Definitions of System-Level Managed Objects for Applications

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1. Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes a basic set of managed objects for fault, configuration and performance management of applications from a systems perspective. More specifically, the managed objects are restricted to information that can be determined from the system itself and which does not require special instrumentation within the applications to make the information available.

This memo does not specify a standard for the Internet community.

2. The SNMPv2 Network Management Framework

The SNMPv2 Network Management Framework consists of the following major components:

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

2.1. Object Definitions

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) [1], defined in the Structure of Management Information (SMI) (See RFC 1902 [2]). In particular, each object type is named by an OBJECT IDENTIFIER, an administratively assigned name. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the object descriptor, to refer to the object type.
3. Overview

The primary purpose of computing technologies is the execution of application software. These applications, typically specialized collections of executables, files, and interprocess communications, exist to solve business, scientific or other "problems". The configuration, fault detection, performance monitoring and control of application software across its life on a host computer is of great economic importance. For the purposes of our work, we define applications as one or more units of executable code and other resources, installed on a single host system that a manager may think of as a single object for management purposes.

The information described by the objects in the System Application MIB support configuration, fault, and performance management; they represent some of the basic attributes of application software from a systems (non-application specific) perspective. The information allows for the description of applications as collections of executables and files installed and executing on a host computer.

This draft is concerned primarily with, and defines a model for, application information resident on a host computer which can be determined from the system itself, and not from the individual applications. This system-level view of applications is designed to provide information about software applications installed and running on the host system without requiring modifications and code additions to the applications themselves. This approach was taken to insure ease and speed of implementation, while allowing room for future growth.
4. Architecture for Application Management

In the area of application management it is fully acknowledged and even expected that additional MIB modules will be defined over time to provide an even greater level of detail regarding applications. This MIB module presents the most general case: a set of management objects for providing generic information about applications and whose object values can be determined from the computer system itself without requiring instrumentation within the application.

A finer-grained level of detail is planned for the future "appl MIB" which will be a common set of management objects relating to generic applications, but which require some type of instrumentation in the application in order to be determined. Since the applmib MIB module will provide a finer level of detail, any connection to the sysAppl MIB should be made by having references from the more detailed appl MIB back to the more generic sysAppl MIB. Likewise, as application-specific MIB modules such as the WWW MIB, etc., are developed over time, these more specific MIBs should reference back to the more generic MIBs.

While this MIB module does not attempt to provide every detailed piece of information for managing applications, it does provide a basic systems-level view of the applications and their components on a single host system.
5. The Structure of the MIB

The System Application MIB structure models application packages as a whole, and also models the individual elements (files and executables) which collectively form an application. The MIB is structured to model information regarding installed application packages and the elements which make up each application package. The MIB also models activity information on applications (and in turn, their components) that are running or have previously run on the host system. In modeling applications and their elements, this MIB module provides the necessary link for associating executing processes with the applications of which they are a part.

The objects are arranged into the following groups:

- System Application Installed Group
  - sysApplInstallPkgTable
  - sysApplInstallElmtTable

- System Application Run Group
  - sysApplRunTable
  - sysApplPastRunTable
  - sysApplElmtRunTable
  - sysApplElmtPastRunTable
  - (scalars for restricting table sizes)

- System Application Map Group
  - sysApplMapTable

As can be seen by the arrangement above, for each category, the MIB first treats an application package as a whole, and then breaks down the package to provide information about each of the elements (executable and non-executable files) of the package.

5.1. System Application Installed Group

The System Application Installed group consists of two tables. Through these two tables, administrators will be able to determine which applications have been installed on a system and what their constituent components are. The first table, the sysApplInstallPkgTable, lists the application packages
installed on a particular host. The second, the 
sysApplInstallElmtTable, provides information regarding the 
executables and non-executable files, or elements, which 
collectively compose an application.

NOTE: This MIB is intended to work with applications that have 
been installed on a particular host, where "installed" means 
that the existence of the application and the association 
between an application and its component files can be 
discovered without requiring additional instrumentation of the 
application itself. This may require that certain conventions 
be used, such as using a central software installation 
mechanism or registry, when installing application packages. 
For example, many UNIX systems utilize a "pkgadd" utility to 
track installed application packages, while many PC systems 
utilize a global registry.

5.2. System Application Run Group

This group models activity information for applications that 
have been invoked and are either currently running, or have 
previously run, on the host system. Likewise, the individual 
elements of an invoked application are also modeled to show 
currently running processes, and processes that have run in 
the past. This information is modeled using two pairs of 
tables: a pair of tables for currently running applications 
and past run applications, and a pair of tables for the 
currently running elements and the past run elements. Seven 
scalars are also defined to control the size of the past run 
tables.

5.2.1. sysApplRunTable and sysApplPastRunTable

The sysApplRunTable and the sysApplPastRunTable make up the 
first pair of tables. The sysApplRunTable contains the 
application instances which are currently running on the host. 
Each time an application is invoked, a new entry is created in 
the sysApplRunTable to provide information about that 
particular invocation of the application. An entry will 
remain in this table until the application instance 
terminates, at which time the entry will be deleted from the 
sysApplRunTable and placed in the sysApplPastRunTable.
The `sysApplPastRunTable` maintains a history of instances of applications which have previously executed on the host. Entries to this table are made when an invoked application from the `sysApplRunTable` terminates; the table entry which represents the application instance is removed from the `SysApplRunTable` and a corresponding entry is added to the `sysApplPastRunTable`.

Because the `sysApplPastRunTable` will continuously grow as applications are executed and terminate, two scalars are defined to control the aging-out of table entries. The value of `sysApplPastRunMaxRows` specifies the maximum number of entries the table may contain, while the `sysApplPastRunTblTimeLimit` specifies the maximum age of the table entries. Oldest entries are removed first.

It is important to note that the `sysApplRunTable` and `sysApplPastRunTable` contain entries for each invocation of an application. A single application package might be invoked multiple times; each invocation is properly recorded by a separate entry in the `sysApplRunTable`.

In order to implement this group, the agent must be able to recognize that an application has been invoked, and be able to determine when that invocation terminates. This poses a complex problem since a single application invocation may involve numerous processes, some of which may be required to remain running throughout the duration of the application, others which might come and go. The `sysApplInstallElmtRole` columnar object in the `sysApplInstallElmtTable` is meant to assist in this task by indicating which elements must be running in order for the application to be running, which elements are dependent on required elements, etc. See the description of `sysApplInstallElmtRole` for more details.

### 5.2.2. `sysApplElmtRunTable` and `sysApplElmtPastRunTable`

While the `sysApplRunTable` and `sysApplPastRunTable` focus on applications as a whole, the `sysApplElmtRunTable` and `sysApplElmtPastRunTable` provide information regarding an application’s executable elements, (processes), which are either currently executing or have executed in the past.
The sysAppElmtRunTable contains an entry for every process currently running on the host. An entry is created in this table for each process at the time it is started, and will remain in the table until the process terminates. Note that in order to provide complete information on the load on the system, this table lists EVERY running process, not just those processes that are running as part of an identified application. However, when processes terminate, only information from entries corresponding to elements of an identified application are moved to the sysAppElmtPastRunTable.

