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Energy Object Context MIB

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 energy relationships between devices.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc7461>.

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1. Introduction

The Energy Management (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 [RFC7326]. 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 (ENERGY-OBJECT-CONTEXT-MIB) and IANA Energy Relationship (IANA-ENERGY-RELATION-MIB) modules. The Energy Object Context MIB module specifies MIB objects for identification of Energy Objects, and reporting context and relationship of an Energy Object. The IANA Energy Relationship MIB module specifies the first version of the IANA-maintained definitions of relationships between Energy Objects.

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 [RFC7326], 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 [RFC6988]. Based on the requirements in [RFC6988], [RFC7326] presents a solution approach.

Accordingly, the scope of the MIB modules in this document is in accordance to the requirements specified in [RFC6988] and the concepts from [RFC7326].

This document is based on the Energy Management Framework [RFC7326] and meets the requirements on identification of Energy Objects and their context and relationships as specified in the Energy Management requirements document [RFC6988].

A second MIB module meeting the EMAN requirements [RFC6988] the Monitoring and Control MIB for Power and Energy [RFC7460], 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, describes the common aspects between existing Energy standards and the EMAN standard, and shows how the EMAN framework relates to other frameworks.

1.2. 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 [RFC2119].

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. Terminology

Please refer to [RFC7326] for the definitions of the following terminology used in this document.

- Energy Management
- Energy Management System (EnMS)
- Energy Monitoring
- Energy Control
- electrical equipment
- non-electrical equipment (mechanical equipment)
- device
- component
- power inlet
- power outlet
- energy
- power
- demand
- provide energy
- receive energy
- meter (energy meter)
- battery
- Power Interface
- Nameplate Power
- Power Attributes
- Power Quality
- Power State
- Power State Set

4. Architecture Concepts Applied to the MIB Module

This section describes the basic concepts specified in the Energy Management Framework [RFC7326], with specific information related to the MIB modules specified in this document.

The Energy Object Context (ENERGY-OBJECT-CONTEXT-MIB) MIB module in this document specifies MIB objects for the 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 the link to the other MIB modules, on identification, and on the context of the Energy Object. The second table, eoRelationTable, specifies the relationships between Energy Objects. This is a simplified representation of the relationship between Energy Objects.

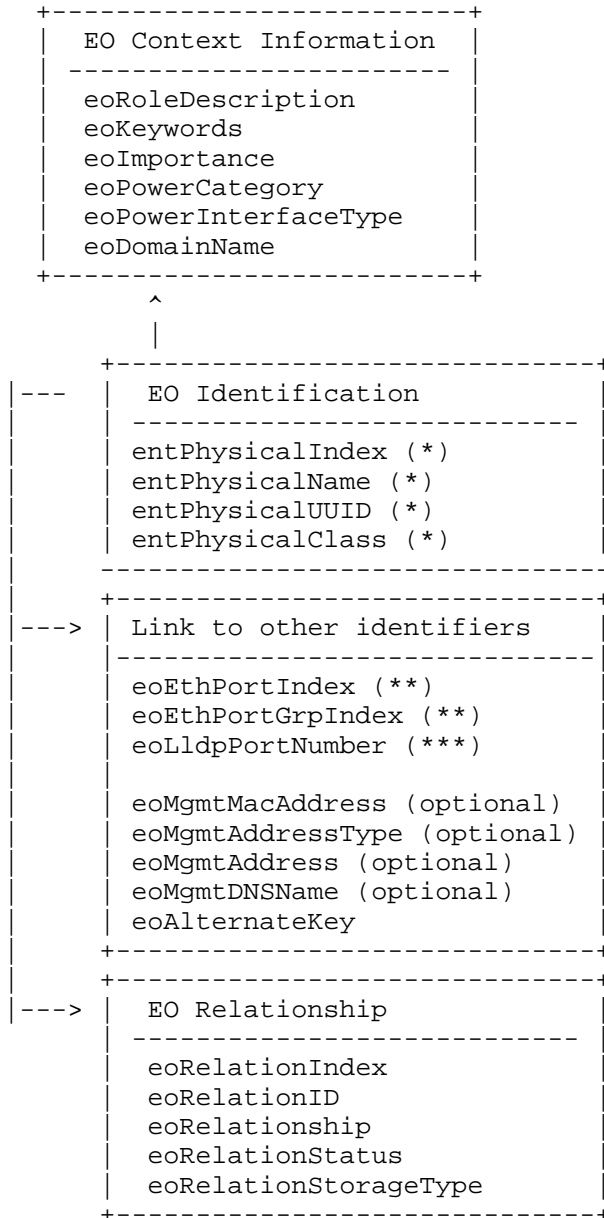
A "smidump-style" tree presentation of the MIB modules contained in the document is presented. The meaning of the three symbols in is a compressed representation of the object's MAX-ACCESS clause, which may have the following values:

```
"not-accessible"->"---"
"accessible-for-notify"->"--n"
"read-only"->"r-n"
"read-write"->"rwn"
```

```
+-- eoTable(1)
   |
   +- 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)
      +-- r-n OCTET STRING                   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)
      +-- r-n INTEGER                        eoPowerInterfaceType(14)
```

```
+-- eoRelationTable(2)
|
+-- eoRelationEntry(1) [entPhysicalIndex, eoRelationIndex]
|
+-- --n Integer32          eoRelationIndex(1)
+-- rwn UUIDorZero        eoRelationID(2)
+-- rwn IANAEnergyRelationship eoRelationship(3)
+-- rwn RowStatus          eoRelationStatus(4)
+-- rwn StorageType        eoRelationStorageType(5)
```

