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AC DEVICE-LEVEL POWER CONSUMPTION MEASURE, ATTRIBUTION AND CONTROL FOR FLEXIBLE OFFICE WORKSPACES

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ABSTRACT

While Power-over-Ethernet (PoE) systems are able to perform per-connected-device DC-power control, monitoring, and reporting, such an equivalent does not exist for AC-powered devices. Techniques presented herein enable a holistic view of both AC and DC powered devices, which may enable organizations, such as organizations operating multi-tenanted workspaces or those charged with improving their real-estate carbon footprint, to develop a detailed view of their power footprint, as well as manage power consumption of individuals, devices, and/or workspace locations in a proactive and intelligent manner.

DETAILED DESCRIPTION

As we move into a future where sustainability in the workplace is of increasing importance, factors such as power consumption and efficiency will need to be captured in the cost of business. Individuals and companies will respond to increasing energy costs by small acts, such as turning off idle computers and computer monitors but in order for this to be possible, individuals need to be aware of their power consumption.

In most modern office buildings, power consumption monitoring solutions are typically deployed at the circuit-breaker level, with monitoring solutions deployed in electrical cabinets. These solutions measure the utilization of all devices present on the circuit and, as a result, are unable to provide insights at a more granular level. While this approach may be sufficient in some instances, such as where workers are in fixed desk locations, or where a company occupies an entire section of a building, modern flexible office work environments enable and encourage improved workspace efficiency by allocating people to different desk locations within a building, rather than having fixed assignments.

Furthermore, with shared office facilities in which a management agent typically manages a building, offering workspaces on a per hour, per day or for extended time periods, the tenants of the space are other companies, and those companies are constantly changing. This means that the energy consumption measured at the circuit breaker does not necessarily map concisely to the space being occupied by any particular tenant and therefore may fail to capture the consumption of the devices operated by that tenant.

In such environments, facilities management teams are unable to determine how much power a particular individual or group of tenants are consuming since the current power consumption monitoring solutions operate the circuit-level. At best, the total consumption figure can be divided by the number of tenants present to offer an average consumption over time figure or some form of proportional assignment could be applied based on space occupied by a tenant.

Further, current power consumption monitoring solutions are typically focused on driving behaviors of individuals within an organization in order to reduce power usage and are often provided within a fixed-location setting rather than a flexible office-space configuration.

As individuals and companies are encouraged to reduce their power consumption and improve their power efficiency, it will be important to more accurately reflect the amount of power being consumed in the price being charged for use of a workspace.

This proposal provides for the ability to address the issue of fine-grain power consumption information that can be tied to a device that, in turn, can be linked to an individual or company that uses power within a multi-tenant flexible workspace environment. Consider an example workspace environment, as shown below in Figure 1.

