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S. Waldbusser
Lucent Technologies Inc.
P. Grillo
WeSync.com
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Host Resources MIB

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. This memo obsoletes RFC 1514, the "Host Resources MIB". This memo extends that specification by clarifying changes based on implementation and deployment experience and documenting the Host Resources MIB in SMIV2 format while remaining semantically identical to the existing SMIV1-based MIB.

This memo defines a MIB for use with managing host systems. The term "host" is construed to mean any computer that communicates with other similar computers attached to the internet and that is directly used by one or more human beings. Although this MIB does not necessarily apply to devices whose primary function is communications services (e.g., terminal servers, routers, bridges, monitoring equipment), such relevance is not explicitly precluded. This MIB instruments attributes common to all internet hosts including, for example, both personal computers and systems that run variants of Unix.

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1. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- o An overall architecture, described in RFC 2571 [RFC2571].
- o Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIV1 and described in STD 16, RFC 1155 [RFC1155], STD 16, RFC 1212 [RFC1212] and RFC 1215 [RFC1215]. The second version, called SMIV2, is described in STD 58, RFC 2578 [RFC2578], RFC 2579 [RFC2579] and RFC 2580 [RFC2580].
- o Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [RFC1157]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [RFC1901] and RFC 1906 [RFC1906]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [RFC1906], RFC 2572 [RFC2572] and RFC 2574 [RFC2574].

- o Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [RFC1157]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [RFC1905].
- o A set of fundamental applications described in RFC 2573 [RFC2573] and the view-based access control mechanism described in RFC 2575 [RFC2575].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [RFC2570].

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

This memo specifies a MIB module that is compliant to the SMIV2. A MIB conforming to the SMIV1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible (use of Counter64). Some machine readable information in SMIV2 will be converted into textual descriptions in SMIV1 during the translation process. However, this loss of machine readable information is not considered to change the semantics of the MIB.

2. Host Resources MIB

The Host Resources MIB defines a uniform set of objects useful for the management of host computers. Host computers are independent of the operating system, network services, or any software application.

The Host Resources MIB defines objects which are common across many computer system architectures.

In addition, there are objects in the SNMPv2-MIB [RFC1907] and IF-MIB [RFC2233] which also provide host management functionality. Implementation of the System and Interfaces groups is mandatory for implementors of the Host Resources MIB.

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 [RFC2119].

3. IANA Considerations

This MIB contains type definitions for storage types, device types, and file system types for use as values for the hrStorageType, hrDeviceType, and hrFSType objects, respectively. As new computing technologies are developed, new types need to be registered for these technologies. The IANA (Internet Assigned Numbers Authority) is designated as the registration authority for new registrations beyond those published in this document. The IANA will maintain the HOST-RESOURCES-TYPES module as new registrations are added and publish new versions of this module.

Given the large number of such technologies and potential confusion in naming of these technologies (such as a technology known by two names or a name and an acronym), there is a real danger that more than one registration might be created for what is essentially the same technology. In order to ensure that future type registrations are performed correctly, applications for new types will be reviewed by a Designated Expert appointed by the IESG.

4. Definitions

```
HOST-RESOURCES-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
MODULE-IDENTITY, OBJECT-TYPE, mib-2,  
Integer32, Counter32, Gauge32, TimeTicks FROM SNMPv2-SMI
```

```
TEXTUAL-CONVENTION, DisplayString,  
TruthValue, DateAndTime, AutonomousType FROM SNMPv2-TC
```

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

```
InterfaceIndexOrZero FROM IF-MIB;
```

```
hostResourcesMibModule MODULE-IDENTITY
```

```
    LAST-UPDATED "200003060000Z" -- 6 March 2000
```

```
    ORGANIZATION "IETF Host Resources MIB Working Group"
```

```
    CONTACT-INFO
```

```
        "Steve Waldbusser
```

```
        Postal: Lucent Technologies, Inc.
```

```
                1213 Innsbruck Dr.
```

```
                Sunnyvale, CA 94089
```

```
                USA
```

```
        Phone: 650-318-1251
```

```
        Fax: 650-318-1633
```

```
        Email: waldbusser@lucent.com
```

In addition, the Host Resources MIB mailing list is dedicated to discussion of this MIB. To join the mailing list, send a request message to `hostmib-request@andrew.cmu.edu`. The mailing list address is `hostmib@andrew.cmu.edu`."

DESCRIPTION

"This MIB is for use in managing host systems. The term 'host' is construed to mean any computer that communicates with other similar computers attached to the internet and that is directly used by one or more human beings. Although this MIB does not necessarily apply to devices whose primary function is communications services (e.g., terminal servers, routers, bridges, monitoring equipment), such relevance is not explicitly precluded. This MIB instruments attributes common to all internet hosts including, for example, both personal computers and systems that run variants of Unix."

REVISION "200003060000Z" -- 6 March 2000

DESCRIPTION

"Clarifications and bug fixes based on implementation experience. This revision was also reformatted in the SMIV2 format. The revisions made were:

New RFC document standards:

Added Copyright notice, updated introduction to SNMP Framework, updated references section, added reference to RFC 2119, and added a meaningful Security Considerations section.

New IANA considerations section for registration of new types

Conversion to new SMIV2 syntax for the following types and macros:

Counter32, Integer32, Gauge32, MODULE-IDENTITY, OBJECT-TYPE, TEXTUAL-CONVENTION, OBJECT-IDENTITY, MODULE-COMPLIANCE, OBJECT-GROUP

Used new Textual Conventions:

TruthValue, DateAndTime, AutonomousType, InterfaceIndexOrZero

Fixed typo in `hrPrinterStatus`.

Added missing error bits to `hrPrinterDetectedErrorState` and clarified confusion resulting from suggested mappings to `hrPrinterStatus`.

Clarified that size of objects of type
InternationalDisplayString is number of octets, not number
of encoded symbols.

Clarified the use of the following objects based on
implementation experience:

hrSystemInitialLoadDevice, hrSystemInitialLoadParameters,
hrMemorySize, hrStorageSize, hrStorageAllocationFailures,
hrDeviceErrors, hrProcessorLoad, hrNetworkIfIndex,
hrDiskStorageCapacity, hrSWRunStatus, hrSWRunPerfCPU,
and hrSWInstalledDate.

Clarified implementation technique for hrSWInstalledTable.

Used new AUGMENTS clause for hrSWRunPerfTable.

Added Internationalization Considerations section.

