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ATIS-1000116.2000(S2020)

Signalling System Number 7 (SS7) – Operations, Maintenance, and Administration Park (OMAP)

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ATIS-1000116.2000(S2020), *Signalling System Number 7 (SS7) – Operations, Maintenance, and Administration Park (OMAP)*

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American National Standard for Telecommunications –

Signalling System Number 7 (SS7) – Operations, Maintenance, and Administration Part (OMAP)

Secretariat

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Abstract

Signalling System Number 7 (SS7) - Operations, Maintenance, and Administration Part (OMAP)OMAP is an American National Standard based on ITU-T Recommendations Q.750 through Q.756 of Signalling System No. 7 (SS7) for international use, and is intended to be compatible with that standard. It has been modified for use within and between U.S. Networks to meet the anticipated needs and applications of those entities. These modifications are the result of extensive work by the members of the T1S1.3 Working Group on U.S. Standards for Common Channel Signalling.

Topics included are an Overview of Signalling System Number 7 (SS7) Management (OMAP), Monitoring and Measurements for Signalling System Number 7 Networks, Signalling System Number 7 (SS7) Management Functions MRVT, SRVT, CVT and Definition of the OMASE-User, Signalling System Number 7 (SS7) - OMAP Management ASE (OMASE) Definitions for Functions MRVT, SRVT and CVT, and a Signalling System Number 7 Guide Book to OMAP.

Foreword

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.

This document is entitled *American National Standard for Telecommunications – Signalling System Number 7 (SS7) –* Operations, Maintenance and Administration Part (OMAP). It is based on the ITU-T Recommendations Q.750 through Q.756.of Signalling System No. 7 (SS7) for international use and is intended to be compatible with that standard. It has been modified for use within and between U.S. Networks to meet the anticipated needs and applications of those entities. These modifications are the result of extensive work by the members of the T1S1.3 Working Group on U.S. Standards for Common Channel Signalling. In general, these modifications fall into two categories:

1. the specification of options designated by the ITU-T for national use; and

2. extensions to the 1988 protocol to provide for new applications of the SS7 protocol. This is in accordance with current and projected ITU-T activity.

[A change bar on the right margin indicates a change from the 1996 issue of this American National Standard. These change bars are advisory only, and reflect the editors' views of which textual changes constitute significant technical changes. Because of the differences in style and content between this standard and the ITU-T Recommendations, it is not possible to indicate differences using margin marks.]

This standard contains the following seven chapters:

T1.116.0,	Overview of Signalling System Number 7 (SS7) Management (OMAP)
T1.116.1,	Network Element Management Information Model for the MTP (For Further Study)
T1.116.2,	Monitoring and Measurements for Signalling System Number 7 Networks
T1.116.3,	Signalling System Number 7 (SS7) Management Functions MRVT, SRVT, CVT and Definition of the OMASE-User
T1.116.4,	Signalling System Number 7 (SS7) - OMAP Management ASE (OMASE) Definitions for Functions MRVT, SRVT and CVT
T1.116.5,	Signalling System Number 7 Protocol Testers (For Further Study)
T1.116.6,	Signalling System Number 7 Guide Book to OMAP

This standard is intended for use in conjunction with T1.110-1999 *Signalling System Number 7 (SS7) – General Information*, , which includes an overview of SS7, a glossary, and a chapter on abbreviations.

The overall and detailed organization of these specifications parallels that used in the equivalent ITU-T recommendations. Thus, T1.116.0-2000 through T1.116.6-2000 of this standard corresponds to ITU-T Recommendations Q.750 through Q.756. The major changes in organization and appearance of these ITU-T Recommendations account for many of the changes to this standard from the previous issue. The following is an overview of the changes and additions incorporated into these specifications:

- the MRVT has been clarified and revised to enhance the capability of testing MTP routes to adjacent signalling networks;

- the SRVT has been clarified and revised to enhance the capability of testing MTP routes to adjacent signalling networks;

- the SRVT has been clarified and revised to include new SCCP routing capabilities; and
- T1.116.0-2000, clause 6, was revised to include details on compatibility issues.

Information contained in a normative annex in these specifications *is* considered part of this standard. Information contained in an informative annex in these specifications is *not* considered part of this standard but is auxiliary to the standard. Similarly, footnotes are not officially part of this standard.

Caution should be exercised in using the Specification and Description Language (SDL) diagrams to interpret the standard since they may not fully align with the text. Please note that, in case of any conflict between the text and the SDL diagrams, the text always takes precedence over the SDL.

Future control of this document will reside with Accredited Standards Committee on Telecommunications, T1. This control of additions to the specification, such as ongoing protocol evolution, new applications, and operational requirements, will permit compatibility among U.S. networks. Such additions will be incorporated in an orderly manner with due consideration to the ITU-T-layered model principles, conventions, and functional boundaries.

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

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Abbreviations & Acronyms List for T1.116-2000(S2020)

AE	Application Entity
AMI	Application Management Interface
APDU	Application Protocol Data Unit
ASE	Application Service Element
ASN.1	Abstract Syntax Notation 1
CIC	Circuit Identification Code
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CR	Connection Request
CVT	Circuit Validation Test
DPC	Destination Point Code
DTSP	Duplex Translation Signalling Point
FTA	Facility Test Acknowledgement
FTL	Facility Test Loopback
FTPC	Final Translation Point Code
FTR	Facility Test Results
FTSP	Final Translation Signalling Point
FTU	Facility Test Underway
GT	Global Title
GTI	Global Title Indicator
GTT	Global Title Translation
ITPC	Intermediate Translation Point Code
ISDN-UP	Integrated Services Digital Network User Part
ISUP	ISDN User Part
ITSP	Initial Translation Signalling Point
ITU-T	International Telecommunications Union
LEA	Link Equipment Available
LEF	Link Equipment Failure
LEU	Link Equipment Unavailable
LFS	Link Fault Sectionalization
LME	Layer Management Entity
LMI	Level Management Interface
LSSU	Link Status Signal Unit
MIB	Management Information Base
MIS	Management Information Service
MML	Man-Machine Language
MRVA	MTP Routing Verification Acknowledgment
MRVR	MTP Routing Verification Result
MRVT	MTP Routing Verification Test
MT	MTP Tester
MTBF	Mean Time Before Failure
MTP	Message Transfer Part
MTTR	Mean Time to Repair
NE	Network Element
NEF	Network Element Functions
NEF	Network Element Function
NEMF	Network Element Management Function
NMF	Network Management Function
NSAP	Network Service Access Point
OM	OMAP Management
OMAP	Operations, Maintenance and Administration Part
OMASE	OMAP Management ASE
OMC	Operations and Maintenance Center
OPC	Originating Point Code
OS	Operations System
OSF	Operations System Functions
OSI	Operations System Interconnection
PC	Point Code
PPC	Primary Point Code
RPOA	Recognized Public Operating Agency
SCCP	Signalling Connection Control Part
SDH	Synchronous Digital Hierarchy
SDL	Specification and Description Language
SIB	Status Indication Busy
SIF	Signalling Information Field
SIO	Service Information Octet
SL	SubLayer
SLC	Signalling Link Code
SMSI	Systems Management Service Interface
SP	Signalling Point
SPC	Secondary Point Code
SRVA	SCCP Routing Verification Acknowledgment
SRVR	SCCP Routing Verification Result
SRVT	SCCP Routing Verification Test
SS7	Signalling System Number 7
SSN	SubSystem Number
ST	SCCP Tester
STP	Signalling Transfer Point
SU	Signal Unit
TC	Transaction Capabilities
TCAP	Transaction Capabilities Application Part
TFA	Transfer Allowed
TFP	Transfer Prohibited
TID	Transaction Identification
TMN	Telecommunications Management Network
TPC	Tested Point Code
TrVT	Transaction Verification Test
TSP	Translation Signalling Point
TUP	Telephony User Part
UDTS	UnitData Service Message
UP	User Part

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Chapter T1.116.0

Overview of
Signalling System Number 7 (SS7) Management

Overview of Signalling System Number 7 (SS7) Management

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Signalling System Number 7 (SS7) – Overview of Signalling System Number 7 (SS7) Management

1 Introduction

This series of standards on the Operations, Maintenance, and Administration Part (OMAP) define the functions, procedures, and entities for managing the Signalling System Number 7 (SS7) network.

The management functions of SS7 are divided into three main parts:

a) management functions located in the Telecommunications Management Network (TMN) (which means the Network Element Functions (NEFs) and the Operations System Functions (OSF) - see Recommendation M.3000). These functions include measurement collection, and cover TMN to TMN interactions;

b) management functions within the SS7 protocol itself (e.g., changeover, forced rerouting, subsystem management, etc.); and

c) management functions defined to enable verification and validation of routing tables, Circuit Identification Codes (CICs), etc. These functions may require communication within the signalling network, and for this, a separate protocol is defined. Such management functions are modeled as managed objects at the interface between the network elements and an operations system.

Of the three sets of management functions defined above, OMAP provides a) and c). Set b) can be modeled as existing within the "Layer Management Entities" of SS7, and the functions are defined in the standards pertinent to those layers.

OMAP interacts with all layers (i.e., with all the levels) of SS7 in order to effect control of the network.

This standard comprises six chapters:

- T1.116.0 gives the OMAP overview;
- T1.116.1 defines the SS7 managed objects;
- T1.116.2 defines SS7 monitoring and measurements;
- T1.116.3-2000 defines the SS7 management functions for managed objects that themselves require SS7 communication in the network, and also the OMAP Management Application Service Element (OMASE)-User where the logic of these functions (MRVT, SRVT LEF and LFS) is modeled;
- T1.116.4-2000 defines the Application Service Element (ASE) for those functions defined in T1.116.3-2000, i.e., OMASE;
- T1.116.5-2000 defines the SS7 testers; and
- T1.116.6-2000 is a Guide Book to Operations, Maintenance, and Administration Part (OMAP).

Figure A-1/T1.116.0 shows the relationship between TMN, SS7 management, and the OMAP standards.

OMAP uses principles of management defined in ITU-T Rec. M.3000 (TMN), and in ITU-T Recommendations of the X.700 series (OSI Management).

1.2 Normative References

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

T1.111-2001, *Signalling System Number 7, Message Transfer Part.*[1]

T1.112-2001, *Signalling System Number 7, Connection Control Part Functional Description.*[1]

ITU-T Rec. M.3000(02/00), *Overview of TMN Recommendations*. [2]

ITU-T Rec. M.3010(02/00), *Principles for a Telecommunications management network.*[2]

ITU-T Rec. Q.752(06/97), *Monitoring and measurements for Signalling System No. 7 networks.*[2]

ITU-T Rec. Q.753(06/97), *Signalling System No. 7 management functions MRVT, SRVT, CVT and definition of the OMASE-user.*[2]

ITU-T Rec. Q.811(06/97), *Lower Layer Protocol Profiles for the Q3 and X Interfaces.*[2]

ITU-T Rec. Q.812(06/97), *Upper Layer Protocol Profiles for the Q3 and X Interfaces.*[2]

ITU-T Rec. X.701(08/97), *Information Technology — Open Systems Interconnection — Systems Management Overview.*[2]

ITU-T Rec. X.731(01/92), *Information Technology — Open Systems Interconnection — Systems Management: State Management Function.*[2]

2 Requirements upon SS7 Management

There are three main requirements upon the management of SS7 and its network. These may be summarized as:

a) To provide a TMN interface for the network administration[3];

   This requires that the administration-to-OMAP interface be presented using TMN-defined concepts (see T1.116.1-2000).

b) To interwork with other TMN parts to enable the provision of a unified approach for managing the whole Telecommunications Network. Examples of these other parts are the Synchronous Digital Hierarchy (SDH) or the Integrated Services Digital Network (ISDN). These other parts could be

[1] This document is available from the Alliance for Telecommunications Industry Solutions <http://www.atis.org>.
[2] This document is available from the International Telecommunications Union <http://www.itu.int/ITU-T>.
[3] Here, the word "administration" in the term "network administration" refers to the body or bodies (either Administrations or RPOAs) responsible for controlling the SS7 network.

administered by the same body responsible for the MTP network or Tans or other jurisdictions (e.g., when an SCCP network covers more than one MTP network, one jurisdiction might exist for each MTP network).

This means that the OMAP managed objects (see T1.116.1-2000) must be compatible with, and have appropriate attributes defined for interacting with, other Tans- managed objects.

c) To extend, where necessary, the management of the SS7 network as described in functional SS7 standards (e.g., T1.111.3-2001 and T1.111.4-2001 for the MTP or T1.112-2001 for the SCCP), and to amalgamate this with the TMN approach.

   Hence, OMAP should provide for the complete management of the SS7 network. It should provide consistency in approach between the different layers of SS7, and it should provide consistency across the SS7 network and its network elements. SS7 already has certain management defined in T1.111.4-2001, and SCCP management defined in T1.112-2001. These functions provide some automatic fault, configuration and performance management activities. OMAP has taken these functions into account in the definition of the behavior of SS7 managed objects. OMAP also extends the functionality already defined in the MTP recommendations to a complete management service for the whole SS7 network.

2.1 OMAP Layers of Management Functions

The “layers” of management functions define the partitioning of management processes on a hierarchical basis.

The definition of TMN is concerned with five layers in management: namely business management, service management, network management, network element management, and the elements in the network that are managed.

Of these, OMAP currently is not concerned with business management, and interacts with other TMN parts to provide service management. For example, this latter interaction occurs if the addition of ISDN services is required so that subscribers at one exchange can use these services to connect with subscribers at another exchange. The OMAP implementation would be involved in these changes.

The top management level of OMAP is network management, which provides the functions and resources to allow administrations (possibly via a set of administration managed objects) to control the SS7 network. Management functions and resources are provided by OMAP to allow management within the SS7 signalling points. See clause 3 for further information on the OMAP reference model.

The definitions of both network management and network element management functions and resources utilize the TMN and OSI managed object approach, and allow changes to be coordinated within OMAP. Certain managed objects (e.g., signalling link set and linksetNePart) have relations defined between them to allow network actions to be correlated with actions in concerned signalling points.

Relations are also defined between managed objects to allow “management hierarchies” to be satisfied (e.g., to forbid removal of a signalling link set without first removing all its constituent signalling links).

2.2 OMAP Management Categories

The purpose of management is to provide a service. This can be classified as initial provisioning, maintaining existing service, and expansion or contraction of the service.

Management activities can be divided into categories that satisfy one or more of the above classifications.

OSI defines the categories of fault management, configuration management, performance management, accounting management, and security management. Of these, the first three categories are applicable to OMAP, the last two are for further study in OMAP.

2.2.1 Fault Management for OMAP

OMAP fault management encompasses fault detection, location, isolation, and the correction of abnormal operation of the SS7 network. Correction of faults can in some instances require fault diagnosis. Faults can cause the network to fail to meet operational objectives (e.g., visible faults might reduce the network's traffic capacity, latent faults would reduce the network's reliability).

Fault management includes:

- Handling of alarm conditions, e.g., the failure of a signalling link set or the inaccessibility of a signalling point. The MTP provides automatic mechanisms in MTP signalling network management that attempt restoration of normal operation. OMAP network management takes these automatic mechanisms into account, and coordinates attempts by the network operator to handle abnormal situations and to isolate faults within the network. Other levels of SS7 have analogous automatic mechanisms.

  This function includes the required interactions with resources of other TMN parts (e.g., transmission failures causing signalling link failures need to be correlated).

- The activation of measurements or tests. These include certain T1.116.2-2000 defined measurements, and the MTP route verification test. Such actions allow correlation of reports in an attempt to resolve and isolate specific faults. When several signalling points detect similar errors, correlation across the network is useful in determining whether or not a single fault causes these errors, and if so, the location of it.

- Network-wide collection of statistics which could be used by staff in preventive maintenance.

- Statistics collected about network elements that might be used for detection of marginal performance of those elements.

2.2.2 Configuration Management

Configuration management controls the resources of, and collects and provides data for, the signalling network and its components. This facilitates the preparation for, and initialization of, signalling services and allows such services to be started, continued, and stopped.

Two main activities can be distinguished:

- setting the static configuration in the SS7 network (e.g., installing and initializing SS7 components), and

- altering the configuration of the network while it is running, and providing information about its changing state.

The division of effort between the two activities above depends, to some extent, upon the method adopted for installing the network – a network might be nearly fully provisioned at the start, and hence dynamic changes could be limited to preserving existing service; or it could be grown from a small initial provision, and thus initial dynamic configuration changes would consist mainly of those required for growth.

Note that certain activities might require higher security authorization than others (e.g., removing from service the last link set in a routeset).

Such activities require coordination within the network, and might also require activation or de-activation of network components. For example, establishing a new route requires changes to routing tables at several signalling points. these changes require orchestration within OMAP so that all signalling points recognize the route at the same time.

The following OMAP functionality is required:

a) Composition of routing tables at the concerned signalling points, from a routing plan determined by the administration. This routing plan is subject to constraints imposed by relevant SS7 functional standards (e.g., some of the MTP routing constraints are defined in T1.111.4-2001), and by additional constraints determined by the routing policy, network structure, and capacities of the network resources.

b) Verification of routing tables — this is a check for *network consistency*, and is done either by the administration against the routing plan, using “reads” of the routing tables in relevant signalling points, or it is done by performing a Route Verification Test (RVT) as defined in T1.116.3-2000. At present, only MTP and SCCP routing tables can be verified in the latter way. These tests also check all designated physical routes from origin to destination.

c) Installation and initialization of signalling link sets, and links within their defined link sets;

d) Verification of consistency in naming between the two ends of certain network resources. For example, the SLC of a signalling link must be the same at each connected signalling point (an automatic signalling link test is also used in the MTP just before allowing the link into service), and the CIC of a speech circuit must be the same at each end.

e) Initialization of network-wide protocol timers (e.g., MTP restart timers at emergency or normal values) and other protocol functions requiring network consistency;

f) Interaction with resources used by other TMN parts on a network basis (e.g., transmission equipment used in configuring a signalling link).

OMAP provides facilities for the administration to alter the configuration of the network while the network is running. OMAP also provides information on the internal automatic SS7 management activities.

Thus for example, a signalling link might be activated by the administration in an already active link set because of failures of other links in the link set. Such activities must take into account the management hierarchies defined by the OMAP managed objects, and will typically be constrained by the permissible state changes of the managed objects — these changes themselves are defined with respect to the hierarchy.

Dynamic configuration information includes the current use of the network as visible by the administration. Thus, for example, a request for a display of the MTP routing data for a particular signalling relationship might also result in identification of the route currently used in the routeset.

The particular facilities provided are specified by the operations applicable to, and the behavior of, the managed objects defined in T1.116.1-2000.

2.2.3 Performance Management

This enables the behavior of network resources and the effectiveness of communication activities in the network to be evaluated.

Functions to gather statistics, maintain and read logs of the network and system state histories, and to determine network performance under normal and abnormal conditions are provided. Certain system parameters may be altered in order to monitor and change the performance of the network.

Network performance can be optimized by monitoring and managing the network.

Performance management functions include:

a) collection of measurements to enable long and short term control, viz:

   i) alarm monitoring,

   ii) activation of certain T1.116.2-2000 measurements, and

   iii) provision of network information from these measurements regarding resource usage, e.g., route utilization;

b) medium term control of resources, e.g.:

   i) modification of link set capacity (e.g., increasing the number of active links),

   ii) modification of route capacity (e.g., coordinated increase in constituent link set sizes), and

   iii) timer adjustments;

c) real time control of message and traffic flows in the network, e.g.,:

   i) real time adjustment of routing tables (e.g., changing time of day routing),

   ii) activation of additional signalling links or link sets.

3 Reference Model for SS7 Management

3.1 OMAP functional reference model

ITU-T Rec. M.3010 defines five layers of management in a telecommunications network. Figure 1/T1.116.0 (which is derived from clause 5.2.1 of ITU-T Rec. M.3010) shows three layers and the reference points between them.

OMAP provides network management and network element management for the SS7 managed network. The simplified functional reference configuration based on the TMN model shown in figure 1/T1.116.0 below would show SS7 network management as a single rectangle, with network elements located at signalling points.

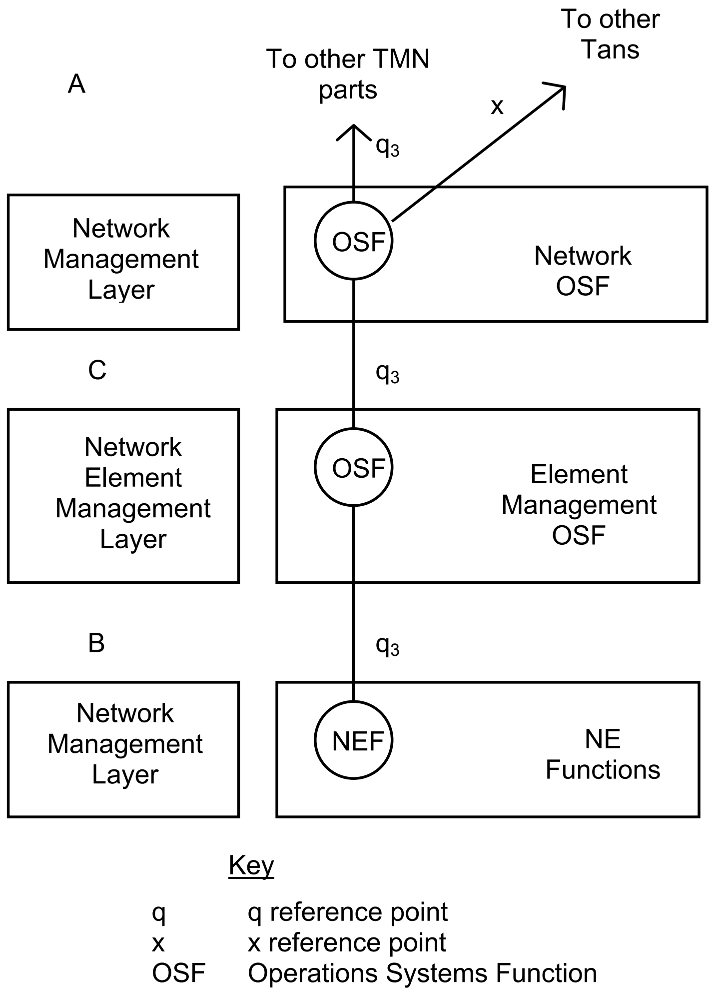


Figure 1/T1.116.0 TMN Functional Reference Model as Applied to SS7 Management

The network management layer could be distributed in an implementation. Any synchronization and orchestration required because of this distribution would be an implementation-dependent matter, and not subject to requirements in T1.116-2000.

Figure 1/T1.116.0 shows three TMN q reference points A, B, and C. These reference points might become interfaces in an implementation of OMAP. Point A is the reference point for SS7 network management, point B is the reference point for SS7 network element management. Point C is also a reference point for SS7 network element management. The view at point C can be the same as that point B, with the understanding that several signalling points could be visible at C.

Network management allows the end-to-end control of managed objects, and ensures network coordination of the managed objects' constituent network element parts. Thus, for example, route management ensures the coordination and orchestration of changes in the routing tables situated in concerned signalling points, while link set management coordinates actions at the link set ends.

Network element management is performed on managed objects that are restricted to one network element (e.g., management of the managed object representing a signalling terminal).

3.1.1 Network Management

OMAP manages the SS7 network. To do this, it coordinates, synchronizes, and orchestrates activities in the network to achieve consistency between signalling points.

Certain items (e.g., signalling link, route, etc.) require information in more than one signalling point (SP). Management (i.e., OMAP) at each SP requires a nodal view to manage the parameters of the item pertinent to one SP (i.e., the item is defined as a network element managed object); but, in addition, the coordination of the separate SP views to form the whole network view of the item is the responsibility of OMAP. Thus, the information pertinent to one SP is given in a “nodal view” of an item, but included in this view must be any information to enable the construction of a network view of the item.

3.1.2 Network Element Management

Certain items requiring management reside entirely within one signalling point (i.e., “node” of the network). For these, OMAP takes a “nodal view” of the item, and will present a nodal view of the associated managed object to the network operator. An example of such an item is a signalling terminal.

3.1.3 Network Element Functions

The SS7 network element functions are located within the signalling points, and comprise, for example, MTP, SCCP and ISDN User Part traffic carrying procedures.

3.1.4 Relationship between Network Management and Network Element Management

Where a network management-defined managed object has terminations in one or more signalling points, network element managed object(s) can be defined to represent these terminations. Relations are then defined between these objects for coordination of management actions.

Thus, the “network view” is given by the network management object, and the “SP view” is given by the network element managed object.

These managed objects form “clusters”, in which part of the cluster consists of network management-defined managed objects, while the other part consists of network element managed objects. This clustering ensures coordination and orchestration of management actions: relations between the managed objects in the network management part and the network element management part define the interactions. An example of such a cluster is the collection “signalling link set” (which is the network management part) and “signalling link set NE part”. Relations defined between these two managed objects ensure that if, for example, a link set is defined, then the appearance of one end of it in one signalling point and the other end in another signalling point are registered. Alternatively, if one end of the link set becomes unavailable, MTP reports from each end are correlated and associated with the network management link set managed object.

3.2 Physical Realization for SS7 Management

Three different example physical realizations are shown in figure 2/T1.116.0 (1, 2, and 3 of 3)

NOTE - In these diagrams, ellipses represent functional entities, rectangles represent physical entities.

a) The first diagram shows the network management functional entity (NMF) resident in one network management center, with the network element management functional entity (NEMF) resident in at least one signalling point, and the network element functional entity (NEF) resident in the signalling points. The q_3 reference point between NMF and NEMF is realized as a Q_3 interface. The q_3 reference point between NEMF and NEF is realized as a Q_3 interface if the NEMF and NEF are in different signalling points.

b) The second diagram shows a single network management center, several network element management centers, and the signalling points containing the NEFs.

c) The last diagram shows the NEMF combined with the NMF in a single network management center.

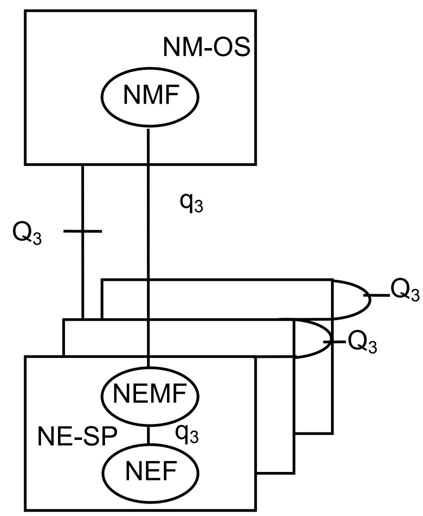


Figure 2/T1.116.0 (1 of 3) Example Physical Realization for SS7 Management

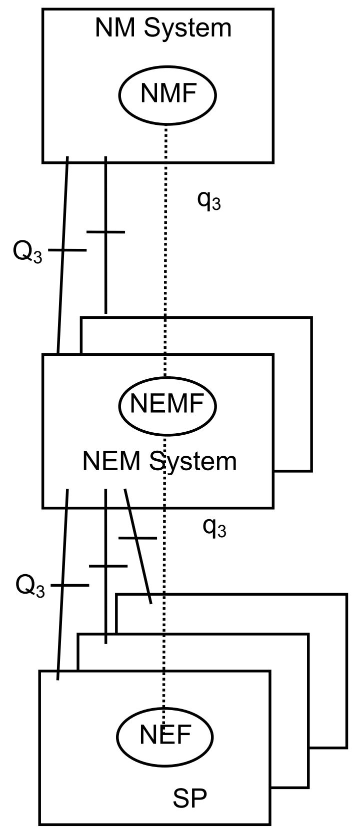


Figure 2/T1.116.0 (2 of 3) **Example Physical Realization for SS7 Management**

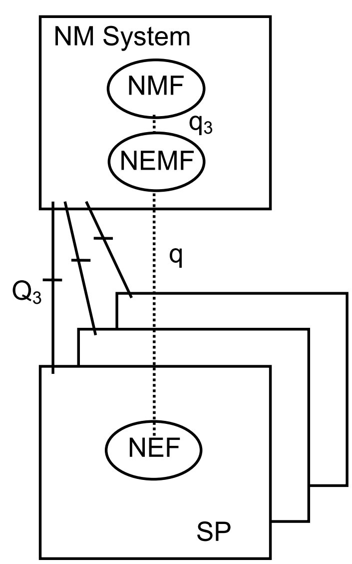


Figure 2/T1.116.0 (3 of 3) **Example Physical Realization for SS7 Management**

3.3 OMAP and the OSI Management Model

3.3.1 OSI States, Resource States, Mappings and Constraints

ITU-T Rec. X.731 defines the OSI state management functions. Each OMAP managed object's "OSI state" (i.e., the state perceived for its management) should be defined as part of the object behavior definition in T1.116.1-2000. If the managed object has a "functional state" defined, then the mapping between functional state and OSI state is also part of the object definition (e.g., T1.111.4-2001 defines the functional states for a signalling link — the mapping between these and the OSI states would be part of the managed object definition). Information descriptions of behavior could use text; SDL might be used for a more formal description.

The management hierarchies within which SS7 resources are active constrain the state changes of managed objects. For example, a manual request to take a signalling link out of service might be refused if this means that its "owning" link set then goes out of service, and thereby a destination becomes inaccessible.

OSI management also defines log control functions and alarm reporting. The former enables certain measurements to be collected; the latter allows notification of urgent events. Each managed object's definition provides, where appropriate, for interaction with these functions, and managed objects are defined for their control.

Discriminator functions are also defined in OSI to enable reports to be made or measurements to be collected only if a threshold is exceeded.

3.3.2 Managed Object Model

OSI systems management (see ITU-T Rec. X.701 for example) defines a model of management, and this model is employed in OMAP. The model is used for most of the OMAP managed objects. Figure 4/T1.116.0 shows this model.

Communication in the SS7 network can occur between resources represented by this type of managed object. Any such communication is invisible to the administration; it is defined in the resources' functional standards (e.g., T1.111.3-2001 and T1.111.4-2001 for MTP resources), and not by OMAP. If synchronization is required in the TMN for network management managed objects of this type, then OMAP relationships are defined between these managed objects and the appropriate network element managed objects.

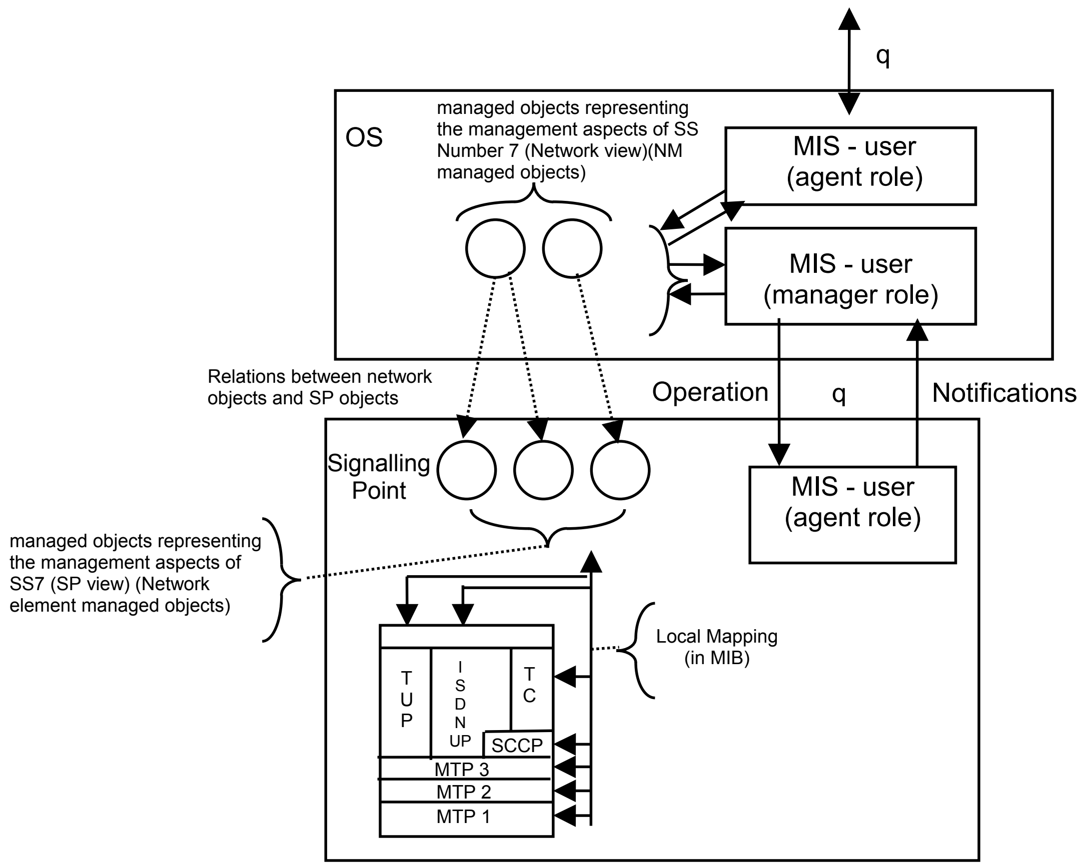
For other OMAP managed objects (e.g., MRVT), the model is modified. Figure 4/T1.116.0 shows this modified model. Here, the object is spread over more than one signalling point, but in non-failure operation, the originating signalling is the only one at which the object interacts with the administration. The coordination, communication, and synchronization of activities between signalling points occurs as an internal function of the object, and is defined in OMAP. Explicit relationships between network management managed objects and network element managed objects are not required to enable synchronization.

3.3.2.1 Classical OMAP Managed Object Model

ITU-T Rec. X.701 defines management in terms of an MIS user in a manager role governing the behavior of an MIS user in an agent role.

This model is the preferred one for SS7 management managed objects, except where the object is an abstraction of a test of the SS7 network itself.

The way OMAP uses the model is represented in figure 3/T1.116.0.



Key:
MIS: Management Information Service

Figure 3/ T1.116.0 Classical OMAP Managed Objects Model

A typical managed object in the network view is a signalling link set. Operations performed on an instance might result in operations being performed upon two instances of the managed object signalling link set NE part, one instance being in one signalling SP, the other being in another SP.

In some cases, e.g., for scheduled management activities, the MIS-user (manager role) operates autonomously in the OS, handling the network management aspects.

The managed object class definitions are an *abstraction* of the properties of the items defined in the functional standard. Thus, for example, those items defined in T1.111.4-2001 (e.g., signalling link, link set, etc.) representing resources which interact with “management” are *represented* as managed objects either on the network element management reference point or on the network management reference point. The properties of the items shown interacting with management by e.g., T1.111.4-2001, given in the initial entity-relationship diagrams in T1.116.1-2000, are abstracted to provide entity-relationship diagrams showing containment and naming relationships.

3.3.2.2 OMAP Managed Objects using Internal Communication

Here, certain managed objects (e.g., MRVT) are defined to allow the network operator control, but communication is required within the SS7 network between signalling points to correlate actions. From the administration’s perspective, the managed object is simple, and an instance can be started from one signalling point, but the SS7 resource represented in the MIB spans more than one signalling point. Conceptually, for example, there is an MRVT instance for every signalling relationship in every signalling point in the network. Figure 4/T1.116.0 below shows this.

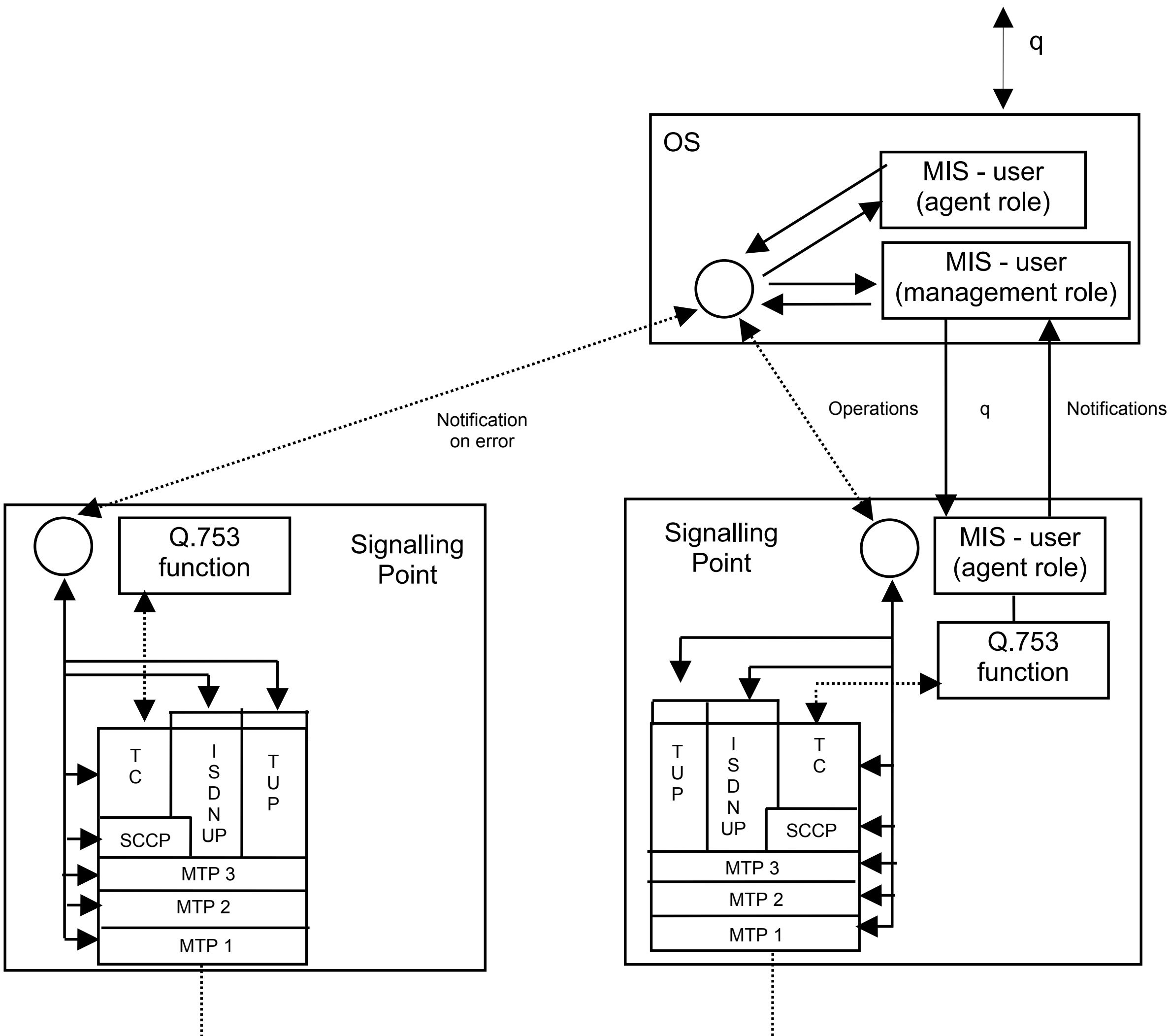


Figure 4/T1.116.0 Managed Objects using Internal Communication

Note that the internal communication in the SS7 network employed by these objects is part of their behavior

Examples of such managed objects are the MTP routing verification test (MRVT), SCCP routing verification test (SRVT) and circuit validation test (CVT). See T1.116.3-2000 for their definition. The MRVT, CVT and SRVT use the “short stack”, with ASEs defined for use with TC for communication over the SS7 network. The protocol profile is defined in 4 below.

Other examples of such objects are the MTP Tester (MT) and the SCCP Tester (ST) (see T1.116.5-2000). The Tester-managed objects use just the SS7 levels that are being tested, with support from any underlying levels, for communication.

3.4 SS7 Managed Objects and SS7 Structure

OMAP manages the SS7 network. The definition of this function uses a management model (see e.g., ITU-T Rec. X.701) which contains a *Management Information Base* (MIB), through which OMAP exerts control over the items requiring management in each level of SS7. Each level possesses a *Layer Management Entity* (LME) in which these items (conceptually) reside. OMAP at a signalling point can thus control items in the local LMEs via the local MIB. Each level of SS7 has managed objects defined to allow administrative control and monitoring. Certain managed objects span more than one level or more than one vertical functional division (e.g., a signalling point). Some objects (e.g., signalling terminal) are particular to just one signalling point, and are therefore network element managed objects. Other objects span more than one SP, and, consequently, are defined as network management managed objects. An example of the latter is a signalling link set.

Managed objects have relations defined between them to allow coordinated and orchestrated management. Coordination is required, for example, when defining a route; each signalling point and link set in the route has to be identified and primed; each link in each link set might be affected. In addition, the termination points of the managed objects need to be synchronized.

In its management, OMAP takes an “OMAP view” of the items presented for management by the other layers of SS7. OMAP defines the rules which pertain between items managed in the SS7 network, where these items span or affect more than one layer of SS7 (e.g., a routeset defined in the MTP might affect circuits connected between the signalling end points, where these circuits are controlled by TUP or ISDN-UP, and OMAP must coordinate the UP and the MTP).

Figure 5/T1.116.0 shows both the functional relationships between the different levels of SS7 for management, and the internal configuration model of the signalling point.

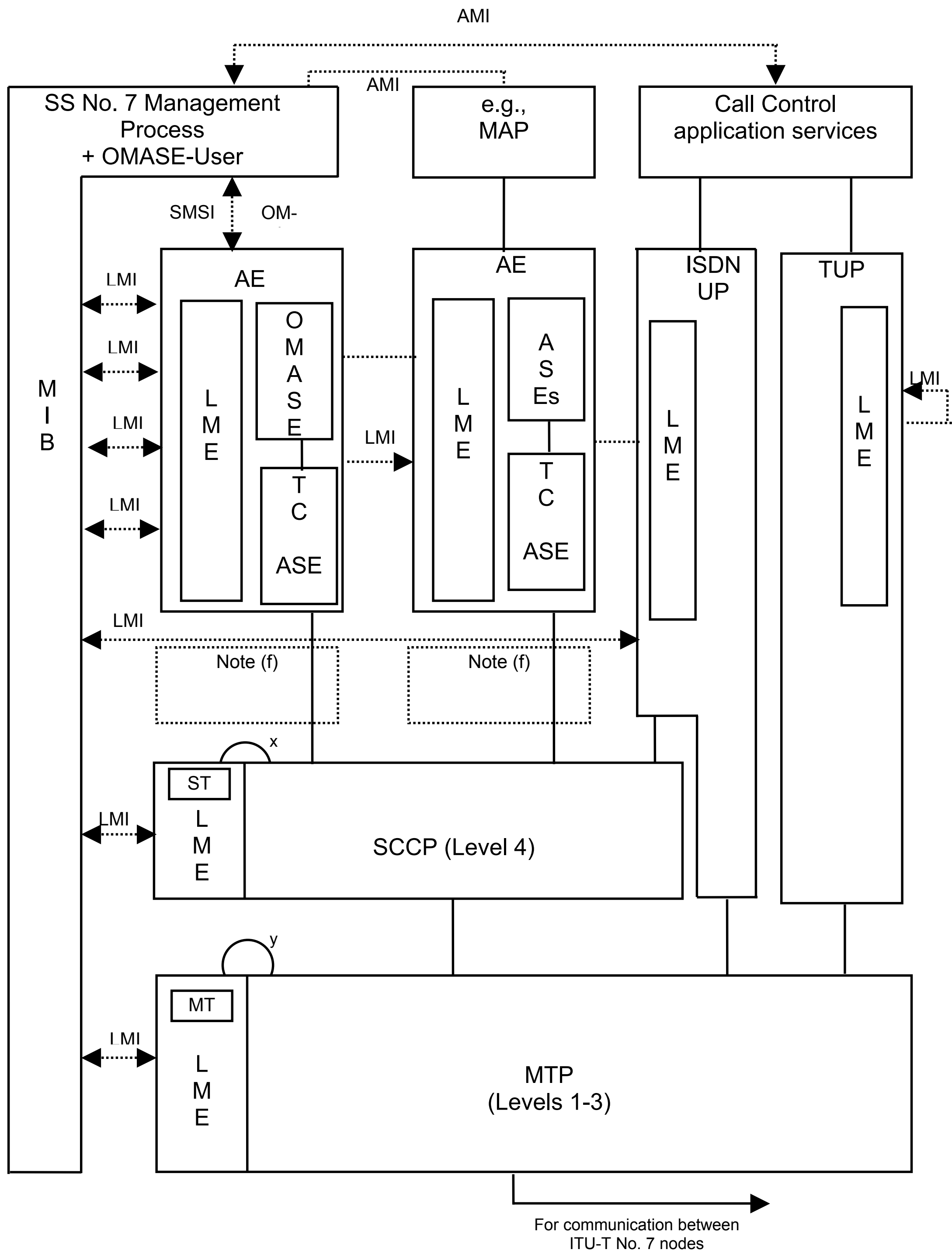


Figure 5/T1.116.0. **SS7 Management and Internal Configuration of an SP**

NOTES (for figure 5/T1.116.0):

a) Dotted lines (but not boxes) denote direct management interfaces. Only the SMSI (see below) is realized with primitives.

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

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

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

e) The SMSI is the systems management service interface. The OM primitives are defined for use over it for managed object functions defined in T1.116.6-2000.

f) OSI layers 4, 5, and 6 are null in SS7. TC forms the bottom of OSI layer 7, SCCP the top of OSI layer 3 (but in SS7 layer 4).

g) Interface x uses subsystem number to test the SCCP using the SCCP Tester (ST); interface y uses SIO to test the MTP using the MTP Tester (MT).

h) The LME (Level Management Entity) is defined for management of and within each level of SS7. This is conceptually where each managed item resides as far as the level is concerned.

4 Communication Profiles for Management Interfaces

For those managed objects defined in T1.116.1-2000, management communication is effected using the Q_3 interface. Figure 3/Q.811, ITU-T Rec. Q.811, defines the lower layer parts of the protocol stack, while figure 2/Q.812, ITU-T Rec. Q.812, defines the upper layer parts. Note that the stack using MTP and SCCP is for further study. The upper SCCP interface would need to supply an NSAP addressing mechanism for the stack to be used for the Q_3 interface.

Communication using the SS7 network for the functions defined in T1.116.3-2000 and T1.116.4-2000 of certain managed objects (e.g., MRVT, SRVT, CVT), uses the protocol profile defined in figure 6/T1.116.0.

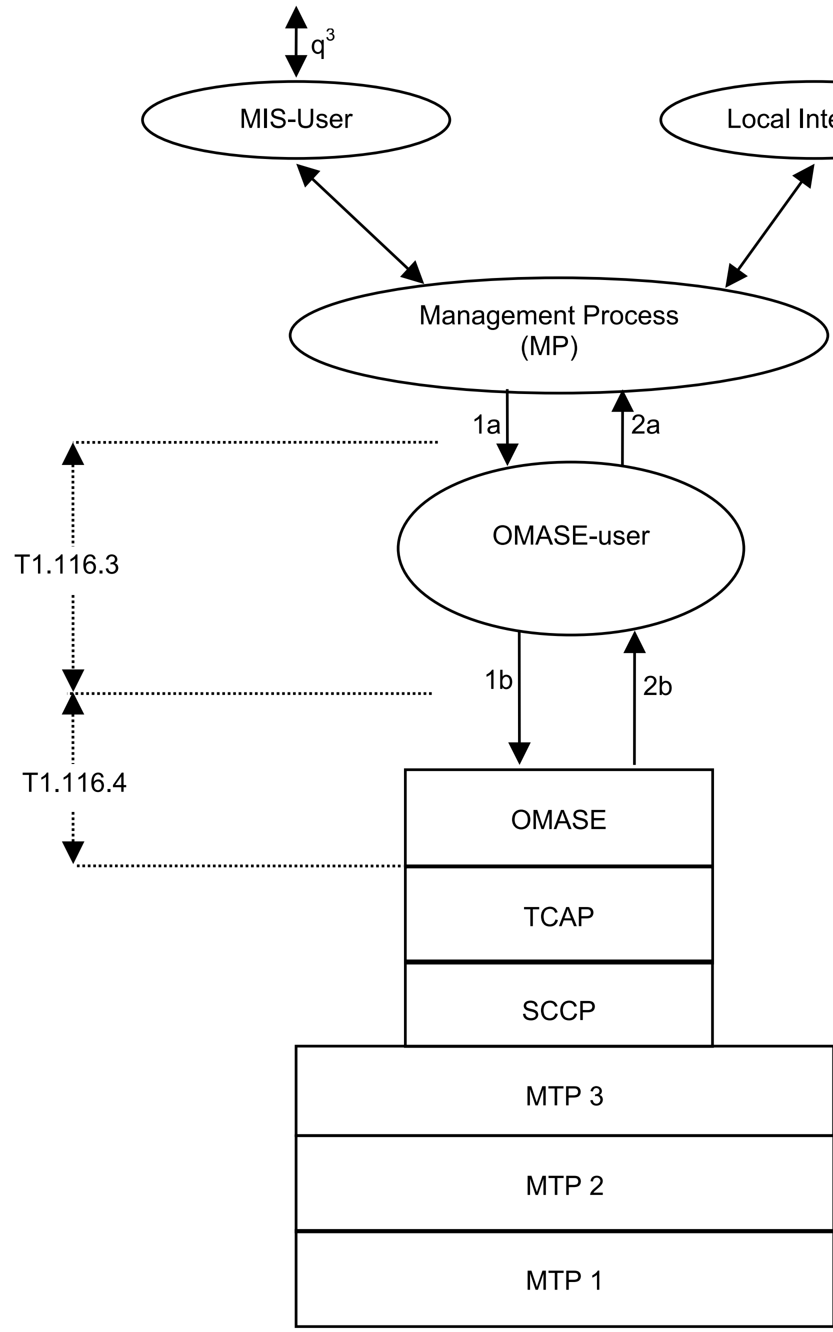


Figure 6/T1.116.0 Short Stack used for Internal SS7 Management Protocol

See T1.116.3-2000 for the mapping of the primitives between interfaces “a” and “b”.

5 Methodology

The three-stage description technique has been applied for the management functions defined in T1.116.3-2000 and T1.116.4-2000. Stage 1 is an informal text description of the properties and behavior of such managed objects, and is documented in T1.116.3-2000. Stage 2 is a description of the information flow, and is informally described in T1.116.3-2000, more formally in T1.116.4-2000. Stage 3 is a formal description of information flow, and uses ASN.1 and ASE definitions. These are documented in T1.116.4-2000.

For the managed objects, the methodology adopted is that described in the Annex of T1.116.1-2000. The behavior of a managed object is currently defined in text. This definition also includes constraints to be satisfied by the object for satisfactory operation in the network. A formal description of these properties will be provided when an appropriate technique is approved (e.g., the routing rules for the MTP imply constraints upon routesets, routes (capacity, connectivity, number of “hops”, circularity avoidance, etc.), link sets and links within link sets).

6 Compatibility and Handling of Unrecognized Information

6.1 Backwards Compatibility

6.1.1 T1.116 and the Present OMAP

- Detailed changes, e.g., measurement 2.15 is now a count of LSSU SIBs sent during a 5-minute period, rather than a measurement of the busy duration in this period.

6.1.2 SS7 Network without TMN

TMN will possess the capability of filtering reports, so that human-readable output can be kept at a manageable level. Where a TMN-OS is interposed between an implementation of SS7 and the human-machine interface, the SS7 network could output high volumes of measurements. T1.116.2-2000 takes this into account.

Current implementations of SS7 limit the output to human-machine interfaces in a variety of ways. The intent is to limit the volume according to the output medium.

6.1.3 Existing SS7 Networks and their Evolution to using TMN

To interconnect existing SS7 networks into a TMN-OS, the following possibilities are recommended:

6.1.3.1 Q-Adaptation Function

A TMN-defined Q-Adaptation Function may be implemented for each signalling point, possibly located within a device separate from the signalling point.

6.1.3.2 Limitations upon the Output to the TMN-OS

Certain provisions of T1.116.2-2000 might not be satisfied when using a Q-Adaptation function. For example, where T1.116.2-2000 now recommends a 5-minute measurement interval, and ITU-T Rec. Q.752 recommends 30-minutes, signalling points implemented to ITU-T Rec. Q.752 might not be able to follow T1.116.2-2000 without modification, and the Q-Adaptation Function could not provide the interval conversion. The TMN-OS should be flexible enough to accommodate this.

6.2 Compatibility within OMAP Communication Protocols

6.2.1 Handling of Unrecognized Messages

Any unrecognized messages shall be discarded.

6.2.2 Handling of Unsupported or Unrecognized Parameters

When an unsupported optional parameter is detected by OMAP, the parameter value shall be passed on transparently. Any unrecognized parameter within a message shall be ignored and passed on transparently.

6.2.3 Handling of Unrecognized Parameter Values

The handling of a recognized parameter with an unsupported or unrecognized value shall be implementation dependent.

6.2.4 Treatment of Spare Fields

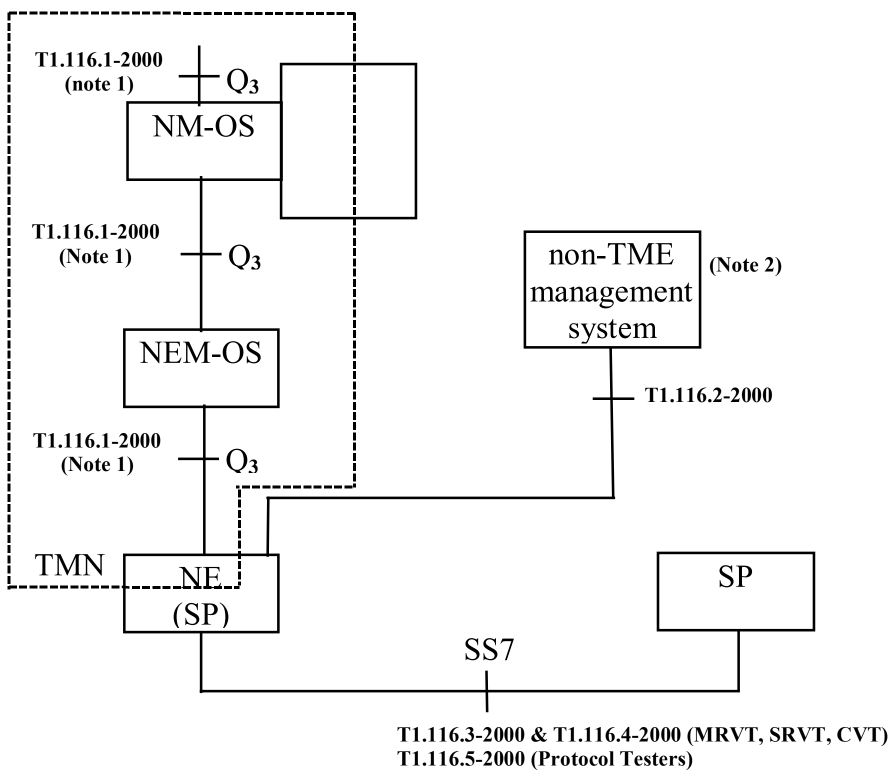
OMAP shall handle spare fields in OMAP messages in the following manner:

- Spare fields or subfields are set to zero on message creation.
- Spare fields or subfields are examined neither at intermediate nodes nor at destination nodes.
- Spare fields or subfields shall remain unchanged at signalling points.

Annex A
(informative)

A OMAP ITU-T Recommendations and ANSI Standards for the SS7 Network

This annex contains figure A-1/T1.116.0, showing the OMAP standards that apply to the TMN and SS7 interfaces used for management of the SS7 network. Note that the SS7 interface is used for functions that test the SS7 network, and messages flowing across it are part of the behavior of the respective managed objects.



Key:

NM-OS	Network Management Operations System
NEM-OS	Network Element Management OS
NE	Network element
SP	Signalling Point
------	Within this line is the TMN domain

NOTES:
1. T1.116.1 references T1.116.2 for measurements
2. This is an implementation dependent system.

Figure A1/T1.116.0 TMN, SS7 Management and OMAP Standards

Chapter T1.116.1

Network Element Management Information Models

American National Standard for Telecommunications —

Signalling System Number 7 (SS7) – Network Element Management Information Models

1 Scope

This chapter is currently under study by Working Group T1S1.3.

2 Normative References

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

ITU-T Rec. Q.751.1(10/95), Network Element Information Model for the Message Transfer Part (MTP).[1]

ITU-T Rec. Q.751.2(06/97), Network Element Information Model for Signalling Connection Control Part.[1]

ITU-T Rec. Q.751.3(09/97), Network Element Information Model for MTP Accounting.[1]

[1] This document is available from the International Telecommunications Union <http://www.itu.int/ITU-T>.

