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AMENDMENT

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**This amendment A1 modifies
the European Telecommunication Standard ETS 300 324-1 (1994)**

Signalling Protocols and Switching (SPS);
V interfaces at the digital Local Exchange (LE);
V5.1 interface for the support of Access Network (AN);
Part 1: V5.1 interface specification

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Foreword

This amendment to ETS 300 324-1 (1994) has been produced by the Signalling Protocols and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This amendment contains changes of clauses, subclauses and annexes of ETS 300 324-1 (1994) as detailed below:

Clauses 4 and 5:	The general reference to other ETSs and ITU-T Recommendations concerning the physical/electrical and functional characteristics of the interface layer 1 have to be extended by specifying particular requirements for those aspects having conceptual implications to the V5.1 interface specification.
Subclause 8.7.3:	This subclause uses the term "operational and activated" as state description. But this state name does not exist. Amendment: The correct state name is used.
Subclause 10.4.5.5.2:	This subclause refers to "different unnumbered commands". Since the only unnumbered command which may be used for the peer-to-peer procedures of the data link sublayer, is the SABME command, this term is not applicable.
Subclause 11.1:	Editorial error: HDSL has to be replaced by HDLC.
Subclause 13.4.6.3:	Table 20 (coding of PSTN FSM state) does not specify the meaning of unused code points. Amendment: The usage of all possible code points is clarified.
Subclause 13.4.7.5:	Editorial error: The last sentence of this subclause belongs to figure 24.
Subclause 13.4.7.6:	Editorial error: The last sentence of this subclause belongs to figure 25.
Subclause 13.5.2.1:	This subclause mentions the code point of the described protocol error cause value (Protocol discriminator error). The other subclauses which describe the error handling procedure do not. Amendment: Delete the mentioning of the code point in subclause 13.5.2.1.
Subclause 13.5.2.10:	This subclause has been specified as requiring the generation of two error indications for one received unexpected event. If the LE PSTN protocol receives an unexpected event, it shall generate an error indication and send a STATUS ENQUIRY message. On receipt of a STATUS message with incompatible path states, the LE shall generate again an error indication. Amendment: The requirement for generating two error indications at the LE side is deleted. The used term "message sequence error" is ambiguous. Amendment: Delete the term "message sequence error".
Subclause 13.5.3:	The used term "message sequence error" is ambiguous. Amendment: Replace the term "message sequence error" by "unexpected message".
Subclause 13.5.3.1.1.2:	Editorial error: This subclause contains a wrong subclause reference.
Subclause 13.7:	The PSTN state tables concerning the handling of unexpected events in state AN7 are contradictory to subclause 13.5.3.5.1.2 which reflects the basic intention that in state AN7 no reaction on messages other than DISCONNECT and DISCONNECT COMPLETE is to be required, because the PSTN protocol FSMs are in the clearing down phase and the FSMs will be reset. **But:** Table 29 requires that on receipt of PROTOCOL PARAMETER in state AN7 the sending of a STATUS message is required.

Amendment: Table 29, state AN7, event PROTOCOL PARAMETER: No STATUS has to be sent. The text in subclause 13.5.4.1.2 and the SDL diagram in figure L.9.10 are adapted accordingly.

The PSTN state tables create error indications by itself in the case of port blocking or PSTN restart.
If a DISCONNECT COMPLETE message is received in the Port Blocked (AN6/LE6) or Out of Service (AN0/LE0) state of the PSTN protocol, the STATUS/STATUS ENQUIRY procedure will be invoked. As a result, the LE receives a STATUS message. According to table 30, the LE PSTN protocol has then to generate an internal error indication to the LE-system management (table 30: STATUS received in LE0/LE6).
But: Upon receipt of MDU-CTRL (port blocked) or MDU-CTRL (restart request), the PSTN protocol has to send a DISCONNECT COMPLETE message before entering the proper state. This applies to both sides. Therefore, it is most likely that one side will receive this message in the Port Blocked or Out of Service state (the port blocking and restart procedure are synchronized by the Control protocol).
Amendment: The handling of STATUS in table 30 is changed.

LE PSTN state table does not cover call collision in the Line Information state.
Amendment: Allow the sending of DISCONNECT COMPLETE in state LE2.

Editorial: Note 3 refers to the SDL diagrams. Since the SDL diagrams are only informative, this is an inappropriate reference. As note 3 is not urgently needed to understand the table, it is deleted.

Subclause 14.1.3.4:	Assume a state mismatch of the AN and LE ISDN user port FSMs, such that the AN stays in AN2.2 (access activated) and LE enters LE1.0 (blocked). If the LE then tries to unblock and synchronize the port by sending FE201, according to table 35 the AN will not send any message over the V5.1 interface and the LE FSM hangs up in state LE1.1 (local unblock). Amendment: AN sends the response FE104 back to LE.
Subclause 14.4.1.3:	Note 3 of table 48 is contradictory to table 55. Note 3 of table 48 implies that the variant information element is included in a common control message for the control-function-IDs "blocking started", "restart request" and "restart complete". This is not correct (refer to table 55). Furthermore the information given in the notes of table 48 is redundant. Amendment: Replace notes 1 to 3 of table 48 by a general note referring to table 55.
Subclause 14.4.4.1:	The fifth paragraph of this subclause uses a wrong state name. Amendment: The state name is corrected.
Subclause 14.4.4.2.10:	Editorial error: This subclause contains wrong table references.
Annex C, item 2):	Editorial error: This item contains wrong subclause references.
Annex C, item 5):	According to annex C, item 5), the receiving entity of an unblock request message is allowed to send no response back because it does not agree with the unblock request. But then it is not possible for the sender of the unblock request to distinguish between such a disagreement and a mismatch of the port FSMs which has to be resolved by a block-unblock sequence. Amendment: To avoid a situation where the FSMs stay misaligned and undetected, the receiver of a MPH-UBR shall respond to an unblock request within a certain time limit.
Annex C, item 12):	The text concerning re-provisioning verification is clarified.

Annex C, item 13):   Initial state of the ISDN user port FSM, PSTN user port FSM and PSTN protocol after system start up is not defined clearly.
Amendment: The system startup procedure is clarified. The SDL diagrams in figures L.9.1, L9.9, L25.1, L25.7 are adapted accordingly.

It is stated that the interface and the variant ID shall be checked during system startup. No procedure exists for the case of an unsuccessful check.
Amendment: The treatment of a unsuccessful system startup is be the same as in the case of an unsuccessful restart (refer to annex C, item 14 b), last paragraph).

Annex C, item 14):   This item defines an asymmetrical PSTN restart procedure (master-slave relationship). This leads to a lock-up situation if the restart is required from both sides at the same point in time.
Amendment: The restart procedure is defined in a symmetrical way. The SDL diagrams in figures L.9.17.4, L17.8, L33.4, L33.8 are adapted accordingly.

Annex C, item 17):   If TC3 expires only on one side of the V5.1 interface, a mismatch of the PSTN protocol FSMs after a re-establishment of the PSTN_DL can persist.
Amendment: The PSTN restart procedure is added in case of a re-establishment of the PSTN_DL.

Annex C, table C.1:   "Cause for start" of Timer TC2 is wrong.
Amendment: The cause for start is corrected.

Annex L, figure L.9.5:   Figure L.9.5 is contradictory to table 29 concerning the handling of an ESTABLISH message in state AN4. Table 29 requires "No action, no state change", figure L.9.5 requires the sending of a STATUS message.
Amendment: Update of figure L.9.5 according to table 29.

Annex L, figure L.17.1:   If during startup the CONTROL_DL is not able to establish the connection (sending of SABME four times), it sends MDL-RELEASE-INDICATION to system management. In figure L17.1, this event is not shown and the required reaction of system management is not clear.
Amendment: Update of figure L.17.1 to show the sending of MDL-RELEASE-INDICATION.

Annex L, figure L.17.2:   Figure L.17.2 is contradictory to annex C, item 13), which requires that the variant and interface ID shall be checked during system startup. Figure L.17.2 shows only a check of the interface ID.
Amendment: Update of figure L.17.2 by adding a decision for the correct variant.

The treatment of MDU-CTRL(request variant&interface ID) is missing in states AN1/LE1(SYS).
Amendment: Take into account MDU-CTRL(request variant&interface ID) from AN/LE Control protocol.

The handling of DL release is missing in states AN2/LE2(SYS) (Activate PSTN).
Amendment: Take into account MDL-RELEASE-INDICATION from AN/LE PSTN_DL.

Annex L, figure L.17.7:   The recovery from PSTN_DL release is not working properly.
When MDL-RELEASE-INDICATION is received, timer TC3 is started and MDL-ESTABLISH-REQUEST is sent to PSTN_DL. When PSTN_DL receives MDL-ESTABLISH-REQUEST it sends a SABME command over the V5.1 interface. IF PSTN_DL receives no response, it repeats the SABME three times having breaks of 1 second between each transmission. If PSTN_DL does not receive any response from the remote side after up to 4 seconds it will send again MDL-RELEASE-INDICATION to system management, which then starts TC3 again and returns MDL-ESTABLISH-REQUEST to PSTN_DL.
Amendment: TC3 is fixed to 15 seconds, and thus it will never time out.

When PSTN_DL finally manages to re-establish the connection and returns MDL-ESTABLISH-CONFIRMATION to system management, the condition "TC3 running" is insufficient to determine the status of the PSTN ports (blocked or unblocked). Assume that TC3 could time out. The PSTN ports will then be blocked. If MDL-RELEASE-INDICATION is however once more received, TC3 is restarted. Then if MDL-ESTABLISH-CONFIRMATION is received TC3 is running but the port unblock procedure would need to be initiated.
Amendment: Update of figure L.17.7 to avoid deadlocks.

Annex L, Figure L25.3:   The handling of a call collision in the Line information case is not covered.
Amendment: Show treatment of FE-disconnect_complete_request in state LE2.

Annex L, figure L.27.1:   Editorial error: The input symbol for PORT CONTROL ACK needs to be flipped.

Annex L, figure L.27.2:   Editorial error: Timer TO1 is misspelled.

Annex L, figure L.33.1:   Same as figure L.17.1.

Annex L, figure L.33.2:   Same as figure L.17.2.

Annex L, figure L.33.5:   This figure is not in line with annex C, item 12). MDU-CTRL (blocking started) is missing.
Amendment: Update of figure L.33.5 to include MDU-CTRL (blocking started).

Annex L, figure L.33.7:   Same as figure L.17.7.

Transposition dates	
Date of adoption of this amendment:	12 January 1996
Date of latest announcement of this amendment (doa):	30 April 1996
Date of latest publication or endorsement of this amendment (dop/e):	31 October 1996
Date of withdrawal of any conflicting National Standard (dow):	31 October 1996

Amendments

Page 16, clause 2

Add the following normative references:

[8]   CCITT Recommendation O.9 (1988): "Measuring arrangements to assess the degree of unbalance about earth".

[9]   CCITT Recommendation O.151 (1992): "Error performance measuring equipment operating at the primary rate and above".

Page 21, clause 4

Replace the complete text of clause 4 by:

"The V5.1 interface consists of a single 2 048 kbit/s interface as defined in ETS 300 166 [1] and ETS 300 167 [2].

The electrical and physical characteristics of the interface shall conform to ETS 300 166 [1], 2 048 kbit/s case.

Two interface presentation alternatives are defined in ETS 300 166 [1], the balanced interface pair type and the coaxial type. According to the two alternatives of interface applications shown in figure 1, it is left to the network operator to request the interface presentation required.
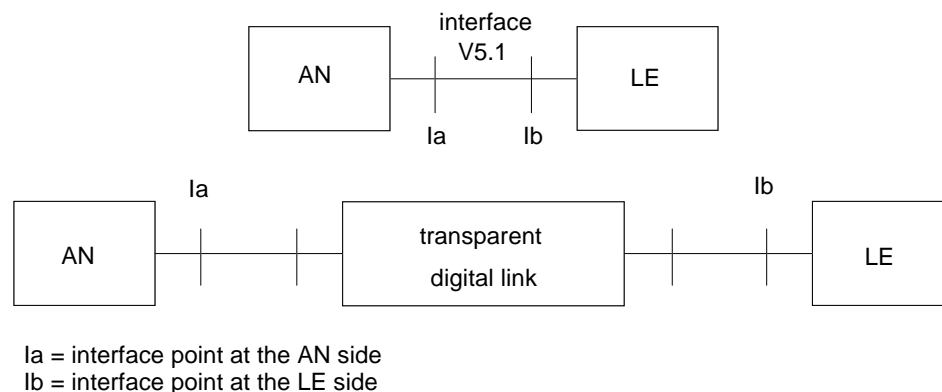
Ia = interface point at the AN side
Ib = interface point at the LE side

Figure 1: V5.1 application with and without transparent digital link

This clause identifies the layer 1 requirements from the referenced specifications including the specific characteristics and parameters.

The specific requirements and characteristics from ETS 300 166 [1] and CCITT Recommendation G.703 are listed in table 0a. Where the requirements do not fit into the table, only the reference is shown and the detailed requirements are given below.

Table 0a: Electrical/physical requirements from ETS 300 166 [1] or CCITT Recommendation G.703

Item	Requirements based on ETS 300 166 or CCITT Recommendation G.703	AN	LE
a)	Bit rate during operational condition	synchronous to LE	synchronous to LE internal clock
b)	Bit rate in free running mode	≤ ±50 ppm	≤ ±50 ppm for AIS
c)	Code	HDB3 (annex A/G.703)	
d)	Pulse shape	figure 15/G.703	
e)	Pairs in each direction	no test	
f)	Over voltage requirement - symmetrical interface - coaxial interface	annex B/G.703 figures B-1/G.703 and B-2/G.703	
g)	Test load impedance - input return loss - output return loss	6.3.3/G.703 5.3 [1]	

h)	Pulse shape normalized characteristics
	- nominal peak voltage of a mark
	    balanced
	    coaxial
	- peak voltage of a space
	    balanced
	    coaxial
	- nominal pulse width
		
		3 V
		2,37 V
		
		0 ± 0,3 V
		0 ± 0,237 V
		covered by item d)	

i)	Relative tolerance between consecutive pulses - ratio of the amplitudes at center of pulse - ratio of widths at nominal half amplitude	 0,95 to 1,05 0,95 to 1,05	
j)	Maximum output jitter	high-Q clock, see detailed requirements below	
k)	Tolerable longitudinal voltage - symmetrical interface - coaxial interface	 5.1 [1] not applicable	
l)	Immunity against reflections	6.3.4/G.703	
m)	Output signal balance - symmetrical interface - coaxial interface	 5.2 [1] not applicable	
n)	Tolerable input jitter and wander	G.823 [7], table 2/G.823 (low-Q)	
o)	Connection of outer conductor or screen	6.4/G.703 and table 1/G.703, note 7	

Detailed requirements for indicated items in table 0a:

a)   The synchronization of the AN to the LE clock frequency may be through the V5.1 interface or through a synchronization interface. The lock range of the AN shall be ≥ 1 ppm and the maximum frequency deviation from the nominal frequency during operation shall be ≤ 1 ppm.

c)   The HDB3 code is a modified Alternate Mark Inversion (AMI) code. Binary ONE bits are generally represented by alternate positive and negative pulses, and binary ZERO bits as spaces. Exceptions, as defined for the HDB3 code below, are made when strings of successive ZERO bits occur in the binary signal.

In the definition below, B represents an inserted pulse conforming to the AMI rule and V represents an AMI violation. The encoding of the binary signal in accordance with this rule includes frame alignment bits, etc.

