



# THE W3C LINKED **B**UILDING **D**ATA COMMUNITY GROUP

## Chairs:

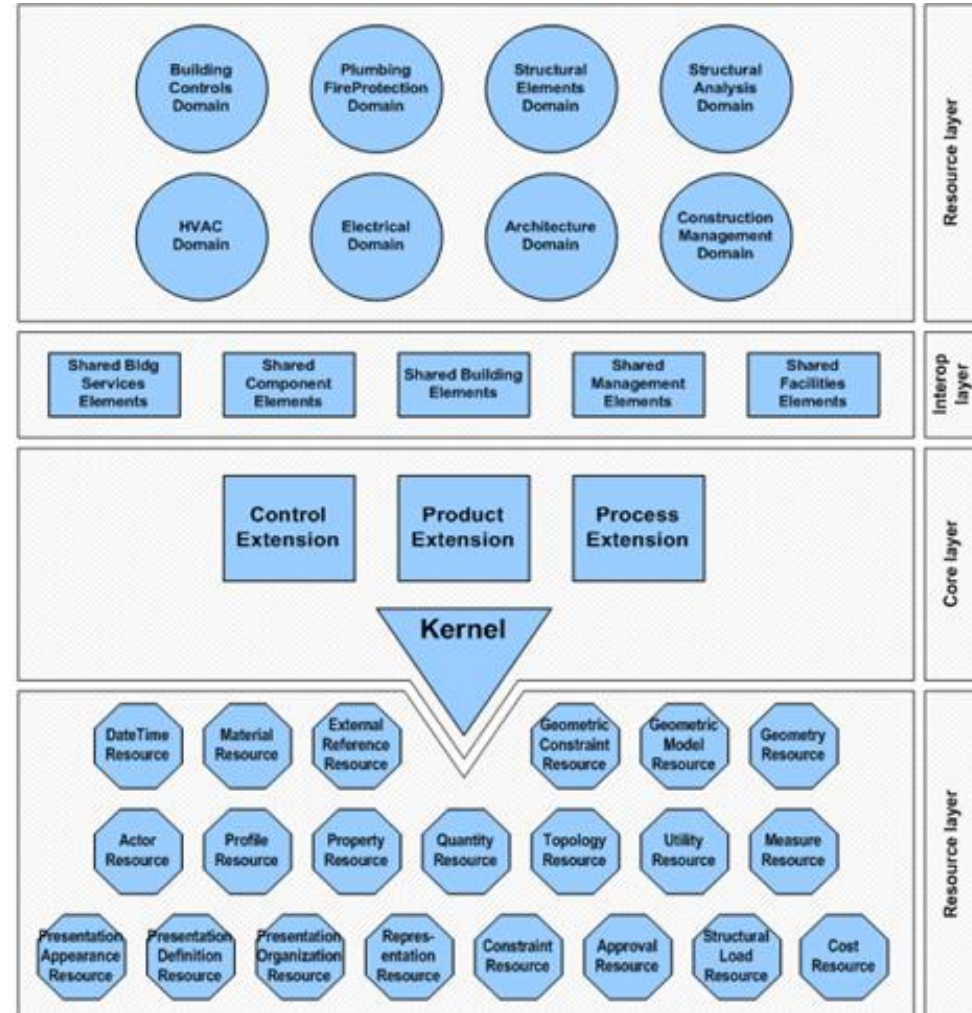
- Kris McGlinn, Trinity College Dublin, Ireland
- Georg Ferdinand Schneider, Schaeffler Technologies AG & Co. KG, Germany
- Maxime Lefrançois, MINES Saint-Étienne, France
- Mads Holten Rasmussen, NIRAS, Denmark

