

W3C LBD Community Group

Minutes - Call 17/05/2022

Attendees:

- Karl Hammar (Jönköping University)
- Mathias Bonduel (KU Leuven and Neanex Technologies)
- Joel Bender (Cornell University)
- Alex Donkers (Eindhoven University of Technology)
- Maria Husmann (Siemens Smart Infrastructure)
- Katja Breitenfelder (acatech / Fraunhofer IBP)
- Philipp Hagedorn (Ruhr-Universität Bochum)
- Kevin Luwemba Mugumya (University of Nottingham Malaysia)
- Calin Boje (Luxembourg Institute of Science and Technology)
- Hervé Pruvost (Fraunhofer IIS EAS)
- Jing Ying Wong
- Erik Wallin (ProptechOS/RealEstateCore)
- Niedermeier, Christoph
- Salvador Gonzalez Gerpe

Presentation slides

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Date and time

- 17/05/2022, Tuesday, 15:00-16:30@UTC/ 17:00-18:30@CEST/ 08:00-09:30@PST

Moderators

1. Karl Hammar

Agenda

1. Introduction of new members
2. Presentation: Keith Berkoben, Google Digital Building Ontology
3. Questions
4. Further topics

Minutes

1. **Introduction of new members**
 - a. none

2. Presentation: Keith Berkoben, Google Digital Building Ontology - objectives, structure, results

a. Digital Buildings Ontology and why we built it

- i. Smart buildings > difficult to apply to commercial buildings compared to regular homes. Difficult to build software that is portable
- ii. Large amount of assets owned by Google > apply ML, increase interoperability, build one application and replicate
- iii. Complexity
- iv. Similarities between equipment
- v. System architecture
 1. Building ontology > published on Github, modeling language
 2. UDMI to assemble data from devices
 3. All able to run on cloud products
- vi. Why not use already existing models to describe buildings?
 1. Existing ontologies have often expressivity, coverage in industry, but all lack usability in couple of ways
 - a. Not strict enough, lack of standardization and tooling on how to model a building (e.g. Haystack and Brick)
 - b. Goal: easy to use for person who is a domain expert but has only limited software knowledge (no abstract modeling knowledge - computer scientists). Able to validate by machines, enforcing standards
- vii. Tooling to use datasets applying the ontology
- viii. Fields
 1. Building industry uses already descriptive names > add meaning with proper semantics context
 2. Very well defined subfields that can be combined to field names with strong meaning
- ix. Units and states
- x. Entity types (equipment)
 1. Name and description
 2. Inheritance
 3. Optional fields > give flexibility; does not change behavior of device
- xi. Scalability
- xii. Concrete models = actual equipment in a specific building
- xiii. Mapping example
 1. States
 2. Automatic mapping
- xiv. Remap points in virtual devices > make them suitable for your application
- xv. connections/relations
 1. Implicit (derived from spatial geometry, e.g. contains)
 2. Explicit (e.g. feeds)

- xvi. Current status
 - 1. Canonical device models
 - 2. Live applications
- xvii.
- b. Applications implementing the ontology
 - i. learnings
 - 1. Standardized functional models accelerate application dev
 - 2. Modeling is similar to feature engineering for ML
 - 3. Relationship reasoning less used
 - ii. ML setpoint optimization application
 - 1. Carbon intensity - cost in dollars
 - 2. Availability of clean energy per hour => min overall cost for carbon
 - 3. Net yet rolled out over entire fleet
 - iii. Zero config ML-driven fault detection
 - 1. Large amount of devices. 1% giving an issue is impossible already to deal with manually
 - 2. Find anomalies and priorities them by severity; zero-config (unsupervised ML, there's a paper on the Github page)
 - a. Replacing existing heuristic models
 - b. Expect that it will work for new devices
 - c. Expect that it will work for indiv functions over devices (subfunction of device) > still to try this
 - iv. Building comfort analysis
 - 1. At scale > lightweight dashboard
 - v. Spatial analysis (extension)
 - 1. We don't make spatial information explicit in digital building ontology (DBO). Other project IBR (internal building representation). Thinking about connecting it to DBO
 - 2. Physical security system > draw CAD to see what a camera can see. Help operators to save time

