                  Internet Group Management Protocol MIB

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
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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 describes objects used for managing the Internet
   Group Management Protocol (IGMP).

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1. Introduction

   This memo defines a portion of the Management Information Base (MIB)
   for use with network management protocols in the Internet community.
   In particular, it describes objects used for managing the Internet

Group Management Protocol (IGMP), version 1 [16] or version 2 [17].
A future version of this MIB will support IGMP version 3 (currently a
work in progress). All of this MIB module is applicable to IPv4
multicast routers; a subset is applicable to hosts implementing IGMP.
Since IGMP is specific to IPv4, this MIB does not support management
of equivalent functionality for other address families, such as IPv6.
Such management may be supported by other MIBs.

2. The SNMP Network Management Framework

The SNMP Management Framework presently consists of five major
components:

o   An overall architecture, described in RFC 2571 [1].

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 [2], STD 16, RFC 1212 [3] and RFC 1215 [4].
     The second version, called SMIv2, is described in STD 58, RFC
     2578 [5], STD 58, RFC 2579 [6] and STD 58, RFC 2580 [7].

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 [8]. A second version of the SNMP
     message protocol, which is not an Internet standards track
     protocol, is called SNMPv2c and described in RFC 1901 [9] and
     RFC 1906 [10]. The third version of the message protocol is
     called SNMPv3 and described in RFC 1906 [10], RFC 2572 [11] and
     RFC 2574 [12].

o   Protocol operations for accessing management information. The
     first set of protocol operations and associated PDU formats is
     described in STD 15, RFC 1157 [8]. A second set of protocol
     operations and associated PDU formats is described in RFC 1905
     [13].

o   A set of fundamental applications described in RFC 2573 [14] and
     the view-based access control mechanism described in RFC 2575
     [15].

Managed objects are accessed via a virtual information store, termed
the Management Information Base or MIB. Objects in the MIB are
defined using the mechanisms defined in the SMI.

This memo specifies a MIB module that is compliant to the SMIv2. A
MIB conforming to the SMIv1 can be produced through the appropriate
translations. The resulting translated MIB must be semantically

equivalent, except where objects or events are omitted because no
translation is possible (use of Counter64). Some machine readable
information in SMIv2 will be converted into textual descriptions in
SMIv1 during the translation process. However, this loss of machine
readable information is not considered to change the semantics of the
MIB.

3. Overview

   This MIB module contains two tables:

   (1) the IGMP Interface Table which contains one row for each
        interface on which IGMP is enabled, and

   (2) the IGMP Cache Table which contains one row for each IP
        multicast group for which there are members on a particular
        interface.

   Both tables are intended to be implemented by hosts and routers, but
   some columnar objects in each table apply only to routers.

4. Definitions

IGMP-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, mib-2, Counter32, Gauge32,
    Unsigned32, IpAddress, TimeTicks FROM SNMPv2-SMI
    RowStatus, TruthValue   FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP FROM SNMPv2-CONF
    InterfaceIndexOrZero,
    InterfaceIndex   FROM IF-MIB;

igmpStdMIB MODULE-IDENTITY
    LAST-UPDATED "200009280000Z" -- September 28, 2000
    ORGANIZATION "IETF IDMR Working Group."
    CONTACT-INFO
            " Dave Thaler
              Microsoft Corporation
              One Microsoft Way
              Redmond, WA 98052-6399
              US