# THE CURENT PROBLEM:

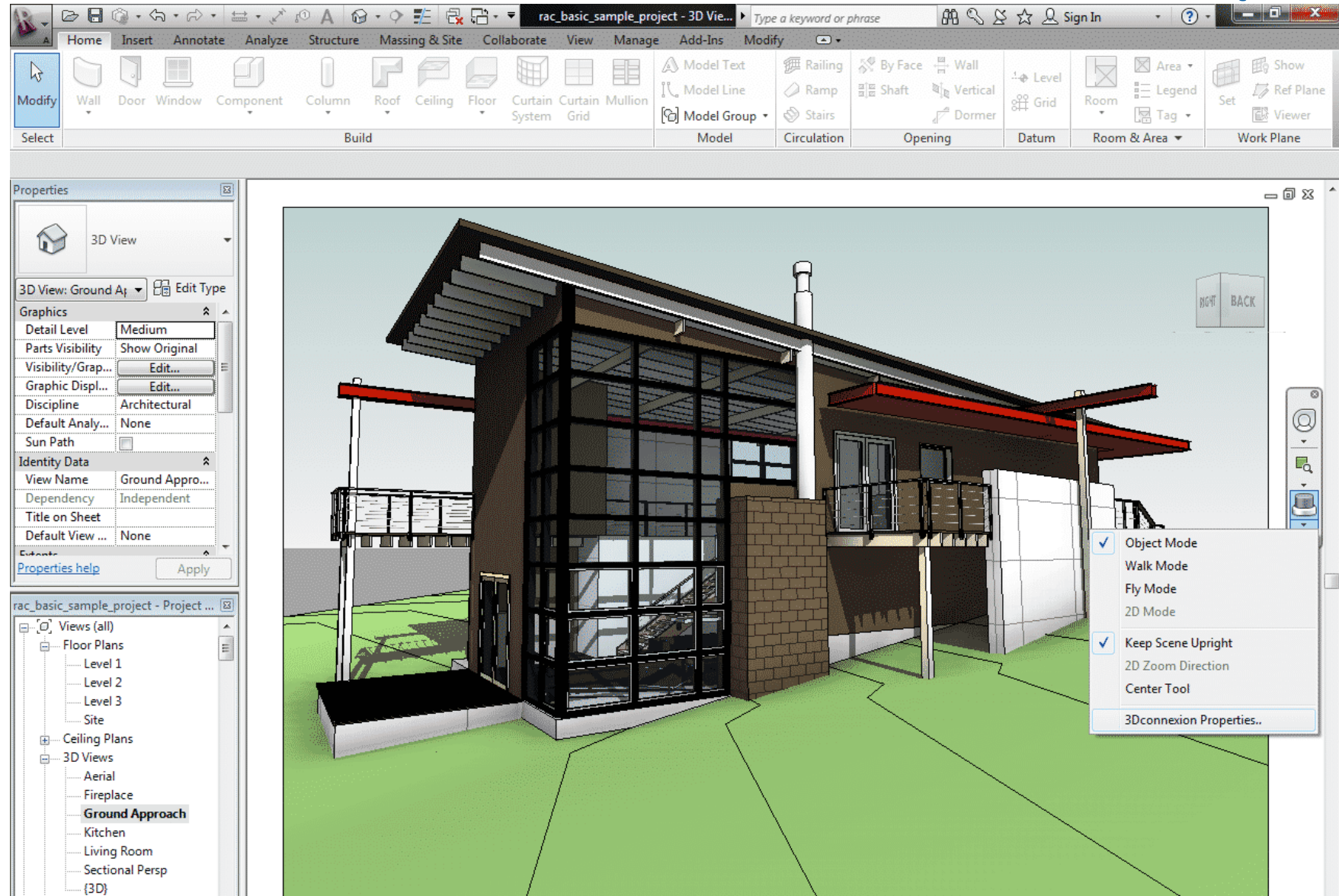
## INDUSTRY FOUNDATION CLASSES (IFC)

There exists a standard, but:

- not modular
- not extensible
- not simple enough to use
- AND not Web-compliant !

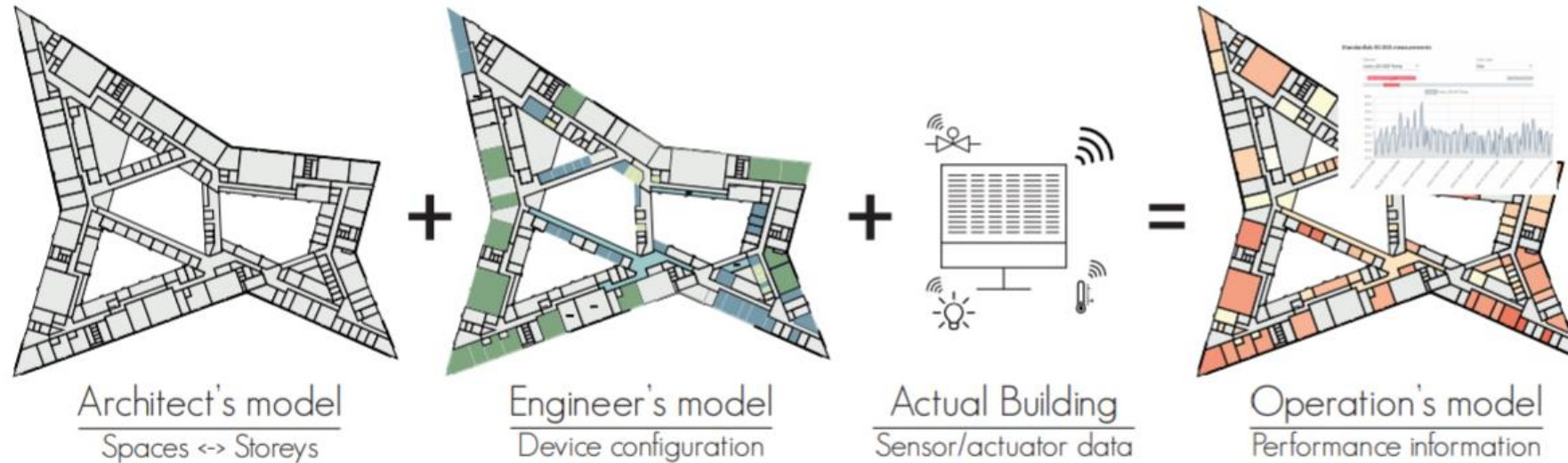


# BUILDING INFORMATION MODELLING (BIM)<sup>3</sup>





# BUILDING LIFE CYCLE



Vast amounts of heterogeneous data produced during the **life cycle of a building**:

- product data (building elements)
- sensor measurements data
- usage data
- intelligent domotic system data
- geographical data, weather data, ...

