Socially Optimal Multi-modal Routing Platform

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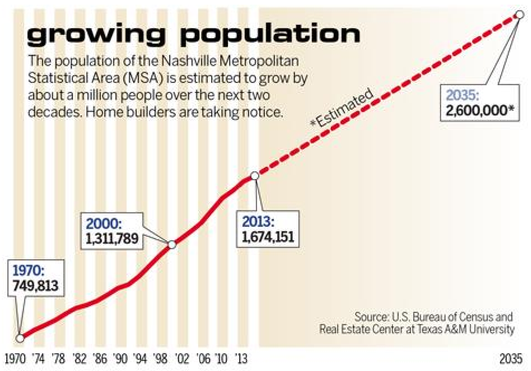
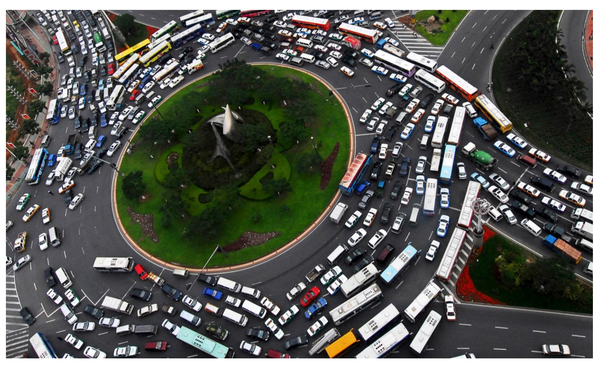
A CONTEXT-AWARE SOCIALLY OPTIMAL SOLUTION TO MULTI-MODAL ROUTING PROBLEM IN SMART CITIES

BLOOMING POPULATION



Source: The Nashville Ledger

TRAFFIC CONGESTION



Source: The Atlantic

MULTI-MODAL MOBILITY

Source: The Road to SMART CITY by Surya Jeedigunta

MOBILECROWD SENSING & ANALYTICS

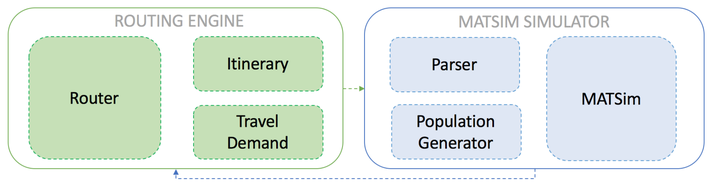
CONNECTED AND SHARED MOBILITY

PLATFORM PROPERTIES

Property	Description
Pluggability	Providing plug and play services to easily add and delete rental stations, modes and other dynamic services
Failure Resilience	When service failures and data anomalies happen, the platform should run and provide surrogate services and data sources
Deployment	The services are divided into micro-services and packed into Docker containers that can be conveniently deployed
Integrated Simulation	Providing a testbed so that services can use it to validate their analytics results before providing decisions to the end users

SIMULATION BASED TESTBED FOR DECISION VALIDATION

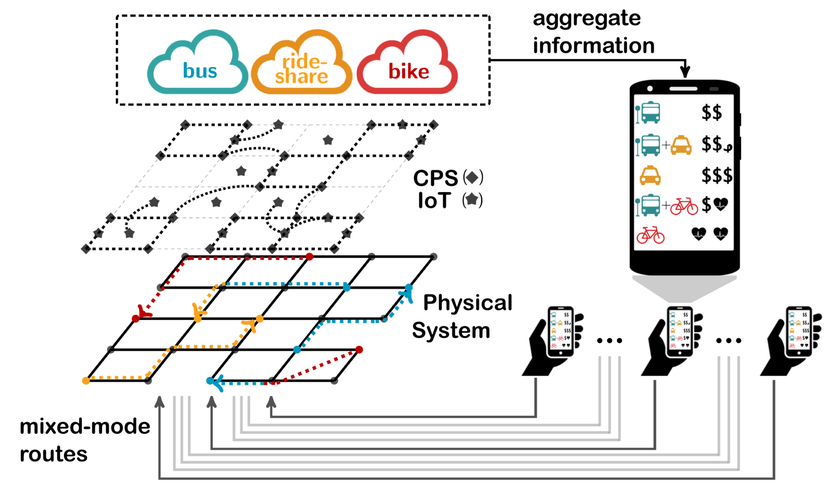
- *Based on MATSim, an open-sourced multi-modal transport simulator*
- *Supports walk, car, bike, bus, etc.*
- *Validating routing plans and providing feedbacks*



