Portable Queries Using the *Brick Schema* for Building Applications

B. Balaji[1], A. Bhattacharya[2], G. Fierro[2], J. Gao[3], J. Gluck[3], D. Hong[4], A. Johansen[5], J. Koh[6], J. Ploennigs[7], Y. Agarwal[3], M. Berges[3], D. Culler[2], R. Gupta[6], M. Kjærgaard[5], M. Srivastava[1], K. Whitehouse[4] ([1]UCLA, [2]UCB, [3]CMU, [4]UVA, [5]USD, [6]UCSD, [7]IBM-Ireland)

http://brickschema.org
Open sourced with BSD License

Brick Overview

- A common metadata description
- It can express application requirements
- Query metadata without domain knowledge

Goals

- Completeness: capture all sensors/subsystems
- Expressiveness: capture all relationships needed to run applications
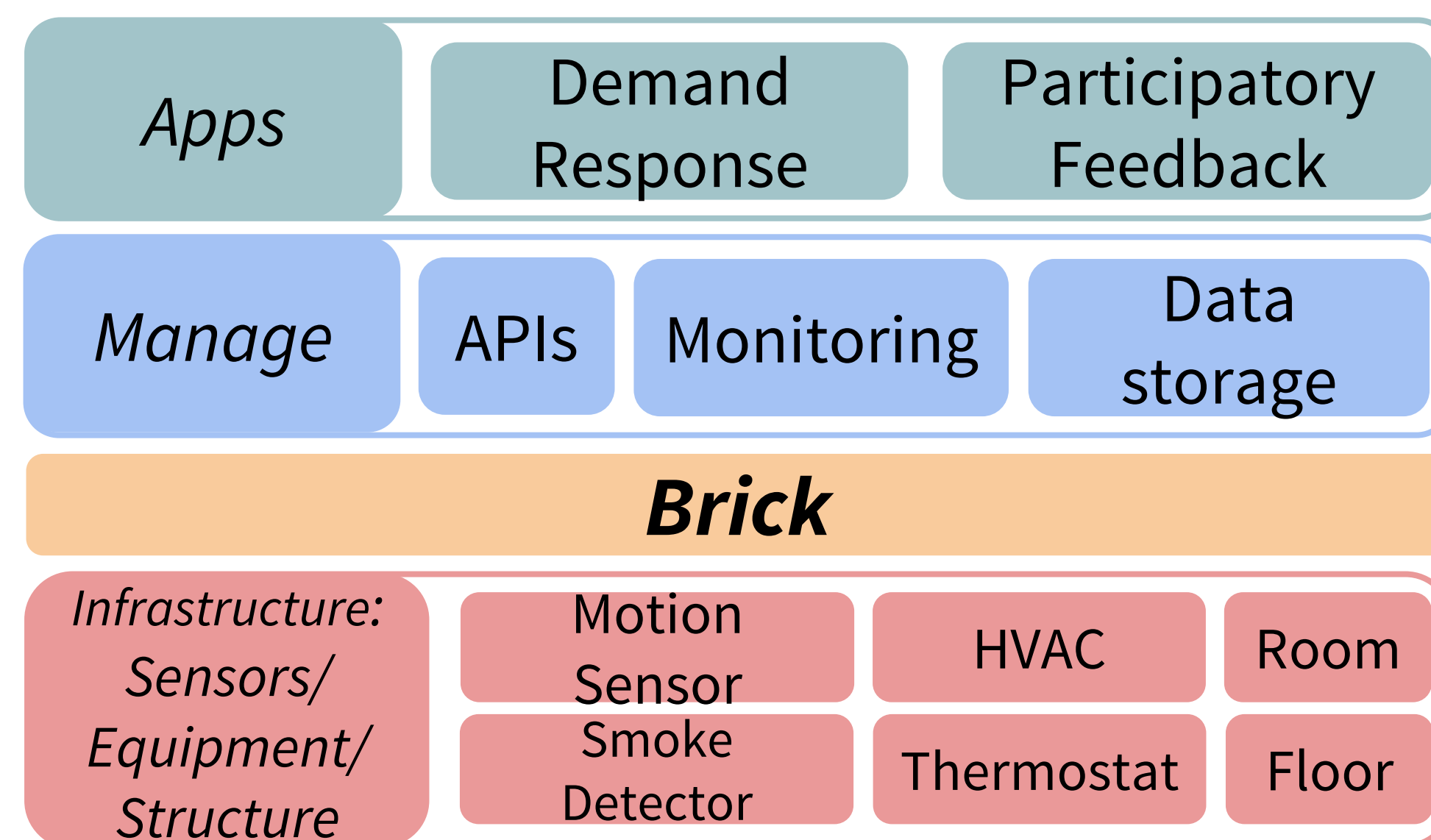- Usability: easy to understand, easy to port buildings

Fig. 1. Architecture for Smart Building Systems.