This revision published as RFC2790."

```

REVISION "9910202200Z"      -- 20 October, 1999
DESCRIPTION
    "The original version of this MIB, published as
    RFC1514."
 ::= { hrMIBAdminInfo 1 }

host      OBJECT IDENTIFIER ::= { mib-2 25 }

hrSystem      OBJECT IDENTIFIER ::= { host 1 }
hrStorage     OBJECT IDENTIFIER ::= { host 2 }
hrDevice      OBJECT IDENTIFIER ::= { host 3 }
hrSWRun       OBJECT IDENTIFIER ::= { host 4 }
hrSWRunPerf   OBJECT IDENTIFIER ::= { host 5 }
hrSWInstalled OBJECT IDENTIFIER ::= { host 6 }
hrMIBAdminInfo OBJECT IDENTIFIER ::= { host 7 }

-- textual conventions

KBytes ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
        "Storage size, expressed in units of 1024 bytes."
    SYNTAX Integer32 (0..2147483647)

ProductID ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
        "This textual convention is intended to identify the

```

manufacturer, model, and version of a specific hardware or software product. It is suggested that these OBJECT IDENTIFIERS are allocated such that all products from a particular manufacturer are registered under a subtree distinct to that manufacturer. In addition, all versions of a product should be registered under a subtree distinct to that product. With this strategy, a management station may uniquely determine the manufacturer and/or model of a product whose productID is unknown to the management station. Objects of this type may be useful for inventory purposes or for automatically detecting incompatibilities or version mismatches between various hardware and software components on a system.

For example, the product ID for the ACME 4860 66MHz clock doubled processor might be:
enterprises.acme.acmeProcessors.a4860DX2.MHz66

A software product might be registered as:
enterprises.acme.acmeOperatingSystems.acmeDOS.six(6).one(1)
"

SYNTAX OBJECT IDENTIFIER

```
-- unknownProduct will be used for any unknown ProductID
-- unknownProduct OBJECT IDENTIFIER ::= { 0 0 }
```

InternationalDisplayString ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This data type is used to model textual information in some character set. A network management station should use a local algorithm to determine which character set is in use and how it should be displayed. Note that this character set may be encoded with more than one octet per symbol, but will most often be NVT ASCII. When a size clause is specified for an object of this type, the size refers to the length in octets, not the number of symbols."

SYNTAX OCTET STRING

```
-- The Host Resources System Group
```

hrSystemUptime OBJECT-TYPE

SYNTAX TimeTicks

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The amount of time since this host was last initialized. Note that this is different from sysUpTime in the SNMPv2-MIB [RFC1907] because sysUpTime is the uptime of the network management portion of the system."
 ::= { hrSystem 1 }

hrSystemDate OBJECT-TYPE
SYNTAX DateAndTime
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The host's notion of the local date and time of day."
 ::= { hrSystem 2 }

hrSystemInitialLoadDevice OBJECT-TYPE
SYNTAX Integer32 (1..2147483647)
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The index of the hrDeviceEntry for the device from which this host is configured to load its initial operating system configuration (i.e., which operating system code and/or boot parameters).

Note that writing to this object just changes the configuration that will be used the next time the operating system is loaded and does not actually cause the reload to occur."
 ::= { hrSystem 3 }

hrSystemInitialLoadParameters OBJECT-TYPE
SYNTAX InternationalDisplayString (SIZE (0..128))
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"This object contains the parameters (e.g. a pathname and parameter) supplied to the load device when requesting the initial operating system configuration from that device.

Note that writing to this object just changes the configuration that will be used the next time the operating system is loaded and does not actually cause the reload to occur."
 ::= { hrSystem 4 }

hrSystemNumUsers OBJECT-TYPE

```
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of user sessions for which this host is
    storing state information.  A session is a collection
    of processes requiring a single act of user
    authentication and possibly subject to collective job
    control."
 ::= { hrSystem 5 }
```

hrSystemProcesses OBJECT-TYPE

```
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of process contexts currently loaded or
    running on this system."
 ::= { hrSystem 6 }
```

hrSystemMaxProcesses OBJECT-TYPE

```
SYNTAX      Integer32 (0..2147483647)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The maximum number of process contexts this system
    can support.  If there is no fixed maximum, the value
    should be zero.  On systems that have a fixed maximum,
    this object can help diagnose failures that occur when
    this maximum is reached."
 ::= { hrSystem 7 }
```

-- The Host Resources Storage Group

-- Registration point for storage types, for use with hrStorageType.
-- These are defined in the HOST-RESOURCES-TYPES module.

hrStorageTypes OBJECT IDENTIFIER ::= { hrStorage 1 }

hrMemorySize OBJECT-TYPE

```
SYNTAX      KBytes
UNITS       "KBytes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The amount of physical read-write main memory,
    typically RAM, contained by the host."
 ::= { hrStorage 2 }
```

hrStorageTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrStorageEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of logical storage areas on the host.

An entry shall be placed in the storage table for each logical area of storage that is allocated and has fixed resource limits. The amount of storage represented in an entity is the amount actually usable by the requesting entity, and excludes loss due to formatting or file system reference information.

These entries are associated with logical storage areas, as might be seen by an application, rather than physical storage entities which are typically seen by an operating system. Storage such as tapes and floppies without file systems on them are typically not allocated in chunks by the operating system to requesting applications, and therefore shouldn't appear in this table. Examples of valid storage for this table include disk partitions, file systems, ram (for some architectures this is further segmented into regular memory, extended memory, and so on), backing store for virtual memory ('swap space').

This table is intended to be a useful diagnostic for 'out of memory' and 'out of buffers' types of failures. In addition, it can be a useful performance monitoring tool for tracking memory, disk, or buffer usage."

```
::= { hrStorage 3 }
```

hrStorageEntry OBJECT-TYPE

SYNTAX HrStorageEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one logical storage area on the host. As an example, an instance of the hrStorageType object might be named hrStorageType.3"

