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S. Waldbusser

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Application Performance Measurement MIB

Status of this Memo

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Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP-based internets. In particular, it defines objects for measuring the application performance as experienced by end-users.

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1. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [8].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [1], STD 58, RFC 2579 [2] and STD 58, RFC 2580 [3].

2. Overview

This document continues the architecture created in the RMON MIB [7] by providing analysis of application performance as experienced by end-users.

Application performance measurement measures the quality of service delivered to end-users by applications. With this perspective, a true end-to-end view of the IT infrastructure results, combining the performance of the application, desktop, network, and server, as well as any positive or negative interactions between these components.

Despite all the technically sophisticated ways in which networking and system resources can be measured, human end-users perceive only two things about an application: availability and responsiveness.

Availability - The percentage of the time that the application is ready to give a user service.

Responsiveness - The speed at which the application delivers the requested service.

A transaction is an action initiated by a user that starts and completes a distributed processing function. A transaction begins when a user initiates a request for service (i.e., pushing a submit button) and ends when the work is completed (i.e., information is provided or a confirmation is delivered). A transaction is the fundamental item measured by the APM MIB.

A failed transaction is a transaction that fails to provide the service requested by the end user, regardless of whether it is due to a processing failure or transport failure.

An application protocol (e.g., POP3) may implement different commands or application "verbs" (e.g., POP3 Login and POP3 Retrieval). It will often be interesting to monitor these verbs separately because:

1) The verbs may have widely differing performance characteristics (in fact some may be response time oriented while others are throughput oriented)
2) The verbs have varying business significance
3) It provides more granularity of exactly what might be performing poorly

This MIB Module allows the measurement of a parent application, its component verbs, or both. If monitoring both, one can watch the top-level application and then drill down to the verbs when trouble is spotted to learn which subcomponents are in trouble. Each application verb is registered separately in the Protocol Directory [5] [6] as a child of its parent application.

Application protocols implement one of three different types of transactions: transaction-oriented, throughput-oriented, or streaming-oriented. While the availability metric is the same for all three types, the responsiveness metric varies:

Transaction-Oriented: These transactions have a fairly constant workload to perform for all transactions. In particular, to the degree that the workload may vary, it doesn't vary based on the amount of data to be transferred but based on the parameters of the transaction. The responsiveness metric for transaction-oriented applications is application response time, the elapsed time between the user's request for service (e.g., pushing the submit button) and the completion of the request (e.g., displaying the results) and is measured in milliseconds. This is commonly referred to as end-user response time.

Throughput-Oriented: These transactions have widely varying workloads based on the amount of data requested. The responsiveness metric for throughput-oriented applications is kilobits per second.

Streaming-Oriented: These transactions deliver data at a constant metered rate of speed regardless of excess capacity in the networking and computing infrastructure. However, when the infrastructures cannot deliver data at this speed, interruption of service or degradation of service can result. The responsiveness

metric for streaming-oriented applications is the signal quality ratio of time that the service is degraded or interrupted to the total service time. This metric is measured in parts per million.

2.1. Report Aggregation

This MIB Module provides functions to aggregate measurements into higher level summaries.

Every transaction is identified by its application, server, and client and has an availability measure as well as a responsiveness measure. The appropriate responsiveness measure is context-sensitive depending on whether the application is transaction-oriented, throughput-oriented, or streaming- oriented. For example, in a 5 minute period several transactions might be recorded:

Application	Client	Server	Successful	Responsiveness
HTTP	Jim	Sales	1	6 sec.
SAP/R3	Jane	Finance	1	17 sec.
HTTP	Joe	HR	0	-
FTP	Jim	FTP	1	212 Kbps
HTTP	Joe	HR	1	25 sec.
RealVideo	Joe	Videoconf	1	100.0%
HTTP	Jane	HR	1	5 sec.

These transactions can be aggregated in several ways, providing statistical summaries - for example summarizing all HTTP transactions, or all HTTP transactions to the HR Server. Note that data from different applications may not be summarized because:

1. The performance characteristics of different applications differ widely enough to render statistical analysis meaningless.

2. The responsiveness metrics of different applications may be different, making a statistical analysis impossible (in other words, one application may be transaction-oriented, while another is throughput-oriented).

Aggregating transactions collected over a period requires an aggregation algorithm. In this MIB Module, transaction aggregation always results in the following statistics:

TransactionCount
: The total number of transactions during this period

SuccessfulTransactions
The total number of transactions that were successful. The management station can derive the percent success by dividing SuccessfulTransactions by the TransactionCount.

ResponsivenessMean
The average of the responsiveness metric for all aggregated transactions that completed successfully.

ResponsivenessMin
The minimum responsiveness metric for all aggregated transactions that completed successfully.

ResponsivenessMax
The maximum responsiveness metric for all aggregated transactions that completed successfully.

ResponsivenessBx
The count of successful transactions whose responsiveness metric fell into the range specified for Bx. There are 7 buckets specified. Because the performance of different applications varies widely, the bucket ranges are specified separately for each application (in the apmAppDirTable) so that they may be tuned to typical performance of each application.

For example, when aggregating the previous set of transactions by application we get (for simplicity the example only shows TransactionCount, SuccessfulTransactions, and ResponsivenessMean):

Application	Count	Successful	ResponsivenessMean
HTTP	4	3	12 sec.
SAP/R3	1	1	17 sec.
FTP	1	1	212 Kbps.
RealVideo	1	1	100.0%

There are four different types of aggregation.

The flows(1) aggregation is the simplest. All transactions that share common application/server/client 3-tuples are aggregated together, resulting in a set of metrics for all such unique 3-tuples.

The clients(2) aggregation results in somewhat more aggregation (i.e., fewer resulting records). All transactions that share common application/client tuples are aggregated together, resulting in a set of metrics for all such unique tuples.

The servers(3) aggregation usually results in still more aggregation (i.e., fewer resulting records). All transactions that share common application/server tuples are aggregated together, resulting in a set of metrics for all such unique tuples.

The applications(4) aggregation results in the most aggregation (i.e., the fewest resulting records). All transactions that share a common application are aggregated together, resulting in a set of metrics for all such unique applications.

For example, if in a 5 minute period the following transactions occurred:

Actual Transactions:

#	App	Client	Server	Successful	Responsiveness
1	HTTP	Jim	CallCtr	N	-
2	HTTP	Jim	HR	Y	12 sec.
3	HTTP	Jim	Sales	Y	7 sec.
4	HTTP	Jim	CallCtr	Y	5 sec.
5	Email	Jim	Pop3	Y	12 sec.
6	HTTP	Jane	CallCtr	Y	3 sec.
7	SAP/R3	Jane	Finance	Y	19 sec.
8	Email	Jane	Pop3	Y	16 sec.
9	HTTP	Joe	HR	Y	18 sec.

The flows(1) aggregation results in the following table. Note that the first record (HTTP/Jim/CallCtr) is the aggregation of transactions #1 and #4:

Flow Aggregation:

App	Client	Server	Count	Succe-ssful	Rsp Mean	Rsp Min	Rsp Max	RspB1	RspB2
HTTP	Jim	CallCtr	2	1	5	5	5	1	0
HTTP	Jim	HR	1	1	12	12	12	0	1
HTTP	Jim	Sales	1	1	7	7	7	1	0
Email	Jim	Pop3	1	1	12	12	12	0	1
HTTP	Jane	CallCtr	1	1	3	3	3	1	0
SAP/R3	Jane	Finance	1	1	19	19	19	0	1
Email	Jane	Pop3	1	1	16	16	16	0	1
HTTP	Joe	HR	1	1	18	18	18	0	1

(Note: Columns above such as RspMean and RspB1 are abbreviations for objects in the apmReportTable)

The clients(2) aggregation results in the following table. Note that the first record (HTTP/Jim) is the aggregate of transactions #1, #2, #3 and #4:

Client Aggregation:

App	Client	Count	Succe-ssful	Rsp Mean	Rsp Min	Rsp Max	RspB1	RspB2 ...
HTTP	Jim	4	3	8	5	12	2	1
Email	Jim	1	1	12	12	12	0	1
HTTP	Jane	1	1	3	3	3	1	0
SAP/R3	Jane	1	1	19	19	19	0	1
Email	Jane	1	1	16	16	16	0	1
HTTP	Joe	1	1	18	18	18	0	1

The servers(3) aggregation results in the following table. Note that the first record (HTTP/CallCtr) is the aggregation of transactions #1, #4 and #6:

Server Aggregation:

App	Server	Count	Succe-ssful	Rsp Mean	Rsp Min	Rsp Max	RspB1	RspB2 ...
HTTP	CallCtr	3	2	4	3	5	2	0
HTTP	HR	2	2	15	12	18	0	2
HTTP	Sales	1	1	7	7	7	1	0
Email	Pop3	2	2	14	12	16	0	2
SAP/R3	Finance	1	1	19	19	19	0	1

The applications(4) aggregation results in the following table. Note that the first record (HTTP) is the aggregate of transactions #1, #2, #3, #5, #6 and #9:

Application Aggregation:

App	Count	Succe-ssful	Rsp Mean	Rsp Min	Rsp Max	RspB1	RspB2 ...
HTTP	6	5	9	3	18	3	2
Email	2	2	14	12	16	0	2
SAP/R3	1	1	19	19	19	0	1

