Network Working Group
Request for Comments: 4544
Category: Standards Track

M. Bakke
Cisco Systems
M. Krueger
Hewlett-Packard
T. McSweeney
IBM
J. Muchow
Qlogic Corp.
May 2006

# Definitions of Managed Objects for Internet Small Computer System Interface (iSCSI)

## Status of This Memo



## Copyright Notice



## Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP-based internets. In particular, it defines objects for managing a client using the Internet Small Computer System Interface (iSCSI) protocol (SCSI over TCP).

Table of Contents

## 1. Introduction

This document defines a MIB module for iSCSI [RFC3720], used to manage devices that implement the iSCSI protocol.

## 2. Specification of Requirements

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

## 3. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

## 4. Relationship to Other MIB Modules

The iSCSI MIB module is normally layered between the SCSI MIB module [RFC4455] and the TCP MIB module [RFC4022], and makes use of the IP Storage (IPS) Identity Authentication MIB module [RFC4545]. Here is how these modules are related:

SCSI MIB  Within systems where a SCSI layer is present, each iscsiNode, whether it has an initiator role, target role, or both, is related to one SCSI device within the SCSI MIB module. In this case, the iscsiNodeTransportType attribute points to the SCSI transport object within the SCSI MIB module, which in turn contains an attribute that points back to the iscsiNode. In this way, a management station can navigate between the two MIB modules. In systems where a SCSI layer is not present, such as within an iSCSI proxy device, the iscsiNodeTransportType attribute points to the appropriate corresponding object within the appropriate MIB, or is left blank.

TCP MIB Each iSCSI connection is related to one transport-level connection. Currently, iSCSI uses only TCP; the iSCSI connection is related to a TCP connection using its normal (protocol, source address, source port, destination address, destination port) 5-tuple.

AUTH MIB Each iSCSI node that serves a target role can have a list of authorized initiators. Each of the entries in this list points to an identity within the IPS Identity Authentication MIB module that will be allowed to access the target. iSCSI nodes that serve in an initiator role can also have a list of authorized targets. Each of the entries in this list points to an identity within the Auth MIB module to which the initiator should attempt to establish sessions. The Auth MIB module includes information used to identify initiators and targets by their iSCSI name, IP address, and/or credentials.

This MIB module imports objects from RFCs 2578 [RFC2578], 2579 [RFC2579], 2580 [RFC2580], and 3411 [RFC3411]. It also imports textual conventions from the INET-ADDRESS-MIB [RFC4001].

## 5. Relationship to SNMP Contexts

Each non-scalar object in the iSCSI MIB module is indexed first by an iSCSI Instance. Each instance is a collection of nodes, portals, sessions, etc., that can define a physical or virtual partitioning of an iSCSI-capable device. The use of an instance works well with partitionable or hierarchical storage devices and fits in logically with other management schemes. Instances do not replace SNMP contexts, however they do provide a very simple way to assign a virtual or physical partition of a device to one or more SNMP contexts, without having to do so for each individual node, portal, and session row.

## 6. Discussion

This MIB module structure supplies configuration, fault, and statistics information for iSCSI devices [RFC3720]. It is structured around the well-known iSCSI objects, such as targets, initiators, sessions, connections, and the like.

This MIB module may also be used to configure access to iSCSI targets, by creating iSCSI Portals and authorization list entries.

It is worthwhile to note that this is an iSCSI MIB module and as such reflects only iSCSI objects. This module does not contain information about the SCSI-layer attributes of a device. If a SCSI layer is present, the SCSI MIB module, currently under development, may be used to manage SCSI information for a device.

The iSCSI MIB module consists of several "objects", each of which is represented by one or more tables. This section contains a brief description of the "object" hierarchy and a description of each object, followed by a discussion of the actual table structure within the objects.

### 6.1. iSCSI MIB Object Model

The top-level object in this structure is the iSCSI instance, which "contains" all of the other objects.

```
iscsiInstance
   -- A distinct iSCSI entity within the managed system.
   iscsiPortal
      -- An IP address used by this instance
      iscsiTargetPortal
         -- Contains portal information relevant when the portal
         -- is used to listen for connections to its targets.
      iscsiInitiatorPortal
         -- Contains portal information relevant when the portal
         -- is used to initiate connections to other targets.
   iscsiNode
      -- An iSCSI node can act as an initiator, a target, or both.
      -- Contains generic (non-role-specific) information.
      iscsiTarget
         -- Target-specific iSCSI node information.
         iscsiTgtAuth
            -- A list of initiator identities that are allowed
            -- access to this target.
      iscsiInitiator
         -- Initiator-specific iSCSI node information.
         iscsiIntrAuth
            -- A list of target identities to which this initiator
            -- is configured to establish sessions.
      iscsiSession
         -- An active iSCSI session between an initiator and target.
         -- The session's direction may be Inbound (outside
         -- initiator to our target) or Outbound (our initiator to
         -- an outside target).
         iscsiConnection
            -- An active TCP connection within an iSCSI session.
```

An iSCSI node can be an initiator, a target, or both. The iSCSI node's portals may be used to initiate connections (initiator) or listen for connections (target), depending on whether the iSCSI node is acting as an initiator or target. The iSCSI MIB module assumes that any target may be accessed via any portal that can take on a target role, although other access controls not reflected in the module might limit this.

## 6.2. iSCSI MIB Table Structure

Each iSCSI object exports one or more tables: an attributes table, and zero or more statistics tables, which augment the attributes table. Since iSCSI is an evolving standard, it is much cleaner to provide statistics and attributes as separate tables, allowing attributes and statistics to be added independently. In a few cases, there are multiple categories of statistics that will likely grow; in this case, an object will contain multiple statistics tables.

```
iscsiObjects
  iscsiDescriptors
  iscsiInstance
    iscsiInstanceAttributesTable
    iscsiInstanceSsnErrorStatsTable
      -- Counts abnormal session terminations
  iscsiPortal
    iscsiPortalAttributesTable
  iscsiTargetPortal
    iscsiTgtPortalAttributesTable
  iscsiInitiatorPortal
    iscsiIntrPortalAttributesTable
  iscsiNode
    iscsiNodeAttributesTable
  iscsiTarget
    iscsiTargetAttributesTable
    iscsiTargetLoginStatsTable
      -- Counts successful and unsuccessful logins
    iscsiTargetLogoutStatsTable
      -- Counts normal and abnormal logouts
  iscsiTgtAuthorization
    iscsiTgtAuthAttributesTable
  iscsiInitiator
    iscsiInitiatorAttributesTable
    iscsiInitiatorLoginStatsTable
      -- Counts successful and unsuccessful logins
    iscsiInitiatorLogoutStatsTable
      -- Counts normal and abnormal logouts
  iscsiIntrAuthorization
    iscsiIntrAuthAttributesTable
```

```
iscsiSession
  iscsiSessionAttributesTable
  iscsiSessionStatsTable
    -- Performance-related counts (requests, responses, bytes)
  iscsiSessionCxnErrorStatsTable
    -- Counts digest errors, connection errors, etc.
iscsiConnection
  iscsiConnectionAttributesTable
```

Note that this module does not attempt to count everything that could be counted; it is designed to include only those counters that would be useful for identifying performance, security, and fault problems from a management station.

### 6.3. iscsiInstance

The iscsiInstanceAttributesTable is the primary table of the iSCSI MIB module. Every table entry in this module is "owned" by exactly one iSCSI instance; all other table entries in the module include this table's index as their primary index.

Most implementations will include just one iSCSI instance row in this table. However, this table exists to allow for multiple virtual instances. For example, many IP routing products now allow multiple virtual routers. The iSCSI MIB module has the same premise; a large system could be "partitioned" into multiple, distinct virtual systems.

This also allows a single SNMP agent to proxy for multiple subsystems, perhaps a set of stackable devices, each of which has one or even more instances.

The instance attributes include the iSCSI vendor and version, as well as information on the last target or initiator at the other end of a session that caused a session failure.

The iscsiInstanceSsnErrorStatsTable augments the attributes table and provides statistics on session failures due to digest, connection, or iSCSI format errors.

### 6.4. iscsiPortal

The iscsiPortalAttributesTable lists iSCSI portals that can be used to listen for connections to targets, to initiate connections to other targets, or to do both.

Each row in the table includes an IP address (either v4 or v6), and a transport protocol (currently only TCP is defined). Each portal may have additional attributes, depending on whether it is an initiator portal, a target portal, or both. Initiator portals also have portal tags; these are placed in corresponding rows in the iscsiIntrPortalAttributesTable. Target portals have both portal tags and ports (e.g., TCP listen ports if the transport protocol is TCP); these are placed in rows in the iscsiTgtPortalAttributesTable.

Portal rows, along with their initiator and target portal counterparts, may be created and destroyed through this MIB module by a management station. Rows in the initiator and target portal tables are created and destroyed automatically by the agent, whenever a row is created or destroyed in the iscsiPortalAttributesTable, or if the value of iscsiPortalRoles changes. Attributes in these tables may then be modified by the management station if the agent implementation allows.

When created by a management station, the iscsiPortalRoles attribute is used to control row creation in the initiator and target portal tables. Creating a row with the targetTypePortal bit set in iscsiPortalRoles will cause the implementation to start listening for iSCSI connections on the portal. Creating a row with the initiatorTypePortal bit set in iscsiPortalRoles will not necessarily cause connections to be established; it is left to the implementation whether and when to make use of the portal. Both bits may be set if the portal is to be used by both initiator and target nodes.

When deleting a row in the iscsiPortalAttibutesTable, all connections associated with that row are terminated. The implementation may either terminate the connection immediately or request a clean shutdown as specified in [RFC3720]. An outbound connection (when an iscsiInitiatorPortal is deleted) matches the portal if its iscsiCxnLocalAddr matches the iscsiPortalAddr. An inbound connection (when an iscsiTargetPortal is deleted) matches the portal if its iscsiCxnLocalAddr matches the iscsiPortalAddr, and its iscsiCxnLocalPort matches the iscsiTargetPortalPort.

Individual objects within a row in this table may not be modified while the row is active. For instance, changing the IP address of a portal requires that the rows associated with the old IP address be deleted, and new rows be created (in either order).

### 6.5. iscsiTargetPortal

The iscsiTgtPortalAttributesTable contains target-specific attributes for iSCSI portals. Rows in this table use the same indices as their corresponding rows in the iscsiPortalAttributesTable, with the addition of iscsiNodeIndex.

Rows in this table are created when the targetTypePortal bit is set in the iscsiPortalRoles attribute of the corresponding iscsiPortalAttributesEntry; they are destroyed when this bit is cleared.

This table contains the TCP (or other protocol) port on which the socket is listening for incoming connections. It also includes a portal group aggregation tag; iSCSI target portals within this instance sharing the same tag can contain connections within the same session.

This table will be empty for iSCSI instances that contain only initiators (such as iSCSI host driver implementations).

Many implementations use the same target portal tag and protocol port for all nodes accessed via a portal. These implementations will create a single row in the iscsiTgtPortalAttributeTable, with an iscsiNodeIndex of zero.

Other implementations do not use the same tag and/or port for all nodes; these implementations will create a row in this table for each (portal, node) tuple, using iscsiNodeIndex to designate the node for this portal tag and port.

### 6.6. iscsiInitiatorPortal

The iscsiIntrPortalAttributesTable contains initiator-specific objects for iSCSI portals. Rows in this table use the same indices as their corresponding entries in the iscsiPortalAttributesTable. A row in this table is created when the initiatorTypePortal bit is set in the iscsiPortalRoles attribute; it is destroyed when this bit is cleared.

Each row in this table contains a portal group aggregation tag, indicating which portals an initiator may use together within a multiple-connection session.

This table will be empty for iSCSI instances that contain only targets (such as most iSCSI devices).

Many implementations use the same initiator tag for all nodes accessing targets via a given portal. These implementations will create a single row in iscsiIntrPortalAttributeTable, with an iscsiNodeIndex of zero.

Other implementations do not use the same tag and/or port for all nodes; these implementations will create a row in this table for each (portal, node) tuple, using iscsiNodeIndex to designate the node for this portal tag and port.

## 6.7. iscsiNode

The iscsiNodeAttributesTable contains a list of iSCSI nodes, each of which may have an initiator role, a target role, or both.

This table contains the node's attributes that are common to both roles, such as its iSCSI name and alias string. Attributes specific to initiators or targets are available in the iscsiTarget and iscsiInitiator objects. Each row in this table that can fulfill a target role has a corresponding row in the iscsiTarget table; each entry that fulfills an initiator role has a row in the iscsiInitiator table. Nodes such as copy managers that can take on both roles have a corresponding row in each table.

This table also contains the login negotiations preferences for this node. These objects indicate the values this node will offer or prefer in the operational negotiation phase of the login process.

For most implementations, each entry in the table also contains a RowPointer to the transport table entry in the SCSI MIB module that this iSCSI node represents. For implementations without a standard SCSI layer above iSCSI, such as an iSCSI proxy or gateway, this RowPointer can point to a row in an implementation-specific table that this iSCSI node represents.

