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Energy Object Context MIB  
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#### 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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## 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 Characteristics 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

Please refer to [EMAN-FMWK] for the definitions of the following terminology used in this draft.

Device

Component

Energy Management System (EnMS)

ISO Energy Management System

Energy

Power

Demand

Power Characteristics

Electrical Equipment

Non-Electrical Equipment (Mechanical Equipment)

Energy Object

Electrical Energy Object

Non-Electrical Energy Object

Energy Monitoring

Energy Control

Provide Energy

Receive Energy

Power Interface

Power Inlet

Power Outlet

Energy Management Domain

Energy Object Identification

Energy Object Context

Energy Object Relationship

Aggregation Relationship

Power Source Relationship

Energy Object Parent

Energy Object Child

Power State

Power State Set

Nameplate Power

## 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 eoRelationTable.

The first table eoTable focuses on link to the other MIB modules, context of the Energy Object. The second table eoRelationTable specifies the relationships between Energy Objects. This is a simplified representation of relationship between Energy Objects.

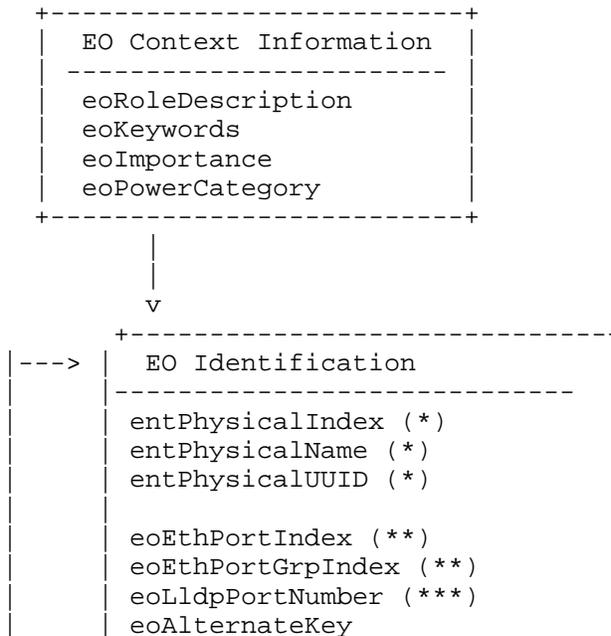
```
+-- eoTable(2)
|
|  +- eoEntry(1) [entPhysicalIndex]
|  |
|  |  +-- r-n PethPsePortIndexOrZero          eoEthPortIndex(1)
|  |  +-- r-n PethPsePortGroupIndexOrZero    eoEthPortGrpIndex(2)
|  |  +-- r-n LldpPortNumberOrZero           eoLldpPortNumber(3)
|  |  +-- rwn MacAddress                      eoMgmtMacAddress(4)
|  |  +-- r-n InetAddressType                eoMgmtAddressType(5)
|  |  +-- r-n InetAddress                    eoMgmtAddress(6)
```

