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IP Performance Metrics (IPPM) reporting Information Base (MIB)
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Status of this Memo

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Abstract

This memo defines a portion of the Management Information Base (MIB) designed for use with network management protocols in TCP/IP-based internets. In particular, this MIB specifies the objects used for

managing the results of the IPPM metrics measures, for pushing alarms, and for reporting the measures results.

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1. Introduction

This memo defines a MIB for managing network measurements based upon the IP performance metrics specified by the IPPM Working Group.

The definition of objects in the IPPM MIB are built on notions introduced and discussed in the IPPM Framework document, RFC 2330 [RFC2330].

This memo defines a Management Information Base (MIB), and as such it is intended to be respectful of the "Boilerplate for IETF MIBs" defined in http://www.ops.ietf.org/mib-boilerplate.html.

There are companion documents to the IPPM-REPORTING-MIB both in the Transport Area (See section 2), and in the Operations and Management Area (See section 3). The reader should be familiar with these documents.

2. The IPPM Framework

The IPPM Framework consists of 3 major components:

o A general framework for defining performance metrics, as described in the Framework for IP Performance Metrics, RFC 2330 [RFC2330];

o A set of standardized metrics which conform to this framework:

  * IPPM Metrics for Measuring Connectivity, RFC 2678 [RFC2678];

  * One-way Delay Metrics, RFC 2679 [RFC2679];

  * One-way Packet Loss Metrics, RFC 2680 [RFC2680];

  * Round-trip Delay Metrics, RFC 2681 [RFC2681];

  * One-way Loss Pattern Sample Metrics, RFC 3357 [RFC3357];

- IP Packet Delay Variation Metric, RFC 3393 [RFC3393];

- IPPM Metrics for periodic streams, RFC 3432 [RFC3432];

- Emerging metrics that are being specified in respect of this framework.

3. 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];.

4. Overview

Although the number of measurement devices that implement IPPM metrics is growing, there is not currently any standardized management interface to manage remotely the measurement of these metrics. This memo defines a Management Information Base for managing the measurement of IPPM metrics.

To permit metrics to be referenced by other MIBs and other protocols, the IPPM WG has defined a registry of the current metrics and a framework for the integration of future metrics in the [IPPM metrics registry].

As the specification of new metrics is a continuous process, this memo defines a framework for the integration of the future standardized metrics.

The IPPM-REPORTING-MIB introduces a framework where each application identifies its measures in an owner namespace. The administrator may grant access to a measure, or set of measures to another owner via view based access control. As a result, one owner may compute aggregated metrics on another owner's network measures.

Different architectures may be used to perform metric measurements, using a control protocol and a test protocol. Different control frameworks are suitable for performing measurements. The memo lists them, while also looking for a way to integrate them with the IPPM-REPORTING-MIB. This section is for informational purposes only, and is intended to help specify the relationship among the test protocol, the control protocol and the IPPM-REPORTING-MIB.

Special care has been taken to provide a reporting mode suitable for control protocols and test protocols. It addresses the need to provide access to results for the applications.

This MIB is intended to handle multiple concurrent sessions by SNMP applications. However, the SNMP requests are not necessarily to be handled explicitly by the measurement devices, but can be sent to middleware performing an aggregation function. This allows for continuous collection of measurements and statistics computation.

4.1 Textual Conventions

Eight types of data are introduced as textual conventions in this document: IppmOwnerString, IppmOwnerIndex, TimeUnit, PacketType, PacketTypeAddress, GMTTimeStamp, IppmStandardMetrics and IppmMetricResultFilter.

4.1.1 OwnerString

This octet string is used to represent the owners of the various measures and reports in the measurement system.

4.1.2 IppmOwnerIndex

This integer identifies an instance of an object in an owner namespace.

4.1.3 TimeUnit

This textual convention is used to indicate a unit of time, ranging from nanosecond, microsecond, millisecond, second, hour, day, and week.

4.1.4 PacketType and PacketTypeAddres

Section 13 of the IPPM framework [2] introduces the generic notion of a "packet of type P", because in some contexts the metric's value depends on the type of the packets involved in the metric. In the definition of a metric, the type P will be explicitly defined, partially defined, or left generic. Measurement of metrics defined with generic type P are made specific when performing actual measurements. It is important that one be conscious of the exact type of traffic being measured.

The standardization of the management of IPPM measures relies on the capability to unambiguously configure the type P of the packets, and the parameters of the protocol suites of the type P.

RMON2 introduced the concept of protocol identifiers. RFC2895 [xxv] specifies a macro for the definition of protocol identifier. The RFC2896 [xxvi] defines the protocol identifiers for different protocol encapsulation trees.

The type P implementation relies on the MACRO PROTOCOL-IDENTIFIER defined for identifying protocol suites in RMON2. It is achieved by defining the PacketType and the PacketTypeAddress as new syntax in SMIv2 TEXTUAL-CONVENTION.

4.1.4.1 Internet addresses

The section 14 of the IPPM framework defines (for the usual case of a unidirectional path through the Internet) the term "Src" and "Dst". "Src" denotes the IP address of the beginning of the path, and "Dst" denotes the IP address of the end.

The section 3 of the RMON PI Reference specifies the Protocol Identifier Encoding rules, which consists briefly in a recursive length value format. "Src" and "Dst" are protocol identifier parameters. Their values are encoded in separated fields using the encoding rules of the protocol identifier, but without trailing parameters.

The packet encapsulation defined in an instance of PacketType embeds the format of "Src" and "Dst" and their values. The type and value of these addresses depend on the type P of the packet, IP version 4, IPV6, IP in IP... Both participate in the completion of the packet encoding.

Examples:

RFC2896 defines the protocol identifiers ip and ipip4. Should there be an Internet tunnel end-point of the IP address 192.168.1.1 in the tunnel 128.2.6.7. the PacketType of the source address of the tunnel, Src, is 'ip.ipip4'. The encoding of 'ip.ipip4' using the RFC2895 rules adds a trailer 2.0.0. It means that an instance of this protocol identifier has 2 parameters, which values will be set only when implemented. In the IPPM PacketType context these 2 parameters are provided in Src (or Dst). In the current example the value of Src is "192.168.1.1 128.2.6.7".

4.1.5 GMTTimeStamp

This textual convention defines the time at which an event occurred.

It is very similar to the NTP timestamp format except that it represents the time elapsed since January 1st, 2000 instead of January 1st, 1900.

4.1.6 IppmStandardMetrics

Each standard metric is identified in the IPPM-METRICS-REGISTRY under the node rfc in chronological order. This textual convention defines an octet string to permit several metrics to be performed in a single measure.

4.1.7 Report definition

A report consists of sending, or logging, a subset of results of measurements that have been taken over a period of time. The report defines actions that are taken on the measurement results. An action is performed either:

For each result;

On the results corresponding to a measurement cycle;

On the results available at the measurement completion.

To preserve the scalability of the whole measurement system, it limits:

The amount of data sent to the applications;

The bandwidth consumption for uploading the result;

The number of alarms sent to the applications;

The amount of data saved in the point of measure.

Metric thresholds (low, high, inband, outband...) may be defined that indicate when measure values should be reported. These values and their associated time may directly impact service availability.

One may also want to report when particular values (i.e. constantly over a threshold) repeatedly occur over a period of time. For example, if one-way-day is constantly over a specified acceptable threshold value for 10 minutes, then the values should be reported.

The combination of IPPM metric results, threshold events, and event filtering provides a very efficient mechanism to report measurement results, events, and alarms.

A report is described using the TEXTUAL-CONVENTION IppmMetricResultFilter. The report setup must not dramatically increase the amount of data needed by the control protocol to setup a measure:

A basic report is defined in the object ippmAggrMeasureFilter;

More elaborate reports are described using a metric threshold to generate alarms and events;

The generation of alarms and reports requires a management station address to which the data will be sent;

SLA alarms are described using an events duration threshold.

The TEXTUAL-CONVENTION IppmMetricResultFilter specifies the list of events and actions that are used to create a report.

4.2 Structure of the MIB

The MIB is arranged as follow:

```
   ippmSystem Group:

      ippmPointOfMeasureTable;

      ippmSynchronizationTable;

      ippmMetricsTable.

   ippmOwners Group:

      ippmOwnersTable;

   ippmHistory Group:

      ippmHistoryTable;

   ippmNetMeasure Group:

      ippmNetMeasureTable;
```

ippmAggrMeasure Group:

ippmAggrMeasureTable.

ippmNotifications

4.2.1 The ippmSystem Group

The implementation of this group is mandatory.

This group consists of a set of parameters describing the clock synchronization at a particular point of measure over time, as well as the system clock of the IPPM-REPORTING-MIB agent.

The table ippmPointOfMeasureTable describes the points of measure.

The table ippmSynchronisationTable is critical to the implementation, especially to be respectful of the Section 6.3. of the IPPM Framework, which states that "Those who develop such measurement methodologies should strive to:

Minimize their uncertainties/errors,

Understand and document the sources of uncertainty/error, and

Quantify the amounts of uncertainty/error."

Consequently the table ippmSynchronisationTable makes these values available to compute reliable statistics.

The table ippmMetricsTable list all the IPPM metrics using the registry order and describes their implementation (unit...).

4.2.1.1 The ippmOwners Group

This group identifies an owner, or group of owners, that have access to measurements on a probe.

4.2.2 The ippmHistory Group

The results of any given measure are stored in the ippmHistoryTable. The indexing is such that there is an entry in this table for each result of a given measure for a given metric.

4.2.3 The ippmNetMeasure Group

The control protocol registers a description of the existing network measures in the ippmNetMeasureTable.

This group displays the network measures defined by the control protocol. The results are saved in the ippmHistoryTable.

ippmNetMeasureTable is a reflection of the configuration of the network measure.

4.2.4 The ippmAggrMeasure Group

ippmAggrMeasureTable is responsible for the aggregation of results. The aggregated results are saved in the ippmHistoryTable and may be used for higher aggregated measures.

4.2.5 The Notification Group

The Notification group specifies a list of valid notifications. They are used to generate alarms, or reports, to management applications.

4.3 Row identification in an application namespace

IPPM metrics measurement is a distributed task. An owner namespace is defined to avoid the need of polling to determine the next free index, to avoid index collision when 2 applications are looking for a new index as the same time; to increase the speed of the management operations; to reduce bandwidth consumption and to reduce CPU load in the agents and applications.

In a MIB, an object instance identifier is defined by the clause INDEX of the table as a list of objects.

The owner namespace is defined in the INDEX as a couple of 2 objects where the type of first one is IppmOwnerString and the type of the second is IppmOwnerIndex.

The first term of the instance identifier is the name of the owner. The second term is an private index managed by the owner. This index value is unique in an owner namespace. Before the creation of an instance the creator pick up an IppmOwnerIndex value not in use.

This allows the user to choose arbitrary values for the remaining fields of the INDEX clause without checking that the values of these fields exists in the MIB tables. Moreover this allows the owner to use the same instance identifier over a set of IPPM MIB implementations.

Measurements are requested by management applications. An instance of an object managed by a management station is identified by the management station IppmOwnerString and the private index provided by the MS.

4.4 Relationship of IPPM REPORTING MIB tables

There is inherently a relationship between various tables in the IPPM REPORTING MIB, and as such, the data integrity must be assured. This relationship is depicted in the following examples.

4.4.1 Relationship between the Owners Table and the aggregated measure table

The owners table contains the list of "owners" that can create and activate remotely aggregated measures in an IPPM agent, or read the existing network measures.

It is recommended to make use of "view based access control" in order to restrict access to this table. For example, the master user "administrator" may be given "write" privileges on the ippmOwnersTable, whereas all others are restricted to "read" access. The user "administrator" can then setup the list of other users that have access to measures.

There must be at least 1 owner in the owners' table. This owner may be either setup by default by the IPPM agent, or configured as stated above.

