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P. Grillo
Network Innovations
Intel Corporation
S. Waldbusser
Carnegie Mellon University
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Host Resources MIB

Status of this Memo

This RFC 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" for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Abstract

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 Network Management Framework

The Internet-standard Network Management Framework consists of three components. They are:

STD 16, RFC 1155 [1] which defines the SMI, the mechanisms used for describing and naming objects for the purpose of management. STD 16, RFC 1212 [2] defines a more concise description mechanism, which is wholly consistent with the SMI.

STD 17, RFC 1213 [3] which defines MIB-II, the core set of managed objects for the Internet suite of protocols.

STD 15, RFC 1157 [4] which defines the SNMP, the protocol used for network access to managed objects.

The Framework permits new objects to be defined for the purpose of experimentation and evaluation.

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Within a given MIB module, objects are defined using STD 16, RFC 1212's OBJECT-TYPE macro. At a minimum, each object has a name, a syntax, an access-level, and an implementation-status.

The name is an object identifier, an administratively assigned name, which specifies an object type. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the object descriptor, to also refer to the object type.

The syntax of an object type defines the abstract data structure corresponding to that object type. The ASN.1[5] language is used for this purpose. However, RFC 1155 purposely restricts the ASN.1 constructs which may be used. These restrictions are explicitly made for simplicity.

The access-level of an object type defines whether it makes "protocol sense" to read and/or write the value of an instance of the object type. (This access-level is independent of any administrative authorization policy.)

The implementation-status of an object type indicates whether the object is mandatory, optional, obsolete, or deprecated.

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 MIB-II [3] which also provide host management functionality. Implementation of the System and Interfaces groups is mandatory for implementors of the Host Resources MIB.

3. Definitions

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

IMPORTS
    OBJECT-TYPE               FROM RFC-1212
    DisplayString             FROM RFC1213-MIB
    TimeTicks,
    Counter, Gauge            FROM RFC1155-SMI;

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 }


-- textual conventions

-- a truth value
Boolean ::=   INTEGER { true(1), false(2) }


-- memory size, expressed in units of 1024bytes
KBytes ::=    INTEGER (0..2147483647)

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

   -- 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)


   DateAndTime ::= OCTET STRING (SIZE (8 | 11))
   --        A date-time specification for the local time of day.
   --        This data type is intended to provide a consistent
   --        method of reporting date information.
   --
   --            field  octets  contents                  range
   --            _____  ______  ________                  _____
   --              1      1-2   year                      0..65536
   --                           (in network byte order)
   --              2       3    month                     1..12
   --              3       4    day                       1..31
   --              4       5    hour                      0..23
   --              5       6    minutes                   0..59
   --              6       7    seconds                   0..60
   --                           (use 60 for leap-second)
   --              7       8    deci-seconds              0..9
   --              8       9    direction from UTC        "+" / "-"
   --                           (in ascii notation)
   --              9      10    hours from UTC            0..11
   --             10      11    minutes from UTC          0..59
   --
   --            Note that if only local time is known, then
   --            timezone information (fields 8-10) is not present.

   InternationalDisplayString ::= OCTET STRING
   --  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.


   -- The Host Resources System Group
   --
   -- Implementation of this group is mandatory for all host systems.
   hrSystemUptime OBJECT-TYPE
       SYNTAX TimeTicks
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
              "The amount of time since this host was last
              initialized.  Note that this is different from
              sysUpTime in MIB-II [3] because sysUpTime is the
              uptime of the network management portion of the
              system."
       ::= { hrSystem 1 }

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

   hrSystemInitialLoadDevice OBJECT-TYPE
       SYNTAX INTEGER (1..2147483647)
       ACCESS read-write
       STATUS mandatory
       DESCRIPTION
              "The index of the hrDeviceEntry for the device from
              which this host is configured to load its initial
              operating system configuration."
       ::= { hrSystem 3 }

   hrSystemInitialLoadParameters OBJECT-TYPE
       SYNTAX InternationalDisplayString (SIZE (0..128))
       ACCESS read-write
       STATUS mandatory
       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."
       ::= { hrSystem 4 }
```

```
   hrSystemNumUsers OBJECT-TYPE
       SYNTAX Gauge
       ACCESS read-only
       STATUS mandatory
       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 Gauge
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
              "The number of process contexts currently loaded or
              running on this system."
       ::= { hrSystem 6 }

   hrSystemMaxProcesses OBJECT-TYPE
       SYNTAX INTEGER (0..2147483647)
       ACCESS read-only
       STATUS mandatory
       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
   --
   -- Implementation of this group is mandatory for all host systems.