INDEX { hrStorageIndex }

```
::= { hrStorageTable 1 }
```

```
HrStorageEntry ::= SEQUENCE {
    hrStorageIndex          Integer32,
```

```
        hrStorageType           AutonomousType,
        hrStorageDescr          DisplayString,
        hrStorageAllocationUnits Integer32,
        hrStorageSize            Integer32,
        hrStorageUsed            Integer32,
        hrStorageAllocationFailures Counter32
    }

hrStorageIndex OBJECT-TYPE
    SYNTAX      Integer32 (1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A unique value for each logical storage area
         contained by the host."
    ::= { hrStorageEntry 1 }

hrStorageType OBJECT-TYPE
    SYNTAX      AutonomousType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of storage represented by this entry."
    ::= { hrStorageEntry 2 }

hrStorageDescr OBJECT-TYPE
    SYNTAX      DisplayString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A description of the type and instance of the storage
         described by this entry."
    ::= { hrStorageEntry 3 }

hrStorageAllocationUnits OBJECT-TYPE
    SYNTAX      Integer32 (1..2147483647)
    UNITS       "Bytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The size, in bytes, of the data objects allocated
         from this pool.  If this entry is monitoring sectors,
         blocks, buffers, or packets, for example, this number
         will commonly be greater than one.  Otherwise this
         number will typically be one."
    ::= { hrStorageEntry 4 }

hrStorageSize OBJECT-TYPE
```

```
SYNTAX      Integer32 (0..2147483647)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "The size of the storage represented by this entry, in
    units of hrStorageAllocationUnits. This object is
    writable to allow remote configuration of the size of
    the storage area in those cases where such an
    operation makes sense and is possible on the
    underlying system. For example, the amount of main
    memory allocated to a buffer pool might be modified or
    the amount of disk space allocated to virtual memory
    might be modified."
 ::= { hrStorageEntry 5 }
```

```
hrStorageUsed OBJECT-TYPE
SYNTAX      Integer32 (0..2147483647)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The amount of the storage represented by this entry
    that is allocated, in units of
    hrStorageAllocationUnits."
 ::= { hrStorageEntry 6 }
```

```
hrStorageAllocationFailures OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of requests for storage represented by
    this entry that could not be honored due to not enough
    storage. It should be noted that as this object has a
    SYNTAX of Counter32, that it does not have a defined
    initial value. However, it is recommended that this
    object be initialized to zero, even though management
    stations must not depend on such an initialization."
 ::= { hrStorageEntry 7 }
```

```
-- The Host Resources Device Group
--
-- The device group is useful for identifying and diagnosing the
-- devices on a system. The hrDeviceTable contains common
-- information for any type of device. In addition, some devices
-- have device-specific tables for more detailed information. More
-- such tables may be defined in the future for other device types.
--
-- Registration point for device types, for use with hrDeviceType.
```

```

-- These are defined in the HOST-RESOURCES-TYPES module.
hrDeviceTypes          OBJECT IDENTIFIER ::= { hrDevice 1 }

hrDeviceTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF HrDeviceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The (conceptual) table of devices contained by the
        host."
    ::= { hrDevice 2 }

hrDeviceEntry OBJECT-TYPE
    SYNTAX      HrDeviceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A (conceptual) entry for one device contained by the
        host.  As an example, an instance of the hrDeviceType
        object might be named hrDeviceType.3"
    INDEX { hrDeviceIndex }
    ::= { hrDeviceTable 1 }

HrDeviceEntry ::= SEQUENCE {
    hrDeviceIndex      Integer32,
    hrDeviceType       AutonomousType,
    hrDeviceDescr      DisplayString,
    hrDeviceID         ProductID,
    hrDeviceStatus     INTEGER,
    hrDeviceErrors     Counter32
}

hrDeviceIndex OBJECT-TYPE
    SYNTAX      Integer32 (1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A unique value for each device contained by the host.
        The value for each device must remain constant at
        least from one re-initialization of the agent to the
        next re-initialization."
    ::= { hrDeviceEntry 1 }

hrDeviceType OBJECT-TYPE
    SYNTAX      AutonomousType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION

```

"An indication of the type of device.

If this value is
'hrDeviceProcessor { hrDeviceTypes 3 }' then an entry
exists in the hrProcessorTable which corresponds to
this device.

If this value is
'hrDeviceNetwork { hrDeviceTypes 4 }', then an entry
exists in the hrNetworkTable which corresponds to this
device.

If this value is
'hrDevicePrinter { hrDeviceTypes 5 }', then an entry
exists in the hrPrinterTable which corresponds to this
device.

If this value is
'hrDeviceDiskStorage { hrDeviceTypes 6 }', then an
entry exists in the hrDiskStorageTable which
corresponds to this device."

::= { hrDeviceEntry 2 }

hrDeviceDescr OBJECT-TYPE

SYNTAX DisplayString (SIZE (0..64))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A textual description of this device, including the
device's manufacturer and revision, and optionally,
its serial number."

::= { hrDeviceEntry 3 }

hrDeviceID OBJECT-TYPE

SYNTAX ProductID

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The product ID for this device."

::= { hrDeviceEntry 4 }

hrDeviceStatus OBJECT-TYPE

SYNTAX INTEGER {
 unknown(1),
 running(2),
 warning(3),
 testing(4),
 down(5)

```

    }
MAX-ACCESS read-only
STATUS current
DESCRIPTION
    "The current operational state of the device described
    by this row of the table. A value unknown(1)
    indicates that the current state of the device is
    unknown. running(2) indicates that the device is up
    and running and that no unusual error conditions are
    known. The warning(3) state indicates that agent has
    been informed of an unusual error condition by the
    operational software (e.g., a disk device driver) but
    that the device is still 'operational'. An example
    would be a high number of soft errors on a disk. A
    value of testing(4), indicates that the device is not
    available for use because it is in the testing state.
    The state of down(5) is used only when the agent has
    been informed that the device is not available for any
    use."
::= { hrDeviceEntry 5 }

```

```

hrDeviceErrors OBJECT-TYPE
    SYNTAX Counter32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The number of errors detected on this device. It
        should be noted that as this object has a SYNTAX of
        Counter32, that it does not have a defined initial
        value. However, it is recommended that this object be
        initialized to zero, even though management stations
        must not depend on such an initialization."
    ::= { hrDeviceEntry 6 }

```

```

hrProcessorTable OBJECT-TYPE
    SYNTAX SEQUENCE OF HrProcessorEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "The (conceptual) table of processors contained by the
        host.

        Note that this table is potentially sparse: a
        (conceptual) entry exists only if the correspondent
        value of the hrDeviceType object is
        'hrDeviceProcessor'."
    ::= { hrDevice 3 }

```

hrProcessorEntry OBJECT-TYPE

SYNTAX HrProcessorEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one processor contained by the host. The hrDeviceIndex in the index represents the entry in the hrDeviceTable that corresponds to the hrProcessorEntry.

As an example of how objects in this table are named, an instance of the hrProcessorFrwID object might be named hrProcessorFrwID.3"

INDEX { hrDeviceIndex }

::= { hrProcessorTable 1 }

HrProcessorEntry ::= SEQUENCE {

hrProcessorFrwID

ProductID,

hrProcessorLoad

Integer32

}**hrProcessorFrwID OBJECT-TYPE**

SYNTAX ProductID

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The product ID of the firmware associated with the processor."

::= { hrProcessorEntry 1 }

hrProcessorLoad OBJECT-TYPE

SYNTAX Integer32 (0..100)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The average, over the last minute, of the percentage of time that this processor was not idle. Implementations may approximate this one minute smoothing period if necessary."

::= { hrProcessorEntry 2 }

hrNetworkTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrNetworkEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of network devices contained by the host.

Note that this table is potentially sparse: a (conceptual) entry exists only if the correspondent value of the hrDeviceType object is 'hrDeviceNetwork'."

::= { hrDevice 4 }

hrNetworkEntry OBJECT-TYPE

SYNTAX HrNetworkEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one network device contained by the host. The hrDeviceIndex in the index represents the entry in the hrDeviceTable that corresponds to the hrNetworkEntry.

As an example of how objects in this table are named, an instance of the hrNetworkIfIndex object might be named hrNetworkIfIndex.3"

INDEX { hrDeviceIndex }

::= { hrNetworkTable 1 }

HrNetworkEntry ::= SEQUENCE {

hrNetworkIfIndex InterfaceIndexOrZero

}

hrNetworkIfIndex OBJECT-TYPE

SYNTAX InterfaceIndexOrZero

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of ifIndex which corresponds to this network device. If this device is not represented in the ifTable, then this value shall be zero."

::= { hrNetworkEntry 1 }

hrPrinterTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrPrinterEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of printers local to the host.

