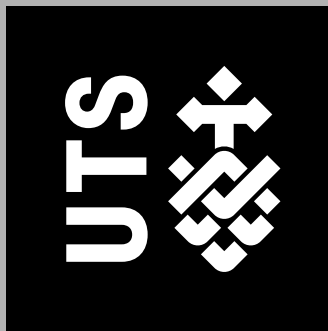


# **An algorithm for reducing vehicles' stop behind the bus pre-signals**

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# INTRODUCTION:

- **Traffic congestion**
- **By comparing private and public vehicles in terms of passenger factor**
- **On the other hand, public transit systems have several problems:**
  - ✓ **Connectivity**
  - ✓ **Reliability**
  - ✓ **Travel time**
- **So it is necessary to prioritize public transit systems.**

# INTRODUCTION:

## Pre-signal ...

- is an innovative procedure for prioritizing buses behind signalized intersections.
- should be implemented in arterials with a separate bus lane.
- is an effective strategy for reducing the average delay per passenger and the potential conflicts between buses and private vehicles.

## Its shortcomings:

- does not consider cars
- imposes additional stops to private cars

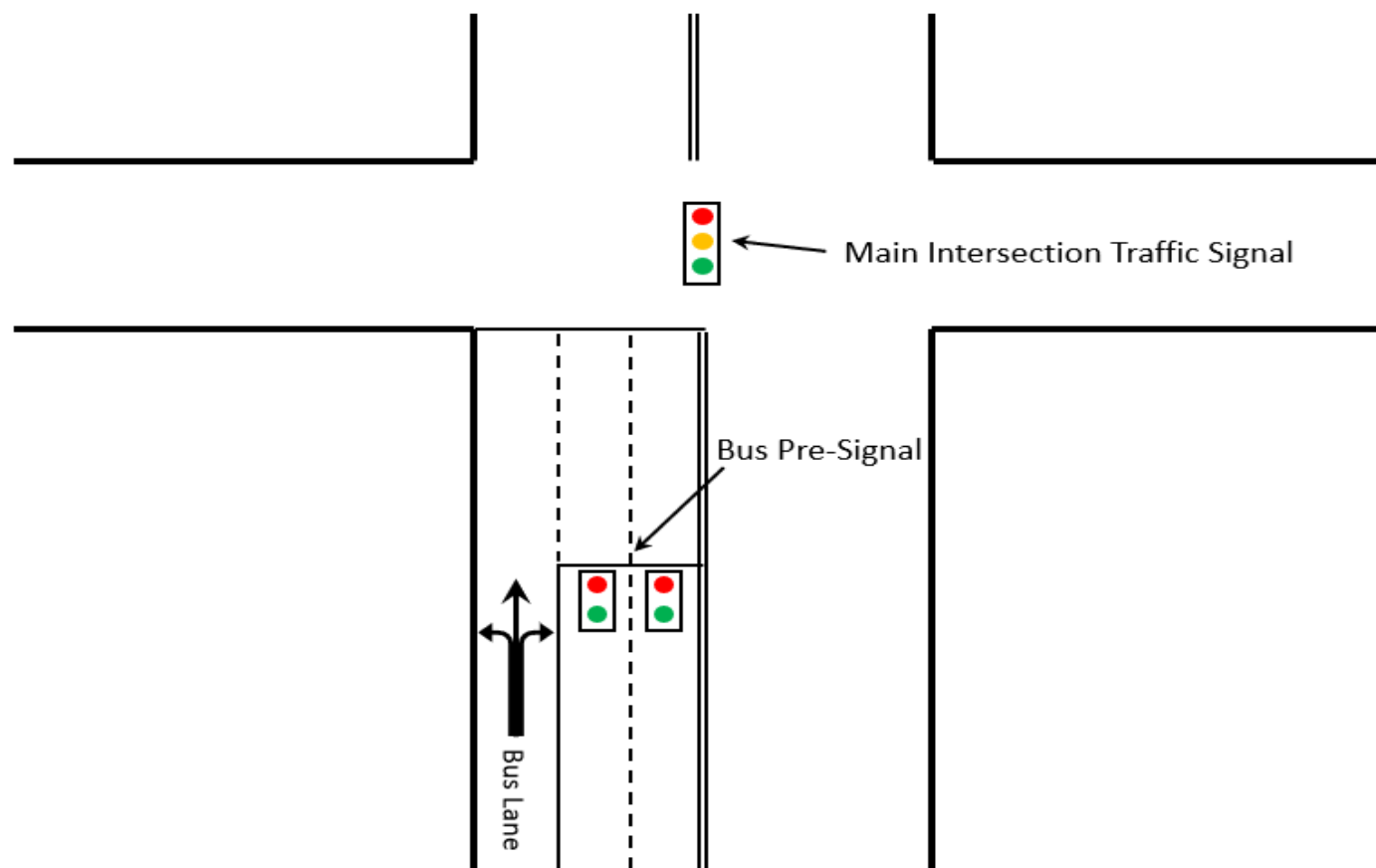
## Its shortcoming:

- Bus pre-signals cause additional stops for cars, there is no study to decrease these number of stops.

My research provides unconditional signal priority while at the same time reducing time penalties to private car traffic.

# THE MODEL PURPOSE:

The study aims to minimize the number of stops for optimizing the performance of the buses and private vehicles in urban arterials with signalized intersections equipped with pre-signals.



# Objective Function:

$$F(x) = \min [d_3]$$

Initial queue behind the  
pre-signal

Subject to:

the delay parameter

$$d_3 = \frac{1800 \times Q_b \times (1 + u) \times t}{CT}$$

the duration of unmet  
demand in T (h)

the adjusted lane group  
capacity (veh/h)

the duration of analysis period (h)

$$\text{If } v_{car,suggested} \geq 5 \text{ km/h then } Q_b = 0$$

the initial queue at the  
start of period (veh)

# THE MODEL PROCEDURE:

Step 1: Estimate the optimal distance for implementing pre-signals (By modifying Guler and Menedez (2015) model)

$$d_{bus} = [(c - r_{ms})_1 \times (\frac{C}{k_{jam}} - v_1) + (c - r_{ms})_2 \times (0 - \frac{C}{k_{jam}})] \times 1000$$

cycle length (h)

total capacity across all lanes (veh/h)

red duration (h)

the bus initial speed

the jam density (density at zero speed) (veh/km)