Each block of 4 successive ZEROs shall be replaced by 000V or B00V. The choice of 000V or B00V shall be made so that the number of B pulses between consecutive V pulses is odd, i.e. successive V pulses shall be of alternate polarity so that no dc component is introduced.

d) The pulse mask given in figure 1a (which is based on figure 15/G.703) shall be met at the output port of the layer 1 interface with the amplitude values as defined in table 0a, item h).
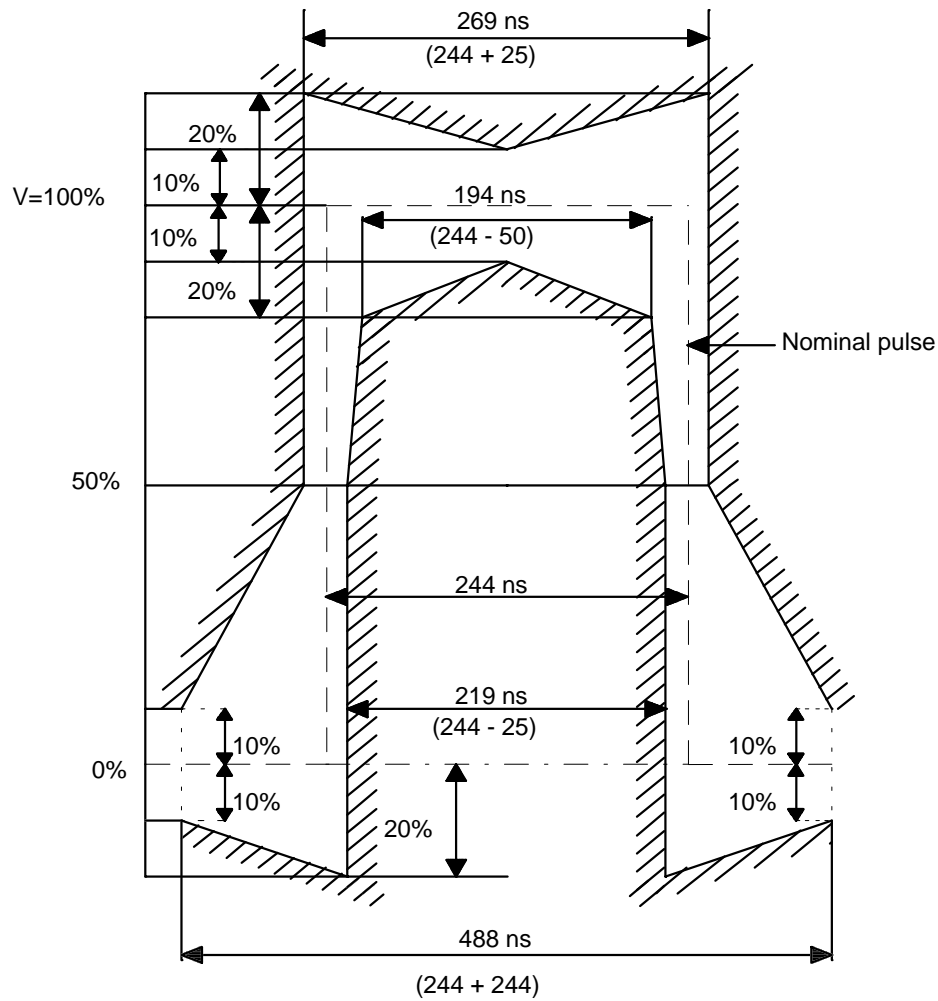

Figure 1a: Mask of the pulse at the output port of the layer 1 interface

f) The input and output ports shall withstand without damage the following tests with 10 standard lightning pulses (1,2/50 μs) with a maximum amplitude of U (5 negative and 5 positive impulses).

1) at the interface for symmetrical pairs:

- differential mode: with a pulse generator as defined in figure 1b (which is based on figure B-1/G.703), no test value is specified;

- common mode: with a pulse generator as defined in figure 1c (which is based on figure B-2/G.703), U = 100 Vdc.
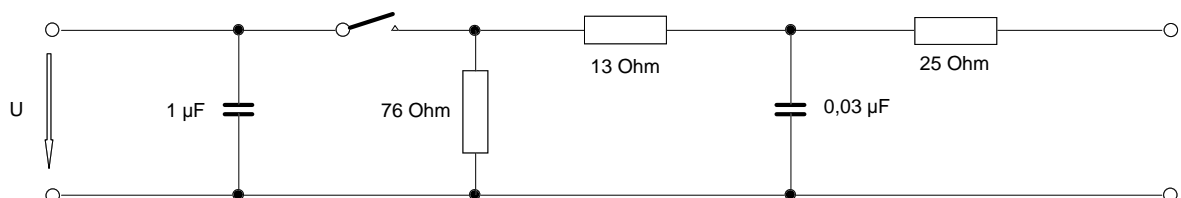

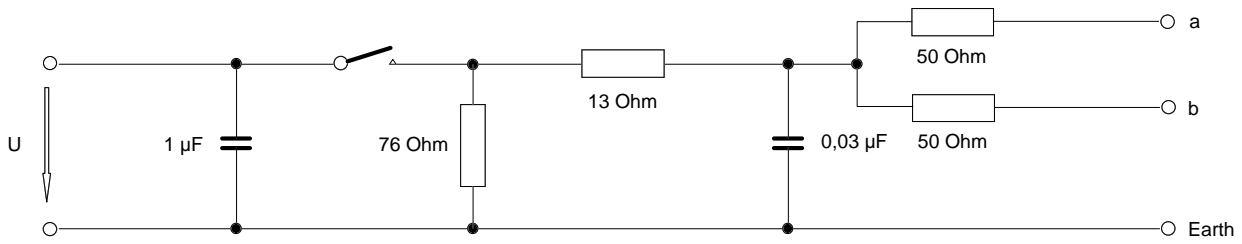**Figure 1b: Pulse generator 1,2/50 μs for differential mode voltages**

Figure 1c: Pulse generator 1,2/50 μs for common mode voltages at symmetrical interfaces

2)   at the interface for coaxial pairs:

due to the lack of detailed requirements and test voltages there are no tests defined. However, the pulse generator defined in figure 1b may be used for differential mode voltage test.

g)   The input port of the layer 1 interface shall meet the return loss requirements as given in table 0b.

Table 0b: Input port return loss

Frequency range (kHz)	Return loss (dB)
51 to 102	≥ 12
102 to 2 048	≥ 18
2 048 to 3 072	≥ 14

The output port of the layer 1 interface shall meet the return loss requirements as given in table 0c.

Table 0c: Output port return loss

Frequency range (kHz)	Return loss (dB)
51 to 102	≥ 6
102 to 3 072	≥ 8

j)   The output port of the layer 1 interface shall meet the jitter limit of $\leq 0,11$ UI when measured with a band-pass with cut-off frequencies at 40 Hz (first order linear high-pass) and 100 kHz with presence of tolerable jitter at the relevant synchronizing input port.

k)   The input port of the layer 1 interface shall meet the requirement for minimum tolerance to longitudinal voltage and the receiver shall operate without errors with any valid input signal in the presence of a longitudinal voltage V_L.

The test value V_L shall be 2 V_{rms} over the frequency range 10 Hz to 30 MHz.

l)   The input port of the layer 1 interface shall have adequate immunity against reflections that can arise due to impedance irregularities at digital distribution frames and at digital output ports and shall meet the following requirement:

A nominal aggregate signal, encoded into HDB3 and having a pulse shape as defined in the pulse mask, shall have added to it an interfering signal with the same pulse shape as the wanted signal. The interfering signal shall have a bit rate within the limits specified below but shall not be synchronous with the wanted signal. The interfering signal shall be combined with the wanted signal in a combining network, with an overall zero loss in the signal path and with the nominal impedance 75 Ω (in the case of coaxial-pair interface) or 120 Ω (in the case of symmetrical-pair interface), to give a signal-to-interference ratio of 18 dB. The binary content of the interfering signal shall comply with CCITT Recommendation O.151 [9], subclause 2.1 (2^{15} - 1 bit period). No errors shall result when the combined signal, attenuated by up to the maximum specified interconnecting cable loss, is applied to the input port.

m) The output port of the layer 1 interface shall meet the output signal balance requirement, which shall be measured in accordance with CCITT Recommendation O.9 [8], subclause 2.7:

    1) at 1 024 kHz: $\geq$ 40 dB;

    2) 1 024 kHz to 30 MHz: minimum value decreasing from 40 dB at 20 dB/decade.

n) The output port of the layer 1 interface shall meet the jitter and wander requirements defined in figure 1d and table 0d.
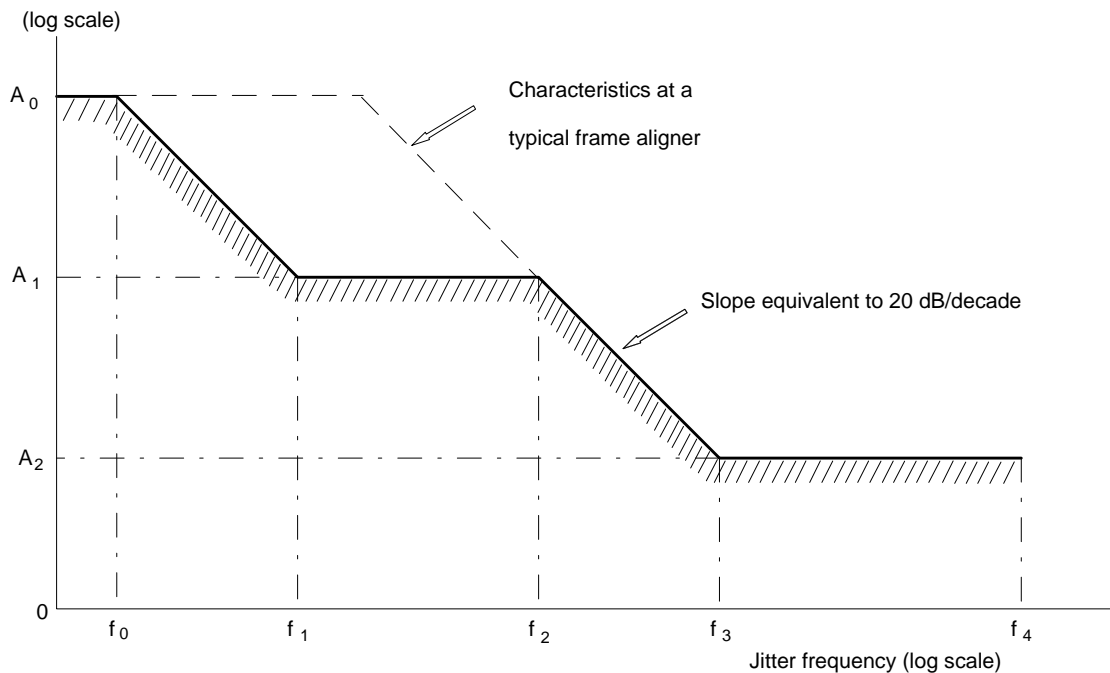

Figure 1d: Lower limit of maximum tolerable input jitter and wander

Table 0d: Parameter values for input jitter and wander tolerance

Peak-to-peak amplitude (unit interval UI)			Frequency (Hz)				
A_0	A_1	A_2	f_0	f_1	f_2	f_3	f_4
36,9 (18 μs)	1,5	0,2	$1,2 \times 10^{-5}$	20	$2,4 \times 10^3$	18×10^3	100×10^3
NOTE 1: 1 UI = 488 ns.							
NOTE 2: The value for A_0 represents a relative phase deviation between the incoming signal and the internal timing local signal derived from the reference clock.							
NOTE 3: The wander requirement of 26 μs takes into account the application of SDH transmission systems providing the transparent digital link between the AN and LE.							

The tolerance to jitter of interface inputs shall conform with the requirements for low-Q clock recovery according to CCITT Recommendation G.823 [7]. Interface outputs shall conform with the requirements for high-Q clock recovery according to CCITT Recommendation G.823 [7] even with tolerable input jitter according to low-Q clock recovery, i.e. a jitter reduction capability is required in the frequency area between high-Q and low-Q cut off frequencies for the jitter transfer. This requirement supports independence of the interface implementation from application in networks using different clock recovery Q factors as well as with an additional digital link to increase the range of the interface.

o) The outer conductor of the coaxial pair or the screen of the symmetrical pair shall be connected to the signal ground both at the input and at the output port of the layer 1 interface."

Page 21, clause 5

Replace the complete text of clause 5 by:

"The functional and procedural requirements of the interface shall conform to ETS 300 167 [2], 2 048 kbit/s case. The CRC-4 procedure specified in ETS 300 167 [2] shall be applied including the Cyclic Redundancy Check (CRC) error reporting using bit E in the CRC-multiframe.

This clause identifies the layer 1 requirements from the referenced specifications including the specific characteristics and parameters.

The specific requirements and characteristics from ETS 300 167 [2] and CCITT Recommendation G.704 are listed in table 0e. Where the requirements do not fit into the table, only the reference is shown and the detailed requirements are given below.

Table 0e: Functional requirements from ETS 300 167 [2] or CCITT Recommendation G.704

Item	Requirements based on ETS 300 167 or CCITT Recommendation G.704	AN	LE
a)	Frame length	2.3.1/G.704	
b)	Allocation of bits 1 to 8	2.3.2/G.704	
c)	Use of bit 1 for CRC-4	2.3.3.1/G.704, but covered by items d) and e)	
d)	Allocation of bit 1	2.3.3.2/G.704 and 2.3.3.3/G.704	
e)	Use of bit 1 of CRC-4 multiframe	2.3.3.4/G.704	
f)	Cyclic redundancy check	2.3.3.5/G.704	
g)	Frame structure	5.1.1/G.704	

Detailed requirements for indicated items in table 0e:

a)   The frame length shall be 256 bits, numbered 1 to 256. The frame repetition rate shall be 8 kHz.

b)   The allocation of bits number 1 to 8 of the frame shall be as defined in table 0f.

Table 0f: Allocation of bits 1 to 8 of the frame

	Bit number							
Alternate frames	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Frame containing the frame alignment signal	S_i note 1	0	0	1	1	0	1	1
		Frame alignment signal						
Frame not containing the frame alignment signal	S_i note 1	1 note 2	A note 3	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
				note 4				
NOTE 1: This bit shall be used for the CRC-4 procedure.								
NOTE 2: This bit shall be fixed at ONE.								
NOTE 3: This bit shall be used for the Remote Alarm Indication (RAI). In undisturbed operation, set to ZERO; in alarm condition, set to ONE.								
NOTE 4: These bits are not used in the V5.1 interface and shall be set to ONE.								

d)   The allocation of bits 1 to 8 of the frame shall be as defined in table 0g.

Each CRC-4 multiframe, which is composed of 16 frames numbered 0 to 15, shall be divided into two 8-frame Sub-Multiframes (SMF), designated SMF I and SMF II which signifies their respective order of occurrence within the CRC-4 multiframe structure. The SMF shall be of the CRC-4 block size (i.e. 2 048 bits).

Table 0g: CRC-4 multiframe structure

	Sub-multiframe (SMF)	Frame number	Bits 1 to 8 of the frame							
			1	2	3	4	5	6	7	8
Multiframe	I	0	C_1	0	0	1	1	0	1	1
		1	0	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
		2	C_2	0	0	1	1	0	1	1
		3	0	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
		4	C_3	0	0	1	1	0	1	1
		5	1	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
		6	C_4	0	0	1	1	0	1	1
		7	0	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
	II	8	C_1	0	0	1	1	0	1	1
		9	1	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
		10	C_2	0	0	1	1	0	1	1
		11	1	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
		12	C_3	0	0	1	1	0	1	1
		13	E	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
		14	C_4	0	0	1	1	0	1	1
		15	E	1	A	S_{a4}	S_{a5}	S_{a6}	S_{a7}	S_{a8}
Notation: C_1 to C_4 = CRC-4 bits E = CRC-4 error indication bits A = Remote Alarm Indication (RAI)										

e) In those frames containing the frame alignment signal, bit 1 shall be used to transmit the CRC-4 bits. There are four CRC-4 bits, designated C_1, C_2, C_3 and C_4 in each SMF.

