

Network Working Group
Request for Comments: 2959
Category: Standards Track

M. Baugher
B. Strahm
Intel Corp.
I. Suconick
VideoServer Corp.
October 2000

Real-Time Transport Protocol Management Information Base

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

Copyright (C) The Internet Society (2000). All Rights Reserved.

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it defines objects for managing Real-Time Transport Protocol (RTP) systems (RFC1889).

Table of Contents

1. The Network Management Framework	2
2. Overview	3
2.1 Components	3
2.2 Applicability of the MIB to RTP System Implementations	4
2.3 The Structure of the RTP MIB	4
3 Definitions	5
4. Security Considerations	26
5. Acknowledgements	27
6. Intellectual Property	27
7. References	28
8. Authors' Addresses	30
9. Full Copyright Statement	31

1. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- o An overall architecture, described in RFC 2571 [RFC2571].
- o 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 STD 16, RFC 1155 [RFC1155], STD 16, RFC 1212 [RFC1212] and RFC 1215 [RFC1215]. The second version, called SMIV2, is described in STD 58, RFC 2578 [RFC2578], RFC 2579 [RFC2579] and RFC 2580 [RFC2580].
- o Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPV1 and described in STD 15, RFC 1157 [RFC1157]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPV2C and described in RFC 1901 [RFC1901] and RFC 1906 [RFC1906]. The third version of the message protocol is called SNMPV3 and described in RFC 1906 [RFC1906], RFC 2572 [RFC2572] and RFC 2574 [RFC2574].
- o Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [RFC1157]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [RFC1905].
- o A set of fundamental applications described in RFC 2573 [RFC2573] and the view-based access control mechanism described in RFC 2575 [RFC2575].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [RFC2570].

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.

2. Overview

An "RTP System" may be a host end-system that runs an application program that sends or receives RTP data packets, or it may be an intermediate-system that forwards RTP packets. RTP Control Protocol (RTCP) packets are sent by senders and receivers to convey information about RTP packet transmission and reception [RFC1889]. RTP monitors may collect RTCP information on senders and receivers to and from an RTP host or intermediate-system.

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.

2.1 Components

The RTP MIB is structured around "Session," "Receiver" and "Sender" conceptual abstractions.

2.1.1 An "RTP Session" is the "...association of participants communicating with RTP. For each participant, the session is defined by a particular pair of destination transport addresses (one network address plus a port pair for RTP and RTCP). The destination transport addresses may be common for all participants, as in the case of IP multicast, or may be different for each, as in the case of individual unicast addresses plus a common port pair," as defined in section 3 of [RFC1889].

2.1.2 A "Sender" is identified within an RTP session by a 32-bit numeric "Synchronization Source," or "SSRC", value and is "...the source of a stream of RTP packets" as defined in section 3 of [RFC1889]. The sender is also a source of RTCP Sender Report packets as specified in section 6 of [RFC1889].

2.1.3 A "Receiver" of a "stream of RTP packets" can be a unicast or multicast Receiver as described in 2.1.1, above. An RTP Receiver has an SSRC value that is unique to the session. An RTP Receiver is a source of RTCP Receiver Reports as specified in section 6 of [RFC1889].

2.2 Applicability of the MIB to RTP System Implementations

The RTP MIB may be used in two types of RTP implementations, RTP Host Systems (end systems) and RTP Monitors, see section 3 of [RFC1889]. Use of the RTP MIB for RTP Translators and Mixers, as defined in section 7 of [RFC1889], is for further study.

2.2.1 RTP host Systems are end-systems that may use the RTP MIB to collect RTP session and stream data that the host is sending or receiving; these data may be used by a network manager to detect and diagnose faults that occur over the lifetime of an RTP session as in a "help-desk" scenario.

2.2.2 RTP Monitors of multicast RTP sessions may be third-party or may be located in the RTP host. RTP Monitors may use the RTP MIB to collect RTP session and stream statistical data; these data may be used by a network manager for capacity planning and other network-management purposes. An RTP Monitor may use the RTP MIB to collect data to permit a network manager to detect and diagnose faults in RTP sessions or to permit a network manager to configure its operation.

2.2.3 Many host systems will want to keep track of streams beyond what they are sending and receiving. In a host monitor system, a host agent would use RTP data from the host to maintain data about streams it is sending and receiving, and RTCP data to collect data about other hosts in the session. For example, an agent for an RTP host that is sending a stream would use data from its RTP system to maintain the `rtpSenderTable`, but it may want to maintain a `rtpRcvrTable` for endpoints that are receiving its stream. To do this the RTP agent will collect RTCP data from the receivers of its stream to build the `rtpRcvrTable`. A host monitor system MUST set the `rtpSessionMonitor` object to 'true(1)', but it does not have to accept management operations that create and destroy rows in its `rtpSessionTable`.

2.3 The Structure of the RTP MIB

There are six tables in the RTP MIB. The `rtpSessionTable` contains objects that describe active sessions at the host, or monitor. The `rtpSenderTable` contains information about senders to the RTP session. The `rtpRcvrTable` contains information about receivers of RTP session data. The `rtpSessionInverseTable`, `rtpSenderInverseTable`, and `rtpRcvrInverseTable` contain information to efficiently find indexes into the `rtpSessionTable`, `rtpSenderTable`, and `rtpRcvrTable`, respectively.

