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NEMA IoT White Paper on Standby Power

The attached white paper from the NEMA Internet Of Things Council is submitted for review and consideration by interested parties. Standby Power is not a drain on the system, to be minimized at costs and with the potential penalty of loss of connectivity and the benefits thereof.

Additional submitted attachment is included below.

A NEMA White Paper IOTP 1-2018

Standby Power of Connected Devices and the Internet of Things

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Purpose

This NEMA white paper explores the conflict between limitations on what is commonly referred to as standby power and the potential services and benefits of connected devices in the Internet of Things (IoT) and Industrial Internet of Things (IIoT). Traditional approaches and definitions of standby power are device-focused and do not address network related services, only device level on/off or settings changes. As such, standby power is treated as a drain or waste on building energy consumption. An excellent example of this negative attitude is the European Union's colloquialism for standby power: vampire power. Narrow-minded or device-focused views on standby power treat it as a loss without considering the myriad benefits it might enable. Responsible regulations for standby power must accurately characterize and address power consumption needs of connected systems devices.

(In this paper the abbreviation IoT refers to both IoT and IIoT.)

I. Introduction

The Internet of Things, Industrial Internet of Things, and proliferation of connected, data-generating devices are providing new insight and yet to be discovered ways to improve the safety, security, and efficiency of today's homes, commercial buildings, and cities. The impact of the long-term operational trends and the relationship between the buildings behavior and people's productivity, for example, is still a developing field of study. This application of new sensor and device innovation and the new insights about the behavior of the entire system, the building, and its occupants, in this case, calls for a tempered and collaborative approach to any regulatory action that could restrict or limit the innovation in these areas. Big data and associated analytics are driving new insights, and increased awareness about our environment and many new and innovative data-driven services are emerging. The purpose of this white paper is to outline the careful, and more holistic approach energy-efficiency governing bodies and regulators should consider before fixing governance over the power consumption or other enabling properties of these newer application areas.

What is the IoT? Today it is being described and marketed by many different industry stakeholders, resulting in myriad definitions in a wide range of contexts, from research publications to marketing material. The following examples of definitions show the diversity in focus:

The Internet of Things is…	*…the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.*
	…the internetworking of physical devices…embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data.
	…an infrastructure of interconnected objects, people, systems and information resources together with intelligent services to allow them to process information of the physical and the virtual world and react.
	…a network that connects uniquely identifiable things to the internet. The things have sensing/actuation and potential programmability capabilities… Information about the thing can be collected and the state of the thing can be changed.

Source: DOE SSL program:
https://energy.gov/eere/ssl/downloads/cls-interoperability-study-part-1-application-programming-interfaces

II. The NEMA Product Perspective on IoT

Some devices perform their primary function for brief periods and then are quiescent for longer periods of time; examples are computers, personal devices, tablets, printers and cell phones. These devices routinely employ standby modes. Importantly, these devices are not operated continuously or 24/7.

Arguably, the occasional impact of a failure to recover or a required reboot of these devices, while frustrating, is not detrimental.

Many IoT devices by design operate continuously. They are integrated with and continually operate and communicate over a network with each other and other components in the environment. Devices for temperature control (thermostats), energy measurement, water management, building management, fire detection and notification, smoke control, emergency communications systems, hospital equipment, and security management operate continuously. Discussion regarding IoT and connected devices and how to regulate their standby power continues to be made without the benefit of reviewing the intended use or function of the IoT device.

An important note about specialized systems:

Fire detection and notification systems, intrusion and security alarms, smoke control, emergency communications systems, nurse call systems, and other critical systems make use of the internet for communicating various conditions associated with life safety to various monitoring locations to generate an appropriate response. These systems are governed by national standards that require system connections which are constantly monitored for integrity and establish latency requirements for message delivery. For monitoring, these systems are always actively communicating in a “powered-on” mode. Interestingly, in the security industry, this is referred to as their “standby” mode. This difference in use of terms should not be overlooked, and these systems should be exempted from general power-saving regulations. Standby mode for security systems, as in this example, should not be confused with standby mode and standby power terminology discussed in this paper.

Similarly to the preceding security monitoring systems, medical devices save and extend lives. Patients rely on image, test, and treatment accuracy and quality to detect diseases at an early stage and to successfully treat them while minimizing adverse impacts. Such devices rely on sufficient energy to provide such functions, and the devices must be able to quickly start up for the tests and treatments these devices provide. This makes stand-by modes critical for their practical operation. The benefit of the tests and treatments provided by medical devices, including the saving of thousands of lives, far outweigh the negative impacts of energy use for these devices.