   -- Registration for some storage types, for use with hrStorageType
   hrStorageTypes          OBJECT IDENTIFIER ::= { hrStorage 1 }
   hrStorageOther          OBJECT IDENTIFIER ::= { hrStorageTypes 1 }
   hrStorageRam            OBJECT IDENTIFIER ::= { hrStorageTypes 2 }
   -- hrStorageVirtualMemory is temporary storage of swapped
   -- or paged memory
   hrStorageVirtualMemory  OBJECT IDENTIFIER ::= { hrStorageTypes 3 }
   hrStorageFixedDisk      OBJECT IDENTIFIER ::= { hrStorageTypes 4 }
   hrStorageRemovableDisk  OBJECT IDENTIFIER ::= { hrStorageTypes 5 }
   hrStorageFloppyDisk     OBJECT IDENTIFIER ::= { hrStorageTypes 6 }
```

```
   hrStorageCompactDisc    OBJECT IDENTIFIER ::= { hrStorageTypes 7 }
   hrStorageRamDisk        OBJECT IDENTIFIER ::= { hrStorageTypes 8 }

   hrMemorySize OBJECT-TYPE
       SYNTAX KBytes
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
              "The amount of physical main memory contained by
              the host."
       ::= { hrStorage 2 }


   hrStorageTable OBJECT-TYPE
       SYNTAX SEQUENCE OF HrStorageEntry
       ACCESS not-accessible
       STATUS mandatory
       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
        ACCESS not-accessible
        STATUS mandatory
        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               INTEGER,
            hrStorageType                OBJECT IDENTIFIER,
            hrStorageDescr               DisplayString,
            hrStorageAllocationUnits     INTEGER,
            hrStorageSize                INTEGER,
            hrStorageUsed                INTEGER,
            hrStorageAllocationFailures  Counter
        }

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

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

    hrStorageDescr OBJECT-TYPE
        SYNTAX DisplayString
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "A description of the type and instance of the
                storage described by this entry."
```

```
        ::= { hrStorageEntry 3 }

    hrStorageAllocationUnits OBJECT-TYPE
        SYNTAX      INTEGER (1..2147483647)
        ACCESS      read-only
        STATUS      mandatory
        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 INTEGER (0..2147483647)
        ACCESS read-write
        STATUS mandatory
        DESCRIPTION
               "The size of the storage represented by this entry,
               in units of hrStorageAllocationUnits."
        ::= { hrStorageEntry 5 }

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

    hrStorageAllocationFailures OBJECT-TYPE
        SYNTAX Counter
        ACCESS read-only
        STATUS mandatory
        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 Counter, that it does not
               have a defined initial value.  However, it is
               recommended that this object be initialized to
               zero."
        ::= { hrStorageEntry 7 }
```

```
   -- The Host Resources Device Group
   --
   -- Implementation of this group is mandatory for all host systems.
   --
   -- 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 for some device types, for use with hrDeviceType
   hrDeviceTypes             OBJECT IDENTIFIER ::= { hrDevice 1 }

