Data Taxonomy Glossary
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1. Motivation

The "Smart Plug Load Controls Integrated with Building Energy Management Systems" contract EPC-20-009 examines the benefits of implementing plug load controllers (PLC) into building energy management systems (BEMS). PLCs have unique functions and relationships to people and plug loads that motivate a unique taxonomy. The purpose of the taxonomy is to standardize metering and control of plug loads and their interfaces with the BEMS and building occupants. The intent of the taxonomy is to initiate the creation of an industry standard that would be adopted by other PLC products and users.

2. Brick Semantics

Brick is an open-source software to standardize semantic descriptions of building assets and the relationships between them. Brick consists of an extensible dictionary, a set of relationships for linking concepts together, and a flexible data model permitting seamless integration with existing tools and databases. Through the use of powerful Semantic Web technology, Brick can harmonize the broad set of idiosyncratic and custom features, assets, and subsystems found across building types.

Brick presents an integrated, cross-vendor representation of the multitude of subsystems in modern buildings, including HVAC, lighting, and other subsystems. By reducing the reliance upon the non-standard, unstructured labels endemic to BEMS, Brick lowers the cost of deploying analytics, energy efficiency measures, and intelligent controls across buildings to make them truly interoperable.

3. Data Taxonomy

3.1. Introduction

For EPC-20-009 the project team adopted the Brick Schema conventions to define a data taxonomy glossary. The glossary is split into people relationships and points (Figure 1) and plug load relationships and points (Figure 2). Brick definitions are color coded as in Brick relationships (orange), Brick classes (yellow), Brick location class (red), and BERT BACNet Points (blue).

3.2. People

For the people relationships and points, a new "People" class is defined with a "Person" object. The Person has a location in a room and a building, which is typically their office. The Person has points in his/her contact data. The Person also has a role as Occupant, Building Manager, or Department Head. An occupant is at the bottom of the hierarchy. An occupant may only be affected by PLC without decision making authority or the occupant may have decision making authority over one or a small number of PL in their office. A department head and/or building manager would have control over all or a subgroup of occupants in setting policies (such as delegating decision-making authority to occupants) and/or directly controlling PLC for plug loads in common spaces such as shared copy machines, vending machines, etc. The building manager would be in charge of network access for the PLC, have more intimate knowledge of PL usage, and understand any device particularities that would prevent plug loads from being remotely controlled. For example, some devices experience hardware and/or software issues when not being gracefully shut down and would not be eligible for

PLC. Or other devices may be accessed remotely (e.g. printers) which would not allow usage of the PLC override button if a device is shut down when a user wants to use it during off-hours.

3.3. Equipment relationships and points
For the equipment relationships and points, the Equipment class is defined by the PLC as an object. The PLC has an address in its MAC address and a location as in its room that is occupied by one or more occupants.

The PLC collects measurements of temperature, current, voltage, power, and wireless network signal strength. The PLC can set its relay to be on or off and - in addition to time - the relay can be controlled by a power threshold specific to the attached load and by temperature (e.g. for ACs or heaters).

The PLC has Brick relationships, where it is defined as a load type and as a brand and model. The plug load (PL) can be categorized as controllable or as monitoring only. While eventually the controllable category is the ultimate goal of all PLC deployments, there may be investigation periods where the building owner or occupant wants to assess whether a PL is worth controlling, e.g. depending on its energy consumption or usage patterns. In addition to standard static PLC based on time of day and day of the week, Brick relationships also define if a PL can be turned off during demand response (DR) events when there are greater financial incentives to turn off PL.
Within such event-based control, the scheduling level can be set to none, default, or aggressive. For example, the scheduling levels can be linked to probability thresholds, where an artificial intelligence algorithm predicts the likelihood of a PL being used within a DR interval. The decision to turn off a PL is based on a previously defined threshold or risk probability that the device will actually be used during the DR period.