In those frames not containing the frame alignment signal, bit 1 shall be used to transmit the 6-bit CRC-4 multiframe alignment signal and two CRC-4 error indication bits (E).

The CRC-4 multiframe alignment signal shall have the form 001011.

The E-bits shall be used to indicate received faulty sub-multiframes by setting the binary state of one E-bit from ONE to ZERO for each faulty sub-multiframe. Any delay between the detection of an faulty sub-multiframe and the setting of the E-bit that indicates the error state shall be less than 1 second.

The E-bits shall always be taken into account even if the SMF which contains them is found to be faulty.

f) Cyclic redundancy check

Multiplication/division process:

a particular CRC-4 word, located in sub-multiframe N, shall be the reminder after multiplication by x^4 and then division (modulo 2) by the generator polynomial $x^4 + x + 1$, of the polynomial representation of sub-multiframe (N - 1). When representing the contents of the check block as a polynomial, the first bit in the block, i.e. frame 0, bit 1 or frame 8, bit 1, shall be the most significant bit. Similarly, C_1 shall be the most significant bit of the remainder and C_4 the least significant bit of the remainder.

Encoding procedure:

1) the CRC-4 bits in the SMF shall be replaced by ZEROs;
2) the SMF shall then be acted upon by the multiplication/division process specified above;
3) the remainder resulting from the multiplication/division process shall be stored, ready for insertion into the respective CRC-4 locations of the next SMF.

Decoding procedure:

1) a received SMF shall be acted upon by the multiplication/division process specifies above, after having its CRC-4 bits extracted and replaced by ZEROs;
2) the remainder resulting from this division process shall then be stored and subsequently compared on a bit-by-bit basis with the CRC bits received in the next SMF;
3) if the remainder calculated in the decoder exactly corresponds to the CRC-4 bits received in the next SMF, it is assumed that the checked SMF is error free.

g) Bits 1 to 256 of the frame shall be structured into 32 octet interleaved 64 kbit/s time slots numbered 0 to 31. Each time slot shall have eight bits, numbered 1 to 8.

The allocation of bits of time slot 0 (bits 1 to 8 of the frame) shall be as defined in table 6. The use of the other time slots shall be as defined in subclause 8.3.

The specific requirements and characteristics from ETS 300 167 [2] and CCITT Recommendation G.706 are listed in table 0h. Where the requirements do not fit into the table, only the reference is shown and the full requirement is given below.

Table 0h: Functional requirements from ETS 300 167 [2] or CCITT Recommendation G.706

Item	Requirements based on ETS 300 167 or CCITT Recommendation G.706	AN	LE
a)	Loss of frame alignment	4.1.1/G.706	
b)	Recovery of frame alignment	4.1.2/G.706	
c)	CRC multiframe alignment	4.2/G.706	
d)	CRC bit monitoring	4.3.1/G.706 and 4.3.2/G.706, 4.3.3/G.706 is replaced by item e)	
e)	Error performance monitoring	14.3.4 (this ETS)	
f)	Status indication	14.3.2, 14.3.3 (this ETS)	
g)	Bearer channel allocation by provisioning	7.2.2, 8.3 (this ETS)	
h)	PSTN port bearer channel interruption	13.5.3.1.1.1, 13.5.3.1.2.1 (this ETS)	not relevant

Detailed requirements for indicated items in table 0h:

a) Frame alignment shall be assumed to have been lost when three consecutive incorrect frame alignment signals have been received. Loss of frame alignment shall also be invoked by an inability to achieve CRC multiframe alignment as specified in item c), or by exceeding the specified limit of faulty CRC message blocks as specified in item d).

NOTE: In addition, frame alignment may be assumed to have been lost when bit 2 in time slot 0 in frames not containing the frame alignment signal has been received with an error on three consecutive occasions.

b) Frame alignment shall be assumed to have been recovered when the following sequence is detected:

1) for the first time, the presence of the correct frame alignment signal;
2) the absence of the frame alignment signal in the following frame detected by verifying that bit 2 of the basic frame is a ONE;
3) for the second time, the presence of the correct frame alignment signal in the next frame.

To avoid the possibility of a state in which no frame alignment can be achieved due to the presence of a spurious frame alignment signal, the following procedure shall be used. When a valid frame alignment signal is detected in frame N, a check shall be made to ensure that a frame alignment signal does not exist in frame N + 1, and also that a frame alignment signal exists in frame N + 2. Failure to meet one or both of these requirements shall cause a new search to be initiated in frame N + 2.

c) If frame alignment condition has been achieved, CRC multiframe alignment shall be deemed to have occurred if at least two valid CRC multiframe alignment signals can be located within 8 ms, the time separating two CRC multiframe alignment signals being 2 ms or a multiple of 2 ms. The search for the CRC multiframe alignment signal shall be made only in basic frames not containing the frame alignment signal.

If multiframe alignment cannot be achieved within 8 ms, it shall be assumed that frame alignment is due to a spurious frame alignment signal and a re-search for frame alignment shall be initiated. The re-search for frame alignment shall be started at a point just after the location of the assumed spurious frame alignment signal. This will usually avoid realignment onto the spurious frame alignment signal.

Consequent actions taken as a result of loss of frame alignment shall no longer be applied once frame alignment has been recovered. However, if CRC multiframe alignment cannot be achieved within a time limit in the range of 100 ms to 500 ms, consequent actions shall be taken equivalent to those specified for loss of frame alignment.

d) If frame and CRC multiframe alignment have been achieved, the monitoring of the CRC bits in each sub-multiframe shall commence. The monitoring procedure shall be according to clause 4, item f), decoding procedure.

The threshold count of ≥ 915 faulty CRC blocks out of 1 000 indicates false frame alignment and the re-search for frame alignment shall be started at a point just after the location of the assumed frame alignment signal. This will usually avoid realignment onto the spurious frame alignment signal."

Page 31, subclause 8.7.3, last sentence

Replace the term "operational and activated" by "in the access activated state". The last sentence reads:

"The user port stays in the access activated state to enable periodic D-channel unblocking by the LE management to verify the persistence of the problem."

Page 40, subclause 10.4.5.5.2

Replace the complete text of subclause 10.4.5.5.2 by:

"Since the only unnumbered command, which may be used for the peer-to-peer procedures of the data link sublayer, is the SABME command, a collision of different transmitted and received unnumbered commands cannot occur. The corresponding subclause 5.5.5.2 of ETS 300 125 [5] (Q.921) is not applicable."

Page 44, subclause 11.1, fifth hyphen

Replace the term "HDSL" by "HDLC".

Page 60, table 20

Replace the last row of table 20 by the following two rows:

⋮	⋮
1 0 0 0 to 1 1 1 0	not used
1 1 1 1	not applicable

Page 65, subclause 13.4.7.5, last sentence

Move the sentence "Bits 5 and 6 of the third octet shall be ZERO" as a note to figure 24.

Page 65, subclause 13.4.7.6, last sentence

Move the sentence "Bit 7 of the fourth octet shall be ZERO" as a note to figure 25.

Page 71, subclause 13.5.2.1, second paragraph

Delete in the second paragraph the expression "value No.1".

Page 74, subclause 13.5.2.10, first sentence

Delete the first sentence.

Page 74, subclause 13.5.2.10, fourth paragraph

Delete "and generate an internal error indication". The fourth paragraph reads:

"the LE V5 Protocol entity: shall ignore the message, send a STATUS ENQUIRY message and apply the procedures specified in subclause 13.5.2.13."

Page 77, subclause 13.5.3, last sentence

Replace the term "message sequence error" by "unexpected message". The last sentence reads:

"The result of this process shall be, either the handling of unexpected messages or the ignorance of the message (this may lead to the path failure)."

Page 77, subclause 13.5.3.1.1.2, second bullet item

Replace "13.5.3" by "13.5.3.6" in the second bullet item.

Page 86, subclause 13.5.4.1.2

Replace the complete text of subclause 13.5.4.1.2 by:

"The AN Protocol entity receiving a PROTOCOL PARAMETER message in any other state than the PATH ACTIVE or the PATH DISCONNECT REQUEST state shall apply procedures specified in subclause 13.5.2.10."

Page 92, table 29, row ESTABLISH

Delete all references to note 3.

Page 93, table 29, row PROTOCOL PARAMETER, column AN7

Delete the sending of STATUS (only "-" remains):

STATE EVENT		...	DISCONNECT REQUEST AN7
⋮		⋱	⋮
PROTOCOL PARAMETER (NOTE 7)		...	-
⋮			⋮

Page 94, table 30, row STATUS, columns LE0 and LE6

Split the cells in two rows and apply note 11 accordingly (as for states LE1 to LE4):

STATE EVENT	OUT OF SERVICE LE0		...	PORT BLOCKED LE6
⋮	⋮		⋱	⋮
STATUS (NOTE 11)	stop T4 (NOTE 10); - MDU-error_ind.; -			stop T4 (NOTE 10); - MDU-error_ind.; -
⋮	⋮			⋮

Page 95, table 30, row FE-disconnect_complete_request, column LE2

Replace "/" by "stop timers, DISCONNECT COMPLETE, LE1":

STATE EVENT		...	PATH INITIATED BY LE LE2		...
⋮		⋱	⋮		
FE-disconnect_ complete_request		...	stop timers, DISC. COMPLETE; LE1		...
⋮			⋮		⋱

Page 96, note 3

Delete note 3.

Page 106, table 35, row FE201, column AN 2.2

Add the sending of FE104:

State State name Event		...	AN 2.2 Access activated		...
⋮		⋱	⋮		
FE201		...	MPH-UBI; FE104; -		...
⋮			⋮		⋱

Page 117, table 48, notes

Replace notes 1 to 3 by a general note:

"NOTE: Refer to table 55 for the required combinations of included optional information elements depending on the control function ID."

Page 124, subclause 14.4.4.1, third paragraph, last sentence

Replace the term "state 1" by "state AN1/LE1". The last sentence reads:

"The next event shall be transmitted when the relevant control protocol FSM has entered state AN1/LE1."

Page 127, subclause 14.4.4.2.10

Replace "tables 50 and 57" by "tables 48 and 55".

Page 139, annex C, item 2), second paragraph

Replace in the second sentence "subclause 7.1.1.3)" by "subclause 7.1.1, item 3)".

Page 139, annex C, item 5)

Insert at the end of item 5):

"The remote side shall react on a MPH-UBR within a time limit of 5 min with MPH-BI or MPH-UBI."

Page 141, annex C, item 12), "Re-provisioning verification:"

Replace the second sentence "This procedure (...) re-provisioning" by:

"This procedure avoids a situation in which ports are operational while there is a mismatch of variant ID or interface ID after re-provisioning."

Page 142, annex C, item 13)

Insert at the end of item 13):

"During the system startup procedure all user ports shall enter the blocked state. After the completion of the system startup procedure, all relevant ports shall go through the co-ordinated unblock procedure. In case of an unsuccessful check of the variant&interface ID a notification shall be given to the maintenance entity and the process shall be stopped. A system integrity process shall ensure that the system management is put into the SYSTEM STARTUP state repeatedly."

Page 142, annex C, item 14 a), second paragraph, first sentence

Modify the first sentence as follows:

"Upon reception of the MDU-CTRL (restart complete) from the control protocol entity timer TR2 shall be stopped; upon reception of the MDU-CTRL (restart ack) indication from all state machines of the PSTN protocol entity timer TR1 shall be stopped and a MDU-CTRL (restart complete) shall be sent to the control protocol entity."

Page 142, annex C, item 14 b)

Replace the complete text of item 14 b) by:

"b) if a MDU-CTRL (restart request) is received from the control protocol entity, a MDU-CTRL(restart request) shall be sent to all PSTN protocol FSMs. Timers TR1 and TR2 shall be started and the state REST2 shall be entered.

Upon receipt of the MDU-CTRL (restart complete) from the control protocol entity timer TR2 shall be stopped; upon receipt of the MDU-CTRL (restart ack) indication from all state machines of the PSTN protocol entity timer TR1 shall be stopped and a MDU-CTRL (restart complete) shall be sent to the control protocol entity. When the MDU-CTRL (restart complete) indication from the control protocol and the MDU-CTRL (restart ack) indications from all state machines of the PSTN protocol entity have been received a MDU-CTRL (restart complete) indication shall be sent to all state machines of the PSTN protocol entity.

Upon expiry of TR1 or TR2 an error indication shall be sent to the maintenance entity and the IN SERVICE state shall be entered;"

Page 143, annex C, item 14 c), second paragraph

Replace the second paragraph by:

"Upon receipt of the MDU-CTRL (restart complete) from the control protocol entity timer TR2 shall be stopped; upon receipt of the MDU-CTRL (restart ack) indication from all state machines of the PSTN protocol entity timer TR1 shall be stopped and a MDU-CTRL (restart complete) shall be sent to the control protocol entity. When the MDU-CTRL (restart complete) indication from the control protocol and the MDU-CTRL (restart ack) indications from all state machines of the PSTN protocol entity have been received an MDU-CTRL (restart complete) indication shall be sent to all state machines of the PSTN protocol entity."

Page 143, annex C, item 17, last paragraph

Replace the last sentence by:

"The PSTN restart procedure (refer to annex C, item 14) shall be invoked after the re-establishing of the PSTN_DL. On completion of the PSTN restart a MDU-CTRL (port unblocked) shall be sent to the appropriate PSTN protocol FSMs."

Page 145, annex C, table C.1, row TC2, column Cause for start
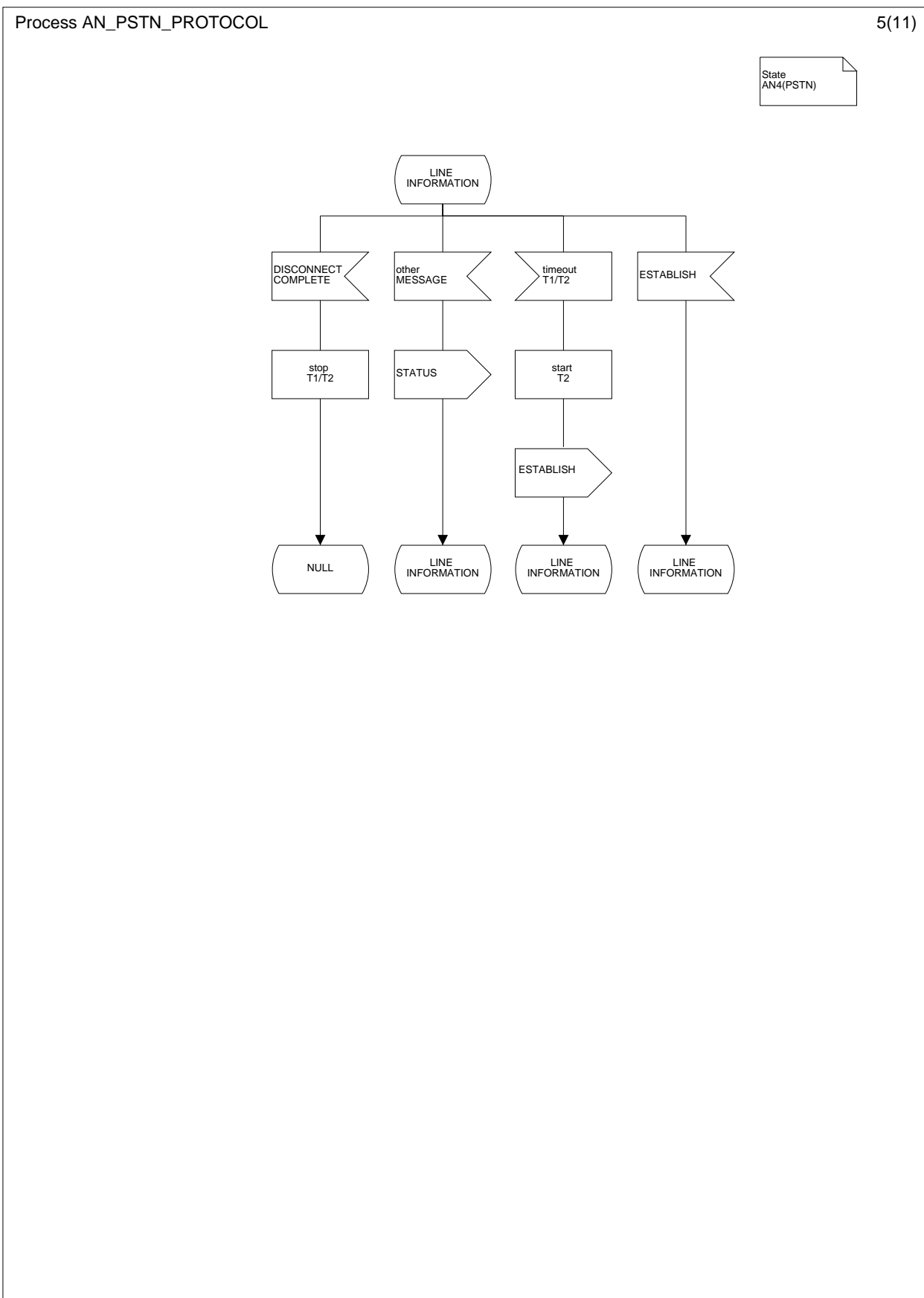
Replace the text by: "Expiry of TC1".

