UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Linked Transportation Services for Connected Travelers

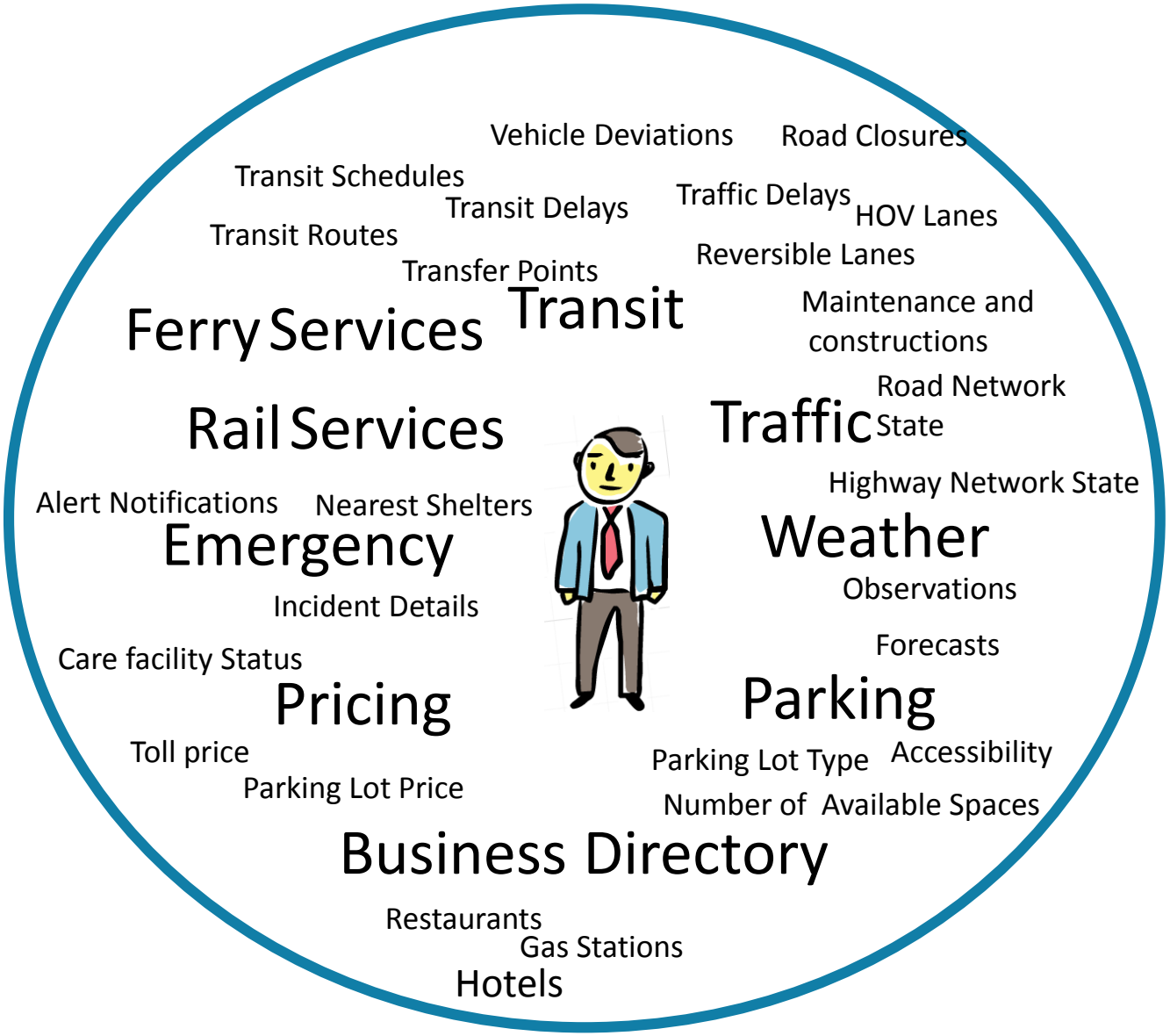
MOHAMED ELSHENAWY

UNIVERSITY OF TORONTO

ATIS Systems

Play an important role in

1. Reducing frustration
2. Improving travelers' decision making
3. Encouraging more sustainable travel and mode choice behaviour (active transportation)
4. Travel Demand Management (alternative routes, alternative modes, alternative times of day)
5. Incident Management
6. Emergency Management / Disaster Response


