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Transmission and Multiplexing (TM); Optical Access Networks (OANs); Operations and Maintenance (OAM) of OANs

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Foreword

This ETSI Technical Report (ETR) has been produced by the Transmission and Multiplexing (TM) Technical Committee (TC) of the European Telecommunication Standards Institute (ETSI).

ETSI Technical Reports (ETRs) are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

This ETR has been produced by ETSI Sub-Technical Committee (STC) TM2 in order to provide an information model which covers the management aspects of Optical Access Networks (OANs).

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1 Scope

This ETR is one of a family of related ETSs covering the various aspects of Operations And Maintenance (OAM) of OANs.

The scope of this ETR and associated ETSs (for which this document provides the requirements and framework), is to provide an information model which covers the management aspects of Optical Access Networks (OAN) with the Optical Line Termination (OLT)/Optical Network Unit (ONU) type of topology as defined in ETS 300 463 [7]. This is shown in figure 1. This ETR is currently limited to the Passive Optical Network (PON) technology, however, it is an objective that models developed will be technology independent.

This ETR covers management aspects of the reference points qoan3 and qoan4 as shown in figure 4. qoan1 and qoan2 are out of scope of this document but parts of the information model developed may be applicable at these reference points.

The scope covers management of V5 services as described in ETS 300 324-1 [9] and ETS 300 347-1 [10]. It also covers leased line services and interfaces to leased line networks. The document is also applicable to the management of non-standard interfaces at an abstract level.

With regard to leased lines the scope of this document is limited to the sub-network connection that the OAN carries and the reporting of the availability of that connection.

This ETR does not cover the management of Access Networks (ANs) carrying distributive or broadband services or Asynchronous Transfer Mode (ATM). However it is an objective that any models developed should be extendible to cover these services. The management of distributive and broadband services will be covered in a future ETS.

The models developed in this ETR should allow for the possibility of multiple managers when considering Operations System (OS) to OS interfaces.

The specification of protocol stacks for physical Q interfaces are not included in this ETR, but the stacks specified in ETS 300 376-1 [12] may be used.

In order to allow for innovations, premature standardization has been avoided within this ETR.

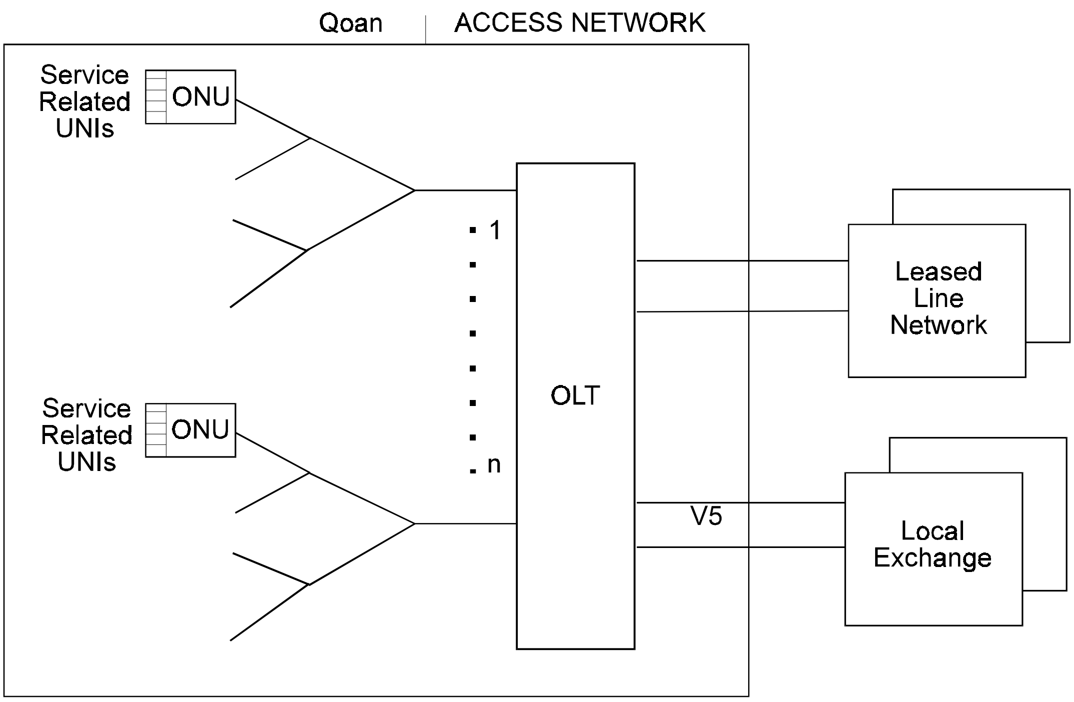

Figure 1: A typical optical access network

This ETR defines:

- requirements for interfaces for the management of OANs;
- managed objects for the management of OANs at the element and network level;
- reference points applicable in the management of OANs.

This ETR does not define:

- the conformance requirements to be met by an implementation of this information model;
- information models for other systems or equipment;
- ensembles;
- end to end management of trails in the circuit layer;
- methods of data encryption;
- information models for the qoan1 and qoan2 (see figure 4);
- management of Virtual Container-12s (VC-12s) across the OAN.

2 References

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

[1] ITU-T Recommendation G.803 (1992): "Architectures of transport networks based on the synchronous digital hierarchy (SDH)".

[2] ITU-T Recommendation M.3010 (1992): "Principles for a telecommunications management network".

[3] ITU-T Recommendation M.3100 (1992): "Generic network information model".

[4] ITU-T Recommendation X.721 (1992): "Information technology - Open Systems Interconnection - Structure of management information: Definition of management information".

[5] ITU-T Recommendation X.745 (1992): "Information technology - Open Systems Interconnection - Systems Management: Test management function".

[6] prETS 300 417: "Transmission and Multiplexing (TM); Generic functional requirements for SDH equipment".

[7] prETS 300 463: "Transmission and Multiplexing (TM); Requirements of passive Optical Access Networks (OANs) to provide services up to 2 Mbit/s bearer capacity".

[8] prI-ETS 300 653: "Telecommunications Management Network (TMN); Generic managed object class library for the network level view".

[9] ETS 300 324-1: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN); Part 1: V5.1 interface specification".

[10] ETS 300 347-1: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN); Part 1: V5.2 interface specification".

[11] ETS 300 371: "Transmission and Multiplexing (TM); Plesiochronous Digital Hierachcy (PDH) information model for the Network Element (NE) view".

[12] ETS 300 376-1: "Signalling Protocols and Switching (SPS); Q3 interface at the Access Network (AN) for configuration management of V5 interfaces and associated user ports; Part 1: Q3 interface specification".

[13] ETS 300 378-1: "Signalling Protocols and Switching (SPS); Q3 interface at the Access Network (AN) for fault and performance management of V5 interfaces and associated user ports; Part 1: Q3 interface specification".

[14] ITU-T Recommendation Q.821 (1993): "Stage 2 and stage 3 description for the Q3 interface - Alarm surveillance".

[15] ITU-T Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".

[16] ITU-T Recommendation G.821 (1990): "Error performance of an international digital connection forming part of an integrated services digital network".

[17] ITU-T Recommendation G.826 (1994): "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

access aspects: These are the parts of the access network which relate to the adaptation between the transmission systems and the external traffic interfaces. Typical external traffic interfaces are the Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) user ports and the V5 interfaces.

addressing path: This indicates the way in which specific managed objects are addressed on a physical management interface. It takes account of the root object in the naming hierarchy, the addressing within protocol stacks, and the multiplexing of protocol stacks at the interface.

Element Management Layer (EML): The Element Management Layer (EML) provides Element Manager (EM) Operations System Functions (OSF)s that are intended to manage one or more OANs from a single vendor in the case that a proprietary interface is provided to the OAN. In the case that a standard interface is provided, the EM OSF may manage OANs from multiple vendors. An EM OSF may present both element and network level views. The EM layer performs EM functions that may be distributed over several OSs and/or may be combined with upper layer functions on a single OS (see figure 2).

external logging/filtering: This is logging or filtering which is performed outside of the Network Element (NE).

feeder: A feeder is a transmission system which lies between the OAN and the service node (e.g. an exchange).

integral transmission system: An Integral transmission system is a transmission system which is functionally integrated within the OAN for a specific OAN implementation, but which can form an independent transmission system in other applications and can be managed as such by the Telecommunications Management Network (TMN).

internal logging/filtering: This is logging or filtering which is performed within an NE.

managed unit: A managed unit is a logical grouping of telecommunications functions which can be considered to be a single unit for some purposes. The term does not imply the use of any particular managed objects for modelling or the adoption of a particular management view.

media aspects: These are parts of the access network which relate to the media used for transmission between the OLT and ONU. The media are typically optical fibre, radio or copper. This ETR only considers optical fibre media aspects.

Network Element (NE): An OLT and its associated ONUs are considered to be an NE if it provides a Q3 interface. If it does not provide a Q3 interface it is considered to be NE like interface.

