

Network Working Group
Request for Comments: 2933
Category: Standards Track

K. McCloghrie
cisco Systems
D. Farinacci
Procket Networks
D. Thaler
Microsoft
October 2000

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 and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

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

Abstract

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

Table of Contents

1 Introduction	1
2 The SNMP Network Management Framework	2
3 Overview	3
4 Definitions	3
5 Security Considerations	14
6 Intellectual Property Notice	15
7 Acknowledgements	15
8 Authors' Addresses	16
9 References	17
10 Full Copyright Statement	19

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

EEmail: 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,
igmpInterfaceLastMemQueryIntvl	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

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

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

7. Acknowledgements

This MIB module was updated based on feedback from the IETF's Inter-Domain Multicast Routing (IDMR) Working Group.

8. Authors' Addresses

Keith McCloghrie
cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706

Phone: +1 408 526 5260
EMail: kzm@cisco.com

Dino Farinacci
Procket Networks
3850 North First Street
San Jose, CA 95134

Phone: +1 408-954-7909
Email: dino@procket.com

Dave Thaler
Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

Phone: +1 425 703 8835
EMail: dthaler@microsoft.com

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

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

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

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

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

Acknowledgement

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

