W3C LBD Community Group
Minutes - Call 06/04/2021

Attendees:

- Ana Wagner (Individual affiliated to PROSTEP)
- Karl Hammar (Jönköping University, Sweden)
- Katja Breitenfelder (Fraunhofer IBP, TU Munich)
- Mathias Bonduel (KU Leuven and Neanex Technologies)
- Philipp Hagedorn (RU Bochum, Germany)
- Jeroen Werbrouck (UGent / RWTH)
- Peter Imbrechts (Neanex Technologies)
- Jyrki Oraskari (RWTH Aachen University)
- Hervé Pruvost (Fraunhofer IIS EAS)
- Mads Holten Rasmussen (Niras, DK)
- Nico Pauen (RWTH Aachen University)
- Ko Takahashi (Shibaura institute of technology)

Presentation slides

- https://docs.google.com/presentation/d/1yJgPC8IplN9_DKvu46od39aOk01L40tvp65M51u75ks/edit#slide=id.gca26a9dcee_0_139
- 2021-02-06 -- DTDL Ontology Use in Azure Digital Twins.pdf

Date and time

- 06/04/2021, Tuesday, 16:00-17:30@UTC/ 17:00-18:30@CET/ 08:00-09:30@PST/ 00:00-01:30@CST

Agenda

1. Introduction
2. New participants
3. **Presentation 'DTDL ontology modelling and utilization within Azure Digital Twins'** by Karl Hammer
4. Q&A
5. Further topics

Moderators

1. Anna Wagner

Minutes

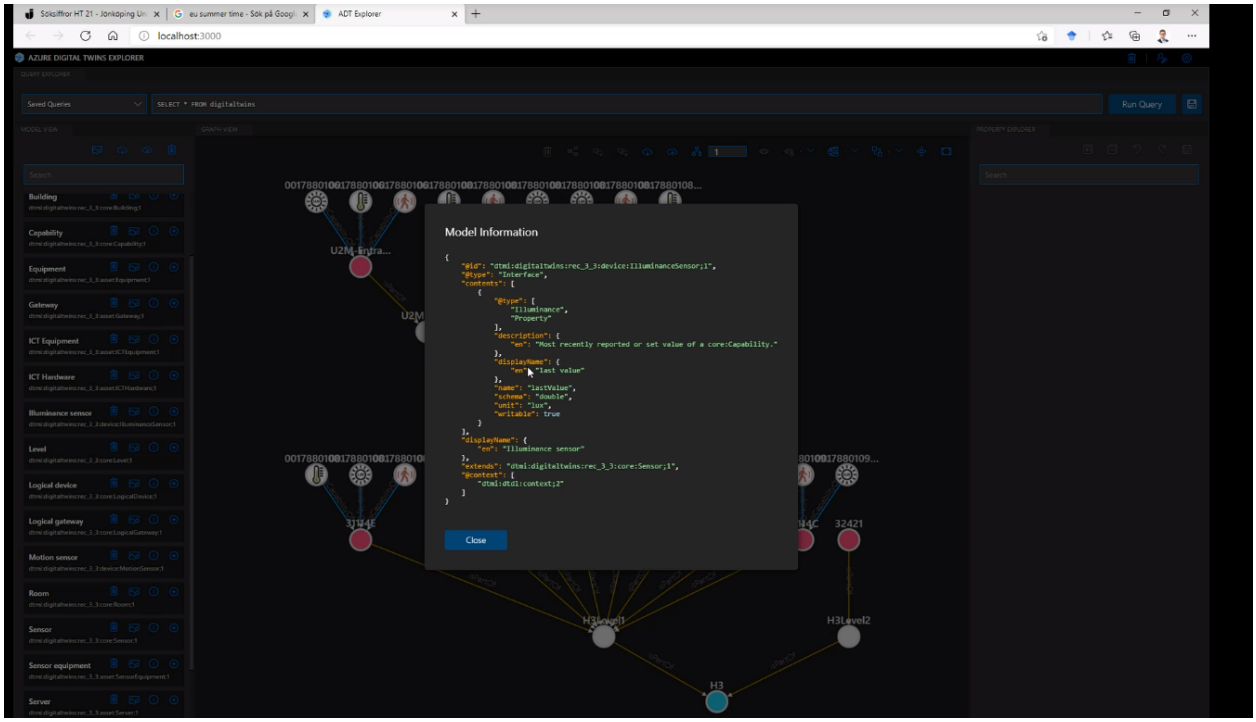
1. Introduction
    a. Call for participation by chairs:
        i. elevator pitches and PhD talks
            1. see accompanying slides for the format
            2. Talk to us, via email or before/after calls
        ii. 1st Focus group workshop: pitches at start
            1. **Call of 04/05/2021**
            2. see accompanying slides for the format
            3. Fill in form (open till 20/04/2021)
2. New participants
    a. none
3. **Presentation 'DTDL Ontology Use in Azure Digital Twins'** by Karl Hammar
    a. General overview
        i. RealEstateCore (REC) ontology: updates since previous presentation in the group
        ii. Overview of MS Azure IoT services: digital twins, IoT Hub, IoT Edge, etc.
        iii. DTDL (Digital Twin Definition Language): modeling language of MS for some of the MS services
        iv. Translation of DTDL to REC and other ontologies
        v. Small implementations examples
    b. RealEstateCore (REC) ontology
        i. Non-exhaustive, built by and for real estate owners and operators: overview over fine-grained details
        ii. Ontology has been growing
        iii. Light edge message format: JSON-LD is comparatively verbose => built smaller schema suited for REC
        iv. OpenAPI spec auto generated from ontology: swagger, RESTful endpoints
        v. Optional certification process: consortium has for-pay service for certification (no for pay use of ontology and tools), economic ecosystem around REC but requires extra degree of compliance
        vi. REC Redux (3.3?): new concepts since last presentation in LBD group
            1. Asset: not part of building itself, rather systems (furniture, access control systems, HVAC systems, etc.); developed together with Willow, influenced by Brick Schema
            2. Capability: point, influenced by Brick Schema
            3. Improved spatial model influenced by BOT

