



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.753

(06/97)

SERIES Q: SWITCHING AND SIGNALLING

Specifications of Signalling System No. 7 – Signalling
System No. 7 management

**Signalling System No. 7 management functions
MRVT, SRVT and CVT and definition of the
OMASE-user**

ITU-T Recommendation Q.753

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION Q.753

SIGNALLING SYSTEM No. 7 MANAGEMENT FUNCTIONS MRVT, SRVT AND CVT AND DEFINITION OF THE OMASE-USER

Summary

This Recommendation contains the informal text descriptions of the functions MRVT (MTP Routing Verification Test), SRVT (SCCP Routing Verification Test) and CVT (Circuit Validation Test), as well as the definition of the OMASE-User process containing the logic of these functions at a node.

The MRVT is a function started at a node by management action (defined in the MRVT managed object of Recommendation Q.751.1), which uses the SS No. 7 network to perform an MTP routing audit.

The SRVT is an analogous function for the SCCP.

The CVT ensures consistency of data and physical connection for the signalling points at each end of an ISDN User Part or Telephony User Part trunk circuit.

The main revisions to the 1993 version of this Recommendation are:

- a) enhancement of the compatibility rules and definition of a mechanism to transfer unrecognized parameters transparently;
- b) an extension to the MRVT to provide route priority information;
- c) addition of an explicit check on the maximum allowed number of MRV Tests, and SRV Tests, at a node at any time;
- d) revision of the MRVT text;
- e) addition of an ASN.1 module and mapping of primitives to allow management control.

Source

ITU-T Recommendation Q.753 was revised by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 5th of June 1997.

FOREWORD

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NOTE

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Recommendation Q.753

SIGNALLING SYSTEM NO. 7 MANAGEMENT FUNCTIONS MRVT, SRVT AND CVT AND DEFINITION OF THE OMASE-USER

(revised in 1997)

1 Introduction

This Recommendation contains the informal text descriptions of the functions MRVT, SRVT and CVT, the semi-formal description of the OMASE-User SDL and primitive mapping. The name MRVT stands for "MTP Routing Verification Test", SRVT stands for "SCCP Routing Verification Test", and CVT stands for "Circuit Validation Test".

These functions require the resource modelled by the managed object at the initiating Signalling Point (SP) to communicate with similar resources at other SPs, using the Signalling System No. 7 network and protocol, in order to audit certain SS No. 7 data. The network is also checked in these audits on its use of this data.

See Figure 1 for an illustration of the OMAP model for these functions.

In this Recommendation, the informal text description of the complete function as seen external to the signalling point is followed by a semi-formal description (including a mapping of primitives between OMASE-User and OMASE, and SDL for the OMASE-User) of the OMASE-User.

The logic in these functions is assumed to be located in the OMASE-User; the Management Process provides the mapping between the Signalling Point Management and the OMASE-User; and the communication functions reside in OMASE.

For a definition of OMASE, see Recommendation Q.754.

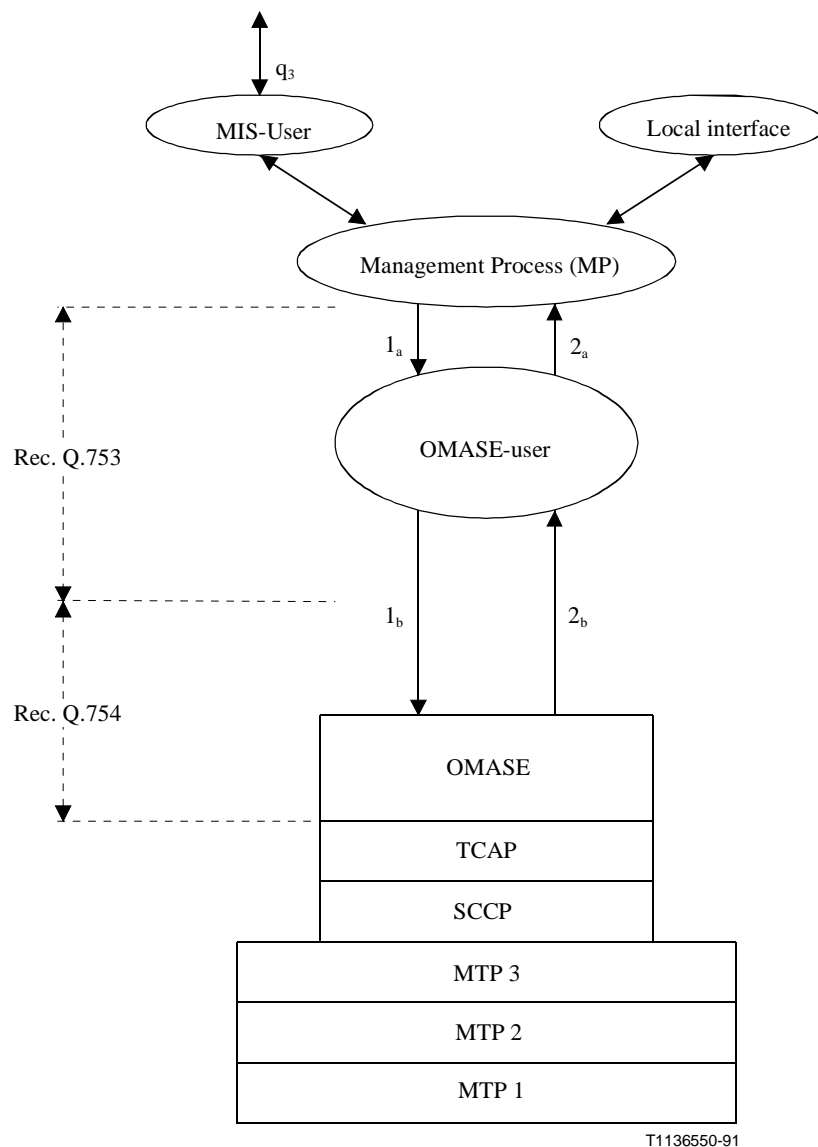


Figure 1/Q.753 – Application layer and application process model

2 MTP management functions

2.1 General

At present, the only function defined here for managing the MTP is the MRVT.

2.2 Network routing management – MTP Routing Verification Test (MRVT)

The MTP routing verification test requirements are as follows:

- a) Independence from MTP routing policy.
- b) Independence from linkset failures.
- c) To use the existing MTP without modifications.
- d) To respond to all tests (positive or negative).
- e) Independence from the network structure (but note that the test has not been examined yet to see if it is suitable in broadband networks – this is for further study).

- f) The procedure should:
- detect loops in MTP routing;
 - detect excessive length routes;
 - detect unknown destinations (i.e. non-existent destinations, missing routing entries and routing corruptions);
 - check the bidirectionality of signalling relations (i.e. if SP A can reach SP B, can SP B reach SP A?).

Note that the test might need extending to cater for asymmetrical routes, and for ping-pong loops if TFP messages are lost.

2.2.1 General procedure considerations

The object of the MTP routing verification test is to determine if the data of the MTP routing tables in the network are consistent. It is based on a decentralized test procedure using test messages. It will follow all possible routes to reach the test destination, while tracking the identities of STPs crossed.

In defining the MRV Test for a particular network, the following points should be considered:

- a) Inter-network operator agreements are required if the test is to traverse inter-operator MTP boundaries.
- b) If there is network congestion, the MRV Test should be run (if at all) with circumspection to avoid overload of the network.
- c) The MRVR trace on success should only be used if essential.
- d) The value of timer T_1 could be increased if the priority of the MRV Test is low at the nodes of the network. This approach requires discretion: T_1 should be short enough to give a true picture of the network's routing, but long enough to provide a low message frequency.

The test is started in any point (SP or STP) for any destination which is in the MTP routing tables and is stopped at the test destination or any intermediate SP at which an error is detected. The test will check the complete routing in the network only if all intermediate signalling points have routing information for the initiator and for the test destination and no errors are detected at intermediate SPs.

When an inconsistency or failure is detected, local actions are as specified. The initiator of the test is alerted.

The MRVT procedure is applied to individual MTP routing tables.

In terms of Recommendation Q.751.1, the managed items involved in the MRVT procedure are signRouteSetNePart instances contained in the same mtpSignPoint as the mtpRouteVerifTest instance and the signRouteNePart instances contained in these signRouteSetNePart instances.

An "accessible signalling point/initiator/destination" mentioned in this Recommendation is a signRouteSetNePart instance, representing that destination, whose operationalState attribute has the value "enabled".

An "available route" mentioned in this Recommendation is a signRouteNePart instance whose operationalState attribute has the value "enabled".

The words "there is routing information for a signalling point" or "known signalling point/initiator/destination" mentioned in this Recommendation means that a signRouteSetNePart instance representing that signalling point exists.

If the MTP is to use structured routing tables (e.g. some or all of the entries in the routing tables may refer to sets of point codes), then the procedure (and/or its initiation) is for further study.

2.2.1.1 Running the MRVT procedure at a signalling point

The procedure in 2.2.4.1 should be started on demand (under conditions determined by the network operator) from local maintenance staff or an operations centre when, for example:

- a) New MTP routing data are introduced. Each signalling routeset should pass the MRVT procedure successfully before being opened to traffic.
- b) MTP routing data are changed.
- c) An unexpected MRVR (due to unknown signalling point, see 2.3) is received.
- d) Measurement 5.5 of Recommendation Q.752 indicates a significant routing problem.

In cases c) and d) above, the traceRequested parameter of the MRVT message should be set to indicate no detailed information is expected.

Starting an MRV Test on receipt of an unexpected MRVR message (indicating "unknown Destination Point Code") requires consideration – subclause 13.2.2 iii/Q.704 defines sending a transfer prohibited message from a signalling transfer point Y relating to a destination X when Y is unable to transfer messages to X. If Y has no routing data for X, routeset tests to Y for the unknown destination X might be started by the recipient of the transfer prohibited message. The MRV Test could be used to diagnose the errors in the routing table; the MRVR message which triggered the test indicates that any routeset tests started on receipt of related transfer prohibited messages should be stopped, e.g. by manual intervention.

2.2.1.2 Definitions in the MRVT

The notion of an MTP route is defined in B.1.2.8/Q.751.1.

A hop of an MTP route is the combination of signalling point and adjacent signalling point in the route's ordered sequence of SPs.

The parameter "pointCodesTraversed" contains a list of the SPs encountered by successive MRVT messages along one path from the test initiator SP to the tested destination. The first entry in this list is the test initiator.

The optional parameter "routePriorityList" is a list of elements, arranged in the same order as pointCodesTraversed, each element is the priority of the route at the corresponding signalling point to the test destination. Thus, if the value of pointCodesTraversed is SP_1, SP_2, \dots, SP_n in an MRVT message sent out from SP_n , the value of routePriorityList is p_1, p_2, \dots, p_n where p_i is the priority at SP_i of this route through SP_{i+1} towards the test destination.

By "priority p_i of the route" is to be understood the order of the linkset (from SP_i to SP_{i+i}) in the route selection at SP_i to the test destination (see clause 4/Q.704).

2.2.1.3 Use of the routePriorityList parameter

The network operator might construct routing tables which contain paths indicated by the MRV Test as loops, but such paths will never be followed by any MSU (because certain hops in the path will not be available at the same time as others, whatever link failures there are in the network). In order for such "pseudo-loops" never to become real loops, network implementation dependent rules need to be constructed by the operator, and the network's MTP must enforce them.

Such rules might be enforced by an MTP sending extra preventive transfer prohibited messages during certain re-routing activity [an extension of the MTP's use of preventive TFPs as in 13.2.2 i)/Q.704], they also might imply that only some hop priority sequences are valid.

If the network does have rules which imply that only certain priority sequences are valid, then the routePriorityList optional parameter, which has as elements the priority of each hop of the route

traced out by the MRVT message in which it is contained, might be used to distinguish real from pseudo-loops.

The extension of the MRV Test to contain knowledge of any extra MTP functions for sending preventive TFPs, to allow the MRV Test to distinguish real from pseudo-loops, and to allow it to continue when a pseudo-loop is detected, is network dependent, and not considered here.

2.2.1.4 MRV Test compatibility considerations

- 1) It should not be necessary to enhance old nodes in order for an enhanced test to work, but the test should still behave in the same way as the old test at these nodes;
- 2) the new test should supply at least as much useful information as the old, even when some old nodes are present in the network;
- 3) a new node should handle old messages in the same way as old nodes;
- 4) a new message should be handled by an old node in the same way as an old message.

For backwards compatibility, if an MRVA, MRVR, or MRVT message received in an SP contains information as OPTIONAL parameters extra to that defined in 2.2.2, the extra information is not acted upon, but is transmitted unchanged if messages are regenerated by this SP in this test.

If an unknown ErrorTag value is received in an MRVR message at the test initiator, it is still passed up to management.

If an unknown FailureString value is received in an MRVA message at the test initiator, it is still passed up to management.

If an unknown FailureString value is received in an MRVA message at an intermediate point, the value is still put (logical inclusive "or") into the MRVA message to be passed back.

2.2.2 The MRVT messages

The MTP routing verification test procedure uses three Operations, Maintenance, and Administration Part (OMAP) messages.

2.2.2.1 The MTP Routing Verification Test (MRVT) message

The MRVT message is sent from an SP to an adjacent SP. The MRVT message may use any available signalling route to reach its destination. It contains:

- a) information indicating an MRVT message;
- b) the Point Code of the test destination;
- c) the initiator Point Code;
- d) the threshold N of the maximum allowed number of SPs crossed (including the initiator). This threshold is also the maximum number of point codes in the pointCodesTraversed parameter;
- e) the information indicating that a trace is requested; the possible values are:
 - 1) for all routes which may be used to reach the test destination, the MRVR messages are returned regardless of the result of the test;
 - 2) no detailed information requested (the MRVR messages sent only if a failure or inconsistency is detected);
- f) a list consisting of the identities of the SPs crossed plus the initiator Point Code. This list forms the pointCodesTraversed parameter;
- g) optionally a list, called the routePriorityList, arranged in the same order as the list in f) above, each element's value is the priority of that part of the route to the test destination, or it

has the value "unknown". This form of the list can only be used if, for all routes from test initiator to test destination, each hop of the route has a single priority associated with it. This parameter can only be present if the infoRequest parameter is also present [see h) following];

- h) optionally a parameter, called infoRequest, which indicates:
 - 1) that the test initiator is able to understand MRVR messages with optional parameters, and;
 - 2) the information that any MRVR message may contain, if the MRVR sender understands it;
- i) an optional parameter, called returnUnknownParams, which indicates which parameters of the MRVT message, if an SP does not understand them, should be returned in any MRVR message. This parameter can only be present if the infoRequest parameter is;
- j) optionally information requesting a direct route check. This check is that a receiver of an MRVT message has a route through the MRVT sender to the test initiator.

Note that parameters g), h) and i) must not be present in MRVT messages regenerated by intermediate nodes if they were not present in the received MRVT message (i.e. the test initiator is the only node allowed to insert them).

2.2.2.2 The MTP Routing Verification Acknowledgment (MRVA) message

The MRVA message is sent from the SP receiving an MRVT message back to the SP that has sent the MRVT message. The MRVA message may use any available signalling routes to reach its destination. It contains:

- a) information indicating an MRVA message;
- b) information indicating whether or not an MRVR message has been sent;
- c) the reason for any failure (partial or complete). If any failure has occurred, one or more of the following indications is present:
 - i) detected loop;
 - ii) detected excessive length route;
 - iii) unknown Destination Point Code;
 - iv) MRVT not sent due to inaccessibility (e.g. network blockage or network congestion);
 - v) timer expired (MRVA not received);
 - vi) unknown initiator Point Code (this result means that the test destination or an intermediate point does not know the initiator of the test).

If the prompting MRVT message contained the infoRequest parameter, the MRVA message can optionally contain information in the copyData parameter to be sent in the requested MRVR message. This contains information copied from the MRVT message (see 2.2.4.2.1 and 2.2.4.3) if requested by its returnUnknownParams parameter. This copyData parameter is not regenerated in MRVA messages, once the requested MRVR has been sent. See B.3 for an explanatory diagram;

- vii) test cannot be run due to local conditions (i.e. unavailability of processing resources, or MRVT message rejected by a remote SCCP or TC, or remote OMAP subsystem prohibited);
- viii) intermediate SP does not have the MTP transfer function;
- ix) indirect route detected in the network;
- x) maximum number of MRV Tests are already running at the signalling point.

Note that in the case of success, only a) will be present; in the cases of partial success and failure, a), b), and c) will be present. Also note that SCCP Class 1 service should be used with the sequence information the same as that for any associated MRVR message sent out.

2.2.2.3 The MTP Routing Verification Result (MRVR) message

There are two types of MRVR message, one with and one without optional parameters. The type containing optional parameters (routeTraceNew) may only be used if the MRVT or MRVA message triggering it contained the optional infoRequest parameter or copyData parameter, respectively.

The MRVR message is sent from an SP to the initiator of the MTP routing verification test, and also on receipt in the MTP of a message for an unknown destination (see 2.3.3/Q.704). It contains:

- a) information indicating an MRVR message;
- b) the Point Code of the tested destination;
- c) the result of the test;
- d) the information field;

The content of this information field depends on the result of the test. It contains:

- i) if the result of the test is "success":
 - the pointCodesTraversed parameter contained in the MRVT message;
 - optionally, the route priority list contained in the MRVT message;
- ii) if the result of the test is "detected loop":
 - the Point Codes of STPs which are in the loop;
 - optionally, the route priority list contained in the MRVT message;
- iii) if the result of the test is "detected excessive length route":
 - the pointCodesTraversed parameter contained in the MRVT message;
 - optionally, the route priority list contained in the MRVT message;
- iv) if the result of the test is "unknown Destination Point Code":
 - either no additional information; or
 - optionally, but only if the prompting MRVT message contained the infoRequest parameter requesting them, the routePriorityList and pointCodesTraversed parameters of the MRVT;
- v) if the result of the test is "MRVT not sent due to inaccessibility":
 - the Point Code of the inaccessible SP;
 - optionally, but only if the prompting MRVT message requested it with the infoRequest parameter, if more than one SP were inaccessible, a list of all the inaccessible SPs;
- vi) if the result of the test is "MRVA not received":
 - the identity of the SP(s) from which an MRVA was not received when expected;
- vii) if the result of the test is "unknown initiator Point Code":
 - the Point Code of the SP returning an MRVA that caused the MRVR to be sent;
 - optionally, any information from the MRVA message that it requested to be sent (in the copyData parameter);

- viii) if the result of the test is "test cannot be run due to local conditions" (i.e. "processingFailure"):
 - either no additional information; or
 - optionally, but only if the prompting MRVT message requested it with the infoRequest parameter, the Point Code of the SP where the test could not be run;
- ix) if the result of the test is "intermediate SP does not have the MTP transfer function":
 - the pointCodesTraversed parameter;
 - optionally, the route priority list contained in the MRVT message;
- x) if the result of the test is "indirect route":
 - the point code of the SP from which the prompting MRVT was sent, through which no direct return route is available (the OPC in the MTP label of the MRVR message indicates the SP which does not contain the direct route);
- xi) if the result of the test is "maximum number of MRV Tests already running at the SP":
 - either no additional information; or
 - optionally, but only if the prompting MRVT message requested it with the infoRequest parameter, the Point Code of the SP where the test could not be run;
- e) optionally, if the MRVR message was prompted by an MRVT message, if the SP receiving the MRVT did not understand some of the parameters in it, and the returnUnknownParams parameter was in the MRVT and indicated a selection of these unrecognized MRVT parameters, a copyData parameter containing the selection is put into the MRVR. Each such selected parameter is copied completely (i.e. its tag, length and value is put into the copyData parameter).

Note that the SCCP Class 1 service should be used, with the sequence information the same as that of any other associated MRVR messages and the MRVA message to be sent.

2.2.3 Initiation of the MRVT procedure at a signalling point

The conditions under which the MRV Test is started are described in 2.2.1.1. An MRV Test can be initiated manually at a signalling point, or remotely from a management centre. See Recommendations Q.750, Q.751, and Q.756 and Annex A/Q.754 for more information.

2.2.4 The MRVT procedure

2.2.4.1 At the point initiating the procedure

2.2.4.1.1 Initial actions

If a signalling point is requested to initiate an MRVT procedure, it checks that the maximum number of MRVT procedures with different (test initiator, test destination) values allowed to run at any time at the SP, n_T , has not been exceeded. If this test fails, the MRV Test is refused.

An SP cannot initiate an MRVT procedure for a test destination until any MRVT procedure previously initiated there for the same tested destination has completed.

When a Signalling Point initiates an MRVT procedure, it sends an MRVT message for each configured signalling route which is contained in the MTP routing tables to reach the test destination (if the test destination is adjacent to the test initiator on such a route, an MRVT message is still sent). The destination (DPC) of each of these messages is the adjacent signalling point within the particular route under test.

When the MRVT procedure is initiated, a timer T_1 (see 2.4) is started in the OMASE-User, and timers T_1 are started in TC for each MRVT message sent out.

2.2.4.1.2 Subsequent actions

2.2.4.1.2.1 Reception of an MRVA message

An MRVA message acknowledges an MRVT message previously sent. If received within its TC T_1 timer, the timer is stopped.

The reception of the last expected MRVA message stops the OMASE-User T_1 . When all MRVA messages expected have been received or when a T_1 expires, the test is complete and results are given to the SP management.

The possible test results at this point in the procedure are listed in 2.2.2.2.

A test is positive when all expected MRVA messages have been received inside their TC T_1 without fault indications.

If an MRVA message is received after its TC T_1 , it is ignored.

The result "unknown initiator Point Code" could be a positive result (e.g. when installing a new SP).

2.2.4.1.2.2 Reception of an MRVR message

The reception of an MRVR message causes the information contained in the message to be given to the SP management (see 2.2.2.3), when either the MRVR message is in response to an MRV Test initiated at the SP or is caused by the receipt in the MTP of a message for an unknown destination.

