RECOMMENDATION ITU-R S.1250

NETWORK MANAGEMENT ARCHITECTURE FOR DIGITAL SATELLITE SYSTEMS FORMING PART OF SDH TRANSPORT NETWORKS IN THE FIXED-SATELLITE SERVICE

(Question ITU-R 201/4)

(1997)

The ITU Radiocommunication Assembly,

considering

a) that digital satellite systems will remain as constituents elements of public/private networks in a technologically independent way;

b) that ITU-T Recommendation G.707 (1996) specifies the Synchronous Digital Hierarchy (SDH);

c) that ITU-T Recommendations G.803 and G.805 define the architecture of SDH transport networks which should be reflected in the management functionality definitions;

d) that ITU-T Recommendation G.783 specifies the general characteristics and functions of synchronous multiplexing equipment which have to be measured and controlled via the management system;

e) that ITU-T Recommendations G.831 and G.784 define the management principles and capabilities of SDH transport networks with which this Recommendation has to be compatible;

f) that ITU-T Recommendation G.774 defines the managed objects for terrestrial SDH transport networks which form the precedents for the object definitions in this Recommendation;

g) that compatibility with the Telecommunications Management Network (TMN) as defined in ITU-T Recommendation M.3000 is desirable;

h) that ITU-T Recommendation G.861 defines the principles and guidelines for the integration of satellite and radio systems in SDH transport networks including their management capabilities;

j) that Recommendation ITU-R S.1149 specifies the satellite specific SDH transport system upon which this Recommendation is based,

recommends

that digital satellite systems in the fixed-satellite service (FSS) comply with the management functionality defined in this and associated Recommendations to facilitate their integration with international SDH transport networks.

1 Scope

The scope of this Recommendation is the definition of Network-Element-management features for satellite specific SDH functions as defined in Recommendation ITU-R S.1149 “Network Architecture and Equipment functional aspects of Digital Satellite Systems in the FSS forming part of SDH Transport Networks”.

One objective is to ensure that these features are compatible with terrestrial SDH Transport Network management systems.

This Recommendation is concerned with the lowest level details of the Telecommunications Management Network (TMN) concept. This level is referred to as the “Network Element” level.

CONTENTS

1.1 Introduction

Many proprietary management systems have been installed in recent years to try to achieve a level of performance (including economic efficiency) from large networks which meets modern quality of service demands.

To support worldwide communications it is necessary to be able to interconnect management systems on a worldwide basis, hence the introduction of the TMN concept.

This applies both to the interconnection of different public network operators' systems and the connection of the private internal systems of end-users.

Thus, international standards have been drafted under the TMN heading which have a sufficient degree of abstraction to facilitate interoperation of a multitude of management systems whilst not imposing the need for the complete replacement of existing systems.

This has been attempted in the terrestrial environment by the definition of standards for "functions" which do not impose directly any restrictions on their implementation in particular types of equipment. These functions are defined using the notation of software object classes.

Two international authorities have been concerned with the creation of existing management system standards:

– the ITU-T under the heading of the "Telecommunications Management Network" (TMN),

– the IETF under the title "Simple Network Management Protocol" (SNMP).

The first has been concerned with the public networks and the latter with private networks.

There has been considerable similarities in the object-oriented methodologies employed by the two organizations but there are some differences. It is proposed that these differences are studied and catered for in the drafting of a compatible, and therefore commercially attractive, network management Recommendation in the ITU-R Sector.

The greatest difference between the TMN and SNMP approaches is the underlying communication protocol. Therefore, it is proposed to separate the management function definitions from the definition of the underlying communication protocol to maximize compatibility between the two management systems. Thus, this Recommendation assumes this separation.

1.2 Methodology

To achieve the required degree of abstraction whilst maintaining a high level of precision the definition of the management functions is based upon abstract-software-entities called,

"managed objects"

which are used to represent, in a computer software environment, a model of the management functionality of real network elements.

These objects are designed to support only four general functions:

– **measurements-from,**

– **actions-on,**

– **reports-from,**

– **changes-to,** the objects,

to keep the management control protocol simple and robust. Both TMN and SNMP employ this approach.

The parameters which are measured or manipulated via these management objects are related only to the management functionality of Network Elements (NE). The management object definitions are not intended to influence the implementation details of the network elements.

It should be recognized that this approach is in marked contrast to traditional SDH Recommendations whose main purpose was to define, in detail, communication infrastructures.

An additional consideration when drafting such a Recommendation is the need to recognize the desirability of defining a software platform that may be exploited by systems implementors to support proprietary facilities as well as the basic standard functionality. This allows the adaptation to existing systems and the introduction of competition in the supply of new systems.

Therefore, such Recommendations are not drafted in the traditional SDH manner but in a more general way which takes into account the much greater flexibility available on a computer system compared to that provided by a traditional fixed transmission system.

For example, it may be assumed that the various computer resources employed in a management system may be able to invoke a file transfer operation to download a new version of the software when an upgrade or a correction is required.

1.3 Object background

The abstract-entities (software objects) are defined in a way specified in the X.700-Series of ITU-T Recommendations. The primary requirement is to define the objects in a formal way, to ensure maximum precision and thereby the maximum compatibility between different implementors.

Individual object definitions are kept relatively simple by arranging the objects in a hierarchy of,

object classes,

with lower classes automatically inheriting the features of those classes above them.

The instantiation (bring into existence) of specific managed objects only happens by processing the hierarchical chain of object classes and then adding a specific identification when a target system is being implemented.

Special objects have been identified in this Recommendation to support SDH satellite transmission systems but the definition of these objects follows, as closely as possible, the precedents set by the terrestrial management Recommendations. Thus ensuring the maximum compatibility throughout all management systems for all the technologies employed in SDH transport networks.

1.4 Structure of the Recommendation

ITU-T Recommendation G.774 "SDH Management Information Model for the Network Element View" is the main source of object class definitions for SDH transport networks, at the Network Element level, and therefore the main terrestrial Recommendation with which this ITU-R Recommendation has been aligned.

ITU-T Recommendation G.774 is a multipart Recommendation to provide flexibility in adding new parts as the TMN develops. The following parts have been published and most have recently been extensively updated. It is important to always refer to the latest version.

TABLE 1

Structure of ITU-T Recommendation G.774

G.774	Base document including alarms + Corrigendum 1996	1992
G.774-01	Performance Monitoring + Corrigendum 1996	1995
G.774-02	Configuration of the Payload Structure + Corrigendum 1996	1995
G.774-03	Management of Multiplex-Section Protection + Corrigendum 1996	1995
G.774-04	Management of the Subnetwork Connection Protection + Corrigendum 1996	1995
G.774-05	Management of Connection Supervision Functionality (HCS/LCS) + Corrigendum 1996	1995
G.774-06	SDH Unidirectional Performance Monitoring for the Network Element View	1996
G.774-07	SDH Management of Lower Order Path Trace and Interface Labelling for the Network Element View	1996

This Recommendation will not follow the same pattern of Parts. There will be an introductory Recommendation, this one, and the more specialized subject areas will be covered by their own separate management Recommendations. Cross-references will be provided in each Recommendation.

TABLE 2

Structure of ITU-R network management Recommendations

S.1250	Base document introduction	1997
S.1251	Performance Monitoring (including Unidirectional)	1997
S.1252	Configuration of Satellite Payload	1997
S.XZ3	Management of Multiplex-Section Protection(1)	
S.XZ4	Management of the Subnetwork Connection Protection(1)	
S.XZ5	Management of Connection Supervision Functionality(1) (HCS/LCS)	
S.XZ6	SDH Management of Lower Order Path Trace and Interface Labelling for the Network Element View(1)	

(1) To be developed.

1.5 Abbreviations

ASN.1: Abstract Syntax Notation One

ATM: Asynchronous Transfer Mode

CP: Connection Point

CTP: Connection Termination Point

DAF: Directory Access Function

DSF: Directory System Function

GDMO: Guidelines for the Definition of Managed Objects

IA: Indirect Adapter

ICF: Information Conversion Function

ISP: International Standard Profile

ITU: International Telecommunication Union

MAF: Management Application Function

MCF: Message Communication Function

MF-MAF: Mediation Function – Management Application Function

NE: Network Element

NEF: Network Element Function

NEF-MAF: Network Element Function – Management Application Function

NMF: Network Management Forum

OS: Operations System

OSF: Operations System Function

OSF-MAF: Operations System Function – Management Application Function

PNO: Public Network Operator

QAF-MAF: Q Adapter Function – Management Application Function

RDN: Relative Distinguished Name

SDH: Synchronous Digital Hierarchy

SF: Security Function

SP: Service Provider

SPI: Synchronous Physical Interface

TMN: Telecommunications Management Network

TTP: Trail Termination Point

UISF: User Interface Support Function

WSSF: Workstation Support Function

1.6 Definitions

A layer, or transport network layer: A layer, or transport network layer, is defined as [G.805] a topological component solely concerned with the generation and transfer of characteristic information.

Partitioning: Partitioning is defined [G.805] as a framework for defining the network structure within a network layer.

Profile: A profile of a managed object is the additional normative text which is required to restrict conditionally (e.g. specifies that a conditional package is or is not present) and specifies additional behaviour which may be required for a given implementation.

Ensemble: An ensemble is the result of a particular profiling technique which provides a requirements-based view of a particular solution to a management problem. Ensembles are described in the “NM Forum Ensemble Concepts and Format” specification document.

2 Alternative management systems

The two management systems which have international standard status, TMN and SNMP, should both be considered when discussing management.

SNMP is widely used in private networks already. TMN is a more comprehensive approach which will probably be needed for the implementation of a worldwide multisupplier management environment.

The source of SNMP is the Internet Engineering Task Force (IETF) of the Internet and the source of the TMN is the ITU (Study Groups 2, 4, 7, 13, 15 and 11) and the International Organization for Standardization (ISO) JTC 1.

For example, the ITU-T X.700-Series of Recommendations is joint text with ISO standards.

Both of these management systems have extensive documentation within their own standards bodies. Therefore, it is recommended that reference is made out to this documentation wherever possible and that duplication is not employed beyond the extent necessary to explain the subject matter.

2.1 Discussion of network management concepts

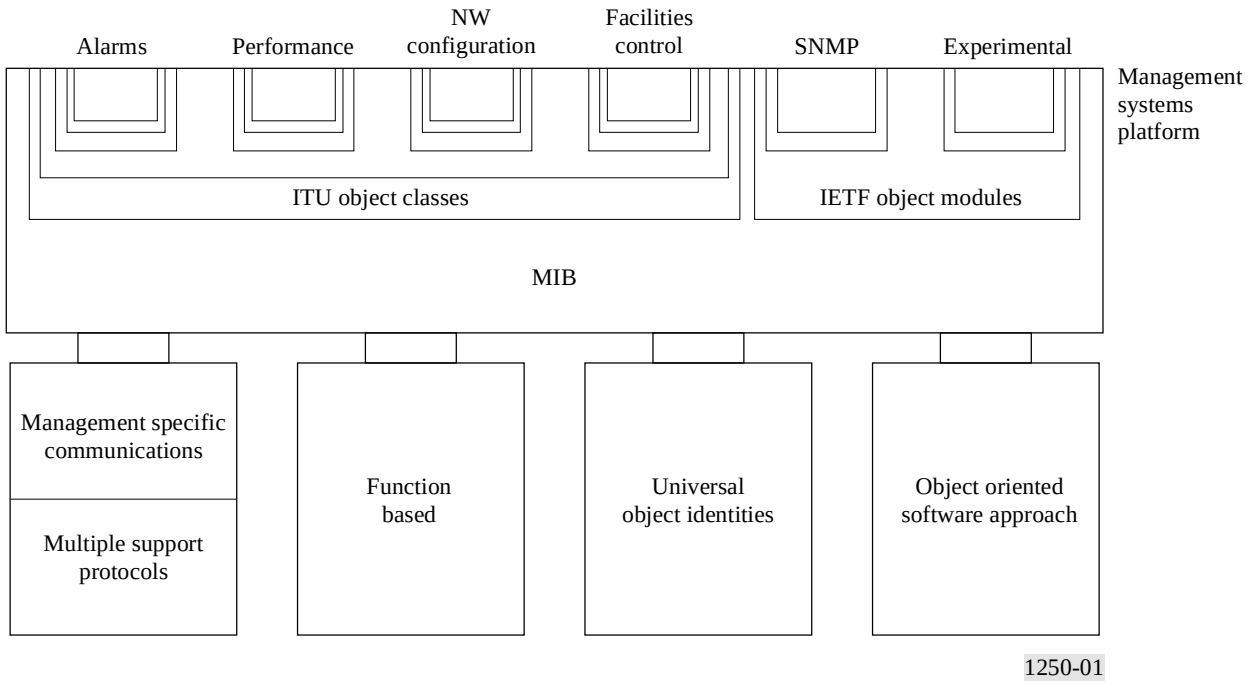
Both TMN and SNMP management systems share the same set of basic concepts as illustrated in Fig. 1.

This shows that the heart of any management system is a shared database of knowledge about the system under management.

This is called the Management Information Base (database) (MIB).

FIGURE 1

General structure of management systems



2.1.1 The MIB

The MIB is common set of knowledge shared between the remote managing system and the local managed system. It is derived by employing a standardized object modelling definition process. Thus, the MIB may be regarded as a platform on top of which the various management services may be developed.

2.2 The IETF approach, the SNMP

Standards produced by the IETF are called Requests For Comments (RFCs).

SNMP version 2 is defined by RFCs 1441 to 1452 published in 1993.

Version 1 was defined by RFCs 1155, 1156 (replaced by 1212) and 1157 published in 1990.

See Annex A for further details.

2.3 The ITU and ISO's TMN management approach

2.3.1 Principles of TMN

Within the context of the TMN, management refers to a set of capabilities to allow for the exchange and processing of information to assist administrations in conducting their businesses efficiently. A TMN may be shared by several administrations or one administration may employ several separate TMNs. It is also recognized that many administrations have already deployed a large infrastructure of monitoring and maintenance systems.

2.3.1.1 Basic objectives for TMNs

The objective of specifying TMNs is to provide a framework for telecommunications management.

The performance of general management of diverse equipment and services is facilitated by the introduction of the following concepts:

– generic network models,

– generic information models,

– standard interfaces.

