W3C LBD Community Group
Minutes - Call 20/01/2025

Attendees

- Alex Donkers (Eindhoven University of Technology, The Netherlands)
- Mathias Bonduel (Neanex Technologies, Belgium)
- Francisco Regateiro (IST, Lisbon University, Portugal)
- Hervé Pruvost (Fraunhofer IIS/EAS)
- Serio Acero Gonzalez (Empa)
- Alex Acquier
- Conor Shaw
- Flavia de Andrade Pereira
- Karim Farghaly
- Irfan Custovic
- Omar Zerhouni
- Sebastian Blechmann (RWTH Aachen University, Germany)
- Alessandro Tell
- Andreas Wilde
- Allan James
- Christian Schmid
- Timothy Rossi

Please join the W3C LBD CG and subscribe to the internal mailing list:
Linked Building Data Community Group (w3.org)

Presentation slides and other material

slides

Date and time

- Monday 20th of January 2025, 15:00-16:30@UTC/ 16:00-17:30@CET/ 07:00-08:30@PST

Moderators

1. Mathias Bonduel

Agenda

1. Introduction of new members
2. Flavia de Andrade Pereira on "Enabling Portable, Interoperable and Scalable Demand Flexibility Controls with Semantic Modelling"
3. Discussion
4. Further topics

Minutes

1. **Introduction of new members**
    a. Andreas Wilde, colleague of Hervé Pruvost, and also working together with Sebastian Blechmann
    b. Alessandro Tell, from Empa, working on digital twins, together with Sergio Acero Gonzalez
    c. Alex Acquier, University of Galway, starting to work in semantic web, working on developing models for geothermal systems, embedded energy and carbon in materials

2. **Flavia de Andrade Pereira on "Enabling Portable, Interoperable and Scalable Demand Flexibility Controls with Semantic Modelling"**
    a. The presentation is related to the PhD work of Flavia, conducted as part of the CBIM MSCA network. Find her work on Google Scholar: https://scholar.google.com.br/citations?user=CVNjPjMAAAAJ&hl=pt-BR
    b. Research scope (**portability, interoperability, scalability**)
    c. Different issues with renewable energy:
        i. Renewable overgeneration
        ii. Growing peak demand
        iii. Steep backup ramp
    d. This is where demand flexibility/demand management comes into place. Flavia focused on Shift Load and Shed Load. The thesis focused on the lack of standardization, interoperability, and the lack of control algorithms.
    e. The lack of interoperability and standardisation is led by buildings' heterogeneity. This leads to building-specific applications, where a lot is hardcoded, and such applicaitons are hard to reuse in other buildings.
    f. Semantic models can enable more consistent data across buildings. Most of the plug-and-play work using semantic models does not focus on building control, but on analytics. Semantics-driven demand flexibility exists, but the ontologies are custom-built and logic is often embedded in the ontology.
    g. Three milestones in the work.
        i. The initial framework (**portability)**: https://www.sciencedirect.com/science/article/pii/S2352710224002134
        ii. The extended framework (**interoperability**): https://www.sciencedirect.com/science/article/pii/S1474034624007006
        iii. DFLEXLIBS (**scalability**): https://github.com/LBNL-ETA/DFLEXLIBS
    h. **Milestone 1: Semantics-driven framework for portable apps.**
        i. framework to enable portability and to reuse data models and algorithms in other buildings.
        ii. Finding: not only the data models, but also the control algorithms should be flexible enough to be able to be reused in other buildings. This is developed in the **development phase**
        iii. In the **validation phase**, it is tested whether the building matched metadata requirements (using SHACL)
        iv. In the **deployment phase**, cross-platform deployment is developed and tested.
        v. The ideas for portability came from the mobile phone/app industry (mobile cross-platform deployment), where different operation systems (android, iphone os), have abstraction layers to ensure that apps run on different phones and can communicate with each other.
        vi. Key takeaways:

1. Portability of controls relies on platform-specific dependencies and site-specific constraints
    a. Interfaces that account for customization beyond semantic models
2. Semantic models do not fully solve the data mapping challenge
    a. Automated, consisted semantic model generation based on well-established ontologies
3. Generalisability of controls relies on lower-level logic and existing systems
    a. Comprehensive testing across different scenarios

i. **Milestone 2: Extended framework for interoperable apps**
    1. Proposes a novel alignment between Brick and SAREF
    2. Introduces metadata mapping methods for BIM and BAS
    3. Introduces an actor and microservices middleware platform

ii. Brick and SAREF had some concepts that could be directly related to each other, but some needed rule based alignment (e.g. TemperatureSensor is a concept that does not exist in SAREF, so additional concepts from quantitykind were used)

