



esri Canada | Education
& Research

GEO SEMANTICS EXCHANGE (GSX)

CONNECTING CONTENT AND PROVIDING CONTEXT

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About us



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iCity Ontology Developer
University of Toronto (UTTRI)

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Higher Education Developer, Esri Canada

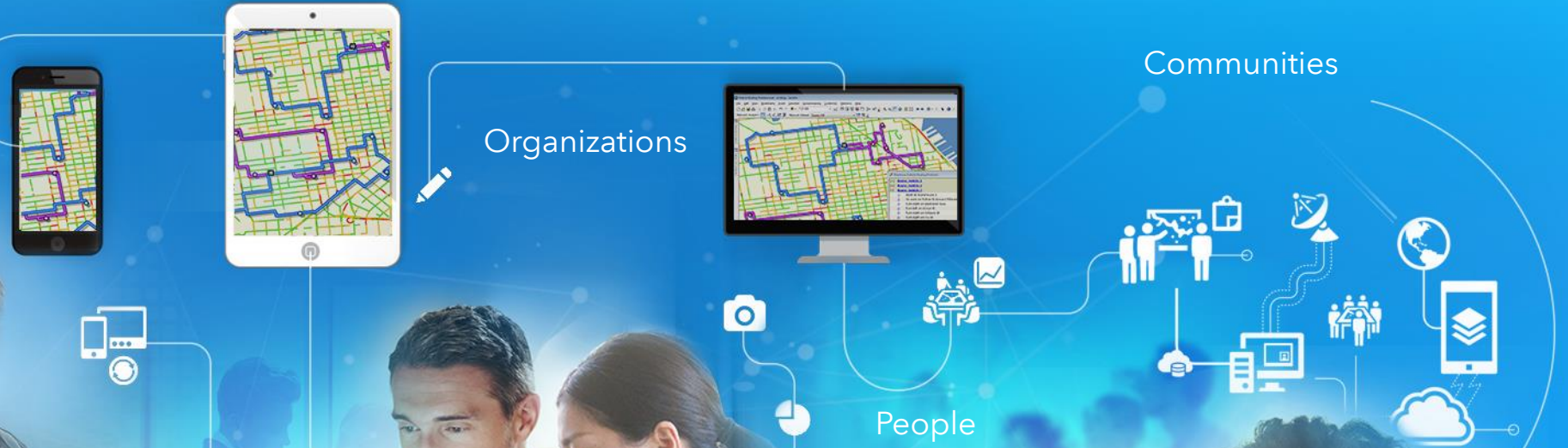
- Supervisors: Brent Hall (PhD), Jon Salter (PhD)

The GFX

GeoFoundation Exchange
(GFX) Data

35+ Datasets

- Road segments
- Neighbourhoods
- ...



The Data Dilemma for GIS

- Dataset Silos: There is a disconnect between geospatial datasets.
- Difficult and time consuming to perform complex geospatial queries.
- This results in missed opportunities to combine geospatial data with external data sources.

System of
Engagement

Helping Organizations
Understand ...