## 6.8. iscsiTarget

The iscsiTargetAttributesTable contains target-specific attributes for iSCSI nodes. Each entry in this table uses the same index values as its corresponding iscsiNode entry.

This table contains attributes used to indicate the last failure that was (or should have been) sent as a notification.

This table is augmented by the iscsiTargetLoginStatsTable and the iscsiTargetLogoutStatsTable, which count the numbers of normal and abnormal logins and logouts to this target.

### 6.9. iscsiTgtAuthorization

The iscsiTgtAuthAttributesTable contains an entry for each initiator identifier that will be allowed to access the target under which it appears. Each entry contains a RowPointer to a user identity in the IPS Authorization MIB module, which contains the name, address, and credential information necessary to authenticate the initiator.

### 6.10. iscsiInitiator

The iscsiInitiatorAttributesTable contains a list of initiator-specific attributes for iSCSI nodes. Each entry in this table uses the same index values as its corresponding iscsiNode entry.

Most implementations will include a single entry in this table, regardless of the number of physical interfaces the initiator may use.

This table is augmented by the iscsiInitiatorLoginStatsTable and the iscsiInitiatorLogoutStatsTable, which count the numbers of normal and abnormal logins and logouts from this initiator.

### 6.11. iscsiIntrAuthorization

The iscsiIntrAuthAttributesTable contains an entry for each target identifier to which the initiator is configured to establish a session.

Each entry contains a RowPointer to a user identity in the IPS Authorization MIB module, which contains the name, address, and credential information necessary to identify (for discovery purposes) and authenticate the target.

### 6.12. iscsiSession

The iscsiSessionAttributesTable contains a set of rows that list the sessions known to be existing locally for each node in each iSCSI instance.

The session type for each session indicates whether the session is used for normal SCSI commands or for discovery using the SendTargets text command. Discovery sessions that do not belong to any particular node have a node index attribute of zero.

The session direction for each session indicates whether it is an Inbound session or an Outbound session. Inbound sessions are from some other initiator to the target node under which the session appears. Outbound sessions are from the initiator node under which the session appears to a target outside this iSCSI instance.

Many attributes may be negotiated when starting an iSCSI session. Most of these attributes are included in the session object.

Some attributes, such as the integrity and authentication schemes, have some standard values that can be extended by vendors to include their own schemes. These contain an object identifier, rather than the expected enumerated type, to allow these values to be extended by other MIB modules, such as an enterprise MIB module.

The iscsiSessionStatsTable includes statistics related to performance; it counts iSCSI data bytes and PDUs.

For implementations that support error recovery without terminating a session, the iscsiSessionCxnErrorStatsTable contains counters for the numbers of digest and connection errors that have occurred within the session.

## 6.13. iscsiConnection

The iscsiConnectionAttributesTable contains a list of active connections within each session. It contains the IP addresses and TCP (or other protocol) ports of both the local and remote sides of the connection. These may be used to locate other connection-related information and statistics in the TCP MIB module [RFC4022].

The attributes table also contains a connection state. This state is not meant to directly map to the state tables included within the iSCSI specification; they are meant to be simplified, higher-level definitions of connection state that provide information more useful to a user or network manager.

No statistics are kept for connections.

## 6.14. IP Addresses and TCP Port Numbers

The IP addresses in this module are represented by two attributes, one of type InetAddressType, and the other of type InetAddress. These are taken from [RFC4001], which specifies how to support addresses that may be either IPv4 or IPv6.

The TCP port numbers that appear in a few of the structures are described as simply port numbers, with a protocol attribute indicating whether they are TCP ports or something else. This will allow the module to be compatible with iSCSI over transports other than TCP in the future.

### 6.15. Descriptors: Using OIDs in Place of Enumerated Types

The iSCSI MIB module has a few attributes, namely, the digest method attributes, where an enumerated type would work well, except that an implementation may need to extend the attribute and add types of its own. To make this work, this MIB module defines a set of object identities within the iscsiDescriptors subtree. Each of these object identities is basically an enumerated type.

Attributes that make use of these object identities have a value that is an Object Identifier (OID) instead of an enumerated type. These OIDs can indicate either the object identities defined in this module or object identities defined elsewhere, such as in an enterprise MIB module. Those implementations that add their own digest methods should also define a corresponding object identity for each of these methods within their own enterprise MIB module, and return its OID whenever one of these attributes is using that method.

### 6.16. Notifications

Three notifications are provided. One is sent by an initiator detecting a critical login failure, another is sent by a target detecting a critical login failure, and the third is sent upon a session being terminated due to an abnormal connection or digest failure. Critical failures are defined as those that may expose security-related problems that may require immediate action, such as failures due to authentication, authorization, or negotiation problems. Attributes in the initiator, target, and instance objects provide the information necessary to send in the notification, such as the initiator or target name and IP address at the other end that may have caused the failure.

To avoid sending an excessive number of notifications due to multiple errors counted, an SNMP agent implementing the iSCSI MIB module SHOULD NOT send more than three iSCSI notifications in any 10-second period.

The 3-in-10 rule was chosen because one notification every three seconds was deemed often enough, but should two or three different notifications happen at the same time, it would not be desirable to suppress them. Three notifications in 10 seconds is a happy medium,

where a short burst of notifications is allowed, without inundating the network and/or notification host with a large number of notifications.