Brick Structure

- A Tagset consists of Tags
  - *Room Temperature Sensor* consists of *Room, Temperature* and *Sensor*
- Tagsets constitute a taxonomy
  - Four major categories: Equipment, Point, Location, Measurement
- An entity is an instantiation of a Tagset
  - RT2 is an instantiation of *Room Temperature Sensor*.
- Entities have relationships between them.
  - RT2 *hasLocation* Room-101.

Relationship	Inverse	Transitive?
hasLocation	isLocationOf	Yes
controls	isControlledBy	No
hasPart	isPartOf	Yes
hasPoint	isPointOf	No
feeds	isFedBy	Yes
hasInput	isInputOf	No
hasOutput	isOutputOf	No

Tagset Class Hierarchy
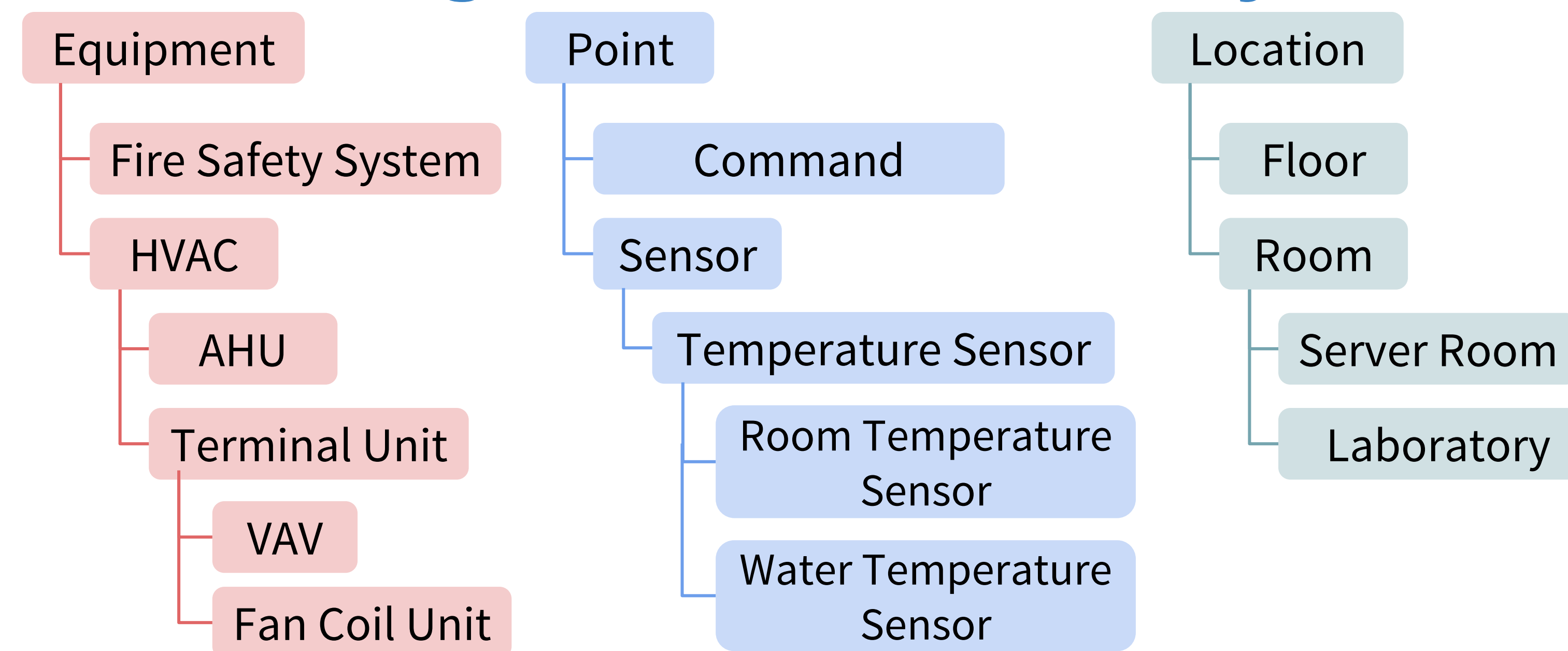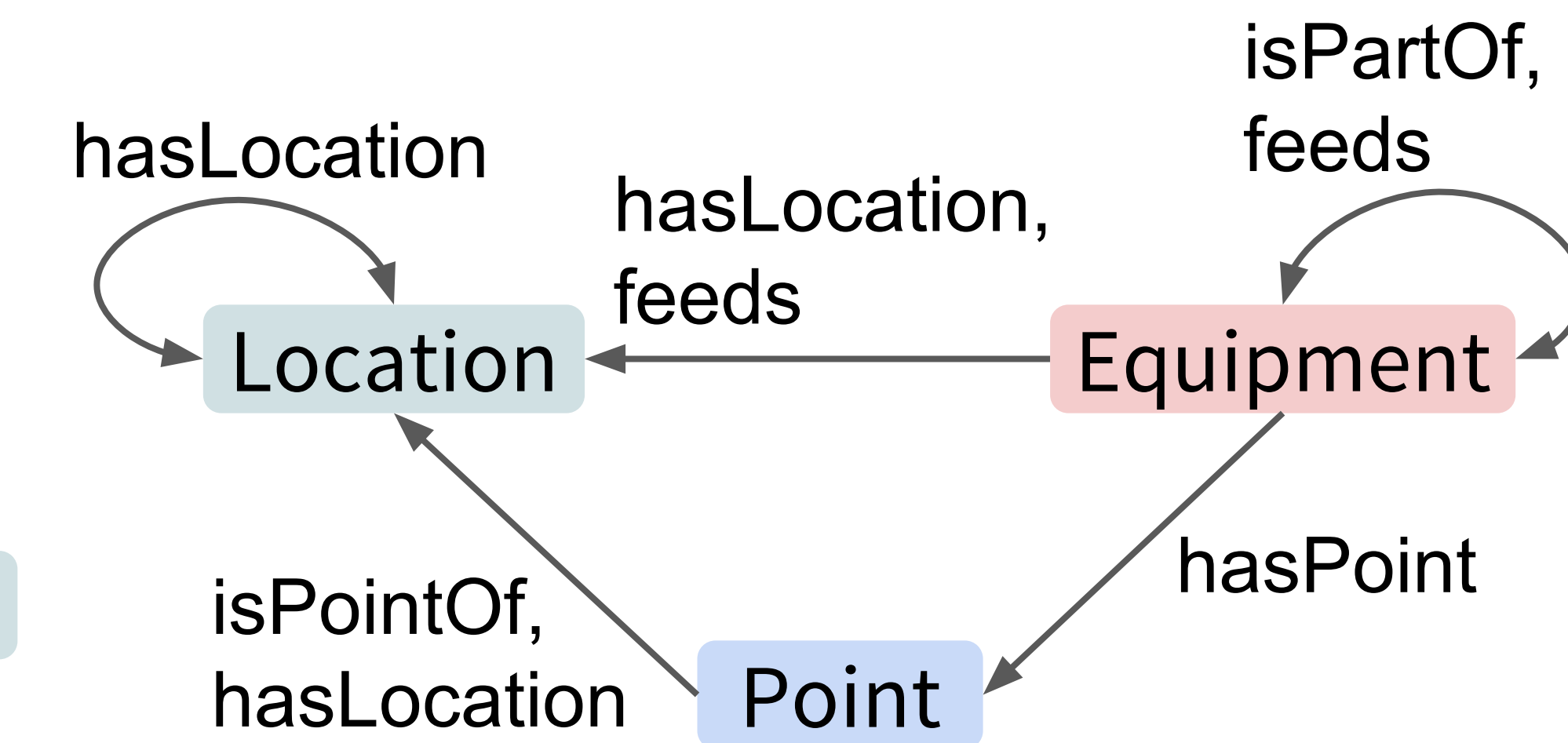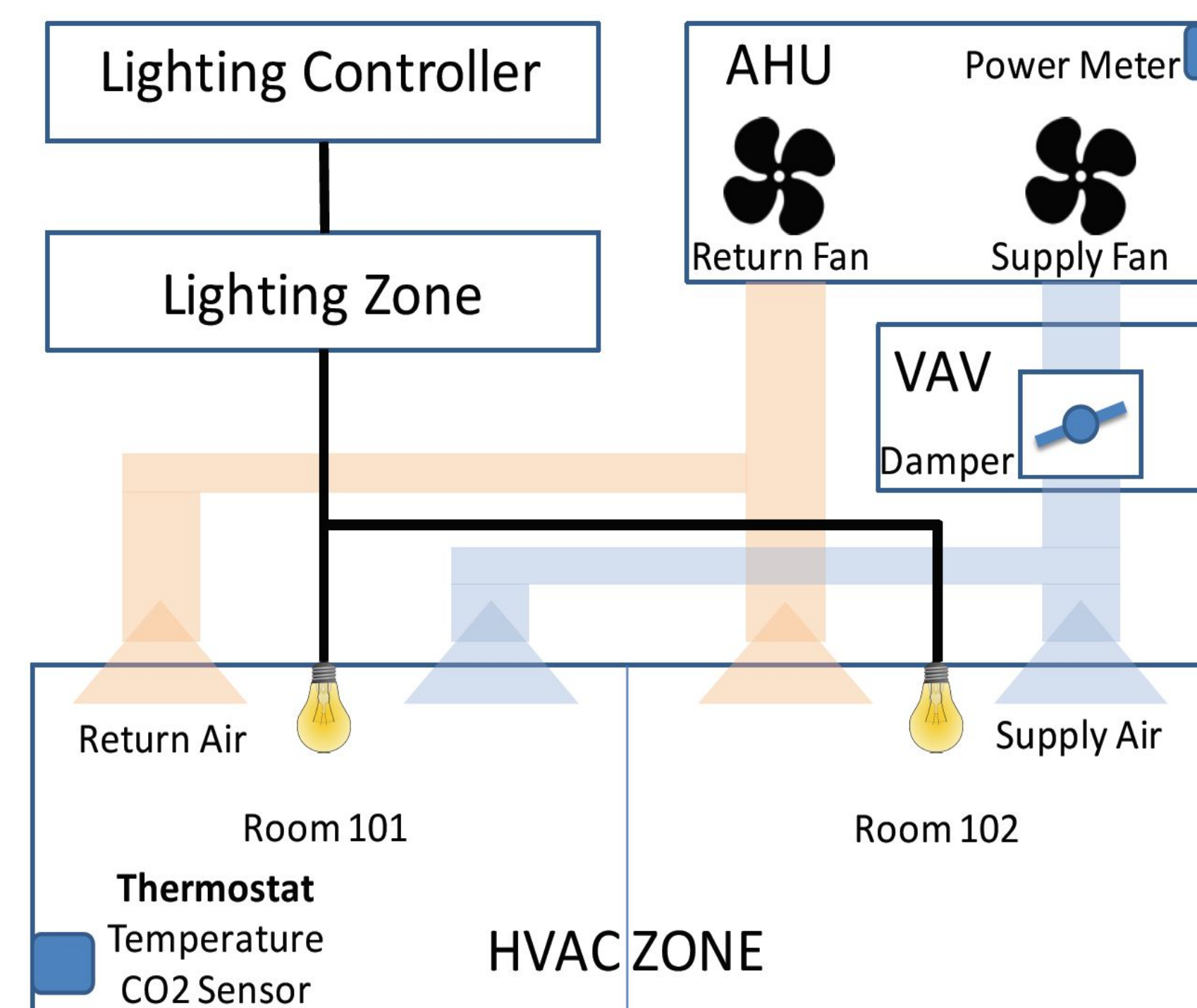
Example Building
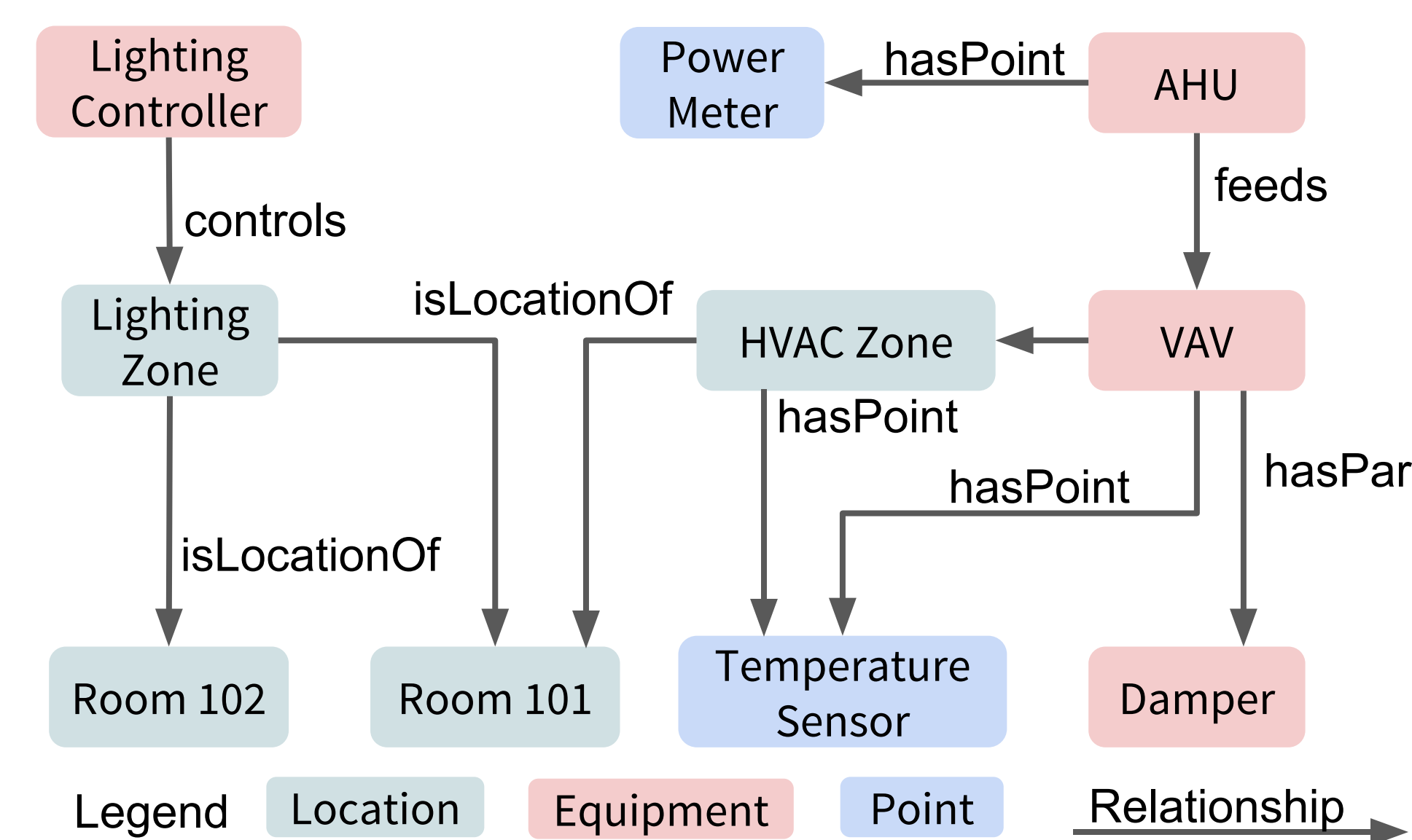

