FREIGHT MOBILITY RESEARCH INSTITUTE (FMRI)

A **USDOT** University Transportation Center

Improving Reliability and Efficiency on Urban Transportation Networks through Freight and Transit Signal Priority Strategies

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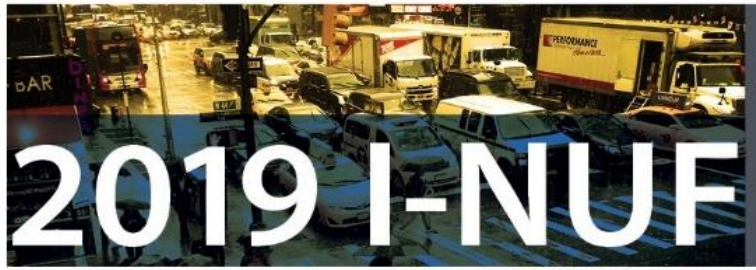


8TH METRANS
International Urban Freight Conference
October 16-18, 2019 | Hotel Maya, Long Beach, CA

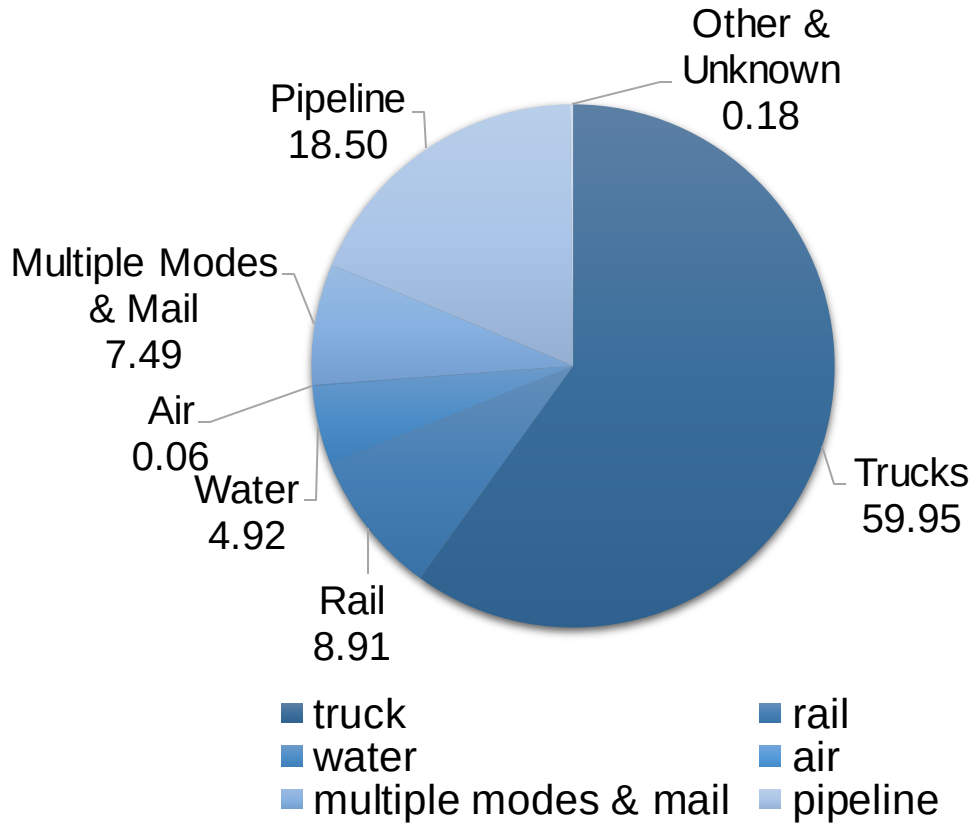
Outline

- Introduction
- Objectives
- Methodology
- Case Study
- Microsimulation Model
- Results
- Conclusions & Recommendations

Freight transport holds a fundamental role on the economic system in the United States

- 8.9% of the Nation's economic activity as measured by gross domestic product (GDP),
- 4% of total US labor force in freight transport,
- 63 tons of goods per American each year,
- 49.3 million tons - daily average freight movements,
- 52.5 billion dollars - freight value

Percentage of Freight Movements by Mode of Transport

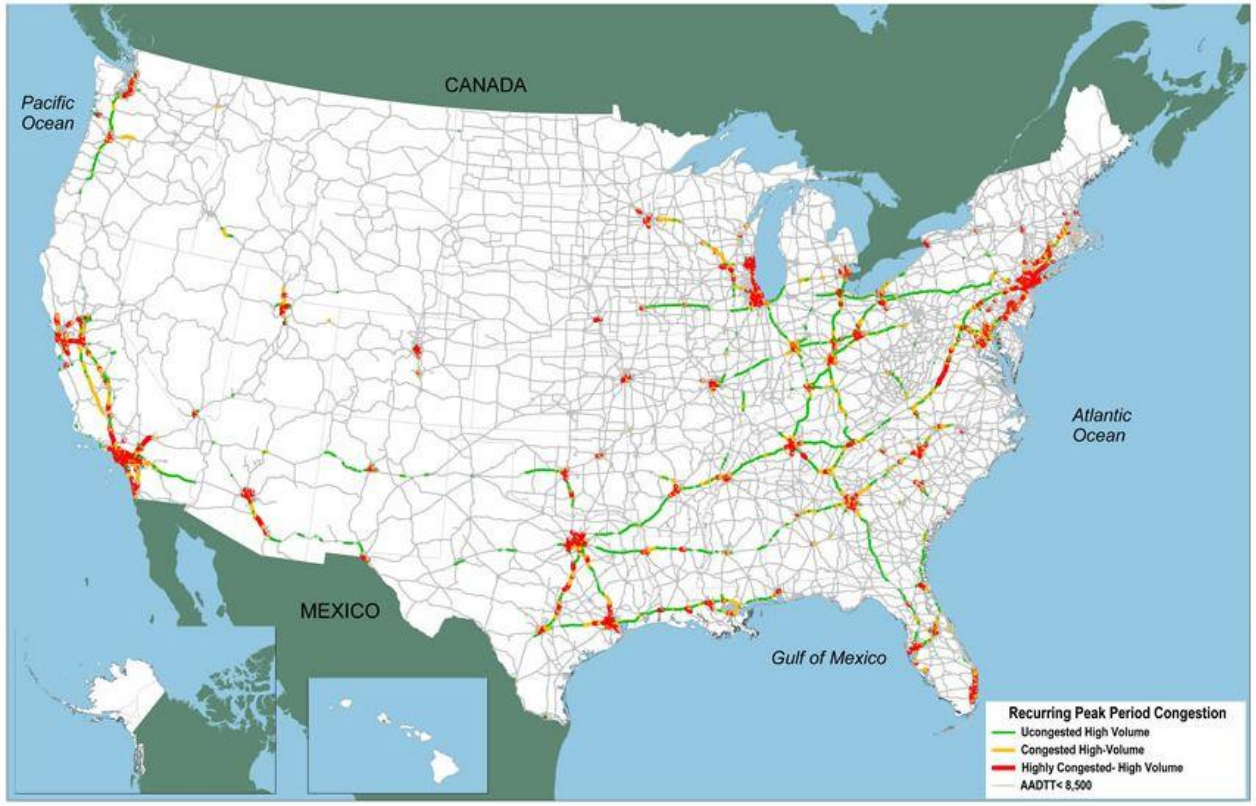


Source: Bureau of Transportation Statistics (2017)

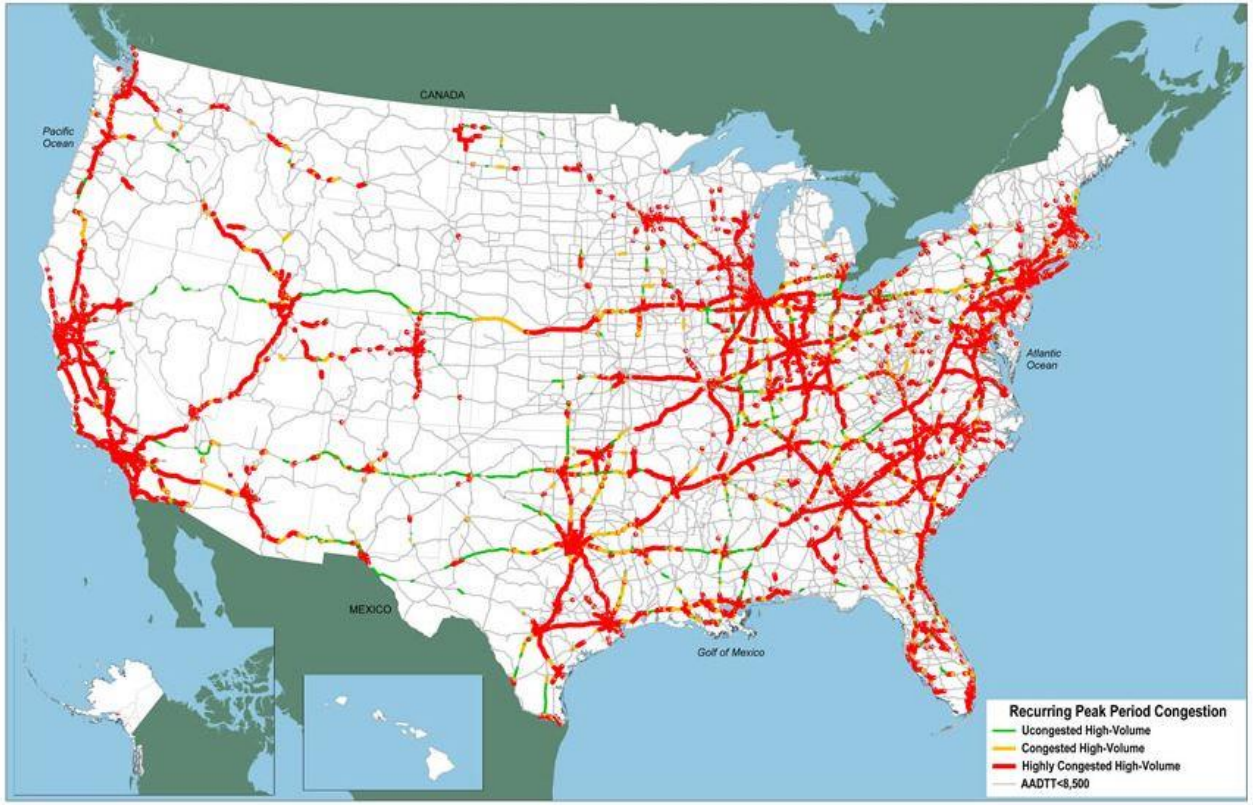
Introduction Cont.

