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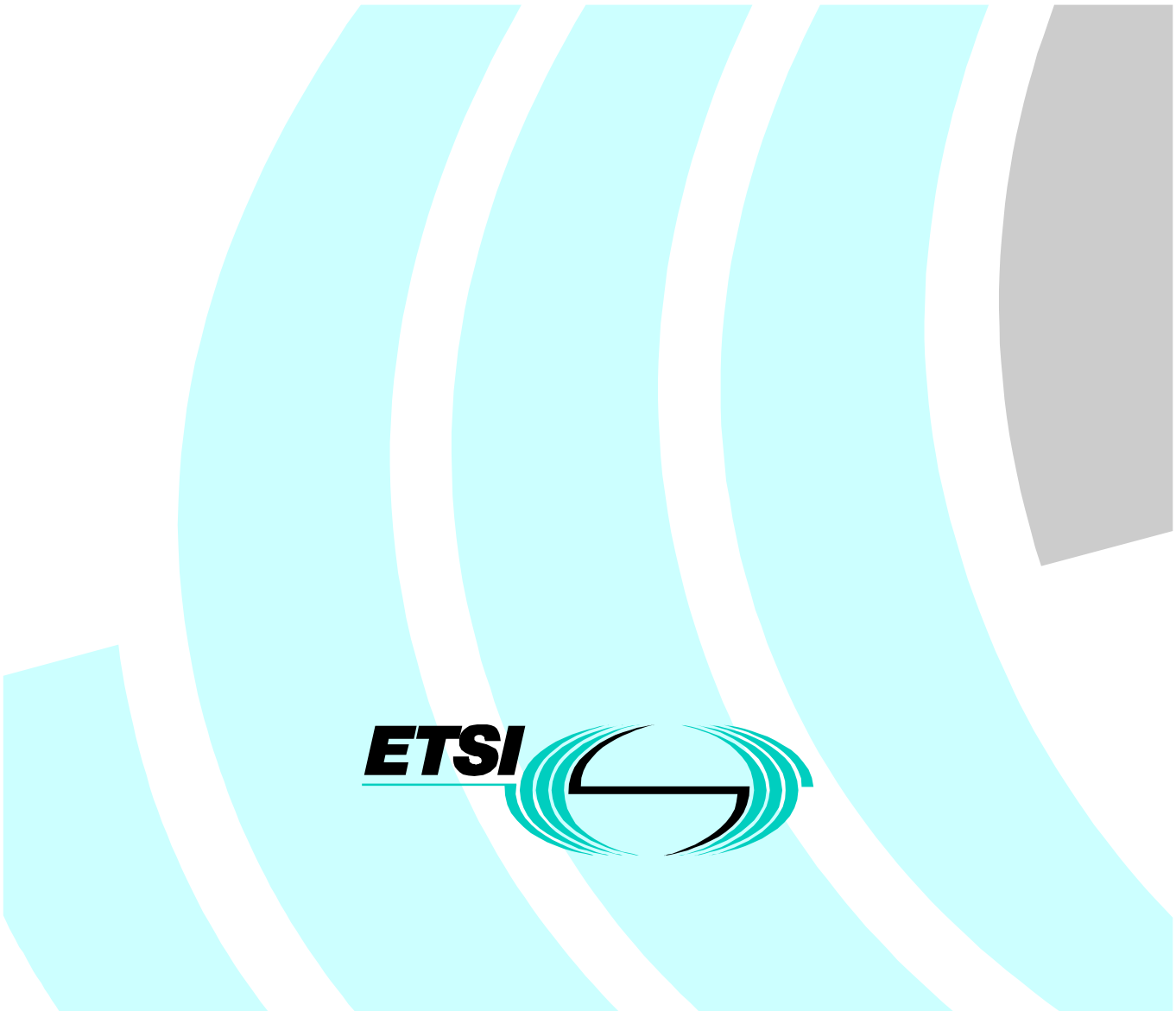
European Standard (Telecommunications series)

Telecommunications Management Network (TMN); Asynchronous Transfer Mode (ATM) management information model for the X interface between Operation Systems (OSs) of a Virtual Path (VP)/Virtual Channel (VC) cross connected networks; Part 2: alarm management



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Contents

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Foreword

This European Standard (Telecommunication series) has been produced by ETSI Technical Committee Telecommunications Management Network (TMN), and is now submitted for the ETSI standards Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

The present document is Part 1 of a multi-Part EN covering the management information model for the X-type interface between Operations Systems (OSs) of a Virtual Path (VP)/Virtual Channel (VC) cross connected network, as identified below:

Part 1: "Configuration management";

Part 2: "Alarm management";

Part 3: "VP Performance management".

(VC Performance Management aspects are for further study)

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1 Scope

The present document addresses the requirements of network and service providers of Asynchronous Transfer Mode (ATM) cross connected networks for managing the fault alarms associated with the Virtual Path (VP) connections and Virtual Channel (VC) connections (generally denoted as 'VP/VC connections' in the present document), which span several administrative ATM domains. These requirements are satisfied by the use of a standardized interface (the "X-interface") between Operation Systems (OSs) belonging to different Network Operators (PNOs).

Readers of the present document should be made aware that the abbreviation 'PNO' is taken to mean Providing Network Operator. In the previous version of the present document (and related documents), PNO was defined as Public Network Operator. The change in definition has been provided to reflect the change in market conditions for provision of interconnected telecommunications services. However, it is considered necessary to retain the abbreviation 'PNO' because it is found in many of the managed object definitions used to specify the X-interface. It would be disadvantageous to introduce major changes in these managed object definitions, which serve purely technical purposes for management of interconnections only.

The present document should be used in conjunction with Parts 1 and 3 of the standard [1]. The present document describes the X-interface VP / VC alarm management area covering the following aspects:

- the Management Services (MS) and functions needed that provide the necessary alarm messages for faults detected and related recovery procedures within ATM VP or VC Connections which span several administrative domains;
- the management information crossing the X-interface. This management information specification uses the Guidelines for the Definition of Managed Objects (GDMO) formalism, described in ITU-T Recommendation X.722 [2].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] EN 300 820-1: "Telecommunications Management Network (TMN); Asynchronous Transfer Mode (ATM) Management information model for X interface between Operation Systems (OSs) of a Virtual Path (VP)/Virtual Channel (VC) cross connected networks; Part 1: Configuration Management".

[2] ITU-T Recommendation X.722: "Information Technology - Open Systems Interconnection - Structure of management information: Guidelines for the definition of managed objects".

[3] ITU-T Recommendation G.805: "Generic Functional Architecture of Transport Networks".

[4] ES 200 653: 'Telecommunications Management Network (TMN) Generic managed object class library for the network level view'

[5] ITU-T Recommendation M.3010: "Principles for a Telecommunications Management Network".

[6] Network Management Forum NMF025: "The 'Ensembles' Concepts and Format", Issue 1.0, August 1992.

[7] ITU-T Recommendation X.733: "Information Technology - Open Systems Interconnection - Systems Management: Alarm reporting function".

[8] ITU-T Recommendation X.711: "Common management information protocol specification for ITU-T Applications".

[9] ITU-T Recommendation X.721: "Definition of Management Information".

[10] ITU Recommendation M.3400: "TMN management functions".

[11] ITU-T Recommendation X.734: "Event report management Function".

[12] ITU-T Recommendation X.208: "Specification of Abstract Syntax Notation One".

[13] TS 101 674-1: "Technical Framework for the provision of interoperable ATM services NNI-Interface; Part 1: User and Control plane specification (including network functions and service aspects) Phase 1".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

(Some definitions depend on the future acceptance of the "cascaded/mixed mode" as described in EN 300 820-1 [1]. This dependence is already taken into account in these definitions. PNO is provided as the first definition in order to help clarify several different PNO roles subsequently provided in the list below).

Providing Network Operator (PNO): operator able to provide network resources to customers (including other PNOs). For the purposes of the present document these resources are ATM VP or VC subnetwork resources which may be interconnected to compatible resources provided by another operator or customer.

access point: defined in ITU-T Recommendation G.805 [3].

A PNO: PNO where the Initiator (I PNO) starts reserving the End-to-end VP or VC connection. If the termination point of the connection is at a User accesspoint, this is considered to be the **A User** Accesspoint. The A PNO can be the Initiating PNO, but this is not always the case. It is the Consumer of other PNO's parts of the VP / VC connection.

