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Directory Server Monitoring MIB

Status of this Memo

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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. This memo obsoletes RFC 1567, "X.500 Directory Monitoring MIB". This memo extends that specification to a more generic MIB for monitoring one or more directory servers each of which may support multiple access protocols. The MIB defined in this memo will be used in conjunction with the NETWORK-SERVICES-MIB [19] for monitoring Directory Servers.

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1. The SNMP Network Management Framework

The SNMP Network Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2571 [1].
- 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], RFC 2579 [6] and RFC 2580 [7].
- 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].
- 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].
- 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.

2. The Directory Services Model.

The Directory comprises of a set of servers (Directory Servers). Clients or Directory User Agents (DUA) are provided access to the Directory which maybe local or distributed, by the Directory Servers. The server maybe a X.500 Directory System Agent (DSA) [16] running over the OSI suite of protocols or, a (C)LDAP[17,18] frontend to the X.500 Directory System Agent or, a native LDAP Directory Server running directly over TCP or other protocols, or a database acting as a backend to another server, or any other application protocol, or any combination of the above. A Directory Server has one or more application protocol interfaces. Through these interfaces the Directory Server interacts with the DUA and with the peer Directory Servers.

Fig. 1 shows the case of a Directory Server that receives requests and sends back responses in some protocol. Fig. 2 shows one possible scenario where the Directory Server speaks multiple protocols.

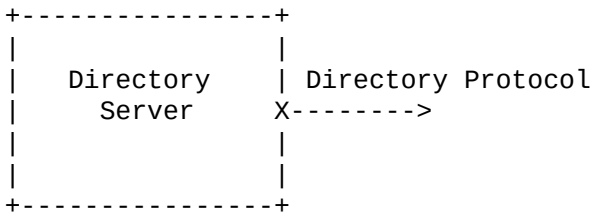

FIG. 1.

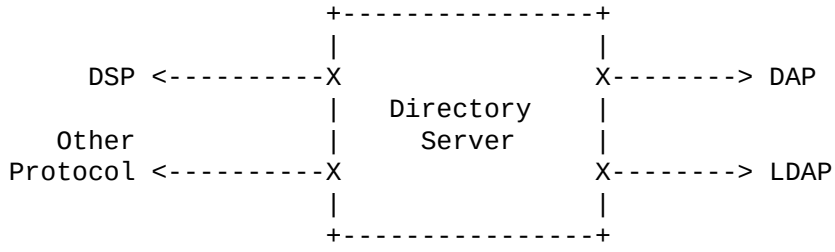

FIG. 2.

The Directory contains information in the form of entries. An entry is a collection of attributes and is uniquely identified by a name, the Distinguished Name (DN). The entries are arranged in a hierarchical tree-like structure called the Directory Information Tree (DIT).

A DUA requests a Directory Server to perform some operation on the Directory. The Directory Server is responsible for performing the operation and after completing its effort to carry out the request, returns a response to the DUA.

A Directory Server may use information stored in its local database or interact with (chain the request to) other Directory Servers to service the DUA request. Alternatively, a Directory Server may return a reference to another Directory Server (referral).

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

In the connection oriented mode a DUA "binds" to a Directory Server with a particular identification. The Directory Server may authenticate the identity of the DUA. In the connectionless mode as is employed in CLDAP no binding and/or authentication is carried out between the DUA and the Directory Server. The following type of operations are carried out by the Directory Server : Read, Compare, Addition of an Entry (AddEntry), Modification of an Entry (ModifyEntry), Modification of a DN (ModifyRDN), Deletion of an Entry (RemoveEntry), List, Search, Abandon. Some Directory Servers do not support some type of operations. For example CLDAP does not support AddEntry, ModifyEntry, ModifyRDN, RemoveEntry etc. In response to requests results and/or errors are returned by the Directory Server.

