         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.

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   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
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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

   o   the Transport Session Index (ipfixTransportSessionIndex) and

   o   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

   o   the Metering Process table (ipfixMeteringProcessCacheId; see
       below) and

   o   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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         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.

      -- 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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        Legal Provisions Relating to IETF Documents
        (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:

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

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

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

   o 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

   o 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.

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12. References

12.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
           Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J.
           Schoenwaelder, Ed., "Structure of Management Information
           Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J.
           Schoenwaelder, Ed., "Textual Conventions for SMIv2",
           STD 58, RFC 2579, April 1999.

[RFC2580] McCloghrie, K., Ed., Perkins, D., Ed., and J.
           Schoenwaelder, Ed., "Conformance Statements for SMIv2",
           STD 58, RFC 2580, April 1999.

[RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group
           MIB", RFC 2863, June 2000.

[RFC3873] Pastor, J. and M. Belinchon, "Stream Control Transmission
           Protocol (SCTP) Management Information Base (MIB)",
           RFC 3873, September 2004.

[RFC4001] Daniele, M., Haberman, B., Routhier, S., and J.
           Schoenwaelder, "Textual Conventions for Internet Network
           Addresses", RFC 4001, February 2005.

   [RFC4133] Bierman, A. and K. McCloghrie, "Entity MIB (Version 3)",
              RFC 4133, August 2005.

   [RFC5101] Claise, B., Ed., "Specification of the IP Flow Information
              Export (IPFIX) Protocol for the Exchange of IP Traffic
              Flow Information", RFC 5101, January 2008.

   [RFC5102] Quittek, J., Bryant, S., Claise, B., Aitken, P., and J.
              Meyer, "Information Model for IP Flow Information Export",
              RFC 5102, January 2008.

   [RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an
              IANA Considerations Section in RFCs", BCP 26, RFC 5226,
              May 2008.

   [RFC5815] Dietz, T., Ed., Kobayashi, A., Claise, B., and G. Muenz,
              "Definitions of Managed Objects for IP Flow Information
              Export", RFC 5815, April 2010.

12.2. Informative References

   [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart,
              "Introduction and Applicability Statements for Internet-
              Standard Management Framework", RFC 3410, December 2002.

   [RFC3414] Blumenthal, U. and B. Wijnen, "User-based Security Model
              (USM) for version 3 of the Simple Network Management
              Protocol (SNMPv3)", STD 62, RFC 3414, December 2002.

   [RFC3826] Blumenthal, U., Maino, F., and K. McCloghrie, "The
              Advanced Encryption Standard (AES) Cipher Algorithm in the
              SNMP User-based Security Model", RFC 3826, June 2004.

   [RFC3917] Quittek, J., Zseby, T., Claise, B., and S. Zander,
              "Requirements for IP Flow Information Export (IPFIX)",
              RFC 3917, October 2004.

   [RFC5470] Sadasivan, G., Brownlee, N., Claise, B., and J. Quittek,
              "Architecture for IP Flow Information Export", RFC 5470,
              March 2009.

   [RFC5472] Zseby, T., Boschi, E., Brownlee, N., and B. Claise, "IP
              Flow Information Export (IPFIX) Applicability", RFC 5472,
              March 2009.

   [RFC5474] Duffield, N., Ed., Chiou, D., Claise, B., Greenberg, A.,
              Grossglauser, M., and J. Rexford, "A Framework for Packet
              Selection and Reporting", RFC 5474, March 2009.

   [RFC5475] Zseby, T., Molina, M., Duffield, N., Niccolini, S., and F.
              Raspall, "Sampling and Filtering Techniques for IP Packet
              Selection", RFC 5475, March 2009.

   [RFC5476] Claise, B., Ed., Johnson, A., and J. Quittek, "Packet
              Sampling (PSAMP) Protocol Specifications", RFC 5476,
              March 2009.

   [RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model
              for the Simple Network Management Protocol (SNMP)",
              RFC 5591, June 2009.

   [RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure
              Shell Transport Model for the Simple Network Management
              Protocol (SNMP)", RFC 5592, June 2009.

   [RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport
              Model for the Simple Network Management Protocol (SNMP)",
              RFC 6353, July 2011.

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