the bus moving speed for changing lane and reaching the intersection

# THE MODEL PROCEDURE:

Step 2: Determine the distance for installing a VMS

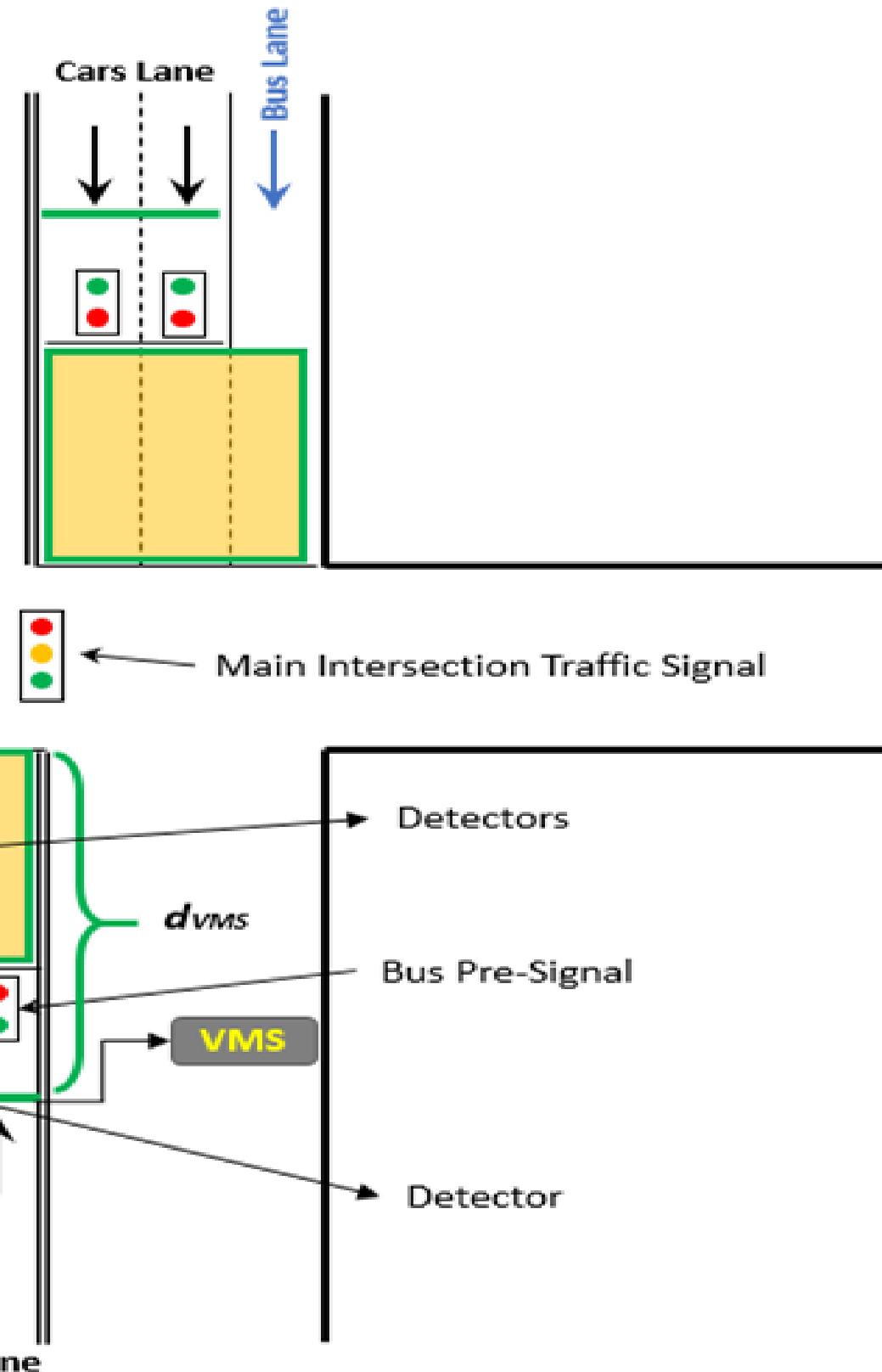
$$d_{VMS} = x + d_{bus}$$

speed of the lead vehicle, which is assumed constant and based on the road rules (km/h)

$$x = \frac{v t_{reaction}}{3.6}$$

the reaction time of the lead vehicle once decides to change its speed (s)

the distance between the lead vehicle and the pre-signal (m)





# THE MODEL PROCEDURE:

Step 3: Optimize the speed of vehicles before reaching pre-signals for the sake of reducing their number of stops

$$t_B = \text{Max}[t_{bus}, r_{ms}]$$

$$t_C = t_B + t_{car}$$

$$t_{bus} = \frac{3.6d_{bus}}{v_{bus}}$$

$$t_{car} = \frac{3.6d_{VMS}}{v_{car,current}}$$

$$v_{car,suggested} = \frac{d_{VMS}}{t_C} \times 3.6 = v_{lead}$$

# THE MODEL PROCEDURE:

The one-way arterial with two lanes, one for buses and the other one for private vehicles

The intersection is controlled by a fixed-time traffic signal.

The studied intersection is isolated.

A Variable Message Sign (VMS) is installed for alarming the private cars.

The AVL system is utilized in each bus for the sake of determining the buses' location, their approach and selected lane.

