

Smart Real-Time Transit Management Strategies in Mixed Traffic on Urban Arterials

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Issues of the current transit systems



Slow

Bus Stuck in Traffic - stock video by Chuck and Sarah Fishbein,
<https://www.gettyimages.ca/detail/video/bus-stuck-in-traffic-stock-video-footage/482494046>



Unreliable

Math explains why your bus route seems so unreliable by Gayah , V and Guler, S; <https://theconversation.com/math-explains-why-your-bus-route-seems-so-unreliable-95485>



Angry Person Cartoon,
https://www.clipartmax.com/middle/m2H7i8i8A0b1d3N4_anger-angry-person-cartoon/

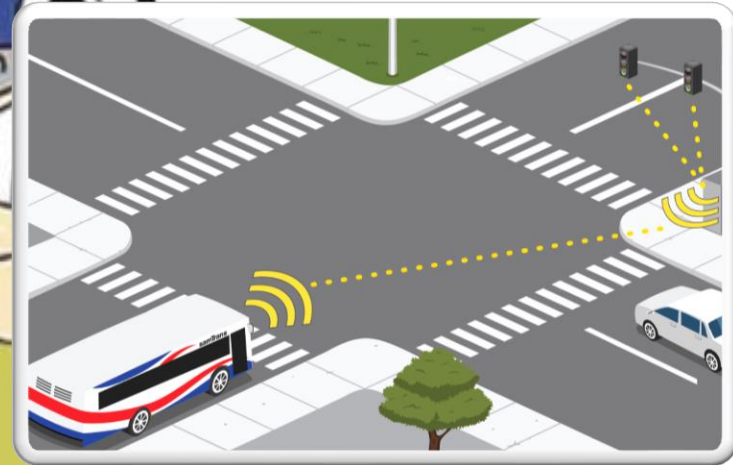
Traditional Transit Management Strategies



EBL (space priority)

reduce the road capacity for other road users, which increases traffic delays and queues

Scarborough's first priority bus lane route takes shape on Eglinton East, by Adler M;
<https://www.toronto.com/news-story/10205078-scarborough-s-first-priority-bus-lane-route-takes-shape-on-eglington-east/>



TSP (time priority)

increases traffic delay on the cross street.

El Camino Real Transit Signal Priority Project,
https://www.samtrans.com/Planning/Capital_Projects_and_Environmental_Planning/SignalPriority.html

Proposed Strategies

- Dynamic Transit Lanes
- Bus Platooning
- Speed Advisory system

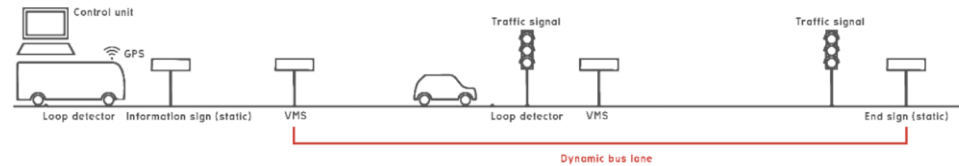
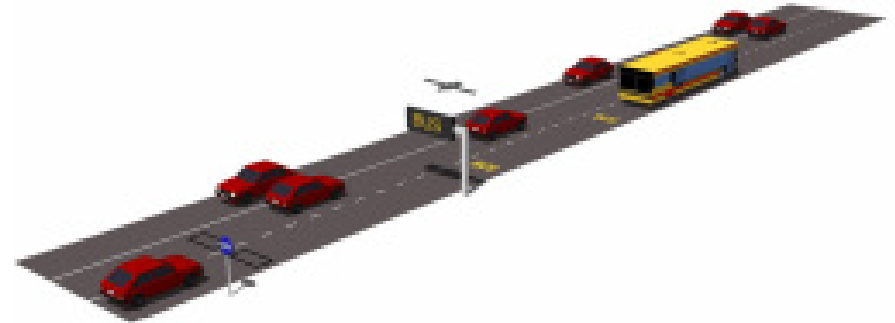
- **Objective:** Improve transit performance while mitigating the impact on the general traffic

The past, present, and future



EBLs

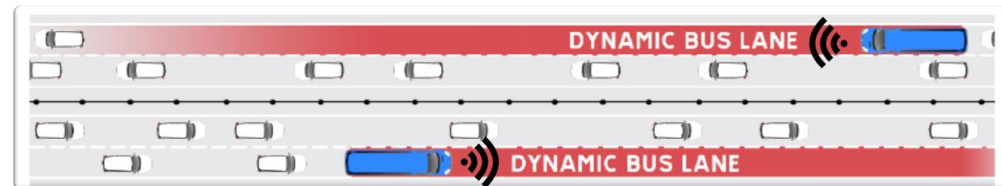
Transit Lanes & Transitways, <https://nacto.org/publication/transit-street-design-guide/transit-lanes-transitways/>



