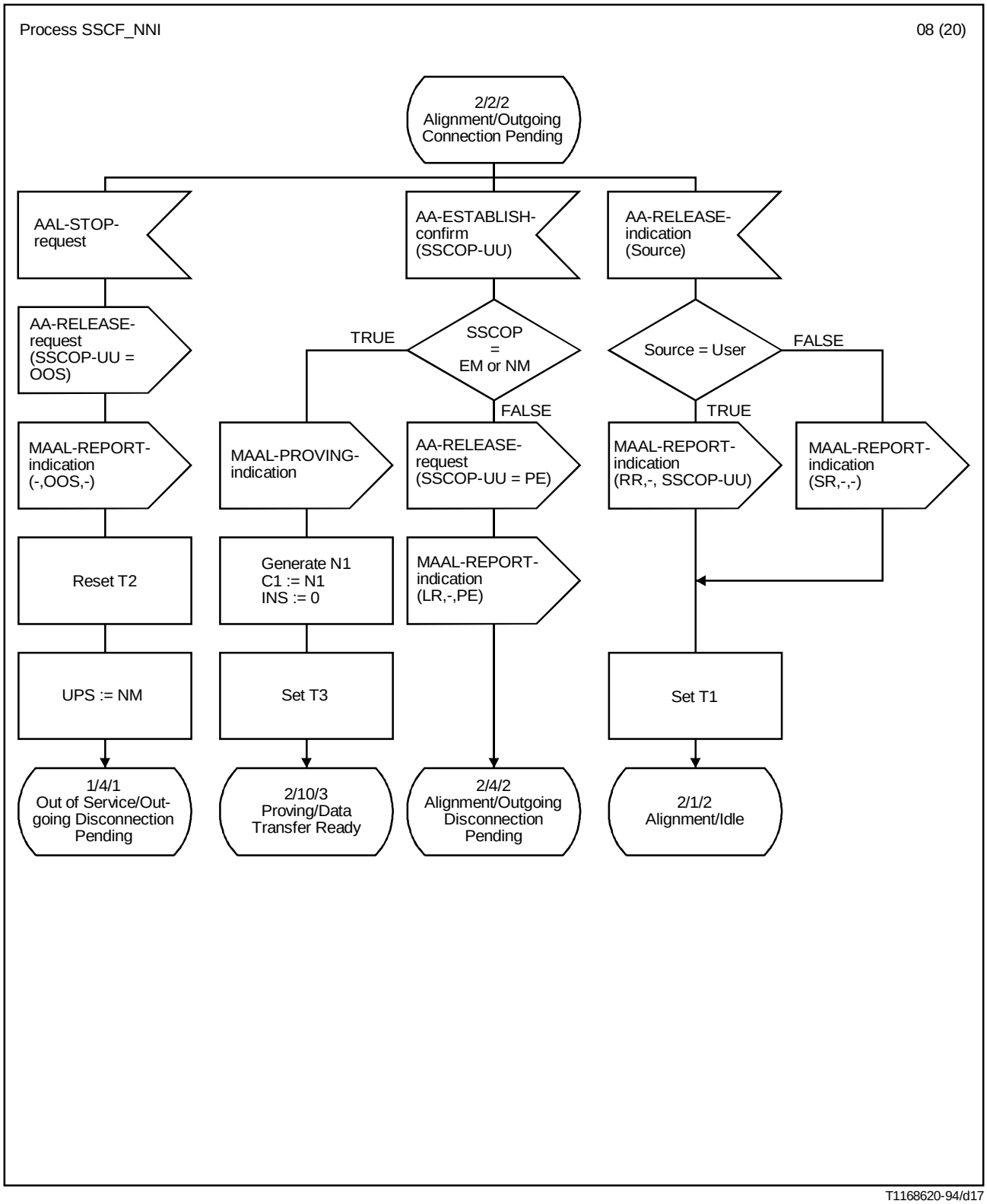

FIGURE III.2/Q.2140 *(sheet 8 of 20)*

Process SSCF_NNI SDL diagram

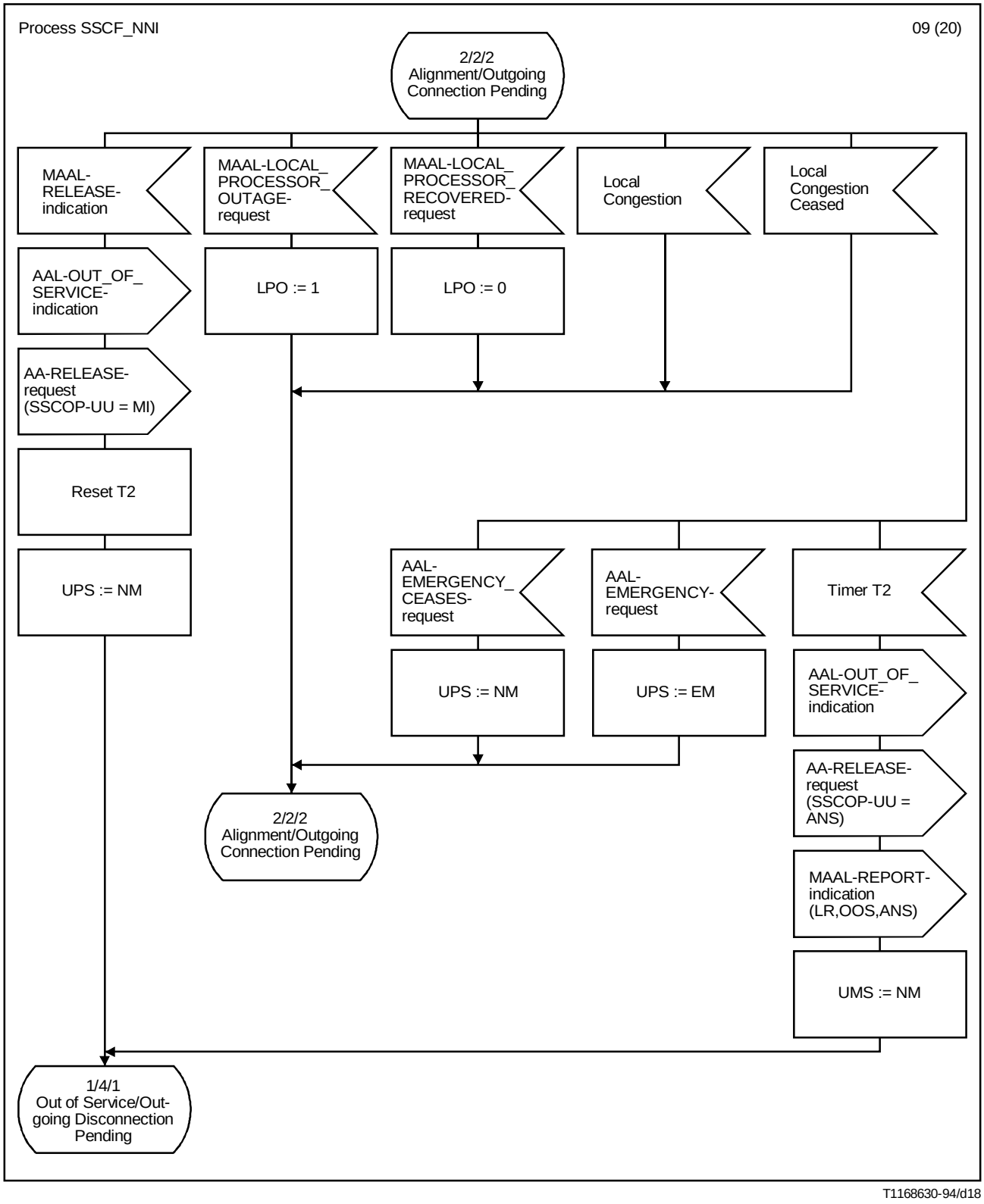

FIGURE III.2/Q.2140 *(sheet 9 of 20)*