The reverse lookup tables (rtpSessionInverseTable, rtpSenderInverseTable, and rtpRcvrInverseTable) are optional tables to help management applications efficiently access conceptual rows in other tables. Implementors of this MIB SHOULD implement these tables for multicast RTP sessions when table indexes (rtpSessionIndex of rtpSessionTable, rtpSenderSSRC of rtpSenderTable, and the SSRC pair in the rtpRcvrTable) are not available from other MIBs. Otherwise, the management application may be forced to perform expensive tree walks through large numbers of sessions, senders, or receivers.

For any particular RTP session, the rtpSessionMonitor object indicates whether remote senders or receivers to the RTP session are to be monitored. If rtpSessionMonitor is true(1) then senders and receivers to the session MUST be monitored with entries in the rtpSenderTable and rtpRcvrTable. RTP sessions are monitored by the RTP agent that updates rtpSenderTable and rtpRcvrTable objects with information from RTCP reports from remote senders or remote receivers respectively.

rtpSessionNewIndex is a global object that permits a network-management application to obtain a unique index for conceptual row creation in the rtpSessionTable. In this way the SNMP Set operation MAY be used to configure a monitor.

3. Definitions

RTP-MIB DEFINITIONS ::= BEGIN

IMPORTS

```

    Counter32, Counter64, Gauge32, mib-2, Integer32,
    MODULE-IDENTITY,
    OBJECT-TYPE, Unsigned32                                FROM SNMPv2-SMI
    RowStatus, TAddress,
    TDomain, TestAndIncr,
    TimeStamp, TruthValue                                  FROM SNMPv2-TC
    OBJECT-GROUP, MODULE-COMPLIANCE                        FROM SNMPv2-CONF
    Utf8String                                             FROM SYSAPPL-MIB
    InterfaceIndex                                         FROM IF-MIB;
```

rtpMIB MODULE-IDENTITY

LAST-UPDATED "200010020000Z" -- 2 October 2000

ORGANIZATION

"IETF AVT Working Group

Email: rem-conf@es.net"

CONTACT-INFO

"Mark Baugher

Postal: Intel Corporation

2111 NE 25th Avenue

Hillsboro, OR 97124

United States
 Tel: +1 503 466 8406
 Email: mbaugher@passededge.com

Bill Strahm
 Postal: Intel Corporation
 2111 NE 25th Avenue
 Hillsboro, OR 97124
 United States
 Tel: +1 503 264 4632
 Email: bill.strahm@intel.com

Irina Suconick
 Postal: Ennovate Networks
 60 Codman Hill Rd.,
 Boxboro, Ma 01719
 Tel: +1 781-505-2155
 Email: irina@ennovatenetworks.com"

DESCRIPTION

"The managed objects of RTP systems. The MIB is structured around three types of information.

1. General information about RTP sessions such as the session address.
2. Information about RTP streams being sent to an RTP session by a particular sender.
3. Information about RTP streams received on an RTP session by a particular receiver from a particular sender.

There are two types of RTP Systems, RTP hosts and RTP monitors. As described below, certain objects are unique to a particular type of RTP System. An RTP host may also function as an RTP monitor. Refer to RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications,' section 3.0, for definitions."

REVISION "200010020000Z" -- 2 October 2000

DESCRIPTION "Initial version of this MIB.
 Published as RFC 2959."

::= { mib-2 87 }

--

-- OBJECTS

--

rtpMIBObjects OBJECT IDENTIFIER ::= { rtpMIB 1 }
 rtpConformance OBJECT IDENTIFIER ::= { rtpMIB 2 }

--

```
-- SESSION NEW INDEX
```

```
--
```

```
rtpSessionNewIndex OBJECT-TYPE
```

```
SYNTAX          TestAndIncr
```

```
MAX-ACCESS      read-write
```

```
STATUS          current
```

```
DESCRIPTION
```

"This object is used to assign values to rtpSessionIndex as described in 'Textual Conventions for SMIV2'. For an RTP system that supports the creation of rows, the network manager would read the object, and then write the value back in the Set that creates a new instance of rtpSessionEntry. If the Set fails with the code 'inconsistentValue,' then the process must be repeated; If the Set succeeds, then the object is incremented, and the new instance is created according to the manager's directions. However, if the RTP agent is not acting as a monitor, only the RTP agent may create conceptual rows in the RTP session table."

```
::= { rtpMIBObjects 1 }
```

```
--
```

```
-- SESSION INVERSE TABLE
```

```
--
```

```
rtpSessionInverseTable OBJECT-TYPE
```

```
SYNTAX          SEQUENCE OF RtpSessionInverseEntry
```

```
MAX-ACCESS      not-accessible
```

```
STATUS          current
```

```
DESCRIPTION
```

"Maps rtpSessionDomain, rtpSessionRemAddr, and rtpSessionLocAddr TAddress pairs to one or more rtpSessionIndex values, each describing a row in the rtpSessionTable. This makes it possible to retrieve the row(s) in the rtpSessionTable corresponding to a given session without having to walk the entire (potentially large) table."

```
::= { rtpMIBObjects 2 }
```

```
rtpSessionInverseEntry OBJECT-TYPE
```

```
SYNTAX          RtpSessionInverseEntry
```

```
MAX-ACCESS      not-accessible
```

```
STATUS          current
```

```
DESCRIPTION
```

