Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

An Ontology for Urban Transportation Modelling, Simulation, and Analysis

iCity Research Day June 27, 2016
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What is an ontology?

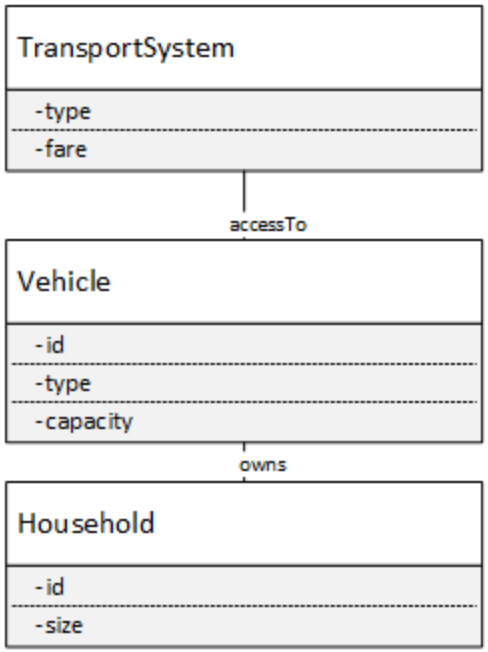
- Ontology
  *an artefact written in a **logical language** that formally defines the **semantics** of a collection of concepts associated with a particular domain of interest.*

What is an ontology?

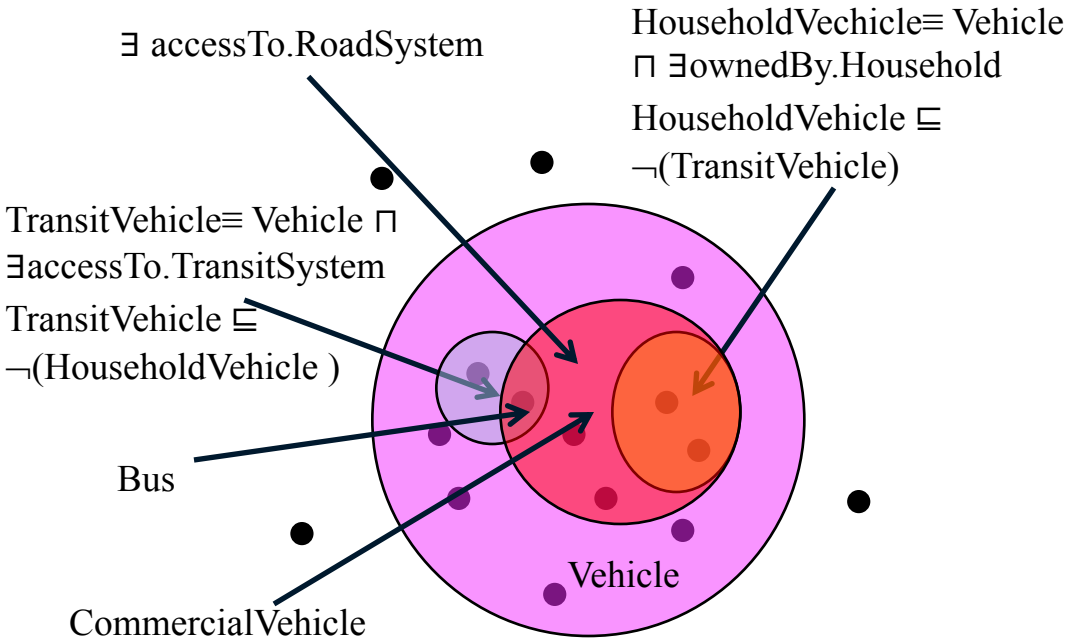
- For example
  - $HouseholdVechicle \equiv Vehicle \sqcap \exists ownedBy.Household$
  - $HouseholdVehicle \sqsubseteq \neg TransitVehicle$
- OWL
  - Based on Description Logic
  - Characterized by a formal semantics (we can prove things)
  - Standard for exchange of information on the web (good for sharing)
  - Tools to support implementation

Ontologies and Data Models

Ontologies can be applied to define data models, but they are not interchangeable solutions.



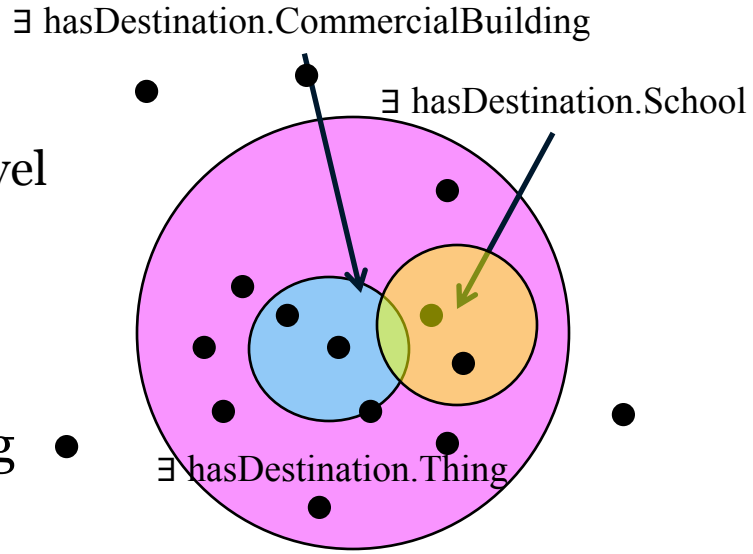
Structure, not semantics!