Process SSCF_NNI SDL diagram

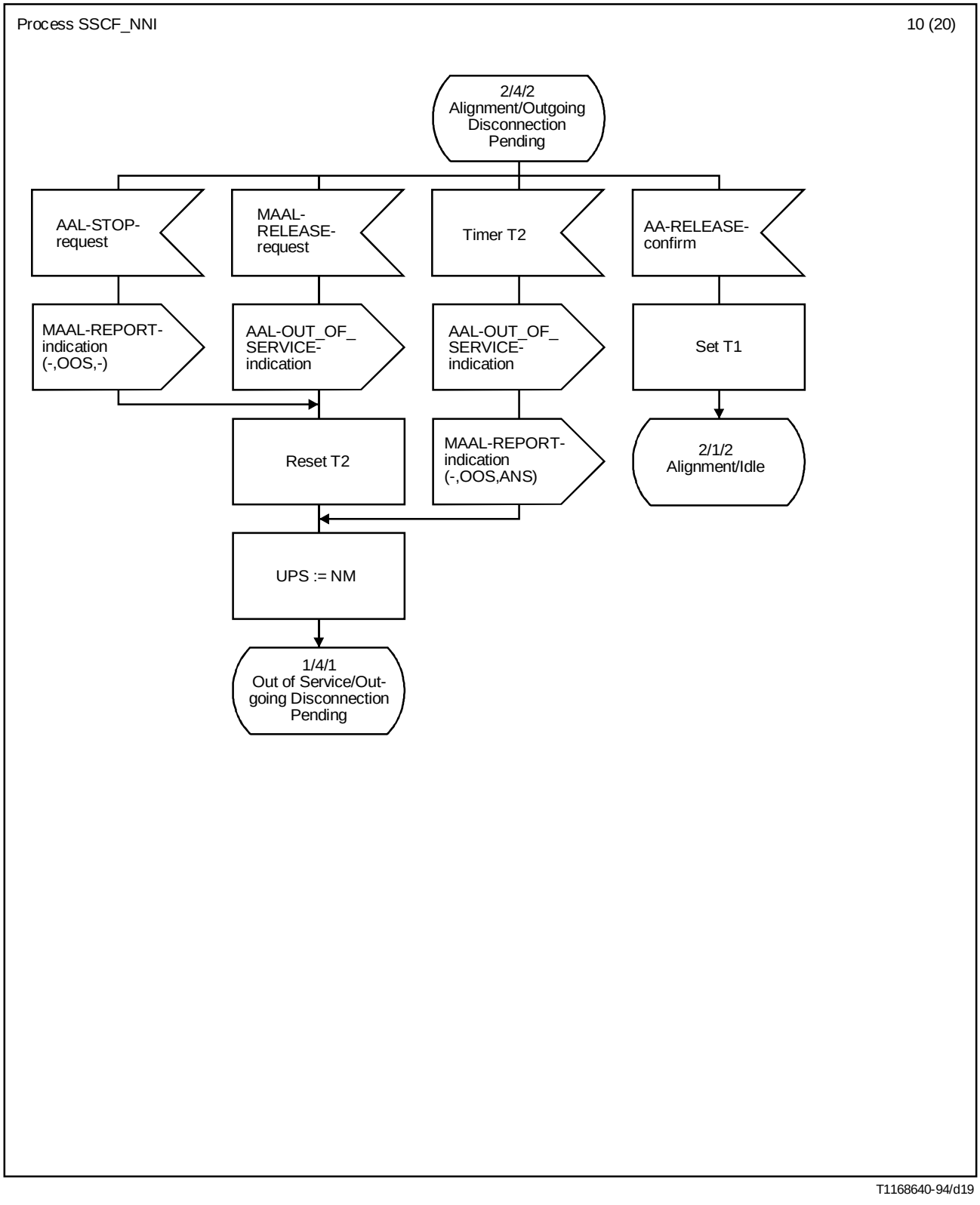

FIGURE III.2/Q.2140 *(sheet 10 of 20)*

Process SSCF_NNI SDL diagram

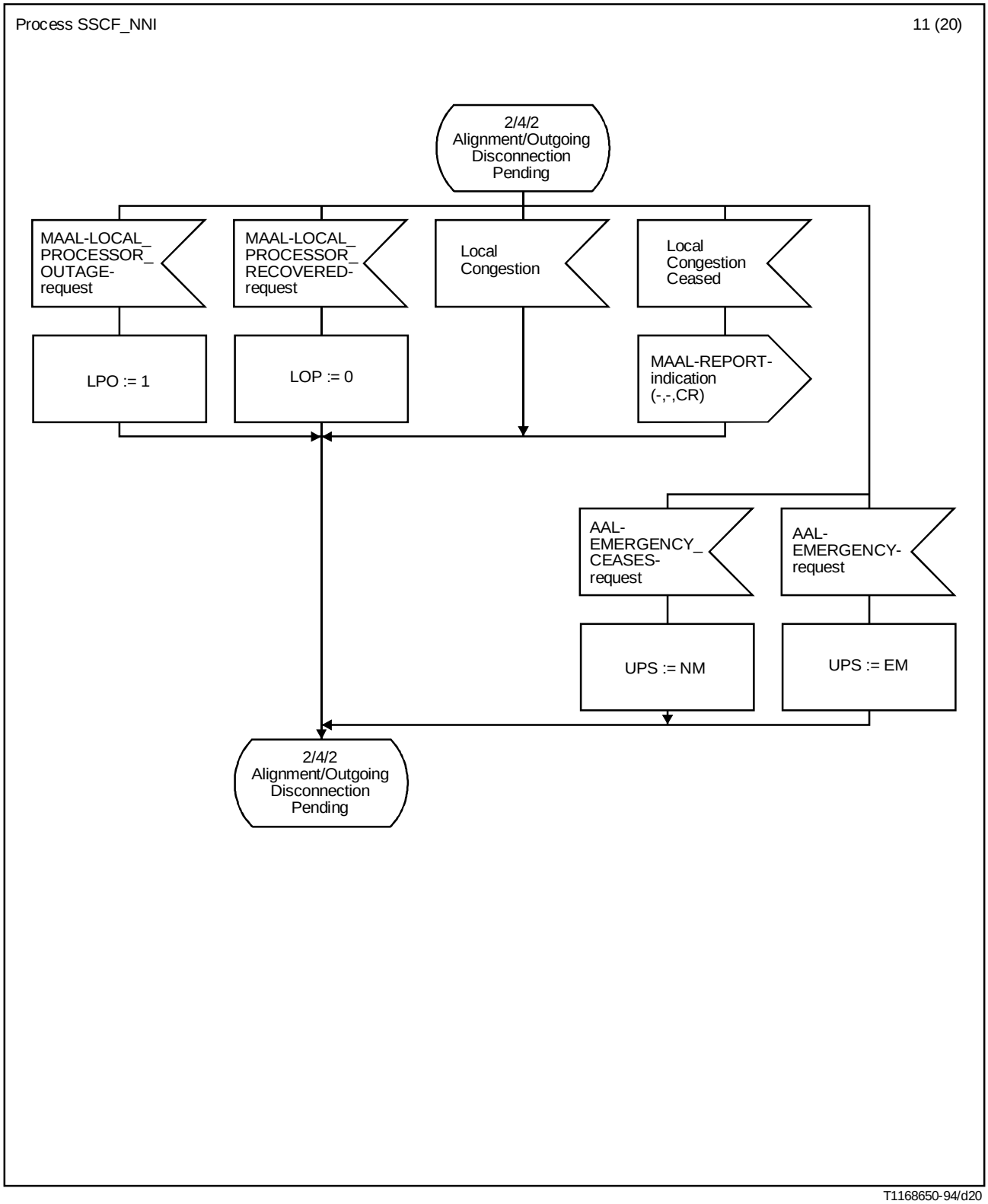