Page 188, figure L.9.1, state "OUT OF SERVICE"
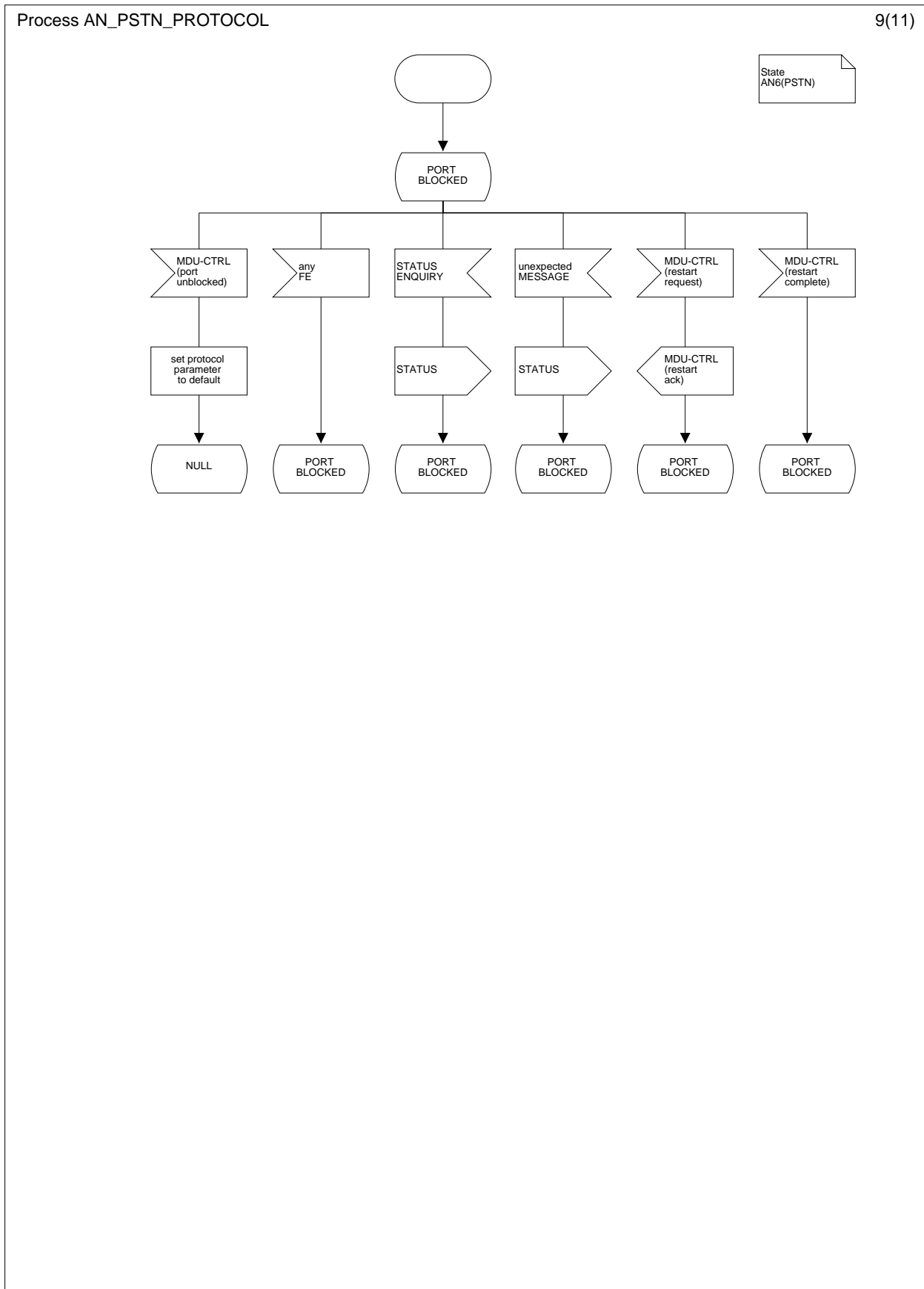
Delete the start symbol.
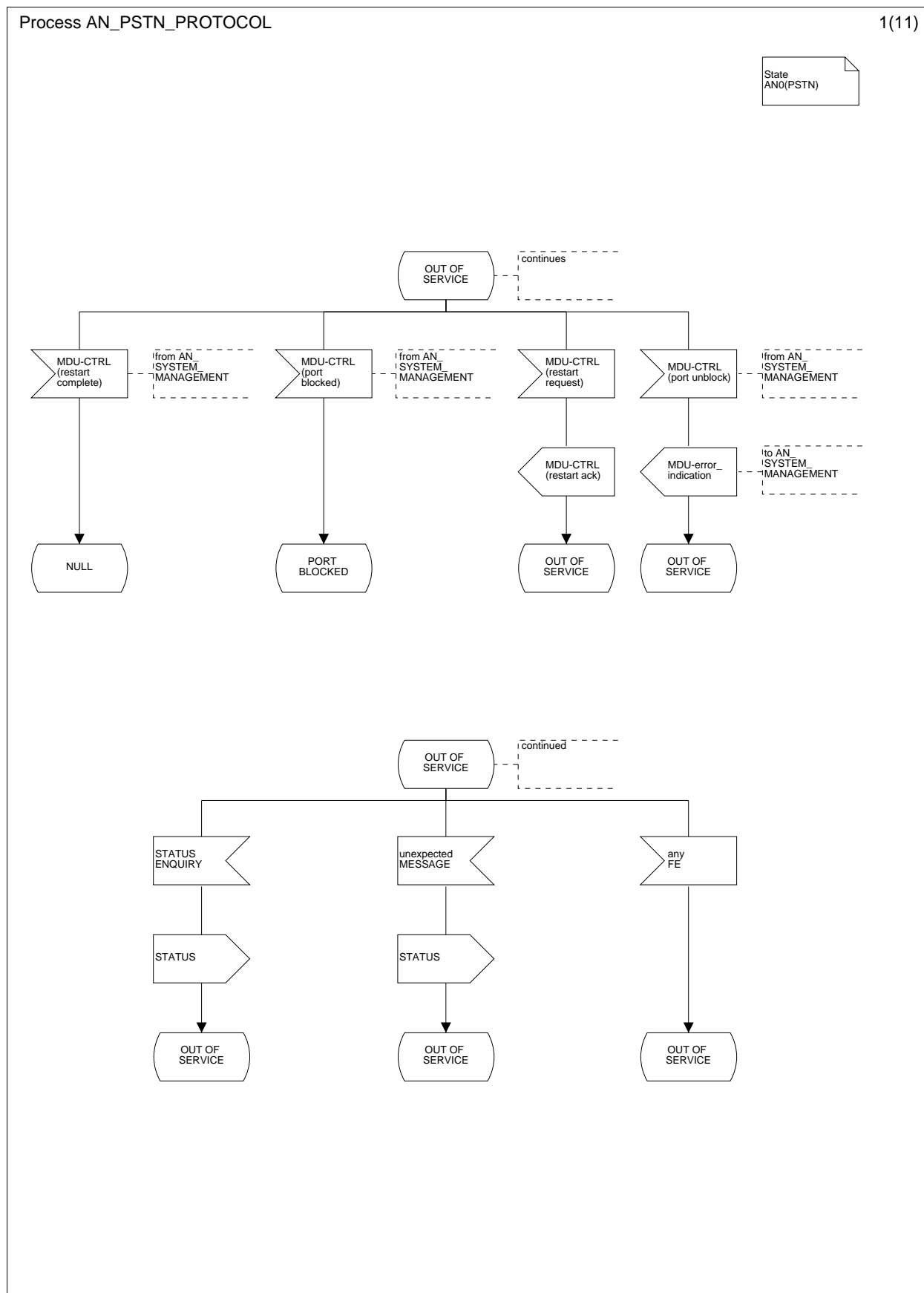
Page 192, figure L.9.5, state "LINE INFORMATION", branch "other MESSAGE"
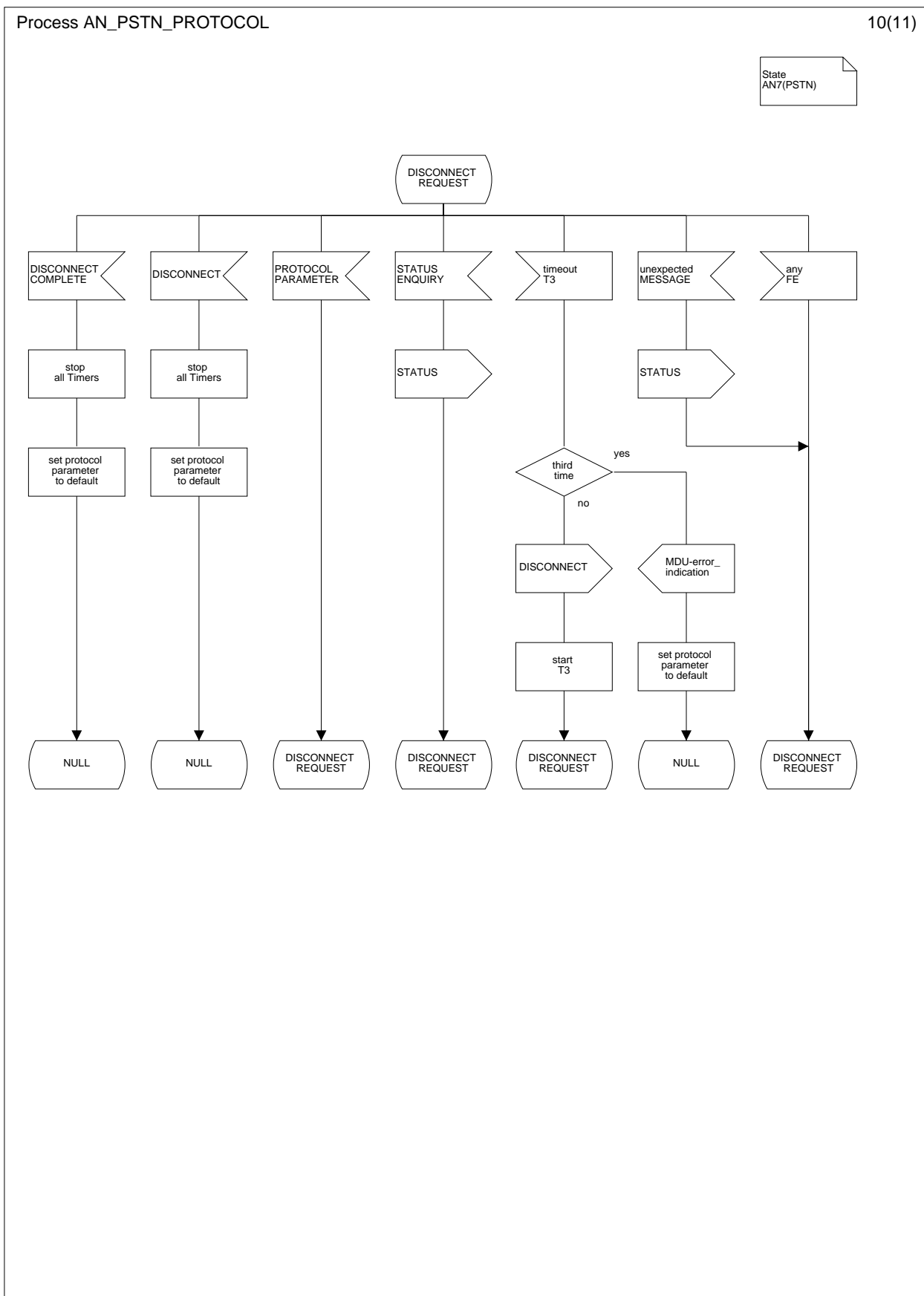
Add a new branch "ESTABLISH" as shown below.

Page 196, figure L.9.9, state "PORT BLOCKED"

Add the start symbol and a transition to "PORT BLOCKED".
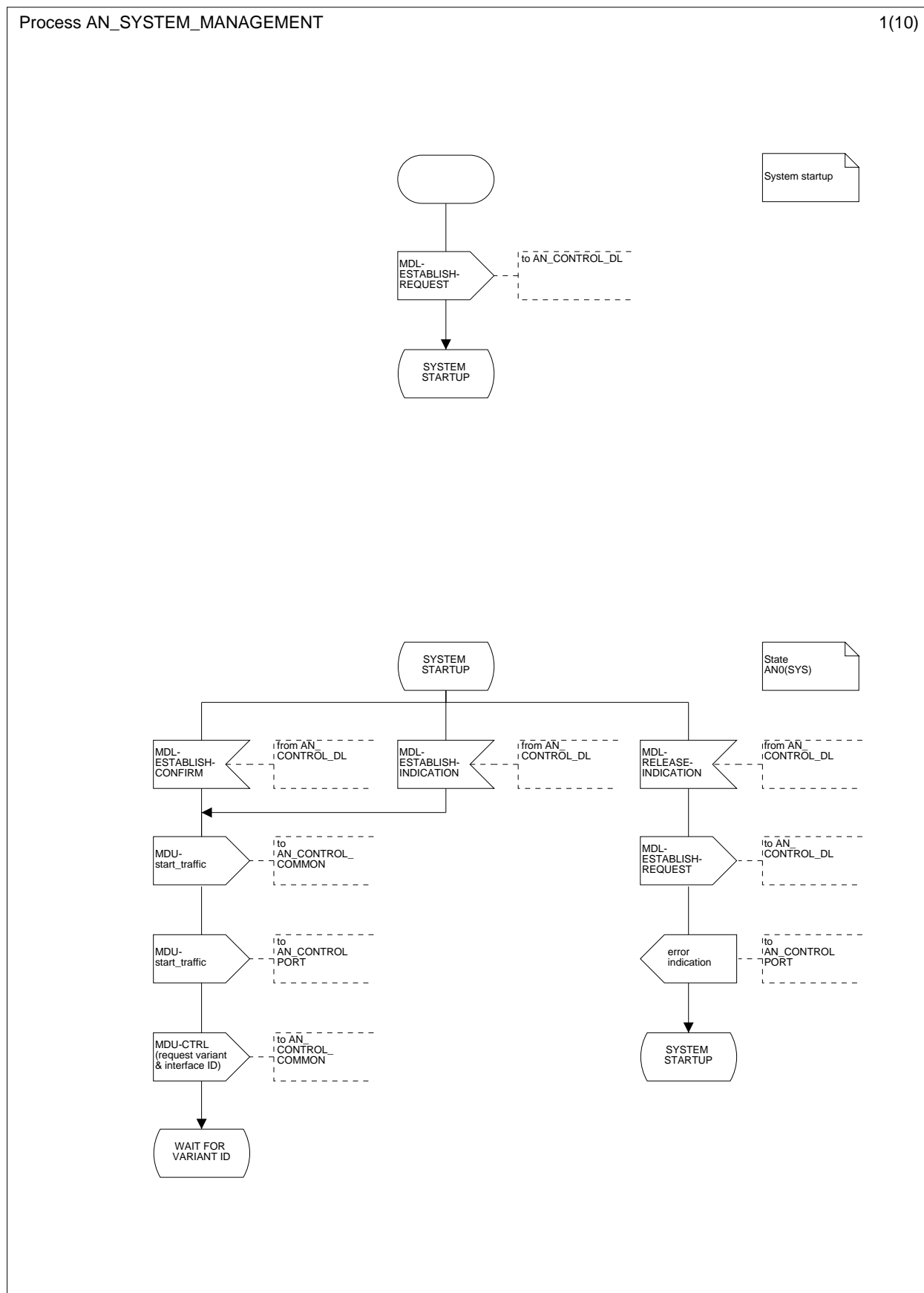
Page 197, figure L.9.10, state "DISCONNECT REQUEST", branch "PROTOCOL PARAMETER"

Delete the sending of STATUS message.

