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Stream Control Transmission Protocol Management Information Base using SMIv2 <draft-ietf-sigtran-sctp-mib-05.txt>

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Abstract

The Stream Control Transmission Protocol (SCTP) is a reliable transport protocol operating on top of a connectionless packet network such as IP, designed to transport PSTN signaling messages over the connectionless packet network, but is capable of broader applications.

This memo defines the Management Information Base (MIB) module which describes the minimum amount of objects needed to manage the implementation of the SCTP.

Open Issues

- Remove this section.

- Remove Revision History

- Decide under which object identifier branch of the SNMP tree, SCTP will be placed (value obtained when submitted to the IETF editor).

- Update references to [RFC2851-update]

TABLE OF CONTENTS

1. Introduction

This memo defines the Management Information Base (MIB) module which describes managed objects for implementations of the SCTP.

The document starts with a brief description of the SNMP framework and continues with the MIB explanation and security consideration among others.

The managed objects in this MIB module have been based on RFC 2012: "SNMPv2 Management Information Base for the Transmission Control Protocol using SMIv2" [RFC 2012] and "IP Version 6 Management Information Base for the Transmission Control Protocol" [RFC 2452].

Terms related to the SCTP architecture are explained in [1]. Other specific abbreviations are listed below.

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

1.1 Abbreviations

DNS - Domain Name System
IANA - Internet Assigned Numbers Authority
ICANN - Internet Corporation for Assigned Names and Numbers
IETF - Internet Engineering Task Force
IP - Internet Protocol
MIB - Management Information Base
RFC - Request For Comment
RTO - Retransmission Time Out
SCTP - Stream Control Transmission Protocol
SMI - Structure of Management Information
SNMP - Simple Network Management Protocol
TCB - Transmission Control Block
TCP - Transmission Control Protocol

2. The SNMP Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2271 [SNMPArch].

- Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in RFC 1155 [SMIv1], RFC 1212 [SNMPv1MIBDef] and RFC 1215 [SNMPv1Traps]. The second version, called SMIv2, is described in RFC 1902 [SMIv2], RFC 1903 [SNMPv2TC] and RFC 1904 [SNMPv2Conf].

- Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in RFC 1157 [SNMPv1]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [SNMPv2c] and RFC 1906 [SNMPv2TM]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [SNMPv2TM], RFC 2272 [SNMPv3MP] and RFC 2574 [SNMPv3USM].

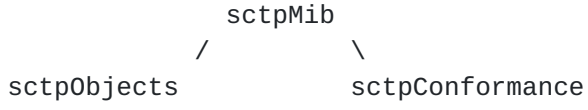
- Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in RFC 1157 [SNMPv1]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [SNMPv2PO].

- A set of fundamental applications described in RFC 2273 [SNMPv3App] and the view-based access control mechanism described in RFC 2575 [SNMPv3VACM].

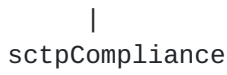
Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the mechanisms defined in the SMI. This memo specifies a MIB module that is compliant to the SMIv2. A MIB conforming to the SMIv1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible (use of Counter64). Some machine-readable information in SMIv2 will be converted into textual descriptions in SMIv1 during the translation process. However, this loss of machine-readable information is not considered to change the semantics of the MIB.

3. Structure of the MIB

The MIB is structured in the following way:




sctpScalars
sctpTables
sctpGroups
sctpCompliances



where:

- sctpObjects, all the SCTP objects are defined under this branch.
  - sctpScalars, containing only scalars values. It can be split into:
    - General variables, listing the main SCTP variables.
    - Statistics for traffic measurements.
      - SCTP state related statistics
      - other statistics
  - sctpTables, tables per association, per local and remote IP address and lookup tables for an easy search.
- sctpConformance, for the Unit of Conformance.
  - sctpGroups, SCTP MIB variables have been grouped according to their function and the context they belong to (general variables, variables/statistics per association, variables per local IP address and variables/statistics per remote IP address).
  - sctpCompliances, Minimal list of objects in the SCTP MIB module that an agent developer must implement.

3.1 Objects

3.1.1 Scalars

3.1.1.1 Protocol General Variables

The first section of the MIB contains the general variables of the SCTP protocol. Maximum, minimum, values by default and initial values are listed here.

Based on the TCP MIB [RFC2012], SCTP RTO mechanism is defined in the same way. In SCTP protocol, only options 'other' and 'vanj' remain because SCTP protocol defines Van Jacobson's algorithm as the one to be used to calculate RTO. 'Other' is left for future use ('rsre' algorithm was eliminated because MIL-STD-1778 is Cancelled-No Superseding Document according to the Military Standard library and 'constant' option doesn't fulfill the SCTP protocol description).

3.1.1.2 Statistics for traffic Measurements

Statistics included here are related to the whole SCTP layer. Statistics related to a specific association, or local/remote IP addresses are defined inside its concerned table.

3.1.1.2.1 State-Related Statistics

These measures are based in the TCP model, but adapted to the SCTP states. They store the number of succeeded association attempts, how many associations have been initiated by the local or the remote SCTP layer, or just the number of associations terminated in a graceful (by means of SHUTDOWN procedure) or ungraceful way (by means of CLOSE procedure).

3.1.1.2.2 Other Statistics

There is a statistic related to the SCTP packets, i.e., the number of out of the blue packets received by the local host. The remainder statistics are based on the data unit of SCTP: the chunk. In this way, the whole picture of the SCTP layer is covered.

3.1.2 MIB Tables

3.1.2.1 Association Table

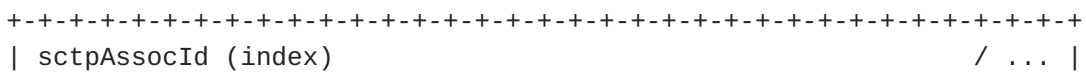
The part of the MIB to define each association is structured according to an expanded table. There is a main table (called association table, sctpAssocTable), indexed by the association identification. The association identification is a value to identify in a unique way an association.