Nevertheless, the medical device industry is fully committed to energy reduction and conservation in ways that do not adversely impact the ability of medical devices to achieve their core mission. As an example of this commitment, manufacturers of medical imaging products have developed, and are already conforming to, best practices under the widely respected EU Self-regulatory Initiative (SRI) (www.cocir.org/initiatives/ecodesign-initiative.html), which includes energy-efficiency measures applicable to medical device types and communication of energy conservation functions to users. The standby mode for medical imaging devices also should not be confused with standby mode and standby power terminology discussed in this paper.

The above examples of terminology challenges between products and systems illustrate the need for careful review of the definition of standby power. This review could be done by device type or types of services delivered. The review could lead to entirely new terms, definitions, and categories of “standby power” to separate power consumption of connected network functions from stand-alone services offered by many devices and appliances.

III. Integration in Connected Building Systems

Today, connected lighting systems are increasingly widespread across indoor and outdoor environments, from residential to commercial and public spaces. In addition to traditional advanced lighting control, lighting systems are now being used as a platform for a growing portfolio of data-driven applications. These can range from applications yielding increased system-oriented energy savings, to the safety and security of public spaces. As added benefits, these lighting systems not only perform their primary function of providing light, but also incorporate secondary functions like demand response, energy storage, sensing, imaging, and extending data networks.

Building Management Systems (BMS) are a platform for automating the functions of a building for optimized energy consumption and control of basic and essential systems, such as temperature, humidity, security, occupancy, emergency management and other features. These systems also manage renewable energy sources and integrate to demand response systems allowing building owners to take advantage of energy subsidies while managing the complexity of energy sources.

More broadly, in the commercial building sector historically standalone building systems such as building automation, lighting, and security systems are becoming horizontally integrated into one holistic building system providing enhanced services by leveraging each other's capabilities. For example, building management systems can sense temperature levels throughout a building's infrastructure to control HVAC. Connected lighting systems today may have occupancy (passive infrared) sensors integrated into every luminaire (fixture) within a commercial building space. By integrating these two systems, the BMS can leverage occupancy data from each luminaire (typically every 100 sq. ft.) to more optimally control HVAC levels based on highly granular occupancy data representing specific, real-time usage of the building.

In these cases, lighting or building management should no longer be regarded as standalone systems, but should rather be considered as integral parts of a wider building ecosystem. This trend toward improved services and energy savings through building systems integration further underscores the need for standby power to be characterized from a holistic systems perspective. Primary functions, secondary functions, and even tertiary functions within a system need to be well understood and need to be important factors in future methods of measurement and regulation of standby power.

IV. The IoT Opportunity

Smart building, smart industry, smart transportation and smart city systems enable tremendous benefits and create value for society by optimizing the intended functionality or providing measurements over extended periods of time.

New applications and functionality can be unlocked and opened up in areas as diverse as asset and space management, bio-adaptive lighting, environmental monitoring, and incident detection. Particularly relevant to this topic of standby power are the opportunities for embedded IoT devices to drive additional energy conservation.

Additional Energy Savings

NEMA believes that smart building systems, including the associated connected devices, can push energy savings to new levels by not just focusing on the energy efficiency of individual systems or devices but on how energy is consumed within the building performance envelope and building systems. Based on network connectivity, data analysis, optimization tools, algorithms, security (including cyber security) and services building power consumption can be further reduced through a systemic approach. Some examples are illustrated below:

Examples of Connected Building Systems

Connected temperature and air controls and connected lighting enable systems reduction in energy consumption based on occupancy and manage the cooling systems to assure control of biological and airborne contaminants in the building performance envelope.

Occupancy management is used to track or authorize the presence of workers and visitors in different parts of a facility, such as a multi-tenant office building, through a network of occupancy sensors. In the same way, connected air handling systems can reduce peak energy consumption without reducing comfort or operating efficiency.

Lighting and climate control can be automatically turned off in unoccupied spaces, thereby saving considerable energy. The occupancy data collected by the connected sensor network can be used in advanced algorithms for automated space utilization services, leading to a better understanding of occupancy levels, patterns, and usage. With this increased understanding, building managers can make better-informed decisions optimizing their respective application and energy usage.

Connected systems can respond to demand-side management signals from electric utilities to reduce energy consumption when demand exceeds capacity. This makes a significant impact on greenhouse gasses by reducing the need to build and maintain additional power plants to support peak energy demand.

Network Connectivity-Essential for Saving Energy

Network connectivity is an essential enabling function to achieve additional system-oriented energy savings. For example, a networked illuminance sensor can switch off the light in unused space, as well as in the corridor leading to that space, providing additional energy saving. Similarly, a networked occupancy sensor can share occupancy data among multiple systems in operation in commercial facilities such as lighting, HVAC, security access and power plug loads. It is important to note that to realize these opportunities for advanced energy savings, these connected sensor networks, whether wired or wireless, need to be powered continuously.