Note that this table is potentially sparse: a (conceptual) entry exists only if the correspondent value of the hrDeviceType object is 'hrDevicePrinter'."

::= { hrDevice 5 }

hrPrinterEntry OBJECT-TYPE

SYNTAX HrPrinterEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one printer local to the host. The hrDeviceIndex in the index represents the entry in the hrDeviceTable that corresponds to the hrPrinterEntry.

As an example of how objects in this table are named, an instance of the hrPrinterStatus object might be named hrPrinterStatus.3"

INDEX { hrDeviceIndex }

::= { hrPrinterTable 1 }

HrPrinterEntry ::= SEQUENCE {

hrPrinterStatus INTEGER,

hrPrinterDetectedErrorState OCTET STRING

}**hrPrinterStatus OBJECT-TYPE**

SYNTAX INTEGER {
 other(1),
 unknown(2),
 idle(3),
 printing(4),
 warmup(5)
 }

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The current status of this printer device."

::= { hrPrinterEntry 1 }

hrPrinterDetectedErrorState OBJECT-TYPE

SYNTAX OCTET STRING

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object represents any error conditions detected by the printer. The error conditions are encoded as bits in an octet string, with the following definitions:

Condition	Bit #
lowPaper	0

noPaper	1
lowToner	2
noToner	3
doorOpen	4
jammed	5
offline	6
serviceRequested	7
inputTrayMissing	8
outputTrayMissing	9
markerSupplyMissing	10
outputNearFull	11
outputFull	12
inputTrayEmpty	13
overduePreventMaint	14

Bits are numbered starting with the most significant bit of the first byte being bit 0, the least significant bit of the first byte being bit 7, the most significant bit of the second byte being bit 8, and so on. A one bit encodes that the condition was detected, while a zero bit encodes that the condition was not detected.

This object is useful for alerting an operator to specific warning or error conditions that may occur, especially those requiring human intervention."

```
::= { hrPrinterEntry 2 }
```

hrDiskStorageTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrDiskStorageEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of long-term storage devices contained by the host. In particular, disk devices accessed remotely over a network are not included here.

Note that this table is potentially sparse: a (conceptual) entry exists only if the correspondent value of the hrDeviceType object is 'hrDeviceDiskStorage'."

```
::= { hrDevice 6 }
```

hrDiskStorageEntry OBJECT-TYPE

SYNTAX HrDiskStorageEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one long-term storage device contained by the host. The hrDeviceIndex in the index represents the entry in the hrDeviceTable that corresponds to the hrDiskStorageEntry. As an example, an instance of the hrDiskStorageCapacity object might be named hrDiskStorageCapacity.3"

```
INDEX { hrDeviceIndex }
::= { hrDiskStorageTable 1 }
```

```
HrDiskStorageEntry ::= SEQUENCE {
    hrDiskStorageAccess      INTEGER,
    hrDiskStorageMedia       INTEGER,
    hrDiskStorageRemoveble   TruthValue,
    hrDiskStorageCapacity    KBytes
}
```

hrDiskStorageAccess OBJECT-TYPE

```
SYNTAX      INTEGER {
                readWrite(1),
                readOnly(2)
            }
```

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"An indication if this long-term storage device is readable and writable or only readable. This should reflect the media type, any write-protect mechanism, and any device configuration that affects the entire device."

```
::= { hrDiskStorageEntry 1 }
```

hrDiskStorageMedia OBJECT-TYPE

```
SYNTAX      INTEGER {
                other(1),
                unknown(2),
                hardDisk(3),
                floppyDisk(4),
                opticalDiskROM(5),
                opticalDiskWORM(6),      -- Write Once Read Many
                opticalDiskRW(7),
                ramDisk(8)
            }
```

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"An indication of the type of media used in this long-term storage device."

```
::= { hrDiskStorageEntry 2 }
```

hrDiskStorageRemovable OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Denotes whether or not the disk media may be removed from the drive."

```
::= { hrDiskStorageEntry 3 }
```

hrDiskStorageCapacity OBJECT-TYPE

SYNTAX KBytes

UNITS "KBytes"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The total size for this long-term storage device. If the media is removable and is currently removed, this value should be zero."

```
::= { hrDiskStorageEntry 4 }
```

hrPartitionTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrPartitionEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of partitions for long-term storage devices contained by the host. In particular, partitions accessed remotely over a network are not included here."

```
::= { hrDevice 7 }
```

hrPartitionEntry OBJECT-TYPE

SYNTAX HrPartitionEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one partition. The hrDeviceIndex in the index represents the entry in the hrDeviceTable that corresponds to the hrPartitionEntry."

As an example of how objects in this table are named, an instance of the hrPartitionSize object might be named hrPartitionSize.3.1"

INDEX { hrDeviceIndex, hrPartitionIndex }

```
::= { hrPartitionTable 1 }
```

```
HrPartitionEntry ::= SEQUENCE {  
    hrPartitionIndex          Integer32,  
    hrPartitionLabel          InternationalDisplayString,  
    hrPartitionID             OCTET STRING,  
    hrPartitionSize           KBytes,  
    hrPartitionFSIndex        Integer32  
}
```

hrPartitionIndex OBJECT-TYPE

SYNTAX Integer32 (1..2147483647)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A unique value for each partition on this long-term storage device. The value for each long-term storage device must remain constant at least from one re-initialization of the agent to the next re-initialization."

::= { hrPartitionEntry 1 }

hrPartitionLabel OBJECT-TYPE

SYNTAX InternationalDisplayString (SIZE (0..128))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A textual description of this partition."

::= { hrPartitionEntry 2 }

hrPartitionID OBJECT-TYPE

SYNTAX OCTET STRING

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A descriptor which uniquely represents this partition to the responsible operating system. On some systems, this might take on a binary representation."

::= { hrPartitionEntry 3 }

hrPartitionSize OBJECT-TYPE

SYNTAX KBytes

UNITS "KBytes"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The size of this partition."

::= { hrPartitionEntry 4 }

hrPartitionFSIndex OBJECT-TYPE

SYNTAX Integer32 (0..2147483647)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The index of the file system mounted on this partition. If no file system is mounted on this partition, then this value shall be zero. Note that multiple partitions may point to one file system, denoting that that file system resides on those partitions. Multiple file systems may not reside on one partition."

::= { hrPartitionEntry 5 }

-- The File System Table

-- Registration point for popular File System types,

-- for use with hrFSType. These are defined in the

-- HOST-RESOURCES-TYPES module.

hrFSTypes OBJECT IDENTIFIER ::= { hrDevice 9 }

hrFSTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrFSEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of file systems local to this host or remotely mounted from a file server. File systems that are in only one user's environment on a multi-user system will not be included in this table."

::= { hrDevice 8 }

hrFSEntry OBJECT-TYPE

SYNTAX HrFSEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one file system local to this host or remotely mounted from a file server. File systems that are in only one user's environment on a multi-user system will not be included in this table.

