

Forwarding and Control Element  
Separation (forces)  
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July 27, 2006

**ForCES MIB**  
**draft-ietf-forces-mib-04**

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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). The ForCES working group is defining a protocol to allow a Control Element (CE) to control the behavior of a Forwarding Element (FE).

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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. 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](#)]).

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](#)].

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.

## **3. ForCES MIB Definition**

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 is UP.
- o Number of other ForCES messages sent from the CE (forcesAssociationOtherMsgSent) and received by the CE (forcesAssociationOtherMsgReceived) since the association is UP. 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.
- o Whenever an association leaves the UP state, a notification (forcesAssociationEntryDown) is issued containing 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

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```
FROM SNMPv2-CONF;
```

```
forcesMib MODULE-IDENTITY
```

```
    LAST-UPDATED "200607261200Z" -- Jul 26, 2006
```

```
    ORGANIZATION "Forwarding and Control Element Separation  
                  (ForCES) Working Group"
```

```
    CONTACT-INFO
```

```
        "Robert Haas (rha@zurich.ibm.com), IBM"
```

```
    DESCRIPTION
```

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

```
    REVISION "200607261200Z" -- Jul 26, 2006
```

```
    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)
```

```
-- Notifications
```

```
forcesAssociationEntryUp NOTIFICATION-TYPE
```

```
    OBJECTS      {
```

```
        forcesAssociationRunningProtocolVersion
```





```
}
STATUS      current
DESCRIPTION
    "This notification is generated as soon
    as an association enters the UP state."
::= { forcesMibNotifications 1 }
```

```
forcesAssociationEntryDown 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."
::= { forcesMibNotifications 2 }
```

-- 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
```

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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."

::= { forcesAssociationEntry 4 }

## forcesAssociationTimeDown OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

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 it is up.

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 it is up.

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

::= { forcesAssociationEntry 7 }

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## 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 it is up.  
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 it is up.  
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 }



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```
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 }

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 3 }
```

```
END
```



#### **4. 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.

#### **5. 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.

#### **6. Security Considerations**

Some of the readable objects in this MIB module may be considered sensitive or vulnerable in some network environment.

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

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rights to indeed GET or SET (change/create/delete) them.

## 7. 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.

## 8. 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-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.

## **[9. References](#)**

### **[9.1. 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.

## **9.2. 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, Xiaoyi Guo, Joel Halpern, Tom Petch, and Jamal Hadi Salim.



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