In the distributed Directory data is often replicated to enhance performance and for other advantages. The data to be replicated is transferred from the "Supplier" Directory Server to the "Consumer" Directory Server according to the replication agreement between the supplier and the receiver.

3. MIB Model for Directory Management.

A Directory manager should be able to monitor all the Directory Servers in his/her domain of management. The Directory Servers may be running on one or more hosts and, multiple Directory Servers may be running on the same host.

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

The MIB defined in this document covers the portion which is specific to Directory services. The network service related part of the MIB, and the host-resources related part of the MIB, as well as other parts of interest to a Manager monitoring the Directory services, are covered in separate documents [19] [20].

The MIB will cover a group of Directory Servers. The grouping will be done on some logical basis by the administrator/manager. In all cases, the grouping will be reflected in the pertinent NETWORK-SERVICES-MIB which will have an entry corresponding to each Directory Server in the group.

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 - dsTable, dsApplIfOpsTable, and dsIntTable.

- The dsTable contains a list of Directory Servers. The list contains a description of the Directory Servers as well as summary statistics on the entries held by and the cache performance of each Directory Server. The group of servers on this list is likely to contain a part of, if not all, the Directory Servers in the management domain.

- The dsApplIfOpsTable provides summary statistics on the accesses, operations and errors for each application protocol interface of a Directory Server.

- The dsIntTable provides some useful information on the interaction of the monitored Directory Servers with peer Directory Servers.

There are references to the Directory itself for static information pertaining to the Directory Server. These references are in the form of "Directory Distinguished Name" [21] of the corresponding object. It is intended that Directory management applications will use these references to obtain further information on the objects of interest.