An owner may have multiple corresponding entries in the network and aggregated measure tables. Each entry in a measure table is associated with one, and only one, entry in the owners' table. That is to say, that a defined measure may NOT have multiple owners.

Thus, we have a 1:N relationship between the owners' table and a measure table.

4.4.2 Relationship between the Network Measure Table and the Aggregated Measure Table

The network measure table is read-only, thus entries in this table must be populated by the agent upon startup.

The agent could potentially read a database that contains network measures configured by a 3rd party proprietary management system that directly interacts with the points of measure. However, the "owner" of the measure must be defined in the owners table. It may be either configured directly, or exported to the agent by the external measurement tool.

The aggregated measure table allows for an "owner" to create aggregated measures (such as average, minimum, maximum...) on existing measures. An owner may even create aggregated measures on network measures that are owned by other owners. However, it is recommended to use view based access control to grant access of network measures to other owners in the system.

5. Measurement architectures

There are three main measurement architectures.

5.1 Proxy architecture

```
            +----+                        +----+
            |NMS1|                        |NMS2|
            +----+                        +----+
              ^                            ^
              |                            |
              +----------+     +----------+
                         |     |
                   SNMP or Sibling
                         |     |
                         v     v
                +--------------------------+
                | IPPM-REPORTING-MIB agent |
                +--------------------------+
                         ^     ^
                         |     |
                     OWDP-Control
                         |     |
              +----------+     +----------+
              |                            |
              v                            v
   +----------------+              +------------------+
   | Packets-Sender |--OWDP-Test-->| Packets-Receiver |
   +----------------+              +------------------+
```

In this architecture, the different NMS's query the IPPM-REPORTING-MIB agent for measurements. The agent controls whether the NMS is granted access to perform the measure requested. Each NMS may access the results of its measurements in the IPPM-REPORTING-MIB history table.

The measurement setup/teardown and the data collection are done using the control protocol and the test protocol.

In this mode the NMS does not depend on the control protocol nor on the test protocol. The entities involved in the measurement do not need to implement the IPPM-REPORTING-MIB nor SNMP. This mode allows for lightweight implementation in the point of measure, and also for heterogeneous control protocols to coexist.

Finally, the proxy is a checkpoint where measurement activity may be logged, and where access to measurement setups may be tightly controlled. Thus, it provides a reliable architecture to manage the security of a measurement system.

5.2 Reporting architecture

In this architecture the SNMP protocol is only used to read the results of the measurements in the IPPM-REPORTING-MIB History Table, and also to inform the NMS that an event has occurred.

```
          +----+                               +----+
          |NMS1|                               |NMS2|
          +----+                               +----+
           ^  ^                                 ^  ^
           |  |                                 |  |
          SNMP|                                SNMP|
           |  |                                 |  |
           |  |                                 |  |
           | OWDP                               | OWDP
           |Control                             |Control
           |  |                                 |  |
           |  |     +------------------------------+
           |  |     |                           |  |
           |  |  +--|---------------------------+  |
           |  |  |  |                           |  |
           |  +--|--|------------------------+  |  |
           |  |  |  |                        |  |  |
           +--------+---------------------+  |  |
           |  |  |  |                     |  |  |  |
           |  |  |  |                     |  |  |  |
           v  v  v  v                     v  v  v  v
    +------------------+              +------------------+
    |IPPM-REPORTING-MIB|              |IPPM-REPORTING-MIB|
    |   agent          |              |     agent        |
    +------------------+              +------------------+
    |  Packets-Sender  |--OWDP-Test-->| Packets-Receiver |
    +------------------+              +------------------+
```

The activation of a measure by the control protocol or the test protocol creates a measure in the IPPM-REPORTING-MIB Network Measure table. The table in question may be not accessible by SNMP. In this case, a list of the measure identifiers (owner, index) is handled by the measurement software.

Each timestamped result of the measure is logged in the IPPM-REPORTING-MIB History table in order to allow read access to the

NMS's and event handling.

On completion, the measurement results are managed according to the measure setup:

The results may be sent to an NMS;

They may be dropped from the IPPM-REPORTING-MIB History table.

In this mode, it is recommended to use an SNMPv2 Inform PDU to send reporting events because it ensures that the entire block of the result is received. There is no control using SNMP Trap PDU.

5.3 Gateway architecture

The gateway architecture combines the proxy mode and the reporting mode.

```
         +--------+                               +------+
         | NMS1   |                               | NMS2 |
         +--------+                               +------+
           ^                                           ^
           |                                           |
         SNMP                                         SNMP
           |                                           |
           |  +----------------------------------------+
           |  |                                        |
           +-------------+          +------------------+
           |  |          |          |                  |
           +----------------------------------------+  |
           |  |          |          |               |  |
           |  |          v          v               |  |
           |  |     +------------------------+      |  |
           |  |     |  IPPM-REPORTING-MIB    |      |  |
           |  |     |       Gateway          |      |  |
           |  |     +------------------------+      |  |
           |  |     |    control server      |      |  |
           |  |     +------------------------+      |  |
           |  |          ^          ^               |  |
           |  |          |          |               |  |
           |  |      OWDP-Control protocol          |  |
           |  |          |          |               |  |
           |  |    +-----+          +-------+       |  |
           |  |    |                        |       |  |
           v  v    v                        v       v  v
    +-------------+---------+            +--------+-------------+
    |    IPPM-    | Packets |            |Packets |   IPPM      |
    |REPORTING-MIB| Sender  |            |Receiver|REPORTING-MIB|
    |  agent      |         |-OWDP-Test->|        |   agent     |
    +-------------+---------+            +--------+-------------+
```

The NMS measurement queries are registered in the IPPM-REPORTING-MIB gateway and performed by the control and the test protocol. The NMS directly consults the result in the corresponding IPPM REPORTING MIB agent of the points of measure.

5.4 Security

The proxy mode provides flexibility and control of the access to the points of measure, while allowing lightweight control protocol and test protocol implementations in the points of measure. Different security rules may be applied to the NMS domain and to measurement system domains.

The reporting mode has 2 security domains:

The control of the measurement setup relies on the control and the test protocol security mechanisms;

The control of access to the results depends on the SNMP security mechanisms such as community strings, but may also be restricted using VACM for customized access.

The gateway mode security relies on the security of the proxy mode and of the reporting mode.

6. Reporting mode integration

The IPPM-REPORTING-MIB standardizes the parameters that:

Define the configuration of the IPPM metric measures;

Define the format of the results of the measure;

Define the report of the IPPM metric measure results.

It introduces the concept of owner namespace to allow for fast configuration and reporting across multiple points of measurement.

A measure is a distributed object describing a task to be performed by the control and the test protocols. A measure is identified by its owner and its owner index. This identifier is the same in all the points of measure. As the owner chooses the index, there is no need for negotiation between the NMS and the points of measure before activating the measure.

A measure is primarily defined by its identifier, the metrics to measure, the description of the end point addresses and the description of the scheduling of the measure.

The description of the measure is distributed to the points of measure involved. The distribution may not be synchronized.

6.1 Integration

The integration of the IPPM-REPORTING-MIB, and the test and control protocols consists in pushing the network measure setup/teardown parameters and the result values from the measurement software to the IPPM-REPORTING-MIB agent.

6.2 Setup of the network measure table

The measurement system updates the MIB on creation of a network measure.

6.3 Setup of the aggregated measure table

There are 2 ways to setup an aggregated measure: The measurement system updates the MIB on creation of an aggregated measure; An SNMP application creates an aggregated measure.

6.4 Updating the history of the MIB

Results have to be written by the measurement task in the agent implementing the IPPM REPORTING MIB.

Adding the results of a measurement consists in the transfer of the result from the measurement software to the SNMP agent. The protocol that provides the result may be the control protocol, or the test protocol, or another mechanism.

6.5 Default value

The default values correspond to IP version 4.

