

# LDAC2018 - 6th Linked Data in Architecture and Construction Workshop (19 - 21 June 2018)

Why software companies in construction industry  
struggle to adopt semantic web technologies?

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# From “Legacy” Systems to BIM systems

1977 - CATIA



1993 - Tekla



2004 - Tekla Structures



3DEXPERIENCE

 CATIA

1982 -  
AutoCAD



2000 - Revit

 Tekla<sup>®</sup>  
Structures

2013 -  
3DEXPERIENCE  
BIM

 TEKLA  
BIMsight

\*EXAMPLES

# IFC releases—



1997-1998 IFC 1

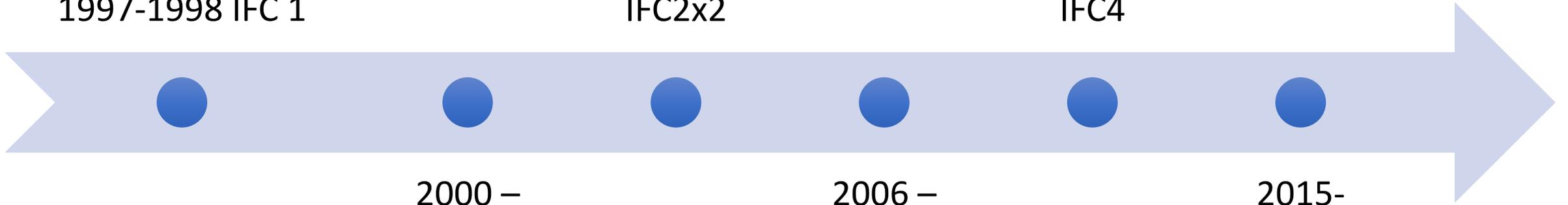
2003 –  
IFC2x2

2013 -  
IFC4

2000 –  
2001  
IFC2x

2006 –  
2007  
IFC2x3

2015-  
2016 IFC4  
Adds

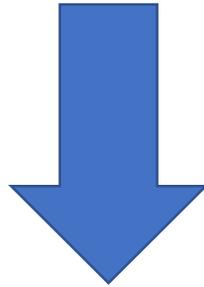


# BIM Systems' interoperability

- IFC compliance
  - 3D engines from legacy systems
  - Needs to do ETL (Extract – Transform – Load) operations
    - E.g.: IFC geometric data representation into legacy systems' data schema
- Several IFC compliant software tools do not fully implement the IFC standard
  - Loss of information
  - ETL operations are not always easy to implement

# BIM Systems' interoperability

- Data and semantic interoperability based on static text files
  - E.g.: STEP format



**Changing paradigm**

- Semantic web technologies to enhance interoperability and reduce loss of information
  - RDF serialization
  - Ontologies: ifcOWL, SSN, CobieOWL, SAREF, etc.

# Demonstrate how SW can improve BIM interoperability

(SPARQL) Federated Queries

# Federated Query



SPARQL "SERVICE"

