The ATM Forum

Technical Committee

Remote Monitoring MIB Extensions for ATM Networks

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1. Introduction

This contribution addresses the traffic monitoring and analysis functionality required for ATM networks. It includes a MIB proposal and design rationale, which are based on the IETF Remote Monitoring (RMON) MIBs.

This specification addresses issues related to applying 'RMON technology' to ATM Networks:
- functional applicability of existing RMON groups
- new functionality for ATM networks
- collection source design issues
- flexible resource allocation
- data reduction mechanisms

RMON-based applications can provide system administrators with valuable data about network utilization and behavior. RMON agents offer applications developers resource-intensive functions such as high-level statistics gathering and low-level filtering/capture of MAC frames.

RMON is traditionally deployed as one or more NMS applications managing multiple RMON probes, each of which is monitoring one or more network segments. RMON for ATM networks will require a different deployment model, as well as many other new MIB features.

2. ATM Monitoring Application Framework Requirements

Network administrators need access to traffic utilization statistics in order to effectively manage their networks. The RMON MIB already provides a rich set of statistical information and management functions for Ethernet and Token Ring networks, and it is desirable to extend this set of functionality to ATM networks.

Adapting RMON to ATM networks requires standards work in three areas:

- **Monitoring Application Framework** -- a set of requirements and rationale focusing the application and MIB design.
- **Monitoring MIB** -- a set of monitoring functions suitable for distributed deployment on various platforms, including switch-embedded and external probe implementations.
- **RMON-2 Protocol Identifiers for ATM** -- a set of protocol encapsulation macros must be added to the RMON-2 Protocol Identifiers Specification to support upper-layer packet decoding for specific ATM encapsulations (e.g., LANE). All frame-based analysis of ATM network traffic can be supported directly by RMON-2, without additional MIB objects.

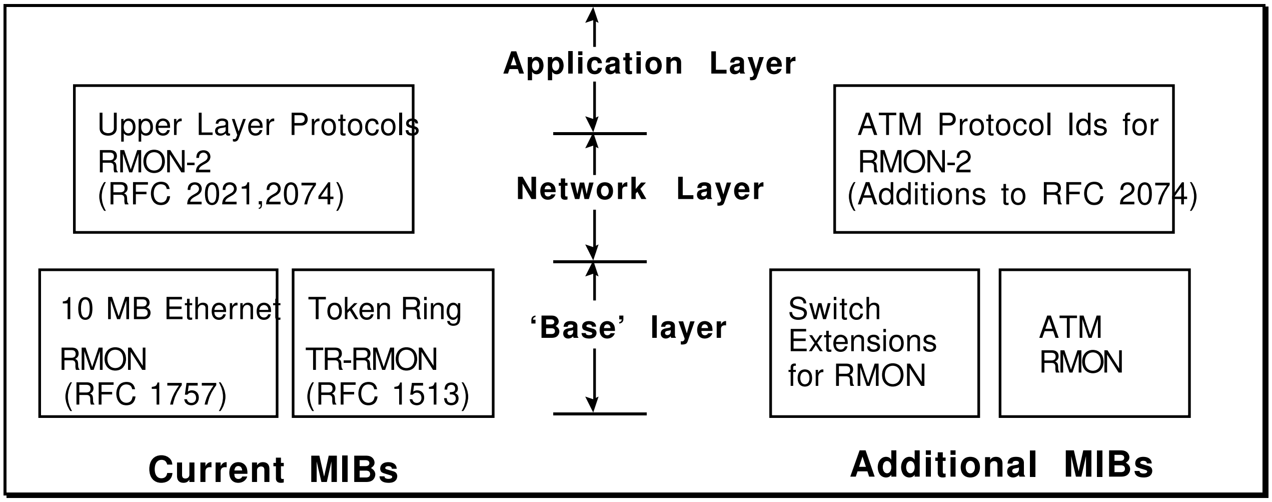

Figure 1: RMON MIB Framework

2.1. Alignment with RMON

The RMON MIBs embody a set of design choices and rationale, which has been standardized and refined over the last six years, such as:

- RMON promiscuously monitors address-based traffic on an individual (physical) subnetwork.
- RMON provides high-level functionality, focusing on correlating network bandwidth/resource utilization to the individual entities using a network, and the conversations between those network entities.
- RMON is intended for remote deployment -- different physical location from the system administrators, and/or attached to different subnetwork(s) than the network management station(s).
- RMON is intended to concurrently support multiple NMS applications, and provide for resource sharing between such applications.
- RMON provides resource-intensive bit-filtering and capture of selected frames for exception handling applications, usually deployed sparingly because of high cost.
- RMON is partially auto-configured, and partially manually configured -- resource-intensive functions such as TopN reporting and filter/capture must be started explicitly, by control-row creation.

2.2. Extending RMON for ATM

The current RMON MIBs analyze frame-based traffic. With some very minor additions to the RMON-2 MIB, frames carried in AAL-5 cell-flows can be counted using the RMON-2 MIB [9].

In addition to frame analysis, an RMON MIB which provides cell-based (per-host and per-conversation) traffic information is desirable.

From an application development perspective, a monitoring MIB is required which has the following attributes:

- maintains RMON structure and architecture to leverage existing application development and user experience.
- provides flexible configuration mechanisms, suited to the connection-oriented nature of ATM.
- provides basic statistics for each monitored cell-stream, for each identified ATM host, and conversation between two ATM hosts, identified by the probe.
- provide aggregated and compacted statistical data to the NMS, reducing NMS load and data transfer times.

- hide low-level details, such as specific VPI/VCI information, which does not pertain to any manageable resource by an NMS. This level of detail does not provide enough useful management information to justify the expense of storing and indexing a huge amount of data on the agent, and then transferring that data to the NMS. (Other MIBs exist which collect per-connection accounting statistics.)
- provide mechanisms to an NMS to allocate probe resources in the more effective ways.
- allows for cost-efficient implementation for both switch-embedded and stand-alone probe designs.
- allows for cost-effective monitoring of high speed links, through configuration optimization and statistical sampling of frame-based traffic.

2.3 RMON Resource Sharing Model

There are some design features that are used throughout all the RMON MIBs. The most important is the RMON resource-sharing model. RMON agents are expected to create certain 'common' data-collection resources (ownerString starts with the string 'monitor'). Only system administrators should be allowed to delete or modify these 'monitor-owned' resources.

NMS applications can create short-lived control entries (ownerString set to unique NMS-ID) if the monitor-owned collections are not appropriate for a given task. Some features, such as TopN reporting, event-reporting, history collection (other than 30 sec/30 min intervals), and filter/capture, require some NMS configuration in most implementations.

The resource owner (NMS) is expected to pick a unique value for the owner string and supply this value in the first setRequest PDU creating the control row. An NMS must check the rowStatus object (i.e., errorStatus of PDU setting status to createAnd* before using the resource, to make sure another NMS was not allocated the resource instead. Before terminating, the NMS application must delete any control entries that it created. There is no control-row garbage collection defined in RMON, so an NMS application must check for its own old, unused control entries before creating new ones, upon startup.

An NMS application may optionally use another applications' resources in a read-only manner, if applicable. Usually, this is only done when a resource request is refused. The system administrator is responsible for deleting RMON resources (monitor or NMS-owned) to make room for new applications.

The latest RMON documents also provide a time-stamp in every data table row, to help an NMS detect the deletion and re-creation of that row. This MIB also provides 'lastCreateTime' time-stamps in all the data tables, as well as the control tables which do not have associated data tables.

This MIB also contains a new resource management feature called the 'ResourcePriority'. Each control entry contains a configurable resource priority identifier ('low', 'normal', or 'high'), which the probe may inspect during garbage-collection of host or matrix entries, in order to avoid inadvertent deletion of important data.

Note that the ResourcePriority only provides additional information to the probe for use during that probe's proprietary garbage collection algorithm (if any). It does not mandate any specific garbage collection or memory management design or implementation. At this time, least recently used (LRU) garbage collection is the recommended approach for probe host and matrix data table memory management.

2.4 Relationship to Existing MIBs

There are several RFCs and Internet drafts which define RMON technology, which may relate to this MIB:

2.4.1. RMON

The Remote Network Monitoring MIB (RMON or RMON-1) [7] provides several management functions that may be directly or indirectly applicable to ATM Networks:

- Detailed link layer statistics for ethernet segments (etherStats group); ATM-RMON maintains a 'stats' group, simply to provide a grand total for the associated host and matrix tables.
- Remote polling of detailed link layer statistics for ethernet segments (history, etherHistory groups); ATM-RMON utilizes the generic history collection application, found in the RMON-2 MIB [9] (see the section on RMON-2 for details).
- Basic statistics--per host and per conversation--for all valid MAC addresses discovered on each monitored segment (host and matrix groups); ATM-RMON contains host and matrix functionality based on the versions found in RMON-2, which contain some updates to the RMON-1 versions.
- TopN Report statistics (topN talkers or errors)--per-host--for each valid MAC address discovered on each monitored segment (hostTopN group) bit-level frame filtering and frame-slice capture (filter, channel, capture groups); ATM-RMON does not implement a hostTopN function, but rather a matrixTopN instead, since hostTopN can be derived from matrixTopN data.
- Simple threshold monitoring, event-logging, and event-notification for any MIB instance; ATM-RMON utilizes the alarms and events groups from RMON-1 [7] without modification. These groups from RMON-1 [7] should be implemented on ATM-RMON probes if a simple thresholding mechanism is desired.

2.4.2. TR-RMON

The Token Ring Extensions for RMON MIB (RFC1513) (TR-RMON) [8] provides the same kind of detailed link layer statistics and remote polling as found in RMON-1 (tokenRingMLStats/History, tokenRingPStats/History). The TR-RMON MIB is highly integrated with RMON-1, which is possible because both link layers use the same address format. An RMON MIB for ATM cannot be structured and positioned like the TR-MIB, because none of the shared tables can be directly applied to ATM. Since RMON-1 will be augmented and updated by RMON-2, any ATM-RMON standardization effort should align with the RMON-2 MIB [9], but maintain the same 'extensions MIB' structure as found in the TR-RMON MIB.

2.4.3. RMON-2 MIB

The emerging 'RMON-2' standard (RMON-2) [9] provides many additions and improvements to RMON-1:

- Complete protocol distribution per segment (or 'collection source').
- Collection of network to MAC address bindings seen in packets on all segments.
- Collection of source MAC address to physical interface bindings on all segments.
- Probe configuration, such as startup parameters and trap destination management.
- Collection of per network-layer host basic statistics (network layer and above).
- Collection of per-conversation basic statistics (network layer and above).
- TopN Report statistics per conversation (network layer and above).
- Improvements such as relative-offset frame filtering, user-defined remote-polling, faster table retrieval, better NMS control of probe resources, and better accuracy reporting.

Although the protocol analysis features are not directly applicable, there are many design improvements in RMON-2 that can be integrated into ATM-RMON:

- TopN report improvements such as auto-restart, report count, reverse-rates, and 'last-create-time' to detect discontinuities.
- Control entry inserts and deletes counters (this replaces the RMON-1 'table-size' object).
- ProtocolDirectory collection-control design (i.e., central configuration defines what data is collected in each functional group).

The usrHistory group (user-defined history collection) should be implemented on ATM-RMON probes if a history collection mechanism is desired for atmStats entries.

2.4.4. RMON-2 Protocol Identifiers

The RMON Protocol Identifiers Specification (RMONPROT) [10] defines encoding rules for protocolDirID, protocolDirParameters, and protocolDirType MIB objects It is required only if RMON-2 packet analysis is applied to frames monitored (on connections which use frames). Statistical analysis of frames is not directly applicable to this MIB, and is not discussed in this document.

