Jacobs Challenging today. Reinventing tomorrow.

Advancing Transit Signal Priority Performance Measure using ATSPM

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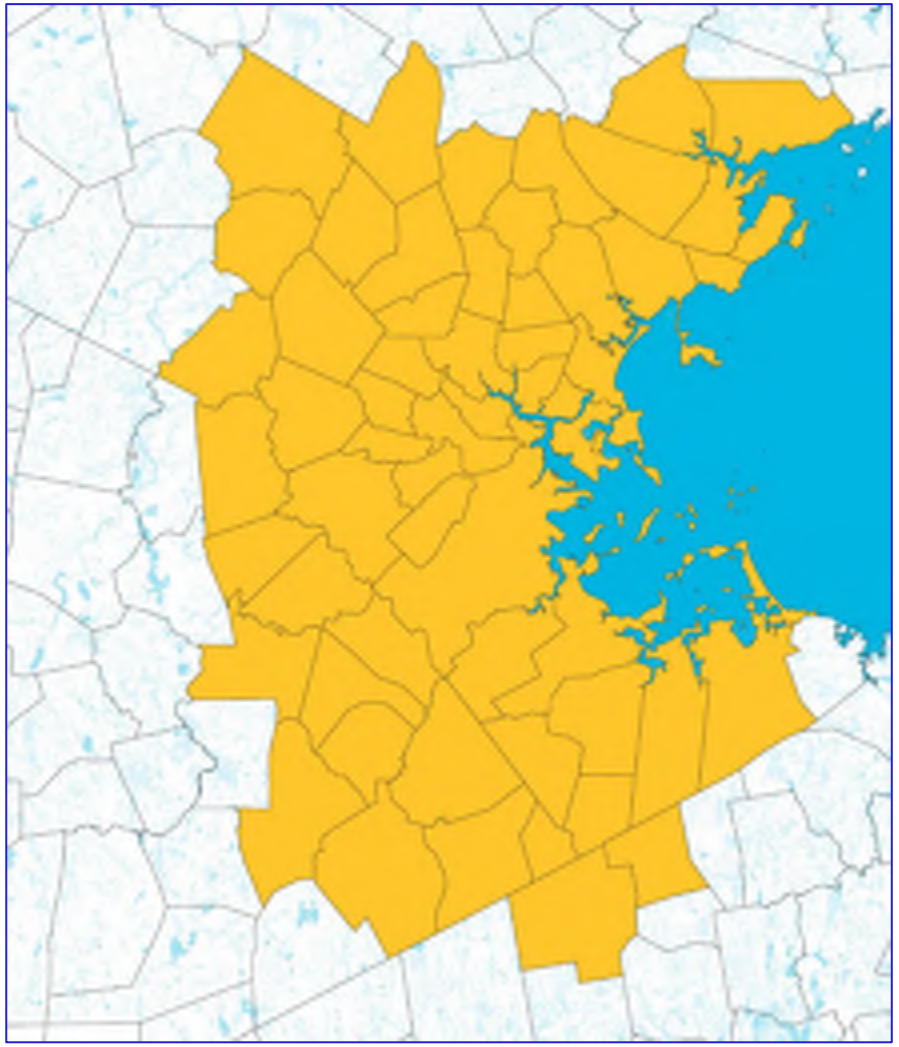
Agenda

- Project Background
- Transit-Specific Signal Performance Measurements (T-SPM)
- Next Steps
- Q & A

Background

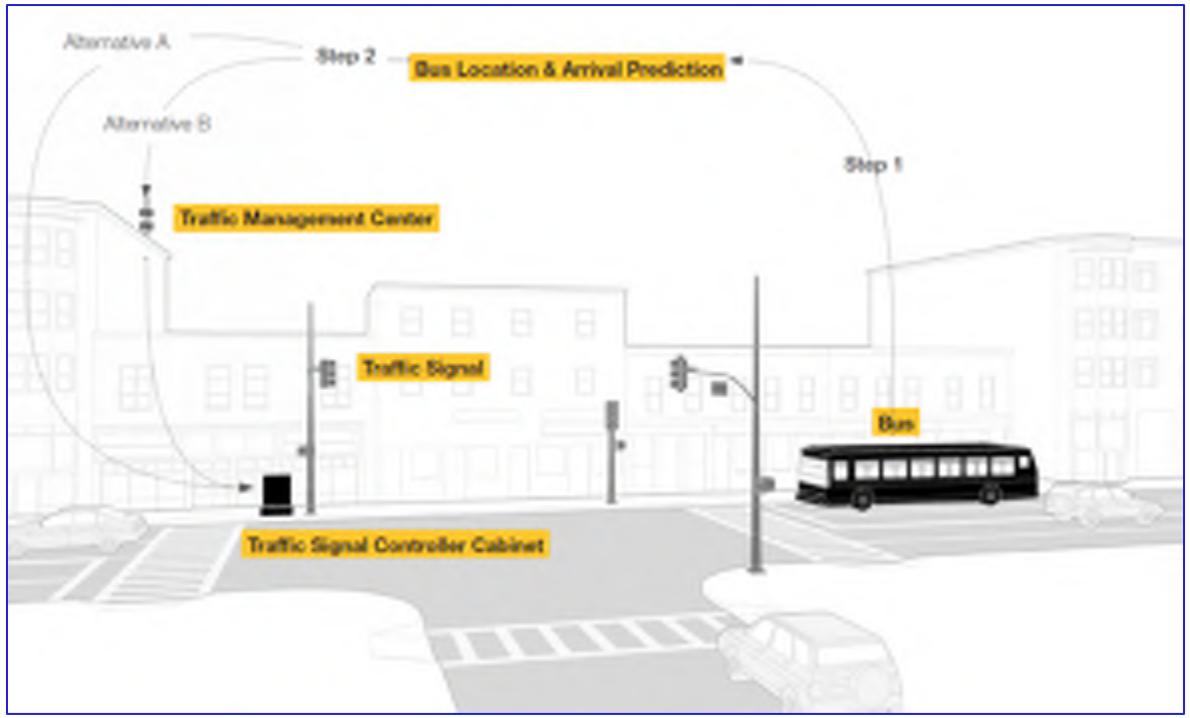
- **Transit Signal Priority Specialized Support Service**
  - ***Transit Signal Priority (TSP):*** Operational strategy to expedite the movement of transit vehicles at signalized intersections.
    - Passive TSP: improve traffic for all vehicles on the roads with significant transit use .
    - **Active TSP:** modify traffic signal timing or phasing to reduce dwell time at traffic signals for transit vehicles.
  - ***Client:*** Massachusetts Bay Transportation Authority (MBTA)
    - The oldest public transit system in the U.S. and the largest transit system in Massachusetts.
    - Type: Subway, Bus, Commuter Rail, Ferry, and Paratransit.
    - Area: Eastern Massachusetts and parts of Rhode Island.