ifcOWL



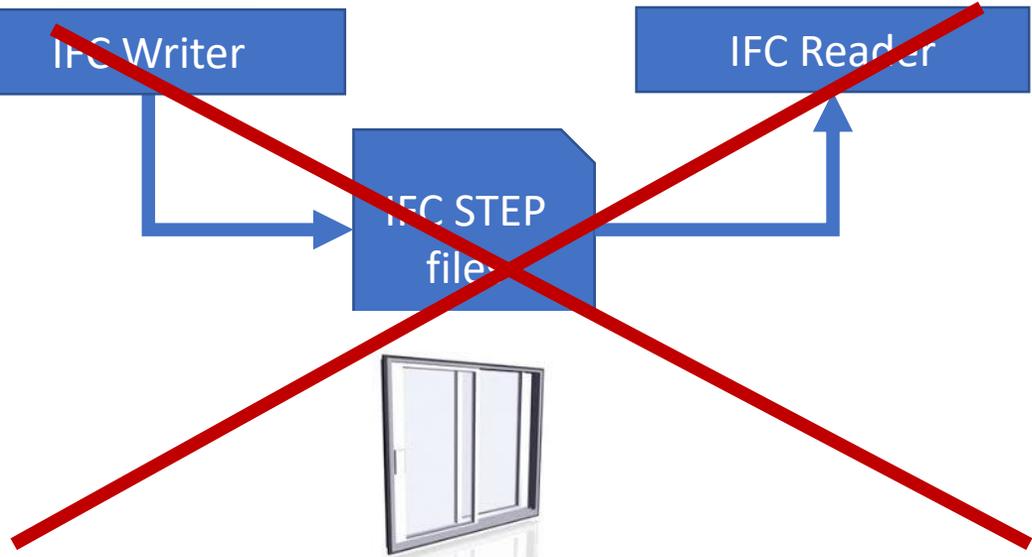
IFC Writer



IFC Reader

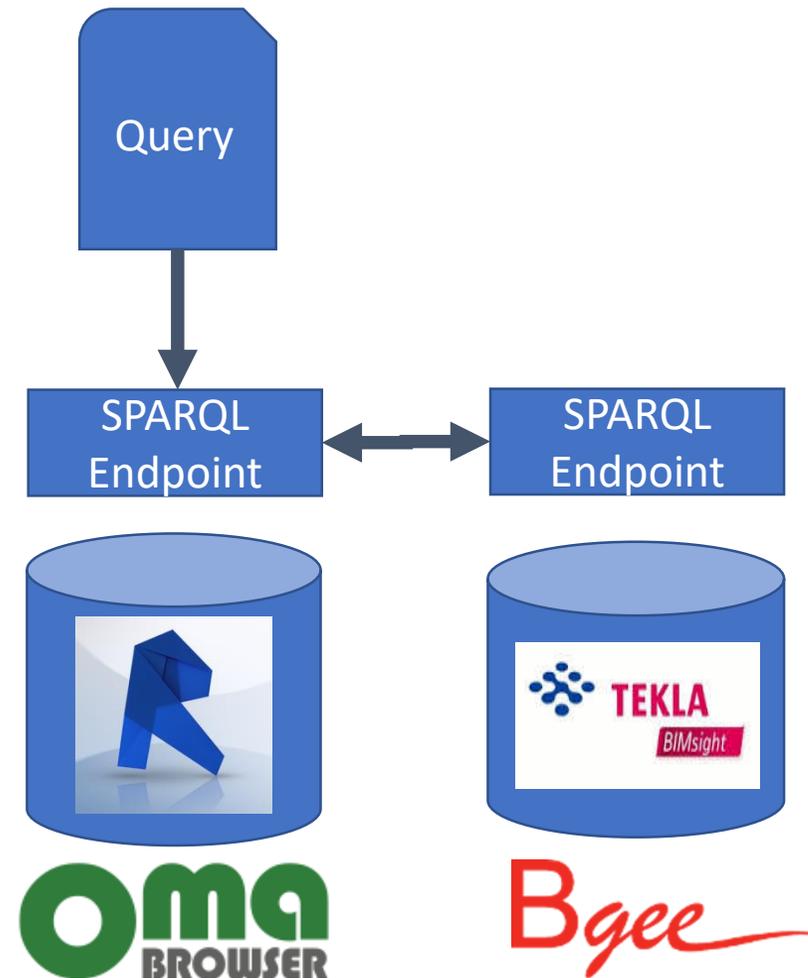


IFC STEP file



# Case study in life sciences

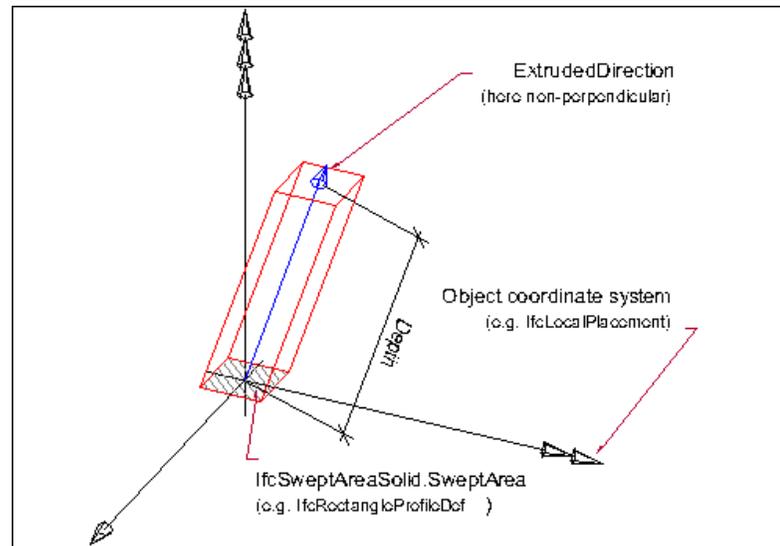
- Retrieve Rattus norvegicus' proteins that are paralogous to Rattus norvegicus' Tp53 protein and their Uniprot function annotations.



