

# Utility of Transit Signal Priority (TSP) for No-Notice Urban Emergency Evacuation

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Resiliency



# LSU

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# Overview

- Introduction
- Methodology
- Case Study
- Results
- Conclusion

# Catastrophic Events

## Short-Notice:

Notice: 24-48 hours

- Hurricanes
- Wild Fires



[www.environmentalfiles.com](http://www.environmentalfiles.com)

## No-Notice

Notice: 24 hours or less

- Flash Floods
- Man-Made



[www.allstate.com](http://www.allstate.com)

# Transit in Evacuation

- Field observations:
  - Roadway Gridlock
  - Transit increases capacity
  - Resource Mismanagement



[www.phillysonline.com](http://www.phillysonline.com)

# Transit Signal Priority (TSP)

- Transit unit receive special treatment at signalized intersections
- Common forms:
  - Green Extension
  - Red Truncation



# Problem Statement

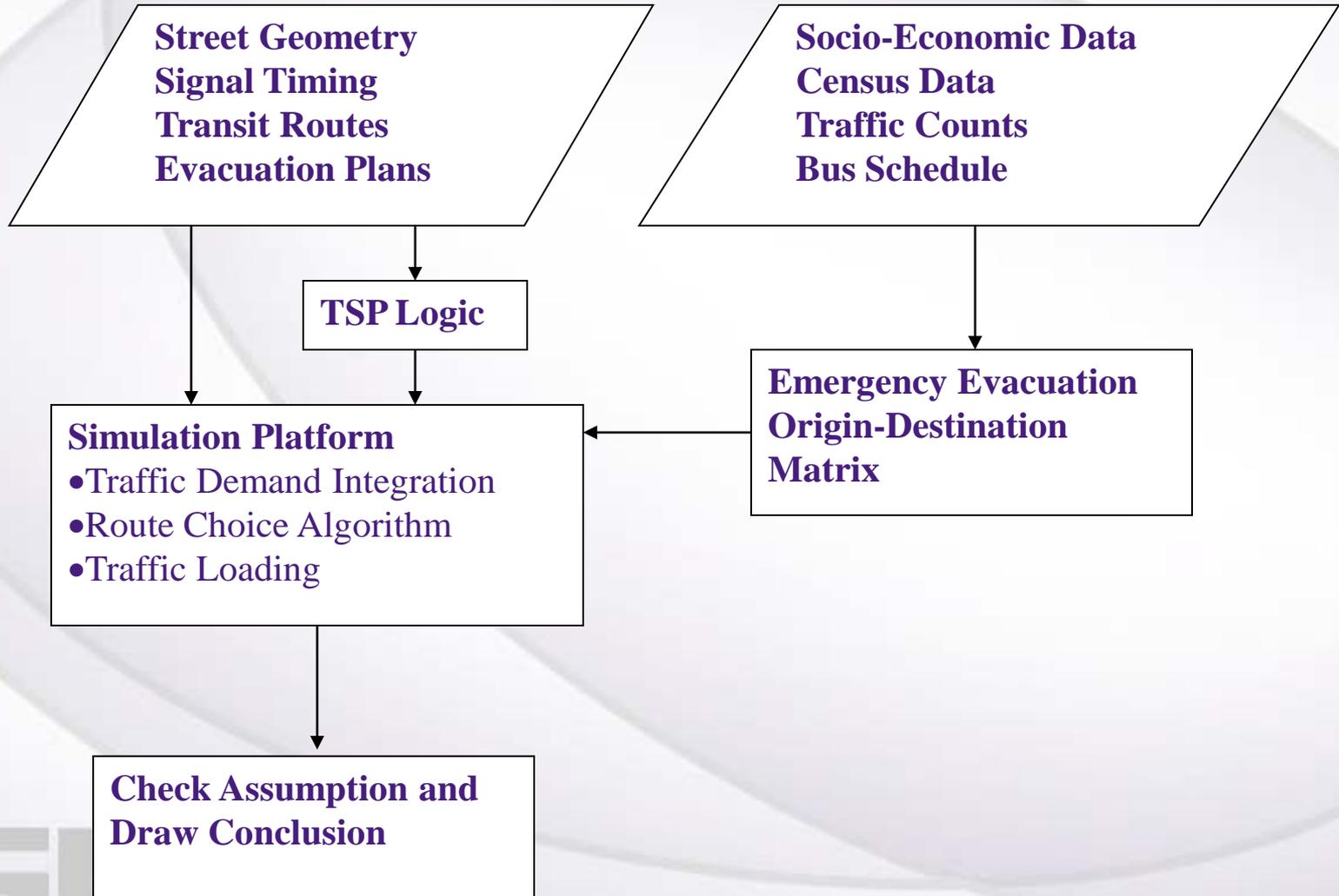
- Is it advisable to policy makers to allow transit signal priority (TSP) during urban evacuation?
  - Do the benefits allowed to buses out weigh the hindrance to personal vehicles?

