

Forwarding and Control Element Separation (forces)	R. Haas	
Internet-Draft	August 25, 2008	
Intended status: Standards Track		
Expires: February 26, 2009		

[TOC](#)

ForCES MIB draft-ietf-forces-mib-07

Status of this Memo

By submitting this Internet-Draft, each author represents that any applicable patent or other IPR claims of which he or she is aware have been or will be disclosed, and any of which he or she becomes aware will be disclosed, in accordance with Section 6 of BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/ietf/lid-abstracts.txt>.

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>.

This Internet-Draft will expire on February 26, 2009.

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).

Table of Contents

- [1.](#) Requirements notation
- [2.](#) The Internet-Standard Management Framework
- [3.](#) Introduction
- [4.](#) ForCES MIB Overview

5.	ForCES MIB Definition
6.	Associations kept in the MIB
7.	Support for multiple CEs and FEs
8.	Security Considerations
9.	IANA Considerations
10.	Changes from Previous Draft Revisions
11.	References
11.1.	Normative References
11.2.	Informative References
Appendix A.	Acknowledgments
§	Author's Address
§	Intellectual Property and Copyright Statements

1. Requirements notation

[TOC](#)

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 [\[RFC2119\] \(Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," March 1997.\)](#).

2. The Internet-Standard Management Framework

[TOC](#)

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of [\[RFC3410\] \(Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework," December 2002.\)](#).

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, [\[RFC2578\] \(McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 \(SMIV2\)," April 1999.\)](#), STD 58, [\[RFC2579\] \(McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIV2," April 1999.\)](#) and STD 58, [\[RFC2580\] \(McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIV2," April 1999.\)](#).

3. Introduction

[TOC](#)

The ForCES MIB module is a read-only MIB module that captures information related to the ForCES protocol ([\[RFC3654\] \(Khosravi, H. and T. Anderson, "Requirements for Separation of IP Control and Forwarding," November 2003.\)](#), [\[RFC3746\] \(Yang, L., Dantu, R., Anderson, T., and R. Gopal, "Forwarding and Control Element Separation \(ForCES\) Framework," April 2004.\)](#), [\[forces-applicability-draft\] \(Crouch, A., Khosravi, H., Handley, M., and A. Doria, "ForCES Applicability Statement," July 2006.\)](#) and [\[forces-protocol-draft\] \(Doria, A., Haas, R., Hadi Salim, J., Khosravi, H., and W. Wang, "ForCES Protocol Specification," August 2008.\)](#)).

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 that are up includes:

- *identifiers of the elements in the association,
- *configuration parameters of the association, and
- *statistics of the association.

4. ForCES MIB Overview

[TOC](#)

The MIB module contains the latest ForCES protocol version supported by the CE (`forcesLatestProtocolVersionSupported`). Note that the CE must also allow interaction with 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 other ForCES messages sent from the CE (forcesAssociationOtherMsgSent) and received by the CE (forcesAssociationOtherMsgReceived) 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. Note that as CE ID and FE ID are indexes, 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.

```

FORCES-MIB DEFINITIONS ::= BEGIN

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

    TEXTUAL-CONVENTION, TimeStamp
        FROM SNMPv2-TC

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

forcesMib MODULE-IDENTITY
    LAST-UPDATED "200808251200Z" -- Aug 25, 2008
    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@peach.ease.lsoft.com
        To Subscribe: listserv@peach.ease.lsoft.com
        In Body: subscribe forces

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

        Editor: Robert Haas
        IBM
        Email: rha@zurich.ibm.com"
    DESCRIPTION
        "This MIB module contains managed object definitions
        for the ForCES Protocol.
        Copyright (C) The Internet Trust (2008). This
        version of this MIB module is part of RFC yyyy; see
        the RFC itself for full legal notices."
-- RFC Ed.: replace yyyy with actual RFC number & remove this note
    REVISION "200808251200Z" -- Aug 25, 2008
    DESCRIPTION
        "Initial version, published as RFC yyyy."
-- RFC Ed.: replace yyyy with actual RFC number & remove this note
    ::= { mib-2 XXX }
-- RFC Ed.: replace XXX with IANA-assigned number & remove this note

```

```

_ _*****

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 four octet quantity."
    SYNTAX      OCTET STRING (SIZE (4))

ForcesProtocolVersion ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "ForCES protocol version number.
        The version numbers used are defined in the
        specifications of the respective protocol:
        1 - ForCESv1 [RFCzzzz]."
```