Necessary & sufficient conditions

Why use ontologies?

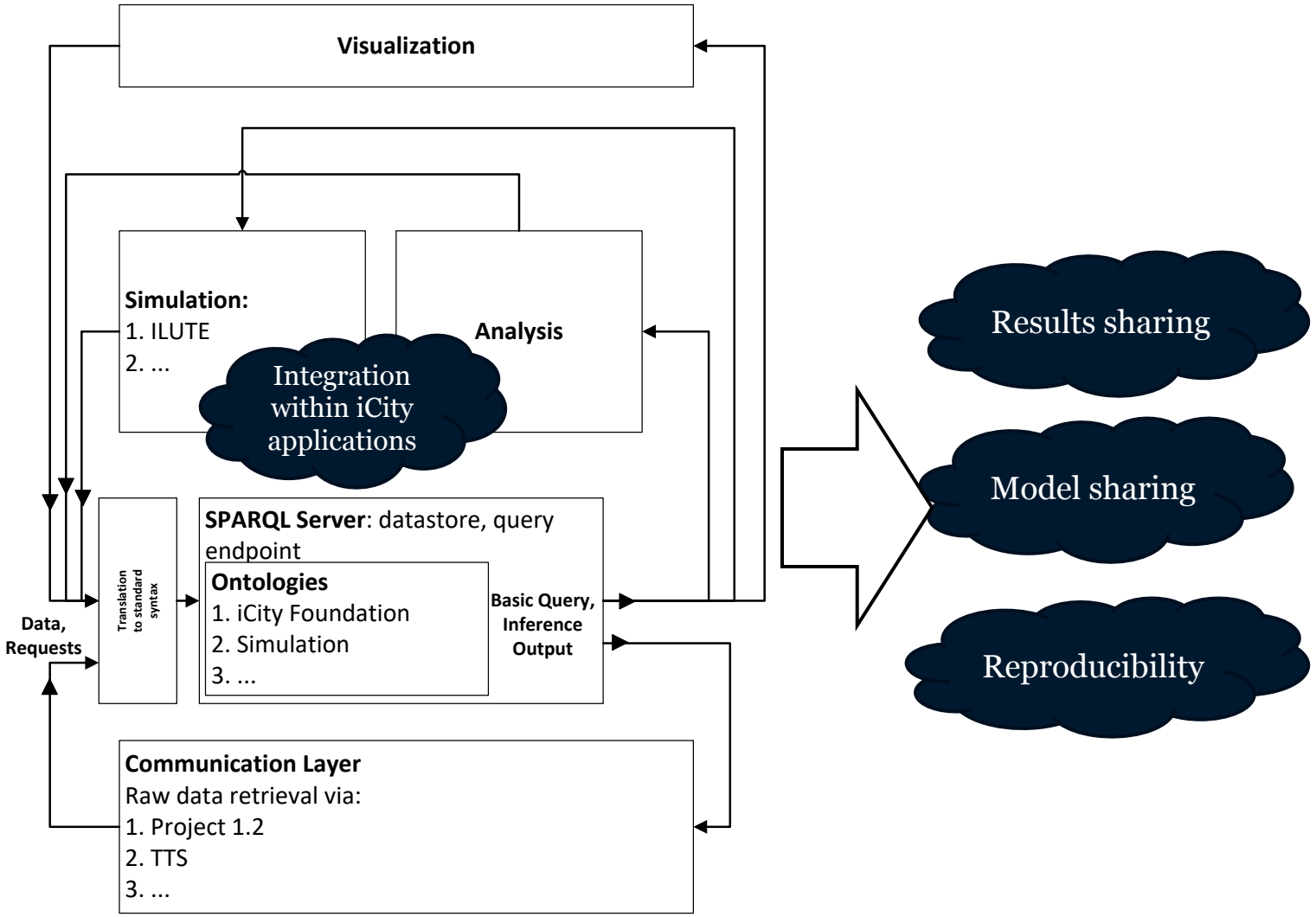
- **Explicit conditions support:**
  - Shareability, integration between applications
    - The meaning of each term is clear
  - Consistency checking (validation of data against definitions)
    - Any trip made with a HouseholdVehicle via a TransitSystem is inconsistent with our definitions
  - Definition-based inference
    - Defining travel behaviour types allows us to categorize instances of travel
      - WorkTrip
      - SchoolTrip
    - Augment results
    - Recognize when something's wrong