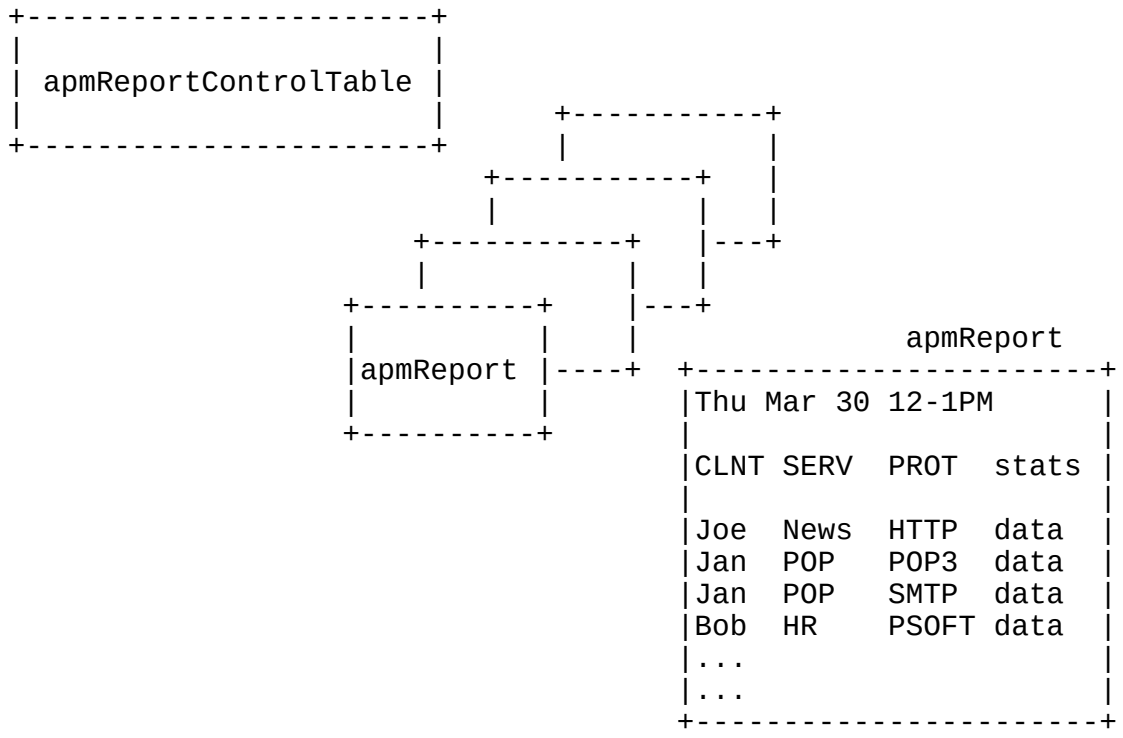
The apmReportControlTable provides for a historical set of the last 'X' reports, combining the historical records found in history tables with the periodic snapshots found in TopN tables. Conceptually the components are:

apmReportControlTable
: Specifies data collection and summarization parameters, including the number of reports to keep and the size of each report.

apmReport
: Each APM Report contains an aggregated list of records that represent data collected during a specific time period.

An apmReportControlEntry causes a family of APM Reports to be created, where each report summarizes different, successive, contiguous periods of time.

While the conceptual model of APM Reports shows them as distinct entities, they are all entries in a single apmReportTable, where entries in report 'A' are separated from entries in report 'B' by different values of the apmReportIndex.



2.2. AppLocalIndex Linkages

The following set of example tables illustrates a few points:

1. How protocolDirEntries, apmHttpFilterEntries and apmUserDefinedAppEntries(not shown) all result in entries in the apmAppDirTable.

2. How a single appLocalIndex may be represented multiple times in the apmAppDirTable and apmReportTable if the agent measures multiple responsiveness types for that application.

A convention in the formatting of these tables is that the columns to the left of the '|' separator are index columns for the table.

Assuming the following entries in the RMON2 protocolDirectory:

```
protocolDirectory
ID (*)     Parameters   |    LocalIndex ...
WWW        None         |    1
WWW Get    None         |    2
SAP/R3     None         |    3
```

(*) These IDs are represented here symbolically. Consult [5] for more detail in their format

and the following entry in the apmHttpFilterTable:

```
ApmHttpFilterTable
Index   |  AppLocalIndex  ServerAddress   URLPath    MatchType ...
5       |  20             hr.example.com  /expense   prefix(3) ...
```

the apmAppDirTable would be populated with the following entries:

```
apmAppDir
AppLocalIndex  ResponsivenessType       | Config  ...
1              transaction(1)           | On      ...
1              throughput(2)            | On      ...
2              transaction(1)           | On      ...
2              throughput(2)            | On      ...
3              transaction(1)           | On      ...
20             transaction(1)           | On      ...
20             throughput(2)            | On      ...
```

The entries in the apmAppDirTable with an appLocalIndex of 1, 2 and 3 correspond to the identically named entries in the protocolDirectory table. appLocalIndex #1 results in 2 entries, one to measure the transaction responsiveness of WWW and one to measure its throughput responsiveness. In contrast, appLocalIndex #3 results in only a transaction entry because the agent does not measure the throughput responsiveness for SAP/R3 (probably because it isn't very meaningful). Finally, appLocalIndex #20 corresponds to the entry in the apmHttpFilterTable and has transaction responsiveness and throughput responsiveness measurements available.

If a report was configured using application aggregation, entries in that report might look like:

apmReportTable

CtlIndex	Index	AppLocalIdx	ResponsivenessType	TransactionCount ...
1	1	1	transaction(1)	counters...
1	1	1	throughput(2)	counters...
1	1	2	transaction(1)	counters...
1	1	2	throughput(2)	counters...
1	1	3	transaction(1)	counters...
1	1	20	transaction(1)	counters...
1	1	20	throughput(2)	counters...

Note that the index items protocolDirLocalIndex, apmReportServerAddress and apmReportClientID were omitted from apmReportTable example for brevity because they would have been equal to zero due to the use of the application aggregation in this example.

2.3. Measurement Methodology

There are many different measurement methodologies available for measuring application performance (e.g., probe-based, client-based, synthetic-transaction, etc.). This specification does not mandate a particular methodology - it is open to any that meet the minimum requirements. Conformance to this specification requires that the collected data match the semantics described herein. In particular, a data collection methodology must be able to measure response time, throughput, streaming responsiveness and availability as specified.

Note that in some cases a transaction may run for a long time but ultimately be successful. The measurement software shouldn't prematurely classify lengthy transactions as failures but should wait as long as the client application will wait for a successful response.

2.4. Instrumentation Architectures

Different architectural approaches and deployment strategies may be taken towards implementation of this specification. If a highly distributed approach is desired (e.g., an agent per desktop), one or both of the two approaches below may be used to make it more practical.

2.4.1. Application Directory Caching

It is necessary for the manager to have a copy of the tables that define the Application Directory in order to interpret APM measurements. It is likely that in a highly distributed network of

thousands of APM agents, this Application Directory will be the same on many, if not all of the agents. Repeated downloads of the Application Directory may be inefficient.

The apmAppDirID object is a single object that identifies the configuration of all aspects of the Application Directory when it is equal to a well-known, registered configuration. Thus, when a manager sees an apmAppDirID value that it recognizes, it need not download the Application Directory from that agent. In fact, the manager may discover a new registered Application Directory configuration on one agent and then re-use that configuration on another agent that shares the same apmAppDirID value.

Application directory registrations are unique within an administrative domain, allowing an administrator to create a custom application directory configuration without the need to assign it a globally-unique registration.

2.4.2. Push Model

When APM agents are installed on "desktops" (including laptops), a few issues make polling difficult:

1. Desktops often have dynamically-assigned addresses so there is no long-lived address to poll.

2. Desktops are not available as much as infrastructure components due to crashes, user-initiated reboots and shutdowns and user control over monitoring software. Thus a desktop may not be available to answer a poll at the moment when the manager is scheduled to poll that desktop.

3. Laptops that are connected via dialup connections are only sporadically connected and will routinely be unreachable when the manager is scheduled to poll.

As a consequence, a push model is usually more appropriate for desktop-based agents. To achieve this, the agent should follow the following rules in deciding what data to send in notifications.

APM Reports
If an agent wishes to push APM reports to a manager, it must send:
apmAppDirID
apmNameTable (any data updated since the last push)
For each report the agent wishes to upload, it must send the entire apmReportControlEntry associated with that report and the associated entries in the apmReportTable that have changed since the last report.

APM Transactions
If an agent wishes to push APM transactions to a manager, it must send:
apmAppDirID
apmNameTable (any data updated since the last push)
apmTransactionTable (relevant entries)

APM Exceptions
The agent must send:
apmAppDirID
apmNameTable (any data updated since the last push)
apmTransactionEntry (of exception transaction)
apmExceptionEntry (entry that generated exception)
[Note that this list supersedes the information in the OBJECTS clauses of the apmTransactionResponsivenessAlarm and apmTransactionUnsuccessfulAlarm when the agent is using a push model. This additional information eliminates the need for the manager to request additional data to understand the exception.]

The order of varbinds and where to segment varbinds into PDUs is at the discretion of the agent.

2.5. Structure of this MIB Module

The objects are arranged into the following groups:

- APM Application Directory Group
- APM User Defined Applications Group
- APM Report Group
- APM Transaction Group
- APM Exception Group
- APM Notification Group

These groups are the basic unit of conformance. If an agent implements a group, then it must implement all objects in that group. While this section provides an overview of grouping and conformance information for this MIB Module, the authoritative reference for such information is contained in the MODULE-COMPLIANCE and OBJECT-GROUP macros later in this MIB Module.

These groups are defined to provide a means of assigning object identifiers, and to provide a method for implementors of managed agents to know which objects they must implement.

2.5.1. The APM Application Directory Group

The APM Application Directory group contains configuration objects for every application or application verb monitored on this system. This group consists of the apmAppDirTable.

2.5.2. The APM User Defined Applications Group

The APM User Defined Applications Group contains objects that allow for the tracking of applications or application verbs that aren't registered in the protocolDirTable. This group consists of the apmHttpFilterTable and the apmUserDefinedAppTable.

2.5.3. The APM Report Group

The APM Report Group is used to prepare regular reports that aggregate application performance by flow, by client, by server, or by application. This group consists of the apmReportControlTable and the apmReportTable.

2.5.4. The APM Transaction Group

The APM Transaction Group is used to show transactions that are currently in progress and ones that have ended recently, along with their responsiveness metric.

Because many transactions last a very short time and because an agent may not retain completed transactions very long, transactions may exist in this table for a very short time. Thus, polling this table isn't an effective mechanism for retrieving all transactions unless the value of apmTransactionsHistorySize is suitably large for the transactions being monitored.

One important benefit of this table is that it allows a management station to check on the status of long-lived transactions. Because the apmReport and apmException mechanisms act only on transactions that have finished, a network manager may not have visibility for

some time into the performance of long-lived transactions such as streaming applications, large data transfers, or (very) poorly performing transactions. In fact, by their very definition, the apmReport and apmException mechanisms only provide visibility into a problem after nothing can be done about it. This group consists primarily of the apmTransactionTable.

2.5.5. The APM Exception Group

The APM Exception Group is used to generate immediate notifications of transactions that cross certain thresholds. The apmExceptionTable is used to configure which thresholds are to be checked for which types of transactions. The apmTransactionResponsivenessAlarm notification is sent when a transaction occurs with a responsiveness that crosses a threshold. The apmTransactionUnsuccessfulAlarm notification is sent when a transaction fails for which exception checking was configured. This group consists primarily of the apmExceptionTable.

2.5.6. The APM Notification Group

The APM Notification Group contains 2 notifications that are sent when thresholds in the APM Exception Table are exceeded.

