Definition of Managed Objects for the Manet Essential Connected Dominating Set (E-CDS) Process
draft-nguyen-manet-ecds-mib-00

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 objects for configuring aspects of the Essential Connected Dominating Set (E-CDS) Process for Mobile Ad-Hoc Networks (MANETs). The ECDS-MIB also reports state information, performance metrics, and notifications. In addition to configuration, the additional state and performance information is useful to operators troubleshooting multicast forwarding problems.

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1. Introduction

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 objects for configuring aspects of a process implementing Essential Connected Dominating Set (E-CDS) [RFC 5614] for Mobile Ad-Hoc Networks (MANETs). E-CDS transforms 2-hop neighborhood topology information for routers to dynamically perform relay self election to form CDS. The ECDS-MIB, an extension to SMF-MIB [draft-ietf-manet-smf-mib-03], reports state information, performance metrics, and notifications. In addition to configuration, this additional state and performance information is useful to operators troubleshooting multicast forwarding problems.

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 [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].

3. Conventions

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.

4. Overview

E-CDS provides method for implementing selection of Multipoint Relay nodes that define an estimate of the Minimum Connected Dominating Set (MCDS) flooding. The MCDS provides an efficient and complete coverage of the nodes comprising the MANET. The packet forwarding rules does not require knowledge of previous hop discovery. Routers that run Simplified Multicast Forwarding (SMF) and have E-CDS enabled can be mixed with routers that run SMF and Classic Flooding (CF) enabled without a problem, even those are not participating in Neighborhood Discovery Protocol (NHDP) [draft-ietf-manet-smf-14]. Another benefit is that packets opportunistically received from non-symmetric neighbors may be forwarded without compromising flooding efficiency or correctness. Furthermore, multicast sources not participating in NHDP may freely inject their traffic and any
neighboring E-CDS relays will properly forward the traffic. The E-CDS based relay set selection algorithm is based upon [RFC5614].

4.1. ECDS-MIB Management Model

As mentioned in Overview section, ECDS-MIB is an extension to SMF-MIB. Meaning, the overall architecture is based on SMF.

```
+---------------+--------------+             |
| Neighborhood  |              |  Relay Set  |
| Discovery     | ------------->|  Selection  |
|               |   neighbor   |  Algorithm  |
|               |     info     |              |
|________________|___________________|
\                        /                  |
\ neighbor\              |/forwarding        |
info* \                 |/ status           |
\ '--> Forwarding      |<--'
| Processing          |
|~~~~~~~~~~~~~~~~~|____________|~~~~~~~~~~~~~~~~~>
| incoming packet,   | forwarded packets|
| interface id*, and |
| previous hop*      |

Figure 1: SMF router Architecture.
```

The Relay Set Selection Algorithm (RSSA) can rely upon topology information gotten from the MANET NHDP, from the specific MANET routing protocol running on the node, or from Layer 2 information passed up to the higher layer protocol processes. As for ECDS, nodes, which select themselves as relays using router identifier and a nodal metric known as "Router Priority" for all one-hop and two-hop neighbors. Differing Router Priority can result in different CDSs for a given network.

4.2. Terms

The following definitions apply throughout this document:

- **Control Objects** - Objects which are initialized to default settings or set through the management interface defined by this MIB.

- **State Objects** - objects are automatically generated values which define the current operating state of the E-CDS process in the
router.

- Performance Objects - objects are automatically generated values which help an administrator or automated tool to assess the performance of the CDS multicast process on the router and the overall multicasting performance within the MANET routing domain.

5. Structure of the MIB Module

This section presents the structure of the ECDS-MIB module. The objects are arranged into the following groups:

5.1. Textual Conventions

The textual conventions defined within the ECDS-MIB are as follows:

- EcdsStatus is defined within the ECDS-MIB. This contains the current operational status of the E-CDS process on an interface.
- EcdsID represents an index that identifies a specific E-CDS operational mode.

5.2. The Configuration Group

The E-CDS device is configured with a set of controls. Some of the prominent configuration controls for the SMF E-CDS device follow:

- E-CDS Operational Mode: indicates router has E-CDS enabled
- Router Identifier: indicates router’s unique identifier in E-CDS neighborhood
- Router Priority: indicates nodal metric value for all one-hop and two-hop neighbors.
- Configuration method that computes Router Priority: indicates what method Router Priority is computed: dynamically configured, management configured, or other.

5.3. The State Group

The state of an ECDS device can be retrieved from the followings:

- E-CDS Operational State - is the node currently in or out of the Relay Set
- Current Router Priority value
5.4. The Performance Group

The E-CDS performance counters consist of per node objects:

- Counter of times the given node changed into or out of E-CDS.
- Counter of times the Router Priority has been changed.

5.5. The Notifications Group

The Notifications Subtree contains the list of notifications supported within the ECDS-MIB and their intended purpose or utility.