Page 217, figure L.17.1, state "SYSTEM STARTUP"

Add a new branch "MDL-RELEASE-INDICATION" as shown below.
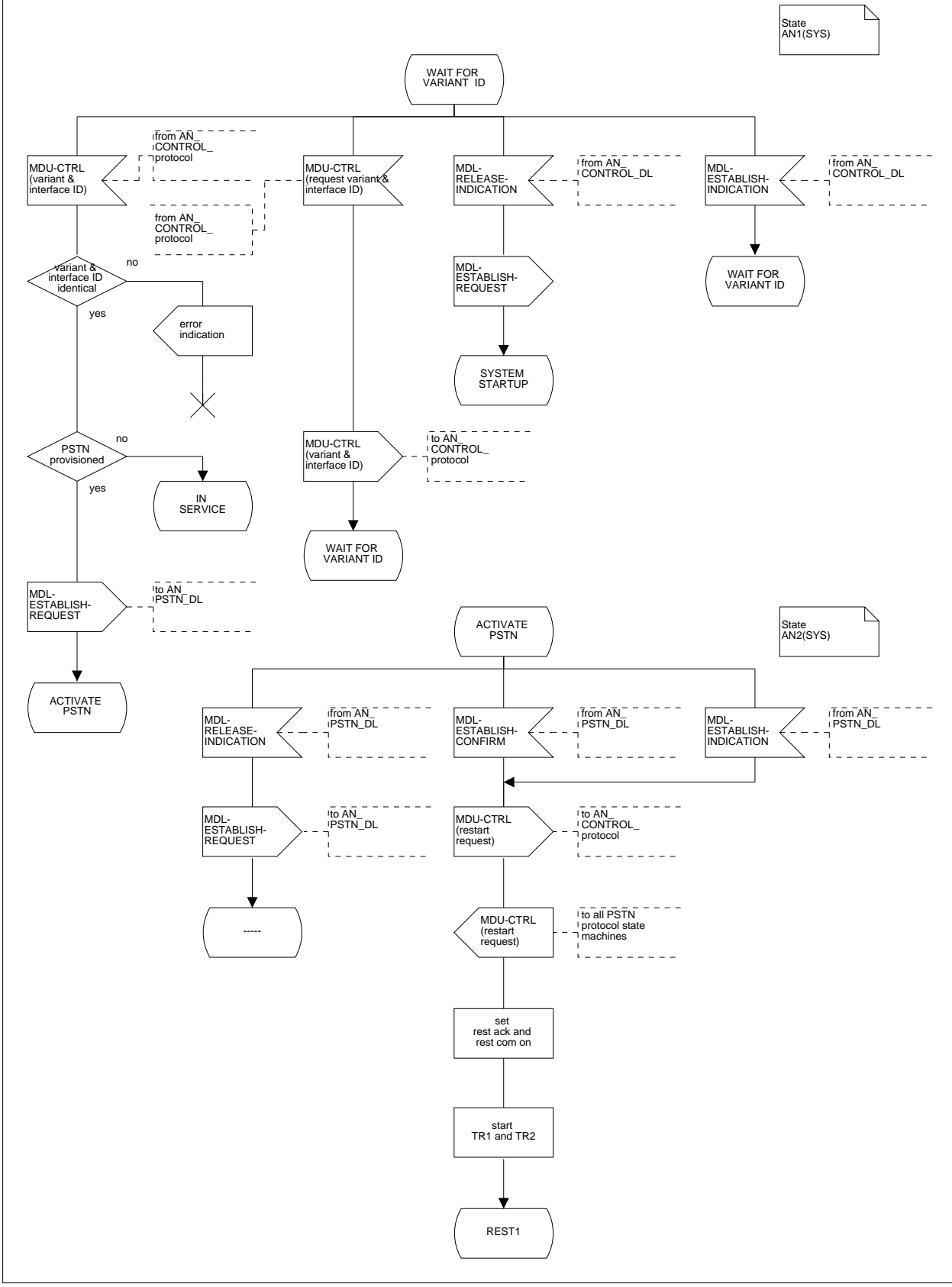
Page 218, figure L.17.2

State "WAIT FOR VARIANT ID", branch "MDU-CTRL (variant&interface ID)":
Replace decision "ID identical" by "variant&interface ID identical".

State "WAIT FOR VARIANT ID":
Add a new branch "MDU-CTRL(request variant&interface ID)" as shown below.

State "ACTIVATE PSTN":
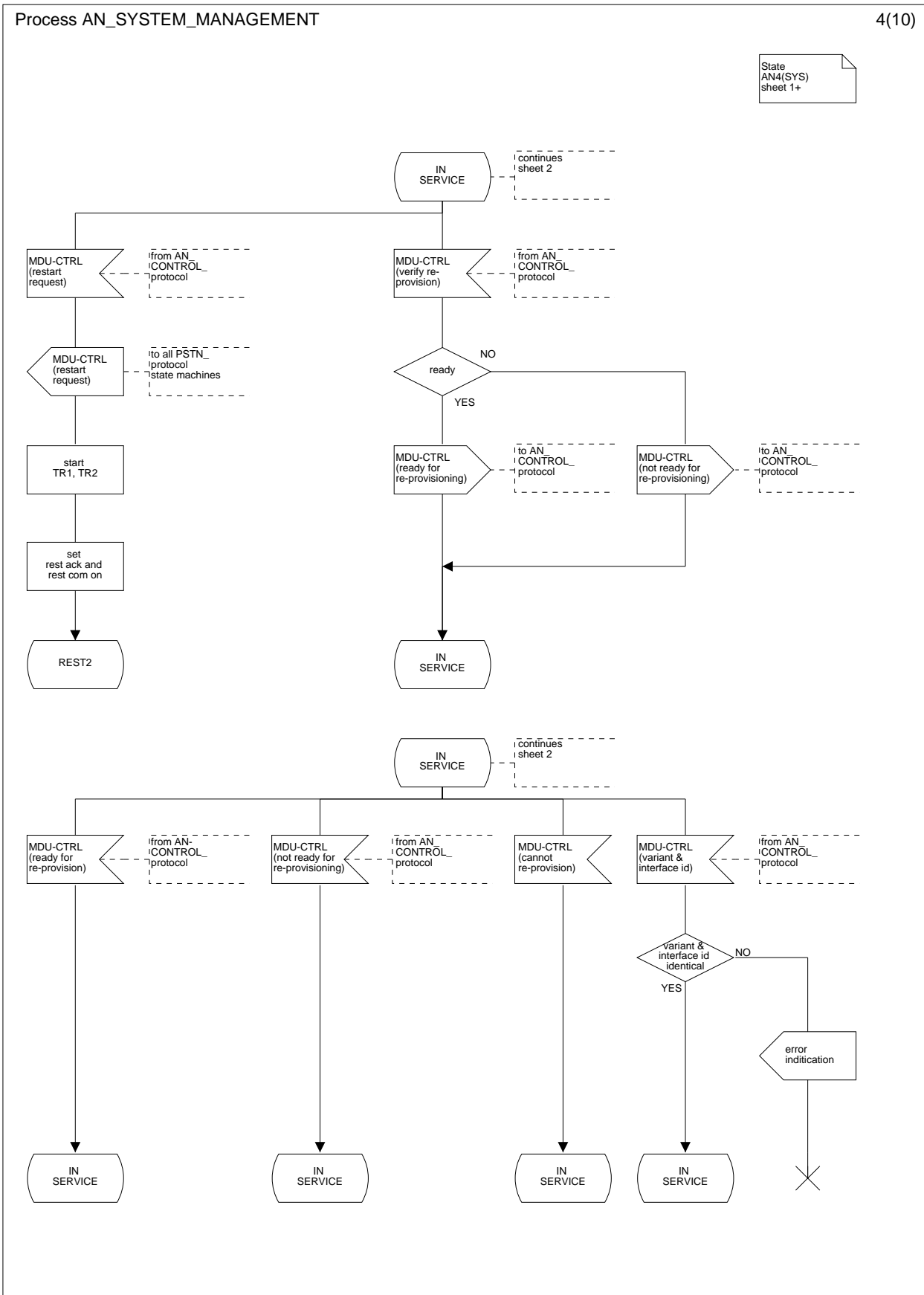Add a new branch "MDL-RELEASE-INDICATION" as shown below.

Process AN_SYSTEM_MANAGEMENT   2(10)

State
AN1(SYS)

WAIT FOR
VARIANT ID

MDU-CTRL
(variant &
interface ID) ◁ --- from AN_
                    CONTROL_
                    protocol

MDU-CTRL
(request variant &
interface ID) ◁

MDL-
RELEASE-
INDICATION ◁ --- from AN_
                  CONTROL_DL

MDL-
ESTABLISH-
INDICATION ◁ --- from AN_
                  CONTROL_DL

--- from AN_
    CONTROL_
    protocol

variant &
interface ID
identical

no

error
indication

✕

MDL-
ESTABLISH-
REQUEST ▷

SYSTEM
STARTUP

WAIT FOR
VARIANT ID

yes

PSTN
provisioned

no

MDU-CTRL
(variant &
interface ID) ▷ --- to AN_
                    CONTROL_
                    protocol

yes

IN
SERVICE

WAIT FOR
VARIANT ID

MDL-
ESTABLISH-
REQUEST ▷ --- to AN_
                PSTN_DL

ACTIVATE
PSTN

State
AN2(SYS)

ACTIVATE
PSTN

ACTIVATE
PSTN

MDL-
RELEASE-
INDICATION ◁ --- from AN_
                  PSTN_DL

MDL-
ESTABLISH-
CONFIRM ◁ --- from AN_
                PSTN_DL

MDL-
ESTABLISH-
INDICATION ◁ --- from AN_
                  PSTN_DL

MDL-
ESTABLISH-
REQUEST ▷ --- to AN_
                PSTN_DL

MDU-CTRL
(restart
request) ▷ --- to AN_
                CONTROL_
                protocol

MDU-CTRL
(restart
request) ▷ --- to all PSTN
                protocol state
                machines

set
rest ack and
rest com on

start
TR1 and TR2

REST1

Page 220, figure L.17.4, state "IN SERVICE", branch "MDU-CTRL (restart request)"

Replace task "set rest ack on" by task "set rest ack and rest com on". Replace task "start TR1" by task "start TR1, TR2".

Process AN_SYSTEM_MANAGEMENT   4(10)

State
AN4(SYS)
sheet 1+

Page 223, figure L.17.7, state "ANY STATE Except AN0, AN1"

Change "ANY STATE except AN0, AN1" to "ANY STATE except AN0, AN1, AN2".

Branch "MDL-RELEASE-INDICATION":
TC3 is only started if not running.

Branch "MDL-ESTABLISH-CONFIRM":
MDU-CTRL (port unblocked) is only sent if ports are blocked. Insert a new decision.

Branch "timeout TC3":
A new flag "ports blocked" is set in order to support the new decision in branch "MDL-ESTABLISH-CONFIRM".

Process AN_SYSTEM_MANAGEMENT   7(10)
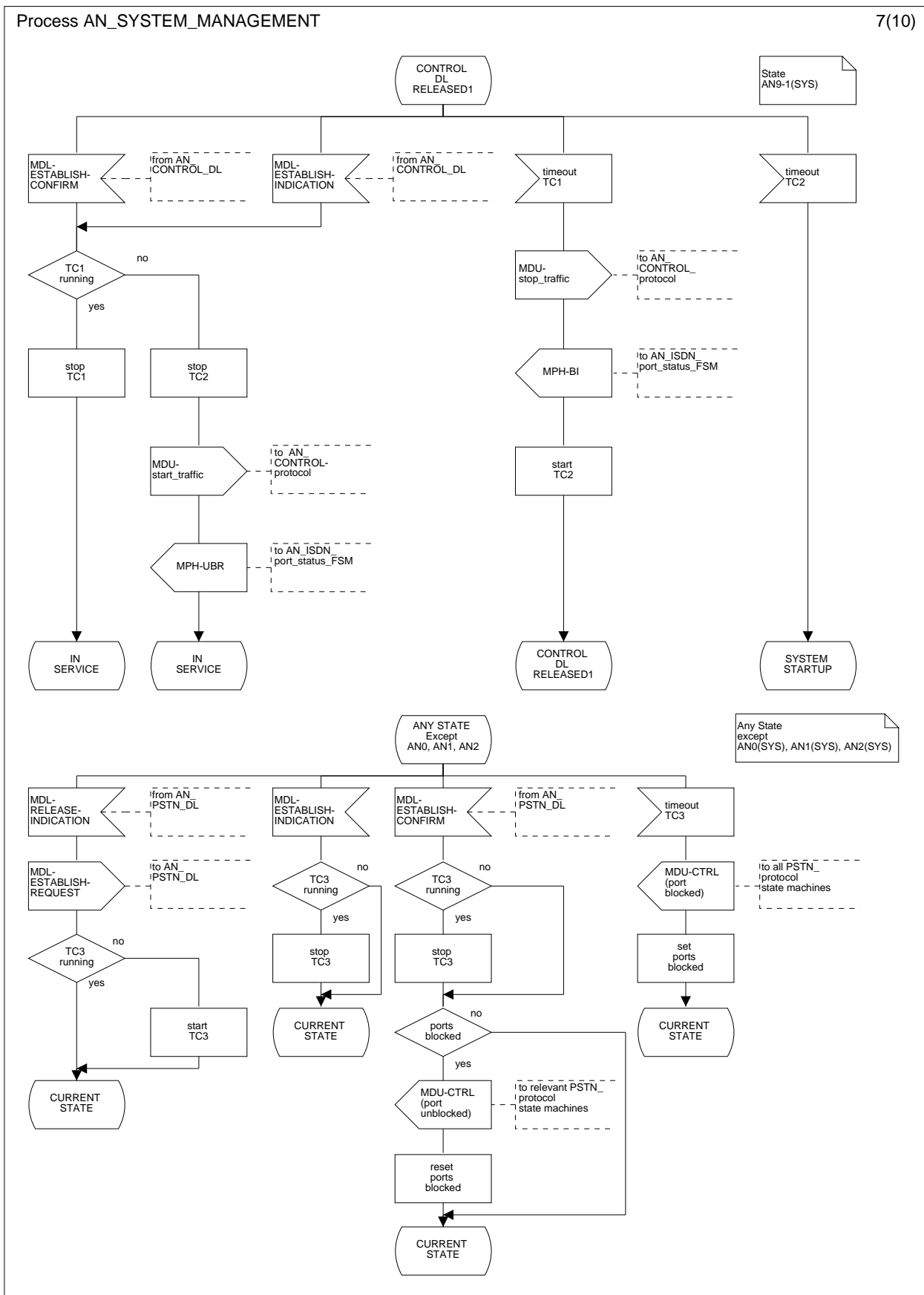
Page 224, figure L.17.8, state "REST2"