Chapter T1.116.2

Monitoring and Measurements for Signalling System Number 7 Networks

Monitoring and Measurements for Signalling System Number 7 Networks

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American National Standard for Telecommunications —

Signalling System Number 7 (SS7) – Monitoring and Measurements for Signalling System Number 7 Networks

1 Introduction

1.1 Principles and Scope

In order to manage effectively the resources provided by a SS7 network, it is necessary to monitor and measure the present, and estimate the future performance, utilization, and availability of these resources. Following are the principles and scope of this Chapter.

- Measurements made on the signalling network resources are known as “raw” or primitive measurements and, in general, only these measurements are identified in this Chapter.
- The recommended primitive measurements and, at times, other derived measurements, whose computation using the primitive measurements is described, are those required for the effective management of the signalling network resources.
- A basic subset (marked as “obligatory” in the tables at the end of this chapter) of signalling network measurements is recommended for international networks, but it is intended that this subset also be useful for national networks which, however, may need additional measurements.
- Monitoring and measuring are considered to be passive processes, and although the results of monitoring and measuring may be used to invoke test and maintenance actions and procedures, it is left to other Chapters, e.g. T1.116.3-2000, to provide details of such actions and procedures.
- T1.116.2-2000 is not intended to provide signalling network testing and maintenance procedures; it is left to other standards to provide such procedures, e.g. T1.111.7-2001, T1.116.3-2000, etc.
- T1.116.2-2000 does not describe any filtering techniques to be applied after measurements are taken (apart from the "first and interval" (1st & Δ) method to reduce the number of output reports). ITU-T Recommendations in the Q.820 series define filtering techniques useful for control of the SS7 network.

The measurements defined in this Chapter are intended to be controlled through the use of the operations, maintenance, and administration part defined in T1.116.0-2000 through T1.116.5-2000. T1.116.1-2000 defines the functions needed to initiate and stop the measurements and the procedures to handle the transfer of data after collection.

1.2 Network View

1.2.1 The signalling network measurements can provide both a local and a global network view of the performance of the signalling network. The primitive measurements which provide the two views are not necessarily different. Rather, the global view is a result of a summary of measurements from more than a single signalling point (SP) so that the behavior of the network is centrally observable. A global view of the performance of the signalling network, in general, becomes more useful as the network becomes larger (i.e. more signalling points or multiple users).

1.3 Guidelines for uses of Measurements

1.3.1 The measurements may be used singly, or in conjunction with other measurements. It is not the intent of the Chapter to specify the computations and algorithms to be applied to the primitive measurements. Guidelines, however, are provided (see clause 6) for some uses of measurements so that, for example, the views at both ends of an international link are consistent.

1.4 Grouping of Measurements

1.4.1 Each primitive measurement is classified for the purpose of guidance into one or more categories called fault management (F), configuration management (C), performance management (P), accounting management (A), and network administration and planning (N). Some of these measurements are also for near-real-time use (R).

1.4.2 A tabular listing of the primitive measurements according to the managed object being measured is provided (see clauses 2 - 5). The tabular listing of the primitive measurements includes, for each measurement, an indication of the appropriate categories and reference to the pertinent Chapters.

1.5 Collection of Measurements

T1.116.1-2000 contains a description of the operations that may be performed upon measurement managed objects. ITU-T Recommendations X.733, X.734, X.735, and X.738 contain descriptions of the requirements for measurement collection.

1.6 Definition of Terms

The classification categories below indicate the general area of use of the measurement; the first four correspond to the respective OSI management categories (see for example 2.2/T1.116.0-2000).

The distinction between categories is not always sharp, for example, a fault measurement may cause the network administration to decide to change the configuration, and measurements may be taken to see if the change had the desired results. The category of the latter measurement might be F or C.

1.6.1 fault (F): This category utilizes on occurrence events and measurements, 5 minute and “1st & Δ” measurements (see 1.7.1.7) to report and detect faults, and to monitor the signalling network response to abnormal conditions.

Measurements made for this purpose are usually for use in near-real time, but resources performing to “just acceptable” limits might require long measurement intervals.

1.6.2 configuration (C): This category is used for dynamic configuration changes associated with faults or administrative action. The measurements are usually for use in near-real time.

1.6.3 performance (P): This category is used for near-real time, medium term, and long term control.

The purpose is to sustain network performance over both the short and long term.

1.6.4 accounting (A): This category is for further study, in particular with respect to the reliability requirements for collection and storage of data, and in the security requirements for access to it.

However, certain measurements (see Table 6), could be useful for STP accounting purposes.

1.6.5 network planning and administration (N):. This category involves measurements that are used on a long-term basis and are in general retained external to the signalling network resources.

The activities include planning and dimensioning (engineering) the signalling network resources, including determination of the resource quantities, e.g., number of link sets, and resource configuration, e.g., routing.

1.6.6 near real time measurements (R): This classification is applied in addition to the categories defined above for those measurements which are for use in near real time. Usually it is applied to those measurements which are marked as “on occurrence”, or “1st & Δ”, or “5-minute” duration. These measurements include for TMN all of the alarms pertinent to the SS7 network, and these might require immediate reaction.

1.7 Listing of Measurements

1.7.1 General

1.7.1.1 The recommended measurements are presented in the tables. Explanatory notes relating to the contents of these tables are given below.

1.7.1.2 The Obl. (for Obligatory) column is used to indicate those measurements which must be provided. The additional Act./Perm. column indicates whether these measurements are activated on demand, or permanently active, respectively. In non-obligatory cases, if the measurement is provided, the network operator must also decide whether the measurement will be activated on demand or be permanently active. Some non-obligatory measurements are marked “perm.” or “act.”, this is just for guidance.

1.7.1.3 The Usage column indicates which categories apply to each measurement.

1.7.1.4 The From column indicates, for a measurement which is not basic, from which other measurements it might be derived.

1.7.1.5 The count items in the tables, identified in the Units column as “event/SP”, “muss/SL”, etc., imply the total count of items in the specified period, and implicitly indicate the identity of what is being counted, i.e., “event/SP” identifies the Signalling Point, “muss/SL” identifies the Signalling Link, etc. The identity of the network element where the measurement is made is also included in the report.

1.7.1.6 The event items in the tables, that are recorded “on occurrence”, are intended to be recorded with a time stamp, giving the unique network time when the event indicator was generated. The resolution and accuracy of the time stamp should be as high as possible to increase the ability to resolve complex and rapid sequences of events.

1.7.1.7 Many of the event items in the tables, which were defined in the *ITU Blue Book* to be recorded “on occurrence”, are now to be recorded as “1st & Δ” in order to avoid occasional massive outputs. Relevant measurements in the tables for SCCP, TC and ISUP are handled in the same way.

These events are expected to occur infrequently; they might indicate failures or loss of quality, but their exact numbers are not of interest.

The first event occurring is reported immediately to the external management system (e.g. TMN-OS) with a time stamp. Following events within the interval which are related to the measurement are counted. At the end of the interval the count is output, by the TMN-OS if the counting is done there, or to the external management system if not. The count is then set to zero.

The “1st & Δ” measurements can be permanent or activated.

1.7.2 Intervals for Measurements

For each type of measurement interval ("5-min.", "15-min.", "30-min." or "1st & interval" – shown as "1st & Δ") in the "duration" column, time is divided into a sequence of equal length consecutive intervals, independent of any events.

The "1st & Δ" measurements use an already-running clock/timer the first event in the interval is associated with that interval, and is reported. The first event plus any successive events are counted, and this count is reported at the end of the interval in which it was made.

For cooperation with a TMN-OS, the future target will be 5-minute intervals for:

- the events measured as "1st & Δ";
- those other measurements for near-real-time use indicated with "R" in the Usage column.

For traffic measurements, the future target interval is 15 minutes.

1.8 Techniques for Filtering Measurements

1.8.1 Single Faults Giving Rise to Multiple Error Reports

Where a single fault could cause recurring event reports (e.g. a single MTP routing data corruption could result in many Muss being discarded), the "1st & Δ" measurement technique can be used. The initial report should contain enough information to establish the location of the fault; the interval count will then indicate its severity. The interval should be short enough to allow real-time control. This technique presents information essential to the maintenance staff and filters out that which is redundant.

1.9 Normative References

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

T1.111-2001, *Signalling System No. 7, Message Transfer Part (MTP).*[1]

T1.112-2001, *Signalling System No. 7, Connection Control Part Functional Description.*[1]

T1.113-2000, *Signalling System No. 7, ISDN User Part.*[1]

T1.114-2000, *Signalling System No. 7 (SS7), Transaction Capabilities Application Part (TCAP).*[1]

ITU-T Rec. X.733(02/92), *Information technology — Open Systems Interconnection — Systems Management: Alarm reporting function.*[2]

ITU-T Rec. X.734(09/92), *Information technology — Open Systems Interconnection — Systems Management: Event report management function.*[2]

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[1] This document is available from the Alliance for Telecommunications Industry Solutions <http://www.atis.org>.
[2] This document is available from the International Telecommunications Union. < http://www.itu.int/ITU-T/>.

ITU-T Rec. X.735(09/92), *Information technology — Open Systems Interconnection — Systems Management: Log control function.*[2]

ITU-T Rec. X.738(11/93), *Information technology — Open Systems Interconnection — Systems management: Summarization function.*[2]

2 MTP Monitoring and Measurements

2.1 General

Signalling link faults and performance, availability, and utilization indicators are detailed in Tables 1, 2, and 3, respectively. These relate to the MTP managed objects signalling link and signalling link NE part.[3]

Signalling linkset and routeset availability indicators are detailed in Table 4. These relate to the MTP managed objects signalling linkset, signalling linkset NE part, signalling routeset and signalling routeset NE part.[3]

Table 5 details the signalling point status (adjacent SP accessibility, routing performance, and MTP User Part availability) indicators. These relate to the MTP managed objects signalling point and MTP User.

Table 6 defines the Signalling Route utilization indicators. These relate to the MTP managed objects signalling route and signalling linkset NE part.[3]

2.2 Table 1

The following comments give the most probable failure reasons. In some cases, other reasons might apply. The comparison of several measurements might give additional information.

2.2.1 Item 1.1 could be derived from 1.2 and 1.12.

2.2.2 The measurement of signalling link (SL) failure is recommended (see Item 1.2). However, the specific cause for the failure (see Items 1.3 through 1.6) is an additional non-obligatory measurement.

- Item 1.3 indicates complex failures in transmission, an intermittent hardware fault, or even a design error.
- Item 1.4 may indicate serious disturbance or an interruption of the signalling data link (SDL).
- Item 1.5 indicates a “noisy” link.
- Item 1.6 may indicate serious congestion at the remote end of the signalling link.
- Item 1.7 indicates a signalling data link fault which prevents the SDL moving into service.
- Item 1.8 indicates the incoming message error rate.
- Item 1.9 indicates the outgoing message error rate.
- Items 1.10 and 1.11 can be deduced from measurements 1.2 and 1.12.

[3] “NE part” denotes that this is, for example, one end of a signalling link or linkset.

- Items 1.2 and 1.12 are used to update the status of a link. They are “event reports” in OSI management.

2.2.3 The measurement of “number of Signal Units received in error” (see Item 1.8) contains the number of items (not necessarily the number of Signal Units sent) between what are perceived as “Flags,” plus the number of sets of 16 octets received in the “octet counting” mode.

2.3 Table 2

2.3.1 Item 2.1 could be derived from other measurements.

2.3.2 Items 2.5 and 2.6 could be derived from more basic measurements which are the start and end of inhibition.

Item 2.7 could be derived from measurements 1.2 and 1.12.

Item 2.9 could be derived from measurements 2.10 and 2.11.

2.3.3 Items 2.10 and 2.11 (start and end, respectively, of remote processor outage) can be used to deduce Item 2.9. They indicate a problem and its cessation at the other end of the link; this problem could be one between level 2 and level 3.

2.3.4 Items 2.13 and 2.14 can be derived from measurements 2.16 and 2.17.

2.3.5 Item 2.15 is a “local busy” measurement. “Local busy” is defined as a period in which “busy” link status signal units (LSSU SIB) are transmitted.

2.3.6 Items 2.16 through 2.19 inclusive are basic measurements from which items 2.5, 2.6, 2.13 and 2.14 can be deduced.

2.4 Table 3

2.4.1 Items 3.1 through 3.5, inclusive, enable the link occupancy to be determined. The “wasted” occupancy due to retransmissions can also be assessed. The average message length can be calculated.

2.4.2 The number of SIF and SIO octets transmitted (see Item 3.1) does not include SIF and SIO octets which are retransmitted.

2.4.3 The opening flag and the check bits are included in Item 3.2.

2.4.4 The number of message signal units transmitted (see Item 3.3) does not include message signal units which are retransmitted.

2.4.5 The number of muss received (see Item 3.5) consists of all muss that are passed to level 3 for processing.

2.4.6 The signalling link congestion (see Item 3.6) refers to link status “congested” at Level 3. A link is marked at Level 3 as congested when a congestion threshold is reached at the transmit side (see 3.6/T1.111.4-2001 on Signalling Network Congestion and clause 11/T1.111.4-2001 on Signalling Traffic Flow Control). Measurements should be kept for thresholds 1, 2, and 3 separately if that national option is selected.

NOTE – The reporting of this item on occurrence should be considered carefully, since there might be many events in a short interval. This might occur for example if the congestion onset and abatement thresholds were close together, or if the transmission/retransmission buffer size were significantly greater than the reception buffer at the other end of the link, and congestion occurred.

2.4.7 Item 3.7, cumulative duration of SL congestion, is kept separately per threshold. The durations are measured on a non-overlapping basis. For example, for the national option of multiple congestion levels with message priorities (see 2.3.5 and 3.8.2 of T1.111.4-2001), if a signalling link which has already exceeded congestion onset threshold 1 becomes more congested and exceeds congestion onset threshold 2, the congestion duration measurement for threshold 1 is suspended and the congestion duration measurement for threshold 2 begins (or resumes). If the signalling link becomes less congested and falls below congestion abatement threshold 2, the congestion duration measurement for threshold 2 is suspended, and the congestion duration measurement for threshold 1 is resumed.

2.4.8 Item 3.9 (stop of SL congestion) occurs for a link at level 3 when the buffer occupancy has dropped below the congestion abatement threshold. If a number of thresholds is used, the event is marked separately for each threshold. See also the Note to 2.4.6.

2.4.9 Item 3.10 is the number of muss discarded due to signalling link congestion. The significance and method of measuring this item depends upon the method of congestion handling employed in the network. The three congestion handling methods are:

a) single congestion level without priority (see 2.3.5.1/T1.111.4-2001 international method and 3.8.2/T1.111.4-1996);

b) national option of multiple levels without message priorities (see 3.8.2.3/T1.111.4-2001); or

c) the national option of multiple congestion levels with message priorities (see 2.3.5 and 3.8.2 of T1.111.4-2001.

For cases a) and b), messages are discarded by the MTP only under extreme overload. Thus the count indicates, if greater than zero, an extreme congestion. It indicates the effectiveness of the flow control procedures. For case c), messages with priority less than the discard level are discarded in the MTP. For this case, the muss discarded due to SL congestion (thresholds 1, 2, and 3 separately) are counted based on the greatest congestion discard threshold in effect on the link. For example, if the congestion of a link has exceeded congestion discard threshold 2, and therefore muss with priority 0 and 1 are being discarded, a MSU discarded with priority 0 is counted in the threshold 2 count.

2.4.10 Item 3.11 is kept per congestion level. For the national option of multiple congestion levels with message priorities, a congestion event which may result in the loss of muss for threshold n begins when congestion discard threshold n is exceeded. A new congestion event which may result in the loss of muss for threshold n cannot begin until the congestion level falls below congestion abatement threshold n. Only one congestion event which may result in the loss of muss can be in effect at one time, this being the greatest numbered threshold. Therefore, the congestion event which may result in the loss of muss for threshold n is suspended (not stopped) when congestion discard threshold $n + 1$ is exceeded, and resumed (not a new one started) when the congestion level falls below congestion abatement threshold $n + 1$.

2.5 Table 4

2.5.1 Item 4.2 is not a basic measurement. It can be derived from Items 4.3 and 4.4.

2.5.2 Item 4.5 – TFPs should be broadcast by an STP each time a destination becomes unavailable for this STP. Item 4.5 is measured when the destination becomes unavailable because of failure of a linkset connected to the STP.

2.5.3 Item 4.6 – TFAs should be broadcast by an STP whenever a destination becomes available for this STP. Item 4.6 is measured when the destination becomes available due to the recovery of a linkset connected to the STP.

2.5.4 Items 4.9 and 4.10 can be derived from 4.11 and 4.12. They are not basic measurements. They are obligatory however in international networks.

2.5.5 Measurements 4.11 and 4.12 are required at Signalling Points in international networks if measurements 5.1 and 5.4 throughout the network are not available to a network operator. In other networks, measurements 5.1 and 5.4 at consecutive Signalling Points on all routes from origin to destination of a routeset might be used to derive measurements 4.11 and 4.12, consequently real time collection of the latter may not be necessary. It should be noted in this that a routeset can become unavailable (depending upon network topology and routing rules) even though all adjacent SPs are accessible.

2.5.6 Measurements 4.5 and 4.6 could only be required at Signalling Transfer Points.

2.5.7 Item 4.13 is a record of failures and recoveries (and all other availabilities and unavailabilities) of a linkset. The identity of the new linkset used (if any), and the old linkset used (if any), are included, as well as the identity of the adjacent SP.

2.7 Table 6

2.7.1 These measurements are needed on a per linkset basis.

2.7.2 Activation of the measurements in Table 6 is recommended on a per Point Code (PC) or set of Point Codes and/or Service Information Octet (SIO) basis. The measurements are not obligatory. They may be used to diagnose focused signalling overloads.

2.7.3 Some of the measurements in Table 6 may be of interest for accounting purposes. The reliability requirements for their collection and retention are for further study.

2.7.4 Items 6.1 through 6.5 could be derived from item 6.6. It should be possible, potentially by activating just a few combinations of OPC, DPC and SIO at a time, to cover any combination that might be applicable for the network in the node in which the measurements are being performed.

Note that these measurements do not specify where they are to be taken, nor do they state what should collect them (e.g. an external monitoring device connected to the signalling links concerned).

Item 6.6 enables the signalling traffic octet dispersion to be measured; 6.7 measures the message dispersion. The effect on the signalling point and network performance should be considered when taking these measurements.

3 SCCP Monitoring and Measurements

3.1 General

The SCCP error performance indicators are detailed in Table 7.

Table 8 details the SCCP and subsystem availability indicators.

Table 9 describes the SCCP utilization indicators.

Table 9 *bis* describes the SCCP quality of service measurements.

Note that internal messages (i.e. those whose source and sink are in the same node) are also counted.

3.2 Table 7

3.2.1 Routing failure measurements (Items 7.1 through 7.7 and 7.9) refer to all possible failures (both local and remote) detected by SCCP Routing Control, and count all SCCP messages which encounter transport problems, regardless of whether or not a (X)Unitdata Service message or N-NOTICE primitive is returned to the originator. Receipt of a (X)Unitdata Service message is not included in this count.

All of these measurements are marked as “1st & ∆”. They enable SCCP routing failures to be identified.

The measurements are also marked as "30 minutes" for network dimensioning and reliability studies.

The reassembly error measurements (Items 7.10 through 7.12) are prescribed for the SCCP connectionless reassembly service. Item 7.12 (no reassembly space) indicates a resource limitation when the first segment of a sequence is received.

Item 7.13 (Hop counter violation) indicates a routing failure, possibly an SCCP circular route. All hop counter violations are reported with this item, including those from Connection Request (CR) messages. Events are counted per calling party address (if this is not present in any offending CR message, an "unknown" value is indicated), called party address, and MTP label OPC combination.

3.3 Table 8

3.3.1 Item 8.5, duration of local SCCP unavailable (all reasons), can be deduced from other measurements, and is not basic.

3.3.2 Coordinated State Change Control measurements (Items 8.6 and 8.7) are to be taken at the signalling point of the subsystem requesting to go out of service. These measurements are only applicable at nodes with replicated subsystems.

3.3.3 Unavailability measurements 8.1, 8.2, 8.3 and 8.4 are architecture-dependent and are non-obligatory.

3.4 Table 9

3.4.1 SCCP management messages are included in the totals of items 9.3 through 9.7; they have SSN = 1 and protocol class = 0.

3.4.2 SCCP utilization measurements, Items 9.3 and 9.4 refer to all messages processed by SCCP Routing Control, whether or not the message is processed or delivered successfully. In Item 9.3 it is assumed that a message transiting an SCCP relay point is counted only once. Item 9.4 is for messages received for local subsystems.

3.4.3 Measurement 9.5 measures the utilization of the translation function within SCCP Routing Control and is a count of all messages for which global title translation is attempted. The measurement is only applicable at nodes with translation capabilities.

3.4.4 Measurements 9.6 and 9.7 are taken per protocol class and per SSN. 9.6 is counted at the origin per source SSN and refers to messages successfully received by the SCCP; 9.7 is counted at the destination per sink SSN and refers to messages successfully sent out of the SCCP.

3.4.5 Measurement 9.8 refers only to those messages which would normally have been routed to a subsystem, but because of a change in the translation process (e.g. due to a routing failure towards that subsystem) are directed to a backup subsystem. The measurement is applicable only at replicated nodes with translation capabilities.

3.4.6 Measurements 9.9, 9.10, 9.11, 9.12, 9.13 and 9.14 are utilization measurements for the data messages sent and received using the SCCP connection oriented service. They are counted per SSN.

All of these Items are to be measured over 5 (P) or 30 (N) minute periods.

3.5 Table 9 bis

3.5.1 The SCCP Quality of Service is estimated by comparing the number of unsuccessful UDT transfers (Items 9 *bis*.2 and 9 *bis*.4) to the total number of UDT transfers (9 *bis*.1 and 9 *bis*.3), the number of unsuccessful connection establishments (9 *bis*.6 and 9 *bis*.8) to the total number of establishment attempts (9 *bis*.5 and 9 *bis*.7), the number of resets and syntax errors detected on existing signalling connections (9 *bis*.9 to 9 *bis*.12) to the total number of successful connection establishments, and the number of unsuccessful XUDT transfers (Items 9 *bis*.14 and 9 *bis*.16) to the total number of XUDT transfers (9 *bis*.13 and 9 *bis*.15). The XUDT transfer counts are for further study. All of these measurements are taken over 5-minute periods (R) or 30-minute periods.

4 ISDN-UP Monitoring and Measurements

4.1 General

The ISDN User Part availability measurements are detailed in Table 10.

Table 11 details the ISDN-UP utilization measurements.

Table 12 details the ISDN-UP error performance measurements.

4.2 Table 10

ISDN User Part availability, unavailability and congestion measurements are listed in Table 10.

4.2.1 The local ISDN-UP availability measurements 10.1, 10.2, 10.3 and 10.4 are architecture-dependent and are non-obligatory.

4.2.2 Item 10.4, duration of local ISDN-UP unavailable (all reasons) can be deduced from items 10.1, 10.2 and 10.3, and is not basic.

4.2.3 Local ISDN-UP congestion measurements 10.5 and 10.6 are architecture-dependent and are not obligatory. If required, measurement 10.5 is only activated if the congestion exceeds an implementation-dependent threshold to free the management function from less severe overload conditions.

4.2.4 Item 10.7, duration of local ISDN-UP congestion, can be deduced from items 10.5 and 10.6, and is not basic.

4.2.5 Items 10.8 through 10.13 apply only to gateway exchanges, since items 10.1 to 10.7 measured remotely would furnish the same information to a centralized network management system.

4.3 Table 11

ISDN User Part utilization measurements are listed in Table 11. These are taken at a Signalling Point.

4.3.1 Measurements 11.1 and 11.2 accumulated over all message types are obligatory. However, a count per message type is not obligatory.

4.4 Table 12

ISDN User Part error performance measurements are listed in Table 12. In the event of a catastrophic failure there are potentially many reports, and these might need to be filtered.

4.4.1 Items 12.8 through 12.15 refer to the abnormal blocking and circuit group blocking procedures in 2.9.2.3/T1.113.4-2000 of which the management system should be notified.

4.4.2 Items 12.1 and 12.2 refer to failures of the reset circuit and reset circuit group procedures in 2.10.3/T1.113.4-2000.

4.4.3 Items 12.16 through 12.19 refer to failures in the blocking/unblocking sequences defined in 2.10.4/T1.113.4-2000.

4.4.4 Items 12.20 through 12.22 relate to protocol errors, namely receipt of unreasonable signalling information messages. See 2.10.5/T1.113.4-2000.

4.4.5 Item 12.5 reports the failure condition of non-receipt of Release Complete message on expiry of timer T5. See 2.10.6/T1.113.4-2000.

4.4.6 Items 12.6 and 12.23 refer to the inability to release a circuit and the abnormal release conditions described in 2.10.8/T1.113.4-2000.

5 TC Monitoring and Measurements

5.1 General

Table 13 describes the TC utilization measurements.

Table 14 defines the TC error performance and stability measurements.

5.2 Table 13

TC utilization measurements are listed in Table 13.

5.2.1 Item 13.7 is a count of all new transactions in the interval, including those closed immediately by an ABORT after the opening BEGIN.

Item 13.8 is a measurement of the mean number of open transactions in the interval. An open transaction is one to which a transaction identity has been allocated, and this identity is not yet frozen.

Measurement 13.10 (the cumulative mean duration of transactions) is the mean duration for all transactions that began between the start of measurements and the end of the measurement interval. It includes the time from opening the transaction to the end of the interval, for those transactions that did not close during the interval. Here, the transaction duration is defined as the time from allocation of the transaction identity to freezing it.

See clause 5.2.2 for more information.

5.2.2 An example of collection of measurements

A model to describe the collection of Items 13.8 and 13.10, used to explain possible measurement techniques but which is not intended to specify implementation, is as follows:

Suppose a system collects measurements in a number *s* of "measurement centers". A measurement center can be defined as a point in the system that launches, or observes directly, the launching of a TC transaction, and it also either finishes the transaction or observes directly its passing. This point is assumed also to be able to count the number of free, frozen, and thawing transaction identities with which it is concerned. Thus in a multi-processor system, there might be one (or more) measurement center(s) per processor per Application Entity definition, which is responsible for launching all the transactions (instances) of that Application Entity. In order for measurements collected by all the centers to refer to the same interval, it is assumed that each center has a clock which "ticks" at a rate sufficiently high to be able to measure with the required precision. The clocks are also assumed to be synchronized to within one clock tick (if they were not, further calculations would be needed to determine the overall precision). If necessary, each center would have an "active" set of measurements, and another set taken in the previous measurement interval, which might be awaiting collection.

Measurement 13.8 is the mean number of open transactions estimated over a measurement interval; observations are taken at each new transaction during the interval.

The measurements can be over the whole Application Entity, or at each center, and then accumulated for the whole Application Entity.

Define a cumulative total A_c of open transactions (this is set to 0 at the start of each measurement interval), and define a as the number of open transactions at any time. a is set to 0 at system initialization, it is incremented at each transaction arrival, and decremented when each transaction leaves. Define n as the number of new transactions arriving during the measurement interval (which is set to 0 at the start of each interval).

When a transaction arrives, set $A_c = A_c + a$; $a = a + 1$; $n = n + 1$;

When a transaction finishes, set $a = a - 1$;

When the reporting event occurs at the end of the measurement interval, report $A_c, n,$ and a. Then initialize A_c and n to 0.

The mean number of open transactions during the interval for this measurement center is $\frac{A_c}{n}$; for several centers use the expression $\frac{\sum A_c}{\sum n}$.

Item 13.10, the cumulative mean duration of transactions, requires that those transactions that were open at the start of measurements (but **not** those open at the start of the interval), be excluded from the measurements. (It would be possible to include those open at the start of measurements, if some estimate of their age could be made, but for simplicity this is not considered here). In order to do this, the transaction record itself needs an indicator equal to an overall (measurement center) value which is set when measurements start and unset when measurements finish, in order to exclude transactions which started before measurements did.

For this measurement, the following variables are kept at each measurement center:

- a running cumulative transaction length time, T_c. This is set to 0 at the start of measurements, but is kept running during the successive measurement intervals.
- a cumulative transaction arrival counter, R_c. This is initialized to 0 at the start of measurements, and is kept running during the successive measurement intervals.

- a counter *time* which is set to 0 at the start of measurements, and is incremented by 1 for each clock tick

The measurement is performed as follows:

1) when a transaction arrives, set $T_c = T_c - time$; $R_c = R_c + 1$;

2) when a transaction finishes, if it started at or after the start of measurements, set $T_c = T_c + time$;

3) at the end of the measurement interval, report T_c, R_c, and use a from Item 13.8 (but with a initialized at the start of measurements). The mean duration of transactions measured in this interval is $\frac{T_c + a.time}{R_c}$ for the center, with appropriate extensions for the overall mean.

A possible alternative measurement could be the mean duration of new transactions occurring in the interval (providing those transactions open at the start of the interval, and long transactions, were catered-for separately). If this were required, then some form of "phase" indication would be required to be kept in each transaction record, so that the finish of a "new" transaction could be distinguished from the finish of a transaction that was open at the start of the interval. Then T_c, R_c, $time$, and a would be kept relative to the interval, with them all set to 0 at its start.

5.3 Table 14

TC error performance and stability measurements are listed in Table 14. Measurements with detailed reasons can be found in Annex A, these are more appropriate during development of a service, rather than for operational use.

5.3.1

Measurement 14.4 (e) (resource limitation) can indicate a local TC resource problem, and requires the maintenance staff to be notified.

Measurement 14.4 (d) (unrecognized transaction identity) might indicate problems of an operational nature. Possible examples are:

- because of SCCP routing problems, the local TC has received a message for a transaction that never existed; or

- messages arriving for transactions that have timed-out and have been closed by the application.

To allow the source of the error to be traced, the originating address of the received message should be logged for later retrieval.

In both the on-occurrence and “1st & Δ” reports, sufficient additional information should be provided to establish the fault's location.

6 Uses of Measurements

6.1 Introduction

6.1.1 This clause provides a context for the measurements listed in the tables. It describes briefly the management activities likely to be associated with a SS7 network and how the measurements may be used to support these activities.

6.1.2 A list of supporting measurements sometimes follows each description. Each measurement is identified by its table number followed by a decimal point and the sequence number of the measurement within the table (e.g. Item 1.2 is the second measurement of Table 1).

6.2 Message Transfer Part (MTP)

6.2.1 Fault and Configuration Management Measurements

6.2.1.1 Detection of Link Failure Events in Either Direction

“Link failure” is an event which causes a particular link to be unavailable for signalling (i.e. a failure at Level 1 or Level 2). Signalling link failures are counted to determine preventive and corrective maintenance actions in order to restore network capabilities. This maintenance action can be required on a single failure event or when the number of failed signalling links in a link set, or across different link sets, exceeds a threshold.

Signalling link failure measurements are summarized, not only for specific link sets, but also across many different link sets, where these may involve common transmission systems or signalling points. The distribution of failure and degradation sources may be randomly located, but if specific network elements appear to be common to a large number of the failures, then they are suspect as a significant failure source requiring further maintenance action.

Measurements:

- number of link failures:
- all reasons (Item 1.2);
- abnormal FIBR/BSNR (Item 1.3);
- excessive delay of acknowledgment (Item 1.4);
- excessive error rate (Item 1.5);
- excessive duration of congestion (Item 1.6);
- signalling link restoration (Item 1.12).

6.2.1.2 Surveillance of Network Status

This activity is concerned with surveillance of the network as a whole, in order to coordinate and assign priorities to maintenance actions. The information to support this activity will come from indicators of the operational and congestion status. These indicators may be found in the tables designated as Usage “F” or “C” and duration of measurements “on occurrence” or “1st & Δ”.

Measurements to survey network status:

- local automatic changeover (Item 1.10);
- local automatic changeback (Item 1.11);
- start of remote processor outage (Item 2.10);
- stop of remote processor outage (Item 2.11);

- SL congestion indications (Item 3.6);
- stop of SL congestion (Item 3.9);
- number of congestion events resulting in loss of muss (Item 3.11);
- start of linkset failure (Item 4.3);
- stop of linkset failure (Item 4.4);
- initiation of Broadcast TFP due to failure of measured linkset (Item 4.5);
- initiation of Broadcast TFA for recovery of measured linkset (Item 4.6);
- start of unavailability in measurement 4.9 (Item 4.11);
- stop of unavailability in measurement 4.9 (Item 4.12);
- adjacent signalling point inaccessible (Item 5.1);
- stop of adjacent signalling point inaccessible (Item 5.4);
- start and end of local inhibition (Items 2.16 and 2.17);
- start and end of remote inhibition (Items 2.18 and 2.19).

Additional measurements may be provided to the user for determining the integrity of the network.

Measurements:

- local management inhibit (Item 2.13);
- local management uninhibit (Item 2.14);
- duration of local busy (Item 2.15);
- number of SIF and SIO octets received (Item 3.4);
- unavailability of route set to a given destination or set of destinations (Item 4.9);
- duration of adjacent signalling point inaccessible (Item 5.2).

6.2.1.3 Detection of Routing and Distribution Table Errors

In operation, the SS7 routing data will be updated frequently as the network changes. It is necessary to keep track of signalling point status and routing problems on a routine basis (see T1.116.3-2000).

Measurements:

- duration of unavailability of signalling linkset (Item 4.2);
- start of linkset failure (Item 4.3);
- stop of linkset failure (Item 4.4);

- initiation of Broadcast TFP due to failure of measured linkset (Item 4.5);
- initiation of Broadcast TFA for recovery of measured linkset (Item 4.6);
- unavailability of route set to a given destination or set of destinations (Item 4.9);
- duration of unavailability in measurement 4.9 (Item 4.10);
- start of unavailability in measurement 4.9 (Item 4.11);
- stop of unavailability in measurement 4.9 (Item 4.12);
- adjacent SP inaccessible (Item 5.1);
- duration of adjacent SP inaccessible (Item 5.2);
- stop of adjacent SP inaccessible (Item 5.4);
- number of muss discarded due to a routing data error (Item 5.5);
- User Part Unavailable muss transmitted and received (Items 5.6 and 5.7).

6.2.1.4 Long Term Fault Detection

The activities described in this clause relate to the detection of degraded performance and to the maintenance of a particular signalling point with its associated signalling links. They may be used on a near-real time basis, or may be monitored over a period of days or weeks to detect unfavorable trends. They are designed so that one signalling point can monitor its own status without relying on measurements from adjacent signalling points.

6.2.1.4.1 Detection of Increases IN Link SU Error Rates

This activity ensures that the signalling data link error rate is not rising beyond specification. The SU Error Rate Monitor is the basic instrument for monitoring signalling data link performance. Basic traffic counts are used to normalize performance measurements in order to compare system performance measurements.

Measurements:

- number of SIF and SIO octets transmitted (Item 3.1);
- number of SIF and SIO octets received (Item 3.4).

Operational measurements counting error events provide supplementary information to warn of impending failures or to give a running assessment of signalling data link quality.

Measurements:

- number of Signal Units (SUs) in error (monitors incoming performance) (Item 1.8);
- number of Negative Acknowledgments (NACKS) received (monitors outgoing performance) (Item 1.9).

Counting total Signal Unit errors allows the estimation of Signalling Data Link bit error ratios (see 3.1/T1.111.6-2001) assuming that errors are random. The estimate uses measurement 1.1, duration of link in the in-service state, multiplied by the link transmission rate.

Measurements:

- duration of link in the in-service state (Item 1.1);
- duration of link unavailability (any reason) (Item 2.1).

6.2.1.4.2 Detection of Marginal Link Faults

Measurement:

- SL alignment or proving failure (Item 1.7).

This activity is concerned with detecting routing instabilities caused by marginal link faults.

Measurements:

- local automatic changeover (Item 1.10);
- local automatic changeback (Item 1.11);
- SL congestion indications (Item 3.6);
- cumulative duration of SL congestions (Item 3.7);
- number of congestion events resulting in loss of muss (Item 3.11).

6.2.2 MTP Performance

6.2.2.1 Link, Linkset, signalling Point, and Routeset Utilization

MTP utilization measurement is concerned with evaluating message flows to ensure that they are not beginning to exceed stated link and signalling point capacities. It also ensures that existing routing is resulting in proportionate utilization of available capacity.

The following measurements are defined:

Measurements by link:

- duration of link in the in-service state (Item 1.1);
- duration of SL unavailable (for any reason) (Item 2.1);
- duration of SL unavailability due to remote processor outage (Item 2.9);
- duration of local busy (Item 2.15);
- number of SIF and SIO octets transmitted (Item 3.1);
- number of octets retransmitted (Item 3.2);
- number of message signal units transmitted (Item 3.3);

- number of SIF and SIO octets received (Item 3.4);
- number of message signal units received (Item 3.5);
- SL congestion indications (Item 3.6);
- cumulative duration of SL congestions (Item 3.7);
- muss discarded due to SL congestion (Item 3.10);
- number of congestion events resulting in loss of muss (Item 3.11).

Measurements by link set:

- duration of unavailability of signalling link set (Item 4.2).

Measurements by signalling point:

- number of SIF and SIO octets received:
  - with given origination point code (OPC) (Item 6.1);
  - with given OPC and SIO (Item 6.4);
- number of SIF and SIO octets transmitted:
  - with given destination point code (DPC) (Item 6.2);
  - with given DPC and SIO (Item 6.5);
- number of SIF and SIO octets handled:
  - with given SIO (Item 6.3);
  - with given OPC, DPC and SIO (Item 6.6).
- number of muss handled with given OPC, DPC and SIO (Item 6.7).

Measurements by signalling route set:

- unavailability of route set to a given destination or set of destinations (Item 4.9);
- duration of unavailability in measurement 4.9 (Item 4.10);
- duration of adjacent signalling point inaccessible (Item 5.2);
- muss discarded due to routing data error (Item 5.5);
- User Part Unavailability muss sent and received (Items 5.6 and 5.7);
- Transfer Controlled MSU received (Item 5.8).

6.2.2.2 Component Reliability and Maintainability Studies

These studies are concerned with calculating the mean time between failures (MTBF) and mean time to repair (MTTR) for each type of component in the SS7 network. It may be useful for some purposes to have MTBF and MTTR data by SS7 function with which to correlate associated maintenance action.

Measurements:

- number of link failures:
  - all reasons (Item 1.2);
  - abnormal FIBR/BSNR (Item 1.3);
  - excessive delay of acknowledgment (Item 1.4);
  - excessive error rate (Item 1.5);
  - excessive duration of congestion (Item 1.6);
- duration of SL inhibition due to local management actions (Item 2.5);
- duration of SL inhibition due to remote management actions (Item 2.6);
- duration of SL unavailability due to link failure (Item 2.7);
- duration of SL unavailability due to remote processor outage (Item 2.9);
- start of remote processor outage (Item 2.10);
- stop of remote processor outage (Item 2.11);
- local management inhibit (Items 2.16 and 2.17);
- local management uninhibit (Items 2.18 and 2.19).

6.3 Signalling Connection Control Part (SCCP)

6.3.1 SCCP Fault Management

6.3.1.1 Routing Failures

The monitoring of routing failures allows the SCCP Routing and Translation function to detect any abnormal number of messages which cannot be routed, independent of the originator being informed through message return.

Measurements:

Routing Failure due to:

- no translation for address of such nature (Item 7.1);
- no translation for this specific address (Item 7.2);
- network failure (point code not available) (Item 7.3);

- network congestion (Item 7.4);
- subsystem failure (unavailable) (Item 7.5);
- subsystem congestion (Item 7.6);
- unequipped user (subsystem) (Item 7.7);
- reason unknown (Item 7.9);
- syntax error detected (Item 7.8).

The last item, 7.8, could occur if there were protocol interworking problems.

In addition, the following measurements can be used as a consistency check or a network protection mechanism:

- Hop counter violation (Item 7.13) (indicates a possible SCCP circular route)– UDTS messages sent (Item 9 *bits*.2);
- XUDTS messages sent (Item 9 *bits*.14) (for further study);
- UDTS messages received (Item 9 *bits*.4);
- UDTS messages sent (Item 9 *bits* 2);
- XUDTS messages received (Item 9 *bits*.16) (for further study).

6.3.1.2 SCCP Unavailability

Local SCCP measurements are:

- Local SCCP unavailable due to
  - failure (Item 8.1);
  - maintenance made busy (Item 8.2);
  - congestion (Item 8.3);
- Stop of local SCCP unavailable
  - all reasons (Item 8.4).

6.3.1.3 Connectionless SCCP Segmentation and Reassembly Faults

Items 7.10 and 7.11 count failures of the reassembly or segmentation processes, possibly due to MTP transport difficulties with the segments.

Item 7.12 is a “1st & Δ” report of lack of reassembly space for new reassembly sequences.

6.3.2 SCCP Configuration Management

The SCCP measurements for configuration management are those for Coordinated State Change Control.

Measurements:

- subsystem out of service request granted (Item 8.6);
- subsystem out of service request denied (Item 8.7).

6.3.3 SCCP Performance

6.3.3.1 Utilization

Network administration is interested in monitoring SCCP utilization for use in analyzing the current network and designing future network configurations. One way to monitor SCCP utilization is to measure the amount of SCCP traffic.

Measurements:

- SCCP traffic received:
  - UDTS messages (Item 9 *bis*.4) ;
  - UDT messages (Item 9 *bis*.3);
  - XUDT messages (Item 9 *bis*.15) (for further study);
  - XUDTS messages (Item 9 *bis*.16) (for further study);
  - DT1 messages/SSN (Item 9.9);
  - DT2 messages/SSN (Item 9.11);
  - ED messages/SSN (Item 9.14);
  - total messages (connectionless classes 0 and 1 only) per SSN (Item 9.7);
- SCCP traffic sent:
  - UDTS messages (Item 9 *bis*.2);
  - UDT messages (Item 9 *bis*.1);
  - XUDT messages (Item 9 *bis*.13) (for further study);
  - XUDTS messages (Item 9 *bis*.14) (for further study);
  - DT1 messages/SSN (Item 9.10);
  - DT2 messages/SSN (Item 9.12);
  - ED messages/SSN (Item 9.13);

  - total messages (connectionless classes 0 and 1 only) per SSN (Item 9.6).

- General:
  - total messages handled (from local or remote subsystems) (Item 9.3);
  - total messages intended for local subsystems (Item 9.4);
  - total messages requiring global title translation (Item 9.5);
  - total messages sent to a backup subsystem (Item 9.8).

6.3.3.2 SCCP Quality of Service

The SCCP Quality of Service can be estimated using the following measurements:

- Connectionless outgoing traffic:
  - UDT messages sent (Item 9 *bis*.1);
  - XUDT messages sent (Item 9 *bis*.13) (for further study);
  - UDTS messages received (Item 9 *bis*.4);
  - XUDTS messages received (Item 9 *bis*.16) (for further study);
- Connectionless incoming traffic:
  - UDT messages received (Item 9 *bis*.3);
  - XUDT messages received (Item 9 *bis*.15) (for further study);
  - UDTS messages sent (Item 9 *bis*.2);
  - XUDTS messages sent (Item 9 *bis*.14) (for further study).
- Connection oriented establishments:
  - Outgoing:
    - → CR messages sent (Item 9 *bis*.5);
    - → CREF messages received (Item 9 *bis*.8).
  - Incoming:
    - → CR messages received (Item 9 *bis*.7);
    - → CREF messages sent (Item 9 *bis*.6).
- Connection oriented syntax/protocol errors:
  - RSR messages sent/received (Items 9 *bis*.9 and 9 *bis*.10);

– ERR messages sent/received (Items 9 *bis*.11 and 9 *bis*.12).

6.4 Integrated Services Digital Network-User Part (ISDN-UP)

6.4.1 Fault and Configuration Management

6.4.1.1 ISDN-UP Availability/Unavailability

The monitoring of ISDN-UP availability may prove useful in the activation or deactivation of other network measurements.

Measurements:

- start of ISDN-UP unavailable due to failure (Item 10.1);
- start of ISDN-UP unavailable due to maintenance (Item 10.2);
- start of ISDN-UP unavailable due to congestion (Item 10.5);
- stop of ISDN-UP unavailable (all reasons) (Item 10.3);
- total duration of ISDN-UP unavailable (all reasons) (Item 10.4);
- stop of local ISDN-UP congestion (Item 10.6);
- duration of local ISDN-UP congestion (Item 10.7);
- start of remote ISDN-UP unavailable (Item 10.8);
- stop of remote ISDN-UP unavailable (Item 10.9);
- duration of remote ISDN-UP unavailable (Item 10.10);
- start of remote ISDN-UP congestion (Item 10.11);
- stop of remote ISDN-UP congestion (Item 10.12);
- duration of remote ISDN-UP congestion (Item 10.13).

6.4.1.2 ISDN-UP Errors

Problem isolation might be assisted by measurements which indicate the reason for a protocol error being reported.

Measurements:

- missing blocking acknowledgment in CGBA message for blocking request in previous CGB message (Item 12.8);
- missing unblocking acknowledgment in CGUA message for unblocking request in previous CGU message (Item 12.9);
- abnormal blocking acknowledgment in CGBA message with respect to previous CGB message (Item 12.10);

- abnormal unblocking acknowledgment in CGUA message with respect to previous CGU message (Item 12.11);
- unexpected CGBA message received with an abnormal blocking acknowledgment (Item 12.12);
- unexpected CGUA message received with an abnormal unblocking acknowledgment (Item 12.13);
- unexpected BLA message received with an abnormal blocking acknowledgment (Item 12.14);
- unexpected UBA message received with an abnormal unblocking acknowledgment (Item 12.15);
- no RLC message received for a previously sent RSC message within timer T17 (Item 12.1);
- no GRA message received for a previously sent GRS message within timer T23 (Item 12.2);
- no BLA message received for a previously sent BLO message within timer T13 (Item 12.16);
- no UBA message received for a previously sent UBL message within timer T15 (Item 12.17);
- no CGBA message received for a previously sent CGB message within timer T19 (Item 12.18);
- no CGUA message received for a previously sent CGU message within timer T21 (Item 12.19);
- message format error (Item 12.20);
- unexpected message received (Item 12.21);
- release due to unrecognized information (Item 12.22);
- RLC not received for a previously sent REL message within timer T5 (Item 12.5);
- inability to release a circuit (Item 12.23);
- abnormal release condition (Item 12.6);
- circuit blocked because of excessive errors detected by CRC failure (Item 12.7).

6.4.2 ISDN-UP Performance

Aspects of ISDN-UP performance which can be monitored are its processing ability in relation to known message volumes.

Measurements:

- total ISDN-UP messages sent (Item 11.1);
- total ISDN-UP messages received (Item 11.2).

6.5 Transaction Capabilities

6.5.1 TC Fault Management Measurements

Problem isolation during development may be assisted by measurements which indicate the reason for a protocol error being reported.

Measurements (those of which are not of resource limitation are in Annex A):

- protocol error detected in transaction portion [Items 14.1 a) to e) and 14.4 a) to e)];
- protocol error detected in component portion [Items 14.2 a) through h) and 14.5 a) through h)];
- TC user generated problems [Items 14.3 a) through k) and 14.6 a) through k)].

During operation, resource limitation measurements 14.1 e), 14.3 d), 14.4 e), and 14.6 d) are pertinent. In addition, Items 14.7 through 14.11 are counts for messages and components discarded, and provide a summary for the Items in Annex A.

The purpose of these measurements is to monitor abnormal events of an operational nature, or peaks in errors that affect the quality of service offered to the TC users. They also provide the means to collect additional information that allows the source of the errors to be traced. To this end, a log of notifications which is retrievable on command (e.g. from an Operations System) could be kept.

Measurements 14.3 d) and 14.6 d) (resource limitations) indicate TC user resource problems when processing an invoked operation. They are included in the TC measurements as they might be applicable to a number of different TC users.

6.5.2 TC Performance

The loading of TC resources may be indicated through the volume of messages and components handled. The dynamic loading of TC resources can be observed by counting the number of new transactions during an interval; the mean number of open transactions during an interval indicates the static loading of TC. The cumulative mean duration of transactions can be used for dimensioning TC and TC user resources, and to indicate operational problems.

Measurements:

- total number of TC messages sent by the node (by message type) (Item 13.1);
- total number of TC messages received by the node (by message type)(Item 13.2);
- total number of components sent by the node (Item 13.3);
- total number of components received by the node (Item 13.4);
- number of new transactions during an interval (Item 13.7)
- mean number of open transactions during an interval (Item 13.8)
- cumulative mean duration of transactions (Item 13.10).
- maximum number of open transactions during an interval (Item 13.11)

In addition, an Operations System can use a measurement to activate this set of measurements :

- a report when the number of open transactions is greater than a pre-defined threshold (Item 13.12). Items 13.11 and 13.12 are equivalent to the X.738 minMaxScanner and ITU-T Rec. Q.822 gaugeThreshold respectively, but they utilize an internal counter per Application Entity which is not itself reported. Hence, it is not given as a measurement (this is the current number of open transaction identities for which a "snapshot" of open transactions at the measurement time is not necessarily representative of the performance of the Application Entity's transactions throughout the measurement interval). For an example of a possible method of implementing these measurements, see 5.2.1.

6.6 Preparation of Traffic Forecasts

6.6.1 This activity is concerned with the calculation of values which will be entered into provisioning tables to determine future equipment quantities required. The data to be used are those already collected to support activities categorized as “P” and “N”. Depending upon implementation, more detailed measurements may be required to provision such items as internal buffers or number of processors where these may vary.

6.7 Network Planning

6.7.1 This activity requires longer-term traffic forecasts, based as much upon marketing intentions as upon extrapolations of existing patterns. Nevertheless, to understand existing patterns, planners need knowledge of traffic origins and destinations.

6.7.2 The measurements in Table 6, Table 9, Table 11, and Table 13 indicate how much traffic is being originated at the measured signalling point, and how much traffic has that signalling point as a destination. These measurements are useful for calculating traffic flows by origin-destination pair.

6.7.3 In reality, however, traffic flows do not spread randomly through a network. For each origin, distance and other factors result in a concentration of flows to favored destinations. As a result, it will be necessary to measure traffic flows on the network by destination.

6.7.4 Given the large potential number of destinations, measurements may have to be grouped. (See the notes in clauses 2 through 5).

6.8 Evaluation of Maintenance Force Effectiveness

6.8.1 This activity consists of managerial control of the maintenance function through examination of failure trends, equipment availabilities, and the amount of outage due to manual as opposed to automatic busying of components.

6.9 Near Real Time Network Control

This activity consists of managing the network configuration and routing tables to maintain service. For this, use is made of near real time measurements.

7 MTP + SCCP Traffic Registration

Not applicable to North American networks.

Table 1/T1.116.2 — MTP Signalling Link Faults and Performance

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
1.1	Duration of link in the In-service state	s/SL	F, P, N	30 min	1.2, 1.12	Yes	Perm.	
1.2	SL failure – All reasons	Event/SL	F, R, P	On occur.	–	Yes	Perm.	
1.3	SL failure – Abnormal FIBR/BSNR	Event/SL	F, R, P	On occur.	–	No		5.3/T1.111.3
1.4	SL failure – Excessive delay of ack.	Event/SL	F, R, P	On occur.	–	No		5.3.1/T1.111.3
1.5	SL failure – Excessive error rate	Event/SL	F, R, P	On occur.	–	No		10.2.2/T1.111.3
1.6	SL failure – Excessive duration of congestion	Event/SL	F, R, P	On occur.	–	No		9.3/T1.111.3
1.7	SL alignment or proving failure	Events/SL	F, R F, P	5 min 30 min	–	No No		10.3/T1.111.3
1.8	Number of signal units received in error [a)]	Events/SL	F, R, P F, P	5 min 30 min	–	No Yes	Perm. Perm.	4/T1.111.3
1.9	Number of negative ack. received	Events/SL	F, R, P F, P	5 min 30 min	–	No No		
1.10	Local automatic changeover	Event/SL Events/SL	F, R, C P	On occur. 30 min	1.2	No No		5/T1.111.3
1.11	Local automatic changeback	Event/SL	F, R, P, C	On occur.	1.12	No		6/T1.111.4
1.12	SL restoration	Event/SL	F, R, P	On occur.	–	No		3.2.3/T1.111.4

SL: Signalling link

a) The interpretation of this count is implementation dependent.

NOTES:

1 Managed objects are signalling link and signalling link NE part.

2 For the meaning of the headings, see 1.7 (applies to all tables).

Table 2/T1.116.2 MTP Signalling Link Availability

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
2.1	Duration of SL unavailability (for any reason)	s/SL	F P, N	30 min	1.2, 1.12 2.5, 2.6	Yes	Perm.	
2.2 - 2.4	Deleted							
2.5	Duration of SL inhibition due to local management actions	s/SL	P	30 min	2.16, 2.17	No		3.2.8/T1.111.4
2.6	Duration of SL inhibition due to remote management actions	s/SL	P	30 min	2.18, 2.19	No		3.2.8/T1.111.4
2.7	Duration of SL unavailability due to link failure	s/SL	P	30 min	1.2, 1.12	No		3.2.2/T1.111.4
2.8	Deleted							
2.9	Duration of SL unavailability due to remote processor outage	s/SL	P	30 min	2.10, 2.11	No		3.2.6/T1.111.4
2.10	Start of remote processor outage	Event/SL	F, R, P, C	On occur.	–	No		3.2.6/T1.111.4
2.11	Stop of remote processor outage	Event/SL	F, R, P, C	On occur.	–	No		3.2.7/T1.111.4
2.12	Deleted							
2.13	Local management inhibit	Events/SL Events/SL	– –	30 min 5 min	2.16 2.16	No No		10.2/T1.111.4
2.14	Local management uninhibit	Events/SL Events/SL	– –	30 min 5 min	2.17, 2.19 2.17, 2.19	No No		10.3/T1.111.4
2.15	Duration of local busy	SIBs/SL	F, R, P F, P	5 min 30 min	–	No No		9.3/T1.111.3
2.16	Start of local inhibition	Event/SL	F, R, C	On occur.	–	No		10/T1.111.4
2.17	End of local inhibition	Event/SL	F, R, C	On occur.	–	No		
2.18	Start of remote inhibition	Event/SL	F, R, C	On occur.	–	No		
2.19	End of remote inhibition	Event/SL	F, R, C	On occur.	–	No		

NOTE – Managed objects are signalling link and signalling link NE part.

Table 3/T1.116.2 MTP Signalling Link Utilization

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
3.1	Number of SIF and SIO octets transmitted	Octets/SL	P, R, N P, N	5 min 30 min	– –	No Yes	Perm. Perm.	2.3.8/T1.111.3
3.2	Octets retransmitted	Octets/SL	P, R, N P, N	5 min 30 min	– –	No No		5/T1.111.3
3.3	Number of message signal units transmitted	muss/SL	P, R, N N, P	5 min 30 min	–	No No		
3.4	Number of SIF and SIO octets received	Octets/SL	P, R, N N, P	5 min 30 min	– –	No Yes	 Act.	
3.5	Number of message signal units received	muss/SL	P, R, N N, P	5 min 30 min	–	No No		
3.6	SL congestion indications	Event/SL Events/SL Events/SL	F P, R, F, N N, P, F	1st & Δ 5 min 30 min	–	No No No	Act. Perm. Perm.	3.8/T1.111.4
3.7	Cumulative duration of SL congestion	s/SL	F, P, N	30 min	3.6, 3.9	No		
3.8	Deleted							
3.9	Stop of SL congestion	Event/SL	F, P	1st & Δ	–	No	Act.	3.8/T1.111.4
3.10	muss discarded due to SL congestion	muss/SL	F, P, R, N N, F, P	5 min 30 min	– –	No Yes	Perm. Perm.	
3.11	Number of congestion events resulting in loss of muss	Event/SL Events/SL Events/SL	F, R P, R, N N, P	1st & Δ 5 min 30 min	–	No No No		

NOTE – Managed objects are signalling link and signalling link NE part.

Table 4/T1.116.2 MTP Signalling Link Set and Route Set Availability

Description of Measurements		Units	Usage	Duration	From	Obl.	Act./Perm.	References
4.1	Deleted							
4.2	Duration of unavailability of signalling linkset	s/linkset	F, P	30 min	4.3, 4.4	No		
4.3	Start of linkset failure	Event/linkset	F, R, C	On occur.	–	No		
4.4	Stop of linkset failure	Event/linkset	F, R, C	On occur.	–	No		
4.5	Init. of broadcast TFP due to failure of measured linkset [a]	Event/linkset	F, R, C	On occur.	–	No		13/T1.111.4
4.6	Init. of broadcast TFA for recovery of measured linkset [a]	Event/linkset	F, R, C	On occur.	–	No		13/T1.111.4
4.7 - 4.8	Deleted							
4.9	Unavailability of route set to a given destination or set of destinations	Event/destination(s)	P, C, N	30 min	4.11	[b]	Perm.	11.2.1/T1.111.4
4.10	Duration of unavailability in 4.9	s/destination(s)	C, P, N	30 min	4.11, 4.12	[b]	Perm.	11.2.2/T1.111.4
4.11	Start of unavailability in 4.9	Event/destination(s)	F, R, C	On occur.	–	No		11.2.1/T1.111.4
4.12	Stop of unavailability in 4.9	Event/destination(s)	F, R, C	On occur.	–	No		11.2.2/T1.111.4
4.13	Change in linkset used to adjacent SP	Dest. & linkset	F, R, C	On occur.	–	No	Perm.	

a) These measurements only apply to Signal Transfer Points.

b) These measurements are obligatory only in the international network.