              Phone: +1 425 703 8835
              EMail: dthaler@microsoft.com"
    DESCRIPTION
            "The MIB module for IGMP Management."
    REVISION   "200009280000Z" -- September 28, 2000

```
        DESCRIPTION
                "Initial version, published as RFC 2933."
        ::= { mib-2 85 }


igmpMIBObjects      OBJECT IDENTIFIER ::= { igmpStdMIB 1 }

--
--  The IGMP Interface Table
--

igmpInterfaceTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IgmpInterfaceEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "The (conceptual) table listing the interfaces on which IGMP
            is enabled."
    ::= { igmpMIBObjects 1 }

igmpInterfaceEntry OBJECT-TYPE
    SYNTAX      IgmpInterfaceEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "An entry (conceptual row) representing an interface on
            which IGMP is enabled."
    INDEX       { igmpInterfaceIfIndex }
    ::= { igmpInterfaceTable 1 }

IgmpInterfaceEntry ::= SEQUENCE {
    igmpInterfaceIfIndex                InterfaceIndex,
    igmpInterfaceQueryInterval          Unsigned32,
    igmpInterfaceStatus                 RowStatus,
    igmpInterfaceVersion                Unsigned32,
    igmpInterfaceQuerier                IpAddress,
    igmpInterfaceQueryMaxResponseTime   Unsigned32,
    igmpInterfaceQuerierUpTime          TimeTicks,
    igmpInterfaceQuerierExpiryTime      TimeTicks,
    igmpInterfaceVersion1QuerierTimer   TimeTicks,
    igmpInterfaceWrongVersionQueries    Counter32,
    igmpInterfaceJoins                  Counter32,
    igmpInterfaceProxyIfIndex           InterfaceIndexOrZero,
    igmpInterfaceGroups                 Gauge32,
    igmpInterfaceRobustness             Unsigned32,
    igmpInterfaceLastMembQueryIntvl     Unsigned32
}
```

```
igmpInterfaceIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The ifIndex value of the interface for which IGMP is
            enabled."
    ::= { igmpInterfaceEntry 1 }

igmpInterfaceQueryInterval OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "seconds"
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
            "The frequency at which IGMP Host-Query packets are
            transmitted on this interface."
    DEFVAL      { 125 }
    ::= { igmpInterfaceEntry 2 }

igmpInterfaceStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
            "The activation of a row enables IGMP on the interface.  The
            destruction of a row disables IGMP on the interface."
    ::= { igmpInterfaceEntry 3 }

igmpInterfaceVersion OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
            "The version of IGMP which is running on this interface.
            This object can be used to configure a router capable of
            running either value.  For IGMP to function correctly, all
            routers on a LAN must be configured to run the same version
            of IGMP on that LAN."
    DEFVAL      { 2 }
    ::= { igmpInterfaceEntry 4 }

igmpInterfaceQuerier OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The address of the IGMP Querier on the IP subnet to which
```

```
                    this interface is attached."
        ::= { igmpInterfaceEntry 5 }

igmpInterfaceQueryMaxResponseTime OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    UNITS       "tenths of seconds"
    MAX-ACCESS read-create
    STATUS      current
    DESCRIPTION
            "The maximum query response time advertised in IGMPv2
            queries on this interface."
    DEFVAL      { 100 }
    ::= { igmpInterfaceEntry 6 }

igmpInterfaceQuerierUpTime OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The time since igmpInterfaceQuerier was last changed."
    ::= { igmpInterfaceEntry 7 }

igmpInterfaceQuerierExpiryTime OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The amount of time remaining before the Other Querier
            Present Timer expires.  If the local system is the querier,
            the value of this object is zero."
    ::= { igmpInterfaceEntry 8 }

igmpInterfaceVersion1QuerierTimer OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The time remaining until the host assumes that there are no
            IGMPv1 routers present on the interface.  While this is non-
            zero, the host will reply to all queries with version 1
            membership reports."
    ::= { igmpInterfaceEntry 9 }

igmpInterfaceWrongVersionQueries OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
```

                    "The number of queries received whose IGMP version does not
                    match igmpInterfaceVersion, over the lifetime of the row
                    entry. IGMP requires that all routers on a LAN be
                    configured to run the same version of IGMP. Thus, if any
                    queries are received with the wrong version, this indicates
                    a configuration error."
         ::= { igmpInterfaceEntry 10 }

igmpInterfaceJoins OBJECT-TYPE
     SYNTAX   Counter32
     MAX-ACCESS read-only
     STATUS   current
     DESCRIPTION
                    "The number of times a group membership has been added on
                    this interface; that is, the number of times an entry for
                    this interface has been added to the Cache Table. This
                    object gives an indication of the amount of IGMP activity
                    over the lifetime of the row entry."
         ::= { igmpInterfaceEntry 11 }

