This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for pseudo wire encapsulation for TDM (T1, E1, T3, E3) bit-streams circuits over a Packet Switch Network (PSN).
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1. Introduction

This document describes a model for managing encapsulated Structure-Agnostic TDM signals for transmission over a Packet Switched Network (PSN) [SATOP].

SAToP is currently specified to carry the TDM bit-streams disregard any structure that may be imposed on these streams, in particular the structure imposed by the standard TDM framing [G.704]

The module for managing a PW service is composed of three to five layers of MIB modules functioning all together. This general model is described in the PWE3 Architecture [FWARCH] and in PWTDMMIB. The layering model is intended to sufficiently isolate PW services from the underlying PSN layer that carries the emulated service. This is done at the same time as providing a standard means for connecting any supported services to any supported PSNs.

The model for managing SAToP at its upper layers consists of a combination of the MIB modules described in [DS1MIB], [DS3MIB], [TDMMIB], [PWMIB] and the textual conventions defined in [PWTC].

The top layer contains the technology-specific management objects, that exist in MIB modules for the native service such as [DS1MIB] and [DS3MIB].

The next layer down is the PW service-specific modules such as the one defined in this document and in [PWTDMMIB]. This layer by itself might consists of one or more MIB modules depending on the specific technology in use.

The next layer is the Generic PW MIB [PWMIB]. This module is used to configure general parameters of PWs that are common to all types of emulated services and PSNs. This layer is connected to the service-specific layer above, and the PSN layer below.

Comments should be made directly to PWE3 group at pwe3@ietf.org.

2. Conventions used in this document

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 [BCP14].

3. Terminology

SAToP terminology used in this document is taken from the [SATOP] draft that describes a mechanism for transporting Structure-Agnostic
(TDM) bit-streams over a packet-oriented network. The mechanism encapsulates TDM bit-streams (T1, E1, T3, E3) as pseudo-wires over a packet-oriented network. This emulation is referred to as "emulation of unstructured TDM circuits" in [PWTDMREQ] and suits applications where the PEs have no need to interpret TDM data or to participate in the TDM signaling.

"PSN-bound" references the traffic direction where TDM data is received, adapted to packet based on number of payload bytes per packet, assigned a SAToP header (Sequence numbers, flags, and timestamps (if the RTP header is used)), prepended multiplexing layer and PSN headers and sent into the PSN.

Conversely, the "CE-bound" references the traffic direction where packets are received from the PSN, packet payloads are reassembled by including a jitter buffer where payload of the received SAToP packets is stored prior to play-out to the TDM line. The size of this buffer SHOULD be locally configurable to allow accommodation to the PSN-specific packet delay variation.

The CE-bound SAToP IWF SHOULD use the sequence number in the control word for detection of lost and mis-ordered packets. If the RTP header is used, the RTP sequence numbers MAY be used for the same purposes.

4. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

5. Overview

This MIB module is designed to satisfy the following requirements and constraints:
1. Fits within the architecture defined in [PWMIB], [PWARCH].
2. The MIB module supports edge-to-edge emulation of Structure-Agnostic TDM bit-stream connections.
3. The MIB module configures the connection and its relevant behavior.
4. The MIB module reports various alarms, counters and status objects.
5. The PSN specific objects are defined in other documents.

6. SAToP MIB module usage

6.1 Structure of SAToP MIB

The SAToP PW Configuration Parameter Table (pwVcSatopCfgTable) has objects for PW connection characteristics. In situations where sets of objects are common amongst few PW connections, a single entry may be referenced by many PW connection entries in pwVcTDMTable [PWTDMMIB].

6.2 SAToP Connection configuration Procedure

Configuring a SAToP PW involves the following steps:

First Configure the interface layer parameters using DS1-MIB and or DS3-MIB.

Next, create an entry in the pwVcTable and configure the PSN tunnels:

- Follow steps as defined in [PWMIB].

