The ATM Forum

Technical Committee

ATM Test Access Function (ATAF)

Version 1.0

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Acknowledgements

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Gregan Crawford (Test Working Group Chair)

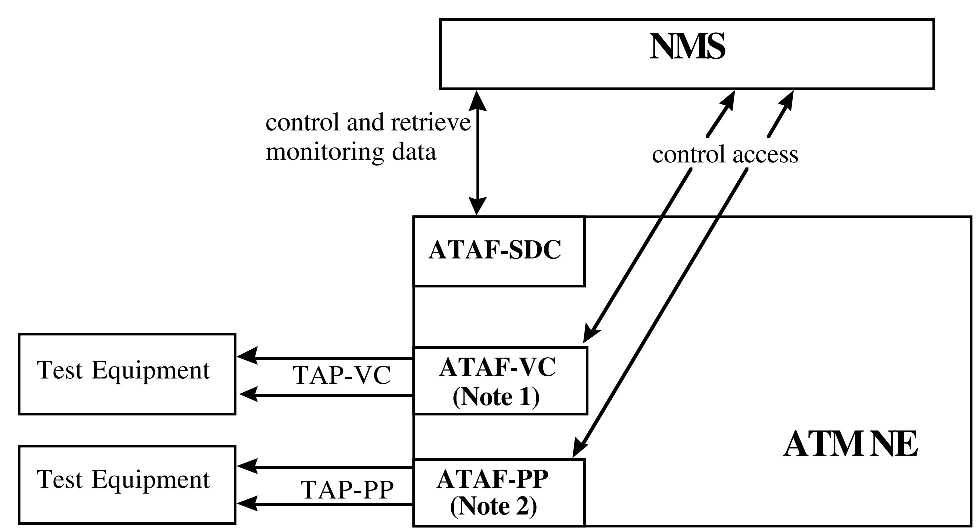
1. Introduction

This specification describes the ATM Test Access Function (ATAF). The purpose of ATAF is to identify methods of access to an ATM cell stream. Three methods of ATAF are specified, Physical Port Mirroring, Virtual Connection Access and Signaling Data Capture. Each method provides a distinct way of monitoring a cell stream. For the purpose of this specification, the word monitoring means observing.

Physical Port Mirroring provides test access to a complete unprocessed cell stream through a physical connection(s) at the switch. Virtual Connection Access provides the capability to access one or more connections (VPC or VCC) via a remotely accessible test access port(s). Signaling Data Capture allows the operator to view data captured from a selected cell stream through a network management system.

2. ATM Test Access Function NE Requirements

The following figure is used as a reference figure to describe the ATM Test Access Function (ATAF) NE requirements.



Note 1: The ATM cell stream being monitored may pass through the ATM NE switch fabric before being placed onto TAP-VC.
Note 2: See (R) PP-3

Figure 2-1. ATAF Reference Figure

An ATM NE may choose to support any one, two, or all three categories of ATAF functions:

- ATAF-PP: ATAF Physical Port Mirroring
- ATAF-VC: ATAF Virtual Connection Access
- ATAF-SDC: ATAF Signaling Data Capture.

The remainder of Section 2 provides requirements for:

- ATAF-PP, including its associated Test Access Path (TAP-PP) interface to test equipment, and its optional control link interface to an NMS
- ATAF-VC, including its associated TAP-VC interface to test equipment, and its required control link interface to an NMS
- ATAF-SDC, including its control and data retrieval interface to an NMS.

2.1 ATAF-PP Requirements

2.1.1 ATAF-PP Functional Requirements

ATAF-PP is a monitoring/mirroring function which maps (mirrors) the whole bit stream on a port to a designated monitor port (TAP-PP). No VP/VC selection is involved.

(R) PP-1 ATAF-PP shall provide a method for non-intrusive monitoring of the complete data stream.

There may be many ports within the NE. Selecting a port for monitoring must not affect the traffic on any of the ports.

(R) PP-2 ATAF-PP shall provide access for any ports on the NE.

(R) PP-3 The data stream shall be monitored before the ATM switch performs any cell processing.

This requirement allows the network provider to see exactly what the customer or network provider is sending in the data stream. As an example this would be helpful in analyzing signaling messages with all of their information elements.

2.1.2 TAP-PP Interface Requirements

A TAP-PP is a physical layer connection that carries an ATM cell stream under test from the ATM NE (ATAF-PP function) to the ATM Test Equipment.

(R) PP-4 In order to monitor a single bi-directional ATM connection, two TAP-PP interfaces must be used (one for each direction of traffic being monitored).

(R) PP-5 The TAP shall not degrade the ATM cell stream(s) under test.

(R) PP-6 All traffic on the port being monitored must be mirrored, including signaling, OAM, ILMI, idle cells, etc.

(R) PP-7 The full duplex mirrored traffic streams transmitted by the monitor port(s) to the test equipment must duplicate the original traffic stream(s) in timing, speed, and quality of service parameters.

(R) PP-8 NEs that support ATAF-PP shall provide physical layer connections for the purpose of observing the mirrored cell stream(s).

(R) PP-9 NEs that support ATAF-PP shall provide a method for selecting the port to be mirrored.

(R) PP-10 The physical layer interfaces for TAPs shall be dedicated to ATM test access traffic only; other traffic types (including control link messages) shall not be multiplexed onto these interfaces.

2.1.3 ATAF-PP Control Link Interface Requirements

(O) PP-11 Port selection may be done by means of console commands or a NMS.

(O) PP-12 The ATAF-PP control link interface is an optional feature of ATAF-PP. If provided, it will allow an NMS to control the ATAF physical port mirroring function in the ATM NE. If provided, the NMS shall be able to perform all of the following functions:

- selection of port to be mirrored
- selection of TAP-PP to be used to carry mirrored traffic to test equipment
- activation/deactivation of mirroring function.

2.2 ATAF-VC Requirements

Virtual Connection Access provides the capability to access one or more connections (VPC or VCC) via a remotely accessible test access port.

2.2.1 ATAF-VC Functional Requirements

(R) VC-1 Except for the full splitting test access case which is optional, ATAF-VC shall provide a method for non-intrusive monitoring of the selected logical connection.

There may be many virtual connections within particular data streams. Selecting a virtual connection for monitoring must not affect the other virtual connections.

(R) VC-2 The data stream(s) shall be monitored after the ATM switch performs its cell processing functions.

(R) VC-3 ATAF-VC shall provide test access to any VC including the signaling channels by a remote test system.

(R) VC-4 ATAF-VC shall provide test access to any non-terminated VP by a remote test system.

(R) VC-5 The cell stream(s) available to the remote test system shall contain all valid (except unassigned) cells present at the monitoring point of the monitored connection.

2.2.2 TAP-VC Interface Requirements

TAP-VC is an ATM layer connection that carries an ATM layer cell stream under test from the ATM NE (ATAF-VC function) to the ATM Test Equipment.

(R) VC-6 In order to monitor a single bi-directional connection, two TAP-VC interfaces must be used (one for each direction of the traffic being monitored).

(R) VC-7 The TAP-VC interface shall be provided in accordance with ATM Forum ATM Layer specifications.

2.2.3 ATAF-VC Control Link Interface Requirements

The purpose of the control link is to provide a standard interface for controlling the NE's test access functions from a remote site (e.g., from a centralized network management system).

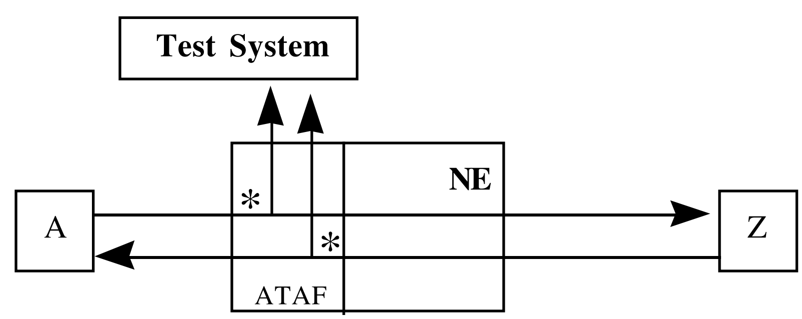
(R) VC-8 In support of ATAF-VC, the M4 Interface shall provide the management system the ability to connect one direction of a bi-directional ATM cell stream (VCL or VPL) to a TAP-VC, and connect the other direction of the bi-directional ATM cell stream to a second TAP-VC.

(R) VC-9 The M4 Interface shall provide the management system the ability to disconnect an ATM cell stream from a TAP-VC.

