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Energy perspective on applicability
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Abstract

This memo discusses applicability for energy management features to various types of devices and buildings. It describes the variety of applications that can use the EMAN energy framework and associated MIB modules. P otential examples are building networks, home energy gateway, etc. Finally, the document will also discuss relationships of the framework to other architectures and frameworks (such as smartgrid). The applicability statement will explain the relationship between the work in this WG and the other existing standards such as those from the IEC, ANSI, DMTF, and others.

Status of this Memo

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1. Introduction

The EMAN framework describes functionality for reporting of energy information in an Internet Protocol network, as a critical first step towards energy management more generally, including control. Other Internet Drafts describe the requirements, framework, and implementation of this system. This document reviews how it is expected to be used, and how it relates to other activities regarding energy and information technology.

This document is intended to be useful to a wide set of audiences, including those with energy as a primary interest (who do not necessarily have any background in networking) as well as the more usual network-centric audience in the IETF.

The most basic example of energy management is a single device reporting only basic information about its own energy status; we call these "simple devices". The information is reported directly to a Network Management System (NMS). The framework also provides additional features for collecting information from devices intermediate between the NMS and end-use devices. These intermediate devices (which we call "complex devices") may have capabilities for monitoring or control, may serve to collect information from many devices for more efficient data transfer, may process the data (e.g. by summing across many devices), or any combination of these. The same protocol is used whether the NMS is communicating with an intermediate or end use device. The same protocol may be used between an intermediate and end use device.

Some aspects of doing energy management include discovering devices, understanding power distribution, and the network management system (NMS).

This protocol does not define anything about the network management system, but only identifies it as the recipient of information. The NMS will commonly have an entire single building as its scope, though in some cases will cover only a part of a building, or multiple buildings. Usually the NMS will be scoped to match the reach of the local area network it is part of.

All devices are in scope, whether they are traditional IT products like computers or network equipment, or other energy-using devices that are only now beginning to get IP connections, such as appliances, lighting, and climate control systems. (Devices that are only ever powered by batteries, such as sensor nodes, could use this protocol, but are not a target).

2. Terminology

This section reviews select terms used in this draft.

2.1. Building Network

Traditional IT local networks are made up of entities that provide information services. Future Building Networks will not be separate from the IT network, but will incorporate many devices whose primary function is not information, such as those that provide light, regulate temperature or ventilation, and appliances. A building network is IP-based and enables full inter-operation of IT and non-IT devices.

Traditional building control systems were developed before IP networking, often have limited scope in the services they address, and are often based on proprietary technologies.

2.2. Network Management System

TBD.

3. Use Contexts

This section reviews the applications that the framework is intended to be suitable for. These vary according to the nature of devices involved, and the institutional environment. The other documents specify nothing about the network management system (NMS)

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3.1.1. Highly managed

Some network environments are closely monitored for what devices are introduced to it, their characteristics and capabilities, and the functions they provide; many data centers are managed this way. These are more likely to use advanced features of energy management technology, including accounting for multiple power supplies for products, use of power control, and more attention to power distribution. They also are more likely to be concerned with power quality characteristics.

The NMS in these contexts may be integrated with systems for functional control of devices. For a data center, the primary focus is the IT equipment it contains, though the devices that provide power and those that do space conditioning are also likely to be monitored through the NMS. Monitoring data may be obtained frequently to closely track a dynamic usage environment.

3.1.2. Loosely managed

Other environments are not actively managed at all. Devices enter or leave the network on their own terms, and are fundamentally autonomous. Power control is not utilized at all, and the goal of the energy management facility is to simply understand what is going on, not to carefully mange it. Most residential buildings are an example of this type of network, where there is no personnel or procedures for active network management. Power quality and capacity are essentially never a concern.

The NMS in a loosely managed environment should be as automatic as possible, so that the user can get useful information with little or no effort. No functional control is involved. Such environments will have a mixture of devices that can report power information as well as many that cannot. The NMS is principally tracking long-term trends and so information gathering is usually not frequent.

3.1.3. Hybrids

Most network environments have elements of these two extremes, both sets of devices of each sort, as well as devices that are managed in an intermediate form. Commercial buildings are commonly of this form, with some devices being highly managed, and others only loosely tracked.

The NMS for a hybrid must be able to accomodate a diverse set of devices and is likely to track some closely, and others much less so.