Challenges

- Partnership Between Agencies
  - MBTA: transit service, On-Board TSP systems (GPS, AVL).
  - Municipalities: Signals and Roadways.
    - 50+ municipalities with different systems.
- No measurement capability
  - 85 TSP signals in the operation of unknown quality and effectiveness.
    - Labor intensive before and after study.
    - Insufficient AVL data granularity.
- ➔ Scalable and Measurable TSP Solution

2002 Silver Line → 2016 Green Line → 2017 Local Bus → 2022 NextGen

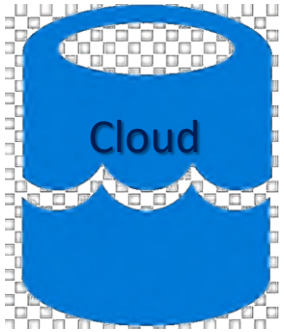


Transit-specific Signal Performance Measures (T-SPMs)

Based on FHWA ATSPM

High-resolution Controller

Communications



Cloud

Dashboard

Bus Detection

High Resolution

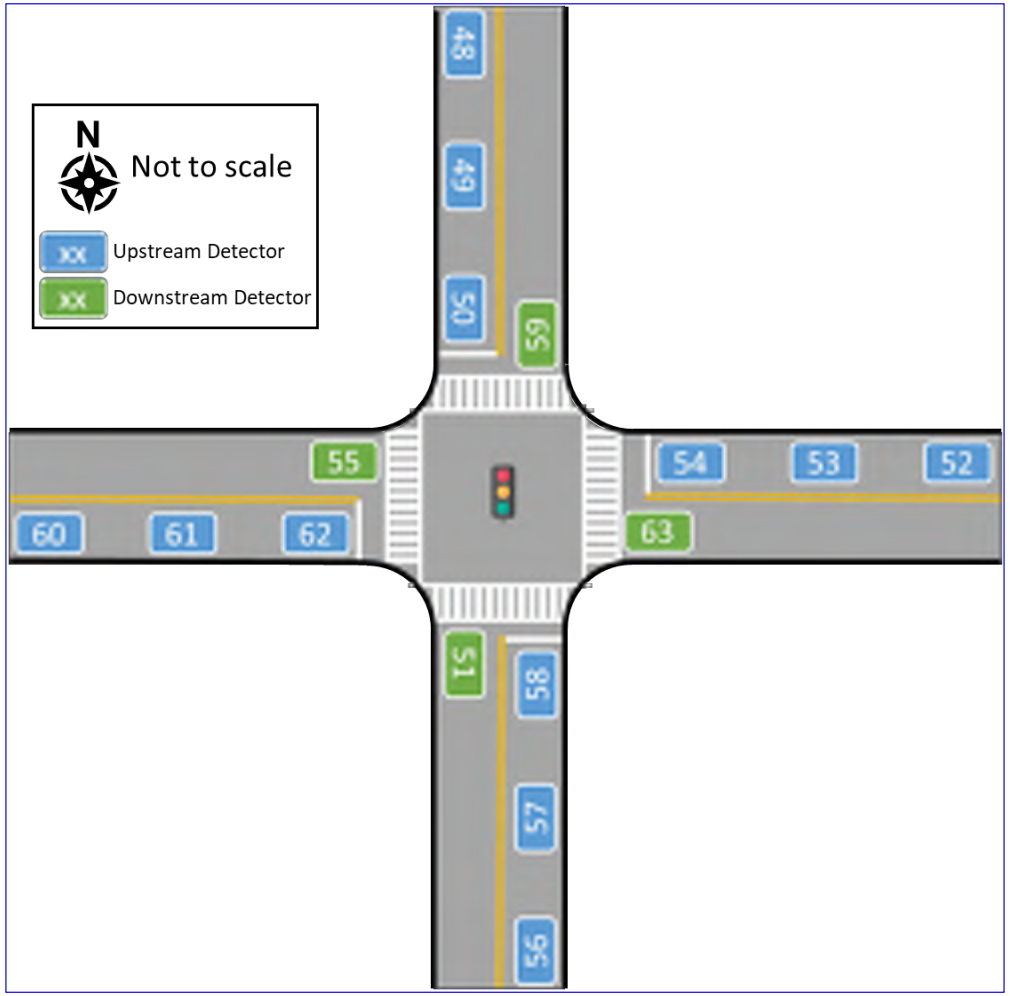
Automated

Cost Effective

Scalable

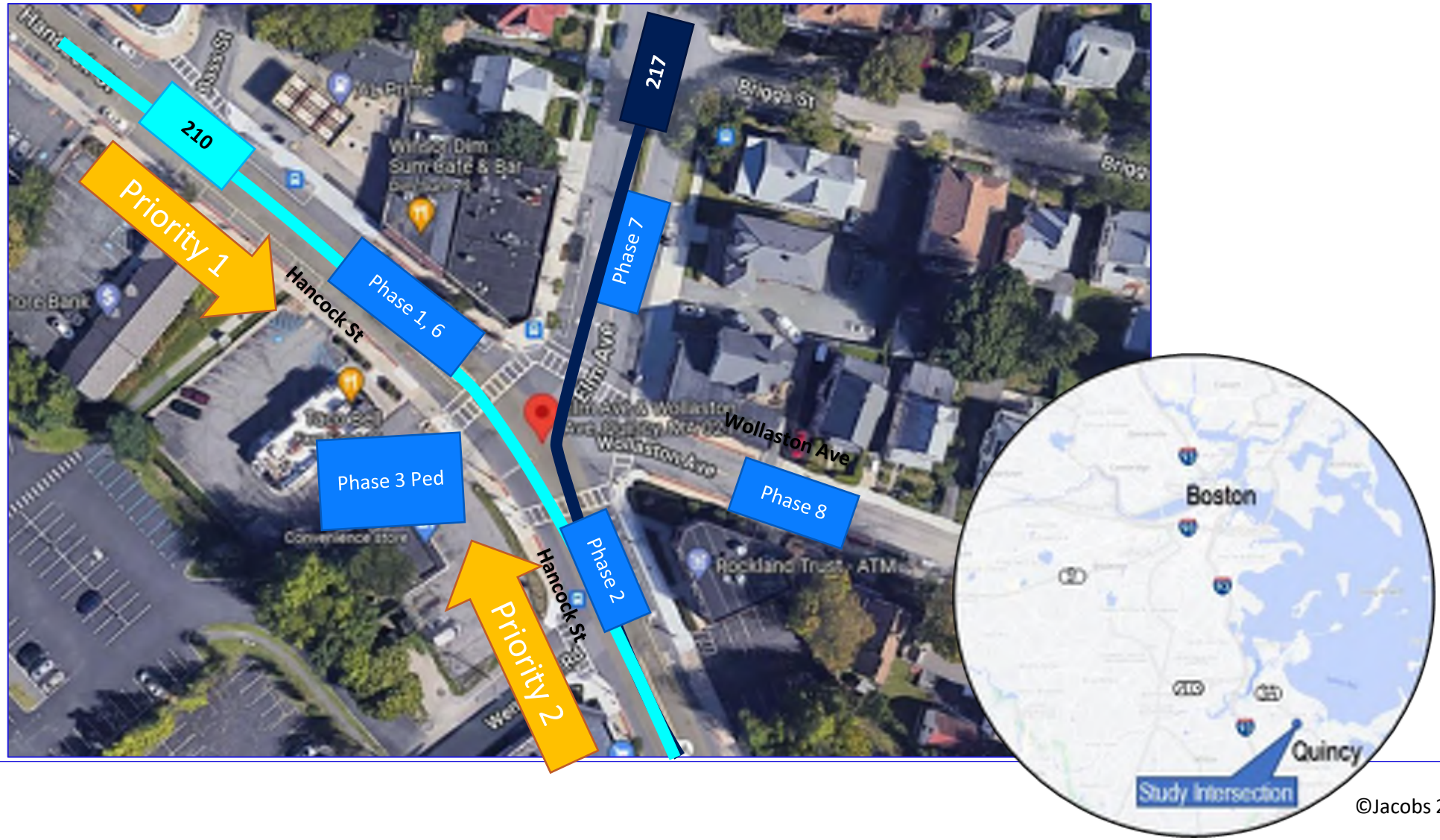
Transit-Specific Signal Performance Measurements (T-SPM)