Vehicle Deviations
Road Closures
Transit Schedules
Traffic Delays
Transit Delays
HOV Lanes
Transit Routes
Reversible Lanes
Transfer Points
Transit
Ferry Services
Maintenance and constructions
Road Network State
Rail Services
Traffic
Highway Network State
Alert Notifications
Nearest Shelters
Emergency
Weather
Observations
Incident Details
Forecasts
Care facility Status
Pricing
Parking
Toll price
Parking Lot Type
Accessibility
Parking Lot Price
Number of Available Spaces
Business Directory
Restaurants
Gas Stations
Hotels

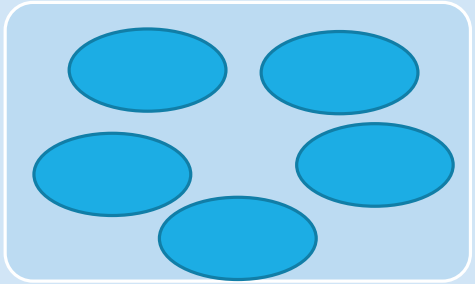
Information Provision Systems

Silos

Particular information Service

Single mode of travel

Single Agency

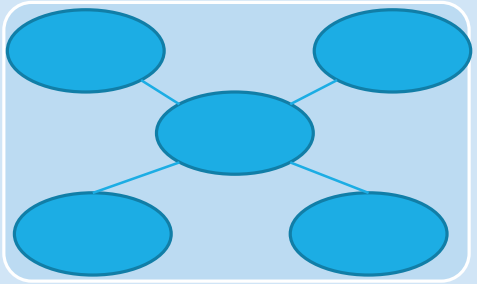


Partially Integrated

Single point of access to multiple sources

Multimodal

User have to seek information about each mode



Fully Integrated

Ecosystem

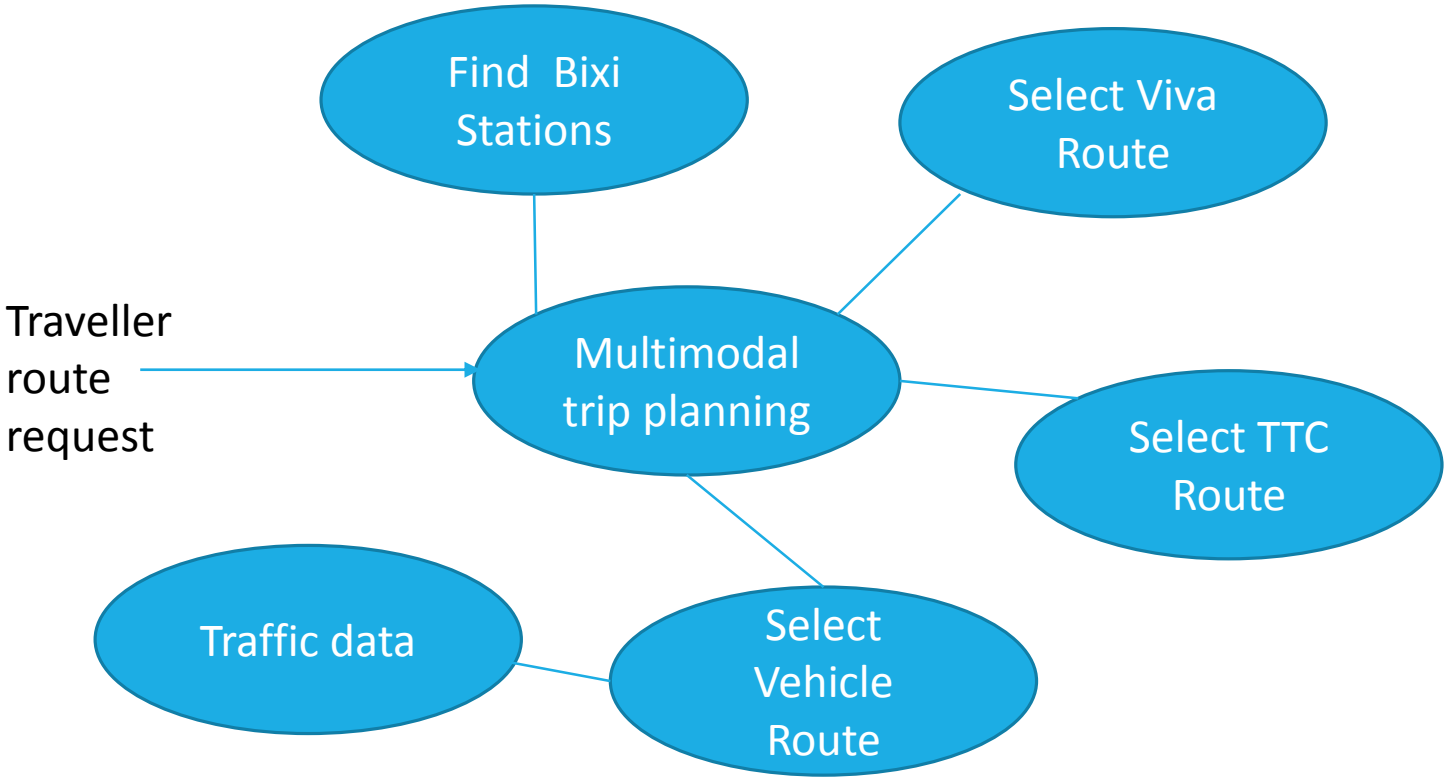
Multiple data sources collaborate to provide a particular information service