NE level viewpoint: The NE level viewpoint is concerned with the information that is required to manage a NE. This refers to the information required to manage the Network Elelement Function (NEF) and the physical aspects of the NE. The information may be derived for open systems other than the NE. For instance splitter information may be obtained from another OS (see figure 2).

network level viewpoint: The network level viewpoint is concerned with the information representing the network, both physically and logically. It is concerned with how NE entities are related, topographically interconnected and configured to provide and maintain end-end connectivity.

network management layer: This layer has the responsibility for the management of all the NEs as presented by the element management layer, both individually and as a set. It is not concerned with how a particular element provides services internally (see figure 2).

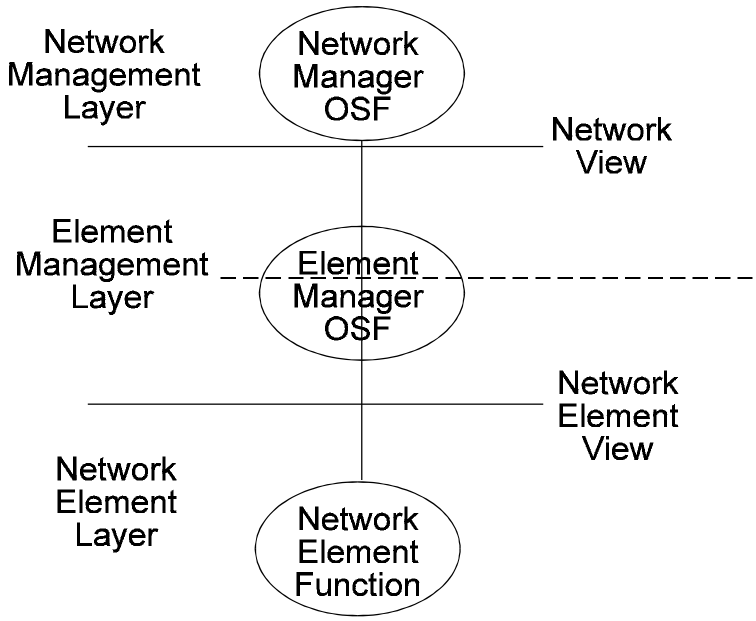

Figure 2: Levels of abstraction in TMN architecture

optical access network: This is defined in prETS 300 463 [7].

ordering functions: These are the set of management functions which are used to support the on-going build and evolution of OANs. They include the continual installation and eventual decommissioning of Field Replaceable Units (FRUs), and the recording of details of available capacity on an OAN.

Q-adaptor function: As defined in ITU-T Recommendation M.3010 [2].

transmission aspects: These are the parts of the Access Network (AN) which relate to its transmission systems and protocols, and which operate over the media.

3.2 Abbreviations

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

AN	Access Network
ATM	Asynchronous Transfer Mode
CP	Connection Point
CTP	Connection Termination Point
EFD	Event Forwarding Discriminator
EM	Element Manager
EML	Element Manager Layer
FRU	Field Replaceable Unit
IOS	Intra Office Section
ISDN	Integrated Services Digital Network
LE	Local Exchange
LLA	Logical Layered Architecture
M/C	Mandatory/Conditional
MD	Mediation Device
MF	Mediation Function
MIB	Management Information Base
NE	Network Element
NEF	Network Element Function
NM	Network Manager
NML	Network Management Layer
NTU	Network Termination Unit
OAN	Optical Access Network
ODN	Optical Distribution Network
OLT	Optical Line Terminal
ONU	Optical Network Unit
OAM	Operation And Maintenance
OS	Operations System
OSF	Operations System Function
OSI	Open Systems Interconnection
PDH	Plesiochronous Digital Hierarchy
PI	Physical Interface
PON	Passive Optical Network
PSTN	Public Switched Telephone Network
QAF	Q-Adapter Function
RDN	Relative Distinguished Name
SDH	Synchronous Digital Hierarchy
SU	Service Unit
TIB	Task Information Base
TMN	Telecommunications Management Network
TP	Termination Point
TTP	Trail Termination Point
TS	Time Slot
TU	Tributary Unit
UNI	User Network Interface
VC	Virtual Container
WDM	Wavelength Division Multiplexing
WSF	Work-Station Function

4 Introduction

4.1 Relationship with other standards

This ETR specifies the management information model for those aspects of Optical Access Networks (OANs) defined in the Scope, including the modelling of the transmission and media aspects relevant to its scope and the integration of these aspects with other relevant standards, in particular ETS 300 376-1 [12], ETS 300 378-1 [13], prI-ETS 300 653 [8], ETS 300 371 [11]. The boundary between the transmission and media core aspects and the access aspects is shown in figure 3.

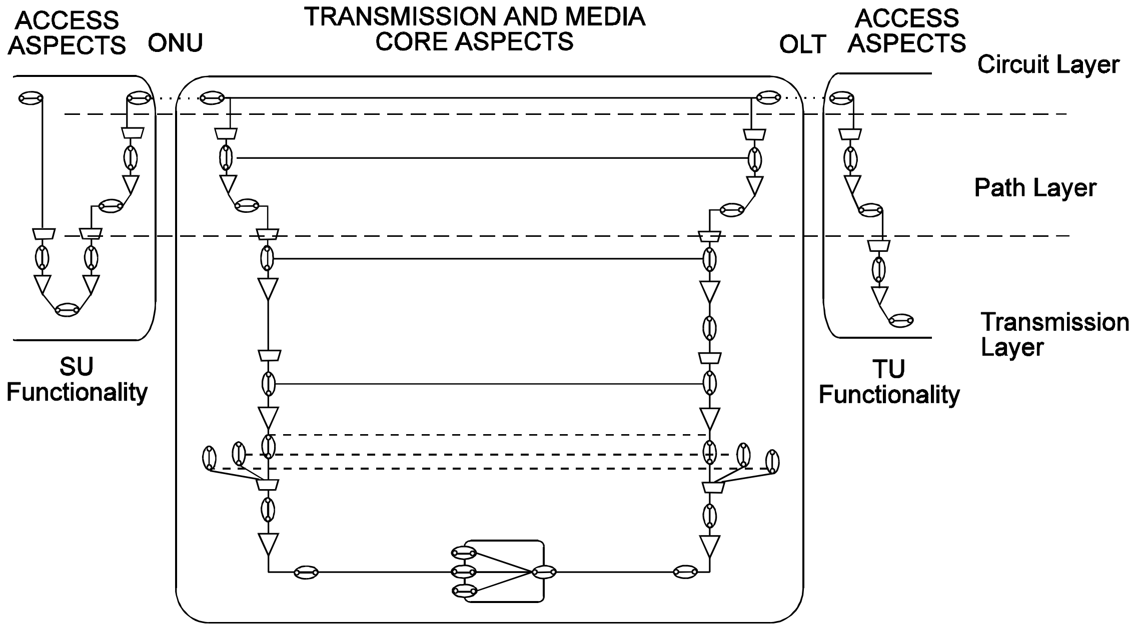

Figure 3: Mapping of access aspects, transmission and media aspects to functional architecture

ETS 300 376-1 [12] and ETS 300 378-1 [13] include the management information model for the V5 service aspects of all access networks. These service aspects contain the V5 interfaces and their associated user ports, and are not concerned with the transmission and media aspects. Parts of ETS 300 376-1 [12] and ETS 300 378-1 [13] are imported or otherwise included in this ETR so that this ETR can provide a complete model as specified in its scope.

I-ETS 300 653 [8] specifies a generic network model for the management of telecommunications networks. Parts of I-ETS 300 653 [8] are also imported or otherwise included in this ETR so that it provides a complete model as specified in its scope.

ETS 300 371 [8] specifies an information model for managing Plesiochronous Digital Hierarchy (PDH) equipment. Objects from this specification will be imported or otherwise to cover PDH interfaces.

4.2 Reference points

This ETR describes an information model for the management of OANs. A functional model is developed which is used to derive the transmission fragments of the object model. This document considers both element and network view points. The model described may be applicable between:

- Network Element to Operations System (NE-OS);
- Medication Device to Operations System (MD-OS); or
- Operations System to Operations System (OS-OS).

The objects defined within this specification will be applicable at any of the following reference points shown in figure 4, qoan3, qoan4:

- qoan1 is the reference point between the NEF or Q-Adapter Function (QAF) and the OSF;
- qoan2 is the reference point between the NEF and a Mediation Function (MF);
- qoan3 is the reference point between the MF or QAF and the OSF.

qoan4 is a reference point between an element manager OSF and another OSF. The qoan4 reference point may be split into several sub-reference points indicating the functionality available across the reference point. This is illustrated in figure 5. A number of other OSFs may act upon the same element manager OSF. The qoan4 reference point presents a more abstract view of the OAN.

moan represents a proprietary reference point which may be used in the case where the cost of providing a Q interface to the OLT will be prohibitive and may be replaced by a proprietary M Interface as described in ITU-T Recommendation M.3010 [2]. Its application implies the use of a QAF.

