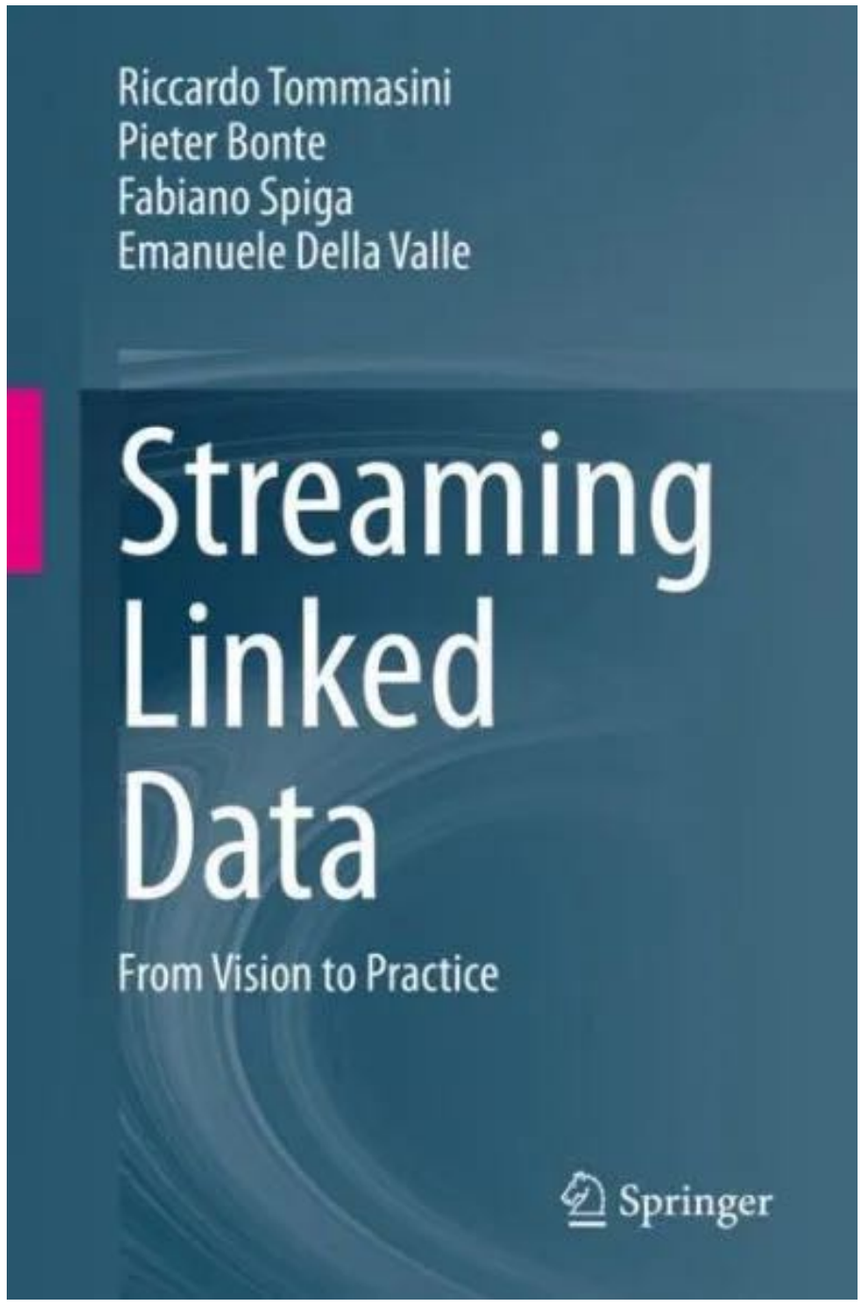
Streaming Linked Data & RSP4J!

Recent Advancements and Future Work

SRW, Amsterdam, Netherlands, Europe,
Earth, Milky Way, Universe …. 42

A Book

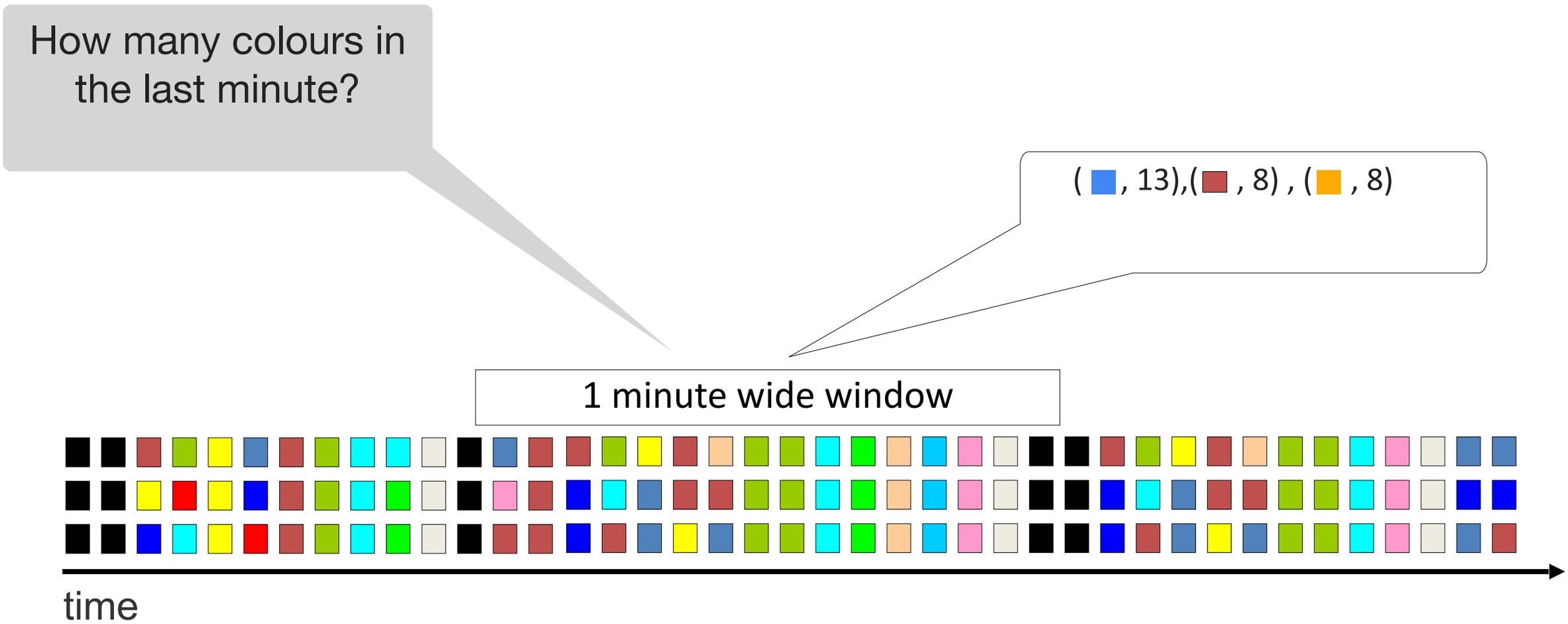

Riccardo Tommasini
Pieter Bonte
Fabiano Spiga
Emanuele Della Valle
Streaming Linked Data
From Vision to Practice
Springer

Semantic Intelligence for
nated Media Produc
– Real-time Intelli
– Thorough Underst

Streaming Data

- Continuous Processing
  - Querying
  - Machine Learning
- Reactive Processing
  - Complex Event Recognition
  - Anomaly Detection

