

Network Working Group
Request for Comments: 2591
Category: Standards Track

D. Levi
Nortel Networks
J. Schoenwaelder
TU Braunschweig
May 1999

Definitions of Managed Objects for Scheduling Management Operations

Status of this Memo

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

Copyright Notice

Copyright (C) The Internet Society (1999). All Rights Reserved.

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 set of managed objects that are used to schedule management operations periodically or at specified dates and times.

Table of Contents

1. Introduction	2
2. The SNMP Management Framework.....	2
3. Overview	3
3.1 Periodic Schedules	3
3.2 Calendar Schedules	4
3.3 One-shot Schedules	4
3.4 Time Transitions	4
3.5 Actions	5
4. Definitions	5
5. Usage Examples	18
5.1 Starting a script to ping devices every 20 minutes	18
5.2 Starting a script at the next Friday the 13th	18
5.3 Turning an interface off during weekends	19
6. Security Considerations	21
7. Intellectual Property	22
8. Acknowledgments	22

9. References	22
10. Editors' Addresses	24
11. Full Copyright Statement	25

1. Introduction

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 set of managed objects that are used to schedule management operations periodically or at specified dates and times.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [19].

2. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- o An overall architecture, described in RFC 2271 [1].
- o Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIV1 and described in STD 16, RFC 1155 [2], STD 16, RFC 1212 [3] and RFC 1215 [4]. The second version, called SMIV2, is described in STD 58, RFC 2578 [5], RFC 2579 [6] and RFC 2580 [7].
- o Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in RFC 1157 [8]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [9] and RFC 1906 [10]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [10], RFC 2272 [11] and RFC 2274 [12].
- o Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [8]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [13].
- o A set of fundamental applications described in RFC 2273 [14] and the view-based access control mechanism described in RFC 2275 [15].

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

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

3. Overview

The MIB defined in this memo provides scheduling of actions periodically or at specified dates and times. The actions can be used to realize on-duty / off-duty schedules or to trigger management functions in a distributed management application.

Schedules can be enabled or disabled by modifying a control object. This allows pre-configured schedules which are activated or de-activated by some other management functions.

The term 'scheduler' is used throughout this memo to refer to the entity which implements the scheduling MIB and which invokes the actions at the specified points in time.

3.1. Periodic Schedules

Periodic schedules are based on fixed time periods between the initiation of scheduled actions. Periodic schedules are defined by specifying the number of seconds between two initiations. The time needed to complete the action is usually not known by the scheduler and does therefore not influence the next scheduling point.

Implementations must guarantee that action invocations will not occur before their next scheduled time. However, implementations may be forced to delay invocations in the face of local constraints (e.g., a heavy load on higher-priority tasks). An accumulation of such delays would result in a drift of the scheduling interval with respect to time, and should be avoided.

Scheduled actions collecting statistical data should retrieve time stamps from the data source and not rely on the accuracy of the periodic scheduler in order to obtain accurate statistics.

3.2. Calendar Schedules

Calendar schedules trigger scheduled actions at specified days of the week and days of the month. Calendar schedules are therefore aware of the notion of months, days, weekdays, hours and minutes.

It is possible to specify multiple values for each calendar item. This provides a mechanism for defining complex schedules. For example, a schedule could be defined which triggers an action every 15 minutes on a given weekday.

Months, days and weekdays are specified using the objects schedMonth, schedDay and schedWeekDay of type BITS. Setting multiple bits to one in these objects causes an OR operation. For example, setting the bits monday(1) and friday(5) in schedWeekDay restricts the schedule to Mondays and Fridays.

The bit fields for schedMonth, schedDay and schedWeekDay are combined using an AND operation. For example, setting the bits june(5) and july(6) in schedMonth and combining it with the bits monday(1) and friday(5) set in schedWeekDay will result in a schedule which is restricted to every Monday and Friday in the months June and July. Wildcarding of calendar items is achieved by setting all bits to one.

It is possible to define calendar schedules that will never trigger an action. For example, one can define a calendar schedule which should trigger an action on February 31st. Schedules like this will simply be ignored by the scheduler.

Finally, calendar schedules are always expressed in local time. A scalar, schedLocalTime is provided so that a manager can retrieve the notion of local time and the offset to GMT time.

3.3. One-shot Schedules

One-shot Schedules are similar to calendar schedules. The difference between a calendar schedule and a one-shot schedule is that a one-shot schedule will automatically disable itself once an action has been invoked.

