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Definitions of Managed Objects for IP Flow Information Export

Abstract

This document defines managed objects for IP Flow Information eXport (IPFIX). These objects provide information for monitoring IPFIX Exporters and IPFIX Collectors, including basic configuration information.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6615.

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1. Introduction

This document defines two MIB modules for monitoring IP Flow Information eXport (IPFIX) Devices, including Exporters and Collectors. While most of the objects defined by the IPFIX MIB module must be implemented, some objects may be implemented corresponding to the functionality implemented in the equipment. Since the IPFIX architecture [RFC5470] foresees the possibility of using Filtering and/or Sampling functions to reduce the data volume, this document also provides the IPFIX SELECTOR MIB module, which contains the standardized selection methods and is controlled by IANA. The full configuration of the IPFIX Metering Process is out of the scope of these MIB modules.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. IPFIX Documents Overview

The IPFIX protocol provides network administrators with access to IP Flow information. The architecture for the export of measured IP Flow information out of an IPFIX Exporting Process to a Collecting Process is defined in [RFC5470], per the requirements defined in [RFC3917]. The protocol document [RFC5101] specifies how IPFIX Data Records and Templates are carried via a congestion-aware transport protocol from IPFIX Exporting Processes to IPFIX Collecting Processes. IPFIX has a formal description of IPFIX Information Elements -- their name, type, and additional semantic information -- as specified in [RFC5102]. Finally, [RFC5472] describes what type of applications can use the IPFIX protocol and how they can use the information provided. It furthermore shows how the IPFIX framework relates to other architectures and frameworks.

It is assumed that Flow metering, export, and collection are performed according to the IPFIX architecture defined in [RFC5470]. The monitored configuration parameters of the export and collection of Flow Templates and Data Records are modeled according to [RFC5101]. Packet selection methods that may be optionally used by the IPFIX Metering Process are not considered in this MIB document. They are defined in the Packet Sampling (PSAMP) framework [RFC5474] and Sampling techniques [RFC5475] documents. Nevertheless, the basis for defining Sampling and Filtering functions is given with the IPFIX SELECTOR MIB module. Since the PSAMP export protocol [RFC5476] is based on the IPFIX protocol, the Sampling and Filtering functions can be added to the IPFIX SELECTOR MIB module as needed.

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 MIB modules that are 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. Terminology

The definitions of basic terms such as IP Traffic Flow, Exporting Process, Collecting Process, Observation Points, etc. can be found in the IPFIX protocol document [RFC5101].

5. Structure of the IPFIX MIB

The IPFIX MIB module consists of seven main tables: the Transport Session table, the Template table and the corresponding Template Definition table, the Export table, the Metering Process table, the Observation Point table, and the Selection Process table. Since the IPFIX architecture [RFC5470] foresees the possibility of using Filtering and/or Sampling functions to reduce the data volume, the IPFIX MIB module provides the basic objects for these functions with the Selection Process table. The IPFIX SELECTOR MIB module, defined in the next section, provides the standard Filtering and Sampling functions that can be referenced in the ipfixSelectionProcessTable.

All remaining objects contain statistical values for the different tables contained in the MIB module.

The following subsections describe all tables in the IPFIX MIB module.

5.1. The Transport Session Table

The Transport Session is the basis of the MIB module. The Transport Session table (ipfixTransportSessionTable) contains all Transport Sessions between the Exporter and Collector. The table specifies the transport layer protocol of the Transport Session and, depending on that protocol, further parameters for the Transport Session. In the case of UDP and TCP, these are the source and destination address as

well as the source and destination port. For the Stream Control Transmission Protocol (SCTP), the table contains ipfixTransportSessionSctpAssocId, which is the index for the SCTP association in the SCTP MIB module [RFC3873]. The mode of operation of the device, i.e., whether the Transport Session is used for collecting or exporting, is given in the ipfixTransportSessionDeviceMode object. Further on, the table contains the configured refresh parameters for Templates and Options Templates that are used across unreliable connections such as UDP. Finally, the IPFIX version that is exported or collected by this Transport Session and a status of the Transport Session are given in the table.

To illustrate the use of this table, let us assume the following scenario: we have an Exporter on IP address 192.0.2.22 and a Collector on IP address 192.0.2.37. The Exporter uses TCP to export Templates and Data Records. The same Exporter also exports, with UDP, to a Collector with the IP address of 192.0.2.44. This would lead to the following Transport Session table on the Exporter:

```
ipfixTransportSessionTable (1)
|
+- ipfixTransportSessionEntry (1)
   |
   +- index (5) (ipfixTransportSessionIndex)
   |  +- ipfixTransportSessionIndex (1) = 5
   |  +- ipfixTransportSessionProtocol (2) = 6 (TCP)
   |  +- ipfixTransportSessionSourceAddressType (3) = 1 (ipv4)
   |  +- ipfixTransportSessionSourceAddress (4) = 192.0.2.22
   |  +- ipfixTransportSessionDestinationAddressType (5) = 1 (ipv4)
   |  +- ipfixTransportSessionDestinationAddress (6) = 192.0.2.37
   |  +- ipfixTransportSessionSourcePort (7) = 7653
   |  +- ipfixTransportSessionDestinationPort (8) = 4739
   |  +- ipfixTransportSessionSctpAssocId (9) = 0
   |  +- ipfixTransportSessionDeviceMode (10) = exporting(1)
   |  +- ipfixTransportSessionTemplateRefreshTimeout (11) = 0
   |  +- ipfixTransportSessionOptionsTemplateRefreshTimeout (12) = 0
   |  +- ipfixTransportSessionTemplateRefreshPacket (13) = 0
   |  +- ipfixTransportSessionOptionsTemplateRefreshPacket (14) = 0
   |  +- ipfixTransportSessionIpfixVersion (15) = 10
   |  +- ipfixTransportSessionStatus (16) = 2 (active)
   .
   .
   .
   +- index (11) (ipfixTransportSessionIndex)
      +- ipfixTransportSessionIndex (1) = 11
      +- ipfixTransportSessionProtocol (2) = 17 (UDP)
      +- ipfixTransportSessionSourceAddressType (3) = 1 (ipv4)
      +- ipfixTransportSessionSourceAddress (4) = 192.0.2.22
      +- ipfixTransportSessionDestinationAddressType (5) = 1 (ipv4)
      +- ipfixTransportSessionDestinationAddress (6) = 192.0.2.44
      +- ipfixTransportSessionSourcePort (7) = 14287
      +- ipfixTransportSessionDestinationPort (8) = 4739
      +- ipfixTransportSessionSctpAssocId (9) = 0
      +- ipfixTransportSessionDeviceMode (10) = exporting(1)
      +- ipfixTransportSessionTemplateRefreshTimeout (11) = 100
      +- ipfixTransportSessionOptionsTemplateRefreshTimeout (12)
      |                                                    = 100
      +- ipfixTransportSessionTemplateRefreshPacket (13) = 10
      +- ipfixTransportSessionOptionsTemplateRefreshPacket (14) = 10
      +- ipfixTransportSessionIpfixVersion (15) = 10
      +- ipfixTransportSessionStatus (16) = 2 (active)
```

The values in parentheses are the OID numbers. The Collectors would then have the same entry, except that the index would most likely differ and the ipfixTransportSessionDeviceMode value would be collecting(2).

5.2. The Template Table

The Template table lists all Templates (including Options Templates) that are sent (by an Exporter) or received (by a Collector). The (Options) Templates are unique per Observation Domain and per Transport Session. Note that the Transport Session also gives the device mode, i.e., Exporter or Collector. Thus, the table is indexed by

- the Transport Session Index (ipfixTransportSessionIndex) and
- the Observation Domain ID (ipfixTemplateObservationDomainId).

It contains the Set ID and an access time denoting the time when the (Options) Template was last sent or received.

To resume the above example, the Exporter may want to export a Template and an Options Template for each Transport Session defined above. This leads to the following Template table, which defines the Template and Options Template:

```
ipfixTemplateTable (3)
|
+- ipfixTemplateEntry (1)
   |
   +- index (5) (ipfixTransportSessionIndex)
   |  +- index (3) (ipfixTemplateObservationDomainId)
   |     + index (257) (ipfixTemplateId)
   |     | +- ipfixTemplateObservationDomainId (1) = 3
   |     | +- ipfixTemplateId (2) = 257
   |     | +- ipfixTemplateSetId (3) = 2
   |     | +- ipfixTemplateAccessTime (4)
   |     |                              = 2008-7-1,12:49:11.2,+2:0
   |     |
   |     + index (264) (ipfixTemplateId)
   |       +- ipfixTemplateObservationDomainId (1) = 3
   |       +- ipfixTemplateId (2) = 264
   |       +- ipfixTemplateSetId (3) = 3
   |       +- ipfixTemplateAccessTime (4)
   .                                  = 2008-7-1,12:47:04.8,+2:0
   .
   .
   .
   +- index (11) (ipfixTransportSessionIndex)
      +- index (3) (ipfixTemplateObservationDomainId)
         + index (273) (ipfixTemplateId)
         | +- ipfixTemplateObservationDomainId (1) = 3
         | +- ipfixTemplateId (2) = 273
         | +- ipfixTemplateSetId (3) = 2
         | +- ipfixTemplateAccessTime (4)
         |                            = 2008-7-1,12:49:11.2,+2:0
         |
         + index (289) (ipfixTemplateId)
           +- ipfixTemplateObservationDomainId (1) = 3
           +- ipfixTemplateId (2) = 289
           +- ipfixTemplateSetId (3) = 3
           +- ipfixTemplateAccessTime (4)
                                      = 2008-7-1,12:47:04.8,+2:0
```

We assume that the Transport Session that is stored with index 5 in the Transport Session table of the Exporter is stored with index 17 in the Transport Session table of the (corresponding) Collector. Then, the Template table would look as follows:

```
ipfixTemplateTable (3)
|
+- ipfixTemplateEntry (1)
   |
   +- index (17) (ipfixTransportSessionIndex)
      +- index (3) (ipfixTemplateObservationDomainId)
         + index (257) (ipfixTemplateId)
         | +- ipfixTemplateObservationDomainId (1) = 3
         | +- ipfixTemplateId (2) = 257
         | +- ipfixTemplateSetId (3) = 2
         | +- ipfixTemplateAccessTime (4)
         |                              = 2008-7-1,12:49:11.8,+2:0
         |
         + index (264) (ipfixTemplateId)
           +- ipfixTemplateObservationDomainId (1) = 3
           +- ipfixTemplateId (2) = 264
           +- ipfixTemplateSetId (3) = 3
           +- ipfixTemplateAccessTime (4)
                                        = 2008-7-1,12:47:05.3,+2:0
```

The table on the second Collector would be analogous to the one shown above.

5.3. The Template Definition Table

The Template Definition table lists all the Information Elements contained in a Template or Options Template. Therefore, it has the same indexes as the corresponding Template table plus the Template ID. Its own index denotes the order of the Information Element inside the Template. Besides the Information Element ID and the length of the encoded value, the table contains the enterprise number for enterprise-specific Information Elements and flags for each Information Element. The flags indicate whether the Information Element is used for scoping or as a Flow Key.

