

# **Public Transit:**

## **GGR424 - Transportation Geography & Planning**

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## What is public transit?

- ▶ Regularly scheduled vehicle trips
- ▶ Open to all paying passengers
- ▶ Can carry multiple passengers
- ▶ Whose trips may have different origins, destinations, and purposes

"transit is about multiple people riding in one vehicle even though they are not intentionally travelling together or even going to the same places"

Walker (2011)



## Public Transit Benefits: Efficiency



[https://www.reddit.com/r/Damnthat'sinteresting/comments/daugu5/public\\_transport\\_vs\\_private\\_transport/](https://www.reddit.com/r/Damnthat'sinteresting/comments/daugu5/public_transport_vs_private_transport/)

**What makes transit useful?** Seven demands of public transit:

1. It takes me *where* I want to go
2. It takes me *when* I want to go
3. It is a good use of my *time*
4. It is a good use of my *money*
5. It *respects* me in the level of safety, comfort, and amenity it provides
6. I can *trust* it
7. It gives me *freedom* to change my plans

Walker (2011)

## Components of a public transit system:

- ▶ **Network** - the combination of all connecting routes and stops
- ▶ **Routes** - connections between stops, usually fixed
- ▶ **Vehicles** - that traverse routes on set schedules
- ▶ **Stops** - where people access and exit the network, or transfer between routes



# Types of transit network layouts: Radial



<https://www.gotransit.com/en/trip-planning/system-and-route-map>

# Types of transit network layouts: Grid

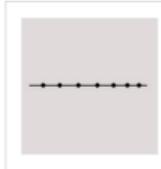


<https://www.ttc.ca/routes-and-schedules/>

# Types of transit network layouts: Circle-Radial



# Types of transit network layouts:



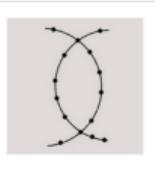
Line, e.g. Algiers, Almaty, Baltimore, Cleveland, Gwangju, Helsinki, Hiroshima, Jakarta, Kazan, Miami, Mumbai, Quito, Sydney, Yekaterinburg, Lima



Cross, e.g. Atlanta, Bangalore, Incheon, Kyoto, Monterrey, Nizhny Novgorod, Panama City, Philadelphia (SEPTA), Rotterdam, Sendai, Warsaw



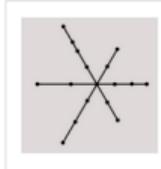
X-shaped, e.g. Amsterdam, Brussels, San Francisco Bay Area, Stockholm, Thessaloniki



Two crossing paths (air bladder), e.g. Cairo, Chennai, Lille, Marseille, Montreal, Nanchang, Nuremberg, Rotterdam, Toronto



Secant, e.g. Athens, Budapest, Busan, Guadalajara, Kharkiv, Hyderabad, Lisbon, Milan, Munich, Philadelphia (including PATCO), Prague, Rome, São Paulo, Tashkent



Radial, e.g. Boston, Budapest, Buenos Aires, Chicago, Daegu, Kyiv, Los Angeles, Sapporo, Tehran, Washington



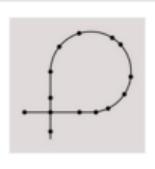
Circle, e.g. Glasgow



Circle-radial, e.g. Bangkok, Beijing, Bucharest, Chengdu, Chongqing, Copenhagen, Delhi, Hamburg, London, Madrid, Moscow, Nagoya, Paris, Seoul, Shanghai, Singapore, Tokyo, Zhengzhou



Complex grid, e.g. Barcelona, Berlin, Guangzhou, Hangzhou, Hong Kong, Mexico City, Milan, Nanjing, New York, Osaka, Shenzhen, Taipei, Tianjin, Wuhan, Vienna



Extended loop, e.g. Sofia, Naples, Newcastle

## Routes Characteristics:

- ▶ Technology
- ▶ Level of separation from other transport
- ▶ Capacity
- ▶ Comfort/Safety
- ▶ Frequency
- ▶ Stop Spacing
- ▶ Reliability
- ▶ Network hierarchy



## Routes - Technology



## Routes - Level of separation from other transport

1. Completely separated (can be above, below, or at ground-level)
  - ▶ e.g. TTC Subway Lines
2. Separated from other traffic, but with at-grade crossing
  - ▶ e.g. Spadina Streetcar, Eglinton LRT, Highway 7 BRT
3. Shared with traffic
  - ▶ e.g. Most TTC bus and streetcar routes



## Routes - Level of separation from other transport

1. Completely separated (can be above, below, or at ground-level)
  - ▶ many names, e.g. Rapid Transit, Metro, Underground, Heavy Rail, etc.
  - ▶ Run in exclusive Rights Of Way (ROW)



## Routes - Level of separation from other transport

### 2. Separated from other traffic, but with at-grade crossing

- ▶ LRT (Light Rail Transit)
- ▶ BRT (Bus Rapid Transit)