3.2. Building types

The EMAN facility is designed to be used in any building type (though the specific needs of industrial buildings have not yet been considered). Core building types are residential, commercial, and vehicle. In the United States, buildings account for just over 70% of electricity use, with this split almost evenly between residential and commercial.

The cases of multi-tenant buildings (residential and commercial) noted below raise the possibility of a device reporting to more than one NMS.

3.2.1. Residential

Residential buildings usually have no existing infrastructure for reporting energy use of devices within them. There are products available that can monitor and track whole-building use, either from added hardware, or by leveraging a communicating meter. However, this gives no visibilty to how much electricity is being consumed by each device. There are expensive systems available for houses that integrate control of many systems (e.g. climate control, lighting, security, entertainment) that can incorporate tracking of usage times and so well approximate energy use, but these are generally proprietary and not IP-based.

Residential buildings that incorporate multiple units are best dealt with as each unit being a separate building for NMS purposes. Privacy and security both preclude sharing much information outside the NMS, except for services that are centrally provided (e.g. hot water or space conditioning). Such buildings also have energy used in common areas and common functions.

3.2.2. Commercial

Commercial buildings vary enormously in scale, with some smaller than a typical house, to entire campuses of multi-story buildings. Smaller buildings share many characteristics with houses in terms of technology and management styles. Larger buildings usually have some sorts of building control systems, though usually there are several systems for individual types of functions, and most are not IP-based. Thus, while some energy information can usually be extracted digitally, it is usually not comprehensive, and often derived from proprietary systems.

Some commercial buildings have the multi-tenant character of some residential buildings, though the degree to which services are the responsibility of the building owner is greater than with residential.

3.2.3. Vehicles

While it may initially seem curious to treat automobiles, airplanes, and boats as types of buildings, for purposes of energy management, it is quite appropriate. They are generally self-contained structures with electricity distribution for a variety of uses (some infrastructure and some occupant oriented). Electricity is typically more expensive in energy and carbon terms than for fixed buildings and may have constrained capacity, so the reason to be concerned with energy management is even greater with vehicles.

3.3. Device types

The EMAN facility is designed to be used for any device type.

3.3.1. Information technology

For many years, the only devices on IP networks were computers and network equipment. To these were added other types of information technology devices, such as printers and storage. Even televisions have a primary purpose of displaying information, and thus the traditional category of entertainment consumer electronics can be logically grouped under information technology. These devices are at the core of EMAN and will see the widest initial use of EMAN reporting.

3.3.2. Non-electronic devices

"Electronics" are devices whose primary function is information so that "non-electronics" is everything else in buildings, such as lighting, appliances, and equipment for space conditioning. This term does not imply that they have no electronic components, but rather that

4. Framework summary

The Framework document [REF] provides a detailed description of the architecture of the EMAN system. This section provides a brief summary of that architecture.

NOTE: This summary is highly informed by . To the extent that there are differences between this summmary and the architecture document, this is a proposal to modify the architecture.

4.1. Power distribution

An aspect of energy reporting that may not be initially apparent is how it can support understanding of power distribution systems. That is, different collections of devices in a building may be in different 'domains' of electricity distribution, with a common fate (e.g. downstream of a circuit breaker), or under the same electricity meter. This is accomplished two ways: via reporting by products which have a power distribution function themselves (e.g. a Power Distribution Unit or an Ethernet switch that supports Power over Ethernet).

5. Discovery

A Network Management System requires some method of collecting a list of the entities on the network that it needs to be cognizant of, both when it initially begins operation, and maintaining this on an ongoing basis as the population of devices evolves. There are three basic methods: protocol, manual, and opportunistic. A NMS can utilize more than one method.

In the protocol approach, the NMS periodically broadcasts a request for any EMAN reporting entity to identify itself to the NMS. For each entity that replies, the NMS queries it for the specific information it has.

In the manual approach, the identity of each device to be managed is provided to the NMS. Usually, additional information will also be provided, such as functional relationships among devices, policies to be employed (e.g. prioritization of the importance of each device), and control strategies (e.g. under what conditions a device should be have its power supply removed or reinstated).

In the opportunistic approach, the NMS observes the network to notice when a new device appears, then queries it for EMAN capabilities.