FIGURE III.2/Q.2140 *(sheet 11 of 20)*

Process SSCF_NNI SDL diagram

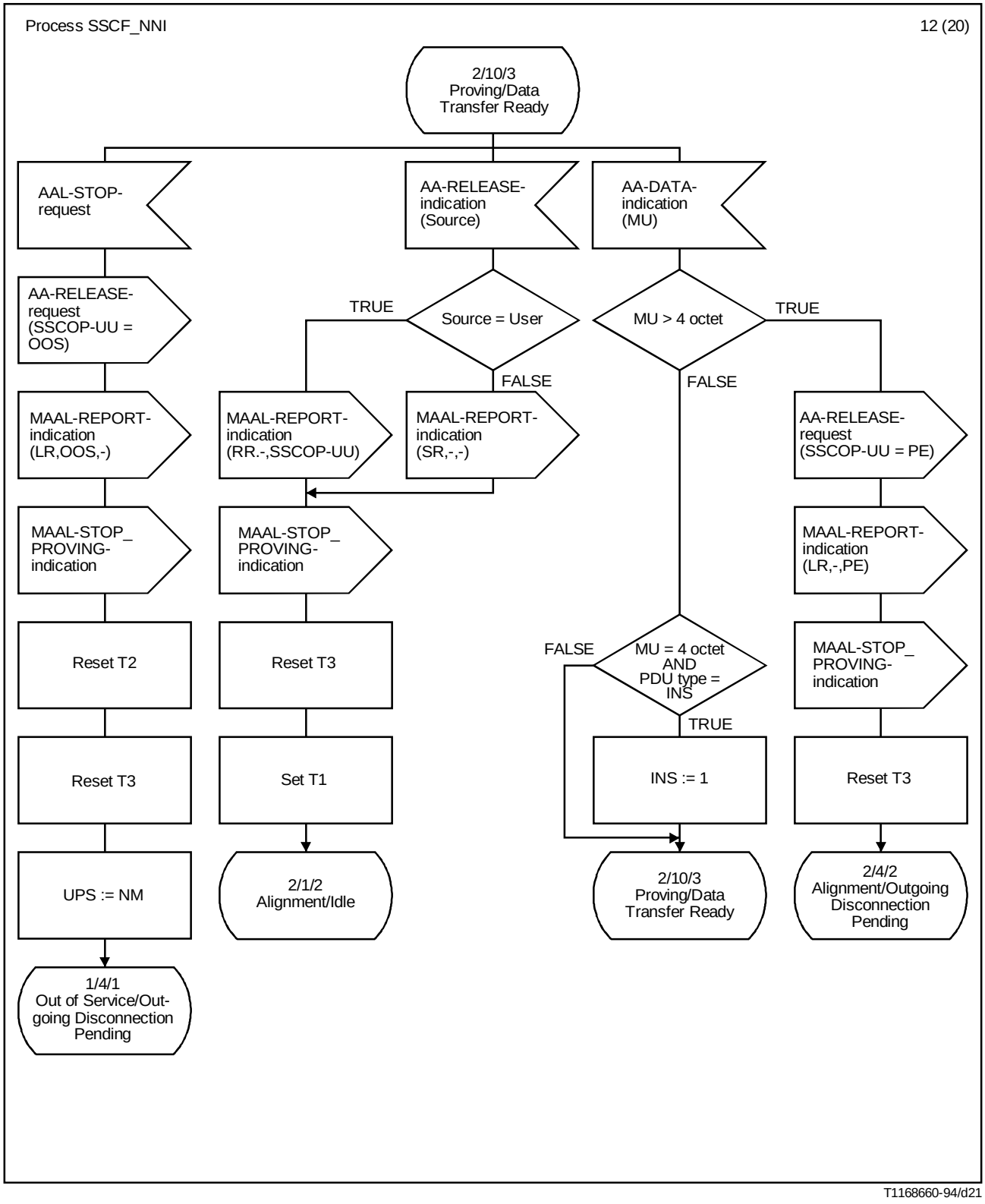

FIGURE III.2/Q.2140 *(sheet 12 of 20)*

Process SSCF_NNI SDL diagram

