Audio/Video Working Group
Internet-Draft
Expires: August 31, 2006

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March 2006

RTP Control Protocol Extended Reports (RTCP XR) VoIP Metrics Management Information Base draft-ietf-avt-rtcp-xr-mib-04.txt

Status of this Memo

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 Control Protocol Extended Reports (RTCP XR) VoIP Metrics (RFC3611).

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1. 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].

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 [RFC3550]. RTCP Extended Report (XR) [RFC3611] packets are sent by receivers to convey additional information about certain types of RTP packet reception.

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 RTCP XR MIB is structured around "Session", "Source", "Destination" and "Receiver" conceptual abstractions.

2.1.1 An RTP Session is an association of two or more 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 [RFC3550].

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 [RFC3550]. The sender is also a source of RTCP Sender Report packets as specified in section 6 of [RFC3550].

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 [RFC3550] and RTCP XR VoIP Metrics Reports as specified in section 4.7 of [RFC3611].

2.2 Applicability of the MIB to RTP System Implementations

The RTCP XR MIB may be used in RTP Host Systems (end systems), see section 3 of [RFC3550], that are supporting Voice over IP (VoIP host systems) or in intermediate systems.

2.2.1 VoIP host Systems are end-systems that may use the RTCP XR MIB to collect RTP Voice over IP session 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 a VoIP session as in a "help-desk" scenario.

2.2.2 Monitors of RTP Voice over IP sessions may be third-party or may be located in the RTP host. Monitors may use the RTCP XR MIB to collect Voice over IP session statistical data; these data may be used by a network manager for planning and other network-management purposes. A Monitor may use the RTCP XR MIB to collect data to permit a network manager to diagnose faults in VoIP sessions.

2.3 Relationship to the RTP MIB V2

The RTP MIB V2 [draft-ietf-avt-mib-rtp-bis-00.txt] defines a table of session identifying information. The tables in the RTCP XR MIB augment the session data from the RTP MIB V2, providing detailed performance information for RTP sessions transporting Voice over IP. The RTP MIB V2 session table MUST be implemented if the RTCP XR MIB Basic Parameter and Call Quality tables are implemented. The history table in this MIB contains aggregate information and does not have any relationship to the RTP MIB V2 session table. In implementations that use only the RTCP XR history table to report aggregate data, the RTP MIB V2 session table MUST NOT be implemented.

2.4 Relationship to the RAQMON Architecture

The Real-time Application QoS monitoring (RAQMON) Framework [RAQMON] defines an architecture that extends the Remote Monitoring (RMON) family of applications for monitoring of application QoS in real time, and an extensible data model with objects carried between RAQMON data sources and RAQMON collectors. The RAQMON work is more generic, and complementary in concept to RTCP-XR, covering a wider range of applications running concurrently, while RTCP-XR focuses on in-depth QoS monitoring of media traffic in VoIP.

The Real-time Application QoS Monitoring (RAQMON) MIB is defined by [xxx] and runs on RAQMON collectors. A performance monitoring application may query (i) RAQMON collectors for RAQMON MIB information about the QoS parameters of multiple concurrent applications (ii) end-points and gateways for in-depth RTCP-XR information about the media QoS of VoIP or (iii) both.

2.5 The Structure of the RTCP XR MIB

There are three tables in the RTCP XR MIB

The rtcpXrBasicParametersTable contains basic packet loss, discard and delay related parameters about a session.

The rtcpXrVoiceQualityMetricsTable contains information about the call quality of a session

The rtcpXrHistoryTable contains aggregate information about a group of sessions.

2.6 Application to multi-party and multicast calls

The RTCP XR MIB may be applied to multi-party calls. The RTP MIB Session table is defined in terms of uni-directional RTP streams from a source to a destination.

For a multi-party IP-IP conference call in which parties are directly interconnected in a mesh network, a row should be created in the session table for each such interconnection.

For a multi-party call in which parties are interconnected via a bridge function and RTP streams are literally or logically terminated at the bridge, a row should be created in the session table for the RTP sessions established to and from each endpoint and the bridge.