# Research Objectives

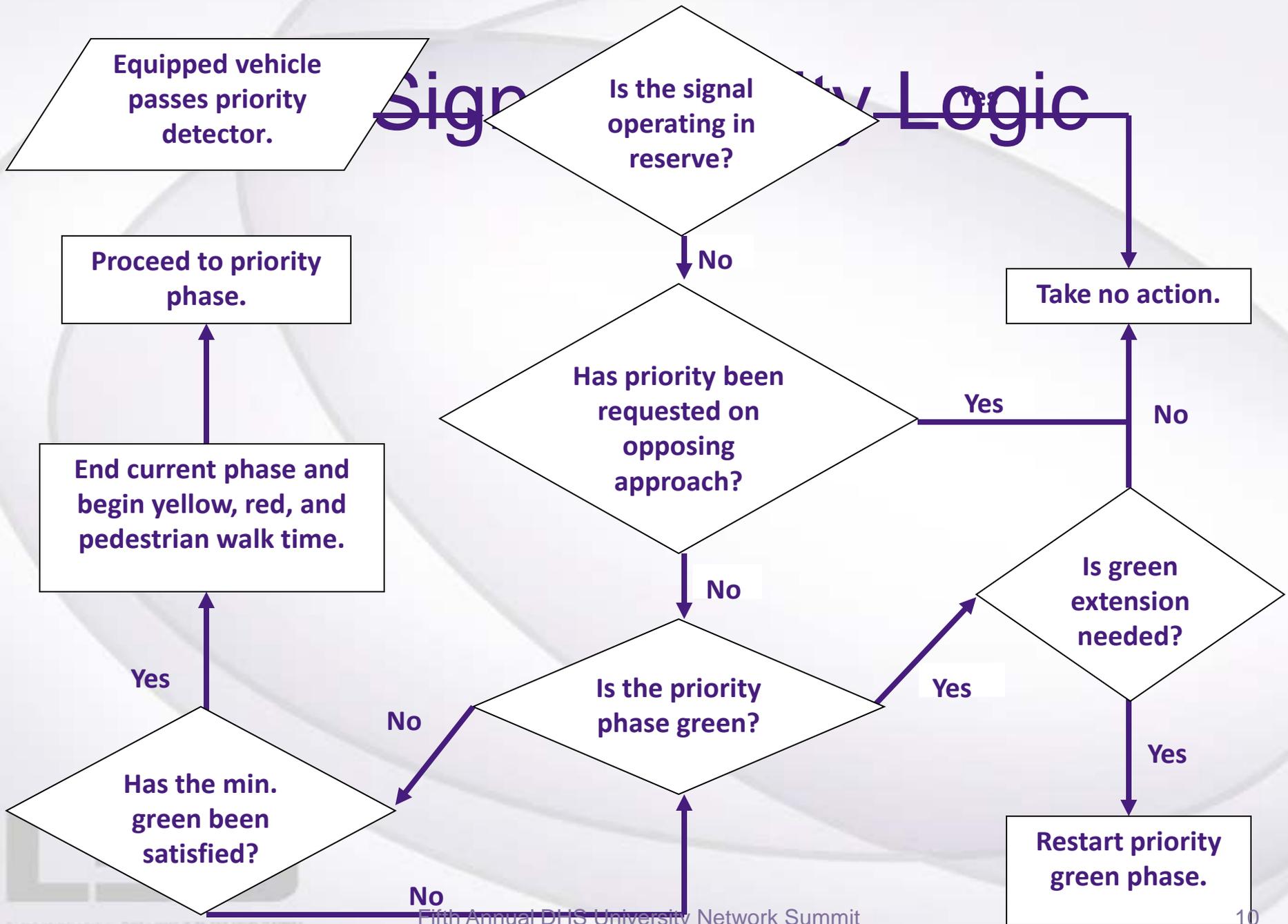
- Develop a “typical” transit priority system
- Simulate Transit Signal Priority (TSP) and evacuation in micro-simulation environment
- Compute evacuation clearance times and evacuee travel time
- Make recommendations

## Supply Side

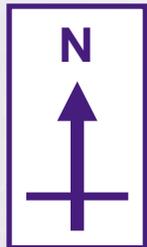
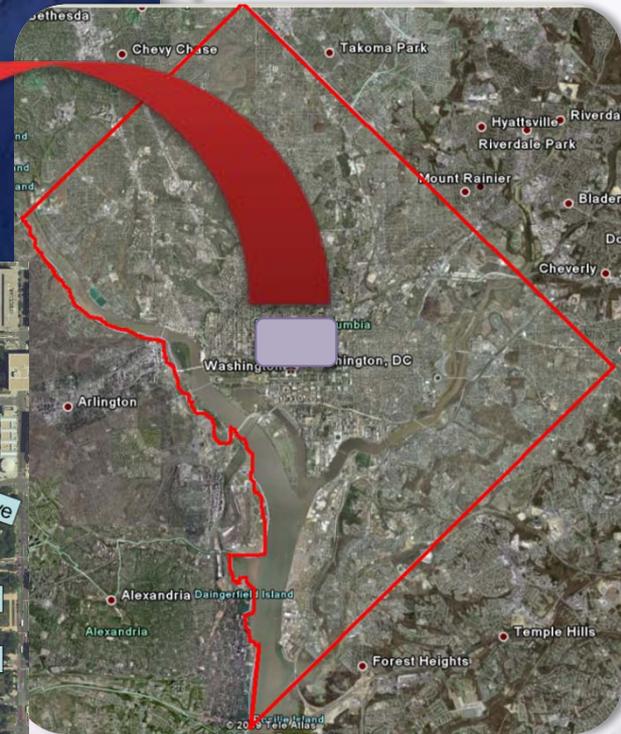
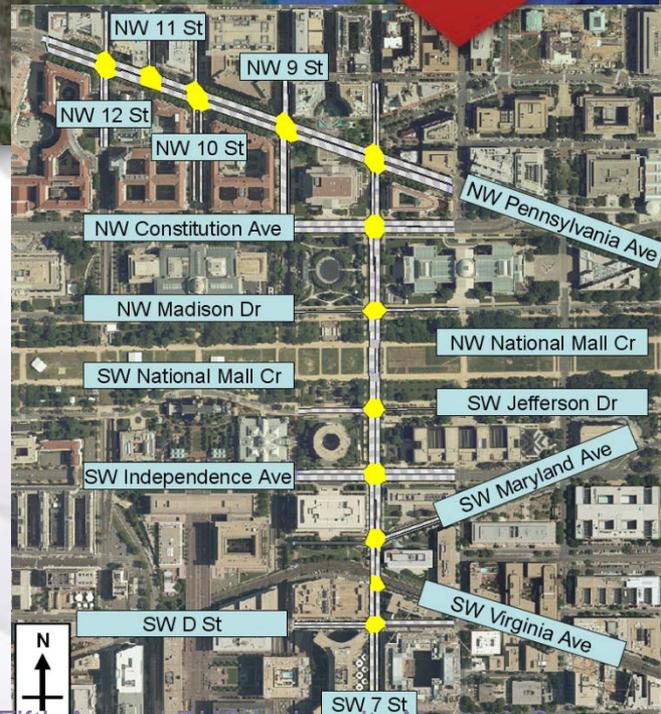
## Demand Side