Peak Period Congestion on High-Volume Truck Portions of the National Highway System

2012



2045

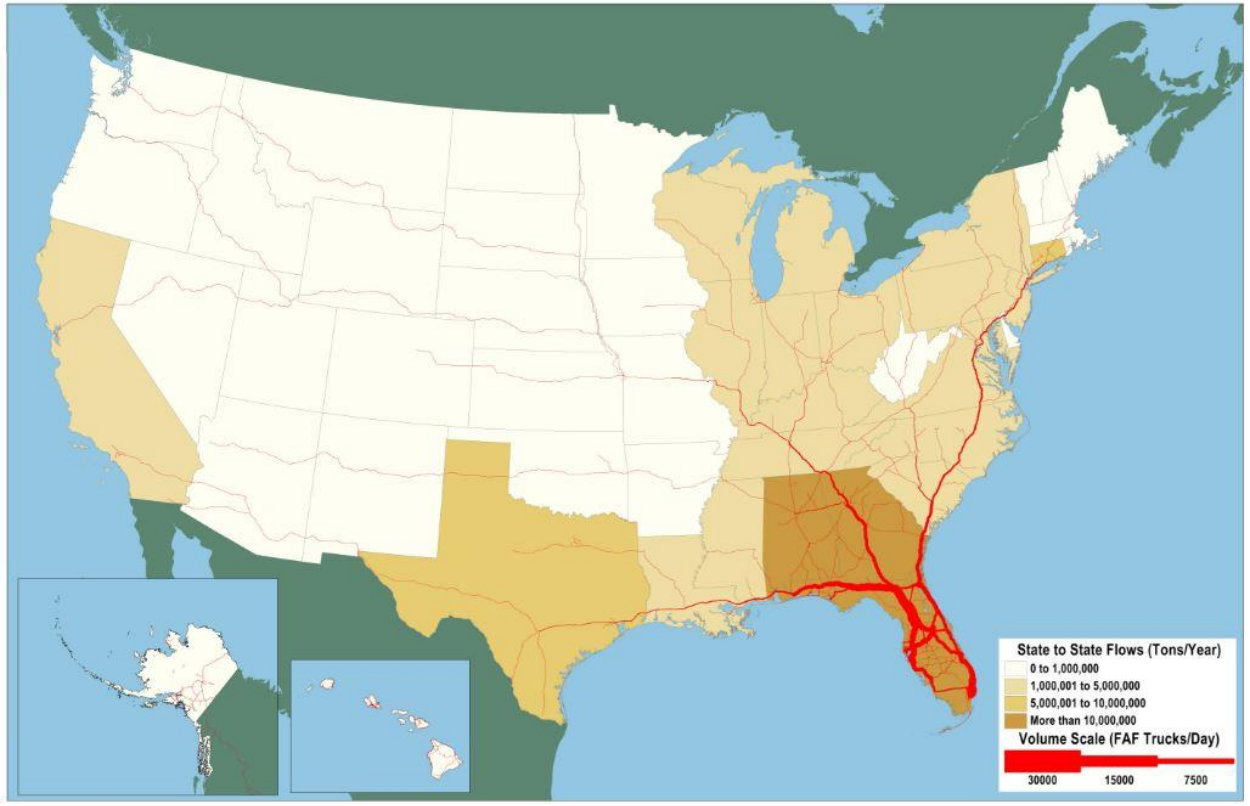


Source: Bureau of Transportation Statistics

Introduction Cont.

Major Flows by Truck to, from and within Florida

2012



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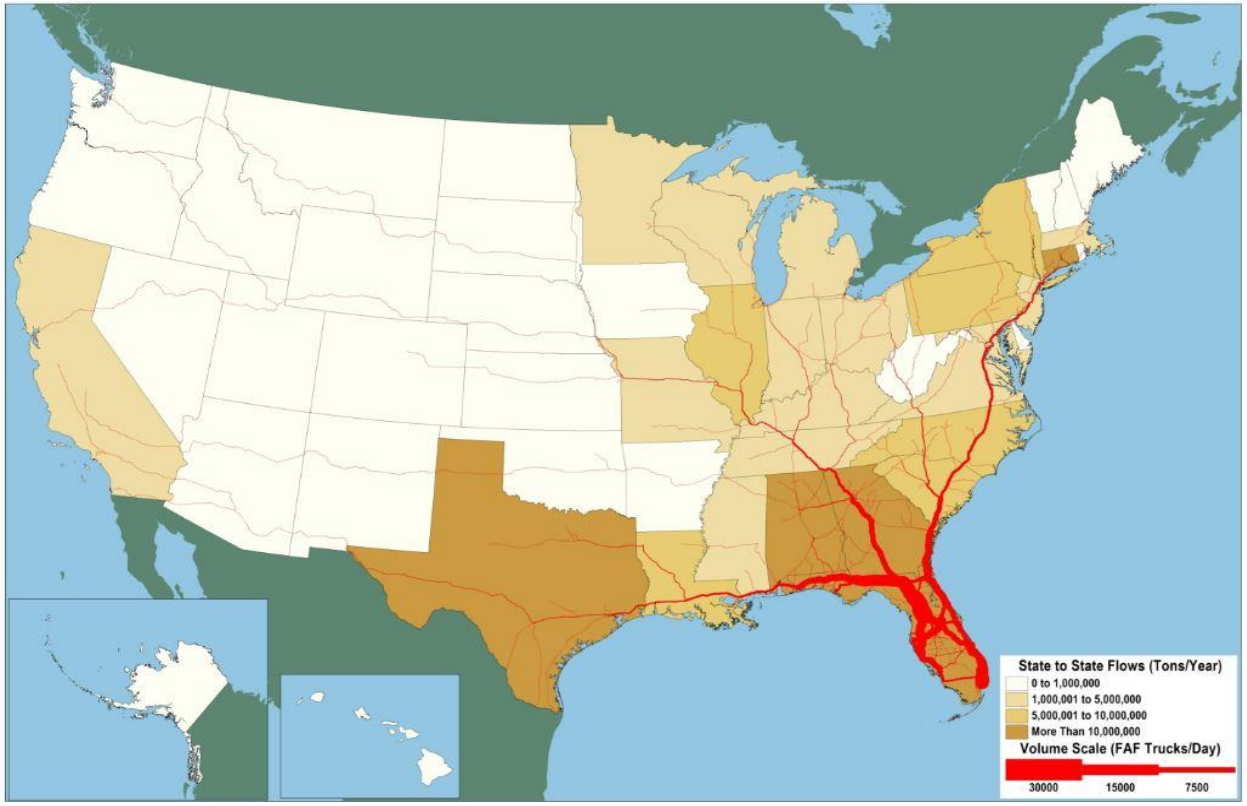
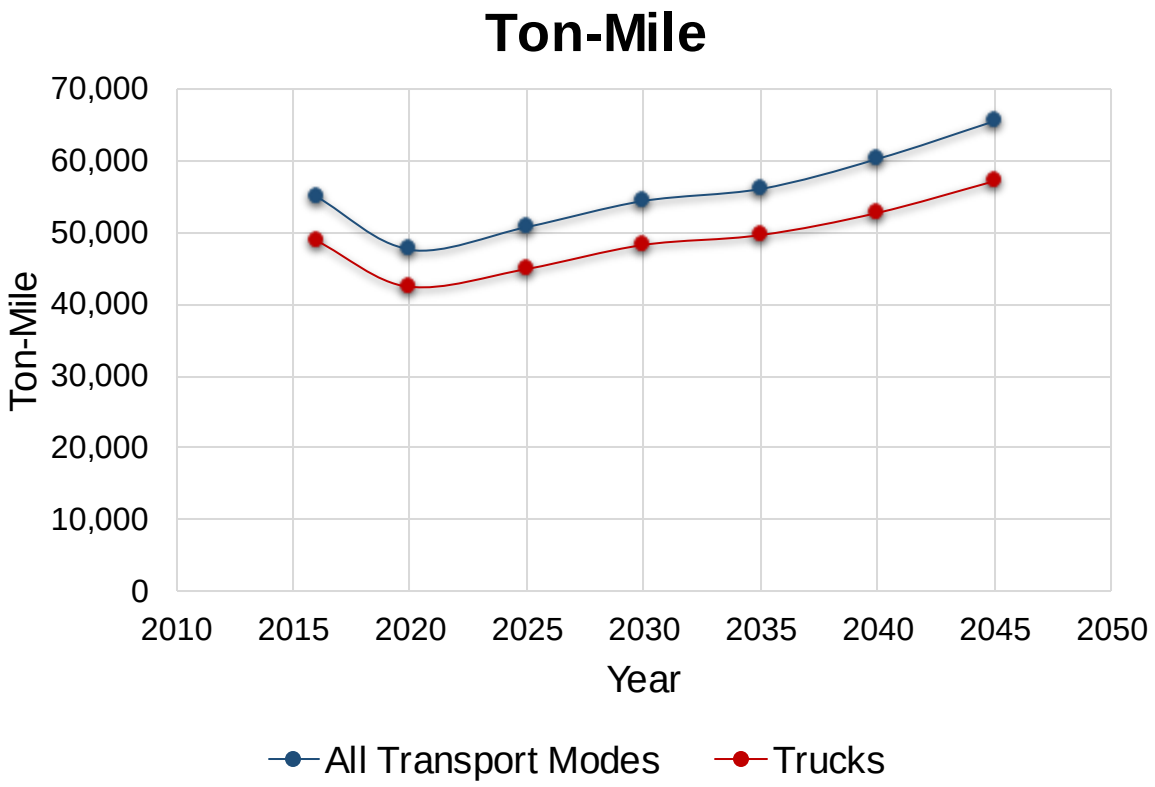
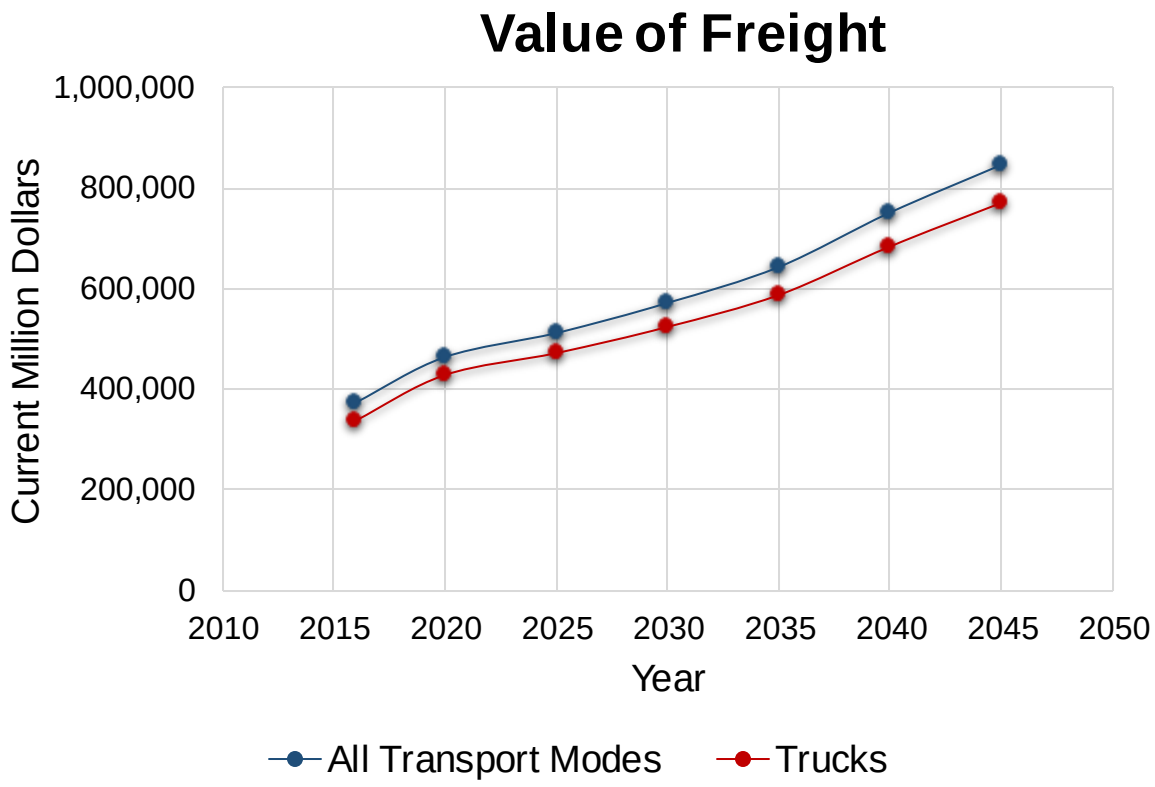


Source: Bureau of Transportation Statistics

Introduction Cont.