2.2.4.2 In an intermediate point X

2.2.4.2.1 Initial actions (on reception of an MRVT message)

- a) If the MRVT message contains a route priority list parameter, and this parameter is shorter than the pointCodesTraversed parameter f) in 2.2.2.1, the intermediate point "backfills" the route priority list parameter up to the last "known" value with the value "unknown".
- b) If the intermediate point X does not have the MTP transfer function or it has a screening function as defined in clause 8/Q.705 which was able to be used, and which indicated that X was not authorized to transfer messages from the test initiator towards the test destination¹, it:
 - 1) sends an MRVR message to the initiating point (if there is routing to it);
 - 2) acknowledges the received MRVT message by an MRVA message with the indication "intermediate SP does not have the MTP transfer function" when X has routing to the initiator, or "unknown initiating SP" when X has no routing to the initiator (the MRVA indicates whether or not an MRVR has been sent);
 - 3) gives an indication to the SP management, and stops the test.
- c) If the test cannot be run due to local conditions, X:
 - 1) sends an MRVR message with contents as described in 2.2.2.3 to the initiating point, if there is routing to it from X;
 - 2) sends an MRVA message containing the indication "test cannot be run due to local conditions" to the sender of the MRVT;

¹ It is desirable that a check is made in the MRV Test for unauthorized use of X as an STP, if the function is supplied and can be used during the MRVT, since this will audit the screening data.

- 3) informs the SP management and stops the test.
- d) If the number of MRV Tests already running at X is the maximum value n_T , X:
 - 1) sends an MRVR message with contents as described in 2.2.2.3 to the initiating point, if there is routing to it from X (with the reason "processingFailure" if the routeTrace MRVR is used, rather than routeTraceNew);
 - 2) sends an MRVA message containing the indication "maximum number of MRV Tests already running at the SP" to the sender of the MRVT;
 - 3) informs the SP management and stops the test.
- e) If the test can be run, X determines if there is routing information for the initiating SP, and if information for the tested destination exists in the MTP routing tables. Then:
 - 1) if there is no routing information for the initiating SP, X:
 - i) returns an MRVA message with result "unknown initiating SP", the value of the "MRVR sent" indicator denotes that the MRVR message was not sent;
 - [a] if the prompting MRVT message requested it in the infoRequest parameter, the MRVA message contains the pointCodesTraversed parameter, copied from the MRVT message into the copyData parameter;
 - [b] if the prompting MRVT message requested it in the infoRequest parameter, the MRVA message contains the routePriorityList parameter, copied from the MRVT message into the copyData parameter;
 - [c] if the MRVT message contained a returnUnknownParams parameter, copyData contains those unrecognized parameters whose tags were indicated, copied from the MRVT;
 - ii) informs the SP management and stops the test;
 - 2) if there is no routing information for the destination, X:
 - i) sends an MRVR message to the initiating point;
 - ii) acknowledges the received MRVT message by an MRVA message with indication "unknown Destination Point Code";
 - iii) gives an indication to the SP management and stops the test;
 - 3) if there is routing information for the initiating point of the test as well as for the test destination within X's routing tables:
 - i) X checks if the direct route test was requested by the initiator. If it was:
 - [a] X checks that it has a route to the test initiator directly via the preceding SP (i.e. the MRVT message sender). If such a route does not exist:
 - [1] an MRVR message is sent to the test initiator indicating "indirect route";
 - [2] an MRVA message is returned to the MRVT sender indicating "indirect route";
 - [3] the SP management is informed and the test is stopped (MRVT messages are not regenerated);
 - [b] if such a route does exist, the test continues;
 - ii) if the direct route test was not requested, the test continues;

- iii) X makes a list "A" of the following adjacent SPs:
 - STPs used to route to the destination (according to the MTP routing tables), excluding the SP from which the MRVT message was received²;
 - the tested destination, if this is adjacent;
- iv) X then compares the pointCodesTraversed parameter contained in the MRVT message with its own list "A". One of the following conditions is possible:
 - [a] if the Point Code of an SP in "A" is already in pointCodesTraversed in the MRVT message, a loop is detected. X:
 - [1] sends an MRVR message with the indications described in 2.2.2.3 to the initiator of the test;
 - [2] sends an MRVA message with the indication "detected loop" to the point which has sent the MRVT message;
 - [3] stops the test (MRVT message are not regenerated), after informing the SP management;
 - [b] if no Point Code of "A" is in the pointCodesTraversed parameter in the MRVT message, and if the number of PCs in the latter is equal to a threshold *N* in the MRVT message, an excessive length route is detected. X:
 - [1] sends an MRVR message with the indications described in 2.2.2.3 to the initiator of the test;
 - [2] sends an MRVA message with the indication "detected excessive length route" to the point which has sent the MRVT message;
 - [3] informs the SP management and stops the test (MRVT messages are not regenerated);
 - [c] if it is impossible to route any MRVT message, X:
 - [1] sends MRVR messages with the indications described in 2.2.2.3 to the initiator of the test (one MRVR for each inaccessible SP in list "A" if the prompting MRVT message did not request in the infoRequest parameter a list of all inaccessible³ SPs, but just one MRVR listing all such inaccessible SPs otherwise);
 - [2] sends an MRVA message containing the indication "MRVT not sent due to inaccessibility" to the point which has sent the MRVT message;
 - [3] informs the SP management and stops the test (no MRVT messages are regenerated);

² Note that if list "A" is empty, but the SP from which the MRVT message was received is an STP used to route to the test destination, then the test has failed, and the actions of iv) [a] following are performed.

³ "inaccessible" here includes also SPs whose SCCP is unavailable, or whose OMAP subsystem is prohibited. The "result" parameter in a single routeTraceNew MRVR is set to routeInaccessible if any SP of the set is inaccessible by the MTP. If one MRVR is returned for each unavailable SP, its result indicates why that SP is unavailable (processingFailure for rejects or OMAP prohibited, routeInaccessible if the MTP cannot access it).

[d] in other cases:

- [1] X starts a timer T_1 in TC for each MRVT message to be sent out; and
- [2] sends MRVT messages to all the accessible SPs in list "A", after noting the inaccessible³ SPs:
 - [i] it adds its identity into the pointCodesTraversed parameter of the MRVT message sent (and the priority of the route to the tested destination, if the route priority list parameter was present in the prompting MRVT message);
 - [ii] the content of the "trace requested" field is obtained from the received MRVT message;
- [3] X also sends MRVR messages concerning inaccessible SPs in list "A":
 - [i] if the prompting MRVT message did not request in the infoRequest parameter a list of all inaccessible SPs, X sends an MRVR message with the indications described in 2.2.2.3 to the test initiator for each inaccessible SP in list "A";
 - [ii] otherwise just one MRVR message is sent, listing all the inaccessible SPs in list "A";
 - [iii] if all SPs in list "A" are accessible, no MRVR is sent.

2.2.4.2.2 Subsequent actions (on reception of an MRVA message, or MRVT message rejection)

- a) The reception of an MRVA message acknowledges the corresponding MRVT message previously sent. The last TC T_1 timer is stopped when all the expected MRVA messages have been received.
- b) An MRVA message is sent when all expected MRVA messages have been received. The result of the test contains the different results from the MRVAs received, plus any noted SP inaccessibility.
- c) If any MRVA message reported "unknown initiating SP" and the value of its "MRVR sent" indicator denotes that the MRVR was not sent, an MRVR is returned to the initiator. MRVA messages sent subsequently during the test should indicate that an MRVR has been sent. See B.3.
- d) If one (or several) MRVA messages are not received before a T_1 expires:
 - 1) the intermediate point X sends an MRVR message with the indications described in 2.2.2.3 to the initiator of the test; and
 - 2) an MRVA message to the prompter of the test.
- e) If an MRVA message cannot be sent, no action is taken.
- f) If an MRVA message is received after a T_1 expires, it is ignored.
- g) If an MRVT message is rejected by a remote SCCP or TC, or by a newly prohibited remote OMAP, the remote node is considered unable to run the test due to local conditions (i.e. processing failure). An MRVR message is returned to the test initiator, and an MRVA message is sent to the prompter of the test.

2.2.4.3 At the test destination receiving an MRVT message

- a) If the MRVT message contains a route priority list parameter, and this parameter is shorter than the pointCodesTraversed parameter f) in 2.2.2.1), the destination "backfills" the route priority list parameter up to the last "known" value with the value "unknown".

- b) The test destination then checks that there is routing information for the initiator of the test:
- 1) if there is no information for the initiator, the destination sends an MRVA message to the point which had sent the MRVT message:
 - i) this MRVA message contains the result "unknown initiator Point Code", the "MRVR sent" indicator denotes that the MRVR was not sent;
 - ii) if the MRVT message requested it in the infoRequest parameter, the MRVT message's pointCodesTraversed parameter is copied into the copyData parameter of the MRVA message;
 - iii) if the MRVT message requested it in the infoRequest parameter, the MRVT message's routePriorityList parameter is copied into the copyData parameter of the MRVA message;
 - iv) if the MRVT message contained a returnUnknownParams parameter, and it indicated parameters in the MRVT which the destination does not understand, then these are copied into the copyData parameter of the MRVA;
 - 2) if there is information for the initiator of the test, the SP checks if the direct route test was requested by the initiator. If it was:
 - i) the SP checks that it has a route to the test initiator directly via the preceding SP (i.e. the MRVT message sender):
 - [a] if such a route does not exist:
 - [1] an MRVR message is sent to the test initiator indicating "indirect route";
 - [2] an MRVA message is returned to the MRVT sender indicating "indirect route"; and
 - [3] the SP management is informed;
 - [b] if there is a route through the MRVT sender to the test initiator, the test continues as ii) following;
 - ii) if the direct route test was not requested, it is finished with success and the following actions are taken:
 - [a] if the MRVT message received contains the indication that a trace is expected, (see 2.2.2.1), an MRVR message with the indications described in 2.2.2.3 is sent to the initiator of the test. An MRVA message is then sent to the point which had sent the MRVT message;
 - [b] if the MRVT message received contains the indication that a trace is not expected, (see 2.2.2.1), an MRVA message is sent to the point which had sent the MRVT message. No MRVR message is sent.
- c) If an MRVA message cannot be sent, no action is taken.

2.3 Reception of a message for an unknown destination

When an indication is received from the MTP due to the reception of a message for an unknown destination, an MRVR message with the indications described in 2.2.2.3 is returned to the point which has sent the message.

When an SP receives such an unexpected MRVR message, an indication is given to the SP management and an MRV Test might be started.

2.4 Timer definition and values

2.4.1 MRVT timers

T_1 at a signalling point (Near End Signalling Point) initiating an MRVT is the guard time waiting for all MRVA messages in response to the MRVT messages sent from the Near End SP.

$$T_{1,(Near\ End\ SP)} = D(N + 1)$$

where N is defined in 2.2.2.1 d), and D is defined in 2.4.2 below.

T_1 at an intermediate signalling point is the guard time associated with a received MRVT message, waiting for all MRVA messages in response to all MRVT messages sent.

$$T_{1,(Intermediate\ SP)} = T_1^1 - D$$

where T_1^1 is deduced from the received MRVT message,

$$T_1^1 = T_{1,(Near\ End\ SP)} - nD = D(N + 1 - n),$$

with n the number of SPs in the pointCodesTraversed parameter of the MRVT message.

2.4.2 Performance time definitions and values

$$D = \text{Max}(d_1) + \text{Max}(d_2) + \text{Max}(d_3) + \text{Max}(d_4)$$

where:

- d_1 Time to transfer an MRVT message.
- d_2 Time to take account of an MRVT message received:
 - In an Intermediate SP, performance time d_2 is the time between the reception of an MRVT message and the sending of the MRVT messages to the concerned SPs (or the sending of the MRVA message to the point which has sent the MRVT message when a problem is detected).
 - In the tested destination, performance time d_2 is the time between the reception of an MRVT message and the sending of the MRVA message to the point which has sent the MRVT message.
- d_3 Time to transfer an MRVA message.
- d_4 Time to take account of an MRVA received:
 - In an Intermediate SP, performance time d_4 is the time between the reception of the last MRVA message and the sending of the MRVA message to the point which has sent the MRVT message.

Performance time	Estimated maximum value
d_1	2 seconds
d_2	3 seconds
d_3	2 seconds
d_4	1 second
D	8 seconds

The following parameters must be identical in all nodes using MRVT. The values are provisionally set at:

- a) $n_T = 2$ (the maximum number of different tests running at an SP. See 2.2.4.2.1. Here, a different MRV Test is indicated by a different combination of test initiator, test destination Point Codes).
- b) $D = 8$ seconds (the time to perform the actions for a complete MRVT within one node). This time is based on restricting the network structure to allow not more than 32 different routes between the test initiator OPC and the test destination DPC.
- c) N_{max} is to be determined for a maximum MTP SIF length of 272 octets, it is the maximum value of the number N of signalling transfer points allowed to be crossed plus the test initiator. N is carried in the MRVT message, and is input by network operator personnel.

2.5 OMAP model for MRVT

See Figures 1 and A.1 for diagrams.

The OMAP model assumes that the logic defined in 2.2 resides in the OMASE-User, which provides a service MRVT(Start) and MRVT(Result). The management process (MP) uses MRVT(Start) to initiate an MRV Test, and MRVT(Result) is used by the OMASE-User to give the results of the test to the MP. The actions, e.g. sending an MRVT message, described in the text of the MRV Test correspond to the sending of primitives from the OMASE-User to OMASE, and receiving primitives in the OMASE-User from OMASE. The mapping of the text-defined actions to primitives is described in the next subclause.

NOTE – The MRVT initiator's OMASE-User runs a timer T_1 in addition to the T_1 timer run in TC, which is marginally greater than the TC T_1 timer. This extra timer at the initiator guards against rare untoward happenings, e.g. ill-formed APDUs passed from TC to OMASE.

2.5.1 Mapping of primitives

See Table 1.

Table 1/Q.753 – Mapping of text-defined actions to OM service primitives

"a" interface	"b" interface
1a MRVT(Start)	1b OM-CNF-ACTION request
2a MRVT(Result)	2b OM-CNF-ACTION indication
1a –	1b OM-CNF-ACTION response
2a MRVT(Result)	2b OM-CNF-ACTION confirmation
1a –	1b OM-EVENT-REPORT request
2a MRVT(Result)	2b OM-EVENT-REPORT indication

2.5.2 State transition diagrams for MRVT – Logic in the OMASE-User

See Figure 2.

Procedure OMASE-User mrvt-1 (4)

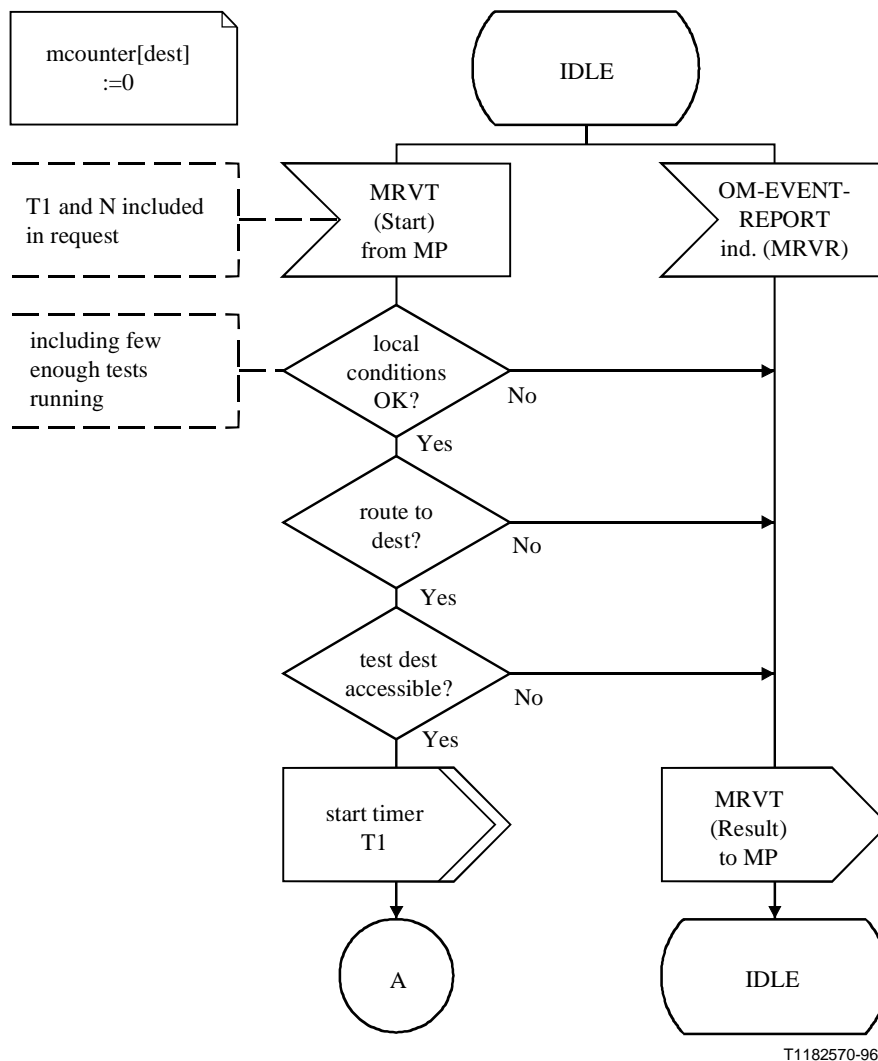


Figure 2/Q.753 (sheet 1 of 4) – MRVT SDL in the OMASE-User

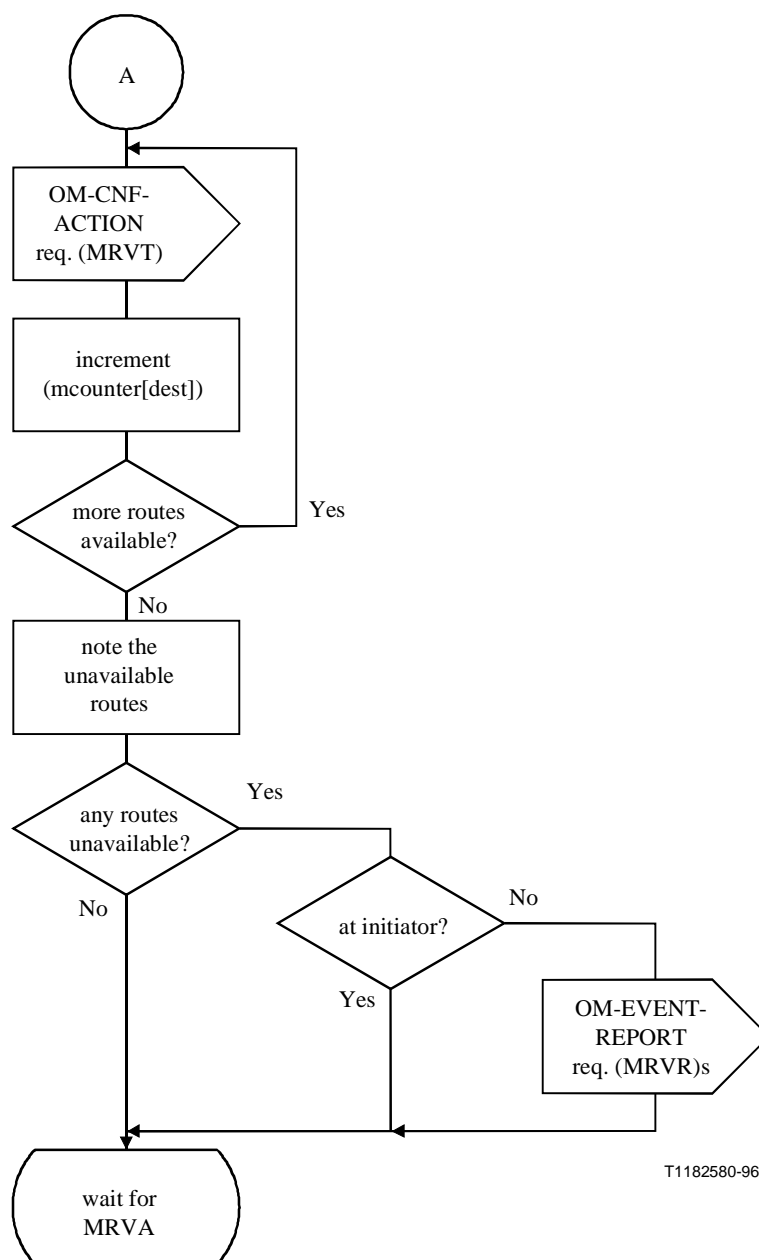
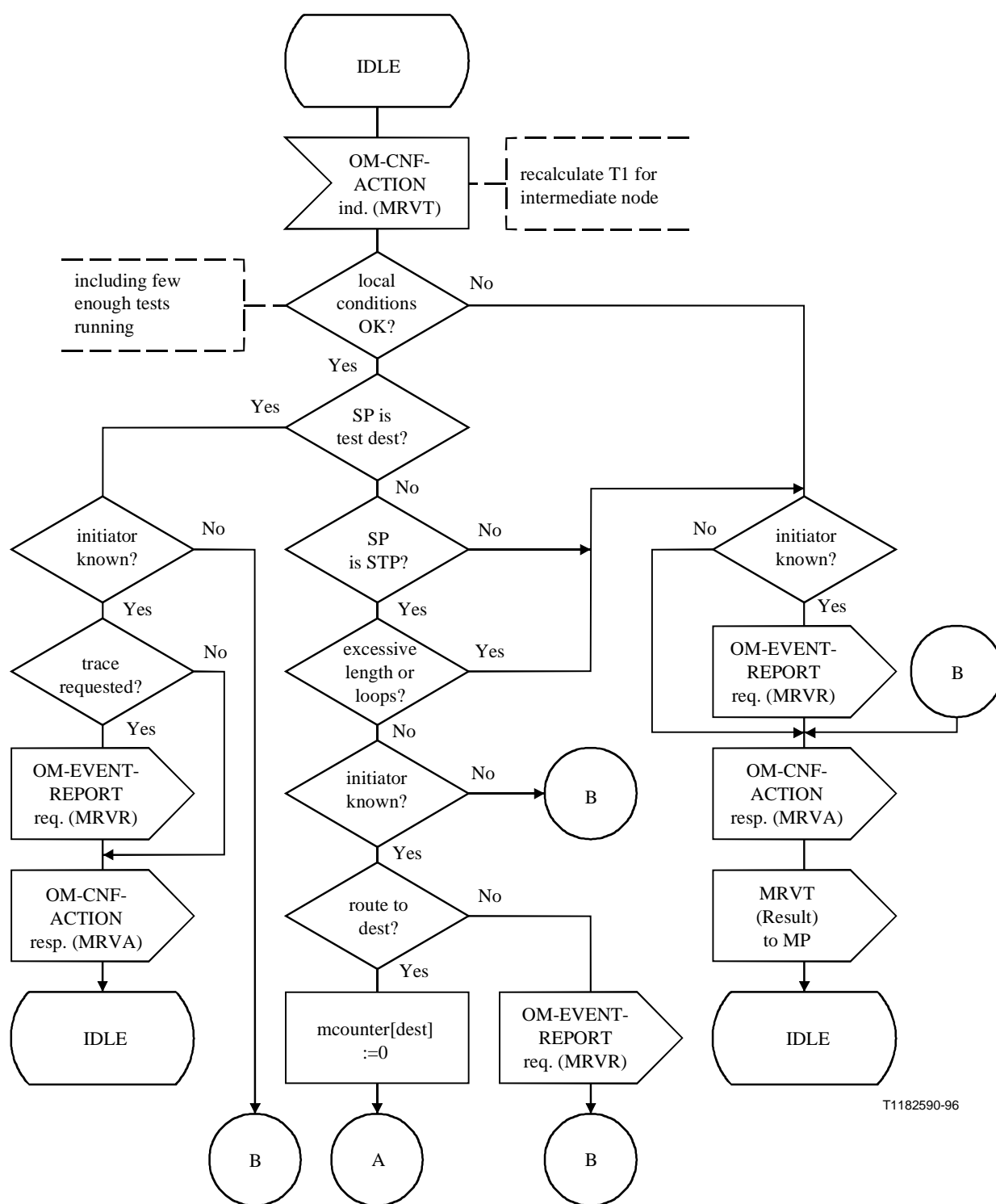
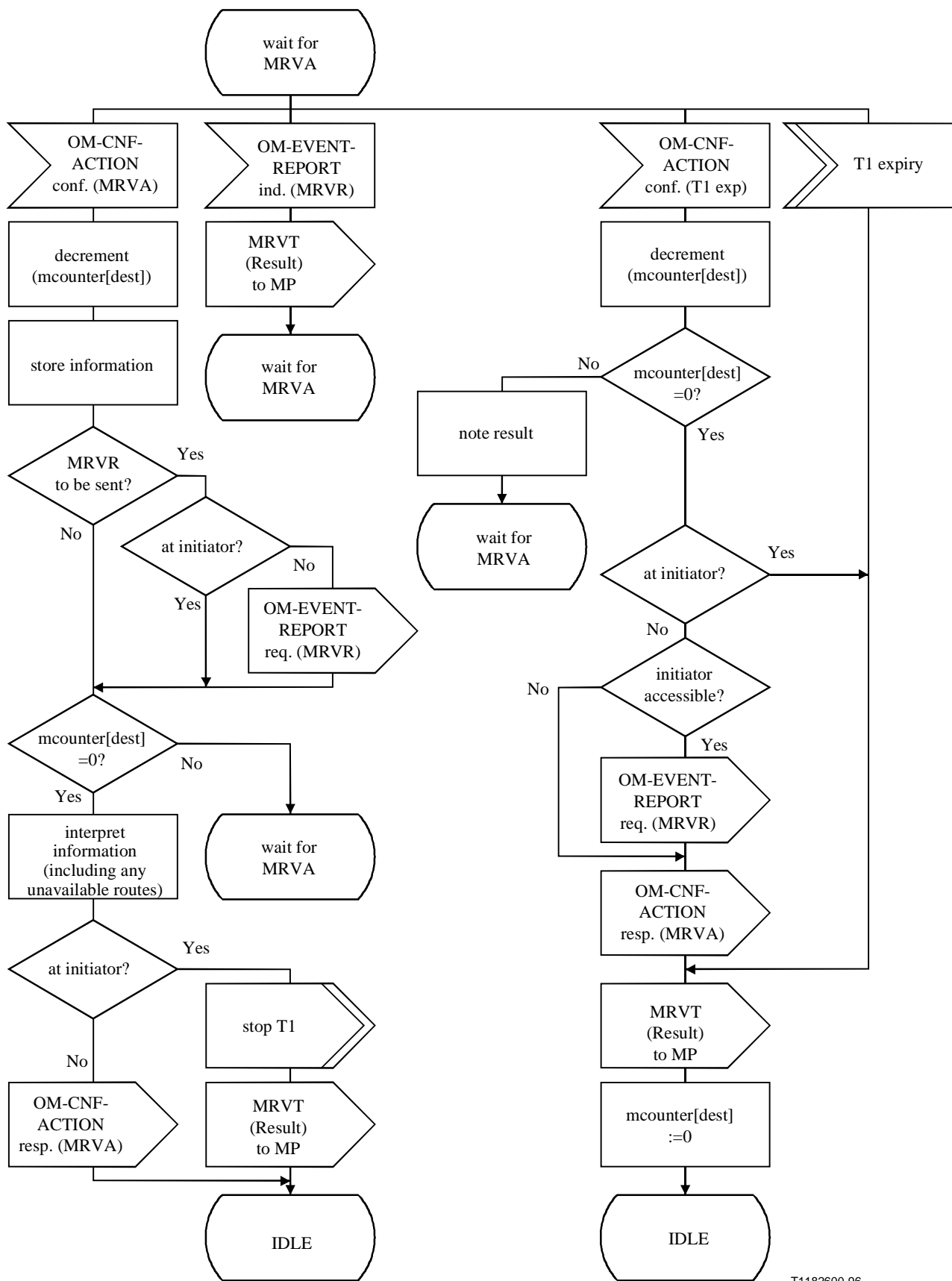