   hrDeviceOther             OBJECT IDENTIFIER ::= { hrDeviceTypes 1 }
   hrDeviceUnknown           OBJECT IDENTIFIER ::= { hrDeviceTypes 2 }
   hrDeviceProcessor         OBJECT IDENTIFIER ::= { hrDeviceTypes 3 }
   hrDeviceNetwork           OBJECT IDENTIFIER ::= { hrDeviceTypes 4 }
   hrDevicePrinter           OBJECT IDENTIFIER ::= { hrDeviceTypes 5 }
   hrDeviceDiskStorage       OBJECT IDENTIFIER ::= { hrDeviceTypes 6 }
   hrDeviceVideo             OBJECT IDENTIFIER ::= { hrDeviceTypes 10 }
   hrDeviceAudio             OBJECT IDENTIFIER ::= { hrDeviceTypes 11 }
   hrDeviceCoprocessor       OBJECT IDENTIFIER ::= { hrDeviceTypes 12 }
   hrDeviceKeyboard          OBJECT IDENTIFIER ::= { hrDeviceTypes 13 }
   hrDeviceModem             OBJECT IDENTIFIER ::= { hrDeviceTypes 14 }
   hrDeviceParallelPort      OBJECT IDENTIFIER ::= { hrDeviceTypes 15 }
   hrDevicePointing          OBJECT IDENTIFIER ::= { hrDeviceTypes 16 }
   hrDeviceSerialPort        OBJECT IDENTIFIER ::= { hrDeviceTypes 17 }
   hrDeviceTape              OBJECT IDENTIFIER ::= { hrDeviceTypes 18 }
   hrDeviceClock             OBJECT IDENTIFIER ::= { hrDeviceTypes 19 }
   hrDeviceVolatileMemory    OBJECT IDENTIFIER ::= { hrDeviceTypes 20 }
   hrDeviceNonVolatileMemory OBJECT IDENTIFIER ::= { hrDeviceTypes 21 }


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

   hrDeviceEntry OBJECT-TYPE
       SYNTAX HrDeviceEntry
       ACCESS not-accessible
       STATUS mandatory
       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           INTEGER,
            hrDeviceType            OBJECT IDENTIFIER,
            hrDeviceDescr           DisplayString,
            hrDeviceID              ProductID,
            hrDeviceStatus          INTEGER,
            hrDeviceErrors          Counter
        }

    hrDeviceIndex OBJECT-TYPE
        SYNTAX INTEGER (1..2147483647)
        ACCESS read-only
        STATUS mandatory
        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 OBJECT IDENTIFIER
        ACCESS read-only
        STATUS mandatory
        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))
        ACCESS read-only
        STATUS mandatory
        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
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "The product ID for this device."
        ::= { hrDeviceEntry 4 }

    hrDeviceStatus OBJECT-TYPE
         SYNTAX  INTEGER {
              unknown(1),
              running(2),
              warning(3),
              testing(4),
              down(5)
         }
         ACCESS  read-only
         STATUS  mandatory
         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 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 Counter
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
               "The number of errors detected on this device.  It
               should be noted that as this object has a SYNTAX
               of Counter, that it does not have a defined
               initial value.  However, it is recommended that
               this object be initialized to zero."
       ::= { hrDeviceEntry 6 }

   hrProcessorTable OBJECT-TYPE
       SYNTAX SEQUENCE OF HrProcessorEntry
       ACCESS not-accessible
       STATUS mandatory
       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
       ACCESS not-accessible
       STATUS mandatory
       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             INTEGER
       }

   hrProcessorFrwID OBJECT-TYPE
```

```
        SYNTAX ProductID
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "The product ID of the firmware associated with the
               processor."
        ::= { hrProcessorEntry 1 }

    hrProcessorLoad OBJECT-TYPE
        SYNTAX INTEGER (0..100)
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "The average, over the last minute, of the
               percentage of time that this processor was not
               idle."
        ::= { hrProcessorEntry 2 }

    hrNetworkTable OBJECT-TYPE
        SYNTAX SEQUENCE OF HrNetworkEntry
        ACCESS not-accessible
        STATUS mandatory
        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
        ACCESS not-accessible
        STATUS mandatory
        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    INTEGER
       }

   hrNetworkIfIndex OBJECT-TYPE
       SYNTAX INTEGER
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
              "The value of ifIndex which corresponds to this
              network device."
       ::= { hrNetworkEntry 1 }