NextGen TSP Specifications

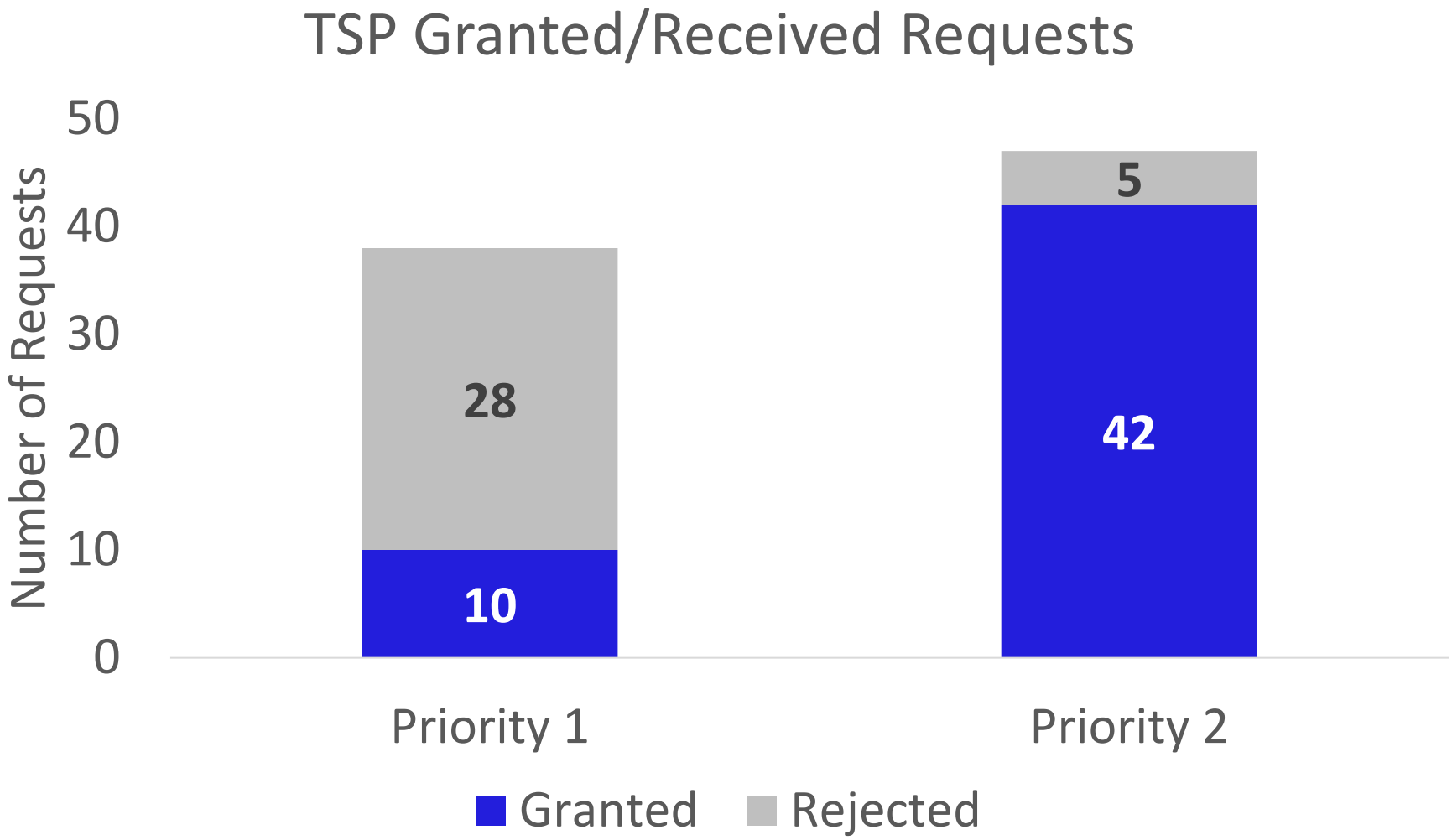


T-SPMs Sample Output

Two days of data were collected 11/16/2021 + 11/17/2021



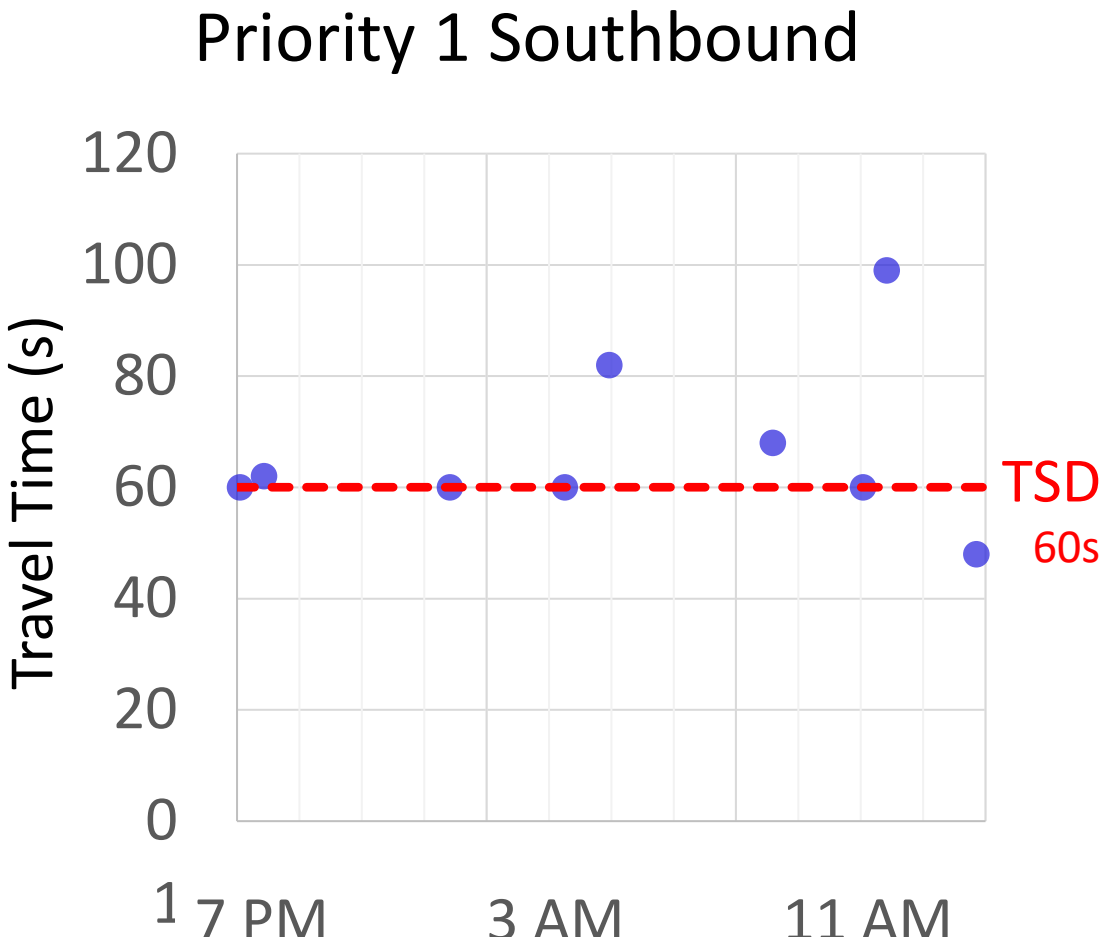
System Diagnosis

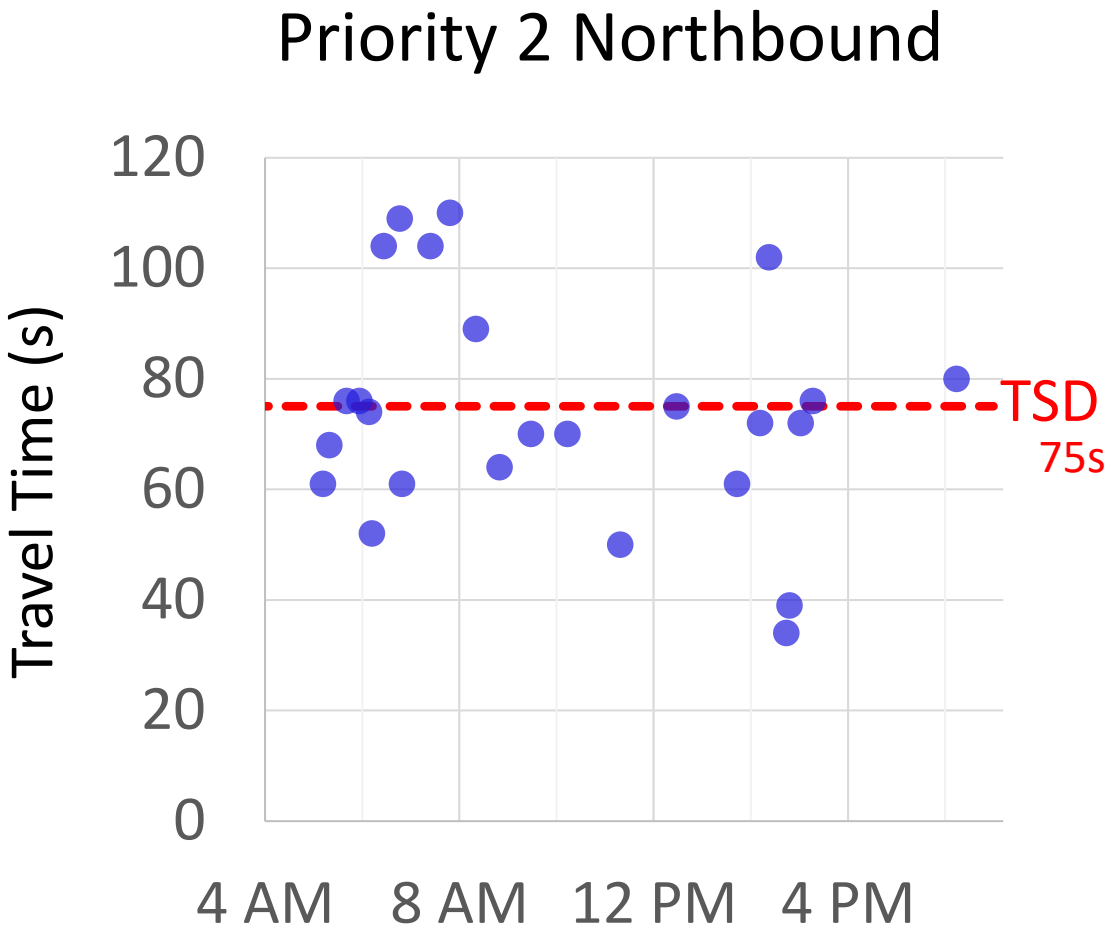


Travel Time – Predicted vs Observed

STREET	DIRECTION	SIGNAL PHASE	CONTROLLER PRIORITY	TSD (S)	AVG. FIELD TRAVEL TIME (S)	STD . FIELD TRAVEL TIME	# of Records
HANCOCK ST	SB	Φ 1 & Φ 6	Priority 1	60	67	15	9
HANCOCK ST	NB	Φ 2	Priority 2	75	74	20	25

