

Network Working Group
Request for Comments: 1567
Category: Standards Track

G. Mansfield
AIC Systems Laboratory
S. Kille
ISODE Consortium
January 1994

X.500 Directory Monitoring 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.

Abstract

This document defines a portion of the Management Information Base (MIB). It defines the MIB for monitoring Directory System Agents (DSA), a component of the OSI Directory. This MIB will be used in conjunction with the APPLICATION-MIB for monitoring DSAs.

Table of Contents

1. The SNMPv2 Network Management Framework	1
2. MIB Model for DSA Management	2
3. The DSA functions and operations	2
4. MIB design	3
5. The Directory Monitoring MIB	3
6. Acknowledgements	17
7. References	17
Security Considerations	18
Authors' Addresses	18

1. The SNMPv2 Network Management Framework

The major components of the SNMPv2 Network Management framework are described in the documents listed below.

- o RFC 1442 [1] defines the Structure of Management Information (SMI), the mechanisms used for describing and naming objects for the purpose of management.
- o STD 17, RFC 1213 [2] defines MIB-II, the core set of managed objects (MO) for the Internet suite of protocols.

- o RFC 1445 [3] defines the administrative and other architectural aspects of the management framework.
- o RFC 1448 [4] defines the protocol used for network access to managed objects.

The framework is adaptable/extensible by defining new MIBs to suit the requirements of specific applications/protocols/situations.

Managed objects are accessed via a virtual information store, the MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) defined in the SMI. In particular, each object type is named by an OBJECT IDENTIFIER, which is an administratively assigned name. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, often a textual string, termed the descriptor, is used to refer to the object type.

2. MIB Model for DSA Management

A DSA-manager may wish to monitor several aspects of the operational DSA. He/she may want to know the process related aspects-the resource utilization of the operational DSA; the network service related aspects e.g., inbound-associations, outbound-associations, operational status, and finally the information specific to the DSA application - its operations and performance.

The MIB defined in this document covers the portion which is specific to the DSA-application. The network service related part of the MIB, and the host-resources related part of the MIB, as well other parts of interest to a Manager monitoring the DSA-application, are covered in separate documents [6] [7].

3. The DSA functions and operations

The Directory System Agent [DSA], a component of the OSI-Directory [5] [9], is an application process. It provides access to the Directory Information Base [DIB] to Directory User Agents [DUA] and/or other DSAs. Functionally, a User [DUA] and the Directory are bound together for a period of time at an access point to the Directory [DSA]. A DSA may use information stored in its local database or interact with (chain the request to) other DSAs to service requirements. Alternatively, a DSA may return a reference to another DSA.

The local database of a DSA consists of the part of the DIT that is mastered by the DSA, the part of the DIT for which it keeps slave copies and cached information that is gathered during the operation

of the DSA.

The specific operations carried out by the DSA are: Read, Compare, AddEntry, ModifyEntry, ModifyRDN, RemoveEntry, List, Search. There is also the special operation Abandon. In response to requests results and/or errors are returned by the DSA.

4. MIB design

The basic principle has been to keep the MIB as simple as possible. The Managed objects included in the MIB are divided into three tables - dsaOpsTable, dsaEntryTable and dsaIntTable.

- The dsaOpsTable provides summary statistics on the accesses, operations and errors.
- The dsaEntriesTable provides summary statistics on the entries held by the DSA and on cache performance.
- The dsaIntTable provides some useful information on the interaction of the monitored DSA with peer DSAs.

There are references to the Directory itself for static information pertaining to the DSA. These references are in the form of "Directory Distinguished Name" [8] of the corresponding object. It is intended that DSA management applications will use these references to obtain further related information on the objects of interest.