   hrPrinterTable OBJECT-TYPE
       SYNTAX SEQUENCE OF HrPrinterEntry
       ACCESS not-accessible
       STATUS mandatory
       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
       ACCESS not-accessible
       STATUS mandatory
       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)
       }
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
               "The current status of this printer device.  When
               in the idle(1), printing(2), or warmup(3) state,
               the corresponding hrDeviceStatus should be
               running(2) or warning(3).  When in the unknown
               state, the corresponding hrDeviceStatus should be
               unknown(1)."
       ::= { hrPrinterEntry 1 }

   hrPrinterDetectedErrorState OBJECT-TYPE
       SYNTAX OCTET STRING
       ACCESS read-only
       STATUS mandatory
       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 #    hrDeviceStatus

                    lowPaper          0        warning(3)
                    noPaper           1        down(5)
                    lowToner          2        warning(3)
                    noToner           3        down(5)
                    doorOpen          4        down(5)
                    jammed            5        down(5)
                    offline           6        down(5)
                    serviceRequested  7        warning(3)

               If multiple conditions are currently detected and
               the hrDeviceStatus would not otherwise be
               unknown(1) or testing(4), the hrDeviceStatus shall
               correspond to the worst state of those indicated,
               where down(5) is worse than warning(3) which is
               worse than running(2).

               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
        ACCESS not-accessible
        STATUS mandatory
        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
        ACCESS not-accessible
        STATUS mandatory
        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      Boolean,
            hrDiskStorageCapacity       KBytes
```

```
        }

    hrDiskStorageAccess OBJECT-TYPE
        SYNTAX INTEGER {
                        readWrite(1),
                        readOnly(2)
                }
        ACCESS read-only
        STATUS mandatory
        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)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "An indication of the type of media used in this
               long-term storage device."
        ::= { hrDiskStorageEntry 2 }

    hrDiskStorageRemoveble OBJECT-TYPE
        SYNTAX Boolean
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "Denotes whether or not the disk media may be
                removed from the drive."
        ::= { hrDiskStorageEntry 3 }

    hrDiskStorageCapacity OBJECT-TYPE
        SYNTAX KBytes
        ACCESS read-only
        STATUS mandatory
```

```
        DESCRIPTION
                "The total size for this long-term storage device."
        ::= { hrDiskStorageEntry 4 }

    hrPartitionTable OBJECT-TYPE
        SYNTAX SEQUENCE OF HrPartitionEntry
        ACCESS not-accessible
        STATUS mandatory
        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
        ACCESS not-accessible
        STATUS mandatory
        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                INTEGER,
            hrPartitionLabel                InternationalDisplayString,
            hrPartitionID                   OCTET STRING,
            hrPartitionSize                 KBytes,
            hrPartitionFSIndex              INTEGER
        }

    hrPartitionIndex OBJECT-TYPE
        SYNTAX INTEGER (1..2147483647)
        ACCESS read-only
        STATUS mandatory
        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))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "A textual description of this partition."
        ::= { hrPartitionEntry 2 }

    hrPartitionID OBJECT-TYPE
        SYNTAX OCTET STRING
        ACCESS read-only
        STATUS mandatory
        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
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The size of this partition."
        ::= { hrPartitionEntry 4 }

    hrPartitionFSIndex OBJECT-TYPE
        SYNTAX INTEGER (0..2147483647)
        ACCESS read-only
        STATUS mandatory
        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
    hrFSTable OBJECT-TYPE
        SYNTAX SEQUENCE OF HrFSEntry
```

```
        ACCESS not-accessible
        STATUS mandatory
        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
        ACCESS not-accessible
        STATUS mandatory
        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 }

    -- Registration for some popular File System types,
    -- for use with hrFSType.

    hrFSTypes               OBJECT IDENTIFIER ::= { hrDevice 9 }

    hrFSOther               OBJECT IDENTIFIER ::= { hrFSTypes 1 }
    hrFSUnknown             OBJECT IDENTIFIER ::= { hrFSTypes 2 }
    hrFSBerkeleyFFS         OBJECT IDENTIFIER ::= { hrFSTypes 3 }
    hrFSSys5FS              OBJECT IDENTIFIER ::= { hrFSTypes 4 }
    -- DOS
    hrFSFat                 OBJECT IDENTIFIER ::= { hrFSTypes 5 }
    -- OS/2 High Performance File System
    hrFSHPFS                OBJECT IDENTIFIER ::= { hrFSTypes 6 }
    --  Macintosh Hierarchical File System
    hrFSHFS                 OBJECT IDENTIFIER ::= { hrFSTypes 7 }


