



22/10/2020

# Using big data for demand-responsive service planning

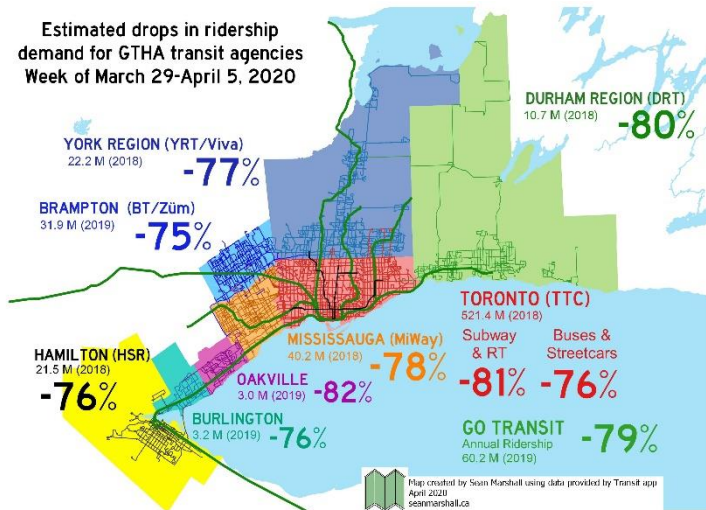
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Expert Advisory Services & New Markets*





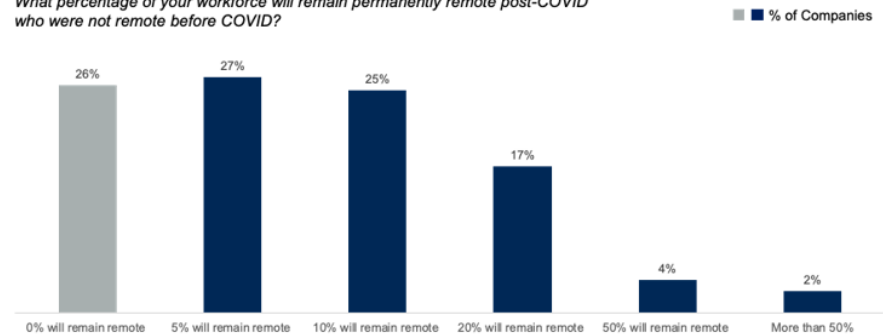
# COVID-19 WILL IMPACT TRAVEL PATTERNS TEMPORARILY AND PERMANENTLY – HOW WILL YOU ADAPT?



Ridership plummeted during the pandemic, especially during the lockdown.

With an ongoing second wave and threat of more, ridership could remain variable and unpredictable for the near future.

What percentage of your workforce will remain permanently remote post-COVID who were not remote before COVID?



Source: Gartner (April 2020)

Pandemic could/will permanently change our societies.

As we reach a new normal, travel patterns will be permanently impacted.

# METRO SYSTEM OVERVIEW



## BUS

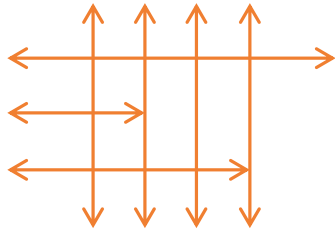
- 170 routes
- 2,300 buses
- 14,000 stops
- 800,000 weekday boardings
- 7 million annual service hours
- \$1.2 billion annual operations

## RAIL

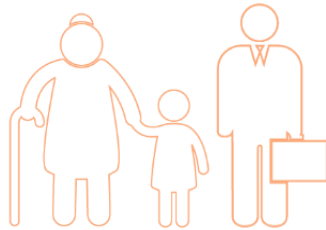
- 4 light rail/2 subway
- 240 cars
- 93 stations
- 350,000 weekday boardings
- 1.3 million annual service hours
- \$542 million annual operations

**Despite an extensive network and ongoing investment in mass transit, ridership had fallen by more than 20% over last 5 years.**

# > SO, WHAT IS NEXTGEN?



A new bus network



Something for everyone

Why and how?

Outdated bus network

25 years since last redesign!

Travel patterns have changed

What do people want?