5. The Directory Monitoring MIB

DSA-MIB DEFINITIONS ::= BEGIN

```
IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE,
    NOTIFICATION-TYPE
        FROM SNMPv2-SMI
    DisplayString, TimeStamp,
    TEXTUAL-CONVENTION
        FROM SNMPv2-TC
    mib-2
        FROM RFC1213-MIB
    applIndex, DistinguishedName
        FROM APPLICATION-MIB;

dsaMIB MODULE-IDENTITY
    LAST-UPDATED "9311250000Z"
    ORGANIZATION "IETF Mail and Directory Management Working
        Group"
```

CONTACT-INFO

" Glenn Mansfield

Postal: AIC Systems Laboratory
6-6-3, Minami Yoshinari
Aoba-ku, Sendai, 989-32
JP

Tel: +81 22 279 3310

Fax: +81 22 279 3640

E-Mail: glenn@aic.co.jp"

DESCRIPTION

" The MIB module for monitoring Directory System Agents."
::= { mib-2 29 }

dsaOpsTable OBJECT-TYPE

SYNTAX SEQUENCE OF DsaOpsEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

" The table holding information related to the
DSA operations."
::= { dsaMIB 1}

dsaOpsEntry OBJECT-TYPE

SYNTAX DsaOpsEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

" Entry containing operations related statistics
for a DSA."
INDEX { applIndex }
::= { dsaOpsTable 1}

DsaOpsEntry ::= SEQUENCE {

-- Bindings

dsaAnonymousBinds
Counter32,
dsaUnauthBinds
Counter32,
dsaSimpleAuthBinds
Counter32,
dsaStrongAuthBinds
Counter32,
dsaBindSecurityErrors
Counter32,

-- In-coming operations

```
    dsaInOps
        Counter32,
    dsaReadOps
        Counter32,
    dsaCompareOps
        Counter32,
    dsaAddEntryOps
        Counter32,
    dsaRemoveEntryOps
        Counter32,
    dsaModifyEntryOps
        Counter32,
    dsaModifyRDNOps
        Counter32,
    dsaListOps
        Counter32,
    dsaSearchOps
        Counter32,
    dsaOneLevelSearchOps
        Counter32,
    dsaWholeTreeSearchOps
        Counter32,
```

-- Out going operations

```
    dsaReferrals
        Counter32,
    dsaChainings
        Counter32,
```

-- Errors

```
    dsaSecurityErrors
        Counter32,
    dsaErrors
        Counter32
}

dsaAnonymousBinds OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of anonymous binds to this DSA from DUAs
          since application start."
    ::= {dsaOpsEntry 1}
```

dsaUnauthBinds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" Number of un-authenticated binds to this
DSA since application start."

::= {dsaOpsEntry 2}

dsaSimpleAuthBinds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" Number of binds to this DSA that were authenticated
using simple authentication procedures since
application start."

REFERENCE

" CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
Section 8.1.2.1.1."

::= {dsaOpsEntry 3}

dsaStrongAuthBinds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" Number of binds to this DSA that were authenticated
using the strong authentication procedures since
application start. This includes the binds that were
authenticated using external authentication procedures."

REFERENCE

" CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
Sections 8.1.2.1.2 & 8.1.2.1.3."

::= {dsaOpsEntry 4}

dsaBindSecurityErrors OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" Number of bind operations that have been rejected
by this DSA due to inappropriateAuthentication or
invalidCredentials."

REFERENCE

" CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
Section 12.7.2"

```
 ::= {dsaOpsEntry 5}

dsaInOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of operations forwarded to this DSA
          from DUAs or other DSAs since application
          start up."
    ::= {dsaOpsEntry 6}

dsaReadOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of read operations serviced by
          this DSA since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 9.1."
    ::= {dsaOpsEntry 7}

dsaCompareOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of compare operations serviced by
          this DSA since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 9.2."
    ::= {dsaOpsEntry 8}

dsaAddEntryOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of addEntry operations serviced by
          this DSA since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 11.1."
    ::= {dsaOpsEntry 9}
```

dsaRemoveEntryOps OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 " Number of removeEntry operations serviced by
 this DSA since application startup."
REFERENCE
 " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
 Section 11.2."
::= {dsaOpsEntry 10}

dsaModifyEntryOps OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 " Number of modifyEntry operations serviced by
 this DSA since application startup."
REFERENCE
 " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
 Section 11.3."
::= {dsaOpsEntry 11}

