iCity - ITSoS Integrative Platform

Ahmed Aqra (PhD Candidate) , Dr. Hasan Bayanouni (PostDoc)

Prof. Baher Abdulhai, Prof. Mohamad Al Darieby

May 31st 2019

iCity Research Day 2019

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING
Transportation Research Institute

Agenda

- **iCity-ITSoS as a Platform**:
  - iCity-ITSoS Architecture
  - iCity-ITSoS Linked Data and Data Lake
  - iCity-ITSoS Software Development Kit

- **iCity-ITSoS Applications**
  - Semantic Advanced Traveler Information System
  - Highway Traffic Estimation using Deep Convolutional Neural Network
  - Comparative Study of Web Service Architectures for Software Development Kit of Transportation Application

- **iCity-ITSoS Team**

- **Next Year Plan**

Objective:

- Create a platform to facilitate/enable the process of building transport applications

- **Challenges**:
  1. Data variety and heterogeneity
  2. Multiple siloed services
  3. Difficult re-usability

- **Approach**: ITSoS Integrative platform

iCity-ITSoS as a Platform

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iCity-ITSoS Architecture

Application Layer

Services Layer

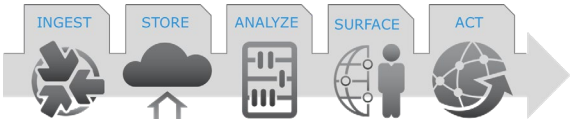
Platform as a Services

Data Lake Layer

- Traffic Camera Data
- Loop Detectors Data
- Traffic Travel Time Data
- Travel Demand Data
- GFTS Data
- Weather Data

Infrastructure as a Services (Multi-Could Strategy)

- Applications
- Visualization
- Application Programming Interface (APIs)



- Analytics Engine
- Software Development Kit
- Multi-Layers Data
- UofT*
- Azure

*UofT Cloud: in-house and secure cloud service by UofT, to host confidential data.

Challenge (1): Data Heterogeneity

- Integrating new datasets is a challenging task

- Heterogeneity in
  - Access methods
  - Data formats
  - Schema

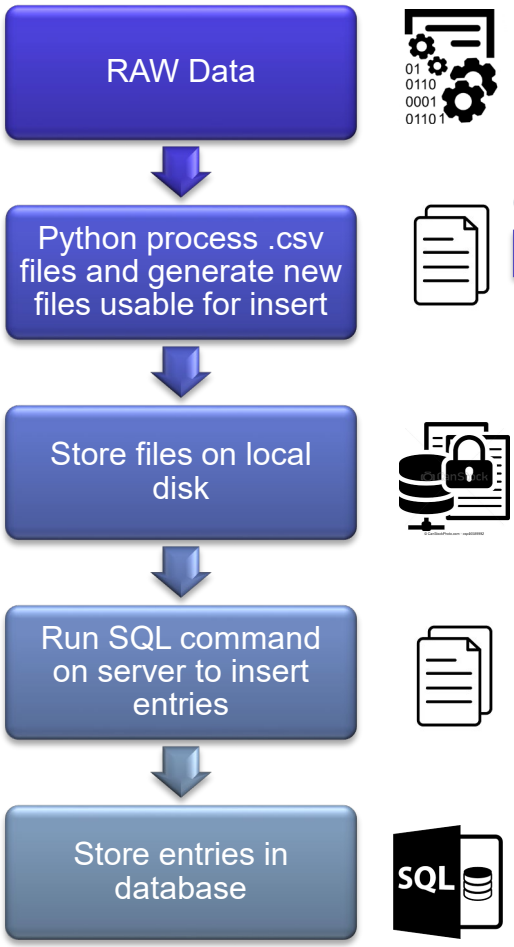
- Data Types
- MTO Loop Detectors
  - Microwave
- Traffic Cameras- MTO & CoT
- GIS / Maps)
- Travel Time
  - HERE/ Google/ Tomotom
- Weather

Data processing and data ingestion:

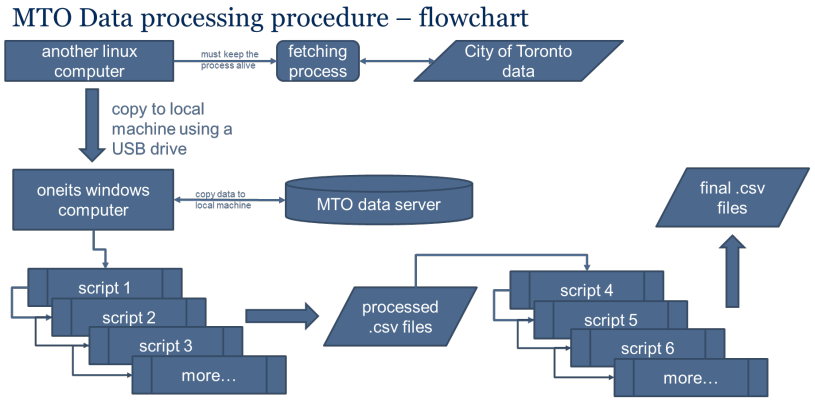
Example: MTO Data (2010-2018)

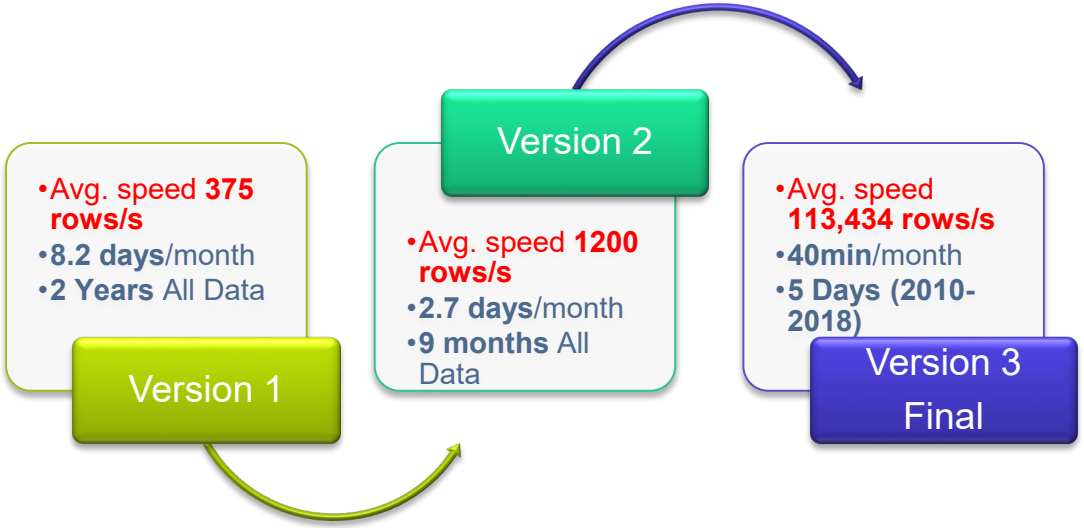
RAW Data => Rows/Month = 265,549,166 rows

