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Foreword

This European Telecommunication Standard (ETS) has been produced by the Signalling Protocol and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS details exceptions and clarifications to ITU-T Recommendation Q.755 defining the protocol testers to be used as an aid when performing validation testing of an implementation or compatibility testing between implementations.

Transposition dates	
Date of adoption:	19 September 1997
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1 Scope

This European Telecommunication Standard (ETS) specifies the Message Transfer Part (MTP) protocol Tester (MT) to be used as an aid when testing the MTP of Signalling System No.7.

This tester applies to all MTP implementations conforming with ETS 300 008-1 [1] regardless of its date of issue, as long as they provide the equivalent of the MTP primitives, and the Service Indicator (SI) of the MT is supported.

This ETS draws upon ITU-T Recommendation Q.750 [2] for architectural considerations of the relationship between the MT and Signalling System No.7 management (OMAP), and upon ETS 300 008 [1] for the specification of the MTP.

NOTE: The applicability of the MTP tester to broadband MTPs according to EN 301 004-1 is outside the scope of this ETS.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETS 300 008-1: "Integrated Services Digital Network (ISDN); Signalling System No.7; Message Transfer Part (MTP) to support international interconnection (Part 1: Protocol specification)".

[2] ITU-T Recommendation Q.750 (1993): "Overview of Signalling System No.7 management".

3 Definitions

For the purposes of this ETS, the following definition applies:

MTP Service Access Point instance (SAPi): The interface between an MTP user and the MTP, used to access a particular MTP network.

4 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AE	Application Entity
ASE	Application Service Element
CF	Control Function
DPC	Destination PC
GPC	Generating PC
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
LME	Level Management Entity
LMI	Level Management Interface
MAP	Mobile Application Part
MIB	Management Information Base
MSU	Message Signal Unit
MT	MTP protocol Tester
MTP	Message Transfer Part
OMAP	Operations, Maintenance and Administration Part
OMASE	OMAP ASE
OPC	Originating PC
OSI	Open Systems Interconnection
PC	Point Code

SAP	Service Access Point
SAPi	SAP instance
SCCP	Signalling Connection Control Part
SDL	Specification and Description Language
SI	Service Indicator
SIF	Signalling Information Field
SLS	Signalling Link Selection
SP	Signalling Point
SSNo.7	Signalling System No.7
TC	Transaction Capabilities
TMN	Telecommunications Management Network
TPC	Turn-around PC
TUP	Telephony User Part

5 General

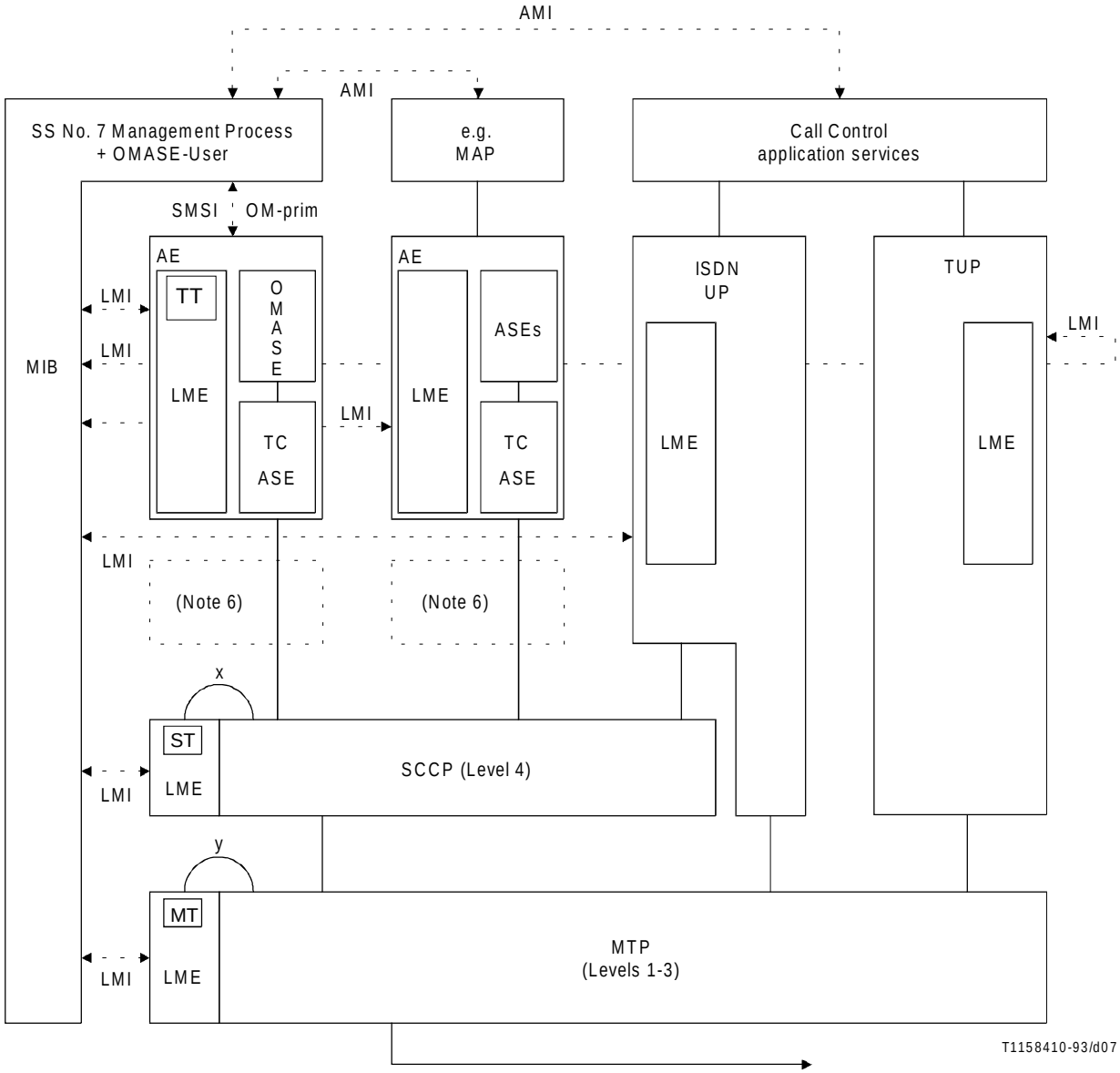
The protocol tester may be used as an aid when testing the Message Transfer Part (MTP) of Signalling System No.7 between two implementations. The tester's main function is simulation of an ordinary user part, as seen from the MTP, for the generation of test traffic.

ITU-T Recommendations I.320 and I.321 specify the ISDN protocol reference model to be used. User plane (U-plane), Control plane (C-plane) and Management plane (M-plane) are identified. The layering principles apply in each of these planes. The U-plane provides the user information flow transfer with associated controls. The C-plane handles the call and connection control information. The M-plane is divided into two portions, the Layer Management functions and the Plane Management functions. Plane Management performs management functions related to a system as a whole, it provides co-ordination between all the planes and has no layered structure. The Layer Management part of the M–plane contains Layer Management Entities (LMEs). Each of these entities provides management functions relating to resources and parameters residing in its associated protocol layer. Layer Management handles the operation and maintenance information flows. The interface between adjacent layers within a plane and between the Layer Management Entity and its associated layer have to be defined in terms of service primitives. The interface between the Layer Management Entities and Plane Management does not need to be specified, it is implementation dependent.

For Signalling System No.7, the **Level Management Entity** is defined by analogy with the Layer Management Entity of ITU-T Recommendations I.320 and I.321. This is to account for the different positions of the boundaries between Signalling System No.7 lower layers and those of Open Systems Interconnection (OSI) (e.g. the upper part of the MTP is level 3 in Signalling System No.7, the SCCP is level 4, but both would be within layer 3 if the OSI model strictly applied). For Signalling System No.7 MTP, the term LME is taken to mean "Level Management Entity".

Thus the MT is contained in the LME of the MTP (MTP LME).

In this ETS, the service primitives between MTP LME and the MTP are described, as well as the procedures, the messages and the MT substructure. It is necessary to define the information flow across the interface between the Plane Management (MIB) and the MT (shown as the lowest Level Management Interface (LMI) in figure 1) and so this is done in terms of signals which are required to control the concerned testing functions and report results (see figure 1, which is a copy of figure 5/Q.750).



NOTES

1 Dotted lines (but not boxes) denote direct management interfaces. Only the SMSI [see note 5 below] is realized with primitives.

2 The LMI (Level Management Interface) is not a subject for standardization.

3 The AMI (Application Management Interface) is not a subject for standardization.

4 The items managed by OMAP can be regarded as conceptually resident in the MIB.

5 The SMSI is the systems management service interface, the OM primitives are defined for use over it for managed object functions defined in Recommendation Q.753.

6 OSI layers 4, 5 and 6 are null in SS No. 7. TC forms the bottom of OSI layer 7, SCCP the top of OSI layer 3 (but is in SS No. 7 level 4).

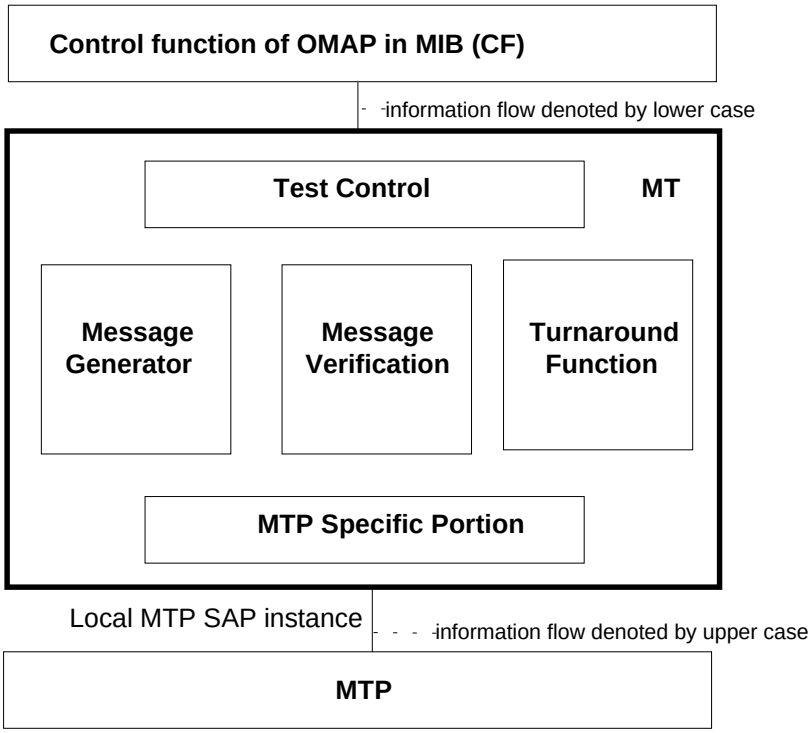
7 Interface x uses sub-system number to test the SCCP using the SCCP Tester (ST), interface y uses SIO to test the MTP using the MTP Tester (MT). The TC Test Responder (TT) has its own SSN, conceptually it resides in the OMAP LME.

8 The LME (Level Management Entity) is defined for management of and within each level of SS No. 7. This is conceptually where each managed item resides as far as the level is concerned.

Figure 1: Signalling System No.7 management and internal configuration of a Signalling Point (SP)

6 MTP Tester (MT)

The MT is connected to the MTP as a user part, i.e. it is identified by a service indicator. It generates test traffic messages (TEST TRAFFIC) containing a serial number (and possibly additional information) by using MTP-TRANSFER request primitives, and the MTP converts these into Message Signal Units (MSUs), with the TEST TRAFFIC in the Signalling Information Field (SIF). On reception of these messages a check is performed to verify that the messages are delivered correctly (e.g. without loss, corruption, missequencing or duplication).



