A Model for Traffic Control in Urban Environments

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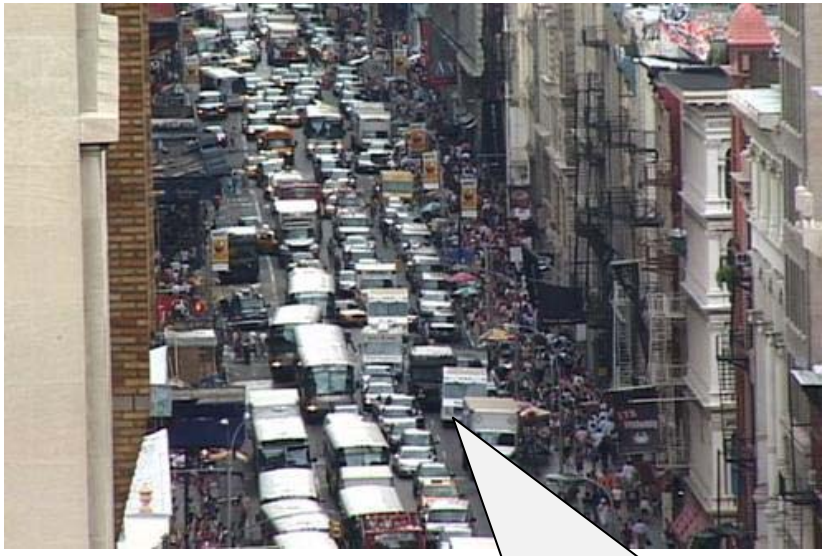
Outline

- Scope and motivation
- The proposed model
  - Entities, vehicles, communicatic
- Experimental results
- Conclusions

Context

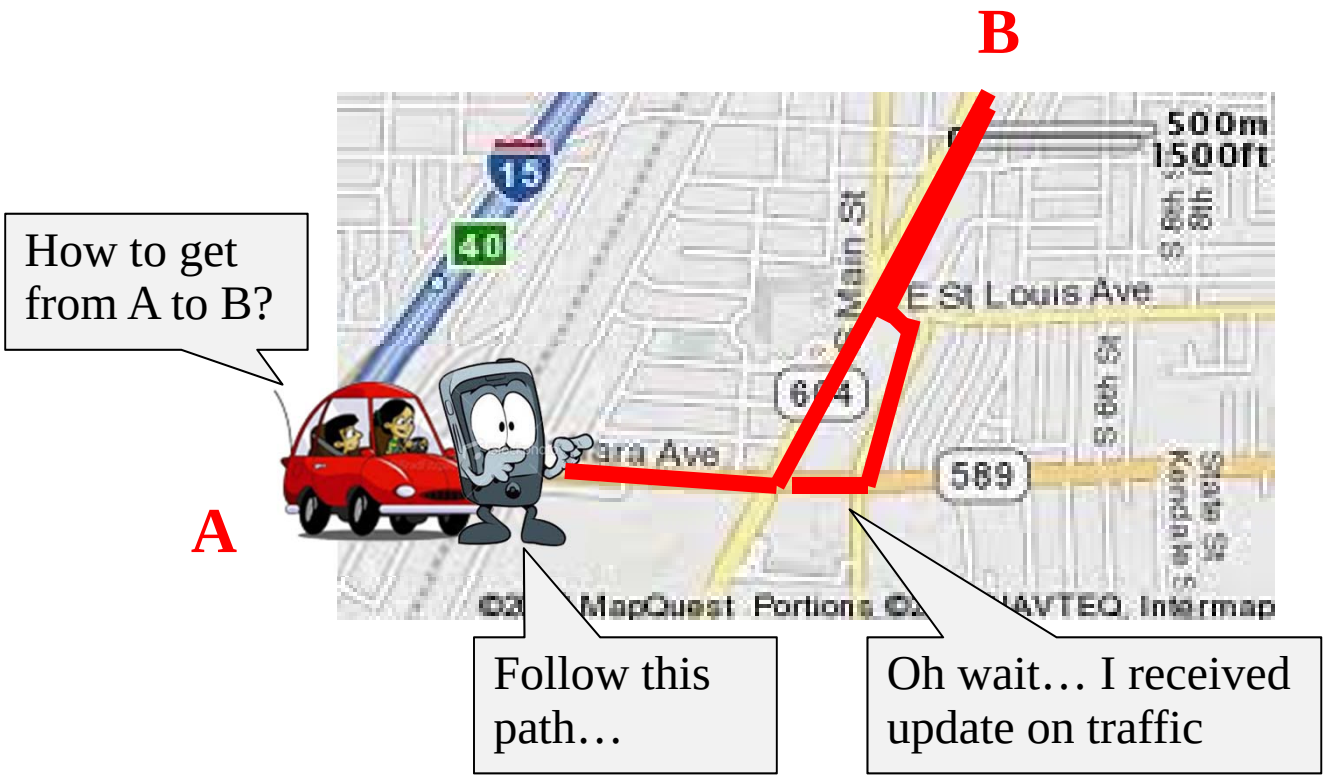
- Traffic congestions



Have you been there?
….
Have you considered alternative solutions?

