Providing Bus Priority Using Adaptive Pre-signals

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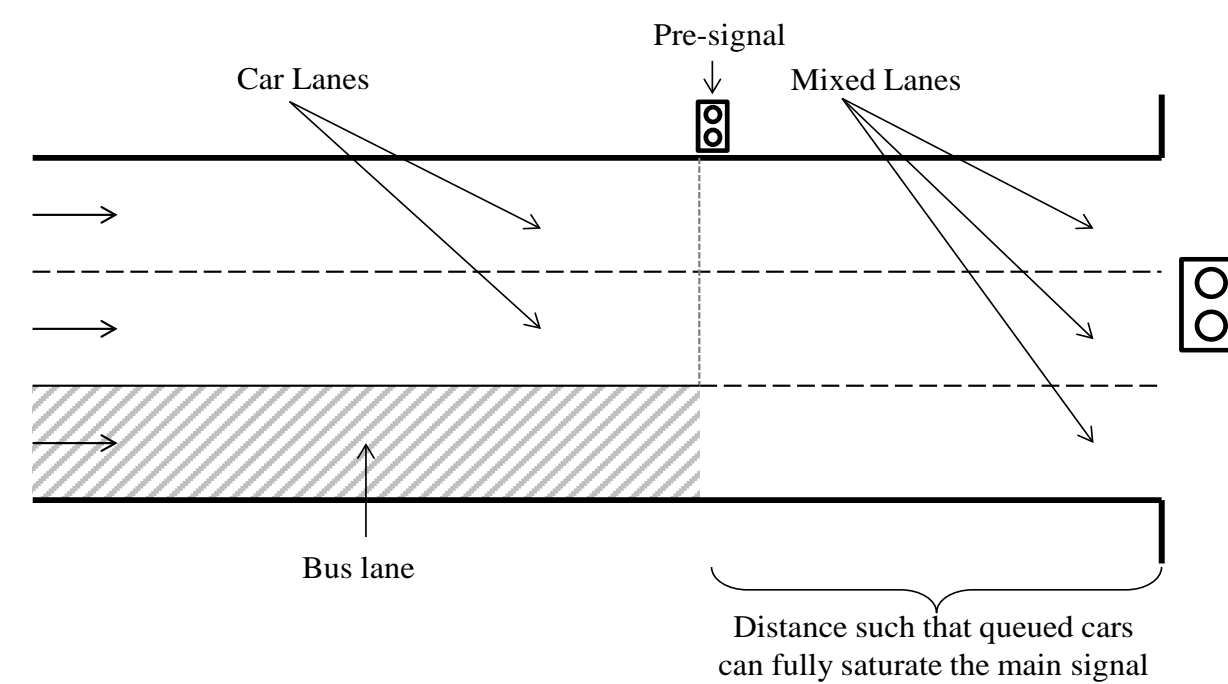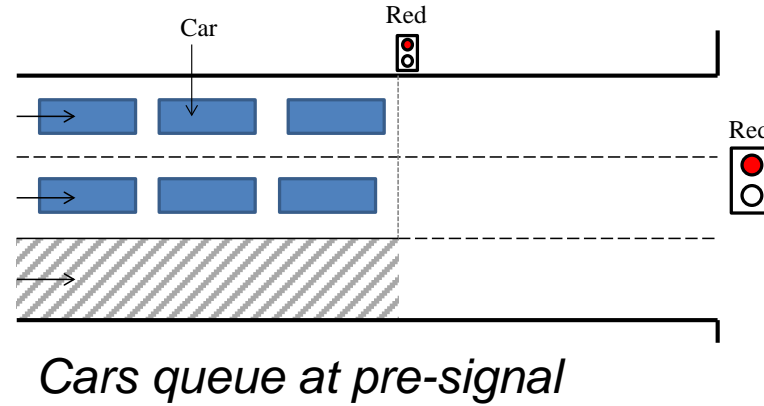
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Research Question