NOTE 1: If, in future the "cascaded" mode should be accepted as defined in EN 300 820-1 [1], and if the A PNO also acts as initiating PNO, then the A PNO is the consumer of the other PNO's parts of the VP/VC connection.

ATM Interconnection Gateway: represents an ATM access point in one subnetwork, which is associated with an ATM access point in another subnetwork for the purpose of topological interconnection.

connection: "transport entity" which is capable of transferring information transparently between "connection points (CP)". A "connection" defines the association between the "connection points" and the "connection points" delimit the "connection".

consumer and provider roles of a PNO: with respect to a particular End-to-end connection, a PNO acts as a consumer if it has delegated the management of a VP/VC subnetwork connection plus the outgoing link connection to another PNO (being a Provider PNO). If, in future, the "cascaded/mixed" mode should be accepted (EN 300 820-1 [1]), a PNO can have both roles at once, if it is providing Part of the End-to-end connection (being a Provider), and at the same time asks another PNO to provide a Part of the End-to-end connection (being a Consumer).

destination PNO: Z PNO (This term was used in older versions of the specification).

end-to-end connection: overall Connection which can be one of the following types:
- User-to-user VPC / VCC,
- Network-to-user VPC,
- User-to-network VPC or Network-to-network VPC.

These types are defined in [1]. For a given end-to-end connection, any PNO may act in any of the I, A, T or Z PNO roles according to the interconnection requirements to provide the service.

initiating Network Operator (I PNO): initiating PNO is the PNO requesting a particular ATM End-to-end connection. It starts requesting in the subnetwork of the A PNO and ends in the subnetwork of the Z PNO; It controls the overall End-to-end connection.

Inter PNO Physical Link (IPPL): it represents a physical link that offers bi-directional transmission capabilities and connects two pnoVpSubnetworks. Each InterPNOPhysicalLink is terminated by two pnoNWAtmAccessPoints which are in charge of emitting failures related to the link or to the access point itself. An IPPL can be realized by any transmission capability (SDH, PDH etc.). There is no explicit managed object defined in the X-interface that represents this resource. Information about IPPLs is included in the interPnoTopologicalSubnetworkPair object EN 300 820-1 [1]

link: "topological component" which describes the fixed relationship between a "sub-network" and another "sub-network" or "access group". It is defined by an access point on one sub-network, which is associated with an access point on another subnetwork.

network-to-network VPC: VP "transport entity" formed by the series of "connections" between "termination CPs", starting at an ATM Interconnection Gateway and ending at an ATM Interconnection Gateway. This involves the ATM resources of more than one PNO. The Network-to-network connections that are relevant to the X Interface are of the VP type.

network-to-user VPC: VP "transport entity" formed by the series of "connections" between "termination CPs", starting at an ATM Interconnection Gateway and ending at the Z User Accesspoint in the network of the Z PNO. This involves the ATM resources of more than one PNO. The Network-to-user connections that are relevant to the X Interface are of the VP type.

Providing Network Operator (PNO): operator able to provide network resources to customers (including other PNOs).

pnoVcSubnetwork: topological component used to effect routing and management of ATM cells. It describes the potential for setting up "ATM-VC connections" across the subnetwork. The pnoVcSubnetworks are delineated by ATM AccessPoints and interconnected by "inter-PNO Physical links".
A pnoVcSubnetwork can be partitioned into interconnected "sub-networks" and "links", but this partitioning is not shown over X Interface. In the context of the present document, one pnoVcSubnetwork represents an ATM network belonging to one PNO.

pnoVpSubnetwork: topological component used to effect routing and management of ATM cells. It describes the potential for setting up "ATM-VP connections" across the subnetwork. The pnoVpSubnetworks are delineated by ATM AccessPoints and interconnected by "inter-PNO Physical links".A pnoVpSubnetwork can be partitioned into interconnected "sub-networks" and "links", but this partitioning is not shown over the X-interface. In the context of the present document one pnoVpSubnetwork represents an ATM Vp network belonging to one PNO.

NOTE 2: In principle (cf. to ES 200 653 [4]) one subnetwork can consist of several subcomponents: subnetworks and connections between subnetworks. However, this capability is not supported in this specification for the X-interface. Usually one pnoVpSubnetwork or pnoVcSubnetwork represents an ATM network belonging to the domain one network operator.

protection switching: automatic switching to pre-assigned spare capacity in network resources, consequent on reaction to receipt of an alarm signal by a network management system. (In the context of the present document, this is internal to a PNO).

recovery: recovery is a procedure performed by a PNO which makes use of spare capacity in the subnetwork or inter-pno physical links belonging to this PNO. It follows after an alarm signal from a fault in the PNO's network resources.

star organization: it is described in EN 300 820-1 [1]. It is the organizational form that is used in this specification.

subnetwork: "topological component" used to effect routing and management. It describes the potential for "subnetwork connections" across the "sub-network". It can be partitioned into interconnected "sub-networks" and "links". Each " sub-network" in turn can be partitioned into smaller "sub-networks " and "links" and so on. A "sub-network" may be contained within one physical node. In the present document this partition is not used.

subnetwork connection: "transport entity" formed by a "connection" across a "sub-network" between "connection points". It can be configured as Part of the "trail management process" as defined in ITU-T Recommendation G.805 [3].

transit PNO (T PNO): transit PNO is a PNO using its own subnetwork to perform its required transit Part of VP/VC connection. It has a provider role and corresponds to a leaf in the X-interface tree, not being the **Z** side. In the "cascaded/mixed approach" case (EN 300 820-1 [1]), it can be both a provider (where it acts as a Transit operator) and a Consumer (where it virtually acts as an Initiating PNO).

user: consumer of the ATM interconnection, provided by the End-to-end connection.

User-to-network VPC: "transport entity" formed by the series of "connections" between "termination CPs", starting at the A User Accesspoint in the network of the A PNO and ending at an ATM Interconnection Gateway. This involves the ATM resources of more than one PNO. The User-to-network connections that are relevant to the X Interface are of the VP type.

user-to-user VPC / VCC: "transport entity" formed by the series of "connections" between "termination CPs", starting at the A User Accesspoint in the network of the A PNO and ending at the Z User Accesspoint in the network of the Z PNO. This involves the ATM resources of more than one PNO. The User-to-user connections that are relevant to the X Interface can be of the VP type or the VC type.

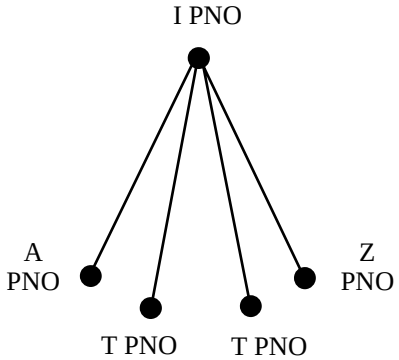
VC subnetwork connection: "transport entity" which is capable of transferring information transparently between "connection points" across a VC subnetwork or from a VC subnetwork access point to a user.

VP subnetwork connection: "transport entity" which is capable of transferring information transparently between "connection points" across a VP subnetwork or from a VP subnetwork access point to a user.

X-interface: management interface between two PNOs. In the "Responsibility Model", which is described in ITU-T Recommendation M.3010 [5], two Operations Systems Functions (= Managers) that are located in different TMNs (= different PNOs), communicate over an X Reference Point.

X-interface tree: with respect to a particular VPC/VCC, an X-interface relationship exists between each provider PNO and its consumer PNO. Because each provider has exactly one consumer, the X-interface relations between all PNOs involved in the management of a particular VPC/VCC form a tree, the X-interface relation tree. Note, that for a particular VP/VC there can be several possible X-interface relation trees; the actual tree is formed at VP/VC set-up. The root of the tree is the Initiating PNO; it uses (using X-interface management processes) the PNOs (often transit PNOs), to which it is connected in the tree via its branches. The most right leaf of the tree is the Z PNO. Figure 1 shows an example of an X-interface tree.

Z PNO: PNO where the Initiator (I PNO) ends reserving the End-to-end VP or VC connection. If the termination point of the connection is at a User accesspoint, this is considered to be the Z User Accesspoint. In this case, the I PNO views the Z PNO as a PNO whose subnet is connected to the Z User.