NOTE 1: This model is not intended to constrain implementation.

NOTE 2: The Control Function (CF) of OMAP provides the management interface for the MT. It is used to define the test traffic message contents, to start and stop tests, to determine the action on congestion, and receive test results.

Figure 2: Architectural model of the MT

6.1 Functions

6.1.1 Objectives and scope

The main use of the MT is:

- a tool for performing routeing and bidirectionality tests for Signalling System No.7 in networks which are in service. If such verification in the international network should be needed, the MT would be the preferred message traffic generator.

The MT is also:

- a possible tool for validation testing when traffic generation is needed whilst performing tests. However, other traffic generators may be used if required when performing validation tests;

- the possible message traffic generator for compatibility tests between different network operators.

NOTE: Caution is necessary in the case of a request to generate message traffic that might cause an overload.

6.1.2 Main functions

The main function is the generation of bi-directional message test traffic, giving the possibility at the receiving node of analysing the received test traffic (i.e. detection of missequencing, duplication or loss of messages - verification of transfer delays and detection of message corruption is only possible on the generating side). Errors may be introduced in the Signalling System No.7 network (only by external means to the testers) during the transmission of message test traffic.

NOTE: Undefined or unexpected messages with SI = "MTP tester" received are discarded, optionally with a report. For the purposes of this ETS, an unexpected message is one that is not shown as input in a particular state in the Specification and Description Language (SDL) diagrams or the state transition matrix.

6.1.3 Architectural model

The OMAP architectural model is as given in figure 1, the MT model is shown in figure 2.

The MT functions are located in the MTP Level Management Entity (LME), control of the MT is located within the Management Information Base (MIB) (see ITU-T Recommendation Q.750 [2] for the network management aspects).

6.1.4 Functional roles

There are two functional roles which are defined for the MTP tester:

- the tester generating the test traffic messages; and
- the tester turning them around.

It is possible for a tester to be generating test traffic messages towards one signalling point whilst performing the turn-around role in another test to a different signalling point.

6.1.4.1 Generator role

When performing the generator role, a node uses the services of the various functional blocks within the MT (see figure 2) in the following way. The Test Control function confirms that the remote end is ready and able to start a test, then controls the duration and termination of the test. The Message Generator function generates the appropriate TEST TRAFFIC messages at the rate requested in the test set-up procedure. It also controls the compatibility between message length and the message rate requested. The Message Verification function receives the TEST TRAFFIC messages returning from the turn-around node and checks them for loss, missequencing and duplication. The generator role may also include a check for message corruption and other generator node dependent checks. The MTP Specific Portion deals with generating the MTP transfer primitives and handling the incoming MTP primitives. The Control Function of OMAP in the MIB handles test requests from TMN, test supervision and control, and the presentation and interpretation of test results.

6.1.4.2 Turn-around role

When performing the turn-around role, a node uses the services of the various functional blocks within the MT (see figure 2) in the following way. The Test Control function controls the acceptance and supervision of a test. TEST TRAFFIC messages arriving from the remote generator node are checked by the Message Verification function before being returned to the generator via the Turnaround function. The MTP Specific Portion again deals with the sending and receiving of MTP primitives. The Control Function of OMAP in the MIB deals with the test acceptance, test control and the presentation and interpretation of results.

6.1.5 Identification of test sequences at a node

A particular test sequence is identified by the remote Point Code (PC) and local MTP Service Access Point (SAP) instance. Thus it is only possible to have one test at a time running between two signalling points. The Generating Point Code (GPC), the PC corresponding to the MTP SAP instance of the generating tester, is included in the test messages as an additional security feature. Checks of the GPC are for further study.

6.1.6 Message rate considerations

To secure delivery in sequence via the MTP all test traffic messages of the test sequence use the same code value for the Signalling Link Selection (SLS) parameter. Thus they will use only one link from each linkset utilized. This should be considered when defining the actual message rate. Although the same value for the SLS parameter is used by the Turnaround function, it may or may not define the same link(s) or linkset(s) in the backward direction as in the forward direction, as the load-sharing key is implementation dependent.

6.2 Procedures

6.2.1 Test set-up

There are two phases during test set-up:

- test request; and
- either test acceptance or test refusal.

6.2.1.1 Test request

Once a test request has been received by the tester from the OMAP Control Function a check shall be made to ensure that no test already exists between the GPC and Turn-around Point Code (TPC) in either direction. If a clash is detected an error indication shall be returned to the Control Function with an appropriate reason, the test already in place shall not be affected. A local test request may also be refused due to local conditions (this is implementation dependent). If a valid request is received then the necessary counters (*messages sent* counter and *messages received* counter) shall be initialized to zero, and a guard timer T1 started to control the test set-up. A TEST REQUEST message shall then be sent to the TPC.

The information provided by the Control Function shall include an indication of the required response to the receipt of an MTP-STATUS, which has as its cause "network congestion". The required response may be to terminate the test.

The Control Function might specifically request to report congestion indications, but continue the test. The indication shall be passed in the TEST REQUEST message.

NOTE 1: The procedure to continue despite congestion should only be used with extreme caution.

NOTE 2: In the event of a test request from the Control Function clashing with receipt of a TEST REQUEST message, the first request to be processed by the MT shall determine the action: if the test request from the Control Function is processed before the TEST REQUEST message, both requests shall be refused; if the TEST REQUEST message is processed first, the request from the Control Function shall be refused and the MT shall wait for the response to the TEST REQUEST message from the Control Function.

6.2.1.2 Test acceptance

6.2.1.2.1 By the turn-around tester

On reception of a TEST REQUEST message a check shall be performed to ensure that a test with the originating tester is not already in progress. If a test is found to be in progress then a TEST REFUSAL message shall be sent, a test termination procedure shall be activated for the test already running, and a report shall be made to the Control Function.

If no test is found to be in progress then the turn-around tester shall request the Control Function to start a test with the respective PC. On receiving a negative response from the Control Function (e.g. due to local conditions), a TEST REFUSAL message shall be sent. A positive response shall initiate the sending of a TEST ACCEPTANCE message, test duration timer T4 to be started and the *messages received* counter to be initialized to zero. The Control Function’s response can additionally request to terminate the test on congestion, even though the test request message indicated to continue despite congestion.

6.2.1.2.2 By the generator

The reception of a TEST ACCEPTANCE message by the generator shall cause the termination of the set-up timer T1. The Control Function shall be informed that a test is in progress, the generation of test traffic shall begin and timer T2 shall be started. The action on congestion shall be to terminate the test if either the local OMAP Control Function so requested, or it was indicated in the TEST ACCEPTANCE message.

6.2.1.3 Test refusal

If a TEST REFUSAL message is received then the set-up timer T1 shall be stopped. Any resources initialized shall be released and a report made to the Control Function.

6.2.1.4 Timer T1 expiry

If timer T1 expires then any resources initialized shall be released and a report made to the Control Function. It is assumed that the TEST REQUEST or TEST ACCEPTANCE or TEST REFUSAL were lost.

6.2.2 Procedures during the test

6.2.2.1 At the generator

On receipt of a TEST ACCEPTANCE message the test duration timer T2 shall be started and TEST TRAFFIC messages shall be generated according to the rate information supplied by the Control Function. This is modelled by a timer Tt in the state transition matrix and in the SDL diagrams. Before each message is sent, the *messages sent* counter shall be incremented. The value of the count shall be given as the serial number field within the TEST TRAFFIC message. The generating tester may place further information (e.g. a time stamp) in the generator dependent information of the TEST TRAFFIC message, which shall be padded to give the overall message length as requested during test set-up by the Control Function.

When TEST TRAFFIC messages are received at the generator, the messages can be checked by comparing the GPC value with the tester's own PC. As messages are terminated at the MT the *messages received* counter shall be incremented, and the message serial number checked as a means of sequence validation (see also subclause 6.2.2.2). Any further checking may be done using the information in the generator dependent information.

6.2.2.2 At the turn-around tester

A check is made to verify if a current test to the relevant PC is running for the incoming message's Originating Point Code (OPC) and the local MTP SAP instance. The GPC can be examined. If these checks are successful, the message shall be turned around, otherwise the message shall be discarded. The *messages received* counter shall be incremented and the serial number of the incoming message checked for missequencing (e.g. against an expected sequence number variable, which is set to the last received sequence number + 1). The generator dependent information shall not be modified.

The OPC and Destination Point Code (DPC) of the MTP-TRANSFER indication primitive shall then be swapped, the SLS field and generator dependent information copied and the message formed into an MTP-TRANSFER request primitive.

6.2.2.3 Response to missequencing

If, on checking the message serial number, an error is detected, a report shall be made to the Control Function which shall include the message serial number, the expected serial number and its additional information (if any).

6.2.3 Test termination

The test termination procedure shall be activated at the generator or turn-around node by either:

- the expiry of T2 (where the value of T2 was specified during test set-up by the Control Function); or
- a congestion indication, if the Control Function or the TEST REQUEST message or TEST ACCEPTANCE message have instructed it not to be ignored (see subclause 6.2.1.2.2, last sentence); or
- a specific request from the Control Function; or
- the expiry of T4 (where the value of T4 was derived from T2 in the TEST REQUEST message).

The test termination procedure shall involve the sending of a TEST TERMINATION REQUEST message and the starting of a test termination timer T3.

If a TEST TERMINATION REQUEST message is received then a TEST TERMINATION ACKNOWLEDGEMENT message shall be sent and the test results and reason for its ending shall be sent to the Control Function.

6.2.3.1 By the generator

On receipt of a TEST TERMINATION ACKNOWLEDGEMENT message the test results and reason for the test ending shall be sent to the Control Function and the counters cleared. If timer T3 expires then the Control Function shall be informed and local resources released.

6.2.3.2 By the turn-around tester

After sending a TEST TERMINATION REQUEST the turn-around tester shall continue in its turn-around role until either it receives a TEST TERMINATION ACKNOWLEDGEMENT or T3 expires. If T3 expires, the local Control Function shall be informed and local resources released.

6.2.3.3 Test termination acknowledgement

Upon receipt of a TEST TERMINATION REQUEST, the local test shall be stopped and a TEST TERMINATION ACKNOWLEDGEMENT sent.

6.2.4 Reaction to MTP management primitives and MTP restart

When the MTP restart procedure is terminated, the MTP indicates the end of MTP restart to all local MTP users showing each signalling point's accessibility or inaccessibility. The means of doing this is implementation dependent (see ETS 300 008 [1]). The end of MTP restart where the remote signalling point to which a test is running is accessible is modelled in this ETS by MTP-RESUME.indications at the appropriate MTP SAP instance.

6.2.4.1 MTP-PAUSE caused by unavailability of a destination

6.2.4.1.1 At the generator side

If the generator receives an MTP-PAUSE and the affected PC denotes the turn-around tester in one of the current tests then the test shall be paused, no more messages shall be generated and the Control Function shall be informed.

The timers shall continue running and might expire. The counters shall be held. If a local request to terminate the test is received, or if T2 expires whilst in this held state, the generator shall release local resources and stop the local test. If T1 is running when the MTP-PAUSE is received, T1 shall be stopped, local resources shall be released and the test shall be stopped.

If T3 is running when the MTP-PAUSE is received, T3 shall be stopped, local resources shall be released and the test shall be stopped.

6.2.4.1.2 At the turn-around side

If an MTP-PAUSE is received by a tester performing in the turn-around role for the affected PC (the GPC) the local Control Function shall be informed, but no further action is necessary. If the local Control Function subsequently requests to terminate the test, the tester shall stop T4, release local resources and stop the test.

6.2.4.2 MTP-RESUME

If there is a held test to the affected PC then the test shall resume.

Otherwise the MTP-RESUME shall be ignored.

6.2.4.3 MTP-STATUS

The MTP-STATUS primitive contains two parameters, the affected PC and a cause.