How to dynamically implement different levels of bus priority at intersections while minimizing the negative effects on general traffic using: i) a dedicated bus lane, ii) a pre-signal, or iii) mixed lanes.
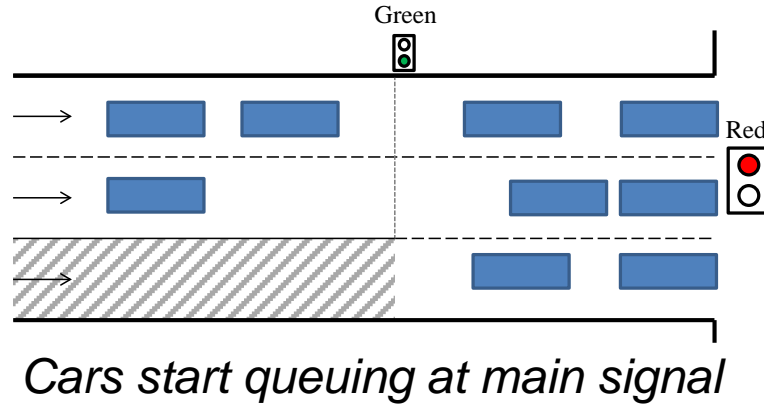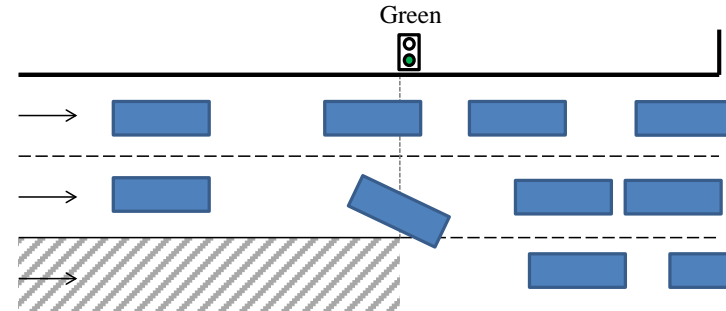
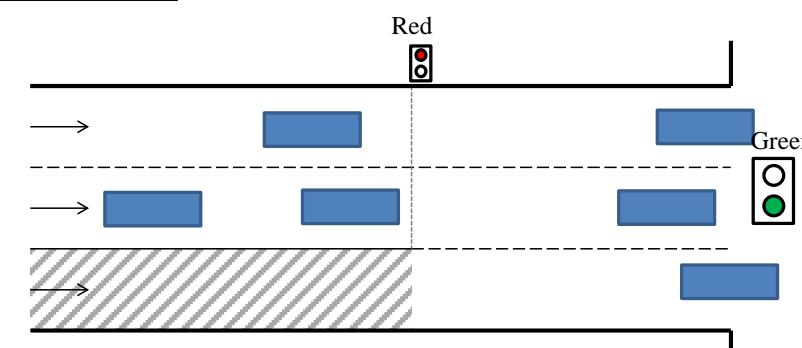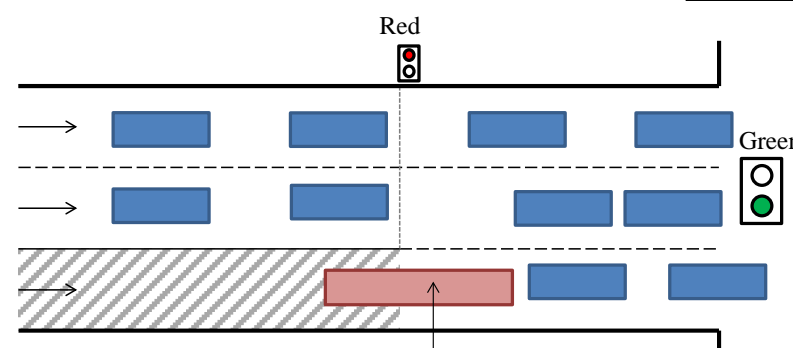## Operation of Pre-signals