Legend:
PNO Providing Network Operator
I PNO Initiating PNO A PNO Access PNO
T PNO Transit PNO Z PNO Terminating PNO

Figure 1: Example of an X-interface tree with the Initiating PNO not being the A PNO

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

A PNO	Access PNO. Refer also to Definitions
ASN.1	Abstract Syntax Notation.1
ATM	Asynchronous Transfer Mode
CMISE	Common Management Information Service Element
CP	Connection Point
eFD	Event Forwarding Discriminator
EN	European Norm
ETS	European Technical Standard
GDMO	Guidelines for the Definition of Managed Objects
I PNO	Initiating PNO. Refer also to Definitions
INMS	Inter-operator Network Management System
IPPL	Inter-PNO Physical Link
ITU-T	International Telecommunications Union, Telecommunications Standardization Sector
MFS	Management Function Set
MS	Management Service
NMS	Network Management System
ONMS	Operator's Network Management System
OS	Operations System
PDH	Plesiochronous Digital Hierarchy
PNO	Providing Network Operator
PS	Protection Switching
QALog	Qualified Alarm Log
RALog	Received Alarm Log
SALog	Sent Alarm Log
SDH	Synchronous Digital Hierarchy
T PNO	Transit PNO. Refer also to Definitions
TMN	Telecommunications Management Network
VC	Virtual Channel
VCC	Virtual Channel Connection
VCSC	Virtual Channel Subnetwork Connection
VP	Virtual Path
VPC	Virtual Path Connection
VPSC	Virtual Path Subnetwork Connection
X-type	Network Management interface between telecommunications operators

4 Requirements

1 In case of faults, it should be possible to localize faults on a PNO sub-network and/or IPPL level.

2 All parties which are affected by a faulty PNO sub-network are to be informed of the failure.

3 All alarm information passed across the X-interface should be time-stamped.

4 Elimination of redundant multiple alarms relating to a single underlying cause before the alarm information is transmitted across the X-interface.

5 Protection switching and the result of the protection should be notified.

6 Under_recovery actions and the results of under_recovery actions should be notified.

7 It should be possible to enable/disable alarm reporting on a given connection or group of connections.

5 Resources for ATM VP/VC alarm management

5.1 The basis for the exchange of management information

The architectural framework characterizing the exchange of management information across the X-interface is represented in figure 2:

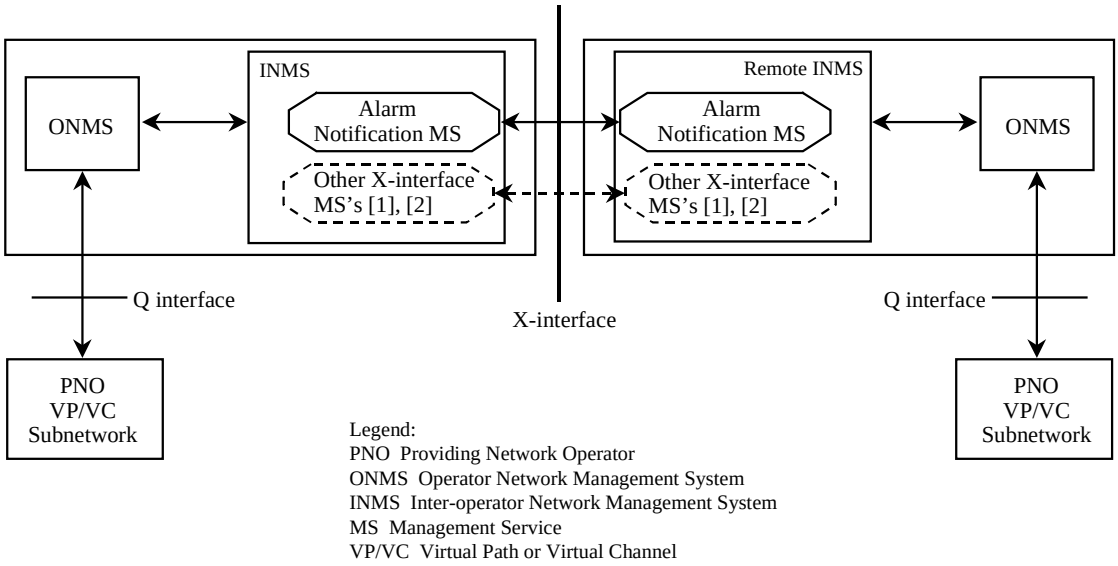


Figure 2: Architectural framework for the X-interface

In figure 2, the term "ONMS" is defined as an Operator Network Management System. For the purpose of the present document the ONMS is taken to be the management system which controls an operator's VP/VC subnetwork which is interconnected to another operator's compatible VP/VC subnetwork. (Interconnection at the VP/VC subnework level is not shown in figure 2 but may in accordance with the specification defined in TS 101 674-1 [13]). The term denoted as 'INMS' is defined as an Inter-operator Network Management System. "INMS" can be considered as an operator's management system for an X-interface interconnection with another operator, whether within national boundaries or across them.

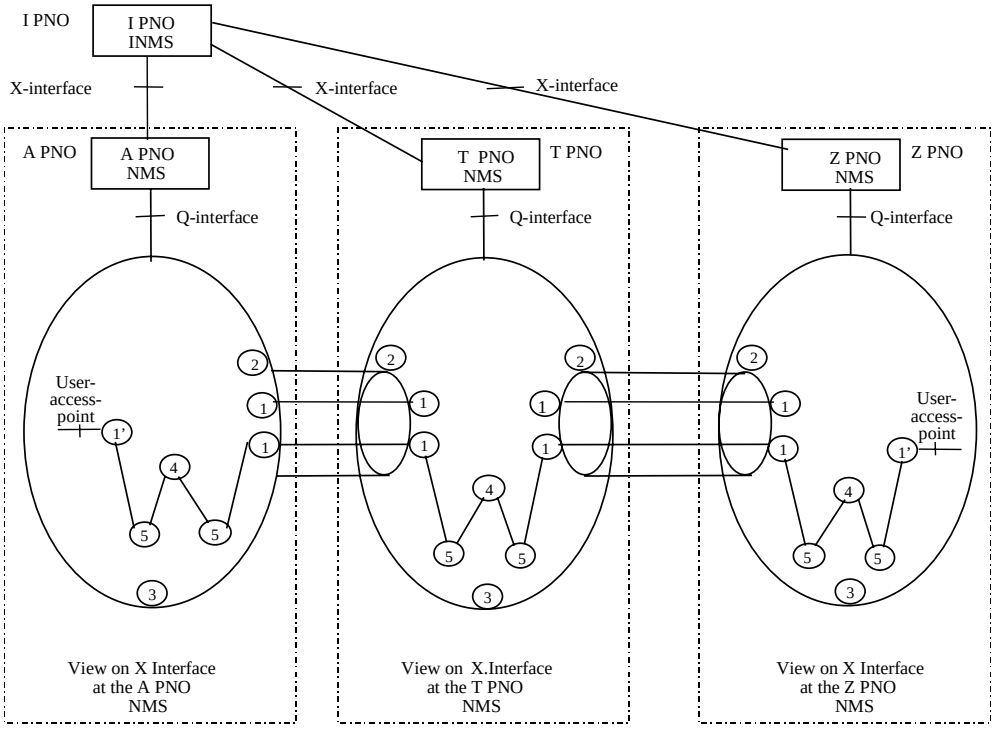
The distinction between ONMS and INMS has been made because these two systems act on different Information Models and because there is the necessity of exchange of information between them. The logical positioning of the "Q" interface, which basically controls network switches in the PNO VP/VC Subnetwork, is also indicated but any matters relating to this interface are outside the scope of the present document.

The INMS belonging to any operator has to support the following operations as far as the Alarm Notification MS is concerned:

- reception of notifications coming from a remote INMS. These notifications are described in detail in subclause 7.1;
- reception of alarms coming from the ONMS and relevant to the X-interface. These alarms are associated with faulty VP/VC connections used for end-to-end connections (they may be Physical Layer alarms or VP/VC Layer alarms or faults affecting the ATM Cross Connect which acts as the inter-network gateway);
- elaboration of alarms coming from the ONMS (qualification and adaptation to inter-network alarm format);
- sending of alarms to the appropriate PNOs (Initiating PNO in the case of a VPSC or VCSC fault or all PNOs in the case of Inter-PNO Physical Link (IPPL) fault);
- logging alarms and retrieving alarm reports.

5.2 The managed resources

A simplified view of the network level resources being managed is provided in figure 3. This view is provided in the form of an example of the management view after a user-to-user VP or VC connection has been set up. Further details and related examples are provided in [1]. Figure 3 shows the X-interfaces between the I PNO and other PNOs which may be used to support the VP/VC alarm management functions defined in the present document. The NMS's associated with the A, T and Z PNOs may or may not have INMS functionality implemented as defined in subclause 5.1.