# INDUSTRIAL POINT OF VIEW

The Linked Data and Knowledge Graph technologies create opportunities for the industry:

- indoor navigation
- energy efficiency simulation
- web-based facility management
- and many more (cf. prop-tech)

# WHAT IS OUR MISSION

Bring together experts in the area of Building Information Modeling (BIM), who are working to address the challenge of managing the huge amount of data that is generated across the building life cycle.

We want to provide a forum for bringing together researchers and practitioners who are working on advancing the field.

<https://www.w3.org/DesignIssues/LinkedData.html>

## ADAPTED TO BUILDING DATA

- Using URIs as names for building-related things such as: rooms, walls, products, elements, enable different parties to provide complementary descriptions of the same uniquely identified entities in different knowledge graphs.
- Using HTTP URIs for these things enables the authority responsible for these URIs to provide reference information about this entity when one looks it up on the Web. For example, products in a catalogue, building appliances, or even the building itself.
- Providing information using common standards (RDF, SPARQL) and common Knowledge Graph models enable semantic interoperability between data sources.
- Include links to other URIs can help to discover more things, such as a link to the catalogue an appliance has been chosen from, or a link to the [Web of Things Servient](#) that enables it to interact with this appliance.



Kris McClinn  
University of Glasgow



Georg Ferdinand Schneider  
University of Cologne



Maxime Lefrançois  
Université de Lyon



Mads Holten Rasmussen  
University of Copenhagen

# WHO WE ARE (2020)

started Dec. 2014  
now 143 participants  
18th biggest W3C CG

## Participants

Yongwon Jeong Korea University	Weining Huang University of Science and Technology of China	Walter Torka University of Cologne	Vladimir Vukobratovic University of Zagreb	Ville Rakkonen University of Jyväskylä	Victor Malvar University of Zaragoza	Tomislav Novak University of Zagreb	Thomas Polach University of Cologne	Thomas Rijnse University of Cologne	Ted Galt University of Colorado	Tereza Mendes de Faria University of Coimbra	Sylvain MARIE University of Lyon	Stefan Hesse University of Cologne	Srinivasan Venkatesh University of Cologne	Søren Rasmussen University of Copenhagen	Simon Douma University of Cologne	Silvia Costa University of Cologne	Sören Petersen University of Cologne	Serge Chénais University of Cologne	Seppo Törmä University of Jyväskylä	Sebastian Fella Zappe University of Cologne	Sander van der Velden University of Cologne	Sander Smits University of Cologne	Rui Ma University of Cologne	Rui de Klerk University of Cologne	Richard Pinks University of Cologne	Riccardo Turchi University of Cologne	Raúl García Castro University of Cologne
Radej K. Soman University of Cologne	Frank van der Velden University of Cologne	Pradyumn Singh University of Cologne	Pieter Steneker University of Cologne	Pim van den Heuvel University of Cologne	Pierre Couper University of Cologne	Peter Kropf University of Cologne	Mihail Stoeckert University of Cologne	Niklas Pauer University of Cologne	Niklas HBS University of Cologne	Nathalie Labonne University of Cologne	Nathalie Chabert University of Cologne	Nam Vu Hoang University of Cologne	Mr. Sorey University of Cologne	Mithra Ponnusamy University of Cologne	Mikel Spertzi University of Cologne	Michel Böhme University of Cologne	Michael Pechenkin University of Cologne	Mehdiad Nikan University of Cologne	Maximilian Roth University of Cologne	Matthias Weiser University of Cologne	Matthew Waychoff University of Cologne	Mathias Bandtke University of Cologne	Mathias Beyerle University of Cologne	Marcin Misiński University of Cologne	Maria Poveda-Villalba University of Cologne	Marijn Heule University of Cologne	
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Jan Koh University of Cologne	Jan Veldhuis University of Cologne	Jelle Dierckx University of Cologne	Jelle Prins University of Cologne	Steffen Winkler University of Cologne	Tie Yan University of Cologne	Gino Gatta University of Cologne	George Chen University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	François Besset University of Cologne	
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# HOW WE WORK

- W3C entrypoint: <https://www.w3.org/community/lbd/>
- Group entrypoint: <https://w3c-lbd-cg.github.io/lbd>
- On GitHub <https://github.com/w3c-lbd-cg>
- Public mailing list
- Regular online calls (every 2 weeks), minutes public, joint note-taking
- Laisons with other groups and initiatives :  
BuildingSMART, ETSI SmartM2M, OGC, AFNOR, CEN, ISO,  
RealEstateCore, AIOTI WG3, ASHRAE 223 Semantic Interoperability,  
Brick Schema, AACE International, German expert groups "BIM und  
Holzbau" ("BIM and wood") and "Stahlbauforum" ("Steel  
construction")

# LINKS TO EXISTING STANDARDISATION GROUPS



ISO TC59 SC13 : ISO 21597 Information Container for Data Drop (Parts 1&2), ISO 23262 GIS and BIM interoperability (TR)  
ISO TC184 SC4 : WG12 T1 « Geometry Topology Ontology Feasibility »



buildingSmart Data Dictionary (bSDD)  
Linked Data Working Group (LDWG)



CEN TC 442 Building Information Modelling – WG4 Support Data Dictionaries “Semantic Modeling & Linking Guide”  
CEN TC 205 WG19 Reference Ontology for Smart Appliances (CENELEC)



ETSI SmartM2M SAREF (Smart Applications Reference ontology)  
<https://saref.etsi.org/>



ASHRAE 135/223P BACnet Semantic Interoperability Working Group  
<https://www.ashrae.org/technical-resources/standards-and-guidelines/titles-purposes-and-scopes#223P>



PPBIM : Dictionary of properties, Infrastructure, Processes  
IDMI : Geometry Ontology



French national plan for buildings' digital transition

# POSSIBLE LINKS TO OTHER W3C GROUPS

W3C

Interest Groups

Working Groups

Community Groups

Dataset  
Exchange

**Web of  
Things**

**Spatial  
Data on  
the Web**

Automotive  
(V2Building?)