# Signal Priority Logic



# Study Area Washington D.C. USA

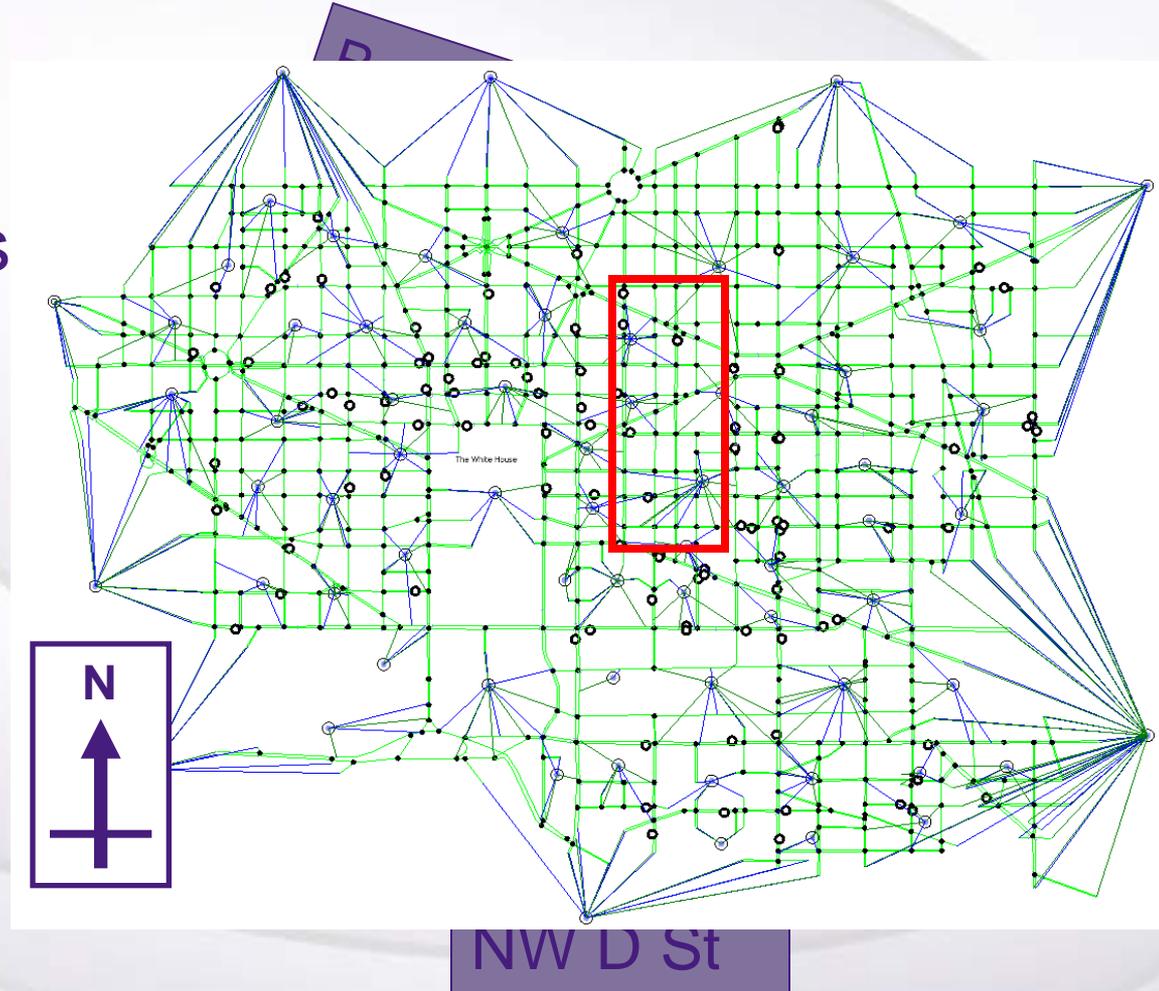


# Micro-Simulation

## AIMSUN NG

Professional 6.1

- Individual vehicles
- Car following
- Lane changing
- Inputs
  - GIS shape file
  - Traffic counts
  - Signal timing



# Calibration

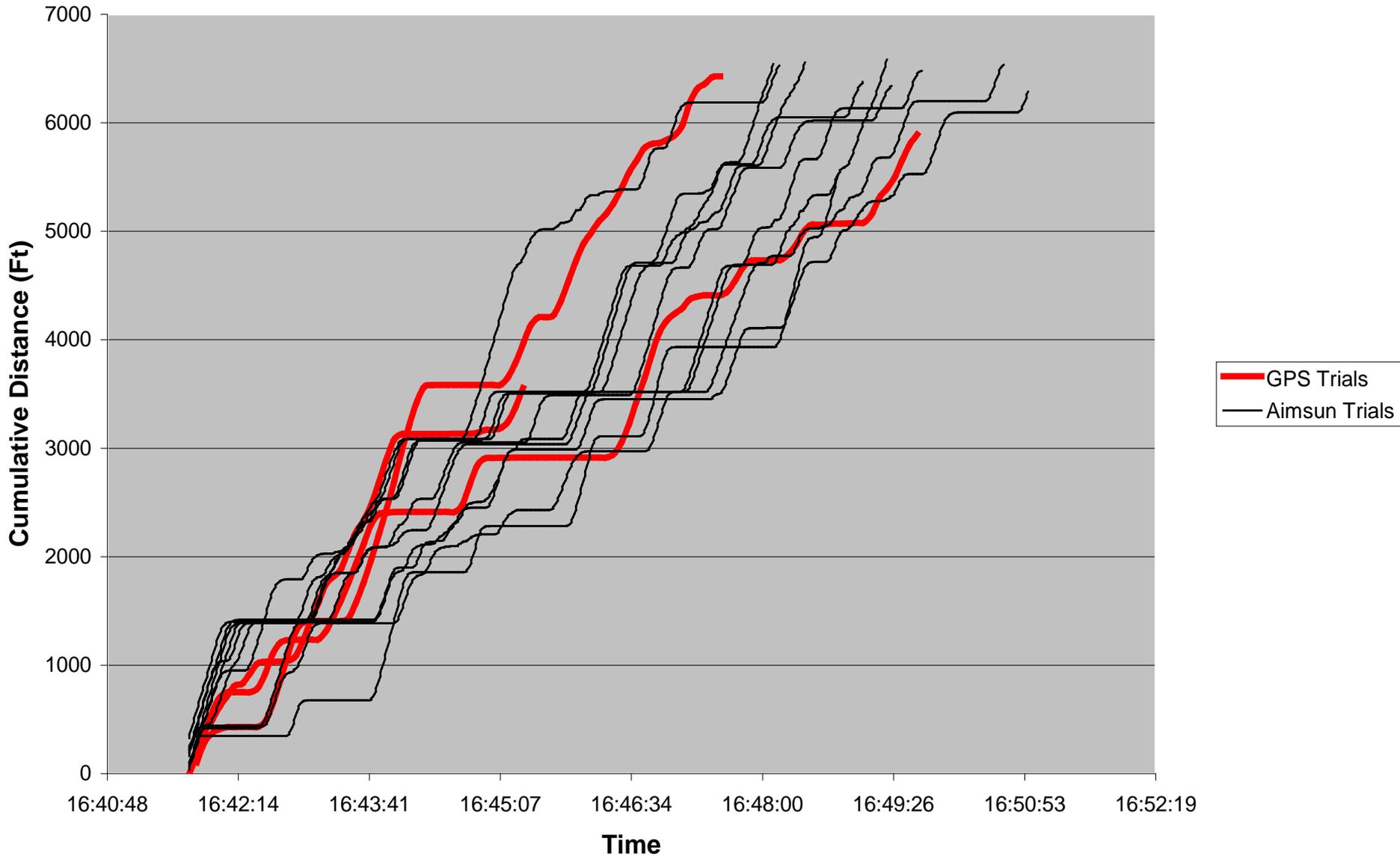
Super 51-CH Performance  
Bluetooth GPS Travel Recorder