4. Agent: more exhaustive then FOAF (companies, dept)

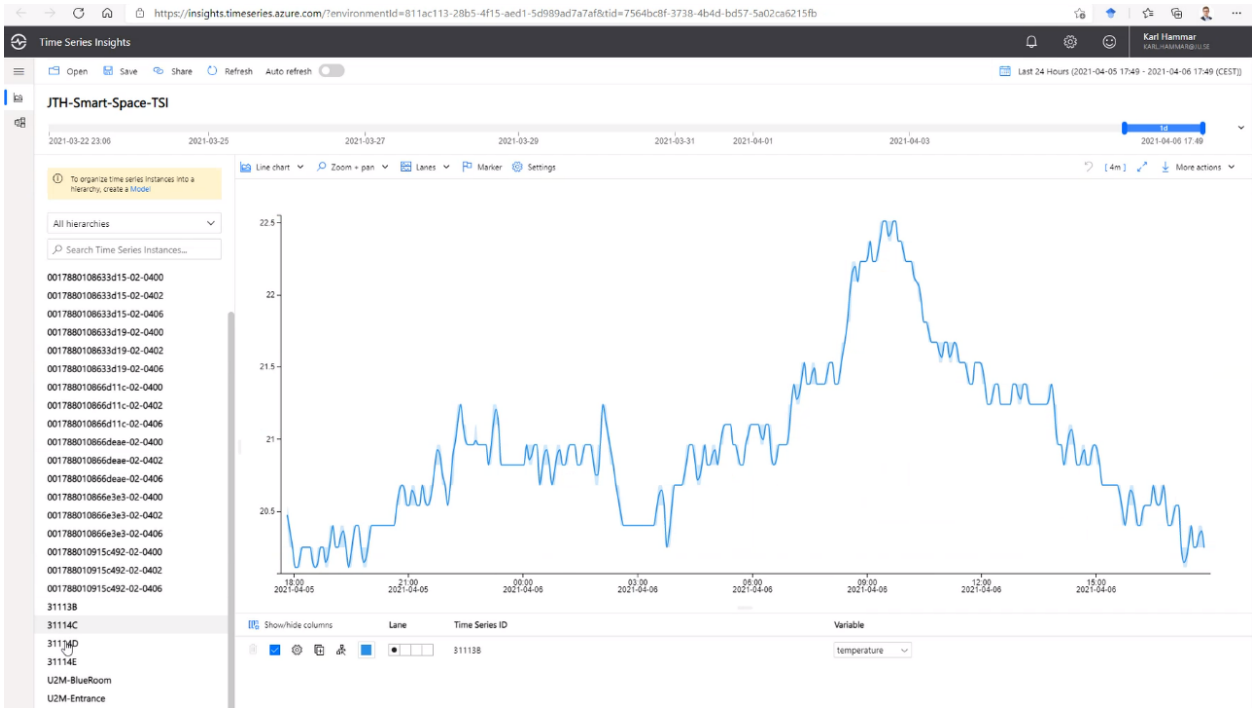
c. Microsoft Azure IoT services
    i. IoT Edge: install runtime on device, manage devices centrally (Cloud2Device and Device2Cloud)
    ii. IoT Hub: cloud counterpart of IoT Edge, software updates of Edge devices
    iii. Azure Digital Twins platform
        1. Graph database
        2. When you update the state (e.g. room temp), can push to other services that either update the graph (propagating state changes) or provide some other value (e.g. Time Series Insights)
        3. Uses DTDL modelling language
    iv. Time Series Insights
    v. IoT Central
        1. easy, drag-and-drop (software as a service vs. platform as a service)
    vi. Example diagram
        1. B: ingestion, pushes to IoT Hub
        2. A: azure function (serverless function), updates graph database
        3. C: change is pushed to event grid (messaging), which triggers another function and updates the room data; also possible to send to other systems
d. DTDL
    i. Digital twin alternative to OWL: basic building blocks to build a digital model
    ii. Based on JSON-LD, “Interface” (~class, root)
    iii. Interfaces have content:
        1. Telemetry
        2. Property: e.g. sensitivity
        3. Command: e.g. ‘open lock’ command for locked door (request-response)
        4. Relationship: have targeted interfaces
        5. Component: nested components, part of same interface by value
    iv. Interfaces can extend (subsumption hierarchy)
    v. URNs as identifiers instead of HTTP URIs/IRIs often used in OWL/RDF world
    vi. Example of interface def:
        1. Note: URN for @id
        2. Conference room1 inherits from room1, thus inherits property ‘occupied’
e. Translation of OWL to DTDL
    i. OWL classes = Interface
    ii. rdfs:label = displayName (also multilinguality support)

