ACTS GUIDELINE
NIM-G2

A GENERIC INFORMATION MODEL
FOR ACCESS NETWORKS

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Contents

1. EXECUTIVE SUMMARY ................................................................. 3
2. SCOPE .......................................................................................... 4
3. TARGET AUDIENCE .................................................................. 4
4. RECOMMENDATIONS ............................................................... 4
5. STATE OF STANDARDISATION .................................................. 4
   5.1. OVERVIEW ........................................................................... 4
   5.2. STANDARDS RELATED TO THE GENERIC INFORMATION MODEL ............. 5
6. DEVELOPMENT TRENDS ............................................................ 5
7. STATE OF THE ART ................................................................. 6
   7.1.1. Network Information Model ................................................ 7
   7.1.2. Network Element Information Model .................................... 7
   7.1.3. The Communications Aspects - CMIP ..................................... 7
   7.2. THE GENERIC INFORMATION MODEL FOR ACCESS NETWORKS .................... 7
      7.2.1. Information Model .......................................................... 7
           7.2.1.1. Introduction .............................................................. 7
8. REFERENCE APPLICATIONS ..................................................... 9
9. SUPPORTING DOCUMENTATION ............................................. 9
1. Executive Summary

A Generic Information Model for Access Networks has a key role to play in achieving interoperability between management systems. Sometimes, only the communications aspects (the so called “protocol stack”) of standard management interfaces (the X or Q interfaces) are considered. The system functionality tends to be represented in a proprietary way, in spite of the use of a standard description language. To achieve full interoperability it is important to take into account not only “how” the information is described and transferred but also “what” is represented by the transferred information.

Management interoperability offers network operators the benefits of system interworking and reduced operational costs.

In the access area these two factors are even more important. This is because the “variability” in the access area prevents a single solution from being applicable to all situations. A number of “optimal” solutions need to be devised, each tailored to a particular set of typical situations. This results in large variety of systems to be developed, deployed and managed.

In spite of this variety of access systems, they must perform an equivalent functionality and must provide a unified management view of their functionality in order to achieve the two objectives of inter-working and cost reduction.

This guideline addresses the issue of defining a Generic Model for Access Networks and shows how it is related to the standardisation process. Work being carried out in this field, in particular on ATM based Access Networks, is described and possible future developments are discussed.

The conclusion is that an information model can be designed describing an access system in a technology independent way, compliant with standardised functional specifications for B-ISDN equipment and TMN management architectures.
2. Scope

The scope of this guideline is a technology independent representation of Access Networks as viewed by the Management System. The concepts are applicable to ATM access systems (PON, HFx, fixed wireless etc) although the focus is on ATM, VP based Access Networks, which appear to offer an high degree of flexibility but which keep complexity and system costs low.

The abstract representation of the Access Systems addresses configuration and fault management functions and is co-located at the SubNetwork layer. In the TMN layered approach, a SubNetwork Operation System (OS) is defined for managing large numbers and different types of Access Systems, relying on a technology independent representation of the Access Systems resources. The SubNetwork OS uses a TMN Q3an interface to communicate with the Network Element OS that deals with the characteristics specific to each type of Access System.

3. Target audience

The guideline is aimed at:

- Equipment manufacturers
- Network operators
- Standardisation bodies (ETSI-TM2)
- Fora (ATM-Forum NM)
- Initiatives (FSAN)

4. Recommendations

In a multi-vendor, multi-operator environment a wide range of different equipment will be deployed, but an objective should be to manage access systems using a unified approach, based on a common generic information model.

A generic information model of the type proposed allows all technology independent features to be captured. This offers maximum interoperability, since each network operator can manage each different access system in homogeneous and similar way.

A future proof definition and development of the Generic Model for Access Networks must consider evolution to support management in ONP (VB5.1 interface) and concentration in an Access Network (VB5.2 interface).

5. State of standardisation

5.1. Overview

The Generic Information Model concerns the management functionality of the Generic Access Network Operations System at SubNetwork layer, together with its relationship with the functionality of the other Operations Systems at the Network Element layer and at the Network Layer. This layering concept is derived from the TMN OS functional hierarchy.

Design of Operations Systems needs to consider a number of activities in a number of standardisation bodies and fora. The most important are:
Section 9 'Supporting Documentation' presents a list of standard Recommendations. The most active bodies on the definition of Information Models are ITU and ETSI. However, the general areas covered by all the bodies are outlined below identifying the aspects related to the realisation of the Information Models.