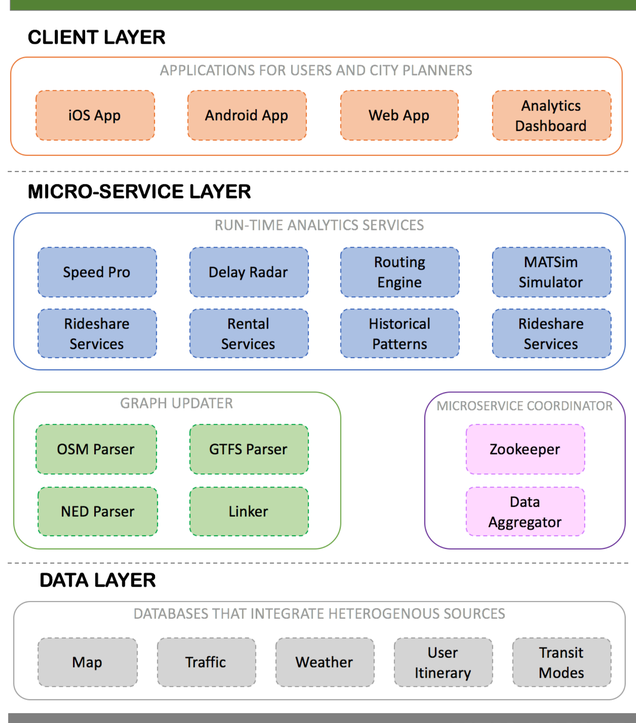
INCENTIVE DESIGN FOR MULTI-MODAL ROUTING

We model agents as decision-makers and incentivize them to use multi-modal routes that are more efficient from the system level perspective.

- *Incentives are used to encourage computational resource sharing & more efficient route selection.*
- *We leverage our platform to assess the efficacy of the design incentive mechanisms*



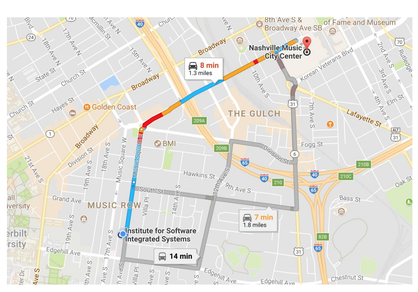
KEY LAYERS IN THE SYSTEM ARCHITECTURE



MICROSERVICES

- *Runtime microservices act as the interface to process user requests*
- *Graph Updater microservices ensures mode pluggability while building graph*
- *Microservice coordinator provides highly reliable distributed coordination between all the microservices.*

SIMULATION SCENARIO



- *Travel demand of 2000 people*
- *From Institute of Software Integrated System to Music City Center*
- *Start Time: May 9 2017 at 7 am*
- *5 itineraries to choose from (3 by car + 2 by bus)*

TYPICAL SCENARIO

1: Car	2: Car	3: Car	4: Bus	5: Bus
2000	0	0	0	0

- *Everyone chooses the fastest route by driving private cars*
- *Severe congestion occurs*