(R) VC-10 The ATAF-VC shall allow selection of the ATM cell stream under test as follows:

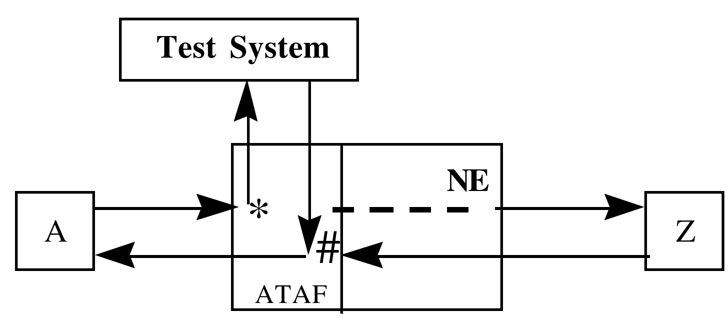
- VC - Selectable by interface identification and VPI/VCI
- VP - Selectable by interface identification and VPI

(O) VC-11 The M4 Interface shall support management system requests to change the test access mode of an accessed ATM cell stream among the following test access modes: monitor traffic leaving NE (see Figure 2-2), monitor traffic entering NE (see Figure 2-2), split away from NE (see Figure 2-3), split towards NE (see Figure 2-4).



* = point at which ATM cell stream is copied and sent to test system
Note: While two access points are required for bi-derectional monitoring, only one access point would be used in a uni-directional monitoring scenario.

Figure 2-2. “Monitoring” Test Access



* = point at which ATM cell stream is diverted to test system
(Note that if any cells are not involved in the test, they would not b
disrupted)
= any cells that are associated with the ATM cell stream under test get dropped at this point

Figure 2-3. “Full-Splitting” Test Access
(Split Direction is Away from NE (Optional))

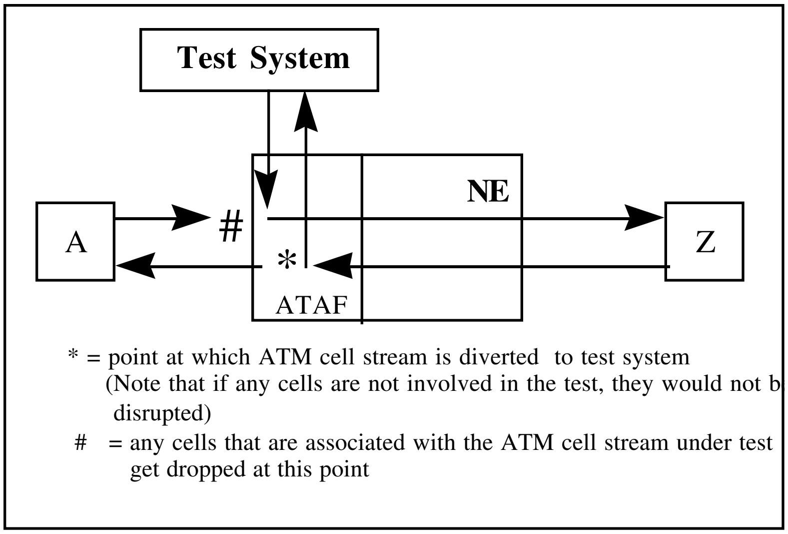


Figure 2-4. "Full-Splitting" Test Access
(Split Direction is Towards NE (Optional))

2.3 ATAF-SDC Requirements

2.3.1 ATAF-SDC Functional Requirements

The data capture activity applies to both the receive and transmit side of ATM Access and Interoffice signaling channels, and it consists of maintaining a log of SSCOP PDUs and a log of information about related timer expiration events. The timer expirations may be for SSCOP timers or timers related to a higher protocol level. Such a log may be activated for an SSCOP connection to gather diagnostic information. It may be activated when a problem is observed, or, more pro-actively, a log may be activated on selected signaling channels on an ongoing basis so maintenance personnel will have immediate access to diagnostic information. This alternative may be invoked when an problem is suspected. The pro-active approach may require more simultaneous logs and hence more resources.

In order to fully understand a sequence of states at one end of an SSCOP connection to diagnose problems, it is important to know the order in which PDUs were sent, received, and when timers expired. This allows analysis of the state transitions that occurred. Thus, a single log is indicated.

(R) SDC-1 ATAF-SDC shall be provided by ATM NEs and requires the support of a log that monitors both the transmit and receive direction of a signaling channel. The logging capability shall be activated/deactivated independently from any other protocol monitoring activities. When the log is full, new information shall replace the oldest information in the log. The ATM NE shall be capable of logging SSCOP PDUs and timer expires for at least 10% of its access signaling channels at any given time, and for at least 5 separate interoffice signaling channels at a given time.

- The log shall maintain entries for the most recent SSCOP PDUs or timer expiries of a connection. For access signaling channels, the log needs to be capable of storing 100 large SSCOP PDUs. For interoffice signaling channels, the log needs to be capable of storing 1000 large SSCOP PDUs. Log information from one SSCOP connection shall not overwrite information from another connection.

- An entry in the log shall be made upon the transmission of an SSCOP PDU, upon the receipt of any SSCOP PDU, or upon expiry of any local SSCOP timer.

- An entry in the log shall be made upon expiry of any local DSS2 timer.

- An entry in the log shall be made upon expiry of any local BISUP timer.

- There are two types of log entries: SSCOP PDUs and timer expiries. When PDUs are logged, entries shall contain the following:

    1. Timestamp (time of log entry, accurate to the nearest ms, according to the local clock). The timestamp shall preserve the actual sequence of events.
    2. PDU. For data PDUs (SD PDU, UD PDU and MD PDU), only the last 32 octets of the information field would need to be logged to get information about SSCOP operation. However, *the entire PDU shall be logged in order to support analysis of the operation of higher-layer PDUs within the SSCOP PDUs (e.g., DSS2 or BISUP).*
    3. Whether PDU was sent or received.

- The log entry for a timer expiry event shall be as follows:

    1. Timestamp (time of log entry, accurate to the nearest ms, according to the local clock). The time recorded shall preserve the actual sequence of events.
    2. Timer identifier
    3. Timer value.
    4. Signaling Identifier for BISUP timer expiries
    5. Call Reference ID for DSS2 timer expiries

Some Additional Information

An estimate of the memory requirements follows. The SSCOP log needs to be capable of logging a modest number of worst case (i.e., big) messages such as SETUP and IAM, which can be on the order of 250 octets. For access signaling channels, in order to store 100 SSCOP PDUs, the log would need on the order of 25,000 octets of memory. For interoffice signaling channels, the log would need on the order of 250,000 octets of memory to store 1000 large SSCOP PDUs.

(R) SDC-2 ATAF-SDC shall be non-intrusive and not affect other data in the NE’s connections.

2.3.2 ATAF-SDC NMS Interface Requirements

(R) SDC-3 ATAF-SDC shall allow a Management System to activate/deactivate the logging capability and to retrieve the data that has been logged.

3. M4 "NE View" Logical MIB

3.1 MIB to Support ATAF-VC and ATAF-PP

Figure 3-1 provides a summary of the ATAF managed entities.