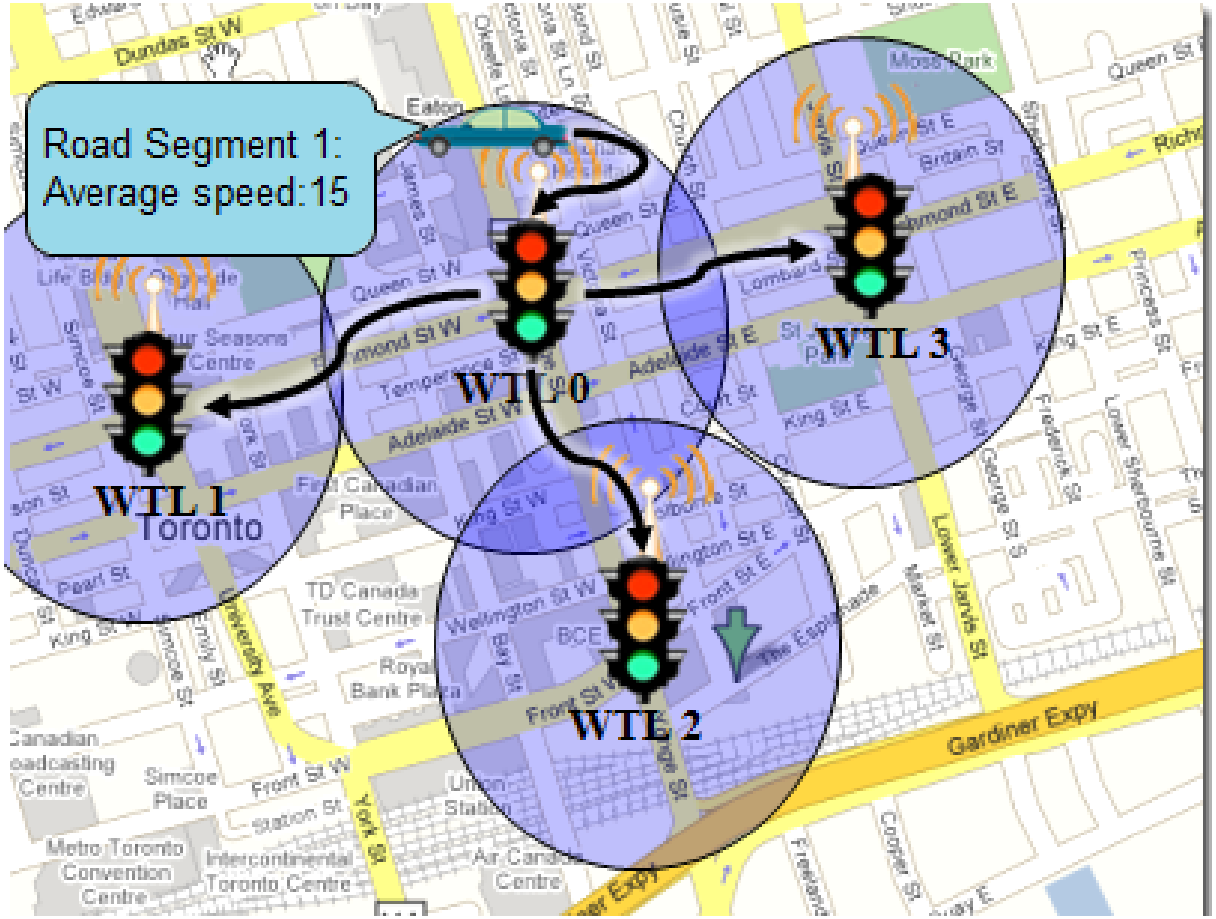
So traffic congestions are real….

- The upgrade on the road infrastructure – not viable
- Intelligent Transport Systems (ITS)
- Dynamic modification of directions as my smartphone learns about possible traffic congestions along the way…



Our approach

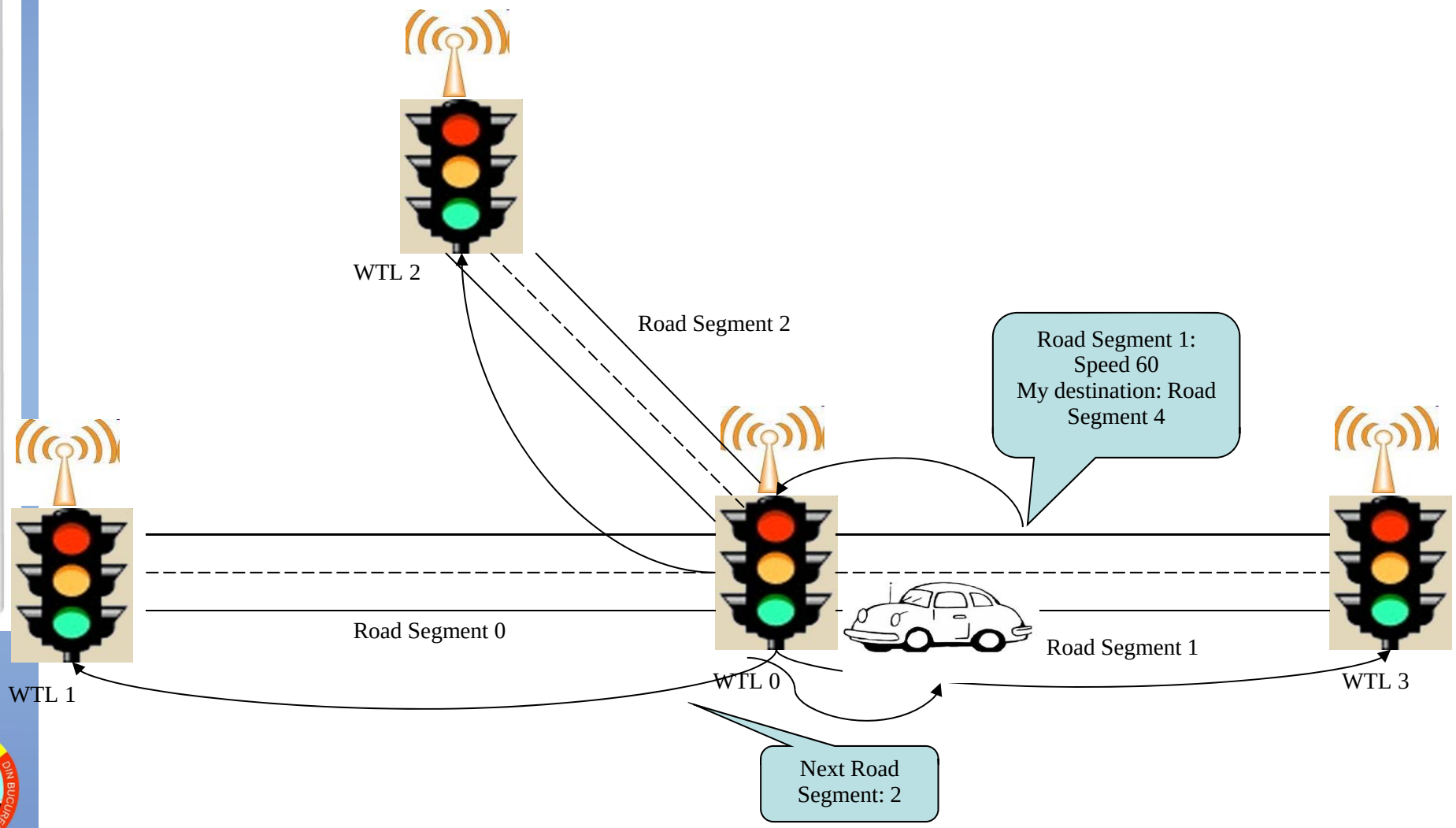
- Model for traffic control / congestion avoidance
- Cars collect traffic data
- Data is collected and aggregated by Wireless Traffic Lights