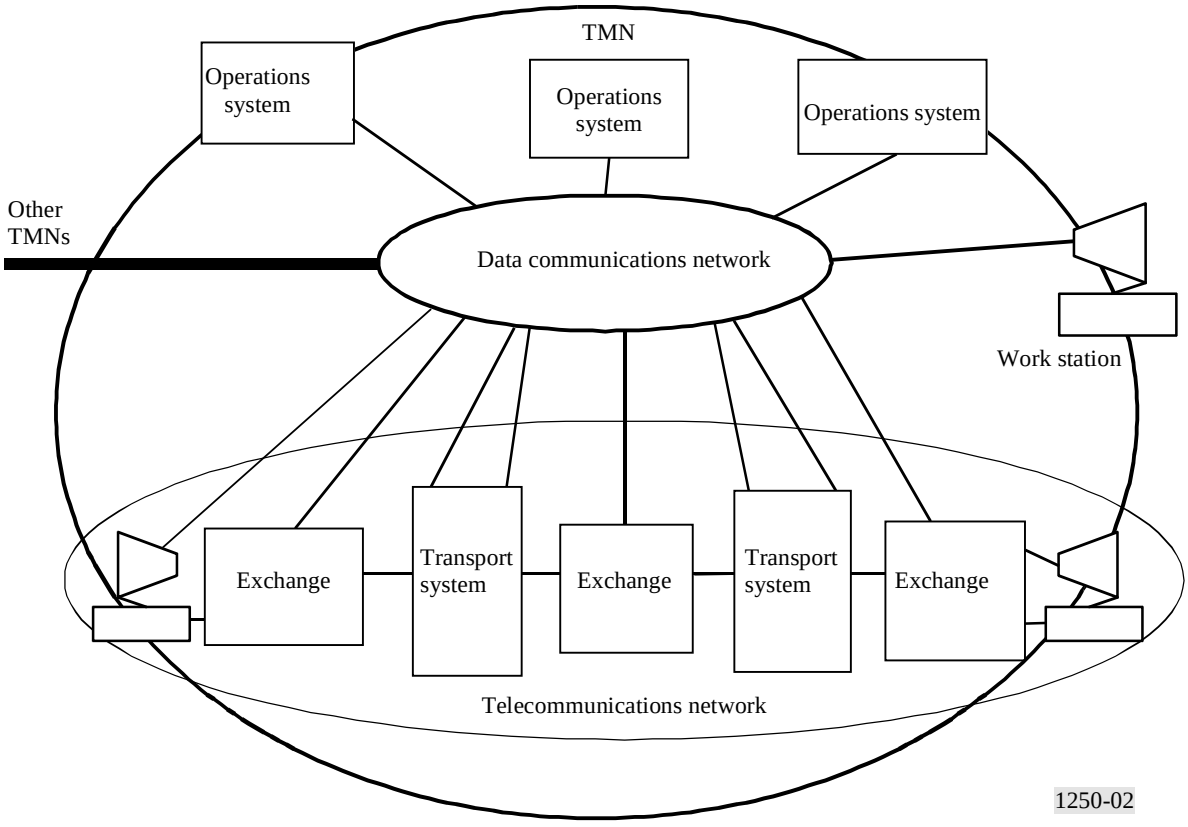
An object-oriented approach has been selected to support these basic objectives.

Distributed management environments may require the employment of emerging "object-oriented distributed processing techniques" such as Open Distributed Processing, ODP.

TMNs are kept logically distinct from the networks and services being managed to allow the functionality of TMNs to be distributed across decentralized management control systems. Thus a number of management systems/operators may perform management on a wide range of geographically distributed equipment. Security and distributed data integrity are fundamental requirements of the generic architecture of TMNs (see Fig. 2 for a general architecture of TMN).

FIGURE 2

TMN architecture



2.3.1.2 TMN architecture

The TMN architecture has two basic components,

– information architecture,

– functional architecture.

The information architecture uses object-oriented techniques to define items of information with a precise methodology based upon ASN.1.

A managed object is a conceptual view of a resource such that it only makes visible to the management system an abstraction of its capabilities for the purposes of management.

This approach does not constrain the actual implementation of the resource other than to make; the required attributes visible at its boundary (one or more interfaces),

– it exhibits the required behaviour to defined stimuli;

– it emits the required notifications when the defined events take place. e.g. a threshold is crossed.

There is no requirement for a one-to-one mapping between real resources and the managed objects which represent them.

A real resource may be represented by one or several managed objects.

Managed objects can be embedded in other managed objects.

If a resource is not represented by a managed object then it cannot be managed by the management system as it is effectively invisible.

The details of the functional architecture of TMN can be found in Annex B.

2.3.2 TMN management services

Telecommunications management is the integration of the management of several telecommunication managed areas of a service provider to maximize the overall quality of service provided to the customers by maximizing the productivity of the resources of the service provider.

Thus the business objective of telecommunications management is to continually improve the quality of service delivered to the customer by improving the productivity of the operations of the service provider.

TMN management services are defined as a matrix of service components as illustrated in Table 3 which is taken from ITU-T Recommendation M.3200 1992 – TMN Management Services Overview.

TABLE 3

TMN management services template

Functional area / Layer	a Fault	b Configuration	c Performance	d Security	e Accounting	f Others e.g. provision
1. Business management						
2. Service management						
3. Network management						
4. Network Element management						

ITU-T Recommendation G.774 only deals with the lowest network element management layer.

The revised ITU-T Recommendation M.3200 “TMN Management Services” dated April 1995 expanded the five areas of management (performance, fault, configuration, accounting and security management) to include several other areas as detailed below. The latest text will be adopted for this Recommendation.

2.3.2.1 List of management services

The following list of **management services** have been identified;

– Customer administration

– Network provisioning management

– Work force management

– Tariffs, charging and accounting administration

– Quality of service and network performance administration

– Traffic measurement and analysis administration

– Traffic management

– Routing and digit analysis administration

– Maintenance administration

– Security administration

– Logistics management.

NOTE 1 – The above list is not exhaustive and is meant only as a guide.

NOTE 2 – Some management services may be too large to handle as a single service.

NOTE 3 – Some definitions which are of interest to this Recommendation are reproduced below.

2.3.2.2 Management services definitions

2.3.2.2.1 Quality of service (QoS) and network performance management

QoS degradation can be the result of many different causes such as design errors, under-dimensioning of resources and failures of components. When there is no testing coverage for some of these root causes then the only way to uncover them is by QoS monitoring or via the complaints of dissatisfied customers. Experience has shown that it can take several years to solve some deep rooted problems even with the best expertise available.

Some common QoS degradations are hard-to-reach directions and poor transmission quality. ITU-T Recommendations E.420-E.428 and E.800-E.880 explore this aspect of management.

Techniques to improve the quality of the design process, called design reliability management, have recently been introduced (see similar techniques described in Recommendation M.20).

Traffic measurement and analysis administration, see ITU-T Recommendations E.500 through E.720 and their supplements.

Traffic management, see ITU-T Recommendations E.410 through E.414.

2.3.2.3 Development from TMN management services

TMN Management Services (MSs) are the starting point for the development of the TMN interface specifications via the performance of Tasks 1 and 2 of the interface-definition methodology, using GDMS, as described in ITU-T Recommendation M.3020 “TMN Interface Specification Methodology”.

2.3.2.4 Management information processing

Previous sections have defined the management environment in global terms, e.g. the employment of an object-oriented management information database.

It is now necessary to define the interactions between these various management entities.

Management of telecommunications systems is an information processing activity which is geographically distributed over a very wide range of distances and a large number of terminals.

2.3.3 Manager and agent roles

The Management Application Function (MAF) can adopt one of two roles which are referred to as manager or agent. For any given activity it is usually in one or other of these roles but there may be cases where it has to function in both roles simultaneously.

2.3.3.1 The manager role

The part of the distributed application that issues directives, receives responses to its directives and also receives unsolicited notifications.

2.3.3.2 The agent role

The part of the application process that provides a front-end process to a collection of managed objects and generates the responses to directives from the manager and also issues unsolicited notifications about events detected by the resources under its control which are represented as managed objects for the purpose of supporting the management function.

In the general case managers and agents may be involved in “many-to-many” type relationships which is rather difficult to control as it raises difficulties about synchronization and concurrent and possibly conflicting directives.

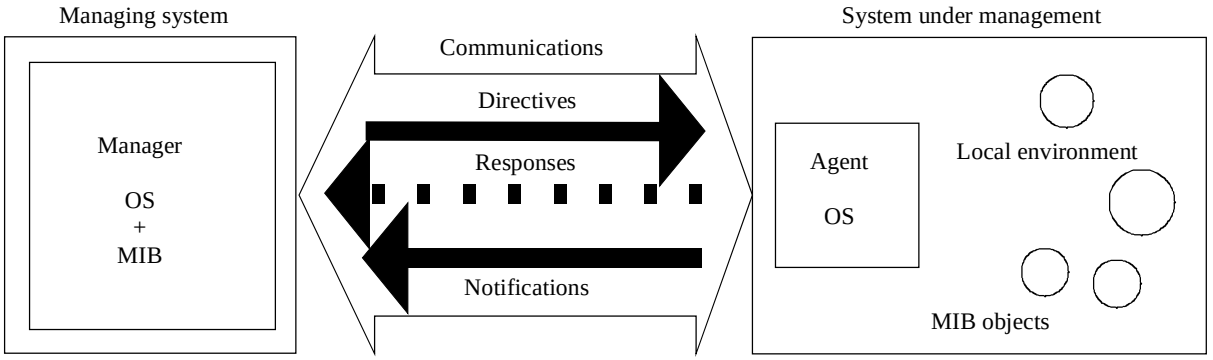
This issue is for further study.

2.4 TMN management communication services

See Fig. 3 for a block diagram of TMN management communications.

FIGURE 3

Management communications



2.5 Separation from underlying communications

The separation of the management communication from any underlying communication protocol is considered to be beneficial for several reasons:

– it will make integration of these new management concepts into existing management systems much easier;

– it will facilitate the interoperation of the two types of management systems;

– it will allow greater flexibility in solving any communication access problem caused by any fault condition;

– it avoids translation between the two management systems at the private/public network boundary;

– it avoids some duplication of objects and object classes.

Therefore this Recommendation does not call for any underlying protocol requirements.

3 Interactions with Operations, Administration and Maintenance (OA&M) systems

The interaction of management systems with OA&M systems has not yet been clarified so this is a matter for further study.

3.1 SDH path level

For further study.

3.2 SDH section level

For further study.

4 TMN managed object classes

4.1 Generic object classes

ITU-T Recommendation M.3100 contains a listing of generic object classes which would be needed in any management system.

These start with the definition of an initial class, called "Top" in the general case, then derived from this seed class are: identification functions for both equipment and transmission systems, administrative and operational status, notification generation when network elements or their management functions change and general condition changes.

The following is a list of object class definitions which has been formulated from the latest version of ITU-T Recommendation M.3100 1996.

4.1.1 Description of object classes

4.1.1.1 The "Top" object class

This is the object class from which every other managed object class is derived as a subclass.

It is just as conceptual convenience with the meaning that this is the starting point for all ITU (ITU-T) managed object definitions. It is defined in ITU-T Recommendation X.721 and registered as smi2MObjectClass 14 which is not the top of the whole managed object class structure as defined in ITU-T Recommendation X.660/ISO 9834-1 "Procedures for the operation of OSI registration authorities – Part 1".

All managed object classes which will be referred to in this contribution come under the classification heading (which is referred to as an "arc" in the standard):

{joint-iso-ccitt ms(9)}.

Below this arc comes:

–	system management overview	smo(0)	X.720
–	Common Management Information Protocol	cmip(1)	X.711
–	Systems Management functions	function(2)	X.7NN
–	Structure of Management Information	smi(3)	X.72N

This Recommendation is mainly concerned with definitions below the arc:

{joint-iso-ccitt ms(9) smi(3)}.

4.1.1.1.1 Managed object classes defined in ITU-T Recommendation M.3100

These are catalogued under the smi(3) arc and are listed in Table 4.

TABLE 4

M.3100 managed object classes

Object class name	Object class identity	
Alarm Record	alarmRecord	
Alarm Severity Assignment Profile	alarmSeverityAssignmentProfile	
Attribute Value Change Record	attributeValueChangeRecord	
Circuit Pack	circuitPack	
Circuit End Point Sub-group	circuitEndPointSubgroup	
Connection	connection	D
Connection R1	connectionR1	
Connection Termination Point Bidirectional	connectionTerminationPointBidirectional	
Connection Termination Point Sink	connectionTerminationPointSink	
Connection Termination Point Source	connectionTerminationPointSource	
Connectivity	connectivity	D
Cross-Connection	crossConnection	
Current Alarm Summary Control	currentAlarmSummaryControl	
Discriminator	discriminator	
Equipment	equipment	
Equipment Holder	equipmentHolder	
Equipment R1	equipmentR1	
Event Forwarding Discriminator	eventForwardingDiscriminator	
Event Log Record	eventLogRecord	
Fabric	fabric	
Fabric R1	fabricR1	
Group Terminating Point	gtp	
Log	log	
Log Record	logRecord	
Managed Element	managedElement	
Managed Element R1	managedElementR1	
Managed Element Complex	managedElementComplex	
Management Operations Scheduler	managementOperationsScheduler	
Multipoint Cross-Connection	mpCrossConnection	
Named Cross-Connection	namedCrossConnection	
Named Multipoint Cross-Connection Network	namedMpCrossConnectionNetwork	
Network	network	
Network R1	networkR1	
Object Creation Record	objectCreationRecord	
Object Deletion Record	objectDeletionRecord	
Pipe	pipe	
Software	software	
Software R1	softwareR1	
State Change Record	stateChangeRecord	
Termination Point	terminationPoint	
TP Pool	tpPool	
Trail	trail	D
Trail R1	trailR1	
Trail Termination Point Bidirectional	trailTerminationPointBidirectional	
Trail Termination point Sink	trailTerminationPointSink	
Trail Termination Point Source	trailTerminationPointSource	

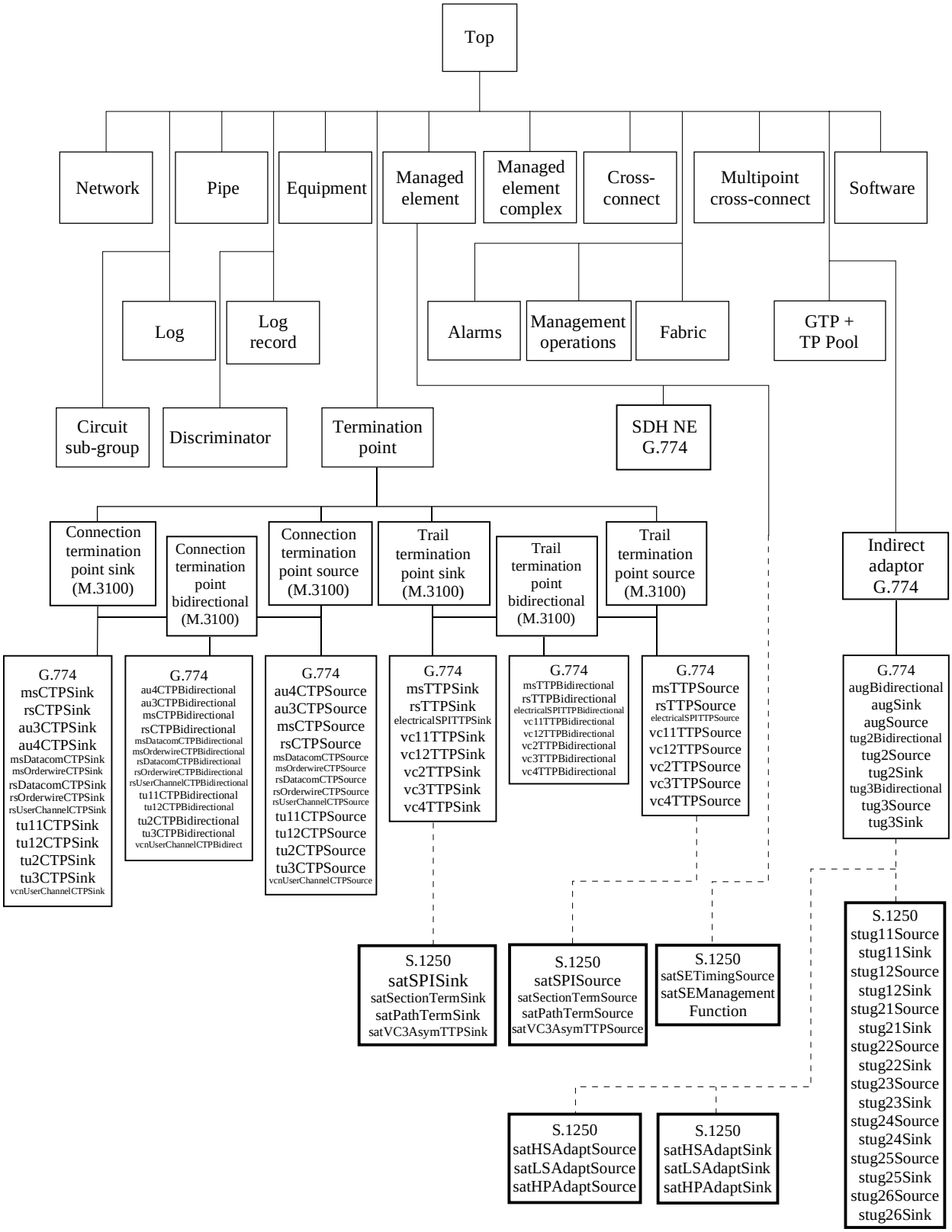
NOTE 1 – D indicates Deprecated (obsolete).