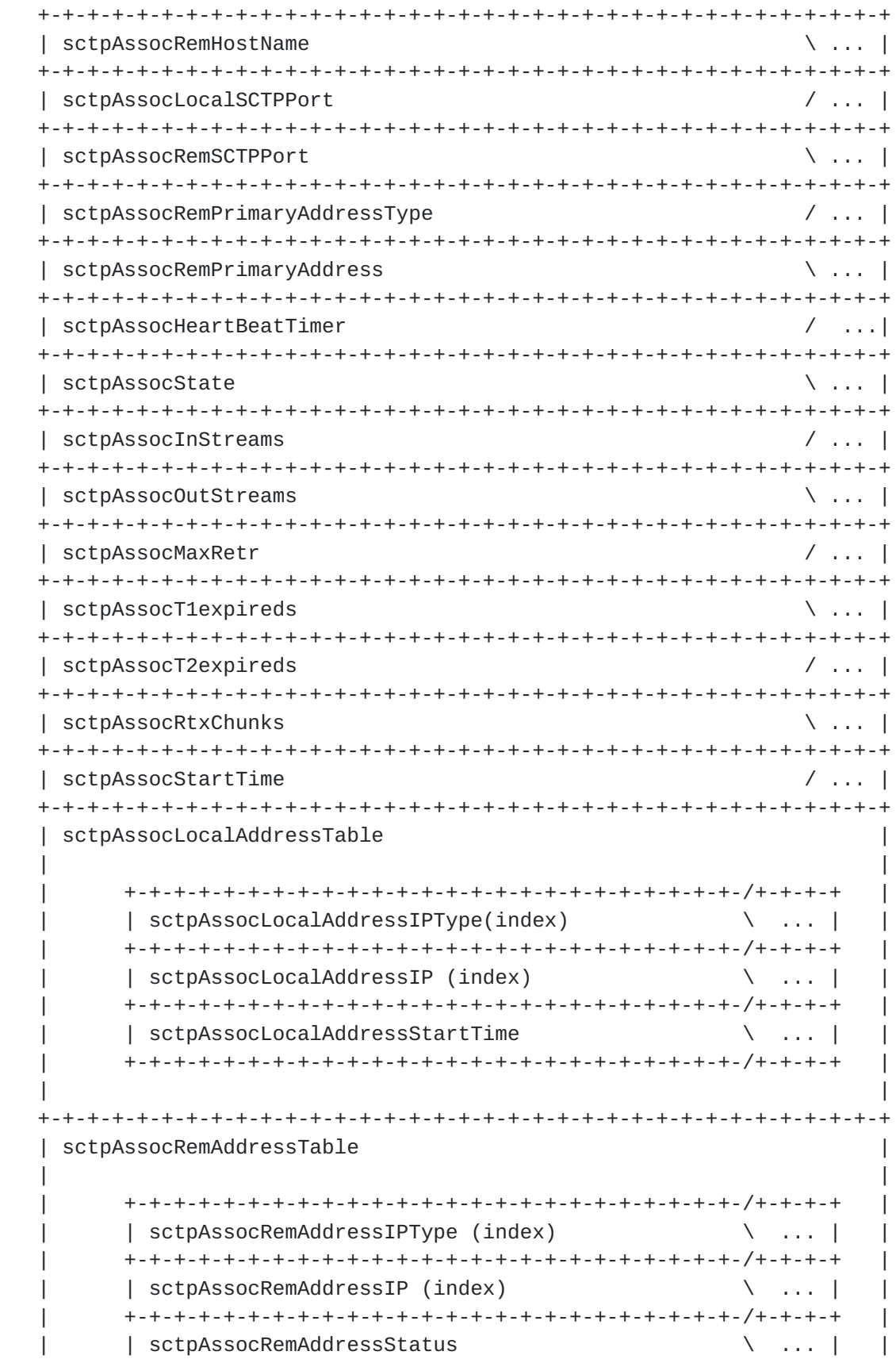
The MIB does not restrict which value must be written here. It can be the tag value, or the TCB creation time, or any other value the implementers decide.

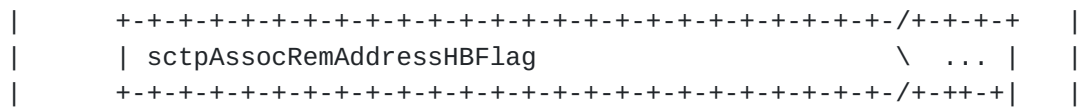
This main table contains common information for a given association and two other tables inside: local IP addresses table (sctpAssocLocalAddressTable), and remote IP addresses table (sctpAssocRemAddressTable).

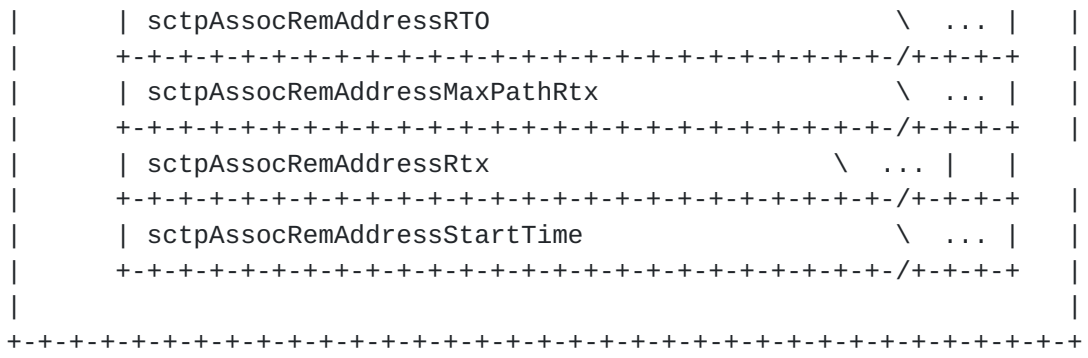
Note: The following representation is a conceptual mode of describing the relationship between the tables in this MIB. Note that the real relationship of the tables is by sharing an index, so tables are not truly within tables.

sctpAssocTable


| sctpAssocId (index) / ... |


sctpAssocRemHostName
sctpAssocLocalSCTPPort
sctpAssocRemSCTPPort
sctpAssocRemPrimaryAddressType
sctpAssocRemPrimaryAddress
sctpAssocHeartBeatTimer
sctpAssocState
sctpAssocInStreams
sctpAssocOutStreams
sctpAssocMaxRetr
sctpAssocT1expireds
sctpAssocT2expireds
sctpAssocRtxChunks
sctpAssocStartTime
sctpAssocLocalAddressTable
sctpAssocLocalAddressIPType(index)
sctpAssocLocalAddressIP (index)
sctpAssocLocalAddressStartTime
sctpAssocRemAddressTable
sctpAssocRemAddressIPType (index)
sctpAssocRemAddressIP (index)
sctpAssocRemAddressStatus


sctpAssocRemAddressHBFlag
...



Every entry is explained when defining the MIB.

Note that the IP address indexing the tables is valid for IPv4, IPv6 and DNS. Therefore, IP address is defined by the Internet address type and the value of the IP address, according to the Textual Conventions for Internet Network Address [RFC2851-update].

The IP addresses that the MIB supports are defined in the [RFC2851-update]: global and non-global (either with a zone index or not) IPv4 addresses, global and non-global (either with a zone index or not) IPv6 addresses.

DNS value is not used to identify an IP address since it is only valid during initialization (once this stage is finished, both sides only use IP addresses). To keep the name of the remote peer, an entry has been created in the association table (sctpAssocRemHostName). When no DNS name is provided by the remote endpoint at initialization time, this value will be NULL. Otherwise, the received DNS name will be stored.

It is NOT possible creating rows in any table (sctpAssocTable, sctpAssocLocalAddressTable, sctpRemAddressTable and Reverse Lookup tables).

If it is required to abort an existing association, the value deleteTCB has to be written in the variable sctpAssocState. That is the only way to delete rows in any of the mentioned tables.

3.1.2.1.1 Local IP addresses Table

Table for local IP addresses information. This table stores information related to the local IP address/-es reserved for the association. It is indexed by the local IP addresses (and the shared index sctpAssocId).

3.1.2.1.2 Remote IP addresses Table

Table for remote IP addresses information. This table stores information related to the remote IP address/-es reserved for the association. It is indexed by the remote IP addresses (and the shared index sctpAssocId).

3.1.2.2 Reverse Lookup Tables

There are five reverse lookup tables. These tables are optional to help management applications to efficiently access conceptual rows in other tables. This is the way for not performing expensive tree walks through large number of associations.

