The Role of Right Turn in Bus Operation

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iMOVE

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Previous Study: Regression Results

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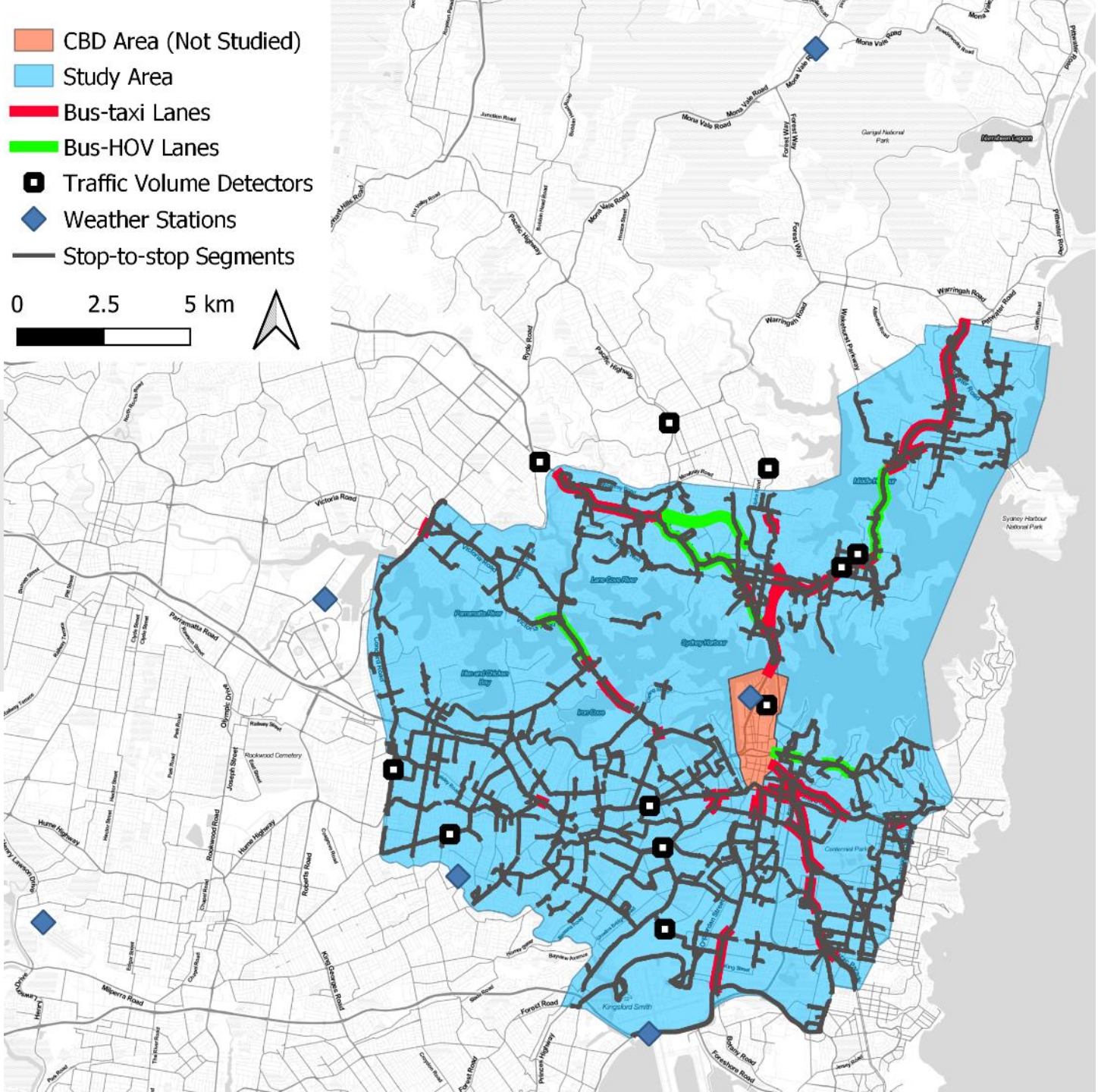
Study Area


CBD Area (Not Studied)
Study Area
Bus-taxi Lanes
Bus-HOV Lanes
Traffic Volume Detectors
Weather Stations
Stop-to-stop Segments
0
2.5
5 km

0 100 200 m
Traffic Lights
Bus Stops
Bus-taxi Lanes
Bus-HOV Lanes
Stop-to-stop Segment without Right Turn
Stop-to-stop Segment with Right Turn

Panel Regression Model

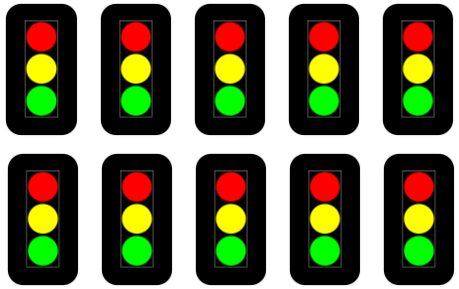
$$\Delta_{it} = \alpha_i + \beta_B B_i + \beta_H H_i + \beta_S S_i + \beta_D D_t + \beta_T T_{it} + \beta_V V_{it} + \beta_L L_i + \beta_{RT} RT_i + \beta_{RF} RF_i + \beta_W W_i + \beta_{PH} PH_i + \beta_{SH} SH_i + \beta_{SI} SI_i + \epsilon_{it}$$

Symbol	Name	Units
Δ_{it}	Marginal delay change at link i time t	Seconds
α_i	Link-specific effects	
β	Fitted coefficients	
B_i	Bus-taxi lane length on link i	km
H_i	Bus-HOV lane length on link i	km
S_i	Number of traffic signals on link i	
D_t	Traffic flow at time t	10^3 veh/(hour$\times$ lane)
T_{it}	Scheduled travel time on link i at time t	s
V_{it}	Scheduled Travel speed on link i at time t	km/h
L_i	Length on link i	km
RT_i	Right turn on link i	
RF_i	Rainfall on link i at time t	mm
W_i	Weekend at time t	
PH_i	Public Holiday at time t	
SH_i	School Holiday at time t	
SI_i	COVID stringency index at time t	
ϵ_{it}	Error term	

Stop-to-stop Marginal Delay Mean
Fixed-effects Panel Regression Results

Variable	Coefficient	Std. Err.	P-value
Bus-taxi lane Length	-6.1557	0.0516	0.0000
Bus-HOV lane Length	-7.1653	0.0690	0.0000
Number of Traffic signals	2.5920	0.0076	0.0000
Traffic Flow	5.0509	0.0337	0.0000
Cross-traffic Turn	26.232	0.0208	0.0000
Scheduled Travel Time	-0.4373	0.0002	0.0000
Link Length	30.384	0.0339	0.0000
Precipitation	-0.1582	0.0087	0.0000
Weekend	-0.6852	0.0185	0.0000
Public Holiday	-1.7229	0.0501	0.0000
School Holiday	-2.2104	0.0187	0.0000
COVID Stringency Index	-0.1354	0.0003	0.0000
Number of observations	15962428		
R^2	0.5263		