The cause may be one of:

- signalling network congestion;
- remote user inaccessible;
- remote user unequipped;
- remote user unknown.

On receiving remote user inaccessible, remote user unequipped or remote user unknown for a PC with which the tester is acting in a turn-around or generator role, the MT shall stop the test to the destination and inform the Control Function. The normal test termination procedure shall not take place.

If an MTP-STATUS is received with cause network congestion, for a PC with which the tester is acting in a turn-around or generator role, then the action on congestion negotiated as in subclauses 6.2.1.2.1 and 6.2.1.2.2 shall determine the tester's action.

6.3 State transition matrix

The state transition matrix following takes precedence over the text in case of discrepancies.

Table 1: State transition matrix

State / Event	Idle	Await setup response (TPC)	Generating (TPC)	Gen stopping (PC)
Timers running	None	T1	T2, Tt	T3
test request (PC,T2,SAPi,SLS,c.resp,lng,rate) from CF	check length against rate msgs_recvd:=0 msgs_sent:=0 exp_seq_nr:=1 start T1 save c.resp TEST REQUEST(T2,c.resp) to TPC GOTO: Await setup response (TPC)	refusal reason:=clash test refusal(TPC) to CF GOTO: Await setup response (TPC)	refusal reason:=clash test refusal (TPC) to CF GOTO: Generating (TPC)	refusal reason:=GPC_clash test refusal (PC) to CF reason:=reason + GPC_clash GOTO: Gen stopping (PC)
test acceptance (PC,c.respr) from CF	GOTO: Idle (wrt PC)	-	-	-
test refusal (PC) from CF	GOTO: Idle (wrt PC)	-	-	-
test termination request(PC,SAPi) from CF	-	reason:=CF_req stop T1 start T3 TEST TERMINATION REQUEST to TPC GOTO: Gen stopping (TPC)	reason:=CF_req stop T2 start T3 TEST TERMINATION REQUEST to TPC stop Tt GOTO: Gen stopping (TPC)	-
TEST TERMINATION ACKNOWLEDGEMENT from PC	GOTO: Idle (wrt PC)	-	-	test termination ack. (PC) to CF stop T3 release resources GOTO: Idle (wrt PC)
TEST REQUEST(T2,c.resp) from PC	save c.resp test request(GPC,T2,SAPi,SLS, c.resp) to CF GOTO: Wait CF response (GPC)	reason:=clash TEST REFUSAL to TPC test termination indication (TPC) to CF stop T1 release resources GOTO: Idle (wrt TPC)	reason:=clash TEST REFUSAL to TPC TEST TERMINATION REQUEST to TPC stop T2 stop Tt start T3 GOTO: Gen stopping (TPC)	reason:=reason + clash TEST REFUSAL to PC GOTO: Gen stopping (PC)

Table 1 (continued): State transition matrix

State / Event	Gen held (TPC)	Wait CF response (GPC)	Turn around (GPC)	Turn around stopping (GPC)
Timers running	T2	None	T4	T3
test request (PC,T2,SAPi,SLS,c.resp,lng, rate) from CF	refusal reason:=GPC_clash test refusal (TPC) to CF GOTO: Gen held (TPC)	refusal reason:=clash test refusal (GPC,..) to CF GOTO: Wait CF response (GPC)	refusal reason:=clash test refusal (GPC) to CF GOTO: Turn around (GPC)	refusal reason:=clash reason:=reason + clash test refusal (GPC,..) to CF GOTO: Turn around stopping (GPC)
test acceptance (PC,c.respr from CF	-	TEST ACCEPTANCE (c.respr,..) to GPC start T4 exp_seq_nr:=1 msgs_rcvd:=0 clear reason c.resp:=c.resp & c.respr GOTO: Turn around (GPC)	-	-
test refusal (PC) from CF	-	TEST REFUSAL to GPC GOTO: Idle (wrt GPC)	-	-

test termination request(PC,SAPi) from CF	reason:=reason + CF_req
	TPC paused to CF
	stop T2
	test termination ack (TPC) to CF
	release resources
	GOTO: Idle (wrt TPC)
		-	stop T4
			reason:=reason + CF_req
			IF (mtp_pause)
			THEN
			  test termination indication (GPC) to CF
			  release resources
			  GOTO: Idle (wrt GPC)
			ELSE
			  start T3
			  TEST TERMINATION REQUEST to GPC
			  GOTO: Turn around stopping (GPC)
				-

TEST TERMINATION ACKNOWLEDGEMENT from PC	-	-	-	test termination ack. (GPC) to CF stop T3 release resources GOTO: Idle (wrt GPC)
TEST REQUEST(T2,c.resp) from PC	-	reason:=GPC_clash TEST REFUSAL to GPC test termination indication (GPC) to CF release resources GOTO: Idle (wrt GPC)	reason:=GPC_clash TEST REFUSAL to GPC TEST TERMINATION REQUEST to GPC stop T4 start T3 GOTO: Turn around stopping (GPC)	reason:=reason + GPC_clash TEST REFUSAL to GPC TEST TERMINATION REQUEST to GPC GOTO: Turn around stopping (GPC)

Table 1 (continued): State transition matrix

State / Event	Idle	Await setup response (TPC)	Generating (TPC)	Gen stopping (PC)
Timers running	None	T1	T2, Tt	T3
TEST ACCEPTANCE(c.respr) from PC	TEST TERMINATION REQUEST to PC GOTO: Idle (wrt PC)	stop T1 start Tt start T2 c.resp:=c.resp & c.respr test acceptance (TPC,c.resp) to CF GOTO: Generating (TPC)	-	-
TEST REFUSAL from PC	GOTO: Idle (wrt PC)	refusal reason:=TPC_refusal test refusal (TPC) to CF stop T1 release resources GOTO: Idle (wrt TPC)	-	-
TEST TERMINATION REQUEST from PC	TEST TERMINATION ACK. to PC GOTO: Idle (wrt PC)	TEST TERMINATION ACK. to TPC stop T1 reason:=TPC_req test termination indication (TPC) to CF release resources GOTO: Idle (wrt TPC)	reason:=TPC_req TEST TERMINATION ACK. to TPC stop Tt stop T2 test termination indication (TPC) to CF release resources GOTO: Idle (wrt TPC)	reason:=reason + TPC_req TEST TERMINATION ACK. to PC test termination request (PC) to CF stop T3 release resources GOTO: Idle (wrt PC)

TEST TRAFFIC
from PC
	TEST TERMINATION REQUEST to PC
	test traffic when idle to CF
	GOTO: Idle (wrt PC)
		-	msgs_recvd:=msgs_recvd + 1
			IF (rcvd_seq_nr =exp_seq_nr)
			THEN
			  exp_seq_nr:=exp_seq_nr + 1
			  IF NOT (other impl. dep. checks OK)
			  THEN
			  traffic error (TPC,..) to CF
			ELSE
			  exp_seq_nr:=rcvd_seq_nr + 1
			  error (TPC,..) to CF
			GOTO: Generating (TPC)
				msgs_recvd:=msgs_recvd + 1
				IF (rcvd_seq_nr =exp_seq_nr)
				THEN
				  exp_seq_nr:=exp_seq_nr + 1
				  IF NOT (other impl. dep. checks OK)
				  THEN
				  traffic error (TPC,..) to CF
				ELSE
				  exp_seq_nr:=rcvd_seq_nr + 1
				  error (TPC,..) to CF
				GOTO: Gen stopping (PC)

MTP-PAUSE(wrt PC)	GOTO: Idle (wrt PC)	reason:=mtp_pause mtp pause wrt TPC to CF stop T1 release resources GOTO: Idle (wrt TPC)	reason:=mtp_pause mtp_pause wrt TPC to CF stop Tt GOTO: Gen held (TPC)	reason:=reason + mtp_pause stop T3 test termination indication (PC) to CF release resources GOTO: Idle (wrt PC)
MTP-RESUME(wrt PC)	GOTO: Idle (wrt PC)	-	-	-

Table 1 (continued): State transition matrix

State / Event	Gen held (TPC)	Wait CF response (GPC)	Turn around (GPC)	Turn around stopping (GPC)
Timers running	T2	None	T4	T3
TEST ACCEPTANCE(c.respr) from PC	-	-	-	-
TEST REFUSAL from PC	-	-	-	-
TEST TERMINATION REQUEST from PC	-	reason:=GPC_req TEST TERMINATION ACK. to GPC test termination indication (GPC) to CF release resources GOTO Idle (wrt GPC)	reason:=reason + GPC_req test termination indication (GPC) to CF stop T4 TEST TERMINATION ACK. to GPC release resources GOTO: Idle (wrt GPC)	reason:=reason + GPC_req TEST TERMINATION ACK. to GPC test termination indication (GPC) to CF stop T3 release resources GOTO Idle (wrt GPC)

TEST TRAFFIC from PC	-	-	IF NOT (Optional GPC check OK)
			THEN
			  discard message
			  wrong traffic msg to CF
			ELSE
			  msgs_rcvd:=msgs_rcvd +1
			  IF (rcvd_seq_nr =exp_seq_nr)
			  THEN
			  exp_seq_nr:=exp_seq_nr + 1
			  ELSE
			  error(GPC) to CF
			  exp_seq_nr:=rcvd_seq_nr + 1
			  swap OPC,DPC, copy other info
			  TEST TRAFFIC to GPC
			GOTO: Turn around (GPC)
				IF NOT (Optional GPC check OK)
				THEN
				  discard message
				  wrong traffic msg to CF
				ELSE
				  msgs_rcvd:=msgs_rcvd +1
				  IF (rcvd_seq_nr =exp_seq_nr)
				  THEN
				  exp_seq_nr:=exp_seq_nr + 1
				  ELSE
				  error(GPC) to CF
				  exp_seq_nr:=rcvd_seq_nr + 1
				  swap OPC,DPC, copy other info
				  TEST TRAFFIC to GPC
				GOTO: Turn around stopping (GPC)

MTP-PAUSE(wrt PC)	GOTO: Gen held (TPC)	mtp_pause (GPC) to CF GOTO: Idle (wrt GPC)	mtp_pause wrt GPC to CF mark mtp_pause reason:=reason + mtp_pause GOTO: Turn around (GPC)	reason:=reason + mtp_pause stop T3 test termination indication (GPC) to CF release resources GOTO: Idle (wrt GPC)
MTP-RESUME(wrt PC)	start Tt mtp_resume wrt TPC to CF GOTO: Generating (TPC)	-	mtp_resume wrt GPC to CF unmark mtp_pause reason:=reason - mtp_pause GOTO: Turn around (GPC)	-

Table 1 (continued): State transition matrix

State / Event	Idle	Await setup response (TPC)	Generating (TPC)	Gen stopping (PC)
Timers running	None	T1	T2, Tt	T3

MTP-STATUS(congestion) wrt PC	-	IF (c.resp=term.)
		THEN
		reason:=TPC_cong
		TEST TERMINATION REQUEST to TPC
		stop T1
		start T3
		GOTO: Gen stopping (TPC)
		ELSE
		congestion wrt TPC to CF
		GOTO: Await setup response (TPC)
			IF (c.resp=term.)
			THEN
			reason:=TPC_cong
			stop T2
			start T3
			TEST TERMINATION REQUEST to TPC
			stop Tt
			GOTO: Gen stopping (TPC)
			ELSE
			congestion wrt TPC to CF
			GOTO: Generating (TPC)
				reason:=reason + PC_cong
				GOTO: Gen stopping (PC)

