Bus Priority Procedure for Signalized Intersections Based on Bus Occupancy and Delay

SUMO User Conference 2024

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Motivation and Research Questions

A near-future scenario in which the bus prioritisation is not first-come, first-served-based, but uses additional information transmitted with V2X communication (ETA, delay, occupancy).

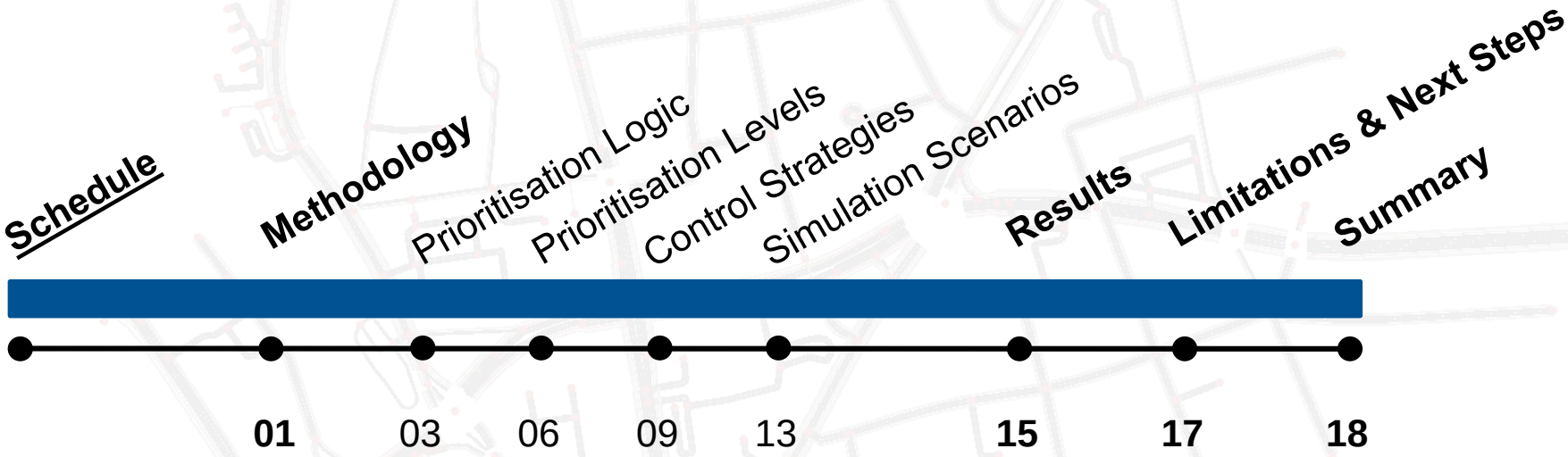
How do the priority levels determine the timing of the prioritisation, depending on ETA?

What does a practical assignment of priority levels based on delay and occupancy look like?

The prioritisation schemes must:

- ☑ be scalable depending on ETA and
- ☑ be flexible and easy to adapt because the bus to be prioritised can change

Schedule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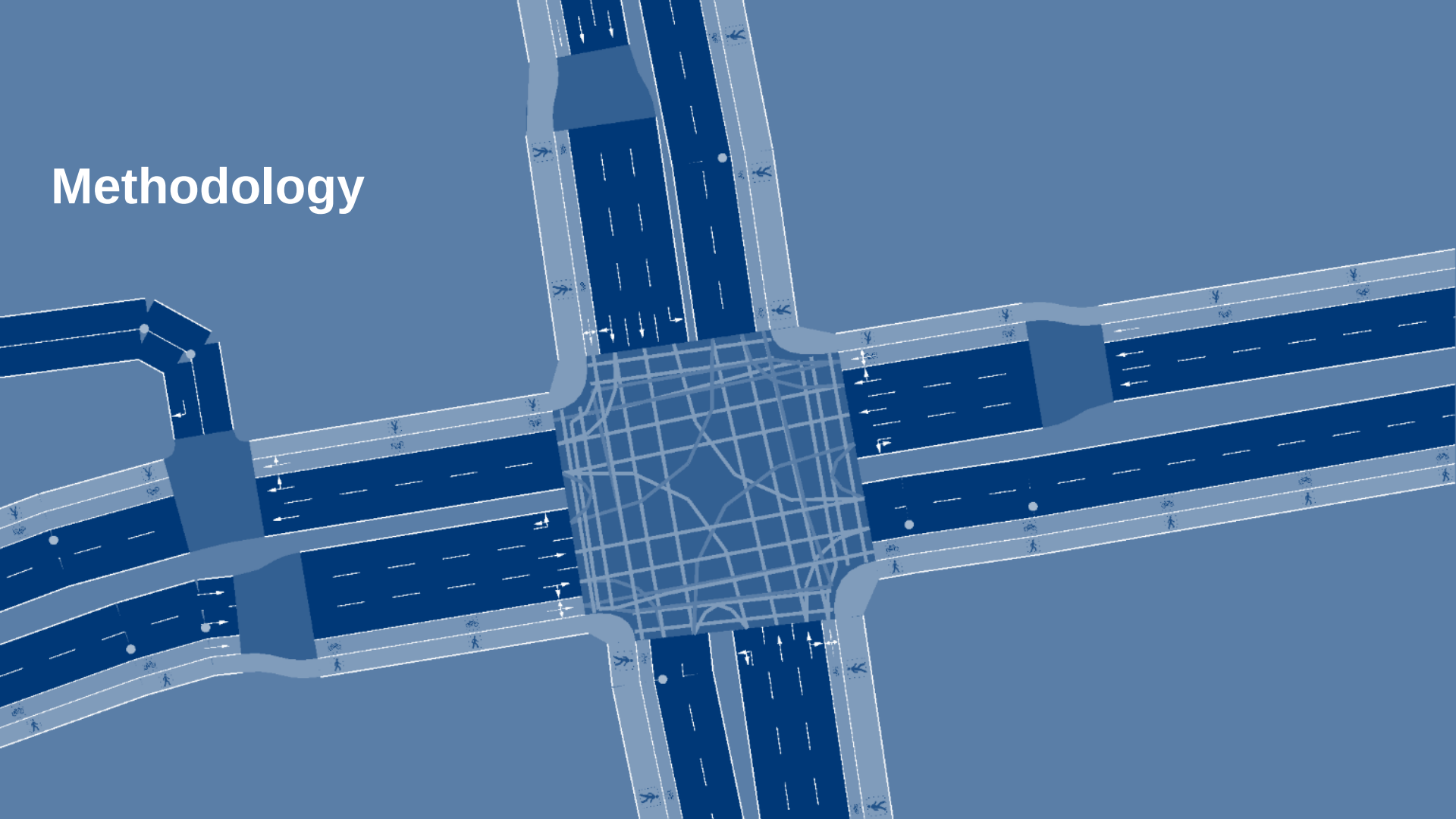
Methodology