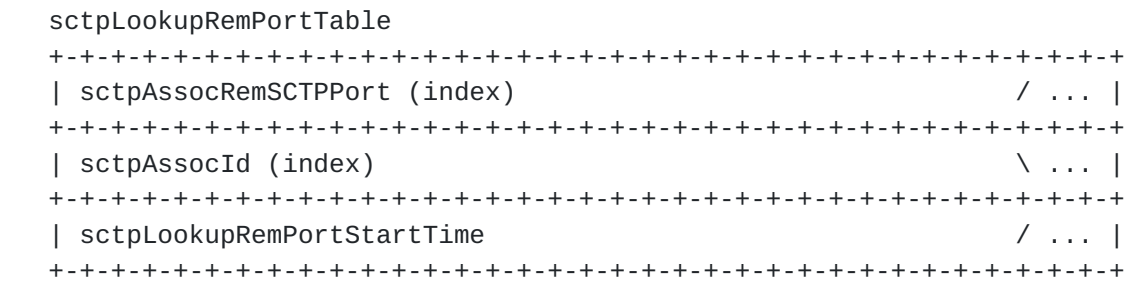
It is not possible to either create or delete rows in this table.

All the lookup tables contains a timestamp to indicate when a row in the table was created.

Several tables have been created for this purpose:

- Local Port: It allows finding the associations in which the local endpoint is using the specified local port.
- Remote Port: It allows finding the associations in which the remote endpoint is using the specified remote port.
- Remote Host Name: It allows finding the associations that have defined the specified host name as remote endpoint.
- Remote Primary IP Address: It allows finding the associations that have defined the specified remote IP address as primary.
- Remote IP address: List of all the associations that have the specified IP address belonging to the set of remote addresses.

As an example the picture below shows the table to look up by remote port.



3.2 Conformance

3.2.1 Groups

This section includes all the variables defined in the MIB grouped by function (variables or statistics) and context (SCTP general

parameters, association context, local IP address context or remote IP address context).

Therefore the following groups have been created:

- General variables for the SCTP layer.
- General statistics for the states of the SCTP layer.
- General statistics for the SCTP layer.
- Variables and statistics per association, and variables per local and remote IP address.
- Statistics per remote IP address.

3.2.2 Compliance

Requirements of the SCTP MIB to be implemented.

4. Definitions

```
SCTP-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, Unsigned32, Gauge32, Counter32
       FROM SNMPv2-SMI               -- RFC2578
  TimeStamp
       FROM SNMPv2-TC                -- RFC2579
  MODULE-COMPLIANCE, OBJECT-GROUP
       FROM SNMPv2-CONF              -- RFC2580
  InetAddressType, InetAddress, InetPortNumber
       FROM INET-ADDRESS-MIB         -- RFC2851-update
       ;

-- RFC2851 is being update. Needed to update the import clause
-- as well as other references to RFC2851 to include all the
-- textual conventions defined in the new RFC2851-update

sctpMIB MODULE-IDENTITY
  LAST-UPDATED "200110170000Z"       -- 17th October 2001
  ORGANIZATION "IETF SIGTRAN Working Group"
  CONTACT-INFO
       "         Maria-Carmen Belinchon-Vergara
                 Jose-Javier Pastor-Balbas

       Postal:   Ericsson Espana S. A.
                 Ombu street 3, 4th floor
                 28045 Madrid
                 Spain

       Phones:   +34 91 339 3535
```

+34 91 339 3819

```
          Emails:   Maria.C.Belinchon@ericsson.com
                    J.Javier.Pastor@ericsson.com"
      DESCRIPTION
           "The MIB module for managing an SCTP implementation."
      REVISION
      "200110170000Z"              -- 17th October 2001

      DESCRIPTION
           "MIB module developed for the SIGTRAN IETF group. Based on
           SCTP, RFC2960"
      ::= { xxxx }   -- IANA needs to choose this value
                     -- when sent to the RFC editor


   -- Top-level structure of the MIB

   sctpObjects      OBJECT IDENTIFIER ::= { sctpMIB 1 }
   sctpConformance  OBJECT IDENTIFIER ::= { sctpMIB 2 }

   sctpScalars      OBJECT IDENTIFIER ::= { sctpObjects 1 }
   sctpTables       OBJECT IDENTIFIER ::= { sctpObjects 2 }



   -- PROTOCOL GENERAL VARIABLES
   -- *************************

   sctpRtoAlgorithm OBJECT-TYPE
     SYNTAX         INTEGER {
                         other(1),      -- Other new one. Future use
                         vanj(2)        -- Van Jacobson's algorithm
                    }
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The algorithm used to determine the timeout value (T3-rtx)
          used for re-transmitting unacknowledged chunks."

     ::= { sctpScalars 1 }


   sctpRtoMin OBJECT-TYPE
     SYNTAX         Unsigned32
     UNITS          "milliseconds"
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The minimum value permitted by a SCTP implementation for the
          retransmission timeout, measured in milliseconds.  More
```