2.4.5. ATOM MIB

The Atom MIB is the fundamental MIB for managing ATM networks (RFC 1695) [11], but it is not directly referenced by this MIB, except for use of the 'IfIndex' textual convention. It is possible other textual conventions will be imported as well.

2.4.6. ATOM Supplemental MIB

The Atom Supplemental MIB [12] defines additional management capabilities for ATM networks. The 'AtmAddr' textual convention is used from this MIB, as well as the AtmVclAddrTable.

Since ATM-RMON only monitors address-based traffic, endpoint addresses have to be configured for a PVC before it can be counted by a probe.

An agent implementation may choose to support statistics collection on PVC circuits if the AtmVclAddrTable is implemented as well. An NMS must properly configure the endpoint addresses on each PVC to be monitored, before activating any related ATM-RMON collections.

3. ATM-RMON MIB Functional Requirements

Applying RMON to ATM networks will require some new design changes and new functionality. Special problems such as high speeds, "cells vs. frames" issues, and the connection-oriented nature of ATM need special MIB solutions in order to implement RMON for ATM networks.

3.1. Physical Ports and Logical Ports

Support for VP-tunneling via ATM Logical Ports [12] should be provided without special-case MIB objects. An NMS should be able to specify 'monitored-connections' (in part) by the ifIndex values associated with the ATM interfaces to be monitored. Any ifIndex value associated with an ifType value of 'atm(37)' (Interfaces MIB RFC 1573 [13]) or 'atmLogicalPort(80)' [12] can be specified for monitoring purposes.

Note that a given ATM port is allowed to be included in at most one collection group, so as not to require a probe to count each monitored cell-stream more than once per function (e.g., stats, host, matrix).

3.2. Address-Based vs. Non-Address-Based Traffic

Although ATM networks are capable of carrying many types of traffic (e.g., voice, video, data), only a subset of this traffic is monitored by ATM-RMON probes. RMON technology traditionally provides functions to monitor address-based traffic (i.e., transmissions for which the source and destination entities can be identified by examination).

Therefore, an ATM-RMON probe only monitors connections established between two endpoint addresses. Although the 'AtmAddr' textual convention [12] allows several address type variants, only the 20 octet NSAP format is used in this MIB.

An NMS can monitor the 'ifInOctets' and 'ifOutOctets' objects for a particular ATM port (ifType = 'atm(37)' or 'atmLogicalPort(80)') to determine the total cell traffic through that port. The ATM-RMON MIB can be configured to provide the total address-based cell-traffic for a given port, which can be subtracted from the if*Octets counters to produce the non-address-based traffic totals.

Note that the term "source address" is used throughout the MIB to indicate the ATM address of the particular end of an ATM connection from which the cells are sent, and the term "destination address" indicates the ATM address of the particular end of an ATM connection at which the cells are received. This is irrespective of whether such an address was the Calling Party or Called Party on the particular connection.

3.3. Cell-Level Filter and Capture

Since most applications requiring filter/capture functionality in the probe are for frame-based traffic (handled by RMON-1 and RMON-2), no cell-specific filter/capture MIB objects are included at this time. This functionality may be added in a future release of this MIB.

Note that cell-specific filter/capture would not be restricted to address-based traffic, and may possibly be specified several ways (e.g., ifIndex/VPI/VCI or endpoint address).

3.4. Collection Perspective

There are four different 'collection perspectives' that are possible:

- (A) stand-alone probe attached to a single port of a switch. ATM traffic is copied somehow to the RMON probe.
- (B) embedded probe within a switch., with no access to the switch fabric. ATM traffic is copied somehow to the RMON probe.
- (C) embedded probe within a switch, with access to the switch fabric. ATM traffic is monitored directly, possibly implemented in hardware. Probes of this type are likely to monitor traffic at cell header level only. A lower level of conformance, or some other mechanism (e.g., additional software), will most likely be needed for this type of probe.
- (D) stand-alone probe, tapping an NNI link between two switches. ATM traffic is monitored directly (subject to probe capabilities), without switch intervention. All cells in both directions are monitored somehow by the RMON probe, without disturbing traffic on the link.

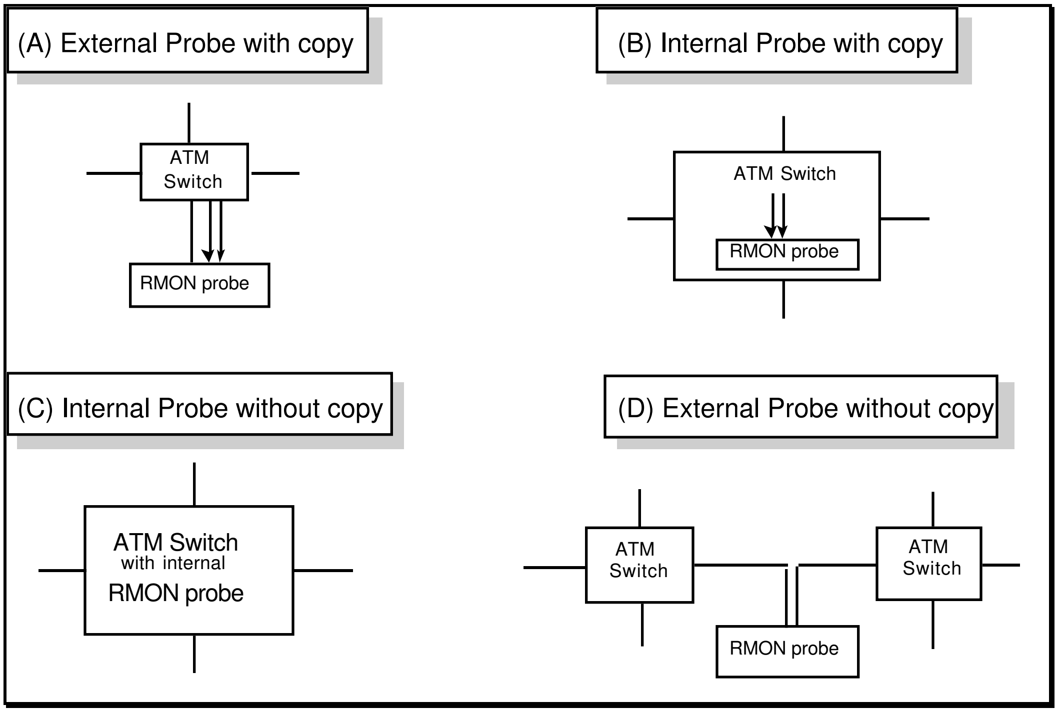

Figure2: Probe Location

Unless RMON instrumentation is embedded into the switch fabric (C), or placed between two switches (D), then circuit steering is required (A and B) for RMON instrumentation software to access ATM traffic. For such probes, each full-duplex circuit is (presumably) mapped into two redirected half-duplex ATM connection:

- inbound(ifIndex/VPI/VCI)
- outbound(ifIndex/VPI/VCI)

A 'probe-tap' (D) does not pre-filter data by selecting particular ATM connections for monitoring. Instead, it receives all VCs on an NNI link, without switch participation.

3.5 Cell Collection Requirements

This MIB provides the following new functionality:

- ATM layer instrumentation
- collection source aggregation
- data reduction configuration and status
- basic cell statistics (i.e., statsTable)
- basic cell statistics per host (i.e., hostTable)
- basic cell counts per conversation (i.e., matrixTable)
- sorted reports, based on basic cell counts per conversation (i.e., matrixTopNTable)

At this time, only some very basic statistics are defined in the proposed MIB:

- cells-sent count (32/32 pair and 64-bit counter)
- cells-received count (32/32 pair and 64-bit counter)
- number of successful call setups (32 bit counter)
- number of attempted call setups (32 bit counter)
- total connection time (32 bit counter, units of seconds)

Other statistics (e.g., error counters) may be added in the future.

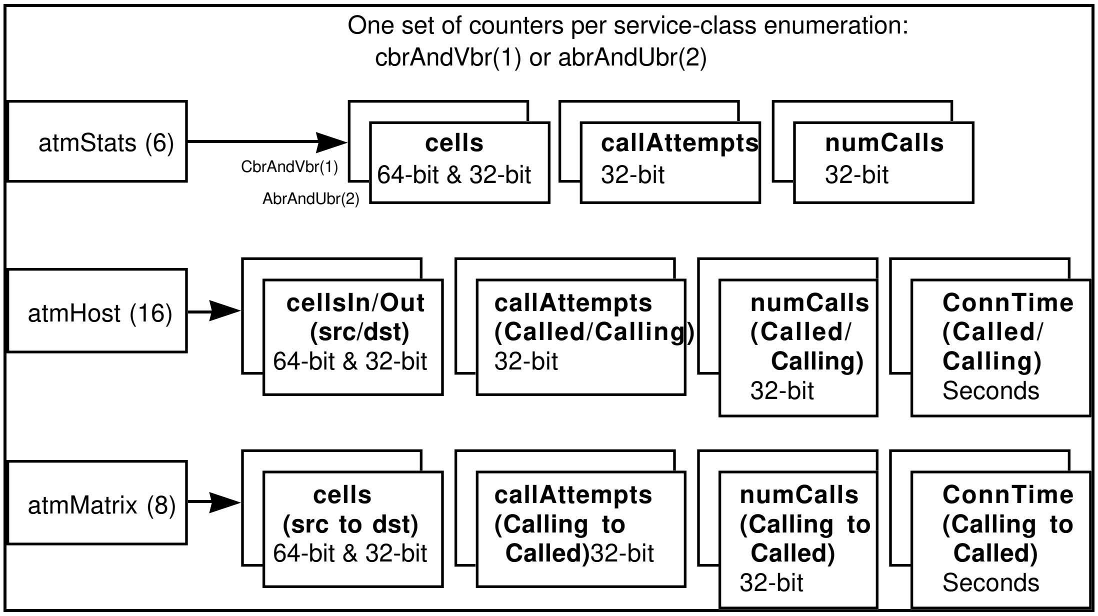

Figure 3: ATM-RMON Counters

Circuit Steering requirements are not addressed in this document. RMON collection requirements will be considered independently of circuit steering techniques. Although references to 'copied' ATM connections are made in this document, actual circuit-steering implementation may be different. Therefore, this MIB is (presently) only directly applicable to collection models which do not require circuit-steering (i.e., models 'C' and 'D' in figure2).

3.6. Frame Collection Requirements

An optional feature set for ATM-RMON is the analysis of frames on AAL-5 ATM connections. This can be accomplished with some minor additions to the RMON-2 MIB [9]. New values for dataSource objects can be defined which reference ATM collection sources. The data can be formatted into RMON-2 host, matrix, matrixTopN, and filter/capture groups without requiring any RMON-2 MIB changes. (Encapsulation definitions have to be added to the Protocol Identifiers Specification [10].)

Details on frame analysis integration with RMON-1 and RMON-2 MIBs are not discussed in this document, and will be deferred to a future release.

4. ATM-RMON Design

The RMON Working Group within the Internet Engineering Task Force (IETF) will be updating and augmenting the RMON MIB soon, and several of these changes can be incorporated into an ATM-RMON MIB. The main advantages of borrowing from the RMON MIB [7]:

- allow system administrators to reuse operational experience with RMON concepts and RMON data presentation (e.g., basic stats/host/matrix for a given media or protocol).
- allow portions of standard MIBs to be applied directly to ATM-RMON without modification.
- allow RMON NMS and probe vendors to possibly take advantage of their RMON-1 implementation experience.
- allow flexible configuration with low complexity.