BT-Q1000

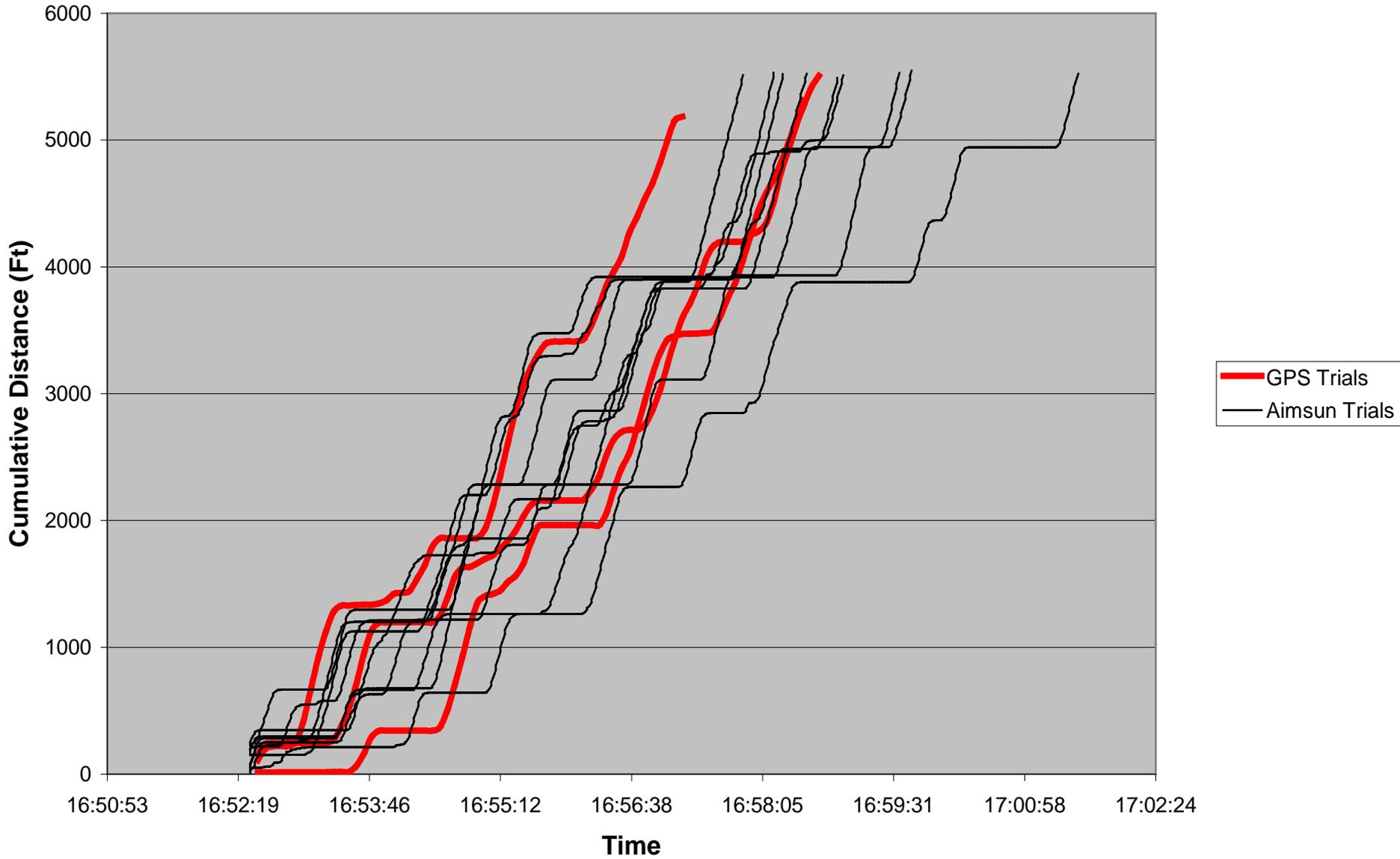


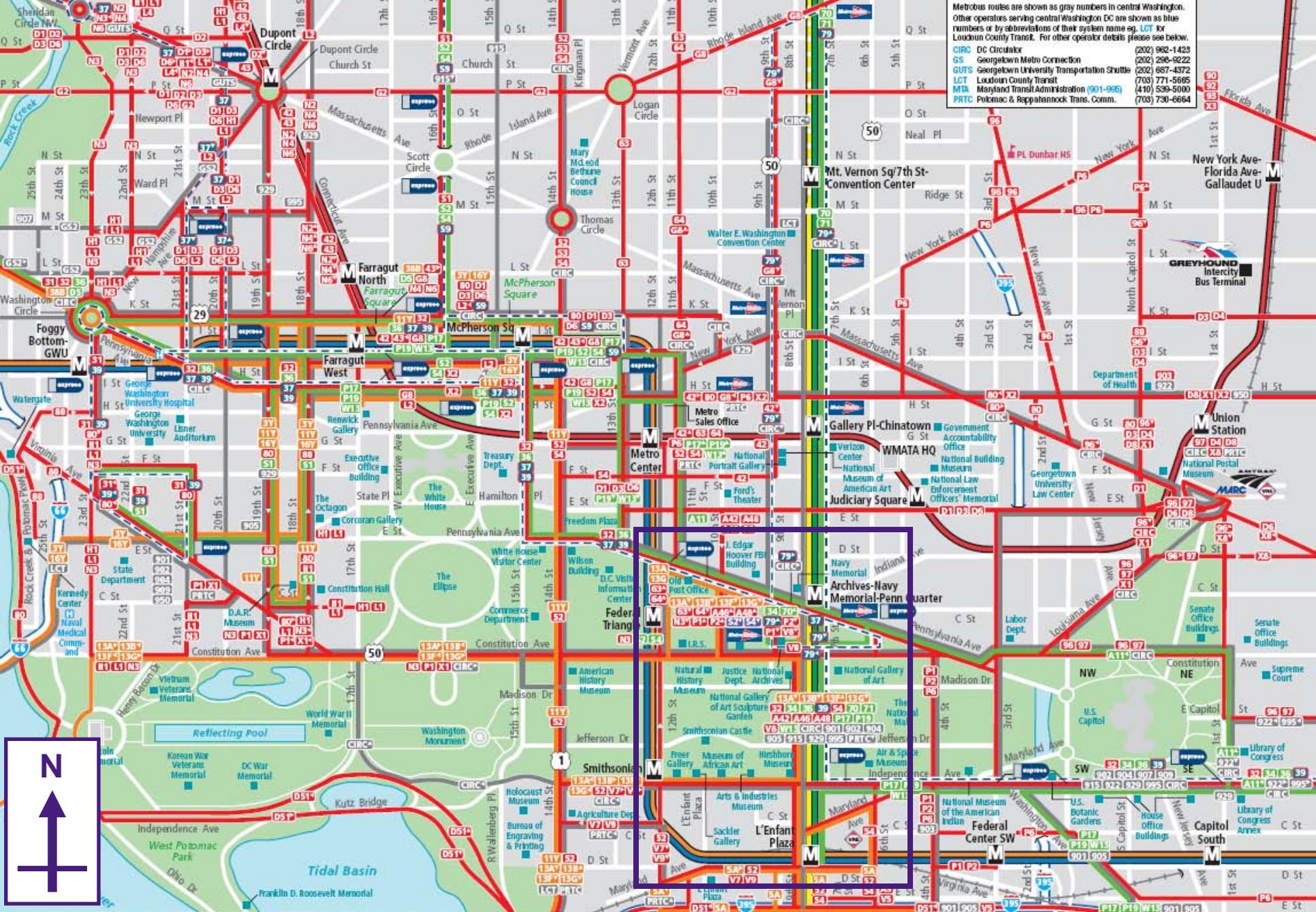
- Using a GPS travel recorder\* 3 driving trials were conducted during PM Peak hour (4pm-6pm) on two separate Routes
- Northbound Route
  - SW 7 St and SW D St to NW 12 St and NW G St via Pennsylvania Ave
- Southbound Route
  - NW 11 St and NW G St to SW 7 St and SW D St via Pennsylvania Ave

