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Technical Committee**

Network Management

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for the
M4 “NE View”
Interface**

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AAL Management for the M4 “NE View” Interface

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1. Introduction

This contribution proposes a set of requirements, logical information model, and CMIP specification to support AAL Management. The contents of this contribution are supplements to af-nm-0020.000 (*M4 "NE View" Interface Requirements & Logical MIB*) and Section 2 of af-nm-0027.000 (*CMIP MIB for the M4 "NE View" Interface*). This model has been coordinated with the CES model in af-nm-0072-000.

2. Overview of AAL Management

2.1.X. AAL Configuration Management

AAL management criteria vary depending on the AAL Type (i.e., Type 1, Type 3/4, or Type 5). Note that although most AAL processing is done outside the public network, there are expected to be some ATM PVCs for which AAL processing resides in the public network. Connections that terminate on Inter-Working Units, connections that terminate on higher-layer Packet Handlers, as well as connections that support signaling or operations message transfer are just a few examples. The criteria presented in this paper applies only to those connections for which AAL processing and associated management is the responsibility of the public network.

The ATM Forum UNI Specification Version 4.0 defines an *AAL Parameters Information Element* and B-ICI Version 2.0 defines an *AAL Parameters Parameter*. This *information element* is used during the SVC set-up process to negotiate AAL-specific parameters that characterize the desired AAL processing to be performed at both ends of the SVC. While the UNI and B-ICI Specifications only address the configuration of AAL parameters from an SVC perspective, the need to configure AAL parameters applies to some network-terminated PVCs as well.

(R) CM-1 The M4 Interface shall support management system requests to configure the AAL Type for a given VCC termination point in an ATM NE. Valid values are: AAL Type 1, Type 2(for future use), Type 3/4, and Type 5.

2.1.X.1. AAL Type 1 Configuration Information

If the ATM NE supports AAL Type 1 on a connection, it must support the ability to read the following information:

- Subtype
- CBR Rate
- Clock Recovery Type
- Forward Error Correction Type
- Structured Data Transfer
- Partially Filled Cells
- Cell Loss Integration Period

Furthermore, if the ATM NE does not automatically configure this information, then the M4 interface must support configuration of this information by the Management System.

(R) CM-2 For connections supporting AAL Type 1, the following information shall be readable by the Management System across the M4 Interface. If the ATM NE needs this information to be configured by the Management System, this information shall also be configurable across the M4 interface.

1. The AAL type 1 subtype used by the CBR service application (e.g. 64 kbps voiceband signal transport, circuit transport);
2. The CBR service application rate (e.g. 64 kbps, 1544 kbps, 44736 kbps, $n \times 64$ kbps)
3. The source clock frequency recovery method in use
 - Synchronous, or
 - Asynchronous - Synchronous Residual Time Stamp (SRTS), or
 - Asynchronous - Adaptive Clock.
4. Structured Data Transfer (SDT) Block Size ($1 \leq \text{Blk Sz} \leq 2^{16} - 1$ in octets) (optional)
5. Partial Cell Payload Fill ($0 < \text{Payload Fill} < 47$ octets of AAL user information) (optional)
6. Forward Error Correction (FEC) Type (optional)
 - No forward error correction
 - FEC for Loss Sensitive Signal Transport (i.e., (128,124) Reed-Solomon encoded long interleaver)
 - FEC for Delay Sensitive Signal Transport (i.e., (94, 88) Reed-Solomon encoded short interleaver).
7. Cell Loss Integration Period (in milliseconds)

2.1.X.2. AAL Type 3/4 Configuration Information

If the ATM NE supports AAL Type 3/4 on a connection, it must support the ability to read the following information:

- Max CPCS SDU Size
- MID Range
- Mode
- SSCS Type

(R) CM-3 For connections supporting AAL Type 3/4, the following information shall be readable by the Management System across the M4 Interface. If the ATM NE needs this information to be configured by the Management System, this information shall also be configurable across the M4 interface.

1. Message Identifier (MID) field range (i.e. the lowest and highest MID field values);

2. Maximum CPCS_SDU Size (i.e. upper bound on the AAL type 3/4 CPCS_SDU size in octets where the SDU size range is $0 \leq \text{SDU} \leq 2^{16} - 1$ octets)
 - for the forward direction (i.e., the calling user to called user direction for SVC service) and
 - for the backward direction (i.e., called user to calling user direction for SVC service);
3. Mode of operation (e.g. Message or Streaming, Assured or Unassured);
4. Identify AAL type 3/4 convergence sublayer protocol options applicable to the specific service application supported by the AAL (i.e., AAL type 3/4 SSCS).

2.1.X.3. AAL Type 5 Configuration Information

If the ATM NE supports AAL Type 5 on a connection, it must support the ability to read the following information:

- Max CPCS SDU Size
- Mode
- SSCS Type

(R) CM-4 For connections supporting AAL Type 5, the following information shall be readable by the Management System across the M4 Interface. If the ATM NE needs this information to be configured by the Management System, this information shall also be configurable across the M4 interface.

1. Maximum CPCS_SDU Size (i.e., upper bound on the AAL type 5 CPCS_SDU size in octets where the SDU size range is $0 \leq \text{SDU} \leq 2^{16} - 1$ octets)
 - for the forward direction (i.e., the calling user to called user direction for SVC service) and
 - for the backward direction (i.e., called user to calling user direction for SVC service);
2. Mode of operation (e.g., Message or Streaming, Assured or Unassured);
3. Identify AAL type 5 convergence sublayer protocol options applicable to the specific service application supported by the AAL (i.e., AAL type 5 SSCS).

2.2.Y AAL Fault Management

For connections that terminate on IWUs supporting DS_n Circuit Emulation, there is a need to generate an alarm (to the OS) when a receiving AAL Type 1 entity spends an excessive amount of time in the Starvation Condition. Note that a receiving AAL Type 1 entity enters a Starvation Condition when AAL-SDU information is needed to construct the DS_n bit stream and none is available for the number of milliseconds specified by Cell Loss Integration Period. This is described further in Bellcore GR-1248-CORE.

FM-1 The M4 Interface shall support autonomous notifications used to report AAL Type 1 failures such as Cell Starvation.

Note: This requirement is supported by the information model described in af-nm-0072-000.

2.3.Z. AAL Performance Management - Protocol Monitoring

The approach for AAL performance monitoring is based on maintaining counts of errors in received Segmentation And Reassembly (SAR) and Convergence Sublayer (CS) Protocol Data Units (PDUs) per VCC termination point. Tables 1, 2, and 3 summarize information regarding AAL protocol monitoring for AAL Types 1, 3/4, and 5. Note that, as in the case of TC Sublayer and ATM Layer protocol monitoring, the granularity period for AAL protocol monitoring shall be 15 minutes. Also 8 hours of history shall be maintained in the ATM NE.

Table 1 AAL Type 1 Protocol Monitoring Summary

Parameter	Simple Counter	Thresholded
AAL Header Errors	√	√
Sequence Violations	√	√
Cell Loss	√	√
Cell Misinsertion	√	√
Buffer Underflow Events	√	√
Buffer Overflow Events	√	√
SDT Pointer Reframes	√	√
SDT Pointer Parity Check Failures	√	√

Table 2 AAL Type 3/4 Protocol Monitoring Summary

Parameter		Sum of Errors	Simple Counter	Thresholded
CS	Invalid Fields (Invalid CPI + Invalid Alignment + Invalid BAsize)	√		√
	Incorrect Fields	√		√
	BTag ≠ ETag		√	
	BAsize not consistent with Length		√	
	Actual length not consistent with Length		√	
SAR	Invalid Fields (Invalid MID + Invalid Length Indication)	√		√
	Incorrect Fields	√		√
	Incorrect CRC		√	
	Unexpected Sequence Number		√	
	Unexpected MID		√	
	SRI Time Outs		√	√
	Number of Aborts		√	

Table 3 AAL Type 5 Protocol Monitoring Summary

Parameter		Sum of Errors	Simple Counter	Threshold
CS	Invalid Fields (Invalid CPI + Oversized Received SDU + Length Violation)	√		√
	Incorrect Fields (CRC-32 Violation)		√	√
	Reassembly Timer Expirations		√	√

2.3.Z.1. AAL Type 1 Protocol Monitoring

(R) PM-1 In support of AAL Type 1 protocol monitoring, the M4 Interface shall provide management systems the ability to retrieve current (15 minute) counts of the following errors (at the CS layer) at each connection end point where receiving IWF functions (with an AAL Type 1 supporting UDT) are performed:

1. AAL Header Errors (i.e., the number of AAL1 header errors detected, including those corrected. Header errors include correctable and uncorrectable CRC plus bad parity.)
2. Sequence Count Violations total violations (i.e., the count of incoming AAL Type 1 SAR-PDUs where the sequence count in the PDU header causes a transition from the SYNC state to the OUT OF SEQUENCE state as defined by ITU-T Rec. I.363.1), (optional)
 - lost cells (i.e., the number of lost cells, as detected by the AAL1 sequence number processing, for example. This count records the number of cells detected as lost in the network prior to the destination interworking function AAL1 layer processing.), (optional)
 - misinserted cells (i.e., the number of sequence violation events which the AAL CS interprets as misinserted of cells as defined by ITU-T Rec. I.363.1), (optional)
3. Buffer Underflows (i.e., the number of times the reassembly buffer underflows. In the case of a continuous underflow caused by a loss of ATM cell flow, a single buffer underflow should be counted. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer underflow will cause this count to be incremented). Buffer underflow may be caused by slight clocking differences between the node at which segmentation takes place and the node at which reassembly takes place. Buffer underflow may also result from unexpectedly large CDV.
4. Buffer Overflows (i.e., the number of times the reassembly buffer overflows. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer overflow will cause this count to be incremented). Buffer overflow may be caused by slight clocking differences between the node at which segmentation takes place and the node at which reassembly takes place. Buffer overflow may also result from unexpectedly large CDV.
5. SDT Pointer Reframes (i.e., the number of events in which the AAL1 reassembler found that a structured data pointer is not where it is expected, and the pointer must be reacquired. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. (mandatory for structured data transfer)
6. SDT Pointer Parity Check Failures (i.e., the number of times the AAL reassembler detects a parity check failure at the point where a structured data pointer is expected. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers.), (optional for structured data transfer).

(R) PM-2 The M4 Interface shall support management system requests to define at least one set of threshold values (i.e., threshold value packages) for the supported parameters listed in **PM-1** and selectively assign each set to one or more AAL Type 1 entities in the ATM NE.

(R) PM-3 The M4 Interface shall provide management systems the ability to modify threshold values for the supported performance parameters identified in requirement **PM-1**.

(R) PM-4 The M4 Interface shall support autonomous notifications (generated by the ATM NE) used to report threshold crossings for the supported parameters identified in requirement **PM-1**.

(R) PM-5 The M4 Interface shall provide the management system the ability to retrieve history counts (thirty-two 15 minute counts) of the supported performance parameters identified in **PM-1**.

2.3.Z.2. AAL Type 3/4 Protocol Monitoring

(R) PM-6 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve a single, aggregate, thresholded current (15 minute) sum of errors count that reflects the following errors:

1. Invalid Message Identifier (MID); i.e., MID = 0 when there is multiplexing, or MID not equal to 0 when there is no multiplexing.
2. Invalid SAR-PDU Length Indication; i.e., Length Indication not equal to 44 octets for a BOM or COM, not in the set of values [4, 8, ..., 44] octets or 63 octets for an EOM, or not in the set of values [8, 12, ..., 44] octets for an SSM. The value "63" is used in the abort procedures, as described in ITU-T Rec. I.363.3.

(R) PM-7 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve a current (15 minute) sum of errors count that reflects the following errors:

1. SAR-PDU CRC incorrect when computed
2. COM/EOM Segment with unexpected SAR Sequence Number, i.e., SAR Sequence Number not incremented by 1 (modulo 16) relative to the previous (non-EOM) SAR-PDU received over the same VPC/VCC, and containing the same MID.
3. BOM/EOM Segment with unexpected MID, i.e., a BOM is received with a currently active MID (a MID for which an EOM has not yet been received), or an EOM received for which a MID is not currently active.

(R) PM-8 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve separate performance counters on each connection end point that terminates the AAL Type 3/4 protocol, for each of the SAR-PDU incorrect field error types listed in **PM-7**.

(R) PM-9 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve current (15 minute) counts of the number of SRI time-outs that occur on each connection end point that terminates the AAL Type 3/4 protocol.

(R) PM-10 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve current (15 minute) counts of the number of aborts that occur on each connection end point that terminates the AAL Type 3/4 protocol.

(R) PM-11 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve a current (15 minute) sum of errors count that reflects the following errors:

- BAsize Field value not valid on an incoming AAL Type 3/4 CS-PDU; i.e., < 37 octets for multi-segment messages
- Common Part Indicator not valid (i.e., not equal to 0)
- Alignment Field not equal to 0.

Note that not all ATM NEs that terminate AAL Type 3/4 will check for these errors.

(R) PM-13 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve a current (15 minute) sum of errors count that reflects the following errors:

1. Beginning Tag (BTag) not equal to End Tag (ETag)
2. Buffer Allocation Size (BAsize) and Length fields not equal when message mode is used, or BAsize < Length when streaming mode is used. (When supporting SMDS, BAsize must always be = Length.)
3. Actual length of CS-PDU Payload not consistent with Length field. For clarification, the length is consistent in the following cases. In a proper CS-PDU composed of multiple segments, the number of octets in the partially assembled CS-PDU plus the SAR Length Indication field must be in the range [Length + 4, Length + 7], because the last SAR-PDU will contain 4 octets CS trailer and 0-3 octets Pad. (A range is specified because the size of the Pad is not known by the CS layer.) In a proper CS-PDU composed of only a single segment, the SAR Length Indication field must be in the range [Length + 8, Length + 11], because the SAR-PDU will contain 4 octets CS header, 4 octets CS trailer, and 0-3 octets Pad.

(R) PM-14 In support of AAL Type 3/4 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve separate performance counters for each connection end point that terminates the AAL Type 3/4 protocol, for each of the CS-PDU incorrect field error types listed in **PM-13**.

(R) PM-15 The M4 Interface shall support management system requests to define at least one set of threshold values (i.e., threshold value packages) for the parameters listed in **PM-6**, **PM-7**, **PM-9**, **PM-11**, and **PM-13**; and selectively assign each set to one or more AAL Type 3/4 entities in the ATM NE.

(R) PM-16 The M4 Interface shall provide management systems the ability to modify threshold values for the performance parameters identified in requirements **PM-6**, **PM-7**, **PM-9**, **PM-11**, and **PM-13**.

(R) PM-17 The M4 Interface shall support autonomous notifications (generated by the ATM NE) used to report threshold crossings for the parameters identified in requirement **PM-6**, **PM-7**, **PM-9**, **PM-11**, and **PM-13**.

(R) PM-18 The M4 Interface shall provide the management system the ability to retrieve history counts (thirty-two 15 minute counts) of the performance parameters identified in requirements **PM-6** to **PM-14**.

2.3.Z.3 AAL Type 5 Protocol Monitoring

(R) PM-19 In support of AAL Type 5 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve current (15 minute) sum of errors count of the following errors at each connection end point where AAL Type 5 is terminated:

1. Invalid CPI
2. Oversized Received SDU
3. Length Violation (a length violation results in an invalid Pad field size).

(R) PM-20 In support of AAL Type 5 protocol monitoring, the M4 Interface shall provide the management system the ability to retrieve current (15 minute) counts of CRC-32 violations.

(R) PM-21 In support of AAL Type 5 protocol monitoring, if a reassembly timer is implemented, the M4 Interface shall provide the management system the ability to retrieve current (15 minute) counts of the number of reassembly timer expirations on each receiving connection end point where AAL Type 5 is terminated.

(R) PM-22 The M4 Interface shall support management system requests to define at least one set of threshold values (i.e., threshold value packages) for the parameters listed in **PM-19**, **PM-20**, and **PM-21** and selectively assign each set to one or more AAL Type 5 entities in the ATM NE.

(R) PM-23 The M4 Interface shall provide management systems the ability to modify threshold values for the performance parameters identified in requirement **PM-19**, **PM-20**, and **PM-21**.

(R) PM-24 The M4 Interface shall support autonomous notifications (generated by the ATM NE) used to report threshold crossings for the parameters identified in requirement **PM-19**, **PM-20**, and **PM-21**.

(R) PM-25 The M4 Interface shall provide the management system the ability to retrieve history counts (thirty-two 15 minute counts) of the performance parameters identified in **PM-19**, **PM-20**, and **PM-21**.

3. M4 Logical MIB

3.1. AAL1 Profile

This managed entity is used to organize data that describes the AAL Type 1 processing functions of the ATM NE. It is used with the Interworking VCC Termination Point object class defined in af-nm-0072-000.

In an ATM environment, AAL Type 1 performance monitoring parameters are associated with an Interworking VCC Termination Point object through a pointer relationship. Each instance of this object class defines a combination of parameter values that may be associated with multiple Interworking VCC Termination Point objects.

Attributes

AAL Profile Id: This is an attribute whose distinguished value can be used as an RDN when naming an instance of the AAL1 Profile managed object class.

Sub Type: This attribute is used to identify the AAL subtype. Valid values for this attribute are NULL, Voice-band based on 64 kbps, Circuit Emulation (synchronous), Circuit Emulation (asynchronous), High-quality Audio, and Video.

CBR Rate: This attribute represents the rate of the CBR service supported by the AAL.

Clock Recovery Type: This attribute indicates whether the clock recovery type is Synchronous, SRTS (Synchronous Residual Time Stamp), or Adaptive Clock Recovery.