7. Definition

```
      IPPM-REPORTING-MIB DEFINITIONS ::= BEGIN


      IMPORTS
      mib-2,
      MODULE-IDENTITY,
      NOTIFICATION-TYPE,
      OBJECT-TYPE,
      Integer32, zeroDotZero, Counter64, Unsigned32
          FROM SNMPv2-SMI
      InetAddressType,
      InetAddress
          FROM INET-ADDRESS-MIB
      SnmpAdminString
          FROM SNMP-FRAMEWORK-MIB
      RowStatus,
      StorageType,
      TEXTUAL-CONVENTION
          FROM SNMPv2-TC
      MODULE-COMPLIANCE,
      OBJECT-GROUP,
      NOTIFICATION-GROUP
          FROM SNMPv2-CONF;






   ippm MODULE-IDENTITY
      LAST-UPDATED "200407151200Z" --  15 July 2004
      ORGANIZATION "IP Performance Metrics (ippm) Working Group"
      CONTACT-INFO
        "Emile Stephan
        France Telecom - R&D
        E-mail: emile.stephan@francetelecom.com


        Jessie Jewitt
        France Telecom - R&D
        E-mail : jessie.jewitt@rd.francetelecom.com
```

```
          Comments about this document should be send to the IPPM
          working group mailing list at ippm@ietf.org.
          "
        DESCRIPTION
            "This memo defines a portion of the Management Information
            Base (MIB) for use with network management protocols in
            TCP/IP-based internets. In particular, it specifies the
            objects used for managing the results of the IPPM metrics
            measurements, alarms and reporting of measurement results."

        REVISION "200210181200Z" -- 18 October 2002
        DESCRIPTION
            "General cleanup
            Change 5 tables to read write"

        REVISION "200302141200Z" --  14 February 2003
        DESCRIPTION
            "Modifications based upon feedback from IETF-55"

        REVISION "200306291200Z" --  29 June 2003
        DESCRIPTION
            "Adaptation to VACM, preparation of the final version"

        REVISION "200310241200Z" --  24 October 2003
        DESCRIPTION
            "Modifications based upon feedback from experimental
            implementation."

        REVISION "200402121200Z" --  12 February 2004
        DESCRIPTION
            "Modifications based upon feedback 58th IETF: The report
            group and the corresponding notification are removed."

        REVISION "200407151200Z" --  15 July 2004
        DESCRIPTION
            "Rewritten in XML and Clean up."

        ::= { mib-2 XXX }
        -- RFC Ed.: replace XXX with IANA-assigned number
        --          & remove this note
```

```
   --
   -- TEXTUAL-CONVENTION


   --


   IppmOwnerString ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
          "The owner namespace is defined in the INDEX of a table as a
          couple of 2 objects where the type of the first one is
          IppmOwnerString and the type of the second is IppmOwnerIndex.
          IppmOwnerString is an OwnerString which length is limited to
          32 bytes."
      SYNTAX OCTET STRING (SIZE (0..32))









   IppmOwnerIndex ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
          "The owner namespace is defined in the INDEX of a table as a
          couple of 2 objects where the type of first one is
          IppmOwnerString and the type of the second is IppmOwnerIndex.
          An object of type IppmOwnerIndex uniquely identifies a row of
          a table inside an owner namespace.
          Inside one namespace several objects of type IppmOwnerIndex
          coexist and share the IppmOwnerIndex range of values to
          provide an unique instance identifier.
          "
          SYNTAX Unsigned32 (1.. 65535)


   TimeUnit ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
          "A enumerated list of time units."
      SYNTAX       INTEGER {
          week(1),
          day(2),
          hour(3),
          minute(4),
          second(5),
          millisecond(6),
          microsecond(7),
          nanosecond(8)
```

```
      }






   --
   --


   IppmStandardMetrics ::= TEXTUAL-CONVENTION
      STATUS      current
      DESCRIPTION
       " Each standard metric is identified in the IPPM-METRICS-
       REGISTRY under the node rfc in chronological order. In order to
       allow for several metrics to be calculated in a single measure,
       there is a need to describe in a bit string the metrics to be
       measured.


       This textual convention defines an octet string that gathers in a
       bit string a sequence of bits. The bit order corresponds to the
       order of the metric identifiers in the registry.
       The first bit of the string has the index 0. The index 1
       corresponds to the first metric of the registry
       (instantaneousUnidirectionalConnectivity ).


       Example:
       One-way-Delay(6) is identified as the leaf number 6 of the node
       rfc of the registry. One-way-Packet-Loss(12) is identified as the
       leaf number 12 of the node
       rfc of the registry. A network measure performing both One-way-
       Delay(6) and One-way-Packet-Loss(12) will be described as
       '0001000001000000'b, '1040'B.
       "
      SYNTAX OCTET STRING (SIZE (1..64))
```

```
   IppmMetricsRegistryIndex ::= TEXTUAL-CONVENTION
      STATUS      current
      DESCRIPTION
       "IppmMetricsRegistryIndex defines an unambiguous index for each
       standardized metric. It identifies a metric, and as such its
       value is the value of the node of the metric in the IPPM
       registry. This value is the same in any implementation of the
       IPPM REPORTING MIB.


       Example:
       In the IPPM-METRICS-REGISTRY, onewayPacketLossAverage is
       registered as the node 14 of ippmMetricsRegistry.metrics.rfc.
       Consequently the index of the metric onewayPacketLossAverage in
       the IppmMetricsTable will always be '14'. At large an instance,
       which type is IppmMetricsRegistryIndex and which value is '14',
       points to the metric onewayPacketLossAverage."
      SYNTAX Unsigned32 (1.. 65535)







   GMTTimeStamp ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
          "The time value at which a measure or an event took place.


          field  octets  contents                  range
          -----  ------  --------                  -----
          1       1-4    second since 1 Jan 1900 0H00*    0..2^31 - 1
          2       5-8    fractional part of the second*   0..2^32 - 1
          * the value is in network-byte order


          The timestamp format is the NTP timestamp format [RFC 1305].
          The reference of time is GMT.


          "
      SYNTAX       OCTET STRING (SIZE (8))
```

```
   PacketType  ::= TEXTUAL-CONVENTION
     STATUS       current
     DESCRIPTION
       "This textual convention is a display string used to describe the
       protocol encapsulation list of a packet, and is used as the value
       of the SYNTAX clause for the type of the Src and Dst of an IPPM
       measure. The RFC2895 specifies a macro named PROTOCOL-IDENTIFIER
       for the definition of protocol identifiers, while its companion
       document, the RFC2896 defines a set of protocol identifiers.

       PacketType is defined as a display string. It consists of a list
       of dot separated protocol names. Each protocol name has been
       previously defined using the macro PROTOCOL-IDENTIFIER of the RFC
       2895.

       Examples:
       The RFC2896 defines the protocol identifiers 'ether2', 'ip',
       'ipip4', 'udp', 'tcp', 'telnet'...

       The PacketType of the source address corresponding to telnet is
       the string 'ip.tcp.telnet'.

       The PacketType of the source address corresponding to UDP packets
       sent in an IP tunnel is the string 'ip.ipip4.udp'.

       Note:
       An IPPM measure is active, so generally a PacketType value does
       not describe the link layer (i.e. ether2...). Valid Internet
       packets are sent from Src to Dst. Then the choice of the link
       layer relies on the Internet stack."
     SYNTAX       OCTET STRING (SIZE (0..512))
```

```
   PacketTypeAddress ::= TEXTUAL-CONVENTION
     DISPLAY-HINT "255a"
     STATUS       current
     DESCRIPTION
       "This textual convention is a Display string used to describe the
       parameters of the protocol encapsulation list of a packet,
       basically the address.


       PacketTypeAddress is defined as a display string. It consists in
       a list of blank separated addresses that reflect the
       encapsulation of the PacketType. Each parameter in the list
       corresponds to a parameter of a PROTOCOL-IDENTIFIER of the
       PacketType.
       Example:
       The PacketType 'ip.ipip4' has 2 parameters. A valid
       PacketTypeAddress value is '192.168.1.1 128.2.6.7'."
     SYNTAX       OCTET STRING (SIZE (0..512))








     IppmMetricResultFilter ::= TEXTUAL-CONVENTION
     STATUS        current
     DESCRIPTION
     "Given that not all results from a metric measurement are
        pertinent, and that the size of the history must be limited whenever
        possible, the TC IppmMetricResultFilter defines basic filters to
        limit the among of data collected:


        Filter's parameters are the 2 fields ippmAggrMeasureLowThreshold and
        ippmAggrMeasureLowThreshold of the aggregated measure setup.


        A filter determines if the result of the current aggregation has to
        be stored:


        LogInBandValue:
        The value is stored if it is lower than the high threshold of
        the aggregated measure setup and greater than the low
        threshold of of the aggregated measure setup.
```

LogOutBandValue:
The value is stored if it is greater than the high threshold of the aggregated measure setup or lower than the low threshold of the aggregated measure setup.

```
        LogAboveValue:
        The value is stored if it is greater than the high threshold
        of the aggregated measure setup.


        LogBelowValue:
        The value is stored if it is lower than the low metric
        threshold field of the aggregated measure setup.


        logUpAndDownValue:
        This filter stores contiguous results that are on opposite
        sides of the up and down metric thresholds:
             A result is stored if it is the first result aggregated:
        If it is greater than the high threshold and lower than the
        low threshold then its value is set to the value of the low
        threshold;


             A result greater than the high threshold is stored if the
        previous result is lower than the low threshold;


             A result lower than the low threshold is stored if the
        previous result is greater than the high threshold;


        "
```

```
         SYNTAX       INTEGER {
             logInBandValue(1),
             logOutBandValue(2),
             logAboveValue(3),
             logBelowValue(4),
             logUpAndDownValue(5)
         }




      --
      -- IPPM  Notifications
      --
      ippmNotifications OBJECT IDENTIFIER ::= { ippm 0 }


      --
      -- IPPM MIB Object definitions
      --
      ippmMibObjects      OBJECT IDENTIFIER   ::= { ippm 1 }



      ippmSystem           OBJECT IDENTIFIER   ::= { ippmMibObjects 1 }
      ippmOwners           OBJECT IDENTIFIER   ::= { ippmMibObjects 2 }
      ippmHistory          OBJECT IDENTIFIER   ::= { ippmMibObjects 3 }
      ippmNetMeasure       OBJECT IDENTIFIER   ::= { ippmMibObjects 4 }
      ippmAggrMeasure      OBJECT IDENTIFIER   ::= { ippmMibObjects 5 }



      --
      -- IPPM  Conformance
      --
      ippmConformance      OBJECT IDENTIFIER   ::= { ippm 2 }






      --
      -- ippmSystem  Group
      --
      --
```

```
   ippmSystemTime OBJECT-TYPE
      SYNTAX GMTTimeStamp
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The current time of the system running the IPPM REPORTING MIB
          SNMP agent. When the agent is running in proxy mode, it is the
          current time of the proxy agent.
          When the agent is located in the probe, it is the current time
           of the probe agent. "
      ::= { ippmSystem  1 }


   ippmSystemSynchronizationType OBJECT-TYPE
      SYNTAX INTEGER  {
           other(0),


           ntp(1),
           gps(2),
           cdma(3)
      }
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "ippmSystemSynchronizationType describes the mechanism
          used to synchronize the system running the IPPM REPORTING MIB
          SNMP agent.


          Other(0)
          The synchronization process must be defined
          in the ippmSystemSynchonizationDescription.


          Ntp(1)
          The system is synchronized using the network
          time protocol. The NTP synchronization must be described
          in the ippmSystemSynchonizationDescription.


          Gps(2)
          The system is synchronized using the GPS clocks.


          Cdma(3)
          The system is synchronized using the CDMA clocks."
      ::= { ippmSystem 2 }
   ippmSystemSynchronizationDesc OBJECT-TYPE
      SYNTAX SnmpAdminString
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The description of the synchronization process of the system
          running the IPPM REPORTING MIB SNMP agent."
      ::= { ippmSystem 3 }


   ippmSystemClockResolution OBJECT-TYPE
      SYNTAX     Unsigned32
      UNITS "Nanoseconds"
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
        "ippmSystemClockResolution provides the precision of the clock
        used for the measures . The unit is the nanosecond. For example,
        the clock on an old Unix host might advance only once every 10
        msec, and thus have a resolution of 10 msec. So its resolution
        is 10000000 nanoseconds and the value of
        ippmSystemClockResolution is 10000000."
      ::= { ippmSystem 4 }



   ippmSystemOperationalStatus OBJECT-TYPE


      SYNTAX INTEGER  {
           unknown(0),
           up(1),
           down(2)
      }
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
        "This object describes the status of the system running the IPPM
        REPORTING MIB SNMP agent. It does not describe end point
        measurement status:


          unknown(0) means the service is unknown.
          up(1) means the service is operational and available for
          general use.
          down(2) means the agent is not available for use.
          "
      ::= { ippmSystem 5 }


   ippmSystemAggregatedMetrics OBJECT-TYPE
      SYNTAX     IppmStandardMetrics
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "ippmSystemAggregatedMetrics lists the aggregated metrics that
          are performed in the SNMP agent instead of in the point of
          measure."
      ::= { ippmSystem 6 }
```

```
   ippmSynchronizationTable OBJECT-TYPE
      SYNTAX     SEQUENCE OF IppmSynchronizationEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "This table registers the event related to the synchronization
           of the points of measure. Each event is described in an
          ippmSynchronizationEntry.
          ippmSynchronizationTable is mandatory.
          ippmSynchronizationTable content is read only."
      ::= { ippmSystem 7 }


      ippmSynchronizationEntry OBJECT-TYPE
      SYNTAX     IppmSynchronizationEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "An entry describes a modification of the synchronization
          status."
      INDEX { ippmPointOfMeasureIndex, ippmSynchronizationIndex }
      ::= { ippmSynchronizationTable 1 }



   IppmSynchronizationEntry ::=
      SEQUENCE {
          ippmSynchronizationIndex               Unsigned32,
          ippmSynchronizationTime                GMTTimeStamp,
          ippmSynchronizationStratum             Unsigned32,
          ippmSynchronizationResolution          Unsigned32
      }



   ippmSynchronizationIndex     OBJECT-TYPE
      SYNTAX     Unsigned32 (1 .. 65535)
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "An index that identifies the synchronization events in
          chronological order.
          65535 is an arbitrary size. It is not recommended to keep
          permanently a history of 65535 events."
      ::= { ippmSynchronizationEntry 1 }
   ippmSynchronizationTime OBJECT-TYPE
   SYNTAX GMTTimeStamp
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The time when the synchronization event occurs."
      ::= { ippmSynchronizationEntry 2 }


   ippmSynchronizationStratum OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The stratum level of the clock computed when the
          synchronization event occurs."
      ::= { ippmSynchronizationEntry 3 }


   ippmSynchronizationResolution OBJECT-TYPE
      SYNTAX     Unsigned32
      UNITS      "Nanoseconds"
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The new time resolution computed after the synchronization
          event occurred."
      ::= { ippmSynchronizationEntry 4 }








   ippmPointOfMeasureTable OBJECT-TYPE
      SYNTAX     SEQUENCE OF IppmPointOfMeasureEntry
      MAX-ACCESS not-accessible
      STATUS     current


      DESCRIPTION
          " This table is the list of measurement end points available
          in the measurement system.


          Proxy mode:
          It is the list of the measurement end points of the set of
          probes for which the IPPM agent provides an SNMP interface.


          IPPM MIB implemented in a probe:
```

It is the list of the measurement end points of the probe.