# Northbound Route



# Southbound Route





# Emergency Scenario

- A “dirty bomb” (explosive device surrounded by radioactive material) detonates at L’enfant plaza metro station at 16:50
- All people within a half mile radius of the station must evacuate ASAP
- Citizens are directed to shelters: International Trade Center, Ronald Reagan Convention Center, and I-395 Northbound
- Evacuees do not travel through the fallout

International  
Convention  
Center

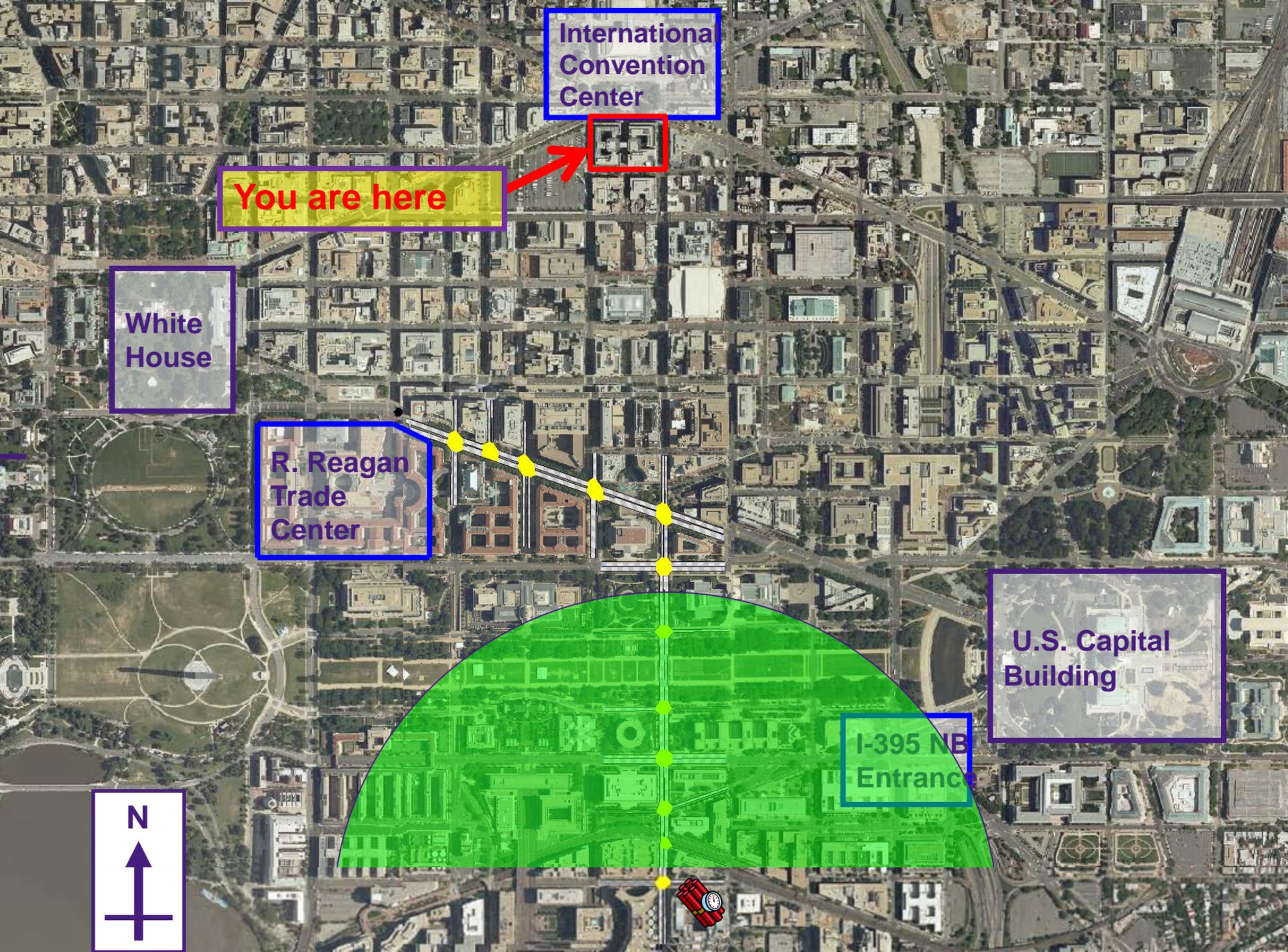
You are here

White  
House

R. Reagan  
Trade  
Center

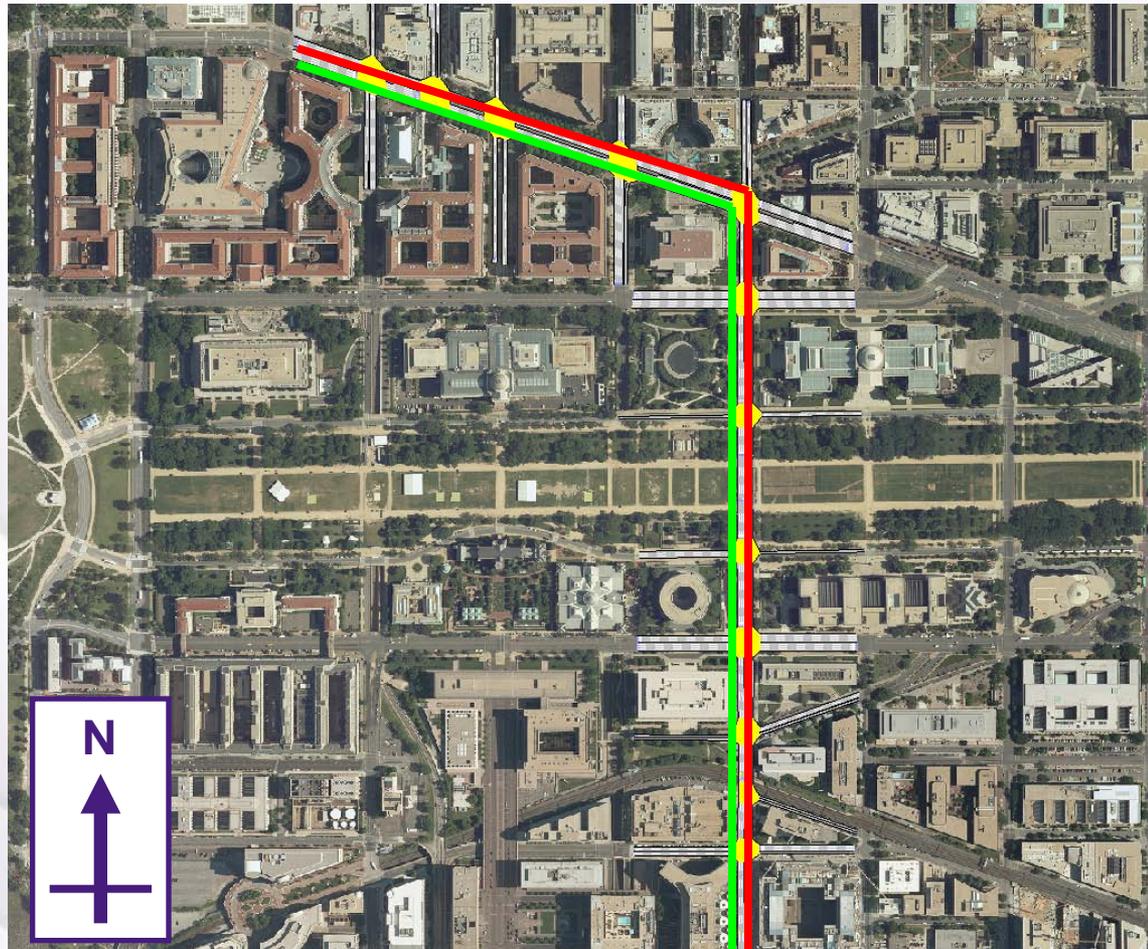
U.S. Capital  
Building

I-395 NB  
Entrance



# Evacuation Bus Routes

- Two routes:
  - 901 and 905
- Service to:
  - L'enfant Plaza