5. The Directory Server Monitoring MIB.

```
DIRECTORY-SERVER-MIB DEFINITIONS ::= BEGIN

 IMPORTS
   MODULE-IDENTITY,  Counter32, Gauge32, OBJECT-TYPE
              FROM SNMPv2-SMI
   mib-2      FROM RFC1213-MIB
   DisplayString,    TimeStamp
```

```
                FROM SNMPv2-TC
      MODULE-COMPLIANCE, OBJECT-GROUP
                FROM SNMPv2-CONF
      ZeroBasedCounter32
                FROM RMON2-MIB
      applIndex, DistinguishedName, URLString

                FROM NETWORK-SERVICES-MIB;

    dsMIB MODULE-IDENTITY
       LAST-UPDATED "9906070000Z"
       ORGANIZATION "IETF Mail and Directory Management Working
                     Group"
       CONTACT-INFO
      "                       Glenn Mansfield
                    Postal: Cyber Solutions Inc.
                            6-6-3, Minami Yoshinari
                            Aoba-ku, Sendai, Japan 989-3204.

                       Tel: +81-22-303-4012
                       Fax: +81-22-303-4015
                    E-mail: glenn@cysols.com
       Working Group E-mail: ietf-madman@innosoft.com
                To subscribe: ietf-madman-request@innosoft.com"

       DESCRIPTION
               " The MIB module for monitoring Directory Services."

       -- revision information

       REVISION "9906070000Z"
       DESCRIPTION
         "This revision of this MIB is published in RFC 2605.

          This revision obsoletes RFC 1567. It is incompatible with
          the original MIB and so it has been renamed from dsaMIB
          to dsMIB."

       REVISION "9311250000Z" -- 25th November 1993
       DESCRIPTION
         "The original version of this MIB was published in RFC 1567."
       ::= { mib-2 66 }

    dsTable OBJECT-TYPE
        SYNTAX SEQUENCE OF DsTableEntry
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
```

```
          " The table holding information related to the Directory
            Servers."
        ::= {dsMIB 1}

    dsTableEntry OBJECT-TYPE
        SYNTAX DsTableEntry
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
          " Entry containing summary description for a Directory
            Server."
        INDEX { applIndex }
        ::= {dsTable 1}

   -- General description of the Directory Server application will be
   -- available in the applTable of the NETWORK-SERVICES-MIB indexed by
   -- applIndex.

    DsTableEntry ::= SEQUENCE {
        dsServerType
            BITS,
        dsServerDescription
            DisplayString,

    -- Entry statistics/Cache performance
        dsMasterEntries
            Gauge32,
        dsCopyEntries
            Gauge32,
        dsCacheEntries
            Gauge32,
        dsCacheHits
            Counter32,
        dsSlaveHits
            Counter32
    }

    dsServerType OBJECT-TYPE
        SYNTAX BITS {
                    frontEndDirectoryServer(0),
                    backEndDirectoryServer(1)
               }
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          "This object indicates whether the server is
           a frontend or, a backend or, both. If the server
           is a frontend, then the frontEndDirectoryServer
```

```
            bit will be set. Similarly for the backend."
        ::= {dsTableEntry 1}

    dsServerDescription OBJECT-TYPE
       SYNTAX DisplayString
       MAX-ACCESS read-only
       STATUS current
       DESCRIPTION
         "A text description of the application.  This information
          is intended to identify and briefly describe the
          application in a status display."
        ::= {dsTableEntry 2}


   -- A (C)LDAP frontend to the X.500 Directory will not have
   -- MasterEntries, CopyEntries; the following counters will
   -- be inaccessible for LDAP/CLDAP frontends to the X.500
   -- directory: dsMasterEntries, dsCopyEntries, dsSlaveHits.

    dsMasterEntries OBJECT-TYPE
        SYNTAX Gauge32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of entries mastered in the Directory Server."
        ::= {dsTableEntry 3}

    dsCopyEntries OBJECT-TYPE
        SYNTAX Gauge32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of entries for which systematic (slave)
            copies are maintained in the Directory Server."
        ::= {dsTableEntry 4}

    dsCacheEntries OBJECT-TYPE
        SYNTAX Gauge32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of entries cached (non-systematic copies) in
            the Directory Server. This will include the entries that
            are cached partially. The negative cache is not counted."
        ::= {dsTableEntry 5}

    dsCacheHits OBJECT-TYPE
        SYNTAX Counter32
```

```
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of operations that were serviced from
            the locally held cache."
        ::= {dsTableEntry 6}

    dsSlaveHits  OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of operations that were serviced from
            the locally held object replications ( copy-
            entries)."
        ::= {dsTableEntry 7}

    dsApplIfOpsTable OBJECT-TYPE
        SYNTAX SEQUENCE OF DsApplIfOpsEntry
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
          " The table holding information related to the
            Directory Server operations."
        ::= {dsMIB 2}

    dsApplIfOpsEntry OBJECT-TYPE
        SYNTAX DsApplIfOpsEntry
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
          " Entry containing operations related statistics
            for a Directory Server."
        INDEX { applIndex, dsApplIfProtocolIndex }
        ::= {dsApplIfOpsTable 1}
    DsApplIfOpsEntry ::= SEQUENCE {

        dsApplIfProtocolIndex
             INTEGER,
        dsApplIfProtocol
             OBJECT IDENTIFIER,

    -- Bindings

        dsApplIfUnauthBinds
            Counter32,
        dsApplIfSimpleAuthBinds
            Counter32,
```

```
        dsApplIfStrongAuthBinds
            Counter32,
        dsApplIfBindSecurityErrors
            Counter32,

    -- In-coming operations

        dsApplIfInOps
