

Entity MIB Working Group
Internet Draft
Document: [draft-ietf-entmib-state-02.txt](#)
Category: Standards Track
Expiration Date: June 2004

S. Chisholm
Nortel Networks
D. Perkins
SNMPinfo
December 2003

Entity State MIB

Status of this Memo

This document is an Internet-Draft and is in full conformance with all provisions of [Section 10 of RFC2026](#).

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/1id-abstracts.txt>

The list of Internet-Draft Shadow Directories can be accessed at

<http://www.ietf.org/shadow.html>.

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes extensions to the Entity MIB to provide information about the state of the entity.

Table of Contents

1. The Internet-Standard Management Framework
2. Entity State
 - 2.1. Hierarchical State Management
 - 2.2. Entity Redundancy
3. Relationship to Other MIBs
 - 3.1. Relation to Interfaces MIB
 - 3.2. Relation to Alarm MIB

- 3.3. Relation to Bridge MIB
- 3.4. Relation to Host Resource MIB
- 4. Definitions

- 5. Security Considerations
- 6. Intellectual Property
- 7. Authors' Addresses
- 8. Acknowledgements
- 9. References
- 10. Full Copyright Statement**

1. 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 RFC 3410](#) [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, [RFC 2578](#) [RFC2578], STD 58, [RFC 2579](#) [RFC2579] and STD 58, [RFC 2580](#) [RFC2580].

2. Entity State

The goal in adding state objects to the Entity MIB [[RFC2737](#)] is to define a useful subset of the possible state attributes that could be tracked for a given entity that both fit into the state models such as those used in the Interfaces MIB [[RFC2863](#)] as well as leverage existing well-deployed models. The entStateTable contains state objects that are a subset of the popular ISO/OSI states that are also defined in ITU's X.731 specification [[X.731](#)]. Objects are defined to capture administrative, operational and usage states. In addition there are further state objects defined to provide additional information for these three basic states.

Administrative state indicates permission to use or prohibition against using the entity and is imposed through the management services.

Operational state indicates whether or not the entity is physically installed and working. Note that unlike the ifOperStatus [[RFC2863](#)], this operational state is independent of the administrative state.

Usage state indicates whether or not the entity is in use at a specific instance, and if so, whether or not it currently has spare capacity to serve additional users. In the context of this MIB, the user is equivalent to an entity, so this term is substituted. This state refers to the ability of the entity to service other entities within its containment hierarchy.

Alarm state indicates whether or not there are any alarms active against the entity. In addition to those alarm status defined in X.731 [[X.731](#)], warning and indeterminate status are also defined to provide a more complete mapping to the Alarm MIB [Alarm-MIB].

Standby state indicates whether the entity is currently running as hot standby, cold standby or is currently providing service.

The terms state and status are used interchangeably in this memo.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

[2.1](#) Hierarchical State Management

Physical entities exist within a containment hierarchy. This raises some interesting issues not addressed in existing work on state management [[X.731](#)].

There are two types of state for an entity:

- 1) The state of the entity independent of the states of its parents and children in its containment hierarchy. This is often referred to as raw state.
- 2) The state of the entity, as it may be influenced by the state of its parents and children. This is often referred to as computed state.

All state objects in this memo are raw state.

[2.2](#) Entity Redundancy

While this memo is not attempting to address the entire problem space around redundancy, the entStateStandby object provides an important piece of state information for entities, which helps identify which pieces of redundant equipment are currently providing service, and which are waiting in either hot or cold standby mode.

[3](#) Relation to other MIBs

[3.1](#) Relationship to the Interfaces MIB

The Interfaces MIB [[RFC2863](#)] defines the ifAdminStatus object, which has states of up, down and testing and the ifOperStatus object, which has states of up, down, testing, unknown, dormant, notPresent and lowerLayerDown.

An ifAdminStatus of 'up' is equivalent to setting the entStateAdmin object to 'unlocked'. An ifAdminStatus of 'down' is equivalent to setting the entStateAdmin object to either 'locked' or 'shuttingDown', depending on a systems interpretation of 'down'.