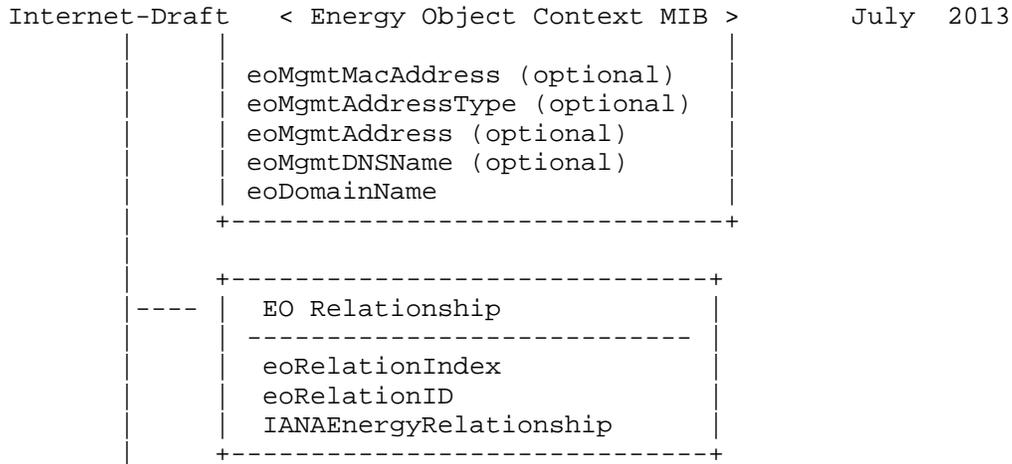
```

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|
|   +-- r-n SnmpAdminString           eoMgmtDNSName(7)
|   +-- rwn SnmpAdminString           eoDomainName(8)
|   +-- rwn SnmpAdminString           eoRoleDescription(9)
|   +-- rwn EnergyObjectKeywordList   eoKeywords(10)
|   +-- rwn Integer32                 eoImportance(11)
|   +-- r-n INTEGER                   eoPowerCategory(12)
|   +-- rwn SnmpAdminString           eoAlternateKey(13)
|
|   +- eoRelationTable(2)
|   |
|   |   +- eoRelationEntry(1) [entPhysicalIndex,
eoRelationIndex]
|   |   |
|   |   |   +-- --n Integer32           eoRelationIndex(1)
|   |   |   +-- --n UUIDorZero         eoRelationID(2)
|   |   |   +-- rwn IANAEnergyRelationship
eoRelationship(3)

```

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





- (\*) Compliance with the ENTITY MIB V4 [RFC6933]
- (\*\*) 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 [RFC6933].
- 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"

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, entPhysicalName and entPhysicalUUID from the ENTITY MIB [RFC6933]. Module Compliance with respect to entity4CRCompliance of ENTITY-MIB should be supported which require a limited number of objects supported (entPhysicalClass, entPhysicalName, entPhysicalUUID). entPhysicalIndex 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 [RFC6933], which must contain the Energy Object name.

For the ENERGY-OBJECT-CONTEXT-MIB compliance, every Energy Object instance MUST implement the entPhysicalUUID from the ENTITY MIB [RFC6933].

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.

For example, to understand the relationship between Energy Object Components and Energy Objects, the ENTITY-MIB physical containment tree [RFC6933] 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 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

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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 the definition and background information. In order to link the Energy Object Child and the Energy Object Parent, a separate table (eoRelationTable) has been introduced in this MIB module. The following relationships between Energy objects have been considered in the eoRelationTable.

Metering Relationship -> meteredBy, metering  
Power Source Relationship -> poweredBy, powering  
Aggregation Relationship -> aggregatedBy, aggregating

Each Energy object can have one or more Energy Object relationships with other Energy Objects. Depending on the direction of the relationship, an Energy Object can be considered as an Energy Object Parent or an Energy Object Child. The relationship between the Energy Objects is specified with an arbitrary index and the UUID of the remote Energy Object. The UUID MUST comply to the RFC 4122 specifications. It is

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important to note that it is possible that an Energy Object may not have an Energy Object relationship with other Energy Objects.

Since the communication between the Energy Object Parent and Energy Object Child may not be SNMP and is left to the choice of the device manufacturer (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). For the optional objects that may not be included in some vendor implementations, the expected behavior when those objects are polled is `noSuchInstance` response.

#### 5.5 Parent: Energy Object Relationships

When the Energy Object is an Energy Object Parent, the relationship table specifies the relationships to every Energy Object children. The explicit relationship between the Energy Object parent and each Energy Object child can be powering, metering and aggregating.