Forecasting conditions at Florida until 2045





Source: Freight Analysis Framework Data

Introduction Cont.

- The presence of trucks around urban areas worsens problematic situations on the traffic network.
  - Slow Dynamics.
  - Additional time for acceleration/deceleration.
  - Often stops due to signal heads.

- Trucks have significant impact on increasing congestion and affecting
  - the transit and vehicle movements,
  - the reliability and efficiency of freight operations.

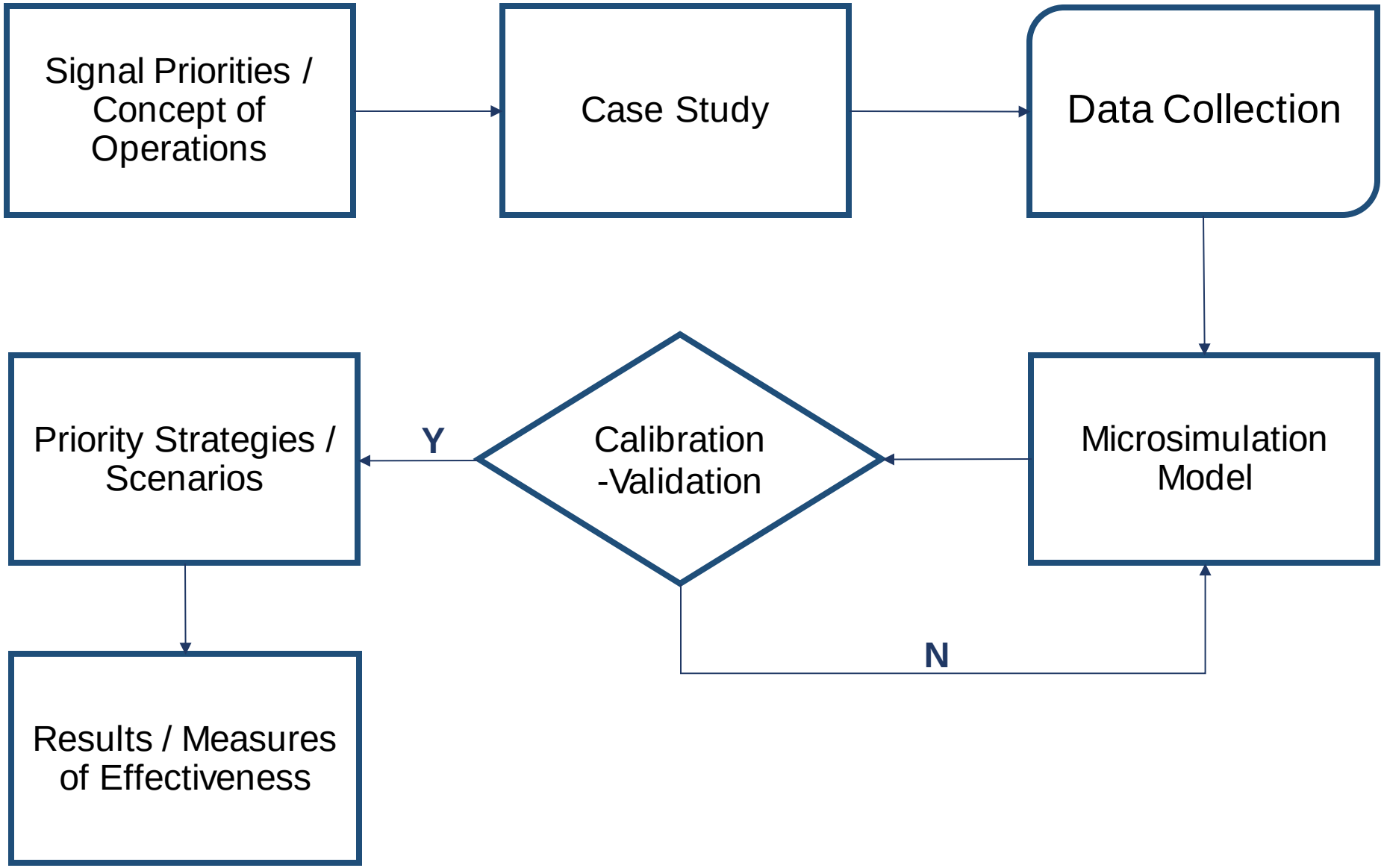
Source: Federal Highway Administration

Objectives

- Prioritization of the freight and transit movements along an urban multimodal corridor.

- Simultaneous implementation of Freight & Transit Signal Priority
  - improve freight mobility,
  - provide good transit services,
  - deteriorate the congested traffic conditions.

Methodology



- Intelligent Transportation Systems (ITS) components.
  - unconditional preemption, (emergency vehicles, railroad crossing, drawbridge)
  - transit signal priority (TSP),
  - freight signal priority (FSP).

- **Transit Signal Priority** provides priority to transit vehicles by adjusting signal timing and phasing.

- **Freight Signal Priority** is the descendant of TSP, that uses similar technology with TSP to favor the movements of freight vehicles.

Signal Priorities

- TSP & FSP strategy aims to
  - increase travel time reliability for freight and transit vehicles,
  - enhance safety at intersections, and
  - provide environmental benefits.

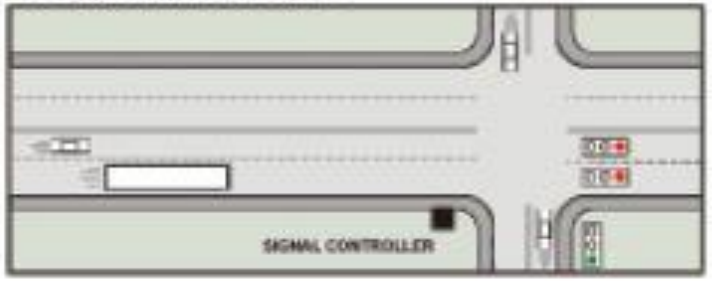
- Priority strategies
  - Passive priority
  - Active priority
  - Priorities operating on real-time

Source: me.umn.edu

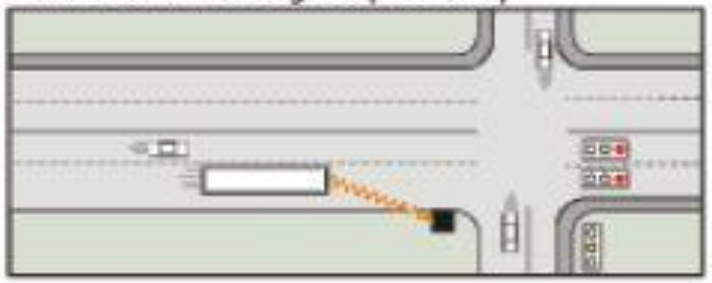
Signal Priorities Cont.

RED TRUNCATION

Bus approaches red signal



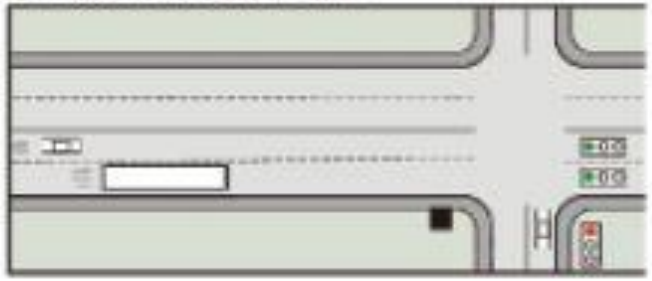
Signal controller detects bus;
terminates side street green phase early



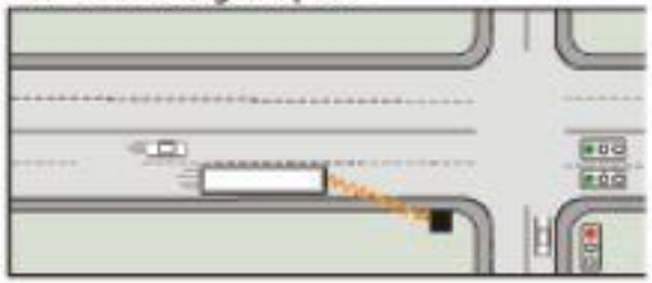
Bus proceeds on green signal

GREEN EXTENSION

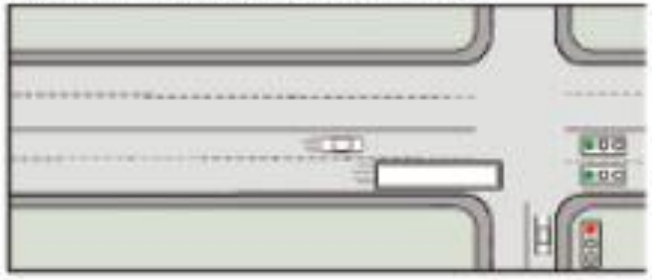
Bus approaches green signal



Signal controller detects bus;
extends current green phase



Bus proceeds on extended green signal



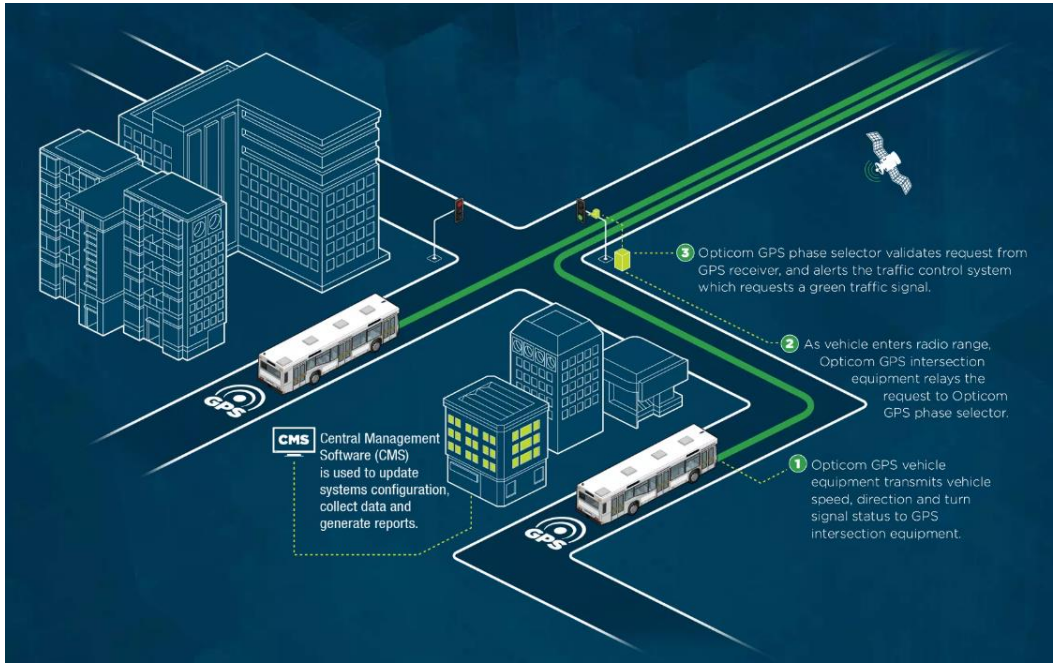
Source: Smith, H. R et al., 2005

- Support the system engineering process.
- Accommodate different
  - technology platforms,
  - products,
  - agency preferences.
- Accommodate multiple priority requests from different modes and fleets at the same.
- Priority based on
  - vehicle mode,
  - vehicle operation attributes,
  - position,
  - speed,
  - traffic and weather conditions,
  - local policies.