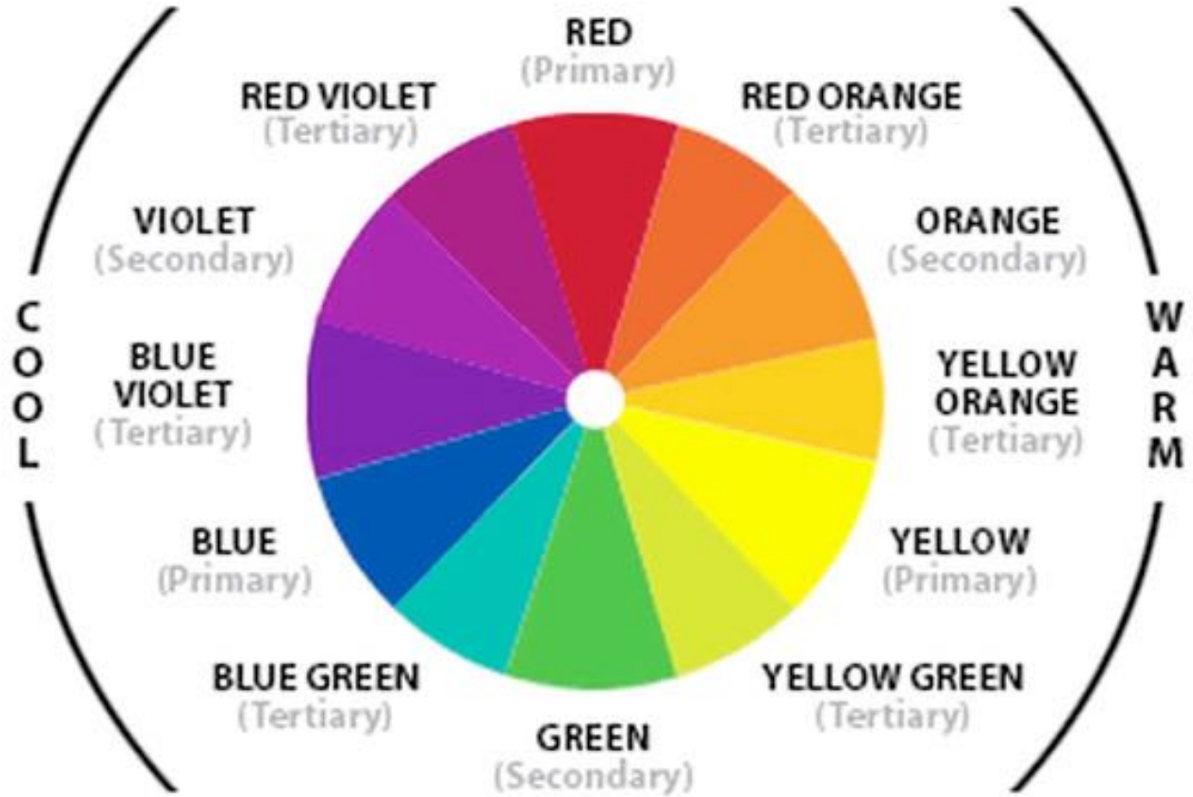
Stream Processing

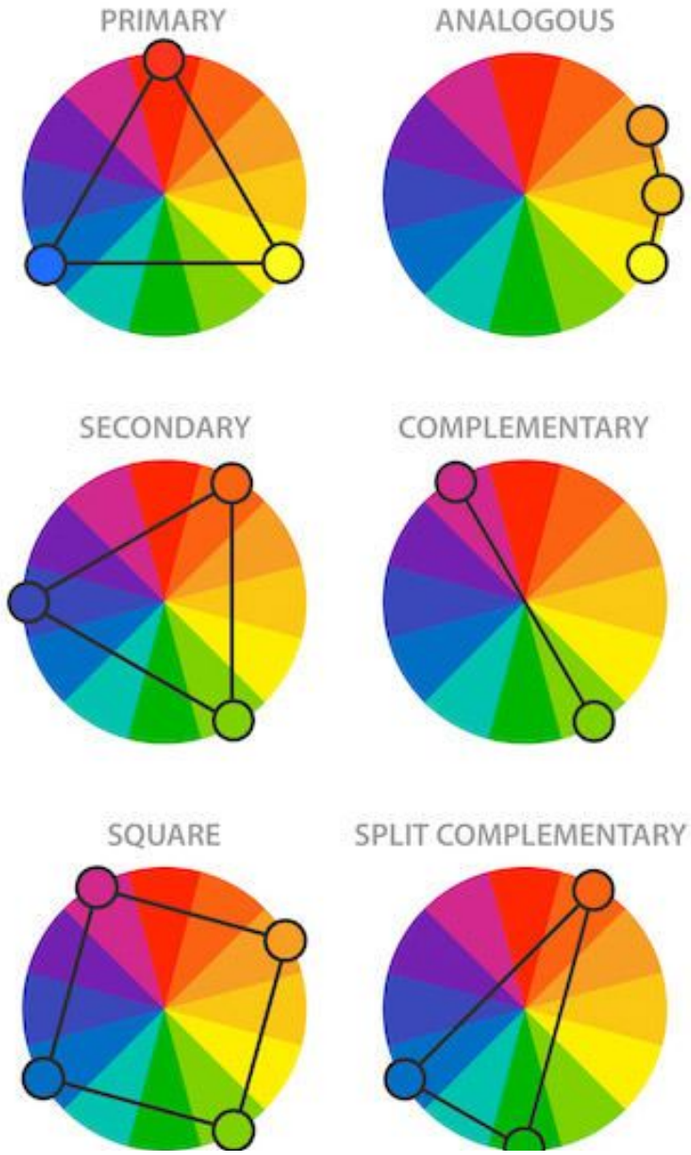


Linked Data

- Linked Data are structured data which is interlinked with other data so it becomes more valuable through semantic queries.

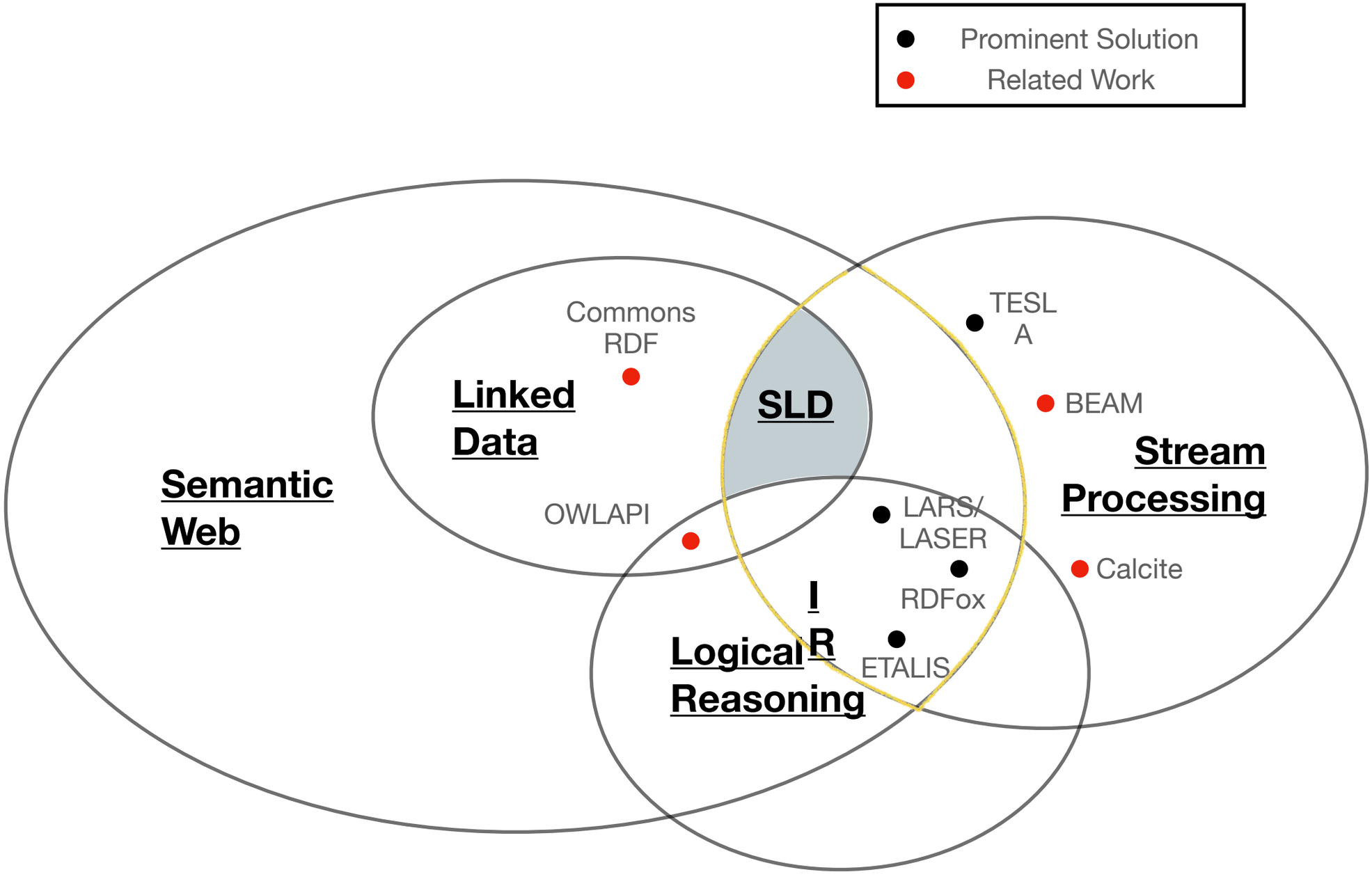
Data Semantics





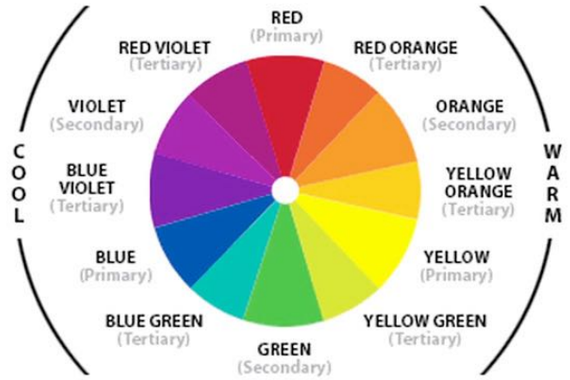
Stream Linked Data

State-of-the-art



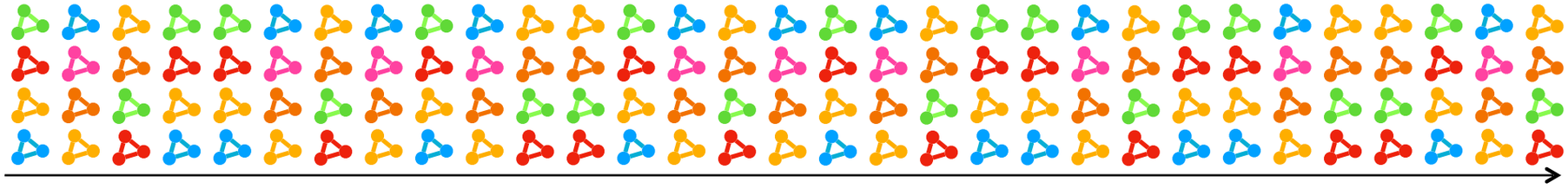
Stream Processing

How many colours in the last minute?