1. Both signals are red:
Cars queue at pre-signal

2. Pre-signal turns green:
Cars start queuing at main signal

3. Main signal turns green
Enough cars can discharge from the queue at the main signal to saturate the green

4. Pre-signal turns red if:
a) a bus arrives;   b) or such that cars only queue at the pre-signal
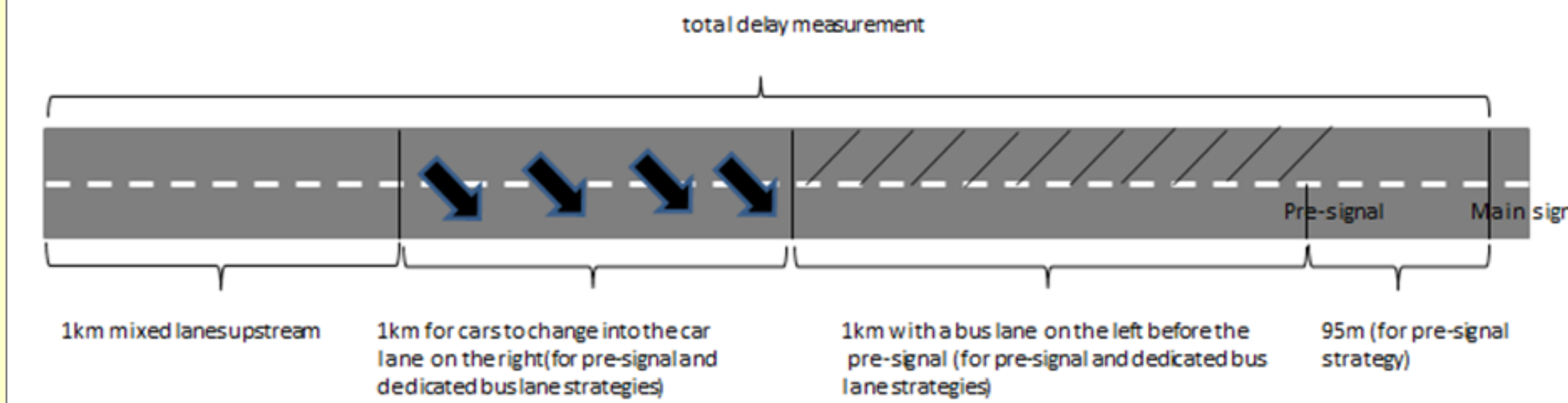
Methodology

Use a microscopic simulation model built in VISSIM to determine performance metrics for three bus-priority strategies under different levels of demand.
Three bus-priority strategies are compared:
  (1) A dedicated bus lane;
  (2) Fully mixed lanes; and
  (3) A pre-signal.