Figure 2/Q.753 (sheet 2 of 4) – MRVT SDL in the OMASE-User



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Figure 2/Q.753 (sheet 3 of 4) – MRVT SDL in the OMASE-User



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Figure 2/Q.753 (sheet 4 of 4) – MRVT SDL in the OMASE-User

3 SCCP management functions

3.1 General

At present, the only SCCP management function defined in this Recommendation is the SRVT.

3.2 Network routing management – SCCP Routing Verification Test

3.2.1 Requirements upon an SCCP Routing Verification Test (SRVT)

These are as follows:

- a) No modification should be needed to the SCCP protocol Recommendation.
- b) The SRVT should be independent of the SCCP routing policy.
- c) The SRVT should be independent of the network structure.
- d) The SRVT is not required to verify MTP routing, the MRVT is defined for that.
- e) A response (either positive or negative) is to be given to all tests.
- f) The procedure should:
 - be able to check all possible SCCP routes, including parallel SCCP routing points (e.g. duplicate Translation SPs), serial SCCP routing points (e.g. multiple Translation SPs), multiple destinations corresponding to the tested Global Title [this is understood to mean multiple SPs and SubSystem Numbers (SSNs), where SCCP permits a maximum of two destinations to be derived from a Global Title];
 - detect loops in SCCP routing;
 - detect unknown destinations (e.g. a destination does not correspond to a tested Global Title);
 - verify SCCP routing data for accuracy, completeness and consistency.

3.2.2 Specific SCCP Routing Verification Tests

3.2.2.1 General procedure considerations

This particular SCCP Routing Verification Test is the means of testing the Global Title Translation service of the Signalling Connection Control Part (SCCP). The test is designed to verify the accuracy and completeness of the Global Title Translation data in Global Title Translation service points. This test is only meant for the case of a single MTP network.

The changes to be made for an SRV Test to cross MTP network boundaries, the changes to be made because of the 1996 SCCP Recommendations, and the applicability of the current SRV Test in the international network are for further study.

The test will be used after a recent translation data change, when a translation problem is suspected, or on a periodic basis to detect cases of mutilation of translation data.

When an inconsistency or failure is detected, local actions are as specified. The initiator of the test is alerted.

3.2.2.1.1 Running the SRVT procedure at a signalling point

The procedure is started on demand, either a local input from OA&M or from an operations centre, when for example:

- a) new SCCP routing data is introduced (each Global Title Translation should pass the SRVT before being opened to traffic);

- b) SCCP translation data are changed;
- c) periodically at an SP to detect cases of mutilation of translation data. The period is network dependent and should be such that the load on the network is not seriously increased.

For case c), no additional trace information should be requested.

3.2.2.1.2 SRV Test compatibility considerations

- 1) It should not be necessary to enhance old nodes in order for an enhanced test to work, but the test should still behave in the same way as the old test at these nodes;
- 2) the new test should supply at least as much useful information as the old, even when some old nodes are present in the network;
- 3) a new node should handle old messages in the same way as old nodes;
- 4) a new message should be handled by an old node in the same way as an old message.

For backwards compatibility, if an SRVA, SRVR, or SRVT message received in an SP contains information as OPTIONAL parameters extra to that defined in 3.2.2, the extra information is not acted upon, but is transmitted unchanged if messages are regenerated by this SP in this test.

If an unknown ErrorTag value is received in an SRVR message at the test initiator, it is still passed up to management.

If an unknown FailureString value is received in an SRVA message at the test initiator, it is still passed up to management.

If an unknown FailureString value is received in an SRVA message at an intermediate point, the value is still put (logical inclusive "or") into the SRVA message to be passed back.

3.2.2.2 Messages

The SCCP Routing Verification Test uses three OMAP messages whose contents are specified below.

3.2.2.2.1 SCCP Routing Verification Test (SRVT) Message

The SRVT message is sent from a Signalling Point (SP) initiating the appropriate part of the SRVT procedure based on the function (e.g. initiator, translator, etc.) of the respective SP. The message serves three different functions, depending upon the nature of the SP sending it. In coding, both Verify and Request are delineated by the No Compare setting of the Form Indicator parameter.

The Request form of the SRVT message is sent by an SP to request a Global Title Translation within the SRVT procedure. The originating SP may be either the initiator (i.e. the Near End SP), or an Intermediate Translation Signalling Point (ITSP). The destination of the message is a Translation Signalling Point (TSP) that is to perform a Global Title Translation on the Global Title contained in the message. Hence, the Translation Point Code (TPC) is the Destination Point Code (DPC) in the routing label.

The Verify form of the SRVT message is sent by a Final Translation Signalling Point (FTSP), i.e. the last SP that performs the Global Title Translation service, to both the Primary Point Code (PPC) and the Secondary Point Code (SPC), if any, derived from the Global Title Translation. Hence, the PPC and SPC are used as the DPC in the routing labels.

The Compare form of the SRVT message is sent by a TSP to an SP performing the duplicate Global Title Translation. The message is sent so the results of both translations can be compared. This message is necessary only in networks that have a duplicate Global Title Translation service (i.e. the identical translation is duplicated at a mate SP). The Point Code of the Duplicate Translation Signalling Point (DTSP) is the DPC in the routing label.

The message contains:

- a) information indicating an SRVT message;
- b) the Form Indicator (Compare or No Compare);
- c) the test GTI + GT – Global Title Indicator + Global Title (Tested GT: Destination GT: Terminating GT);
- d) the MTP Backward Routing Required Indicator for SRVA and SRVR;
- e) the Initiator's PC (i.e. the NEPC) – the Near End Point Code from which test was initiated;
- f) the Initiator's GTI + GT – Global Title Indicator + Near End Global Title;
- g) the DPC – Destination Point Code (Translation PC or Primary PC);
- h) the Destination SSN – Optional SubSystem Number based on DPC;
- i) the Backup DPC – Backup Destination Point Code (Translation PC or Secondary PC);
- j) the Backup SSN – Optional SubSystem Number based on Backup DPC;
- k) the threshold *N* of maximum allowed number of crossed TSPs;
- l) the Additional Trace Information Requested Indicator (SRVR Requested);
- m) the list of TPCs – used to check for translation loops and whether or not the threshold number of translations is exceeded;
- n) the Original GTI + GT – Global Title Indicator + Global Title (Original value of Test GTI + GT);
- o) the Input GTI + GT – Global Title Indicator + Global Title (the test GTI + GT prior to translation at the TSP);
- p) optionally a parameter, called infoRequest, which indicates:
 - that the test initiator is able to understand SRVR messages with optional parameters; and
 - the information that any SRVR message may contain, if the SRVR sender understands it;
- q) an optional parameter, called returnUnknownParams, which indicates which parameters of the SRVT message, if an SP does not understand them, should be returned in any SRVR message. This parameter can only be present if the infoRequest parameter is.

Note that parameters p) and q) must not be present in SRVT messages regenerated by intermediate nodes if they were not present in the received SRVT message (i.e. the test initiator is the only node allowed to insert them).

3.2.2.2.2 SCCP Routing Verification Acknowledgement (SRVA) message

The SRVA message is the standard message sent in response to an associated SRVT message. It carries the results of the test and is sent back using either direct routing on the Originating Point Code (OPC), or by global title translation on the Near End Global Title (i.e. the initiator GT). Both addresses are found in the original message to which the SRVA is responding. The Destination Point Code (DPC) in the routing label may be dependent upon a global title translation if the MTP Backward Routing Indicator in the SRVT message is not set.

The message contains:

- a) information indicating an SRVA message;
- b) information indicating whether or not an SRVR has been sent;
- c) the result of the test.

This last field contains one of the possible indications:

- success (no error indication); or
- partial success (at least one SRVA indicating success or partial success); or
- failure.

In the case of partial success or failure, some or all of the following failure reasons are provided:

- i) no translation data exist for the GTI + GT at TSP;
- ii) incorrect translation for PPC + SSN at TSP;
- iii) incorrect translation for SPC + SSN at TSP;
- iv) incorrect intermediate translation for next TPC or new GT at TSP;
- v) SRVT message arrived at wrong SP (Compare form SRVT arrived at an SP that is not duplicated or the mated SCCP relay node of the sender, or a Request form SRVT arrived at an SP that is not an SCCP relay node);
- vi) the primary destination of the Global Title address does not serve GTI + GT as the primary destination;
- vii) the secondary destination of the Global Title address does not serve GTI + GT as the secondary destination;
- viii) the primary destination of the Global Title address does not recognize the SPC + SSN as the secondary destination for the GTI + GT;
- ix) the secondary destination of the Global Title address does not recognize the PPC + SSN as the primary destination for the GTI + GT;
- x) timeout waiting for SRVA message;
- xi) inability to send message due to inaccessibility (network congestion or blockage);
- xii) detected loop at SP;
- xiii) exceeded threshold of *N* translations at SP;
- xiv) unrecognized Point Code from translation Result (possible MTP routing problem – run MRVT);
- xv) unknown initiator – The Initiator PC is unrecognized and the MTP Backward Routing Required Indicator was set, or the Initiator GT (NEGT) is unrecognized and the MTP Backward Routing Required Indicator was not set;
- xvi) test cannot be run due to local conditions (i.e. "processing failure", which means unavailability of processing resources, or SRVT message rejected by a remote SCCP or TC, or remote OMAP subsystem prohibited);
- xvii) maximum number of SRV Tests with different (test initiator, test destination) combinations are already running at the signalling point.

If the prompting SRVT message contained the infoRequest parameter, the SRVA message can optionally contain information in the copyData parameter to be sent in the requested SRVR message. This contains information copied from the SRVT message (see 3.2.2.2.1 and 3.2.2.2.3). This copyData parameter is not regenerated in SRVA messages, once the requested SRVR has been sent.

3.2.2.2.3 SCCP Routing Verification Result (SRVR) message

There are two types of SRVR message, one with and one without optional parameters. The type containing optional parameters may only be used if the SRVT or SRVA message triggering it contained the optional infoRequest parameter or copyData parameter, respectively.

An SRVR message is sent to the initiator from an SP which stops the test. It is sent from the tested destination when the Additional Trace Information Requested Indicator is set, or from an intermediate SP if the test is not completely successful. It carries the results of the test with additional information on a failure. It is sent back using either direct routing on the Initiator Point Code (NEPC) if the MTP Backward Routing Required Indicator is set or using Global Title Translation on the Initiator Global Title (NEGT) if the MTP Backward Routing Required Indicator is not set.

The message contains:

- a) information indicating an SRVR message;
- b) the result of the test;
- c) the information field;

the content of this information field depends on the result of the test. It contains:

- i) if the result of the test is "success":
 - the Point Codes of the crossed SCCP Relay Nodes contained in the SRVT message;
- ii) if the result of the test is "detected loop":
 - the Point Codes of the SCCP Relay Nodes which are in the loop;
- iii) if the result of the test is "detected excessive length route":
 - the Point Codes of crossed SCCP Relay Nodes contained in the SRVT message;
- iv) if the result of the test is "no translation data exist":
 - either no additional information; or
 - optionally, but only if the prompting SRVT message contained the infoRequest parameter requesting it, the Point Codes of crossed SCCP Relay Nodes contained in the SRVT message;
- v) if the result of the test is "SRVT not sent due to inaccessibility":
 - the Point Code of the inaccessible SP;
 - optionally, but only if the prompting SRVT message requested it with the infoRequest parameter, if more than one SP were inaccessible, a list of all the inaccessible SPs;
- vi) if the result of the test is "SRVA not received":
 - the Point Code of the SP(s) from which an SRVA was not received;
- vii) if the result of the test is "unknown initiator":
 - the Point Code of the SP returning a SRVA to cause the SRVR to be sent;
 - optionally, any information from the SRVA message that it requested to be sent (in the copyData parameter);
- viii) if the result of the test is "test cannot be run due to local conditions" (i.e. "processingFailure"):
 - either no additional information; or
 - optionally, but only if the prompting SRVT message requested it with the infoRequest parameter, the Point Code of the SP where the test could not be run;

- ix) if the result of the test is "maximum number of SRV Tests already running at the SP":
 - either no additional information; or
 - optionally, but only if the prompting SRVT message requested it with the infoRequest parameter, the Point Code of the SP where the test could not be run;
- x) if any other failure result:
 - the Point Codes of the crossed SCCP Relay Nodes contained in the SRVT message.

If the SRVR message was prompted by an SRVT message, if the SP receiving the SRVT did not understand some of the parameters in it, and the returnUnknownParams parameter was in the SRVT and indicated a selection of these unrecognized SRVT parameters, a copyData parameter containing the selection is included in the SRVR. Each such selected parameter is copied completely [i.e. its name (identifier octets), length and value is put into the copyData parameter].

3.2.2.3 Initiation of the SRVT procedure at a signalling point

The conditions under which an SRV Test are started are described in 3.2.2.1.1. An SRV Test can be initiated manually at a signalling point, or remotely from a management centre. See Recommendations Q.750, Q.751, and Q.756 and Annex A/Q.754 for more information.

3.2.2.4 Procedures

The capability to execute a complete SCCP Routing Verification Test is realized by three procedures. These procedures are organized by the function of the SP in which they reside for a given test instance. The procedures are partitioned into functions at the initiator, functions at a TSP, and functions at the tested destination. The duplicate translation procedures are found in the TSPs.

3.2.2.4.1 Initiating point

The procedure is started when there is an input from OA&M as defined under the conditions of 3.2.2.1.1. It is initiated at an SP with SCCP capabilities in the network, and is triggered by an SRVT request. The SRVT request must include the Global Title of the tested destination. An SCCP node cannot initiate an SRVT procedure for a test destination until any previous SRVT procedures for that destination have completed.

3.2.2.4.1.1 Initial actions

If a signalling point is requested to initiate an SRVT procedure, it checks that the maximum number of SRVT procedures with different (test initiator, test destination) values allowed to run at any time at the SP, n_{SRVT} , has not been exceeded. If this test fails, the SRV Test is refused.

Upon receipt of an SRVT request on a given Global Title, the initiator determines the TPC(s) of the initial Global Title Translation. The initiator then begins a guard timing period, T_2 , and sends SRVT messages to the TPC(s) previously determined. The initiator then waits for SRVA messages corresponding to each SRVT sent.

If the initiator was identified as a TSP for the respective Global Title, it performs the Global Title Translation, and follows the procedures defined at a TSP (see 3.2.2.4.2), depending upon the nature of the translation (i.e. intermediate or final).

3.2.2.4.1.2 Subsequent actions

Upon receipt of all expected SRVA messages, the guard timer, T_2 , is stopped and the test is complete. The results are reported to the SP management in accordance with the result of test and information parameters (see 3.2.2.2.2) and proper actions are taken to fix any problems. If the timer

expires before receipt of an SRVA message, the result, "Timeout waiting for SRVA message" [see 3.2.2.2.2 c), x)], is reported to the SP management along with the Point Code of the SP. There is no penalty for not receiving an SRVR. However, it is assumed, analogous to the MRVT's MRVR message, that the SRVR will return before the final SRVA.

3.2.2.4.2 Translation point

For the SRVT, two types of TSPs exist: intermediate and final. The procedure at the ITSP differs from the FTSP only in the content of the SRVT messages which emerge. An ITSP is an SP with SCCP functions that have been specified at the NESP for the translation of the Global Title originally given. However, due to the nature of the Global Title, further translation is needed at another SP to determine the PC of the tested destination.

A final TSP is an SP with SCCP functionality that has been specified at the initiator (NESP) or an ITSP for the translation of the Global Title. It performs the final Global Title Translation to determine a Primary Point Code + SubSystem Number (PPC + SSN) and a Secondary Point Code + SubSystem Number [SPC + SSN (optional)]. Note that the initiator does not know if it sends an SRVT message to an ITSP or FTSP.

If a Request form SRVT arrives at an SP that is not designated as an SCCP relay node, the SP sends an SRVR message with the result "wrong SP" [see 3.2.2.2.3 c), x)] to the test initiator, sends an SRVA to the sender of the SRVT and stops the test after informing the SP management.

3.2.2.4.2.1 Upon Receipt of an SRVT Message

When a TSP receives an SRVT message with the form indicator set to "No Compare", it:

- a) Checks if the TSP is unable to send the SRVT due to local conditions:
 - i) If local conditions prohibit the continuing of the test, the TSP sends an SRVR to the initiator, an SRVA with "SRVR sent" indication and the corresponding result parameter [see 3.2.2.2.2 c), xvi)] to the OPC, and an indication to the SP management. The test is stopped.

NOTE 1 – Conditions of this type can be the unavailability of local processing resources, exceeding the maximum number of tests n_{SRVT} for different initiator, destination combinations at a given node, or some other unspecified problem which might be implementation dependent.
 - ii) If no local conditions exist to prohibit the sending of SRVT messages, then the test continues as follows.
- b) Attempts to translate the GTI + GT (Destination) either to a PPC + SSN and optional SPC + SSN or to a new GTI + GT:
 - i) If the SP is unable to perform the translation, the reason for failure is equal to "No translation data exist". The SP sends an SRVR to the initiator, an SRVA message with "SRVR sent" indication and corresponding result parameter [see 3.2.2.2.2 c), iv)] to the OPC, and an indication to the SP management.
 - ii) If it recognizes that further translation is needed, a TPC and a backup TPC (optional) are derived from the GTI + GT.
 - iii) If the translation is final and successful, the PPC + SSN and SPC + SSN (optional) are derived from the GTI + GT and retained.
 - iv) The TSP determines the Test GTI + GT for any SRVT messages to be sent:
If translation derived a new (i.e. different) GT, the Test GTI + GT for any SRVT messages sent is the new GT value. If translation did not derive a new GT, the Test GTI + GT for any SRVT messages sent is the Test GTI + GT in the received SRVT message.