NOTE: The agent should create an entry in the pwVcTDMTable [PWTDMMIB] for any entry created in the pwVcTable with pwVcType equal one of the following values:
- 17  Structure-agnostic E1 over Packet
- 18  Structure-agnostic T1 (DS1) over Packet
- 19  Structure-agnostic E3 over Packet
- 20  Structure-agnostic T3 (DS3) over Packet

Next complete the SAToP PW configuration:

- If necessary, create an entry in the pwVcSatopCfgTable (a suitable entry may already exist).

- Set the index of this pwVcSatopCfgTable entry in the pwVcTDMTable [PWTDMMIB].

6.3 SAToP PW Monitoring

Upon making the SAToP PW operational, the pwVcTDMPerfCurrentTable, pwVcTDMPerfIntervalTable, and pwVcTDMPerfTable [PWTDMMIB] can be used to monitor the various counters, indicators, and conditions of the
This section provides an example of using the various MIB objects described in Figure 1 below to set up a SAToP PW connection of DS1 type. While this example is not meant to illustrate all options of the MIB, it is intended as an aid to understanding some of the key concepts. See [PWMIB] for an example of setting up PSN Tunnels.

1. configure the DS1 interface [DS1MIB].
2. Get a new pwVcIndexNext [PWMIB] and create a new pwVcTable [PWMIB] entry using the value of pwVcIndexNext (assume here, the PW index = 20).
3. Set the pwVcType [PWMIB] of the new entry to (18) ‘Structure-agnostic T1 (DS1) over Packet’. This should create a new entry in the pwVcTDMTable [PWTDMMIB].
4. If needed, create an entry in the pwVcTDMCfgTable. Verify that there are no error in the configuration using the relevant object.
5. If needed, create an entry in the pwVcSatopCfgTable. Verify that there are no error in the configuration using the relevant object.
6. Configure the newly created TDM PW with the required pointers, indices and the relevant entry in pwVcTDMCfgTable and in pwVcSatopCfgTable (assuming 13 and 10 respectively).

In [DS1MIB] dsx1IfIndex = 4
In [PWMIB] pwVcIndex = 20
In [PWTDMMIB] pwVcTDMTable, has a corresponding index of 20.

Figure 1: An entry in pwVcSatopCfgTable

In pwVcSatopCfgTable create a new entry(index = 10):
{
    pwVcSatopCfgConsecPktLoss2Normal = 3 -- Exit LOPS state
    pwVcSatopCfgConsecMissPktNorma2Loss = 5 -- Enter LOPS state
    ...
    pwVcSatopCfgPktReplacePolicy = allOnes(1)
    ...
    pwVcSatopCfgMissingPktsToSes = 3 -- packets,
    pwVcSatopCfgRowStatus = createAndGo
}
Check that there are no error bits set in pwVcSatopCfgConfigError.

Complete the pwVcTDMTable with:

```
{
  pwVcTDMIfIndex = 4    -- IfIndex of associated DS1 entry
  pwVcGenTDMCfgIndex = 13   -- Index of associated entry
    -- in pwVcTDMCfgTable.
  pwVcTDMCfgIndex = 10   -- Index of associated entry
    -- in pwVcSatopCfgTable (above).
}
```

Check that there are no error bits set in pwVcTDMConfigError [PWTDMMIB].

It is important to note that such configuration reflects one end point of PW connection. In order to have the connection well operating, both end points should have compatible configuration, each within its own device.

7. Object definition

PW-SATOP-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE,
  Unsigned32
    FROM SNMPv2-SMI

  MODULE-COMPLIANCE, OBJECT-GROUP
    FROM SNMPv2-CONF

  RowStatus, StorageType
    FROM SNMPv2-TC

  pwStdMIB
    FROM PW-TC-DRAFT04-MIB

  PwVcTDMCfgIndex
    FROM PW-TDM-MIB;

  -- The SAToP MIB
This MIB contains managed object definitions for encapsulating TDM bit-streams (T1,E1, T3, E3) as pseudo-wires over packet-switching networks (PSN). as in: Structure- Agnostic TDM over Packet [SATOP].

This MIB reports to the PW-STD-MIB as in: Zelig, D., Nadeau, T. 'Pseudo Wire (PW) Management Information Base’. The PW-STD-MIB contains structures and MIB associations generic to Pseudo-Wire (PW) emulation. PW-specific MIBs (such as this) contain config and stats for specific PW types.