## 7. MIB Definitions

```
ISCSI-MIB DEFINITIONS  ::= BEGIN

    IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, OBJECT-IDENTITY, NOTIFICATION-TYPE,
    Unsigned32, Counter32, Counter64, Gauge32,
    mib-2
    FROM SNMPv2-SMI

    TEXTUAL-CONVENTION, TruthValue, RowPointer, TimeStamp, RowStatus,
    AutonomousType, StorageType
    FROM SNMPv2-TC

    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
    FROM SNMPv2-CONF

    SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB -- RFC 3411

    InetAddressType, InetAddress, InetPortNumber
    FROM INET-ADDRESS-MIB -- RFC 4001
    ;

iscsiMibModule MODULE-IDENTITY
    LAST-UPDATED  "200605220000Z" -- May 22, 2006
    ORGANIZATION  "IETF IPS Working Group"
    CONTACT-INFO
    "
    Mark Bakke
    Cisco Systems, Inc
    7900 International Drive, Suite 400
    Bloomington, MN
    USA 55425

    E-mail: mbakke@cisco.com

    Marjorie Krueger
    Hewlett-Packard
    Networked Storage Architecture
    Networked Storage Solutions Org.
    8000 Foothills Blvd.
    Roseville, CA 95747
```

```
    E-mail: marjorie_krueger@hp.com

    Tom McSweeney
    IBM Corporation
    600 Park Offices Drive
    Research Triangle Park, NC
    USA 27709

    E-mail: tommcs@us.ibm.com

    James Muchow
    Qlogic Corp.
    6321 Bury Dr.
    Eden Prairie, MN
    USA 55346

    E-mail: james.muchow@qlogic.com"

    DESCRIPTION
        "The iSCSI Protocol MIB module.
         Copyright (C) The Internet Society (2006).  This version of
         this MIB module is part of RFC 4544;  see the RFC itself for
         full legal notices."
    REVISION "200605220000Z" -- May 22, 2006
    DESCRIPTION
        "Initial version of the iSCSI Protocol MIB module"

::= { mib-2 142 }

iscsiNotifications OBJECT IDENTIFIER ::= { iscsiMibModule 0 }
iscsiObjects       OBJECT IDENTIFIER ::= { iscsiMibModule 1 }
iscsiConformance   OBJECT IDENTIFIER ::= { iscsiMibModule 2 }
iscsiAdmin         OBJECT IDENTIFIER ::= { iscsiMibModule 3 }

-- Textual Conventions

IscsiTransportProtocol ::= TEXTUAL-CONVENTION
    DISPLAY-HINT  "d"
    STATUS        current
    DESCRIPTION
        "This data type is used to define the transport
        protocols that will carry iSCSI PDUs."
    REFERENCE
        "RFC791, RFC1700

        The presently known, officially delegated numbers
        can be found at:
        http://www.iana.org/assignments/protocol-numbers"
```

```
    SYNTAX        Unsigned32 (0..255)

IscsiDigestMethod ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "This data type represents the methods possible
        for digest negotiation.
        none     - a placeholder for a secondary digest method
                   that means only the primary method can be
                   used.
        other    - a digest method other than those defined below.
        noDigest - does not support digests (will operate without
                   a digest (Note: implementations must support
                   digests to be compliant with the RFC3720).
        CRC32c   - require a CRC32C digest."
    REFERENCE
        "RFC 3720, Section 12.1, HeaderDigest and DataDigest"
    SYNTAX        INTEGER {
                      none(1),
                      other(2),
                      noDigest(3),
                      crc32c(4)
                  }

IscsiName ::= TEXTUAL-CONVENTION
    DISPLAY-HINT  "223t"
    STATUS        current
    DESCRIPTION
        "This data type is used for objects whose value is an
        iSCSI name with the properties described in RFC 3720
        section 3.2.6.1, and encoded as specified in RFC 3720
        section 3.2.6.2.  A zero-length string indicates the
        absence of an iSCSI name."
    REFERENCE
        "RFC 3720, Section 3.2.6, iSCSI Names."
    SYNTAX        OCTET STRING (SIZE(0 | 16..223))

--**********************************************************************

iscsiDescriptors OBJECT IDENTIFIER ::= { iscsiAdmin 1 }

iscsiHeaderIntegrityTypes OBJECT IDENTIFIER ::= { iscsiDescriptors 1 }

iscsiHdrIntegrityNone OBJECT-IDENTITY
    STATUS      current
    DESCRIPTION
        "The authoritative identifier when no integrity
        scheme (for either the header or data) is being
```

```
        used."
    REFERENCE
        "RFC 3720, Section 12.1, HeaderDigest and DataDigest"
::= { iscsiHeaderIntegrityTypes 1 }

iscsiHdrIntegrityCrc32c OBJECT-IDENTITY
    STATUS      current
    DESCRIPTION
        "The authoritative identifier when the integrity
        scheme (for either the header or data) is CRC32c."
    REFERENCE
        "RFC 3720, Section 12.1, HeaderDigest and DataDigest"
::= { iscsiHeaderIntegrityTypes 2 }

iscsiDataIntegrityTypes OBJECT IDENTIFIER ::= { iscsiDescriptors 2 }

iscsiDataIntegrityNone OBJECT-IDENTITY
    STATUS      current
    DESCRIPTION
        "The authoritative identifier when no integrity
        scheme (for either the header or data) is being
        used."
    REFERENCE
        "RFC 3720, Section 12.1, HeaderDigest and DataDigest"
::= { iscsiDataIntegrityTypes 1 }

iscsiDataIntegrityCrc32c OBJECT-IDENTITY
    STATUS      current
    DESCRIPTION
        "The authoritative identifier when the integrity
        scheme (for either the header or data) is CRC32c."
    REFERENCE
        "RFC 3720, Section 12.1, HeaderDigest and DataDigest"
::= { iscsiDataIntegrityTypes 2 }

--**********************************************************************

iscsiInstance OBJECT IDENTIFIER ::= { iscsiObjects 1 }

-- Instance Attributes Table

iscsiInstanceAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiInstanceAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of iSCSI instances present on the system."
::= { iscsiInstance 1 }
```

```
iscsiInstanceAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiInstanceAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular iSCSI instance."
    INDEX { iscsiInstIndex }
::= { iscsiInstanceAttributesTable 1 }

IscsiInstanceAttributesEntry ::= SEQUENCE {
    iscsiInstIndex                  Unsigned32,
    iscsiInstDescr                  SnmpAdminString,
    iscsiInstVersionMin             Unsigned32,
    iscsiInstVersionMax             Unsigned32,
    iscsiInstVendorID               SnmpAdminString,
    iscsiInstVendorVersion          SnmpAdminString,
    iscsiInstPortalNumber           Unsigned32,
    iscsiInstNodeNumber             Unsigned32,
    iscsiInstSessionNumber          Unsigned32,
    iscsiInstSsnFailures            Counter32,
    iscsiInstLastSsnFailureType     AutonomousType,
    iscsiInstLastSsnRmtNodeName     IscsiName,
    iscsiInstDiscontinuityTime      TimeStamp
}

iscsiInstIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a particular
        iSCSI instance.  This index value must not be modified or
        reused by an agent unless a reboot has occurred.  An agent
        should attempt to keep this value persistent across reboots."
::= { iscsiInstanceAttributesEntry 1 }

iscsiInstDescr OBJECT-TYPE
    SYNTAX        SnmpAdminString
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A UTF-8 string, determined by the implementation to
        describe the iSCSI instance.  When only a single instance
        is present, this object may be set to the zero-length
        string; with multiple iSCSI instances, it may be used in
        an implementation-dependent manner to describe the purpose
        of the respective instance."
```

```
::= { iscsiInstanceAttributesEntry 2 }

iscsiInstVersionMin OBJECT-TYPE
    SYNTAX        Unsigned32 (0..255)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The minimum version number of the iSCSI specification
        such that this iSCSI instance supports this minimum
        value, the maximum value indicated by the corresponding
        instance in iscsiInstVersionMax, and all versions in
        between."
    REFERENCE
        "RFC 3720, Section 10.12, Login Request"
::= { iscsiInstanceAttributesEntry 3 }

iscsiInstVersionMax OBJECT-TYPE
    SYNTAX        Unsigned32 (0..255)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The maximum version number of the iSCSI specification
        such that this iSCSI instance supports this maximum
        value, the minimum value indicated by the corresponding
        instance in iscsiInstVersionMin, and all versions in
        between."
    REFERENCE
        "RFC 3720, Section 10.12, Login Request"
::= { iscsiInstanceAttributesEntry 4 }

iscsiInstVendorID OBJECT-TYPE
    SYNTAX        SnmpAdminString
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A UTF-8 string describing the manufacturer of the
        implementation of this instance."
::= { iscsiInstanceAttributesEntry 5 }

iscsiInstVendorVersion OBJECT-TYPE
    SYNTAX        SnmpAdminString
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A UTF-8 string set by the manufacturer describing the
        version of the implementation of this instance.  The
        format of this string is determined solely by the
        manufacturer, and is for informational purposes only.
```

```
        It is unrelated to the iSCSI specification version numbers."
::= { iscsiInstanceAttributesEntry 6 }

iscsiInstPortalNumber OBJECT-TYPE
    SYNTAX        Unsigned32
    UNITS         "transport endpoints"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of rows in the iscsiPortalAttributesTable
        that are currently associated with this iSCSI instance."
::= { iscsiInstanceAttributesEntry 7 }

iscsiInstNodeNumber OBJECT-TYPE
    SYNTAX        Unsigned32
    UNITS         "iSCSI nodes"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of rows in the iscsiNodeAttributesTable
        that are currently associated with this iSCSI instance."
::= { iscsiInstanceAttributesEntry 8 }

iscsiInstSessionNumber OBJECT-TYPE
    SYNTAX        Unsigned32
    UNITS         "sessions"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of rows in the iscsiSessionAttributesTable
        that are currently associated with this iSCSI instance."
::= { iscsiInstanceAttributesEntry 9 }

iscsiInstSsnFailures  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "sessions"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object counts the number of times a session belonging
        to this instance has been failed.  If this counter has
        suffered a discontinuity, the time of the last discontinuity
        is indicated in iscsiInstDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 12.1, HeaderDigest and DataDigest"
::= { iscsiInstanceAttributesEntry 10 }

iscsiInstLastSsnFailureType  OBJECT-TYPE
```

```
    SYNTAX        AutonomousType
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The counter object in the iscsiInstSsnErrorStatsTable
        that was incremented when the last session failure occurred.

        If the reason for failure is not found in the
        iscsiInstSsnErrorStatsTable, the value { 0.0 } is
        used instead."
::= { iscsiInstanceAttributesEntry 11 }

iscsiInstLastSsnRmtNodeName  OBJECT-TYPE
    SYNTAX        IscsiName
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The iSCSI name of the remote node from the failed
        session."
::= { iscsiInstanceAttributesEntry 12 }

iscsiInstDiscontinuityTime  OBJECT-TYPE
    SYNTAX        TimeStamp
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The value of SysUpTime on the most recent occasion
        at which any one or more of this instance's counters
        suffered a discontinuity.

        If no such discontinuities have occurred since the last
        re-initialization of the local management subsystem,
        then this object contains a zero value."
::= { iscsiInstanceAttributesEntry 13 }


-- Instance Session Failure Stats Table

iscsiInstanceSsnErrorStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiInstanceSsnErrorStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Statistics regarding the occurrences of error types
        that result in a session failure."
::= { iscsiInstance 2 }

iscsiInstanceSsnErrorStatsEntry OBJECT-TYPE
```

```
    SYNTAX        IscsiInstanceSsnErrorStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular iSCSI instance."
    AUGMENTS { iscsiInstanceAttributesEntry }
::= { iscsiInstanceSsnErrorStatsTable 1 }

IscsiInstanceSsnErrorStatsEntry ::= SEQUENCE {
    iscsiInstSsnDigestErrors       Counter32,
    iscsiInstSsnCxnTimeoutErrors   Counter32,
    iscsiInstSsnFormatErrors       Counter32
}

iscsiInstSsnDigestErrors OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "sessions"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of sessions that were failed due to receipt of
        a PDU containing header or data digest errors.  If this
        counter has suffered a discontinuity, the time of the last
        discontinuity is indicated in iscsiInstDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 6.7, Digest Errors"
::= { iscsiInstanceSsnErrorStatsEntry 1 }

iscsiInstSsnCxnTimeoutErrors OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "sessions"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of sessions that were failed due to a sequence
        exceeding a time limit.  If this counter has suffered a
        discontinuity, the time of the last discontinuity
        is indicated in iscsiInstDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 6.4, Connection Timeout Management"
::= { iscsiInstanceSsnErrorStatsEntry 2 }

iscsiInstSsnFormatErrors OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "sessions"
    MAX-ACCESS    read-only
    STATUS        current
```

```
    DESCRIPTION
        "The count of sessions that were failed due to receipt of
        a PDU that contained a format error.  If this counter has
        suffered a discontinuity, the time of the last discontinuity
        is indicated in iscsiInstDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 6.6, Format Errors"
::= { iscsiInstanceSsnErrorStatsEntry 3 }

--*****************************************************************

iscsiPortal OBJECT IDENTIFIER ::= { iscsiObjects 2 }

-- Portal Attributes Table

iscsiPortalAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiPortalAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of transport endpoints (using TCP or another transport
        protocol) used by this iSCSI instance.  An iSCSI instance may
        use a portal to listen for incoming connections to its targets,
        to initiate connections to other targets, or both."
::= { iscsiPortal 1 }

iscsiPortalAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiPortalAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular portal instance."
    INDEX { iscsiInstIndex, iscsiPortalIndex  }
::= { iscsiPortalAttributesTable 1 }

IscsiPortalAttributesEntry ::= SEQUENCE {
    iscsiPortalIndex               Unsigned32,
    iscsiPortalRowStatus           RowStatus,
    iscsiPortalRoles               BITS,
    iscsiPortalAddrType            InetAddressType,
    iscsiPortalAddr                InetAddress,
    iscsiPortalProtocol            IscsiTransportProtocol,
    iscsiPortalMaxRecvDataSegLength Unsigned32,
    iscsiPortalPrimaryHdrDigest    IscsiDigestMethod,
    iscsiPortalPrimaryDataDigest   IscsiDigestMethod,
    iscsiPortalSecondaryHdrDigest  IscsiDigestMethod,
    iscsiPortalSecondaryDataDigest IscsiDigestMethod,
```

```
    iscsiPortalRecvMarker          TruthValue,
    iscsiPortalStorageType         StorageType
}

iscsiPortalIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a particular
        transport endpoint within this iSCSI instance.  This index
        value must not be modified or reused by an agent unless a
        reboot has occurred.  An agent should attempt to keep this
        value persistent across reboots."
::= { iscsiPortalAttributesEntry 1 }

iscsiPortalRowStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "This field allows entries to be dynamically added and
        removed from this table via SNMP.  When adding a row to
        this table, all non-Index/RowStatus objects must be set.
        When the value of this object is 'active', the values of
        the other objects in this table cannot be changed.
        Rows may be discarded using RowStatus.

        Note that creating a row in this table will typically
        cause the agent to create one or more rows in
        iscsiTgtPortalAttributesTable and/or
        iscsiIntrPortalAttributesTable."
::= { iscsiPortalAttributesEntry 2 }

iscsiPortalRoles OBJECT-TYPE
    SYNTAX        BITS {
                      targetTypePortal(0),
                      initiatorTypePortal(1)
                  }
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "A portal can operate in one or both of two roles:
        as a target portal and/or an initiator portal.  If
        the portal will operate in both roles, both bits
        must be set.

        This object will define a corresponding row that
```

```
        will exist or must be created in the
        iscsiTgtPortalAttributesTable, the
        iscsiIntrPortalAttributesTable or both.  If the
        targetTypePortal bit is set, one or more corresponding
        iscsiTgtPortalAttributesEntry rows will be found or
        created.  If the initiatorTypePortal bit is set,
        one or more corresponding iscsiIntrPortalAttributesEntry
        rows will be found or created.  If both bits are set, one
        or more corresponding rows will be found or created in
        one of the above tables."
::= { iscsiPortalAttributesEntry 3 }

iscsiPortalAddrType OBJECT-TYPE
    SYNTAX        InetAddressType
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The type of Internet Network Address contained in the
        corresponding instance of the iscsiPortalAddr."
    DEFVAL        { ipv4 }
::= { iscsiPortalAttributesEntry 4 }

iscsiPortalAddr OBJECT-TYPE
    SYNTAX        InetAddress
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The portal's Internet Network Address, of the type
        specified by the object iscsiPortalAddrType.  If
        iscsiPortalAddrType has the value 'dns', this address
        gets resolved to an IP address whenever a new iSCSI
        connection is established using this portal."
::= { iscsiPortalAttributesEntry 5 }

iscsiPortalProtocol OBJECT-TYPE
    SYNTAX        IscsiTransportProtocol
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The portal's transport protocol."
    DEFVAL        { 6 } -- TCP
::= { iscsiPortalAttributesEntry 6 }

iscsiPortalMaxRecvDataSegLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-create
    STATUS        current
```

```
    DESCRIPTION
        "The maximum PDU length this portal can receive.
        This may be constrained by hardware characteristics
        and individual implementations may choose not to
        allow this object to be changed."
    REFERENCE
        "RFC 3720, Section 12.12, MaxRecvDataSegmentLength"