The sysAppElmtPastRunTable maintains a history of instances of processes which have previously executed on the host as part of an application. When a process from the sysAppElmtRunTable terminates, the entry’s information is moved to this sysAppElmtPastRunTable provided that the process was part of an identified application. If the process cannot be associated with any ‘parent’ application, than it is simply removed from the sysAppElmtRunTable. This allows for processes like ‘ps’ or ‘grep’ to show up in the sysAppElmtRunTable, (where they are consuming resources and are thus, "interesting"), but not in the sysAppElmtPastRunTable.

Because the sysAppElmtPastRunTable will continuously grow as processes are executed and terminate, two scalars are defined to control the aging-out of table entries. The value of sysAppElmtPastRunMaxRows specifies the maximum number of entries the table may contain, while the sysAppElmtPastRunTblTimeLimit specifies the maximum age of the table entries. Oldest entries are removed first.

5.3. System Application Map Group

The Map group contains a single table, the sysAppMapTable, whose sole purpose is to provide a backwards mapping for determining the invoked application, installed element, and installed application package given a known process identification number.
6. Definitions

SYSAPPL-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE,
    Integer32, Unsigned32, TimeTicks, Counter32, Gauge32
    FROM SNMPv2-SMI
    DateAndTime, TEXTUAL-CONVENTION
    FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP
    FROM SNMPv2-CONF
    mib-2 FROM RFC1213-MIB;

-- System Application MIB

sysApplMIB MODULE-IDENTITY
    LAST-UPDATED "9611250000Z"
    ORGANIZATION "IETF Applications MIB Working Group"
    CONTACT-INFO
        "Cheryl Krupczak (Editor, WG Advisor)
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        One First Avenue
        Waltham, MA 02254-9111
        USA
        Phone: (617) 891-0000
        Email: saperia@networks.bgs.com
    DESCRIPTION
        "The MIB module defines management objects that model
        applications as collections of executables and files
        installed and executing on a host system. The MIB
        presents a system-level view of applications; i.e.,
        objects in this MIB are limited to those attributes
        that can typically be obtained from the system itself
without adding special instrumentation to the applications."
 ::= { mib-2 9999 } 

sysApplOBJ OBJECT IDENTIFIER ::= { sysApplMIB 1 }
sysApplInstalled OBJECT IDENTIFIER ::= { sysApplOBJ 1 }
sysApplRun OBJECT IDENTIFIER ::= { sysApplOBJ 2 }
sysApplMap OBJECT IDENTIFIER ::= { sysApplOBJ 3 }
sysApplNotifications OBJECT IDENTIFIER ::= { sysApplMIB 2 }
sysApplConformance OBJECT IDENTIFIER ::= { sysApplMIB 3 }

-- Textual Conventions

RunState ::= TEXTUAL-CONVENTION
 STATUS current
 DESCRIPTION "This TC describes the current execution state of
 a running application or process."
 SYNTAX INTEGER {
 running (1),
 runnable (2), -- waiting for resource (CPU, etc.)
 waiting (3), -- waiting for event
 exiting (4),
 other (5)     -- other invalid state
 }

LongUtf8String ::= TEXTUAL-CONVENTION
 DISPLAY-HINT "1024a"
 STATUS current
 DESCRIPTION "To facilitate internationalization, this TC
 represents information taken from the ISO/IEC IS
 10646-1 character set, encoded as an octet string using
 the UTF-8 character encoding scheme described in RFC
 2044 [10]. For strings in 7-bit US-ASCII, there is
 no impact since the UTF-8 representation is identical
 to the US-ASCII encoding."
 SYNTAX OCTET STRING (SIZE (0..1024))

Utf8String ::= TEXTUAL-CONVENTION
 DISPLAY-HINT "255a"
 STATUS current
 DESCRIPTION "To facilitate internationalization, this TC
 represents information taken from the ISO/IEC IS
 10646-1 character set, encoded as an octet string using
 the UTF-8 character encoding scheme described in RFC
 2044 [10]. For strings in 7-bit US-ASCII, there is
 no impact since the UTF-8 representation is identical
 to the US-ASCII encoding."
10646-1 character set, encoded as an octet string using
the UTF-8 character encoding scheme described in RFC
2044 [10]. For strings in 7-bit US-ASCII, there is
no impact since the UTF-8 representation is identical
to the US-ASCII encoding."
SYNTAX OCTET STRING (SIZE (0..255))

-- sysApplInstalled Group
-- This group provides information about application packages
-- that have been installed on the host computer. The group
-- contains two tables. The first, the sysApplInstallPkgTable,
-- describes the application packages, the second, the
-- sysApplInstElmtTable, describes the constituent elements
-- (files and executables) which compose an application package.
--
-- In order to appear in this group, an application and its
-- component files must be discoverable by the system itself,
-- possibly through some type of software installation mechanism
-- or registry.

-- sysApplInstallPkgTable
-- The system installed application packages table provides information
-- on the software packages installed on a system. These packages may
-- consist of many different files including executable and
-- non-executable files.

sysApplInstallPkgTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SysApplInstallPkgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The table listing the software application packages
installed on a host computer. In order to appear in
this table, it may be necessary for the application
to be installed using some type of software
installation mechanism or global registry so that its
existence can be detected by the agent implementation."
::: = { sysApplInstalled 1 }

sysApplInstallPkgEntry OBJECT-TYPE
SYNTAX      SysApplInstallPkgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The logical row describing an installed application
package."
INDEX { sysApplInstallPkgIndex }
::= { sysApplInstallPkgTable 1 }

SysApplInstallPkgEntry ::= SEQUENCE {
  sysApplInstallPkgIndex               Unsigned32,
  sysApplInstallPkgManufacturer        Utf8String,
  sysApplInstallPkgProductName         Utf8String,
  sysApplInstallPkgVersion             Utf8String,
  sysApplInstallPkgSerialNumber        Utf8String,
  sysApplInstallPkgDate                DateAndTime,
  sysApplInstallPkgLocation            LongUtf8String
}

sysApplInstallPkgIndex OBJECT-TYPE
SYNTAX     Unsigned32 (1..fffffff'h)
MAX-ACCESS not-accessible
STATUS      current
DESCRIPTION
"An integer used only for indexing purposes.
Generally monotonically increasing from 1 as new
applications are installed.

The value for each installed application must
remain constant at least from one re-initialization of
the network management entity which implements this
MIB module to the next re-initialization.