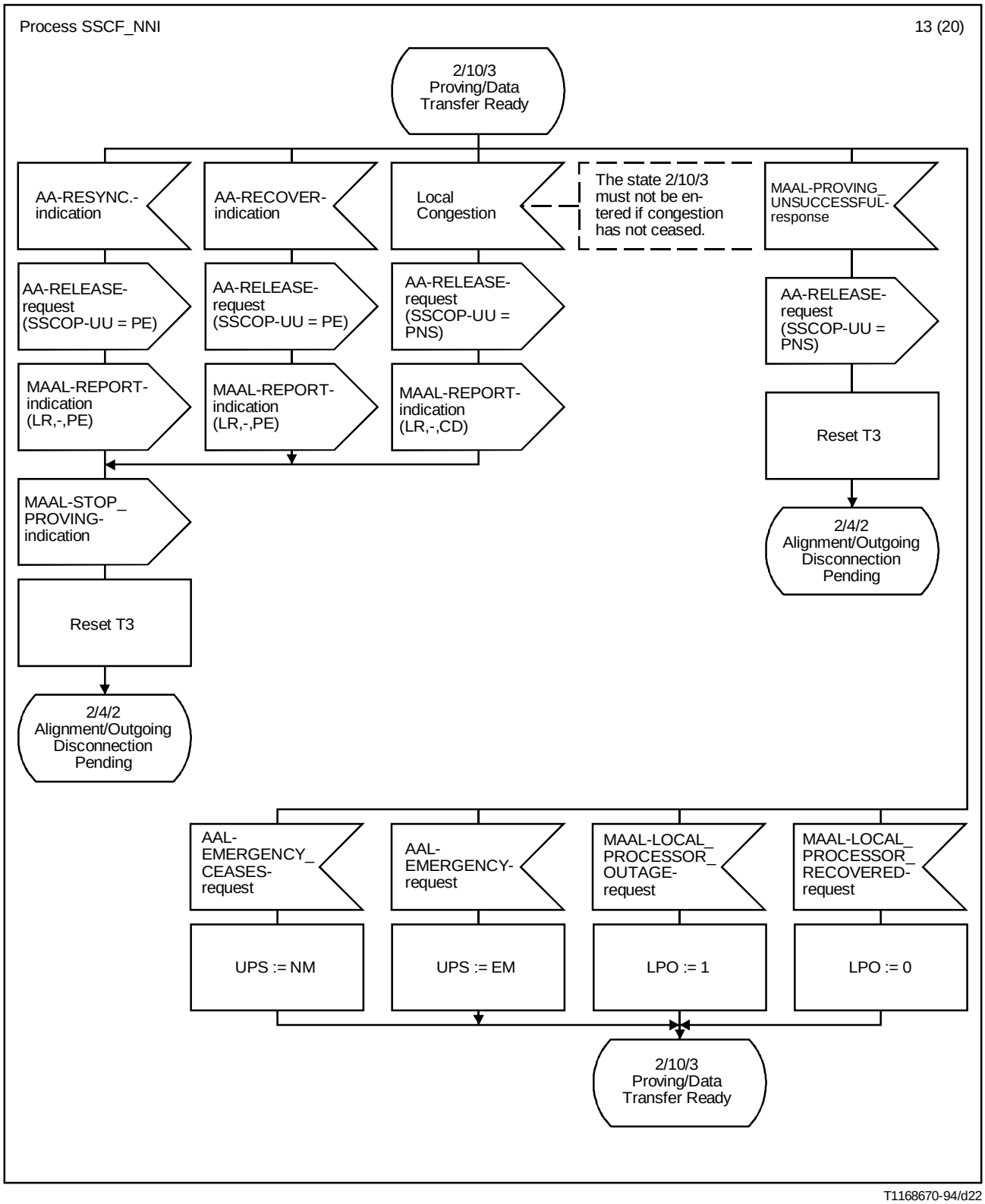

FIGURE III.2/Q.2140 *(sheet 13 of 20)*

Process SSCF_NNI SDL diagram

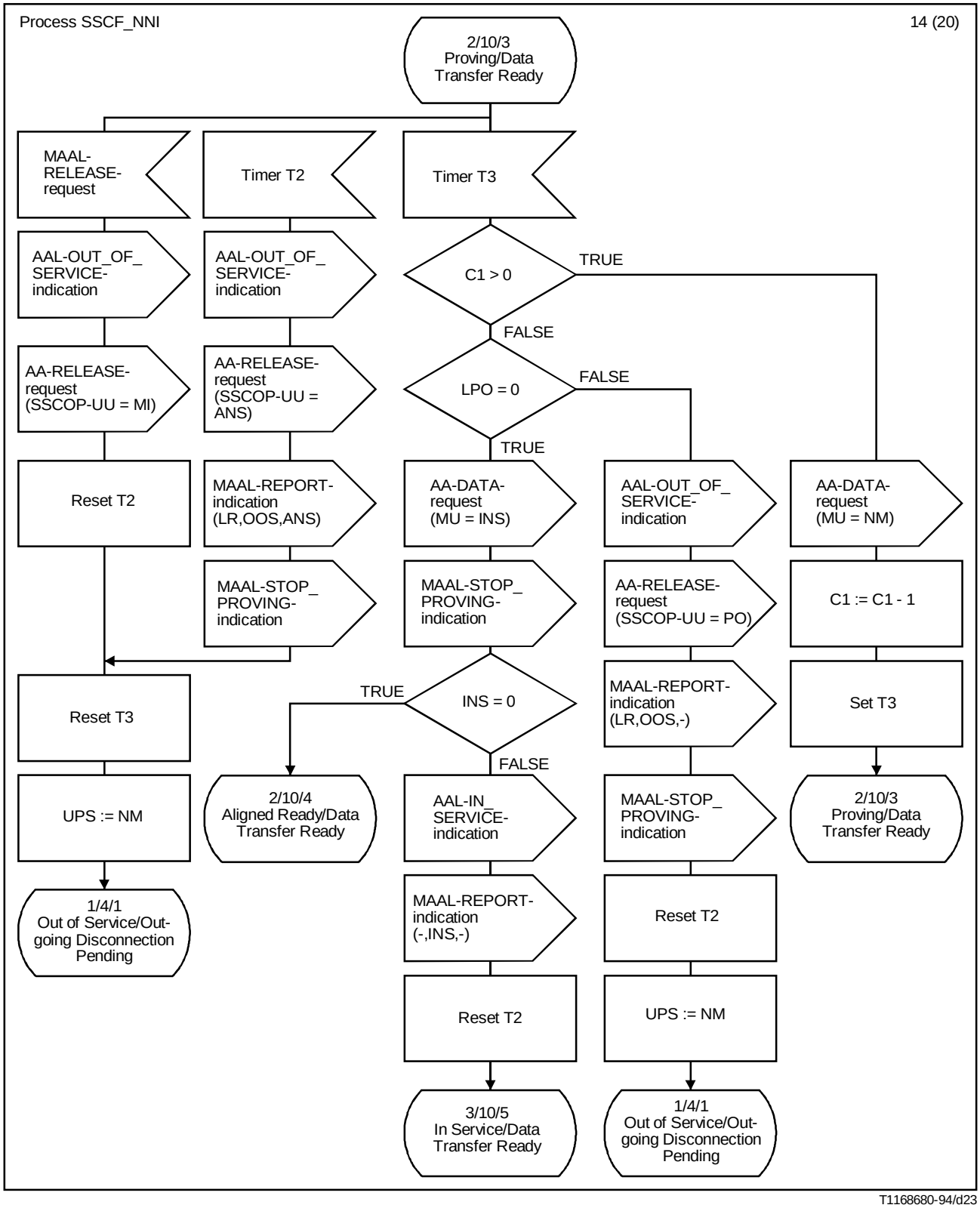

