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Energy Object Context MIB
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Status of this Memo

Abstract

This document defines a subset of a Management Information Base (MIB) for energy management of devices. The module addresses device identification, context information, and the relationships between reporting devices, remote devices, and monitoring devices.

Conventions used in this document

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

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OPEN ISSUE:

1. Is the UUID always 45 bytes? eoProxyParentUUID has
a current size of " OCTET STRING (SIZE(0..45))".

2. use the UUID as index for a table

- it is a design decision whether to use integer
  indexes (and to think careful about there
  persistency properties), UUIDs in some fixed size

compact binary format (perhaps rendered by DISPLAY-HINTS)

- If the UUID is represented as a URI that conforms to RFC 4122, the correct datatype is DisplayString (i.e., visible ASCII) - non-ASCII octets are impossible in the RFC 4122 encoding.

3. From http://www.ietf.org/proceedings/82/slides/eman-1.pdf

(Do we need eoMeteringChildrenList, eoPoweringChildrenList, eoAggregatingChildrenList, eoProxyingChildrenList?

- Bit vector representation of parent/child relationship

4. Compliance with ENTITY-MIB

5. Reuse of eoethPortIndex, eoethPortGrpIndex indices from PoE MIB and lldpLocPortNum from Lldp MIB

6. Comments on review of draft-ietf-eman-energy-aware-mib-04

1. Introduction

The EMAN standards provide a specification for Energy Management. This document defines a subset of a Management Information Base (MIB) for use with network management protocols for Energy monitoring of network devices and devices attached to the network and possibly extending to devices in the industrial automation setting with a network interface.

The focus of the MIB module specified in this document is on the identification of Energy Objects and reporting the context and relationships of Energy Objects as defined in [EMAN-FMWK]. The module addresses Energy Object Identification, Energy Object Context, and Energy Object Relationships.

1.1. Energy Management Document Overview

This document specifies the ENERGY-OBJECT-CONTEXT-MIB module. This document is based on the Energy Management Framework [EMAN-FMWK] and meets the requirements on identification of Energy Objects and their context and relationships as specified in the Energy Management requirements [EMAN-REQ].

A second MIB module required by the [EMAN-FMWK], the Power and Energy Monitoring MIB [EMAN-MON-MIB], monitors the Energy Objects for Power States, for the Power and Energy consumption. Power State monitoring includes: retrieving Power States, Power State properties, current Power State, Power State transitions, and Power State statistics. In addition, this MIB module provides the Power Quality properties of the Power and Energy, along with optional characteristics.

The applicability statement document [EMAN-AS] provides the list of use cases, and describes the common aspects of between existing Energy standards and the EMAN standard, and shows how the EMAN framework relates to other frameworks.

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 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 MIB modules that are compliant with SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

3. Requirements and Use Cases

Firstly, to illustrate the importance of energy monitoring in networks and secondly to list some of the important areas to be addressed by the energy management Framework, several use cases and network scenarios are presented in the EMAN applicability statement document [EMAN-AS]. In addition, for each scenario, the target devices for energy management, and how those devices

powered and metered are also presented. To address the network scenarios, requirements for power and energy monitoring for networking devices are specified in [EMAN-REQ]. Based on the requirements [EMAN-REQ], the [EMAN-FMWK] presents an solution approach.

Accordingly, the scope of the MIB module in this document is in accordance to the requirements specified in [EMAN-REQ] and [EMAN-FMWK].

4. Terminology

EDITOR'S NOTE:
- All terms are copied over from the version 4 of the [EMAN-TERMINOLOGY] draft. The only difference in definition is the Energy Management Domain, which has been improved, to address one comment from Bill Mielke. Hopefully, this version 4 is the final version.
- "All" terms have been copied. Potentially, some unused terms might have to be removed (example Electrical Equipment". Alternatively, as this document is the first standard track document in the EMAN WG, it may become the reference document for the terminology (instead of cutting/pasting the terminology in all drafts)
- "Reference: herein" has not been copied over from the terminology draft.

Energy Management

Energy Management is a set of functions for measuring, modeling, planning, and optimizing networks to ensure that the network elements and attached devices use energy efficiently and is appropriate for the nature of the application and the cost constraints of the organization.
Reference: Adapted from [ITU-T-M-3400]
Example: A set of computer systems that will poll electrical meters and store the readings
NOTES:

1. Energy management refers to the activities, methods, procedures and tools that pertain to measuring, modeling, planning, controlling and optimizing the use of energy in networked systems [NMF].
2. Energy Management is a management domain which is congruent to any of FCAPS areas of management in the ISO/OSI Network Management Model [TMN]. Energy Management for communication networks and attached devices is a subset or part of an organization's greater Energy Management Policies.

Energy Management System (EnMS)

An Energy Management System is a combination of hardware and software used to administer a network with the primarily purpose being Energy Management.
Reference: Adapted from [1037C]
Example: A single computer system that polls data from devices using SNMP
NOTES:

1. An Energy Management System according to [ISO50001] (ISO-EnMS) is a set of systems or procedures upon which organizations can develop and implement an energy policy, set targets, action plans and take into account legal requirements related to energy use. An EnMS allows organizations to improve energy performance and demonstrate conformity to requirements, standards, and/or legal requirements.
2. Example ISO-EnMS: Company A defines a set of policies and procedures indicating there should exist multiple computerized systems that will poll energy from their meters and pricing / source data from their local utility. Company A specifies that their CFO should collect information and summarize it quarterly to be sent to an accounting firm to produce carbon accounting reporting as required by their local government.
3. For the purposes of EMAN, the definition from [1037C] is the preferred meaning of an Energy Management System (EnMS). The definition from [ISO50001] can be referred to as ISO Energy Management System (ISO-EnMS).

ISO Energy Management System

Energy Management System as defined by [ISO50001]

Energy

That which does work or is capable of doing work. As used by electric utilities, it is generally a reference to electrical energy and is measured in kilo-watt hours (kWh).
Reference: [IEEE100]
NOTES
1. Energy is the capacity of a system to produce external activity or perform work [ISO50001]

Power

The time rate at which energy is emitted, transferred, or received; usually expressed in watts (or in joules per second).
Reference: [IEEE100]

Demand

The average value of power or a related quantity over a specified interval of time. Note: Demand is expressed in kilowatts, kilovolt-amperes, kilovars, or other suitable units.

Reference: [IEEE100]
NOTES:
1. typically kilowatts
2. Energy providers typically bill by Demand measurements as well as for maximum Demand per billing periods. Power values may spike during short-terms by devices, but Demand measurements recognize that maximum Demand does not equal maximum Power during an interval.