For a multicast call in which RTP sessions are terminated in logical IP addresses from they are redistributed, a row in the session table should be created for the source to multicast address RTP session.

```
RTCPXR-MIB DEFINITIONS ::= BEGIN
IMPORTS
       mib-2, MODULE-IDENTITY, NOTIFICATION-TYPE,
       OBJECT-TYPE, Unsigned32, Integer32,
       Gauge32, Counter32                    FROM SNMPv2-SMI
       OBJECT-GROUP, MODULE-COMPLIANCE,
       NOTIFICATION-GROUP                    FROM SNMPv2-CONF
       TEXTUAL-CONVENTION, RowPointer, DateAndTime
                                             FROM SNMPv2-TC
       SnmpAdminString                       FROM SNMP-FRAMEWORK-MIB
       ItuPerceivedSeverity                  FROM ITU-ALARM-TC-MIB
       rtpSessionIndex, rtpSessionCallStatus
                                             FROM RTP-MIBV2;

rtcpXrMIB MODULE-IDENTITY
    LAST-UPDATED "200603040000Z"
    ORGANIZATION
        "IETF AVT Working Group"
    CONTACT-INFO
        "IETF AVT Working Group
         Chairs: Colin Perkins, Magnus Westerlund
         Working Group Email:  avt@ietf.org

         Editors: Alan Clark
                  Telchemy
                  Email: alan@telchemy.com

                  Amy Pendleton
                  Nortel
                  Email: aspen@nortel.com"
   DESCRIPTION
                "RTCP Extended Reports MIB
                Copyright (c) The Internet Society (2005)
                This version of the MIB module is part of
                RFC nnnn and is based on RFC3611."

   REVISION      "200603040000Z"
   DESCRIPTION
                "Published as draft-ietf-avt-rtcp-xr-mib-04.txt"

-- RFC Ed: replace above draft with RFC number and remove this note

::= { mib-2 nnn }

-- IANA: need assignment of a mib-2 OID for this MIB
-- RFC Ed: replace mmm with assigned OID number and remove this note
```

```
--
-- RTCP Extended Reports - Voice over IP Metrics
--
-- Description
--    This MIB module provides basic voice quality monitoring
--    capabilities for Voice-over-packet systems. The MIB contains
--    3 tables of information that augment the data available in
--    the RTP MIB V2.
--         a table of basic parameters for each Stream
--         a table of call quality metrics for each Stream
--         a table of aggregate statistics for groups of calls
--    the indexes to these tables are imported from the RTP MIB V2
--    and hence this MIB MUST be used in conjunction with at least
--    the RTP session table from that MIB

-- TEXTUAL CONVENTIONS

LeveldB ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS      current
DESCRIPTION
      "Represents a signal level in decibels (dB)."
SYNTAX      Integer32 (-120..120|127)

Rfactor ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS      current
DESCRIPTION
      "Call or transmission quality expressed as an
       R factor in the range 0 to 120. A value of
       127 shall be interpreted as NULL or unsupported."
REFERENCE
       "ITU-T G.107"
SYNTAX      Unsigned32 (0..120|127)

ScaledMOSscore ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS      current
DESCRIPTION
       "Call or transmission quality expressed as a
       MOS score scaled by 10.  MOS is typically represented
       as a 1.0 to 5.0 score with a single decimal place and
       hence in this representation as 10 to 50. A value of
       127 shall be interpreted as NULL or unsupported."
REFERENCE
       "ITU-T P.800"
SYNTAX      Integer32 (10..50|127)

Percentage ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS       current
DESCRIPTION
       "Percentage expressed as a rounded integer."
SYNTAX      Unsigned32 (0..100)
```

```
--
-- OBJECTS
--

rtcpXrEvents      OBJECT IDENTIFIER ::= { rtcpXrMIB 0 }
rtcpXrMIBObjects  OBJECT IDENTIFIER ::= { rtcpXrMIB 1 }
rtcpXrConformance OBJECT IDENTIFIER ::= { rtcpXrMIB 2 }

--
-- Table of basic RTP stream parameters
--

rtcpXrBaseParamTable OBJECT-TYPE
    SYNTAX SEQUENCE OF RtcpXrBaseParamEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
     "Table of basic parameters related to RTP sessions in
      the Session table. "
    ::= { rtcpXrMIBObjects 2 }

rtcpXrBaseParamEntry OBJECT-TYPE
    SYNTAX RtcpXrBaseParamEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry in the table of basic parameters. A row in this table
         is created for each RTP session endpoint participating."
    INDEX { rtpSessionCallStatus, rtpSessionIndex }
    ::= { rtcpXrBaseParamTable 1 }

RtcpXrBaseParamEntry ::= SEQUENCE {
    rtcpXrBaseParamCodecType                    OCTET STRING,
    rtcpXrBaseParamCodecBitRate                 Unsigned32,
    rtcpXrBaseParamFrameDuration                Unsigned32,
    rtcpXrBaseParamFramesPerPacket              Unsigned32,
    rtcpXrBaseParamSampleRate                   Unsigned32,
    rtcpXrBaseParamDurationMs                   Counter32,
    rtcpXrBaseParamNetworkLossRate              Percentage,
    rtcpXrBaseParamAvgDiscardRate               Percentage,
    rtcpXrBaseParamBurstLossDensity             Percentage,
    rtcpXrBaseParamBurstLenMs                   Gauge32,
    rtcpXrBaseParamGapLossDensity               Percentage,
    rtcpXrBaseParamGapLenMs                     Gauge32,
    rtcpXrBaseParamAvgOWDelay                   Gauge32,
    rtcpXrBaseParamAvgEndSysDelay               Gauge32,
    rtcpXrBaseParamNoiseLeveldBm                LeveldB,
    rtcpXrBaseParamSignalLeveldBm               LeveldB,
    rtcpXrBaseParamLocalRERLdB                  LeveldB,
    rtcpXrBaseParamRemoteRERLdB                 LeveldB,
    rtcpXrBaseParamPlcType                      INTEGER,
    rtcpXrBaseParamJBuffAdaptMode               INTEGER,
    rtcpXrBaseParamJBuffAdaptRate               Unsigned32,
    rtcpXrBaseParamJBuffAverageDelay            Gauge32,
```

```
    rtcpXrBaseParamJBuffMaximumDelay              Gauge32,
    rtcpXrBaseParamJBuffAbsMaxDelay               Gauge32,
    rtcpXrBaseParamJitterLevel                    Gauge32
}

rtcpXrBaseParamCodecType OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..32))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Codec type used on this call. The format used shall be
         ITU-T G.7xx, GSM FR, GSM EFR, GSM HR, AMR, AMR WB, iLBC
         or similar.  For example 'ITU G.729A'. It is recommended
         that Codecs are described in consistently with SDP."
    ::= { rtcpXrBaseParamEntry 1 }

rtcpXrBaseParamCodecBitRate OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Codec rate in use at the time this data was captured
         expressed in bits per second.  For example G.711 would
         have the rate 64000 and G.729 would have the rate 8000."
    ::= { rtcpXrBaseParamEntry 2 }

rtcpXrBaseParamFrameDuration OBJECT-TYPE
    SYNTAX Unsigned32 (0..16384)
    UNITS "sample clock ticks"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Companion information to Codec type.  This represents the
         duration of the time interval represented by a frame, which
         is generally equivalent to the nominal spacing of frames.
         This is expressed in sample clock ticks as defined under
         rtxpXrSampleRate.
         This parameter may be equated to the SDP ptime parameter
         which is expressed in milliseconds (however which cannot
         represent certain Codec types, e.g. those with 2.5mS
         frames)."
    ::= { rtcpXrBaseParamEntry 3 }