    DEFVAL { 8192 }
::= { iscsiPortalAttributesEntry 7 }

iscsiPortalPrimaryHdrDigest OBJECT-TYPE
    SYNTAX        IscsiDigestMethod
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The preferred header digest for this portal."
    DEFVAL        { crc32c }
::= { iscsiPortalAttributesEntry 8 }

iscsiPortalPrimaryDataDigest OBJECT-TYPE
    SYNTAX        IscsiDigestMethod
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The preferred data digest method for this portal."
    DEFVAL        { crc32c }
::= { iscsiPortalAttributesEntry 9 }

iscsiPortalSecondaryHdrDigest OBJECT-TYPE
    SYNTAX        IscsiDigestMethod
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "An alternate header digest preference for this portal."
    DEFVAL        { noDigest }
::= { iscsiPortalAttributesEntry 10 }

iscsiPortalSecondaryDataDigest OBJECT-TYPE
    SYNTAX        IscsiDigestMethod
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "An alternate data digest preference for this portal."
    DEFVAL        { noDigest }
::= { iscsiPortalAttributesEntry 11 }

iscsiPortalRecvMarker OBJECT-TYPE
    SYNTAX        TruthValue
```

```
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "This object indicates whether or not this portal will
        request markers in its incoming data stream."
    REFERENCE
        "RFC 3720, Appendix A."
    DEFVAL        { false }
::= { iscsiPortalAttributesEntry 12 }

iscsiPortalStorageType OBJECT-TYPE
    SYNTAX        StorageType
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The storage type for this row.  Rows in this table that were
         created through an external process may have a storage type of
         readOnly or permanent.

         Conceptual rows having the value 'permanent' need not
         allow write access to any columnar objects in the row."
    DEFVAL        { nonVolatile }
::= { iscsiPortalAttributesEntry 13 }

--**********************************************************************
iscsiTargetPortal OBJECT IDENTIFIER ::= { iscsiObjects 3 }

-- Target Portal Attributes Table

iscsiTgtPortalAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiTgtPortalAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of transport endpoints (using TCP or another transport
        protocol) on which this iSCSI instance listens for incoming
        connections to its targets."
::= { iscsiTargetPortal 1 }

iscsiTgtPortalAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiTgtPortalAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular portal instance that is used to listen for
        incoming connections to local targets.  One or more rows in
        this table is populated by the agent for each
```

```
        iscsiPortalAttributesEntry row that has the bit
        targetTypePortal set in its iscsiPortalRoles column."
    INDEX { iscsiInstIndex, iscsiPortalIndex,
            iscsiTgtPortalNodeIndexOrZero  }
::= { iscsiTgtPortalAttributesTable 1 }

IscsiTgtPortalAttributesEntry ::= SEQUENCE {
    iscsiTgtPortalNodeIndexOrZero  Unsigned32,
    iscsiTgtPortalPort             InetPortNumber,
    iscsiTgtPortalTag              Unsigned32
}

iscsiTgtPortalNodeIndexOrZero OBJECT-TYPE
    SYNTAX        Unsigned32 (0..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a
        particular node within an iSCSI instance present
        on the local system.

        For implementations where each {portal, node} tuple
        can have a different portal tag, this value will
        map to the iscsiNodeIndex.

        For implementations where the portal tag is the
        same for a given portal regardless of which node
        is using the portal, the value 0 (zero) is used."
::= { iscsiTgtPortalAttributesEntry 1 }

iscsiTgtPortalPort OBJECT-TYPE
    SYNTAX        InetPortNumber (1..65535)
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The portal's transport protocol port number on which the
        portal listens for incoming iSCSI connections when the
        portal is used as a target portal.  This object's storage
        type is specified in iscsiPortalStorageType."
::= { iscsiTgtPortalAttributesEntry 2 }

iscsiTgtPortalTag OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The portal's aggregation tag when the portal is used as
        a target portal.  Multiple-connection sessions may
```

```
        be aggregated over portals sharing an identical
        aggregation tag.  This object's storage type is
        specified in iscsiPortalStorageType."
    REFERENCE
        "RFC 3720, Section 3.4.1, iSCSI Architectural Model"
::= { iscsiTgtPortalAttributesEntry 3 }

--**********************************************************************

iscsiInitiatorPortal OBJECT IDENTIFIER ::= { iscsiObjects 4 }

-- Initiator Portal Attributes Table

iscsiIntrPortalAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiIntrPortalAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of Internet Network Addresses (using TCP or another
        transport protocol) from which this iSCSI instance may
        initiate connections to other targets."
::= { iscsiInitiatorPortal 1 }

iscsiIntrPortalAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiIntrPortalAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular portal instance that is used to initiate
        connections to iSCSI targets.  One or more rows in
        this table is populated by the agent for each
        iscsiPortalAttributesEntry row that has the bit
        initiatorTypePortal set in its iscsiPortalRoles column."
    INDEX { iscsiInstIndex, iscsiPortalIndex,
            iscsiIntrPortalNodeIndexOrZero  }
::= { iscsiIntrPortalAttributesTable 1 }

IscsiIntrPortalAttributesEntry ::= SEQUENCE {
    iscsiIntrPortalNodeIndexOrZero Unsigned32,
    iscsiIntrPortalTag             Unsigned32
}

iscsiIntrPortalNodeIndexOrZero OBJECT-TYPE
    SYNTAX        Unsigned32 (0..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
```

```
        "An arbitrary integer used to uniquely identify a
        particular node within an iSCSI instance present
        on the local system.

        For implementations where each {portal, node} tuple
        can have a different portal tag, this value will
        map to the iscsiNodeIndex.

        For implementations where the portal tag is the
        same for a given portal regardless of which node
        is using the portal, the value 0 (zero) is used."
::= { iscsiIntrPortalAttributesEntry 1 }

iscsiIntrPortalTag OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The portal's aggregation tag when the portal is used as
        an initiator portal.  Multiple-connection sessions may
        be aggregated over portals sharing an identical
        aggregation tag.  This object's storage type is
        specified in iscsiPortalStorageType."
    REFERENCE
        "RFC 3720, Section 3.4.1, iSCSI Architectural Model"
::= { iscsiIntrPortalAttributesEntry 2 }

--*****************************************************************

iscsiNode OBJECT IDENTIFIER ::= { iscsiObjects 5 }

-- Node Attributes Table

iscsiNodeAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiNodeAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of iSCSI nodes belonging to each iSCSI instance
        present on the local system.  An iSCSI node can act as
        an initiator, a target, or both."
::= { iscsiNode 1 }

iscsiNodeAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiNodeAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
```

```
        "An entry (row) containing management information applicable
        to a particular iSCSI node."
    INDEX { iscsiInstIndex, iscsiNodeIndex }
::= { iscsiNodeAttributesTable 1 }

IscsiNodeAttributesEntry ::= SEQUENCE {
    iscsiNodeIndex                  Unsigned32,
    iscsiNodeName                   IscsiName,
    iscsiNodeAlias                  SnmpAdminString,
    iscsiNodeRoles                  BITS,
    iscsiNodeTransportType          RowPointer,
    iscsiNodeInitialR2T             TruthValue,
    iscsiNodeImmediateData          TruthValue,
    iscsiNodeMaxOutstandingR2T      Unsigned32,
    iscsiNodeFirstBurstLength       Unsigned32,
    iscsiNodeMaxBurstLength         Unsigned32,
    iscsiNodeMaxConnections         Unsigned32,
    iscsiNodeDataSequenceInOrder    TruthValue,
    iscsiNodeDataPDUInOrder         TruthValue,
    iscsiNodeDefaultTime2Wait       Unsigned32,
    iscsiNodeDefaultTime2Retain     Unsigned32,
    iscsiNodeErrorRecoveryLevel     Unsigned32,
    iscsiNodeDiscontinuityTime      TimeStamp,
    iscsiNodeStorageType            StorageType
}

iscsiNodeIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a particular
        node within an iSCSI instance.  This index value must not be
        modified or reused by an agent unless a reboot has occurred.
        An agent should attempt to keep this value persistent across
        reboots."
::= { iscsiNodeAttributesEntry 1 }

iscsiNodeName OBJECT-TYPE
    SYNTAX        IscsiName
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This node's iSCSI name, which is independent of the location
        of the node, and can be resolved into a set of addresses
        through various discovery services."
::= { iscsiNodeAttributesEntry 2 }
```

```
iscsiNodeAlias OBJECT-TYPE
    SYNTAX        SnmpAdminString
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A character string that is a human-readable name or
        description of the iSCSI node.  If configured, this alias
        may be communicated to the initiator or target node at
        the remote end of the connection during a Login Request
        or Response message.  This string is not used as an
        identifier, but can be displayed by the system's user
        interface in a list of initiators and/or targets to
        which it is connected.

        If no alias exists, the value is a zero-length string."
    REFERENCE
        "RFC 3720, Section 12.6, TargetAlias, 12.7, InitiatorAlias"
::= { iscsiNodeAttributesEntry 3 }

iscsiNodeRoles OBJECT-TYPE
    SYNTAX        BITS {
                      targetTypeNode(0),
                      initiatorTypeNode(1)
                  }
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A node can operate in one or both of two roles:
        a target role and/or an initiator role.  If the node
        will operate in both roles, both bits must be set.

        This object will also define the corresponding rows that
        will exist in the iscsiTargetAttributesTable, the
        iscsiInitiatorAttributesTable or both.  If the
        targetTypeNode bit is set, there will be a corresponding
        iscsiTargetAttributesEntry.  If the initiatorTypeNode bit
        is set, there will be a corresponding
        iscsiInitiatorAttributesEntry.  If both bits are set,
        there will be a corresponding iscsiTgtPortalAttributesEntry
        and iscsiPortalAttributesEntry."
::= { iscsiNodeAttributesEntry 4 }

iscsiNodeTransportType OBJECT-TYPE
    SYNTAX        RowPointer
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A pointer to the corresponding row in the appropriate
```

```
        table for this SCSI transport, thereby allowing management
        stations to locate the SCSI-level device that is represented
        by this iscsiNode.  For example, it will usually point to the
        corresponding scsiTrnspt object in the SCSI MIB module.

        If no corresponding row exists, the value 0.0 must be
        used to indicate this."
    REFERENCE
        "SCSI-MIB"
::= { iscsiNodeAttributesEntry 5 }

iscsiNodeInitialR2T OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object indicates the InitialR2T preference for this
        node:
        true = YES,
        false = will try to negotiate NO, will accept YES "
    REFERENCE
        "RFC 3720, Section 12.10, InitialR2T"
::= { iscsiNodeAttributesEntry 6 }

iscsiNodeImmediateData OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "This object indicates ImmediateData preference for this
        node:
        true = YES (but will accept NO),
        false = NO "
    REFERENCE
        "RFC 3720, Section 12.11, ImmediateData"
    DEFVAL        { true }
::= { iscsiNodeAttributesEntry 7 }

iscsiNodeMaxOutstandingR2T OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    UNITS         "R2Ts"
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "Maximum number of outstanding requests-to-transmit (R2Ts)
        allowed per iSCSI task."
    REFERENCE
        "RFC 3720, Section 12.17, MaxOutstandingR2T"
```

```
    DEFVAL        { 1 }
::= { iscsiNodeAttributesEntry 8 }

iscsiNodeFirstBurstLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The maximum length (bytes) supported for unsolicited data
        to/from this node."
    REFERENCE
        "RFC 3720, Section 12.14, FirstBurstLength"
    DEFVAL        { 65536 }
::= { iscsiNodeAttributesEntry 9 }

iscsiNodeMaxBurstLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
     "The maximum number of bytes that can be sent within
     a single sequence of Data-In or Data-Out PDUs."
    REFERENCE
        "RFC 3720, Section 12.13, MaxBurstLength"
    DEFVAL        { 262144 }
::= { iscsiNodeAttributesEntry 10 }

iscsiNodeMaxConnections OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    UNITS         "connections"
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The maximum number of connections allowed in each
        session to and/or from this node."
    REFERENCE
        "RFC 3720, Section 12.2, MaxConnections"
    DEFVAL        { 1 }
::= { iscsiNodeAttributesEntry 11 }

iscsiNodeDataSequenceInOrder OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The DataSequenceInOrder preference of this node.
```

```
        False (=No) indicates that iSCSI data PDU sequences may
        be transferred in any order.  True (=Yes) indicates that
        data PDU sequences must be transferred using
        continuously increasing offsets, except during
        error recovery."
    REFERENCE
        "RFC 3720, Section 12.19, DataSequenceInOrder"
    DEFVAL        { true }
::= { iscsiNodeAttributesEntry 12 }

iscsiNodeDataPDUInOrder OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The DataPDUInOrder preference of this node.
        False (=No) indicates that iSCSI data PDUs within sequences
        may be in any order.  True (=Yes) indicates that data PDUs
        within sequences must be at continuously increasing
        addresses, with no gaps or overlay between PDUs."
    REFERENCE
        "RFC 3720, Section 12.18, DataPDUInOrder"
    DEFVAL        { true }
::= { iscsiNodeAttributesEntry 13 }

iscsiNodeDefaultTime2Wait OBJECT-TYPE
    SYNTAX        Unsigned32 (0..3600)
    UNITS         "seconds"
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The DefaultTime2Wait preference of this node.  This is the
        minimum time, in seconds, to wait before attempting an
        explicit/implicit logout or active iSCSI task reassignment
        after an unexpected connection termination or a connection
        reset."
    REFERENCE
        "RFC 3720, Section 12.15, DefaultTime2Wait"
    DEFVAL        { 2 }
::= { iscsiNodeAttributesEntry 14 }

iscsiNodeDefaultTime2Retain OBJECT-TYPE
    SYNTAX        Unsigned32 (0..3600)
    UNITS         "seconds"
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The DefaultTime2Retain preference of this node.  This is
```

```
        the maximum time, in seconds after an initial wait
        (Time2Wait), before which an active iSCSI task reassignment
        is still possible after an unexpected connection termination
        or a connection reset."
    REFERENCE
        "RFC 3720, Section 12.16, DefaultTime2Retain"
    DEFVAL        { 20 }
::= { iscsiNodeAttributesEntry 15 }

iscsiNodeErrorRecoveryLevel OBJECT-TYPE
    SYNTAX        Unsigned32 (0..255)
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The ErrorRecoveryLevel preference of this node.
        Currently, only 0-2 are valid.

        This object is designed to accommodate future error recovery
        levels.

        Higher error recovery levels imply support in addition to
        support for the lower error level functions.  In other words,
        error level 2 implies support for levels 0-1, since those
        functions are subsets of error level 2."
    REFERENCE
        "RFC 3720, Section 12.20, ErrorRecoveryLevel"
    DEFVAL        { 0 }
::= { iscsiNodeAttributesEntry 16 }

iscsiNodeDiscontinuityTime  OBJECT-TYPE
    SYNTAX        TimeStamp
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The value of SysUpTime on the most recent occasion
        at which any one or more of this node's counters
        suffered a discontinuity.

        If no such discontinuities have occurred since the last
        re-initialization of the local management subsystem,
        then this object contains a zero value."
::= { iscsiNodeAttributesEntry 17 }

iscsiNodeStorageType OBJECT-TYPE
    SYNTAX        StorageType
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
```

```
        "The storage type for all read-write objects within this
        row.  Rows in this table are always created via an
        external process, and may have a storage type of readOnly
        or permanent.  Conceptual rows having the value 'permanent'
        need not allow write access to any columnar objects in
        the row.

        If this object has the value 'volatile', modifications
        to read-write objects in this row are not persistent
        across reboots.  If this object has the value
        'nonVolatile', modifications to objects in this row
        are persistent.

        An implementation may choose to allow this object
        to be set to either 'nonVolatile' or 'volatile',
        allowing the management application to choose this
        behavior."
    DEFVAL        { volatile }
::= { iscsiNodeAttributesEntry 18 }

--*****************************************************************

iscsiTarget OBJECT IDENTIFIER ::= { iscsiObjects 6 }

-- Target Attributes Table

iscsiTargetAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiTargetAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of iSCSI nodes that can take on a target role,
        belonging to each iSCSI instance present on the local
        system."
::= { iscsiTarget 1 }

iscsiTargetAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiTargetAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular node that can take on a target role."
    INDEX { iscsiInstIndex, iscsiNodeIndex }
::= { iscsiTargetAttributesTable 1 }

IscsiTargetAttributesEntry ::= SEQUENCE {
    iscsiTgtLoginFailures           Counter32,
```

```
    iscsiTgtLastFailureTime         TimeStamp,
    iscsiTgtLastFailureType         AutonomousType,
    iscsiTgtLastIntrFailureName     IscsiName,