MTP-STATUS(UPU) wrt PC	-	reason:=UPU(TPC) test termination indication (TPC) to CF stop T1 release resources GOTO: Idle (wrt TPC)	reason:=UPU(TPC) test termination indication (TPC) to CF stop Tt stop T2 release resources GOTO: Idle (wrt TPC)	reason:=reason + UPU(PC) stop T3 test termination indication (PC) to CF release resources GOTO: Idle (wrt PC)
T1 expiry	-	reason:=T1_expiry test termination indication (TPC) to CF release resources GOTO: Idle (wrt TPC)	-	-
T2 expiry	-	-	reason:=T2_expiry start T3 TEST TERMINATION REQUEST to TPC stop Tt GOTO: Gen stopping (TPC)	-
T3 expiry	-	-	-	reason:=reason + T3_expiry test termination indication (PC) to CF release resources GOTO: Idle (wrt PC)

Table 1 (continued): State transition matrix

State / Event	Gen held (TPC)	Wait CF response (GPC)	Turn around (GPC)	Turn around stopping (GPC)
Timers running	T2	None	T4	T3

MTP-STATUS(congestion) wrt PC	-	congestion wrt GPC to CF
		IF (c.resp =term.)
		THEN
		TEST REFUSAL to GPC
		GOTO: Idle (wrt GPC)
		ELSE
		GOTO: Wait CF response (GPC)
			IF (c.resp =term.)
			THEN
			reason:=GPC_cong
			stop T4
			start T3
			TEST TERMINATION REQUEST to GPC
			GOTO: Turn around stopping
			ELSE
			congestion wrt GPC to CF
			GOTO: Turn around (GPC)
				reason:=reason + GPC_cong
				GOTO: Turn around stopping (GPC)

MTP-STATUS(UPU) wrt PC	-	upu wrt GPC to CF GOTO: Idle (wrt GPC)	reason:=UPU(GPC) test termination indication (GPC) to CF stop T4 release resources GOTO: Idle (wrt GPC)	reason:=reason + UPU(GPC) stop T3 test termination indication (GPC) to CF release resources GOTO: Idle (wrt GPC)
T1 expiry	-	-	-	-
T2 expiry	reason:=reason + T2_expiry test termination ack (TPC) to CF release resources GOTO: Idle (wrt TPC)	-	-	-
T3 expiry	-	-	-	reason:=reason + T3_expiry test termination indication (GPC) to CF release resources GOTO: Idle (wrt GPC)

Table 1 (continued): State transition matrix

State / Event	Idle	Await setup response (TPC)	Generating (TPC)	Gen stopping (PC)
Timers running	None	T1	T2, Tt	T3
T4 expiry	-	-	-	-
Tt expiry	-	-	msgs_sent:=msgs_sent + 1 seq_nr:=msgs_sent insert info in message pad message TEST TRAFFIC to TPC start Tt GOTO: Generating (TPC)	-

Table 1 (concluded): State transition matrix

State / Event	Gen held (TPC)	Wait CF response (GPC)	Turn around (GPC)	Turn around stopping (GPC)
Timers running	T2	None	T4	T3

T4 expiry	-	-	reason:=reason + T4_expiry
			IF (mtp_pause)
			THEN
			test termination indication to CF
			release resources
			GOTO: Idle (wrt GPC)
			ELSE
			start T3
			TEST TERMINATION REQUEST to GPC
			GOTO: Turn around stopping (GPC)
				-

Tt expiry	-	-	-	-

6.4 Formats and codes

In the figures, the fields are shown from right to left (the first field to be transmitted is at the right). Within each field the information shall be transmitted least significant bit first.

Numeric values shall be encoded in the binary format.

6.4.1 Header codes

The first header code is the H0 header code; this is a four bit field that shall follow the label and identify the message group. The H1 header code field shall occupy the next four bits and shall indicate the actual message within each group. The H0 field shall be coded as follows:

0000	Test control messages
0001	Test traffic messages
0010 - 1111	Reserved

6.4.1.1 Test control

The H0 = 0000 group represents the test control messages. For this group the H1 codes shall be as follows:

DCBA

0000	TEST REQUEST message
0001	TEST ACCEPTANCE message
0010	TEST REFUSAL message
0011	TEST TERMINATION REQUEST message
0100	TEST TERMINATION ACKNOWLEDGE message
0101 - 1111	Reserved

The test control messages shall be formatted as depicted in figure 3.

	BA		DCBA	0000	
T2	Indicator	GPC	H1	H0	Label
24	2	14	4	4	32

GPC: The PC of the tester which performs the generator role.

Figure 3: Test control messages

The Indicator field shall be used only within TEST REQUEST and TEST ACCEPTANCE messages; it shall be coded as follows:

BA

00	Terminate test on congestion indication
01	Report and then ignore congestion indications (i.e. continue test)
10 - 11	Reserved

For the TEST REFUSAL, TEST TERMINATION REQUEST and TEST TERMINATION ACKNOWLEDGE messages, bits BA are reserved and shall be coded 00 on generation, and shall not be examined on reception.

T2 is the value of test duration in seconds (present only in the TEST REQUEST message).

6.4.1.2 Test traffic

The H0 = 0001 group represents the TEST TRAFFIC messages, for this group the H1 codes shall be as follows:

0000	TEST TRAFFIC message
0001 - 1111	Reserved

The TEST TRAFFIC messages shall be formatted as depicted in figure 4.

		BA		0000	0001	
Generator dependent info.octets	Serial Number	Reserved	GPC	H1	H0	Label
m × 8	32	2	14	4	4	32

$0 \leq m \leq 261$

GPC — The PC of the tester performing the generator role.
Serial number — The serial number assigned to the message.
Generator dependent info. octets — Additional octets of information e.g. a time stamp

Figure 4: Test traffic messages

Bits BA shall be coded 0 0 on generation, and shall not be examined on reception of TEST TRAFFIC messages.

6.4.2 Timers

T1	3 s to 5 s	This timer controls the setting up of a test
T2	10 s to 500 s	This timer defines the duration of the test at the generator
T3	5 s to 10 s	This timer controls the test termination
T4	T2 + Δ	Guard timer at the turn-around node. Δ is network dependent but a provisional value could be 5 seconds

6.4.3 Interface requirements

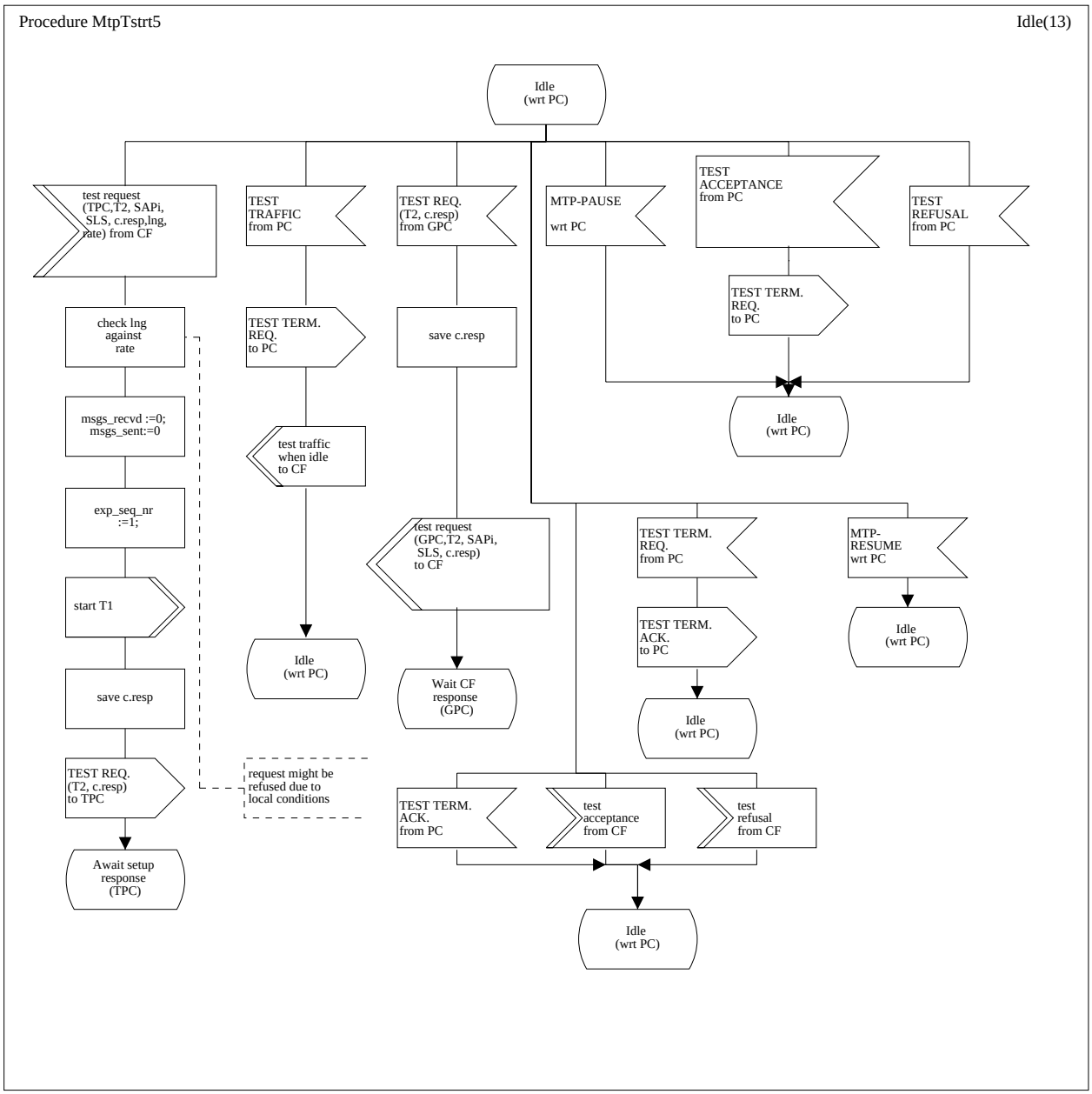
The description of the interface between the MT and the control function is outlined in table 2.

Table 2

LMI control signals	Direction	Contents
test request	CF - MT (request)	DPC, MTP Service Access Point (SAP) instance, SLS, message length, test duration. Message rate and congestion response
	MT - CF (indication) (see note)	OPC, MTP SAP instance, SLS, test duration, congestion response
test acceptance	CF - MT	DPC, MTP SAP instance, congestion response
	MT - CF	OPC, MTP SAP instance, congestion response
test refusal	CF - MT	DPC, MTP SAP instance, refusal reason
	MT - CF	OPC, MTP SAP instance, refusal reason
test termination request	CF - MT	DPC, MTP SAP instance
test termination acknowledge, indication	MT - CF	OPC, MTP SAP instance + Test Result + Reason for Termination
error indication	MT – CF	OPC, MTP SAP instance, SLS, message contents including sequence number, number of messages received, expected sequence number
traffic error indication	MT – CF	OPC, MTP SAP instance, SLS, message contents, number of messages received
NOTE: The Control Function (CF) shall decide at the turn around node whether or not the request is acceptable.		

The method of conveying additional notifications, e.g. MTP-STATUS, MTP-PAUSE, MTP-RESUME, test clash, from the tester to the Control Function, is implementation dependent.

