

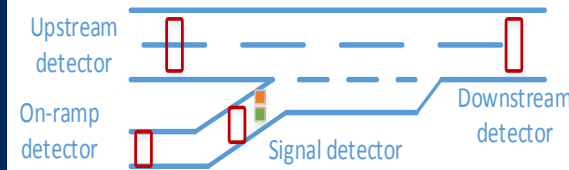
# Self-Learning Adaptive Ramp Metering

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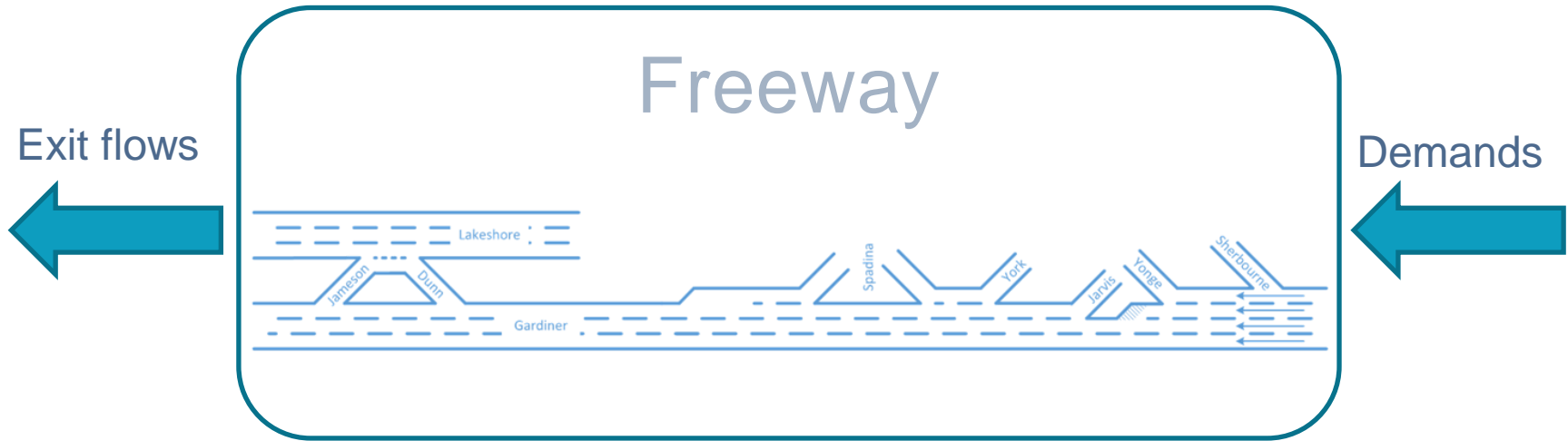
Baher Abdulhai, Ph.D., P.Eng.

*Professor, Dept of Civil Engineering*



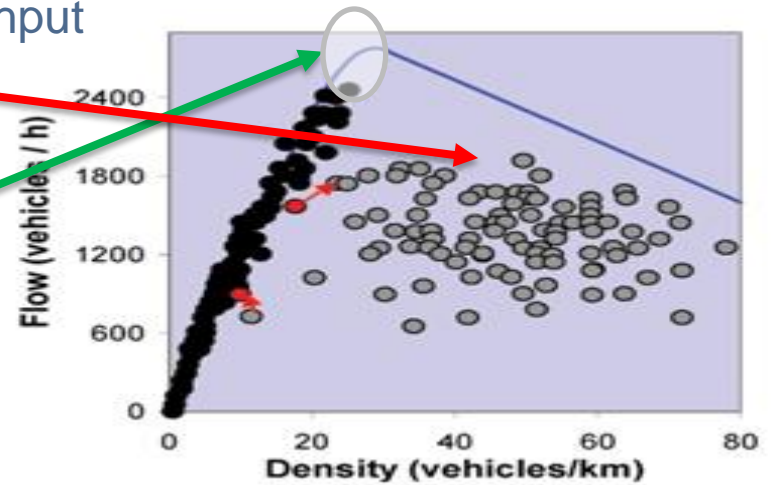
UNIVERSITY OF TORONTO  
FACULTY OF APPLIED SCIENCE & ENGINEERING  
Transportation Research Institute