A NMS may also participate in one or more service discovery protocols to determine when a new device appears, though as none of these protocols are universal, this will always be an incomplete method. A NMS also has to deal with the fact that some devices will eventually disappear from the network and need to be expired from its databases. Also, some devices will be only intermittently on the network, either from being physically absent some of the time, or powered down to a low-power state in which they can't respond to EMAN queries.

6. Related Standards and Activities

This section reviews related standards and other activities that have some relationship to the EMAN protocol.

6.1. Standards that inform measurement

There are many energy test procedures for specific products. These generally are for tests conducted in laboratory conditions in specified configurations to assess energy performance for comparison to other models or criteria levels. However, EMAN measurements are not conducted in a laboratory, not under such specified conditions, and need to be universal across all products, so a "horizontal" test procedure is more relevant. The most widely used of these is IEC

62301 on measurement of standby power. While 62301 was created by a committee with a mandate on household appliances, it has been designed to be universal for any product commonly found in residential or commercial buildings, and is referenced in test procedures for appliances, electronics, and other devices.

6.2. Standards that inform reporting

Energy reporting over networks is a relatively new service. Few devices had the hardware ability to measure power, and few of the rest made an attempt to estimate it. Further, for power state, devices could only report when they were fully on, so never could report themselves when in a low power state. Finally, the ability to remotely apply or remove power from a device has been confined to very specific usage environments.

6.2.1. DMTF

The Distributed Management Task Force (DMTF) has specified communication of power state information.

The DMTF Common Information Model (CIM) includes information about power states.

6.2.2. Ecma SDC

The Ecma International committee on Smart Data Centre (TC38-SDC) is in the process of defining semantics for management of entities in a data center such as servers, network equipment, etc. It covers energy as one of many functional resources or attributes of systems for measurement and/or control. It only defines terms and variables, and does not reference any specific protocol. Its goal is to enable interoperability of such protocols by ensuring a common semantic model across them.

The SDC process is still underway, with a timeframe similar to EMAN. There seems to be no fundamental barrier to the two efforts to harmonize on aspects they have in common. These include identity, power states, power levels, accumulated energy use, and tracking of time.

6.3. Other Standards and Programs

While manufacturers may implement EMAN capabilities in their products, their are other organizations that may also do this. Future standards may reference EMAN as functionality that more comprehensive systems rely on. They may also define extensions to or particular uses of the EMAN facility.

In future, energy standards, both voluntary and mandatory, may reward or require use of EMAN capabilities. For example, the Energy Star program already references other specific network technologies in a variety of its specifications. In fact, the initial framework document for revising the Energy Star Computer specification references the IETF eman activity. The most likely use of EMAN would be simply for a device to be able to report on its own basic status as defined by EMAN, such as identity, power state, power level, and accumulated energy.

6.3.1. Smart Grid

There are many definitions of what constitutes the "Smart Grid". In the most general sense, it is the application of information technology to our electricity system, so that the EMAN framework is an excellent example of that. Alternatively, it can describe using information technology to improve the electricity grid, from the power plant through transmission and distribution systems and ending at the meter. In this case, the EMAN framework has no connection to the Smart Grid. The most common definitions of the Smart Grid acknowledge that what occurs in buildings is different from the utility-managed grid, but specify some communication directly between the grid and end-use devices. The EMAN framework does not anticipate communication with entities outside the building, but rather only with a local NMS. The NMS could communicate with the grid, but that is well outside the EMAN scope and framework. End-use devices can still coordinate with the grid through other protocols, either in one-way communication (receiving demand response or direct price signals from the grid), or in two-way communication with the grid.

7. Security Considerations

The energy management facilities discussed here raise a number of security considerations. While not a part of the current drafts, the ability of one device to control the power state of a second connected device can be a problem if they do not share the same management goal. This can be either the act of powering down a device (e.g. from on to sleep or off), rendering it unable to perform ordinary services it might otherwise accomplish, or powering the device up, and consequently using energy resources not otherwise desired. Beyond control, simple information about the current or historic energy use of a device can indicate details of occupancy of the main person using the device, or of applications running on the device.

The capabilities described in this document do not introduce any new capabilities for security. Rather, any device that implements them must use existing security intrastructure and policies.

8. IANA Considerations

This memo creates several possible actions for IANA. First is a single canonical listing of "identity" of a device, in terms of what it is. Second is possible enumeration of power states, and/or functional states.

9. Acknowledgements

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10. Informative References

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