Annex A (informative): Procedure SDL diagrams



NOTE:

SAPi	MTP SAP instance
c.resp	reaction to congestion during test
exp_seq_nr	expected sequence number
wrt	with respect to
	State(TPC) ≡ State(GPC) ≡ State(PC), "PC" should be replaced by the value

Figure A.1 (sheet 1 of 13): Generator role

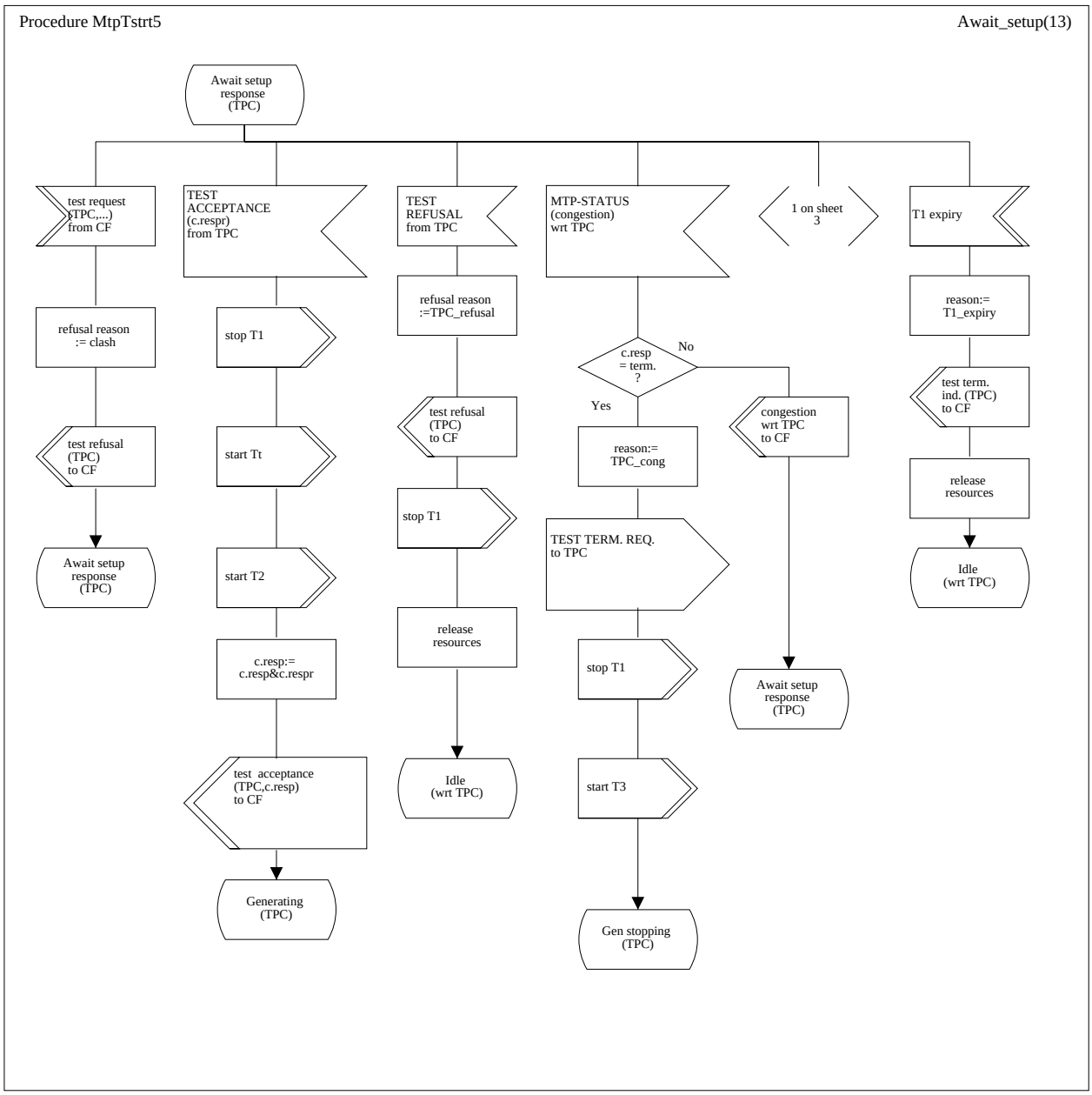


Figure A.1 (sheet 2 of 13): Generator role

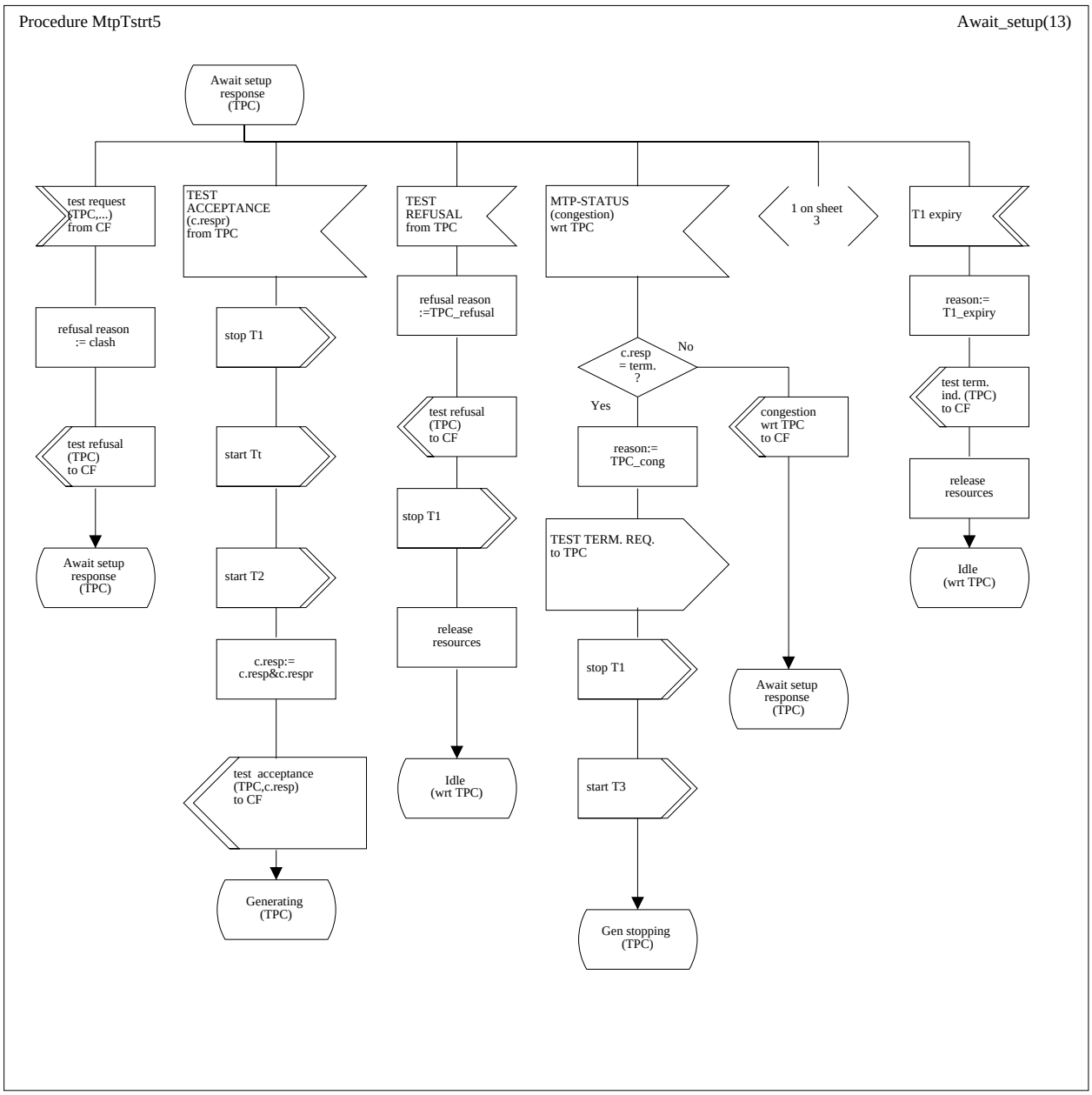


Figure A.1 (sheet 3 of 13): Generator role