# Freeway Traffic Control



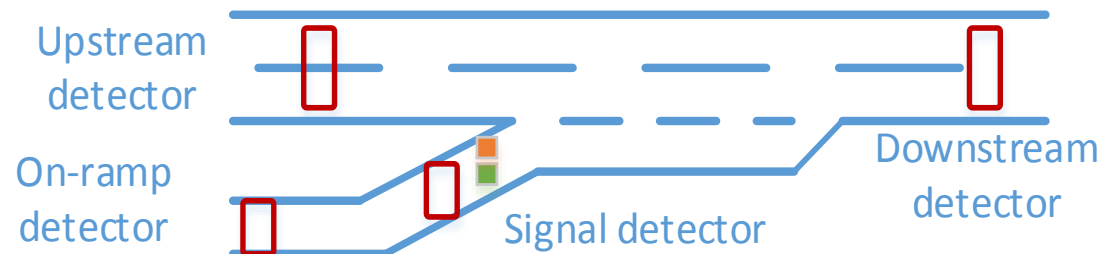
5% - 10% drop in freeway throughput

Optimal traffic condition



# Ramp Metering

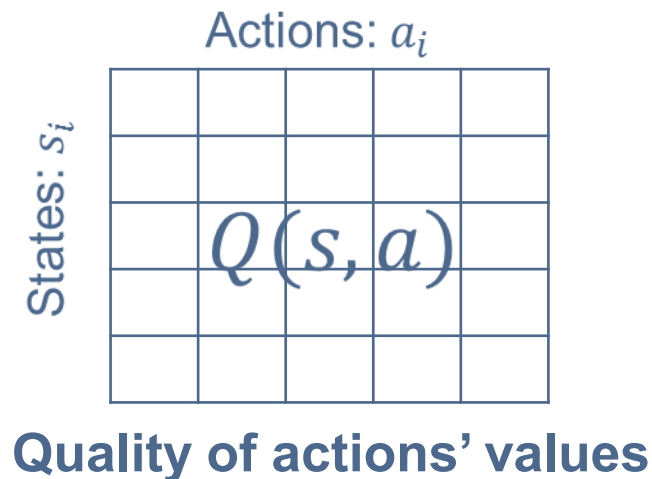
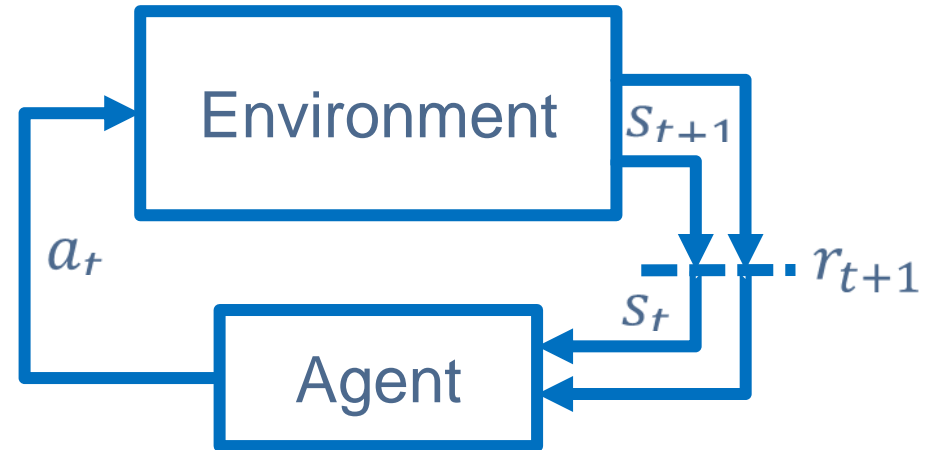
- Ramp metering (RM) is the use of a traffic signal(s) employed on a ramp to control the pace at which vehicles enter a freeway