rtcpXrBaseParamFramesPerPacket OBJECT-TYPE
    SYNTAX Unsigned32 (0..65535)
    UNITS "frames per packet"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Number of Codec frames contained in a single IP packet in
         this RTP stream at the time of sampling. The duration of
         speech per IP packet is the product of Frame Duration and
         Frames Per Packet. This may vary during a call."
    ::= {rtcpXrBaseParamEntry 4 }
```

```
rtcpXrBaseParamSampleRate OBJECT-TYPE
    SYNTAX Unsigned32 (0..16777215)
    UNITS "samples per second"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Companion information to Codec type.  This represents the
         rate at which media was sampled (e.g. 8000 for narrowband
         voice, 16000 for wideband voice)."
    ::= { rtcpXrBaseParamEntry 5 }

rtcpXrBaseParamDurationMs OBJECT-TYPE
    SYNTAX Counter32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Current duration of call in milliseconds if still active,
         duration of call in milliseconds if complete."
    ::= { rtcpXrBaseParamEntry 6 }

rtcpXrBaseParamNetworkLossRate OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average rate of network packet loss."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 7 }

rtcpXrBaseParamAvgDiscardRate OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average rate of discards due to jitter."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 8 }

rtcpXrBaseParamBurstLossDensity OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Density of loss and discarded packets during burst periods."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 9 }
```

```
rtcpXrBaseParamBurstLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average length of bursts in milliseconds."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 10 }

rtcpXrBaseParamGapLossDensity OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Density of loss and discarded packets during gap periods."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 11 }

rtcpXrBaseParamGapLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average length of gaps in milliseconds."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 12 }

rtcpXrBaseParamAvgOWDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average (symmetric) one way RTCP delay on call. A value of
         zero indicates that this value has not yet been determined."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 13 }

rtcpXrBaseParamAvgEndSysDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average end system delay on call. A value of zero may
         indicate that this value has not yet been determined."
```

```
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 14 }

rtcpXrBaseParamNoiseLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Measured received silent period noise level in dBm.
         A value of 127 indicates that this parameter is not
         available.
         In midpoint applications this parameter may not be
         available.  If this is a midstream device and call
         quality metrics were calculated using the value of
         this parameter reported from the endpoint in an
         RTCP XR payload then the value used in this
         calculation MAY be reported."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 15 }

rtcpXrBaseParamSignalLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Measured received signal level during talkspurts in dBm.
         A value of 127 indicates that this parameter is not
         available.
         In midpoint applications this parameter may not be
         available. If this is a midstream device and call
         quality metrics were calculated using the value of
         this parameter reported from the endpoint in an
         RTCP XR payload then the value used in this
         calculation MAY be reported."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 16 }

rtcpXrBaseParamLocalRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Residual Echo Return Loss measured at this endpoint,
         or at the terminating endpoint of this RTP session.
         This relates to the echo level from the network beyond
         the terminating endpoint and may be interpreted as either
         line echo in the case of a gateway or acoustic echo in the
         case of a handset.
```

```
         Note that this echo affects conversational quality as
         perceived by the user at the originating end of this
         RTP session.
         A value of 127 indicates that this parameter is not
         available.


         In midpoint applications this parameter may not be
         available.  If this is a midstream device and call
         quality metrics were calculated using the value of
         this parameter reported from the endpoint in an
         RTCP XR payload then the value used in this
         calculation MAY be reported."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 17 }

rtcpXrBaseParamRemoteRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Residual Echo Return Loss measured at originating endpoint
         of this RTP session (i.e. the remote endpoint if this MIB
         is implemented in an endpoint).
         Note that this affects the conversational quality
         metrics reported by the terminating (this) endpoint, hence
         is useful in understanding what has affected the reported
         call quality metrics
         A value of 127 indicates that this parameter is not
         available.
         In midpoint applications this parameter may not be
         available.  If this is a midstream device and call
         quality metrics were calculated using the value of
         this parameter reported from the endpoint in an
         RTCP XR payload then the value used in this
         calculation MAY be reported."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 18 }

rtcpXrBaseParamPlcType OBJECT-TYPE
    SYNTAX INTEGER { disabled(1),
                     enhanced(2),
                     standard(3),
                     unspecified (4)}
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Defines type of packet loss concealment used on this call."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry  19 }
```

```
rtcpXrBaseParamJBuffAdaptMode OBJECT-TYPE
    SYNTAX INTEGER { reserved (1),
                     nonAdaptive (2),
                     adaptive (3),
                     unknown (4) }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Defines if jitter buffer is in fixed or adaptive mode."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry  20 }

rtcpXrBaseParamJBuffAdaptRate OBJECT-TYPE
    SYNTAX Unsigned32 (0..15)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Estimated adaptation rate of jitter buffer."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= {  rtcpXrBaseParamEntry 21 }

rtcpXrBaseParamJBuffAverageDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average size of jitter buffer in mS."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry 22 }

rtcpXrBaseParamJBuffMaximumDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Maximum delay through jitter buffer at current size in mS."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry  23 }

rtcpXrBaseParamJBuffAbsMaxDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Absolute maximum size jitter buffer can reach in mS."