Intermittent Bus lanes

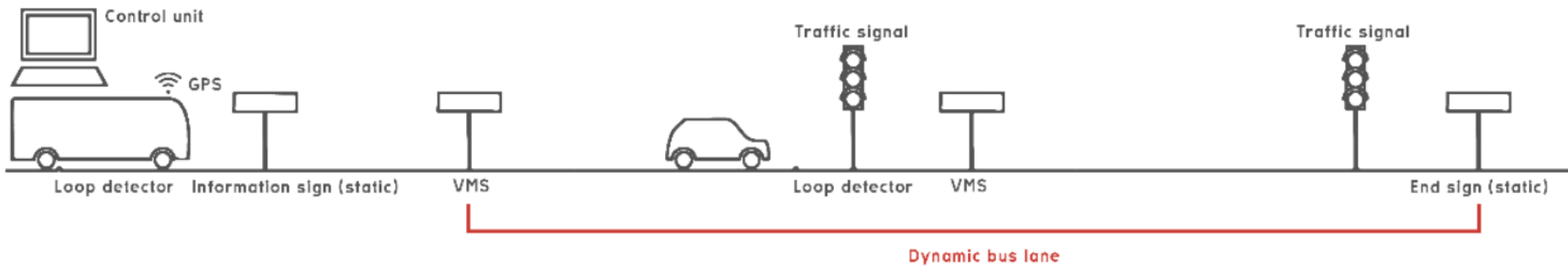


Lane allocation with CMS



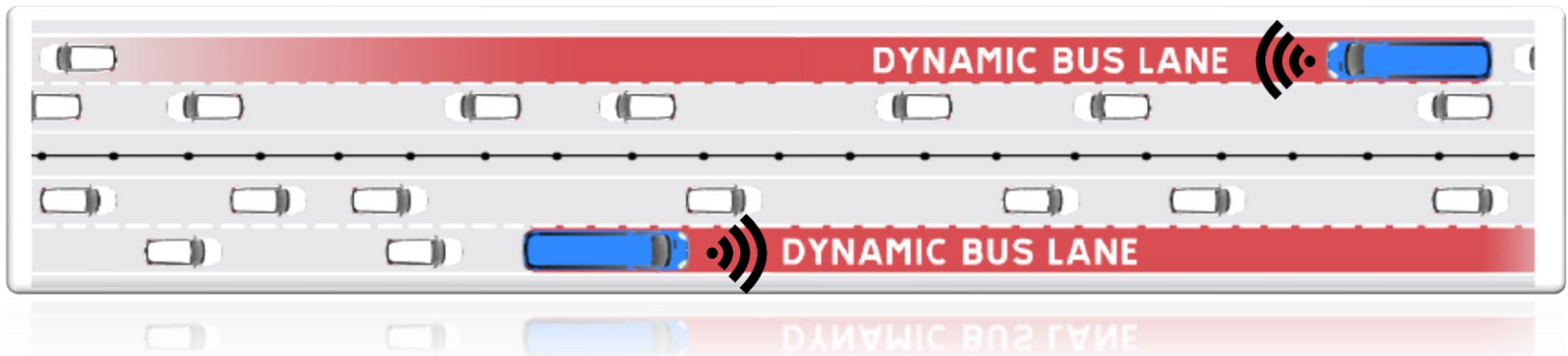
Dynamic Bus lane

Intermittent Bus Lanes



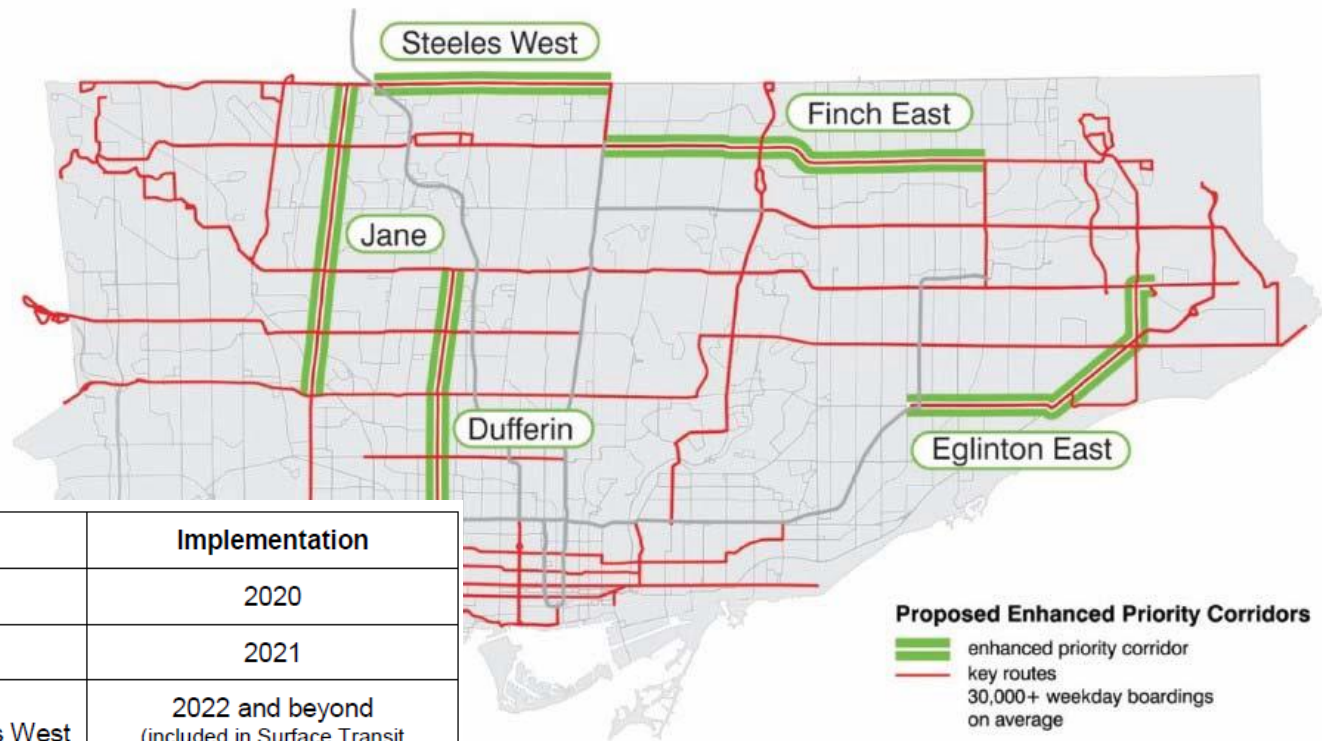
The future (DTLs)

- DTLs are lanes that are accessible to cars when transit is not present.
- Connected vehicles
- Similar to emergency vehicles (ambulance,...)



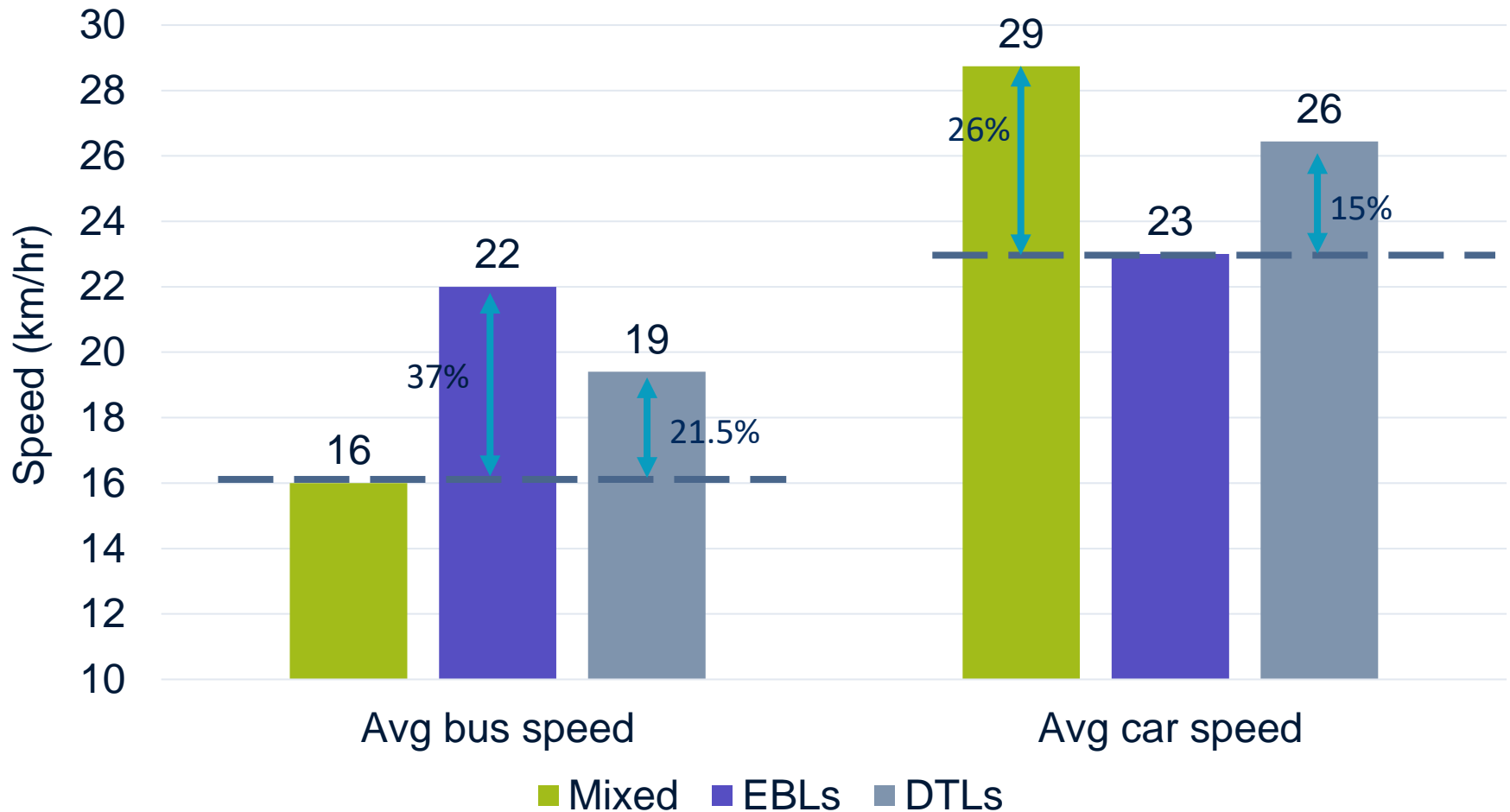
Simulation Case study-RapidTO- Eglinton E