NOTE – Managed objects are linkset, linkset NE part, routeset.

Table 5/T1.116.2 MTP Signalling Point Status

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./perm.	References
5.1	Adjacent SP inaccessible	Event/SP Events/SP Events/SP	F, R P, R P	On occur. 5 min 30 min	–	Yes No No	Perm.	
5.2	Duration of adjacent SP inaccessible	s/SP s/SP	P, R P	5 min 30 min	5.1, 5.4	Yes	Perm.	
5.3	Deleted							
5.4	Stop of adjacent SP inaccessible	Event/SP	F, R, C	On occur.	–	No		
5.5	MSU discarded due to a routing data error [a)]	muss/SP	F, R, P, N N, F, P	1st & Δ 30 min	–	No Yes	Perm. Perm.	2.3.3/T1.111.4
5.6	User Part Unavailable MSU transmitted [b)]	Event/UP/SP	F, R, C, P	1st & Δ	–	No	Perm.	11.7.2/T1.111.4
5.7	User Part Unavailable MSU received [b), c)]	Event/UP/SP	F, R, C, P	1st & Δ	–	No	Perm.	11.7.2/T1.111.4
5.8	TFC received	Event/SP/ cong.level	F, R, P	1st & Δ	–	No	Perm.	

a) The number of muss discarded might be used to indicate that the MTP Route Verification Test (MRVT) described in 2.2/T1.116.3-2000 should be run.

b) If either of these measurements exceeds an implementation-dependent threshold, the management process is informed.

c) Includes UPU received for a not-equipped MTP User. The management process is informed immediately for this occurrence.

NOTE – Managed objects are signalling point, MTP User.

Table 6/T1.116.2 MTP Signalling Traffic Distribution (Signalling Route Utilization)

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
6.1	Number of SIF and SIO octets received with given OPC [a)]	Octets/OPC	A, N, P P, A, N	15 min 30 min	6.6	No No		
6.2	Number of SIF and SIO octets transmitted with given DPC [a)]	Octets/DPC	P, A, N P, A, N	15 min 30 min	6.6	No No		
6.3	Number of SIF and SIO octets handled with given SIO	Octets/SIO	P, A, N P, A, N	15 min 30 min	6.6	No No		
6.4	Number of SIF and SIO octets received with given OPC and SIO [a)]	Octets/SIO/OPC	P, A, N P, A, N	15 min 30 min	6.6	No No		
6.5	Number of SIF and SIO octets transmitted with given DPC and SIO [a)]	Octets/SIO/DPC	P, A, N P, A, N	15 min 30 min	6.6	No No		
6.6	Number of SIF and SIO octets handled with given OPC, DPC and SIO [b)]	Octets/SIO/ OPC/DPC	P, A, N P, A, N	5 min 30 min	–	No No		
6.7	Number of muss handled with given OPC, DPC and SIO [b)]	muss/SIO/ OPC/DPC	A, P, R, N P, A, N	5 min 30 min	–	No No		

a) Activation of these measurements should be limited to a small number of signalling point codes at a given time.

b) Activation of these measurements should be limited to a small number of OPC/DPC combinations at a given time.

NOTE – Managed objects are signalling route and signalling linkset NE part.

Table 7/T1.116.2 SCCP Error Performance

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
7.1	Routing Failure – No translation for address of such nature [a)]	Events	F, R, P N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.2	Routing Failure – No translation for this specific address [a)]	Events	F, R, P N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.3	Routing Failure – Network Failure (Point Code not available)	Events	F, R, P N	1st & Δ 30 min	–	Yes [c)]	Act Perm.	2.4/T1.112.4
7.4	Routing Failure – Network Congestion	Events	F, R, P N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.5	Routing Failure – Subsystem Failure (unavailable)	Events	F, R, P, C N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.6	Routing Failure – Subsystem Congestion [b)]	Events	F, R, P N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.7	Routing Failure – Unequipped user (Subsystem)	Events	F, R, C N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.8	Syntax Error Detected	Events	F, R, P –	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	4.3/T1.112.4
7.9	Routing Failure – unqualified	Events	F, R, P, C N	1st & Δ 30 min	–	Yes [c)]	Act. Perm.	2.4/T1.112.4
7.10	Reassembly error - Timer T_y expiry	Event/CGPA/ seg.LR	F,R,P	1st.& Δ	-	Yes [d)]	Perm.	4.1.1.3.1/T1.112.4
7.11	Reassembly error - segment received out of sequence (inc. duplicates, recpt. of non-first segment for which no reassembly process)	Event/CGPA/ seg.LR	F,R,P	1st.& Δ	-	Yes [d)]	Perm.	4.1.1.3.2/T1.112.4
7.12	Reassembly error - no reassembly space	Events	R,P,N	1st.& Δ	-	Yes [d)]	Perm.	4.1.1.3.1/T1.112.4
7.13	Hop counter violation (XUDT, XUDTS and other messages - e.g. CR)	Event/[CGPA]/ CDPA/OPC	F,R,P	1st.& Δ	-	Yes [e)]	Perm.	2.3.1 3/T1.112.4

Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References

a) These measurements are only required at SCCP nodes with global title translation capabilities.

b) For further study.

c) Chapter Q.752 (*Blue Book*) had duration “on occurrence” marked as obligatory. See 6.2/T1.116.0-2000 for compatibility between implementations to Chapter Q.752 and this Chapter.

d) This measurement is obligatory if SCCP connectionless segmentation and reassembly is supported.

e) This measurement is obligatory if the node supports 1993 SCCP Global Title Translation or later, and the network supports XUDT or XUDTS or other messages (e.g. CR) routed on GT and containing a hop counter. Note that the calling party address (CGPA) might not be present in CR messages. It is used, if present in messages, to register violations.

NOTE - Managed objects to be specified (but includes SCCP routing tables).

Table 8/T1.116.2 SCCP Subsystem Availability

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
8.1	Start of local SCCP unavailable – Failure [a)]	Event	F, R, P, C	On occur.	–	No	Perm.	
8.2	Start of local SCCP unavailable – Maintenance made busy [a)]	Event	R, P, C	On occur.	–	No	Perm.	
8.3	Start of local SCCP unavailable – Congestion [a)]	Event	F, R, P, C	On occur.	–	No	Perm.	
8.4	Stop of local SCCP unavailable – All reasons [a)]	Event	F, R, P, C	On occur.	–	No	Perm.	
8.5	Duration of local SCCP unavailable – All reasons [a)]	s	P, N	30 min	8.1, 8,2, 8.3, 8.4	No	Perm.	
8.6	Subsystem out-of-service request granted	Event	C, R	On occur.	–	[b)]	Perm.	5.3.5.3/T1.112.4
8.7	Subsystem out-of-service request denied	Event	C, R	On occur.	–	[b)]	Perm.	5.3.5.3/T1.112.4

a) These measurements are system architecture dependent.

b) These measurements are obligatory for replicated subsystems.

NOTE – Managed objects to be specified (include subsystem availability status).

Table 9/T1.116.2 SCCP – Utilization

Description of Measurements		Units	Usage	Duration	From	Obl.	Act./perm.	References
9.1	UDTS messages sent *moved to* 9 *bis*.2							
9.2	UDTS messages received *moved to* 9 *bis*.4							
9.3	Total messages handled (from local or remote subsystems)	Msgs	P, R, N N, P	5 min 30 min	–	No No	Perm.	2.3/T1.112.4
9.4	Total messages intended for local subsystems	Msgs	P, R, N N, P	5 min 30 min	–	No No	Perm.	2.3/T1.112.4
9.5	Total messages requiring global title translation [a)]	Msgs	P, R, N N, P	5 min 30 min	–	No No	Perm.	2.2/T1.112.4
9.6	Total messages originating (for connectionless classes 0,1 only) per source SSN	Msgs/ class/SSN	P, R, N N, P	5 min 30 min	–	No Yes	Perm.	1.1.2/T1.112.4
9.7	Total messages received (for connectionless classes 0,1 only) per sink SSN	Msgs class/SSN	P, R, N N, P	5 min 30 min	–	No Yes	Perm.	1.1.2/T1.112.4
9.8	Messages sent to a backup subsystem	Msgs/SS	P, R, N N, P	5 min 30 min	–	No [b)]	Perm.	5.3.2/T1.112.4
9.9	DT1 messages received from MTP per sink SSN	Msgs/SSN	P, R, N N, P	5 min 30 min	–	No	Perm.	3.5/T1.112.4
9.10	DT1 messages sent to MTP per source SSN	Msgs/SSN	P, R, N N, P	5 min 30 min	–	No	Perm.	3.5/T1.112.4
9.11	DT2 messages received from MTP per sink SSN	Msgs/SSN	P, R, N N, P	5 min 30 min	–	No	Perm.	3.5/T1.112.4
9.12	DT2 messages sent to MTP per source SSN	Msgs/SSN	P, R, N N, P	5 min 30 min	–	No	Perm.	3.5/T1.112.4
9.13	ED messages sent to MTP per source SSN	Msgs/SSN	P, R, N N, P	5 min 30 min	–	No	Perm.	3.6/T1.112.4
9.14	ED messages received from MTP per sink SSN	Msgs/SSN	P, R, N N, P	5 min 30 min	–	No	Perm.	3.6/T1.112.4

a) This measurement is required only at SCCP nodes with global title translation capabilities.

b) 30 minute measurement is obligatory for replicated subsystems.

NOTE – Managed objects for further study.

Table 9bis/T1.116.2 SCCP – Quality of Service

Description of Measurements		Units	Usage	Duration	From	Obl.	Act./Perm.	References
9 *bis*.1	UDT messages sent	Msgs	P, R P	5 min 30 min	9.6 & 9 *bis*.2	No	Perm.	4.1/T1.112.4
9 *bis*.2	UDTS messages sent	Msgs	P, R, F P, F	5 min 30 min	–	No	Perm.	4.2/T1.112.4
9 *bis*.3	UDT messages received	Msgs	P, R P	5 min 30 min	9.7 & 9 *bis*.4	No	Perm.	4.1/T1.112.4
9 *bis*.4	UDTS messages received	Msgs	P, R, F P, F	5 min 30 min	–	No	Perm.	4.2/T1.112.4
9 *bis*.5	CR messages sent to MTP plus ISDN-UP embedded CRs (ffs)	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.1/T1.112.4
9 *bis*.6	CREF messages sent to MTP	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.2/T1.112.4
9 *bis*.7	CR messages received from MTP plus ISDN-UP embedded CRs (ffs)	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.1/T1.112.4
9 *bis*.8	CREF messages received from MTP	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.2/T1.112.4
9 *bis*.9	RSR messages sent to MTP	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.7/T1.112.4
9 *bis*.10	RSR messages received from MTP	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.7/T1.112.4
9 *bis*.11	ERR messages sent to MTP	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.10/T1.112.4
9 *bis*.12	ERR messages received from MTP	Msgs	P, R P	5 min 30 min	–	No	Perm.	3.10/T1.112.4
9 *bis*.13	XUDT messages sent (ffs)	Msgs	P, R P	5 min 30 min	–	No	Perm.	4.1/T1.112.4
9 *bis*.14	XUDTS messages sent (ffs)	Msgs	P, R, F P, F	5 min 30 min	–	No	Perm.	4.2/T1.112.4
9 *bis*.15	XUDT messages received (ffs)	Msgs	P, R P	5 min 30 min	–	No	Perm.	4.1/T1.112.4
9 *bis*.16	XUDTS messages received (ffs)	Msgs	P, R, F P, F	5 min 30 min	–	No	Perm.	4.2/T1.112.4

Table 10/T1.116.2 ISDN User Part Availability

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
10.1	Start of local ISDN-UP unavailable-failure [b)]	Event	F, P, R	On occur.	–	No	Act.	11.2.7/T1.111.4
10.2	Start of local ISDN-UP unavailable – maint. made busy [b)]	Event	P, R, C	On occur.	–	No	Act.	
10.3	ISDN-UP available [b)]	Event	F, P, R, C	On occur.	–	No	Act.	11.2.7/T1.111.4
10.4	Total duration ISDN-UP unavailable [b)]	s	P, N	30 min	10.1, 10.2, 10.3	No	Act.	
10.5	Start of local ISDN-UP congestion [a)]	Event	P, R	On occur.	–	No	Act.	2.12/T1.113.4
10.6	Stop of local ISDN-UP congestion	Event	P, R	On occur.	–	No	Act.	2.12/T1.113.4
10.7	Duration of local ISDN-UP congestion [a)]	s	P	30 min	10.5, 10.6	No	Act.	2.12/T1.113.4
10.8	Start of remote ISDN-UP unavailable [b), c)]	Event/dest.	F, P, C, R	On occur.	–	No	Act.	2.14/T1.113.4 2.15/T1.113.4
10.9	Stop of remote ISDN-UP unavailable [b), c)]	Event/dest.	F, P, C, R	On occur.	–	No	Act.	2.14/T1.113.4 2.15/T1.113.4
10.10	Duration of remote ISDN-UP unavailable [b), c)]	s/dest.	P	30 min	10.8, 10.9	No	Act.	2.14/T1.113.4 2.15/T1.113.4
10.11	Start of remote ISDN-UP congestion [c)]	Event/dest.	P, R	On occur.	–	No	Act.	2.12/T1.113.4
10.12	Stop of remote ISDN-UP congestion [c)]	Event/dest.	P, R	On occur.	–	No	Act.	2.12/T1.113.4
10.13	Duration of remote ISDN-UP congestion [c)]	s/dest.	P	30 min	10.11, 10.12	No	Act.	2.12/T1.113.4

a) If required, this measurement is only activated if the congestion exceeds an implementation-dependent threshold.

b) These measurements are system architecture dependent.

c) Remote measurements are only necessary at gateway signalling points.

NOTE – Managed objects for further study.

Table 11/T1.116.2 ISDN User Part Utilization

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
11.1	Total ISDN-UP messages sent	Msgs/type	N, P, R P, N	5 min 30 min	–	a)	Act.	
11.2	Total ISDN-UP messages received	Msgs/type	N, P, R P, N	5 min 30 min	–	a)	Act.	

a) Only the sum over all message types is obligatory. The count per type is non-obligatory.

NOTE – Managed objects for further study.

Table 12/T1.116.2 ISDN User Part errors

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
12.1	No ack. for ckt. reset within T17	Event/CIC/dest.	F, R	1st & Δ	–	No	Act.	2.10.3.1/T1.113.4
12.2	No GRA received for GRS within T23	Event/CIC/dest.	F, R	1st & Δ	–	No	Act.	2.10.3.2/T1.113.4
12.3	Measurement replaced							
12.4	Measurement replaced							
12.5	RLC not received within T5	Event/CIC/dest.	F, R	On occur.	–	Yes	Act.	2.10.6.2/T1.113.4
12.6	Release initiated due to abnormal conditions	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.10.8.3/T1.113.4
12.7	Circuit BLO (excessive errors detected by CRC)	Event/CIC/dest.	F, R	On occur.	–	No	Act.	T1.111
12.8	Missing blocking ack. in CGBA for previous CGB	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 iv)/ T1.113.4
12.9	Missing unblocking ack. in CGUA for previous CGU	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 iv)/ T1.113.4
12.10	Abnormal blocking ack. in CGBA for previous CGB	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 v)/ T1.113.4
12.11	Abnormal unblocking ack. in CGUA for previous CGU	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 vi)/ T1.113.4
12.12	Unexpected CGBA with abnormal blocking ack.	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 vii)/ T1.113.4
12.13	Unexpected CGUA with abnormal unblocking ack.	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 viii)/ T1.113.4
12.14	Unexpected BLA with abnormal blocking ack.	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 xii)/ T1.113.4

Description of Measurements		Units	Usage	Duration	From	Obl.	Act./Perm.	References
12.15	Unexpected UBA with abnormal unblocking ack.	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.9.2.3 xiii)/ T1.113.4
12.16	No BLA received for BLO within T13 (old 12.3+)	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.10.4/T1.113.4
12.17	No UBA received for UBL within T15 (old 12.3+)	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.10.4/T1.113.4
12.18	No CGBA received for CGB within T19 (old 12.3+)	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.10.4/T1.113.4
12.19	No CGUA received for CGU within T21 (old 12.3+)	Event/CIC/dest.	F, R	1st & Δ	–	Yes	Act.	2.10.4/T1.113.4
12.20	Message format error (old 12.4+)	Event/CIC/dest.	F, R	1st & Δ	–	No	Act.	2.10.5/T1.113.4
12.21	Unexpected message received (old 12.4+)	Event/CIC/dest.	F, R	1st & Δ	–	No	Act.	2.10.5.1/T1.113.4
12.22	Release due to unrecognized info. (old 12.4+)	Event/CIC/dest.	F, R	1st & Δ	–	No	Act.	2.10.5.3/T1.113.4
12.23	Inability to release a circuit [a)]	Event/CIC	F, R	1st & Δ	–	Yes	Act.	2.10.8.1/T1.113.4

a) This measurement is implementation dependent.

NOTE – Managed objects for further study.

Table 13/T1.116.2 Local TC Utilization

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
13.1	Total number of TC messages sent by the node (by message type)	Messages /Type	P, R N	5 min 30 min	–	No	Perm.	
13.2	Total number of TC messages received by the node (by message type)	Messages /Type	P, R N	5 min 30 min	–	No	Perm.	
13.1*bis*	Total number of TC messages sent by the node	Messages	P, R N	5 min 30 min	–	Yes	Perm.	
13.2*bis*	Total number of TC messages received by the node	Messages	P, R N	5 min 30 min	–	Yes	Perm.	
13.3	Total number of components sent by the node	Comps	P, R N	5 min 30 min	–	No	Act.	3.1/T1.114
13.4	Total number of components received by the node	Comps	P, R N	5 min 30 min	–	No	Act.	3.1/T1.114
13.5	(measurement deleted)				–			
13.6					–			
13.7	Number of new transactions in the interval	trans./AE	P,R,N	5 min. (prov)	–	No	Act.	
13.8	Mean nr. of open transaction ids in interval(measured at the start of transactions)	trans./AE	P,R,N	5 min. (prov)	–	No	Act.	
13.9	Not used							
13.10	Cumulative mean duration of transactions	trans./AE	P,R,N	5 min. (prov)	–	No	Act.	
13.11	Maximum nr. of open transaction ids during interval	trans./AE	P,R,N	5 min. (prov)	–	No	Act.	
13.12	Number of open transaction ids > threshold [a)]	event	P,R,N	on occur.	–	No	Perm.	

a) The threshold is pre-defined per Application Entity.

NOTE – Managed objects for further study.

Table 14/T1.116.2 TC Fault Measurements

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
14.1	Protocol error detected in transaction portion (abort received) – with P-abort cause:							2.3/Q.774
	(moved to Annex A)							
	(moved to Annex A)						Act.	
	(moved to Annex A)						Act.	
	d) unrecognized TID [a)]	Event	F, R	1st & Δ	–	Yes	Act.	
	e) resource limitation	Event	F, R	1st & Δ	–	Yes	Act.	
14.2	Protocol error detected in component portion (reject received) – with problem code: (all moved to Annex A)							3.8/T1.114
14.3	TC user generated problems (TC-user Reject received):							3.8/T1.114
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	d) resource limitation (invoke problem)	Event	F, R	1st & Δ	–	No	Act.	
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
14.4	Protocol error detected in component portion – with problem code:							2.3/T1.114
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	d) unrecognized TID	Event[a)]	F, R	1st & Δ	–	No	Act.	

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
	e) resource limitation	Event	F, R	1st & Δ	–	No	Act.	
14.5	Protocol error detected in component portion (reject sent) – with problem code (all moved to Annex A):							8/T1.114
14.6	TC-user generated problems TC-user reject sent:							8/T1.114
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	d) resource limitation (invoke problem)	Event/dest. User	F, R	1st & Δ	–	No	Act.	
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
	(moved to Annex A)							
14.7	Nr. of TC_L_CANCEL indications for class 1 operations	Inds.	F,R	5 min. (prov)	–	No	Perm.	8/T1.114
14.8	Nr. of messages discarded (all reasons) [b)]	Messages	F,R	5 min. (prov)	–	No	Perm.	8/T1.114
14.9	Not used							
14.10	Nr. of provider aborts received	Messages	F,R	5 min. (prov)	–	No	Perm.	8/T1.114
14.11	Nr. of rejects received	Comps	F,R	5 min. (prov)	–	No	Perm.	8/T1.114
14.12	Nr. of errors detected in transaction portion	Messages	F,R	5 min. (prov)	–	No	Perm.	8/T1.114

a) The address of the peer TC entity should be logged against this event

b) Includes END messages with unrecognized TIDs

NOTE – Managed objects for further study.

Annex A
(informative)

A Fault Measurements pertinent to development of TC and its users

Table A1/T1.116.2 Fault Measurements pertinent to development of TC and its users

	Description of Measurements	Units	Usage	Duration	From	Obl.	Act./Perm.	References
14.1	Protocol error detected in transaction portion (abort received) – with P-abort cause:							2.3/Q.774
	a) unrecognized message type	event	F,R	1st.&Δ	-	Yes	act.	
	b) Incorrect TP	event	F,R	1st.&Δ	-	Yes	act.	
	c) Badly formatted TP	event	F,R	1st.&Δ	-	Yes	act.	
14.2	Protocol error detected in component portion (reject received) – with problem code:							3.8/T1.114
	a) unrecognized component (general problem)	event	F,R	1st.&Δ	-	Yes	act.	
	b) mistyped component (general problem)	event	F,R	1st.&Δ	-	Yes	act.	
	c) badly structured component (general problem)	event	F,R	1st.&Δ	-	Yes	act.	
	d) unrecognized linked id (invoke) (invoke problem)	event	F,R	1st.&Δ	-	No	act.	
	e) unrecognized invoke id (return result problem)	event	F,R	1st.&Δ	-	No	act.	
	f) return result (RR) unexpected (return result problem)	event	F,R	1st.&Δ	-	No	act.	
	g) unrecognized invoke id (RE) (return error problem)	event	F,R	1st.&Δ	-	No	act.	
	h) return error (RE) unexpected (return error problem)	event	F,R	1st.&Δ	-	No	act.	

Chapter T1.116.3

Management Functions MRVT, SRVT, CVT and Definition of the OMASE-User

Management Functions MRVT, SRVT, CVT and Definition of the OMASE-User

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1 Introduction

This standard contains the informal text descriptions of the functions MRVT, SRVT and CVT, the semi-formal description of the OMAP ASE (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 modeled by the managed object at the initiating signalling point (SP) to communicate with similar resources at other SPs, using the Signalling System Number 7 (SS7) network and protocol, in order to audit certain SS7 data. The network is also checked in these audits on its use of this data.

See figure 1/T1.116.3 for an illustration of the OMAP model for these functions.

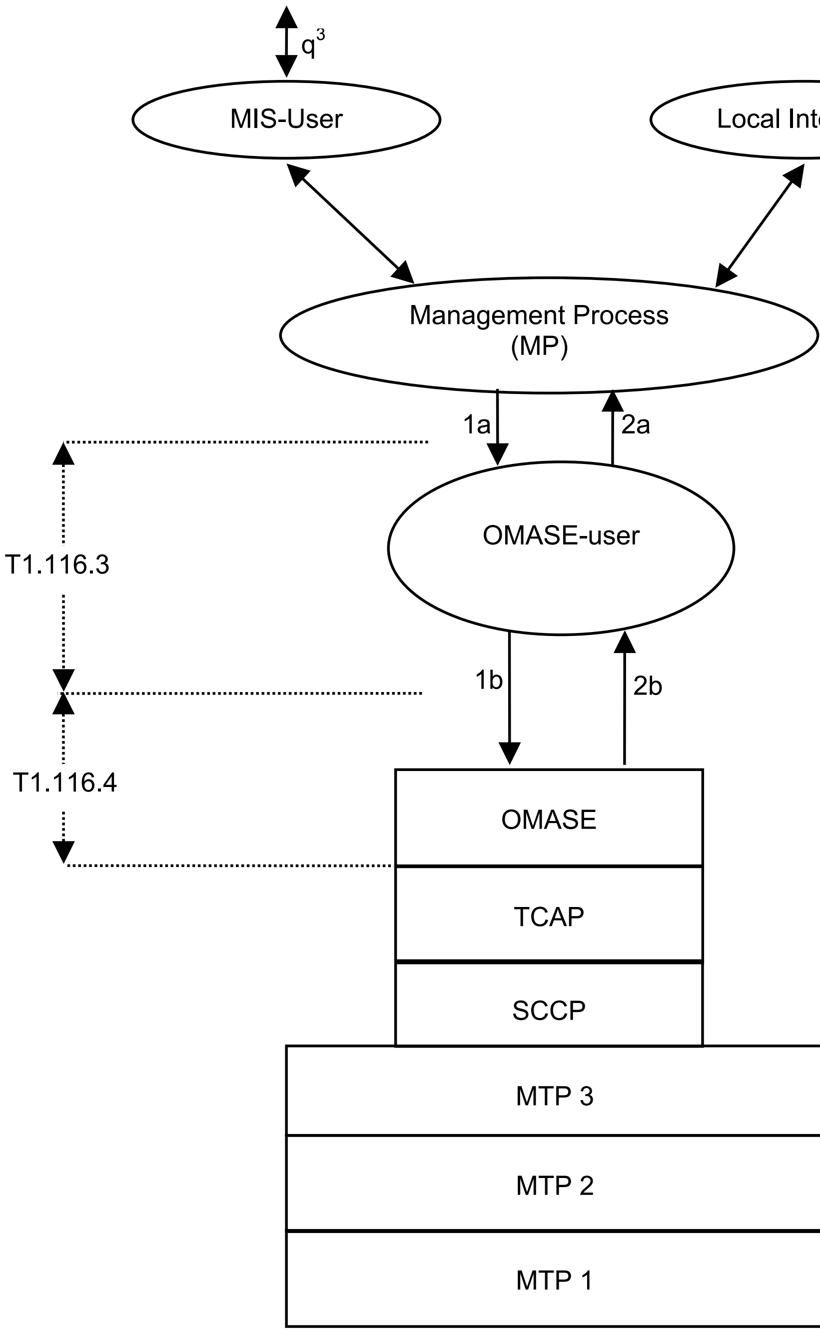

Figure 1/T1.116.3 Application Layer and Application Process Model

In this standard, 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 an 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 T1.116.4-2000.

1.1 Normative References

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

T1.111-2001, *Signalling System Number 7 - Message Transfer Part (MTP)*.[1]

T1.112-2001, *Signalling System Number 7 - Signalling Connection Control Part.*[1]

T1.113-2000, *Signalling System Number 7 - ISDN User Part.*[1]

ITU-T Rec. Q.541 (03/93), *Digital exchange design objectives - General*.[2]

ITU-T Rec. Q.543 (03/93), *Digital exchange performance design objectives*.[2]

ITU-T Rec. Q.544 (11/88), *Digital exchange measurements*.[2]

ITU-T Rec. Z.100 (11/99), *Specification and Description Language (SDL)*.[2]

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) The MRVT should be independent of the MTP routing policy.

b) The MRVT should be independent of link set failures.

c) No modifications to the MTP protocol specification should be needed.

d) A response (positive or negative) is to be given at all tests.

e) The MRVT should be independent of network structure.

f) The procedure should:

   i) detect loops in MTP routing;

   ii) detect excessive-length routes;

   iii) detect unknown destinations;

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[1] This document is available from the Alliance for Telecommunications Industry Solutions <http://www.atis.org>.
[2] This document is available from the International Telecommunications Union. < http://www.itu.int/ITU-T/>.

iv) detect indirect routing within the network;

v) detect inefficient routing within the network.

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 Signalling Transfer Points (STPs) crossed. The procedure is independent of signalling link set availability status. The test is started in any SP for any destination that 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 tables in the network only if all intermediate SPs have routing access to the initiator and no errors are detected at intermediate SPs.

Note that in this document the term "known or known point code" indicates that routing access is available to the point code, and "unknown" indicates that routing access is not available.

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

The MRVT procedure is applied to individual MTP routing tables. If the MTP is to use structured routing tables, then the procedure (and/or its initiation) is for further study (e.g., testing an entire set of point codes in one test).

2.2.1.1 Backwards Compatibility

If an MRVA, MRVR, or MRVT message received at an SP contains information extra to that defined in clause 2.2.2, the extra information is ignored unless it is contained as spare sub fields within defined fields, in which case it will be sent onwards. If an intermediate SP receives an unrecognized parameter in an MRVT or MRVA message, that parameter shall be sent onwards to the next SP. In the case of an MRVR or MRVA message received at the test initiator, the unrecognized information in a known parameter is given to SP Management; if a parameter is unknown, its identifier and the information contained in the parameter are given to SP Management.

The presence of the infoRequest parameter in the MRVT message identifies a post-Issue 1 SP. If the infoRequest parameter is present in the MRVT message, and the test requires that an MRVR message be returned to the test initiator, then a post-Issue 1 MRVR message, the routeTraceNew as defined in T1.116.4-2000, should be sent to the test initiator. The superset of the information requested in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result should be returned to the test initiator. If the information requested is the point code, this should be the point code of the SP sending the MRVR message, unless required otherwise due to the specific result.

If the infoRequest parameter is not present in the MRVT message and the test requires that an MRVR message be sent to the test initiator, an Issue 1 MRVR, routeTrace, should be sent to the test initiator. For results to be reported to the test initiator but have no corresponding representation in the MRVR routeTrace (i.e., indirect route, inefficient route), the result "local conditions" should be used as a default.

If the returnUnknownParams parameter together with the infoRequest parameter is present in the MRVT message received, the SP shall return in the copyData parameter of the MRVR message any unknown parameters in the MRVT message received that are requested in the returnUnknownParams parameter.[3] If the infoRequest parameter is not present and the test requires that an MRVR message be sent to the the

[3] Unknown parameters can be identified by their tag and length.

test initiator, an Issue 1 MRVR message, routeTrace, is returned. In the case of "unknown test initiator," the unknown parameters and any additional information (see 2.2.4.2.1 and 2.2.4.3) are placed in the MRVA message's copyData parameter sent to the sender of the MRVT message. An intermediate post-Issue 1 SP shall not insert the infoRequest nor returnUnknownParams parameters into the MRVT message if they were not present in the received MRVT message.

If the routePriorityList parameter is not present in the received MRVT message, an intermediate post-Issue 1 SP will add the routePriorityList parameter and will compare the length of the pointCodesTraversed parameter with the routePriorityList parameter and backfill the route priority list with the value "unknown (0)" before adding the priority of the route used to reach the adjacent SP. This allows post-Issue 1 SPs to detect true loops in the network.

An Issue 1 SP is not required to perform the direct route check or generate the associated parameters. If a post-Issue 1 SP receives an MRVT message without the direct route check parameter, the direct route check is not performed. For MRVT messages generated in response to an MRVT message received, the post-Issue 1 SP is required to generate the direct route check parameter that will indicate, "direct route check not requested."

2.2.2 The MRVT Messages

The MTP routing verification test procedure uses three 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 (the SCCP protocol layer information for the MRVT message shall indicate “return on error” (see T1.112.3-2001, clause 3.6) so that SCCP will not discard the MRVT message if SCCP cannot route the message). The MRVT message contains:

a) information indicating an MRVT message;

b) the Point Code of the test destination;

c) the Point Code of the initiator;

d) the threshold N of the maximum allowed number of STPs crossed (including the initiator if it has an STP function);[4]

e) the information indicating that a trace (i.e., MRVR) is requested; the possible values are:

   i) 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; or

   ii) 0 = no detailed information requested (the MRVR messages sent only if a failure or inconsistency is detected).

f) the list of STPs crossed, including the initiator Point Code if it has an STP function;

g) the list containing the priority of the route selected by each STP in the STPs crossed list;

h) the information indicating that a direct route check is requested; the possible values are:

[4] Determined by the network administration and held in the OMASE-User.

i) 1 = direct route check requested on all routes; or

ii) 0 = direct route check not requested.

i) information requested by the initiator to be returned in a response[5]; The possible values are:

i) the point code;

ii) the point code list; or

iii) the route priority list.

j) information indicating the unknown parameters to be returned when responding to the test initiator; and

k) local return SP.

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.

The SCCP protocol layer information for the MRVA message shall not indicate “return on Error” (see T1.112.3-2001, clause 3.6) because OMAP does not regenerate MRVA messages.

The MRVA message contains:

a) Information indicating an MRVA message;

b) Information indicating whether 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 message 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 SP does not know the initiator of the test);

vii) test cannot be run due to local conditions (e.g., unavailability of processing resources or MRVT message rejected due to screening);

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[5]The information requested is returned in an MRVR only if a failure or inconsistency is detected at any SP processing the MRVT messages, or if a trace is requested and the MRVT is successful at the tested destination. See footnote 4.

viii) wrong SP (the MRVT message arrived at an SP that does not have the STP function and is not the test destination);

ix) indirect route detected in the network;

x) success to gateway;

xi) detected inefficient route;

d) The following information to be returned, in the copyData parameter, to the previous SP when the test initiator is unknown:

i) information requested by the test initiator in the infoRequest parameter,

ii) the information specified in clause 2.2.2.3 for the specific test result, and

iii) any unknown parameters requested in the returnUnknownParams parameter.

Note that in the case of success, only (a) will be present; in the cases of partial success and failure, (a), (b), and (c), and possibly (d) will be present.

2.2.2.3 The MTP Routing Verification Result (MRVR) Message

The MRVR message is sent from an SP to the initiator of the MTP routing verification test.

The SCCP protocol layer information for the MRVR message shall not indicate “return on Error” (see T1.112.3-2001, clause 3.6) because OMAP does not regenerate MRVR messages.

The MRVR message contains:

a) information indicating an MRVR message;

b) the Point Code of the test destination;

c) the result of the test;

d) the information field; This field contains the information requested by the test initiator in the infoRequest parameter and the information given below for the particular result of the test:

i) If the result of the test is "success",

1) the Point Codes of the STPs crossed contained in the MRVT message, and

2) the associated route priorities contained in the MRVT message if the test initiator is a post-Issue 1 SP.

ii) If the result of the test is "detected loop",

1) the list of STPs crossed contained in the received MRVT message augmented by the point code of the SP detecting the loop, and

2) the associated route priorities contained in the MRVT message if the test initiator is a post-Issue 1 SP;

iii) If the result of the test is "detected excessive length route",

1) the Point Codes of STPs crossed contained in the MRVT message, and

2) the associated route priorities contained in the MRVT message if the test initiator is a post-Issue 1 SP;

iv) If the result of the test is "unknown Destination ",

1) no additional information if the test initiator is an Issue 1 node,

2) the Point Codes of the STPs crossed contained in the MRVT message if the test initiator is a post-Issue 1 SP, and

3) the associated route priorities contained in the MRVT message if the test initiator is a post-Issue 1 SP.

v) If the result of the test is "MRVT not sent due to inaccessibility",

1) the Point Code of the inaccessible SP, if the test initiator is an Issue 1 SP; or

2) the Point Codes of all the inaccessible SPs if the test initiator is a post-Issue 1 SP,

vi) If the result of the test is "MRVA not received",

1) the identity of the SP(s) from which an MRVA message was not received.

vii) If the result of the test is "unknown initiator Point Code",

1) the Point Code of the SP returning an MRVA message that caused the MRVR message to be sent.

viii) If the result of the test is "test cannot be run due to local conditions",

1) no additional information if the test initiator is an Issue 1 SP, and

2) the Point Code of the SP where the test cannot be run if the test initiator is a post-Issue 1 SP.

ix) If the result of the test is "wrong SP",

1) the Point Codes of the STPs crossed contained in the MRVT message, and

2) the associated route priorities contained in the MRVT message if the test initiator is a post-Issue 1 SP.

x) If the result of the test is "indirect route" (if the test initiator is a post-Issue 1 SP),

1) the Point Code of the SP with no direct return route to the test initiator.

xi) If the result of the test is "success to gateway"),

1) the Point Codes of the STPs crossed and the Point Code of the gateway in the next network, and

2) the associated route priorities contained in the MRVT message (if the test initiator is a post-Issue 1 SP).

xii) If the result of the test is "detected inefficient route" (if the test initiator is a post-Issue 1 SP),

1) the Point Codes of the STPs contained in the MRVT message, and

2) the associated route priorities contained in the MRVT message.

xiii) If there are unrecognized parameters requested to be returned by the initiator or information to be copied from the MRVA message (if the test initiator is a post-Issue 1 SP):

1) a copy of the data requested placed in the "copyData" parameter.

2.2.3 Initiation of the MRVT Procedure at an SP

The procedure is started:

a) when MTP routing data is introduced (it is mandatory that each signalling relation should pass the MRVT procedure successfully before being opened to traffic if possible);

b) when MTP routing data is changed;

c) on receipt of an MRVT message;

d) on demand from local maintenance staff or an operations and maintenance center; or

e) periodically at an SP (having an STP function) to detect cases of mutilation of routing data (the period is network dependent and should be such that the load on the network is not seriously increased).

In case (e) above, the "trace requested" indicator of the MRVT message should be set to 0. In case (c) above, the "trace requested" indicator is obtained from the received MRVT message (see 2.2.2.1). There is no automatic initiation of the MRVT procedures. An MRVT procedure may be performed in response to receiving an MRVT message, but the procedures in clause 2.2.4.1 will not be automatically initiated.

2.2.4 The MRVT Procedure

2.2.4.1 At the Point Initiating the Procedure

2.2.4.1.1 Initial Actions

An SP cannot initiate an MRVT procedure for a test destination until any previous MRVT procedure for that destination completes. The following actions are performed in sequence at the SP initiating the MRVT procedures:

a) Upon receipt of an MRVT request from SP Management, the initiating SP determines if the test can start due to local conditions. If local conditions do not allow the test to start, SP Management is informed that the test cannot be started at the initiating SP (result “test cannot run due to local conditions”) and no further action is taken.

b) If the destination is unknown, SP Management is informed that the destination is unknown (result “unknown destination”) by the initiating SP and no further action is taken.

c) The SP determines each adjacent signalling point in a signalling route within the MTP routing tables to reach the destination. If the C-link set has an automatic backup function for the MTP routing, the mated STP should be considered as an adjacent node to which an MRVT message shall be sent. SP Management is informed of each inaccessible SP (result “MRVT not sent due to inaccessibility”) from the initiating SP, and the test is allowed to continue to all accessible adjacent SPs.

d) SP Management is informed of each MRVT message that cannot be sent from the test initiator to an SP due to subsystem prohibited status for the OMAP application at the SP (result "test cannot run due to local conditions"), and the test is allowed to continue to all adjacent SPs with available OMAP subsystems.

e) The destination (DPC) of each MRVT message sent is the adjacent SP within the particular route under test. The SP specifies in the infoRequest parameter, the information requested by the test initiator to be returned in a MRVR message upon a failure of the MRVT at any node, or if a trace is requested and the MRVT is successful at the tested destination[6]. The returnUnknownParams parameter (if sent with the infoRequest parameter) is used to indicate the parameters to be returned by earlier Issue SPs. For Issue 2 SPs, the returnUnknownParams parameter is not included in the MRVT message sent by the test initiator[7]. The initiator then begins a guard timing period, T1, and sends the MRVT messages. The initiator then waits for MRVA message messages corresponding to each MRVT message sent.

f) If an MRVT message is rejected[8], SP Management is informed of each SP where the test cannot be run (result "test cannot run due to local conditions").

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. The reception of the last expected MRVA message stops T1. When an MRVA message is received after T1, it is ignored. When all MRVA messages expected have been received or when T1 expires, the test is complete and results, including unrecognized results and information in the copyData parameter (if available), are given to SP Management.

The possible test results at this point in the procedure are listed in 2.2.2.2 c). A test is positive when all expected MRVA messages have been received inside T1 without fault indications.

2.2.4.1.2.2 Reception of an MRVR Message

The reception of an MRVR message causes the information contained in the message, including unrecognized results and information in the copyData parameter (if available), to be given to SP Management (see 2.2.2.3).

2.2.4.2 In an Intermediate Point

2.2.4.2.1 Initial Actions (On Reception of an MRVT Message)

The following steps are performed in sequence until the test completes or stops. If the test is stopped and an MRVA message could not be sent, no further action is taken.

1) If the test cannot be run due to local conditions, the SP determines if the initiator is known.

    a) If the initiator is known, the SP:

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[6]. The information actually returned in the MRVR message is the superset of the information requested by the initiator in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result. Any unknown parameters requested in the returnUnknownParams parameter should be copied in the copyData parameter.

[7]The purpose of the returnUnknownParams parameter is for future backwards compatibility of Issue 2 nodes with post-Issue2 test initiators.

[8] OMAP could receive indication of a rejected MRVT message through the SCCP N-UNITDATA Indication primitive (see T1.112.1-2001, Table 8A) or TCAP Reject or ReturnError messages.

i) sends an MRVR message with the result "local conditions" (see 2.2.2.3 d) viii)) to the test initiator;

ii) sends an MRVA message to the sender of the MRVT message with the result "local conditions" (see 2.2.2.2 c) vii)) and the value of the "traceSent" indicator denoting that an MRVR message was sent; and

iii) stops the test after informing SP Management.

b) If the initiator is unknown, the SP:

i) sends an MRVA message to the sender of the MRVT message with the result "local conditions" (see 2.2.2.2 c) vii)) and the value of the "traceSent" indicator denoting that an MRVR message was not sent (the result “unknown initiating SP”, see 2.2.2.2 c) vi), is not returned in the MRVA message). If the infoRequest parameter is present in the MRVT message received, the following information should be copied into the copyData parameter included in the MRVA message that is sent:

(1) the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in 2.2.2.3 for the specific test result, and

(2) any unknown parameters requested in the returnUnknownParams parameter.

ii) stops the test after informing SP Management.

NOTE - Conditions of this type can be the unavailability of local processing resources, exceeding the maximum number of tests at a given node (implementation dependent threshold), or some other unspecified problem which might be implementation dependent.

2) If the SP receiving an MRVT message is not the test destination (the PC of the test destination is neither the SP's PC nor its alias PC (if applicable)) and does not have the STP function, the SP determines if the initiator is known.

a) If the initiator is known, the SP:

i) sends an MRVR message with the result "wrong SP" (see 2.2.2.3 d) ix)) to the test initiator;

ii) sends an MRVA message to the sender of the MRVT message with the result "wrong SP" (see 2.2.2.2 c) viii)) and the value of the "traceSent" indicator denoting that an MRVR message was sent; and

iii) stops the test after informing SP Management.

b) If the initiator is unknown, the SP:

i) sends an MRVA message to the sender of the MRVT message with the result "wrong SP" (see 2.2.2.2 c) viii)) and the value of the "traceSent" indicator denoting that an MRVR message was not sent (the result “unknown initiating SP” is not returned in the MRVA message). If the infoRequest parameter is present in the MRVT message received, the following information should be copied into the copyData parameter included in the MRVA message that is sent:

(1) the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result, and

(2) any unknown parameters requested in the returnUnknownParams parameter.

ii) stops the test after informing SP Management.

3) If the checks above for “local conditions” and for “wrong SP” do not result in failure, then:

a) If the initiator is unknown:

i) an MRVA message is returned with the result "unknown initiating SP" and the value of the "traceSent" indicator denotes that the MRVR message was not sent. If the infoRequest parameter is present in the MRVT message received, the following information should be copied into the copyData parameter included in the MRVA message that is sent:

(1) the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result, and

(2) any unknown parameters requested in the returnUnknownParams parameter.

ii) The test is then stopped, after informing SP Management.

b) If the destination is unknown, the SP acknowledges the received MRVT message by an MRVA message with indication "unknown Destination", after an MRVR message is sent to the test initiator with the indication “unknown Destination” (see 2.2.2.3d) iv)). An indication is given to SP Management and the test is stopped.

c) If the MRVT sender used a primary route to the test destination to reach the SP and a primary route exists to the test destination via the sender, then MRVR and MRVA messages are returned indicating "inefficient route" (see 2.2.2.3 d) xii) and 2.2.2.2 c) xi) respectively). The test is stopped after SP management is informed. It is a network provider option to check for other inefficient routes; for example, a comparison of the priorities of the outgoing routes could be made against the list of route priorities contained in the received MRVT message.

d) If the PC of the SP is present in the STPs crossed list of the received MRVT message, the intermediate STP should determine whether the previous route chosen (given by the PC of the next STP after its own in the STPs crossed list) requires the transmission of a preventive MTP Transfer-Prohibited (TFP) message to the sender of the received MRVT message (this determination may reflect local policy or provisioned data).

i) If the previous route chosen does require a TFP for the MRVT sender, then, as network provider option, a check for inefficient routes (other than those checked for in the mandatory portion of clause 2.2.4.2.1 item 3) c)) can be made if not previously made as part of the optional test portion of clause 2.2.4.2.1 item 3) c).

(1) If an inefficient route is discovered, then MRVR and MRVA messages are returned indicating "inefficient route" and the intermediate STP takes no further action. The MRVR message contains a list of STPs crossed (which form a loop) and the priorities of routes taken (see 2.2.2.3 d) xii)). If the translation derived multiple Translation Signalling Point (TSP) point codes, each point code is placed in the Compare form in separate destinationPC parameters (and destination SSN parameters if provided) in order of priority. The TSP point code priorities are placed in the destinationPriorities parameter I, the respective order corresponding to the point codes.

(2) If the translation derived multiple destination point codes and subsystem numbers, each point code and subsystem number is placed in the Compare form in separate destinationPC and destinationSSN parameters, respectively, in order of destination priority. The destination priorities are placed in the destinationPriorities parameter in the respective order corresponding to the destinations. If a destination SSN is provided it shall be placed immediately after the destinationPC parameter. If no check for inefficient routes is made or if no inefficient route was found, then an MRVA message is returned to the MRVT sender indicating "success" and no further actions are taken by the intermediate STP.

ii) If the previous route chosen does not require a TFP for the MRVT sender, then an MRVR message is sent to the test initiator indicating "detected loop" with the indications described in clause 2.2.2.3 d) ii). An MRVA message is returned to the sender of the received MRVT message with a "detected loop" indication (see 2.2.2.2 c) i)). The test is stopped (MRVT messages are not regenerated) after SP Management is informed.

e) If an SP receiving an MRVT message has routing access to the initiator as well as the test destination, the SP checks if the direct route check was selected by the initiator. If the option was selected, the intermediate STP checks the route priority list to determine if the route on which the MRVT message was received was a primary route.

i) If the route used by the sender of the MRVT message was a primary route, the intermediate STP checks whether it can route to the initiator via a direct (i.e., without intermediate STPs) route to the sender of the MRVT message. If it cannot, the SP should send an MRVR message to the initiator with the indication "indirect route" (see 2.2.2.3 d) x)). An MRVA message should be sent to the sender of the MRVT message with the indication "indirect route". An indication is given to the SP Management and the test stopped.

ii) If the route used by the sender of the MRVT message is not a primary route, a direct route check is not performed.

f) If the initiator of the test as well as the test destination exist within the SP's routing tables, the SP makes a list "A" of the following adjacent SPs:

i) STPs which are used to route to the destination (according to the MTP routing tables), and

ii) the tested destination, if this is adjacent.

If the adjacent SP which sent the MRVT message is an STP used to route to the destination, this STP is excluded from the list "A". In addition, if the use of a different STP in the MTP routing tables (i.e., not the SP that sent the MRVT) requires the transmission of a preventive TFP message to the SP which sent the MRVT message, this STP, as a network provider option, may also be excluded from the list "A".[9]

Then:

i) If the list "A" is empty, then an MRVA message is returned to the SP that sent the MRVT message to indicate success.

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[9] If this STP is not excluded from the list “A”, all routing data is tested by the MRVT but trace information reported for a “success” indication may contain traces that do not correspond to possible message routes.

ii) If the size of the STPs crossed list is equal to a threshold N in the MRVT message, an excessive length route is detected. An MRVR message is sent to the initiator of the test with the indication “detected excessive length route” (see 2.2.2.3 d) iii)), then an MRVA message is sent to the SP which has sent the MRVT message with the indication "detected excessive length route" (see 2.2.2.2 c) iii)). The test is stopped (MRVT messages are not regenerated) after SP Management is informed.

iii) If one or more SPs in the list "A" are inaccessible for any reason, the Point Codes of such SPs are removed from the list "A". An MRVR message is sent to the test initiator listing all the inaccessible SPs. The test is allowed to continue to all remaining SPs in the list "A". If after the previous step, the list "A" does not contain any Point Codes, an MRVA message is sent to the sender of the MRVT message. The MRVA message indicates that an MRVT message could not be sent due to an inaccessible SP. Otherwise, the test is allowed to continue.

Note - A SP is inaccessible if all routes to the SP are unavailable, or all available routes are congested, so that an MRVT message cannot be sent

iv) If the MRVT message was received over C-links from the mate STP (but for a test not initiated by the mate STP), and the checks above have not resulted in the generation of MRVA message and/or MRVR messages due to problems encountered, the STP will generate an MRVA message to the mate STP indicating success. For the particular MRVT message received, no further action is taken. Otherwise, an STP that receives an MRVT message that was initiated by its mate will continue the test.

v) If an MRVT message can not be sent to a SP due to the subsystem prohibited status for the OMAP application at the SP, the Point Codes of those SPs are removed from the list "A". For each SP removed, an MRVR message is sent to the test initiator. The MRVR message indicates that the "test cannot be run due to local conditions" (see 2.2.2.3 d) viii)) and specifies the Point Code of the SP with the subsystem prohibited status for the OMAP application. The test is allowed to continue to all remaining SPs in the list "A". If the list "A" does not contain any Point Codes after the previous step, then an MRVA message is sent to the sender of the MRVT message with the indication that the "test cannot be run due to local conditions". For the particular MRVT message received, no further action is taken.

vi) In other cases, a timer, T1, is started and MRVT messages are sent to all the SPs in list "A". (The MRVT message can only be sent to the "true" PC of the adjacent SP.) In all cases, including the case where the alias PC resides at the adjacent SP, the DPC in the MTP routing label of the message is the "true" PC). When an MRVT message is sent by a SP with an STP function or any other intermediate SP, the SP adds its identity in the MRVT message sent and the priority of the route to the SP. If the received MRVT message did not contain a list of route priorities, the MRVT messages sent contain a list of route priorities with the unknown route priorities coded as unknown. The other parameters in the received MRVT message and their contents are copied into the MRVT messages that are sent.

vii) If an MRVT message is rejected[10], an MRVR message should be returned to the test initiator indicating that the "test cannot be run due to local conditions" (see 2.2.2.3 d) viii)) and specifying the Point Code of the SP where the test could not be run. The MRVA message sent should also indicate that the test could not be run due to local conditions.

[10]OMAP could receive an indication of a rejected MRVT message through the SCCP N-NOTICE indication primitive (see Table 8B/T1.112.1-2001) or TCAP “reject” or “returnError” messages.

2.2.4.2.2 Subsequent Actions (On Reception of an MRVA Message)

The reception of an MRVA message acknowledges the corresponding MRVT message previously sent. The timer, T1, is stopped when all the expected MRVA messages have been received. 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 [11]received.

If the received MRVT message contained the infoRequest parameter and any national-specific errors were detected at the SP or were indicated in any received MRVA message, the MRVA message that is sent to the sender of the MRVT message should contain the failureTypeNational parameter; otherwise, the failureTypeNational parameter is not included in the MRVA message sent. Currently there are no national-specific errors specified for the MRVT.

If the received MRVT message did not contain the infoRequest parameter and national-specific errors were detected at the SP, the result “local conditions” should be indicated in the failureType parameter in the MRVA message sent; the MRVA message should not contain the failureTypeNational parameter.

The copyData parameter(s) in the received MRVA message(s) are not copied into the subsequent MRVA message sent. If one or more MRVT messages could not be sent due to SP inaccessibility, OMAP applications (sub-systems) at adjacent nodes are prohibited, or MRVT messages are rejected,[8] the returned MRVA message also indicates "MRVT not sent due to inaccessibility" for the first condition, or "test cannot be run due to local conditions" for the second and third conditions.

If in any MRVA message the value of the "traceSent" indicator denotes that the MRVR message was not sent, the SP will do the following:

a) If a copyData parameter is received in the MRVA message, a post-Issue 1 MRVR (routeTraceNew) message is sent to the initiator with an error condition corresponding to the error indication contained in the MRVA message received. The copyData parameter is copied into the MRVR message. Since the information specified in 2.2.2.3 for the specific test result has been included in the copyData parameter, it is not repeated in separate parameters in the MRVR message that is sent.

b) If a copyData parameter is not received in the MRVA message and the result indicates “unknown Initiating SP”, a Issue 1 MRVR (routeTrace) message is sent to the initiator of the test with the error indication “unknown Initiating SP” and the information specified in 2.2.2.3.

If one (or several) MRVA message(s) is not received before T1 expires, an MRVA message is sent and a single MRVR message is sent to the initiator of the test with the indications described in 2.2.2.3. If an MRVA message cannot be sent, no action is taken. If an MRVA message is received after T1 expires, it is ignored.

2.2.4.3 At the Test Destination Receiving an MRVT Message

If the Test Destination is the alias PC of the STP, the STP treats the MRVT message as if it arrived at the test destination. Any corresponding MRVA or MRVR messages sent by the STP insert the "true" PC in the OPC in the MTP routing label. The "true" PC is not considered as an intermediate SP. Therefore, neither the "true" nor the alias PCs are included in the list of STPs crossed of any MRVR message sent. The alias PC is included in the MRVR message as the point code of the test destination (in the Resource Instance field (see T1.116.4-2000)).

[11] The resulting MRVA message is the logical “or” of the results from all the MRVA messages received. Therefore, the MRVA results (encoded as a bit string (see T1.116.4-2000, clause 2.1.1.3.1)) will have the length of the longest MRVA results bit string received.

The following steps are performed in sequence until the test completes or stops:

1) If the test cannot be run due to local conditions, the SP determines if the initiator is known.

   a) If the initiator is known, the SP:

      i) sends an MRVR message with the result "local conditions" (see 2.2.2.3 d) viii)) to the test initiator;

      ii) sends an MRVA message to the sender of the MRVT message with the result "local conditions" (see 2.2.2.2 c) vii)) and the value of the "traceSent" indicator denoting that an MRVR message was sent (if an MRVA message cannot be sent, no action is taken); and

      iii) stops the test after informing SP Management.

   b) If the initiator is unknown, the SP:

      i) sends an MRVA message to the sender of the MRVT message with the result "local conditions" (see 2.2.2.2 c) vii)) and the value of the "traceSent" indicator denoting that an MRVR message was not sent (the result “unknown initiating SP” is not returned in the MRVA message).

      If the infoRequest parameter is present in the MRVT message received, the following information should be copied into the copyData parameter included in the MRVA message that is sent (if an MRVA message cannot be sent no action is taken):

      (1) the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result, and

      (2) any unknown parameters requested in the returnUnknownParams parameter.

      ii) stops the test after informing SP Management.

2) If the SP receiving the MRVT message is not the test destination (the PC of the test destination is neither the SP's PC nor its alias PC (if applicable)) and does not have the STP function, the SP determines if the initiator is known.

   a) If the initiator is known, the SP:

      i) sends an MRVR message with the result "wrong SP" (see 2.2.2.3 d) ix)) to the test initiator if the initiator is recognized;

      ii) sends an MRVA message to the sender of the MRVT message with the result "wrong SP" (see 2.2.2.2 c) viii)) and the value of the "traceSent" indicator denoting that an MRVR message was sent (If an MRVA message cannot be sent no action is taken); and

      iii) stops the test after informing SP Management.

   b) If the initiator is unknown, the SP:

      i) Sends an MRVA message to the sender of the MRVT message with the result "wrong SP" (see 2.2.2.2 c) viii)) and the value of the "traceSent" indicator denoting that an MRVR message was not sent.

ii) If the infoRequest parameter is present in the MRVT message received, the following information should be copied into the copyData parameter included in the MRVA message that is sent:

(1) the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result, and

(2) any unknown parameters requested in the returnUnknownParams parameter.

iii) Stops the test after informing SP Management.