igmpInterfaceProxyIfIndex OBJECT-TYPE
     SYNTAX   InterfaceIndexOrZero
     MAX-ACCESS read-create
     STATUS   current
     DESCRIPTION
                    "Some devices implement a form of IGMP proxying whereby
                    memberships learned on the interface represented by this
                    row, cause IGMP Host Membership Reports to be sent on the
                    interface whose ifIndex value is given by this object. Such
                    a device would implement the igmpV2RouterMIBGroup only on
                    its router interfaces (those interfaces with non-zero
                    igmpInterfaceProxyIfIndex). Typically, the value of this
                    object is 0, indicating that no proxying is being done."
     DEFVAL   { 0 }
         ::= { igmpInterfaceEntry 12 }

igmpInterfaceGroups OBJECT-TYPE
     SYNTAX   Gauge32
     MAX-ACCESS read-only
     STATUS   current
     DESCRIPTION
                    "The current number of entries for this interface in the
                    Cache Table."
         ::= { igmpInterfaceEntry 13 }

igmpInterfaceRobustness OBJECT-TYPE
     SYNTAX   Unsigned32 (1..255)
     MAX-ACCESS read-create

```
    STATUS      current
    DESCRIPTION
            "The Robustness Variable allows tuning for the expected
            packet loss on a subnet.  If a subnet is expected to be
            lossy, the Robustness Variable may be increased.  IGMP is
            robust to (Robustness Variable-1) packet losses."
    DEFVAL      { 2 }
    ::= { igmpInterfaceEntry 14 }

igmpInterfaceLastMembQueryIntvl OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    UNITS       "tenths of seconds"
    MAX-ACCESS read-create
    STATUS      current
    DESCRIPTION
            "The Last Member Query Interval is the Max Response Time
            inserted into Group-Specific Queries sent in response to
            Leave Group messages, and is also the amount of time between
            Group-Specific Query messages.  This value may be tuned to
            modify the leave latency of the network.  A reduced value
            results in reduced time to detect the loss of the last
            member of a group.  The value of this object is irrelevant
            if igmpInterfaceVersion is 1."
    DEFVAL      { 10 }
    ::= { igmpInterfaceEntry 15 }

--
--   The IGMP Cache Table
--

igmpCacheTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IgmpCacheEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "The (conceptual) table listing the IP multicast groups for
            which there are members on a particular interface."
    ::= { igmpMIBObjects 2 }

igmpCacheEntry OBJECT-TYPE
    SYNTAX      IgmpCacheEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "An entry (conceptual row) in the igmpCacheTable."
    INDEX       { igmpCacheAddress, igmpCacheIfIndex }
    ::= { igmpCacheTable 1 }
```

```
IgmpCacheEntry ::= SEQUENCE {
    igmpCacheAddress              IpAddress,
    igmpCacheIfIndex              InterfaceIndex,
    igmpCacheSelf                 TruthValue,
    igmpCacheLastReporter         IpAddress,
    igmpCacheUpTime               TimeTicks,
    igmpCacheExpiryTime           TimeTicks,
    igmpCacheStatus               RowStatus,
    igmpCacheVersion1HostTimer    TimeTicks
}

igmpCacheAddress OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The IP multicast group address for which this entry
            contains information."
    ::= { igmpCacheEntry 1 }

igmpCacheIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The interface for which this entry contains information for
            an IP multicast group address."
    ::= { igmpCacheEntry 2 }

igmpCacheSelf OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
            "An indication of whether the local system is a member of
            this group address on this interface."
    DEFVAL      { true }
    ::= { igmpCacheEntry 3 }

igmpCacheLastReporter OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The IP address of the source of the last membership report
            received for this IP Multicast group address on this
            interface.  If no membership report has been received, this
            object has the value 0.0.0.0."
```

```
     ::= { igmpCacheEntry 4 }

igmpCacheUpTime OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The time elapsed since this entry was created."
    ::= { igmpCacheEntry 5 }

igmpCacheExpiryTime OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The minimum amount of time remaining before this entry will
            be aged out.  A value of 0 indicates that the entry is only
            present because igmpCacheSelf is true and that if the router
            left the group, this entry would be aged out immediately.
            Note that some implementations may process membership
            reports from the local system in the same way as reports
            from other hosts, so a value of 0 is not required."
    ::= { igmpCacheEntry 6 }

igmpCacheStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS read-create
    STATUS      current
    DESCRIPTION
            "The status of this entry."