```

```
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrBaseParamEntry  24 }

rtcpXrBaseParamJitterLevel OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Average jitter level measured according to RFC3550 and
         represented in terms of milliseconds."
    REFERENCE
         "See RFC3550 Section 6.4."
    ::= { rtcpXrBaseParamEntry  25 }


--
-- Table of Call Quality Metrics
--

rtcpXrCallQualityTable OBJECT-TYPE
    SYNTAX SEQUENCE OF RtcpXrCallQualityEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
     "Table of voice quality metrics. A row is created
      in this table for each row in the Session table."
    ::= { rtcpXrMIBObjects 3 }

rtcpXrCallQualityEntry OBJECT-TYPE
    SYNTAX RtcpXrCallQualityEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry in the table of voice quality metrics.  A row in
         this table is created for each row in the Session
         table."
    INDEX { rtpSessionCallStatus, rtpSessionIndex }
    ::= { rtcpXrCallQualityTable 1 }

RtcpXrCallQualityEntry ::= SEQUENCE {
    rtcpXrCallQualityRCQ                        Rfactor,
    rtcpXrCallQualityRLQ                        Rfactor,
    rtcpXrCallQualityExternalRCQ                Rfactor,
    rtcpXrCallQualityMOSCQ                      ScaledMOSscore,
    rtcpXrCallQualityMOSLQ                      ScaledMOSscore,
    rtcpXrCallQualityRLQestAlgorithm            OCTET STRING,
    rtcpXrCallQualityRCQestAlgorithm            OCTET STRING,
    rtcpXrCallQualityMOSLQEstAlgorithm          OCTET STRING,
    rtcpXrCallQualityMOSCQEstAlgorithm          OCTET STRING
}
```

```
rtcpXrCallQualityRCQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Conversational quality R factor for this call. This value
         SHOULD be calculated using ITU G.107 (The E Model) or
         extended versions thereof."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrCallQualityEntry 1 }

rtcpXrCallQualityRLQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Listening quality R factor for this call. This value
         SHOULD be calculated using ITU G.107 (The E Model) or
         extended versions thereof."
    ::= { rtcpXrCallQualityEntry 2 }

rtcpXrCallQualityExternalRCQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "External R factor for this call. This value
         SHOULD be calculated using ITU G.107 (The E Model) or
         extended versions thereof.
         The External R factor relates to the quality of an
         incoming voice from another network segment.  For example
         if a conference bridge terminates and re-creates voice
         streams then an R factor would be calculated at the bridge
         for the endpoint A to bridge segment and relayed to the
         subsequent bridge to endpoint B as an External R factor.
         This allows endpoint B to estimate the end-to-end call
         quality."
    ::= { rtcpXrCallQualityEntry 3 }

rtcpXrCallQualityMOSCQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Estimated conversational quality MOS for this call
        expressed in MOS x 10 (e.g. 41 = MOS of 4.1). This value
        MAY be calculated by converting the R-CQ value to a MOS."
```

```
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrCallQualityEntry 4 }

rtcpXrCallQualityMOSLQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Estimated listening quality MOS for this call
       expressed in MOS x 10 (e.g. 41 = MOS of 4.1). This value
        MAY be calculated by converting the R-CQ value to a MOS."
    REFERENCE
         "See RFC3611 Section 4.7."
    ::= { rtcpXrCallQualityEntry 5 }

rtcpXrCallQualityRLQestAlgorithm OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..128))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Call quality algorithm used to determine R-LQ factors.
        For example, 'ITU-T G.107' for the ITU G.107
        E model or 'ETSI TS101329-5E' for ETSI
        TS 101 329-5 Annex E."
    ::= { rtcpXrCallQualityEntry 6 }

rtcpXrCallQualityRCQestAlgorithm OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..128))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Call quality algorithm used to determine R-CQ factors.
        For example, 'ITU-T G.107' for the ITU G.107
        E model or 'ETSI TS101329-5E' for ETSI
        TS 101 329-5 Annex E."
    ::= { rtcpXrCallQualityEntry 7 }

rtcpXrCallQualityMOSLQEstAlgorithm OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..128))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Call quality algorithm used to determine MOS-LQ scores.
        If any localized parameter scaling is used
        (for example Japan's TTC MOS scaling) then this
        MUST also be reported."
    ::= { rtcpXrCallQualityEntry 8 }
```

```
rtcpXrCallQualityMOSCQEstAlgorithm OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..128))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Call quality algorithm used to determine MOS-CQ scores.
        If any localized parameter scaling is used
        (for example Japan's TTC MOS scaling) then this
        MUST also be reported."
    ::= { rtcpXrCallQualityEntry 9 }

--
-- History Table
--
--

rtcpXrHistoryTable OBJECT-TYPE
    SYNTAX SEQUENCE OF RtcpXrHistoryEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
     "Table of aggregate measurement data for groups
      of RTP sessions.  A group may be a flow or any
      other logical association of streams."
    ::= { rtcpXrMIBObjects 4 }

rtcpXrHistoryEntry OBJECT-TYPE
    SYNTAX RtcpXrHistoryEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry in the table of call history records."
    INDEX { rtcpXrHistoryIndex }
    ::= { rtcpXrHistoryTable 1 }

RtcpXrHistoryEntry ::= SEQUENCE {
    rtcpXrHistoryIndex                      Unsigned32,
    rtcpXrHistoryGroupName                  OCTET STRING,
    rtcpXrHistoryStartTime                  DateAndTime,
    rtcpXrHistoryStopTime                   DateAndTime,
    rtcpXrHistoryNumOfSessions              Counter32,
    rtcpXrHistoryMinDurationMs              Gauge32,
    rtcpXrHistoryMaxDurationMs              Gauge32,
    rtcpXrHistoryAvgDurationMs              Gauge32,
    rtcpXrHistoryMaxNetworkLossRate         Percentage,
    rtcpXrHistoryAvgNetworkLossRate         Percentage,
    rtcpXrHistoryMaxDiscardRate             Percentage,
    rtcpXrHistoryAvgDiscardRate             Percentage,
    rtcpXrHistoryMaxBurstLossDensity        Percentage,
    rtcpXrHistoryAvgBurstLossDensity        Percentage,
    rtcpXrHistoryMinBurstLenMs              Gauge32,
    rtcpXrHistoryMaxBurstLenMs              Gauge32,
    rtcpXrHistoryAvgBurstLenMs              Gauge32,
    rtcpXrHistoryMaxGapLossDensity          Percentage,
```

```
    rtcpXrHistoryAvgGapLossDensity          Percentage,
    rtcpXrHistoryMinGapLenMs                Gauge32,
    rtcpXrHistoryMaxGapLenMs                Gauge32,
    rtcpXrHistoryAvgGapLenMs                Gauge32,
    rtcpXrHistoryMinOneWayDelay             Gauge32,
    rtcpXrHistoryMaxOneWayDelay             Gauge32,
    rtcpXrHistoryAvgOneWayDelay             Gauge32,
    rtcpXrHistoryOneWayDelayCount           Counter32,
    rtcpXrHistoryMinEndSystemDelay          Gauge32,
    rtcpXrHistoryMaxEndSystemDelay          Gauge32,
    rtcpXrHistoryAvgEndSystemDelay          Gauge32,
    rtcpXrHistoryEndSystemDelayCount        Counter32,
    rtcpXrHistoryMinJitterLevel             Gauge32,