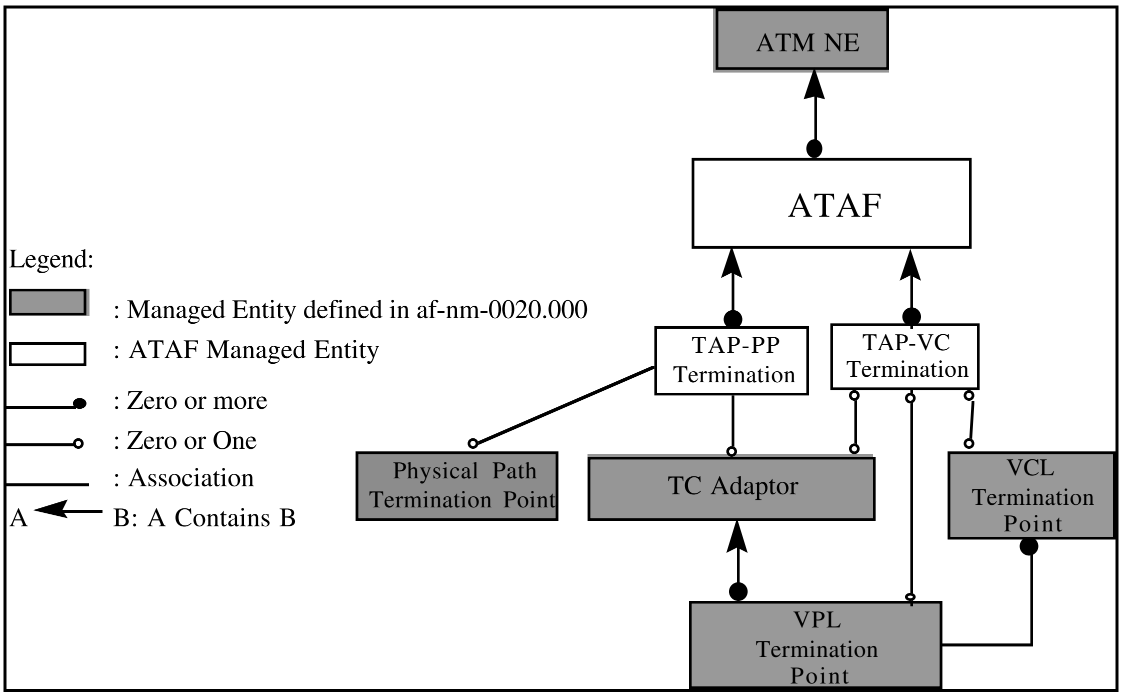


Figure 3-1. Managed Entity Relationship Diagram

The ATAF (with type VC) and TAP-VC Termination managed entities shall be supported by all ATM NEs. The ATAF (with type PP) and TAP-PP Termination managed entities only need to be supported by ATM NEs that support the optional ATAF-PP Control Link Interface (see Section 2.1.3).

For Virtual Connection Access, the ATM NE would support a single instance of the ATAF (with type VC) managed entity and multiple instances of the TAP-VC Termination managed entity. Permanent VCLs and VPLs (represented by instances of the VCL Termination Point and VPL Termination Point managed entities) would be set up between the ATM NE and the Testing System. Each of these VCLs and VPLs would be associated with an instance of the TAP-VC Termination managed entity. The resource to be accessed (for monitoring and/or testing) would be represented by the ResourceID of the TAP-VC Termination managed entity.

For Physical Port Mirroring, the ATM NE would support an additional instance of the ATAF managed entity (this second instance would be with type PP) and multiple instances of the TAP-PP Termination managed entity. Permanent high-speed facilities (represented by instances of the Physical Path Termination Point managed entity) would be set up between the ATM NE and the Testing System. Each Physical Path Termination Point would be associated with an instance of the TAP-PP Termination managed entity. The resource to be accessed (for mirroring) would be represented by an instance of the TC Adaptor managed entity.

3.1.1 ATAF

This managed entity represents the ATAF (VC or PP) functionality within the ATM NE. It is inherently created by the ATM NE. A single instance of type VC will be present in all ATM NEs. A second instance of type PP will be present only when the NE supports the ATAF-PP Control Link Interface (see Section 2.1.3).

Attributes:

ATAF Id: This read-only attribute provides a unique name for each instance of the ATAF
managed entity.

ATAF Type: This read only attribute identifies whether the ATAF managed entity is of type VC or PP.

Operational State: This read-only attribute identifies whether or not the ATAF is capable of performing its normal functions (i.e., in-service or out-of-service).

Administrative State: This read/write attribute is used to activate (unlock) and deactivate (lock) the ATAF function performed by this managed entity. A request to lock the ATAF
function may result in a transition to the shutting down state before the locked state can occur.

Usage State: This read-only attribute identifies whether or not the ATAF is idle, active, or
busy. Idle is the state in which no data streams are being accessed from the NE. Active is the state in which one or more data streams are being accessed from the NE (expect when the busy state has been reached). Busy is the state in which several data streams are being accessed from the NE such that the NE's capacity to access additional data streams has been exhausted. When busy, the ATAF will reject additional requests for test access.

Actions

Connect TAP: This action will connect one TAP-PP or one TAP-VC to a resource to be tested. Each instance of TAP-PP or TAP-VC is bi-directional but can only be used to monitor one direction of a cell stream. To monitor both sides of a bi-directional cell stream requires the use of two TAP managed entities. The following parameters shall be supplied with this action:

- Resource ID: For ATAF of type VC, this parameter contains TC Adaptor managed entity, the VPI value and Vci value (if needed) for the VP or VC that will be monitored/tested. For ATAF of type PP, this parameter contains the ID of the TC Adaptor that will be mirrored.

- Access Mode: The values to which the Access Mode attribute of a TAP-PP or TAP-VC object selected should be set. Valid values for the TAP-VC are monitor in towards NE, monitor out from NE, split in towards NE, or split out from NE. Valid values for TAP-PP are monitor in towards NE, or monitor out from NE.

- TAP Termination ID: This argument is the identifier of the TAP-VC or TAP-PP Termination used for test access and is an optional parameter. If this parameter is supplied, the ATAF should return an error if the TAP-VC or TAP-PP termination is out of service or busy. If the TAP-VC or TAP-PP Termination is available, the TAP-VC or TAP-PP Termination ID is echoed in the action reply.

- The following shall be supplied in the reply upon successful completion of the action:

    - TAP Termination ID: This parameter is the identifier of the TAP-VC or TAP-PP Termination used for test access.

Notifications

Managed Entity Creation: This notification is used to report the creation of an instance of this managed entity.

Managed Entity Deletion: This notification is used to report the deletion of an instance of this managed entity.

State Change: This notification is used to report changes to the Operational State attribute, the Administrative State attribute, and the Usage State attribute of this managed entity. The notification shall identify the state attribute that changed, its old value, and its new value.

Relationships

One instance of the ATAF managed entity (with type VC) shall be contained in an instance of the ATM NE managed entity. Optionally, a second instance of the ATAF managed entity (with type PP) may be contained in an instance of the ATM NE managed entity.

An instance of this managed entity may contain multiple instances of either the ATM TAP-VC Termination managed entity or the TAP-PP Termination managed entity depending on the value of the ATAF Type attribute.

3.1.2 TAP-PP Termination

This managed entity represents the physical and logical Test Access Path (TAP) that is used between the ATM NE and the test system. It is inherently created by the ATM NE. It may be deleted by the ATM NE or by a management system.

Attributes

TAP-PP Termination Id: This read-only attribute provides a unique name for each instance of the TAP-PP Termination managed entity.

Access Mode: This read-only attribute indicates the direction of the traffic being mirrored by the TAP-PP Termination (monitor in towards NE, or monitor out from NE). It will have a null value when the TAP is not in use.

Resource ID: This read-only attribute indicates the TC Adaptor managed entity under test associated with this TAP. It will have a null value when the TAP is not in use.

Supported By Entity: This read-only attribute indicates the Physical Path Termination Point managed entity that is performing the ATAF-PP functionality.

Operational State: This read-only attribute identifies whether or not the TAP-PP Termination is capable of performing its normal functions (i.e., in-service or out of service).

Administrative State: This read/write attribute is used to activate (unlock) and deactivate (lock) the TAP-PP Termination.

Actions

Disconnect ATM Test Access: This action is used to disconnect test access and return the
resource that was being tested back to its normal state.

Notifications

Attribute Value Change: This notification is used to report changes to attribute values of this managed entity. It applies to the following attributes: Resource ID, Directionality, and Supported By Entity.

Managed Entity Creation: This notification is used to report the creation of an instance of this managed entity.

Managed Entity Deletion: This notification is used to report the deletion of an instance of this managed entity.

State Change: This notification is used to report changes to the Operational State attribute, the Administrative State attribute, and the Usage State attribute of this managed entity. The notification shall identify the state attribute that changed, its old value, and its new value.

Relationships

Multiple instances of this managed entity may exist for each instance of the ATAF managed entity with type PP.

An instance of this managed entity shall be associated with zero or one instances of the TC Adaptor managed entity, and with zero or one instance of the Physical Path Termination Point managed entity.

3.1.3 TAP-VC Termination

This managed entity represents the physical and logical Test Access Paths (TAPs) that are used between the ATM NE and the test system. It is inherently created by the ATM NE. It may be selected by the ATM NE or by a management system.

Attributes

TAP-VC Termination Id: This read-only attribute provides a unique name for each instance of the TAP-VC Termination managed entity.

Resource ID: This read-only attribute indicates the TC Adaptor managed entity, the VPI value and VCI value (if needed) for the VP or VC connection under test that is associated with this TAP. It will have a null value when the TAP is not in use.

Access Mode: This read-only attribute indicates the access mode that the TAP-VC is performing (monitor in towards NE, monitor out from NE, split in towards NE, or split out from NE). It will have a null value when the TAP is not in use.

Supported By Entity: This read-only attribute indicates the VCL Termination Point or the VPL Termination Point managed entity that is performing the TAP functionality.

Operational State: This read-only attribute identifies whether or not the TAP-VC is capable of performing its normal functions (i.e., in-service or out-of-service).