ATM-RMON will require new configuration mechanisms to deal with varying application needs and probe capabilities. RMON-1 [7] defines a 'dataSource' object of type OBJECT IDENTIFIER, which allows new or proprietary mechanisms beyond the 'ifIndex' object. RMON-2 provides for extension of allowable dataSource values.

4.1. Switch Port Aggregation

Since ATM-RMON implementation is (in part) intended for ATM switches, special consideration for switches is desirable.

All switched-based-RMON technology shares a similar problem regarding the per-port nature of RMON. AN NMS must configure and collect statistics independently for each monitored port. Usually, an NMS will 'collapse' most of the per-port statistics into an aggregate version for the switch.

ATM-RMON provides a flexible mechanism to specify a particular 'data- source', including the ability to aggregate traffic from different ports into a single collection. See the portSelectGroup set of MIB objects for more details on port aggregation.

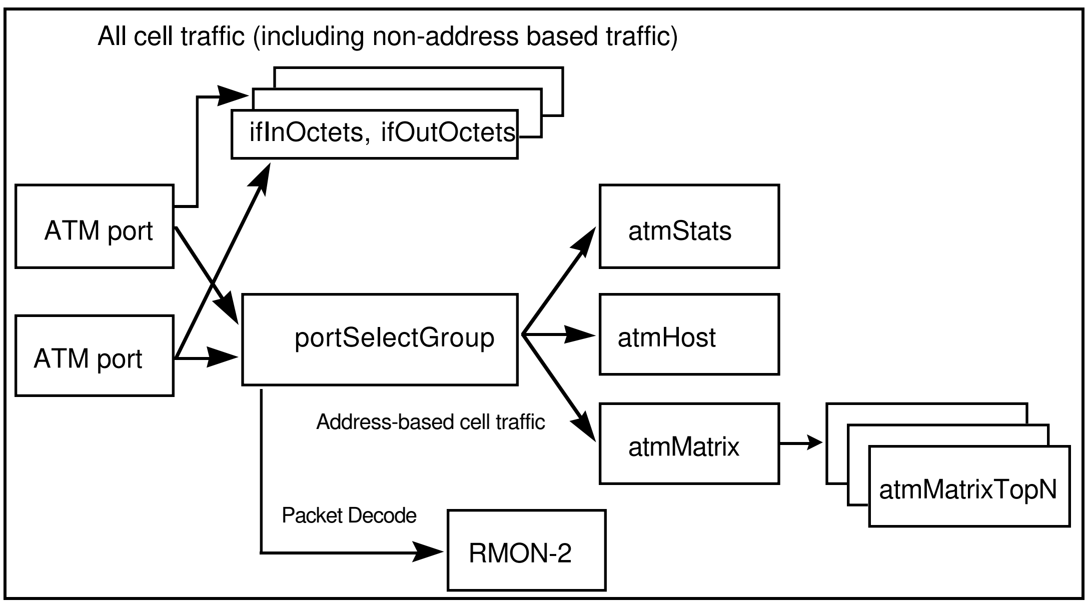

Figure 4: PortSelectGroup example

4.2. Data Reduction

Traditionally, RMON host and matrix tables can be very large, and take a great deal of resources to manage by the NMS and maintain by the agent. The high speeds and complex collection requirements of ATM-RMON make it very desirable to reduce both the agent and NMS load for processing cell-traffic data.

Generally, agent resources can be saved with pre-collection data reduction, and NMS resources can be saved with post-collection data reduction. Both types are integrated into ATM-RMON.

4.2.1. Pre-collection Data Reduction

The most effective way to save probe resources is to limit what data is processed in any manner by the probe, such as the use of statistical sampling. Note that statistical sampling only applies to frame capture and analysis. Frame capture mechanisms for ATM are not defined in this document, and there is no provision for the sampling of cells in the ATM-RMON MIB.

The portSelectGroup mechanism described in the ATM-RMON MIB provides configurable grouping of cell traffic for ATM-RMON counting purposes. This feature can be configured to reduce the amount of data that must be maintained for each collection, and reduce overall redundant data collection within the probe.

Agents are not required to allow a particular port to be included in more than one port select group at a time.

4.2.2. Post-collection Data Reduction

Even with pre-collection data reduction it is possible that ATM-RMON data tables will grow quite large, so it is also desirable to minimize the number of SNMP transactions required to retrieve or refresh these data tables.

The mechanisms included in this MIB are:
- collection aggregation -- ability to control the granularity of the entries in the host and matrix tables. Entries can be selected by full-address or partial-address (e.g., the ESI bytes can be cleared to zero for indexing and counting purposes). This reduces the number of entries actually maintained by the probe.
- TopN Report aggregation -- probe can continuously monitor the top talkers over a given interval, and automatically generate a report at the end of each interval.

4.3. Collection Source Identifier

This MIB does not use the traditional RMON 'dataSource and arbitrary integer index' model for identifying collection sources. Instead, a set of global tables are used to define 'circuit selection groups' (called 'portSelectGroups').

Traditional RMON collections (e.g., stats, host, matrix, matrixTopN) can be done using a portSelectGroup as the 'dataSource'. However, instead of an OBJECT IDENTIFIER dataSource identifier, a common integer index (identifying the portSelectGroup) is used in each control and data table. This allows an NMS to identify the source of a collection by examining the index of any columnar object. It also prevents duplicate collections from occurring on the probe.

Note the collection criteria setup cannot be modified on the fly for a particular portSelectGroup, while any collections based on that portSelectGroup are in progress. In order to reduce agent complexity and maintain data integrity, specific collections must be halted, reconfigured, and then restarted (with an empty data-set) if runtime changes are required. However, individual atmStatsControl, atmHostControl, atmMatrixControl, and atmMatrixTopNControl entries may be created, modified, or destroyed while the associated portSelGrpEntry is active.

5. Definitions

The following MIB proposal is based, in part, on the RMON-2 MIB [9].

The MIB contains four groups:
- **portSelect** -- port selection; data tables are indexed by a common object (portSelGrpIndex), which replaces the columnar 'dataSource' pointer and arbitrary integer index used in all other RMON MIBs.
- **atmStats** -- basic statistics; allows individual host traffic contribution percentage to be easily calculated.
- **atmHost** -- ATM per-host statistics.

- **atmMatrix** -- ATM per-circuit statistics and ATM per-circuit matrixTopN reporting.

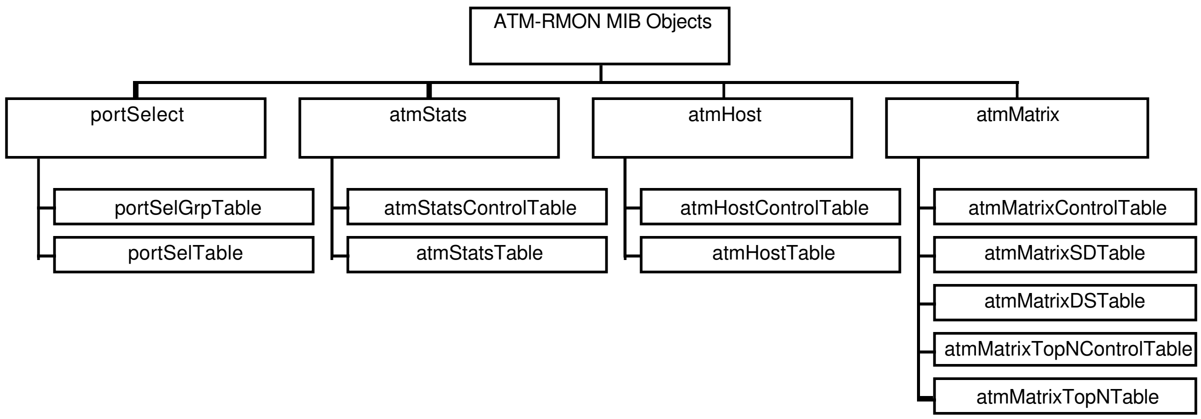

Figure 5: ATM-RMON MIB Structure

The portSelectGroup is used to define the ports to be monitored for a particular set of functions (a subset of all ATM-RMON, RMON-1, and RMON-2 groups).

For processing of frames collected (in an implementation-specific manner) from the portSelectGroup, the appropriate RMON-1 or RMON-2 dataSource instance is set to the OBJECT IDENTIFIER 'portSelGrpIndex.I'.

For processing of packets collected on behalf of RMON-2 functions, the proper protocol identifiers must be set up before the nlHost, alHost, nlMatrix, alMatrix, and filter2 groups can be utilized.

5.1 MIB Objects

This section includes the ATM-RMON MIB proposal described in the previous section, which was originally published as an Internet Draft [14].

```
ATM-RMON-MIB DEFINITIONS ::= BEGIN

IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE, Counter32, Integer32,
   Counter64, Gauge32, experimental, TimeTicks, Unsigned32
        FROM SNMPv2-SMI
   TEXTUAL-CONVENTION, RowStatus, DisplayString,
   TimeStamp
       FROM SNMPv2-TC
   MODULE-COMPLIANCE, OBJECT-GROUP
       FROM SNMPv2-CONF
   OwnerString
       FROM RMON-MIB
   ZeroBasedCounter32, LastCreateTime
       FROM RMON2-MIB
   AtmAddr
       FROM ATM-TC-MIB
   ifIndex
```

```
    FROM IF-MIB;

--  Remote Network Monitoring MIB for ATM Networks
atmRmon MODULE-IDENTITY
   LAST-UPDATED "9702210000Z"
   ORGANIZATION "ATM Forum"
   CONTACT-INFO
      "Andy Bierman
       Cisco Systems, Inc.
       Phone: +1 408 527-3711
       Email: abierman@cisco.com

       Keith McCloghrie
       Cisco Systems, Inc.
       Phone: +1 408 526-5260
       Email: kzm@cisco.com"
   DESCRIPTION
        "The MIB module for managing remote monitoring device implementations for ATM networks."
   ::= { experimental xx }

-- ATM-RMON MIB groups
atmRmonMIBObjects       OBJECT IDENTIFIER ::= { atmRmon 1 }
atmRmonNotifications    OBJECT IDENTIFIER ::= { atmRmon 2 }
atmRmonConformance      OBJECT IDENTIFIER ::= { atmRmon 3 }

-- ATM-RMON MIB object groups
portSelect              OBJECT IDENTIFIER ::= { atmRmonMIBObjects 1 }
atmStats                OBJECT IDENTIFIER ::= { atmRmonMIBObjects 2 }
atmHost                 OBJECT IDENTIFIER ::= { atmRmonMIBObjects 3 }
atmMatrix               OBJECT IDENTIFIER ::= { atmRmonMIBObjects 4 }

-- Textual Conventions:

ServiceClass ::= TEXTUAL-CONVENTION
   STATUS current
   DESCRIPTION
        "This TC describes an object that identifies the cell delivery class-of-service classification,
        associated with a particular statistics collection.  In order to conserve agent resources, the
        classifications are limited to two values which distinguish delay-guarantee.

        Statistics gathered on behalf on collections identified by the 'cbrAndVbr(1)' enumeration
        represent constant-bit-rate  (CBR), real-time and non-real-time variable bit rate (VBR) traffic.

        Statistics gathered on behalf on collections identified by the 'abrAndUbr(2)' enumeration
        represent available-bit-rate  (ABR) and unspecified-bit-rate (UBR) traffic."
   SYNTAX INTEGER  {
        cbrAndVbr(1),     -- constant and variable bit rate
        abrAndUbr(2)      -- available and unspecified bit rate
   }

ResourcePriority ::= TEXTUAL-CONVENTION
   STATUS current
   DESCRIPTION
```

"This TC describes an object which indicates the desired resource priority of the entire entry. Lower priorities indicate a lesser requirement to retain resources than higher priority values.