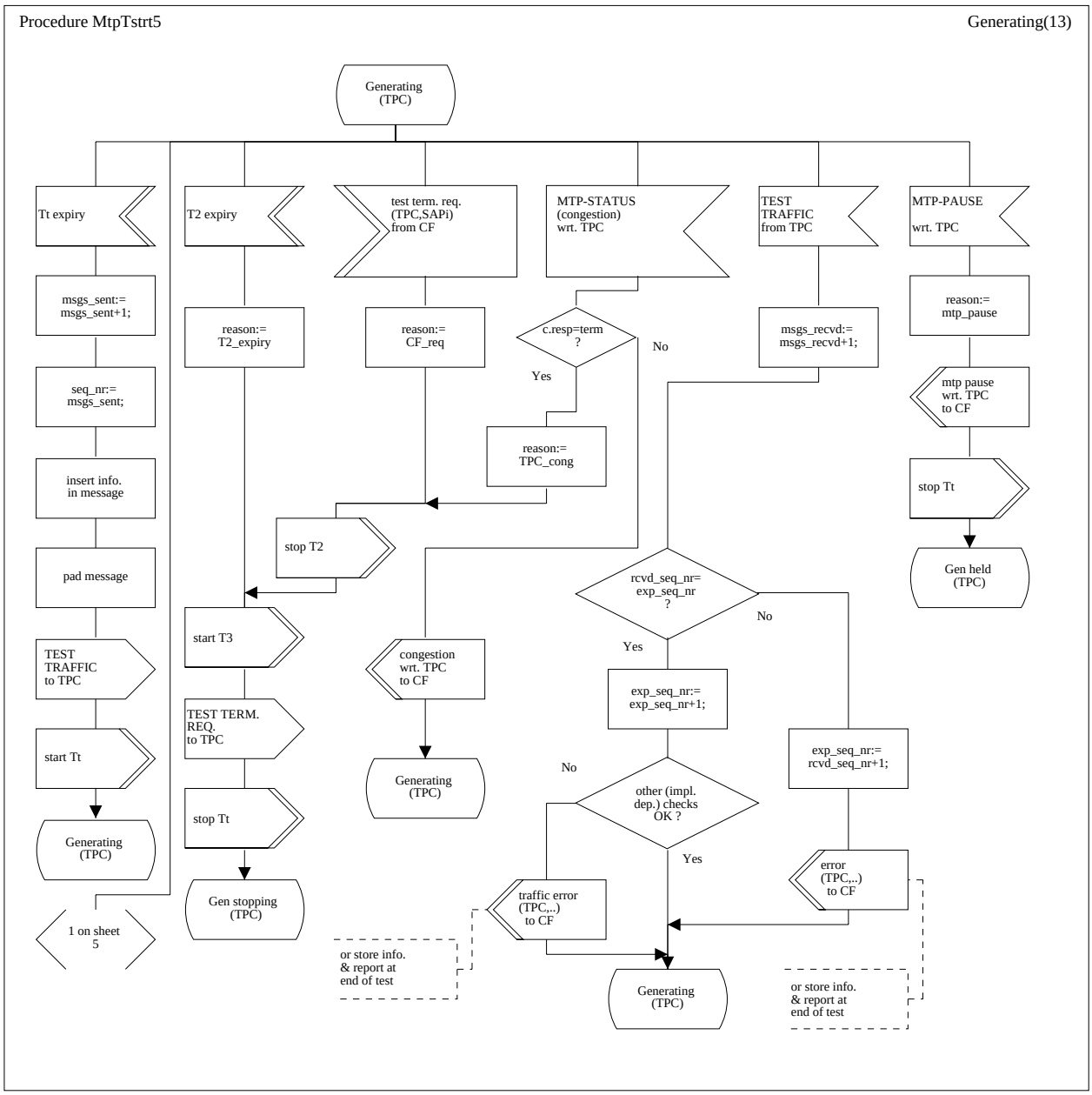


Figure A.1 (sheet 4 of 13): Generator role

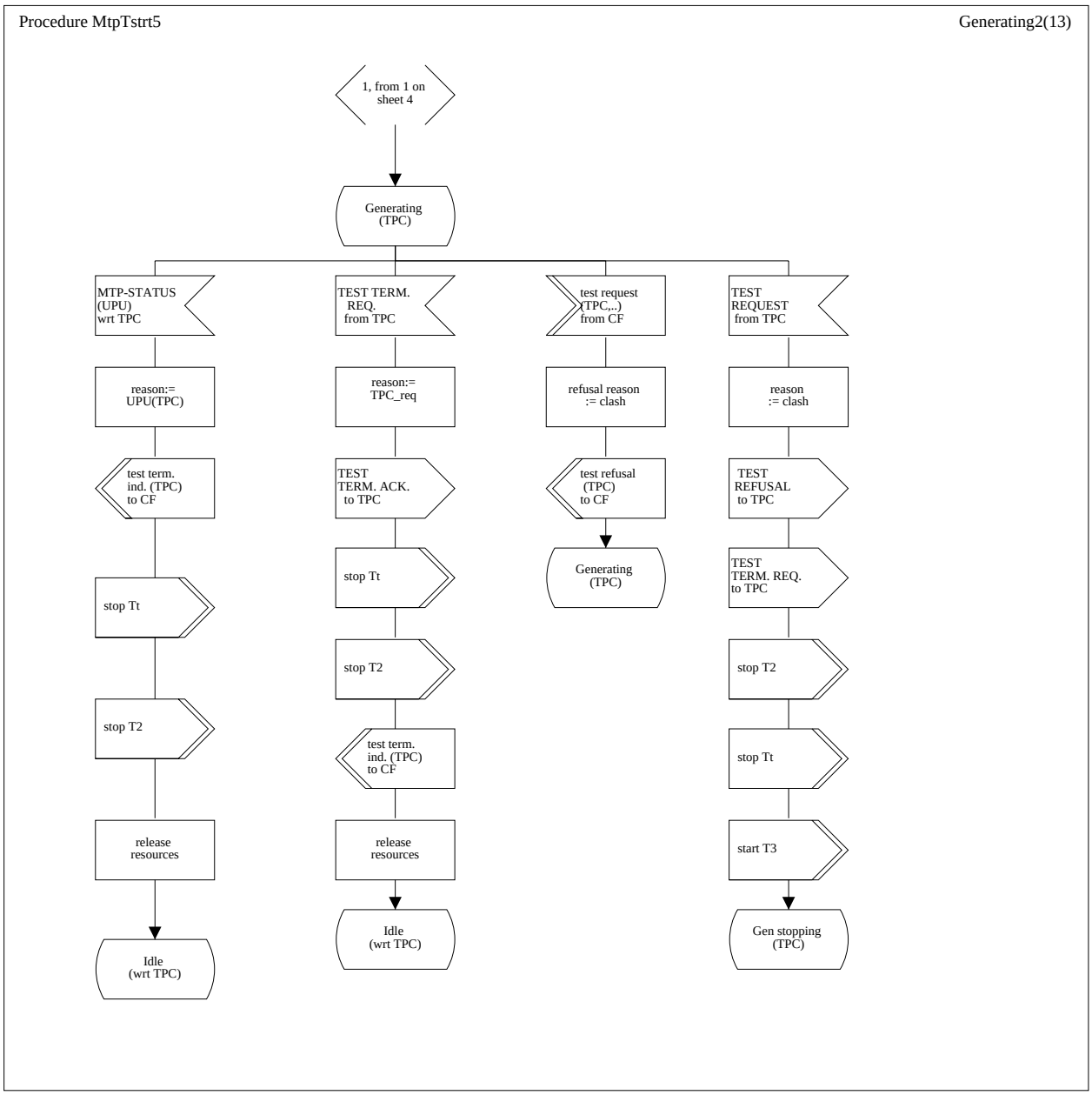


Figure A.1 (sheet 5 of 13): Generator role

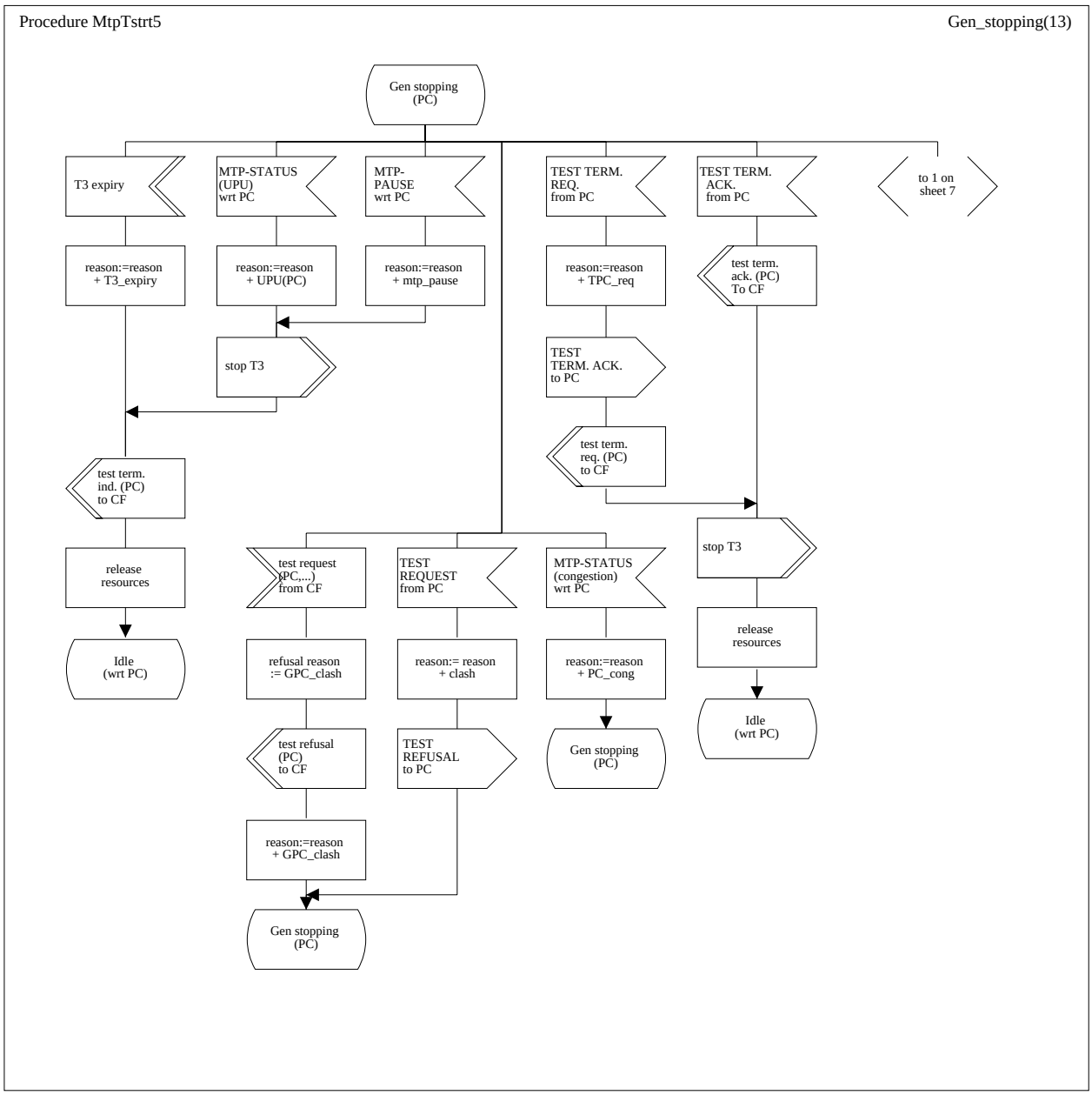


Figure A.1 (sheet 6 of 13): Generator role

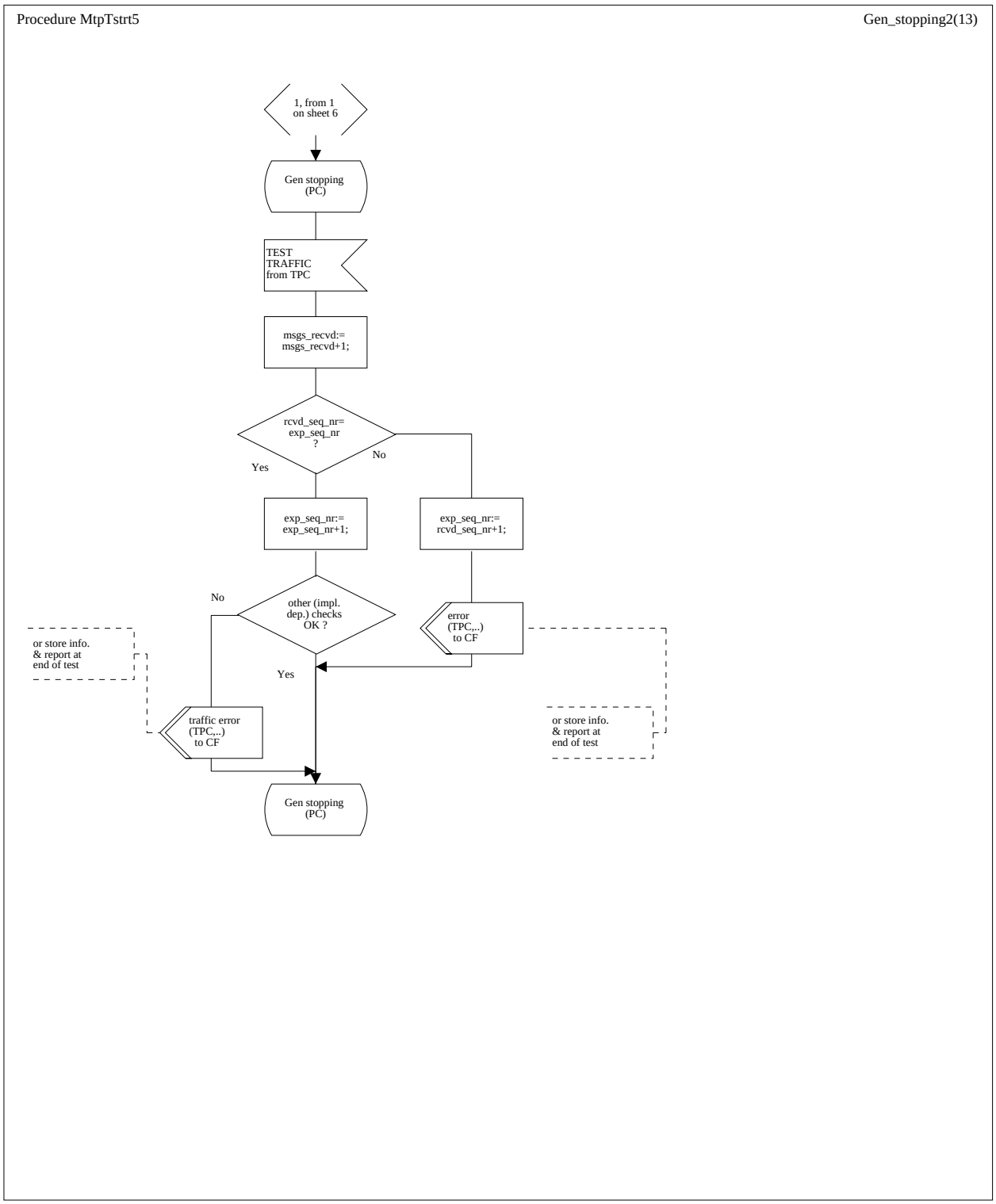


Figure A.1 (sheet 7 of 13): Generator role

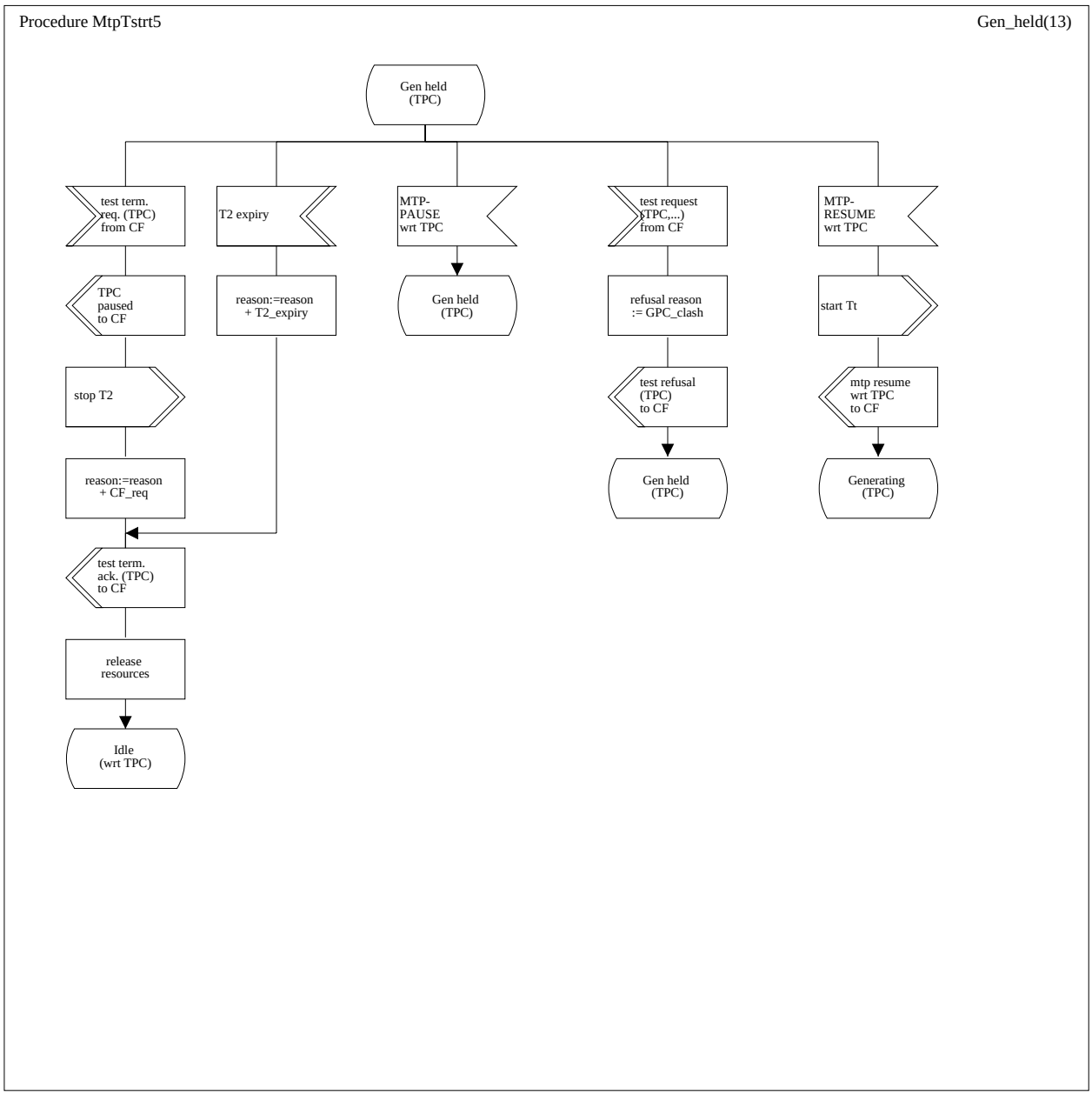


Figure A.1 (sheet 8 of 13): Generator role

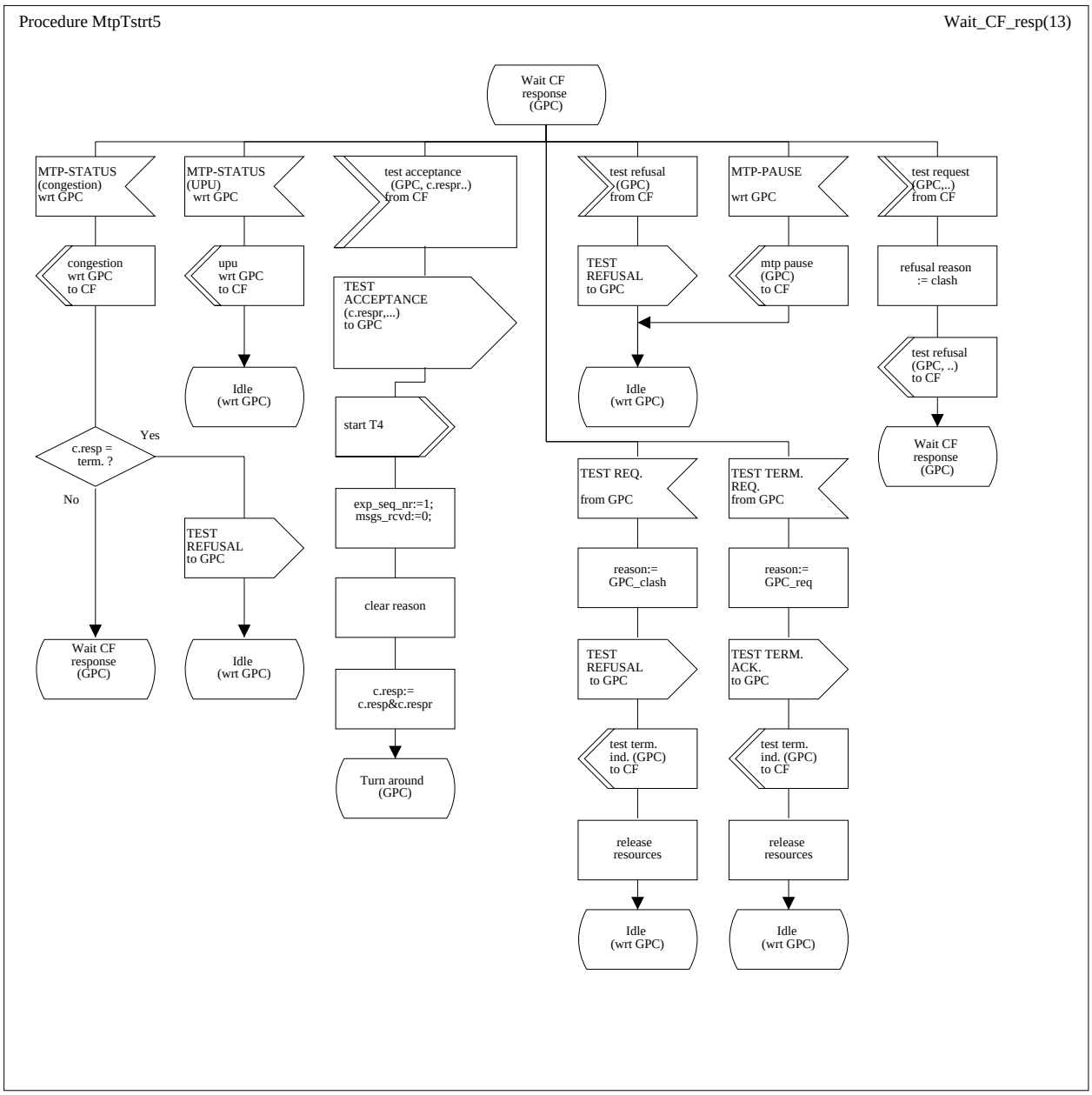


Figure A.1 (sheet 9 of 13): Turn-around role