Power Quality

Characteristics of the electric current, voltage and frequencies at a given point in an electric power system, evaluated against a set of reference technical parameters. These parameters might, in some cases, relate to the compatibility between electricity supplied in an electric power system and the loads connected to that electric power system.
Reference: [IEC60050]

Electrical Equipment

A general term including materials, fittings, devices, appliances, fixtures, apparatus, machines, etc., used as a part of, or in connection with, an electric installation.
Reference: [IEEE100]

Non-Electrical Equipment (Mechanical Equipment)

A general term including materials, fittings, devices appliances, fixtures, apparatus, machines, etc., used as a part of, or in connection with, non-electrical power installations.
Reference: Adapted from [IEEE100]

Energy Object

An Energy Object (EO) is a piece of equipment that is part of or attached to a communications network that is monitored, controlled, or aids in the management of another device for Energy Management.

Electrical Energy Object

An Electrical Energy Object (EEO) is an Energy Object that is a piece of Electrical Equipment

Non-Electrical Energy Object

A Non-Electrical Energy Object (NEEO) an Energy Object that is a piece of Non-Electrical Equipment.

Energy Monitoring

Energy Monitoring is a part of Energy Management that deals with collecting or reading information from Energy Objects to aid in Energy Management.
NOTES:
1. This could include Energy, Power, Demand, Power Quality, Context and/or Battery information.

Energy Control

Energy Control is a part of Energy Management that deals with directing influence over Energy Objects.

NOTES:
1. Typically in order to optimize or ensure its efficiency.

Energy Device

An Energy Device is an Energy Object that may be monolithic or contain Energy Device Components.

Energy Device Component

An Energy Device Component is an Energy Object contained in an Energy Device, for which the containing Energy Device provides individual energy management functions. Typically, the Energy Device Component is part the Energy Device physical containment tree in the ENTITY-MIB [RFC4133].

Energy Management Domain

An Energy Management Domain is a set of Energy Objects where all objects in the domain are considered one unit of management.

For example, power distribution units and all of the attached Energy Objects are part of the same Energy Management Domain.

For example, all EEO's drawing power from the same distribution panel with the same AC voltage within a building, or all EEO's in a building for which there is one main meter, would comprise an Energy Management Domain.

NOTES:
1. Typically, this set will have as members all EO's that are powered from the same source.

Energy Object Identification

Energy Object Identification is a set of attributes that enable an Energy Object to be: uniquely identified among all Energy Management Domains; linked to other systems; classified as to type, model, and or manufacturer

Energy Object Context

Energy Object Context is a set of attributes that allow an Energy Management System to classify the use of the Energy Object within an organization.
NOTES:
1. The classification could contain the use and/or the ranking of the Energy Object as compared to other Energy Objects in the Energy Management Domain.

Energy Object Relationship

An Energy Objects Relationship is a functional association between one or more Energy Objects

NOTES
1. Relationships can be named and could include Aggregation, Metering, Power Source, Proxy.

Aggregation Relationship

An Energy Object may aggregate the Energy Management information of one or more Energy Objects and is referred to as an Aggregation Relationship.

NOTES:
1. Aggregate values may be obtained by reading values from multiple Energy Objects and producing a single value of more significant meaning such as average, count, maximum, median, minimum, mode and most commonly sum [SQL].

Metering Relationship

An Energy Object may measure the Power or Energy of another Energy Object(s) and is referred to as a Metering Relationship.

Example: a PoE port on a switch measures the Power it provides to the connected Energy Object.

Power Source Relationship

An Energy Object may be the source of or distributor of Power to another Energy Object(s) and is referred to as a Power Source Relationship.

Example: a PDU provides power for a connected host.

Proxy Relationship

An Energy Object that provides Energy Management capabilities on behalf of another Energy Object is referred to a Proxy Relationship.

Example: a protocol gateways device for Building Management Systems (BMS) with subtended devices.

Energy Object Parent

An Energy Object Parent is an Energy Object that participates in an Energy Object Relationships and is considered as providing the capabilities in the relationship.

Energy Object Child

An Energy Object Child is an Energy Object that participates in an Energy Object Relationships and is considered as receiving the capabilities in the relationship.

Power State

A Power State is a condition or mode of a device that broadly characterizes its capabilities, power consumption, and responsiveness to input.

Reference: Adapted from [IEEE1621]

NOTES:

1. A Power State can be seen as a power setting of an Energy Object that influences the power consumption, the available functionality, and the responsiveness of the Energy Object.

2. A Power State can be viewed as one method for Energy Control

Power State Set

A collection of Power States that comprise one named or logical grouping of control is a Power State Set.

Example: The states {on, off, and sleep} as defined in [IEEE1621], or the 16 power states as defined by the [DMTF] can be considered two different Power State Sets.

Nameplate Power

The Nameplate Power is the maximal (nominal) Power that a device can support.

NOTES:

1. This is typically determined via load testing and is specified by the manufacturer as the maximum value required for operating the device. This is

sometimes referred to as the worst-case Power. The actual or average Power may be lower. The Nameplate Power is typically used for provisioning and capacity planning.

5. Architecture Concepts Applied to the MIB Module

This section describes the basic concepts specified in the Energy Management Architecture [EMAN-FMWK], with specific information related to the MIB module specified in this document.

The Energy Object Context MIB module defined in this document defines MIB objects for identification of Energy Objects, and reporting context and relationship of an Energy Object. The managed objects are contained in two tables eoTable and eoProxyTable.

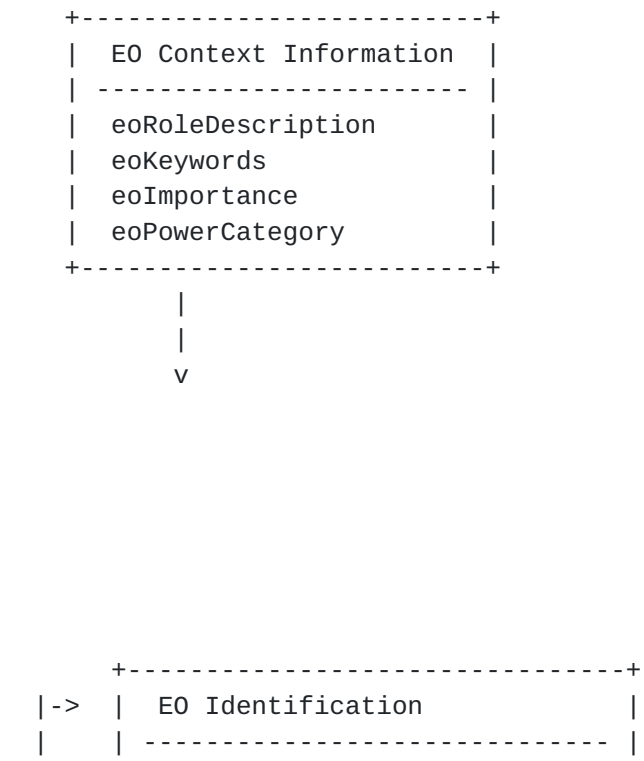
The first table eoTable (OIDs ending with 1-18) focuses on link to the other MIB modules, context of the Energy Object and the relationship of the Energy Object. The second table eoProxyTable describes the proxy capabilities of a Energy Object Parent for a specific local Energy Object Child. The global variable eoTablePeristence deals with the persistence of identity of the Energy Object.