Legend:
1' pnoNWAtmAccessPoint for user access (no association with (2))
1: pnoNWAtmAccessPoint
2: interPnoTopologicalSubnetworkPair
3: pnoVpSubnetwork or pnoVcSubnetwork
4: pnoVpSubnetworkConnection or pnoVcSubnetworkConnection
5: pnoVPCTP or pnoVCCTP (VP/VC Connection Termination Point)
NMS: Network Management System (may contain ONMS and INMS)

Figure 3: X-interface managed network resources and connections

6 The VP/VC alarm reporting management function sets

6.1 VP/VC alarm reporting MS - Overview

In defining the VP/VC Alarm Reporting Management Service (MS) for the X-interface and following the Ensembles concept, defined by the Network Management Forum NMF025 [6], some Management Function Sets (MFS) have been identified. Each MFS has been decomposed in MF. The following MFSs have been identified to manage the notifications described in clause 7:

- Alarm notification MFS;
- Alarm event logging MFS;
- Alarm processing MFS.

The identified VP/VCs Alarm Reporting MFSs are organized as depicted in figure 4 and described in more detail in subclauses 6.2, 6.3 and 6.4. (Note that details of implementation of the INMS functions, MSs and data bases are an internal matter for any PNO wishing to provide an X-interface in accordance with the specification in the present document and therefore implementation guidance or specifications are outside the scope of the present document).

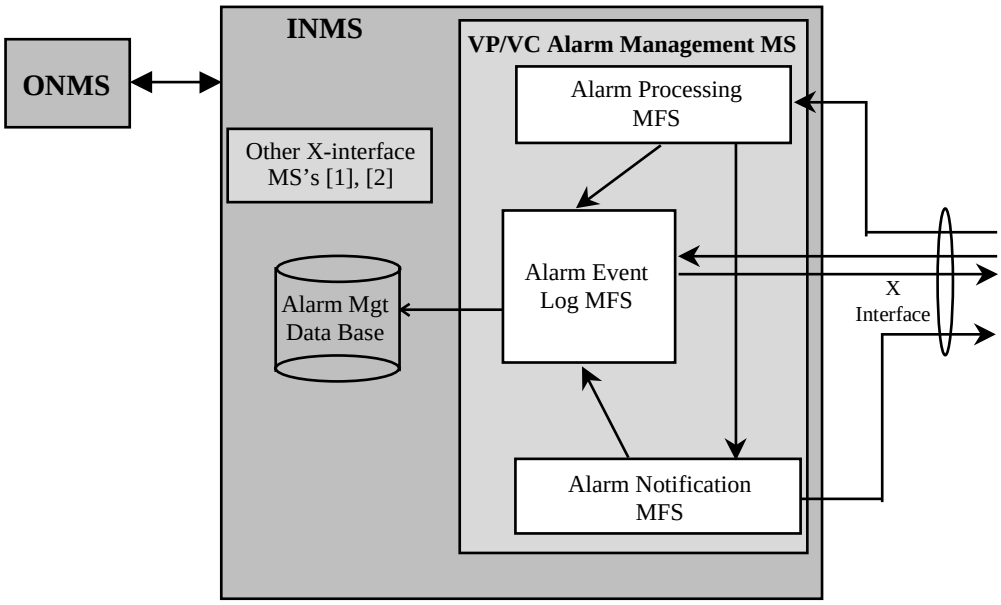


Figure 4: MFSs and other X-interface MSs relative to the VP/VC alarm management MS

6.2 Alarm notification MFS

This MFS performs the following tasks:

transmission of faulty VP/VC alarm notifications across the X-interface; these notifications contain the following parameters:

- SubnetworkId, resource id (vpConnectionId or vcConnectionId or atmAccessPointId), time of event, probable cause, perceived severity, specific problems (the last three of which are described in more detail below and are derived from the event information section of ITU-T Recommendation X.733 [7] and are reproduced here in order to clarify the basis on which the MFS messages are generated by the system).

forwarding of sent alarms to the Alarm Event Logging MFS to be recorded in the SALog:

- The four types of Alarm Notifications are summarized in figure 5. In the case of an IPPL failure the same notifications are sent but to all PNOs instead of only the Origin PNO:

probableCause:

This parameter defines further qualification (after Event Type and information) as to the probable cause of the alarm. Probable cause values for notifications shall be indicated in the behaviour clause of the object class definition. The syntax of standard probableCauses shall be the ASN.1 type object identifier. The managed object class designer should choose the most specific probableCause applicable.

The set of probableCauses will not be further elaborated here and reference should be made to ITU-T Recommendation X.733 [7].

specificProblems:

This parameter identifies the status of the alarm in the VP/VC Alarm management service. In the context of these specifications, the specificProblems values have been restricted to:

- protection-switched;
- under-recovery;
- cleared;
- unrecoverable.

perceivedSeverity: this parameter defines six severity levels, which provide an indication of how it is perceived that the capability of the managed object has been affected. Briefly, these are:

cleared: indicates the clearing of one or more previously reported alarms.

indeterminate: indicates that the severity level cannot be determined.

critical: Indicates that a service affecting condition has occurred and an immediate corrective action is required.

major: indicates that a service affecting condition has happened and an urgent corrective action is required.

minor: indicates the existence of a non-service affecting fault condition and that corrective action should be taken in order to prevent a more serious fault.

warning: indicates the detection of a potential or impending service affecting fault, before any significant effects have been felt.

Again, reference should be made to ITU Recommendation X.733 [7] for full descriptions.

6.3 Alarm processing MFS

For the Alarm Processing MFS the following tasks are identified:

- With regard to the ONMS Q-interface, as depicted in Figure 2 (Not a Part of the X-interface specification):
  - **reception** of alarms concerning the Part of the PNO's ONMS-based sub-network supporting INMS-based connections. It is assumed that these alarms are "qualified" in the sense that the recognition of repeating alarms and the measurement of persistence has been already performed by the ONMS;
  - **adaptation** of the ONMS-based alarm to the required INMS format. This adaptation will allow the same treatment for ONMS-based and INMS-based alarms;
  - **forwarding** the INMS alarms (i.e. the ONMS alarms that have been adapted to INMS format and that shall be sent to other PNOs) to the VP/VC Alarm Notification MFS.
- With regard to the INMS Interface:
  - **reception of alarms from remote INMSs** across the X-interface; the alarm indications will contain the following parameters: Subnetwork Id (Sub-network whose PNO has detected the Fault), affected resource id (VpconnectionId or VcconnectionId, pnoNWAtmAccessPoint,...), time of event, probable cause, perceived severity, and specific problems. It is supposed that the Sub-network has performed recognition of repeating alarms and measurement of persistence before issuing the alarm across the X-interface. The end of the alarm event will be communicated by using the same alarm indication with the perceived severity field set to "cleared";
  - **forwarding** the received alarms to the RA Log to be stored.

- Filtering:

- **discrimination and failure localization**: it localizes the failure on the basis of the information received. The PNO which receives one or more alarm notifications coming from other PNOs will be capable of distinguishing the cause of the fault from the inducing causes by analysing the alarm notification parameters.

The alarm notification is logged in RAlog (see alarm event logging MFS).

6.4 Alarm event logging MFS

This task is in charge of managing the interactions with the logs. Logging of alarms may be organized as follows:

- RALog: log of received alarms from remote INMSs, recorded sequentially;

- QALog: is a log which records the qualified alarms, storing begin, end, counting of alarm repetitions;

- SALog: log of sent alarms across the X-interface. This log (and only this type) may also be viewed from a remote INMS.

Therefore this MFS performs the following tasks:

writing alarms that are generated by the Alarm Processing MFS and the Alarm Notification MFS. This function records the next alarm events:

- The ones that qualify as alarms (with regard to number of occurrences, persistence, etc.). The set of these alarms are summarized under the concept "QALog". (QALog is not visible over the X-interface);

- Alarm notifications that arrive from the X-interface (these are summarized under RALog, which is not visible over the X-interface);

- The alarm notifications that are transmitted over the X-interface (these are recorded in the SALog, which is visible over the X-interface).

reading: information (not a Part of the X-interface specification) contained in the logs upon request by the operator. This function accesses the SALog, RALog and QALog in order to read alarm records. Some access keys may be identified for accessing the information stored in the logs.

request alarm report: this function is performed (over the X-interface) when an INMS wants to read the SALog of a remote INMS. The output of this function is the Alarm Record retrieved from the INMS of the remote PNO by the requesting INMS. It is supposed here that the requesting INMS will specify a set of characteristics of the alarm in order to get the proper Alarm Record.