Administrative State: This read/write attribute is used to activate (unlock) and deactivate (lock) the TAP-VC.

Actions

Change Access Mode: This optional used to change the access mode of test access that has already been established. The following parameter shall be supplied with this action:

- Access Mode (monitor in towards NE, monitor out from NE, split out from NE)

Disconnect ATM Test Access: This action is used to disconnect test access and return the resource that was being tested back to its normal state.

Notifications

Attribute Value Change: This notification is used to report changes to attribute values of this managed entity. It applies to the following attributes: Resource ID, Access Mode, and Supported By Entity.

Managed Entity Creation: This notification is used to report the creation of an instance of this managed entity.

Managed Entity Deletion: This notification is used to report the deletion of an instance of this managed entity.

State Change: This notification is used to report changes to the Operational State attribute, the Administrative State attribute, and the Usage State attribute of this managed entity. The notification shall identify the state attribute that changed, its old value, and its new value.

Relationships

Multiple instances of this managed entity may exist for each instance of the ATAF managed entity with type VC.

Instances of this managed entity shall be directly associated with one instance of a TC Adaptor and one instance of either the VCL Termination Point managed entity or the VPL Termination Point managed entity.

An instance of this managed entity may be indirectly associated with another instance of the VPL Termination Point or VCL Termination Point managed entity representing the PVC under test.

3.2 MIB to Support ATAF-SDC

3.2.1 Entity Relationship Diagram

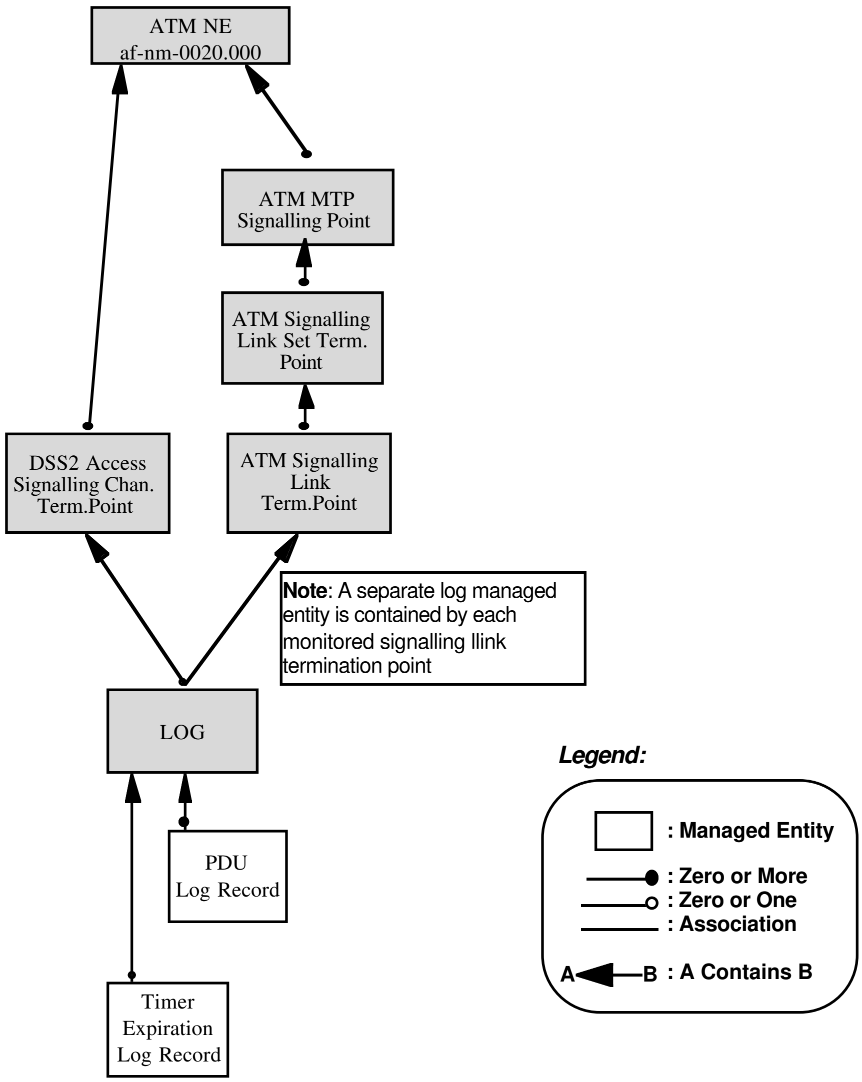


Figure 3-2. Entity Relationship Diagram

3.2.2 Managed Entities

PDU Log Record

This managed entity is used to capture transmitted and received PDUs, e.g., SSCOP received PDUs and SSCOP transmitted PDUs, that are to be retained in a log. It is used to provide information about PDUs that can be used for fault and performance trouble analysis.

Instances of this object are created and deleted by the managed system. An instance of this record is created by the managed system for each PDU that is to be logged. After the log becomes full, the newest record should replace the oldest one regardless of record type

Attributes

Managed Entity ID: This attribute provides a unique name for the managed entity instance in the ATM NE. (R) (mandatory)

Logging Time: This attribute identifies the time that the record was entered into the log accurate to the nearest millisecond. The time must preserve actual sequence of events. (R) (mandatory)

Source Entity: Pointer to the object instance that represents the ATM signaling channel that is the source of the PDU being logged, e.g., a DSS2 Access Signaling Channel Termination Point object for access channel SSCOP PDUs, or an ATM Signaling Link object for interoffice SSCOP PDUs. (R) (Mandatory)

Event Type: Identifies type of event or abnormality, if any, that caused logging of the PDU information The event type should distinguish between received and transmitted PDUs. (R) (Mandatory)

PDU Octets: Entire contents of the PDU to be retained in the log. (R) (Mandatory)

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

One record is created for each PDU to be logged. A separate instance of the Log managed entity should be created for: (1) each monitored access signaling channel (up to 10 percent of all access signaling channels terminated on the ATM NE), and (2) for up to five monitored interoffice signaling channels. A single log should be created for SSCOP received PDU Log Records, SSCOP transmitted PDU Log Records, and Timer Expiration Log Records for both the receive and transmit sides of each monitored signaling channel. Space for 100 SSCOP PDU Log Records shall be retained in the log for each monitored ATM access signaling channel, and space for 1000 SSCOP PDU Log Records shall be retained for each monitored ATM interoffice signaling channel.

Timer Expiration Log Record

This object class is used to log timer expirations. Instances of this object class provide information about timer expirations that can be used for fault and performance trouble analysis.

An instance of this record is created by the managed system for each timer expiration event that is to be logged. After the log is full, the newest record shall replace the oldest one regardless of record type.

Attributes

Call Reference ID: The Call Reference value associated with a DSS2 timer expiry. (R) (Mandatory for DSS2 timer expiries only)

Managed Entity ID: This read-only attribute provides a unique name for the managed entity instance in the ATM NE. (R) (mandatory)

Logging Time: This attribute identifies the time that the record was entered into the log accurate to the nearest millisecond. This time must preserve actual sequence of events. (R) (mandatory)

Signaling Identifier: The value of the Signaling Identifier for a BISUP timer expiry. (R) (Mandatory for BISUP timer expiries only)

Source Entity: Pointer to the object instance that represents the source of the event logged, e.g., an DSS2 Access Signaling Termination Point object for DSS2 timers, an ATM Signaling Link object for BISUP timers, or either a DSS2 Access Signaling Channel Termination Point or an ATM Signaling Link Termination Point for SSCOP timers. (R) (Mandatory)

Timer Type: Identifies the timer that expired. (R) (Mandatory)

Timer Value: Identifies the value of the timer when it expired (R) (Mandatory)

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

One record is created for each timer expiration event. A separate instance of the Log entity should be created for: (1) each monitored access signaling channel (up to 10 percent of all access signaling channels terminated on the ATM NE), and (2) for up to five monitored interoffice signaling channels. A single log should be created for SSCOP received PDU Log Records, SSCOP transmitted PDU Log Records, and Timer Expiration Log Records for both the receive and transmit sides of each monitored signaling channel.

4 . M4 CMIP MIB

The following containment diagram, inheritance diagram, managed object classes, conditional packages, attributes, name bindings, actions, and ASN.1 productions are a supplement to the existing ATM Forum CMIP Specification for the M4 Interface described in af-nm-0027.000.