To resume the above example again, the Exporter is configured to export the octets received and dropped at the Observation Point since the last export of these values. In addition, it exports the start and end time of the Flow relative to the timestamp contained in the IPFIX header. This leads to the following Template Definition table on the Exporter:

```
ipfixTemplateDefinitionTable (4)
|
+- ipfixTemplateDefinitionEntry (1)
   |
   +- index (5) (ipfixTransportSessionIndex)
      +- index (3) (ipfixTemplateObservationDomainId)
         + index (257) (ipfixTemplateId)
           +- index (1) (ipfixTemplateDefinitionIndex)
           |  +- ipfixTemplateDefinitionIndex (1) = 1
           |  +- ipfixTemplateDefinitionIeId (2) = 158
           |  |                      (flowStartDeltaMicroseconds)
           |  +- ipfixTemplateDefinitionIeLength (3) = 4
           |  +- ipfixTemplateDefinitionEnterpriseNumber (4) = 0
           |  +- ipfixTemplateDefinitionFlags (5) = 0
           |
           +- index (2) (ipfixTemplateDefinitionIndex)
           |  +- ipfixTemplateDefinitionIndex (1) = 2
           |  +- ipfixTemplateDefinitionIeId (2) = 159
           |  |                      (flowEndDeltaMicroseconds)
           |  +- ipfixTemplateDefinitionIeLength (3) = 4
           |  +- ipfixTemplateDefinitionEnterpriseNumber (4) = 0
           |  +- ipfixTemplateDefinitionFlags (5) = 0
           |
           +- index (3) (ipfixTemplateDefinitionIndex)
           |  +- ipfixTemplateDefinitionIndex (1) = 3
           |  +- ipfixTemplateDefinitionIeId (2) = 1
           |  |                                  (octetDeltaCount)
           |  +- ipfixTemplateDefinitionIeLength (3) = 8
           |  +- ipfixTemplateDefinitionEnterpriseNumber (4) = 0
           |  +- ipfixTemplateDefinitionFlags (5) = 0
           |
           +- index (4) (ipfixTemplateDefinitionIndex)
              +- ipfixTemplateDefinitionIndex (1) = 4
              +- ipfixTemplateDefinitionIeId (2) = 132
              |                           (droppedOctetDeltaCount)
              +- ipfixTemplateDefinitionIeLength (3) = 8
              +- ipfixTemplateDefinitionEnterpriseNumber (4) = 0
              +- ipfixTemplateDefinitionFlags (5) = 0
```

The corresponding table entry on the Collector is the same, except that it would have another ipfixTransportSessionIndex, e.g., 17 as in the previous example.

5.4. The Export Table

On Exporters, the Export table (ipfixExportTable) can be used to support features like failover, load-balancing, duplicate export to several Collectors, etc. The table has three indexes that link an entry with

- the Metering Process table (ipfixMeteringProcessCacheId; see below) and
- the Transport Session table (ipfixTransportSessionIndex).

Those entries with the same ipfixExportIndex and the same ipfixMeteringProcessCacheId define a Transport Session group. The member type for each group member describes its functionality. All Transport Sessions referenced in this table MUST have a ipfixTransportSessionDeviceMode value of exporting(1).

If the Exporter does not use Transport Session grouping, then each ipfixExportIndex contains a single ipfixMeteringProcessCacheId, and thus a single Transport Session (ipfixTransportSessionIndex); this session MUST have a member type value of primary(1).

For failover, a Transport Session group can contain one Transport Session with member type primary(1) and several Transport Sessions with type secondary(2). Entries with other member types are not allowed for that type of group. For load-balancing or parallel export, all Transport Sessions in the group MUST have the same member type -- either loadBalancing(4) or parallel(3).

The algorithms used for failover or load-balancing are out of the scope of this document.

To continue the example, we assume that the Exporter uses the two connections shown in the examples above as one primary Transport Session protected by a secondary Transport Session. The Exporter then has the following entries in the ipfixExportTable:

```
ipfixExportTable (5)
|
+- ipfixExportEntry (1)
   |
   +- index (7) (ipfixExportIndex)
   |  +- index (9) (ipfixMeteringProcessCacheId)
   |     |  +- index (5) (ipfixTransportSessionIndex)
   |        |  +- ipfixExportIndex (1) = 7
   |        |  +- ipfixExportMemberType (2) = 1 (primary)
   |        |
   |        +- index (11) (ipfixTransportSessionIndex)
   |           +- ipfixExportIndex (1) = 7
   |           +- ipfixExportMemberType (2) = 2 (secondary)
   |
   +- index (8) (ipfixExportIndex)
      +- index (9) (ipfixMeteringProcessCacheId)
         +- index (5) (ipfixTransportSessionIndex)
         |  +- ipfixExportIndex (1) = 8
         |  +- ipfixExportMemberType (2) = 2 (secondary)
         +- index (11) (ipfixTransportSessionIndex)
            +- ipfixExportIndex (1) = 8
            +- ipfixExportMemberType (2) = 1 (primary)
```

The example shows that the Exporter uses the Metering Process cache (index (9)), explained below, to export IPFIX Data Records for Transport Sessions 5 and 11. Templates 257 and 264 defined above are exported within Transport Session 5 as primary, while the secondary Transport Session is 11. Templates 273 and 289 are exported within Transport Session 11 as primary, while the secondary Transport Session is 5.

Here are the steps required by a manager in order to understand what the backups are (if any) for Template Records exported from a specific Exporter to a specific Collector:

1. Look up the Collector IP address in the ipfixTransportSessionDestinationAddress object (in the ipfixTransportSessionTable).

2. From the same row, double-check the Exporter IP address in the ipfixTransportSessionSourceAddress object.

3. From the same row, write down the ipfixTransportSessionIndex value.

4. Use that ipfixTransportSessionIndex value in the ipfixTemplateTable and look up the pairs of (ipfixTemplateObservationDomainId, ipfixTemplateId). From there, the manager deduces the Template Record(s) (ipfixTemplateId), exported from the Observation Domain(s) (ipfixTemplateObservationDomainId) on the tracked Exporter (ipfixTransportSessionSourceAddress) to the tracked Collector (ipfixTransportSessionDestinationAddress).

5. Reusing the same ipfixTransportSessionIndex in the ipfixExportTable, look in the table for a value of ipfixExportMemberType that equals "primary". Note that there could be multiple entries for which the ipfixExportMemberType equals "primary" in the ipfixExportTable, so multiple iterations might be required until the correct value of ipfixTransportSessionIndex is found.

6. From the same row, write down the ipfixExportIndex value.

7. In the ipfixExportTable, under the same three index values (ipfixExportIndex, ipfixMeteringProcessCacheId, and ipfixTransportSessionIndex), look up the entries for which ipfixExportMemberType is different than "primary". Write down the associated ipfixTransportSessionIndex value.

8. From the ipfixTransportSessionTable, look up the Transport Session details for this ipfixTransportSessionIndex value -- for example, the secondary Collector IP address and port (ipfixTransportSessionDestinationAddress and ipfixTransportSessionSourcePort).

5.5. The Metering Process Table

The Metering Process, as defined in [RFC5101], consists of a set of functions. Maintaining the Flow Records is one of them. This function is responsible for passing the Flow Records to the Exporting Process and also for detecting Flow expiration. The Flow Records that are maintained by the Metering Process can be grouped by the Observation Points at which they are observed. The instance that maintains such a group of Flow Records is a kind of cache. For this reason, the Metering Process table (ipfixMeteringProcessTable) is indexed by cache IDs (ipfixMeteringProcessCacheId). Each cache can be maintained by a separate instance of the Metering Process. To specify the Observation Point(s) where the Flow Records are gathered, the ipfixMeteringProcessObservationPointGroupRef may contain an ipfixObservationPointGroupId from the Observation Point table (ipfixObservationPointTable), which is described in the next subsection. If an Observation Point is not specified for the Flow

Records, the ipfixMeteringProcessObservationPointGroupRef MUST be zero(0). The timeouts (ipfixMeteringProcessCacheActiveTimeout and ipfixMeteringProcessCacheIdleTimeout) specify when Flows are expired.

```
 ipfixMeteringProcessTable (6)
 |
 +- ipfixMeteringProcessEntry (1)
    |
    +- index (9) (ipfixMeteringProcessCacheId)
       +- ipfixMeteringProcessCacheId (1) = 9
       +- ipfixMeteringProcessObservationPointGroupRef (2) = 17
       +- ipfixMeteringProcessCacheActiveTimeout (3) = 100
       +- ipfixMeteringProcessCacheIdleTimeout (4) = 100
```

5.6. The Observation Point Table

The Observation Point table (ipfixObservationPointTable) groups Observation Points with the ipfixObservationPointGroupId. Each entry contains the Observation Domain ID in which the Observation Point is located and a reference to the ENTITY MIB module [RFC4133] or the Interfaces MIB module [RFC2863]. The objects in the ENTITY MIB module referenced by ipfixObservationPointPhysicalEntity, or the objects in the Interfaces MIB module referenced by ipfixObservationPointPhysicalInterface, denote the Observation Point. At least one reference for the objects ipfixObservationPointPhysicalEntity or ipfixObservationPointPhysicalInterface MUST exist for a valid Observation Point entry. If a reference to the Observation Point is given in both object ipfixObservationPointPhysicalEntity and ipfixObservationPointPhysicalInterface, then both MUST point to the same physical interface. However, if one of two references (ipfixObservationPointPhysicalEntity or ipfixObservationPointPhysicalInterface) cannot be given, its reference MUST be 0. In addition, a direction can be given to render more specifically which Flow to monitor.

```
ipfixObservationPointTable (7)
|
+- ipfixObservationPointEntry (1)
   |
   +- index (17) (ipfixObservationPointGroupId)
      +- index (1) (ipfixObservationPointIndex)
      |  +- ipfixObservationPointGroupId (1) = 17
      |  +- ipfixObservationPointIndex (2) = 1
      |  +- ipfixObservationPointObservationDomainId (3) = 3
      |  +- ipfixObservationPointPhysicalEntity (4) = 6
      |  +- ipfixObservationPointPhysicalInterface(5) = 0
      |  +- ipfixObservationPointPhysicalEntityDirection (6)
                                                    = 3 (both)
      |
      +- index (2) (ipfixObservationPointIndex)
         +- ipfixObservationPointGroupId (1) = 17
         +- ipfixObservationPointIndex (2) = 2
         +- ipfixObservationPointObservationDomainId (3) = 3
         +- ipfixObservationPointPhysicalEntity (4) = 0
         +- ipfixObservationPointPhysicalInterface (5) = 0
         +- ipfixObservationPointPhysicalEntityDirection (6)
                                                  = 1 (ingress)
```

5.7. The Selection Process Table

This table supports the usage of Filtering and Sampling functions, as described in [RFC5470]. It contains lists of functions per Metering Process cache (ipfixMeteringProcessCacheId). The selection process index ipfixSelectionProcessIndex forms groups of selection methods that are applied to an observed packet stream. The selection process selector index (ipfixSelectionProcessSelectorIndex) indicates the order in which the functions are applied to the packets observed at the Observation Points associated with the Metering Process cache. The selection methods are applied in increasing order; i.e., selection methods with a lower ipfixSelectionProcessSelectorIndex are applied first. The functions are referenced by object identifiers pointing to each function with its parameters. If the selection method does not use parameters, then it MUST point to the root of the function subtree (see also Section 6). If the function uses parameters, then it MUST point to an entry in the parameter table of the selection method. If no Filtering or Sampling function is used for a Metering Process, then an entry for the Metering Process SHOULD be created that points to the Select All function (ipfixFuncSelectAll).