The IPPL SAlogs should be readable by all PNOs interconnected by an X-interface. The VPSC or VCSC SALogs should be readable only for the PNO that requested the connections involved (i.e., the I PNO).

The identified MF across the X-interface is the function described in clause 7.

7 Management functions

7.1 Alarm notification management functions

(The structure of the Alarm notifications should be in accordance with ITU-T X.733 [7]. For reading the proper alarm record the use of filters specified in ITU-T Recommendation X.711 [8] may be required).

- a) to h) describe the MFs composing the MFS:

Table 1: case a) MF: Notification of VP/VC Sub-network Connection Protection Switching

MF Name	Notification of VP/VC Sub-network Connection Protection Switching
Functionality	This function generates the emission of a VPSC or VCSC Protection Switching notification across the X-interface. This is done in consequence of having received from the ONMS an indication of a protection switching action affecting a PNO's sub-network protected resources supporting inter-PNO communications. The notification is emitted towards the Initiating PNO by the **pnoVpSubnetworkConnection or pnoVcSubnetworkConnection** object.
Object class	PnoVpSubnetworkConnection or PnoVcSubnetworkConnection
Notifications	"ITU-T Recommendation X.721 [9]": communicationsAlarm
Instance values	subnetwork identification, Vp connection identification (for VP) subnetwork identification, Vc connection identification (for VC)
Request/parameters	time of event probableCause specificProblems = protection-switched perceivedSeverity = warning
Response/parameters	not confirmed
Security	Writes in the SALog

Table 2: case b) MF: Notification of Inter-PNO Physical Link Protection Switching

MF Name	Notification of Inter-PNO Physical Link Protection Switching
Functionality	This function generates the emission of an IPPL Protection Switching notification across the X-interface. This is done by the responsible PNO in consequence of having received from the ONMS an indication of performing a protection switching procedure on a protected link affected by a recoverable failure. The notification is emitted towards every PNO by the **pnoNWAtmAccessPoint** object.
Object class	pnoNWAtmAccessPoint
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	subnetwork Identification, pno Access Point Identification (for VP) subnetwork Identification, pno Access Point Identification (for VC)
Request/parameters	time of event probableCause specificProblems = protection-switched perceivedSeverity = warning
Response/parameters	not confirmed
Security	Writes in the SALog

Table 3: case c) MF: Notification of VP/VC Sub-network Connection Under Recovery

MF Name	Notification of VP/VC Sub-network Connection Under Recovery
Functionality	This function generates the emission of a VPSC or VCSC Under Recovery notification across the X-interface. This is done in consequence of having received from the ONMS an indication of a recovery action affecting the PNO's sub-network resources supporting inter-PNO communications. This notification is sent by the **pnoVpSubnetworkConnection** object or **pnoVcSubnetworkConnection** object to the Initiating PNO.
Object class	PnoVpSubnetworkConnection or pnoVcSubnetworkConnection
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	subnetwork identification, Vp connection identification (for VP) subnetwork identification, Vc connection identification (for VC)
Request/parameters	time of event probableCause specificProblems = under-recovery perceivedSeverity = critical OR major OR minor OR warning OR indeterminate (i.e. any valid severity value except "cleared").
Response/parameters	not confirmed
Security	Writes in the SALog

Table 4: case d) MF: Notification of Inter-PNO Physical Link Under Recovery

MF Name	Notification of Inter-PNO Physical Link Under Recovery
Functionality	This function consists in the emission of an IPPL Recovery notification across the X-interface. This is done by the PNO responsible for the link in consequence of the detection of a recoverable failure affecting the link. This notification is sent by the **pnoNWAtmAccessPoint** object to all the PNOs.
Object class	pnoNWAtmAccessPoint
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarms
Instance values	subnetwork Identification, pno Access Point Identification (for VP) subnetwork Identification, pno Access Point Identification (for VC)
Request/parameters	time of event probableCause specificProblems = under-recovery perceivedSeverity = critical OR major OR minor OR warning OR indeterminate (i.e. any valid severity value except "cleared").
Response/parameters	not confirmed
Security	Writes in the SALog

Table 5: case e) MF: Notification of VP/VC Sub-network Connection Recovery Result

MF Name	Notification of VP/VC Sub-network Connection Recovery Result
Functionality	This function generates the emission of a VPSC or VCSC Recovery Result notification across the X-interface. This is emitted after having received from the ONMS an indication of the recovery procedure results. This notification is sent by the **pnoVpSubnetworkConnection** object or **pnoVcSubnetworkConnection** object to the Initiating PNO.
Object class	PnoVpSubnetworkConnection or pnoVcSubnetworkConnection
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	subnetwork identification, Vp connection identification (for VP) subnetwork identification, Vc connection identification (for VC)
Request/parameters	specificProblems = cleared OR unrecoverable perceivedSeverity = cleared OR if specificProblems = unrecoverable then any valid value except "cleared" (but shall be the same as for the corresponding Under Recovery notification)
Response/parameters	not confirmed
Security	Writes in the SALog

Table 6: case f) MF: Notification of Inter-PNO Physical Link Recovery Result

MF Name	Notification of Inter-PNO Physical Link Recovery Result
Functionality	This function generates the emission of an IPPL Recovery Result notification across the X-interface by the responsible PNO. This is done in consequence of having received the recovery procedure results about the affected link. This notification is sent by the **pnoNWAtmAccessPoint** object to all the PNOs.
Object class	pnoNWAtmAccessPoint
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	subnetwork Identification, pno Access Point Identification (for VP) subnetwork Identification, pno Access Point Identification (for VC)
Request/parameters	specificProblems = cleared OR unrecoverable perceivedSeverity = cleared OR if specificProblems = unrecoverable then any valid value except for cleared (but shall be the same as for the corresponding Under Recovery notification).
Response/parameters	not confirmed
Security	Writes in the SALog

Table 7: case g) MF: Notification of VP/VC Sub-network Connection Unrecoverable

MF Name	Notification of VP/VC Sub-network Connection Unrecoverable
Functionality	This function generates the emission of a VPSC or VCSC Failure Indication notification across the X-interface. This is done in consequence of having received from the ONMS an indication of a fault affecting a PNO's sub-network resources supporting inter-PNO communications which are non protected or no recovery procedure is available. This notification is sent by the **pnoVpSubnetworkConnection** object or **pnoVcSubnetworkConnection** object to the Initiating PNO which might decide to interrupt the service.
Object class	PnoVpSubnetworkConnection or pnoVcSubnetworkConnection
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	subnetwork identification, Vp connection identification (for VP) subnetwork identification, Vc connection identification (for VC)
Request/parameters	specificProblems = Unrecoverable time of event probableCause perceivedSeverity = critical/major/minor/warning/indeterminate (i.e. any valid severity value except "cleared").
Response/parameters	not confirmed
Security	Writes in the SALog

Table 8: case h) MF: Notification of Inter-PNO Physical Link Unrecoverable

MF Name	Notification of Inter-PNO Physical Link Unrecoverable
Functionality	This function consists in the emission of an IPPL Unrecoverable Failure notification across the X-interface. This is done by the responsible PNO in consequence of having received an indication of an unrecoverable failure. This notification is sent by the **pnoNWAtmAccessPoint** object to all PNOs which are then expected to update their topology information.
Object class	pnoNWAtmAccessPoint
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	subnetwork Identification, pno Access Point Identification (for VP) subnetwork Identification, pno Access Point Identification (for VC)
Request/parameters	time of event probableCause specificProblems = Unrecoverable perceivedSeverity = critical/major/minor/warning/indeterminate (i.e. any valid severity value except "cleared").
Response/parameters	not confirmed
Security	Writes in the SALog

Figure 5 summarizes the use of the Alarm notification MF X-interface messages, and is followed by some additional explanation:

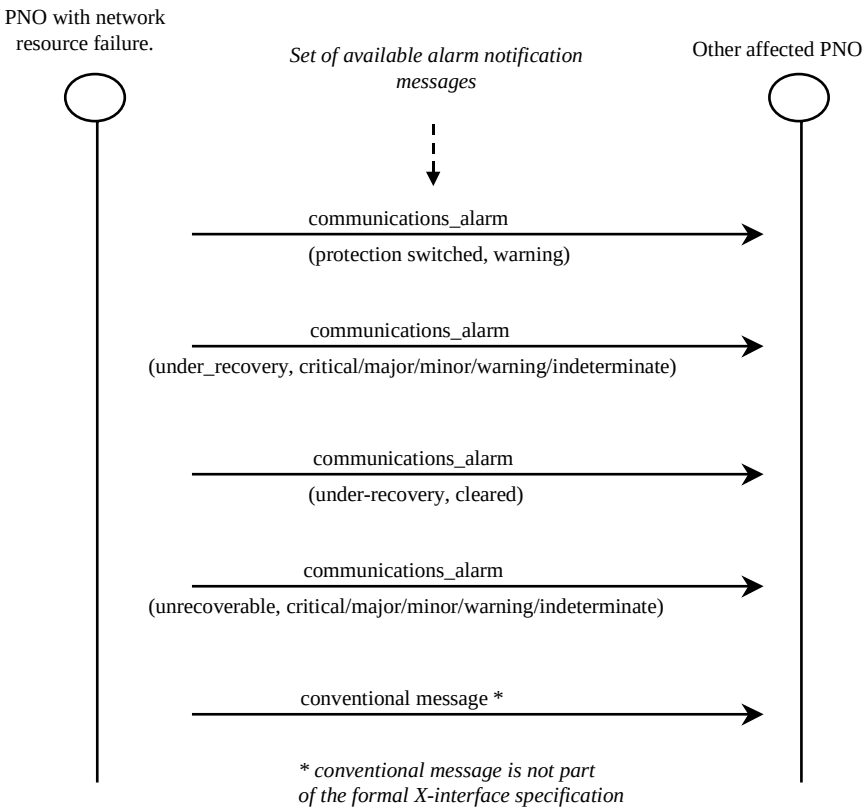


Figure 5: Alarm notification management messages

The set of Communications_alarms messages which may be emitted by a PNO affected by a VP or VC subnetwork resource failure is illustrated by the horizontal arrows shown in figure 5. The sequence of arrows from the top of figure 5 is indicative of a possible order of messages from the affected PNO. That is:

The affected PNO will be presumed to attempt to rectify the associated fault by automatically switching to pre-assigned spare capacity which is defined as "Protection Switching (PS)" within the scope of the present document. This is notified (across the X-interface) by emission of the communications_alarm, protection switched_warning.

If PS is unavailable or fails, a recovery procedure should be commenced.

If there is no recovery procedure available, a communications_alarm, unrecoverable should be emitted immediately.

If a recovery procedure is available, a communications_alarm, under_recovery should be emitted immediately. This is followed by recovery actions. At the completion of these actions a further communications_alarm is emitted. This will either report that the fault is cleared or that the fault is unrecoverable. (The present document is not able to be prescriptive on 'time-outs'. That is, the I PNO may have a policy or bi-lateral agreements on the total time available for recovery actions before undertaking VP/VC reconfiguration or other management actions).

Consequent on receipt of an unrecoverable failure message, the Initiating PNO could be expected to wish to reconfigure the VP/VC service, EN 300 820-1 [1].

The 'conventional message' arrow in figure 5 is not formally defined in the present document. However, this arrow indicates the necessity for operators to be able to exchange management information by 'conventional' means (e.g. fax, telephone) when implementation of the X-interface using automated computer-based facilities fails or is unavailable.

7.2 Alarm processing management function

The following function performs the alarm processing MFS across the X-interface:

Table 9: MF: Alarm reception

MF Name	Alarm Reception
Functionality	This function receives alarm notifications sent by remote PNOs across the X-interface.
Object class	vpSubNetworkConnection OR pnoNWAtmAccessPoint
Notifications	ITU-T Recommendation "X.721 [9]": communicationsAlarm
Instance values	Subnetwork Identification, Vp connection Id or Vc connection Id Subnetwork Identification, Access point identification
Request/parameters	Time of Event Probable cause Perceived severity Specific Problems
Response/parameters	not confirmed
Security	Writes in the RALog

7.3 Alarm event logging management function

The following function performs the alarm event logging MFS across the X-interface:

(The structure of the alarm should be in accordance with ITU-T Recommendation X.733 [7]).

Table 10: MF: Request alarm report

MF Name	Request alarm report
Functionality	This function consists of the emission of a read message across the X interface requesting a remote INMS about an alarm in the SALog. The message sent through the X-interface is a GET request on the **log** object.
Object class	log
Action	get
Instance values	Subnetwork Identification, Log identification
Request/parameters	(Parameters used for filtering). They could include the remote subNetworkId, the pnoNWAtmAccessPointId, vpConnectionId or vcConnectionId, Probable cause, Perceived severity,...
Response/parameters	alarmRecord attribute values
Security	Access (only read) to SAlog

8 Scenarios

To clarify the exchange of messages across the X-interface, two scenarios are considered: The first usage case relates to when a failure occurs within a sub-network and the second usage case relates to when a failure occurs on a physical link between two PNO's sub-networks. The two usage cases are based on use of the 'Star' organizational model described in [1].

Case 1

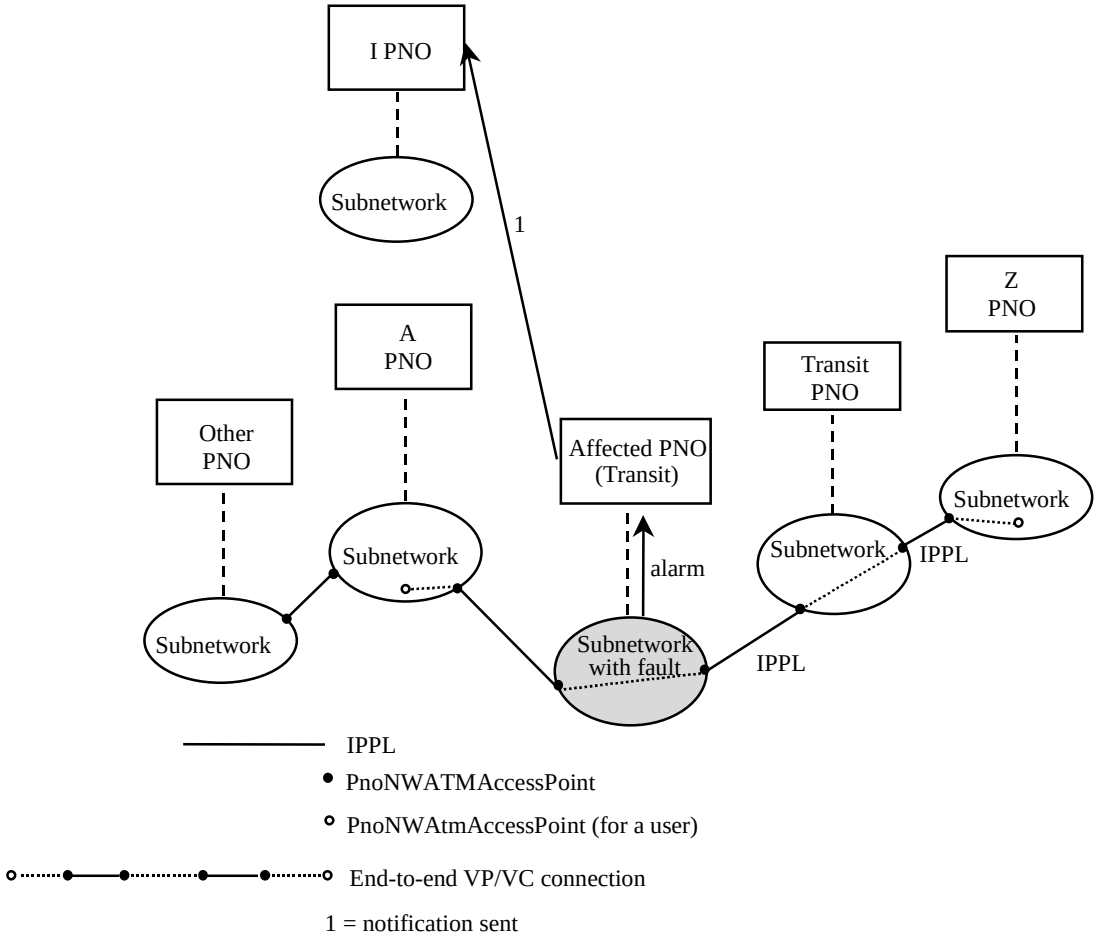


Figure 6: Alarm reporting management when a sub-network fails

If a sub-network fails, its INMS (**alarm management**) should inform the PNOs which are initiating PNOs of the VP/VC sub-network connections that cross the faulty Sub-network. Figure 6 represents the alarm reporting process in the case that just one VP/VC sub-network connection makes use of the faulty sub-network resources. (In this figure, the initiating PNO is not the A PNO). In this case a VPSC or VCSC alarm notification is sent to the one initiating PNO indicated. Clearly, the process would have to be repeated "n" times for "n" different subnetwork connections using alarms emitted from the faulty sub-network at the time of failure.