System of
Record

System of
Insight

Supports Multiple
Types of Systems



Our Vision

Using **ontologies** to enable
a Smarter Community

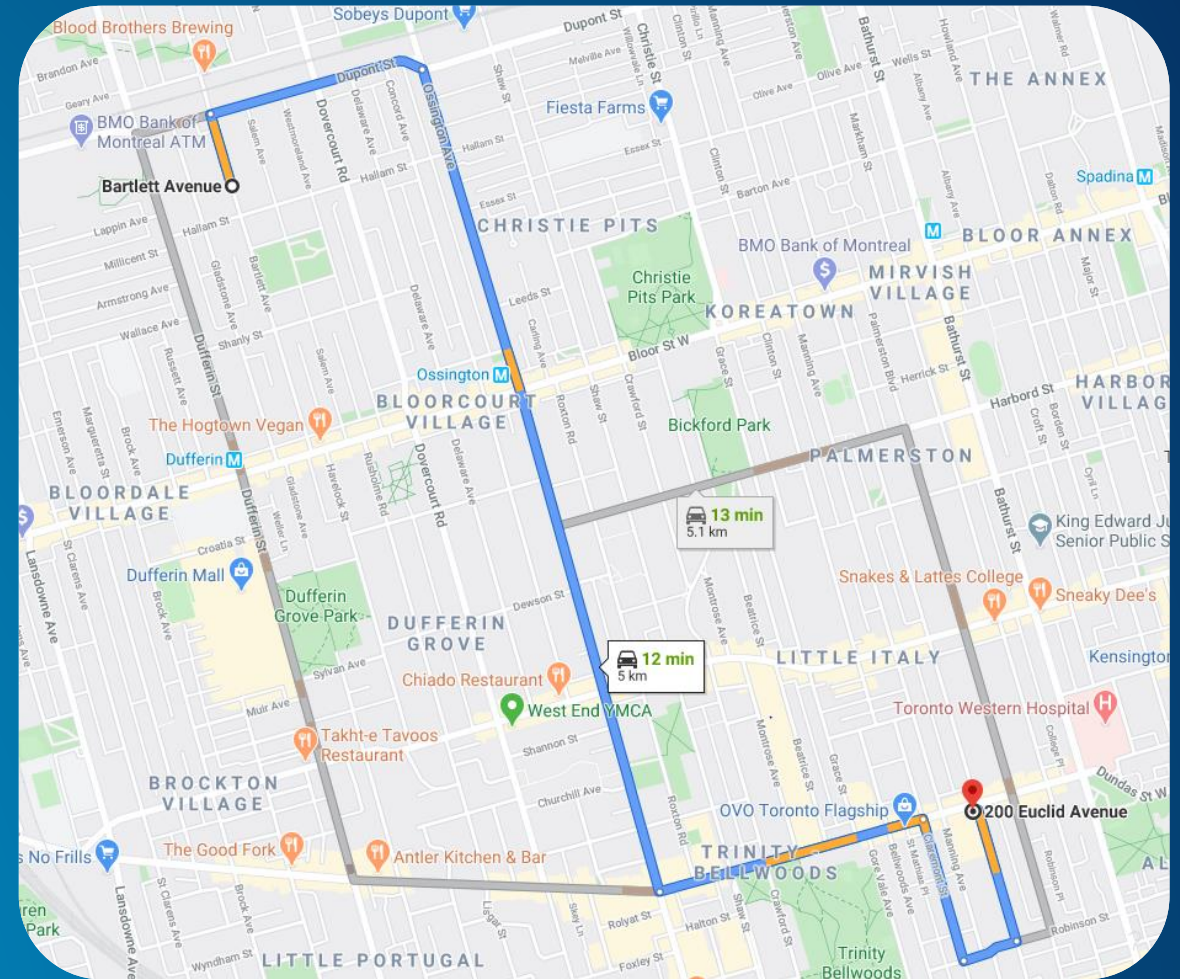
Connecting Content
and Providing Context

Data → Knowledge

Integrated data as more than the sum of its parts

A Case Study:

Identify the points-of-interest, neighbourhoods and land use types along the shortest path between two points, over the road network.




A Simple Algorithm:

- Select: **Point A** and **Point B (Origin => Destination)**
- Find the **Road Segments** in the **Road Network** that define the **shortest path** between A and B.
- Identify the **Neighbourhoods** the path goes through.
- Identify the **Land Use & LandCover** types along the path.
- Locate the **Points-of-interest** "near" the path.