Travel Time – Predicted VS Observed



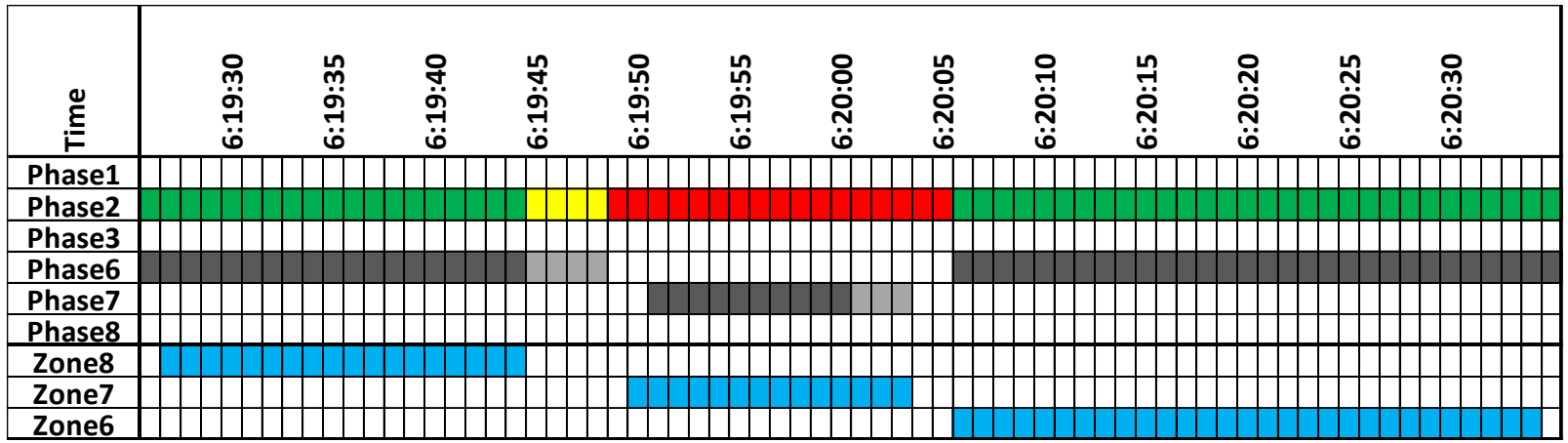


*TSD: Time of Service Desired

Arrival on Green – Example 1

The signal changes to green when the bus arrives at the stop bar detector zone

AoG-1



Legend

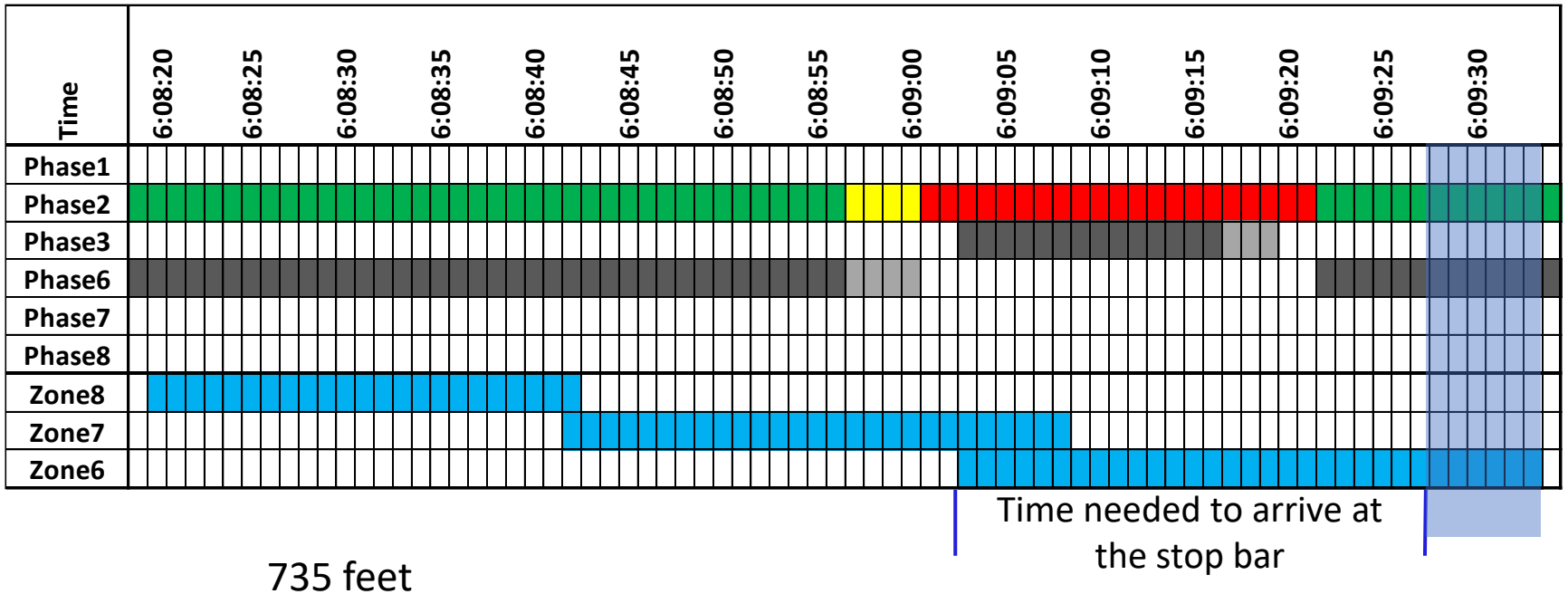
- Priority Phase Green
- Priority Phase Yellow
- Priority Phase Red
- Other Phase Green
- Other Phase Yellow
- Bus in the Detector Zone

*Each box equals 1 second

Arrival on Green – Example 2

The signal is red when the bus arrives at the stop bar detector zone and changes to green before the bus arrives at the stop bar