-- RFC Ed.: replace zzzz with actual RFC number of ForCES protocol
-- & remove this note

```

    SYNTAX      Integer32 (1..255)
    DISPLAY-HINT "d"

-- 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,
    forcesAssociationHBMsgSent,
    forcesAssociationHBMsgReceived,
    forcesAssociationOtherMsgSent,
    forcesAssociationOtherMsgReceived
}
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,
    forcesAssociationOtherMsgSent,
    forcesAssociationOtherMsgReceived
}
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     Counter32,
    forcesAssociationHBMsgReceived Counter32,
    forcesAssociationOtherMsgSent  Counter32,
    forcesAssociationOtherMsgReceived Counter32 }

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 }

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 Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 "A counter of how many heartbeat messages have
 have been sent by the CE on this association
 since the association entered the UP state.
 If this association started prior to the last
 initialization of the network subsystem, then

this object contains the value since the
 initialization."
 ::= { forcesAssociationEntry 6 }

forcesAssociationHBMsgReceived OBJECT-TYPE

SYNTAX Counter32

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.
 If this association started prior to the last
 initialization of the network subsystem, then
 this object contains the value since the
 initialization."

::= { forcesAssociationEntry 7 }

forcesAssociationOtherMsgSent OBJECT-TYPE

SYNTAX Counter32

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.
 If this association started prior to the last
 initialization of the network subsystem, then
 this object contains the value since the
 initialization."

::= { forcesAssociationEntry 8 }

forcesAssociationOtherMsgReceived OBJECT-TYPE

SYNTAX Counter32

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.
 If this association started prior to the last
 initialization of the network subsystem, then
 this object contains the value since the
 initialization."

::= { forcesAssociationEntry 9 }

```

-- 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,
              forcesAssociationOtherMsgSent,
              forcesAssociationOtherMsgReceived
    }
    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

[TOC](#)

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 not initialized to zero when the association is created. Instead, a delta value must be calculated from two successive readings. Note that the optional up and down notifications contain the statistics with the initial and final value of the statistics.

7. Support for multiple CEs and FEs

[TOC](#)

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

[TOC](#)

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 [\[RFC3410\] \(Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework," December 2002.\)](#), 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

[TOC](#)

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

Descriptor -----	OBJECT IDENTIFIER value -----
forcesMIB	{ mib-2 XXX }

Editor's Note (to be removed prior to publication): the IANA is requested to assign a value for "XXX" under the 'mib-2' subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "XXX" (here and in the MIB module) with the assigned value and to remove this note.

10. Changes from Previous Draft Revisions

[TOC](#)

Editor's Note (to be removed prior to publication): Prior to RFC publication of this document, the RFC Editor is asked to remove this entire section titled "Changes from Previous Draft Versions".

Changes from draft-ietf-forces-mib-06:

- *Informational RFCs 3654 and 3746 moved to Informative References section.
- *Updated chairs' names in the MIB description.
- *Update references to protocol and applicability drafts.
- *Reversed the order of the two first sentences in section "Associations kept in the MIB"

Changes from draft-ietf-forces-mib-05: Copyright statement in the MIB description corrected to IETF Trust.

Changes from draft-ietf-forces-mib-04. They are changes suggested by the MIB doctor review, according to the MIB Review Checklist in Appendix A of RFC 4181:

- *Changed MIB descriptions with "since the association entered the UP state" instead of "since the association is up".
- *Updated the I-D boilerplate copyright statement.
- *Removed last sentence of abstract.
- *Moved the MIB boilerplate into a section of its own.
- *Moved the MIB definition into a section of its own.
- *Updated the Security Considerations section according to the boilerplate at <http://www.ops.ietf.org/mib-security.html>.
- *Updated the MIB description with the copyright statement.
- *Added DISPLAY-HINT to the ForCESProtocolVersion. Note that the smilint tool doesn't like it.
- *Added IETF to the MODULE-IDENTITY ORGANIZATION.
- *Updated CONTACT-INFO to indicate how to reach the group.
- *Changed forcesAssociationTimeDown MAX-ACCESS to accessible-for-notify.
- *Added text to DESCRIPTION of forcesAssociationTimeUp to indicate that it allows to uniquely identify associations with the same FE and CE IDs.
- *Added two optional notifications that carry stats and added corresponding text in the last paragraph of section titled "Associations kept in the MIB". The reason is that optional objects such as stats in a mandatory notification are not supported.

Changes from draft-ietf-forces-mib-03. They are small fixes to the text and the MIB module:

- *Added MIB boilerplate according to <http://www.ops.ietf.org/mib-boilerplate.html>
- *Clarified terminology with respect to MIB module and MIB managed objects.