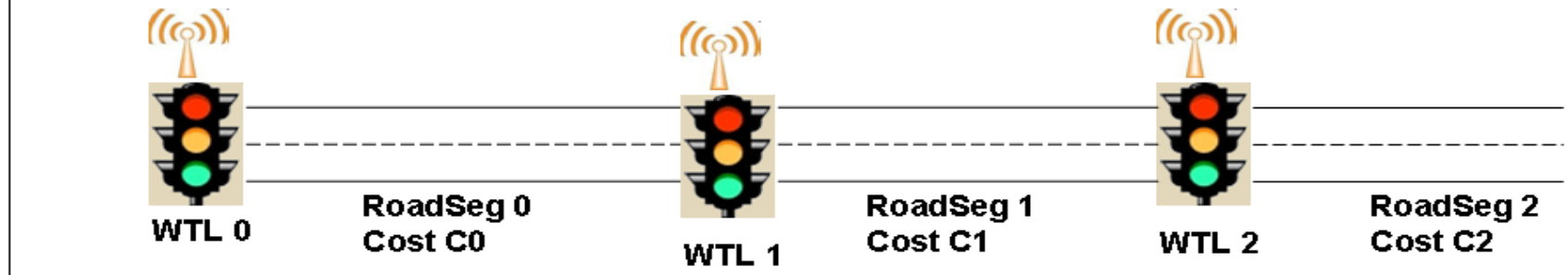
The Model - Entities

- Vehicles (data source)
  - Broadcast recorded data
  - Average transit time per road segment
  - Query WTL for next segment/next hop
- Wireless Traffic Lights (WTL)
  - Receive data from vehicles
  - Analyze received data
  - Update road segments' costs
  - Reply to vehicles' queries
  - Communicate with neighboring WTL

Vehicle - infrastructure communication



A distance-vector routing for route exchange



DestRouteSeg	null
Cost	null
ViaRouteSeg	null

DestRouteSeg	null
Cost	null
ViaRouteSeg	null

DestRouteSeg	null
Cost	null
ViaRouteSeg	null

RS 1, cost 0

RS 2, cost 0

RS 0, cost 0

DestRouteSeg	RS1
Cost	C0
ViaRouteSeg	RS0

DestRouteSeg	RS2
Cost	C1
ViaRouteSeg	RS1

DestRouteSeg	RS0
Cost	C1
ViaRouteSeg	RS1

RS 2, cost C1

DestRouteSeg	RS1	RS2
Cost	C0	C0+C1
ViaRouteSeg	RS0	RS0

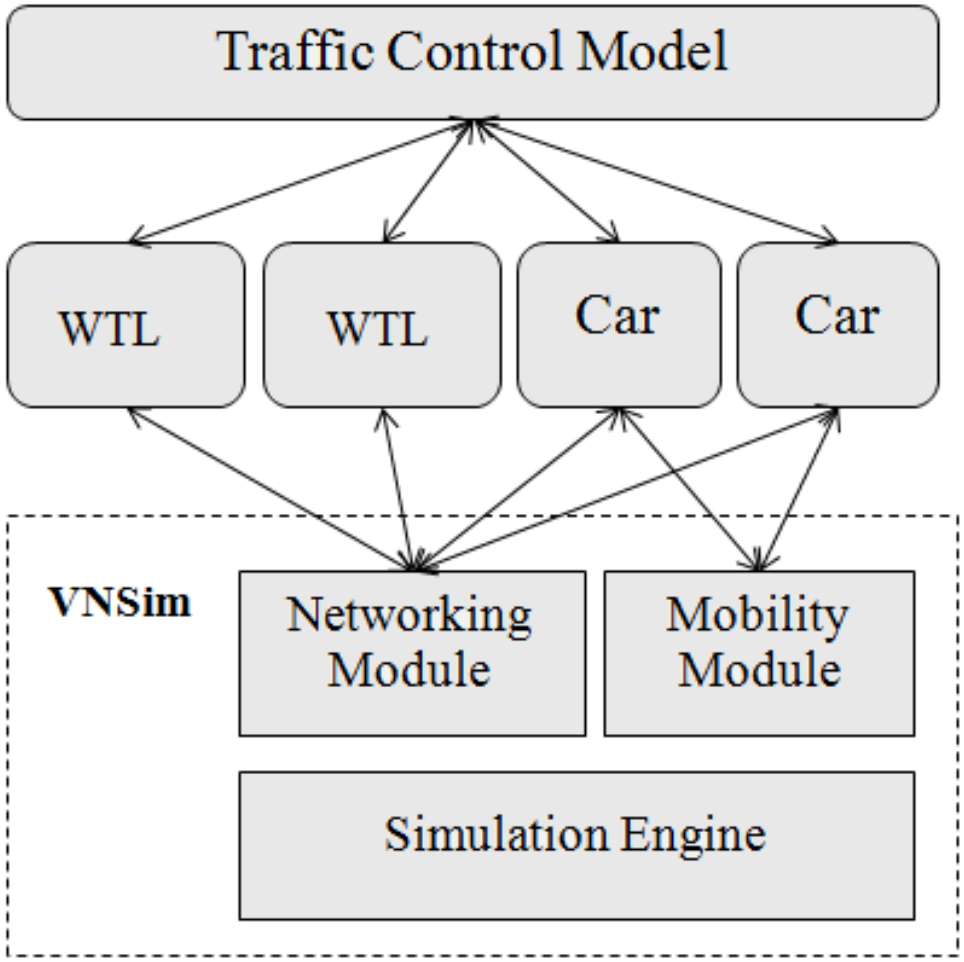
DestRouteSeg	RS2
Cost	C1
ViaRouteSeg	RS1