Forward Error Correction Type: This attribute indicates the FEC method: no FEC, FEC for Loss Sensitive Signal Transport, or FEC for Delay Sensitive Signal Transport. (optional)

Structured Data Transfer: This attribute indicates whether Structured Data Transfer (SDT) has been configured at the AAL. A value of TRUE means SDT has been selected. This attribute value cannot be set to TRUE when the Forward Error Correction Type attribute equals TRUE. (optional)

Partially Filled Cells: This attribute identifies the number of leading octets in use. (optional)

Cell Loss Integration Period: This attribute represents the time in milliseconds for the cell loss integration period. If cells are lost for this period of time, the Interworking VCC Termination Point entity will generate a cell starvation alarm.

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

One instance of this managed entity shall exist for each combination of AAL1 parameter values used within an ATM NE.

3.2. AAL3/4 Profile

This managed entity is used to organize data that describes the AAL Type 3/4 processing functions of the ATM NE. It is used with the Interworking VCC Termination Point object class defined in af-nm-0072-000.

In an ATM environment, AAL Type 3/4 performance monitoring parameters are associated with an Interworking VCC Termination Point object through a pointer relationship. Each instance of this object class defines a combination of parameter values that may be associated with multiple Interworking VCC Termination Point objects.

Attributes

AAL Profile Id: This is an attribute whose distinguished value can be used as an RDN when naming an instance of the AAL Profile managed object class.

Max CPCS SDU Size: This multi-valued attribute represents the maximum CPCS_PDU size that will be transmitted over the connection in both the incoming (forward) and outgoing (backward) direction of transmission.

MID Range: This attribute represents the range of MID values supported at the AAL for the supporting VCC.

AAL Mode: This attribute indicates whether the AAL for the supporting VCC is operating in message mode or streaming mode, assured or unassured.

SSCS Type: This attribute identifies the SSCS type for the AAL. Valid values are NULL, Data SSCS based on SSCOP (assured operation), Data SSCS based on SSCOP (non-assured operation), or Frame Relay SSCS.

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

One instance of this managed entity shall exist for each combination of AAL 3/4 parameter values used within the ATM NE.

3.3. AAL5 Profile

This managed entity is used to organize data that describes the AAL Type 5 processing functions of the ATM NE. It is used with the Interworking VCC Termination Point object class defined in af-nm-0072-000.

In an ATM environment, AAL Type 5 performance monitoring parameters are associated with an Interworking VCC Termination Point object through a pointer relationship. Each instance of the object class defines a combination of parameter values that may be associated with multiple Interworking VCC Termination Point objects.

Attributes

AAL Profile Id: This is an attribute whose distinguished value can be used as an RDN when naming an instance of the AAL Profile managed object class.

Max CPCS SDU Size: This multi-valued attribute represents the maximum CPCS_PDU size that will be transmitted over the connection in both the incoming (forward) and outgoing (backward) direction of transmission.

AAL Mode: This attribute indicates whether the AAL for the supporting VCC is operating in message mode or streaming mode, assured or unassured.

SSCS Type: This attribute identifies the SSCS type for the AAL. Valid values are NULL, Data SSCS based on SSCOP (assured operation), Data SSCS based on SSCOP (non-assured operation), or Frame Relay SSCS.

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

One instance of this managed entity shall exist for each combination of AAL5 parameter values used within the ATM NE.

3.4. AAL1 Protocol Current Data

This managed entity contains the current performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring.

Instances of this managed entity shall be inherently created by the managed system whenever an instance of the Interworking VCC Termination Point managed entity is created that represents AAL functions.

Attributes

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

Administrative State: This read/write attribute is used to activate (unlock) and deactivate (lock) the data collection function performed by this managed entity.

Suspect Interval Flag: This attribute is used to indicate that the performance data for the current period may not be reliable.

Elapsed Time: This read-only attribute represents the difference between the current time and the start of the present summary interval.

Threshold Data ID: This read/write attribute provides a pointer to an instance of the Threshold Data managed entity that contains the threshold values for the performance monitoring data collected by this managed entity.

Number of Suppressed Intervals: This read-only attribute is non-zero only if the ATM NE is suppressing AAL1 Protocol History Data creation when the current interval terminates with “all-zeroes” performance measurements.

Header Errors: This attribute represents a count of the number of AAL1 header errors detected, including those corrected. Header errors include correctable and uncorrectable CRC plus bad parity.

Sequence Violations: This attribute represents a count of incoming AAL Type 1 SAR-PDUs where the sequence count in the PDU header causes a transition from the SYNC state to the OUT OF SEQUENCE state as defined by ITU-T Rec. I.363.1. A negative value indicates that this attribute is not supported.

Cell Loss: This attribute represents a count of the number of lost cells, as detected by the AAL1 sequence number processing, for example. This count records the number of cells detected as lost in the network prior to the destination interworking function AAL1 layer processing. A negative value indicates that this attribute is not supported.

Cell Misinsertion: This attribute represents a count of sequence violation events which the AAL CS interprets as misinserted cells as defined by ITU-T Rec. I.363.1. A negative value indicates that this attribute is not supported.

Buffer Underflows: This attribute represents a count of the number of times the reassembly buffer underflows. In the case of a continuous underflow caused by a loss of ATM cell flow, a single buffer underflow should be counted. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer underflow will cause this count to be incremented.

Buffer Overflows: This attribute represents a count of the number of times the reassembly buffer overflows. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer overflow will cause this count to be incremented.

SDT Pointer Reframes: This attribute represents a count of the number of events in which the AAL1 reassembler found that a structured data pointer is not where it is expected, and the pointer must be reacquired. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. A negative value indicates that this attribute is not supported, however it must be supported when pointers are used.

SDT Pointer Parity Check Failures: This attribute represents a count of the number of times the AAL reassembler detects a parity check failure at the point where a structured data pointer is expected. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. A negative value indicates that this attribute is not supported.

Actions

No actions have been defined for this managed entity.

Notifications

Threshold Crossing Alert: This message is used to notify the management system when one of the above values exceeds a pre-set threshold. The following information shall be supplied with this notification:

- The ID of the Managed Entity Reporting the Threshold Crossing Alert
- The Type of Performance Parameter that Exceeded the Threshold

Relationships

One instance of this managed entity shall exist for each instance of the Interworking VCC Termination Point managed entity that represents AAL1 functions.

3.5. AAL3/4 Protocol Current Data

This managed entity contains the current performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring.

Instances of this managed entity shall be inherently created by the managed system whenever an instance of an Interworking VCC Termination Point managed entity is created that represents AAL 3/4 functions.

Attributes

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

Administrative State: This read/write attribute is used to activate (unlock) and deactivate (lock) the data collection function performed by this managed entity.

Suspect Interval Flag: This attribute is used to indicate that the performance data for the current period may not be reliable.

Elapsed Time: This read-only attribute represents the difference between the current time and the start of the present summary interval.

Threshold Data ID: This read/write attribute provides a pointer to an instance of the Threshold Data managed entity that contains the threshold values for the performance monitoring data collected by this managed entity.

Number of Suppressed Intervals: This read-only attribute is non-zero only if the ATM NE is suppressing AAL3/4 Protocol History Data creation when the current interval terminates with “all-zeroes” performance measurements.

Sum Of Invalid SAR Field Errors: This attribute provides a sum-of-errors count for invalid Segmentation And Reassembly (SAR) field errors. For AAL Type 3/4, this attribute provides a single count of the number of SAR_PDUs discarded due to one of the following error conditions: MID=0 when there is multiplexing, MID not equal to 0 when there is no multiplexing, Length field not equal to 44 octets for a BOM or COM, Length field not in the set [4, 8, ..., 44] octets or 63 octets for an EOM, or Length field

not in the set
[8, 12, ..., 44] octets for an SSM.

Sum Of Incorrect SAR Field Errors: This attribute provides a sum-of-errors count for incorrect Segmentation And Reassembly (SAR) field errors. For AAL Type 3/4, this attribute provides a single count of SAR_PDUs discarded due to one of the following errors: CRC violation, unexpected Sequence Number (SN) field value, or unexpected MID field value

SAR CRC Violations: This attribute represents the number of CRC violations that were detected for the incoming SAR PDUs.

COMS EOMS Unexpected SN: This attribute represents the number of COM and EOM segments received with an unexpected Sequence Number (SN). For a particular message (i.e., MID) transported over a VPC or VCC, this attribute is incremented by one each time a COM or EOM is received with a SAR Sequence Number (SN) that is not correct relative to the SN in the previous (non-EOM) segment.

BOMS EOMS Unexpected MID: This attribute represents the number of BOM/EOM segments with an unexpected MID value. This attribute will be incremented by one each time a BOM is received with a currently active MID (a MID for which an EOM has not yet been received), or when an EOM is received for which a MID is NOT currently active.

SRI Time Outs: This attribute represents a count of the number of SRI time-outs that occurred on an ATM connection.