refined semantics for objects of this type depend upon the algorithm used to determine the retransmission timeout.

```
          Minimum recommended value is 1000 milliseconds. Some telephony
          applications could require less than 1 second."


      ::= { sctpScalars 2 }


   sctpRtoMax OBJECT-TYPE
     SYNTAX         Unsigned32
     UNITS          "milliseconds"
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The maximum value permitted by a SCTP implementation for the
          retransmission timeout, measured in milliseconds.  More
          refined semantics for objects of this type depend upon the
          algorithm used to determine the retransmission timeout.
          Recommended value is 60000 milliseconds."

       ::= { sctpScalars 3 }


   sctpRtoInitial OBJECT-TYPE
     SYNTAX         Unsigned32
     UNITS          "milliseconds"
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Initial value for the Retransmission timer. Recommended value
          is 3000 milliseconds."

     ::= { sctpScalars 4 }


   sctpMaxAssoc OBJECT-TYPE
     SYNTAX         Unsigned32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The limit on the total number of SCTP associations the entity
          can support. In entities where the maximum number of
          associations is dynamic, this object should contain the value
          -1."

     ::= { sctpScalars 5 }


   sctpValCookieLife OBJECT-TYPE
     SYNTAX         Unsigned32
```

```
    UNITS          "milliseconds"
    MAX-ACCESS     read-only
```

```
    STATUS         current
    DESCRIPTION
         "Valid cookie life in the 4-way start-up handshake procedure.
         Recommended value: 60000 milliseconds."

    ::= { sctpScalars 6 }


  sctpMaxInitRetr OBJECT-TYPE
    SYNTAX         Unsigned32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "The maximum number of retransmissions at the start-up phase
         (INIT and COOKIE ECHO chunks). Recommended value: 8 attempts."

    ::= { sctpScalars 7 }



  -- STATE-RELATED STATISTICS

  sctpCurrEstab OBJECT-TYPE
    SYNTAX         Gauge32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "The number of SCTP associations for which the current state
         is either ESTABLISHED, SHUTDOWN-RECEIVED or SHUTDOWN-PENDING."

    ::= { sctpScalars 8 }


  sctpActiveEstabs OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "The number of times that SCTP associations have made a direct
         transition to the ESTABLISHED state from the COOKIE-ECHOED
         state: COOKIE-ECHOED -> ESTABLISHED. The upper layer has
         initiated the association attempt."

    ::= { sctpScalars 9 }


  sctpPassiveEstabs OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
```

```
    STATUS        current
    DESCRIPTION
```

```
          "The number of times that SCTP associations have made a direct
          transition to the ESTABLISHED state from the CLOSED state:
          CLOSED -> ESTABLISHED. The remote endpoint has initiated the
          association attempt."

    ::= { sctpScalars 10 }


  sctpAborteds OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
          "The number of times that SCTP associations have made a direct
          transition to the CLOSED state from any state using the
          primitive 'ABORT': AnyState --Abort--> CLOSED. Ungraceful
          termination of the association."

    ::= { sctpScalars 11 }


  sctpShutdowns OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
          "The number of times that SCTP associations have made a direct
          transition to the CLOSED state from either the SHUTDOWN-SENT
          state or the SHUTDOWN-ACK-SENT state. Graceful termination of
          the association."

    ::= { sctpScalars 12 }


  -- OTHER LAYER STATISTICS

  sctpStatOutOfBlues OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
          "Number of out of the blue packets (SCTP packet correctly
          formed -right checksum- but the receiver is not able to
          identify the association to which this packet belongs)
          received by the host."

    ::= { sctpScalars 13 }

  sctpStatChecksumErrors OBJECT-TYPE
```

```
    SYNTAX          Counter32
    MAX-ACCESS      read-only
```

```
      STATUS         current
      DESCRIPTION
           "Number of SCTP packets received from the peers with an
           invalid checksum."

   ::= { sctpScalars 14 }
   sctpStatSentCtrlChunks OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of SCTP control chunks sent to the peers (no
          retransmissions included)."

     ::= { sctpScalars 15 }

   sctpStatSentOrderChunks OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of SCTP ordered data chunks sent to the peers (no
          retransmissions included)."

     ::= { sctpScalars 16 }

   sctpStatSentUnorderChunks OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of SCTP unordered chunks (data chunks in which the U
          bit is set to 1) sent to the peers (no retransmissions
          included)."

     ::= { sctpScalars 17 }

   sctpStatRecCtrlChunks OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of SCTP control chunks received from the peers (no
          duplicated included)."

     ::= { sctpScalars 18 }


   sctpStatRecOrderChunks OBJECT-TYPE
```

```
    SYNTAX          Counter32
    MAX-ACCESS      read-only
```

```
    STATUS         current
    DESCRIPTION
         "Number of SCTP ordered data chunks received from the peers
         (no duplicated included)."

    ::= { sctpScalars 19 }


  sctpStatRecUnorderChunks OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Number of SCTP unordered chunks (data chunks in which the U
         bit is set to 1) received from the peers (no duplicated
         included)."

    ::= { sctpScalars 20 }




  sctpStatFragmentedUsrMessages OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Number of user messages that have to be fragmented because of
         the MTU."

    ::= { sctpScalars 21 }


  sctpStatReassembledUsrMessages OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Number of user messages reassembled."

    ::= { sctpScalars 22 }


  sctpStatSentSCTPPacks OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Number of SCTP packets received from the peers."
```

```
    ::= { sctpScalars 23 }
```

```
   sctpStatRecSCTPPacks OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of SCTP packets received from the peers."

     ::= { sctpScalars 24 }


   -- SCTP ASSOCIATION DESCRIPTION PARAMETERS
   -- **************************************

   -- the SCTP Association TABLE
   -- **************************

   -- The SCTP association table contains information about each
   -- association that the local endpoint is taking part.


   sctpAssocTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpAssocEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "A table containing SCTP association-specific information."

     ::= { sctpTables 1 }


   sctpAssocEntry OBJECT-TYPE
     SYNTAX         SctpAssocEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "General common variables and statistics for the whole
          association."
     INDEX          { sctpAssocId }

     ::= { sctpAssocTable 1 }


   SctpAssocEntry ::= SEQUENCE {
     sctpAssocId                       Unsigned32,
     sctpAssocRemHostName              OCTET STRING,
     sctpAssocLocalSCTPPort            InetPortNumber,
     sctpAssocRemSCTPPort              InetPortNumber,
```

```
    sctpAssocRemPrimaryAddressType     InetAddressType,
    sctpAssocRemPrimaryAddress         InetAddress,
```

```
    sctpAssocHeartBeatTimer          Unsigned32,
    sctpAssocState                   INTEGER,
    sctpAssocInStreams               Unsigned32,
    sctpAssocOutStreams              Unsigned32,
    sctpAssocMaxRetr                 Unsigned32,
    sctpAssocT1expireds              Counter32,     -- Statistic
    sctpAssocT2expireds              Counter32,     -- Statistic
    sctpAssocRtxChunks               Counter32,     -- Statistic
    sctpAssocStartTime               TimeStamp
    }


  sctpAssocId OBJECT-TYPE
    SYNTAX         Unsigned32
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
         "Association Identification. Value identifying the association
         (typically the Initiate Verification Tag).
         If the selected AssocID is the Initiate Verification Tag, this
         value must not be zero."

    ::= { sctpAssocEntry 1 }


  sctpAssocRemHostName OBJECT-TYPE
    SYNTAX         OCTET STRING (SIZE(0..255))
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Peer's DNS name. If no DNS domain name was received at init
         time (embedded in the INIT or INIT-ACK chunk) from the peer,
         this entry will be meaningless, therefore it will contain a
         NULL value. Otherwise, the remote host name received at init
         time will be stored."

    ::= { sctpAssocEntry 2 }


  sctpAssocLocalSCTPPort OBJECT-TYPE
    SYNTAX         InetPortNumber
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Local SCTP port number used for this association. A zero
         value means unknown according to the RFC-update."

    ::= { sctpAssocEntry 3 }
```

```
   sctpAssocRemSCTPPort OBJECT-TYPE
```

```
    SYNTAX          InetPortNumber
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
         "Remote SCTP port number used for this association. A zero
         value means unknown according to the RFC2851-update."

    ::= { sctpAssocEntry 4 }


  sctpAssocRemPrimaryAddressType OBJECT-TYPE
    SYNTAX          InetAddressType
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
         "Internet type of primary destination IP address.

         -  unknown (0) An unknown address type. This value MUST be
            used if the value of the corresponding InetAddress object
            is a zero-length string. It may also be used to indicate an
            IP address different from IPv4 or IPv6. This value is used
            in this MIB for error conditions.

         -  ipv4 (1): An IPv4 address as defined by the InetAddressIPv4
            textual convention [RFC2851-update].

         -  ipv6 (2): An IPv6 address as defined by the InetAddressIPv6
            textual convention [RFC2851-update]. It represents global
            IPv6 addresses and non-global IPv6 addresses in case where
            no zone index is needed.

         -  ipv4z(3): A non-global IPv4 address including a zone index
            as defined by the InetAddressIPv4z textual convention
            [RFC2851-update].

         -  ipv6z(4): A non-global IPv6 address including a zone index
            as defined by the InetAddressIPv6z textual convention
            [RFC2851-update].


         This value will be filled in after the INIT or INIT ACK chunks
         have been received (when the primary path is selected by
         SCTP)."

    ::= { sctpAssocEntry 5 }

  sctpAssocRemPrimaryAddress OBJECT-TYPE
    SYNTAX          InetAddress
    MAX-ACCESS      read-only
```

```
    STATUS        current
    DESCRIPTION
```

```
          "Primary destination IP address. An InetAddress value is
          always interpreted within the context of an InetAddressType
          value.
          This value will be filled in after INIT or INIT ACK chunks
          have been received (when the primary path is selected by
          SCTP)."

     ::= { sctpAssocEntry 6 }


   sctpAssocHeartBeatTimer OBJECT-TYPE
     SYNTAX         Unsigned32
     UNITS          "milliseconds"
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The current heartbeat time-out. The recommended default value
          is 30000 milliseconds."

     ::= { sctpAssocEntry 7 }


   sctpAssocState OBJECT-TYPE
     SYNTAX         INTEGER {
                         closed(1),
                         cookieWait(2),
                         cookieEchoed(3),
                         established(4),
                         shutdownPending(5),
                         shutdownSent(6),
                         shutdownReceived(7),
                         shutdownAckSent(8),
                         deleteTCB(9)
                         }
     MAX-ACCESS     read-write
     STATUS         current
     DESCRIPTION
          "The state of this SCTP association.
          As in TCP, deleteTCB is the only value that may be set by a
          management station. Accordingly, it is appropriate for an
          agent to return a 'badValue' response if a management station
          attempts to set this object to any other value.
          If a management station sets this object to the value
          deleteTCB(9), then this has the effect of deleting the TCB (as
          defined in SCTP) of the corresponding association on the
          managed node, resulting in immediate termination of the
          association.
          As an implementation-specific option, an ABORT chunk may be
```

```
            sent from the managed node to the other SCTP endpoint."

        ::= { sctpAssocEntry 8 }
```

```
   sctpAssocInStreams OBJECT-TYPE
     SYNTAX         Unsigned32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Inbound Streams according to the negotiation at association
          start up. This parameter has to be read-only by the manager."

     ::= { sctpAssocEntry 9 }

   sctpAssocOutStreams OBJECT-TYPE
     SYNTAX         Unsigned32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Outbound Streams according to the negotiation at association
          start up. This parameter has to be read-only by the manager."

     ::= { sctpAssocEntry 10 }


   sctpAssocMaxRetr OBJECT-TYPE
     SYNTAX         Unsigned32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The maximum number of data retransmissions in the association
          context. This value is specific for each association and the
          upper layer can change it calling the appropriate primitives.
          This value has to be smaller than the addition of all the
          maximum number for all the paths
          (sctpAssocRemAddressMaxPathRtx).
          Recommended value: 10 attempts."

     ::= { sctpAssocEntry 11 }




   -- Association Statistics

   sctpAssocT1expireds OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of times that T1 timer expired (timer for sending
```