Stop-to-stop Marginal Delay Mean Effects

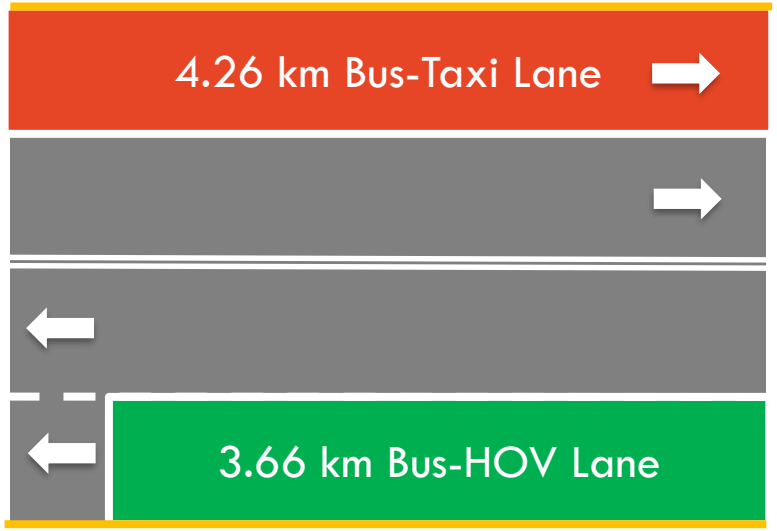


10.1 × Traffic Lights

519 veh
per lane per hour

Right Turn

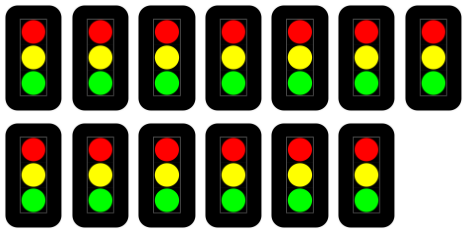
165 mm rainfall
per hour



Stop-to-stop Marginal Delay Std
Pooled Panel Regression Results

Variable	Coefficient	Std. Err.	P-value
Bus-taxi lane Length	-12.564	0.0407	0.0000
Bus-HOV lane Length	-5.5584	0.0560	0.0000
Number of Traffic signals	0.9709	0.0065	0.0000
Traffic Flow	14.195	0.0281	0.0000
Scheduled Travel Time	0.1772	0.0001	0.0000
Scheduled Speed	0.4437	0.0009	0.0000
Cross-traffic Turn	12.902	0.0171	0.0000
Precipitation	0.4112	0.0072	0.0000
Weekend	-1.8418	0.0154	0.0000
Public Holiday	-0.6829	0.0414	0.0000
School Holiday	0.4149	0.0155	0.0000
COVID Stringency Index	0.0854	0.0003	0.0000
Number of observations	15962428		
R^2	0.7345		

Stop-to-stop Marginal Delay Std Effects

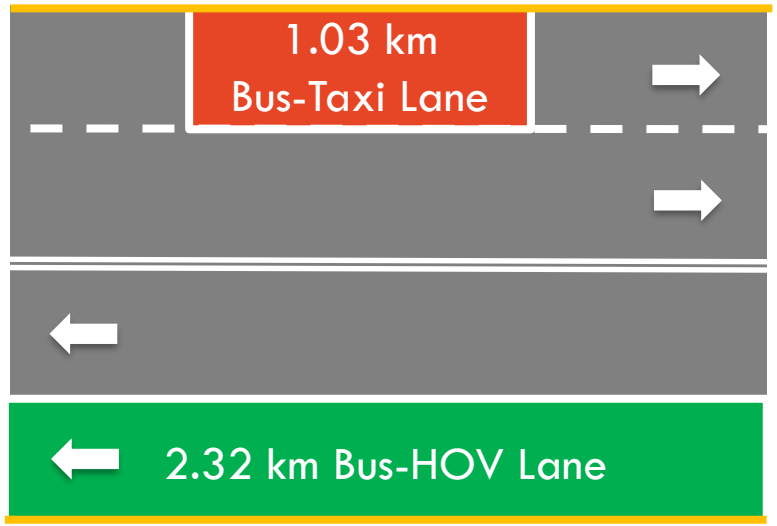


13.3 × Traffic Lights

908 veh
per lane per hour

31 mm rainfall
per hour

Right Turn



Statistical Significance

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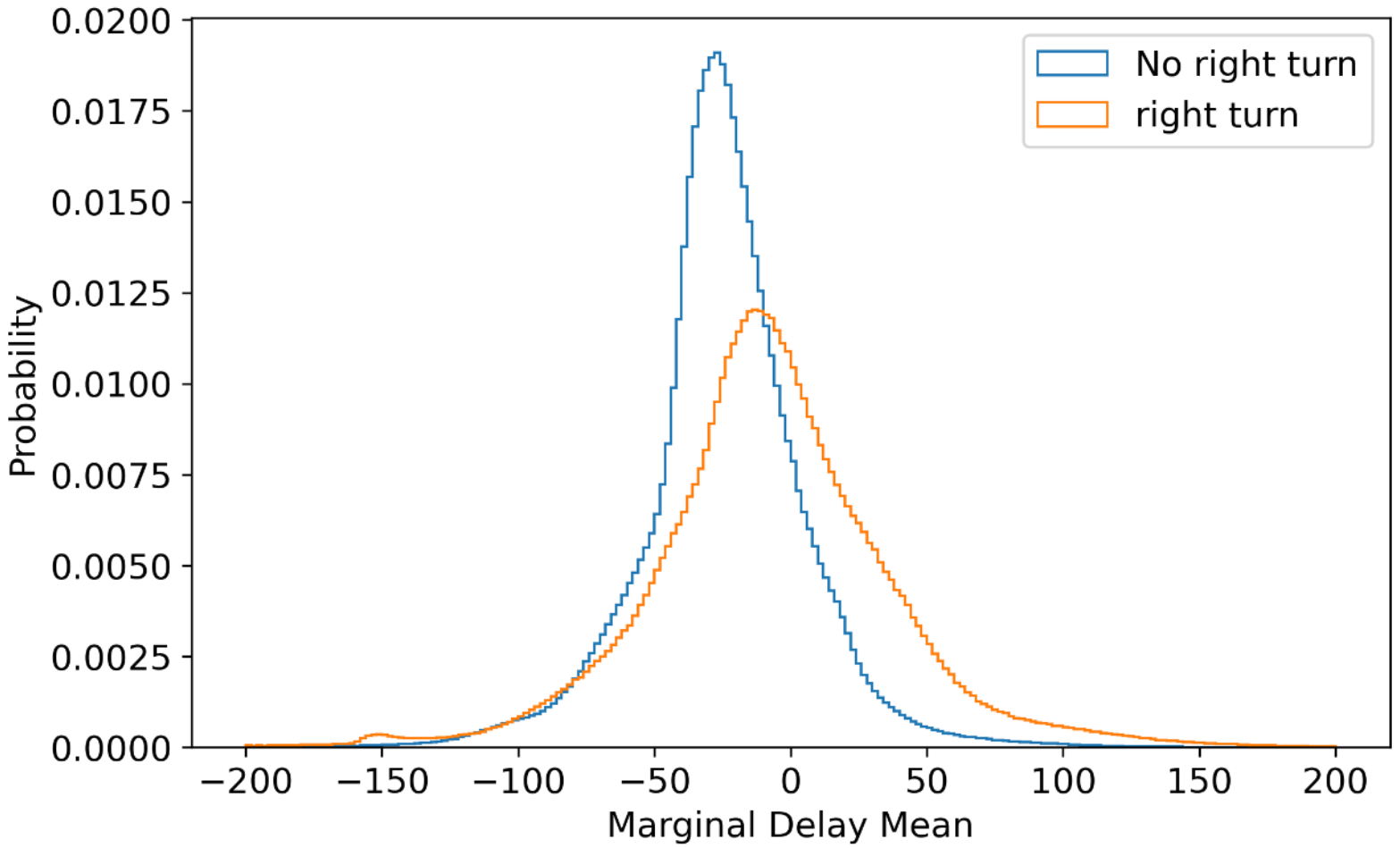
Stop-to-stop Marginal Delay Mean Comparison