Example - Multimodal Trip Planner System

A trip from Richmond Hill to downtown Toronto may involve using

1. Car (traffic data)
2. Viva (transit data)
3. TTC (transit data)
4. Bixi (bike sharing)
5. Multimodal trip planning service
6. Travel time estimation

Example - Multimodal Trip Planner System



Proposed Framework

Automatically generate regional context-aware traveller information by *semantically* interlinking open transportation datasets provided by different agencies/jurisdictions

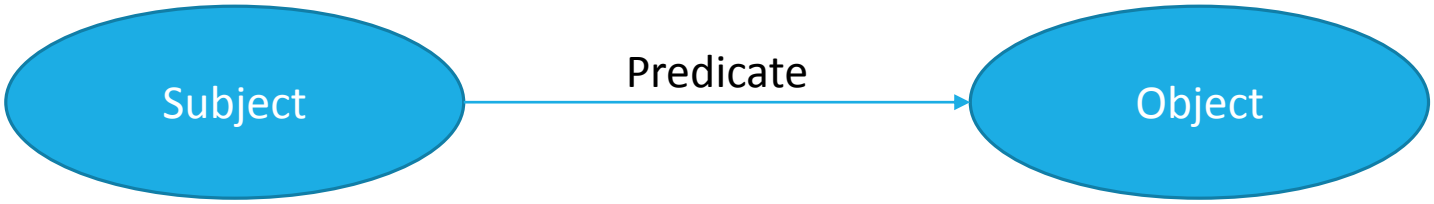
Two components:

1. Service Registry
2. Rule-based engine to support automatic discovery of relevant datasets based on the user context.

Service Registry

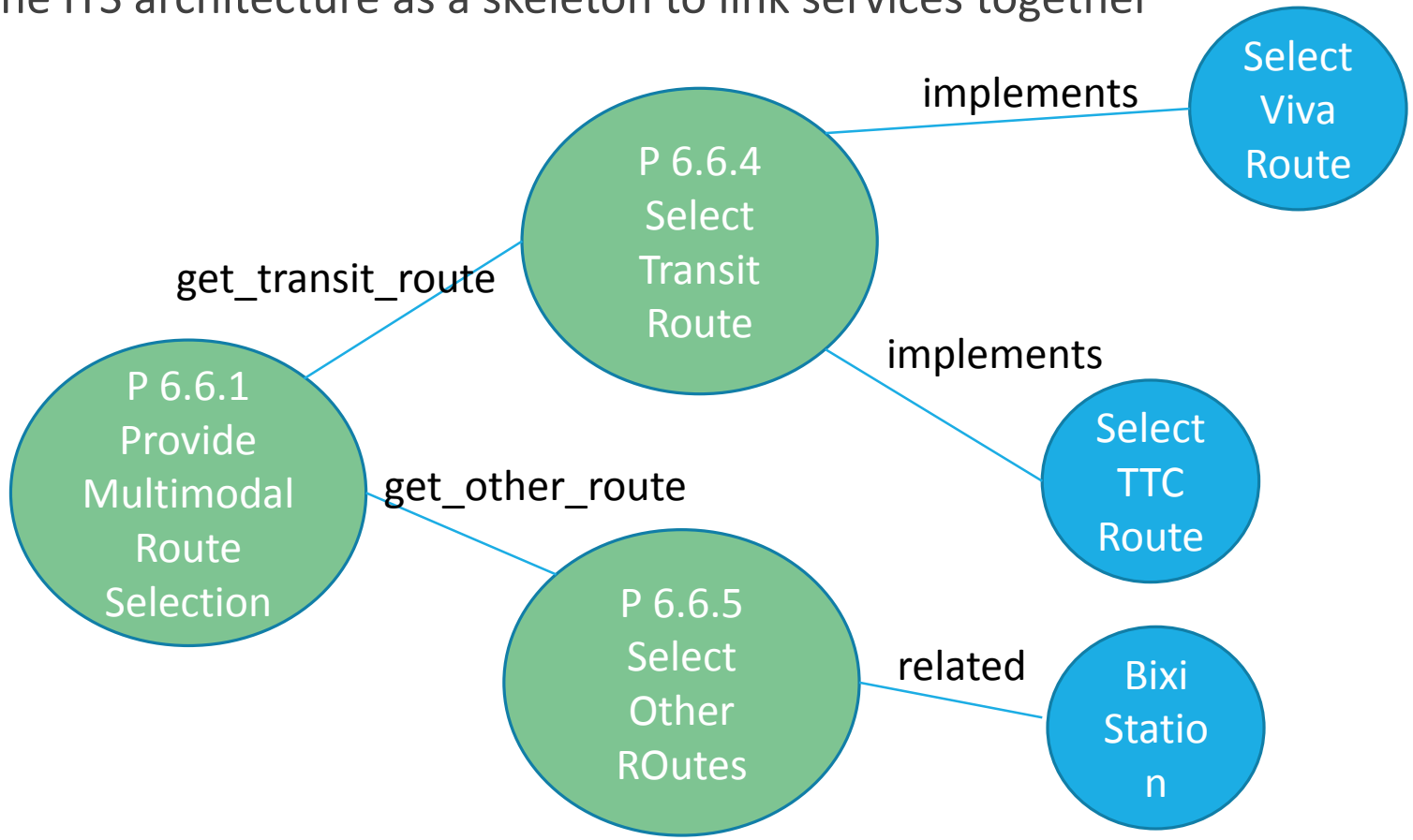
New service/dataset is linked to existing services/datasets using semantic relations

Resource Description Framework (RDF) is used to describe relations in a machine readable format