NOTE 2 – R1 indicates Revision One. This usually replaces the original version which becomes depreciated. However, in some parts of ITU-T Recommendation M.3100 it is used as a mechanism to extend the capabilities of a “class” and both versions continue together.

NOTE 3 – All subordinate classes inherit the functionality of their parent object classes. The inheritance hierarchy below Top is illustrated in Fig. 4.

FIGURE 4

Inheritance hierarchy from Top down through M.3100 to G.774 to S.1250



NOTE 1 – The object classes in the lower G.774 and S.1250 boxes are all at the same level of the hierarchy.

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4.1.2 Summary of functions by generic object class

The following list is abstracted from the object class definitions of the latest version of ITU-T Recommendation M.3100. Conditional features are shown in brackets only if they remain as conditional and have not been selected as mandatory for deployment in the satellite transport network management environment. Activating conditional features usually results in more notification messages which may cause overloading of management communication facilities in some situations.

TABLE 5

Functions of object classes

Object Class	Functionality
Network	
	networkId,
	userLabel.
Network R1	
	systemTitle.
Managed Element Complex	
	managedElementComplexId,
	systemTitle,
	createDeleteNotifications.
Managed Element	
	managedElementId,
	systemTitle,
	alarmStatus,
	administrativeState,
	operationalState,
	usageState,
	environmentalAlarm,
	equipmentAlarm,
	communicationsAlarm,
	processingErrorAlarm,
	createDeleteNotification,
	(attributeValueChangeNotification),
	(stateChangeNotification),
	(audibleVisualLocalAlarm),
	(resetAudibleAlarm),
	userLabel,
	(vendorName),
	(version),
	(locationName),
	currentProblemList,
	externalTime,
	systemTimingSource.

TABLE 5 *(continued)*

Object Class	Functionality
Managed Element R1	
	environmentalAlarm,
	logRecordIdParameter,
	correlatedRecordNameParameter,
	suspectObjectListParameter,
	equipmentAlarm,
	logRecordIdParameter,
	correlatedRecordNameParameter,
	suspectObjectListParameter,
	communicationsAlarm,
	logRecordIdParameter,
	correlatedRecordNameParameter,
	suspectObjectListParameter,
	processingErrorAlarm,
	logRecordIdParameter,
	correlatedRecordNameParameter,
	suspectObjectListParameter,
	alarmSeverityAssignmentPointer.
Termination Point	
	supportedByObjectList,
	createDeleteNotifications,
	(attributeValueChangeNotification),
	(stateChangeNotification),
	operationalState,
	crossConnectionPointer,
	tmnCommunicationsAlarmInformation,
	alarmSeverityAssignmentPointer.
Trail Termination Point Sink	
	upstreamConnectivityPointer,
	administrativeState,
	supportableClientList.
Trail Termination Point Source	
	downstreamConnectivityPointer,
	administrativeState,
	supportableClientList.
Connection Termination Point Source	
	upstreamConnectivityPointer,
	CTPUUpstreamPointer,
	(ctpInstance),
	(channelNumber).
Connection Termination Point Sink	
	downstreamConnectivityPointer,
	CTPUDownstreamPointer,
	(ctpInstance),
	(channelNumber).

TABLE 5 *(continued)*

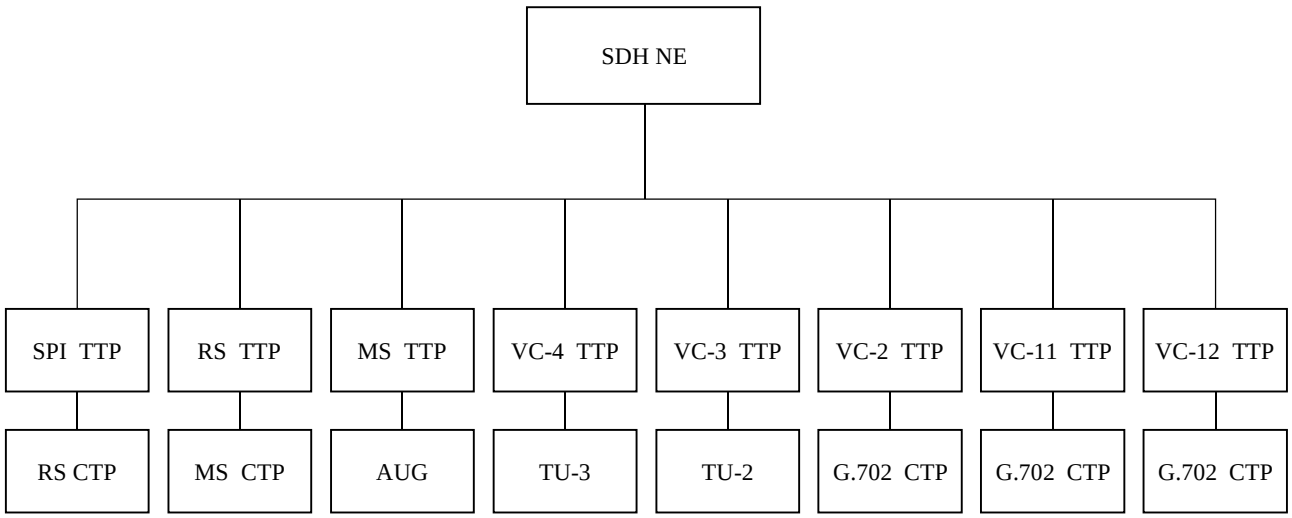
Object Class	Functionality
Equipment	
	equipmentId,
	replaceable,
	(createDeleteNotifications),
	(attributeValueChangeNotification),
	(stateChangeNotification),
	(administrativeOperationalStates),
	affectedObjectList,
	environmentAlarm,
	tmnCommunicationsAlarmInformation,
	processingErrorAlarm,
	userLable,
	vendorName,
	version,
	locationName,
	currentProblemList.
Equipment R1	
	serialNumber,
	supportedByObjectsList,
	alarmSeverityAssignmentPointer,
	equipmentsEquipmentAlarmR1,
	processing ErrorAlarmR1,
	environmentalAlarmR1,
	processingErrorAlarmR1.
General Management Support	
	Alarm Severity Assignment Profile,
	Attribute Value Change Record,
	Alarm Record,
	Discriminator,
	Event Forwarding Discriminator,
	Event Log Record,
	Log,
	Log Record,
	State Change Record,
	Object Creation Record,
	Object Deletion Record,
	Management Operations Scheduler,
	Current Alarm Summary Control.

5 SDH object classes

The inheritance structure and naming tree for SDH specific management object classes are defined in ITU-T Recommendation G.774 and are shown in Fig. 5.

FIGURE 5

Naming tree for G.774 SDH object classes



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5.1 Summary of facilities and alarms contained in SDH object classes

Table 6 is abstracted from ITU-T Recommendation G.774-01 and contains examples of SDH specific object classes for administration events and alarm conditions.

TABLE 6

Alarms in SDH object classes

Object class	Functionality	Sub-functions
sdhNE		
	(just acts as the top of the naming hierarchy).	
electrical SPITTP Source		
	administrativeStatePackage,	
	createDeleteNotificationsPackage,	
	stateChangeNotificationPackage,	
	electricalSPIPackage,	
		electricalSPITTPId,
		stmLevel.
	electricalSPITTPSourcePkg,	
	userLabel.	
electrical SPITTP Sink		
	administrativeStatePackage,	
	createDeleteNotificationPackage,	
	stateChangeNotificationPackage,	
	electricalSPIPackage,	
		electricalSPITTPId,
		stmLevel.
	electricalSPITTPSinkPkg,	
	userLabel.	

6 Introduction to satellite specific NETWORK ELEMENT managed object classes

The approach taken in the telecommunications management network philosophy is to restrict the information captured by the TMN management objects to that required for management purposes only.

NOTE 1 – The definition of the TMN is still in progress so there are some limitations in the set of Recommendations which define the TMN and on which this Recommendation is based.

The new satellite specific functions defined in Recommendation ITU-R S.1149 have been presented in this Recommendation using a tabular presentation which has been split into three parts for ease of comprehension.

The first part in Table 7 contains the Scenario 1 object classes.

The second part in Table 8 contains the Scenario 2 object classes.

The third part in Table 11 contains Scenario 3 object classes.

To ensure that the remote management of SDH satellite systems is not only viable but also commercially attractive, the definitions of the new functions introduced by Recommendation ITU-R S.1149 – "SDH satellite systems" need to be modelled as TMN management objects with sufficient detail to make their remote monitoring and control simple but comprehensive.

The level of detail presented in the Tables is only sufficient to identify the existence, identity and in some cases the operational state of objects. This is probably sufficient for planning (inventory control) and simple fault identification but more detail would add greater power.

6.1 Scenario 1

Figures 4a and 4b of Recommendation ITU-R S.1149 identify only the following satellite specific functions:

– the satellite synchronous physical interface;

– the satellite section termination;

– the higher order satellite section adaptation;

– the lower order satellite section adaptation;

– the synchronous equipment timing source;

– the synchronous equipment management function.

All the other functions are the same as for terrestrial transmission systems so the same management functions can be applied.

However, it has to be recognized that the terrestrial side of management systems is still under development.

A tabular presentation of the special satellite management functionality identified above is detailed in Table 7.

TABLE 7

Satellite specific SDH management objects

Object Class	Packages	Attributes and notifications	Comments
satSPIBidirectional			
satSPISource			
	administrativeStatePackage		optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satSPIPackage	satSPIId, satSynchLevel	
	satSPISourcePackage		Model of conversion of internal logic signals to satellite side in-station electrical signal specification.

TABLE 7 *(continued)*

Object Class	Packages	Attributes and notifications	Comments
satSPISink			
	administrativeStatePackage		optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satSPIPackage	satSPIId, satSynchLevel	
	satSPISinkPackage		Model of the conversion of incoming satellite side in-station electrical signals to internal logic signals.
satSectionTermSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satSectionTermSen1SourcePackage		Originates a satellite section.
	satSectionTermPackage	satSectionTermId satSynchLevel	
satSectionTermSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSectionTermSen1SinkPackage		Terminates a satellite section. i.e. triggers a communicationsAlarm if: BER threshold exceeded, degraded signal detected, or MS alarm indication detected. Passes on AIS or not as controlled by BERMtceInhibit.
	satSectionTermPackage	satSectionTermId satSynchLevel	
satHSAdaptSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satHSAdaptSourcePackage		Models a satellite section higher order-*n* source adaptation function. Generates AU pointers and forms VC-3*s* into AU-3s. Adapts signal to 51.84 Mbit/s signal for transmission over S-IOS.

TABLE 7 *(continued)*

Object Class	Packages	Attributes and notifications	Comments
	satSectionAdaptPackage	satSectionAdaptId satSynchLevel	
satHSAdaptSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satHSAdaptSinkPackage		Models a satellite section higher order-*n* sink adaptation function. Recovers frame synch and frame offset from S-IOS signals. Extracts TU-2s and TU-12s. Buffering received signals to remove Doppler without data loss. A communicationAlarm is sent on detection of LOP.
	satSectionAdaptPackage	satSectionAdaptId satSynchLevel	
satLSAdaptSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satLSAdaptSen1SourcePackage		Models a satellite section lower order-*m* source adaptation function. Generates pointers and adapts the signal for transport over the satellite.
	satSectionAdaptPackage	satSectionAdaptId satSynchLevel	
satLSAdaptSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class

TABLE 7 *(continued)*

Object Class	Packages	Attributes and notifications	Comments
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satLSAdaptSen1SinkPackage		Models a satellite section lower order-*m* sink adaptation function. Recovers frame synch and offsets from received satellite signals Buffers satellite signal to remove Doppler without data loss.
	satSectionAdaptPackage	satSectionAdaptId satSynchLevel	
satSETimingSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSETimingSen1SourcePackage	satSETimingId satSynchLevel	Models a satellite section synchronous equipment timing source SETS function.
satSEManagement Function	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSEManagementFunctionPackage	satSEManagementFunctionId	Models a satellite synchronous equipment management function SEMF.

NOTE 1 – The attribute name “satSynchLevel” has been used in preference to the term “stmLevel” of the terrestrial case because the STM level is probably not visible at this layer and satellite systems may employ extra overhead which increases the data-rate over the STM rate.

6.2 Scenario 2

Scenario 2 introduces an asymmetrically loaded multidestination topology which requires the support of several more satellite specific functions. i.e.:

– the Higher order Satellite Path Adaptation (HSPA);

– the Higher order Satellite Path Termination (HSPT);

– a satellite section termination which supports the satellite specific section overhead content for scenario 2;

– a special timing recovery system.

6.2.1 Scenario 2 special satellite functions

These functions are detailed in Table 8.

TABLE 8

Scenario 2 Satellite managed objects

Object Class	Packages	Attributes and notifications	Comments
satSectionTermSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satSectionTermSen2SourcePackage		Originates a satellite section by adding the special scenario-2 satellite section overhead SSOH.
	satSectionTermPackage	satSectionTermId satSynchLevel	
satSectionTermSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSectionTermSen2SinkPackage		Terminates a satellite section. i.e. extracts the scenario-2 SSOH, triggers a communicationsAlarm if: BER threshold exceeded, degraded signal detected, or MS alarm indication detected. Passes on AIS or not as controlled by BERMtceInhibit.

TABLE 8 *(continued)*

Object Class	Packages	Attributes and notifications	Comments
	satSectionTermPackage	satSectionTermId satSynchLevel	
satPathTermSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satSectionTermSourcePackage		Originates a satellite path.
	satPathTermPackage	satPathTermId satSynchLevel	
satPathTermSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satPathTermSinkPackage		Terminates a satellite path. i.e. triggers a communicationsAlarm if: BER threshold exceeded, degraded signal detected, or MS alarm indication detected. Passes on AIS or not as controlled by BERMtceInhibit.
	satPathTermPackage	satPathTermId satSynchLevel	
satHPAdaptSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class

TABLE 8 *(continued)*

Object Class	Packages	Attributes and notifications	Comments
	satHPAdaptSourcePackage		Models a satellite path higher order source adaptation function. Asymmetry processing.
	satPathAdaptPackage	satPathAdaptId satSynchLevel	
satHPAdaptSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satHPAdaptSinkPackage		Models a satellite path higher order sink adaptation function. Asymmetry reconciliation of signals received from S-IOS. A communicationAlarm is sent on detection of LOP.
	satPathAdaptPackage	satPathAdaptId satSynchLevel	
satSETimingSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSETimingSen2SourcePackage	satSETimingId satSynchLevel	Models a satellite section synchronous equipment timing source SETS function.

6.2.2 Scenario 2 – Multipoint VC-3 signal structure

Scenario 2 is a point-to-multipoint system. Therefore although the transmitted and received signals within the earth station equipment are of STM-0 bandwidth the received satellite signals are only carrying lower order streams e.g. TUG-2s or TU-12s.

Thus the payload configuration and alarm identity processes need the support of a special managed object class. This class has been named “satVC3Asym” and its supporting trail termination point functions are defined below.