    ::= { igmpCacheEntry 7 }

igmpCacheVersion1HostTimer OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The time remaining until the local router will assume that
            there are no longer any IGMP version 1 members on the IP
            subnet attached to this interface.  Upon hearing any IGMPv1
            Membership Report, this value is reset to the group
            membership timer.  While this time remaining is non-zero,
            the local router ignores any IGMPv2 Leave messages for this
            group that it receives on this interface."
    ::= { igmpCacheEntry 8 }

-- conformance information
```

```
igmpMIBConformance
                OBJECT IDENTIFIER ::= { igmpStdMIB 2 }
igmpMIBCompliances
                OBJECT IDENTIFIER ::= { igmpMIBConformance 1 }
igmpMIBGroups  OBJECT IDENTIFIER ::= { igmpMIBConformance 2 }


-- compliance statements

igmpV1HostMIBCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "The compliance statement for hosts running IGMPv1 and
            implementing the IGMP MIB."
    MODULE  -- this module
    MANDATORY-GROUPS { igmpBaseMIBGroup }

    OBJECT      igmpInterfaceStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."

    OBJECT      igmpCacheStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."

    ::= { igmpMIBCompliances 1 }

igmpV1RouterMIBCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "The compliance statement for routers running IGMPv1 and
            implementing the IGMP MIB."
    MODULE  -- this module
      MANDATORY-GROUPS { igmpBaseMIBGroup,
                         igmpRouterMIBGroup
                       }

    OBJECT      igmpInterfaceStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."
    OBJECT      igmpCacheStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."
```

```
    ::= { igmpMIBCompliances 2 }

igmpV2HostMIBCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "The compliance statement for hosts running IGMPv2 and
            implementing the IGMP MIB."
    MODULE  -- this module
    MANDATORY-GROUPS { igmpBaseMIBGroup,
                       igmpV2HostMIBGroup
                     }

    OBJECT      igmpInterfaceStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."

    OBJECT      igmpCacheStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."

    ::= { igmpMIBCompliances 3 }

igmpV2RouterMIBCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "The compliance statement for routers running IGMPv2 and
            implementing the IGMP MIB."
    MODULE  -- this module
    MANDATORY-GROUPS { igmpBaseMIBGroup,
                       igmpRouterMIBGroup,
                       igmpV2RouterMIBGroup
                     }

    OBJECT      igmpInterfaceStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."
    OBJECT      igmpCacheStatus
    MIN-ACCESS read-only
    DESCRIPTION
            "Write access is not required."

    ::= { igmpMIBCompliances 4 }


-- units of conformance
```

```
igmpBaseMIBGroup OBJECT-GROUP
    OBJECTS { igmpCacheSelf,
              igmpCacheStatus, igmpInterfaceStatus
            }
    STATUS  current
    DESCRIPTION
            "The basic collection of objects providing management of
            IGMP version 1 or 2."
    ::= { igmpMIBGroups 1 }


igmpRouterMIBGroup OBJECT-GROUP
    OBJECTS { igmpCacheUpTime, igmpCacheExpiryTime,
              igmpInterfaceJoins, igmpInterfaceGroups,
              igmpCacheLastReporter, igmpInterfaceQuerierUpTime,
              igmpInterfaceQuerierExpiryTime,
              igmpInterfaceQueryInterval
            }
    STATUS  current
    DESCRIPTION
            "A collection of additional objects for management of IGMP
            version 1 or 2 in routers."
    ::= { igmpMIBGroups 2 }


igmpV2HostMIBGroup OBJECT-GROUP
    OBJECTS { igmpInterfaceVersion1QuerierTimer }
    STATUS  current
    DESCRIPTION
            "A collection of additional objects for management of IGMP
            version 2 in hosts."
    ::= { igmpMIBGroups 3 }

igmpHostOptMIBGroup OBJECT-GROUP
    OBJECTS { igmpCacheLastReporter, igmpInterfaceQuerier }
    STATUS  current
    DESCRIPTION
            "A collection of optional objects for IGMP hosts.
            Supporting this group can be especially useful in an
            environment with a router which does not support the IGMP
            MIB."
    ::= { igmpMIBGroups 4 }

igmpV2RouterMIBGroup OBJECT-GROUP
    OBJECTS { igmpInterfaceVersion, igmpInterfaceQuerier,
              igmpInterfaceQueryMaxResponseTime,
              igmpInterfaceRobustness,
              igmpInterfaceWrongVersionQueries,
```

```
                    igmpInterfaceLastMembQueryIntvl,
                    igmpCacheVersion1HostTimer
                }
    STATUS   current
    DESCRIPTION
            "A collection of additional objects for management of IGMP
            version 2 in routers."
    ::= { igmpMIBGroups 5 }

igmpV2ProxyMIBGroup OBJECT-GROUP
    OBJECTS { igmpInterfaceProxyIfIndex }
    STATUS   current
    DESCRIPTION
            "A collection of additional objects for management of IGMP
            proxy devices."
    ::= { igmpMIBGroups 6 }

END
```