"Each entry corresponds to exactly one entry in the rtpSessionTable - the entry containing the tuple, rtpSessionDomain, rtpSessionRemAddr, rtpSessionLocAddr and rtpSessionIndex."

```
INDEX { rtpSessionDomain, rtpSessionRemAddr, rtpSessionLocAddr,
        rtpSessionIndex }
```

```
::= { rtpSessionInverseTable 1 }
```

```

RtpSessionInverseEntry ::= SEQUENCE {
    rtpSessionInverseStartTime    TimeStamp
}

rtpSessionInverseStartTime OBJECT-TYPE
    SYNTAX          TimeStamp
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The value of SysUpTime at the time that this row was
        created."
    ::= { rtpSessionInverseEntry 1 }

--
--      SESSION TABLE
--
rtpSessionTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF RtpSessionEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "There's one entry in rtpSessionTable for each RTP session
        on which packets are being sent, received, and/or
        monitored."
    ::= { rtpMIBObjects 3 }

rtpSessionEntry OBJECT-TYPE
    SYNTAX          RtpSessionEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "Data in rtpSessionTable uniquely identify an RTP session.  A
        host RTP agent MUST create a read-only row for each session to
        which packets are being sent or received.  Rows MUST be created
        by the RTP Agent at the start of a session when one or more
        senders or receivers are observed.  Rows created by an RTP agent
        MUST be deleted when the session is over and there are no
        rtpRcvrEntry and no rtpSenderEntry for this session.  An RTP
        session SHOULD be monitored to create management information on
        all RTP streams being sent or received when the
        rtpSessionMonitor has the TruthValue of 'true(1)'.  An RTP
        monitor SHOULD permit row creation with the side effect of
        causing the RTP System to join the multicast session for the
        purposes of gathering management information (additional
        conceptual rows are created in the rtpRcvrTable and
        rtpSenderTable).  Thus, rtpSessionTable rows SHOULD be created
        for RTP session monitoring purposes.  Rows created by a
        management application SHOULD be deleted via SNMP operations by

```


management applications. Rows created by management operations are deleted by management operations by setting rtpSessionRowStatus to 'destroy(6)'."

```
INDEX { rtpSessionIndex }
 ::= { rtpSessionTable 1 }
```

```
RtpSessionEntry ::= SEQUENCE {
    rtpSessionIndex      Integer32,
    rtpSessionDomain     TDomain,
    rtpSessionRemAddr    TAddress,
    rtpSessionLocAddr    TAddress,
    rtpSessionIfIndex    InterfaceIndex,
    rtpSessionSenderJoins Counter32,
    rtpSessionReceiverJoins Counter32,
    rtpSessionByes       Counter32,
    rtpSessionStartTime  TimeStamp,
    rtpSessionMonitor    TruthValue,
    rtpSessionRowStatus  RowStatus
}
```

```
rtpSessionIndex OBJECT-TYPE
    SYNTAX      Integer32 (1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The index of the conceptual row which is for SNMP purposes
        only and has no relation to any protocol value. There is
        no requirement that these rows are created or maintained
        sequentially."
    ::= { rtpSessionEntry 1 }
```

```
rtpSessionDomain OBJECT-TYPE
    SYNTAX      TDomain
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The transport-layer protocol used for sending or receiving
        the stream of RTP data packets on this session.
        Cannot be changed if rtpSessionRowStatus is 'active'."
    ::= { rtpSessionEntry 2 }
```

```
rtpSessionRemAddr OBJECT-TYPE
    SYNTAX      TAddress
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The address to which RTP packets are sent by the RTP system.
        In an IP multicast RTP session, this is the single address used
```

by all senders and receivers of RTP session data. In a unicast RTP session this is the unicast address of the remote RTP system. 'The destination address pair may be common for all participants, as in the case of IP multicast, or may be different for each, as in the case of individual unicast network address pairs.' See RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications,' sec. 3. The transport service is identified by rtpSessionDomain. For snmpUDPDomain, this is an IP address and even-numbered UDP Port with the RTCP being sent on the next higher odd-numbered port, see RFC 1889, sec. 5."

::= { rtpSessionEntry 3 }

rtpSessionLocAddr OBJECT-TYPE

SYNTAX TAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"The local address used by the RTP system. In an IP multicast RTP session, rtpSessionRemAddr will be the same IP multicast address as rtpSessionLocAddr. In a unicast RTP session, rtpSessionRemAddr and rtpSessionLocAddr will have different unicast addresses. See RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications,' sec. 3. The transport service is identified by rtpSessionDomain. For snmpUDPDomain, this is an IP address and even-numbered UDP Port with the RTCP being sent on the next higher odd-numbered port, see RFC 1889, sec. 5."

::= { rtpSessionEntry 4 }

rtpSessionIfIndex OBJECT-TYPE

SYNTAX InterfaceIndex
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"The ifIndex value is set to the corresponding value from IF-MIB (See RFC 2233, 'The Interfaces Group MIB using SMIV2'). This is the interface that the RTP stream is being sent to or received from, or in the case of an RTP Monitor the interface that RTCP packets will be received on. Cannot be changed if rtpSessionRowStatus is 'active'."

::= { rtpSessionEntry 5 }

rtpSessionSenderJoins OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"The number of senders that have been observed to have joined the session since this conceptual row was created

(rtpSessionStartTime). A sender 'joins' an RTP session by sending to it. Senders that leave and then re-join following an RTCP BYE (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications,' sec. 6.6) or session timeout may be counted twice. Every time a new RTP sender is detected either using RTP or RTCP, this counter is incremented."