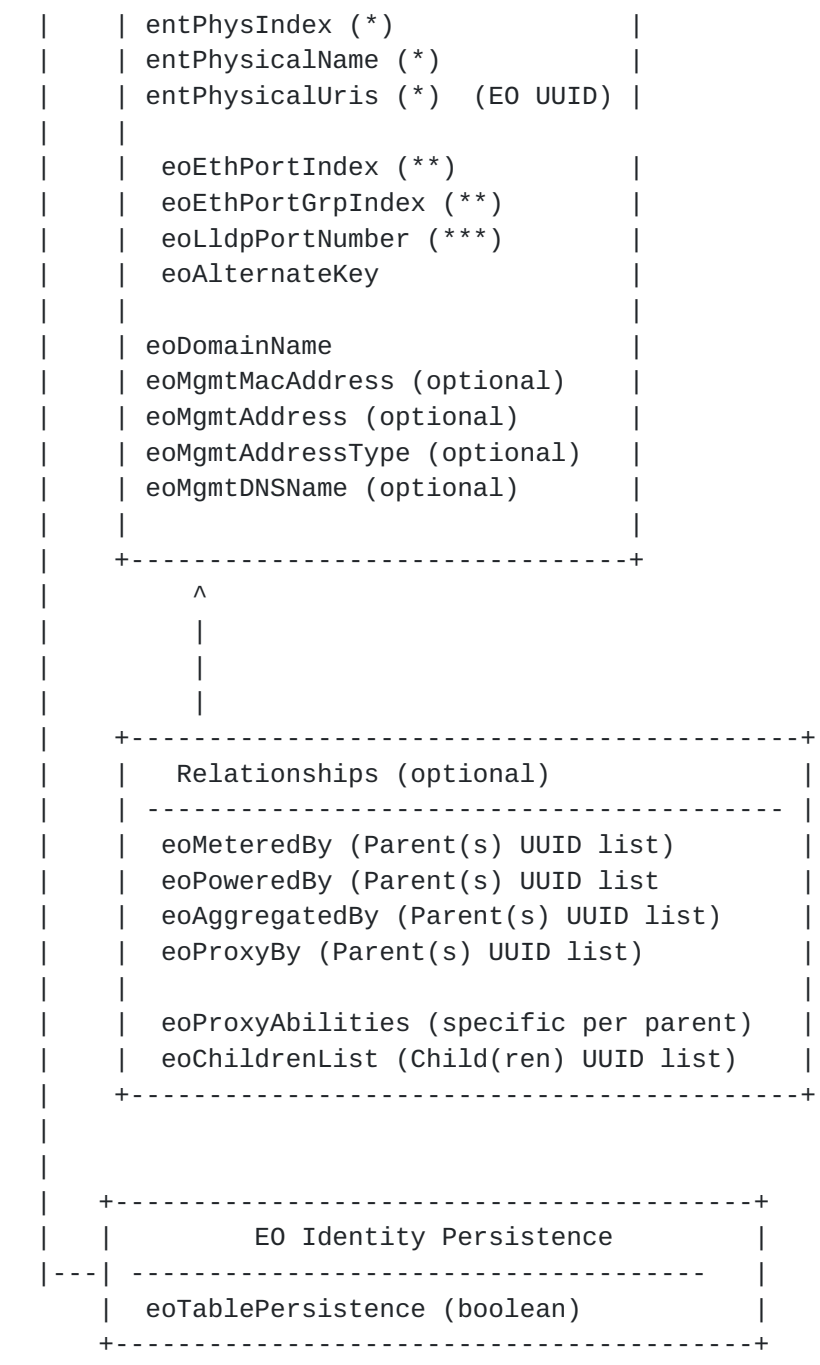
```
+--  rwn TruthValue      eoTablePersistence(1)

+- eoTable(2)
   |
   +- eoEntry(1) [entPhysicalIndex]
   |  |
   |  +-- r-n PethPsePortIndexOrZero       eoEthPortIndex(1)
   |  +-- r-n PethPsePortGroupIndexOrZero  eoEthPortGrpIndex(2)
   |  +-- r-n LldpPortNumberOrZero         eoLldpPortNumber(3)
   |  +-- rwn SnmpAdminString              eoDomainName(4)
   |  +-- rwn SnmpAdminString              eoRoleDescription(5)
   |  +-- rwn MacAddress                   eoMgmtMacAddress(6)
   |  +-- r-n eoMgmtAddressType            eoMgmtAddressType(7)
   |  +-- r-n InetAddress                  eoMgmtAddress(8)
   |  +-- r-n SnmpAdminString              eoMgmtDNSName(9)
   |  +-- rwn SnmpAdminString              eoAlternateKey(10)
   |  +-- rwn EnergyObjectKeywordList      eoKeywords(11)
   |  +-- rwn Integer32                    eoImportance(12)
```

```
      |  +-- r-n INTEGER                    eoPowerCategory(13)
      |  +-- r-n OCTET STRING               eoMeteredBy(14)
      |  +-- r-n OCTET STRING               eoPoweredBy(15)
      |  +-- r-n OCTET STRING               eoAggregatedBy(16)
      |  +-- r-n OCTET STRING               eoAggregatedBy(17)
      |  +-- r-n OCTET STRING               eoChildrenList(18)
      |
   +- eoProxyTable(3)
      |
      +- eoProxyEntry (1)[eoProxyChild, eoProxyParentUUID]
      |  |
      |  +-- --n PhysicalIndex          eoProxyChild(1)
      |  +-- --n OCTET STRING           eoProxyParentUUID(2)
      |  +-- r-n BITS                   eoProxyAbilities(3)
```

The following UML diagram illustrates the relationship of the MIB objects in the eoTable and eoProxyTable that describe the identity, context and relationship an Energy Object.





(*) Compliance From the ENTITY MIB [RFC4133]
(**) Link with the Power over Ethernet MIB [RFC3621]
(***) Link with LLDP MIBs [LLDP-MIB] [LLDP-MED-MIB]

Figure 1: MIB Objects Grouping

As displayed in figure 1, the MIB objects can be classified in different logical grouping of MIB objects.