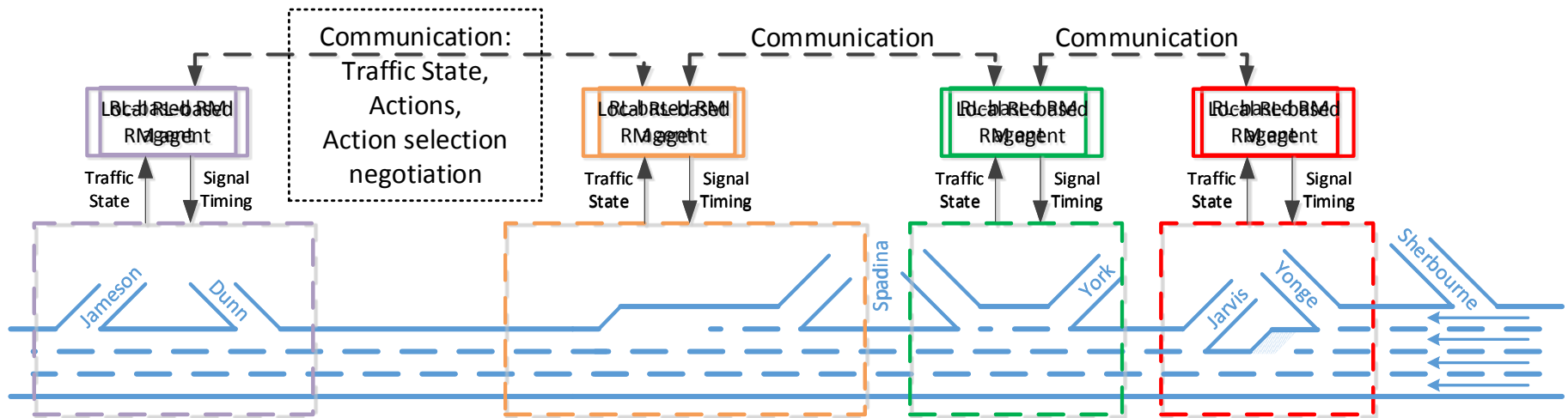
- Challenge
  - Avoid Counter productive excessive queueing at downstream on-ramps

# Reinforcement Learning

- Model-free control
- Agent goal:
  - Maximize expected reward
- Q-learning
  - Exploration vs. exploitation



