Fact Sheet: Automatic Type and Location Identification System for Commercial Plug Load Management

BETTER BUILDINGS ALLIANCE

Introduction

Plug and process loads (PPLs) include all plugged-in and hardwired electronic devices that are not associated with other major building end uses such as heating, cooling, ventilation, and lighting. PPLs account for 47% of the energy consumed in U.S. commercial buildings, and that portion is expected to increase.[1] As a result, there is growing interest in managing PPLs, a challenging proposition given there can be thousands of PPL devices, each serving a unique function, in large commercial buildings.

Residential smart home management systems exist today that connect to Internet of Things (IoT) devices, such as lighting, thermostats, and plug loads, and allow homeowners to control their devices from a central system. These systems have not been scaled to commercial buildings, largely because there are orders of magnitude more occupants, devices, and device types in commercial buildings.

This fact sheet summarizes the Automatic Type and Location Identification System, or ATLIS for short.

What is ATLIS?

ATLIS is a plug load management (PLM) system framework developed by researchers at the National Renewable Energy Laboratory[2] that automates controls and reduces setup and maintenance time by taking advantage of more IoT devices entering commercial buildings. Figure 1 shows the ATLIS framework.

ATLIS takes advantage of the ability of smart, connected devices to identify their own locations in a building, meter and control their power, and communicate this information to a central database. The framework includes five primary capabilities: location identification, communication, control, energy metering, and data storage.

- **Location Identification**
  Radio Frequency Identification (RFID) tags at each outlet correspond to device locations in a building. RFID readers at the device plug read the tag and send the location to the dashboard and database.
- **Communication**
  Controls and device data are sent between devices and the system dashboard through the central control hub.
- **Control**
  Instructions or "controls" are sent through the central control hub directly to devices to administer. Controls are associated with the device rather than the outlet, providing access

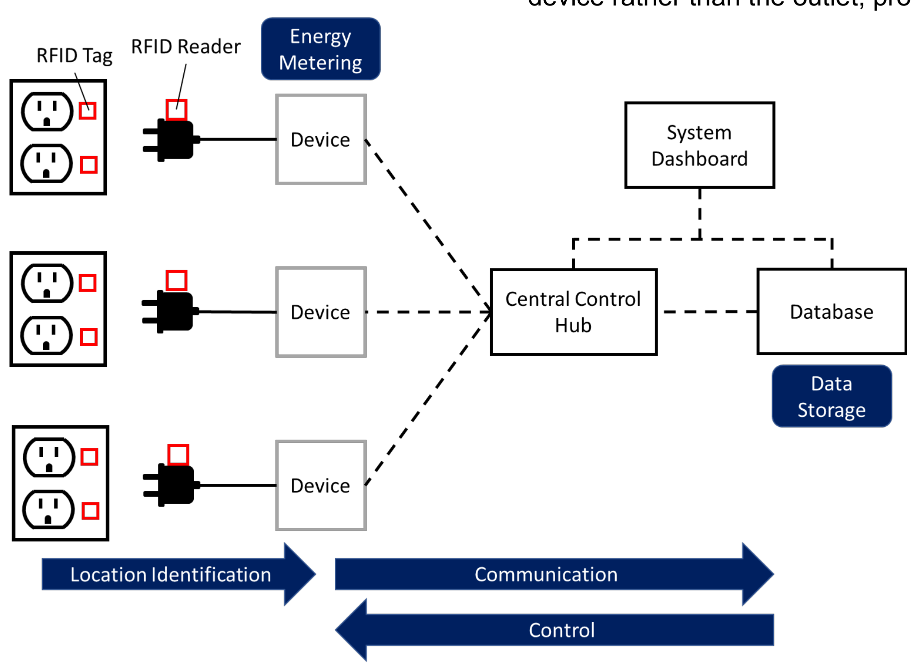

Fig. 1 The ATLIS framework workflow

to more advanced controls, such as "low power mode" rather than just on and off.

- **Energy Metering**
  Devices self-meter and send data to the system dashboard and database. Some devices can already self-meter, and more are expected to be able to as the IoT grows.
- **Data Storage**
  Device data are stored in an external database, rather than using devices' internal memory.

How does ATLIS work?

The most common application of ATLIS is as a PLM system for a single building. During system installation, tags are placed at every outlet in a building, and the outlet locations are logged in the system. Each device will have an RFID reader at its plug to read the outlet tags.

During operation, ATLIS automatically registers a device when it is plugged into an outlet. If the device is moved and plugged in to a different outlet, the system registers the new location of the device and maintains whatever controls were associated with it. For example, if a coffee maker is moved to a different outlet in an office kitchen, its controls will follow the device and it will maintain regular operation, regardless of what had been previously plugged into that outlet. Devices send data, such as electricity consumption, operating state, and device health statistics, to the system dashboard. The data are also sent to a database for storage. The system dashboard allows users to visualize real-time and historical data and administer controls. Control signals are sent through the central control hub directly to the corresponding device to implement the control.

Technology Status

The ATLIS framework is still in the early stages of technology development. A laboratory-scale proof of concept was constructed to lay the groundwork for the framework. A commercially available ATLIS-based system that can be installed in buildings will require device manufacturers to incorporate energy metering and communication protocols into their devices and building owners to install the required infrastructure, such as RFID tags at outlets. Consumers and market demand will also be crucial in encouraging manufacturers to pursue this type of technology.

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NON-ENERGY BENEFITS AND APPLICATIONS

- **Grid-Interactive Efficient Buildings:** ATLIS supports grid-interactive efficient buildings by enabling efficient, centralized control of PPLs. ATLIS inventory of devices and locations could allow the system to automatically identify devices "approved" for curtailing. Nonbinary PPL controls allow for better response to grid signals.
- **Virtual Emergency Circuits:** Commercial buildings with backup generators have dedicated, hardwired circuits for powering critical equipment when the main power fails. An ATLIS-based PLM system could create virtual emergency circuits in which only certain devices are permitted to be on during an outage.
- **Automated Audits:** Energy audit software could connect with ATLIS to automatically gather necessary information about the building's PPLs, saving time.
- **Better-Informed Building Design:** An ATLIS-based PLM system could develop libraries of PPL load profiles and help designers develop building plans that accurately represent PPLs.
- **Asset Management:** The framework enables the system user to determine quickly and easily how devices are being used and where they are in the building.

[1] U.S. Energy Information Administration, "Annual Energy Outlook 2020," 2020.

[2] A. LeBar, K. L. Trenbath, B. Doherty, and W. Livingood, "A Commercial Building Plug Load Management System That Uses Internet of Things Technology to Automatically Identify Plugged-In Devices and Their Locations," 2021, *International Journal of Energy and Environmental Engineering*, vol. 15, no. 9, pp. 279–287.