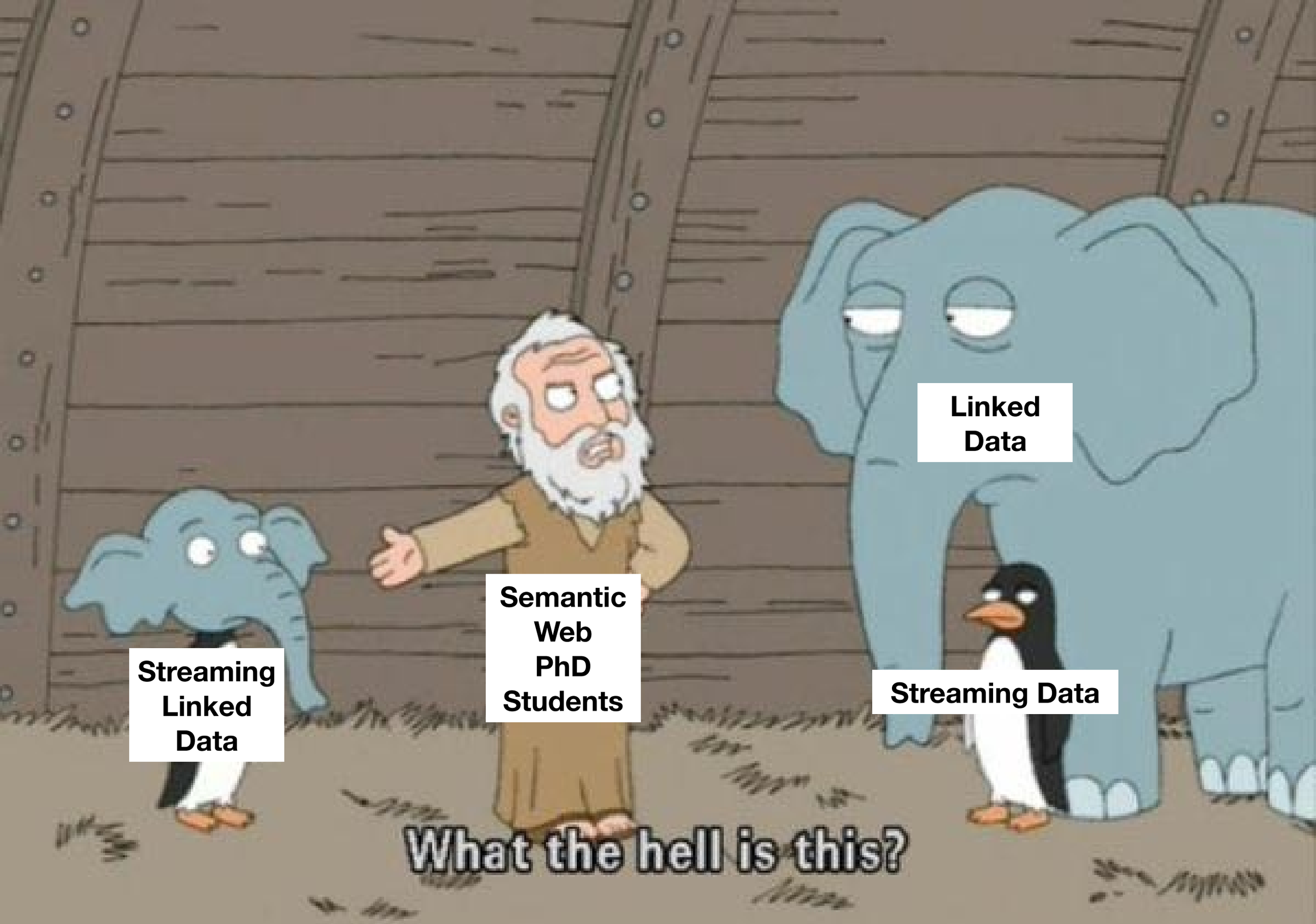


(13),(, 8) , , 8)

1 minute wide window

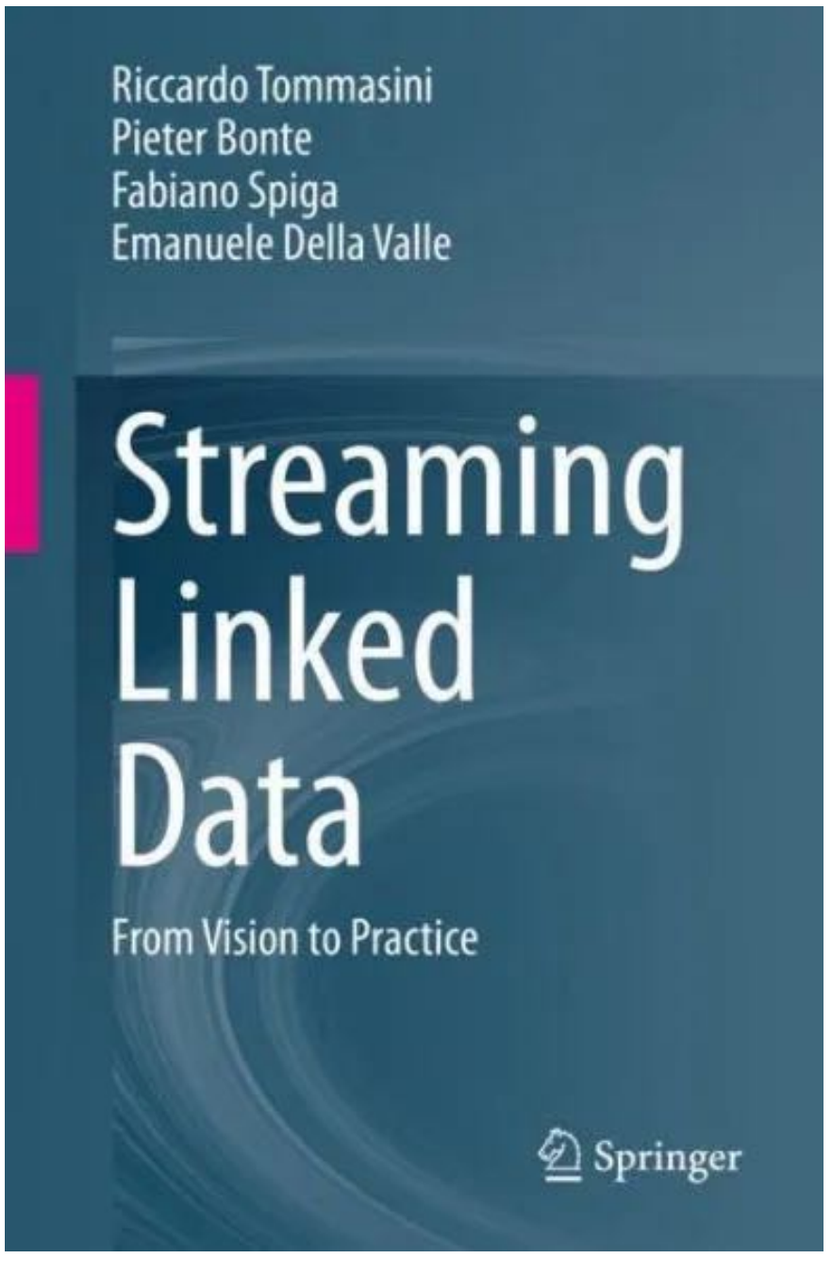


time


Linked Data
Semantic Web PhD Students
Streaming Linked Data
Streaming Data
What the hell is this?

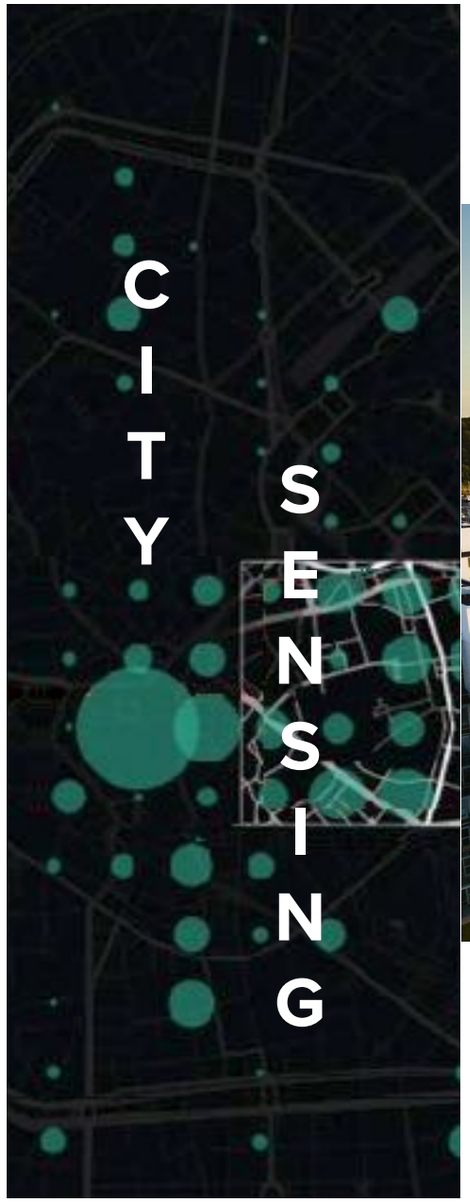
Outline

- Projects
- Processing
  - Systems & Languages
- Benchmarking



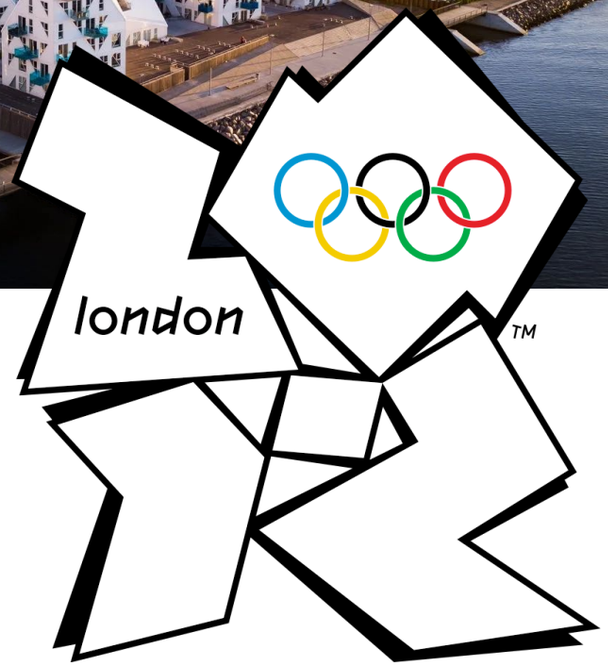
ST⭐R-CITY

BOTTARI
좋은 씨앗
Volga
볼가


CITY SENSING

CITY PULSE

Optique


london
TM

Stream Reasoning Projects

Projet	Year	Deployment	Domain
Bottari	2012	Seul, Korea	Social Media
SLD	2013	London, UK Milan, Italy	Event Management
StarCity	2014	Dublin, Ireland	Smart City
CityPulse	2016	Aarhus, Denmark	Smart City
AgriIoT	2016		Smart Farming
Optique	2017	Munich, Germany Stanger, Norway	Manufacturing, Oil Extraction
StreamingMASSIF	2018	Ghent, Belgium	Smart City
CitySensing	2019	Milan, Italy	Smart City

Table 1
Summary of the Selected Projects.