3. Definitions

```
APM-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE,
    NOTIFICATION-TYPE,
    Counter32, Unsigned32                          FROM SNMPv2-SMI
    TEXTUAL-CONVENTION, RowStatus, TimeStamp,
    TimeInterval, TruthValue, DateAndTime,
    StorageType                                    FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP,
    NOTIFICATION-GROUP                             FROM SNMPv2-CONF
    SnmpAdminString                                FROM SNMP-FRAMEWORK-MIB
    rmon, OwnerString                              FROM RMON-MIB
    protocolDirLocalIndex                          FROM RMON2-MIB;

--  Application Performance Measurement MIB

apm MODULE-IDENTITY
    LAST-UPDATED "200402190000Z"  -- February 19, 2004
    ORGANIZATION "IETF RMON MIB Working Group"
    CONTACT-INFO
        "Author:
                    Steve Waldbusser
```

```
            Phone:  +1-650-948-6500
            Fax :   +1-650-745-0671
            Email:  waldbusser@nextbeacon.com

         Working Group Chair:
                    Andy Bierman
                    Cisco Systems, Inc.
            Postal: 170 West Tasman Drive
                    San Jose, CA USA 95134
               Tel: +1 408 527-3711
            E-mail: abierman@cisco.com

         Working Group Mailing List: <rmonmib@ietf.org>
         To subscribe send email to: <rmonmib-request@ietf.org>
        "
    DESCRIPTION
        "The MIB module for measuring application performance
        as experienced by end-users.

        Copyright (C) The Internet Society (2004). This version of
        this MIB module is part of RFC 3729; see the RFC itself for
        full legal notices."

    REVISION "200402190000Z"    -- February 19, 2004
    DESCRIPTION
        "The original version of this MIB Module, published as
        RFC3729."

    ::= { rmon 23 }

apmMibObjects OBJECT IDENTIFIER ::= { apm 1 }
apmConformance OBJECT IDENTIFIER ::= { apm 2 }
apmCompliances    OBJECT IDENTIFIER ::= { apmConformance 1 }
apmGroups         OBJECT IDENTIFIER ::= { apmConformance 2 }


AppLocalIndex ::= TEXTUAL-CONVENTION
    STATUS       current
    DESCRIPTION
        "A locally arbitrary unique identifier associated with an
        application or application verb.

        All objects of type AppLocalIndex are assigned by the agent
        out of a common number space. In other words, AppLocalIndex
        values assigned to entries in one table must not overlap with
        AppLocalIndex values assigned to entries in another
        table. Further, every protocolDirLocalIndex value registered
        by the agent automatically assigns the same value out of the
```

```
        AppLocalIndex number space.

        For example, if the protocolDirLocalIndex values { 1, 3, 5, 7 }
        have been assigned, and the apmHttpFilterAppLocalIndex values
        { 6, 8, 9 } have been assigned:

            - Assignment of new AppLocalIndex values must not use the
              values { 1, 3, 5, 6, 7, 8, 9 }.
            - AppLocalIndex values { 1, 3, 5, 7 } are automatically
              assigned and are associated with the identical value of
              protocolDirLocalIndex. In particular, an entry in the
              apmAppDirTable indexed by a value provides further
              information about a protocol indexed by the same value
              in the protocolDirTable of RMON2.

        The value for each supported application must remain constant
        at least from one re-initialization of the entity's network
        management system to the next re-initialization, except that
        if an application is deleted and re-created, it must be
        re-created with a new value that has not been used since the
        last re-initialization.

        The specific value is meaningful only within a given SNMP
        entity. An AppLocalIndex value must not be re-used until the
        next agent restart."
    SYNTAX       Unsigned32 (1..2147483647)

ProtocolDirNetworkAddress ::= TEXTUAL-CONVENTION
    STATUS       current
    DESCRIPTION
        "A network level address whose semantics and encoding are
        specified by an associated protocolDirLocalIndex
        value. Objects of this type must specify which
        protocolDirLocalIndex value is used. This value is encoded
        according to the encoding rules for the identified
        protocolDirectory entry.

        For example, if the associated protocolDirLocalIndex indicates
        an encapsulation of ip, this object is encoded as a length
        octet of 4, followed by the 4 octets of the ip address,
        in network byte order.

        Objects of this type may allow this value to be the zero
        length string. If so, they must identify they meaning of this
        value."
    SYNTAX        OCTET STRING (SIZE(0..255))

DataSourceOrZero ::= TEXTUAL-CONVENTION
```

```
    STATUS       current
    DESCRIPTION
        "Identifies the source of the data that the associated
        function is configured to analyze. This source can be any
        interface on this device.

        In order to identify a particular interface, this
        object shall identify the instance of the ifIndex
        object, defined in [4], for the desired interface.

        For example, if an entry were to receive data from
        interface #1, this object would be set to ifIndex.1.

        If the source of the data isn't an interface or cannot be
        localized to an interface, this object would be set to 0.0"

    REFERENCE    "The DataSource textual convention is defined in
                  RFC 2021 [5]."
    SYNTAX       OBJECT IDENTIFIER

RmonClientID ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
         "A long-lived unique ID assigned to an end-system. This ID is
         assigned by the agent using an implementation-specific
         algorithm.

         Because a client machine may be assigned multiple addresses
         over any time period it can be difficult to attribute
         behavior to a particular client based solely on its
         address. A ClientID may be assigned to provide a more
         stable handle for referencing that client. The entity that
         assigns the ClientID may use various implementation
         techniques to keep track of a client but if the assigning
         entity is unable to track client address mappings, it may map
         client identifiers to client addresses rather than to
         distinct client machines.

         This is named ClientID because it helps to solve a problem
         seen in network clients (servers usually have well-known,
         long-lived addresses). However, ClientID's may be assigned to
         any end-system regardless of its role on the network."
    SYNTAX      Unsigned32 (0..4294967295)


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

```
        "Specifies one of 4 different techniques for aggregating
        transactions.

        The metrics for a single transaction are the responsiveness of
        the transaction and whether the transaction succeeded (a
        boolean). When such metrics are aggregated in this MIB Module,
        these metrics are replaced by averages and distributions of
        responsiveness and availability. The metrics describing
        aggregates are constant no matter which type of aggregation is
        being performed. These metrics may be found in the
        apmReportTable.

        The flows(1) aggregation is the simplest. All transactions
        that share common application/server/client 3-tuples are
        aggregated together, resulting in a set of metrics for all
        such unique 3-tuples.

        The clients(2) aggregation results in somewhat more
        aggregation (i.e., fewer resulting records). All transactions
        that share common application/client tuples are aggregated
        together, resulting in a set of metrics for all such unique
        tuples.

        The servers(3) aggregation usually results in still more
        aggregation (i.e., fewer resulting records). All transactions
        that share common application/server tuples are aggregated
        together, resulting in a set of metrics for all such unique
        tuples.

        The applications(4) aggregation results in the most
        aggregation (i.e., the fewest resulting records). All
        transactions that share a common application are aggregated
        together, resulting in a set of metrics for all such unique
        applications.

        Note that it is not meaningful to aggregate applications, as
        different applications have widely varying characteristics. As a
        result, this set of aggregations is complete."
    SYNTAX      INTEGER {
                  flows(1),    -- Least Aggregation
                  clients(2),
                  servers(3),
                  applications(4) -- Most Aggregation
                }

-- The APM Application Directory Group

-- The Application Directory Table contains a record for every
```

```
-- application monitored by this agent. This table is also used to
-- configure whether or not an application will be measured and which
-- bucket boundaries will be used for the application.
--
-- The bucket boundaries define the break-points between bins of a
-- histogram analysis for that application. As an example of how this
-- works, consider an entry representing response-time for http.
-- If the boundaries are set as follows:
-- Boundary1: 500 milliseconds
-- Boundary2: 1 second
-- Boundary3: 2 seconds
-- Boundary4: 5
-- Boundary5: 15
-- Boundary6: 60
--
-- If the following measurements are made (all in milliseconds):
-- 377, 8645, 1300, 487, 1405, 775, 1115, 850, 945, 1054, 7745, 9380
--
-- A report run during this interval would report the following
-- counts:
-- Bucket1: 2
-- Bucket2: 3
-- Bucket3: 4
-- Bucket4: 0
-- Bucket5: 3
-- Bucket6: 0
-- Bucket7: 0

apmAppDirTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmAppDirEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The APM MIB directory of applications and application
        verbs. The agent will populate this table with all
        applications/verbs of any responsivenessType it has the
        capability to monitor. Since the agent populates this table
        with every entry it has the capability to monitor, the
        entries in this table are read-write, allowing the management
        station to modify parameters in this table but not to add new
        entries or delete entries (however, entries may be
        disabled). If new entries are added to the apmHttpFilterTable
        or the apmUserDefinedAppTable, the agent will add the
        corresponding entries to this table.

        It is an implementation-dependent matter as to how the agent
        sets these default parameters. For example, it may leave
        certain entries in this table 'off(0)' if the agent developer
```

```
        believes that combination will be infrequently used, allowing
        a manager that needs that capability to set it to 'on(1)'.

        Some applications are registered in the RMON2 protocol
        directory and some are registered in other tables in this
        MIB Module. Regardless of where an application is originally
        registered, it is assigned an AppLocalIndex value that is the
        primary index for this table.

        The contents of this table affect all reports and exceptions
        generated by this agent. Accordingly, modification of this
        table should be performed by a manager acting in the role of
        administrator. In particular, management software should not
        require or enforce particular configuration of this table - it
        should reflect the preferences of the site administrator, not
        the software author. As a practical matter, this requires
        management software to allow the administrator to configure
        the values it will use so that it can be adapted to the site
        policy."
    ::= { apmMibObjects 1 }

apmAppDirEntry OBJECT-TYPE
    SYNTAX      ApmAppDirEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The APM MIB directory of applications and application
        verbs. An entry will exist in this table for all applications
        for which application performance measurement is supported."
    INDEX { apmAppDirAppLocalIndex,
            apmAppDirResponsivenessType }
    ::= { apmAppDirTable 1 }

ApmAppDirEntry ::= SEQUENCE {
    apmAppDirAppLocalIndex            AppLocalIndex,
    apmAppDirResponsivenessType       INTEGER,
    apmAppDirConfig                   INTEGER,
    apmAppDirResponsivenessBoundary1  Unsigned32,
    apmAppDirResponsivenessBoundary2  Unsigned32,
    apmAppDirResponsivenessBoundary3  Unsigned32,
    apmAppDirResponsivenessBoundary4  Unsigned32,
    apmAppDirResponsivenessBoundary5  Unsigned32,
    apmAppDirResponsivenessBoundary6  Unsigned32
}

apmAppDirAppLocalIndex OBJECT-TYPE
    SYNTAX      AppLocalIndex
    MAX-ACCESS  not-accessible
```

```
    STATUS      current
    DESCRIPTION
        "The AppLocalIndex assigned for this application Directory
        entry."
    ::= { apmAppDirEntry 1 }

apmAppDirResponsivenessType OBJECT-TYPE
    SYNTAX      INTEGER {
                  transactionOriented(1),
                  throughputOriented(2),
                  streamingOriented(3)
                }
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object describes and configures the agent's support for
        application performance measurement for this application.
        There are 3 types of measurements for different types of
        applications:

        Transaction-Oriented applications have a fairly constant
        workload to perform for all transactions. The responsiveness
        metric for transaction-oriented applications is application
        response time (from first request to final delivery of
        service) and is measured in milliseconds. This is
        commonly referred to as end-user response time.