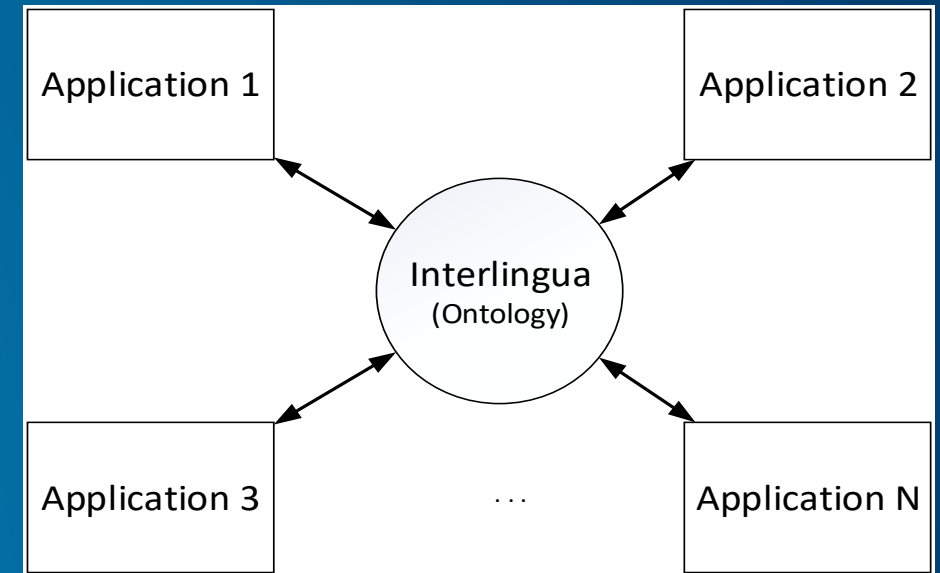
Problem Context: Dataset Silos

- Select: **Point A** and **Point B (Origin => Destination)**
 - Find the **Road Segments** in the **Road Network** that define the **shortest path** between A and B.
 - Identify the **Neighbourhoods** the path goes through.
 - Identify the **Land Use** types along the path.
 - Identify the **Land Cover** types along the path.
 - Locate the **Points-of-interest** "near" the path.