The following Unified Modeling Language (UML) diagram illustrates the relationship of the MIB objects in the eoTable, eoRelationTable, and ENTITY-MIB. The MIB objects describe the identity, context, and relationship of an Energy Object. The UML diagram, furthermore, contains objects from the ENTITY-MIB [RFC6933].



- (*) Compliance with entity4CRCompliance ENTITY-MIB [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 4.1 "Energy Object Context".
- 3) The links to other MIB modules. See Section 4.3 "Links to Other Identifiers".
- 4) The Energy Object Relationships specific information. See Section 4.4 "Energy Object Relationships".
- 5) The Energy Object Identity Persistence. See Section 4.5 "Energy Object Identity Persistence".

4.1. Energy Object Identification

Refer to the "Identification" section in [RFC7326] for background information about Energy Objects.

Every Energy Object MUST implement the unique index, entPhysicalIndex, entPhysicalName, entPhysicalClass, and entPhysicalUUID from the ENTITY-MIB [RFC6933]. Module Compliance with respect to entity4CRCompliance of ENTITY-MIB MUST be supported, which requires a limited number of objects supported (entPhysicalIndex, entPhysicalName, entPhysicalClass, and entPhysicalUUID). entPhysicalIndex is used as index for the Energy Object 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 Universally Unique Identifier (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.

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 "Context: Domain" section in [RFC7326] 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. The Energy Object MAY inherit some of the domain parameters (possibly domain name, some of the context information such as role or keywords, importance) from the Energy Object or the Energy Management Domain MAY be configured directly in an Energy Object.

When an Energy Object acts as a Power Aggregator, the Energy Objects for which Power should be aggregated MUST be members of the same Energy Management Domain, specified by the eoDomainName MIB Object.

4.2. Energy Object Context

Refer to the "Context: Domain" section in [RFC7326] 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 have Power Interfaces and those interfaces can be classified as Power Inlet, Power Outlet, or both.

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.

4.3. 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 Power over Ethernet (PoE) port, and if the Power over Ethernet MIB [RFC3621] is supported by the SNMP agent managing the Energy Object, then the Energy Objects `eoethPortIndex` and `eoethPortGrpIndex` MUST contain the corresponding values of `pethPsePortIndex` and `pethPsePortGroupIndex` [RFC3621].