        Throughput-Oriented applications have widely varying workloads
        based on the nature of the client request. In particular,
        throughput-oriented applications vary widely in the amount of
        data that must be transported to satisfy the request. The
        responsiveness metric for throughput-oriented applications is
        kilobits per second.

        Streaming-Oriented applications deliver data at a constant
        metered rate of speed regardless of the responsiveness of the
        networking and computing infrastructure. This constant rate of
        speed is generally specified to be below (sometimes well
        below) the nominal capability of the infrastructure. However,
        when the infrastructures cannot deliver data at this speed,
        interruption of service or degradation of service can
        result. The responsiveness metric for streaming-oriented
        applications is the ratio of time that the service is degraded
        or interrupted to the total service time. This metric is
        measured in parts per million.

        Note that for some applications, measuring more than one
        responsiveness type may be interesting. For agents that wish
```

```
        to support more than one measurement for a application, they
        will populate this table with multiple entries for that
        application, one for each type."
    ::= { apmAppDirEntry 2 }

apmAppDirConfig OBJECT-TYPE
    SYNTAX      INTEGER {
                  off(1),
                  on(2)
                }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This object describes and configures support for application
        performance measurement for this application.

        If the value of this object is on(2), the agent supports
        measurement of application performance metrics for this
        application and is configured to measure such metrics for all
        APM MIB functions and all interfaces.  If the value of this
        object is off(1), the agent supports measurement of
        application performance for this application but is configured
        to not measure these metrics for any APM MIB functions or
        interfaces.  Whenever this value changes from on(2) to off(1),
        the agent shall delete all related entries in all tables in
        this MIB Module.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 3 }

apmAppDirResponsivenessBoundary1 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The boundary value between bucket1 and bucket 2. If this
        value is modified, all entries in the apmReportTable must be
        deleted by the agent.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 4 }

apmAppDirResponsivenessBoundary2 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The boundary value between bucket2 and bucket 3. If this
```

```
        value is modified, all entries in the apmReportTable must be
        deleted by the agent.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 5 }

apmAppDirResponsivenessBoundary3 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The boundary value between bucket3 and bucket 4. If this
        value is modified, all entries in the apmReportTable must be
        deleted by the agent.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 6 }

apmAppDirResponsivenessBoundary4 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The boundary value between bucket4 and bucket 5. If this
        value is modified, all entries in the apmReportTable must be
        deleted by the agent.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 7 }

apmAppDirResponsivenessBoundary5 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The boundary value between bucket5 and bucket 6. If this
        value is modified, all entries in the apmReportTable must be
        deleted by the agent.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 8 }

apmAppDirResponsivenessBoundary6 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The boundary value between bucket6 and bucket 7. If this
```

```
        value is modified, all entries in the apmReportTable must be
        deleted by the agent.

        The value of this object must persist across reboots."
    ::= { apmAppDirEntry 9 }

-- Scalars related to the Application Directory table

apmBucketBoundaryLastChange OBJECT-TYPE
    SYNTAX     TimeStamp
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The value of sysUpTime the last time that any bucket boundary
        in any appDirEntry was changed. This object can help to
        determine if two managers are both trying to enforce different
        configurations of this table."
    ::= { apmMibObjects 2 }

apmAppDirID OBJECT-TYPE
    SYNTAX     OBJECT IDENTIFIER
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
        "This object allows managers to avoid downloading application
        directory information when the directory is set to a known
        (usually fixed) configuration.

        If the value of this object isn't 0.0, it signifies
        that the entire contents of the apmAppDirTable,
        apmHttpFilterTable, apmUserDefinedAppTable and
        protocolDirTable are equal to a known state identified
        by the value of this object. If a manager recognizes this
        value as identifying a directory configuration it has a local
        copy of, it may use this local copy rather than downloading
        these tables. Note that it may have downloaded this local copy
        (and the ID) from another agent and used this copy for all
        other agents that advertised the same ID.

        If an agent recognizes that the entire contents of the
        apmAppDirTable, apmHttpFilterTable,
        apmUserDefinedAppTable and protocolDirTable are equal to
        a known state to which an ID has been assigned, it should set
        this object to that ID.

        In many cases when this feature is used, the application
        directory information will be in read-only memory and thus the
        tables may not be modified via SNMP requests. In the event
```

```
        that the tables are writable and a modification is made, the
        agent is responsible for setting this object to 0.0 if it
        cannot determine that the state is equal to a known state.

        An agent is not obligated to recognize and advertise all such
        registered states as it may not have knowledge of all states.
        Thus, a manager may encounter agents whose DirectoryID value
        is 0.0 even though the contents of the directory were equal to
        a registered state.

        Note that the contents of those tables includes the
        protocolDirLocalIndex and appLocalIndex values. In other
        words, these values can't be assigned randomly on each agent,
        but must be equal to values that are part of the known
        state. While it is possible for a manager to download
        application directory details using SNMP and to set the
        appropriate directoryID, the manager would need to have some
        scheme to ensure consistent values of LocalIndex variables
        from agent to agent. Such schemes are outside the scope of
        this specification.

        Application directory registrations are unique within an
        administrative domain.

        Typically these registrations will be made by an agent
        software developer who will set the application directory
        tables to a read-only state and assign a DirectoryID to that
        state. Thus, all agents running this software would share the
        same DirectoryID. As the application directory might change
        from one software release to the next, the developer may
        register different DirectoryID's for each software release.

        A customer could also create a site-wide application directory
        configuration and assign a DirectoryID to that configuration
        as long as consistent values of LocalIndex variables can be
        ensured.

        The value of this object must persist across reboots."
     ::= { apmMibObjects 3 }

-- APM HTTP Filter Table

-- The HTTP Filter Table creates virtual applications which measure the
-- performance of certain web pages  or sets of web pages. Some
-- circumstances where this is particularly useful are:
--
--      - An Intranet or ASP scenario where a business application is
--        running on one or more web pages or scripts.
```

```
--         (i.e., /expense/submit.cgi?employeeID=3426&...)
--       - A web-hosting scenario where one wants to measure the
--         service level for a particular customer
--       - An e-commerce scenario where the performance of certain
--         pages needs to be monitored more closely.
--         (i.e., shopping cart, shipping, credit card authorization)

apmHttpFilterTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmHttpFilterEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A table that creates virtual applications which measure the
        performance of certain web pages or sets of web pages.

        When an entry is added to this table, the agent will
        automatically create one or more entries in the
        apmAppDirTable (one for each responsivenessType it is
        capable of measuring).

        Note that when entries exist in this table some HTTP
        transactions will be summarized twice: in applications
        represented here as well as the HTTP application. If entries
        in this table overlap, these transactions may be summarized
        additional times.

        The contents of this table affect all reports and exceptions
        generated by this agent. Accordingly, modification of this
        table should be performed by a manager acting in the role of
        administrator. In particular, management software should not
        require or enforce particular configuration of this table - it
        should reflect the preferences of the site administrator, not
        the software author."
    ::= { apmMibObjects 4 }

apmHttpFilterEntry OBJECT-TYPE
    SYNTAX      ApmHttpFilterEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A virtual application which measure the performance of certain
        web pages or sets of web pages."
    INDEX { apmHttpFilterIndex }
    ::= { apmHttpFilterTable 1 }

ApmHttpFilterEntry ::= SEQUENCE {
    apmHttpFilterIndex              Unsigned32,
    apmHttpFilterAppLocalIndex      AppLocalIndex,
```

```
    apmHttpFilterServerProtocol     Unsigned32,
    apmHttpFilterServerAddress      ProtocolDirNetworkAddress,
    apmHttpFilterURLPath            OCTET STRING,
    apmHttpFilterMatchType          INTEGER,
    apmHttpFilterOwner              OwnerString,
    apmHttpFilterStorageType        StorageType,
    apmHttpFilterRowStatus          RowStatus
}

apmHttpFilterIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An index that uniquely identifies an entry in the
        apmHttpFilterTable."
    ::= { apmHttpFilterEntry 1 }

apmHttpFilterAppLocalIndex OBJECT-TYPE
    SYNTAX      AppLocalIndex
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The AppLocalIndex that represents HTTP transactions
        that match this entry.

        This object is read-only. A value is created by the agent from
        an unused AppLocalIndex value when this apmHttpFilterEntry is
        created."
    ::= { apmHttpFilterEntry 2 }

apmHttpFilterServerProtocol OBJECT-TYPE
    SYNTAX      Unsigned32 (1..2147483647)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The protocolDirLocalIndex value of the network level protocol
        of the apmHttpFilterServerAddress."
    ::= { apmHttpFilterEntry 3 }

apmHttpFilterServerAddress OBJECT-TYPE
    SYNTAX      ProtocolDirNetworkAddress
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This entry will only represent transactions coming from the
        network address specified in this object.
```

```
        This is represented as an octet string with
        specific semantics and length as identified
        by the associated apmHttpFilterServerProtocol object.

        If this object is the zero-length string, then this entry will
        match one of the addresses represented by the 'host' component
        of the associated apmHttpFilterURLPath object, where the
        format if a URL [9] is
        http://<host>:<port>/<path>?<searchpart>."
    ::= { apmHttpFilterEntry 4 }

apmHttpFilterURLPath OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..65535))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This entry will only represent HTTP transactions
        where the URL path component in the request matches this
        value. This value represents the requested path regardless of
        any substitution that the server might perform.

        Prior to the matching, the URL is stripped of any server
        address or DNS name and consists solely of the path name on
        that server.

        If the length of this object is zero, then this entry will
        match if the associated apmHttpFilterServerAddress match. If
        the length of that object is also zero, then this entry will
        match nothing.