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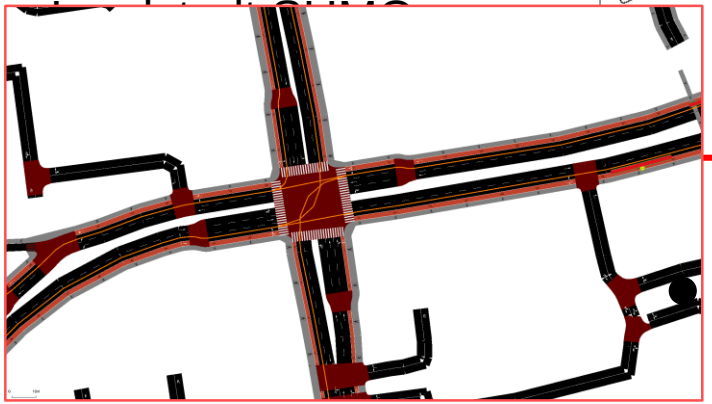
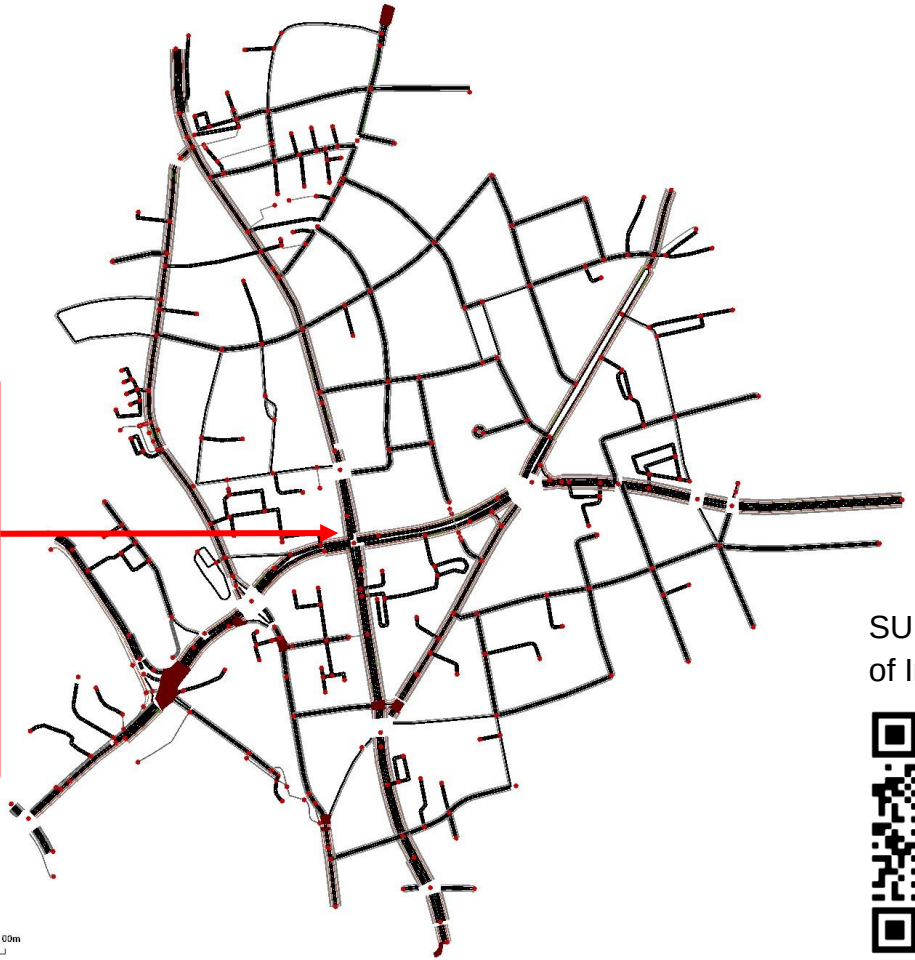
Methodology



Intersection at which prioritisation takes place



SUMO network of Ingolstadt:

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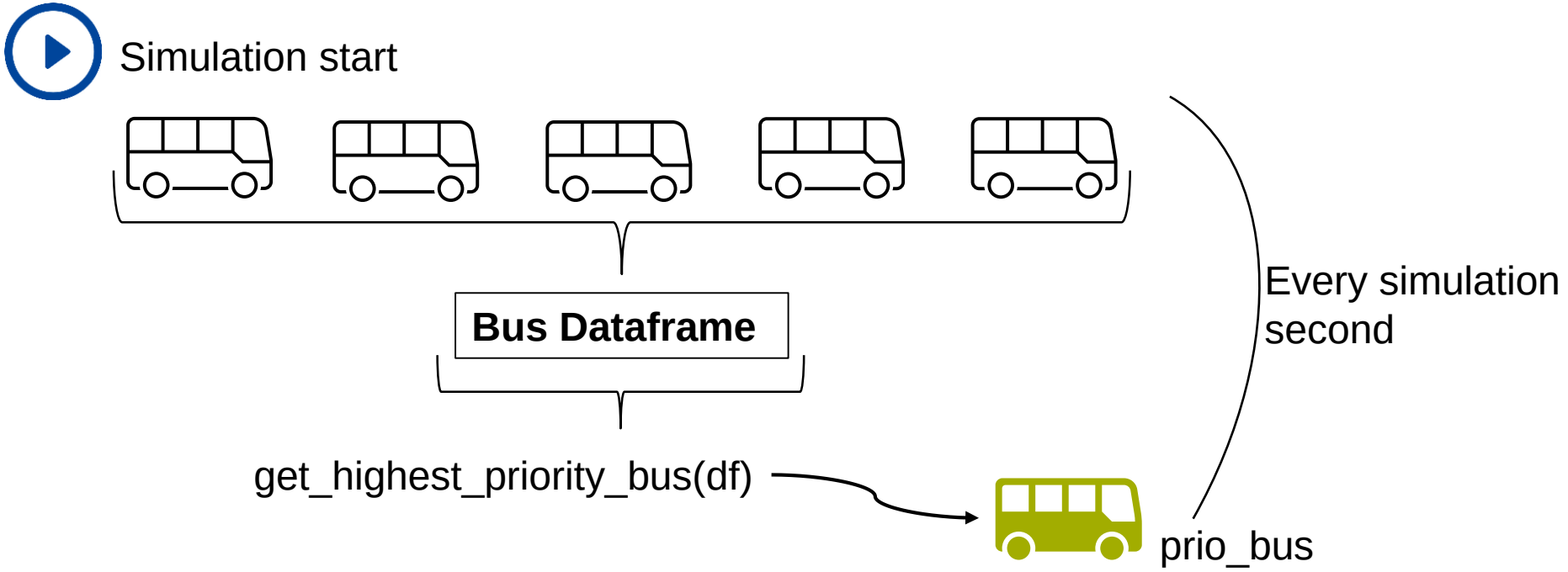
Methodology: Prioritisation Logic



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Methodology: Prioritisation Levels

get_highest_priority_bus(df)

Delay  From A to E
Occupancy  From 1 to 5

e.g. A1

Priority A
Green as soon as poss

ETA – 20 sec

ETA – 10 sec

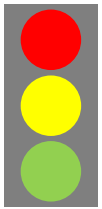
riority D
een at ETA

Delay in sec		Occupancy <=5	<=15	<=30	<=45	>46	Priority Degree	Green Time Start
	<=59	E5	E4	E3	E2	E1	-	
	<=119	D5	D4	D3	D2	D1	D	ETA
	<=239	C5	C4	C3	C2	C1	C	ETA-10
	<=420	B5	B4	B3	B2	B1	B	ETA-20
	>420	A5	A4	A3	A2	A1	A	Check-In

tension

Red Truncation

Red Truncation
Extended



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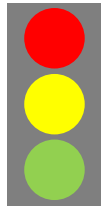
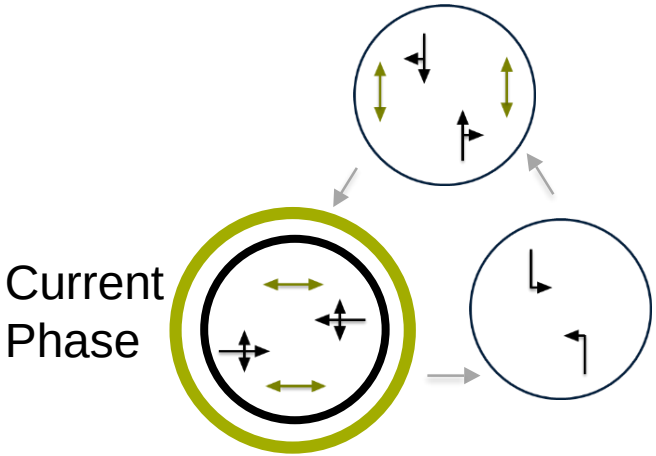
Methodology: Control Strategies