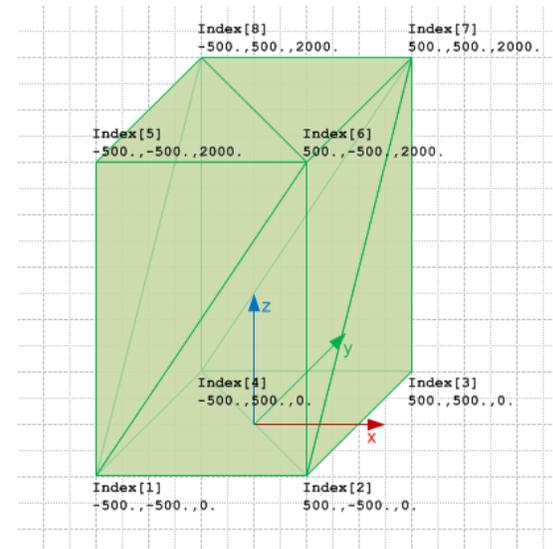
RDF serialization is not (specific)  
designed to process geometric data

# BIM Systems' interoperability

- IfcRepresentation
  - Product shape
  - Representation Types
    - 'SweptSolid' for 3D swept solids, 'Brep' for boundary representation, Tessellation



Swept solid

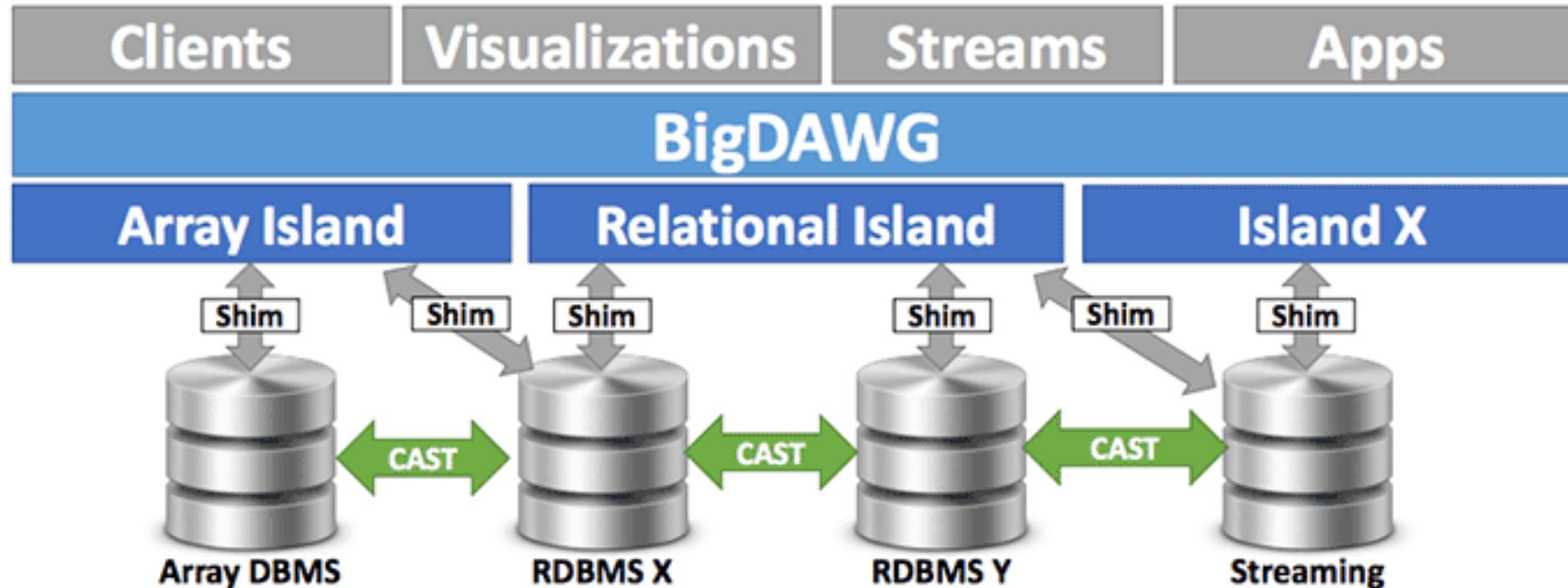


Tessellation