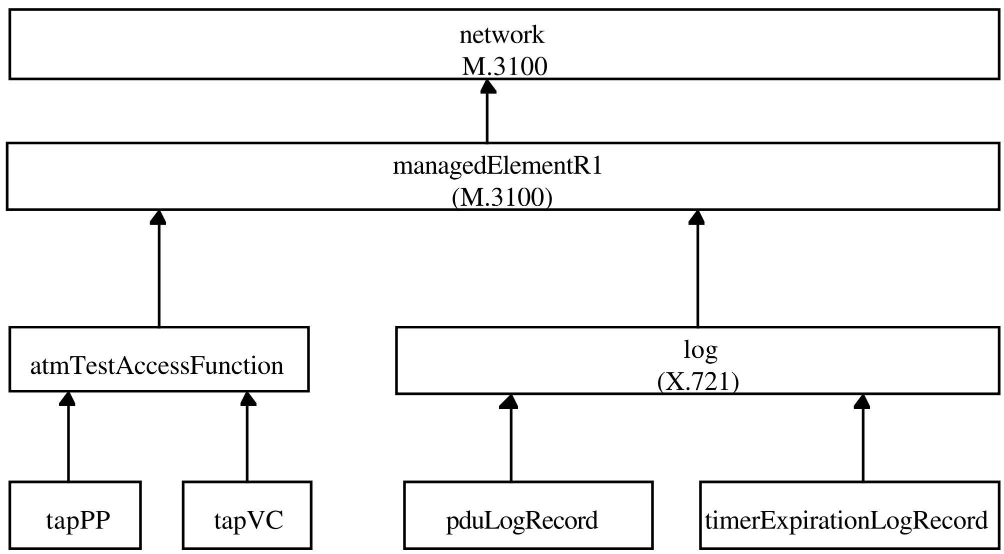


Figure 4-1. Containment Tree Diagram

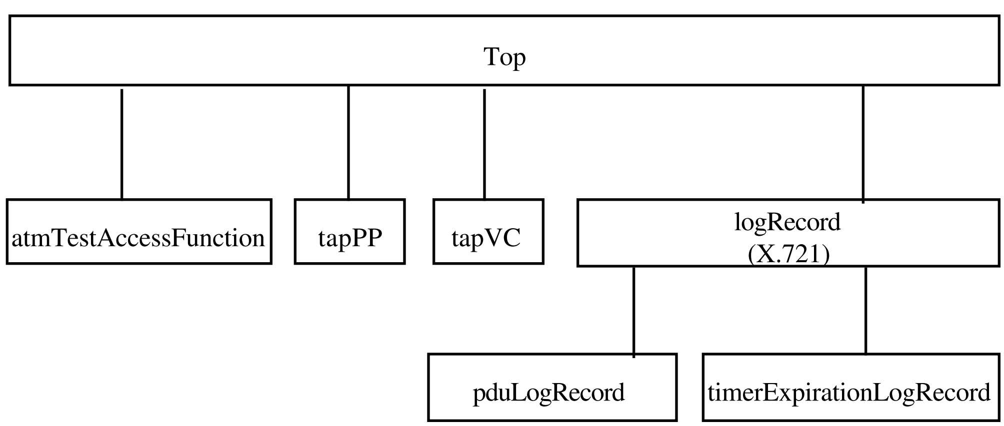


Figure 4-2. Inheritance Diagram

4.1 Managed Objects

4.1.1 atmTestAccessFunction

```
atmTestAccessFunction MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. X.721 | ISO/IEC 10165-2":top;
  CHARACTERIZED BY "ITU-T M.3100":createDeleteNotificationsPackage,
  "ITU-T M.3100":stateChangeNotificationsPackage,
  atmTestAccessFunctionPkg PACKAGE
    BEHAVIOUR atmTestAccessFunctionBeh;
    ATTRIBUTES
      atmTestAccessFunctionId
         GET
         SET-BY-CREATE,
      atmTestAccessFunctionType
         GET
         SET-BY-CREATE,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":administrativeState
         GET-REPLACE,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":operationalState
         GET,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":usageState
         GET;
    ACTIONS
      connectTap;;;
REGISTERED AS {atmfM4ObjectClass atmTestAccessFunction(33)};
atmTestAccessFunctionBeh BEHAVIOUR
  DEFINED AS
    " Instances of this object class are used to manage an ATM Test Access Function
    (ATAF) within the ATM NE. An instance of this object represents either a Physical
    Port Mirroring (PP) or a Virtual Connection Access (VC) type of ATAF.  A single
    instance of type VC will be present in all ATM NEs that support virtual connection test
    access.  A second instance of type PP will be present only if the ATM NE supports a
    control link interface for physical port mirroring access.  Instances of this object class
    are inherently created and deleted by the ATM NE.  The type of test access function
    being managed, PP or VC, is identified by the value of the testAccessFunctionType
    attribute.  An instance of this object class will contain one or more instances of the
    tapPP or tap VC object class depending on the value of the
    atmTestAccessFunctionType attribute.  Valid values of the administrativeState attribute
    are unlocked, locked, and shuttingDown.  If locked, all test access functions of the type
    represented (PP or VC) are disabled in the ATM NE. If set to shutting down, no new
    connectTap actions may be invoked, and the state will automatically change to locked
    when all associated TAPs are disconnected.";
```

4.1.2 pduLogRecord

```
pduLogRecord MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. X.721 | ISO/IEC 10165-2":logRecord;
  CHARACTERIZED BY pduLogRecordPkg PACKAGE
    BEHAVIOUR pduLogRecordBeh;
    ATTRIBUTES
      sourceEntity
         GET,
      eventType
         GET,
      pduOctets
         GET;;;
REGISTERED AS {atmM4ObjectClass pduLogRecord(34)};

pduLogRecordBeh BEHAVIOUR
  DEFINED AS
    " Instances of this object class are used to capture transmitted and received protocol data
    units (PDUs), e.g., SSCOP received and transmitted PDUs.  These log records are
    used to provide information about PDUs for fault and performance trouble analysis.
    Instances of this object class are created and deleted by the ATM NE. An instance of
    this record is created by the managed system for each PDU that is to be logged.  A
    separate instance of the superior log object class shall be created for each monitored
    entity, e.g., a signaling channel.  A single log should be used for received PDUs,
    transmitted PDUs, and any associated timerExpirationLogRecord objects. When the log
    becomes full, the newest log record should replace the oldest one regardless of type.
    The inherited loggingTime attribute identifies the time that the record was entered into
    the log.  It shall be accurate to the nearest millisecond. This time must preserve the
    actual sequence of events.  The sourceEntity attribute is a pointer to a managed object
    that represents the source of the PDU being logged, e.g., a signaling channel.  The
    eventType attribute identifies the type of event or abnormality, if any, that caused
    logging of the PDU.  The pduOctets attribute contains the entire contents of the received
    or transmitted PDU.";
```

4.1.3 tapPP

```
tapPP MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. X.721 | ISO/IEC 10165-2":top;
  CHARACTERIZED BY "ITU-T M.3100":attributeValueChangeNotificationPackage,
  "ITU-T M.3100":createDeleteNotificationsPackage,
  "ITU-T M.3100":stateChangeNotificationPackage,
  tapPPPkg PACKAGE
    BEHAVIOUR tapPPBeh;
    ATTRIBUTES
      tapPPId
        GET,
      resourceUnderTest
        GET,
      accessMode
        GET,
      supportedByObject
        GET,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":administrativeState
        GET-REPLACE,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":operationalState
        GET;
    ACTIONS
      disconnectTap;;;
REGISTERED AS {atmM4ObjectClass tapPP(35)};
```

tapPPBeh BEHAVIOUR
DEFINED AS
" Instances of this object class are used to manage the physical Test Access Path (TAP) that is used between the ATM NE and a test system. This object class is used with the Physical Port Mirroring (PP) test access function. Instances are of this object class inherently created by the ATM NE. They may be deleted by either the ATM NE or a managing system. The resourceUnderTest attribute is a pointer to an instance of the tcAdaptorTTPBidirectional object class that represents the ATM cell stream to be monitored. The suportedByObject attribute is a pointer to a physical path termination point object that represents the physical port on the ATM NE that is providing access to the TAP PP. The accessMode attribute indicates the direction of traffic being mirrored by the TAP PP (relative to the tcAdaptorTTPBidirectional under test). For this object class the valid values of accessMode are monitor egress traffic, monitor ingress traffic, and NULL (not in use). Valid values of the administrativeState attribute are locked and unlocked. If the administrativeState attribute is set to locked, then the TAP may not be used for test access until it is set to unlocked. The shuttingDown state does not apply to instances of this object class. An attributeValueChange notification is generated for changes in the value of the resourceUnderTest, accessMode, or supportedByObject attribute.";