    iscsiTgtLastIntrFailureAddrType InetAddressType,
    iscsiTgtLastIntrFailureAddr     InetAddress
}

iscsiTgtLoginFailures OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed login attempts"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object counts the number of times a login attempt to this
        local target has failed.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiTargetAttributesEntry 1 }

iscsiTgtLastFailureTime OBJECT-TYPE
    SYNTAX        TimeStamp
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The timestamp of the most recent failure of a login attempt
        to this target.  A value of zero indicates that no such
        failures have occurred since the last system boot."
::= { iscsiTargetAttributesEntry 2 }

iscsiTgtLastFailureType  OBJECT-TYPE
    SYNTAX        AutonomousType
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The type of the most recent failure of a login attempt
        to this target, represented as the OID of the counter
        object in iscsiTargetLoginStatsTable for which the
        relevant instance was incremented.  A value of 0.0
        indicates a type that is not represented by any of
        the counters in iscsiTargetLoginStatsTable."
::= { iscsiTargetAttributesEntry 3 }

iscsiTgtLastIntrFailureName  OBJECT-TYPE
    SYNTAX        IscsiName
    MAX-ACCESS    read-only
    STATUS        current
```

```
    DESCRIPTION
        "The iSCSI name of the initiator that failed the last
        login attempt."
::= { iscsiTargetAttributesEntry 4 }

iscsiTgtLastIntrFailureAddrType OBJECT-TYPE
    SYNTAX        InetAddressType
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The type of Internet Network Address contained in the
        corresponding instance of the iscsiTgtLastIntrFailureAddr.
        The value 'dns' is not allowed."
::= { iscsiTargetAttributesEntry 5 }

iscsiTgtLastIntrFailureAddr OBJECT-TYPE
    SYNTAX        InetAddress
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "An Internet Network Address, of the type specified by
        the object iscsiTgtLastIntrFailureAddrType, giving the
        host address of the initiator that failed the last login
        attempt."
::= { iscsiTargetAttributesEntry 6 }

-- Target Login Stats Table

iscsiTargetLoginStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiTargetLoginStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table of counters that keep a record of the results
        of initiators' login attempts to this target."
::= { iscsiTarget 2 }

iscsiTargetLoginStatsEntry OBJECT-TYPE
    SYNTAX        IscsiTargetLoginStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing counters for each result of
        a login attempt to this target."
    AUGMENTS { iscsiTargetAttributesEntry }
::= { iscsiTargetLoginStatsTable 1 }

IscsiTargetLoginStatsEntry ::= SEQUENCE {
```

```
    iscsiTgtLoginAccepts           Counter32,
    iscsiTgtLoginOtherFails        Counter32,
    iscsiTgtLoginRedirects         Counter32,
    iscsiTgtLoginAuthorizeFails    Counter32,
    iscsiTgtLoginAuthenticateFails Counter32,
    iscsiTgtLoginNegotiateFails    Counter32
}

iscsiTgtLoginAccepts OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "successful logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status
        0x0000, Accept Login, transmitted by this
        target.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiTargetLoginStatsEntry 1 }

iscsiTgtLoginOtherFails OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of Login Response PDUs that were transmitted
        by this target and that were not counted by any other
        object in the row.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiTargetLoginStatsEntry 2 }

iscsiTgtLoginRedirects OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "redirected logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status class 0x01,
        Redirection, transmitted by this target.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
```

```
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiTargetLoginStatsEntry 3 }

iscsiTgtLoginAuthorizeFails OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status 0x0202,
        Forbidden Target, transmitted by this target.

        If this counter is incremented, an iscsiTgtLoginFailure
        notification should be generated.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiTargetLoginStatsEntry 4 }

iscsiTgtLoginAuthenticateFails OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status 0x0201,
        Authentication Failed, transmitted by this target.

        If this counter is incremented, an iscsiTgtLoginFailure
        notification should be generated.

        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiTargetLoginStatsEntry 5 }

iscsiTgtLoginNegotiateFails OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of times a target has effectively refused a
        login because the parameter negotiation failed.
```

```
        If this counter is incremented, an iscsiTgtLoginFailure
        notification should be generated.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
::= { iscsiTargetLoginStatsEntry 6 }

-- Target Logout Stats Table

iscsiTargetLogoutStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiTargetLogoutStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "When a target receives a Logout command, it responds
        with a Logout Response that carries a status code.
        This table contains counters for both normal and
        abnormal logout requests received by this target."
::= { iscsiTarget 3 }

iscsiTargetLogoutStatsEntry OBJECT-TYPE
    SYNTAX        IscsiTargetLogoutStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing counters of Logout Response
        PDUs that were received by this target."
    AUGMENTS { iscsiTargetAttributesEntry }
::= { iscsiTargetLogoutStatsTable 1 }

IscsiTargetLogoutStatsEntry ::= SEQUENCE {
    iscsiTgtLogoutNormals          Counter32,
    iscsiTgtLogoutOthers           Counter32
}

iscsiTgtLogoutNormals OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "normal logouts"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Logout Command PDUs received by this target,
        with reason code 0 (closes the session).
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.14.1, Reason Code"
::= { iscsiTargetLogoutStatsEntry 1 }
```

```
iscsiTgtLogoutOthers OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "abnormal logouts"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Logout Command PDUs received by this target,
        with any reason code other than 0.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.14.1, Reason Code"
::= { iscsiTargetLogoutStatsEntry 2 }

--*****************************************************************

iscsiTgtAuthorization OBJECT IDENTIFIER ::= { iscsiObjects 7 }

-- Target Authorization Attributes Table

iscsiTgtAuthAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiTgtAuthAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of initiator identities that are authorized to
        access each target node within each iSCSI instance
        present on the local system."
::= { iscsiTgtAuthorization 1 }

iscsiTgtAuthAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiTgtAuthAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information
        applicable to a particular target node's authorized
        initiator identity."
    INDEX { iscsiInstIndex, iscsiNodeIndex, iscsiTgtAuthIndex }
::= { iscsiTgtAuthAttributesTable 1 }

IscsiTgtAuthAttributesEntry ::= SEQUENCE {
    iscsiTgtAuthIndex              Unsigned32,
    iscsiTgtAuthRowStatus          RowStatus,
    iscsiTgtAuthIdentity           RowPointer,
    iscsiTgtAuthStorageType        StorageType
}
```

```
iscsiTgtAuthIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a particular
        target's authorized initiator identity within an iSCSI
        instance present on the local system.  This index value must
        not be modified or reused by an agent unless a reboot has
        occurred.  An agent should attempt to keep this value
        persistent across reboots."
::= { iscsiTgtAuthAttributesEntry 1 }

iscsiTgtAuthRowStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "This field allows entries to be dynamically added and
        removed from this table via SNMP.  When adding a row to
        this table, all non-Index/RowStatus objects must be set.
        When the value of this object is 'active', the values of
        the other objects in this table cannot be changed.
        Rows may be discarded using RowStatus."
::= { iscsiTgtAuthAttributesEntry 2 }

iscsiTgtAuthIdentity OBJECT-TYPE
    SYNTAX        RowPointer
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "A pointer to the corresponding user entry in the IPS-AUTH
        MIB module that will be allowed to access this iSCSI target."
    REFERENCE
        "IPS-AUTH MIB, RFC 4545"
::= { iscsiTgtAuthAttributesEntry 3 }

iscsiTgtAuthStorageType OBJECT-TYPE
    SYNTAX        StorageType
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The storage type for this row.  Rows in this table that were
         created through an external process may have a storage type of
         readOnly or permanent.

         Conceptual rows having the value 'permanent' need not
         allow write access to any columnar objects in the row."
```

```
    DEFVAL        { nonVolatile }
::= { iscsiTgtAuthAttributesEntry 4 }

--*****************************************************************

iscsiInitiator OBJECT IDENTIFIER ::= { iscsiObjects 8 }

-- Initiator Attributes Table

iscsiInitiatorAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiInitiatorAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of iSCSI nodes that can take on an initiator
        role, belonging to each iSCSI instance present on
        the local system."
::= { iscsiInitiator 1 }

iscsiInitiatorAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiInitiatorAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information
        applicable to a particular iSCSI node that has
        initiator capabilities."
    INDEX  { iscsiInstIndex, iscsiNodeIndex }
::= { iscsiInitiatorAttributesTable 1 }

IscsiInitiatorAttributesEntry ::= SEQUENCE {
    iscsiIntrLoginFailures         Counter32,
    iscsiIntrLastFailureTime       TimeStamp,
    iscsiIntrLastFailureType       AutonomousType,
    iscsiIntrLastTgtFailureName    IscsiName,
    iscsiIntrLastTgtFailureAddrType InetAddressType,
    iscsiIntrLastTgtFailureAddr    InetAddress
}

iscsiIntrLoginFailures OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object counts the number of times a login attempt from
        this local initiator has failed.
        If this counter has suffered a discontinuity, the time of the
```

```
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiInitiatorAttributesEntry 1 }

iscsiIntrLastFailureTime OBJECT-TYPE
    SYNTAX        TimeStamp
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The timestamp of the most recent failure of a login attempt
        from this initiator.  A value of zero indicates that no such
        failures have occurred since the last system boot."
::= { iscsiInitiatorAttributesEntry 2 }

iscsiIntrLastFailureType  OBJECT-TYPE
    SYNTAX        AutonomousType
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The type of the most recent failure of a login attempt
        from this initiator, represented as the OID of the counter
        object in iscsiInitiatorLoginStatsTable for which the
        relevant instance was incremented.  A value of 0.0
        indicates a type that is not represented by any of
        the counters in iscsiInitiatorLoginStatsTable."
::= { iscsiInitiatorAttributesEntry 3 }

iscsiIntrLastTgtFailureName  OBJECT-TYPE
    SYNTAX        IscsiName
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A UTF-8 string giving the name of the target that failed
        the last login attempt."
::= { iscsiInitiatorAttributesEntry 4 }

iscsiIntrLastTgtFailureAddrType OBJECT-TYPE
    SYNTAX        InetAddressType
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The type of Internet Network Address contained in the
        corresponding instance of the iscsiIntrLastTgtFailureAddr.
        The value 'dns' is not allowed."
::= { iscsiInitiatorAttributesEntry 5 }

iscsiIntrLastTgtFailureAddr OBJECT-TYPE
```

```
    SYNTAX        InetAddress
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "An Internet Network Address, of the type specified by the
        object iscsiIntrLastTgtFailureAddrType, giving the host
        address of the target that failed the last login attempt."
::= { iscsiInitiatorAttributesEntry 6 }

-- Initiator Login Stats Table

iscsiInitiatorLoginStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiInitiatorLoginStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A table of counters which keep track of the results of
        this initiator's login attempts."
::= { iscsiInitiator 2 }

iscsiInitiatorLoginStatsEntry OBJECT-TYPE
    SYNTAX        IscsiInitiatorLoginStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing counters of each result
        of this initiator's login attempts."
    AUGMENTS { iscsiInitiatorAttributesEntry }
::= { iscsiInitiatorLoginStatsTable 1 }

IscsiInitiatorLoginStatsEntry ::= SEQUENCE {
    iscsiIntrLoginAcceptRsps       Counter32,
    iscsiIntrLoginOtherFailRsps    Counter32,
    iscsiIntrLoginRedirectRsps     Counter32,
    iscsiIntrLoginAuthFailRsps     Counter32,
    iscsiIntrLoginAuthenticateFails Counter32,
    iscsiIntrLoginNegotiateFails   Counter32
}

iscsiIntrLoginAcceptRsps OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "successful logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status
        0x0000, Accept Login, received by this initiator.
        If this counter has suffered a discontinuity, the time of the
```

```
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiInitiatorLoginStatsEntry 1 }

iscsiIntrLoginOtherFailRsps OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs received by this
        initiator with any status code not counted in the
        objects below.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiInitiatorLoginStatsEntry 2 }

iscsiIntrLoginRedirectRsps OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status class 0x01,
        Redirection, received by this initiator.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiInitiatorLoginStatsEntry 3 }

iscsiIntrLoginAuthFailRsps OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Login Response PDUs with status class 0x201,
        Authentication Failed, received by this initiator.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiInitiatorLoginStatsEntry 4 }
```

```
iscsiIntrLoginAuthenticateFails OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of times the initiator has aborted a
        login because the target could not be authenticated.

        No response is generated.

        If this counter is incremented, an iscsiIntrLoginFailure
        notification should be generated.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.13.5, Status-Class and Status-Detail"
::= { iscsiInitiatorLoginStatsEntry 5 }

iscsiIntrLoginNegotiateFails OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "failed logins"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of times the initiator has aborted a
        login because parameter negotiation with the target
        failed.

        No response is generated.

        If this counter is incremented, an iscsiIntrLoginFailure
        notification should be generated.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 6.10, Negotiation Failures"
::= { iscsiInitiatorLoginStatsEntry 6 }

-- Initiator Logout Stats Table

iscsiInitiatorLogoutStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiInitiatorLogoutStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "When an initiator attempts to send a Logout command, the target
        responds with a Logout Response that carries a status code.
```

```
        This table contains a list of counters of Logout Response
        PDUs of each status code that was received by each
        initiator belonging to this iSCSI instance present on this
        system."
::= { iscsiInitiator 3 }

iscsiInitiatorLogoutStatsEntry OBJECT-TYPE
    SYNTAX        IscsiInitiatorLogoutStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing counters of Logout Response
        PDUs of each status code that was generated by this
        initiator."
    AUGMENTS { iscsiInitiatorAttributesEntry }
::= { iscsiInitiatorLogoutStatsTable 1 }

IscsiInitiatorLogoutStatsEntry ::= SEQUENCE {
    iscsiIntrLogoutNormals         Counter32,
    iscsiIntrLogoutOthers          Counter32
}

iscsiIntrLogoutNormals OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "normal logouts"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Logout Command PDUs generated by this initiator
        with reason code 0 (closes the session).
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.14.1, Reason Code"
::= { iscsiInitiatorLogoutStatsEntry 1 }

iscsiIntrLogoutOthers OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "abnormal logouts"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Logout Command PDUs generated by this initiator
        with any status code other than 0.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiNodeDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 10.14.1, Reason Code"
```

```
::= { iscsiInitiatorLogoutStatsEntry 2 }

--**********************************************************************

iscsiIntrAuthorization OBJECT IDENTIFIER ::= { iscsiObjects 9 }

-- Initiator Authorization Attributes Table

iscsiIntrAuthAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiIntrAuthAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of target identities that each initiator
        on the local system may access."
::= { iscsiIntrAuthorization 1 }

iscsiIntrAuthAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiIntrAuthAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular initiator node's authorized target identity."
    INDEX { iscsiInstIndex, iscsiNodeIndex, iscsiIntrAuthIndex }
::= { iscsiIntrAuthAttributesTable 1 }

IscsiIntrAuthAttributesEntry ::= SEQUENCE {
    iscsiIntrAuthIndex              Unsigned32,
    iscsiIntrAuthRowStatus          RowStatus,
    iscsiIntrAuthIdentity           RowPointer,
    iscsiIntrAuthStorageType        StorageType
}

iscsiIntrAuthIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a
        particular initiator node's authorized target
        identity within an iSCSI instance present on the
        local system.  This index value must not be modified
        or reused by an agent unless a reboot has occurred.
