

Network Working Group
Request for Comments: 4150
Category: Standards Track

R. Dietz
Hifn, Inc.
R. Cole
JHU/APL
August 2005

Transport Performance Metrics MIB

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

Copyright (C) The Internet Society (2005).

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects used for monitoring selectable performance metrics and statistics derived from the monitoring of network packets and sub-application level transactions. The metrics can be defined through reference to existing IETF, ITU, and other standards organizations' documents. The monitoring covers both passive and active traffic generation sources.

Table of Contents

1. The Internet-Standard Management Framework	2
2. Overview	2
2.1. Terms	5
2.2. Report Aggregation	5
2.3. Structure of the MIB	6
2.4. Statistics for Aggregation of Data: Conventions	7
2.5. Relationship to the Remote Monitoring MIB	7
2.6. Relationship to RMON2-MIB Protocol Identifier Reference	7
2.7. Relationship to Standards-Based Performance Metrics	7
2.8. Relationship to Application Performance Measurement MIB	8
3. Statistics Perspective	8
3.1. Statistics Structure	10
3.2. Statistics Analysis	11
4. Definitions	11
5. Acknowledgements	51
6. Security Considerations	52
7. Normative References	53
8. Informative References	54

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 [RFC3410].

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 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

2. Overview

This document continues the architecture created in the RMON2-MIB [RFC2021] by providing a major feature upgrade, primarily by providing new metrics and studies to assist in the analysis of performance for sub-application transaction flows in the network, in direct relationship to the transport of application layer protocols.

Performance-monitoring agents have been widely used to analyze the parameters and metrics related to the perceived performance of distributed applications and services in networks. The metrics collected by these agents have ranged from basic response time to a

combination of metrics related to the loss and re-transmission of datagrams and PDUs. Although the metrics are becoming more useful in the implementation of service-level monitoring and troubleshooting tools, the lack of a standard method to report these has limited the deployment to very specific customer needs and areas.

This document is intended to create a general framework for the collection and reporting of performance-related metrics on sub-application level transaction flows in a network. The MIB in this document is directly linked to the current RMON2-MIB [RFC2021], and uses the Protocol Directory as a key component in reporting the layering involved in the sub-application level transaction flows.

The specific objectives of this document are to:

- + Provide a drill-down capability to complement the user-perceived monitoring defined within the Application Performance Measurement MIB (APM-MIB) [RFC3729]. This capability is intended to support trouble resolution, further characterization of performance, and a finer granularity of monitoring capabilities. The APM-MIB provides a method for retrieving aggregated measurement data of the end-user's perception of application-level performance. APM additionally provides thresholding and associated alarms if the end-user perceived performance degrades below defined thresholds. The Transport Performance Metrics MIB (TPM-MIB) complements the APM-MIB capabilities by monitoring sub-application level transaction aspects not typically perceived by the end-user. As an example, APM-MIB provides response time statistics of a typical web-browser application. This application typically consists of DNS transactions, TCP connection establishment (or multiple establishments), HTTP download of the base page, and multiple downloads of the various embedded objects. Ideally, TPM-MIB would provide statistics on the performance aspects of these multiple sub-application level transactions.
- + Provide additional performance metrics and related statistics. For troubleshooting and a finer granularity of performance monitoring, it is useful to provide measurements of additional metrics beyond those supported by the APM-MIB.
- + Support standards-based metrics and associated statistical aggregation by defining methods to reference those standards. The TPM-MIB provides a capability to describe metrics by reference to appropriate IETF, ITU, or other standards bodies defining metrics, including enterprise-specific standards bodies. This capability is provided through the `tpmMetricsDefTable`.

Specifically, this MIB itself does not make references to metric specifications of the IETF, ITU and other organizations. Instead, it allows for the setup of the `tpmMetricDefTable` that does reference such IETF, ITU, and other metric specifications, and it allows pointers to such specifications to be dynamically listed in this table. The following objects allow for that, and the DESCRIPTION clauses (of the objects below) explain how this is done:

```
tpmMetricDefName OBJECT-TYPE
tpmMetricDefReference OBJECT-TYPE
tpmMetricDefGlobalID OBJECT-TYPE
```

The `tpmMetricDefGlobalID` object contains a reference to the Object ID in a metrics registration MIB being developed in the IP Performance Metrics (IPPM) Working Group at the IETF; e.g., the IPPM-REGISTRY-MIB [RFC4148], which defines the metric. For metrics defined within the IPPM Working Group, which are included in the IPPM-REGISTRY-MIB, this object is used to reference those metrics directly. For metrics not included within the IPPM-REGISTRY-MIB, the value of this object is set to 0.0 for none.

Examples of appropriate references include the ITU-T Recommendation Y.1540 [Y.1540] on IP packet transfer performance metrics, and the IETF documents from the IPPM WG; e.g., RFC 2681 on the round trip delay metric [RFC2681] or RFC3393 on the delay variation metric [RFC3393]. Others include RFC 2679 [RFC2679], RFC2680 [RFC2680], and RFC3432 [RFC3432]. Although no specific metric is mandatory, implementations should, at a minimum, support a round-trip delay and a round-trip loss metric.

- + Provide (as an option) a table storing the measurements of the metrics on a transaction by transaction basis. There are times when it is useful to have access to the raw measurements. The `tpmCurReportTable` optionally provides access to this capability.

Although this document outlines the basic measurements of performance in regard to the transport of application flows, it does not attempt to measure or provide a means to measure the actual perceived performance of the application transactions or quality. The detailed measurements of end-user-perceived performance are directly related to this document and may be found in the APM-MIB [RFC3729].

The objects defined in this document are intended as an interface between an RMON agent and an RMON management application and are not intended for direct manipulation by humans. Although some users may tolerate the direct display of some of these objects, few will

tolerate the complexity of manually manipulating objects to accomplish row creation. These functions should be handled by the management application.

2.1. Terms

This document uses some terms that need introduction:

DataSource

A source of data for monitoring purposes. This term is used exactly as defined in the RMON2-MIB [RFC2021].

protocol

A specific protocol encapsulation, as identified for monitoring purposes. This term is used exactly as defined in the RMON Protocol Identifiers document [RFC2895].

performance metric

A specific, measured reporting metric, as identified for monitoring purposes. There can be several metrics reported by an agent in the same implementation. The metrics are extensible based on the agent implementation.

application

A network-based, high-level protocol performing useful work to an end-user of an end-system. Typically, the application performs multiple request/response transactions to complete its work. E.g., a web application downloading a web page completes DNS, TCP-connect, and multiple HTTP GET transactions prior to completing its task.

transactions

Elemental request/response transactions comprising more complex network-based applications. E.g., a transaction may include an ftp get request and the file download in response.

2.2. Report Aggregation

This MIB module provides functions that aggregate measurements into higher-level summaries identical to the aggregation defined in the APM-MIB [RFC3729]. In addition to temporal aggregation of data, the Textual Convention, TransactionAggregationType, is imported from the APM-MIB, which specifies the nature of the spatial aggregation employed.

2.3. Structure of the MIB

The objects are arranged in the following groups:

- tpmCapabilitiesGroup
- tpmAggregateReportsGroup
- tpmCurrentReportsGroup
- tpmExceptionReportsGroup

These groups are the basic units of conformance. If an agent implements a group, then it must implement all objects in that group. Although 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 implementers of managed agents to know which objects they must implement.

2.3.1. The tpmCapabilitiesGroup

The tpmCapabilitiesGroup contains objects and tables that show the measurement protocol and metric capabilities of the agent. This group primarily consists of the tpmTransMetricDirTable and the tpmMetricDefTable.

2.3.2. The tpmAggregateReportsGroup

The tpmAggregateReportsGroup is used to provide the collection of aggregated statistical measurements for the configured report intervals. The tpmAggregateReportsGroup consists of the tpmAggrReportCntrlTable and the tpmAggrReportTable.

2.3.3. The tpmCurrentReportsGroup

The tpmCurrentReportsGroup is used to provide the collection of uncompleted measurements for the current configured report for those transactions caught in progress. A history of these transactions is also maintained once the current transaction has been completed. The tpmCurrentReportsGroup consists of the tpmCurReportTable and the tpmCurReportSize object.

2.3.4. The tpmExceptionReportsGroup

The tpmExceptionReportsGroup is used to link immediate notifications of transactions that exceed certain thresholds defined in the apmExceptionGroup [RFC3729]. This group reports the aggregated sub-application measurements for those applications exceeding thresholds. The tpmExceptionReportsGroup consists of the tpmExcpReportTable.

2.4. Statistics for Aggregation of Data: Conventions

In order to measure the performance of traffic flows in a network, the proper analysis of a set of statistics is required. Because a large majority of the statistics have a basis of time, the use of a simple statistical model is feasible. Therefore, the MIB definitions within this document all use a basic set of statistical computed values to assist in further analysis by a management application.

The remaining subsections in this section detail the common structured features that are applied to the performance metrics in the statistical format described above. The tpmMetricsDefTable (discussed below) describes the set of metrics supported in this MIB module.

2.5. Relationship to the Remote Monitoring MIB

This document describes the implementation of an additional MIB for the support of performance-related metrics within the framework of the RMON2-MIB [RFC2021]. The objects and table defined in this MIB module are an extension to the existing framework for the support of both Client/Server and Server push-related applications and services.

2.6. Relationship to RMON2-MIB Protocol Identifier Reference

This document uses the Protocol Identifiers outlined in the current Protocol Identifier Reference document, RFC 2895 [RFC2895]. The protocol index values throughout the document are a direct reference to the same relationship that exists between the RMON2-MIB [RFC2021] and the Protocol Identifier Reference document, RFC 2895 [RFC2895]. An important extension of the Protocol Identification to application-level verbs is found in RFC 3395 [RFC3395].