3) If the checks above for “local conditions”, and for "wrong SP" do not result in failure, then:

a) If the initiator is unknown, an MRVA message is returned with the result "unknown initiating SP" and the value of the "traceSent" indicator denotes that the MRVR message was not sent. If the infoRequest parameter is present in the MRVT message received, the following information should be copied into the copyData parameter included in the MRVA message that is sent:

i) the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 2.2.2.3 for the specific test result, and

ii) any unknown parameters requested in the returnUnknownParams parameter.

The test is stopped after informing SP Management.

If the MRVA message cannot be sent no action is taken.

b) If the test continues then:

i) If the test destination receives an MRVT message containing the indication "direct route check = 1", the SP checks whether it can route to the initiator via a direct (i.e., without intermediate STPs) route to the sender of the MRVT message. If it cannot, the SP should send an MRVR message to the initiator with an indication of "indirect route" (see 2.2.2.3 d) x)). An MRVA message is returned to the SP that sent the MRVT message. The test is stopped after informing SP management. If the MRVA message cannot be sent no action is taken

ii) If the MRVT message received contains the indication "traceRequested = 1" (see 2.2.2.1), an MRVR message is sent to the test initiator with the result “success” (see 2.2.2.3 d) i)).

An MRVA message is returned to the SP that sent the MRVT message. The test is stopped after informing SP Management. If the MRVA message cannot be sent no action is taken.

iii) If the tests were not performed the MRVA message is sent without any error indications. The test is stopped after optionally informing SP Management. If the MRVA message cannot be sent no action is taken.

2.3 Internetwork MRVT

This procedure is a supplement to the MRVT that allows its running across network boundaries. In a semi-closed environment, it may not be advisable to send or return trace information of paths in one network to an adjacent network. One network should not be concerned about where an error occurred in another network, only that the error did occur there.

2.3.1 Procedure

In the procedural description that follows, the term "gateway" refers to any SP connected to a non-local network. An “outgoing gateway” is an SP that sends an MRVT message to an interconnecting network. An “incoming” gateway is an SP that receives an MRVT message from an interconnecting network. The connection between two networks may be by A, E, D, or F links. In addition, "terminating network" refers to the network containing the test destination, while "initiating network" shall refer to the network containing the SP initiating the test.

2.3.1.1 Actions at an Outgoing Gateway in an Initiating or Intermediate Network

The outgoing gateway SP may be either the initiator of the test (if the local network is the initiating network) or an intermediate SP. If the outgoing gateway SP is the initiator, the actions specified in clause 2.2.4 are performed. However, in this case, the initiator will not receive any MRVR messages. This means that results are given to SP Management based only on the MRVT messages sent and MRVA messages received.

If the outgoing gateway SP is an intermediate SP, it should first perform the functions as outlined in clause 2.2.4.2.1. However, prior to sending any MRVT message(s) to another network, the outgoing gateway SP shall save the list of STPs crossed (including the Point Code of the outgoing gateway), the Point Code of the incoming gateway in the next network, and the value of the trace requested indicator from the received MRVT message. The trace in the resulting MRVT message(s) sent to the incoming gateway in the next network should then contain only the Point Code of the outgoing gateway in the local network and the Point Codes of the outgoing gateways from the trace in the received MRVT message. Other parameters in the MRVT message sent should contain the same information as the MRVT message received.

Before sending a MRVT message to an incoming gateway in the next network, the SP also checks if there is a test in progress from the same test initiator for the test destination. A test is in progress from the same test initiator if an MRVT message for the test destination has been sent to the remote SP, an MRVA message has not been received for the MRVT message sent and timer T1 has not expired. If a test is in progress, no MRVT message is sent to the incoming gateway in the next network — test results for the incoming gateway in the next network will be taken from the test results for the test in progress. If a test is not in progress, the SP sends a MRVT message.

The outgoing SP then waits for respective MRVA message(s) to be returned in acknowledgment. Upon reception of an MRVA message, the following actions are taken based on the corresponding condition. The actions are repeated for any new MRVT messages with the same test destination and same test initiator that were received while waiting for the MRVA message.

a) If the received MRVA message indicates success and a trace was requested (trace requested = 1), then an MRVR message is returned to the initiator (if the local network is the initiating network) or to the localReturnSP (if the local network is an intermediate network) with the indication of success as described in clause 2.2.2.3. The trace includes the stored list of STPs crossed (including the Point Code of the outgoing gateway) and the Point Code of the incoming gateway in the next network, which are encoded in the pointCodeList parameter. Note that an MRVR message is sent for each MRVA received. An MRVA message is then sent to the sender of the MRVT message according to the procedures described in clause 2.2.4.2.2.

b) If the received MRVA message indicates at least one error, then an MRVR message is returned to the initiator (if the local network is the initiating network) or to the localReturnSP (if the local network is an intermediate network) with the indication "success to gateway" as described in clause 2.2.2.3 d) xi). The trace includes the stored list of STPs crossed (including the Point Code of the outgoing gateway) and the Point Code of the incoming gateway in the next network, which are encoded in the pointCodeList parameter. Note that an MRVR message is sent for each MRVA message received. An MRVA message is sent to the sender of the MRVT message with the "success to gateway" indication and the results of the MRVA messages received according to the procedures described in clause 2.2.4.2.2.

2.3.1.2 Actions at an Incoming Gateway in an Intermediate or Terminating Network

The incoming gateway SP may be either the tested destination or an intermediate SP. The network provider has the option at the incoming gateway to change the tests requested in the MRVT message, change the information requested in the infoRequest parameter, the threshold N of the maximum allowed number of STP's crossed, and to remove the returnUnknownParams parameter.

If the incoming gateway SP is the tested destination, the test completes as defined in clause 2.2.4.3 with the exception that no MRVR message is returned. In the case of error, the MRVA should indicate the error that was detected, denote in the traceSent indicator that an MRVR message was not sent, and should not include a copyData parameter.

If the incoming gateway SP is an intermediate SP, it should first perform the functions as outlined in clause 2.2.4.2.1. In addition, the gateway should check if a test for the same test destination is already in progress. If so, an MRVA message is sent indicating that the "test cannot be run due to local conditions" and the traceSent indicator denoting that an MRVR message was not sent. In the case of an error, when the functions in clause 2.2.4.2.1 are performed, no MRVR message is returned and the MRVA message should indicate the error that was detected, denote in the traceSent indicator that an MRVR message was not sent, and should not include the copyData parameter.

If no error is detected, MRVT messages are sent with the additional localReturnSP parameter. This parameter contains the Point Code of the incoming gateway in the local network. If this parameter is present, all MRVR messages originating in the local network are returned to the Point Code it specifies. If this parameter is not present, then in any returned MRVA messages the "unknown initiator" failure should be indicated in addition to any other failures. The traceSent indicator should also denote that an MRVR message was not sent.

The incoming gateway SP then waits for respective MRVA and MRVR message(s) to be returned in acknowledgment. Upon reception of appropriate MRVAs and MRVRs (or time out waiting) messages, a report is sent to SP Management indicating the result of the test. This report should be similar to that of an initiator. An MRVA message with appropriate indications as specified in clause 2.2.2.2 is then returned to the outgoing gateway in the previous network, and the copyData parameter is not included in the MRVA message. The traceSent indicator in the MRVA message should denote that an MRVA message was not sent.

2.3.1.3 Actions at Other SPs in an Intermediate or Terminating Network

At other SPs in an intermediate or terminating network, the test proceeds according to the procedure specified in clause 2.2.4. MRVR messages are sent to the Point Code specified in the localReturnSP parameter instead of to the "Initiating SP". If the Point Code of the "Local Return SP" is not known, the SP returns a failure MRVA message of reason “unknown initiator” to the sender of the MRVT message with the traceSent indicator denoting that an MRVR message was not sent.

2.3.2 Prevention of Internetwork MRVT Testing

The gateway node in an intermediate or terminating network should have the option of rejecting the request, or continuing the test as previously specified. If it wishes to reject it, two possible alternatives exist:

(a) It may screen the message at the SCCP layer, in which case it may return a UDTS with diagnostic (e.g., unequipped user, or subsystem failure, etc.). As specified in clause 2.3.1.1, the outgoing gateway SP in the previous network returns MRVA and MRVR messages indicating “test cannot run due to local conditions”.

(b) It may screen the message at the OMAP layer or MRVT level and send an MRVA message indicating “test cannot run due to local conditions”. Indeed, while this provides the most information, it puts a processing burden on the gateway node, which doesn't want to run the test to begin with. In this case, it is the tested destination that is inaccessible.

Note that in the case of any errors in an intermediate or terminating network, an MRVR message is returned to the localReturnSP with the “success to gateway” indication.

2.4 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 is sent to the SP that has sent the messages with the indications described in clause 2.2.2.3. When an SP receives such an unexpected MRVR message, the SP Management is notified.

2.5 Timer Definitions and Values

2.5.1 T1[12] for MRVT

T1 at an SP initiating an MRVT message is the guard time waiting for all MRVA messages in response to the MRVT message sent from the initiator.

$$\mathrm{T1}_{\mathrm{Initiator}} = D_{mrvt}\left(N_{mrvt} + 1\right)$$

where D_{mrvt} is the estimated maximum delay between TSPs (see 2.5.2) and N_{mrvt}, defined in the MRVT procedure, is the maximum number of relays allowed.

T1 at an Intermediate Signalling Point (ISP) is the guard time associated with a received MRVT message, waiting for all MRVA messages in response to all MRVT messages sent.

$$\mathrm{T1}_{\mathrm{ISP}} = \mathrm{T1}_{\mathrm{Previous\ SP}} - D_{mrvt}$$

2.5.2 Delay for MRVT

$$D_{mrvt} = \mathrm{MAX}_{(\tau_{\mathrm{M1}})} + \mathrm{MAX}_{(\tau_{\mathrm{M2}})} + \mathrm{MAX}_{(\tau_{\mathrm{M3}})} + \mathrm{MAX}_{(\tau_{\mathrm{M4}})}$$

where,

τ_{M1} is the time to transfer an MRVT message between applications. This includes the overhead time of the respective network layer functionality.

τ_{M2} is the time to process MRVT request at the application level. In an ISP, this is the time between the reception of an MRVT message and the sending of the MRVT messages to the concerned SPs. It may also be the time to send a responding MRVA message if an error is detected. In the tested destination, it is the time between the reception of an MRVT message and the sending of the MRVA message to the point sending the MRVT message.

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[12] The value of timer could be increased if the priority of the MRV Test is low at the nodes of the network. This approach requires discretion: T1 should be short enough to give a true picture of the network’s routing, but long enough to provide a low message frequency.

τ_{M3} is the time to transfer an MRVA message between applications. Again, this includes the overhead time of the respective network layer functionality.

τ_{M4} is the time to process an MRVA received at the application level. This includes the compilation of any results into the result of test for the next MRVA. This is the time between the reception of the last MRVA message and the sending of the MRVA message to the previous Signalling Point.

Performance Time	Estimated Maximum Value
τ_{M1}	2 seconds (provisional)
τ_{M2}	3 seconds (provisional)
τ_{M3}	2 seconds (provisional)
τ_{M4}	1 second (provisional)
D_{mrvt}	8 seconds (provisional)

2.6 OMAP model for MRVT

See figure 1/T1.116.3 for a diagram. The OMAP model assumes that the logic defined in clause 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 clause.

NOTE - The MRVT initiator's OMASE-User runs a timer T1 in addition to the T1 timer run in TC, which is marginally greater than the TC T1 timer. This extra timer at the initiator guards against rare untoward happenings, e.g., ill-formed APDUs passed from TC to OMASE.

2.6.1 Mapping Primitives

Table 1/T1.116.3 Mapping Text-Defined Actions to OM Service Primitives

"a" interface	"b" interface
1a sendMRVT	1b OM-CNF-ACTION request
2a receiveMRVT	2b OM-CNF-ACTION indication
1a sendMRVA	1b OM-CNF-ACTION response
2a receiveMRVA	2b OM-CNF-ACTION confirm
1a sendMRVR	1b OM-EVENT-REPORT request
2a receiveMRVR	2b OM-EVENT-REPORT indication

2.6.2 State Transition Diagrams for MRVT Procedure

Figure 2/T1.116.3 shows the state transition diagrams according to the Specification and Description Language (SDL), ITU-T Rec. Z.100. This gives the logic in the OMASE-User.

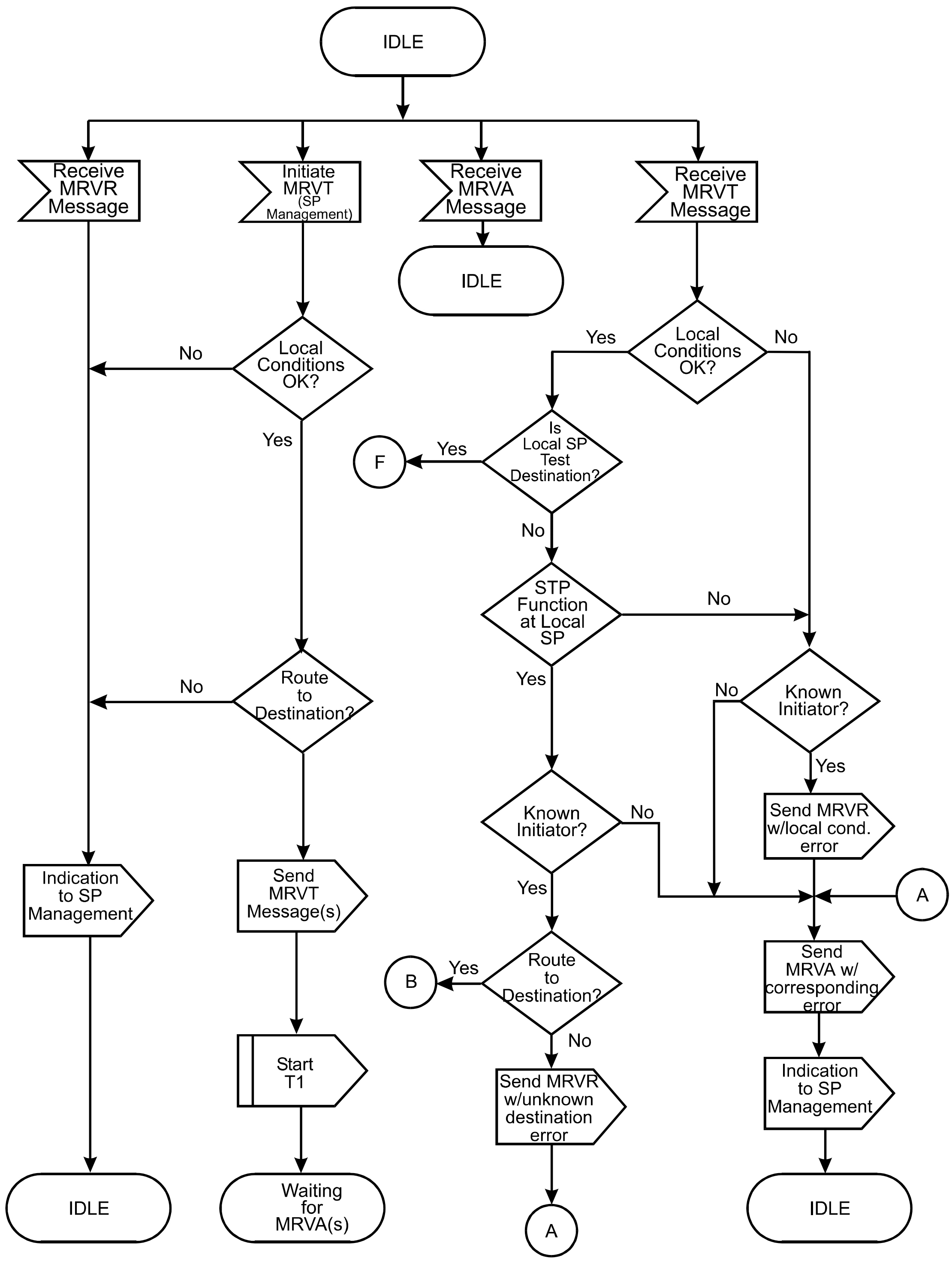

Figure 2/T1.116.3 MTP Routing Verification Test (Sheet 1 of 5)

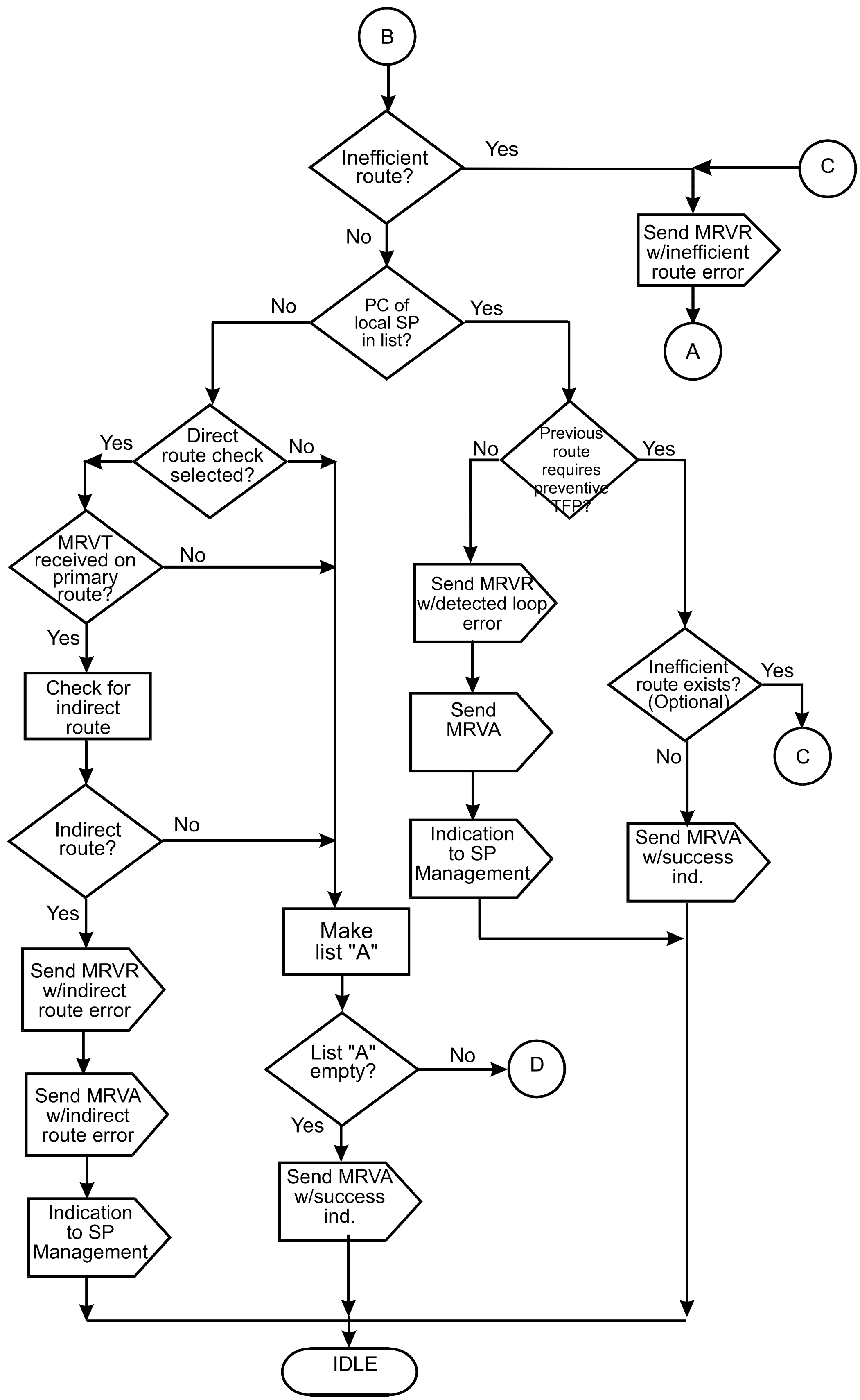

Figure 2/T1.116.3 MTP Routing Verification Test (Sheet 2 of 5)

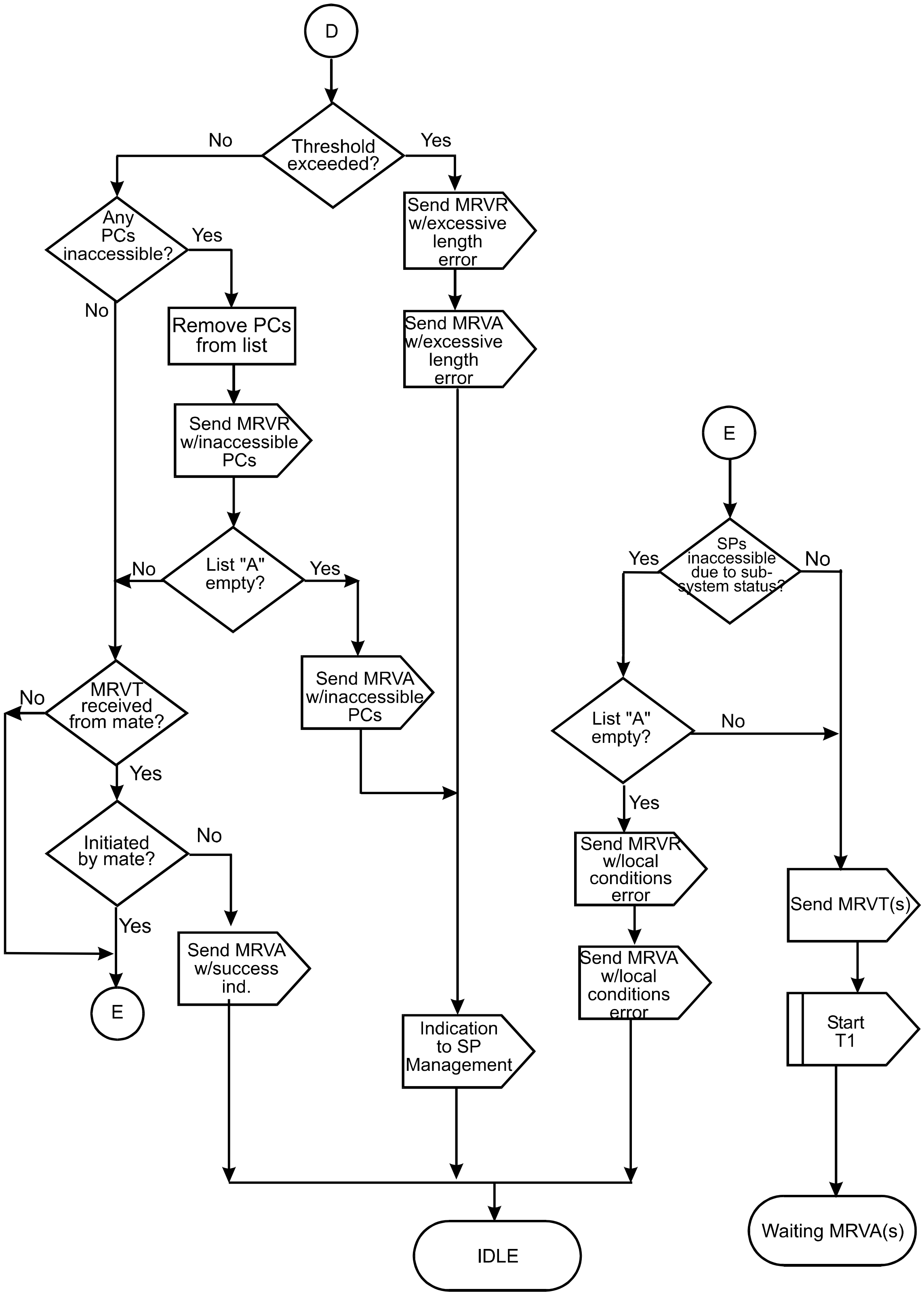

Figure 2/T1.116.3 MTP Routing Verification Test (Sheet 3 of 5)

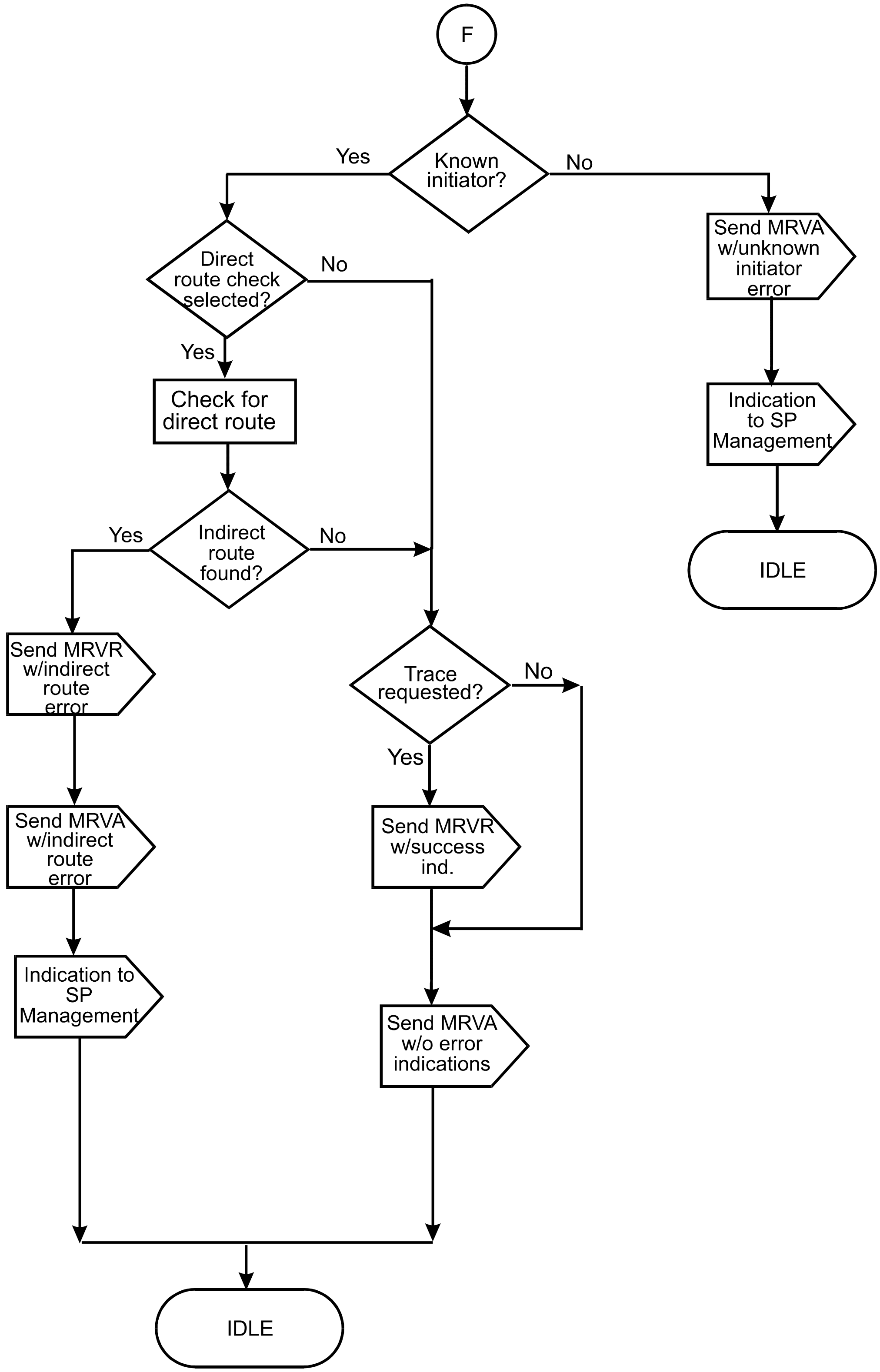

Figure 2/T1.116.3 MTP Routing Verification Test (Sheet 4 of 5)

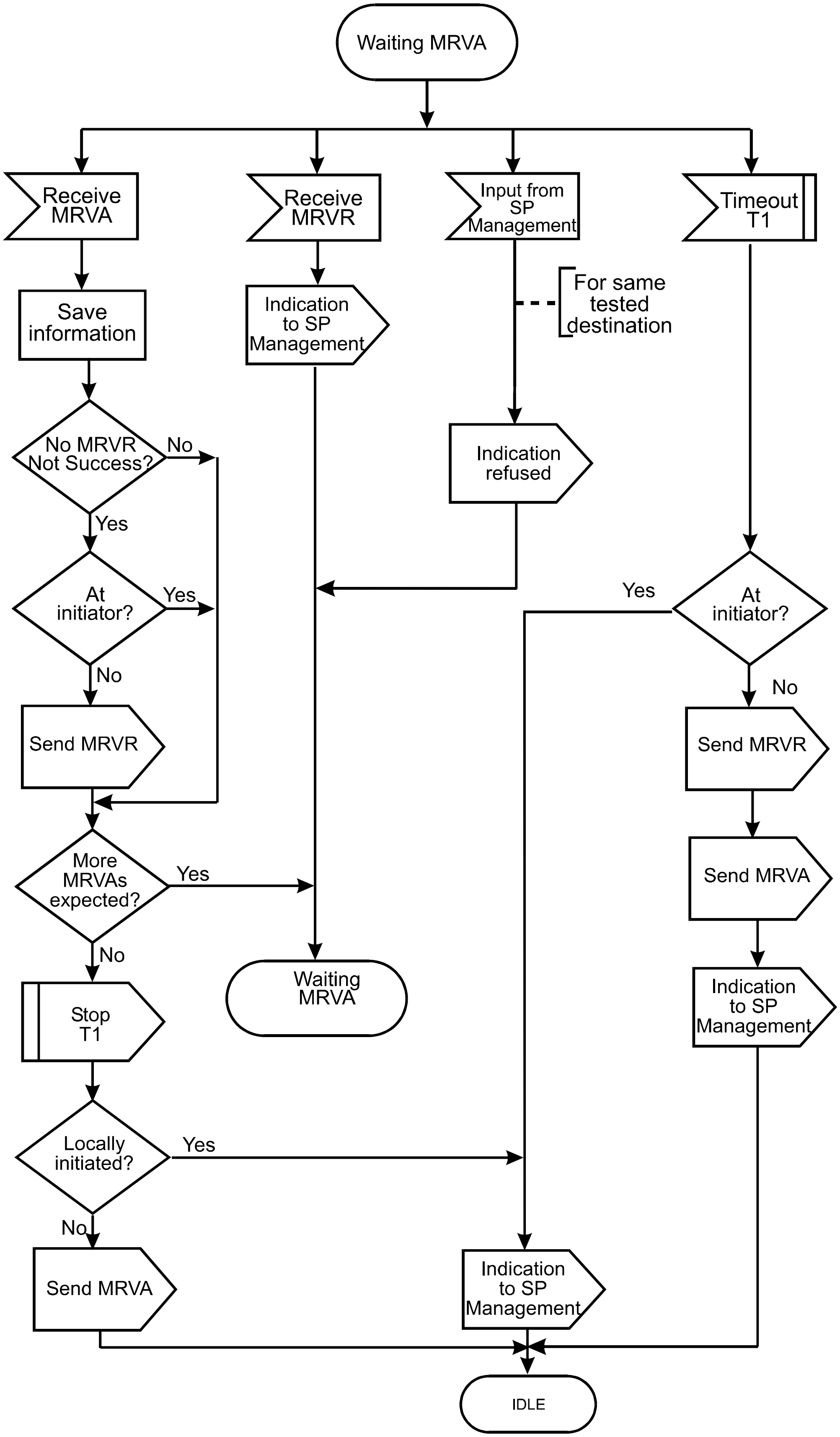

Figure 2/T1.116.3 MTP Routing Verification Test (Sheet 5 of 5)

3. SCCP Management Functions

3.1 General

At present, the only SCCP management function defined in this standard is the SCCP Routing Verification Test (SRVT).

3.2 Network Routing Management - SCCP Routing Verification Test

3.2.1 Requirements upon an SCCP Routing Verification Test (SRVT)

The SCCP routing verification test requirements are as follows:

a) No modification should be needed to the SCCP protocol specification.

b) The SRVT should be independent of the SCCP routing policy.

c) The SRVT should be independent from the network structure.

d) The SRVT is not required to verify MTP routing correctness; the MRVT is expected to do this.

e) A response (either positive or negative) is to be given to all tests.

f) The procedure should:

   i) be able to check all possible SCCP routes, including parallel SCCP routing points (this is understood to mean duplex Translation Signalling Points (TSPs)), serial SCCP routing points (this is understood to mean multiple TSPs), multiple destinations corresponding to the tested Global Title (this is understood to be multiple SPs and subsystem numbers);

   ii) detect loops in the SCCP routing;

   iii) detect unknown destinations (i.e., a destination does not correspond to the tested Global Title); and

   iv) verify Global Title Translation data for accuracy, completeness, and consistency.

3.2.2 Specific SCCP Routing Verification Tests

3.2.2.1 General Procedure Considerations

The 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 designed for the case of a single MTP network. 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 to be specified. The initiator of the test is alerted.

Alias point codes cannot be used in the SRVT test for the:

a) DPC of an SRVT Compare Message;

b) OPC of an SRVT, SRVA or SRVR message; or

c) a trace entry in the list of Tested Point Codes (TPCs) crossed in the SRVT or SRVR message.

Alias point codes may be used for the following cases:

a) DPC of the SRVT message;

b) in the SRVR message for the result "SRVA not received", the PC from where the SRVA message was not received (only in the case where the alias point code was used to route to the adjacent TSP); or

c) point code of the adjacent TSP where local conditions detected for the result "test cannot be run due to local conditions" in the SRVR message.

It should be noted that when the Test Global Title Indicator (GTI) + (Global Title (GT) changes as a result of the translation, the Original GTI + GT assumes the value of the Test GTI + GT prior to translation on the first occurrence of this event. Subsequent changes to the Test GTI + GT do not change the Original GTI + GT. The Input GTI + GT always assumes value of the Test GTI + GT prior to a change due to the translation.

3.2.2.1.1 Backwards Compatibility

If an SRVA, SRVR, or SRVT message received in an SP contains information extra to that defined in clause 3.2.2.2, the extra information contained as spare sub fields within defined fields, will be sent onwards.

If an intermediate SP receives an unknown[13] parameter in an SRVT or SRVA message, that parameter shall be sent onwards to the next SP. In the case of an SRVR or SRVA message received at the test initiator, the unrecognized information in the parameters is given to SP Management. If a parameter is unknown, its identifier and the information contained in the parameter are given to SP Management.

The presence of the infoRequest parameter in the SRVT message identifies a post-Issue 1 SP. If the infoRequest parameter is present in the SRVT message and the test requires an SRVR message to be sent to the test initiator, a post-Issue 1 SRVR message, the routeTraceNew as defined in T1.116.4-2000, should be sent to the test initiator; the superset of the information requested in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result should be returned to the test initiator. If the information requested is the point code, it should be the point code of the SP sending the SRVR, unless required otherwise due to the specific result. The SRVA that is sent to the sender of the SRVT message should contain the failureTypeNational parameter if any national-specific errors were detected at the SP or were indicated in any received SRVA message. Otherwise, the failureTypeNational parameter is not included in the SRVA sent.

If the infoRequest parameter is not present in the SRVT message and the test requires an SRVR to be sent to the test initiator, an Issue 1 SRVR, the routeTrace as defined in T1.116.4-2000, should be sent to the test initiator. For results to be reported to the test initiator that have no corresponding representation in the SRVR routeTrace (see 3.2.2.2.2 c) xxviii), xix), xx), and xxi); and 3.2.2.2.3 c) xx), xxi), xxii), and xxiii)), the result "local conditions" should be used as a default. The SRVA that is sent to the sender of the SRVT message should not contain the failureTypeNational parameter. If any national-specific errors were detected at the SP (see 3.2.2.2.2 c) xviii), xix), xx), and xxi)), the result “local conditions” should be indicated in the failureType parameter in the SRVA sent.

If the returnUnknownParams parameter is present together with the infoRequest parameter in the SRVT message received, the SP shall return in the copyData parameter of the SRVR message any unknown parameters in the SRVT message received that are requested in the returnUnknownParams parameter. If

[13] Unknown parameters can be identified by their tag and length.

the infoRequest parameter is not present and the test requires that an SRVR be sent to the test initiator, an Issue 1 SRVR, routeTrace, is returned.

In the case of "unknown test initiator," the unknown parameters and any additional information (see 3.2.2.4.2 and 3.2.2.4.3) are placed in the SRVA message's copyData parameter sent to the sender of the SRVT message.

An intermediate SP shall not insert the infoRequest nor returnUnknownParams parameters into the SRVT message if they were not present in the received SRVT message.

3.2.2.2 Messages

The SCCP Routing Verification Test uses three OMAP messages that are specified by the OMAP Application Service Element.

3.2.2.2.1 SCCP Routing Verification Test (SRVT) Message

The SRVT message is sent from an SP initiating the appropriate part of the SRVT procedure based on the function (e.g., initiator, translation) 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, or an Intermediate TSP (ITSP). The destination of the message is a 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 TSP (FTSP), i.e., the last SP that performs the Global Title Translation service, the Tested Destinations derived from the Global Title Translation.

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

The SCCP protocol layer information for the SRVT message shall indicate “return on Error” so that SCCP will not discard the SRVT message if SCCP cannot route the message (see T1.112.3-2001, clause 3.6.).

The message contains:

a) information indicating an SRVT message;

b) the Form Indicator (Compare or No Compare);

c) the information indicating that a trace (SRVR) is requested; the possible values are:

   i) 1 = SRVR messages are returned from the test destination for all routes used to reach the test destination regardless of the result of the test; or

   ii) 0 = SRVR messages are only returned if a failure or inconsistency is found at the test destination.

d) the Test GTI + GT - Global Title Indicator + Global Title (Tested GT: Destination GT: Terminating GT);

e) the MTP Backward Routing Requested Indicator for SRVR;

f) the Initiator PC - Point Code from which test was initiated;

g) the Initiator GTI + GT - Global Title Indicator + Global Title;

h) the DPC - Point Code of a Translation SP or Tested Destination SP;

i) the Destination SSN - Optional Subsystem Number based on DPC;

j) the Backup DPC - Point Code where mated subsystem is located (Mate Tested Destination SP);[14]

k) the Backup SSN - Optional Subsystem Number based on Backup DPC;[13]

l) the threshold N of maximum allowed number of crossed TSPs (including mate TSPs);

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) information requested by the test initiator returned in a response.[15] The possible values are:

    i) the point code;

    ii) the point code list;

(p) information indicating the unknown parameters to be returned when responding to the test initiator;

(q) the Input GTI + GT - Global Title Indicator + Global Title (the Test GTI + GT prior to translation at the TSP);

(r) the Local Return SP - the SP to which a local SRVR should be sent; and

(s) Destination Priorities - priorities of Translation SPs or Tested Destination SPs+SSNs resulting from translation.[13]

3.2.2.2.2 SCCP Routing Verification Acknowledgment (SRVA) Message

The SRVA message is the standard message sent in response to an SRVT message. It carries the results of the test and is sent back using direct routing on the Originating Point Code (OPC).

The SCCP protocol layer information for the SRVA message shall not indicate “return on Error” (see T1.112.3-2001 clause 3.6) because OMAP does not regenerate SRVA messages.

The SRVA message contains:

a) information indicating an SRVA message;

b) information indicating whether an SRVR has been sent;

c) the reason for any failure (partial or complete)or inconsistency. If a failure or inconsistency has occurred, one or more of the following indications are present:

    i) unknown Global Title for the GTI + GT at TSP;

[14] There is no Backup DPC nor Backup SSN when a solitary destination is tested.

[15] The information requested is only returned in an SRVR if a failure or inconsistency is detected at any SP processing the SRVT message, or if a trace is requested and the SRVT is successful at the tested destination. The information actually returned in the SRVR message is the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result.

ii) incorrect translation for PPC + SSN at FTSP;

iii) incorrect translation for SPC + SSN at FTSP;[14, 16]

iv) incorrect intermediate translation for next TPC or new GT at ITSP;

v) SRVT message arrived at wrong SP (Compare form of SRVT arrived at an SP that is not the mated TSP of the sender, or a Request form of SRVT arrived at an SP that is not an TSP);

vi) the tested destination of the Global Title address does not serve GTI + GT as a destination;

vii) the secondary destination of the Global Title address does not serve GTI + GT as the secondary destination;[14, 15]

viii) the tested destination of the Global Title address does not recognize the Backup DPC+ SSN as its mated node/subsystem; [14]

ix) the secondary destination of the Global Title address does not recognize the PPC + SSN as the primary destination for the GTI + GT;[14, 15]

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);

xv) unknown initiator -- the Initiator PC is unrecognized if the MTP Backward Routing Requested Indicator is set, or the Initiator GT is unrecognized if the MTP Backward Routing Requested Indicator is not set;

xvi) test cannot be run due to local conditions, (e.g., unavailability of processing resources, or SRVT message rejected due to screening);

xvii) success to gateway;

xviii) correct DPC+SSNs at FTSPs but different priorities;

xix) correct DPCs+SSNs at intermediate TSPs but different priorities;

xx) FTSP routing data not checked with tested destination coordinated state change data; or

xxi) no coordinated state change routing information present at destination.

d) the following information to be returned to the previous SP when the test initiator is unknown:

[16] For purposes of backward compatibility these error codes are retained so that Issue 1 nodes can continue to use this code and so that post-Issue 1 nodes can interpret them. Codes (iii), (vii), and (ix) are redundant with (ii), (vi), and (viii) respectively, and should be deleted when Issue 1 nodes no longer exist. Post-issue 1 nodes should not initiate error codes (iii), (vii), and (ix).

i) information requested by the test initiator in the infoRequest parameter;

ii) the information specified in clause 3.2.2.2.3 for the specific test result; and

iii) any unknown parameters requested in the returnUnknownParams parameter.

Note that in the case of success, only (a) will be present; in the cases of partial success and failure, (a), (b), (c) and possibly (d) will be present.

3.2.2.2.3 SCCP Routing Verification Result (SRVR) Message

The SRVR message is sent from an SP, which stops the test, to the initiator. 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 if the MTP Backward Routing Requested Indicator is set, or using Global Title Translation on the Initiator Global Title if the MTP Backward Routing Requested Indicator is not set.

The SCCP protocol layer information for the SRVR message shall not indicate “return on Error” (see T1.112.3-2001 clause 3.6) because OMAP does not regenerate SRVR messages.

The SRVR message contains:

a) information indicating an SRVR message;

b) the result of the test;

c) the information field; this field contains the information requested by the test initiator in the infoRequest parameter and the information given below for the particular result of the test:

  i) if the result of the test is "success",

    1) the Point Codes of the crossed TSPs contained in the SRVT message;

  ii) if the result of the test is "detected loop",

    1) the Point Codes of the TSPs which are in the loop;

  iii) if the result of the test is "detected excessive length route",

    1) the Point Codes of crossed TSPs contained in the SRVT message;

  iv) if the result of the test is "unknown Global Title",

    1) no additional information, if the test initiator is an Issue 1 SP,

    2) the Point Codes of the crossed TSPs contained in the SRVT message, if the test initiator is a post-Issue 1 SP;

  v) if the result of the test is "SRVT not sent due to inaccessibility",

    1) the Point Code of the inaccessible SP;

  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",

1) the Point Code of the SP returning an SRVA to cause the SRVR to be sent;

viii) if the result of the test is "test cannot be run due to local conditions",

1) no additional information, if the test initiator is an Issue 1 SP,

2) the Point Code of the SP where the test cannot be run, if the test initiator is a post-Issue 1 SP (the SSN is not included; it is always OMAP);

ix) if the result of the test is "wrong SP"

1) the Point Codes of the TSPs contained in the SRVT message;

x) if the result of the test is "incorrect-Translation - ",

1) the Point Codes of the TSPs contained in the SRVT message;

xi) if the result of the test is "incorrect-Translation - Secondary",[17]

1) the Point Codes of the TSPs contained in the SRVT message;

xii) if the result of the test is "incorrect-Translation - Intermediate",

1) the Point Codes of the TSPs contained in the SRVT message;

xiii) if the result of the test is "not a Destination",

1) the Point Codes of the TSPs contained in the SRVT message;

xiv) if the result of the test is "not Secondary Destination",

1) the Point Codes of the TSPs contained in the SRVT message;

xv) if the result of the test is "not Mated Destination",

1) the Point Codes of the TSPs contained in the SRVT message;

xvi) if the result of the test is "not Recognized Secondary Destination",

1) the Point Codes of the TSPs contained in the SRVT message;

xvii) if the result of the test is "routing problem",

1) the Point Codes of the TSPs contained in the SRVT message;

xviii) if the result of the test is “success to gateway”,

[17] For purposes of backward compatibility these error codes are retained so that Issue 1 nodes can continue to use these codes and so that post-Issue 1 nodes can interpret them. Codes xi), xiv), and xvi) are redundant with x), xiii), and xv) respectively and should be deleted when Issue 1 nodes no longer exist. Post-issue 1 nodes should not initiate error codes xi), xiv), and xvi).

1) the Point Codes of the TSPs crossed and the PC of the gateway TSP in the next network;

xix) if the result of the test is “correct DPCs+SSNs at FTSP but different priorities,”

1) the Point Codes of the crossed TSPs contained in the SRVT message;

xx) if the result of the test is “correct DPCs+SSNs at intermediate TSP but different priorities,”

1) the Point Codes of the crossed TSPs contained in the SRVT message;

xxi) if the result of the test is “FTSP routing data not checked with tested destination coordinated state change data,”

1) the Point Codes of the crossed TSPs contained in the SRVT message; or

xxii) if the result of the test is “no coordinated state change information available at destination,”

1) the Point Codes of the crossed TSPs contained in the SRVT message.

d) the Test GTI + GT from the SRVT message sent by the test initiator (Note: this is the Test GTI + GT parameter if the Original GTI + GT parameter is not present in the received SRVT message; otherwise it is the Original GTI + GT. This information is placed in the Tested Destination (Resource Instance Value) parameter (see T1.116.4-2000));

e) if there are unrecognized parameters requested to be returned by the initiator or information to be copied from the SRVA message (if the test initiator is a post-Issue 1 SP):

i) a copy of the data requested placed in the copy Data parameter.

3.2.2.3 Test Initiation

The procedure is started when there is an input from OA&M SP Management resulting in the sending of an SRVT message. The test is initiated,

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

b) when SCCP translation data is changed;

c) on receipt of an SRVT message (see 3.2.2.4.2.1);

d) on demand from local maintenance staff or an operations and maintenance center; or

e) 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). No additional trace information should be requested.

3.2.2.4 Procedures

The capability to execute a complete SRVT is found in 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 duplex translation procedures are found in the TSPs.

3.2.2.4.1 Initiating Point

The procedure is started when there is an input from SP Management as defined under the conditions of clause 3.2.2.3. It is initiated at an SP with SCCP capabilities in the network and is triggered by an SRVT request. The SRVT request shall include the Global Title of the tested destination. It shall also include the information requested to be returned in an SRVR message. An SCCP Node cannot initiate an SRVT procedure for a test destination until any previous SRVT procedures for that destination have completed. If local conditions prevent sending an SRVT message or the route is unavailable to the TSP, the test is stopped and the results are reported to SP Management.

3.2.2.4.1.1 Initial Actions

The following actions are performed in sequence at the SP initiating the SRVT procedures:

a) Upon receipt of an SRVT request on a given Global Title from SP Management, the initiator determines if the test cannot start due to local conditions. If local conditions do not allow the test to start, SP Management is informed that the test cannot be started at the initiating SP (result “test cannot be run due to local conditions”) and no further action is taken.

b) If local conditions allow the test to start, the initiator determines the TPC(s) of the initial Global Title Translation. SP Management is informed of each inaccessible TSP (result “SRVT not sent due to inaccessibility”) from the initiating SP, and the test is allowed to continue to all accessible TSPs.

c) SP Management is informed for each SRVT message that cannot be sent from the test initiator to a TSP due to subsystem prohibited status for the OMAP application at the TSP (result “test cannot be run due to local conditions”). and the test is allowed to continue to all adjacent SPs with available OMAP subsystem.

d) The initiator SP formats the SRVT messages for the TPC(s) determined previously for the initial Global Title Translation. If TSPs are mated, the SRVT need only be sent to one of them. The SP specifies in the infoRequest parameter the information requested by the test initiator to be returned in an SRVR message upon a failure of the SRVT at any node, or if a trace is requested and the SRVT is successful at the tested destination.[18] The returnUnknownParams parameter (if sent with the infoRequest parameter) is used to indicate the parameters to be returned by earlier Issues SPs. For Issue 2 SPs, the returnUnknownParams is not included in the SRVT message sent to test initiator.[7]

   The initiator then begins a guard timing period, T2, and sends the SRVT messages. The initiator then waits for SRVA messages corresponding to each SRVT message 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).

e) If an SRVT message is rejected,[19] SP Management is informed of each TSP where the test cannot be run (result “test cannot be run due to local conditions”).

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[18] The information actually returned in the SRVR message is the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result. Any unknown parameters requested in the returnUnknownParams parameter should be copied in the copyData parameter.

[19] OMAP could receive an indication of a rejected SRVT message through the SCCP N-NOTICE indication primitive (see Table 8B/T1.112.1-2001) or TCAP "reject" or "returnError" messages.

3.2.2.4.1.2 Subsequent Actions

3.2.2.4.1.2.1 Reception of an SRVA Message

Upon receipt of all SRVA messages, the test's initiator stops the guard timer, T2, and the test is complete. The results are reported to SP Management in accordance with the structure of the result of test and information parameters (see 3.2.2.2.1) and proper actions are taken to fix any problems. If the timer expires before receipt of an SRVA message, the result "Time out waiting for SRVA message" (see 3.2.2.2.2 c) x)), is reported to SP Management along with the Point Code of the SP. If the copyData parameter is present in the SRVA and or SRVR message, the information in the parameter is reported with any results in the message to SP Management.

3.2.2.4.1.2.2 Reception of an SRVR Message

The reception of an SRVR message causes the information contained in the message, including parameters and information that are not recognized by the test initiator and unrecognized results and information in the copyData parameter (if available) to be given to SP Management (see 3.2.2.2.3).

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 that emerge. Due to the nature of the Global Title, further translation may be 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 or an ITSP for the translation of the Global Title. It performs the final Global Title Translation to determine at least one Destination Point Code+Subsystem (DPC+SSN)). Note that the initiator does not know if it sends an SRVT message to an ITSP or FTSP.

3.2.2.4.2.1 Upon Receipt of an SRVT Message

The following steps are performed in sequence until the test completes or stops.

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

a) checks if the test cannot be run due to local conditions:

   i) If local conditions prohibit the continuing of the test, the TSP attempts to send an SRVR to the initiator, an SRVA with " traceSent" indication set appropriately and the corresponding result parameter (see 3.2.2.2.2 c) xvi)) to the OPC, and an indication to SP Management. The test is stopped.

      Note - Conditions of this type can be the unavailability of local processing resources, exceeding the maximum number of tests at a given node (implementation dependent threshold), 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) If an SP that is not designated as a TSP receives an SRVT the SP:

   i) sends an SRVR message with the result "wrong SP" (see 3.2.2.2.3 c) ix)) to the test initiator,

   ii) sends an SRVA to the sender of the SRVT, and

   iii) stops the test after informing SP Management.

c) attempts to translate the GTI + GT either to DPC(s)+SSNs of Tested Destination(s) or to a new GTI + GT:

i) If the SP is unable to perform the translation, the reason for failure is equal to "unknown Global Title". The SP attempts to send an SRVR to the initiator, an SRVA message with " traceSent" indication set appropriately and corresponding result parameter (see 3.2.2.2.2 c) i)) to the OPC, and an indication to SP Management.

ii) If the TSP recognizes that further translation is needed, a TPC(s) is derived from the GTI + GT.

iii) If the translation is final and successful, the DPC(s)+SSN(s) of a Tested Destination(s) is derived from the GTI + GT and retained.

iv) The TSP determines the Test GTI + GT for any SRVT messages to be sent. If the translation derived a new (i.e. different) global title, the Test GTI+GT for any SRVT messages sent is the new global title value. If translation did not derive a new global title, the Test GTI + GT for any SRVT messages sent is the Test GTI + GT in the received SRVT message.

d) checks for mated TSP;

i) If a mated TSP exists for the current TSP, an SRVT message is sent to the mate so that it may perform a duplex translation for comparison purposes. The comparison is described in the procedure for Duplex translation in 3.2.2.4.2.3. If translation derived a new Global Title, 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.

If the translation derived multiple TSP point codes, each point code is placed in the compare form in separate destinationPC parameters (and destination SSN parameters if provided) in order of priority. The TSP point code priorities are placed in the destinationPriorities parameter in the respective order corresponding to the point codes.

If the translation derived multiple destination point codes and subsystem numbers, each point code and subsystem number is placed in the compare form in separate destinationPC and destinations parameters, respectively, in order of destination priority. The destination priorities are placed in the destinationPriorities parameter in the respective order corresponding to the destinations. If a destination SSN is provided it shall be placed immediately after the destinationPC parameter.

If the translation did not derive a new global title and the SRVT received did not contain an Original GTI + GT parameter, then the SRVT message sent to the mate TSP does not contain an Original GTI + GT parameter. After the sending of the SRVT, the test proceeds with step e).

ii) If no mated TSP exists, the test proceeds with step e).

e) examines the list of TPCs (see 3.2.2.2.1 m)) (only if the TSP is not the initiator; otherwise the test proceeds with step f)).

i) If the Point Code of the next TSP or the Point Code of the duplex of the next TSP (if present) appears in the SRVT's list of TPCs, then the SP attempts to send an SRVR to the initiator. If an SRVT Compare was sent, the SP waits for an SRVA. Upon receipt of the SRVA (or time out waiting), another SRVR is sent (if the test initiator is known) and if the SRVA indicates an error was detected at the duplex TSP and the “traceSent” indicator denotes that an SRVR was not sent. Compare results are incorporated with the "SCCP loop detected" error. Regardless of whether an SRVR was sent, the SP sends an SRVA with the "traceSent" indication set appropriately and at least an "SCCP loop detected" indication (see 3.2.2.2.2 c) xii)) to the OPC, and an indication to SP Management. The test is stopped.

ii) If the number of Point Codes in the SRVT's list of TPCs is greater than or equal to a predefined threshold number of translation point codes, then the SP attempts to send an SRVR to the initiator. If an SRVT compare was sent, the SP waits for an SRVA. Upon receipt of the SRVA (or time out waiting), another SRVR is sent (if test initiator is known) and if the SRVA indicates an error was detected at the duplex TSP and the “traceSent” indicator denotes that an SRVR was not sent. Compare results are incorporated with the "excessive length route" error (see 3.2.2.2.3 c) iii)). Regardless of whether an SRVR was sent, the SP sends an SRVA message with "traceSent" indication set appropriately and at least the "threshold exceeded" indication (see 3.2.2.2.2 c) xiii)) to the OPC, and an indication to SP Management. The test is stopped.

iii) If neither the Point Code(s) of the next TSP(s) nor that of the next TSP’s duplex (if present) appears in the SRVT's list of TSPs, then the TSP will add both its own Point Code and the Point Code of the mated TSP (if any) to the list of TSPs.

f) attempts to send an SRVT message to the next TPC(s) or Tested Destination(s) (from c) above).

i) If the TSP is unable to send the SRVT due to node inaccessibility, then for each inaccessible node, an SRVR message is sent (if the test initiator is known). It indicates that an SRVT message was not sent due to node inaccessibility and specifies the inaccessible Point Code. If no SRVT messages can be sent due to node inaccessibility, the SP sends an SRVA message with the " traceSent" indication set appropriately to the sender of the SRVT message and an indication is given to SP Management. The SRVA message indicates that an SRVT message could not be sent due to SP inaccessibility. The test is allowed to continue.