These innovative connected IoT systems are expected to cover a wide-range of applications. The benefits, features, and functionality of the systems are increasingly enabled by incorporating additional secondary functions like energy storage, sensing, imaging and networking functions. These additional functions will consume some low level of additional energy and cannot be switched off completely without source loss of benefits and performance to the system. Managing systems, air handling, water and waste water, lighting, and building security and management is a full time job requiring continuous uptime and operation. Sensing the building envelope performance is a 24/7 activity. For example, temperature spikes could be a precursor to a fire alarm. Water controls in chilling systems need continuous control to manage biological and other contamination. If these functions, and the value that they deliver, are not accounted for in future standby power regulatory policy, these devices could not be operational when needed, eliminating the collection of sensor data and the availability of their intended network functionality.

Connected Lighting—Example of a Multifunction System

Connected lighting systems host an increasing number of these valuable secondary functions. New methods are needed to characterize the power consumption of the primary and secondary functions of these multifunction systems. This power consumption differentiation can then be used to guide future energy efficiency regulation. Of specific importance will be the need to separate the primary lighting function from the secondary functions in establishing total energy consumption and resulting energy efficiency of the lighting function itself.

As an example, there are connected LED street lights currently on the market that combine the lighting function with a built-in security camera triggered by a motion sensor. Is this a street light or is it part of a security system? In standby mode, the device will wait for motion or another control input. It is also listening to the network for a command. Appropriate power allowances need to be established and included in future standby mode regulatory policies. Today’s methods need updating to prevent stifling future innovation and deployment of beneficial secondary applications like these and more broadly embrace the realization of the benefits of the IoT.

V. The Risk

Device-level standby power regulations are too easily focused on the primary function of that device, and miss the synergy that connected devices can bring the system. Devices that are already regulated must be carefully evaluated during regulatory revision cycles or the establishment of new regulations, lest they are excluded from potential future innovation. Products become regulated because they are ubiquitous and on the whole represent significant energy savings potential. This same ubiquity enables them to be connected to the IoT with less power consumption than a new stand-alone device with its additional power needs. It makes sense to allow the enablement of advanced connectivity through already-established device and appliance infrastructures rather than add new definite-purpose devices or relegate IoT capabilities and services to less-common devices. Overly stringent limitations on standby power consumption for regulated devices will cut those devices or appliances off from future IoT network services and benefits.

VI. New Regulatory Classifications are Needed

Current regulatory energy efficiency and standby power requirements do not address or characterize the benefits of additional connected secondary and tertiary functions or their associated energy consumption needs. Blanket regulations that do not recognize these additional deliverables inhibit innovation and development of IoT devices. Because of this, regulatory intervention may slow down the implementation and the growth of the associated benefits of the IoT. In support, Industry standards development organiz**ations (SDOs) and regulators must develop standby power and energy efficiency policies that represent** and characterize these multifunction systems. These updated policies may include new terminology, allowances of power by type of connected service, and other modernized considerations.

VII. A Systems-oriented Perspective

A new systems-oriented perspective is needed in future building and residential management application segments for the characterization and regulation of power consumption. Instead of the current emphasis on component-based regulation, a shift in focus is needed towards system-performance-based regulation. This entails measuring and regulating for *consumed power*, that is, the power actually consumed by the whole system, the building in this paper’s examples. By focusing on the entire system, power consumed by individual devices (e.g., sensors) is not the focus of the regulation. The older approach that we propose replacing is sometimes referred to as *installed power*, which refers to the power consumed by every installed device regardless of its role in the system.

For this to become a reality, the separation between the building management functions and other applications (and value) embedded within the device and appliance infrastructure needs to be recognized. There needs to be a growing understanding between standards bodies and regulatory agencies that there should be a separation between the intended use primary function or base function, and the secondary function(s) of a system. This will require a fundamental change from the current component-based regulatory approach to one that looks at the system as a whole, including new, updated definitions of standby power and new methods of measurement for standby power with tradeoffs or allocations by delivered service. If implemented properly, these policies can drive further energy efficiency and simultaneously enable innovation and advanced consumer satisfaction and comfort.

VIII. Conclusion

It is well recognized that the IoT, with all its smart and enabling benefits and energy saving potential, will deliver significant value to society and transform the way we work, live and play. NEMA supports energy-efficiency products, systems, and programs and believes new, systems-oriented methodologies need to be developed to properly characterize and measure energy consumption of these new multi-function connected building systems. With effective efforts in this direction, regulatory agencies worldwide will be able to continue their primary mission of driving improved energy regulation and policy while enabling continued deployment of complementary applications beneficial to a society driven by innovation within the IoT.

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