2.7. Relationship to Standards-Based Performance Metrics

This document uses the tpmMetricsDefTable to describe the metrics supported by an instance of the TPM-MIB. The performance metric index values throughout the document are a direct reference to the

metrics defined in that table. The table defines metrics by directly referencing other standards that provide definitive descriptions of the metric.

2.8. Relationship to Application Performance Measurement MIB

This document uses the `apmReportControlIndex`, `appLocalIndex`, and `apmReportIndex`, as outlined in the current Application Performance Measurement MIB [RFC3729]. These objects are used to create a reference link for the purpose of reporting transaction flow details on application-level measurements. As such, the TPM-MIB is designed to provide a drill-down extension to the APM-MIB. Further, it draws heavily on the ideas and designs laid out in the APM-MIB.

3. Statistics Perspective

When dealing with time-based measurements on application data packets, ideally all the timestamps and related data could be stored and forwarded for later analysis. However, when faced with thousands of conversations per second on ever-faster networks, storing all the data, even if compressed, would take too much processing, memory, and manager download time to be practical.

It is important to note that in dealing with network data we will be dealing with statistical populations and not samples. Statistics books deal with both because the math is similar. In collecting agent data, a population (i.e., all the data) must be processed.

Because of the nature of application protocols, just sampling some of the packets will not give good results. Missing just one critical packet, such as one that specified an ephemeral port on which data will be transmitted or what application will be run, can cause much valid data to be lost.

The time-based measurements the agent collects will come from examining the entire group of data, i.e., the population. The population will be finite. The agent will seek only to provide information that will describe the actual data. Analysis of that data will be left to the management station.

The simplest form of representing a group of data is by frequency distributions, i.e., buckets. Statistics provides a great many ways of analyzing this type of data, and there are some rules in creating the buckets. First, the range needs to be known. Second, a bucket size needs to be determined. Fixed bucket sizes are best, although variable may be used if needed. However, the statistics texts tend only to refer to operations of fixed-size buckets. This method of describing data is expensive for an agent to implement. First, the

agent must process a great amount of data at a time. Storing the data, determining the range, locating the buckets, and then filling in the data after the fact takes a fair amount of storage and time. Fixing the range and bucket sizes in the beginning can be problematic, as the agent may have to adjust the values for each of the applications it collects data on. Such numbers can be in the thousands. Additional complexity arises in adding new protocols and even in describing the buckets themselves to the management application. This is the approach taken in the APM-MIB.

A complimentary approach is to provide frequency distribution statistics. They describe aggregation such as mean and standard deviation that can be obtained by summation functions on the individual data elements in a population. Analysis of the data described by these functions has been thoroughly studied, and interpretation of these values is available to anyone with an introduction to statistics. In fact, frequency distributions are routinely analyzed to generate these varied numbers, which are then used for further analysis. Note that frequency distributions, by their very nature, provide an exact characterization of the data. Whereas buckets will introduce error factors that are not present with direct analysis by summation-type formulas. Because the TPM-MIB provides a drill-down capability to the APM MIB, it has to measure and store much more information than the APM-MIB. For this reason, and in order to complement the APM-MIB, the TPM-MIB relies on statistical descriptions rather than a bucket description of the measurement data.

The agent will provide data that can be used to calculate the most basic and useful statistical aggregates. The agent will not perform the calculations and will not provide the statistical measurement directly. There are several reasons why this is not desired. The first is that finding the final measurement can be expensive in terms of computation and representation. There are divisions and square roots, and the measurements are expressed as floating point values. The second is that by providing the variables to the statistical functions, those variables are scalable. It is possible to combine smaller intervals into larger ones.

An example is the arithmetic mean or average. This is the sum of the data divided by the number of data elements. The agent will provide the sum of the x and the number of elements N . The management station can perform the division to obtain the average. Given two samples, they can be combined by adding the sum of the x 's and by adding the number of elements to get a combined sum and number of elements. The average formula then works just the same. Also, the sum of the x and the number of element variables are used in calculating other statistical measurement values.

3.1. Statistics Structure

The data statistical elements, datum, of the metric have been chosen to maximize the amount of data available while minimizing the amount of memory needed to store the statistic and minimizing the CPU processing requirement needed to generate the statistic.

The statistic data structure contains five unsigned integer datum.

N	count of the number of data points for the metric
S(X)	sum of all the data point values for the metric
S(X2)	sum of all the data point values squared for the metric
Xmax	maximum data point value for the metric
Xmin	minimum data point value for the metric
S(I*X)	sum of the data points multiplied by their order, i.e., = SUM from i=1 to N { i*X sub i }

A performance metric is used to describe events over a time interval. The measurement points can be processed immediately into the statistic and do not have to be stored for later processing. For example, to count the number of events in a time interval, it is sufficient to increment a counter for each event. It is not necessary to cache all the events and then to count them at the end of the interval. The statistic is also designed to be easily scalable in terms of combining adjacent intervals. For example, if an agent created a specific statistic every 30 seconds and a user table interval was set to 60 seconds, the 60-second statistic could be obtained by combining the two 30-second statistics. The following rules will be applied when combining adjacent statistics.

N	S(N)
S(X)	S(S(X))
S(X2)	S(S(X2))
Xmax	MAX(Xmax)
Xmin	MIN(Xmin)
S(I*X)	S(I*X) + N*S(X) +S(I*X) where the last two terms refer to the statistics from the later 30 second period and N is the count from the former 30 second period.

This structure gives a generic framework upon which the actual performance statistics will be defined. Each specific statistical definition must address the specific significance, if any, given to each metric datum. While a specific metric definition should try to conform to the generic framework, it is acceptable for a metric datum to not be used, and to have no meaning, for a specific metric. In such cases the datum will default to a 0 value.

3.2. Statistics Analysis

The actual meaning of a specific statistical datum is determined by the definition of the specific statistic. The following is a discussion of the operations and observations that can be performed on a generic metric. This means that the following may or may not apply and/or have meaning when applied to any specific metric.

The following observations and analysis techniques are not all inclusive. Rather these are the ones we have come up with at the time of writing this document.

- + Number.
- + Frequency.
- + The time interval is that specified in the control table. It is not a metric datum, but it is associated with the metric sample.
- + Maximum
- + Minimum
- + Range
- + Arithmetic Mean
- + Root Mean Square
- + Variance
- + Standard Deviation
- + Slope of a least-squares line

These are accessible from the statistical datum provided by this MIB module.

4. Definitions

```
--  
-- RMON2-MIB extensions for the monitoring metrics related to the  
-- performance of transporting traffic in networks.  
--  
--   TPM Metric Collection  
--       * Application-to-Protocol transaction linkage  
--       * Metric-to-Protocol linkage
```

```
--      * Metric study control
--      * Metrics for Client/Server Conversations
--
```

```
TPM-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY, OBJECT-TYPE,
    Counter32, Unsigned32          FROM SNMPv2-SMI      --[RFC2578]
```

```
    MODULE-COMPLIANCE,
    OBJECT-GROUP                  FROM SNMPv2-CONF     --[RFC2580]
```

```
    SnmpAdminString              FROM SNMP-FRAMEWORK-MIB --[RFC3411]
```

```
    RowStatus, TEXTUAL-CONVENTION, TimeStamp,
    StorageType                  FROM SNMPv2-TC       --[RFC2579]
```

```
    rmon, OwnerString            FROM RMON-MIB        --[RFC2819]
```

```
    protocolDirLocalIndex,
    ZeroBasedCounter32           FROM RMON2-MIB      --[RFC2021]
```

```
    ZeroBasedCounter64          FROM HCNUM-TC       --[RFC2856]
```

```
    AppLocalIndex, TransactionAggregationType,
    RmonClientID, DataSourceOrZero,
    apmAppDirAppLocalIndex, apmExceptionIndex,
    apmReportGroup, apmExceptionGroup,
    apmAppDirResponsivenessType FROM APM-MIB        --[RFC3729]
```

```
    SspmClockSource, SspmClockMaxSkew,
    SspmMicroSeconds            FROM SSPM-MIB;      --[RFC4149]
```

```
-- Transaction Performance Monitoring MIB
```

```
tpmMIB MODULE-IDENTITY
```

```
    LAST-UPDATED      "200507280000Z"  -- 28 July 2005
```

```
    ORGANIZATION      "IETF RMON MIB Working Group"
```

```
    CONTACT-INFO
```

```
        "E-mail: rmonmib@ietf.org
```

```
        Subscribe: rmonmib-request@ietf.org
```

```
            w/ msg body: subscribe rmonmib
```

```

        Russell Dietz
```

```
        Hifn, Inc.
```

```
        Postal: 750 University Ave
```

```
        Los Gatos, CA 95032-7695
```

USA
 Tel: +1 408 399-3623
 Fax: +1 408 399-3501
 E-mail: rdietz@hifn.com

Robert G. Cole
 Johns Hopkins University Applied Physics Laboratory
 Postal: MP2-170
 11100 Johns Hopkins Road
 Laurel, MD 20723-6099
 USA
 Tel: +1 443 778-6951
 E-mail: robert.cole@jhupl.edu"

DESCRIPTION

"This module defines extensions to the RMON2-MIB module for the collection of Performance Metrics related to application traffic in a network. In particular, it describes managed objects used for monitoring selectable performance metrics and statistics derived from the monitoring of network packets and sub-application level transactions.