1) The Energy Object Identification. See Section 5.1 "Energy Object Identification". Devices and their sub-components are characterized by the power-related attributes of a physical entity present in the ENTITY MIB [RFC4133].
2) The Context Information. See Section 5.2 "Energy Object Context"
3) The links to other MIB modules. See Section 5.3 "Links to other Identifiers"
4) The Energy Object Child Relationships specific information. See Section 5.4 "Child: Energy Objects Relationship."
5) The Energy Object Parent Relationships specific information. See Section 5.5 "Parent: Energy Objects Relationship."
6) The Energy Object Identity Persistence. See Section 5.6 "Energy Object Identity Persistence"

5.1 Energy Object Identification

Refer to the "Energy Object Information" section in [EMAN-FMWK] for background information about Energy Objects.

Every Energy Object MUST implement the unique index, entPhysicalIndex, from the ENTITY MIB [RFC4133], which is used as index for the primary Energy Object information in the ENERGY-OBJECT-CONTEXT-MIB module.

Every Energy Object MUST have a printable name assigned to it. Energy Objects MUST implement the entPhysicalName object specified in the ENTITY-MIB, which must contain the Energy Object name.

By the [RFC4133] definition, the entPhysicalUris contains a white space separated list of Uniform Resource Identifier (s)(URIs). For the ENERGY-OBJECT-CONTEXT-MIB compliance, every Energy Object instance MUST implement the entPhysicalUris from the ENTITY MIB [RFC4133]. The entPhysicalUris MUST contain the Energy Object UUID, in a form consistent with [RFC4122]. Note that the entPhysicalUris, from the ENTITY-MIB, is a read-write managed object, and that, as a consequence the UUID could be set by a management system.

As displayed in [RFC4122], the following is an example of the string representation of a UUID as a URN: urn:uuid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6.

Other ENTITY MIB related managed objects, in addition to entPhysicalIndex, entPhysicalName, and entPhysicalUris [RFC4133] MAY be implemented. For example, to understand the relationship between Energy Object Components and Energy Objects, the ENTITY-MIB physical containment tree [RFC4133] MUST be implemented. A second example deals with one of the ENTITY-MIB extensions: if the Energy Object temperature is required, the managed objects from the ENTITY-SENSOR-MIB [RFC3433] should be supported.

When an Energy Object Parent acts as a Power Aggregator or a Power Proxy, the Energy Object Parent and its Energy Object Child/Children MUST be members of the same Energy Management Domain, specified by the eoDomainName MIB Object.

Each Energy Object MUST belong to a single Energy Management Domain or in other words, an Energy Object cannot belong to more than one Energy Management Domain. Refer to the "Energy Management Domain" section in [EMAN-FMWK] for background information. The eoDomainName, which is an element of the eoTable, is a read-write MIB object. The Energy Management Domain should map 1-1 with a metered or sub-metered portion of the network. The Energy Management Domain MUST be configured on the Energy Object Parent. The Energy Object Children MAY inherit the some of the domain parameters (possibly domain name, some of the context information such as role or keywords, importance) from the Energy Object Parent or the Energy Management Domain MAY be configured directly in an Energy Object Child.

5.2 Energy Object Context

Refer to the "Energy Object Context" section in [EMAN-FMWK] for background information.

An Energy Object must provide a value for eoImportance in the range of 1..100 to help differentiate the use or relative value of the device. The importance range is from 1 (least important) to 100 (most important). The default importance value is 1.

An Energy Object can provide a set of eoKeywords. These keywords are a list of tags that can be used for grouping and summary reporting within or between Energy Management Domains.

An Energy Object can be classified based on the physical properties of the Energy Object. That Energy Object can be classified as consuming power or supplying power to other devices or that Energy Object can perform both of those functions and finally, an Energy Object can be a passive meter.

Additionally, an Energy Object can provide an eoRoleDescription string that indicates the purpose the Energy Object serves in the network.

5.3 Links to Other Identifiers

While the entPhysicalIndex is the primary index for all MIB objects in the ENERGY-OBJECT-CONTEXT-MIB module, the Energy Management Systems (EnMS) must be able to make the link with the identifier(s) in other supported MIB modules.

If the Energy Object is a PoE port, and if the Power over Ethernet MIB [RFC3621] is supported by the Energy Object SNMP agent, then the Energy Object eoethPortIndex and eoethPortGrpIndex MUST contain the values of pethPsePortIndex and pethPsePortGroupIndex [RFC3621].

The Energy Object eoLldpPortNumber MUST contain the lldpLocPortNum from the LLDP MIB [LLDP-MIB], if the LLDP-MED MIB is supported on the Energy Object SNMP agent.

The intent behind the links to the other MIB module identifier(s) is to correlate the instances in the different MIB modules. This will allow the ENERGY-OBJECT-CONTEXT-MIB MIB module to reference other MIB modules in cases where the Power over Ethernet and the LLDP MIB modules are supported by the SNMP agent. Some use cases may not implement any of these two MIB modules for the Energy Objects. However, in situation where any of these two MIB modules are implemented, the EnMS must be able to correlate the instances in the different MIB modules.

The eoAlternateKey alternate key object specifies a manufacturer defined string that can be used to identify the Energy Object. Since EnMS may need to correlate objects across management systems, this alternate key is provided to facilitate such a link. This optional value is intended as a foreign key or alternate identifier for a manufacturer or EnMS to use to correlate the unique Energy Object Id in other systems or

namespaces. If an alternate key is not available or is not applicable then the value is the zero-length string.

5.4 Child: Energy Object Relationships

Refer to the "Energy Object Parent and Child" section in [EMAN-FMWK] for background information.

In order to link the Energy Object Child and the Energy Object Parent, multiple objects are introduced in the MIB module. Depending on the Energy Object Relationship type, the following objects are appropriate:

Metering Relationship	->	eoMeteredBy
Power Source Relationship	->	eoPoweredBy
Aggregation Relationship	->	eoAggregatedBy
Proxy Relationship	->	eoProxyBy,
	->	eoProxyAbilities

Each object contains the list of Energy Object Parent UUIDs for the specific Energy Object Relationship type. The UUIDs MUST comply to the RFC 4122 specifications. The object contains URIs and, therefore, the syntax of this object must conform to RFC 3986 [RFC3986], section 2. Multiple URIs may be present and are separated by white space characters. Leading and trailing white space characters are ignored.

For example, if an Energy Object Child is powered by two power sources, eoPoweredBy would contain the two power sources UUIDs, separated by a space: "urn:uuid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6 urn:uuid:abcdec11-7abc-23e1-b876-00a0c91e6bf8".

The eoProxyAbilities object is specific to the Proxy Relationship. This object describes the capabilities of the Energy Object Parent for the Energy Object Child represented by the entPhysicalIndex. The possible capabilities are: report, configuration, and/or wakeonlan. This object only applies to an Energy Object Child.