        The value of the associated apmHttpFilterMatchType dictates
        the type of matching that will be attempted."
    ::= { apmHttpFilterEntry 5 }

apmHttpFilterMatchType OBJECT-TYPE
    SYNTAX      INTEGER {
                    exact(1),
                    stripTrailingSlash(2),
                    prefix(3)
                }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The matching algorithm used to compare the URL pathname.

        If the value is exact(1), then the pathname component will be
        compared with the associated apmHttpFilterURLPath and
        will only be associated with this entry if it matches exactly.
```

```
        If the value is stripTrailingSlash(2), then the pathname
        component will be compared with the associated
        apmHttpFilterURLPath and will only be associated with this
        entry if it matches exactly or if the pathname ends with a '/'
        symbol and matches apmHttpFilterURLPath if the '/' symbol is
        removed from the pathname. This option exists for those paths
        where an optional trailing slash is possible but for which a
        prefix match would be too broad.

        If the value is prefix(3), then the pathname component will be
        compared with the associated apmHttpFilterURLPath and will
        only be associated with this entry if the beginning of the
        pathname matches every octet of this value. Octets that extend
        beyond the length of this value are ignored."
    ::= { apmHttpFilterEntry 6 }

apmHttpFilterOwner 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."
    ::= { apmHttpFilterEntry 7 }

apmHttpFilterStorageType OBJECT-TYPE
    SYNTAX      StorageType
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The storage type of this apmHttpFilterEntry. If the value of
        this object is 'permanent', no objects in this row need to be
        writable."
    ::= { apmHttpFilterEntry 8 }

apmHttpFilterRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this apmHttpFilterEntry. No objects in this row
        may be modified while the row's status is 'active'."
    ::= { apmHttpFilterEntry 9 }

apmHttpIgnoreUnregisteredURLs OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
```

```
    DESCRIPTION
        "When true, APM measurements of HTTP transactions will only
        measure transactions relating to URLs that match a filter in
        the apmHttpFilterTable. Thus, measurements for the HTTP
        application will present aggregated statistics for
        URL-matching HTTP transactions and measurements for the HTTP
        GET application verb will present aggregated statistics for
        URL-matching HTTP GET transactions.

        This will be used in environments that wish to monitor only
        targeted URLs and to ignore large volumes of internet web
        browsing traffic.

        This object affects all APM reports and exceptions generated
        by this agent. Accordingly, modification of this object should
        be performed by a manager acting in the role of
        administrator. In particular, management software should not
        require or enforce particular configuration of this object -
        it should reflect the preferences of the site administrator,
        not the software author.

        The value of this object must persist across reboots."
    ::= { apmMibObjects 5 }

apmHttp4xxIsFailure OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "When true, this agent will recognize HTTP errors in the range
        of 400 through 499 and will treat them as unavailable
        transactions. When false or when this object isn't supported,
        they will be treated as successful transactions.

        This object allows such error pages to be tracked at the
        possible expense of having user typos treated as poor service
        on the part of the web server.

        This object affects all reports and exceptions generated by
        this agent. Accordingly, modification of this object should be
        performed by a manager acting in the role of administrator. In
        particular, management software should not require or enforce
        particular configuration of this object - it should reflect
        the preferences of the site administrator, not the software
        author.

        The value of this object must persist across reboots."
    ::= { apmMibObjects 6 }
```

```
-- The APM User-Defined Application Table

-- Many application protocols will never be registered with a
-- standards body (and thus included in a protocol directory standard)
-- because they are custom, in-house or proprietary
-- applications. Nevertheless, implementation strategies exist for
-- monitoring the end-user experience of these applications.
--
-- This read-only table provides a means for the agent to advertise
-- which user-defined applications it is monitoring and to associate
-- each with an AppLocalIndex value. It is an implementation-dependent
-- matter as to how the agent learns how to monitor these
-- applications.

apmUserDefinedAppTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmUserDefinedAppEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A table that advertises user-defined applications that the
        agent is measuring.

        The agent will automatically create one or more entries in the
        apmAppDirTable (one for each responsivenessType it is
        capable of measuring) for each entry in this table.

        Note that when entries exist in this table some
        transactions can be summarized more than once if there is
        overlap between applications defined here and applications
        defined in the protocol directory or in the httpFilter table."
    ::= { apmMibObjects 7 }

apmUserDefinedAppEntry OBJECT-TYPE
    SYNTAX      ApmUserDefinedAppEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A user-defined application that the agent is measuring, along
        with its AppLocalIndex assignment.

        The apmAppDirAppLocalIndex value in the index identifies
        the agent-assigned AppLocalIndex value for this user-defined
        application."
    INDEX { apmAppDirAppLocalIndex }
    ::= { apmUserDefinedAppTable 1 }

ApmUserDefinedAppEntry ::= SEQUENCE {
    apmUserDefinedAppParentIndex    Unsigned32,
```

```
    apmUserDefinedAppApplication    SnmpAdminString
}

apmUserDefinedAppParentIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The protocolDirLocalIndex value of the highest-layer
        protocol defined in the protocolDirTable that this
        application is a child of."
    ::= { apmUserDefinedAppEntry 1 }

apmUserDefinedAppApplication OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A human readable descriptive tag for this application."
    ::= { apmUserDefinedAppEntry 2 }

-- The APM Name Table

apmNameTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A client machine may have multiple addresses during a period
        of monitoring. The apmNameTable assigns a long-lived
        identifier to a client and records what addresses were
        assigned to that client for periods of time. Various
        implementation techniques exist for tracking this mapping but
        if an agent is unable to track client address mappings, it may
        map client identifiers to client addresses rather than to
        distinct client machines.

        A particular apmNameClientID should be a constant attribute of
        a particular client. When available, the agent may also record
        the machine name and/or user name which may be valuable for
        displaying to humans. The apmNameMachineName and
        apmNameUserName are relatively constant, changing only if
        these attributes actually change on the client.

        The agent will store a historical log of these entries, aging
        out old entries as the log becomes too large. Since this table
        contains information vital to the interpretation of other
        tables (e.g., the apmReportTable), the agent should ensure that
```

```
        the log doesn't age out entries that would be referenced by
        data in those tables.

        Note that an entry for a clientID is active from its
        StartTime until the StartTime of another entry (for the same
        clientID) that supersedes it, or 'now' if none supersede
        it. Therefore, if a clientID only has a single entry, it is by
        definition very new and should never be aged out. No entry for
        a clientID should be aged out unless it has been updated by a
        new entry for the client (i.e., with an updated address) and
        only if the new entry is 'old' enough.

        To determine how old is old enough, compute the maximum value
        of Interval * (NumReports + 1) of all entries in the
        apmReportControlTable (the '+ 1' is to allow a reasonable
        period of time for the report to be downloaded). Then take the
        larger of this value and the age in seconds of the oldest
        entry in the current transaction table. If an entry for a
        clientID is superseded by another entry whose StartTime is
        more than this many seconds ago, then the older entry may be
        deleted."
    ::= { apmMibObjects 8 }

apmNameEntry OBJECT-TYPE
    SYNTAX      ApmNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An entry in the APM name table. An entry exists for each
        period of time that a client has been associated with a
        particular address.

        The protocolDirLocalIndex value in the index identifies
        the network layer protocol for the ClientAddress for this
        entry.

        Note that some combinations of index values may result in an
        index that exceeds 128 sub-identifiers in length which exceeds
        the maximum for the SNMP protocol. Implementations should take
        care to avoid such combinations."
    INDEX { apmNameClientID,
            protocolDirLocalIndex, apmNameClientAddress,
            apmNameMappingStartTime }
    ::= { apmNameTable 1 }

ApmNameEntry ::= SEQUENCE {
    apmNameClientID                 RmonClientID,
    apmNameClientAddress            ProtocolDirNetworkAddress,
```

```
    apmNameMappingStartTime          DateAndTime,
    apmNameMachineName               SnmpAdminString,
    apmNameUserName                  SnmpAdminString
}

apmNameClientID OBJECT-TYPE
    SYNTAX      RmonClientID
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
         "A unique ID assigned to the machine represented by this
         mapping. This ID is assigned by the agent using an
         implementation-specific algorithm."
    ::= { apmNameEntry 1 }

apmNameClientAddress OBJECT-TYPE
    SYNTAX      ProtocolDirNetworkAddress (SIZE(1..255))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The network client address for this client when this mapping
        was active.

        This is represented as an octet string with specific semantics
        and length as identified by the protocolDirLocalIndex
        component of the index. This object may not be the zero length
        string.

        Since this object is an index variable, it is encoded in the
        index according to the index encoding rules.  For example, if
        the protocolDirLocalIndex component of the index indicates an
        encapsulation of ip, this object is encoded as a length octet
        of 4, followed by the 4 octets of the ip address, in network
        byte order. Care should be taken to avoid values of this
        object that, in conjunction with the other index variables,
        would result in an index longer than SNMP's maximum of 128
        subidentifiers."
    ::= { apmNameEntry 2 }

apmNameMappingStartTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The time that the agent first discovered this mapping
        as active."
    ::= { apmNameEntry 3 }
```

```
apmNameMachineName OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The human readable name of the client machine.

        If the client has no machine name or the agent is
        unable to learn the machine name, this object will be
        a zero-length string."
    ::= { apmNameEntry 4 }

apmNameUserName OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The human readable name of a human user using the client
        machine. If more than one user name are available
        simultaneously, it is an implementation-dependent matter as to
        which is used here. However, if the user name changes, this
        object should change to reflect that change.

        Non-human user names like 'root' or 'administrator' aren't
        intended as values for this object. If the client has no
        recorded user name or the agent is unable to learn a user
        name, this object will be a zero-length string."
    ::= { apmNameEntry 5 }

-- The APM Report Group

apmReportControlTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmReportControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Parameters that control the creation of a set of reports that
        aggregate application performance."
    ::= { apmMibObjects 9 }

apmReportControlEntry OBJECT-TYPE
    SYNTAX      ApmReportControlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the apmReportControlTable.

        An example of the indexing of this table is
```

```
        apmReportControlInterval.3"
    INDEX { apmReportControlIndex }
    ::= { apmReportControlTable 1 }

ApmReportControlEntry ::= SEQUENCE {
    apmReportControlIndex            Unsigned32,
    apmReportControlDataSource       DataSourceOrZero,
    apmReportControlAggregationType  TransactionAggregationType,
    apmReportControlInterval         Unsigned32,
    apmReportControlRequestedSize    Unsigned32,
    apmReportControlGrantedSize      Unsigned32,
    apmReportControlRequestedReports Unsigned32,
    apmReportControlGrantedReports   Unsigned32,
    apmReportControlStartTime        TimeStamp,
    apmReportControlReportNumber     Unsigned32,
    apmReportControlDeniedInserts    Counter32,
    apmReportControlDroppedFrames    Counter32,
    apmReportControlOwner            OwnerString,
    apmReportControlStorageType      StorageType,
    apmReportControlStatus           RowStatus
}


apmReportControlIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An index that uniquely identifies an entry in the
        apmReportControlTable.  Each such entry defines a unique
        report whose results are placed in the apmReportTable on
        behalf of this apmReportControlEntry."
    ::= { apmReportControlEntry 1 }

apmReportControlDataSource OBJECT-TYPE
    SYNTAX      DataSourceOrZero
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The source of the data for APM Reports generated on
        behalf of this apmReportControlEntry.