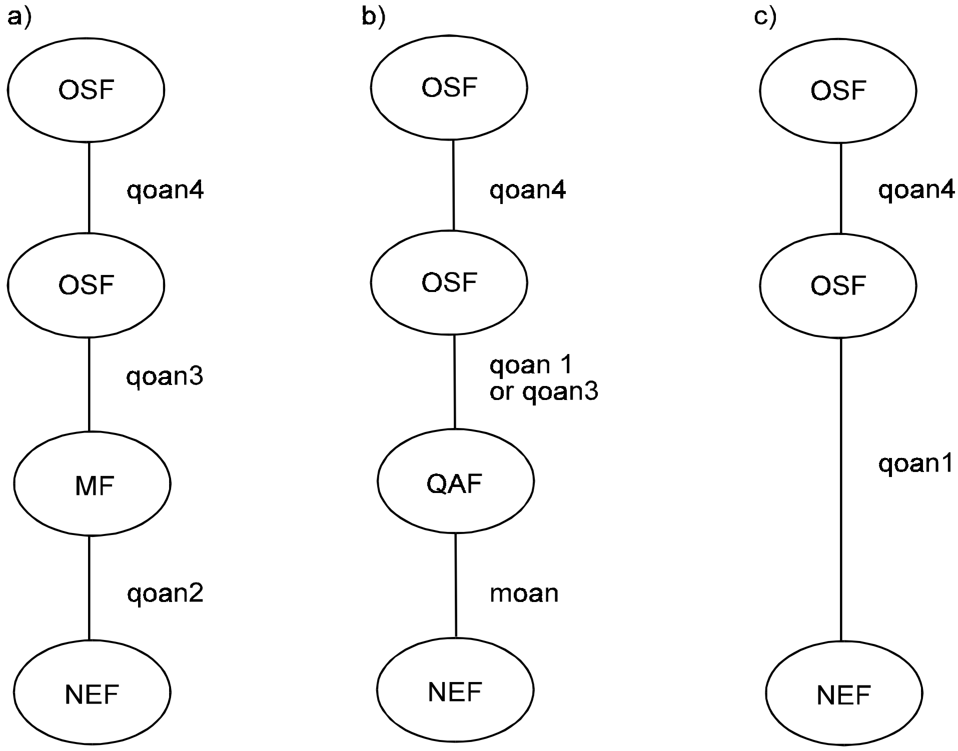

Figure 4: Reference points applicable for the management of OANs

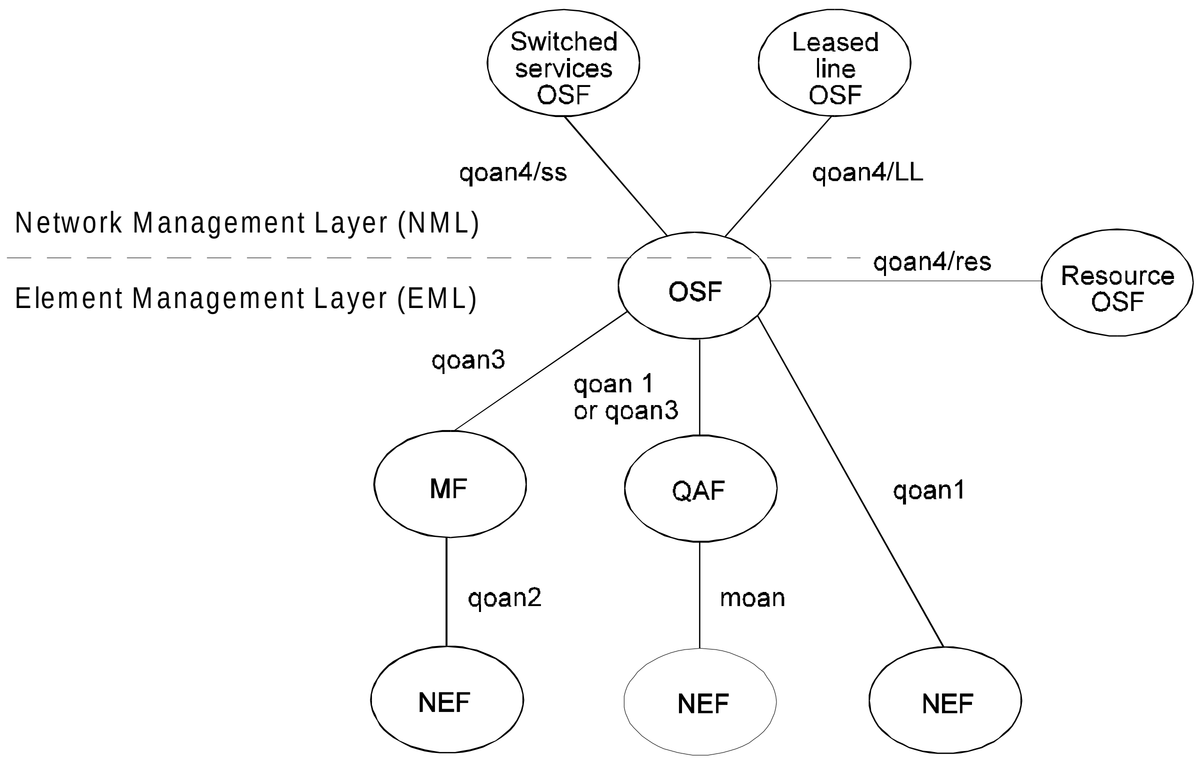

Figure 5: Example of functional architecture

Figure 5 illustrates an example functional architecture applicable for the management of OANs. In this diagram 3 different ways are illustrated to connect an OSF to the NEFs. A number of OSFs are shown in a manager role to the OSF responsible for the management of the OANs.

In this example the switched services OSF represents the Network Management Layer (NML) functionality for the coordinated management between Local Exchanges (LEs) and ANs. (For example V5 provisioning).

The leased line OSF represents the NML functionality for the leased line network.

The resource OSF represents the functionality which is neither part of the EML or of the NML, as defined in ITU-T Recommendation M.3100 [3], but rather a "support" functionality. It may include e.g. equipment management (including that equipment not installed in the network, and including cables), network analysis for planning purposes, management of the physical topology (ducts, streets, buildings), etc..

4.3 Management architectures

Figure 6 gives some examples of architectures that may be used to manage OANs. It should be noted that the EML OSF may be physically distributed onto separate OSs, examples may be for reasons of redundancy, different levels of abstractions, functional distribution or administrative purposes. Additionally it may be located on OSs combined with OSFs at other layers. This ETR does not limit the architectures that may be used. The diagrams illustrate both functional and physical architectures.