- v) The TSP determines the Terminating GT (Object Instance value) for any SRVR message sent:

If the received SRVT contained an Original GTI + GT parameter, then the Terminating GT for any SRVR message sent is the value of the Original GTI + GT parameter. If the received SRVT did not contain an Original GTI + GT parameter, then the Terminating GT for any SRVR message sent is the value of the Test GTI + GT parameter in the received SRVT message.

- c) Checks for mated SCCP Relay Node;

- i) If a mated SCCP Relay Node exists for the current TSP, an SRVT message is sent to the mate so that it may perform a duplicate translation for comparison purposes. The comparison is described in the procedure for Duplicate translation in 3.2.2.4.2.3. If translation derived a new GT, then the SRVT message sent to the mate TSP contains an Input GTI + GT parameter set to the value of the Test GTI + GT in the received SRVT message. If the Original GTI + GT was not present in the received SRVT message, the Original GTI + GT is set to the value of the Test GTI + GT. After the sending of the SRVT, the test proceeds with step d).

- ii) If no mated SCCP Relay Node exists, the test proceeds with step d).

- d) Examines the list of TSPs [see 3.2.2.2.1 m)];

- i) If the Point Code of the next TSP or the Point Code of the mated SCCP Relay Node (optional) appears in the SRVT's list of TSPs, then the SP sends an SRVR to the initiator, an SRVA with "SRVR sent" indication and an "SCCP loop detected" indication [see 3.2.2.2.2 c), xii)] to the OPC of the received SRVT, and an indication to the SP management. The test is stopped.

- ii) If the number of Point Codes in the SRVT's list of TPCs exceeds the predefined threshold number *N* of translations, then the SP sends an SRVR to the initiator, an SRVA message with "SRVR sent" indication and the "threshold exceeded" indication [see 3.2.2.2.2 c), xiii)] to the OPC of the received SRVT, and an indication to the SP management. The test is stopped.

- iii) If neither the Point Code(s) of the next TSP(s) nor that of the mated SCCP Relay Node (Optional) appears in the SRVT's list of TSPs, then the TSP adds both its own Point Code and the Point Code of the mated SCCP Relay Node (if any) to the list of TSPs.

- e) Attempts to send an SRVT message to the next TPC or Tested Destination [from b) above]:

- i) If the TSP is unable to send any SRVT due to inaccessibility (or MTP routing problem or subsystem unavailable or OMAP prohibited), the TSP sends one or more SRVRs to the test initiator. One SRVR⁴ indicating all the unavailable SPs is sent to the initiator if the infoRequest parameter was present in the prompting SRVT message and requested an SP list, otherwise one SRVR is sent for each unavailable SP. Then an SRVA with "SRVR sent" indication and corresponding result parameter(s) [see 3.2.2.2.2 c), xi) and xiv)] is sent to the OPC of the received SRVT, and an indication is given to the SP management. The test is stopped.

⁴ The "result" parameter in a single routeTraceNew SRVR is set to routeInaccessible if any SP of the set is inaccessible by the MTP. If one SRVR is returned for each unavailable SP, its result indicates why that SP is unavailable (processingFailure for rejects or OMAP prohibited, routeInaccessible if the MTP cannot access it).

NOTE 2 – A destination is determined to be inaccessible if it is blocked, accessed only by non-SS7 signalling, across a network boundary in a closed network, or if all routes to the destination are unavailable or congested.

- ii) If an SRVT may be sent, a guard timer, T_2 , is started and SRVT message(s) are sent to either the next TPC(s) or the PPC + SSN and SPC + SSN (optional) resulting from translation. This timer is the guard for SRVA(s) received in response to both the Compare and No Compare SRVT messages. The value of the "Additional trace information requested indicator" is obtained from the received SRVT message. The unavailable SPs are noted, and one or several SRVR messages are sent to the test initiator for each unavailable SP. The conditions upon the SRVR(s) are as i) above.
- iii) If the SRVT message received contained an Original GTI + GT parameter, then the SRVT message sent contains an Original GTI + GT parameter set to the value in the received SRVT message.

If the SRVT message received did not contain an Original GTI + GT parameter then:

- if translation derived a new GT, then the SRVT message sent contains an Original GTI + GT parameter set to the value of the Test GTI + GT in the received SRVT message.
- if translation did not derive a new GT, then the SRVT message sent does not contain an Original GTI + GT parameter.

3.2.2.4.2.2 Subsequent actions (on reception of an SRVA message, or SRVT message rejection)

Upon receipt of an SRVA message, the following actions are taken:

- a) if all of the SRVA(s) in response to the SRVT(s) have not yet been received, the results are stored, waiting for pending SRVA(s).
- b) if all other expected SRVA(s) have been received, the following actions are taken:
 - i) The guard timer, T_2 , is stopped.
 - ii) If the MTP Backward Routing Required indicator was set in the SRVT, a check is made to see if MTP routing information for the Initiator PC exists. If the MTP Backward Routing Required indicator was not set, a global title translation is made upon the Initiator GT (NEGT). If no MTP routing information or no translation exists, the "Unknown initiator" indication [see 3.2.2.2.2 c), xv)] is included in the SRVA returned to the previous SP, with "SRVR not sent" indicated.
 - iii) Results of the duplicate translation comparison are incorporated into the results of the test parameters (see 3.2.2.2.2). This is optional in networks not subscribing to the concept of mated SCCP Relay Nodes and duplicate translations. If the SRVA in response to the SRVT has not yet been received, the ITSP waits for it up to the expiry of the T_2 timer.
 - iv) If the "SRVR sent" indication is not set and the received SRVA indicates that an error was detected, the SP sends an SRVR message with appropriate indications from the SRVA.
 - v) The SP sends an SRVA message in response to the original SRVT message. The complete result of test parameter list is retained and the "SRVR sent" indication is set appropriately.
- c) If the timer has already expired, the message is discarded.

- d) If the guard timer expires before receipt of all expected SRVA(s), an attempt is made to send an SRVR to the initiator with the result "SRVA not received" [see 3.2.2.2.3 c), vi)]. Results of any SRVAs received, along with the result "Timeout waiting for SRVA message" [see 3.2.2.2.2 c), x)] and an indication that an SRVR has been sent, are returned in an SRVA to the SP from which the SRVT message was received. If the SRVR cannot be sent because neither the Initiator GT nor the Initiator PC are recognized, the SRVA should add the result "Unknown initiator" [see 3.2.2.2.2 c) xv)] and should indicate that an SRVR has not been sent [see 3.2.2.2.2 b)]. Any SRVAs received after the timer expires will be discarded. If an SRVA cannot be sent, no further action is taken.
- e) If an SRVT message is rejected by a remote SCCP or TC, or by a newly prohibited remote OMAP, the remote node is considered unable to run the test due to local conditions (i.e. processing failure).

3.2.2.4.2.3 Duplicate translation (Optional)

This procedure should be performed in networks which have translations duplicated at mated TSPs. When a TSP receives an SRVT message with the form indicator set to "Compare", it:

- a) checks to determine if the originating SP is a mated SCCP Relay Node to the receiving SP. If not, an SRVA is returned with "SRVT arrived at wrong SP" [see 3.2.2.2.2 c), v)];
- b) attempts a duplicate translation and compares the result with information contained in the received SRVT message. If the SRVT message contained an Input GTI + GT parameter, the duplicate translation is performed on the Input GTI + GT parameter and the result is compared with the Test GTI + GT parameter in the SRVT message. If the SRVT message did not contain an Input GTI + GT parameter, the duplicate translation is performed on the Test GTI + GT parameter of the SRVT message, and the result is compared with the Point Code information contained in the SRVT message.
 - i) If the results of the duplicate translation match the data in the SRVT message from the previous translation, an SRVA message is returned with test result equal to success (see 3.2.2.2.2).
 - ii) If no translation data exist for the Global Title, then an SRVA message is returned to the sender of the SRVT, and optionally an SRVR is sent to the test initiator, with the results "No translation data exist for the GTI + GT" [see 3.2.2.2.2 c), i)]. If the SRVR is not sent, the SRVA indicates "SRVR not sent".
 - iii) If the results of the duplicate translation do not match the data in the SRVT message from the previous translation, an SRVA message is returned to the sender of the SRVT, and optionally an SRVR is returned to the test initiator, with test results equal to either "Incorrect intermediate translation" [see 3.2.2.2.2 c), iv)], "Incorrect translation for PPC + SSN" [see 3.2.2.2.2 c), ii)] or "Incorrect translation for SPC + SSN" [see 3.2.2.2.2 c), iii)]. If the SRVR is not sent, the SRVA indicates "SRVR not sent".

3.2.2.4.3 Tested destination

The tested destination is an SP with SCCP functionality that has been specified at the FTSP by use of Global Title Translation. The address is referred to as either the PPC + SSN or SPC + SSN.

If the SRVT message received at the tested destination contains an Original GTI + GT parameter, then the Terminating GT parameter for any SRVR message sent is set to the value of this Original GTI + GT parameter.

3.2.2.4.3.1 Primary point

This procedure is performed at the primary destination SP derived from the Global Title Translation. When the destination receives an SRVT message, it verifies that the PPC + SSN serves as the primary destination for the GTI + GT. The analyses and the actions that follow are:

- a) If the test is successful, the SP sends an SRVR (if requested in SRVT Message) with "success" indication to the initiator, an SRVA with success indication to the OPC, and an indication to the SP management.
- b) If the MTP Backward Routing Required indicator was set in the SRVT message and the Initiator PC (NEPC) is not contained in the MTP routing tables, or the MTP Backward Routing Indicator was not set and the Initiator GT (NEGT) does not yield a translation, the test is unsuccessful. The SP cannot send any SRVR to the test initiator, but it includes the "Unknown initiator" result [see 3.2.2.2.2 c), xv)] in the SRVA sent to the OPC of the SRVT message and sends an indication to the SP management.
- c) If the SP does not serve GTI + GT as the primary destination, the test is unsuccessful and the SP sends an SRVR to the Initiator PC (NEPC), an SRVA with the "SRVR sent" indication set appropriately and the corresponding result parameter [see 3.2.2.2.2 c), vi)] to the OPC, and an indication to the SP management.
- d) If the SP does not recognize SPC + SSN as the secondary destination for GTI + GT, then the test is unsuccessful and the SP sends an SRVR to the Initiator PC, an SRVA with the "SRVR sent" indication set appropriately and the corresponding result parameter [see 3.2.2.2.2 c), viii)] to the OPC, and an indication to the SP management.

If an SRVA cannot be sent, no further action is taken.

3.2.2.4.3.2 Secondary point

This procedure is performed at the secondary destination SP (optional) derived from the Global Title Translation. When the destination receives an SRVT message, it verifies the SPC + SSN serves as the secondary destination for the GTI + GT. The following action should result:

- a) If the test is successful, the SP sends an SRVR (if requested in an SRVT Message) with "success" indication to the initiator, an SRVA with "success" indication to the OPC, and an indication to the SP management.
- b) If the MTP Backward Routing Required indicator was set in the SRVT message and the Initiator PC (NEPC) is not contained in the MTP routing tables, or the MTP Backward Routing Indicator was not set and the Initiator GT (NEGT) does not yield a translation, the test is unsuccessful. The SP cannot send any SRVR to the test initiator, but it includes the "Unknown initiator" result [see 3.2.2.2.2 c), xv)] in the SRVA sent to the OPC of the SRVT message and sends an indication to the SP management.
- c) If the SP does not serve GTI + GT as the secondary destination, the test is unsuccessful and the SP sends an SRVR to the initiator, an SRVA with the "SRVR sent" indication set appropriately and the corresponding result parameter [see 3.2.2.2.2 c), vii)] to the OPC of the received SRVT, and an indication to the SP management.
- d) If the SP does not recognize PPC + SSN as the primary destination for GTI + GT, then the test is unsuccessful and the SP sends an SRVR to the initiator, an SRVA with the "SRVR sent" indication set appropriately and the corresponding Result of Test parameter [see 3.2.2.2.2 c), ix)] to the OPC, and an indication to the SP management.

If an SRVA cannot be sent, no further action is taken.

3.2.2.5 T_2 for SRVT

T_2 at an SP initiating an SRVT is the guard time waiting for all SRVA messages in response to the SRVT message sent from the initiator.

$$T_{2,Initiator} = D_{srvt} (N_{srvt} + 1)$$

where D_{srvt} is the estimated maximum delay between relay nodes (see 3.2.2.6) and N_{srvt} , defined in the SRVT procedure, is the maximum number of relays allowed.

T_2 at a Translation Signalling Point (TSP) is the guard time associated with a received SRVT message, waiting for all SRVA messages in response to all SRVT messages sent.

$$T_{2,STP} = T_{2,Previous SP} - D_{srvt}$$

For the above definitions, it is important to note that SRVT/SRVA messages of the compare type are not considered since their propagation times are considered to be far less than τ_{s1} and τ_{s3} respectively.

3.2.2.6 Delay for SRVT

$$D_{srvt} = \text{Max}(\tau_{s_1}) + \text{Max}(\tau_{s_2}) + \text{Max}(\tau_{s_3}) + \text{Max}(\tau_{s_4})$$

where:

- τ_{s_1} The time to transfer an SRVT message between applications. This includes the overhead time of the respective network layer functionality.
- τ_{s_2} The time to process SRVT request at the application level. This consists of the time to translate the Global Title at a Translation Signalling Point, or the time for determining the validity of a Translation at the tested destination.
- τ_{s_3} The time to transfer an SRVA message between applications. Again, this includes the overhead time of the respective network layer functionality.
- τ_{s_4} The time to process an SRVA received at the application level. This includes the compilation of any results into the result of test for the next SRVA.

NOTE – The table defining the estimated maximum time values for the SRVT is for further study.

3.2.3 OMAP model for SRVT

This is illustrated in Figures 1 and A.1.

The OMAP model assumes that the logic defined in 3.2.2 resides in the OMASE-User, which provides a service SRVT(Start) and SRVT(Result). The actions defined in the text (e.g. sending an SRVT message), correspond to the sending of primitives to OMASE and receiving primitives from OMASE. The mapping is as shown in the next subclause.

NOTE – A timer T_2 is run in the OMASE-User at the test initiator node as well as in TC, the OMASE-User timer is marginally greater than that run in TC. This is to cater for rare abnormal events (e.g. ill-formed APDUs being received in OMASE from TC).

3.2.3.1 Text-defined actions mapped to OM primitives

See Table 2.

Table 2/Q.753 – Mapping of text-defined actions to OM service primitives

"a" interface	"b" interface
1a SRVT(Start)	1b OM-CNF-ACTION request
2a SRVT(Result)	2b OM-CNF-ACTION indication
1a –	1b OM-CNF-ACTION response
2a SRVT(Result)	2b OM-CNF-ACTION confirmation
1a –	1b OM-EVENT-REPORT request
2a SRVT(Result)	2b OM-EVENT-REPORT indication

3.2.3.2 State transition diagram for the SRVT procedure

Figure 3 shows the state transition diagram for the SRVT using SDL. This gives the logic for SRVT in the OMASE-User.

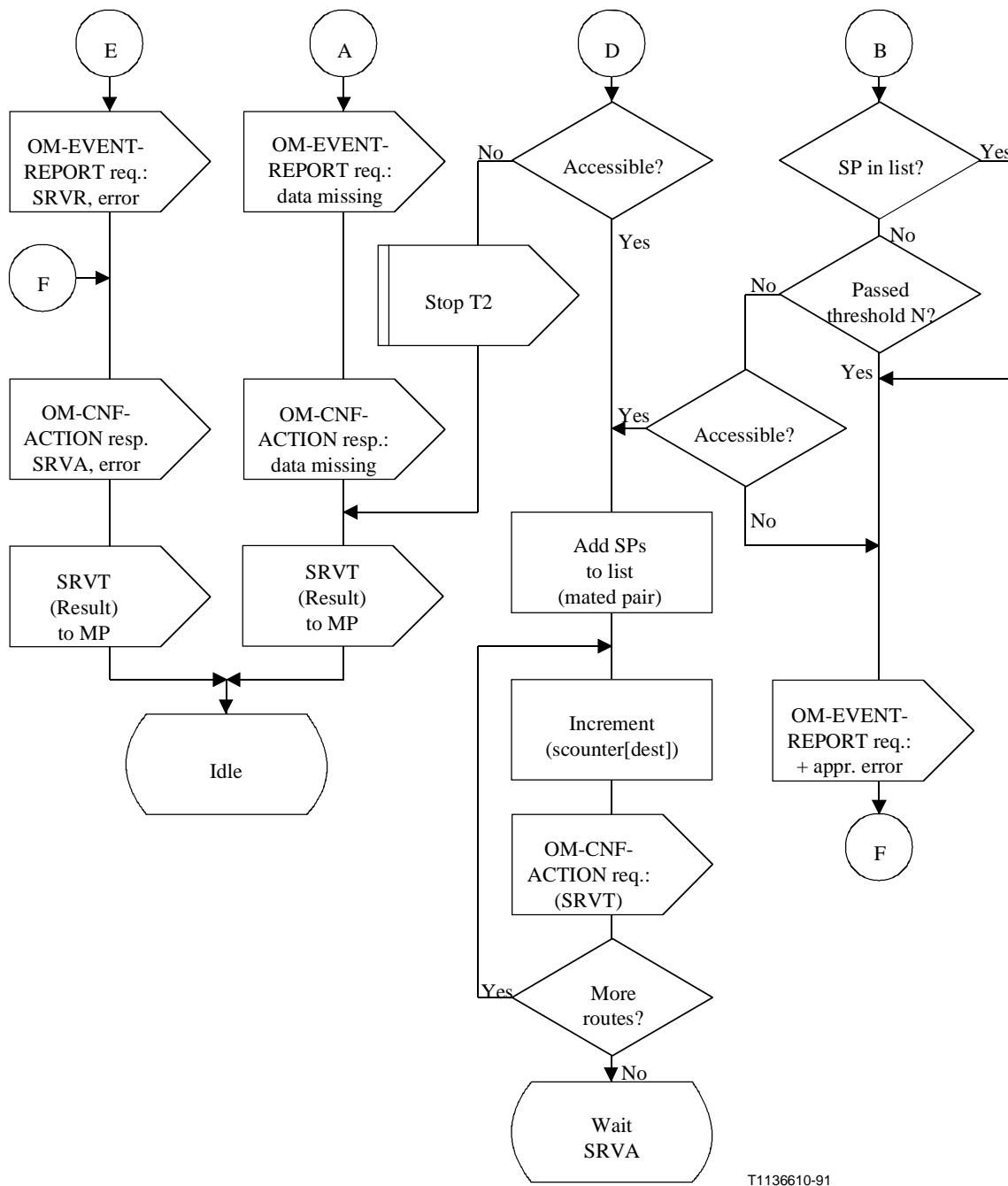
3.2.3.3 Example of SRVT

Figure 4 demonstrates the SRVT. It should be noted that the SPs shown are assumed to be SCCP adjacent and not MTP adjacent. Furthermore, the example shows both primary and secondary destinations, and duplicate translation points. The duplicate translation points and secondary destinations may be considered optional.

```

graph TD
    Idle1([Idle]) --> SRVT_Start[/SRVT (Start) from MP/]
    Idle1 --> OM_CNF_ACTION_ind[/OM-CNF-ACTION ind. (SRVT)/]
    
    SRVT_Start --> Local_OK1{Local conditions OK?}
    Local_OK1 -- No --> SRVT_Res1[/SRVT (Result) to MP/]
    SRVT_Res1 --> Idle2([Idle])
    Local_OK1 -- Yes --> SP_TSP{SP a TSP for GT?}
    SP_TSP -- No --> Determine_TSP[Determine TSPs]
    Determine_TSP --> Start_T2_1[/Start timer T2/]
    Start_T2_1 --> OM_CONF_ACTION_req1[/OM-CONF-ACTION req. (SRVT)/]
    OM_CONF_ACTION_req1 --> Increment1[Increment (scounter[dest])]
    Increment1 --> More_routes1{More routes?}
    More_routes1 -- No --> Waiting_SRVA([Waiting SRVA])
    More_routes1 -- Yes --> At_initiator1{At initiator?}
    At_initiator1 -- Yes --> Start_T2_2[/Start timer T2/]
    Start_T2_2 --> D((D))
    At_initiator1 -- No --> Examine_RPs[Examine list of RPs]
    Examine_RPs --> B((B))
    
    SP_TSP -- Yes --> Request[Request]
    Request --> Translate_GT1[Translate GT]
    Translate_GT1 --> GT_exists1{GT exists?}
    GT_exists1 -- No --> A((A))
    GT_exists1 -- Yes --> At_initiator2{At initiator?}
    At_initiator2 -- No --> A
    At_initiator2 -- Yes --> SRVT_Res2[/SRVT (Result) to MP/]
    SRVT_Res2 --> OM_CONF_ACTION_resp1[/OM-CONF-ACTION resp.: t. data missing/]
    OM_CONF_ACTION_resp1 --> Idle3([Idle])
    
    OM_CNF_ACTION_ind --> Local_OK2{Local conditions OK?}
    Local_OK2 -- No --> E((E))
    Local_OK2 -- Yes --> Format{Format?}
    Format -- Verify --> C((C))
    Format -- Compare --> Checks_mate_SCCP_RP[Checks on mate SCCP RP]
    Checks_mate_SCCP_RP --> Match1{Match?}
    Match1 -- No --> OM_CNF_ACTION_resp2[/OM-CNF-ACTION resp.: no mate/]
    OM_CNF_ACTION_resp2 --> Idle4([Idle])
    Match1 -- Yes --> Translate_GT2[Translate GT]
    Translate_GT2 --> GT_exists2{GT exists?}
    GT_exists2 -- No --> A
    GT_exists2 -- Yes --> Final_translation{Final translation?}
    Final_translation -- No --> Translation_match{Translation match?}
    Translation_match -- No --> OM_CONF_ACTION_resp3[/OM-CONF-ACTION resp.: TSP error/]
    OM_CONF_ACTION_resp3 --> Idle5([Idle])
    Translation_match -- Yes --> Destinations_match{Destinations match?}
    Destinations_match -- No --> OM_CONF_ACTION_resp4[/OM-CNF-ACTION resp.: dest. error/]
    OM_CONF_ACTION_resp4 --> Idle6([Idle])
    Destinations_match -- Yes --> OM_CONF_ACTION_resp5[/OM-CNF-ACTION resp.: success/]
    OM_CONF_ACTION_resp5 --> Idle6
    Final_translation -- Yes --> OM_CONF_ACTION_resp5
    
    style Idle1 fill:#fff,stroke:#000,stroke-width:1px
    style Idle2 fill:#fff,stroke:#000,stroke-width:1px
    style Idle3 fill:#fff,stroke:#000,stroke-width:1px
    style Idle4 fill:#fff,stroke:#000,stroke-width:1px
    style Idle5 fill:#fff,stroke:#000,stroke-width:1px
    style Idle6 fill:#fff,stroke:#000,stroke-width:1px
    style A fill:#fff,stroke:#000,stroke-width:1px
    style B fill:#fff,stroke:#000,stroke-width:1px
    style C fill:#fff,stroke:#000,stroke-width:1px
    style D fill:#fff,stroke:#000,stroke-width:1px
    style E fill:#fff,stroke:#000,stroke-width:1px
  
```

Figure 1 is a state transition diagram for the SRVT (Start of Route Verification) process. The diagram shows the flow from an 'Idle' state through various decision points and actions, including checking local conditions, verifying format, translating GT, and checking for mated SCCP RP. It includes a counter 'scounter[dest] := 0' and a timer 'T2'. The process ends at states A, B, C, D, E, or returns to 'Idle'.