- ITU, ETSI and AF, being involved in all aspects of ATM standardisation, play a particularly important role when considering Management Information Models. In particular, ETSI-TM2 addresses this issue directly.
- Of the NMF areas relevant to OSs design (Omnipoint, SPIRIT, SMART), only Omnipoint is relevant. It collects standards covering items such as stack profiles and managed object definition.
- IETF is the source of TCP/IP and UDP protocol stacks and of the Simple Network Management Protocol (SNMP). SNMP might play a role at Network Element layer, but does not appear suitable for the management at the Network layer.
- OMG is defining a reference framework for a Common Object Request Broker Architecture (CORBA) which is important for standardised object based interoperability. The framework foresees the presence of various areas such as Common Object Services, Common Facilities and Application Objects. It is important to note that OMG is directly involved in only the first two areas whilst the Generic Information Model is eventually implemented in Application Objects. In a client-server approach OMG services and facilities can be seen a server-layer for the Information Model but no direct liaison with OMG is to be envisaged.
- TINA-C is defining a technical framework for the support of future telecommunications services. These services will operate in a Distributed Processing Environment. TINA-C is often claimed to be a comprehensive and very influential framework on future OSs design. The overall architecture comprises an operational management framework which is based on the work of OMG (object oriented technique) and ISO/ODP (ODP viewpoints). However TINA-C concepts do not have a direct implication on the definition of the Generic Information Model.

Access System issues are specifically addressed by the Full Services Access Networks initiative (FSAN). FSAN is supported by network operators and equipment manufacturers and aims to reduce the initial cost of Access Network deployment. FSAN addresses all aspects of Access Networks and a group has been created specifically on network management. A follow up of FSAN (FSAM, Full Services Access Management) is already under discussion, its the mandate being to investigate how running costs for Access Networks can be reduced. The definition of a Generic Information Model for Access Networks will contribute to this goal.

5.2. Standards related to the Generic Information Model

The standards relating to the definition of a proper generic information model for access networks are listed in Section 9 'Supporting Documentation'.

6. Development Trends

The Generic Information Model for Access Networks is expected to evolve as described below. The projected dates should be regarded as indicative and not as fixed milestones.
A first version of a Generic Information Model for Access Network has been available since mid 1996. This version was closely related to an ATM PON system and showed its origin in several points. It is still evolving but should reach a more stable state by mid 1998.

It is worth noting that ETSI intends to specify the management of generalised Access Networks and to cover the production of Q-type interfaces for Operation and Maintenance of Access Networks in the document DE/TM-02227 [1].

The VB5 interface (in the two flavours VB5.1 and VB5.2) plays a key role when using Access Systems in the context of Open Network Provision. The information model needs to take the implications of this into account and be updated accordingly. This work has already started for VB5.1 (1997) and it is expected to be up to date until the end of 1998. From then on, VB5.2 will take over by adding concentration capabilities. However work on the implications of VB5.2 on the information model has not yet started and is expected to continue into 1999.

The relevant documents are two ETSI drafts addressing the management aspects of VB5: DE/SPS-03049-1 [2] (VB5.1) and DE/SPS-03045-1 [3] (VB5.2).

The final visionary step concerns evolution towards a generic photonic access system information model. Research projects are already working (1997) on information models for photonic networks. The incorporation/integration of results into the model for the access systems could start in 1998 and continue until at least 2000.

7. State of the Art

The generic information model for access networks is co-located at the SubNetwork layer, which exchanges information with the Network Layer (management of the ATM access points and related ATM connections in the access network as well as of the access network as a whole), and with the Network Element Layer (management of the physical components of the access network and related ATM connections). The model can be considered as an intermediate representation between the information models at the network layer and the network element layer.

Figure 1 shows the location of the generic access network information model in the TMN hierarchy.

![Figure 1 - The generic access network information model in the TMN hierarchy](image)
7.1.1. Network Information Model

The Network Information Model is dealt with in the ETSI NA4-3316 recommendation [4]. However, this recommendation is too generic and the ATM requirements are not covered by the general Information Model. The network Managed Objects classes defined for the access network, use the standard attributes and inherit from the MO classes defined in this recommendation.

7.1.2. Network Element Information Model

The Information Model at the Network Element is dealt with in the ITU-T recommendation I.751 [5]. This recommendation provides management requirements and an information model that pertain to the plane management of the ATM network element. Such information is modelled using design principles outlined in recommendation X.720 [6].

This recommendation uses the generic object classes of the recommendations X.721 [7], M.3100 [8], Q.821 [9] and Q.822 [10] to provide an information model specific to the ATM network element. Functional capabilities of the ATM Network Element are given in recommendations I.731 [11] and I.732 [12].

7.1.3. The Communications Aspects - CMIP

A Managed Object is described in terms of attributes, notifications and actions. Operations on Managed Objects are performed via a standardised Common Management Information Protocol (CMIP) (ITU-T X.711 [13]). The communication model has been designed around the management information model: every management exchange is expressible in terms of the management operations get, set, create, delete, action and event report. These are the operations of CMIP.

7.2. The Generic Information Model for Access Networks

7.2.1. Information Model

7.2.1.1. Introduction

As stated in ITU-T Recommendation M.3010 [14], there are many possible physical configurations that could implement the TMN functions.