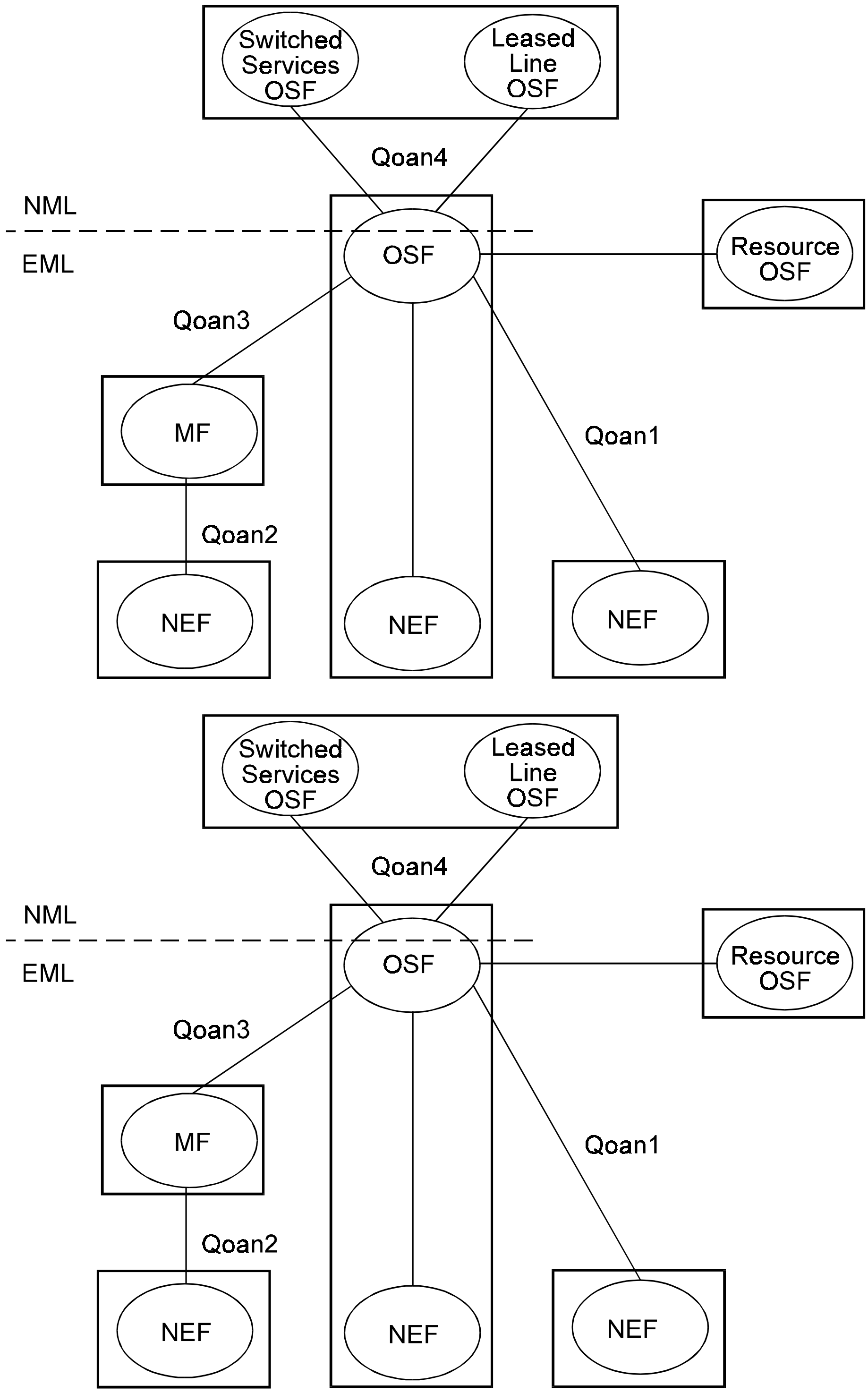

Figure 6: Example of management architectures for the management of OANs

Figure 7 describes how the management of OANs can be fitted in with the overall management of mixed technology access networks.

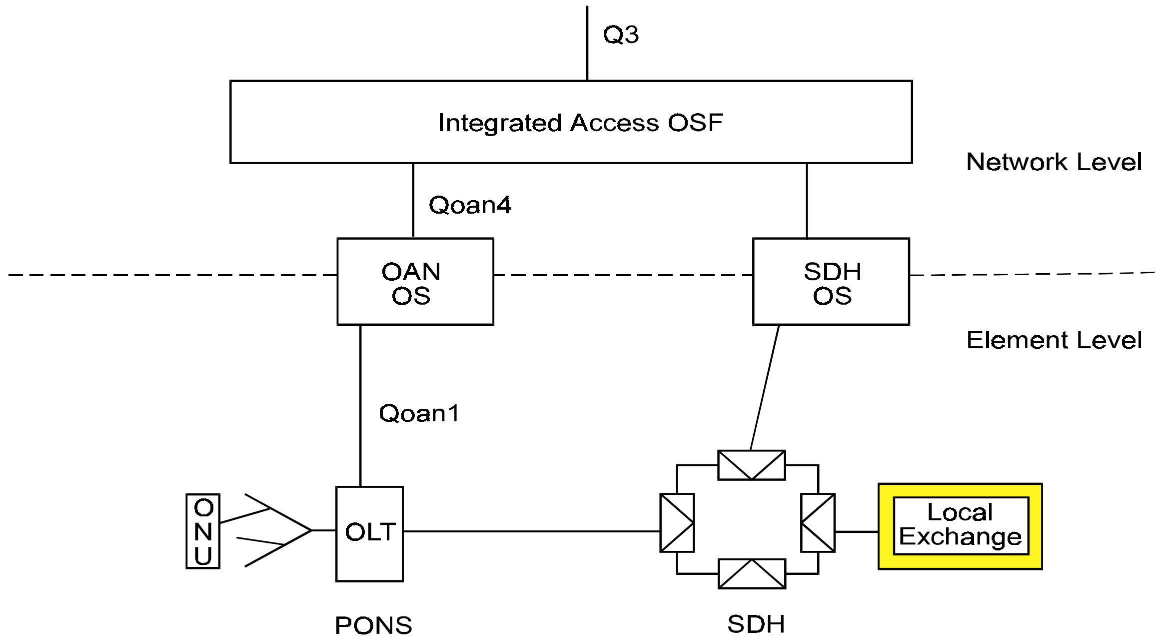

Figure 7: Example of management of mixed technology access networks

Figure 7 shows two of the reference points indicated in subclause 4.2 implemented as Physical Interfaces (PI). This is shown as the Qoan1 between the OLT and the OAN OS and the Qoan4 between the OAN OS and the integrated access OS. The qoan4 is the highest point in the Logical Layered Architecture (LLA) that this ETR considers.

4.4 Application of mediation device

The Mediation Device (MD) is a device that performs mediation functions as described in ITU-T Recommendation M.3010 [2]. The MD may also optionally provide OSFs QAFs and Work-Station Functions (WSFs).

Mediation is a process within the TMN which acts on information passing between NE functions or Q-adaptor functions and operation system functions and provides local management functionality to NE(s). Mediation uses standard interfaces and can be realised in a separate mediation device or be shared among NE(s). Mediation enables the cost-effective implementations of the connection of NEs of different complexity to the same OS. In addition it gives the capability for future design of new equipment to support a greater level of processing within individual NEs, without the need to redesign an existing TMN.

The mediation function acts between the qoan2 and qoan3 reference points.

5 Functional model description

This clause contains a description of a functional model example used to derive the transmission fragment(s) of the information model. This uses the principles defined in ITU-T Recommendation G.803 [1] and also used in prETS 300 417 [6].

5.1 Layering

Figure 8 shows the functional architecture of an OAN. The OAN consists of three types of functionality; the transmission and media core, the Service Units (SU)s and the tributary units, these are illustrated in figure 3. For each of these three layers, the circuit layer, path layer and transmission layer are defined.

5.1.1 Transmission functionality

5.1.1.1 Transmission layer

The transmission layer is split into a number of sublayers:

- **OAN transmission protocol layer:** The OAN transmission protocol layer represents the transfer of information from the OLT to the ONU over the Optical Distribution Network (ODN). Each OAN transmission protocol trail is terminated by a OAN transmission protocol trail termination point which is responsible for the integrity of the data across the ODN. It is also the point where the overhead channels associated with each ONU are interpreted.

- **Optical layer:** This layer represents the physical optical transmission across the ODN. It is in this layer that Wavelength Division Multiplexing (WDM) would take place.

- **Fibre layer:** This layer represents the optical fibre.

5.1.1.2 Path layer

The path layer is the client of the transmission layer. An adaptation function is defined to deal with the mapping of the path trail in the path layer to the OAN transmission protocol trail. Each path trail consists of a payload channel and an associated overhead. The path Trail Termination Points (TTP)s are responsible for adding and extracting data from the overhead channel. Every path TTP will be associated with a OAN Connection Point (CP) (PON timeslot).

5.1.1.3 Circuit layer

The circuit layer provides users with telecommunications services. Different circuit layer networks can be defined depending on the service carried. The payload CP allows for connection to the path layer.

5.1.2 Tributary Unit (TU) functionality

Figure 8 shows the TU functionality in the OLT. This functionality also consists of a number of layers. This is modelled according to the atomic functions defined in prETS 300 417 [6]. An E12 Intra-Office Section Trail Termination Point (E12 IOS TTP) is shown representing the ITU-T Recommendation G.703 [15] connection to the exchange or transport system (if the OLT is remote from exchange). In the client layer to this is the P12 TTP which is responsible for terminating the 2 Mbit/s path. A P12 to E12 adaptation function maps between the layers. The P12 TTP contains P0 Connection Termination Points (CTPs) which represent the timeslots on the ITU-T Recommendation G.703 [15] interface. A sub-network connection is shown to represent the timeslot allocation.

