Abstract

This memo defines a Management Information Base (MIB) module for use with network management protocols in the Internet community. In particular, it defines managed objects for the Forwarding and Control Element Separation (ForCES) Network Element (NE).

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc5813.

Copyright Notice

Copyright (c) 2010 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust’s Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.
1. The Internet-Standard Management Framework

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

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

2. Introduction

The ForCES MIB module is a read-only MIB module that captures information related to the ForCES protocol ([RFC3654], [RFC3746], [FORCES-APP], and [RFC5810]).

The ForCES MIB module does not include information that is specified in other MIB modules, such as packet counters for interfaces, etc.

More specifically, the information in the ForCES MIB module relative to associations (between Control Elements and Forwarding Elements) that are in the UP state includes:

- identifiers of the elements in the association,
- configuration parameters of the association, and
- statistics of the association.
3. Requirements Notation

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

4. ForCES MIB Overview

The MIB module contains the latest ForCES protocol version supported by the Control Element (CE) (forcesLatestProtocolVersionSupported). Note that the CE must also allow interaction with Forwarding Elements (FEs) supporting earlier versions.

For each association identified by the pair CE ID and FE ID, the following associated information is provided by the MIB module as an entry (forcesAssociationEntry) in the association table (forcesAssociationTable):

- Version number of the ForCES protocol running in this association (forcesAssociationRunningProtocolVersion).

- Time when the association entered the UP state (forcesAssociationTimeUp).

- Time when the association left the UP state (forcesAssociationTimeDown). Note that this is only used for notification purposes as the association is removed from the MIB immediately after it leaves the UP state.

- Number of ForCES Heartbeat messages sent from the CE (forcesAssociationHBMsgSent) and received by the CE (forcesAssociationHBMsgReceived) since the association entered the UP state.

- Number of operational ForCES messages sent from the CE (forcesAssociationOperMsgSent) and received by the CE (forcesAssociationOperMsgReceived) since the association entered the UP state. Only messages other than Heartbeat, Association Setup, Association Setup Response, and Association Teardown are counted.

Finally, the MIB module defines the following notifications:

- Whenever an association enters the UP state, a notification (forcesAssociationEntryUp) is issued containing the version of the ForCES protocol running. CE ID and FE ID are concatenated to form the table index, hence they appear in the OID of the ForCES-protocol running-version object. Optionally, a notification
(forcesAssociationEntryUpStats) can instead be issued with all associated information for this association, except forcesAssociationTimeDown.

Whenever an association leaves the UP state, a notification (forcesAssociationEntryDown) is issued containing the version of the ForCES protocol running. Optionally, a notification (forcesAssociationEntryDownStats) can instead be issued with all associated information for this association. The reason is that the association and all its associated information will be removed from the MIB immediately after this notification has been issued.

5. ForCES MIB Definition

FORCES-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
  mib-2, Integer32
  FROM SNMPv2-SMI

  TEXTUAL-CONVENTION, TimeStamp
  FROM SNMPv2-TC

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

  ZeroBasedCounter32
  FROM RMON2-MIB;

forcesMib MODULE-IDENTITY
  LAST-UPDATED "201003100000Z" -- March 10, 2010
  ORGANIZATION "IETF Forwarding and Control Element Separation (ForCES) Working Group"
  CONTACT-INFO
    "WG Charter:
      http://www.ietf.org/html.charters/forces-charter.html

    Mailing lists:
      General Discussion: forces@ietf.org
      To Subscribe:
      https://www.ietf.org/mailman/listinfo/forces"

    Chairs: Patrick Droz
      Email: dro@zurich.ibm.com
    Jamal Hadi Salim
      Email: hadi@mojatatu.com
DESCRIPTION

"This MIB module contains managed object definitions for the ForCES Protocol.

Copyright (c) 2010 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in Section 4.c of the IETF Trust’s Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info).

This version of this MIB module is part of RFC 5813; see the RFC itself for full legal notices."

REVISION "201003100000Z" -- March 10, 2010

DESCRIPTION

"Initial version, published as RFC 5813."