DestRouteSeg	RS0
Cost	C1
ViaRouteSeg	RS1

time

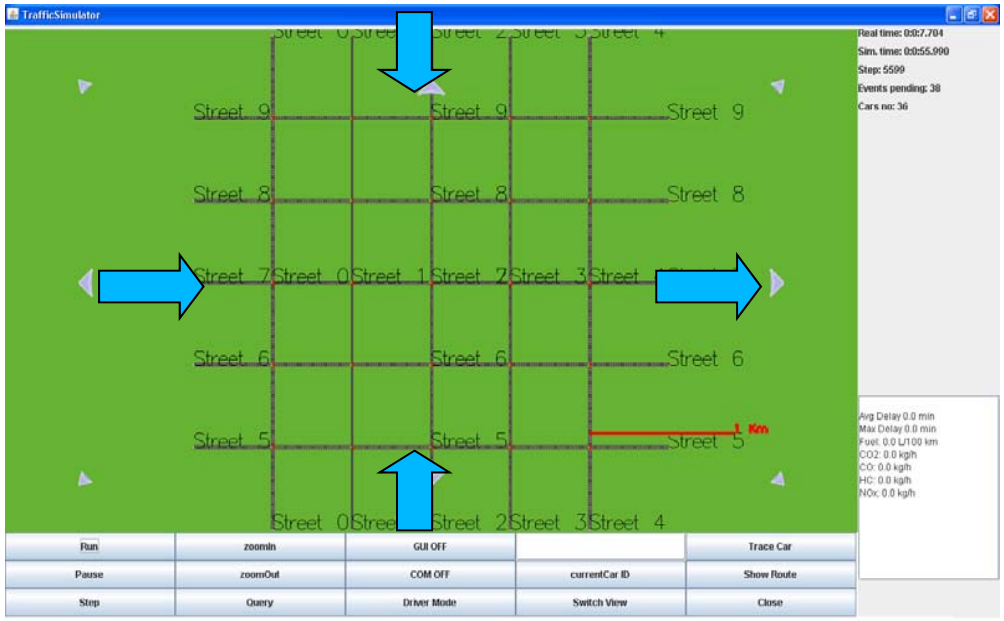
Experimental evaluation of the model

- Evaluation using modeling and simulation - VNSim

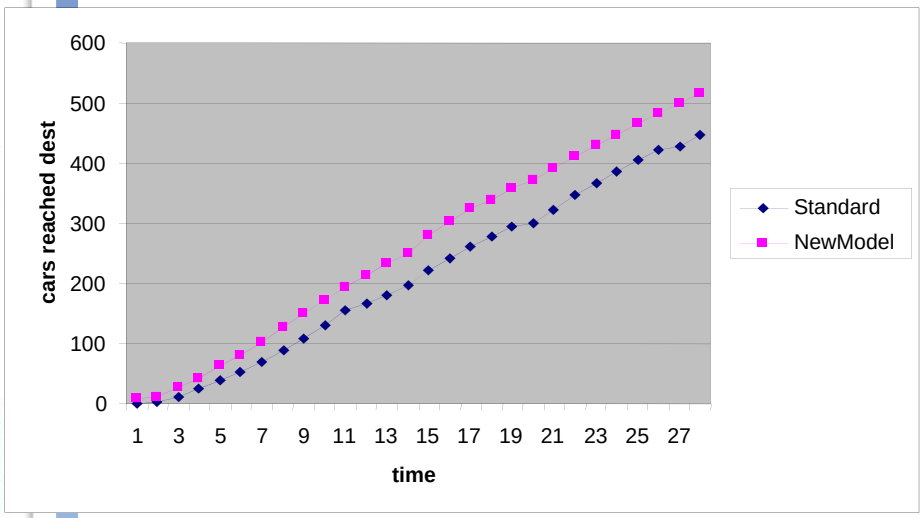


Experimental scenario

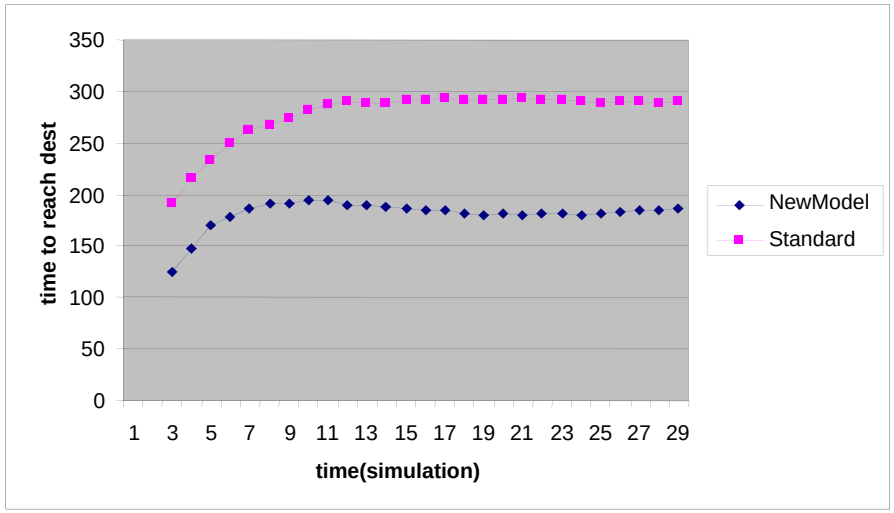
- Different flows of cars/lane/hour
  - 100 cars/lane/hour