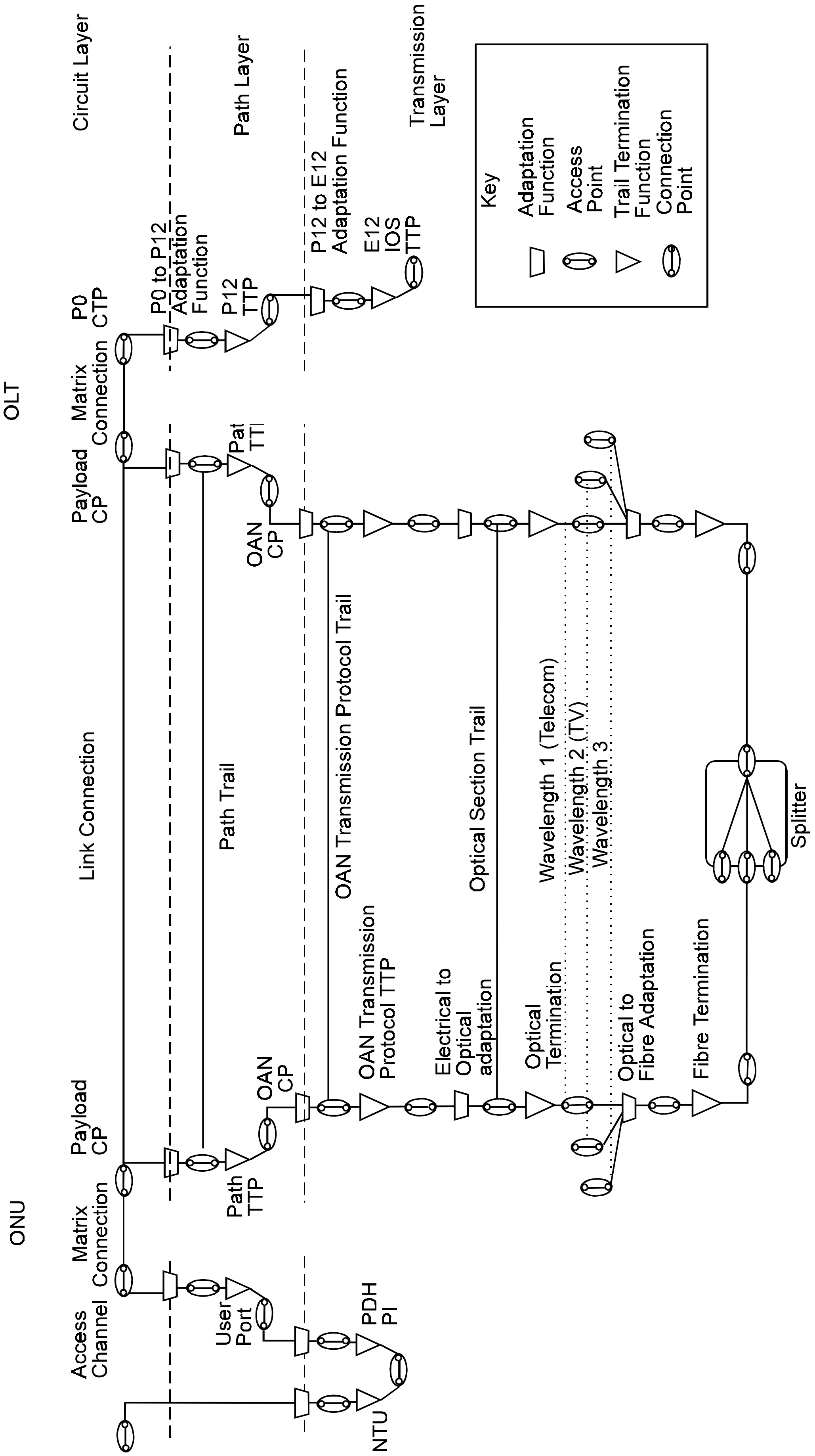

Figure 8: Example functional architecture of OANs

5.1.3 Service unit functionality

The SU Functionality depends on the service being carried. Figure 9 shows a basic rate ISDN example. A user port is shown representing the service delivered to the customer. In this case it represents two bearer (B) channels and a data (D) channel. An adaptation function is shown to illustrate the division of the three signals. The service unit functionality will consist of a number of layers.

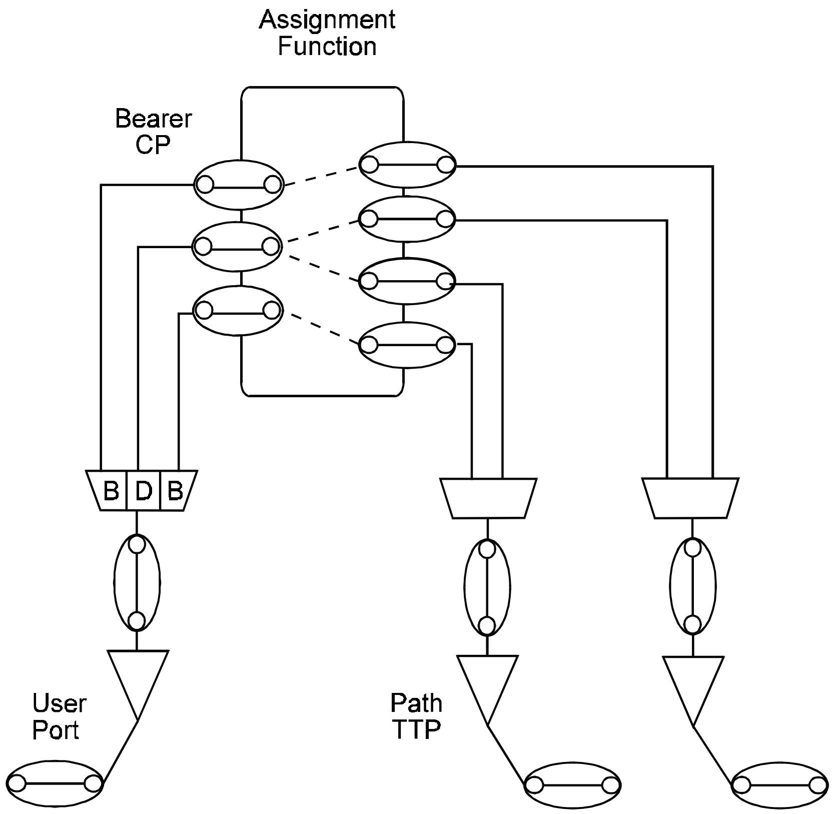

Figure 9: Example of functional model of basic rate ISDN (ONU)

5.2 Partitioning

Figure 10 illustrates an example of partitioning of the circuit layer applied to OANs. The diagram shows the access network being represented as a sub-network. A sub-network can be considered to be a single OAN or a number of OANs grouped together for some management purpose (connected to the same service node for instance).

Figure 10 shows two optical access sub-networks. Link connections are provided to the core sub-network which could represent an operators leased-line network. Sub-network connections are set-up across the optical access sub-network in order to provide a connection between the service node and the access ports.

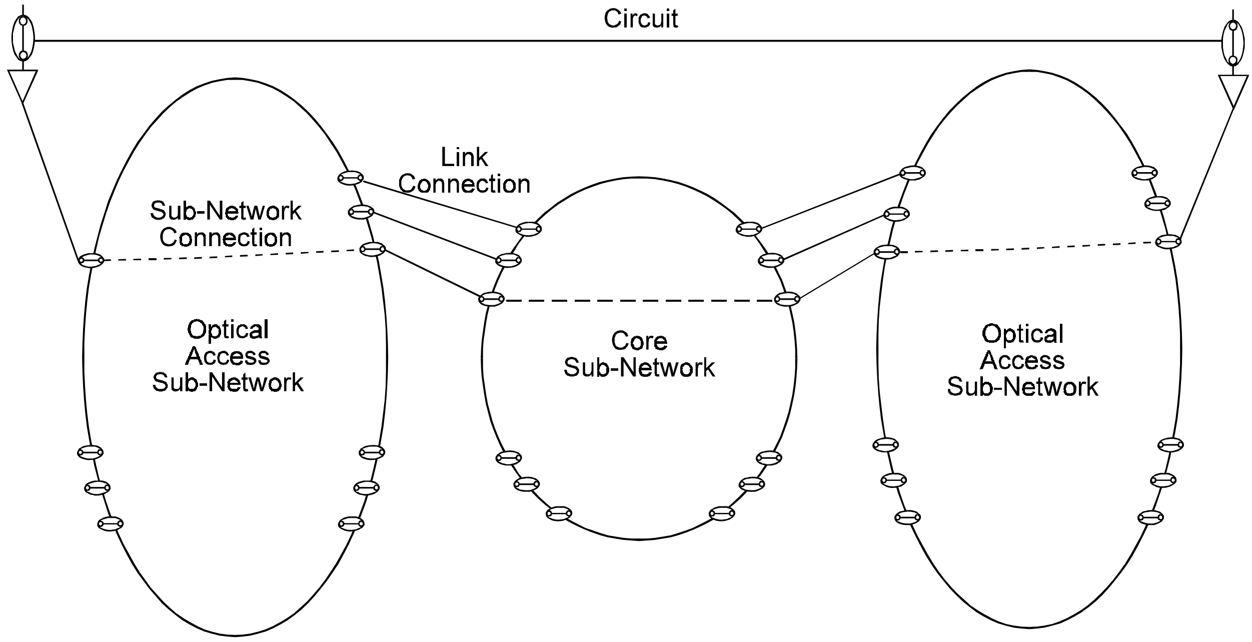

Figure 10: Example of application of partitioning to the optical access network

6 Information model description

This clause provides an overview of the information model defined for the Operations and Maintenance (OAM) of OANs. The model consists of a number of fragments. The fragments that will be implemented in a particular interface depend on the requirements for that interface.

Figure 11 illustrates that the fragments will be contained within the ITU-T Recommendation X.721 [4] system object. Within a particular architecture it is envisaged that a number of OSFs may be implemented each containing one or a number of the fragments.