Extensive customer outreach

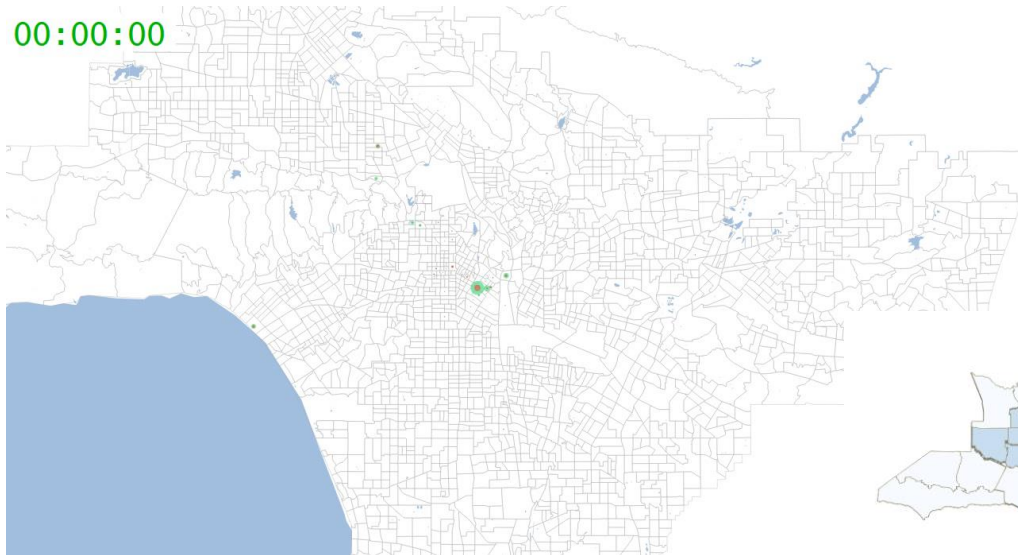
What does the data say?

Used tap card and cell phone data

# > BIG DATA ON TRAVEL DEMAND

Data on travel patterns of residents  
(origin-destination-time of day)

00:00:00

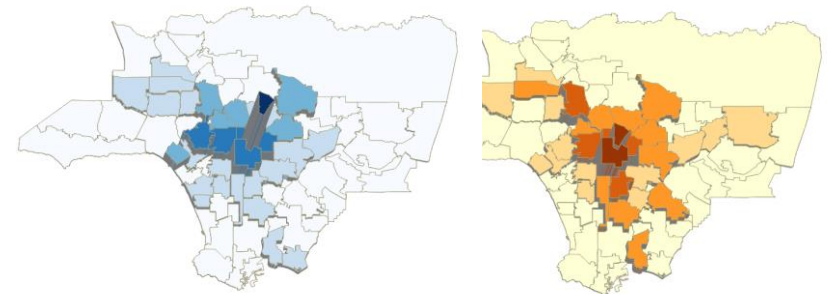


2 sources

Cellphones (LBS)

Smart cards (TAP card)

Collection period  
**6 months**



# > THE CUSTOMER IMPACT SIMULATOR





# CALIBRATING MODEL USING SMART CARD DATA & OD MATRIX

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios

Multiple possible paths for a single pair of OD

What is the importance of every element in the travel path?