Number Of Aborts: This attribute provides a count of the number of aborts (i.e., EOM with SAR_PDU Length Indication = 63) that are received for the underlying VPC or VCC.

Sum Of Invalid CS Field Errors: This attribute provides a sum-of-errors count for invalid Convergence Sublayer (CS) field errors. For AAL Type 3/4, this attribute provides a single count of the number of CS_PDUs discarded due to one of the following error conditions: Common Part Indicator (CPI) field not equal to 0, Alignment field value not equal to 0, or BAsize field value < 37 octets for multi-segment messages.

Sum Of Incorrect CS Field Errors: This attribute provides a sum-of-errors count for incorrect Convergence Sublayer (CS) field errors. For AAL Type 3/4, this attribute provides a single count of CS_PDUs discarded due to one of the following error conditions: BTag mismatch, BAsize field value not consistent with Length field value, or Length field value not consistent with CS_PDU length.

BE Tag Mismatch: This attribute represents the number of times an incoming CS_PDU had a BTag field value that did not equal the ETag field value.

Length BA Size Mismatch: This attribute represents the number of CS_PDUs in which the Length field value was not consistent with the BAsize field value. The definition of consistent depends on the mode in which CS_PDU fragments are being processed. In the message-mode, the BAsize field must equal the Length field. In the streaming mode, the BAsize field must be less than the Length field.

Length Mismatch: This attribute represents the number of CS_PDUs received with a Length field value that does not represent the actual length of the CS_PDU payload.

Actions

No actions have been defined for this managed entity.

Notifications

Threshold Crossing Alert: This message is used to notify the management system when one of the above values exceeds a pre-set threshold. The following information shall be supplied with this notification:

- The ID of the Managed Entity Reporting the Threshold Crossing Alert
- The Type of Performance Parameter that Exceeded the Threshold

Relationships

One instance of this managed entity shall exist for each instance of an Interworking VCC Termination Point managed entity that represents AAL 3/4 functions.

3.6. AAL5 Protocol Current Data

This managed entity contains the current performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring.

Instances of this managed entity shall be inherently created by the managed system whenever an instance of the Interworking VCC Termination Point managed entity is created that represents AAL 5 functions.

Attributes

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

Administrative State: This read/write attribute is used to activate (unlock) and deactivate (lock) the data collection function performed by this managed entity.

Suspect Interval Flag: This attribute is used to indicate that the performance data for the current period may not be reliable.

Elapsed Time: This read-only attribute represents the difference between the current time and the start of the present summary interval.

Threshold Data ID: This read/write attribute provides a pointer to an instance of the Threshold Data managed entity that contains the threshold values for the performance monitoring data collected by this managed entity.

Number of Suppressed Intervals: This read-only attribute is non-zero only if the ATM NE is suppressing AAL5 Protocol History Data creation when the current interval terminates with “all-zeroes” performance measurements.

Sum Of Invalid CS Field Errors: This attribute provides a sum-of-errors count for invalid Convergence Sublayer (CS) field errors. For AAL Type 5, this attribute provides a single count of the number of CS_PDUs discarded due to one of the following error conditions: Invalid Common Part Indicator (CPI), oversized received SDU, or length violation.

CRC Violations: This attribute represents the number of CRC violations that were detected for the incoming AAL PDUs.

Reassembly Timer Expirations: This attribute provides a count of reassembly timer expirations. A negative value indicates that this attribute is not supported. (mandatory if reassembly timer is implemented)

Actions

No actions have been defined for this managed entity.

Notifications

Threshold Crossing Alert: This message is used to notify the management system when one of the above values exceeds a pre-set threshold. The following information shall be supplied with this notification:

- The ID of the Managed Entity Reporting the Threshold Crossing Alert
- The Type of Performance Parameter that Exceeded the Threshold

Relationships

One instance of this managed entity shall exist for each instance of the Interworking VCC Termination Point managed entity that represents AAL5 functions.

3.7. AAL1 Protocol History Data

This is a managed entity that contains the past performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring.

Attributes

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

Period End Time: This read-only attribute records the time at the end of the interval.

Suspect Interval Flag: This attribute is used to indicate that the performance data for the current period may not be reliable.

Number of Suppressed Intervals: This read-only attribute is non-zero only if the ATM NE is suppressing AAL1 Protocol History Data creation when the current interval terminates with “all-zeroes” performance measurements.

Header Errors: This attribute represents a count of the number of AAL1 header errors detected, including those corrected. Header errors include correctable and uncorrectable CRC plus bad parity

Sequence Violations: This attribute represents a count of incoming AAL Type 1 SAR-PDUs where the sequence count in the PDU header causes a transition from the SYNC state to the OUT OF SEQUENCE state as defined by ITU-T Rec. I.363.1. A negative value indicates that this attribute is not supported.

Cell Loss: This attribute represents a count the number of lost cells, as detected by the AAL1 sequence number processing, for example. This count records the number of cells detected as lost in the network

prior to the destination interworking function AAL1 layer processing. A negative value indicates that this attribute is not supported.

Cell Misinsertion: This attribute represents a sequence violation events which the AAL CS interprets as misinserted of cells as defined by ITU-T Rec. I.363.1. A negative value indicates that this attribute is not supported.

Buffer Underflows: This attribute represents a count the number of times the reassembly buffer underflows. In the case of a continuous underflow caused by a loss of ATM cell flow, a single buffer underflow should be counted. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer underflow will cause this count to be incremented.

Buffer Overflows: This attribute represents a count of the number of times the reassembly buffer overflows. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer overflow will cause this count to be incremented.

SDT Pointer Reframes: This attribute represents a count of the number of events in which the AAL1 reassembler found that a structured data pointer is not where it is expected, and the pointer must be reacquired. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. A negative value indicates that this attribute is not supported, however it must be supported when pointers are used.

SDT Pointer Parity Check Failures: This attribute represents a count of the number of times the AAL reassembler detects a parity check failure at the point where a structured data pointer is expected. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. A negative value indicates that this attribute is not supported.

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

A new instance of this entity is created at the end of each 15-minute interval for each current data object. This managed entity will create a copy of the performance management attributes that are present in the AAL1 Current Protocol data managed entity at the end of the 15-minute interval. From zero to thirty-two instances of this object shall be supported for each current data object.

3.8. AAL3/4 Protocol History Data

This is a managed entity that contains the past performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring.

Attributes

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

Period End Time: This read-only attribute records the time at the end of the interval.

Suspect Interval Flag: This attribute is used to indicate that the performance data for the current period may not be reliable.

Number of Suppressed Intervals: This read-only attribute is non-zero only if the ATM NE is suppressing AAL3/4 Protocol History Data creation when the current interval terminates with “all-zeroes” performance measurements.

Sum Of Invalid SAR Field Errors: This attribute provides a sum-of-errors count for invalid Segmentation And Reassembly (SAR) field errors. For AAL Type 3/4, this attribute provides a single count of the number of SAR_PDUs discarded due to one of the following error conditions: MID=0 when there is multiplexing, MID not equal to 0 when there is no multiplexing, Length field not equal to 44 octets for a BOM or COM, Length field not in the set [4, 8, ..., 44] octets or 63 octets for an EOM, or Length field not in the set [8, 12, ..., 44] octets for an SSM.

Sum Of Incorrect SAR Field Errors: This attribute provides a sum-of-errors count for incorrect Segmentation And Reassembly (SAR) field errors. For AAL Type 3/4, this attribute provides a single count of SAR_PDUs discarded due to one of the following errors: CRC violation, unexpected Sequence Number (SN) field value, or unexpected MID field value

SAR CRC Violations: This attribute represents the number of CRC violations that were detected for the incoming SAR PDUs.

COMS EOMS Unexpected SN: This attribute represents the number of COM and EOM segments received with an unexpected Sequence Number (SN). For a particular message (i.e., MID) transported over a VPC or VCC, this attribute is incremented by one each time a COM or EOM is received with a SAR Sequence Number (SN) that is not correct relative to the SN in the previous (non-EOM) segment.

BOMS EOMS Unexpected MID: This attribute represents the number of BOM/EOM segments with an unexpected MID value. This attribute will be incremented by one each time a BOM is received with a currently active MID (a MID for which an EOM has not yet been received), or when an EOM is received for which a MID is NOT currently active.

SRI Time Outs: This attribute represents a count of the number of SRI time-outs that occurred on an ATM connection.

Number Of Aborts: This attribute provides a count of the number of aborts (i.e., EOM with SAR_PDU Length Indication = 63) that are received for the underlying VPC or VCC.

Sum Of Invalid CS Field Errors: This attribute provides a sum-of-errors count for invalid Convergence Sublayer (CS) field errors. For AAL Type 3/4, this attribute provides a single count of the number of CS_PDUs discarded due to one of the following error conditions: Common Part Indicator (CPI) field not equal to 0, Alignment field value not equal to 0, or BAsize field value < 37 octets for multi-segment messages.