- 
- **Road network** defined by connected **Road Segments**.
 - **Road segments** not connected to **Neighbourhoods**.
 - **Road segments** not connected to **Land Use** types.
 - **Road segments** not connected to **Land Cover** types.
 - **Road segments** not connected to **Points-of-interest**

What is an Ontology?

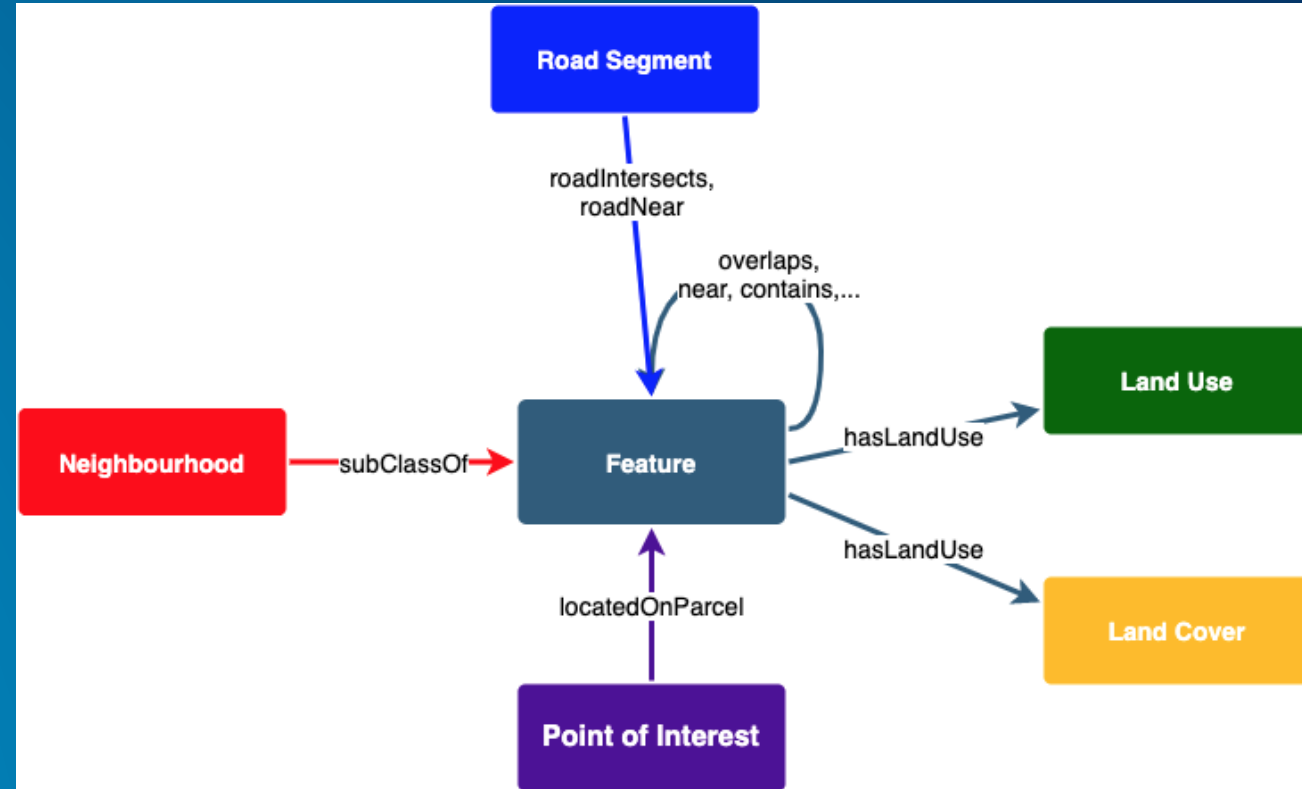
...and how can we use it to solve this problem?