Note - A SP is determined to be inaccessible if all routes to the SP are unavailable, or all available routes are congested, so that an SRVT cannot be sent.

ii) If the TSP is unable to send the SRVT due to the subsystem prohibited status for the OMAP application at the destination, then, for each such destination, an SRVR message is sent (if the test initiator is known). The SRVR message indicates that the "test cannot be run due to local conditions" (see 3.2.2.2.3 c) viii)) and specifies the Point Code of the SP where the test cannot be run if the test initiator is a post-Issue 1 SP. If no SRVT messages can be sent due to the subsystem prohibited status for the OMAP application at the destination, the SP sends an SRVR to the test initiator (if the test initiator is known), an SRVA message with the "traceSent" indication set appropriately to the sender of the SRVT message, and an indication is given to SP Management. The SRVA message indicates that the "test cannot be run due to local conditions" (see 3.2.2.2.2 c) xvi)). The test is allowed to continue.

iii) If an SRVT may be sent, a guard timer, T2, is started and SRVT message(s) are sent to either the next TPC(s) or the Tested Destination(s), identified by DPC(s)+SSN(s),resulting from attempted translation. This timer is the guard for SRVA(s) received in response to both the Compare and No Compare SRVT messages. If the Global Title Translation yielded more than one DPC+SSN for replicated nodes/subsystems, the Backup DPC+SSN is determined for each SRVT message sent as follows. Let D_i ($i \geq 1$) be a destination (including subsystem) with priority (D_i) ≥ priority (D_{i+1}), for all i. If for any even i priority (D_i) = priority (D_{i+1}), then a

Backup DPC+SSN is not included in any of the SRVT messages sent. Otherwise, for $D_{i =odd}$, the Backup DPC+SSN is that of D_{i+1}, for $D_{i =even}$, the Backup DPC+SSN is that of $D_{i -1}$.[20]

The value of the "traceRequested " indicator is obtained from the received SRVT message.

If the SRVT received contained an Original GTI + GT parameter, then the SRVT message sent contains an Original GTI + GT parameter set to the value of the received Original GTI + GT value. If the SRVT received did not contain an Original GTI + GT parameter, then:

1) if the translation derived a new GTI + GT, then the SRVT message sent contains an Original GTI + GT parameter set to the value of the Test GTI + GT and the Test GTI + GT parameter set to the derived GTI + GT.

2) if the translation did not derive a new Global Title, then the SRVT message sent does not contain an Original GTI + GT parameter.

g) If an SRVT message is rejected,[18] an SRVR message should be sent to the test initiator (if the test initiator is known) indicating that the "test cannot be run due to local conditions"(see 3.2.2.2.3 (c)(viii)) and specifying the Point Code of the SP where the test could not be run if the test initiator is a post-Issue 1 SP. The SRVA message sent, with the " traceSent" indication set appropriately, should also indicate that the test could not be run due to local conditions.

NOTE - In any of the tests above, a) through f)), if an SRVR message shall be sent, the following shall be performed:

i. If the received SRVT contained an Original GTI + GT parameter, then the Test Destination, the Resource Instance Value in the SRVR message, 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 Test Destination for any SRVR message sent is the value of the Test GTI + GT parameter in the received SRVT message.

ii. The TSP determines if the test initiator is known. If the MTP Backward Routing Required indicator was set, a check is made to see if routing on the Initiator PC is possible. If the MTP Backward Routing Requested indicator was not set, a check is made to see if the Initiator GT is recognized.

If no MTP routing information exists or the Initiator GT is unknown, the "unknown initiator" indication (see 3.2.2.2.2 c) xv)) is included with any other applicable results in the SRVA returned to the previous SP with the "traceSent " indicator denoting that no SRVR was sent.

If the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

- the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and

- and any unknown parameters requested in the returnUnknownParams parameter.

3.2.2.4.2.2 Subsequent Actions

Upon receipt of an SRVA message (at a TSP other than the initiator), 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).

[20] In other words, the FTSP assumes every two destinations are mated based on the priorities of the destinations. Note, from the perspective of SCCP, knowledge of mating only exists at the destinations, not at the FTSPs.

b) If all the other expected SRVA(s) have been received, the following actions are taken:

i) The guard timer, T2, is stopped.

ii) Results of the duplicate translation comparison are incorporated into the reason for failure parameters (see 3.2.2.2.2). This is optional in networks not subscribing to the concept of mated TSPs and duplex translations.

iii) If the " traceSent" indication is not set and the received SRVA indicates that error(s) were detected, the SP sends an SRVR message for each error in the failureString with appropriate indications from the SRVA. If the test initiator is a post-Issue 1 SP, the copyData parameter, if present, from the received SRVA is copied into the copyData parameter of the SRVR sent. If the SRVR indication is not set and the SRVA indicates success, no SRVR is sent.

iv) The SP sends an SRVA message in response to the original SRVT message. If an SRVR was sent, the copyData parameter is removed from the SRVA message sent. If an SRVR could not be sent and the test initiator is a post-Issue 1 SP, the copyData parameter is copied from the SRVA messages received with the " traceSent" indications not set. The complete result of test parameter list is retained and the " traceSent" indication is set appropriately.

If the received SRVT message contained the infoRequest parameter and any national-specific errors were detected at the SP or were indicated in any received SRVA message, the SRVA that is sent to the sender of the SRVT message should contain the failureTypeNational parameter; otherwise, the failureTypeNational parameter is not included in the SRVA sent.

If the received SRVT message did not contain the infoRequest parameter and national-specific errors were detected at the SP, the result "local conditions" should be indicated in the failureType parameter in the SRVA sent; the SRVA should not contain the failureTypeNational parameter.

c) if the timer has already expired, the message is discarded.

If the guard timer expires before receipt of all expected SRVA(s), a single SRVR is sent 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 not indicate that an SRVR has 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.

3.2.2.4.2.3 Duplex Translation (Optional)

This procedure is mandatory in networks which have translations duplicated (duplex) at mated SPs.

When a TSP receives an SRVT message with the form indicator set to "Compare", it:

a) determines if the originating SP is a mated TSP to the receiving SP. If not, an SRVA is returned with "SRVT arrived at wrong SP" (see 3.2.2.2.2 c) v)). Optionally, an SRVR is sent to the test initiator with the result, "SRVT arrived at wrong SP" (see 3.2.2.2.3 c) ix)). If the SRVR is not sent to the test initiator, the traceSent indicator in the SRVA denotes that an SRVR was not sent.

In this case, if the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

- the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and
- any unknown parameters requested in the returnUnknownParams parameter.

Otherwise, if the SRVR is sent to the test initiator, the traceSent indicator in the SRVA denotes that an SRVR was sent.

b) attempts a duplex translation and compares the results with information contained in the SRVT message. If the SRVT received contains an Input GTI+GT parameter, the duplex 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 received does not contain an Input GTI + GT parameter, the duplex translation is performed on the Test GTI + GT parameter and the result is compared with the Point Code, Subsystem Number, and Destination Priority information contained in the SRVT message. Clause 3.2.2.4.2.1 d) i) specifies the format of this information as received in the SRVT compare form.

   i) If the results of the duplex 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 exists 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 result, "Unknown Global Title for the GTI + GT" (see 3.2.2.2.2 c) i)).

   If the SRVR is not sent to the test initiator, the traceSent indicator in the SRVA denotes that an SRVR was not sent.

   In this case, if the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

   - the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and
   - any unknown parameters requested in the returnUnknownParams parameter.

   iii) Otherwise, if the SRVR is sent to the test initiator, the traceSent indicator in the SRVA denotes that an SRVR was sent.

   If the results of the duplex 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 message and, optionally, an SRVR is returned to the test initiator with test result equal to one of the following: “incorrect-Translation” (see 3.2.2.2.3 c) x)), “incorrect-Translation-Intermediate” (see 3.2.2.2.3 c) xii)), “correct DPCs+SSNs at FTSP but different priorities” (see 3.2.2.2.3 c) xx)). If the SRVR is not sent to the test initiator, the traceSent indicator in the SRVA denotes that an SRVR was not sent. In this case, if the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

   - the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and
   - any unknown parameters requested in the returnUnknownParams parameter.

Otherwise, if the SRVR is sent to the test initiator, the traceSent indicator in the SRVA denotes that an SRVR was sent.

NOTE: - In any of the tests above, if an SRVR message shall be sent, the following shall be performed:

i) If the received SRVT contained an Original GTI + GT parameter, then the Test Destination, the Resource Instance Value in the SRVR message, 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 Test Destination for any SRVR message sent is the value of the Test GTI + GT parameter in the received SRVT message.

ii) The TSP determines if the test initiator is known. If the MTP Backward Routing Required indicator was set, a check is made to see if routing on the Initiator PC is possible. If the MTP Backward Routing Requested indicator was not set, a check is made to see if the Initiator GT is recognized.

If no MTP routing information exists or the Initiator GT is unknown, the "unknown initiator" indication (see 3.2.2.2.2 c) xv)) is included with any other applicable results in the SRVA returned to the previous SP with the "traceSent " indicator denoting that no SRVR was sent.

If the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

- the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and
- any unknown parameters requested in the returnUnknownParams parameter

3.2.2.4.3 Tested Destination

The tested destination is an SP and subsystem identified at the FTSP through a Global Title Translation. The address is referred to as DPC + SSN. If a Backup DPC+SSN is present in the Verify form, it contains a DPC + SSN that the FTSP has assumed is the mate of the Tested Destination[21]. If the SRVT received at the tested destination contains an Original GTI + GT parameter, then the Tested Destination parameter (the Resource Instance Value) for any SRVR message sent is set to the value of the Original GTI + GT parameter.

The following procedure is performed at all Tested Destinations. When a destination receives the SRVT message, the following analyses and actions are performed in sequence or until the test stops:

a) The destination verifies that it serves as a destination for the GTI + GT. It also verifies that the Backup DPC+SSN (if present) is its mated node/subsystem. If the test is successful, the SP sends an SRVR (if requested in SRVT Message) with "success" indication to the initiator (see 3.2.2.2.3 c) i)), an SRVA with success indication to the OPC, and an indication to SP Management. The test is stopped after the SP management is informed.

b) If the destination does not serve GTI + GT as a destination, the test is unsuccessful and the SP sends an SRVR to the Initiator PC with the indications defined in 3.2.2.2.3 c) xiii), an SRVA with the "traceSent" indication set appropriately and the corresponding result parameter (see 3.2.2.2.2 c) vi)) to the OPC, and an indication to SP Management. The test is stopped after the SP management is informed.

c) If a Backup DPC + SSN is present in the SRVT message, and if the destination does not recognize the Backup DPC + SSN as the mated destination for GTI + GT, then the test is

[21] The mating information is used by SCCP at the destination to perform coordinated state change.

unsuccessful and the SP sends an SRVR to the Initiator PC (see 3.2.2.2.3 c) xv)), an SRVA with the "traceSent" indication set appropriately and the corresponding result parameter (see 3.2.2.2.2 c) viii)) to the OPC, and an indication to SP Management. The test is stopped after the SP management is informed.

d) If a Backup DPC + SSN is present in the SRVT message, but the destination does not have a mated node/subsystem, then the SP sends an SRVR to the Initiator PC with the corresponding result (see 3.2.2.2.3 c) xxii)), an SRVA with the “traceSent” indication set appropriately and the corresponding result parameter (see 3.2.2.2.2 c) xxi)) to the OPC, and an indication to SP Management. The test is stopped after the SP management is informed.

e) If a Backup DPC + SSN is not present in the SRVT message, but the destination does have a mated node/subsystem, then the SP sends an SRVR to the Initiator PC with the corresponding result (see 3.2.2.2.3 c) xxi)), an SRVA with the “traceSent” indication set appropriately and the corresponding result parameter (see 3.2.2.2.2 c) xx)) to the OPC, and an indication to SP management. The test is stopped after the SP management is informed.

f) Checks to determine if the test initiator is known; if the MTP Backward Routing Requested indicator was set, a check is made to see if routing to the Initiator PC is possible. If no MTP routing information data exists, the "Unknown initiator" indication (see 3.2.2.2.3) is included with any other applicable results in the SRVA returned to the previous SP, with the traceSent indicator denoting that an SRVR was not sent. If the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

- the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and
- any unknown parameters requested in the returnUnknownParams parameter.

NOTE: - In any of the tests above, if an SRVR message shall be sent, the following shall be performed:

i) If the received SRVT contained an Original GTI + GT parameter, then the Test Destination, the Resource Instance Value in the SRVR message, 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 Test Destination for any SRVR message sent is the value of the Test GTI + GT parameter in the received SRVT message.

ii) The TSP determines if the test initiator is known. If the MTP Backward Routing Required indicator was set, a check is made to see if routing on the Initiator PC is possible. If the MTP Backward Routing Requested indicator was not set, a check is made to see if the Initiator GT is recognized.

If no MTP routing information data exists or the Initiator GT is unknown, the "unknown initiator" indication (see 3.2.2.2.2 c) xv)) is included with any other applicable results in the SRVA returned to the previous SP with the "traceSent " indicator denoting that no SRVR was sent.

If the infoRequest parameter is present in the SRVT message received, the following information should be copied into the copyData parameter included in the SRVA message that is sent:

- the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.2.2.2.3 for the specific test result, and
- any unknown parameters requested in the returnUnknownParams parameter.

If an SRVA cannot be sent, no further action is taken and the test is stopped after the SP management is informed.

3.3 Internetwork SRVT in a Semi-Closed Environment

This procedure is a supplement to the SRVT which will allow its running across network boundaries. In a semi-closed environment, it may not be advisable to send or return trace information of paths in one network to an adjacent network. One network should not be concerned about where an error occurred in another network, only that the error did occur there.

3.3.1 Procedure

In the procedural description which follows, the term "gateway" refers to a Translation Signalling Point (TSP) returning a non-local point code. It may or may not be directly connected or adjacent to a non-local network. An “outgoing gateway” is an SP that sends an SRVT message to an interconnected network. An “incoming gateway” SP is an SP that receives an SRVT message from an interconnected network.

In addition, "terminating network" refers to the network receiving an SRVT request message; while "initiating network" shall refer to a network sending the SRVT request.

3.3.1.1 Actions at an Outgoing Gateway in an Initiating or Intermediate Network

This outgoing gateway SP may be either the initiator of the test (if the local network is the initiating network) or an intermediate SP. If the outgoing gateway is the initiator, the actions specified in clause 3.2.2.4 are performed. However, in this case, the initiator will not receive any SRVR messages. This means that results are given to SP Management based only on the SRVTs sent and SRVAs received.

If the outgoing gateway SP is an intermediate SP, it should first perform the checks as outlined in clause 3.2.2.4. However, prior to sending any SRVT message(s) to another network, the outgoing gateway SP shall save the list of TSPs crossed (including the PC of the outgoing gateway), the PC of the incoming gateway in the next network, and the value of the trace requested indicator from the received SRVT message. The trace in the resulting SRVT message(s) sent to the incoming gateway in the next network should then contain only the Point Code of the outgoing gateway SP in the local network and the Point Codes of the outgoing gateways from the trace in the received SRVT. The localReturnSP parameter should not be sent to the incoming gateway in the next network. Other parameters in the SRVT sent should contain the same information as the SRVT received.

The outgoing gateway SP then waits for respective SRVA message(s) to be returned in acknowledgment.

Upon reception of an SRVA, the following actions are taken based on the corresponding condition.

a) If the SRVA received from the terminating network indicates and a trace was requested, then an SRVR is returned to the initiator (if the local network is the initiating network) or to the Local Return SP (if the local network is an intermediate network) with the indication of success as described in 3.2.2.2.3 c) i). The trace includes the stored list of TSPs crossed (including the Point Code of the outgoing gateway) and the Point Code of the incoming gateway in the next network. An SRVA message is then sent to the sender of the SRVT message according to the procedures described in clause 3.2.2.4.2.2. Note than an SRVR is returned for each SRVA received.

b) If the SRVA received indicates at least one error, then an SRVR is returned to the initiator (if the local network is the initiating network) or to the Local Return SP (if the local network is an intermediate network) with the indication "success to gateway" as described in 3.2.2.2.3 c) xviii). The trace includes the stored list of TSPs crossed (including the Point Code of the outgoing gateway) and the Point Code of the gateway in the next network, which are encoded in the pointCodeList parameter. An SRVA message is sent to the sender of the SRVT with the "success to gateway" indication and the results of the SRVAs received according to the procedures described in clause 3.2.2.4.2.2. Note than an SRVR is sent for each SRVA received.

3.3.1.2 Actions at an Incoming Gateway in an Intermediate or Terminating Network

This incoming gateway SP may be either the tested destination or an intermediate SP. The network provider has the option at the incoming gateway to change the tests requested in the SRVT message, change the information requested in the infoRequest parameter, the threshold N of the maximum allowed number of STPs crossed, and to remove the returnUnknownParams parameter.

If the incoming gateway SP is the test destination, the test completes as defined in clause3.2.2.4.3 procedure with the exception that no SRVR message is returned. In the case of error, the SRVA should indicate the error that was detected, denoted in the traceSent indicator that an SRVR was not sent, and should not include the copyData parameter.

If the incoming gateway SP is an intermediate SP, it should first perform the functions as outlined in clause 3.2.2.4.2.1. In addition, the gateway should check if a test for the same test destination is already in progress. If so, an SRVA is sent indicating that the "test cannot be run due to local conditions" and the traceSent indicator denoting that an SRVR was not sent. In the case of an error, when the functions in 3.2.2.4.2.1 are performed, no SRVR is returned and the SRVA should indicate the error that was detected, denote in the traceSent indicator that an SRVR was not sent, and should not include a copyData parameter.

If no error is detected, SRVT messages are sent with the additional localReturnSP parameter. This parameter contains the Point Code of the incoming gateway TSP in the local network. If this parameter is present, all SRVRs originating in the terminating network are to be returned to the Point Code it specifies. If this parameter is not present then in any returned SRVAs, the "unknown initiator" failure should be indicated in addition to any other failures. The traceSent indicator should also denote that an SRVR was not sent. The incoming gateway SP then waits for respective SRVA and SRVR message(s) to be returned in acknowledgment. Upon reception of appropriate SRVAs and SRVRs (or time out waiting), a report is sent to SP Management indicating the result of the test. This report should be similar to that of an initiator. An SRVA with appropriate indications as specified in clause 3.2.2.2.2 is then returned to the outgoing gateway in the previous network, and the copyData parameter is not included in the SRVA. The "traceSent " indicator in the SRVA should denote that an SRVR was not sent.

3.3.1.3 Actions at Other SPs in an Intermediate or Terminating Network

At other SPs in an intermediate or terminating network, the test proceeds according to the procedure specified in clause 3.2.2.4. SRVR messages are sent to the Point Code specified in the localReturnSP parameter instead of to the "Initiating SP". If the Point Code of the "Local Return SP" is not known, the SP returns a failure SRVA message of reason unknown initiator to the sender of the SRVT message with the traceSent indicator denoting that an SRVR was not sent.

3.3.2 Prevention of Internetwork SRVT Testing

The gateway node in an intermediate or terminating network should have the option of rejecting the request, or continuing the test as previously specified. If it wishes to reject it, two possible alternatives exist:

a) It may screen the message at the SCCP layer, in which case it may return a UDTS with return cause (e.g. unequipped user, or subsystem failure, etc.). As specify in 3.3.1.1, the outgoing gateway SP in the previous network returns SRVA and SRVR messages indicating “test cannot run due to local conditions”.

b) It may screen the message at the OMAP layer or SRVT level and return an SRVA indicating “test cannot run due to local conditions”. Indeed, while this provides the most information, it puts a processing burden on the gateway node which doesn't want to run the test to begin with. In this case, it is the tested destination which is inaccessible.

Note that in the case of any errors in an intermediate or terminating network, an SRVR is returned to the localReturnSP with the "success to gateway" indication.

3.4 Timer Definitions and Values

3.4.1 T2 for SRVT

T2 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.

$$T2_{Initiator} = D_{srvt}(N_{srvt} + 1)$$

where D_{srvt} is the estimated maximum delay between TSPs (see 3.4.2) and N_{srvt}, defined in the SRVT procedure, is the maximum number of relays allowed.

T2 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.

$$T2_{TSP} = T2_{Previous\ SP} - D_{srvt}$$

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.

3.4.2 Delay for SRVT

$$D_{srvt} = MAX_{(\tau_{S1})} + MAX_{(\tau_{S2})} + MAX_{(\tau_{S3})} + MAX_{(\tau_{S4})}$$

where,

τ_{S1} = The time to transfer an SRVT message between applications. This includes the overhead time of the respective network layer functionality.

τ_{S2} = 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_{S3} = The time to transfer an SRVA message between applications. Again, this includes the overhead time of the respective network layer functionality.

τ_{S4} = The time to process an SRVA received at the application level. This includes the compilation of any results into the result of the test for the next SRVA.

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

3.4.3 OMAP Model for SRVT

This is illustrated in figure 1/T1.116.3. 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 clause.

NOTE - A timer, T2, 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 accommodate rare abnormal events (e.g., ill-formed APDUs being received in OMASE from TC).

3.4.3.1 Text-Defined Actions Mapped to OM Primitives

Table 2/T1.116.3 Mapping of text-defined actions to OM service primitives

"a" interface	"b" interface
1a sendSRVT	1b OM-CNF-ACTION request
2a receiveSRVT	2b OM-CNF-ACTION indication
1a sendSRVA	1b OM-CNF-ACTION response
2a receiveSRVA	2b OM-CNF-ACTION confirm
1a sendSRVR	1b OM-EVENT-REPORT request
2a receiveSRVR	2b OM-EVENT-REPORT indication

3.4.3.2 State Transition Diagram for the SRVT Procedure

Figure 3/T1.116.3 shows the state transition diagrams according to the ITU-T Rec. Z.100. This gives the logic for SRVT in the OMASE-User.

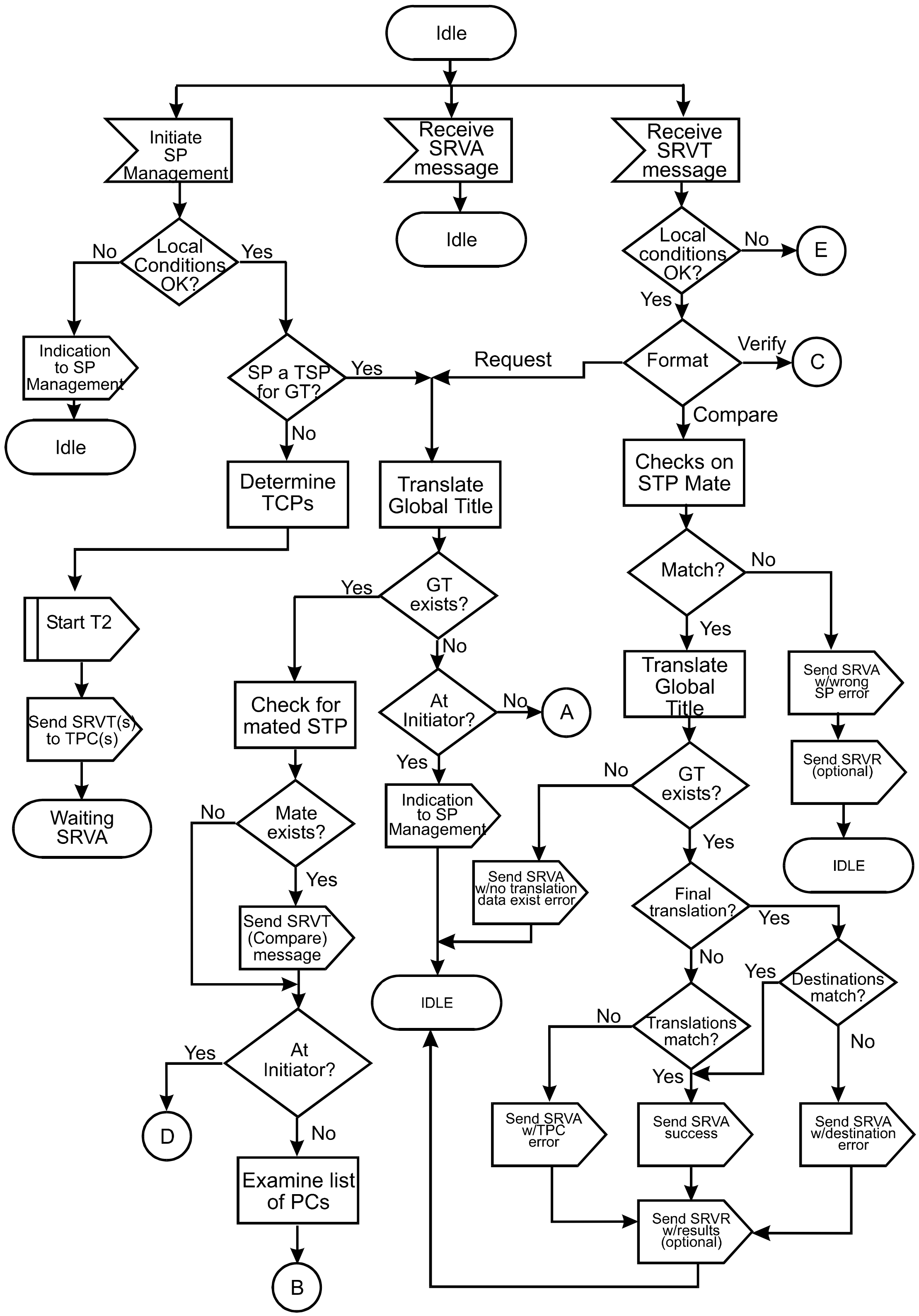


Figure 3/T1.116.3 SCCP Routing Verification Test (Sheet 1 of 4)

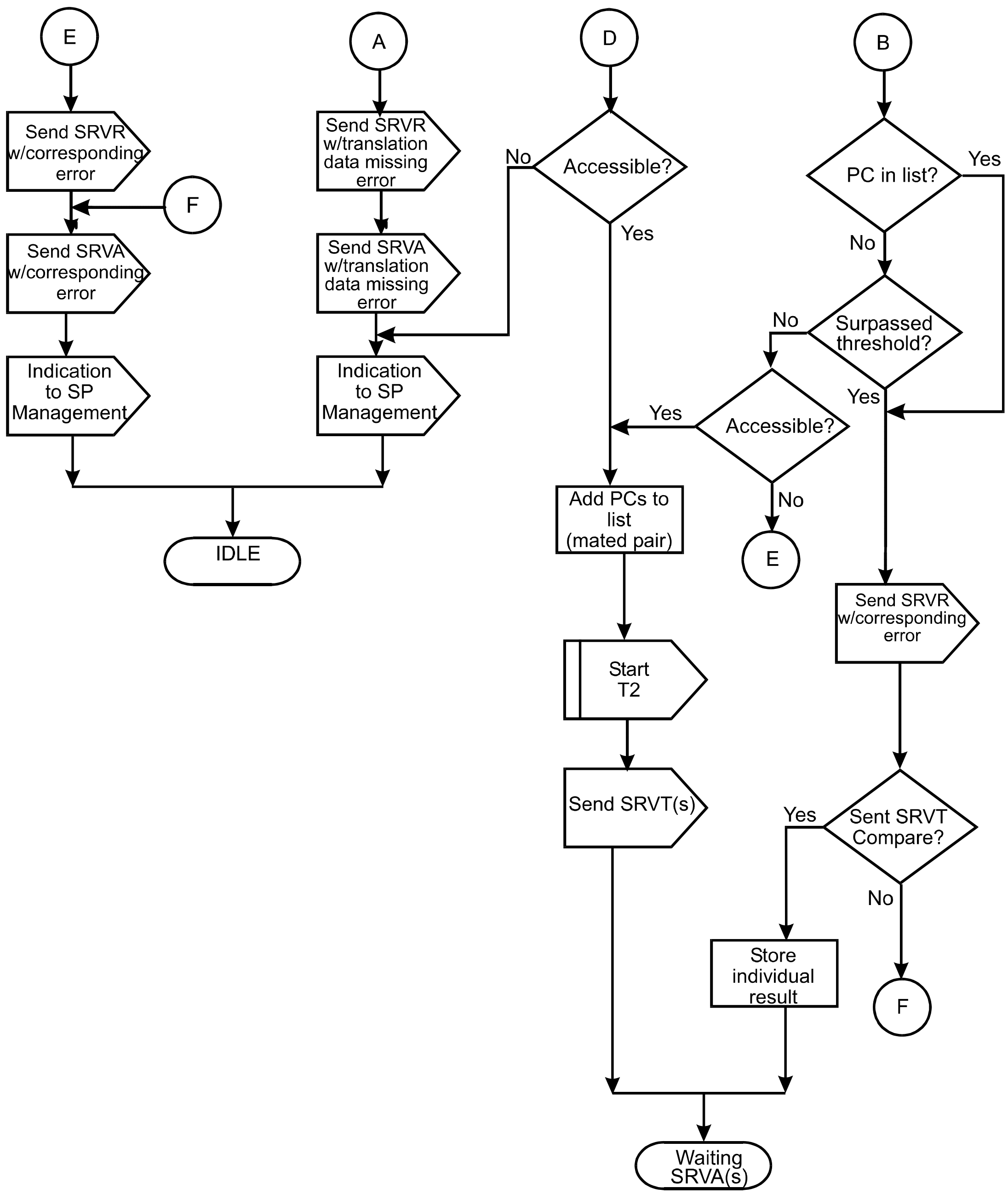


Figure 3/T1.116.3 SCCP Routing Verification Test (Sheet 2 of 4)

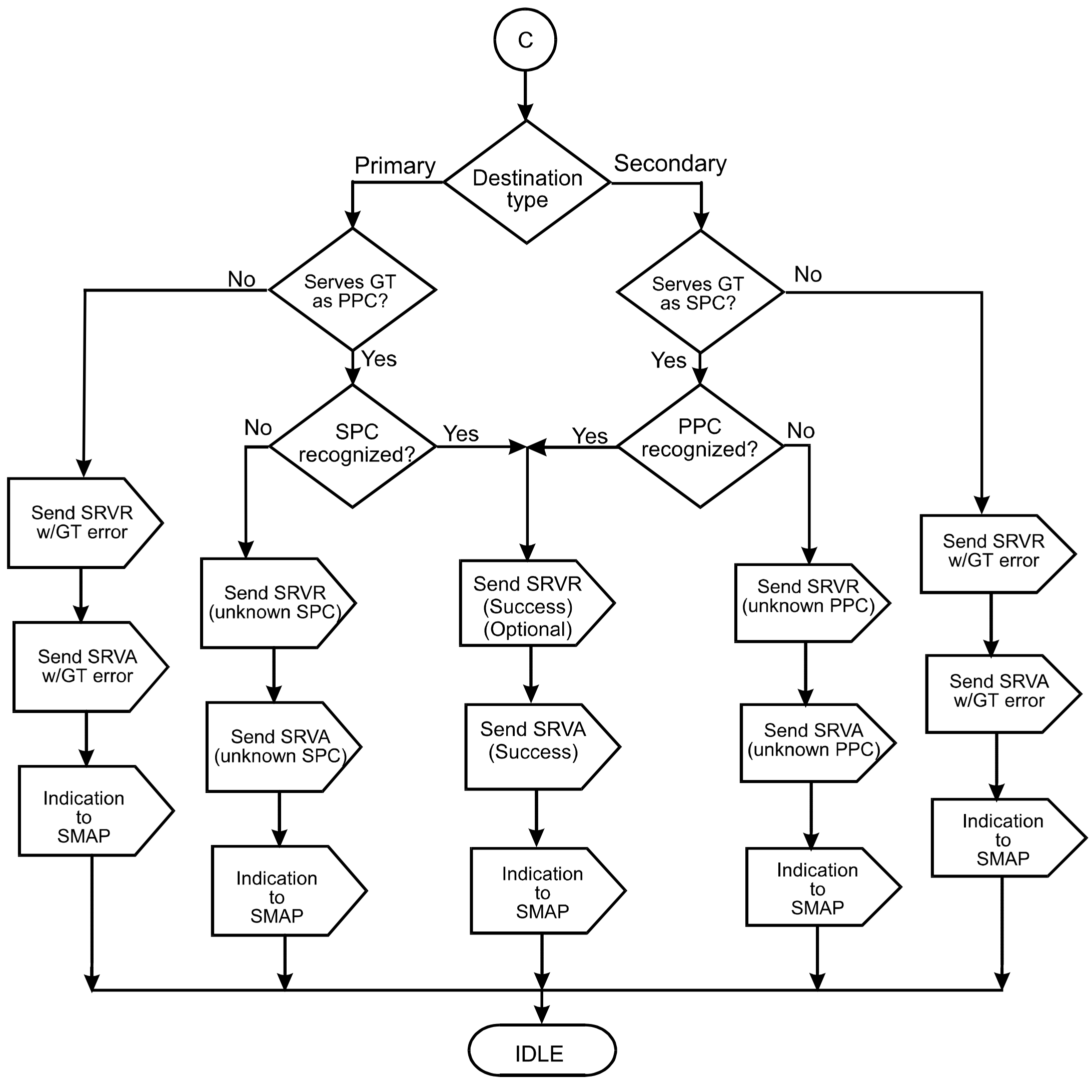


Figure 3/T1.116.3 SCCP Routing Verification Test (Sheet 3 of 4)

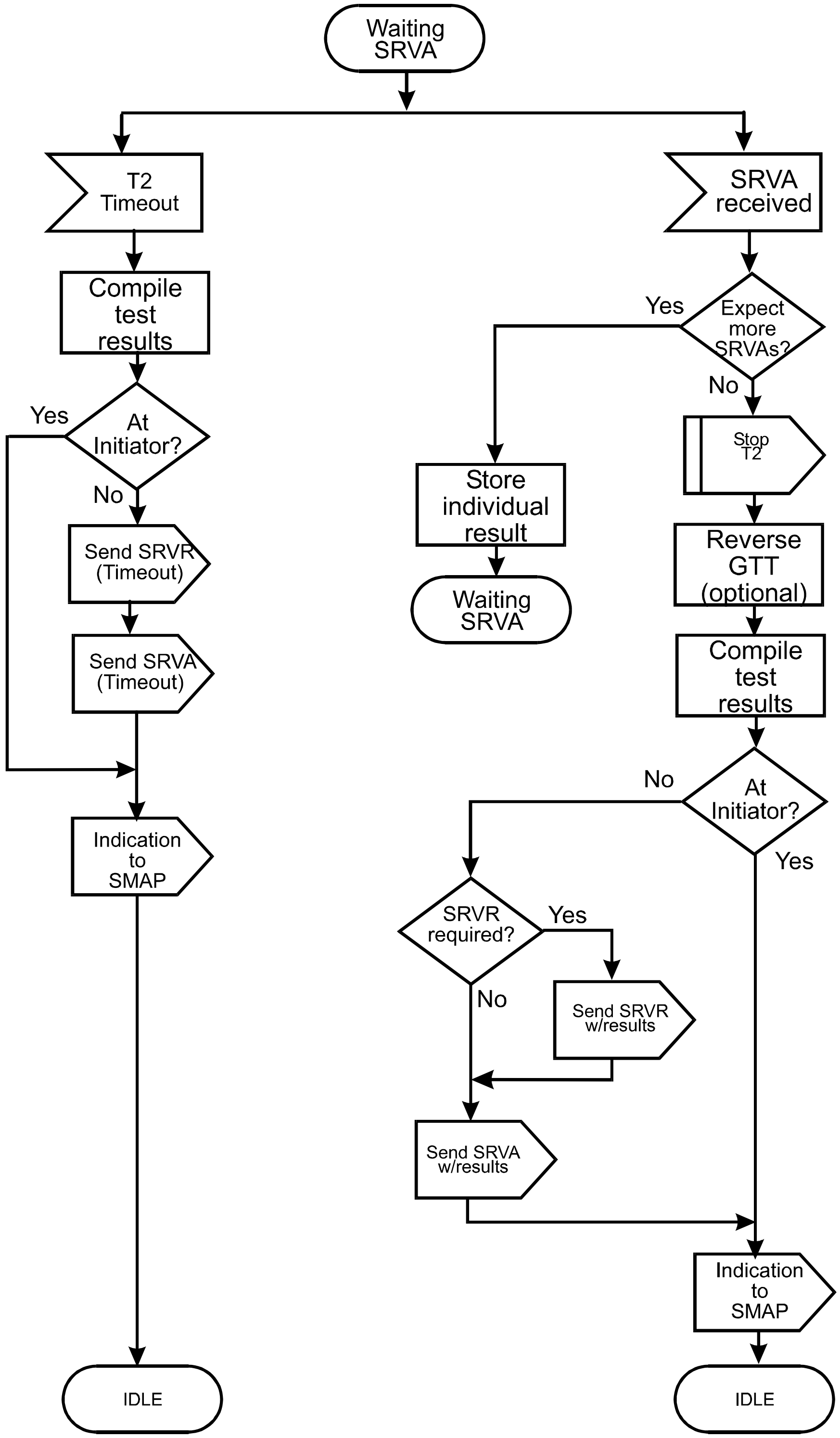
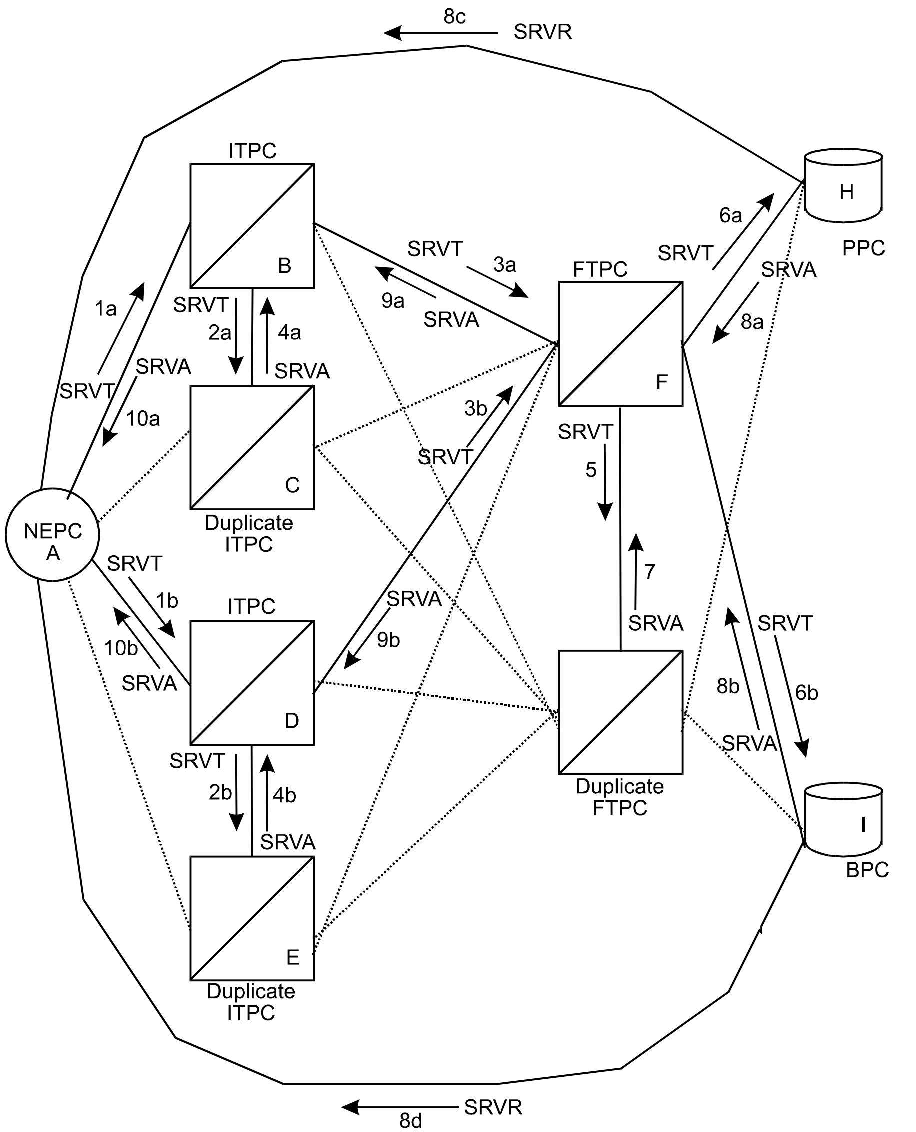


Figure 3/T1.116.3 SCCP Routing Verification Test (Sheet 4 of 4)

3.4.3.3 Example SRVT

Figure 4/T1.116.3 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.



KEY:

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

Figure 4/T1.116.3 Example of SRVT Procedure

4 Operations and Maintenance Procedures for the Exchanges

This clause deals with those procedures associated with the operation and maintenance of local and non-local exchanges.

4.1 Circuit Validation Test

NOTE - The message encoding is specified in the ISDN User Part, T1.113-2000.

4.2 General Procedures

The purpose of a CVT is to ensure that the two exchanges have sufficient and consistent Translation data for placing a call on a specific circuit of an interexchange circuit group. A CVT may be initiated by either exchange on demand by maintenance or operations personnel. The test is to be performed before a continuity test while turning up a circuit, so that if a continuity failure is experienced it may be uniquely attributed to a circuit hardware trouble. Before a test is performed, it is necessary to ensure that messages are capable of being routed to that exchange.

4.2.1 Translations Tested

a) 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 local implementation dependent request. The circuit is identified by an identification code agreed upon by the two exchanges at each end of the circuit. The Translation check at the initiating end shall perform adequate tests to ensure that Translation data exists for:

b) deriving a physical appearance for the circuit so that a transceiver may be connected to it, and

c) 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 test fails, the local maintenance personnel 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. The far end receiving the CVT request message will check 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 shall perform adequate tests to ensure that Translation data exists 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 shall also check that an identification code for the circuit exists for the physical circuit appearance. If the far end checks fail, the CVT response message will contain the reason for failure and will include an identification code of the failing exchange, when available, as agreed upon by the two exchanges. If the far end checks pass, the CVT response message will contain the far end derived identification code for the circuit. At the near end, a comparison of the near end and the far end circuit identification codes are made. If they match, an identification of a successful CVT is given to the maintenance personnel at the initiating end. If the comparison fails, a CVT failure indication with all the relevant data is given to the maintenance personnel for the purpose of isolating the problem. The CVT response message will also contain data about the circuit with respect to the characteristics of the interexchange circuit group that it is part of. The interexchange circuit group characteristics will include whether:

   i) odd or even CICs are in control in the case of double seizing;

   ii) the carrier group containing the circuit is processed by software carrier handling or hardware carrier handling;

iii) whether the interexchange circuit group contains analogue, digital or a mix of analogue and digital circuits in order to determine if continuity checks should be performed; and

iv) whether or not the continuity check is required. If the continuity check is required, whether it is on a per call or statistical basis.

If the group characteristics are unavailable, the CVT response shall explicitly indicate this with an unavailable indication. Inconsistencies between the interexchange circuit group characteristics between the two exchanges shall be reported to the initiating end maintenance personnel for corrective action.

4.2.2 CVT State Transition Diagram

Figure 5/T1.116.3 contains the state transition diagrams for the CVT in the form of SDL.

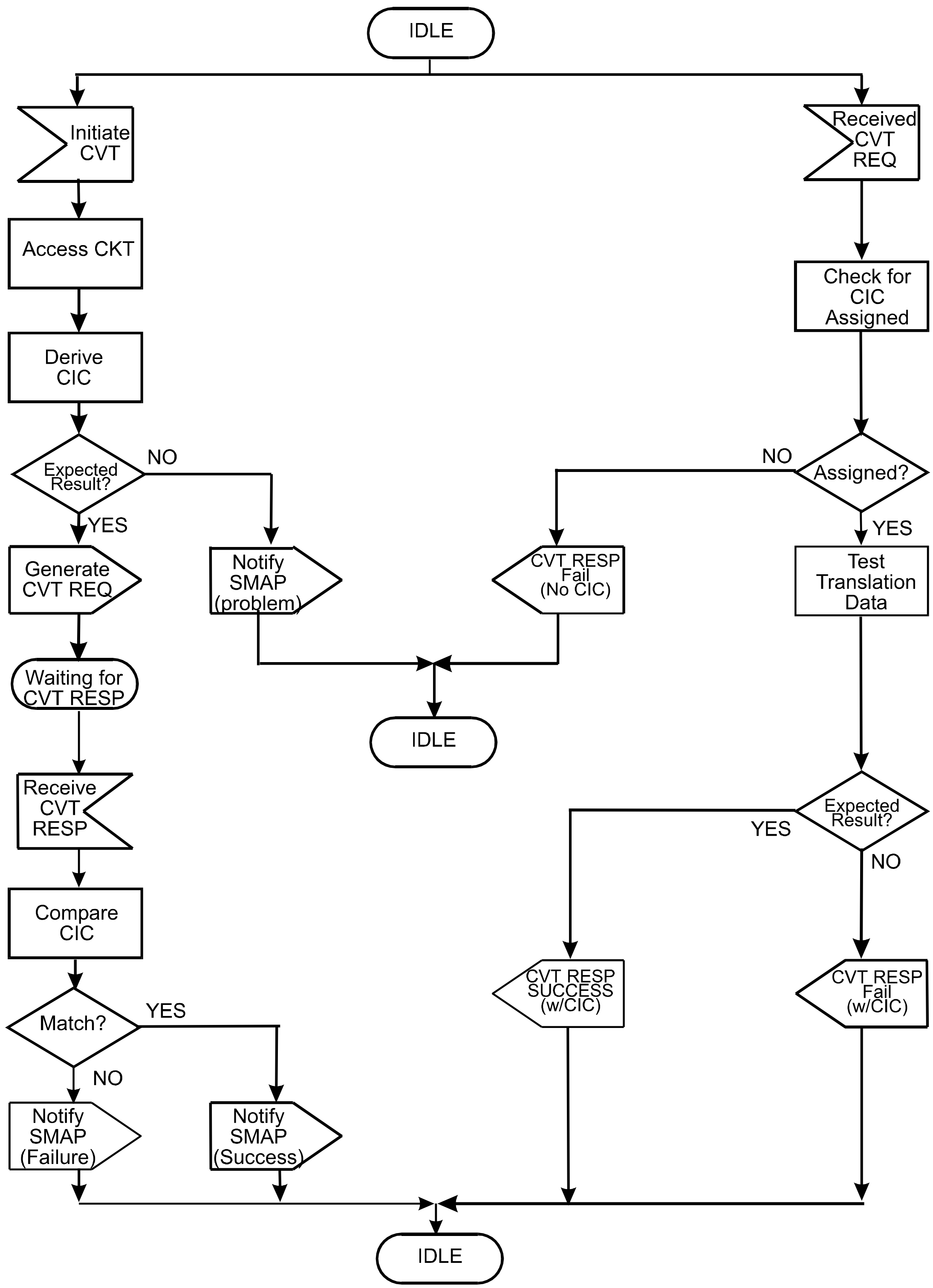


Figure 5/T1.116.3 Circuit Validation Test (CVT)

5 LINK MANAGEMENT

5.1 Management Link Equipment Failure

After a signalling link failure, there is no automatic notification to indicate whether the problem is due to a signalling terminal or interface equipment failure at the far end of the link, or if the problem is due to the local facility interface itself. Nevertheless, because a signalling link failure is an event, a possible local facility failure is reported to local maintenance. This offers a dilemma to local maintenance which does not know if it is responsible for repairing the failure.

The following procedure defines a simple method using OMAP which keeps the equipment at each end of a link informed of the link status at the other end. It does NOT recommend the changing of an MTP state, but merely informs systems management. The procedure merely obviates both the running of a prolonged local restoration procedure and the sounding of unneeded local alarms in the case of a link failure resulting from a remote equipment problem. An OMAP procedure is used to take advantage of the high reliability of the SS7 network.

5.1.1 Messages

The Link Equipment Failure (LEF) procedure uses two OMAP messages, namely the Link Equipment Unavailable (LEU) message and the Link Equipment Available (LEA) message.

5.1.1.1 LEU Message

The Link Equipment Unavailable (LEU) message is sent from an SP experiencing the unavailability of local signalling terminal or interface equipment to the adjacent SP at the far-end of the link. The message notifies the adjacent SP that the given link equipment is unavailable. The LEU message does not change the state of level 2 or level 3 MTP, i.e., it does not prohibit the adjacent SP from attempting to align the link. The message contains:

a) information indicating an LEU message;

b) the OPC (Originating Point Code); and

c) the SLC (Signalling Link Code).

5.1.1.2 LEA Message

The Link Equipment Available (LEA) message is sent from an SP which previously sent a LEU message to the adjacent SP at the far-end of the link. The message notifies the adjacent SP that the given link is now available and ready for alignment. The message contains:

a) information indicating an LEA message;

b) the OPC (Originating Point Code); and

c) the SLC (Signalling Link Code).

5.1.2 Procedure

If local terminal equipment becomes unavailable for any reason, OMAP receives an indication to send an LEU message to the OMAP located in the SP at the far-end of the link. The far-end SP, upon reception of the LEU message, indicates to the local application process (SP Management not a part of OMAP) that the link unavailability is not due to a local failure; hence, a less severe link alarm is needed and there is no attempt needed to restore the link. When the local terminal equipment becomes available again and is attempting alignment, OMAP receives an indication to send an LEA message to the OMAP located in the

SP at the far-end of the link. The far-end SP, upon reception of the LEA message, indicates to the local application process that restoration of the link is no longer prevented by far-end hardware failure.

5.1.3 State Transition Diagrams for Management Link Equipment Failure

Figure 6/T1.116.3 shows the state transition diagram for the management of link equipment failure according to ITU-T Rec. Z.100. This gives the logic for the LEU in the OMASE-User.

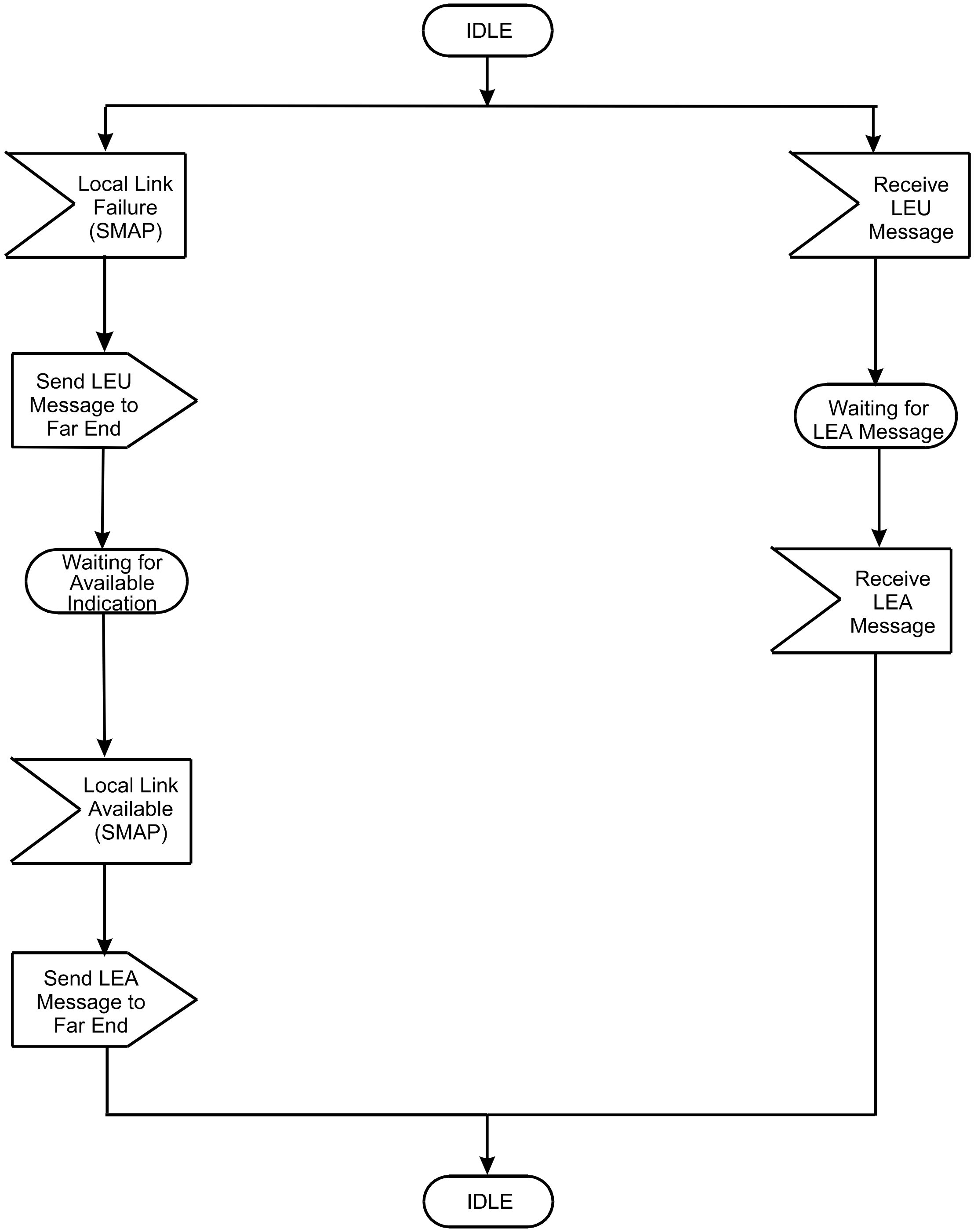


Figure 6/T1.116.3 Management of Link Equipment Failure

5.2 Link Fault Sectionalization

The procedure requirements are as follows:

a) The procedure can be performed on any deactivated digital SS7 link.

b) The procedure is performed when the local link equipment is available.

c) Multiple procedures may be performed in one Signalling Point (SP).

d) Since the link is deactivated before the procedure begins, MTP link states are not affected by the link fault sectionalization procedure.

e) The execution of the procedure depends on the link component database.

f) The procedure should:

  i) test individual link components;

  ii) indicate the closest faulty link component; and

  iii) indicate if all link components are operational.

5.2.1 General Procedure Considerations

The purpose of the link fault sectionalization procedure is to identify a faulty component on a signalling link. Often the link components are in unstaffed offices. The addition of the procedure provides a standardized means of testing link components from remote locations. This procedure is used to diagnose the cause of failed links, to test changed link components, and to determine marginal link performance reasons. Figure 7/T1.116.3 shows a typical link configuration.

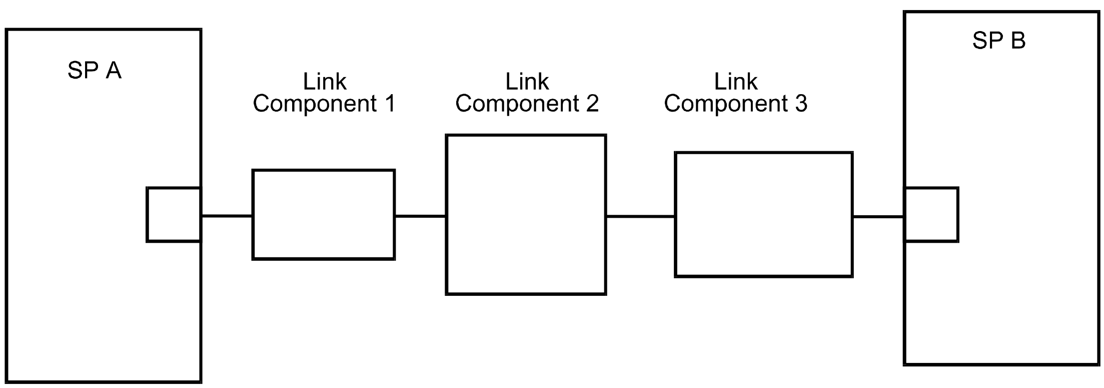


Figure 7/T1.116.3 Typical Link Configuration

There can be any number of link components between two signalling points (SP). The link connects to the SP at the link interface. When a faulty link component is identified, local actions are to be specified. If a Facility Test Underway (FTU), Facility Test Loopback (FTL), Facility Test Acknowledgment (FTA), or Facility Test Results (FTR) message received in an SP contains information extra to that defined in clause 5.2.2, the extra information is ignored.

5.2.2 Messages

The link fault sectionalization procedure uses four messages. They are: Facility Test Underway (FTU), Facility Test Loopback (FTL), Facility Test Acknowledgment (FTA), and Facility Test Results (FTR).

5.2.2.1 The Facility Test Underway (FTU) Message

The FTU message is sent from an SP to an adjacent SP to indicate that a signalling link test is beginning. The message contains:

a) information indicating an FTU message;

b) the OPC -- Originating Point Code; and

c) the SLC -- Signalling Link Code.

5.2.2.2 The Facility Test Loopback (FTL) Message

The FTL message is sent by the controlling SP to cause the controlled SP link interface to loopback all incoming data. If the loopback is successfully initiated at the controlled SP, the loopback condition lasts until the FTR message is received. The message contains:

a) information indicating an FTL message;

b) the OPC -- Originating Point Code; and

c) the SLC -- Signalling Link Code.

5.2.2.3 The Facility Test Acknowledgment (FTA) Message

The FTA message is sent from the controlled SP in response to the FTL message. It indicates if the local loopback was initiated successfully. The message contains:

a) information indicating an FTA message; and

b) an error indication if the loopback is not successfully initiated.

5.2.2.4 The Facility Test Results (FTR) Message

The FTR message is sent by the controlling SP to the controlled SP. It is notification that the test has finished.