5. Security Considerations

This MIB contains readable objects whose values provide information
related to multicast sessions. Some of these objects could contain
sensitive information. In particular, the igmpCacheSelf and
igmpCacheLastReporter can be used to identify machines which are
listening to a given group address. There are also a number of
objects that have a MAX-ACCESS clause of read-write and/or read-
create, which allow an administrator to configure IGMP in the router.

While unauthorized access to the readable objects is relatively
innocuous, unauthorized access to the write-able objects could cause
a denial of service. Hence, the support for SET operations in a
non-secure environment without proper protection can have a negative
effect on network operations.

SNMPv1 by itself is such an insecure environment. 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 SET (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 [12] and the View-based
Access Control Model RFC 2575 [15] is recommended.

It is then a customer/user responsibility to ensure that the SNMP
entity giving access to this MIB, is properly configured to give
access to those objects only to those principals (users) that have
legitimate rights to access them.

6. Intellectual Property Notice

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9. References

   [1] Wijnen, B., Harrington, D. and R. Presuhn, "An Architecture for
        Describing SNMP Management Frameworks", RFC 2571, April 1999.

   [2] Rose, M. and K. McCloghrie, "Structure and Identification of
        Management Information for TCP/IP-based Internets", STD 16, RFC
        1155, May 1990.

   [3] Rose, M. and K. McCloghrie, "Concise MIB Definitions", STD 16,
        RFC 1212, March 1991.

   [4] Rose, M., "A Convention for Defining Traps for use with the
        SNMP", RFC 1215, March 1991.

   [5] 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.

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

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

   [8] Case, J., Fedor, M., Schoffstall, M. and J. Davin, "Simple
        Network Management Protocol", STD 15, RFC 1157, May 1990.

   [9] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser,
        "Introduction to Community-based SNMPv2", RFC 1901, January
        1996.

   [10] 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.

   [11] Case, J., Harrington D., Presuhn R. and B. Wijnen, "Message
        Processing and Dispatching for the Simple Network Management
        Protocol (SNMP)", RFC 2572, April 1999.

   [12] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM)
        for version 3 of the Simple Network Management Protocol
        (SNMPv3)", RFC 2574, April 1999.

   [13] 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.

   [14] Levi, D., Meyer, P. and B. Stewart, "SNMPv3 Applications", RFC
        2573, April 1999.

   [15] Wijnen, B., Presuhn, R. and K. McCloghrie, "View-based Access
        Control Model (VACM) for the Simple Network Management Protocol
        (SNMP)", RFC 2575, April 1999.

   [16] Deering, S., "Host Extensions for IP Multicasting", STD 5, RFC
        1112, August 1989.

   [17] Fenner, W., "Internet Group Management Protocol, Version 2", RFC
        2236, November 1997.

10. Full Copyright Statement

Acknowledgement