Sum Of Incorrect CS Field Errors: This attribute provides a sum-of-errors count for incorrect Convergence Sublayer (CS) field errors. For AAL Type 3/4, this attribute provides a single count of CS_PDUs discarded due to one of the following error conditions: BETag mismatch, BAsize field value not consistent with Length field value, or Length field value not consistent with CS_PDU length.

BE Tag Mismatch: This attribute represents the number of times an incoming CS_PDU had a BTag field value that did not equal the ETag field value.

Length BA Size Mismatch: This attribute represents the number of CS_PDUs in which the Length field value was not consistent with the BASize field value. The definition of consistent depends on the mode in which CS_PDU fragments are being processed. In the message-mode, the BASize field must equal the Length field. In the streaming mode, the BASize field must be less than the Length field.

Length Mismatch: This attribute represents the number of CS_PDUs received with a Length field value that does not represent the actual length of the CS_PDU payload.

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

A new instance of this entity is created at the end of each 15-minute interval for each current data object. This managed entity will create a copy of the performance management attributes that are present in the AAL3/4 Current Protocol data managed entity at the end of the 15-minute interval. From zero to thirty-two instances of this object shall be supported for each current data object.

3.9. AAL5 Protocol History Data

This is a managed entity that contains the past performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring.

Attributes

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

Period End Time: This read-only attribute records the time at the end of the interval.

Suspect Interval Flag: This attribute is used to indicate that the performance data for the current period may not be reliable.

Number of Suppressed Intervals: This read-only attribute is non-zero only if the ATM NE is suppressing AAL5 Protocol History Data creation when the current interval terminates with “all-zeroes” performance measurements.

Sum Of Invalid CS Field Errors: This attribute provides a sum-of-errors count for invalid Convergence Sublayer (CS) field errors. For AAL Type 5, this attribute provides a single count of the number of CS_PDUs discarded due to one of the following error conditions: Invalid Common Part Indicator (CPI), oversized received SDU, or length violation.

CRC Violations: This attribute represents the number of CRC violations that were detected for the incoming AAL PDUs.

Reassembly Timer Expirations: This attribute provides a count of reassembly timer expirations. A negative value indicates that this attribute is not supported. (mandatory if reassembly timer is implemented)

Actions

No actions have been defined for this managed entity.

Notifications

No notifications have been defined for this managed entity.

Relationships

A new instance of this entity is created at the end of each 15-minute interval for each current data object. This managed entity will create a copy of the performance management attributes that are present in the AAL5 Current Protocol data managed entity at the end of the 15-minute interval. From zero to thirty-two instances of this object shall be supported for each current data object.

4. M4 CMIP MIB

The following managed object classes, conditional packages, attributes, name binding, and ASN.1 productions are a supplement to the existing ATM Forum M4 NE View CIMISE MIB (af-nm-0027.001).

4.1. Managed Object Classes

4.1.1. aalProfile

```
aalProfile MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. X.721 | ISO/IEC 10165-2":top;
  CHARACTERIZED BY
    aalProfilePkg PACKAGE
      BEHAVIOUR aalProfileBeh;
      ATTRIBUTES
        aalProfileId
          GET,
        aalType
          GET;;;
  CONDITIONAL PACKAGES
    aalTypeOneProfilePkg
      PRESENT IF "the aalType attribute is set to aal1",
    aalTypeThreeFourProfilePkg
      PRESENT IF "the aalType attribute is set to aal34",
    aalTypeFiveProfilePkg
      PRESENT IF "the aalType attribute is set to aal5";
  REGISTERED AS {atmfM4ObjectClass 30};
```

```
aalProfileBeh BEHAVIOUR
  DEFINED AS
  "The aalProfile object class is a managed support object used to organize data that describes the AAL
  processing functions of the ATM NE. The attribute aalType identifies the type of AAL processing (i.e.,
  AAL1, AAL3/4, or AAL5). The AAL profiling information is contained in packages which are present
  based on the value of the aalType attribute. ";
```

4.1.2. aalProtocolCurrentData

```
aalProtocolCurrentData MANAGED OBJECT CLASS
  DERIVED FROM "ITU-T Rec. Q.822: 1993":currentData;
  CHARACTERIZED BY
    aalProtocolCurrentDataPkg PACKAGE
      BEHAVIOUR aalProtocolCurrentDataBeh;;;
  CONDITIONAL PACKAGES
    aalTypeOnePerformanceParameterPkg
      PRESENT IF "AAL Type 1 processing is being performed",
    aalTypeThreeFourPerformanceParameterPkg
      PRESENT IF "AAL Type 3/4 processing is being performed",
    aalTypeFivePerformanceParameterPkg
      PRESENT IF "AAL Type 5 processing is being performed";
  REGISTERED AS {atmfM4ObjectClass 31};
```

aalProtocolCurrentDataBeh BEHAVIOUR
DEFINED AS

"The aalProtocolCurrentData object is a managed support object that contains the current performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring. The granularityPeriod attribute inherited from the scanner object class shall be set to 15-minutes. Instances of this object class shall be inherently created by the managed system whenever an instance of the Interworking VCC Termination Point object class is created that represents AAL functions.";

4.1.3. aalProtocolHistoryData

aalProtocolHistoryData MANAGED OBJECT CLASS

DERIVED FROM "ITU-T Rec. Q.822: 1993": historyData;
CHARACTERIZED BY

aalProtocolHistoryDataPkg PACKAGE
BEHAVIOUR aalProtocolHistoryDataBeh;;;

CONDITIONAL PACKAGES

aalTypeOnePerformanceParameterHistoryDataPkg
PRESENT IF "AAL Type 1 processing is being performed",
aalTypeThreeFourPerformanceParameterHistoryDataPkg
PRESENT IF "AAL Type 3/4 processing is being performed",
aalTypeFivePerformanceParameterHistoryDataPkg
PRESENT IF "AAL Type 5 processing is being performed";

REGISTERED AS {atmfM4ObjectClass 32};

aalProtocolHistoryDataBeh BEHAVIOUR
DEFINED AS

"The aalProtocolHistoryData object is a managed support object that contains the past performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring. Instances of this object class can only be created locally by an agent (managed system) according to the value of the historyRetention attribute specified in the aalProtocolCurrentData object. ";

4.2. Conditional Packages

4.2.1. aalTypeOnePerformanceParameterPkg

aalTypeOnePerformanceParameterPkg PACKAGE

ATTRIBUTES

sequenceViolations
REPLACE-WITH-DEFAULT
DEFAULT VALUE ATMMIBMod.integerZero
GET,
cellLoss
REPLACE-WITH-DEFAULT
DEFAULT VALUE ATMMIBMod.integerZero
GET,

```

cellMisinsertion
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
bufferUnderflows
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
bufferOverflows
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
headerErrors
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
stdPointerReframes
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
stdPointerParityFailures
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET;
REGISTERED AS {atmfM4Package 20};

```

4.2.2. aalTypeOnePerformanceParameterHistoryDataPkg

```

aalTypeOnePerformanceParameterHistoryDataPkg PACKAGE
    ATTRIBUTES
        sequenceViolations
            GET,
        cellLoss
            GET,
        cellMisinsertion
            GET,
        bufferUnderflows
            GET,
        bufferOverflows
            GET,
        headerErrors
            GET,
        stdPointerReframes
            GET,
        stdPointerParityFailures
            GET;
REGISTERED AS {atmfM4Package 21};

```

4.2.3. aalTypeOneProfilePkg

```

aalTypeOneProfilePkg PACKAGE
  ATTRIBUTES
    cbrRate
      GET,
    cellLossIntegrationPeriod,
      GET,
    clockRecoveryType
      GET,
    forwardErrorCorrectionMethod
      GET,
    partiallyFilledCells
      GET,
    structuredDataTransfer
      GET,
    subType
      GET;
REGISTERED AS {atmfM4Package 22};

```

4.2.4. aalTypeThreeFourPerformanceParameterPkg

```

aalTypeThreeFourPerformanceParameterPkg PACKAGE
  ATTRIBUTES
    sumOfInvalidSARFieldErrors
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,
    sumOfIncorrectSARFieldErrors
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,
    sarCrcViolations
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,
    comsEomsUnexpectedSN
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,
    bomsEomsUnexpectedMID
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,
    sriTimeOuts
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,
    numberOfAborts
      REPLACE-WITH-DEFAULT
      DEFAULT VALUE ATMMIBMod.integerZero
      GET,

```

```

sumOfInvalidCSFieldErrors
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
sumOfIncorrectCSFieldErrors
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
bETagMismatch
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
lengthBASizeMismatch
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET,
lengthMismatch
    REPLACE-WITH-DEFAULT
    DEFAULT VALUE ATMMIBMod.integerZero
    GET;
REGISTERED AS {atmfM4Package 23};

