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\[5\] 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:

<table>
<thead>
<tr>
<th>Application</th>
<th>Client</th>
<th>Server</th>
<th>Successful</th>
<th>Responsiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>Jim</td>
<td>Sales</td>
<td>1</td>
<td>6 sec.</td>
</tr>
<tr>
<td>SAP/R3</td>
<td>Jane</td>
<td>Finance</td>
<td>1</td>
<td>17 sec.</td>
</tr>
<tr>
<td>HTTP</td>
<td>Joe</td>
<td>HR</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>FTP</td>
<td>Jim</td>
<td>FTP</td>
<td>1</td>
<td>212 Kbps</td>
</tr>
<tr>
<td>HTTP</td>
<td>Joe</td>
<td>HR</td>
<td>1</td>
<td>25 sec.</td>
</tr>
<tr>
<td>RealVideo</td>
<td>Joe</td>
<td>Videoconf</td>
<td>1</td>
<td>100.0%</td>
</tr>
<tr>
<td>HTTP</td>
<td>Jane</td>
<td>HR</td>
<td>1</td>
<td>5 sec.</td>
</tr>
</tbody>
</table>

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):

```
<table>
<thead>
<tr>
<th>Application</th>
<th>Count</th>
<th>Successful</th>
<th>ResponsivenessMean</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>4</td>
<td>3</td>
<td>12 sec.</td>
</tr>
<tr>
<td>SAP/R3</td>
<td>1</td>
<td>1</td>
<td>17 sec.</td>
</tr>
<tr>
<td>FTP</td>
<td>1</td>
<td>1</td>
<td>212 Kbps.</td>
</tr>
<tr>
<td>RealVideo</td>
<td>1</td>
<td>1</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
```

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 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 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:

<table>
<thead>
<tr>
<th>Actual Transactions:</th>
<th>#</th>
<th>App</th>
<th>Client</th>
<th>Server</th>
<th>Successful</th>
<th>Responsiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1</td>
<td>HTTP</td>
<td>Jim</td>
<td>CallCtr</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>2</td>
<td>HTTP</td>
<td>Jim</td>
<td>HR</td>
<td>Y</td>
<td>12 sec.</td>
</tr>
<tr>
<td>#3</td>
<td>3</td>
<td>HTTP</td>
<td>Jim</td>
<td>Sales</td>
<td>Y</td>
<td>7 sec.</td>
</tr>
<tr>
<td>#4</td>
<td>4</td>
<td>HTTP</td>
<td>Jim</td>
<td>CallCtr</td>
<td>Y</td>
<td>5 sec.</td>
</tr>
<tr>
<td>#5</td>
<td>5</td>
<td>Email</td>
<td>Jim</td>
<td>Pop3</td>
<td>Y</td>
<td>12 sec.</td>
</tr>
<tr>
<td>#6</td>
<td>6</td>
<td>HTTP</td>
<td>Jane</td>
<td>CallCtr</td>
<td>Y</td>
<td>3 sec.</td>
</tr>
<tr>
<td>#7</td>
<td>7</td>
<td>SAP/R3</td>
<td>Jane</td>
<td>Finance</td>
<td>Y</td>
<td>19 sec.</td>
</tr>
<tr>
<td>#8</td>
<td>8</td>
<td>Email</td>
<td>Jane</td>
<td>Pop3</td>
<td>Y</td>
<td>16 sec.</td>
</tr>
<tr>
<td>#9</td>
<td>9</td>
<td>HTTP</td>
<td>Joe</td>
<td>HR</td>
<td>Y</td>
<td>18 sec.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Flow Aggregation:</th>
<th>App</th>
<th>Client</th>
<th>Server</th>
<th>Count</th>
<th>Successful</th>
<th>Rsp Mean</th>
<th>Rsp Min</th>
<th>Rsp Max</th>
<th>RspB1</th>
<th>RspB2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>Jim</td>
<td>CallCtr</td>
<td></td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>HTTP</td>
<td>Jim</td>
<td>HR</td>
<td></td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HTTP</td>
<td>Jim</td>
<td>Sales</td>
<td></td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Email</td>
<td>Jim</td>
<td>Pop3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HTTP</td>
<td>Jane</td>
<td>CallCtr</td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SAP/R3</td>
<td>Jane</td>
<td>Finance</td>
<td></td>
<td>1</td>
<td>1</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Email</td>
<td>Jane</td>
<td>Pop3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HTTP</td>
<td>Joe</td>
<td>HR</td>
<td></td>
<td>1</td>
<td>1</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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

The clients 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:

<table>
<thead>
<tr>
<th>App</th>
<th>Client</th>
<th>Count</th>
<th>Successful</th>
<th>Rsp</th>
<th>Rsp</th>
<th>Rsp</th>
<th>RspB1</th>
<th>RspB2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>Jim</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>12</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Email</td>
<td>Jim</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HTTP</td>
<td>Jane</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SAP/R3</td>
<td>Jane</td>
<td>1</td>
<td>1</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Email</td>
<td>Jane</td>
<td>1</td>
<td>1</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HTTP</td>
<td>Joe</td>
<td>1</td>
<td>1</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>App</th>
<th>Server</th>
<th>Count</th>
<th>Successful</th>
<th>Rsp</th>
<th>Rsp</th>
<th>Rsp</th>
<th>RspB1</th>
<th>RspB2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>CallCtr</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>HTTP</td>
<td>HR</td>
<td>2</td>
<td>2</td>
<td>15</td>
<td>12</td>
<td>18</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>HTTP</td>
<td>Sales</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Email</td>
<td>Pop3</td>
<td>2</td>
<td>2</td>
<td>14</td>
<td>12</td>
<td>16</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>SAP/R3</td>
<td>Finance</td>
<td>1</td>
<td>1</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>App</th>
<th>Count</th>
<th>Successful</th>
<th>Rsp</th>
<th>Rsp</th>
<th>Rsp</th>
<th>RspB1</th>
<th>RspB2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>18</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Email</td>
<td>2</td>
<td>2</td>
<td>14</td>
<td>12</td>
<td>16</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>SAP/R3</td>
<td>1</td>
<td>1</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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`.

```
+-----------------------+      +-----------+
|                       |      |           |
| apmReportControlTable |      |           |
+-----------------------+      +-----------+
|                       |      |           |
| +---------------------+      |           |
| |                     |      |           |
| | apmReport            |      |           |
| +---------------------+      |           |
| apmReport             +------|Thu Mar 30 12-1PM      |
|                       +------|               |
|                       +------|CLNT SERV PROT stats |
|                       +------|Joe  News HTTP data  |
|                       +------|Jan  POP POP3 data   |
|                       +------|Jan  POP SMTP data   |
|                       +------|Bob  HR PSOFT data   |
|                       +------|...                   |
|                       +------|...                   |
+-----------------------+
```

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"
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 }
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 Waldbusser Standards Track [Page 19]
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
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.
--      - 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
 appliedTable."
::= { 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

::= { 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 supersedes
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

**TRANSLATION**

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.

```plaintext
::= { 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."

```plaintext
::= { 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."

```plaintext
::= { 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

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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


5.2. Informative References


6. Author’s Address

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