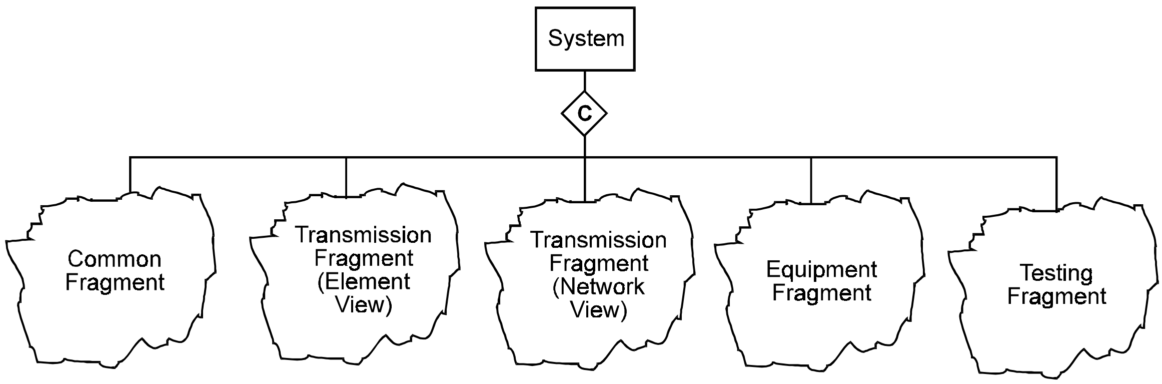

Figure 11: Information model framework

Other fragments may be defined which may be named directly from system or via objects defined within one of the other fragments.

If the model is realised within a NE the top of the naming tree will be managed element and the network view will not normally be provided.

6.1 Transmission fragment (element view)

This provides an element level technology dependant view of the resources being managed. Objects are imported from the V5 model defined in ETS 300 324-1 [9] and ETS 300 347-1 [10], and the PDH model in ETS 300 371 [11]. In addition objects from ITU-T Recommendation M.3100 [3] or sub-classes are used to model entities such as the ODN or connectivity.

6.2 Transmission fragment (network view)

This fragment uses objects defined in I-ETS 300 653 [8] in order to present a technology independent, network view of the OAN. A profile of these objects is developed in order to describe their applications. The objects may be extended as described in I-ETS 300 653 [8] in order to provide any additional functionality that is required for OANs. This fragment covers the AN side of the co-ordinated provisioning of V5 interfaces and associated user ports between the LE and the AN. OLTs and ONUs are not visible but some information relating to them may be visible e.g. location.

6.3 Equipment fragment

The equipment fragment provides objects to model the actual physical resources present in the network. This is in terms of entities such as racks, shelves, slots etc. that denote positions within the network and also in terms of Field Replaceable Units (FRU)s.

6.4 Testing fragment

The testing fragments provides objects that allow network resources and services to be tested. The model is based upon objects defined in ITU-T Recommendation X.745 [5] and the V5 Testing model ETS 300 347-1 [10].

6.5 Common fragment

The common fragment provides generic management functionality such as logs and Event Forwarding Discriminators (EFD)s. It uses objects imported from ITU-T Recommendations X.721 [4] and Q.821 [14].

Annex A: TMN management service; OAM of OANs

A.1 Task Information Base (TIB) A

A.1.1 Preface

This description is derived from the TMN management service "Management of Customer Access" and deals with the specific example when customer access is achieved by the use of OANs.

A.1.2 Description

Management of customer access relates to the part of the network that extends from the network terminating equipment up to the service node termination. An access network may consist of a number of technologies, OANs, SDH, PDH. This service deals purely with the aspects concerned with operation and maintenance of OANs. Management of feeder network is not included within this management service.

A.1.3 Service components

A.1.3.1 Fault management

- alarm surveillance;
- testing;
- equipment protection;
- failure localisation.

A.1.3.2 Configuration management

- installation;
- inventory management;
- provisioning;
- state and status management;
- configure OAN;
- configure OAN services;
- lifecycle provisioning (ordering);
- capacity management;
- software management.

A.1.3.3 Accounting management

- sub-network connection availability.

A.1.3.4 Performance management

- performance monitoring.

A.1.3.5 Security management

- security audit trail;
- local terminal access control;
- authentication and identification of FRUs.

A.1.4 Management functions

The following subclauses deal with the management functions that may be implemented for OANs.

A.1.4.1 Alarm surveillance

A TMN provides the capability to monitor OAN failures. When such a failure occurs, a message is sent to the manager by the OAN indicating the nature and severity of the fault. The OANs should have sufficient intelligence to detect and report such a failure. When possible the failure report should indicate the FRU that should be replaced in order to clear the alarm. When this is not possible, as much information as is available should be reported. for example, when communication to a piece of equipment has failed, it is sometimes impossible to know if the power supply, a communications board, or the communications medium has failed.

The requirements for alarm surveillance are based upon requirements identified in ITU-T Recommendation Q.821 [14].

An alarm should have a unique identifier so that it can be associated with a trouble ticket.

A.1.4.2 Alarm reporting

A manager may initiate, delete, suspend or resume an alarm reporting service and modify the criteria that are used to filter alarm information for real time delivery. Alarm information passes through an EFD to determine what alarms should be sent to the manager.

A.1.4.2.1 Retrieve/Set alarm reporting criteria

A manager may retrieve/set the attributes of one or more EFDs to recognize their current alarm reporting criteria.

A.1.4.2.2 Alarm logging

A manager may initiate, delete , suspend or resume an alarm logging service, and may modify the criteria that are used to filter alarm information for the alarm log file. Alarm information may be placed into a log file, for manager access. The specific alarms that are recorded into this log are determined by a second filter that contains criteria which may be different from those used in the filter for real-time alarms.

A.1.4.2.3 Retrieve/Set alarm logging criteria

A manager may retrieve the current alarm logging criteria for one or more alarm logs.

A.1.4.2.4 Alarm retrieval

A manager may request an alarm log, in whole or in part. For example, a manager may request all logged alarms for a specific circuit in a specific time period or display the active alarms of a specific equipment.

A.1.4.2.5 Retrieve/Set alarm severity assignment list

The manager instructs the agent to assign specific alarms with specific perceived severities.

A.1.4.2.6 Route alarm report

The manager specifies the destination address(es) to the agent for a specified set of alarm reports. This may be in the form of normal address and backup address.

A.1.4.2.7 Request alarm report route

The manager requests an agent to send the current assignment of the destination addresses for a specified set of alarm reports. The agent responds with the current assignment of destination address(es).

A.1.4.2.8 Event report buffering

In the event of management communication failure between the managed system and the manager, event reports information should be stored at the relevant managed system until management communications have been restored, when this event information should be sent to the manager.

The loss of communications with the managed system should be flagged in the managing system.

A.1.4.2.9 Optical line failure monitoring

Failure states associated with incoming optical signals should be monitored and reported from the respective active units of the OAN.

A.1.4.2.10 Digital path failure monitoring

Digital paths should be monitored where they are terminated in the OAN. Situations may occur where the digital path between the ONU and OLT is lost even though the optical signal is within the limits.

A.1.4.3 Testing

Requirements are based upon the V5 testing model ETS 300 347-1 [10] this has been supplemented for the management of leased lines. The manager may be able to request a test with the following options:

- perform the test even if it is service affecting;
- reject the test if it is service affecting;
- perform the test when it has become non-service affecting.

A.1.4.3.1 Request on-demand test

A manager may request that a test be performed.

A.1.4.3.2 Schedule tests

Some tests need to be scheduled. In this case the test request should indicate either:

- the time when the test starts; or
- the time when the request should be stopped in any case (timeout); or
- both.

A.1.4.3.3 Test repetition

Some tests may be repeated a given number of times with a given repetition period. This requirement covers the management of routine tests.

The manager may specify a list of user ports that will be tested using routine testing.

A.1.4.3.4 Receive test results

A manager may be notified that a test is complete. This notification may be accompanied by test results, or the manager may be required to take specific action to receive the results. This capability applies to both scheduled and on demand tests.

A.1.4.3.5 User port testing

Requirements for the following types of test are covered in ETS 300 347-1 [10]:

- PSTN line testing;
- PSTN line circuit testing;
- ISDN Basic Rate Access (BRA) line testing;
- ISDN BRA line termination testing;
- ISDN Primary Rate Access (PRA) testing.

User ports providing the same services but via non-V5 interfaces may be tested in the same way.

Other user ports supporting services described in prETS 300 463 [7] may also be tested.

A.1.4.3.6 Power supply testing

A manager may test ONU or remote OLT power supplies.

A.1.4.3.7 Transmission testing

It may be possible for a manager to invoke tests on the transmission system.

The tests may be based on a loopback. Having performed a loop pattern, tests may be carried out. This may be using internal or external equipment. The manager should be able to view all facilities that have an active loopback. Loopbacks should remain active until removed by the manager or removed due to a timeout.

A.1.4.3.8 Leased line testing

It may be possible for a manager to invoke tests on a leased line.

The tests may be based on a loopback. Having performed a loop pattern, tests may be carried out. This may be using internal or external equipment. The manager should be able to view all facilities that have an active loopback. Loopbacks should remain active until removed by the manager or removed due to a timeout.

A.1.4.4 Equipment protection

Examples of equipment to be protected include power supplies and ODN interfaces.

A.1.4.4.1 Operate/Release manual protection switching

A manager may operate/release a manual protection switch.

A.1.4.4.2 Operate/Release force protection switching

A manager may operate/release a force protection switch.

A.1.4.4.3 Operate/Release lockout

A manager may operate a lockout.