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Figure 3/Q.753 (sheet 2 of 4) – SRVT SDL in the OMASE-User

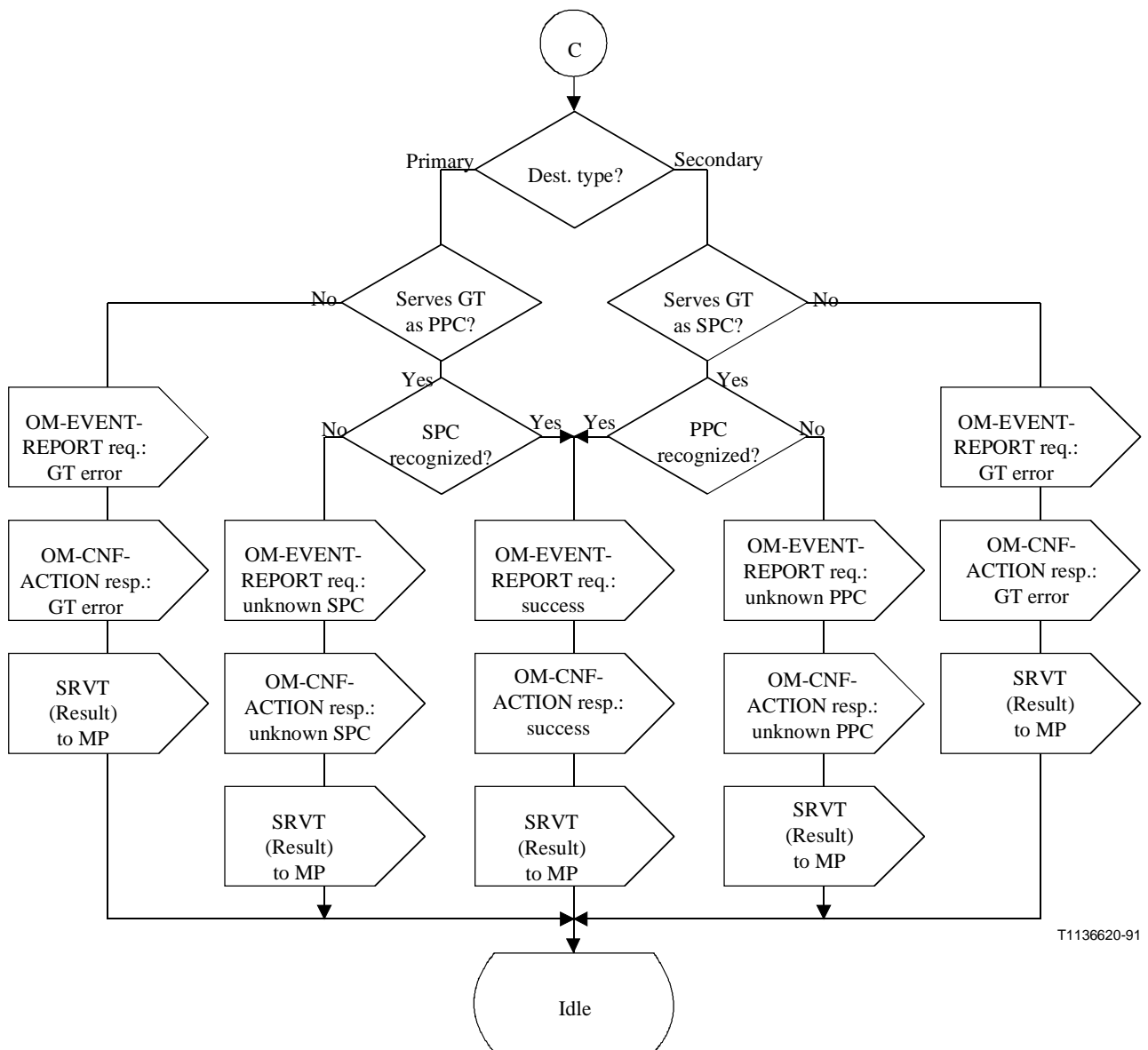


Figure 3/Q.753 (sheet 3 of 4) – SRVT SDL in the OMASE-User

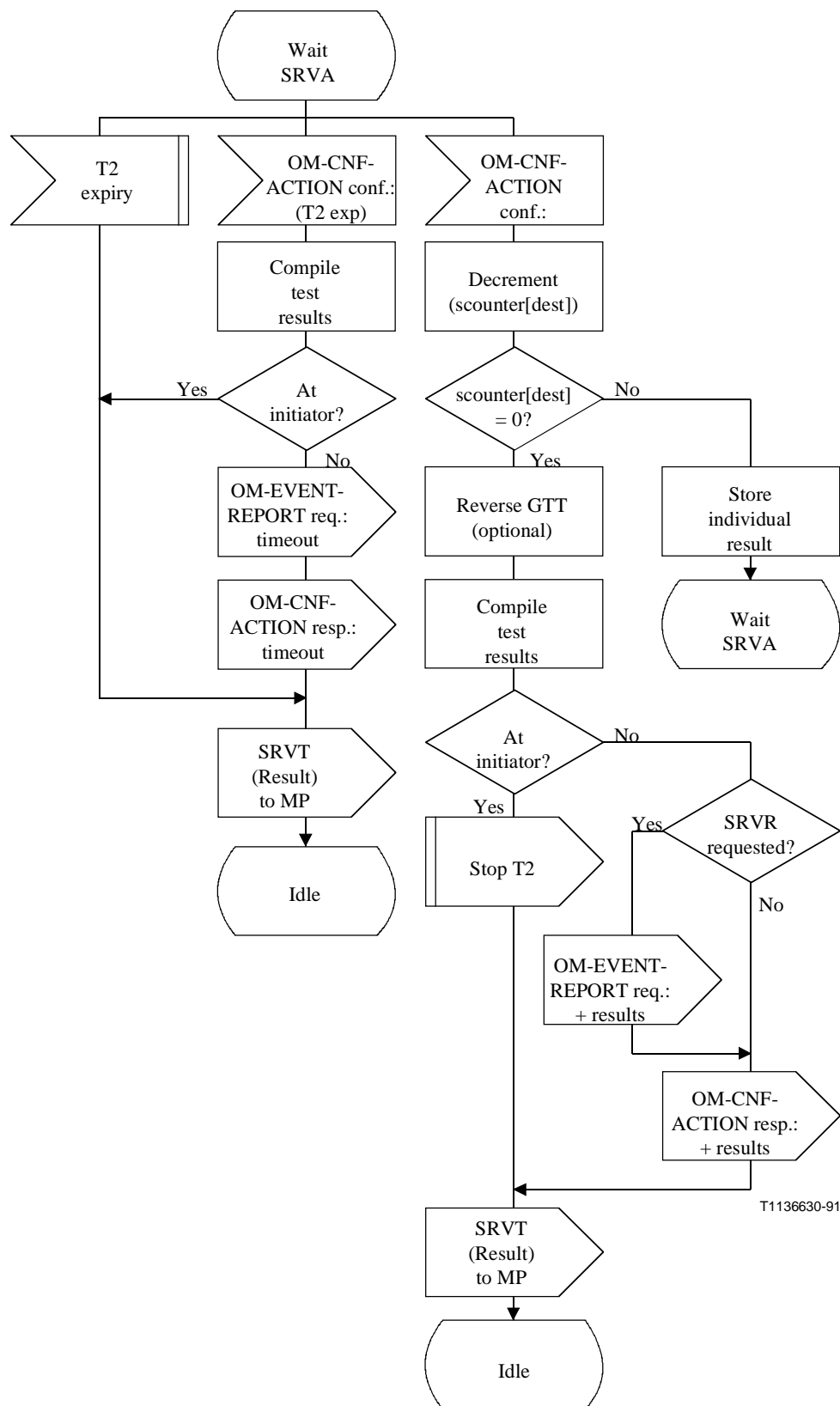
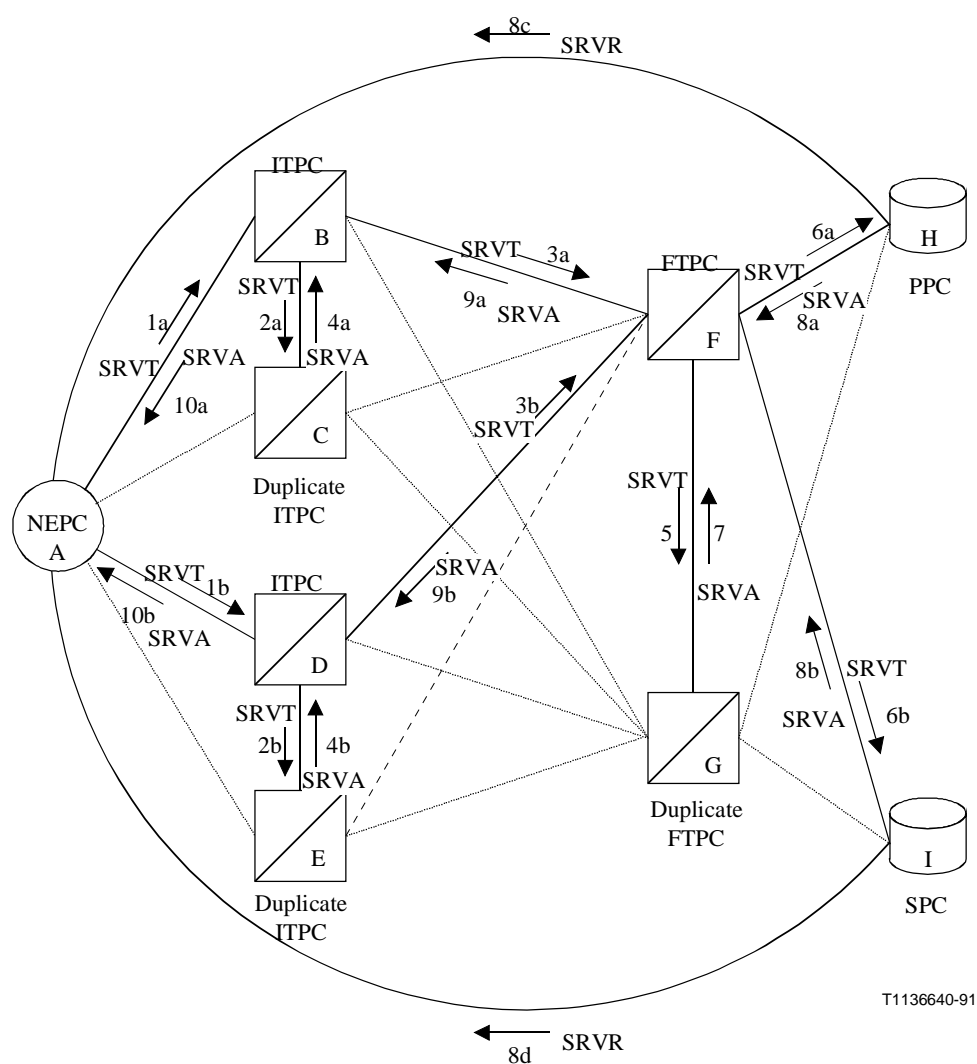


Figure 3/Q.753 (sheet 4 of 4) – SRVT SDL in the OMASE-User



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NEPC	Near End Point Code
ITPC	Intermediate Translation PC
FTPC	Final Translation PC
PPC	Primary Destination PC
SPC	Secondary Destination PC
SRVT	SCCP Routing Verification Test Msg.
SRVA	SCCP Routing Verification Ack. Msg.
SRVR	SCCP Routing Verification Result Msg.

Figure 4/Q.753 – Example of SRVT procedure

4 Circuit management functions

4.1 General

These management functions relate to testing of ISDN User Part or Telephony User Part (TUP) resources, or sections of the SS No. 7 network used by these User Parts, where communication in the SS No. 7 network is required for the test. Currently, just the Circuit Validation Test (CVT) is defined here.

4.2 Circuit Validation Test (CVT)

This test includes a connectivity check. For circuit used in just speech or 3.1 kHz audio connections, the connectivity check uses the hardware supplied for the continuity check employed in call handling as defined in Recommendations Q.724 and Q.764, but the CVT is a self-contained procedure with no impact on the Q.724 and Q.764 call handling procedures.

The circuits controlled by the ISDN User Part include speech, 3.1 kHz audio, or 64 kbit/s connections. TUP controls circuits offering digital connections (usually this means 64 kbit/s), as well as "normal" speech connections.

In international interconnections, digital circuits may be extended from one exchange to another via various transmission equipments such as digital cross-connect systems or digital multiplexers. If a digital cross-connect system is employed, the inherent fault indicators in the digital transmission facility might be disassociated from the individual bearers.

If a 1544 Mbit/s primary multiplex interworks with a 2048 Mbit/s system, rate conversion (and A/μ law conversion for speech/3.1 kHz audio) have to be provided.

Digital transmission equipment evolution catering for requirements from a variety of digital interfaces has tended to lead to more complex (and hence more error prone) parameter settings. Certain errors in these parameters might affect only a 64 kbit/s service, but not speech/3.1 kHz audio; in other cases bit integrity might be lost.

For circuits supporting only speech/3.1 kHz audio, the CVT connectivity check is based on the continuity check defined in clause 7/Q.724 and clause 8/Q.724; for 64 kbit/s circuits, a pseudo-random bit pattern test (e.g. a 2047 pseudo-random bit pattern test conforming to Recommendation O.152) should be carried out.

The purpose of a CVT is to ensure that the exchanges at each end of an interexchange circuit group have sufficient and consistent data for placing a call on a specific circuit of the group, and that the data refers to the same physical circuit.

A CVT may be initiated by either exchange on demand by SS No. 7 management, but the load on the exchanges should not be seriously increased by such tests. Only one CVT using tone transceivers should be run at a time in one signalling point, the start of CVTs using pseudo-random bit pattern tests should be separated by at least the synchronisation time (the value of which is for further study, but is approximately 2 seconds at normal bit error rates on a 64 kbit/s circuit).

Bit patterns generated in concurrent tests should all be different, and no pattern used should be a cyclic rearrangement of any other pattern generated concurrently by the signalling point. A signalling point should only loop circuits for connectivity tests for one other signalling point at any one time, and should not itself generate tone or bit patterns for CVT tests during this time.

The test is to be performed before a circuit is put initially into service, or after rearrangement of its associated transmission resources. Before a test is performed, it is necessary to ensure that messages are capable of being routed between the exchanges involved.

For 64 kbit/s connections, it is an option to use either the tone transceiver or the pseudo-random bit pattern transceiver for the connectivity check.

Note that the timer ranges defined for circuits supporting 64 kbit/s are minimum ranges, if a more comprehensive transmission test is required, the ranges should all be increased proportionately.

4.2.1 The test

Both the near end and far end checks are required to perform a complete CVT. The initiating end starts the test by accessing the circuit to be tested when stimulated by a management request. The

circuit is identified by an identification code agreed upon by the two exchanges at each end of the circuit.

The data check at the initiating end must be adequate to ensure that data exist for:

- 1) deriving a physical appearance for the circuit so that a transceiver may be connected to it; and
- 2) deriving a Circuit Identification Code (CIC) and routing label so that a Common Channel Signalling circuit-related message may be generated.

If the near end data test fails, the management is notified with the reason for the near end failure (e.g. failure reason – circuit unequipped). The test is terminated and a CVT request message is not generated for the circuit under test.

If the near end data test succeeds, the following sequence occurs:

- a) An overall test timer T_c is started at the near end. This is between 25 to 30 seconds for circuits on which the pseudo-random bit pattern connectivity test is to be run (e.g. 64 kbit/s circuits; it is between 3 and 4 seconds for the connectivity test using tone transceivers as defined in clause 7/Q.724 and clause 8/Q.724 (e.g. for circuits supporting just speech/3.1 kHz radio).
- b) At the near end, if the test uses a tone transceiver, any echo suppressor/canceller device associated with a circuit is disabled; otherwise, any associated bit manipulating devices (e.g. echo canceller, ADPCM equipment, A/μ law equipment) are disabled.
- c) The CVT request message (CVI) is sent to the far end.
- d) If the test uses a pseudo-random bit pattern sequence, an implementation dependent transceiver generating a pseudo-random test pattern in conformance with the requirements in Recommendation O.152 is connected at the near end of the circuit immediately after the CVI message is sent; otherwise, an implementation dependent continuity check transceiver in conformance with the requirements in clause 7/Q.724 and clause 8/Q.724 is connected at the near end of the circuit immediately after the CVI is sent.
- e) The near end then waits for the pseudo-random bit pattern or continuity check tone to return in the circuit's return direction; if the test uses continuity check tone as defined in Recommendation Q.724, the transceiver should receive valid tone within 2 seconds (see 7.4/Q.724) after the CVI message has been sent, otherwise the test fails. If the test uses a pseudo-random bit pattern, the near end attempts to synchronise to the received pattern.
- f) When the far end receives the CVI message, it checks to see if the CIC indicated in the message is assigned. If the CIC is unassigned, a failure indication is explicitly returned to the near end via a CVT response message (rather than via an unequipped CIC message). If the CIC is assigned, the far-end must perform adequate tests to ensure that data exist for deriving a physical circuit appearance from the received routing label and the CIC so that a loop or transceiver may be connected to the physical circuit appearance. Additionally, the far end must also check that an identification code for the circuit exists for the physical circuit appearance. If the far end checks fail, the CVR message contains the reason for failure and includes an identification code of the failing exchange, as agreed upon by the two exchanges. If the far end checks pass, the CVR message eventually sent contains the far-end-derived identification code for the circuit.
- g) If the far end's data checks succeed, it disables any echo canceller/suppressor or bit manipulating device, attaches a loop to the circuit being tested – this should be a digital loop if the circuit is 64 kbit/s, and starts a timer T_x . T_x is 2 to 2.1 seconds if there is no time parameter in the CVI message, otherwise its value is given by the time parameter. This timer has a maximum value of 19 to 21 seconds, it must be at least the pattern synchronization

time (for a 2047 pseudo-random bit pattern this is about 2 seconds) plus T_y [see h) below] (the value is for further study).

- h) If the near end uses a pseudo-random bit pattern test, and the transceiver manages to synchronise on the received pattern, it starts a timer T_y (14.9 to 15.1 seconds) to perform a Bit Error Ratio (BER) test.
- i) When T_x expires, the far end removes the loop from the tested circuit, and enables any previously disabled bit manipulating/echo cancelling/suppressing devices.
- j) The far end then returns the CVR.
- k) The near end stops timer T_c on receipt of the CVR message.

If valid tone (for circuits supporting only speech/3.1 kHz audio) is received (see clause 7/Q.724), or a satisfactory BER test for the period T_y occurs (see e.g. Recommendations M.550 and G.821), either one followed by removal of tone/pattern before the CVR message is received and before timer T_c expires, then the test succeeds. The test fails if T_c expires without a CVR message being received at the near end.

The test also fails if a CVR message is received at the near end, or T_c expires, before synchronization is achieved (for the pseudo-random bit pattern test), or tone or pattern is still being received when the CVR is received or T_c expires.

At the near end, a comparison of the near end and the far end circuit identification codes is made. If they match, and the connectivity test has succeeded, an identification of a successful CVT is given to the management at the initiating end. If the comparison fails, a CVT failure indication with all the relevant data is given to the management for the purpose of isolating the problem.