# Control of Multiple On-ramps



# 401 Eastbound Collector at Keele Street Freeway Ramp Metering Study



# Calibration of Paramics Network

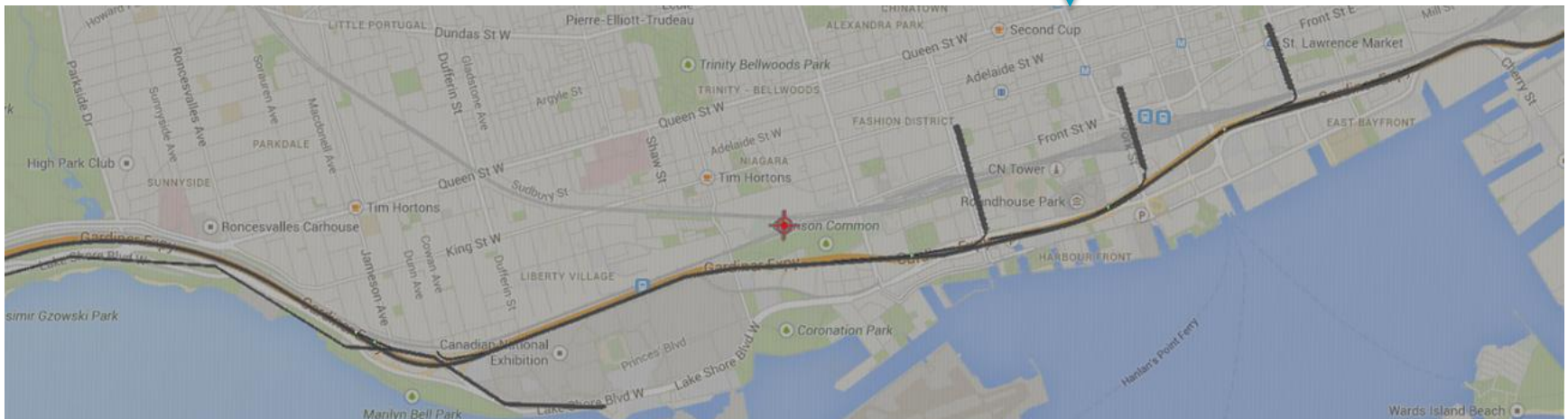
- Driver Behaviour

- Freeway capacity
- Congestion propagation speed