Ontologies for Stream Reasoning

- We surveys the knowledge representation efforts in the aforementioned projects and more

- we identified 10 ontologies and we study their organisation

- finding and best practices observation are currently under review

Three Perspectives

30k ft view

FAIR Principles

verify compliance

SAO,VoCaLS, LDES, IoTStream

10k ft view

MetaCncpt

discover structure

SSN/SOSA, Frappe, SAO, SAREF, IotS, Acts, SIOC, LODE

1k ft view

CEM*

verify compliance

FAIR Principles

- FINDABLE
- ACCESSIBLE
- INTEROPERABLE
- REUSABLE

Analysis

- A community efforts for finding streams and making them Accessible

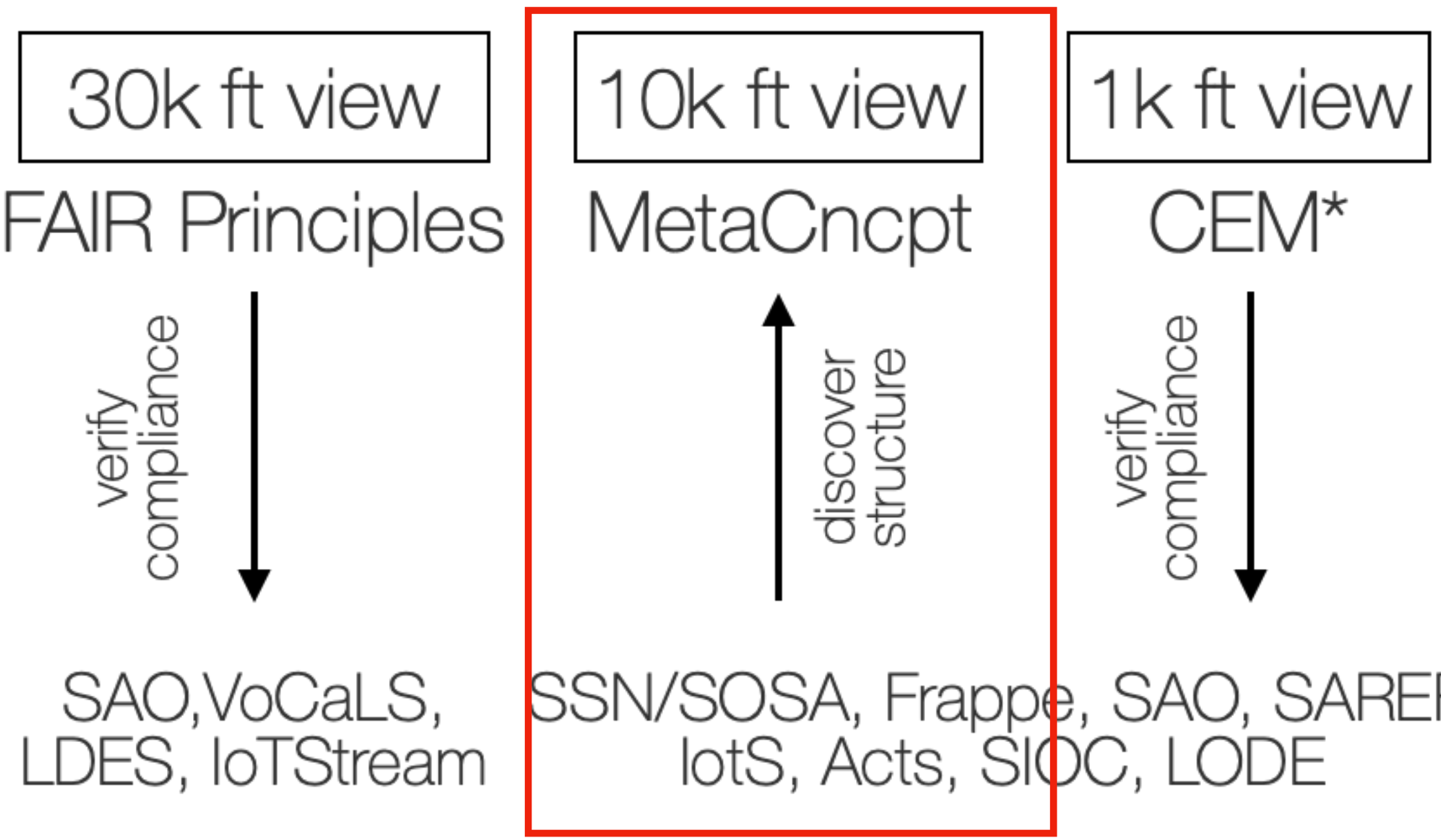
- A question for us: what is preventing people to make their stream available?

- Relates to decentralisation initiative, cf SOLID.

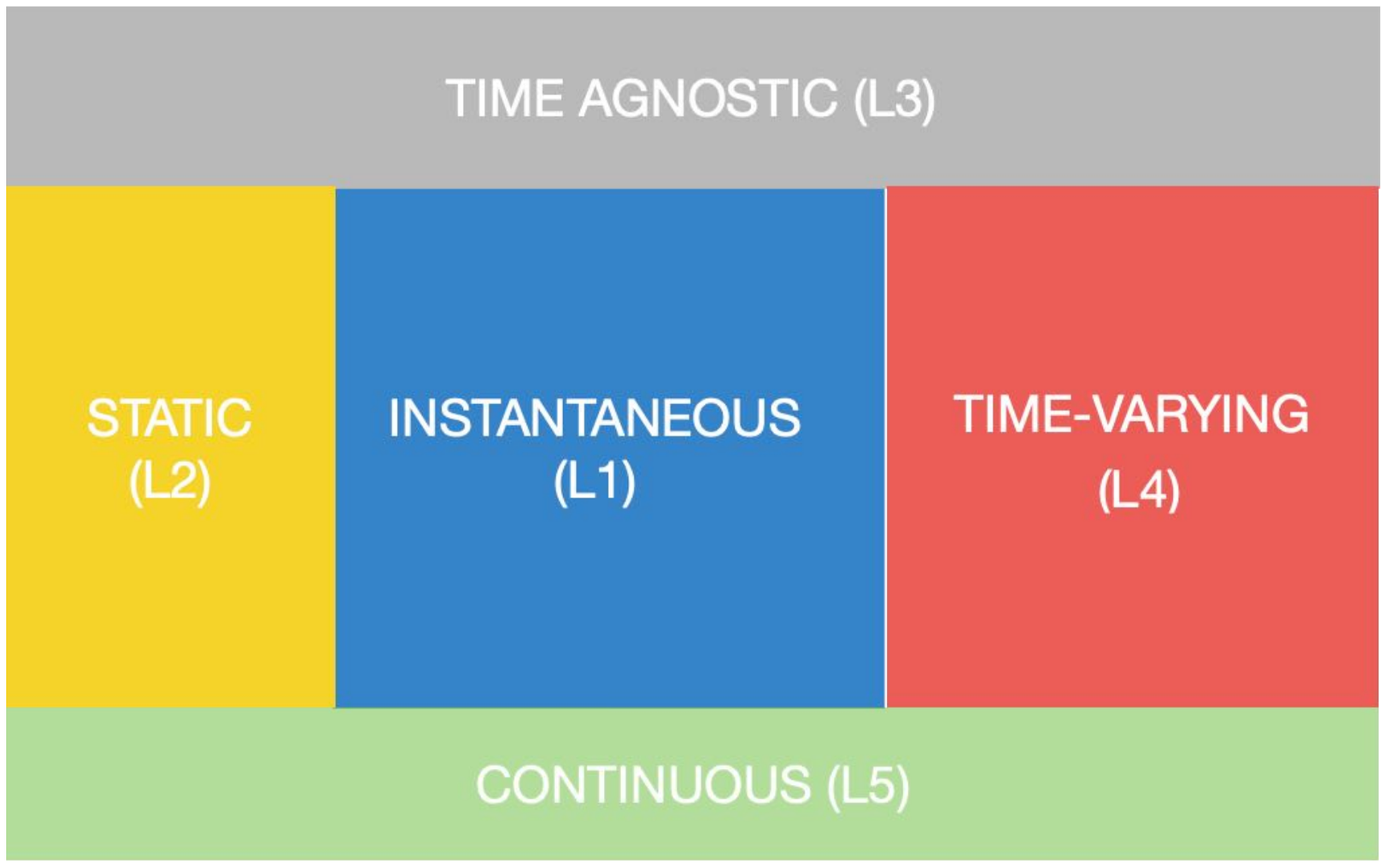
Cataloging Web Streams

- SR projects assumed that KR languages like OWL/RDFS were enough
- Recent years have shown lots of interesting results on temporal logics for stream reasoning
- We still lack a dedicated KR methodology

Three Perspectives



10k ft View


TIME AGNOSTIC (L3)
STATIC (L2)
INSTANTANEOUS (L1)
TIME-VARYING (L4)
CONTINUOUS (L5)

Analysis

- Ontologies distribute the modelling complexity across different temporal levels

- The goal is facilitate the alignment with applications

- What KR Method do they use?