# A possible solution - Polystore

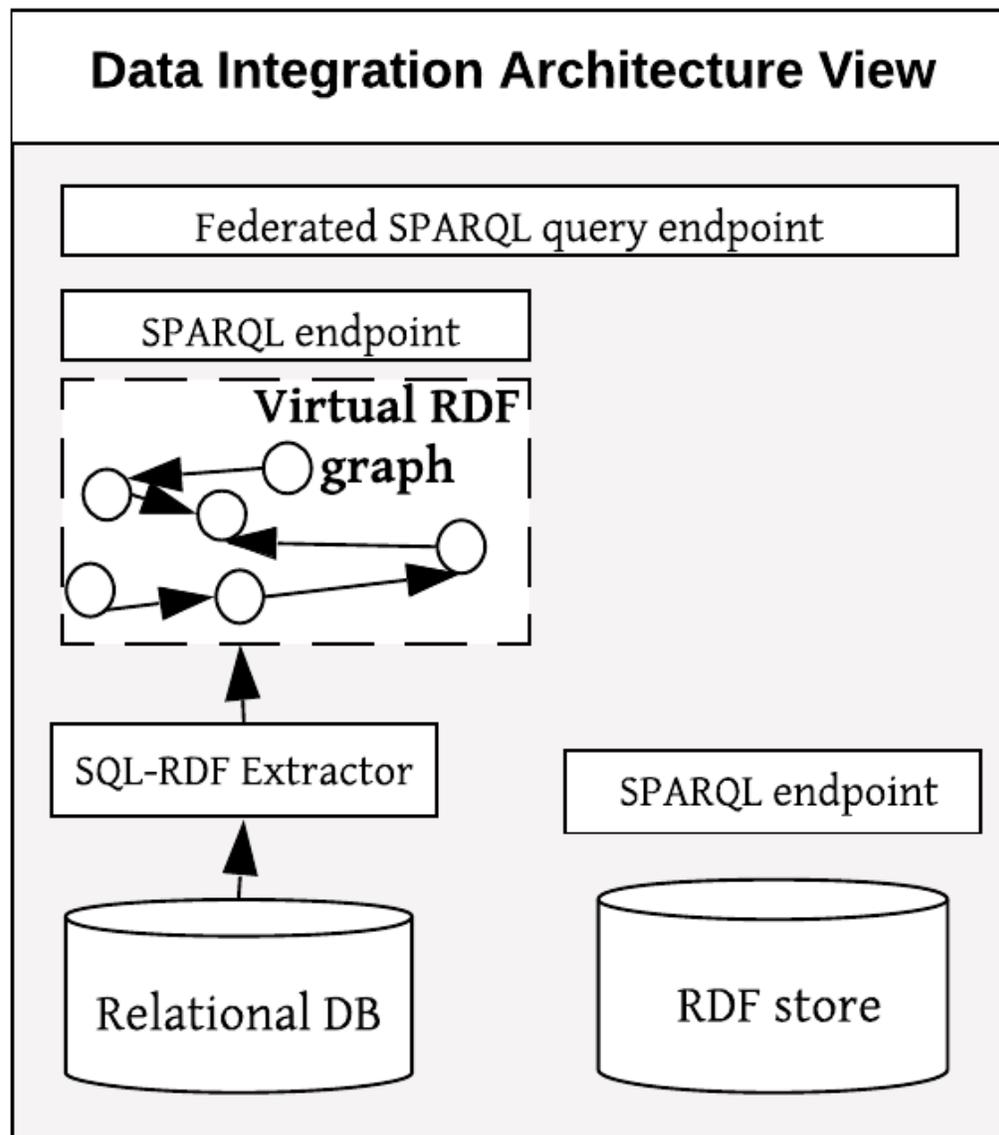
- Processing geometric data from IFC-STEP files for 3D visualization is a considerable time-consuming task
- Polystore approach – efficient query execution
  - “one size does not fit all”.
  - *A new generation of federated databases that support seamless access to the different data models of database or storage engines [1].*