If the LLDP-MED MIB [LLDP-MIB] is supported by the Energy Object SNMP agent, then the Energy Object `eoLldpPortNumber` MUST contain the corresponding `lldpLocPortNum` from the LLDP MIB.

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 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 either of these two MIB modules for the Energy Objects. However, in situations where either of these two MIB modules are implemented, the EnMS must be able to correlate the instances in the different MIB modules.

The `eoAlternateKey` object specifies an alternate key string that can be used to identify the Energy Object. Since an 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.

An Energy Object can have additional MIB objects that can be used for easier identification by the EnMS. The optional objects `eoMgmtMacAddress`, `eoMgmtAddressType`, and `eoMgmtDNSName` can be used to help identify the relationship between the Energy Objects 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 a response `noSuchInstance`.

4.4. Energy Object Relationships

Refer to the "Relationships" section in [RFC7326] for the definition and background information. In order to link two Energy Objects, a separate table (eoRelationTable) has been introduced in this MIB module.

Each Energy Object can have one or more Energy Object relationships with other Energy Objects. The relationship between Energy Objects is specified in eoRelationTable. The relationship between the Energy Objects is specified with the entPhysicalIndex of the Energy Object and the UUID of the remote Energy Object. The UUID MUST comply to the RFC 4122 specifications. It is important to note that it is possible that an Energy Object may not have an Energy Object relationship with other Energy Objects.

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

Energy Object B has a "meteredBy" relationship with Energy Object A, if the energy consumption of Energy Object B is measured by Energy Object A. Equivalently, it is possible to indicate that Energy Object A has a "metering" relationship with Energy Object B.

Energy Object B has a "poweredBy" relationship with Energy Object A, if the power source of Energy Object B is Energy Object A. Equivalently, it is possible to indicate that Energy Object A has a "powering" relationship with Energy Object B.

Energy Object B has "aggregatedBy" relationship with Energy Object A, if Energy Object A is an aggregation point for energy usage of Energy Object B. Equivalently, it is possible to indicate that Energy Object A has "aggregating" relationship with Energy Object B.

The IANA-ENERGY-RELATION-MIB module in Section 5 below specifies the first version of the IANA-maintained definitions of relationships. This way, for Energy Relationships, new textual conventions can be specified, without updating the primary Energy Object Context MIB module.

4.5. 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.

5. 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                -- RFC 2578
    TEXTUAL-CONVENTION, MacAddress, TruthValue,
        RowStatus, StorageType
        FROM SNMPv2-TC                -- RFC 2579
    MODULE-COMPLIANCE, OBJECT-GROUP
        FROM SNMPv2-CONF              -- RFC 2580
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB       -- RFC 3411
    InetAddressType, InetAddress
        FROM INET-ADDRESS-MIB         -- RFC 4001
    entPhysicalIndex
        FROM ENTITY-MIB                -- RFC 6933
    UUIDorZero
        FROM UUID-TC-MIB               -- RFC 6933
    IANAEnergyRelationship
        FROM IANA-ENERGY-RELATION-MIB;
```

energyObjectContextMIB MODULE-IDENTITY
LAST-UPDATED "201502090000Z"

ORGANIZATION "IETF EMAN Working Group"
CONTACT-INFO

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

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DESCRIPTION

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

REVISION

"201502090000Z"

DESCRIPTION

"Initial version, published as RFC 7461."

::= { mib-2 231 }

energyObjectContextMIBNotifs OBJECT IDENTIFIER

::= { energyObjectContextMIB 0 }

energyObjectContextMIBObjects OBJECT IDENTIFIER

::= { energyObjectContextMIB 1 }

energyObjectContextMIBConform OBJECT IDENTIFIER

::= { energyObjectContextMIB 2 }

-- 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 Power Sourcing Equipment (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 in RFC 3621, which defines a greater-than-zero value used to identify the 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))

-- Objects

eoTable OBJECT-TYPE

SYNTAX SEQUENCE OF EoEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table lists Energy Objects."