5.8. The Statistical Tables

Statistical tables that augment the ipfixTransportSessionTable, ipfixTemplateTable, ipfixMeteringProcessTable, and ipfixSelectionProcessTable have been defined. All the statistical tables contain a discontinuity object that holds a timestamp denoting the time when a discontinuity event occurred, in order to notify the management system that the counters contained in those tables might not be continuous anymore.

5.8.1. The Transport Session Statistical Table

The Transport Session Statistical table (ipfixTransportSessionStatsTable) augments the ipfixTransportSessionTable with statistical values. It contains the rate (in bytes per second) at which it receives or sends out IPFIX Messages; the number of bytes, packets, messages, Records, Templates, and Options Templates received or sent; and the number of messages that were discarded.

5.8.2. The Template Statistical Table

This table contains a statistical value for each Template. It augments the Template table (ipfixTemplateTable) and specifies the number of Data Records exported or collected for the Template.

5.8.3. The Metering Process Statistical Table

This table augments the Metering Process table (ipfixMeteringProcessTable). It contains the statistical values for the exported Data Records and the number of unused cache entries.

5.8.4. The Selection Process Statistical Table

This table augments the Selection Process table (ipfixSelectionProcessTable) and introduces two generic statistical values: the number of packets observed and the number of packets dropped by the selection method.

6. Structure of the IPFIX SELECTOR MIB

The IPFIX SELECTOR MIB module defined in this section provides the standard Filtering and Sampling functions that can be referenced in the ipfixSelectionProcessTable. All standard Filtering and Sampling functions MUST be registered in the subtree under object ipfixSelectorFunctions (iso.org.dod.internet.mgmt.mib-2.ipfixSelectorMIB.ipfixSelectorObjects.ipfixSelectorFunctions, or 1.3.6.1.2.1.194.1.1). The top-level OIDs in the subtree under object

ipfixSelectorFunctions MUST be registered in a sub-registry maintained by IANA at http://www.iana.org/assignments/smi-numbers. The first entry in this subtree is the Select All function (ipfixFuncSelectAll), defined in this document as {ipfixSelectorFunctions 1}.

New Selector Functions MUST be registered at IANA and are subject to Expert Review [RFC5226], i.e., review by one of a group of experts designated by an IETF Area Director. The group of experts MUST check the requested MIB objects for completeness and accuracy of the description. Requests for MIB objects that duplicate the functionality of existing objects SHOULD be declined. The smallest available OID SHOULD be assigned to new MIB objects. The specification of new MIB objects SHOULD follow the structure specified in Section 6.1 and MUST be published using a well-established and persistent publication medium. The experts will initially be drawn from the Working Group Chairs and document editors of the IPFIX and PSAMP Working Groups.

6.1. The Selector Functions

The following figure shows what the MIB tree usually should look like. It already contains ipfixFuncSelectAll. The subtree in ipfixFuncF2 gives the basic structure that all selection methods SHOULD follow.

```
 ipfixSelectorFunctions
 |
 +- ipfixFuncSelectAll
 |  |
 |  +- ipfixFuncSelectAllAvail (is the function available?)
 |
 +- ipfixFuncF2
 |  |
 |  +- ipfixFuncF2Avail (is the function F2 available?)
 |  |
 |  +- ipfixFuncF2Parameters (a table with parameters)
 ...
 |
 +- ipfixFuncFn...
```

The selection method SHOULD be designed as a MIB subtree introduced by an object with the name ipfixFunc appended by a function name. The objects in this subtree SHOULD be prefixed by this name. If the function is named Fx, then we would start a subtree with an OID named ipfixFuncFx. This subtree should contain an object ipfixFuncFxAvail that has the type TruthValue. If a selection method takes parameters, the MIB should contain a table named

ipfixFuncFxParameters, which should contain all the parameters that the selection method specifies. An entry in this table will be referenced by the IPFIX MIB module if the selection method with the parameters is used.

To illustrate the structure defined above, the following contains an example of a function MyFunc that holds three integer parameters Param1, Param2, and Param3. In the example, there are currently two instances of the parameter sets, defined with indexes 1 and 4.

```
 ipfixSelectorFunctions (1)
 |
 +- ipfixFuncMyFunc (?)
    |
    +- ipfixFuncMyFuncAvail (1) = true
    +- ipfixFuncMyFuncParameters (2)
       |
       +- ipfixFuncMyFuncParametersEntry (1)
          |
          +- index (1) (ipfixFuncMyFuncParametersIndex)
          |  +- ipfixFuncMyFuncParam1 (1) = 47
          |  +- ipfixFuncMyFuncParam2 (2) = -128
          |  +- ipfixFuncMyFuncParam3 (3) = 19
          |
          +- index(4) (ipfixFuncMyFuncParametersIndex)
             +- ipfixFuncMyFuncParam1 (1) = 19
             +- ipfixFuncMyFuncParam2 (2) = -1
             +- ipfixFuncMyFuncParam3 (3) = 728
```

If the function defined above is referenced in the IPFIX MIB module, the ipfixSelectionProcessTable would look as follows:

```
 ipfixSelectionProcessTable (8)
 |
 +- ipfixSelectionProcessEntry (1)
    |
    +- index (9) (ipfixMeteringProcessCacheId)
       +- index (1) (ipfixSelectionProcessIndex)
          +- index (1) (ipfixSelectionProcessSelectorIndex)
          |  +- ipfixSelectionProcessSelectorFunction (3)
          |                            = ipfixSelectorFunctions.?.2.1.4
          +- index (2) (ipfixSelectionProcessSelectorIndex)
             +- ipfixSelectionProcessSelectorFunction (3)
                                       = ipfixSelectorFunctions.?.2.1.1
```

This means that for the ipfixMeteringProcessCacheId(9), a Selection Process with index 1 is created that applies the same function two times but with different parameter sets. First, the function MyFunc is applied with the parameters of the set with index 4, and then with the parameters of the set with index 1.

7. Relationship to Other MIB Modules

Besides the usual imports from the SNMP Standards [RFC2578], [RFC2579], and [RFC2580], the IPFIX MIB module references the ENTITY MIB module [RFC4133] and the Interfaces MIB module [RFC2863].

7.1. Relationship to the ENTITY MIB and Interfaces MIB

The Observation Point table (ipfixObservationPointTable) contains a reference to the ENTITY MIB module [RFC4133] (ipfixObservationPointPhysicalEntity) and a reference to the Interfaces MIB module [RFC2863] (ipfixObservationPointPhysicalInterface). If the implementers of the IPFIX MIB module want to specify the physical entity where Flows are observed, then they SHOULD also implement the ENTITY MIB and/or the Interfaces MIB module. The implementation of the ENTITY MIB and/or the Interfaces MIB module is OPTIONAL. If one of them is not implemented, then all values of the respective column ipfixObservationPointPhysicalEntity or ipfixObservationPointPhysicalInterface in the Observation Point table are zero and the values of the ipfixObservationPointPhysicalEntityDirection columns are unknown(0), if none of them are defined.

7.2. MIB Modules Required for IMPORTS

The IPFIX MIB module requires the modules SNMPv2-SMI [RFC2578], SNMPv2-TC [RFC2579], and SNMPv2-CONF [RFC2580]. Further on, it imports the textual conventions InetAddressType and InetAddress from the INET ADDRESS MIB module [RFC4001].

The IPFIX SELECTOR MIB module also requires the modules SNMPv2-SMI [RFC2578], SNMPv2-TC [RFC2579], and SNMPv2-CONF [RFC2580].

8. MIB Definitions

This section contains the definitions of the IPFIX-MIB module and the IPFIX-SELECTOR-MIB module. There are different mandatory groups defined for Collector and Exporter implementations. The statistical objects are made OPTIONAL.