Data  
Exchange

**Web  
of  
Things**

Schema.org

Blockchain

**Automotive  
ontology**



# WHAT WE PRODUCE

Some of us push their work in the group



# Linked Building Data Community Group Use Cases & Requirements



Draft Community Group Report 19 October 2018

Latest editor's draft:

TABLE

overview of the structure of the document

(at <https://w3c-lbd-cg.github.io/lbd/UseCasesAndRequirements/> )

-Étienne)

1.

2.

## Deliverables

- 2.1 Use Cases and Requirements
- 2.2 Linked Building Data on the Web Best Practices
- 2.3 BOT - Building Topology Ontology
- 2.4 PRODUCT - Building Product Ontology
- 2.5 PSET - Building Element Property Ontology
- 2.6 GEOM - Geometry Ontology
- 2.7 Alignment with building control and automation domain
- 2.8 Alignment with building units and measurements domain

3.

## Methodology

4.

## Use Cases

- 4.1 Interlinking Irish Building Data Based On Authoritative URIs
- 4.2 Property on partial element
- 4.3 Reasoning on geometry
- 4.4 Materializing requirements
- 4.5 Design: heat loss computation for

## Repository:

[We are on GitHub](#)

[Copyright](#) © 2018 the Contributors to the Linked Building Data Community Group Use Cases & Requirements Specification, published by the [Linked Building Data Community Group](#) under the [W3C Community Contributor License Agreement \(CLA\)](#). A human-readable [summary](#) is available.

## Abstract

This document describes use cases that demand a combination of linked data technologies for the building domain. It underpins the collaborative work of the [Linked Building Data Community Group](#) operated by the [W3C](#).

## Status of This Document

This specification was published on the W3C Standards [\(CLA\)](#) there is a limited of [Groups](#).

If you wish to make comments

Comprehensive use case gathering is conducted across the LBD community, and also wider research and industrial communities (as part of the h2020 SWIMing project)

Used to identify deliverables and their scope in the charter

Currently **54 use cases, 7 requirements**

# BOT (BUILDING TOPOLOGY ONTOLOGY)

overview of the structure of the document (at <https://w3id.org/bot/> )

W3C Community Group  
Draft Report

**TABLE OF CONTENTS**

1. Introduction
2. Requirements
3. Axiomatization
  - 3.1 Namespace
  - 3.2 Overview of Classes and Properties
  - 3.3 Zones and sub-zones
    - 3.3.1 Overview and Examples
    - 3.3.2 Specification
      - 3.3.2.1 bot:Zone
      - 3.3.2.2 bot:Site  $\sqsubseteq$  bot:Zone
      - 3.3.2.3 bot:Building  $\sqsubseteq$  bot:Zone
      - 3.3.2.4 bot:Storey  $\sqsubseteq$  bot:Zone
      - 3.3.2.5 bot:Space  $\sqsubseteq$  bot:Zone
      - 3.3.2.6 bot:containsZone
      - 3.3.2.7 bot:hasBuilding  $\sqsubseteq$  bot:containsZone
      - 3.3.2.8 bot:hasStorey  $\sqsubseteq$  bot:containsZone
      - 3.3.2.9 bot:hasSpace  $\sqsubseteq$  bot:containsZone
      - 3.3.2.10 bot:adjacentZone
      - 3.3.2.11 bot:intersectsZone
  - 3.4 Elements
    - 3.4.1 Overview and Examples
    - 3.4.2 Specification
      - 3.4.2.1 bot:Element

## Building Topology Ontology

Draft Community Group Report 18 September 2020



### Latest editor's draft:

<https://w3c-lbd-cg.github.io/lbd/bot/>

### Implementation report:

<https://w3c-lbd-cg.github.io/lbd/bot/>

### Editors:

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Pieter Pauwels (Ghent University)

Maxime Lefrançois (École Nationale Supérieure des Mines de Saint-Étienne)

Georg Ferdinand Schneider (Fraunhofer Institute for Building Physics, Technische Hochschule Nürnberg)

Copyright © 2020 the Contributors to the Building Topology Ontology Specification, published by the [Linked Building Data Community Group](#) under the [W3C Community Contributor License Agreement \(CLA\)](#). A human-readable summary is available.

## Abstract

The Building Topology Ontology (BOT) is a minimal ontology for describing the core topological concepts of a building.