Two-Sample T-test:

T-statistics value: 699.60

P-Value: 0.00

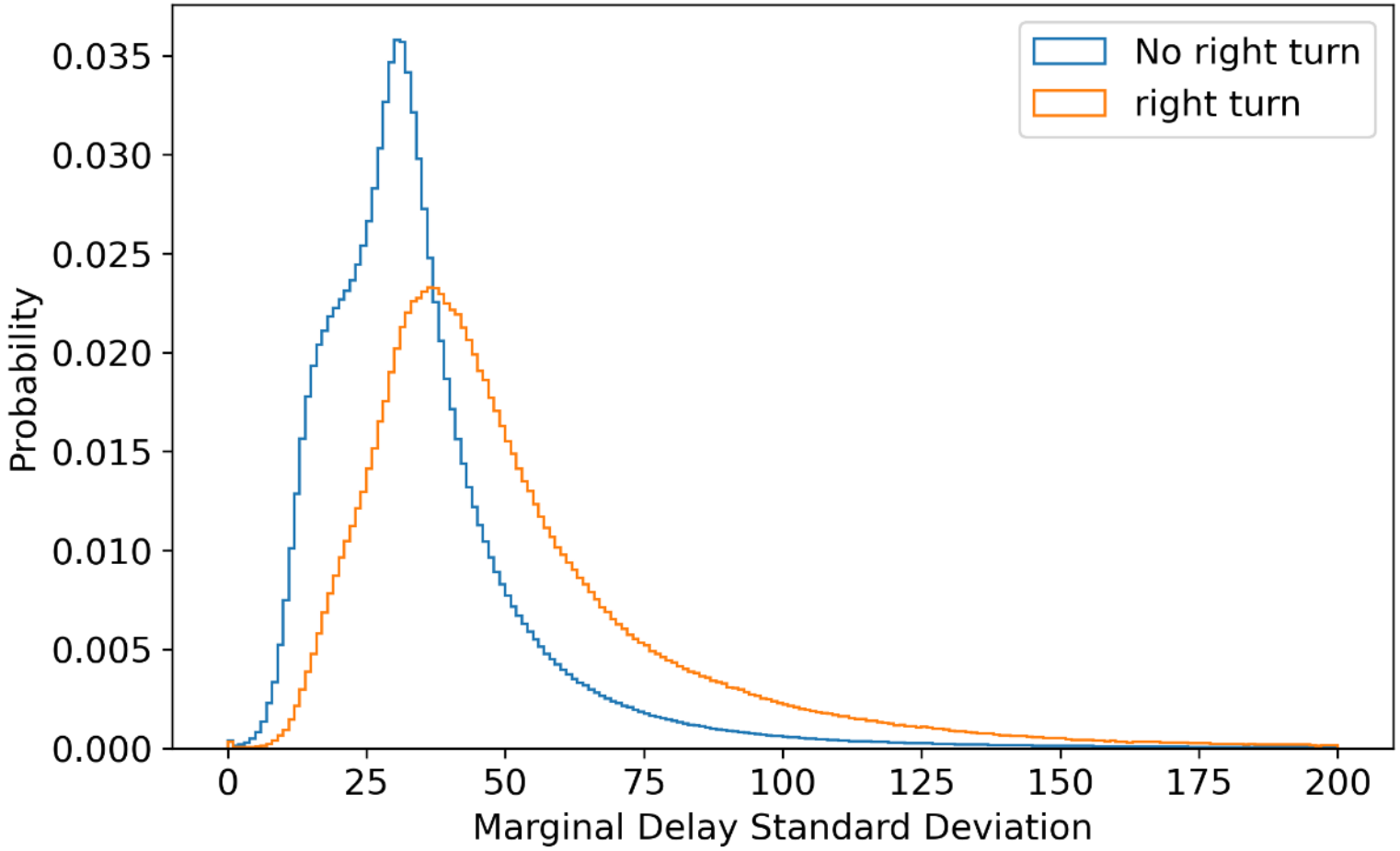


Stop-to-stop Marginal Delay Std Comparison

Two-Sample T-test:

T-statistics value: 1055.26

P-Value: 0.00

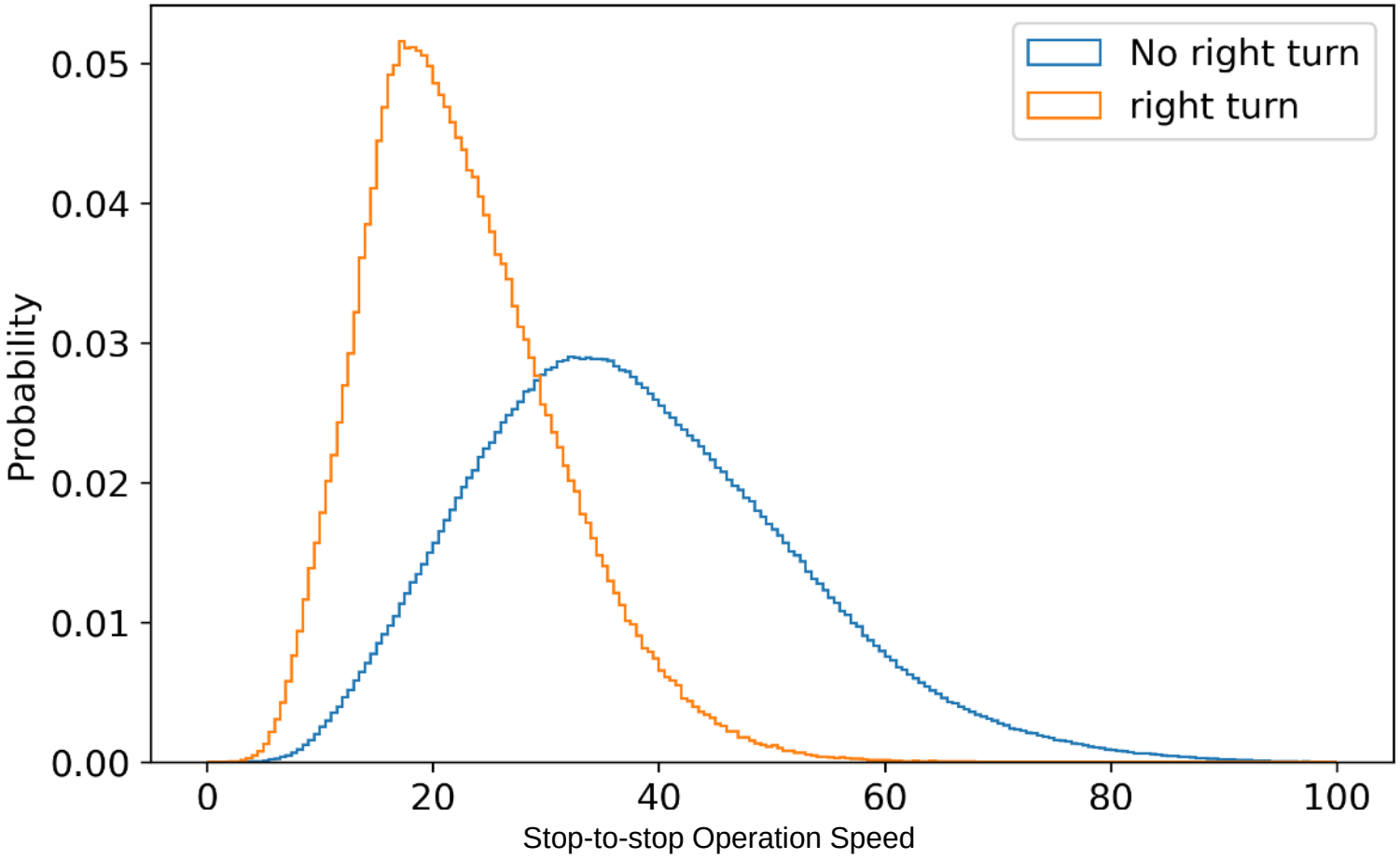


Stop-to-stop Speed Comparison

Two-Sample T-test:

T-statistics value: 823.10

P-Value: 0.00



Microscopic Analysis

© Busways

GTFS-Vehicle Positions

Ashfield

0
50
100 m
Average Speed (km/h)
0 - 5
5- 10
10 - 15
15 - 20
20 - 25
25- 30
30- 35
35 - 40
40 - 45
45 +
Parramatta Rd
Liverpool Rd
Ashfield

GTFS-Vehicle Positions Leichhardt

Norton St
Parramatta Rd
Crystal St
Leichhardt
0
50
100 m
Average Speed (km/h)
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 45
45 +

Validation