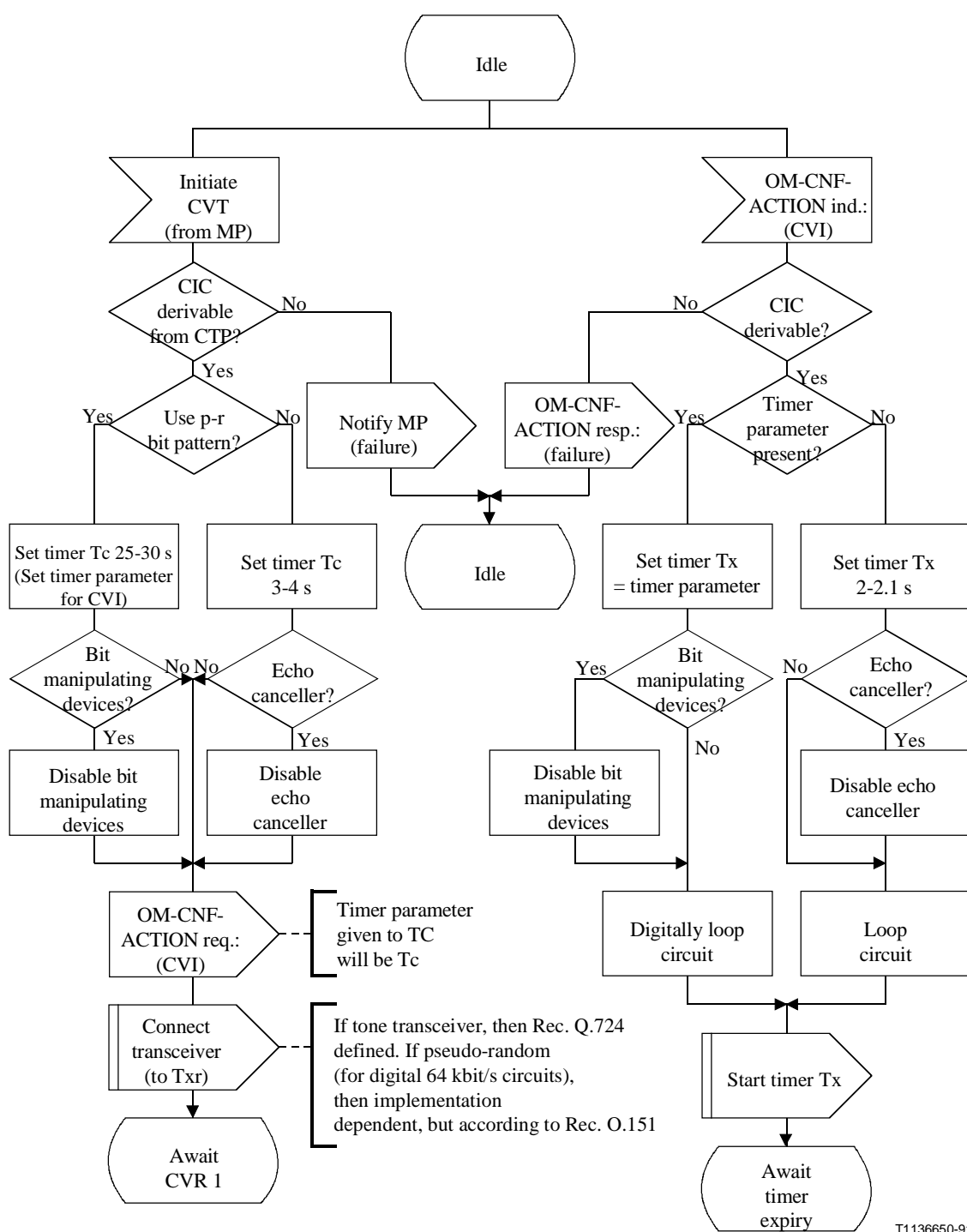
The CVT message also contains data about the circuit with respect to the characteristics of the interexchange circuit group of which it is a part. The interexchange circuit group characteristics include whether:

- a) odd or even CICs are in control in the case of double seizing;
- b) the blocked circuit group is classified as "Block, immediately release the call" or "Block, as soon as the call is normally released";
- c) the interexchange circuit group contains analogue, digital or a mix of analogue and digital circuits. This determines if continuity checks should be performed during call set-up.

If the group characteristics are unavailable, the CVR message must explicitly indicate this with an unavailable indication. Inconsistencies between the interexchange circuit group characteristics of the two exchanges are reported to the initiating end management for corrective action.

4.2.2 CVT State Transition Diagrams

Figure 5 contains the state transition diagrams for the CVT in the form of SDL. There are three sets of diagrams, the first set is the logic in the OMASE-User, the next set is the logic for the near end pseudo-random bit pattern transceiver, the last set is for the continuity check transceiver.



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NOTE 1 – "Bit manipulating" devices include A/μ law converters, Echo Cancellers, ADPCM equipment, etc.

NOTE 2 – The CVI timer parameter has a maximum value of 19 to 21 seconds, its minimum is at least the pattern synchronization time.

NOTE 3 – The result of the test "use p-r bit pattern?" is true if there is a timer parameter in the CNF-ACTION of the "initiate CVT" request from the MP. This timer parameter is copied into the optional timer parameter of the CVI message.

Figure 5/Q.753 (sheet 1 of 7) – CVT SDL in the OMASE-User

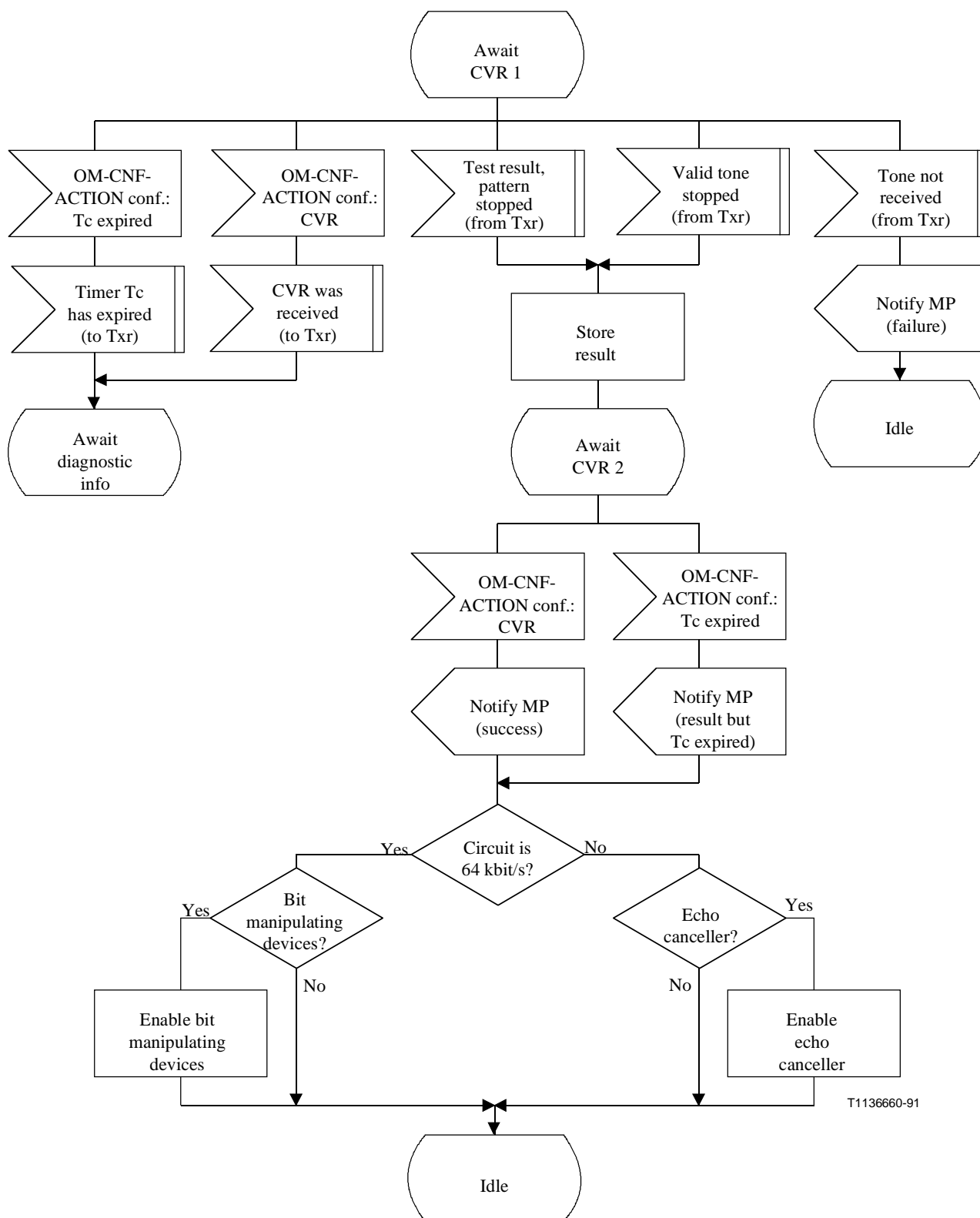


Figure 5/Q.753 (sheet 2 of 7) – CVT SDL in the OMASE-User

Procedure OMASE-User cvt-3 (4)

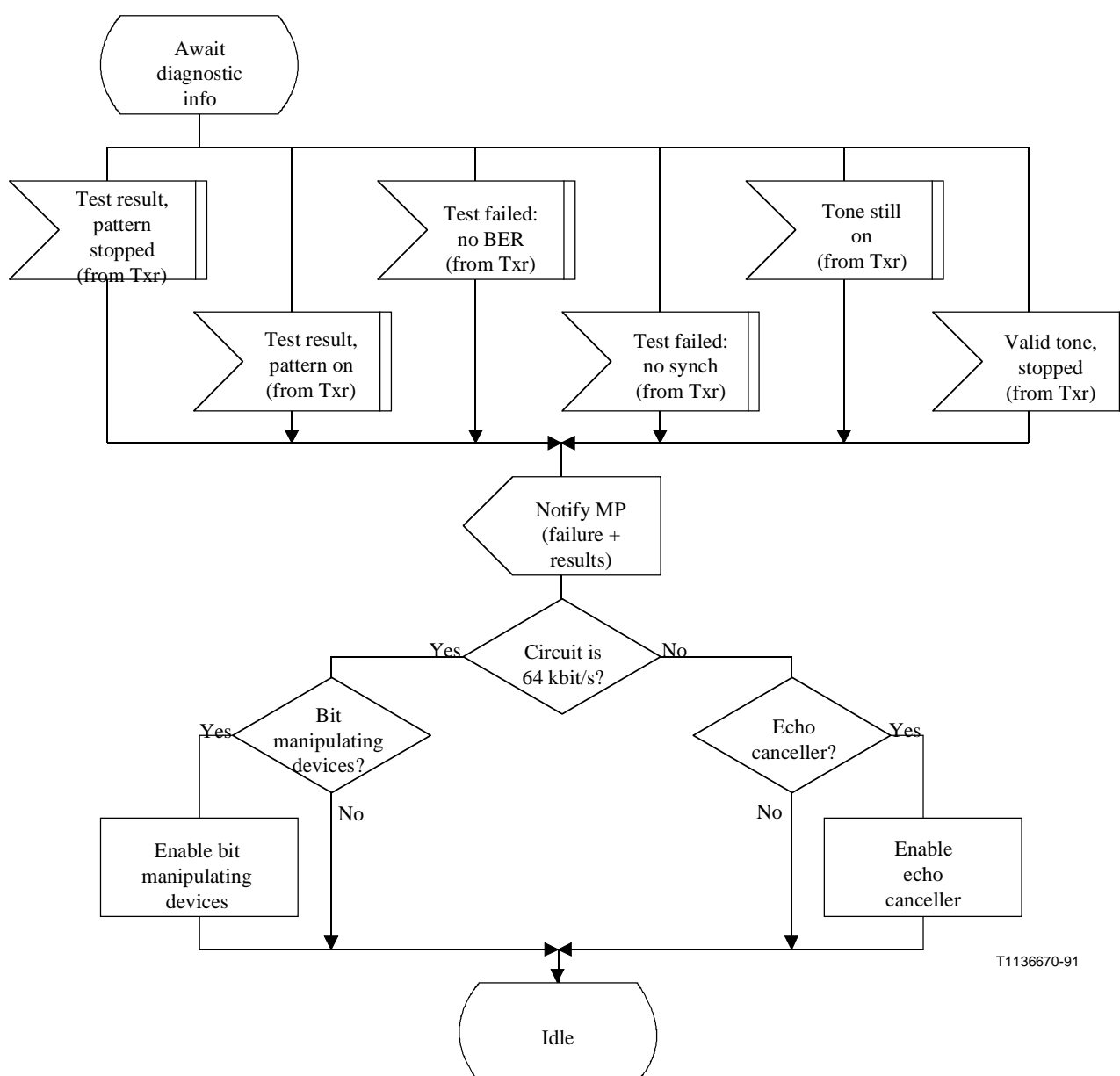
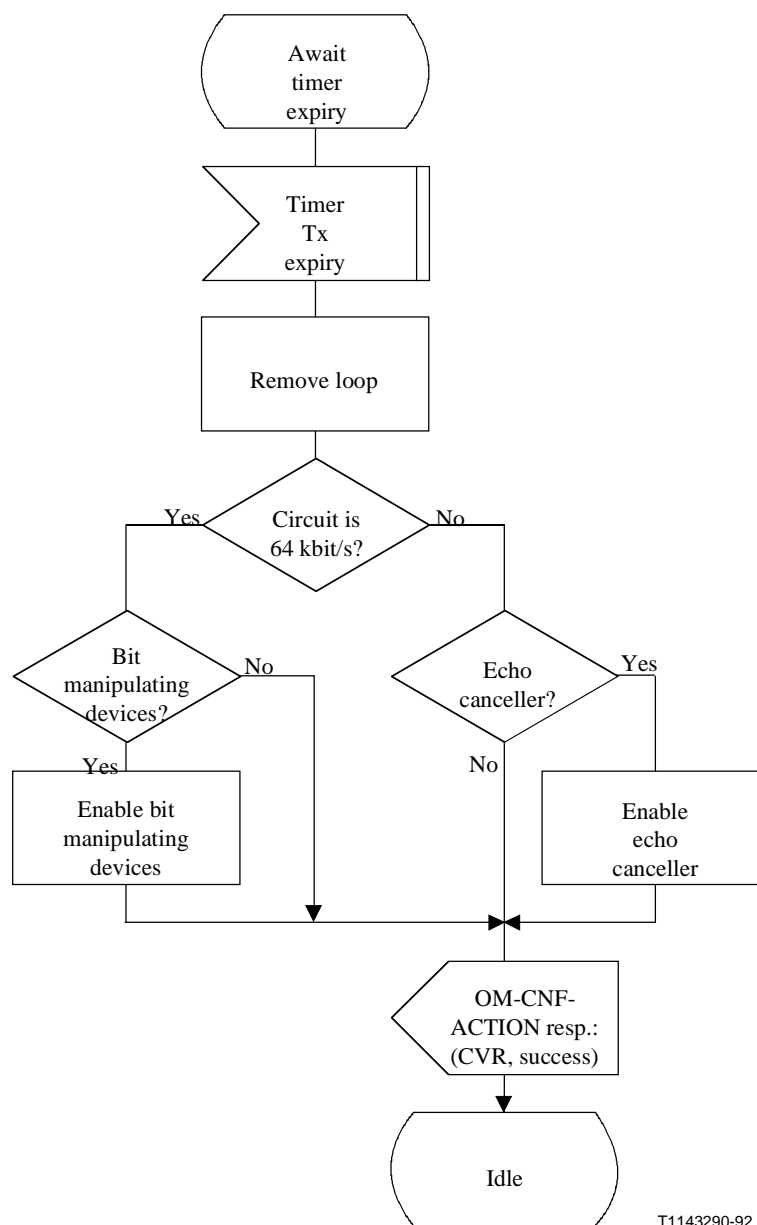


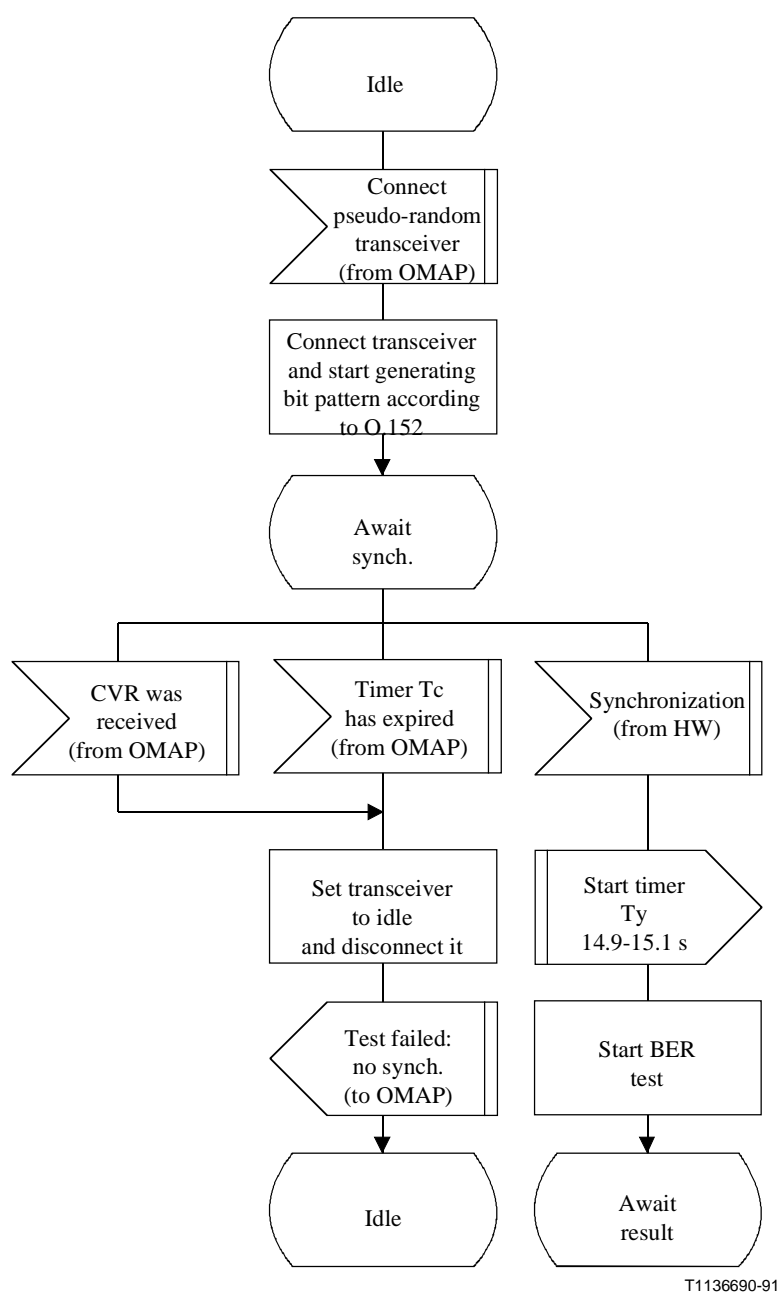
Figure 5/Q.753 (sheet 3 of 7) – CVT SDL in the OMASE-User



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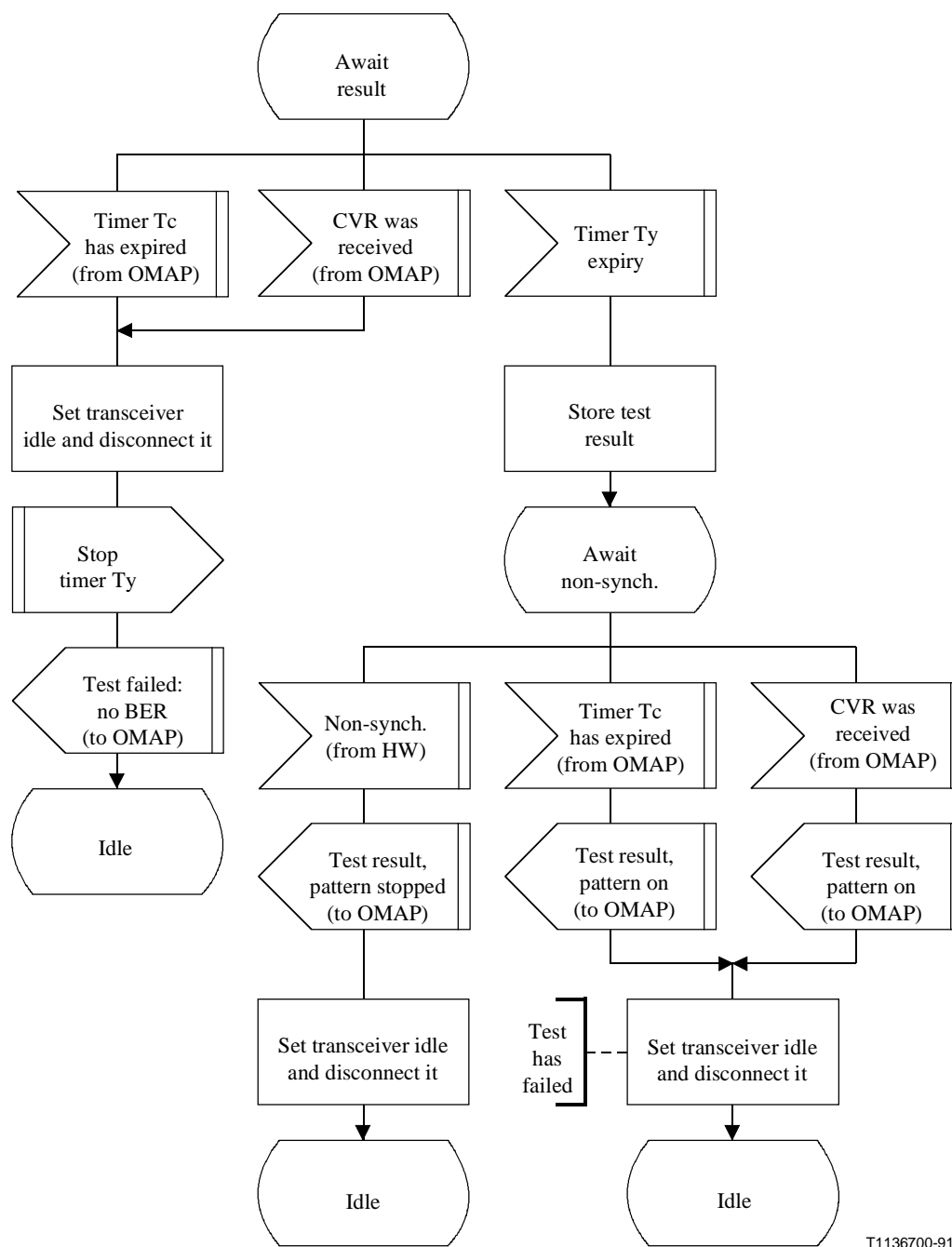
Figure 5/Q.753 (sheet 4 of 7) – CVT SDL in the OMASE-User

Procedure CVT-pseudo-random-generator-1 (2)