The specific value is meaningful only within a given SNMP
entity. A sysApplInstallPkgIndex value must not be re-used
until the next agent entity restart in the event the installed
application entry is deleted."
::= { sysApplInstallPkgEntry 1 }

sysApplInstallPkgManufacturer OBJECT-TYPE
SYNTAX       Utf8String
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
"The Manufacturer of the software application package."
::= { sysApplInstallPkgEntry 2 }

sysApplInstallPkgProductName OBJECT-TYPE
SYNTAX Utf8String
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The name provided to the software application package by the Manufacturer."
::= { sysApplInstallPkgEntry 3 }

sysApplInstallPkgVersion OBJECT-TYPE
SYNTAX Utf8String
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The version number assigned to the application package by the manufacturer of the software."
::= { sysApplInstallPkgEntry 4 }

sysApplInstallPkgSerialNumber OBJECT-TYPE
SYNTAX Utf8String
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The serial number of the software assigned by the manufacturer."
::= { sysApplInstallPkgEntry 5 }

sysApplInstallPkgDate OBJECT-TYPE
SYNTAX DateAndTime
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The date and time this software application was installed on the host."
::= { sysApplInstallPkgEntry 6 }

sysApplInstallPkgLocation OBJECT-TYPE
SYNTAX LongUtf8String
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The complete path name where the application package is installed. For example, the value would be
'/opt/MyapplDir' if the application package was installed in the /opt/MyapplDir directory."
::= { sysApplInstallPkgEntry 7 }

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-- sysApplInstallElmtTable
-- The table describing the individual application package
-- elements (files and executables) installed on the host computer.

sysApplInstallElmtTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SysApplInstallElmtEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"This table details the individual application package elements (files and executables) which comprise the applications defined in the sysApplInstallPkg Table. Each entry in this table has an index to the sysApplInstallPkg table to identify the application package of which it is a part. As a result, there may be many entries in this table for each instance in the sysApplInstallPkg Table.

Table entries are indexed by sysApplInstallPkgIndex, sysApplInstallElmtIndex to facilitate retrieval of all elements associated with a particular installed application package."
 ::= { sysApplInstalled 2 }

sysApplInstallElmtEntry OBJECT-TYPE
SYNTAX      SysApplInstallElmtEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The logical row describing an element of an installed application. The element may be an executable or non-executable file."
INDEX    {sysApplInstallPkgIndex, sysApplInstallElmtIndex}
 ::= { sysApplInstallElmtTable 1 }

SysApplInstallElmtEntry ::= SEQUENCE {
  sysApplInstallElmtIndex                 Unsigned32,
  sysApplInstallElmtName                  Utf8String,
  sysApplInstallElmtType                  INTEGER,
  sysApplInstallElmtDate                  DateAndTime,
  sysApplInstallElmtPath                  LongUtf8String,
  sysApplInstallElmtSizeHigh              Unsigned32,
  sysApplInstallElmtSizeLow               Unsigned32,

Expires September 6, 1997
sysApplInstallElmtRole OBJECT-TYPE
SYNTAX      BITS,
sysApplInstallElmtModifyDate OBJECT-TYPE
SYNTAX      DateAndTime,
sysApplInstallElmtCurSizeHigh OBJECT-TYPE
SYNTAX      Unsigned32,
sysApplInstallElmtCurSizeLow OBJECT-TYPE
SYNTAX      Unsigned32
}

sysApplInstallElmtIndex OBJECT-TYPE
SYNTAX      Unsigned32 (1..'ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "An arbitrary integer used for indexing. The value of this index is unique among all rows in this table that exist or have existed since the last agent restart."
::= { sysApplInstallElmtEntry 1 }

sysApplInstallElmtName OBJECT-TYPE
SYNTAX      Utf8String
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "The name of this element which is contained in the application."
::= { sysApplInstallElmtEntry 2 }

sysApplInstallElmtType OBJECT-TYPE
SYNTAX      INTEGER {
  unknown(1),
  nonexecutable(2),
  operatingSystem(3),  -- executable
  deviceDriver(4),     -- executable
  application(5)       -- executable
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "The type of element that is part of the installed application."
::= { sysApplInstallElmtEntry 3 }

sysApplInstallElmtDate OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
 STATUS      current
DESCRIPTION
 "The date and time that this component was installed on
the system."
::= { sysApplInstallElmtEntry 4 }

sysApplInstallElmtPath OBJECT-TYPE
SYNTAX      LongUtf8String
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
 "The full directory path where this element is installed.
For example, the value would be '/opt/EMPuma/bin' for an
element installed in the directory '/opt/EMPuma/bin'."
::= { sysApplInstallElmtEntry 5 }

sysApplInstallElmtSizeHigh OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
 "The installed file size in 2^32 byte blocks. This is
the size of the file on disk immediately after installation.

For example, for a file with a total size of 4,294,967,296
bytes, this variable would have a value of 1; for a file
with a total size of 4,294,967,295 bytes this variable
would be 0."
::= { sysApplInstallElmtEntry 6 }

sysApplInstallElmtSizeLow OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
 "The installed file size modulo 2^32 bytes. This is
the size of the file on disk immediately after installation.

For example, for a file with a total size of 4,294,967,296
bytes this variable would have a value of 0; for a file
with a total size of 4,294,967,295 bytes this variable would be
4,294,967,295."
::= { sysApplInstallElmtEntry 7 }

sysApplInstallElmtRole OBJECT-TYPE
SYNTAX BITS {
    executable(0),
    -- An application may have one or
    -- more executable elements. The rest of the
    -- bits have no meaning if the element is not
    -- executable.
    exclusive(1),
    -- Only one copy of an exclusive element may be
    -- running per invocation of the running
    -- application.
    primary(2),
    -- The primary executable. The execution of
    -- this element constitutes an invocation of
    -- the application. This is used by the agent
    -- implementation to determine the initiation of
    -- an application.
    required(3),
    -- An application may have zero or more required
    -- elements. All required elements must be running
    -- in order for the application to be judged to be
    -- running and healthy.
    dependent(4),
    -- An application may have zero or more
    -- dependent elements. Dependent elements may
    -- not be running unless required elements are.
    unknown(5)
    -- Default value for the case when an operator
    -- has not yet assigned one of the other values.
    -- When set, bits 1, 2, 3, and 4 have no meaning.
}
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"An operator assigned value used in the determination of
application status. This value is used by the agent to
determine both the mapping of started processes to the
initiation of an application, as well as to allow for a
determination of application health. The default value,
unknown(5), is used when an operator has not yet assigned
one of the other values. If unknown(5) is set, bits
1 - 4 have no meaning."
DEFVAL { unknown }
::= { sysApplInstallElmtEntry 8 }

sysApplInstallElmtModifyDate OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"The date and time that this element was last modified. Modification of the sysApplInstallElmtRole columnar object does NOT constitute a modification of the element itself and should not affect the value of this object.
::= { sysApplInstallElmtEntry 9 }

sysApplInstallElmtCurSizeHigh OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"The current file size in 2^32 byte blocks. For example, for a file with a total size of 4,294,967,296 bytes, this variable would have a value of 1; for a file with a total size of 4,294,967,295 bytes this variable would be 0."
::= { sysApplInstallElmtEntry 10 }

sysApplInstallElmtCurSizeLow OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"The current file size modulo 2^32 bytes. For example, for a file with a total size of 4,294,967,296 bytes this variable would have a value of 0; for a file with a total size of 4,294,967,295 bytes this variable would be 4,294,967,295."
::= { sysApplInstallElmtEntry 11 }

-- sysApplRun Group
-- This group models activity information for applications that have been invoked and are either currently running, or have previously run on the host system. Likewise, the individual elements of an invoked application are also modeled to show currently running processes, and processes that have run in the past.