The ippmPointOfMeasureTable content is read only. This implies that the measurement software handles the table internally ippmPointOfMeasureTable is mandatory."

```
      ::= { ippmSystem 8 }


   ippmPointOfMeasureEntry OBJECT-TYPE
      SYNTAX     IppmPointOfMeasureEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          " An entry may be the management address of some middleware in
          charge of the management of a set of probes. It may the
          management address of a probe that contains several line
          cards.


          An entry describes the capability of a point of measure.


          ippmPointOfMeasureMetrics lists the metrics handles by the
          point of measure."
      INDEX { ippmPointOfMeasureIndex }
      ::= { ippmPointOfMeasureTable 1 }


   IppmPointOfMeasureEntry ::= SEQUENCE {
      ippmPointOfMeasureIndex                Unsigned32,
      ippmPointOfMeasureMgmtAddrType         InetAddressType,
      ippmPointOfMeasureMgmtAddress          InetAddress,
      ippmPointOfMeasureTestAddrType      InetAddressType,
      ippmPointOfMeasureTestAddress          InetAddress,
      ippmPointOfMeasureMetrics              IppmStandardMetrics
   }




   ippmPointOfMeasureIndex OBJECT-TYPE
      SYNTAX Unsigned32 (1 .. 65535)
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "A local index that identifies an entry in the point of
          measure table."


      ::= { ippmPointOfMeasureEntry 1 }


   ippmPointOfMeasureMgmtAddrType OBJECT-TYPE
```

```
        SYNTAX InetAddressType
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The address type associated with the management address."
        ::= { ippmPointOfMeasureEntry 2 }
```

```
   ippmPointOfMeasureMgmtAddress OBJECT-TYPE
      SYNTAX InetAddress  (SIZE  (1..128))
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The management address on the point of measure"
      ::= { ippmPointOfMeasureEntry 3 }



   ippmPointOfMeasureTestAddrType OBJECT-TYPE
      SYNTAX InetAddressType
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "Defines the address type of the measurement interface of the
          point of measure."
      ::= { ippmPointOfMeasureEntry 4 }


   ippmPointOfMeasureTestAddress OBJECT-TYPE
      SYNTAX InetAddress
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "Specifies the address of the measurement interface for the
          point of measure."
      ::= { ippmPointOfMeasureEntry 5}


   ippmPointOfMeasureMetrics OBJECT-TYPE
      SYNTAX     IppmStandardMetrics
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          " ippmPointOfMeasureMetrics lists the metrics this point of
          measure implements."
      ::= { ippmPointOfMeasureEntry 6 }







   ippmMetricsTable OBJECT-TYPE
      SYNTAX     SEQUENCE OF IppmMetricsEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "This table is mandatory. It describes the current
          implementation. Each IPPM standardized metric must be
          described in the table.
          ippmMetricsTable content is read only."
      ::= { ippmSystem 9 }


   ippmMetricsEntry OBJECT-TYPE
      SYNTAX     IppmMetricsEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "An entry describes the static capabilities of a metric
          implementation."
      INDEX { ippmMetricsIndex }
      ::= { ippmMetricsTable 1 }


   IppmMetricsEntry ::=
   SEQUENCE {
      ippmMetricsIndex            IppmMetricsRegistryIndex,
      ippmMetricsType             INTEGER,
      ippmMetricsUnit             INTEGER,
      ippmMetricsDescription      SnmpAdminString
   }


   ippmMetricsIndex OBJECT-TYPE
      SYNTAX IppmMetricsRegistryIndex
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "ippmMetricsIndex defines an unambiguous index for each
          standardized metric. It identifies a metric, and as such its
          value is the value of the node of the metric in the IPPM
          registry. This value is the same in any implementation of the
          IPPM REPORTING MIB.


          Example:
          In the IPPM-METRICS-REGISTRY, onewayPacketLossAverage is
          registered as the node 14 of ippmMetricsRegistry.metrics.rfc.
          Consequently the index of the metric onewayPacketLossAverage
          in the IppmMetricsTable will always be '14'"
      ::= { ippmMetricsEntry 1 }



   ippmMetricsType OBJECT-TYPE
```

```
      SYNTAX INTEGER {
      network(0),
      aggregated(1)
      }
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "Indicates the metric type, whether it is network or
          aggregated."
      ::= { ippmMetricsEntry 2 }



   ippmMetricsUnit OBJECT-TYPE
      SYNTAX INTEGER {
           noUnit(0),
           second(1),
           millisecond(2),
           microsecond(3),
           nanosecond(4),
           percentage(5),
           packet(6),
           byte(7),
           kilobyte(8),
           megabyte(9)
           }
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The unit used in the current entity for the results of the
          measurement of this metric."
      ::= { ippmMetricsEntry 3 }


   ippmMetricsDescription OBJECT-TYPE
      SYNTAX SnmpAdminString
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "A textual description of the metric implementation following
          the exact name of this metric in the registry. For example:
          oneWayDelay: OWD Metric ."
      ::= { ippmMetricsEntry 4 }







   --
   -- ippmOwners Group
   --
   -- The ippmOwners objects are responsible for managing
   -- the owners access to the measurements.
   --
   --


   ippmOwnersTable OBJECT-TYPE
      SYNTAX     SEQUENCE OF IppmOwnersEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
   "A management entity wishing to access or aggregate remote Ippm
   measurements in an agent must previously be registered in the
   ippmOwnersTable. This table is read-create and contains at least  the
   owner 'monitor'."


      ::= { ippmOwners 1 }


   ippmOwnersEntry OBJECT-TYPE
      SYNTAX     IppmOwnersEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "The description of the resources granted to an SNMP
          application.


          For example, an instance of ippmOwnersOwner with an
          IppmOwnerString 'acme', which represents the 14th owner
          created in ippmOwnersTable would be named
          ippmOwnersEntryOwner.14.
          "
      INDEX { ippmOwnersOwner }
      ::= { ippmOwnersTable 1 }


   IppmOwnersEntry ::= SEQUENCE {
      ippmOwnersOwner              IppmOwnerString,
      ippmOwnersGrantedMetrics     IppmStandardMetrics,
      ippmOwnersQuota              Unsigned32,
      ippmOwnersIpAddressType      InetAddressType,
      ippmOwnersIpAddress          InetAddress,
      ippmOwnersEmail              SnmpAdminString,
      ippmOwnersStatus             RowStatus
   }


   ippmOwnersOwner OBJECT-TYPE
```

```
      SYNTAX     IppmOwnerString
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "The owner described by this entry."
      ::= { ippmOwnersEntry 1 }
```

```
   ippmOwnersGrantedMetrics OBJECT-TYPE
      SYNTAX     IppmStandardMetrics
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          " Defines the metrics granted to an owner for which
          measurements can be performed."
      ::= { ippmOwnersEntry 2 }


   ippmOwnersQuota OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The maximum number of records that this owner may have in the
          history table and in the report table."
      ::= { ippmOwnersEntry 3 }



   ippmOwnersIpAddressType OBJECT-TYPE
      SYNTAX     InetAddressType
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The IP address type of the management entity corresponding to
          this owner.
           InetAddressType is restricted to ipv4(1),ipv6(2)and dns(16)."
      ::= { ippmOwnersEntry 4 }


   ippmOwnersIpAddress OBJECT-TYPE
      SYNTAX     InetAddress  (SIZE  (1..128))
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The IP address of the management entity corresponding to this
          owner. For example, the IP address of the management console
          used to send SNMP requests."
      ::= { ippmOwnersEntry 5 }


   ippmOwnersEmail OBJECT-TYPE
      SYNTAX     SnmpAdminString
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
```

```
          "The email address of the management entity corresponding to
          this owner."
      ::= { ippmOwnersEntry 6 }
```

```
   ippmOwnersStatus OBJECT-TYPE
      SYNTAX     RowStatus
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The status of this table entry. Once this status is set to
          active, the corresponding entry in the table may not be
          modified."
      ::= { ippmOwnersEntry 7 }






   --
   -- ippmHistory Group
   --
   --
   -- ippmHistoryTable
   --


   ippmHistoryTable OBJECT-TYPE
      SYNTAX     SEQUENCE OF IppmHistoryEntry
      MAX-ACCESS not-accessible


      STATUS     current
      DESCRIPTION
          "The table containing the measurement results."
      ::= { ippmHistory 1 }



   ippmHistoryEntry OBJECT-TYPE
      SYNTAX     IppmHistoryEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
         "An ippmHistoryEntry entry is one of the results of a measure
         identified by ippmHistoryMeasureOwner, ippmHistoryMeasureIndex,
         ippmHistoryMetricIndex and ippmHistorySequence.


         In the index :
```

- ippmHistoryMeasureOwner identifies the owner of the measure;

- ippmHistoryMeasureIndex identifies the measure in the owner namespace;