        An agent should attempt to keep this value persistent
        across reboots."
::= { iscsiIntrAuthAttributesEntry 1 }
```

```
iscsiIntrAuthRowStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "This field allows entries to be dynamically added and
        removed from this table via SNMP.  When adding a row to
        this table, all non-Index/RowStatus objects must be set.
        When the value of this object is 'active', the values of
        the other objects in this table cannot be changed.
        Rows may be discarded using RowStatus."
::= { iscsiIntrAuthAttributesEntry 2 }

iscsiIntrAuthIdentity OBJECT-TYPE
    SYNTAX        RowPointer
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "A pointer to the corresponding user entry in the IPS-AUTH
        MIB module to which this initiator node should attempt to
        establish an iSCSI session."
    REFERENCE
        "IPS-AUTH MIB, RFC 4545"
::= { iscsiIntrAuthAttributesEntry 3 }

iscsiIntrAuthStorageType OBJECT-TYPE
    SYNTAX        StorageType
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The storage type for this row.  Rows in this table that were
        created through an external process may have a storage type of
        readOnly or permanent.

        Conceptual rows having the value 'permanent' need not
        allow write access to any columnar objects in the row."
    DEFVAL        { nonVolatile }
::= { iscsiIntrAuthAttributesEntry 4 }

--*****************************************************************

iscsiSession OBJECT IDENTIFIER ::= { iscsiObjects 10 }

-- Session Attributes Table

iscsiSessionAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiSessionAttributesEntry
    MAX-ACCESS    not-accessible
```

```
    STATUS        current
    DESCRIPTION
        "A list of sessions belonging to each iSCSI instance
        present on the system."
::= { iscsiSession 1 }

iscsiSessionAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiSessionAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular session.

        If this session is a discovery session that is not attached
        to any particular node, the iscsiSsnNodeIndex will be zero.
        Otherwise, the iscsiSsnNodeIndex will have the same value as
        iscsiNodeIndex."
    INDEX  { iscsiInstIndex, iscsiSsnNodeIndex, iscsiSsnIndex }
::= { iscsiSessionAttributesTable 1 }

IscsiSessionAttributesEntry ::= SEQUENCE {
    iscsiSsnNodeIndex               Unsigned32,
    iscsiSsnIndex                   Unsigned32,
    iscsiSsnDirection               INTEGER,
    iscsiSsnInitiatorName           IscsiName,
    iscsiSsnTargetName              IscsiName,
    iscsiSsnTSIH                    Unsigned32,
    iscsiSsnISID                    OCTET STRING,
    iscsiSsnInitiatorAlias          SnmpAdminString,
    iscsiSsnTargetAlias             SnmpAdminString,
    iscsiSsnInitialR2T              TruthValue,
    iscsiSsnImmediateData           TruthValue,
    iscsiSsnType                    INTEGER,
    iscsiSsnMaxOutstandingR2T       Unsigned32,
    iscsiSsnFirstBurstLength        Unsigned32,
    iscsiSsnMaxBurstLength          Unsigned32,
    iscsiSsnConnectionNumber        Gauge32,
    iscsiSsnAuthIdentity            RowPointer,
    iscsiSsnDataSequenceInOrder     TruthValue,
    iscsiSsnDataPDUInOrder          TruthValue,
    iscsiSsnErrorRecoveryLevel      Unsigned32,
    iscsiSsnDiscontinuityTime       TimeStamp
}

iscsiSsnNodeIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (0..4294967295)
    MAX-ACCESS    not-accessible
```

```
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a
        particular node within an iSCSI instance present
        on the local system.  For normal, non-discovery
        sessions, this value will map to the iscsiNodeIndex.
        For discovery sessions that do not have a node
        associated, the value 0 (zero) is used."
::= { iscsiSessionAttributesEntry 1 }

iscsiSsnIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a
        particular session within an iSCSI instance present
        on the local system.  An agent should attempt to
        not reuse index values unless a reboot has occurred.
        iSCSI sessions are destroyed during a reboot; rows
        in this table are not persistent across reboots."
::= { iscsiSessionAttributesEntry 2 }

iscsiSsnDirection OBJECT-TYPE
    SYNTAX        INTEGER {
                      inboundSession(1),
                      outboundSession(2)
                  }
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Direction of iSCSI session:
        inboundSession  - session is established from an external
                          initiator to a target within this iSCSI
                          instance.
        outboundSession - session is established from an initiator
                          within this iSCSI instance to an external
                          target."
::= { iscsiSessionAttributesEntry 3 }

iscsiSsnInitiatorName OBJECT-TYPE
    SYNTAX        IscsiName
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "If iscsiSsnDirection is Inbound, this object is a
        UTF-8 string that will contain the name of the remote
        initiator.  If this session is a discovery session that
```

```
        does not specify a particular initiator, this object
        will contain a zero-length string.

        If iscsiSsnDirection is Outbound, this object will
        contain a zero-length string."
::= { iscsiSessionAttributesEntry 4 }

iscsiSsnTargetName OBJECT-TYPE
    SYNTAX        IscsiName
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "If iscsiSsnDirection is Outbound, this object is a
        UTF-8 string that will contain the name of the remote
        target.  If this session is a discovery session that
        does not specify a particular target, this object will
        contain a zero-length string.

        If iscsiSsnDirection is Inbound, this object will
        contain a zero-length string."
::= { iscsiSessionAttributesEntry 5 }

iscsiSsnTSIH OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The target-defined identification handle for this session."
    REFERENCE
        "RFC 3720, Section 10.12.6, TSIH"
::= { iscsiSessionAttributesEntry 6 }

iscsiSsnISID OBJECT-TYPE
    SYNTAX        OCTET STRING (SIZE(6))
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The initiator-defined portion of the iSCSI Session ID."
    REFERENCE
        "RFC 3720, Section 10.12.5, ISID"
::= { iscsiSessionAttributesEntry 7 }

iscsiSsnInitiatorAlias OBJECT-TYPE
    SYNTAX        SnmpAdminString
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A UTF-8 string that gives the alias communicated by the
```

```
        initiator end of the session during the login phase.

        If no alias exists, the value is a zero-length string."
    REFERENCE
        "RFC 3720, Section 12.7, InitiatorAlias"
::= { iscsiSessionAttributesEntry 8 }

iscsiSsnTargetAlias OBJECT-TYPE
    SYNTAX        SnmpAdminString
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A UTF-8 string that gives the alias communicated by the
        target end of the session during the login phase.

        If no alias exists, the value is a zero-length string."
    REFERENCE
        "RFC 3720, Section 12.6, TargetAlias"
::= { iscsiSessionAttributesEntry 9 }

iscsiSsnInitialR2T OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "If set to true, indicates that the initiator must wait
        for an R2T before sending to the target.  If set to false,
        the initiator may send data immediately, within limits set
        by iscsiSsnFirstBurstLength and the expected data transfer
        length of the request."
    REFERENCE
        "RFC 3720, Section 12.10, InitialR2T"
::= { iscsiSessionAttributesEntry 10 }

iscsiSsnImmediateData OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Indicates whether the initiator and target have agreed to
        support immediate data on this session."
    REFERENCE
        "RFC 3720, Section 12.11, ImmediateData"
::= { iscsiSessionAttributesEntry 11 }

iscsiSsnType OBJECT-TYPE
    SYNTAX        INTEGER {
                      normalSession(1),
```

```
                    discoverySession(2)
                }
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Type of iSCSI session:
        normalSession    - session is a normal iSCSI session
        discoverySession - session is being used only for discovery."
    REFERENCE
        "RFC 3720, Section 12.21, SessionType"
::= { iscsiSessionAttributesEntry 12 }

iscsiSsnMaxOutstandingR2T OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    UNITS         "R2Ts"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The maximum number of outstanding requests-to-transmit
        (R2Ts) per iSCSI task within this session."
    REFERENCE
        "RFC 3720, Section 12.17, MaxOutstandingR2T"
::= { iscsiSessionAttributesEntry 13 }

iscsiSsnFirstBurstLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The maximum length supported for unsolicited data sent
        within this session."
    REFERENCE
        "RFC 3720, Section 12.14, FirstBurstLength"
::= { iscsiSessionAttributesEntry 14 }

iscsiSsnMaxBurstLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The maximum number of bytes that can be sent within
        a single sequence of Data-In or Data-Out PDUs."
    REFERENCE
        "RFC 3720, Section 12.13, MaxBurstLength"
::= { iscsiSessionAttributesEntry 15 }
```

```
iscsiSsnConnectionNumber OBJECT-TYPE
    SYNTAX        Gauge32 (1..65535)
    UNITS         "connections"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The number of transport protocol connections that currently
        belong to this session."
::= { iscsiSessionAttributesEntry 16 }

iscsiSsnAuthIdentity OBJECT-TYPE
    SYNTAX        RowPointer
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object contains a pointer to a row in the
        IPS-AUTH MIB module that identifies the authentication
        method being used on this session, as communicated
        during the login phase."
    REFERENCE
        "IPS-AUTH MIB, RFC 4545"
::= { iscsiSessionAttributesEntry 17 }

 iscsiSsnDataSequenceInOrder OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "False indicates that iSCSI data PDU sequences may
        be transferred in any order.  True indicates that
        data PDU sequences must be transferred using
        continuously increasing offsets, except during
        error recovery."
    REFERENCE
        "RFC 3720, Section 12.19, DataSequenceInOrder"
::= { iscsiSessionAttributesEntry 18 }

iscsiSsnDataPDUInOrder OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "False indicates that iSCSI data PDUs within sequences
        may be in any order.  True indicates that data PDUs
        within sequences must be at continuously increasing
        addresses, with no gaps or overlay between PDUs.

        Default is true."
```

```
    REFERENCE
        "RFC 3720, Section 12.18, DataPDUInOrder"
::= { iscsiSessionAttributesEntry 19 }

iscsiSsnErrorRecoveryLevel OBJECT-TYPE
    SYNTAX        Unsigned32 (0..255)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The level of error recovery negotiated between
        the initiator and the target.  Higher numbers
        represent more detailed recovery schemes."
    REFERENCE
        "RFC 3720, Section 12.20, ErrorRecoveryLevel"
::= { iscsiSessionAttributesEntry 20 }

iscsiSsnDiscontinuityTime  OBJECT-TYPE
    SYNTAX        TimeStamp
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The value of SysUpTime on the most recent occasion
        at which any one or more of this session's counters
        suffered a discontinuity.
        When a session is established, and this object is
        created, it is initialized to the current value
        of SysUpTime."
::= { iscsiSessionAttributesEntry 21 }

-- Session Stats Table

iscsiSessionStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiSessionStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of general iSCSI traffic counters for each of the
        sessions present on the system."
::= { iscsiSession 2 }

iscsiSessionStatsEntry OBJECT-TYPE
    SYNTAX        IscsiSessionStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing general iSCSI traffic counters
        for a particular session."
    AUGMENTS { iscsiSessionAttributesEntry }
```

```
::= { iscsiSessionStatsTable 1 }

IscsiSessionStatsEntry ::= SEQUENCE {
    iscsiSsnCmdPDUs                Counter32,
    iscsiSsnRspPDUs                Counter32,
    iscsiSsnTxDataOctets           Counter64,
    iscsiSsnRxDataOctets           Counter64,
    iscsiSsnLCTxDataOctets         Counter32,
    iscsiSsnLCRxDataOctets         Counter32
}

iscsiSsnCmdPDUs OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "PDUs"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Command PDUs transferred on this session.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
::= { iscsiSessionStatsEntry 1 }

iscsiSsnRspPDUs OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "PDUs"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of Response PDUs transferred on this session.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
::= { iscsiSessionStatsEntry 2 }

iscsiSsnTxDataOctets OBJECT-TYPE
    SYNTAX        Counter64
    UNITS         "octets"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of data octets that were transmitted by
        the local iSCSI node on this session.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
::= { iscsiSessionStatsEntry 3 }

iscsiSsnRxDataOctets OBJECT-TYPE
    SYNTAX        Counter64
    UNITS         "octets"
```

```
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of data octets that were received by
        the local iSCSI node on this session.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
::= { iscsiSessionStatsEntry 4 }

iscsiSsnLCTxDataOctets OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "octets"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A Low Capacity shadow object of iscsiSsnTxDataOctets
        for those systems that don't support Counter64.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
::= { iscsiSessionStatsEntry 5 }

iscsiSsnLCRxDataOctets OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "octets"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A Low Capacity shadow object of iscsiSsnRxDataOctets
        for those systems that don't support Counter64.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
::= { iscsiSessionStatsEntry 6 }

-- Session Connection Error Stats Table

iscsiSessionCxnErrorStatsTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiSessionCxnErrorStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "A list of error counters for each of the sessions
        present on this system."
::= { iscsiSession 3 }

iscsiSessionCxnErrorStatsEntry OBJECT-TYPE
    SYNTAX        IscsiSessionCxnErrorStatsEntry
    MAX-ACCESS    not-accessible
    STATUS        current
```

```
    DESCRIPTION
        "An entry (row) containing error counters for
        a particular session."
    AUGMENTS { iscsiSessionAttributesEntry }
::= { iscsiSessionCxnErrorStatsTable 1 }

IscsiSessionCxnErrorStatsEntry ::= SEQUENCE {
    iscsiSsnCxnDigestErrors        Counter32,
    iscsiSsnCxnTimeoutErrors       Counter32
}

iscsiSsnCxnDigestErrors OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "PDUs"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of PDUs that were received on the session and
        contained header or data digest errors.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 6.7, Digest Errors"
::= { iscsiSessionCxnErrorStatsEntry 1 }

iscsiSsnCxnTimeoutErrors OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "connections"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The count of connections within this session
        that have been terminated due to timeout.
        If this counter has suffered a discontinuity, the time of the
        last discontinuity is indicated in iscsiSsnDiscontinuityTime."
    REFERENCE
        "RFC 3720, Section 6.4, Connection Timeout Management"
::= { iscsiSessionCxnErrorStatsEntry 2 }

--*****************************************************************

iscsiConnection OBJECT IDENTIFIER ::= { iscsiObjects 11 }

-- Connection Attributes Table

iscsiConnectionAttributesTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF IscsiConnectionAttributesEntry
    MAX-ACCESS    not-accessible
```

```
    STATUS        current
    DESCRIPTION
        "A list of connections belonging to each iSCSI instance
        present on the system."
::= { iscsiConnection 1 }

iscsiConnectionAttributesEntry OBJECT-TYPE
    SYNTAX        IscsiConnectionAttributesEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry (row) containing management information applicable
        to a particular connection."
    INDEX  { iscsiInstIndex, iscsiSsnNodeIndex, iscsiSsnIndex,
             iscsiCxnIndex }
::= { iscsiConnectionAttributesTable 1 }

IscsiConnectionAttributesEntry ::= SEQUENCE {
    iscsiCxnIndex                  Unsigned32,
    iscsiCxnCid                    Unsigned32,
    iscsiCxnState                  INTEGER,
    iscsiCxnAddrType               InetAddressType,
    iscsiCxnLocalAddr              InetAddress,
    iscsiCxnProtocol               IscsiTransportProtocol,
    iscsiCxnLocalPort              InetPortNumber,
    iscsiCxnRemoteAddr             InetAddress,
    iscsiCxnRemotePort             InetPortNumber,
    iscsiCxnMaxRecvDataSegLength   Unsigned32,
    iscsiCxnMaxXmitDataSegLength   Unsigned32,
    iscsiCxnHeaderIntegrity        IscsiDigestMethod,
    iscsiCxnDataIntegrity          IscsiDigestMethod,
    iscsiCxnRecvMarker             TruthValue,
    iscsiCxnSendMarker             TruthValue,
    iscsiCxnVersionActive          Unsigned32
}

iscsiCxnIndex OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An arbitrary integer used to uniquely identify a
        particular connection of a particular session within
        an iSCSI instance present on the local system.  An
        agent should attempt to not reuse index values unless
        a reboot has occurred.  iSCSI connections are destroyed
        during a reboot; rows in this table are not persistent
        across reboots."
```

```
::= { iscsiConnectionAttributesEntry 1 }

iscsiCxnCid OBJECT-TYPE
    SYNTAX        Unsigned32 (1..65535)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The iSCSI Connection ID for this connection."
::= { iscsiConnectionAttributesEntry 2 }

iscsiCxnState OBJECT-TYPE
    SYNTAX        INTEGER {
                      login(1),
                      full(2),
                      logout(3)
                  }
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The current state of this connection, from an iSCSI negotiation