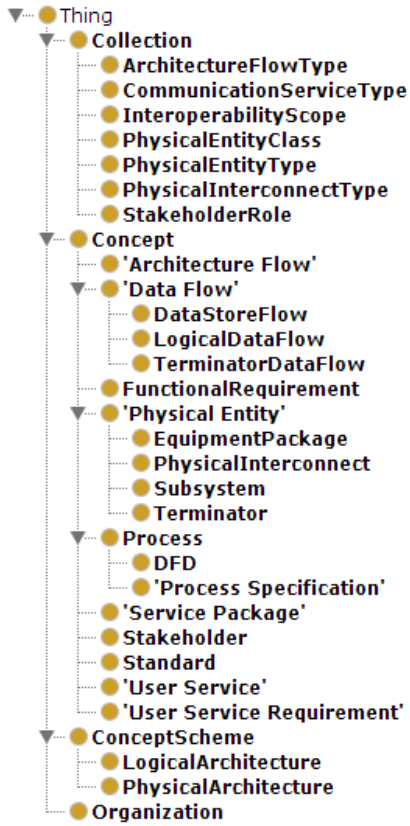


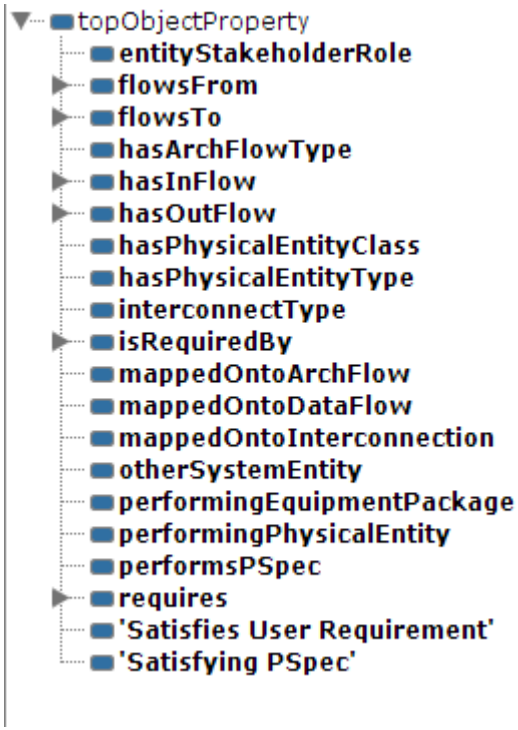
Service Registry

The ITS architecture as a skeleton to link services together

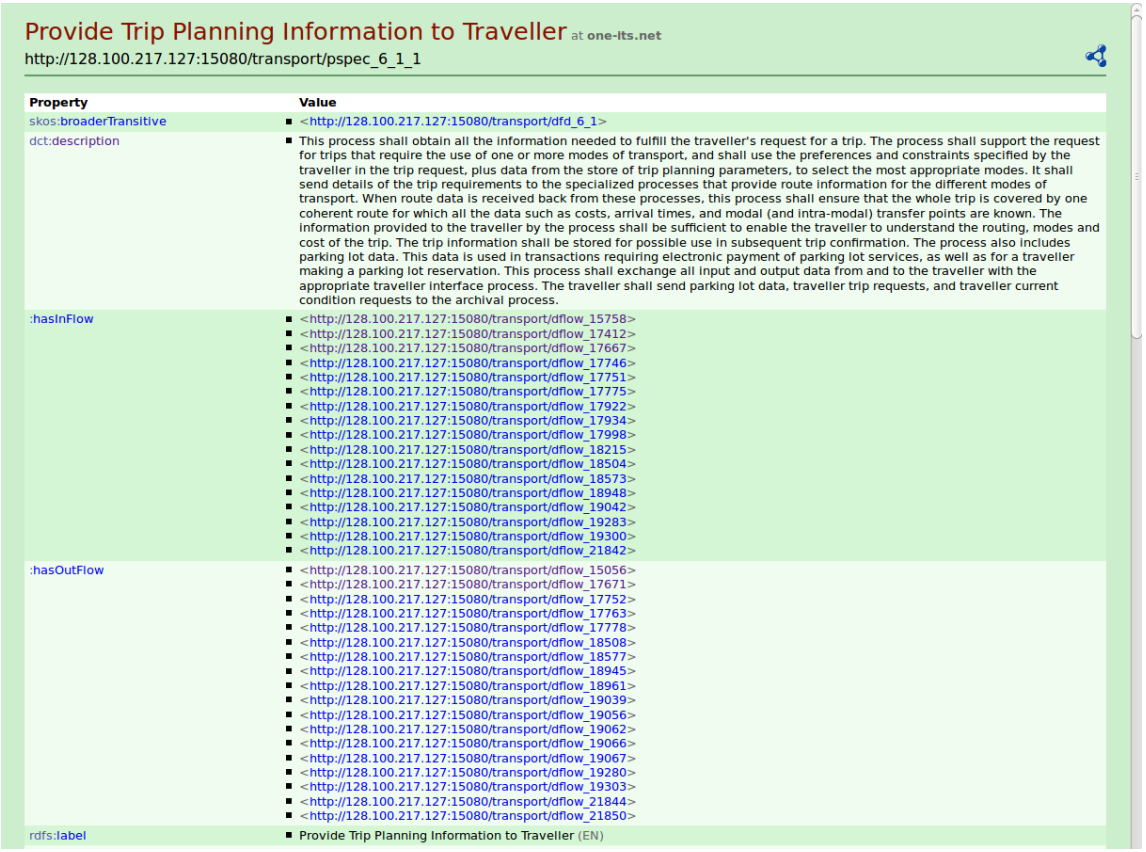


Semantic relations





Encoding ITS Architecture



Provide Trip Planning Information to Traveller at one-its.net

http://128.100.217.127:15080/transport/pspec_6_1_1

Property	Value
skos:broaderTransitive	<http://128.100.217.127:15080/transport/dfd_6_1>
dct:description	This process shall obtain all the information needed to fulfill the traveller's request for a trip. The process shall support the request for trips that require the use of one or more modes of transport, and shall use the preferences and constraints specified by the traveller in the trip request, plus data from the store of trip planning parameters, to select the most appropriate modes. It shall send details of the trip requirements to the specialized processes that provide route information for the different modes of transport. When route data is received back from these processes, this process shall ensure that the whole trip is covered by one coherent route for which all the data such as costs, arrival times, and modal (and intra-modal) transfer points are known. The information provided to the traveller by the process shall be sufficient to enable the traveller to understand the routing, modes and cost of the trip. The trip information shall be stored for possible use in subsequent trip confirmation. The process also includes parking lot data. This data is used in transactions requiring electronic payment of parking lot services, as well as for a traveller making a parking lot reservation. This process shall exchange all input and output data from and to the traveller with the appropriate traveller interface process. The traveller shall send parking lot data, traveller trip requests, and traveller current condition requests to the archival process.
:hasInFlow	<http://128.100.217.127:15080/transport/dflow_15758> <http://128.100.217.127:15080/transport/dflow_17412> <http://128.100.217.127:15080/transport/dflow_17667> <http://128.100.217.127:15080/transport/dflow_17746> <http://128.100.217.127:15080/transport/dflow_17751> <http://128.100.217.127:15080/transport/dflow_17775> <http://128.100.217.127:15080/transport/dflow_17922> <http://128.100.217.127:15080/transport/dflow_17934> <http://128.100.217.127:15080/transport/dflow_17998> <http://128.100.217.127:15080/transport