In order to maintain the RMON 'look-and-feel', some of the text from the RMON2 [RFC2021] and HC-RMON [RFC3273] MIBs by Steve Waldbusser have been used in this MIB module.

Copyright (C) The Internet Society (2005). This version of this MIB module is part of RFC 4150; see the RFC itself for full legal notices."

REVISION "200507280000Z" -- 28 July 2005

DESCRIPTION

"The original version of this MIB module, published as RFC 4150."
 ::= { rmon 30 }

--

-- Object Identifier Assignments

--

tpmCapabilities	OBJECT IDENTIFIER ::= { tpmMIB 1 }
tpmReports	OBJECT IDENTIFIER ::= { tpmMIB 2 }
tpmConformance	OBJECT IDENTIFIER ::= { tpmMIB 3 }

-- tpmAggrReportCntlTable	OBJECT IDENTIFIER ::= { tpmReports 1 }
-- tpmAggrReportTable	OBJECT IDENTIFIER ::= { tpmReports 2 }
-- tpmCurReportTable	OBJECT IDENTIFIER ::= { tpmReports 3 }
-- tpmCurReportSize	OBJECT IDENTIFIER ::= { tpmReports 4 }

```

-- tpmExcpReportTable      OBJECT IDENTIFIER ::= { tpmReports 5 }

--
-- Textual Conventions
--

TpmTransactionMetricIndex ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS      current
    DESCRIPTION
        "An index used to identify an entry in the
         tpmTransMetricDir table uniquely. Each such entry defines
         the protocol transaction and metric instance to be
         monitored for a specific application."
    SYNTAX      Unsigned32 (1..65535)

TpmMetricDefID ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS      current
    DESCRIPTION
        "An index that identifies through reference to a specific
         performance metrics. The metrics are referenced
         through their type (connect, delay, loss, etc.), their
         directional characteristics (one-way, round trip, etc.),
         their name, and their reference to a documented definition."
    SYNTAX      Unsigned32 (1..2147483647)

--
-- The tpmCapabilitiesGroup
--

tpmClockResolution OBJECT-TYPE
    SYNTAX      SspmMicroSeconds
    MAX-ACCESS   read-only
    STATUS      current
    -- UNITS      Microseconds
    DESCRIPTION
        "A read-only variable indicating the resolution
         of the measurements possible by this device."
    ::= { tpmCapabilities 1 }

tpmClockMaxSkew OBJECT-TYPE
    SYNTAX      SspmClockMaxSkew
    MAX-ACCESS   read-only
    STATUS      current
    -- UNITS      Seconds
    DESCRIPTION
        "A read-only variable indicating the maximum

```

offset error due to skew of the local clock
 over the time interval 86400 seconds, in seconds."
 ::= { tpmCapabilities 2 }

tpmClockSource OBJECT-TYPE

SYNTAX SspmClockSource

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A read-only variable indicating the source of the clock.

This is provided to allow a user to determine how accurate
 the timing mechanism is compared with other devices."

::= { tpmCapabilities 3 }

tpmTransMetricDirLastChange OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of sysUpTime at the time the
 tpmTransMetricDirTable was last modified, through
 modifications of the tpmTransMetricDirConfig object."

::= { tpmCapabilities 4 }

tpmTransMetricDirTable OBJECT-TYPE

SYNTAX SEQUENCE OF TpmTransMetricDirEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table is used to describe and link sets of
 performance metrics and protocols to an entry in
 the application directory. This table, with the
 tpmMetricDefTable, describes the capability of
 the agent to collection sub-application level
 data related to each entry in the
 apmAppDirectoryTable.

This table lists the protocol transactions and their
 corresponding performance metrics that this agent
 has the capability to compute and collect, for the specified
 application. There is one entry in this table for each such
 application, protocol transaction, and metric combination
 supported by this agent. The entries in this
 table represent the metrics that are collected for each
 protocol transaction that comprise the application.
 The agent should boot up with this table pre-configured
 with those combinations of applications, protocol
 transactions, and metrics that it knows about and wishes to

monitor. Implementations must populate the table with all possible application, protocol transaction, and metric combinations and have the default configuration objects set to supportedOff(2). This table does not support the creation of new combinations by the management application.

The deletion of an entry in the apmAppDirectoryTable will cause the removal of entries from this table. These entries must be removed because the appLocalIndex value will no longer be visible in the apmAppDirectoryTable. When an entry is created in the apmAppDirectoryTable and the agent has the ability to support metrics for these protocol transactions, the appropriate entries must be made in the tpmTransMetricDefTable."

```
::= { tpmCapabilities 5 }
```

tpmTransMetricDirEntry OBJECT-TYPE

SYNTAX TpmTransMetricDirEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row in the tpmTransMetricDirTable.

An example of the indexing of this entry is tpmTransMetricDirConfig.5.2 where 5 is the value of a valid and visible appLocalIndex object in the appLocalDir table. The entries describe the transaction and metric pairs monitored for this application. The tpmTransMetricProtocolIndex identifies the protocol transaction and the tpmMetricDefIndex describes the metric monitored."

```
INDEX { tpmTransMetricAppLocalIndex, -- Application Index
        tpmTransMetricIndex          -- (Protocol,Metric) Index
      }
```

```
::= { tpmTransMetricDirTable 1 }
```

TpmTransMetricDirEntry ::= SEQUENCE {

tpmTransMetricAppLocalIndex AppLocalIndex,

tpmTransMetricIndex TpmTransactionMetricIndex,

tpmTransMetricProtocolIndex Unsigned32,

tpmTransMetricMetricIndex Unsigned32,

tpmTransMetricDirConfig INTEGER

}

tpmTransMetricAppLocalIndex OBJECT-TYPE

SYNTAX AppLocalIndex

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An index used to uniquely identify the application with which the entries in the tpmTransMetricDir table are associated."

::= { tpmTransMetricDirEntry 1 }

tpmTransMetricIndex OBJECT-TYPE

SYNTAX TpmTransactionMetricIndex

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An index used to uniquely identify an entry in the tpmTransMetricDir table. Each such entry defines protocol transaction and metric instance to be monitored for a specific application."

::= { tpmTransMetricDirEntry 2 }

tpmTransMetricProtocolIndex OBJECT-TYPE

SYNTAX Unsigned32 (1..2147483647)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The protocolDirLocalIndex of the particular transaction to be analyzed when computing and generating the selected metric for a specific application."

::= { tpmTransMetricDirEntry 3 }

tpmTransMetricMetricIndex OBJECT-TYPE

SYNTAX Unsigned32 (1..2147483647)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The tpmMetricDefinitionID of the particular metric to be generated."

::= { tpmTransMetricDirEntry 4 }

tpmTransMetricDirConfig OBJECT-TYPE

SYNTAX INTEGER {
notSupported(1),
supportedOff(2),
supportedOn(3)
}

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This object describes and configures the probe's support for this performance metric in relationship to the specified transaction and application. The agent

creates entries in this table for all metric and transaction combinations that it can generate. Because the probe will only populate this table with supported entries, and the table cannot have entries added, the `notSupported(1)` setting is only used to signify that other configuration parameters are causing the agent currently not to support the generation and collection of this metric for the specified protocol and application. Also, the status of this object will not change to `notSupported(1)` due to a change to `supportedOff(2)` in the `tpmMetricDir` table.

If the value of this object is `notSupported(1)`, the probe will not perform computations for this performance metric and transaction combination and will not allow this object to be changed to any other value. If the value of this object is `supportedOn(3)`, the probe supports computations for this performance metric and protocol and is configured to perform the computations for this performance metric and protocol combination for the application for all interfaces. If the value of this object is `supportedOff(2)`, the probe supports computations for this performance metric for the specified protocol, but is configured not to perform the computations for this performance metric and protocol for the application for any interfaces. Whenever this value changes from `supportedOn(3)` to `supportedOff(2)`, the probe shall cause the deletion of all entries in the `tpmReportGroup` tables, for all appropriate studies configured in the `tpmAggrReportCntrlTable`.

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

--

-- TPM Metric Definitions Table

--

`tpmMetricDefTable` OBJECT-TYPE

SYNTAX SEQUENCE OF `TpmMetricDefEntry`

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The `tpmMetricDefTable` describes the metrics available to the TPM-MIB. The `tpmMetricDefTable` can define metrics by referencing existing IETF, ITU, and other standards organizations' documents, including enterprise-specific documents."

Examples of appropriate references include the ITU-T Recommendation Y.1540 [Y.1540] on IP packet transfer performance metrics and the IETF documents from the IPPM WG; e.g., RFC2681 on the round trip delay metric [RFC2681] or RFC3393 on the delay variation metric [RFC3393]. Other examples include RFC2679 [RFC2679], RFC2680 [RFC2680], and RFC3432 [RFC3432]. Although no specific metric is mandatory, implementations should, at a minimum, support a round-trip delay and a round-trip loss metric.