- In December 2019, the Toronto Transit Commission (TTC) Board approved the TTC's 5-Year Service Plan.
- The TTC identified 5 corridors for the implementation of EBLs these corridors experience heavy vehicle and carry high volumes of transit passengers travel every weekday .



Priority	Corridor	Implementation
A	Eglinton East	2020
B	Jane Street	2021
C	Dufferin Street, Finch East, Steeles West	2022 and beyond (included in Surface Transit Network Improvement Study)

Simulation Results of Eglinton E



Bus Platooning- Motivation

- Platooning has been considered in multiple cities to provide additional capacity, especially after COVID-19

The TTC wants to test 'platoons' of



By **Ben Spurr** Transportation Reporter
Fri., Nov. 27, 2020 | 3 min. read

Article was updated Nov. 30, 2020



Challenges

One challenge is fluctuations in demand. The G Line passes by three colleges, and student ridership produces several peaks throughout the day in addition to the normal a.m. and p.m. peaks. Student demand is closely tied to class schedules and is different every quarter/semester, which makes it difficult to plan for. LA Metro has also observed that student demand is highest at the beginning of every semester and tends to decline as the semester goes on.

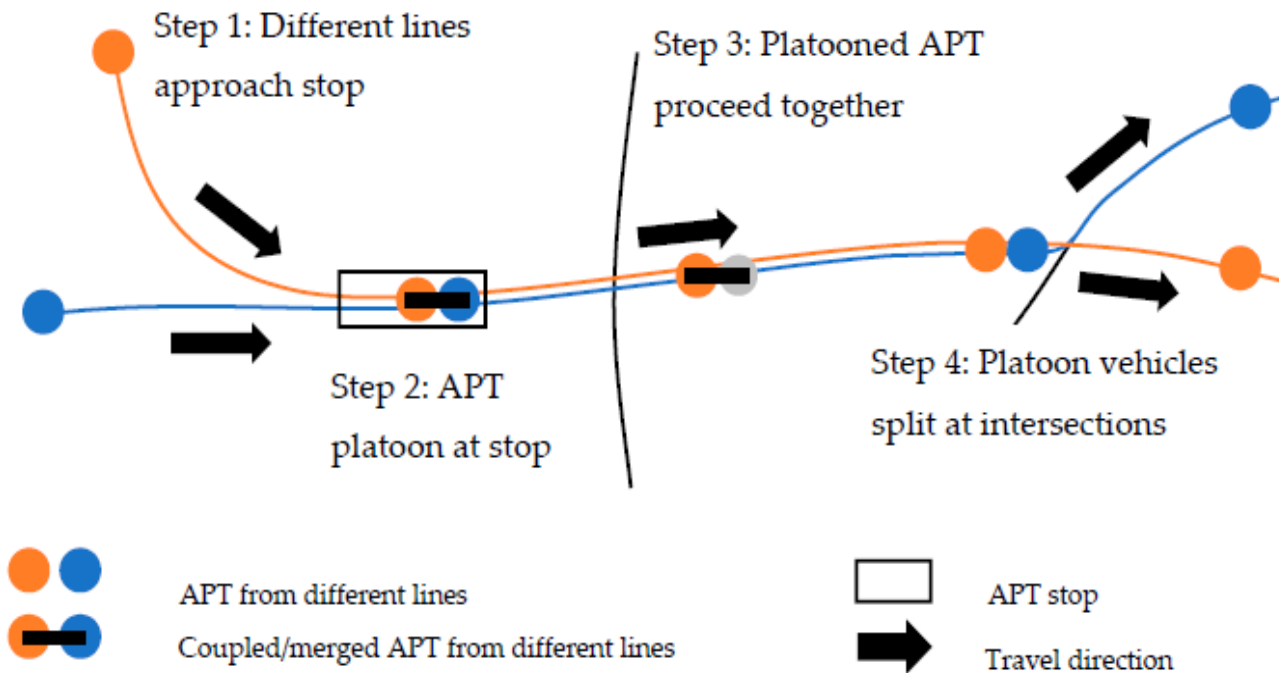
Another challenge is capacity. The G Line is close to capacity, but the constraints of TSP make it challenging to run headways shorter than 4 minutes. [LA Metro is exploring the idea of bus platoons](#), where two buses would run back to back and share station platforms and TSP calls, as a way to provide additional capacity. Another proposal to address the capacity issue is to convert the G Line to light rail.

As all transit agencies have done, LA Metro has made numerous changes in response to the ongoing COVID-19 pandemic. As of July 2020, LA Metro had made two service changes systemwide with one more planned for August. LA Metro has been monitoring ridership data on a weekly basis and deciding where to add or modify service. Previously, service updates were made every 6 months. The G Line is currently operating a Sunday schedule with 10-minute headways all day.

Ridership is down 70% systemwide, but service levels have been maintained somewhat higher to reduce passenger load and allow for social distancing. LA Metro is talking about a target of 75% passenger load for the August schedule update to balance social distancing needs with resource (bus and operator) constraints. All passengers are now required to wear masks. This rule is not really enforced due to operator concerns, but LA Metro estimates that 90% of passengers are wearing a mask. Still, LA Metro has received many passenger complaints about crowded buses and the risk of COVID exposure.