::= { rtpSessionEntry 6 }

rtpSessionReceiverJoins OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The number of receivers that have been observed to have joined this session since this conceptual row was created (rtpSessionStartTime). A receiver 'joins' an RTP session by sending RTCP Receiver Reports to the session. Receivers that leave and then re-join following an RTCP BYE (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications,' sec. 6.6) or session timeout may be counted twice."

::= { rtpSessionEntry 7 }

rtpSessionByes OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"A count of RTCP BYE (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications,' sec. 6.6) messages received by this entity."

::= { rtpSessionEntry 8 }

rtpSessionStartTime OBJECT-TYPE

SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The value of SysUpTime at the time that this row was created."

::= { rtpSessionEntry 9 }

rtpSessionMonitor OBJECT-TYPE

SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"Boolean, Set to 'true(1)' if remote senders or receivers in addition to the local RTP System are to be monitored using RTCP. RTP Monitors MUST initialize to 'true(1)' and RTP Hosts SHOULD initialize this 'false(2)'. Note that because 'host monitor' systems are receiving RTCP from their remote participants they MUST set this value to 'true(1)'."

```
::= { rtpSessionEntry 10 }
```

```
rtpSessionRowStatus OBJECT-TYPE
```

```
SYNTAX          RowStatus
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

"Value of 'active' when RTP or RTCP messages are being sent or received by an RTP System. A newly-created conceptual row must have the all read-create objects initialized before becoming 'active'.

A conceptual row that is in the 'notReady' or 'notInService' state MAY be removed after 5 minutes."

```
::= { rtpSessionEntry 11 }
```

```
--
```

```
-- SENDER INVERSE TABLE
```

```
--
```

```
rtpSenderInverseTable OBJECT-TYPE
```

```
SYNTAX          SEQUENCE OF RtpSenderInverseEntry
MAX-ACCESS      not-accessible
STATUS          current
```

```
DESCRIPTION
```

"Maps rtpSenderAddr, rtpSessionIndex, to the rtpSenderSSRC index of the rtpSenderTable. This table allows management applications to find entries sorted by rtpSenderAddr rather than sorted by rtpSessionIndex. Given the rtpSessionDomain and rtpSenderAddr, a set of rtpSessionIndex and rtpSenderSSRC values can be returned from a tree walk. When rtpSessionIndex is specified in the SNMP Get-Next operations, one or more rtpSenderSSRC values may be returned."

```
::= { rtpMIBObjects 4 }
```

```
rtpSenderInverseEntry OBJECT-TYPE
```

```
SYNTAX          RtpSenderInverseEntry
MAX-ACCESS      not-accessible
STATUS          current
```

```
DESCRIPTION
```

"Each entry corresponds to exactly one entry in the rtpSenderTable - the entry containing the index pair, rtpSessionIndex, rtpSenderSSRC."

```
INDEX { rtpSessionDomain, rtpSenderAddr, rtpSessionIndex,
```

```

        rtpSenderSSRC }
 ::= { rtpSenderInverseTable 1 }

RtpSenderInverseEntry ::= SEQUENCE {
    rtpSenderInverseStartTime    TimeStamp
    }

rtpSenderInverseStartTime OBJECT-TYPE
    SYNTAX          TimeStamp
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The value of SysUpTime at the time that this row was
        created."
    ::= { rtpSenderInverseEntry 1 }

--
-- SENDERS TABLE
--

rtpSenderTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF RtpSenderEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "Table of information about a sender or senders to an RTP
        Session. RTP sending hosts MUST have an entry in this table
        for each stream being sent. RTP receiving hosts MAY have an
        entry in this table for each sending stream being received by
        this host. RTP monitors MUST create an entry for each observed
        sender to a multicast RTP Session as a side-effect when a
        conceptual row in the rtpSessionTable is made 'active' by a
        manager."
    ::= { rtpMIBObjects 5 }

rtpSenderEntry OBJECT-TYPE
    SYNTAX          RtpSenderEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "Each entry contains information from a single RTP Sender
        Synchronization Source (SSRC, see RFC 1889 'RTP: A Transport
        Protocol for Real-Time Applications' sec.6). The session is
        identified to the the SNMP entity by rtpSessionIndex.
        Rows are removed by the RTP agent when a BYE is received
        from the sender or when the sender times out (see RFC
        1889, Sec. 6.2.1) or when the rtpSessionEntry is deleted."
    INDEX { rtpSessionIndex, rtpSenderSSRC }
    ::= { rtpSenderTable 1 }

```

```

RtpSenderEntry ::= SEQUENCE {
    rtpSenderSSRC          Unsigned32,
    rtpSenderCNAME         Utf8String,
    rtpSenderAddr          TAddress,
    rtpSenderPackets       Counter64,
    rtpSenderOctets        Counter64,
    rtpSenderTool          Utf8String,
    rtpSenderSRs           Counter32,
    rtpSenderSRTime        TimeStamp,
    rtpSenderPT            INTEGER,
    rtpSenderStartTime     TimeStamp
}

rtpSenderSSRC OBJECT-TYPE
    SYNTAX          Unsigned32
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "The RTP SSRC, or synchronization source identifier of the
        sender. The RTP session address plus an SSRC uniquely
        identify a sender to an RTP session (see RFC 1889, 'RTP: A
        Transport Protocol for Real-Time Applications' sec.3)."
    ::= { rtpSenderEntry 1 }