            Counter32,
        dsApplIfReadOps
            Counter32,
        dsApplIfCompareOps
            Counter32,
        dsApplIfAddEntryOps
            Counter32,
        dsApplIfRemoveEntryOps
            Counter32,
        dsApplIfModifyEntryOps
            Counter32,
        dsApplIfModifyRDNOps
            Counter32,
        dsApplIfListOps
            Counter32,
        dsApplIfSearchOps
            Counter32,
        dsApplIfOneLevelSearchOps
            Counter32,
        dsApplIfWholeSubtreeSearchOps
            Counter32,

    -- Out going operations

        dsApplIfReferrals
            Counter32,
        dsApplIfChainings
            Counter32,

    -- Errors

        dsApplIfSecurityErrors
            Counter32,
        dsApplIfErrors
            Counter32,

   --  replications

        dsApplIfReplicationUpdatesIn
            Counter32,
```

```
        dsApplIfReplicationUpdatesOut
            Counter32,

    -- Traffic Volume

        dsApplIfInBytes
            Counter32,
        dsApplIfOutBytes
            Counter32
    }

    -- CLDAP does not use binds; for the CLDAP interface of a Directory
    -- Server the bind related counters will be inaccessible.
    --
    -- CLDAP and LDAP implement "Read" and "List" operations
    -- indirectly via the "search" operation; the following
    -- counters will be inaccessible for the CLDAP and LDAP interfaces of
    -- Directory Servers:  dsApplIfReadOps, dsApplIfListOps
    --
    -- CLDAP does not implement "Compare", "Add", "Remove",
    -- "Modify", "ModifyRDN"; the following counters will be
    -- inaccessible for the CLDAP interfaces of Directory Servers:
    -- dsApplIfCompareOps, dsApplIfAddEntryOps,  dsApplIfRemoveEntryOps,
    -- dsApplIfModifyEntryOps, dsApplIfModifyRDNOps.
    --
    -- CLDAP Directory Servers do not return Referrals
    -- the following fields will remain inaccessible for
    -- CLDAP interfaces of Directory Servers: dsApplIfReferrals.

    dsApplIfProtocolIndex OBJECT-TYPE
        SYNTAX INTEGER (1..2147483647)
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
         "An index to uniquely identify an entry corresponding to a
          application-layer protocol interface. This index is used
          for lexicographic ordering of the table."
        ::= {dsApplIfOpsEntry 1}

    dsApplIfProtocol OBJECT-TYPE
        SYNTAX OBJECT IDENTIFIER
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
         "An identification of the protocol being used by the application
          on this interface.  For an OSI Application, this will be the
          Application Context.  For Internet applications, the IANA
          maintains a registry[22] of the OIDs which correspond to
```

```
          well-known applications.  If the application protocol is
          not listed in the registry, an OID value of the form
          {applTCPProtoID port} or {applUDProtoID port} are used for
          TCP-based and UDP-based protocols, respectively. In either
          case 'port' corresponds to the primary port number being
          used by the protocol. The OIDs applTCPProtoID and
          applUDPProtoID are defined in NETWORK-SERVICES-MIB"
        ::= {dsApplIfOpsEntry 2}

    dsApplIfUnauthBinds OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of unauthenticated/anonymous bind requests
            received."
        ::= {dsApplIfOpsEntry 3}

    dsApplIfSimpleAuthBinds OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of bind requests that were authenticated
            using simple authentication procedures like password
            checks. This includes the
            password authentication using SASL mechanisms like
            CRAM-MD5."
        ::= {dsApplIfOpsEntry 4}

    dsApplIfStrongAuthBinds OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of bind requests that were authenticated
            using TLS and X.500 strong authentication procedures.
            This includes the binds that were
            authenticated using external authentication procedures."
        ::= {dsApplIfOpsEntry 5}

    dsApplIfBindSecurityErrors OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of bind requests that have been rejected
            due to inappropriate authentication or
```

```
            invalid credentials."
        ::= {dsApplIfOpsEntry 6}

    dsApplIfInOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of requests received from DUAs or other
            Directory Servers."
        ::= {dsApplIfOpsEntry 7}

    dsApplIfReadOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of read requests  received."
        ::= {dsApplIfOpsEntry 8}


    dsApplIfCompareOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of compare requests received."
        ::= {dsApplIfOpsEntry 9}

    dsApplIfAddEntryOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of addEntry requests received."
        ::= {dsApplIfOpsEntry 10}


    dsApplIfRemoveEntryOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of removeEntry requests received."
        ::= {dsApplIfOpsEntry 11}


    dsApplIfModifyEntryOps OBJECT-TYPE
```

```
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of modifyEntry requests received."
        ::= {dsApplIfOpsEntry 12}


    dsApplIfModifyRDNOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of modifyRDN requests received."
        ::= {dsApplIfOpsEntry 13}

    dsApplIfListOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of list requests received."
        ::= {dsApplIfOpsEntry 14}

    dsApplIfSearchOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of search requests- baseObject searches,
            oneLevel searches and  whole subtree searches,
            received."
        ::= {dsApplIfOpsEntry 15}

    dsApplIfOneLevelSearchOps OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of oneLevel search requests received."
        ::= {dsApplIfOpsEntry 16}


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