3.4. Time Transitions

When a system's notion of time is changed for some reason, implementations of the Schedule MIB must schedule actions differently. One example of a change to a system's notion of time is when a daylight savings time transition occurs.

There are two possible situations when a time transition occurs. First, time may be set backwards, in which case particular times will appear to occur twice within the same day. These are called 'ambiguous times'. Second, time may be set forwards, in which case particular times will appear to not occur within a day. These are called 'nonexistent times'.

When an action is configured in the Schedule MIB to occur at an ambiguous time during a time transition, the action SHALL only be invoked at the first occurrence of the ambiguous time. For example, if an action is scheduled to occur at 2:00 am, and a time transition occurs at 3:00 am which sets the clock back to 2:00 am, the action SHALL only be invoked at the first occurrence of 2:00 am.

When an action is configured in the Schedule MIB to occur at a nonexistent time, the action SHOULD be invoked immediately upon a time transition. If multiple actions are invoked in this way, they SHALL be invoked in the order in which they normally would be invoked had the time transition not occurred. For example, if an action (a) is scheduled at 2:05 am and another action (b) at 2:10 am, then both actions SHOULD be invoked at 3:00 am in the order (a),(b) if the time jumps forward from 2:00 am to 3:00 am.

3.5. Actions

Scheduled actions are modeled by SNMP set operations on local MIB variables. Scheduled actions described in this MIB are further restricted to objects of type INTEGER. This restriction does not limit the usefulness of the MIB. Simple schedules such as on-duty / off-duty schedules for resources that have a status MIB object (e.g. ifAdminStatus) are possible.

More complex actions can be realized by triggering a management script which is responsible for performing complex state transitions. A management script can also be used to perform SNMP set operations on remote SNMP engines.

4. Definitions

```
DISMAN-SCHEDULE-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,  
    Integer32, Unsigned32, Counter32, mib-2  
    FROM SNMPv2-SMI
```

```
    TEXTUAL-CONVENTION,  
    DateAndTime, RowStatus, StorageType, VariablePointer
```

```
FROM SNMPv2-TC

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

SnmpAdminString
FROM SNMP-FRAMEWORK-MIB;

schedMIB MODULE-IDENTITY
    LAST-UPDATED "9811171800Z"
    ORGANIZATION "IETF Distributed Management Working Group"
    CONTACT-INFO
        "David B. Levi
        Nortel Networks
        4401 Great America Parkway
        Santa Clara, CA 95052-8185
        U.S.A.
        Tel: +1 423 686 0432
        E-mail: dlevi@nortelnetworks.com

        Juergen Schoenwaelder
        TU Braunschweig
        Bueltenweg 74/75
        38106 Braunschweig
        Germany
        Tel: +49 531 391-3283
        E-mail: schoenw@ibr.cs.tu-bs.de"
    DESCRIPTION
        "This MIB module defines a MIB which provides mechanisms
        to schedule SNMP set operations periodically or at
        specific points in time."
    ::= { mib-2 63 }

--
-- The various groups defined within this MIB definition:
--

schedObjects      OBJECT IDENTIFIER ::= { schedMIB 1 }
schedNotifications OBJECT IDENTIFIER ::= { schedMIB 2 }
schedConformance  OBJECT IDENTIFIER ::= { schedMIB 3 }

--
-- Textual Conventions:
--

SnmpPduErrorStatus ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
```

"This TC enumerates the SNMPv1 and SNMPv2 PDU error status codes as defined in RFC 1157 and RFC 1905. It also adds a pseudo error status code 'noResponse' which indicates a timeout condition."

```
SYNTAX      INTEGER {
                noResponse(-1),
                noError(0),
                tooBig(1),
                noSuchName(2),
                badValue(3),
                readOnly(4),
                genErr(5),
                noAccess(6),
                wrongType(7),
                wrongLength(8),
                wrongEncoding(9),
                wrongValue(10),
                noCreation(11),
                inconsistentValue(12),
                resourceUnavailable(13),
                commitFailed(14),
                undoFailed(15),
                authorizationError(16),
                notWritable(17),
                inconsistentName(18)
            }
```

```
--
-- Some scalars which provide information about the local time
-- zone.
--
```

schedLocalTime OBJECT-TYPE

```
SYNTAX      DateAndTime (SIZE (11))
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

DESCRIPTION

"The local time used by the scheduler. Schedules which refer to calendar time will use the local time indicated by this object. An implementation MUST return all 11 bytes of the DateAndTime textual-convention so that a manager may retrieve the offset from GMT time."