6.2.2.1 Scenario 2 – VC-3 signal structure managed objects in GDMO format

satVC3AsymTTPSource

satVC3AsymTTPSource **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointSource**;**
CHARACTERIZED BY
"Recommendation X.721:1992":administrativeStatePackage**,**
"Recommendation M.3100:1992":createDeleteNotificationPackage**,**
"Recommendation M.3100:1992":stateChangeNotificationPackage**,**
vc3 – 4SourcePackageR1**,**
satVC3AsymTTPSourcePackage **PACKAGE**
BEHAVIOUR
satVC3AsymTTPSourceBehaviour **BEHAVIOUR**
DEFINED AS
“This object class models a scenario 2 asymmetric STM0 source.
This may be a standard terrestrial STM0 signal or there may be a need to add some extra information to assist with the operation of the multipoint network topology. This issue is FFS.”**;;**
ATTRIBUTES
"Recommendation ITU-R S.1250:1997":satVC3AsymTTPId **GET,**
REGISTERED AS **{**rRecS.1250ObjectClass 01**};**

satVC3AsymTTPSink

satVC3AsymTTPSink **MANAGED OBJECT CLASS**
DERIVED FROM " ITU-T Recommendation M.3100":trailTerminationPointSink**;**
CHARACTERIZED BY
"Recommendation X.721:1992":administrativeStatePackage**,**
"Recommendation M.3100:1992":createDeleteNotificationPackage**,**
"Recommendation M.3100:1992":stateChangeNotificationPackage**,**
vc3 – 4SinkPackageR1**,**
satVC3AsymTTPSinkPackage **PACKAGE**
BEHAVIOUR
satVC3AsymTTPSinkBehaviour **BEHAVIOUR**
DEFINED AS
“This object class models a scenario 2 asymmetric STM0 sink.
This is a satellite specific STM0 signal with asymmetric loading and additional information to assist with the operation of the multipoint network topology. This is defined in ITU-R Recommendation S.1149.”**;;**
ATTRIBUTES
"Recommendation ITU-R S.1250:1997":sat VC3AsymTTPId **GET,**
REGISTERED AS **{**rRecS.1250ObjectClass 02**};**

6.3 Scenario 3

6.3.1 Scenario 3 satellite specific payloads

Scenario 3 requires two new payloads types, sstm-2*n* and sstm-1*k*.

These are created by the LSSA function.

The scenario 3 payloads are shown in Table 9 from Recommendation ITU-R S.1149.

6.3.1.1 Scenario 3 multiplex section bit rates

TABLE 9

Sub-STM-1 synchronous signal, payload, SSOH and bit rates

Module designation	Payload		SSOH (kbit/s)	S-IOS rate (kbit/s)
	Composition	Rate (kbit/s)		
SSTM-11	1 × TU-12	2 304	128	2 432
SSTM-12	2 × TU-12	4 608	128	4 736
SSTM-21	1 × TUG-2	6 912	128	7 040
SSTM-22	2 × TUG-2	13 824	128	13 952
SSTM-23	3 × TUG-2	20 736	128	20 864
SSTM-24	4 × TUG-2	27 684	128	27 812
SSTM-25	5 × TUG-2	34 560	128	34 688
SSTM-26	6 × TUG-2	41 472	128	41 600

NOTE 1 – The need for a higher maximum SSTM-2*n* is for further study.

Two new Satellite Tributary Unit Groups STUGs have been defined:

– STUG-2*n* made up of 1 to 6 TUG-2s,

– STUG-1*k* made up of 1 to 2 TU-12s.

In object information terms these are identified, as:

stug11Source	stug11Sink
stug12Source	stug12Sink
stug21Source	stug21Sink
stug22Source	stug22Sink
stug23Source	stug23Sink
stug24Source	stug24Sink
stug25Source	stug25Sink
stug26Source	stug26Sink

The bidirectional case has not been included because the method of applying loop-backs (the main reason for the bidirectional object classes) in Scenario 3 has not been defined.

6.3.1.2 Background information

These lower SDH rates for the satellite multiplexing hierarchy are also being considered for terrestrial application but the issue is still FFS.

Identification parameter values for all possible combinations of tributaries to make up any STUGs have been provided in the ASN.1 Productions so that non-standard combinations can also be uniquely identified.

6.3.2 Scenario 3 – Object classes

A tabular representation of the satellite SDH hierarchy elements is shown in Table 10.

TABLE 10

SDH multiplexing hierarchy extensions

Object class	Packages	Attributes and notifications	Comments
stug11Source	stug11Source	stug11Id stug11Content	Models an STUG-11 source with a payload of one TU-12
stug11Sink	stug11Sink	stug11Id stug11Content	Models an STUG-11 sink
stug12Source	stug12Source	stug12Id stug12Content	Models an STUG-12 source with a payload of two TU-12s
stug12Sink	stug12Sink	stug12Id stug12Content	Models an STUG-12 sink
stug21Source	stug21Source	stug21Id stug21Content	Models an STUG-21 source with contents of 1 TUG-2
stug21Sink	stug21Sink	stug21Id stug21Content	Models an STUG-21 sink with contents of 1 TUG-2
stug22Source	stug22Source	stug22Id stug22Content	Models an STUG-22 source with contents of 2 TUG-2s
stug22Sink	stug22Sink	stug22Id stug22Content	Models an STUG-22 sink with contents of 2 TUG-2s
stug23Source	stug23Source	stug23Id stug23Content	Models an STUG-23 source with contents of 3 TUG-2s
stug23Sink	stug23Sink	stug23Id stug23Content	Models an STUG-23 sink with contents of 3 TUG-2s
stug24Source	stug24Source	stug24Id stug24Content	Models an STUG-24 source with contents of 4 TUG-2s
stug24Sink	stug24Sink	stug24Id stug24Content	Models an STUG-24 sink with contents of 4 TUG-2s
stug25Source	stug25Source	stug25Id stug25Content	Models an STUG-25 source with contents of 5 TUG-2s
stug25Sink	stug25Sink	stug25Id stug25Content	Models an STUG-25 sink with contents of 5 TUG-2s
stug26Source	stug26Source	stug26Id stug26Content	Models an STUG-26 source with contents of 6 TUG-2s
stug26Sink	stug26Sink	stug26Id stug26Content	Models an STUG-26 sink with contents of 6 TUG-2s

6.3.2.1 Packages

See table entries for package names and contents.

6.3.2.2 Attributes

stug1Content

An integer indicating the number of TU-12s contained in the STUG-1*k* i.e. the value of *k*.

stug2Content

An integer indicating the number of TUG-2s contained in the STUG-2*n* i.e. the value of *n*.

See the ASN.1 Productions section for the specific value of the integers.

6.3.3 Scenario 3 – Satellite specific signal processing functions

Scenario 3 does not introduce any new signal processing function names but the operations performed by the functions named for earlier scenarios operate in a slightly different manner. Therefore, Table 11 contains the same object class names but with different, Scenario 3, packages and attributes.

TABLE 11

Scenario 3 variations on established object classes

Object classes	Packages	Attributes	Comments
satSectionTermSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satSectionTermSen3SourcePackage		Originates a Satellite section by adding the special scenario-3 satellite section overhead SSOH.
	satSectionTermPackage	satSectionTermId satSynchLevel	
satSectionTermSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSectionTermSen3SinkPackage		Terminates a satellite section, i.e. extracts the scenario-3 SSOH, triggers a communicationsAlarm if: BER threshold exceeded, degraded signal detected, or MS alarm indication detected. Passes on AIS or not as controlled by BERMtceInhibit.

TABLE 11 *(continued)*

Object classes	Packages	Attributes	Comments
	satSectionTermPackage	satSectionTermId satSynchLevel	
satLSSAdaptSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	satLSSAdaptSen3SourcePackage		Models a satellite section lower order-*m* source adaptation function. Generates TU pointers to form TU-12s, multiplexes TUs into satellite tributary unit groups STUGs and adapts them to the SSTM-1/2*n* for transport over the S-IOS.
	satSectionAdaptPackage	satSectionAdaptId satSynchLevel	
satLSSAdaptSink	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satLSSAdaptSen3SinkPackage		Models a Satellite Section Lower Order-*m* Sink Adaptation function. Recovers VC-12s and their associated frame offsets from individual STUGs received from the SSTM-1/2*n* ports. Buffers TU-12s from the S-IOS to remove Doppler without data loss
	satSectionAdaptPackage	satSectionAdaptId satSynchLevel	

TABLE 11 *(continued)*

Object classes	Packages	Attributes	Comments
satSETimingSource	administrativeStatePackage		optional in parent terminationPoint class
		createDeleteNotificationPackage	optional in parent terminationPoint class
		stateChangeNotificationPackage	optional in parent terminationPoint class
	tmnCommunicationAlarmInfoPkg		optional in parent terminationPoint class
	operationalStatePackage		optional in parent terminationPoint class
	satSETimingSen3SourcePackage	satSETimingId satSynchLevel	Models a satellite section synchronous equipment timing source SETS function.

6.4 Scenario 3 GDMO Object Class Definitions

stug11Source

stug11Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug11SourcePackage **PACKAGE**
BEHAVIOUR
stug11SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-11 source.
A STUG11 has a payload of one TU-12."**;;**
ATTRIBUTES
stug11Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 03**};**

stug11Sink

stug11Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug11SinkPackage **PACKAGE**
BEHAVIOUR
stug11SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-11 sink.
A STUG11 has a payload of one TU-12."**;;**
ATTRIBUTES
stug11Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 04**};**

stug12Source

stug12Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug12SourcePackage **PACKAGE**
BEHAVIOUR
stug12SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-12 source.
A STUG12 has a payload of two TU-12s."**;;**
ATTRIBUTES
stug12Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 05**};**

stug12Sink

stug12Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug12SinkPackage **PACKAGE**
BEHAVIOUR
stug12SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-12 sink.
A STUG12 has a payload of two TU-12s."**;;**
ATTRIBUTES
stug12Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 06**};**

stug21Source

stug21Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug21SourcePackage **PACKAGE**
BEHAVIOUR
stug21SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-21 source.
A STUG21 has a payload of one, two or three TU-12s or one TU-2."**;;**
ATTRIBUTES
stug21Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 07**};**

stug21Sink

stug21Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug21SinkPackage **PACKAGE**
BEHAVIOUR
stug21SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-21 sink.
A STUG21 has a payload of one, two or three TU-12s or one TU-2."**;;**
ATTRIBUTES
stug21Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 08**};**

stug22Source

stug22Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug22SourcePackage **PACKAGE**
BEHAVIOUR
stug22SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-22 source.
A STUG22 has a payload of four, five or six TU-12s or two TU-2s or one VC-2 plus one VC-12 or one VC-2 plus two VC-12s."**;;**
ATTRIBUTES
stug22Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 09**};**

stug22Sink

stug22Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug22SinkPackage **PACKAGE**
BEHAVIOUR
stug22SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-22 sink.
A STUG22 has a payload of four, five or six TU-12s or two TU-2s or one VC-2 plus one VC-12 or one VC-2 plus two VC-12s."**;;**
ATTRIBUTES
stug22Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 10**};**

stug23Source

stug23Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug23SourcePackage **PACKAGE**
BEHAVIOUR
stug23SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-23 source.
A STUG23 has a payload of seven, eight or nine VC-12s, or three TU-2s or one VC-2 plus four, five or six VC-12s, or two VC-2s plus one, two or three VC-12s."**;;**
ATTRIBUTES
stug23Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 11**};**

stug23Sink

stug23Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug23SinkPackage **PACKAGE**
BEHAVIOUR
stug23SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-23 sink.
A STUG23 has a payload of seven, eight or nine VC-12s, or three TU-2s or one VC-2 plus four, five or six VC-12s, or two VC-2s plus one, two or three VC-12s."**;;**
ATTRIBUTES
stug23Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 12**};**

stug24Source

stug24Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug24SourcePackage **PACKAGE**
BEHAVIOUR
stug24SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-24 source.
A STUG24 has a payload of ten, eleven or twelve VC-12s, or four TU-2s or one VC-2 plus seven, eight or nine VC-12s, or two VC-2s plus four, five or six VC-12s, or three VC-2s plus one, two or three VC-12s."**;;**
ATTRIBUTES
stug24Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 13**};**

stug24Sink

stug24Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug24SinkPackage **PACKAGE**
BEHAVIOUR
stug24SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-24 sink.
A STUG24 has a payload of ten, eleven or twelve VC-12s, or four TU-2s or one VC-2 plus seven, eight or nine VC-12s, or two VC-2s plus four, five or six VC-12s, or three VC-2s plus one, two or three VC-12s."**;;**
ATTRIBUTES
stug24Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 14**};**

stug25Source

stug25Source **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**
CHARACTERIZED BY
stug25SourcePackage **PACKAGE**
BEHAVIOUR
stug25SourceBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-25 source.
A STUG25 has a payload of thirteen, fourteen or fifteen VC-12s or five TU-2s or one VC-2 plus ten, eleven or twelve VC-12s, or two VC-2s plus seven, eight or nine VC-12s, or three VC-2s plus four, five or six VC-12s, or four VC-2s plus one, two or three VC-12s."**;;**
ATTRIBUTES
stug25Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 15**};**

stug25Sink

stug25Sink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**
CHARACTERIZED BY
stug25SinkPackage **PACKAGE**
BEHAVIOUR
stug25SinkBehaviourPackage **BEHAVIOUR**
DEFINED AS
"This object class models a STUG-25 sink.
A STUG25 has a payload of thirteen, fourteen or fifteen VC-12s or five TU-2s or one VC-2 plus ten, eleven or twelve VC-12s, or two VC-2s plus seven, eight or nine VC-12s, or three VC-2s plus four, five or six VC-12s, or four VC-2s plus one, two or three VC-12s."**;;**
ATTRIBUTES
stug25Id **GET,**
supportableClientList **GET;**
REGISTERED AS **{**rRecS.1250ObjectClass 16**};**

stug26Source

stug26Source **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource**;**

CHARACTERIZED BY

stug26SourcePackage **PACKAGE**

BEHAVIOUR

stug26SourceBehaviourPackage **BEHAVIOUR**

DEFINED AS

"This object class models a STUG-26 source.

A STUG26 has a payload of sixteen, seventeen or eighteen VC-12s, or six TU-2s or one VC-2 plus thirteen, fourteen or fifteen VC-12s, or two VC-2s plus ten, eleven or twelve VC-12s, or three VC-2s plus seven, eight or nine VC-12s, or four VC-2s plus four, five or six VC-12s, or five VC-2s plus one, two or three VC-12s." **;;**

ATTRIBUTES

stug26Id **GET,**

supportableClientList **GET;**

REGISTERED AS **{**rRecS.1250ObjectClass 17**};**

stug26Sink

stug26Sink **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink**;**

CHARACTERIZED BY

stug26SinkPackage **PACKAGE**

BEHAVIOUR

stug26SinkBehaviourPackage **BEHAVIOUR**

DEFINED AS

"This object class models a STUG-26 sink.

A STUG26 has a payload of sixteen, seventeen or eighteen VC-12s, or six TU-2s or one VC-2 plus thirteen, fourteen or fifteen VC-12s, or two VC-2s plus ten, eleven or twelve VC-12s, or three VC-2s plus seven, eight or nine VC-12s, or four VC-2s plus four, five or six VC-12s, or five VC-2s plus one, two or three VC-12s." **;;**

ATTRIBUTES

stug26Id **GET,**

supportableClientList **GET;**

REGISTERED AS **{**rRecS.1250ObjectClass 18**};**

7 Object class definitions for satellite SDH NEs

This section defines the object classes for NEs and SDH hierarchy signal units from which object instantiations may be developed for the management of specific functions in satellite based transport systems, as described in Recommendation ITU-R S.1149.

Object classes which deal with signal structures as distinct from equipment functions are defined in § 6 of this Recommendation.