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Cross Validation between Trip Updates and Vehicle Positions

Intersection	Direction	Start Bus Stop ID	End Bus Stop ID	Trip Updates TT Estimates (s)	Vehicle Positions TT Estimates (s)
Parramatta Rd and Liverpool Rd	Through	213022	213128	72	72.83
	Right Turn	213127	204518	178	191.78
Parramatta Rd and Norton St	Through	204924	204925	165	171.01
	Right Turn	204924	204026	211	256.55

How to Improve?
Bus Queue Jump Lanes

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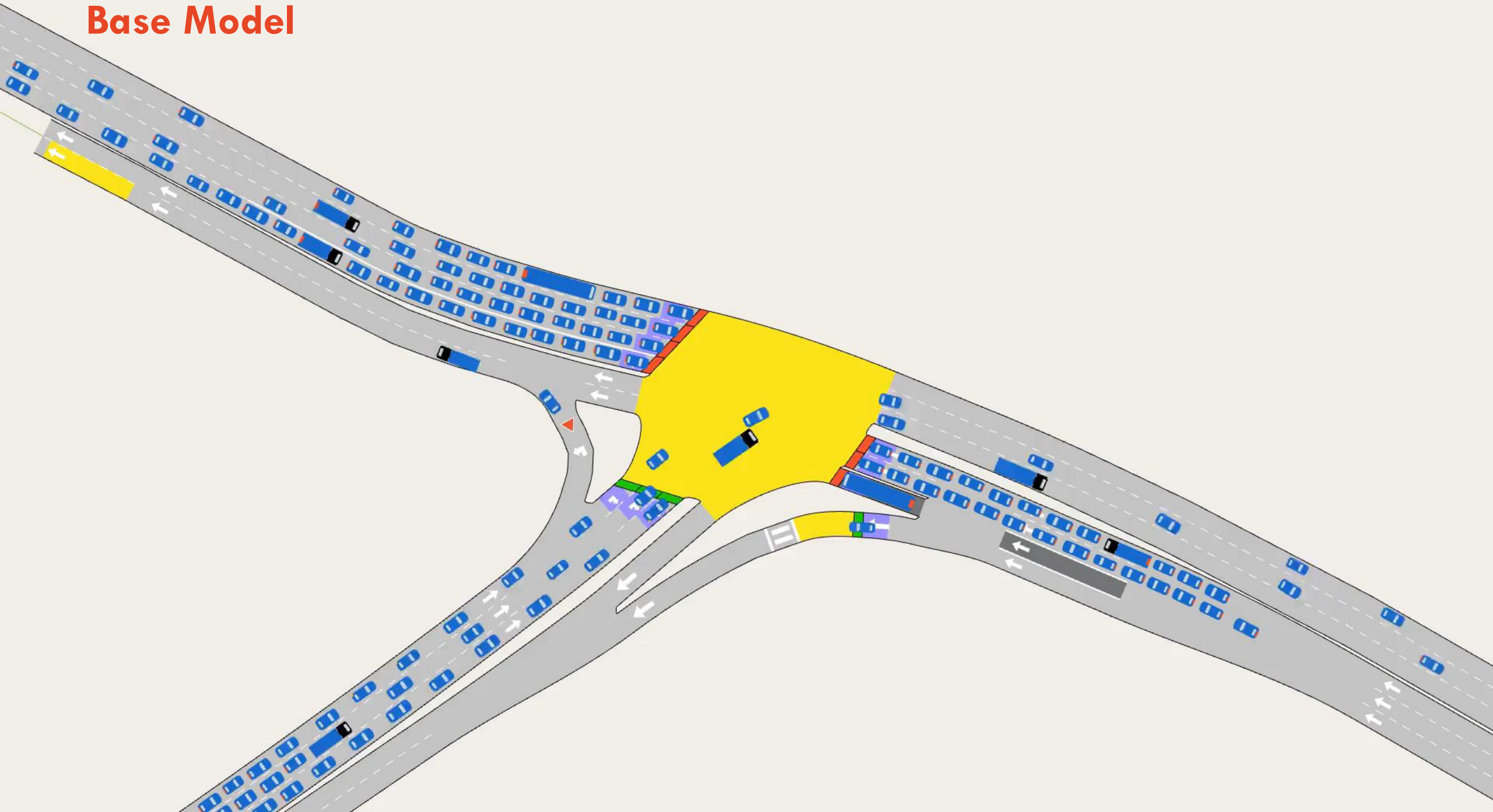
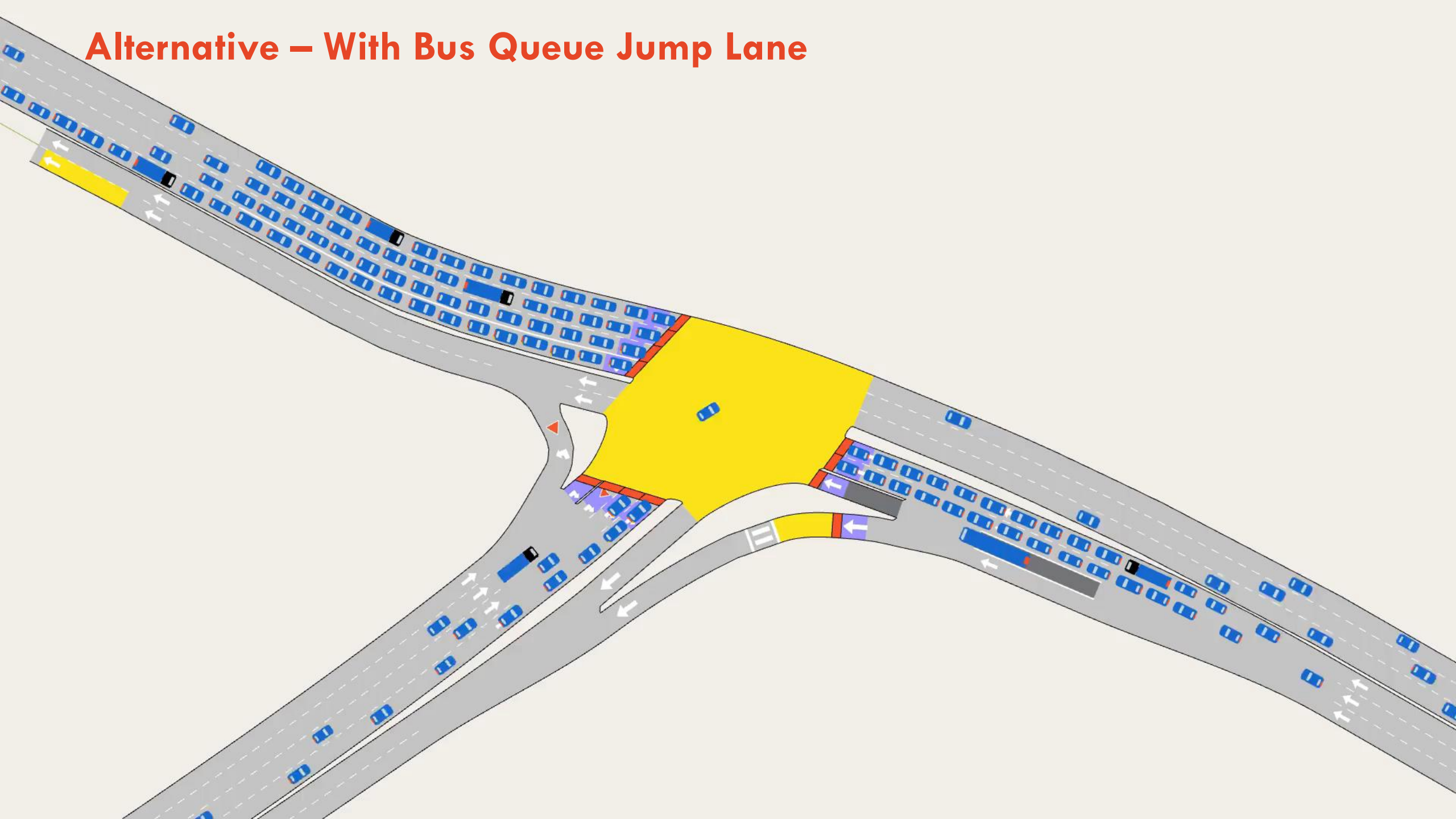
Bus Priority at Intersection:
Bus Right Turn Queue Jump Lane