- ippmHistoryMetricIndex identifies the metric measured by the

```
         measure. The metric is described in the corresponding entry of
         the  ippmMetricsTable;


         + ippmHistorySequence is the sequence number of the measurement
         result for an entry in the history table."
      INDEX { ippmHistoryMeasureOwner, ippmHistoryMeasureIndex,
      ippmHistoryMetricIndex, ippmHistorySequence }
      ::= { ippmHistoryTable 1 }


   IppmHistoryEntry ::=
      SEQUENCE {
          ippmHistoryMeasureOwner      IppmOwnerString,
          ippmHistoryMeasureIndex      IppmOwnerIndex,
          ippmHistoryMetricIndex       IppmMetricsRegistryIndex,
          ippmHistorySequence          Unsigned32,
          ippmHistoryTimestamp         GMTTimeStamp,
          ippmHistoryValue             Integer32
      }


   ippmHistoryMeasureOwner OBJECT-TYPE
      SYNTAX     IppmOwnerString
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "The owner of the measure that produced this result. The
          measure is either an ippmNetMeasure or an ippmAggrMeasure."
      ::= { ippmHistoryEntry 1 }



   ippmHistoryMeasureIndex OBJECT-TYPE
      SYNTAX IppmOwnerIndex
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "The owner index of the measure that produced this result. The
          measure is either an entry of the ippmNetMeasureTable or of
          the ippmAggrMeasureTable."
      ::= { ippmHistoryEntry 2 }


   ippmHistoryMetricIndex OBJECT-TYPE
      SYNTAX IppmMetricsRegistryIndex
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          " ippmHistoryMetricIndex identifies the metric measured by the
          measure. The metric is described in the corresponding entry of
          the ippmMetricsTable."
      ::= { ippmHistoryEntry 3 }
```

```
   ippmHistorySequence OBJECT-TYPE
      SYNTAX Unsigned32 (0..4294967295)
      MAX-ACCESS not-accessible
          STATUS     current
          DESCRIPTION
          "ippmHistorySequence is the sequence number of the measurement
          results for a metric.


          Network metrics:
          It's the sequence number of a measurement packet. Typically,
          it identifies the order of the packet in the stream of packets
          sent by the source.


          Aggregated metrics:
          It is the sequence order of the aggregation computed."
      ::= { ippmHistoryEntry 4 }




   ippmHistoryTimestamp OBJECT-TYPE
      SYNTAX GMTTimeStamp
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The timestamp when the measurement occurred."
      ::= { ippmHistoryEntry 5 }


   ippmHistoryValue OBJECT-TYPE
      SYNTAX Integer32


      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The observed value of the measurement."
      ::= { ippmHistoryEntry 6 }


   ippmHistoryPathToResults   OBJECT-TYPE
      SYNTAX SnmpAdminString
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "It is typically an URL describing the file location where
```

```
            bulk results are logged."
        ::= { ippmHistory 2 }
```

```
   --
   -- ippmNetMeasure Group
   --



   --
   -- ippmNetMeasureTable
   --
   --


   ippmNetMeasureTable OBJECT-TYPE
      SYNTAX     SEQUENCE OF IppmNetMeasureEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "An entry is a measurement that performs network measures and
          provides results.
          It performs several metric measurements per packet exchange.
          Each step of a measure produces a singleton result per metric.
          The time of the measurement and the value of the metric are
          saved in the ippmHistoryTable."
      ::= { ippmNetMeasure 1 }


   ippmNetMeasureEntry OBJECT-TYPE
      SYNTAX     IppmNetMeasureEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
         " The IppmNetMeasureTable is mandatory, and its content is read
         only. It means that the measurement software handles the table
         internally. The setup of the network measure is not permitted
         through the IPPM REPORTING MIB. As an example, OWAP provides a
         setup protocol to setup and tear down networks measures.


         The ippmNetMeasureMetrics is set to a list of metrics to be
         computed from the same raw packet exchange. Each step of
         measurement delivers a singleton per metric. Results are
         timestamped and saved in the ippmHistoryTable.


         One may create aggregated measures by using the results of
         network measures."
```

```
       INDEX { ippmNetMeasureOwner, ippmNetMeasureIndex }
       ::= { ippmNetMeasureTable 1 }


    IppmNetMeasureEntry ::= SEQUENCE {
       ippmNetMeasureOwner               IppmOwnerString,
       ippmNetMeasureIndex               IppmOwnerIndex,
       ippmNetMeasureName                 SnmpAdminString,
       ippmNetMeasureMetrics              IppmStandardMetrics,
       ippmNetMeasureBeginTime            GMTTimeStamp,
       ippmNetMeasureCollectionRateUnit   TimeUnit,
       ippmNetMeasureCollectionRate       Unsigned32,
       ippmNetMeasureDurationUnit         TimeUnit,
       ippmNetMeasureDuration             Unsigned32,
       ippmNetMeasureHistorySize          Unsigned32,
       ippmNetMeasureFailureMgmtMode      INTEGER,
       ippmNetMeasureResultsMgmt          INTEGER,
       ippmNetMeasureSrcPacketType        PacketType,
       ippmNetMeasureSrc                  PacketTypeAddress,
       ippmNetMeasureDstPacketType        PacketType,
       ippmNetMeasureDst                  PacketTypeAddress,
       ippmNetMeasureTxMode               INTEGER,
       ippmNetMeasureTxPacketRateUnit     TimeUnit,
       ippmNetMeasureTxPacketRate         Unsigned32,
       ippmNetMeasureMedOrBurstSize       Unsigned32,
       ippmNetMeasureDevOrIntBurstSize    Unsigned32,
       ippmNetMeasureLossTimeout          Unsigned32,
       ippmNetMeasureL3PacketSize         Unsigned32,
       ippmNetMeasureDataPattern          OCTET STRING,
       ippmNetMeasureTotalPktsRecv        Counter64,
       ippmNetMeasureLastUpdate           GMTTimeStamp,
       ippmNetMeasureOperState            INTEGER
    }








    ippmNetMeasureOwner OBJECT-TYPE
       SYNTAX     IppmOwnerString
       MAX-ACCESS not-accessible
       STATUS     current
       DESCRIPTION
           "The owner of the network measure."
       ::= { ippmNetMeasureEntry 1 }


    ippmNetMeasureIndex OBJECT-TYPE
       SYNTAX IppmOwnerIndex
       MAX-ACCESS not-accessible
       STATUS     current
       DESCRIPTION
```

```
           "The owner index of the network measure."
       ::= { ippmNetMeasureEntry 2 }
```

```
   ippmNetMeasureName OBJECT-TYPE
      SYNTAX SnmpAdminString
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The name of the metric instance(s) as defined in
          ippmNetMeasureMetrics. It illustrates the specificity of the
          metric(s) and includes the metric(s) and the PacketType.


          Example:
          IP-TCP-HTTP-One-way-Delay: free text "
      ::= { ippmNetMeasureEntry 3 }




   ippmNetMeasureMetrics OBJECT-TYPE
      SYNTAX IppmStandardMetrics
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "ippmNetMeasureMetrics defines the metrics to compute within
          this measure. Only network metrics of the same type are
          allowed in this field (e.g. poisson-based metrics and
          periodic-based metrics are incompatibles, while one-way delay
          and packet loss are generally processed simultaneously: a very
           bad delay is potentially a very good packet loss).


          Results are saved in the ippmHistoryTable.


          Results of a metric are identified using an index of type
          IppmMetricsRegistryIndex.


          Example:
          Given a multi-metrics measure of One-way-Delay(6) and One-way-
          Packet-Loss(12). The value of the field ippmNetMeasureMetrics
          is '0001000001000000'b, '1040'B. Results are logged in the
          ippmHistoryTable where One-way-Delay singletons have a value
          of ippmMetricsIndex of 6 while One-way-Packet-Loss singletons
          have a value of ippmMetricsIndex of 12.


          "
      ::= { ippmNetMeasureEntry 4 }
   ippmNetMeasureBeginTime OBJECT-TYPE
      SYNTAX GMTTimeStamp
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the time at which the measurement begins."
      ::= { ippmNetMeasureEntry 5 }



   ippmNetMeasureCollectionRateUnit OBJECT-TYPE
      SYNTAX TimeUnit
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the unit of the measurement period."
      ::= { ippmNetMeasureEntry 6 }


   ippmNetMeasureCollectionRate OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
           "Gives the period used to collect singletons from the point
           of measures. This value is used as the cycle period in the
           report."
      ::= { ippmNetMeasureEntry 7 }



   ippmNetMeasureDurationUnit OBJECT-TYPE
      SYNTAX TimeUnit
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the measurement duration unit."
      ::= { ippmNetMeasureEntry 8 }


   ippmNetMeasureDuration OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the measurement duration."
      ::= { ippmNetMeasureEntry 9 }


   ippmNetMeasureHistorySize OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the maximum number of results saved for each metric
          of this measure.
          Overflow condition will be managed by the object
          ippmNetMeasureResultsMgmt. "

      ::= { ippmNetMeasureEntry 10 }


   ippmNetMeasureFailureMgmtMode OBJECT-TYPE
      SYNTAX     INTEGER {
          auto(1),
          manual(2),
          discarded(3)
      }
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
          "This object defines whether this row (and the measure
          controlled by this row) is restarted automatically, manually,
          or discarded upon failure, or reboot of the measurement
           system:
            'auto'
               The measure is restarted automatically.
            'manual'
               The measure has to be restarted manually.
            'discarded'
               The measure and it results are discarded.
          "
      ::= { ippmNetMeasureEntry 11 }


   ippmNetMeasureResultsMgmt OBJECT-TYPE
      SYNTAX INTEGER {
          wrap(1),
          suspend(2)
      }
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "
          Action to take when the log is full. The measurement system
          owner may choose to either wrap, in which case the agent
          writes over existing records. The user may choose to suspend
          writing to the log in the event that he wishes to archive the
          data. The resume action causes the agent to begin to write in
          the log, and assumes the data has been cleared.
          This object indicates the way the measurement results are
          managed when the owner quota has been exceeded:
            'wrap'
```

```
                 continue the measurement and erase the older entries in
                 the history.
               'suspend'
```

```
                 stop the measure and keep the results in the history.
            "
        ::= { ippmNetMeasureEntry 12 }


     ippmNetMeasureSrcPacketType OBJECT-TYPE
        SYNTAX PacketType
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "Defines the type P of the source address of the packets sent
            by the measure."
        ::= { ippmNetMeasureEntry 13 }


     ippmNetMeasureSrc OBJECT-TYPE
        SYNTAX PacketTypeAddress
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "Specifies the address of the source of the measure.
            It is represented as a list of parameters corresponding to
            those of the PROTOCOL IDENTIFIER set in
            ippmNetMeasureSrcPacketType."
        ::= { ippmNetMeasureEntry 14}


     ippmNetMeasureDstPacketType OBJECT-TYPE
        SYNTAX PacketType
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "Defines the type P of the destination address of the packets
            sent by the measure."
        ::= { ippmNetMeasureEntry 15 }



     ippmNetMeasureDst OBJECT-TYPE
        SYNTAX PacketTypeAddress
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "Specifies the address of the destination of the measure.
            It is represented as a list of parameters corresponding to
            those of the PROTOCOL IDENTIFIER set in
            ippmNetMeasureDstPacketType."
        ::= { ippmNetMeasureEntry 16 }
```

```
   ippmNetMeasureTxMode OBJECT-TYPE
      SYNTAX INTEGER {
          other(0),
          periodic(1),
          poisson(2),
          multiburst(3)
             }
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The transmit mode used to send the packets:


          'other'
             The rule used to send the packets is unknown.
          'periodic'
             Packets are sent periodically at ippmNetMeasureTxPacketRate
               rate.
          'poisson'
             Packets are sent using a Poisson law, the median is the
             value of ippmNetMeasureDevOrIntBurstSize, the deviation is
             ippmNetMeasureMedOrBurstSize.
          'multiburst'
             Packets are sent bursty at ippmNetMeasureTxPacketRate. The
             size of the burst is made of ippmNetMeasureMedOrBurstSize
             packets.
             Between 2 consecutive bursts, transmission stops during the
             time needed to send ippmNetMeasureDevOrIntBurstSize.


          "
      ::= { ippmNetMeasureEntry 17 }


   ippmNetMeasureTxPacketRateUnit      OBJECT-TYPE
      SYNTAX TimeUnit
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The packet rate unit used to send the packets."
      ::= { ippmNetMeasureEntry 18 }


   ippmNetMeasureTxPacketRate OBJECT-TYPE
      SYNTAX Unsigned32
      UNITS "Packets"
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The rate the packets are sent."
      ::= { ippmNetMeasureEntry 19 }
   ippmNetMeasureMedOrBurstSize   OBJECT-TYPE
      SYNTAX     Unsigned32
      UNITS "Packets"
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "
          Multi-burst mode: This field represents the burst size in
          number of packets.
          Poisson mode: This field indicates the number of packets sent,
          on average, during each period corresponding to the median.
          The median is therefore
          MedOrBurstSize*TxPacketRateUnit/TxPacketRate.


          Example:
          If  TxPacketRateUnit/TxPacketRate is 100 packets/second, and
          if MedOrBurstSize, the number of packets sent during the
          period corresponding to the median is 50 packets, then the
          median equals 50*1/100 = 1/2 seconds.
          "
      ::= { ippmNetMeasureEntry 20 }



   ippmNetMeasureDevOrIntBurstSize   OBJECT-TYPE
      SYNTAX     Unsigned32
      UNITS "Packets"
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "
          Multi-burst mode: This field indicates the gap between 2
          bursts, in number of packets.
          Example:
          If TxPacketRateUnit/TxPacketRate is 100 packets/second,
          and DevOrIntBurstSize equals 50 packets, then the gap between
          2 bursts is equal to 50*1/100, or 1/2 second.


          Poisson mode:
          This field indicates the typical difference between the
          packets of the period corresponding to the median.


          "
      ::= { ippmNetMeasureEntry 21 }



   ippmNetMeasureLossTimeout OBJECT-TYPE
```

```
       SYNTAX     Unsigned32
       UNITS      "Milliseconds"
       MAX-ACCESS read-create
       STATUS     current
       DESCRIPTION
```

```
           "Specifies the delay after which the packet is considered
           lost by the sink."
       ::= { ippmNetMeasureEntry 22 }



   ippmNetMeasureL3PacketSize OBJECT-TYPE
       SYNTAX     Unsigned32
       UNITS      "Bytes"
       MAX-ACCESS read-create
       STATUS     current
       DESCRIPTION
           "Specifies the size of the packets counted at the IP network
           layer in regards to the PacketType definition.
           Example: For a PacketType 'ip ipip4' the L3 size will be the
           size of the packet at ipip4 level.
           "
       ::= { ippmNetMeasureEntry 23 }


   ippmNetMeasureDataPattern OBJECT-TYPE


       SYNTAX     OCTET STRING
       MAX-ACCESS read-create
       STATUS     current
       DESCRIPTION
           "The pattern used to fill the payload of the packet."


       ::= { ippmNetMeasureEntry 24 }



   ippmNetMeasureTotalPktsRecv  OBJECT-TYPE
       SYNTAX Counter64
       UNITS "Packets"
       MAX-ACCESS read-only
       STATUS     current
       DESCRIPTION
           "Reports the current number of packets received since the
           beginning of the measure.
           This parameters is useful to monitor the measure and it is
           needed to compute statistics."
       ::= { ippmNetMeasureEntry 25 }
    ippmNetMeasureLastUpdate OBJECT-TYPE
    SYNTAX GMTTimeStamp
       MAX-ACCESS read-only
       STATUS     current
       DESCRIPTION
           "The time when the last aggregation was computed."
       ::= { ippmNetMeasureEntry 26 }


    ippmNetMeasureOperState OBJECT-TYPE
       SYNTAX INTEGER {
           unknown(0),
           running(1),
           stopped(2)
       }
       MAX-ACCESS read-only
       STATUS     current
       DESCRIPTION
           "Reports the operational status of the network measure."
       ::= { ippmNetMeasureEntry 27 }







    --
    --
    -- ippmAggrMeasure Group
    --
    --


    --




    --
    -- ippmAggrMeasureTable
    --
    --


    ippmAggrMeasureTable OBJECT-TYPE
       SYNTAX     SEQUENCE OF IppmAggrMeasureEntry
       MAX-ACCESS not-accessible
       STATUS     current
       DESCRIPTION
           "An aggregated measure summarizes the results of previous
           network or aggregated measures. The results are saved in the
           ippmHistoryTable.
           Each step of the calculation for the measure produces a
           singleton result per metric."
       ::= { ippmAggrMeasure 1 }


    ippmAggrMeasureEntry OBJECT-TYPE
```

```
      SYNTAX     IppmAggrMeasureEntry
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "Typically, the configuration operation creates and sets the
          value of the fields of a new ippmAggrMeasureEntry.
          ippmAggrMeasureOwner and ippmAggrMeasureIndex identify the
          instance created.
          The field ippmAggrMeasureMetrics identifies the metric to
          compute. As such its ippmMetricsType should be 'aggregated'.


          The measure aggregates the results of a measure identified by
          ippmAggrMeasureHistoryOwner, ippmAggrMeasureHistoryIndex and
          ippmAggrMeasureHistoryMetric. The measure to aggregate belongs
          to ippmNetMeasureTable or ippmAggrMeasureTable.


          The aggregation starts at ippmAggrMeasureBeginTime and ends
          after ippmAggrMeasureDuration.


          An aggregated result is computed for each
          ippmMeasureCollectionRate tick and saved in the
          ippmHistoryTable."
      INDEX { ippmAggrMeasureOwner, ippmAggrMeasureIndex }
      ::= { ippmAggrMeasureTable 1 }



   IppmAggrMeasureEntry ::= SEQUENCE {
      ippmAggrMeasureOwner                  IppmOwnerString,
      ippmAggrMeasureIndex                  IppmOwnerIndex,
      ippmAggrMeasureName                   SnmpAdminString,
      ippmAggrMeasureMetrics                IppmStandardMetrics,
      ippmAggrMeasureHistoryOwner           IppmOwnerString,
      ippmAggrMeasureHistoryIndex           IppmOwnerIndex,
      ippmAggrMeasureHistoryMetric          IppmMetricsRegistryIndex,
      ippmAggrMeasureFilter                 IppmMetricResultFilter,
      ippmAggrMeasureLowThreshold           Unsigned32,
      ippmAggrMeasureHighThreshold          Unsigned32,
      ippmAggrMeasureBeginTime              GMTTimeStamp,
      ippmAggrMeasureAggrPeriodUnit         TimeUnit,
      ippmAggrMeasureAggrPeriod             Unsigned32,
      ippmAggrMeasureDurationUnit           TimeUnit,
      ippmAggrMeasureDuration               Unsigned32,
      ippmAggrMeasureHistorySize            Unsigned32,
      ippmAggrMeasureStorageType            StorageType,
      ippmAggrMeasureAdminState                INTEGER,
      ippmAggrMeasureFastReport                OBJECT IDENTIFIER,
      ippmAggrMeasureResultsMgmt               INTEGER,
      ippmAggrMeasureLastUpdate                GMTTimeStamp,
      ippmAggrMeasureOperState              INTEGER,
      ippmAggrMeasureNbPktsTreated          Counter64,
      ippmAggrMeasureStatus                 RowStatus
   }


   ippmAggrMeasureOwner OBJECT-TYPE
      SYNTAX     IppmOwnerString
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "The owner who has configured this entry."
      ::= { ippmAggrMeasureEntry 1 }


   ippmAggrMeasureIndex OBJECT-TYPE
      SYNTAX IppmOwnerIndex
      MAX-ACCESS not-accessible
      STATUS     current
      DESCRIPTION
          "The index of the aggregated measure. The value is managed by
          the owner."
      ::= { ippmAggrMeasureEntry 2 }


   ippmAggrMeasureName OBJECT-TYPE
      SYNTAX SnmpAdminString
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The name of the instance of the metric. It illustrates the
          specificity of the metric and includes the metric and the
          typeP.


          example: IP-port-HTTP-connectivity: free text."
      ::= { ippmAggrMeasureEntry 3 }



   ippmAggrMeasureMetrics OBJECT-TYPE
      SYNTAX IppmStandardMetrics


      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "ippmAggrMeasureMetrics defines the metrics to compute within
```