rtpSenderCNAME OBJECT-TYPE
    SYNTAX          Utf8String
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The RTP canonical name of the sender."
    ::= { rtpSenderEntry 2 }

rtpSenderAddr OBJECT-TYPE
    SYNTAX          TAddress
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The unicast transport source address of the sender. In the
        case of an RTP Monitor this address is the address that the
        sender is using to send its RTCP Sender Reports."
    ::= { rtpSenderEntry 3 }

rtpSenderPackets OBJECT-TYPE
    SYNTAX          Counter64
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Count of RTP packets sent by this sender, or observed by

```

an RTP monitor, since rtpSenderStartTime."
::= { rtpSenderEntry 4 }

rtpSenderOctets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Count of non-header RTP octets sent by this sender, or observed by an RTP monitor, since rtpSenderStartTime."

::= { rtpSenderEntry 5 }

rtpSenderTool OBJECT-TYPE

SYNTAX Utf8String (SIZE(0..127))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Name of the application program source of the stream."

::= { rtpSenderEntry 6 }

rtpSenderSRs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of the number of RTCP Sender Reports that have been sent from this sender, or observed if the RTP entity is a monitor, since rtpSenderStartTime."

::= { rtpSenderEntry 7 }

rtpSenderSRTime OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"rtpSenderSRTime is the value of SysUpTime at the time that the last SR was received from this sender, in the case of a monitor or receiving host. Or sent by this sender, in the case of a sending host."

::= { rtpSenderEntry 8 }

rtpSenderPT OBJECT-TYPE

SYNTAX INTEGER (0..127)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Payload type from the RTP header of the most recently received RTP Packet (see RFC 1889, 'RTP: A Transport Protocol for

Real-Time Applications' sec. 5)."
 ::= { rtpSenderEntry 9 }

rtpSenderStartTime OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of SysUpTime at the time that this row was created."

::= { rtpSenderEntry 10 }

--

-- RECEIVER INVERSE TABLE

--

rtpRcvrInverseTable OBJECT-TYPE

SYNTAX SEQUENCE OF RtpRcvrInverseEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Maps rtpRcvrAddr and rtpSessionIndex to the rtpRcvrSRCSSRC and rtpRcvrSSRC indexes of the rtpRcvrTable. This table allows management applications to find entries sorted by rtpRcvrAddr rather than by rtpSessionIndex. Given rtpSessionDomain and rtpRcvrAddr, a set of rtpSessionIndex, rtpRcvrSRCSSRC, and rtpRcvrSSRC values can be returned from a tree walk. When rtpSessionIndex is specified in SNMP Get-Next operations, one or more rtpRcvrSRCSSRC and rtpRcvrSSRC pairs may be returned."

::= { rtpMIBObjects 6 }

rtpRcvrInverseEntry OBJECT-TYPE

SYNTAX RtpRcvrInverseEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Each entry corresponds to exactly one entry in the rtpRcvrTable - the entry containing the index pair, rtpSessionIndex, rtpRcvrSSRC."

INDEX { rtpSessionDomain, rtpRcvrAddr, rtpSessionIndex,
 rtpRcvrSRCSSRC, rtpRcvrSSRC }

::= { rtpRcvrInverseTable 1 }

RtpRcvrInverseEntry ::= SEQUENCE {

 rtpRcvrInverseStartTime TimeStamp
 }

rtpRcvrInverseStartTime OBJECT-TYPE

SYNTAX TimeStamp


```

MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "The value of SysUpTime at the time that this row was
    created."
 ::= { rtpRcvrInverseEntry 1 }

--
--  RECEIVERS TABLE
--
rtpRcvrTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF RtpRcvrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Table of information about a receiver or receivers of RTP
        session data. RTP hosts that receive RTP session packets
        MUST create an entry in this table for that receiver/sender
        pair. RTP hosts that send RTP session packets MAY create
        an entry in this table for each receiver to their stream
        using RTCP feedback from the RTP group. RTP monitors
        create an entry for each observed RTP session receiver as
        a side effect when a conceptual row in the rtpSessionTable
        is made 'active' by a manager."
    ::= { rtpMIBObjects 7 }

rtpRcvrEntry OBJECT-TYPE
    SYNTAX      RtpRcvrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Each entry contains information from a single RTP
        Synchronization Source that is receiving packets from the
        sender identified by rtpRcvrSRCSSRC (SSRC, see RFC 1889,
        'RTP: A Transport Protocol for Real-Time Applications'
        sec.6). The session is identified to the the RTP Agent entity
        by rtpSessionIndex. Rows are removed by the RTP agent when
        a BYE is received from the sender or when the sender times
        out (see RFC 1889, Sec. 6.2.1) or when the rtpSessionEntry is
        deleted."
    INDEX { rtpSessionIndex, rtpRcvrSRCSSRC, rtpRcvrSSRC }
    ::= { rtpRcvrTable 1 }