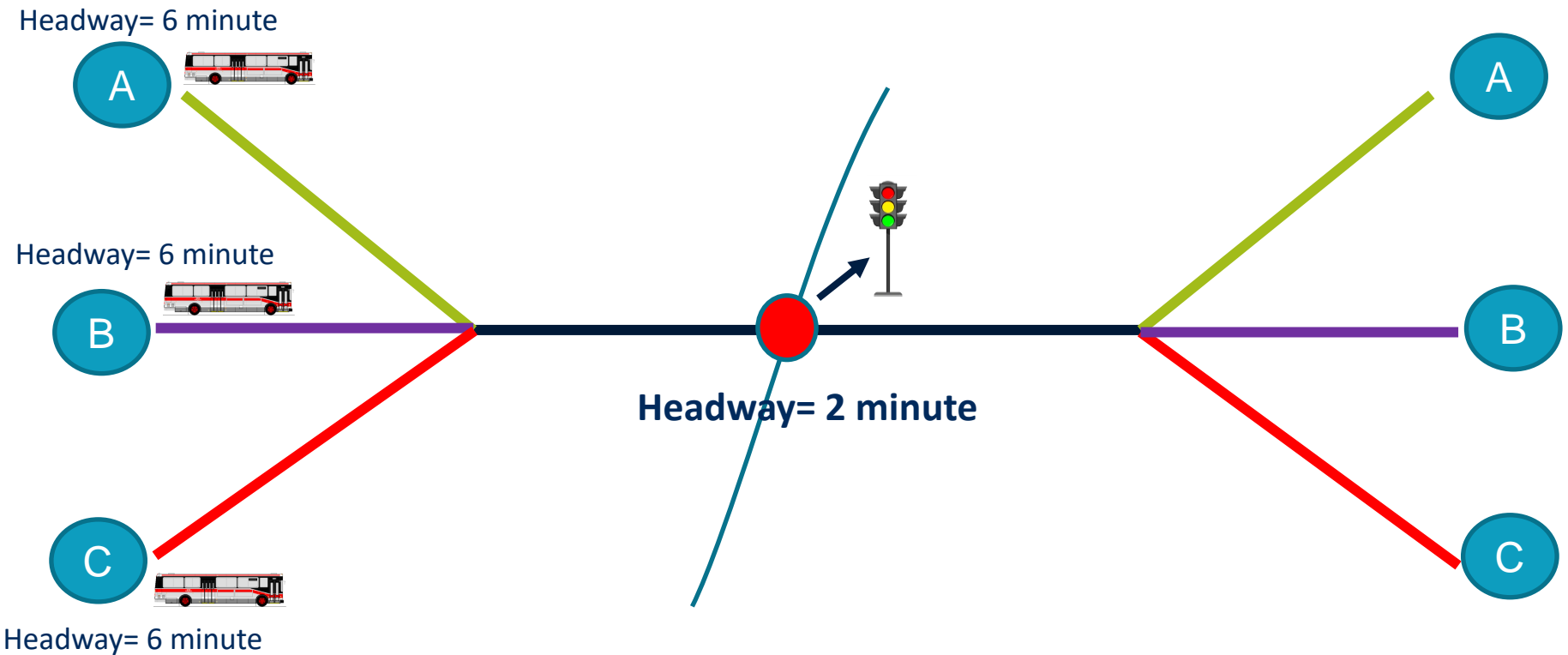
Bus Platooning

- Buses from multiple lines form a platoon before arriving at the intersection then receive one signal priority to facilitate the movement of the entire platoon through the intersection.



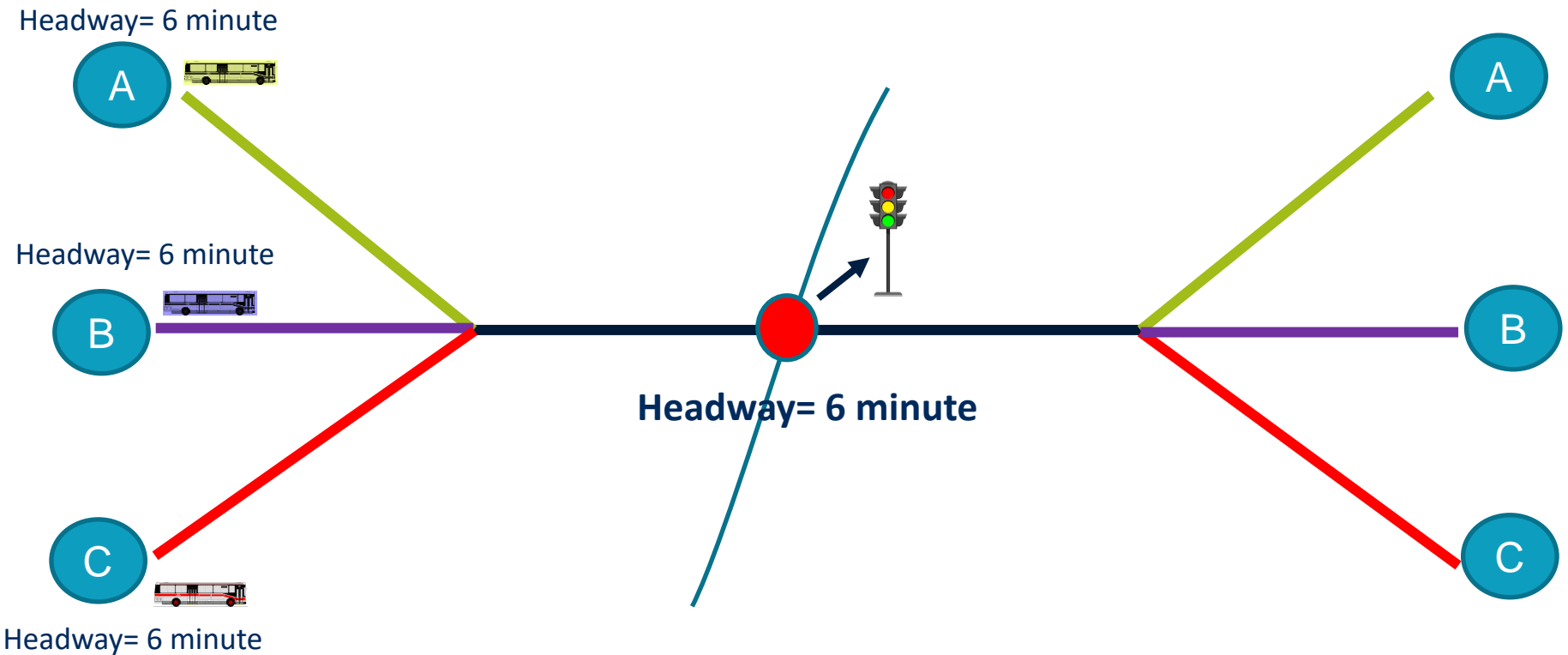
Benefits of Bus Platooning

1- Reduce the number of TSP calls so more efficient system for both traffic and transit.