  - R. Reagan Convention Center



# Test Scenarios

- No Priority
  - No bus receives transit signal priority
- Priority
  - All buses receive transit signal priority
- Select Priority
  - Only buses evacuating the disaster site receive transit signal priority

# Evacuation Results

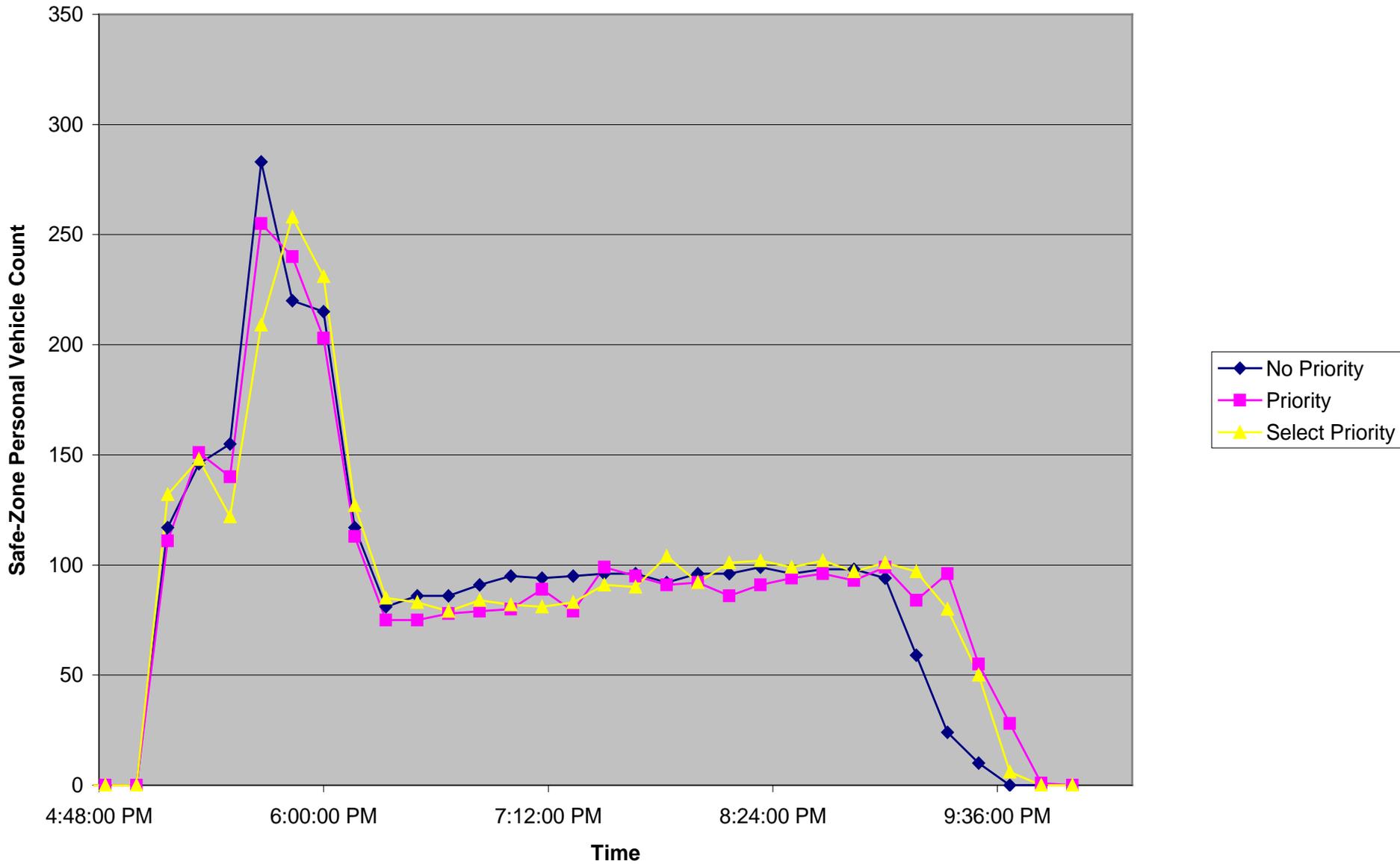
- Two measure of effectiveness are presented
  - Evacuation Clearance Time  
(the time at which the last vehicle has left the network)
  - Peak Evacuation Demand Travel Time  
(The highest demand period for transit vehicle)
- Bus operation outside the contamination area remain unchanged
- Inside contamination area:
  - select routes operate on varying headways  
(20 min, 15 min, 10 min, 5 min, 2 min)