  - 150 cars/lane/hour
- Different traffic lights
  - Standard traffic lights
  - Adaptive traffic lights
- Routing types
  - Predefined, static
  - Using New Model



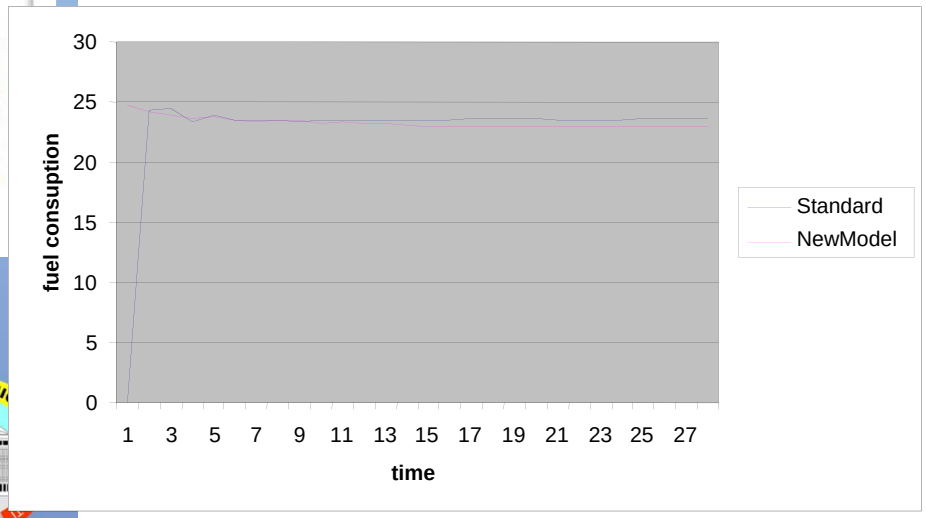
Results - non-adaptive traffic lights, 100 cars/lane/hour



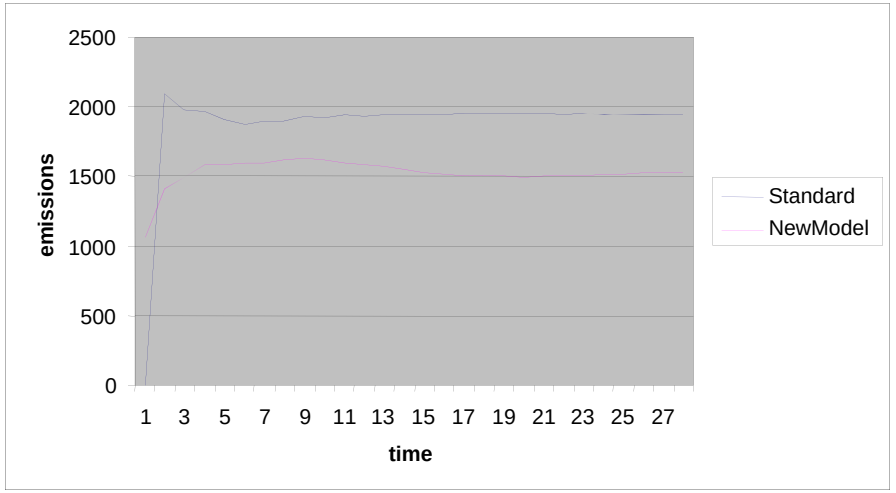
- Vehicles reached destination - Increase of ~15 %