If the Energy Object is not an Energy Object Child, or if the Energy Object doesn't have an Energy Object Relationship, the

eoMeteredBy, eoPoweredBy, eoAggregatedBy, eoProxyBy, and eoProxyAbilities objects are not instantiated. A zero length octet string MAY also be returned in this case. The eoMeteredBy, eoPoweredBy, eoAggregatedBy, eoProxyBy, and eoProxyAbilities implementations are optional.

The Energy Object Child can indicate that it wants its Energy Object Parent to proxy capabilities such as, energy reporting, power state configurations, non physical wake capabilities (such as Wake-on-LAN)), or any combination of capabilities. These capabilities are indicated in the eoProxyAbilities object. In the case of Energy Object Parent, the eoProxyAbilities MUST be set to "none" (0).

Since the communication between the Energy Object Parent and Energy Object Child may not be via SNMP (as defined in EMAN-FMWK), an Energy Object Child can have additional MIB objects that can be used for easier identification by the EnMS. The optional objects eoMgmtMacAddress, eoMgmtAddressType eoMgmtDNSName can be used to help identify the relationship between the child and other NMS objects. These objects can be used as an alternate key to help link the Energy Object with other keyed information that may be stored within the EnMS(s).

5.5 Parent: Energy Object Relationships

When the Energy Object is an Energy Object Parent, the eoChildrenList object represents the list of Energy Object Child(ren) UUIDs. This UUID list will help in the network discovery of Energy Objects, using the Energy Object Parent as entry points.

eoChildrenList has the same format as the eoMeteredBy, eoPoweredBy, eoAggregatedBy, and eoProxyBy. The UUIDs MUST comply to the RFC 4122 specifications. The UUIDs MUST comply to the RFC 4122 specifications. The eoChildrenList object contains URIs and, therefore, the syntax of this object must conform to RFC 3986 [RFC3986], section 2. Multiple URIs may be present and are separated by white space characters. Leading and trailing white space characters are ignored.

If the Energy Object is not an Energy Object Parent, the eoChildrenList objects is not instantiated. A zero length octet string MAY also be returned in this case.

The eoChildrenList implementation is optional.

5.6 Energy Object Identity Persistence

In some situations, the Energy Object identity information should be persistent even after a device reload. For example, in a static setup where a switch monitors a series of connected PoE phones, there is a clear benefit for the EnMS if the Energy Object Identification and all associated information persist, as it saves a network discovery. However, in other situations, such as a wireless access point monitoring the mobile user PCs, there is not much advantage to persist the Energy Object Information. Therefore, a specific MIB object, the eoTablePersistence, enables and disables the persistence globally for all Energy Objects information in the eoTable and eoProxyTable MIB tables.

6. MIB Definitions

```
-- ************************************************************
--
--
-- This MIB is used for describing the identity and the
-- context information of Energy Objects in network
--
--
-- ************************************************************

ENERGY-OBJECT-CONTEXT-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    mib-2,
    Integer32
        FROM SNMPv2-SMI
    TEXTUAL-CONVENTION, MacAddress, TruthValue
        FROM SNMPv2-TC
    MODULE-COMPLIANCE,
```

```
       OBJECT-GROUP
           FROM SNMPv2-CONF
       SnmpAdminString
           FROM SNMP-FRAMEWORK-MIB
       InetAddressType, InetAddress
          FROM INET-ADDRESS-MIB
       entPhysicalIndex, PhysicalIndex
          FROM ENTITY-MIB;

   energyAwareMIB MODULE-IDENTITY
       LAST-UPDATED    "201203120000Z"
       ORGANIZATION    "IETF EMAN Working Group"
       CONTACT-INFO
          "WG Charter:
           http://datatracker.ietf.org/wg/eman/charter/

          Mailing Lists:
           General Discussion: eman@ietf.org
           To Subscribe: https://www.ietf.org/mailman/listinfo/eman
           Archive: http://www.ietf.org/mail-archive/web/eman

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```

```
       DESCRIPTION
          "This MIB is used for describing the identity and the
          context information of Energy Objects"
       REVISION
           "201203120000Z"
       DESCRIPTION
          "Initial version, published as RFC XXXX."


      ::= { mib-2 xxxxx }

   energyAwareMIBNotifs OBJECT IDENTIFIER
       ::= { energyAwareMIB 0 }

   energyAwareMIBObjects OBJECT IDENTIFIER
       ::= { energyAwareMIB 2 }

   energyAwareMIBConform  OBJECT IDENTIFIER
       ::= { energyAwareMIB 3 }


   -- Textual Conventions


   PethPsePortIndexOrZero ::= TEXTUAL-CONVENTION
   DISPLAY-HINT "d"
      STATUS            current
      DESCRIPTION
          "This textual convention is an extension of the
          pethPsePortIndex convention, which defines a greater than
          zero value used to identify a power Ethernet PSE port.
          This extension permits the additional value of zero.  The
          semantics of the value zero are object-specific and must,
          therefore, be defined as part of the description of any
          object that uses this syntax.  Examples of the usage of
          this extension are situations where none or all physical
          entities need to be referenced."
      SYNTAX Integer32 (0..2147483647)

  PethPsePortGroupIndexOrZero::= TEXTUAL-CONVENTION
   DISPLAY-HINT "d"
      STATUS            current
      DESCRIPTION
```

```
          "This textual convention is an extension of the
          pethPsePortGroupIndex convention from the Power Over
          Ethernet MIB [RFC3621], which defines a greater than zero
          value used to identify group containing the port to which
          a power Ethernet PSE is connected.  This extension
          permits the additional value of zero.  The semantics of
          the value zero are object-specific and must, therefore,
          be defined as part of the description of any object that
          uses this syntax.  Examples of the usage of this
          extension are situations where none or all physical
          entities need to be referenced."
      SYNTAX Integer32 (0..2147483647)

 LldpPortNumberOrZero ::= TEXTUAL-CONVENTION
      DISPLAY-HINT "d"
      STATUS     current
      DESCRIPTION
          "This textual convention is an extension of the
          LldpPortNumber convention specified in the LLDP MIB,
          which defines a greater than zero value used to uniquely
          identify each port contained in the chassis (that is
          known to the LLDP agent) by a port number.  This
          extension permits the additional value of zero. The
          semantics of the value zero are object-specific and must,
          therefore, be defined as part of the description of any
          object that uses this syntax.  Examples of the usage of
          this extension are situations where none or all physical
          entities need to be referenced."
     SYNTAX Integer32(0..4096)

   EnergyObjectList ::= TEXTUAL-CONVENTION
      STATUS          current
      DESCRIPTION
          "A list of Energy Object Universally Unique Identifiers
          (UUIDs).

          The UUIDs must comply to the RFC 4122 specifications.