```
          " Number of whole subtree search requests received."
        ::= {dsApplIfOpsEntry 17}


    dsApplIfReferrals OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of referrals returned in response
            to requests for operations."
        ::= {dsApplIfOpsEntry 18}

    dsApplIfChainings OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of operations forwarded by this Directory Server
            to other Directory Servers."
        ::= {dsApplIfOpsEntry 19}

    dsApplIfSecurityErrors OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of requests received
            which did not meet the security requirements. "
        ::= {dsApplIfOpsEntry 20}

    dsApplIfErrors  OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of requests 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 naming-related, update-related,
            attribute-related and service-related errors."
        ::= {dsApplIfOpsEntry 21}

   -- Replication operations

    dsApplIfReplicationUpdatesIn OBJECT-TYPE
```

```
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of replication updates fetched or received from
            supplier Directory Servers."
        ::= {dsApplIfOpsEntry 22}

    dsApplIfReplicationUpdatesOut OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Number of replication updates sent to or taken by
            consumer Directory Servers."
        ::= {dsApplIfOpsEntry 23}

    dsApplIfInBytes  OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Incoming traffic, in bytes, on the interface.
            This will include requests from DUAs as well
            as responses from other Directory Servers."
        ::= {dsApplIfOpsEntry 24}

    dsApplIfOutBytes OBJECT-TYPE
        SYNTAX Counter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Outgoing traffic in bytes on the interface.
            This will include responses to DUAs and Directory
            Servers as well as requests to other Directory Servers."
        ::= {dsApplIfOpsEntry 25}


    -- The dsIntTable contains statistical data on the peer
    -- Directory Servers  with which the monitored Directory
    -- Server interacts or, attempts to interact. This  table is
    -- expected to provide a useful insight into the effect of
    -- neighbours on the Directory Server's performance.
    -- The table keeps track of the last "N" Directory Servers
    -- with which  the  monitored   Directory  has  interacted
    -- (attempted to interact), where "N" is a locally-defined
    -- constant.
    -- For a multiprotocol server, statistics for each protocol
```

```
    -- are kept separetely.

    dsIntTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF DsIntEntry
        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 Directory Server with its
            peer Directory Servers."
        ::= { dsMIB 3 }

    dsIntEntry OBJECT-TYPE
        SYNTAX  DsIntEntry
        MAX-ACCESS  not-accessible
        STATUS  current
        DESCRIPTION
          " Entry containing interaction details of a Directory
            Server with a peer Directory Server."
        INDEX { applIndex,dsIntEntIndex, dsApplIfProtocolIndex }
        ::= { dsIntTable 1 }

    DsIntEntry ::= SEQUENCE {
       dsIntEntIndex
                 INTEGER,
       dsIntEntDirectoryName
                 DistinguishedName,
       dsIntEntTimeOfCreation
                 TimeStamp,
       dsIntEntTimeOfLastAttempt
                 TimeStamp,
       dsIntEntTimeOfLastSuccess
                 TimeStamp,
       dsIntEntFailuresSinceLastSuccess
                 Gauge32,
       dsIntEntFailures
                 ZeroBasedCounter32,
       dsIntEntSuccesses
                 ZeroBasedCounter32,
       dsIntEntURL
                 URLString
    }

    dsIntEntIndex  OBJECT-TYPE
        SYNTAX INTEGER (1..2147483647)
        MAX-ACCESS not-accessible
        STATUS current
```