RtpRcvrEntry ::= SEQUENCE {
    rtpRcvrSRCSSRC      Unsigned32,
    rtpRcvrSSRC         Unsigned32,
    rtpRcvrCNAME        Utf8String,
    rtpRcvrAddr         TAddress,

```

rtpRcvrRTT	Gauge32,
rtpRcvrLostPackets	Counter64,
rtpRcvrJitter	Gauge32,
rtpRcvrTool	Utf8String,
rtpRcvrRRs	Counter32,
rtpRcvrRRTime	TimeStamp,
rtpRcvrPT	INTEGER,
rtpRcvrPackets	Counter64,
rtpRcvrOctets	Counter64,
rtpRcvrStartTime	TimeStamp
}	

rtpRcvrSRCSSRC OBJECT-TYPE

SYNTAX Unsigned32
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION

"The RTP SSRC, or synchronization source identifier of the sender. The RTP session address plus an SSRC uniquely identify a sender or receiver of an RTP stream (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications' sec.3)."

::= { rtpRcvrEntry 1 }

rtpRcvrSSRC OBJECT-TYPE

SYNTAX Unsigned32
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION

"The RTP SSRC, or synchronization source identifier of the receiver. The RTP session address plus an SSRC uniquely identify a receiver of an RTP stream (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications' sec.3)."

::= { rtpRcvrEntry 2 }

rtpRcvrCNAME OBJECT-TYPE

SYNTAX Utf8String
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"The RTP canonical name of the receiver."

::= { rtpRcvrEntry 3 }

rtpRcvrAddr OBJECT-TYPE

SYNTAX TAddress
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION

"The unicast transport address on which the receiver is receiving RTP packets and/or RTCP Receiver Reports."
 ::= { rtpRcvrEntry 4 }

rtpRcvrRTT OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The round trip time measurement taken by the source of the RTP stream based on the algorithm described on sec. 6 of RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications.' This algorithm can produce meaningful results when the RTP agent has the same clock as the stream sender (when the RTP monitor is also the sending host for the particular receiver). Otherwise, the entity should return 'noSuchInstance' in response to queries against rtpRcvrRTT."

::= { rtpRcvrEntry 5 }

rtpRcvrLostPackets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of RTP packets lost as observed by this receiver since rtpRcvrStartTime."

::= { rtpRcvrEntry 6 }

rtpRcvrJitter OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"An estimate of delay variation as observed by this receiver. (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications' sec.6.3.1 and A.8)."

::= { rtpRcvrEntry 7 }

rtpRcvrTool OBJECT-TYPE

SYNTAX Utf8String (SIZE(0..127))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Name of the application program source of the stream."

::= { rtpRcvrEntry 8 }

rtpRcvrRRs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only
STATUS current
DESCRIPTION

"A count of the number of RTCP Receiver Reports that have been sent from this receiver, or observed if the RTP entity is a monitor, since rtpRcvrStartTime."

::= { rtpRcvrEntry 9 }

rtpRcvrRRTime OBJECT-TYPE

SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"rtpRcvrRRTime is the value of SysUpTime at the time that the last RTCP Receiver Report was received from this receiver, in the case of a monitor or RR receiver (the RTP Sender). It is the value of SysUpTime at the time that the last RR was sent by this receiver in the case of an RTP receiver sending the RR."

::= { rtpRcvrEntry 10 }

rtpRcvrPT OBJECT-TYPE

SYNTAX INTEGER (0..127)
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"Static or dynamic payload type from the RTP header (see RFC 1889, 'RTP: A Transport Protocol for Real-Time Applications' sec. 5)."

::= { rtpRcvrEntry 11 }

rtpRcvrPackets OBJECT-TYPE

SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"Count of RTP packets received by this RTP host receiver since rtpRcvrStartTime."

::= { rtpRcvrEntry 12 }

rtpRcvrOctets OBJECT-TYPE

SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"Count of non-header RTP octets received by this receiving RTP host since rtpRcvrStartTime."

::= { rtpRcvrEntry 13 }

```

rtpRcvrStartTime OBJECT-TYPE
    SYNTAX          TimeStamp
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The value of SysUpTime at the time that this row was
        created."
    ::= { rtpRcvrEntry 14 }

--
--  MODULE GROUPS
--
--
--  There are two types of RTP Systems, RTP hosts and RTP Monitors.
--  Thus there are three kinds of objects: 1) Objects common to both
--  kinds of systems, 2) Objects unique to RTP Hosts and 3) Objects
--  unique to RTP Monitors.  There is a fourth group, 4) Objects that
--  SHOULD be implemented by Multicast hosts and RTP Monitors

rtpGroups OBJECT IDENTIFIER ::= { rtpConformance 1 }
rtpSystemGroup OBJECT-GROUP
    OBJECTS
        {
            rtpSessionDomain,
            rtpSessionRemAddr,
            rtpSessionIfIndex,
            rtpSessionSenderJoins,
            rtpSessionReceiverJoins,
            rtpSessionStartTime,
            rtpSessionByes,
            rtpSessionMonitor,
            rtpSenderCNAME,
            rtpSenderAddr,
            rtpSenderPackets,
            rtpSenderOctets,
            rtpSenderTool,
            rtpSenderSRs,
            rtpSenderSRTime,
            rtpSenderStartTime,
            rtpRcvrCNAME,
            rtpRcvrAddr,
            rtpRcvrLostPackets,
            rtpRcvrJitter,
            rtpRcvrTool,
            rtpRcvrRRs,
            rtpRcvrRRTime,
            rtpRcvrStartTime
        }
    STATUS          current

```

DESCRIPTION

"Objects available to all RTP Systems."

::= { rtpGroups 1 }

```
rtpHostGroup      OBJECT-GROUP
OBJECTS           {
                  rtpSessionLocAddr,
                  rtpSenderPT,
                  rtpRcvrPT,
                  rtpRcvrRTT,
                  rtpRcvrOctets,
                  rtpRcvrPackets
                  }
```

STATUS current

DESCRIPTION

"Objects that are available to RTP Host systems, but may not be available to RTP Monitor systems."

::= { rtpGroups 2 }