either INIT or COOKIE-ECHO chunks and receiving an
acknowledgment)."

```
    ::= { sctpAssocEntry 12 }

  sctpAssocT2expireds OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Number of times that T2-shutdown timer expired (shutdown
         timer)."

    ::= { sctpAssocEntry 13 }


  sctpAssocRtxChunks OBJECT-TYPE
    SYNTAX         Counter32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "Number of data chunks retransmitted to the peer in the
         current association."

    ::= { sctpAssocEntry 14 }


  sctpAssocStartTime OBJECT-TYPE
    SYNTAX         TimeStamp
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
         "The value of SysUpTime at the time that this row was
         created."

    ::= { sctpAssocEntry 15 }



  -- Expanded tables: Including Multi-home feature

  -- Local Address TABLE
  -- ******************

  sctpAssocLocalAddressTable OBJECT-TYPE
    SYNTAX         SEQUENCE OF SctpAssocLocalAddressEntry
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
         "Expanded table of sctpAssocTable based on the AssocId index.
         This table shows data related to each local IP address which
```

is used by this association."

```
    ::= { sctpTables 2 }

  sctpAssocLocalAddressEntry OBJECT-TYPE
    SYNTAX         SctpAssocLocalAddressEntry
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
         "Local information about the available addresses."
    INDEX     {    sctpAssocId,   -- shared index
                   sctpAssocLocalAddressIPType,
                   sctpAssocLocalAddressIP }

    ::= { sctpAssocLocalAddressTable 1 }


  SctpAssocLocalAddressEntry ::= SEQUENCE {
    sctpAssocLocalAddressIPType        InetAddressType,
    sctpAssocLocalAddressIP            InetAddress,
    sctpAssocLocalAddressStartTime     TimeStamp
    }


  sctpAssocLocalAddressIPType OBJECT-TYPE
    SYNTAX         InetAddressType
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
         "Internet type of local IP address used for this association.

         -  unknown (0) An unknown address type. This value MUST be
            used to indicate an IP address different from IPv4 or IPv6.
            This value is used in this MIB for error conditions.

         -  ipv4 (1): An IPv4 address as defined by the InetAddressIPv4
            textual convention [RFC2851-update].

         -  ipv6 (2): An IPv6 address as defined by the InetAddressIPv6
            textual convention [RFC2851-update]. It represents global
            IPv6 addresses and non-global IPv6 addresses in case where
            no zone index is needed.

         -  ipv4z(3): A non-global IPv4 address including a zone index
            as defined by the InetAddressIPv4z textual convention
            [RFC2851-update].

         -  ipv6z(4): A non-global IPv6 address including a zone index
            as defined by the InetAddressIPv6z textual convention
            [RFC2851-update]. "
```

```
    ::= { sctpAssocLocalAddressEntry 1 }
```

```
   sctpAssocLocalAddressIP OBJECT-TYPE
     SYNTAX         InetAddress (SIZE(1..64))
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "The value of a local IP address available for this
          association. An InetAddress value is always interpreted within
          the context of an InetAddressType value. If SCTP is using a
          DNS name, the mapping to IP address/-es will be done at
          reception of INIT or INIT_ACK chunks.

          The sctpAssocRemAddressIP may not be empty due to the SIZE
          restriction."

     ::= { sctpAssocLocalAddressEntry 2 }


   sctpAssocLocalAddressStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."

     ::= { sctpAssocLocalAddressEntry 3 }



   -- Remote Addresses TABLE
   -- **********************

   sctpAssocRemAddressTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpAssocRemAddressEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "Expanded table of sctpAssocTable based on the AssocId index.
          This table shows data related to each remote peer IP address
          which is used by this association."

     ::= { sctpTables 3 }


   sctpAssocRemAddressEntry OBJECT-TYPE
     SYNTAX         SctpAssocRemAddressEntry
     MAX-ACCESS     not-accessible
```

```
    STATUS        current
    DESCRIPTION
```

```
        "Information about the most important variables for every
        remote IP address "
    INDEX   { sctpAssocId,   -- shared index
              sctpAssocRemAddressIPType,
              sctpAssocRemAddressIP }

    ::= { sctpAssocRemAddressTable 1 }


  SctpAssocRemAddressEntry ::= SEQUENCE {
    sctpAssocRemAddressIPType          InetAddressType,
    sctpAssocRemAddressIP              InetAddress,
    sctpAssocRemAddressStatus          INTEGER,
    sctpAssocRemAddressHBFlag          INTEGER,
    sctpAssocRemAddressRTO             Unsigned32,
    sctpAssocRemAddressMaxPathRtx      Unsigned32,
    sctpAssocRemAddressRtx             Counter32,     -- Statistic
    sctpAssocRemAddressStartTime       TimeStamp
    }


  sctpAssocRemAddressIPType OBJECT-TYPE
    SYNTAX         InetAddressType
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
        "Internet type of a remote IP address available for this
        association.

        -  unknown (0) An unknown address type. This value MUST be
           used to indicate an IP address different from IPv4 or IPv6.
           This value is used in this MIB for error conditions.

        -  ipv4 (1): An IPv4 address as defined by the InetAddressIPv4
           textual convention [RFC2851-update].

        -  ipv6 (2): An IPv6 address as defined by the InetAddressIPv6
           textual convention [RFC2851-update]. It represents global
           IPv6 addresses and non-global IPv6 addresses in case where
           no zone index is needed.

        -  ipv4z(3): A non-global IPv4 address including a zone index
           as defined by the InetAddressIPv4z textual convention
           [RFC2851-update].

        -  ipv6z(4): A non-global IPv6 address including a zone index
           as defined by the InetAddressIPv6z textual convention
           [RFC2851-update]. "
```

```
    ::= { sctpAssocRemAddressEntry 1 }
```

```
   sctpAssocRemAddressIP OBJECT-TYPE
     SYNTAX         InetAddress (SIZE(1..64))
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "The value of a remote IP address available for this
          association. An InetAddress value is always interpreted within
          the context of an InetAddressType value. If SCTP is using a
          DNS name, the mapping to IP address/-es will be done at
          reception of INIT or INIT_ACK chunks

          The sctpAssocRemAddressIP may not be empty due to the SIZE
          restriction."

     ::= { sctpAssocRemAddressEntry 2 }


   sctpAssocRemAddressStatus OBJECT-TYPE
     SYNTAX         INTEGER {
                         active(0),
                         inactive(1)
                    }
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The current status of the remote transport address, according
          to [SCTP].
          Active means that the threshold of no answer received from
          this IP address has not been reached. Inactive means that
          either no heartbeat was received from this address, or any
          other message, reaching the threshold defined by the
          protocol."

     ::= { sctpAssocRemAddressEntry 3 }


   sctpAssocRemAddressHBFlag OBJECT-TYPE
     SYNTAX         INTEGER {
                         active(0),
                         inactive(1)
                     }
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The optional Heartbeat associated to one destination
          transport address could be active or not (value equal to 0 or
          1, respectively).
```

```
          An active destination transport address is the one considered
          available by a peer endpoint for receiving SCTP packets, as it
          is described in [sctp]."

      ::= { sctpAssocRemAddressEntry 4 }


   sctpAssocRemAddressRTO OBJECT-TYPE   -- T3-rtx- Timer
     SYNTAX         Unsigned32
     UNITS          "milliseconds"
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The current Retransmission Timeout. T3-rtx timer as defined
          in the protocol SCTP."

      ::= { sctpAssocRemAddressEntry 5 }


   sctpAssocRemAddressMaxPathRtx OBJECT-TYPE
     SYNTAX         Unsigned32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Maximum number of DATA chunks retransmissions allowed to a
          remote IP address before it is considered inactive, as defined
          in [sctp]. Recommended value 5 attempts."

      ::= { sctpAssocRemAddressEntry 6 }


   -- Remote Address Statistic

   sctpAssocRemAddressRtx OBJECT-TYPE
     SYNTAX         Counter32
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "Number of DATA chunks retransmissions as defined in [sctp]."

      ::= { sctpAssocRemAddressEntry 7 }

   sctpAssocRemAddressStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."
```

```
    ::= { sctpAssocRemAddressEntry 8 }
```

```
   -- ASSOCIATION INVERSE TABLE
   -- ************************

   -- BY LOCAL PORT

   sctpLookupLocalPortTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpLookupLocalPortEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "With the use of this table, a list of associations which are
          using the specified local port can be got"

     ::= { sctpTables 4 }


   sctpLookupLocalPortEntry OBJECT-TYPE
     SYNTAX         SctpLookupLocalPortEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "This table is indexed by local port and association ID.
          Specifying a local port, we would get a list of the
          associations whose local port is the one specified"

     INDEX          { sctpAssocLocalSCTPPort,
                    sctpAssocId }

     ::= { sctpLookupLocalPortTable 1 }


   SctpLookupLocalPortEntry::= SEQUENCE {
     sctpLookupLocalPortStartTime            TimeStamp
     }


   sctpLookupLocalPortStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."

     ::= { sctpLookupLocalPortEntry 1 }
```