Branch "MDU-CTRL (restart ack)":
Use the same tasks as in state "REST1", branch "MDU-CTRL (restart ack)" of figure L.17.3.
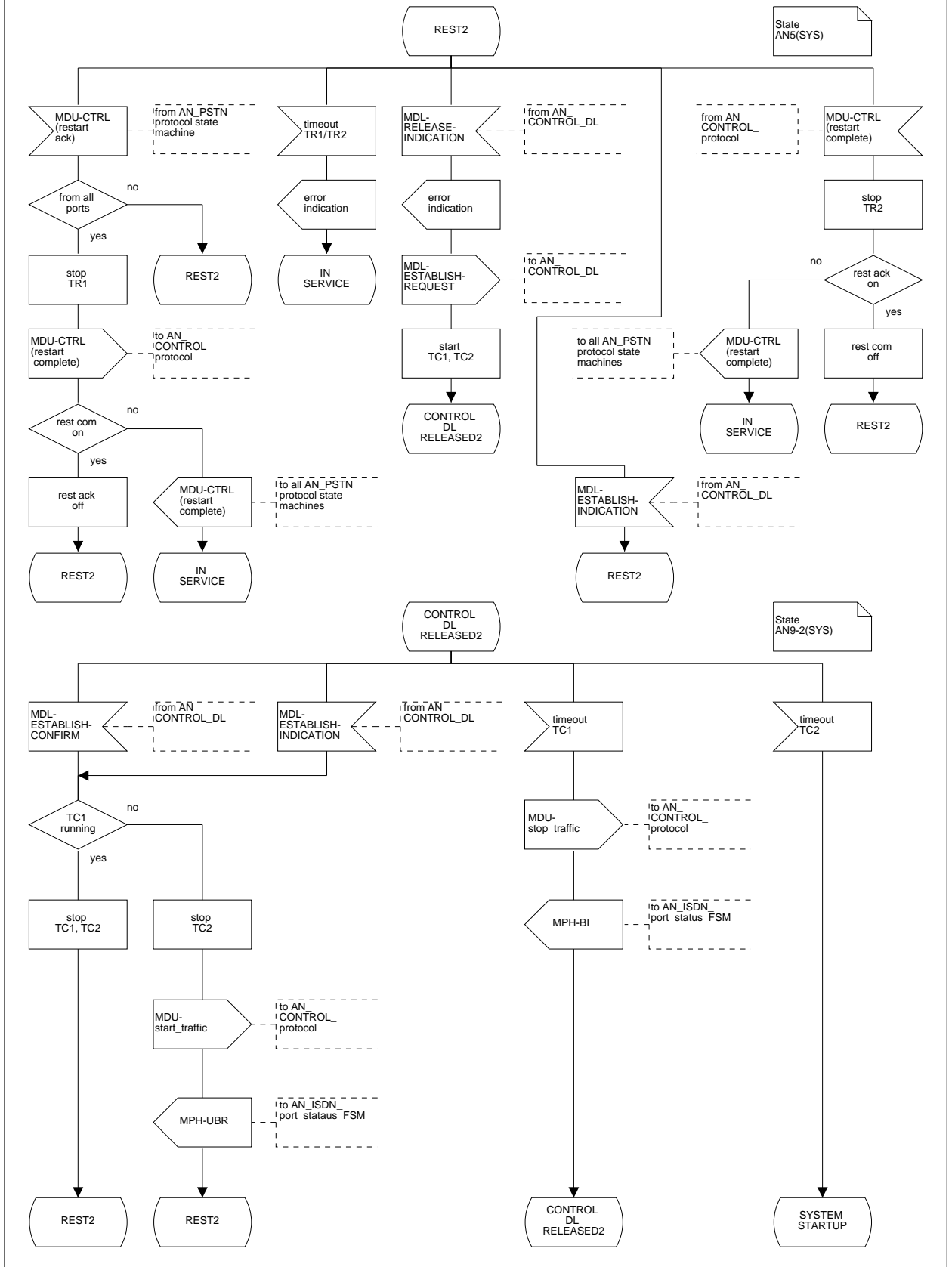
Branch "timeout TR1":
Replace event "timeout TR1" by "timeout TR1/TR2".

Insert a new branch "MDU-CTRL (restart complete)":
Use the same tasks as in state "REST1", branch "MDU-CTRL (restart complete)" of figure L.17.3.
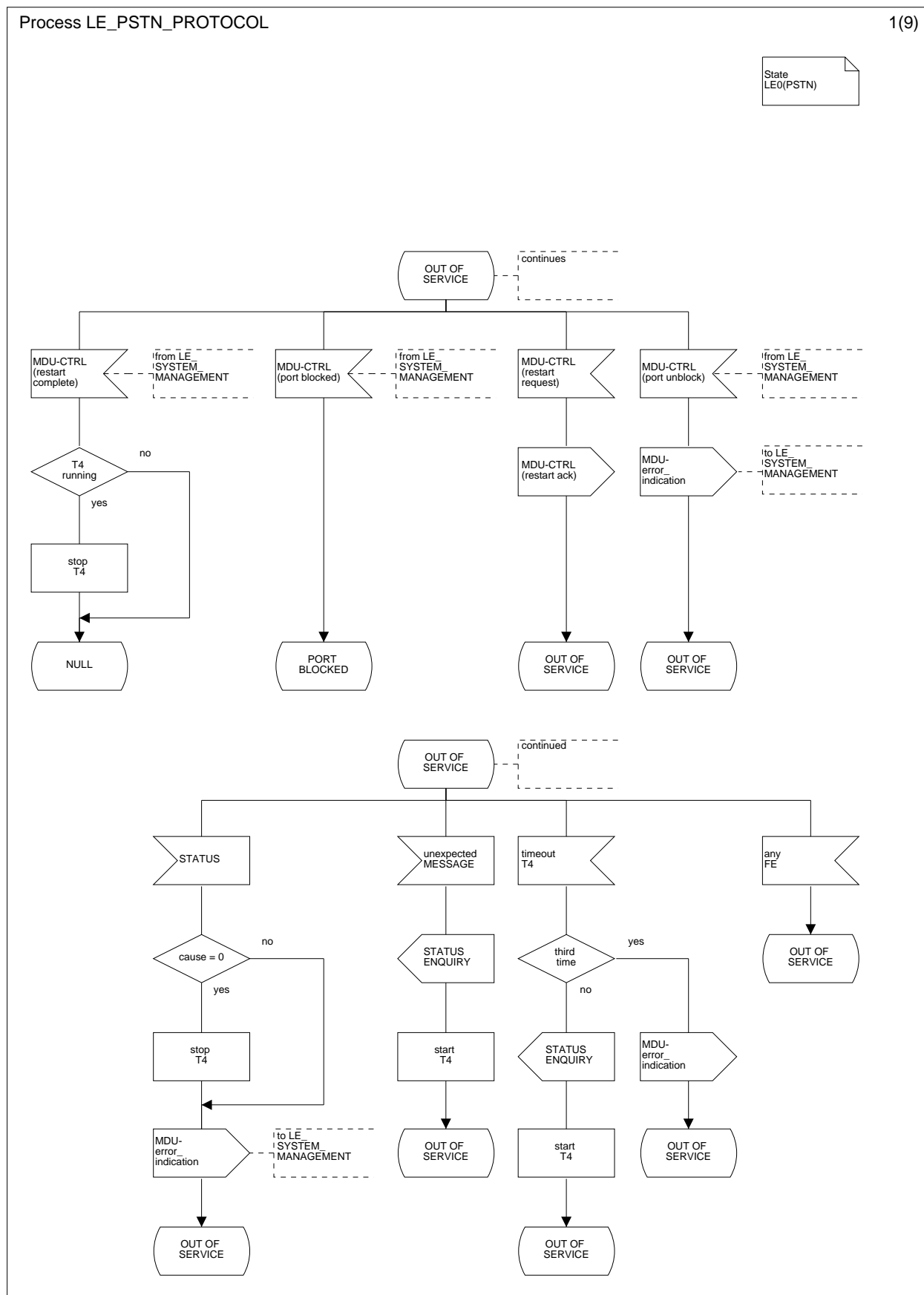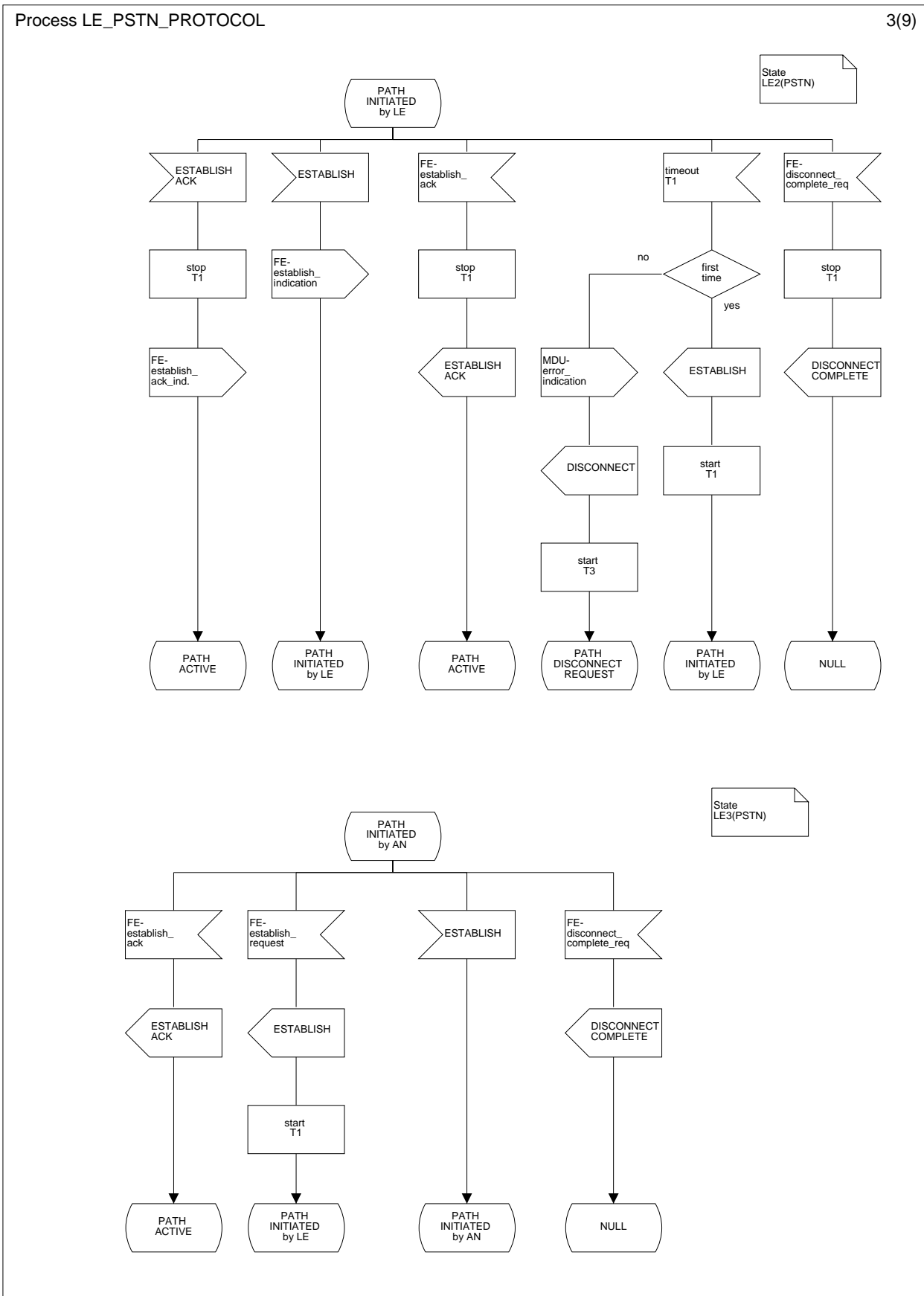
Process AN_SYSTEM_MANAGEMENT   8(10)

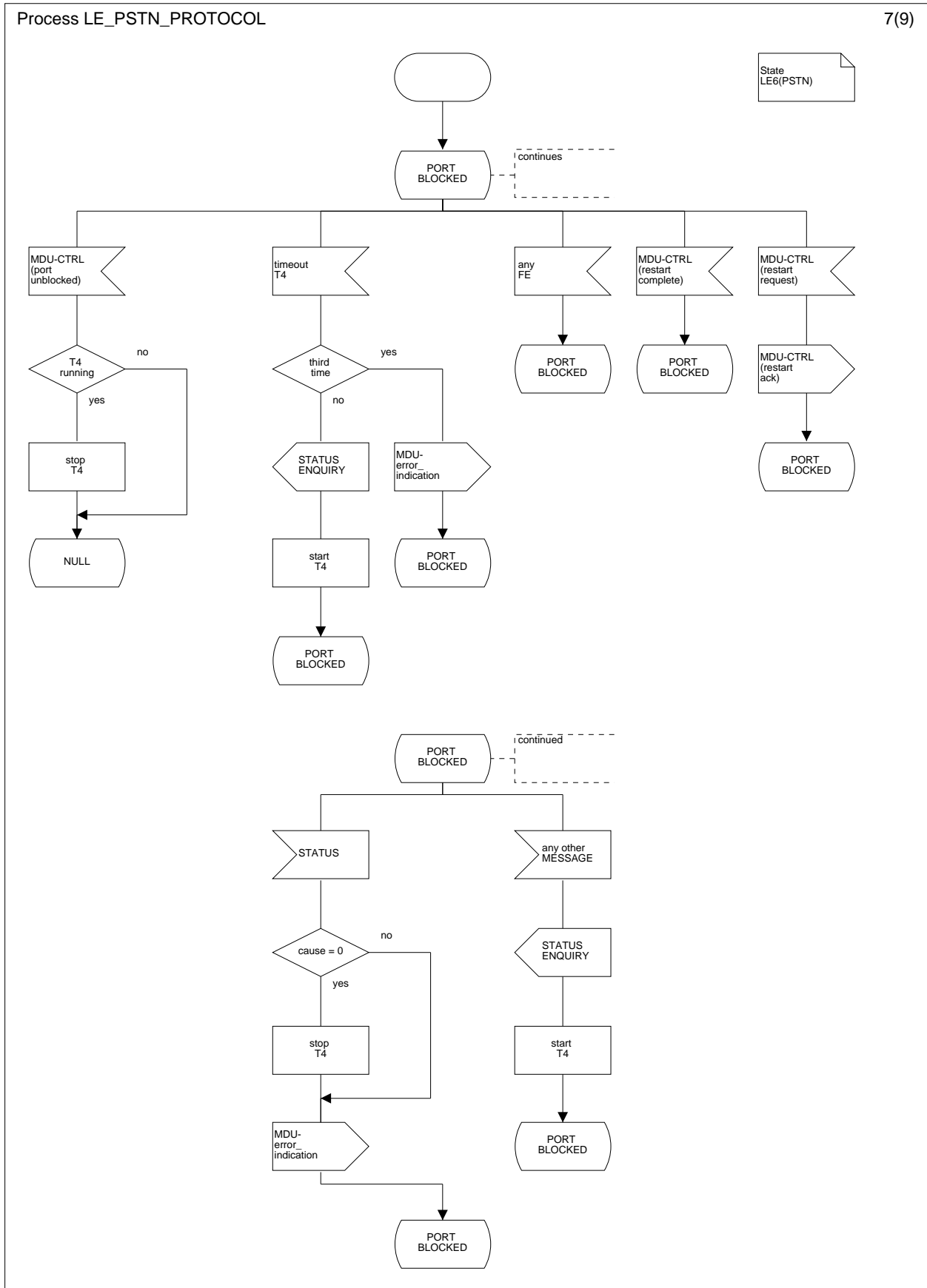**Page 235, figure L.25.1, state "OUT OF SERVICE"**

Delete the start symbol.