```
::= { energyObjectContextMIBObjects 1 }
```

```
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          OCTET STRING,
  eoDomainName           SnmpAdminString,
  eoRoleDescription      SnmpAdminString,
  eoKeywords              EnergyObjectKeywordList,
  eoImportance           Integer32,
  eoPowerCategory        INTEGER,
  eoAlternateKey          SnmpAdminString,
  eoPowerInterfaceType   INTEGER
}
```

```
eoEthPortIndex OBJECT-TYPE
```

```
SYNTAX      PethPsePortIndexOrZero
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
```

```
"This variable uniquely identifies the power Ethernet
port to which a Power over Ethernet device is connected.
If the Power over Ethernet MIB in RFC 3621 is supported by
the SNMP agent managing the Energy Object, then the
Energy Object eoethPortIndex MUST contain the
corresponding value of pethPsePortIndex. If such a power
Ethernet port cannot be specified or is not known, then
the object is zero."
```

```
REFERENCE
```

```
"RFC 3621: Power Ethernet MIB"
```

```
DEFVAL { 0 }
```



```
::= { 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 over Ethernet device PSE is
        connected (RFC 3621).  If the Power over Ethernet MIB (RFC
        3621) is supported by the SNMP agent managing the Energy
        Object, then the Energy Object eoEthPortGrpIndex MUST
        contain the corresponding value of eoethPortGrpIndex.  If
        such a power Ethernet port cannot be specified or is not
        known, then the object is zero."
    REFERENCE
        "RFC 3621: Power Ethernet MIB"
    DEFVAL { 0 }
    ::= { 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 the LLDP-MIB is supported by the
        SNMP agent managing the Energy Object, then the Energy
        Object eoLldpPortNumber MUST contain the corresponding
        value of lldpLocPortNum from the LLDP-MIB.  If such a
        port number cannot be specified or is not known, then the
        object is zero."
    REFERENCE
        "LLDP MIB, IEEE 802.1AB-2005; LLDP-MED-MIB, ANSI/TIA-1057"
    DEFVAL { 0 }

    ::= { eoEntry 3 }
```

```
eoMgmtMacAddress OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This object specifies a Media Access Control (MAC) address
        of the Energy Object."
    ::= { eoEntry 4 }
```

```

eoMgmtAddressType OBJECT-TYPE
    SYNTAX          InetAddressType
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "This object specifies the eoMgmtAddress type, i.e., an
        IPv4 or IPv6 address. This object MUST be
        populated when eoMgmtAddress is populated."
    ::= { 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)."
    ::= { eoEntry 6 }

eoMgmtDNSName OBJECT-TYPE
    SYNTAX          OCTET STRING
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "This object specifies a 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). A DNS Name must always be a
        fully qualified name. This MIB uses the same encoding as
        the DNS protocol."
    REFERENCE
        "RFC 1034: Domain names - concepts and facilities,
        Section 3.1."
    ::= { 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. By default, this object
        should be an empty string. 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 that 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

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 89 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

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

DEFVAL { 1 }
 ::= { eoEntry 11 }

eoPowerCategory OBJECT-TYPE

SYNTAX INTEGER {
 consumer(0),
 producer(1),
 meter(2),
 distributor(3),
 store(4)
 }
 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), meter(2), distributor(3), or store(4).

In some cases, a meter is required to measure the power consumption. In such a case, this meter Energy Object category is meter(2). If a device is distributing

electric Energy, the category of the Energy Object is distributor (3). If a device is storing electric Energy, the category of the device can be store (4)."

```
::= { eoEntry 12 }
```

eoAlternateKey OBJECT-TYPE

SYNTAX SnmpAdminString

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The eoAlternateKey object specifies an alternate key string that can be used to identify the Energy Object. Since Energy Management Systems (EnMS) and Network Management Systems (NMSs) 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 least from one re-initialization of the entity local management system to the next re-initialization."

```
::= { eoEntry 13 }
```