A management station can use the resource priority to provide a probe with additional information for managing memory allocation. A probe is strongly encouraged, but not required, to honor all priority requests, all of the time.

Objects declared with this TC should be contained within a conceptual control table entry. The indicated resource priority applies to the control entry, all internal data structures maintained on behalf of the control entry, and all external MIB data represented by the control entry.

A probe should honor the priority requests in an implementation-dependent way. The data allocation granularity (i.e., shared data structures) may vary greatly for different implementations, so a particular implementation strategy is not mandated. However, the following guidelines are suggested for those agents which implement garbage-collection based on 'least-recently used' (LRU) or other criteria:

In the event that the probe runs short of resources, and data entries are to be removed from particular tables to reclaim resources, then entries associated with lower ResourcePriority values should be deleted before entries associated with higher ResourcePriority values, regardless of the resource reclamation algorithm in use. In addition, entries associated with a higher AddressCollectScope value should be deleted before entries with a lower AddressCollectScope value.

Note that the priority ordering of entries with the same ResourcePriority and addressCollectScope values is unspecified."

```
    SYNTAX INTEGER  {
        lowPriority(1),
        normalPriority(2),
        highPriority(3)
    }

AddressCollectScope ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
```

"This TC describes an object which indicates the granularity of the addresses represented in associated ATM-RMON collections.

Addresses gathered on behalf of collections identified by the 'prefix(1)' enumeration will be cleared to zero in bytes 13 through 20, for indexing and counting purposes.

Addresses gathered on behalf of collections identified by the 'prefixAndEsi(2)' enumeration will be cleared to zero in byte 20, for indexing and counting purposes.

Addresses gathered on behalf of collections identified by the 'entireAddr(3)' enumeration will be unmodified, for indexing and counting purposes."

```
    SYNTAX INTEGER {
        prefix(1),
        prefixAndEsi(2),
        entireAddr(3)
    }

ConnectTime ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
```

"This TC describes an object which indicates the sum of the elapsed times of all connections associated with a particular collection. This is a cumulative total and includes all connections which currently exist and all connections which have been released.

```
        Elapsed connection time begins when the call attempt is detected, and ends when the call is
        released. It is an implementation-specific matter whether call attempts which do not result in
        successful connections are represented in this total.
        Call duration is maintained in units of seconds, and may be rounded to the nearest second when
        counted."
    SYNTAX Gauge32

--
-- Port Selection (portSelect Group)
--
-- Defines the ports to be included in a particular stats, host or matrix collection.
--
--    portSelGrpTable
--    portSelTable

portSelGrpTable OBJECT-TYPE
    SYNTAX       SEQUENCE OF PortSelGrpEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "Controls the setup of port and ATM connection selection criteria used on behalf of any collection
        associated with entries in this table (e.g., atmHostTable).
        This table allows portSelTable entries with the same value of the portSelCollectGroup object to
        be grouped together to form port select groups.
        Note that an agent implementation may restrict the actual number of portSelGrp entries, due to
        resource limitations."
    ::= { portSelect 1 }

portSelGrpEntry OBJECT-TYPE
    SYNTAX       PortSelGrpEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "A conceptual row in the portSelGrpTable.
        An example of the indexing of this entry is portSelGrpCreateTime.7 ."
    INDEX { portSelGrpIndex }
    ::= { portSelGrpTable 1 }

PortSelGrpEntry ::= SEQUENCE {
    portSelGrpIndex          Integer32,
    portSelGrpDescr          DisplayString,
    portSelGrpCreateTime     LastCreateTime,
    portSelGrpOwner          OwnerString,
    portSelGrpStatus         RowStatus
}

portSelGrpIndex OBJECT-TYPE
    SYNTAX       Integer32 (1..65535)
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
```

```
        "An arbitrary and unique index for this portSelGrpEntry.  If portSelGrpTable entries are recreated
        by the agent after a restart, then the portSelGrpIndex value must be retained across a restart as
        well."
    ::= { portSelGrpEntry 1 }

portSelGrpDescr  OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..64))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "An administratively-assigned descriptive label for this portSelGrp entry."
    ::= { portSelGrpEntry 2 }

portSelGrpCreateTime OBJECT-TYPE
    SYNTAX      LastCreateTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of sysUpTime when this portSelGrp entry was activated.  This can be used by the
        management station to ensure that the table has not been deleted and recreated between polls."
    ::= { portSelGrpEntry 3 }

portSelGrpOwner OBJECT-TYPE
    SYNTAX      OwnerString
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The entity that configured this entry and is therefore using the resources assigned to it."
    ::= { portSelGrpEntry 4 }

portSelGrpStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this row.

        An entry may not exist in the active state unless all objects in the entry have an appropriate value.
        No objects are required to be written prior to the row being set to active(1).  However, all
        portSelTable entries which are to be included in collections on behalf of this portSelectGroup,
        must be completely configured and activated before this object is set to active(1), since the
        associated instances of portSelStatus cannot be modified once this object has been set to active(1).

        If this object is not equal to active(1), all associated data collections shall be deleted (e.g., any
        associated collections in the atmStats, atmHostTable or atmMatrixSDTable).  Note that associated
        portSelTable and any configured collection control entries (e.g., atmHostControlTable) are not
        deleted when this entry leaves the active state."
    ::= { portSelGrpEntry 5 }

--
-- portSelTable: used to specify the collection configuration
-- for a single ATM port
--
```

```
portSelTable OBJECT-TYPE
    SYNTAX       SEQUENCE OF PortSelEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "Controls the setup of selection criteria for a single ATM port, used on behalf of any collections
        identified with the associated portSelectGroup (identified by its portSelGrpIndex value).

        This table identifies the collection characteristics for the ATM port indicated by the ifIndex value
        in the index. Note that an agent implementation may restrict the actual number of portSelTable
        entries, due to resource limitations."

    ::= { portSelect 2 }

portSelEntry OBJECT-TYPE
    SYNTAX       PortSelEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "A conceptual row in the portSelTable.

        Entries may only be created on behalf of ATM interfaces. That is, the ifType value associated with
        each ifIndex value must be equal to atm(37) or atmLogicalPort(80).

        An example of the indexing of this entry is portSelCreateTime.7 ."

    INDEX { ifIndex }
    ::= { portSelTable 1 }

PortSelEntry ::= SEQUENCE {
    portSelCollectGroup       Integer32,
    portSelCreateTime         LastCreateTime,
    portSelOwner              OwnerString,
    portSelStatus             RowStatus
}

portSelCollectGroup OBJECT-TYPE
    SYNTAX       Integer32 (1..65535)
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "This object identifies the associated instance of portSelGrpIndex, which indicates the
        portSelectGroup to which this port is assigned.

        This object may not be modified if the associated instance of portSelStatus is equal to active(1)."

    ::= { portSelEntry 1 }

portSelCreateTime OBJECT-TYPE
    SYNTAX       LastCreateTime
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The value of sysUpTime when this entry was activated.  This can be used by the management
        station to ensure that the table has not been deleted and recreated between polls."

    ::= { portSelEntry 2 }
```

```
portSelOwner OBJECT-TYPE
    SYNTAX       OwnerString
    MAX-ACCESS  read-create
    STATUS       current
    DESCRIPTION
            "The entity that configured this entry and is therefore using the resources assigned to it."
    ::= { portSelEntry 3 }

portSelStatus OBJECT-TYPE
    SYNTAX       RowStatus
    MAX-ACCESS  read-create
    STATUS       current
    DESCRIPTION
            "The status of this row.

            An entry may not exist in the active state unless all objects in the entry have an appropriate value.
            Specifically, an appropriate value for the portSelCollectGroup object must be set before this object
            may be set to active(1). An agent may wish to allow portSelTable entries to exist which reference
            non-existent portSelGrpTable entries, in order to reduce row creation order dependencies.

            All portSelTable entries which are to be included in a particular collection (as indicated by the
            portSelCollectGroup object), should be completely configured and activated before the associated
            portSelGrpStatus object is set to active(1).  Configuration of a portSelectGroup cannot be
            modified once collections on its behalf have been started.

            This object may not be modified if the associated portSelGroupStatus is in the active(1) state,
            indicated by a portSelGrpIndex value identical to the value of the portSelCollectGroup object in
            this entry."
    ::= { portSelEntry 4 }

–
-- ATM Stats Group
–
-- Counts the total amount of traffic
-- counted on behalf of one or more portSelectGroups

atmStatsControlTable OBJECT-TYPE
    SYNTAX       SEQUENCE OF AtmStatsControlEntry
    MAX-ACCESS  not-accessible
    STATUS       current
    DESCRIPTION
            "A list of ATM basic statistic collection table control entries.  These entries will enable the
            collection of statistical totals for an entire portSelectGroup."
    ::= { atmStats 1 }

atmStatsControlEntry OBJECT-TYPE
    SYNTAX       AtmStatsControlEntry
    MAX-ACCESS  not-accessible
    STATUS       current
    DESCRIPTION
            "A conceptual row in the atmStatsControlTable.  Entries in this table are identified and indexed by
            the portSelGrpIndex object.  At most one atmStats collection is done per portSelectGroup.

            An example of the indexing of this entry is atmStatsDropEvents.1 ."
    INDEX { portSelGrpIndex }
```

```
    ::= { atmStatsControlTable 1 }

AtmStatsControlEntry ::= SEQUENCE {
    atmStatsControlDropEvents        Counter32,
    atmStatsControlOwner             OwnerString,
    atmStatsControlStatus            RowStatus
}

atmStatsControlDropEvents OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The total number of events in which cells which should have been counted in the associated
        atmStatsEntry, but were dropped by the probe due to lack of resources.  Note that this number is
        not necessarily the number of cells or calls dropped; it is just the number of times this condition
        has been detected."
    ::= { atmStatsControlEntry 1 }

atmStatsControlOwner OBJECT-TYPE
    SYNTAX      OwnerString
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The entity that configured this entry and is therefore using the resources assigned to it."
    ::= { atmStatsControlEntry 2 }

atmStatsControlStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this atmStatsControlEntry.

        This control entry may be created and destroyed independently of the associated portSelGrpEntry,
        however its associated atmStatsTable can exist only when the portSelGrpEntry controlling this
        collection is active.

        If this object is not equal to active(1), all associated entries in the atmStatsTable shall be deleted."
    ::= { atmStatsControlEntry 3 }

-- atmStatsTable
-- call and traffic basic statistics collected on behalf of specific
-- portSelectGroups

atmStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A collection of statistical totals for all ATM addresses that have been discovered on behalf of the
        portSelectGroup associated with this entry."
    ::= { atmStats 2 }
```

```
atmStatsEntry OBJECT-TYPE
    SYNTAX      AtmStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "A conceptual row in the atmStatsTable.

            The portSelGrpIndex value in the index identifies the portSelectGroup on whose behalf this entry
            was created.

            An example of the indexing of this entry is atmStatsCells.8.1"

    INDEX { portSelGrpIndex, atmStatsSClass }
    ::= { atmStatsTable 1 }

AtmStatsEntry ::= SEQUENCE {
    atmStatsSClass                ServiceClass,
    atmStatsCreateTime            LastCreateTime,
    atmStatsCells                 Counter32,
    atmStatsCellsRollovers        Counter32,
    atmStatsHCCells               Counter64,
    atmStatsNumCallAttempts       Counter32,
    atmStatsNumCalls              Counter32,
    atmStatsConnTime              ConnectTime
}

atmStatsSClass OBJECT-TYPE
    SYNTAX      ServiceClass
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The quality of service classification for this entry.  See the ServiceClass textual convention for
            details and specific class-of-service values."
    ::= { atmStatsEntry 1 }

atmStatsCreateTime OBJECT-TYPE
    SYNTAX      LastCreateTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The value of sysUpTime when this entry was created.  This can be used by the management
            station to ensure that the entry has not been deleted and recreated between polls."
    ::= { atmStatsEntry 2 }

atmStatsCells OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The total number of error-free cells detected on all ATM connections on behalf of this
            portSelectGroup collection.  Note that a particular cell may only cause this counter to increment
            once, even if multiple criteria is met for inclusion in this portSelectGroup."
    ::= { atmStatsEntry 3 }

atmStatsCellsRollovers OBJECT-TYPE
```

```
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The number of times that the associated instance of the atmStatsCells object has incremented
            from the value 2^^32-1 to zero."
    ::= { atmStatsEntry 4 }

atmStatsHCCells OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The high capacity version of the atmStatsCells object."
    ::= { atmStatsEntry 5 }

atmStatsNumCallAttempts OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The number of call attempts detected on all signalled ATM connections on behalf of this
            portSelectGroup collection.  A probe should increment this counter each time a connection setup
            attempt (identified with this portSelectGroup) is detected. For point-to-multipoint connections,
            this counter is incremented once per counted connection, regardless of the number of leafs identified
            in the connection."
    ::= { atmStatsEntry 6 }

atmStatsNumCalls OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The number of successfully established calls detected on all signalled ATM connections on behalf
            of this portSelectGroup collection.  Note that this value includes successfully established calls that
            are currently in progress.  A probe should increment this counter each time a valid connection
            (identified with this portSelectGroup) is successfully established. For point-to-multipoint ATM
            connections, this counter is incremented once per counted connection, regardless of the number of
            leafs identified in the connection. Note that when a point-to-point connection setup enters on one
            port and leaves on another port in the same port select group, it is counted only once."
    ::= { atmStatsEntry 7 }

atmStatsConnTime OBJECT-TYPE
    SYNTAX      ConnectTime
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The elapsed time of all calls identified by the associated instance of the
            atmStatsNumCallAttempts object.  Note that point-to-multipoint calls are counted only once,
            regardless of the number of leafs participating in the call."
    ::= { atmStatsEntry 8 }
```

```
–
-- ATM Host Group
–
-- Counts the amount of traffic sent on behalf of each ATM address
-- discovered by the probe, according to associated portSelectGroup
-- criteria

atmHostControlTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmHostControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A list of ATM host table control entries.

        These entries will enable the collection of ATM host information in the atmHostTable.

        Entries in the atmHostTable will be created on behalf of each entry in this table. A probe is
        required to support at most one atmHost collection per instance of an associated portSelectGroup,
        therefore the table is indexed by the portSelGrpIndex."

    ::= { atmHost 1 }

atmHostControlEntry OBJECT-TYPE
    SYNTAX      AtmHostControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the atmHostControlTable.  Entries in this table are identified and indexed by
        the portSelGrpIndex object.  At most one atmHost collection is done per portSelectGroup.

        An example of the indexing of this entry is atmHostControlInserts.1"

    INDEX { portSelGrpIndex }
    ::= { atmHostControlTable 1 }

AtmHostControlEntry ::= SEQUENCE {
    atmHostControlInserts               Counter32,
    atmHostControlDeletes               Counter32,
    atmHostControlMaxDesiredEntries     Integer32,
    atmHostControlPriority              ResourcePriority,
    atmHostControlAddrCollectScope      AddressCollectScope,
    atmHostControlDropEvents            Counter32,
    atmHostControlOwner                 OwnerString,
    atmHostControlStatus                RowStatus
}

atmHostControlInserts OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The number of times an atmHost entry has been inserted into the atmHost table.  If an entry is
        inserted, then deleted, and then inserted, this counter will be incremented by 2.

        To allow for efficient implementation strategies, agents may delay updating this object for short
        periods of time.  For example, an implementation strategy may allow internal data structures to
```