dsaModifyRDNops OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 " Number of modifyRDN operations serviced by
 this DSA since application startup."
REFERENCE
 " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
 Section 11.4."
::= {dsaOpsEntry 12}

dsaListOps OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 " Number of list operations serviced by
 this DSA since application startup."
REFERENCE
 " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
 Section 10.1."
::= {dsaOpsEntry 13}


```
dsaSearchOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of search operations- baseObjectSearches,
          oneLevelSearches and subTreeSearches, serviced
          by this DSA since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 10.2."
    ::= {dsaOpsEntry 14}

dsaOneLevelSearchOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of oneLevelSearch operations serviced
          by this DSA since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 10.2.2.2."
    ::= {dsaOpsEntry 15}

dsaWholeTreeSearchOps OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of wholeTreeSearch operations serviced
          by this DSA since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 10.2.2.2."
    ::= {dsaOpsEntry 16}

dsaReferrals OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of referrals returned by this DSA in response
          to requests for operations since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 12.6."
    ::= {dsaOpsEntry 17}
```

```
dsaChainings OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of operations forwarded by this DSA
          to other DSAs since application startup."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.518, 1988:
          Section 14."
    ::= {dsaOpsEntry 18}

dsaSecurityErrors OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of operations forwarded to this DSA
          which did not meet the security requirements. "
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Section 12.7."
    ::= {dsaOpsEntry 19}

dsaErrors          OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of operations that could not be serviced
          due to errors other than security errors, and
          referrals.
          A partially serviced operation will not be counted
          as an error.
          The errors include NameErrors, UpdateErrors, Attribute
          errors and ServiceErrors."
    REFERENCE
        " CCITT Blue Book Fascicle VIII.8 - Rec. X.511, 1988:
          Sections 12.4, 12.5, 12.8 & 12.9."
    ::= {dsaOpsEntry 20}

-- Entry statistics/Cache performance
dsaEntriesTable OBJECT-TYPE
    SYNTAX SEQUENCE OF DsaEntriesEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        " The table holding information related to the
```

```
        entry statistics and cache performance of the DSAs."
 ::= {dsaMIB 2}

dsaEntriesEntry OBJECT-TYPE
    SYNTAX DsaEntriesEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        " Entry containing statistics pertaining to entries
          held by a DSA."
    INDEX { applIndex }
    ::= {dsaEntriesTable 1}

DsaEntriesEntry ::= SEQUENCE {
    dsaMasterEntries
        Gauge32,
    dsaCopyEntries
        Gauge32,
    dsaCacheEntries
        Gauge32,
    dsaCacheHits
        Counter32,
    dsaSlaveHits
        Counter32
}

dsaMasterEntries OBJECT-TYPE
    SYNTAX Gauge32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of entries mastered in the DSA."
    ::= {dsaEntriesEntry 1}

dsaCopyEntries OBJECT-TYPE
    SYNTAX Gauge32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of entries for which systematic (slave)
          copies are maintained in the DSA."
    ::= {dsaEntriesEntry 2}

dsaCacheEntries OBJECT-TYPE
    SYNTAX Gauge32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
```

```

    " Number of entries cached (non-systematic copies) in
      the DSA. This will include the entries that are
      cached partially. The negative cache is not counted."
 ::= {dsaEntriesEntry 3}

```

```

dsaCacheHits OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of operations that were serviced from
          the locally held cache since application
          startup."
    ::= {dsaEntriesEntry 4}

```

```

dsaSlaveHits OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Number of operations that were serviced from
          the locally held object replications [ shadow
          entries] since application startup."
    ::= {dsaEntriesEntry 5}

```

```

-- The dsaIntTable contains statistical data on the peer DSAs
-- with which the monitored DSAs [attempt to] interact. This
-- table will provide a useful insight into the effect of
-- neighbours on the DSA performance.
-- The table keeps track of the last "N" DSAs with which the
-- monitored DSAs has interacted [attempted to interact],
-- where "N" is a locally-defined constant.