```

4.2.5. aalTypeThreeFourPerformanceParameterHistoryDataPkg

```

aalTypeThreeFourPerformanceParameterHistoryDataPkg PACKAGE
    ATTRIBUTES
        sumOfInvalidSARFieldErrors
            GET,
        sumOfIncorrectSARFieldErrors
            GET,
        sarCrcViolations
            GET,
        comsEomsUnexpectedSN
            GET,
        bomsEomsUnexpectedMID
            GET,
        sriTimeOuts
            GET,
        numberOfAborts
            GET,
        sumOfInvalidCSFieldErrors
            GET,
        sumOfIncorrectCSFieldErrors
            GET,
        bETagMismatch
            GET,
        lengthBASizeMismatch
            GET,
        lengthMismatch
            GET;
REGISTERED AS {atmfM4Package 24};

```

4.2.6. aalTypeThreeFourProfilePkg

aalTypeThreeFourProfilePkg PACKAGE

ATTRIBUTES

maxCpcsSduSize

GET,

midRange

GET,

aal Mode

GET,

sscsType

GET;

REGISTERED AS {atmfM4Package 25};

4.2.7. aalTypeFivePerformanceParameterPkg

aalTypeFivePerformanceParameterPkg PACKAGE

ATTRIBUTES

sumOfInvalidCSFieldErrors

REPLACE-WITH-DEFAULT

DEFAULT VALUE ATMMIBMod.integerZero

GET,

crcViolations

REPLACE-WITH-DEFAULT

DEFAULT VALUE ATMMIBMod.integerZero

GET,

reassemblyTimerExpirations

REPLACE-WITH-DEFAULT

DEFAULT VALUE ATMMIBMod.integerZero

GET;

REGISTERED AS {atmfM4Package 26};

4.2.8. aalTypeFivePerformanceParameterHistoryDataPkg

aalTypeFivePerformanceParameterHistoryDataPkg PACKAGE

ATTRIBUTES

sumOfInvalidCSFieldErrors

GET,

crcViolations

GET,

reassemblyTimerExpirations

GET;

REGISTERED AS {atmfM4Package 27};

4.2.9. aalTypeFiveProfilePkg

aalTypeFiveProfilePkg PACKAGE

ATTRIBUTES

maxCpcsSduSize

GET,

aal Mode
 GET,
 sscsType
 GET;
REGISTERED AS {atmfM4Package 28};

4.3. Attributes

4.3.1. aalMode

aalMode ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.AalMode;
 MATCHES FOR EQUALITY, ORDERING;
 BEHAVIOUR aalModeBeh;
REGISTERED AS {atmfM4Attribute 61};

aalModeBeh BEHAVIOUR
 DEFINED AS
" This attribute indicates whether the AAL for the supporting VCC is operating in message mode or streaming mode, assured or unassured. ";

4.3.2. aalProfileId

aalProfileId ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.NameType;
 MATCHES FOR EQUALITY;
 BEHAVIOUR aalAccessPointIdBeh;
REGISTERED AS {atmfM4Attribute 62};

aalProfileIdBeh BEHAVIOUR
 DEFINED AS
"This attribute can be used as an RDN when naming an instance of the aalProfile managed object class. ";

4.3.3. aalType

aalType ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.AalType;
 MATCHES FOR EQUALITY;
 BEHAVIOUR aalTypeBeh;
REGISTERED AS {atmfM4Attribute 63};

aalTypeBeh BEHAVIOUR
 DEFINED AS
"This attribute identifies the AAL Type. Valid types are AAL1, AAL3/4, and AAL5. ";

4.3.4. bETagMismatch

bETagMismatch ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR bETagMismatchBeh;
REGISTERED AS {atmfM4Attribute 64};

bETagMismatchBeh BEHAVIOUR
DEFINED AS

" This attribute represents the number of times an incoming CS_PDU had a BTag field value that did not equal the ETag field value. ";

4.3.5. bomsEomsUnexpectedMID

bomsEomsUnexpectedMID ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR bomsEomsUnexpectedMIDBeh;
REGISTERED AS {atmfM4Attribute 65};

bomsEomsUnexpectedMIDBeh BEHAVIOUR
DEFINED AS

" This attribute represents the number of BOM/EOM segments with an unexpected MID value. This attribute will be incremented by one each time a BOM is received with a currently active MID (a MID for which an EOM has not yet been received), or when an EOM is received for which a MID is NOT currently active. ";

4.3.6. bufferOverflows

bufferOverflows ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR bufferOverflowsBeh;
REGISTERED AS {atmfM4Attribute 66};

bufferOverflowsBeh BEHAVIOUR
DEFINED AS

" This attribute represents a count of the number of times the reassembly buffer overflows. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer overflow will cause this count to be incremented.";

4.3.7. bufferUnderflows

bufferUnderflows ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR bufferUnderflowsBeh;
REGISTERED AS {atmfM4Attribute 67};

bufferUnderflowsBeh BEHAVIOUR
DEFINED AS

" This attribute represents a count the number of times the reassembly buffer underflows. In the case of a continuous underflow caused by a loss of ATM cell flow, a single buffer underflow should be counted. If

the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer underflow will cause this count to be incremented.";

4.3.8. cbrRate

cbrRate ATTRIBUTE
WITH ATTRIBUTE SYNTAX ATMMIBMod.Integer;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR cbrRateBeh;
REGISTERED AS {atmfM4Attribute 68};

cbrRateBeh BEHAVIOUR
DEFINED AS
" This attribute represents the rate of the CBR service supported by the AAL. ";

4.3.9. cellLoss

cellLoss ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR cellLossBeh;
REGISTERED AS {atmfM4Attribute 69};

cellLossBeh BEHAVIOUR
DEFINED AS
"This attribute represents a count the number of lost cells, as detected by the AAL1 sequence number processing, for example. This count records the number of cells detected as lost in the network prior to the destination interworking function AAL1 layer processing. A negative value indicates that this attribute is not supported. "

4.3.10. cellLossIntegrationPeriod

cellLossIntegrationPeriod ATTRIBUTE
WITH ATTRIBUTE SYNTAX ATMMIBMod.Integer;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR cellLossIntegrationPeriodBeh;
REGISTERED AS {atmfM4Attribute 70};

cellLossIntegrationPeriodBeh BEHAVIOUR
DEFINED AS
"This attribute identifies the time in milliseconds for the cell loss integration period. If cells are lost for this period of time, the containing interworkingVCTTPBidirectional object will generate a communications alarm. "

4.3.11. cellMisinsertion

cellMisinsertion ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR cellMisinsertionBeh;

REGISTERED AS {atmfM4Attribute 71};

cellMisinsertionBeh BEHAVIOUR
DEFINED AS

"This attribute represents a count of sequence violation events which the AAL CS interprets as misinserted of cells as defined by ITU-T Rec. I.363.1.A negative value indicates that this attribute is not supported. "

4.3.12. clockRecoveryType

clockRecoveryType ATTRIBUTE
WITH ATTRIBUTE SYNTAX ATMMIBMod.ClockRecoveryType;
MATCHES FOR EQUALITY;
BEHAVIOUR clockRecoveryTypeBeh;
REGISTERED AS {atmfM4Attribute 72};

clockRecoveryTypeBeh BEHAVIOUR
DEFINED AS

" This attribute indicates whether the clock recovery type is Synchronous, SRTS (Synchronous Residual Time Stamp), or Adaptive Clock Recovery. ";

4.3.13. comsEomsUnexpectedSN

comsEomsUnexpectedSN ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR comsEomsUnexpectedSNBeh;
REGISTERED AS {atmfM4Attribute 73};

comsEomsUnexpectedSNBeh BEHAVIOUR
DEFINED AS

"This attribute represents the number of COM and EOM segments received with an unexpected Sequence Number (SN). For a particular message (i.e., MID) transported over a VPC or VCC, this attribute is incremented by one each time a COM or EOM is received with a SAR Sequence Number (SN) that is not correct relative to the SN in the previous (non-EOM) segment. ";

4.3.14. crcViolations

crcViolations ATTRIBUTE
DERIVED FROM "ITU-T Rec. X.721":counter;
BEHAVIOUR crcViolationsBeh;
REGISTERED AS {atmfM4Attribute 74};

crcViolationsBeh BEHAVIOUR
DEFINED AS

"This attribute represents the number of CRC violations that were detected for the incoming AAL PDUs. ";

4.3.15. forwardErrorCorrectionMethod

forwardErrorCorrectionMethod ATTRIBUTE

WITH ATTRIBUTE SYNTAX ATMMIBMod.FecMethod;
 MATCHES FOR EQUALITY;
 BEHAVIOUR errorCorrectionTypeBeh;
 REGISTERED AS {atmfM4Attribute 75};

forwardErrorCorrectionMethodBeh BEHAVIOUR
 DEFINED AS

" This attribute indicates the FEC method: no FEC, FEC for Loss Sensitive Signal Transport, or FEC for Delay Sensitive Signal Transport.";

4.3.16. headerErrors

headerErrors ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR crcViolationsBeh;
 REGISTERED AS {atmfM4Attribute 76};

headerErrorsBeh BEHAVIOUR
 DEFINED AS

" This attribute represents a count of the number of AAL1 header errors detected, including those corrected. Header errors include correctable and uncorrectable CRC plus bad parity. "