# Example: BigDAWG Polystore

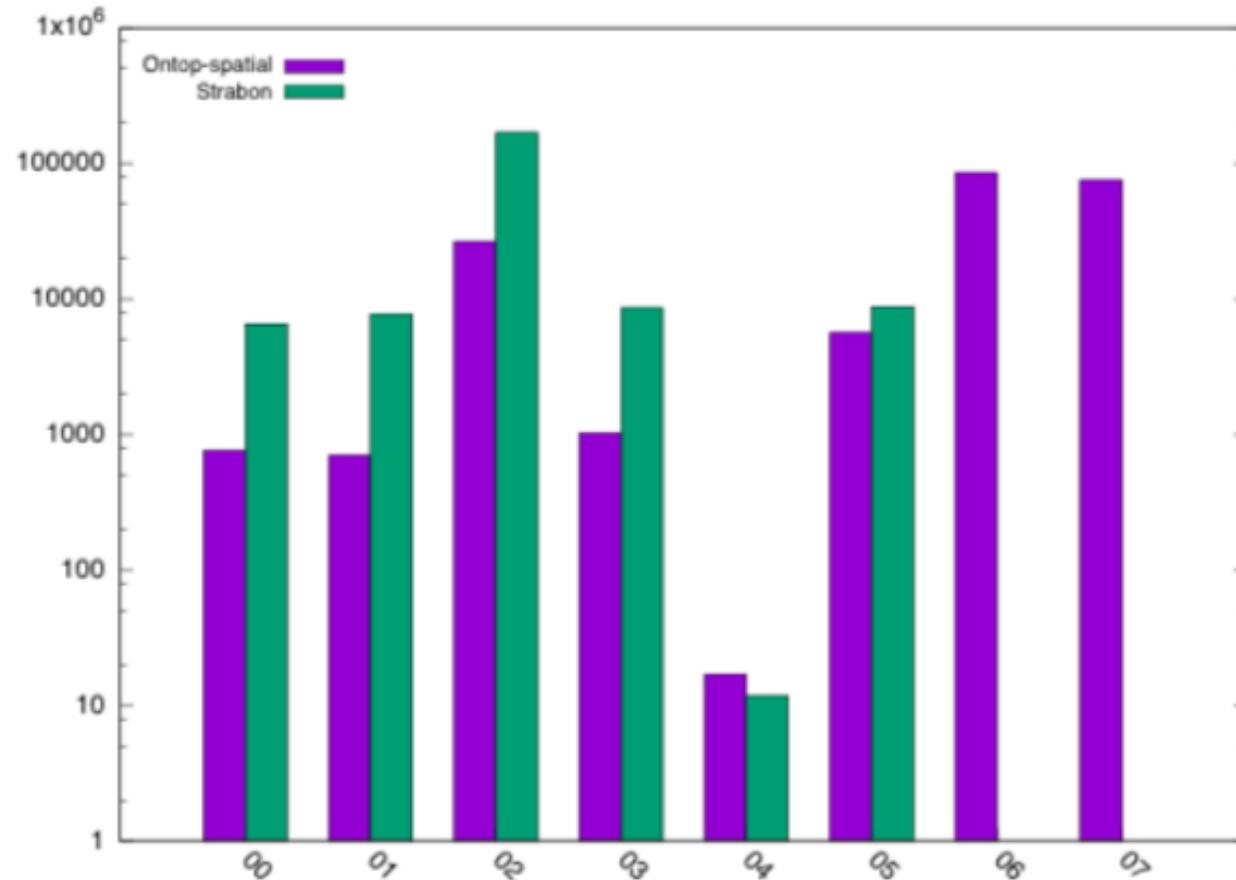


[1]Gadepally, V. et al., 2016. The BigDAWG polystore system and architecture. In 2016 IEEE High Performance Extreme Computing Conference (HPEC). pp. 1–6. <https://doi.org/10.1109/HPEC.2016.7761636>