3. Questions

- a. [Calin] documentation is not available (github google.io)
 - i. [Keith] <https://github.com/google/digitalbuildings>
 - ii. What is contained in the DBO regarding buildings (beyond devices)? Instances are concrete models and Tbox are the device models?
 - 1. [Keith] yes. You can model the building in more detail if you want.
 - iii. We try to measure differences between applications of different manufacturers. Fault detection to keep an eye on calibration?
 - 1. [Keith] use ML and takes care of it implicitly. Will be detected as an anomaly automatically. Based on historical data and looking at data from other buildings in the same region/municipality (same weather etc). The relationships are pretty robust
 - iv. Types of sensors?

1. [Keith] looking at behavior of our equipment, mechanical or sensor problems:
 - a. VAV damper position (flow control)
- b. [Karl] what if there are multiple representations, e.g. in brownfield situation? Large amount of work to do mapping? Could the product be deployed in the market?
 - i. [Keith] all brownfield projects; mapping is large challenge and created tooling for this. Yes, it could be a product for the market. A collaborator in the Github page is doing optimization for business. They are mapping to our ontology (using it internally)
- c. [Karl] use it to share data or internal silo?
 - i. [Keith] already have API that we use to expose data to our partners. Anyone who is a vendor to Google. Share some data externally for papers. No plans to share all of our building data with the world
- d. (Mathias) Mapping is one of the challenges. Would you expect to be happy in the future if there were structured datasets delivered to you, using an ontology that can be aligned to yours?
 - i. The more consistent the structure of datasets the better.
- e. (Mathias) Did you add restrictions to the Google DBO? Can something like SHACL be used?
 - i. Yes, some explicit rules.
 - ii. RDF generator for the ontologies developed and available on Github (is to be updated)
- f. (Mathias) Which kind of approaches do you use for the mapping challenges?
 - i. 90% heuristics
 - ii. Tools from a partner
- g. (Mathias) Is there a link to use linked data as a technology stack with expected benefits?
 - i. Linked data benefits not exploited yet. But honor the use of it
 - ii. Language appropriate use (change between languages)
 - iii. Greater challenge of processing raw data
- h. (Karl) Looking forward a number of years will we ever find one common language to describe the building sector and is there interest in interoperability between systems?
 - i. There is a new upcoming spec for vendors of smart home systems (MATTER)
 - ii. BACNET still used a lot. So many vendors and systems. You can't built with only one vendor, so interoperability must happen. Some vendors have lock-in at data aggregation level, but can break with interoperability standards. Interfacing between systems will always remain difficult
- i. [Joel] vendors produce devices with Bacnet interfaces and can provide data along with the controller. Should a vendor include model with the device? Would it be a YAML file?

- i. [Keith] point naming good place to start. Some public library of equipment you can reference against for equipment types. Challenge is that there's often too much information (too many data points). Most applications need only 25/150 datapoints of an equipment. Keep size of model low, suitable for applications.
- ii. [Joel] Bacnet application profile group > try to come up with a library as they fail to gain a consensus instead of just designing something. Do you have a set of profiles in your library that could be used as a basis?
 - 1. [Keith] checkout our abstract types on Github (e.g. fan control, etc.). By general type, we have canonical types for relatively simple applications
- j. [Calin] does Google one HVAC supplier?
 - i. [Keith] actual HVAC equipment is almost bespoke, rel. custom ; The actual hardware configurations are very variable even when using devices from one supplier

4. Further topics

Next Call

- 31/05/2022, Tuesday, 15:00-16:30@UTC/ 17:00-18:30@CEST/ 08:00-09:30@PST

Agenda: TBD

We are interested in getting suggestions from the community about potential agenda items and **Elevator Pitches** for the following calls. Please send your suggestions to the chairs or to internal-lbd@w3.org, whether you have a short presentation to bootstrap the discussion, and an approximate duration you think the discussion will last.

Previous minutes

<https://www.w3.org/community/lbd/meeting-minutes/>