[https://en.wikipedia.org/wiki/Light\\_rail](https://en.wikipedia.org/wiki/Light_rail)

## Routes - Level of separation from other transport

### 2. Separated from other traffic, but with at-grade crossing

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## Routes - Level of separation from other transport

### 3. Shared with traffic



## Routes - Capacity

Can be measured per vehicle, or per route in a given time (e.g. an hour)



[https://en.wikipedia.org/wiki/Medellin\\_Metro](https://en.wikipedia.org/wiki/Medellin_Metro)



# Routes - Comfort & Safety

Some components can be measured like crowding, but many are subjective

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## Quarter of TTC surface routes regularly exceed crowding standards

TTC numbers show that 43 of roughly 155 bus and streetcar routes exceed the transit agency's crowding standards at some point during the week.

By [Ben Spurr](#) Transportation Reporter  
▲ Fri., Nov. 18, 2016 | 4 min. read

 [READ THE CONVERSATION](#)



## example of a TTC stop schedule (501)

### Routes - Frequency

In transit planning & operations, frequency is often measured by a routes scheduled **headway**, the time between vehicles

"Frequency is freedom" - Walker

5 AM	5:30	5:38	5:46	5:48	5:55	
6 AM	6:03 6:51	6:11 6:59	6:19	6:27	6:35	6:43
7 AM	7:07	7:15	7:26	7:36	7:44	7:52
8 AM	8:01 8:49	8:09 8:57	8:17	8:25	8:33	8:41
9 AM	9:05 9:53	9:13	9:21	9:29	9:37	9:45
10 AM	10:01 10:47	10:09 10:55	10:17	10:25	10:30	10:39
11 AM	11:03 11:51	11:11 11:59	11:19	11:27	11:35	11:43
12 PM	12:07 12:55	12:15	12:23	12:31	12:39	12:47
1 PM	1:03 1:51	1:11 1:59	1:19	1:27	1:35	1:43