Figure 2 shows the reference configuration for access networks which provide multiplexing, bandwidth management and concentration functions for virtual path links. Ownership scenario, management domains and relevant management interfaces (Q3, X) are also shown in the figure. The X and Q3 interfaces are used by the TMN of the ATM network to monitor and/or control the network elements in the access network. The use of standard X and Q3 interfaces allows maximum flexibility in planning communications functionality. There is a set of protocol suites for the Q3 interface. The choice of lower protocol layers is dependent on the implementation requirements of the physical configuration. For the Q3 family, it is recommended that each set of TMN application functions with similar protocol needs is supported with the same protocol profile for the upper layers. Profiles of the lower and upper protocol layers are specified by the ITU-T recommendations Q.811 [15] and Q.812 [16] respectively.
The VP based access network sets-up/releases virtual path connections (VPCs) as a result of management actions. Call set-up/release procedures will have to be handled via the VB5.2 interface, when this interface is available. ATM Layer functions at the Management Interface located between the Access Network Element and the Access Network management Operations System have to be modelled using design principles outlined in ITU-T Recommendation X.720 [6], “Management Information Model”.

The main recommendations to be applied are: ITU-T M.3100 [8], X.721 [7], and I.751 [5].

The generic information model for access networks describes the sub-network management view present at the Q3nn reference point, harmonising and integrating a number of different Q3an information models resulting from different types of Access Systems.

Resources are modelled as objects. Within Access Networks, some of the standard objects may be reused. Additional objects (management support objects) are defined to support AN management functions. The basic management functions represented in the Information Model are related to configuration, performance and fault management.

The entity relationship diagram is shown in Figure 3.
The main characteristics are briefly described below.

<table>
<thead>
<tr>
<th>Object</th>
<th>Main characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>AtmAccessNetworkME</td>
<td>Administrative and Operational State</td>
</tr>
<tr>
<td>&amp;tcAdaptorTTPBidirectional</td>
<td>AccessProfile (Ingress/Egress Bandwidth limitations, VPC allowed and range)</td>
</tr>
<tr>
<td></td>
<td>currentData (statistics on the traffic), vpCTPlist (associated vpCTPs)</td>
</tr>
<tr>
<td>uni / nni</td>
<td>TTPAdaptorReference, loopbackId, trafficLoad</td>
</tr>
<tr>
<td>eqTport / eqVport</td>
<td>Type, Administrative and Operational States of interfaces</td>
</tr>
<tr>
<td>AtmFabric</td>
<td>Administrative and Operational State, Availability status, list of cross-connections</td>
</tr>
<tr>
<td>AtmCrossConnection</td>
<td>Administrative and Operational State, VP identifiers</td>
</tr>
<tr>
<td>VpCTPBidirectional</td>
<td>VPid (up/downstream), traffic descriptors (UPC), QoS</td>
</tr>
</tbody>
</table>

The `atmAccessNetwork` object represents the Access System as a whole, providing for state management.

The `tcAdaptorTTPBidirectional` object represents the adaptation of the ATM layer to the underlying physical infrastructure. ATM Access profile information is included. Fault management (loss of ATM cell delineation) and performance monitoring are supported.

The `uni / nni` objects are used to configure and identify an ATM interface as User Network Interface (UNI) or Network Node Interface (NNI). It is associated to a `tcAdaptorTTPBidirectional` objects and provides also for OAM purposes (loopback, traffic load).

The `eqTport` and `eqVport` represents AN physical ports as linked to `tcAdaptorTTPBidirectional` object. State management is provided. The type of physical interface is shown in order to support a variety of architectures.

The `atmFabric` object represents the function of managing the establishment an release of ATM cross-connections. Administrative and operational state management is supported as well as the availability status to report a degraded functionality while still available for service (operational state is “enabled”).

The `atmCrossConnection` object represents an ATM cross-connect relationship between (bidirectional) links terminating in the AN. State management is supported. Referencing to a couple of `vpCTPBidirectional` objects, the information about connection identifiers (VPI) translation is provided. The `vpCTPBidirectional` objects is used to represent the termination of a VP link. Included is information about the VP link identifier (VPI), traffic descriptors, and Quality of Service (QoS).

### 8. Reference Applications

The concepts developed in this guideline are being validated in the ACTS project BONAPARTE, which is developing an Access Network Management Operation System at element, sub-network and network layers.

### 9. Supporting Documentation

2. Draft ETS DE/SPS-03049-1, “Q3 interface specification for VB5 reference points for the support of broadband or combined narrowband/broadband access networks; Part 1: Q3 interface specification for VB5.1 reference points
3. Draft ETS DE/SPS-03045-1, “Q3 interface specification for VB5 reference points for the support of broadband or combined narrowband/broadband access networks; Part 1: Q3 interface specification for VB5.2 reference points”
5. ITU-T Recommendation 1.751 - “Asynchronous Transfer Mode (ATM) Management of the Network Element View”