Three Perspectives

30k ft view

FAIR Principles

verify compliance

SAO, VoCaLS, LDES, IoTStream

10k ft view

MetaCncpt

discover structure

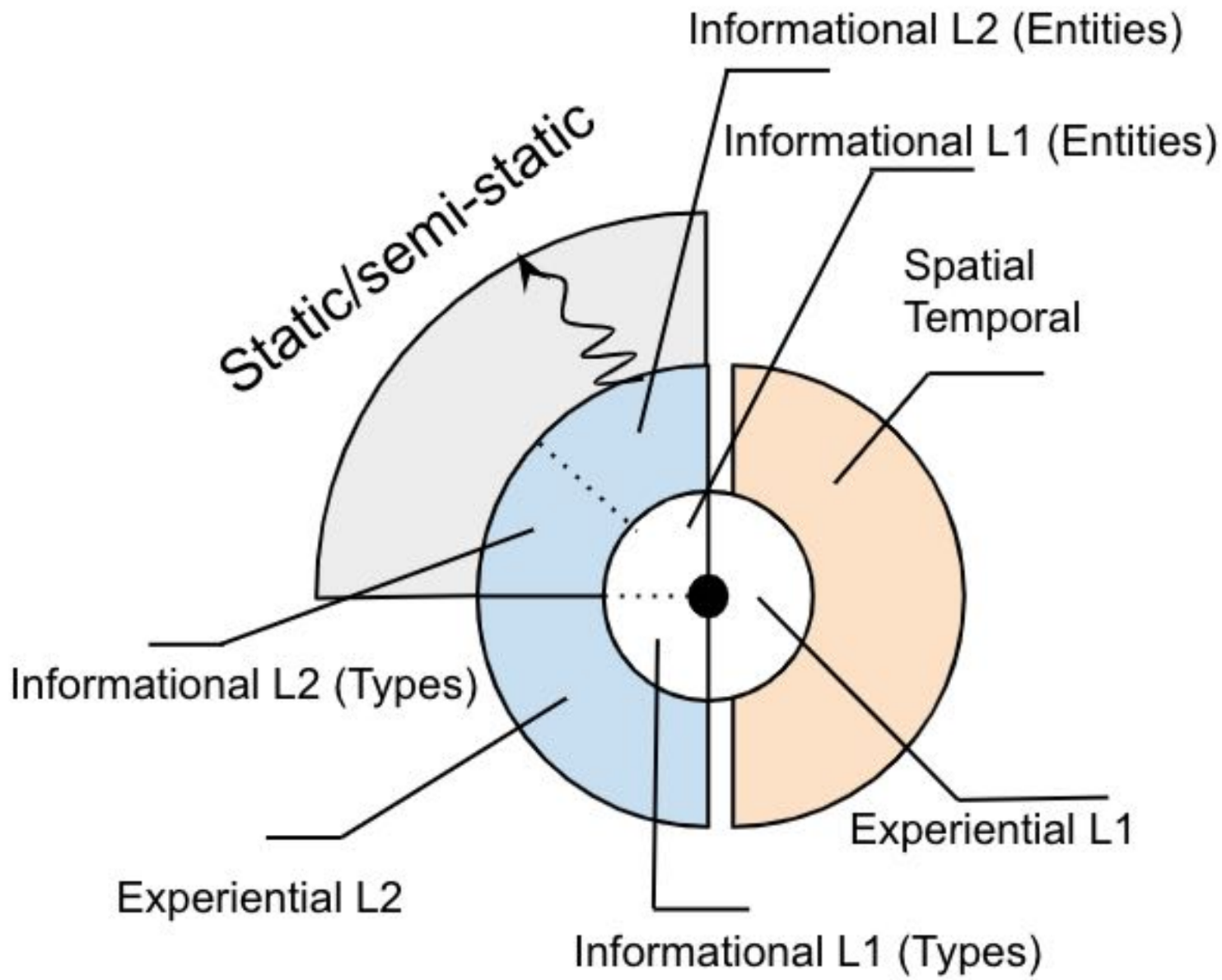
SSN/SOSA, Frappe, SAO, SAREF, IotS, Acts, SOC, LODE

1k ft view

CEM*

verify compliance

1k ft View


Informational L2 (Entities)
Informational L1 (Entities)
Static/semi-static
Spatial
Temporal
Informational L2 (Types)
Experiential L1
Experiential L2
Informational L1 (Types)

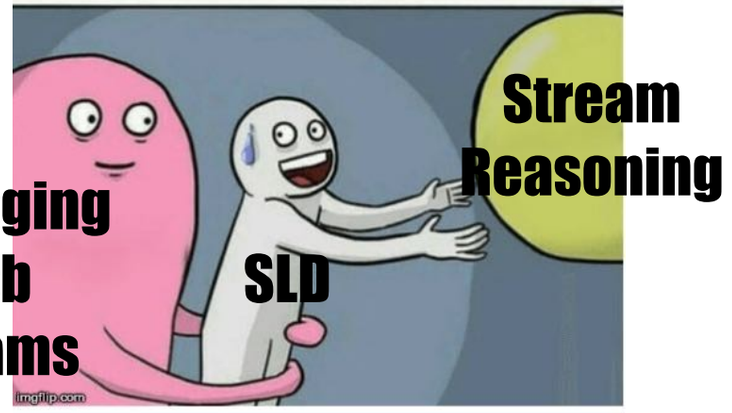
Analysis

- Ontologies keep their kernel small
- This is because the the further away from the kernel, the more static the data.
- What KR method did they use?

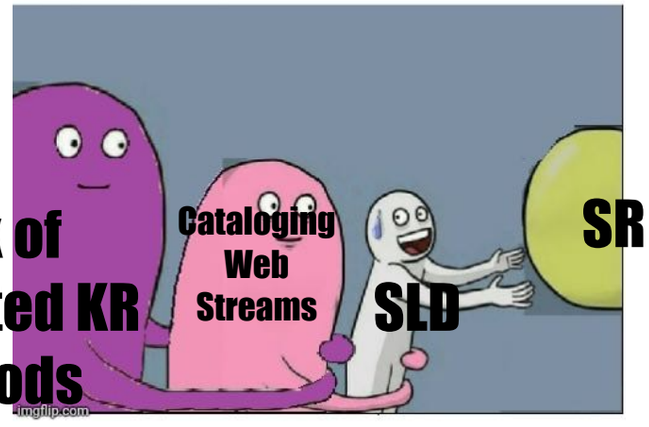
Representing Ephemeral Knowledge

- SR projects assumed that KR languages like OWL/RDFS were enough

- Recent years have shown lots of interesting results on temporal logics for stream reasoning