eoPowerInterfaceType OBJECT-TYPE

SYNTAX INTEGER {
inlet(0),
outlet(1),
both(2)
}

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object describes the Power Interface for an Energy Object. A Power Interface is an interface at which an Energy Object is connected to a power transmission medium, at which it can in turn receive power, provide power, or both. A Power Interface type can be an inlet(0), an outlet(1), or both(2), respectively."

```
::= { eoEntry 14 }
```

eoRelationTable OBJECT-TYPE

SYNTAX SEQUENCE OF EoRelationEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table describes the relationships between Energy Objects."

```
::= { energyObjectContextMIBObjects 2 }
```

eoRelationEntry OBJECT-TYPE

SYNTAX EoRelationEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in this table specifies the Energy relationship between Energy objects. Energy relations between two Energy objects are defined in RFC 7326."

REFERENCE

" RFC 7326: Energy Management Framework"

INDEX { entPhysicalIndex, eoRelationIndex }

```
::= { eoRelationTable 1 }
```

EoRelationEntry ::= SEQUENCE {

 eoRelationIndex Integer32,

 eoRelationID UUIDorZero,

 eoRelationship IANAEnergyRelationship,

 eoRelationStatus RowStatus,

 eoRelationStorageType StorageType

}

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-create

STATUS current

DESCRIPTION

"This object specifies the Universally Unique Identifier (UUID) of the peer (other) Energy Object. The UUID must comply with the specifications of UUID in UUID-TC-MIB.

If the UUID of the Energy Object is unknown or nonexistent, the eoRelationID will be set to a zero-length string instead. It is preferable that the value of entPhysicalUUID from ENTITY-MIB is used for values for this object."

REFERENCE

"RFC 6933: Entity MIB (Version 4)"
 ::= { eoRelationEntry 2 }

eoRelationship OBJECT-TYPE
 SYNTAX IANAEnergyRelationship
 MAX-ACCESS read-create
 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."
 ::= { eoRelationEntry 3 }

eoRelationStatus OBJECT-TYPE
 SYNTAX RowStatus
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION
 "The status controls and reflects the creation and
 activation status of a row in this table to specify energy
 relationship between Energy Objects.

An entry status may not be active(1) unless all objects in
 the entry have the appropriate values.

No attempt to modify a row columnar object instance value
 in the eoRelationTable should be issued while the value of
 eoRelationStatus is active(1). The data can be destroyed by
 setting up the eoRelationStatus to destroy(2)."

::= { eoRelationEntry 4 }

eoRelationStorageType OBJECT-TYPE
 SYNTAX StorageType
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION
 "This variable indicates the storage type for this row."
 DEFVAL { nonVolatile }
 ::= { eoRelationEntry 5 }

-- Conformance

energyObjectContextMIBCompliances OBJECT IDENTIFIER
 ::= { energyObjectContextMIBConform 1 }

energyObjectContextMIBGroups OBJECT IDENTIFIER

```
::= { energyObjectContextMIBConform 2 }
```

```
energyObjectContextMIBFullCompliance 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 Compliance of ENTITY-MIB with respect to
entity4CRCompliance MUST be supported."
```

```
MODULE -- this module
```

```
MANDATORY-GROUPS {
    energyObjectContextMIBTableGroup,
    energyObjectRelationTableGroup
}
```

```
GROUP energyObjectOptionalMIBTableGroup
```

```
DESCRIPTION
```

```
"A compliant implementation does not have to
implement."
```

```
::= { energyObjectContextMIBCompliances 1 }
```

```
energyObjectContextMIBReadOnlyCompliance 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 MUST be supported."
```

```
MODULE -- this module
```

```
MANDATORY-GROUPS {
    energyObjectContextMIBTableGroup,
    energyObjectRelationTableGroup
}
```

```
GROUP energyObjectOptionalMIBTableGroup
```

```
DESCRIPTION
```