FIGURE III.2/Q.2140 *(sheet 14 of 20)*

Process SSCF_NNI SDL diagram

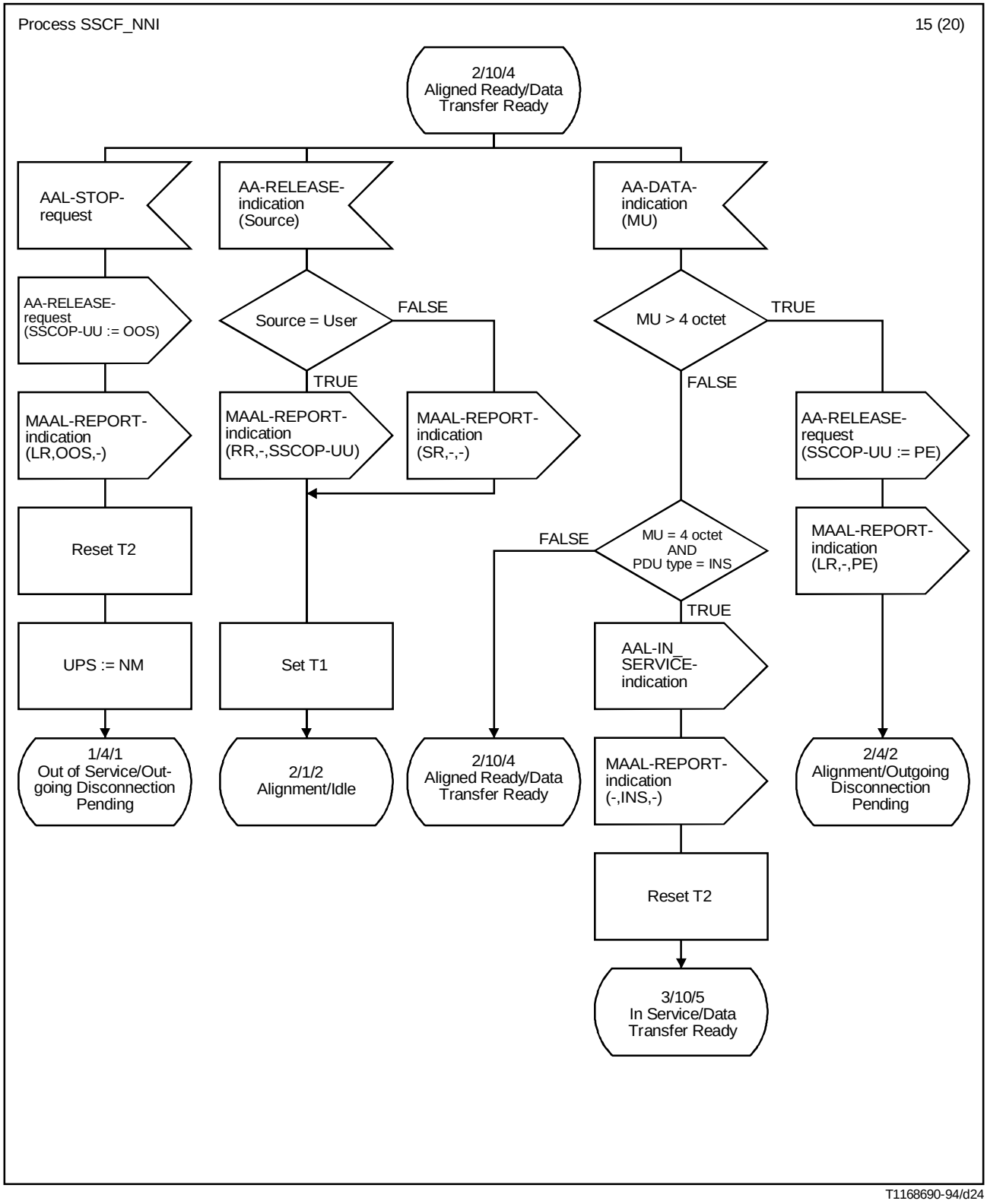

FIGURE III.2/Q.2140 *(sheet 15 of 20)*

Process SSCF_NNI SDL diagram