```
        DESCRIPTION
          " Together with applIndex and dsApplIfProtocolIndex, this
            object forms the unique key to
            identify the conceptual row which contains useful info
            on the (attempted) interaction between the Directory
            Server (referred to by applIndex) and a peer Directory
            Server using a particular protocol."
        ::= {dsIntEntry 1}

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

    dsIntEntTimeOfCreation  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."
        ::= {dsIntEntry 3}

    dsIntEntTimeOfLastAttempt  OBJECT-TYPE
        SYNTAX TimeStamp
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " The value of sysUpTime when the last attempt was made
            to contact the peer Directory Server. If the last attempt
            was made before the network management subsystem was
            initialized, this object will contain a value of zero."
        ::= {dsIntEntry 4}

    dsIntEntTimeOfLastSuccess  OBJECT-TYPE
        SYNTAX TimeStamp
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " The value of sysUpTime when the last attempt made to
            contact the peer Directory Server 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."
        ::= {dsIntEntry 5}

    dsIntEntFailuresSinceLastSuccess  OBJECT-TYPE
        SYNTAX Gauge32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " The number of failures since the last time an
            attempt to contact the peer Directory Server was successful.
            If there have been no successful attempts, this counter
            will contain the number of failures since this entry
            was created."
        ::= {dsIntEntry 6}

   -- note this gauge has a maximum value of 4294967295 and,
   -- it does not wrap.[5]

    dsIntEntFailures  OBJECT-TYPE
        SYNTAX ZeroBasedCounter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Cumulative failures in contacting the peer Directory Server
            since the creation of this entry."
        ::= {dsIntEntry 7}

    dsIntEntSuccesses  OBJECT-TYPE
        SYNTAX ZeroBasedCounter32
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " Cumulative successes in contacting the peer Directory Server
            since the creation of this entry."
        ::= {dsIntEntry 8}

    dsIntEntURL  OBJECT-TYPE
        SYNTAX URLString
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          " URL of the peer Directory Server."
        ::= {dsIntEntry 9}


    -- Conformance information
```

```
    dsConformance OBJECT IDENTIFIER ::= { dsMIB 4 }

    dsGroups      OBJECT IDENTIFIER ::= { dsConformance 1 }
    dsCompliances OBJECT IDENTIFIER ::= { dsConformance 2 }

    -- Compliance statements

    dsEntryCompliance MODULE-COMPLIANCE
        STATUS  current
        DESCRIPTION
                "The compliance statement for SNMP entities
                which implement the DIRECTORY-SERVER-MIB for
                a summary overview of the Directory Servers ."

        MODULE  -- this module
            MANDATORY-GROUPS { dsEntryGroup }

        ::= { dsCompliances 1 }

    dsOpsCompliance MODULE-COMPLIANCE
        STATUS  current
        DESCRIPTION
                "The compliance statement for SNMP entities
                which implement the DIRECTORY-SERVER-MIB for monitoring
                Directory Server operations,  entry statistics and cache
                performance."

        MODULE  -- this module
            MANDATORY-GROUPS { dsEntryGroup, dsOpsGroup }

        ::= { dsCompliances 2 }

    dsIntCompliance MODULE-COMPLIANCE
           STATUS  current
           DESCRIPTION
                   " The compliance statement  for SNMP  entities
                     which implement the DIRECTORY-SERVER-MIB for
                     monitoring Directory Server operations and the
                     interaction of the Directory Server with peer
                     Directory Servers."