total delay measurement

1km mixed lanes upstream | 1km for cars to change into the car lane on the right (for pre-signal and dedicated bus lane strategies) | 1km with a bus lane on the left before the pre-signal (for pre-signal and dedicated bus lane strategies) | 95m (for pre-signal strategy)
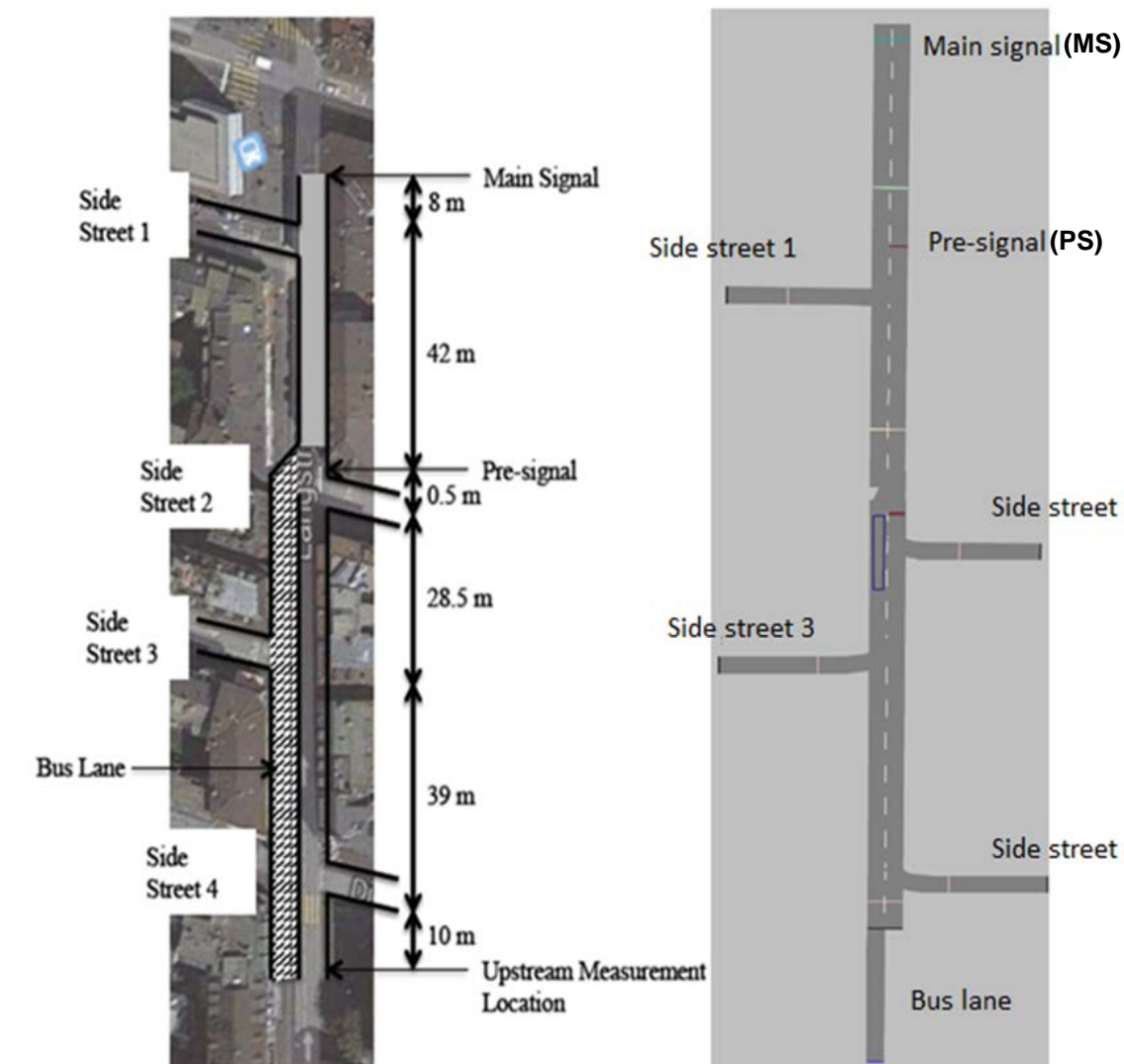
Selection criteria for each demand level:
1. No excessive upstream queue
2. Minimize average person delay

Simulation Calibration and Validation

Data collection with video cameras in existing pre-signal at Zurich, Switzerland

	Average delay		Total delay
	PS [s]	MS [s]	[s]
Data set 1 measured	35.1	6.3	41.3
Data set 1 simulation (calibration)	33.2	6.5	39.7
Data set 2 measured	15.4	6.0	21.4
Data set 2 simulation (validation)	17.3	7.2	24.5

Parameters	Calibrated values	
	Cars	Trucks
Average standstill distance [m]	2.3	2.5
Additive part of safety distance [m]	2.0	2.0
Multiplicative part of safety distance [m]	4.0	4.5
Minimum headway [m]	0.7	1.0
Safety distance reduction factor	0.7	0.9