-- sysApplRunTable
-- The sysApplRunTable contains the application instances
-- which are currently running on the host. Since a single
-- application might be invoked multiple times, an entry is
-- added to this table for each INVOCATION of an application.
-- The table is indexed by sysApplInstallPkgIndex, sysApplRunIndex
-- to enable managers to easily locate all invocations of
-- a particular application package.

sysApplRunTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SysApplRunEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The table describes the applications which are executing
on the host. Each time an application is invoked,
an entry is created in this table. When an application ends,
the entry is removed from this table and a corresponding
entry is created in the SysApplPastRunTable.

The table is indexed by sysApplInstallPkgIndex,
sysApplRunIndex to enable managers to easily locate all
invocations of a particular application package."
::= { sysApplRun 1 }

SysApplRunEntry ::= SEQUENCE {
sysApplRunIndex                         Unsigned32,
sysApplRunStarted                       DateAndTime,
sysApplRunCurrentState                  RunState
}

SysApplRunIndex OBJECT-TYPE
SYNTAX      Unsigned32 (1..'ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Part of the index for this table. An arbitrary integer used only for indexing purposes. Generally monotonically increasing from 1 as new applications are started on the host, it uniquely identifies application invocations.

The numbering for this index increases by 1 for each INVOCATION of an application, regardless of which installed application package this entry represents a running instance of.

An example of the indexing for a couple of entries is shown below.

: sysApplRunStarted.17.14
  sysApplRunStarted.17.63
  sysApplRunStarted.18.13
 :

In this example, the agent has observed 12 application invocations when the application represented by entry 18 in the sysApplInstallPkgTable is invoked. The next invocation detected by the agent is an invocation of installed application package 17. Some time later, installed application 17 is invoked a second time.

NOTE: this index is not intended to reflect a real-time (wall clock time) ordering of application invocations; it is merely intended to uniquely identify running instances of applications. Although the sysApplInstallPkgIndex is included in the INDEX clause for this table, it serves only to ease searching of this table by installed application and does not contribute to uniquely identifying table entries."

::= { sysApplRunEntry 1 }

sysApplRunStarted OBJECT-TYPE
SYNTAX DateAndTime
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The date and time that the application was started."
::= { sysApplRunEntry 2 }
sysApplRunCurrentState OBJECT-TYPE
SYNTAX RunState
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The current state of the running application. The possible values are running(1), runnable(2) but waiting for a resource such as CPU, waiting(3) for an event, exiting(4), or other(5)."
::= { sysApplRunEntry 3 }

-- sysApplPastRunTable
-- The sysApplPastRunTable provides a history of applications previously run on the host computer. Entries are removed from the sysApplRunTable and corresponding entries are added to this table when an application becomes inactive. Entries remain in this table until they are aged out when either the table size reaches a maximum as determined by the sysApplPastRunMaxRows, or when an entry has aged to exceed a time limit as set by sysApplPastRunTblTimeLimit.
-- When aging out entries, the oldest entry, as determined by the value of sysApplPastRunTimeEnded, will be removed first.

sysApplPastRunTable OBJECT-TYPE
SYNTAX SEQUENCE OF SysApplPastRunEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A history of the applications that have previously run on the host computer. An entry’s information is moved to this table from the sysApplRunTable when the invoked application represented by the entry ceases to be running. Entries remain in this table until they are aged out when either the table size reaches a maximum as determined by the sysApplPastRunMaxRows, or when an entry has aged to exceed a time limit as set by sysApplPastRunTblTimeLimit.

Entries in this table are indexed by sysApplInstallPkgIndex, sysApplPastRunIndex to facilitate retrieval of all past run invocations of a particular installed application."
::= { sysApplRun 2 }
sysApplPastRunEntry OBJECT-TYPE
SYNTAX      SysApplPastRunEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The logical row describing an invocation of an application
which was previously run and has terminated. The entry
is basically copied from the sysApplRunTable when the
application instance terminates. Hence, the entry’s
value for sysApplPastRunIndex is the same as its value was
for sysApplRunIndex."
INDEX      { sysApplInstallPkgIndex, sysApplPastRunIndex }
::= { sysApplPastRunTable   1 }

SysApplPastRunEntry ::= SEQUENCE {
  sysApplPastRunIndex                     Unsigned32,
  sysApplPastRunStarted                   DateAndTime,
  sysApplPastRunExitState                 INTEGER,
  sysApplPastRunTimeEnded                 DateAndTime
}

sysApplPastRunIndex OBJECT-TYPE
SYNTAX      Unsigned32 (1..ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Part of the index for this table. An integer
matching the value of the removed sysApplRunIndex
corresponding to this row."
 ::= { sysApplPastRunEntry 1 }

sysApplPastRunStarted OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"The date and time that the application was started."
 ::= { sysApplPastRunEntry 2 }

sysApplPastRunExitState OBJECT-TYPE
SYNTAX      INTEGER {
  complete (1), -- normal exit at sysApplRunTimeEnded
  failed (2),   -- abnormal exit
  other (3)
}

Expires September 6, 1997
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The state of the application instance when it terminated."
 ::= { sysApplPastRunEntry 3 }

sysApplPastRunTimeEnded OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The DateAndTime the application instance was determined to be no longer running."
 ::= { sysApplPastRunEntry 4 }

-- sysApplElmtRunTable
-- The sysApplElmtRunTable contains an entry for each process that
-- is currently running on the host. An entry is created in
-- this table for each process at the time it is started, and will
-- remain in the table until the process terminates.
--
-- The table is indexed by sysApplElmtRunInstallPkg,
-- sysApplElmtRunInvocID, and sysApplElmtRunIndex to make it easy
-- to locate all running elements of a particular invoked application
-- which has been installed on the system.

sysApplElmtRunTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SysApplElmtRunEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION  "The table describes the processes which are currently executing on the host system. Each entry represents a running process and is associated with the invoked application of which that process is a part, if possible. This table contains an entry for every process currently running on the system, regardless of whether its 'parent' application can be determined. So, for example, processes like 'ps' and 'grep' will have entries though they are not associated with an installed application package. Because a running application may involve more than one executable, it is possible to have multiple entries in this table for each application."
Entries are removed from this table when the process terminates.