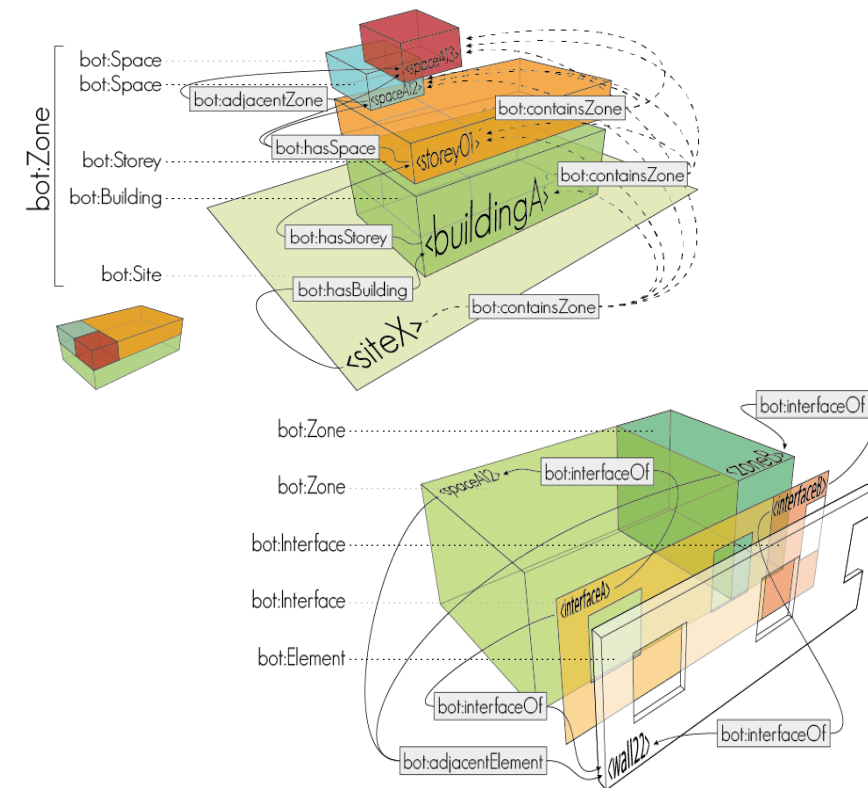
The namespace for BOT terms is <https://w3id.org/bot#>

The suggested prefix for the BOT namespace is `bot`

The Turtle version of the BOT ontology is available at <http://www.w3id.org/bot/bot.ttl>

## Status of This Document

This specification was published by the [Linked Building Data Community Group](#). It is not a W3C Standard nor is it on the W3C Standards Track. Please note that under the [W3C Community Contributor License Agreement](#)



# BOT (BUILDING TOPOLOGY ONTOLOGY)

- Outgoing links

- | BOT Resource URI | Predicate       | Aligned Resource URI |
|------------------|-----------------|----------------------|
| bot:Zone         | rdfs:subClassOf | brick:Location       |
| bot:Zone         | rdfs:subClassOf | dogont:Environnement |

“The Building Topology Ontology (BOT) is a simple ontology defining the core concepts of a building.”

- Incoming links

- | Aligned Resource URI  | Predicate          | BOT Resource URI    |
|---|--------------------|---------------------|
| brick:Building, dogont:Building, dogont:Flat, ifc:IfcBuilding, rooms:Building, saref4bldg:Building  | rdfs:subClassOf    | bot:Building        |
| brick:Equipment, brick:Point, dogont:Controllable, dogont:Device, dogont:UnControllable, dogont:TechnicalSystem                                 | rdfs:subClassOf    | bot:Element         |
| ifc:IfcElement, rooms:Desk, saref4bldg:PhysicalObject, saref4bldg:Sensor, saref4bldg:Actuator, ifc:IfcSite, rooms:Site                          | rdfs:subClassOf    | bot:Site            |
| brick:Basement, brick:Outside, brick:Room, brick:Space, brick:Wing, brick:Zone, dogont:Room, ifc:IfcSpace, rooms:Room, saref4bldg:BuildingSpace | rdfs:subClassOf    | bot:Space           |
| brick:Floor, dogont:Storey, ifc:BuildingStorey, rooms:Floor, rooms:FloorSection   | rdfs:subClassOf    | bot:Storey          |
| dogont:BuildingEnvironnement  | rdfs:subClassOf    | bot:Zone            |
| brick:contains, saref4bldg:contains   | rdfs:subPropertyOf | bot:containsElement |
| dogont:hasWallOpening   | rdfs:subPropertyOf | bot:hosts           |
| rooms:contains, saref4bldg:hasSpace   | rdfs:subPropertyOf | bot:containsZone    |

bot: <https://w3id.org/bot#>  
 brick: <https://brickschema.org/schema/1.0.2/Brick#>  
 dogont: <http://elite.polito.it/ontologies/dogont.owl#>  
 ifc: [http://www.buildingsmart-tech.org/ifcOWL/IFC4\\_ADD2#](http://www.buildingsmart-tech.org/ifcOWL/IFC4_ADD2#)  
 rdfs: <http://www.w3.org/2000/01/rdf-schema#>  
 rooms: <http://vocab.deri.ie/rooms#>  
 saref4bldg: <https://saref.etsi.org/saref4bldg/>