Concept of Operations Cont.

- Distributed Architecture
  - Sensor Classification
  - AVI/AVL Technology - Controller Cabinet
  - Approaching Priority Vehicle
  - Vehicle and Cabinet
  - Vehicle and Cabinet Utilizing Connected Vehicle (CV) Technologies

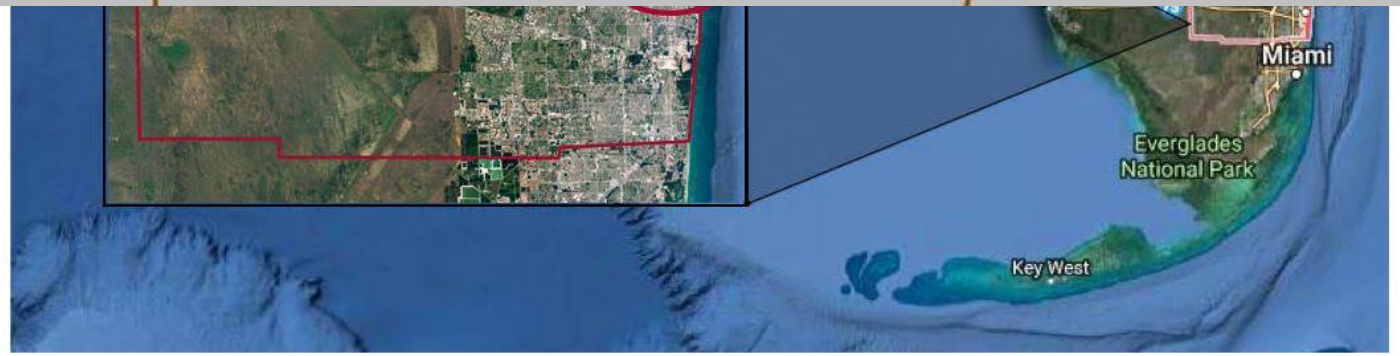
- Central Architecture
  - Fleet Management Center
  - Fleet Management Center and TMC
  - Extension of previous option with CV send information and priority level through cell communications to center



Source: https://www.gtt.com/opticom-transit-signal-priority/opticom-transit-gps-system

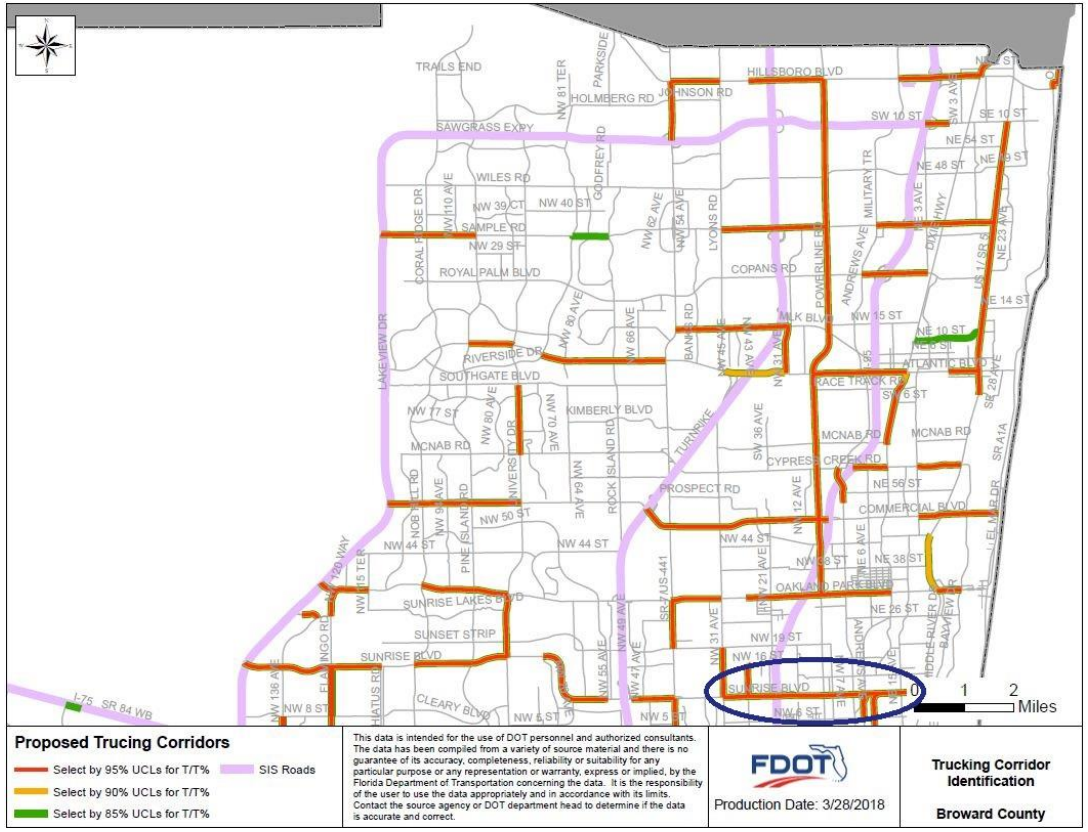
Case Study, South East Florida

Sunrise Boulevard: NW 31st Avenue – N Federal Highway



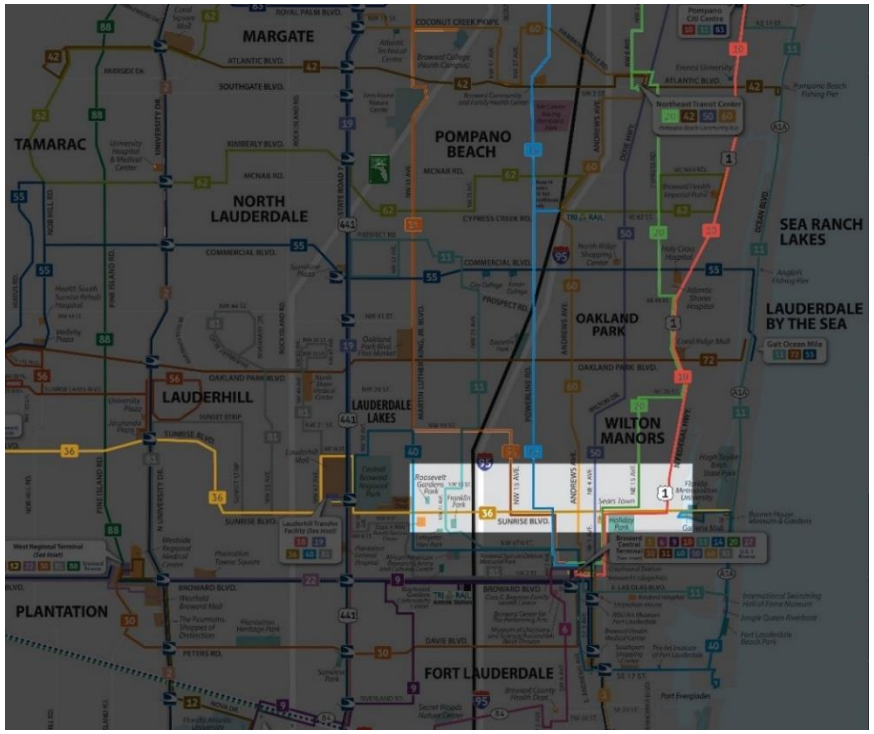
Source: Florida Traffic Online & Google maps

Sunrise Boulevard - *State Road 838*



Sunrise Boulevard at Fort Lauderdale, Broward County

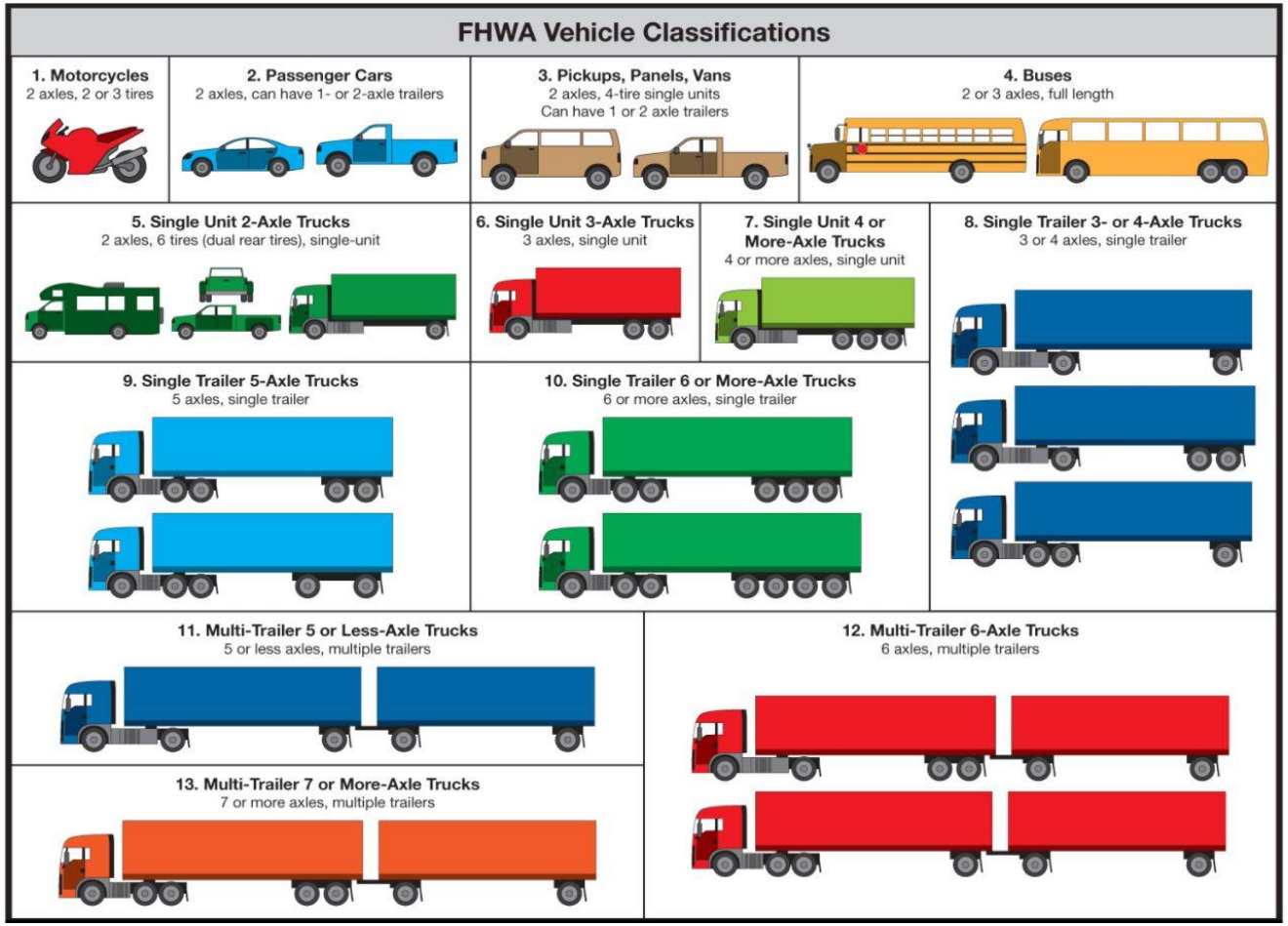
- 4.2 miles corridor,
- 22 signalized intersections,
- 5 bus routes – 4 buses per hour per direction
- high truck volumes
- school zone area – speed limit 25mph