6. Relationship to Other MIB Modules

6.1. Relationship to the SNMPv2-MIB

The ‘system’ group in the SNMPv2-MIB [RFC3418] is defined as being mandatory for all systems, and the objects apply to the entity as a whole. The ‘system’ group provides identification of the management entity and certain other system-wide data. The ECDS-MIB does not duplicate those objects.

6.2. Relationship to the SMF-MIB

TBD

6.3. MIB modules required for IMPORTS

The textual conventions imported for use in the SMF-MIB are as follows. The MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE, Counter32, Unsigned32, Integer32 and mib-2 textual conventions are imported from RFC 2578 [RFC2578]. The TEXTUAL-CONVENTION, RowStatus and TruthValue textual conventions are imported from RFC 2579 [RFC2579]. The MODULE-COMPLIANCE, OBJECT-GROUP and NOTIFICATIONGROUP textual conventions are imported from RFC 2580 [RFC2580]. The InterfaceIndexOrZero textual convention is imported from RFC 2863 [RFC2863]. The SnmpAdminString textual convention is imported from RFC 3411 [RFC3411]. The InetAddress, InetAddressType and InetAddressPrefixLength textual conventions are imported from RFC 4001 [RFC4001].

7. Definitions

MANET-ECDS-MIB DEFINITIONS ::= BEGIN
IMPORTS

MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
Counter32, Integer32, TimeTicks, experimental
FROM SNMPv2-SMI -- [RFC2578]

TEXTUAL-CONVENTION, RowStatus, TruthValue
FROM SNMPv2-TC -- [RFC2579]

MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
FROM SNMPv2-CONF -- [RFC2580]

InterfaceIndexOrZero
FROM IF-MIB -- [RFC2863]

SnmpAdminString
FROM SNMP-FRAMEWORK-MIB -- [RFC3411]

InetAddress, InetAddressType, InetAddressPrefixLength
FROM INET-ADDRESS-MIB -- [RFC4001]

;

manetEcdsMIB MODULE-IDENTITY
ORGANIZATION "IETF MANET Working Group"
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DESCRIPTION
"This MIB module contains managed object definitions for the Manet E-CDS process defined in: [RFC5614]

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SYNTAX          EcdsStatus
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
"The configured status of the E-CDS process on this device.
- Enabled(1) means that E-CDS is configured to run on this device.
- Disabled(2) mean that the E-CDS process is configured off.
This object is persistent and when written the entity SHOULD save the change to non-volatile storage."
::= { ecdsConfigurationGroup 1 }

ecdsRouterID OBJECT-TYPE
SYNTAX          InetAddress
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
"The IP address used as the E-CDS router ID.  This can be set by the management station.  If not explicitly set, then the ... MUST be unique within the scope of the operating MANET network regardless of the method used for selecting it.
This object is persistent and when written the entity SHOULD save the change to non-volatile storage."
::= { ecdsConfigurationGroup 2 }

dynamically_configured (1),
management_configured (2),
other (3)

ecdsConfiguredRtrPriMethod OBJECT-TYPE
SYNTAX INTEGER
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
"This object indicates which method Router Priority value is computed."
::= { ecdsConfiguredRtrPriMethod 3 }

ecdsConfiguredRouterPriority OBJECT-TYPE
SYNTAX          Integer32
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
"a nodal metric for all 1-hop and 2-hop neighbors.  Relay routers use tuple of router identifier and router priority to compute self-election of MPR."
::= { ecdsConfigurationGroup 4 }

potential(1),
always(2),
ever(3)
The E-CDS downselects a set of forwarders for multicast forwarding. Sometimes, it is useful to force an agent to be included or excluded from the resulting CDS. This object is a switch to allow for this behavior.

- The value potential(1) allows the selected E-CDS to determine if this agent is included or excluded from the E-CDS.
- The value always(1) forces the selected E-CDS process
- The value never(3) forces not to use E-CDS process

The default setting for this object is 'potential(1)'. Other settings could pose operational risks under certain conditions.

This object is persistent and when written the entity SHOULD save the change to non-volatile storage.

DEFVAL { 1 }

::= { ecdsConfigurationGroup 5 }

-- E-CDS State Group

ecdsStateGroup OBJECT IDENTIFIER ::= { ecdsMIBObjects 2 }

ecdsOperationStatus OBJECT-VALUE
SYNTAX          EcdsStatus
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"The configured status of the E-CDS process on this device.
- Enabled(1) means that E-CDS is configured to run on this device.
- Disabled(2) means that E-CDS is configured to not run on this device.
- Guaranteed(3) means that E-CDS is configured to run on this device."

This object is persistent and when written the entity SHOULD save the change to non-volatile storage.

::= { ecdsStateGroup 1 }

ecdsCurrentRtrPriValue OBJECT-TYPE
SYNTAX          Integer32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current Router Priority value"

:: = { ecdsStateGroup 2 }

ecdsCurrentInEcds OBJECT-TYPE
SYNTAX INTEGER {
true (0),
false (1)}
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS"

:: = { ecdsStateGroup 3 }

ecdsCurrentInEcdsStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 4 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 5 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 6 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 7 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 8 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 9 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 10 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 11 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 12 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 13 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 14 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 15 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 16 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 17 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 18 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 19 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 20 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 21 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 22 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 23 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 24 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"

:: = { ecdsStateGroup 25 }

ecdsCurrentInEcdsOpStatus OBJECT-TYPE
SYNTAX { enabled(1),
disabled(2),
guaranteed(3) }
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
"current in E-CDS configured status"
false (1)

MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object indicates that the current node has E-CDS configured and in E-CDS."