```

```

dsaIntTable OBJECT-TYPE
    SYNTAX SEQUENCE OF DsaIntEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        " Each row of this table contains some details
          related to the history of the interaction
          of the monitored DSAs with their respective
          peer DSAs."
    ::= { dsaMIB 3 }

```

```

dsaIntEntry OBJECT-TYPE
    SYNTAX DsaIntEntry
    MAX-ACCESS not-accessible

```

```

        STATUS current
        DESCRIPTION
            " Entry containing interaction details of a DSA
              with a peer DSA."
        INDEX { applIndex,dsaIntIndex }
        ::= { dsaIntTable 1 }

DsaIntEntry ::= SEQUENCE {
    dsaIntIndex
        INTEGER,
    dsaName
        DistinguishedName,
    dsaTimeOfCreation
        TimeStamp,
    dsaTimeOfLastAttempt
        TimeStamp,
    dsaTimeOfLastSuccess
        TimeStamp,
    dsaFailuresSinceLastSuccess
        Counter32,
    dsaFailures
        Counter32,
    dsaSuccesses
        Counter32
}

dsaIntIndex OBJECT-TYPE
    SYNTAX INTEGER (1..2147483647)
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        " Together with applIndex it forms the unique key to
          identify the conceptual row which contains useful info
          on the (attempted) interaction between the DSA (referred
          to by applIndex) and a peer DSA."
    ::= { dsaIntEntry 1}

dsaName OBJECT-TYPE
    SYNTAX DistinguishedName
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        " Distinguished Name of the peer DSA to which this
          entry pertains."
    ::= { dsaIntEntry 2}

dsaTimeOfCreation OBJECT-TYPE
    SYNTAX TimeStamp

```

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" The value of sysUpTime when this row was created.
If the entry was created before the network management
subsystem was initialized, this object will contain
a value of zero."

::= {dsaIntEntry 3}

dsaTimeOfLastAttempt OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" The value of sysUpTime when the last attempt was made
to contact this DSA. If the last attempt was made before
the network management subsystem was initialized, this
object will contain a value of zero."

::= {dsaIntEntry 4}

dsaTimeOfLastSuccess OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" The value of sysUpTime when the last attempt made to
contact this DSA was successful. If there have
been no successful attempts this entry will have a value
of zero. If the last successful attempt was made before
the network management subsystem was initialized, this
object will contain a value of zero."

::= {dsaIntEntry 5}

dsaFailuresSinceLastSuccess OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

" The number of failures since the last time an
attempt to contact this DSA was successful. If
there has been no successful attempts, this counter
will contain the number of failures since this entry
was created."

::= {dsaIntEntry 6}

dsaFailures OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

```
STATUS current
DESCRIPTION
    " Cumulative failures since the creation of
      this entry."
 ::= {dsaIntEntry 7}

dsaSuccesses OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
    " Cumulative successes since the creation of
      this entry."
 ::= {dsaIntEntry 8}

-- Conformance information

dsaConformance OBJECT IDENTIFIER ::= { dsaMIB 4 }

dsaGroups          OBJECT IDENTIFIER ::= { dsaConformance 1 }
dsaCompliances     OBJECT IDENTIFIER ::= { dsaConformance 2 }

-- Compliance statements

dsaOpsCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
    "The compliance statement for SNMPv2 entities
    which implement the DSA-MIB for monitoring
    DSA operations."

MODULE -- this module
MANDATORY-GROUPS { dsaOpsGroup }

 ::= { dsaCompliances 1 }

dsaEntryCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
    "The compliance statement for SNMPv2 entities
    which implement the DSA-MIB for monitoring
    DSA operations, entry statistics and cache
    performance."

MODULE -- this module
MANDATORY-GROUPS { dsaOpsGroup,dsaEntryGroup }
```

```

 ::= { dsaCompliances 2 }

dsaIntCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        " The compliance statement for SNMPv2 entities
          which implement the DSA-MIB for monitoring DSA
          operations and the interaction of the DSA with
          peer DSAs."

    MODULE -- this module
        MANDATORY-GROUPS { dsaOpsGroup, dsaIntGroup }

 ::= { dsaCompliances 3 }

-- Units of conformance

dsaOpsGroup OBJECT-GROUP
    OBJECTS {
        dsaAnonymousBinds, dsaUnauthBinds, dsaSimpleAuthBinds,
        dsaStrongAuthBinds, dsaBindSecurityErrors, dsaInOps,
        dsaReadOps, dsaCompareOps, dsaAddEntryOps,
        dsaRemoveEntryOps, dsaModifyEntryOps, dsaModifyRDNOps,
        dsaListOps, dsaSearchOps, dsaOneLevelSearchOps
    },
    dsaWholeTreeSearchOps, dsaReferrals, dsaChainings,
    dsaSecurityErrors, dsaErrors}
    STATUS current
    DESCRIPTION
        " A collection of objects for monitoring the DSA
          operations."
 ::= { dsaGroups 1 }

dsaEntryGroup OBJECT-GROUP
    OBJECTS { dsaMasterEntries, dsaCopyEntries, dsaCacheEntries,
        dsaCacheHits, dsaSlaveHits}
    STATUS current
    DESCRIPTION
        " A collection of objects for monitoring the DSA
          entry statistics and cache performance."
 ::= { dsaGroups 2 }

dsaIntGroup OBJECT-GROUP
    OBJECTS {
        dsaName, dsaTimeOfCreation, dsaTimeOfLastAttempt,
        dsaTimeOfLastSuccess, dsaFailuresSinceLastSuccess, dsaFailures,
        dsaSuccesses}
    STATUS current