-- BY REMOTE PORT

```
   sctpLookupRemPortTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpLookupRemPortEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "With the use of this table, a list of associations which are
          using the specified remote port can be got"

     ::= { sctpTables 5 }


   sctpLookupRemPortEntry OBJECT-TYPE
     SYNTAX         SctpLookupRemPortEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "This table is indexed by remote port and association ID.
          Specifying a remote port we would get a list of the
          associations whose local port is the one specified "

     INDEX          { sctpAssocRemSCTPPort,
                      sctpAssocId }

     ::= { sctpLookupRemPortTable 1 }


   SctpLookupRemPortEntry::= SEQUENCE {
     sctpLookupRemPortStartTime              TimeStamp
     }


   sctpLookupRemPortStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."

     ::= { sctpLookupRemPortEntry 1 }



   -- BY REMOTE HOST NAME

   sctpLookupRemHostNameTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpLookupRemHostNameEntry
     MAX-ACCESS     not-accessible
```

```
    STATUS        current
    DESCRIPTION
```

```
          "With the use of this table, a list of associations with that
          particular host can be got"

     ::= { sctpTables 6 }


   sctpLookupRemHostNameEntry OBJECT-TYPE
     SYNTAX         SctpLookupRemHostNameEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "This table is indexed by remote host name and association ID.
          Specifying a host name we would get a list of the associations
          specifying that host name as the remote one"

     INDEX          { sctpAssocRemHostName,
                    sctpAssocId }

     ::= { sctpLookupRemHostNameTable 1 }


   SctpLookupRemHostNameEntry::= SEQUENCE {
     sctpLookupRemHostNameStartTime               TimeStamp
     }


   sctpLookupRemHostNameStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."

     ::= { sctpLookupRemHostNameEntry 1 }


   -- BY REMOTE PRIMARY IP ADDRESS

   sctpLookupRemPrimIPAddrTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpLookupRemPrimIPAddrEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "With the use of this table, it can be got a list of
          associations that have that the specified IP address as
          primary within the remote set of active addresses "

     ::= { sctpTables 7 }
```

```
   sctpLookupRemPrimIPAddrEntry OBJECT-TYPE
     SYNTAX         SctpLookupRemPrimIPAddrEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "This table is indexed by primary address and association ID.
          Specifying a primary address, we would get a list of the
          associations that have the specified remote IP address marked
          as primary. "

     INDEX          { sctpAssocRemPrimaryAddressType,
                    sctpAssocRemPrimaryAddress,
                    sctpAssocId }

     ::= { sctpLookupRemPrimIPAddrTable 1 }


   SctpLookupRemPrimIPAddrEntry::= SEQUENCE {
     sctpLookupRemPrimIPAddrStartTime             TimeStamp
     }


   sctpLookupRemPrimIPAddrStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."

     ::= { sctpLookupRemPrimIPAddrEntry 1 }


   -- BY REMOTE IP ADDRESS

   sctpLookupRemIPAddrTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF SctpLookupRemIPAddrEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
          "With the use of this table, a list of associations that have
          the specified IP address as one of the remote ones can be got"

     ::= { sctpTables 8 }


   sctpLookupRemIPAddrEntry OBJECT-TYPE
     SYNTAX         SctpLookupRemIPAddrEntry
     MAX-ACCESS     not-accessible
```

```
    STATUS        current
    DESCRIPTION
```

```
          "This table is indexed by a remote IP address and association
          ID. Specifying an IP address we would get a list of the
          associations that have the specified IP address included
          within the set of remote IP addresses"

     INDEX          { sctpAssocRemAddressIPType,
                      sctpAssocRemAddressIP,
                      sctpAssocId }

     ::= { sctpLookupRemIPAddrTable 1 }


   SctpLookupRemIPAddrEntry::= SEQUENCE {
     sctpLookupRemIPAddrStartTime            TimeStamp
     }


   sctpLookupRemIPAddrStartTime OBJECT-TYPE
     SYNTAX         TimeStamp
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
          "The value of SysUpTime at the time that this row was
          created."

     ::= { sctpLookupRemIPAddrEntry 1 }


   -- 4.1 Conformance Information

   sctpGroups       OBJECT IDENTIFIER ::= { sctpConformance 1 }
   sctpCompliances  OBJECT IDENTIFIER ::= { sctpConformance 2 }


   -- 4.1.1 Units of conformance

   --
   -- MODULE GROUPS
   --


   sctpGeneralVariablesGroup OBJECT-GROUP
     OBJECTS   { sctpRtoAlgorithm,
                 sctpRtoMin,
                 sctpRtoMax,
                 sctpRtoInitial,
                 sctpMaxAssoc,
                 sctpValCookieLife,
                 sctpMaxInitRetr
```

```
}
```

```
    STATUS    current
    DESCRIPTION
         "Common parameters for all the associations. They can usually
         be referred as configuration parameters"

    ::= { sctpGroups 1 }


  sctpStateStatGroup OBJECT-GROUP
    OBJECTS   {sctpCurrEstab,
               sctpActiveEstabs,
               sctpPassiveEstabs,
               sctpAborteds,
               sctpShutdowns
              }

    STATUS    current
    DESCRIPTION
         "The sctp group of objects to control state changes in the
         SCTP protocol local layer. They include the data for all the
         associations."

    ::= { sctpGroups 2 }


  sctpOtherStatGroup OBJECT-GROUP
    OBJECTS   {sctpStatOutOfBlues,
               sctpStatChecksumErrors,
               sctpStatSentCtrlChunks,
               sctpStatSentOrderChunks,
               sctpStatSentUnorderChunks,
               sctpStatRecCtrlChunks,
               sctpStatRecOrderChunks,
               sctpStatRecUnorderChunks,
               sctpStatFragmentedUsrMessages,
               sctpStatReassembledUsrMessages,
               sctpStatSentSCTPPacks,
               sctpStatRecSCTPPacks
              }

    STATUS    current
    DESCRIPTION
         "The sctp group of objects providing for management of SCTP
         most common statistics for the local SCTP layer."

    ::= { sctpGroups 3 }


  sctpAssocTablesVariablesGroup OBJECT-GROUP
```

```
     OBJECTS   {sctpAssocRemHostName,
                sctpAssocLocalSCTPPort,
```

```
                sctpAssocRemSCTPPort,
                sctpAssocRemPrimaryAddressType,
                sctpAssocRemPrimaryAddress,
                sctpAssocHeartBeatTimer,
                sctpAssocState,
                sctpAssocInStreams,
                sctpAssocOutStreams,
                sctpAssocMaxRetr,
                sctpAssocT1expireds,
                sctpAssocT2expireds,
                sctpAssocRtxChunks,
                sctpAssocStartTime,
                sctpAssocLocalAddressStartTime,
                sctpAssocRemAddressStatus,
                sctpAssocRemAddressHBFlag,
                sctpAssocRemAddressRTO, sctpAssocRemAddressMaxPathRtx,
                sctpAssocRemAddressStartTime
              }

    STATUS    current
    DESCRIPTION
         "The sctp group of objects to manage specific local and remote
         SCTP variables (local and remote tables). These variables
         include all the SCTP basic features."

    ::= { sctpGroups 4 }


  sctpAssocStatGroup OBJECT-GROUP
    OBJECTS   {sctpAssocRemAddressRtx
              }

    STATUS    current
    DESCRIPTION
         "The sctp group of objects to manage SCTP statistics related
         to the remote endpoint."

    ::= { sctpGroups 5 }

  sctpInverseGroup OBJECT-GROUP
    OBJECTS   {sctpLookupLocalPortStartTime,
                sctpLookupRemPortStartTime,
                sctpLookupRemHostNameStartTime,
                sctpLookupRemPrimIPAddrStartTime,
                sctpLookupRemIPAddrStartTime
              }

    STATUS    current
    DESCRIPTION
```