this aggregated measure.

Only aggregated metrics of the same type are allowed in this field (e.g. Measurement of minimum, average and maximum metrics are generally processed simultaneously on the same network measure).

```
          Results are saved in the ippmHistoryTable.


          Results of a metric are identified using an index of type
          IppmMetricsRegistryIndex.


          Example:
          Given a multi-aggregation of One-way-Delay-Median(9) and
          One-way-Delay-Minimum(10). The value of the field
          ippmAggrMeasureMetrics is '0000011000000000'b, '0600'B.


          Results are logged in the ippmHistoryTable where
          One-way-Delay-Median singletons have a value of
          ippmMetricsIndex of 9 while One-way-Delay-Minimum singletons
          have a value of ippmMetricsIndex of 10.


          NOTE WELL: It is not recommended to use the multi aggregation
          capability in conjunction with the filter feature.
      "
      ::= { ippmAggrMeasureEntry 4 }



   ippmAggrMeasureHistoryOwner OBJECT-TYPE
      SYNTAX IppmOwnerString
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The owner of the measure to summarize. "
      ::= { ippmAggrMeasureEntry 5 }


   ippmAggrMeasureHistoryIndex OBJECT-TYPE
      SYNTAX IppmOwnerIndex
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The owner index of the measure to summarize. "
      ::= { ippmAggrMeasureEntry 6 }


   ippmAggrMeasureHistoryMetric OBJECT-TYPE
      SYNTAX IppmMetricsRegistryIndex
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The metric of the measure to summarize. "
      ::= { ippmAggrMeasureEntry 7 }



   ippmAggrMeasureFilter OBJECT-TYPE
```

```
      SYNTAX IppmMetricResultFilter
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "
          ippmAggrMeasureFilter defines the kind of filter to apply on a
          result to determine if the result is stored or not. The
          parameters of the filter are ippmAggrMeasureLowThreshold and
          ippmAggrMeasureHighThreshold.


          Thresholds have the same unit as the metric value.


          In the following examples we consider an aggregated measure.
          Its low threshold is set to 80.its high threshold is set to
          100. The aggregation produced a flow of 12 aggregated results
          {40 30 60 85 140 130 190 95 50 90 30 20}.


          If the filter is set to 'logInBandValue' then the results 85,
          95, 90 will be stored.


          If the filter is set to 'logOutBandValue' then the results 40
          30 60 140 130 190 50 30 20 will be stored.


          If the filter is set to 'logAboveValue' then the results 140
          130 190 will be stored.


          If the filter is set to 'logBelowValue' then the results 40 30
           60 50 30 20 will be stored.


          If the filter is set to 'logUpAndDownValue' then the results
          40, 140, 50 will be stored."
      ::= { ippmAggrMeasureEntry 8 }



   ippmAggrMeasureLowThreshold OBJECT-TYPE
      SYNTAX Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "An event is generated when the result of the measure of the
```

```
           metric is lower that the value of ippmAggrMeasureLowThreshold.
           The threshold has the same unit as the metric. The metric unit
           is recorded in the object ippmMetricsUnit of this metric entry
           in the ippmMetricsTable.
           "
       ::= { ippmAggrMeasureEntry 9 }


   ippmAggrMeasureHighThreshold OBJECT-TYPE
```

```
      SYNTAX Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "An event is generated when the result of the measure of the
          metric exceeds the value of ippmAggrMeasureHighThreshold.
          The threshold has the same unit as the metric. The metric unit
          is recorded in the object ippmMetricsUnit of this metric entry
          in the ippmMetricsTable.
          "
      ::= { ippmAggrMeasureEntry 10 }


   ippmAggrMeasureBeginTime OBJECT-TYPE
      SYNTAX GMTTimeStamp
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the time at which the aggregated measure starts."
      ::= { ippmAggrMeasureEntry 11 }



   ippmAggrMeasureAggrPeriodUnit OBJECT-TYPE
      SYNTAX TimeUnit
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the unit of the aggregated measure period."
      DEFVAL { second }
      ::= { ippmAggrMeasureEntry 12 }


   ippmAggrMeasureAggrPeriod OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the amount of time between 2 measurement action
          intervals. The action is specific to the semantic of the
          measure.


          Network metrics:


          The ippmNetMeasureClockPattern transforms the flow of
          periodical instants as a flow of unpredictable instants of
```

measurement packet emission.