```
::= { schedObjects 1 }
```

```
--
-- The schedule table which controls the scheduler.
--
```

schedTable OBJECT-TYPE

SYNTAX SEQUENCE OF SchedEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table defines scheduled actions triggered by
SNMP set operations."

::= { schedObjects 2 }

schedEntry OBJECT-TYPE

SYNTAX SchedEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry describing a particular scheduled action."

INDEX { schedOwner, schedName }

::= { schedTable 1 }

SchedEntry ::= SEQUENCE {

schedOwner SnmpAdminString,

schedName SnmpAdminString,

schedDescr SnmpAdminString,

schedInterval Unsigned32,

schedWeekDay BITS,

schedMonth BITS,

schedDay BITS,

schedHour BITS,

schedMinute BITS,

schedContextName SnmpAdminString,

schedVariable VariablePointer,

schedValue Integer32,

schedType INTEGER,

schedAdminStatus INTEGER,

schedOperStatus INTEGER,

schedFailures Counter32,

schedLastFailure SnmpPduErrorStatus,

schedLastFailed DateAndTime,

schedStorageType StorageType,

schedRowStatus RowStatus

}

schedOwner OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE(0..32))

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The owner of this scheduling entry. The exact semantics of
this string are subject to the security policy defined by

the security administrator."
 ::= { schedEntry 1 }

schedName OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE(1..32))

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The locally-unique, administratively assigned name for this scheduling entry. This object allows a schedOwner to have multiple entries in the schedTable."

::= { schedEntry 2 }

schedDescr OBJECT-TYPE

SYNTAX SnmpAdminString

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The human readable description of the purpose of this scheduling entry."

DEFVAL { 'H' }

::= { schedEntry 3 }

schedInterval OBJECT-TYPE

SYNTAX Unsigned32

UNITS "seconds"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The number of seconds between two action invocations of a periodic scheduler. Implementations must guarantee that action invocations will not occur before at least schedInterval seconds have passed."

The scheduler must ignore all periodic schedules that have a schedInterval value of 0. A periodic schedule with a scheduling interval of 0 seconds will therefore never invoke an action.

Implementations may be forced to delay invocations in the face of local constraints. A scheduled management function should therefore not rely on the accuracy provided by the scheduler implementation."

DEFVAL { 0 }

::= { schedEntry 4 }

schedWeekDay OBJECT-TYPE

SYNTAX BITS {

```

        sunday(0),
        monday(1),
        tuesday(2),
        wednesday(3),
        thursday(4),
        friday(5),
        saturday(6)
    }
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "The set of weekdays on which the scheduled action should
    take place. Setting multiple bits will include several
    weekdays in the set of possible weekdays for this schedule.
    Setting all bits will cause the scheduler to ignore the
    weekday."
DEFVAL { {} }
 ::= { schedEntry 5 }

schedMonth OBJECT-TYPE
    SYNTAX      BITS {
        january(0),
        february(1),
        march(2),
        april(3),
        may(4),
        june(5),
        july(6),
        august(7),
        september(8),
        october(9),
        november(10),
        december(11)
    }
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "The set of months during which the scheduled action should
    take place. Setting multiple bits will include several
    months in the set of possible months for this schedule.
    Setting all bits will cause the scheduler to ignore the
    month."
DEFVAL { {} }
 ::= { schedEntry 6 }

schedDay OBJECT-TYPE
    SYNTAX      BITS {
        d1(0),    d2(1),    d3(2),    d4(3),    d5(4),

```

```

        d6(5),    d7(6),    d8(7),    d9(8),    d10(9),
        d11(10),  d12(11),  d13(12),  d14(13),  d15(14),
        d16(15),  d17(16),  d18(17),  d19(18),  d20(19),
        d21(20),  d22(21),  d23(22),  d24(23),  d25(24),
        d26(25),  d27(26),  d28(27),  d29(28),  d30(29),
        d31(30),
        r1(31),   r2(32),   r3(33),   r4(34),   r5(35),
        r6(36),   r7(37),   r8(38),   r9(39),   r10(40),
        r11(41),  r12(42),  r13(43),  r14(44),  r15(45),
        r16(46),  r17(47),  r18(48),  r19(49),  r20(50),
        r21(51),  r22(52),  r23(53),  r24(54),  r25(55),
        r26(56),  r27(57),  r28(58),  r29(59),  r30(60),
        r31(61)
    }

```