Source: FDOT

Data Collection

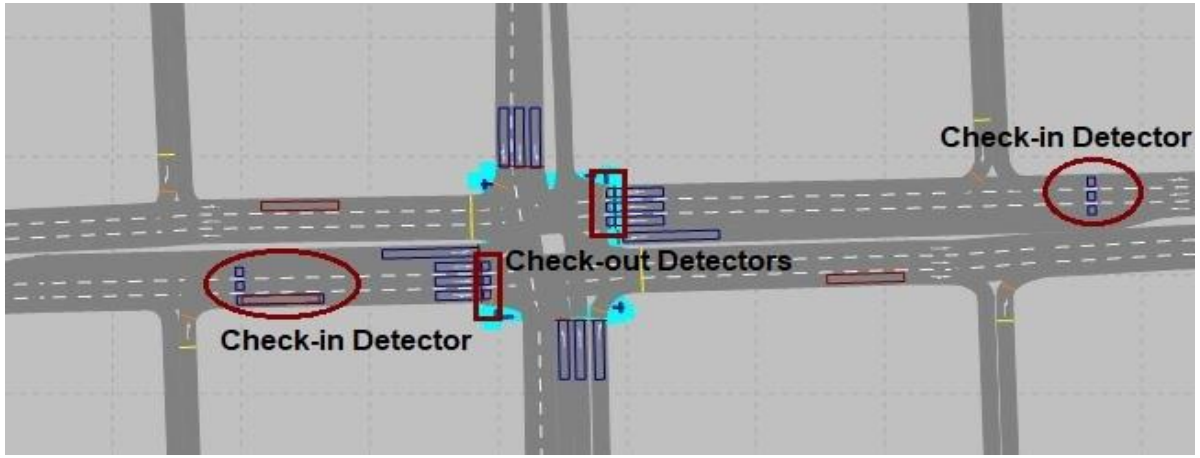
- Peak-hour Volumes
- Traffic Counts and Turning Movements
  - ➢ Vehicle Classification
- Truck Characteristics & Dynamics
- Transit Data

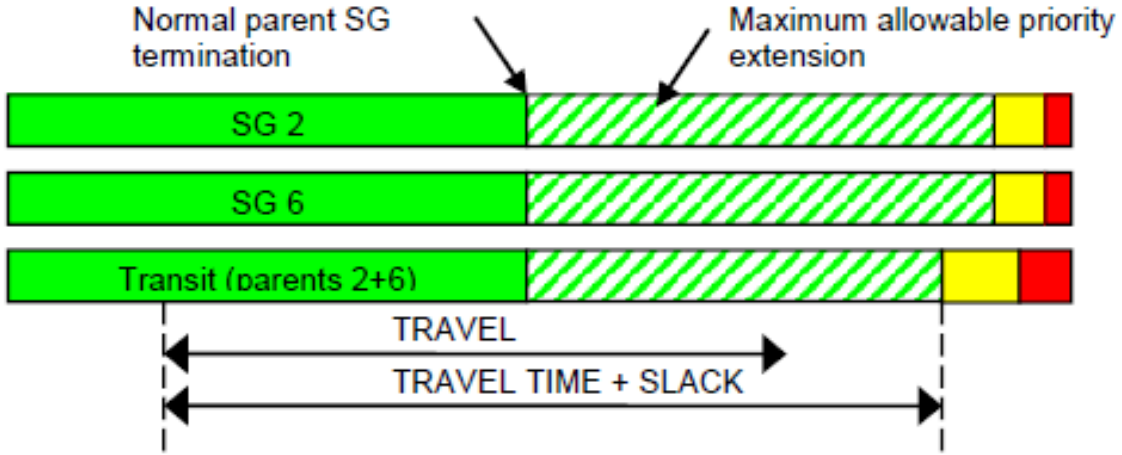


Source: Federal Highway Administration

Microsimulation Model

- PTV VISSIM microsimulation platform, Version 10
  - ➢ Update existing Microsimulation model
- Calibration - Validation process
  - ➢ Bluetooth Data Travel Time data
- Implementation of Priorities
  - ➢ Detection System
  - ➢ Signal Timing Adjustments