- Ontology (computer science): a machine interpretable artefact that formally defines the semantics of a collection of concepts associated with a domain of interest.
- Applications:
 - Automated reasoning
 - Data validation
 - *Semantic integration: a common language to integrate data sources through a description of its domain*



Describing the “Structure of the Knowledge” in the GFX with an Ontology

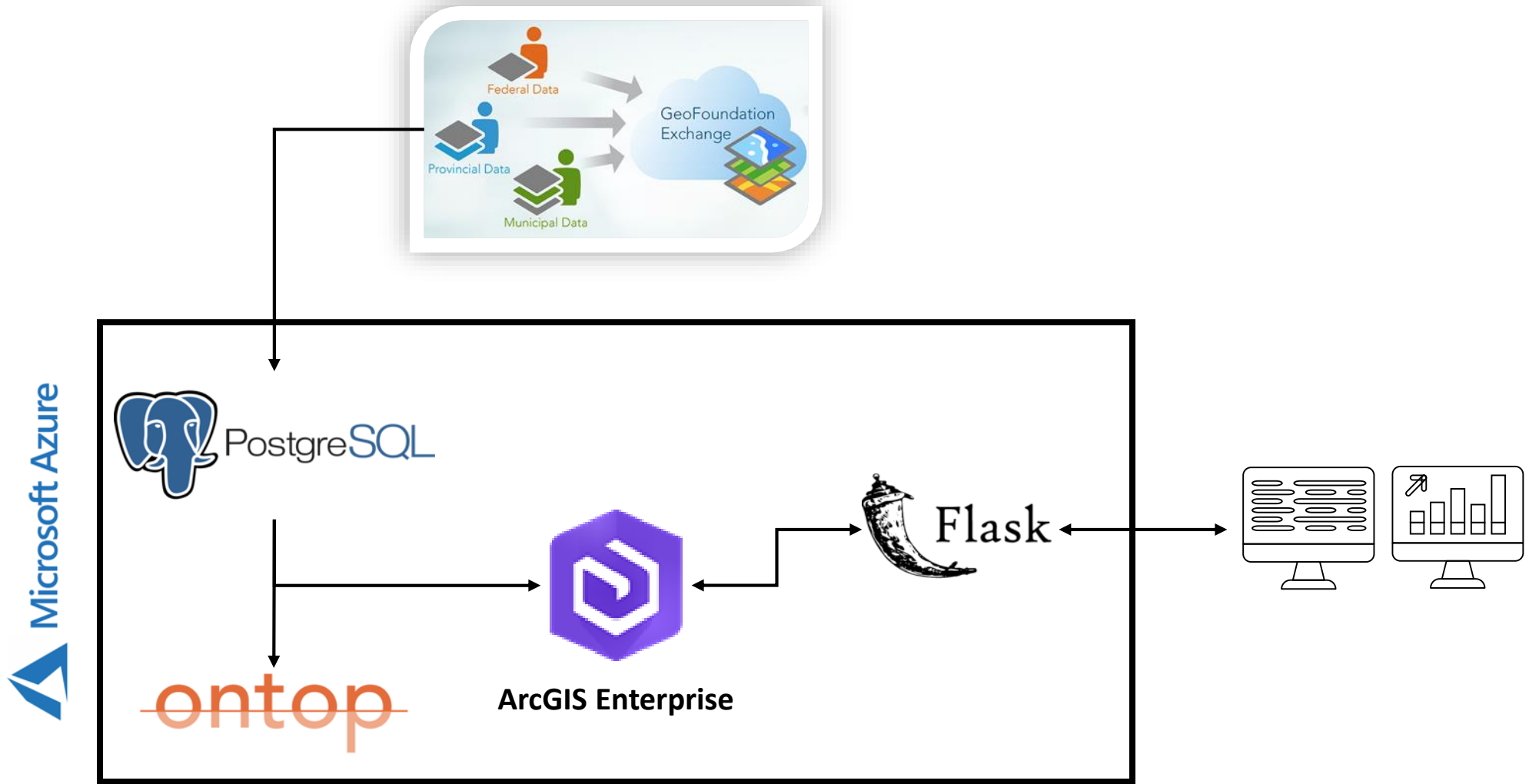
- Select Point A and Point B.
- Find the road segments in the road network that define the shortest path between A and B.
- Identify the neighbourhoods along the road segments the path goes through.
- Identify the land use types along the road segments the path goes through.
- Locate the points-of-interest “near” the path.