    -- Macintosh File System
    hrFSMFS                 OBJECT IDENTIFIER ::= { hrFSTypes 8 }
    -- Windows NT
    hrFSNTFS                OBJECT IDENTIFIER ::= { hrFSTypes 9 }
```

```
   hrFSVNode               OBJECT IDENTIFIER ::= { hrFSTypes 10 }
   hrFSJournaled           OBJECT IDENTIFIER ::= { hrFSTypes 11 }
   -- CD File systems
   hrFSiso9660             OBJECT IDENTIFIER ::= { hrFSTypes 12 }
   hrFSRockRidge           OBJECT IDENTIFIER ::= { hrFSTypes 13 }

   hrFSNFS                 OBJECT IDENTIFIER ::= { hrFSTypes 14 }
   hrFSNetware             OBJECT IDENTIFIER ::= { hrFSTypes 15 }
   -- Andrew File System
   hrFSAFS                 OBJECT IDENTIFIER ::= { hrFSTypes 16 }
   -- OSF DCE Distributed File System
   hrFSDFS                 OBJECT IDENTIFIER ::= { hrFSTypes 17 }
   hrFSAppleshare          OBJECT IDENTIFIER ::= { hrFSTypes 18 }
   hrFSRFS                 OBJECT IDENTIFIER ::= { hrFSTypes 19 }
   -- Data General
   hrFSDGCFS               OBJECT IDENTIFIER ::= { hrFSTypes 20 }
   -- SVR4 Boot File System
   hrFSBFS                 OBJECT IDENTIFIER ::= { hrFSTypes 21 }



   HrFSEntry ::= SEQUENCE {
           hrFSIndex                   INTEGER,
           hrFSMountPoint              InternationalDisplayString,
           hrFSRemoteMountPoint        InternationalDisplayString,
           hrFSType                    OBJECT IDENTIFIER,
           hrFSAccess                  INTEGER,
           hrFSBootable                Boolean,
           hrFSStorageIndex            INTEGER,
           hrFSLastFullBackupDate      DateAndTime,
           hrFSLastPartialBackupDate   DateAndTime
       }

   hrFSIndex OBJECT-TYPE
       SYNTAX INTEGER (1..2147483647)
       ACCESS read-only
       STATUS mandatory
       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))
       ACCESS read-only
       STATUS mandatory
```

```
        DESCRIPTION
                "The path name of the root of this file system."
        ::= { hrFSEntry 2 }

    hrFSRemoteMountPoint OBJECT-TYPE
        SYNTAX InternationalDisplayString (SIZE(0..128))
        ACCESS read-only
        STATUS mandatory
        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 OBJECT IDENTIFIER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "The value of this object identifies the type of
               this file system."
        ::= { hrFSEntry 4 }

    hrFSAccess OBJECT-TYPE
        SYNTAX INTEGER {
                readWrite(1),
                readOnly(2)
            }
        ACCESS read-only
        STATUS mandatory
        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 Boolean
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "A flag indicating whether this file system is
               bootable."
```

```
        ::= { hrFSEntry 6 }

    hrFSStorageIndex OBJECT-TYPE
        SYNTAX INTEGER (0..2147483647)
        ACCESS read-only
        STATUS mandatory
        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
        ACCESS read-write
        STATUS mandatory
        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
        ACCESS read-write
        STATUS mandatory
        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
   --
   -- Implementation of this group is optional.
   --
   -- 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 INTEGER (1..2147483647)
       ACCESS read-only
       STATUS mandatory
       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
       ACCESS not-accessible
       STATUS mandatory
       DESCRIPTION
              "The (conceptual) table of software running on the
              host."
       ::= { hrSWRun 2 }