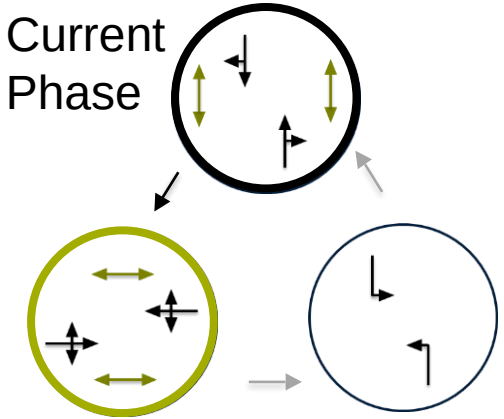


Green Extension



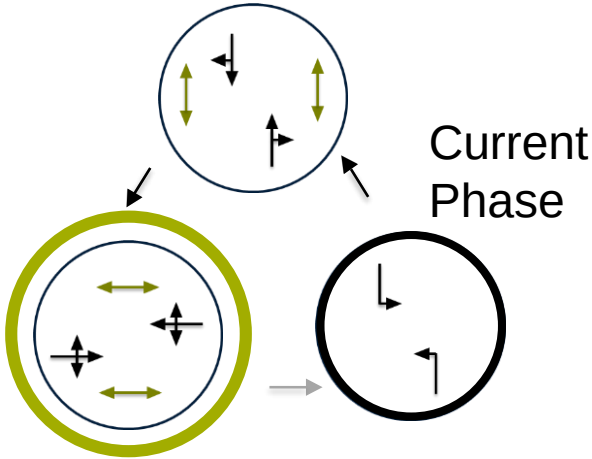
Desired Phase

Red Truncation



Desired Phase

Red Truncation Extended



Desired Phase

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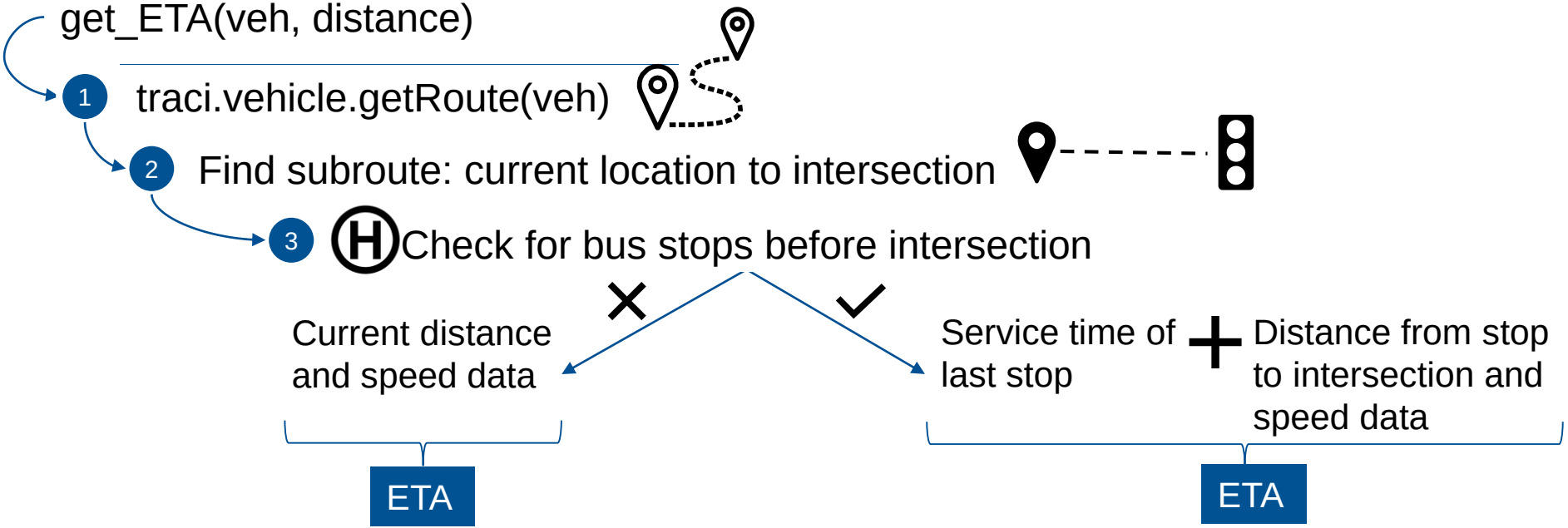
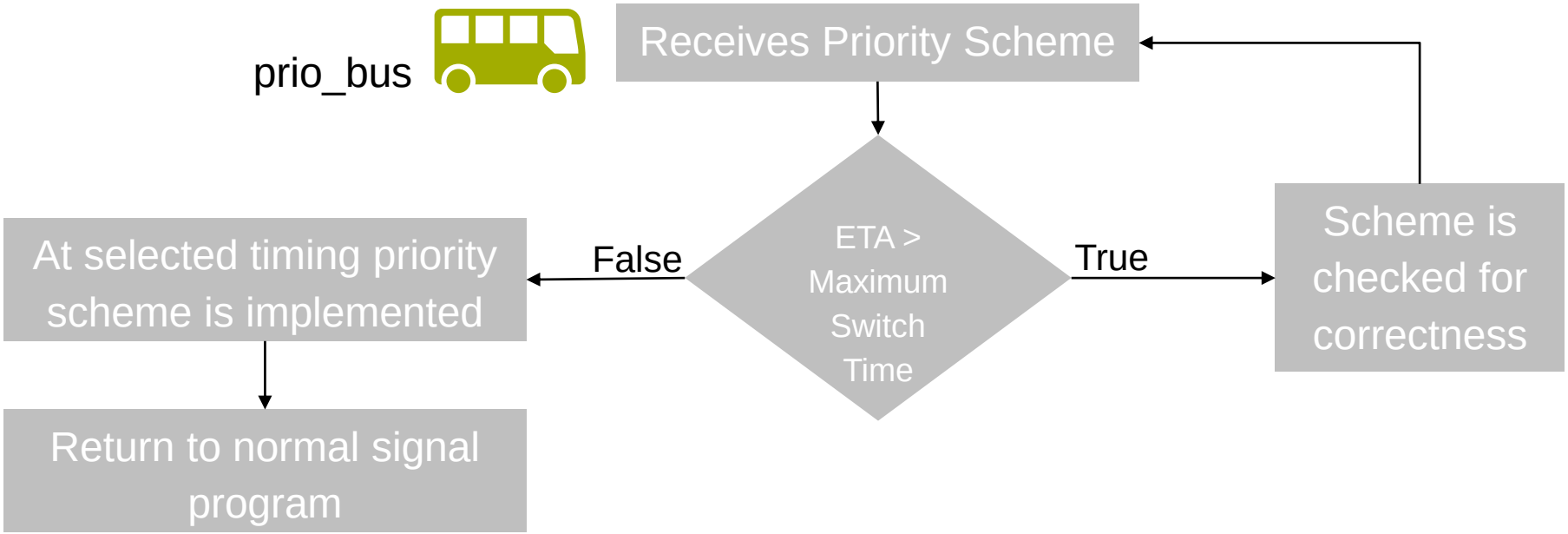
Methodology: Prioritisation Levels – ETA Function



