



UNIVERSITY OF  
**TORONTO**



**esri** Canada | Education  
& Research

# **GEO SEMANTICS EXCHANGE (GSX)**

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Anastassios Dardas, PhD – Esri Canada

# About us



**Megan Katsumi, PhD** - Postdoctoral & iCity Ontology Developer, University of Toronto (UTTRI)

- Supervisor(s): Prof. Mark Fox
- Specializes:
  - Ontology development
  - Semantic Web Technologies



**Hasan Bayanouni, PhD** - Postdoctoral & team leader (iCity-ITSoS), University of Toronto

- Supervisor(s): Prof. Baher Abdulhai
- Specializes:
  - IT Infrastructure
  - Solutions Architect & Systems Engineering
  - IoT & Smart Cities Solutions



**Anastassios (Tasos) Dardas, PhD** - Higher Education Developer, Esri Canada

- Supervisor(s): Brent Hall (PhD), Jon Salter (PhD)
- Specializes:
  - GIS, Health & Transport Geography
  - Development – Automated pipelines, Multiprocessing, WebGIS
  - Data Science, Deep Learning, GeoAnalytics



# Our Vision

Enabling a  
Smarter Community

Connecting Content  
and Providing Context

Enabling a  
Semantic Querying within  
ArcGIS Enterprise Platform



NG-  
9-1-1

How can Esri Canada better support the identification and assessment of GIS public safety data?

Connecting Content  
and Providing Context

Enabling a  
Semantic Querying within  
ArcGIS Enterprise Platform

# Problem:

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

System of Record



System of Engagement



System of Insight



Supports Multiple Types of Systems

Helping Organizations Understand ...

GeoFoundation Exchange (GFX) Data

35+ Datasets

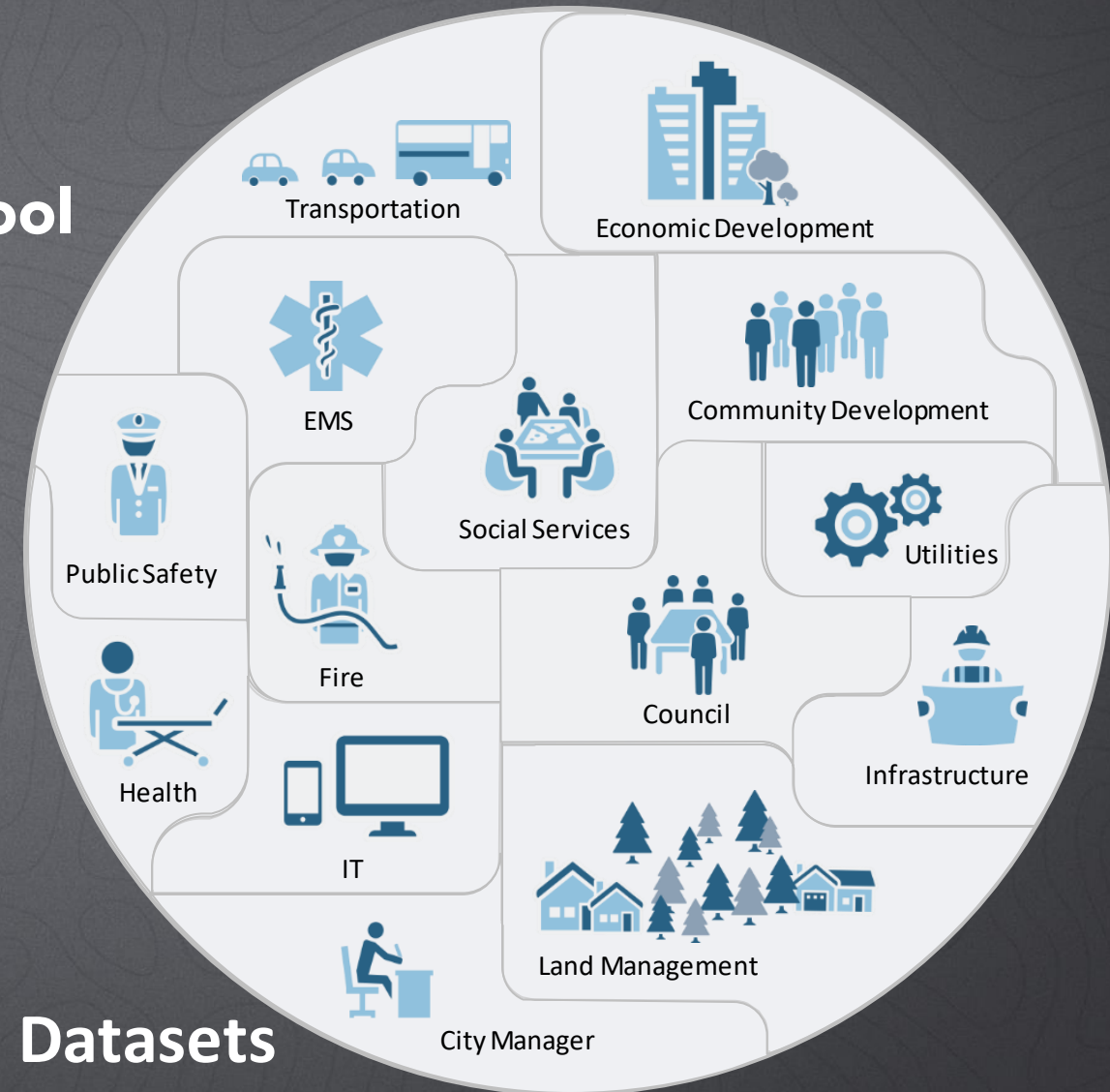
**Objective:** Investigate a solution that uses the *iCity Ontology* to integrate the GFX datasets and enable semantic querying: the GeoSemantics Exchange (GSX)