As an example of how objects in this table are named, an instance of the hrFSMountPoint object might be named hrFSMountPoint.3"

INDEX { hrFSIndex }

::= { hrFSTable 1 }

```
HrFSEntry ::= SEQUENCE {  
    hrFSIndex                Integer32,  
    hrFSMountPoint           InternationalDisplayString,  
    hrFSRemoteMountPoint     InternationalDisplayString,  
    hrFSType                 AutonomousType,  
    hrFSAccess               INTEGER,  
    hrFSBootable             TruthValue,  
    hrFSStorageIndex         Integer32,  
    hrFSLastFullBackupDate   DateAndTime,  
    hrFSLastPartialBackupDate DateAndTime  
}
```

```
hrFSIndex OBJECT-TYPE  
    SYNTAX      Integer32 (1..2147483647)  
    MAX-ACCESS  read-only  
    STATUS      current  
    DESCRIPTION  
        "A unique value for each file system local to this  
        host. The value for each file system must remain  
        constant at least from one re-initialization of the  
        agent to the next re-initialization."  
    ::= { hrFSEntry 1 }
```

```
hrFSMountPoint OBJECT-TYPE  
    SYNTAX      InternationalDisplayString (SIZE(0..128))  
    MAX-ACCESS  read-only  
    STATUS      current  
    DESCRIPTION  
        "The path name of the root of this file system."  
    ::= { hrFSEntry 2 }
```

```
hrFSRemoteMountPoint OBJECT-TYPE  
    SYNTAX      InternationalDisplayString (SIZE(0..128))  
    MAX-ACCESS  read-only  
    STATUS      current  
    DESCRIPTION  
        "A description of the name and/or address of the  
        server that this file system is mounted from. This  
        may also include parameters such as the mount point on  
        the remote file system. If this is not a remote file  
        system, this string should have a length of zero."  
    ::= { hrFSEntry 3 }
```

```
hrFSType OBJECT-TYPE  
    SYNTAX      AutonomousType  
    MAX-ACCESS  read-only  
    STATUS      current  
    DESCRIPTION
```

```
    "The value of this object identifies the type of this
    file system."
 ::= { hrFSEntry 4 }

hrFSAccess OBJECT-TYPE
    SYNTAX      INTEGER {
                    readWrite(1),
                    readOnly(2)
                }
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
        "An indication if this file system is logically
        configured by the operating system to be readable and
        writable or only readable. This does not represent
        any local access-control policy, except one that is
        applied to the file system as a whole."
 ::= { hrFSEntry 5 }

hrFSBootable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
        "A flag indicating whether this file system is
        bootable."
 ::= { hrFSEntry 6 }

hrFSStorageIndex OBJECT-TYPE
    SYNTAX      Integer32 (0..2147483647)
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
        "The index of the hrStorageEntry that represents
        information about this file system. If there is no
        such information available, then this value shall be
        zero. The relevant storage entry will be useful in
        tracking the percent usage of this file system and
        diagnosing errors that may occur when it runs out of
        space."
 ::= { hrFSEntry 7 }

hrFSLastFullBackupDate OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS read-write
    STATUS      current
    DESCRIPTION
        "The last date at which this complete file system was
```

copied to another storage device for backup. This information is useful for ensuring that backups are being performed regularly.

If this information is not known, then this variable shall have the value corresponding to January 1, year 0000, 00:00:00.0, which is encoded as (hex)'00 00 01 01 00 00 00 00'."

```
::= { hrFSEntry 8 }
```

hrFSLastPartialBackupDate OBJECT-TYPE

SYNTAX DateAndTime

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The last date at which a portion of this file system was copied to another storage device for backup. This information is useful for ensuring that backups are being performed regularly.

If this information is not known, then this variable shall have the value corresponding to January 1, year 0000, 00:00:00.0, which is encoded as (hex)'00 00 01 01 00 00 00 00'."

```
::= { hrFSEntry 9 }
```

```
-- The Host Resources Running Software Group
```

```
--
```

```
-- The hrSWRunTable contains an entry for each distinct piece of
-- software that is running or loaded into physical or virtual
-- memory in preparation for running. This includes the host's
-- operating system, device drivers, and applications.
```

hrSWOSIndex OBJECT-TYPE

SYNTAX Integer32 (1..2147483647)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of the hrSWRunIndex for the hrSWRunEntry that represents the primary operating system running on this host. This object is useful for quickly and uniquely identifying that primary operating system."

```
::= { hrSWRun 1 }
```

hrSWRunTable OBJECT-TYPE

SYNTAX SEQUENCE OF HrSWRunEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The (conceptual) table of software running on the host."

::= { hrSWRun 2 }

hrSWRunEntry OBJECT-TYPE

SYNTAX HrSWRunEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A (conceptual) entry for one piece of software running on the host. Note that because the installed software table only contains information for software stored locally on this host, not every piece of running software will be found in the installed software table. This is true of software that was loaded and run from a non-local source, such as a network-mounted file system.

As an example of how objects in this table are named, an instance of the hrSWRunName object might be named hrSWRunName.1287"

INDEX { hrSWRunIndex }

::= { hrSWRunTable 1 }

HrSWRunEntry ::= SEQUENCE {

hrSWRunIndex	Integer32,
hrSWRunName	InternationalDisplayString,
hrSWRunID	ProductID,
hrSWRunPath	InternationalDisplayString,
hrSWRunParameters	InternationalDisplayString,
hrSWRunType	INTEGER,
hrSWRunStatus	INTEGER

}

hrSWRunIndex OBJECT-TYPE

SYNTAX Integer32 (1..2147483647)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A unique value for each piece of software running on the host. Wherever possible, this should be the system's native, unique identification number."

::= { hrSWRunEntry 1 }

hrSWRunName OBJECT-TYPE

SYNTAX InternationalDisplayString (SIZE (0..64))

MAX-ACCESS read-only

STATUS current
DESCRIPTION
"A textual description of this running piece of software, including the manufacturer, revision, and the name by which it is commonly known. If this software was installed locally, this should be the same string as used in the corresponding hrSWInstalledName."
::= { hrSWRunEntry 2 }

hrSWRunID OBJECT-TYPE
SYNTAX ProductID
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The product ID of this running piece of software."
::= { hrSWRunEntry 3 }

hrSWRunPath OBJECT-TYPE
SYNTAX InternationalDisplayString (SIZE(0..128))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A description of the location on long-term storage (e.g. a disk drive) from which this software was loaded."
::= { hrSWRunEntry 4 }

hrSWRunParameters OBJECT-TYPE
SYNTAX InternationalDisplayString (SIZE(0..128))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A description of the parameters supplied to this software when it was initially loaded."
::= { hrSWRunEntry 5 }