0
25
50 m
Bus Only
Parramatta Rd
Liverpool Rd
Ashfield

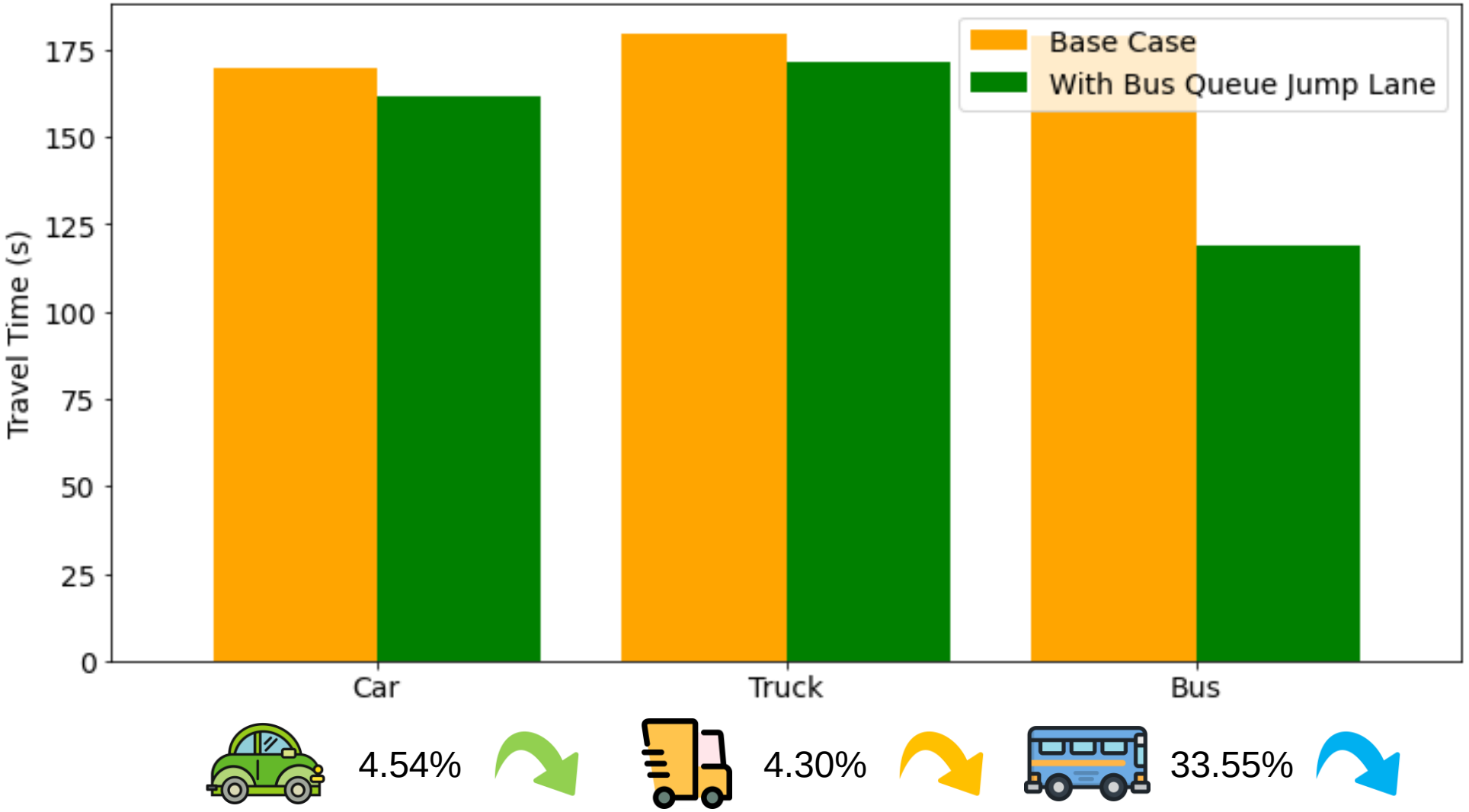
Base Model



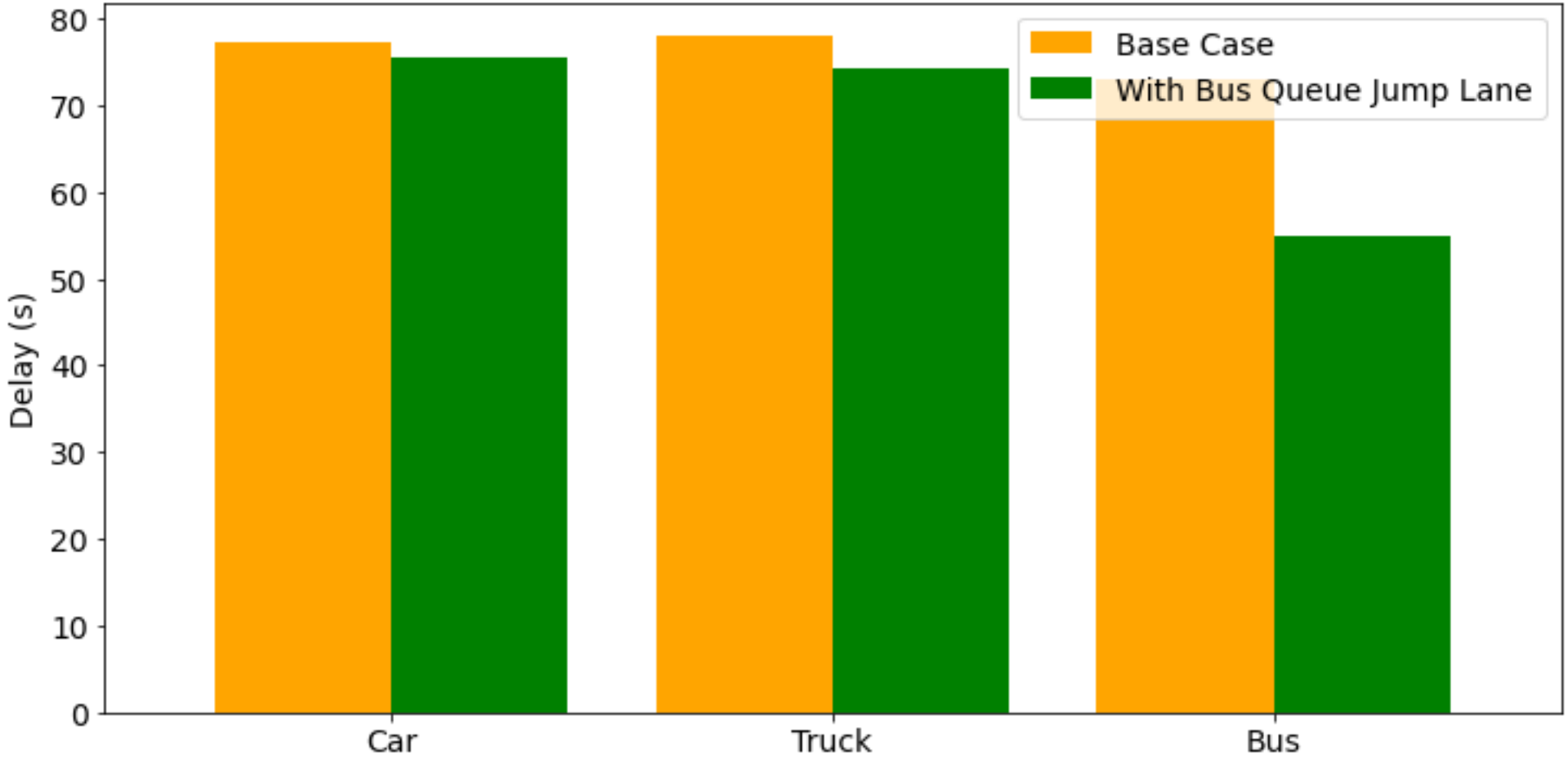
Alternative – With Bus Queue Jump Lane



Simulation Results – Liverpool Road Right Turn



Simulation Results – All Directions



How to Improve?