AoG-2



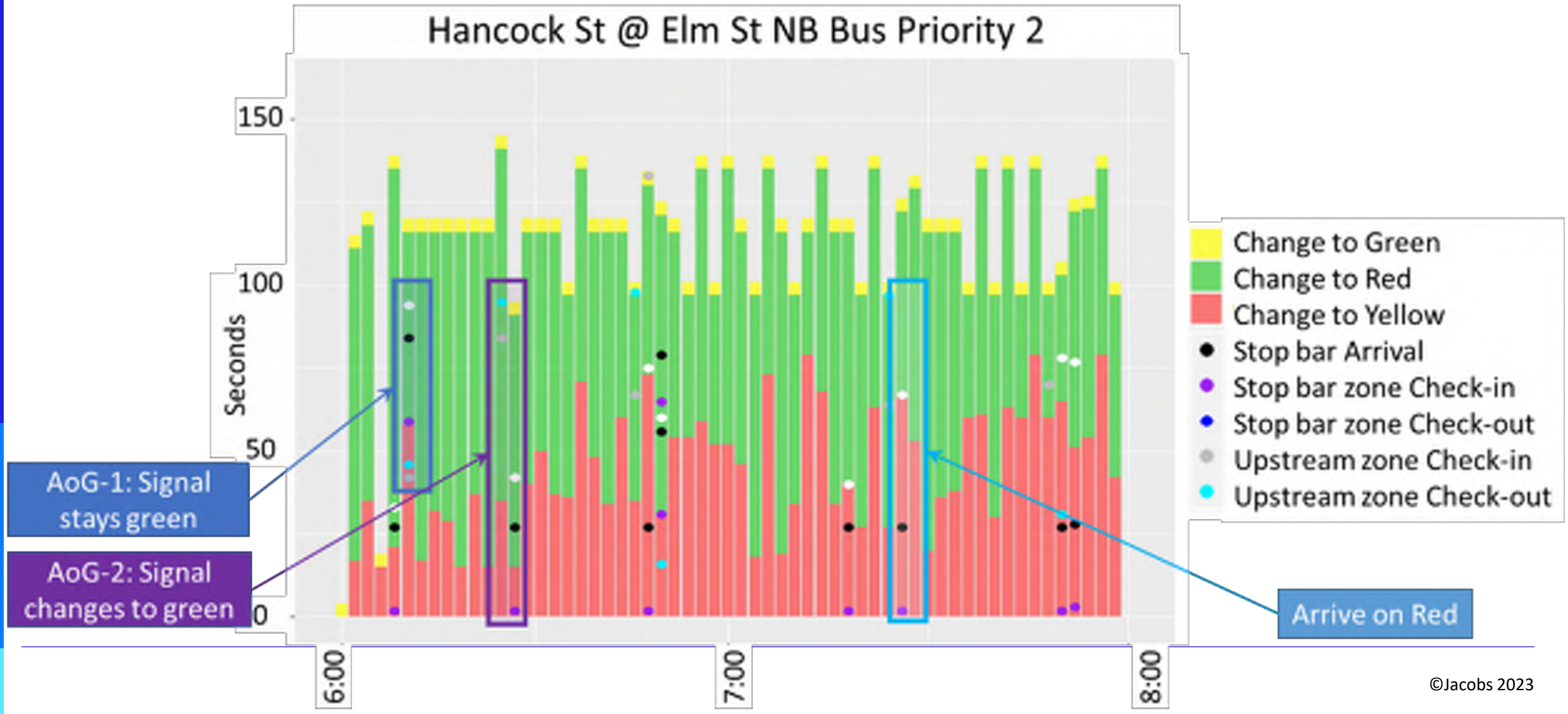
Legend

- Priority Phase Green
- Priority Phase Yellow
- Priority Phase Red
- Other Phase Green
- Other Phase Yellow
- Bus in the Detector Zone

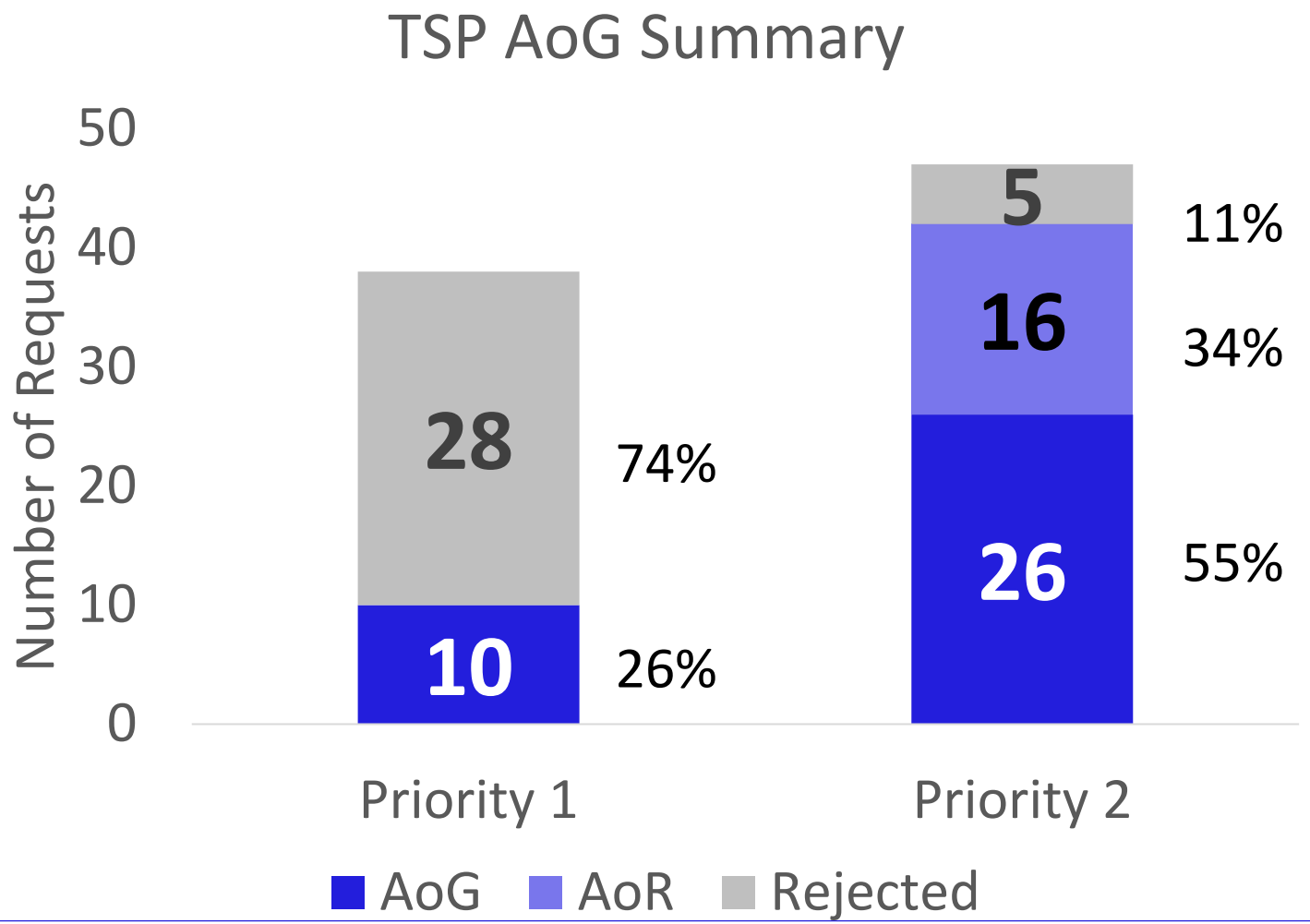
$$\frac{735 \text{ feet}}{25\text{s}} = 29 \text{ ft/s} = 20 \text{ MPH}$$

*Each box equals 1 second

PCD: Are buses arriving on green?