# BOT (BUILDING TOPOLOGY ONTOLOGY)

- Simple geolocation

**bot:hasZeroPoint** links to wsg84:Point

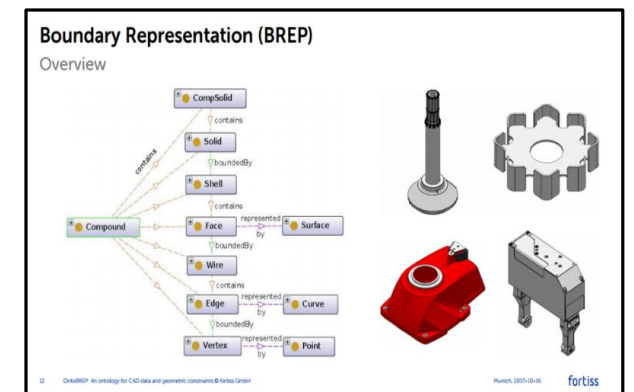
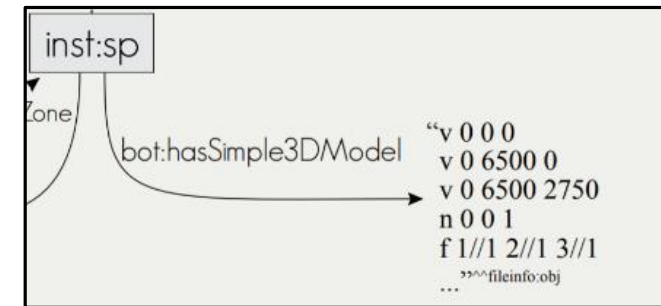
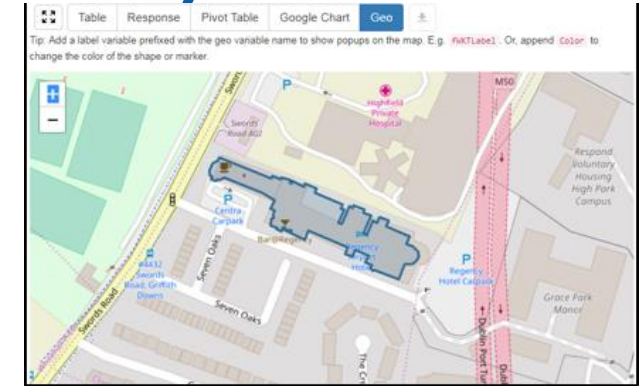
- 2D geospatial data

**bot:Building** is a subclass of **geo:Feature**, and can have geometry, which can be expressed as GeoSPARQL WKT.

- 3D geometry

**bot:hasSimple3DModel** links to a literal that encodes 3D geometry (e.g., OBJ model)

**bot:has3DModel** links to a resource that further describes the 3D geometry with another vocabulary (e.g., the Geom ontology - <http://rdf.bg/geometry.ttl> )







# SOME IMPLEMENTATIONS AND TOOLS

What our community members built

# BOT + SOSA + GEOMETRY



[https://youtu.be/P\\_38gIvrbmg](https://youtu.be/P_38gIvrbmg)

# IFCTOLBD CONVERTER

**Base URL**  
https://www.ugent.be/myAwesomeFirstBIMProject#

**Options**

PRODUCT ☒ [Read more](#)

PROPS ☒ [Read more](#)

Level 1 ☐ Level 2 ☐ Level 3 ☒ [OPM: Read more](#)

Blank nodes ☐

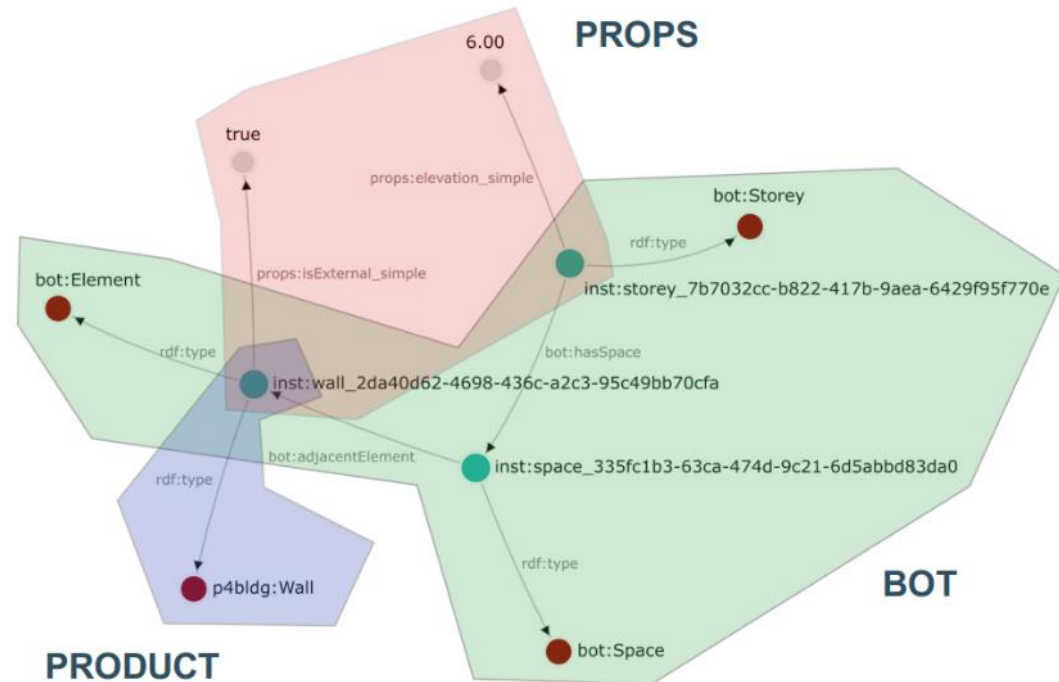
Separate file ☒

- ifcOWL Abox graph: 17428.0 KB in Turtle (227143 triples)