T1136690-91

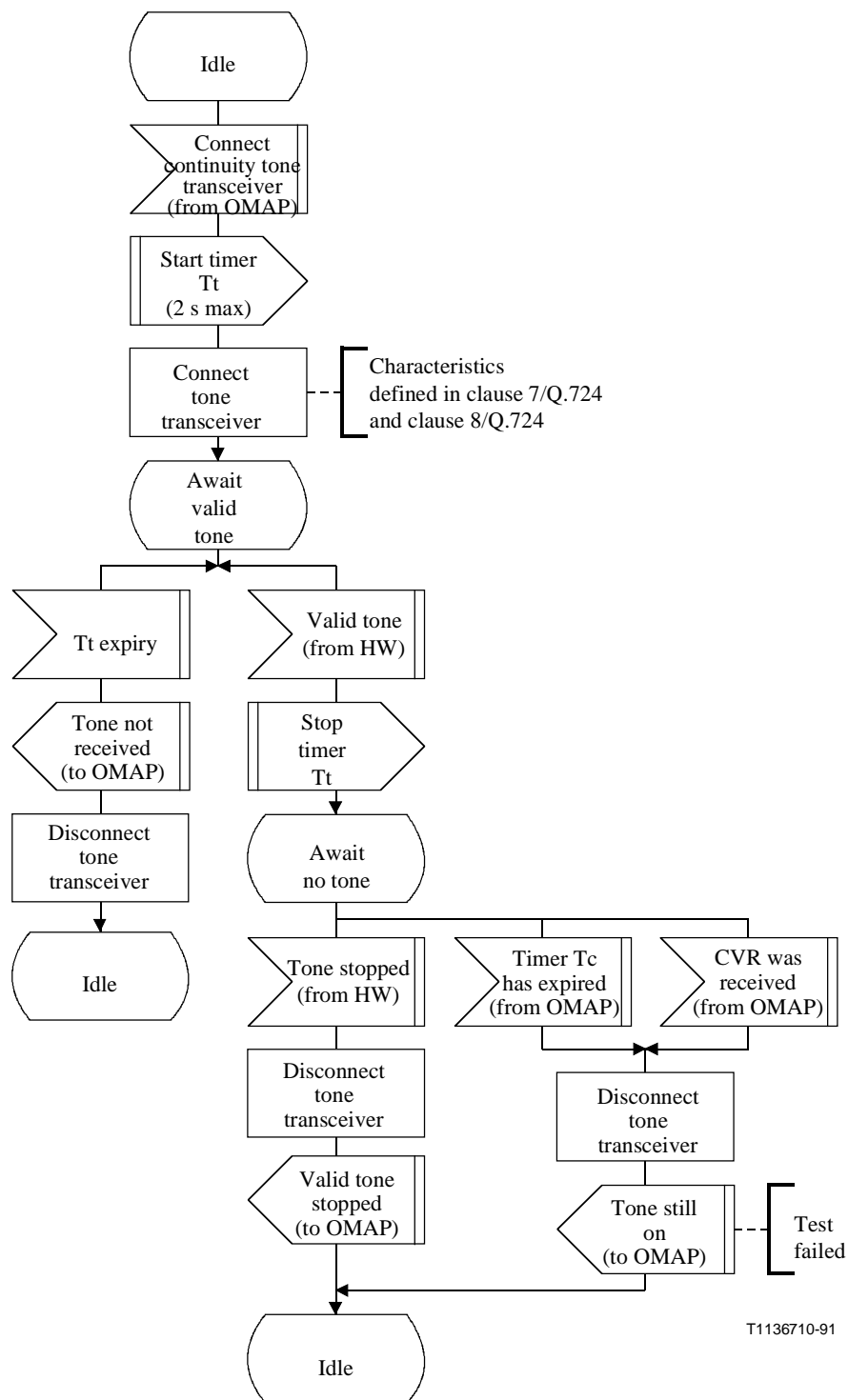
Figure 5/Q.753 (sheet 5 of 7) – CVT SDL pseudo-random generator (Txr)



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Figure 5/Q.753 (sheet 6 of 7) – CVT SDL pseudo-random generator (Txr)

Procedure CVT-continuity-check-transceiver-1 (1)



T1136710-91

Figure 5/Q.753 (sheet 7 of 7) – CVT SDL continuity-check transceiver (Txr)

ANNEX A

NOTE – The old Annex A (1993 version) has been replaced with a new Annex A.

A.1 Detailed model of the OMASE-User

The OMASE-User can be described (note that this does not imply its implementation) as consisting of a set of MRVT functions, a set of SRVT functions, and a set of CVT functions.

In order for the indication and confirmation OM-primitives to be routed to the correct set of functions, a distribution function is also required inside the OMASE-User. This distributes the primitives on the basis of the object identifier (mtp-Routing-Tables-1992 for MRVT, sccp-Routing-Tables-1992 for SRVT, etc.). The invoke and dialogue identities are assumed to be included in all primitives, as are the calling and called addresses and sequence information from SCCP.

For request OM-primitive invocations, a function is required to assign unique dialogue and invoke identities across MRVT, SRVT and CVT functions. See Figure A.1 for a diagram.

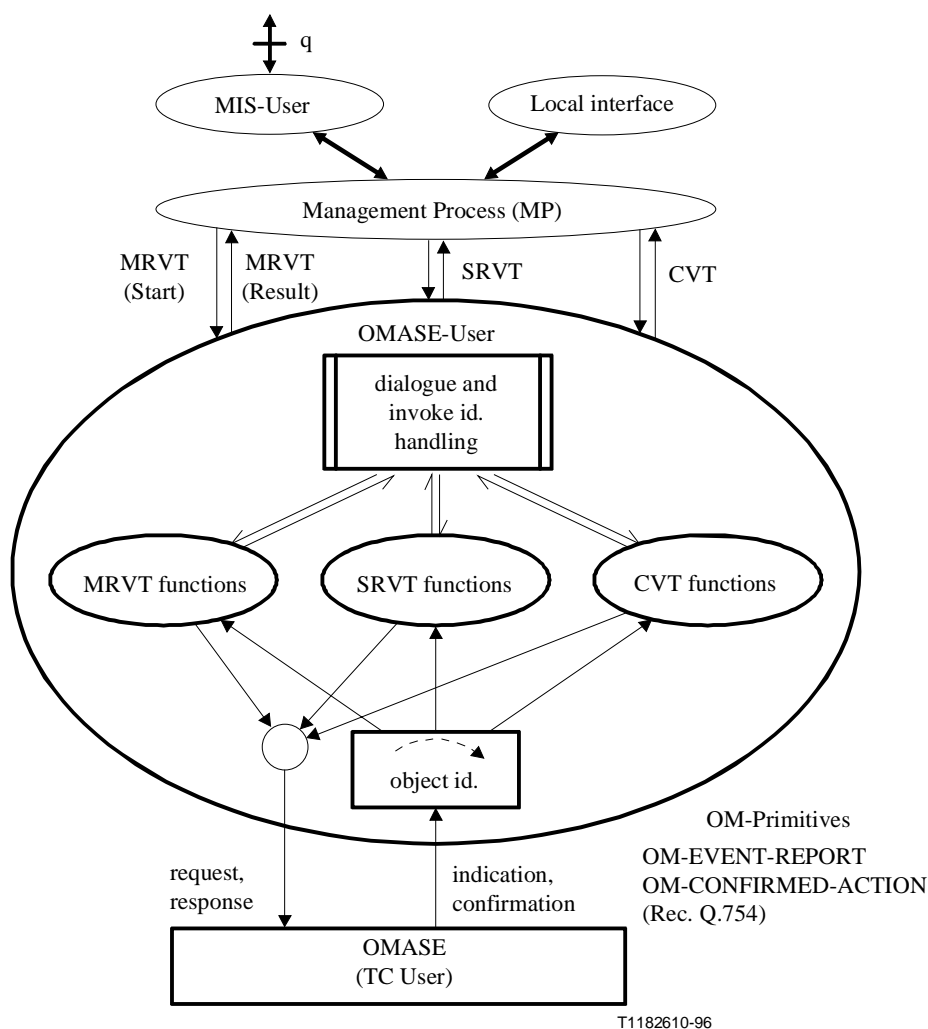


Figure A.1/Q.753 – Detailed model of the OMASE-User and its interfaces

A.2 MIS-User to management process interface

This interface is used to control MRVT, SRVT and CVT functions. The mrvt managed object class defined in Recommendation Q.751.1, and the srvt managed object class defined in

Recommendation Q.751.2 have ACTIONs confirmedAction to start the MRVT and SRVT, and NOTIFICATIONs eventReport for both. The MRVT confirmedAction maps to MRVT(Start) from the MP to OMASE-User, MRVT(Result) maps to eventReport. The SRVT functions map in the same way.

For MRVT the confirmedAction as defined in Figure 3/Q.754 employs startMRVT. The SRVT is also a confirmedAction employing startSRVT. The information model is as follows:

-- Management Process information model --

MP {itu-t(0) recommendation q(17) 753 mp(1) version1(1) }

DEFINITIONS EXPLICIT TAGS::=

BEGIN

EXPORTS EVERYTHING;

IMPORTS OPERATION, ERROR, eventReport, confirmedAction, CNF-ACTION, EVENT, RoutePriorityList, failure, partialSuccess, GlobalTitle, PointCodeList, CopyData

FROM OMASE { itu-t(0) recommendation q 754 omase(0) version2(2) };

startMRVT CNF-ACTION ::=

```

{
    ACTIONARG SEQUENCE {
        traceRequested      [1] IMPLICIT BOOLEAN,
        threshold           [2] IMPLICIT INTEGER,
        routePriorityList    [12] IMPLICIT RoutePriorityList
                                OPTIONAL,
        infoRequest          [13] IMPLICIT BIT STRING {
                                pointCode(0),
                                pointCodeList(1),
                                routePriorityList(2),
                                ... } OPTIONAL,
        -- infoRequest is used to indicate that the test initiator node can accept a routeTraceNew
        -- RVR message, and also asks for particular parameters to be returned in it, if it is sent. This
        -- parameter can only be inserted at the initiator node, but it can be copied into regenerated
        -- MRVTs. --

        returnUnknownParams [14] IMPLICIT BIT STRING {
                                tag15(0),
                                tag16(1),
                                ... } OPTIONAL ,
        -- returnUnknownParams is used to indicate which parameters that a node does not
        -- understand should be returned in an RVR if one is sent (or in an RVA message in the
        -- copyData field if the test initiator is unknown). Bit 0 represents an RVT parameter with tag
        -- value 15, bit 1 an RVT parameter with tag value 16, etc.
        -- This parameter can only be present if infoRequest is present. --
        directRouteCheck     [15] IMPLICIT BOOLEAN OPTIONAL,
        ... }
    ACTIONRESULT { success | failure | partialSuccess }
    CODE          localValue:1
}

```

Figure A.2/Q.753 (sheet 1 of 2) – Formal syntax of the MP

```

startSRVT CNF-ACTION ::=
{
    ACTIONARG SEQUENCE {
        traceRequested      [1] IMPLICIT BOOLEAN,
        threshold           [2] IMPLICIT INTEGER,

        mtpBackwardRoutingRequested
        originalGT          [5] IMPLICIT BOOLEAN OPTIONAL,
                           [11] IMPLICIT GlobalTitle
                           OPTIONAL,
        infoRequest         [13] IMPLICIT BIT STRING {
                           pointCode(0),
                           pointCodeList(1),
                           routePriorityList(2),
                           ... } OPTIONAL,

        returnUnknownParams [14] IMPLICIT BIT STRING {
                           tag15(0),
                           tag16(1),
                           ...} OPTIONAL ,

        -- returnUnknownParams is used to indicate which parameters that a node does not
        -- understand should be returned in an RVR if one is sent (or in an RVA message in the
        -- copyData field if the test initiator is unknown). Bit 0 represents an RVT parameter with tag
        -- value 15, bit 1 an RVT parameter with tag value 16, etc.
        -- This parameter can only be present if infoRequest is present. --

        ... }
    ACTIONRESULT { success | failure | partialSuccess }
    CODE          localValue:2
}

success EVENT ::=
{
    EVENTINFO CHOICE {
        empty      [0] IMPLICIT NULL,
        trace      [1] IMPLICIT PointCodeList,
        traceNew   [2] IMPLICIT SEQUENCE {
            pointCodeList [2] IMPLICIT PointCodeList,
            routePriorityList [3] IMPLICIT RoutePriorityList OPTIONAL,
            copyData [4] IMPLICIT CopyData OPTIONAL,
            ...}
        }
    CODE          localValue:0
}
-- the supporting definitions are as in Figure 3/Q.754. On the MIS-User to MP interface, the
-- copyData parameter is used to report parameters not understood in the RVT message (for
-- "success", by the test destination, for other results by the node detecting the error). --

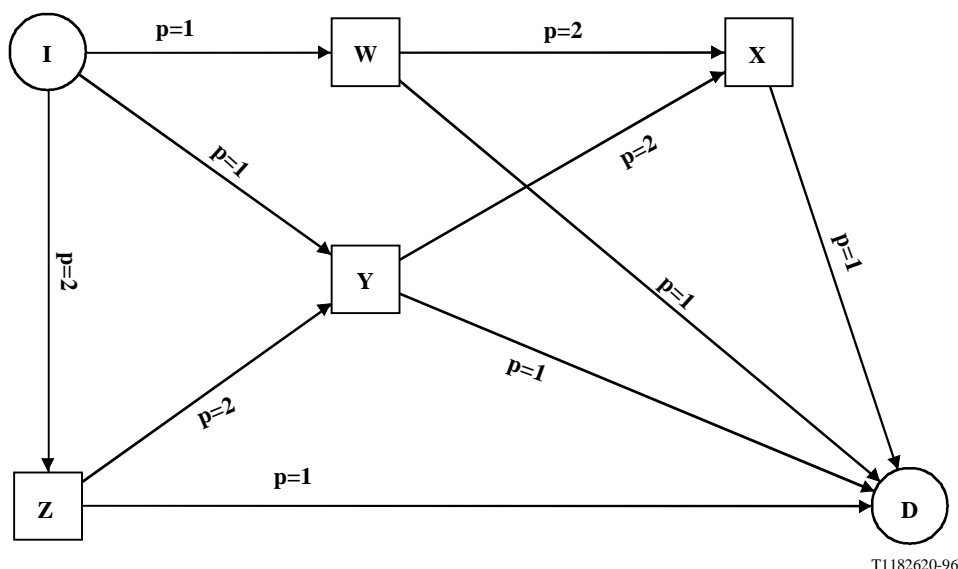
END -- MP syntax --

```

Figure A.2/Q.753 (sheet 2 of 2) – Formal syntax of the MP

B.1 Example of successful MRVT

The following diagram illustrates the test.



Here, the test initiator is denoted by I, the test destination by D, and W, X, Y and Z denote intermediate STPs. All the routes defined in the routing tables are shown, and their directions. The priorities of the routes to the test destination are also shown (thus e.g. the route WXD, forming part of the route IWXD, has priority 2 at W. The linksets IW and IY have equal first priority, and form a combined linkset to D). Assume for the purposes of this example that all routes to D are available.

The first step of the MRV Test is for I to send an MRVT message to W, another to Y, and another to Z. I notes the SPs to which it has sent MRVTs, its TC starts a timer for an MRVA acknowledging each MRVT sent.

The next step is for W to send out an MRVT to X, and another to D. Y sends out two MRVTs also, one to D and another to X. Z sends out an MRVT to D and another to Y. W starts a timer for each MRVT message sent, as do Y and Z.

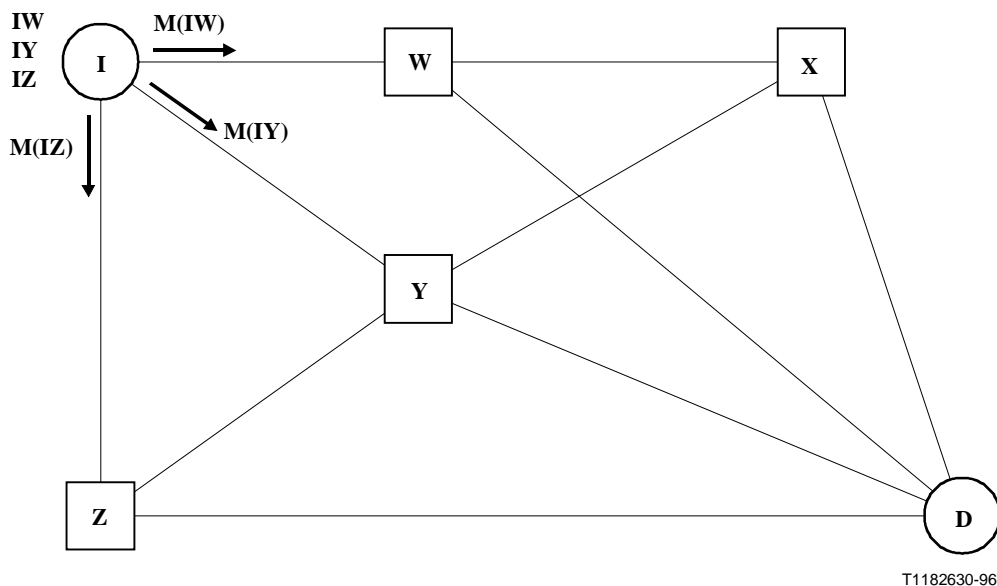
MRVT messages are regenerated in this manner at each STP used to reach D. Each MRVT contains the test initiator and test destination identities, a pointCodesTraversed parameter, and a routePriorityList parameter. Each MRVT has associated with it its origin (i.e. the SP sending the MRVT), and a transaction identity, which identify the MRVT uniquely.

As D receives each MRVT message, it returns an MRVA, with the transaction identity (and invoke identity also) of the prompting MRVT. If a trace of the route was requested in the MRVT, pointCodesTraversed is copied from the MRVT to the MRVR, as is routePriorityList.

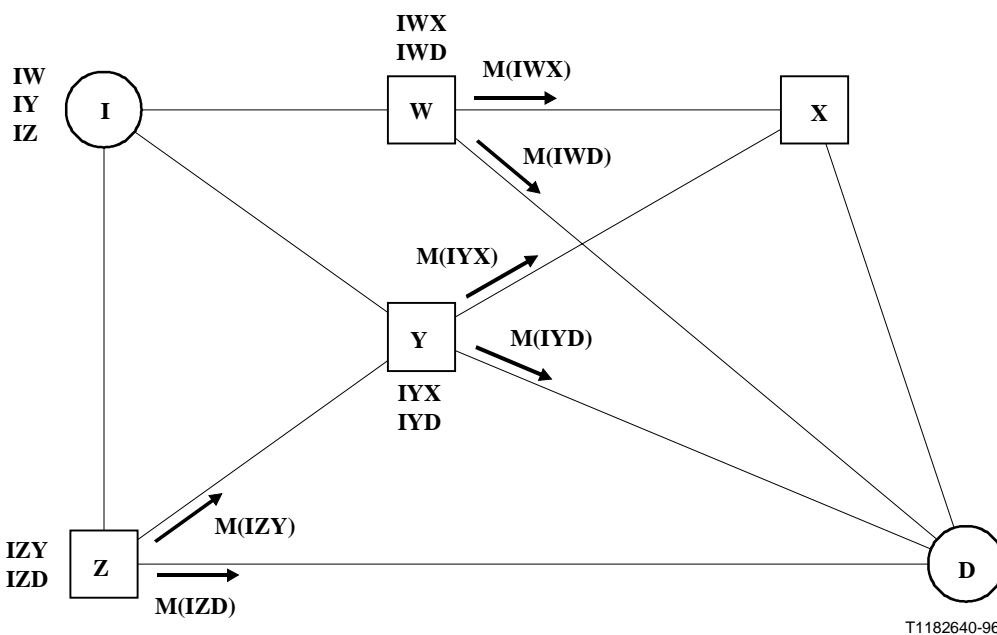
An intermediate STP receiving an MRVA notes the contents of the MRVA (and would keep a running tally of any failures detected). When each MRVT previously sent out has been acknowledged by an MRVA (or the respective TC timer has expired), the STP constructs and sends an MRVA to acknowledge the MRVT it received, with the results of the MRVAs it received noted in this MRVA. The STP then stops its test timer.