8.1. IPFIX MIB Definition

```
IPFIX-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, mib-2, Unsigned32, Counter64,
    Gauge32
        FROM SNMPv2-SMI                                 -- [RFC2578]
    TimeStamp, DateAndTime
        FROM SNMPv2-TC                                  -- [RFC2579]
    MODULE-COMPLIANCE, OBJECT-GROUP
        FROM SNMPv2-CONF                                -- [RFC2580]
    InterfaceIndexOrZero
        FROM IF-MIB                                     -- [RFC2863]
    InetAddressType, InetAddress, InetPortNumber
        FROM INET-ADDRESS-MIB                           -- [RFC4001]
    PhysicalIndexOrZero
        FROM ENTITY-MIB;                                -- [RFC4133]

ipfixMIB MODULE-IDENTITY
    LAST-UPDATED "201206110000Z"          -- 11 June 2012
    ORGANIZATION "IETF IPFIX Working Group"
    CONTACT-INFO
        "WG charter:
          http://www.ietf.org/html.charters/ipfix-charter.html

        Mailing Lists:
          General Discussion: ipfix@ietf.org
          To Subscribe: http://www1.ietf.org/mailman/listinfo/ipfix
          Archive:
      http://www1.ietf.org/mail-archive/web/ipfix/current/index.html

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            Chair for Network Architectures and Services (I8)
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            Garching  85748
            Germany
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        DESCRIPTION
            "The IPFIX MIB defines managed objects for IP Flow
            Information eXport.  These objects provide information about
            managed nodes supporting the IPFIX protocol,
            for Exporters as well as for Collectors.

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            authors of the code.  All rights reserved.

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            to the license terms contained in, the Simplified BSD
            License set forth in Section 4.c of the IETF Trust's
            Legal Provisions Relating to IETF Documents
            (http://trustee.ietf.org/license-info)."

    --  Revision history

        REVISION     "201206110000Z"         -- 11 June 2012
        DESCRIPTION
```

```
            "Fixed errata from RFC 5815.  Published as RFC 6615."

        REVISION     "201004190000Z"         -- 19 April 2010
        DESCRIPTION
            "Initial version, published as RFC 5815."

        ::= { mib-2 193 }

    --**********************************************************************
    -- Top-Level Structure of the MIB
    --**********************************************************************

    ipfixObjects     OBJECT IDENTIFIER ::= { ipfixMIB 1 }
    ipfixConformance OBJECT IDENTIFIER ::= { ipfixMIB 2 }

    ipfixMainObjects OBJECT IDENTIFIER ::= { ipfixObjects 1 }
    ipfixStatistics  OBJECT IDENTIFIER ::= { ipfixObjects 2 }

    --======================================================================
    -- 1.1: Objects Used by All IPFIX Implementations
    --======================================================================
    ----------------------------------------------------------------------
    -- 1.1.1: Transport Session Table
    ----------------------------------------------------------------------
    ipfixTransportSessionTable  OBJECT-TYPE
        SYNTAX      SEQUENCE OF IpfixTransportSessionEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "This table lists the currently established Transport
            Sessions between an Exporting Process and a Collecting
            Process."
        ::= { ipfixMainObjects 1 }

    ipfixTransportSessionEntry OBJECT-TYPE
        SYNTAX      IpfixTransportSessionEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Defines an entry in the ipfixTransportSessionTable."
        INDEX       { ipfixTransportSessionIndex }
        ::= { ipfixTransportSessionTable 1 }

    IpfixTransportSessionEntry ::=
        SEQUENCE {
           ipfixTransportSessionIndex                Unsigned32,
           ipfixTransportSessionProtocol             Unsigned32,
           ipfixTransportSessionSourceAddressType    InetAddressType,
```

```
          ipfixTransportSessionSourceAddress          InetAddress,
          ipfixTransportSessionDestinationAddressType InetAddressType,
          ipfixTransportSessionDestinationAddress     InetAddress,
          ipfixTransportSessionSourcePort             InetPortNumber,
          ipfixTransportSessionDestinationPort        InetPortNumber,
          ipfixTransportSessionSctpAssocId            Unsigned32,
          ipfixTransportSessionDeviceMode             INTEGER,
          ipfixTransportSessionTemplateRefreshTimeout Unsigned32,
          ipfixTransportSessionOptionsTemplateRefreshTimeout Unsigned32,
          ipfixTransportSessionTemplateRefreshPacket  Unsigned32,
          ipfixTransportSessionOptionsTemplateRefreshPacket Unsigned32,
          ipfixTransportSessionIpfixVersion           Unsigned32,
          ipfixTransportSessionStatus                 INTEGER
      }

   ipfixTransportSessionIndex OBJECT-TYPE
       SYNTAX      Unsigned32 (1..4294967295)
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Locally arbitrary, but unique identifier of an entry in
           the ipfixTransportSessionTable.  The value is expected to
           remain constant from a re-initialization of the entity's
           network management agent to the next re-initialization."
       ::= { ipfixTransportSessionEntry 1 }

   ipfixTransportSessionProtocol OBJECT-TYPE
       SYNTAX      Unsigned32 (1..255)
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The transport protocol used for receiving or transmitting
           IPFIX Messages.  Protocol numbers are assigned by IANA.  A
           current list of all assignments is available from
           <http://www.iana.org/assignments/protocol-numbers/>."
       REFERENCE
           "RFC 5101, Specification of the IP Flow Information Export
           (IPFIX) Protocol for the Exchange of IP Traffic Flow
           Information, Section 10."
       ::= { ipfixTransportSessionEntry 2 }

   ipfixTransportSessionSourceAddressType OBJECT-TYPE
       SYNTAX      InetAddressType { unknown(0), ipv4(1), ipv6 (2) }
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The type of address used for the source address,
           as specified in RFC 4001.  The InetAddressType supported
```

```
            values are ipv4(1) and ipv6(2).  This object is used with
            protocols (specified in ipfixTransportSessionProtocol) like
            TCP (6) and UDP (17) that have the notion of addresses.
            SCTP (132) should use the ipfixTransportSessionSctpAssocId
            instead.  If SCTP (132) or any other protocol without the
            notion of addresses is used, the object MUST be set to
            unknown(0)."
        ::= { ipfixTransportSessionEntry 3 }

    ipfixTransportSessionSourceAddress OBJECT-TYPE
        SYNTAX      InetAddress
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The source address of the Exporter of the IPFIX Transport
            Session.  This value is interpreted according to the value of
            ipfixTransportSessionAddressType, as specified in RFC 4001.
            This object is used with protocols (specified in
            ipfixTransportSessionProtocol) like TCP (6) and UDP (17) that
            have the notion of addresses.  SCTP (132) should use the
            ipfixTransportSessionSctpAssocId instead.  If SCTP (132) or
            any other protocol without the notion of addresses is used,
            the object MUST be set to a zero-length string."
        ::= { ipfixTransportSessionEntry 4 }

    ipfixTransportSessionDestinationAddressType OBJECT-TYPE
        SYNTAX      InetAddressType { unknown(0), ipv4(1), ipv6 (2) }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The type of address used for the destination address,
            as specified in RFC 4001.  The InetAddressType supported
            values are ipv4(1) and ipv6(2).  This object is used with
            protocols (specified in ipfixTransportSessionProtocol) like
            TCP (6) and UDP (17) that have the notion of addresses.
            SCTP (132) should use the ipfixTransportSessionSctpAssocId
            instead.  If SCTP (132) or any other protocol without the
            notion of addresses is used, the object MUST be set to
            unknown(0)."
        ::= { ipfixTransportSessionEntry 5 }

    ipfixTransportSessionDestinationAddress OBJECT-TYPE
        SYNTAX      InetAddress
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The destination address of the Collector of the IPFIX
            Transport Session.  This value is interpreted according to
```

```
            the value of ipfixTransportSessionAddressType, as specified
            in RFC 4001.  This object is used with protocols
            (specified in ipfixTransportSessionProtocol) like TCP (6)
            and UDP (17) that have the notion of addresses.  SCTP (132)
            should use the ipfixTransportSessionSctpAssocId instead.
            If SCTP (132) or any other protocol without the notion of
            addresses is used, the object MUST be set to a zero-length
            string."
        ::= { ipfixTransportSessionEntry 6 }

    ipfixTransportSessionSourcePort OBJECT-TYPE
        SYNTAX      InetPortNumber
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The transport protocol port number of the Exporter.
            This object is used with protocols (specified in
            ipfixTransportSessionProtocol) like TCP (6)
            and UDP (17) that have the notion of ports.  SCTP (132)
            should copy the value of sctpAssocLocalPort if the
            Transport Session is in collecting mode or
            sctpAssocRemPort if the Transport Session is in
            exporting mode.  The association is referenced
            by the ipfixTransportSessionSctpAssocId.
            If any other protocol without the notion of
            ports is used, the object MUST be set to zero."
        ::= { ipfixTransportSessionEntry 7 }

    ipfixTransportSessionDestinationPort OBJECT-TYPE
        SYNTAX      InetPortNumber
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The transport protocol port number of the Collector.  The
            default value is 4739 for all currently defined transport
            protocol types.  This object is used with protocols
            (specified in ipfixTransportSessionProtocol) like TCP (6)
            and UDP (17) that have the notion of ports.  SCTP (132)
            should copy the value of sctpAssocRemPort if the
            Transport Session is in collecting mode or
            sctpAssocLocalPort if the Transport Session is in
            exporting mode.  The association is referenced
            by the ipfixTransportSessionSctpAssocId.
            If any other protocol without the notion of
            ports is used, the object MUST be set to zero."

        ::= { ipfixTransportSessionEntry 8 }
```

```
   ipfixTransportSessionSctpAssocId OBJECT-TYPE
       SYNTAX      Unsigned32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The association ID used for the SCTP session between the
           Exporter and the Collector of the IPFIX Transport Session.
           It is equal to the sctpAssocId entry in the sctpAssocTable
           defined in the SCTP MIB.  This object is only valid if
           ipfixTransportSessionProtocol has the value 132 (SCTP).  In
           all other cases, the value MUST be zero."
       REFERENCE
           "RFC 3873, Stream Control Transmission Protocol (SCTP)
           Management Information Base (MIB)."
       ::= { ipfixTransportSessionEntry 9 }

   ipfixTransportSessionDeviceMode OBJECT-TYPE
       SYNTAX      INTEGER {
                       exporting(1),
                       collecting(2)
                   }
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The mode of operation of the device for the given Transport
           Session.  This object can have the following values:

           exporting(1)
               This value MUST be used if the Transport Session is
               used for exporting Records to other IPFIX Devices;
               i.e., this device acts as Exporter.

           collecting(2)
               This value MUST be used if the Transport Session is
               used for collecting Records from other IPFIX Devices;
               i.e., this device acts as Collector."
       ::= { ipfixTransportSessionEntry 10 }

   ipfixTransportSessionTemplateRefreshTimeout OBJECT-TYPE
       SYNTAX      Unsigned32
       UNITS       "seconds"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "On Exporters, this object contains the time in seconds
           after which IPFIX Templates are resent by the
           Exporter.
```

```
            On Collectors, this object contains the lifetime in seconds
            after which a Template becomes invalid when it is not
            received again within this lifetime.

            This object is only valid if ipfixTransportSessionProtocol
            has the value 17 (UDP).  In all other cases, the value MUST
            be zero."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Sections 10.3.6 and 10.3.7."
        ::= { ipfixTransportSessionEntry 11 }

    ipfixTransportSessionOptionsTemplateRefreshTimeout OBJECT-TYPE
        SYNTAX      Unsigned32
        UNITS       "seconds"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "On Exporters, this object contains the time in seconds
            after which IPFIX Options Templates are resent by the
            Exporter.

            On Collectors, this object contains the lifetime in seconds
            after which an Options Template becomes invalid when it is
            not received again within this lifetime.

            This object is only valid if ipfixTransportSessionProtocol
            has the value 17 (UDP).  In all other cases, the value MUST
            be zero."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Sections 10.3.6 and 10.3.7."
        ::= { ipfixTransportSessionEntry 12 }

    ipfixTransportSessionTemplateRefreshPacket OBJECT-TYPE
        SYNTAX      Unsigned32
        UNITS       "packets"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "On Exporters, this object contains the number of exported
            IPFIX Messages after which IPFIX Templates are resent
            by the Exporter.
```

```
            On Collectors, this object contains the lifetime in number
            of exported IPFIX Messages after which a Template becomes
            invalid when it is not received again within this lifetime.

            This object is only valid if ipfixTransportSessionProtocol
            has the value 17 (UDP).  In all other cases, the value MUST
            be zero."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Sections 10.3.6 and 10.3.7."
        ::= { ipfixTransportSessionEntry 13 }

    ipfixTransportSessionOptionsTemplateRefreshPacket OBJECT-TYPE
        SYNTAX      Unsigned32
        UNITS       "packets"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "On Exporters, this object contains the number of exported
            IPFIX Messages after which IPFIX Options Templates are
            resent by the Exporter.

            On Collectors, this object contains the lifetime in number
            of exported IPFIX Messages after which an Options Template
            becomes invalid when it is not received again within this
            lifetime.

            This object is only valid if ipfixTransportSessionProtocol
            has the value 17 (UDP).  In all other cases, the value MUST
            be zero."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Sections 10.3.6 and 10.3.7."
        ::= { ipfixTransportSessionEntry 14 }

    ipfixTransportSessionIpfixVersion OBJECT-TYPE
        SYNTAX      Unsigned32 (0..65535)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "On Exporters, the object contains the version number of the
            IPFIX protocol that the Exporter uses to export its data in
            this Transport Session.

            On Collectors, the object contains the version number of the
            IPFIX protocol it receives for this Transport Session.
```

```
            If IPFIX Messages of different IPFIX protocol versions are
            transmitted or received in this Transport Session, this
            object contains the maximum version number."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.1."
        ::= { ipfixTransportSessionEntry 15 }

    ipfixTransportSessionStatus OBJECT-TYPE
        SYNTAX      INTEGER {
                        unknown(0),
                        inactive(1),
                        active(2)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The status of a Transport Session.  This object can have the
            following values:

            unknown(0)
                This value MUST be used if the status of the
                Transport Session cannot be detected by the equipment.
                This value should be avoided as far as possible.

            inactive(1)
                This value MUST be used for Transport Sessions that
                are specified in the system but are not currently active.
                The value can be used, for example, for Transport
                Sessions that are backup (secondary) sessions in a
                Transport Session group.

            active(2)
                This value MUST be used for Transport Sessions that are
                currently active and transmitting or receiving data."
        ::= { ipfixTransportSessionEntry 16 }
```

```
   ---------------------------------------------------------------------
   -- 1.1.2: Template Table
   ---------------------------------------------------------------------
   ipfixTemplateTable  OBJECT-TYPE
       SYNTAX      SEQUENCE OF IpfixTemplateEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "This table lists the Templates and Options Templates that
           are transmitted by the Exporting Process or received by the
           Collecting Process.

           The table contains the Templates and Options Templates that
           are received or used for exporting data for a given
           Transport Session group and Observation Domain.

           Withdrawn or invalidated (Options) Templates MUST be removed
           from this table."
       ::= { ipfixMainObjects 2 }

   ipfixTemplateEntry OBJECT-TYPE
       SYNTAX      IpfixTemplateEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Defines an entry in the ipfixTemplateTable."
       INDEX       {
           ipfixTransportSessionIndex,
           ipfixTemplateObservationDomainId,
           ipfixTemplateId
       }
       ::= { ipfixTemplateTable 1 }

   IpfixTemplateEntry ::=
       SEQUENCE {
           ipfixTemplateObservationDomainId Unsigned32,
           ipfixTemplateId                  Unsigned32,
           ipfixTemplateSetId               Unsigned32,
           ipfixTemplateAccessTime          DateAndTime
       }

   ipfixTemplateObservationDomainId OBJECT-TYPE
       SYNTAX      Unsigned32 (0..4294967295)
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "The ID of the Observation Domain for which this Template
           is defined.  This value is used when sending IPFIX Messages.
```

```
            The special value of 0 indicates that the Data Records
            exported with this (Options Template) cannot be applied to a
            single Observation Domain."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.1."
        ::= { ipfixTemplateEntry 1 }

    ipfixTemplateId OBJECT-TYPE
        SYNTAX      Unsigned32 (256..65535)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "This number indicates the Template ID in the IPFIX
            Message.  Values from 0 to 255 are not allowed for Template
            IDs."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.4.1."
        ::= { ipfixTemplateEntry 2 }

    ipfixTemplateSetId OBJECT-TYPE
        SYNTAX      Unsigned32 (1..65535)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This number indicates the Set ID of the Template.  This
            object allows the Template type to be easily retrieved.

            Currently, there are two values defined.  The value 2 is
            used for Sets containing Template definitions.  The value 3
            is used for Sets containing Options Template definitions."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.3.2."
        ::= { ipfixTemplateEntry 3 }

    ipfixTemplateAccessTime OBJECT-TYPE
        SYNTAX      DateAndTime
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "If the Transport Session is in exporting mode
            (ipfixTransportSessionDeviceMode) the time when this
            (Options) Template was last sent to the Collector(s).
```

```
            In the specific case of UDP as transport protocol, this
            time is used to know when a retransmission of the
            (Options) Template is needed.