Results
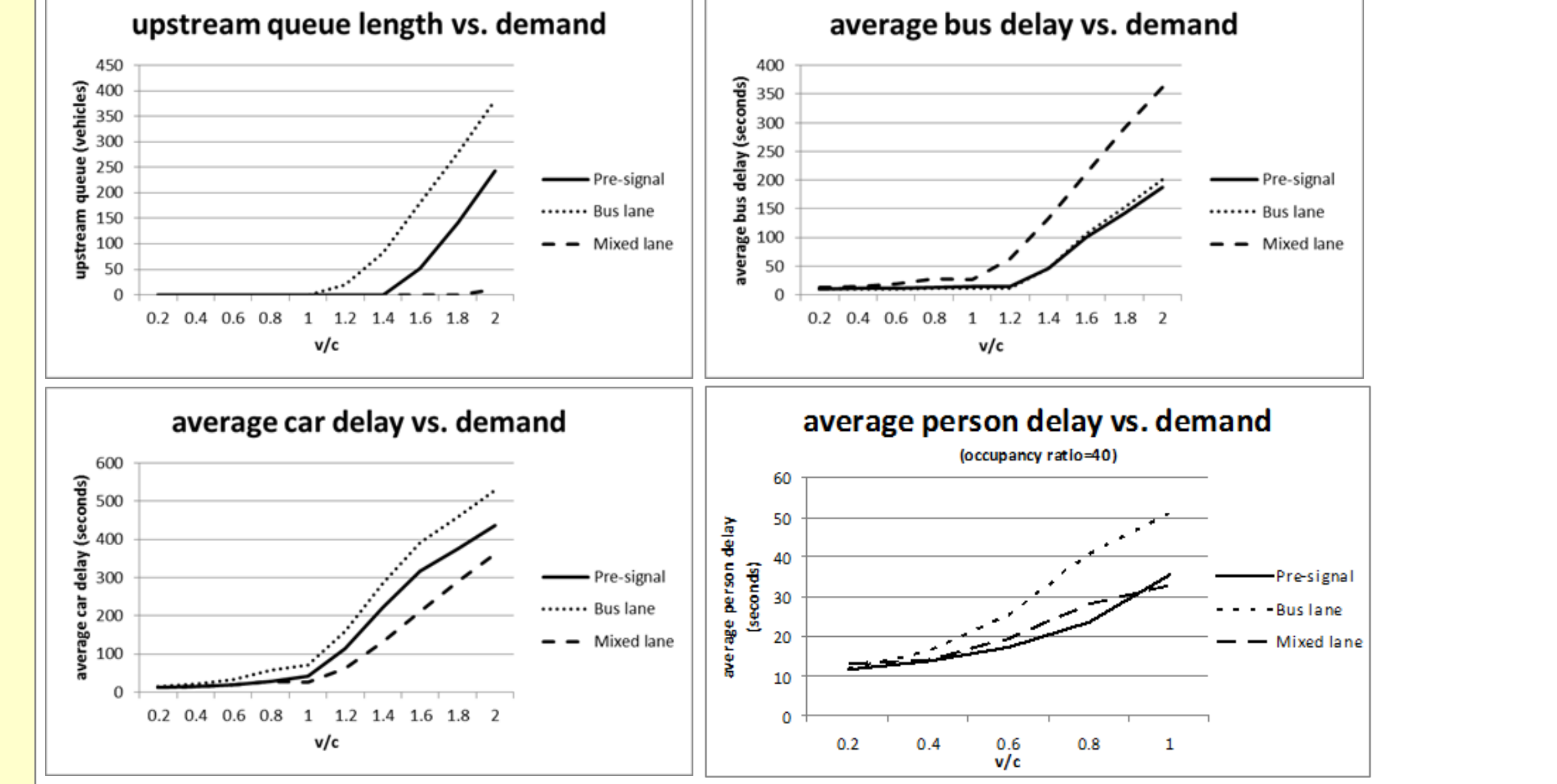
The dynamic pre-signal strategy

The dynamic operating strategy:

	V/C < 0.8	V/C > 0.8
Bus Lane	Closed to Cars	Open to Cars
Pre-Signal Operation	On	Off

Comparison of dynamic pre-signals to a static dedicated bus lane or mixed lanes:

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