::= { mib-2 187 }

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

forcesMibNotifications OBJECT IDENTIFIER ::= { forcesMib 0 }
forcesMibObjects OBJECT IDENTIFIER ::= { forcesMib 1 }
forcesMibConformance OBJECT IDENTIFIER ::= { forcesMib 2 }

ForcesID ::= TEXTUAL-CONVENTION
  STATUS current
  DESCRIPTION
   "The ForCES identifier is a 4-octet quantity."
  SYNTAX OCTET STRING (SIZE (4))

ForcesProtocolVersion ::= TEXTUAL-CONVENTION
  DISPLAY-HINT "d"
  STATUS current
  DESCRIPTION
   "ForCES protocol version number.
   The version numbers used are defined in the specifications of the respective protocol:
   1 - ForCESv1, RFC 5810."
  SYNTAX Integer32 (1..255)
-- Notifications

forcesAssociationEntryUp NOTIFICATION-TYPE
OBJECTS
  { forcesAssociationRunningProtocolVersion }
STATUS current
DESCRIPTION
  "This notification is generated as soon as an association enters the UP state. Note that these
  notifications are not throttled as the CE itself should throttle the setup of associations."
::= { forcesMibNotifications 1 }

forcesAssociationEntryDown NOTIFICATION-TYPE
OBJECTS
  { forcesAssociationRunningProtocolVersion }
STATUS current
DESCRIPTION
  "This notification is generated as soon as an association leaves the UP state. Note that these
  notifications are not throttled as the CE itself should throttle the setup of associations."
::= { forcesMibNotifications 2 }

forcesAssociationEntryUpStats NOTIFICATION-TYPE
OBJECTS
  { forcesAssociationRunningProtocolVersion, forcesAssociationTimeUp }
STATUS current
DESCRIPTION
  "This notification is generated as soon as an association enters the UP state. Note that these
  notifications are not throttled as the CE itself should throttle the setup of associations."
::= { forcesMibNotifications 3 }
forcesAssociationEntryDownStats NOTIFICATION-TYPE
OBJECTS
  { forcesAssociationRunningProtocolVersion,
    forcesAssociationTimeUp,
    forcesAssociationTimeDown,
    forcesAssociationHBMsgSent,
    forcesAssociationHBMsgReceived,
    forcesAssociationOperMsgSent,
    forcesAssociationOperMsgReceived,
    forcesAssociationCounterDiscontinuityTime
  }
STATUS current
DESCRIPTION
"This notification is generated as soon as an association leaves the UP state.
Note that these notifications are not throttled as the CE itself should throttle the setup of associations."
 ::= { forcesMibNotifications 4 }
-- Objects

forcesLatestProtocolVersionSupported OBJECT-TYPE
SYNTAX ForcesProtocolVersion
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The ForCES protocol version supported by the CE.
The current protocol version is 1.
Note that the CE must also allow interaction with FEs supporting earlier versions."
 ::= { forcesMibObjects 1 }

forcesAssociations OBJECT IDENTIFIER ::= { forcesMibObjects 2 }

forcesAssociationTable OBJECT-TYPE
SYNTAX SEQUENCE OF ForcesAssociationEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The (conceptual) table of associations."
 ::= { forcesAssociations 1 }
forcesAssociationEntry OBJECT-TYPE
  SYNTAX ForcesAssociationEntry
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
    "A (conceptual) entry for one association."
  INDEX { forcesAssociationCEID, forcesAssociationFEID }
  ::= { forcesAssociationTable 1 }