differ from those visible via SNMP for short periods of time. This counter may reflect the internal data structures for those short periods of time.

Note that the table size can be determined by subtracting atmHostControlDeletes from atmHostControlInserts."

::= { atmHostControlEntry 1 }

```
atmHostControlDeletes OBJECT-TYPE
   SYNTAX     Counter32
   MAX-ACCESS read-only
   STATUS     current
   DESCRIPTION
```

"The number of times an atmHost entry has been deleted from the atmHost table (for any reason). If an entry is deleted, then inserted, and then deleted, this counter will be incremented by 2.

To allow for efficient implementation strategies, agents may delay updating this object for short periods of time. For example, an implementation strategy may allow internal data structures to differ from those visible via SNMP for short periods of time. This counter may reflect the internal data structures for those short periods of time.

Note that the table size can be determined by subtracting atmHostControlDeletes from atmHostControlInserts."

::= { atmHostControlEntry 2 }

```
atmHostControlMaxDesiredEntries OBJECT-TYPE
   SYNTAX      Integer32
   MAX-ACCESS  read-create
   STATUS      current
   DESCRIPTION
```

"The maximum number of entries that are desired in the atmHostTable on behalf of this control entry. The probe will not create more than this number of associated entries in the table, but may choose to create fewer entries in this table for any reason including the lack of resources.

If this value is set to -1, the probe may create any number of entries in this table.

If the associated instance of atmHostControlStatus object is equal to active(1), this object may not be modified."

DEFVAL { -1 }
::= { atmHostControlEntry 3 }

```
atmHostControlPriority OBJECT-TYPE
   SYNTAX        ResourcePriority
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
```

"The priority this collection should be given to retain resources, in the event the probe must reclaim some resources in order to add new entries to an existing atmHost collection or add new collections of other types.

If the associated instance of atmHostControlStatus object is equal to active(1), this object may not be modified."