"Objects used in the inverse lookup table."

```
     ::= { sctpGroups 6 }



   -- 4.1.2 Compliance Statements

   --
   -- MODULE COMPLIANCES
   --


   sctpCompliance MODULE-COMPLIANCE
     STATUS  current
     DESCRIPTION
          "The compliance statement for SNMPv3 entities which implement
          SCTP.

          The SCTP MIB specifies in this compliant implementation that
          only need to support IPv4/IPv6 addresses without a zone index,
          unknown type and DNS names. Support for IPv4/IPv6 addresses
          without zone indices is not required."

     MODULE  -- this module

          MANDATORY-GROUPS    {  sctpGeneralVariablesGroup,
                                 sctpAssocTablesVariablesGroup
                              }

          GROUP sctpStateStatGroup
          DESCRIPTION
               "The sctp group of objects to control state changes in
               the SCTP protocol."

          GROUP sctpOtherStatGroup
          DESCRIPTION
               "The sctp group of objects providing for management of
               SCTP general statistics."

          GROUP sctpAssocStatGroup
          DESCRIPTION
               "The sctp group of objects to manage SCTP statistics
               related to the remote endpoint."

          GROUP sctpInverseGroup
          DESCRIPTION
               "Objects used in inverse lookup tables. This should be
               implemented for easier lookups in the association
               tables."
```

```
        OBJECT  sctpAssocRemPrimaryAddressType
        SYNTAX  InetAddressType { unknown(0),
                                  ipv4(1),
                                  ipv6(2),
                                  dns(16)
                                }
        DESCRIPTION
             "It is only required to have IPv4 and IPv6 addresses
             without zone indices. Unknown values must also be
             supported in case the IP address has a zero string length
             or an invalid/unknown format."


        OBJECT  sctpAssocLocalAddressIPType
        SYNTAX  InetAddressType { unknown(0),
                                  ipv4(1),
                                  ipv6(2),
                                  dns(16)
                                }
        DESCRIPTION
             "It is only required to have IPv4 and IPv6 addresses
             without zone indices. Unknown values must also be
             supported in case the IP address has an invalid/unknown
             format "


        OBJECT  sctpAssocRemAddressIPType
        SYNTAX  InetAddressType { unknown(0),
                                  ipv4(1),
                                  ipv6(2),
                                  dns(16)
                                }
        DESCRIPTION
             "It is only required to have IPv4 and IPv6 addresses
             without zone indices. Unknown values must also be
             supported in case the IP address has an invalid/unknown
             format "

    ::= { sctpCompliances 1 }


END
```

5. References

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6. Security Consideration

There are a number of management objects defined in this MIB that have a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

It is thus important to control even GET access to these objects and possibly to even encrypt the values of these object when sending them over the network via SNMP. Not all versions of SNMP provide features for such a secure environment.

SNMPv1 by itself is not a secure environment. Even if security measures are taken (e.g., using IPSEC), there is no per-user control as to who (once an IPSEC association is established between hosts) is allowed to GET or SET the objects in this MIB

It is recommended that the implementers consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [RFC2574] and the View-based Access Control Model RFC 2575 [RFC2575] is recommended.

It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

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9. Revision History

9.1 Changes from <SCTP-MIB-predraft-01.txt>

o Open issues updated

o Section 2: Reference to RFC227x changed to RFC257x

o Section 4: Inside the sctpRtoAlgorithm definition has been put "other" first rather than last. That way, it won't end up in the middle of things when new enumerations are added later.