Methodology: Prioritisation Logic



Methodology: Simulation Scenarios

7 - 8 am

Registration at the same time

Scenario 1
SameRegSamePrio
Same Priority Level
A

Scenario 2
SameRegDiffPrio
Different Priority
Levels
A and D

Registration at different times

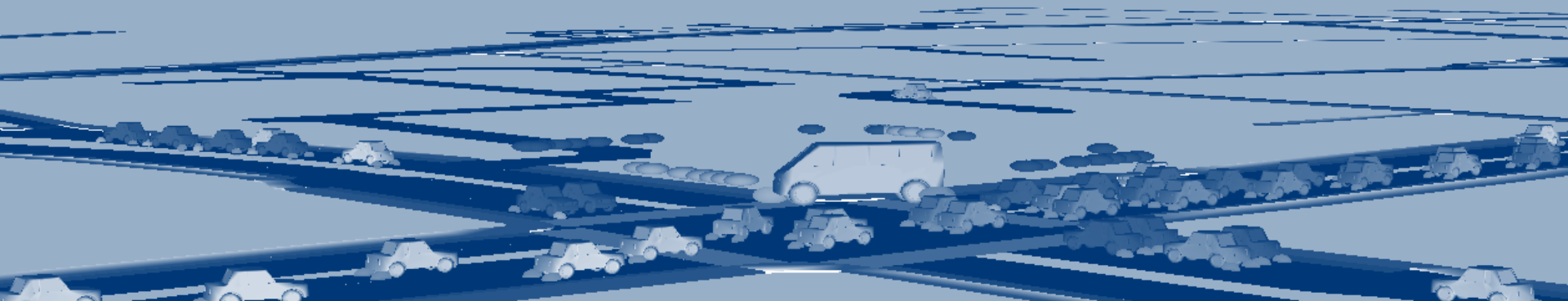
Scenario 3
DiffRegDiffPrio
Different Priority
Levels
B and C

10 - 11 am

Registration at the same time

Scenario 4
SameRegDiffPrio_Off
Different Priority
Levels
A and D

Results



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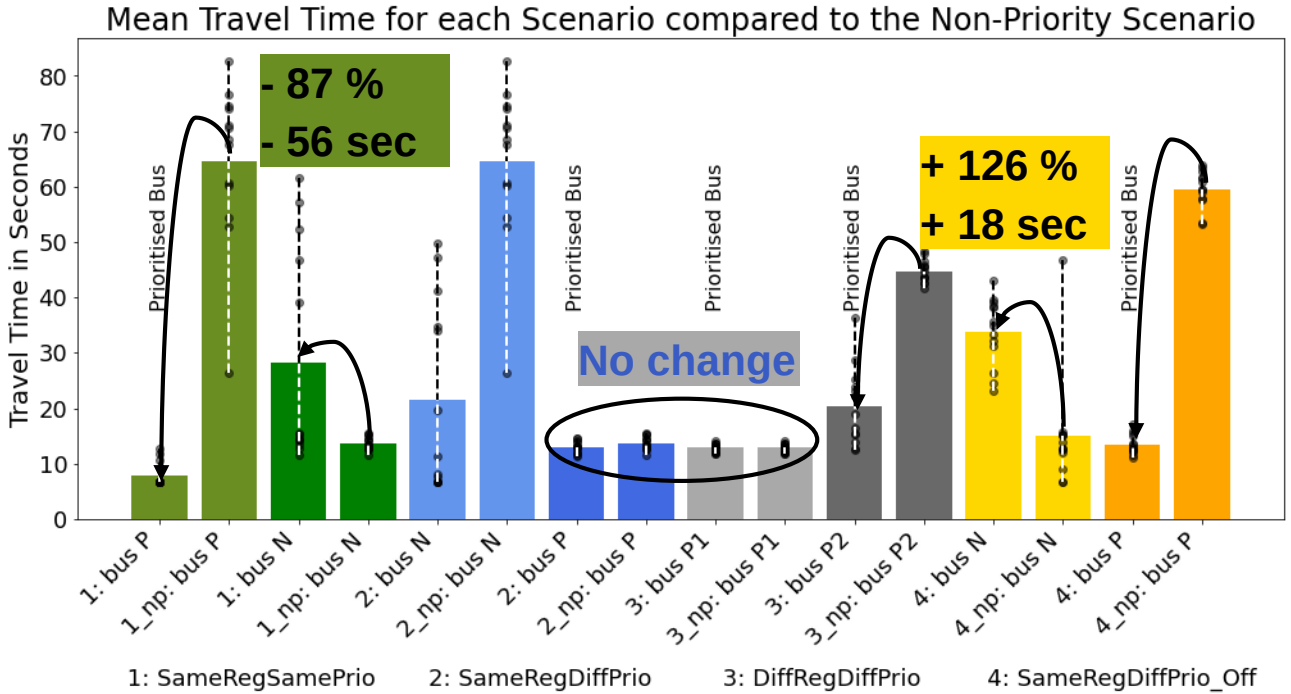
Results: Travel Time