- Time to destination - Decrease of ~40 %

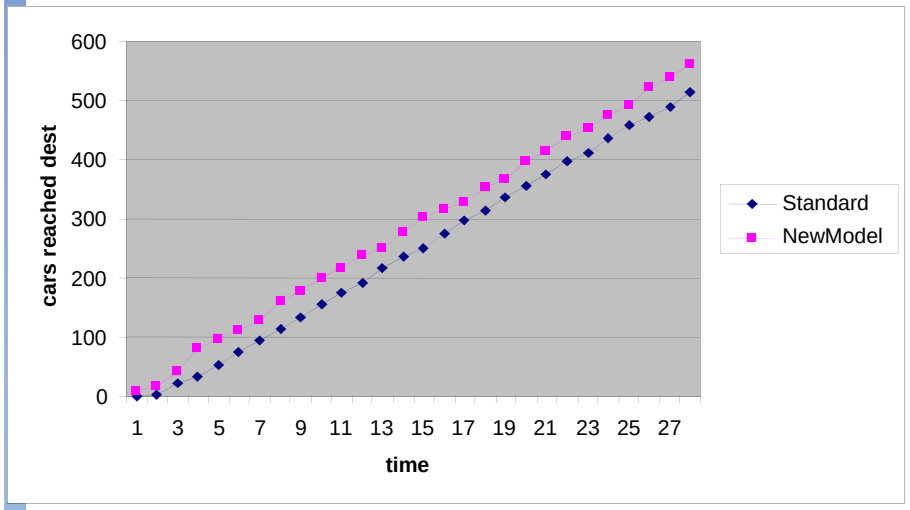


- Fuel consumption - Decrease of ~3 %

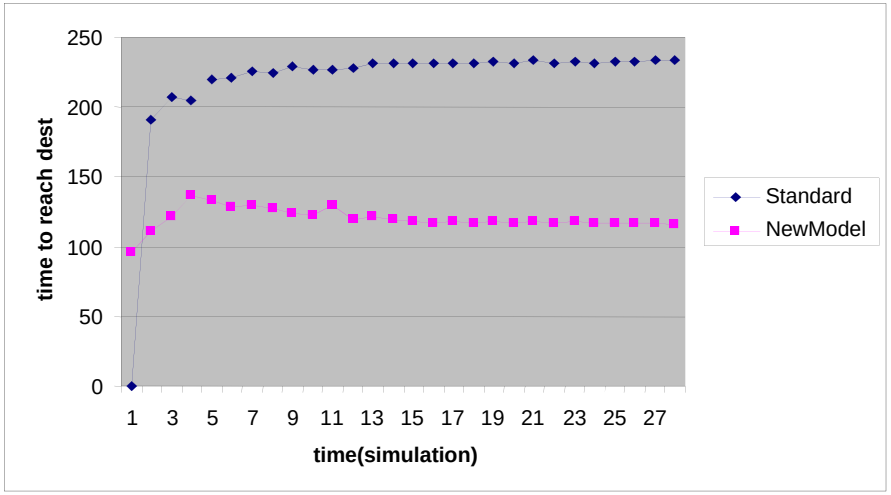


- Emissions - Decrease of ~20 %

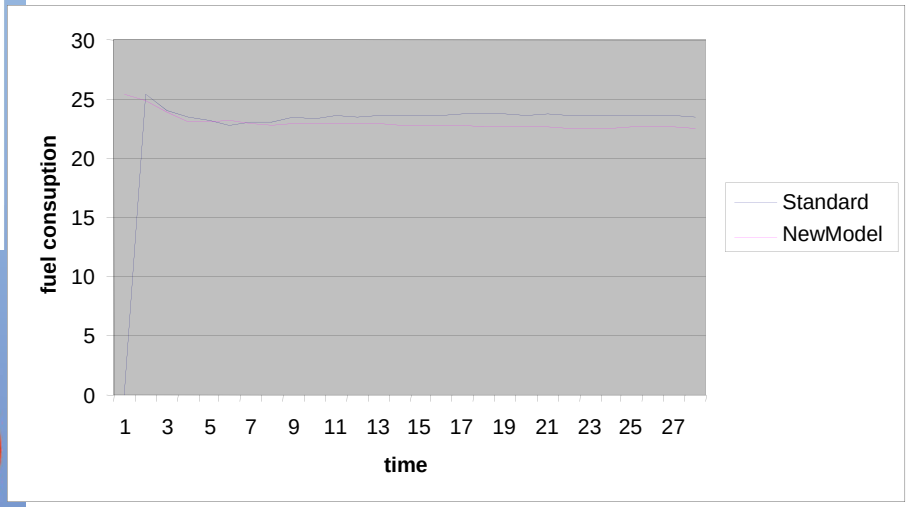
Results - adaptive traffic lights, 100 cars/lane/hour



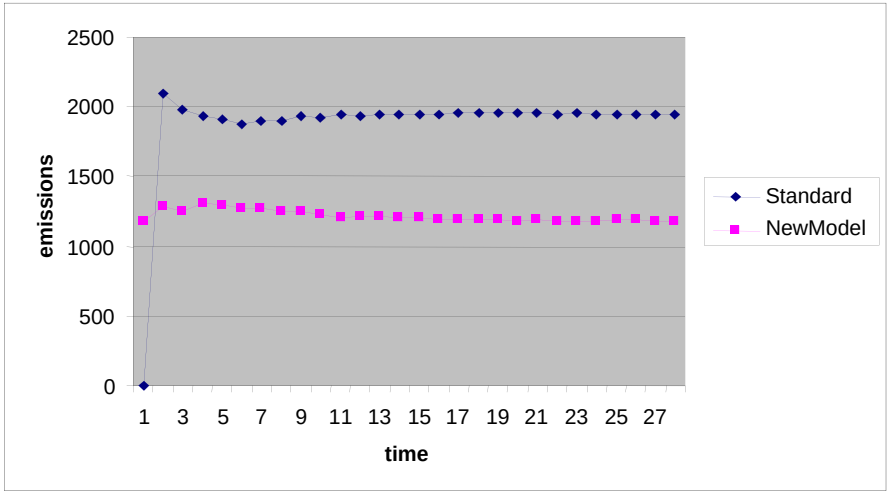
- Vehicles reached destination - Increase of ~8 %