An ifOperStatus of 'up' is equivalent to an entStateOper value of 'enabled'. An ifOperStatus of 'down' due to operational failure is equivalent to an entStateOper value of 'disabled'. An ifOperStatus

of 'down' due to being administratively disabled is equivalent to an entStateAdmin value of 'locked' and an entStateOper value of either 'enabled' or 'disabled' depending on whether there are any known issues that would prevent the entity from becoming operational when its entStateAdmin is set to 'unlocked'. An ifOperStatus of 'unknown' is equivalent to an entStateOper value of 'notSupported'. The ifOperStatus values of 'testing' and 'dormant' are not explicitly supported by this MIB, but the state objects will be able to reflect other aspects of the entities administrative and operational state. The ifOperStatus values of 'notPresent' and 'lowerLayerDown' are in some ways computed states and so are therefore not supported in this MIB. They can though be computed by examining the states of entities within this objects containment hierarchy and other available related states.

3.2 Relation to Alarm MIB

The entStateAlarm object indicates whether or not there are any active alarms against this entity. If there are active alarms, then the alarmActiveTable in the Alarm MIB [Alarm MIB] should be searched for alarmActiveResourceId that match this entPhysicalIndex.

3.3 Relation to Bridge MIB

For entities of physical type of 'port' that support the dot1dStpPortEnable object in the Bridge MIB [[RFC1493](#)], a value of 'enabled' is equivalent to setting the entStateAdmin object to 'unlocked'. Setting dot1dStpPortEnable to 'disabled' is equivalent to setting the entStateAdmin object to 'locked'.

3.4 Relation to the Host Resources MIB

The hrDeviceStatus object in the Host Resources MIB [[RFC2790](#)] provides an operational state for devices. For entities that logically correspond to the concept of a device, a value of 'unknown' for hrDeviceStatus corresponds to an entStateOper value of 'notSupported'. A value of 'running' corresponds to an entStateOper value of 'enabled'. A value of 'warning' also corresponds to an entStateOper value of 'enabled', but with appropriate bits set in the entStateAlarm object to indicate the alarms corresponding to the unusual error condition detected. A value of 'testing' or 'down' is equivalent to an entStateOper value of 'disabled'.

4. Definitions

ENTITY-STATE-MIB DEFINITIONS ::= BEGIN

IMPORTS

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

```
TEXTUAL-CONVENTION, DateAndTime
    FROM SNMPv2-TC
MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
    FROM SNMPv2-CONF
entPhysicalIndex
    FROM ENTITY-MIB;

entityStateMIB MODULE-IDENTITY
    LAST-UPDATED "200312180000Z"
    ORGANIZATION "IETF Entity MIB Working Group"
    CONTACT-INFO
        " General Discussion: entmib@ietf.org
        To Subscribe:
            http://www.ietf.org/mailman/listinfo/entmib

            http://www.ietf.org/html.charters/entmib-charter.html

        Sharon Chisholm
        Nortel Networks
        PO Box 3511 Station C
        Ottawa, Ont. K1Y 4H7
        Canada
        schishol@nortelnetworks.com

        David T. Perkins
        548 Qualbrook Ct
        San Jose, CA 95110
        USA
        Phone: 408 394-8702
        dperkins@snmpinfo.com
        "
DESCRIPTION
    "This MIB defines a state extension to the Entity MIB.

    Copyright (C) The Internet Society 2003. 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    "200312180000Z"
DESCRIPTION
    "Initial version, published as RFC YYYY."
    -- RFC-Editor assigns yyyy
::= { mib-2 XX } -- to be assigned by IANA

-- Textual conventions
```

AdminState ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION

" Represents the various possible administrative states.

A value of 'locked' means the resource is administratively prohibited from use. A value of 'shuttingDown' means that usage is administratively limited to current instances of use. A value of 'unlocked' means the resource is not administratively prohibited from use."

REFERENCE

"ITU Recommendation X.731, 'Information Technology - Open Systems Interconnection - System Management: State Management Function', 1992"

SYNTAX INTEGER
 {
 notSupported(1),
 locked(2),
 shuttingDown(3),
 unlocked(4)
 }

OperState ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

" Represents the possible values of operational states.

A value of 'disabled' means the resource is totally inoperable. A value of 'enabled' means the resource is partially or fully operable."