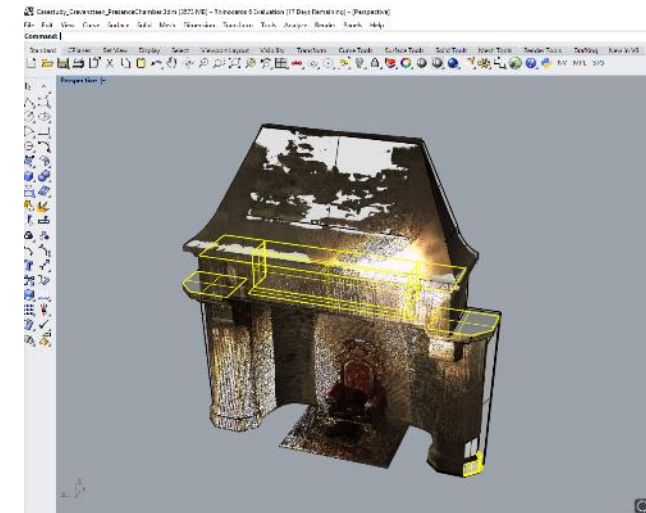
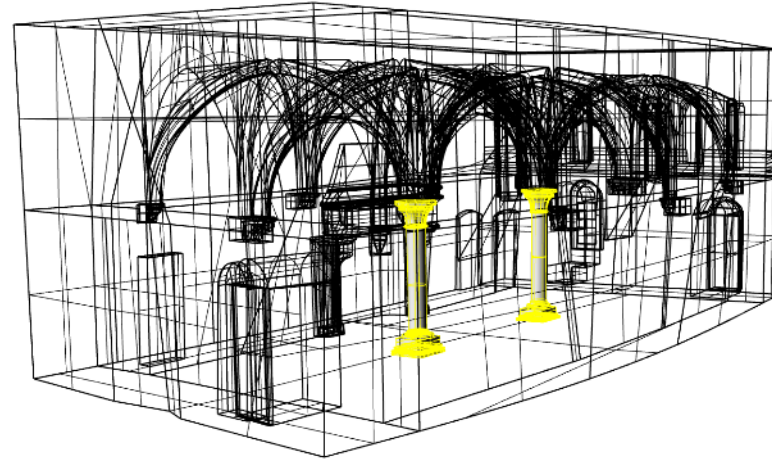
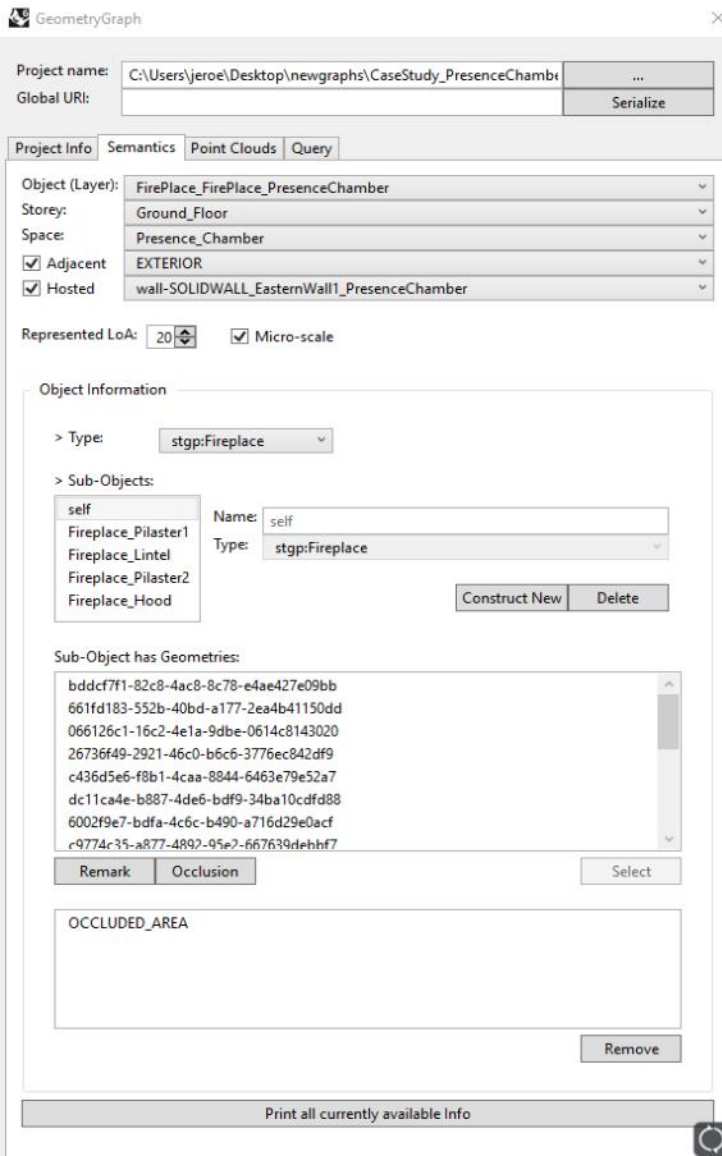
83% less  
triples