4.1.4 tapVC

```
tapVC MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. X.721 | ISO/IEC 10165-2":top;
  CHARACTERIZED BY "ITU-T M.3100":attributeValueChangeNotificationPackage,
  "ITU-T M.3100":createDeleteNotificationsPackage,
  "ITU-T M.3100":stateChangeNotificationPackage,
  tapVCPkg PACKAGE
    BEHAVIOUR tapVCBeh;
    ATTRIBUTES
      tapVCId
          GET,
      resourceUnderTest
          GET,
      accessMode
          GET,
       supportedByObject
          GET,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":administrativeState
          GET-REPLACE,
      "ITU-T Rec. X.721 | ISO/IEC 10165-2":operationalState
          GET;
    ACTIONS
        disconnectTap;;;
CONDITIONAL PACKAGES
        changeAccessModePkg
                PRESENT IF "an instance supports it";
REGISTERED AS {atmM4ObjectClass tapVC(36)};

tapVCBeh BEHAVIOUR
  DEFINED AS
```

" Instances of this object class are used to manage the physical Test Access Path (TAP) that is used between the ATM NE and a test system. This object class is used with the Virtual Connection Access (VC) test access function. Instances of this object class are inherently created by the ATM NE. They may be deleted by the ATM NE or a managing system. The resourceUnderTest attribute is a pointer to an instance of a tcAdaptorTTPBidirectional object class, a VPI value, and , if necessary, a VCI value that identify the ATM connection to be monitored. The suportedByObject attribute points to a vcCTPBidirectional or vpCTPBidirectional object that represents the path to a remote test system, i.e., the TAP. The accessMode attribute indicates if the TAP VC is performing a monitor of ingress traffic, a monitor of egress traffic, a split toward the NE, or a split out from the NE test access function. If the tap is not in use it is set to NULL. Valid values of the administrativeState attribute are locked and unlocked. If the administrativeState attribute is set to locked, then the TAP may not be used for test access until it is unlocked. The shuttingDown state does not apply to instances of this object class. An attributeValueChange notification is generated for changes in the value of the resourceUnderTest, accessMode, or supportedByObject attribute.";

4.1.5 timerExpirationLogRecord

```
timerExpirationLogRecord MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. X.721 | ISO/IEC 10165-2":logRecord;
  CHARACTERIZED BY timerExpirationLogRecordPkg PACKAGE
    BEHAVIOUR timerExpirationLogRecordBeh;
     ATTRIBUTES
       sourceEntity
           GET,
       timerType
           GET,
      timerValue
           GET;;;
   CONDITIONAL PACKAGES
    signalingIdentifierPkg
        PRESENT IF "the instance is logging a BISUP timer expiry",
    callReferencePkg
        PRESENT IF "the instance is logging a DSS2 timer expiry";
REGISTERED AS {atmM4ObjectClass timerExpirationLogRecord(37)};

timerExpirationLogRecordBeh BEHAVIOUR
  DEFINED AS
    " Instances of this object class are used to record timer expiration events.  These log
    records are used to provide information about timer expirations for fault and
    performance trouble analysis. Instances of this object class are created and deleted by
    the ATM NE. An instance of this object class is created by the managed system for each
    timer expiry that is to be logged.  A separate instance of the log object class shall be
    created for each monitored entity, e.g., a signaling channel.  A single log should be
    used for timerExpirationLogRecord objects, and any associated pduLogRecordObjects.
    When the log becomes full, the newest log record should replace the oldest one
    regardless of type.  The inherited loggingTime attribute identifies the time that the
    record was entered into the log.  It shall be accurate to the nearest millisecond. This
    time must preserve the actual sequence of events.  The sourceEntity attribute is a pointer
    to a managed object that represents the source of the timer expiry being logged, e.g., a
    signaling channel. In the case of BISUP or DSS2 timer expirations additional
    information about the source of the timer expiry is given in the conditional
    signalingIdentifier or callReference attribute.  The timerType and timerValue attributes
    identify the type of timer that expired and its value at the time it expired.";
```

4.2 Conditional Packages

4.2.1 callReferencePkg

```
callReferencePkg PACKAGE
   ATTRIBUTES
     callReference
          GET;
REGISTERED AS {atmfM4Package callReferencePkg(29)};
```

4.2.2 change AccessModePkg

```
changeAccessModePkg PACKAGE
    ACTIONS
        changeAccessMode;
REGISTERED AS {atmM4Package changeAccessModePkg(30)};
```

4.2.3 signalingIdentifierPkg

```
signalingIdentifierPkg PACKAGE
   ATTRIBUTES
     signalingIdentifier
          GET;
REGISTERED AS {atmfM4Package signalingIdentifierPkg(31)};
```

4.3 Attributes

4.3.1 accessMode

```
accessMode ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.AccessMode;
   MATCHES FOR EQUALITY;
  BEHAVIOUR accessModeBeh;
REGISTERED AS {atmfM4Attribute accessMode(96)};

accessModeBeh BEHAVIOUR
  DEFINED AS
    " The value of this attribute indicates the access mode that a test access path (TAP) is
    using.  The value is with respect to the object that represents the resource under test.
    Valid values for the access mode include monitor egress traffic, monitor ingress traffic,
    split toward the NE (TAP VC only), split out from the NE (TAP VC only), and NULL
    (TAP not in use).";
```

4.3.2 atmTestAccessFunctionId

```
atmTestAccessFunctionId ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.NameType;
   MATCHES FOR EQUALITY;
   BEHAVIOUR atmTestAccessFunctionIdBeh;
REGISTERED AS {atmfM4Attribute atmTestAccessFunctionId(97)};

atmTestAccessFunctionIdBeh BEHAVIOUR
  DEFINED AS
    " This attribute is used to name instances of the atmTestAccessFunction managed object
    class.  ";
```

4.3.3 atmTestAccessFunctionType

```
atmTestAccessFunctionType ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.AtmTestAccessFunctionType;
   MATCHES FOR EQUALITY;
   BEHAVIOUR atmTestAccessFunctionTypeBeh;
REGISTERED AS {atmfM4Attribute atmTestAccessFunctionType(98)};

atmTestAccessFunctionTypeBeh BEHAVIOUR
  DEFINED AS
    " The value of this attribute identifies the type of test access function to be supported.
    Valid types include physical port mirroring (PP) and  virtual connection access (VC).";
```

4.3.4 callReference

```
callReference ATTRIBUTE
```

```
  WITH ATTRIBUTE SYNTAX AtmMIBMod.BitString;
  MATCHES FOR EQUALITY, SUBSTRINGS;
  BEHAVIOUR callReferenceBeh;
REGISTERED AS {atmfM4Attribute callReference(99)};

callReferenceBeh BEHAVIOUR
  DEFINED AS
    " The value of this attribute is the call reference value associated with a call by a DSS2
    access signaling entity.";
```

4.3.5 eventType

```
eventType ATTRIBUTE
  WITH ATTRIBUTE SYNTAX AtmMIBMod.GraphicStringOrNull;
  MATCHES FOR EQUALITY, SUBSTRINGS;
  BEHAVIOUR eventTypeBeh;
REGISTERED AS {atmfM4Attribute eventType(100)};

eventTypeBeh BEHAVIOUR
  DEFINED AS
    " The value of this attribute identifies the type of event or abnormality, if any, that
    caused information to be logged. If the event type is not applicable, or cannot be
    determined, the value of this attribute should be NULL.";
```

4.3.6 pduOctets

```
pduOctets ATTRIBUTE
  WITH ATTRIBUTE SYNTAX AtmMIBMod.OctetString;
  MATCHES FOR EQUALITY, SUBSTRINGS;
  BEHAVIOUR pduOctetsBeh;
REGISTERED AS {atmfM4Attribute pduOctets(101)};

pduOctetsBeh BEHAVIOUR
  DEFINED AS
    " This attribute contains the entire contents of a protocol data unit (PDU) that is to be
    retained in a log.";
```

4.3.7 resourceUnderTest

```
resourceUnderTest ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.ResourceUnderTest;
   MATCHES FOR EQUALITY;
   BEHAVIOUR resourceUnderTestBeh;
REGISTERED AS {atmfM4Attribute resourceUnderTest(102)};

resourceUnderTestBeh BEHAVIOUR
   DEFINED AS
     " This attribute identifies an ATM cell stream or connection that is connected to a test
     access path (TAP). It will point to a tcAdaptorTTPBidirectional object and for virtual
     connection (VC) test access, it will also identify the VPI value and if necessary the VCI
     value of the connection under test.  If the associated TAP is idle, the value of this
     attribute will be NULL.";
```