As the source and the sink share the definition of the clock of the measure, and as the sending timestamp is part of the measurement packet, the sink has the information to verify

```
          that the stream of packets generated by the source respects
          the clock law.

          Aggregated metrics:


          They are performed periodically on a sequence of results of
          other measures. The period corresponds to the interval between
          two successive computations of the metric. The value of
          ippmHistoryTimestamp result of a aggregated metric computed
          corresponds to the value of the ippmHistoryTimestamp of the
          last metric result of the sequence used to compute the
          aggregated metric."
      DEFVAL { 60 }

      ::= { ippmAggrMeasureEntry 13 }


   ippmAggrMeasureDurationUnit OBJECT-TYPE
      SYNTAX TimeUnit
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the unit of the measure duration."
      DEFVAL { second }
      ::= { ippmAggrMeasureEntry 14 }

   ippmAggrMeasureDuration OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the duration of the measure."
      DEFVAL { 120 }
      ::= { ippmAggrMeasureEntry 15 }

   ippmAggrMeasureHistorySize OBJECT-TYPE
      SYNTAX     Unsigned32
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "Specifies the maximum number of results saved for each metric
```

```
             of this measure. Overflow condition will be managed by the
             object ippmAggrMeasureResultsMgmt. "
         DEFVAL { 2 }
         ::= { ippmAggrMeasureEntry 16 }


      ippmAggrMeasureStorageType OBJECT-TYPE
         SYNTAX     StorageType
         MAX-ACCESS  read-create
         STATUS      current
         DESCRIPTION
             "This object defines whether this row and the measure
             controlled by this row are kept in volatile storage and lost
              upon reboot or if this row is backed up
             by non-volatile or permanent storage.


             Possible values are: other(1), volatile(2), nonVolatile(3),
             permanent(4), readOnly(5)."
         DEFVAL { nonVolatile }
         ::= { ippmAggrMeasureEntry 17 }


      ippmAggrMeasureResultsMgmt OBJECT-TYPE
         SYNTAX INTEGER {
             wrap(1),
             suspend(2)
         }
         MAX-ACCESS read-only
         STATUS     current
         DESCRIPTION
             "This object displays the way the history of the aggregated
             measure is managed.
             'wrap'
                continue the measure and erase the older entries in the
             history.
             'suspend'
                stop the measure and keep the results in the history.
             "
         DEFVAL { wrap }
         ::= { ippmAggrMeasureEntry 18 }



      ippmAggrMeasureAdminState OBJECT-TYPE
         SYNTAX INTEGER {
             start(0),
             stop(1)
         }
         MAX-ACCESS read-create
         STATUS     current
         DESCRIPTION
             "This object controls the activity of the aggregated measure.
             'start'
                The aggregated measure is started.
             'stop'
                The aggregated measure is stopped."
         DEFVAL { start }
```

```
      ::= { ippmAggrMeasureEntry 19 }


   ippmAggrMeasureFastReport OBJECT-TYPE
      SYNTAX     OBJECT IDENTIFIER
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "A fast report is required in order to verify quickly that a
          measure is running well.
          'fast report' feature is active if ippmAggrMeasureFastReport
          is not null and points to a notification.
          A fast report consists of sending by email to the owner of the
          measure, a table of the results of all the metrics computed by
          this aggregated measure. The owner email address is read from
          the ippmOwnersTable.


          ippmAggrMeasureFastReport identifies the notification which
          defines the header of the report.


          The results part of the report is made of a column of results
          per metrics. Results are separated using commas.


          To avoid disaster, an aggregated measure using a fast report
          must have a cycle of aggregation greater than or equal to 1
          second and should not sent more than an email every 5 minutes
          and should not sent more than 12 emails."
      DEFVAL { zeroDotZero }
      ::= { ippmAggrMeasureEntry 20 }


   ippmAggrMeasureLastUpdate OBJECT-TYPE
   SYNTAX GMTTimeStamp
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "The time when the last aggregated measure was computed."
      ::= { ippmAggrMeasureEntry 21 }


   ippmAggrMeasureOperState OBJECT-TYPE
      SYNTAX INTEGER {
          unknown(0),
          running(1),
          stopped(2)
      }
      MAX-ACCESS read-only
      STATUS     current
```

```
      DESCRIPTION
          "Reports the operational status of the aggregated measure."
      ::= { ippmAggrMeasureEntry 22 }



   ippmAggrMeasureNbPktsTreated  OBJECT-TYPE
      SYNTAX Counter64
      UNITS  "Packets"
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "Reports the current number of packets used to calculate the
          aggregation since the start of the measure.


          This parameters is useful to monitor the measure and it is
          needed to compute statistics."
      ::= { ippmAggrMeasureEntry 23 }


   ippmAggrMeasureStatus OBJECT-TYPE
      SYNTAX     RowStatus
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "The status of this entry. Once the entry status is set to
          active, the associate entry cannot be modified.
          "
      ::= { ippmAggrMeasureEntry 24 }







   --
   -- IPPM  Notifications
   --



   ippmAggrMeasureReport    NOTIFICATION-TYPE
      OBJECTS      {
          ippmAggrMeasureFilter,
          ippmAggrMeasureLowThreshold,
          ippmAggrMeasureHighThreshold,
          ippmMetricsType,
          ippmMetricsUnit,
          ippmMetricsDescription,
          ippmHistoryTimestamp,
          ippmHistoryValue,
          ippmHistoryPathToResults
      }
      STATUS       current
      DESCRIPTION
          "A notification sent because the value of the measure is under
          the high threshold value and greater than the low threshold
          value.
          The notification contains the instances of the
          ippmHistoryValue object that exceeded the threshold.
          The notification contains the instances of the
          ippmHistoryTimestamp identifying the time the event occurred.
          ippmHistoryPathToResults is a link to the file name, which
          contains detailed results corresponding to this event."
      ::= { ippmNotifications 1 }




   ippmAggrMeasureHistoryFull    NOTIFICATION-TYPE
      OBJECTS      {
          ippmAggrMeasureName,


          ippmAggrMeasureHistorySize,
          ippmMetricsType,
          ippmMetricsUnit,
          ippmMetricsDescription,
          ippmHistoryTimestamp,
          ippmHistoryValue


      }
      STATUS       current
      DESCRIPTION
          "A notification sent when the size of the history of a metric
          of a aggregated measure exceeds ippmAggrMeasureHistorySize.
          The agent will then manage the reports according to the policy
          described in ippmAggrMeasureResultsMgmt."
      ::= { ippmNotifications 2 }


   ippmNetMeasureHistoryFull    NOTIFICATION-TYPE
      OBJECTS {
          ippmNetMeasureName,
          ippmNetMeasureHistorySize,
          ippmMetricsType,
          ippmMetricsUnit,
          ippmMetricsDescription,
          ippmHistoryTimestamp,
          ippmHistoryValue
      }
      STATUS       current
      DESCRIPTION
          "A notification sent when the size of the history of a metric
          of a network measure exceeded ippmNetMeasureHistorySize. Then
          the agent manages the records according to the policy
          described in ippmNetMeasureResultsMgmt."
      ::= { ippmNotifications 3 }







   --
   -- IPPM MIB Conformance statements
   --


   ippmCompliances OBJECT IDENTIFIER ::={ ippmConformance 1 }


   ippmGroups OBJECT IDENTIFIER ::={ ippmConformance 2 }







   ippmProxyInterDomainCompliances         MODULE-COMPLIANCE
      STATUS             current
      DESCRIPTION
          "The compliance statement for SNMP entities which implement
          the IPPM MIB as a proxy in interdomain. The implementation of
          the VACM control is mandatory."
      MODULE -- this module
      MANDATORY-GROUPS {


          ippmSystemGroup, ippmHistoryGroup, ippmNetMeasureGroup,
          ippmAggrMeasureGroup, ippmNotificationGroup
      }



      OBJECT   ippmNetMeasureName
      MIN-ACCESS read-only
      DESCRIPTION
```

```
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureMetrics
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureBeginTime
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureCollectionRateUnit
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureCollectionRate
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDurationUnit
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDuration
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureHistorySize
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureFailureMgmtMode
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureResultsMgmt
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureSrcPacketType
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureSrc
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDstPacketType
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDst
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureTxMode
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureTxPacketRateUnit
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureTxPacketRate
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureMedOrBurstSize
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDevOrIntBurstSize
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureLossTimeout
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureL3PacketSize
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDataPattern
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      ::= { ippmCompliances 1 }






   ippmProxyCompliance         MODULE-COMPLIANCE
      STATUS             current
      DESCRIPTION
          "The compliance statement for SNMP entities which implement
          the IPPM MIB as a proxy."
      MODULE -- this module
      MANDATORY-GROUPS {
          ippmSystemGroup, ippmOwnersGroup, ippmHistoryGroup,
          ippmNetMeasureGroup, ippmAggrMeasureGroup,
          ippmNotificationGroup
      }
      GROUP ippmOwnersGroup
      DESCRIPTION
          "The ippmOwnersGroup is manadatory if VACM is not
```

```
          implemented."

      OBJECT   ippmNetMeasureName
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."

      OBJECT   ippmNetMeasureMetrics
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."

      OBJECT   ippmNetMeasureBeginTime
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."

      OBJECT   ippmNetMeasureCollectionRateUnit
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."

      OBJECT   ippmNetMeasureCollectionRate
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."

      OBJECT   ippmNetMeasureDurationUnit
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."

      OBJECT   ippmNetMeasureDuration
      MIN-ACCESS read-only
      DESCRIPTION
```

```
          "In Proxy mode network measures may be managed using another
          interface than SNMP."


       OBJECT   ippmNetMeasureHistorySize
       MIN-ACCESS read-only
       DESCRIPTION
          "In Proxy mode network measures may be managed using another
```

```
            interface than SNMP."


      OBJECT   ippmNetMeasureFailureMgmtMode
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureResultsMgmt
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureSrcPacketType
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureSrc
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDstPacketType
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureDst
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureTxMode
      MIN-ACCESS read-only
      DESCRIPTION
```

```
         "In Proxy mode network measures may be managed using another
         interface than SNMP."


      OBJECT   ippmNetMeasureTxPacketRateUnit
      MIN-ACCESS read-only
      DESCRIPTION
         "In Proxy mode network measures may be managed using another
```

```
               interface than SNMP."


            OBJECT   ippmNetMeasureTxPacketRate
            MIN-ACCESS read-only
            DESCRIPTION
               "In Proxy mode network measures may be managed using another
               interface than SNMP."


            OBJECT   ippmNetMeasureMedOrBurstSize
            MIN-ACCESS read-only
            DESCRIPTION
               "In Proxy mode network measures may be managed using another
               interface than SNMP."


            OBJECT   ippmNetMeasureDevOrIntBurstSize
            MIN-ACCESS read-only
            DESCRIPTION
               "In Proxy mode network measures may be managed using another
               interface than SNMP."


            OBJECT   ippmNetMeasureLossTimeout
            MIN-ACCESS read-only
            DESCRIPTION
               "In Proxy mode network measures may be managed using another
               interface than SNMP."


            OBJECT   ippmNetMeasureL3PacketSize
            MIN-ACCESS read-only
            DESCRIPTION
               "In Proxy mode network measures may be managed using another
               interface than SNMP."


            OBJECT   ippmNetMeasureDataPattern
            MIN-ACCESS read-only
            DESCRIPTION
               "In Proxy mode network measures may be managed using another
               interface than SNMP."
            ::= { ippmCompliances 2 }
```

```
   ippmEmbeddedCompliance  MODULE-COMPLIANCE
      STATUS            current
      DESCRIPTION
          "The compliance statement for SNMP entities which implement
          the IPPM MIB in a probe."
      MODULE -- this module
      MANDATORY-GROUPS {
          ippmSystemGroup, ippmHistoryGroup, ippmNetMeasureGroup
      }
      ::= { ippmCompliances 3 }






   ippmSystemGroup    OBJECT-GROUP
      OBJECTS {
          ippmSystemSynchronizationDesc,
          ippmSystemTime,
          ippmSystemSynchronizationType,
          ippmSystemClockResolution,
          ippmSynchronizationTime,
          ippmSynchronizationStratum,
          ippmSynchronizationResolution,
          ippmPointOfMeasureMgmtAddrType,
          ippmPointOfMeasureMgmtAddress,
          ippmPointOfMeasureTestAddrType,
          ippmPointOfMeasureTestAddress,
          ippmSystemOperationalStatus,
          ippmSystemAggregatedMetrics,
          ippmPointOfMeasureMetrics,
          ippmMetricsType,
          ippmMetricsUnit,


          ippmMetricsDescription
      }
      STATUS  current
      DESCRIPTION
          "The IPPM System Group"
      ::=  { ippmGroups  1}



   ippmNetMeasureGroup   OBJECT-GROUP
      OBJECTS  {
          ippmNetMeasureName,
          ippmNetMeasureMetrics,
          ippmNetMeasureBeginTime,
          ippmNetMeasureCollectionRateUnit,
          ippmNetMeasureCollectionRate,
          ippmNetMeasureDurationUnit,
          ippmNetMeasureDuration,
          ippmNetMeasureHistorySize,
          ippmNetMeasureFailureMgmtMode,
          ippmNetMeasureResultsMgmt,
          ippmNetMeasureSrcPacketType,
          ippmNetMeasureSrc,
          ippmNetMeasureDstPacketType,
          ippmNetMeasureDst,
          ippmNetMeasureTxMode,
          ippmNetMeasureTxPacketRateUnit,
          ippmNetMeasureTxPacketRate,
          ippmNetMeasureMedOrBurstSize,
          ippmNetMeasureDevOrIntBurstSize,
          ippmNetMeasureLossTimeout,
          ippmNetMeasureL3PacketSize,
          ippmNetMeasureDataPattern,
          ippmNetMeasureTotalPktsRecv,
          ippmNetMeasureLastUpdate,
          ippmNetMeasureOperState
      }
      STATUS  current
      DESCRIPTION
          "The IPPM Network Measure Group"
      ::=  { ippmGroups  2}



   ippmHistoryGroup   OBJECT-GROUP
      OBJECTS  {
          ippmHistoryTimestamp,
          ippmHistoryValue,
          ippmHistoryPathToResults
      }
      STATUS  current
      DESCRIPTION
          "The IPPM History Group"


      ::=  { ippmGroups  3}


   ippmAggrMeasureGroup       OBJECT-GROUP
      OBJECTS  {
          ippmAggrMeasureName,
          ippmAggrMeasureMetrics,
          ippmAggrMeasureBeginTime,
          ippmAggrMeasureAggrPeriodUnit,
          ippmAggrMeasureAggrPeriod,
          ippmAggrMeasureDurationUnit,
          ippmAggrMeasureDuration,
          ippmAggrMeasureFilter,
          ippmAggrMeasureLowThreshold,
          ippmAggrMeasureHighThreshold,
          ippmAggrMeasureHistorySize,
          ippmAggrMeasureStorageType,
          ippmAggrMeasureHistoryOwner,
          ippmAggrMeasureHistoryIndex,
          ippmAggrMeasureHistoryMetric,
          ippmAggrMeasureAdminState,
          ippmAggrMeasureFastReport,
          ippmAggrMeasureResultsMgmt,
          ippmAggrMeasureLastUpdate,
          ippmAggrMeasureOperState,
          ippmAggrMeasureNbPktsTreated,
          ippmAggrMeasureStatus
      }
      STATUS  current
      DESCRIPTION
          "The IPPM AggregatedMeasure Group"
      ::=  { ippmGroups 4}



   ippmOwnersGroup    OBJECT-GROUP
      OBJECTS  {
          ippmOwnersGrantedMetrics,
          ippmOwnersQuota,
          ippmOwnersIpAddressType,
          ippmOwnersIpAddress,
          ippmOwnersEmail,
          ippmOwnersStatus
      }
      STATUS  current
      DESCRIPTION
          "The IPPM Owners Group"
      ::=  { ippmGroups 5}



   ippmNotificationGroup       NOTIFICATION-GROUP
      NOTIFICATIONS  {
          ippmAggrMeasureReport,


          ippmNetMeasureHistoryFull,
          ippmAggrMeasureHistoryFull
```

```
        }
        STATUS  current
        DESCRIPTION
```

```
           "The IPPM Notification Group"
       ::=  { ippmGroups 6}

   END
```