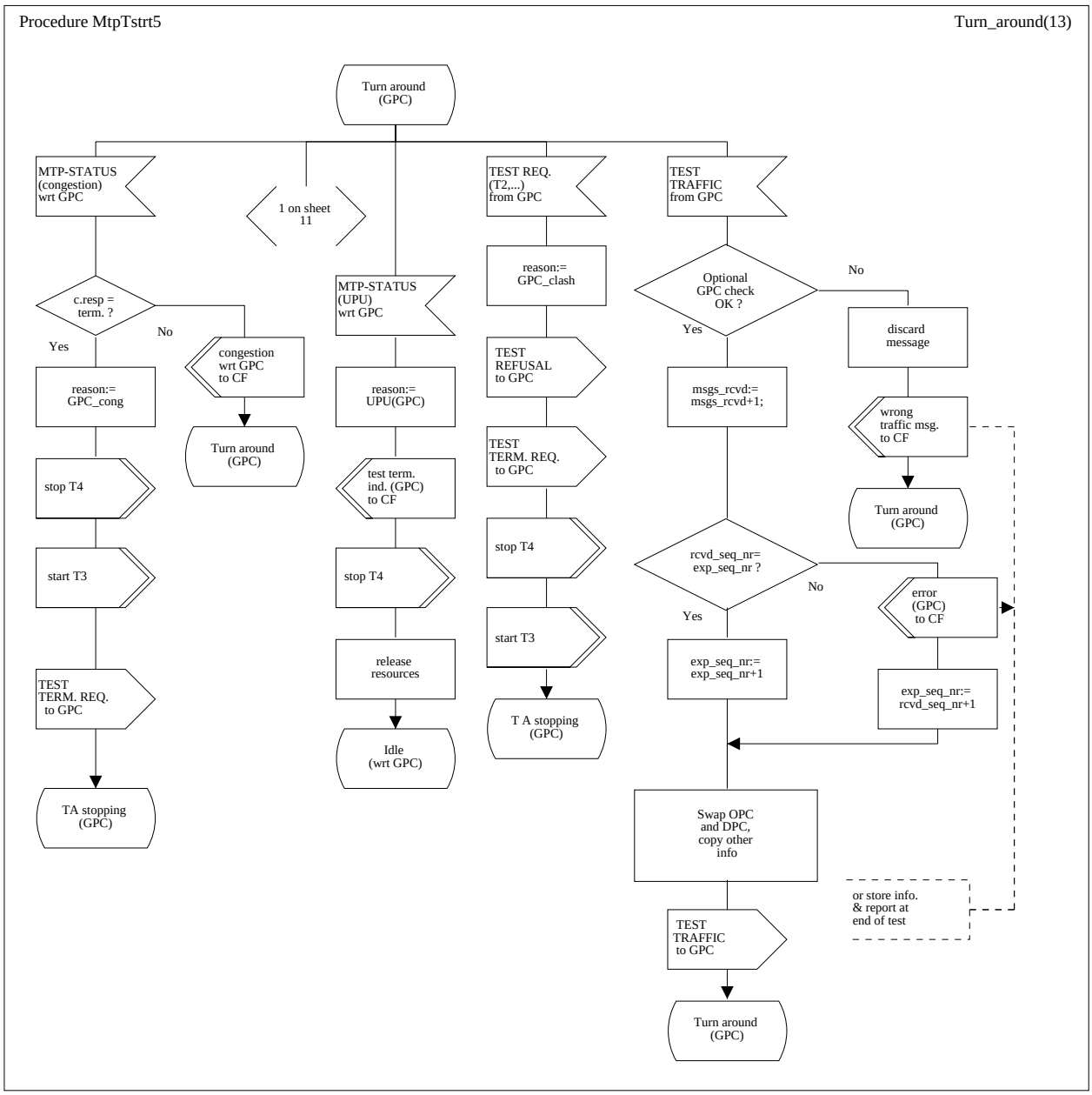


Figure A.1 (sheet 10 of 13): Turn-around role

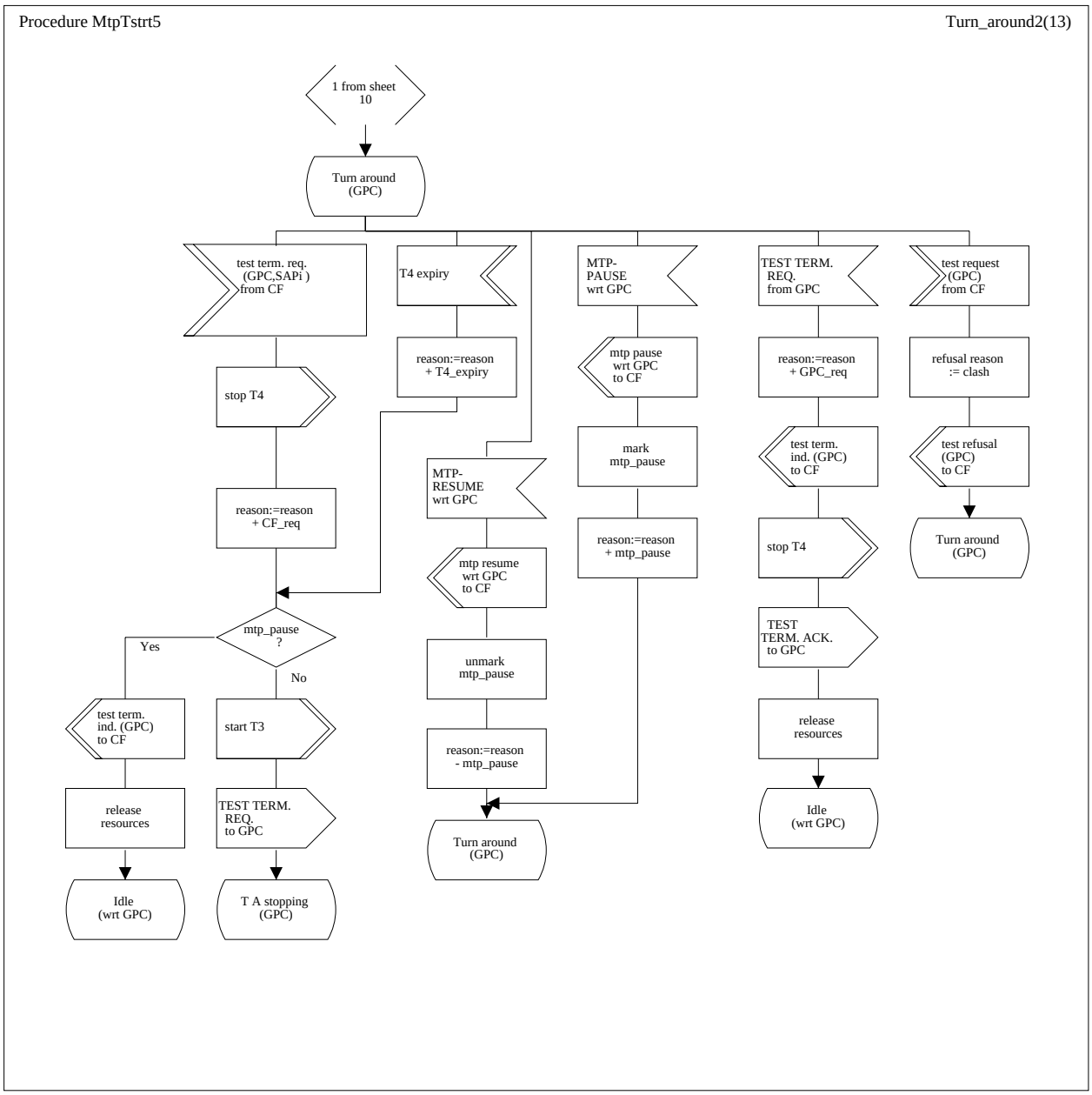


Figure A.1 (sheet 11 of 13): Turn-around role

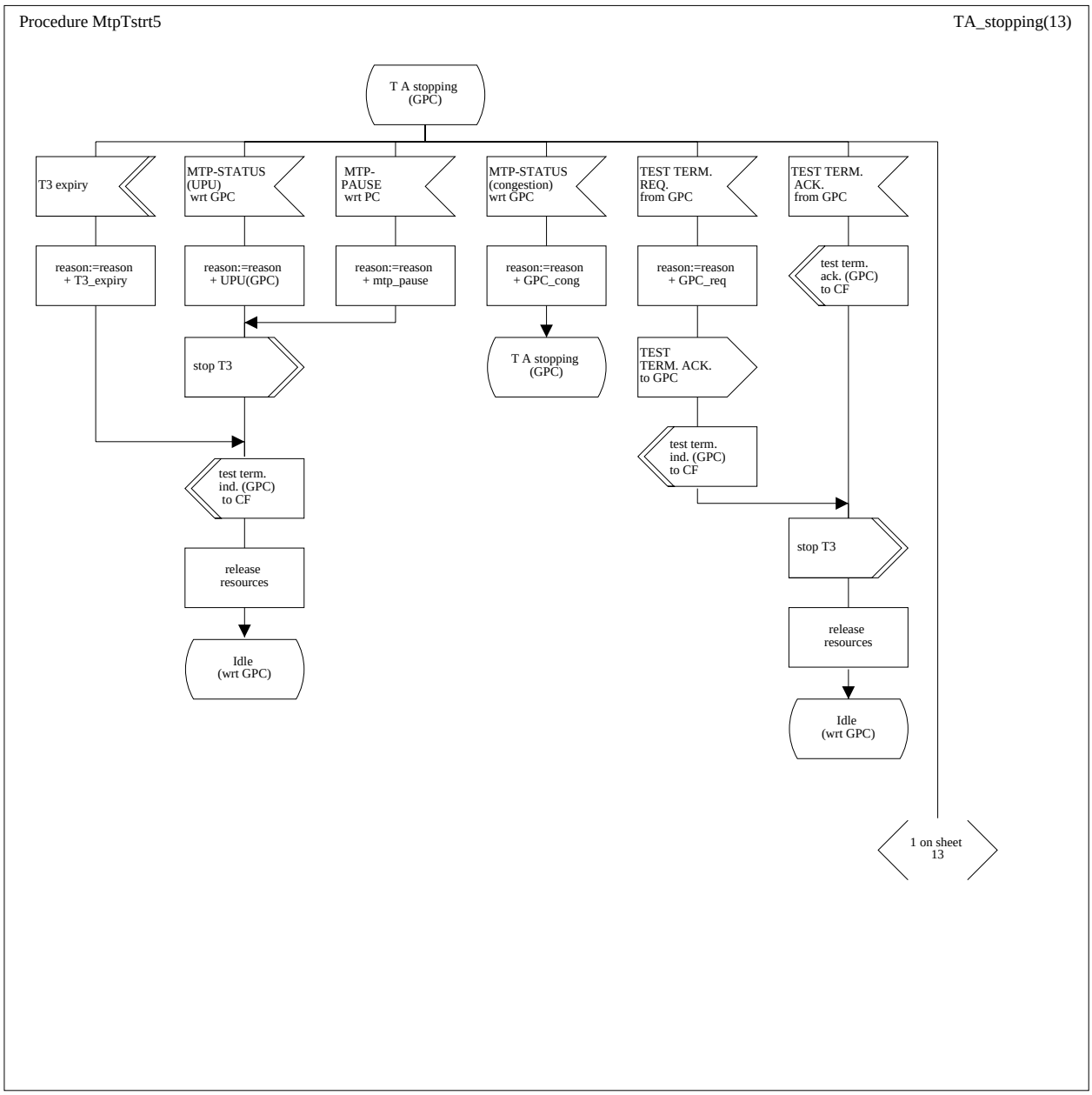


Figure A.1 (sheet 12 of 13): Turn-around role

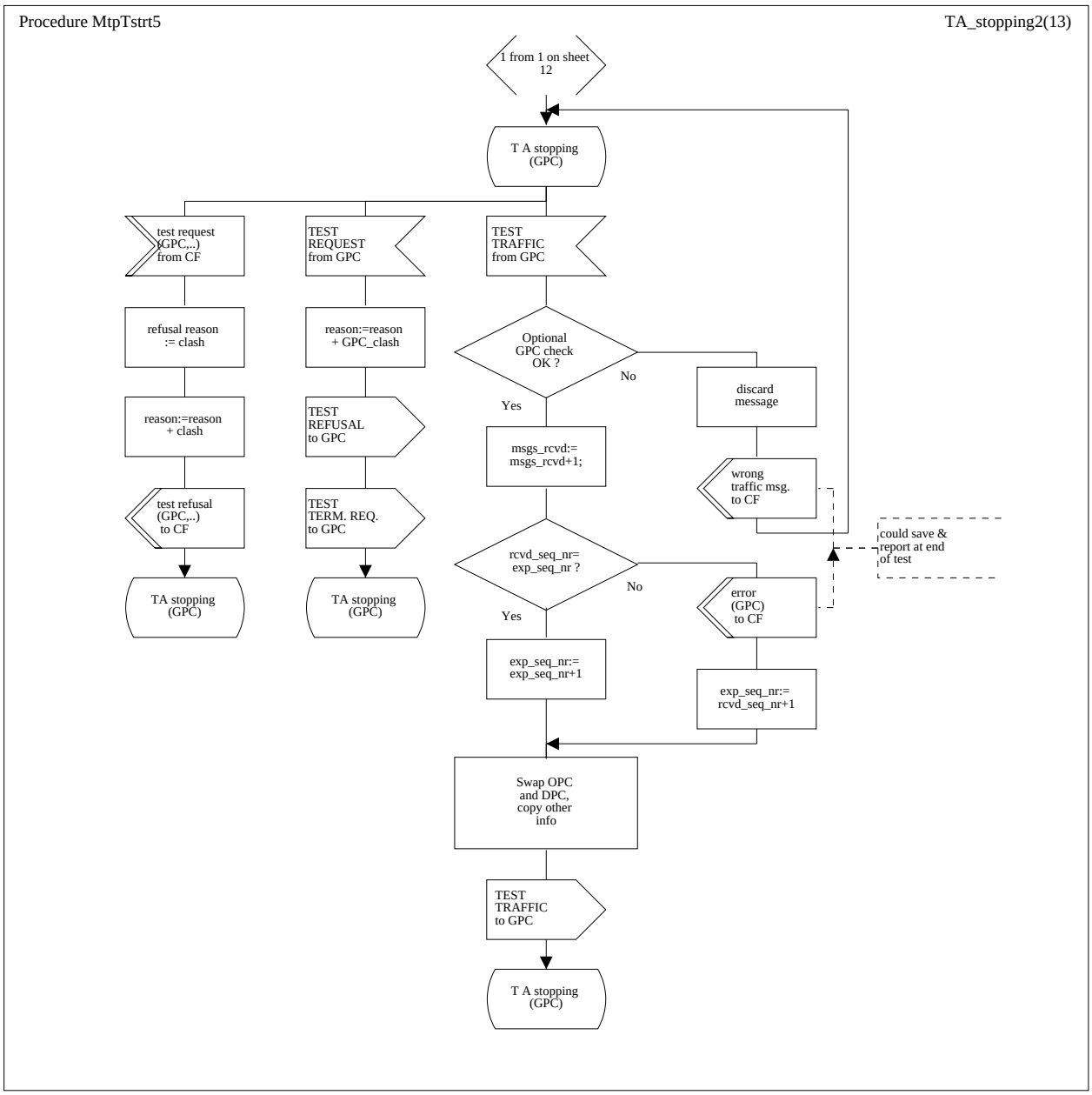


Figure A.1 (sheet 13 of 13): Turn-around role

Annex B (informative): Bibliography

- ITU Recommendation Q.755: "Signalling System No.7 protocol tests".

  NOTE: This Recommendation has been mis-named, it should have been "...protocol test**er**s".

- ITU-T Recommendation I.320: "ISDN protocol reference model".

- ITU-T Recommendation I.321: "B-ISDN protocol reference model and its application ".

- ITU-T Recommendation Q.2210: "MTP Layer 3 functions and messages using the services of ITU-T Recommendation Q.2140".

- ITU-T Recommendation Q.714: "SCCP Procedures", subclause 2.4.2.2.

History

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