REFERENCE

"ITU Recommendation X.731, 'Information Technology - Open Systems Interconnection - System Management: State Management Function', 1992"

SYNTAX INTEGER
 {
 notSupported (1),
 disabled(2),
 enabled(3)
 }

UsageState ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

" Represents the possible values of usage states.

A value of 'idle' means the resource is servicing no users. A value of 'active' means the resource is currently in use and it has sufficient spare capacity to provide for additional users. A value of 'busy' means the resource is currently in use, but it currently has no spare capacity to provide for

additional users."

REFERENCE

"ITU Recommendation X.731, 'Information Technology - Open
Systems Interconnection - System Management: State

```
Management Function', 1992"
SYNTAX      INTEGER
{
    notSupported (1),
    idle(2),
    active(3),
    busy(4)
}
```

AlarmStatus ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"Represents the possible values of alarm status.

When no bits of this attribute are set, then none of the status conditions described below are present. When the value of under repair is set, the resource is currently being repaired.

When the value of 'critical' is set, one or more critical alarms are active against the resource. When the value of 'major' is set, one or more major alarms are active against the resource. When the value of 'minor' is set, one or more minor alarms are active against the resource. When the value of 'warning' is set, one or more warning alarms are active against the resource. When the value of 'indeterminate' is set, one or more alarms of indeterminate severity are active against the resource.

When the value of 'alarmOutstanding' is set, one or more alarms is active against the resource. The fault may or may not be disabling. "

REFERENCE

"ITU Recommendation X.731, 'Information Technology - Open Systems Interconnection - System Management: State Management Function', 1992"

```
SYNTAX      BITS
{
    notSupported (0),
    underRepair(1),
    critical(2),
    major(3),
    minor(4),
    alarmOutstanding(5),
    -- The following are not defined in X.733
    warning (6),
    indeterminate (7)
}
```

}

StandbyStatus ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

" Represents the possible values of standby status.

A value of 'hotStandby' means the resource is not providing service, but is will be immediately able to take over the role of the resource to be backed-up, without the need for initialization activity, and will contain the same information as the resource to be backed up. A value of 'coldStandby' means that the resource is to back-up another resource, but will not be immediately able to take over the role of a resource to be backed up, and will require some initialization activity. A value of 'providingService' means the resource is providing service."

REFERENCE

"ITU Recommendation X.731, 'Information Technology - Open Systems Interconnection - System Management: State Management Function', 1992"

SYNTAX INTEGER

```
{
  notSupported (1),
  hotStandby(2),
  coldStandby(3),
  providingService(4)
}
```

-- Entity State Objects

entStateObjects OBJECT IDENTIFIER ::= { entityStateMIB 1 }

entStateTable OBJECT-TYPE

SYNTAX SEQUENCE OF EntStateEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A table of information about state/status of entities.

This is a sparse augment of the entPhysicalTable.

"

::= { entStateObjects 1 }

entStateEntry OBJECT-TYPE

SYNTAX EntStateEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "State information about this entity."

INDEX { entPhysicalIndex }

```
::= { entStateTable 1 }
```

```
EntStateEntry ::= SEQUENCE {  
    entStateLastChanged DateAndTime,
```

```
    entStateAdmin      AdminState,
    entStateOper       OperState,
    entStateUsage      UsageState,
    entStateAlarm      AlarmStatus,
    entStateStandby     StandbyStatus
}
```

entStateLastChanged OBJECT-TYPE

```
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION "The value of this object is the date and
            time when state/status of the entity
            last changed, or zero."
 ::= { entStateEntry 1 }
```

entStateAdmin OBJECT-TYPE

```
SYNTAX      AdminState
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "The administrative state for this entity. A value
    of 'notSupported' means that this entity is unable
    to report administrative state. This object can not
    be administratively set to 'notSupported'. For
    entities that do not support administrative state,
    changing the value of this object to something other
    than 'notSupported' is not permitted. A value of
    'inconsistentValue' will be returned in either case.

    Some physical entities exhibit only a subset of the
    remaining administrative state values. Some entities
    cannot be locked, and hence this object exhibits only
    the 'unlocked' state. Other entities can not be shutdown
    gracefully, and hence this object does not exhibit the
    'shuttingDown' state. A value of 'inconsistentValue'
    will be returned if attempts are made to set this
    object to values not supported by its administrative
    model."
 ::= { entStateEntry 2 }
```

entStateOper OBJECT-TYPE

```
SYNTAX      OperState
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The operational state for this entity. A value
    of 'notSupported' means that this entity is unable
```

to report operational state.