4.3.8 signalingIdentifier

```
signalingIdentifier ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.BitString;
   MATCHES FOR EQUALITY, SUBSTRINGS;
   BEHAVIOUR signalingIdentifierBeh;
REGISTERED AS {atmfM4Attribute signalingIdentifier(103)};

signalingIdentifierBeh BEHAVIOUR
   DEFINED AS
     " The value of this attribute is a BISUP Originating Signaling Identifier or   Destination
     Signaling Identifier.";
```

4.3.9 sourceEntity

```
sourceEntity ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.ObjectInstance;
   MATCHES FOR EQUALITY;
   BEHAVIOUR sourceEntityBeh;
REGISTERED AS {atmfM4Attribute sourceEntity(104)};

sourceEntityBeh BEHAVIOUR
   DEFINED AS
" This attribute is a pointer to the object instance that represents the source of
information to be logged.";
```

4.3.10 supportedByObject

```
supportedByObject ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.ObjectInstance;
   MATCHES FOR EQUALITY;
   BEHAVIOUR supportedByObjectBeh;
REGISTERED AS {atmfM4Attribute supportedByObject(105)};

supportedByObjectBeh BEHAVIOUR
  DEFINED AS
    " This attribute points to an object that represents supporting functions for the given
    object.";
```

4.3.11 tapPPId

```
tapPPId ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.NameType;
   MATCHES FOR EQUALITY;
   BEHAVIOUR tapPPIdBeh;
REGISTERED AS {atmfM4Attribute tapPPId(106)};

tapPPIdBeh BEHAVIOUR
  DEFINED AS
    " This attribute is used for naming instances of the tapPP managed object class.";
```

4.3.12 tapVCId

```
tapVCId ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.NameType;
   MATCHES FOR EQUALITY;
  BEHAVIOUR tapVCIdBeh;
REGISTERED AS {atmfM4Attribute tapVCId(107)};

tapVCIdBeh BEHAVIOUR
  DEFINED AS
    " This attribute is used for naming instances of the tapVC managed object class.";
```

4.3.13 timerType

```
timerType  ATTRIBUTE
    WITH ATTRIBUTE SYNTAX AtmMIBMod.TimerType;
   MATCHES FOR EQUALITY;
   BEHAVIOUR timerTypeBeh;
REGISTERED AS {atmfM4Attribute timerType(108)};

timerTypeBeh BEHAVIOUR
  DEFINED AS
" The value of this attribute is the name of the timer that expired and caused creation of
the given timerExpirationLogRecord object.";
```

4.3.14 timerValue

```
timerValue ATTRIBUTE
   WITH ATTRIBUTE SYNTAX AtmMIBMod.TimerValue;
   MATCHES FOR EQUALITY, ORDERING;
  BEHAVIOUR timerValueBeh;
REGISTERED AS {atmfM4Attribute timerValue(109)};

timerValueBeh BEHAVIOUR
  DEFINED AS
    " The value of this attribute is the value of the associated timer when it expired and
    caused the creation of the given timerExpirationLogRecord object.";
```

4.4 Name Bindings

4.4.1 atmTestAccessFunction-managedElement

```
atmTestAccessFunction-managedElement NAME BINDING
  SUBORDINATE OBJECT CLASS atmTestAccessFunction AND SUBCLASSES;
  NAMED BY SUPERIOR OBJECT CLASS "ITU-T M.3100":managedElement AND
  SUBCLASSES;
   WITH ATTRIBUTE atmTestAccessFunctionId;
REGISTERED AS {atmfM4NameBinding atmTestAccessFunction-
managedElement(33)};
```

4.4.2 tapPP-atmTestAccessFunction

```
tapPP-atmTestAccessFunction NAME BINDING
  SUBORDINATE OBJECT CLASS tapPP AND SUBCLASSES;
  NAMED BY SUPERIOR OBJECT CLASS atmTestAccessFunction AND
SUBCLASSES;
   WITH ATTRIBUTE tapPPId;
  DELETE
    DELETES-CONTAINED-OBJECTS;
REGISTERED AS {atmfM4NameBinding tapPP-atmTestAccessFunction(34)};
```

4.4.1 tapVC-atmTestAccessFunction

```
tapVC-atmTestAccessFunction NAME BINDING
  SUBORDINATE OBJECT CLASS tapVC AND SUBCLASSES;
  NAMED BY SUPERIOR OBJECT CLASS atmTestAccessFunction AND
SUBCLASSES;
   WITH ATTRIBUTE tapVCId;
  DELETE
    DELETES-CONTAINED-OBJECTS;
REGISTERED AS {atmfM4NameBinding tapVC-atmTestAccessFunction(35)};
```

4.5 Actions

4.5.1 changeAccessMode

changeAccessMode ACTION
BEHAVIOUR changeAccessModeBeh;
MODE CONFIRMED;
WITH INFORMATION SYNTAX AtmMIBMod.ChangeAccessModeInfo;
WITH REPLY SYNTAX AtmMIBMod.ChangeAccessModeReply;
REGISTERED AS {atmfM4Action changeAccessMode(10)};

changeAccessModeBeh BEHAVIOUR
DEFINED AS
" This action is used to change the access mode of a test access that has already been established. The action request indicates the new value for the accessMode attribute.";

4.5.2 connectTap

connectTap ACTION
BEHAVIOUR connectTapBeh;
MODE CONFIRMED;
WITH INFORMATION SYNTAX AtmMIBMod.ConnectTapInfo;
WITH REPLY SYNTAX AtmMIBMod.ConnectTapReply;
REGISTERED AS {atmfM4Action connectTap(11)};

connectTapBeh BEHAVIOUR
DEFINED AS
" This action will connect one TAP-PP or one TAP-VC to a resource to be tested. Each invocation will allow monitoring one direction of a cell stream. To monitor both sides of a bi-directional cell stream requires the connection of two TAP objects The action request contains an identification of the resource to be monitored. For physical port mirroring (PP) or virtual connection access (VC), this parameter contains a pointer to the tcAdaptor object that represents the cell stream to be monitored. For virtual connection access, this parameter will also identify the VPI value, and if necessary, the VCI value of the connection under test. The test access path to be used is identified in the action request by a pointer to a tapPP or tapVC object. If a value is not supplied, the ATM NE should select an available TAP of the appropriate type. The name of the selected tapPP or tapVC object shall be returned in the action reply. If the requested TAP is not available or if all TAPs of the requested type are unavailable, the action reply should indicate TAP not available. The value of the accessMode attribute of the TAP object is also defined in the action request.";

4.5.3 disconnectTap

```
disconnectTap ACTION
  BEHAVIOUR disconnectTapBeh;
   MODE CONFIRMED;
   WITH INFORMATION SYNTAX AtmMIBMod.DisconnectTapInfo;
   WITH REPLY SYNTAX AtmMIBMod.DisconnectTapReply;
REGISTERED AS {atmfM4Action disconnectTap(12)};

disconnectTapBeh BEHAVIOUR
  DEFINED AS
    " This action will disconnect the given test access path and return the resource under
    test to its normal state.  The value of the resourceUnderTest and directionality attributes
    in a given tapPP object will be set to NULL, or the value of the resourceUnderTest,
    directionality, and accessMode in a given tapVC object will be set to NULL.";
```

4.6 Supporting Productions

```
-- The following are added to the AtmMIBMod in af-nm-0027.000

AccessMode ::= CHOICE {
    noMode    [0] NULL,
    mode      [1] AccessModeUsage}

AccessModeUsage ::= ENUMERATED {
    monitorEgressTraffic     (0), -- monitor traffic leaving NE
    monitorIngressTraffic    (1), -- monitor traffic entering NE
    splitIn                  (2), -- split in towards the NE
    splitOut                 (3)} -- split out from the NE

AtmTestAccessFunctionType ::= ENUMERATED {
    pp  (0), -- physical port mirroring
    vc  (1)} -- virtual connection access

BitString ::= BIT STRING

ChangeAccessModeInfo ::= AccessModeUsage

ChangeAccessModeReply ::= CHOICE {
    changed       [0] NULL,
    notChanged    [1] ProblemCause}

ConnectTapInfo ::= SEQUENCE {
    resourceToBeTested    ResourceID,
    accessMode            AccessModeUsage,
    tapToSelect           ObjectInstance OPTIONAL}

ConnectTapReply ::= CHOICE {
    tapConnected       [0] NULL,
    tapNotConnected    [1] ProblemCause}

DisconnectTapInfo ::= NULL

DisconnectTapReply ::= CHOICE {
    tapDisconnected       [0] NULL,
    tapNotDisconnected    [1] ProblemCause}

IntegerOrReal ::= CHOICE {
    integer    Integer,
```

```
    real            Real}

  Real ::= REAL
  ResourceId ::=SEQUENCE {
     tcAdaptor  ObjectInstance,
     vpi            Integer  OPTIONAL,  --required for VC test access
     vci             Integer  OPTIONAL}  --required for VC test Access to VC connection

  ResourceUnderTest ::=CHOICE {
     idle              [0]  NULL,
     resourceId …[1] ResourceId}

  TimerType ::= GraphicString

  TimerValue ::= IntegerOrReal
```