- We still lack a dedicated KR methodology



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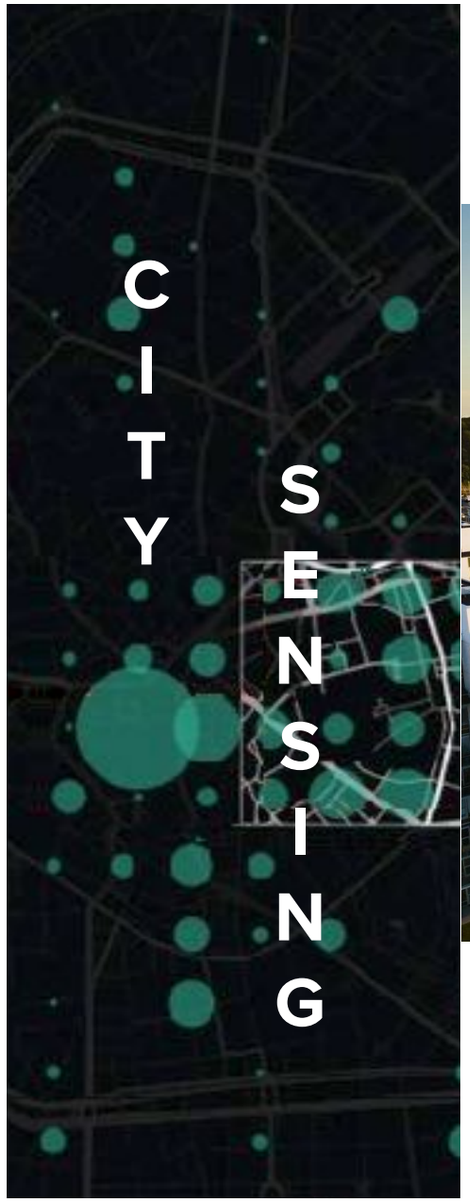
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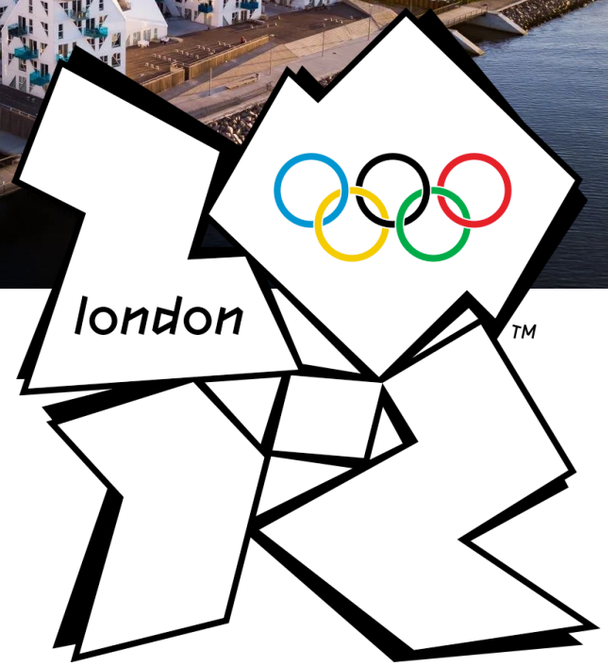
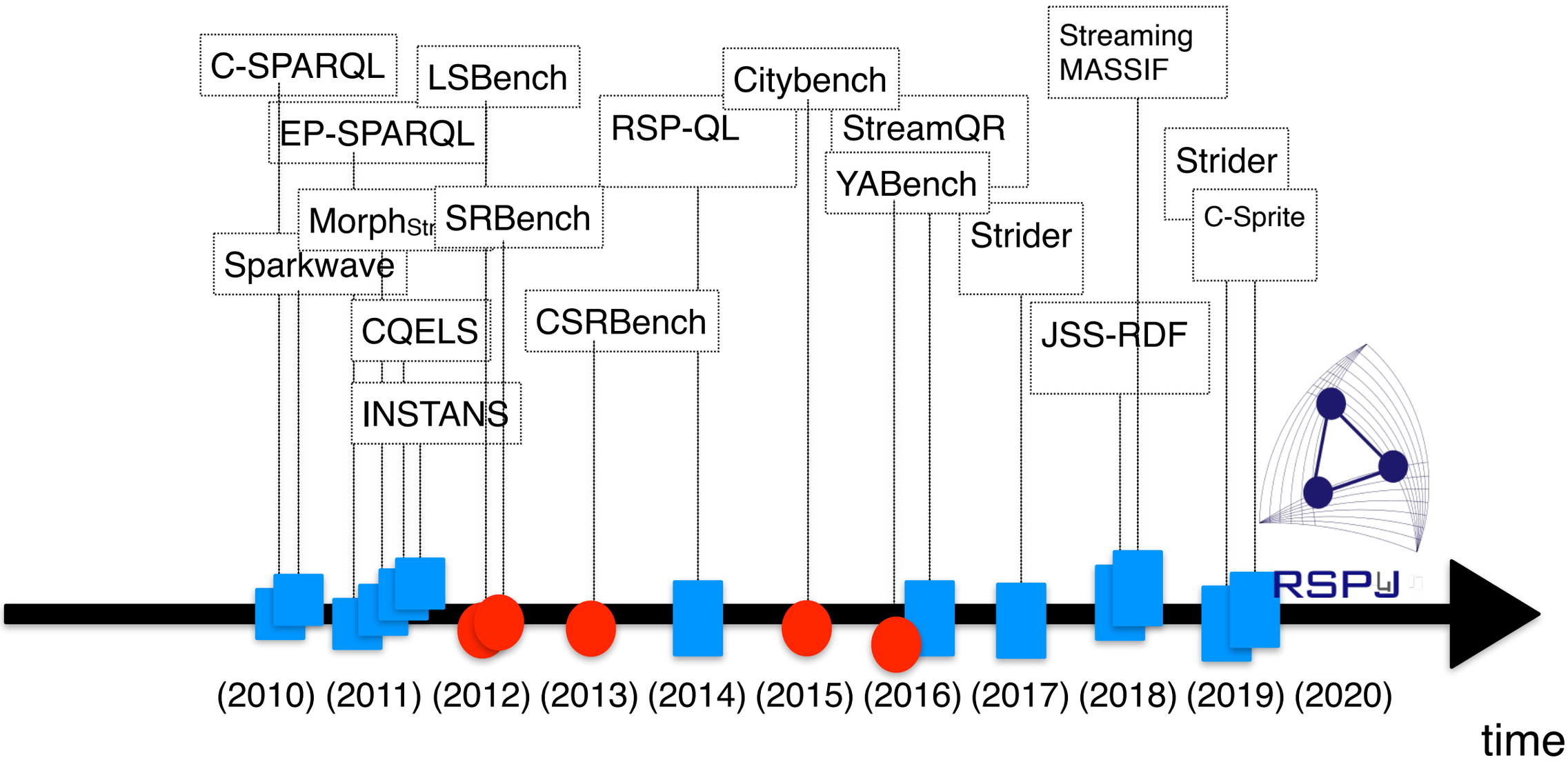
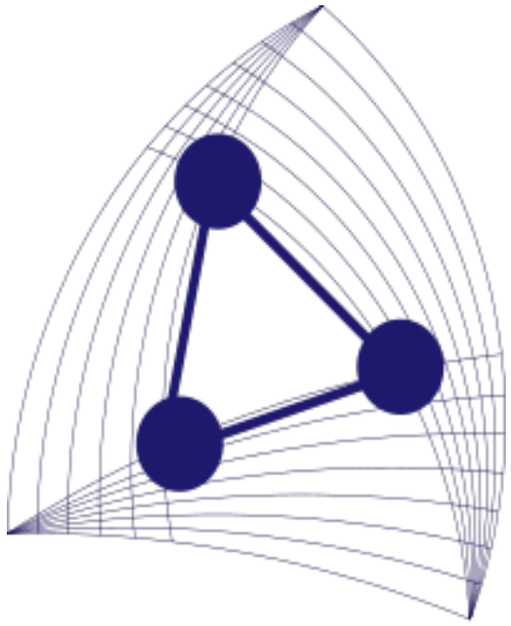