8. Security Considerations

8.1 VACM Access control

View Based Access Control, or VACM may be used to restrict access to certain objects, or even object instances within tables. For example, one may:

- o Give an 'administrator' write access to the ippmOwnersTable, whereas all other users may only have read access;

- o Give access to individual rows in the network measure, aggregated measure, history, and report table to particular owners based upon indexing on an 'owners name', and even upon a particular measure. This will be illustrated below.

- o Give access of one owner's measure, and associated results, to another owner in order to create an aggregated measure based upon the results.

8.1.1 Example of implementing VACM control for the IPPM-REPORTING-MIB

The following example illustrates how one could use VACM to restrict access to particular objects within the MIB. It uses syntax specific to a particular agent development toolkit, but may be generalized using the concepts as defined in the VACM MIB.

In this example, we have two NMS users, namely user1=owner1 and user2=owner2:

1) First we define the two users and their host addresses:

```
   com2sec        owner1    owner1computer@    private

   com2sec        owner2    owner2computer@    private
```

2) We then define SNMPv2c groups

```
   group    owner1    v2c    owner1
   group    owner2    v2c    owner2

   view    notif        included    ippmNotifications    ff
```

3.1) For the user owner1, we now define the views for which he will have read access

```
   # covers PointOfMeasureTable SynchronizationTable and all scalars

   view    owner1read    included    ippmSystem        ff

   # covers OwnersTable

   view    owner1read    included    ippmOwners        ff

   # covers MetricsTable

   view    owner1read    included    ippmMeasure    ff

   # covers NetworkMeasureTable

   view    owner1read    included
   ippmNetMeasureOwner.6.111.119.110.101.114.49    ff.df.c0

   # covers AggrMeasureTable

   view    owner1read    included
   ippmAggrMeasureOwner.6.111.119.110.101.114.49    ff.df.c0
```

3.2) We will now define the views for which owner1 will have write access

```
   view    owner1write    included
   ippmAggrMeasureOwner.6.111.119.110.101.114.49    ff.df.c0
   # covers ReportSetupTable

   view    owner1read    included
   ippmReportSetupOwner.6.111.119.110.101.114.49    ff.df.c0

   view    owner1write    included
   ippmReportSetupOwner.6.111.119.110.101.114.49    ff.df.c0

   # covers HistoryTable

   view    owner1read    included
   ippmHistoryMeasureOwner.6.111.119.110.101.114.49    ff.df.c0
   # covers ReportTable

   view    owner1read    included
   ippmReportSequence.6.111.119.110.101.114.49    ff.df.c0
```

3.3) For owner2, we will define the views for which he has read access

```
   view    owner2read    included    ippmSystem        ff

   view    owner2read    included    ippmOwners        ff

   view    owner2read    included    ippmMeasure    ff

   # covers NetworkMeasureTable plus let's say the owner1 network
   measure of index X

   view    owner2read    included
   ippmNetMeasureOwner.6.111.119.110.101.114.50    ff.df.c0

   view    owner2read    included
   ippmNetMeasureOwner.6.111.119.110.101.114.49.X    ff.df.e0

   # covers AggrMeasureTable plus let's say the OWNER1 aggregated
   measure of index Y

   view    owner2read    included
   ippmAggrMeasureOwner.6.111.119.110.101.114.50    ff.df.c0

   view    owner2read    included
   ippmAggrMeasureOwner.6.111.119.110.101.114.49.Y    ff.df.e0
```

3.4) For owner2, we will define the views for which he has write access

```
   view    owner2write    included
   ippmAggrMeasureOwner.6.111.119.110.101.114.50    ff.df.c0


   # covers ReportSetupTable


   view    owner2read    included
   ippmReportSetupOwner.6.111.119.110.101.114.50    ff.df.c0


   view    owner2write    included
   ippmReportSetupOwner.6.111.119.110.101.114.50    ff.df.c0


   # covers HistoryTable plus OWNER1 related X network measure results
   and OWNER1 related Y aggregated measure results
```

```
view    owner2read    included
ippmHistoryMeasureOwner.6.111.119.110.101.114.50    ff.df.c0


view    owner2read    included
ippmHistoryMeasureOwner.6.111.119.110.101.114.49.X    ff.df.e0


view    owner2read    included
ippmHistoryMeasureOwner.6.111.119.110.101.114.49.Y    ff.df.e0


# covers ReportTable


view    owner2read    included
ippmReportSequence.6.111.119.110.101.114.50    ff.df.c0
```

3.5) Now we give the two users access to the views defined above. Note that owner1 and owner2 have read access to owner1read and owner2read views respectively. They have write access to owner1write and owner2write view respectively. And they both have access to all the notifications.

```
access    owner1    ""    any    noauth    exact    owner1read
owner1write    notif


access    owner2    ""    any    noauth    exact    owner2read
owner2write    notif
```

8.2 Privacy

The privacy concerns of network measurement are intrinsically limited by the active measurements. Unlike passive measurements, there can be no release of existing user data.

8.3 Measurement aspects

Conducting Internet measurements raises both security and privacy concerns. This memo does not specify an implementation of the metrics, so it does not directly affect the security of the Internet nor of applications that run on the Internet. However, implementations of these metrics must be mindful of security and privacy concerns.

There are two types of security concerns: potential harm caused by the measurements, and potential harm to the measurements. The measurements could cause harm because they are active, and inject packets into the network. The measurement parameters MUST be carefully selected so that the measurements inject trivial amounts of additional traffic into the networks they measure. If they inject "too much" traffic, they can skew the results of the measurement, and in extreme cases cause congestion and denial of service.

The measurements themselves could be harmed by routers giving measurement traffic a different priority than "normal" traffic, or by an attacker injecting artificial measurement traffic. If routers can recognize measurement traffic and treat it separately, the measurements will not reflect actual user traffic. If an attacker injects artificial traffic that is accepted as legitimate, the loss rate will be artificially lowered. Therefore, the measurement methodologies SHOULD include appropriate techniques to reduce the probability measurement traffic can be distinguished from "normal" traffic.

Authentication techniques, such as digital signatures, may be used where appropriate to guard against injected traffic attacks.

8.4 Management aspects

There are a number of management objects defined in this MIB that have a MAX-ACCESS clause of read-write and/or read-only. 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.

SNMPv1 by itself is not a secure environment. 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.

It is recommended that the implementors consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [18] and the View-based Access Control Model RFC 2575 [21] is recommended.

It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, 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.

9. Document management

9.1 Open issues

Do we use accessible-for-notify to report index values in the notifications ?

ippmNetMeasure items Read Write ?

Do we need an "IANA Considerations" Section ?

Do we need separate NetMeasure history from aggregateMeasure History (may help compliance module spec) ?

9.2 Changes done since release 05

- Document rewriten in xml;
- Section 3 updated with the "standard" introductionary text for MIB;
- nodes cleanup;
- ippmNetMeasure max acces set to read-create;
- proxy compliances module reviewed for the usage of the ippmNetMeasureTable with a min acces of read-only;
- A new co-authored: Tom;

9.3 Changes done since release 04

- Report Group deleted:
  - reportHistoryTable deleted;
  - reportSetupTable deleted;
- 6 related notifications deleted;

- low and high thresholds added in ippmAggrMeasureTable;

- TC IppmOwnerIndex added to clearly define the owner namespace.

- GMTTimestamp time origine changed to NTP (1900).

9.4 Changes done since release 03

- SMI subtype: INTEGER vs Integer32...;

- SMI UNITS: Clauses added;

- cleanup of DEFVAL values;

- Counter/index wrapping:

- the index of the table wrap independently of the sequence of the results. That makes it very difficult for application to track the results. As the sequence id identify the instance of the result of a measure the index is removed both from the table and from the index clause:

  * ippmHistoryIndex removed from ippmHistoryEntry;

  * ippmHistoryIndex removed from the INDEX clause of the table ippmHistoryTable;

  * ippmReportIndex removed from ippmAggrHistoryEntry;

  * ippmReportIndex removed from the clause INDEX of ippmAggrHistoryEntry INDEX clause of the table ippmAggrHistoryTable;

9.5 Changes done since release 02

- Security/VACM: sharing table removed; ippmMeasure merged with networkMeasure and AggrMeasure to have all networkMeasure objects in read only. Indexes belong to the table; remove all reference to SNMPv1 ...inSNMPTrapPDU

- System: ippmSystemOperationalStatus added ippmSynchronizationTable adapted for proxy mode: ippmPointOfMeasureIndex added to the index of ippmSystemCurrentSynchronization removed from system capabilities: ippmPointOfMeasureMetrics added to IppmPointOfMeasureEntry; ippmMetricsType added to ippmMetricsTable;

- Owners: ippmMetricMaxHistorySize replaced with quota in ippmOwnersTable;

- ippmOnHistoryFullAction replaced with resultsMgmt in aggr and network.;

- network measure: ippmNetMeasureOperState added to indicate the state of the network measure state; added burst mode; state of the measure: nb of singletons collected and oper status added;

- aggregated metric: fast report added to get raw results by email;

- report setup: onReportDeliveryClearHistory removed from IppmMetricResultFilter;

- Map field added to network, aggr and report tables to help to map on topology map or admin view.

10. Acknowledgments

A Kerbe.

11. References

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