- Time to destination - Decrease of ~45 %



- Fuel consumption - Decrease of ~4 %



- Emissions - Decrease of ~40 %

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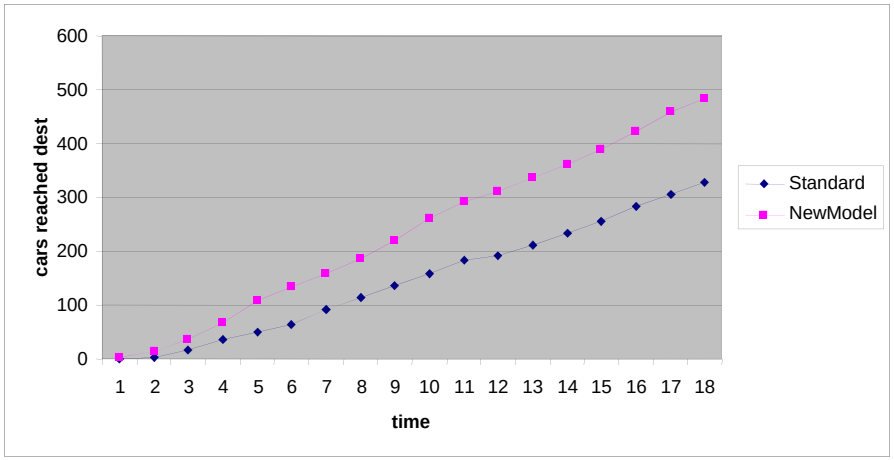
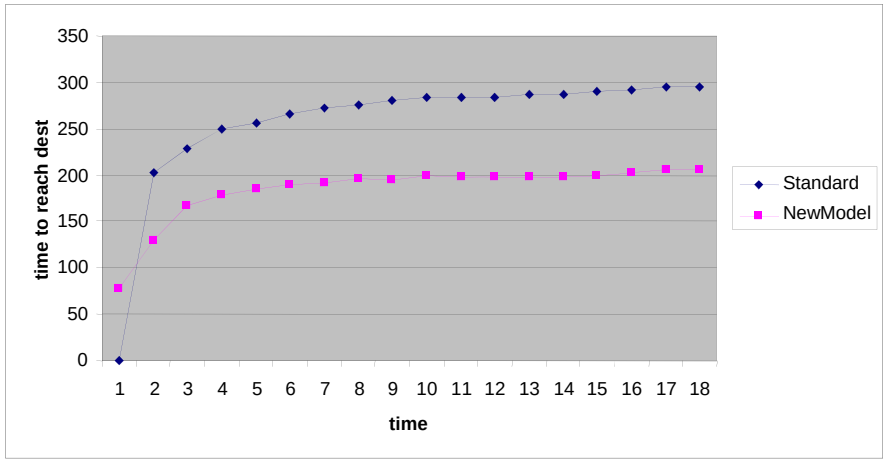
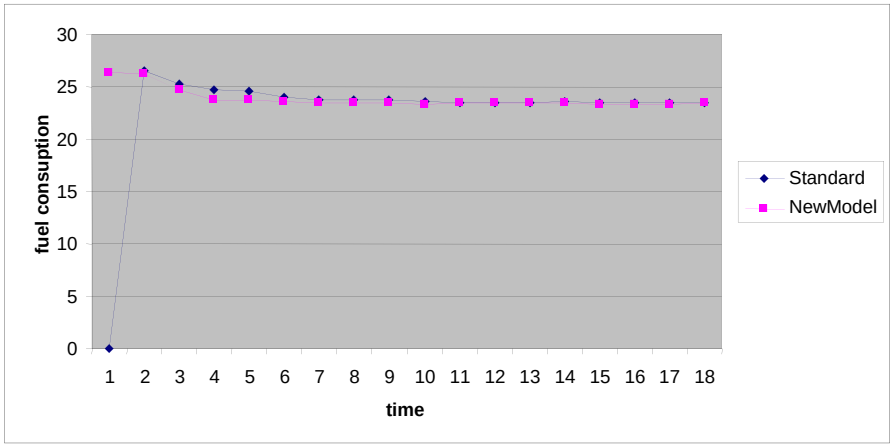
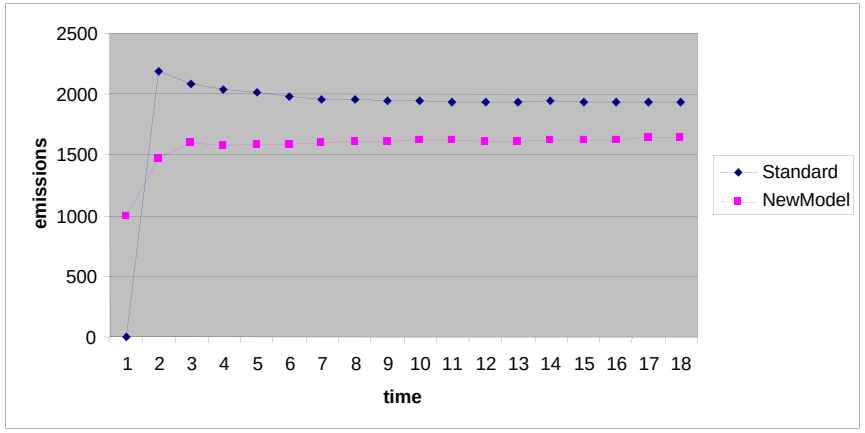
Results - non-adaptive traffic lights, 150 cars/lane/hour





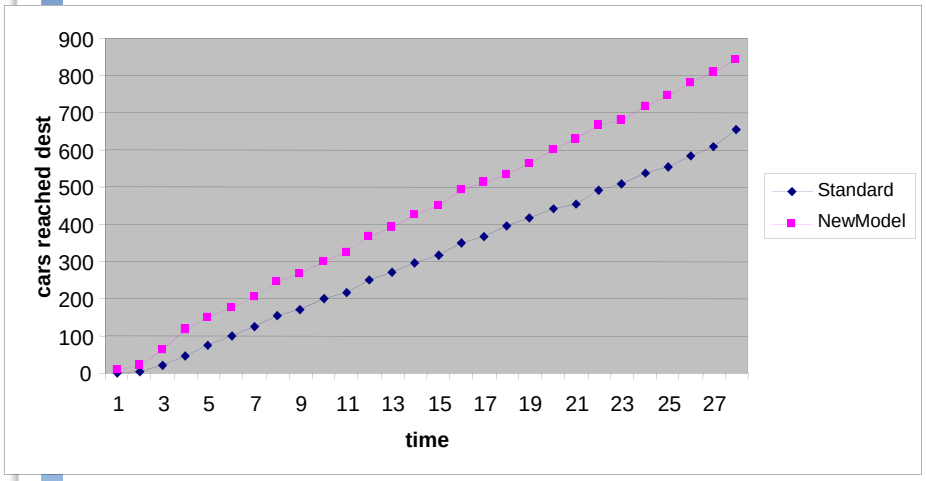
- Vehicles reached destination - Increase of ~45 %
- Time to destination - Decrease of ~30 %