Object classes for SDH performance monitoring and payload configuration will be found in associated ITU-R management Recommendations.

NOTE 1 – All the satellite specific object classes which refer to functions have a name which begins with "sat". Satellite object classes which refer to SDH hierarchy entities follow the precedent of the terrestrial naming practice with the addition of a leading 's'. e.g. stug11Source compared to tug11Source.

TABLE 12

List of satellite specific object classes defined in this section

S.1250 object class identifier	
1	satSPISource
2	satSPISink
3	satSPIBidirectional
4	satSectionTermSource
5	satSectionTermSink
6	satHSAdaptSource
7	satHSAdaptSink
8	satLSAdaptSource
9	satLSAdaptSink
10	satPathTermSource
11	satPathTermSink
12	satHPAdaptSource
13	satHPAdaptSink
14	satSETimingSource
15	satSEManagementFunction

7.1 Specification of managed object classes in GDMO format

7.1.1 Satellite synchronous physical interface

satSPISource **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointSource**;**

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage**,**

"Recommendation M.3100":stateChangeNotificationPackage**,**

satSPIPackage**,**

satSPISourcePackage **PACKAGE**

BEHAVIOUR

satSPISourceBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of converting an internal logic level STM-*N* signal into an outgoing satellite system synchronous in-station interface signal. As described in section 4.2.1 of Recommendation ITU-R S.1149.

The downstream connectivity pointer is NULL for instances of this class.

A communications alarm notification shall be issued if any of the following conditions occur:

The output sub-function fails, with a probableCause parameter of txFail.

Any other sub-function fails, with a probableCause parameter of interfaceFail.

A failure of the input signal to the sub-function is usually difficult to differentiate from a failure of the interface function."**;;;**

ATTRIBUTES

"ITU-T Recommendation M.3100 1994": userLabel **GET – REPLACE;;;**

REGISTERED AS **{**rRecS.1250ObjectClass 19**};**

– – – – – – – – – – – –

satSPISink

satSPISink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointSink**;**
CHARACTERIZED BY
"Recommendation X.721":administrativeStatePackage**,**
"Recommendation M.3100":stateChangeNotificationPackage**,**
satSPIPackage**,**
satSPISinkPackage **PACKAGE**
BEHAVIOUR
satSPISinkBehaviour **BEHAVIOUR**
DEFINED AS
"This managed object class models the process of converting an in-station satellite system synchronous interface signal into an internal logic signal and recovering timing as described in section 4.2.1 of Recommendation ITU-R S.1149.
The upstream connectivity pointer is NULL for instances of this class.
A communications alarm notification shall be issued if any of the following conditions occur:-
The received signal fails, with a probableCause parameter of rxFail.
Any other sub-function fails, with a probableCause parameter of interfaceFail.
A Failure of the output signal of the sub-function is usually difficult to differentiate from a failure of the interface function."**;;;**
ATTRIBUTES
"ITU-T Recommendation M.3100 1994": userLabel **GET – REPLACE;;;**
REGISTERED AS **{**rRecS.1250ObjectClass 20**};**

satSPIBidirectional

satSPIBidirectional **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointBidirectional**;**
CHARACTERIZED BY
"Recommendation X.721"**:**administrativeStatePackage**,**
"Recommendation M.3100"**:**stateChangeNotificationPackage**,**
satSPIPackage**,**
satSPIBidirectionalPackage **PACKAGE**
BEHAVIOUR
satSPIBidirectionalBehaviour **BEHAVIOUR**
DEFINED AS
"This managed object class models the process of looping the signal at an internal logic signal point just before the conversion to and from the satellite system synchronous in-station interface signal conversion. Details of its operation are for further study"**;;;**
ATTRIBUTES
"ITU-T Recommendation M.3100 1994": userLabel **GET – REPLACE;;;**
REGISTERED AS {rRecS.1250ObjectClass 21**};**

7.1.2 Satellite section termination

satSectionTermSource **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation M.3100"**:**trailTerminationPointSource**;**
CHARACTERIZED BY
"Recommendation X.721"**:**administrativeStatePackage**,**
"Recommendation M.3100"**:**stateChangeNotificationPackage**,**
"Recommendation M.3100"**:**operationalStatePackage**,**
satSectionTermPackage**,**
CONDITIONAL PACKAGES
satSectionTermSen1SourcePackage **PACKAGE** **PRESENT IF** "Scenario 1 functionality, as defined in Recommendation ITU-R S.1149, is required."**;**
BEHAVIOUR
satSectionTermSen1SourceBehaviour **BEHAVIOUR**

DEFINED AS
"This managed object class models the processes of originating a satellite section. As described in section 5.1.1 of Recommendation ITU-R S.1149.
The downstream connectivity pointer is NULL for instances of this class.
A communications alarm notification shall be issued if the following condition occurs:
Any sub-function fails, with a probableCause parameter of msFail."**;;;;**

satSectionTermSen2SourcePackage **PACKAGE** **PRESENT IF** "Scenario 2 functionality, as defined in Recommendation ITU-R S.1149, is required."**;;;;**

BEHAVIOUR
satSectionTermSen2SourceBehaviour **BEHAVIOUR**
DEFINED AS
"This managed object class models the processes of originating a satellite section.
The downstream connectivity pointer is NULL for instances of this class.
A communications alarm notification shall be issued if the following condition occurs:-
Any sub-function fails, with a probableCause parameter of msFail."**;;;;**
REGISTERED AS **{**rRecS.1250ObjectClass 22**};**

– – – – – – – – – – – –

satSectionTermSink **MANAGED OBJECT CLASS**
DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointSink**;**
CHARACTERIZED BY
"Recommendation X.721":administrativeStatePackage**,**
"Recommendation M.3100":stateChangeNotificationPackage**,**
"Recommendation M.3100":tmnCommunicationsAlarmInformationPackage**,**
"Recommendation M.3100":operationalStatePackage**,**
satSectionTermPackage**,**
CONDITIONAL PACKAGES
satSectionTermSen1SinkPackage **PACKAGE** **PRESENT IF** "Scenario 1 functionality, as defined in Recommendation ITU-R S.1149, is required."**;**

BEHAVIOUR
satSectionTermSen1SinkBehaviour **BEHAVIOUR**
DEFINED AS
"This managed object class models the processes of terminating a satellite section. As described in section 5.1.1 of Recommendation ITU-R S.1149.
The upstream connectivity pointer is NULL for instances of this class.
A communications alarm notification shall be issued if any of the following conditions occur:
– BER threshold exceeded,
– degraded signal detected,
– MS alarm indication detected.
The above alarms may be suppressed by the BERMtceInhibit condition.
Any sub-function fails, with a probableCause parameter of msFail."**;**

satSectionTermSen2SinkPackage **PACKAGE** **PRESENT IF** "Scenario 2 functionality, as defined in Recommendation ITU-R S.1149, is required."**;;;;**

BEHAVIOUR
satSectionTermSen2SinkBehaviour **BEHAVIOUR**
DEFINED AS
"This managed object class models the processes of terminating a satellite section.
The upstream connectivity pointer is NULL for instances of this class.
A communications alarm notification shall be issued if any of the following conditions occur:-
– BER threshold exceeded,
– degraded signal detected,
– MS alarm indication detected.
The above alarms may be suppressed by the BERMtceInhibit condition.
Any sub-function fails, with a probableCause parameter of msFail."**;;;;**
REGISTERED AS **{**rRecS.1250ObjectClass 23**};**

– – – – – – – – – – – –

7.1.3 Satellite higher order section adaptation

satHSAdaptSource **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774"**:**indirectAdaptorSource**;**

CHARACTERIZED BY

"Recommendation X.721"**:**administrativeStatePackage**,**

"Recommendation M.3100"**:**stateChangeNotificationPackage**,**

"Recommendation M.3100"**:**tmnCommunicationsAlarmInformationPackage**,**

"Recommendation M.3100"**:**operationalStatePackage**,**

satSectionAdaptPackage**,**

satHSAdaptSourcePackage **PACKAGE**

BEHAVIOUR

satHSAdaptSourceBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of Adaptation between the higher order path connection HPC-*n* in scenario 1 or the higher order satellite path termination HSPT and the corresponding satellite section termination SST. As described in scenario 2 of Recommendation ITU-R S.1149 section 5.1.3.

It may have a null functionality in scenario 1 as the signal is not manipulated and the satellite system acts only as a regenerator.

In scenario 2 applications, it generates AU pointers and forms AU-3s. It also adapts signals going towards the satellite into 51.84 Mbps signal streams."**;;;;**

REGISTERED AS **{**rRecS.1250ObjectClass 24**};**

---

satHSAdaptSink **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774": indirectAdaptorSink**;**

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage**,**

"Recommendation M.3100":stateChangeNotificationPackage**,**

"Recommendation M.3100":tmnCommunicationsAlarmInformationPackage**,**

"Recommendation M.3100":operationalStatePackage**,**

satSectionAdaptPackage,

satHSAdaptSinkPackage **PACKAGE**

BEHAVIOUR

satHSAdaptSinkBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of adapting an incoming signal from the satellite section termination SST function into a format suitable for the mutliplexor or regenerator section termination in scenario 1, or for the higher order satellite path section termination HSPT in scenario 2 applications. As described in Recommendation ITU-R S.1149 sections 5.1.1 and 5.1.3.

This function also removes the doppler effect from the received data, without loss of data, as part of its AU pointer tracking function.

It also issues alarm conditions if; Loss of Frame synch LOF, or Loss of Pointer LOP is detected."**;;;;**

REGISTERED AS **{**rRecS.1250ObjectClass 25**};**

7.1.4 Satellite lower order section adaptation

satLSAdaptSource **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774"**:** indirectAdaptorSource**;**

CHARACTERIZED BY

"Recommendation X.721"**:**administrativeStatePackage**,**

"Recommendation M.3100"**:**stateChangeNotificationPackage**,**

"Recommendation M.3100"**:**tmnCommunicationsAlarmInformationPackage**,**

"Recommendation M.3100"**:**operationalStatePackage**,**

satSectionAdaptPackage**,**

satLSAdaptSen3SourcePackage **PACKAGE**

BEHAVIOUR

satLSAdaptSen3SourceBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of Adaptation between the lower order path connection LPC-*m* and the corresponding satellite section termination SST in the scenario 3 functional block diagram (Fig. 17) of Recommendation ITU-R S.1149.

In the scenario 1 application it does not have any defined functionality and in it is not used in scenario 2."**;;;;**

REGISTERED AS {rRecS.1250ObjectClass 26**};**

---

satLSAdaptSink **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774": indirectAdaptorSink**;**

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage**,**

"Recommendation M.3100":stateChangeNotificationPackage**,**

"Recommendation M.3100":tmnCommunicationsAlarmInformationPackage**,**

"Recommendation M.3100":operationalStatePackage**,**

satSectionAdaptPackage**,**

satLSAdaptSen1SinkPackage **PACKAGE**

BEHAVIOUR

satLSAdaptSen1SinkBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of Adaptation between the satellite section termination SST and the corresponding lower order path connection LPC-*m* in the scenario 3 functional block diagram (Fig. 17) of Recommendation ITU-R S.1149.

The LSSA function also removes the doppler effect from the received satellite signals.

In the scenario 1 application it does not have any defined functionality and in it is not used in scenario 2."**;;;;**

REGISTERED AS **{**rRecS.1250ObjectClass 27**};**

7.1.5 Satellite path termination

satPathTermSource **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointSource**;**

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage**,**

"Recommendation M.3100":stateChangeNotificationPackage**,**

satPathTermPackage**,**

satPathTermSourcePackage **PACKAGE**

BEHAVIOUR

satPathTermSourceBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of originating a satellite Path. As described in Recommendation ITU-R S.1149 sections 5.1.1 and 5.1.3.

The downstream connectivity pointer is NULL for instances of this class.

A communications alarm notification shall be issued if the following condition occurs:

any sub-function fails, with a probableCause parameter of msFail."**;;;;**

REGISTERED AS **{**rRecS.1250ObjectClass 28**};**

---

satPathTermSink **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation M.3100":trailTerminationPointSink**;**

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage**,**

"Recommendation M.3100":stateChangeNotificationPackage**,**

satPathTermPackage**,**

satPathTermSinkPackage **PACKAGE**

BEHAVIOUR

satPathTermSinkBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the processes of terminating a satellite Path. As described in Recommendation ITU-R S.1149 sections 5.1.1 and 5.1.3.

The upstream connectivity pointer is NULL for instances of this class.

A communications alarm notification shall be issued if the following condition occurs:

– BER threshold exceeded,
– degraded signal detected,
– MS alarm indication detected.

All the above may be inhibited by the BERMtce Inhibit command,

any sub-function fails, with a probableCause parameter of msFail.";;;;

REGISTERED AS {rRecS.1250ObjectClass 29};

– – – – – – – – – – –

7.1.6 Satellite higher order path adaptation

satHPAdaptSource **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSource;

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage,

"Recommendation M.3100":stateChangeNotificationPackage,

"Recommendation M.3100":tmnCommunicationsAlarmInformationPackage,

"Recommendation M.3100":operationalStatePackage,

satPathAdaptPackage,

satHPAdaptSourcePackage **PACKAGE**

BEHAVIOUR

satHPAdaptSourceBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of Adaptation between the lower order path connection LPC-*m* and the corresponding higher order satellite path termination HSPT. As described in scenario 2 of Recommendation ITU-R S.1149 section 5.1.3.

It may have a null functionality in scenario 2 as some satellite signals are unidirectional receive only.";;;;

REGISTERED AS {rRecS.1250ObjectClass 30};

– – – – – – – – – – –

satHPAdaptSink **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation G.774":indirectAdaptorSink;

CHARACTERIZED BY

"Recommendation X.721":administrativeStatePackage,

"Recommendation M.3100":stateChangeNotificationPackage,

"Recommendation M.3100":tmnCommunicationsAlarmInformationPackage,

"Recommendation M.3100":operationalStatePackage,

satPathAdaptPackage,

satHPAdaptSinkPackage **PACKAGE**

BEHAVIOUR

satHPAdaptSinkBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of adapting an incoming signal from the satellite path termination HSPT function into a format suitable for the lower order path cross connect LPC-*m*. As described in scenario 2 of Recommendation ITU-R S.1149 section 5.1.3.

It performs asymmetry reconciliation.

It issues an alarm condition if a Loss of Pointer LOP is detected.";;;;

REGISTERED AS {rRecS.1250ObjectClass 31};

– – – – – – – – – – –

7.1.7 Satellite system timing

satSETimingSource **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation M.3100":managedElement**;**

CHARACTERIZED BY

"Recommendation M.3100":stateChangeNotificationPackage**,**

"Recommendation M.3100":tmnCommunicationsAlarmInformationPackage**,**

"Recommendation M.3100":userLabelPackage**,**

"Recommendation M.3100":vendorNamePackage**,**

"Recommendation M.3100":currentProblemListPackage**,**

"Recommendation M.3100":externalTimePackage**,**

"Recommendation M.3100":systemTimingSourcePackage**,**

satSETimingSourcePackage **PACKAGE**

BEHAVIOUR

satSETimingSourceBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the process of adapting incoming signals from both the satellite section physical interface function SSPI and the terrestrial synchronous physical interface function SPI into a set of clock streams, to the SDH standard ITU-T Recommendation G.813, suitable for all requirements in the synchronous baseband equipment including Doppler effect compensation.

Where multiple satellite side inputs are employed the function will require configuration commands to associate the correct clock feeds with the appropriate signal processing functions.

Automatic fall-back to secondary and tertiary clock sources will be supported according to the algorithm in G.813.

The algorithm to be adopted for doppler compensation when there is a loss of the satellite side primary source, is a matter for further study.

A map of the current configuration of the function will be maintained ready for inspection by a GET command at any time.