          The object contains URIs and, therefore, the syntax of
          this object must conform to RFC 3986, section 2.
```

```
        Multiple URIs may be present and are separated by white
        space characters.  Leading and trailing white space
        characters are ignored."
    REFERENCE
        "RFC 3986, Uniform Resource Identifiers (URI): Generic
        Syntax, section 2, August 1998.
        RFC 4122, Uniform Resource Identifier (UUID) URN
        Namespace, July 2005."
     SYNTAX OCTET STRING (SIZE (0..65535))


  EnergyObjectKeywordList ::= TEXTUAL-CONVENTION
      STATUS          current
      DESCRIPTION
          "A list of keywords that can be used to group Energy
          Objects for reporting or searching. If multiple keywords
          are present, then this string will contain all the
          keywords separated by the ',' character. All alphanumeric
          characters and symbols (other than a comma), such as #,
          (, $, !, and &, are allowed. White spaces before and
          after the commas are excluded, as well as within a
          keyword itself.

          For example, if an Energy Object were to be tagged with
          the keyword values 'hospitality' and 'guest', then the
          keyword list will be 'hospitality,guest'."
      SYNTAX OCTET STRING (SIZE (0..2048))


   -- Objects

   eoTablePersistence OBJECT-TYPE
       SYNTAX          TruthValue
       MAX-ACCESS      read-write
       STATUS          current
       DESCRIPTION
          "This object enables/disables persistence for
          all entries in the eoTable and eoProxyTable. A value of
          True enables the persistence, while a value of False
          disables the persistence."
       ::= { energyAwareMIBObjects 1 }


   eoTable OBJECT-TYPE
```

```
        SYNTAX          SEQUENCE OF EoEntry
        MAX-ACCESS      not-accessible
        STATUS          current
        DESCRIPTION
           "This table lists Energy Objects."
        ::= { energyAwareMIBObjects 2 }

    eoEntry OBJECT-TYPE
        SYNTAX          EoEntry
        MAX-ACCESS      not-accessible
        STATUS          current
        DESCRIPTION
           "An entry describes the attributes of an Energy Object.
           Whenever a new Energy Object is added or deleted a row in
           the eoTable is added or deleted."

         INDEX      {entPhysicalIndex  }
        ::= { eoTable 1 }

    EoEntry ::= SEQUENCE {
            eoEthPortIndex              PethPsePortIndexOrZero,
            eoEthPortGrpIndex           PethPsePortGroupIndexOrZero,
            eoLldpPortNumber            LldpPortNumberOrZero,
            eoDomainName                SnmpAdminString,
            eoRoleDescription           SnmpAdminString,
            eoMgmtMacAddress            MacAddress,
            eoMgmtAddressType           InetAddressType,
            eoMgmtAddress               InetAddress,
            eoMgmtDNSName               SnmpAdminString,
            eoAlternateKey              SnmpAdminString,
            eoKeywords                  EnergyObjectKeywordList,
            eoImportance                Integer32,
            eoPowerCategory             INTEGER,
            eoMeteredBy                 EnergyObjectList,
            eoPoweredBy                 EnergyObjectList,

            eoAggregatedBy              EnergyObjectList,
            eoProxyBy                   EnergyObjectList,
            eoChildrenList              EnergyObjectList
    }


    eoEthPortIndex   OBJECT-TYPE
        SYNTAX       PethPsePortIndexOrZero
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
```

```
          "This variable uniquely identifies the power Ethernet
          port to which the attached device is connected [RFC3621].
          If such a power Ethernet port cannot be specified or is
          not known then the object is zero."
       ::= { eoEntry 1 }

   eoEthPortGrpIndex   OBJECT-TYPE
       SYNTAX       PethPsePortGroupIndexOrZero
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
          "This variable uniquely identifies the group containing
          the port to which a power Ethernet PSE is connected
          [RFC3621].  If such a group cannot be specified or is not
          known then the object is zero."
       ::= { eoEntry 2 }

   eoLldpPortNumber   OBJECT-TYPE
       SYNTAX       LldpPortNumberOrZero
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
         "This variable uniquely identifies the port component
         (contained in the local chassis with the LLDP agent) as
         defined by the lldpLocPortNum in the [LLDP-MIB] and
         [LLDP-MED-MIB]. If such a port number cannot be specified
         or is not known then the object is zero."
      ::= { eoEntry 3 }

   eoDomainName OBJECT-TYPE
       SYNTAX          SnmpAdminString
       MAX-ACCESS      read-write
       STATUS          current
       DESCRIPTION
          "This object specifies the name of an Energy Management
          Domain for the Energy Object.  This object specifies a
          zero-length string value if no Energy Management Domain
          name is configured. The value of eoDomainName must remain
          constant at least from one re-initialization of the
          entity's network management system to the next re-
          initialization."

       ::= { eoEntry 4 }

   eoRoleDescription OBJECT-TYPE
       SYNTAX          SnmpAdminString
       MAX-ACCESS      read-write
       STATUS          current
```

```
        DESCRIPTION
           "This object specifies an administratively assigned name
           to indicate the purpose an Energy Object serves in the
           network.

           For example, we can have a phone deployed to a lobby with
           eoRoleDescription as 'Lobby phone'.

           This object specifies the value is the zero-length string
           value if no role description is configured."

        ::= { eoEntry 5 }

    eoMgmtMacAddress OBJECT-TYPE
        SYNTAX          MacAddress
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
           "This object specifies a MAC address of the Energy
           Object. This object typically only applies to Energy
           Object Children. This object can be used as an alternate
           key to help link the Energy Object with other keyed
           information that may be stored within the EnMS(s). The
           eoMgmtMacAddress MIB object SHOULD be implemented for
           Energy Object Children, and MAY be implemented for Energy
           Object Parents."
        ::= { eoEntry 6 }

    eoMgmtAddressType OBJECT-TYPE
        SYNTAX          InetAddressType
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
          "This object specifies the eoMgmtAddress type, i.e. an
          IPv4 address or an IPv6 address. This object MUST be
          implemented when eoMgmtAddress is populated.  The
          eoMgmtAddressType MIB object SHOULD be implemented for
          Energy Object Children, and MAY be implemented for Energy
          Object Parents."
        ::= { eoEntry 7 }

    eoMgmtAddress OBJECT-TYPE
        SYNTAX          InetAddress
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
          "This object specifies the management address as an IPv4
          address or IPv6 address of Energy Object. The IP address
```

```
          type, i.e. IPv4 or IPv6, is determined by the
          eoMgmtAddressType value. This object can be used as an
          alternate key to help link the Energy Object with other
          keyed information that may be stored within the EnMS(s).
          The eoMgmtAddress MIB object SHOULD be implemented for
          Energy Object Children, and MAY be implemented for Energy
          Object Parents."
        ::= { eoEntry 8 }

    eoMgmtDNSName OBJECT-TYPE
        SYNTAX          SnmpAdminString
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
           "This object specifies the DNS name of the eoMgmtAddress.
           This object can be used as an alternate key to help link
           the Energy Object with other keyed information that may
           be stored within the EnMS(s).  The eoMgmtDNSName MIB
           objects SHOULD be implemented for Energy Object Children,
           and MAY be implemented for Energy Object Parents."