```

    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION

```

"The set of days in a month on which a scheduled action should take place. There are two sets of bits one can use to define the day within a month:

Enumerations starting with the letter 'd' indicate a day in a month relative to the first day of a month. The first day of the month can therefore be specified by setting the bit d1(0) and d31(30) means the last day of a month with 31 days.

Enumerations starting with the letter 'r' indicate a day in a month in reverse order, relative to the last day of a month. The last day in the month can therefore be specified by setting the bit r1(31) and r31(61) means the first day of a month with 31 days.

Setting multiple bits will include several days in the set of possible days for this schedule. Setting all bits will cause the scheduler to ignore the day within a month. Setting all bits starting with the letter 'd' or the letter 'r' will also cause the scheduler to ignore the day within a month."

```

    DEFVAL { {} }
    ::= { schedEntry 7 }

```

schedHour OBJECT-TYPE

```

    SYNTAX      BITS {
        h0(0),   h1(1),   h2(2),   h3(3),   h4(4),
        h5(5),   h6(6),   h7(7),   h8(8),   h9(9),
        h10(10), h11(11), h12(12), h13(13), h14(14),
        h15(15), h16(16), h17(17), h18(18), h19(19),

```

```

        h20(20), h21(21), h22(22), h23(23)
    }
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "The set of hours within a day during which the scheduled
    action should take place."
DEFVAL { {} }
 ::= { schedEntry 8 }

schedMinute OBJECT-TYPE
    SYNTAX      BITS {
        m0(0),    m1(1),    m2(2),    m3(3),    m4(4),
        m5(5),    m6(6),    m7(7),    m8(8),    m9(9),
        m10(10),  m11(11),  m12(12),  m13(13),  m14(14),
        m15(15),  m16(16),  m17(17),  m18(18),  m19(19),
        m20(20),  m21(21),  m22(22),  m23(23),  m24(24),
        m25(25),  m26(26),  m27(27),  m28(28),  m29(29),
        m30(30),  m31(31),  m32(32),  m33(33),  m34(34),
        m35(35),  m36(36),  m37(37),  m38(38),  m39(39),
        m40(40),  m41(41),  m42(42),  m43(43),  m44(44),
        m45(45),  m46(46),  m47(47),  m48(48),  m49(49),
        m50(50),  m51(51),  m52(52),  m53(53),  m54(54),
        m55(55),  m56(56),  m57(57),  m58(58),  m59(59)
    }
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "The set of minutes within an hour when the scheduled action
    should take place."
DEFVAL { {} }
 ::= { schedEntry 9 }

schedContextName OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..32))
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "The context which contains the local MIB variable pointed
    to by schedVariable."
 ::= { schedEntry 10 }

schedVariable OBJECT-TYPE
    SYNTAX      VariablePointer
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
    "An object identifier pointing to a local MIB variable

```

which resolves to an ASN.1 primitive type of INTEGER."
 ::= { schedEntry 11 }

schedValue OBJECT-TYPE

SYNTAX Integer32
 MAX-ACCESS read-create
 STATUS current

DESCRIPTION

"The value which is written to the MIB object pointed to by schedVariable when the scheduler invokes an action. The implementation shall enforce the use of access control rules when performing the set operation on schedVariable. This is accomplished by calling the isAccessAllowed abstract service interface as defined in RFC 2271."

::= { schedEntry 12 }

schedType OBJECT-TYPE

SYNTAX INTEGER {
 periodic(1),
 calendar(2),
 oneshot(3)
 }

MAX-ACCESS read-create
 STATUS current

DESCRIPTION

"The type of this schedule. The value periodic(1) indicates that this entry specifies a periodic schedule. A periodic schedule is defined by the value of schedInterval. The values of schedWeekDay, schedMonth, schedDay, schedHour and schedMinute are ignored.

The value calendar(2) indicates that this entry describes a calendar schedule. A calendar schedule is defined by the values of schedWeekDay, schedMonth, schedDay, schedHour and schedMinute. The value of schedInterval is ignored. A calendar schedule will trigger on all local times that satisfy the bits set in schedWeekDay, schedMonth, schedDay, schedHour and schedMinute.

The value oneshot(3) indicates that this entry describes a one-shot schedule. A one-shot schedule is similar to a calendar schedule with the additional feature that it disables itself by changing in the 'finished' schedOperStatus once the schedule triggers an action.

Changing a schedule's type is equivalent to deleting the old-type schedule and creating a new-type one."

DEFVAL { periodic }