```
rtpMonitorGroup   OBJECT-GROUP
OBJECTS           {
                  rtpSessionNewIndex,
                  rtpSessionRowStatus
                  }
```

STATUS current

DESCRIPTION

"Objects used to create rows in the RTP Session Table. These objects are not needed if the system does not create rows."

::= { rtpGroups 3 }

```
rtpInverseGroup   OBJECT-GROUP
OBJECTS           {
                  rtpSessionInverseStartTime,
                  rtpSenderInverseStartTime,
                  rtpRcvrInverseStartTime
                  }
```

STATUS current

DESCRIPTION

"Objects used in the Inverse Lookup Tables."

::= { rtpGroups 4 }

--

-- Compliance

--

rtpCompliances OBJECT IDENTIFIER ::= { rtpConformance 2 }

```
rtpHostCompliance MODULE-COMPLIANCE
STATUS              current
```

DESCRIPTION

"Host implementations MUST comply."

MODULE RTP-MIB

MANDATORY-GROUPS {
 rtpSystemGroup,
 rtpHostGroup
 }

GROUP rtpMonitorGroup

DESCRIPTION

"Host systems may optionally support row creation and deletion.

This would allow an RTP Host system to act as an RTP Monitor."

GROUP rtpInverseGroup

DESCRIPTION

"Multicast RTP Systems SHOULD implement the optional tables."

OBJECT rtpSessionNewIndex

MIN-ACCESS not-accessible

DESCRIPTION

"RTP system implementations support of row creation and deletion is OPTIONAL so implementation of this object is OPTIONAL."

OBJECT rtpSessionDomain

MIN-ACCESS read-only

DESCRIPTION

"RTP system implementation support of row creation and deletion is OPTIONAL. When it is not supported so write access is OPTIONAL."

OBJECT rtpSessionRemAddr

MIN-ACCESS read-only

DESCRIPTION

"Row creation and deletion is OPTIONAL so read-create access to this object is OPTIONAL."

OBJECT rtpSessionIfIndex

MIN-ACCESS read-only

DESCRIPTION

"Row creation and deletion is OPTIONAL so read-create access to this object is OPTIONAL."

OBJECT rtpSessionRowStatus

MIN-ACCESS not-accessible

DESCRIPTION

"Row creation and deletion is OPTIONAL so read-create access to this object is OPTIONAL."

OBJECT rtpSessionInverseStartTime

MIN-ACCESS not-accessible

DESCRIPTION

"Multicast RTP Systems SHOULD implement the optional tables."

```

OBJECT rtpSenderInverseStartTime
  MIN-ACCESS not-accessible
  DESCRIPTION
    "Multicast RTP Systems SHOULD implement the optional
    tables."
OBJECT rtpRcvrInverseStartTime
  MIN-ACCESS not-accessible
  DESCRIPTION
    "Multicast RTP Systems SHOULD implement the optional
    tables."
 ::= { rtpCompliances 1 }

rtpMonitorCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
    "Monitor implementations must comply. RTP Monitors are not
    required to support creation or deletion."
  MODULE RTP-MIB
  MANDATORY-GROUPS {
    rtpSystemGroup,
    rtpMonitorGroup
  }
  GROUP rtpHostGroup
  DESCRIPTION
    "Monitor implementations may not have access to values in the
    rtpHostGroup."
  GROUP rtpInverseGroup
  DESCRIPTION
    "Multicast RTP Systems SHOULD implement the optional
    tables."
  OBJECT rtpSessionLocAddr
    MIN-ACCESS not-accessible
    DESCRIPTION
      "RTP monitor sourcing of RTP or RTCP data packets
      is OPTIONAL and implementation of this object is
      OPTIONAL."
  OBJECT rtpRcvrPT
    MIN-ACCESS not-accessible
    DESCRIPTION
      "RTP monitor systems may not support
      retrieval of the RTP Payload Type from the RTP
      header (and may receive RTCP messages only). When
      queried for the payload type information"
  OBJECT rtpSenderPT
    MIN-ACCESS not-accessible
    DESCRIPTION
      "RTP monitor systems may not support
      retrieval of the RTP Payload Type from the RTP

```