It issues alarm conditions if any of the following are detected;

– Loss of Primary Sources (LOPS),
– Loss of Secondary Sources (LOSS),
– Loss of Output (LOO),
– Deterioration of Output Clock Quality (DOCQ)."**;;;**

ATTRIBUTES

satSynchConfig **GET -- REPLACE;;**

REGISTERED AS **{**rRecS.1250ObjectClass 32**};**

7.1.8 Satellite system Network Element management

satSEManagementFunction **MANAGED OBJECT CLASS**

DERIVED FROM "ITU-T Recommendation M.3100"**:**managedElement**;**

CHARACTERIZED BY

"Recommendation M.3100"**:**tmnCommunicationsAlarmInformationPackage**,**

"Recommendation M.3100"**:**stateChangeNotificationPackage**,**

"Recommendation M.3100"**:**userLabelPackage**,**

"Recommendation M.3100"**:**vendorNamePackage**,**

"Recommendation M.3100"**:**currentProblemListPackage**,**

"Recommendation M.3100"**:**externalTimePackage**,**

satSEManagementFunctionPackage **PACKAGE**

BEHAVIOUR

satSEManagementFunctionBehaviour **BEHAVIOUR**

DEFINED AS

"This managed object class models the Agent process SEMF and Message Communication Function MCF in the Synchronous Baseband equipment.

It tries to issues alarm conditions if any of the following conditions are detected:

– Loss of communication with any internal function (LOIF),

– Loss of communication with external manager (LOXM),

– Overload condition (OLC).”**;;;;**

REGISTERED AS **{**rRecS.1250ObjectClass 33**};**

7.2 Packages

Some packages are defined within the object class definitions. Others, particularly those which are used in several object classes are defined in this section.

7.2.1 List of packages

TABLE 13

List of packages

Package name	Definition location
satSPI	PDS
satSPISource	OCS
satSPISink	OCS
satSPIBidirectional	OCS
satSectionTerm	PDS
satSectionTermSen1Source	OCS
satSectionTermSen2Source	OCS
satSectionTermSen1Sink	OCS
satSectionTermSen2Sink	OCS
satSectionAdapt	PDS
satHSAdaptSource	OCS
satHSAdaptSink	OCS
satLSAdaptSource	OCS
satLSAdaptSink	OCS
satPathTerm	PDS
satPathTermSource	OCS
satPathTermSink	OCS
satPathAdapt	PDS
satHPAdaptSource	OCS
satHPAdaptSink	OCS
satSETimingSource	OCS
satSEManagementFunction	OCS

PDS: Package Definition Section.

OCS: Object Class Definition Section.

7.2.2 Definition of packages

7.2.2.1 satSPI

satSPIPackage **PACKAGE**
BEHAVIOUR
satSPIBehaviour **BEHAVIOUR**
DEFINED AS
"This package supports identification of the interface and its hierarchical level, from which the speed of operation may be deduced. The equivalent terrestrial package employs the STM level but in the satellite environment this would probably not be visible at this point so a specialised hierarchy has been developed called the satellite synchronous level."**;**
ATTRIBUTES
satSPIId **GET – REPLACE**
satSynchLevel **GET – REPLACE**
REGISTERED AS **{**rRecS.1250Package 01**};**

– – – – – – – – – – – –

7.2.2.2 satSectionTerm

satSectionTermPackage **PACKAGE**
BEHAVIOUR
satSectionTermBehaviour **BEHAVIOUR**
DEFINED AS
"This package supports identification of the satellite section termination and its hierarchical level, from which the speed of operation may be deduced. The equivalent terrestrial package employs the STM level but in the satellite environment this would probably not be visible at this point so a specialised hierarchy has been developed called the satellite synchronous level."**;**
ATTRIBUTES
satSectionTermId **GET – REPLACE**
satSynchLevel **GET – REPLACE**
REGISTERED AS **{**rRecS.1250Package 02**};**

– – – – – – – – – – – –

7.2.2.3 satSectionAdapt

satSectionAdaptPackage **PACKAGE**
BEHAVIOUR
satSectionAdaptBehaviour **BEHAVIOUR**
DEFINED AS
"This package defines the identification of the section adaptation function and its satellite synchronous hierarchical level, from which the speed of operation may be deduced and the supportable clients list. The equivalent terrestrial package employs the STM level but in the satellite environment this would probably not be visible at this point so a specialised hierarchy has been developed called the satellite synchronous level."**;**
ATTRIBUTES
satSectionAdaptId **GET – REPLACE**
satSynchLevel **GET – REPLACE**
supportableClientList **GET**
REGISTERED AS **{**rRecS.1250Package 03**};**

– – – – – – – – – – – –

7.2.2.4 satPathTerm

satPathTermPackage **PACKAGE**
BEHAVIOUR
satPathTermBehaviour **BEHAVIOUR**
DEFINED AS
"This package supports identification of the satellite path termination and its hierarchical level, from which the speed of operation may be deduced. The equivalent terrestrial package employs the STM level but in the satellite environment this would probably not be visible at this point so a specialised hierarchy has been developed called the satellite synchronous level."**;**

ATTRIBUTES

satPathTermId **GET – REPLACE**

satSynchLevel **GET – REPLACE**

REGISTERED AS **{**rRecS.1250Package 04**};**

7.2.2.5 satPathAdapt

satPathAdaptPackage **PACKAGE**

BEHAVIOUR

satPathAdaptBehaviour **BEHAVIOUR**

DEFINED AS

"This package supports identification of the path adaptation function and its hierarchical level, from which the speed of operation may be deduced and the supportable clients list. The equivalent terrestrial package employs the STM level but in the satellite environment this would probably not be visible at this point so a specialised hierarchy has been developed called the satellite synchronous level."**;**

ATTRIBUTES

satPathAdaptId **GET – REPLACE**

satSynchLevel **GET – REPLACE**

supportableClientList **GET**

REGISTERED AS **{**rRecS.1250Package 05**};**

Virtual Container Package

NOTE 1 – These packages are also used in vc12 object classes. These definitions are included here because they have not yet been incorporated in ITU-T Recommendation G.774.

vc11-2SinkPackageR1

vc11-2SinkPackageR1 **PACKAGE**

BEHAVIOUR

vc11-2SinkPackageR1Behaviour **BEHAVIOUR**

DEFINED AS

"A communicationsAlarm notification shall be issued if the signal label received (V5 byte) does not match the signal label expected. The probableCause parameter of the notification shall indicate signal label mismatch."**;;**

ATTRIBUTES

"Recommendation G.774:1992": v5SignalLabelExpected **GET,**

"Recommendation G.774:1992": v5SignalLabelReceive **GET;**

REGISTERED AS **{**rRecS.1250Package 06**};**

---

vc3-4SourcePackageR1

vc3-4SourcePackageR1 **PACKAGE**

BEHAVIOUR

vc3-4SourcePackageR1Behaviour **BEHAVIOUR**

DEFINED AS

"When 16 bytes are supported, the 16 bytes of the path trace shall be conveyed at the management interface."**;;**

ATTRIBUTES

"Recommendation G.774-05:1994": j1PathTraceSend **GET-REPLACE,**

"Recommendation G.774:1992": c2SignalLabelSend **GET-REPLACE;**

REGISTERED AS **{**rRecS.1250Package 07**};**

---

vc3-4SinkPackageR1

vc3-4SinkPackageR1 **PACKAGE**

BEHAVIOUR

vc3-4SinkPackageR1Behaviour **BEHAVIOUR**

DEFINED AS

"A communicationsAlarm notification shall be issued if the signal label expected (C2 byte) does not match the signal label expected. The probableCause parameter of the notification shall indicate signal label mismatch.

A communicationsAlarm notification shall be issued if the path trace received (J1 Byte)does not match the path trace expected. The probableCause parameter shall indicate path trace mismatch.

A communicationsAlarm notification shall be issued if a loss of TU multiframe indicator (H4 Byte) is detected. The probableCause parameter shall indicate loss of TU multiframe. This communicationAlarm notification is only required for higher order paths with payloads that require the use of the multiframe indicator.

When 16 bytes are supported, the 16 bytes of the path trace shall be conveyed at the management interface in both ways. It is a local issue whether the NE recomputes the CRC7 under a replace operation."**;;**

ATTRIBUTES

"Recommendation G.774:1992": j1PathTraceExpected
DEFAULT VALUE SDH.Null **GET-REPLACE-WITH-DEFAULT**

"Recommendation G.774-05:1994": j1PathTraceReceive **GET,**

"Recommendation G.774:1992": c2SignalLabelExpected **GET,**

"Recommendation G.774:1992": c2SignalLabelReceived **GET;**

REGISTERED AS **{**rRecS.1250Package 08**};**

7.3 Attributes

7.3.1 Satellite synchronous physical interface identification

satSPIId **ATTRIBUTE**

WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.NameType**;**

MATCHES FOR EQUALITY**;**

BEHAVIOUR

satSPIIdBehaviour **BEHAVIOUR**

DEFINED AS

"This attribute is used as a Relative Distinguished Name for naming instances of the satSPI object class."**;;**

REGISTERED AS **{**rRecS.1250Attribute 01**};**

7.3.2 satSectionTermId

satSectionTermId **ATTRIBUTE**

WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.NameType**;**

MATCHES FOR EQUALITY**;**

BEHAVIOUR

satSectionTermIdBehaviour **BEHAVIOUR**

DEFINED AS

"This attribute is used as a Relative Distinguished Name for naming instances of the satSectionTerm object class."**;;**

REGISTERED AS **{**rRecS.1250Attribute 02**};**

7.3.3 satSectionAdaptId

satSectionAdaptId **ATTRIBUTE**

WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.NameType**;**

MATCHES FOR EQUALITY**;**

BEHAVIOUR
satSectionAdaptIdBehaviour **BEHAVIOUR**
DEFINED AS
"This attribute is used as a Relative Distinguished Name for naming instances of the satSectionAdapt object class."**;;**
REGISTERED AS **{**rRecS.1250Attribute 03**};**

7.3.4 satPathTermId

satPathTermId **ATTRIBUTE**
WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.NameType**;**
MATCHES FOR EQUALITY**;**
BEHAVIOUR
satPathTermIdBehaviour **BEHAVIOUR**
DEFINED AS
"This attribute is used as a Relative Distinguished Name for naming instances of the satPathTerm object class."**;;**
REGISTERED AS **{**rRecS.1250Attribute 04**};**

7.3.5 satPathAdaptId

satPathAdaptId **ATTRIBUTE**
WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.NameType**;**
MATCHES FOR EQUALITY**;**
BEHAVIOUR
satPathAdaptIdBehaviour **BEHAVIOUR**
DEFINED AS
"This attribute is used as a Relative Distinguished Name for naming instances of the satPathAdapt object class."**;;**
REGISTERED AS **{**rRecS.1250Attribute 05**};**

7.3.6 satSynchLevel

satSynchLevel **ATTRIBUTE**
WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.SatSynchLevel**;**
MATCHES FOR EQUALITY**;**
BEHAVIOUR
satSynchLevelBehaviour **BEHAVIOUR**
DEFINED AS
"This attribute defines the level in the synchronous hierarchy of the satellite system at which operation is required. The actual clock frequency required will depend upon the amount of overhead carried in addition to the main signal at this point in the transport system."**;;**
REGISTERED AS **{**rRecS.1250Attribute 06**};**

7.3.7 supportableClientList

Refer to ITU-T Recommendation M.3100 for definition.

7.3.8 satSynchConfig

satSynchConfig **ATTRIBUTE**
WITH ATTRIBUTE SYNTAX SDHSatelliteTpASN1.SatSynchConfig**;**
MATCHES FOR EQUALITY**;**
BEHAVIOUR
satSynchConfigBehaviour **BEHAVIOUR**

DEFINED AS

"This attribute defines the configuration of the synchronisation feeds within the satellite system.

The multiple sources of traffic on the satellite side make the synchronisation situation more complex than for a terrestrial transport system."**;;**

REGISTERED AS **{**rRecS.1250Attribute 07**};**

– – – – – – – – – – – –

7.3.9 Satellite VC-3 asymmetric identity

satVC3AsymTTPId **ATTRIBUTE**

WITH ATTRIBUTE SYNTAX SDH.NameType**;**

MATCHES FOR EQUALITY, ORDERING, SUBSTRINGS**;**

BEHAVIOUR

atVC3AsymTTPIdBehaviour **BEHAVIOUR**

DEFINED AS

"This attribute is used as an RDN for naming instances of the vc3AsymTTP object classes If the STRING choice of the syntax is used then matching on sub-strings is permitted. If the NUMBER choice is used then matching on ordering is permitted"**;;**

REGISTERED AS **{**rRecS.1250Attribute 08**};**

– – – – – – – – – – – –

7.4 Name bindings

satVC3AsymTTPSource – vc3TTPSourceR1

satVC3AsymTTPSource – vc3TTPSourceR1 **NAME BINDING**

SUBORDINATE OBJECT CLASS "Recommendation ITU-R S.1250:1997": satVC3AsymTTPSource **AND SUBCLASSES;**

NAMED BY

SUPERIOR OBJECT CLASS "ITU-T Recommendation G.774": vc3TTPSourceR1 **AND SUBCLASSES;**

WITH ATTRIBUTE "Recommendation ITU-R S.1250:1997": satVC3AsymTTPSourceId**;**

BEHAVIOUR

satVC3AsymTTPSource-vc3TTPSourceR1Behaviour **BEHAVIOUR**

DEFINED AS

"In scenario 2, the subordinate managed objects are automatically instantiated when the superior managed object is instantiated, according to the make-up and mode of operation of the NE."**;;**

REGISTERED AS **{**rRecS.1250NameBinding 01**};**

– – – – – – – – – – – –

satVC3AsymTTPSink – vc3TTPSinkR1

satVC3AsymTTPSink – vc3TTPSinkR1 **NAME BINDING**

SUBORDINATE OBJECT CLASS "Recommendation ITU-R S.1250:1997": satVC3AsymTTPSink **AND SUBCLASSES;**

NAMED BY

SUPERIOR OBJECT CLASS "ITU-T Recommendation G.774": vc3TTPSinkR1 **AND SUBCLASSES;**

WITH ATTRIBUTE "Recommendation ITU-R S.1250:1997": satVC3AsymTTPSinkId**;**

BEHAVIOUR

satVC3AsymTTPSink-vc3TTPSinkR1Behaviour **BEHAVIOUR**

DEFINED AS

"In scenario 2, the subordinate managed objects are automatically instantiated when the superior managed object is instantiated, according to the make-up and mode of operation of the NE."**;;**