#### 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. The identity information of an Energy Object should be persisted and there is value in the writable MIB objects persisted.

```
-- *****  
--  
--  
-- 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

FROM ENTITY-MIB

UUIDorZero

FROM UUID-TC-MIB

IANAEnergyRelationship

FROM IANA-ENERGY-RELATION-MIB;

energyAwareMIB MODULE-IDENTITY

LAST-UPDATED "201306300000Z"

ORGANIZATION "IETF EMAN Working Group"

CONTACT-INFO

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<http://datatracker.ietf.org/wg/eman/charter/>

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DESCRIPTION

"This MIB is used for describing the identity and the  
context information of Energy Objects"

REVISION

"201306300000Z"

DESCRIPTION

"Initial version, published as RFC XXXX."

::= { mib-2 xxxxxx }

energyAwareMIBNotifs OBJECT IDENTIFIER

::= { energyAwareMIB 0 }

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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)
```

```
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 ignored, 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))
```

```
EnergyRelations ::= TEXTUAL-CONVENTION
    STATUS          current
    DESCRIPTION
        "This object specifies relationship between Energy
        Objects. For example, poweredby relationship indicates,
        Energy Object A is powered by Energy Object B. From the
```

```

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point of view of Energy Object B, it is powering Energy
Object A. "
SYNTAX BITS {
    none (0), --
    poweredby(1), -- power relationship
    powering(2),
    meteredby(3), -- meter relationship
    metering(4),
    aggregatedby(7), -- aggregation relationship
    aggregating(8)
}

```

-- Objects

```

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 an existing
    Energy Object is deleted, a row in the eoTable is added
    or deleted."

INDEX {entPhysicalIndex }
 ::= { eoTable 1 }

```

```

EoEntry ::= SEQUENCE {
    eoEthPortIndex PethPsePortIndexOrZero,
    eoEthPortGrpIndex PethPsePortGroupIndexOrZero,
    eoLldpPortNumber LldpPortNumberOrZero,
    eoMgmtMacAddress MacAddress,
    eoMgmtAddressType InetAddressType,
    eoMgmtAddress InetAddress,
    eoMgmtDNSName SnmpAdminString,
    eoDomainName SnmpAdminString,

```

```
    eoRoleDescription      SnmpAdminString,
    eoKeywords              EnergyObjectKeywordList,
    eoImportance            Integer32,
    eoPowerCategory         INTEGER,
    eoAlternateKey          SnmpAdminString
```

```
  }
```

```
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].
    In addition, PoE MIB should be instantiated on the
    device. 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]. In addition, PoE MIB should be instantiated on
    the device. 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]. In addition, LLDP MIB should be
    instantiated on the device If such a port number cannot
    be specified or is not known then the object is zero."
  ::= { eoEntry 3 }
```

```
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 4 }

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 populated when eoMgmtAddress is populated. The eoMgmtAddressType MIB object SHOULD be implemented for Energy Object Children, and MAY be implemented for Energy Object Parents."

::= { eoEntry 5 }

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 6 }

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 7 }

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 local management system to the next re-initialization."

::= { eoEntry 8 }

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.

The value of eoRoleDescription must remain constant at least from one re-initialization of the entity local management system to the next re-initialization. "

::= { eoEntry 9 }

eoKeywords OBJECT-TYPE

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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 local management agent. "