This table contains one row per metric supported by this agent, and it should be populated during system initialization."

```
::= { tpmCapabilities 6 }
```

```
tpmMetricDefEntry OBJECT-TYPE
```

```
SYNTAX          TpmMetricDefEntry
```

```
MAX-ACCESS      not-accessible
```

```
STATUS          current
```

```
DESCRIPTION
```

```
    "Information about a particular metric."
```

```
INDEX          { tpmMetricDefinitionID }
```

```
::= { tpmMetricDefTable 1 }
```

```
TpmMetricDefEntry ::= SEQUENCE {
```

```
    tpmMetricDefinitionID
```

```
    TpmMetricDefID,
```

```
    tpmMetricDefType
```

```
    INTEGER,
```

```
    tpmMetricDefDirType
```

```
    INTEGER,
```

```
    tpmMetricDefName
```

```
    SnmpAdminString,
```

```
    tpmMetricDefReference
```

```
    SnmpAdminString,
```

```
    tpmMetricDefGlobalID
```

```
    OBJECT IDENTIFIER
```

```
}
```

```
tpmMetricDefinitionID OBJECT-TYPE
```

```
SYNTAX          TpmMetricDefID
```

```
MAX-ACCESS      not-accessible
```

```
STATUS          current
```

```
DESCRIPTION
```

```
    "The index for this entry.  This object identifies
     the particular metric in this MIB module."
```

```
::= { tpmMetricDefEntry 1 }
```

```
tpmMetricDefType OBJECT-TYPE
```

```
SYNTAX          INTEGER {
```

```
    other(1),
```

```
    connectMetric(2),
```

```

                                delayMetric(3),
                                lossMetric(4)
                                }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "The basic type of metric indicated by this entry.

    The value 'other(1)' indicates that this metric cannot be
    characterized by any of the remaining enumerations specified
    for this object.

    The value 'connectMetric(2)' indicates that this metric
    measures connectivity characteristics.

    The value 'delayMetric(3)' indicates that this metric
    measures delay characteristics.

    The value 'lossMetric(4)' indicates that this metric
    measures loss characteristics."
 ::= { tpmMetricDefEntry 2 }

```

```

tpmMetricDefDirType  OBJECT-TYPE
    SYNTAX      INTEGER {
                                oneWay(1),
                                twoWay(2),
                                multiWay(3)
                                }
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The directional characteristics of the this metric.

        The value 'oneWay(1)' indicates that this metric is measured
        with some sort of unidirectional test.

        The value 'twoWay(2)' indicates that this metric is measured
        with some sort of bidirectional test.

        The value 'multiWay(3)' indicates that this metric is
        measured with some combination of unidirectional and/or
        bidirectional tests."
 ::= { tpmMetricDefEntry 3 }

```

```

tpmMetricDefName  OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS      read-only
    STATUS          current

```

DESCRIPTION

"The textual name of this metric. For example, if this tpmMetricDefEntry identified the IPPM metric for round trip delay, then this object should contain the value, e.g., 'Type-P-Round-Trip-Delay'."

::= { tpmMetricDefEntry 4 }

tpmMetricDefReference OBJECT-TYPE

SYNTAX SnmpAdminString

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object contains a reference to the document that defines this metric. If this document is available online via electronic download, then a de-referencable URL should be specified in this object. The implementation must support an HTTP URL type and may support additional types of de-referencable URLs such as an FTP type.

For example, if this tpmMetricDefName identified the IPPM metric 'Type-P-Round-Trip-Delay', then this object should contain the value, e.g.,
'http://www.ietf.org/rfc/rfc2681.txt'."

::= { tpmMetricDefEntry 5 }

tpmMetricDefGlobalID OBJECT-TYPE

SYNTAX OBJECT IDENTIFIER

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object contains a reference to the Object ID in a metrics registration MIB being developed in the IPPM WG at the IETF; e.g., the IPPM-REGISTRY-MIB [RFC4148], which defines the metric. In the event that this metric has no corresponding object identifier (OID) or until the IPPM-REGISTRY-MIB is defined, then the value should be set to 0.0 for none."

::= { tpmMetricDefEntry 6 }

--

-- The tpmAggregateReportsGroup

--

tpmAggrReportCntrlTable OBJECT-TYPE

SYNTAX SEQUENCE OF TpmAggrReportCntrlEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The tpmAggrReportCntrlTable is the controlling entry that manages the population of studies in the Transport Aggregate Report for selected interfaces, metrics, and transaction protocols and applications.

Note that this is not like the typical RMON controlTable and dataTable in which each entry creates its own data table. Each entry in this table enables the creation of multiple data tables on a study basis. For each interval, the study is updated in place, and the current data content of the table becomes invalid.

The control table entries are persistent across system reboots."

```
::= { tpmReports 1 }
```

tpmAggrReportCntrlEntry OBJECT-TYPE

SYNTAX TpmAggrReportCntrlEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row in the tpmAggrReportCntrlTable.

An example of the indexing of this entry is

tpmAggrReportCntrlDataSource.1"

```
INDEX { tpmAggrReportCntrlIndex }
```

```
::= { tpmAggrReportCntrlTable 1 }
```

TpmAggrReportCntrlEntry ::= SEQUENCE {

tpmAggrReportCntrlIndex

Unsigned32,

tpmAggrReportCntrlApmCntrlIndex

Unsigned32,

tpmAggrReportCntrlDataSource

DataSourceOrZero,

tpmAggrReportCntrlAggrType

TransactionAggregationType,

tpmAggrReportCntrlInterval

Unsigned32,

tpmAggrReportCntrlReqSize

Unsigned32,

tpmAggrReportCntrlGrantedSize

Unsigned32,

tpmAggrReportCntrlReqReports

Unsigned32,

tpmAggrReportCntrlGrantedReports

Unsigned32,

tpmAggrReportCntrlStartTime

TimeStamp,

tpmAggrReportCntrlReportNumber

Unsigned32,

tpmAggrReportCntrlInsertsDenied

Counter32,

tpmAggrReportCntrlDroppedFrames

Counter32,

tpmAggrReportCntrlOwner

OwnerString,

tpmAggrReportCntrlStorageType

StorageType,

tpmAggrReportCntrlStatus

RowStatus

}

tpmAggrReportCntrlIndex OBJECT-TYPE

SYNTAX Unsigned32 (1..65535)

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An index that uniquely identifies an entry in the tpmAggrReportCntrlTable. Each such entry defines a unique report whose results are placed in the tpmAggrReportTable on behalf of this tpmAggrReportCntrlEntry."

::= { tpmAggrReportCntrlEntry 1 }

tpmAggrReportCntrlApmCntrlIndex OBJECT-TYPE

SYNTAX Unsigned32 (0..65535)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This index associates this TpmAggrReportCntrlEntry directly with an existing ApmReportControlEntry. This link is used to synchronize reports in the associated tpmAggrReportTable.

A value of 0 (zero) enables an independent control table that will report entries to tpmAggrReportTable based only on the other objects in this table.

A non-zero value indicates that this row is defined through the APM-MIB. In this case, all row objects are set to their corresponding values in the APM-MIB. In the event that a SET is issued to a row object, while the value of the tpmAggrReportCntrlApmCntrlIndex is non-zero, the agent MUST respond as if the object of the SET command had MAX-ACCESS of read-only.

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

DEFVAL { 0 }

::= { tpmAggrReportCntrlEntry 2 }

tpmAggrReportCntrlDataSource OBJECT-TYPE

SYNTAX DataSourceOrZero

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The source of the data for TPM Reports generated on behalf of this tpmAggrReportCntrlEntry.

If the measurement is being performed by a probe, this should be set to the 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 if this information isn't known, this object should be set to 0.0.

If the `tpmAggrReportCntrlApmCntrlIndex` is non-zero, then this object is set to the corresponding `apmReportControlTable` object in the APM-MIB [RFC3729].

This object may not be modified if the associated `tpmAggrReportCntrlStatus` object is equal to `active(1)`.

```
::= { tpmAggrReportCntrlEntry 3 }
```

`tpmAggrReportCntrlAggrType` OBJECT-TYPE

SYNTAX TransactionAggregationType

```
-- INTEGER {
--     flows(1),
--     clients(2),
--     servers(3),
--     applications(4)
-- }
```

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The type of aggregation being performed for this set of reports.

If the `tpmAggrReportCntrlApmCntrlIndex` is non-zero, then this object should be set by the agent to the value of the `apmReportControlAggregationType` object.

This object may not be modified if the associated `tpmAggrReportCntrlStatus` object is equal to `active(1)`.

```
::= { tpmAggrReportCntrlEntry 4 }
```

`tpmAggrReportCntrlInterval` 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 `tpmAggrReportTable`. All reports with the same `tpmAggrReportCntrlIndex` will be based on the same interval.

If the `tpmAggrReportCntrlApmCntrlIndex` is non-zero, then this object should be set by the agent to the value

of the apmReportControlControlInterval object.

This object may not be modified if the associated
tpmReportAggregateCntrlStatus object is equal to active(1)."
DEFVAL { 3600 }
::= { tpmAggrReportCntrlEntry 5 }

tpmAggrReportCntrlReqSize OBJECT-TYPE

SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current

DESCRIPTION

"The maximum number of Client and Server combination
entries requested for this report.

If the tpmAggrReportCntrlApmCntrlIndex is non-zero,
then this object should be set by the agent to the value
of the apmReportControlRequestedSize object.

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

It is important to note that this value is the number of
requested entries in the tpmAggrReportTable only. Because
the probe can derive this table from the apmReportTable, the
probe must make sure that sufficient resources exist to
support the creation of the apmReportTable, plus any
additional resources required to convert or support this
table.

This object may not be modified if the associated
tpmReportAggregateCntrlStatus object is equal to active(1)."
::= { tpmAggrReportCntrlEntry 6 }

tpmAggrReportCntrlGrantedSize OBJECT-TYPE

SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The maximum number of performance entries in this report.

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

value except as a result of a set to the associated tpmAggrReportCntrlReqSize object.

It is an implementation-specific matter as to whether zero-valued entries are available."