A.1.4.4.4 Request status of protection switching

Manager interrogates a FRU to determine if it is a working or a standby where an FRU is able to perform these roles.

A.1.4.4.5 Status report of protection switching

The system reports the occurrence of a protection switch event.

A.1.4.5 Fault localisation

The capability of isolating the trouble to its most elementary source, usually corresponding to a system resource. This functional component includes the selection, evaluation and running of tests and correlation analysis of different reported troubles.

A.1.4.5.1 Report failed equipment

The system reports the faulty units that need to be replaced.

A.1.4.5.2 Associate faults with affected circuits

Notify the manager which circuits are affected by a particular fault.

A.1.4.5.3 Fault location on the ODN

By identifying the disabled ODN Interface functions on the ONUs a manager may be able to deduce location information concerning the position of a fault on the ODN. Distance information may also be provided by other means under the control of the manager.

A.1.4.6 Installation

The scope of the installation functional component is the operation concerning the placement of network resources at a required position, as well as, the physical and electrical interconnection of the network and the supporting elements and their components, according to an agreed engineering practice. Furthermore installation is also responsible for the physical removal or update of equipment, whenever it is requested by maintenance or provisioning functional components.

A.1.4.6.1 Install/Remove/Reconfigure OLT

A manager supports the installation and removal of OLTs from the network. Details of any change to the physical configuration of the system should be sent to the manager.

A.1.4.6.2 Install/Remove/Reconfigure ONU

A manager supports the installation and removal of ONUs from the network. Details of any change to the physical configuration of the system should be sent to the manager.

There is a need to specify the type and capability (e.g. bandwidth, services) of ONU to be installed.

A.1.4.6.3 Install/Remove ODN

A manager supports the installation and removal of ODNs.

The function defines the ODN-structure and the topological layout of the ODN including splitting ratio, splitting points, locations, stubs and OLT interface(s) and ONUs connected to the ODN.

A.1.4.6.4 Install/Remove FRU

A manager supports the installation and removal of FRUs from the network. Details of any change to the physical configuration of the system should be sent to the manager.

It may be required to emit an alarm if an FRU is installed outside a configurable time window.

The user may create a record of the equipment in the TMN Management Information Base (MIB) describing the equipment that will be deployed. It may be possible to do this before the equipment is physically installed. The TMN should download the parameters to the NE as soon as the installation occurs.

A.1.4.6.5 Perform a consistency check on NE

After each change in the OAN infrastructure a consistency check of the MIB or the OAN setup may be performed. Following actions should be possible in case of inconsistency:

- update of MIB based on current resource configuration;
- update of resource configuration based on the MIB.

In particular a consistency check should be performed in the case where communications across the interface have failed and then been restored. The update may be automatically or manually initiated.

Examples are:

- automatic:
    - total loss of configuration in the NE;
    - loss of software.
- manual:
    - SU Installation/update;
    - configuration discrepancy due to craft device operation.

Automatic updating may be disabled on operator request, as in circumstances where a short term interruption such as maintenance activity is the cause.

A.1.4.6.6 Identify physical connectivity

It should be possible to identify the physical association between equipment and ports and the connectivity between ports.

A.1.4.6.7 Locate physical resources

It should be possible to determine the location of physical resources such as equipment or splitters.

A.1.4.7 Inventory management

Inventory management is required to represent the positions into which physical equipment may be installed. There is also a requirement for OSFs to keep track of FRUs within their domain.

A.1.4.7.1 Get/Set/Modify inventory information

A manager is able to read information associated with a piece of equipment such as equipment type, serial number, version number, revision of version, date of manufacture, vendor, etc. which is read only. There may be additional information that can be changed by a manager.

A.1.4.7.2 Equipment inventory report

The manager should be able to request a report listing all the equipment in a specific section of the AN or listing every location of a specific type of equipment.

A.1.4.7.3 NE inventory update

The OAN should immediately notify the manager of an insertion/removal of a FRU. An alarm may be emitted if the FRU is not valid otherwise the manager updates the inventory information. It may be possible to mask such an alarm with scheduled changes to the OAN topology and equipment.

A.1.4.8 Provisioning

This functional component deals with the provisioning of service to the user. The component deals with equipment, service and network provisioning.

It may be necessary for a manager to control the allocation of services to particular payload CPs in certain systems.

Within certain systems there will be flexibility of bandwidth allocation on the PON. The information models developed should cover the case where there is flexibility in the ONU and where there is not.

There may be a need for visibility of a PON timeslot for a particular reference point if there is flexibility in the ONU.

A.1.4.8.1 Insert a user port

The manager may request the creation of a user port.

A.1.4.8.2 Delete a user port

The manager may request the deletion of a user port.

A.1.4.8.3 Modify a user port

The manager may modify certain information relating to the user port.

A.1.4.8.4 Read a user port

The manager may read information relating to the user port.

A.1.4.8.5 Configure a user port

The manager may configure a user port. If it is a V5 user port the following may be performed:

- assign access port to V5 interface, including V5 port address;
- assign PSTN signalling to V5 communications channel;
- assign ISDN Ds-type data to V5 communication channel;
- assign ISDN p-type data to V5 communication channel;
- assign ISDN f-type data to V5 communication channel.

User ports outside the scope of V5 such as leased lines based on PDH or SDH technologies should use ETS 300 376-1, annex B [12] as a basis for their configuration management functions if no appropriate standards are available.

Other parameters may be configured for fault and performance where applicable.

A.1.4.8.6 Insert a service node interface

The manager may request the creation of a service node interface.

A.1.4.8.7 Configure a service node interface

The manager may configure a service node Interface. If it is a V5 interface the following may be configured:

- interface identity;
- provisioning variant;
- grading threshold;
- number of 2 Mbit/s links;
- persistency checking;
- time slots for communication channels;
- allocation of communication channels.

The following may also be configured on a service node interface:

- threshold crossing (see annex A, subclause A.1.4.13);
- timing source (see annex A, subclause A.1.4.8);
- alarm severity assignment. This may be configured on a per tributary basis.

A.1.4.8.8 Set resources in service/out of service

Resources can be put in or out of service by management operations.

A.1.4.8.9 Identify connectability

A manager may be able to identify the possible connectivity between TU CPs and subscriber CPs.

A.1.4.8.10 Set up/Release a sub-network connection

A manager will have the ability to request a sub-network connection between two connection points or groups of connection points. A manager may also request the release of a sub-network connection.

A.1.4.8.11 Provision a sub-network

A manager may have the ability to request the creation or deletion of sub-networks.

A.1.4.8.12 Set up/Release trail

A manager may initiate or release an OAN transmission protocol trail. The initiation of this trail may be as a result of other internal functions.

A.1.4.8.13 Reserve a sub-network connection

A manager is able to reserve the use of the resources required for a sub-network connection so that they cannot be used by another manager.

A.1.4.8.14 Set a time based configuration

A manager may schedule the set-up or release of sub-network connections.

A.1.4.8.15 Identify ONUs attached to the ODN

A manager should be able to request the identification of all the ONUs attached to a particular ODN.

A.1.4.8.16 Identify circuits carried by ODN

A manager should be able to identify the sub-network connections carried by a particular ODN.

A.1.4.8.17 Assign/Read user port to equipment relationship

This function maps physical resources onto logical resources. These form the basis for further provisioning operations. It assigns for example equipment slots to user ports through which further management functions are operated on. This operation permits the network operator to prepare ports for use with functions such as provisioning without having to wait for the effective installation of the equipment. It should be possible for a manager to identify the relationship.

Each logical resource representation should have a unique, and possibly a user-defined name.

A.1.4.9 Configure OANs

A.1.4.9.1 Retrieve current NE configuration

A manager may retrieve the current NE configuration.

A.1.4.9.2 Configure timing source

A manager should be able to configure the OAN to receive synchronisation from one of the following sources:

- a tributary interface function source (e.g. V5 interface source);
- an external source;
- an internal oscillator source.

A.1.4.10 Lifecycle provisioning (ordering)

Lifecycle provisioning involves the provisioning of resources through planning, installation, configuration, provisioning, maintenance and cessation.

A.1.4.10.1 Ordering

This is for further study but initial requirements are described in annex B.

A.1.4.11 Capacity management

A user is able to set thresholds to measure the spare capacity of various resources within the OAN. The resources subject to capacity monitoring are for further study but may include the following:

- ODN interface capacity;
- spare TUs in an OLT;
- spare SUs in an ONU;
- spare timeslots on a TU;
- user ports on an SU.

The spare capacity of the PON will be shown by an integer identifying the number of spare 64 kbit/s timeslots available on the PON. Another integer will indicate the total capacity of the PON in terms of 64 kbit/s timeslots. The service state should be taken into account during capacity monitoring.

A.1.4.12 Software management

A.1.4.12.1 Software download

It should be possible for a manager to initiate, control the download of software and verify correct installation.

A.1.4.12.2 Software activation

It may be possible to activate abd verify the correct operation of newly downloaded software.

A.1.4.12.3 Software Identification

A manager should be able to read information associated with a piece of software such as version, build number, vendor, etc..