    rtcpXrHistoryMaxJitterLevel             Gauge32,
    rtcpXrHistoryAvgJitterLevel             Gauge32,
    rtcpXrHistoryMinNoiseLeveldBm           LeveldB,
    rtcpXrHistoryMaxNoiseLeveldBm           LeveldB,
    rtcpXrHistoryAvgNoiseLeveldBm           LeveldB,
    rtcpXrHistoryNoiseLevelCount            Counter32,
    rtcpXrHistoryMinSignalLeveldBm          LeveldB,
    rtcpXrHistoryMaxSignalLeveldBm          LeveldB,
    rtcpXrHistoryAvgSignalLeveldBm          LeveldB,
    rtcpXrHistorySignalLevelCount           Counter32,
    rtcpXrHistoryMinLocalRERLdB             LeveldB,
    rtcpXrHistoryMaxLocalRERLdB             LeveldB,
    rtcpXrHistoryAvgLocalRERLdB             LeveldB,
    rtcpXrHistoryLocalRERLCount             Counter32,
    rtcpXrHistoryMinRemoteRERLdB            LeveldB,
    rtcpXrHistoryMaxRemoteRERLdB            LeveldB,
    rtcpXrHistoryAvgRemoteRERLdB            LeveldB,
    rtcpXrHistoryRemoteRERLCount            Counter32,
    rtcpXrHistoryMinRCQ                     Rfactor,
    rtcpXrHistoryMaxRCQ                     Rfactor,
    rtcpXrHistoryAvgRCQ                     Rfactor,
    rtcpXrHistoryRCQCount                   Counter32,
    rtcpXrHistoryMinRLQ                     Rfactor,
    rtcpXrHistoryMaxRLQ                     Rfactor,
    rtcpXrHistoryAvgRLQ                     Rfactor,
    rtcpXrHistoryRLQCount                   Counter32,
    rtcpXrHistoryMinMOSCQ                   ScaledMOSscore,
    rtcpXrHistoryMaxMOSCQ                   ScaledMOSscore,
    rtcpXrHistoryAvgMOSCQ                   ScaledMOSscore,
    rtcpXrHistoryMOSCQCount                 Counter32,
    rtcpXrHistoryMinMOSLQ                   ScaledMOSscore,
    rtcpXrHistoryMaxMOSLQ                   ScaledMOSscore,
    rtcpXrHistoryAvgMOSLQ                   ScaledMOSscore,
    rtcpXrHistoryMOSLQCount                 Counter32,
    rtcpXrHistoryCQAlgorithm                OCTET STRING,
    rtcpXrHistoryReset                      INTEGER
}
```

```
rtcpXrHistoryIndex OBJECT-TYPE
    SYNTAX Unsigned32 (0..4294967295)
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Index for this set of aggregate data."
    ::= { rtcpXrHistoryEntry 1 }

rtcpXrHistoryGroupName OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..128))
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Name of this set of aggregate data. Examples may include
         a flow, an interface or some other logical grouping of
         RTP sessions."
    ::= { rtcpXrHistoryEntry 2 }

rtcpXrHistoryStartTime OBJECT-TYPE
    SYNTAX DateAndTime
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Time at which this history was reset or started."
    ::= {rtcpXrHistoryEntry 3 }

rtcpXrHistoryStopTime OBJECT-TYPE
    SYNTAX DateAndTime
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Time at which this history was stopped."
    ::= {rtcpXrHistoryEntry 4 }

rtcpXrHistoryNumOfSessions OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of calls included in this history."
    ::= {rtcpXrHistoryEntry 5 }

rtcpXrHistoryMinDurationMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum duration of calls."
    ::= {rtcpXrHistoryEntry 6 }
```

```
rtcpXrHistoryMaxDurationMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum duration of calls."
    ::= {rtcpXrHistoryEntry 7 }

rtcpXrHistoryAvgDurationMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Average duration of calls within this history."
    ::= {rtcpXrHistoryEntry 8 }

rtcpXrHistoryMaxNetworkLossRate OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum loss rate occurring on any call in this history."
    ::= {rtcpXrHistoryEntry 9 }

rtcpXrHistoryAvgNetworkLossRate OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean for all calls in this history of the individual
       per call packet loss rate."
    ::= {rtcpXrHistoryEntry 10 }

rtcpXrHistoryMaxDiscardRate OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum discard rate occurring on any call in this history."
    ::= {rtcpXrHistoryEntry 11 }
```

```
rtcpXrHistoryAvgDiscardRate OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean for all calls in this history of the individual
       per call packet discard rate."
    ::= {rtcpXrHistoryEntry 12 }

rtcpXrHistoryMaxBurstLossDensity OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call average burst densities for any
       call in this history. A value of 0 shall be reported if
       no bursts were reported."
    ::= {rtcpXrHistoryEntry 13 }

rtcpXrHistoryAvgBurstLossDensity OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean for all calls in this history of the individual
       per call burst density. A value of 0 shall be reported if
       no bursts were reported."
    ::= {rtcpXrHistoryEntry 14 }

rtcpXrHistoryMinBurstLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call burst length for all calls in this
       history for which a burst length was reported. A value of
       0 shall be reported if no bursts were present."
    ::= {rtcpXrHistoryEntry 15 }

rtcpXrHistoryMaxBurstLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call burst length for all calls in this
       history for which a burst length was reported. A value of
       0 shall be reported if no bursts were present."
    ::= {rtcpXrHistoryEntry 16 }
```

```
rtcpXrHistoryAvgBurstLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call burst length for all calls in this
       history for which a burst length was reported. A value of
       0 shall be reported if no bursts were present."
    ::= {rtcpXrHistoryEntry 17 }

rtcpXrHistoryMaxGapLossDensity OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call gap density for all calls in this
       history for which a gap density was reported. A value of
       0 shall be reported if no gaps were present."
    ::= {rtcpXrHistoryEntry 18 }

rtcpXrHistoryAvgGapLossDensity OBJECT-TYPE
    SYNTAX Percentage
    UNITS "percent"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call gap density for all calls in this
       history for which a gap density was reported. A value of
       0 shall be reported if no gaps were present."
    ::= {rtcpXrHistoryEntry 19 }
```

```
rtcpXrHistoryMinGapLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call gap length for all calls in this
       history for which a gap length was reported. A value of
       0 shall be reported if no gaps were present."
    ::= {rtcpXrHistoryEntry 20 }
```

```
rtcpXrHistoryMaxGapLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call gap length for all calls in this
       history for which a gap length was reported. A value of
       0 shall be reported if no gaps were present."
    ::= {rtcpXrHistoryEntry 21 }

rtcpXrHistoryAvgGapLenMs OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call gap length for all calls in this
       history for which a gap length was reported. A value of
       0 shall be reported if no gaps were present."
    ::= {rtcpXrHistoryEntry 22 }

rtcpXrHistoryMinOneWayDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call OW Delays for all calls in this
       history for which a Delay was reported. A value of
       0 shall be reported if no Delay values were reported."
    ::= {rtcpXrHistoryEntry 23 }

rtcpXrHistoryMaxOneWayDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call OW Delays for all calls in this
       history for which a Delay was reported. A value of