Table 3: IFCToLBD converter output results per module

BOT	PRODUCT	PROPS	TOTAL
45.5 KB (729 triples)	18.8 KB (263 triples)	PROPS L1 397.7 KB (6099 triples)	441.2 KB (7091 triples)
		PROPS L2 1665.3 KB (19831 triples)	1708.4 KB (20823 triples)
		PROPS L3 3399.0 KB (38128 triples)	3442.4 KB (39120 triples)



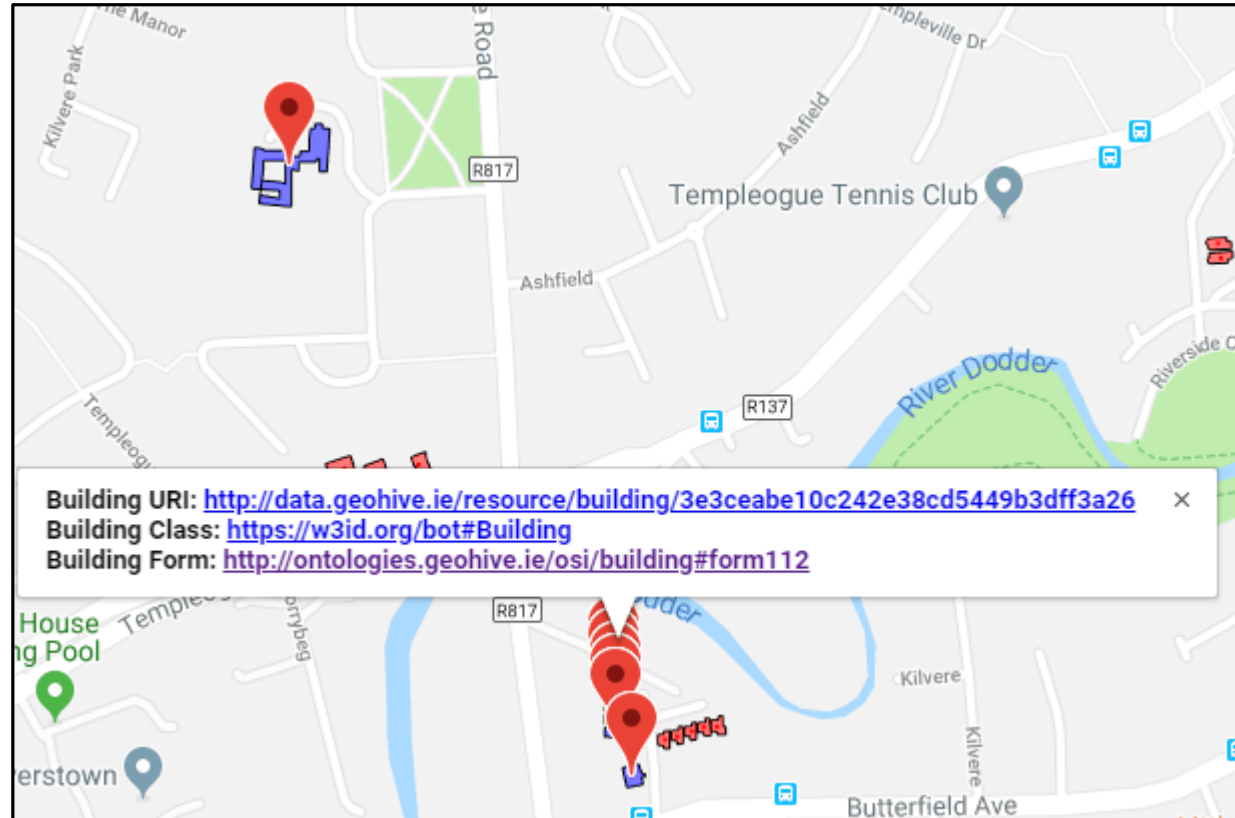
# SCAN TO LBD GRAPH





# BOT WITH ADDED GEOSPATIAL

- Using BOT to interlink Ordnance Survey Ireland building data (>3.5 million buildings)
- Provide a registry of authoritative URI's for Irish building stock.
- <http://geovis.adaptcentre.ie/>
  - Username: odef\_adapt
  - Password: geo123
- <https://www.scss.tcd.ie/~mcglink/video/tutorial/geovis/geovis.html>





# WHERE WE ARE HEADING AT?

Community as a platform and forum to gather experts and interested persons

→ Spin-off working group ? Pushing items to existing groups ?

# BUILDING DATA ON THE WEB BEST PRACTICES ?

W3C Recommendation

## Data on the Web Best Practices

W3C Recommendation 31 January 2017

**This version:**  
<https://www.w3.org/TR/2017/REC-dwbp-20170131/>

**Latest published version:**  
<https://www.w3.org/TR/dwbp/>

**Latest editor's draft:**  
<http://w3c.github.io/dwbp/bp.html>

**Implementation report:**  
<http://w3c.github.io/dwbp/dwbp-implementation-report.html>

**Previous version:**  
<https://www.w3.org/TR/2016/PR-dwbp-20161215/>

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W3C Working Group Note

## Spatial Data on the Web Best Practices

OGC® Making location count. W3C

W3C Working Group Note 28 September 2017

**This version:**  
<https://www.w3.org/TR/2017/NOTE-sdw-bp-20170928/>

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... (?)