        If the measurement is being performed by a probe, this should
        be set to interface or port where data was received for
        analysis. If the measurement isn't being performed by a probe,
        this should be set to the primary interface over which the
        measurement is being performed. If the measurement isn't being
        performed by a probe and there is no primary interface or this
```

```
        information isn't known, this object should be set to 0.0.

        This object may not be modified if the associated
        apmReportControlStatus object is equal to active(1)."
    ::= { apmReportControlEntry 2 }

apmReportControlAggregationType OBJECT-TYPE
    SYNTAX      TransactionAggregationType
            --    INTEGER {
            --      flows(1),
            --      clients(2),
            --      servers(3),
            --      applications(4)
            --    }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The type of aggregation being performed for this set of
        reports.

        The metrics for a single transaction are the responsiveness of
        the transaction and whether the transaction succeeded (a
        boolean). When such metrics are aggregated in this MIB Module,
        these metrics are replaced by averages and distributions of
        responsiveness and availability. The metrics describing
        aggregates are constant no matter which type of aggregation is
        being performed. These metrics may be found in the
        apmReportTable.

        The flows(1) aggregation is the simplest. All transactions
        that share common application/server/client 3-tuples are
        aggregated together, resulting in a set of metrics for all
        such unique 3-tuples.

        The clients(2) aggregation results in somewhat more
        aggregation (i.e., fewer resulting records). All transactions
        that share common application/client tuples are aggregated
        together, resulting in a set of metrics for all such unique
        tuples.

        The servers(3) aggregation usually results in still more
        aggregation (i.e., fewer resulting records). All transactions
        that share common application/server tuples are aggregated
        together, resulting in a set of metrics for all such unique
        tuples.

        The applications(4) aggregation results in the most
        aggregation (i.e., the fewest resulting records). All
```

```
        transactions that share a common application are aggregated
        together, resulting in a set of metrics for all such unique
        applications.

        Note that it is not meaningful to aggregate applications, as
        different applications have widely varying characteristics.
        As a result, this set of aggregations is complete.

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

apmReportControlInterval OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "Seconds"
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The interval in seconds over which data is accumulated before
        being aggregated into a report in the apmReportTable.  All
        reports with the same apmReportControlIndex will be based on
        the same interval. This object must be greater than zero.

        Many users desire that these reports be synchronized to within
        seconds of the beginning of the hour because the results may
        be correlated more meaningfully to business behavior and so
        that data from multiple agents is aggregated over the same
        time periods. Thus management software may take extra effort
        to synchronize reports to the beginning of the hour and to one
        another. However, the agent must not allow reports to 'drift'
        over time as they will quickly become unsynchronized. In
        particular, if there is any fixed processing delay between
        reports, the reports should deduct this time from the interval
        so that reports don't drift.

        This object may not be modified if the associated
        apmReportControlStatus object is equal to active(1)."
    DEFVAL { 3600 }
    ::= { apmReportControlEntry 4 }

apmReportControlRequestedSize OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The number of entries requested to be allocated for each
        report generated on behalf of this entry."
    ::= { apmReportControlEntry 5 }
```

```
apmReportControlGrantedSize OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of entries per report the agent has allocated
        based on the requested amount in apmReportControlRequestedSize.
        Since multiple reports are saved, the total number of entries
        allocated will be this number multiplied by the value of
        apmReportControlGrantedReports, or 1 if that object doesn't
        exist.

        When the associated apmReportControlRequestedSize object is
        created or modified, the agent should set this object as
        closely to the requested value as is possible for the
        particular implementation and available resources. When
        considering resources available, the agent must consider its
        ability to allocate this many entries for all reports.

        Note that while the actual number of entries stored in the
        reports may fluctuate due to changing conditions, the agent
        must continue to have storage available to satisfy the full
        report size for all reports when necessary. Further, the agent
        must not lower this value except as a result of a set to the
        associated apmReportControlRequestedSize object."
    ::= { apmReportControlEntry 6 }

apmReportControlRequestedReports OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The number of saved reports requested to be allocated on
        behalf of this entry."
    ::= { apmReportControlEntry 7 }

apmReportControlGrantedReports OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of saved reports the agent has allocated
        based on the requested amount in
        apmReportControlRequestedReports. Since each report can have
        many entries, the total number of entries allocated will be
        this number multiplied by the value of
        apmReportControlGrantedSize, or 1 if that object doesn't
        exist.
```

```
        When the associated apmReportControlRequestedReports object is
        created or modified, the agent should set this object as
        closely to the requested value as is possible for the
        particular implementation and available resources. When
        considering resources available, the agent must consider its
        ability to allocate this many reports each with the number of
        entries represented by apmReportControlGrantedSize, or 1 if
        that object doesn't exist.

        Note that while the storage required for each report may
        fluctuate due to changing conditions, the agent must continue
        to have storage available to satisfy the full report size for
        all reports when necessary. Further, the agent must not lower
        this value except as a result of a set to the associated
        apmReportControlRequestedSize object."
    ::= { apmReportControlEntry 8 }

apmReportControlStartTime OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of sysUpTime when the system began processing the
        report in progress. Note that the report in progress is not
        available.

        This object may be used by the management station to figure
        out the start time for all previous reports saved for this
        apmReportControlEntry, as reports are started at fixed
        intervals."
    ::= { apmReportControlEntry 9 }

apmReportControlReportNumber OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of the report in progress. When an
        apmReportControlEntry is activated, the first report will be
        numbered one."
    ::= { apmReportControlEntry 10 }

apmReportControlDeniedInserts OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of failed attempts to add an entry to reports for
```

```
        this apmReportControlEntry because the number of entries
        would have exceeded apmReportControlGrantedSize.

        This number is valuable in determining if enough entries have
        been allocated for reports in light of fluctuating network
        usage. Note that since an entry that is denied will often be
        attempted again, this number will not predict the exact number
        of additional entries needed, but can be used to understand
        the relative magnitude of the problem.

        Also note that there is no ordering specified for the entries
        in the report, thus there are no rules for which entries will
        be omitted when not enough entries are available. As a
        consequence, the agent is not required to delete 'least
        valuable' entries first."
    ::= { apmReportControlEntry 11 }

apmReportControlDroppedFrames OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
       "The total number of frames which were received by the agent
        and therefore not accounted for in the *StatsDropEvents, but
        for which the agent chose not to count for this entry for
        whatever reason.  Most often, this event occurs when the agent
        is out of some resources and decides to shed load from this
        collection.

        This count does not include packets that were not counted
        because they had MAC-layer errors.

        This counter is only relevant if this apm report is based on
        a data source whose collection methodology is based on
        analyzing network traffic.

        Note that if the apmReportTables are inactive because no
        applications are enabled in the application directory, this
        value should be 0.

        Note that, unlike the dropEvents counter, this number is the
        exact number of frames dropped."
    ::= { apmReportControlEntry 12 }

apmReportControlOwner 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."
    ::= { apmReportControlEntry 13 }

apmReportControlStorageType OBJECT-TYPE
    SYNTAX      StorageType
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The storage type of this apmReportControlEntry. If the value
        of this object is 'permanent', no objects in this row need to
        be writable."
    ::= { apmReportControlEntry 14 }

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

        An entry may not exist in the active state unless all
        objects in the entry have an appropriate value. The only
        objects in the entry that may be modified while the entry is
        in the active state are apmReportControlRequestedSize and
        apmReportControlRequestedReports.

        If this object is not equal to active(1), all
        associated entries in the apmReportTable shall be deleted
        by the agent."
    ::= { apmReportControlEntry 15 }

-- The APM Report Table

apmReportTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmReportEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The data resulting from aggregated APM reports. Consult the
        definition of apmReportControlAggregationType for the
        definition of the various types of aggregations."
    ::= { apmMibObjects 10 }

apmReportEntry OBJECT-TYPE
    SYNTAX      ApmReportEntry
    MAX-ACCESS  not-accessible
```

```
    STATUS      current
    DESCRIPTION
        "A conceptual row in the apmReportTable.
        The apmReportControlIndex value in the index identifies the
        apmReportControlEntry on whose behalf this entry was created.
        The apmReportIndex value in the index identifies which report
        (in the series of reports) this entry is a part of.
        The apmAppDirAppLocalIndex value in the index identifies
        the common application of the transactions aggregated in this
        entry.
        The apmAppDirResponsivenessType value in the index
        identifies the type of responsiveness metric reported by
        this entry and uniquely identifies this entry when more
        than one responsiveness metric is measured for a flow.
        Entries will only exist in this table for those
        combinations of AppLocalIndex and ResponsivenessType
        that are configured 'on(1)'.
        The protocolDirLocalIndex value in the index identifies
        the network layer protocol of the apmReportServerAddress.
        When the associated apmReportControlAggregationType value is
        equal to applications(4) or clients(2), this
        protocolDirLocalIndex value will equal 0.
        The apmReportServerAddress value in the index identifies the
        network layer address of the server in transactions aggregated
        in this entry.
        The apmNameClientID value in the index identifies the
        client in transactions aggregated in this entry. If the
        associated apmReportControlAggregationType is equal to
        applications(4) or servers(3), then this protocolDirLocalIndex
        value will equal 0.