       0 shall be reported if no Delay values were reported."
    ::= {rtcpXrHistoryEntry 24 }

rtcpXrHistoryAvgOneWayDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call OW Delays for all calls in this
       history for which a Delay was reported. A value of
       0 shall be reported if no Delay values were reported."
    ::= {rtcpXrHistoryEntry 25 }
```

```
rtcpXrHistoryOneWayDelayCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the One Way Delay
       history values (as Delay may not be available on
       all calls."
    ::= {rtcpXrHistoryEntry 26 }

rtcpXrHistoryMinEndSystemDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call ES Delays for all calls in this
       history for which an ES Delay was reported."
    ::= {rtcpXrHistoryEntry 27 }

rtcpXrHistoryMaxEndSystemDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call ES Delays for all calls in this
       history for which an ES Delay was reported."
    ::= {rtcpXrHistoryEntry 28 }

rtcpXrHistoryAvgEndSystemDelay OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call ES Delays for all calls in this
       history for which an ES Delay was reported."
    ::= {rtcpXrHistoryEntry 29 }

rtcpXrHistoryEndSystemDelayCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the End System
       Delay history values (as End System Delay
       may not be available on all calls."
    ::= {rtcpXrHistoryEntry 30 }
```

```
rtcpXrHistoryMinJitterLevel OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call jitter for all calls in this
       history for which a jitter value was reported."
    ::= {rtcpXrHistoryEntry 31 }

rtcpXrHistoryMaxJitterLevel OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call jitter for all calls in this
       history for which a jitter value was reported."
    ::= {rtcpXrHistoryEntry 32 }

rtcpXrHistoryAvgJitterLevel OBJECT-TYPE
    SYNTAX Gauge32
    UNITS "milliseconds"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call jitter for all calls in this
       history for which a jitter value was reported."
    ::= {rtcpXrHistoryEntry 33 }

rtcpXrHistoryMinNoiseLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call Noise Level for all calls in this
       history for which a Noise Level value was reported."
    ::= {rtcpXrHistoryEntry 34 }

rtcpXrHistoryMaxNoiseLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call Noise Level for all calls in this
       history for which a Noise Level value was reported."
    ::= {rtcpXrHistoryEntry 35 }
```

```
rtcpXrHistoryAvgNoiseLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call Noise Level for all calls in this
       history for which a Noise Level value was reported."
    ::= {rtcpXrHistoryEntry 36 }

rtcpXrHistoryNoiseLevelCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the Noise Level
       history values (as Noise Level is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 37 }

rtcpXrHistoryMinSignalLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call Signal Level for all calls in this
       history for which a Signal Level value was reported."
    ::= {rtcpXrHistoryEntry 38 }

rtcpXrHistoryMaxSignalLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call Signal Level for all calls in this
       history for which a Signal Level value was reported."
    ::= {rtcpXrHistoryEntry 39 }

rtcpXrHistoryAvgSignalLeveldBm OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm0"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call Signal Level for all calls in this
       history for which a Signal Level value was reported."
    ::= {rtcpXrHistoryEntry 40 }
```

```
rtcpXrHistorySignalLevelCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the Signal Level
       history values (as Signal Level is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 41 }

rtcpXrHistoryMinLocalRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call local RERL for all calls in this
       history for which a local RERL value was reported."
    ::= {rtcpXrHistoryEntry 42 }

rtcpXrHistoryMaxLocalRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call local RERL for all calls in this
       history for which a local RERL value was reported."
    ::= {rtcpXrHistoryEntry 43 }

rtcpXrHistoryAvgLocalRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call local RERL for all calls in this
       history for which a local RERL value was reported."
    ::= {rtcpXrHistoryEntry 44 }

rtcpXrHistoryLocalRERLCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the Local RERL
       history values (as Local RERL is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 45 }
```

```
rtcpXrHistoryMinRemoteRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call remote RERL for all calls in this
       history for which a remote RERL value was reported."
    ::= {rtcpXrHistoryEntry 46 }

rtcpXrHistoryMaxRemoteRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call remote RERL for all calls in this
       history for which a remote RERL value was reported."
    ::= {rtcpXrHistoryEntry 47 }

rtcpXrHistoryAvgRemoteRERLdB OBJECT-TYPE
    SYNTAX LeveldB
    UNITS "dBm"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call remote RERL for all calls in this
       history for which a remote RERL value was reported."
    ::= {rtcpXrHistoryEntry 48 }

rtcpXrHistoryRemoteRERLCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the Remote RERL
       history values (as Remote RERL is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 49 }

rtcpXrHistoryMinRCQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call R-CQ for all calls in this
       history for which an R-CQ value was reported."
    ::= {rtcpXrHistoryEntry 50 }
```

```
rtcpXrHistoryMaxRCQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call R-CQ for all calls in this
       history for which an R-CQ value was reported."
    ::= {rtcpXrHistoryEntry 51 }

rtcpXrHistoryAvgRCQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call R-CQ for all calls in this
       history for which an R-CQ value was reported."
    ::= {rtcpXrHistoryEntry 52 }

rtcpXrHistoryRCQCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the R CQ
       history values (as R CQ is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 53 }

rtcpXrHistoryMinRLQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call R-LQ for all calls in this
       history for which an R-LQ value was reported."
    ::= {rtcpXrHistoryEntry 54 }

rtcpXrHistoryMaxRLQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call R-LQ for all calls in this
       history for which an R-LQ value was reported."
    ::= {rtcpXrHistoryEntry 55 }
```

```
rtcpXrHistoryAvgRLQ OBJECT-TYPE
    SYNTAX Rfactor
    UNITS "R factor"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call R-LQ for all calls in this
       history for which an R-LQ value was reported."
    ::= {rtcpXrHistoryEntry 56 }

rtcpXrHistoryRLQCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the R LQ
       history values (as R LQ is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 57 }

rtcpXrHistoryMinMOSCQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call MOS-CQ for all calls in this
       history for which a MOS-CQ value was reported."
    ::= {rtcpXrHistoryEntry 58 }

rtcpXrHistoryMaxMOSCQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call MOS-CQ for all calls in this