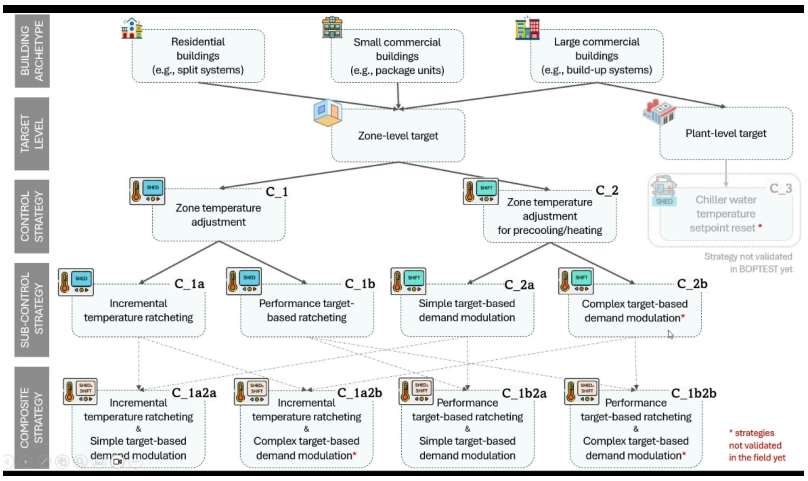
iii. A demonstration project (real building in Greece) was serialized in a both a Brick and a SAREF graph.

iv. Then, the actor and microservices-based platform handles the application logic, independent from the data models

v. Key takeaways:
    1. BIM helps to add contextual info to BAS
    2. Mapping relies on having a common instance presented in both the BIM and BAS (e.g. common device IDs)
    3. Reliance on proper IFC modeling and proper CSV files
    4. No single data source needs to capture everything
    5. SAREF and Brick both lack Demand Flexibility concepts
    6. SAREF lacks expressiveness (zones, HVAC concepts)
    7. Brick can support simple DF but lacks complex HVAC topology

j. **Milestone 3:** DFLEXLIBS: DF controls library using semantics

i. Portable DF controls and analytic apps that have been tested with simulation models in BOPTEST

ii. 

iii. Main output was that both controls and analytics apps were able to be reused in other buildings (only changing 2 lines of code)

iv. Some work was done on a GUI.

v. Key takeaways:

1. Controls performance vary, as buildings and situations in which they operate vary
2. This work integrates fragmented research fields

k. Conclusion

i. Novel semantics-driven frameworks enhancing DF control applications in terms of Portability, Interoperability, Scalability
ii. The work presents 13 developed controls, is tested in 2 real and 4 virtual buildings, and promises to save effort and energy.

l. Future work

i. Comprehensive assessment of the framework benefits
ii. extend existing ontologies
iii. addition of new controls to the library
iv. comprehensive analytics with controls results
v. compliance with new standards
vi. more robust GUI
vii. Explore LLMs to automate semantic model generation

m. Research impact

i. First work proven semantics-driven portability of buildings controls
ii. Open source solutions: DFLEXLIBS, Mapping algorithms

3. Discussion

a. [Sebastian]: Do you have solutions for buildings without IFC files?
b. [Flavia]: If there is no IFC, an alternative is to fill different CSV templates to generate a basic knowledge graph.
c. [Mathias]: Even if there is an IFC file, the most valuable data is relations between objects, but this is often missing in IFC.
d. [Flavia]: A colleague (Dimitrios Mavrokapnidis) worked on generating those knowledge graphs, some of those solutions might be open source.
e. [Timothy]: Great presentation, thank you! Will you provide the slides for us to view? And do you have a link or website for us to view your work! Thank you, Tim
f. [Flavia]: I will upload the slides and add links to the github.
g. [Karim]: Shouldn't we first define which datapoints we need, and then collect those in a structured manner?
h. [Flavia]: There are different types of buildings, with different needs, and this leads to different setups of datapoints. We cannot predefine the datapoints for all buildings, as some buildings needs a different setup. Therefore, the microservices that we build should be able to cope with those different setpoints.
i. [Karim]: Do you need such detailed BIM, couldn't you get certain links (e.g. device location) from CSV files?
j. [Flavia]:
k. [Karim]: Have you thought about Digital Product Passports? Several information in there that can help in the control of buildings.
l. [Flavia]: We didn't use DPP, but it's a very good suggestion to use this in the future
m. [Alex]: The need for a common instance between files limits a lot of data integration. Any idea on how to (in general) tackle this problem in the future?
n. [Flavia]: It is more a training issue than a technological issue. We need to train people to create such identifiers. It is hard to automate this. Maybe inference of other information.
o. [Alex]: How easy is it for others to contribute to DFLEXLIBS?
p. [Flavia]: There is a readme on github (https://github.com/flaand/DFLEXLIBS) explaining how to extend our work.

q. [Mathias]: Any insights from other domains on how they look at the data interoperability challenges? If you had to give some potential downsides to semantic interoperability, what would they be? Did you talk to developers that were not so used to working with semantic web technologies.
r. [Flavia]: We try to make it as easy as possible for developers to use the work, and not interact with SPARQL or other semantic web technologies. The middleware takes care of the semantic web technologies, and we expose the results through an API. Users interact with the API via a GUI, and the middleware automatically generates SPARQL queries / deals with the graphs.
s. [Mathias]: Suggestion from the people of RealEstateCore, they are working with Microsoft (DTDL). They allow building ontologies in Azure DT, trying to make the barrier to work with graphs lower.

4. **Further topics**

Next Call

- 17/02/2025, Monday, 15:00-16:30@UTC/ 16:00-17:30@CET/ 07:00-08:30@PST

  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://github.com/w3c-lbd-cg/lbd/tree/gh-pages/minutes