

Forwarding and Control Element
Separation (forces)
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ForCES MIB
draft-ietf-forces-mib-05

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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).

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1. 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 [\[RFC2119\]](#).

2. 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, [\[RFC2580\]](#).

3. Introduction

The ForCES MIB module is a read-only MIB module that captures information related to the ForCES protocol ([\[RFC3654\]](#), [\[RFC3746\]](#), [\[forces-applicability-draft\]](#) and [\[forces-protocol-draft\]](#)).

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:

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

4. ForCES MIB Overview

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):

- o Version number of the ForCES protocol running in this association (forcesAssociationRunningProtocolVersion).
- o Time when the association entered the UP state (forcesAssociationTimeUp).
- o 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.
- o Number of ForCES Heartbeat messages sent from the CE (forcesAssociationHBMsgSent) and received by the CE (forcesAssociationHBMsgReceived) since the association entered the UP state.
- o 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:

- o 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.
- o 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, Counter32  
    FROM SNMPv2-SMI
```

```
    TEXTUAL-CONVENTION, TimeStamp  
    FROM SNMPv2-TC
```

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

```
forcesMib MODULE-IDENTITY
```

```
    LAST-UPDATED "200703011200Z" -- Mar 1, 2007  
    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
```

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            Email: dro@zurich.ibm.com
```

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            David Putzolu
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            Email: David.Putzolu@intel.com
```

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        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 Society (2007). 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 "200703011200Z" -- Mar 01, 2007
```

```
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 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

Only associations that are UP are reflected in this MIB module. 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.

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

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:

- o Objects in the forcesMibGroup are protocol versions. They are neither sensitive nor vulnerable.
- o 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:

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

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-04](#). They are changes suggested by the MIB doctor review, according to the MIB Review Checklist in [Appendix A of RFC 4181](#):

- o Changed MIB descriptions with "since the association entered the UP state" instead of "since the association is up".
- o Updated the I-D boilerplate copyright statement.
- o Removed last sentence of abstract.
- o Moved the MIB boilerplate into a section of its own.
- o Moved the MIB definition into a section of its own.
- o Updated the Security Considerations section according to the boilerplate at <http://www.ops.ietf.org/mib-security.html>.
- o Updated the MIB description with the copyright statement.
- o Added DISPLAY-HINT to the ForCESProtocolVersion. Note that the smilint tool doesn't like it.
- o Added IETF to the MODULE-IDENTITY ORGANIZATION.
- o Updated CONTACT-INFO to indicate how to reach the group.
- o Changed forcesAssociationTimeDown MAX-ACCESS to accessible-for-notify.
- o Added text to DESCRIPTION of forcesAssociationTimeUp to indicate that it allows to uniquely identify associations with the same FE and CE IDs.
- o 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:

- o Added MIB boilerplate according to <http://www.ops.ietf.org/mib-boilerplate.html>
- o Clarified terminology with respect to MIB module and MIB managed objects.
- o Added RFC Editor note to indicate RFC number for version 1 of ForCES protocol under ForcesProtocolVersion.

- o Renumbered elements in forcesAssociationEntry starting with 1.
- o Changed ForcesProtocolVersion from INTEGER to Integer32.
- o Added forcesLatestProtocolVersionSupported into the mandatory forcesMibGroups conformance group.
- o Explicitely added the forcesStatsGroup to the forcesMibCompliance compliance statement as optional.
- o Moved the MIB Definition section to the front.
- o Rephrased IANA Considerations section according to [RFC 4181 Section 3.5.2](#).
- o 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:

- o Changed forcesAssociationCEID and forcesAssociationFEID from read-only to not-accessible to conform with [Section 7.7 in \[RFC2578\]](#).
- o Removed forcesAssociationCEID and forcesAssociationFEID from the notifications. This information is conveyed in the OID anyway.
- o Added MIB conformance information.

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

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

[11. References](#)

11.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, [RFC 2578](#), April 1999.
- [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, [RFC 2579](#), April 1999.
- [RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, [RFC 2580](#), April 1999.
- [RFC3654] Khosravi, H. and T. Anderson, "Requirements for Separation of IP Control and Forwarding", [RFC 3654](#), November 2003.
- [RFC3746] Yang, L., Dantu, R., Anderson, T., and R. Gopal, "Forwarding and Control Element Separation (ForCES) Framework", [RFC 3746](#), April 2004.
- [forces-protocol-draft] Doria, A., Haas, R., Hadi Salim, J., Khosravi, H., and W. Wang, "ForCES Protocol Specification", ID Document: [draft-ietf-forces-protocol-08.txt](#), March 2006.

11.2. Informative References

- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", [RFC 3410](#), December 2002.
- [forces-applicability-draft] Crouch, A., Khosravi, H., Handley, M., and A. Doria, "ForCES Applicability Statement", ID Document: [draft-ietf-forces-applicability-04.txt](#), February 2006.

Appendix A. Acknowledgments

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

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