```


DESCRIPTION

" A collection of objects for monitoring the DSA's
interaction with peer DSAs."
 ::= { dsaGroups 3 }

END

6. Acknowledgements

This draft is the product of discussions and deliberations carried out in the following working groups:

ietf-madman-wg ietf-madman@innosoft.com
wide-isode-wg isode-wg@wide.ad.jp
wide-netman-wg netman-wg@wide.ad.jp

7. References

- [1] Case, J., McCloghrie, K., Rose, M., and S. Waldbusser, "Structure of Management Information for version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1442, SNMP Research, Inc., Hughes LAN Systems, Dover Beach Consulting, Inc., Carnegie Mellon University, April 1993.
- [2] McCloghrie, K., and M. Rose, Editors, "Management Information Base for Network Management of TCP/IP-based internets: MIB-II", STD 17, RFC 1213, Hughes LAN Systems, Performance Systems International, March 1991.
- [3] Galvin, J., and K. McCloghrie, "Administrative Model for version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1445, Trusted Information Systems, Hughes LAN Systems, April 1993.
- [4] Case, J., McCloghrie, K., Rose, M., and S. Waldbusser, "Protocol Operations for version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1448, SNMP Research, Inc., Hughes LAN Systems, Dover Beach Consulting, Inc., Carnegie Mellon University, April 1993.
- [5] CCITT Blue Book, "Data Communication Networks: Directory", Recommendations X.500-X.521, December 1988.
- [6] Kille, S., WG Chair, and N. Freed, Editor, "The Network Services Monitoring MIB", RFC 1565, ISODE Consortium, Innosoft, January 1994.

- [7] Grillo, P., and S. Waldbusser, "Host Resources MIB", RFC 1514, Network Innovations, Intel Corporation, Carnegie Mellon University, September 1993.
- [8] Kille, S., "A String Representation of Distinguished Names (OSI-DS 23 (v5))", RFC 1485, ISODE Consortium, July 1993.
- [9] Kille, S., Huizer, E., Cerf, V., Hobby, R., and S. Kent, "A Strategic Plan for Deploying an Internet X.500 Directory Service", RFC 1430, ISODE Consortium, SURFnet bv, Corporation for National Research Initiatives, University of California, Davis, Bolt, Beranek and Newman, February 1993.

Security Considerations

Security issues are not discussed in this memo.

Authors' Addresses

Glenn Mansfield
AIC Systems Laboratories
6-6-3 Minami Yoshinari
Aoba-ku, Sendai 989-32
Japan

Phone: +81-22-279-3310
EMail: glenn@aic.co.jp

Steve E. Kille
ISODE Consortium
The Dome, The Square
Richmond TW9 1DT
UK

Phone: +44-81-332-9091
EMail: S.Kille@isode.com