```

 ::= { schedEntry 13 }

schedAdminStatus OBJECT-TYPE
    SYNTAX      INTEGER {
                    enabled(1),
                    disabled(2)
                }
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The desired state of the schedule."
    DEFVAL { disabled }
    ::= { schedEntry 14 }

schedOperStatus OBJECT-TYPE
    SYNTAX      INTEGER {
                    enabled(1),
                    disabled(2),
                    finished(3)
                }
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The current operational state of this schedule. The state
        enabled(1) indicates this entry is active and that the
        scheduler will invoke actions at appropriate times. The
        disabled(2) state indicates that this entry is currently
        inactive and ignored by the scheduler. The finished(3)
        state indicates that the schedule has ended. Schedules
        in the finished(3) state are ignored by the scheduler.
        A one-shot schedule enters the finished(3) state when it
        deactivates itself."
    ::= { schedEntry 15 }

schedFailures OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "This variable counts the number of failures while invoking
        the scheduled action."
    ::= { schedEntry 16 }

schedLastFailure OBJECT-TYPE
    SYNTAX      SnmpPduErrorStatus
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION

```

"The most recent error that occurred during the invocation of a scheduled action. The value noError(0) is returned if no errors have occurred yet."

```
DEFVAL { noError }
::= { schedEntry 17 }
```

schedLastFailed OBJECT-TYPE

SYNTAX DateAndTime

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The date and time when the most recent failure occurred. The value '0000000000000000'H is returned if no failure occurred since the last re-initialization of the scheduler."

```
DEFVAL { '0000000000000000'H }
::= { schedEntry 18 }
```

schedStorageType OBJECT-TYPE

SYNTAX StorageType

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object defines whether this scheduled action is kept in volatile storage and lost upon reboot or if this row is backed up by non-volatile or permanent storage.

Conceptual rows having the value 'permanent' must allow write access to the columnar objects schedDescr, schedInterval, schedContextName, schedVariable, schedValue, and schedAdminStatus. If an implementation supports the schedCalendarGroup, write access must be also allowed to the columnar objects schedWeekDay, schedMonth, schedDay, schedHour, schedMinute."

```
DEFVAL { volatile }
::= { schedEntry 19 }
```

schedRowStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The status of this scheduled action. A control that allows entries to be added and removed from this table.

The minimum number of objects that need to be set during row creation before a row can be set to 'active' are schedContextName, schedVariable and schedValue."

```
::= { schedEntry 20 }
```

```

--
-- Notifications that are emitted to indicate failures. The
-- definition of schedTraps makes notification registrations
-- reversible (see STD 58, RFC 2578).
--

schedTraps OBJECT IDENTIFIER ::= { schedNotifications 0 }

schedActionFailure NOTIFICATION-TYPE
    OBJECTS      { schedLastFailure, schedLastFailed }
    STATUS       current
    DESCRIPTION
        "This notification is generated whenever the invocation of a
        scheduled action fails."
    ::= { schedTraps 1 }

-- conformance information

schedCompliances OBJECT IDENTIFIER ::= { schedConformance 1 }
schedGroups      OBJECT IDENTIFIER ::= { schedConformance 2 }

-- compliance statements

schedCompliance MODULE-COMPLIANCE
    STATUS       current
    DESCRIPTION
        "The compliance statement for SNMP entities which implement
        the scheduling MIB."
    MODULE       -- this module
    MANDATORY-GROUPS {
        schedGroup, schedNotificationsGroup
    }
    GROUP        schedCalendarGroup
    DESCRIPTION
        "The schedCalendarGroup is mandatory only for those
        implementations that support calendar based schedules."
    OBJECT schedType
    DESCRIPTION
        "The values calendar(2) or oneshot(3) are not valid for
        implementations that do not implement the
        schedCalendarGroup. Such an implementation must return
        inconsistentValue error responses for attempts to set
        schedAdminStatus to calendar(2) or oneshot(3)."
    ::= { schedCompliances 1 }