*Creating a System of Engagement*

# Solution & Case Study

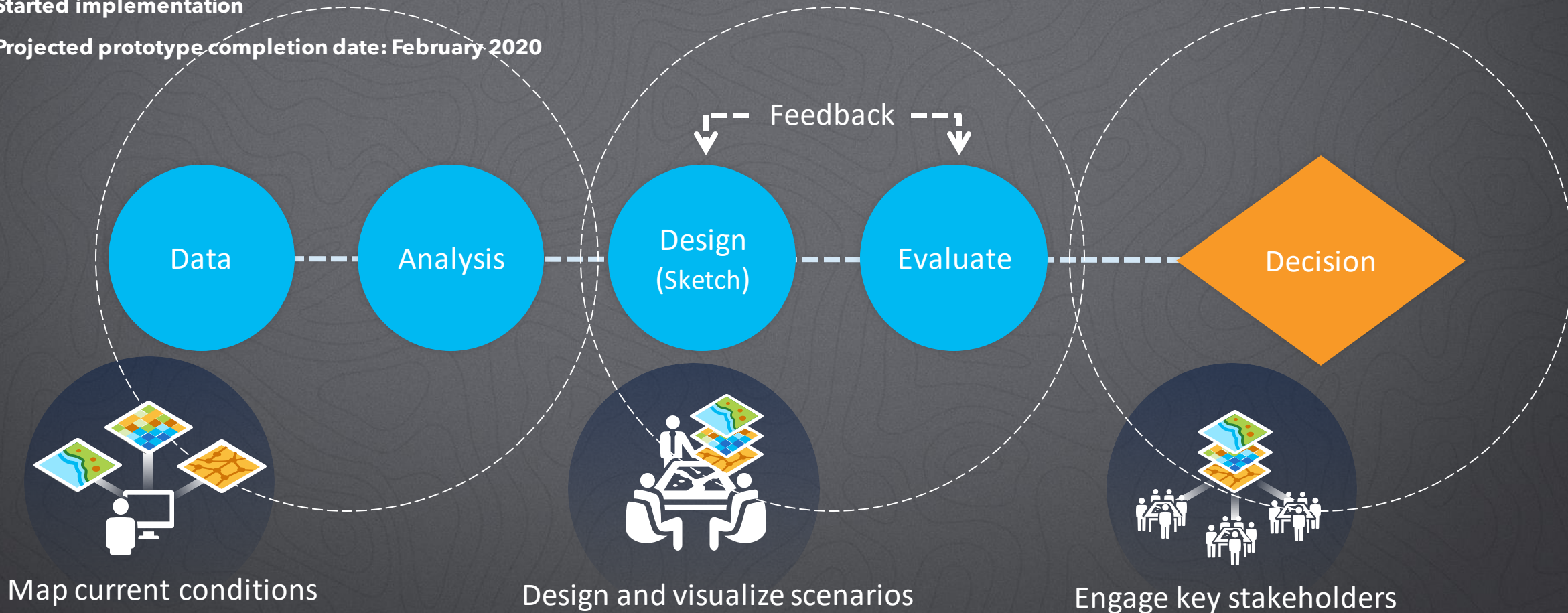
- In-Depth Context of Shortest Route Tool
- Feature Classes in Scope:
  - Point-of-Interest (POI)
  - Neighbourhoods
  - Land Use
  - Road Segments
  - Other