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-- RFC Ed.: replace yyyy with actual RFC number & remove this note

::= { pwStdMIB x } --To be assigned by IANA
   -- we request to assign value 6

-- Tables, Scalars
pwVcSatopObjects OBJECT IDENTIFIER
   ::= { pwVcSatopMIB 1 }

-- Notifications
pwVcSatopTraps OBJECT IDENTIFIER
   ::= { pwVcSatopMIB 2 }

-- Conformance
pwVcSatopConformance OBJECT IDENTIFIER
   ::= { pwVcSatopMIB 3 }
-- Obtain index for PW SAToP Configuration table entries

pwVcSatopCfgIndexNext OBJECT-TYPE
SYNTAX PwVcTDMCfgIndex
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object contains the value to be used for pwVcSatopCfgIndex when creating entries in the pwVcSatopCfgTable. The value 0 indicates that no unassigned entries are available. To obtain the value of pwVcSatopCfgIndex for a new entry in the pwVcSatopCfgTable, the manager issues a management protocol retrieval operation to obtain the current value of pwVcSatopCfgIndex. After each retrieval operation, the agent should modify the value to reflect the next unassigned index. After a manager retrieves a value the agent will determine through its local policy when this index value will be made available for reuse."
 ::= { pwVcSatopObjects 1 }

-- PW SAToP PW Configuration Table

pwVcSatopCfgTable OBJECT-TYPE
SYNTAX SEQUENCE OF PwVcSatopCfgEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table contains a set of parameters that may be referenced by one or more SAToP PWs in pwVcTDMTable."
REFERENCE
"See [PWTDMMIB]"
 ::= { pwVcSatopObjects 2 }

pwVcSatopCfgEntry OBJECT-TYPE
SYNTAX PwVcSatopCfgEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"These parameters define the characteristics of a SAToP PW. They are grouped here to ease NMS burden. Once an entry is created here it may be re-used by many PWs."

INDEX { pwVcSatopCfgIndex }
 ::= { pwVcSatopCfgTable 1 }

PwVcSatopCfgEntry ::= SEQUENCE {
  pwVcSatopCfgIndex                   PwVcTDMCfgIndex,
  pwVcSatopCfgRowStatus               RowStatus,
  pwVcSatopCfgConsecPktsLoss2Normal   Unsigned32,
  pwVcSatopCfgConsecMissPktNorma2Loss Unsigned32,
  pwVcSatopCfgPktReplacePolicy       INTEGER,
  pwVcSatopCfgTDMDatasetUp2Synch      Unsigned32,
  pwVcSatopCfgSetUp2SynchTimeOut      Unsigned32,
  pwVcSatopCfgAlarmThreshold          Unsigned32,
  pwVcSatopCfgClearAlarmThreshold     Unsigned32,
  pwVcSatopCfgExcessivePktLossThreshold Unsigned32,
  pwVcSatopCfgMissingPktsToSes        Unsigned32,
  pwVcSatopCfgTimestampMode           INTEGER,
  pwVcSatopCfgStorageType             StorageType
}

pwVcSatopCfgIndex   OBJECT-TYPE
SYNTAX        PwVcTDMCfgIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "Primary index in this table"
 ::= { pwVcSatopCfgEntry 1 }

pwVcSatopCfgRowStatus    OBJECT-TYPE
SYNTAX               RowStatus
MAX-ACCESS           read-create
STATUS               current
DESCRIPTION
 "Object used for creating, modifying, and deleting
  a row from this table."
 ::= { pwVcSatopCfgEntry 2 }