- *Added RFC Editor note to indicate RFC number for version 1 of ForCES protocol under ForcesProtocolVersion.
- *Renumbered elements in forcesAssociationEntry starting with 1.
- *Changed ForcesProtocolVersion from INTEGER to Integer32.
- *Added forcesLatestProtocolVersionSupported into the mandatory forcesMibGroups conformance group.
- *Explicitely added the forcesStatsGroup to the forcesMibCompliance compliance statement as optional.
- *Moved the MIB Definition section to the front.
- *Rephrased IANA Considerations section according to RFC 4181 Section 3.5.2.
- *Added RFC Editor note to remove the "Changes from Previous Draft Revisions" section prior to publication.

Changes from draft-ietf-forces-mib-02. They are refinements of the MIB module:

- *Changed forcesAssociationCEID and forcesAssociationFEID from read-only to not-accessible to conform with Section 7.7 in [\[RFC2578\] \(McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 \(SMIV2\)," April 1999.\)](#).
- *Removed forcesAssociationCEID and forcesAssociationFEID from the notifications. This information is conveyed in the OID anyway.
- *Added MIB conformance information.

Changes from draft-ietf-forces-mib-01. The changes are in response to the Working Group Last Call:

- *Addition of two traps/notifications to signal the associations that enter or leave the UP state.
- *Suppression of the DOWN and ESTABLISHING states. Only associations in the UP state are kept in the table.
- *Split of the Message counters into Heartbeat and other messages.
- *Addition of the current running version of ForCES protocol for each association in the UP state.

*Addition of the latest version of the ForCES protocol supported by the CE.

11. References

[TOC](#)

11.1. Normative References

[TOC](#)

[RFC2119]	Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," BCP 14, RFC 2119, March 1997 (TXT , HTML , XML).
[RFC2578]	McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)," STD 58, RFC 2578, April 1999 (TXT).
[RFC2579]	McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2," STD 58, RFC 2579, April 1999 (TXT).
[RFC2580]	McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2," STD 58, RFC 2580, April 1999 (TXT).
[forces-protocol-draft]	Doria, A., Haas, R., Hadi Salim, J., Khosravi, H., and W. Wang, "ForCES Protocol Specification," ID Document: draft-ietf-forces-protocol-15.txt, August 2008.

11.2. Informative References

[TOC](#)

[RFC3410]	Case, J., Mundy, R., Partain, D., and B. Stewart, " Introduction and Applicability Statements for Internet-Standard Management Framework ," RFC 3410, December 2002 (TXT).
[RFC3654]	Khosravi, H. and T. Anderson, " Requirements for Separation of IP Control and Forwarding ," RFC 3654, November 2003 (TXT).
[RFC3746]	Yang, L., Dantu, R., Anderson, T., and R. Gopal, " Forwarding and Control Element Separation (ForCES) Framework ," RFC 3746, April 2004 (TXT).
[forces-applicability-draft]	Crouch, A., Khosravi, H., Handley, M., and A. Doria, "ForCES Applicability Statement," ID Document: draft-ietf-forces-applicability-05.txt, July 2006.

Appendix A. Acknowledgments

[TOC](#)

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

Author's Address

[TOC](#)

	Robert Haas
	IBM
	Saeumerstrasse 4
	Rueschlikon 8803
	CH
Email:	rha@zurich.ibm.com
URI:	http://www.zurich.ibm.com/~rha

Full Copyright Statement

[TOC](#)

Copyright © The IETF Trust (2008).

This document is subject to the rights, licenses and restrictions contained in BCP 78, and except as set forth therein, the authors retain all their rights.

This document and the information contained herein are provided on an "AS IS" basis and THE CONTRIBUTOR, THE ORGANIZATION HE/SHE REPRESENTS OR IS SPONSORED BY (IF ANY), THE INTERNET SOCIETY, THE IETF TRUST AND THE INTERNET ENGINEERING TASK FORCE DISCLAIM 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.

Intellectual Property

The IETF takes no position regarding the validity or scope of any Intellectual Property Rights 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; nor does it represent that it has made any independent effort to identify any such rights. Information on the procedures with respect to rights in RFC documents can be found in BCP 78 and BCP 79.

Copies of IPR disclosures made to the IETF Secretariat 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 implementers or users of this specification can be obtained from the IETF on-line IPR repository at <http://www.ietf.org/ipr>.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard. Please address the information to the IETF at ietf-ipr@ietf.org.