# CURRENT STATUS

Enable A New Context For Understanding With Geodesign

- **First use case identified**
- **Project plan defined**
- **Initial architecture design completed**
  - **Tools reviewed and selected**
- **Started implementation**
- **Projected prototype completion date: February 2020**





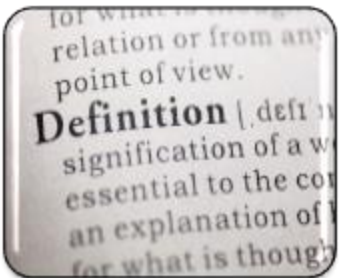
# Ontology Components



## Micro-Theory

- Axioms/Rules
- Deduction - answering questions

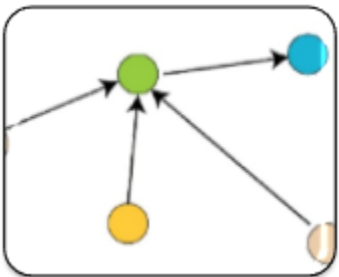
- Every road of class X built by Acme construction will have an average life of Y years.



## Definitions and Constraints

- Class Definitions (in Logic)
- Automated classification

- A Parcel with a land use code of "2" is classified as being for Government land use

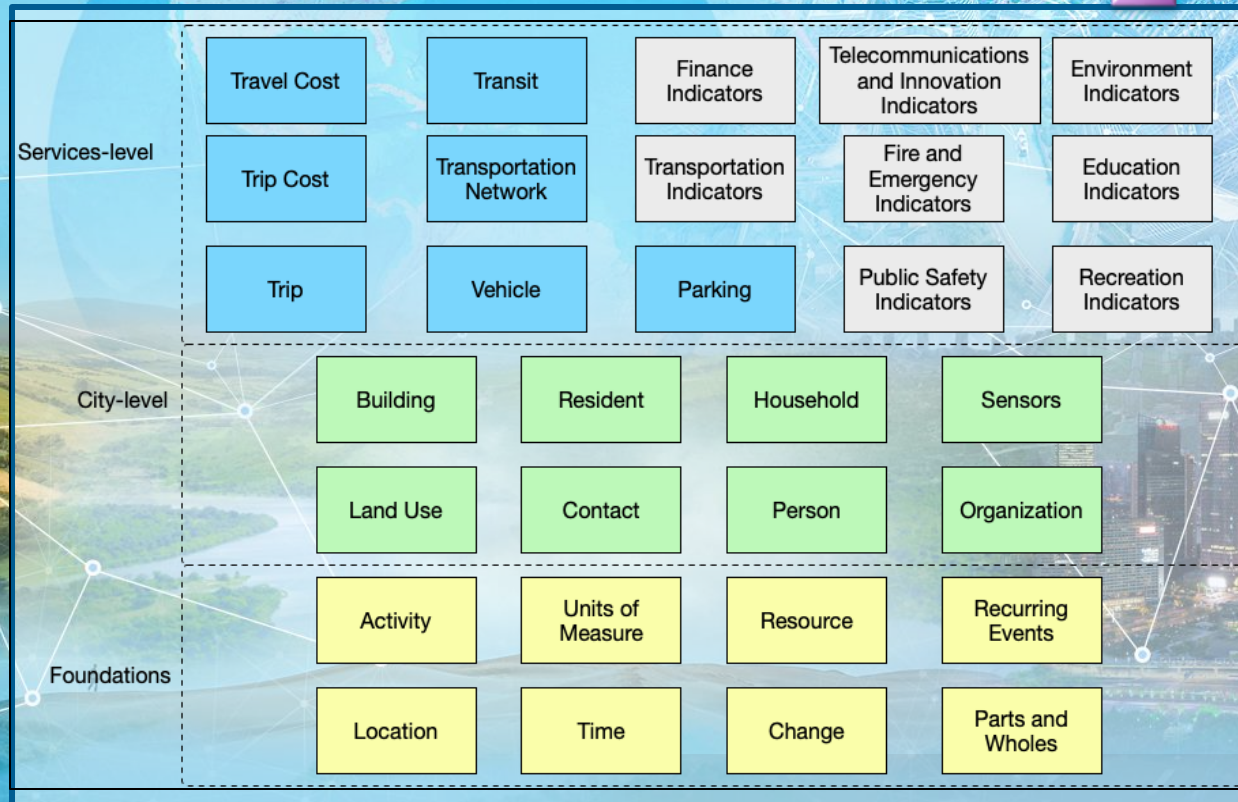
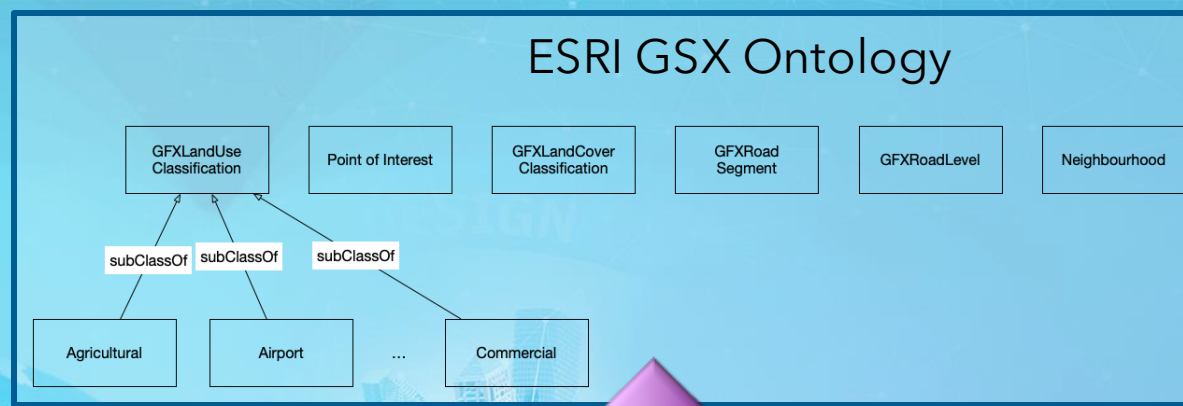