        point of view.  Here are the states:

        login  - The transport protocol connection has been established,
                 but a valid iSCSI login response with the final bit set
                 has not been sent or received.
        full   - A valid iSCSI login response with the final bit set
                 has been sent or received.
        logout - A valid iSCSI logout command has been sent or
                 received, but the transport protocol connection has
                 not yet been closed."
::= { iscsiConnectionAttributesEntry 3 }

iscsiCxnAddrType OBJECT-TYPE
    SYNTAX        InetAddressType
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The type of Internet Network Addresses contained in the
        corresponding instances of iscsiCxnLocalAddr and
        iscsiCxnRemoteAddr.
        The value 'dns' is not allowed."
::= { iscsiConnectionAttributesEntry 4 }

iscsiCxnLocalAddr OBJECT-TYPE
    SYNTAX        InetAddress
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
```

```
        "The local Internet Network Address, of the type specified
        by iscsiCxnAddrType, used by this connection."
::= { iscsiConnectionAttributesEntry 5 }

iscsiCxnProtocol OBJECT-TYPE
    SYNTAX        IscsiTransportProtocol
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The transport protocol over which this connection is
        running."
::= { iscsiConnectionAttributesEntry 6 }

iscsiCxnLocalPort OBJECT-TYPE
    SYNTAX        InetPortNumber
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The local transport protocol port used by this connection.
        This object cannot have the value zero, since it represents
        an established connection."
::= { iscsiConnectionAttributesEntry 7 }

iscsiCxnRemoteAddr OBJECT-TYPE
    SYNTAX        InetAddress
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The remote Internet Network Address, of the type specified
        by iscsiCxnAddrType, used by this connection."
::= { iscsiConnectionAttributesEntry 8 }

iscsiCxnRemotePort OBJECT-TYPE
    SYNTAX        InetPortNumber
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The remote transport protocol port used by this connection.
        This object cannot have the value zero, since it represents
        an established connection."
::= { iscsiConnectionAttributesEntry 9 }

iscsiCxnMaxRecvDataSegLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
```

```
        "The maximum data payload size supported for command
        or data PDUs able to be received on this connection."
    REFERENCE
        "RFC 3720, Section 12.12, MaxRecvDataSegmentLength"
::= { iscsiConnectionAttributesEntry 10 }

iscsiCxnMaxXmitDataSegLength OBJECT-TYPE
    SYNTAX        Unsigned32 (512..16777215)
    UNITS         "bytes"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "The maximum data payload size supported for command
        or data PDUs to be sent on this connection."
    REFERENCE
        "RFC 3720, Section 12.12, MaxRecvDataSegmentLength"
::= { iscsiConnectionAttributesEntry 11 }

iscsiCxnHeaderIntegrity OBJECT-TYPE
    SYNTAX        IscsiDigestMethod
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object identifies the iSCSI header
        digest scheme in use within this connection."
::= { iscsiConnectionAttributesEntry 12 }

iscsiCxnDataIntegrity OBJECT-TYPE
    SYNTAX        IscsiDigestMethod
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object identifies the iSCSI data
        digest scheme in use within this connection."
::= { iscsiConnectionAttributesEntry 13 }

iscsiCxnRecvMarker OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object indicates whether or not this connection
        is receiving markers in its incoming data stream."
    REFERENCE
        "RFC 3720, Appendix A."
::= { iscsiConnectionAttributesEntry 14 }

iscsiCxnSendMarker OBJECT-TYPE
```

```
    SYNTAX        TruthValue
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object indicates whether or not this connection
        is inserting markers in its outgoing data stream."
    REFERENCE
        "RFC 3720, Appendix A."
::= { iscsiConnectionAttributesEntry 15 }

iscsiCxnVersionActive OBJECT-TYPE
    SYNTAX        Unsigned32 (0..255)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "Active version number of the iSCSI specification negotiated
        on this connection."
    REFERENCE
        "RFC 3720, Section 10.12, Login Request"
::= { iscsiConnectionAttributesEntry 16 }

--************************************************************************
-- Notifications

iscsiTgtLoginFailure NOTIFICATION-TYPE
    OBJECTS {
        iscsiTgtLoginFailures,
        iscsiTgtLastFailureType,
        iscsiTgtLastIntrFailureName,
        iscsiTgtLastIntrFailureAddrType,
        iscsiTgtLastIntrFailureAddr
    }
    STATUS current
    DESCRIPTION
        "Sent when a login is failed by a target.

        To avoid sending an excessive number of notifications due
        to multiple errors counted, an SNMP agent implementing this
        notification SHOULD NOT send more than 3 notifications of
        this type in any 10-second time period."
::= { iscsiNotifications 1 }

iscsiIntrLoginFailure NOTIFICATION-TYPE
    OBJECTS {
        iscsiIntrLoginFailures,
        iscsiIntrLastFailureType,
        iscsiIntrLastTgtFailureName,
        iscsiIntrLastTgtFailureAddrType,
```

```
        iscsiIntrLastTgtFailureAddr
    }
    STATUS current
    DESCRIPTION
        "Sent when a login is failed by an initiator.

        To avoid sending an excessive number of notifications due
        to multiple errors counted, an SNMP agent implementing this
        notification SHOULD NOT send more than 3 notifications of
        this type in any 10-second time period."
::= { iscsiNotifications 2 }

iscsiInstSessionFailure NOTIFICATION-TYPE
    OBJECTS {
        iscsiInstSsnFailures,
        iscsiInstLastSsnFailureType,
        iscsiInstLastSsnRmtNodeName
    }
    STATUS current
    DESCRIPTION
        "Sent when an active session is failed by either the initiator
        or the target.

        To avoid sending an excessive number of notifications due
        to multiple errors counted, an SNMP agent implementing this
        notification SHOULD NOT send more than 3 notifications of
        this type in any 10-second time period."
::= { iscsiNotifications 3 }

--*****************************************************************

-- Conformance Statements

iscsiCompliances OBJECT IDENTIFIER ::= { iscsiConformance 1 }
iscsiGroups      OBJECT IDENTIFIER ::= { iscsiConformance 2 }

iscsiInstanceAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiInstDescr,
        iscsiInstVersionMin,
        iscsiInstVersionMax,
        iscsiInstVendorID,
        iscsiInstVendorVersion,
        iscsiInstPortalNumber,
        iscsiInstNodeNumber,
        iscsiInstSessionNumber,
        iscsiInstSsnFailures,
        iscsiInstLastSsnFailureType,
```

```
        iscsiInstLastSsnRmtNodeName,
        iscsiInstDiscontinuityTime
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about iSCSI
        instances."
::= { iscsiGroups 1 }

iscsiInstanceSsnErrorStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiInstSsnDigestErrors,
        iscsiInstSsnCxnTimeoutErrors,
        iscsiInstSsnFormatErrors
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about
        errors that have caused a session failure for an
        iSCSI instance."
::= { iscsiGroups 2 }

iscsiPortalAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiPortalRowStatus,
        iscsiPortalStorageType,
        iscsiPortalRoles,
        iscsiPortalAddrType,
        iscsiPortalAddr,
        iscsiPortalProtocol,
        iscsiPortalMaxRecvDataSegLength,
        iscsiPortalPrimaryHdrDigest,
        iscsiPortalPrimaryDataDigest,
        iscsiPortalSecondaryHdrDigest,
        iscsiPortalSecondaryDataDigest,
        iscsiPortalRecvMarker
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about
        the transport protocol endpoints of the local targets."
::= { iscsiGroups 3 }

iscsiTgtPortalAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiTgtPortalPort,
        iscsiTgtPortalTag
    }
```

```
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about
        the transport protocol endpoints of the local targets."
::= { iscsiGroups 4 }

iscsiIntrPortalAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiIntrPortalTag
    }
    STATUS current
    DESCRIPTION
        "An object providing information about
        the portal tags used by the local initiators."
::= { iscsiGroups 5 }

iscsiNodeAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiNodeName,
        iscsiNodeAlias,
        iscsiNodeRoles,
        iscsiNodeTransportType,
        iscsiNodeInitialR2T,
        iscsiNodeImmediateData,
        iscsiNodeMaxOutstandingR2T,
        iscsiNodeFirstBurstLength,
        iscsiNodeMaxBurstLength,
        iscsiNodeMaxConnections,
        iscsiNodeDataSequenceInOrder,
        iscsiNodeDataPDUInOrder,
        iscsiNodeDefaultTime2Wait,
        iscsiNodeDefaultTime2Retain,
        iscsiNodeErrorRecoveryLevel,
        iscsiNodeDiscontinuityTime,
        iscsiNodeStorageType
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        local targets."
::= { iscsiGroups 6 }

iscsiTargetAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiTgtLoginFailures,
        iscsiTgtLastFailureTime,
        iscsiTgtLastFailureType,
        iscsiTgtLastIntrFailureName,
```

```
        iscsiTgtLastIntrFailureAddrType,
        iscsiTgtLastIntrFailureAddr
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        local targets."
::= { iscsiGroups 7 }

iscsiTargetLoginStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiTgtLoginAccepts,
        iscsiTgtLoginOtherFails,
        iscsiTgtLoginRedirects,
        iscsiTgtLoginAuthorizeFails,
        iscsiTgtLoginAuthenticateFails,
        iscsiTgtLoginNegotiateFails
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        login attempts by remote initiators to local targets."
::= { iscsiGroups 8 }

iscsiTargetLogoutStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiTgtLogoutNormals,
        iscsiTgtLogoutOthers
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        logout events between remote initiators and local targets."
::= { iscsiGroups 9 }

iscsiTargetAuthGroup OBJECT-GROUP
    OBJECTS {
        iscsiTgtAuthRowStatus,
        iscsiTgtAuthStorageType,
        iscsiTgtAuthIdentity
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        remote initiators that are authorized to connect to local
        targets."
::= { iscsiGroups 10 }
```

```
iscsiInitiatorAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiIntrLoginFailures,
        iscsiIntrLastFailureTime,
        iscsiIntrLastFailureType,
        iscsiIntrLastTgtFailureName,
        iscsiIntrLastTgtFailureAddrType,
        iscsiIntrLastTgtFailureAddr
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about
        all local initiators."
::= { iscsiGroups 11 }

iscsiInitiatorLoginStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiIntrLoginAcceptRsps,
        iscsiIntrLoginOtherFailRsps,
        iscsiIntrLoginRedirectRsps,
        iscsiIntrLoginAuthFailRsps,
        iscsiIntrLoginAuthenticateFails,
        iscsiIntrLoginNegotiateFails
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        login attempts by local initiators to remote targets."
::= { iscsiGroups 12 }

iscsiInitiatorLogoutStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiIntrLogoutNormals,
        iscsiIntrLogoutOthers
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        logout events between local initiators and remote targets."
::= { iscsiGroups 13 }

iscsiInitiatorAuthGroup OBJECT-GROUP
    OBJECTS {
        iscsiIntrAuthRowStatus,
        iscsiIntrAuthStorageType,
        iscsiIntrAuthIdentity
    }
    STATUS current
```

```
    DESCRIPTION
        "A collection of objects providing information about all
        remote targets that are initiators of the local system
        that they are authorized to access."
::= { iscsiGroups 14 }

iscsiSessionAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiSsnDirection,
        iscsiSsnInitiatorName,
        iscsiSsnTargetName,
        iscsiSsnTSIH,
        iscsiSsnISID,
        iscsiSsnInitiatorAlias,
        iscsiSsnTargetAlias,
        iscsiSsnInitialR2T,
        iscsiSsnImmediateData,
        iscsiSsnType,
        iscsiSsnMaxOutstandingR2T,
        iscsiSsnFirstBurstLength,
        iscsiSsnMaxBurstLength,
        iscsiSsnConnectionNumber,
        iscsiSsnAuthIdentity,
        iscsiSsnDataSequenceInOrder,
        iscsiSsnDataPDUInOrder,
        iscsiSsnErrorRecoveryLevel,
        iscsiSsnDiscontinuityTime
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information applicable to
        all sessions."
::= { iscsiGroups 15 }

iscsiSessionPDUStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiSsnCmdPDUs,
        iscsiSsnRspPDUs
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about PDU
        traffic for each session."
::= { iscsiGroups 16 }

iscsiSessionOctetStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiSsnTxDataOctets,
```

```
        iscsiSsnRxDataOctets
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about octet
        traffic for each session using a Counter64 data type."
::= { iscsiGroups 17 }

iscsiSessionLCOctetStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiSsnLCTxDataOctets,
        iscsiSsnLCRxDataOctets
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about octet
        traffic for each session using a Counter32 data type."
::= { iscsiGroups 18 }

iscsiSessionCxnErrorStatsGroup OBJECT-GROUP
    OBJECTS {
        iscsiSsnCxnDigestErrors,
        iscsiSsnCxnTimeoutErrors
    }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about connection
        errors for all sessions."
::= { iscsiGroups 19 }

iscsiConnectionAttributesGroup OBJECT-GROUP
    OBJECTS {
        iscsiCxnCid,
        iscsiCxnState,
        iscsiCxnProtocol,
        iscsiCxnAddrType,
        iscsiCxnLocalAddr,
        iscsiCxnLocalPort,
        iscsiCxnRemoteAddr,
        iscsiCxnRemotePort,
        iscsiCxnMaxRecvDataSegLength,
        iscsiCxnMaxXmitDataSegLength,
        iscsiCxnHeaderIntegrity,
        iscsiCxnDataIntegrity,
        iscsiCxnRecvMarker,
        iscsiCxnSendMarker,
        iscsiCxnVersionActive
    }
```

```
    STATUS current
    DESCRIPTION
        "A collection of objects providing information about all
        connections used by all sessions."
::= { iscsiGroups 20 }

iscsiTgtLgnNotificationsGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        iscsiTgtLoginFailure
    }
    STATUS current
    DESCRIPTION
        "A collection of notifications that indicate a login
        failure from a remote initiator to a local target."
::= { iscsiGroups 21 }

iscsiIntrLgnNotificationsGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        iscsiIntrLoginFailure
    }
    STATUS current
    DESCRIPTION
        "A collection of notifications that indicate a login
        failure from a local initiator to a remote target."
::= { iscsiGroups 22 }

iscsiSsnFlrNotificationsGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        iscsiInstSessionFailure
    }
    STATUS current
    DESCRIPTION
        "A collection of notifications that indicate session
        failures occurring after login."
::= { iscsiGroups 23 }

--*****************************************************************

iscsiComplianceV1 MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "Initial version of compliance statement based on
        initial version of this MIB module.

        If an implementation can be both a target and an
        initiator, all groups are mandatory."
    MODULE       -- this module
    MANDATORY-GROUPS {
```

```
        iscsiInstanceAttributesGroup,
        iscsiInstanceSsnErrorStatsGroup,
        iscsiPortalAttributesGroup,
        iscsiNodeAttributesGroup,
        iscsiSessionAttributesGroup,
        iscsiSessionPDUStatsGroup,
        iscsiSessionCxnErrorStatsGroup,
        iscsiConnectionAttributesGroup,
        iscsiSsnFlrNotificationsGroup
    }

    -- Conditionally mandatory groups depending on the ability
    -- to support Counter64 data types and/or to provide counter
    -- information to SNMPv1 applications.

    GROUP iscsiSessionOctetStatsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that can support Counter64 data types."

    GROUP iscsiSessionLCOctetStatsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that provide information to SNMPv1-only applications;
        this includes agents that cannot support Counter64
        data types."

    -- Conditionally mandatory groups to be included with
    -- the mandatory groups when the implementation has
    -- iSCSI target facilities.

    GROUP iscsiTgtPortalAttributesGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI target facilities."

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

    OBJECT iscsiNodeStorageType
    MIN-ACCESS read-only
    DESCRIPTION
        "Write access is not required; an implementation may
         choose to allow this object to be set to 'volatile'
         or 'nonVolatile'."
```

```
    GROUP iscsiTargetAttributesGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI target facilities."

    GROUP iscsiTargetLoginStatsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI target facilities."

    GROUP iscsiTargetLogoutStatsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI target facilities."

    GROUP iscsiTgtLgnNotificationsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI target facilities."

    GROUP iscsiTargetAuthGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI target facilities."

    -- Conditionally mandatory groups to be included with
    -- the mandatory groups when the implementation has
    -- iSCSI initiator facilities.

    GROUP iscsiIntrPortalAttributesGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI initiator facilities."

    GROUP iscsiInitiatorAttributesGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI initiator facilities."

    GROUP iscsiInitiatorLoginStatsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI initiator facilities."

    GROUP iscsiInitiatorLogoutStatsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI initiator facilities."
```

```
    GROUP iscsiIntrLgnNotificationsGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI initiator facilities."

    GROUP iscsiInitiatorAuthGroup
    DESCRIPTION
        "This group is mandatory for all iSCSI implementations
        that have iSCSI initiator facilities."

    OBJECT       iscsiNodeErrorRecoveryLevel
    SYNTAX       Unsigned32 (0..2)
    DESCRIPTION
        "Only values 0-2 are defined at present."

::= { iscsiCompliances 1 }

END
```