Note that unlike the state model used within the
Interfaces MIB [[RFC2863](#)], this object does not follow

the administrative state. An administrative state of down does not predict an operational state of disabled.

A value of 'disabled' means that an entity is totally inoperable and unable to provide service both to entities within its containment hierarchy, as defined by having a value of entPhysicalContainedIn that refers to this entity, or to other receivers of its service as defined in ways outside the scope of this MIB.

A value of 'enabled' means that an entity is fully or partially operable and able to provide service both to entities within its containment hierarchy, as defined by having a value of entPhysicalContainedIn that refers to this entity, or to other receivers of its service as defined in ways outside the scope of this MIB."

::= { entStateEntry 3 }

entStateUsage OBJECT-TYPE

SYNTAX UsageState

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The usage state for this entity. A value of 'notSupported' means that this entity is unable to report usage state.

Note that in the context of a physical entity, this object refers to an entity's ability to service more physical entities in a containment hierarchy. A value of 'idle' means this entity is able to contain other entities but that no other entity is currently contained within this entity, as would have been demonstrated by a value of entPhysicalContainedIn that referenced this entity.

A value of 'active' means that at least one entity is contained within this entity and therefore has a value of entPhysicalContainedIn that references this entity, but that it could handle more. A value of 'busy' means that the entity is unable to handle any additional entities being contained in it, as demonstrated by having a value of entPhysicalContainedIn that refers to this entity.

Some entities will exhibit only a subset of the

usage state values. Entities that are unable to ever service any entities within a containment hierarchy will always have a usage state of 'busy'. Some entities will only ever be able to support one entity within its

containment hierarchy and will therefore only exhibit values of 'idle' and 'busy'."

```
::= { entStateEntry 4 }
```

entStateAlarm OBJECT-TYPE

SYNTAX AlarmStatus

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The alarm status for this entity. It does not include the alarms raised on child components within its containment hierarchy, as defined by a value of entPhysicalContainedIn that references this entity.

A value of 'notSupported' means that this entity is unable to report alarm state. Note that this differs from 'indeterminate' which means that that alarm state is supported and there are alarms against this entity, but the severity of some of the alarms is not known.

If no bits are set, then this entity supports reporting of alarms, but there are currently no active alarms against this entity.

"

```
::= { entStateEntry 5 }
```

entStateStandby OBJECT-TYPE

SYNTAX StandbyStatus

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The standby status for this entity. A value of 'notSupported' means that this entity is unable to report standby state.

Some entities will exhibit only a subset of the remaining standby state values. If this entity does not have a standby, this object will always be 'providingService'."

```
::= { entStateEntry 6 }
```

-- Notifications

entStateTraps OBJECT IDENTIFIER ::= { entityStateMIB 2 }

entStateTrapPrefix OBJECT IDENTIFIER ::= { entStateTraps 0 }

entStateOperEnabled NOTIFICATION-TYPE

OBJECTS { entStateAdmin,
entStateAlarm

}
STATUS
DESCRIPTION

current

Chisholm & Perkins

Standards Track

[Page 12]

"An entStateOperEnabled trap signifies that the SNMP entity, acting in an agent role, has detected that the entStateOper object for one of its entities has left the 'disabled' state and transitioned into the 'enabled' state.

The entity this notification refers can be identified by extracting the entPhysicalIndex from one of the variable bindings."

```
::= { entStateTrapPrefix 1 }
```

entStateOperDisabled NOTIFICATION-TYPE

OBJECTS { entStateAdmin,
 entStateAlarm }

STATUS current

DESCRIPTION

"An entStateOperDisabled trap signifies that the SNMP entity, acting in an agent role, has detected that the entStateOper object for one of its entities has left the 'enabled' state and transitioned into the 'disabled' state.