```
::= { eoEntry 10 }
```

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

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The value of eoImportance must remain constant at least  
from one re-initialization of the entity local  
management system to the next re-initialization. "  
DEFVAL { 1 }  
 ::= { eoEntry 11 }

eoPowerCategory OBJECT-TYPE  
SYNTAX INTEGER {  
 consumer(0),  
 producer(1),  
 consumerproducer(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 consumerproducer  
 (2) or meter (3).  
  
 There are devices with a dual mode - consuming energy and  
 producing of energy and those are identified as  
 consumerproducer.  
  
 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 12 }

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.  
 The value of eoAlternateKey must remain constant at

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least from one re-initialization of the entity local  
management system to the next re-initialization. "  
 ::= { eoEntry 13 }

eoRelationTable OBJECT-TYPE  
SYNTAX SEQUENCE OF EoRelationEntry  
MAX-ACCESS not-accessible  
STATUS current  
DESCRIPTION  
"This table describes the relationships between Energy Objects."  
 ::= { energyAwareMIBObjects 3 }

eoRelationEntry OBJECT-TYPE  
SYNTAX EoRelationEntry  
MAX-ACCESS not-accessible  
STATUS current  
DESCRIPTION  
"An entry in this table describes the relationship between  
Energy objects."  
INDEX { entPhysicalIndex, eoRelationIndex }  
 ::= { eoRelationTable 1 }

EoRelationEntry ::= SEQUENCE {  
 eoRelationIndex Integer32,  
 eoRelationID UUIDorZero,  
 eoRelationship IANAEnergyRelationship  
 }

eoRelationIndex OBJECT-TYPE  
SYNTAX Integer32 (0..2147483647)  
MAX-ACCESS not-accessible  
STATUS current  
DESCRIPTION  
"This object is an arbitrary index to identify the Energy Object  
related to another Energy Object"  
 ::= { eoRelationEntry 1 }

eoRelationID OBJECT-TYPE  
SYNTAX UUIDorZero  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION

"This object specifies the Universally Unique Identifier (UUID)  
of the peer (other) Energy Object. The UUID must comply the

If UUID of the energy object is unknown or non-existent, the eoRelationID will be set to a zero-length string instead."

REFERENCE

"RFC 6933, Entity MIB - version 4, May 2013 "  
::= { eoRelationEntry 2 }

eoRelationship OBJECT-TYPE  
SYNTAX IANAEnergyRelationship  
MAX-ACCESS read-write  
STATUS current

DESCRIPTION

"This object describes the relations between Energy objects. For each Energy object, the relations between the other Energy objects are specified using the bitmap. If the Energy Object is a Parent and has no other relations, none(0) is specified."

::= { eoRelationEntry 3 }

-- Conformance

energyAwareMIBCompliances OBJECT IDENTIFIER  
::= { energyAwareMIBObjects 5 }

energyAwareMIBGroups OBJECT IDENTIFIER  
::= { energyAwareMIBObjects 6 }

energyAwareMIBFullCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"When this MIB is implemented with support for read-write, then such an implementation can claim full compliance. Such devices can then be both monitored and configured with this MIB."

MODULE -- this module

MANDATORY-GROUPS {  
energyAwareMIBTableGroup,  
energyAwareRelationTableGroup  
}

```
GROUP energyAwareOptionalMIBTableGroup
DESCRIPTION
  "A compliant implementation does not have to
  implement. Module Compliance of ENTITY-MIB
  with respect to entity4CRCompliance should
  be supported. "
```

```
::= { energyAwareMIBCompliances 1 }
```

```
energyAwareMIBReadOnlyCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
  "When this MIB is implemented without support for
  read-write (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.
  Module Compliance of ENTITY-MIB with respect to
  entity4CRCompliance should be supported."
MODULE -- this module
```

```
MANDATORY-GROUPS {
  energyAwareMIBTableGroup,
  energyAwareRelationTableGroup
}
```

```
GROUP energyAwareOptionalMIBTableGroup
DESCRIPTION
  "A compliant implementation does not have to implement
  the managed objects in this GROUP.
  Module Compliance of ENTITY-MIB
  with respect to entity4CRCompliance should
  be supported. "
```