The results of the test are also provided in this message. This message contains:

a) information indicating an FTR message.

b) The OPC -- Originating Point Code.

c) The SLC -- Signalling Link Code.

d) Information indicating the results of the test; the possible values are:

   i) 0 = all link tests passed;

   ii) 1 = loopback failed (due to excessive number of bit errors, loopback setup failed, etc.); or

   iii) 2 = timer T4 expired.

e) If the test failed, number of bit errors recorded for the failing link component during the link fault sectionalization procedure.

f) If the test failed, location identifier for the failing link component. This field includes:

   i) Loopback Code which contains the Loopback Select Code (LSC) or non-latching control code used in testing the component where the test failed (see Table 1/T1.111.7 and Table 2/T1.111.7 for the specific loopback code values), i.e., if a latching loopback or non-latching loopback test failed, the loopback code values in Table 1/T1.111.7 and Table 2/T1.111.7 would be used, respectively, to identify the failed component.

   ii) The Component No. identifies the position of the failed component from a component identified by the same loopback code. Thus, if the failed component is the only component in the link under test identified by a particular loopback code, the component number default is zero. If there are two or more components in the link under test identified by the same loopback code, the first component of that type which is nearest to the testing office, and failed the test, would have a component number of 0000001, the second would have a component number of 00000010, and so on.

5.2 Initiation of the Link Fault Sectionalization Procedure

The procedure is started:

a) when MTP notifies SP Management that timer T19 (failed link craft referral timer) has expired (automatic initiation is optional);

b) when components on a signalling link are added or changed; or

c) on demand from local maintenance staff or an operations and maintenance center.

5.2.4 The Link Fault Sectionalization Procedure

5.2.4.1 At the Point Initiating the Procedure

Information on the link components is fetched from the link component database. If there is a list of link components, timer T4 is started and an FTU message is sent to the SP at the remote end of the link to be tested (the controlled SP). If no list of link components is in the database, the FTU message is not sent and no loopback testing begins.

Next, a request is made to Level 1 to test the first component in the link component list. Each component is tested by 1) operating the loopback on that component, and 2) sending sufficient test data to verify the operation of the loopback. If the test data is looped back correctly, the received test data matches the sent test data bit for bit. If the test passes, the next component is tested until the end of the list is reached or until a test fails. If the end of the list is reached, the link is considered operational. Timer T4 is stopped and the FTR message is sent to the controlled SP. If a link component fails the loopback test, the type of component, the number of bit errors and location identifier for the failing component are reported to SP Management and recorded. Timer T4 is stopped and the FTR message is sent to the controlled SP. If timer T4 expires before the procedure finishes, the FTR message is sent to the controlled SP and the test results are given to SP Management.

5.2.4.2 At the Test Destination Receiving the FTU Message

When an FTU message is received, timer T4 is started to ensure that the link is not left in the test state indefinitely. SP Management is notified that the link is being remotely tested. When the FTR message is received, the results of the test are forwarded to SP Management. If timer T4 expires before the FTR message is received, SP Management is informed and any echo mode is removed.

5.2.4.3 Initiation of the FTL Message

The last element in the component list obtained from the link component database could indicate that the remote link interface has the ability to echo incoming data. If so, the FTL message is sent and the controlling SP waits for the FTA message. Timer T3 is also started. When the FTA message is received with no loopback failure indication, timer T3 is stopped. Next, test data is sent and the received data is verified. When the test is complete, the FTR message is sent. If timer T3 expires or a loopback failure indication is given in the FTA message, the FTR message is sent and the results of the test are forwarded to SP Management. The link is considered operational if this test passes.

5.2.4.4 At the Destination Receiving the FTL Message

When an FTL message is received after receiving the FTU message, level 1 is requested to loopback all incoming data. If the loopback is successfully initiated, the FTA message is returned to the controlling SP. Otherwise, the FTA message is returned to the controlling SP with a loopback failure indication. The link stays in this mode until the FTR message is received or timer T4 expires.

5.2.4.5 Initiation of the FTR Message

The FTR message is sent from the controlling SP to the controlled SP when all link components have been tested, when a link component test has failed, or when timer T3 or T4 has expired. The results of the test are indicated in the FTR message.

5.2.4.6 At the Destination Receiving the FTR Message

When the FTR message is received in the controlled SP, timer T4 is stopped and the test results from the message are forwarded to SP Management. If an FTL message was received during the link fault sectionalization procedure, Level 1 is requested to end the loopback of incoming data.

5.2.4.7 Abnormal Conditions During Link Fault Sectionalization Procedures

If an FTU message is received for a link currently running the link fault sectionalization procedure, the SP with the lower point code becomes the controlled SP. For various reasons, including local link equipment failure, SP Management may terminate the link fault sectionalization procedure. In the controlling SP, Level 1 is requested to end link testing, timer T4 is stopped, the FTR message is sent and the test results are given to SP Management and any local loopbacks are removed. If an FTU request is received from SP Management while the link is in the remote test state, the request is denied. No action is taken if unexpected messages are received.

5.2.5 Database Required for Link Fault Sectionalization Procedure

The link component database used during the fault sectionalization procedure contains information on a per link basis. A link component list is provided for each link. The database contains the following information on each link component:

a) Loopback Code indicating the type of component that failed;

b) information indicating if the FTL message may be sent;

c) Location identifier for the Component Number which will indicate exactly which component of the type component identified in (a) above failed; and

d) the error threshold at which the component should be considered failed.

If a link's component list is empty, then the link fault sectionalization procedure is not executed on that link.

5.2.6 Timer Definition and Values

5.2.6.1 T3 for Link Fault Sectionalization

T3 is the guard timer waiting for the controlled SP to send the FTA message in response to the FTL message. Timer T3 is a provisional timer in the range of 1 to 30 seconds.

5.2.6.2 T4 for Link Fault Sectionalization

T4 is the guard timer for the link fault sectionalization procedure. It is started in both the controlled SP and the controlling SP. The timer is stopped when the FTR message is sent or received. The range of this provisional timer is for further study.

5.2.6.3 State Transition Diagrams for Link Fault Sectionalization

Figure 8/T1.116.3 shows the state transition diagram for the link fault sectionalization according to the ITU-T Rec. Z.100.

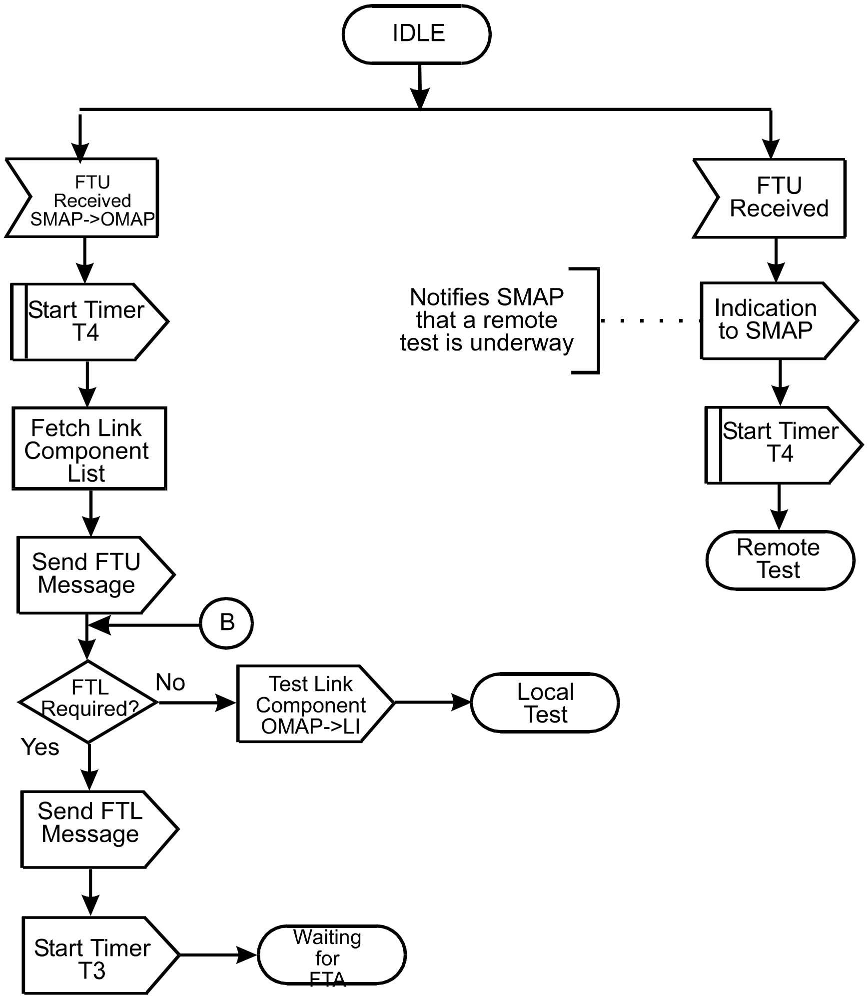


Figure 8/T1.116.3 Link Fault Sectionalization (Sheet 1 of 4)

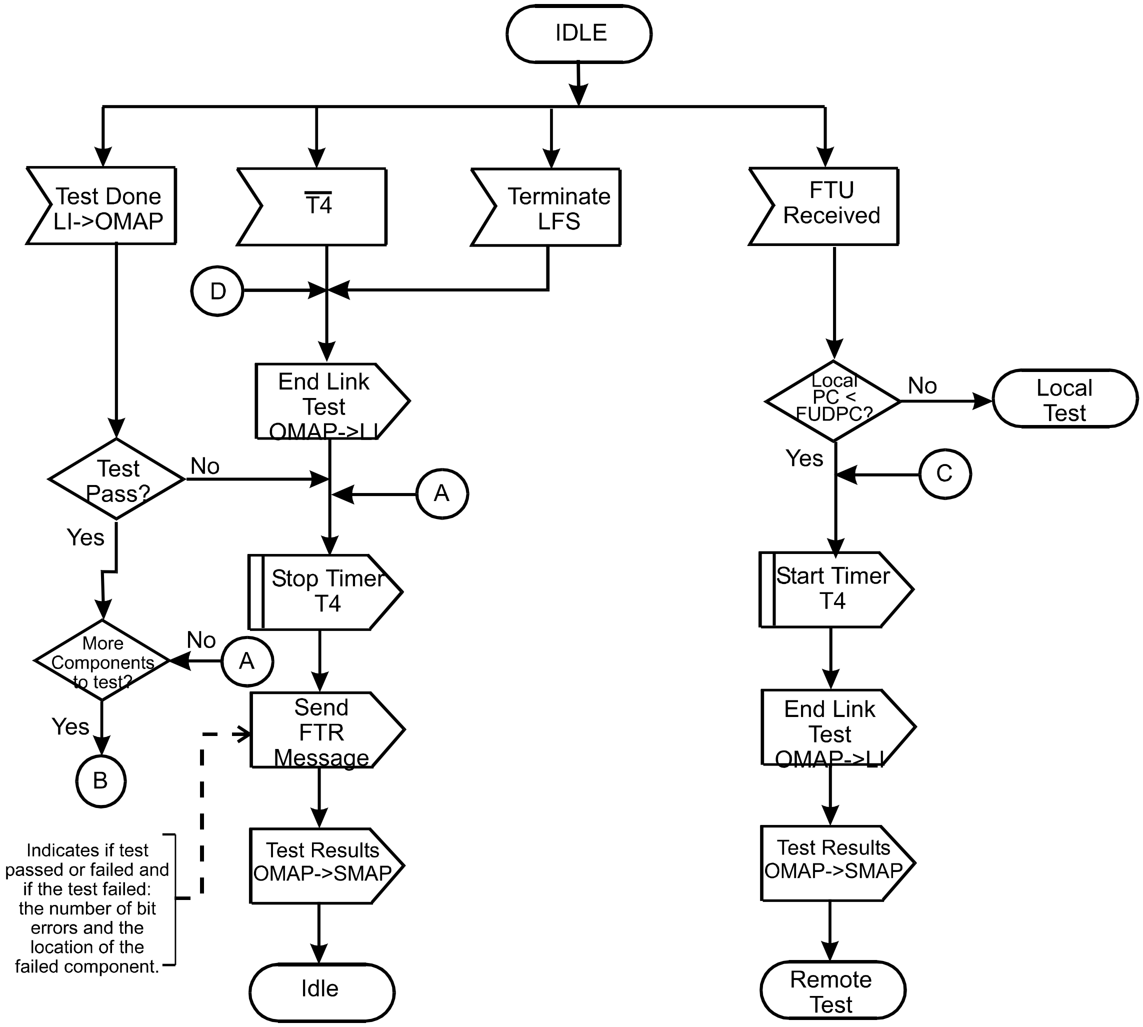


Figure 8/T1.116.3 Link Fault Sectionalization (Sheet 2 of 4)

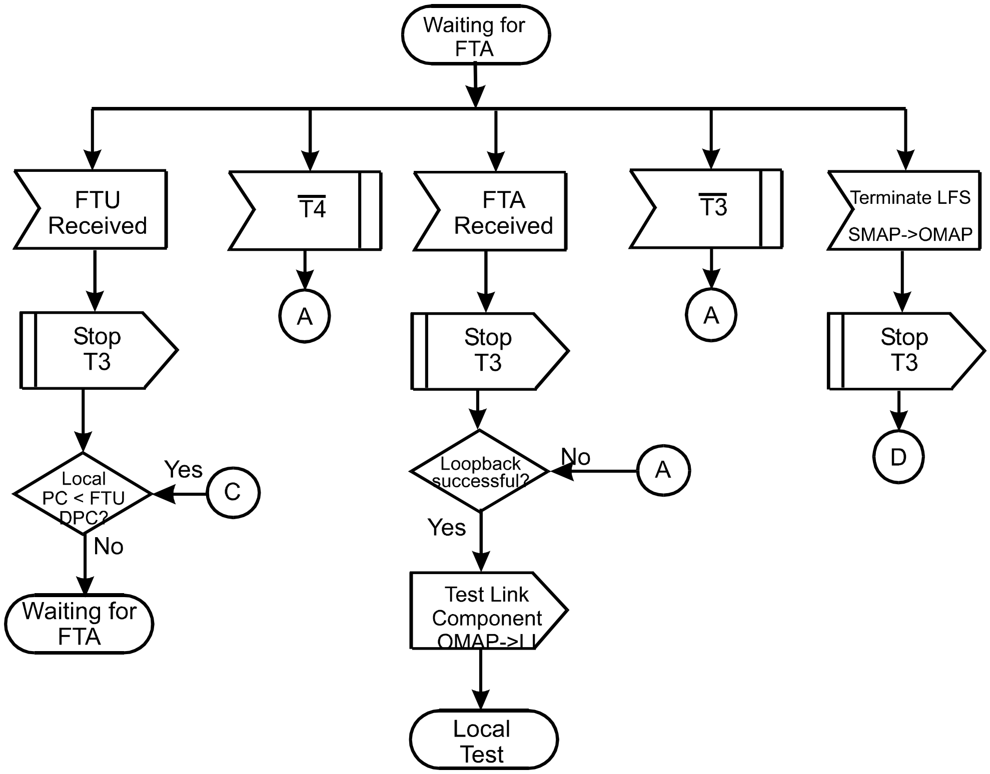


Figure 8/T1.116.3 Link Fault Sectionalization (Sheet 3 of 4)

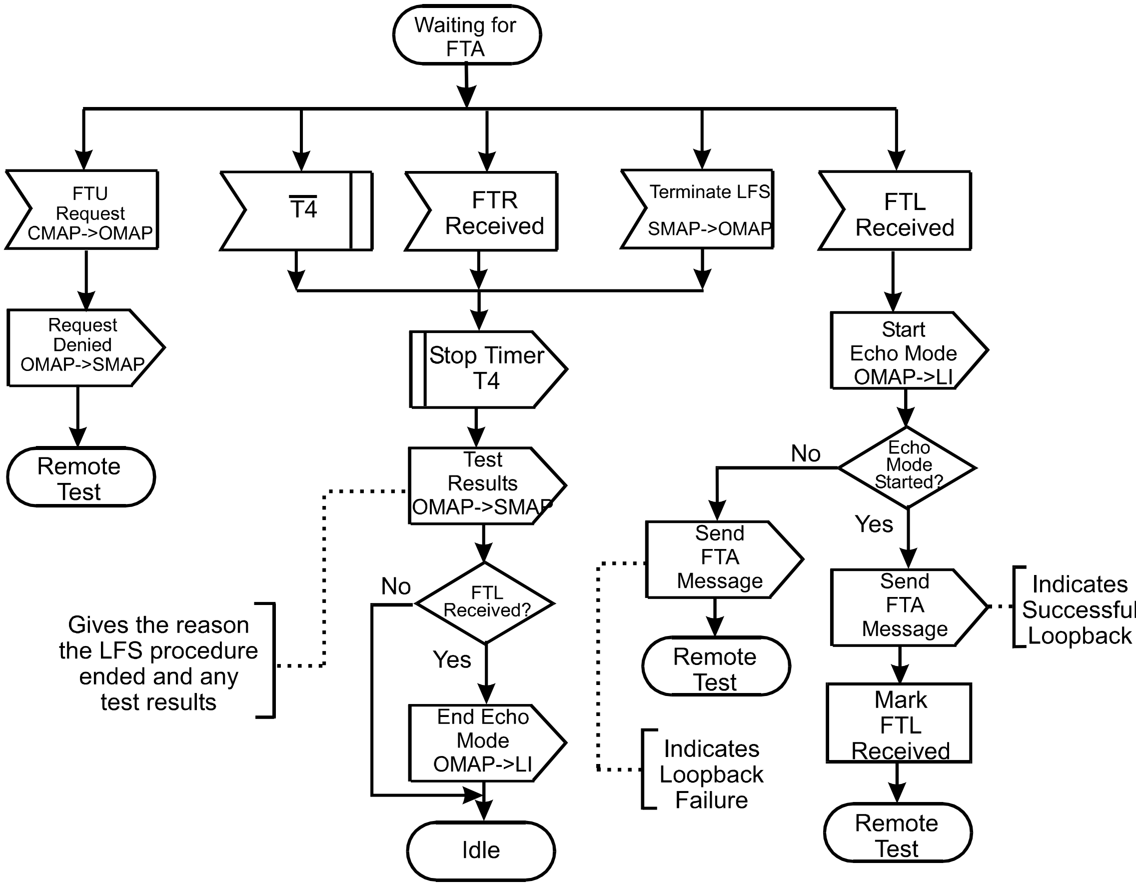


Figure 8/T1.116.3 Link Fault Sectionalization (Sheet 4 of 4)

6 Transaction Verification Test

The definition of a TrVT is for further study.

7 Long-Term Measurement Collection

The measurements to be taken are given in T1.116.2-2000. Periodically, at the same time, every Signalling Point collects the required data. The data collected may be transferred toward the appropriate signalling point(s) (e.g., an operations and maintenance center) either on demand or on a scheduled basis.

The procedures and means used for transfer of data are for further study.

7.1 Functions

7.1.1 Parameter Initialization

This function initializes, in a Signalling Point, the destination address(es) to which measurements will be transferred, sets up default parameters describing which indications should be reported and, if scheduled, when the measurements should be transferred.

7.1.2 Parameter Modification

This function allows modifications to the default measurements that are collected in a Signalling Point. It may not be used to modify the measurements' duration nor to remove those measurements described as being obligatory in T1.116.2-2000. The following list represents the set of modifications currently available and the information elements that shall be provided at the controlled Signalling Point. Other modifications have been left for further study.

a) *Allow Measurement Collection* is used to indicate that a particular measurement(s) should be collected for a particular controlling Signalling Point. The format is as follows: Command, controlling address, measurement 1, measurement 2, etc.

b) *Inhibit Measurement Collection* is used to indicate that a particular measurement(s) should not be collected for a particular controlling Signalling Point. The format is as follows: Command, controlling address, measurement 1, measurement 2, etc.

7.2 Information Elements

7.2.1 Command

Command indicates the function to be performed.

7.2.2 Controlling Address

Controlling Address is the address of the Signalling Point from which commands are sent and to which the measurements are transferred.

7.2.3 Measurement

Measurement is the name of a particular measurement which should (not) be collected.

8 On-occurrence Measurement Reporting

These procedures deal with the transfer and control of the measurements described in T1.116.2-2000, which are being reported on occurrence. The record of an on-occurrence measurement is referred to as an *event indicator* or *indicator.*

8.1 Functions

8.1.1 Parameter Initialization

This function initializes, in a Signalling Point, the destination address(es) to which reporting should be made (e.g., an OMC), sets up default parameters describing which indicators should be reported, what thresholds are associated with the indicators and which indicators should be logged along with the establishment of logging files (see 2.11.1.4).

8.1.2 Parameter Modification

Parameter modification allows modifications to be made to the default indicators that are to be logged and transmitted. In addition, it allows the modification of the destination addresses that are associated with particular indicators. The following list represents the set of modifications available and the information elements that shall be provided at the controlled signalling point. Other modifications have been left for further study.

a) *Create a logging file* is used to create a logging file and to set the number of event indicators to be logged before overwriting old indicators: command, controlling address, file name, size.

b) *Change a controlling address* is used to modify a controlling address (e.g., of an OMC) to which reports should be made: command, old controlling address, new controlling address.

c) *Allow event logging* is used to indicate that a particular indicator(s) should be logged and to optionally assign a threshold to the indicator: command, controlling address, event indicator 1, threshold 1, etc.

d) *Inhibit event logging* is used to indicate that a particular indicator(s) should not be logged: command, controlling address, event indicator 1, event indicator 2, etc.

e) *Change event logging* threshold is used to modify a threshold associated with a particular indicator(s) to be logged: command, controlling address, event indicator 1, threshold 1, etc.

f) *Allow event reporting* is used to indicate that a particular indicator(s) should be reported to a controlling address and to optionally assign a threshold to the indicator: command, controlling address, event indicator 1, threshold 1, etc.

g) *Inhibit event reporting* is used to indicate that a particular indicator(s) should not be reported: command, controlling address, event indicator 1, event indicator 2, etc.

h) *Change event reporting* threshold is used to modify a threshold associated with a particular indicator(s) to be reported: command, controlling address, event indicator 1, threshold 1, etc.

8.1.3 Event Indicator Reporting

This function notifies a specified controlling address of on-occurrence measurements by the transfer of an event indicator. The following information elements are included in each message that is sent for reporting purposes: event type, controlled address, affected address, time stamp, additional information.

8.1.4 Recovery of Recent On-Occurrence Measurement History

In the event of failure of a controlling Signalling Point (e.g., an operations maintenance center) or a signalling relation to that controlling signalling point, a recovery procedure is required to allow the controlling signalling point to recover a recent history of on-occurrence measurements in the signalling network. This is accomplished by maintaining a log of the last N event indicators at the Signalling Point, which may be requested by the controlling Signalling Point after recovery. The logging file may also be used to store event indicators that have not been requested for reporting by the controlling Signalling Point, for example, measurements with lower thresholds for logging than for reporting. The maximum number of event indicators logged (N) is a function of implementation.

8.2 Information Elements

8.2.1 Controlling Address

Controlling Address is the address of the Signalling Point from which commands are sent and to which the event indicators are reported.

8.2.2 Controlled Address

Controlled Address is the address of the Signalling Point which is being controlled and from which measurements are being reported.

8.2.3 Affected Address

Affected Address is the address of the Signalling Point about which an event indicator pertains.

8.2.4 Command

Command indicates a function to be performed.

8.2.5 File Name

File Name is the name of a file at the Signalling Point where logging is to be performed.

8.2.6 Size

Size (N) is the maximum number of event indicators that may be recorded in an event log.

8.2.7 Event Type

Event Type describes the on-occurrence measurement associated with an event indicator.

8.2.8 Threshold

Threshold represents some threshold associated with an on-occurrence measurement before its associated event indicator is reported or logged.

8.2.9 Time Stamp

Time Stamp represents the unique network time when the event indicator was generated.

8.2.10 Additional Information

Additional Information is any additional information associated with the on-occurrence measurement being indicated (e.g., the link ID of a signalling link experiencing a failure).

9 Delay Measurements

These procedures deal with measuring delays across the signalling network, whether these delays are measured point-to-point or round trip.

9.1 Functions

The specification of functions is left for further study.

9.2 Information Elements

The specification of information elements is left for further study.

10 Clock Initialization

The clock initialization procedures provide a means for setting clocks in a Signalling Point for operations and maintenance and for other purposes. This allows all clocks in the network to be set to a unique network time.

10.1 Functions

The specification of specific functions has been left for further study.

10.2 Information Elements

The specification of information elements is left for further study.

These procedures allow for automatic or manual controls to be taken in a controlled Signalling Point based on input from a controlling signalling point. The controlling Signalling Point may initiate these procedures based on input from procedures like the on-occurrence measurement reporting procedures.

11 Real-Time Control

11.1 Functions

The specifications of functions is left for further study.

11.2 Information Elements

The specification of information elements is left for further study.

12 Operations

These procedures provide a capability to perform operations, such as activation of links, within the signalling network.

12.1 Functions

The specification of functions is left for further study.

12.2 Information Elements

The specification of information elements is left for further study.

13 Operations and Maintenance Procedures for Both the Signalling Network and Exchanges

This clause deals with those procedures associated with operations and maintenance that are found in common with both the Signalling Network and the Exchanges. See ITU-T Recommendations Q.541, Q.543, Q.544, and M.3010 The contents of this clause remain as a topic for further study.

14 Requirements for the Protocols Used to Support the Operations and Maintenance Procedures

It is assumed that the procedures defined in the previous clauses will make use of the protocols defined by American National Standards in the various functional layers of the OSI model. This clause describes the capabilities required from these layers. No attempt is made to allocate the requirements to specific functional layers of the OSI model. See OMAP procedures and protocols in this document, and also ITU-T Recommendations Q.541, Q.543, Q.544, and M.30.

14.1 Addressing Capability

This capability allows the user of the OMAP to address applications in nodes in the signalling network or to applications in nodes that may exist in any interconnected network.

14.2 Distribution Capability

This capability is responsible for delivering information to the appropriate operations and maintenance application within the destination node.

14.3 Connection-Oriented Communication Capability

This capability establishes a connection, whether physical or logical, for the purposes of transporting operations and maintenance information between two Signalling Points. This is required, for example, for the interactions between a controlling Signalling Point where MML commands are entered and a controlled Signalling Point where the functions controlled by the MML commands exist.

14.4 Connectionless Communication Capability

The capability allows the transfer of operations and maintenance information between two Signalling Points without the establishment of a connection. This is required, for example, to transfer event indicators used in the on-occurrence measurement reporting.

14.5 File Transfer Capability

This capability provides the means for communications between operations and maintenance applications that require file transfers. This is required, for example, to transport files generated by *long-term measurement collection.*

14.6 Other Capabilities

Other capabilities that may be required are for further study.

Chapter T1.116.4

OMAP Management ASE (OMASE) Definitions for MRVT, SRVT and CVT

OMAP Management ASE (OMASE)
Definitions for MRVT, SRVT and CVT

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American National Standard for Telecommunications —

Signalling System Number 7 (SS7) – OMAP Management ASE (OMASE) Definitions for MRVT, SRVT and CVT

1. Introduction

Note that in the event of a conflict between T1.116.3-2000 and T1.116.4-2000, T1.116.3-2000 will take precedence.

This standard defines the OMAP ASE, OMASE. OMASE provides the service invoked using the OM-EVENT-REPORT and OM-CONFIRMED-ACTION primitives across the OMASE-User to OMASE boundary. (See T1.116.3-2000 for a diagram and mapping between the services invoked in the OMASE-User and those of OMASE).

The OMASE services are derived from those defined in CMIP[1].

The OMASE primitives are defined in 9. The formal syntax defined in figure 1/T1.116.4 uses Transaction Capabilities (TCV) OPERATION and ERROR macros. The interworking between OMASE and TC is also given in clause 11.

OMASE provides operations allowing the network administration, via the OMAP Management Process and the OMASE-User, to perform MTP and SCCP Routing Verification Tests (MRVT and SRVT), and circuit validation tests (CVT).

This standard contains the ASE definition for MRVT, SRVT and CVT.

The SRVT referred to here is for the specific test in clause 3.2 of T1.116.3-2000.

The arguments used for primitives across the OMAP Management Process to OMASE-User boundary, for primitives across the OMASE-User to OMASE boundary, and between OMASE and TC contain the same information if they have the same name. Those arguments are defined in this standard.

1.1 Normative References

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

T1.111-2001, *Signalling System Number 7 — Message Transfer Part (MTP)* [2]

T1.112-2001, *Signalling System Number 7 — Signalling Connection Control Part (SCCP)*[2]

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[1] CMIP is defined in ISO/IEC 9596-1 and ITU-T Rec. X.711.
[2] This document is available from the Alliance for Telecommunications Industry Solutions. < http://www.atis.org >.

T1.114-2000, *Signalling System Number 7 — Transaction Capabilities Application Part (TCAP)*[2]

ISO/IEC 9596-1:1998, *Information technology -- Open Systems Interconnection -- Common management information protocol -- Part 1: Specification*[3]

ITU-T Rec. X.209 (11/88), *Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*[4]

ITU-T Rec. X.711 (10/97), *Information technology - Open Systems Interconnection - Common Management Information Protocol: Specification*[4]

2. ASE Definitions[5]

2.1 MRVT ASE.

The MRVT ASE provides the services accessed via the two OM-primitives OM-CONFIRMED-ACTION and OM-EVENT-REPORT. MRVT uses a particular instance of each primitive. testRoute is the CnfActionValue of the OM-CONFIRMED-ACTION primitive; while routeTrace, for Issue 1 test initiators, and routeTraceNew, for post-Issue 1 test initiators, is the EventValue of the OM-EVENT-REPORT primitive. Each is described below with the appropriate arguments (ActionArg for testRoute and EventInfo for routeTrace (Issue 1 SPs) or routeTraceNew (post-Issue 1 SPs)) and, for testRoute, the appropriate ActionResults and ActionErrors. For OM-primitives, the InvokeID in the respective primitives is the InvokeID passed to TCAP. The ResoureClass indicates MTP Routing Tables, and the ResourceInstance contains the Point Code of the test destination. In addition, the accessControl argument in OM-CONFIRMED-ACTION is absent. The testRoute Cnf Action makes use of the Query (MRVT) message with result (MRVA) returning in a Response. The routeTrace Event and the routeTraceNew Event (MRVR) uses a Query message with prearranged end.

2.1.1 testRoute Cnf Action

The testRoute Cnf Action is invoked to initiate an MTP routing verification test. At the initiator node, this invocation is requested by the local SP Management. At subsequent nodes, the Cnf Action is requested implicitly by the receipt of a testRoute Cnf Action invocation. A successful reply indicates successful completion of the test at the point it was invoked and, implicitly, at all subsequent points where the test was invoked. A failure indication is returned to indicate that the test failed in this or a subsequent node.

testRoute CNF_ACTION	*Timer*=T1	*Class*=1	*Code*=00000001
ActionArg		*Opt/Man*	*Reference*
initiatingSP		M	2.1.1.1.1
traceRequested		M	2.1.1.1.2
threshold		M	2.1.1.1.3
pointCodesTraversed		M	2.1.1.1.4
route PriorityList		O[6]	2.1.1.1.5
localReturnSP		O	2.1.1.1.6
directRouteCk		O[4]	2.1.1.1.7
infoRequest		O[4]	2.1.1.1.8

[3] This document is available from the International Organization for Standardization. <http://www.iso.ch/iso/en/prods-services/ISOstore/store.html >
[4] This document is available from the International Telecommunications Union. < http://www.itu.int/ITU-T/>.
[5] See ITU-T Rec. X.209 for description of formal notation.
[6] This parameter is mandatory for post-Issue 1 nodes.

returnUnknownParams	O	2.1.1.1.9
ActionResult		
empty		
Linked Operations		
N/A		
Specific Errors		Reference
failure partialSuccess		2.1.1.3.1 2.1.1.3.2

```
testRoute CNF_ACTION
ACTIONARG SEQUENCE {
                    initiatingSP            [0] IMPLICIT PointCode
                    traceRequested          [1] IMPLICIT BOOLEAN,
                    threshold               [2] IMPLICIT INTEGER,
                    pointCodesTraversed     [3] IMPLICIT PointCodeList
                    routePriorityList       [12] IMPLICIT RoutePriorityList OPTIONAL,
                    localReturnSP           [16] IMPLICIT PointCode OPTIONAL
                    directRouteCk           [17] IMPLICIT BOOLEAN OPTIONAL
                    infoRequest             [18] IMPLICIT RequestParams OPTIONAL
                    returnUnknownParams     [19] IMPLICIT UnknownParams OPTIONAL
}
ACTIONRESULT        empty
SPECIFICERRORS      {failure, partialSuccess}

::=1
```

2.1.1.1 testRoute Cnf Action Arguments

2.1.1.1.1 initiatingSP

The initiatingSP identifies the original requestor of the test. It is of type PointCode, defined as an octet string.

Parameter	Code
initiatingSP	10000000
Contents	
Bit 0 contains the first bit of the Point Code, Bit 1 contains the second bit of the Point Code, etc.	

```
PointCode ::= OCTETSTRING
--Coding of the contents of PointCode
--must follow specifications given in T1.111.4
--sections 2.2.3, 2.2.3A and in Figure 3B/T1.111.4
```

```
--for point codes in U.S. national routing labels.
```

2.1.1.1.2 traceRequested

traceRequested indicates that either a routeTrace or a routeTraceNew for all routes used to reach the destination should be reported to the originator (the routeTrace Event is described in 2.1.2; the routeTraceNew Event is described in 2.1.3). It is of type BOOLEAN.

Parameter	Code
traceRequested	10000001
Contents	Meaning
TRUE (=1)	trace was requested, return routeTrace or routeTraceNew on success and failure.
FALSE (=0)	trace not requested, return routeTrace or routeTraceNew only on failure.

2.1.1.1.3 threshold

The originator sets a maximum threshold level of Signalling Points (SP) that are allowed to be crossed in the course of the test. This aids in detecting overly long routes. This threshold is an integral number of SP's; thus, it is of type INTEGER.

Parameter	Code
threshold	10000010
Contents	
Integer number represented in binary.	

2.1.1.1.4 pointCodesTraversed

As each intermediate SP is crossed, it adds its own Point Code to the list of Point Codes traversed. This aids in detecting loops and is also useful information in case of a failure or if a route trace is requested. It is a list of Point Codes thus of type PointCodeList. This pointCodeList could be empty.

Parameter	Code
pointCodesTraversed	10100011
Contents	
Sequence of Point Codes, tagged as 'PointCode' with the contents indicating the exact Point Code.	

```
PointCodeList  ::= SEQUENCE OF PointCode
```

2.1.1.1.5 routePriorityList

When an intermediate SP send an MRVT message to an adjacent SP in the particular route under test, it adds the priority of the route to the SP to the list of route priorities in the MRVT message. This aids in detecting loops and is also useful information in case of a failure or if a route trace is requested. It is a list of route priorities used by the SP sending the MRVT message to the next SP in the route under test. It is an integer number; thus, it is of type INTEGER.

Parameter	Code
routePriorityList	10101100
Contents	
Sequence of integer route priorities, coded "0" for unknown, "1" for primary (first choice) route, "2" for first alternate (second choice) route, etc.	

```
RoutePriorityList ::= SEQUENCE OF routePriority INTEGER {     unknown (0),
                                                              firstChoice(1),
                                                              secondChoice(2),
                                                              thirdChoice(3) }
```

2.1.1.1.6 localReturnSP

The localReturnSP identifies the SP to which the local MRVR should be sent. It is of type PointCode, defined as an octet string.

Parameter	Code
localReturnSP	10010000
Contents	References
Bit 0 contains the first bit of the Point Codes Bit 1 contains the second bit of the Point Codes, etc.	2.1.1.1.1

2.1.1.1.7 directRouteCk

The originator indicates that a direct route check is requested. It is of a type BOOLEAN.

Parameter	Code
directRouteCk	10010001
Contents	Meaning
TRUE(=1) FALSE(=0)	direct route check requested on all routes. direct route check not requested.

2.1.1.1.8 infoRequest

The parameter is used to indicate the information requested by the test initiator to be returned in an MRVR message in addition to the result[7]. It is of type BIT STRING.

Parameter	Code
infoRequest	10010010
Bit	Meaning
H (0) G (1) F (2)	pointCode pointCodeList routePriorityList

```
RequestParam::=     BIT STRING
                    {pointCode (0)
                    pointCodeList (1)
                    routePriorityList (2),
                    ...
                    }
```

2.1.1.1.9 returnUnknownParams

Indicates the parameters to be returned to the test initiator in the MRVR message if such parameters are unknown to the sender of the MRVR message.

Parameter	Code
returnUnknownParams	10010011
Bit	Meaning
H[4] (0) G (1) F (2) E (3) D (4) C (5) B (6) A (7)	tag20 tag21 tag22 tag23 tag24 tag25 tag26 tag27

[7] The information actually returned in the MRVR message is the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 2.1.3.1 for the specific test result.

```
UnknownParams::=        BIT STRING
                        {tag20 (0)
                        tag21 (1)
                        ...
                        }
```

These parameters are currently unused.

2.1.1.2 Action Results

There are no contents in a successful return indication.

2.1.1.3 Action Errors

SpecificErrors are possible errors that can occur during this test which are unique to this test. These specific errors are in addition to the errors already identified in the OM-CONFIRMED-ACTION service and appear as parameters to the Processing Failure Error.

2.1.1.3.1 failure.

failure indicates a condition of total failure, where no route worked correctly. Most often this will be used as a failure indication from the point which detects the error and does not invoke any further testRoute Actions. The failure SpecificError may have with it up to two parameters to indicate the error condition causing the failure. This first parameter, failureType, is represented as a big string[8] and contains the error indications standardized nationally and internationally. The second parameter, failureTypeNational, is represented as a bit string and contains the error indications that have not been standardized internationally (i.e., only in North America). Error conditions causing the failure as indicated in the failure Type bit string are represented by a binary one (1) in the bit position of the particular failure type. As an example, a binary one (true) in the first bit of the bit string, detectedLoop (0) (bit position H), indicates a loop has been detected in the processing of the MRVT. In addition, the second parameter, traceSent, is to be used when failureType indicates the error Unknown Initiating SP. traceSent indicates whether or not a routeTrace Event has been invoked to report trace information. It is necessary to indicate traceSent for this error since the node detecting the error cannot send the routeTrace, thus the previous node must. traceSent is a type of BOOLEAN. If the failureType, unknownInitiatingSP, is present, traceSent is FALSE, the copyData parameter must also be present in the MRVA message, if the infoRequest parameter or returnUnknownParams parameter was in the MRVT message. The copyData parameter contains the information specified in T1.116.3-2000, section 2.2.2.2(d). The copyData parameter is of type OCTETSTRING.

Specific Error	Code
failure	00000001
Parameters	References
failureType failureTypeNational traceSent copyData	2.1.1.3.1 2.1.1.3.1 2.1.1.3.1 2.1.1.3.1

[8] Bit strings must be encoded according to the definitions found in the CCITT recommendation X.209.

Specific Error	Code
failure	00000001
Parameters	References
failureType failureTypeNational traceSent copyData	2.1.1.3.1 2.1.1.3.1 2.1.1.3.1 2.1.1.3.1

Parameter	Code
failureType	10000000
Bit	Meaning
H[9] (0) G (1) F (2) E (3) D (4) C (5) B (6) A (7) H (8) G (9) F (10)	detectedLoop excessiveLengthRoute unknownDestinationPC routeInaccessible localConditions unknownInitiatingSP timerExpired wrongSP indirectRoute successToGateway inefficientRoute

Parameter	Code
failureTypeNational	10011110
Bit	Meaning
Currently there are no national-specific errors specified for the MRVT	

Parameter	Code
traceSent	10000001
Contents	Meaning
TRUE (=1) FALSE (=0)	a routeTrace or routeTraceNew was sent a route Trace or routeTraceNew was not sent

[9] The letters A through represent positions of the bits in the octet of transmitted data. See Annex D for an example of the bit positions and the direction of transmitted data.

Parameter	Code
copyData	10000100
Contents	
Octet 0 is the first octet of the information specified in T1.116.3-2000, clause 2.2.2.2 d) Octet 1 is the second octet of the information specified in T1.116.3 Section 2.2.2.2 (d) etc.	

```
failure    SPECIFICERROR
           PARAMETER SEQUENCE     {failureType          [0] IMPLICIT FailureString,
                                   traceSent            [1] IMPLICIT BOOLEAN
                                   copyData             [4] IMPLICIT CopyData OPTIONAL
                                   failureTypeNational  [30] IMPLICIT FailureStringNational
                                                             OPTIONAL

                                   ...
                                   }

                                   ::=1
```

```
FailureString ::= BITSTRING
                       {detectedLoop (0),
                       excessiveLengthRoute (1),
                       unknownDestinationPC (2),
                       routeInaccessible (3),
                       localConditions (4),
                       unknownOPC (5),
                       timerExpired (6),
                       wrongSP (7)
                       asymmetricalRoute (8)
                       successToGateway (9)
                       inefficientRoute (10)
                       ...
                       }
```

```
FailureStringNational ::= BITSTRING
                       {
                       ...
                       }
```

```
CopyData::=OCTET STRING
```

2.1.1.3.2 Partial Success

This indication is given when at least one testRoute Cnf Action invocation failed and at least one succeeded (at least partially). In this case, each type of error that occurred will be noted and sent in the final reply. The format and contents of partial success are the same as failure.

Specific Error	Code
partialSuccess	00000010
Parameters	References
failureType failureTypeNational traceSent copyData	2.1.1.3.1 2.1.1.3.1 2.1.1.3.1 2.1.1.3.1

```
partialSuccess    SPECIFICERROR
                  PARAMETER      {failureType          [0] IMPLICIT FailureString,
                  SEQUENCE       traceSent             [1] IMPLICIT BOOLEAN
                                 copyData              [4] IMPLICIT copyData OPTIONAL
                                 failureTypeNational   [30] IMPLICIT FailureTypeNational
                                 ...                        OPTIONAL
                                 }

                                 ::=2
```

2.1.2 routeTrace Event

The routeTrace Event reports trace information. Trace information consists of zero, one or more Point Codes, such as the Point Code detecting an error or the entire list of point codes traversed along a route. This event is invoked either at the explicit request of the originating SP (indicated by traceRequested, see 2.1.1.1.2) or by failure at any point along the route when an Issue 1 SP is the test initiator. An Issue 1 test initiator is identified by the absence of the infoRequest in the testRouteCNF_ACTION (2.1.1). If the test initiator is post-Issue 1 SP (identified by the presence of the infoRequest parameter in the testRoute CNF_ACTION (see 2.1.1)), the routeTraceNew Event (see 2.1.3) should be the event. This event is not confirmed, therefore no replies to this invocation are expected (no error or success indications are expected).

routeTrace EVENT	*Timer*=0[b]	*Class*=4	*Code*=00000010
EventInfo		*Opt/Man*[a] *Reference*	
success		O	2.1.2.1.1
detectedLoop		O	2.1.2.1.2
excessiveLengthRoute		O	2.1.2.1.3
unknownDestination		O	2.1.2.1.4
routeInaccessible		O	2.1.2.1.5
localConditions		O	2.1.2.1.6
unknownInitiatingSP		O	2.1.2.1.7
timerExpired		O	2.1.2.1.8
wrongSP		O	2.1.2.1.9
successToGateway		O	2.1.2.1.10

Note a: One and only one parameter must be present.
Note b: Timer = 0 means that a timer is not initiated upon sending this message.

```
routeTrace    EVENT
              EVENTINFO CHOICE {
                  success                 [0] IMPLICIT PointCodeList,
                  detectedLoop            [1] IMPLICIT PointCodeList,
                  excessiveLengthRoute    [2] IMPLICIT PointCodeList,
                  unknownDestination      [3] IMPLICIT NULL,
                  routeInaccessible       [4] IMPLICIT PointCode,
                  localConditions         [5] IMPLICIT NULL,
                  unknownInitiatingSP     [6] IMPLICIT PointCode,
                  timerExpired            [7] IMPLICIT PointCodeList,
                  wrongSP                 [8] IMPLICIT PointCodeList,
                  successToGateway        [20] IMPLICIT PointCodeList,
              ...
              }
              ::=2
```

2.1.2.1 Event Information

2.1.2.1.1 success

On successful completion, the trace of the Point Codes (one or more) of the crossed SP's are included.

Parameter	Code
success	10100000
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code	2.1.1.1.4

2.1.2.1.2 detectedLoop

When a loop is detected, the trace of crossed STPs' point codes augmented by the point code of the SP detecting the loop is included.

Parameter	Code
detectedLoop	10100001
Contents	References
Sequence of Point Codes, Tagged as ‘Point Code’, with contents indicating the exact Point Code	2.1.1.1.4

2.1.2.1.3 excessiveLengthRoute

When an excessively long route is found (threshold exceeded), the entire route is included.

Parameter	Code
excessiveLengthRoute	10100010
Contents	References
Sequence of Point Codes, Tagged as ‘Point Code’, with contents indicating the exact Point Code	2.1.1.1.4

2.1.2.1.4 unknownDestination

If the test destination is unknown, no additional information is required. NOTE: In Issue 1, this result was called unknownResourceInstance.

Parameter	Code
unknownDestination	10000011
Contents	References
empty	-

2.1.2.1.5 routeInaccessible.

The Point Code of the SP that was inaccessible is included.

Parameter	Code
routeInaccessible	10000100
Contents	References
Bit 0 contains the first bit of the Point Code Bit 1 contains the second bit of the Point Code, etc.	2.1.1.1.1

2.1.2.1.6 localConditions.

If a test cannot be run due to local conditions, no additional information is required. Note: In Issue 1, this result was called processingFailure.

Parameter	Code
localConditions	10000101
Contents	References
empty	-

2.1.2.1.7 unknownInitiatingSP.

The Point Code of the node detecting the unknown Initiating SP is included.

Parameter	Code
unknownInitiatingSP	10000110
Contents	References
Bit 0 contains the first bit of the Point Code, Bit 1 contains the second bit of the Point Code, etc.	2.1.1.1.1

2.1.2.1.8 timerExpired.

The Point Code(s) of the node(s) from where no result for the testRoute Action was received is included.

Parameter	Code
timerExpired	10100111
Contents	References
Sequence of Point Codes,	2.1.1.1.4

2.1.2.1.9 wrongSP.

The complete list of Point Codes traversed in the route to the invalid SP.

Parameter	Code
wrongSP	10101000
Contents	References
Sequence of Point Codes, Tagged as ‘Point Code’, with contents indicating the exact Point Code	2.1.1.1.4

2.1.2.1.10 successToGateway.

The complete list of Point Codes traversed in route to the gateway SP and the Point Code of the gateway in the next network.

Parameter	Code
successToGateway	10110100

Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code	2.1.1.1.4

2.1.3 routeTraceNew Event

The routeTrace Event reports trace information. Trace information consists of one or more Point Codes, such as the entire list of Translation Point Codes traversed along a route. This event is invoked either at the explicit request of the originating node (indicated by traceRequested, see 2.1.1.1..2) or by failure at any point along the route when a post-Issue 1 SP is the test initiator. A post-Issue 1 test initiator is identified by the presence of the infoRequest parameter in the testRoute CNF-ACTION (see 3.1.1). This event is not confirmed, therefore no replies to this invocation are expected (no error or success indications are expected).

routeTraceNew EVENT	*Timer*=0	*Class*=4	*Code=00000100*
EventInfo		*Opt/Man**	*Reference*
result		M	2.1.3.1.1
pointCode		O	2.1.3.1.2
pointCodeList		O	2.1.3.1.3
routePriorityList		O	2.1.3.1.4
copyData		O	2.1.3.1.5

```
routeTraceNew       EVENT
                    EVENTINFO CHOICE {
                    --result              [0] IMPLICIT ErrorTag,
                    --pointCode           [1] IMPLICIT PointCode OPTIONAL,
                    --pointCodeList       [2] IMPLICIT PointCodeList OPTIONAL,
                    --routePriorityList   [3] IMPLICIT RoutePriorityList OPTIONAL,
                    --copyData            [4] IMPLICIT copyData OPTIONAL,
                      ...
                    }
                    ::=4
```

2.1.3.1 Event Information

2.1.3.1.1 result

This contains the specific result of the test. Each result has the same meaning and is encoded with the same tag value as the parameters in clause 2.1.2.

NOTE - One and only one prior to is present.

Parameter	Code
result	10000000
Contents	References
Error tag value for appropriate result.	-

```
ErrorTag::=        INTEGER
                   {success (0),
                   detectedLoop (1),
                   excessiveLengthRoute (2),
                   unknownDestination (3),
                   routeInaccessible (4),
                   local Conditions (5),
                   unknownInitiatingSP (6),
                   timerExpired (7),
                   wrongSP (8)
                   successToGateway (20),
                   indirectRoute (21),
                   inefficientRoute (22),
                   ...
}
```

2.1.3.1.2 pointCode.

It is of type PointCode, defined as an octet string. This parameter is only included with the following results in the result errorTag in clause 2.1.3.1.1 or if requested in the infoRequest parameter in the received MRVT:

- routeInaccessible,
- localConditions,
- indirectRoute, or
- unknownInitiating SP.

Parameter	Code
pointCode	10000001
Contents	References
Bit 0 contains the first bit of the Point Code Bit 1 contains the second bit of the Point Code, etc.	2.1.1.1.1

2.1.3.1.3 pointCodeList.

It is a list of Point Codes thus of type PointCodeList. This pointCodeList could be empty. This parameter is only included with the following results in the result ErrorTag in clause 2.1.3.1.1 or if requested in the infoRequest parameter in the received MRVT message:

- success[10],
- detectedLoop,
- excessiveLengthRoute,
- unknownDestination,
- timerExpired
- wrongSP,
- successToGateway,
- inefficientRoute, or
- routeInaccessible.

Parameter	Code
pointCodeList	10100010
Contents	References
Sequence of Point Codes, tagged as "PointCode" with the contents indicating the exact Point Code, etc.	2.1.1.1.4

2.1.3.1.4 routePriorityList.

The list of route priorities used by an SP sending the MRVT message to the next SP in the route under test. This parameter is only included with the following results in the result errorTag in clause 2.1.3.1.1 or if requested in the infoRequest parameter in the received MRVT:

- success[10]
- detectedLoop,
- excessiveLengthRoute,
- unknownDestination,

[10] An MRVR with result "success" with the associated parameters PointCodeList and routePriorityList is only returned to the test initiator if a trace is requested.

- wrongSP,
- successToGateway, or
- inefficientRoute.

It is an integer number, thus it is of type INTEGER.

Parameter	Code
routePriorityList	10100011
Contents	References
Sequence of integer route priorities	2.1.1.1.5

2.1.3.1.5 copyData.

The copyData parameter contains either unrecognized information by the SP sending the routeTraceNew and requested in the returnUnknownParams parameter, or in the case of an unknownInitiatingSP result, the copyData parameter is a copy of the same parameter contained in the Action Errors in an MRVA message. It is of type OCTET STRING.

Parameter	Code
copyData	10000100
Contents	
Parameters requested by the test initiator in the returnUnknownParams parameter (see 2.1.1.1.9) when such parameters are unknown by the SP sending the MRVR, or a direct copy of the contents of the copyData parameter received in an MRVA message if the traceSent parameter indicates that an MRVR has not been sent.	

3 SCCP

3.1 SRVT ASE

The SRVT ASE provides the services accessed via the two OM-primitives OM-CONFIRMED-ACTION and OM-EVENT-REPORT. SRVT uses a particular instance of each primitive. testRoute is the CnfActionType of the OM-CONFIRMED-ACTION primitive, while routeTrace for Issue 1 test initiators, and routeTraceNew, for post-Issue 1 test initiators, is the EventType of the OM-EVENT-REPORT primitive. Each is described below with the appropriate arguments (ActionArg for testRoute and EventInfo for routeTrace (Issue 1 SPs) or routeTraceNew (post-Issue 1 SPs)) and, for testRoute, the appropriate ActionResults and ActionErrors. For OM-primitives, the InvokeID in the respective primitives is the InvokeID passed to TCAP, the ResourceClass indicates SCCP Global Title Translation Tables, and the ResourceInstance contains the Global Title Indicator and Tested Global Title. The GTI is coded as defined in the SCCP Address Indicator except that bits 1, 2, 7, and 8 are reserved as shown in Figure D5/T1.116.4[11]. In addition, the accessControl argument in OM-CONFIRMED-ACTION is absent. The testRoute Action (SRVT) makes use of the Query message with the result (SRVA) returning in an Response. The routeTrace Event (Issue 1 SPs) and the routeTraceNew Event (post-Issue 1 SPs) (SRVR) uses a Query message with prearranged end.

[11] See Annex D/T1.116.4-2000 for the encoding of the Global Title Indicator and Global Title parameters.

3.1.1 testRoute Cnf Action

The testRoute Action is invoked to initiate an SCCP Routing Verification Test. At the initiator node, this invocation is requested by the local SP Management. At subsequent nodes, the Action is requested implicitly by the receipt of a testRoute Action invocation. A successful reply indicates successful completion of the test at the point it was invoked and, implicitly, at all subsequent points where the test was invoked. A failure indication is returned to indicate that the test failed in this or a subsequent node.

testRoute CNF-ACTION	*Timer*=T2	*Class*=1	*Code*=00000001
ActionArg		*Opt/Man*	*Reference*
initiatingSP		M	3.1.1.1.1
traceRequested		M	3.1.1.1.2
threshold		M	3.1.1.1.3
pointCodesTraversed		M	3.1.1.1.4
formIndicator		M M	3.1.1.1.5
mtpBackwardRoutingRequested		O	3.1.1.1.6
testInitiatorGT		O	3.1.1.1.7
destinationPC		O	3.1.1.1.8
destinationSSN		O	3.1.1.1.9
backupDPC		O	3.1.1.1.10
backupSSN		O	3.1.1.1.11
originalGT		O[11]	3.1.1.1.12
infoRequest		O	3.1.1.1.13
returnUnknownParams		O	3.1.1.1.14
inputGT		O	3.1.1.1.15
localReturnSP		O	3.1.1.1.16
destinationPriorities			3.1.1.1.17
ActionResult			
empty			
Linked Operations			
N/A			
Specific Errors			*Reference*
failure			3.1.1.3.1
partialSuccess			3.1.1.3.2

```
testRoute CNF-ACTION

ACTIONARG SEQUENCE {

                    initiating SP                  [0] IMPLICIT PointCode
                    traceRequested                 [1] IMPLICIT BOOLEAN,
                    threshold                      [2] IMPLICIT INTEGER,
                    pointCodesTraversed            [3] IMPLICIT PointCodeList,
                    formIndicator                  [4] IMPLICIT FormIndicator,
                    mtpBackwardRoutingRequested    [5] IMPLICIT BOOLEAN,
                    testInitiatorGT                [6] IMPLICIT GlobalTitle OPTIONAL,
                    destinationPC                  [7] IMPLICIT PointCode OPTIONAL,
                    destinationSSN                 [8] IMPLICIT SubsystemNumber OPTIONAL,
                    backupDPC                      [9] IMPLICIT PointCode OPTIONAL,
                    backupSSN                      [10] IMPLICIT SubsystemNumber OPTIONAL,
                    originalGT                     [11] IMPLICIT GlobalTitle OPTIONAL,
                    infoRequest                    [12] IMPLICIT RequestParams OPTIONAL,
                    returnUnknownParams            [13] IMPLICIT UnknownParams OPTIONAL,
                    inputGT                        [14] IMPLICIT GlobalTitle OPTIONAL
                    destinationPriorities          [29] IMPLICIT RoutePriorityList OPTIONAL
                    localReturnSP                  [30] IMPLICIT PointCode OPTIONAL
}
ACTIONRESULT        empty
SPECIFICERRORS      { failure, partialSuccess}

::=1
```

3.1.1.1 testRoute Cnf Action Arguments

3.1.1.1.1 initiatingSP.

The initiatingSP identifies the test initiator. It is of type PointCode.

Parameter	Code
initiatingSP	10000000
Contents	
Bit 0 contains the first half of the Point Code, Bit 1 contains the second half of the Point Code, etc.	

The encoding of the point code must be consistent to the encoding for the point code found in the MTP standard, T1.111-2001 and the SCCP standard, T1.112-2001 (see Annex D for an example of the point code encoding). This encoding of the point code is true for all parameters in the OMAP standard that contains a point code.

```
PointCode ::=OCTETSTRING
--Coding of the contents of PointCode
--must follow specifications given in T1.111.4-2001
--clauses 2.2.3, 2.2.3A and in Figure 3B/T1.111.4-
2001
--for point codes in U.S. national routing labels.
```

3.1.1.1.2 traceRequested.

traceRequested indicates that either a routeTrace or a routeTraceNew for all routes used to reach the destination should be reported to the originator (the routeTrace Event is described in clause 3.1.2; the routeTraceNew Event is described in clause 3.1.3). It is of type BOOLEAN.