Demo

The screenshot displays a GIS application interface. The top navigation bar includes the GSX (GeoSemantics Exchange) logo, the location 'Toronto, Ontario' with a Canadian flag, the 'iCity' logo, and the 'esri Canada' logo with 'Education and Research' text. On the left, there is a vertical toolbar with icons for home, zoom in, zoom out, and location. The main map area shows a dark-themed map of the Greater Toronto Area with a green boundary highlighting a specific region. Labeled municipalities include King, Nobleton, Vaughan, Markham, Pickering, Ajax, North York, Scarborough, Bramalea, Malton, Etobicoke, Toronto, Mississauga, and Clarkson. A scale bar and 'Esri, HERE, NPS' text are at the bottom left of the map. The bottom right of the map area says 'Powered by Esri'. On the right side of the interface, there is a white panel titled 'Knowledge Graph' and 'Network Statistics'. The 'Network Statistics' section contains two columns of labels: 'Total Nodes:', '# of Roads:', 'Neighs:', '# of Landuse:', '# of LandCover:', and '# of POIs:' in the left column; and 'Total Links:', 'Road links:', 'Neigh Link:', 'Landuse Links:', 'Landcover Link:', and 'POIs Links:' in the right column. A mouse cursor is visible over the 'Total Links:' label.

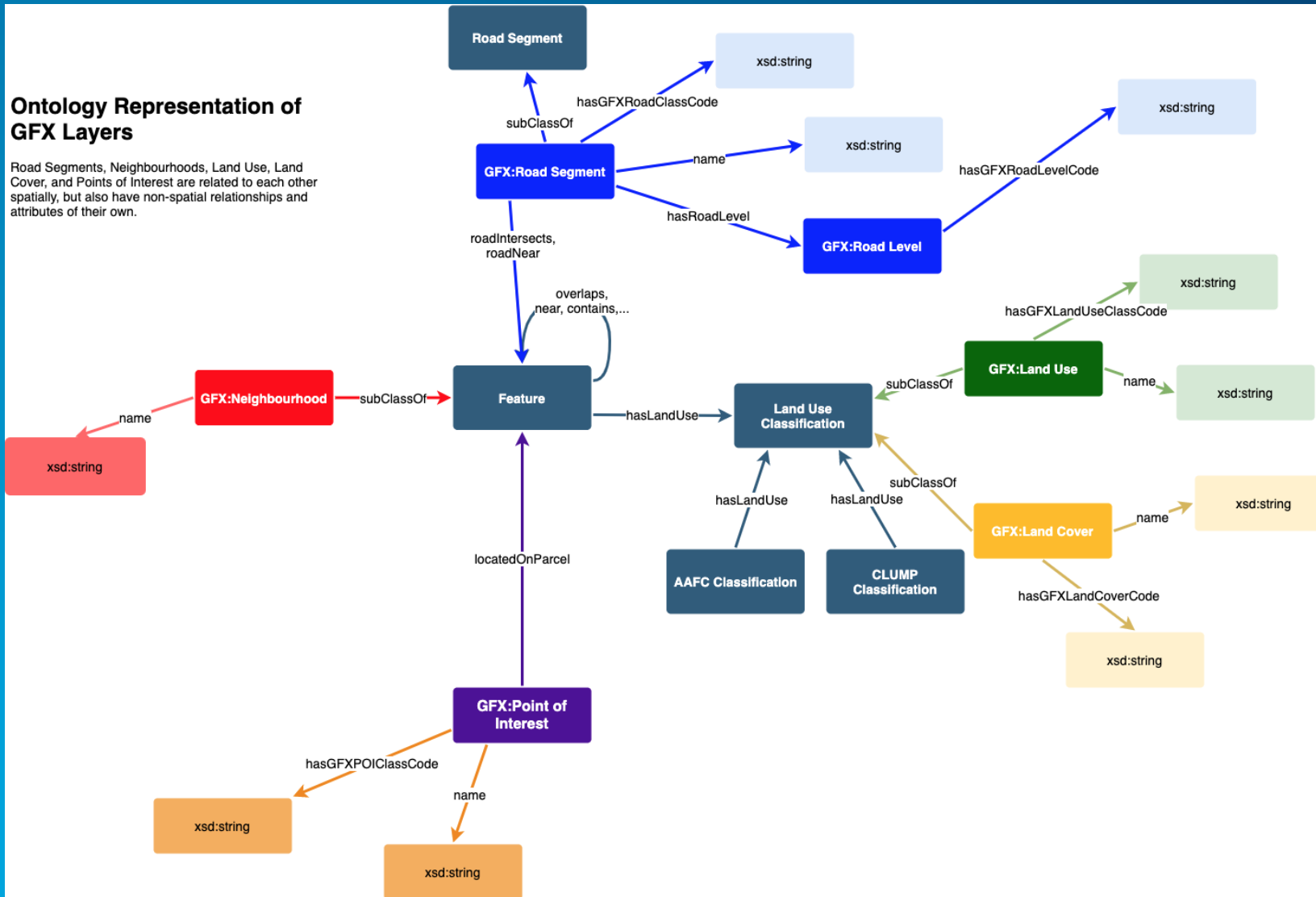
GSX ARCHITECTURE



Packages & APIs

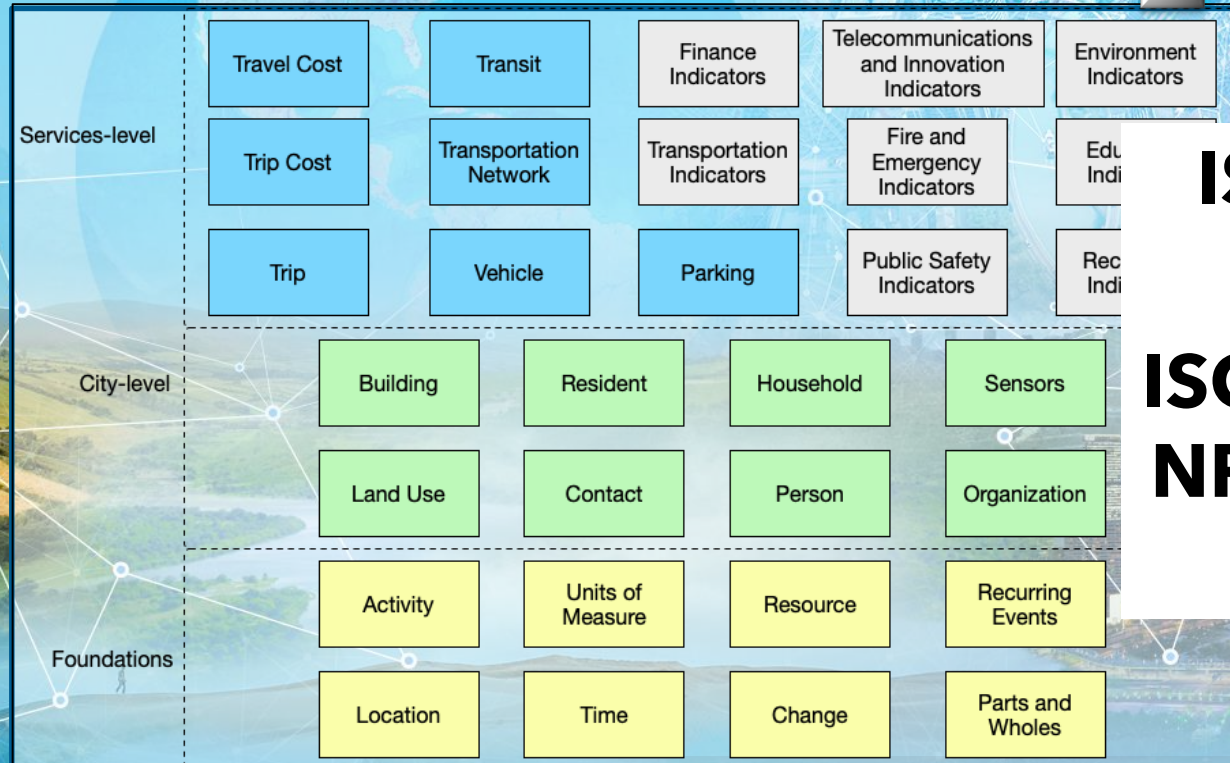
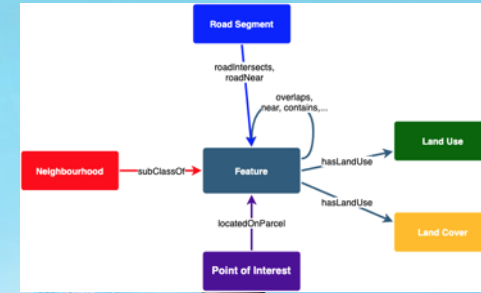
- OWLReady2
- rdflib
- python
- NumPy + Pandas
- JS
- DB

Knowledge Graph - Ontology Structure



GSX Ontology

ESRI GSX Ontology



**ISO/IEC JTC1 WG11
Smart Cities**

**ISO standards projects:
NP5087-1, NP5087-2,
NP5087-3**

**iCity-ORF Project 1.1: iCity Transportation
Planning Suite of Ontologies**



Next Steps

- Continued design improvements (efficiency, functionality)
- Integrate external data sources
- Apply and adapt Esri prototype for other use cases
- Continued efforts on ISO standardization

iCity: Urban Informatics for Sustainable Metropolitan Growth



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धन्यवाद
Thank you
Nandi
Спасибо
Tack
Хвала
Köszönöm
Takk
Gracias
Grazie
Obrigado
感謝您
Děkujeme
Kiitos
شكرا
धन्यवाद
תודה
Merci
Teşekkürler
Dziękuję
Děkuji
ありがとうございます
Danke
Terima Kasih
Dziękuję
Dank u
감사합니다
Tak