hrSWRunType OBJECT-TYPE
SYNTAX INTEGER {
unknown(1),
operatingSystem(2),
deviceDriver(3),
application(4)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The type of this software."

```

 ::= { hrSWRunEntry 6 }

hrSWRunStatus OBJECT-TYPE
    SYNTAX      INTEGER {
        running(1),
        runnable(2),      -- waiting for resource
                           -- (i.e., CPU, memory, IO)
        notRunnable(3),   -- loaded but waiting for event
        invalid(4)        -- not loaded
    }
    MAX-ACCESS read-write
    STATUS      current
    DESCRIPTION
        "The status of this running piece of software.
        Setting this value to invalid(4) shall cause this
        software to stop running and to be unloaded. Sets to
        other values are not valid."
    ::= { hrSWRunEntry 7 }

-- The Host Resources Running Software Performance Group
--
-- The hrSWRunPerfTable contains an entry corresponding to
-- each entry in the hrSWRunTable.

hrSWRunPerfTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF HrSWRunPerfEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
        "The (conceptual) table of running software
        performance metrics."
    ::= { hrSWRunPerf 1 }

hrSWRunPerfEntry OBJECT-TYPE
    SYNTAX      HrSWRunPerfEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
        "A (conceptual) entry containing software performance
        metrics. As an example, an instance of the
        hrSWRunPerfCPU object might be named
        hrSWRunPerfCPU.1287"
    AUGMENTS { hrSWRunEntry } -- This table augments information in
                                -- the hrSWRunTable.
    ::= { hrSWRunPerfTable 1 }

HrSWRunPerfEntry ::= SEQUENCE {
    hrSWRunPerfCPU      Integer32,

```

```

        hrSWRunPerfMem          KBytes
    }

hrSWRunPerfCPU OBJECT-TYPE
    SYNTAX      Integer32 (0..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of centi-seconds of the total system's CPU
        resources consumed by this process. Note that on a
        multi-processor system, this value may increment by
        more than one centi-second in one centi-second of real
        (wall clock) time."
    ::= { hrSWRunPerfEntry 1 }

hrSWRunPerfMem OBJECT-TYPE
    SYNTAX      KBytes
    UNITS       "KBytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total amount of real system memory allocated to
        this process."
    ::= { hrSWRunPerfEntry 2 }

-- The Host Resources Installed Software Group
--
-- The hrSWInstalledTable contains an entry for each piece
-- of software installed in long-term storage (e.g. a disk
-- drive) locally on this host. Note that this does not
-- include software loadable remotely from a network
-- server.
--
-- Different implementations may track software in varying
-- ways. For example, while some implementations may track
-- executable files as distinct pieces of software, other
-- implementations may use other strategies such as keeping
-- track of software "packages" (e.g., related groups of files)
-- or keeping track of system or application "patches".
--
-- This table is useful for identifying and inventorying
-- software on a host and for diagnosing incompatibility
-- and version mismatch problems between various pieces
-- of hardware and software.

hrSWInstalledLastChange OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
    "The value of sysUpTime when an entry in the
    hrSWInstalledTable was last added, renamed, or
    deleted.  Because this table is likely to contain many
    entries, polling of this object allows a management
    station to determine when re-downloading of the table
    might be useful."
::= { hrSWInstalled 1 }

```

```

hrSWInstalledLastUpdateTime OBJECT-TYPE
SYNTAX      TimeTicks
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The value of sysUpTime when the hrSWInstalledTable
    was last completely updated.  Because caching of this
    data will be a popular implementation strategy,
    retrieval of this object allows a management station
    to obtain a guarantee that no data in this table is
    older than the indicated time."
::= { hrSWInstalled 2 }

```

```

hrSWInstalledTable OBJECT-TYPE
SYNTAX      SEQUENCE OF HrSWInstalledEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The (conceptual) table of software installed on this
    host."
::= { hrSWInstalled 3 }

```

```

hrSWInstalledEntry OBJECT-TYPE
SYNTAX      HrSWInstalledEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "A (conceptual) entry for a piece of software
    installed on this host.

    As an example of how objects in this table are named,
    an instance of the hrSWInstalledName object might be
    named hrSWInstalledName.96"
INDEX { hrSWInstalledIndex }
::= { hrSWInstalledTable 1 }

```

```

HrSWInstalledEntry ::= SEQUENCE {
    hrSWInstalledIndex      Integer32,

```

```
        hrSWInstalledName      InternationalDisplayString,
        hrSWInstalledID        ProductID,
        hrSWInstalledType      INTEGER,
        hrSWInstalledDate      DateAndTime
    }

hrSWInstalledIndex OBJECT-TYPE
    SYNTAX      Integer32 (1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A unique value for each piece of software installed
        on the host.  This value shall be in the range from 1
        to the number of pieces of software installed on the
        host."
    ::= { hrSWInstalledEntry 1 }

hrSWInstalledName OBJECT-TYPE
    SYNTAX      InternationalDisplayString (SIZE (0..64))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A textual description of this installed piece of
        software, including the manufacturer, revision, the
        name by which it is commonly known, and optionally,
        its serial number."
    ::= { hrSWInstalledEntry 2 }

hrSWInstalledID OBJECT-TYPE
    SYNTAX      ProductID
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The product ID of this installed piece of software."
    ::= { hrSWInstalledEntry 3 }

hrSWInstalledType OBJECT-TYPE
    SYNTAX      INTEGER {
        unknown(1),
        operatingSystem(2),
        deviceDriver(3),
        application(4)
    }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of this software."
    ::= { hrSWInstalledEntry 4 }
```

```
hrSWInstalledDate OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The last-modification date of this application as it
        would appear in a directory listing.

        If this information is not known, then this variable
        shall have the value corresponding to January 1, year
        0000, 00:00:00.0, which is encoded as
        (hex)'00 00 01 01 00 00 00 00'."
    ::= { hrSWInstalledEntry 5 }

-- Conformance information

hrMIBCompliances OBJECT IDENTIFIER ::= { hrMIBAdminInfo 2 }
hrMIBGroups      OBJECT IDENTIFIER ::= { hrMIBAdminInfo 3 }

-- Compliance Statements
hrMIBCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "The requirements for conformance to the Host Resources MIB."
    MODULE -- this module
        MANDATORY-GROUPS { hrSystemGroup, hrStorageGroup,
                           hrDeviceGroup }

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

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

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

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

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

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

GROUP hrSWRunGroup
  DESCRIPTION
    "The Running Software Group. Implementation
    of this group is mandatory only when the
    hrSWRunPerfGroup is implemented."

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

GROUP hrSWRunPerfGroup
  DESCRIPTION
    "The Running Software Performance Group.
    Implementation of this group is at the discretion
    of the implementor."

GROUP hrSWInstalledGroup
  DESCRIPTION
    "The Installed Software Group.
    Implementation of this group is at the discretion
    of the implementor."

::= { hrMIBCompliances 1 }

hrSystemGroup OBJECT-GROUP
  OBJECTS {
    hrSystemUptime, hrSystemDate,
    hrSystemInitialLoadDevice,
    hrSystemInitialLoadParameters,
    hrSystemNumUsers, hrSystemProcesses,
    hrSystemMaxProcesses
  }
  STATUS current
  DESCRIPTION
    "The Host Resources System Group."
  ::= { hrMIBGroups 1 }
```

```
hrStorageGroup OBJECT-GROUP
  OBJECTS {
    hrMemorySize, hrStorageIndex, hrStorageType,
    hrStorageDescr, hrStorageAllocationUnits,
    hrStorageSize, hrStorageUsed,
    hrStorageAllocationFailures
  }
  STATUS current
  DESCRIPTION
    "The Host Resources Storage Group."
    ::= { hrMIBGroups 2 }

hrDeviceGroup OBJECT-GROUP
  OBJECTS {
    hrDeviceIndex, hrDeviceType, hrDeviceDescr,
    hrDeviceID, hrDeviceStatus, hrDeviceErrors,
    hrProcessorFrwID, hrProcessorLoad,
    hrNetworkIfIndex, hrPrinterStatus,
    hrPrinterDetectedErrorState,
    hrDiskStorageAccess, hrDiskStorageMedia,
    hrDiskStorageRemoveble, hrDiskStorageCapacity,
    hrPartitionIndex, hrPartitionLabel,
    hrPartitionID, hrPartitionSize,
    hrPartitionFSIndex, hrFSIndex, hrFSMountPoint,
    hrFSRemoteMountPoint, hrFSType, hrFSAccess,
    hrFSBootable, hrFSStorageIndex,
    hrFSLastFullBackupDate,
    hrFSLastPartialBackupDate
  }
  STATUS current
  DESCRIPTION
    "The Host Resources Device Group."
    ::= { hrMIBGroups 3 }

hrSWRunGroup OBJECT-GROUP
  OBJECTS {
    hrSWOSIndex, hrSWRunIndex, hrSWRunName,
    hrSWRunID, hrSWRunPath, hrSWRunParameters,
    hrSWRunType, hrSWRunStatus
  }
  STATUS current
  DESCRIPTION
    "The Host Resources Running Software Group."
    ::= { hrMIBGroups 4 }

hrSWRunPerfGroup OBJECT-GROUP
  OBJECTS { hrSWRunPerfCPU, hrSWRunPerfMem }
  STATUS current
```