DEFVAL { normalPriority }
::= { atmHostControlEntry 4 }

```
atmHostControlAddrCollectScope OBJECT-TYPE
   SYNTAX      AddressCollectScope
```

```
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object controls the granularity of address collection in atmHostTable entries created on behalf
        of this control entry, according to the rules specified by the AddressCollectScope textual
        convention.

        If the associated instance of atmHostControlStatus object is equal to active(1), this object may not
        be modified."
    DEFVAL { prefixAndEsi }
    ::= { atmHostControlEntry 5 }

atmHostControlDropEvents OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of events in which cells which should have been counted in the associated
        atmHostEntry, but were dropped by the probe due to lack of resources.  Note that this number is
        not necessarily the number of cells or calls dropped; it is just the number of times this condition
        has been detected."
    ::= { atmHostControlEntry 6 }

atmHostControlOwner OBJECT-TYPE
    SYNTAX      OwnerString
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The entity that configured this entry and is therefore using the resources assigned to it."
    ::= { atmHostControlEntry 7 }

atmHostControlStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this atmHostControlEntry.

        An entry may not exist in the active state unless all objects in the entry have an appropriate value.
        Specifically, appropriate values for the associated instances of atmHostControlMaxDesiredEntries,
        atmHostControlPriority, and atmHostControlAddrCollectScope must be set before this object may
        be set to active(1).

        This control entry may be created and destroyed independently of the associated portSelGrpEntry,
        however its associated atmHostTable can exist only when the portSelGrpEntry controlling this
        collection is active.

        If this object is not equal to active(1), all associated entries in the atmHostTable shall be deleted."
    ::= { atmHostControlEntry 8 }

–
-- ATM Host Table
–

atmHostTable OBJECT-TYPE
```

```
    SYNTAX      SEQUENCE OF AtmHostEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A collection of statistics for a particular ATM host address that has been discovered on behalf of
        the portSelectGroup associated with this entry.

        The probe will add to this table all addresses seen as the source or destination address in all calls,
        on all ports configured in the portSelGrpEntry controlling this collection."
    ::= { atmHost 2 }

atmHostEntry OBJECT-TYPE
    SYNTAX      AtmHostEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the atmHostTable.

        The portSelGrpIndex value in the index identifies the portSelectGroup on whose behalf this entry
        was created.

        An example of the indexing of this entry is atmHostInCells.4.20.<NSAP>.2"
    INDEX { portSelGrpIndex, atmHostAddress, atmHostSClass }
    ::= { atmHostTable 1 }

AtmHostEntry ::= SEQUENCE {
    atmHostAddress               AtmAddr,
    atmHostSClass                ServiceClass,
    atmHostCreateTime            LastCreateTime,
    atmHostInCells               ZeroBasedCounter32,
    atmHostInCellsRollovers      ZeroBasedCounter32,
    atmHostInHCCells             Counter64,
    atmHostOutCells              ZeroBasedCounter32,
    atmHostOutCellsRollovers     ZeroBasedCounter32,
    atmHostOutHCCells            Counter64,
    atmHostInNumCallAttempts     ZeroBasedCounter32,
    atmHostInNumCalls            ZeroBasedCounter32,
    atmHostOutNumCallAttempts    ZeroBasedCounter32,
    atmHostOutNumCalls           ZeroBasedCounter32,
    atmHostInConnTime            ConnectTime,
    atmHostOutConnTime           ConnectTime
}

atmHostAddress OBJECT-TYPE
    SYNTAX      AtmAddr
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The ATM address for this atmHostEntry.

        This is represented as an octet string with specific semantics and length as identified by the
        AtmAddr textual convention. Note that only 20 octet 'AtmAddr' addresses are collected in this
        table."
    ::= { atmHostEntry 1 }
```

```
atmHostSClass OBJECT-TYPE
    SYNTAX       ServiceClass
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
         "The quality of service classification for this entry.  See the ServiceClass textual convention for
         details and specific class-of-service values."
    ::= { atmHostEntry 2 }

atmHostCreateTime OBJECT-TYPE
    SYNTAX       LastCreateTime
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
         "The value of sysUpTime when this entry was activated.  This can be used by the management
         station to ensure that the entry has not been deleted and recreated between polls."
    ::= { atmHostEntry 3 }

atmHostInCells OBJECT-TYPE
    SYNTAX       ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
         "The number of error-free cells detected on ATM connections associated with this portSelectGroup,
         in which this ATM address was identified as the receiver address, or one of the leaf addresses on a
         point-to-multipoint ATM connection.  This counter includes OAM cells transmitted on behalf of
         this source address."
    ::= { atmHostEntry 4 }

atmHostInCellsRollovers OBJECT-TYPE
    SYNTAX       ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
         "The number of times that the associated instance of the atmHostInCells object has incremented
         from the value 2^^32-1 to zero."
    ::= { atmHostEntry 5 }

atmHostInHCCells OBJECT-TYPE
    SYNTAX       Counter64
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
         "The high capacity version of the atmHostInCells object."
    ::= { atmHostEntry 6 }

atmHostOutCells OBJECT-TYPE
    SYNTAX       ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
```

```
        "The number of error-free cells detected on ATM connections associated with this portSelectGroup,
        in which this ATM address was identified as the sender address. This counter includes OAM cells
        transmitted on behalf of this  destination address."
    ::= { atmHostEntry 7 }

atmHostOutCellsRollovers OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of times that the associated instance of the atmHostOutCells object has incremented
        from the value 2^^32-1 to zero."
    ::= { atmHostEntry 8 }

atmHostOutHCCells OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The high capacity version of the atmHostOutCells object."
    ::= { atmHostEntry 9 }

atmHostInNumCallAttempts OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of calls detected on ATM connections associated with this entry, in which the
        associated endpoint address was identified as the Called Party in an signalled ATM connection
        establishment attempt.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a connection attempt is detected in which this ATM host is identified as the
        Called Party, or one of the leaf addresses for point-to-multipoint ATM connections."
    ::= { atmHostEntry 10 }

atmHostInNumCalls OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successfully established calls detected on ATM connections associated with this
        entry, in which the associated endpoint address was identified as the Called Party address.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a connection is successfully established in which this ATM host is identified as
        the Called Party address, or one of the leaf addresses for point-to-multipoint ATM connections."
    ::= { atmHostEntry 11 }

atmHostOutNumCallAttempts OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
```

```
    DESCRIPTION
        "The number of calls detected on ATM connections associated with this entry, in which the
        associated endpoint address was identified as the Calling Party in an signalled ATM connection
        establishment attempt.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a connection attempt is detected in which this ATM host is identified as the
        Calling Party.

        Note that for point-to-multipoint ATM connections, this counter is incremented only once per
        call, regardless of the number of leafs established at setup time or the number of leaf-initiated-join
        attempts since the call was established."
    ::= { atmHostEntry 12 }

atmHostOutNumCalls OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successfully established calls detected on ATM connections associated with this
        entry, in which the associated endpoint address was identified as the Calling Party address.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a connection is successfully established in which this ATM host is identified as
        the Calling Party address."
    ::= { atmHostEntry 13 }

atmHostInConnTime OBJECT-TYPE
    SYNTAX      ConnectTime
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The elapsed time of all calls identified by the associated instance of
        atmHostInNumCallAttempts."
    ::= { atmHostEntry 14 }

atmHostOutConnTime OBJECT-TYPE
    SYNTAX      ConnectTime
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The elapsed time of all calls identified by the associated instance of
        atmHostOutNumCallAttempts."
    ::= { atmHostEntry 15 }

–
-- ATM Matrix Group
–
-- Counts the amount of traffic sent on behalf of each source
-- and destination ATM address discovered by the probe,
-- according to associated portSelectGroup criteria
```

```
atmMatrixControlTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmMatrixControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A list of ATM matrix table control entries.

        These entries will enable the collection of ATM matrix information in the atmMatrixSDTable and
        atmMatrixDSTable.

        A probe is required to support at most one atmMatrix collection per instance of an associated
        portSelectGroup, therefore the table is indexed by the portSelGrpIndex."
    ::= { atmMatrix 1 }

atmMatrixControlEntry OBJECT-TYPE
    SYNTAX      AtmMatrixControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the atmMatrixControlTable.

        An example of the indexing of this entry is atmMatrixControlInserts.1"
    INDEX { portSelGrpIndex }
    ::= { atmMatrixControlTable 1 }

AtmMatrixControlEntry    ::= SEQUENCE {
    atmMatrixControlInserts                Counter32,
    atmMatrixControlDeletes                Counter32,
    atmMatrixControlMaxDesiredEntries      Integer32,
    atmMatrixControlPriority               ResourcePriority,
    atmMatrixControlAddrCollectScope       AddressCollectScope,
    atmMatrixControlDropEvents             Counter32,
    atmMatrixControlOwner                  OwnerString,
    atmMatrixControlStatus                 RowStatus
}

atmMatrixControlInserts OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of times an atmMatrix entry has been inserted into the atmMatrix table.  If an entry
        is inserted, then deleted, and then inserted, this counter will be incremented by 2.  The addition of a
        conversation into both the atmMatrixSDTable and atmMatrixDSTable shall be counted as two
        insertions (even though every addition into one table must be accompanied by an insertion into the
        other).

        To allow for efficient implementation strategies, agents may delay updating this object for short
        periods of time.  For example, an implementation strategy may allow internal data structures to
        differ from those visible via SNMP for short periods of time.  This counter may reflect the internal
        data structures for those short periods of time."
    ::= { atmMatrixControlEntry 1 }

atmMatrixControlDeletes OBJECT-TYPE
    SYNTAX      Counter32
```

```
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of times an atmMatrix entry has been deleted from the atmMatrix table (for any
        reason).  If an entry is deleted, then inserted, and then deleted, this counter will be incremented by
        2.  The deletion of a conversation from both the atmMatrixSDTable and atmMatrixDSTable shall
        be counted as two deletions (even though every deletion from one table must be accompanied by a
        deletion from the other).