Processing Flow



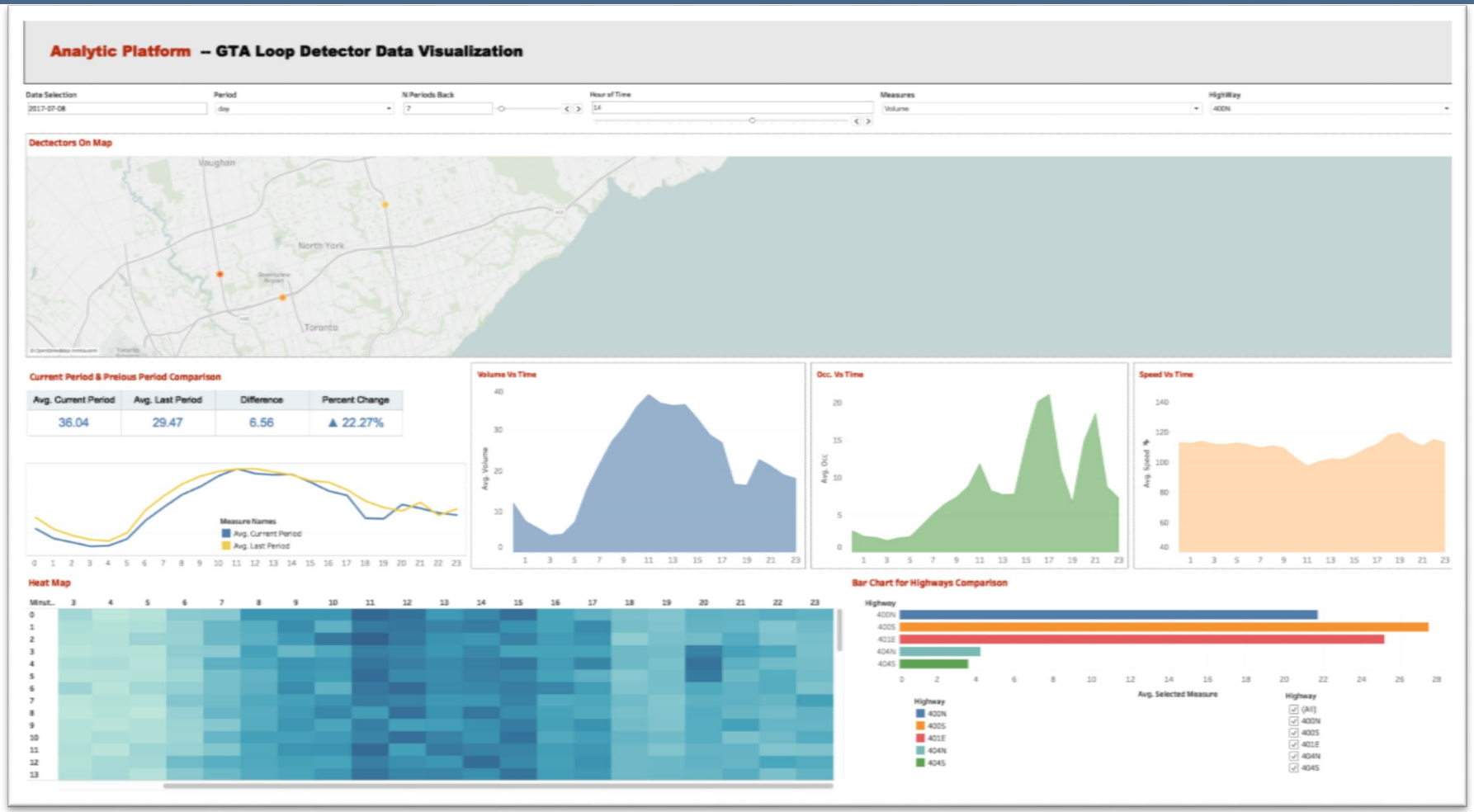
Code





Testing and Optimization

Analytics Platform



Linked Data & iCity Ontology

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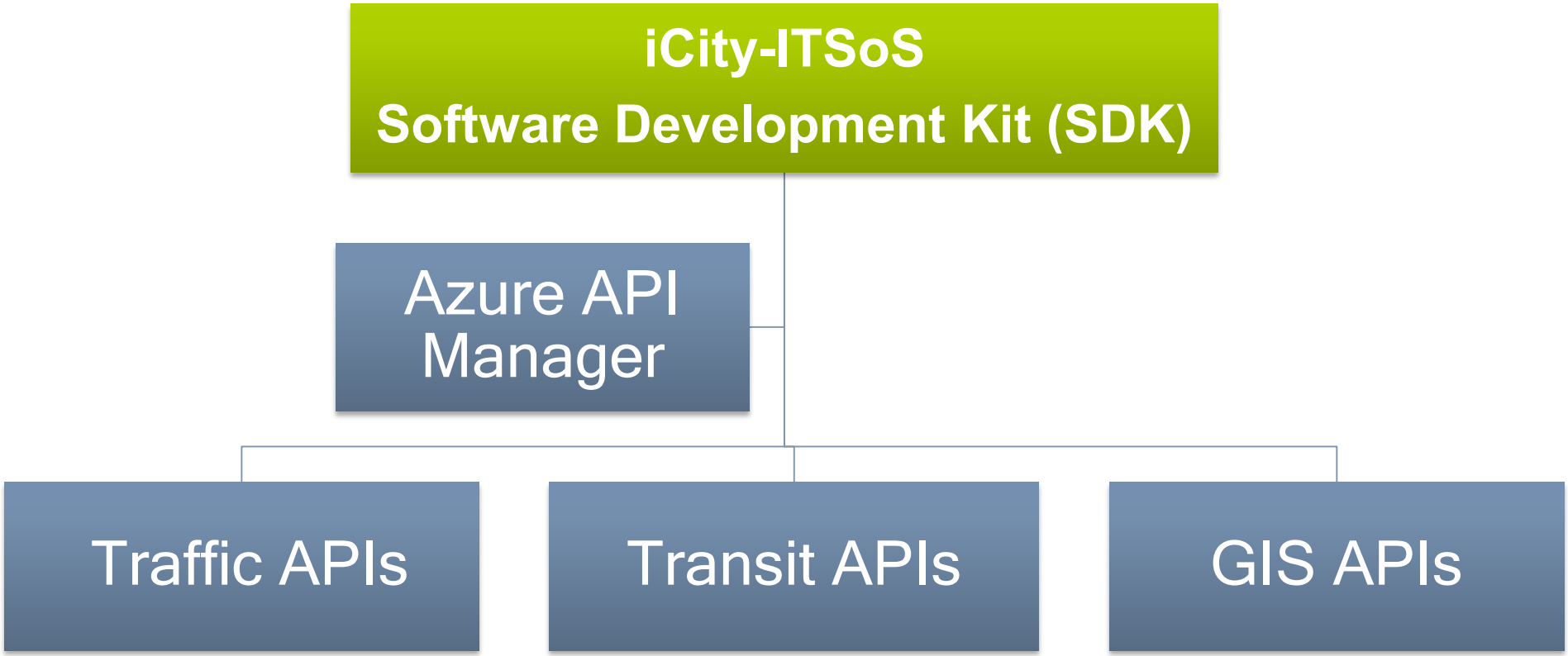
Challenge 2: Siloed Services

iCity-ITSoS SDK Architecture:



iCity-ITSoS Applications

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iCity-ITSoS Applications

1. **Application 1.0** : Semantic Advanced Traveler Information System

2. **Application 2.0** : Highway Traffic Estimation using Deep Convolutional Neural Network