4.3.17. lengthBASizeMismatch

lengthBASizeMismatch ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR lengthBASizeMismatchBeh;
 REGISTERED AS {atmfM4Attribute 77};

lengthBASizeMismatchBeh BEHAVIOUR
 DEFINED AS

" This attribute represents the number of CS_PDUs in which the Length field value was not consistent with the BASize field value. The definition of consistent depends on the mode in which CS_PDU fragments are being processed. In the message-mode, the BASize field must equal the Length field. In the streaming mode, the BASize field must be less than the Length field. ";

4.3.18. lengthMismatch

lengthMismatch ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR lengthMismatchBeh;
 REGISTERED AS {atmfM4Attribute 78};

lengthMismatchBeh BEHAVIOUR
 DEFINED AS

" This attribute represents the number of CS_PDUs received with a Length field value that does not represent the actual length of the CS_PDU payload.";

4.3.19. maxCpcsSduSize

maxCpcsSduSize ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.MaxCpcsSduSize;
 MATCHES FOR EQUALITY;
 BEHAVIOUR maxCpcsSduSizeBeh;
 REGISTERED AS {atmfM4Attribute 79};

maxCpcsSduSizeBeh BEHAVIOUR
 DEFINED AS

" This multi-valued attribute represents the maximum CPCS_PDU size that will be transmitted over the connection in both the incoming (forward) and outgoing (backward) direction of transmission.";

4.3.20. midRange

midRange ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.MidRange;
 MATCHES FOR EQUALITY, ORDERING;
 BEHAVIOUR midRangeBeh;
 REGISTERED AS {atmfM4Attribute 80};

midRangeBeh BEHAVIOUR
 DEFINED AS

" This attribute represents the range of MID values supported at the AAL for the supporting VCC.";

4.3.21. numberOfAborts

numberOfAborts ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR numberOfAbortsBeh;
 REGISTERED AS {atmfM4Attribute 81};

numberOfAbortsBeh BEHAVIOUR
 DEFINED AS

" This attribute provides a count of the number aborts (i.e., EOM with SAR_PDU Length Indication = 63) that are received for the underlying VPC or VCC. ";

4.3.22. partiallyFilledCells

partiallyFilledCells ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.Integer;
 MATCHES FOR EQUALITY, ORDERING;
 BEHAVIOUR partiallyFilledCellsBeh;
 REGISTERED AS {atmfM4Attribute 82};

partiallyFilledCellsBeh BEHAVIOUR
 DEFINED AS

" This attribute identifies the number of leading octets in use.";

4.3.23. reassemblyTimerExpirations

reassemblyTimerExpirations ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR reassemblyTimerExpirationsBeh;
 REGISTERED AS {atmfM4Attribute 83};

reassemblyTimerExpirationsBeh BEHAVIOUR
 DEFINED AS

" This attribute provides a count of reassembly timer expirations. A negative value indicates that this attribute is not supported.. ";

4.3.24. sarCrcViolations

sarCrcViolations ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR sarCrcViolationsBeh;
 REGISTERED AS {atmfM4Attribute 84};

sarCrcViolationsBeh BEHAVIOUR
 DEFINED AS

"This attribute represents the number of CRC violations that were detected for the incoming SAR PDUs. ";

4.3.25. sequenceViolations

sequenceViolations ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR sequenceViolationsBeh;
 REGISTERED AS {atmfM4Attribute 853};

sequenceViolationsBeh BEHAVIOUR
 DEFINED AS

" This attribute represents a count incoming AAL Type 1 SAR-PDUs where the sequence count in the PDU header causes a transition from the SYNC state to the OUT OF SEQUENCE state as defined by ITU-T Rec. I.363.1. A negative value indicates that this attribute is not supported. ";

4.3.26. sriTimeOuts

sriTimeOuts ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR sriTimeOutsBeh;
 REGISTERED AS {atmfM4Attribute 86};

sriTimeOutsBeh BEHAVIOUR
 DEFINED AS

" This attribute represents a count of the number of SRI time-outs that occurred on an ATM connection. ";

4.3.27. sscsType

sscsType ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.SscsType;
 MATCHES FOR EQUALITY;
 BEHAVIOUR sscsTypeBeh;
 REGISTERED AS {atmfM4Attribute 87};

sscsTypeBeh BEHAVIOUR
 DEFINED AS

" This attribute identifies the SSCS type for the AAL. Valid values are NULL, Data SSCS based on SSCOP (assured operation), Data SSCS based on SSCOP (non-assured operation), or Frame Relay SSCS. ";

4.3.28. stdPointerParityFailures

stdPointerParityFailures ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR stdPointerParityFailuresBeh;
 REGISTERED AS {atmfM4Attribute 88};

stdPointerParityFailuresBeh BEHAVIOUR
 DEFINED AS

" This attribute represents a count of the number of times the AAL reassembler detects a parity check failure at the point where a structured data pointer is expected. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. A negative value indicates that this attribute is not supported. ";

4.3.29. stdPointerReframes

stdPointerReframes ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR stdPointerReframesBeh;
 REGISTERED AS {atmfM4Attribute 89};

stdPointerReframesBeh BEHAVIOUR
 DEFINED AS

" This attribute represents a count of the number of events in which the AAL1 reassembler found that a structured data pointer is not where it is expected, and the pointer must be reacquired. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. A negative value indicates that this attribute is not supported, however it must be supported when pointers are used. ";

4.3.30. structuredDataTransfer

structuredDataTransfer ATTRIBUTE
 WITH ATTRIBUTE SYNTAX ATMMIBMod.Boolean;
 MATCHES FOR EQUALITY;
 BEHAVIOUR structuredDataTransferBeh;
 REGISTERED AS {atmfM4Attribute 90};

structuredDataTransferBeh BEHAVIOUR

DEFINED AS

"This attribute indicates whether Structured Data Transfer (SDT) has been configured at the AAL. A value of TRUE means SDT has been selected. This attribute value cannot be set to TRUE when the errorCorrectionType attribute equals TRUE. ";

4.3.31.subType

subType ATTRIBUTE

WITH ATTRIBUTE SYNTAX ATMMIBMod.SubType;

MATCHES FOR EQUALITY;

BEHAVIOUR subTypeBeh;

REGISTERED AS {atmfM4Attribute 91};

subTypeBeh BEHAVIOUR

DEFINED AS

"This attribute is used to identify the AAL subtype. Valid values for this attribute are NULL, Voice-band based on 64 kbps, Circuit Emulation (synchronous), Circuit Emulation (asynchronous), High-quality Audio, and Video.";

4.3.32.sumOfIncorrectCSFieldErrors

sumOfIncorrectCSFieldErrors ATTRIBUTE

DERIVED FROM "ITU-T Rec. X.721":counter;

BEHAVIOUR sumOfIncorrectCSFieldErrorsBeh;

REGISTERED AS {atmfM4Attribute 92};

sumOfIncorrectCSFieldErrorsBeh BEHAVIOUR

DEFINED AS

" This attribute provides a sum-of-errors count for incorrect Convergence Sublayer (CS) field errors. For AAL Type 3/4, this attribute provides a single count of CS_PDUs discarded due to one of the following error conditions: BETag mismatch, BASize field value not consistent with Length field value, or Length field value not consistent with CS_PDU length. ";

4.3.33.sumOfIncorrectSARFieldErrors

sumOfIncorrectSARFieldErrors ATTRIBUTE

DERIVED FROM "ITU-T Rec. X.721":counter;

BEHAVIOUR sumOfIncorrectSARFieldErrorsBeh;

REGISTERED AS {atmfM4Attribute 93};

sumOfIncorrectSARFieldErrorsBeh BEHAVIOUR

DEFINED AS

" This attribute provides a sum-of-errors count for incorrect Segmentation And Reassembly (SAR) field errors. For AAL Type 3/4, this attribute provides a single count of SAR_PDUs discarded due to one of the following errors: CRC violation, unexpected Sequence Number (SN) field value, or unexpected MID field value ";

4.3.34. sumOfInvalidCSFieldErrors

sumOfInvalidCSFieldErrors ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR sumOfInvalidCSFieldErrorsBeh;
 REGISTERED AS {atmfM4Attribute 94};

sumOfInvalidCSFieldErrorsBeh BEHAVIOUR
 DEFINED AS

" This attribute provides a sum-of-errors count for invalid Convergence Sublayer (CS) field errors. For AAL Type 3/4, this attribute provides a single count of the number of CS_PDU's discarded due to one of the following error conditions: Common Part Indicator (CPI) field not equal to 0, Alignment field value not equal to 0, or BAsize field value < 37 octets for multi-segment messages. For AAL Type 5, this attribute provides a single count of the number of CS_PDU's discarded due to one of the following error conditions: Invalid Common Part Indicator (CPI), oversized received SDU, or length violation. ";