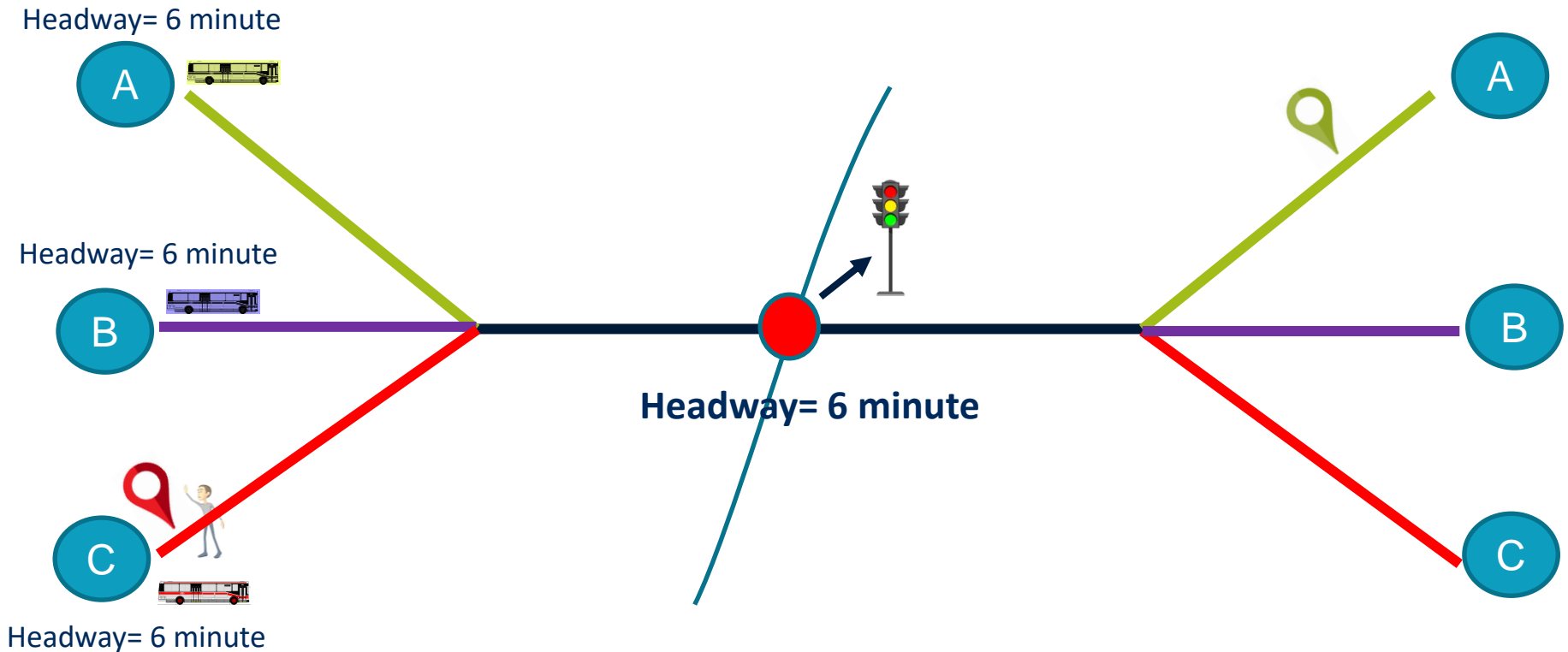
Benefits of Bus Platooning

1- Reduce the number of TSP calls so more efficient system for both traffic and transit.



Benefits of Bus Platooning

2- Transfer time between overlapping lines (Min)



Platooning-Technology

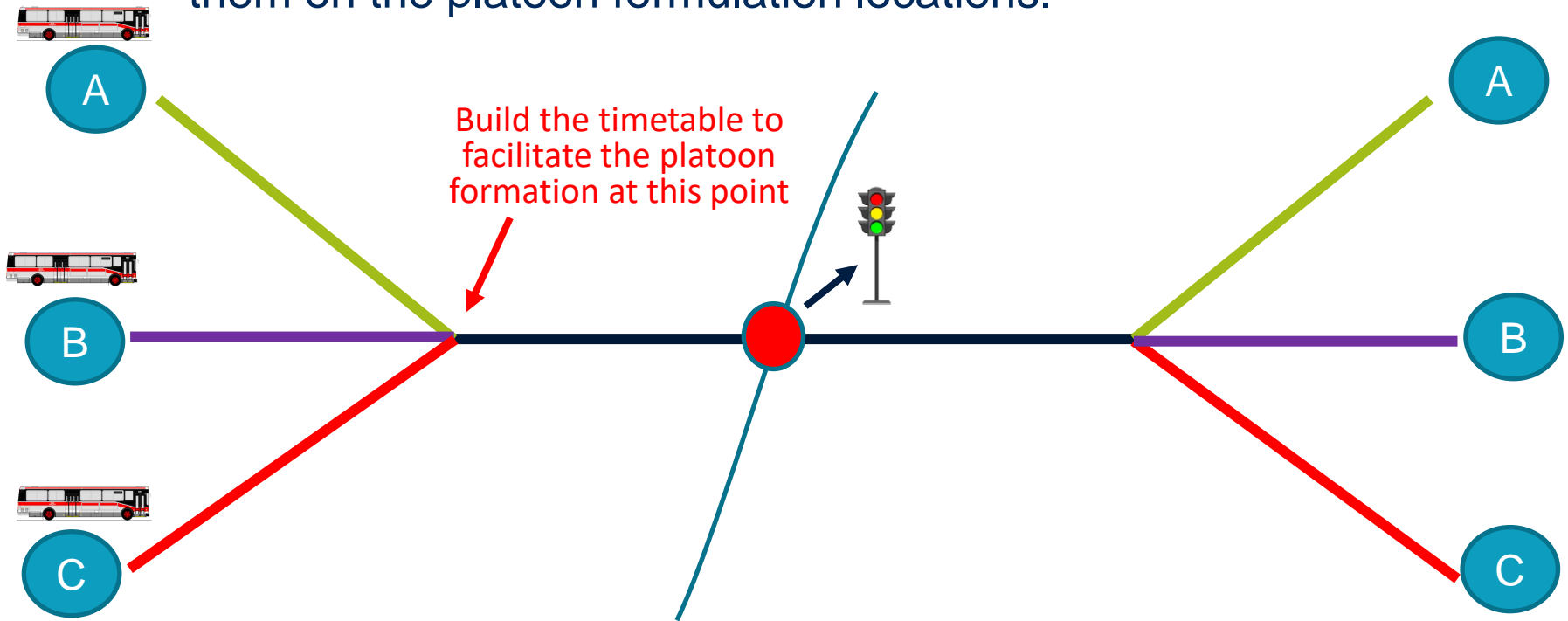
- The technology exist but never been used for transit



Platoon Formation

▪ Three stages to formulate the platoon:

- 1- Strategic planning: to coordinate timetables of different bus lines.
 - Instead of building the timetable at the terminals, we will build them on the platoon formulation locations.



Platoon Formulation

- **Three stages to formulate the platoon:**
 - 2- The tactical operation: to coordinate buses from different lines in real-time to ensure the planned platooning.
 - DTLs

 - 3- Local behavior: to operate individual buses to realize the platooning.
 - Make sure the platoon is formulated