:: { ecdsStateGroup 3 }

--
-- E-CDS Performance Group
--

ecdsPerformanceGroup OBJECT IDENTIFIER ::= { ecdsMIBObjects 3 }

ecdsInEcdsChange OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object indicates how many times the current node is configured to be in E-CDS."

:: { ecdsPerformanceGroup 1 }

ecdsCurrentRtrPriValueChange
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object indicates how many times the Router Priority of the current node has been changed."

:: { ecdsPerformanceGroup 2 }

--
-- E-CDS Notification
--

ecdsMIBNotifObjects OBJECT IDENTIFIER ::= { ecdsMIBNotifications 1 }

--
-- E-CDS Notification Objects
--

ecdsAdminStatusChange NOTIFICATION-TYPE
OBJECTS {
  ecdsRouterID, -- the originator of notification
  ecdsAdminStatus -- the new status of E-CDS process
}

STATUS current
DESCRIPTION
"ecdsAdminStatusChange notification is sent when ecdsAdminStatus is changed."
::= { ecdsMIBNotifObjects 1 }

ecdsConfiguredMemberChange NOTIFICATION-TYPE
OBJECTS {ecdsRouterID,
          ecdsConfiguredMember}
STATUS current
DESCRIPTION
"ecdsConfiguredMemberChange notification is sent when ecdsConfiguredMember is changed."
::= {ecdsMIBNotifObjects 2}

ecdsRtrPriChange NOTIFICATION-TYPE
OBJECTS {ecdsRouterID,
          ecdsConfiguredRouterPriority}
STATUS current
DESCRIPTION
"ecdsIfRtrPriChange notification is sent when ecdsIfRtrPri value is changed."
::= {ecdsMIBNotifObjects 3}

ecdsRtrPriMethodChange NOTIFICATION-TYPE
OBJECTS {ecdsRouterID,
          ecdsConfiguredRtrPriMethod}
STATUS current
DESCRIPTION
"ecdsRtrPriMethodChange notification is sent when ecdsConfiguredRtrPriMethod is changed."
::= {ecdsMIBNotifObjects 3}

-- Compliance Statements
--
ecdsCompliances OBJECT IDENTIFIER ::= { ecdsMIBConformance 1 }
ecdsMIBGroups OBJECT IDENTIFIER ::= { ecdsMIBConformance 2 }

ecdsBasicCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION "The basic implementation requirements for managed network entities that implement the E-CDS process."
MODULE -- this module
MANDATORY-GROUPS {ecdsConfigurationObjectsGroup}
::= { ecdsCompliances 1 }

ecdsFullCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION "The full implementation requirements for managed network entities that implement the E-CDS process."

MODULE -- this module

MANDATORY-GROUPS {
  ecdsConfigurationObjectsGroup,
  ecdsStateObjectsGroup,
  ecdsPerformanceObjectsGroup,
  ecdsNotificationsGroup
}

::= { ecdsCompliances 2 }

ecdsConfigObjectsGroup OBJECT-GROUP

OBJECTS {
  ecdsAdminStatus,
  ecdsRouterID,
  ecdsConfiguredRouterPriority,
  ecdsConfiguredMember,
  ecdsConfiguredRtrPriMethod
}

STATUS current

DESCRIPTION "Set of configuration objects implemented in this module"

::= { ecdsMIBGroups 1 }

ecdsStateObjectsGroup OBJECT-GROUP

OBJECTS {
  ecdsOperationStatus,
  ecdsCurrentRtrPri,
  ecdsCurrentInEcds
}

STATUS current

DESCRIPTION "Set of state objects implemented in this module"

::= { ecdsMIBGroups 2 }

ecdsPerformanceObjectsGroup OBJECT-GROUP

OBJECTS {
  ecdsAdminStatusChange,
  ecdsCurrentRtrPriValueChange
}

STATUS current

DESCRIPTION "Set of performance objects implemented in this module"
::= { ecdsMIBGroups 3 }

ecdsNotificationsGroup OBJECT-GROUP
  OBJECTS {
    ecdsAdminStatusChange,
    ecdsConfiguredMemberChange,
    ecdsRtrPriChange,
    ecdsRtrPriMethodChange
  }
  STATUS current
  DESCRIPTION "set of notification objects implemented in this module"
::= { ecdsMIBGroups 4 }

END

8. Security Considerations
   TBD

9. Contributors
   TTBD

10. Acknowledgements
    TBD

11. References
11.1. Normative References
11.2. Informative References

Appendix A. Change Log

Appendix B. Open Issues
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