4.3.35. sumOfInvalidSARFieldErrors

sumOfInvalidSARFieldErrors ATTRIBUTE
 DERIVED FROM "ITU-T Rec. X.721":counter;
 BEHAVIOUR sumOfInvalidSARFieldErrorsBeh;
 REGISTERED AS {atmfM4Attribute 95};

sumOfInvalidSARFieldErrorsBeh BEHAVIOUR
 DEFINED AS

" This attribute provides a sum-of-errors count for invalid Segmentation And Reassembly (SAR) field errors. For AAL Type 3/4, this attribute provides a single count of the number of SAR_PDU's discarded due to one of the following error conditions: MID=0 when there is multiplexing, MID not equal to 0 when there is no multiplexing, Length field not equal to 44 octets for a BOM or COM, Length field not in the set [4, 8, ..., 44] octets or 63 octets for an EOM, or Length field not in the set [8, 12, ..., 44] octets for an SSM";

4.4. Name Bindings

4.4.1. aalProfile-managedElementR1

aalProfile-managedElementR1 NAME BINDING
 SUBORDINATE OBJECT CLASS
 alProfile AND SUBCLASSES;
 NAMED BY SUPERIOR OBJECT CLASS
 ITU-T Rec. M.3100":managedElementR1 AND SUBCLASSES;
 WITH ATTRIBUTE aalProfileId;
 CREATE
 WITH-REFERENCE-OBJECT,
 WITH-AUTOMATIC-INSTANCE-NAMING;
 DELETE
 DELETES-CONTAINED-OBJECTS;
 REGISTERED AS {atmfM4NameBinding 31};

4.4.2. aalProtocolCurrentData- interworkingVCTTPBidirectional

```
aalProtocolCurrentData-interworkingVCTTPBidirectional NAME BINDING
SUBORDINATE OBJECT CLASS
  alProtocolCurrentData AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS
  interworkingVCTTPBidirectional AND SUBCLASSES;
WITH ATTRIBUTE "ITU-T Rec. X.739":scannerId;
CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
  DELETES-CONTAINED-OBJECTS;
REGISTERED AS {atmfM4NameBinding 32};
```

4.5. Supporting ASN.1 Productions

--The following are added to the ATMMIBMod in af-nm-0027.000

IMPORTS

```

ElapsedTime
FROM
BCRTR836Iss1Mod {1 3 17 104 module(9) tr836(3) bCRTR836Iss1Mod(1)}

```

-- additional value definitions to probableCause production

```
cellStarvation ProbableCause ::= globalValue : {atmProbableCause 4}
```

```
activeDefault ActiveInactive ::= active
```

```
offDefault OnOff ::= off
```

```
recDurDefault INTEGER ::= 4
```

```

AalMode ::= ENUMERATED {
  message_assured (0),
  message_unassured (1),
  streaming_assured (2)
  streaming_unassured (3)}

```

```

AalType ::= ENUMERATED {
  aal1 (0),
  aal2 (1), -- encoded for future use
  aal34 (2),
  aal5 (3)}

```

```

ClockRecoveryType ::= ENUMERATED {
  synchronous (0),
  srts (1),
  adaptive (2)}

```

```

FecMethod ::= ENUMERATED{
  noFEC (0),
  lossSensitiveSignalFEC (1),
  delaySensitiveSignalFEC (2)}

```

```

MaxCpcsSduSize ::= SEQUENCE {
  forward [0] INTEGER (1..65535) OPTIONAL,
  backward [1] INTEGER (1..65535) OPTIONAL}

```

```

MidRange ::= SEQUENCE {
  lowvalue [0] INTEGER (1..66536)
  highvalue [1] INTEGER (1..66536)}

```

```
SscsType ::= ENUMERATED {  
    null (0),  
    dataAssured (1),  
    dataNonAssured (2),  
    frameRelay (3)}
```

```
SubType ::= ENUMERATED {  
    null (0),  
    voiceBand (1),  
    circuitEmulationSynchronous (2),  
    circuitEmulationAsynchronous (3),  
    highQualityAudio (4),  
    video (5)}
```


5. Figures

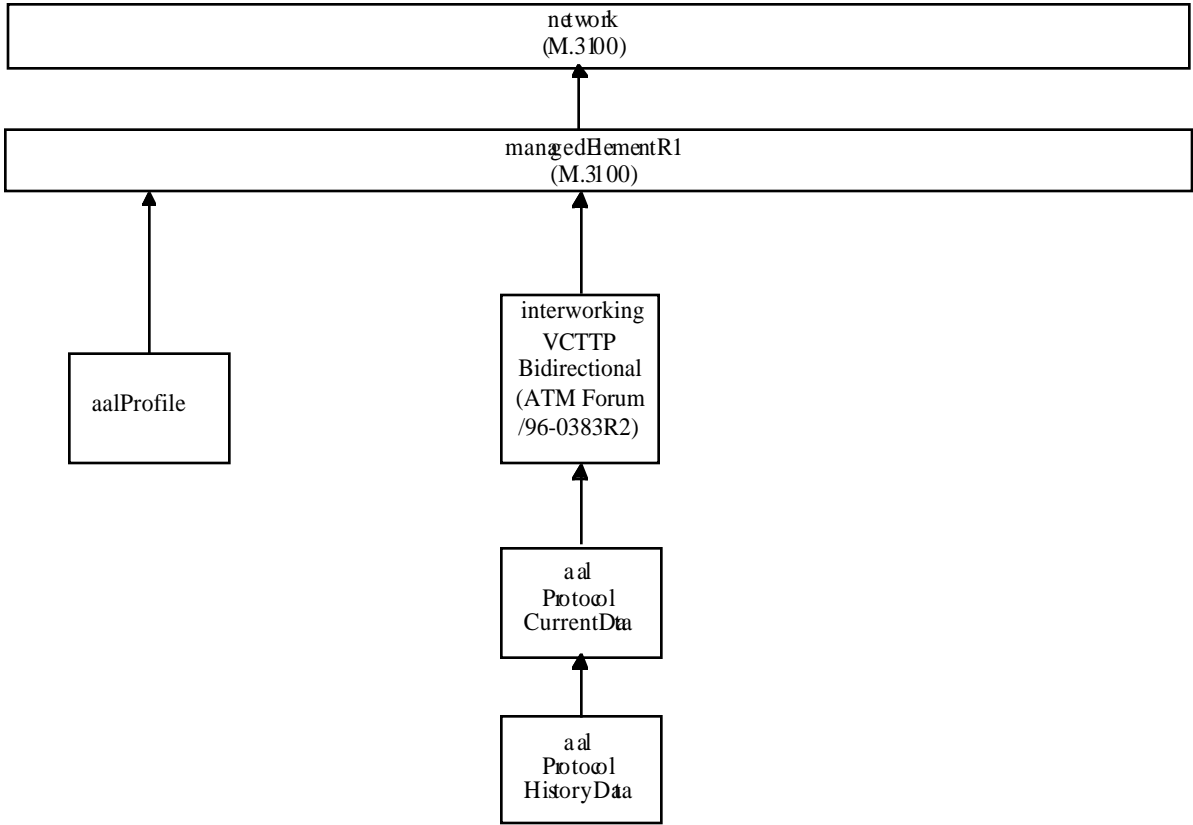


Figure 1 Containment Tree Diagram

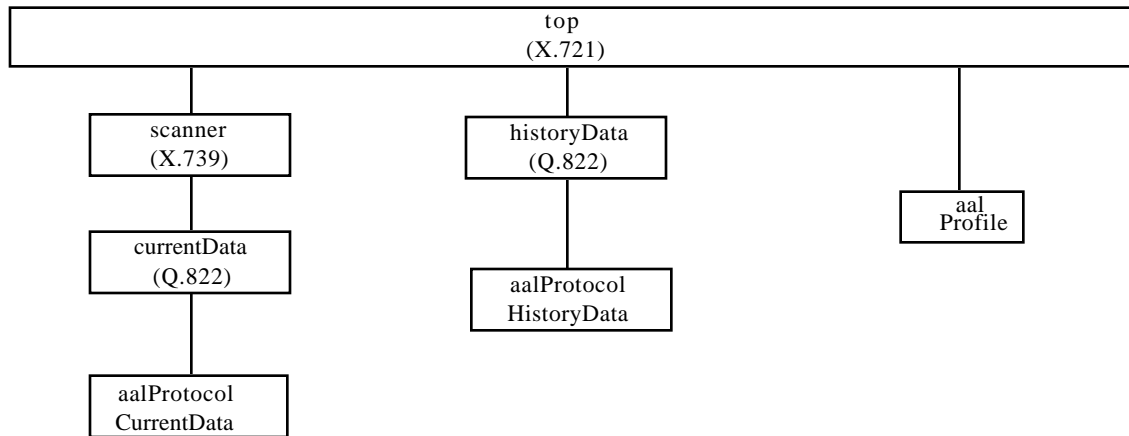


Figure 2 Inheritance Tree Diagram