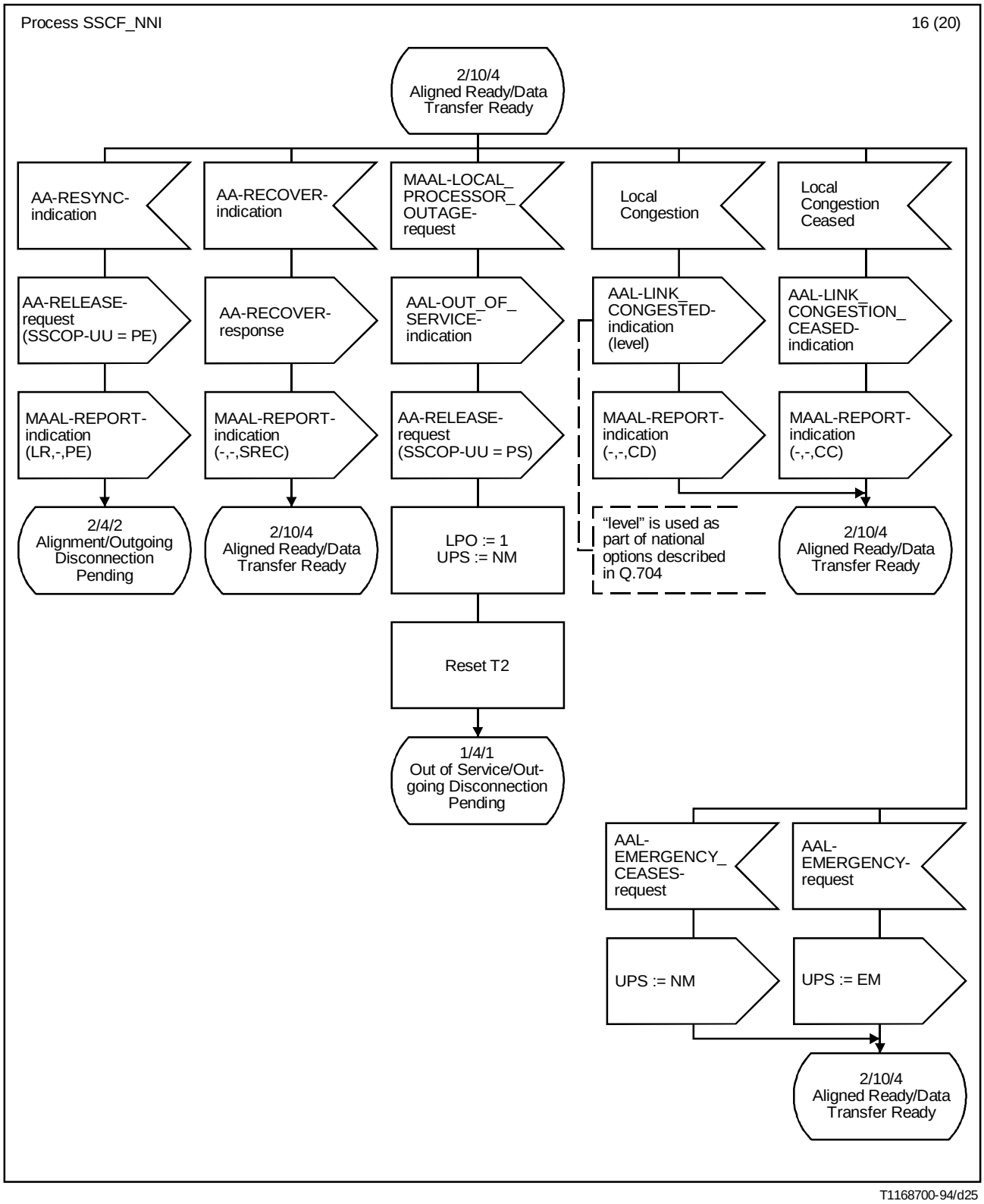

FIGURE III.2/Q.2140 *(sheet 16 of 20)*

Process SSCF_NNI SDL diagram

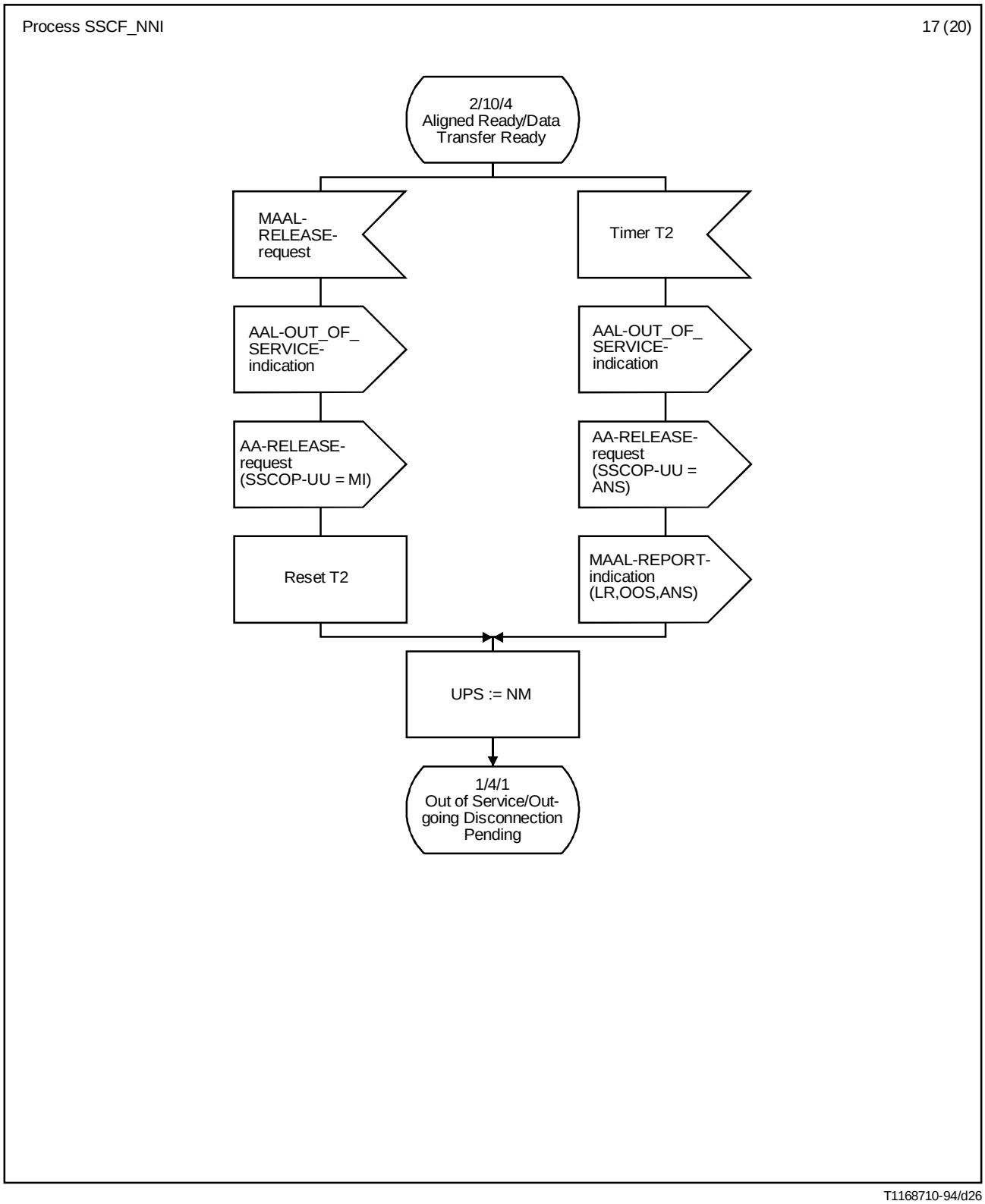

FIGURE III.2/Q.2140 *(sheet 17 of 20)*