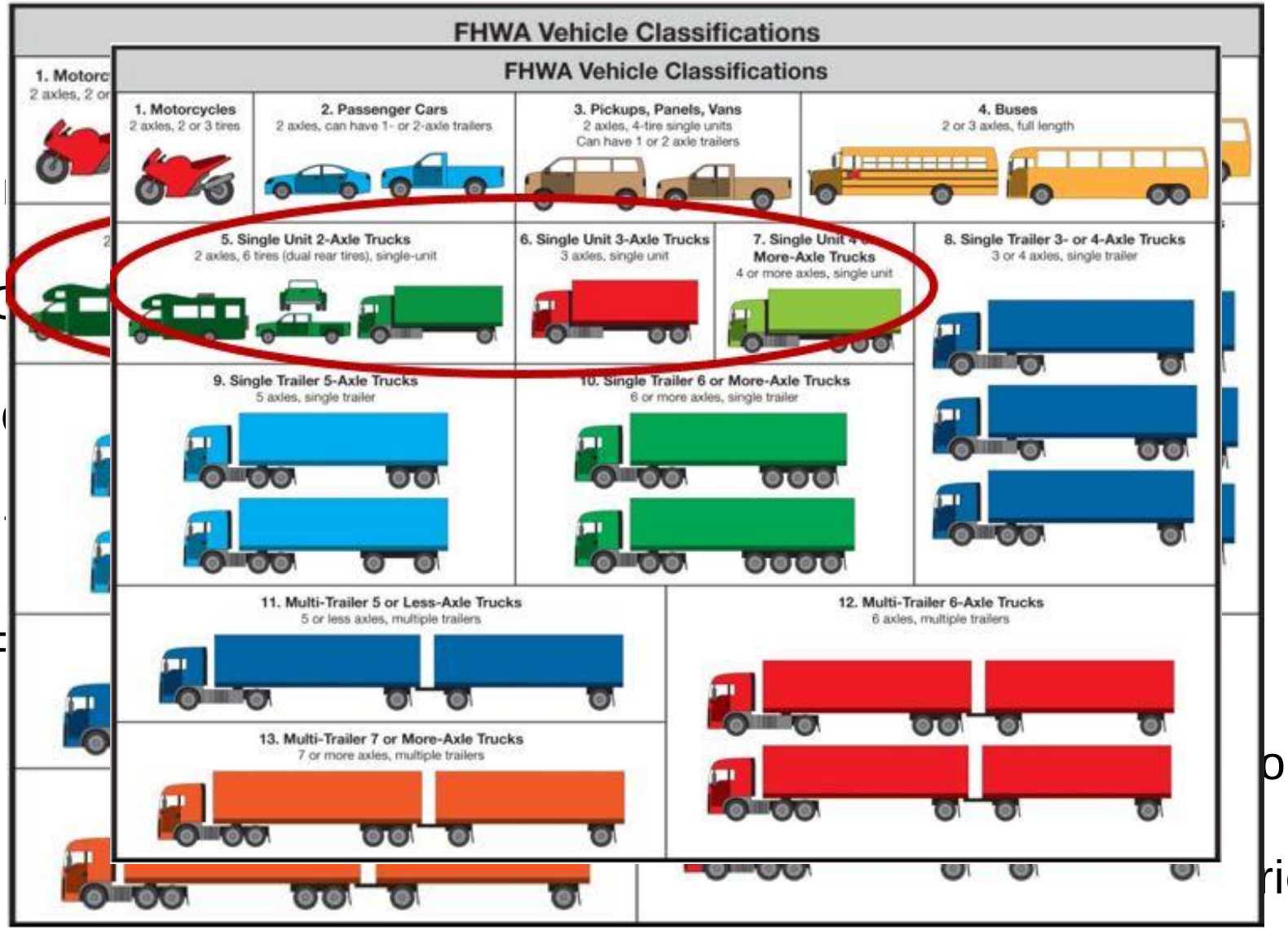




Source: Manual RBC – PTV VISSIM

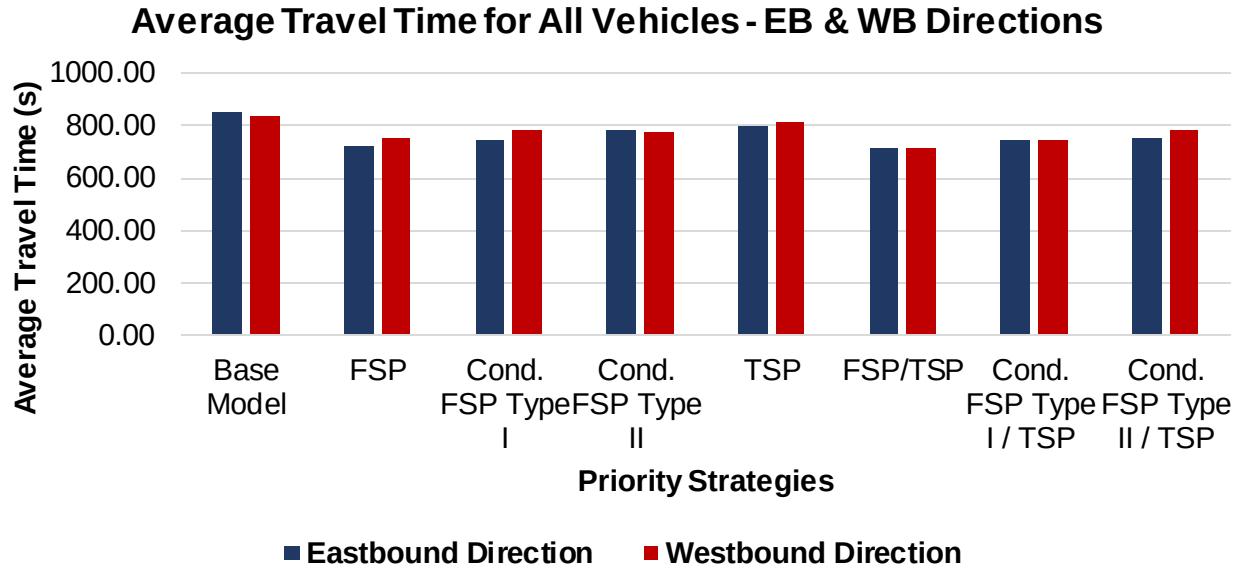
Scenarios

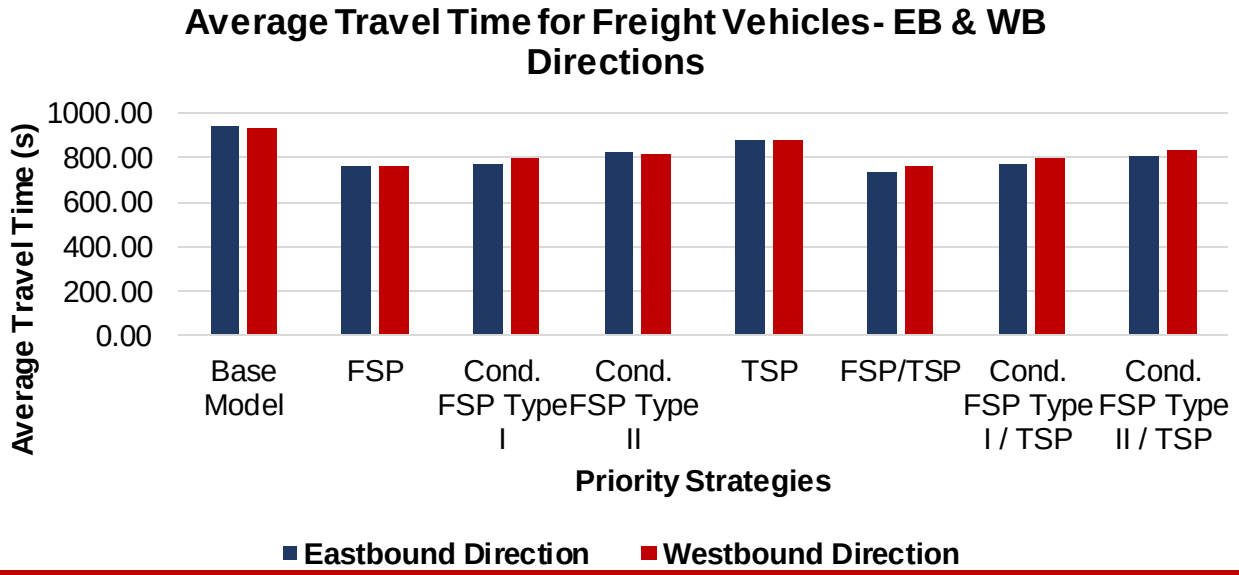
- *Base Model:*
- *Scenario I:* F
- *Scenario II:* C
- *Scenario III:*
- *Scenario IV:*
- *Scenario V:* F
- *Scenario VI:* ority
- *Scenario VII:* riority