            If the Transport Session is in collecting mode, this object
            contains the time when this (Options) Template was last
            received from the Exporter.  In the specific case of UDP as
            transport protocol, this time is used to know when this
            (Options) Template times out and thus is no longer valid."
        ::= { ipfixTemplateEntry 4 }

    ---------------------------------------------------------------------
    -- 1.1.3: Exported Template Definition Table
    ---------------------------------------------------------------------
    ipfixTemplateDefinitionTable  OBJECT-TYPE
        SYNTAX      SEQUENCE OF IpfixTemplateDefinitionEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "On Exporters, this table lists the (Options) Template fields
            of which a (Options) Template is defined.  It defines the
            (Options) Template given in the ipfixTemplateId specified in
            the ipfixTemplateTable.

            On Collectors, this table lists the (Options) Template fields
            of which a (Options) Template is defined.  It defines the
            (Options) Template given in the ipfixTemplateId specified in
            the ipfixTemplateTable."
        ::= { ipfixMainObjects 3 }

    ipfixTemplateDefinitionEntry OBJECT-TYPE
        SYNTAX      IpfixTemplateDefinitionEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Defines an entry in the ipfixTemplateDefinitionTable."
        INDEX       {
            ipfixTransportSessionIndex,
            ipfixTemplateObservationDomainId,
            ipfixTemplateId,
            ipfixTemplateDefinitionIndex
        }
        ::= { ipfixTemplateDefinitionTable 1 }

    IpfixTemplateDefinitionEntry ::=
        SEQUENCE {
            ipfixTemplateDefinitionIndex            Unsigned32,
            ipfixTemplateDefinitionIeId             Unsigned32,
```

```
            ipfixTemplateDefinitionIeLength         Unsigned32,
            ipfixTemplateDefinitionEnterpriseNumber Unsigned32,
            ipfixTemplateDefinitionFlags            BITS
        }

    ipfixTemplateDefinitionIndex OBJECT-TYPE
        SYNTAX      Unsigned32 (1..65535)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "The ipfixTemplateDefinitionIndex specifies the order in
            which the Information Elements are used in the (Options)
            Template Record.

            Since a Template Record can contain a maximum of 65535
            Information Elements, the index is limited to this value."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Sections 3.4.1 and 3.4.2."
        ::= { ipfixTemplateDefinitionEntry 1 }

    ipfixTemplateDefinitionIeId OBJECT-TYPE
        SYNTAX      Unsigned32 (1..65535)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This indicates the Information Element ID at position
            ipfixTemplateDefinitionIndex in the (Options) Template
            ipfixTemplateId.  This implicitly specifies the data type
            of the Information Element.  The elements are registered
            at IANA.  A current list of assignments can be found at
            <http://www.iana.org/assignments/ipfix/>."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.2.

            RFC 5102, Information Model for IP Flow Information Export."
        ::= { ipfixTemplateDefinitionEntry 2 }

    ipfixTemplateDefinitionIeLength OBJECT-TYPE
        SYNTAX      Unsigned32 (0..65535)
        MAX-ACCESS  read-only
        STATUS      current
```

```
        DESCRIPTION
            "This indicates the length of the Information Element ID at
            position ipfixTemplateDefinitionIndex in the (Options)
            Template ipfixTemplateId."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.2.

            RFC 5102, Information Model for IP Flow Information Export."
        ::= { ipfixTemplateDefinitionEntry 3 }

    ipfixTemplateDefinitionEnterpriseNumber OBJECT-TYPE
        SYNTAX      Unsigned32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "IANA enterprise number of the authority defining the
            Information Element identifier in this Template Record.
            Enterprise numbers are assigned by IANA.  A current list of
            all assignments is available from
            <http://www.iana.org/assignments/enterprise-numbers/>.

            This object must be zero(0) for all standard Information
            Elements registered with IANA.  A current list of these
            elements is available from
            <http://www.iana.org/assignments/ipfix/>."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.2.

            RFC 5102, Information Model for IP Flow Information Export."
        ::= { ipfixTemplateDefinitionEntry 4 }

    ipfixTemplateDefinitionFlags OBJECT-TYPE
        SYNTAX      BITS {
                        scope(0),
                        flowKey(1)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This bitmask indicates special attributes for the
            Information Element:

            scope(0)
                This Information Element is used for scope.
```

```
            flowKey(1)
                This Information Element is a Flow Key.

            Thus, we get the following values for an Information Element:

            If neither bit scope(0) nor bit flowKey(1) is set
                The Information Element is neither used for scoping nor
                as Flow Key.
            If only bit scope(0) is set
                The Information Element is used for scoping.
            If only bit flowKey(1) is set
                The Information Element is used as Flow Key.

            Both bit scope(0) and flowKey(1) MUST NOT be set at the same
            time.  This combination is not allowed."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Sections 2 and 3.4.2.1.

            RFC 5102, Information Model for IP Flow Information Export."
        ::= { ipfixTemplateDefinitionEntry 5 }

    ----------------------------------------------------------------------
    -- 1.1.4: Export Table
    ----------------------------------------------------------------------
    ipfixExportTable  OBJECT-TYPE
        SYNTAX      SEQUENCE OF IpfixExportEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "This table lists all exports of an IPFIX Device.

            On Exporters, this table contains all exports grouped by
            Transport Session, Observation Domain ID, Template ID, and
            Metering Process represented by the
            ipfixMeteringProcessCacheId.  Thanks to the ipfixExportIndex,
            the exports can group one or more Transport Sessions to
            achieve a special functionality like failover management,
            load-balancing, etc.  The entries with the same
            ipfixExportIndex, ipfixObservationDomainId,
            and ipfixMeteringProcessCacheId define a Transport
            Session group.  If the Exporter does not use Transport
            Session grouping, then each ipfixExportIndex contains a
            single ipfixMeteringProcessCacheId, and thus a single
            Transport Session; this session MUST have a member type
```

```
            value of primary(1).  Transport Sessions referenced in this
            table MUST have a ipfixTransportSessionDeviceMode value of
            exporting(1).

            On Collectors, this table is not needed."
        ::= { ipfixMainObjects 4 }

    ipfixExportEntry OBJECT-TYPE
        SYNTAX      IpfixExportEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Defines an entry in the ipfixExportTable."
        INDEX       {
            ipfixExportIndex,
            ipfixMeteringProcessCacheId,
            ipfixTransportSessionIndex
        }
        ::= { ipfixExportTable 1 }

    IpfixExportEntry ::=
        SEQUENCE {
           ipfixExportIndex      Unsigned32,
           ipfixExportMemberType INTEGER
        }

    ipfixExportIndex OBJECT-TYPE
        SYNTAX      Unsigned32 (1..4294967295)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Locally arbitrary, but unique identifier of an entry in
            the ipfixExportTable.  The value is expected
            to remain constant from a re-initialization of the entity's
            network management agent to the next re-initialization.

            A common ipfixExportIndex between two entries from this
            table indicates that there is a relationship between the
            Transport Sessions in ipfixTransportSessionIndex.  The type
            of relationship is expressed by the value of
            ipfixExportMemberType."
        ::= { ipfixExportEntry 1 }

    ipfixExportMemberType OBJECT-TYPE
        SYNTAX      INTEGER {
                        unknown(0),
                        primary(1),
                        secondary(2),
```

```
                    parallel(3),
                    loadBalancing(4)
                }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of member Transport Session in a Transport
        Session group (identified by the value of ipfixExportIndex,
        ipfixObservationDomainId, and ipfixMeteringProcessCacheId).
        The following values are valid:

        unknown(0)
            This value MUST be used if the status of the group
            membership cannot be detected by the equipment.  This
            value should be avoided as far as possible.

        primary(1)
            This value is used for a group member that is used as
            the primary target of an Exporter.  Other group members
            (with the same ipfixExportIndex and
            ipfixMeteringProcessCacheId) MUST NOT have the value
            primary(1) but MUST have the value secondary(2).
            This value MUST also be specified if the Exporter does
            not support Transport Session grouping.  In this case,
            the group contains only one Transport Session.

        secondary(2)
            This value is used for a group member that is used as a
            secondary target of an Exporter.  The Exporter will use
            one of the targets specified as secondary(2) within the
            same Transport Session group when the primary target is
            not reachable.

        parallel(3)
            This value is used for a group member that is used for
            duplicate exporting (i.e., all group members identified
            by the ipfixExportIndex are exporting the same Records
            in parallel).  This implies that all group members MUST
            have the same member type (i.e., parallel(3)).

        loadBalancing(4)
            This value is used for a group member that is used
            as one target for load-balancing.  This means that a
            Record is sent to one of the group members in this
            group identified by ipfixExportIndex.
            This implies that all group members MUST have the same
            member type (i.e., loadBalancing(4))."
    ::= { ipfixExportEntry 2 }
```

```
   ---------------------------------------------------------------------
   -- 1.1.5: Metering Process Table
   ---------------------------------------------------------------------
   ipfixMeteringProcessTable  OBJECT-TYPE
       SYNTAX      SEQUENCE OF IpfixMeteringProcessEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "This table lists so-called caches used at the Metering
           Process to store the metering data of Flows observed at
           the Observation Points given in the
           ipfixObservationPointGroupReference.  The table lists the
           timeouts that specify when the cached metering data is
           expired.

           On Collectors, the table is not needed."
       ::= { ipfixMainObjects 5 }

   ipfixMeteringProcessEntry OBJECT-TYPE
       SYNTAX      IpfixMeteringProcessEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Defines an entry in the ipfixMeteringProcessTable."
       INDEX       { ipfixMeteringProcessCacheId }
       ::= { ipfixMeteringProcessTable 1 }

   IpfixMeteringProcessEntry ::=
       SEQUENCE {
           ipfixMeteringProcessCacheId              Unsigned32,
           ipfixMeteringProcessObservationPointGroupRef Unsigned32,
           ipfixMeteringProcessCacheActiveTimeout   Unsigned32,
           ipfixMeteringProcessCacheIdleTimeout Unsigned32
       }

   ipfixMeteringProcessCacheId OBJECT-TYPE
       SYNTAX      Unsigned32 (1..4294967295)
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Locally arbitrary, but unique identifier of an entry in the
           ipfixMeteringProcessTable.  The value is expected to remain
           constant from a re-initialization of the entity's network
           management agent to the next re-initialization."
       ::= { ipfixMeteringProcessEntry 1 }
```

```
   ipfixMeteringProcessObservationPointGroupRef OBJECT-TYPE
       SYNTAX      Unsigned32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The Observation Point Group ID that links this table entry
           to the ipfixObservationPointTable.  The matching
           ipfixObservationPointGroupId in that table gives the
           Observation Points used in that cache.  If the Observation
           Points are unknown, the
           ipfixMeteringProcessObservationPointGroupRef MUST be zero."
       ::= { ipfixMeteringProcessEntry 2 }

   ipfixMeteringProcessCacheActiveTimeout OBJECT-TYPE
       SYNTAX      Unsigned32
       UNITS       "seconds"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "On the Exporter, this object contains the time after which a
           Flow is expired (and a Data Record for the Template is sent),
           even though packets matching this Flow are still received by
           the Metering Process.  If this value is 0, the Flow is not
           prematurely expired."
       REFERENCE
           "RFC 5470, Architecture for IP Flow Information Export,
           Section 5.1.1, item 3."
       ::= { ipfixMeteringProcessEntry 3 }

   ipfixMeteringProcessCacheIdleTimeout OBJECT-TYPE
       SYNTAX      Unsigned32
       UNITS       "seconds"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "On the Exporter, this object contains the time after which a
           Flow is expired (and a Data Record for the Template is sent)
           when no packets matching this Flow are received by the
           Metering Process for the given number of seconds.  If this
           value is zero, the Flow is expired immediately; i.e., a Data
           Record is sent for every packet received by the Metering
           Process."
       REFERENCE
           "RFC 5470, Architecture for IP Flow Information Export,
           Section 5.1.1, item 1"
       ::= { ipfixMeteringProcessEntry 4 }
```

```
   ---------------------------------------------------------------------
   -- 1.1.6: Observation Point Table
   ---------------------------------------------------------------------
   ipfixObservationPointTable  OBJECT-TYPE
       SYNTAX      SEQUENCE OF IpfixObservationPointEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "This table lists the Observation Points used within an
           Exporter by the Metering Process.  The index
           ipfixObservationPointGroupId groups Observation Points
           and is referenced in the Metering Process table.

           On Collectors, this table is not needed."
       ::= { ipfixMainObjects 6 }

   ipfixObservationPointEntry OBJECT-TYPE
       SYNTAX      IpfixObservationPointEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Defines an entry in the ipfixObservationPointTable."
       INDEX       {
           ipfixObservationPointGroupId,
           ipfixObservationPointIndex
       }
       ::= { ipfixObservationPointTable 1 }

   IpfixObservationPointEntry ::=
       SEQUENCE {
           ipfixObservationPointGroupId           Unsigned32,
           ipfixObservationPointIndex             Unsigned32,
           ipfixObservationPointObservationDomainId Unsigned32,
           ipfixObservationPointPhysicalEntity    PhysicalIndexOrZero,
           ipfixObservationPointPhysicalInterface InterfaceIndexOrZero,
           ipfixObservationPointPhysicalEntityDirection INTEGER
       }

   ipfixObservationPointGroupId OBJECT-TYPE
       SYNTAX      Unsigned32 (1..4294967295)
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Locally arbitrary, but unique identifier of an entry in the
           ipfixObservationPointTable.  The value is expected to remain
           constant from a re-initialization of the entity's network
           management agent to the next re-initialization.
```

```
            This index represents a group of Observation Points.

            The special value of 0 MUST NOT be used within this table
            but is reserved for usage in the ipfixMeteringProcessTable.
            An index of 0 for the ipfixObservationPointGroupReference
            index in that table indicates that an Observation Point is
            unknown or unspecified for a Metering Process cache."
        ::= { ipfixObservationPointEntry 1 }

    ipfixObservationPointIndex OBJECT-TYPE
        SYNTAX      Unsigned32 (1..4294967295)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Locally arbitrary, but unique identifier of an entry in the
            ipfixObservationPointTable.  The value is expected to remain
            constant from a re-initialization of the entity's network
            management agent to the next re-initialization.

            This index represents a single Observation Point in an
            Observation Point group."
        ::= { ipfixObservationPointEntry 2 }

    ipfixObservationPointObservationDomainId OBJECT-TYPE
        SYNTAX      Unsigned32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The ID of the Observation Domain in which this
            Observation Point is included.

            The special value of 0 indicates that the Observation
            Points within this group cannot be applied to a single
            Observation Domain."
        REFERENCE
            "RFC 5101, Specification of the IP Flow Information Export
            (IPFIX) Protocol for the Exchange of IP Traffic Flow
            Information, Section 3.1."
        ::= { ipfixObservationPointEntry 3 }

    ipfixObservationPointPhysicalEntity OBJECT-TYPE
        SYNTAX      PhysicalIndexOrZero
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This object contains the index of a physical entity in
            the ENTITY MIB.  This physical entity is the given
            Observation Point.  If such a physical entity cannot be
```

```
            specified or is not known, then the object is zero."
        ::= { ipfixObservationPointEntry 4 }

    ipfixObservationPointPhysicalInterface OBJECT-TYPE
        SYNTAX      InterfaceIndexOrZero
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This object contains the index of a physical interface in
            the Interfaces MIB.  This physical interface is the given
            Observation Point.  If such a physical interface cannot be
            specified or is not known, then the object is zero.

            This object MAY be used alone or in addition to
            ipfixObservationPointPhysicalEntity.  If
            ipfixObservationPointPhysicalEntity is not zero, this
            object MUST point to the same physical interface that is
            referenced in ipfixObservationPointPhysicalEntity.
            Otherwise, it may reference any interface in the
            Interfaces MIB."
        ::= { ipfixObservationPointEntry 5 }

    ipfixObservationPointPhysicalEntityDirection OBJECT-TYPE
        SYNTAX      INTEGER {
                        unknown(0),
                        ingress(1),
                        egress(2),
                        both(3)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The direction of the Flow that is monitored on the given
            physical entity.  The following values are valid:

            unknown(0)
                This value MUST be used if a direction is not known for
                the given physical entity.

            ingress(1)
                This value is used for monitoring incoming Flows on the
                given physical entity.

            egress(2)
                This value is used for monitoring outgoing Flows on the
                given physical entity.

            both(3)
```

```
                This value is used for monitoring incoming and outgoing
                Flows on the given physical entity."
        ::= { ipfixObservationPointEntry 6 }

   ---------------------------------------------------------------------
   -- 1.1.7: Selection Process Table
   ---------------------------------------------------------------------
   ipfixSelectionProcessTable OBJECT-TYPE
       SYNTAX      SEQUENCE OF IpfixSelectionProcessEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "This table contains Selector Functions connected to a
           Metering Process by the index ipfixMeteringProcessCacheId.
           The Selector Functions are grouped into Selection Processes
           by the ipfixSelectionProcessIndex.  The Selector Functions
           are applied within the Selection Process to the packets