schedGroup OBJECT-GROUP
    OBJECTS {
        schedDescr,

```



```
        schedInterval,
        schedContextName,
        schedVariable,
        schedValue,
        schedType,
        schedAdminStatus,
        schedOperStatus,
        schedFailures,
        schedLastFailure,
        schedLastFailed,
        schedStorageType,
        schedRowStatus
    }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing scheduling capabilities."
    ::= { schedGroups 1 }

schedCalendarGroup OBJECT-GROUP
    OBJECTS {
        schedLocalTime,
        schedWeekDay,
        schedMonth,
        schedDay,
        schedHour,
        schedMinute
    }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing calendar based schedules."
    ::= { schedGroups 2 }

schedNotificationsGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        schedActionFailure
    }
    STATUS          current
    DESCRIPTION
        "The notifications emitted by the scheduler."
    ::= { schedGroups 3 }

END
```

5. Usage Examples

This section presents some examples how the scheduling MIB can be used to schedule scripts with the Script MIB [17] or to realize on-duty/off-duty schedules by modifying status objects of other MIB modules.

5.1. Starting a script to ping devices every 20 minutes

It is assumed that the schedule entry is owned by schedOwner = "joe" and its name is schedName = "ping". The instance identifier for the scheduling entry is therefore 3.106.111.101.4.112.105.110.103.

It is further assumed that the smLaunchTable entry is owned by smLaunchOwner = "joe" and its name is smLaunchName = "ping-devs". The complete object identifier for the smLaunchStart object is therefore smLaunchStart.3.106.111.101.9.112.105.110.103.45.100.101.118.115. The script lives in the context identified by the string "engine1".

The configuration of the scheduler entry which launches the script every 20 minutes would look as follows:

```
schedInterval.3.106.111.101.4.112.105.110.103 = 1200

schedValue.3.106.111.101.4.112.105.110.103 = 0
schedContextName.3.106.111.101.4.112.105.110.103 = "engine1"
schedVariable.3.106.111.101.4.112.105.110.103 =
    smLaunchStart.3.106.111.101.9.112.105.110.103.45.100.101.118.115

schedType.3.106.111.101.4.112.105.110.103 = periodic(1)
schedAdminStatus.3.106.111.101.4.112.105.110.103 = enabled(1)
schedStorageType.3.106.111.101.4.112.105.110.103 = nonVolatile(3)
schedRowStatus.3.106.111.101.4.112.105.110.103 = active(1)
```

All the remaining columns in the schedTable represent status information and are not shown here.

5.2. Starting a script at the next Friday the 13th

It is assumed that the schedule entry is owned by schedOwner = "joe" and its name is schedName = "13th". The instance identifier for the scheduling entry is therefore 3.106.111.101.4.49.51.116.104.

It is further assumed that the smLaunchTable entry is owned by smLaunchOwner = "joe" and its name is smLaunchName = "ghost". The complete object identifier for the smLaunchStart object is therefore smLaunchStart.3.106.111.101.5.103.104.111.115.116. The script lives in the context identified by the string "engine1".

The configuration of the scheduler entry which launches the script on every Friday 13th at midnight would look as follows:

```

schedWeekDay.3.106.111.101.4.49.51.116.104 = { friday }
schedMonth.3.106.111.101.4.49.51.116.104 = {
    january, february, march, april, may, june,
    july, august, september, october, november, december
}
schedDay.3.106.111.101.4.49.51.116.104 = { d13 }
schedHour.3.106.111.101.4.49.51.116.104 = { h0 }
schedMinute.3.106.111.101.4.49.51.116.104 = { m0 }

schedValue.3.106.111.101.4.49.51.116.104 = 0
schedContextName.3.106.111.101.4.49.51.116.104 = "engine1"
schedVariable.3.106.111.101.4.49.51.116.104 =
    smLaunchStart.3.106.111.101.5.103.104.111.115.116

schedType.3.106.111.101.4.49.51.116.104 = oneshot(3)
schedAdminStatus.3.106.111.101.4.49.51.116.104 = enabled(2)
schedStorageType.3.106.111.101.4.49.51.116.104 = nonVolatile(3)
schedRowStatus.3.106.111.101.4.49.51.116.104 = active(1)

```

All the remaining columns in the schedTable represent status information and are not shown here.

5.3. Turning an interface off during weekends

This example assumes that a network interface should be taken down during weekends. The interface table (ifTable) of the IF-MIB [18] is assumed to exist in the context identified by an empty string and the index of the interface is ifIndex = 6.

The scheduling entry which brings the interface down on every Friday evening at 20:30 (8:30 pm) is owned by schedOwner = "bob" and its name is schedName = "if-off". The instance identifier for the scheduling entry is therefore 3.98.111.98.6.105.102.45.111.102.102.