```
        header (and may receive RTCP messages only).  When
        queried for the payload type information."
OBJECT   rtpRcvrOctets
MIN-ACCESS not-accessible
DESCRIPTION
    "RTP monitor systems may receive only the RTCP messages
    and not the RTP messages that contain the octet count
    of the RTP message.  Thus implementation of this
    object is OPTIONAL."
OBJECT   rtpRcvrPackets
MIN-ACCESS not-accessible
DESCRIPTION
    "RTP monitor systems may receive only the RTCP messages
    and not the RTP messages that contain the octet count
    of the RTP message.  Thus implementation of this
    object is OPTIONAL."
OBJECT   rtpSessionIfIndex
MIN-ACCESS read-only
DESCRIPTION
    "Row creation and deletion is OPTIONAL so
    read-create access to this object is OPTIONAL."
OBJECT   rtpSessionInverseStartTime
MIN-ACCESS not-accessible
DESCRIPTION
    "Multicast RTP Systems SHOULD implement the optional
    tables."
OBJECT   rtpSenderInverseStartTime
MIN-ACCESS not-accessible
DESCRIPTION
    "Multicast RTP Systems SHOULD implement the optional
    tables."
OBJECT   rtpRcvrInverseStartTime
MIN-ACCESS not-accessible
DESCRIPTION
    "Multicast RTP Systems SHOULD implement the optional
    tables."
::= { rtpCompliances 2 }
END
```

4. Security Considerations

In most cases, MIBs are not themselves security risks; if SNMP security is operating as intended, the use of a MIB to view information about a system, or to change some parameter at the system, is a tool, not a threat. However, 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.

None of the read-only objects in this MIB reports a password, though some SDES [RFC1889] items such as the CNAME [RFC1889], the canonical name, may be deemed sensitive depending on the security policies of a particular enterprise. If access to these objects is not limited by an appropriate access control policy, these objects can provide an attacker with information about a system's configuration and the services that that system is providing. Some enterprises view their network and system configurations, as well as information about usage and performance, as corporate assets; such enterprises may wish to restrict SNMP access to most of the objects in the MIB. This MIB supports read-write operations against `rtpSessionNewIndex` which has the side effect of creating an entry in the `rtpSessionTable` when it is written to. Five objects in `rtpSessionEntry` have read-create access: `rtpSessionDomain`, `rtpSessionRemAddr`, `rtpSessionIfIndex`, `rtpSessionRowStatus`, and `rtpSessionIfAddr` identify an RTP session to be monitored on a particular interface. The values of these objects are not to be changed once created, and initialization of these objects affects only the monitoring of an RTP session and not the operation of an RTP session on any host end-system. Since write operations to `rtpSessionNewIndex` and the five objects in `rtpSessionEntry` affect the operation of the monitor, write access to these objects should be subject to the appropriate access control policy.

Confidentiality of RTP and RTCP data packets is defined in section 9 of the RTP specification [RFC1889]. Encryption may be performed on RTP packets, RTCP packets, or both. Encryption of RTCP packets may pose a problem for third-party monitors though "For RTCP, it is allowed to split a compound RTCP packet into two lower-layer packets, one to be encrypted and one to be sent in the clear. For example, SDES information might be encrypted while reception reports were sent in the clear to accommodate third-party monitors [RFC1889]."

SNMPv1 by itself is not a secure environment. 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. 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.

5. Acknowledgements

The authors wish to thank Bert Wijnen and the participants from the ITU SG-16 management effort for their helpful comments. Alan Batie and Bill Lewis from Intel also contributed greatly to the RTP MIB through their review of various drafts of the MIB and their work on the implementation of an SNMP RTP Monitor. Stan Naudus from 3Com and John Du from Intel contributed to the original RTP MIB design and co-authored the original RTP MIB draft documents; much of their work remains in the current RTP MIB. Bill Fenner provided solid feedback that improved the quality of the final document.

6. Intellectual Property

The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on the IETF's procedures with respect to rights in standards-track and standards-related documentation can be found in BCP-11. Copies of claims of rights made available for publication and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementors or users of this specification can be obtained from the IETF Secretariat.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

7. References

- [RFC1889] Shulzrinne, H., Casner, S., Frederick, R. and V. Jacobson, "RTP: A Transport Protocol for real-time applications," RFC 1889, January 1996.
- [RFC2571] Harrington, D., Presuhn, R. and B. Wijnen, "An Architecture for Describing SNMP Management Frameworks", RFC 2571, April 1999.
- [RFC1155] Rose, M. and K. McCloghrie, "Structure and Identification of Management Information for TCP/IP-based Internets", STD 16, RFC 1155, May 1990.
- [RFC1212] Rose, M. and K. McCloghrie, "Concise MIB Definitions", STD 16, RFC 1212, March 1991.
- [RFC1215] Rose, M., "A Convention for Defining Traps for use with the SNMP", RFC 1215, March 1991.
- [RFC2578] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.
- [RFC2580] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.
- [RFC1157] Case, J., Fedor, M., Schoffstall, M. and J. Davin, "Simple Network Management Protocol", STD 15, RFC 1157, May 1990.
- [RFC1901] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Introduction to Community-based SNMPv2", RFC 1901, January 1996.
- [RFC1906] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Transport Mappings for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1906, January 1996.

- [RFC2572] Case, J., Harrington D., Presuhn R. and B. Wijnen, "Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)", RFC 2572, April 1999.
- [RFC2574] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", RFC 2574, April 1999.
- [RFC1905] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1905, January 1996.
- [RFC2573] Levi, D., Meyer, P. and B. Stewart, "SNMPv3 Applications", RFC 2573, April 1999.
- [RFC2575] Wijnen, B., Presuhn, R. and K. McCloghrie, "View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)", RFC 2575, April 1999.
- [RFC2570] Case, J., Mundy, R., Partain, D. and B. Stewart, "Introduction to Version 3 of the Internet-standard Network Management Framework", RFC 2570, April 1999.

8. Authors' Addresses

Mark Baugher
Intel Corporation
2111 N.E.25th Avenue
Hillsboro, Oregon 97124
U.S.A.

EMail: mbaugher@passededge.com

Bill Strahm
Intel Corporation
2111 N.E.25th Avenue
Hillsboro, Oregon 97124
U.S.A.

EMail: Bill.Strahm@intel.com

Irina Suconick
Ennovate Networks
60 Codman Hill Rd.,
Boxboro, Ma 01719
U.S.A.

EMail: irina@ennovatenetworks.com

9. Full Copyright Statement

Copyright (C) The Internet Society (2000). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