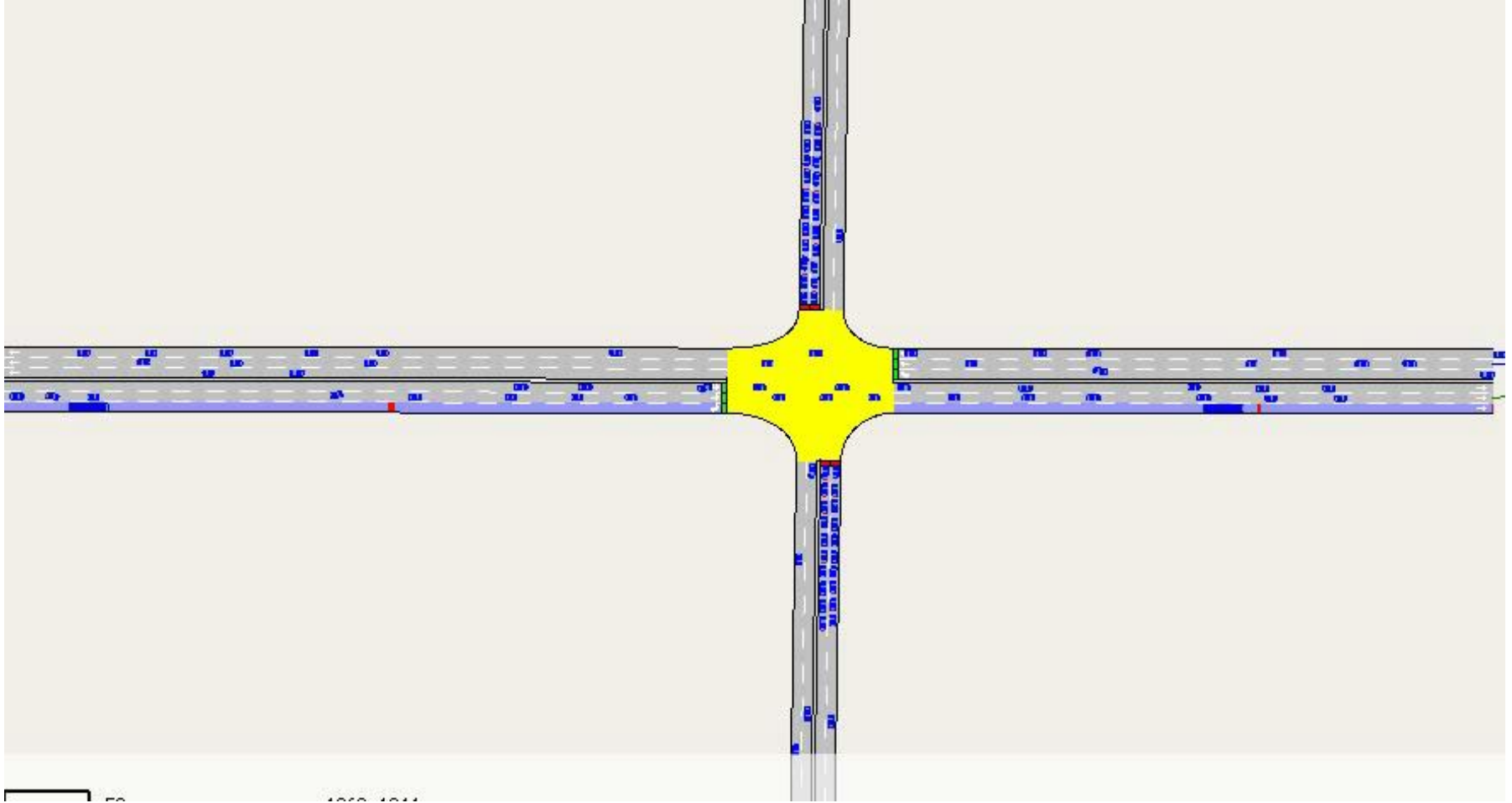
Platooning-Results

- In progress

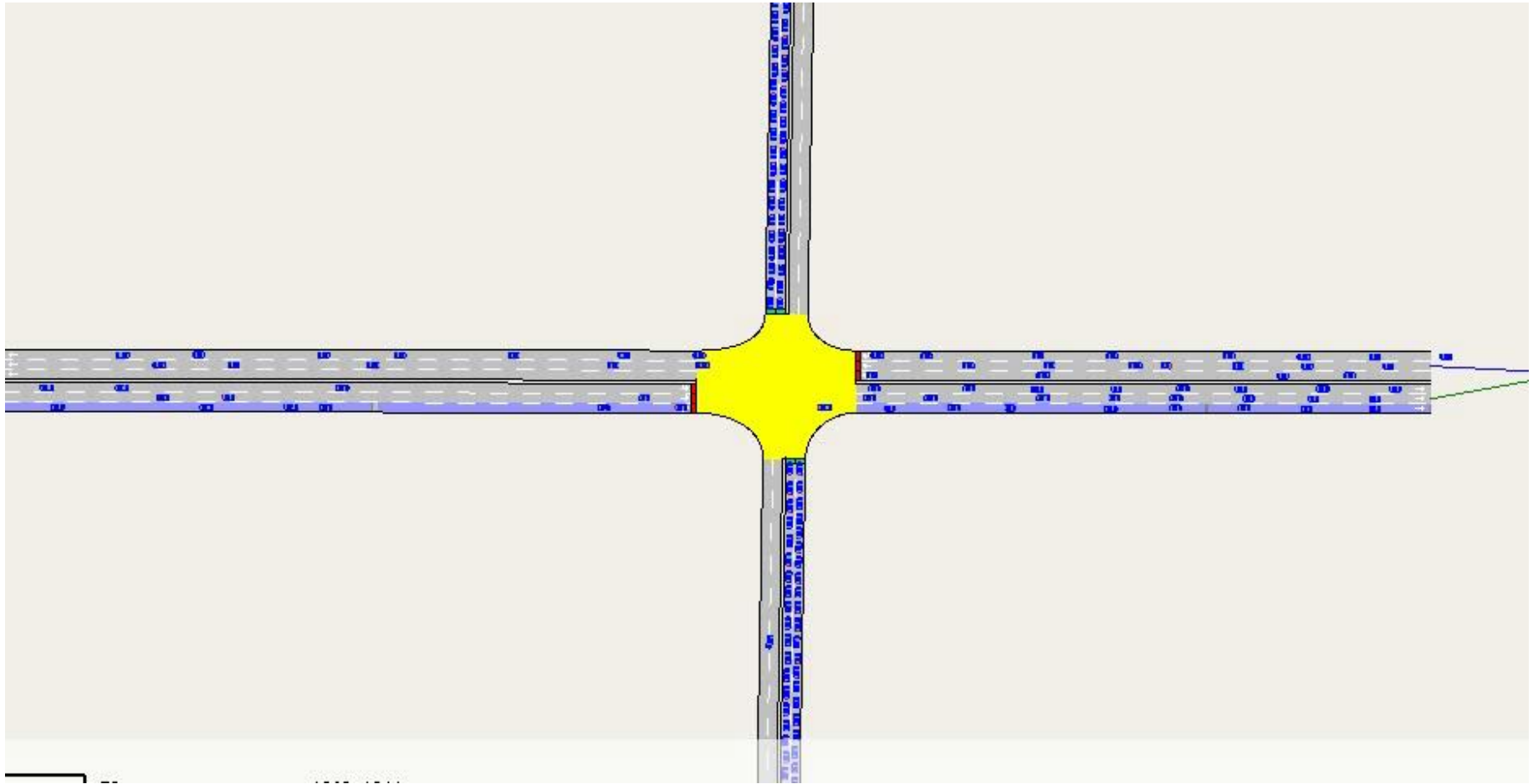


Questions

DTLs-Demo (Green Signal)