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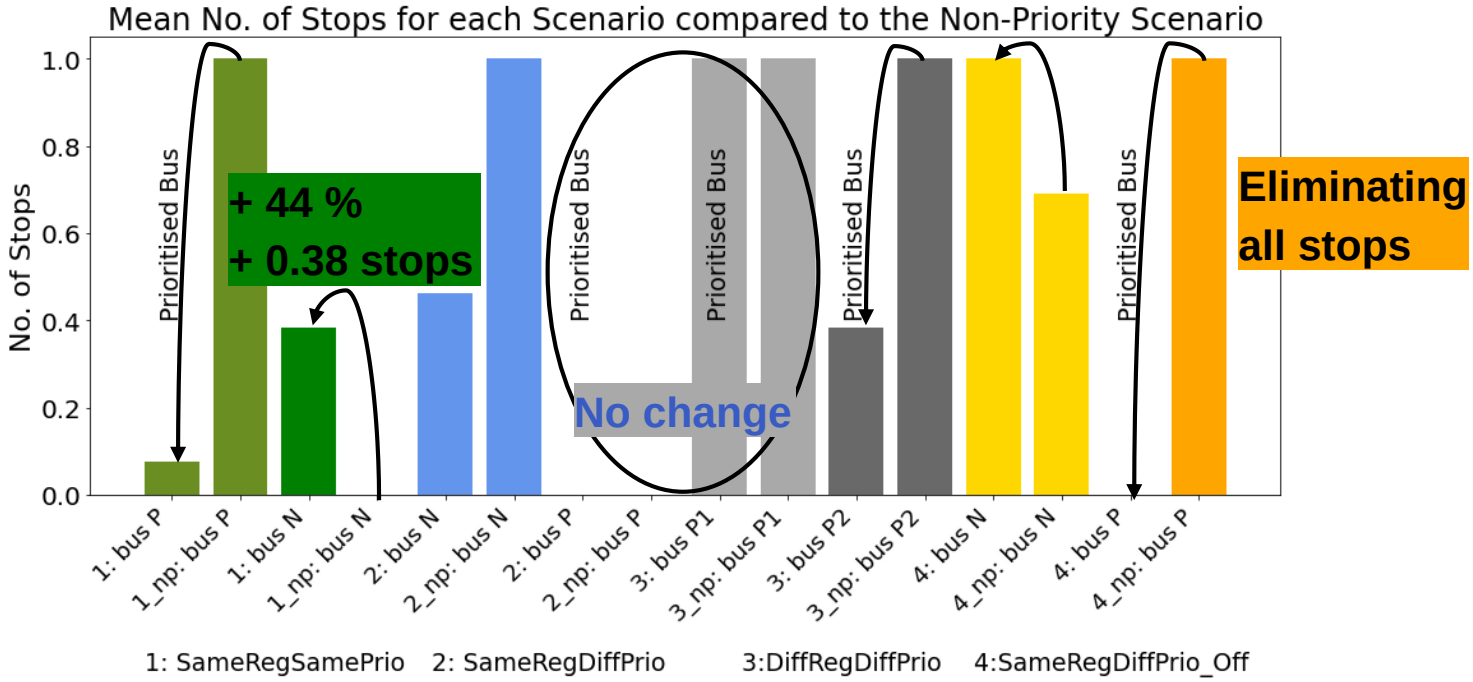
Results: Number of Stops