::= { tpmAggrReportCntrlEntry 7 }

tpmAggrReportCntrlReqReports OBJECT-TYPE

SYNTAX Unsigned32 (1..65535)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The number of saved reports requested to be allocated on behalf of this entry.

If the tpmAggrReportCntrlApmCntrlIndex is non-zero, then this object should be set by the agent to the value of the apmReportControlcwRequestedReportsDataSource object.

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

::= { tpmAggrReportCntrlEntry 8 }

tpmAggrReportCntrlGrantedReports 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 tpmAggrReportCntrlReqReports. Because each report can have many entries, the total number of entries allocated will be this number multiplied by the value of tpmAggrReportCntrlGrantedSize, or by 1 if that object doesn't exist.

When the associated tpmAggrReportCntrlReqReports 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 available resources, the agent must consider its ability to allocate this many reports, each with the number of entries represented by tpmAggrReportCntrlGrantedSize, or by 1 if that object doesn't exist.

Note that although 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 tpmAggrReportCntrlReqSize object."
 ::= { tpmAggrReportCntrlEntry 9 }

tpmAggrReportCntrlStartTime 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 tpmAggrReportCntrlEntry, as reports are started at fixed intervals.

If the tpmAggrReportCntrlApmCntrlIndex is non-zero, then this object is set to the corresponding apmReportControlTable object in the APM-MIB defined in the IETF's RMONMIB WG."

::= { tpmAggrReportCntrlEntry 10 }

tpmAggrReportCntrlReportNumber OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of the report in progress. When an tpmAggrReportCntrlEntry is activated, the first report will be numbered zero.

If the tpmAggrReportCntrlApmCntrlIndex is non-zero, then this object should be set by the agent to the value of the apmReportControlReportNumber object."

::= { tpmAggrReportCntrlEntry 11 }

tpmAggrReportCntrlInsertsDenied OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of attempts to add an entry to reports for this TpmAggrReportCntrlEntry that failed because the number of entries would have exceeded tpmAggrReportCntrlGrantedSize.

This number is valuable in determining if enough entries have

been allocated for reports in light of fluctuating network usage. Note that an entry that is denied will often be attempted again, so this number will not predict the exact number of additional entries needed, but it 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."

```
::= { tpmAggrReportCntrlEntry 12 }
```

tpmAggrReportCntrlDroppedFrames OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The total number of frames that 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.

Note that if the alMatrixTables are not implemented or are inactive because no protocols are enabled in the protocol directory, this value should be 0.

Note that, unlike the dropEvents counter, this number is the exact number of frames dropped."

```
::= { tpmAggrReportCntrlEntry 13 }
```

tpmAggrReportCntrlOwner 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.

If the tpmAggrReportCntrlApmCntrlIndex is non-zero, then this object should be set by the agent to the value of the apmReportControlReportNumber object.

This object may not be modified if the associated
 tpmReportAggregateCntrlStatus object is equal to active(1)."
 ::= { tpmAggrReportCntrlEntry 14 }

tpmAggrReportCntrlStorageType OBJECT-TYPE

SYNTAX StorageType

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The storage type of this tpmAggrReportCntrlEntry. If the
 value of this object is 'permanent', no objects in this row
 need to be writable."

::= { tpmAggrReportCntrlEntry 15 }

tpmAggrReportCntrlStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The status of this performance control entry.

An entry may not exist in the active state unless each
 object in the entry has an appropriate value.

If the tpmAggrReportCntrlApmCntrlIndex is non-zero,
 then this object should be set by the agent to the value
 of the apmReportControlReportNumber object.

Once this object is set to active(1), no objects in the
 tpmAggrReportCntrlTable can be changed.

If this object is not equal to active(1), all associated
 entries in the tpmAggrReportTable shall be deleted."

::= { tpmAggrReportCntrlEntry 16 }

--

-- Transport Aggregate Report Table

--

tpmAggrReportTable OBJECT-TYPE

SYNTAX SEQUENCE OF TpmAggrReportEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table contains transport performance metric
 studies for each of the control table entries in
 tpmAggrReportCntrlTable. These studies are

provided based on the selections and parameters found for the entry in the tpmAggregateReportCntrlTable.

The performance statistics are specified in the tpmTransMetricDirTable associated with the application in question and indexed by appLocalIndex and tpmTransMetricIndex."

::= { tpmReports 2 }

tpmAggrReportEntry OBJECT-TYPE

SYNTAX TpmAggrReportEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row in the tpmAggrReportTable.

The tpmAggrReportCntrlIndex value in the index identifies the tpmAggrReportCntrlEntry on whose behalf this entry was created.

The tpmAggrReportIndex value in the index identifies which report (in the series of reports) this entry is a part of.

The tpmAggrReportAppLocalIndex value in the index identifies the application protocol that is being reported.

The tpmTransMetricIndex value in the index identifies the transaction protocol-metric pair for the traffic flows aggregated in this entry.

The protocolDirLocalIndex value in the index identifies the network layer protocol of the tpmAggrReportServerAddress. When the associated tpmAggrReportCntrlAggrType value is equal to applications(4) or clients(2), this value will equal 0.

The tpmAggrReportServerAddress value in the index identifies the network layer address of the server in traffic flows aggregated in this entry.

The tpmAggrReportApmNameClientID value in the index identifies the client in traffic flows aggregated in this entry. If the associated tpmAggrReportCntrlAggrType is equal to applications(4) or servers(3), then this object will be set to 0.

An example of the indexing of this entry is
tpmAggrReportStatN.3.15.34.262.18.4.128.2.6.7.3256521"

```

INDEX { tpmAggrReportCntrlIndex,
        tpmAggrReportIndex,
        tpmAggrReportAppLocalIndex,           -- Application Layer
        tpmAggrReportTransMetricIndex,       -- Metric and Protocol
        protocolDirLocalIndex,               -- Network Layer
        tpmAggrReportServerAddress,
        tpmAggrReportApmNameClientID
      }
 ::= { tpmAggrReportTable 1 }

TpmAggrReportEntry ::= SEQUENCE {
  tpmAggrReportIndex                Unsigned32,
  tpmAggrReportAppLocalIndex        AppLocalIndex,
  tpmAggrReportTransMetricIndex     TpmTransactionMetricIndex,
  tpmAggrReportServerAddress        OCTET STRING,
  tpmAggrReportApmNameClientID      RmonClientID,
  tpmAggrReportStatN                ZeroBasedCounter32,
  tpmAggrReportOverflowStatN        ZeroBasedCounter32,
  tpmAggrReportHCStatN              ZeroBasedCounter64,
  tpmAggrReportStatSumX             ZeroBasedCounter32,
  tpmAggrReportOverflowStatSumX     ZeroBasedCounter32,
  tpmAggrReportHCStatSumX           ZeroBasedCounter64,
  tpmAggrReportStatMaximum          ZeroBasedCounter32,
  tpmAggrReportStatMinimum          ZeroBasedCounter32,
  tpmAggrReportStatSumSq            ZeroBasedCounter32,
  tpmAggrReportOverflowStatSumSq    ZeroBasedCounter32,
  tpmAggrReportHCStatSumSq          ZeroBasedCounter64,
  tpmAggrReportStatSumIX            ZeroBasedCounter32,
  tpmAggrReportOverflowStatSumIX    ZeroBasedCounter32,
  tpmAggrReportHCStatSumIX          ZeroBasedCounter64,
  tpmAggrReportStatSumIXSq          ZeroBasedCounter32,
  tpmAggrReportOverflowStatSumIXSq  ZeroBasedCounter32,
  tpmAggrReportHCStatSumIXSq        ZeroBasedCounter64
}

tpmAggrReportIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..2147483647)
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "The value of tpmAggrReportCntrlNumber for the report to
        which this entry belongs."
    ::= { tpmAggrReportEntry 1 }

tpmAggrReportAppLocalIndex OBJECT-TYPE
    SYNTAX      AppLocalIndex
    MAX-ACCESS   not-accessible
    STATUS       current

```

DESCRIPTION

"The common application of the transactions aggregated in this entry."

::= { tpmAggrReportEntry 2 }

tpmAggrReportTransMetricIndex OBJECT-TYPE

SYNTAX TpmTransactionMetricIndex

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A unique index that identifies the transaction and metric associated with the statistics reported here."

::= { tpmAggrReportEntry 3 }

tpmAggrReportServerAddress OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (0..108))

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The network layer address of the server host in this conversation."

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

Because 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 IPv4, this object is encoded as a length octet of 4, followed by the 4 octets of the IPv4 address, in network byte order.

If the associated tpmAggrReportCntrlAggrType is equal to application(4) or client(2), then this object will be a null string and will be encoded simply as a length octet of 0."

::= { tpmAggrReportEntry 4 }

tpmAggrReportApmNameClientID 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."

::= { tpmAggrReportEntry 5 }

tpmAggrReportStatN OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The count of the total number of data points for the specified metric. This number always represents the total size of the statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results for one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmAggrReportEntry 6 }

tpmAggrReportOverflowStatN OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated tpmAggrReportStatN counter has overflowed. Note that this object will only be instantiated if the associated tpmAggrReportHCStatN object is also instantiated for a particular dataSource."

::= { tpmAggrReportEntry 7 }

tpmAggrReportHCStatN OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmAggrReportStatN. Note that this object will only be instantiated if the agent supports high-capacity monitoring for a particular dataSource."

::= { tpmAggrReportEntry 8 }

tpmAggrReportStatSumX OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The sum of all the data point values for the specified metric. This number always represents the total values of the statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmAggrReportEntry 9 }

tpmAggrReportOverflowStatSumX OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated tpmAggrReportStatSumX counter has overflowed. Note that this object will only be instantiated if the associated tpmAggrReportHCStatSumX object is also instantiated for a particular dataSource."