           observed for the given Metering Process cache in increasing
           order as indicated by the ipfixSelectionProcessSelectorIndex.
           This means Selector Functions with a lower
           ipfixSelectionProcessSelectorIndex are applied first.
           The remaining packets are accounted for in Flow Records.

           Since IPFIX does not define any Selector Function (except
           selecting every packet), this is a placeholder for future
           use and a guideline for implementing enterprise-specific
           Selector Function objects.

           The following object tree should help the reader visualize
           how the Selector Function objects should be implemented:

           ipfixSelectorFunctions
           |
           +- ipfixFuncSelectAll
           |  |
           |  +- ipfixFuncSelectAllAvail (is the function available?)
           |
           +- ipfixFuncF2
           |  |
           |  +- ipfixFuncF2Avail (is the function F2 available?)
           |  |
           |  +- ipfixFuncF2Parameters (a table with parameters)
           ...
           |
           +- ipfixFuncFn...
```

```
            If a Selector Function takes parameters, the MIB should
            contain a table with an entry for each set of parameters
            used at the Exporter."
        ::= { ipfixMainObjects 7 }

    ipfixSelectionProcessEntry OBJECT-TYPE
        SYNTAX      IpfixSelectionProcessEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Defines an entry in the ipfixSelectionProcessTable."
        INDEX       {
            ipfixMeteringProcessCacheId,
            ipfixSelectionProcessIndex,
            ipfixSelectionProcessSelectorIndex
        }
        ::= { ipfixSelectionProcessTable 1 }

    IpfixSelectionProcessEntry ::= SEQUENCE {
            ipfixSelectionProcessIndex            Unsigned32,
            ipfixSelectionProcessSelectorIndex    Unsigned32,
            ipfixSelectionProcessSelectorFunction OBJECT IDENTIFIER
        }

    ipfixSelectionProcessIndex OBJECT-TYPE
        SYNTAX      Unsigned32 (1..4294967295)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Locally arbitrary, but unique identifier of an entry in the
            ipfixSelectionProcessTable.  The value is expected to remain
            constant from a re-initialization of the entity's network
            management agent to the next re-initialization."
        ::= { ipfixSelectionProcessEntry 1 }

    ipfixSelectionProcessSelectorIndex OBJECT-TYPE
        SYNTAX      Unsigned32 (1..4294967295)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Index specifying the order in which the referenced
            ipfixSelectionProcessSelectorFunctions are applied to the
            observed packet stream within the given Selection Process
            (identified by the ipfixSelectionProcessIndex).  The
            Selector Functions are applied in increasing order; i.e.,
            Selector Functions with a lower index are applied first."
        ::= { ipfixSelectionProcessEntry 2 }
```

```
   ipfixSelectionProcessSelectorFunction OBJECT-TYPE
       SYNTAX      OBJECT IDENTIFIER
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The pointer to the Selector Function used at position
           ipfixSelectionProcessSelectorIndex in the list of Selector
           Functions for the Metering Process cache specified by the
           index ipfixMeteringProcessCacheId and for the given
           Selection Process (identified by the
           ipfixSelectionProcessIndex).

           This usually points to an object in the IPFIX SELECTOR MIB.
           If the Selector Function does not take parameters, then it
           MUST point to the root of the function subtree.  If the
           function takes parameters, then it MUST point to an entry
           in the parameter table of the Selector Function."
       ::= { ipfixSelectionProcessEntry 3 }

   ----------------------------------------------------------------------
   -- 1.2.1: Transport Session Statistics Table
   ----------------------------------------------------------------------
   ipfixTransportSessionStatsTable  OBJECT-TYPE
       SYNTAX      SEQUENCE OF IpfixTransportSessionStatsEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "This table lists Transport Session statistics between
           Exporting Processes and Collecting Processes."
       ::= { ipfixStatistics 1 }

   ipfixTransportSessionStatsEntry OBJECT-TYPE
       SYNTAX      IpfixTransportSessionStatsEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Defines an entry in the ipfixTransportSessionStatsTable."
       AUGMENTS    { ipfixTransportSessionEntry }
       ::= { ipfixTransportSessionStatsTable 1 }

   IpfixTransportSessionStatsEntry ::=
       SEQUENCE {
           ipfixTransportSessionRate              Gauge32,
           ipfixTransportSessionPackets           Counter64,
           ipfixTransportSessionBytes             Counter64,
           ipfixTransportSessionMessages          Counter64,
           ipfixTransportSessionDiscardedMessages Counter64,
           ipfixTransportSessionRecords           Counter64,
```

```
            ipfixTransportSessionTemplates         Counter64,
            ipfixTransportSessionOptionsTemplates  Counter64,
            ipfixTransportSessionDiscontinuityTime TimeStamp
        }

    ipfixTransportSessionRate OBJECT-TYPE
        SYNTAX      Gauge32
        UNITS       "bytes/second"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of bytes per second received by the
            Collector or transmitted by the Exporter.  A
            value of zero (0) means that no packets were sent or
            received yet.  This object is updated every second."
        ::= { ipfixTransportSessionStatsEntry 1 }

    ipfixTransportSessionPackets OBJECT-TYPE
        SYNTAX      Counter64
        UNITS       "packets"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of packets received by the Collector
            or transmitted by the Exporter.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 2 }

    ipfixTransportSessionBytes OBJECT-TYPE
        SYNTAX      Counter64
        UNITS       "bytes"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of bytes received by the Collector
            or transmitted by the Exporter.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 3 }

    ipfixTransportSessionMessages OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
```

```
        STATUS      current
        DESCRIPTION
            "The number of IPFIX Messages received by the
            Collector or transmitted by the Exporter.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 4 }

    ipfixTransportSessionDiscardedMessages OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of received IPFIX Messages that are malformed,
            cannot be decoded, are received in the wrong order, or are
            missing according to the sequence number.

            If used at the Exporter, the number of messages that could
            not be sent due to, for example, internal buffer overflows,
            network congestion, or routing issues.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 5 }

    ipfixTransportSessionRecords OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of Data Records received by the Collector or
            transmitted by the Exporter.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 6 }

    ipfixTransportSessionTemplates OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of Templates received or transmitted.
            Discontinuities in the value of this counter can occur at
```

```
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 7 }

    ipfixTransportSessionOptionsTemplates OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of Options Templates received or transmitted.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTransportSessionDiscontinuityTime."
        ::= { ipfixTransportSessionStatsEntry 8 }

    ipfixTransportSessionDiscontinuityTime OBJECT-TYPE
        SYNTAX      TimeStamp
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The value of sysUpTime at the most recent occasion at which
            one or more of the Transport Session counters suffered a
            discontinuity.
            A value of zero indicates that no such discontinuity has
            occurred since the last re-initialization of the local
            management subsystem."
        ::= { ipfixTransportSessionStatsEntry 9 }

    ----------------------------------------------------------------------
    -- 1.2.2: Template Statistics Table
    ----------------------------------------------------------------------
    ipfixTemplateStatsTable  OBJECT-TYPE
        SYNTAX      SEQUENCE OF IpfixTemplateStatsEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "This table lists statistics objects per Template."
        ::= { ipfixStatistics 2 }

    ipfixTemplateStatsEntry OBJECT-TYPE
        SYNTAX      IpfixTemplateStatsEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Defines an entry in the ipfixTemplateStatsTable."
```

```
        AUGMENTS    { ipfixTemplateEntry }
        ::= { ipfixTemplateStatsTable 1 }

    IpfixTemplateStatsEntry ::=
        SEQUENCE {
            ipfixTemplateDataRecords       Counter64,
            ipfixTemplateDiscontinuityTime TimeStamp
        }

    ipfixTemplateDataRecords OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of Data Records that are transmitted or received
            per Template.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixTemplateDiscontinuityTime."
        ::= { ipfixTemplateStatsEntry 1 }

    ipfixTemplateDiscontinuityTime OBJECT-TYPE
        SYNTAX      TimeStamp
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The value of sysUpTime at the most recent occasion at which
            the Template counter suffered a discontinuity.
            A value of zero indicates that no such discontinuity has
            occurred since the last re-initialization of the local
            management subsystem."
        ::= { ipfixTemplateStatsEntry 2 }

    ---------------------------------------------------------------------
    -- 1.2.3: Metering Process Statistics Table
    ---------------------------------------------------------------------
    ipfixMeteringProcessStatsTable  OBJECT-TYPE
        SYNTAX      SEQUENCE OF IpfixMeteringProcessStatsEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "This table lists statistics objects that have data per
            Metering Process cache.

            On Collectors, this table is not needed."
        ::= { ipfixStatistics 3 }
```

```
   ipfixMeteringProcessStatsEntry OBJECT-TYPE
       SYNTAX      IpfixMeteringProcessStatsEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Defines an entry in the ipfixMeteringProcessStatsTable."
       AUGMENTS    { ipfixMeteringProcessEntry }
       ::= { ipfixMeteringProcessStatsTable 1 }

   IpfixMeteringProcessStatsEntry ::=
       SEQUENCE {
           ipfixMeteringProcessCacheActiveFlows          Gauge32,
           ipfixMeteringProcessCacheUnusedCacheEntries   Gauge32,
           ipfixMeteringProcessCacheDataRecords          Counter64,
           ipfixMeteringProcessCacheDiscontinuityTime    TimeStamp
       }

   ipfixMeteringProcessCacheActiveFlows OBJECT-TYPE
       SYNTAX      Gauge32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The number of Flows currently active at this cache."
       ::= { ipfixMeteringProcessStatsEntry 1 }

   ipfixMeteringProcessCacheUnusedCacheEntries   OBJECT-TYPE
       SYNTAX      Gauge32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The number of unused cache entries."
       ::= { ipfixMeteringProcessStatsEntry 2 }

   ipfixMeteringProcessCacheDataRecords OBJECT-TYPE
       SYNTAX      Counter64
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The number of Data Records generated.
           Discontinuities in the value of this counter can occur at
           re-initialization of the management system and at other
           times as indicated by the value of
           ipfixMeteringProcessCacheDiscontinuityTime."
       ::= { ipfixMeteringProcessStatsEntry 3 }

   ipfixMeteringProcessCacheDiscontinuityTime OBJECT-TYPE
       SYNTAX      TimeStamp
       MAX-ACCESS  read-only
```

```
        STATUS      current
        DESCRIPTION
            "The value of sysUpTime at the most recent occasion at which
            the Metering Process counter suffered a discontinuity.
            A value of zero indicates that no such discontinuity has
            occurred since the last re-initialization of the local
            management subsystem."
        ::= { ipfixMeteringProcessStatsEntry 4 }

    ---------------------------------------------------------------------
    -- 1.2.4: Selection Process Statistics Table
    ---------------------------------------------------------------------
    ipfixSelectionProcessStatsTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF IpfixSelectionProcessStatsEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "This table contains statistics for the Selector Functions
            connected to a Metering Process by the index
            ipfixMeteringProcessCacheId.

            The indexes MUST match an entry in the
            ipfixSelectionProcessTable."
        ::= { ipfixStatistics 4 }

    ipfixSelectionProcessStatsEntry OBJECT-TYPE
        SYNTAX      IpfixSelectionProcessStatsEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Defines an entry in the ipfixSelectionProcessStatsTable."
        AUGMENTS    { ipfixSelectionProcessEntry }
        ::= { ipfixSelectionProcessStatsTable 1 }

    IpfixSelectionProcessStatsEntry ::= SEQUENCE {
            ipfixSelectionProcessStatsPacketsObserved   Counter64,
            ipfixSelectionProcessStatsPacketsDropped    Counter64,
            ipfixSelectionProcessStatsDiscontinuityTime TimeStamp
        }

    ipfixSelectionProcessStatsPacketsObserved OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of packets observed at the entry point of the
            function.  The entry point may be the Observation Point or
            the exit point of another Selector Function.
```

```
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixSelectionProcessStatsDiscontinuityTime."
        ::= { ipfixSelectionProcessStatsEntry 1 }

    ipfixSelectionProcessStatsPacketsDropped OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of packets dropped while selecting packets.
            Discontinuities in the value of this counter can occur at
            re-initialization of the management system and at other
            times as indicated by the value of
            ipfixSelectionProcessStatsDiscontinuityTime."
        ::= { ipfixSelectionProcessStatsEntry 2 }

    ipfixSelectionProcessStatsDiscontinuityTime OBJECT-TYPE
        SYNTAX      TimeStamp
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The value of sysUpTime at the most recent occasion at which
            one or more of the Selector counters suffered a
            discontinuity.
            A value of zero indicates that no such discontinuity has
            occurred since the last re-initialization of the local
            management subsystem."
        ::= { ipfixSelectionProcessStatsEntry 3 }

    --=================================================================
    -- 2: Conformance Information
    --=================================================================
    ipfixCompliances OBJECT IDENTIFIER ::= { ipfixConformance 1 }
    ipfixGroups      OBJECT IDENTIFIER ::= { ipfixConformance 2 }

    ----------------------------------------------------------------------
    -- 2.1: Compliance Statements
    ----------------------------------------------------------------------
    ipfixCollectorCompliance MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION
            "An implementation that builds an IPFIX Collector
            that complies with this module MUST implement the objects
            defined in the mandatory group ipfixCommonGroup.
```

```
            The implementation of all objects in the other groups is
            optional and depends on the corresponding functionality
            implemented in the equipment.

            An implementation that is compliant with this MIB module
            is limited to using only the values TCP (6), UDP (17), and
            SCTP (132) in the ipfixTransportSessionProtocol object
            because these are the only protocols currently specified
            for usage within IPFIX (see RFC 5101)."
        MODULE  -- this module
        MANDATORY-GROUPS {
            ipfixCommonGroup
        }

        GROUP ipfixCommonStatsGroup
        DESCRIPTION
            "These objects should be implemented if the statistics
            function is implemented in the equipment."
        ::= { ipfixCompliances 1 }

    ipfixExporterCompliance MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION
            "An implementation that builds an IPFIX Exporter that
            complies with this module MUST implement the objects defined
            in the mandatory group ipfixCommonGroup.  The implementation
            of all other objects depends on the implementation of the
            corresponding functionality in the equipment."
        MODULE  -- this module
        MANDATORY-GROUPS {
                ipfixCommonGroup,
                ipfixExporterGroup
        }

        GROUP ipfixCommonStatsGroup
        DESCRIPTION
            "These objects should be implemented if the statistics
            function is implemented in the equipment."

        GROUP ipfixExporterStatsGroup
        DESCRIPTION
            "These objects MUST be implemented if statistics functions
            are implemented in the equipment."
        ::= { ipfixCompliances 2 }
```

```
   ----------------------------------------------------------------------
   -- 2.2: MIB Grouping
   ----------------------------------------------------------------------
   ipfixCommonGroup OBJECT-GROUP
       OBJECTS {
           ipfixTransportSessionProtocol,
           ipfixTransportSessionSourceAddressType,
           ipfixTransportSessionSourceAddress,
           ipfixTransportSessionDestinationAddressType,
           ipfixTransportSessionDestinationAddress,
           ipfixTransportSessionSourcePort,
           ipfixTransportSessionDestinationPort,
           ipfixTransportSessionSctpAssocId,
           ipfixTransportSessionDeviceMode,
           ipfixTransportSessionTemplateRefreshTimeout,
           ipfixTransportSessionOptionsTemplateRefreshTimeout,
           ipfixTransportSessionTemplateRefreshPacket,
           ipfixTransportSessionOptionsTemplateRefreshPacket,
           ipfixTransportSessionIpfixVersion,
           ipfixTransportSessionStatus,

           ipfixTemplateSetId,
           ipfixTemplateAccessTime,

           ipfixTemplateDefinitionIeId,
           ipfixTemplateDefinitionIeLength,
           ipfixTemplateDefinitionEnterpriseNumber,
           ipfixTemplateDefinitionFlags
       }
       STATUS      current
       DESCRIPTION
           "The main IPFIX objects."
       ::= { ipfixGroups 1 }

   ipfixCommonStatsGroup OBJECT-GROUP
       OBJECTS {
           ipfixTransportSessionRate,
           ipfixTransportSessionPackets,
           ipfixTransportSessionBytes,
           ipfixTransportSessionMessages,
           ipfixTransportSessionDiscardedMessages,
           ipfixTransportSessionRecords,
           ipfixTransportSessionTemplates,
           ipfixTransportSessionOptionsTemplates,
           ipfixTransportSessionDiscontinuityTime,

           ipfixTemplateDataRecords,
           ipfixTemplateDiscontinuityTime
```

```
        }
        STATUS      current
        DESCRIPTION
            "Common statistical objects."
        ::= { ipfixGroups 2 }

    ipfixExporterGroup OBJECT-GROUP
        OBJECTS {
            ipfixExportMemberType,

            ipfixMeteringProcessObservationPointGroupRef,
            ipfixMeteringProcessCacheActiveTimeout,
            ipfixMeteringProcessCacheIdleTimeout,

            ipfixObservationPointObservationDomainId,
            ipfixObservationPointPhysicalEntity,
            ipfixObservationPointPhysicalInterface,
            ipfixObservationPointPhysicalEntityDirection,

            ipfixSelectionProcessSelectorFunction
        }
        STATUS      current
        DESCRIPTION
            "The main objects for Exporters."
        ::= { ipfixGroups 3 }

    ipfixExporterStatsGroup OBJECT-GROUP
        OBJECTS {
            ipfixMeteringProcessCacheActiveFlows,
            ipfixMeteringProcessCacheUnusedCacheEntries,
            ipfixMeteringProcessCacheDataRecords,
            ipfixMeteringProcessCacheDiscontinuityTime,

            ipfixSelectionProcessStatsPacketsObserved,
            ipfixSelectionProcessStatsPacketsDropped,
            ipfixSelectionProcessStatsDiscontinuityTime
        }
        STATUS      current
        DESCRIPTION
            "The statistical objects for Exporters."
        ::= { ipfixGroups 4 }

    END
```