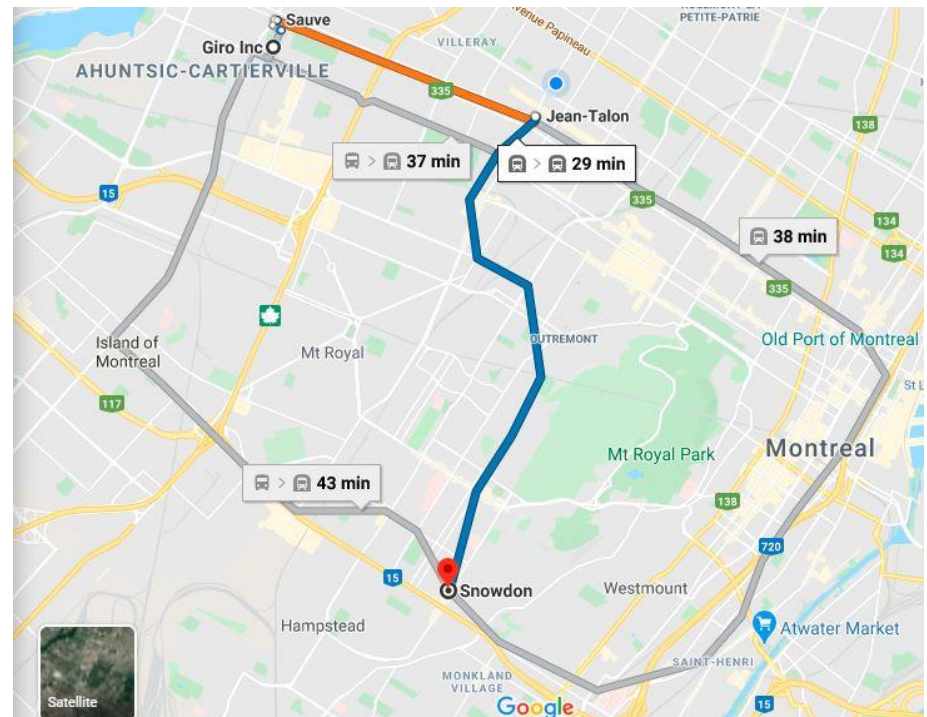
Travel duration

Number of transfers

Wait time

Mode choice

...





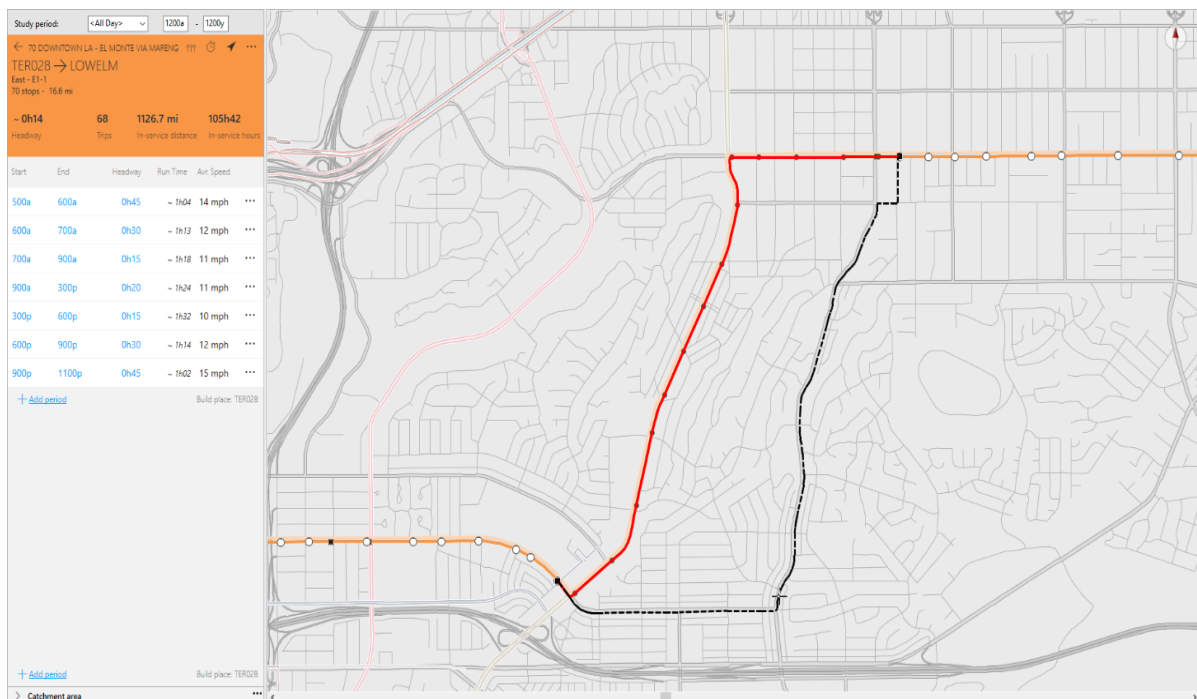
# CREATING VARIOUS NETWORK PLANNING SCENARIOS

Model calibration

**Building scenarios**

Analyzing scenarios

Comparing scenarios



## Several scenarios considered:

- Fewer routes, higher frequency
- Express and local routes replaced with single routes
- Etc.