The entity this notification refers can be identified by extracting the entPhysicalIndex from one of the variable bindings."

```
::= { entStateTrapPrefix 2 }
```

-- Conformance and Compliance

entStateConformance OBJECT IDENTIFIER ::= { entityStateMIB 3 }

entStateCompliances OBJECT IDENTIFIER
 ::= { entStateConformance 1 }

entStateCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"The compliance statement for systems supporting the Entity State MIB."

MODULE -- this module

MANDATORY-GROUPS {
 entStateGroup
}

GROUP entStateNotificationsGroup

DESCRIPTION

"This group is optional."

OBJECT entStateAdmin

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

```
 ::= { entStateCompliances 1 }

entStateGroups OBJECT IDENTIFIER ::= { entStateConformance 2 }

entStateGroup OBJECT-GROUP
  OBJECTS {
    entStateLastChanged,
    entStateAdmin,
    entStateOper,
    entStateUsage,
    entStateAlarm,
    entStateStandby
  }
  STATUS      current
  DESCRIPTION
    "Standard Entity State group."
  ::= { entStateGroups 1}

entStateNotificationGroup NOTIFICATION-GROUP
  NOTIFICATIONS {
    entStateOperEnabled,
    entStateOperDisabled
  }
  STATUS      current
  DESCRIPTION
    "Standard Entity State Notification group."
  ::= { entStateGroups 2}

END
```

5. Security Considerations

There is one management object defined in this MIB that has a MAX-ACCESS clause of read-write. The object may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

The following object is defined with a MAX-ACCESS clause of read-write: entStateAdmin.

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 (entities) that have legitimate rights to indeed GET or SET (change/create/delete) them.

Note that setting the entStateAdmin to 'locked' or 'shuttingDown' can cause disruption of services ranging from those running on a port to those on an entire device, depending on the type of entity. Access to this object should be properly protected.

Access to the objects defined in this MIB allows one to figure out what the active and standby resources in a network are. This information can be used to optimize attacks on networks so even read-only access to this MIB should be properly protected.

6. Intellectual Property

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

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

7. Authors' Addresses

Sharon Chisholm
Nortel Networks
PO Box 3511, Station C
Ottawa, Ontario, K1Y 4H7
Canada
Email: schishol@nortelnetworks.com

David T. Perkins
548 Qualbrook Ct
San Jose, CA 95110

USA

Phone: 408 394-8702

Email: dperkins@snmpinfo.com

8. Acknowledgments

This document is a product of the Entity MIB Working Group.

9. References

9.1 Normative

- [ALARM-MIB] Chisholm, S., Romascanu, D., "Alarm MIB",
[draft-ietf-disman-alarm-mib-16.txt](#), November 2003
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC2578] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J.,
Rose, M. and S. Waldbusser, "Structure of Management
Information Version 2 (SMIv2)", STD 58, [RFC 2578](#), April
1999.
- [RFC2579] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J.,
Rose, M. and S. Waldbusser, "Textual Conventions for
SMIv2", STD 58, [RFC 2579](#), April 1999.
- [RFC2580] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J.,
Rose, M. and S. Waldbusser, "Conformance Statements for
SMIv2", STD 58, [RFC 2580](#), April 1999.
- [RFC2737] McCloghrie, K., Bierman, A., "Entity MIB (Version 2)",
December 1999.
- [X.731] ITU Recommendation X.731, "Information Technology - Open
Systems Interconnection - System Management: State
Management Function", 1992

8.2 Informative References

- [RFC1493] Decker, E., Langille, P., Rijsinghani, A., McCloghrie, K.,
"Definitions of Managed Objects for Bridges", [RFC 1493](#),
July 1993
- [RFC2790] Waldbusser, S., Grillo, P., "Host Resources MIB",
[RFC 2790](#), March 2000

[RFC2863] McCloghrie, K., Kastenholz, F., "The Interfaces Group
MIB using SMIV2", [RFC2863](#), June 2000

[RFC3410] Case, J., Mundy, R., Partain, D. and B. Stewart,
"Introduction and Applicability Statements for Internet-
Standard Management Framework", [RFC 3410](#), December 2002.

10. Full Copyright Statement

Copyright (C) The Internet Society (2003). All Rights Reserved.

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

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

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