Process LE_PSTN_PROTOCOL   1(9)

State
LE0(PSTN)

Page 237, figure L25.3, state "PATH INITIATED BY LE"

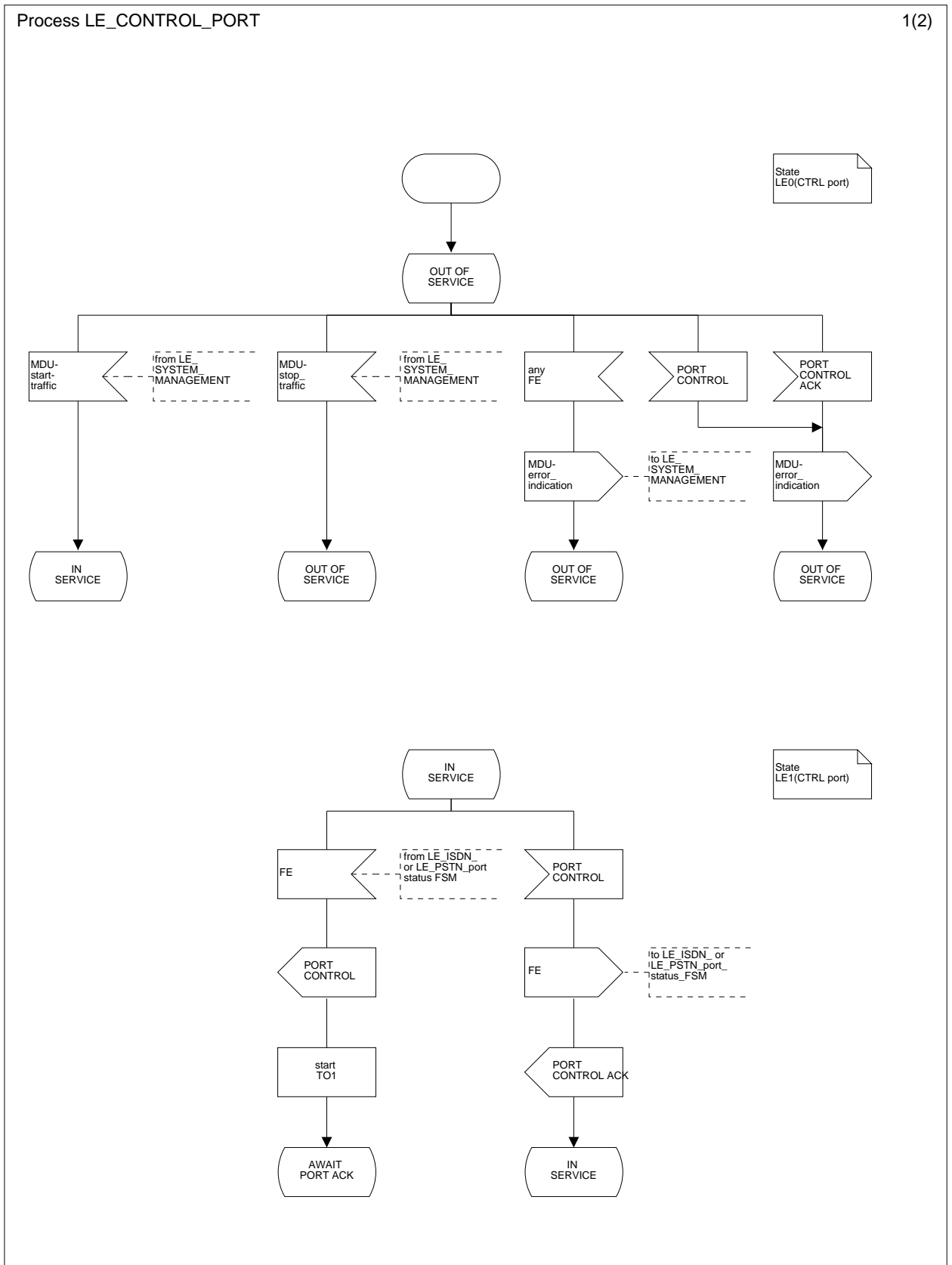Add a new branch "FE-disconnect_complete_request" as shown below

Page 241, figure L.25.7, state "PORT BLOCKED"

Add the start symbol and a transition to "PORT BLOCKED".

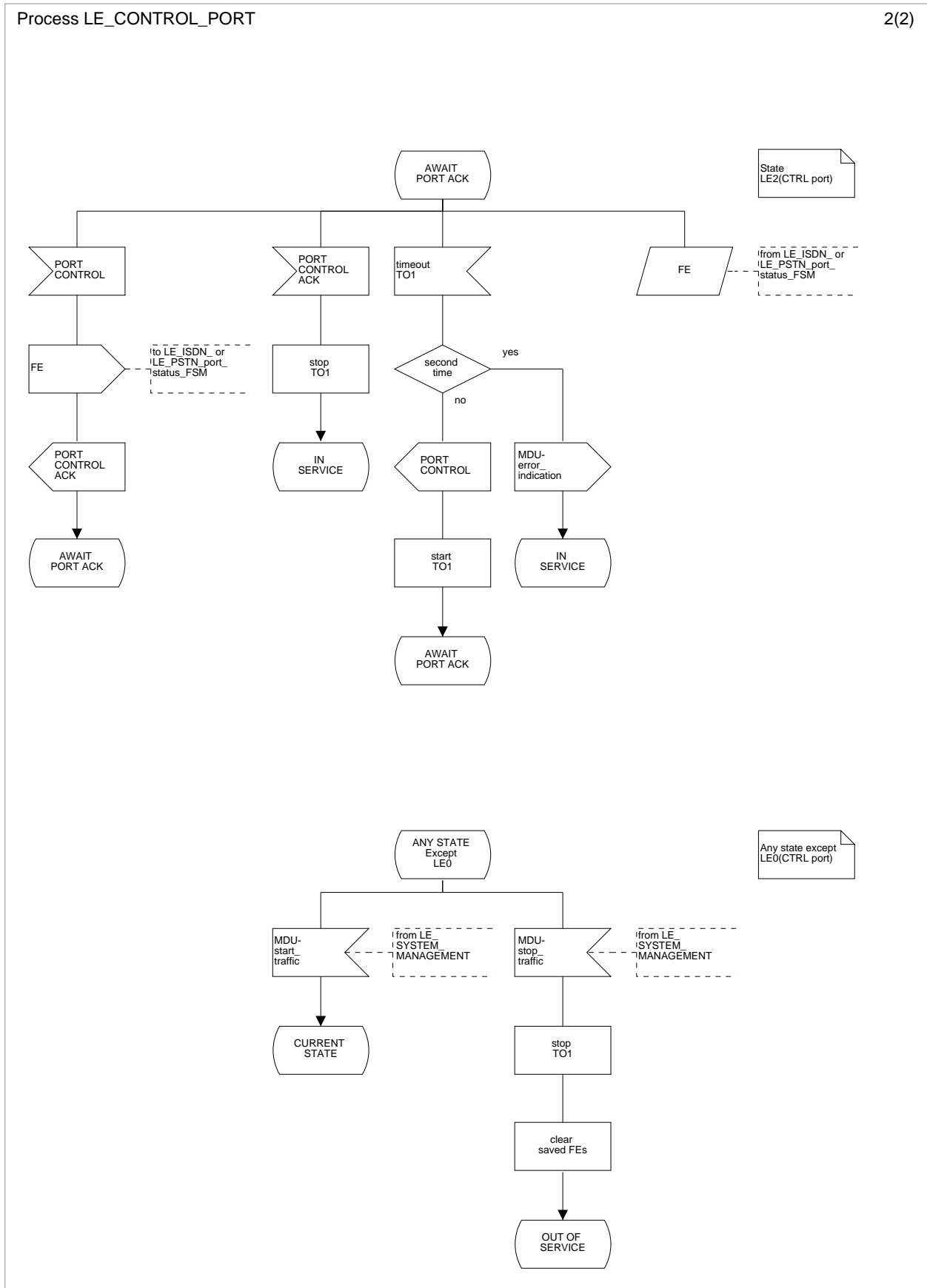**Page 245, figure L.27.1, state "IN SERVICE"**

Flip the input symbol "PORT CONTROL ACK".

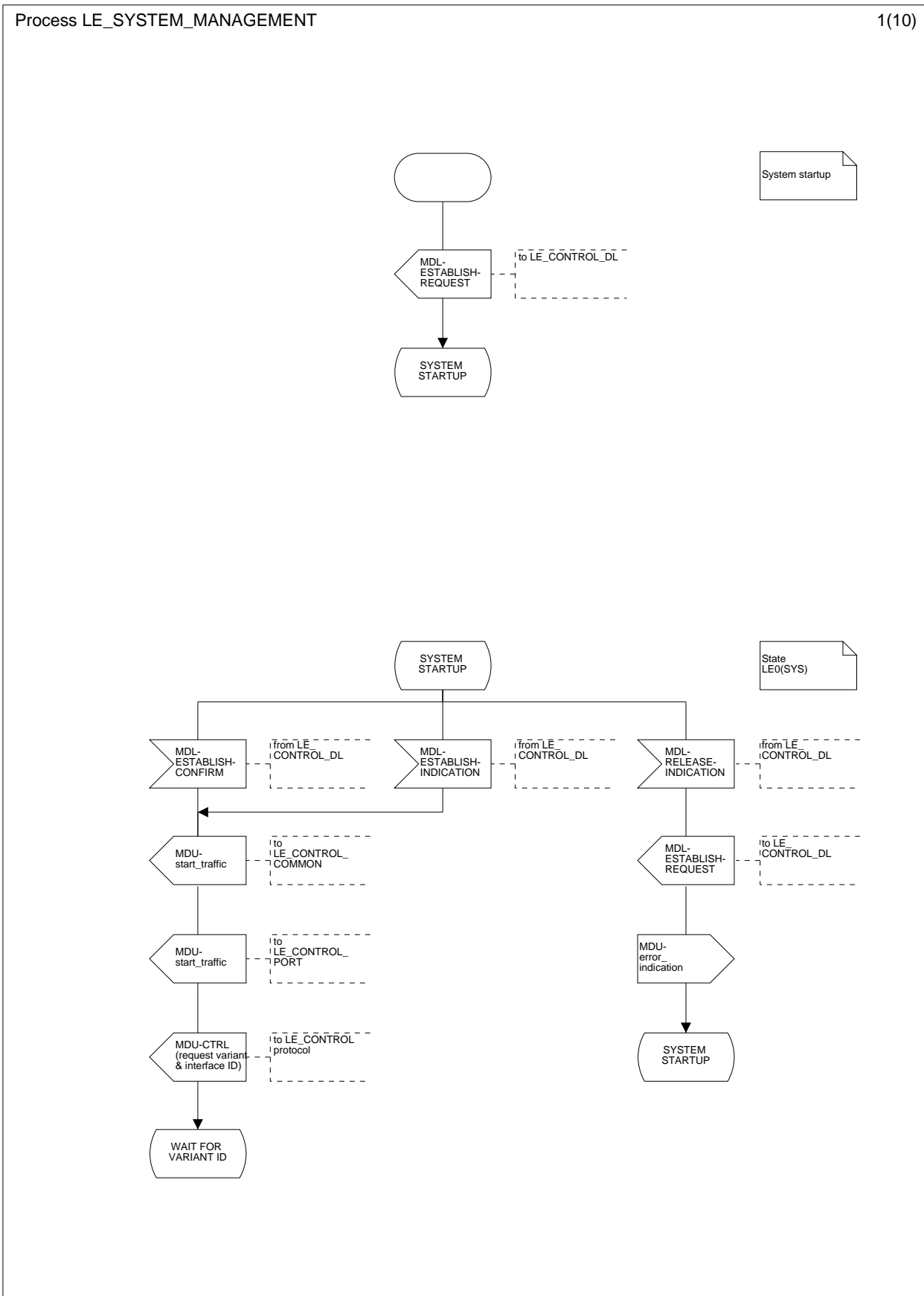Process LE_CONTROL_PORT   1(2)

Page 246, figure L.27.2, state "AWAIT PORT ACK"

Correct the event "timeout TO1".

Page 259, figure L.33.1, state "SYSTEM STARTUP"

Add a new branch "MDL-RELEASE-INDICATION" as shown below.

Process LE_SYSTEM_MANAGEMENT   1(10)
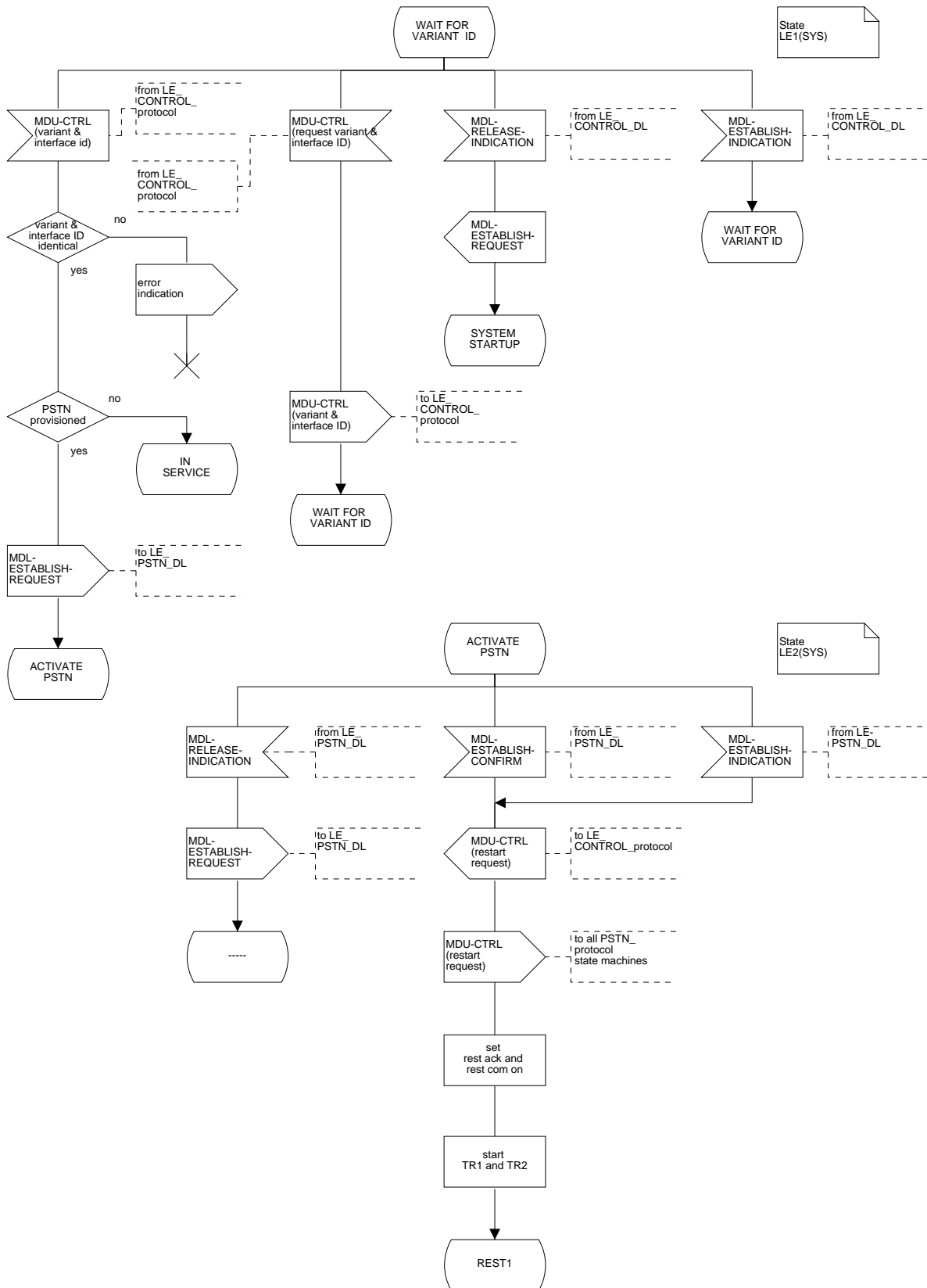
Page 260, figure L.33.2

State "WAIT FOR VARIANT ID", branch "MDU-CTRL (variant&interface ID)":
Replace decision "ID identical" by "variant&interface ID identical".