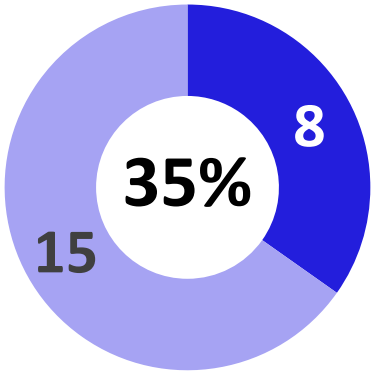


TSP System Outcome: AoG

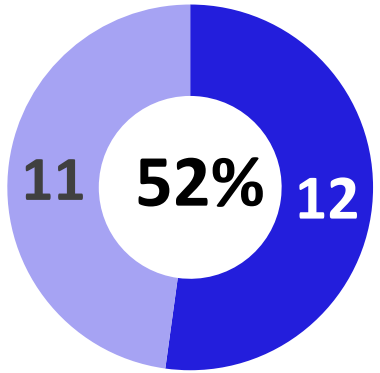


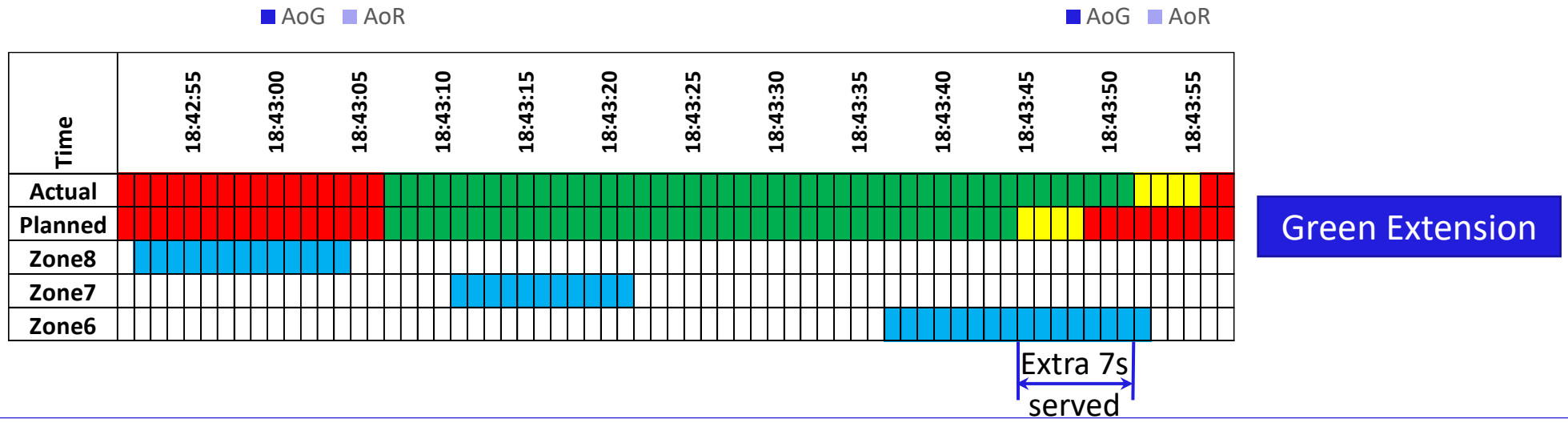
Hypothetical AoG vs Actual AoG

Priority 2 Hypothetical AoG



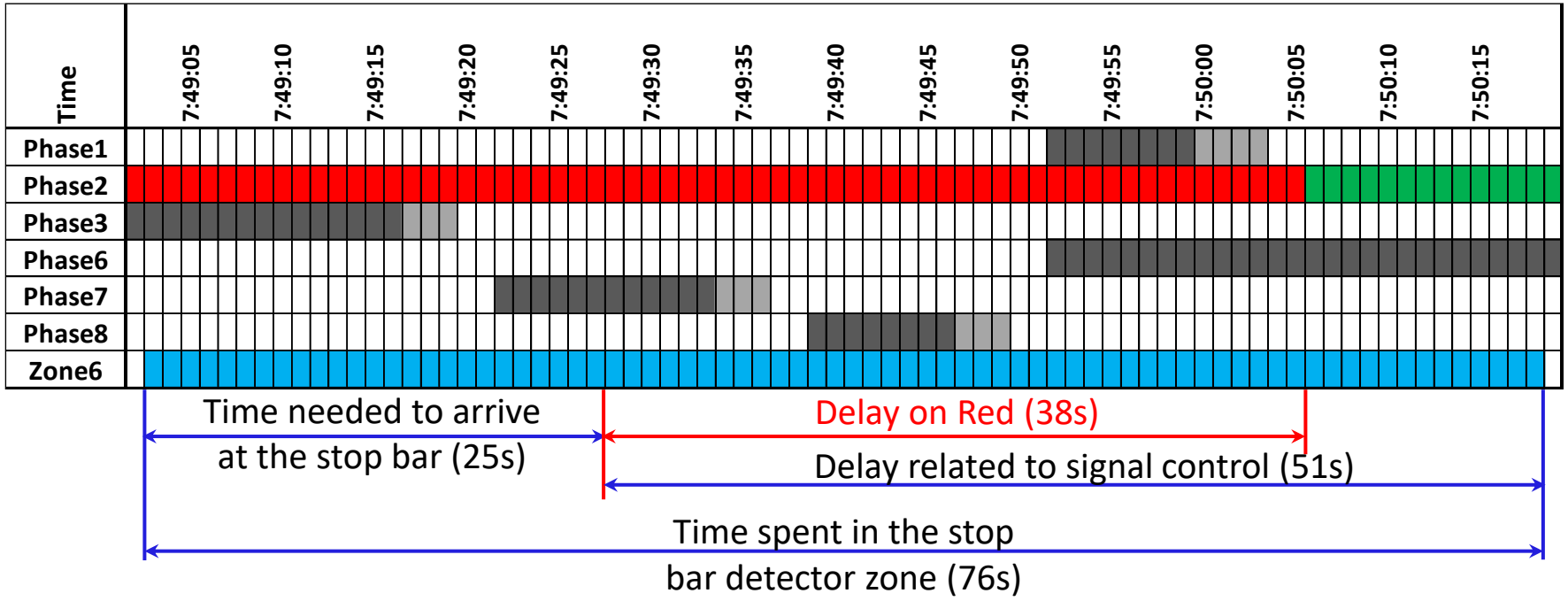
Priority 2 Actual AoG





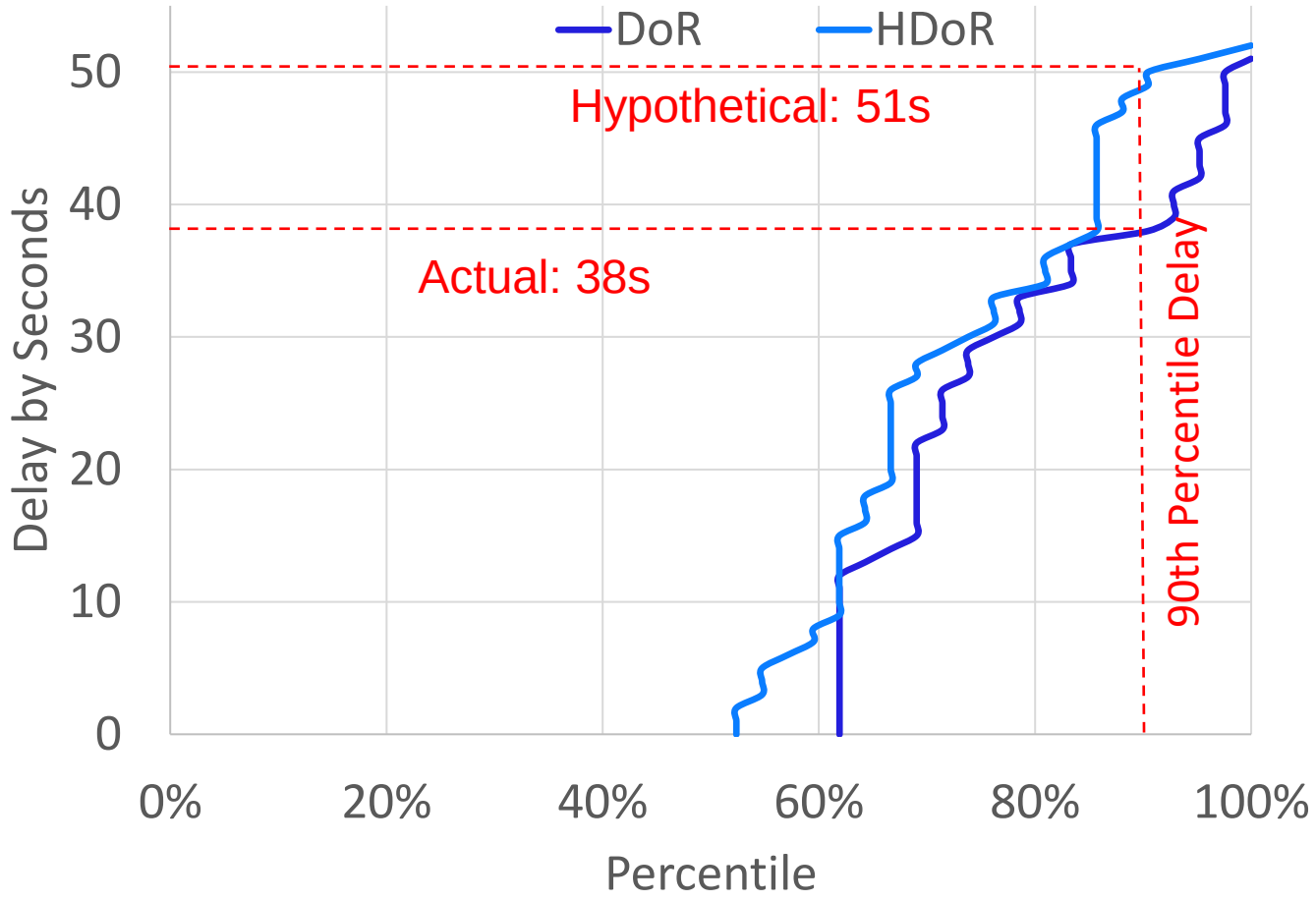