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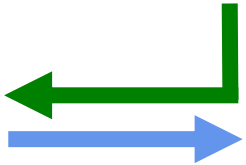
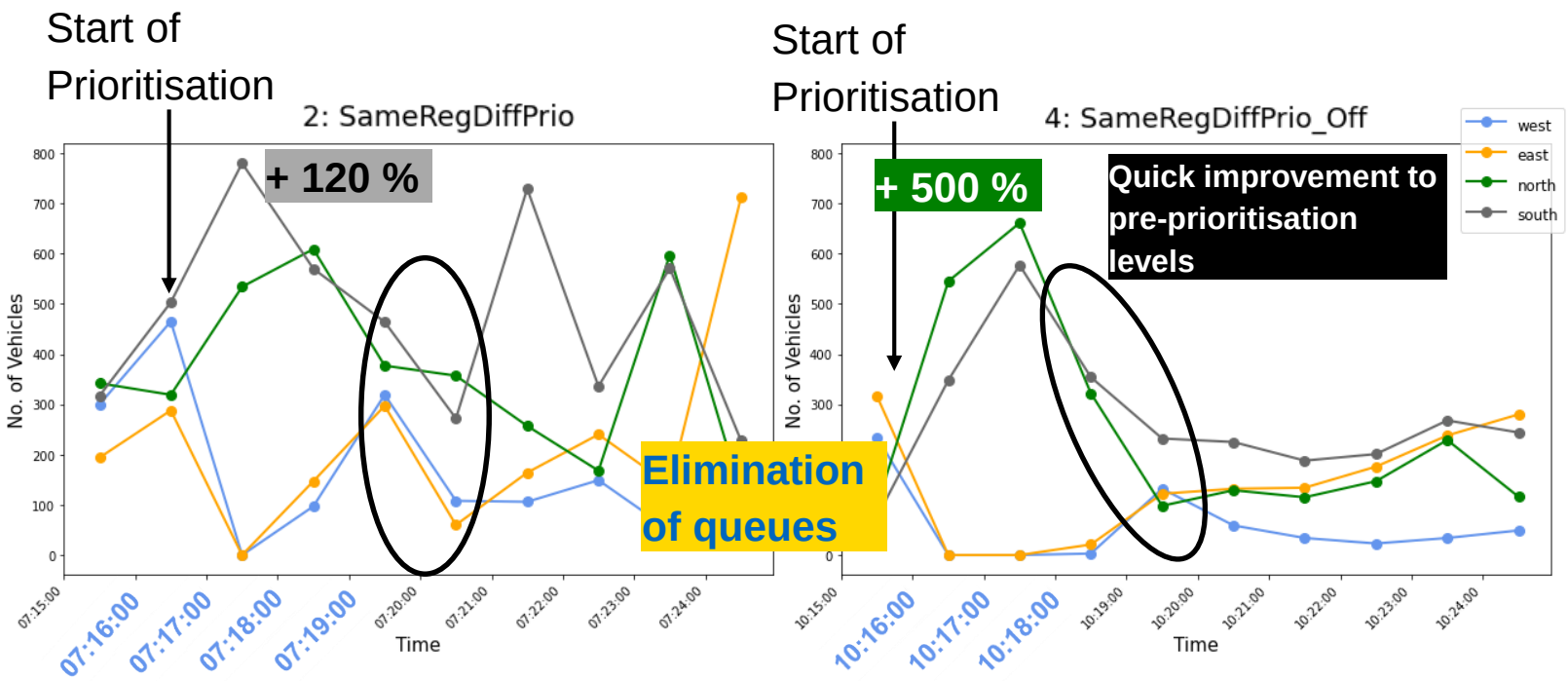
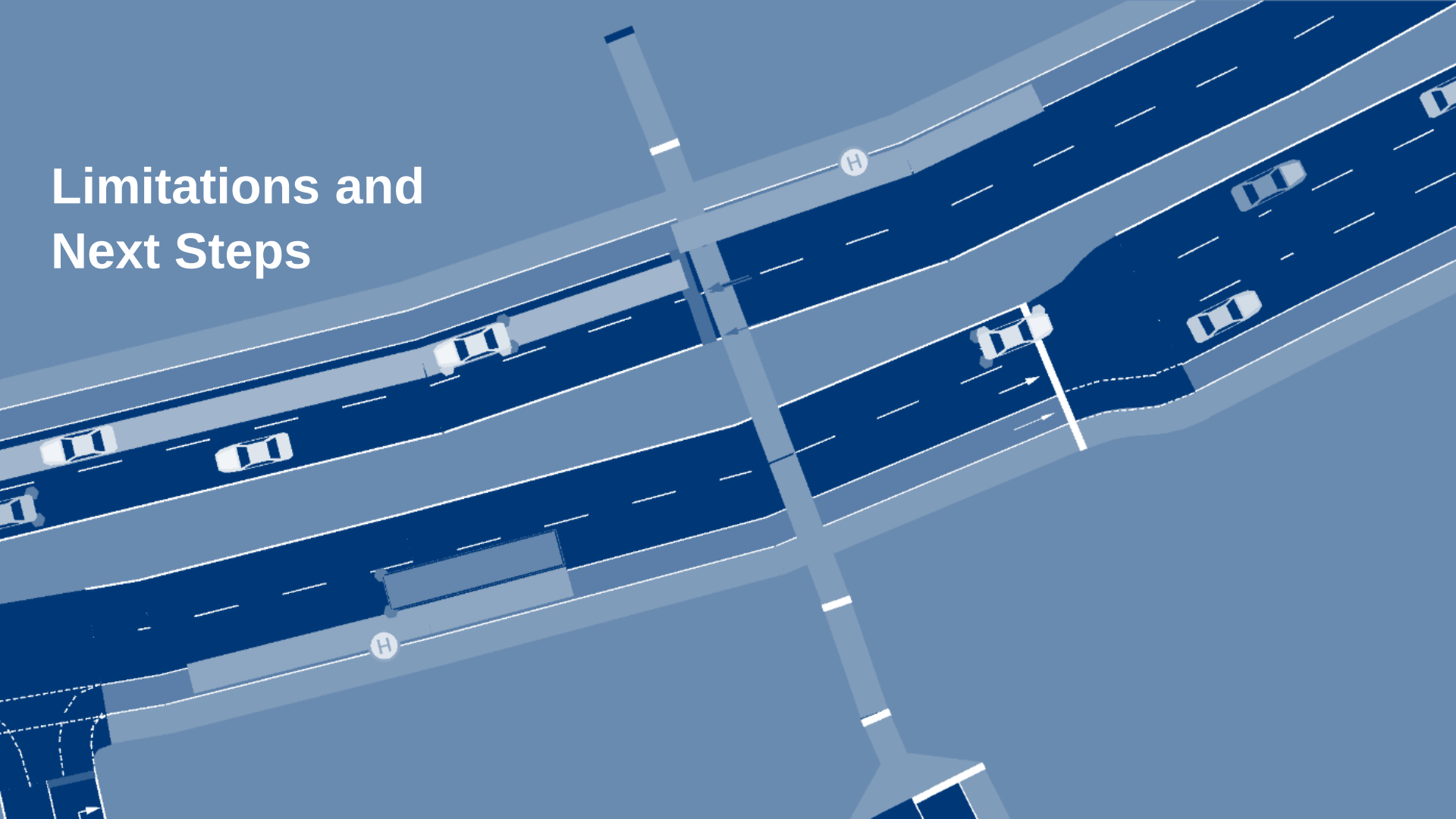
Results: Summed Queue Lengths