REGISTERED AS **{**rRecS.1250NameBinding 02**};**

– – – – – – – – – – – –

stug2NSource – tug2Source

stug2NSource – tug2Source **NAME BINDING**
SUBORDINATE OBJECT CLASS "Recommendation ITU-R S.1250:1997": stug2Nsource **AND SUBCLASSES;**
NAMED BY
SUPERIOR OBJECT CLASS "ITU-T Recommendation G.774": tug2Source **AND SUBCLASSES;**
WITH ATTRIBUTE "Recommendation ITU-R S.1250:1997": stug2NSourceId**;**
BEHAVIOUR
stug2NSource-tug2SourceBehaviour **BEHAVIOUR**
DEFINED AS
"In scenario 3, the subordinate managed objects are automatically instantiated when the superior managed object is instantiated, according to the make-up and mode of operation of the NE."**;;**
REGISTERED AS **{**rRecS.1250NameBinding 03**};**

stug2NSink – tug2Sink

stug2NSink – tug2Sink **NAME BINDING**
SUBORDINATE OBJECT CLASS "Recommendation ITU-R S.1250:1997": stug2Nsink **AND SUBCLASSES;**
NAMED BY
SUPERIOR OBJECT CLASS "ITU-T Recommendation G.774": tug2Sink **AND SUBCLASSES;**
WITH ATTRIBUTE "Recommendation ITU-R S.1250:1997": stug2NSinkId**;**
BEHAVIOUR
stug2NSink-tug2SinkBehaviour **BEHAVIOUR**
DEFINED AS
"In scenario 3, the subordinate managed objects are automatically instantiated when the superior managed object is instantiated, according to the make-up and mode of operation of the NE."**;;**
REGISTERED AS **{**rRecS.1250NameBinding 04**};**

stug1KSource – tu12CTPSourceR1

stug1KSource – tu12CTPSourceR1 **NAME BINDING**
SUBORDINATE OBJECT CLASS "Recommendation ITU-R S.1250:1997": stug1Ksource **AND SUBCLASSES;**
NAMED BY
SUPERIOR OBJECT CLASS "ITU-T Recommendation G.774": tu12CTPSourceR1 **AND SUBCLASSES;**
WITH ATTRIBUTE "Recommendation ITU-R S.1250:1997": stug1KSourceId**;**
BEHAVIOUR
stug1KSource-tu12CTPSourceR1- Behaviour **BEHAVIOUR**
DEFINED AS
"In scenario 3, the subordinate managed objects are automatically instantiated when the superior managed object is instantiated, according to the make-up and mode of operation of the NE."**;;**
REGISTERED AS **{**rRecS.1250NameBinding 05**};**

stug1KSink – tu12CTPSinkR1

stug1KSink – tu12CTPSinkR1 **NAME BINDING**
SUBORDINATE OBJECT CLASS "Recommendation ITU-R S.1250:1997": stug1Ksink **AND SUBCLASSES;**
NAMED BY
SUPERIOR OBJECT CLASS "ITU-T Recommendation G.774: tu12CTPSinkR1 **AND SUBCLASSES;**
WITH ATTRIBUTE "Recommendation ITU-R S.1250:1997": stug1KSinkId**;**

BEHAVIOUR

stug1KSink-tu12CTPSinkR1- Behaviour **BEHAVIOUR**

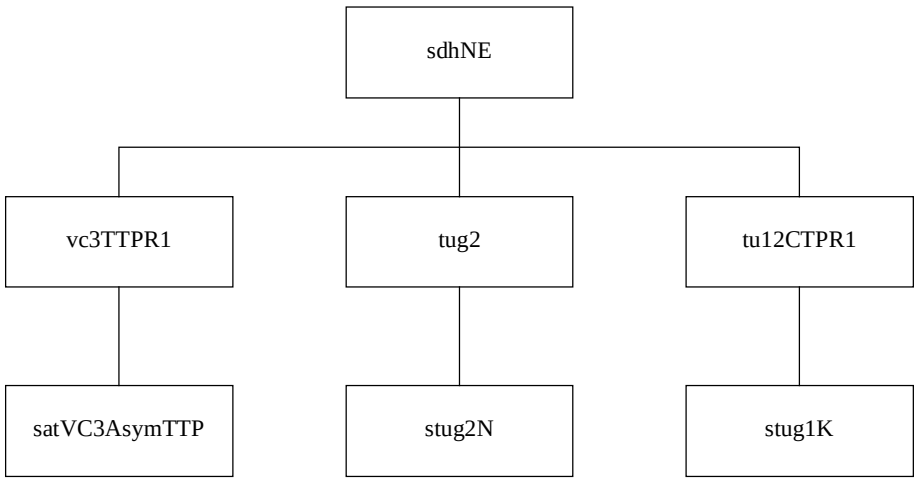
DEFINED AS

"In scenario 3, the subordinate managed objects are automatically instantiated when the superior managed object is instantiated, according to the make-up and mode of operation of the NE."**;;**

REGISTERED AS **{**rRecS.1250NameBinding 06**};**

FIGURE 6

Naming hierarchy for satellite specific object classes



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7.5 Object relations

For further study.

7.6 Supporting ASN.1 Productions

```
SDHsatelliteTpASN1  {rRecS.1250asn1Module(2)sdhSatelliteTpASN1(0)}
DEFINITIONS IMPLICIT TAGS ::= BEGIN
--EXPORT Everything
IMPORTS
NameType  --  M.3100
        FROM ASN1DefinedTypesModule
        {itu(0)  recommendation(0)  m(13)  gnm(3100)  InformationModel(0)       asn1Modules(2)
asn1DefinedTypesModule(0)};
satSynchLevel ::=  ENUMERATED {51.84Mbps  (0)
                                155.52Mbps  (1)
                                  2.432Mbps(2)
                                  4.736Mbps(3)
                                  7.040Mbps(4)
                                 13.952Mbps(5)
                                 20.864Mbps(6)
                                 27.812Mbps(7)
                                 34.688Mbps(8)
                                 41.600Mbps(9)
                               }

satSynchConfig  ::=  For Further Study
```

```
-- The following numbers specify the "Probable Cause Reason" related to Satellite management within a TMN context.
-- These numbers are reserved for communication-alarm-related-probable-causes by ITU-T Recommendation M.3100.
txFail              ::=  localValue  : 30
rxFail              ::=  localValue  : 31
interfaceFail       ::=  localValue  : 32
msFail              ::=  local value  : 33
LOPS                ::=  local value  : 34
LOSS                ::=  local value  : 35
LOO                 ::=  local value  : 36
DOCQ                ::=  local value  : 37
LOIF                ::=  local value  : 38
LOXM                ::=  local value  : 39
OLC                 ::=  local value  : 40

c2SignalLabel ::= INTEGER (0…255)
pathTrace ::= Choice {null  NULL
                      pathTrace          [1]     GRAPHICSSTRING}
v5SignalLabel ::= INTEGER (0….7)
END.
```

ANNEX A

(Informative)

A.1 The IETF approach, the simple network management protocol SNMP

Standards produced by the IETF are called Requests for Comments (RFCs).

SNMP version 2 is defined by RFCs 1441 to 1452 published in 1993.

Version 1 was defined by RFCs 1155, 1156 (replaced by 1212) and 1157 published in 1990.

A.2 The SNMP architecture is defined as follows:

The SNMP architectural model is a collection of network management stations and network elements. Network management stations execute management applications which monitor and control network elements. Network elements are devices such as hosts, gateways and terminal servers which have management agents responsible for performing the network management functions requested by the network management stations.

A.2.1 The goals of the architecture are as follows:

– SNMP should explicitly minimize the number and complexity of management functions that need to be realized by the management agent.

– The functional paradigm for monitoring and control should be sufficiently extensible to accommodate additional, possibly unanticipated aspects of network operation and management.

– The architecture should be, as much as possible, independent of the architecture and mechanisms of particular hosts or gateways.

A.2.2 The scope of management information

Is exactly that represented by instances of all non-aggregate object types either defined in the Internet standard MIB or defined elsewhere according to the conventions set forth in rfc1155, the Structure of Management Information (SMI). The SMI is divided into module definitions, object definitions and trap definitions.

It is viewed as a collection of managed objects residing in a virtual information store called the Management Information Base (MIB). Collections of related objects are called MIB modules.

SNMP utilises a subset of ASN.1, called a TEXTUAL-CONVENTION macro, (RFC 1443) for describing both managed objects and protocol data units PDUs. All encodings use the definite length form and non-constructor encoding wherever possible.

IETF managed objects do not contain optional features. Instead there are mandatory and optional objects. For example the “System group” of objects is mandatory, it contains a system description, a system identification and the local system time since the last restart. Other mandatory objects are the Interfaces Group, the Address Translation Group, the Internet Protocol (IP) Group and the Internet Control Message Protocol (ICMP) Group.

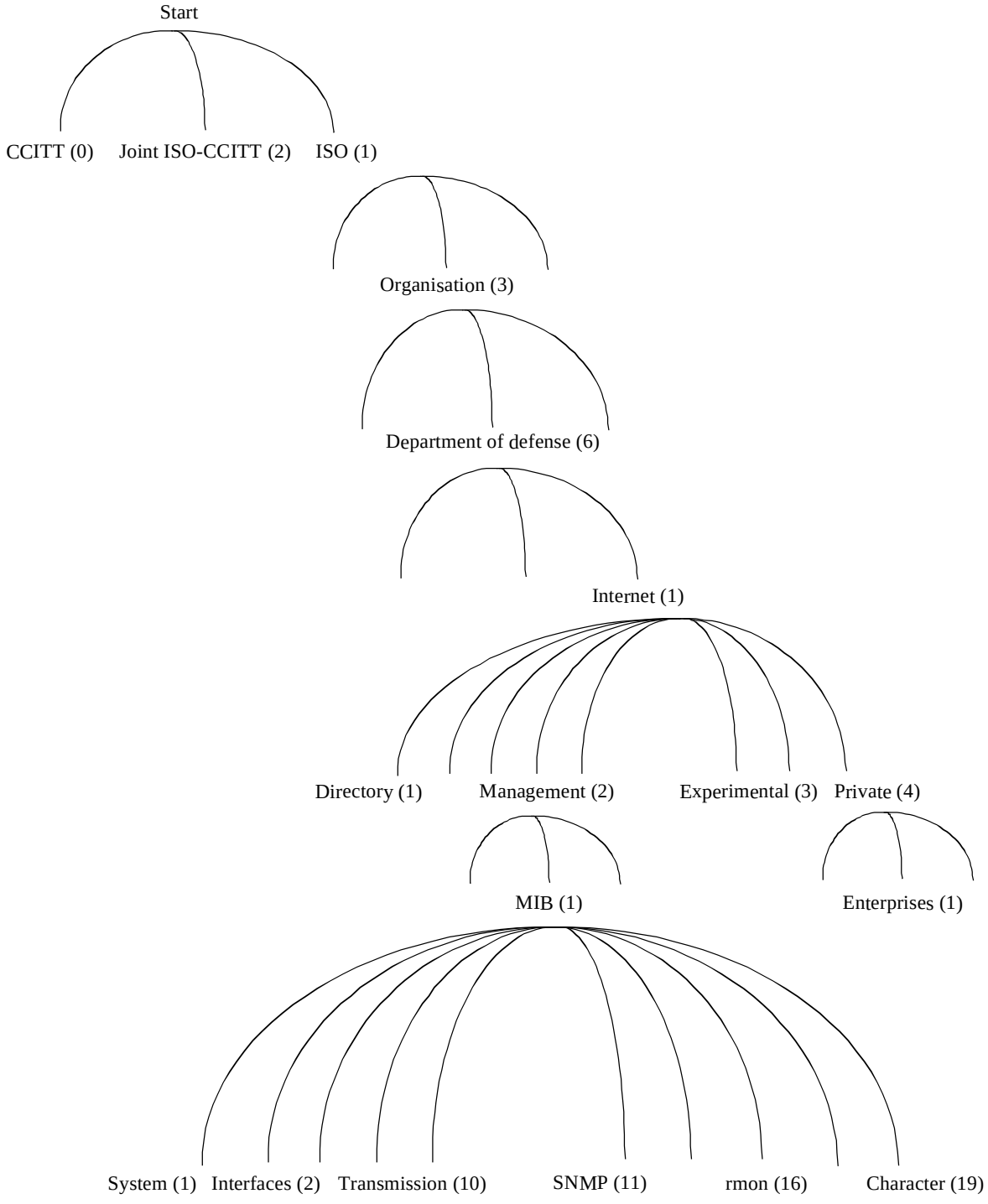
A.2.3 Representation of management information in version 2

Management information of non-aggregate types is defined in RFC1450 for version 2.

The international identification hierarchy for SNMPv2 MIB is illustrated in Fig. 7.

FIGURE 7

International identification hierarchy of objects



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Thus for SNMPv2 the MIB identity is abstracted in Table 14.

TABLE 14

International identity of SNMPv2 MIB

iso	org	dod	internet	snmpv2	snmpModules	snmpMIB	complete identity
1	3	6	1	6	3	1	1361631

SNMP Version 1 MIB identity was slightly different and shorter as it did not identify MIB modules separately = 136121.

A.2.4 Operations supported

SNMP models all management agent functions as alterations or inspections of variables. This means that there are only two essential management functions: one to assign a value to a specified parameter, and the other to retrieve the value of a specified parameter.

It also means that there is no requirement to support imperative management commands. This is a great advantage because the number of such commands is in practice ever increasing and their semantics in general arbitrarily complex. Imperative commands can be emulated by setting a variable to a value which subsequently triggers an action.

The strategy of SNMP is that the monitoring of the state of a network to any significant level of detail is simply accomplished by polling for appropriate variables. A limited number of unsolicited messages (traps) guide the timing and focus of the polling.

Limiting the number of unsolicited messages is consistent with the goal of simplicity and minimising the traffic generated by the network management function.

A.2.5 Protocol exchanges

Consistent with its goal of maintaining simplicity, SNMP messages exchanges have been designed to only require the support of an unreliable datagram service. Every message is entirely and independently represented by a single transport datagram. Version 2 adds a “wrapper” to the basic PDUs which contains the authentication and authorization controls, see RFC 1448. SNMP is suitable for mapping on to a wide variety of transport services, see RFC 1449.

Only a small set of message types (called management communication classes) are employed as shown in Table 15:

TABLE 15

Management communication classes

Message type	ASN.1 tag value	Class
GetRequest	0	1
GetNextRequest	1	2
Response	2	4
SetRequest	3	8
-unused/obsolete-	4	16
GetBulkRequest	5	32
InformRequest	6	64
SNMPv2-Trap	7	128

The communication class is identified by 2 raised to the power of the ASN.1 context-specific tag for the relevant SNMPv2 PDU. A set of classes is represented by the ASN.1 integer value that is the sum of the identifiers in the set. The null set is represented by the value zero.

A.2.6 Security framework

Version 2 introduced greater security and this part of the protocol is defined in RFC 1446.

A.2.7 MIB object definitions

Internet object registration is controlled by the Internet Assigned Numbers Authority (IANA) and a list of assigned numbers is kept in RFC 1340. Interface objects are listed in the **IANAifType** object.

A.2.8 SONET/SDH Interface object definitions

RFC 1595 “Definitions of Managed Objects for the SONET/SDH Interface Type”, March 1994, has the advantage of covering both SONET and SDH.

The major preoccupation of SNMP is with performance monitoring rather than alarms.

ANNEX B

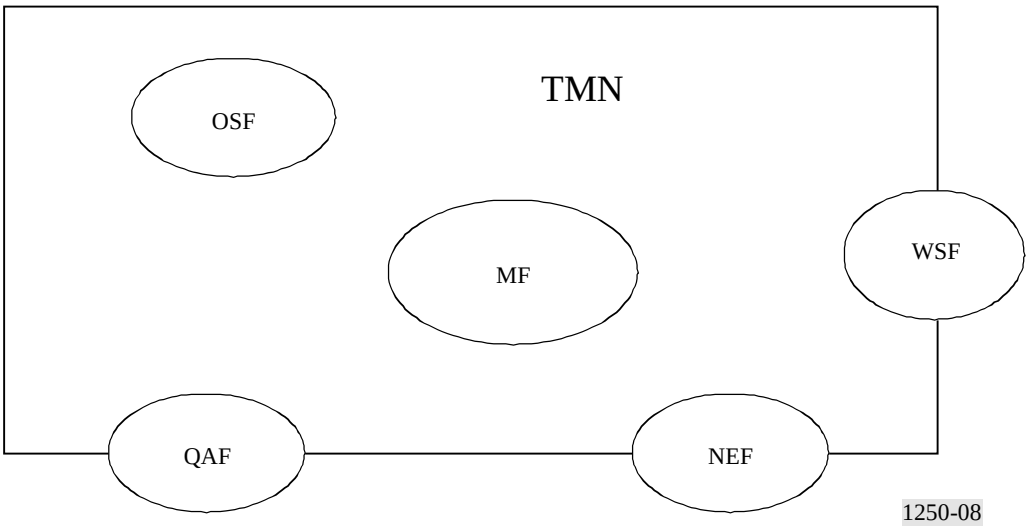
(Informative)

B.1 TMN details

The functional architecture has to allow for a wide range of complexity and geographical distribution of the various resources. This has been done by defining a few very flexible functional blocks (see Fig. 8).