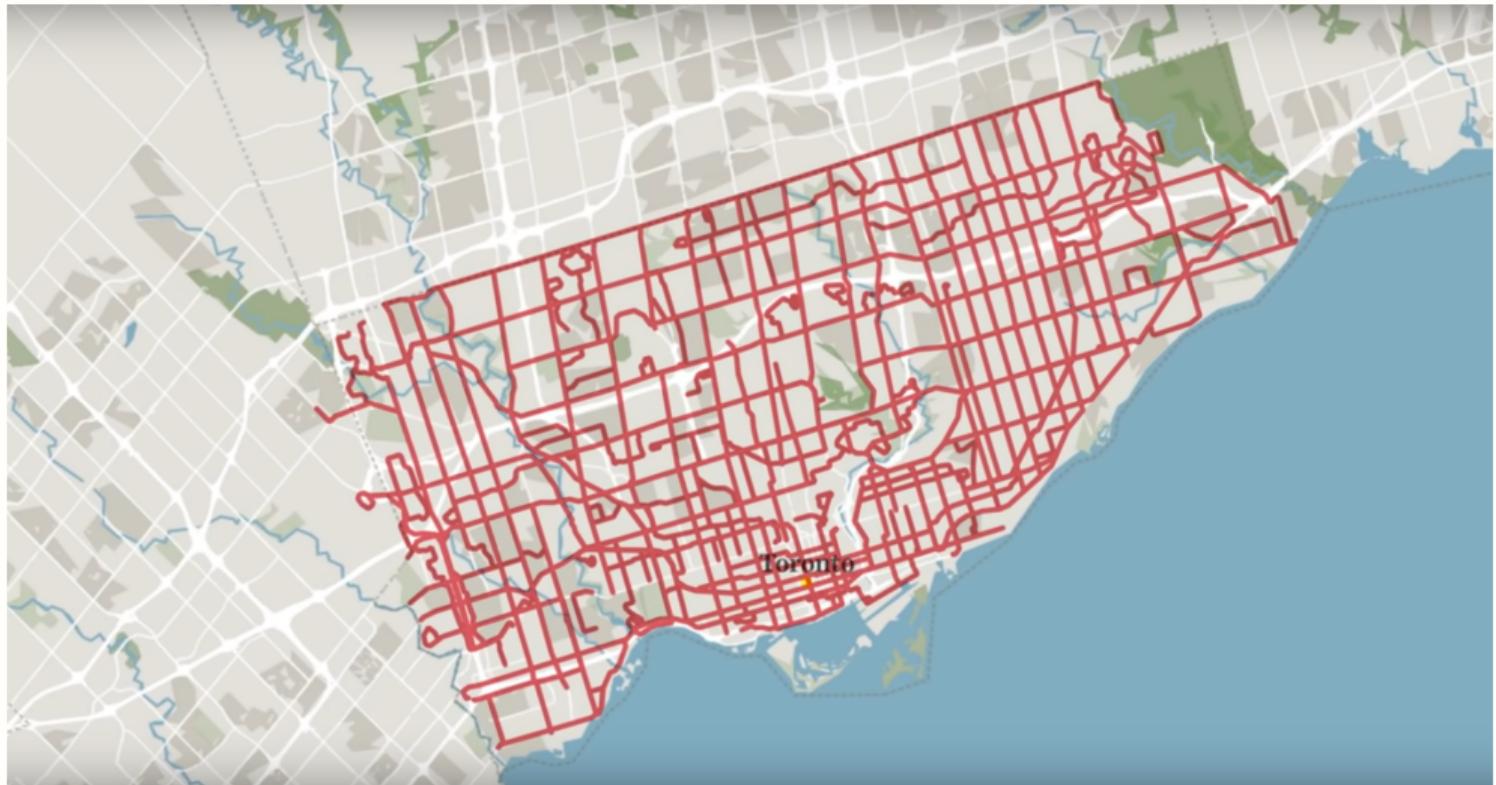
## Routes - Frequency

e.g. bus that comes every 30 minutes, until midnight, 7 days a week:



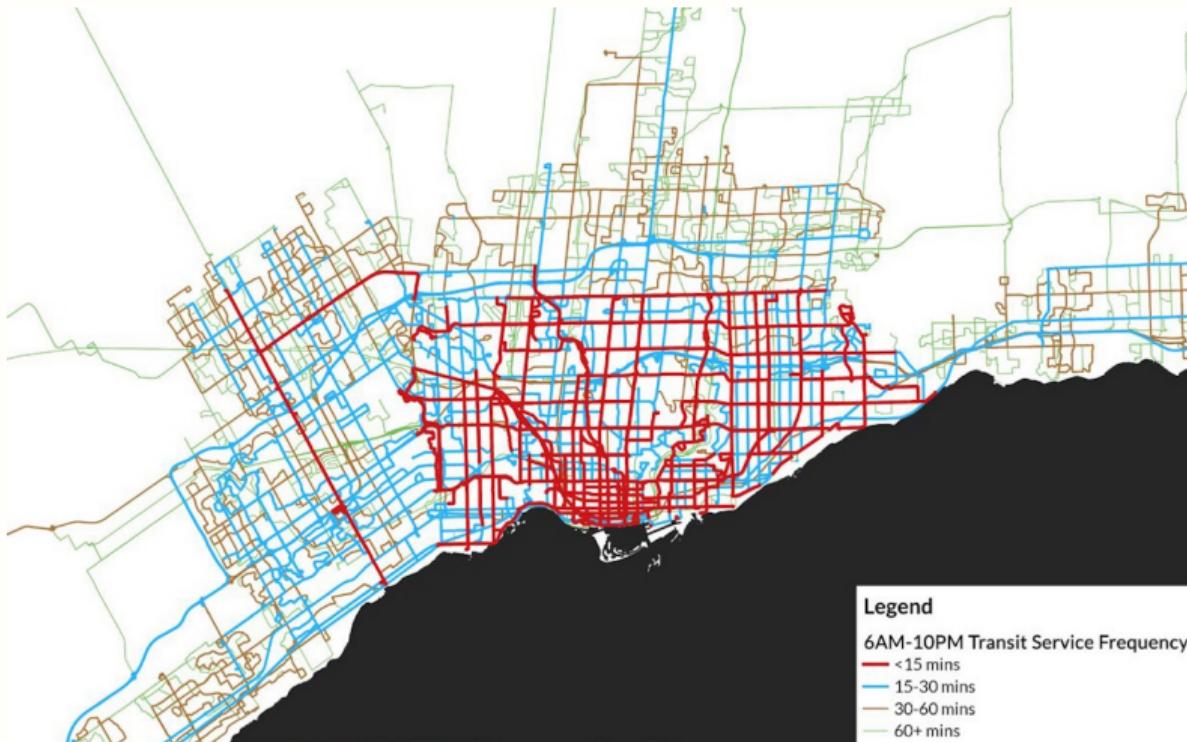
<https://www.youtube.com/watch?v=-ZDZtBRTyeI>