SECOND SCENARIO

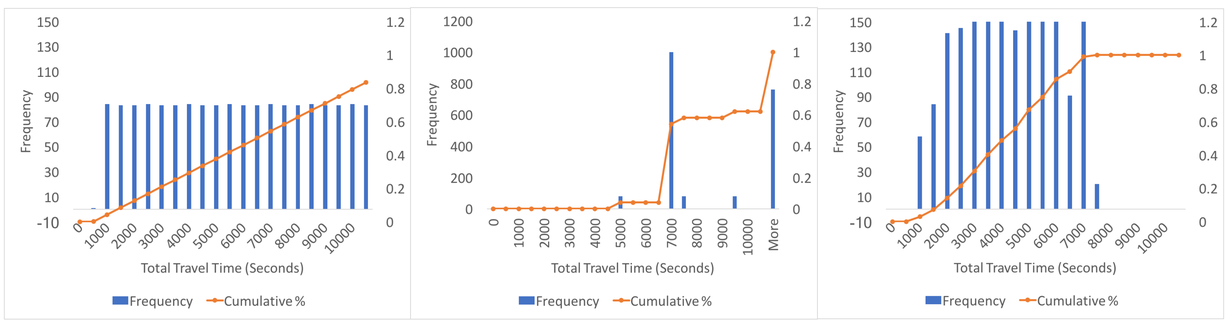
1: Car	2: Car	3: Car	4: Bus	5: Bus
0	0	0	1000	1000

- *The capacity of buses is limited*
- *A small portion of people can travel by bus in short time*

BETTER SCENARIO

1: Car	2: Car	3: Car	4: Bus	5: Bus
450	450	900	100	100

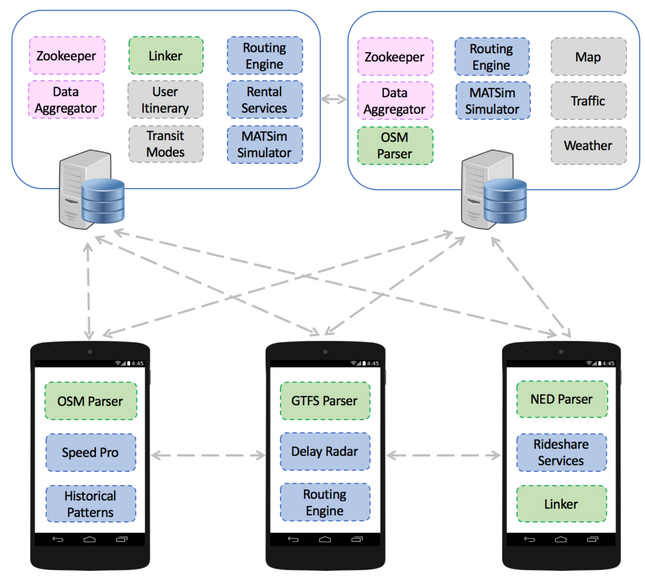
- *Travel demand is distributed by mode and by route*
- *We are working on creating socially optimal solutions*



KEY CONTRIBUTIONS

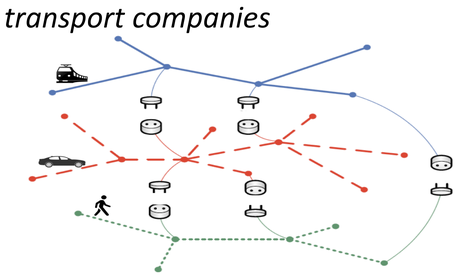
MICROSERVICES ARCHITECTURE

- *Services are divided into micro-services*
- *Deployable in heterogeneous cloud environments and edge devices*
- *Using Blockchain for data integrity, audit and computation distribution*



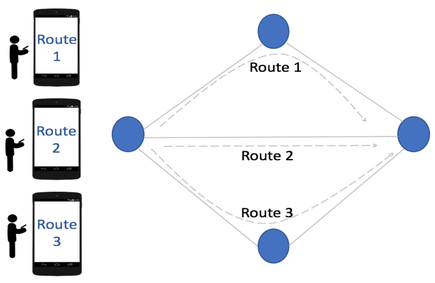
PLUGGABILITY OF MODES

- *Easy addition and deletion of rental stations, modes at runtime*
- *Plug and Play services to commercial transport companies*



SOCIALLY OPTIMAL ROUTING POLICY

- *Making routing decisions which will be beneficial to all the users*
- *Incentivize users to use multi-modal routes*



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