The PLC has Points in that it can be turned on or off and the commanded relay state logs the most recent command, i.e. the current state of the PLC. The PLC has a physical override button, which can be programmed to be disabled (via hardware switch disable) or enabled (via toggle). The PLC also has a temperature sensor whose calibration information can be entered.
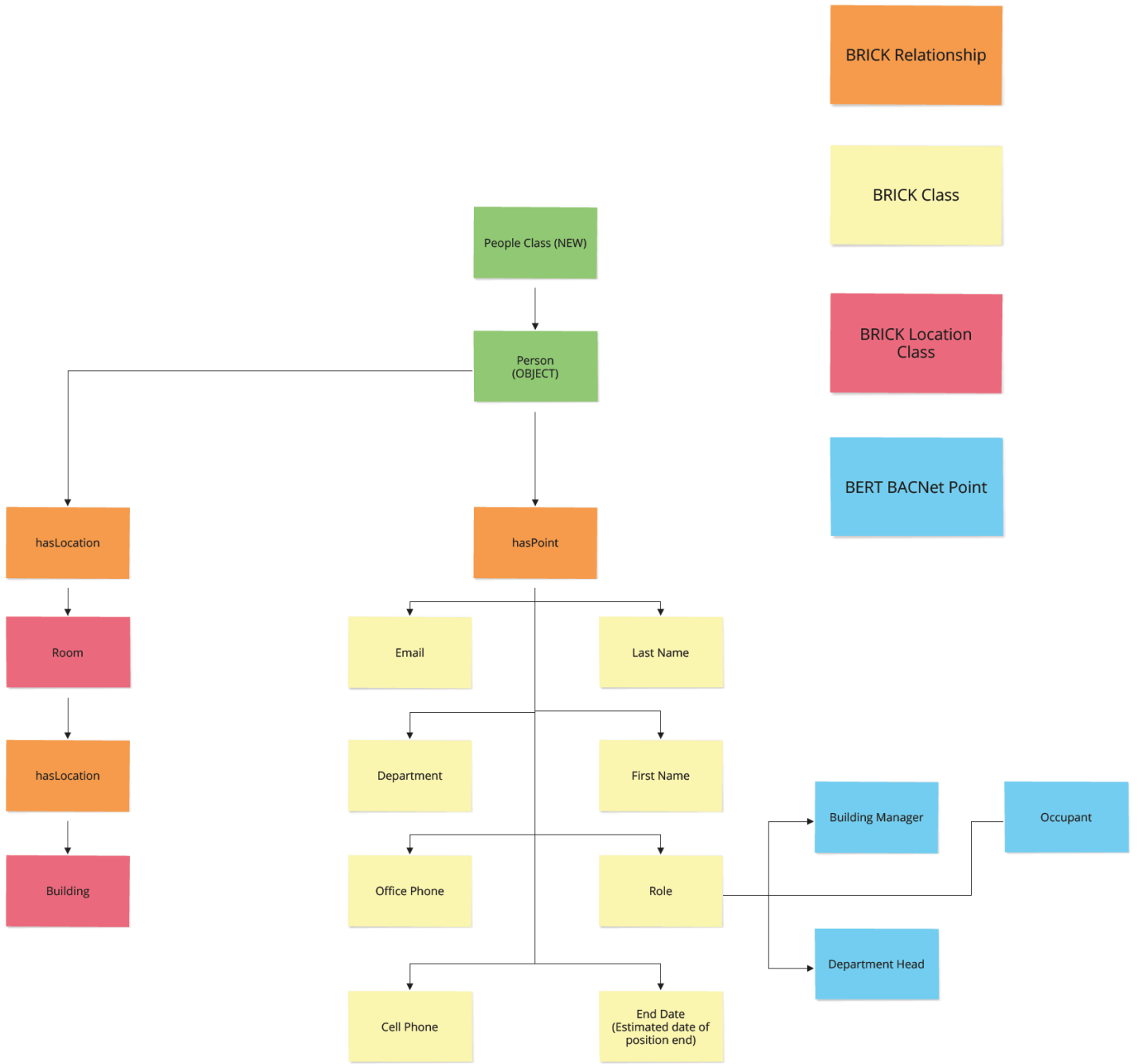
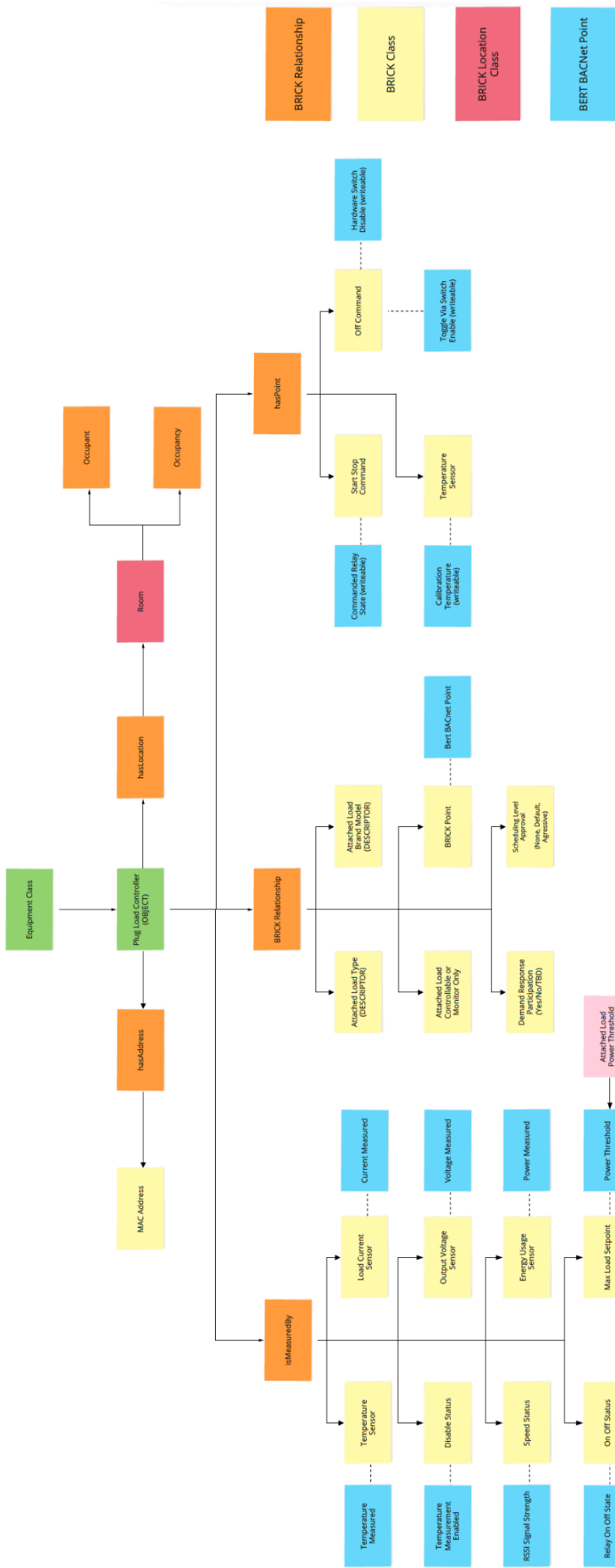Figure 1: People Brick relationships and points for the plug load data taxonomy.

Figure 2: Plug load controller Brick relationships and points for the plug load data taxonomy.