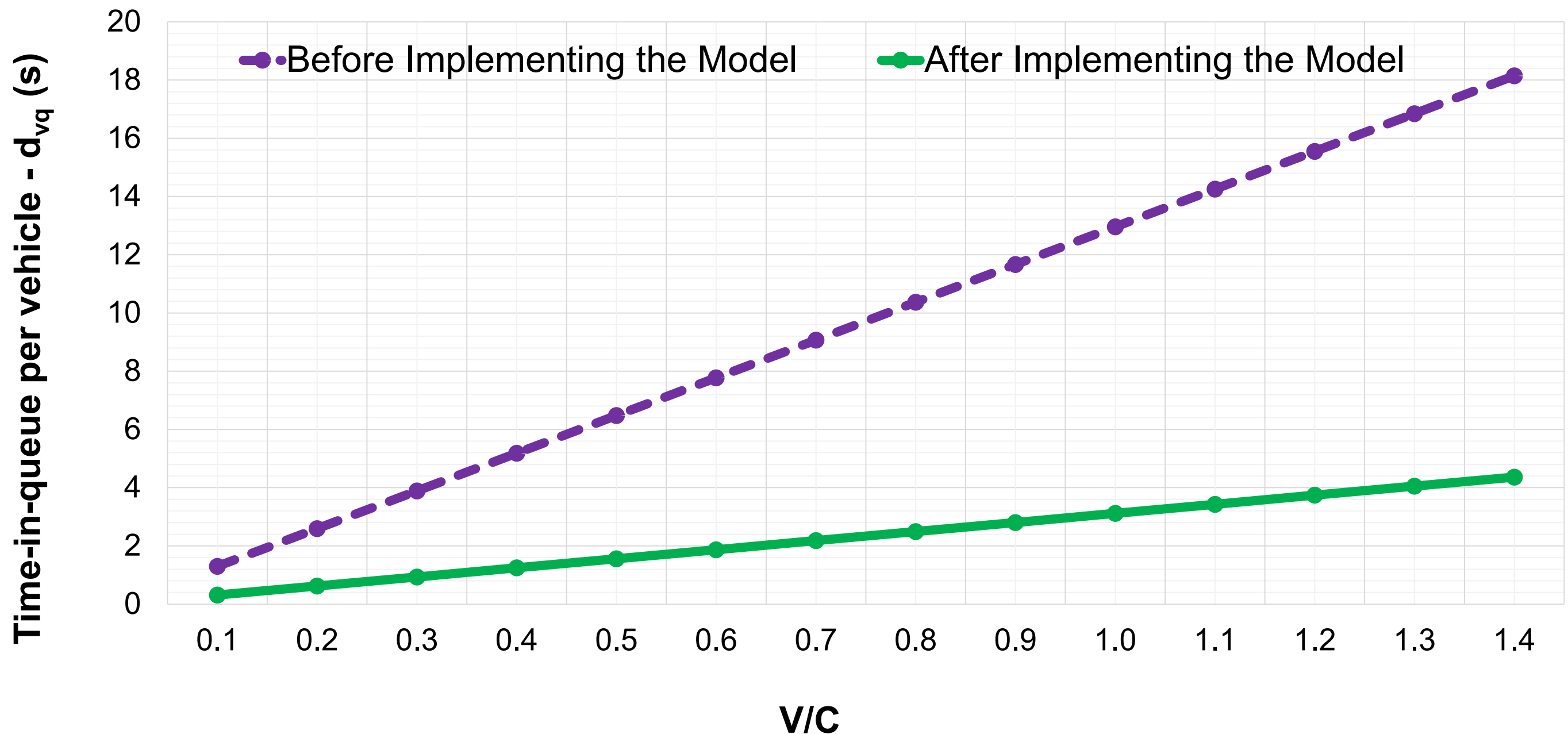
Detectors are needed throughout the area behind the stop line where buses can change their lane. These detectors also declare the existence of other cars and the bus's selected lane.

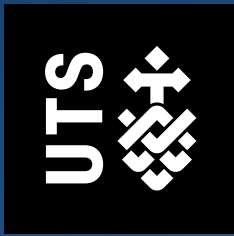
In the point VMS is installed another detector is needed to count the private cars occupied the distance between the VMS and the area behind the stop line.

The movement of the buses and cars are assumed static and their speed value is constant and based on road rules.

# RESULTS:

**Comparison of each vehicle's time-in-queue before and after implementing the proposed model in different V/C ratios**





Thank you

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