## 8. Security Considerations

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- iscsiPortalAttributesTable, iscsiTgtPortalAttributesTable, and iscsiIntrPortalAttributesTable can be used to add or remove IP addresses to be used by iSCSI.

- iscsiTgtAuthAttributesTable entries can be added or removed, to allow or disallow access to a target by an initiator.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- iscsiNodeAttributesTable, iscsiTargetAttributesTable, and iscsiTgtAuthorization can be used to glean information needed to make connections to the iSCSI targets this module represents. However, it is the responsibility of the initiators and targets involved to authenticate each other to ensure that an inappropriately advertised or discovered initiator or target does not compromise their security. These issues are discussed in [RFC3720].

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementors consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator

responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

## 9. IANA Considerations

The IANA has assigned a MIB OID number under the mib-2 branch for the ISCSI-MIB.

## 10. Normative References

[RFC3720] Satran, J., Meth, K., Sapuntzakis, C., Chadalapaka, M., and E. Zeidner, "Internet Small Computer Systems Interface (iSCSI)", RFC 3720, March 2004.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2578] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., and S. Waldbusser, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

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

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

[RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.

[RFC3411] Harrington, D., Presuhn, R., and B. Wijnen, "An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks", STD 62, RFC 3411, December 2002.

[RFC4545] Bakke, M. and J. Muchow, "Definitions of Managed Objects for IP Storage User Identity Authorization", RFC 4545, May 2006.

## 11. Informative References

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

[RFC4022] Raghunarayan, R., "Management Information Base for the Transmission Control Protocol (TCP)", RFC 4022, March 2005.

[RFC4455] Hallak-Stamler, M., Bakke, M., Lederman, Y., Krueger, M., and K. McCloghrie, "Definition of Managed Objects for Small Computer System Interface (SCSI) Entities", RFC 4455, April 2006.

## 12. Acknowledgements

In addition to the authors, several people contributed to the development of this MIB module. Thanks especially to those who took the time to participate in our weekly conference calls to build our requirements, object models, table structures, and attributes: John Hufferd, Tom McSweeney (IBM), Kevin Gibbons (Nishan Systems), Chad Gregory (Intel), Jack Harwood (EMC), Hari Mudaliar (Adaptec), Ie Wei Njoo (Agilent), Lawrence Lamers (SAN Valley), Satish Mali (Stonefly Networks), and William Terrell (Troika).

Special thanks to Tom McSweeney, Ie Wei Njoo, and Kevin Gibbons, who wrote the descriptions for many of the tables and attributes in this MIB module, to Ayman Ghanem for finding and suggesting changes for many problems in this module, and to Keith McCloghrie for serving as advisor to the team.

## Authors' Addresses

Mark Bakke
Cisco Systems, Inc
7900 International Drive, Suite 400
Bloomington, MN
USA 55425

EMail: mbakke@cisco.com

Marjorie Krueger
Hewlett-Packard
Networked Storage Architecture
Networked Storage Solutions Org.
8000 Foothills Blvd.
Roseville, CA
USA 95747

EMail: marjorie_krueger@hp.com

Tom McSweeney
IBM Corporation
600 Park Offices Drive
Research Triangle Park, NC
USA 27709

EMail: tommcs@us.ibm.com

James Muchow
Qlogic Corp.
6321 Bury Drive
Eden Prairie, MN
USA 55346

EMail: james.muchow@qlogic.com

## Full Copyright Statement



## Intellectual Property



## Acknowledgement

Funding for the RFC Editor function is provided by the IETF Administrative Support Activity (IASA).