        ::= { eoEntry 9 }

    eoAlternateKey OBJECT-TYPE
        SYNTAX          SnmpAdminString
        MAX-ACCESS      read-write
        STATUS          current
        DESCRIPTION
           "This object specifies a manufacturer defined string that
           can be used to identify the Energy Object. Since Energy
           Management Systems (EnMS) and Network Management Systems
           (NMS) may need to correlate objects across management
           systems, this alternate key is provided to provide such a
           link. This optional value is intended as a foreign key or
           alternate identifier for a manufacturer or EnMS/NMS to
           use to correlate the unique Energy Object Id in other
           systems or namespaces. If an alternate key is not
           available or is not applicable then the value is the
           zero-length string."

        ::= { eoEntry 10 }

    eoKeywords OBJECT-TYPE
        SYNTAX          EnergyObjectKeywordList
        MAX-ACCESS      read-write
        STATUS          current
        DESCRIPTION
```

```
            "This object specifies a list of keywords that can be
            used to group Energy Objects for reporting or searching.
            The value is the zero-length string if no keywords have
            been configured. If multiple keywords are present, then
            this string will contain all the keywords separated by
            the ',' character. For example, if an Energy Object were
            to be tagged with the keyword values 'hospitality' and
            'guest', then the keyword list will be
            'hospitality,guest'.

            If write access is implemented and a value is written
            into the instance, the agent must retain the supplied
            value in the eoKeywords instance associated with
            the same physical entity for as long as that entity
            remains instantiated.  This includes instantiations
            across all re-initializations/reboots of the network
            management system."
        ::= { eoEntry 11 }

    eoImportance OBJECT-TYPE
        SYNTAX          Integer32 (1..100)
        MAX-ACCESS      read-write
        STATUS          current
        DESCRIPTION
            "This object specifies a ranking of how important the
            Energy Object is (on a scale of 1 to 100) compared with
            other Energy Objects in the same Energy Management
            Domain. The ranking should provide a business or
            operational context for the Energy Object as compared to
            other similar Energy Objects. This ranking could be used
            as input for policy-based network management.


            Although network managers must establish their own
            ranking, the following is a broad recommendation:

            90 to 100 Emergency response
            80 to 90 Executive or business critical
            70 to 79 General or Average
            60 to  69 Staff or support
            40 to  59 Public or guest
            1  to 39 Decorative or hospitality"
        DEFVAL          { 1 }
        ::= { eoEntry 12 }

    eoPowerCategory OBJECT-TYPE
        SYNTAX          INTEGER {
                            consumer(0),
```

```
                        producer(1),
                        consumer-producer(2),
                        meter(3)
                    }
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
         "This object describes the Energy Object category, which
         indicates the expected behavior or physical property of
         the Energy Object, based on its design. An Energy Object
         can be a consumer(0), producer(1), or consumer-producer
         (2) or meter (3).

         There are devices with a dual mode - consuming energy and
         producing of energy and those are identified as consumer-
         producer.

         In some cases, a meter is required to measure the power
         consumption. In such a case, this meter Energy Object
         category is meter(3). "
      ::= { eoEntry 13 }

  eoMeteredBy OBJECT-TYPE
      SYNTAX      EnergyObjectList
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "When this Energy Object is an Energy Object Child, this
         object represents the list of Energy Object Parent
         Universally Unique Identifiers (UUIDs) for the Metering
         Relationship.

         If this Energy Object is not an Energy Object Child, or
         if the Energy Object doesn't have a Metering
         Relationship, the object is not instantiated.  A zero
         length octet string may also be returned in this case."
       ::= { eoEntry 14 }

  eoPoweredBy OBJECT-TYPE
      SYNTAX      EnergyObjectList
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "When this Energy Object is an Energy Object Child, this
         object represents the list of Energy Object Parent
```

```
         Universally Unique Identifiers (UUIDs) for the Power
         Source Relationship.

         If this Energy Object is not an Energy Object Child, or
         if the Energy Object doesn't have a Power Source
         Relationship, the object is not instantiated.  A zero
         length octet string may also be returned in this case."
       ::= { eoEntry 15 }


  eoAggregatedBy OBJECT-TYPE
      SYNTAX      EnergyObjectList
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "When this Energy Object is an Energy Object Child, this
         object represents the list of Energy Object Parent
         Universally Unique Identifiers (UUIDs) for the
         Aggregation Relationship.

         If this Energy Object is not an Energy Object Child, or
         if the Energy Object doesn't have a Aggregation
         Relationship, the object is not instantiated.  A zero
         length octet string may also be returned in this case."
       ::= { eoEntry  16 }

  eoProxyBy OBJECT-TYPE
      SYNTAX      EnergyObjectList
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "When this Energy Object is an Energy Object Child, this
         object represents the list of Energy Object Parent
         Universally Unique Identifiers (UUIDs) for the Proxy
         Relationship.
         If this Energy Object is not an Energy Object Child, or
         if the Energy Object doesn't have a Proxy Relationship,
         the object is not instantiated.  A zero length octet
         string may also be returned in this case."
       ::= { eoEntry  17 }

   eoChildrenList  OBJECT-TYPE
      SYNTAX      EnergyObjectList
```

```
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "When this Energy Object is an Energy Object Parent, this
         object represents the list of Energy Object Children
         Universally Unique Identifiers (UUIDs).

         If this Energy Object is not an Energy Object Parent, the
         object is not instantiated.  A zero length octet string
         may also be returned in this case."
      ::= { eoEntry  18 }

   eoProxyTable OBJECT-TYPE
       SYNTAX          SEQUENCE OF EoProxyEntry
       MAX-ACCESS      not-accessible
       STATUS          current
       DESCRIPTION
          "This table describes the proxy capabilities of a Energy
          Object Parent for a specific local Energy Object Child. "
       ::= { energyAwareMIBObjects 3 }

   eoProxyEntry OBJECT-TYPE
       SYNTAX          EoProxyEntry
       MAX-ACCESS      not-accessible
       STATUS          current
       DESCRIPTION
          "An entry describes the attributes of an Energy Object.
          Whenever a new Energy Object is added or deleted, a row
          in the eoProxyTable is added or deleted."
       INDEX        { eoProxyChild, eoProxyParentUUID }
       ::= { eoProxyTable 1 }

   EoProxyEntry ::= SEQUENCE {
           eoProxyChild          PhysicalIndex,
           eoProxyParentUUID     OCTET STRING,
           eoProxyAbilities      BITS
   }

   eoProxyChild OBJECT-TYPE
       SYNTAX          PhysicalIndex
       MAX-ACCESS      not-accessible
       STATUS          current
       DESCRIPTION
          "This object contains the entPhysicalIndex of the local
          Energy Object, i.e. the Energy Object Child in the
          context of this table."
```

```
       ::= { eoProxyEntry 1 }

   eoProxyParentUUID OBJECT-TYPE
       SYNTAX          OCTET STRING (SIZE(0..45))
       MAX-ACCESS      not-accessible
       STATUS          current
       DESCRIPTION
          "This object describes the Universally Unique Identifier
          (UUID) of the Energy Object Parent.