::= { tpmAggrReportEntry 10 }

tpmAggrReportHCStatSumX OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmAggrReportStatSumX. Note that this object will only be instantiated if the agent supports High Capacity monitoring for a particular dataSource."

::= { tpmAggrReportEntry 11 }

tpmAggrReportStatMaximum OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The single maximum data point value observed during the study period for the specified metric. This number always represents the maximum value of any single statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmAggrReportEntry 12 }

tpmAggrReportStatMinimum OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The single minimum data point value observed during the study period for the specified metric. This number always represents the minimum value of any single statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmAggrReportEntry 13 }

tpmAggrReportStatSumSq OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The sum of all the squared data point values for the specified metric. This number always represents the total of the squared values of the statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmAggrReportEntry 14 }

tpmAggrReportOverflowStatSumSq OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated tpmAggrReportStatSumSq counter has overflowed. Note that this object will only be instantiated if the associated tpmAggrReportHCStatSumSq object is also instantiated for a particular dataSource."

::= { tpmAggrReportEntry 15 }

tpmAggrReportHCStatSumSq OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmAggrReportStatSumSq. Note that this object will only be instantiated if the agent supports High Capacity monitoring for a particular

```

        dataSource."
 ::= { tpmAggrReportEntry 16 }

tpmAggrReportStatSumIX OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "For each interval, each data point is associated with a
        value I, I = 1..N where N is the number of data points;
        tpmAggrReportStatSumIX is the multiplication of the
        data point value with the current I. This value
        along with the other statistics values allow the
        calculation of the slope of the least-squares line
        through the data points."
 ::= { tpmAggrReportEntry 17 }

tpmAggrReportOverflowStatSumIX OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The number of times the associated
        tpmAggrReportStatSumIX counter has overflowed.
        Note that this object will only be instantiated if the
        associated tpmAggrReportHCStatSumIX object is also
        instantiated for a particular dataSource."
 ::= { tpmAggrReportEntry 18 }

tpmAggrReportHCStatSumIX OBJECT-TYPE
    SYNTAX      ZeroBasedCounter64
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The high-capacity version of tpmAggrReportStatSumIX.
        Note that this object will only be instantiated if the
        agent supports High Capacity monitoring for a particular
        dataSource."
 ::= { tpmAggrReportEntry 19 }

tpmAggrReportStatSumIXSq OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "For each interval, each data point is associated with a
        value I, I = 1..N where N is the number of data points;
        tpmAggrReportStatSumIXSq is the multiplication

```

of the data point value with the current I.
 This value along with the other statistics
 values allow the calculation of the slope of
 the least-squares line through the data points."

::= { tpmAggrReportEntry 20 }

tpmAggrReportOverflowStatSumIXSq OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated
 tpmAggrReportStatSumIXSq counter has overflowed.
 Note that this object will only be instantiated if the
 associated tpmAggrReportHCStatSumIXSq object is also
 instantiated for a particular dataSource."

::= { tpmAggrReportEntry 21 }

tpmAggrReportHCStatSumIXSq OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmAggrReportStatSumIXSq.
 Note that this object will only be instantiated if the
 agent supports High Capacity monitoring for a particular
 dataSource."

::= { tpmAggrReportEntry 22 }

--

-- The tpmCurrentReportsGroup

--

tpmCurReportTable OBJECT-TYPE

SYNTAX SEQUENCE OF TpmCurReportEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table will contain entries associated with an
 apmReportControlEntry that constitute a current 'snapshot'
 of the metrics being collected in association with
 a set of TPM-related application transactions.
 This table contains all sub-flow metrics for transactions
 that have been started but have not yet finished (i.e.,
 current) and a history of those that have finished (i.e.,
 completed). It may not always be obvious from the context
 whether a transaction is currently in-progress or has
 been completed. Therefore, the completion status of a

transaction is indicated by the value of the tpmCurReportCompletion object."
 ::= { tpmReports 3 }

tpmCurReportEntry OBJECT-TYPE

SYNTAX TpmCurReportEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row in the tpmCurReportTable.

The tpmAggrReportControlIndex value in the index identifies the tpmAggrReportCntrlEntry on whose behalf this entry was created. The tpmCurReportAppLocalIndex value in the index identifies the application protocol that is being reported. The protocolDirLocalIndex value in the index identifies the network layer protocol of the tpmAggrReportServerAddress. When the associated tpmAggrReportCntrlAggrType value is equal to applications(4), this value will equal 0. The tpmCurReportServerAddress value in the index identifies the network layer address of the server in traffic flows aggregated in this entry. The tpmCurReportCurrentApmNameClientID value in the index identifies the network layer address of the client in traffic flows aggregated in this entry. The tpmCurReportCurrentMetricIndex value in the index identifies the transported application protocol of the traffic flows aggregated in this entry.

Note that the order of protocolDirLocalIndex variables is the opposite of that in the RMON2 MIB (application.network instead of network.application); the report entries are sorted by application first, server second, and client third. The tpmCurReportCntrlIndex value in the index identifies the tpmAggrReportCntrlEntry on whose behalf this entry was created. The tpmCurReportMetricIndex value in the index identifies the metric and protocol of the tpmCurReportServerAddress, via the tpmTransMetricDir table.

An example of the indexing of this table is

```
tpmCurReportStatisticN.3.34.262.18.4.128.2.6.6.3256521.29667"
INDEX { tpmAggrReportCntrlIndex,
        tpmCurReportAppLocalIndex,          -- Application Layer
        tpmCurReportTransMetricIndex,      -- Metric and Protocol
        protocolDirLocalIndex,             -- Network Layer
        tpmCurReportServerAddress,
```

```

        tpmCurReportApmNameClientID,
        tpmCurReportApmTransactionID
    }
    ::= { tpmCurReportTable 1 }

TpmCurReportEntry ::= SEQUENCE {
    tpmCurReportAppLocalIndex          AppLocalIndex,
    tpmCurReportTransMetricIndex       TpmTransactionMetricIndex,
    tpmCurReportServerAddress          OCTET STRING,
    tpmCurReportApmNameClientID        RmonClientID,
    tpmCurReportApmTransactionID       Unsigned32,
    tpmCurReportMetricValue            ZeroBasedCounter32,
    tpmCurReportCompletion             INTEGER
}

tpmCurReportAppLocalIndex OBJECT-TYPE
    SYNTAX      AppLocalIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The common application of the transactions reported
        in this entry."
    ::= { tpmCurReportEntry 1 }

tpmCurReportTransMetricIndex OBJECT-TYPE
    SYNTAX      TpmTransactionMetricIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A unique index that identifies the transaction and
        metric associated with the statistics reported here."
    ::= { tpmCurReportEntry 2 }

tpmCurReportServerAddress OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (0..108))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The network server address for this tpmCurReportEntry.

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

        For example, if the protocolDirLocalIndex indicates an
        encapsulation of IPv4, this object is encoded as a length
        octet of 4, followed by the 4 octets of the IPv4 address,
        in network byte order."

```

```
::= { tpmCurReportEntry 3 }
```

```
tpmCurReportApmNameClientID 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."

```
::= { tpmCurReportEntry 4 }
```

```
tpmCurReportApmTransactionID 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, transaction-layer protocol and metric, and server and client addresses. Implementations may choose to use the value of the client's source port, when possible."

If the tpmAggrReportCntlApmCntlIndex is non-zero, then this object is set to the corresponding apmTransactionID object in the APM-MIB developed in the IETF's RMONMIB WG."

```
::= { tpmCurReportEntry 5 }
```

```
tpmCurReportMetricValue OBJECT-TYPE
```

```
SYNTAX      ZeroBasedCounter32
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
```

"The current value of the metric being evaluated. For some transaction types this value may be 0, e.g., the current round-trip time for a DNS query. For other transaction types, this will represent the current value of a continuously measured metric, e.g., the current throughput of an FTP transaction."

```
::= { tpmCurReportEntry 6 }
```

```
tpmCurReportCompletion OBJECT-TYPE
```

```
SYNTAX      INTEGER {
                    current(1),
                    completed(2)
                }
MAX-ACCESS   read-only
```


STATUS current

DESCRIPTION

"The status of this transaction. It is not always obvious from context whether a transaction is ongoing or completed. E.g., an ftp-GET transaction may last several minutes or hours, and a value found in the tpmCurReportMetricValue object lists to observed throughput for the transaction up to this point in time. The value of the tpmCurReportCompletion indicates whether the transaction has been completed."

::= { tpmCurReportEntry 7 }

tpmCurReportSize OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The maximum number of completed transactions desired to be retained in the tpmCurReportTable. 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 agent should consider this value to give a hint as to how many transactions to save. This is not a hard limit, just a hint to a maximum value of interest. If this value is reduced by the management station, the agent can take note, it may free some records, or it may do nothing.

The value of this object must persist across reboots."

::= { tpmReports 4 }

--

-- The tpmExceptionReportsGroup

--

tpmExcpReportTable OBJECT-TYPE

SYNTAX SEQUENCE OF TpmExcpReportEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table contains all sub-flow metrics for transactions that have been tagged by the apmExceptionTable filter as having had poor performance."

::= { tpmReports 5 }

tpmExcpReportEntry OBJECT-TYPE

SYNTAX TpmExcpReportEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION

"A conceptual row in the tpmExcpReportTable. This table contains aggregated information associated with exceptions counted in the apmExceptionTable. The information is aggregated in a manner identical to the aggregation in the tpmAggrReportTable, with the exception that data only from transactions associated with a flagged application is included.