```

schedWeekDay.3.98.111.98.6.105.102.45.111.102.102 = { friday }
schedMonth.3.98.111.98.6.105.102.45.111.102.102 = {
    january, february, march, april, may, june,
    july, august, september, october, november, december
}
schedDay.3.98.111.98.6.105.102.45.111.102.102 = {
    d1, d2, d3, d4, d5, d6, d7, d8, d9, d10,
    d11, d12, d13, d14, d15, d16, d17, d18, d19, d20,
    d21, d22, d23, d24, d25, d26, d27, d28, d29, d30, d31
}
schedHour.3.98.111.98.6.105.102.45.111.102.102 = { h20 }

```

```
schedMinute.3.98.111.98.6.105.102.45.111.102.102 = { m30 }
```

```
schedValue.3.98.111.98.6.105.102.45.111.102.102 = down(2)
schedContextName.3.98.111.98.6.105.102.45.111.102.102 = ""
schedVariable.3.98.111.98.6.105.102.45.111.102.102 =
    ifAdminStatus.6
```

```
schedType.3.98.111.98.6.105.102.45.111.102.102 = calendar(2)
schedAdminStatus.3.98.111.98.6.105.102.45.111.102.102 = enabled(1)
schedStorageType.3.98.111.98.6.105.102.45.111.102.102 =
    nonVolatile(3)
schedRowStatus.3.98.111.98.6.105.102.45.111.102.102 = active(1)
```

The scheduling entry which brings the interface up on every Monday morning at 5:30 is owned by schedOwner = "bob" and its name is schedName = "if-on". The instance identifier for the scheduling entry is therefore 3.98.111.98.5.105.102.45.111.110.

The entry in the schedTable which brings the interface up again on every Monday morning at 5:30 looks as follows:

```
schedWeekDay.3.98.111.98.5.105.102.45.111.110 = { monday }
schedMonth.3.98.111.98.5.105.102.45.111.110 = {
    january, february, march, april, may, june,
    july, august, september, october, november, december
}
schedDay.3.98.111.98.5.105.102.45.111.110 = {
    d1, d2, d3, d4, d5, d6, d7, d8, d9, d10,
    d11, d12, d13, d14, d15, d16, d17, d18, d19, d20,
    d21, d22, d23, d24, d25, d26, d27, d28, d29, d30, d31
}
schedHour.3.98.111.98.5.105.102.45.111.110 = { h5 }
schedMinute.3.98.111.98.5.105.102.45.111.110 = { m30 }
```

```
schedValue.3.98.111.98.5.105.102.45.111.110 = up(1)
schedContextName.3.98.111.98.5.105.102.45.111.110 = ""
schedVariable.3.98.111.98.5.105.102.45.111.110 = ifAdminStatus.6
```

```
schedType.3.98.111.98.5.105.102.45.111.110 = calendar(2)
schedAdminStatus.3.98.111.98.5.105.102.45.111.110 = enabled(1)
schedStorageType.3.98.111.98.5.105.102.45.111.110 = nonVolatile(3)
schedRowStatus.3.98.111.98.5.105.102.45.111.110 = active(1)
```

A similar configuration could be used to control other schedules. For example, one could change the "if-on" and "if-off" schedules to enable and disable the periodic scheduler defined in the first example.

6. Security Considerations

Scheduled SNMP set operations must use the security credentials that were present when the corresponding row in the scheduling entry was created. An implementation must therefore record and maintain the credentials for every scheduling entry.

An implementation must ensure that access control rules are applied when doing the set operation. This is accomplished by calling the `isAccessAllowed` abstract service interface defined in RFC 2271 [1]:

```

statusInformation =          -- success or errorIndication
    isAccessAllowed(
        IN  securityModel      -- Security Model in use
        IN  securityName      -- principal who wants to access
        IN  securityLevel     -- Level of Security
        IN  viewType           -- read, write, or notify view
        IN  contextName       -- context containing variableName
        IN  variableName      -- OID for the managed object
    )

```

The `securityModel`, `securityName` and `securityLevel` parameters are set to the values that were recorded when the scheduling entry was created. The `viewType` parameter must select the write view and the `contextName` and `variableName` parameters are taken from the `schedContextName` and `schedVariableName` values of the scheduling entry.

This MIB limits scheduled actions to objects in the local MIB. This avoids security problems with the delegation of access rights. However, it might be possible for a user of this MIB to own some schedules that might trigger far in the future. This can cause security risks if the security administrator did not properly update the access control lists when a user is withdrawn from an SNMP engine. Therefore, entries in the `schedTable` SHOULD be cleaned up whenever a user is removed from an SNMP engine.

To facilitate the provisioning of access control by a security administrator using the View-Based Access Control Model (VACM) defined in RFC 2275 [15] for tables in which multiple users may need to independently create or modify entries, the initial index is used as an "owner index". Such an initial index has a syntax of `SnmpAdminString`, and can thus be trivially mapped to a `securityName` or `groupName` as defined in VACM, in accordance with a security policy.

All entries in related tables belonging to a particular user will have the same value for this initial index. For a given user's entries in a particular table, the object identifiers for the

information in these entries will have the same subidentifiers (except for the "column" subidentifier) up to the end of the encoded owner index. To configure VACM to permit access to this portion of the table, one would create vacmViewTreeFamilyTable entries with the value of vacmViewTreeFamilySubtree including the owner index portion, and vacmViewTreeFamilyMask "wildcarding" the column subidentifier. More elaborate configurations are possible.

7. Intellectual Property

The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on the IETF's procedures with respect to rights in standards-track and standards-related documentation can be found in BCP-11. Copies of claims of rights made available for publication and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementors or users of this specification can be obtained from the IETF Secretariat.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

8. Acknowledgments

This document was produced by the IETF Distributed Management (DISMAN) working group.

9. References

- [1] Harrington, D., Presuhn, R. and B. Wijnen, "An Architecture for Describing SNMP Management Frameworks", RFC 2271, January 1998.
- [2] Rose, M. and K. McCloghrie, "Structure and Identification of Management Information for TCP/IP-based Internets", STD 16, RFC 1155, May 1990.
- [3] Rose, M. and K. McCloghrie, "Concise MIB Definitions", STD 16, RFC 1212, March 1991.

- [4] Rose, M., "A Convention for Defining Traps for use with the SNMP", RFC 1215, March 1991.
- [5] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [6] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.
- [7] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.
- [8] Case, J., Fedor, M., Schoffstall, M. and J. Davin, "Simple Network Management Protocol", STD 15, RFC 1157, May 1990.
- [9] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Introduction to Community-based SNMPv2", RFC 1901, January 1996.
- [10] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Transport Mappings for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1906, January 1996.
- [11] Case, J., Harrington D., Presuhn R. and B. Wijnen, "Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)", RFC 2272, January 1998.
- [12] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", RFC 2274, January 1998.
- [13] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)", January 1996.
- [14] Levi, D., Meyer, P. and B. Stewart, "SNMPv3 Applications", RFC 2273, January 1998
- [15] Wijnen, B., Presuhn, R. and K. McCloghrie, "View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)", RFC 2275, January 1998.
- [16] Hovey, R. and S. Bradner, "The Organizations Involved in the IETF Standards Process", BCP 11, RFC 2028, October 1996.

- [17] Levi, D. and J. Schoenwaelder, "Definitions of Managed Objects for the Delegation of Management Scripts", RFC 2592, May 1999.
- [18] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB using SMIV2", RFC 2233, November 1997.
- [19] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

10. Editors' Addresses

David B. Levi
Nortel Networks
4401 Great America Parkway
Santa Clara, CA 95052-8185
U.S.A.

Phone: +1 423 686 0432
EMail: dlevi@nortelnetworks.com

Juergen Schoenwaelder
TU Braunschweig
Bueltenweg 74/75
38106 Braunschweig
Germany

Phone: +49 531 391-3283
EMail: schoenw@ibr.cs.tu-bs.de

11. Full Copyright Statement

Copyright (C) The Internet Society (1999). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