       history for which a MOS-CQ value was reported."
    ::= {rtcpXrHistoryEntry 59 }

rtcpXrHistoryAvgMOSCQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call MOS-CQ for all calls in this
       history for which a MOS-CQ value was reported."
    ::= {rtcpXrHistoryEntry 60 }
```

```
rtcpXrHistoryMOSCQCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the MOS CQ
       history values (as MOS CQ is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 61 }

rtcpXrHistoryMinMOSLQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Minimum of the per-call MOS-LQ for all calls in this
       history for which a MOS-LQ value was reported."
    ::= {rtcpXrHistoryEntry 62 }

rtcpXrHistoryMaxMOSLQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Maximum of the per-call MOS-LQ for all calls in this
       history for which a MOS-LQ value was reported."
    ::= {rtcpXrHistoryEntry 63 }

rtcpXrHistoryAvgMOSLQ OBJECT-TYPE
    SYNTAX ScaledMOSscore
    UNITS "MOS x 10"
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Mean of the per-call MOS-LQ for all calls in this
       history for which a MOS-LQ value was reported."
    ::= {rtcpXrHistoryEntry 64 }

rtcpXrHistoryMOSLQCount OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Number of sessions included in the MOS LQ
       history values (as MOS LQ is an optional
       parameter and may not be present on all calls."
    ::= {rtcpXrHistoryEntry 65 }
```

```
rtcpXrHistoryCQAlgorithm OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(0..32))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
      "Call quality algorithm used - if consistent
       for all calls in this history."
    ::= {rtcpXrHistoryEntry 66 }

rtcpXrHistoryReset OBJECT-TYPE
    SYNTAX INTEGER { running (1),
                     stop (2),
                     reset (3)
                    }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
      "Status of this row in the history table.
       Writing a value of 2 to this object MUST cause
       history updates to be stopped for this row. Writing
       a value of 3 to this object MUST cause the history
       row to be reset.
       Reads MUST return a value of 1 if the row is still
       being updated or 2 if the row update has stopped."
    ::= {rtcpXrHistoryEntry 67 }

--
-- Notifications
--

rtcpXrVoipThresholdViolation NOTIFICATION-TYPE
    OBJECTS { rtcpXrVoipAlertSeverity, rtcpXrVoipAlertType,
              rtcpXrVoipAlertInfoType, rtcpXrVoipAlertPointer }
    STATUS current
    DESCRIPTION
        "Notification that voice quality has changed
         Sent immediately when the condition is detected."
    ::= { rtcpXrEvents 1}


rtcpXrEventParam OBJECT IDENTIFIER ::= { rtcpXrEvents 2 }

rtcpXrVoipAlertType OBJECT-TYPE
    SYNTAX SnmpAdminString
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "Text description of the type of alert.  Where possible,
        this parameter should be populated with the correct
        rtcpXrVoipEntry or rtcpXrVoipHistory description."
    ::= { rtcpXrEventParam 1 }
```

```
rtcpXrVoipAlertInfoType OBJECT-TYPE
    SYNTAX INTEGER {  adminStringOnly (1),
                      sessionPointer (2),
                      historyPointer (3)
                   }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
         "Indicates the type of information returned in the
          rtcpXrVoipAlertInfo parameter."
    ::= { rtcpXrEventParam 2 }

rtcpXrVoipAlertPointer OBJECT-TYPE
    SYNTAX RowPointer
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
         "Pointer to the table of call session information to
         identify the specific call that triggered the alert."
    ::= { rtcpXrEventParam 3 }

rtcpXrVoipAlertSeverity OBJECT-TYPE
    SYNTAX ItuPerceivedSeverity
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The severity of the alert as defined in ITU-T X.733 and
        RFC3877."
    REFERENCE
        "See Alarm MIB - RFC3877."
    ::= { rtcpXrEventParam 4 }

--
--  MODULE GROUPS
--
-- There are four types of RTCP XR VoIP Metrics System.
--
-- RTCP XR VOIP Metrics Systems MUST implement one of the four
-- identified types of system and SHOULD NOT implement the
-- rtcpXrMinimalCompliance system, which is included only
-- for reasons of compatibility with RFC3611's minimal
-- requirements.
--

       rtcpXrCompliances OBJECT IDENTIFIER ::= { rtcpXrConformance 1 }
       rtcpXrGroups OBJECT IDENTIFIER ::= { rtcpXrConformance 2 }


       rtcpXrFullMetricsCompliance MODULE-COMPLIANCE
           STATUS  current
           DESCRIPTION
               "Describes the requirements for conformance to the
                rtcpXr MIB for VoIP devices that support basic
                reporting."
```

```
            MODULE  -- this module
            MANDATORY-GROUPS {
                               rtcpXrBaseParamGroup,
                               rtcpXrCallQualityGroup
                             }
            ::= { rtcpXrCompliances 1 }

        rtcpXrMetricsAlertsCompliance MODULE-COMPLIANCE
            STATUS  current
            DESCRIPTION
                "Describes the requirements for conformance to the
                 rtcpXr MIB for VoIP devices that support reporting
                 and alerts."
            MODULE  -- this module
            MANDATORY-GROUPS {
                               rtcpXrBaseParamGroup,
                               rtcpXrCallQualityGroup,
                               rtcpXrNotificationParmsGroup,
                               rtcpXrNotificationsGroup
                             }
            ::= { rtcpXrCompliances 2 }

        rtcpXrMetricsHistoryCompliance MODULE-COMPLIANCE
            STATUS  current
            DESCRIPTION
                "Describes the requirements for conformance to the
                 rtcpXr MIB for VoIP devices that support reporting,
                 call history and alerts."
            MODULE  -- this module
            MANDATORY-GROUPS {
                               rtcpXrBaseParamGroup,
                               rtcpXrCallQualityGroup,
                               rtcpXrMIBHistoryGroup,
                               rtcpXrNotificationParmsGroup,
                               rtcpXrNotificationsGroup }
            ::= { rtcpXrCompliances 3 }

        rtcpXrHistoryCompliance MODULE-COMPLIANCE
            STATUS  current
            DESCRIPTION
                "Describes the requirements for conformance to the
                 rtcpXr MIB for VoIP devices that support only
                 call history."
            MODULE  -- this module
            MANDATORY-GROUPS { rtcpXrMIBHistoryGroup
                               }
            ::= { rtcpXrCompliances 4 }

       rtcpXrMinimalCompliance MODULE-COMPLIANCE
            STATUS  current
            DESCRIPTION
                "Describes the minimal requirements for conformance to
                 the rtcpXr MIB - NOT RECOMMENDED."
            MODULE  -- this module
```

```
           MANDATORY-GROUPS {
                              rtcpXrBaseParamGroup
                            }
           ::= { rtcpXrCompliances 5 }

      rtcpXrBaseParamGroup OBJECT-GROUP
           OBJECTS {
                   rtcpXrBaseParamCodecType,
                   rtcpXrBaseParamCodecBitRate,
                   rtcpXrBaseParamFrameDuration,
                   rtcpXrBaseParamFramesPerPacket,
                   rtcpXrBaseParamSampleRate,