# Example: a Simplified “Polystore”



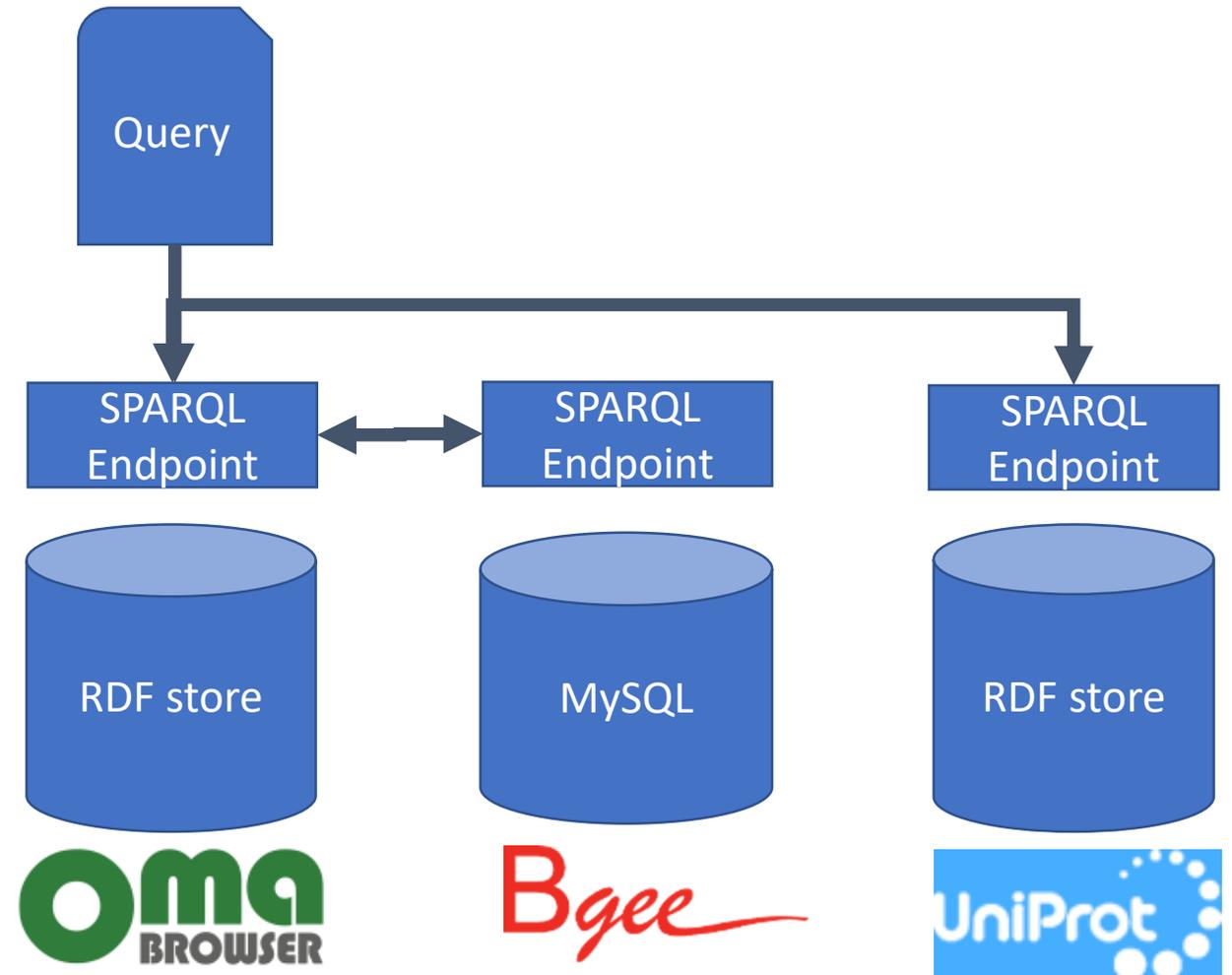
# GeoSPARQL: Pure RDF store vs PostGIS-SQL



```
SELECT ?s1 ?o1 where {  
  ?s1 lgd:asWKT ?o1 .  
  ?s2 lgd:asWKT ?o2 .  
  FILTER(geo:sfOverlaps(?o1, ?o2))}
```

# Case study in life sciences

- The orthologs of a gene that is expressed in the fruit fly's brain
- The orthologs of a gene that is expressed in the fruit fly's brain and the uniprot annotations of these orthologs



# Conclusion and Future works

- Technical aspects along with possible solutions were presented to justify **why software companies struggle to adopt SW technologies**
  - Changing paradigm of BIM data exchange
  - Taking advantage of storage engines to process different types of data and information (e.g.: geometry, topology, etc.)
- Encourage **collaboration** to investigate Array stores to handle and process geometric data.
  - Virtual RDF (ODBA) using SciQL query language

# Acknowledgments

A scenic view of a university campus. In the foreground, there is a large, well-maintained green lawn. To the right, a multi-story, modern building with a curved facade and many windows stands prominently. In the middle ground, a body of water, likely a lake or bay, is visible, with a few small boats. The background features a range of large, rugged mountains with patches of snow under a clear blue sky.

**C. Dessimoz' and  
M. Robinson-Rechavi's labs**