8.2. IPFIX SELECTOR MIB Definition

```
IPFIX-SELECTOR-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, mib-2
        FROM SNMPv2-SMI                                 -- [RFC2578]
    TruthValue
        FROM SNMPv2-TC                                  -- [RFC2579]
    MODULE-COMPLIANCE, OBJECT-GROUP
        FROM SNMPv2-CONF;                               -- [RFC2580]

ipfixSelectorMIB MODULE-IDENTITY
    LAST-UPDATED "201206110000Z"          -- 11 June 2012
    ORGANIZATION "IETF IPFIX Working Group"
    CONTACT-INFO
        "WG charter:
          http://www.ietf.org/html.charters/ipfix-charter.html

        Mailing Lists:
          General Discussion: ipfix@ietf.org
          To Subscribe: http://www1.ietf.org/mailman/listinfo/ipfix
          Archive:
        http://www1.ietf.org/mail-archive/web/ipfix/current/index.html

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        DESCRIPTION
            "The IPFIX SELECTOR MIB module defined in this section
            provides the standard Filtering and Sampling functions that
            can be referenced in the ipfixSelectionProcessTable.  All
            standard Filtering and Sampling functions MUST be registered
            in the subtree under object ipfixSelectorFunctions
            (1.3.6.1.2.1.194.1.1).  The top-level OIDs in the subtree
            under object ipfixSelectorFunctions MUST be registered in a
            sub-registry maintained by IANA at
            <http://www.iana.org/assignments/smi-numbers/>.

            New Selector Functions MUST be registered at IANA and are
            subject to Expert Review [RFC5226], i.e., review by one of a
            group of experts designated by an IETF Area Director.  The
            group of experts MUST check the requested MIB objects for
            completeness and accuracy of the description.  Requests for
            MIB objects that duplicate the functionality of existing
            objects SHOULD be declined.  The smallest available OID
            SHOULD be assigned to new MIB objects.  The specification
            of new MIB objects SHOULD follow the structure specified in
            [RFC6615] and MUST be published using a well-
            established and persistent publication medium.  The experts
            will initially be drawn from the Working Group Chairs and
            document editors of the IPFIX and PSAMP Working Groups.

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            (http://trustee.ietf.org/license-info)."
```

```
   --  Revision history

       REVISION     "201206110000Z"         -- 11 June 2012
       DESCRIPTION
           "Update to MIB description to reflect updated registration
           of new Sampling and Filtering functions.  Published as
           RFC 6615."

       REVISION     "201003150000Z"         -- 15 March 2010
       DESCRIPTION
           "Initial version, published as RFC 5815."

       ::= { mib-2 194 }

   --************************************************************
   -- Top-Level Structure of the MIB
   --************************************************************

   ipfixSelectorObjects     OBJECT IDENTIFIER
       ::= { ipfixSelectorMIB 1 }
   ipfixSelectorConformance OBJECT IDENTIFIER
       ::= { ipfixSelectorMIB 2 }

   --============================================================
   -- 1: Objects Used by All IPFIX Implementations
   --============================================================
   ------------------------------------------------------------
   -- 1.1: Packet Selector Functions for IPFIX
   ------------------------------------------------------------
   ipfixSelectorFunctions OBJECT IDENTIFIER
       ::= { ipfixSelectorObjects 1 }

   ------------------------------------------------------------
   -- 1.1.1: Function 1: Selecting All Packets
   ------------------------------------------------------------
   ipfixFuncSelectAll OBJECT IDENTIFIER
       ::= { ipfixSelectorFunctions 1 }

   ipfixFuncSelectAllAvail OBJECT-TYPE
       SYNTAX      TruthValue
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "This object indicates the availability of the trivial
           function of selecting all packets.  This function is always
           available."
       ::= { ipfixFuncSelectAll 1 }
```

```
--=================================================================
-- 2: Conformance Information
--=================================================================
ipfixSelectorCompliances OBJECT IDENTIFIER
    ::= { ipfixSelectorConformance 1 }
ipfixSelectorGroups      OBJECT IDENTIFIER
    ::= { ipfixSelectorConformance 2 }

-----------------------------------------------------------------
-- 2.1: Compliance Statements
-----------------------------------------------------------------
ipfixSelectorBasicCompliance MODULE-COMPLIANCE
    STATUS      current
    DESCRIPTION
        "An implementation that builds an IPFIX Exporter that
        complies with this module MUST implement the objects defined
        in the mandatory group ipfixBasicGroup.  The implementation
        of all other objects depends on the implementation of the
        corresponding functionality in the equipment."
    MODULE  -- this module
    MANDATORY-GROUPS {
            ipfixSelectorBasicGroup
    }
    ::= { ipfixSelectorCompliances 1 }

-----------------------------------------------------------------
-- 2.2: MIB Grouping
-----------------------------------------------------------------
ipfixSelectorBasicGroup OBJECT-GROUP
    OBJECTS {
        ipfixFuncSelectAllAvail
    }
    STATUS      current
    DESCRIPTION
        "The main IPFIX objects."
    ::= { ipfixSelectorGroups 1 }

END
```