The table is indexed by `sysApplElmtRunInstallPkg`, `sysApplElmtRunInvocID`, and `sysApplElmtRunIndex` to facilitate the retrieval of all running elements of a particular invoked application which has been installed on the system.

```
::= { sysApplRun 3 }
```

```
sysApplElmtRunEntry OBJECT-TYPE
SYNTAX      SysApplElmtRunEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The logical row describing a process currently running on this host. When possible, the entry is associated with the invoked application of which it is a part."
INDEX    { sysApplElmtRunInstallPkg, sysApplElmtRunInvocID, sysApplElmtRunIndex }
::= { sysApplElmtRunTable   1 }
```

```
SysApplElmtRunEntry ::= SEQUENCE {
    sysApplElmtRunInstallPkg        Unsigned32,
sysApplElmtRunInvocID           Unsigned32,
sysApplElmtRunIndex             Unsigned32,
sysApplElmtRunInstallID         Unsigned32,
sysApplElmtRunTimeStarted       DateAndTime,
sysApplElmtRunState             RunState,
sysApplElmtRunName              LongUtf8String,
sysApplElmtRunParameters        Utf8String,
sysApplElmtRunCPU               TimeTicks,
sysApplElmtRunMemory            Gauge32,
sysApplElmtRunNumFiles          Gauge32,
sysApplElmtRunUser              Utf8String
}
```

```
sysApplElmtRunInstallPkg OBJECT-TYPE
SYNTAX      Unsigned32 (0..ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Part of the index for this table, this value identifies the installed software package for the application of which this process is a part.

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Provided that the process’s ‘parent’ application can be determined, the value of this object is the same value as the sysApplInstallPkgIndex for the entry in the sysApplInstallPkgTable that corresponds to the installed application of which this process is a part.

If, however, the ‘parent’ application cannot be determined, (for example the process is not part of a particular installed application), the value for this object is then ‘0’, signifying that this process cannot be related back to an application, and in turn, an installed software package.

::= { sysApplElmtRunEntry 1 }

sysApplElmtRunInvocID OBJECT-TYPE
SYNTAX Unsigned32 (0..ffffffff’h)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Part of the index for this table, this value identifies the invocation of an application of which this process is a part. Provided that the ‘parent’ application can be determined, the value of this object is the same value as the sysApplRunIndex for the corresponding application invocation in the sysApplRunTable.

If, however, the ‘parent’ application cannot be determined, the value for this object is then ‘0’, signifying that this process cannot be related back to an invocation of an application in the sysApplRunTable."

::= { sysApplElmtRunEntry 2 }

sysApplElmtRunIndex OBJECT-TYPE
SYNTAX Unsigned32 (0..ffffffff’h)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Part of the index for this table. A unique value for each process running on the host. Wherever possible, this should be the system’s native, unique identification number."

::= { sysApplElmtRunEntry 3 }
sysApplElmtRunInstallID OBJECT-TYPE
SYNTAX      Unsigned32 (0..'ffffffff'h)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The index into the sysApplInstallElmtTable. The
value of this object is the same value as the
sysApplInstallElmtIndex for the application element
of which this entry represents a running instance.
If this process cannot be associated to an installed
executable, the value should be '0'.'"
::= { sysApplElmtRunEntry 4 }

sysApplElmtRunTimeStarted OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The time the process was started."
::= { sysApplElmtRunEntry 5 }

sysApplElmtRunState OBJECT-TYPE
SYNTAX      RunState
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The current state of the running process. The
possible values are running(1), runnable(2) but waiting
for a resource such as CPU, waiting(3) for an event,
exiting(4), or other(5)."
::= { sysApplElmtRunEntry 6 }

sysApplElmtRunName OBJECT-TYPE
SYNTAX      LongUtf8String
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The full path and filename of the process.
For example, '/opt/MYYpkg/bin/myyproc' would
be returned for process 'myyproc' whose execution
path is '/opt/MYYpkg/bin/myyproc'."
::= { sysApplElmtRunEntry 7 }
sysApplElmtRunParameters OBJECT-TYPE
SYNTAX    Utf8String
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
   "The starting parameters for the process."
::= { sysApplElmtRunEntry 8 }

sysApplElmtRunCPU OBJECT-TYPE
SYNTAX    TimeTicks
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
   have been incremented by more than one centi-second
   in one centi-second of real (wall clock) time."
::= { sysApplElmtRunEntry 9 }

sysApplElmtRunMemory OBJECT-TYPE
SYNTAX    Gauge32
UNITS     "Kbytes"
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
   "The total amount of real system memory measured in
   Kbytes currently allocated to this process."
::= { sysApplElmtRunEntry 10 }

sysApplElmtRunNumFiles OBJECT-TYPE
SYNTAX    Gauge32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
   "The number of files currently open by the
   process. Transport connections (sockets)
   should NOT be included in the calculation of
   this value."
::= { sysApplElmtRunEntry 11 }

sysApplElmtRunUser OBJECT-TYPE
SYNTAX    Utf8String
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
"The process owner’s login name (e.g. root)."
::= { sysApplElmtRunEntry 12 }

sysApplElmtPastRunTable
-- The sysApplElmtPastRunTable maintains a history of
-- processes which have previously executed on
-- the host as part of an application. Upon termination
-- of a process, the entry representing the process is removed from
-- the sysApplElmtRunTable and a corresponding entry is created in
-- this table provided that the process was part of an
-- identifiable application. If the process could not be associated
-- with an invoked application, no corresponding entry is created.
-- Hence, whereas the sysApplElmtRunTable contains an entry for
-- every process currently executing on the system, the
-- sysApplElmtPastRunTable only contains entries for processes
-- that previously executed as part of an invoked application.
--
-- Entries remain in this table until they are aged out when
-- either the number of entries in the table reaches a
-- maximum as determined by sysApplElmtPastRunMaxRows, or
-- when an entry has aged to exceed a time limit as set by
-- sysApplElmtPastRunTblTimeLimit. When aging out entries,
-- the oldest entry, as determined by the value of
-- sysApplElmtPastRunTimeEnded, will be removed first.
--
-- The table is indexed by sysApplInstallPkgIndex (from the
-- sysApplInstallPkgTable), sysApplElmtPastRunInvocID, and
-- sysApplElmtPastRunIndex to make it easy to locate all
-- previously executed processes of a particular invoked application
-- that has been installed on the system.

sysApplElmtPastRunTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SysApplElmtPastRunEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The table describes the processes which have previously
executed on the host system as part of an application.
Each entry represents a process which has previously
executed and is associated with the invoked application
of which it was a part. Because an invoked application
may involve more than one executable, it is possible
to have multiple entries in this table for
each application invocation. Entries are added to this table when the corresponding process in the sysApplElmtRun Table terminates.