Fig. 2. Example Building Diagram

Brickify

Fig. 3. Brick Representation of the Example Building

Legend: Location Equipment Point Relationship →

Relationships

Turtle Example

```
@prefix ex: <http://example-building.com#>
@prefix brick: <http://brickschema.org#>

ex:temp1 a brick:RoomTemperatureSensor
ex:temp1 brick:hasLocation ex:room101
ex:room101 a brick:Room
ex:vav1 a brick:VAV
ex:vav1 feeds ex:room101
ex:vav1 brick:hasPoint ex:temp1
```

Subject   Predicate   Object

SPARQL Example

```
SELECT ?ahu ?room
WHERE {
    ?zone rdf:type brick:HVAC_Zone .
    ?room rdf:type brick:Room .
    ?ahu rdf:type/rdfs:subClassOf* brick:AHU .
    ?ahu brick:feeds+ ?zone .
    ?zone brick:hasPart ?room .
}
```

Brick vs Haystack

Brick	Haystack
6 ported buildings, 8 ported applications	No reference implementation
Supports SPARQL queries that traverse Brick graph	Restrictive query mechanism cannot traverse relationships
Captures relationships within and across building subsystems	Can link entities, but does not classify these relationships
Functional blocks encapsulate complex subsystems; Tagset hierarchy permits partial descriptions	Flat, classless tag structure cannot capture uncertainty or complexity