Parameter	Code
traceRequested	10000001
Contents	Meaning
TRUE(=1) FALSE(=0)	trace was requested, return routeTrace or routeTraceNew on success and failure. trace not requested, return routeTrace or routeTraceNew only on failure.

3.1.1.1.3 threshold.

The originator sets a maximum threshold level of Translation Signalling Points (TSP) which are allowed to be crossed in the course of the test (including the initiator if it is an SCCP Relay Node). This aids in detecting overly long routes. This threshold is an integral number of SP’s, thus it is of type INTEGER.

Parameter	Code
threshold	10000010
Contents	
Integer number represented in binary.	

3.1.1.1.4 pointCodesTraversed

As each Translation SP is crossed, it adds its own Point Code to the list of Point Codes traversed. This aids in detecting loops and is also useful information in case of a failure or if a route trace is requested. It is a list of Point Codes thus of type PointCodeList. This PointCodeList could be empty.

Parameter	Code
initiatingSP	10100011
Contents	
Sequence of Point Codes, tagged as ‘Point Code’ with the contents indicating the exact Point Code.	

```
PointCodeList ::= SEQUENCE OF PointCode
```

3.1.1.5 formIndicator.

The formIndicator identifies the form of the SRVT message, i.e., either Request, Verify, or Compare. It is of type INTEGER, with the values defined as below.

Parameter	Code
initiatingSP	10000100
Contents	
Value 0 = Compare Value 1 = No Compare	

```
FormIndicator ::=       INTEGER
                         { Compare (0),
                           No Compare (1)  }
```

3.1.1.1.6 mtpBackwardRoutingRequested.

The mtpBackwardRoutingRequested identifies whether MTP backward routing to the OPC is required for test success. It is of type BOOLEAN.

Parameter	Code
mtpBackwardRoutingRequested	10000101
Contents	
TRUE (=1) Routing Requested FALSE (=0) Routing Not Requested	

3.1.1.1.7 testInitiatorGT.

The testInitiatorGT identifies the Global Title Indicator and the initiator’s Global Title. It is of type OCTETSTRING.

Parameter	Code
testInitiatorGT	10000110
Contents	
Octet 1 = Global Title Indicator Octet 2, 3, ... = Initiator Global Title	

```
GlobalTitle ::= OCTETSTRING

--Coding of the Global Title Indicator must be
--be in the same format as shown in the SCCP Address Indicator.
--The Global Title must be encoded as shown in the SCCP Global
--title format in T1.112.3-2001 (see Annex D/T1.116.4-2000 for the
--encoding of the Global Title Indicator and Global Title)
```

3.1.1.1.8 destinationPC.

The destinationPC identifies the Destination Point Code (Tested Destination or TPC). It is of type PointCode.

Parameter	Code
destinationPC	10000111
Contents	References
Bit 0 contains the first bit of the Point Code Bit 1 contains the second bit of the Point Code, etc.	3.1.1.1.1

3.1.1.1.9 destinationSSN.

The destinationSSN identifies the destination Subsystem Number. It is of type OCTETSTRING.

Parameter	Code
destinationSSN	10001000
Contents	
Bit 0 contains the first bit of the Subsystem Number, Bit 1 contains the second bit of the Subsystem Number, etc.	

```
Subsystem Number ::= OCTETSTRING
```

3.1.1.1.10 backupDPC.

The backDPC identifies the signalling point where the mated subsystem is located. It is of type PointCode.

Parameter	Code
backupDPC	10001001
Contents	References
Bit 0 contains the first bit of the Point Code Bit 1 contains the second bit of the Point Code, etc.	3.1.1.1.1

3.1.1.1.11 backupSSN.

The backupSSN identifies the backup destination Subsystem Number. It is of type OCTETSTRING.

Parameter	Code
backupSSN	10001010
Contents	
Bit 0 contains the first bit of the Subsystem Number, Bit 1 contains the second bit of the Subsystem Number, etc.	

3.1.1.1.12 originalGT.

The original GT identifies the Test GTI + GT originally submitted by the test initiator. It is of type OCTETSTRING.

Parameter	Code
originalGT	10001011
Contents	References
Octet 1 = Global Title Indicator Octet 2,3, ... = Original Global Title	3.1.1.1.7

3.1.1.1.13 infoRequest.

The parameter is used to indicate the information requested by the test initiator to be returned in an SRVR message in addition to the result[12]. It is of type BIT STRING.

Parameter	Code
infoRequest	10001100
Bit	Meaning
H (0) G (1)	pointcode pointCodeList

```
RequestParam::=        BIT STRING
                       { pointCode (0),
                       pointCodeList (1),
                       ...
                       }
```

[12] The information actually returned in the SRVR message is the superset of the information requested by the test initiator in the infoRequest parameter and the information specified in clause 3.1.3.1 for the specific test result.

3.1.1.1.14 returnUnknownParams.

Indicates the parameters to be returned to the test initiator in the SRVR message if such parameters are unknown to the sender of the SRVR message.

Parameter	Code
returnUnknownParams	10001101
Bit	Meaning
H (0) G (1) F (2) E (3) D (4) C (5) B (6) A (7)	tag14 tag15 tag16 tag17 tag18 tag19 tag20 tag21

```
UnknownParams::=        BIT STRING
                        { tag 14 (0),
                        tag 15 (1),
                        ...
                        }
```

3.1.1.1.15 inputGT.

The inputGT, used only in the SRVT Compare form, identifies the Test GTI + GT prior to translation at a TSP. It is of type OCTETSTRING.

Parameter	Code
inputGT	10001110
Contents	References
Octet 1 = Global Title Indicator Octet 2, 3, ... = Input Global Title to TSP	3.1.1.1.7

3.1.1.1.16 localReturnSP.

The localReturnSP identifies the SP to which the local SRVR should be sent. It is of type PointCode defined as an octet string.

Parameter	Code
localReturnSP	10011110
Contents	References
Bit 0 contains the first bit of the Point Code, Bit 1 contains the second bit of the Point Code, etc.	pointcode pointCodeList

3.1.1.1.17 destinationPriorities

The destinationPriorities identifies the priorities of the Translation SPs or Tested Destination SPs+SSNs resulting from the translation. It is an integer number, thus it is of type INTEGER.

Parameter	Code
routePriorityList	10111101
Contents	
Sequence of integer route priorities coded “1” for primary (first choice) route, “2” for first alternate (second choice) route, etc.	

```
RoutePriorityList ::= SEQUENCE OF routePriority INTEGER {   firstChoice(1).
                                                            secondChoice(2),
                                                            thirdChoice(3),
                                                            fourthChoice(4) }
```

3.1.1.2 Action Results.

There are no contents in a successful return indication.

3.1.1.3 Action Errors.

SpecificErrors are possible errors which can occur during this test which are unique to this test. These specific errors are in addition to the errors already identified in the OM-CONFIRMED-ACTION service and appear as parameters for the processing failure error.

3.1.1.3.1 failure.

Failure indicates a condition of failure, where a Translation could not be successfully done, or was incorrect. Most often this will be used as a failure indication from the point which detects the error and does not invoke any further testRoute Actions. The failure, SpecificError, may have with it up to two parameters to indicate the error condition causing the failure. The first parameter, failureType, is represented as a bit string[3] and contains the error indications standardized nationally and internationally. The second parameter, failureTypeNational, is represented as a bit string and contains the error indications that have not been standardized internationally (i.e., only in North America). In addition, the second parameter is to be used when failureType indicates the error Unknown Initiating SP. traceSent indicates whether or not a routeTrace Event has been invoked to report trace information. It is necessary to indicate this for this error since the node detecting the error cannot send the routeTrace, thus the previous node must. traceSent is of type of BOOLEAN and is optional. If the failureType, unknownInitiatingSP, is present, traceSent is FALSE, the copyData parameter must also be present in the SRVA message if the infoRequest parameter or returnUnkownParams parameter was in the SRVT message . The copyData parameter contains the information specified in T1.116.3-2000, clause 3.2.2.2.2 d). This parameter is present only if the infoRequest parameter or returnUnknownParams parameter was in the SRVT message. It is of type OCTETSTRING.

Specific Error	Code
failure	00000001
Parameters	References
failureType failureTypeNational traceSent copyData	3.1.1.3.1 3.1.1.3.1 3.1.1.3.1

Parameter	Code
failureType	10000000
Bit	Meaning
H[7] (0)	detectedLoop
G (1)	excessiveLengthRoute
F (2)	unknownGT
E (3)	routeInaccessible
D (4)	localConditions
C (5)	unknownInitiatingSP
B (6)	timerExpired
A (7)	wrongSP
H (8)	incorrectTranslation-Primary
G (9)	incorrectTranslation-Secondary
F (10)	incorrectTranslation-Intermediate
E (11)	notPrimaryDestination
D (12)	notSecondaryDestination
C (13)	notRecognizedPrimary
B (14)	notRecognizedSecondary
A (15)	routingProblem
H (16)	successToGateway

Parameter	Code
failureTypeNational	10011110
Bit	Meaning
H[7] (0)	differentPriorities-FTSP
G (1)	differentPriorities-Intermediate
F (2)	routingDataNotChecked
E (3)	NoCoordStateChangeData

Specific Error	Code
traceSent	10000001
Contents	Meaning
TRUE	the trace information was sent
FALSE	the trace information was not sent

Parameter	Code
copyData	10000100
Contents	
Octet 0 is the first octet of the data copied from the SRVT Octet 1 is the second octet of data copied from the SRVT	

```
failure    SPECIFICERROR          {failureType           [0] IMPLICIT FailureString,
           PARAMETER SEQUENCE      traceSent             [1] IMPLICIT BOOLEAN
                                   copyData              [4] IMPLICIT CopyData OPTIONAL,
                                   failureTypeNational   [30] IMPLICIT FailureTypeNational
                                                              OPTIONAL
                                   ...
                                   }
                                   ::= 1
```

```
FailureString ::= BITSTRING
                    {detectedLoop (0),
                    excessiveLengthRoute (1),
                    unknownGT (2),
                    routeInaccessible (3),
                    localConditions (4),
                    unknownInitiatingSP (5),
                    timerExpired (6),
                    wrongSP (7),
                    incorrectTranslation-Primary (8),
                    incorrectTranslation-Secondary (9),
                    incorrectTranslation-Intermediate (10),
                    notPrimaryDestination (11),
                    notSecondaryDestination (12),
                    notRecognizedPrimary (13),
                    notRecognizedSecondary (14),
                    routingProblem (15)
                    successToGateway (16)
                    ...
                    }
```

```
FailureStringNational ::= BITSTRING
                    {differentPriorities-FTSP (0),
                     differentPriorities-Intermediate (1),
                     routingDataNotChecked (2),
                     NoCoordStateChangeData (3),
                    ...
                    }
```

```
CopyData::=OCTET STRING
```

3.1.1.3.2 partialSuccess.

This indication is given when at least one testRoute CnfAction invocation failed and at least one succeeded (at least partially). In this case, each type of error that occurred will be noted and sent in the final reply. The format and contents of partial success are the same as failure.

Specific Error	Code
partialSuccess	00000010
Parameters	References
failureType failureTypeNational traceSent copyData	3.1.1.3.1 3.1.1.3.1 3.1.1.3.1 3.1.1.3.1

```
partialSuccess  SPECIFICERROR        {failureType         [0] IMPLICIT FailureString,
                PARAMETER SEQUENCE   traceSent            [1] IMPLICIT BOOLEAN }
                                     copyData             [4] IMPLICIT CopyData OPTIONAL,
                                     failureTypeNational  [30] IMPLICIT FailureStringNational
                                                              OPTIONAL,

                                     ...
                                     }
                                     ::= 2
```

3.1.2 routeTrace Event.

The routeTrace Event reports trace information. Trace information consists of one or more Point Codes, such as the entire list of Translation Point Codes traversed along a route. This event is invoked either at the explicit request of the originating node (indicated by traceRequested, see 3.1.1.1.2) or by failure at any point along the route when an Issue 1 SP is the test initiator. An Issue 1 test initiator is identified by the absence of the infoRequest in the testRoute CNF-ACTION (see 3.1.1). If the test initiator is a post-Issue 1 SP (identified by the presence of the infoRequest in the testRoute CNF-ACTION (see 3.1.1)), the routeTrace New Event (see 3.1.3) should be the event. This event is not confirmed, therefore no replies to this invocation are expected (no error or success indications are expected).

routeTrace EVENT	*Timer*=0	*Class*=4	*Code*=00000010
EventInfo		*Opt/Man**	*Reference*
success detectedLoop excessiveLengthRoute unknownGT routeInaccessible		O O O O O	3.1.2.1.1 3.1.2.1.2 3.1.2.1.3 3.1.2.1.4 3.1.2.1.5

localConditions	O	3.1.2.1.6
unknownInitiatingSP	O	3.1.2.1.7
timerExpired	O	3.1.2.1.8
wrongSP	O	3.1.2.1.9
incorrectTranslation-Primary	O	3.1.2.1.10
incorrectTranslation-Secondary	O	3.1.2.1.11
incorrectTranslation-Intermediate	O	3.1.2.1.12
notPrimaryDestination	O	3.1.2.1.13
notSecondaryDestination	O	3.1.2.1.14
notRecognizedPrimary	O	3.1.2.1.15
notRecognizedSecondary	O	3.1.2.1.16
routingProblem	O	3.1.2.1.17

* NOTE - One and only one of parameter must be present.

```
routeTrace      EVENT
                EVENTINFO CHOICE {
                        success                             [0] IMPLICIT PointCodeList,
                        detectedLoop                        [1] IMPLICIT PointCodeList,
                        excessiveLengthRoute                [2] IMPLICIT PointCodeList,
                        unknownGT                           [3] IMPLICIT NULL
                        routeInaccessible                   [4] IMPLICIT PointCode,
                        localConditions                     [5] IMPLICIT NULL
                        unknownInitiatingSP                 [6] IMPLICIT PointCode,
                        timerExpired                        [7] IMPLICIT PointCodeList,
                        wrongSP                             [8] IMPLICIT PointCodeList,
                        incorrectTranslation-Primary        [9] IMPLICIT PointCodeList,
                        incorrectTranslation-Secondary      [10] IMPLICIT PointCodeList,
                        incorrectTranslation-Intermediate   [11] IMPLICIT PointCodeList,
                        notPrimaryDestination               [12] IMPLICIT PointCodeList,
                        notSecondaryDestination             [13] IMPLICIT PointCodeList,
                        notRecognizedPrimary                [14] IMPLICIT PointCodeList,
                        notRecognizedSecondary              [15] IMPLICIT PointCodeList,
                        routingProblem                      [16] IMPLICIT PointCodeList,
                        ...
                        }
                        ::= 2
```

3.1.2.1 Event Information

3.1.2.1.1 success

On successful completion, the trace of the Point Codes (one or more) of the crossed SCCP Relay Nodes are included.

Parameter	Code
success	10100000
Contents	References
Sequence of one or more Point Codes, Tagged as ‘Point Code’, with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.2 detectedLoop.

When a loop is detected, the point codes (three or more) contained in the loop are included.

Parameter	Code
detectedLoop	10100001
Contents	References
Sequence of one or more Point Codes, Tagged as ‘Point Code’, with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.3 excessiveLengthRoute.

When an excessively long route is found (threshold exceeded), the entire route is included.

Parameter	Code
excessiveLengthRoute	10100010
Contents	References
Sequence of one or more Point Codes, Tagged as ‘Point Code’, with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.4 unknownGT.

If the Global Title is unknown, no additional information is required. For the SRVT, this refers to the case when no translation data exists for the GTI + GT.

NOTE - In Issue 1, this result was called unknownResourceInstance.

Parameter	Code
unknownGT	10000011
Contents	References
empty	-

3.1.2.1.5 routeInaccessible.

The Point Code of the SP that was inaccessible is included.

Parameter	Code
routeInaccessible	10000100
Contents	References
Bit 0 contains the first bit of the Point Code, Bit 1 contains the second bit of the Point Code, etc.	3.1.1.1.1

3.1.2.1.6 localConditions.

If a test cannot be run due to local conditions, no additional information is required.

NOTE - In Issue 1, this result was called processingFailure.

Parameter	Code
localConditions	10000101
Contents	References
empty	-

3.1.2.1.7 unknownInitiatingSP.

The Point Code of the node detecting the unknown initiating Signalling Point is included.

Parameter	Code
unknownInitiatingSP	10000110
Contents	References
Bit 0 contains the first bit of the Point Code, Bit 1 contains the second bit of the Point Code, etc.	3.1.1.1.1

3.1.2.1.8 timerExpired.

The Point Code(s) of the node(s) where no result for the testRoute Action was received is included.

Parameter	Code
timerExpired	10100111
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.9 wrongSP.

The complete list of Translation SPs traversed in route to the invalid SP.

Parameter	Code
wrongSP	10101000
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.10 incorrectTranslation-Primary.

The complete list of Translation SPs traversed in route to the incorrect primary destination is included.

Parameter	Code
incorrectTranslation-Primary	10101001
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.11 incorrectTranslation-Secondary.

The complete list of Translation SPs traversed in route to the incorrect secondary destination is included.

Parameter	Code
incorrectTranslation-Secondary	10101010
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.12 incorrectTranslation-Intermediate.

The complete list of Translation SPs traversed in route to the incorrect intermediate point is included.

Parameter	Code
incorrectTranslation-Intermediate	10101011
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.13 notPrimaryDestination.

The complete list of Translation SPs traversed in route to the invalid primary destination is included.

Parameter	Code
notPrimaryDestination	10101100
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.14 notSecondaryDestination.

The complete list of Translation SPs traversed in route to the invalid secondary destination is included.

Parameter	Code
notSecondaryDestination	10101101
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.15 notRecognizedPrimary.

The complete list of Translation SPs traversed in route to the secondary destination is included.

Parameter	Code
notRecognizedPrimary	10101110
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.16 notRecognizedSecondary.

The complete list of Translation SPs traversed in route to the primary destination is included.

Parameter	Code
notRecognizedSecondary	10101111
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.2.1.17 routingProblem.

The complete list of Translation SPs traversed in route to the possible routing problem. This occurs when the Point Code from the translation is not recognized.

Parameter	Code
routingProblem	10110000
Contents	References
Sequence of Point Codes, Tagged as 'Point Code', with contents indicating the exact Point Code.	3.1.1.1.4

3.1.3 routeTraceNew Event

The routeTrace Event reports trace information. Trace information consists of one or more Point Codes, such as the entire list of Translation Point Codes traversed along a route. This event is invoked either at the explicit request of the originating node (indicated by traceRequested, see 3.1.1.1.2) or by failure at any point along the route when a post-Issue 1 SP is the test initiator. A post-Issue 1 test initiator is identified by the presence of the infoRequest parameter in the testRoute CNF-ACTION (see 3.1.1). This event is not confirmed, therefore no replies to this invocation are expected (no error or success indications are expected).

routeTraceNew EVENT	*Timer*=0	*Class*=4	*Code*=00000100
EventInfo		*Opt/Man**	*Reference*
result		O	3.1.3.1.1
pointCode		O	3.1.3.1.2
pointCodeList		O	3.1.3.1.3
copyData		O	3.1.3.1.4

```
routeTraceNew       EVENT
                    EVENTINFO SEQUENCE {
                        result              [0] IMPLICIT ErrorTag,
                        pointCode           [1] IMPLICIT PointCode OPTIONAL,
                        pointCodeList       [2] IMPLICIT PointCodeList OPTIONAL,
                        copyData            [4] IMPLICIT copyData OPTIONAL,
                        ...
                        }
                        ::= 4
```

3.1.3.1 Event Information

3.1.3.1.1 result

This is the specific result of the test. Each result has the same meaning and is encoded with the same tag value as the parameters in 3.1.2.

NOTE - One and only one error tag is present.

Parameter	Code
result	10000000
Contents	References
Error tag value for appropriate result.	-

```
errorTag::=         INTEGER
                    {success (0)
                    detectedLoop (1),
                    excessiveLengthRoute (2),
                    unknownGT (3),
                    routeInaccessible (4),
                    localConditions (5),
                    unknownInitiatingSP (6),
                    timerExpired (7),
                    wrongSP (8),
```

```
                 incorrectTranslation-Primary (9)
                 incorrectTranslation-Secondary (10),
                 incorrectTranslation-Intermediate (11),
                 notPrimaryDestination (12),
                 notSecondaryDestination (13),
                 notRecognizedPrimary (14),
                 notRecognizedSecondary (15),
                 routingProblem (16),
                 successToGateway (17),
                 noCoordStateChangeData (251),
                 routingDataNotChecked (252),
                 differentPriorities-Intermediate (253),
                 differentPriorities-FTSP (254),
                 ...

                 }
```

3.1.3.1.2 pointCode.

It is of type PointCode, defined as an octet string. This parameter is only included with the following results in the result errorTag in 3.1.3.1.1, or if requested in the infoRequest parameter in the received SRVT:

- routeInaccessible,
- localConditions, or
- unknownInitiatingSP.

Parameter	Code
pointCode	10000001
Contents	References
Bit 0 contains the first bit of the Point Code Bit 1 contains the second bit of the Point Code, etc.	3.1.1.1.1

3.1.3.1.3 pointCodeList.

This is a list of Point Codes as required with the results shown below. It is a list of Point Codes thus of type PointCodeList. This pointCodeList could be empty. This parameter is only included with the following results in the result errorTag in 3.1.3.1.1, or if requested in the infoRequest parameter in the received SRVT:

- success[13],

[13] An SRVR with result “success” with the associated parameters pointCodeList and routePriorityList is only returned to the test initiator if a trace is requested.

- detectedLoop,
- excessiveLengthRoute,
- unknownGT,
- timerExpired,
- wrongSP,
- incorrectTranslation-Primary,
- incorrectTranslation-Secondary,
- incorrectTranslation-Intermediate,
- notPrimaryDestination,
- notSecondaryDestination,
- notRecognizedPrimary,
- notRecognizedSecondary,
- routingProblem, or
- successToGateway,
- differentPriorities-FTSP,
- differentPriorities-Intermediate,
- routingDataNotChecked,
- noCoordStateChangeData.

Parameter	Code
pointCodeList	10100010
Contents	References
Sequence of Point Codes, tagged as “PointCode” with the contents indicating the exact Point Code.	3.1.1.1.4

3.1.3.1.4 copyData.

The copyData parameter contains either unrecognized information by the SP sending the routeTraceNew and requested in the returnUnknownParams parameter, or in the case of unknownInitiatingSP result, the copyData parameter is a copy of the same parameter contained in the Action Errors in an SRVA message. It is of type OCTET STRING.

Parameter	Code
copyData	10000100
Contents	
Parameters requested by the test initiator in the returnUnknownParams parameter (see 3.1.1.1.14) when such parameters are unknown by the SP sending the SRVR, or a direct copy of the contents of the copyData parameter received in an SRVA message if the traceSent parameter indicates that an MRVR has not been sent.	

4 CIRCUIT MANAGEMENT (For Further Study)

5 TRANSACTION CAPABILITIES (For Further Study)

6 LINK MANAGEMENT

6.1 Link Equipment Failure ASE

The Link Equipment Failure (LEF) ASE provides the service accessed using the OM-primitive OM-EVENT-REPORT. LEF uses an EventType instance (linkStatus) of OM-EVENT-REPORT. The invoke ID in the respective primitive is the invoke ID passed to TCAP. The ResourceClass indicates link_Information and the ResourceInstance contains the Point Code of the facility failure. The linkStatus Event (LEU or LEA) uses a Query message with a pre-arranged end.

6.1.1 linkStatus Event.

The linkStatus Event reports the availability of a given signalling link between two Signalling Points. The information contained in the Event consists only of unavailability/availability and the Signalling Link Code. This event is not confirmed, therefore no replies to this invocation are expected.

linkStatus EVENT	*Timer*=0	*Class*=4	*Code*=00000001
EventInfo		*Opt/Man**	*Reference*
linkEquipmentUnavailable		O	6.1.2.1
linkEquipmentAvailable		O	6.1.2.2
Specific Errors			*Reference*
none			

Note - One and only one parameter must be present.*

```
linkStatus          EVENT
                    EVENTINFO CHOICE {
                        linkEquipmentUnavailable      [0] IMPLICIT LinkCode,
                        linkEquipmentAvailable        [1] IMPLICIT LinkCode }

::= 1
```

```
LinkCode ::= OCTETSTRING SIZE (1)
                                        --The four most significant bits are encoded '0000'.
                                        --The four least significant bits are the binary
                                        --encoding of the Signalling Link Code (SLC).
                                        --The encoding of the SLC should be the same as that
                                        --used in T1.111.4-2001 for MTP management messages.
```

6.1.2 Event Information

6.1.2.1 linkEquipmentUnavailable.

On unavailability of a local facility, this indication is reported to the far end of the link. The SLC code is included.

Parameter	Code
linkEquipmentUnavailable	10100000
Contents	References
Signalling Link Code (SLC)	6.1.1

6.1.2.2 linkEquipmentAvailable.

On the return of availability of a local facility, this indication is reported to the far end of the link. The SLC code is included.

Parameter	Code
linkEquipmentAvailable	10100001
Contents	References
Signalling Link Code (SLC)	6.1.1

7. LINK FAULT SECTIONALIZATION ASE.

The Link Fault Sectionalization ASE provides the service accessed using the two OM-primitives OM-EVENT-REPORT and OM-CONFIRMED-ACTION. A particular instance of each is used. loopRequest is the CnfActionValue of the OM-CONFIRMED-ACTION primitive. Each is described below with the appropriate arguments (ActionArg for loopRequest and EventInfo for linkTest), and, for loopRequest, the appropriate ActionResults and ActionErrors. The invoke ID in the respective primitives is the invoke ID passed to TCAP. The ResourceClass indicates link_Information and the ResourceInstance contains the Point Code of the message initiator. In addition, the accessControl argument in OM-CONFIRMED-ACTION is absent. The loopRequest Cnf Action makes use of the Query (FTL) message with result (FTA) returning in a response. Both the linkTest Event (FTU) and the linkTestResults Event (FTR) uses a Query message with a pre-arranged end.

7.1 linkTest Event

The linkTest Event request the controlled Signalling Point to prepare the signalling link for testing. The information in the Event consists of the Signalling Link Code. This event is not confirmed, therefore no replies to this invocation are expected.

linkTest EVENT	*Timer*=0	*Class*=4	*Code*=00000010
EventInfo		*Opt/Man*	*Reference*
linkCode		M	6.1.1
Specific Errors			*Reference*
none			

```
linkTest        EVENT
                EVENTINFO {
                             linkCode LinkCode }

                ::= 2
```

7.2 loopRequest Cnf Action

The loopRequest Cnf Action is invoked to request the controlled SP to loopback all incoming data. A successful reply indicated the controlled SP initiated the loopback. A failure indication is returned to indicate the loopback was not made in the controlled SP.

loopRequest CNF_ACTION	*Timer*=T3	*Class*=1	*Code*=00000001
EventInfo		*Opt/Man*	*Reference*
linkCode		M	6.1.1
ActionResult			
empty			
Linked Operations			
N/A			
Specific Errors			*Reference*
empty			

```
loopRequest     CNF_ACTION
                ACTIONARG {               linkCode LinkCode }
                ACTIONRESULT    empty
                SPECIFICERRORS
                empty

                ::= 1
```

7.2.1 Action Results

There are no contents in a successful return indication.

7.2.2 Action Errors

SpecificErrors are possible errors that can occur during this test which are unique to this test. These specific errors are in addition to the errors already identified in the OM-CONFIRMED-ACTION service. When the Processing Failure Error is given it is an indication that timer T3 expired or the controlled SP was unable to initiate the loopback.

7.3 linkTestResults Event

The linkTestResults event notifies the controlled SP that the link fault sectionalization procedure has ended. The results of the procedures are included in the message. The information in the Event consists of the reason the errors recorded. This event is not confirmed, therefore no replies to this invocation are expected.

linkTestResults Event	*Timer*=0	*Class*=4	*Code*=00000011
EventInfo		*Opt/Man*	*Reference*
testPassed		O	7.4.1
testFailed		O	7.4.2
timeout		O	7.4.3
Specific Errors			*Reference*
none			

```
linkTestResults    EVENT
                   EVENTINFO CHOICE {
                          testPassed             [0] IMPLICIT LinkCode,
                          testFailed             [1] IMPLICIT ResultData,
::= 3                     timeout                [2] IMPLICIT LinkCode
```

```
ResultData ::= SEQUENCE {     linkCode LinkCode,
                              bitErrors INTEGER,
                              location Location }
```

```
BitErrors ::= INTEGER
```

```
Location ::= OCTETSTRING SIZE (2)
--The first octet contains the Loopback Code.
--The second octet contains the binary encoding
--for the Component Number.
```

7.4 linkTestResults Event Information

7.4.1 testPassed

When all link components have been successfully tested, this indication is given to the far end of the link. The result data includes the SLC.

Parameter	Code
testPassed	10100000
Contents	References
Signalling Link Code (SLC)	6.1.1

7.4.2 testFailed

If the controlling SP tests a link component and the loopback test fail, this indication is given to the controlled SP. The result data includes the Signalling Link Code, the number of bit errors recorded, and the location of the failing link component.

Parameter	Code
testFailed	10100001
Contents	References
Signalling Link Code (SLC)	6.1.1
Bit Errors	7.3
Location	7.3

7.4.3 timeout

If timer T4 expires in the controlling SP, this indication is given to the controlled SP. The result data includes the SLC.

Parameter	Code
timeout	10100010
Contents	References
Signalling Link Code (SLC)	6.1.1

8 TrVT ASE

The definition of an ASE for the TrVT is for further study.

9 RESOURCES AND OPERATIONS

OMAP runs tests on resources such as the MTP and SCCP routing tables. These resources are here described as “Resource Classes” and are identified by an object identifier that specifies the ANSI approved standard, T1.116-2000; and the type of resource. This structure is shown below for the OMAP object identifiers.

omap	OBJECT IDENTIFIER::= {ANSI T1.116}
mtp_Routing_Tables	OBJECT IDENTIFIER::= {omap 0}
sccp_Routing_Tables	OBJECT IDENTIFIER::= {omap 1}
link_Information	OBJECT IDENTIFIER::= {omap 2}
transaction_Information	OBJECT IDENTIFIER::= {omap 3}

The Resource Class of MTP Routing Tables is XX XX XX XX 00[14] (hexadecimal), and for SCCP Routing Tables in XX XX XX XX 01[14] (hexadecimal), etc.

Currently Defined Operations	
0	Event - Report
7	Confirmed - Action
* other operations are for further study	

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 1 of 8)

9.1 OM-EVENT-REPORT

The OM-EVENT-REPORT service provides user with the capability to report the occurrence of an event concerning a management resource to a user in another open system. The specific event that occurred is interpreted in the context of the resource class specified.

OM-EVENT-REPORT Service

Parameter Name	Req/Ind
TransactionID	M
InvokeID	M
ResourceClass	M
ResourceInstance	M
EventValue	M
EventTime	O
EventInfo	O

Parameter Definitions:

TransactionID:	as defined in Chapter T1.114.2 of T1.114-2000.
InvokeID:	as defined in Chapter T1.114.2 of T1.114-2000.
ResourceClass:	identifies the class of resources for which this event is defined.
ResourceInstance:	identifies the resource instance on which the event is reported.

[14] The coding of an ANSI Object Identifier is not yet defined. The Object Identifier for ITU-T is defined as 00 11 86 1B.

EventValue:	specifies the particular event that is being reported by the resource instance.
EventTime:	specifies the time at which the event was generated.
EventInfo:	provides additional event specific information.

The eventReport operation is defined, using the TCAP OPERATION MACRO, as follows:

```
eventReport OPERATION
  PARAMETER SEQUENCE {
    resourceClass                         ResourceClass,
    resourceInstance                      ResourceInstance,
    eventValue                            [0] IMPLICIT EVENT,
    eventTime                             [1] TimeStamp OPTIONAL,
    eventInfo                             [2] ANY DEFINED BY eventValue OPTIONAL}
    ::= 0
```

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 2 of 8)

Specific event reports are categorized by resource class. The protocol uses may be described by the EVENT Macro:

```
EVENT MACRO             ::=
BEGIN
  TYPE NOTATION         ::= EventInfo
  VALUE NOTATION        ::= value (VALUE INTEGER)

  EventInfo             ::= "EVENTINFO" NamedType | empty

  NamedType             ::= identifier type | type
END
```

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 3 of 8)

9.2 OM-CONFIRMED-ACTION

The OM-CONFIRMED-ACTION service provides a user with the capability to request that a management action be performed on a resource instance by a user in another open system. The specific action to be performed is interpreted in the context of the resource class specified. This service is a confirmed service (a report of success or failure is always sent).

OM-CONFIRMED-ACTION Service

Parameter Name	Req/Ind	Res/Con
TransactionID	M	M
InvokeID	M	M
AccessControl	O	-
ResourceClass	M	-
ResourceInstance	M	-
ActionValue	M	-
ActionArg	O	-
ActionResult	-	M[a]
ActionError	-	M[b]

Parameter Definitions:

TransactionID: as defined in Chapter T1.114.2 of ANSI T1.114-2000

InvokeID: as defined in Chapter T1.114.2 of ANSI T1.114-2000

AccessControl: information to be used as input to access control functions.

ResourceClass: identifies the class of resources for which this action is defined.

ResourceInstance: identifies the resource instance on which the action is to be performed.

ActionValue: specifies a particular action that is to be performed on the resource instance.

ActionArg: contains the argument for the particular action being invoked

ActionResult: this field contains the result of the successful action performed, as appropriate.

ActionError: this field indicates error or problem status information if the action did not successfully complete.

NOTES: a - Mandatory in Return Result component (may be empty)
b - Mandatory in Return Error component

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 4 of 8)

The confirmedAction operation is defined, using the TCAP OPERATION MACRO, as follows:

```
confirmedAction OPERATION
  PARAMETER SEQUENCE {
    resourceClass                     ResourceClass,
    resourceInstance                  ResourceInstance,
    accessControl                     [0] AccessControl OPTIONAL
    actionValue                       [1] IMPLICIT CNF_ACTION,
    actionArg                         [2] ANY DEFINED BY actionValue OPTIONAL}

  RESULT actionResult                 ANY

    ERRORS {noSuchResourceClass,
    noSuchResource, accessDenied,
    noSuchAction, noSuchAttribute,
    invalidAttributeValue, processingFailure}

  ::= 7
```

Specific Actions are categorized by resource class. The protocol uses may be described by the CNF_ACTION Macro:

```
CNF_ACTION MACRO          ::=
BEGIN
    TYPE NOTATION         ::= ActionArg ActionResult SpecificErrors
    VALUE NOTATION        ::= value (VALUE INTEGER)

    ActionArg             ::= "ACTIONARG" NamedType | empty
    ActionResult          ::= "ACTIONRESULT" NamedType | empty
    SpecificErrors        ::= "SPECIFICERRORS" "{" SpecificErrorList "}" | empty

    NamedType             ::= identifier type | type
    SpecificErrorList     ::= SpecificError | SpecificErrorList "," SpecificError
    SpecificError         ::= value(SPECIFIC_ERROR)
END
```

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 5 of 8)

ERROR DEFINITIONS

A number of error codes have been referred to in the definition of the two OM-Services. These error situations are defined in this section. The errors that are listed are for further study with the exception of processingFailure.

Definitions

noSuchResourceClass:	the resource class in the Invoke Protocol Data Unit (PDU) is not recognized by the receiving end.
noSuchResource:	while the resource class in the Invoke APDU is recognized, there is no corresponding resource instance of that class at the receiving end.
accessDenied:	access to the resource is denied.
processingFailure:	a failure occurred while processing a specific action or event. The failure indicators and parameters are action or event specific.
noSuchAction:	the action type specified is not supported by or known to the receiving end.
noSuchAttribute:	the attribute specified is not supported by or known to the receiving end.
invalidAttributeValue:	the attribute value is out of range.

--CMIS Error Definitions

```
noSuchResourceClass ERROR
  PARAMETER resourceClass ResourceClass
          ::= 0

noSuchResource ERROR
  PARAMETER SEQUENCE {
    resourceClass ResourceClass,
    resource ResourceInstance}
  ::= 1

accessDenied ERROR
  PARAMETER accessGranted BIT STRING {
    none(0), get(1), set (2), action (3), log (4)}
  ::= 2

processingFailure ERROR
  PARAMETER SEQUENCE {
    errorType [0] SpecificError,
    errorParm [1] ANY OPTIONAL} OPTIONAL
  ::= 3
```

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 6 of 8)

-- CMIS Error Definitions (continued)

```
noSuchAttribute ERROR
  PARAMETER attributeID AttributeID
  ::= 4

invalidAttributeValue ERROR
  PARAMETER attribute Attribute
  ::= 5

noSuchAction ERROR
  PARAMETER actionType CNF_ACTION
  ::= 6
```

Errors that are ACTION or EVENT specific are specified in SPECIFIC_ERROR macros. The general error type "Processing_Failure" is used to report the specific error information.

```
SPECIFIC_ERROR MACRO        ::=
BEGIN

"'TYPE NOTATION             ::= ProcessingErrorParm
"'VALUE NOTATION            ::= value(VALUE INTEGER)

"'ProcessingErrorParm       ::= "PARAMETER" NamedType | empty
"'NamedType                 ::= identifier type | type
END
```

Figure 1/T1.116.4 Formal Definition of the OM-Services Used in the ASE (Sheet 7 of 8)

9.3 OTHER TYPE DEFINITIONS

Additional Types used in OMAP are identified as follows:

```
ResourceClass       := OBJECT IDENTIFIER
ResourceInstance    ::= OCTETSTRING

AttributeID         ::= ANY
Attribute           ::= ANY

AccessControl       ::= ANY -- use for further study
TimeStamp           ::= ANY -- use for further study
```

The following universal identifiers are used:

Defined Type	Universal Identifier
INTEGER	00000010
OCTETSTRING	00000100
OBJECT IDENTIFIER	00000110
SEQUENCE	00110000

10 ENCODING USING ANSI

The encoding of the OM-Services using the Transaction Capabilities defined in T1.114-2000 has additional requirements. The following outlines the appropriate settings for encoding OMAP applications using T1.114-2000.

PRIVATE	The encoding of the OM-Services does not fit with the coding for Operations defined in ANSI T1.114-2000. OMAP Applications must be coded as Private.
SEQUENCE	OM-Services are defined using Parameter Sequences instead of Parameter Sets. Since OMAP applications are coded as Private (see above), the Universal Parameter Sequence Identifier will be used (00110000).
INVOKE	An Invoke ID is Mandatory for the OM-Services and must always be present for OMAP Applications. Correspondingly, the Correlation ID is Mandatory in the Return Result.
PERMISSION	Queries using ANSI T1.114-2000 must be with Permission. Queries without Permission are not applicable to OMAP Applications

As in the encoding rules specified in T1.114, OMAP messages are encoded with the least number of octets necessary.

Figure 1/T1.116.4 - Formal Definition of the OM Services Used in the ASE (Sheet 8 of 8)

Annex A
(informative)

A Use of Primitive Interfaces

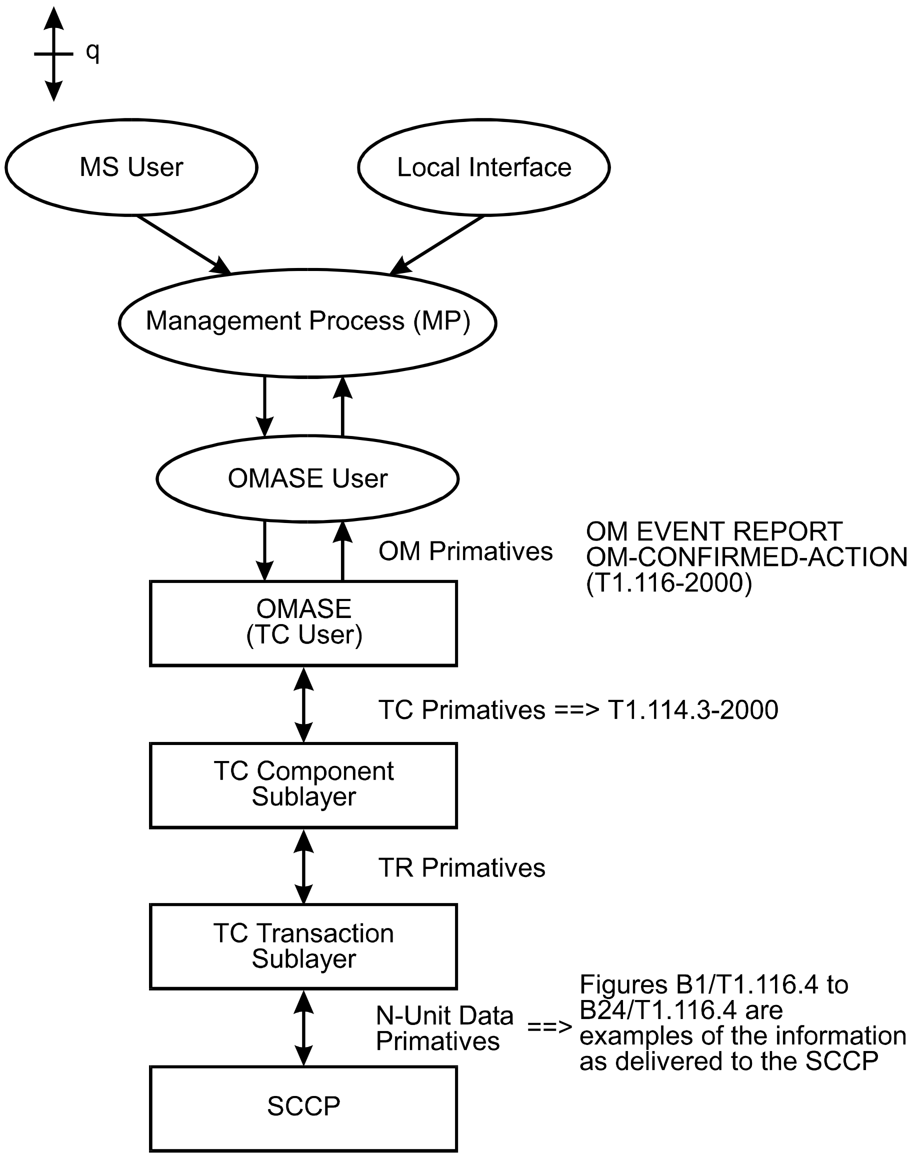


Figure A1/T1.116.4 Primitive Interface

Annex B
(informative)

B Example Messages

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Indent.	11100010	=Query + P (T1.114.3-2000)
Package Length	00110101	53 octets following TC part=
Transaction ID Ident.	11000111	Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00101101	All 45 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00101011	All 43 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation code	00000111	=Confirmed Action (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00100011	All 35 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-MTP Routing Tables	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116-2000
	xxxxxxxx	
	00000000	MTP Routing Tables
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Terminating PC (SP Management)

	xxxxxxxx	<Tested Destination>
	xxxxxxxx	
Confirmed Action Value Ident.	10000001	Figure 1/T1.116.4
Length	00000001	1 octet
Confirmed Action Value	00000001	=testRoute (2.1.1)
Action Arg Ident.	10100010	Figure 1/T1.116.4
Length	00010010	All 18 octets below here
Parameter Seq. Ident.	00110000	=Sequence Ident.
Length	00010000	All 16 octets below here

Figure B1/T1.116.4 Example of an MRVT Message Delivered to the SCCP (Sheet 1 of 2)

Initiating SP Ident. (octet)	10000000	2.1.1.1.1
Length	00000011	3 octets
Initiating SP Value	xxxxxxxx	Initiator Point Code (SP Management)
	xxxxxxxx	
	xxxxxxxx	
Trace Req. Ident.	10000001	2.1.1.1.2
Length	00000001	1 octet
Value	00000001	=TRUE
Threshold Ident.	10000010	=threshold (2.1.1.1.3)
Length	00000001	1 octet
Value of threshold	xxxxxxxx	SP Management
Point Code Trav. Ident.	10100011	2.1.1.1.4
Length	00000000	empty Point Code list
Route Check Req. Ident.	10010001	2.1.1.1.6
Length	00000001	1 octet
Value	00000001	=True

Figure B1/T1.116.4 Example of an MRVT Message Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Indent.	11100100	=Response (T1.114.3-2000)
Package Length	00001111	15 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (MRVT msg)

	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00000111	All 7 octets below here
Component Type Ident.	11101010	=Ret. Res.(L) (T1.114.3)
Length	00000101	all 5 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as MRVT message (Correlation)
Parameter Sequence Ident.	11110010	
Length	00000000	0 octet

Figure B2/T1.116.4 Example of an MRVA (Success) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference Explanation
Transaction Portion		
Package Type Indent.	11100100	=Response (T1.114.3-2000)
Package Length	00011111	31 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in query+P (MRVT msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00010111	All 23 octets below here
Component Type Ident.	11101011	=Ret. Error (T1.114.3-2000)
Length	00010101	All 21 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as MRVT message (Correlation)
Error code Ident.	11010100	=Private (T1.114.3-2000)
Length	00000001	1 octet
Processing Failure	00000011	Figure 1/T1.116.4
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00001101	All 13 octets below here
Parameter Portion		

Error Type Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Failure	00000001	2.1.1.3.1
Error Parameters	10100001	2.1.1.3.1
Length	00001000	All 8 octets below here
Failure Type Ident.	10000000	2.1.1.3.1
Length	00000011	3 octets
Unused Bits	00000101	5 bits
Failure String	xxxxxxxx	Depends on type
	xxx00000	failure (2.1.1.3.1)
Trace Sent Ident.	10000001	2.1.1.3.1
Length	00000001	1 octet
Trace Sent Value	0000000x	True=1, False=0 (2.1.1.3.1)

Figure B3/T1.116.4 Example of an MRVA (Failure) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Indent.	11100100	=Response (T1.114.3-2000)
Package Length	00011111	31 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (MRVT msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00010111	All 23 octets below here
Component Type Ident.	11101011	=Ret. Error (T1.114.3-2000)
Length	00010101	All 21 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as MRVT message (Correlation)
Error code Ident.	11010100	=Private (T1.114.3-2000)
Length	00000001	1 octet below here
Processing Failure	00000011	Figure 1/T1.116.4
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00001101	All 13 octets below here

Parameter Portion		
Error Type Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet below here
Partial Success	00000010	2.1.1.3.2
Error Parameters	10100001	2.1.1.3.1
Length	00001000	All 8 octets below here
Failure Type Ident.	10000000	2.1.1.3.1
Length	00000011	3 octets
Unused Bits	00000111	5 bits
Failure String	xxxxxxxx	Depends on type failure (2.1.1.3.1)
	xxx00000	failure (2.1.1.3.1)
Trace Sent Ident.	10000001	2.1.1.3.1
Length	00000001	1 octet
Trace Sent Value	0000000x	True = 1, False = 0 (2.1.1.3.1)

Figure B4/T1.116.4 Example of an MRVA (Partial Success) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00101111	47 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00100111	All 39 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00100101	All 37 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00011101	All 29 octets below here

Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-MTP Routing Tables	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116-2000
	xxxxxxxx	
	00000000	MTP Routing Tables
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Terminating PC (SP Management)
	xxxxxxxx	<Tested Destination>
	xxxxxxxx	
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000010	=route Trace (2.1.2)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00001100	All 12 octets below here

Figure B5/T1.116.4 Example of an MRVR (success) Message Delivered to the SCCP (Sheet 1 of 2)

Success Identifier	10100000	2.1.2.1.1
Length	00001010	All 10 octets below here
Point Code Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Point Code	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Point Code Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Point Code	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	

Figure B5/T1.116.4 Example of an MRVR (success) Message Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)

Package Length	00111000	56 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
<u>Component Portion</u>		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00110000	All 48 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00101110	All 46 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3)
Length	00000001	1 octet
Operation Code	00000111	=Confirmed Action (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00100110	All 38 octets below here
<u>Parameter Portion</u>		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-SCCP Routing Tables	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116-2000
	xxxxxxxx	
	00000001	SCCP Routing Tables
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets*
Resource Instance Value	xxxxxxxx	Terminating GT (SP Management)
	xxxxxxxx	<Tested Destination)
	xxxxxxxx	
Confirmed Action Value Ident.	10000001	Figure 1/T1.116.4
Length	00000001	1 octet
Confirmed Action Value	00000001	=testRoute (3.1.1)
Action Arg Ident.	10100010	Figure 1/T1.116.4
Length	00010101	All 21 octets below here

Parameter Seq. Ident.	00110000	=Sequence Ident. (Figure 1/T1.116.4)
Length	00010011	All 19 octets below here
Initiating SP Ident. (octet)	10000000	3.1.1.1.1
Length	00000011	3 octets
Initiating SP Value	xxxxxxxx	Initiator Point code (SP Management)
	xxxxxxxx	
	xxxxxxxx	

* The length is three octets for this example only. In general, global titles will have varying length.

Figure B6/T1.116.4 Example of an SRVT Message Delivered to the SCCP (Sheet 1 of 2)

Trace Req. Ident.	10000001	3.1.1.1.2
Length	00000001	1 octet
Value	0000000x	1=TRUE, 0=FALSE
Threshold Ident.	10000010	=threshold (3.1.1.1.3)
Length	00000001	1 octet
Value of threshold	xxxxxxxx	SP Management
Point Code Trav. Ident.	10100011	3.1.1.1.4
Length	00000000	empty Point Code list
Form Indicator Ident.	10000100	3.1.1.1.5
Length	00000001	1 octet
Value	0000000x	0=Compare, 1=No Compare
MTP Back. Req. Ident.	10000101	3.1.1.1.6
Length	00000001	1 octet
Value	0000000x	1=TRUE (Req), 0=FALSE

Figure B6/T1.116.4 Example of an SRVT Message Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Indent.	11100100	=Response (T1.114.3-2000)
Package Length	00001111	15 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (SRVT msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)

Length	00000111	All 7 octets below here
Component Type Ident.	11101010	=Ret. Res.(L) (T1.114.3-2000)
Length	00000101	All 5 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as SRVT message (Correlation)
Parameter Sequence Ident.	11110010	
Length	00000000	0 octet

Figure B7/T1.116.4 Example of an SRVA (Success) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Indent.	11100100	=Response (T1.114.3-2000)
Package Length	00011111	32 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (SRVT msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00010111	All 24 octets below here
Component Type Ident.	11101011	=Ret. Error (T1.114.3-2000)
Length	00010101	All 22 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as SRVT message (Correlation)
Error code Ident.	11010100	=Private (T1.114.3-2000)
Length	00000001	1 octet
Processing Failure	00000011	Figure 1/T1.116.4
Parameter Sequence Ident.	00110000	=Sequence Ident. (Figure 1/T1.116.4)
Length	00001101	All 14 octets below here
Parameter Portion		
Error Type Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Failure	00000001	3.1.1.3.1
Error Parameters	10100001	3.1.1.3.1

Length	00001000	All 9 octets below here
Failure Type Ident.	10000000	3.1.1.3.1
Length	00000011	4 octets
Unused Bits	00000111	7 bits
Failure String	xxxxxxxx	Depends on type failure (3.1.1.3.1)
	xxxxxxxx	
	x0000000	
Trace Sent Ident.	10000001	3.1.1.3.1
Length	00000001	1 octet
Trace Sent Value	0000000x	True = 1, False = 0 (3.1.1.3.1)

Figure B8/T1.116.4 Example of an SRVA (Failure) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Indent.	11100100	=Response (T1.114.3-2000)
Package Length	00011111	32 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (SRVT msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00010111	All 24 octets below here
Component Type Ident.	11101011	=Ret. Error (T1.114.3-2000)
Length	00010101	All 22 octets below here
Component ID Ident	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as SRVT message (Correlation)
Error code Ident.	11010100	=Private (T1.114.3-2000)
Length	00000001	1 octet
Processing Failure	00000011	Figure 1/T1.116.4
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00001101	All 14 octets below here
Parameter Portion		
Error Type Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Partial Success	00000010	3.1.1.3.2

Error Parameters	10100001	3.1.1.3.2
Length	00001000	All 9 octets below here
Failure Type Ident.	10000000	3.1.1.3.2
Length	00000011	3 octets
Unused Bits	00000111	7 bits
Failure String	xxxxxxxx	Depends on type failure (3.1.1.3.2)
	xxxxxxxx	
	x0000000	
Trace Sent Ident.	10000001	3.1.1.3.2
Length	00000001	1 octet
Trace Sent Value	0000000x	True = 1, False = 0 (3.1.1.3.2)

Figure B9/T1.116.4 Example of an SRVA (Partial Success) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00101111	47 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00100111	All 39 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00100101	All 37 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00011101	All 29 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)

Length	00000101	5 octets
Value-SCCP Routing Tables	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116-2000
	xxxxxxxx	
	00000001	SCCP Routing Tables
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets*
Resource Instance Value	xxxxxxxx	Terminating GT (SP Management)
	xxxxxxxx	<Tested Destination>
	xxxxxxxx	
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000010	=route Trace (3.1.2)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00001100	All 12 octets below here

* The length is three octets for this example only. In general, global titles will have varying length.

Figure B10/T1.116.4 Example of an SRVR (success) Message Delivered to the SCCP (Sheet 1 of 2)

Success Identifier	10100000	3.1.2.1.1
Length	00001010	All 10 octets below here
Point Code Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Point Code	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Point Code Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Point Code	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	

Figure B10/T1.116.4 Example of an SRVR (success) Message Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00101000	40 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00100000	All 32 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00011110	All 30 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00010110	All 22 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-Link Information	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116-2000
	xxxxxxxx	
	00000010	
Resource Instance Ident.	00000100	Link Information
Length	00000011	=OCTETSTRING (Figure 1/T1.116.4)
Resource Instance Value	xxxxxxxx	3 octets
	xxxxxxxx	Failure PC (SP Management)
	xxxxxxxx	<Originator>
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet

Event Value	00000001	=linkStatus (6.1.1)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00000101	All 5 octets below here
Link Unavailable	10100000	6.1.2.1
Length	00000011	All 3 octets below here
SLC Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000001	1 octet
SLC	0000xxxx	

Figure B11/T1.116.4 Example of an LEU Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00101000	40 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00100000	All 32 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00011110	All 30 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00010111	All 22 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-Link Information	xxxxxxxx	
	xxxxxxxx	

	xxxxxxxx	=> ANSI, T1.116-2000
	xxxxxxxx	
	00000010	Link Information
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Repaired PC (SP Management)
	xxxxxxxx	<Originator>
	xxxxxxxx	
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000001	=linkStatus (6.1.1)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00000101	All 5 octets below here
Link Available	10100001	6.1.2.2
Length	00000011	All 3 octets below here
SLC Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000001	1 octet
SLC	0000xxxx	

Figure B12/T1.116.4 Example of an LEA Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00110011	38 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00011110	All 30 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00011100	All 28 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management

Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00010100	All 20 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-Link Information	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116
	xxxxxxxx	
	00000010	Link Information
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Repaired PC (SP Management)
	xxxxxxxx	
	xxxxxxxx	
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000010	=linkTest (7.1)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00000101	All 3 octets below here
SLC Ident.	00000100	6.1.1
Length	00000001	1 octet below here
SLC	0000xxxx	

Figure B13/T1.116.4 Example of an FTU Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00100110	38 octets following in TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at the user level.
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	

Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00011110	All 30 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00011100	All 28 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000111	=Cnf. Action (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00010100	All 20 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-Link Information	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116
	xxxxxxxx	
	00000010	Link Information
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Originating PC (SP Management)
	xxxxxxxx	
	xxxxxxxx	
Cnf. Action Value Ident.	10000001	Figure 1/T1.116.4
Length	00000001	1 octet
Conf. Act. Value	00000001	=loopRequest (7.2)
Act. Arg. Ident.	10100010	Figure 1/T1.116.4
Length	00000011	All 3 octets below here
SLC Ident.	00000100	Section 6.1.1
Length	00000001	1 octet below here
SLC	0000xxxx	

Figure B14/T1.116.4 Example of an FTLMessage Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation

Transaction Portion		
Package Type Ident.	11100100	=Response (T1.114.3-2000)
Package Length	00001111	15 octets following in TC part
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (FTL msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00000111	All 7 octets below here
Component Type Ident.	11101010	=Ret. Res.(L) (T1.114.3-2000)
Length	00000101	All 5 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as FTL message (Correlation)
Parameter Sequence Ident.	11110010	
Length	00000000	0 octet

Figure B15/T1.116.4 Example of an FTL (Success) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100100	=Response (T1.114.3-2000)
Package Length	00010010	18 octets following in TC
Transaction ID Ident.	11000111	=Responding (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Same as in Query + P (FTL msg)
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00001010	All 10 octets below here
Component Type Ident.	11101011	=Ret. Err.(L) (T1.114.3-2000)

Length	00001000	All 8 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	Same as FTL message (Correlation)
Error Code Ident.	11010100	=Private (T1.114.3-2000)
Length	00000001	1 octet
Error Code Value	00000011	(Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident. (Figure 1/T1.116.4)
Length	00000000	Length

Figure B16/T1.116.4 - Example of an FTA (Failure) Message Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3-2000)
Package Length	00101000	40 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3-2000)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at
	xxxxxxxx	the user level.
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3-2000)
Length	00100000	All 32 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3-2000)
Length	00011110	All 30 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3-2000)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3-2000)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.