## Routes - Frequency



<https://www.youtube.com/watch?v=-ZDZtBRTyeI>

## Routes - Frequency

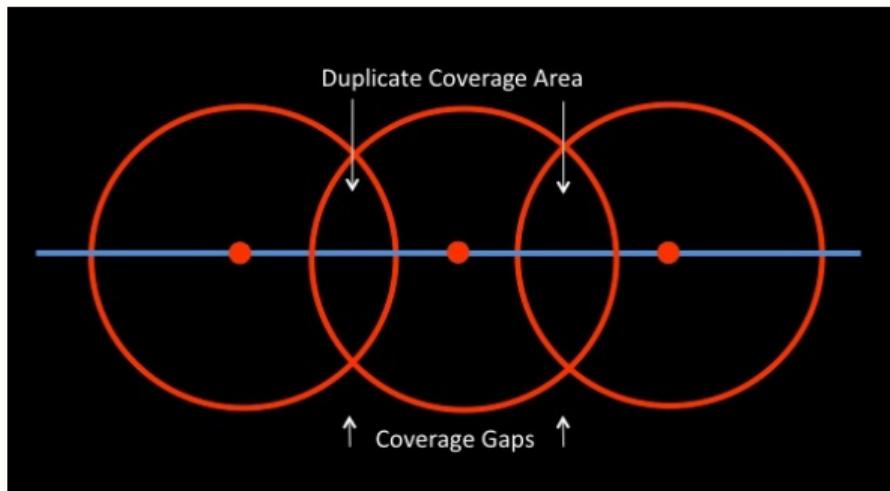


<https://urbantoronto.ca/news/2021/11/board-trade-urges-frequent-transit-service-across-region>

## Routes - Stop Spacing

TTC Bus & Streetcar routes have stops every 100m-300m

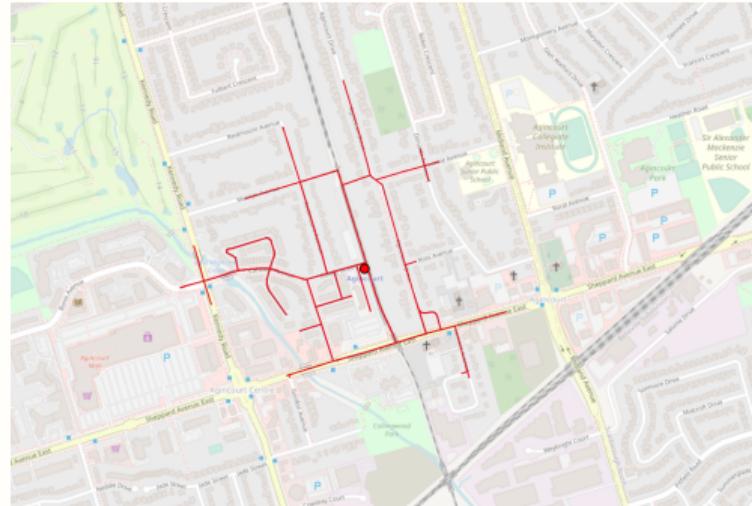
More stops means better local access, but reduced speeds and longer travel times because the vehicle needs to make more stops. i.e. a trade-off.



<https://humantransit.org/2010/11/san-francisco-a-rational-stop-spacing-plan.html>

## Routes - Stop Spacing

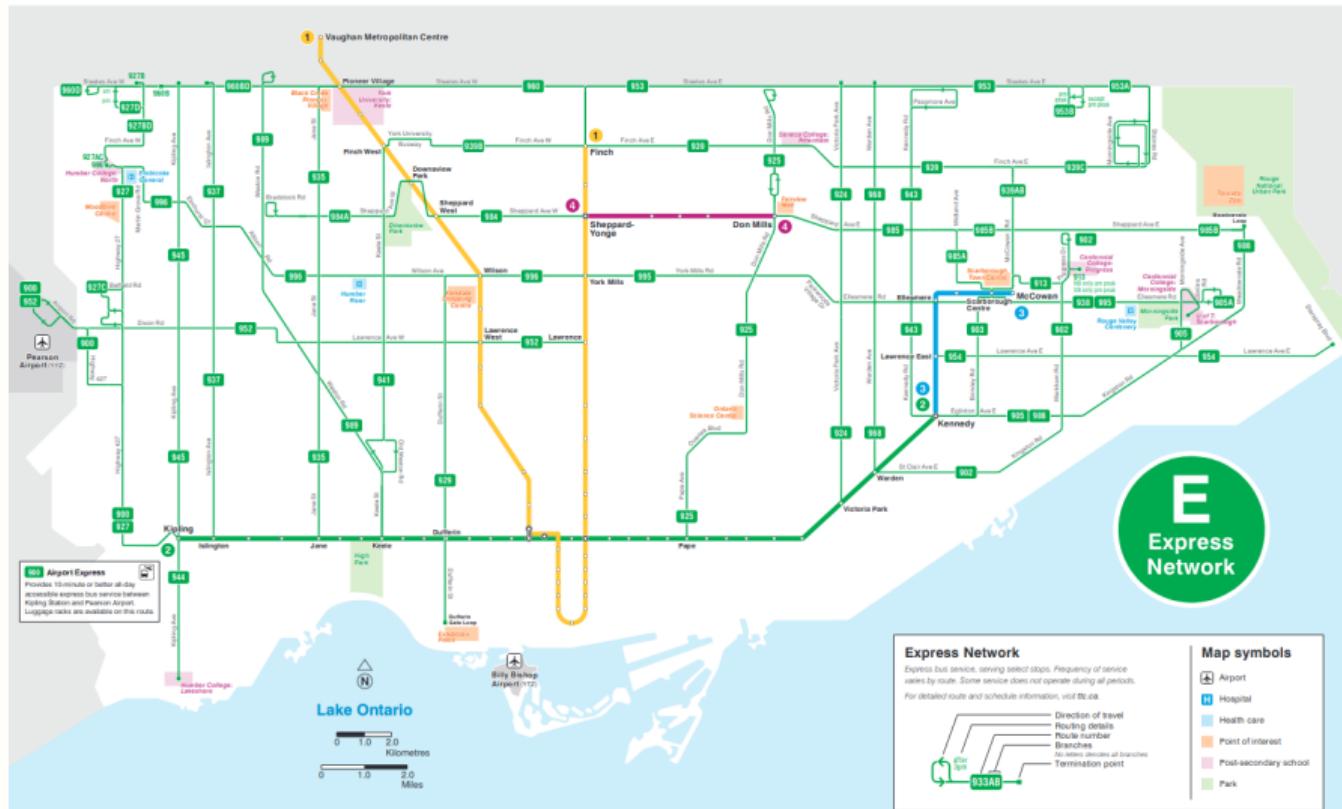
Local access to a stop depends on urban form / street networks (more on this next week)