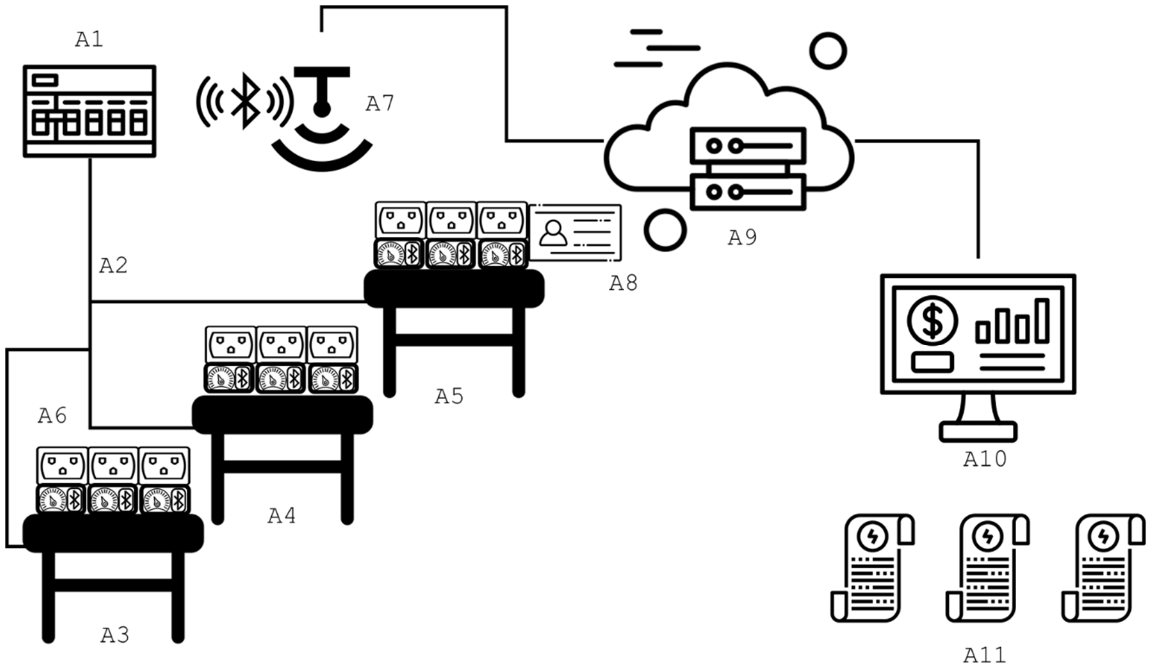

Figure 1: Example Workspace Environment

Consider that the flexible workspace environment as shown in Figure 1 includes multiple working locations, with power being provisioned from the building electrical distribution system (A1) using cabling (A2) to the working locations or desk positions (A3, A4, A5) located throughout the building.

Each of the working locations (A3, A4, A5) will have a set of power sockets with integrated power control, consumption monitoring and Bluetooth® communications (A6) (e.g., Bluetooth Low Energy (BLE) communications) that an individual will use in order to power a device or set of devices. Alternatively, these sockets could be integrated directly into workspace furniture such as a desk or wall unit.

Specifically, such power sockets can be remotely enabled and disabled, and may also include electrical power monitoring capabilities enabling the power that a device is drawing to be measured. In addition, the power clamp can incorporate a Bluetooth communications capability.

The power sockets with integrated power control, consumption monitoring & Bluetooth communications can connect to Bluetooth communications capability offered by Wi-Fi access points with integrated BLE communications (A7), present within the building. This enables power measurement information generated by the power sockets

(A6) to be relayed over the data network infrastructure to building and energy management systems.

During operation, when an individual wishes to use a workspace (A5), they will be required to invoke an identification process (A8), logging into the workspace in order to activate services. In some instances, the binding of an individual user to a workspace could be performed through a formal log-in and authentication process or could be performed through location triangulation technologies. Regardless of the binding mechanism, it is important that an individual (and any associated information relating to the individual such as their company) can be bound to a particular workspace (A5). The authentication process acts to enable power to the power sockets in that workspace, preventing unauthorized/unbilled power usage.

In addition, the use of BLE between an access point (A7) and the power clamp (A6) enables a key capability—namely, location information for the BLE connected power clamps. Since the location of the Wi-Fi access point is known, it acts as a location anchor against which the BLE-connected power socket's own location can be determined. Thus, the location of devices connected to the power socket can also inferred.

Consider for the present example that the individual then attaches their electrical devices to the socket, as illustrated in Figure 2, below, such as a laptop computer (A12), phone (A13) or tablet device (A14).