Process SSCF_NNI SDL diagram

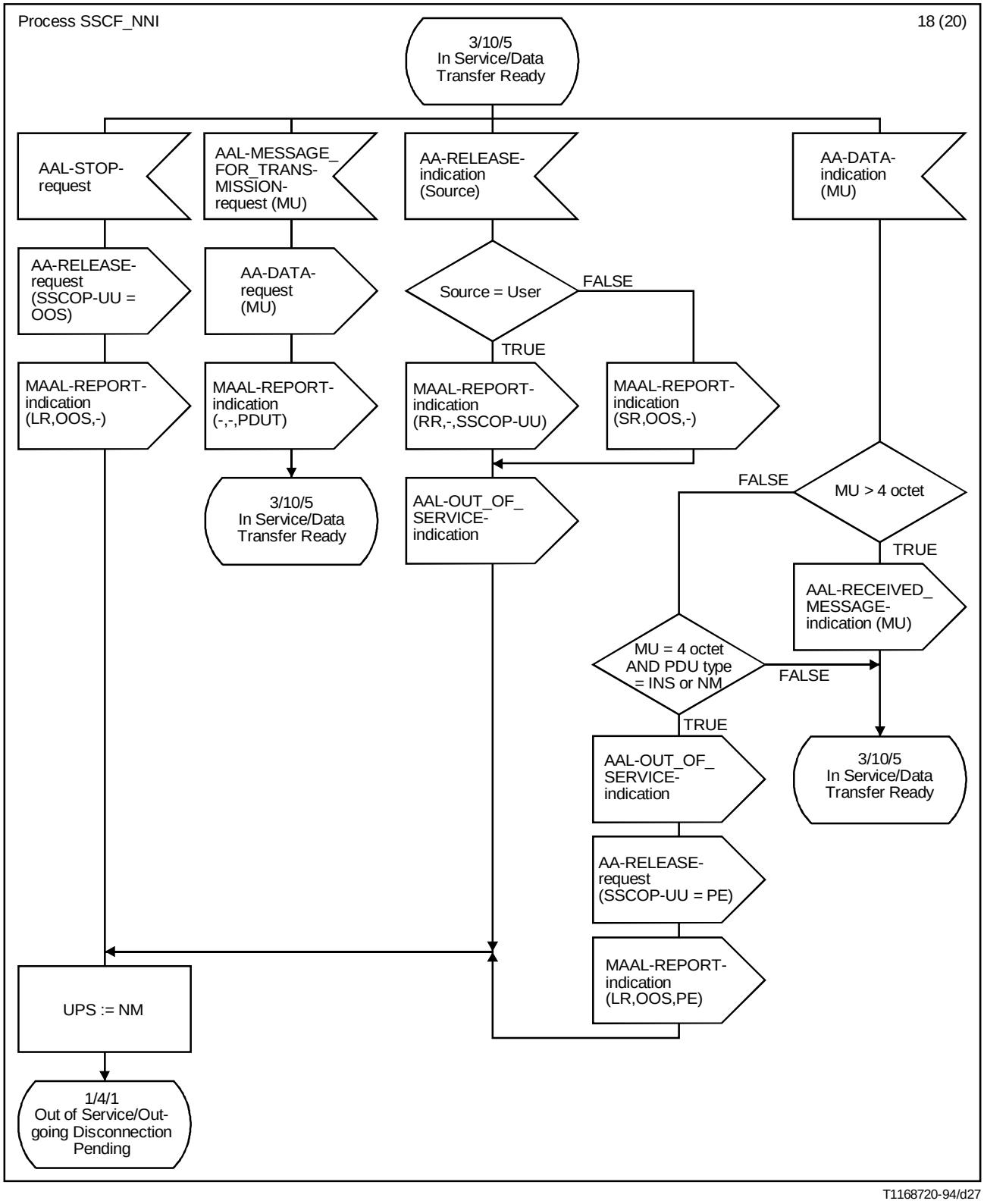

FIGURE III.2/Q.2140 *(sheet 18 of 20)*

Process SSCF_NNI SDL diagram

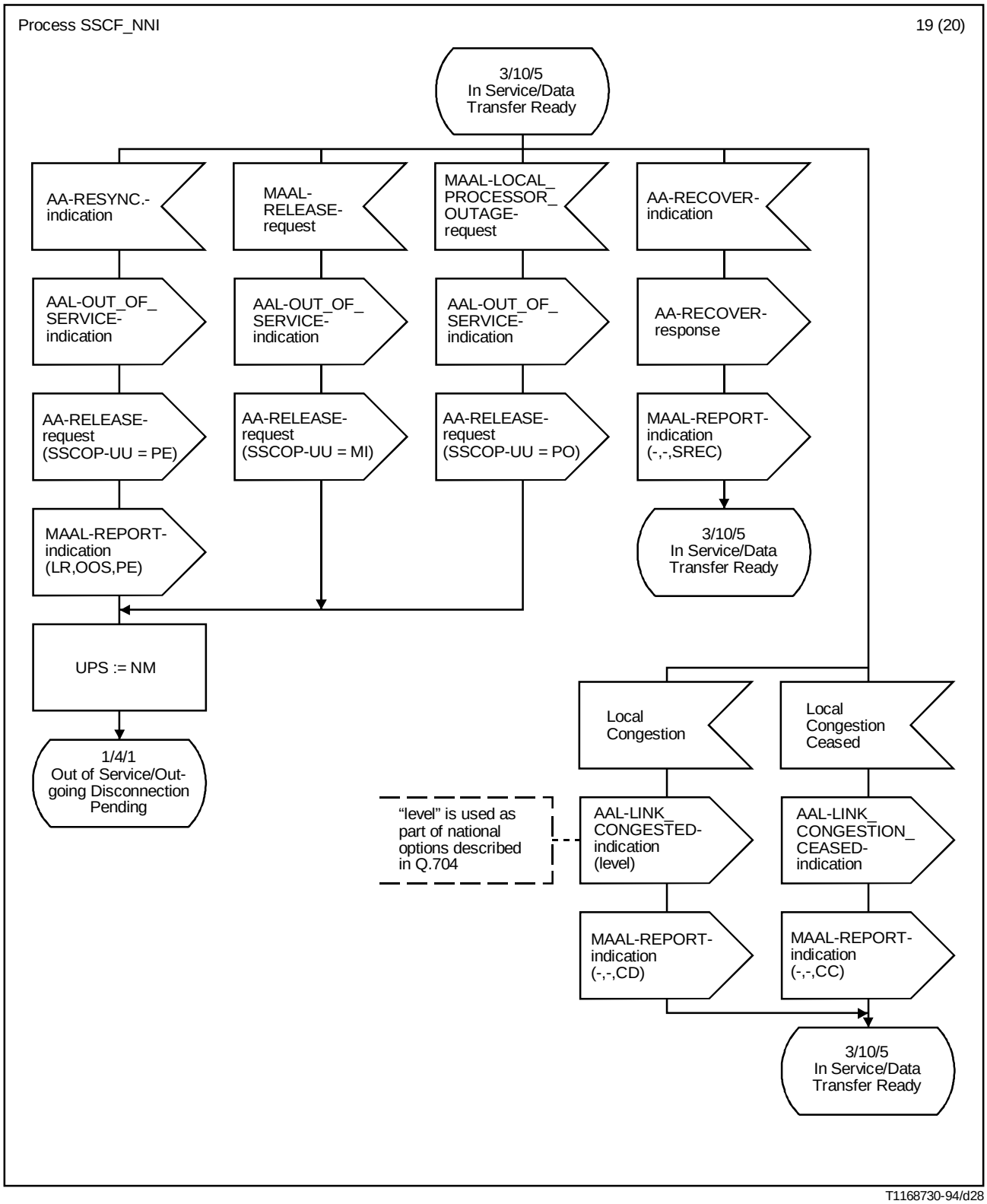