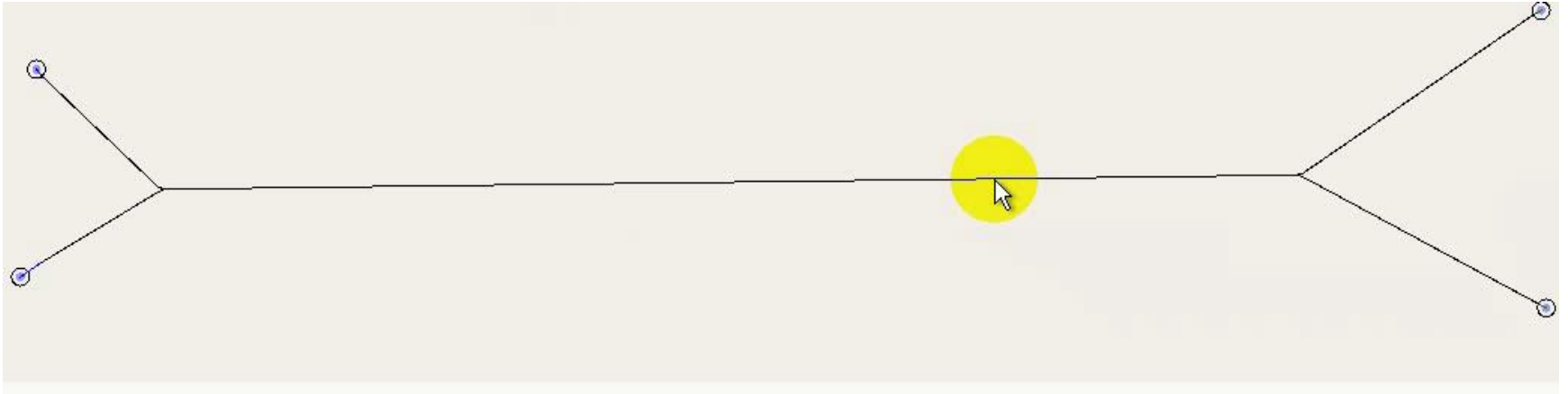
DTLs-Demo (Red Signal)



DTLs-Demo (Straight Section)

The screenshot displays a simulation software interface for a road layout. The main window shows a road with several blue vehicles. A yellow hand cursor is positioned over the road. The interface includes a menu bar (File, Edit, View, Arrange, Project, Tools, Data Analysis, Bookmarks, Window, Help), a toolbar with various simulation controls, and a right-hand sidebar with a project tree and layers panel. The project tree shows a hierarchy: PROJECT > DATA ANALYSIS > DEMAND DATA > INFRASTRUCTURE > SCENARIOS > Dynamic Sce. > Micro SRC > Replic. The layers panel shows Network, Decorati, and Groups. A message box at the bottom indicates "Traffic Condition deactivated. Reason: Trigger Off 1" and "Traffic Condition deactivated. Reason: Trigger Off 2". The Windows taskbar at the bottom shows the time as 5:20 PM on 2/1/2021.

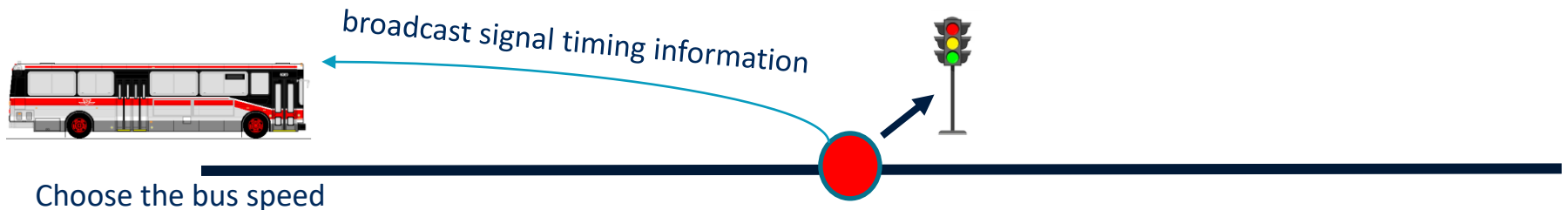
Platooning-Demo (Gap=0.8 sec)