# Routes - Stop Spacing, e.g. having "express" and "local" buses



Express Network Map



# Routes - Reliability

Does the vehicle arrive on time?

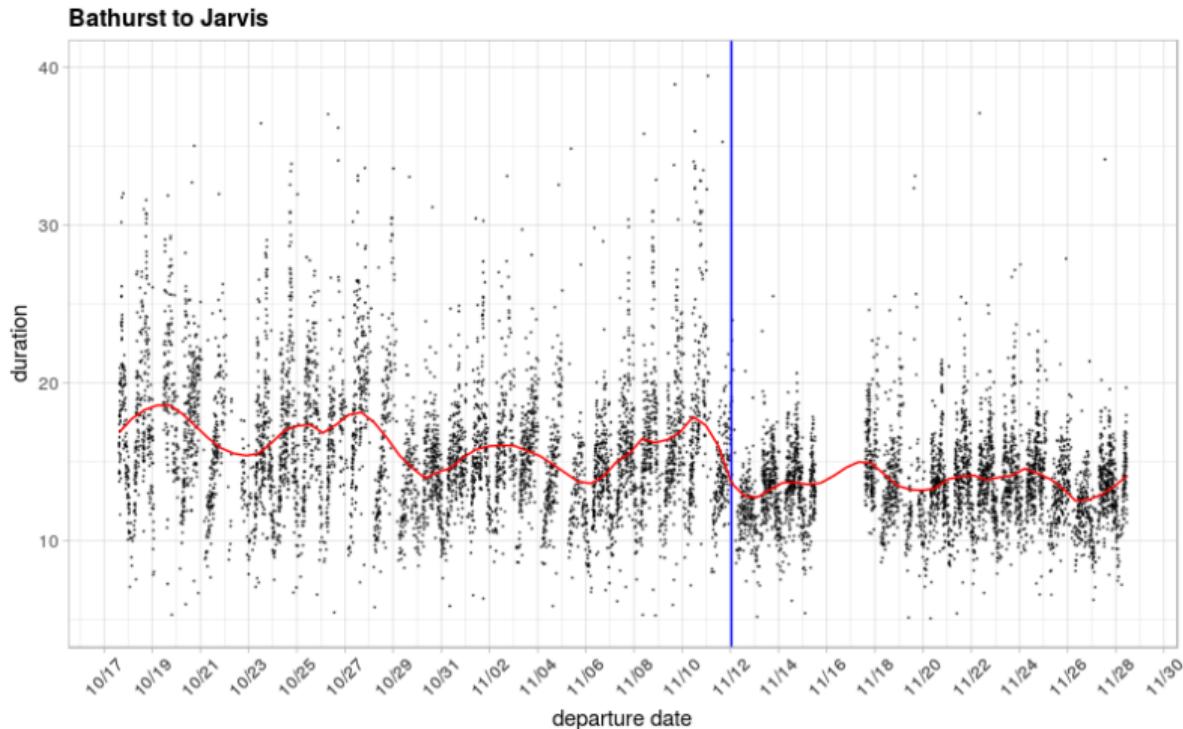


Sort

Sort

## Routes - Reliability

Expected travel times, e.g. along King Street before and after reducing traffic:



## Routes - Reliability

What causes "bus bunching"?



# Routes - Reliability

What causes "bus bunching"?

Why do buses bunch?