Bus Priority Boxes

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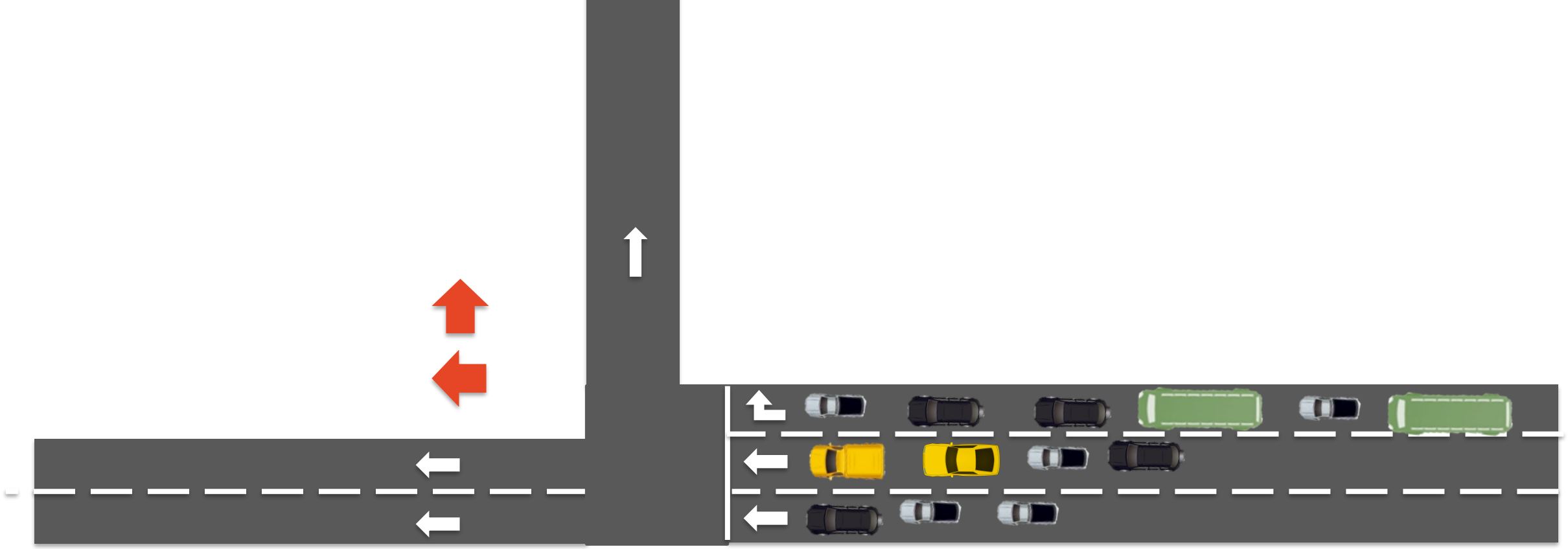
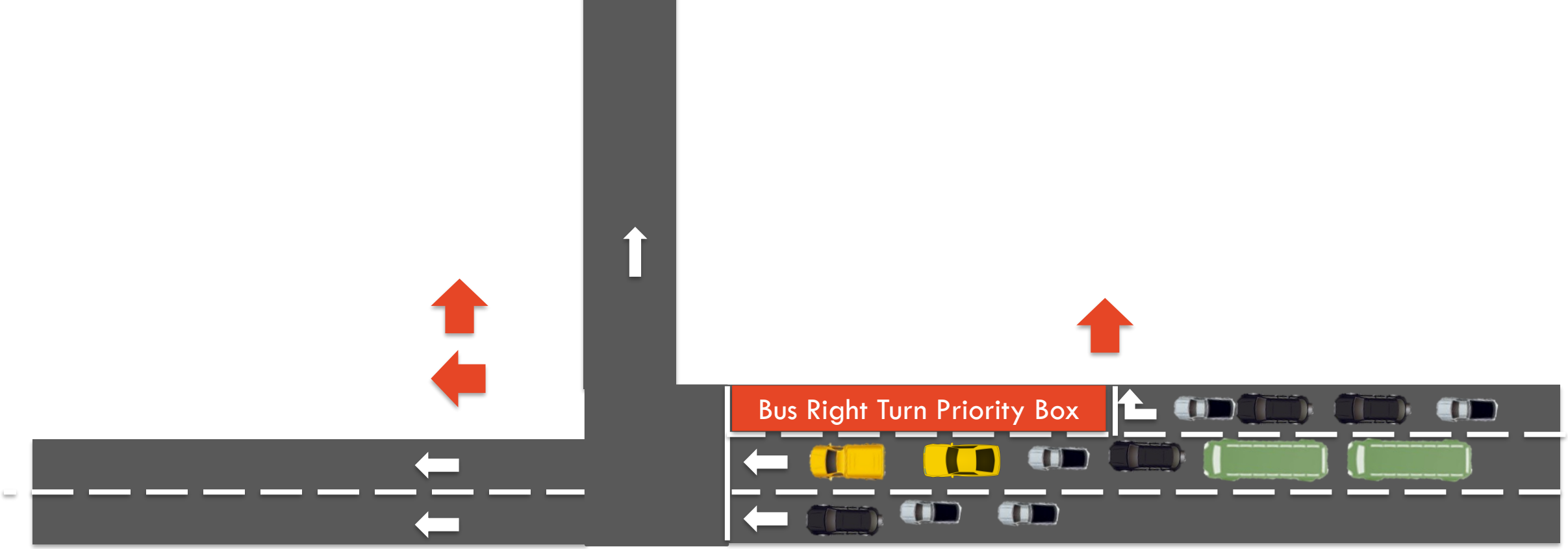
Bike Priority at Intersection:
Bike Boxes

Victoria Rd

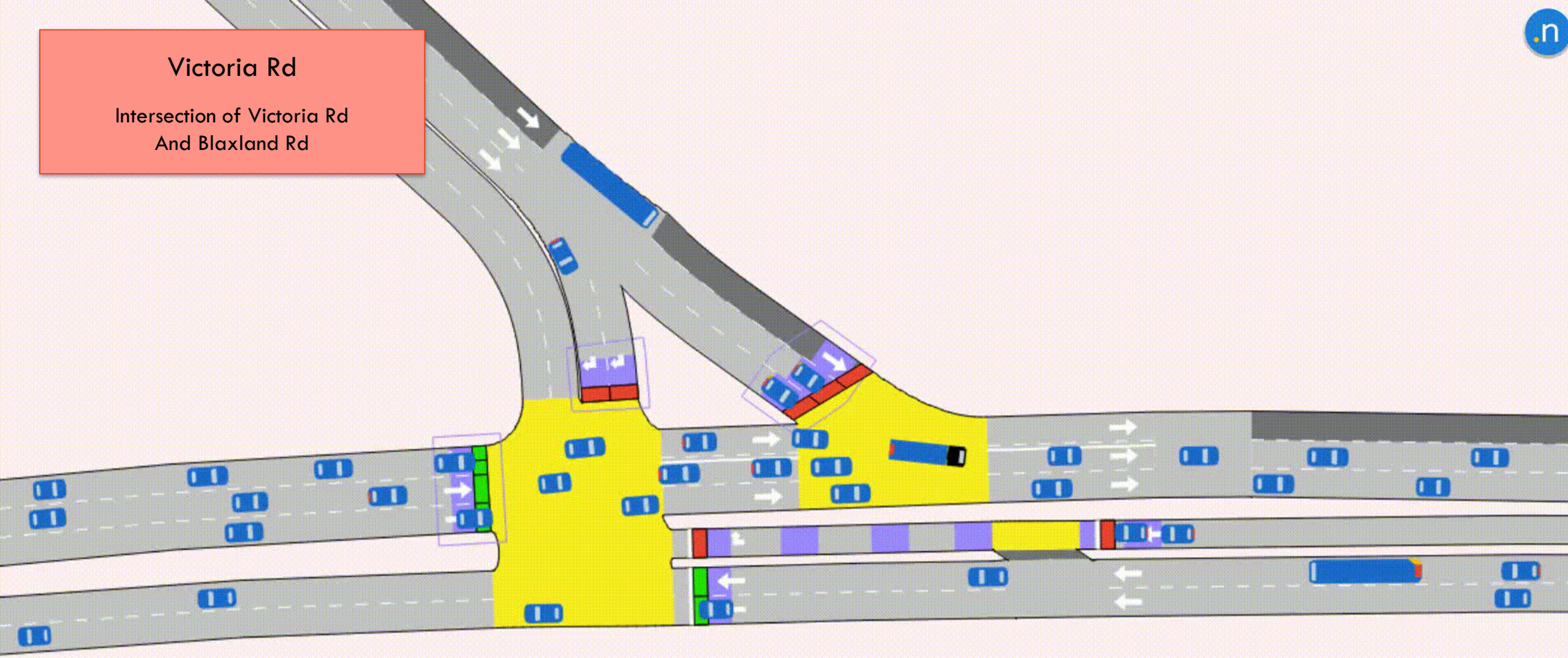
Intersection of Victoria Rd
And Blaxland Rd