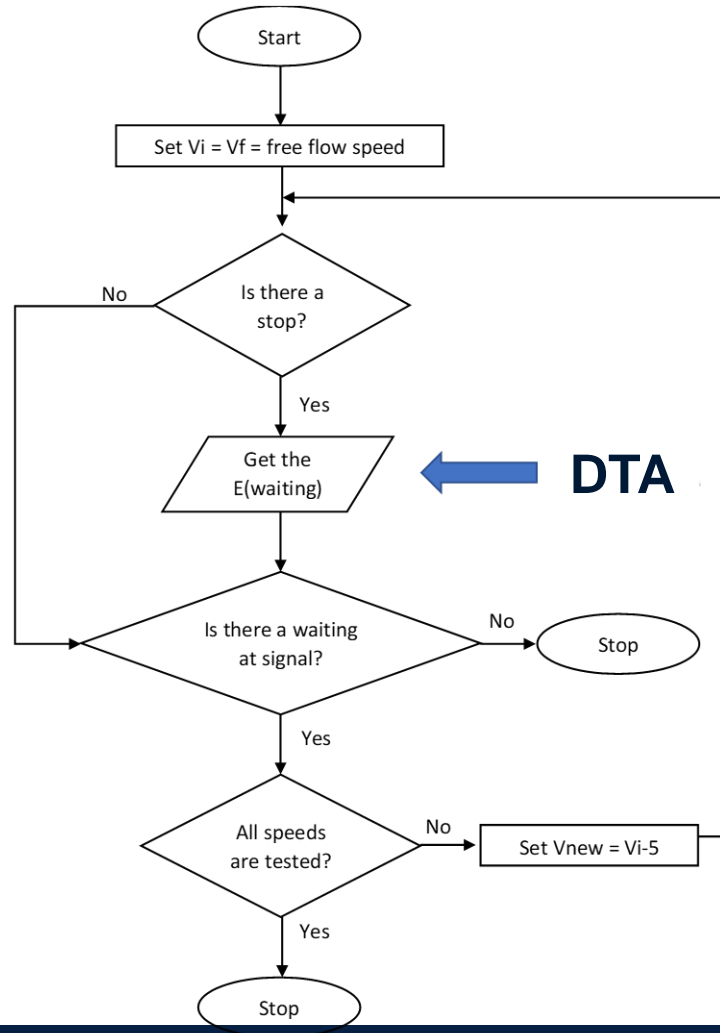
- In Progress, No results yet

Speed Advisory System

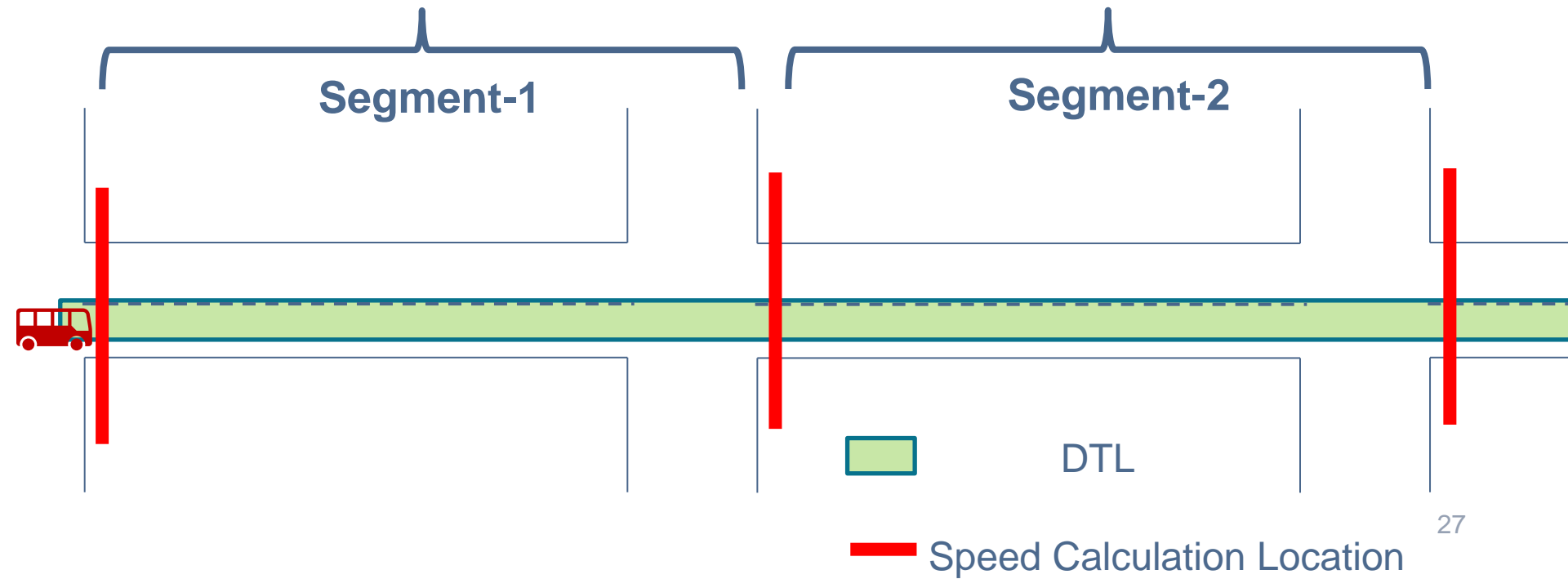
- Although TSP can generally improve transit performance, it increases the traffic delay on the cross street.
- In the near future, signals will be able to broadcast signal phase and timing status information to nearby vehicles.
- Allow buses to arrive at the intersections when the signal is green.



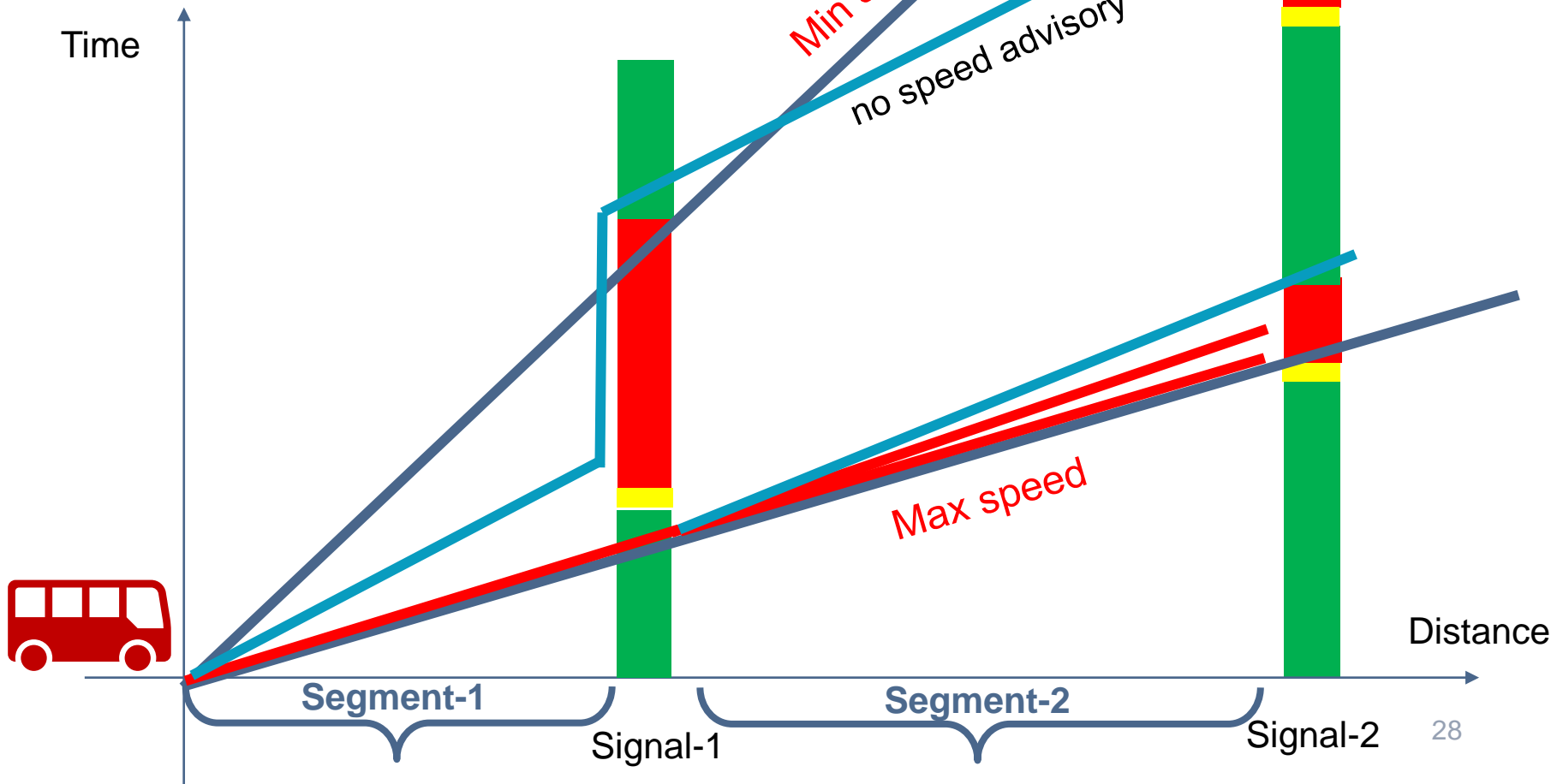
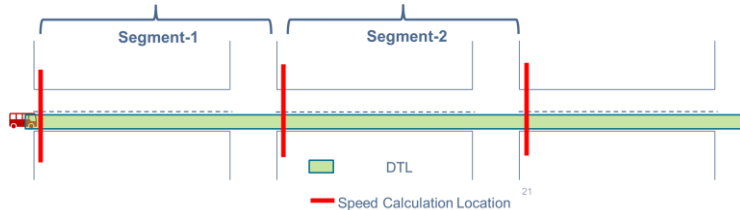
Speed Advisory System-Algorithm



Speed Advisory System-Example



Speed Advisory System



Speed Advisory System-Benefits

- Improve transit performance without modifying the signal timing.
- Thus, unlike TSP, they do not create any additional delays to the general traffic.
- Reduce the number of bus stops (Environment friendly)