                   rtcpXrBaseParamDurationMs,
                   rtcpXrBaseParamNetworkLossRate,
                   rtcpXrBaseParamAvgDiscardRate,
                   rtcpXrBaseParamBurstLossDensity,
                   rtcpXrBaseParamBurstLenMs,
                   rtcpXrBaseParamGapLossDensity,
                   rtcpXrBaseParamGapLenMs,
                   rtcpXrBaseParamAvgOWDelay,
                   rtcpXrBaseParamAvgEndSysDelay,
                   rtcpXrBaseParamNoiseLeveldBm,
                   rtcpXrBaseParamSignalLeveldBm,
                   rtcpXrBaseParamLocalRERLdB,
                   rtcpXrBaseParamRemoteRERLdB,
                   rtcpXrBaseParamPlcType,
                   rtcpXrBaseParamJBuffAdaptMode,
                   rtcpXrBaseParamJBuffAdaptRate,
                   rtcpXrBaseParamJBuffAverageDelay,
                   rtcpXrBaseParamJBuffMaximumDelay,
                   rtcpXrBaseParamJBuffAbsMaxDelay,
                   rtcpXrBaseParamJitterLevel
                   }
           STATUS current
           DESCRIPTION
               "Objects used in rtcpXr VoIP Metrics MIB"
           ::= { rtcpXrGroups 1 }

      rtcpXrCallQualityGroup OBJECT-GROUP
           OBJECTS {
                   rtcpXrCallQualityRCQ,
                   rtcpXrCallQualityRLQ,
                   rtcpXrCallQualityExternalRCQ,
                   rtcpXrCallQualityMOSCQ,
                   rtcpXrCallQualityMOSLQ,
                   rtcpXrCallQualityRLQestAlgorithm,
                   rtcpXrCallQualityRCQestAlgorithm,
                   rtcpXrCallQualityMOSLQEstAlgorithm,
                   rtcpXrCallQualityMOSCQEstAlgorithm
                   }
           STATUS current
           DESCRIPTION
               "Call quality objects used in rtcpXr VoIP Metrics MIB"
           ::= { rtcpXrGroups 2 }
```

```
       rtcpXrMIBHistoryGroup OBJECT-GROUP
           OBJECTS {
                   rtcpXrHistoryGroupName,
                   rtcpXrHistoryStartTime,
                   rtcpXrHistoryStopTime,
                   rtcpXrHistoryNumOfSessions,
                   rtcpXrHistoryMinDurationMs,
                   rtcpXrHistoryMaxDurationMs,
                   rtcpXrHistoryAvgDurationMs,
                   rtcpXrHistoryMaxNetworkLossRate,
                   rtcpXrHistoryAvgNetworkLossRate,
                   rtcpXrHistoryMaxDiscardRate,
                   rtcpXrHistoryAvgDiscardRate,
                   rtcpXrHistoryMaxBurstLossDensity,
                   rtcpXrHistoryAvgBurstLossDensity,
                   rtcpXrHistoryMinBurstLenMs,
                   rtcpXrHistoryMaxBurstLenMs,
                   rtcpXrHistoryAvgBurstLenMs,
                   rtcpXrHistoryMaxGapLossDensity,
                   rtcpXrHistoryAvgGapLossDensity,
                   rtcpXrHistoryMinGapLenMs,
                   rtcpXrHistoryMaxGapLenMs,
                   rtcpXrHistoryAvgGapLenMs,
                   rtcpXrHistoryMinOneWayDelay,
                   rtcpXrHistoryMaxOneWayDelay,
                   rtcpXrHistoryAvgOneWayDelay,
                   rtcpXrHistoryOneWayDelayCount,
                   rtcpXrHistoryMinEndSystemDelay,
                   rtcpXrHistoryMaxEndSystemDelay,
                   rtcpXrHistoryAvgEndSystemDelay,
                   rtcpXrHistoryEndSystemDelayCount,
                   rtcpXrHistoryAvgJitterLevel,
                   rtcpXrHistoryMinJitterLevel,
                   rtcpXrHistoryMaxJitterLevel,
                   rtcpXrHistoryMinNoiseLeveldBm,
                   rtcpXrHistoryMaxNoiseLeveldBm,
                   rtcpXrHistoryAvgNoiseLeveldBm,
                   rtcpXrHistoryNoiseLevelCount,
                   rtcpXrHistoryMinSignalLeveldBm,
                   rtcpXrHistoryMaxSignalLeveldBm,
                   rtcpXrHistoryAvgSignalLeveldBm,
                   rtcpXrHistorySignalLevelCount,
                   rtcpXrHistoryMinLocalRERLdB,
                   rtcpXrHistoryMaxLocalRERLdB,
                   rtcpXrHistoryAvgLocalRERLdB,
                   rtcpXrHistoryLocalRERLCount,
                   rtcpXrHistoryMinRemoteRERLdB,
                   rtcpXrHistoryMaxRemoteRERLdB,
                   rtcpXrHistoryAvgRemoteRERLdB,
                   rtcpXrHistoryRemoteRERLCount,
                   rtcpXrHistoryMinRCQ,
                   rtcpXrHistoryMaxRCQ,
                   rtcpXrHistoryAvgRCQ,
                   rtcpXrHistoryRCQCount,
```

```
                    rtcpXrHistoryMinRLQ,
                    rtcpXrHistoryMaxRLQ,
                    rtcpXrHistoryAvgRLQ,
                    rtcpXrHistoryRLQCount,
                    rtcpXrHistoryMinMOSCQ,
                    rtcpXrHistoryMaxMOSCQ,
                    rtcpXrHistoryAvgMOSCQ,
                    rtcpXrHistoryMOSCQCount,
                    rtcpXrHistoryMinMOSLQ,
                    rtcpXrHistoryMaxMOSLQ,
                    rtcpXrHistoryAvgMOSLQ,
                    rtcpXrHistoryMOSLQCount,
                    rtcpXrHistoryCQAlgorithm,
                    rtcpXrHistoryReset
                  }
            STATUS current
            DESCRIPTION
                "Objects used in rtcpXr VoIP History MIB"
            ::= { rtcpXrGroups 3 }

        rtcpXrNotificationParmsGroup OBJECT-GROUP
            OBJECTS {
                    rtcpXrVoipAlertSeverity,
                    rtcpXrVoipAlertType,
                    rtcpXrVoipAlertInfoType,
                    rtcpXrVoipAlertPointer
                    }
            STATUS current
            DESCRIPTION
                "Notification parameters emitted by a rtcpXr endpoint."
            ::= { rtcpXrGroups 4 }

        rtcpXrNotificationsGroup NOTIFICATION-GROUP
            NOTIFICATIONS {
                    rtcpXrVoipThresholdViolation
                    }
            STATUS current
            DESCRIPTION
                "Notifications emitted by a rtcpXr endpoint."
            ::= { rtcpXrGroups 5 }


    END
```

4. Security Considerations

Access to rtcpXrHistoryReset can result in resetting the table of aggregate call quality information, which results in the loss of useful management data.

It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt their values 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.

5. IANA Considerations

An OID within the mib-2 tree is requested, following which this note may be deleted.

6. Acknowledgements

The authors would like to acknowledge the input and advice provided by Dan Romascanu, Rajesh Kumar Kim Curran, Shane Holthaus and Brian Park.

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8. Normative References

[RFC3550] Shulzrinne, H., Casner, S., Frederick, R. and V. Jacobson, "RTP: A Transport Protocol for real-time applications," RFC 3550, July 2003.

[RFC3611] Friedman, T., Caceres, R., Clark, A., "RTP Control Protocol Reporting Extensions (RTCP XR)," RFC 3611, [October/November] 2003

[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, December 1999.

[RFC2579] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Textual Conventions for SMIv2", STD 58, RFC 2579, December 1999.

[RFC2580] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Conformance Statements for SMIv2", STD 58, RFC 2580, December 1999.

9. Informative References

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

[RAQMON] Siddiqui, A., Romascanu, D., draft-ietf-rmonmib-framework-16.txt

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