5. Acronyms

ATAF	ATM Test Access Function
ATM	Asynchronous Transfer Mode
BICI	Broadband Inter Carrier Interface
BISSI	Broadband Inter Switching System Interface
CP	Common Part
CPE	Customer Premise Equipment
CPI	Common Part Indicator
DSS2	Digital Service Signaling 2
IAM	Initial Address Message
ID	Identifier
I/O	Input/ Output
MIB	Management Information Base
NE	Network Element
NNI	Network Node Interface
OAM	Operations, Administration, and Maintenance
QOS	Quality of Service
PDU	Protocol Data Unit
PM	Performance Monitoring
PVC	Permanent Virtual Circuit
RMON	Remote Monitoring
RX	Receive
SDU	Service Data Unit
SSCF	Service Specific Coordination Function
SSCOP	Service Specific Connection Oriented Protocol
SVC	Switched Virtual Circuit
TAP	Test Access Path
TP	Termination Point
TX	Transmit
UNI	User Node Interface
UPC	User Parameter Control
VC	Virtual Channel
VCC	Virtual Channel Connection
VCC TP	Virtual Channel Connection Termination Point
VCI	Virtual Channel Identifier
VCL	Virtual Channel Link
VCL TP	Virtual Channel Link Termination Point
VP	Virtual Path
VPC	Virtual Path Connection
VPC TP	Virtual Path Connection Termination Point
VPI	Virtual Path Identifier

VPL	Virtual Path Link
VPL TP	Virtual Path Link Termination Point

Appendix A

A1. Maintenance of the Signaling Channel

This is an informational appendix that motivates how ATAF can be a valuable tool in performing maintenance of ATM signaling channels. The appendix discusses maintenance of the ATM Access signaling channel, however, similar concepts would also apply to maintenance of ATM Interoffice signaling channels.

The general approach to maintenance of the signaling channel (and isolation of troubles in particular) is as follows:

- for each protocol layer, utilize the performance/protocol monitoring capabilities supported by the ATM NE,
- when the above are not sufficient, utilize the ATM Test Access Function (ATAF) monitoring mode, and finally
- when the above are not sufficient, utilize the ATAF full-splitting mode.

While the information available via the monitoring capabilities of the ATM NE is very helpful, it also is somewhat limited (due to processing and storage limitations of the NE) and thus using the ATAF monitoring mode capability can provide a more detailed view of PDU exchanges that are occurring (and their associated abnormalities/errors). The ATAF full-splitting mode allows a test equipment (that is known to function properly) to be inserted in place of the suspected faulty equipment (either NE or CPE) to conclusively verify that the piece of equipment that was removed during the test was in fact the source of the trouble.

Figure A-1 shows how signaling messages are exchanged between the ATM NE and the CPE over the UNI. Trouble isolation at each protocol layer (as shown in Figure A-1) is discussed in the following subsections.

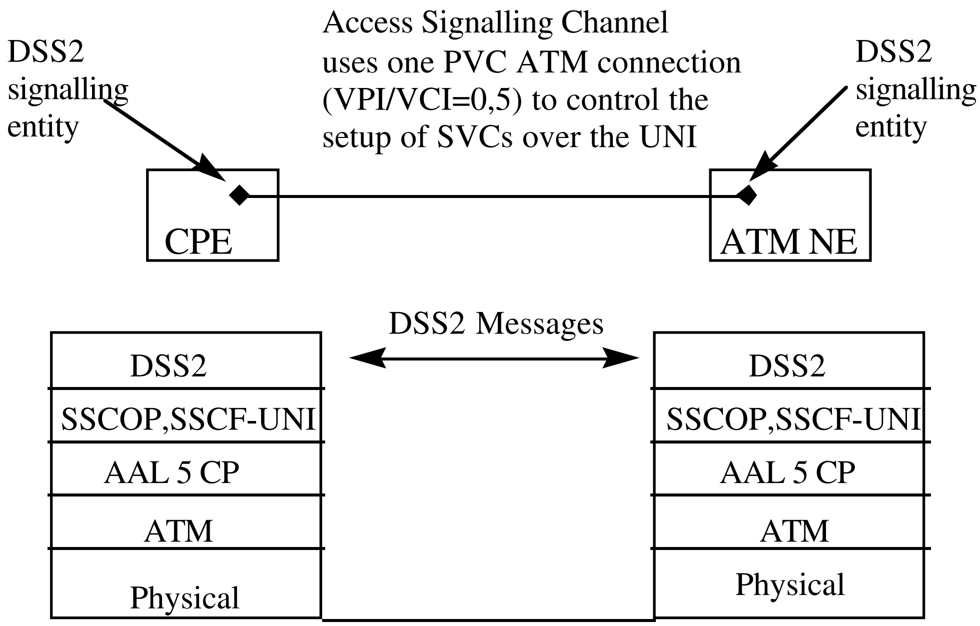


Figure A-1. Access Signalling on a UNI

A1.1 ATM Layer

Troubles that may occur at the ATM Layer are not expected to be unique to the signaling channel. Physical Port Mirroring will probably be the most useful type of test access for diagnosing ATM Layer troubles.

A1.2 AAL Type 5 (Common Part)

According to the protocol monitoring requirements in af-nm-0071-000 (AAL Management for the M4 "NE View" Interface), one counter is used to count the "sum" of any of the following invalid errors: invalid Common Part Indicator (CPI), oversized received Service Data Unit (SDU), and length violation. The ATAF-VC monitoring mode would provide a greater degree of visibility to determine exactly which invalid error was occurring.

A1.3 SSCOP/SSCF-UNI

Annex A of the SSCOP standard (Q.2110) defines a list of 24 different error conditions that may occur at the SSCOP layer. According to the ATM Forum SSCOP protocol monitoring, two separate SSCOP protocol monitoring counters are defined to count the "sum" of different types of errors, i.e., SSCOP Connection Monitoring Counter, and SSCOP Errored PDUs. The ATAF Signaling data Capture (ATAF-SDC) can be used to gain visibility into a explicit log of SSCOP PDUs and a log of information about related timer expiration events.

A1.4 DSS2

Note: DSS2 protocol monitoring requirements have not yet been addressed in ATM Forum network management requirements.

According to Bellcore GR-1248-CORE, Issue 3, the following DSS2 abnormalities can occur:

- Abnormal call/connection termination - A call/connection can be abnormally terminated by unrecoverable conditions that cause termination of the call/connection, or dropping of one of its parties, by issuing a RELEASE, RELEASE COMPLETE, ADD PARTY REJECT or DROP PARTY messages. These messages contain a Cause field that indicates the condition causing the termination (including timer expires) and are issued either in response to an offending message or as a result of a problem in the network or at the other end of the call/connection.

- Status errors - In some instances, a message with errors is received that does not cause termination of the call/connection. In these cases, a STATUS message with a cause field is used to respond to the offending message.

Section 5.4.5.15 of UNI 3.1 lists over 40 different cause field values. Note that although this "cause field" information is present in the signaling PDUs, there is no guarantee that the CPE will process this information and make it available to the user. Therefore, it would be very advantageous if this "cause field" information were available to a craftperson that is trying to resolve a customer complaint.

GR-1248-CORE defines seven protocol monitoring counters that count sum of errors information (derived from the 40+ possible cause field values). The GR further states:

- The ATM NE shall allow a Management System to activate/deactivate the protocol monitoring counting and thresholding capabilities...on a given access signaling channel. At any given time, signaling entity performance monitoring shall be available for an arbitrary subset of at least 10% of all active access signaling channels.

GR-1248-CORE also discusses logs of DSS2 Timers and states:

- The ATM NE shall be capable of supporting, for each access signaling channel, one DSS2 protocol log of DSS2 timers (i.e., timer expiry events). The ATM NE shall allow a Management System to activate/deactivate the logging capability for a given access signaling channel. The logging capability shall be activated/deactivated independently from the protocol monitoring activities.....

The log of DSS2 timers expiries is provided as part of the ATAF Signaling Data Capture (ATAF-SDC) functionality described in Section 2.3.