Green Extension

Delay on Red



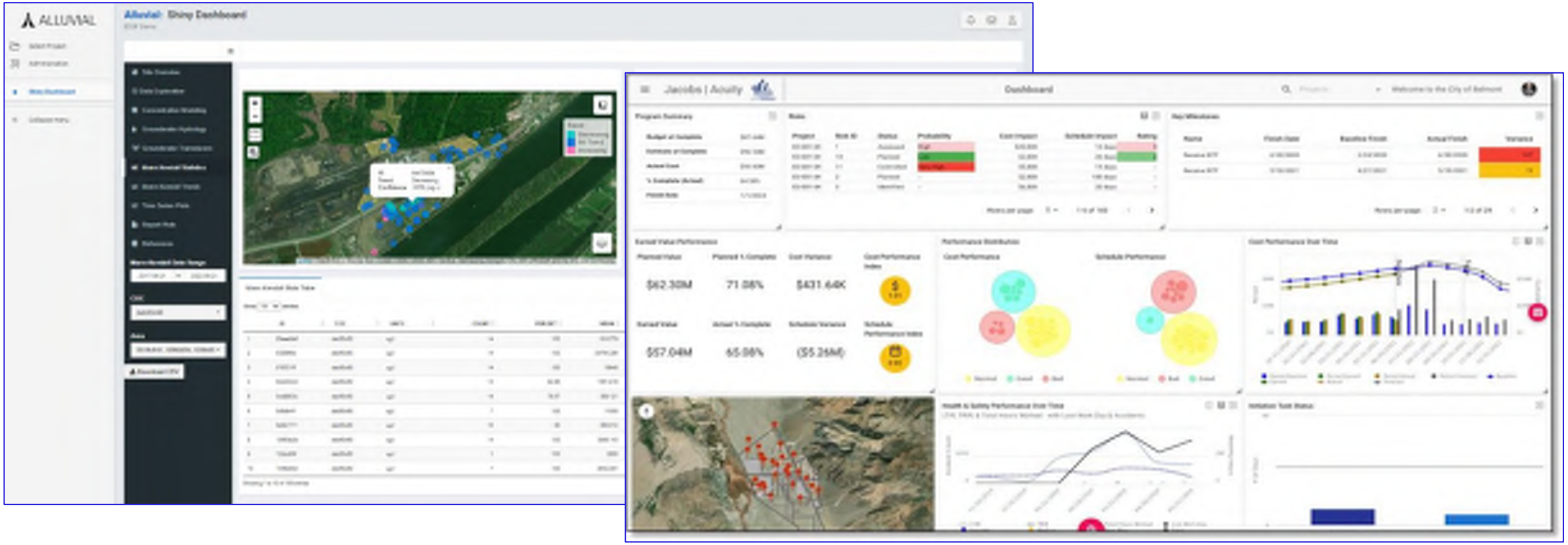
*Each box equals 1 second

Delay on Red Distribution



Next Steps

- T-SPM Dashboard
  - Add new intersections/Metrics, Pull data from signals, store and process data in the cloud



Q & A

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