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

```
::= { energyObjectContextMIBCompliances 2 }
```



```

-- Units of Conformance
energyObjectContextMIBTableGroup OBJECT-GROUP
  OBJECTS
    {
      eoDomainName,
      eoRoleDescription,
      eoAlternateKey,
      eoKeywords,
      eoImportance,
      eoPowerCategory,
      eoPowerInterfaceType
    }
  STATUS current
  DESCRIPTION
    "This group contains the collection of all the objects
    related to the EnergyObject."

 ::= { energyObjectContextMIBGroups 1 }

energyObjectOptionalMIBTableGroup 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."
 ::= { energyObjectContextMIBGroups 2 }

energyObjectRelationTableGroup OBJECT-GROUP
  OBJECTS
    {
      eoRelationID,
      eoRelationship,
      eoRelationStatus,
      eoRelationStorageType
    }
  STATUS current
  DESCRIPTION
    "This group contains the collection of all objects
    specifying the relationship between Energy Objects."
 ::= { energyObjectContextMIBGroups 3 }
END

```

```

IANA-ENERGY-RELATION-MIB DEFINITIONS ::= BEGIN
  IMPORTS
    MODULE-IDENTITY, mib-2
      FROM SNMPv2-SMI
    TEXTUAL-CONVENTION
      FROM SNMPv2-TC;

  ianaEnergyRelationMIB MODULE-IDENTITY
    LAST-UPDATED "201502090000Z" -- February 9, 2015
    ORGANIZATION "IANA"
    CONTACT-INFO "
      Internet Assigned Numbers Authority
      Postal: ICANN
      12025 Waterfront Dr., Suite 300
      Los Angeles, CA 90094
      United States
      Tel: +1-310-301-5800
      EMail: iana@iana.org"

    DESCRIPTION
      "Copyright (c) 2015 IETF Trust and the persons identified as
      authors of the code. All rights reserved.

      Redistribution and use in source and binary forms, with or
      without modification, is permitted pursuant to, and subject
      to the license terms contained in, the Simplified BSD
      License set forth in Section 4.c of the IETF Trust's Legal
      Provisions Relating to IETF Documents
      (http://trustee.ietf.org/license-info).

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

      The initial version of this MIB module was published in
      RFC 7461; for full legal notices see the RFC itself."

    REVISION      "201502090000Z" -- February 9, 2015
    DESCRIPTION   "Initial version of this MIB as published in
      RFC 7461."
    ::= { mib-2 232 }

  -- Textual Conventions

  IANAEnergyRelationship ::= TEXTUAL-CONVENTION
    STATUS          current
    DESCRIPTION     "An enumerated value specifying the type of
      relationship between an Energy Object A, on

```

which the relationship is specified, with the Energy Object B, identified by the UUID.

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

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

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

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

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

The enumeration 'aggregating' is applicable if 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)
            }
```

END

6. Security Considerations

There are a number of management objects defined in this MIB module 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 opens devices to attack. These are the tables and objects and their sensitivity/vulnerability:

Unauthorized changes to the eoDomainName, entPhysicalName, eoRoleDescription, eoKeywords, eoImportance, eoAlternateKey, eoRelationID, eoRelationship, eoRelationStatus, and/or eoRelationStorageType 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 no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

Implementations SHOULD provide the security features described by the SNMPv3 framework (see [RFC3410]), and implementations claiming compliance to the SNMPv3 standard MUST include full support for authentication and privacy via the User-based Security Model (USM) [RFC3414] with the AES cipher algorithm [RFC3826]. Implementations MAY also provide support for the Transport Security Model (TSM) [RFC5591] in combination with a secure transport such as SSH [RFC5592] or TLS/DTLS [RFC6353].

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

In certain situations, energy and power monitoring can reveal sensitive information about individuals' activities and habits. Implementors of this specification should use appropriate privacy protections as discussed in Section 9 of RFC 6988 and monitoring of individuals and homes should only occur with proper authorization.

7. IANA Considerations

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

Descriptor -----	OBJECT IDENTIFIER Value -----
energyObjectContextMIB	{ mib-2 231 }

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 [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-2 232 }

8. References

8.1. Normative References

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