DESCRIPTION

"The Host Resources Running Software
Performance Group."

::= { hrMIBGroups 5 }

hrSWInstalledGroup OBJECT-GROUP

OBJECTS {

hrSWInstalledLastChange,
hrSWInstalledLastUpdateTime,
hrSWInstalledIndex, hrSWInstalledName,
hrSWInstalledID, hrSWInstalledType,
hrSWInstalledDate

}

STATUS current

DESCRIPTION

"The Host Resources Installed Software Group."

::= { hrMIBGroups 6 }

END

5. Type Definitions

HOST-RESOURCES-TYPES DEFINITIONS ::= BEGIN

IMPORTS

MODULE-IDENTITY, OBJECT-IDENTITY FROM SNMPv2-SMI
hrMIBAdminInfo, hrStorage, hrDevice FROM HOST-RESOURCES-MIB;

hostResourcesTypesModule MODULE-IDENTITY

LAST-UPDATED "200003060000Z" -- 6 March, 2000

ORGANIZATION "IETF Host Resources MIB Working Group"

CONTACT-INFO

"Steve Waldbusser

Postal: Lucent Technologies, Inc.

1213 Innsbruck Dr.

Sunnyvale, CA 94089

USA

Phone: 650-318-1251

Fax: 650-318-1633

Email: waldbusser@ins.com

In addition, the Host Resources MIB mailing list is dedicated to discussion of this MIB. To join the mailing list, send a request message to hostmib-request@andrew.cmu.edu. The mailing list address is hostmib@andrew.cmu.edu."

DESCRIPTION

"This MIB module registers type definitions for storage types, device types, and file system types."

```
        After the initial revision, this module will be
        maintained by IANA."
REVISION "200003060000Z"      -- 6 March 2000
DESCRIPTION
    "The original version of this module, published as RFC
    2790."
 ::= { hrMIBAdminInfo 4 }

-- Registrations for some storage types, for use with hrStorageType
hrStorageTypes                OBJECT IDENTIFIER ::= { hrStorage 1 }

hrStorageOther OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used when no other defined
        type is appropriate."
    ::= { hrStorageTypes 1 }

hrStorageRam OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for RAM."
    ::= { hrStorageTypes 2 }

hrStorageVirtualMemory OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for virtual memory,
        temporary storage of swapped or paged memory."
    ::= { hrStorageTypes 3 }

hrStorageFixedDisk OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for non-removable
        rigid rotating magnetic storage devices."
    ::= { hrStorageTypes 4 }

hrStorageRemovableDisk OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for removable rigid
        rotating magnetic storage devices."
    ::= { hrStorageTypes 5 }

hrStorageFloppyDisk OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
```

```
        "The storage type identifier used for non-rigid rotating
        magnetic storage devices."
 ::= { hrStorageTypes 6 }

hrStorageCompactDisc OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for read-only rotating
        optical storage devices."
 ::= { hrStorageTypes 7 }

hrStorageRamDisk OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for a file system that
        is stored in RAM."
 ::= { hrStorageTypes 8 }

hrStorageFlashMemory OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for flash memory."
 ::= { hrStorageTypes 9 }

hrStorageNetworkDisk OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The storage type identifier used for a
        networked file system."
 ::= { hrStorageTypes 10 }

-- Registrations for some device types, for use with hrDeviceType
hrDeviceTypes          OBJECT IDENTIFIER ::= { hrDevice 1 }

hrDeviceOther OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used when no other defined
        type is appropriate."
 ::= { hrDeviceTypes 1 }

hrDeviceUnknown OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used when the device type is
        unknown."
 ::= { hrDeviceTypes 2 }
```

```
hrDeviceProcessor OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a CPU."
    ::= { hrDeviceTypes 3 }

hrDeviceNetwork OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a network interface."
    ::= { hrDeviceTypes 4 }

hrDevicePrinter OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a printer."
    ::= { hrDeviceTypes 5 }

hrDeviceDiskStorage OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a disk drive."
    ::= { hrDeviceTypes 6 }

hrDeviceVideo OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a video device."
    ::= { hrDeviceTypes 10 }

hrDeviceAudio OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for an audio device."
    ::= { hrDeviceTypes 11 }

hrDeviceCoprocessor OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a co-processor."
    ::= { hrDeviceTypes 12 }

hrDeviceKeyboard OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a keyboard device."
    ::= { hrDeviceTypes 13 }
```

```
hrDeviceModem OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a modem."
    ::= { hrDeviceTypes 14 }

hrDeviceParallelPort OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a parallel port."
    ::= { hrDeviceTypes 15 }

hrDevicePointing OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a pointing device
        (e.g., a mouse)."
    ::= { hrDeviceTypes 16 }

hrDeviceSerialPort OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a serial port."
    ::= { hrDeviceTypes 17 }

hrDeviceTape OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a tape storage device."
    ::= { hrDeviceTypes 18 }

hrDeviceClock OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a clock device."
    ::= { hrDeviceTypes 19 }

hrDeviceVolatileMemory OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a volatile memory
        storage device."
    ::= { hrDeviceTypes 20 }

hrDeviceNonVolatileMemory OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The device type identifier used for a non-volatile memory
```

```
        storage device."
    ::= { hrDeviceTypes 21 }

-- Registrations for some popular File System types,
-- for use with hrFSType.
hrFSTypes          OBJECT IDENTIFIER ::= { hrDevice 9 }

hrFSOther OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used when no other
        defined type is appropriate."
    ::= { hrFSTypes 1 }

hrFSUnknown OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used when the type of
        file system is unknown."
    ::= { hrFSTypes 2 }

hrFSBerkeleyFFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        Berkeley Fast File System."
    ::= { hrFSTypes 3 }

hrFSSys5FS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        System V File System."
    ::= { hrFSTypes 4 }

hrFSFat OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for
        DOS's FAT file system."
    ::= { hrFSTypes 5 }

hrFSHPFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for OS/2's
        High Performance File System."
    ::= { hrFSTypes 6 }
```

```
hrFSHFS OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    Macintosh Hierarchical File System."
  ::= { hrFSTypes 7 }

hrFSMFS OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    Macintosh File System."
  ::= { hrFSTypes 8 }

hrFSNTFS OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    Windows NT File System."
  ::= { hrFSTypes 9 }

hrFSVNode OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    VNode File System."
  ::= { hrFSTypes 10 }

hrFSJournaled OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    Journaled File System."
  ::= { hrFSTypes 11 }

hrFSIso9660 OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    ISO 9660 File System for CD's."
  ::= { hrFSTypes 12 }

hrFSRockRidge OBJECT-IDENTITY
  STATUS current
  DESCRIPTION
    "The file system type identifier used for the
    RockRidge File System for CD's."
  ::= { hrFSTypes 13 }
```

```
hrFSNFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        NFS File System."
    ::= { hrFSTypes 14 }

hrFSNetware OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        Netware File System."
    ::= { hrFSTypes 15 }

hrFSAFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        Andrew File System."
    ::= { hrFSTypes 16 }

hrFSDFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        OSF DCE Distributed File System."
    ::= { hrFSTypes 17 }

hrFSAppleshare OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        AppleShare File System."
    ::= { hrFSTypes 18 }

hrFSRFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        RFS File System."
    ::= { hrFSTypes 19 }

hrFSDGCFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        Data General DGCFS."
    ::= { hrFSTypes 20 }
```

```
hrFSBFS OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        SVR4 Boot File System."
    ::= { hrFSTypes 21 }

hrFSFAT32 OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        Windows FAT32 File System."
    ::= { hrFSTypes 22 }

hrFSLinuxExt2 OBJECT-IDENTITY
    STATUS current
    DESCRIPTION
        "The file system type identifier used for the
        Linux EXT2 File System."
    ::= { hrFSTypes 23 }

END
```