london
TM

RSP Systems & Languages

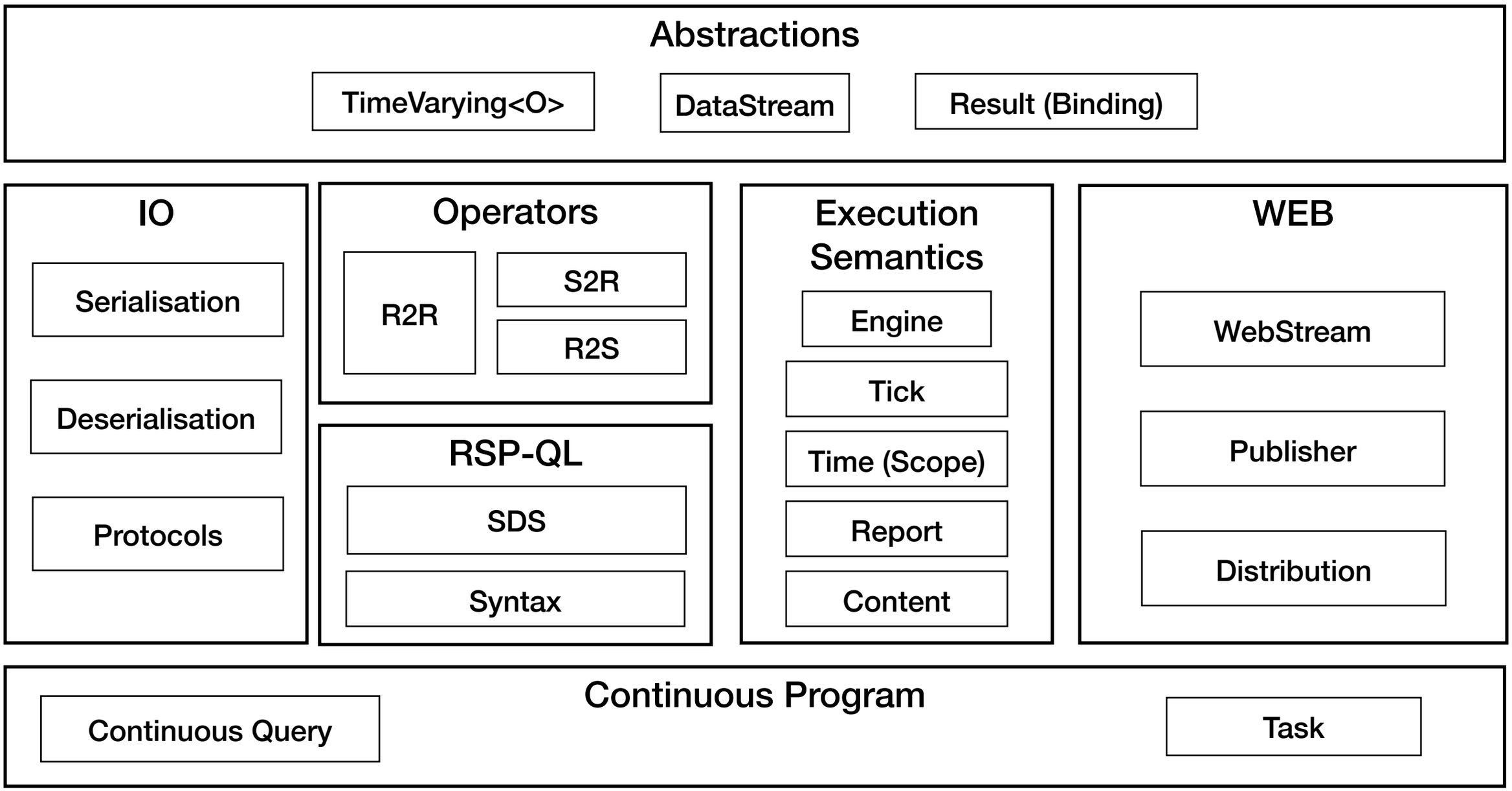




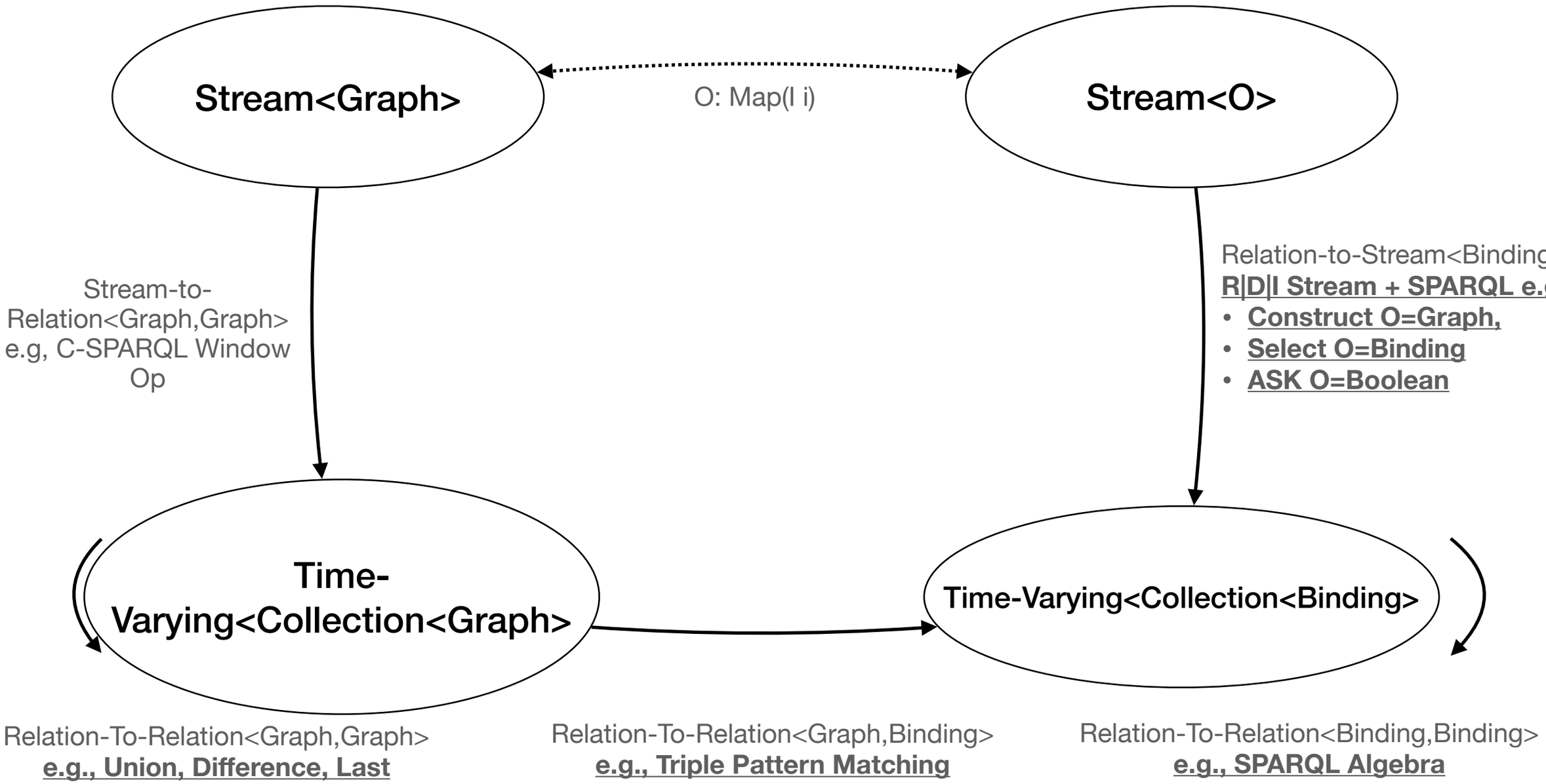
RSPy

A library for RSP fast prototyping based on RSP-QL

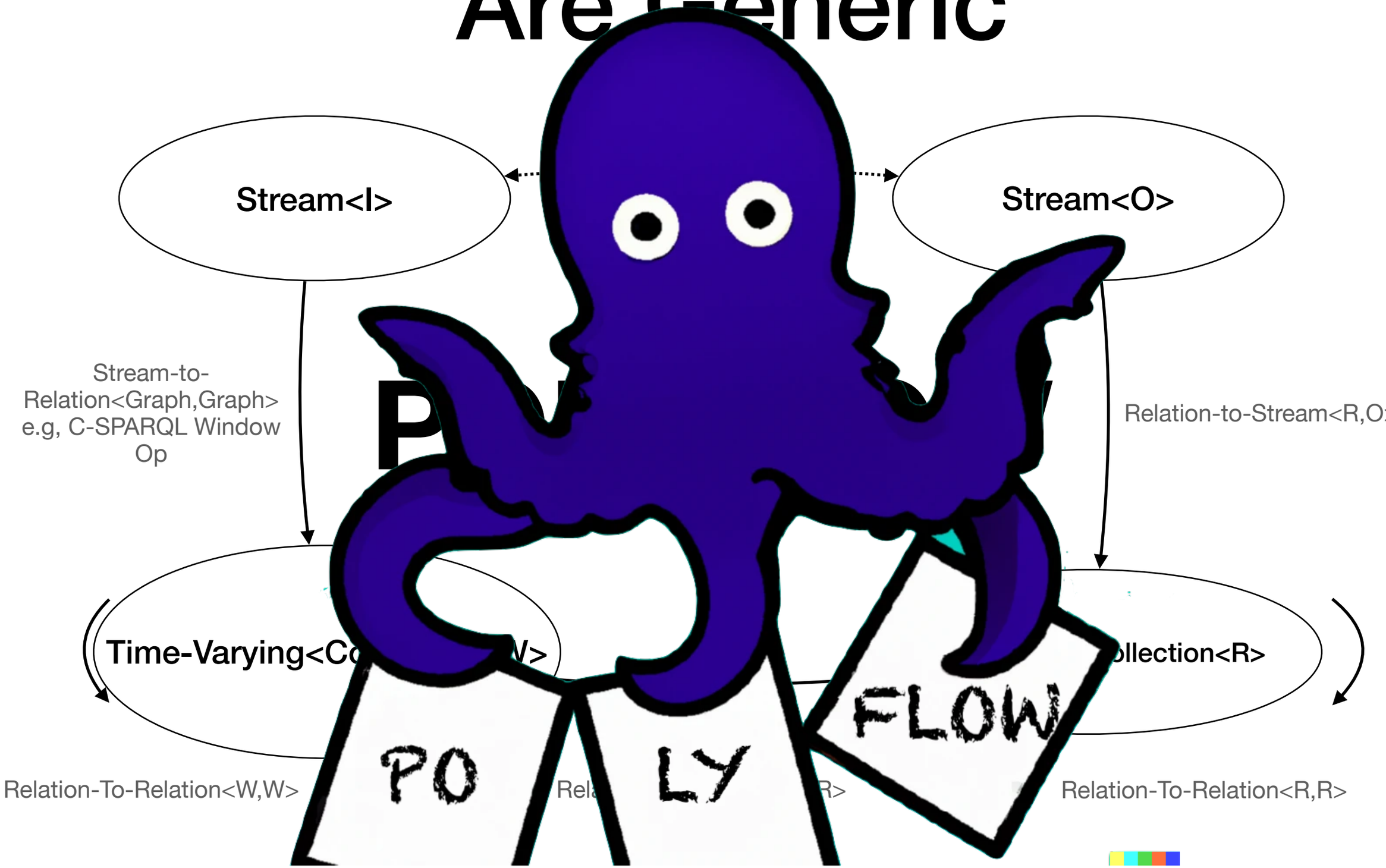
A New Architecture



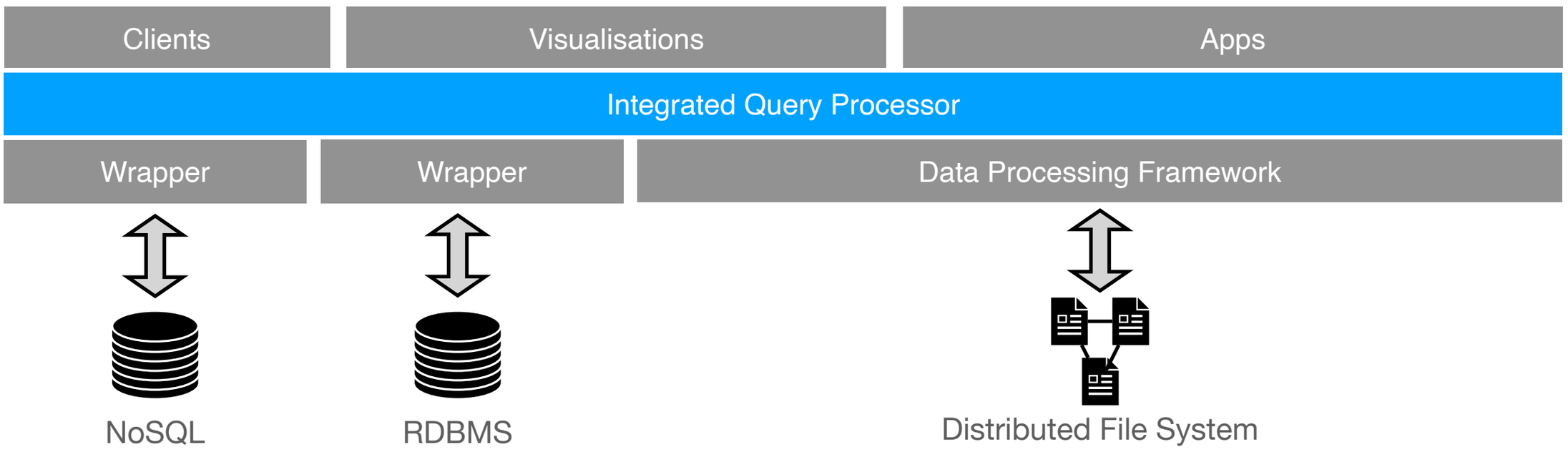
RSP4J Internals



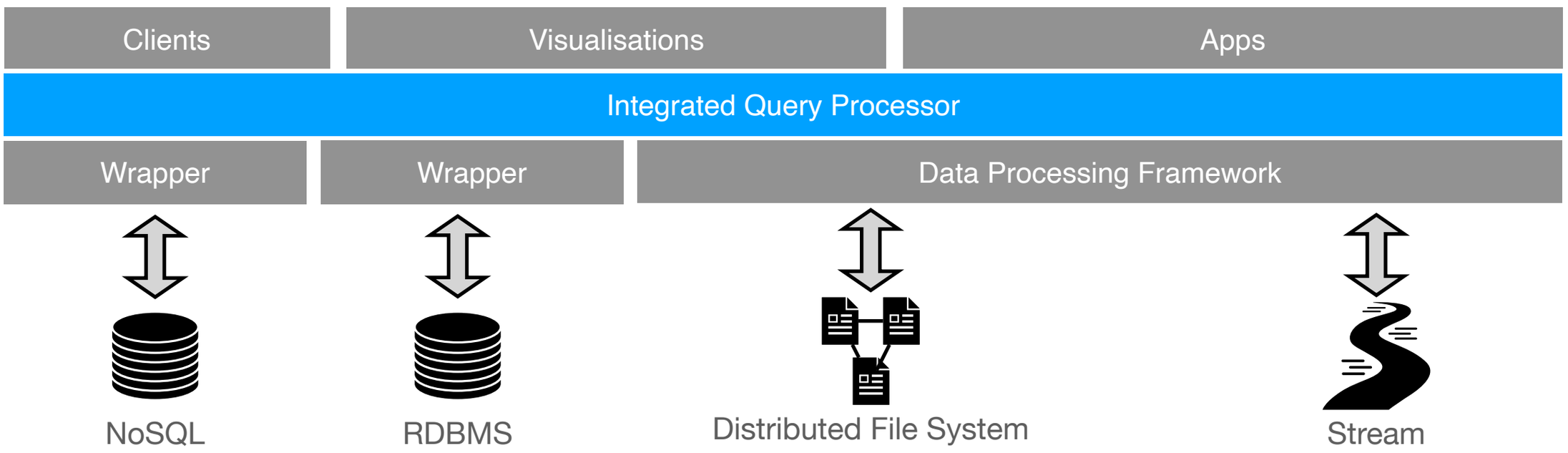
Are Generic


Stream<I>
Stream<O>
Stream-to-Relation<Graph,Graph> e.g, C-SPARQL Window Op
Relation-to-Stream<R,O>
Time-Varying<Co
V>
ollection<R>
Relation-To-Relation<W,W>
Rel
R>
Relation-To-Relation<R,R>
P
PO
LY
FLOW

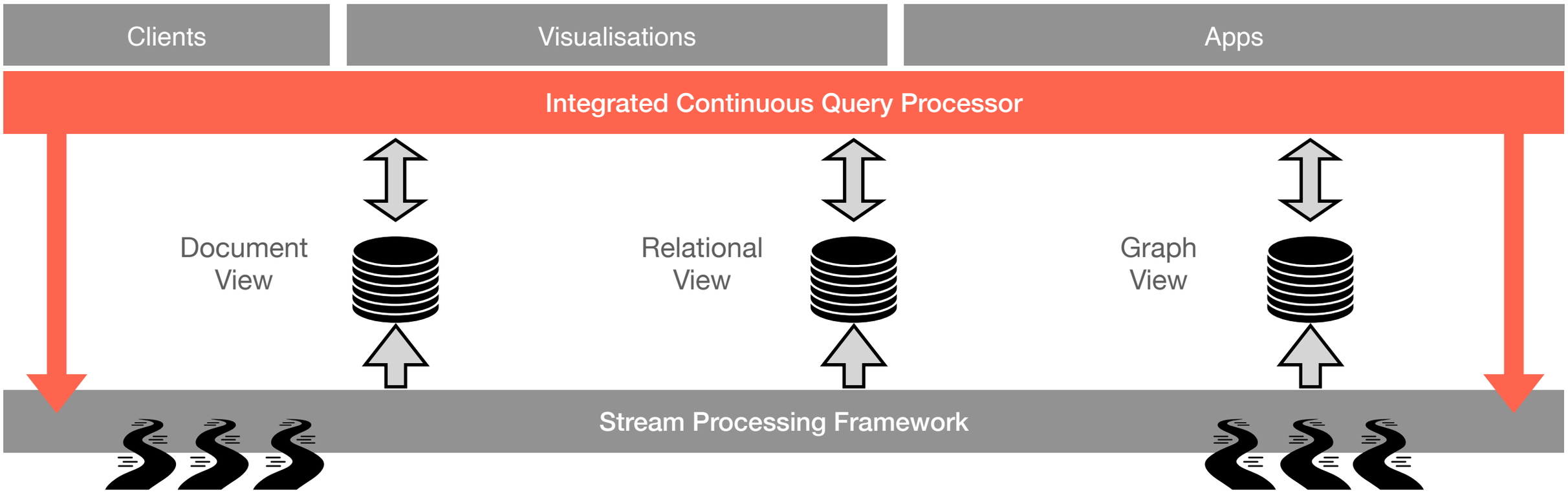
Polystores


Clients
Visualisations
Apps
Integrated Query Processor
Wrapper
Wrapper