iii. Subclass = extends property
iv. OWL Object prop = relationships
v. OWL Datatype prop = property
vi. XSD datatypes = DTDL primitives (fallback to string if needed)
vii. DTDL can have properties on relationships (not possible in OWL)
viii. DTDL inclusion as value not possible/relevant
ix. Developed OWL2DTDL tool (CLI): generic and thus applicable to any ontology but applied already on REC
x. DTMI (Digital Twin Model Identifier) minting: reuse URIs of OWL classes
xi. Generated DTDL version of REC ontology: openly available under Azure organisation on GitHub; supported by MS

f. Demo on JTH Smart Space demonstrator, built at the Jonkoping University
   i. Visualisation using Time Series Insights and Azure Maps service of MS
   ii. Basic pipeline:
      1. Philips Hue equipment: devices - Hue Bridge
      2. IoT Edge / Hub
      3. Azure Digital Twins
   iii. Value of using REC edge: reusable building block for other types of sensors, other buildings
   iv. Live demo:
      1. Azure explorer: accompanying to Azure platform, model information at the right (e.g. temp sensor)
         a. Ideally updated directly (current state)
         b. can be queried



2. Time Series Insights:
    a. Charts, compare/combine
    b. All custom built using standard building blocks



g. What's the point?

i. Rel. easy to combine standard pieces
ii. Trade-off by moving outside OWL comfort zone: WOP paper
    1. principles to adhere to when modeling in OWL, e.g.
    2. don't use property inheritance as not used in much other languages
    3. Built subsumption hierarchy on real world situation instead of trying to create nicely balanced trees
    4. Don't use owl:imports as difficult to convert to other modeling languages
    5. ...
iii. Azure is not open-source, PaaS but at the same time it's easy to apply/start, exposure together with smart spaces team at MS

4. Q&A

a. [Anna] which trade-offs did you have to make when moving outside OWL. Benefits of using OWL directly in Azure
    i. Reasoning is gone, not used often in real world
    ii. Multiple inheritance, DTDL allows 2 inheritance limit (don't know why this limit)
    iii. DTDL is explicitly directed to digital twins: digital and physical representation; gets weird for non-tangible things that OWL models sometimes represent
    iv. Legacy systems (BMS systems):
b. [Hervé] Integrating sensors from different brands with different protocols? How would you do this?
    i. HueBridge was integrated using simple REST API
    ii. Need to write a new connector for other protocols: we can share it with others (repo with edge modules is open, available here. Currently one for the HueGateway but others will follow). Suppliers might be in charge for the development when requested by users
c. [Anna] Can you go from DTDL to OWL? Would it be possible? Desirable?
    i. DTDL has properties on relationships: possible but becomes (unorthodox) annotations
    ii. Data in ecosystem is JSON-LD but not stored/serialized as RDF (CosmosDB), e.g. no SPARQL support. Possible to import/export RDF

5. Further topics
    a. Reminder: Invitation to present "Elevator Pitches" at the beginning of a regular W3C LBD CG call
    b. Reminder: Call for 'Focus Group Pitches' via form and invitation to participate in the first 'Focus Group Workshop' on 04/05/2021

Next Call

- 20/04/2021, Tuesday, 15:00-16:30@UTC

  Agenda: Linked Product Data: Describing Multi-Functional and Parametric Building Products - Anna Wagner

  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/