Bus Right Turn Priority Box

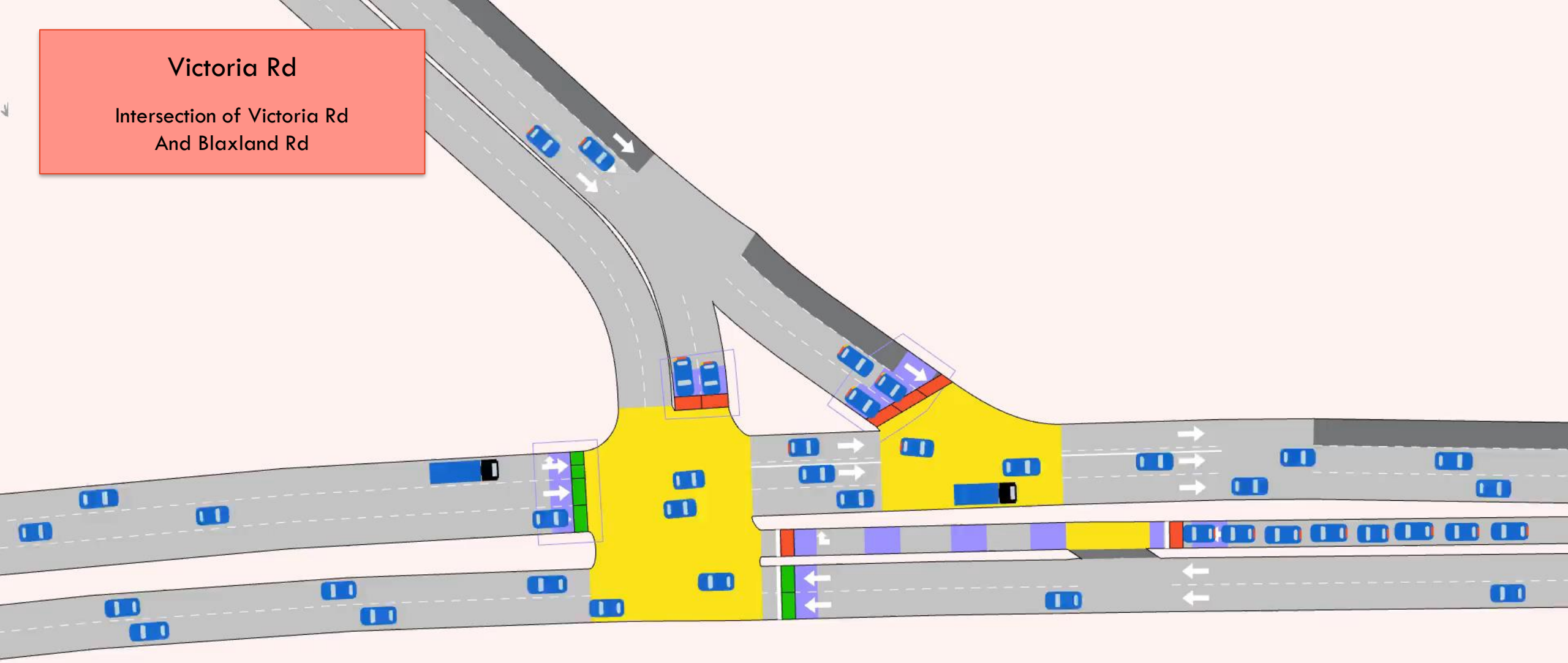
Victoria Rd

Intersection of Victoria Rd
And Blaxland Rd

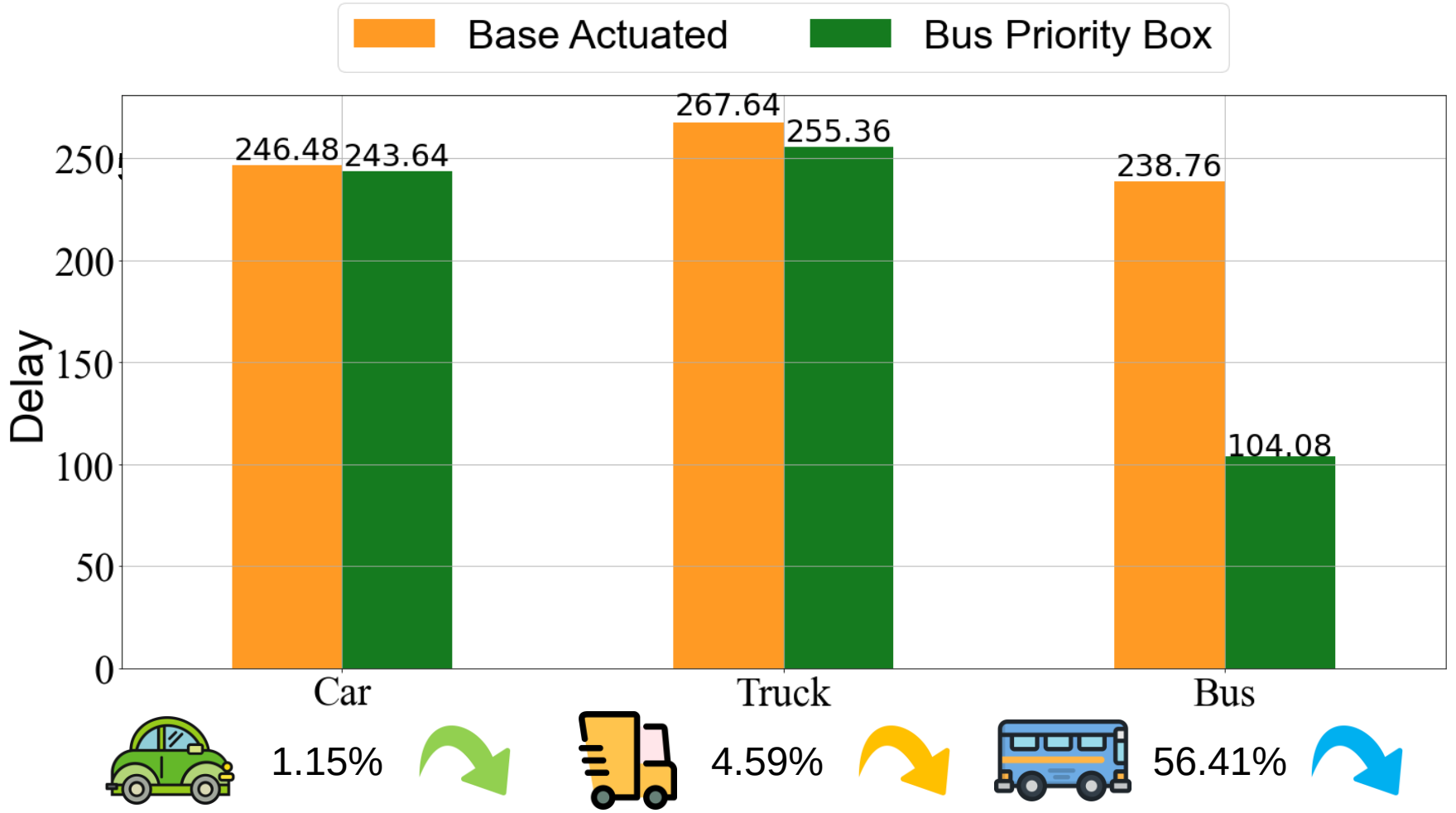


Victoria Rd

Intersection of Victoria Rd
And Blaxland Rd



Simulation Results – Victoria Road Right Turn



Reducing passenger delay by 4.73%
By assuming bus occupancy as 20 pax/veh

The End
Thank You
Questions?

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TransportLab
School of Civil Engineering

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