Length	00010110	All 22 octets below here
Parameter Portion		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-Link Information	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI, T1.116
	xxxxxxxx	
	00000010	Link Information
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Originating PC (SP Management)
	xxxxxxxx	
	xxxxxxxx	
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000011	=linkTest (7.3)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00000101	All 5 octets below here
Test Passed	10100000	7.4.1
Length	00000011	All 3 octets below here
SLC Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000001	1 octet
SLC	0000xxxx	

Figure B 17/T1.116.4 Example of an FTR Message (Success) Delivered to the SCCP

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Ident.	11100010	=Query + P (T1.114.3)
Package Length	00110000	48 octets following TC part
Transaction ID Ident.	11000111	=Originating (T1.114.3)
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	SP Management based on a dialogue at the user level.
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Ident.	11101000	(T1.114.3)

Length	00101000	All 40 octets below here
Component Type Ident.	11101001	=Invoke-L (T1.114.3)
Length	00100110	All 38 octets below here
Component ID Ident.	11001111	=Invoke ID (T1.114.3)
Length	00000001	1 octet
Component ID Value	xxxxxxxx	SP Management
Operation Code Ident.	11010001	=Private (T1.114.3)
Length	00000001	1 octet
Operation Code	00000000	=Event Report (Figure 1/T1.116.4)
Parameter Sequence Ident.	00110000	=Sequence Ident.
Length	00011110	All 30 octets below here
<u>Parameter Portion</u>		
Resource Class Ident.	00000110	=OBJECT ID (Figure 1/T1.116.4)
Length	00000101	5 octets
Value-Link Information	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	=> ANSI T1.116
	xxxxxxxx	
	00000010	Link Information
Resource Instance Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Originating PC (SP Management)
	xxxxxxxx	
	xxxxxxxx	
Event Value Ident.	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000011	=linkTestResults (7.3)
Event Info Type Ident.	10100010	Figure 1/T1.116.4
Length	00001101	All 13 octets below here
Test Failed	10100001	Section 7.4.2
Length	00001011	All 11 octets below here
SLC Ident.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000001	1 octet
SLC	0000xxxx	

Figure B18/T1.116.4 Example of an FTR Message (testFailed) Delivered to the SCCP (Sheet 1 of 2)

Bit Error Indent.	00000010	INTEGER (Figure 1/T1.116.4)
Length	00000010	2 Octets
Bit Errors	xxxxxxxx	
	xxxxxxxx	
Lctn. Indent.	00000100	=OCTETSTRING (Figure 1/T1.116.4)
Length	00000010	2 Octets
Loopback Code	xxxxxxxx	Loopback Code
Component No.	xxxxxxxx	Component Number

Figure B18/T1.116.4 Example of an FTR Message (testFailed) Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Identifier	11100010	Query with permission - T1.114.3/3.1
Package Length (for Issue 2)	xxxxxxxx	variable octets - T1.114.3/3.2
Transaction ID Identifier	11000111	T1.114.3/3.3
Length	00000100	4 octets - T1.114.3/3.4
Transaction ID Value	xxxxxxxx	Originating Transaction ID -
	xxxxxxxx	T1.114.3/3.5.1
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	T1.114.3/5.1
Length	xxxxxxxx	variable octets - T1.114.3/5.2
Component Type Identifier	11101001	Invoke Last - T1.114.3/5.3
Length	xxxxxxxx	variable octets - T1.114.3/5.4
Component ID Identifier	11001111	T1.114.3/5.5
Length	00000001	1 octet - T1.114.3/5.6
Component ID Value	xxxxxxxx	T1.114.3/5.7
Operation Code Identifier	11010001	Private TCAP - T1.114.3/5.8
Length	00000001	1 octet - T1.114.3/5.9
Operation Code	00000111	Confirmed Action - T1.114.3/5.10
Parameter Sequence Identifier	00110000	T1.114.3/5.19
Length	xxxxxxxx	variable octets - T1.114.3/5.20
Parameter Portion		
Resource Class Ident.	00000110	Object ID
Length	00000101	5 octets
Value MTP Routing Tables	00000000	ITU Recommendations
	00010001	(Figure 1/T1.116.4)
	10000110	

	00011011	
	00000000	MTP Routing Tables
Resource Instance Identifier	00000100	
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Terminating PC - OCTET STRING
	xxxxxxxx	<Test Destination>
	xxxxxxxx	
Confirmed Action Value Identifier	10000001	Figure 1/T1.116.4
Length	00000001	1 octet
Confirmed Action Value	00000001	testRoute (2.1.1)
Action Argument Identifier	10100010	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets
Parameter Sequence Identifier	00110000	SEQUENCE
Length	xxxxxxxx	variable octets
initiatingSP Identifier	10000000	2.1.1.1.1
Length	00000011	3 octets
Value	xxxxxxxx	initiating SP - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	

Figure B19/T1.116.4 Example of an Issue 2 MRVT Delivered to the SCCP (Sheet 1 of 2)

traceRequested Identifier	10000001	2.1.1.1.2
Length	00000001	1 octet
Value	00000001	BOOLEAN
threshold Identifier	10000010	2.1.1.1.3
Length	00000001	1 octet
Value	xxxxxxxx	threshold - INTEGER
pointCodesTraversed Identifier	10100011	2.1.1.1.4
Length	00000000	empty point code list
routePriorityList Identifier	10101100	2.1.1.1.5
Length	xxxxxxxx	1 octet per STP crossed
Value	xxxxxxxx	SEQUENCE OF routePriority - INTEGER
localReturnSP Identifier	10010000	2.1.1.1.6 (only if via Gateway)
Length	00000011	3 octets
Value	xxxxxxxx	Local Return Point Code
	xxxxxxxx	

	xxxxxxxx	
directRouteCk Identifier	10010001	2.1.1.1.7
Length	00000001	1 octet
Value	0000000x	1=True or 0=False - BOOLEAN
infoRequest Identifier	10010010	2.1.1.1.8
Length	00000010	2 octets
unused bits	0000xxxx	? bits
Value	xxx00000	BIT STRING

Figure B19/T1.116.4 Example of an Issue 2 MRVT Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Identifier	11100100	Response - T1.114.3/3.1
Package Length	xxxxxxxx	variable octets - T1.114.3/3.2
Transaction ID Identifier	11000111	T1.114.3/3.3
Length	00000100	4 octets - T1.114.3/3.4
Transaction ID Value	xxxxxxxx	MRVT (Originating Transaction) -
	xxxxxxxx	T1.114.3/3.5.1
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	T1.114.3/5.1
Length	xxxxxxxx	variable octets - T1.114.3/5.4
Component Type Identifier	11101001	Return Error - T1.114.3/5.3
Length	xxxxxxxx	variable octets - T1.114.3/5.4
Component ID Identifier	11001111	T1.114.3/5.5
Length	00000001	1 octet - T1.114.3/5.6
Component ID Value	xxxxxxxx	MRVT (Component ID Value) - T1.114.3/5.7
Error Code Identifier	11010100	
Length	00000001	Private TCAP - T1.114.3/5.11
processingFailure ERROR	00000011	1 octet - T1.114.3/5.12
		Figure 1/T1.116.4
Parameter Sequence Ident.	00110000	
Length	xxxxxxxx	T1.114.3/5.19
		variable octets - T1.114.3/5.20
Parameter Portion		
Error Type Identifier	10000000	
Length	00000001	Figure 1/T1.116.4
Specific Error	00000001	1 octet
		failure 2.1.1.3.1

Error Parameter	10100001	Figure 1/T1.116.4	
Length	00001000	8 octets	
failureType Identifier	10000000	2.1.1.3.1	
Length	00000011	3 octets	
unused bits	00000101	5 bits	
Failure string	hgfedcba	depends on type - BIT STRING	
	hgf00000	1-h	detectedLoop
		1-g	excessivelengthRoute
		1-f	unknownDestination
		1-e	routeInaccessible
		1-d	localConditions
		1-c	unknownInitiatingSP
		1-b	timerExpired
		1-a	wrongSP
		2-h	indirectRoute
		2-g	successToGateway
		2-f	inefficientRoute

Figure B20/T1.116.4 Example of an Issue 2 MRVA (failure) Delivered to the SCCP (Sheet 1 of 2)

traceSent Identifier	10000001	2.1.1.3.1
Length	00000001	1 octet
Trace Sent value	0000000x	1 = MRVR sent,
		0 = MRVR not sent - BOOLEAN
copyData Identifier	10000100	2.1.1.3.1 & 2.1.3.1.5
Length	xxxxxxxx	variable octets (params + PC + PCL + RPL)
Unknown Parameter Identifier	xxxxxxxx	OCTET STRING
Length	xxxxxxxx	
Value	xxxxxxxx	
pointCode Identifier	10000001	2.1.3.1.2
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management
	xxxxxxxx	
	xxxxxxxx	
pointCodeList Identifier	10100010	2.1.3.1.3
Length	xxxxxxxx	5 octets per STP crossed
Point Code Identifier	00000100	Figure 1/T1.116.4
Length	00000011	3 octets
Point Code	xxxxxxxx	crossed STP - OCTET STRING
	xxxxxxxx	

	xxxxxxxx	
routePriorityList Identifier	10100011	2.1.3.1.4
Length	xxxxxxxx	1 octet per STP crossed
Value	xxxxxxxx	SEQUENCE OF routePriority INTEGER

Note - For the MVRA (Partial Success) the message is the same as for MRVA (Failure), except for the *Specific Error* being partialSuccess 00000010.

Figure B20/T1.116.4 Example of an Issue 2 MRVA (failure) Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Identifier	11100010	Query with permission
Package Length	xxxxxxxx	variable octets
Transaction ID Identifier	11000111	
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Originating Transaction ID
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	
Length	xxxxxxxx	variable octets
Component Type Identifier	11101001	Invoke Last
Length	xxxxxxxx	variable octets
Component ID Identifier	11001111	
Length	00000001	1 octet
Component ID Value	xxxxxxxx	value from MRVT
Operation Code Ident	11010001	Private TCAP
Length	00000001	1 octet
Operation Code	00000000	Event Report
Parameter Sequence Ident	00110000	
Length	xxxxxxxx	variable octets
Parameter Portion		
Resource Class Ident	00000110	Object ID
Length	00000101	5 octets
Value MTP Routing Tables	00000000	ITU Recommendations
	00010001	(Figure 1/T1.116.4)
	10000110	
	00011011	
	00000000	MTP Routing Tables

Resource Instance Identifier	00000100	
Length	00000011	3 octets
Resource Instance Value	xxxxxxxx	Terminating PC (SP Management) - OCTET STRING
	xxxxxxxx	<Test Destination>
	xxxxxxxx	

Figure B21/T1.116.4 Example of an Issue 2 MRVR Delivered to the SCCP (Sheet 1 of 3)

a) Issue 2 parameters sent if initiating SP is known:

Event Value Ident.ifier	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000100	routeTraceNew (2.1.3)
EventInfo Type Identifier	10100010	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets
result Identifier	10000000	2.1.3.1.1
Length	00000001	1 octet
errorTag (only one)	00000000	success
	00000001	detectedLoop
	00000010	excessiveLengthRoute
	00000011	unknownDestination
	00000100	routeInaccessible
	00000101	localConditions
	00000110	unknownInitiatingSP
	00000111	timerExpired
	00001000	wrongSP
	00010100	successToGateway
	00010101	indirectRoute
	00010110	inefficientRoute
pointCode Identifier	10000001	2.1.3.1.2
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management
	xxxxxxxx	
	xxxxxxxx	
pointCodeList Identifier	10100010	2.1.3.1.3
Length	xxxxxxxx	5 x number of point codes traversed
Point Code Identifier	00000100	Figure 1/T1.116.4
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	

routePriorityList Identifier	10100011	2.1.3.1.4
Length	xxxxxxxx	1 octet per STP crossed
Value	xxxxxxxx	SEQUENCE OF routePriority INTEGER
copyData Identifier	10000100	
Length	xxxxxxxx	2.1.3.1.5
Unknown Parameter(s)		variable octets (params)
Identifier	xxxxxxxx	
Length	xxxxxxxx	
Value	xxxxxxxx	

Figure B21/T1.116.4 Example of an Issue 2 MRVR Delivered to the SCCP (Sheet 2 of 3)

b) Issue 2 parameters sent if initiating SP is unknown:

Event Value Ident.ifier	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000100	routeTraceNew (2.1.3)
EventInfo Type Identifier	10100010	Figure 1/T1.116.4
Lengh	xxxxxxxx	variable octets
result Identifier	10000000	2.1.3.1.1
Length	00000001	1 octet
errorTag (only one)	00000101	localConditions
	00000110	unknownInitiatingSP
	00001000	wrongSP
copyData Identifier	10000100	2.1.3.1.5
Length	xxxxxxxx	variable octets (params)
Unknown Parameter(s)		
Identifier	xxxxxxxx	
Length	xxxxxxxx	
Value	xxxxxxxx	
pointCode Identifier	10000001	2.1.3.1.2
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management
	xxxxxxxx	
	xxxxxxxx	
pointCodeList Identifier	10100010	2.1.3.1.3
Length	xxxxxxxx	5 octets per STP crossed

	Point Code Identifier	00000100	Figure 1/T1.116.4
	Length	00000011	3 octets
	Point Code	xxxxxxxx	crossed STP - OCTET STRING
		xxxxxxxx	
		xxxxxxxx	
routePriorityList Identifier		10000011	2.1.3.1.4
Length		xxxxxxxx	1 octet per STP crossed
Value		xxxxxxxx	SEQUENCE OF routePriority INTEGER

Figure B21/T1.116.4 Example of an Issue 2 MRVR Delivered to the SCCP (Sheet 3 of 3)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Identifier	11100010	Query with permission - T1.114.3/3.1
Package Length (for Issue 2)	xxxxxxxx	variable octets - T1.114.3/3.2
Transaction ID Identifier	11000111	T1.114.3/3.3
Length	00000100	4 octets - T1.114.3/3.4
Transaction ID Value	xxxxxxxx	Originating Transaction ID -
	xxxxxxxx	T1.114.3/3.5.1
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	T1.114.3/5.1
Length	xxxxxxxx	variable octets - T1.114.3/5.2
Component Type Identifier	11101001	Invoke Last - T1.114.3/5.3
Length	xxxxxxxx	variable octets - T1.114.3/5.4
Component ID Identifier	11001111	T1.114.3/5.5
Length	00000001	1 octet - T1.114.3/5.6
Component ID Value	xxxxxxxx	T1.114.3/5.7
Operation Code Identifier	11010001	Private TCAP - T1.114.3/5.8
Length	00000001	1 octet - T1.114.3/5.9
Operation Code	00000111	Confirmed Action - T1.114.3/5.10
Parameter Sequence Identifier	00110000	T1.114.3/5.19
Length	xxxxxxxx	variable octets - T1.114.3/5.20
Parameter Portion		
Resource Class Ident	00000110	Object ID
Length	00000101	5 octets
Value SCCP Routing Tables	00000000	ITU Recommendations
	00010001	(Figure 1/T1.116.4)

	10000110	
	00011011	
	00000001	SCCP Routing Tables
Resource Instance Identifier	00000100	
Length	00000101	5 octets
Resource Instance Value	00001000	Global Title Indicator
	xxxxxxxx	Translation Type - OCTET STRING
	xxxxxxxx	Global Title of destination to be tested
	xxxxxxxx	
	xxxxxxxx	
Confirmed Action Value Identifier	10000001	Figure 1/T1.116.4
Length	00000001	1 octet
Confirmed Action Value	00000001	testRoute (3.1.1)

Figure B22/T1.116.4 Example of an Issue 2 SRVT Delivered to the SCCP (Sheet 1 of 3)

Action Argument Identifier	10100010	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets
Parameter Sequence Identifier	00110000	SEQUENCE
Length	xxxxxxxx	variable octets
initiatingSP Identifier	10000000	3.1.1.1.1
Length	00000011	3 octets
Value	xxxxxxxx	initiating SP - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	
traceRequested Identifier	10000001	3.1.1.1.2
Length	00000001	1 octet
Value	00000000	BOOLEAN
threshold Identifier	10000010	3.1.1.1.3
Length	00000001	1 octet
Value	xxxxxxxx	threshold - INTEGER
pointCodesTraversed Identifier	10100011	3.1.1.1.4
Length	00000000	empty point code list
formIndicator Identifier	10000100	3.1.1.1.5
Length	00000001	1 Octet
Value	00000001	1=No Compare - INTEGER
mtpBackwardRoutingReq. Ident	10000101	3.1.1.1.6

Length	00000001	1 Octet
Value	00000001	1=True - BOOLEAN
testInitiator GT Identifier	10000110	3.1.1.1.7 - OCTET STRING
Length		max 13 octets
Global Title	xxxxxxxx	Global Title Indicator
	xx0010xx	Translation Type
	xxxxxxxx	max 22 digits - initiator's Global Title
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
destinationPC Identifier	10000111	3.1.1.1.8
Length	00000011	3 Octets
Value	xxxxxxxx	DPC
	xxxxxxxx	
	xxxxxxxx	
destinationSSN Identifier	10001000	3.1.1.1.9 - OCTET STRING
Length	00000001	1 Octet
Value	xxxxxxxx	Subsystem Number
backupDPC Identifier	10001001	3.1.1.1.10
Length	00000011	3 Octets
Value	xxxxxxxx	DPC
	xxxxxxxx	
	xxxxxxxx	
backupSSN Identifier	10001010	3.1.1.1.11 - OCTET STRING
Length	00000001	1 Octet
Value	xxxxxxxx	Subsystem Number

Figure B22/T1.116.4 Example of an Issue 2 SRVT Delivered to the SCCP (Sheet 2 of 3)

originalGT Identifier	10001011	3.1.1.1.12 - OCTET STRING
Length	xxxxxxxx	max 13 octets
Global Title	xx0010xx	Global Title Indicator
	xxxxxxxx	Translation Type
	xxxxxxxx	max 22 digits - original initiator's Global Title
	xxxxxxxx	
	xxxxxxxx	
infoRequest Identifier	10001100	3.1.1.1.13
Length	00000010	2 octets

unused bits	0000xxxx	? bits
Value	xx000000	BIT STRING
inputGT Identifier	10001110	3.1.1.1.15 - OCTET STRING
Length	xxxxxxxx	max 13 octets
Global Title	xx0010xx	Global Title Indicator
	xxxxxxxx	Translation Type
	xxxxxxxx	max 22 digits
	xxxxxxxx	- Test GTI+GT prior to translation at a
	xxxxxxxx	TSP
localReturnSP Identifier	10011110	3.1.1.1.16 (only if via Gateway)
Length	00000011	3 octets
Value	xxxxxxxx	Local Return Point Code
	xxxxxxxx	
	xxxxxxxx	
destinationPriorities Identifier	10011101	3.1.1.1.17
Length	xxxxxxxx	1 octet per STP
Value	xxxxxxxx	SEQUENCE OF routePriority INTEGER

Figure B22/T1.116.4 Example of an Issue 2 SRVT Delivered to the SCCP (Sheet 3 of 3)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Identifier	11100100	Response - T1.114.3/3.1
Package Length	xxxxxxxx	variable octets - T1.114.3/3.2
Transaction ID Identifier	11000111	T1.114.3/3.3
Length	00000100	4 octets - T1.114.3/3.4
Transaction ID Value	xxxxxxxx	SRVT (Originating Transaction)
	xxxxxxxx	T1.114.3/3.5.1
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	T1.114.3/5.1
Length	xxxxxxxx	variable octets - T1.114.3/5.2
Component Type Identifier	11101001	Return Error - T1.114.3/5.3
Length	xxxxxxxx	variable octets - T1.114.3/5.4
Component ID Identifier	11001111	T1.114.3/5.5
Length	00000001	1 octet - T1.114.3/5.6
Component ID Value	xxxxxxxx	SRVT (Component ID Value) - T1.114.3/5.7
		Private TCAP - T1.114.3/5.11

Error Code Identifier	11010100	1 octet - T1.114.3/5.12
Length	00000001	(Figure 1/T1.116.4)
processingFailure ERROR	00000011	
Parameter Sequence Ident.	00110000	
Length	xxxxxxxx	variable octets

Parameter Portion

Error Type Ident.	10000000	(Figure 1/T1.116.4)
Length	00000001	1 octet
Specific Error	00000001	failure 3.1.1.3.1
Error Parameter	10100001	(Figure 1/T1.116.4)
Length	00001000	8 octets
failureType Ident	10000000	3.1.1.3.1
Length	00000100	4 octets
unused bits	00000111	7 bits
Failure string	hgfedcba	depends on type - BIT STRING
	hgfedcba	1-h — detectedLoop
	h	1-g — excessivelengthRoute
		1-f — unknownGT
		1-e — routeInaccessible
		1-d — localConditions
		1-c — unknownInitiatingSP
		1-b — timerExpired
		1-a — wrongSP
		2-h — incorrectTranslation-Primary
		2-g — incorrectTranslation-Secondary
		2-f — incorrectTranslation-Intermediate
		2-e — notPrimaryDestination
		2-d — notSecondaryDestination
		2-c — notRecognizedPrimary
		2-b — notRecognizedSecondary
		2-a — routingProblem
		3-h — successToGateway

Figure B23/T1.116.4 Example of an Issue 2 SRVA (failure) Delivered to the SCCP (Sheet 1 of 2)

failureTypeNational Identifier	10011110	3.1.1.3.1
Length	00000010	2 octets
unused bits	0000xxxx	? bits
Value	xxxxxxxx	BIT STRING
traceSent Ident	1000000	3.1.1.3.1

Length	00000001	1 octet
Trace Sent value	0000000x	1 = SRVR sent
		0 = SRVR not sent - BOOLEAN
copyData Identifier	10000100	3.1.1.3.1 & 3.1.3.1.4
Length	xxxxxxxx	variable octets (params + PC + PCL)
Unknown Parameter Identifier	xxxxxxxx	OCTET STRING
Length	xxxxxxxx	
Value	xxxxxxxx	
pointCode Identifier	10000001	3.1.3.1.2
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management
	xxxxxxxx	
	xxxxxxxx	
pointCodeList Identifier	10100010	3.1.3.1.3
Length	xxxxxxxx	5 octets per STP crossed
Point Code Identifier	00000100	(Figure 1/T1.116.4)
Length	00000011	3 octets
Point Code	xxxxxxxx	crossed STP - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	

NOTE - For the SVRA (Partial Success) the message is the same as for SRVA (Failure), except for the *Specific Error* being partialSuccess 00000010.

Figure B23/T1.116.4 Example of an Issue 2 SRVA (failure) Delivered to the SCCP (Sheet 2 of 2)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion		
Package Type Identifier	11100010	Query with permission
Package Length	xxxxxxxx	variable octets
Transaction ID Identifier	11000111	
Length	00000100	4 octets
Transaction ID Value	xxxxxxxx	Originating Transaction ID
	xxxxxxxx	
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	
Length	xxxxxxxx	variable octets
Component Type Identifier	11101001	Invoke Last
Length	xxxxxxxx	variable octets
Component ID Identifier	11001111	
Length	00000001	1 octet

Component ID Value	xxxxxxxx	value from SRVT
Operation Code Ident	11010001	Private TCAP
Length	00000001	1 octet
Operation Code	00000000	Event Report
Parameter Sequence Ident.	00110000	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets

Parameter Portion

Resource Class Ident	00000110	Object ID, Figure 1/T1.116.4
Length	00000101	5 octets
Value SCCP Routing Tables	00000000	ITU Recommendations
	00010001	(Figure 1/T1.116.4)
	10000110	
	00011011	
	00000001	SCCP Routing Tables
Resource Instance Identifier	00000100	OCTET STRING
Length	xxxxxxxx	max 13 octets
Resource Instance Value	xx0010xx	Global Title Indicator
	xxxxxxxx	Translation Type
	xxxxxxxx	max 22 digits
	xxxxxxxx	- Terminating Global Title w/o originalGT
	xxxxxxxx	- Original Global Title w originalGT

Figure B24/T1.116.4 - Example of an Issue 2 SRVR Delivered to the SCCP (Sheet 1 of 3)

a) Issue 2 parameters sent if initiating SP is known:

Event Value Identifier	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000100	routeTraceNew (3.1.3)
EventInfo Type Identifier	10100010	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets
result Identifier	10000000	3.1.3.1.1
Length	00000001	1 octet
errorTag (only one)	00000000	success
	00000001	detectedLoop
	00000010	excessiveLengthRoute
	00000011	unknownGT
	00000100	routeInaccessible
	00000101	localConditions,
	00000110	unknownInitiatingSP

	00000111	timerExpired
	00001000	wrongSP
	00001001	incorrectTranslation-Primary
	00001010	incorrectTranslation-Secondary
	00001011	incorrectTranslation-Intermediate
	00001100	notPrimaryDestination
	00001101	notSecondaryDestination
	00001110	notRecognizedPrimary
	00001111	notRecognizedSecondary
	00010000	routingProblem
	00010001	successToGateway
	11111011	noCoordStateChangeData
	11111100	routingDataNotChecked
	11111101	differentPriorities-Intermediate
	11111110	differentPriorities-FTSP
pointCode Identifier	10000001	3.1.3.1.2
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management
	xxxxxxxx	
	xxxxxxxx	
pointCodeList Identifier	10100010	3.1.3.1.3
Length	xxxxxxxx	5 x number of point codes traversed
Point Code Identifier	00000100	Figure 1/T1.116.4
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	
copyData Identifier	10000100	3.1.3.1.4
Length	xxxxxxxx	variable octets (params)
Unknown Parameter(s)		
Identifier	xxxxxxxx	
Length	xxxxxxxx	
Value	xxxxxxxx	

Figure B24/T1.116.4 Example of an Issue 2 SRVR Delivered to the SCCP (Sheet 2 of 3)

b) Issue 2 parameters sent if initiating SP is unknown:

Event Value Identifier	10000000	Figure 1/T1.116.4
Length	00000001	1 octet
Event Value	00000100	routeTraceNew (3.1.3)

EventInfo Type Identifier	10100010	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets
result Identifier	10000000	3.1.3.1.1
Length	00000001	1 octet
errorTag	00000110	unknownInitiatingSP
copyData Identifier	10000100	3.1.3.1.4
Length	xxxxxxxx	variable octets (params)
Unknown Parameter(8)		
Identifier		
Length	xxxxxxxx	
Value	xxxxxxxx	
	xxxxxxxx	
pointCode Identifier	10000001	3.1.3.1.2
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management
	xxxxxxxx	
	xxxxxxxx	
pointCodeList Identifier	10100010	3.1.3.1.3
Length	xxxxxxxx	5 x number of point codes traversed
Point Code Identifier	00000100	Figure 1/T1.116.4
Length	00000011	3 octets
Point Code	xxxxxxxx	SP Management - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	

Figure B24/T1.116.4 Example of an Issue 2 SRVR Delivered to the SCCP (Sheet 3 of 3)

Field Name	Bit Encoding	Reference/Explanation
Transaction Portion	11100010	Query with permission - T1.114.3/3.1
Package Type Identifier	xxxxxxxx	variable octets - T1.114.3/3.2
Package Length (for Issue 2)	11000111	T1.114.3/3.3
Transaction ID Identifier	00000100	4 octets - T1.114.3/3.4
Length	xxxxxxxx	Originating Transaction ID -
Transaction ID Value	xxxxxxxx	T1.114.3/3.5.1
	xxxxxxxx	
	xxxxxxxx	
Component Portion		
Component Sequence Identifier	11101000	T1.114.3/5.1
Length	xxxxxxxx	variable octets - T1.114.3/5.2
Component Type Identifier	11101001	Invoke Last - T1.114.3/5.3

Length	xxxxxxxx	variable octets - T1.114.3/5.4
Component ID Identifier	11001111	T1.114.3/5.5
Length	00000001	1 octet - T1.114.3/5.6
Component ID Value	xxxxxxxx	T1.114.3/5.7
Operation Code Identifier	11010001	Private TCAP - T1.114.3/5.8
Length	00000001	1 octet - T1.114.3/5.9
Operation Code	00000111	Confirmed Action - T1.114.3/5.10
Parameter Sequence Identifier	00110000	T1.114.3/5.19
Length	xxxxxxxx	variable octets - T1.114.3/5.20
Parameter Portion		
Resource Class Ident.	00000110	Object ID
Length	00000101	5 octets
Value SCCP Routing Tables	00000000	ITU Recommendations
	00010001	(Figure 1/T1.116.4)
	10000110	
	00011011	
	00000001	SCCP Routing Tables
Resource Instance Identifier	00000100	
Length	00000101	5 octets
Resource Instance Value	00001000	Global Title Indicator
	xxxxxxxx	Translation Type - OCTET STRING
	xxxxxxxx	Global Title of destination to be tested
	xxxxxxxx	
	xxxxxxxx	
Confirmed Action Value Identifier	10000001	Figure 1/T1.116.4
Length	00000001	1 octet
Confirmed Action Value	00000001	testRoute (3.1.1)

Figure B 25/T1.116.4 Example of an Issue 2 SRVT Compare Form Delivered to the SCCP (Sheet 1 of 3)

Action Argument Identifier	10100010	Figure 1/T1.116.4
Length	xxxxxxxx	variable octets
Parameter Sequence Identifier	00110000	SEQUENCE
Length	xxxxxxxx	variable octets
initiatingSP Identifier	10000000	3.1.1.1.1
Length	00000011	3 octets
Value	xxxxxxxx	initiating SP - OCTET STRING
	xxxxxxxx	
	xxxxxxxx	
traceRequested Identifier	10000001	3.1.1.1.2
Length	00000001	1 octet
Value	00000000	BOOLEAN
threshold Identifier	10000010	3.1.1.1.3
Length	00000001	1 octet
Value	xxxxxxxx	threshold - INTEGER
pointCodesTraversed Identifier	10100011	3.1.1.1.4
Length	00000000	empty point code list
formIndicator Identifier	10000100	3.1.1.1.5
Length	00000001	1 Octet
Value	00000000	0 = Compare - INTEGER
mtpBackwardRoutingReq. Ident	10000101	3.1.1.1.6
Length	00000001	1 Octet
Value	00000001	1=True - BOOLEAN
testInitiator GT Identifier	10000110	3.1.1.1.7 - OCTET STRING
Length	xxxxxxxx	max 13 octets
Global Title	xx0010xx	Global Title Indicator
	xxxxxxxx	Translation Type
	xxxxxxxx	max 22 digits - initiator’s Global Title
	xxxxxxxx	
	xxxxxxxx	
destinationPC Identifier	10000111	3.1.1.1.8
Length	00000011	3 Octets
Value	xxxxxxxx	DPC - 1st priority
	xxxxxxxx	
	xxxxxxxx	

destinationSSN Identifier	10001000	3.1.1.1.9 - OCTET STRING
Length	00000001	1 Octet
Value	xxxxxxxx	Subsystem Number - 1st priority
destinationPC Identifier	10000111	3.1.1.1.8
Length	00000011	3 Octets
Value	xxxxxxxx	DPC - 2nd priority
	xxxxxxxx	
	xxxxxxxx	
destinationSSN Identifier	10001000	3.1.1.1.9 - OCTET STRING
Length	00000001	1 Octet
Value	xxxxxxxx	Subsystem Number - 2nd priority

Figure B25/T1.116.4 Example of an Issue 2 SRVT Compare Form Delivered to the SCCP (Sheet 2 of 3)

destinationPC Identifier	10000111	3.1.1.1.8
Length	00000011	3 Octets
Value	xxxxxxxx	DPC - 3rd priority
	xxxxxxxx	
	xxxxxxxx	
destinationSSN Identifier	10001000	3.1.1.1.9 - OCTET STRING
Length	00000001	1 Octet
Value	xxxxxxxx	Subsystem Number - 3rd priority
destinationPC Identifier	10000111	3.1.1.1.8
Length	00000011	3 Octets
Value	xxxxxxxx	DPC - 4th priority
	xxxxxxxx	
	xxxxxxxx	
destinationSSN Identifier	10001000	3.1.1.1.9 - OCTET STRING
Length	00000001	1 Octet
Value	xxxxxxxx	Subsystem Number - 4th priority
originalGT Identifier	10001011	3.1.1.1.12 - OCTET STRING
Length	xxxxxxxx	max 13 octets
Global Title	xx0010xx	Global Title Indicator
	xxxxxxxx	Translation Type
	xxxxxxxx	max 22 digits - original initiator's Global
	xxxxxxxx	Title
	xxxxxxxx	

infoRequest Identifier	10001100	3.1.1.1.13
Length	00000010	2 octets
unused bits	0000xxxx	? bits
Value	xx000000	BIT STRING
inputGT Identifier	10001110	3.1.1.1.15 - OCTET STRING
Length	xxxxxxxx	max 13 octets
Global Title	xx0010xx	Global Title Indicator
	xxxxxxxx	Translation Type
	xxxxxxxx	max 22 digits
	xxxxxxxx	Test GTI+GT prior to translation at a
	xxxxxxxx	TSP
localReturnSP Identifier	10011110	3.1.1.1.16 (only if via Gateway)
Length	00000011	3 octets
Value	xxxxxxxx	Local Return Point Code
	xxxxxxxx	
	xxxxxxxx	
destinationPriorities Identifier	10111101	3.1.1.1.17
Length	xxxxxxxx	1 octet per PC/SSN
Value	xxxxxxxx	SEQUENCE OF routePriority INTEGER

Figure B25/T1.116.4 Example of an Issue 2 SRVT Compare Form Delivered to the SCCP (Sheet 3 of 3)

Annex C
(informative)

C MTP & SCCP Settings

MTP provides the basic message routing capabilities on a link by link basis. The SCCP defines the class of signalling connection service used for transmitting the message. Figure C1/T1.116.4 demonstrates the MTP and SCCP format. The bits are labeled A to H (LSB to MSB).

		H	G	F	E	D	B	C	A
MTP	(1)	0	1	1	1	1	1	1	0
	(2)	BIB	Backward Sequence Number						
	(3)	FIB	Forward Sequence Number						
	(4)	0	0	Length Indicator					
	(5)	1	0	1	0	0	0	1	1
	(6)	Destination Point Code							
	(7)	Origination Point Code							
	(8)	Signalling Link Selection							
SCCP	(9)	1	0	1	0	0	0	1	1
	(10)	X	0	0	0	1	0	0	1
	(11)	0 0 0	0 0 0	0 0 0	0 0 0	0 0 1	0 1 0	1 0 0	1 1 0
	(12)	0	0	0	0	0	0	1	0
	(13)	1	1	0	0	0	0	0	1
	(14)	0	0	0	0	0	1	0	0
	(15)	0	0	0	0	0	0	1	0
	(16)	1	1	0	0	0	0	0	1
	(17)	0	0	0	0	0	1	0	0
	(18)	Data Length Indicator							
TCAP	(19)	Data from TCAP Transaction Sublayer							
MTP	(20)	Check Bits							

Figure C1/T1.116.4 MTP/SCCP Message Format

Following are descriptions of the octets shown in figure C1/T1.116.4:

1) Flag. The first octet of the MTP portion of the message is a flag consisting of a unique 8-bit pattern (01111110) used to delimit the SS7 message. To avoid misinterpretation of information octets, bit stuffing is used such that a “0” bit is inserted into the bit stream after every sequence of five consecutive “1” bits that are not part of the delimiting flag.
2) Backward Sequence. The second octet contains the backward sequence number and backward indicator bit (BIB). The BIB is designated as bit H and the sequence numbers are bits G to A. These fields are used in conjunction with forward sequence information to provide signal unit sequence control and acknowledgement functions.
3) Forward Sequence. The third octet contains the forward sequence number and forward indicator bit (FIB). The FIB is designated as bit H and the sequence numbers are bits G to A.
4) Length Indicator. The fourth octet contains the length indicator. This field contains the number of octets (8-63) in the signalling information field. The length indicator is coded in bits F to A; bits G and H are spare.
5) Service Information Octet. The fifth octet contains the service information octet. This field contains the service indicator which indicates the user part being used in bits D to A. SCCP is used and coded as “0011”. The sub-service field contained in bits H to E provides a network indicator (bits H-G) and message priority (bits F-E). Messages should be coded as national network messages with priority of 2, coded “1010”.
6) Destination Point Code. The next three octets contain the Destination Point code (DPC) which form the SS7 address for the recipient node of the message.
7) Originating Point Code. The following three octets contain the Originating Point code (OPC) which form the SS7 address for the node sending the message.
8) Signalling Link Selection. The twelfth octet contains the Signalling Link Selection (SLS) code in bits H to A. This code directs the message to a particular signalling link for transmission.
9) Message Type. This field begins the SCCP unitdata message (i.e., MTP User Information). This octet contains the message type coded for SCCP unitdata.
10) Protocol Class. The protocol class is indicated in bits D to A of this octet. The messages use Protocol Class 0 defining connectionless service with no message sequencing. Bits H to E define that the return message on error option is set for xRVT messages and is not set for xRVR, xRVA and Lex messages.
11) Pointers. The three pointers identify the locations of the variable length parameters: SCCP Called party address, SCCP calling party address, and data field respectively.
12) Length Indicator for Called Party Address.
13) Address Indicator. This octet describes the contents of the Called party address field to follow. Bit A is set indicating the presence of a subsystem number (OMAP). Bits B to F are all set to 0 indicating that no Point code and no Global Title are present. Bit G indicates routing will be done on DPC. Bit H indicates National Network.
14) SCCP Called Party Address. Contains the OMAP subsystem number.
15) Length Indicator for Calling party Address.
16) Address Indicator. This octet describes the contents of the Calling party address field to follow. Bit A is set indicating the presence of a subsystem number (OMAP). Bits B to F are all set to 0 indicating that no Point code and no global Title are present. bit G indicates routing will be done on DPC. Bit H indicates National Network.
17) SCCP Calling Party Address. Contains the OMAP subsystem number.
18) Length Indicator for the TCAP data.

19) TCAP data for which the messages are coded. Delivered to the Transaction sublayer.

20) Check bits. Each signal unit has a 16-bit cyclic redundancy check field for error detection.

Annex D
(informative)

D Encodings

D1 Bit Encodings

Octets are labeled as shown in the Figure D1/T1.116.4. The first octet is the first transmitted. Bits in an octet are labeled as shown in Figure D2/T1.116.4, with bit A as the least significant bit and the first bit transmitted. Bit H is the most significant bit.

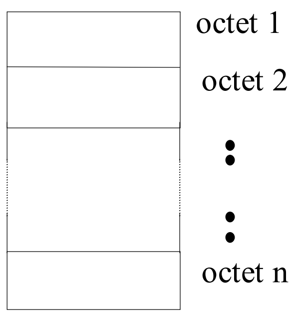


Figure D1/T1.116.4 Octet Labeling Scheme

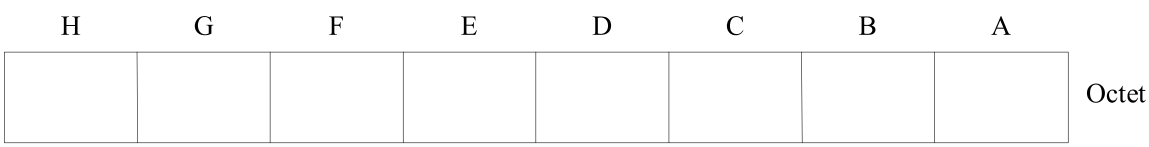


Figure D2/T1.116 Bit Labeling Scheme

D2 Point Code Encoding

Point codes in the OMAP standard are to be encoded to the same format as specified in the MTP and SCCP standards. Thus, the point codes in clauses 8.1.1.1.1, 8.1.1.1.4, 8.1.1.1.5, 8.2.1.1.1, 8.2.1.1.4, 8.2.1.1.8, and 8.2.1.1.10 must be encoded as:

Member
Cluster
NID

Point codes should be encoded to be consistent with the MTP and SCCP standards, T1.111-2001 and T1.112-2001, respectively. Figure D3/T1.116.4 is an example of the encoding of the point code.

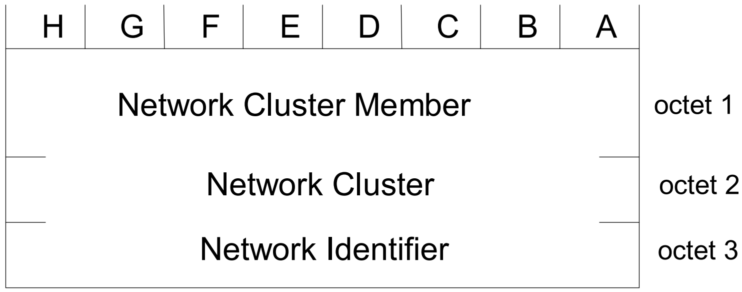
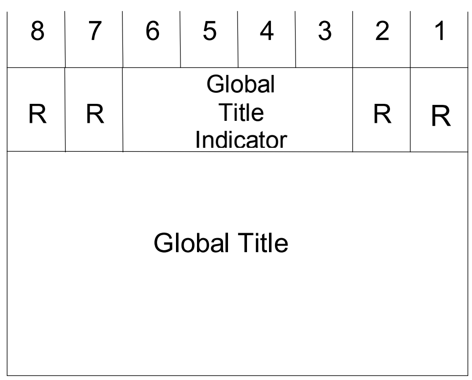


Figure D3/T1.116.4 Point Code Encoding

D3. Global Title Indicator + Global Title Encoding

The Global Title Indicator and global Title in the Initiator, Test and Original GTI + GT parameters of the SRVT message should be encoded as follows:

The GTI + GT should be encoded as:



NOTE - R = reserved in this figure.

Figure D4/T1.116.4 GTI + GT Encoding

The bits not included in the Global Title Indicator field are reserved. The Global title Indicator is encoded as follows:

8	7	6	5	4	3	2	1
Reserved	Reserved	Global Title Indicator				Reserved	Reserved

Figure D5/T1.116.4 Global Title Indicator Encoding

The Global title encoding is as shown in the SCCP standard, T1.112.3 except for the reserved fields. The encoding is shown here for completeness.

There are two formats of the Global Title standardized depending upon the value of the Global Title indicator field.

For Global Title Indicator 0001, the Global Title is encoded as:

	8	7	6	5	4	3	2	1
Octet 1	Translation Type							
Octet 2	Numbering Plan				Encoding Scheme			
	Address Information							
Octet m								

Figure D6/T1.116.4 Global Title Format for Indicator 0001

For Global Title Indicator 0010, the Global Title is encoded as:

	8	7	6	5	4	3	2	1
Octet 1	Translation Type							
Octet 2	Address Information							
Octet m								

Figure D7/T1.116.4 Global Title Format for Indicator 0001

The Address Information is encoded as:

	8	7	6	5	4	3	2	1
Octet 1	2nd Address Signal				1st Address Signal			
Octet 2	4th Address Signal				3rd Address Signal			
Octet m	filler				nth Address Signal			

NOTE - In the case of an odd number of address signals a filler code 0000 is inserted after the last address signal for GTI = 0001. For GTI = 0010, the filler code is 1111.

Figure D8/T1.116.4 Address Information encoding

Annex E
(informative)

E Glossary of Acronyms

AE	Application Entity
ASE	Application Service Element
CCITT	International Telephone and Telegraph Consultive Committee
CIC	Circuit Identification code
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CVT	Circuit Validation Test
DPC	Destination Point Code
DTPC	Duplex Translation Point Code
DTSP	Duplex Translation Signalling Point
FTPC	Final Translation Point Code
FTSP	Final Translation Signalling Point
GT	Global Title
GTI	Global Title Indicator
GTT	Global Title Translation
ITPC	Intermediate Translation Point Code
ITSP	Intermediate Translation Signalling Point
LEA	Link Equipment Available Message
LEF	Link Equipment Failure Procedure
LEU	Link Equipment Unavailable Message
LME	Layer Management Entity
LMI	Layer Management Interface
MIB	Management Information Base
MRVA	MTP Routing Verification Acknowledgment Message

MRVR	MTP Routing Verification Result Message
MRVT	MTP Routing Verification Test Procedure and Message
MTP	Message Transfer Part
OMAP	Operations, Maintenance and Administration Part
OMC	Operations and Maintenance Center
OPC	Originating Point Code
OSI	Open Systems Interconnection
PC	Point Code
PPC	Primary Point Code
SCCP	Signalling Connection Control Part
SDL	State Description Language
SEP	Signalling End Point
SLC	Signalling Link Code
SMAE	System Management Application Entity
SP Management	System Management Application Process
SMSI	System Management Service Interface
SP	Signalling Point
SPC	Secondary Point Code
SRVA	SCCP Routing Verification Acknowledgment
SRVR	SCCP Routing Verification Result
SRVT	SCCP Routing Verification Test Procedure and Message
SS7	Signalling System Number 7
SSN	Subsystem Number
STP	Signal Transfer Point
TCAP	Transaction Capabilities Application Part
TPC	Translation Point Code
TSP	Translation Signalling Point

TrVT	Transaction Verification Test
UDTS	Unit Data Service

Chapter T1.116.5

Signalling System Number 7 Protocol Testers

American National Standard for Telecommunications —

Signalling System Number 7 (SS7) – Protocol Testers

1 Scope

This chapter is currently under study by Working Group T1S1.3.

Chapter T1.116.6

Guidebook to OMAP —
OPERATIONS, MAINTENANCE AND ADMINISTRATION PART

Guidebook to OMAP —
OPERATIONS, MAINTENANCE AND ADMINISTRATION PART

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Signalling System Number 7 (SS7) – Guidebook to OMAP — OPERATIONS, MAINTENANCE, AND ADMINISTRATION PART

1 Introduction

Whereas T1.116.0-2000 is an overview of OMAP architecture and its functions, the basic idea of this guidebook to OMAP, T1.116.6-2000, is to collect background knowledge which is important using the OMAP recommendations be it as:

- network operating administration, deciding on their application
- provider of operating systems (OS) for TMN
- operator working at non-TMN terminals

This guidebook refers to the T1.116-2000 version of OMAP.

1.1 Normative References

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

T1.110-1999, *Signalling System Number 7 — General Information.*[1]

T1.111-2001, *Signalling System Number 7 — Message Transfer Part (MTP).*[1]

ITU-T Rec. G721 (11/88), *32 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM).*[2]

ITU-T Rec. O.152 (10/92), *Error Performance Measuring Equipment for Bit Rates of 64 kbit/s and N x 64 kbit/s*[2]

ITU-T Rec. Q.752 (06/97), *Monitoring and Measurements for Signalling System No. 7 Networks.*[2]

2 Guidebook to T1.116.1-2000 - Signalling System Number 7 Managed Objects

2.1 Point View

The main target of this part of the guidebook is the provider of a TMN-OS. The guidebook refers to the definitions on the Network Element (NE) layer. It provides SS7 knowledge that can be used in help texts, or warnings against dangerous management activities. The guidebook does not define the tasks to be

[1] This document is available from the Alliance for Telecommunications Industry Solutions. < http://www.atis.org >.
[2] This document is available from the International Organization for Standardization. <http://www.iso.ch/iso/en/prods-services/ISOstore/store.html >

done within the OS (on the Network layer), e.g., to combine the NEs of the links. It only deals with some aspects of the OS. It also does not deal with potential coordinated activities from one OS to several Signalling Points (SP).

2.2 Functional Preconditions

2.2.1 Dynamic Aspects

It is assumed that the implementation of the Q3-interface takes into consideration also mass events within the managed signalling points (SP). These mass events may cause notifications, e.g., about all circuits, all links, or all linksets. It is also assumed that mass events that involve all SPs served by an OS at one time (network outage) are taken into consideration when structuring an OS.

2.2.2 Precautions

Some management activities, especially on SS7, are able to cause a network outage by only one action – possibly done erroneously (for an example, see clause 2.4.1). Therefore, it is assumed that the OS employs a system to prevent damage by management activities such as:

- warnings before executing dangerous commands,
- un-eraseable storing of dangerous commands, or
- special authorization for special operators for special dangerous commands.

2.2.3 Restrictions in Manageability

The recommendations of the SS7 protocol e.g., T1.110-1999, T1.111-2001, etc. does not define exactly what entities are to be managed. For a certain kernel, the manageability, e.g., of links, linksets, etc. derives indirectly from the SS7 functions. Against that, in a wide "grey" area, implementations differ in the possibilities they offer to management. Some examples are: modifications of timers, load sharing key, or change of error correction method for a link. Thus, it may occur that actions are requested from the OS-side that will not be executed on the SS7 node side. The operator should be informed when this occurs.

2.3 Handling Prescriptions

An OS is supposed to mask differences between different implementations of NEs as far as possible. Certain implementations might however require, e.g., configuration changes of a linkset, a different order of execution than others, and hence this would be visible through the OS. This may result in implementation-dependent handling prescriptions for the operator, or in implementation-dependent programs within the OS.

2.4 First Collection of Guiding Information to T1.116.1-2000

2.4.1 Managing MTP

2.4.1.1 SP-Code

The modification of the SP-Code within a running network is a highly dangerous action. In the worst case a large area of a network can break down, e.g., as a consequence of a non-coordinated modification or when using two identical SP-Codes. (With regard to gateway exchanges every SP-Code needs the definition of the network indicator where it is valid.)

2.4.1.2 Routing Tables

Errors in routing tables may cause circulation of messages and network breakdown. MTP route verification test (MRVT) may uncover errors, but the damage could already have occurred. Therefore, it is a precondition for large SS7-networks, that routing tables have been verified off-line before they are taken into operation within the live SS7 network.

2.4.2 Managing ISUP

2.4.3 Managing SCCP

2.4.4 Managing TCAP

3 Guidebook to T1.116.2-2000 - Monitoring and Measurements for Signalling System Number 7 Networks

3.1 General

T1.116.2-2000 states which measurements are possible in the SS7 network. The number of measurements defined in T1.116.2-2000 is very large. Most of them are not obligatory; many are not permanent except on activation. Therefore, the influence on measuring by SS7 implementers, by SS7 network providers, and by operators working at terminals may be large.

3.2 Impact Measurements

When defining or activating measurements, the following impacts should be considered:

- (small) dynamic impact on SS7 performance by measurements existing, but currently not activated;
- (larger) dynamic impact on SS7 performance by measurements activated or running permanently;
- amount of data flow via the Q.3 interface from every SP served by an OS;
- amount of data to be processed by an OS, e.g.:
  - for graphical presentation,
  - for comparison of results on both ends of one link, etc., or
  - for derivation of immediate activities (e.g., start of MRVT, see 4.1);
- amount of data to be stored and post processed; or
- resulting information that can be gotten from every single measurement.

4 Guidebook to T1.116.3-2000 - Signalling System Number 7 Management Functions MRVT, SRVT and CVT

4.1 MRVT

Some information about when it would be useful to run MRVT is to be inserted. General Note: MRVT can be used only within one network (i.e., all SPs have the same network indicator). Due to the large number of possible different routes in networks employing an STP, the MRVT could produce a significant message load, especially by MRVR messages. Parts of the network will be tested several times (see clauses 2 and 3). Caution should be given not to start MRVT from several SP within the same time frame. This could happen especially in case of a larger network problem that is realized from several points:

- In networks without TMN, several operators could act independently in the same way, starting MRVT.

- In networks with TMN an automatic start of MRVT could be used - for all SP - where a threshold in measuring routing data errors (ITU-T Rec. Q.752, measurement 5.5) has been exceeded.

A burst of load on the network could be the effect.

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

a) "Inter-administration (or RPOA) agreements are required if the test is to traverse inter-administration (or RPOA) 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.

4.2 SRVT

Up to the ITU White book SRVT can be used only within one MTP-network, i.e. all SP have the same network indicator. Enhancements are intended.

4.3 CVT

The circuit validation test (CVT) allows to combine:

- the test of a correct relationship between circuit identification code (CIC) and circuit with

- a test of transmission quality of the circuit.

CVT is intended to verify that the exchanges at each end of a circuit agree. CVT is not intended specifically as a transmission test. Basing ideas for defining CVT in T1.116.3-2000 were:

During the first test, correct relationship between CIC and circuit; it is important, that one SP performs only one test at one time. Otherwise confusions may be undetected.

For the second test, the test of transmission quality; one test must run up to several days, depending on the bit error ratio achieved. In order to test exchanges with a large number of circuits within a reasonable time frame, many tests in parallel are necessary. An alternative widely used is to test the transmission systems with separate test equipment for about two weeks before taking them into service, (see ITU-T Recommendations G.721 and O.152.) CVT then has only to perform the first test, the correct relationship between CIC and circuit.

5 Guidebook to T1.116.4-2000 - Signalling System Number 7 Management ASE Definitions for MRVT, SRVT and CVT

6 Guidebook to T1.116.5-2000 - Signalling System Number 7 Protocol Tests

6.1 MTP Tester

Examples are to be given where advantages of using the MT are shown, including examining effects of link congestion. Some advantages in international networks are: that the MT is a standardized tool, and that link quality measurements can be made before putting a link into service. For further study.

6.2 Danger for the Network Congestion

When integrated into an SP, the MTP-tester is available in every SP (exchange or standalone STP) and for every operator. The option, "ignoring congestion" may endanger the whole SS7 network. The following two examples will show possible situations within the SS7 network. (Also, if controlled from a TMN-OS, it would be extremely complicated to precalculate potential consequences of overload tests with "ignoring congestion".)

6.2.1 Several Tests Running Independently

Assume several operators independently start this MTP test ignoring congestion.

SP A to SP A'

SP B to SP B'

SP C to SP C'

None of these SPs has any congestion problem, but the STP between them is severely overloaded and the network may break down.

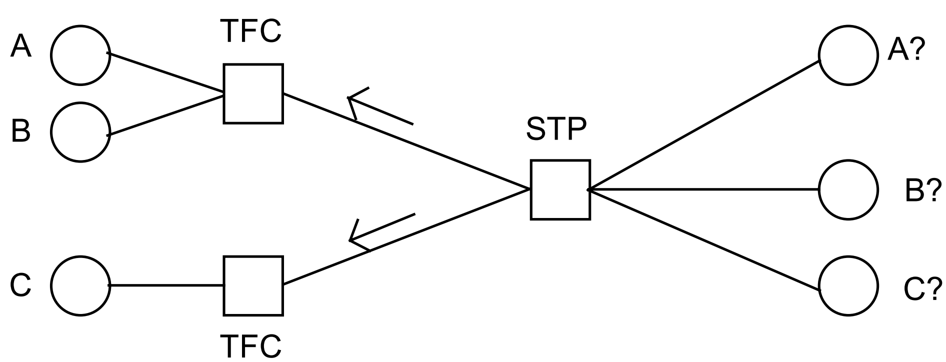

Figure 1/T1.116.6 Interactions of Congestion with the MTP Tests

6.2.2 MTP-Test Running End-to-End Across the Whole SS7 Network

In a network with end-to-end signalling possibility the operator of a very far away OPC may request the testing function via several STPs of the higher levels of the network. This may happen on purpose or by accident due to a typing error within the DPC-number. Using a fairly high rate of test traffic messages this operator could endanger the whole SS7 network.

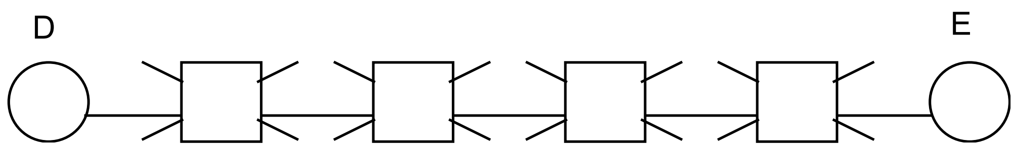

Figure 2/T1.116.6 **- End-to-End MTP Tester Operation**

Table 1/T1.116.6 - Abbreviation List

ASE	Application Service Element
CIC	Circuit Identification Code
CVT	Circuit Validation Test
MRVT	MTP Routing Verification Test
MT	MTP Tester
NE	Network Element
OMAP	Operations, Maintenance and Administration Part
OS	Operating System
SP	Signalling Point
SRVT	SCCP Routing Verification Test
SS7	Signalling System Number 7
STP	Signalling Transfer Point
TFC	Transfer Controlled (Message)
TMN	Telecommunication Management Network