        An example of the indexing of this entry is
        apmReportTransactionCount.3.15.3.1.8.4.192.168.1.2.3232235788

        Note that some combinations of index values may result in an
        index that exceeds 128 sub-identifiers in length which exceeds
        the maximum for the SNMP protocol. Implementations should take
        care to avoid such combinations."
    INDEX { apmReportControlIndex, apmReportIndex,
            apmAppDirAppLocalIndex,
            apmAppDirResponsivenessType,
            protocolDirLocalIndex, apmReportServerAddress,
            apmNameClientID }
    ::= { apmReportTable 1 }

ApmReportEntry ::= SEQUENCE {
    apmReportIndex                  Unsigned32,
    apmReportServerAddress          ProtocolDirNetworkAddress,
```

```
    apmReportTransactionCount       Unsigned32,
    apmReportSuccessfulTransactions Unsigned32,
    apmReportResponsivenessMean     Unsigned32,
    apmReportResponsivenessMin      Unsigned32,
    apmReportResponsivenessMax      Unsigned32,
    apmReportResponsivenessB1       Unsigned32,
    apmReportResponsivenessB2       Unsigned32,
    apmReportResponsivenessB3       Unsigned32,
    apmReportResponsivenessB4       Unsigned32,
    apmReportResponsivenessB5       Unsigned32,
    apmReportResponsivenessB6       Unsigned32,
    apmReportResponsivenessB7       Unsigned32
}

apmReportIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The value of apmReportControlReportNumber for the report to
        which this entry belongs."
    ::= { apmReportEntry 1 }

apmReportServerAddress OBJECT-TYPE
    SYNTAX      ProtocolDirNetworkAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The network server address for this apmReportEntry.

        This is represented as an octet string with
        specific semantics and length as identified
        by the protocolDirLocalIndex component of the index.

        Since this object is an index variable, it is encoded in the
        index according to the index encoding rules.  For example, if
        the protocolDirLocalIndex indicates an encapsulation of ip,
        this object is encoded as a length octet of 4, followed by the
        4 octets of the ip address, in network byte order. Care
        should be taken to avoid values of this object that, in
        conjunction with the other index variables, would result in an
        index longer than SNMP's maximum of 128 subidentifiers.

        If the associated apmReportControlAggregationType is equal to
        applications(4) or clients(2), then this object will be a null
        string and will be encoded simply as a length octet of 0."
    ::= { apmReportEntry 2 }
```

```
apmReportTransactionCount OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of transactions aggregated into this record."
    ::= { apmReportEntry 3 }

apmReportSuccessfulTransactions OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of successful transactions aggregated into
        this record."
    ::= { apmReportEntry 4 }

apmReportResponsivenessMean OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The arithmetic mean of the responsiveness metrics for all
        successful transactions aggregated into this record."
    ::= { apmReportEntry 5 }

apmReportResponsivenessMin OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The minimum of the responsiveness metrics for all
        successful transactions aggregated into this record."
    ::= { apmReportEntry 6 }

apmReportResponsivenessMax OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The maximum of the responsiveness metrics for all
        successful transactions aggregated into this record."
    ::= { apmReportEntry 7 }

-- Note that when updating a report entry, a transaction will not be
-- counted in more than 1 bucket in an entry. It will be counted in
-- the first bucket that matches, starting with Bucket 1 (B1). Note
-- that if a transaction matches 2 application types, it will update
```

```
-- one bucket in each of 2 entries in this table.

apmReportResponsivenessB1 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness was less than boundary1 value for
        this application."
    ::= { apmReportEntry 8 }

apmReportResponsivenessB2 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness did not fall into Bucket 1 and was
        greater than or equal to the boundary1 value for this
        application and less than the boundary2 value for this
        application."
    ::= { apmReportEntry 9 }

apmReportResponsivenessB3 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness did not fall into Bucket 1 or 2
        and as greater than or equal to the boundary2 value for this
        application and less than the boundary3 value for this
        application."
    ::= { apmReportEntry 10 }

apmReportResponsivenessB4 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness did not fall into Buckets 1
        through 3 and was greater than or equal to the boundary3 value
        for this application and less than the boundary4 value for
        this application."
    ::= { apmReportEntry 11 }
```

```
apmReportResponsivenessB5 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness did not fall into Buckets 1
        through 4 and was greater than or equal to the boundary4 value
        for this application and less than the boundary5 value for
        this application."
    ::= { apmReportEntry 12 }

apmReportResponsivenessB6 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness did not fall into Buckets 1
        through 5 and was greater than or equal to the
        boundary5 value for this application and less than the
        boundary6 value for this application."
    ::= { apmReportEntry 13 }

apmReportResponsivenessB7 OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of successful transactions aggregated into this
        record whose responsiveness did not fall into Buckets 1
        through 6 and was greater than or equal to the boundary6 value
        for this application."
    ::= { apmReportEntry 14 }

-- APM Transaction Table

apmTransactionTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmTransactionEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains transactions that are currently running
        or have recently finished."
    ::= { apmMibObjects 11 }

apmTransactionEntry OBJECT-TYPE
    SYNTAX      ApmTransactionEntry
```

```
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the apmTransactionTable.

        The apmAppDirAppLocalIndex value in the index identifies
        the application of the transaction represented by this entry.
        The apmAppDirResponsivenessType value in the index
        identifies the type of responsiveness metric reported by
        this entry and uniquely identifies this entry when more
        than one responsiveness metric is measured for a flow.
        Entries will only exist in this table for those
        combinations of AppLocalIndex and ResponsivenessType
        that are configured 'on(1)'.
        The protocolDirLocalIndex value in the index identifies
        the network layer protocol of the apmTransactionServerAddress.
        The apmTransactionServerAddress value in the index identifies
        the network layer address of the server in the transaction
        represented by this entry.
        The apmNameClientID value in the index identifies the
        client in the transaction represented by this entry.

        An example of the indexing of this entry is
        apmTransactionCount.3.1.8.4.192.168.1.2.3232235788.2987

        Note that some combinations of index values may result in an
        index that exceeds 128 sub-identifiers in length which exceeds
        the maximum for the SNMP protocol. Implementations should take
        care to avoid such combinations."
    INDEX { apmAppDirAppLocalIndex,
            apmAppDirResponsivenessType,
            protocolDirLocalIndex, apmTransactionServerAddress,
            apmNameClientID, apmTransactionID }
    ::= { apmTransactionTable 1 }

ApmTransactionEntry ::= SEQUENCE {
    apmTransactionServerAddress      ProtocolDirNetworkAddress,
    apmTransactionID                 Unsigned32,
    apmTransactionResponsiveness     Unsigned32,
    apmTransactionAge                TimeInterval,
    apmTransactionSuccess            TruthValue
}

apmTransactionServerAddress OBJECT-TYPE
    SYNTAX      ProtocolDirNetworkAddress (SIZE (1..255))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
        "The network server address for this apmTransactionEntry.

        This is represented as an octet string with specific semantics
        and length as identified by the protocolDirLocalIndex
        component of the index. This object may not be the zero length
        string.

        For example, if the protocolDirLocalIndex indicates an
        encapsulation of ip, this object is encoded as a length octet
        of 4, followed by the 4 octets of the ip address, in network
        byte order. Care should be taken to avoid values of this
        object that, in conjunction with the other index variables,
        would result in an index longer than SNMP's maximum of 128
        subidentifiers."
    ::= { apmTransactionEntry 1 }

apmTransactionID OBJECT-TYPE
    SYNTAX      Unsigned32 (0..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A unique value for this transaction amongst other
        transactions sharing the same application layer protocol and
        server and client addresses. Implementations may choose to use
        the value of the client's source port, when possible."
    ::= { apmTransactionEntry 2 }

apmTransactionResponsiveness OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The current value of the responsiveness metric for this
        transaction. If this transaction has completed, the final
        value of the metric will be available.

        Note that this value may change over the lifetime of the
        transaction and it is the final value of this metric that is
        recorded as the responsiveness of the transaction for use in
        other APM MIB functions."
    ::= { apmTransactionEntry 3 }

apmTransactionAge OBJECT-TYPE
    SYNTAX      TimeInterval
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "If this transaction is still executing, this value shall be
```

```
        the length of time since it was started. If it has completed,
        this value shall be the length of time it was executing."
    ::= { apmTransactionEntry 4 }

apmTransactionSuccess OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The success of this transaction up to this time. Once a
        transaction has been marked as failed, it cannot move back
        into the successful state."
    ::= { apmTransactionEntry 5 }

apmTransactionsRequestedHistorySize OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The maximum number of completed transactions desired to be
        retained in the apmTransactionTable. If the agent doesn't have
        enough resources to retain this many, it will retain as many as
        possible. Regardless of this value, the agent must attempt to
        keep records for all current transactions it is monitoring.

        The value of this object must persist across reboots."
    ::= { apmMibObjects 12 }

-- The APM Exception table
-- The APM Exception Table creates filters so that a management
-- station can get immediate notification of a transaction that has
-- had poor availability or responsiveness.
--
-- This function is particularly helpful in unaggregated situations
-- where the numbers of agents is relatively high and the transaction
-- rate per agent is relatively low (such as agents for desktops or
-- dedicated to small workgroups). Polling agents in such an
-- environment would either cause scalability problems (high rate) or
-- lead to long notification delays (low rate).


apmExceptionTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ApmExceptionEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table creates filters so that a management station can
        get immediate notification of a transaction that has had poor
```

```
        availability or responsiveness.

        Each apmExceptionEntry is associated with a particular type of
        transaction and is applied to all transactions of that
        type. Multiple apmExceptionEntries may be associated with a
        particular type of transaction. A transaction type is
        identified by the value of the apmAppDirAppLocalIndex
        component of the index.

        Because the quality of a transaction is not known until it is
        completed, these thresholds are only applied after the
        transaction has completed."
    ::= { apmMibObjects 13 }

apmExceptionEntry OBJECT-TYPE
    SYNTAX      ApmExceptionEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in the apmExceptionTable.

        The apmAppDirAppLocalIndex value in the index identifies
        the application this entry will monitor.
        The apmAppDirResponsivenessType value in the index
        identifies the type of responsiveness metric this entry will
        monitor."