## Knowledge Graph

- Classes and Properties
- Taxonomy and Inheritance

- Parcel **hasUse** Land Use Class
- Road Segment **near** Parcel

# GSX Ontology

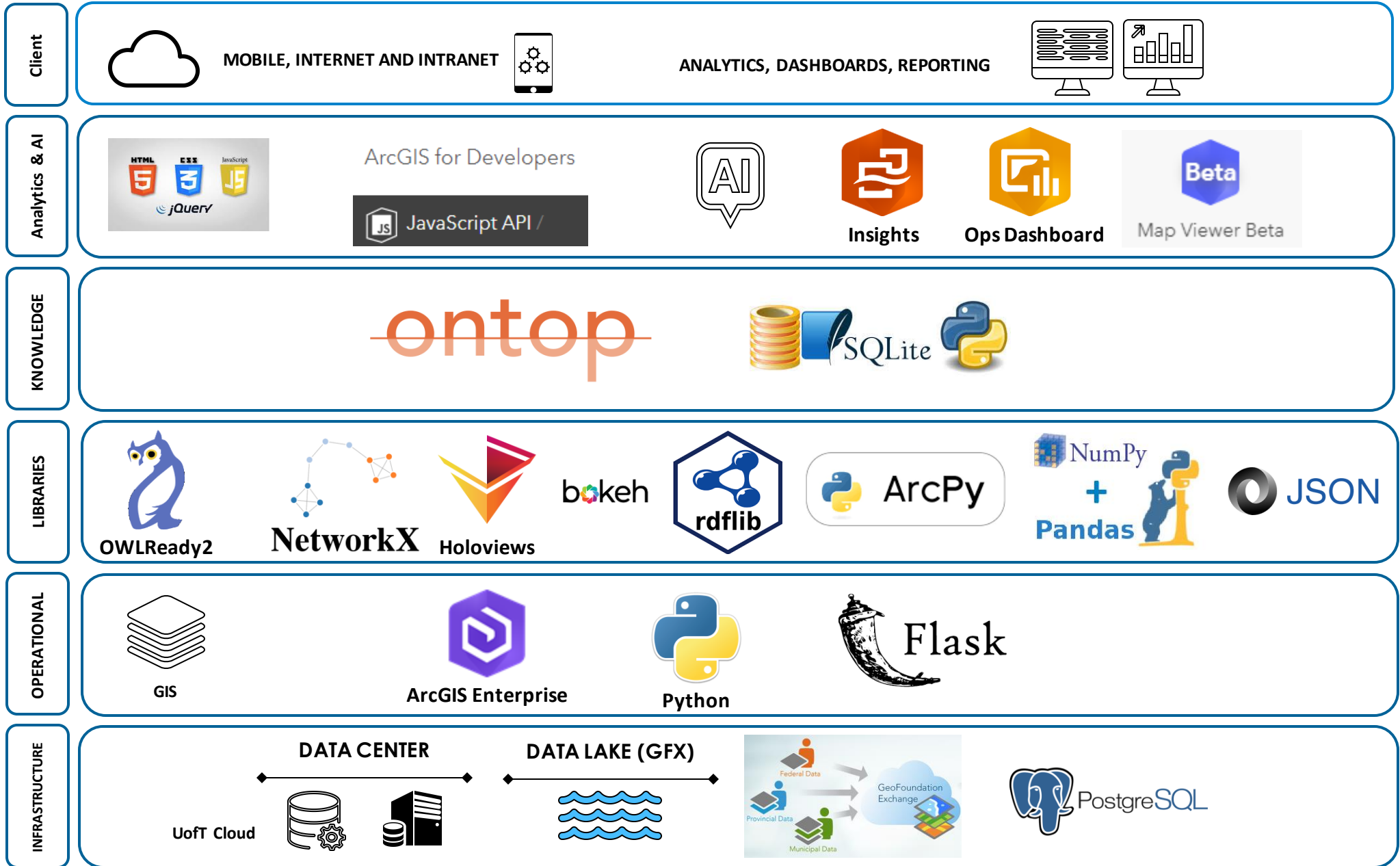


# GSX ARCHITECTURE


INNOVATION


BUSINESS PROCESS

COLLABORATION



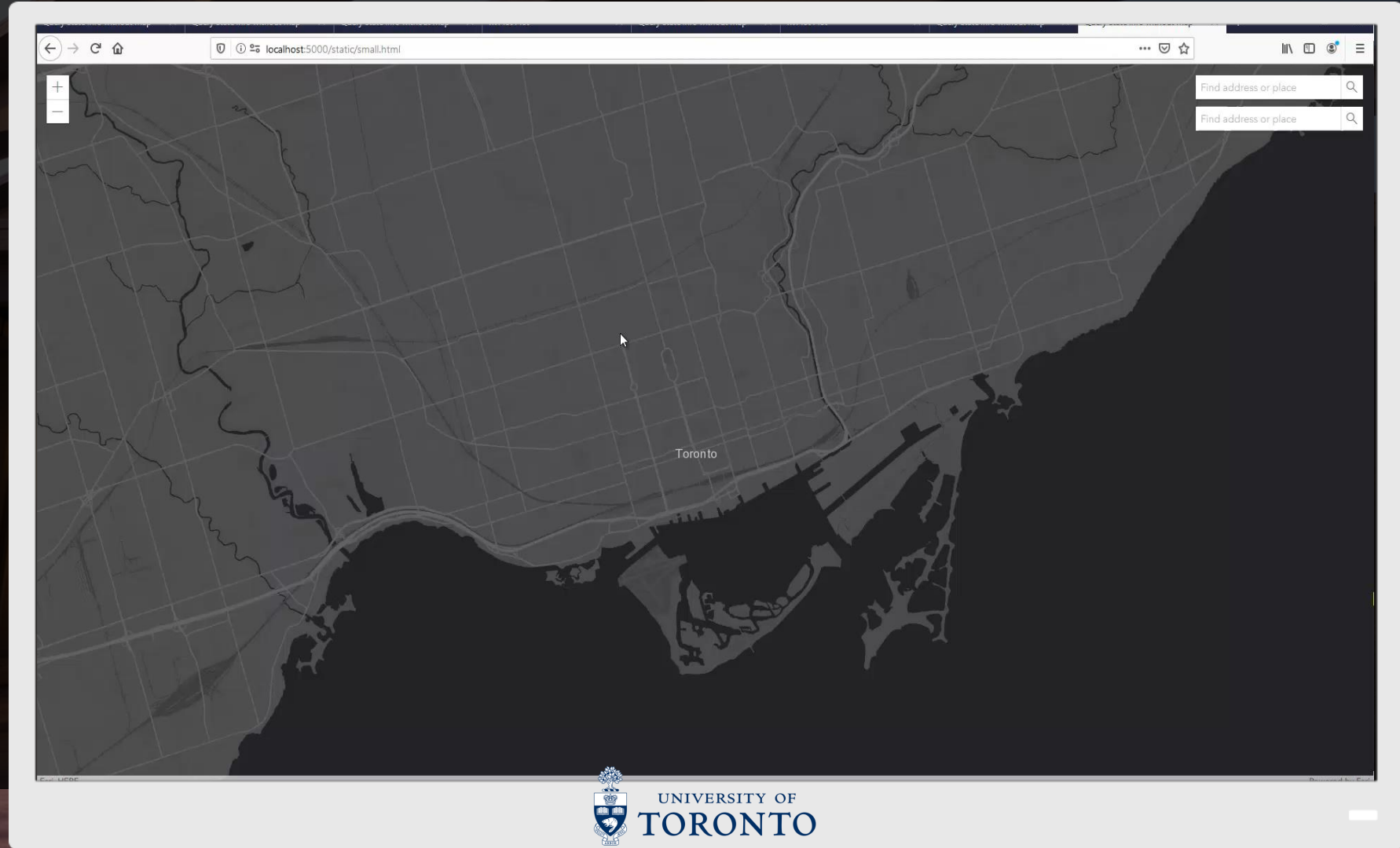
# Case (1) Output:

 **192+**  
Landuse feature classes

 **2+**  
Landuse types

 **3+**  
Neighbourhoods

 **5+**  
Points of Interests  
3 are hotels



A 3D architectural rendering of a city skyline, featuring several skyscrapers and a building under construction. The scene is overlaid with a complex network of white lines and dots, representing a data or knowledge graph. The background is a gradient of blue, transitioning from a lighter shade at the top to a darker shade at the bottom.

# Our .Next

- Automate update from GFX
- Improve query efficiency
- Implement reasoning
- Revise and refine result (knowledge graph) presentation and interaction

# FUTURE WORK

- Applications

- Automated dataset verification (e.g. GFX)
- Apply: NG9-1-1
- Integrate external data



# Acknowledgements



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**iCity - ORF**

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  
谢谢您  
Dank u  
감사합니다  
Tak