-- The following counters work together to integrate
-- errors and the lack of errors on the SAToP PW. An error is
-- caused by a missing packet. Missing packet can be a result
-- of: packet loss in the network, (uncorrectable) packet out
-- of sequence, packet length error, jitter buffer overflow,
-- and jitter buffer underflow. The result is declaring whether
-- or not the SAToP PW is in Loss of Packet (LOPS) state.
--
-- pwVcSatopCfgConsecPktsLoss2Normal    OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     
"The number of consecutive packets with sequential
sequence numbers that are required to exit the
LOPS state."
REFERENCE       "See [SATOP]"
DEFVAL { 2 }
::= { pwVcSatopCfgEntry 3 }

pwVcSatopCfgConsecMissPktNorma2Loss OBJECT-TYPE
SYNTAX          Unsigned32
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     
"The number of consecutive missing packets that are
required to enter the LOPS state."
REFERENCE       "See [SATOP]"
DEFVAL { 10 }
::= { pwVcSatopCfgEntry 4 }

pwVcSatopCfgPktReplacePolicy OBJECT-TYPE
SYNTAX          INTEGER
               {
               allOnes (1),
               implementationSpecific(2)
               }
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     
"This is the value to be played when CE bound packets
have over/underflow the jitter buffer, or are missing
for any reason. This byte pattern is sent (played) on
the TDM line."
DEFVAL { 1 } -- Play all ones
::= { pwVcSatopCfgEntry 5 }

pwVcSatopCfgTDMDataSetUp2Synch OBJECT-TYPE
SYNTAX          Unsigned32
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     
"The SAToP IWF is in an intermediate state until this
amount of TDM data bytes (usually half of the jitter
buffer) has been received in consecutive SAToP packets.
default value is set for E1 line."
DEFVAL {1400 }
 ::= { pwVcSatopCfgEntry 6 }

pwVcSatopCfgSetUp2SynchTimeOut OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The intermediate state timer is set to this value. The SAToP IWF is in an intermediate state until pwVcSatopCfgTDMDataSetUp2Synch amount of TDM data bytes has been received in consecutive SAToP packets or until this timer expires. The timer units are (millisec)"
DEFVAL { 5 }
 ::= { pwVcSatopCfgEntry 7 }

pwVcSatopCfgAlarmThreshold OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"Alarms are only reported when the defect state persists for the length of time specified by this object. The object’s unit is millisec"
DEFVAL { 2500 }
 ::= { pwVcSatopCfgEntry 8 }

pwVcSatopCfgClearAlarmThreshold OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"Alarm MUST be cleared after the corresponding defect is undetected for the amount of time specified by this object. The object’s unit is millisec"
DEFVAL { 10000 }
 ::= { pwVcSatopCfgEntry 9 }

pwVcSatopCfgExcessivePktLossThreshold OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"Excessive packet loss rate is detected by computing the average packet loss rate over a pwVcSatopCfgAvePktLossTimeWindow amount of time and comparing it with this threshold value."
 ::= { pwVcSatopCfgEntry 10 }

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pwVcSatopCfgMissingPktsToSes OBJECT-TYPE
SYNTAX        Unsigned32
UNITS         "seconds"
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "Number of missing packets detected (consecutive or not) within a 1 second window to cause a Severely Error Second (SES) to be counted."
DEFVAL { 3 }
::= { pwVcSatopCfgEntry 11 }

pwVcSatopCfgTimestampMode  OBJECT-TYPE
SYNTAX        INTEGER
             { notApplicable (1),
              absolute      (2),
              differential  (3) }
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "Timestamp generation MAY be used in one of the following modes:
1. Absolute mode: the PSN-bound IWF sets timestamps using the clock recovered from the incoming TDM attachment circuit. As a consequence, the timestamps are closely correlated with the sequence numbers. All SAToP implementations that support usage of the RTP header MUST support this mode.
2. Differential mode: Both IWFs have access to a common high-quality timing source, and this source is used for timestamp generation. Support of this mode is OPTIONAL."
::= { pwVcSatopCfgEntry 12 }

pwVcSatopCfgStorageType  OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "This variable indicates the storage type for this row."
::= { pwVcSatopCfgEntry 13 }

-- End of SAToP PW Configuration Parameter Table

-- Conformance Information
pwVcSatopGroups OBJECT IDENTIFIER ::= { pwVcSatopConformance 1 }
pwVcSatopCompliances OBJECT IDENTIFIER ::= { pwVcSatopConformance 2 }

pwSatopModuleCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION "The compliance statement for agent that support Structure-Agnostic TDM over PSN."