Data Processing Framework
NoSQL
RDBMS
Distributed File System

Polystores


Clients
Visualisations
Apps
Integrated Query Processor
Wrapper
Wrapper
Data Processing Framework
NoSQL
RDBMS
Distributed File System
Stream

Polystreaming Systems



Additional Progress

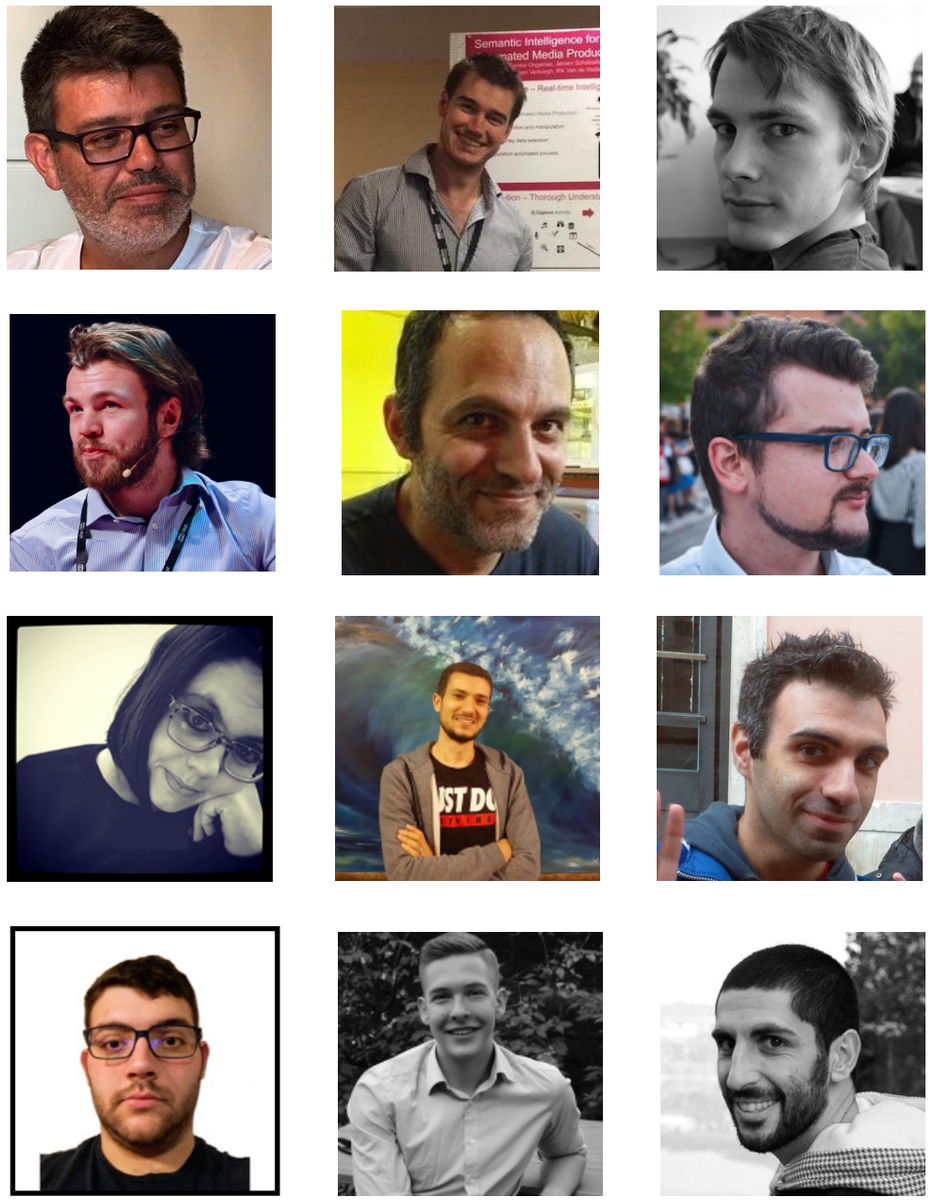
- More Window Operators: including Data-Driven Window

- C/Python Bindings for better data science applications

- Reactive Flow using more modern APIs.

Summary

- We need a community efforts on cataloging
- Lack of KR methods for Stream Reasoning
- RSP4J++
  - in C++
  - Beyond Graphs: POLYFLOW



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Questions?

I Am Hiring!