   hrSWRunEntry OBJECT-TYPE
       SYNTAX HrSWRunEntry
       ACCESS not-accessible
       STATUS mandatory
       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       INTEGER,
            hrSWRunName        InternationalDisplayString,
            hrSWRunID          ProductID,
            hrSWRunPath        InternationalDisplayString,
            hrSWRunParameters  InternationalDisplayString,
            hrSWRunType        INTEGER,
            hrSWRunStatus      INTEGER
        }

    hrSWRunIndex OBJECT-TYPE
        SYNTAX INTEGER (1..2147483647)
        ACCESS read-only
        STATUS mandatory
        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))
        ACCESS read-only
        STATUS mandatory
        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
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The product ID of this running piece of software."
        ::= { hrSWRunEntry 3 }

    hrSWRunPath OBJECT-TYPE
        SYNTAX InternationalDisplayString (SIZE(0..128))
        ACCESS read-only
        STATUS mandatory
        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))
        ACCESS read-only
        STATUS mandatory
        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)
               }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The type of this software."
        ::= { hrSWRunEntry 6 }

    hrSWRunStatus OBJECT-TYPE
        SYNTAX INTEGER {
                running(1),
                runnable(2),    -- waiting for resource (CPU, memory, IO)
                notRunnable(3), -- loaded but waiting for event
                invalid(4)      -- not loaded
            }
        ACCESS read-write
        STATUS mandatory
        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."
        ::= { hrSWRunEntry 7 }


    -- The Host Resources Running Software Performance Group
    -- Implementation of this group is optional.
    --
    -- The hrSWRunPerfTable contains an entry corresponding to
    -- each entry in the hrSWRunTable.
```

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

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

   HrSWRunPerfEntry ::= SEQUENCE {
           hrSWRunPerfCPU          INTEGER,
           hrSWRunPerfMem          KBytes
   }

   hrSWRunPerfCPU OBJECT-TYPE
       SYNTAX INTEGER
       ACCESS read-only
       STATUS mandatory
       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
       ACCESS read-only
       STATUS mandatory
       DESCRIPTION
               "The total amount of real system memory allocated
               to this process."
       ::= { hrSWRunPerfEntry 2 }
```

```
   -- The Host Resources Installed Software Group
   --
   -- Implementation of this group is optional.
   --
   -- 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.
   --
   -- 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
       ACCESS read-only
       STATUS mandatory
       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
       ACCESS read-only
       STATUS mandatory
       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
       ACCESS not-accessible
       STATUS mandatory
       DESCRIPTION
              "The (conceptual) table of software installed on
```

```
                this host."
        ::= { hrSWInstalled 3 }

    hrSWInstalledEntry OBJECT-TYPE
        SYNTAX HrSWInstalledEntry
        ACCESS not-accessible
        STATUS mandatory
        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       INTEGER,
            hrSWInstalledName        InternationalDisplayString,
            hrSWInstalledID          ProductID,
            hrSWInstalledType        INTEGER,
            hrSWInstalledDate        DateAndTime
    }

    hrSWInstalledIndex OBJECT-TYPE
        SYNTAX INTEGER (1..2147483647)
        ACCESS read-only
        STATUS mandatory
        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))
        ACCESS read-only
        STATUS mandatory
        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
        ACCESS read-only
        STATUS mandatory
        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)
               }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The type of this software."
        ::= { hrSWInstalledEntry 4 }

    hrSWInstalledDate OBJECT-TYPE
        SYNTAX DateAndTime
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
               "The last-modification date of this application as
               it would appear in a directory listing."
        ::= { hrSWInstalledEntry 5 }

    END
```

5. References

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7. Security Considerations

Security issues are not discussed in this memo.

8. Authors' Addresses

Pete Grillo
10915 NW Lost Park Drive
Portland OR 97229

Phone: +1 503 526 9766
EMail: pl0143@mail.psi.net

Steven Waldbusser
Carnegie Mellon University
4910 Forbes Ave.
Pittsburgh, PA 15213

Phone: +1 412 268 6628
Fax: +1 412 268 4987
EMail: waldbusser@cmu.edu