Case 2

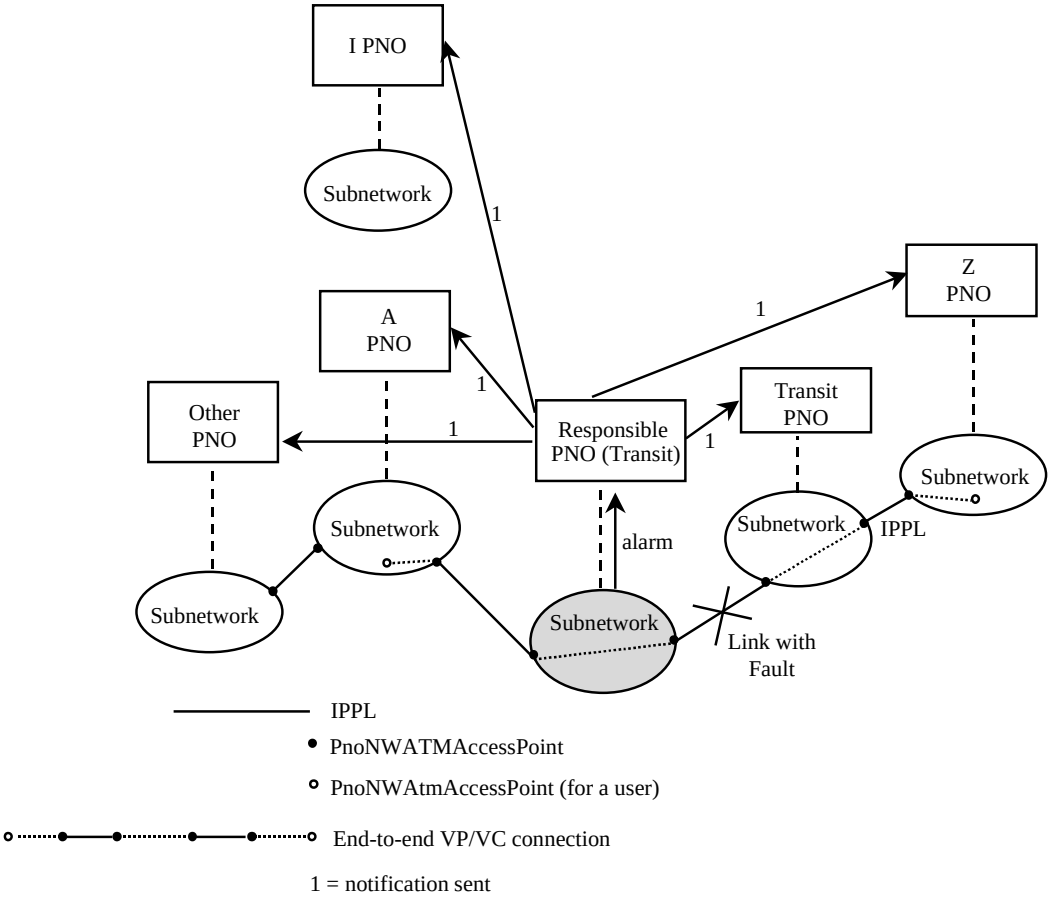


Figure 7: Alarm reporting management when an Inter-PNO Physical Link fails

Each IPPL should have a PNO assigned as responsible in terms of its **alarm management**. It is presumed that this assignment will be by bilateral agreements pending the availability of standardization on this issue.

If an IPPL fails, only the "responsible" one of the two PNOs connected by the link should forward the associated failure notification through the X-interface.

The responsible PNO informs all the other PNOs interconnected with an X-interface about the **alarm management** process of the Inter PNO Physical Link, even if they have no VP/VC connection in common. The reason for informing all the PNOs is that the Topology Information of each PNO should be updated. This is especially important in case of an unrecoverable failure when a corresponding unrecoverable failure notification is sent to all PNOs interconnected with an X-interface.

9 Management information

9.1 Relationships

This subclause lists the Managed Objects, Inheritance Tree and Naming Tree relating to the ATM VP/VC **alarm management** X-interface. A relationship can also be drawn with respect to ITU-T Recommendation M.3400 [10] and the ITU-T Recommendation X.7xx series

9.1.1 Managed objects

For the purpose of defining alarm reporting functions the necessary resources are described as follows:

PnoVpSubnetworkConnection [1**]:** represents a VP connection across a PNO sub-network. This connection is seen by the Origin PNO as a whole, with no details regarding the way the connection is composed inside the PNO domain.

PnoVcSubnetworkConnection [1**]:** represents a VC connection across a PNO sub-network. This connection is seen by the Origin PNO as a whole, with no details regarding the way the connection is composed inside the PNO domain.

pnoNWAtmAccessPoint: represents the access point to the ATM PNO Sub-network, or in other words, it represents an endpoint of a physical link at the cell level between two PNOs. Each IPPL is terminated by two pnoNWAtmAccessPoints which are in charge of emitting alarm notifications when detecting failures related to the link or to the access point itself.

log: described in ITU-T Recommendation X.721 [9]. Each PNO can implement up to three logs in its VP/VC Alarm Reporting Management system. These are the "Sent Alarm (SA)", Qualified Alarm (QA) and Received Alarm (RA) Logs respectively. Only the SA Log is visible over the X-interface and mandatory. It allows the other PNOs to consult the events sent by the affected PNO. (The other two logs are optional and not visible over the X-interface. Briefly, the RA Log will record alarms received over the X-Interface and the QA Log will be used to collect alarms and ensure avoidance of alarm persistence and duplication).

eFD: described in ITU-T Recommendation X.721 [9]. It is not visible over the X-interface but its functionality - or a comparable one is needed to send the events through the X-interface.

alarmRecord: described in ITU-T Recommendation X.721 [9] for alarm event logging.

objectCreationRecord: described in ITU-T Recommendation X.721 [9] for logging the creation of objects.

objectDeletionRecord: described in ITU-T Recommendation X.721 [9] for logging the deletion of objects.

stateChangeRecord: described in ITU-T Recommendation X.721 [9] for logging changes of state attributes.

attributeValueChangeRecord: described in ITU-T Recommendation X.721 [9] for logging changes of attributes values.

9.1.2 Inheritance tree

The inheritance tree of the log objects is shown in figure 8.

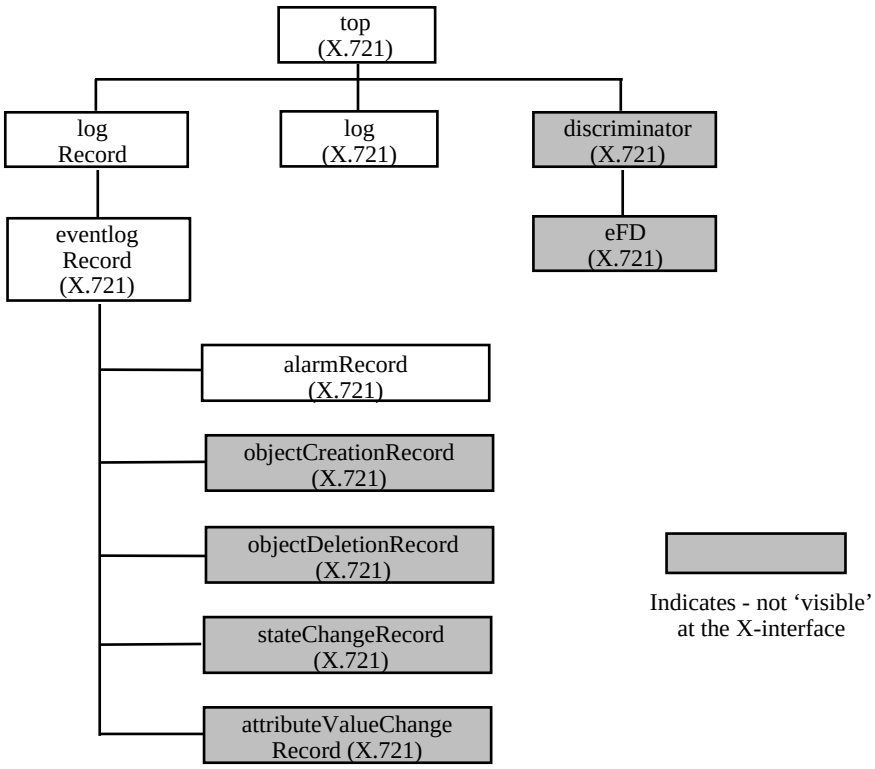


Figure 8: Inheritance tree

9.1.3 Naming tree

To fulfil the management services described in clause 6, the object classes shown in the Naming tree in figure 9 are used. Note that subclauses 9.2 and 9.3 provide details of this Information Model in GDMO and ASN.1 terms.