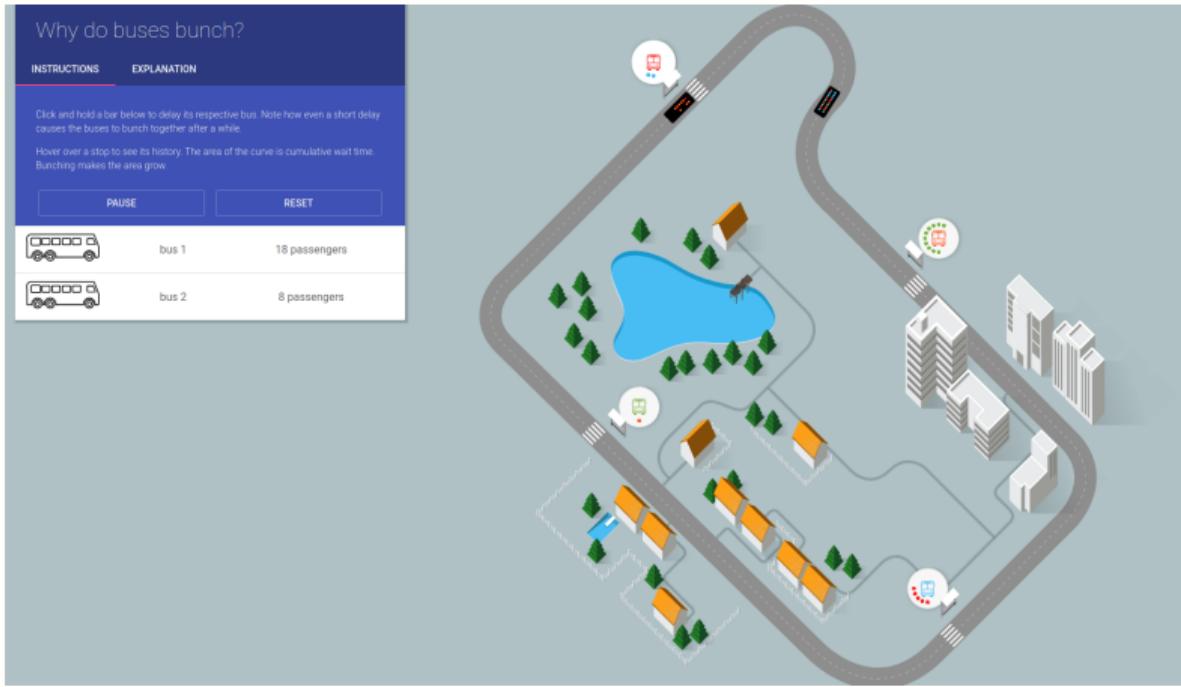
INSTRUCTIONS EXPLANATION

Click and hold a bar below to delay its respective bus. Note how even a short delay causes the buses to bunch together after a while.

Hover over a stop to see its history. The area of the curve is cumulative wait time. Bunching makes the area grow.

PAUSE RESET

 bus 1	18 passengers
 bus 2	8 passengers



The simulation illustrates the concept of bus bunching. Two buses, bus 1 and bus 2, are shown on a route that includes a sharp turn. Bus 1 is delayed at a stop near a lake, causing it to fall behind bus 2. As bus 1 continues, it reaches another stop where bus 2 is also waiting. This creates a 'bunch' of buses at that location. The simulation allows users to delay buses by clicking and holding bars below them, demonstrating how even small delays can lead to significant bunching over time. The area of the curve on the road map represents the cumulative wait time, which grows as more buses bunch together.