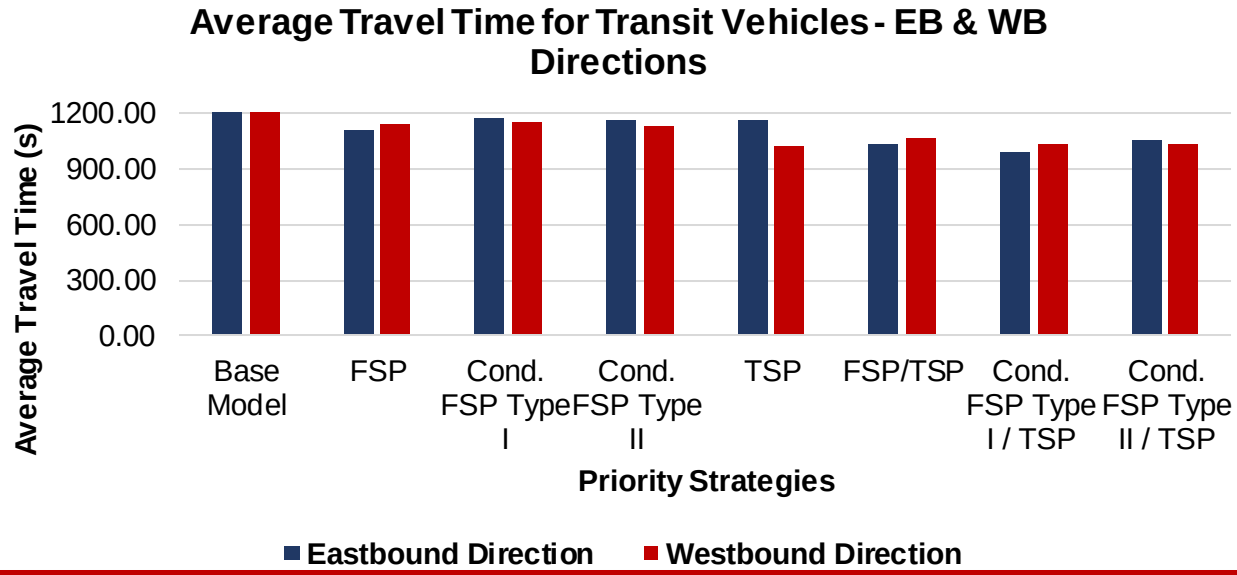


Source: Federal Highway Administration

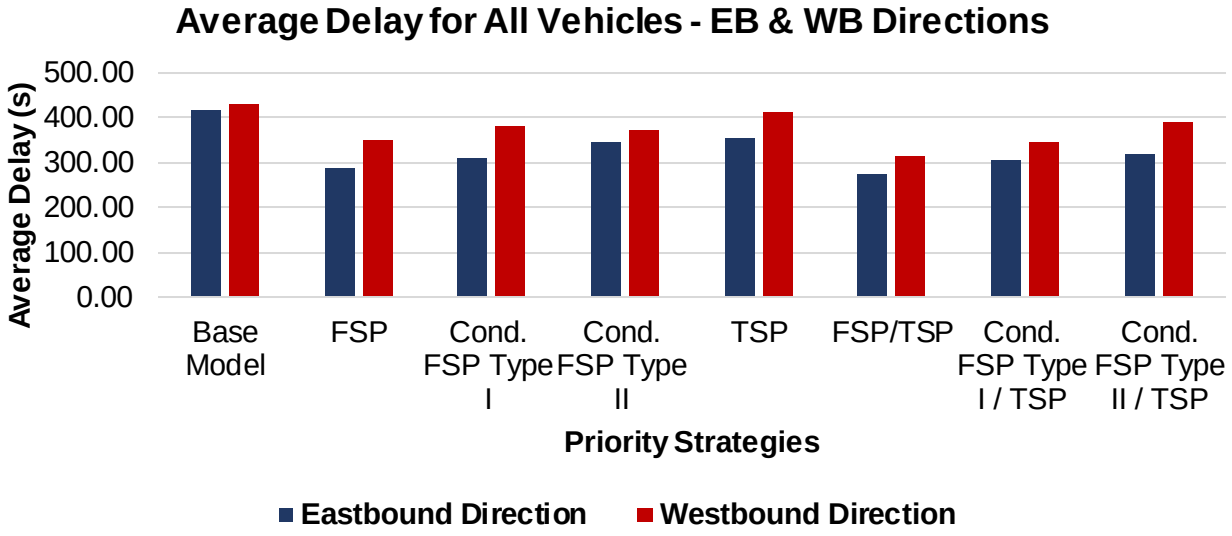
Results- Average Travel Time

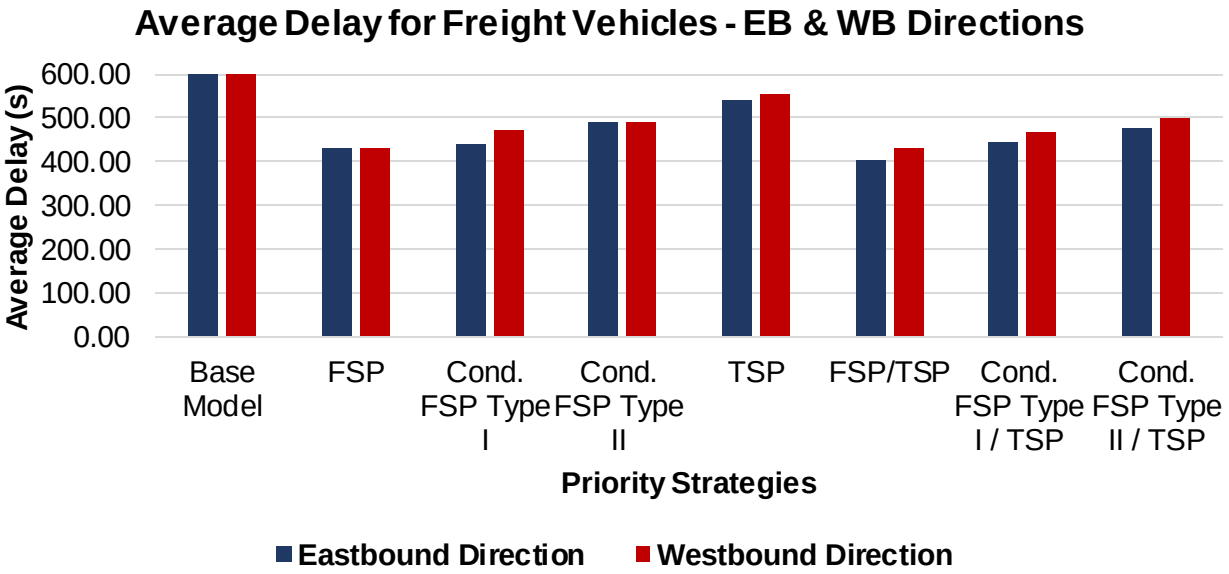


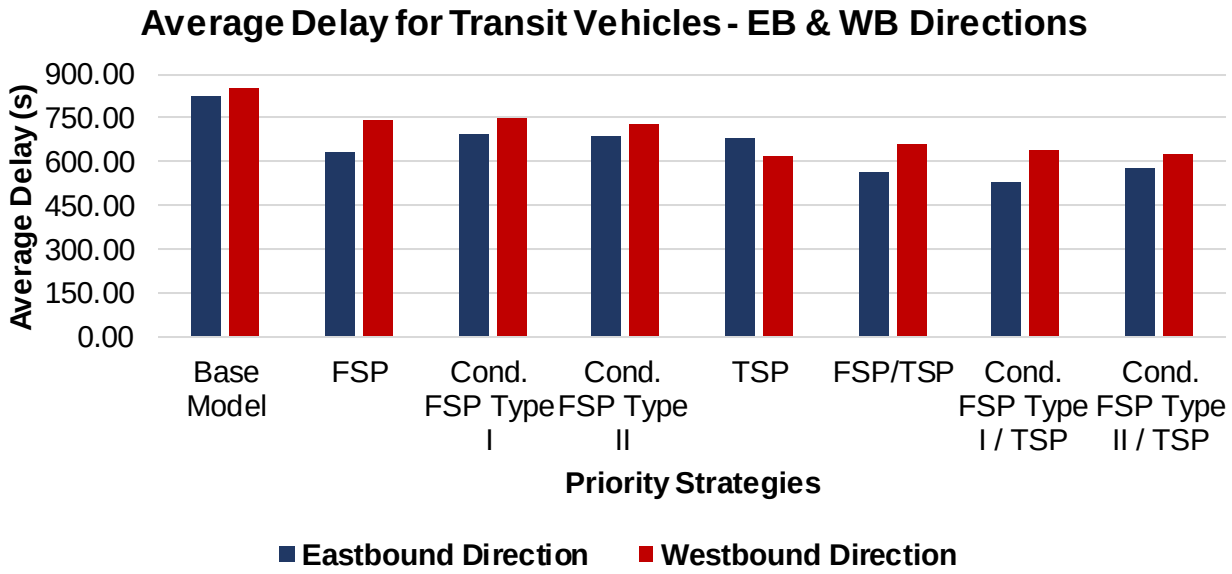




Results – Average Delay







Results – Average Side Street Delay

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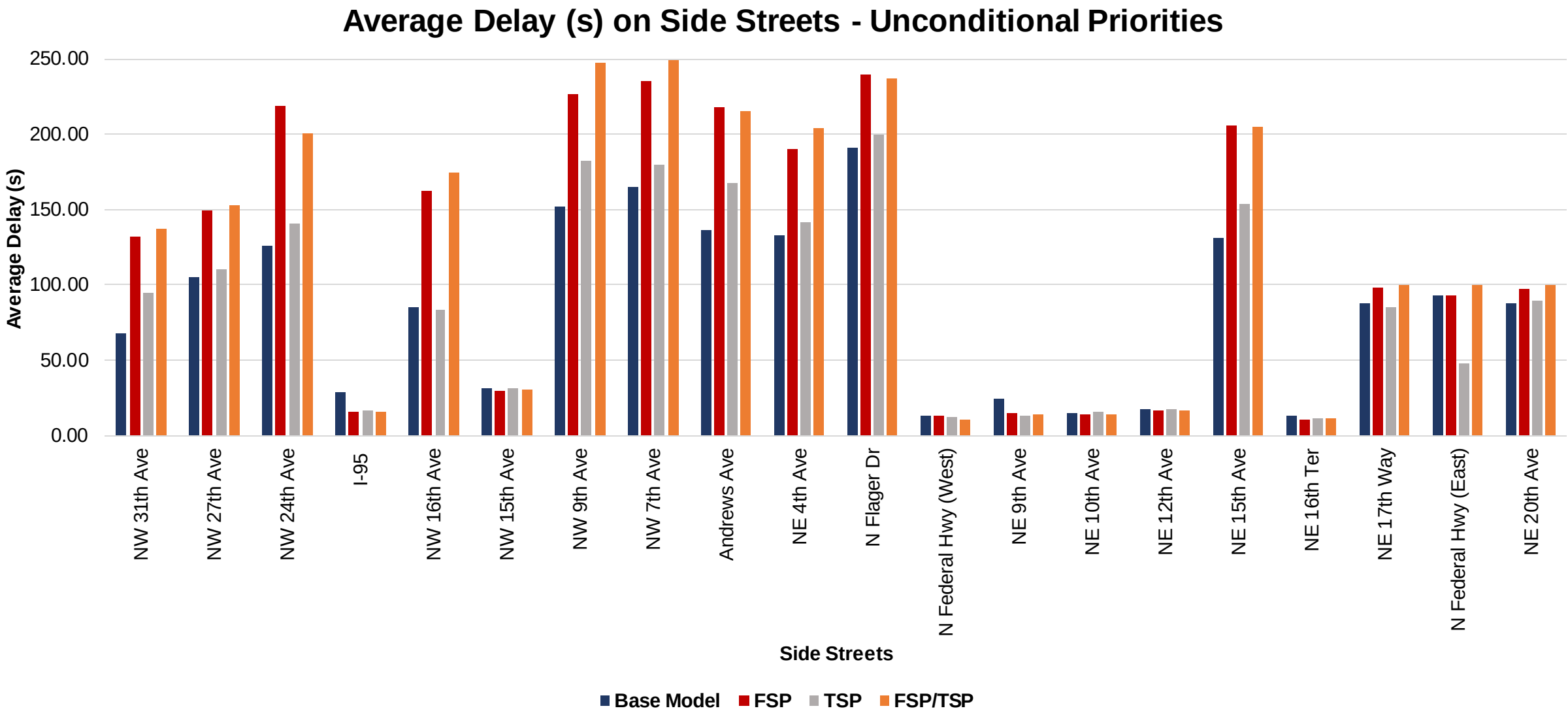

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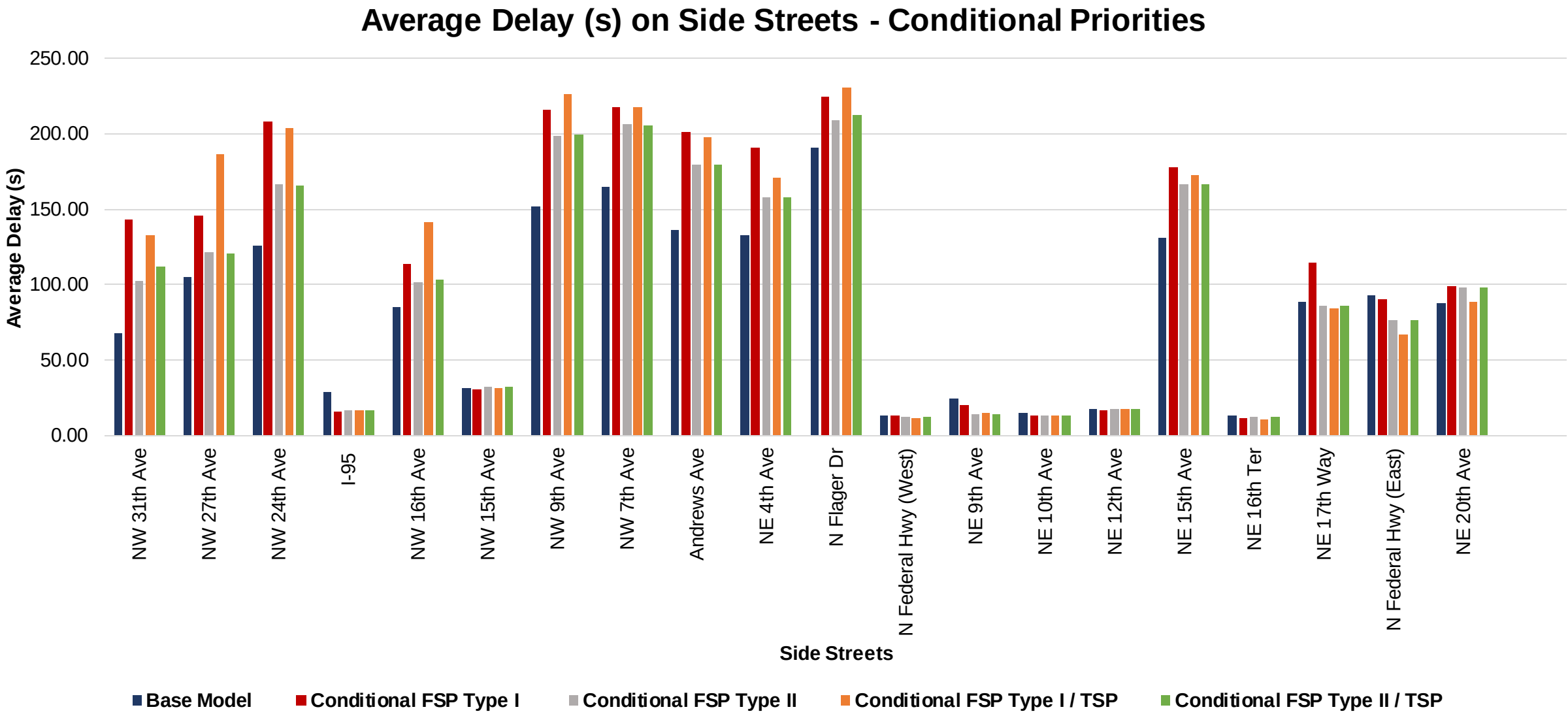
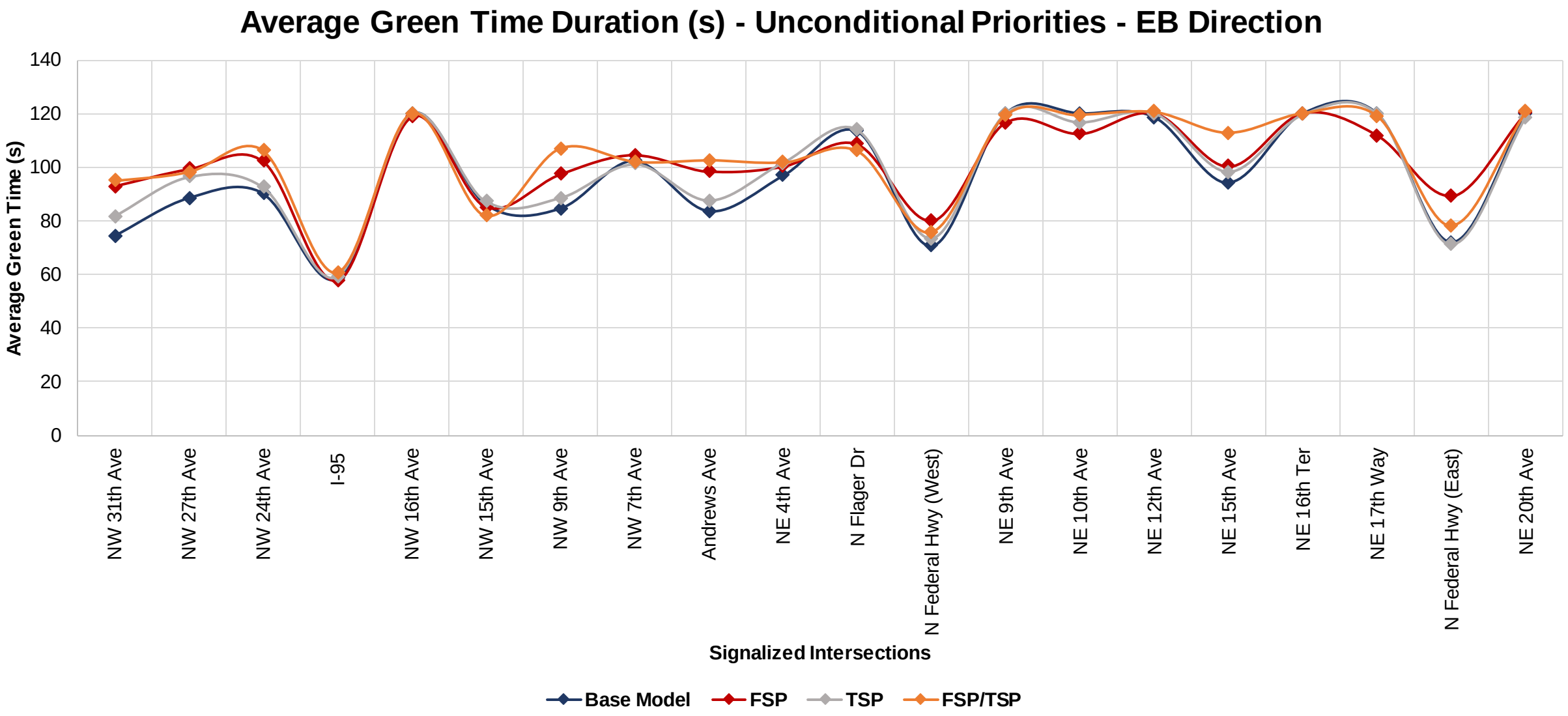