        To allow for efficient implementation strategies, agents may delay updating this object for short
        periods of time.  For example, an implementation strategy may allow internal data structures to
        differ from those visible via SNMP for short periods of time.  This counter may reflect the internal
        data structures for those short periods of time.

        Note that the table size can be determined by subtracting atmMatrixControlDeletes from
        atmMatrixControlInserts, and dividing the result by two."
    ::= { atmMatrixControlEntry 2 }

atmMatrixControlMaxDesiredEntries OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The maximum number of entries that are desired in the atmMatrixTable on behalf of this control
        entry. The probe will not create more than this number of associated entries in the table, but may
        choose to create fewer entries in this table for any reason including the lack of resources.

        If this value is set to -1, the probe may create any number of entries in this table.

        If the associated instance of atmMatrixControlStatus object is equal to active(1), this object may
        not be modified."
    DEFVAL { -1 }
    ::= { atmMatrixControlEntry 3 }

atmMatrixControlPriority OBJECT-TYPE
    SYNTAX      ResourcePriority
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The priority this collection should be given to retain resources, in the event the probe must
        reclaim some resources in order to add new entries to an existing atmMatrix collection or add new
        collections of other types.

        If the associated instance of atmMatrixControlStatus object is equal to active(1), this object may
        not be modified."
    DEFVAL { normalPriority }
    ::= { atmMatrixControlEntry 4 }

atmMatrixControlAddrCollectScope OBJECT-TYPE
    SYNTAX AddressCollectScope
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object controls the granularity of address collection in atmMatrixSDTable and
        atmMatrixDSTable entries created on behalf of this control entry, according to the rules specified
        by the AddressCollectScope textual convention.
```

```
        If the associated instance of atmMatrixControlStatus object is equal to active(1), this object may
        not be modified."
    DEFVAL { prefixAndEsi }
    ::= { atmMatrixControlEntry 5 }

atmMatrixControlDropEvents OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of events in which cells which should have been counted in the associated
        atmMatrixSDEntry and atmMatrixDSEntry, but were dropped by the probe due to lack of
        resources.  Note that this number is not necessarily the number of cells or calls dropped; it is just
        the number of times this condition has been detected."
    ::= { atmMatrixControlEntry 6 }

atmMatrixControlOwner OBJECT-TYPE
    SYNTAX      OwnerString
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
"The entity that configured this entry and is therefore
using the resources assigned to it."
    ::= { atmMatrixControlEntry 7 }

atmMatrixControlStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this atmMatrixControlEntry.

        An entry may not exist in the active state unless all objects in the entry have an appropriate value.
        Specifically, the associated instances of atmMatrixControlMaxDesiredEntries,
        atmMatrixControlPriority, and atmMatrixControlAddrCollectScope objects must be set to
        appropriate values before this object may be set to active(1).

        This control entry may be created and destroyed independently of the associated portSelGrpEntry,
        however its associated atmMatrixSDTable and atmMatrixDSTable can exist only when the
        portSelGrpEntry controlling this collection is active.

        If this object is not equal to active(1), all associated entries in the atmMatrixSDTable and
        atmMatrixDSTable shall be deleted."
    ::= { atmMatrixControlEntry 8 }

-- atmMatrixSDTable
-- call and traffic data collected on behalf of specific
-- portSelectGroups; sorted by source address first

atmMatrixSDTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmMatrixSDEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
        "A collection of statistics for conversations between particular ATM endpoint addresses that have
        been discovered on behalf of the portSelectGroup associated with this entry.

        The probe will add a new entry to this table for all conversations (connections) between distinct
        source and destination address pairs, detected in all calls, on all ports configured in the
        portSelGrpEntry controlling this collection.  Further, this table will only contain entries that have
        a corresponding entry in the atmMatrixDSTable with the same source address and destination
        address."
   ::= { atmMatrix 2 }

atmMatrixSDEntry OBJECT-TYPE
   SYNTAX       AtmMatrixSDEntry
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
        "A conceptual row in the atmMatrixSDTable.

        The portSelGrpIndex value in the index identifies the portSelectGroup on whose behalf this entry
        was created.

        An example of the indexing of this entry is atmMatrixSDCells.1.20.<NSAP>.20.<NSAP>.2"
   INDEX { portSelGrpIndex, atmMatrixSDSrcAddress,
              atmMatrixSDDstAddress, atmMatrixSDSClass }
   ::= { atmMatrixSDTable 1 }

AtmMatrixSDEntry    ::= SEQUENCE {
   atmMatrixSDSrcAddress            AtmAddr,
   atmMatrixSDDstAddress            AtmAddr,
   atmMatrixSDSClass                ServiceClass,
   atmMatrixSDCreateTime            LastCreateTime,
   atmMatrixSDCells                 ZeroBasedCounter32,
   atmMatrixSDCellsRollovers        ZeroBasedCounter32,
   atmMatrixSDHCCells               Counter64,
   atmMatrixSDNumCallAttempts       ZeroBasedCounter32,
   atmMatrixSDNumCalls              ZeroBasedCounter32,
   atmMatrixSDConnTime              ConnectTime
}

atmMatrixSDSrcAddress OBJECT-TYPE
   SYNTAX      AtmAddr
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
        "The transmitting endpoint ATM address for this atmMatrixSDEntry.

        This is represented as an octet string with specific semantics and length as identified by the
        AtmAddr textual convention. Note that only 20 octet 'AtmAddr' addresses are collected in this
        table."
   ::= { atmMatrixSDEntry 1 }

atmMatrixSDDstAddress OBJECT-TYPE
   SYNTAX      AtmAddr
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
```

```
        "The destination endpoint ATM address for this atmMatrixSDEntry.

        This is represented as an octet string with specific semantics and length as identified by the
        AtmAddr textual convention. Note that only 20 octet 'AtmAddr' addresses are collected in this
        table."
    ::= { atmMatrixSDEntry 2 }

atmMatrixSDSClass OBJECT-TYPE
    SYNTAX      ServiceClass
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The quality of service classification for this entry.  See the ServiceClass textual convention for
        details and specific class-of-service values."
    ::= { atmMatrixSDEntry 3 }

atmMatrixSDCreateTime OBJECT-TYPE
    SYNTAX      LastCreateTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of sysUpTime when this entry was activated.  This can be used by the management
        station to ensure that the entry has not been deleted and recreated between polls."
    ::= { atmMatrixSDEntry 4 }

atmMatrixSDCells OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of error-free cells detected on connections in which these ATM addresses were
        identified as the transmitting and receiving endpoint addresses.

        Note that for point-to-multipoint connections, an entry is created for each root-to-leaf address-pair
        that exists, and each cell sent from the root on a point-to-multipoint ATM connection is counted
        once in each distinct matrix entry.  This counter includes OAM cells transmitted on behalf of this
        source/destination address-pair."
    ::= { atmMatrixSDEntry 5 }

atmMatrixSDCellsRollovers OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of times that the associated instance of the atmMatrixSDCells object has incremented
        from the value 2^^32-1 to zero."
    ::= { atmMatrixSDEntry 6 }

atmMatrixSDHCCells OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
```

```
        "The high capacity version of the atmMatrixSDCells object."
    ::= { atmMatrixSDEntry 7 }

atmMatrixSDNumCallAttempts OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of SVC call setup attempts detected on ATM connections within the specified
        portSelectGroup, in which the indicated atmMatrixSDSrcAddress endpoint address was identified as
        the Calling Party and the indicated atmMatrixSDDstAddress was identified as the Called Party.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a connection attempt is detected in which these ATM addresses are identified as
        the calling and called parties."
    ::= { atmMatrixSDEntry 8 }

atmMatrixSDNumCalls OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful SVC call setups detected on ATM connections within the specified
        portSelectGroup, in which the indicated atmMatrixSDSrcAddress endpoint address was identified as
        the Calling Party and the indicated atmMatrixSDDstAddress was identified as the Called Party.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a valid connection is established in which these ATM addresses are identified as
        the calling and called parties."
    ::= { atmMatrixSDEntry 9 }

atmMatrixSDConnTime OBJECT-TYPE
    SYNTAX      ConnectTime
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The elapsed time of all calls identified by the associated instance of
        atmMatrixSDNumCallAttempts."
    ::= { atmMatrixSDEntry 10 }

-- atmMatrixDSTable
-- call and traffic data collected on behalf of specific
-- portSelectGroups; sorted by destination address first

atmMatrixDSTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmMatrixDSEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A collection of statistics for conversations between particular ATM endpoint addresses that have
        been discovered on behalf of the portSelectGroup associated with this entry.
```

```
        The probe will add a new entry to this table for all conversations (connections) between distinct
        source and destination address pairs, detected in all cells identified by the associated
        portSelGrpEntry criteria.  Further, this table will only contain entries that have a corresponding
        entry in the atmMatrixSDTable with the same source address and destination address."
    ::= { atmMatrix 3 }

atmMatrixDSEntry OBJECT-TYPE
    SYNTAX      AtmMatrixDSEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the atmMatrixDSTable.
        The portSelGrpIndex value in the index identifies the portSelectGroup on whose behalf this entry
        was created.
        An example of the indexing of this entry is atmMatrixDSCells.1.20.<NSAP>.20.<NSAP>.2"
   INDEX { portSelGrpIndex, atmMatrixDSDstAddress,
atmMatrixDSSrcAddress, atmMatrixDSSClass }
    ::= { atmMatrixDSTable 1 }

AtmMatrixDSEntry    ::= SEQUENCE {
    atmMatrixDSSrcAddress           AtmAddr,
    atmMatrixDSDstAddress           AtmAddr,
    atmMatrixDSSClass               ServiceClass,
    atmMatrixDSCreateTime           LastCreateTime,
    atmMatrixDSCells                ZeroBasedCounter32,
    atmMatrixDSCellsRollovers       ZeroBasedCounter32,
    atmMatrixDSHCCells              Counter64,
    atmMatrixDSNumCallAttempts      ZeroBasedCounter32,
    atmMatrixDSNumCalls             ZeroBasedCounter32,
    atmMatrixDSConnTime             ConnectTime
}

atmMatrixDSSrcAddress OBJECT-TYPE
    SYNTAX      AtmAddr
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The transmitting endpoint ATM address for this atmMatrixDSEntry.
        This is represented as an octet string with specific semantics and length as identified by the
        AtmAddr textual convention.  Note that only 20 octet 'AtmAddr' addresses are collected in this
        table."
    ::= { atmMatrixDSEntry 1 }

atmMatrixDSDstAddress OBJECT-TYPE
    SYNTAX      AtmAddr
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The destination endpoint ATM address for this atmMatrixDSEntry.
```