3. **Application 3.0** : Comparative Study of Web Service Architectures for Software Development Kit of Transportation Application

Application 1.0: Semantic Advanced Traveler Information System

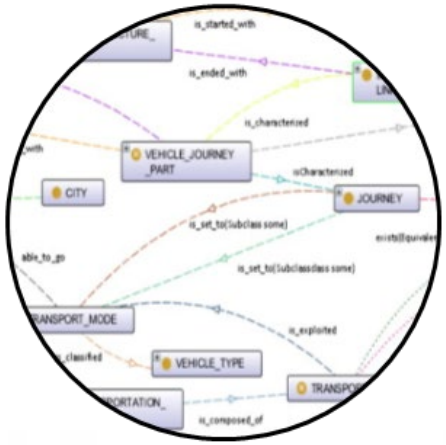
- Traffic representation on OTP by using loop detector data
- Using **iCity Ontology** to map loop detector data
- Test for 207 way-segments on 401 highway express. (LD data linked to OSN's WayID)
- Two tests: Direct integration with the LD data and the 2nd by using the ontology

Semantic ATIS Architecture

SQL DB

Data

WFS



wfs:**GetFeature** service

Use Interface

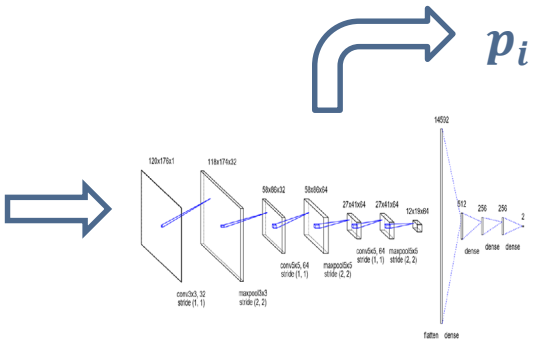
Data | **Ontology Engine** | **OTP Server**