State "WAIT FOR VARIANT ID":
Add a new branch "MDU-CTRL(request variant&interface ID)" as shown below.

State "ACTIVATE PSTN":
Add a new branch "MDL-RELEASE-INDICATION" as shown below.

Process LE_SYSTEM_MANAGEMENT   2(10)

WAIT FOR
VARIANT ID

State
LE1(SYS)

MDU-CTRL
(variant &
interface id)

from LE
CONTROL_
protocol

MDU-CTRL
(request variant &
interface ID)

MDL-
RELEASE-
INDICATION

from LE
CONTROL_DL

MDL-
ESTABLISH-
INDICATION

from LE
CONTROL_DL

from LE_
CONTROL_
protocol

variant &
interface ID
identical

no

yes

error
indication

MDL-
ESTABLISH-
REQUEST

WAIT FOR
VARIANT ID

SYSTEM
STARTUP

PSTN
provisioned

no

yes

MDU-CTRL
(variant &
interface ID)

to LE_
CONTROL_
protocol

IN
SERVICE

WAIT FOR
VARIANT ID

MDL-
ESTABLISH-
REQUEST

to LE_
PSTN_DL

ACTIVATE
PSTN

ACTIVATE
PSTN

State
LE2(SYS)

MDL-
RELEASE-
INDICATION

from LE_
PSTN_DL

MDL-
ESTABLISH-
CONFIRM

from LE_
PSTN_DL

MDL-
ESTABLISH-
INDICATION

from LE-
PSTN_DL

MDL-
ESTABLISH-
REQUEST

to LE_
PSTN_DL

MDU-CTRL
(restart
request)

to LE_
CONTROL_protocol

MDU-CTRL
(restart
request)

to all PSTN_
protocol
state machines

set
rest ack and
rest com on
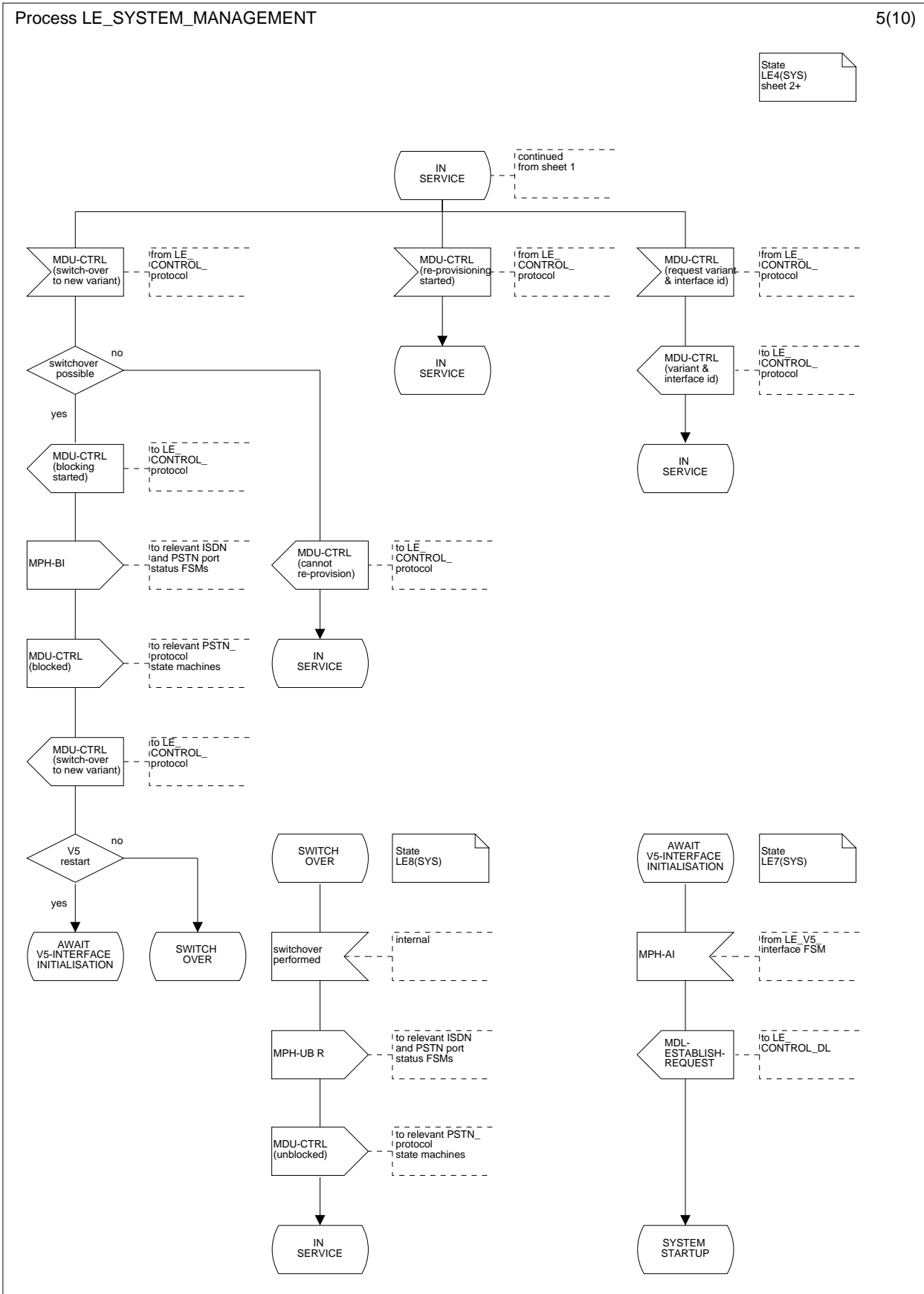
start
TR1 and TR2

REST1

Page 262, figure L.33.4, state "IN SERVICE", branch "MDU-CTRL (restart request)"

Replace task "set rest ack on" by task "set rest ack and rest com on". Replace task "start TR1" by task "start TR1, TR2".

Process LE_SYSTEM_MANAGEMENT   4(10)
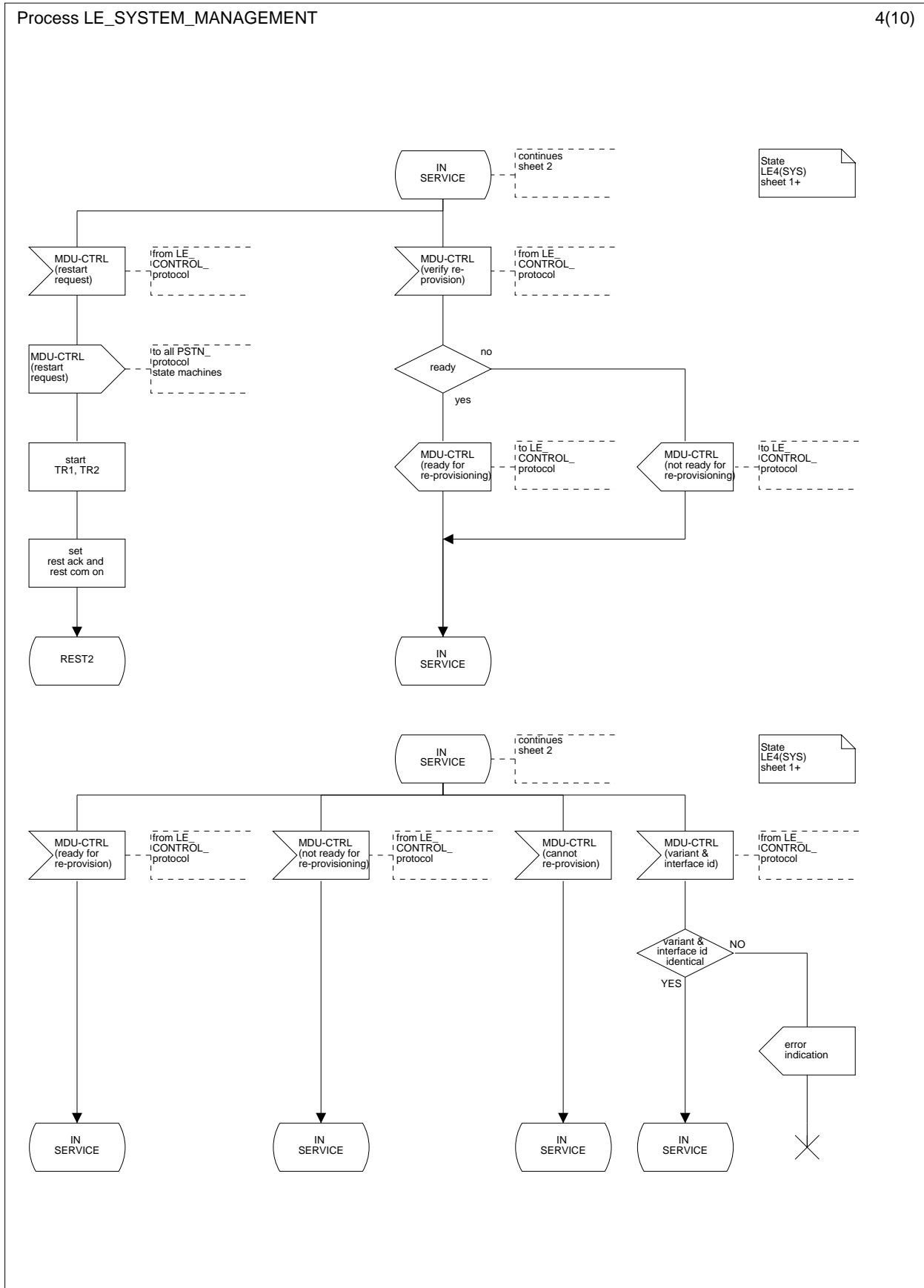
Page 263, figure L.33.5, state "IN SERVICE", branch "MDU-CTRL (switch-over to new variant)"

Insert sending of MDU-CTRL (blocking started) [to LE_CONTROL_protocol] after decision "switchover possible".

Page 265, figure L.33.7, state "ANY STATE Except LE0, LE1"

Change "ANY STATE except LE0, LE1" to "ANY STATE except LE0, LE1, LE2".

Branch "MDL-RELEASE-INDICATION":
TC3 is only started if not running.

Branch "MDL-ESTABLISH-CONFIRM":
MDU-CTRL (port unblocked) is only sent if ports are blocked. Insert a new decision.

Branch "timeout TC3":
A new flag "ports blocked" is set in order to support the new decision in branch "MDL-ESTABLISH-CONFIRM".

Process LE_SYSTEM_MANAGEMENT   7(10)

Page 266, figure L.33.8, state "REST2"

Branch "MDU-CTRL (restart ack)":
Use the same tasks as in state "REST1", branch "MDU-CTRL (restart ack)" of figure L.33.3.
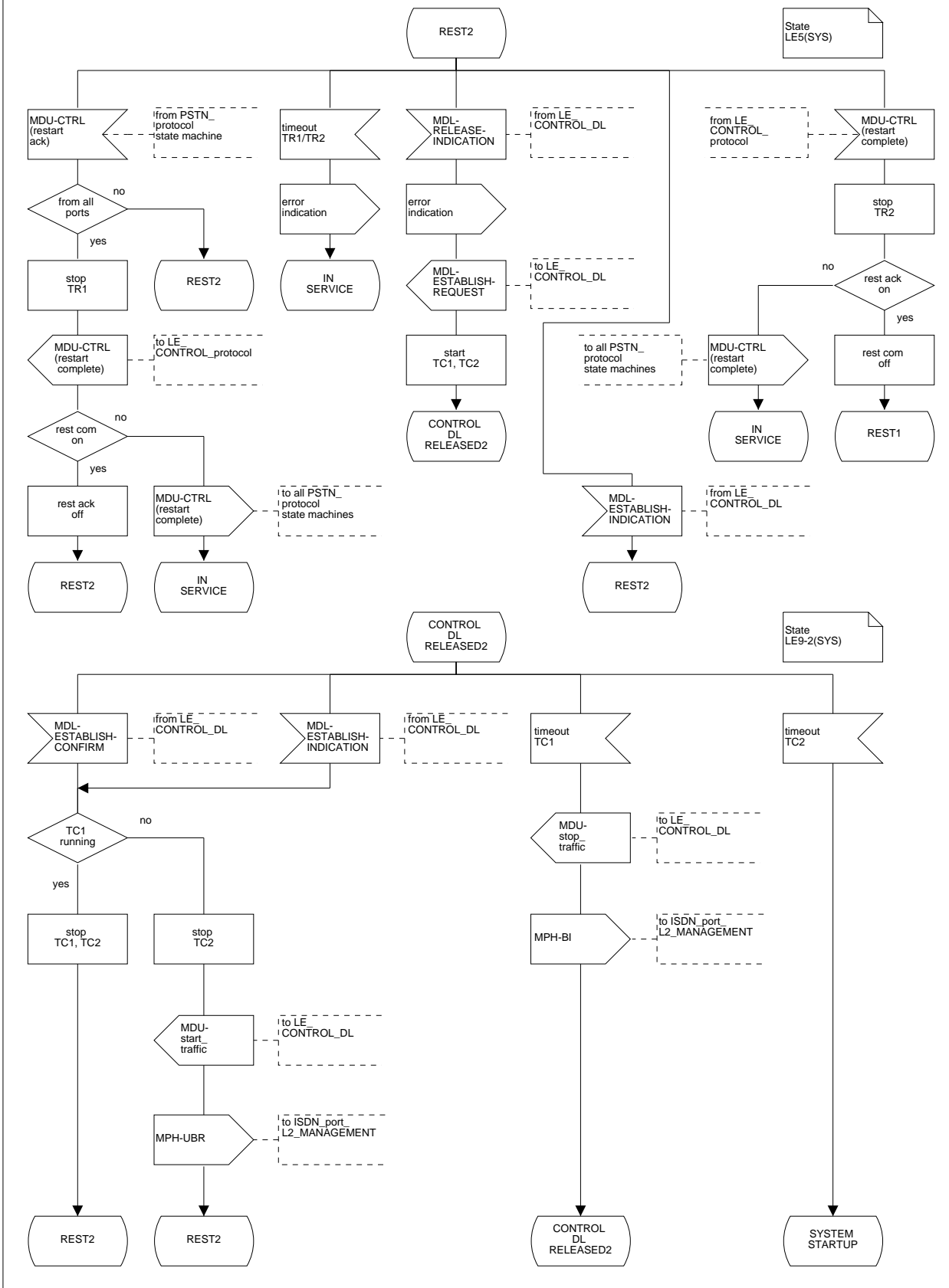
Branch "timeout TR1":
Replace event "timeout TR1" by "timeout TR1/TR2".

Insert a new branch "MDU-CTRL (restart complete)":
Use the same tasks as in state "REST1", branch "MDU-CTRL (restart complete)" of figure L.33.3.

Process LE_SYSTEM_MANAGEMENT   8(10)

History

Document history			
February 1994	First Edition		
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