The messages sent in this example are as follows [where $M(abc)$ represents an MRVT message sent from b to c stimulated by one from a , $A(abc)$ is the MRVA acknowledging this MRVT. The list of MRVT messages awaiting MRVAs is given against each SP]:

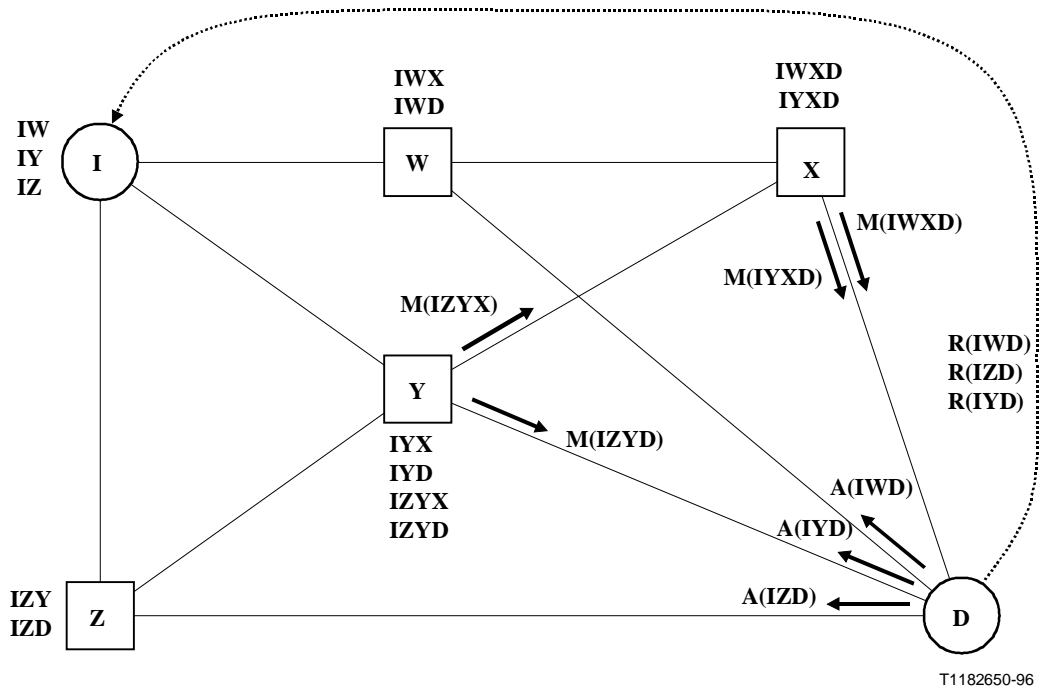
Stage 1



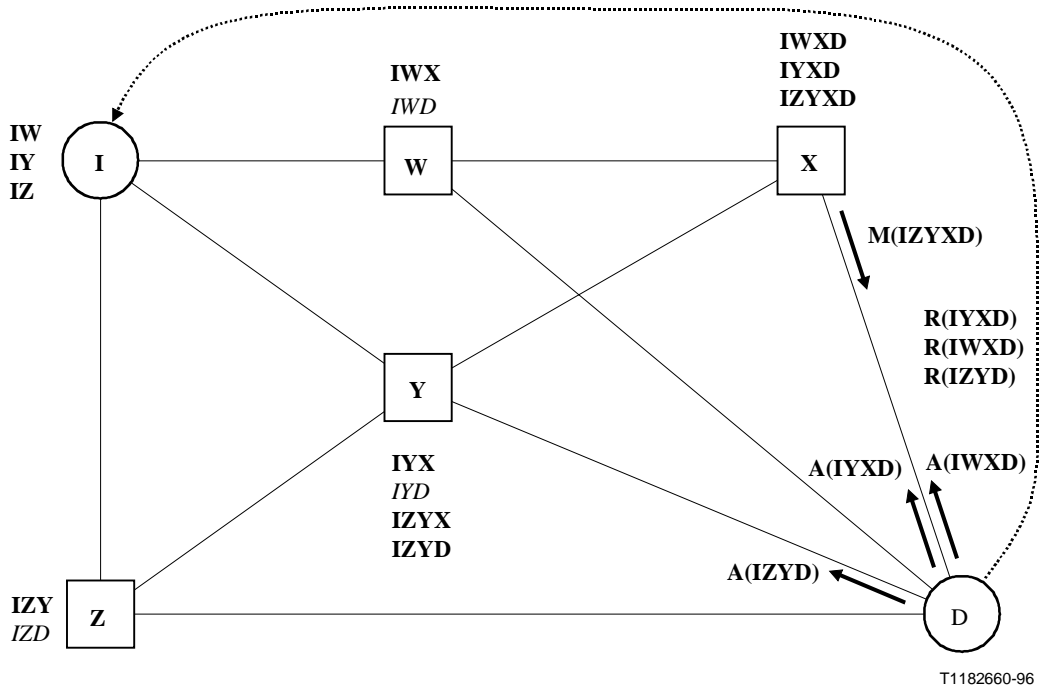
Stage 2



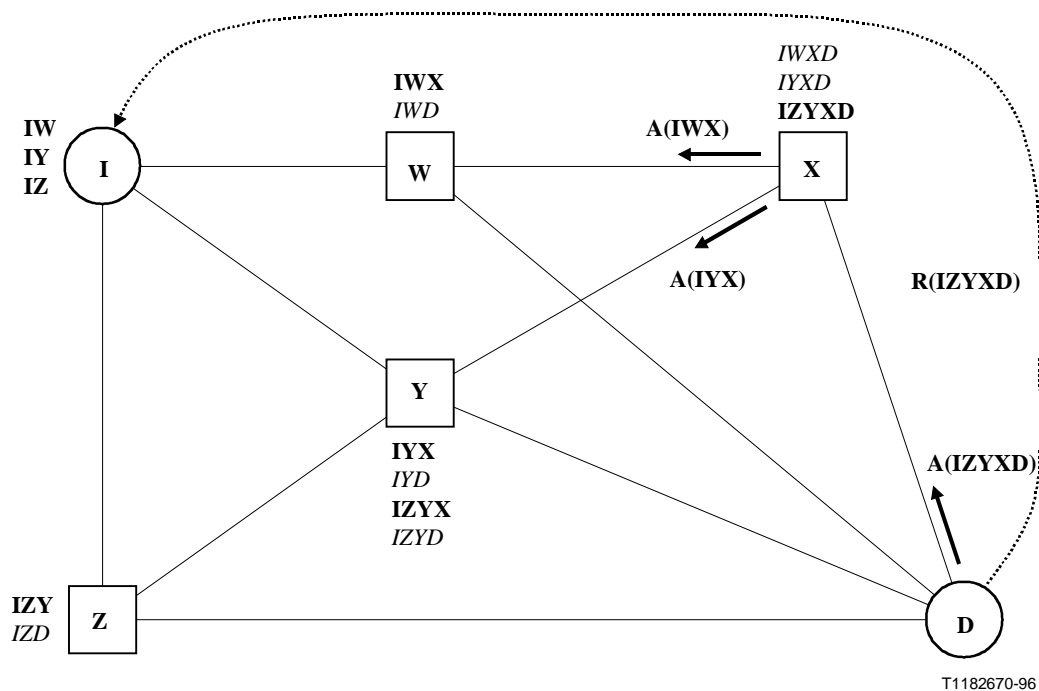
Stage 3



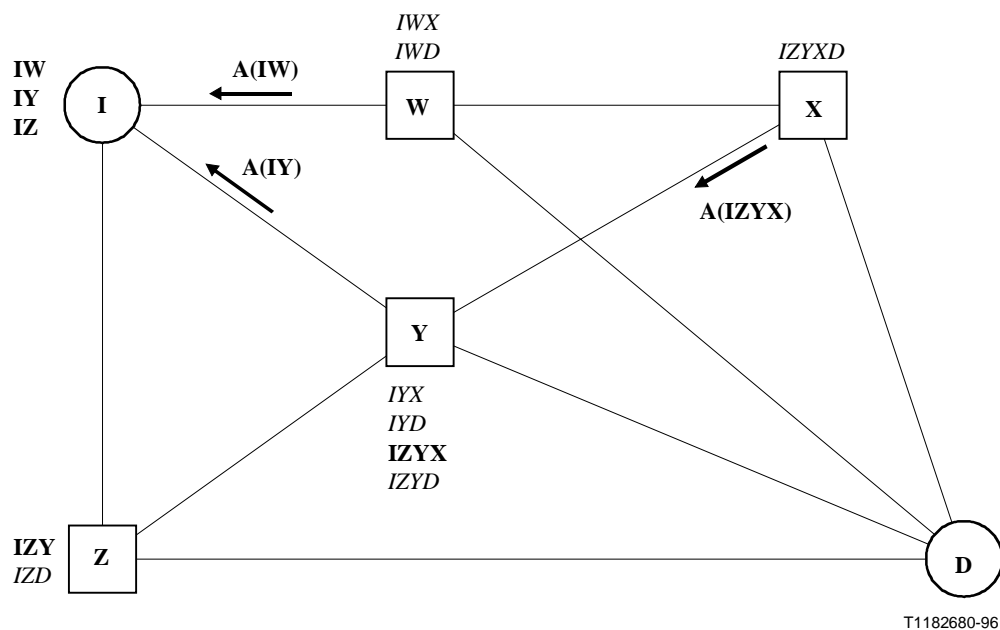
Stage 4



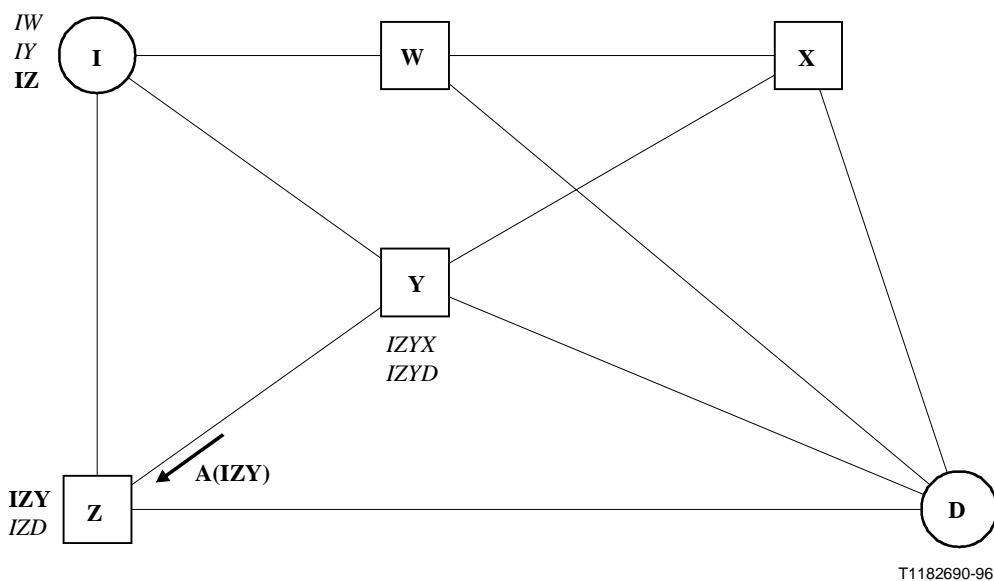
Stage 5



Stage 6



Stage 7



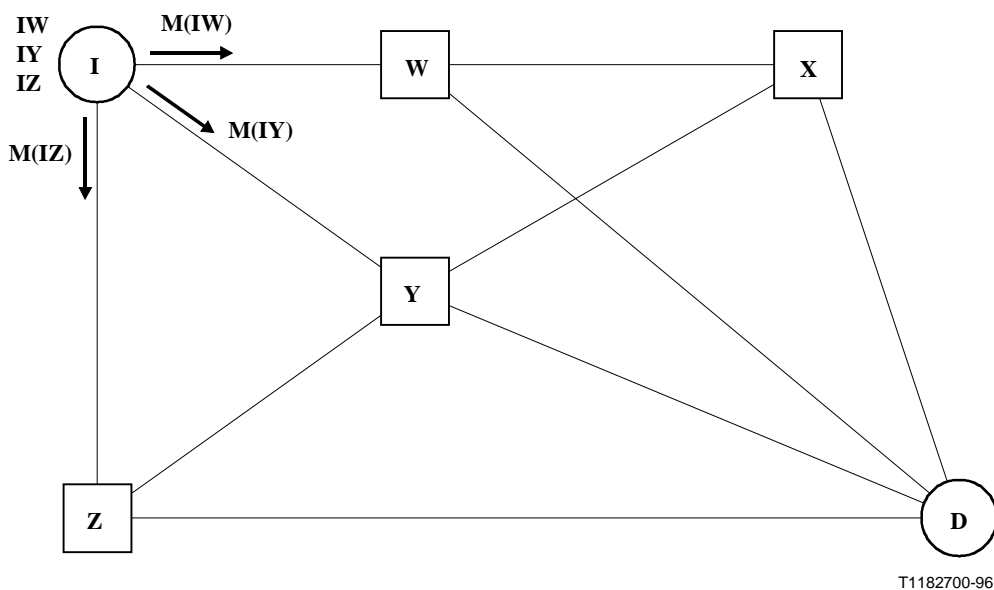
The remaining steps are obvious.

B.2 Example of unsuccessful test (STP X does not know initiator I)

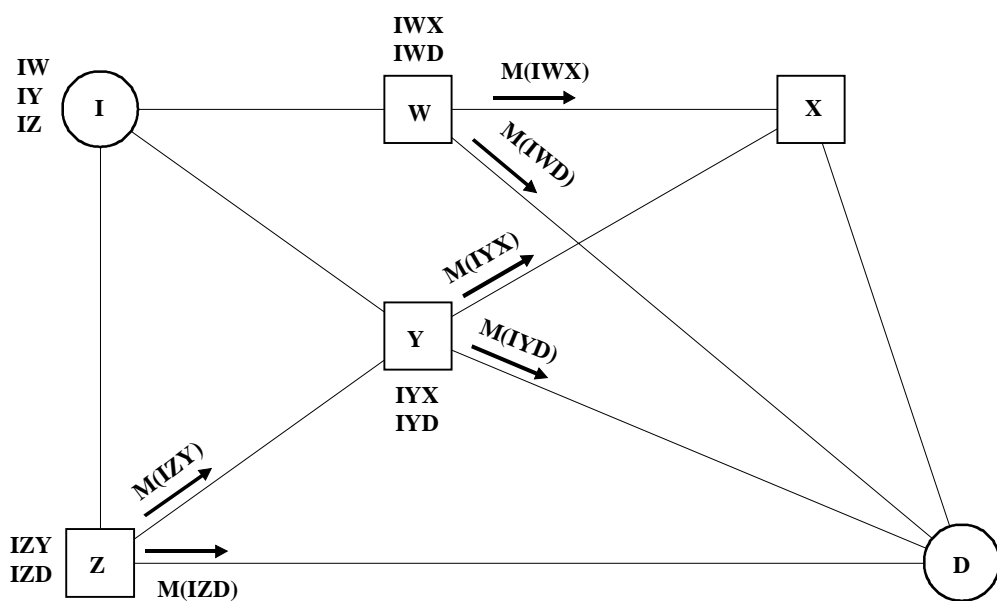
Here, the notation $R(\neg IWX)$ is for an MRVR message where the test failed, because there is no route to D from I via X (in this test, X does not know I, so the MRVR is sent by W for X). $A(\neg IWX)$ is used for the MRVA with the result "failure" in response to the MRVT $M(IWX)$.

The notation $A(pIW)$ is for an MRVA message with the result "partial success" in response to the MRVT message $M(IW)$.

Stage 1

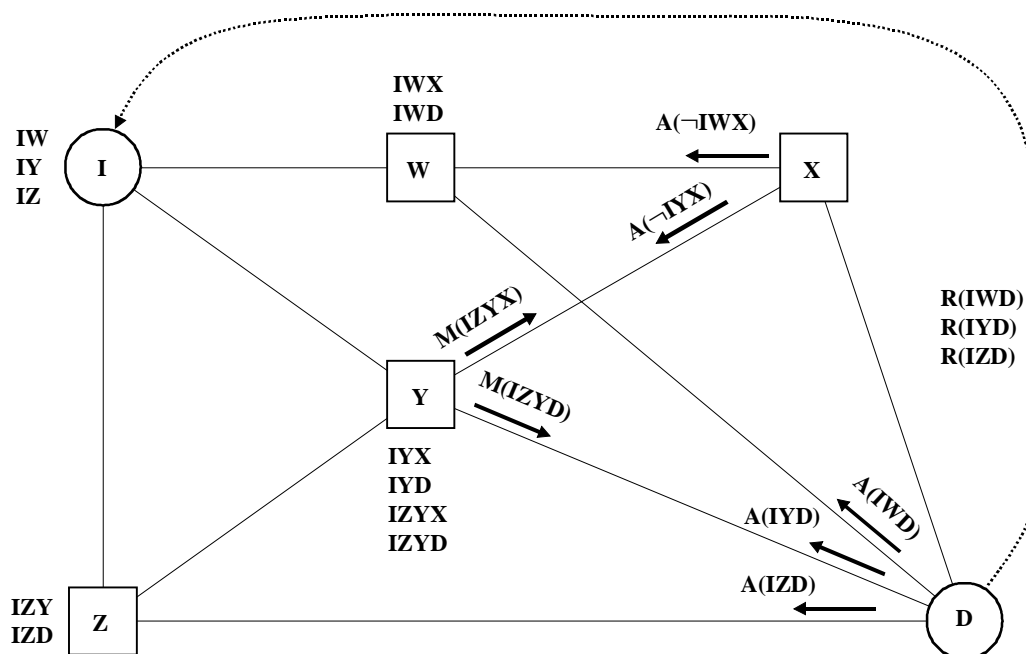


Stage 2



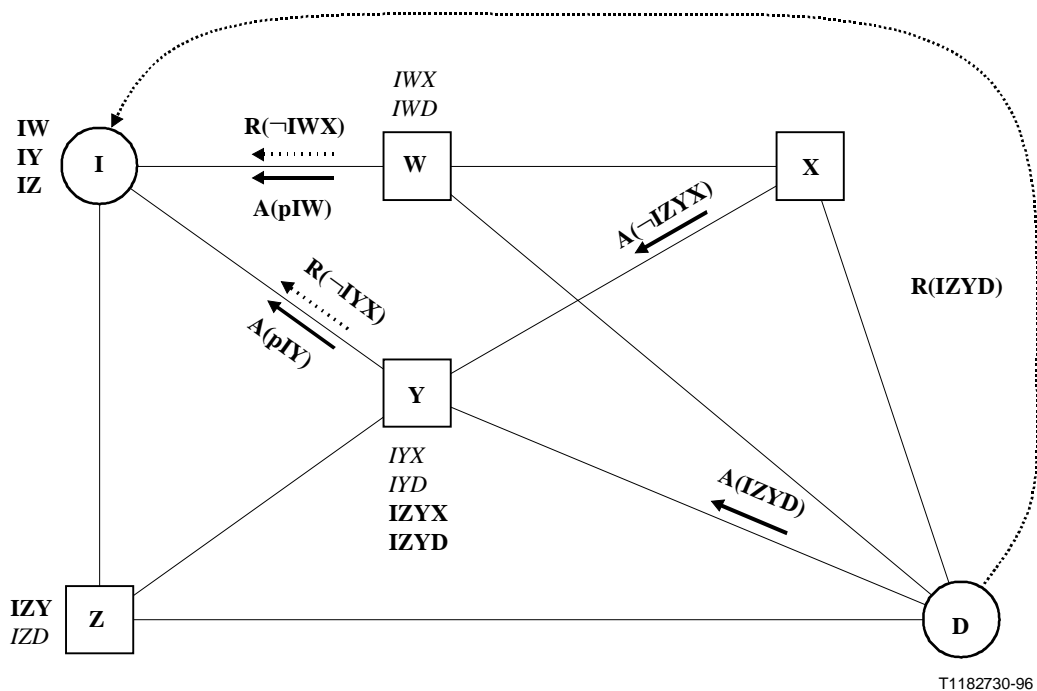
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Stage 3

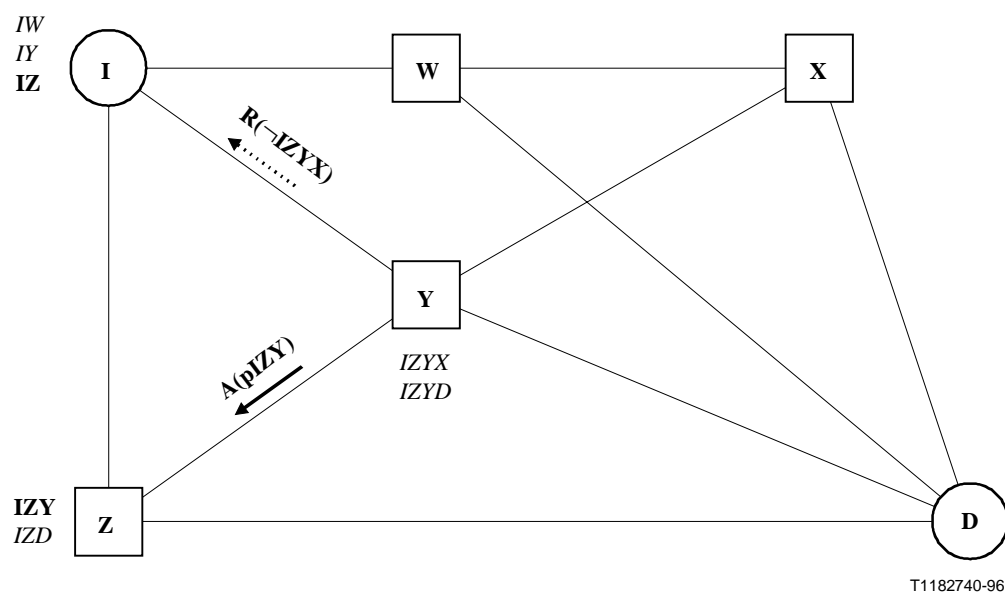


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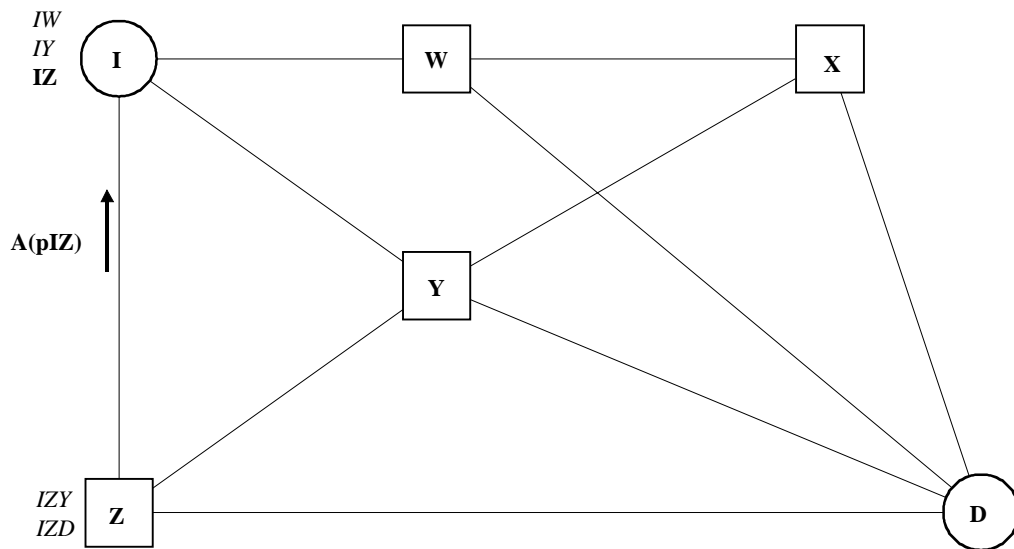
Stage 4



Stage 5

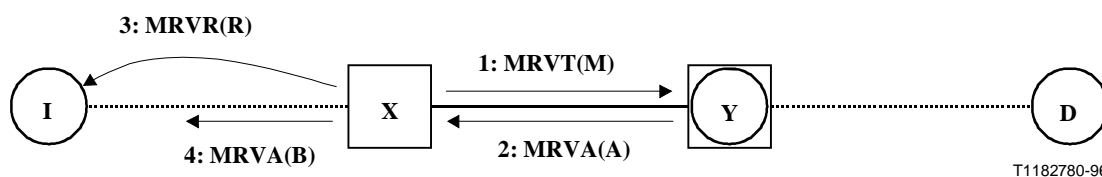


Stage 6



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B.3 Example of "unknown initiator" response with copyData parameter



T1182780-96

Consider the preceding diagram. I is an MRV Test initiator, X an STP which apparently has a route to the test destination D through Y. I is unknown to Y.

Consider the sequence:

- 1: X sends an MRVT message M to Y, concerning tested destination D, with test initiator I. The MRVT message contains a returnUnknownParams parameter. Suppose that there are parameters in M that Y does not recognize, and that some of them are indicated in M's returnUnknownParams parameter.
- 2: Y then returns an MRVA(A) to X, indicating that I is unknown to Y, and that an MRVR has not been sent. Included in MRVA(A) will be a copyData parameter containing the parameters of MRVT(M) that were not understood by Y, and that were also requested to be returned in the returnUnknownParams parameter of M.
- 3: X constructs an MRVR(R) message and sends it to I. MRVR(R) contains the copyData parameter copied from MRVA(A).
- 4: X also returns an MRVA message B, which does not contain the copyData parameter, but it does indicate that an MRVR message has been sent.

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