A.1.4.13 Sub-network connection availability

This component involves reporting on the status of a sub-network connection in order to support billing for leased lines.

A.1.4.14 Performance monitoring

This standard specifies generic aspects of performance monitoring although it is recognised that complete standardisation is not possible due to the proprietary nature of the transmission systems being managed.

A.1.4.14.1 Real-time performance monitoring

Various performance parameters are measured and stored in order to measure performance of various services carried across the OAN. The overall performance of the ODN may also be measured. ITU-T Recommendation G.821 [16] parameters are used for sub-primary rate and ITU-T Recommendation G.826 [17] parameters for primary rate and above.

A.1.4.14.2 Specify real-time performance criteria

A manager may set threshold for counts of various parameters within a time window.

A.1.4.14.3 Set-up autonomous performance reporting

A manager may set-up the automatic reporting of performance parameters from an agent for a particular monitored resource.

A.1.4.14.4 Request on-demand performance information

A manager requests performance information on demand.

A.1.4.14.5 Performance data logging

Performance information may be placed in a log file, for manager access and may be used in generating reports. The specific data that are recorded into this log are determined by a second filter that contains criteria which may be different from those used in the filter for real-time performance monitoring.

A.1.4.14.6 Modify performance data logging criteria

A manager may modify the criteria which are used to filter performance data for the log file.

A.1.4.14.7 Retrieve performance log

A manager may request a performance log, in whole or part, for a specific circuit in a specific time period.

A.1.4.14.8 Monitor degradation of power supplies

A manager may monitor the degradation of ONU and remote OLT power supplies.

A.1.4.14.9 Monitoring of ODN degradation

A manager may determine the degradation of the ODN e.g. increase of laser bias current, fibre degradation etc.

A.1.4.15 Security audit trail function

A.1.4.15.1 Transaction logging

A historical log file(s) may be maintained for a configurable length of time that shows the actions executed on the TMN database or the OAN and the user that initiated the action.

A.1.4.15.2 Read transaction log

An authorised user may read records from the transaction log.

A.1.4.16 State and status management

A.1.4.16.1 Lifecycle status reporting

The manager should be able to obtain the lifecycle states for each user port in the OAN.

A.1.4.16.2 Show a sub-network connection status

A manager is able to interrogate the status of a sub-network connection.

A.1.4.16.3 Status of FRUs

It should be possible to identify the status of a FRU.

A.1.4.16.4 Show ODN status

It should be possible to identify the status of an ODN.

Valid state combinations and state transitions are for further study.

A.1.4.16.5 Show OLT/ONU status

It should be possible to identify the status of an ONU or OLT.

A.1.4.16.6 Show status of an ODN interface function

It should be possible to identify the service state of an ODN.

Valid state combinations and state transitions are for further study.

A.1.4.17 Local terminal access control

Four types of local access control have been identified:

- craft terminal may access OLT at any time;
- craft terminal may access OLT in event of OS communications failure;
- craft terminal may access OLT with permission from the OS;
- craft terminal access is prohibited to an NE.

In addition when a LT has access to an OLT several levels of access are available. Identified so far are:

- read only;
- read/write.

A.1.4.18 Identification of unauthorized physical access

Requirements include:

- detection of access to the system by unauthorised ONUs;
- the detection of malicious attachment of ONUs that only receive data is for further study;
- detection of unauthorised tapping of optical signals (for further study).

Annex B: Lifecycle provisioning

The process of life-cycle management covers all aspects of planning and logical and physical resource management from the initial installation and commissioning of a system, through its various modifications, to its final decommissioning and removal. It is especially relevant to OANs because of the need to be cost-effective in comparison to existing copper networks. In particular, it is important to take advantage of the potentially superior management capabilities of OANs with respect to change in user requirements (order handling) and to facilitate just-in-time provisioning to defer the deployment of FRUs until they are needed.

B.1 Communication of detailed information

To perform life-cycle management effectively, it may be necessary for information specific to a particular implementation of a particular technology to be communicated to other management systems, such as work-force management or inventory management. This communication should be performed using a generic approach which is not dependent on the nature of the information.

B.2 Order handling

Change in user requirements is handled as on-going orders for the deployment, redeployment, or release of logical and physical resources. In some cases the resources which are required may be already available, and the order can be handled immediately by reconfiguration. In other cases, the orders should be rejected because it is impossible for them to be handled.

There are also cases where the system could handle the order if additional resources were allocated to it, or if existing commitments were changed. In these cases the order handling process becomes extended over time and has a wider impact.

B.3 Just-in-time provisioning

This requirement differs from handling on-going orders because it involves delaying the initial deployment of FRUs until they are needed. It is possible for some on-going orders to be handled by the logical reconfiguration of existing resources. Just-in-time provisioning differs because it involves the deployment of physical resources.

For the planning aspect of the life-cycle management of an access network it should be clear which FRUs could be deployed. This information should not be maintained at the higher levels of management because it is specific to the particular implementation and technology. If this information is to be maintained, **it should be maintained** in the access network. The access network should also maintain a record of which FRUs are actually deployed.

B.4 Additional requirements on model

It is considered that the model should allow for both controlled and uncontrolled orders. The following definitions are proposed;

- an uncontrolled order is one which is not subject to monitoring or control. Order results are provided in one or more replies to the order request;

- a controlled order is one for which one or more order objects are created for the purpose of monitoring and control. The order objects of a controlled order are instantiated as a consequence of a single order request.

B.5 Lifecycle provisioning model

The lifecycle provisioning model uses a similar mechanism to the ITU-T Recommendation X.745 [5] testing model. This is illustrated below.

The following acronyms are used:

- MORO: Managed Object Relating to Order;
- OARR: Order Action Request Receiver;
- OCO: Order Control Object.

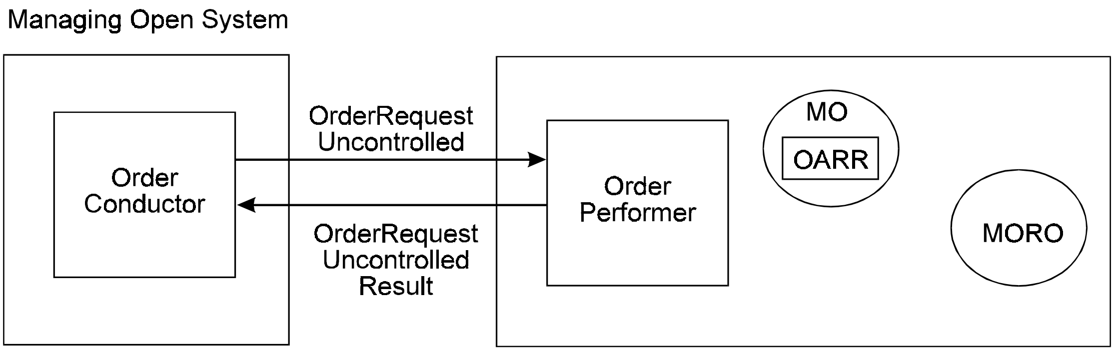

Figure B.1: Example of an uncontrolled order

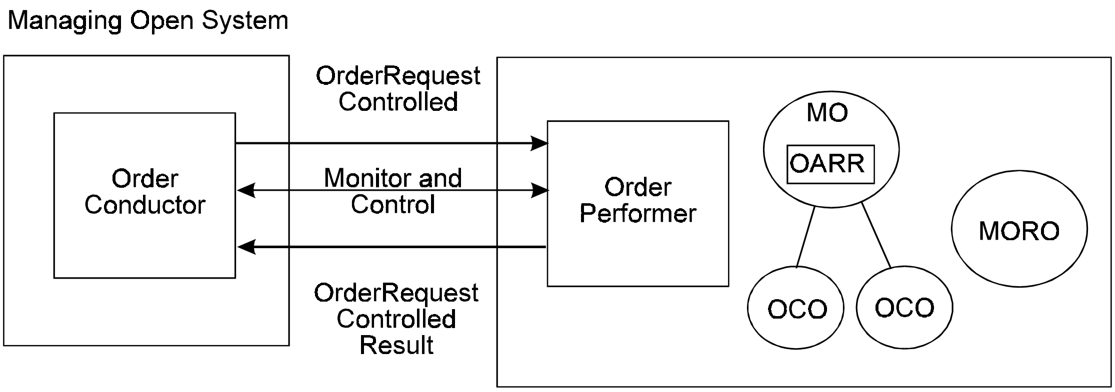

Figure B.2: Example of a controlled order

The order is sent to an object performing what we will define as order action request receiver functionality. This is analogous to test action request receiver in ITU-T Recommendation X.745 [5]. This functionality will be realised in an object similar to the ITU-T Recommendation X.745 [5] test action performer.

The object will emit an notification on receipt of the order in order to allow all orders to be logged (if required). This object and the order control objects (if it is a controlled test) will then co-ordinate the configuration of all the other objects involved in the order and a response will be given indicating the result of the order.

Other responses can be defined in order to meet the requirements detailed in this annex.

History

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