ForcesAssociationEntry ::= SEQUENCE {
  forcesAssociationCEID             ForcesID,
  forcesAssociationFEID             ForcesID,

  forcesAssociationRunningProtocolVersion
    ForcesProtocolVersion,

  forcesAssociationTimeUp           TimeStamp,
  forcesAssociationTimeDown         TimeStamp,

  forcesAssociationHBMsgSent        ZeroBasedCounter32,
  forcesAssociationHBMsgReceived    ZeroBasedCounter32,
  forcesAssociationOperMsgSent      ZeroBasedCounter32,
  forcesAssociationOperMsgReceived  ZeroBasedCounter32,
  forcesAssociationCounterDiscontinuityTime  TimeStamp
}

forcesAssociationCEID OBJECT-TYPE
  SYNTAX ForcesID
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
    "The ForCES ID of the CE."
  ::= { forcesAssociationEntry 1 }

forcesAssociationFEID OBJECT-TYPE
  SYNTAX ForcesID
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
    "The ForCES ID of the FE."
  ::= { forcesAssociationEntry 2 }

Haas Standards Track [Page 8]
forcesAssociationRunningProtocolVersion OBJECT-TYPE
SYNTAX ForcesProtocolVersion
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The current ForCES protocol version used in this association.
The current protocol version is 1."
 ::= { forcesAssociationEntry 3 }

forcesAssociationTimeUp OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The value of sysUpTime at the time this association entered the UP state.
If this association started prior to the last initialization of the network subsystem, then
this object contains a zero value.
This object allows to uniquely identify associations with the same CE and FE IDs."
 ::= { forcesAssociationEntry 4 }

forcesAssociationTimeDown OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION "The value of sysUpTime at the time this association left the UP state."
 ::= { forcesAssociationEntry 5 }

forcesAssociationHBMsgSent OBJECT-TYPE
SYNTAX ZeroBasedCounter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "A counter of how many Heartbeat messages have been sent by the CE on this association since the association entered the UP state.
Discontinuities in the value of this counter can occur at reinitialization of the management system, and at other times as indicated by the value of forcesAssociationCounterDiscontinuityTime."
 ::= { forcesAssociationEntry 6 }
forcesAssociationHBMsgReceived OBJECT-TYPE
SYNTAX ZeroBasedCounter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A counter of how many Heartbeat messages have been received by the CE on this association since the association entered the UP state. Discontinuities in the value of this counter can occur at reinitialization of the management system, and at other times as indicated by the value of forcesAssociationCounterDiscontinuityTime."
::= { forcesAssociationEntry 7 }

forcesAssociationOperMsgSent OBJECT-TYPE
SYNTAX ZeroBasedCounter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A counter of how many messages other than Heartbeat (i.e., Config and Query) have been sent by the CE on this association since the association entered the UP state. Discontinuities in the value of this counter can occur at reinitialization of the management system, and at other times as indicated by the value of forcesAssociationCounterDiscontinuityTime."
::= { forcesAssociationEntry 8 }

forcesAssociationOperMsgReceived OBJECT-TYPE
SYNTAX ZeroBasedCounter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A counter of how many messages other than Heartbeat (i.e., Config response, Query response, event notification, and packet redirect) have been received by the CE on this association since the association entered the UP state. Discontinuities in the value of this counter can occur at reinitialization of the management system, and at other times as indicated by the value of forcesAssociationCounterDiscontinuityTime."
::= { forcesAssociationEntry 9 }
forcesAssociationCounterDiscontinuityTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The value of sysUpTime on the most recent occasion
at which any one or more of this association’s
counters suffered a discontinuity. The relevant
counters are the specific instances associated with
this association of any ZeroBasedCounter32 object
contained in the forcesAssociationTable. If no
such discontinuities have occurred since the last
reinitialization of the local management subsystem,
then this object contains a zero value."
 ::= { forcesAssociationEntry 10 }

-- Conformance

forcesMibCompliances OBJECT IDENTIFIER
 ::= { forcesMibConformance 1 }
forcesMibGroups OBJECT IDENTIFIER
 ::= { forcesMibConformance 2 }

-- Compliance statements

forcesMibCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"The compliance statement for routers running
ForCES and implementing the ForCES MIB."
MODULE -- this module
MANDATORY-GROUPS { forcesMibGroup, forcesNotificationGroup }

GROUP forcesNotificationStatsGroup
DESCRIPTION
"Implementation of this group is recommended."