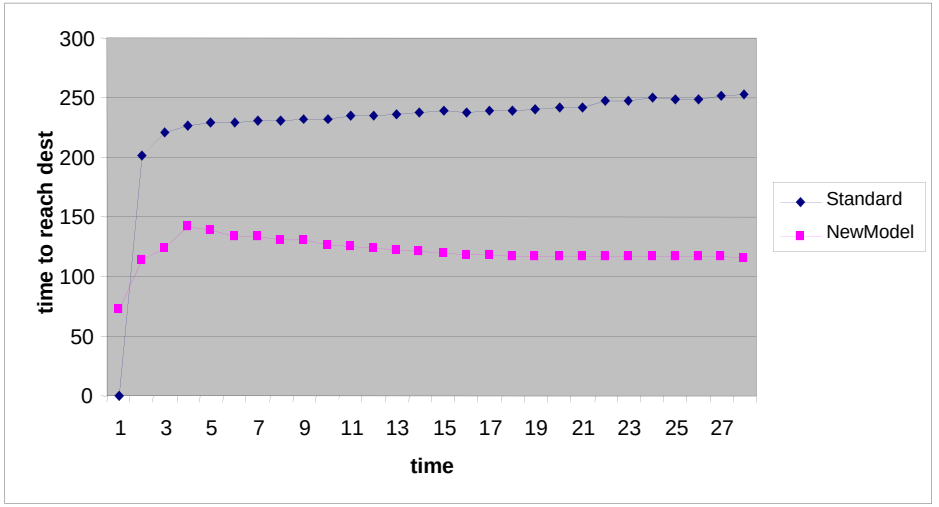


- Fuel consumption - Decrease of ~0.2 %
- Emissions - Decrease of ~14 %

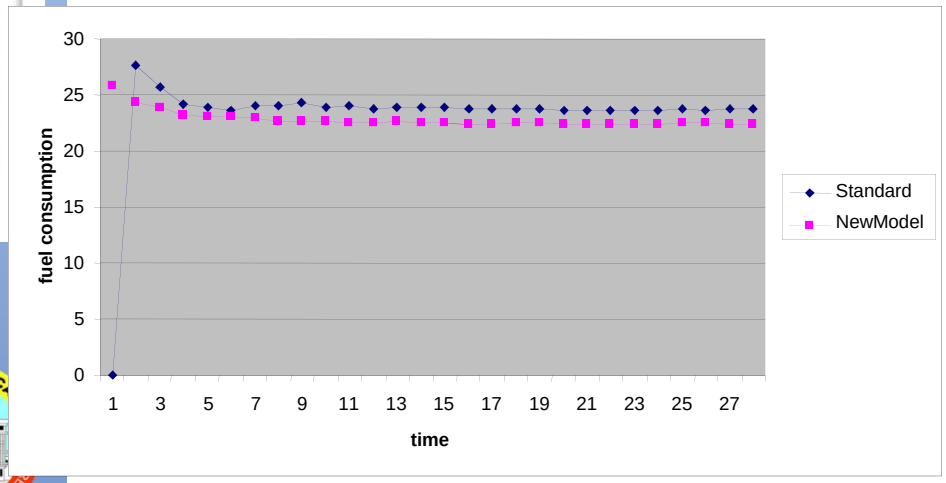
Results - adaptive traffic lights, 150 cars/lane/hour



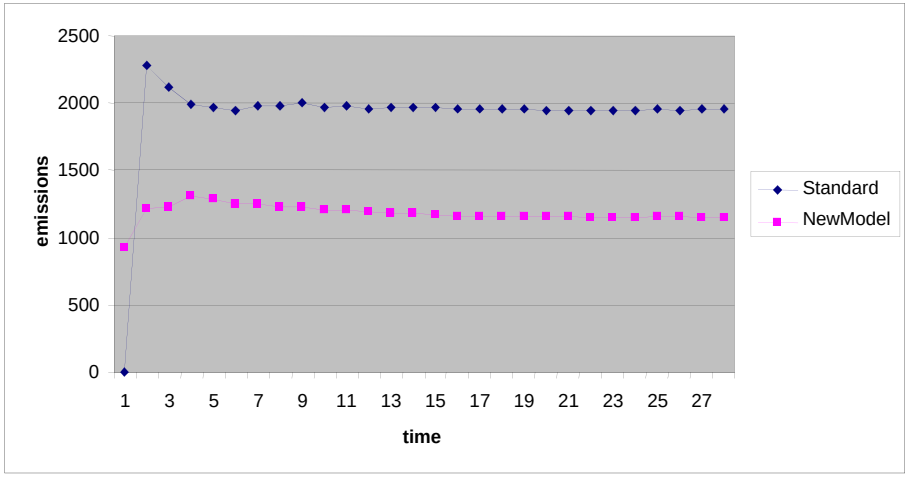
- Vehicles reached destination - Increase of ~8 %



- Time to destination - Decrease of ~45 %



- Fuel consumption - Decrease of ~5 %



- Emissions - Decrease of ~40 %

Conclusions

- Adjustment of traffic flows to avoid congestions
- Increase total number of vehicles that reach the destination at any certain time
- Time to destination decrease of 30 – 45 %
- Fuel economy of 0.2 – 5 %
- Emission reduction of 14 – 40 %
- All should provide lower upkeep of vehicles

Q&A

Thank you!