FIGURE III.2/Q.2140 *(sheet 19 of 20)*

Process SSCF_NNI SDL diagram

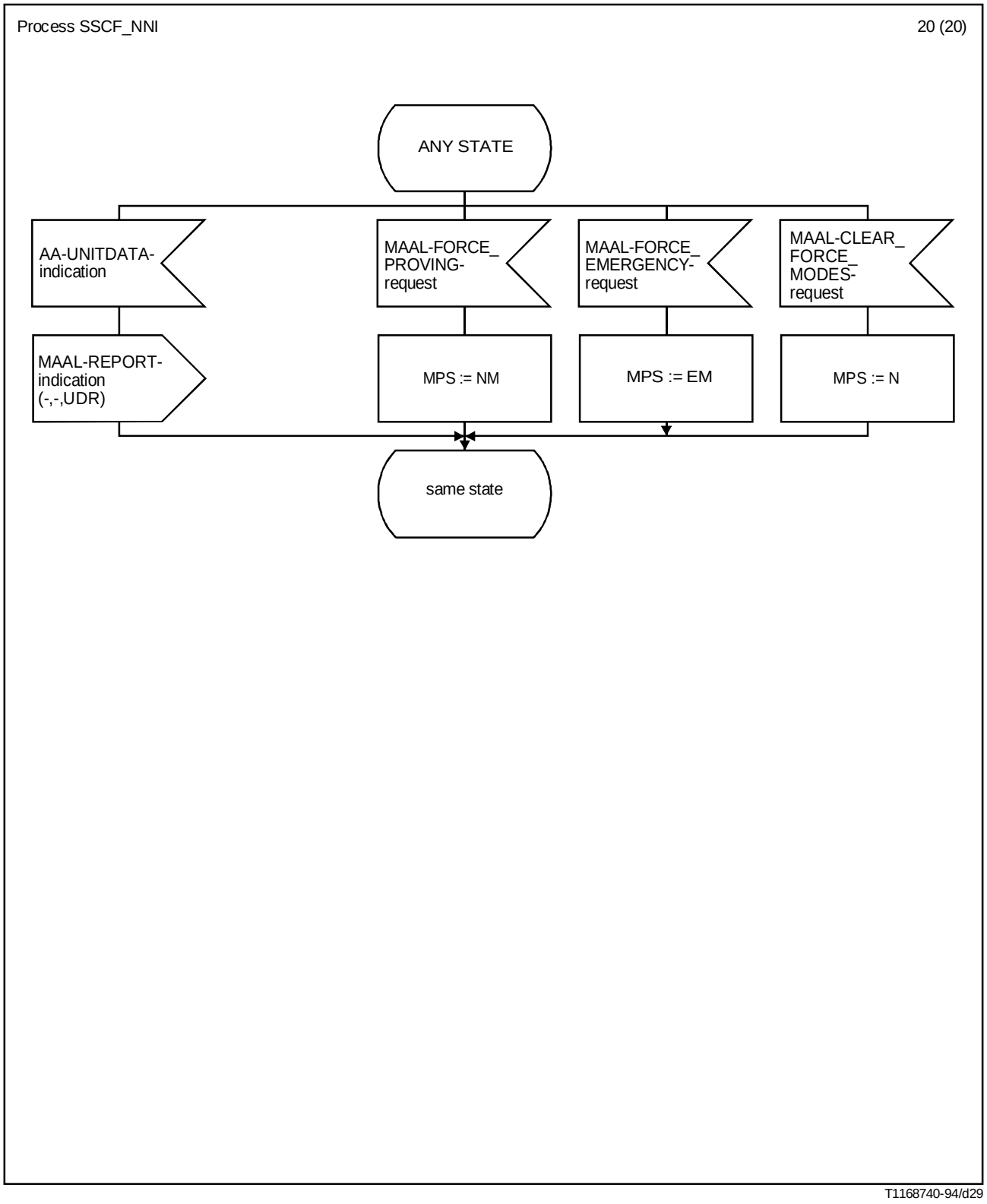

FIGURE III.2/Q.2140 *(sheet 20 of 20)*

Process SSCF_NNI SDL diagram