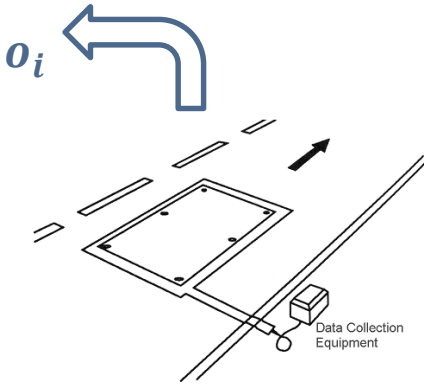
Application 2.0 Highway Traffic Characteristics Estimation using Deep CNN:

- Develop a separate data stream for validation macroscopic flow characteristics
- Leverage existing data in the form of traffic camera images
- Train model that supplements loop detectors, especially where loop detectors are broken
- Work with static images instead of video – greatly reduces inference time, with trade-off of granularity

Application 2.0 Highway Traffic Characteristics Estimation using Deep CNN:

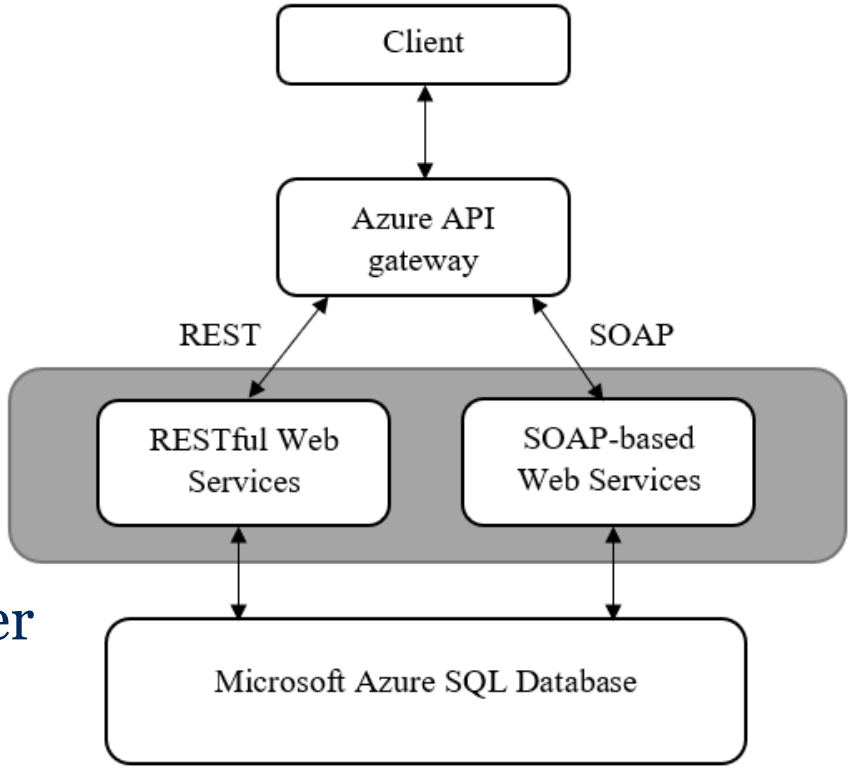
- Large corpus of existing loop detector data
- Preprocess loop detector data to extract macroscopic traffic characteristics, serve as ground truth for images
- Train detector that is robust to road dimensions, camera angle
- Centralizes processing of image data from traffic cameras with computational constraints





Application 3.0: Comparative Study of Web Service Architectures for SDK of Transportation Applications

- Define a performance metrics to compare different styles of web services
- Develop the APIs defined by the ITS researchers in RESTful format.
- Re-Develop the same service in SOAP-based web services
- Compare the performance of these APIs using the API Manager to measure the performance of these APIs in terms of speed, resources used, and reliability.



Team Structure

ITSoS Portal

Next Year Plan

1. Big Data Processing

2. High Performance Application


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