<https://setosa.io/bus/>

**Routes** - Unreliability affects wait times:

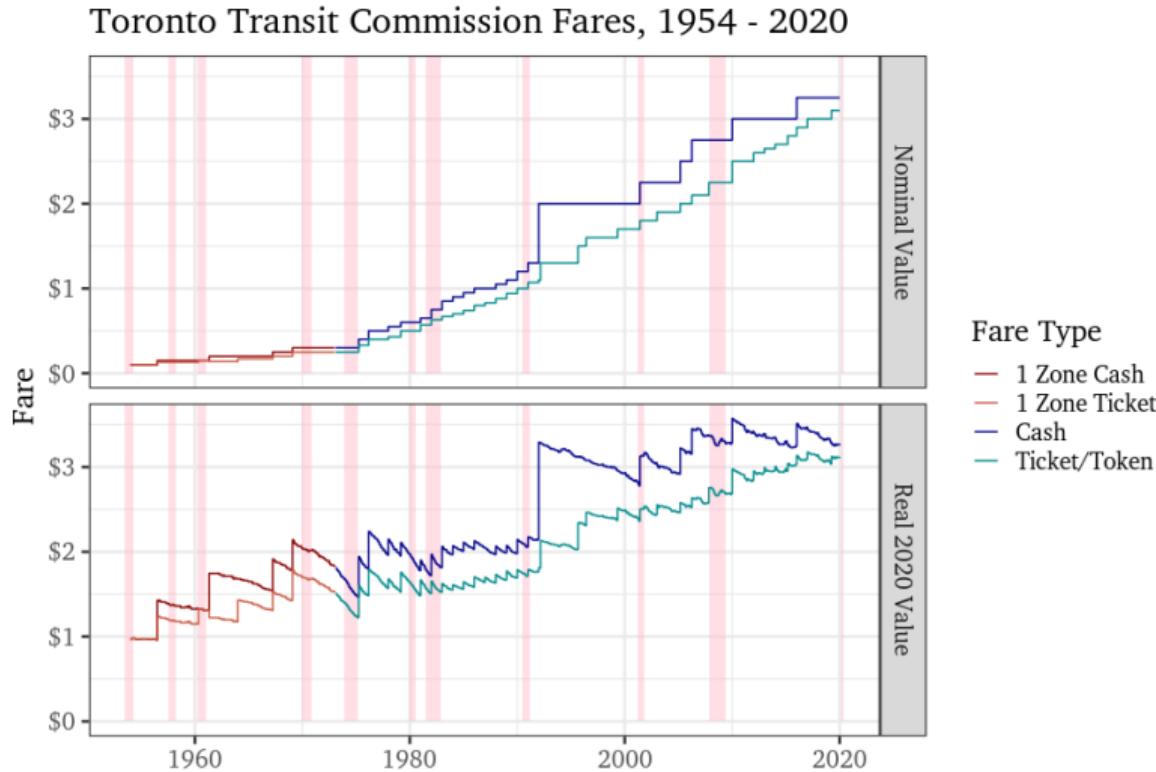
## Fare Types

- ▶ Flat fares (e.g. TTC)
- ▶ By distance (e.g. GO Transit)
- ▶ By zone
- ▶ Daily/weekly/monthly passes
- ▶ Discounts (e.g., child, students, senior, low-income)
- ▶ No fare

## Payment Technology

- ▶ Cash
- ▶ Tokens/Tickets
- ▶ Card (can be tap on only, or tap on and off)