Entries remain in this table until they are aged out when either the number of entries in the table reaches a maximum as determined by sysApplElmtPastRunMaxRows, or when an entry has aged to exceed a time limit as set by sysApplElmtPastRunTblTimeLimit. When aging out entries, the oldest entry, as determined by the value of sysApplElmtPastRunTimeEnded, will be removed first.

The table is indexed by sysApplInstallPkgIndex (from the sysApplInstallPkgTable), sysApplElmtPastRunInvocID, and sysApplElmtPastRunIndex to make it easy to locate all previously executed processes of a particular invoked application that has been installed on the system.

::= { sysApplRun 4 }

sysApplElmtPastRunEntry OBJECT-TYPE
SYNTAX SysApplElmtPastRunEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The logical row describing a process which was previously executed on this host as part of an installed application. The entry is basically copied from the sysApplElmtRunTable when the process terminates. Hence, the entry’s value for sysApplElmtPastRunIndex is the same as its value was for sysApplElmtRunIndex. Note carefully: only those processes which could be associated with an identified application are included in this table."

INDEX { sysApplInstallPkgIndex, sysApplElmtPastRunInvocID, sysApplElmtPastRunIndex }
::= { sysApplElmtPastRunTable 1 }

SysApplElmtPastRunEntry ::= SEQUENCE {
  sysApplElmtPastRunInvocID            Unsigned32,
  sysApplElmtPastRunIndex             Unsigned32,
  sysApplElmtPastRunInstallID         Unsigned32,
  sysApplElmtPastRunTimeStarted       DateAndTime,
  sysApplElmtPastRunTimeEnded         DateAndTime,
  sysApplElmtPastRunExitState         INTEGER,
  sysApplElmtPastRunName              LongUtf8String,
}
sysApplElmtPastRunParameters Utf8String,
sysApplElmtPastRunCPU TimeTicks,
sysApplElmtPastRunMemory Unsigned32,
sysApplElmtPastRunNumFiles Unsigned32,
sysApplElmtPastRunUser Utf8String
}

sysApplElmtPastRunInvocID OBJECT-TYPE
SYNTAX      Unsigned32 (1..'ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Part of the index for this table, this value
identifies the invocation of an application of which
the process represented by this entry was a part.
The value of this object is the same value as the
sysApplRunIndex for the corresponding application
invocation in the sysApplRunTable. If the invoked
application as a whole has terminated, it will be the
same as the sysApplPastRunIndex."
::= { sysApplElmtPastRunEntry 1 }

sysApplElmtPastRunIndex OBJECT-TYPE
SYNTAX      Unsigned32 (0..'ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Part of the index for this table. An integer
assigned by the agent equal to the corresponding
sysApplElmtRunIndex which was removed from the
sysApplElmtRunTable and moved to this table
when the element terminated.

Note: entries in this table are indexed by
sysApplElmtPastRunInvocID, sysApplElmtPastRunIndex.
The possibility exists, though unlikely, of a
collision occurring by a new entry which was run
by the same invoked application (InvocID), and
was assigned the same process identification number
(ElmtRunIndex) as an element which was previously
run by the same invoked application.

Should this situation occur, the new entry replaces
the old entry.
See Section: ‘Implementation Issues – sysApplElmtPastRunTable Entry Collisions’ for the conditions that would have to occur in order for a collision to occur.

::= { sysApplElmtPastRunEntry 2 }

sysApplElmtPastRunInstallID OBJECT-TYPE
SYNTAX Unsigned32 (1..'ffffffff'h)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The index into the installed element table. The value of this object is the same value as the
sysApplInstallElmtIndex for the application element
of which this entry represents a previously executed process."
::= { sysApplElmtPastRunEntry 3 }

sysApplElmtPastRunTimeStarted OBJECT-TYPE
SYNTAX DateAndTime
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The time the process was started."
::= { sysApplElmtPastRunEntry 4 }

sysApplElmtPastRunTimeEnded OBJECT-TYPE
SYNTAX DateAndTime
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The time the process ended."
::= { sysApplElmtPastRunEntry 5 }

sysApplElmtPastRunExitState OBJECT-TYPE
SYNTAX INTEGER {
   completed (1),
   failed (2),
   other (3)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The state of the process when it exited."
::= { sysApplElmtPastRunEntry 6 }
sysApplElmtPastRunName OBJECT-TYPE
SYNTAX       LongUtf8String
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
 "The full path and filename of the process.
 For example, '/opt/MYYpkg/bin/myyproc' would
 be returned for process 'myyproc' whose execution
 path was '/opt/MYYpkg/bin/myyproc'."
::= { sysApplElmtPastRunEntry 7 }

sysApplElmtPastRunParameters OBJECT-TYPE
SYNTAX       Utf8String
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
 "The starting parameters for the process."
::= { sysApplElmtPastRunEntry 8 }

sysApplElmtPastRunCPU OBJECT-TYPE
SYNTAX       TimeTicks
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
 "The last known 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."
::= { sysApplElmtPastRunEntry 9 }

sysApplElmtPastRunMemory OBJECT-TYPE
SYNTAX       Unsigned32 (0..'ffffffff'h)
UNITS        "Kbytes"
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
 "The last known total amount of real system memory
 measured in Kbytes allocated to this process before it
 terminated."
::= { sysApplElmtPastRunEntry 10 }

sysApplElmtPastRunNumFiles OBJECT-TYPE
SYNTAX       Unsigned32 (0..'ffffffff'h)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"The last known number of files open by the
process before it terminated. Transport
connections (sockets) should NOT be included in
the calculation of this value."
::= { sysApplElmtPastRunEntry 11 }

-- Additional Scalar objects to control table sizes

sysApplPastRunMaxRows OBJECT-TYPE
SYNTAX      Unsigned32 (0..ffffffff'h)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"The maximum number of entries allowed in the
sysApplPastRunTable. Once the number of rows in
the sysApplPastRunTable reaches this value, the
management subsystem will remove the oldest entry
in the table to make room for the new entry to be added.
Entries will be removed on the basis of oldest
sysApplPastRunTimeEnded value first.

This object may be used to control the amount of
system resources that can used for sysApplPastRunTable
entries. A conforming implementation should attempt
to support the default value, however, a lesser value
may be necessary due to implementation-dependent issues
and resource availability."
DEFVAL      { 500 }
::= { sysApplRun 5 }

sysApplPastRunTableRemItems OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
A counter of the number of entries removed from
the sysApplPastRunTable because of table size limitations
as set in sysApplPastRunMaxRows. This counter is the
number of entries the management subsystem has had to
remove in order to make room for new entries (so as not
to exceed the limit set by sysApplPastRunMaxRows) since
the last initialization of the management subsystem.

::= { sysApplRun 6 }

sysApplPastRunTblTimeLimit OBJECT-TYPE
SYNTAX Unsigned32 (0..'ffffffff'h)
UNITS "seconds"
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The maximum time in seconds which an entry in the
sysApplPastRunTable may exist before it is removed.
Any entry that is older than this value will be
removed (aged out) from the table.

Note that an entry may be aged out prior to reaching
this time limit if it is the oldest entry in the