Project 1.1

- Objective: develop an ontology for the iCity project

iCity Architecture



iCity Ontology Requirements

- To support this architecture, the iCity ontology must capture:
  - The system begin simulated
  - The models used
    - ILUTE
    - Freight
    - Parking
    - …
  - Other applications in the iCity architecture
    - Data collection (e.g. TTS)
    - …

iCity Ontology Design

- Ontology of the urban system
  - Built Form
  - Transportation Assets
  - Actors
  - Environment

iCity Ontology Design (II)

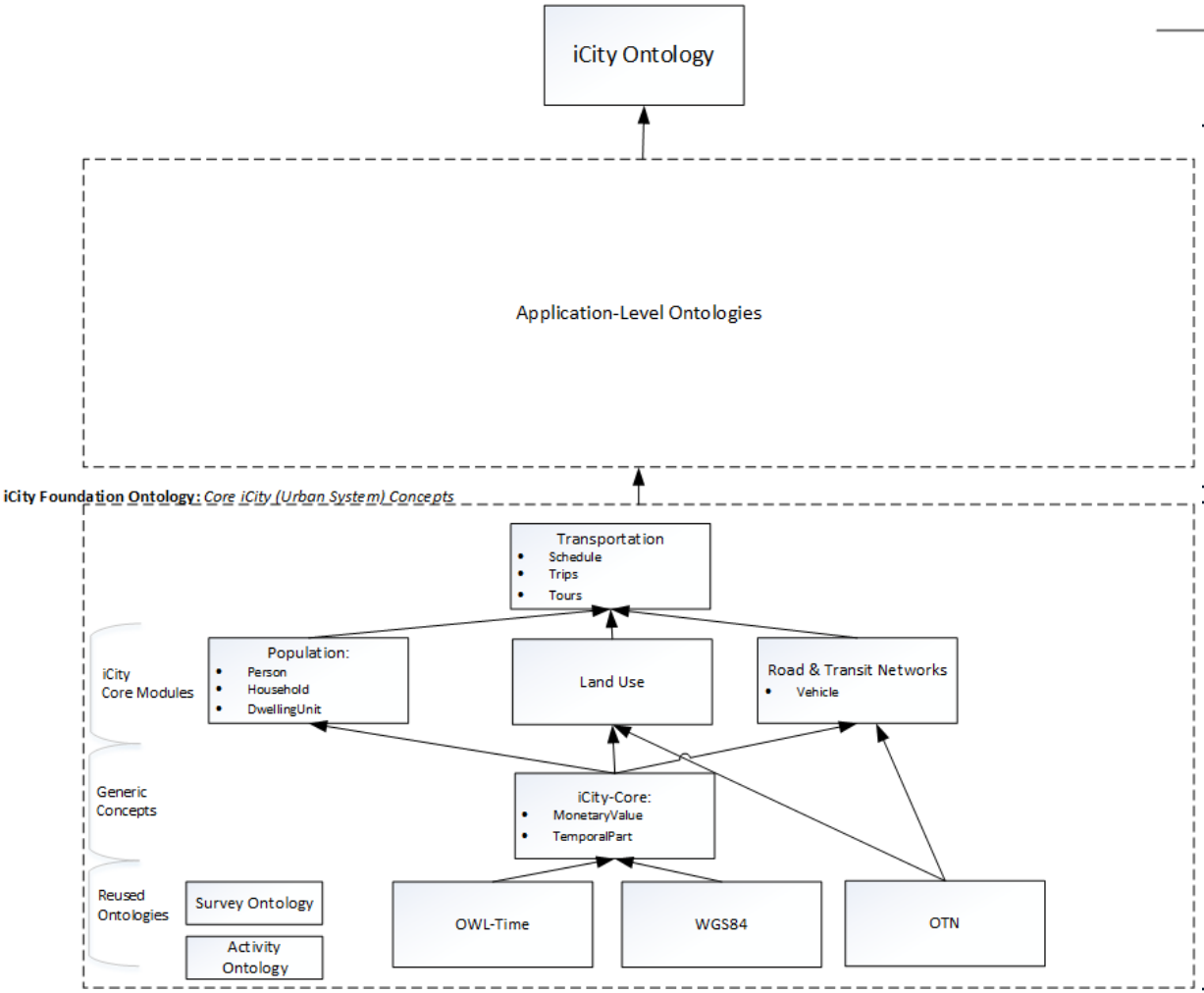
Extended for iCity Applications:

- The simulation
  - States
  - Aggregations, abstractions
  - Model definitions, inputs, outputs
- Data Collection
  - Provenance
- Analysis
  - Inputs, outputs
- Visualization
  - Representations

Status

- Literature Review
  - ILUTE, TTS, TAC report on data collection
  - Survey of transportation ontologies
- Draft of Urban System Ontology in progress
  - Survey ontology

Next Steps



3. Begin application-level extensions

1. Literature review
2. Draft of Urban System Ontology