Results – Average Green Time Duration



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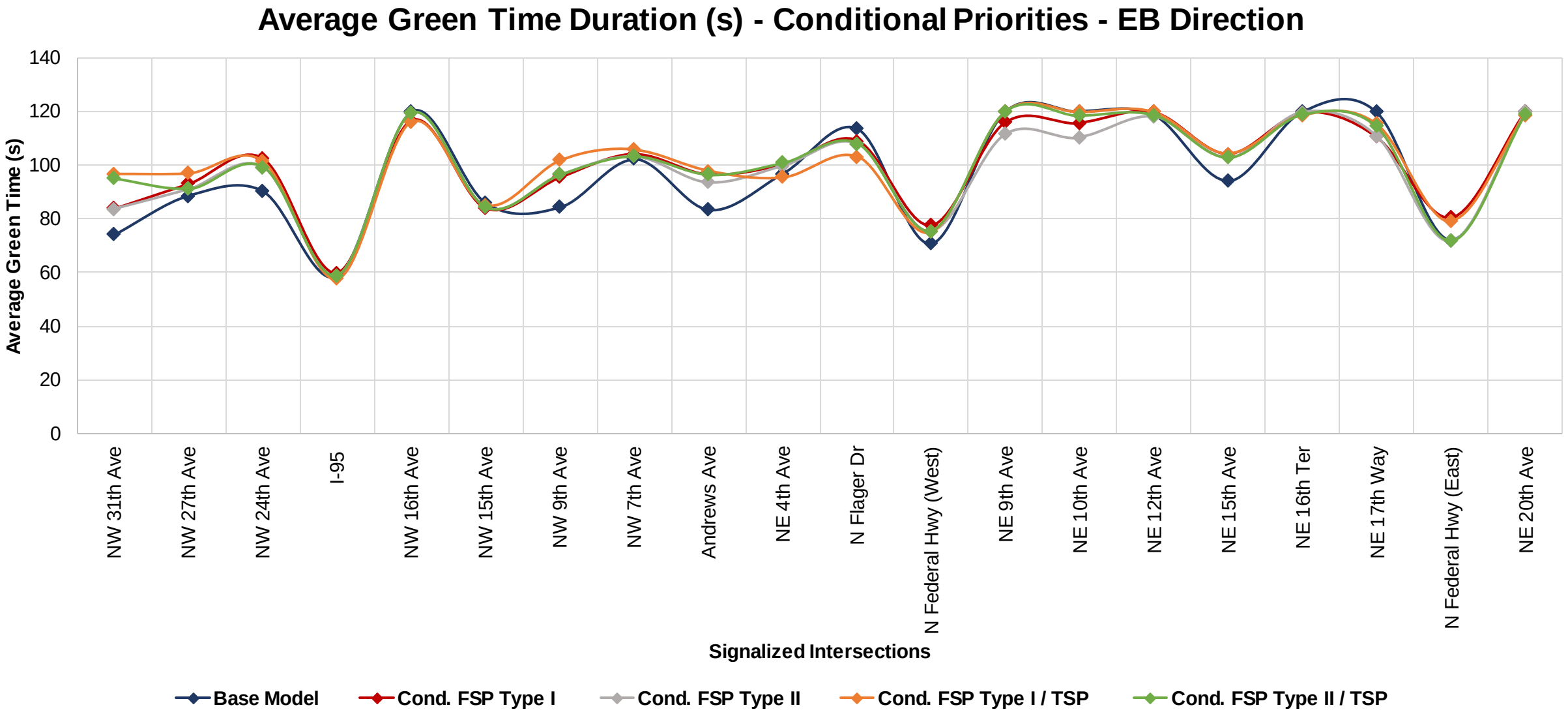

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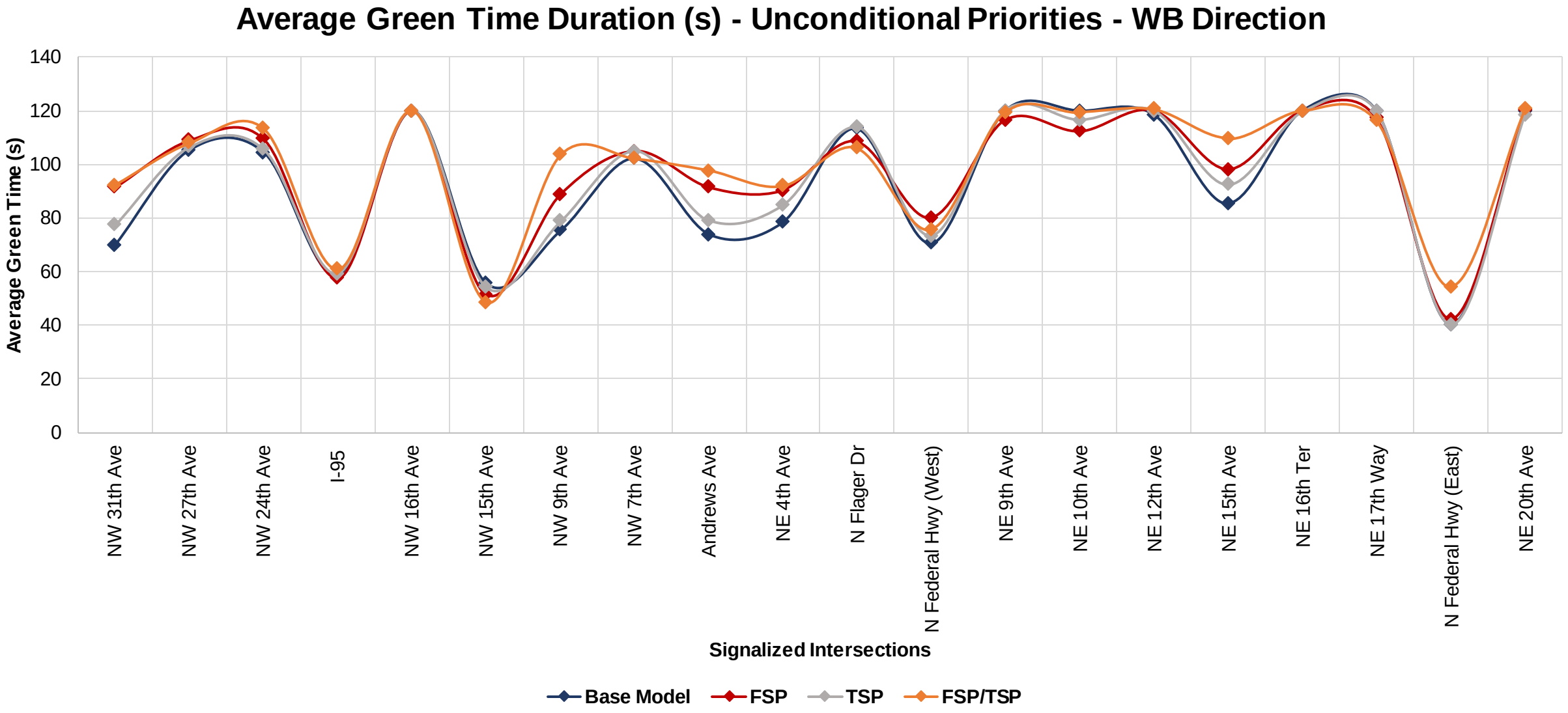

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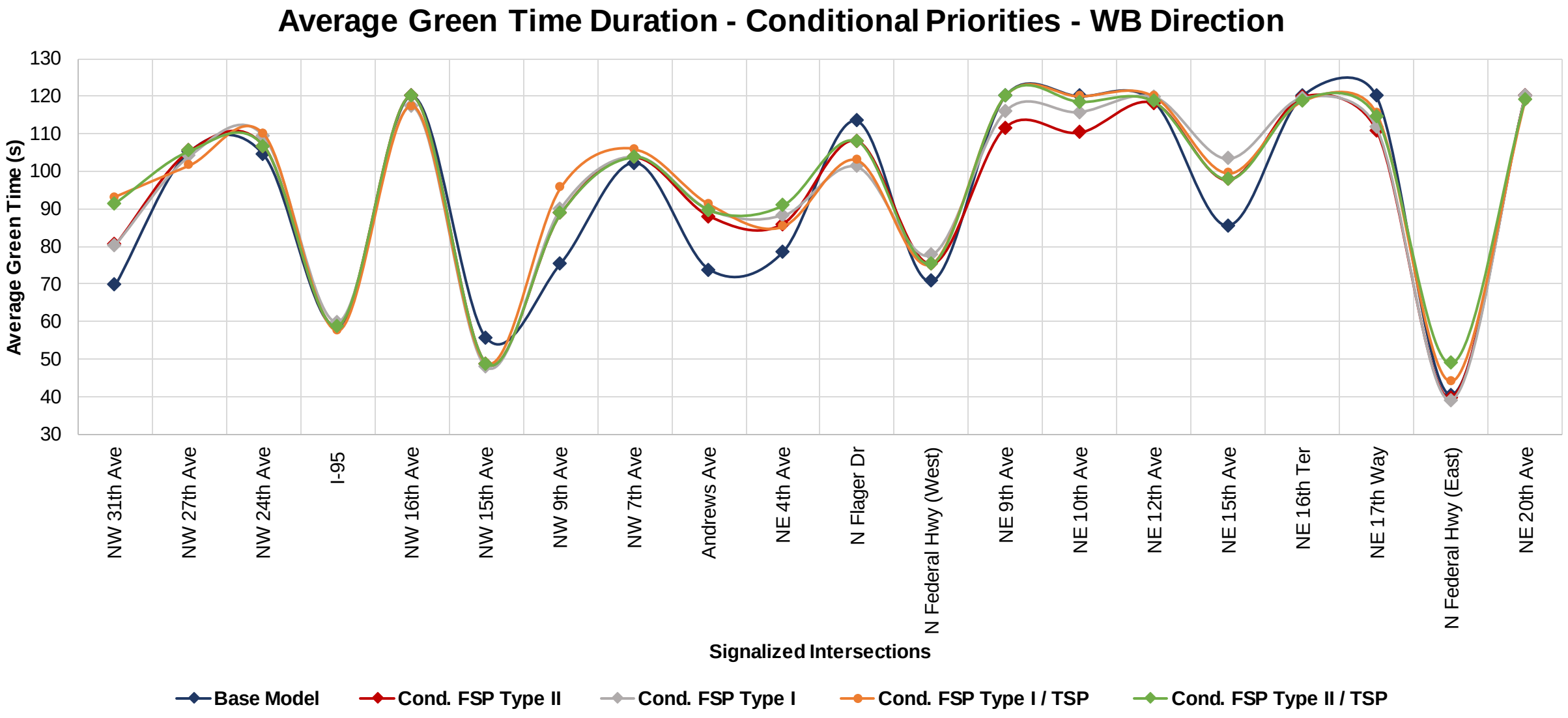

Conclusions

- The evaluation of the FSP and TSP scenarios presented a positive effect on the freight and transit movements.
- The travel time and the delays were reduced significantly.
- The impact of the priority strategies on side street delays differs depending on the strategy applied *(FSP & FSP/TSP presented the highest delays).*
- Scenario with highest mobility improvements was the **FSP/TSP**.
- Scenario with significant mobility improvements and low impact on the side roads was the **Conditional FSP Type I / TSP**.

Recommendations

- Identify the aspects of freight movements that have the greatest impact on the traffic network.
- Develop scenarios with different priority weights on FSP and TSP for evaluating their collaboration.
- Implementation of FSP and TSP strategies on the main arterials of a wider network for evaluating their impact.
- Develop and propose guidelines for the efficient implementation of FSP and TSP.

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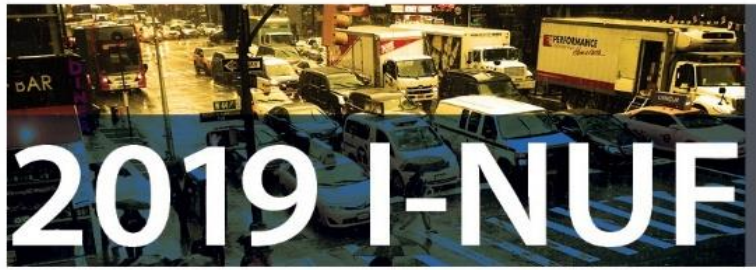
Thank you for your attention!
Questions?



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