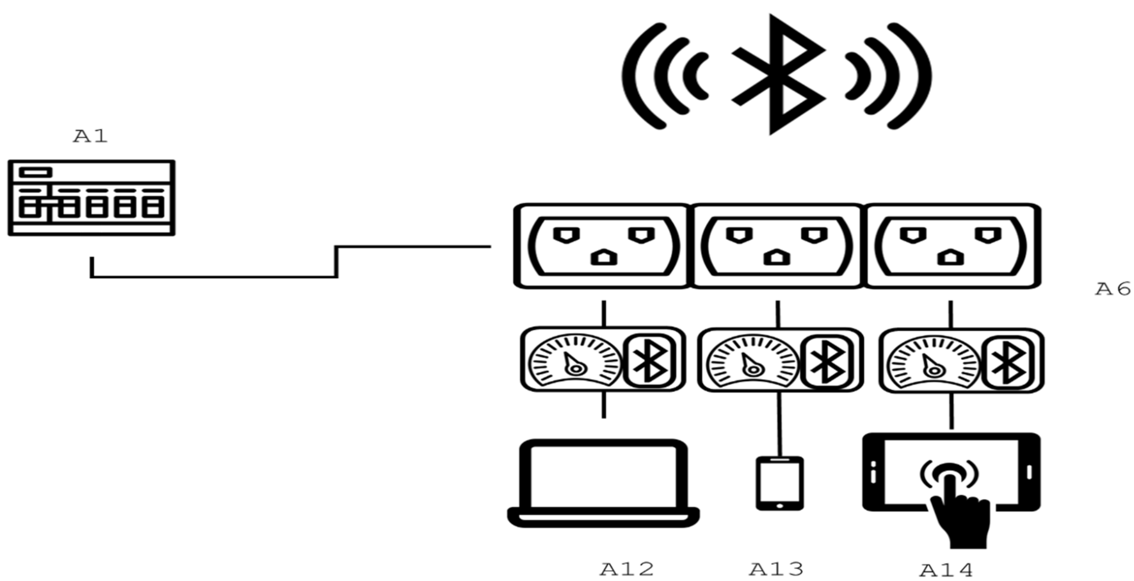

Figure 2: Exemplary Device Connections

In accordance with the techniques of this proposal, the metering function within the power socket (A6) is able to generate data about the power consumption in which the information can then be transmitted over the Bluetooth and Wi-Fi network infrastructure to power monitoring and recording systems (A9). The monitoring/recording systems can be located on-premise or in the cloud.

In both fixed-workspace and flexible workspace settings, it is likely that individuals will move to other locations for work purposes during the day. For example, if a meeting were to be taking place, individuals may relocate from their original workspace to a conference room or office. When the individual plugs in their device (such as a laptop), the location and individual binding enables the creation of metering records that reflects the location change.

A further key capability that techniques herein may offer is the ability to control power provisioning to sockets (and therefore devices attached to those sockets) when an individual moves away from their workspace or is identified as being in another location. If an individual moves from their workspace or order to participate in a meeting in a conference room, their presence in the conference room can be used as trigger to turn off power to the sockets at the workspace where they were previously located. Such a capability provides for the ability to reduce power consumption as a whole by turning off devices such as computer monitors, desk lamps, etc. rather than just placing such devices in a lower power consumption mode. In some instances, policy functions can be applied to determine if power should or should not be withdrawn from a particular socket and device.

By utilizing techniques as prescribed herein, facilities management staff are then able to interrogate power monitoring and recording systems (A9) to produce utilization records (A10) and per-individual/per-company bills (A11).

Various advantages may be realized through the techniques as proposed herein. For example, by binding the identity of an individual to a specific location within a building, and then being able to monitor the power consumption of individual devices at that location, techniques herein are able to provide granular power consumption profile information to the individual, to companies, and/or to facilities management teams. Such granular power consumption information cannot be achieved with circuit-breaker measurement systems currently offered.

Further, by leveraging the location-finding functions offered by BLE, facilities management teams are able to determine the location of power-consuming devices, saving considerable time and effort when compared to physically tracing devices. As noted above, current power consumption monitoring solutions are often constrained to fixed-location environments and not provide for correlating location information with power monitoring data in an intelligent manner, nor do current solutions envision individuals changing their locations throughout a workday. Furthermore, current solutions do not consider automated approaches to reducing power consumption through mechanism, such as disabling power when an individual is not in proximity to a given workspace location.

In contrast, by using location information pertaining to an individual in accordance with the techniques as provided herein, power consumption reduction can be achieved by turning off the provision of power to sockets and thereby, the attached device, when the individual is no long in proximity of the sockets.

Moreover, by utilizing techniques as proposed herein, workspace management systems are able to gain fine-grain power consumption insights for an organization in order to understand the power utilization profile within the building with significantly improved accuracy and, in some instances, may also achieve power consumption reduction by remotely turning off devices.

While PoE systems are able to perform per-connected-device DC-power control, monitoring, and reporting, such an equivalent does not exist for AC-powered devices. However, techniques provided herein may enable a holistic view of both AC and DC powered devices. This is essential to an organization wanting a detailed view of their power footprint. With such a solution, organizations operating multi-tenanted workspaces are able to see accurate power consumption data and charge accordingly.