This is represented as an octet string with specific semantics and length as identified by the AtmAddr textual convention. Note that only 20 octet 'AtmAddr' addresses are collected in this table."

::= { atmMatrixDSEntry 2 }

```
atmMatrixDSSClass OBJECT-TYPE
   SYNTAX      ServiceClass
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
         "The quality of service classification for this entry. See the ServiceClass textual convention for
         details and specific class-of-service values."
   ::= { atmMatrixDSEntry 3 }

atmMatrixDSCreateTime OBJECT-TYPE
   SYNTAX      LastCreateTime
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
         "The value of sysUpTime when this entry was activated. This can be used by the management
         station to ensure that the entry has not been deleted and recreated between polls."
   ::= { atmMatrixDSEntry 4 }

atmMatrixDSCells OBJECT-TYPE
   SYNTAX      ZeroBasedCounter32
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
         "The number of error-free cells detected on ATM connections in which these ATM addresses were
         identified as the transmitting and receiving endpoint addresses.

         Note that for point-to-multipoint connections, an entry is created for each root-to-leaf address-pair
         that exists, and each cell sent from the root on a point-to-multipoint ATM connection is counted
         once in each distinct matrix entry. This counter includes OAM cells transmitted on behalf of this
         source/destination address-pair."
   ::= { atmMatrixDSEntry 5 }

atmMatrixDSCellsRollovers OBJECT-TYPE
   SYNTAX      ZeroBasedCounter32
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
         "The number of times that the associated instance of the atmMatrixDSCells object has incremented
         from the value 2^^32-1 to zero."
   ::= { atmMatrixDSEntry 6 }

atmMatrixDSHCCells OBJECT-TYPE
   SYNTAX      Counter64
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
         "The high capacity version of the atmMatrixDSCells object."
```

```
    ::= { atmMatrixDSEntry 7 }

atmMatrixDSNumCallAttempts OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of SVC call setup attempts detected on ATM connections within the specified
        portSelectGroup, in which the indicated atmMatrixDSSrcAddress endpoint address was identified as
        the Calling Party and the indicated atmMatrixDSDstAddress was identified as the Called Party.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a connection attempt is detected in which these ATM addresses are identified as
        the calling and called parties."
    ::= { atmMatrixDSEntry 8 }

atmMatrixDSNumCalls OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful SVC call setups detected on ATM connections within the specified
        portSelectGroup, in which the indicated atmMatrixDSSrcAddress endpoint address was identified as
        the Calling Party and the indicated atmMatrixDSDstAddress was identified as the Called Party.

        Note that this value includes calls that are currently in progress.  A probe should increment this
        counter each time a valid connection is established in which these ATM addresses are identified as
        the calling and called parties."
    ::= { atmMatrixDSEntry 9 }

atmMatrixDSConnTime OBJECT-TYPE
    SYNTAX      ConnectTime
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The elapsed time of all calls identified by the associated instance of
        atmMatrixDSNumCallAttempts."
    ::= { atmMatrixDSEntry 10 }

–
-- ATM MatrixTopN Tables
–
-- Finds and reports the top traffic contributors,
-- according to associated portSelectGroup criteria

atmMatrixTopNControlTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmMatrixTopNControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A set of parameters that control the creation of a report of the top N matrix entries according to a
        selected metric."
    ::= { atmMatrix 4 }
```

```
atmMatrixTopNControlEntry OBJECT-TYPE
    SYNTAX      AtmMatrixTopNControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the atmMatrixTopNControlTable.
        An example of the indexing of this table is atmMatrixTopNControlDuration.3.1"
    INDEX { portSelGrpIndex, atmMatrixTopNControlIndex }
    ::= { atmMatrixTopNControlTable 1 }

AtmMatrixTopNControlEntry    ::= SEQUENCE {
    atmMatrixTopNControlIndex                  Integer32,
    atmMatrixTopNControlRateBase               INTEGER,
    atmMatrixTopNControlSClass                 ServiceClass,
    atmMatrixTopNControlTimeRemaining          Integer32,
    atmMatrixTopNControlGeneratedReports       Counter32,
    atmMatrixTopNControlDuration               Integer32,
    atmMatrixTopNControlRequestedSize          Integer32,
    atmMatrixTopNControlGrantedSize            Integer32,
    atmMatrixTopNControlStartTime              TimeStamp,
    atmMatrixTopNControlOwner                  OwnerString,
    atmMatrixTopNControlStatus                 RowStatus
}

atmMatrixTopNControlIndex OBJECT-TYPE
    SYNTAX      Integer32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An index that is used to uniquely identify an entry in the atmMatrixTopNControlTable.  Each
        such entry defines one top N report prepared on behalf of one atmMatrix entry, which must exist
        before this entry may be created."
    ::= { atmMatrixTopNControlEntry 1 }

atmMatrixTopNControlRateBase OBJECT-TYPE
    SYNTAX INTEGER {
        atmMatrixTopNCells(1),
        atmMatrixTopNNumCallAttempts(2),
        atmMatrixTopNNumCalls(3),
        atmMatrixTopNConnTime(4)
    }
    MAX-ACCESS      read-create
    STATUS  current
    DESCRIPTION
        "The variable for each atmMatrix entry that the atmMatrixTopNEntries are sorted by.
        This object may not be modified if the associated atmMatrixTopNControlStatus object is equal to
        active(1)."
    ::= { atmMatrixTopNControlEntry 2 }

atmMatrixTopNControlSClass OBJECT-TYPE
    SYNTAX  ServiceClass
```

```
    MAX-ACCESS        read-create
    STATUS  current
    DESCRIPTION
            "The service class for which this topN control entry is collecting information in associated
            atmMatrixTopN reports.

            This object may not be modified if the associated atmMatrixTopNControlStatus object is equal to
            active(1)."
    ::= { atmMatrixTopNControlEntry 3 }

atmMatrixTopNControlTimeRemaining OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
            DESCRIPTION
            "The number of seconds left in the report currently being collected.  When this object is modified
            by the management station, a new collection is started, possibly aborting a currently running
            report.  The new value is used as the requested duration of this report, and is immediately loaded
            into the associated atmMatrixTopNControlDuration object.

            When the report finishes, the probe will automatically start another collection with the same
            initial value of atmMatrixTopNControlTimeRemaining.  Thus the management station may
            simply read the resulting reports repeatedly, checking the start time and duration each time to
            ensure that a report was not missed or that the report parameters were not changed.

            While the value of this object is non-zero, it decrements by one per second until it reaches zero.
            At the time that this object decrements to zero, the report is made accessible in the
            atmMatrixTopNTable, overwriting any report that may be there.

            When this object is modified by the management station, any associated entries in the
            atmMatrixTopNTable shall be deleted."
    DEFVAL { 1800 }
    ::= { atmMatrixTopNControlEntry 4 }

atmMatrixTopNControlGeneratedReports OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
"The number of reports that have been generated by this
entry."
    ::= { atmMatrixTopNControlEntry 5 }

atmMatrixTopNControlDuration OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The number of seconds that this report has collected during the last sampling interval.

            When the associated atmMatrixTopNControlTimeRemaining object is set, this object shall be set
            by the probe to the same value and shall not be modified until the next time the
            atmMatrixTopNControlTimeRemaining is set.

            This value shall be zero if no reports have been requested for this atmMatrixTopNControlEntry."
    ::= { atmMatrixTopNControlEntry 6 }
```

```
atmMatrixTopNControlRequestedSize OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The maximum number of host entries requested for this report.

        When this object is created or modified, the probe should set atmMatrixTopNControlGrantedSize
        as closely to this object as is possible for the particular probe implementation and available
        resources."

    DEFVAL { 150 }
    ::= { atmMatrixTopNControlEntry 7 }

atmMatrixTopNControlGrantedSize OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The maximum number of host entries in this report.

        When the associated atmMatrixTopNControlRequestedSize object is created or modified, the probe
        should set this object as closely to the requested value as is possible for the particular
        implementation and available resources. The probe must not lower this value except as a result of
        a set to the associated atmMatrixTopNControlRequestedSize object.

        For example, if the value of atmMatrixTopNControlRateBase is equal to atmMatrixTopNCells(1),
        when the next topN report is generated, host entries with the highest value of atmMatrixSDCells
        shall be placed in this table in decreasing order of this rate until there is no more room or until
        there are no more matrix entries. Each atmMatrixSDCells value is copied to the associated
        atmMatrixTopNRate object.

        It is an implementation-specific matter how entries with the same value are sorted.  It is also an
        implementation- specific matter as to whether or not zero-valued entries are available."

    ::= { atmMatrixTopNControlEntry 8 }

atmMatrixTopNControlStartTime OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of sysUpTime when this top N report was last started.  In other words, this is the time
        that the associated atmMatrixTopNControlTimeRemaining object was modified to start the
        requested report or the time the report was last automatically (re)started.

        This object may be used by the management station to determine if a report was missed or not."

    ::= { atmMatrixTopNControlEntry 9 }

atmMatrixTopNControlOwner OBJECT-TYPE
    SYNTAX      OwnerString
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The entity that configured this entry and is therefore using the resources assigned to it."

    ::= { atmMatrixTopNControlEntry 10 }
```

```
atmMatrixTopNControlStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this atmMatrixTopNControlEntry.

        An entry may not exist in the active state unless all objects in the entry have an appropriate value.

        If this object is not equal to active(1), all associated entries in the atmMatrixTopNTable shall be
        deleted by the agent."
    ::= { atmMatrixTopNControlEntry 11 }

--
-- atmMatrixTopNTable
--
atmMatrixTopNTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF AtmMatrixTopNEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A set of statistics for those matrix entries that have counted the highest number of cells, calls, or
        connection time."
    ::= { atmMatrix 5 }

atmMatrixTopNEntry OBJECT-TYPE
    SYNTAX      AtmMatrixTopNEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the atmMatrixTopNTable.

        The atmMatrixTopNControlIndex value in the index identifies the atmMatrixTopNControlEntry
        on whose behalf this entry was created.

        An example of the indexing of this table is atmMatrixTopNSrcAddress.1.3.10"
    INDEX { portSelGrpIndex, atmMatrixTopNControlIndex,
                atmMatrixTopNIndex }
    ::= { atmMatrixTopNTable 1 }

AtmMatrixTopNEntry    ::= SEQUENCE {
    atmMatrixTopNIndex              Integer32,
    atmMatrixTopNSrcAddress         AtmAddr,
    atmMatrixTopNDstAddress         AtmAddr,
    atmMatrixTopNRate               Integer32,
    atmMatrixTopNReverseRate        Integer32
}

atmMatrixTopNIndex OBJECT-TYPE
    SYNTAX      Integer32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An index that uniquely identifies an entry in the atmMatrixTopNTable among those in the same
        report.  This index is between 1 and N, where N is the number of entries in this report.
```

```
        Each conversation in the selected atmMatrixSDTable, for the report interval, is ranked in
        descending order of the metric identified by the atmMatrixTopNRate object.

        For example, if the value of atmMatrixTopNControlRateBase is equal to atmMatrixTopNCells(1),
        increasing values of atmMatrixTopNIndex shall be assigned to entries with decreasing delta values
        of atmMatrixSDCells (for the report interval), until index N is assigned or there are no more
        atmMatrixSDEntries.”
    ::= { atmMatrixTopNEntry 1 }

atmMatrixTopNSrcAddress OBJECT-TYPE
    SYNTAX      AtmAddr
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        “The ATM endpoint address identified as the source of the traffic measured in this report.  Note that
        only 20 octet ‘AtmAddr’ addresses are collected in this table.”
    ::= { atmMatrixTopNEntry 2 }

atmMatrixTopNDstAddress OBJECT-TYPE
    SYNTAX      AtmAddr
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        “The ATM endpoint address identified as the destination of the traffic measured in this report.  Note
        that only 20 octet ‘AtmAddr’ addresses are collected in this table.”
    ::= { atmMatrixTopNEntry 3 }

atmMatrixTopNRate OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        “The value of the ranked metric for this conversation, for this report.

        If the associated value of atmMatrixTopNRateBase is equal to atmMatrixTopNCells(1), then this
        object is assigned the delta value of the atmMatrixSDCells object during this report interval.

        If the associated value of atmMatrixTopNRateBase is equal to
        atmMatrixTopNNumCallAttempts(2), then this object is assigned the delta value of the
        atmMatrixSDNumCallAttempts object during this report interval.

        If the associated value of atmMatrixTopNRateBase is equal to atmMatrixTopNNumCalls(3), then
        this object is assigned the delta value of the atmMatrixSDNumCalls object during this report
        interval.

        If the associated value of atmMatrixTopNRateBase is equal to atmMatrixTopNConnTime(4), then
        this object is assigned the delta value of the atmMatrixSDConnTime object during this report
        interval.”
    ::= { atmMatrixTopNEntry 4 }

atmMatrixTopNReverseRate OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
```

```
        "The value of the associated metric for this conversation, and for this report, but for the reverse
        direction.
        For example, if the associated value of atmMatrixTopNRateBase is equal to
        atmMatrixTopNCells(1), then this object contains the atmMatrixSDCells delta cell rate for the
        reverse direction traffic (i.e., destination to source traffic)."
   ::= { atmMatrixTopNEntry 5 }

-- Conformance Macros

atmRmonMIBCompliances   OBJECT IDENTIFIER ::= { atmRmonConformance 1 }
atmRmonMIBGroups        OBJECT IDENTIFIER ::= { atmRmonConformance 2 }

atmRmonMIBCompliance MODULE-COMPLIANCE
   STATUS  current
   DESCRIPTION
        "Describes the requirements for conformance to the ATM-RMON MIB."
   MODULE  -- this module
   MANDATORY-GROUPS {
                    portSelectGroup,
                    atmStatsGroup,
                    atmHostGroup,
                    atmMatrixGroup
   }
   ::= { atmRmonMIBCompliances 1 }

portSelectGroup OBJECT-GROUP
   OBJECTS {
                    portSelGrpDescr,
                    portSelGrpCreateTime,
                    portSelGrpOwner,
                    portSelGrpStatus,
                    portSelCollectGroup,
                    portSelCreateTime,
                    portSelOwner,
                    portSelStatus
   }
   STATUS      current
   DESCRIPTION
        "Selects the ATM connections that should be monitored as part of a specific collection-group."
   ::= { atmRmonMIBGroups 1 }

atmStatsGroup OBJECT-GROUP
   OBJECTS {
                    atmStatsControlDropEvents,
                    atmStatsControlOwner,
                    atmStatsControlStatus,
                    atmStatsCreateTime,
                    atmStatsCells,
                    atmStatsCellsRollovers,
                    atmStatsNumCallAttempts,
                    atmStatsNumCalls,
                    atmStatsConnTime
```

```
    }
    STATUS current
    DESCRIPTION
        "Counts the basic statistics for collections on behalf of particular portSelectGroup collections."
    ::= { atmRmonMIBGroups 2 }

atmStatsHCGroup OBJECT-GROUP
    OBJECTS {
                    atmStatsHCCells
    }
    STATUS current
    DESCRIPTION
        "Counts the high capacity basic statistics for collections on behalf of particular portSelectGroup
        collections. The atmStatsGroup must be implemented if the atmStatsHCGroup is implemented.
        This group is mandatory for implementations which support high capacity counters."
    ::= { atmRmonMIBGroups 3 }

atmHostGroup OBJECT-GROUP
    OBJECTS {
                    atmHostControlInserts,
                    atmHostControlDeletes,
                    atmHostControlMaxDesiredEntries,
                    atmHostControlPriority,
                    atmHostControlAddrCollectScope,
                    atmHostControlDropEvents,
                    atmHostControlOwner,
                    atmHostControlStatus,
                    atmHostCreateTime,
                    atmHostInCells,
                    atmHostInCellsRollovers,
                    atmHostOutCells,
                    atmHostOutCellsRollovers,
                    atmHostInNumCallAttempts,
                    atmHostInNumCalls,
                    atmHostOutNumCallAttempts,
                    atmHostOutNumCalls,
                    atmHostInConnTime,
                    atmHostOutConnTime
    }
    STATUS  current
    DESCRIPTION
        "Counts the amount of traffic sent from and to each ATM address discovered by the probe, on
        behalf of particular portSelectGroup collections."
    ::= { atmRmonMIBGroups 4 }

atmHostHCGroup OBJECT-GROUP
    OBJECTS {
                    atmHostInHCCells,
                    atmHostOutHCCells
    }
    STATUS  current
    DESCRIPTION
```

```
        "Counts the amount of traffic sent from and to each ATM address discovered by the probe, on
        behalf of particular portSelectGroup collections, using high-capacity counters.
        The atmHostGroup must be implemented if the atmHostHCGroup is implemented.  This group is
        mandatory for implementations which support high capacity counters."
    ::= { atmRmonMIBGroups 5 }

atmMatrixGroup OBJECT-GROUP
    OBJECTS {
                        atmMatrixControlInserts,
                        atmMatrixControlDeletes,
                        atmMatrixControlMaxDesiredEntries,
                        atmMatrixControlPriority,
                        atmMatrixControlAddrCollectScope,
                        atmMatrixControlDropEvents,
                        atmMatrixControlOwner,
                        atmMatrixControlStatus,
                        atmMatrixSDCreateTime,
                        atmMatrixSDCells,
                        atmMatrixSDCellsRollovers,
                        atmMatrixSDNumCallAttempts,
                        atmMatrixSDNumCalls,
                        atmMatrixSDConnTime,
                        atmMatrixDSCreateTime,
                        atmMatrixDSCells,
                        atmMatrixDSCellsRollovers,
                        atmMatrixDSNumCallAttempts,
                        atmMatrixDSNumCalls,
                        atmMatrixDSConnTime,
                        atmMatrixTopNControlRateBase,
                        atmMatrixTopNControlSClass,
                        atmMatrixTopNControlTimeRemaining,
                        atmMatrixTopNControlGeneratedReports,
                        atmMatrixTopNControlDuration,
                        atmMatrixTopNControlRequestedSize,
                        atmMatrixTopNControlGrantedSize,
                        atmMatrixTopNControlStartTime,
                        atmMatrixTopNControlOwner,
                        atmMatrixTopNControlStatus,
                        atmMatrixTopNSrcAddress,
                        atmMatrixTopNDstAddress,
                        atmMatrixTopNRate,
                        atmMatrixTopNReverseRate
    }
    STATUS  current
    DESCRIPTION
        "Counts the amount of traffic sent between each pair of ATM addresses discovered by the probe, on
        behalf of particular portSelectGroup collections."
    ::= { atmRmonMIBGroups 6 }

atmMatrixHCGroup OBJECT-GROUP
    OBJECTS {
                        atmMatrixSDHCCells,
                        atmMatrixDSHCCells
```

```
}
STATUS  current
DESCRIPTION
        "Counts the amount of traffic sent between each pair of ATM addresses discovered by the probe, on
        behalf of particular portSelectGroup collections, using high capacity counters. The
        atmMatrixGroup must be implemented if the atmMatrixHCGroup is implemented.  This group is
        mandatory for implementations which support high capacity counters."
::= { atmRmonMIBGroups 7 }

END
```

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