MODULE -- this module
MANDATORY-GROUPS {
  pwVcSatopCfgGroup
}

OBJECT pwVcSatopCfgConsecPktsLoss2Normal
MIN-ACCESS read-only
DESCRIPTION "The ability to set this object is not required."

OBJECT pwVcSatopCfgConsecMissPktNorma2Loss
MIN-ACCESS read-only
DESCRIPTION "The ability to set this object is not required."

OBJECT pwVcSatopCfgPktReplacePolicy
MIN-ACCESS read-only
DESCRIPTION "The ability to set this object is not required."

OBJECT pwVcSatopCfgTDMDataSetUp2Synch
MIN-ACCESS read-only
DESCRIPTION "The ability to set this object is not required."

OBJECT pwVcSatopCfgSetUp2SynchTimeOut
MIN-ACCESS read-only
DESCRIPTION "The ability to set this object is not required."

OBJECT pwVcSatopCfgExcessivePktLossThreshold
MIN-ACCESS read-only
DESCRIPTION
"The ability to set this object is not required."

OBJECT pwVcSatopCfgMissingPktsToSes
MIN-ACCESS read-only
DESCRIPTION
"The ability to set this object is not required."

OBJECT pwVcSatopCfgTimestampMode
MIN-ACCESS read-only
DESCRIPTION
"The ability to set this object is not required."

::= { pwVcSatopCompliances 1 }

-- Units of conformance.

pwVcSatopCfgGroup OBJECT-GROUP
OBJECTS {
  pwVcSatopCfgIndexNext,  
  pwVcSatopCfgRowStatus,  
  pwVcSatopCfgConsecPktsLoss2Normal,  
  pwVcSatopCfgConsecMissPktNorma2Loss,  
  pwVcSatopCfgPktReplacePolicy,  
  pwVcSatopCfgTDMDataSetUp2Synch,  
  pwVcSatopCfgSetUp2SynchTimeOut,  
  pwVcSatopCfgAlarmThreshold,  
  pwVcSatopCfgClearAlarmThreshold,  
  pwVcSatopCfgExcessivePktLossThreshold,  
  pwVcSatopCfgMissingPktsToSes,  
  pwVcSatopCfgTimestampMode,  
  pwVcSatopCfgStorageType
}
STATUS current
DESCRIPTION
"Collection of detailed objects needed to configure SAToP PWs."
::= { pwVcSatopGroups 1 }
8. Security considerations

It is clear that this MIB module is potentially useful for monitoring of SAToP PWs. This MIB can also be used for configuration of certain objects, and anything that can be configured can be incorrectly configured, with potentially disastrous results.

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

The pwVcSatopCfgTable contains objects of SAToP PW parameters on a Provider Edge (PE) device. Unauthorized access to objects in these tables could result in disruption of traffic on the network.

The use of stronger mechanisms such as SNMPv3 security should be considered where possible. Specifically, SNMPv3 VACM and USM MUST be used with any SNMPv3 agent, which implements this MIB module. Administrators should consider whether read access to these objects should be allowed, since read access may be undesirable under certain circumstances.

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.

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

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework "see [RFC3410], section 8", including full support for the SNMPv3 cryptographic mechanisms "for authentication and privacy".

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

9. IANA considerations

As requested in the PW TC MIB [PWTC], PWE3 related standards track MIB modules should be rooted under the pwStdMIB subtree. The IANA is requested to assign { pwStdMIB 6 } to the PW SAToP MIB module specified in this document.

10. References

10.1 Normative references


[CESOPSN] Vainshtein a., et al., "Structured TDM Circuit Emulation Service over Packet Switched Network (CESoPSN)", work in progress.


[DS1MIB] Nicklass O. " Definitions of Managed Objects for the DS1, E1, DS2 and E2 Interface Types",
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work-in-progress.

[DS3MIB] Nicklass O. "Definitions of Managed Objects for the DS3/E3 Interface Types",
<draft-ietf-atommib-rfc2496bis-05.txt>.
work-in-progress.


[G.704] ITU-T Recommendation G.704 (10/98) – Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 Kbit/s hierarchical levels


10.2 Informative references

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