# Evacuation Clearance Time

- The first 10 min interval when no vehicles has exited the network
- Varies between 4 hours and 40 minutes to 5 hours

<b>Clearance Time:</b>	<b>Evacuation Route Headway</b>				
<b>Control Plan</b>	<b>20 Min</b>	<b>15 Min</b>	<b>10 Min</b>	<b>5 Min</b>	<b>2 Min</b>
No Priority	4:40	4:40	4:40	4:40	4:50
Priority	5:00	4:50	4:50	5:00	5:00
Select Priority	4:50	5:00	4:50	4:50	4:40

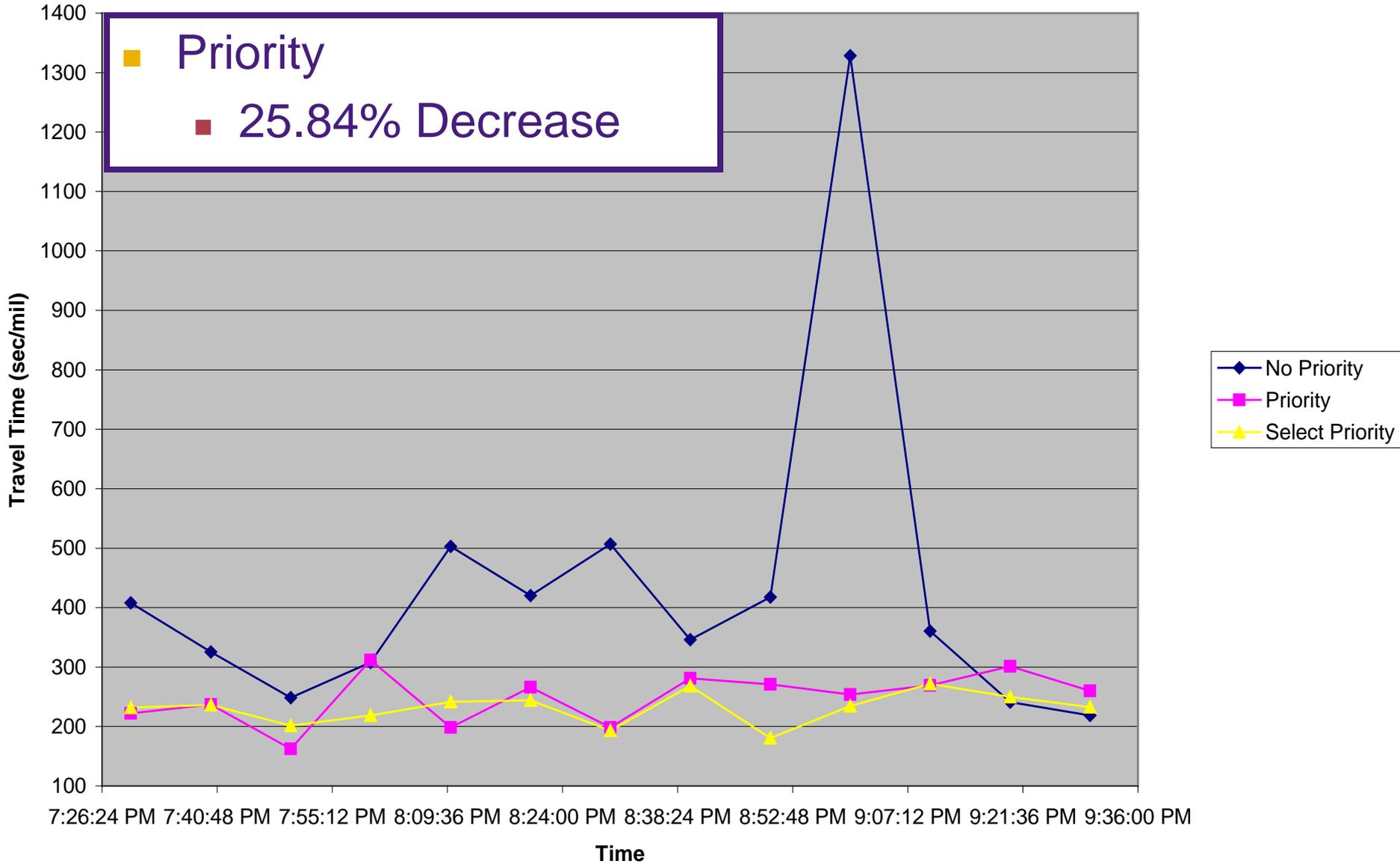
# Person Vehicle Clearance Time



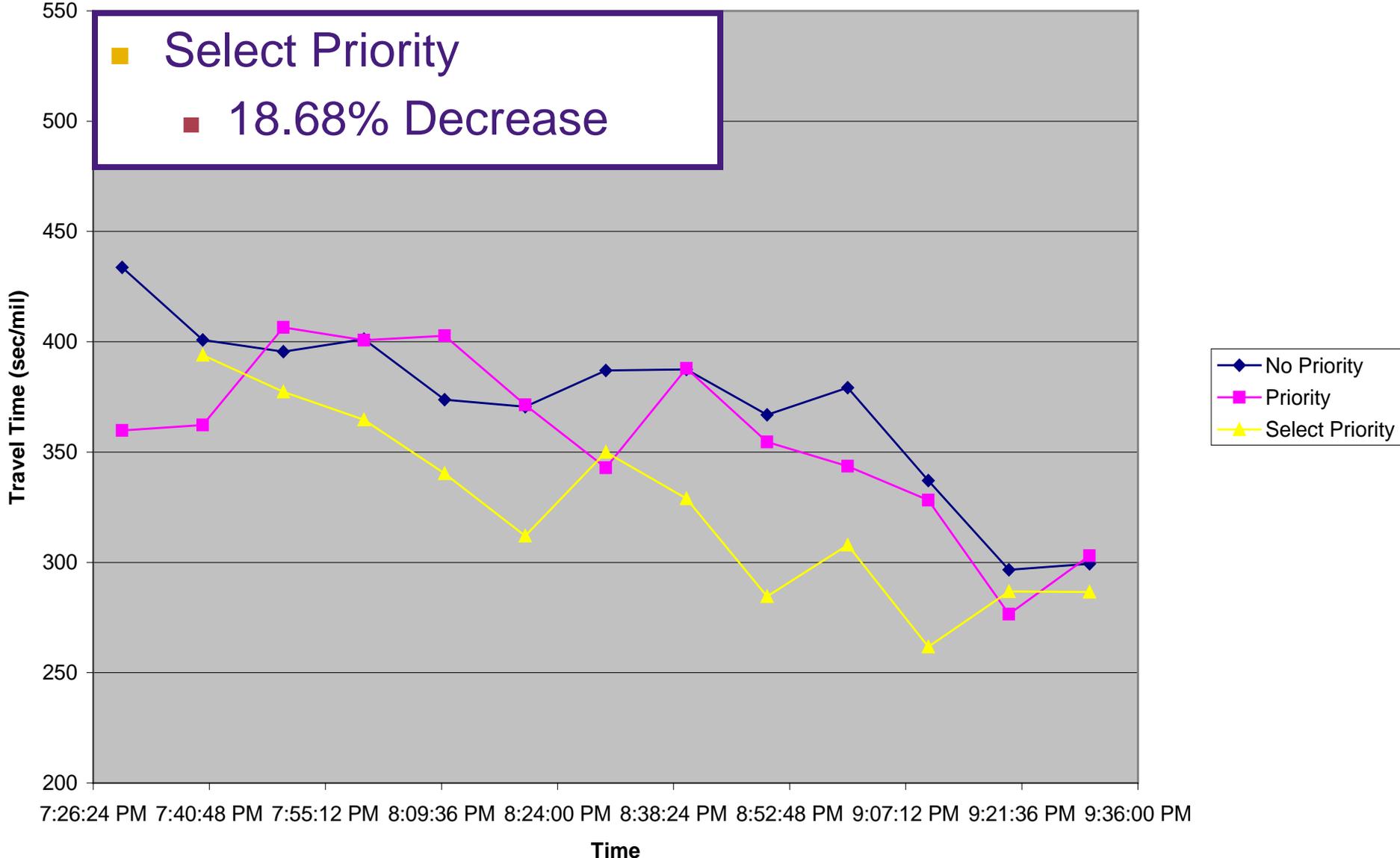
# Peak Demand Travel Time

- Result are consistent across headways
- 5 min headway diagrams used for presentation

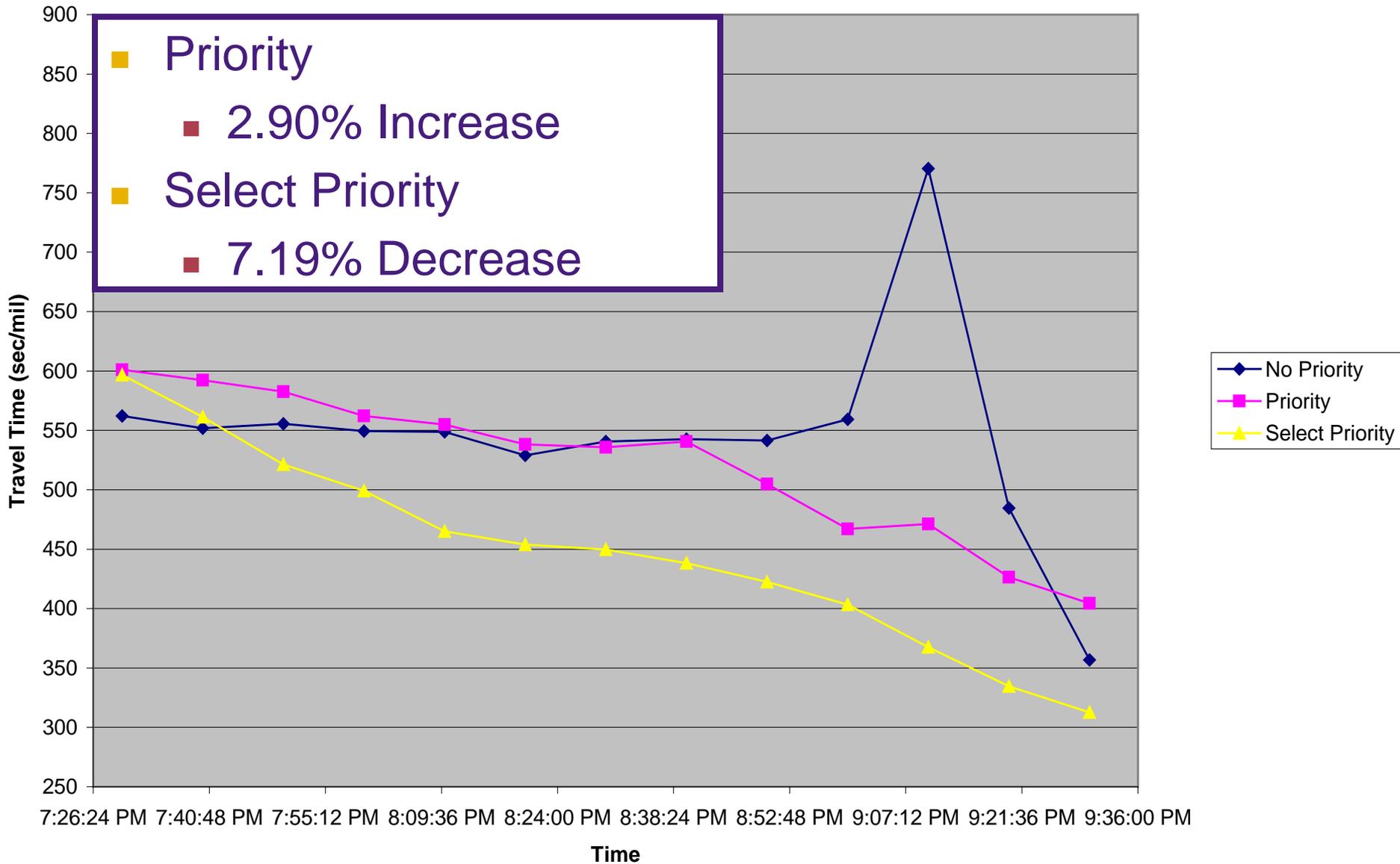
# Evacuation Travel Time for All Bus Route Stakeholder With 5 Min Headway



# Evacuation Travel Time for Select Bus Route Stakeholder With 5 Min Headway



# Evacuation Travel Time for Personal Vehicle Stakeholder With 5 Min Headway



# Conclusion

- TSP restricted to evacuation routes may reduce average personal vehicle travel time
- Transit vehicles can receive up to a 25% reduction in travel time with priority
- Results suggest TSP does not significantly hinder evacuation clearance times and should be considered for urban evacuation

# Acknowledgements

- We would like to thank
  - Federal Transit Administration
  - Washington Metropolitan Area Transit Authority
  - Florida Atlantic University
  - Dr. Evangelos I. Kaisar (FAU)
  - Dr. Aleksander Stevanovic (FAU)
  - Louisiana State University
  - Dr. Brian Wolshon (LSU)
  - Dr. Vinayak Dixit (LSU)

# Thank you

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Questions?

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