## Fares - e.g. TTC Fares over time



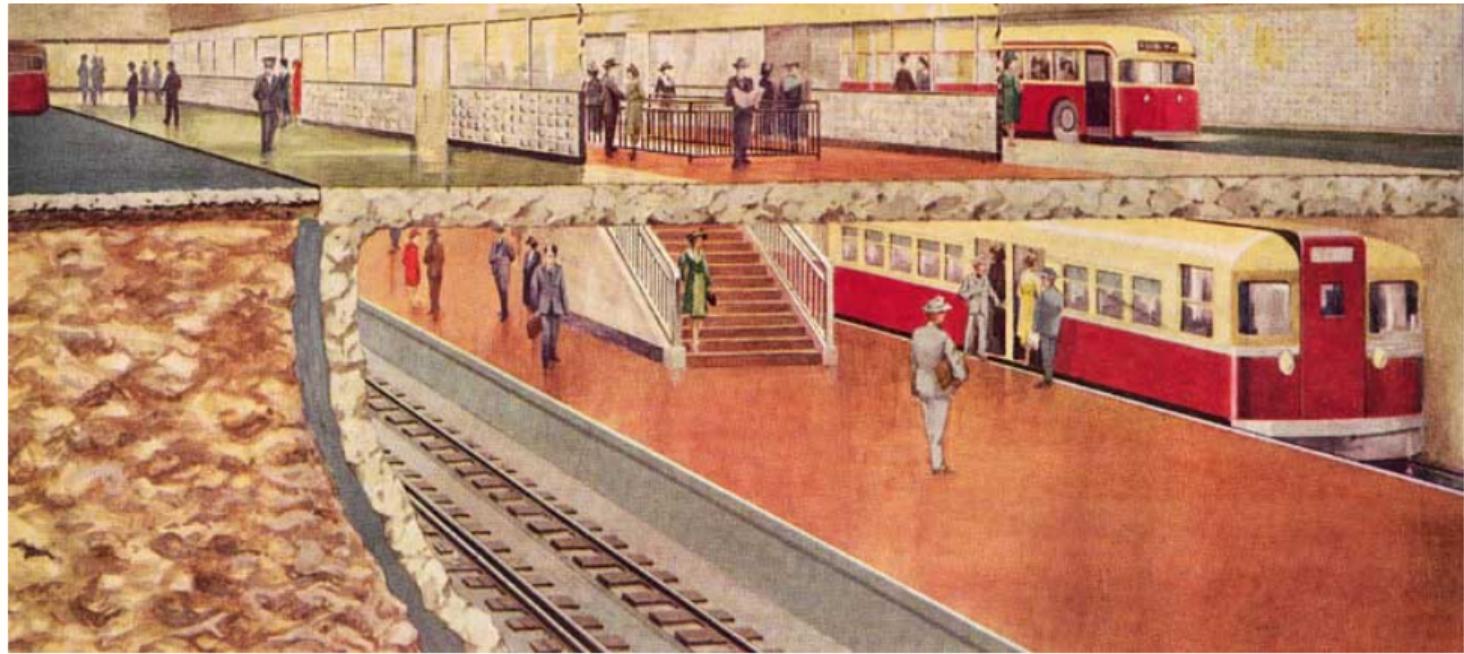
## Stops - Local Stops



## Stops - Transferring

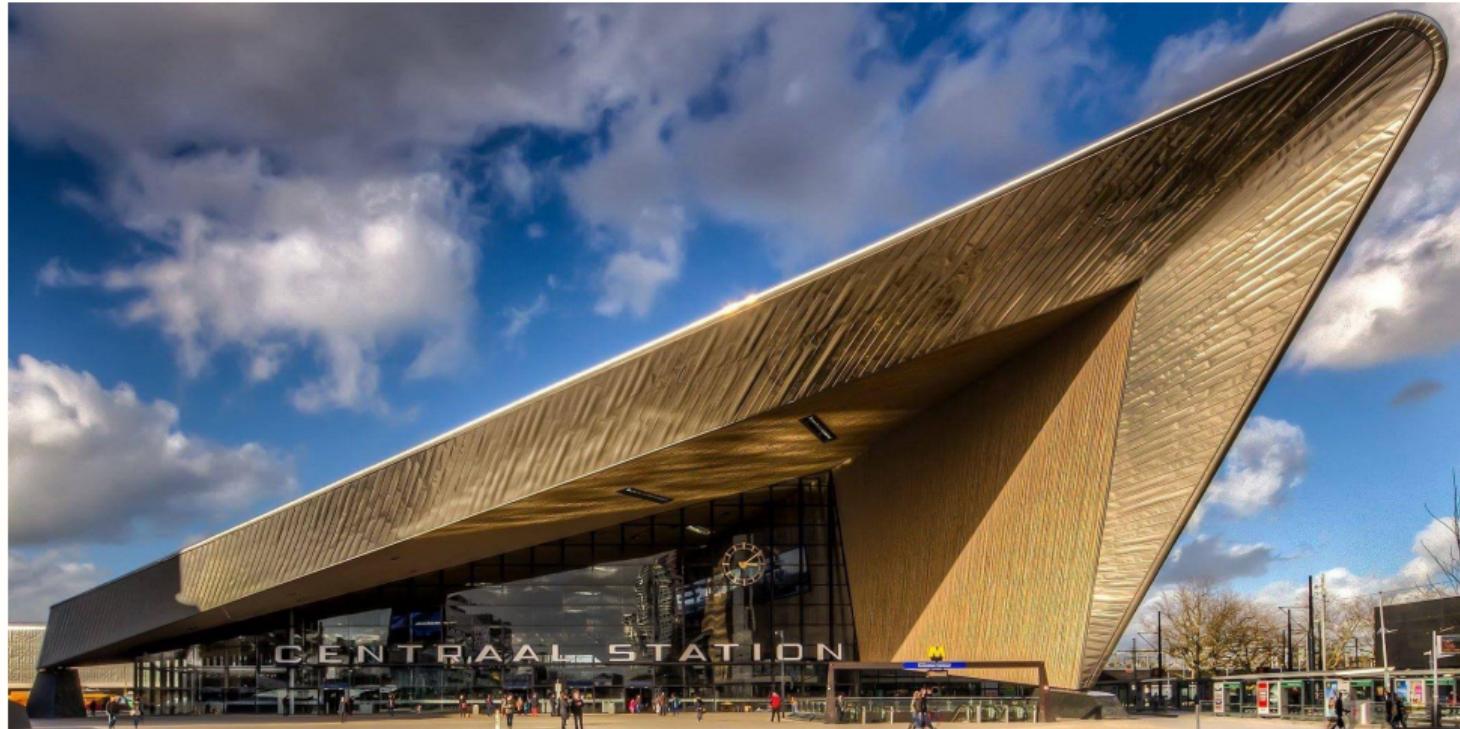


## **Stops - Major stations are key transferring locations**



<https://www.toronto.ca/explore-enjoy/history-art-culture/online-exhibits/web-exhibits/web-exhibits-transportation/canadas-first-subway/canadas-first-subway-why-a-subway/>

**Stops** - Major stations can be iconic public spaces:



[https://www.reddit.com/r/architecture/comments/20ceny/the\\_new\\_rotterdam\\_central\\_train\\_station\\_opened/](https://www.reddit.com/r/architecture/comments/20ceny/the_new_rotterdam_central_train_station_opened/)

## Stops - Access Mode

e.g. in the GTHA:

- ▶ 91.8% by walking
- ▶ 7.4% by car
- ▶ 0.6% by other mode (mostly bike)



RICHARD WHITE PHOTOGRAPHER (2010123); TRANSIT TORONTO COLLECTION (2016)

## **Stops - Land-Use Around Stops**

Whitby GO Station:



Next week (Feb 7)

- ▶ Transportation and land-use
- ▶ Network analysis & GIS
- ▶ Land-use data
- ▶ Measuring accessibility

Following week (Feb 14)

- ▶ Travel surveys
- ▶ Other transportation-related data
- ▶ Maps for navigation
- ▶ Chat about the assignment