GROUP forcesStatsGroup
DESCRIPTION
"Implementation of this group is recommended."

 ::= { forcesMibCompliances 1 }
-- Units of conformance

forcesNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS { forcesAssociationEntryUp,
forcesAssociationEntryDown
}
STATUS current
DESCRIPTION
"A collection of notifications for signaling important ForCES events."
 ::= { forcesMibGroups 1 }

forcesMibGroup OBJECT-GROUP
OBJECTS { forcesLatestProtocolVersionSupported,
forcesAssociationRunningProtocolVersion
}
STATUS current
DESCRIPTION
"A collection of objects to support management of ForCES routers."
 ::= { forcesMibGroups 2 }

forcesNotificationStatsGroup NOTIFICATION-GROUP
NOTIFICATIONS { forcesAssociationEntryUpStats,
forcesAssociationEntryDownStats
}
STATUS current
DESCRIPTION
"A collection of optional notifications for signaling important ForCES events including statistics."
 ::= { forcesMibGroups 3 }
forcesStatsGroup OBJECT-GROUP
  OBJECTS { forcesAssociationTimeUp,
            forcesAssociationTimeDown,
            forcesAssociationHBMsgSent,
            forcesAssociationHBMsgReceived,
            forcesAssociationOperMsgSent,
            forcesAssociationOperMsgReceived,
            forcesAssociationCounterDiscontinuityTime
  }
  STATUS  current
  DESCRIPTION
    "A collection of optional objects to provide
     extra information about the associations.
     There is no protocol reason to keep such
     information, but these objects can be very
     useful in debugging connectivity problems."
  ::= { forcesMibGroups 4}
END

6. Associations Kept in the MIB

Associations enter the UP state as soon as the CE has sent to the FE
an Association Setup Response message containing a successful
Association Setup Result. Only associations that are UP are
reflected in this MIB module.

Associations are removed from the MIB module as soon as they leave
the UP state, i.e., if the CE has not received any message (Heartbeat
or other protocol message) from the FE within a given time period or
if an Association Teardown message has been sent by the CE.

Statistics counters are initialized to zero when the association is
created. If the same association goes down and comes back up, the
counters will reset and the discontinuity can be discovered by
checking the discontinuity timestamp. In addition, the time-up
timestamp in the association allows to distinguish new associations
from past ones with the same index. Note that the optional down
notification contains the statistics with the final values of the
statistics counters.
7. Support for Multiple CEs and FEs

An NE consists of one or more FEs and one or more CEs. Where there is a single CE, that CE will have knowledge of all the associations in the NE and so can provide the information necessary to support the managed objects defined in this MIB module. Where there is more than one CE, information about the associations may be distributed among the CEs. Whether each CE implements the managed objects for the associations of which it is aware or whether the CEs cooperate to present the appearance of a single set of managed objects for all the associations in the NE is outside the scope of this document.

8. Security Considerations

There are no management objects defined in this MIB module that have a MAX-ACCESS clause of read-write and/or read-create. So, if this MIB module is implemented correctly, then there is no risk that an intruder can alter or create any management objects of this MIB module via direct SNMP SET operations.

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

- Objects in the forcesMibGroup are protocol versions. They are neither sensitive nor vulnerable.
- Objects in the forcesStatsGroup are statistics. They are neither sensitive nor vulnerable.

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

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

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator
responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

9. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>forcesMIB</td>
<td>{ mib-2 187 }</td>
</tr>
</tbody>
</table>

10. References

10.1. Normative References


10.2. Informative References

[FORCES-APP]


Appendix A.  Acknowledgments

The author gratefully acknowledges the contributions of Spencer Dawkins, Jinrong Fenggen, John Flick, Xiaoyi Guo, Joel Halpern, Tom Petch, Jamal Hadi Salim, and Bert Wijnen.

Author’s Address

Robert Haas
IBM
Saeumerstrasse 4
Rueschlikon 8803
CH

EMail: rha@zurich.ibm.com
URI: http://www.zurich.ibm.com/~rha