```
::= { energyAwareMIBCompliances 2 }
```

-- Units of Conformance

```
energyAwareMIBTableGroup OBJECT-GROUP
OBJECTS {
```

```

        eoDomainName,
        eoRoleDescription,
        eoAlternateKey,
        eoKeywords,
        eoImportance,
        eoPowerCategory
    }
    STATUS current
    DESCRIPTION
        "This group contains the collection of all the objects
        related to the EnergyObject.
        Module Compliance of ENTITY-MIB
        with respect to entity4CRCompliance should
        be supported. "
    ::= { energyAwareMIBGroups 1 }

energyAwareOptionalMIBTableGroup OBJECT-GROUP
    OBJECTS {
        eoEthPortIndex,
        eoEthPortGrpIndex,
        eoLldpPortNumber,
        eoMgmtMacAddress,
        eoMgmtAddressType,
        eoMgmtAddress,
        eoMgmtDNSName
    }
    STATUS current
    DESCRIPTION
        "This group contains the collection of all the objects
        related to the Energy Object."
    ::= { energyAwareMIBGroups 2 }

energyAwareRelationTableGroup OBJECT-GROUP
    OBJECTS {
        -- Note that object eoRelationIndex is not
        -- included since it is not-accessible

        eoRelationID,
        eoRelationship
    }
    STATUS current
    DESCRIPTION
        "This group contains the collection of all objects
        specifying the relationship between Energy Objects."
    ::= { energyAwareMIBGroups 3 }

```

IANA-ENERGY-RELATION-MIB DEFINITIONS ::= BEGIN

IMPORTS

MODULE-IDENTITY, mib-2  
FROM SNMPv2-SMI  
TEXTUAL-CONVENTION  
FROM SNMPv2-TC;

ianaEnergyRelationMIB MODULE-IDENTITY

LAST-UPDATED "201306300000Z" -- June 30, 2013  
ORGANIZATION "IANA"  
CONTACT-INFO "

Internet Assigned Numbers Authority  
Postal: ICANN  
4676 Admiralty Way, Suite 330  
Marina del Rey, CA 90292  
Tel: +1-310-823-9358  
EMail: iana&iana.org"

DESCRIPTION

"This MIB module defines a TEXTUAL-CONVENTION that  
describes the relationships between Energy Objects.

Copyright (C) The IETF Trust (2013).

The initial version of this MIB module was published in  
RFC yyyy; for full legal notices see the RFC itself.  
Supplementary information may be available at  
<http://www.ietf.org/copyrights/ianamib.html>"

REVISION "201306300000Z" -- June 30, 2013

DESCRIPTION "Initial version of this MIB as published in  
RFC yyyy."

::= { mib-2 xxx }

-- RFC Editor, please replace xxx with the IANA allocation  
-- for this MIB module and yyyy with the number of the  
-- approved RFC

IANAEnergyRelationship ::= TEXTUAL-CONVENTION  
STATUS current  
DESCRIPTION

"An enumerated value specifies the type of relationship between Energy Objects.

The enumeration 'poweredBy' is applicable if the Energy Object A is poweredBy Energy Object B.

The enumeration 'powering' is applicable if the Energy Object A is powering Energy Object B.

The enumeration 'meteredBy' is applicable if the Energy Object A is meteredBy Energy Object B.

The enumeration 'metering' is applicable if the Energy Object A is metering Energy Object B.

The enumeration 'aggregatedBy' is applicable if the Energy Object A is aggregatedBy Energy Object B.

The enumeration 'aggregating' is applicable if the Energy Object A is aggregating Energy Object B."

SYNTAX INTEGER {  
poweredBy(1), -- power relationship  
powering(2),  
meteredBy(3), -- meter relationship  
metering(4),  
aggregatedBy(5), -- aggregation relationship  
aggregating(6)  
}

## 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.

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.

This document defines the first version of the IANA-maintained IANA-ENERGY-RELATION-MIB module, which allows new definitions of relationships between Energy Objects.

A Specification Required as defined in RFC 5226 [RFC5226], is REQUIRED for each modification of the energy relationships.

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

Descriptor	OBJECT IDENTIFIER value
-----	-----
ianaEnergyRelationMIB	{ mib-2 xxx }

## 9. Acknowledgement

We would like to thank Juergen Quittek and Juergen Schoenwalder for their suggestions on the new design of eoRelationTable which was a proposed solution for the open issue on the representation of Energy Object children as a UUIDlist.

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