6. Internationalization Considerations

This MIB has many objects that identify file-system pathnames on the managed host. Many file systems allow pathnames to be encoded in a variety of character sets (other than ASCII), but do not support the encoding of the actual character set used with the pathname. The implementation strategy is that user interfaces (i.e. character-based shells or graphical applications) will have configuration options that control with which character set they will interpret and display all pathnames. This is often a per-user configuration (e.g. an environment variable), so that users using different languages and character sets on a multi-user system may each work effectively with their preferred character set. A human usually controls this configuration. If an application is not configured or is configured incorrectly, it will often have trouble displaying pathnames in the intended character set.

This situation made it important for this MIB to handle two issues:

- 1) Pathname objects must be able to transfer a variety of character sets with potentially multi-byte encodings; and,

- 2) HostMIB agents will generally not be correctly configured for the appropriate character set to be used for all files on the system, particularly on a system with multiple users using different character sets. It was thus impossible to mandate that the agent tag pathnames with the character set in use.

These issues were solved with the introduction of the `InternationalDisplayString` textual convention, which supports multi-byte encodings. Network management stations should use a local algorithm to determine which character set is in use and how it should be displayed. It is expected that network management station applications will rely on human configuration to choose which character set in which to interpret `InternationalDisplayString` objects, much like an application running locally on that host.

7. Security Considerations

There are a number of management objects defined in this MIB that have a `MAX-ACCESS` clause of read-write. 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 system operations.

There are a number of managed objects in this MIB that may contain sensitive information. The objects in the Running Software Group list information about running software on the system (including the operating system software and version). Some may wish not to disclose to others what software they are running. Further, an inventory of the running software and versions may be helpful to an attacker who hopes to exploit software bugs in certain applications. The same issues exist for the objects in the Installed Software Group.

It is thus important to control even GET access to these objects and possibly to even encrypt the values of these object when sending them over the network via SNMP. Not all versions of SNMP provide features for such a secure environment.

SNMPv1 by itself is not a secure environment. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB.

It is recommended that the implementers consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [RFC2574] and the View-based Access Control Model RFC 2575 [RFC2575] is recommended.

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

8. References

- [RFC2571] Harrington, D., Presuhn, R. and B. Wijnen, "An Architecture for Describing SNMP Management Frameworks", RFC 2571, April 1999.
- [RFC1155] Rose, M. and K. McCloghrie, "Structure and Identification of Management Information for TCP/IP-based Internets", STD 16, RFC 1155, May 1990.
- [RFC1212] Rose, M. and K. McCloghrie, "Concise MIB Definitions", STD 16, RFC 1212, March 1991.
- [RFC1215] Rose, M., "A Convention for Defining Traps for use with the SNMP", RFC 1215, March 1991.
- [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.
- [RFC1157] Case, J., Fedor, M., Schoffstall, M. and J. Davin, "Simple Network Management Protocol", STD 15, RFC 1157, May 1990.
- [RFC1901] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Introduction to Community-based SNMPv2", RFC 1901, January 1996.
- [RFC1906] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Transport Mappings for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1906, January 1996.

- [RFC2572] Case, J., Harrington D., Presuhn R. and B. Wijnen, "Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)", RFC 2572, April 1999
- [RFC2574] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", RFC 2574, April 1999.
- [RFC1905] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1905, January 1996.
- [RFC2573] Levi, D., Meyer, P. and B. Stewart, "SNMPv3 Applications", RFC 2573, April 1999.
- [RFC2575] Wijnen, B., Presuhn, R. and K. McCloghrie, "View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)", RFC 2575, April 1999.
- [RFC2570] Case, J., Mundy, R., Partain, D. and B. Stewart, "Introduction to Version 3 of the Internet- standard Network Management Framework", RFC 2570, April 1999.
- [RFC1907] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1907, January 1996.
- [RFC2233] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2233, November 1997.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

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10. Authors' Addresses

Pete Grillo
WeSync.com
1001 SW Fifth Ave, Fifth Floor
Portland, OR 97204

Phone: 503-425-5051
Fax: 503-827-6718
email: pete@wesync.com
Phone: +1 503 827 6717

Steven Waldbusser
Lucent Technologies, Inc.
1213 Innsbruck Dr.
Sunnyvale CA 94089

Phone: +1 650 318 1251
Fax: +1 650 318 1633
EMail: waldbusser@ins.com

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