    INDEX { apmAppDirAppLocalIndex,
            apmAppDirResponsivenessType, apmExceptionIndex }
    ::= { apmExceptionTable 1 }

ApmExceptionEntry ::= SEQUENCE {
    apmExceptionIndex                       Unsigned32,
    apmExceptionResponsivenessComparison    INTEGER,
    apmExceptionResponsivenessThreshold     Unsigned32,
    apmExceptionUnsuccessfulException       INTEGER,
    apmExceptionResponsivenessEvents        Counter32,
    apmExceptionUnsuccessfulEvents          Counter32,
    apmExceptionOwner                       OwnerString,
    apmExceptionStorageType                 StorageType,
    apmExceptionStatus                      RowStatus
}

apmExceptionIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
        "An index that uniquely identifies an entry in the
        apmExceptionTable amongst other entries with equivalent index
        values for apmAppDirAppLocalIndex and
        apmAppDirResponsivenessType. Each such entry sets up
        thresholds for a particular measurement of a particular
        application."
    ::= { apmExceptionEntry 1 }

apmExceptionResponsivenessComparison OBJECT-TYPE
    SYNTAX      INTEGER {
                    none(1),
                    greater(2),
                    less(3)
                }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "If this value is greater(2) or less(3), the associated
        apmExceptionResponsivenessThreshold will be compared to this
        value and an exception will be created if the responsiveness
        is greater than the threshold (greater(2)) or less than the
        threshold (less(3))."
    ::= { apmExceptionEntry 2 }

apmExceptionResponsivenessThreshold OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The threshold that responsiveness metrics are compared to."
    ::= { apmExceptionEntry 3 }

apmExceptionUnsuccessfulException OBJECT-TYPE
    SYNTAX      INTEGER {
                    off(1),
                    on(2)
                }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "If this value is on(2), an exception will be created if a
        transaction of the associated type is unsuccessful."
    ::= { apmExceptionEntry 4 }

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

```
    DESCRIPTION
        "The total number of responsiveness exceptions generated. This
        counter will be incremented even if no notification was sent
        due to notifications not being configured or due to exceeding
        the apmNotificationMaxRate value."
    ::= { apmExceptionEntry 5 }

apmExceptionUnsuccessfulEvents OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of unsuccessful exceptions generated. This
        counter will be incremented even if no notification was sent
        due to notifications not being configured or due to exceeding
        the apmNotificationMaxRate value."
    ::= { apmExceptionEntry 6 }

apmExceptionOwner 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."
    ::= { apmExceptionEntry 7 }

apmExceptionStorageType OBJECT-TYPE
    SYNTAX     StorageType
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
        "The storage type of this apmReportControlEntry. If the value
        of this object is 'permanent', no objects in this row need to
        be writable."
    ::= { apmExceptionEntry 8 }

apmExceptionStatus OBJECT-TYPE
    SYNTAX     RowStatus
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
        "The status of this apmExceptionEntry. The only objects in the
        entry that may be modified while the entry is in the active
        state are apmExceptionResponsivenessComparison,
        apmExceptionResponsivenessThreshold and
        apmExceptionUnsuccessfulException."
    ::= { apmExceptionEntry 9 }
```

```
apmThroughputExceptionMinTime OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "seconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Because the responsiveness for throughput-oriented
        transactions is divided by the elapsed time, it can be very
        sensitive to short-term performance variations for
        transactions that take a short period of time. For example,
        when downloading a very short file, a single dropped packet
        could double or triple the total response time.

        Further, throughput is usually examined for applications that
        transfer a lot of data, and when doing so it is helpful to
        conceptualize transaction costs that are proportional to the
        amount of data separately from those costs that are relatively
        fixed (i.e., independent of the amount of data).  For very
        short transactions, these fixed transaction costs (handshake,
        setup time, authentication, round-trip time) may dominate the
        total response time for the transaction, resulting in
        throughput measurements that aren't really proportional to the
        network's, server's and client's combined data throughput
        capability.

        This object controls the minimum number of seconds that an
        throughput-based transaction must exceed before an exception
        can be generated for it. If this object is set to zero, then
        all throughput-based transactions are candidates for
        exceptions.

        The value of this object must persist across reboots."
    DEFVAL     { 10 }
    ::= { apmMibObjects 14 }

apmNotificationMaxRate OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The maximum number of notifications that can be generated
        from this agent by the apmExceptionTable in any 60 second
        period.

        The value of this object must persist across reboots."
    DEFVAL { 1 }
    ::= { apmMibObjects 15 }
```

```
-- APM Notifications

apmNotifications OBJECT IDENTIFIER ::= { apm 0 }

apmTransactionResponsivenessAlarm NOTIFICATION-TYPE
    OBJECTS     { apmExceptionResponsivenessThreshold,
                  apmTransactionResponsiveness }
    STATUS      current
    DESCRIPTION
        "Notification sent when a transaction exceeds a threshold
        defined in the apmException table. The index of the
        included apmExceptionResponsivenessThreshold object identifies
        the apmExceptionEntry that specified the threshold. The
        apmTransactionResponsiveness variable identifies the actual
        transaction and its responsiveness.

        Agent implementors are urged to include additional data
        objects in the alarm that may explain the reason for the
        alarm. It is helpful to include such data in the alarm because
        it describes the situation at the time the alarm was
        generated, where polls after the fact may not provide
        meaningful information. Examples of such information are CPU
        load, memory utilization, network utilization, and transaction
        statistics."
    ::= { apmNotifications 1 }

apmTransactionUnsuccessfulAlarm NOTIFICATION-TYPE
    OBJECTS     { apmExceptionResponsivenessThreshold }
    STATUS      current
    DESCRIPTION
        "Notification sent when a transaction is unsuccessful.
        The index of the included apmExceptionResponsivenessThreshold
        object identifies both the type of the transaction that caused
        this notification as well as the apmExceptionEntry that
        specified the threshold.

        Agent implementors are urged to include additional data
        objects in the alarm that may explain the reason for the
        alarm. It is helpful to include such data in the alarm because
        it describes the situation at the time the alarm was
        generated, where polls after the fact may not provide
        meaningful information. Examples of such information are CPU
        load, memory utilization, network utilization, and transaction
        statistics."
    ::= { apmNotifications 2 }

apmCompliance MODULE-COMPLIANCE
    STATUS  current
```

```
    DESCRIPTION
        "Describes the requirements for conformance to
        the APM MIB"
    MODULE  -- this module
        MANDATORY-GROUPS { apmAppDirGroup, apmReportGroup }

        GROUP apmUserDefinedApplicationsGroup
          DESCRIPTION
              "Implementation of the apmUserDefinedApplicationsGroup
              is optional."

        GROUP apmTransactionGroup
          DESCRIPTION
              "Implementation of the apmTransactionGroup is optional."

        GROUP apmExceptionGroup
          DESCRIPTION
              "Implementation of the apmExceptionGroup is optional."

        GROUP apmNotificationGroup
          DESCRIPTION
              "Implementation of the apmNotificationGroup is optional."

    ::= { apmCompliances 1 }

apmAppDirGroup OBJECT-GROUP
    OBJECTS { apmAppDirConfig,
              apmAppDirResponsivenessBoundary1,
              apmAppDirResponsivenessBoundary2,
              apmAppDirResponsivenessBoundary3,
              apmAppDirResponsivenessBoundary4,
              apmAppDirResponsivenessBoundary5,
              apmAppDirResponsivenessBoundary6,
              apmBucketBoundaryLastChange, apmAppDirID,
              apmNameMachineName, apmNameUserName }
    STATUS  current
    DESCRIPTION
        "The APM MIB directory of applications and application verbs."
    ::=  { apmGroups 1 }

apmUserDefinedApplicationsGroup OBJECT-GROUP
    OBJECTS {     apmHttpFilterAppLocalIndex,
                  apmHttpFilterServerProtocol,
                  apmHttpFilterServerAddress, apmHttpFilterURLPath,
                  apmHttpFilterMatchType, apmHttpFilterOwner,
                  apmHttpFilterStorageType, apmHttpFilterRowStatus,
                  apmHttpIgnoreUnregisteredURLs, apmHttp4xxIsFailure,
                  apmUserDefinedAppParentIndex,
```

```
                apmUserDefinedAppApplication }
    STATUS  current
    DESCRIPTION
        "Objects used for creating and managing user-defined
        applications."
    ::= { apmGroups 2 }

apmReportGroup OBJECT-GROUP
    OBJECTS { apmReportControlDataSource,
              apmReportControlAggregationType,
              apmReportControlInterval,
              apmReportControlRequestedSize,
              apmReportControlGrantedSize,
              apmReportControlRequestedReports,
              apmReportControlGrantedReports,
              apmReportControlStartTime,
              apmReportControlReportNumber,
              apmReportControlDeniedInserts,
              apmReportControlDroppedFrames,
              apmReportControlOwner,
              apmReportControlStorageType,
              apmReportControlStatus,
              apmReportTransactionCount,
              apmReportSuccessfulTransactions,
              apmReportResponsivenessMean,
              apmReportResponsivenessMin,
              apmReportResponsivenessMax,
              apmReportResponsivenessB1,
              apmReportResponsivenessB2,
              apmReportResponsivenessB3,
              apmReportResponsivenessB4,
              apmReportResponsivenessB5,
              apmReportResponsivenessB6,
              apmReportResponsivenessB7 }
    STATUS  current
    DESCRIPTION
        "The apm report group controls the creation and retrieval of
        reports that aggregate application performance."
    ::=  { apmGroups 3 }

apmTransactionGroup OBJECT-GROUP
    OBJECTS { apmTransactionResponsiveness,
              apmTransactionAge, apmTransactionSuccess,
              apmTransactionsRequestedHistorySize }
    STATUS  current
    DESCRIPTION
        "The apm transaction group contains statistics for
        individual transactions."
```

```
    ::=  { apmGroups 4 }

apmExceptionGroup OBJECT-GROUP
    OBJECTS { apmExceptionResponsivenessComparison,
              apmExceptionResponsivenessThreshold,
              apmExceptionUnsuccessfulException,
              apmExceptionResponsivenessEvents,
              apmExceptionUnsuccessfulEvents,
              apmExceptionOwner, apmExceptionStorageType,
              apmExceptionStatus, apmThroughputExceptionMinTime,
              apmNotificationMaxRate }
    STATUS  current
    DESCRIPTION
        "The apm exception group causes notifications to be sent
        whenever transactions are detected that had poor availability
        or responsiveness."
    ::=  { apmGroups 5 }

apmNotificationGroup NOTIFICATION-GROUP
    NOTIFICATIONS { apmTransactionResponsivenessAlarm,
                    apmTransactionUnsuccessfulAlarm }
    STATUS        current
    DESCRIPTION
        "Notifications sent by an APM MIB agent."
    ::= { apmGroups 6 }

END
```

4. Security Considerations

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

Specifically, most of the read-write and read-create objects in this MIB module may be used to configure an agent to reveal network addresses, application usage information and conversation statistics that may be considered sensitive in some environments.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

Specifically, this MIB contains network addresses, machines names, user names, application usage information, and conversation statistics. Data of this nature should be considered sensitive and the privacy of the users from whom it was gathered protected. Administrators should restrict read access to this data to specifically authorized individuals or agents that recognize the privacy implications of its release. In situations where read access to this data cannot be restricted, it should not be gathered.

Systems that implement the objects in this MIB module have the capability of measuring the time taken to execute transactions. Depending on the transaction type, some or all of this transaction time may be associated with the time taken to perform security calculations. Such data may help an attacker to use timing attacks to extract secrets from the systems involved in the transactions. See [10] for more information.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [8], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

5. References

5.1. Normative References

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5.2. Informative References

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6. Author’s Address

Steven Waldbusser
EMail: waldbusser@nextbeacon.com

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