- Freeway Breakdown

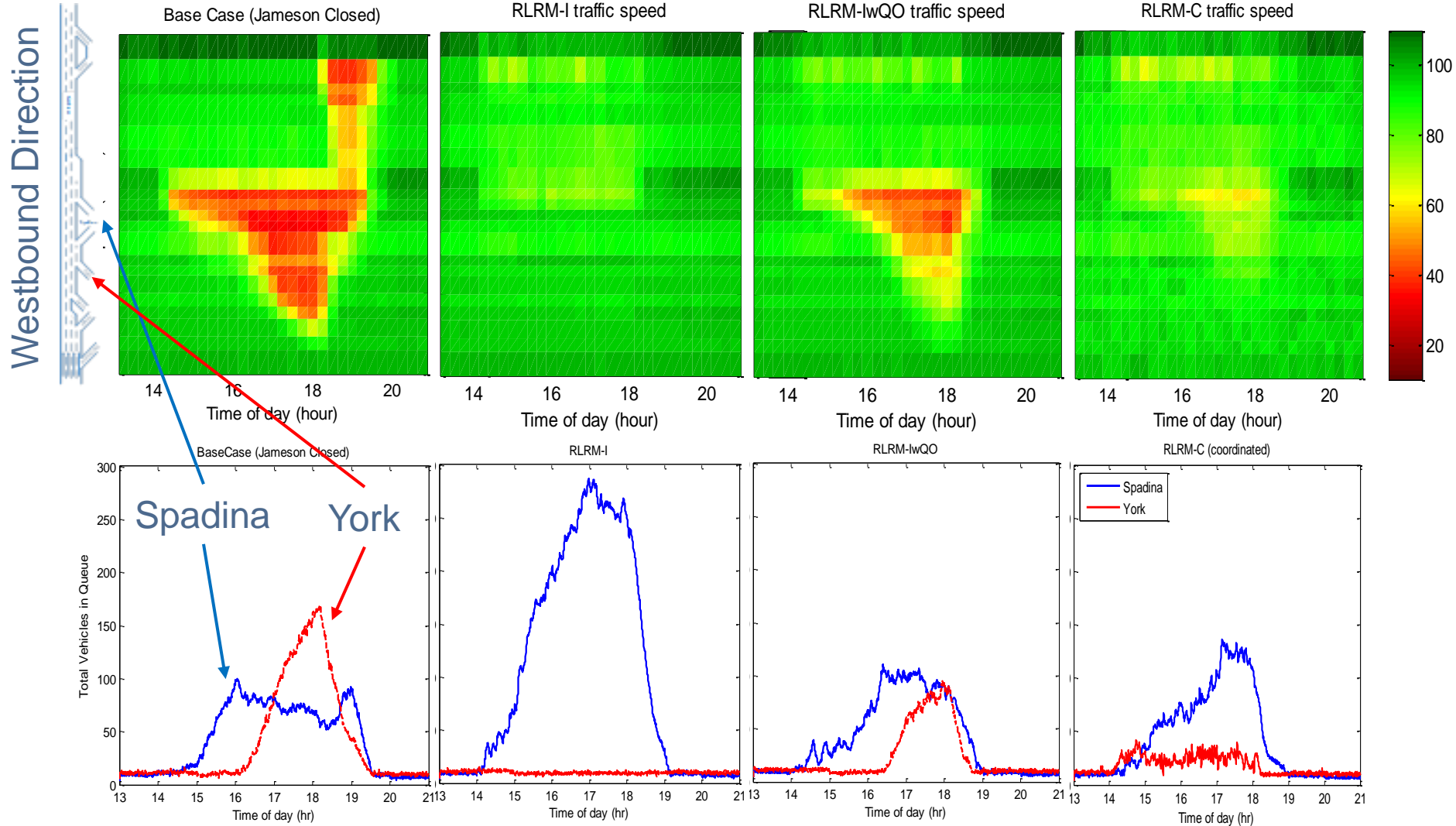
- Demand

- Realistic count
- Realistic congestion

Gardiner Expressway westbound from DVP to Humberbay



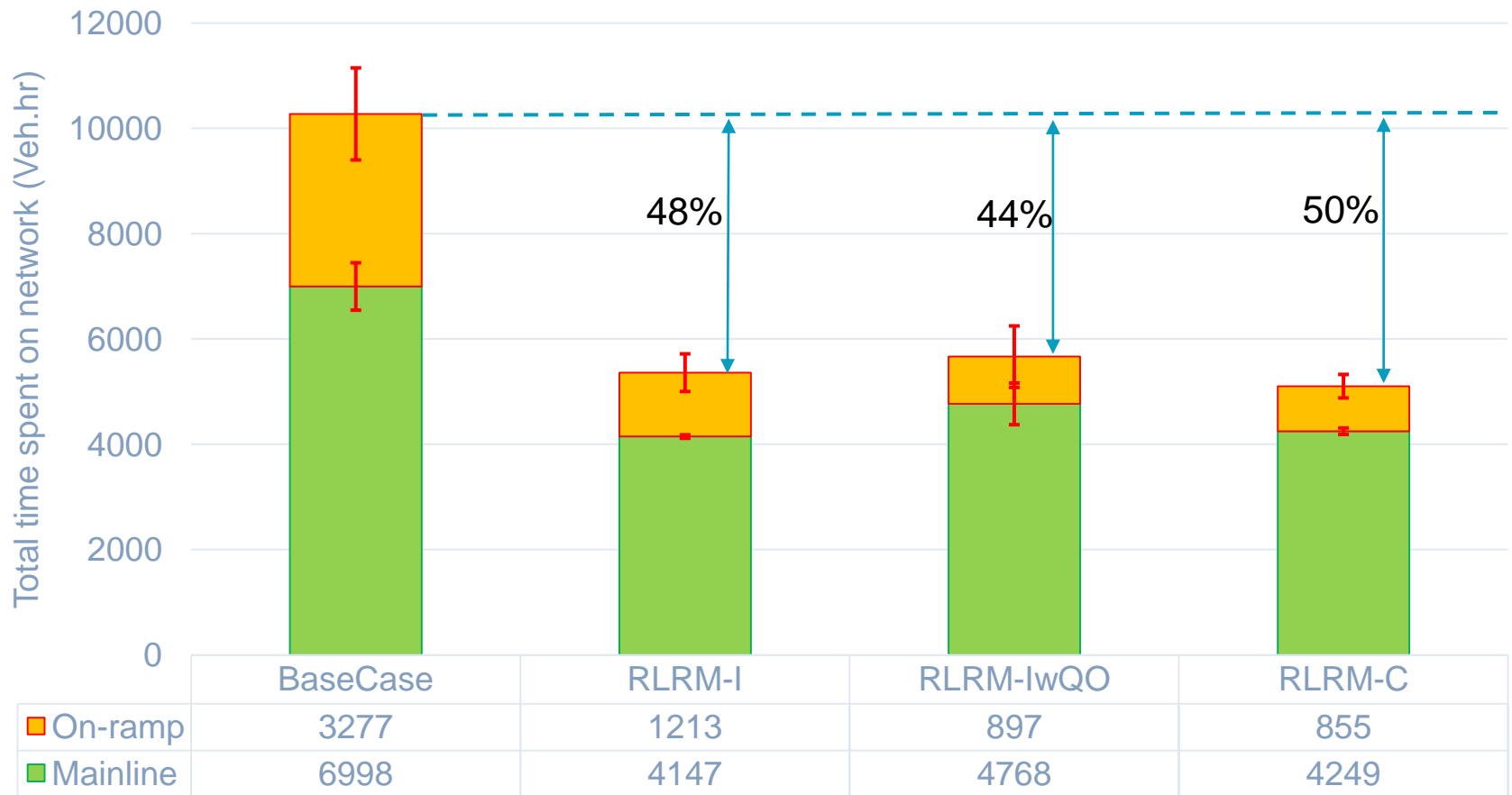
# Local vs. Coordinated



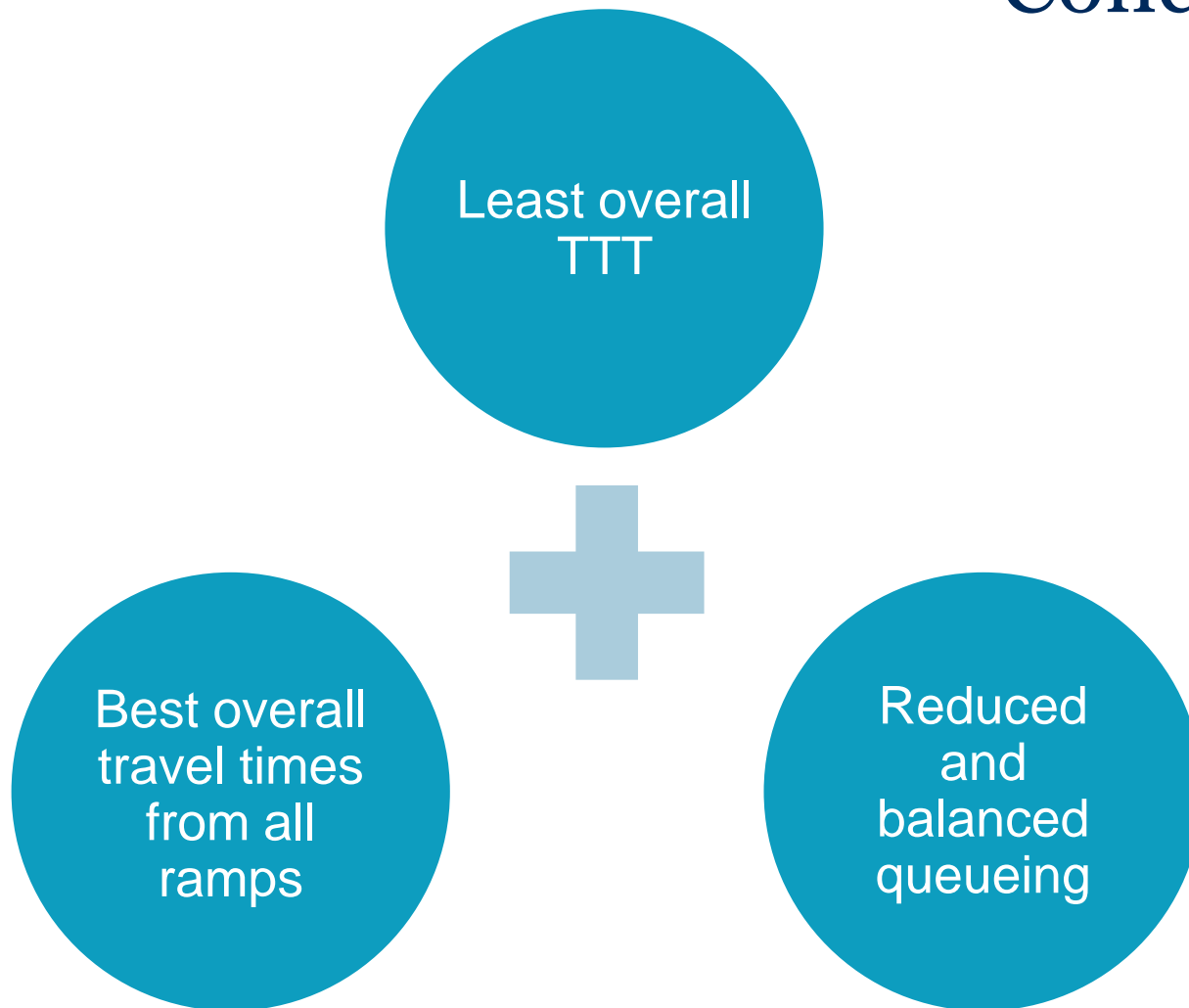


# Network Total Travel Time

Summary of network performance for different scenarios



# Conclusion



# Status

...

*R & D*  
*Looking for Partner*

Research and Lab  
Testing



Thank You!

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