Prio Bus



Limitations and Next Steps

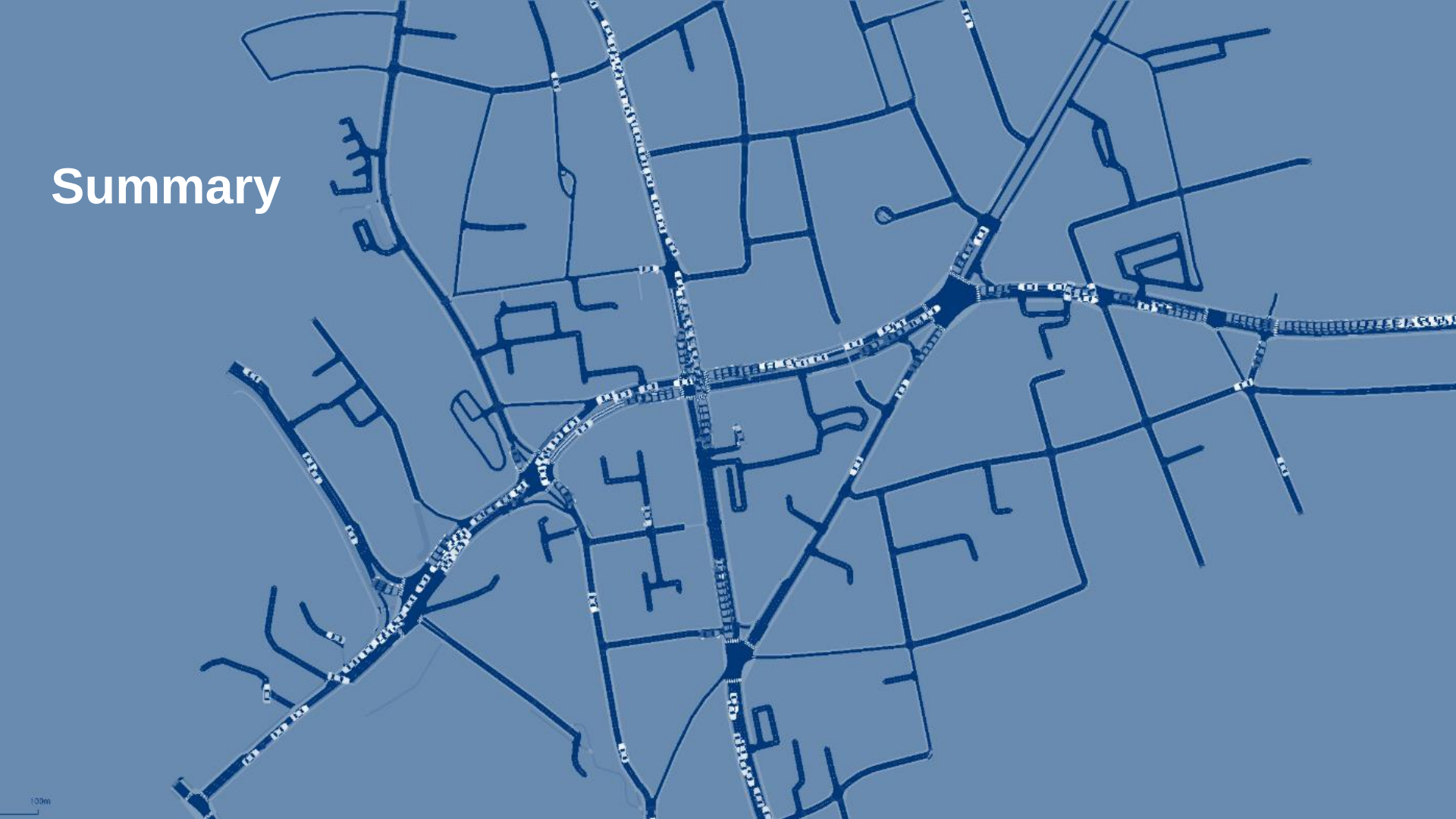


Limitations and Next Steps

1. Accuracy of ETA function
2. Limited testing scenarios
3. Spatial limit of prioritisation effects

1. Addition of simulation scenarios and improved prioritisation functions
2. Extension of prioritisation procedure to more intersections

Summary



Summary

Flexible prioritisation procedure feasible

Based on V2X communication

In a near-future scenario

Prioritisation hierarchy developed

Based on delay and occupancy instead of FCFS

Prioritisation timings based on ETA and priority levels

Testing scenarios showed

High reductions in travel time, stops and queue lengths possible

Temporary negative effects are less than prioritisation benefits

Thank you for your attention!