9. Security Considerations

There are no management objects defined in this MIB module that have a MAX-ACCESS clause of read-write and/or read-create. So, if this MIB module is implemented correctly, then there is no risk that an intruder can alter or create any management objects of this MIB module via direct SNMP SET operations.

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

- ipfixTransportSessionTable - contains configuration data that might be sensitive because objects in this table may reveal information about the network infrastructure

- ipfixExportTable - contains configuration data that might be sensitive because objects in this table may reveal information about the network infrastructure as well

- ipfixMeteringProcessTable - contains configuration data that might be sensitive because objects in this table may reveal information about the IPFIX Device itself

- ipfixObservationPointTable - contains configuration data that might be sensitive because objects in this table may reveal information about the IPFIX Device itself and the network infrastructure

- ipfixSelectorFunctions - currently contains no sensitive data but might want to be secured anyway, since it may contain sensitive data in a future version

All other objects and tables contain no data that is considered sensitive.

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

Implementations MUST provide the security features described by the SNMPv3 framework (see [RFC3410]), including full support for authentication and privacy via the User-based Security Model (USM) [RFC3414] with the AES cipher algorithm [RFC3826]. Implementations MAY also provide support for the Transport Security Model (TSM) [RFC5591] in combination with a secure transport such as SSH [RFC5592] or TLS/DTLS [RFC6353].

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

10. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

Descriptor	OBJECT IDENTIFIER value
ipfixMIB	{ mib-2 193 }
ipfixSelectorMIB	{ mib-2 194 }

The IPFIX SELECTOR MIB registry as defined in [RFC5815] Section 10 has been removed by IANA, as its use is discontinued with this document.

IANA has created and maintains a sub-registry at http://www.iana.org/assignments/smi-numbers, in which the top-level OIDs in the subtree under object ipfixSelectorFunctions MUST be registered. The initial version of this sub-registry should contain the following:

Sub-registry Name: IPFIX-SELECTOR-MIB Functions
Reference: [RFC6615]
Registration Procedures: Expert Review [RFC5226]

Prefix: iso.org.dod.internet.mgmt.
mib-2.ipfixSelectorMIB.ipfixSelectorObjects.ipfixSelectorFunctions
(1.3.6.1.2.1.194.1.1)

Decimal	Name	Description	Reference
1	ipfixFuncSelectAll	Select everything	[RFC6615]

Additions to this sub-registry are subject to Expert Review [RFC5226], i.e., review by one of a group of experts designated by an IETF Area Director. The group of experts MUST check the requested MIB objects for completeness and accuracy of the description. Requests for MIB objects that duplicate the functionality of existing objects SHOULD be declined. The smallest available OID SHOULD be assigned to new MIB objects. The specification of new MIB objects SHOULD follow the structure specified in Section 6.1 and MUST be published using a well-established and persistent publication medium. The experts will initially be drawn from the Working Group Chairs and document editors of the IPFIX and PSAMP Working Groups.

11. Acknowledgments

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