           MODULE  -- this module
           MANDATORY-GROUPS { dsEntryGroup, dsIntGroup }

           ::= { dsCompliances 3 }

    dsOpsIntCompliance MODULE-COMPLIANCE
        STATUS  current
```

```
        DESCRIPTION
                " The compliance statement  for SNMP  entities
                  which implement the DIRECTORY-SERVER-MIB for monitoring
                  Directory Server operations and the interaction of the
                  Directory Server with peer Directory Servers."

        MODULE  -- this module
        MANDATORY-GROUPS { dsEntryGroup, dsOpsGroup, dsIntGroup }

        ::= { dsCompliances 4 }


    -- Units of conformance

    dsEntryGroup    OBJECT-GROUP
        OBJECTS {dsServerType,            dsServerDescription,
                 dsMasterEntries,         dsCopyEntries,
                 dsCacheEntries,          dsCacheHits,
                 dsSlaveHits}
        STATUS  current
        DESCRIPTION
                " A collection of objects for a summary overview of the
                  Directory Servers."
        ::= { dsGroups 1 }

    dsOpsGroup    OBJECT-GROUP
        OBJECTS {
          dsApplIfProtocolIndex,          dsApplIfProtocol,
          dsApplIfUnauthBinds,            dsApplIfSimpleAuthBinds,
          dsApplIfStrongAuthBinds,        dsApplIfBindSecurityErrors,
          dsApplIfInOps,                  dsApplIfReadOps,
          dsApplIfCompareOps,             dsApplIfAddEntryOps,
          dsApplIfRemoveEntryOps,         dsApplIfModifyEntryOps,
          dsApplIfModifyRDNOps,           dsApplIfListOps,
          dsApplIfSearchOps,              dsApplIfOneLevelSearchOps,
          dsApplIfWholeSubtreeSearchOps,  dsApplIfReferrals,
          dsApplIfChainings,              dsApplIfSecurityErrors,
          dsApplIfErrors,                 dsApplIfReplicationUpdatesIn,
          dsApplIfReplicationUpdatesOut,  dsApplIfInBytes,
          dsApplIfOutBytes      }
        STATUS  current
        DESCRIPTION
                " A collection of objects for monitoring the Directory
                  Server operations."
        ::= { dsGroups 2 }

    dsIntGroup    OBJECT-GROUP
        OBJECTS {
```

```
        dsIntEntDirectoryName,          dsIntEntTimeOfCreation,
        dsIntEntTimeOfLastAttempt,      dsIntEntTimeOfLastSuccess,
        dsIntEntFailuresSinceLastSuccess, dsIntEntFailures,
        dsIntEntSuccesses,              dsIntEntURL}
    STATUS  current
    DESCRIPTION
            " A collection of objects for monitoring the Directory
              Server's interaction with peer Directory Servers."
    ::= { dsGroups 3 }


END
```

6. Intellectual Property

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7. Changes from RFC1567.

A more general Directory model in which, several Directory protocols coexist, has been adopted for the purpose of the MIB design. The result is a generic Directory Server Monitoring MIB.

8. Acknowledgements

This memo is the product of discussions and deliberations carried out in the Mail and Directory Management Working Group (ietf-madman-wg).

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Security Considerations

There are no management objects defined in this MIB that have a MAX-ACCESS clause of read-write and/or read-create. So, if this MIB is implemented correctly, then there is no risk that an intruder can alter or create any management objects of this MIB via direct SNMP SET operations.

However, the information itself may partly reveal the configuration of the directory system and passively increase its vulnerability. The information could also be used to analyze network usage and traffic patterns.

Therefore, it may be important in some environments to control read access to these objects and possibly to even encrypt the values of these object when sending them over the network via SNMP. Not all versions of SNMP provide features for such a secure environment.

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 GET (read) the objects in this MIB.

It is recommended that the implementors 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 an instance of this MIB, is properly configured to give access to those objects only to those principals (users) that have legitimate rights to access them.

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