          The UUID must comply to the RFC 4122 specifications.

          The object contains an URI and, therefore, the syntax of
          this object must conform to RFC 3986, section 2."
      REFERENCE
          "RFC 3986, Uniform Resource Identifiers (URI): Generic
          Syntax, section 2, August 1998.
          RFC 4122, Uniform Resource Identifier (UUID) URN
          Namespace, July 2005."

       ::= { eoProxyEntry 2 }

   eoProxyAbilities OBJECT-TYPE
       SYNTAX          BITS {
                           none(0),
                           report(1),
                           configuration(2),
                           wakeonlan(3)
                       }
       MAX-ACCESS      read-only
       STATUS          current
       DESCRIPTION
          "This object describes the proxy capabilities of the
          Energy Object Parent (represented by the eoProxyParent in
          this table) for the local Energy Object Child
          (represented by the eoProxyChild in this table). None (0)
          is be used when the Energy Object Parent does not have
          any proxy abilities regarding the Energy Object Child.
          Report(1) indicates that the Energy Object Parent reports
          the usage for the Energy Object Child.
          Configuration(2) indicates that the Energy Object Parent
          can configure the Power Level for the Energy Object
          Child.
          Wakeonlan(3) indicates that the Energy Object Parent can
          wake up the Energy Object Child (the mechanism is
          unspecified)."
```

```
       ::= { eoProxyEntry 3 }


   -- Conformance

   energyAwareMIBCompliances  OBJECT IDENTIFIER
       ::= { energyAwareMIBObjects 4  }

   energyAwareMIBGroups  OBJECT IDENTIFIER
       ::= { energyAwareMIBObjects 5  }


   energyAwareMIBFullCompliance MODULE-COMPLIANCE
       STATUS          current
       DESCRIPTION
           "When this MIB is implemented with support for
           read-create, then such an implementation can
           claim full compliance. Such devices can then
           be both monitored and configured with this MIB.
           The entPhysicalIndex, entPhysicalName, and
           entPhysicalUris [RFC4133] MUST be implemented."

       MODULE          -- this module
       MANDATORY-GROUPS {
                   energyAwareMIBTableGroup
                       }

      GROUP      energyAwareOptionalMIBTableGroup
                DESCRIPTION
                "A compliant implementation does not have to
                implement."

       ::= { energyAwareMIBCompliances 1 }

   energyAwareMIBReadOnlyCompliance MODULE-COMPLIANCE
       STATUS          current
       DESCRIPTION
           "When this MIB is implemented without support for
           read-create (i.e. in read-only mode), then such an
           implementation can claim read-only compliance.  Such a
           device can then be monitored but cannot be configured
           with this MIB. The entPhysicalIndex, entPhysicalName,
           and entPhysicalUris [RFC4133] MUST be implemented."
       MODULE          -- this module
       MANDATORY-GROUPS {
                    energyAwareMIBTableGroup
                       }
```

```
      GROUP energyAwareOptionalMIBTableGroup
         DESCRIPTION
         "A compliant implementation does not have to implement
         the managed objects in this GROUP."

       OBJECT          eoTablePersistence
       MIN-ACCESS      read-only
       DESCRIPTION
           "Write access is not required."

       OBJECT          eoDomainName
       MIN-ACCESS      read-only
       DESCRIPTION
           "Write access is not required."

       OBJECT          eoRoleDescription
       MIN-ACCESS      read-only
       DESCRIPTION
           "Write access is not required."

       OBJECT          eoKeywords
       MIN-ACCESS      read-only
       DESCRIPTION
           "Write access is not required."

       OBJECT          eoImportance
       MIN-ACCESS      read-only
       DESCRIPTION
           "Write access is not required."

   ::= { energyAwareMIBCompliances 2 }

   -- Units of Conformance

   energyAwareMIBTableGroup OBJECT-GROUP
       OBJECTS         {
                           eoTablePersistence,
                           eoEthPortIndex,
                           eoEthPortGrpIndex,
                           eoLldpPortNumber,
                           eoDomainName,
                           eoRoleDescription,
                           eoAlternateKey,
                           eoKeywords,
                           eoImportance,
                           eoPowerCategory
```

```
                        }
        STATUS          current
        DESCRIPTION
            "This group contains the collection of all the objects
            related to the EnergyObject."
        ::= { energyAwareMIBGroups 1 }

    energyAwareOptionalMIBTableGroup OBJECT-GROUP
        OBJECTS         {
                            eoMgmtMacAddress,
                            eoMgmtAddressType,
                            eoMgmtAddress,
                            eoMgmtDNSName,
                            eoMeteredBy,
                            eoPoweredBy,

                            eoAggregatedBy,
                            eoProxyBy,
                            eoProxyAbilities,
                            eoChildrenList,
                            eoProxyAbilities
                        }
        STATUS          current
        DESCRIPTION
            "This group contains the collection of all the objects
            related to the EnergyObject."
        ::= { energyAwareMIBGroups 2 }

    END
```

7. Security Considerations

Some of the readable objects in these MIB modules (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.

There are a number of management objects defined in these MIB modules with a MAX-ACCESS clause of read-write and/or read-create. Such objects 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 are the tables and objects and their sensitivity/vulnerability:

. Unauthorized changes to the eoDomainName, entPhysicalName, eoRoleDescription, eoKeywords, and/or eoImportance MAY disrupt power and energy collection, and therefore any predefined policies defined in the network.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example, by using IPsec), there is still no secure control over who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in these MIB modules.

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 these MIB modules is properly configured to give access to the objects only to those principals (users) that have legitimate rights to GET or SET (change/create/delete) them.

8. 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
energyAwareMIB	{ mib-2 xxx }

Additions to this MIB module are subject to Expert Review [RFC5226], i.e., review by one of a group of experts designated by an IETF Area Director. The group of experts MUST check the requested MIB objects for completeness and accuracy of the description. Requests for MIB objects that duplicate the functionality of existing objects SHOULD be declined. The smallest available OID SHOULD be assigned to a new MIB objects. The specification of new MIB objects SHOULD follow the structure specified in Section 6 and MUST be published using a well-established and persistent publication medium.

9. References

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[SQL] ISO/IEC 9075(1-4,9-11,13,14):2008

10. Acknowledgments

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