9.2 Changes from <draft-ietf-sigtran-sctp-mib-00.txt>

o Change of "Simple" word to "Stream" word in SCTP acronyms

o Version of the MIB based on SCTPv10

o Section 2: Update SNMP Framework to include the standard explanation

o New Structure for the MIB:

```
            sctpMIB
          \- sctpObjects
                 \- sctpScalars
                 \- sctpTables
          \- sctpConformance
```

o Section 4.1.2: Unit of Conformance updated (functional structure).

o MAX-ACCESS clauses reviewed

o The general statistics has been re-ordered, placed before the tables.

o In SMIv2, indexes should be not-accessible (= the object type is a

column in a table used as index and may not be used as an operand in any operation != SMIv1) (pp109-110 in [])

- o IPv6 compatible:
  - Change of Primary/Local/Remote addresses
  - PENDING: check "MODULE-COMPLIANCE"

- o Row Status included in AssocTable, AssocLocal and AssocRem to create, modify and delete rows in the tables.

- o SCTP general statistics changed from Counter32 to Counter64 since it supports more data changes.

- o sctpCurrEstab ("State-related variables and statistics" section) variable changed from Gauge32 to Counter32.

- o sctpAssocRemAddressT1expired and sctpAssocRemAddressT2expired have been removed from the remote table and added in the general association data since they are variables per association (not per IP address).

- o sctpAssocDropDatag statistic has been removed from the general association statistics since it had an ambiguous meaning.

- o Explained the meaning of the unordered chunks (chunks in which the U bit is set to 1) in sctpStatOutOfOrderSentChunks and sctpStatOutOfOrderRecChunks.

- o Added sctpChecksumErrorCounter to collect information about wrong checksums received from the peer.

- o Specify that sctpStatSentChunks and sctpStatRecChunks does not contain retransmission chunks.

- o Reword the Security Considerations chapter pointing out that IPsec does not secure the network but it provides end-to-end security over a network.

- o sctpAssocRemAddressRtxChunks replaced as a variable per association, meaning the number of chunks retransmited to the peer in the current association.

- o sctpHeartBeatMisses and sctpMaxRetr have been replaced from the general SCTP statistics to the remote IP address table (sctpHeartBeatMisses) and in the association table (sctpMaxRetr).

- o Specify that the retransmissions in the general SCTP statistics include control plus data chunks.

- o Included heartbeat timer for remote IP address.

- Removed sctpAssocRemAddressHeartBeatMisses variable from the remote IP address table.

o Removed sctpAssocRemAddressT3expired variable from the remote IP address table.

o Updated variables to the new SCTP states defined in v10.

9.3 Changes from <draft-ietf-sigtran-sctp-mib-01.txt>

o sctpRtoMin - stray "." outside the double-quotes in the DESCRIPTION clause.

o sctpRtoMax - stray "." outside the double-quotes in the DESCRIPTION clause.

o sctpAssocRemHostName - the type OCTECT STRING should be OCTET STRING.

o sctpAssocRemPrimaryAddress - the DESCRIPTION clause is missing its closing ouble-quote.

o sctpConformance - this is defined as { sctpMIB 2 }, then never used; instead sctpMIBConformance (which is undefined) is used in the definition of sctpMIBGroups and sctpMIBCompliances.

o Reworded the MIB organization

o Removed maximum number of concurrent associations

o In sctpMIBCompliance, removed a missing comma in MANDATORY-GROUPS.

o In sctpAssocTablesVariablesGroup and sctpAssocStatGroup, removed extra commas at end of OBJECTS list.

o sctpAssocInStreams. ACCESS changed from read-create to read-only.

o sctpAssocRemAddressHeartBeatFlag and sctpAssocRemAddressHBTimer changed from per remote IP address to per association.

o Comment on sctpAssocRemAddressHBTimer specifies now that the manager can change it.

o ACCESS on sctpAssocRemAddressHBTimer changed from read-only to read-write.

o ACCESS on sctpAssocRemAddressRetransCount changed from read-write to read-only.

o Move sctpStatChecksumErrorCounter from general statistics to per association.

o sctpMaxInStreams û ItÆs a sctp-user feature.

o sctpStatRetransChunks û ItÆs more useful to have this statistic in a association basis

o sctpAssocRemAddressHeartBeatFlag and sctpAssocRemAddressHBTimer have been created again instead of per association in order to follow the draft. If some implementations want to have the same value for all the associations they have, they should set all the variables in the different remote addresses to the same value.

9.3 Changes from <draft-ietf-sigtran-sctp-mib-02.txt>

o Deleting all the RowStatus Structure. Associated text rewording in Tables section.

o Variable StartTime added in all the tables in order to specify the creation time.

o Adding the Association reverse lookup table for easier management. Associated text rewording in tables section.

o Remove sctpInitialT1 and sctpInitialT2, since these values are equal to RTO.

o Change of the Heartbeats to a per-association basis

o Conformance up-to-date with all of this.

9.4 Changes from <draft-ietf-sigtran-sctp-mib-03.txt>

Main changes are due to the alignment with the TCP and UDP MIBs and the inclusion of new lookup tables.
o Convert MIB to a read-only

o Counters ends with ôsö

o Include ôunknownö as an option for InetAddressType in conformance

o Terminology fix: CLOSED state, unordered chunks instead of out-of-order, ..

o HBFlag changed to per remote address

o ChecksumErrors out of the AssocTable and hangs from Scalars

o Update Ports from Unsigned32 to InetPortNumber according to

o Rework inverse tables: five new lookup tables

o Remove INTEGER32 and change it to UNSIGNED32

o Replace Counter32 by Counter64

o Split Sent and Received chunks per association into control, ordered and unordered chunks

9.5 Changes from <draft-ietf-sigtran-sctp-mib-04.txt>

Changes due to the IETF-51 meeting and requests from the mailing list.

o Typo errors

o Objects renumbering

o All counters to Counter32 to be backward compatible, not to waste memory. Operators needing more than 32 bits will do it by augmentations.

o Limit the number of IP address size when index

o Specify that a port number with value zero means unknown port number according to the RFC2851-update

Changes due to the alignment with the RFC2851-update.

o Include clarification text of the IP address types supported in the SCTP MIB. Chapter 3.1.2.1 (Association table)

o Remote Primary IP address: Addition of the ipv4z an ipv6z types for non-globally IP addresses in which a scope identifier is needed. Addition of the scope of ipv6 type. All of them according to the RFC2851-update v04

o InetAddressType for local and remote IP addresses:

Limit UNKNOWN type only for unknown IP address format. Remove UNKNOWN type for zero-length value in the InetAddress since it will be never zero-length due to the size restriction (0..64)

Addition of the ipv4z an ipv6z types for non-globally IP addresses in which a scope identifier is needed. Addition of the scope of ipv6 type. All of them according to the RFC2851-update v04

o Clarify when mapping DNS <-> IPaddress occurs with the remote IP

addresses

o Conformance:

Description: Specify that the SCTP MIB only need to support IPv4/IPv6 addresses without a zone index, unknown type and DNS names. Support for IPv4/IPv6 addresses with zone indices is not required.

InetAddressType for primary, local and remote IP addresses: Clarify that the implementation is only required to support IPv4 and IPv6 address types without zone indices. Clarify also that UNKONWN type is only used in case of local and remote addresses when invalid/unknown IP address format

InetAddress value of primary, local and remote IP address: Removal of the InetAddress values supported. Limitation of the supported IP address types is already included in the InetAddressType

o Revision of the RFC2851-update v05. Changes in this draft does not affect the SCTP MIB.