The indexing into this table follows the indexing in the APM-MIB but adds the tpmTransMetricIndex to identify the sub-application transaction and metric pair."

INDEX { apmAppDirAppLocalIndex, -- Application
 apmAppDirResponsivenessType, -- Responsiveness Type
 apmExceptionIndex, -- Linkage to ApmExceptions
 tpmExcpReportTransMetricIndex -- Metric and Protocol
 }
 ::= { tpmExcpReportTable 1 }

TpmExcpReportEntry ::= SEQUENCE {
 tpmExcpReportTransMetricIndex TpmTransactionMetricIndex,
 tpmExcpReportStatN ZeroBasedCounter32,
 tpmExcpReportOverflowStatN ZeroBasedCounter32,
 tpmExcpReportHCStatN ZeroBasedCounter64,
 tpmExcpReportStatSumX ZeroBasedCounter32,
 tpmExcpReportOverflowStatSumX ZeroBasedCounter32,
 tpmExcpReportHCStatSumX ZeroBasedCounter64,
 tpmExcpReportStatMaximum ZeroBasedCounter32,
 tpmExcpReportStatMinimum ZeroBasedCounter32,
 tpmExcpReportStatSumSq ZeroBasedCounter32,
 tpmExcpReportOverflowStatSumSq ZeroBasedCounter32,
 tpmExcpReportHCStatSumSq ZeroBasedCounter64,
 tpmExcpReportStatSumIX ZeroBasedCounter32,
 tpmExcpReportOverflowStatSumIX ZeroBasedCounter32,
 tpmExcpReportHCStatSumIX ZeroBasedCounter64,
 tpmExcpReportStatSumIXSq ZeroBasedCounter32,
 tpmExcpReportOverflowStatSumIXSq ZeroBasedCounter32,
 tpmExcpReportHCStatSumIXSq ZeroBasedCounter64
 }

tpmExcpReportTransMetricIndex OBJECT-TYPE
 SYNTAX TpmTransactionMetricIndex
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION

"A unique index that identifies the transaction and metric associated with the data reported here."
 ::= { tpmExcpReportEntry 1 }

tpmExcpReportStatN OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The count of the total number of data points for the specified metric. This number always represents the total size of the statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmExcpReportEntry 2 }

tpmExcpReportOverflowStatN OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated tpmExcpReportStatN counter has overflowed. Note that this object will only be instantiated if the associated tpmExcpReportHCTestN object is also instantiated for a particular dataSource."

::= { tpmExcpReportEntry 3 }

tpmExcpReportHCTestN OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmExcpReportStatN. Note that this object will only be instantiated if the agent supports High Capacity monitoring for a particular dataSource."

::= { tpmExcpReportEntry 4 }

tpmExcpReportStatSumX OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The sum of all the data point values for the specified metric. This number always represents the total values

of the statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmExcpReportEntry 5 }

tpmExcpReportOverflowStatSumX OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated tpmExcpReportStatSumX counter has overflowed. Note that this object will only be instantiated if the associated tpmExcpReportHCStatSumX object is also instantiated for a particular dataSource."

::= { tpmExcpReportEntry 6 }

tpmExcpReportHCStatSumX OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmExcpReportStatSumX. Note that this object will only be instantiated if the agent supports High Capacity monitoring for a particular dataSource."

::= { tpmExcpReportEntry 7 }

tpmExcpReportStatMaximum OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The single maximum data point value observed during the study period for the specified metric. This number always represents the maximum value of any single statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmExcpReportEntry 8 }

tpmExcpReportStatMinimum OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The single minimum data point value observed during the study period for the specified metric. This number always represents the minimum value of any single statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmExcpReportEntry 9 }

tpmExcpReportStatSumSq OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The sum of all the squared data point values for the specified metric. This number always represents the total of the squared values of the statistical datum analyzed. Each metric specifies the exact meaning of this object.

This value represents the results of one metric and is related directly to the specific parameters of the metric and the Server and Client addresses involved."

::= { tpmExcpReportEntry 10 }

tpmExcpReportOverflowStatSumSq OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated tpmExcpReportStatSumSq counter has overflowed. Note that this object will only be instantiated if the associated tpmExcpReportHCTestSumSq object is also instantiated for a particular dataSource."

::= { tpmExcpReportEntry 11 }

tpmExcpReportHCTestSumSq OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmExcpReportStatSumSq.
Note that this object will only be instantiated if the
agent supports High Capacity monitoring for a particular
dataSource."

::= { tpmExcpReportEntry 12 }

tpmExcpReportStatSumIX OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"For each interval, each data point is associated with a
value I, I = 1..N where N is the number of data points;
tpmExcpReportStatSumIX is the multiplication of the
data point value with the current I. This value along with
the other statistics values allow the calculation of the
slope of the least-squares line through the data points."

::= { tpmExcpReportEntry 13 }

tpmExcpReportOverflowStatSumIX OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times the associated
tpmExcpReportStatSumIX counter has overflowed.
Note that this object will only be instantiated if the
associated tpmExcpReportHCStatSumIX object is also
instantiated for a particular dataSource."

::= { tpmExcpReportEntry 14 }

tpmExcpReportHCStatSumIX OBJECT-TYPE

SYNTAX ZeroBasedCounter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The high-capacity version of tpmExcpReportStatSumIX.
Note that this object will only be instantiated if the
agent supports High Capacity monitoring for a particular
dataSource."

::= { tpmExcpReportEntry 15 }

tpmExcpReportStatSumIXSq OBJECT-TYPE

SYNTAX ZeroBasedCounter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"For each interval, each data point is associated with a

```

        value I, I = 1..N where N is the number of data points;
        tpmExcpReportStatSumIXSq is the multiplication of the data
        point value with the current I. This value along with the
        other statistics values allow the calculation of the slope of
        the least-squares line through the data points."
 ::= { tpmExcpReportEntry 16 }

tpmExcpReportOverflowStatSumIXSq OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The number of times the associated
        tpmExcpReportStatSumIXSq counter has overflowed.
        Note that this object will only be instantiated if the
        associated tpmExcpReportHCStatSumIXSq object is also
        instantiated for a particular dataSource."
 ::= { tpmExcpReportEntry 17 }

tpmExcpReportHCStatSumIXSq OBJECT-TYPE
    SYNTAX      ZeroBasedCounter64
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The high-capacity version of tpmExcpReportStatSumIXSq.
        Note that this object will only be instantiated if the
        agent supports High Capacity monitoring for a particular
        dataSource."
 ::= { tpmExcpReportEntry 18 }

--
-- TPM Conformance
--

tpmMIBCompliances OBJECT IDENTIFIER ::= { tpmConformance 1 }
tpmGroups          OBJECT IDENTIFIER ::= { tpmConformance 2 }

--
-- TPM Compliance Statement
--

tpmMIBCompliance MODULE-COMPLIANCE
    STATUS       current
    DESCRIPTION
        "Describes the requirements for conformance to
        the TPM-MIB.

        This compliance statement defines the following

```

TPM-MIB implementation:

- tpmCapabilitiesGroup (minimum)
- tpmAggregateReportsGroup (minimum)
- tpmCurrentReportsGroup (optional)
- tpmExceptionReportsGroup (optional).

In order to implement the (optional) tpmExceptionReportsGroup, it is necessary to implement pieces of the APM-MIB as described in the tpmApmMIBCompliance MODULE below. Further, in the event that the TPM-MIB is used to provide a drill-down capability, which is the true value of this MIB, then the tpmApmReportControlGroup must be implemented."

MODULE -- this module

MANDATORY-GROUPS

```
{ tpmCapabilitiesGroup,
  tpmAggregateReportsGroup }
```

GROUP tpmCurrentReportsGroup

DESCRIPTION

"The implementation of this group is optional."

GROUP tpmExceptionReportsGroup

DESCRIPTION

"The implementation of this group is optional. However, because the control for this reporting group resides with the APM-MIB module, the apmReportGroup and the apmExceptionGroup must also be implemented."

```
::= { tpmMIBCompliances 1 }
```

--

-- tpmCurrentReportsGroup Compliance

--

tpmCurrentReportsCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"This defines the Current Reports compliance. This is useful when information on in-progress and historical transaction-level data is desired."

MODULE -- this module

MANDATORY-GROUPS

```
{ tpmCapabilitiesGroup,
```



```
        tpmAggregateReportsGroup,
        tpmCurrentReportsGroup }

 ::= { tpmMIBCompliances 2 }

--
-- tpmExceptionReportsGroup Compliance
--
tpmExceptionReportsCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "This defines the Exception Reports compliance.
        This is useful when information on
        transactions whose performance is deemed
        out-of-bounds."

    MODULE -- this module

    MANDATORY-GROUPS
        { tpmCapabilitiesGroup,
          tpmAggregateReportsGroup,
          tpmExceptionReportsGroup }

    MODULE APM-MIB

    MANDATORY-GROUPS
        { apmReportGroup,
          apmExceptionGroup }

 ::= { tpmMIBCompliances 3 }

--
-- TPM-MIB Groups
--

tpmCapabilitiesGroup OBJECT-GROUP
    OBJECTS { tpmClockResolution,
              tpmClockMaxSkew,
              tpmClockSource,
              tpmTransMetricDirLastChange,
              tpmTransMetricProtocolIndex,
              tpmTransMetricMetricIndex,
              tpmTransMetricDirConfig,
              tpmMetricDefType,
              tpmMetricDefDirType,
              tpmMetricDefName,
              tpmMetricDefReference,
              tpmMetricDefGlobalID }
```

STATUS current

DESCRIPTION

"The tpmCapabilitiesGroup specifies various capabilities associated with the monitoring agent."