table and must be removed to make space for a new
entry so as to not exceed sysApplPastRunMaxRows."
DEFVAL { 7200 }
::= { sysApplRun 7 }

sysApplElemPastRunMaxRows OBJECT-TYPE
SYNTAX Unsigned32 (0..'ffffffff'h)
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The maximum number of entries allowed in the
sysApplElmtPastRunTable. Once the number of rows in
the sysApplElmtPastRunTable reaches this value,
the management subsystem will remove the oldest entry
to make room for the new entry to be added. Entries
will be removed on the basis of oldest
sysApplElmtPastRunTimeEnded value first.

This object may be used to control the amount of
system resources that can used for sysApplElmPastRunTable
entries. A conforming implementation should attempt
to support the default value, however, a lesser value may be necessary due to implementation-dependent issues and resource availability."
DEFVAL { 500 }
::= { sysApplRun 8 }

sysApplElemPastRunTableRemItems OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A counter of the number of entries removed from the sysApplElemPastRunTable because of table size limitations as set in sysApplElemPastRunMaxRows. This counter is the number of entries the management subsystem has had to remove in order to make room for new entries (so as not to exceed the limit set by sysApplElemPastRunMaxRows) since the last initialization of the management subsystem."
::= { sysApplRun 9 }

sysApplElemPastRunTblTimeLimit OBJECT-TYPE
SYNTAX Unsigned32 (0..ffffffff'h)
UNITS "seconds"
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The maximum time in seconds which an entry in the sysApplElemPastRunTable may exist before it is removed. Any entry that is older than this value will be removed (aged out) from the table.

Note that an entry may be aged out prior to reaching this time limit if it is the oldest entry in the table and must be removed to make space for a new entry so as to not exceed sysApplElemPastRunMaxRows."
DEFVAL { 7200 }
::= { sysApplRun 10 }

sysApplAgentPollInterval OBJECT-TYPE
SYNTAX Unsigned32 (0..ffffffff'h)
UNITS "seconds"
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The minimum interval in seconds that the management
subsystem implementing this MIB will poll the status of the managed resources. Because of the non-trivial effort involved in polling the managed resources, and because the method for obtaining the status of the managed resources is implementation-dependent, a conformant implementation may choose a lower bound greater than 0.

A value of 0 indicates that there is no delay in the passing of information from the managed resources to the agent."

DEFVAL { 60 }
::= { sysApplRun 11 }

-- sysApplMap Group
-- This group contains a table, the sysApplMapTable,
-- whose sole purpose is to provide a ‘backwards’
-- mapping so that, given a known sysApplElmtRunIndex
-- (process identification number), the corresponding invoked
-- application (sysApplRunIndex), installed element
-- (sysApplInstallElmtIndex), and installed application
-- package (sysApplInstallPkgIndex) can be quickly determined.
--
-- The table will contain one entry for each process
-- currently running on the system.
--
-- A backwards mapping is extremely useful since the tables
-- in this MIB module are typically indexed with the
-- installed application package (sysApplInstallPkgIndex)
-- as the primary key, and on down as required by the
-- specific table, with the process ID number (sysApplElmtRunIndex)
-- being the least significant key.
--
-- It is expected that management applications will use
-- this mapping table by doing a ‘GetNext’ operation with
-- the known process ID number (sysApplElmtRunIndex) as the partial
-- instance identifier. Assuming that there is an entry for
-- the process, the result should return a single columnar value,
-- the sysApplMapInstallPkgIndex, with the sysApplElmtRunIndex,
-- sysApplRunIndex, and sysApplInstallElmtIndex contained in the
-- instance identifier for the returned MIB object value.
--
-- NOTE: if the process can not be associated back to an
-- invoked application installed on the system, than the
-- value returned for the columnar value sysApplMapInstallPkgIndex
-- will be '0' and the instance portion of the object-identifier
-- will be the process ID number (sysApplElmtRunIndex) followed
-- by 0.0.

sysApplMapTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SysApplMapEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "The sole purpose of this table is to provide a 'backwards' mapping so that, given a known
sysApplElmtRunIndex (process identification number),
the corresponding invoked application (sysApplRunIndex),
installed element (sysApplInstallElmtIndex), and
installed application package (sysApplInstallPkgIndex)
can be quickly determined.

This table will contain one entry for each process
that is currently executing on the system.

It is expected that management applications will use
this mapping table by doing a 'GetNext' operation with
the known process ID number (sysApplElmtRunIndex) as the
partial instance identifier. Assuming that there is an
entry for the process, the result should return a single
columnar value, the sysApplMapInstallPkgIndex, with the
sysApplElmtRunIndex, sysApplRunIndex, and
sysApplInstallElmtIndex contained in the instance identifier
for the returned MIB object value.

NOTE: if the process can not be associated back to an
invoked application installed on the system, than the
value returned for the columnar value sysApplMapInstallPkgIndex
will be '0' and the instance portion of the object-identifier
will be the process ID number (sysApplElmtRunIndex) followed
by 0.0."

::- { sysApplMap 1 }

sysApplMapEntry OBJECT-TYPE
SYNTAX      SysApplMapEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "A logical row representing a process currently running

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on the system. This entry provides the index mapping from process identifier, back to the invoked application, installed element, and finally, the installed application package. The entry includes only one accessible columnar object, the sysApplMapInstallPkgIndex, but the invoked application and installed element can be determined from the instance identifier since they form part of the index clause."

INDEX  { sysApplElmtRunIndex, sysApplElmtRunInvocID,  
         sysApplMapInstallElmtIndex }

::= { sysApplMapTable 1 }

SysApplMapEntry ::= SEQUENCE {  
    sysApplMapInstallElmtIndex  Unsigned32,  
    sysApplMapInstallPkgIndex   Unsigned32  
}

sysApplMapInstallElmtIndex OBJECT-TYPE
SYNTAX      Unsigned32 (0..'ffffffff'h)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION  "The index into the sysApplInstallElmtTable. The value of this object is the same value as the sysApplInstallElmtIndex for the application element of which this entry represents a running instance. If this process cannot be associated to an installed executable, the value should be '0'."

::= { sysApplMapEntry 1 }

sysApplMapInstallPkgIndex OBJECT-TYPE
SYNTAX      Unsigned32 (0..'ffffffff'h)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The value of this object identifies the installed software package for the application of which this process is a part. Provided that the process’s ‘parent’ application can be determined, the value of this object is the same value as the sysApplInstallPkgIndex for the entry in the sysApplInstallPkgTable that corresponds to the installed application of which this process is a part.

If, however, the ‘parent’ application cannot be