FIGURE 8

TMN functional blocks



B.1.1 Definitions of management functional blocks

Operations Systems Function (OSF) block

This is the controlling function of the management system.

Network Element Function (NEF) block

This is the function which is the subject of management control.

Workstation Function (WSF) block

This function provides interpretation of TMN information for human consumption and allows human control over the TMN functions.

Mediation Function (MF) block

This function may store, adapt filter threshold or condense information passing between the OSF and the NEF or QAF to ensure that the information conforms to the expectations of the function blocks.

Q Adaptor Function (QAF) block

Supports the Q interface.

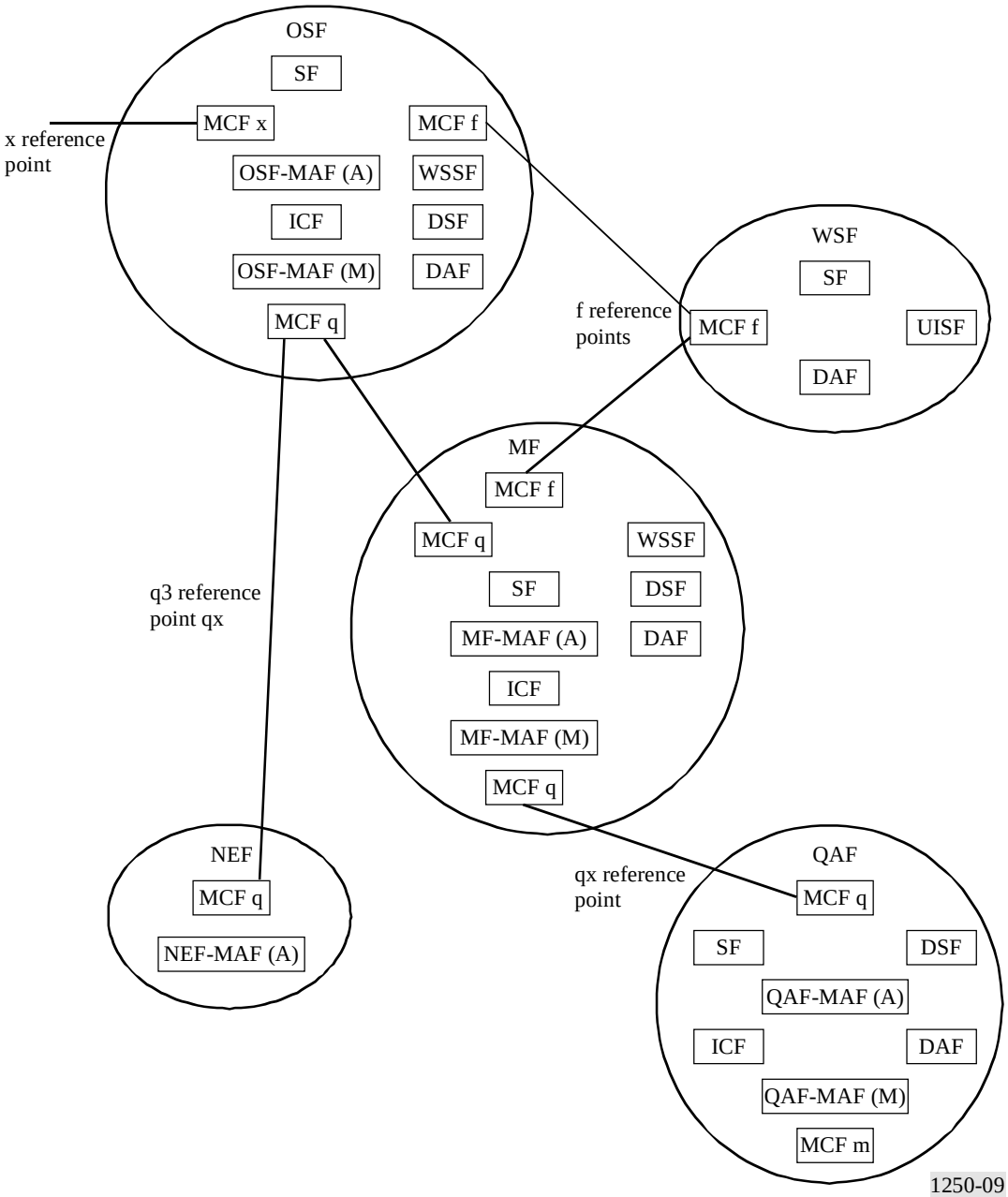
B.1.2 Definitions of management functional components

The TMN functional blocks illustrated in Fig. 8 are composed of functional components.

A number of functional components are identified as elementary building blocks of the functional blocks (see Fig. 9). Functional components are identified but they are not to be standardized, at this moment in time.

FIGURE 9

TMN functional components and interfaces



Management Application Function (MAF)

The MAF implements the TMN management services which are defined in ITU-T Recommendation M.3200 and their supporting functions can be found in Recommendation M.3400. Depending on their invocation, they will act in the role of a manager or an agent and depending upon the function block in which they are contained they may be named by the function block. e.g. MF-MAF, OSF-MAF, NEF-MAF, QAF-MAF.

Mediation Function – Management Application Function (MF-MAF)

A mediation function which can be associated with the MAF wherever it is located.

Operations System Function – Management Application Function (OSF-MAF)

These MAFs are the underlying but essential parts of OSFs. They may support the manager or agent roles in accessing managed object information or they may add value to raw information.

Network Element Function – Management Application Function (NEF-MAF)

The primary role of these MAFs is to support the agent role.

Q Adaptor Function – Management Application Function (QAF-MAF)

These MAFs support the manager or agent roles.

Information Conversion Function (ICF)

The ICF is used in intermediate systems to support translation mechanisms between information models.

Workstation Support Function (WSSF)

The WSSF provides support for the WSF.

User Interface Support Function (UISF)

This translates the information held in the TMN information model into a human readable format and vice versa. Further information on the human readable information format can be found in the Z.300-Series of ITU-T Recommendations.

Message Communication Function (MCF)

This is associated with all functional blocks having a physical interface. Depending upon the protocol stack supported at the reference point, different MCF types will exist.

Directory System Function (DSF)

This represents a locally or globally available distributed directory system. Each DSF stores directory information as a set of hierarchically ordered Directory Objects (DOs). See the X.500-Series of ITU-T Recommendations.

Directory Access Function (DAF)

This component is associated with all functional blocks which need to access the directory.

Security Function (SF)

This provides the security service that is necessary for functional blocks. The security services can be classified into five basic classes; authentication, access control, data confidentiality, data integrity, and non-repudiation as defined in ITU-T Recommendation X.800.

B.1.3 Reference points of TMN

To support delineation of management function blocks conceptual reference points are defined. These reference points assist in the identification of information passing between function blocks.

Three classes of reference points are defined:

- q interface has 2 variants;
  - qx is used between NEF and MF, QAF and MF and MF-to-MF, OSF;
  - q3 is used between NEF and OSF, QAF and OSF, MF and OSF and OSF-to-OSF;
- f interface is used between OSF or MF and a WSF;
- x interface is used between OSFs of two TMNs or an equivalent non-TMN network.

See Fig. 9.

B.2 Telecommunication managed areas

The term "Telecommunication Managed Areas" is defined as "a set of telecommunication resources, logically and/or physically related, which make it possible to provide, partly or completely, services to customers and is selected to be managed as a unit".

For example:

1 Customer access network

2 Transport network

3 Switched telephone network

4 Switched data network

5 Common channel Signalling System No. 7

6 Intelligent network

7 N-ISDN

8 Dedicated reconfigurable circuits network

9 Cellular telephone network (mobile)

10 IMT-2000

11 TMN

12 B-ISDN

This list is intended to apply to both public and private networks.

B.2.1 Management area definitions

B.2.1.1 Customer access network

The customer access network is that part of the local network that extends from the network terminating equipment up to and including the exchange termination. This must take into account any equipment associated with the customer access including multiplex equipment, network terminating units, etc. regardless of whether they are narrow-band or broadband, analogue or digital.

Because of its complexity, the customer access network can no longer be regarded as consisting of copper wires and network terminating equipment. It may now consist of copper wires or optical fibre or radio links along with complex electronic equipment whose functions may need to be updated, or changed by the network provider.

B.2.2 Transport network

The transport network is the set of transmission paths linking together two distribution frames at which terminal equipments or switching nodes are connected. The transmission means used to connect the terminal equipments with the distribution frame are not included in the transport network, because they belong to the customer access network.

The equipments used in the transport network can be analogue or digital and can include multiplexors, line transmitters/receivers, transponders, radios, repeaters/regenerators, satellites, echo cancellors/suppressors, etc.

The transport network provides the transmission means to all telecommunication services and networks, such as, PSTN, PSPDN, VSAT, IN, CCSS, Cellular, etc. This means that within each transmission path we can have telephone circuits, data logic circuits, TV channels, CCSS channels, data circuits, etc.

The main technologies used to build the transport network are FDM, PDH, SDH, copper wires, coaxial cables, optical cables, satellite, digital cross-connect and ATM.

The transport network can also be considered as a set of trails. The trails are characterized by the responsibility, in a service layer, of the integrity of the transfer of characteristic information from one or more client network layers between service layer access points. It is formed by combining a near end termination function, a network connection function and a far end trail termination function. A trail termination has the responsibility of generating the characteristic information of a network layer and ensures its integrity. In SDH a trail could be defined as lower order path or higher order path. Adaptation functions could be done by a digital multiplex for connection functions could be done by a digital cross-connect. In PDH a trail could be defined as a path. Adaptation functions could be done by a multiplex or line system. In ATM a trail could be defined as virtual channel or a virtual path.

For other definitions, refer to the revised version of ITU-T Recommendation M.3200 (1995).

B.3 An overview of the telecommunication management services and their possible telecommunication management areas of application are given in Table 16

TABLE 16

Managed areas versus management services

Telecommunication managed areas Management services	Customer access network	Transport network	Switched telephone network	Switched data network	CCSS No. 7	IN	N-ISDN	Dedicated reconfigur-able circuits network	Cellular telephone network (mobile)	IMT-2000	TMN	B-ISDN
Customer administration	x		x	x		x	x	x	x	x	x	x
Network provision management	x	x	x	x	x	x	x	x	x	x	x	x
Work-force management	x	x	x	x	x	x	x	x	x	x	x	x
Tariff, charging and accounting			x	x		x	x	x	x	x		x
QoS and performance management	x	x	x	x	x	x	x	x	x	x	x	x
Traffic measurement and analysis		x	x	x	x	x	x		x	x	x	x
Traffic management		x	x	x	x	x	x		x	x	x	x
Routing and digit analysis			x	x	x	x	x		x	x	x	x
Maintenance management	x	x	x	x	x	x	x	x	x	x	x	x
Security administration	x	x	x	x	x	x	x	x	x	x	x	x
Logistics management	x	x	x	x	x	x	x	x	x	x	x	x

B.4 Possible relationships between TMN management services and TMN entities

TMN MSs are the set of goals, management contexts, scenarios and architectures which provide for the management of managed areas. There is no direct relationship between a TMN MS and a physical OS. The TMN MSs may be grouped into OSs as best meets the requirements of an administration operating the TMN. One or more OSs may thus perform several MSs or conversely a given TMN MS may be distributed over several OSs. The allocation of these MSs to the OSs is not a subject for standardization.

B.5 Common management information services – CMIS

CMIS is defined in ITU-T Recommendation X.710 (1991).

The CMIS communication services are based upon a desire to ensure a stable set of communication services which does not have to change every time a new feature is added to the management system. This has resulted in a relatively simple set of communication commands as shown by the list of commands in Table 17. Any required level of complexity in the communication service can be supported by the design of the content of the managed objects.

TABLE 17

CMIS Message Types

Service	Type
M-GET	Confirmed
M-SET	Confirmed or non-confirmed
M-CREATE	Confirmed
M-DELETE	Confirmed
M-ACTION	Confirmed or non-confirmed
M-CANCEL-GET	Confirmed
M-EVENT-REPORT	Confirmed or non-confirmed

In addition to the normal mode of communications there is the notification mode.

This allows an operating system (agent or manager) to issue an unsolicited message when triggered by some important event which needs immediate attention, e.g. a major alarm event such as a mains supply power failure.

This type of message is carried in the: M-EVENT-REPORT.

B.5.1 Definition of communication services

M-GET requests the retrieval of management information. It contains the following parameters:

TABLE 18

M-GET parameters

Parameter name	Request or indication	Response/Confirmation
Invoke identifier	M	M
Linked identifier	–	C
Base object class	M	–
Base object instance	M	–
Scope	U	–
Filter	U	–
Access control	U	–
Synchronization	U	–
Attribute identifier list	U	–
Managed object class	–	C
Managed object instance	–	C
Current time	–	U
Attribute list	–	C
Errors	–	C

M: mandatory.

C: conditional.

U: user-option.

Explanation of Table 18 parameters:

– The identifiers identify the message or parts of a message.
– The base object class and base object instance specify the starting point for the filter operation.
– The scope identifies the subtree of the base managed object which is to be searched.
– The filter specifies the set of assertions to be applied to the scoped managed objects.
– Access control can be of any form desired.
– Synchronization may be atomic (all or nothing) or best effort.
– The attribute identifier list, identifies which attribute values are to be returned. The default is all values.
– Managed object class specifies the class of managed object whose attribute values are wanted.
– Managed object instance specifies the instance of a managed object whose attribute values are wanted.
– Current time contains the time at which the response was generated.
– Errors: 17 types of error are defined in ITU-T Recommendation X.710.

The other commands have similar content.

B.6 Common Management Information Protocol – CMIP

CMIP is defined in ITU-T Recommendation X.711 (1991).

This is the ISO's OSI up to and including association control.

This area of communications is outside the scope of this Recommendation.

B.7 Specialized TMNs

TMNs may be tailored for special environments such as the ISDN, B-ISDN and IMT-2000.

See ITU-T Recommendations:

– M.3600 – Principles for Management of the ISDN;
– M.3610 – Principles for applying the TMN concepts to the Management of B-ISDN;
– Draft Recommendation [**FPLMTS.FMGM**] – Framework of Future Public Land Mobile Telecommunications Systems Management.

B.8 Specific functionality required from any supporting protocol stack

The functionality of lower layer protocols is defined in ITU-T Recommendation X.200. For satellite applications some aspects of the protocol require special attention.

B.8.1 Lower layer protocol stack

The first function of the lower layer protocol stack is to be able to establish a connection.

This requires interfacing to various network addressing systems and probably to more than one. Connection needs to be achievable in as many fault conditions as possible because it is the management system which has to repair the fault. Fortunately this requirement is entirely consistent with the basic design philosophy of the Internet and most Internet protocols support this high penetration ability approach.

B.8.2 Common time-frame

A less obvious requirement is the need to agree on a time frame between the various managers and agents involved in a transaction to support a reliable log operation. This is particularly important in a supplier to customer operation because this is a commercial transaction where charges may be dependent on agreed times. Some object class definitions and management protocol PDUs contain fields for transporting time information but these will not contain an agreed common view of the time frame in which both ends are operating unless prior negotiation has taken place.

The IETF protocol called "Point-to-Point Protocol" PPP supports such a function, for example.