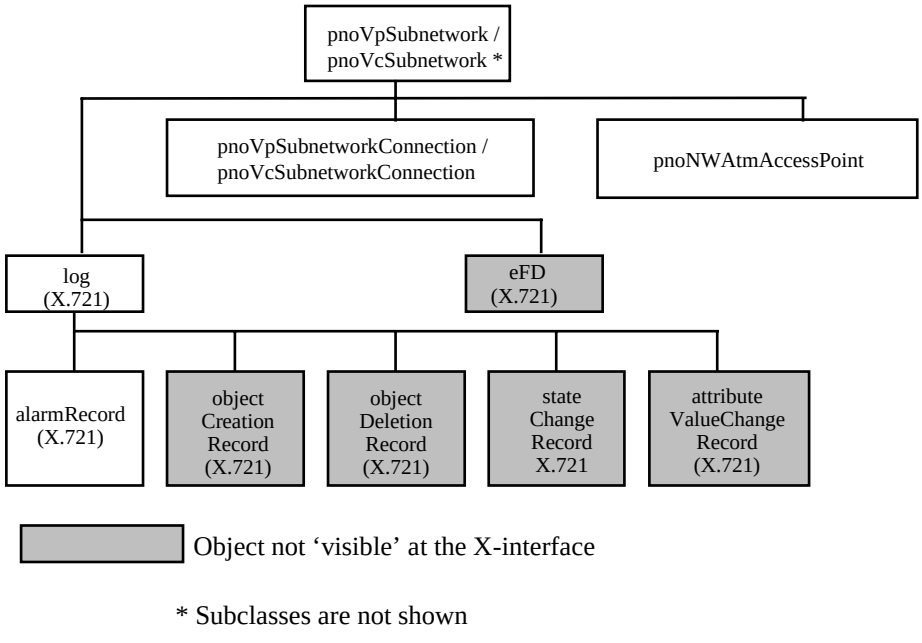


Figure 9: Naming tree

In figure 9, subclasses are not shown. This means that the objects indicated by (*) are subject to enhancement in accordance with revisions to [1] and should be used in X-interface implementations in accordance with such revisions.

IPPL failures are related to the pnoNWAtmAccessPoint object class while the VPSC / VCSC failures relate to the pnoVpSubnetworkConnection or pnoVcSubnetworkConnection object class. Accordingly, it is necessary to include both object classes in the naming tree.

The log object class represents the complete set of alarm records without specifically distinguishing for pnoVpSubnetworkConnection or pnoVcSubnetworkConnection and for pnoNWAtmAccessPoint.

The discriminatorConstruct attribute (type defined as CMISE Filter) of the dedicated log object instance(s) has to be set in accordance with the required event reports (Alarm Notifications) received across the X-interface to enable the creation of the corresponding object instances of eventLogRecord subclasses. This approach covers the requirements for RALog Records.

Read access to the Sent Alarm log records across the X-interface of any PNO could be enabled by setting the authorization profiles accordingly.

In the present document, a PNO is not obliged to allow other PNOs the control over the forwarding of events across the X-interface. This event-forwarding is controlled by the Agent locally, which is in accordance with ITU-T Recommendation X.734 [11], annex B.1.

Therefore, in this specification, an Agent is not obliged to use an eFD (X.721 [9]: eventForwardingDiscriminator, ITU-T Recommendation X.721 [9]) to send Notifications over the X-interface, and thus the eFD needs not to be visible over the X-interface.

However, its functionality -or a comparable one- is needed within the alarm management System for sending the different alarm management messages, as described in clause 7, Alarm notification.

The notifications crossing the X-interface are described in the alarm management specification normally within the behaviour description of the object classes. The parameters contained in these notifications are also defined.

NOTE: The following information could be used for implementation.

The requirements for SALog Records are covered by setting the discriminatorConstruct attribute of the dedicated eventForwardingDiscriminator object instance(s) in accordance with the required event reports (Alarm Notification) to be sent across the X-interface. The event reports then can be logged, forwarded or displayed by the adjacent OS.

The requirements of QALog Records could be covered in the same way as the sent/received records.

9.2 X-interface GDMO description

For the GDMO description refer to EN 300 820-1 [1].

9.3 X-interface ATM VP/VC alarm management ASN.1 module

The ASN.1, ITU-T Recommendation X.208 [12], module below provides an abstract syntactical description of the X-interface GDMO. As such, it gives an implementation and platform independent description of the object classes required in the interface definition.

```
ASN1XatmVpNotificationModule {ITU-T(0) identified-organization(4) etsi(0) (820) informationModel(0)
asn1Module(2) asn1TypesModule(0)} or

ASN1XatmVcNotificationModule {ITU-T(0) identified-organization(4) etsi(0) (820) informationModel(0)
asn1Module(2) asn1TypesModule(0)}

DEFINITIONS

BEGIN

IMPORTS SpecificProblems, SpecificIdentifier

FROM {joint-iso-ITU-T ms(9) smi (3) part2(2) asn1Module(2) 1};

xfSpecificProblems OBJECT IDENTIFIER::= {ITU-T(0) identified-organization (4) etsi (0) (820)
informationModel(0) specificExtension(0) xialarm (0)}

cleared SpecificProblems::= globalValue: {xfSpecificProblems 0}

protectionSwitched SpecificProblems::= globalValue: {xfSpecificProblems 1}

under-recovery SpecificProblems::= globalValue: {xfSpecificProblems 2}

unrecoverable SpecificProblems::= globalValue: {xfSpecificProblems 3}

END
```

Annex A (informative): Security aspects

With regard to access control as seen from a particular PNO's point of view the next table should be considered:

Table A.1

Object class	Access to the instances in accordance with the GDMO definition of the Object Class for:	Alarm Notifications are sent to:
PnoVpSubnetworkConnection or PnoVcSubnetworkConnection	See EN 300 820-1 [1]	Only the PNO that requested the creation of the instances involved. (Initiating PNO)
pnoNWAtmAccessPoint	See EN 300 820-1 [1]	All other PNOs
alarmRecord, regarding pnoVpSubnetworkConnection-alarms or pnoVcSubnetworkConnection-alarms	Only the PNO that requested the creation of the pnoVpSubnetworkConnection or pnoVcSubnetworkConnection instances involved. (Initiating PNO) (Note 1)	-
alarmRecord, regarding pnoNWAtmAccessPoint-alarms.	All PNOs	-
log	Only GET on logId allowed (Note 2)	-
NOTE 1: A Manager, trying to read from alarmRecord all Instances that regard pnoVpSubnetworkConection-alarms or pnoVcSubnetworkConection-alarms shall only get the Instances in which he is the initiating PNO (I PNO). Whether this attempt to read all instances should be registered is a matter for "Security Management". NOTE 2: This log is not manageable over the X-interface, it is used as base for scoped GETs only.		

In general, the usage of a "closed user group" is suggested; only PNOs that are in the closed user group are allowed to set up an association with the appropriate PNO.

How this access control is implemented is not within the scope of the present document.

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

EN 300 820-3: "Telecommunications Management Network (TMN); Asynchronous Transfer Mode (ATM) management information model for the X interface between Operation Systems (OSs) of a Virtual Path (VP)/Virtual Channel (VC) cross connected networks; Part 3: VP Performance management".

History

Document history		
V1.2.3	July 1998	Publication.
V1.2.5	February 2000	Public Enquiry PE 200023: 2000-02-09 to 2000-06-09