determined, (for example the process is not part of a particular installed application), the value for this object is then '0', signifying that this process cannot be related back to an application, and in turn, an installed software package."

::= { sysApplMapEntry 2 }

-- Conformance Macros

sysApplMIBCompliances OBJECT IDENTIFIER ::= { sysApplConformance 1 }
sysApplMIBGroups OBJECT IDENTIFIER ::= { sysApplConformance 2 }

sysApplMIBCompliance MODULE-COMPLIANCE
STATUS  current
DESCRIPTION "Describes the requirements for conformance to the System Application MIB"
MODULE  -- this module
MANDATORY-GROUPS { sysApplInstalledGroup,
    sysApplRunGroup, sysApplMapGroup }
::= { sysApplMIBCompliances 1 }

sysApplInstalledGroup OBJECT-GROUP
OBJECTS { sysApplInstallPkgManufacturer,
    sysApplInstallPkgProductName,
    sysApplInstallPkgVersion,
    sysApplInstallPkgSerialNumber,
    sysApplInstallPkgDate,
    sysApplInstallPkgLocation,
    sysApplInstallElmtName,
    sysApplInstallElmtType,
    sysApplInstallElmtDate,
    sysApplInstallElmtPath,
    sysApplInstallElmtSizeHigh,
    sysApplInstallElmtSizeLow,
    sysApplInstallElmtRole,
    sysApplInstallElmtModifyDate,
    sysApplInstallElmtCurSizeHigh,
    sysApplInstallElmtCurSizeLow }
STATUS  current
DESCRIPTION "The system application installed group contains information about applications and their constituent components which have been installed on the host system."
::= { sysApplMIBGroups 1 }

sysApplRunGroup OBJECT-GROUP
 OBJECTS { sysApplRunStarted,
     sysApplRunCurrentState,
     sysApplPastRunStarted,
     sysApplPastRunExitState,
     sysApplPastRunTimeEnded,
     sysApplElmtRunInstallID,
     sysApplElmtRunTimeStarted,
     sysApplElmtRunState,
     sysApplElmtRunName,
     sysApplElmtRunParameters,
     sysApplElmtRunCPU,
     sysApplElmtRunMemory,
     sysApplElmtRunNumFiles,
     sysApplElmtRunUser,
     sysApplElmtPastRunInstallID,
     sysApplElmtPastRunTimeStarted,
     sysApplElmtPastRunTimeEnded,
     sysApplElmtPastRunExitState,
     sysApplElmtPastRunName,
     sysApplElmtPastRunParameters,
     sysApplElmtPastRunCPU,
     sysApplElmtPastRunMemory,
     sysApplElmtPastRunNumFiles,
     sysApplElmtPastRunUser,
     sysApplPastRunMaxRows,
     sysApplPastRunTableRemItems,
     sysApplPastRunTblTimeLimit,
     sysApplElemPastRunMaxRows,
     sysApplElemPastRunTableRemItems,
     sysApplElemPastRunTblTimeLimit,
     sysApplAgentPollInterval }

STATUS current
DESCRIPTION
"The system application run group contains information about applications and associated elements which have run or are currently running on the host system."
::= { sysApplMIBGroups 2 }

sysApplMapGroup OBJECT-GROUP
 OBJECTS { sysApplMapInstallPkgIndex }

STATUS current
DESCRIPTION
"The Map Group contains a single table, sysApplMapTable, that provides a backwards mapping for determining the invoked application, installed element, and installed application package given a known process identification number."

::= { sysApplMIBGroups 3 }

END

7. Implementation Issues

This section discusses implementation issues that are important for both an agent developer, and a management application developer or user to understand with regards to this MIB module. Although this section does not attempt to prescribe a particular implementation strategy, it does attempt to recognize some of the real world limitations that could effect an implementation of this MIB module.

7.1. Implementation with Polling Agents

Implementations of the System Application MIB on popular operating systems might require some considerable processing power to obtain status information from the managed resources. It might also be difficult to determine when an application or a process starts or finishes. Implementors of this MIB might therefore choose an implementation approach where the agent polls the managed resources at regular intervals. The information retrieved by every poll is used to update a cached version of this MIB maintained inside of the agent. SNMP request are processed based on the information found in this MIB cache.

A scalar sysApplAgentPollInterval is defined to give the manager control over the polling frequency. There is a trade-off between the amount of resources consumed during every poll to update the MIB cache, and the accuracy of the information provided by the System Application MIB agent. A default value of 60 seconds is defined to keep the processing overhead low, while providing usable information for long-lived processes. A
manager is expected to adjust this value if more accurate information about short-lived applications or processes is needed, or if the amount of resources consumed by the agent is too high.

7.2. sysApplElmtPastRunTable Entry Collisions

The sysApplElmtPastRunTable maintains a history of processes which have previously executed on the host as part of an application. Information is moved from the sysApplElmtRunTable to this PastRun table when the process represented by the entry terminates.

The sysApplElmtPastRunTable is indexed by the tuple, (sysApplElmtPastRunInvocID, sysApplElmtPastRunIndex), where the first part identifies the application invocation of which the process was a part, and the second part identifies the process itself.

Recall that the sysApplElmtRunIndex represents the system’s unique identification number assigned to a running process and that this value is mapped to sysApplElmtPastRunIndex when the process terminates and the entry’s information is moved from the sysApplElmtRunTable to the sysApplElmtPastRunTable. Many systems re-use process ID numbers which are no longer assigned to running processes; typically, the process numbers wrap and the next available process number is used.

It is therefore possible for two entries in the sysApplElmtPastRun Table to have the same value for sysApplElmtPastRunIndex. For this reason, entries in the ElmtPastRun table are indexed by the tuple sysApplElmtPastRunInvocID, sysApplElmtPastRunIndex to reduce the chance of a collision by two past run elements with the same sysApplElmtPastRunIndex.

However, it is still possible, though unlikely, for a collision to occur if the following happens:

1) the invoked application (identified by InvocID), has an element which runs, terminates, and is moved into the sysApplElmtPastRun table (index: InvocID, RunIndex)
2) the numbers used for the system’s process identification numbering wrap

3) that same invoked application (same InvocID), has another element process run, AND that process is assigned the same identification number as one of the processes previously run by that invoked application (same RunIndex), and finally,

4) that element process terminates and is moved to the sysApplElmtPastRun table prior to the old, duplicate (InvocID, RunIndex) entry being aged out of the table by settings defined for sysApplElmtPastRunMaxRows and sysApplElmtPastRunTblTimeLimit.

In the event that a collision occurs, the new entry will replace the old entry.

8. Security Considerations

In order to implement this MIB, an agent must make certain management information available about various logical and physical entities within a managed system which may be considered sensitive in some network environments.

Therefore, a network administrator may wish to employ instance-level access control, and configure the access mechanism (i.e., community strings in SNMPv1 and SNMPv2C), such that certain instances within this MIB are excluded from particular MIB views.
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11. References

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