/dflow_18215> <http://128.100.217.127:15080/transport/dflow_18504> <http://128.100.217.127:15080/transport/dflow_18573> <http://128.100.217.127:15080/transport/dflow_18948> <http://128.100.217.127:15080/transport/dflow_19042> <http://128.100.217.127:15080/transport/dflow_19283> <http://128.100.217.127:15080/transport/dflow_19300> <http://128.100.217.127:15080/transport/dflow_21842>
:hasOutFlow	<http://128.100.217.127:15080/transport/dflow_15056> <http://128.100.217.127:15080/transport/dflow_17671> <http://128.100.217.127:15080/transport/dflow_17752> <http://128.100.217.127:15080/transport/dflow_17763> <http://128.100.217.127:15080/transport/dflow_17778> <http://128.100.217.127:15080/transport/dflow_18508> <http://128.100.217.127:15080/transport/dflow_18577> <http://128.100.217.127:15080/transport/dflow_18945> <http://128.100.217.127:15080/transport/dflow_18961> <http://128.100.217.127:15080/transport/dflow_19039> <http://128.100.217.127:15080/transport/dflow_19056> <http://128.100.217.127:15080/transport/dflow_19062> <http://128.100.217.127:15080/transport/dflow_19066> <http://128.100.217.127:15080/transport/dflow_19067> <http://128.100.217.127:15080/transport/dflow_19280> <http://128.100.217.127:15080/transport/dflow_19303> <http://128.100.217.127:15080/transport/dflow_21844> <http://128.100.217.127:15080/transport/dflow_21850>
rdfs:label	Provide Trip Planning Information to Traveller (EN)

Rule-based engine

Define a set of rules to choose services according to user context.

The Inference Engine matches facts and data against Production Rules

A Production Rule is a two-part structure using First Order Logic for reasoning over knowledge representation.

when

<conditions>

then

<actions>;

Examples:

when user location within York Region and using transit choose VIVA service

Conclusion

This research proposes a novel approach to automatically generate regional context-aware traveller information by ***semantically*** interlinking open transportation datasets provided by different agencies/ jurisdictions.

Technologies such as the Resource Description Framework (RDF) and Uniform Resource Identifier URI to identify the relations between traffic management centres, transit agencies, and road network elements, representing these relations in a labeled, directed graph of connected transportation information.

A rule-based engine has been implemented to support automatic discovery of relevant datasets based on the user context.

Questions?