::= { tpmGroups 1 }

tpmAggregateReportsGroup OBJECT-GROUP

OBJECTS { tpmAggrReportCntrlApmCntrlIndex,
tpmAggrReportCntrlDataSource,
tpmAggrReportCntrlAggrType,
tpmAggrReportCntrlInterval,
tpmAggrReportCntrlReqSize,
tpmAggrReportCntrlGrantedSize,
tpmAggrReportCntrlReqReports,
tpmAggrReportCntrlGrantedReports,
tpmAggrReportCntrlStartTime,
tpmAggrReportCntrlReportNumber,
tpmAggrReportCntrlInsertsDenied,
tpmAggrReportCntrlDroppedFrames,
tpmAggrReportCntrlOwner,
tpmAggrReportCntrlStorageType,
tpmAggrReportCntrlStatus,
tpmAggrReportStatN,
tpmAggrReportOverflowStatN,
tpmAggrReportHCStatN,
tpmAggrReportStatSumX,
tpmAggrReportOverflowStatSumX,
tpmAggrReportHCStatSumX,
tpmAggrReportStatMaximum,
tpmAggrReportStatMinimum,
tpmAggrReportStatSumSq,
tpmAggrReportOverflowStatSumSq,
tpmAggrReportHCStatSumSq,
tpmAggrReportStatSumIX,
tpmAggrReportOverflowStatSumIX,
tpmAggrReportHCStatSumIX,
tpmAggrReportStatSumIXSq,
tpmAggrReportOverflowStatSumIXSq,
tpmAggrReportHCStatSumIXSq }

STATUS current

DESCRIPTION

"The tpmAggregateReportsGroup provides control and reporting of aggregate measurement statistics."

::= { tpmGroups 2 }

tpmCurrentReportsGroup OBJECT-GROUP

OBJECTS { tpmCurReportMetricValue,

```

        tpmCurReportCompletion,
        tpmCurReportSize }
STATUS    current
DESCRIPTION
    "The tpmCurrentReportsGroup contains metric
    information relating to ongoing measurements
    as well as historical values."
::= { tpmGroups 3 }

tpmExceptionReportsGroup OBJECT-GROUP
OBJECTS { tpmExcpReportStatN,
          tpmExcpReportOverflowStatN,
          tpmExcpReportHCStatN,
          tpmExcpReportStatSumX,
          tpmExcpReportOverflowStatSumX,
          tpmExcpReportHCStatSumX,
          tpmExcpReportStatMaximum,
          tpmExcpReportStatMinimum,
          tpmExcpReportStatSumSq,
          tpmExcpReportOverflowStatSumSq,
          tpmExcpReportHCStatSumSq,
          tpmExcpReportStatSumIX,
          tpmExcpReportOverflowStatSumIX,
          tpmExcpReportHCStatSumIX,
          tpmExcpReportStatSumIXSq,
          tpmExcpReportOverflowStatSumIXSq,
          tpmExcpReportHCStatSumIXSq }
STATUS    current
DESCRIPTION
    "The tpmExceptionReportsGroup reports
    sub-application level statistics associated
    with errant applications."
::= { tpmGroups 4 }

END

```

5. Acknowledgements

This memo has been produced with a great deal of assistance from David Craver, Joseph Maixner, and John Metzger of Hifn, Inc. The authors also gratefully acknowledge the beneficial discussions they have had with Carter Bullard of QoSient, LLC. The tpmMetricDefTable was taken from Andy Bierman's performance management capabilities document, which was proposed early on in the RMON WG during the formation of the TPM and APM MIB work. Finally, this MIB module draws heavily from the work of Steve Waldbusser and his APM-MIB [RFC3729].

6. Security Considerations

This MIB relates to a system that provides a passive monitoring capability of a broadcast subnet, a switched subnet, or point-to-point subnets. As such, it collects information relating to network layer addresses and traffic statistics relating to conversations and to application-level activities. These statistics could be deemed sensitive in certain networking environments.

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. These are the tables and objects and their sensitivity/vulnerability:

- + The `tpmTransMetricDirConfig` object describes and configures the probe's support for a given performance metric in relation to a specified transaction and application. The agent creates entries in this table for all metric and transaction combinations that it can generate, and this object controls the on/off switch for this capability. If certain statistics for a supported transaction are deemed sensitive, then access to SET operations on this object should be protected.
- + The `tpmAggrReportCntrlDataSource` sets the interface on which the network addresses and conversational and application-level statistics will be collected.
- + The `tpmAggrReportCntrlAggrType` object controls the level of data aggregation implemented in the report tables. For example, this object could be set to allow client-level information to be exposed.

In order to implement this MIB module, an agent must make certain management information available about protocols and network addresses used within a managed system, which may be considered sensitive in some network environments. Therefore 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. These are the tables and objects and their sensitivity/vulnerability:

- + The tpmAggrReportTable contains the statistical studies which the probe was configured to generate. These tables contain the historical, aggregated data providing information on the network address and traffic statistics related to their conversations.
- + The tpmCurReportTable contains information on current transaction flows. This table provides a view of the current activity on a subnet or a client machine.

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 [RFC3410], 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.

7. Normative References

- [RFC2021] Waldbusser, S., "Remote Network Monitoring Management Information Base Version 2 using SMIV2", RFC 2021, January 1997.
- [RFC2026] Bradner, S., "The Internet Standards Process -- Revision 3", BCP 9, RFC 2026, October 1996.
- [RFC2578] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., and S. Waldbusser, "Structure of Management Information Version 2 (SMIV2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., and S. Waldbusser, "Textual Conventions for SMIV2", STD 58, RFC 2579, April 1999.

- [RFC2580] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., and S. Waldbusser, "Conformance Statements for SMIV2", STD 58, RFC 2580, April 1999.
- [RFC2819] Waldbusser, S., "Remote Network Monitoring MIB", STD 59, RFC 2819, May 2000.
- [RFC2856] Bierman, A., McCloghrie, K., and R. Presuhn, "Textual Conventions for Additional High Capacity Data Types", RFC 2856, June 2000.
- [RFC2895] Bierman, A., Bucci, C., and R. Iddon, "Remote Network Monitoring MIB Protocol Identifiers", RFC 2895, August 2000.
- [RFC3273] Waldbusser, S., "Remote Network Monitoring Management Information Base for High Capacity Networks", RFC 3273, July 2002.
- [RFC3395] Bierman, A., Bucci, C., Dietz, R., and A. Warth "Remote Network Monitoring MIB Protocol Identifiers Reference Extensions", RFC 3395, September 2002.
- [RFC3411] Harrington, D., Presuhn, R., and B. Wijnen, "An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks", RFC 3411, December 2002.
- [RFC3729] Waldbusser, S., "Application Performance Measurement MIB", RFC 3729, March 2004.
- [RFC4149] Kalbfleisch, K., Cole, R., and D. Romascanu, "Definition of Managed Objects for Synthetic Sources for Performance Monitoring Algorithms", RFC 4149, August 2005.
- [RFC4148] Stephan, E., "IP Performance Metrics (IPPM) Metrics Registry", RFC 4148, August 2005.

8. Informative References

- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.
- [Y.1540] The ITU-T Recommendation Y.1540, "IP Data Transport Service - IP packet transfer performance metrics", ITU-T Rec. Y.1540, December 2002.

- [RFC2679] Almes, G., Kalidindi, S., and M. Zekauskas, "A One-way Delay Metric for IPPM", RFC 2679, September 1999.
- [RFC2680] Almes, G., Kalidindi, S., and M. Zekauskas, "A One-Way Packet Loss Metric for IPPM" RFC 2680, September 1999.
- [RFC2681] Almes, G., Kalidindi, S., and M. Zekauskas, "A Round-Trip Delay Metric for IPPM", RFC 2681, September 1999.
- [RFC3393] Demichelis, C. and P. Chimento, "IP Packet Delay Variation Metric for IP Performance Metrics (IPPM)", RFC 3393, November 2002.
- [RFC3432] Raisanen, V., Grotefeld, G., and A. Morton, "Network Performance Measurement with Periodic Streams", RFC 3432, November 2002.

Authors' Addresses

Russell Dietz
Hifn, Inc.
750 University Ave
Los Gatos, CA, USA 95032-7695

Tel: +1 408 399-3623
Fax: +1 408 399-3501
EMail: rdietz@hifn.com

Robert Cole
Johns Hopkins University Applied Physics Laboratory
MP2-170
11100 Johns Hopkins Road
Laurel, MD 20723-6099
USA

Tel: +1 443-778-6951
EMail: robert.cole@jhuapl.edu

Full Copyright Statement

Copyright (C) The Internet Society (2005).

This document is subject to the rights, licenses and restrictions contained in BCP 78, and except as set forth therein, the authors retain all their rights.

This document and the information contained herein are provided on an "AS IS" basis and THE CONTRIBUTOR, THE ORGANIZATION HE/SHE REPRESENTS OR IS SPONSORED BY (IF ANY), THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Intellectual Property

The IETF takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights. Information on the procedures with respect to rights in RFC documents can be found in BCP 78 and BCP 79.

Copies of IPR disclosures made to the IETF Secretariat and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this specification can be obtained from the IETF on-line IPR repository at <http://www.ietf.org/ipr>.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard. Please address the information to the IETF at ietf-ipr@ietf.org.

Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