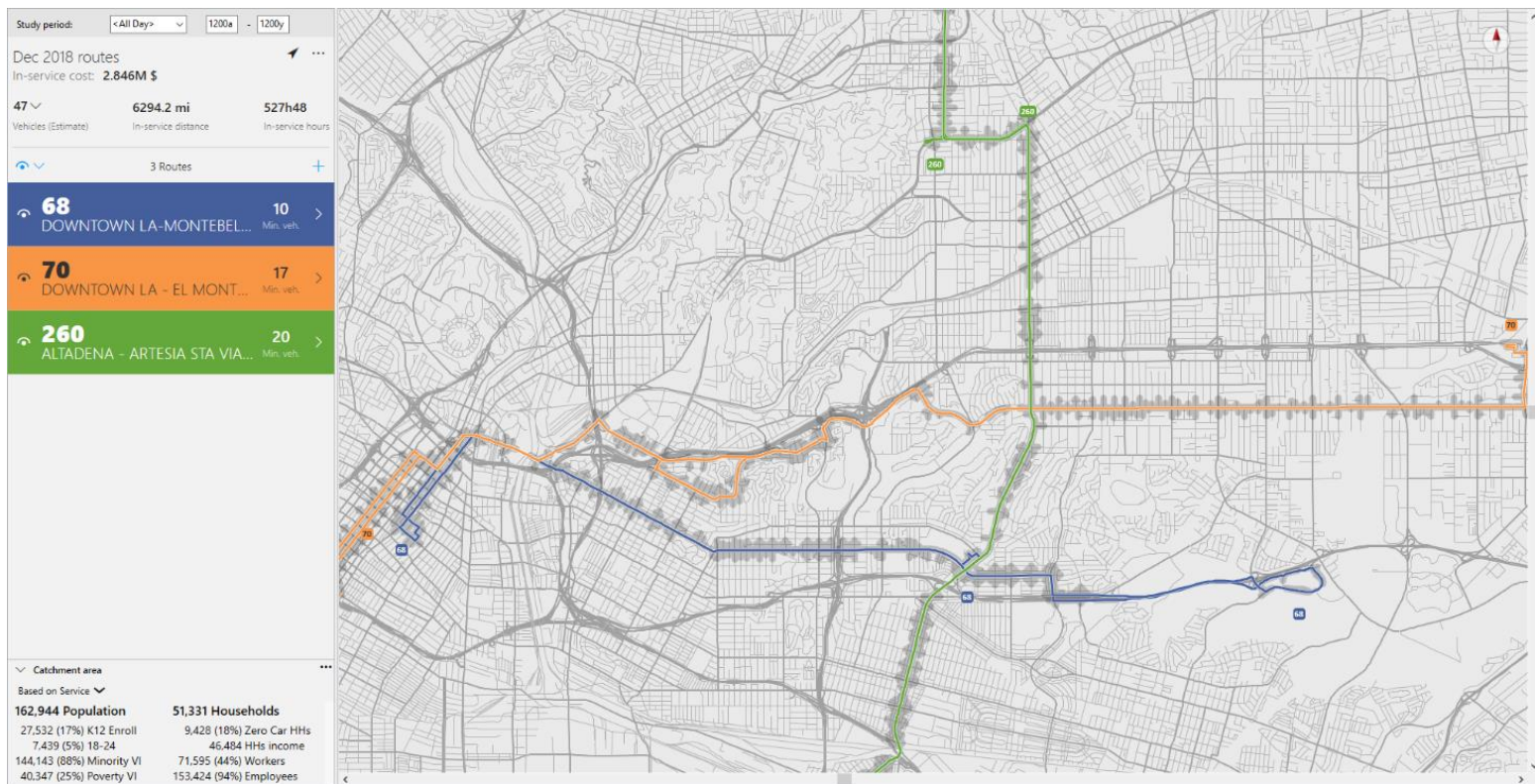
# ANALYZING NETWORK ACCESSIBILITY

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios





# ANALYZING NETWORK COVERAGE

Model calibration

Building scenarios

**Analyzing scenarios**

Comparing scenarios

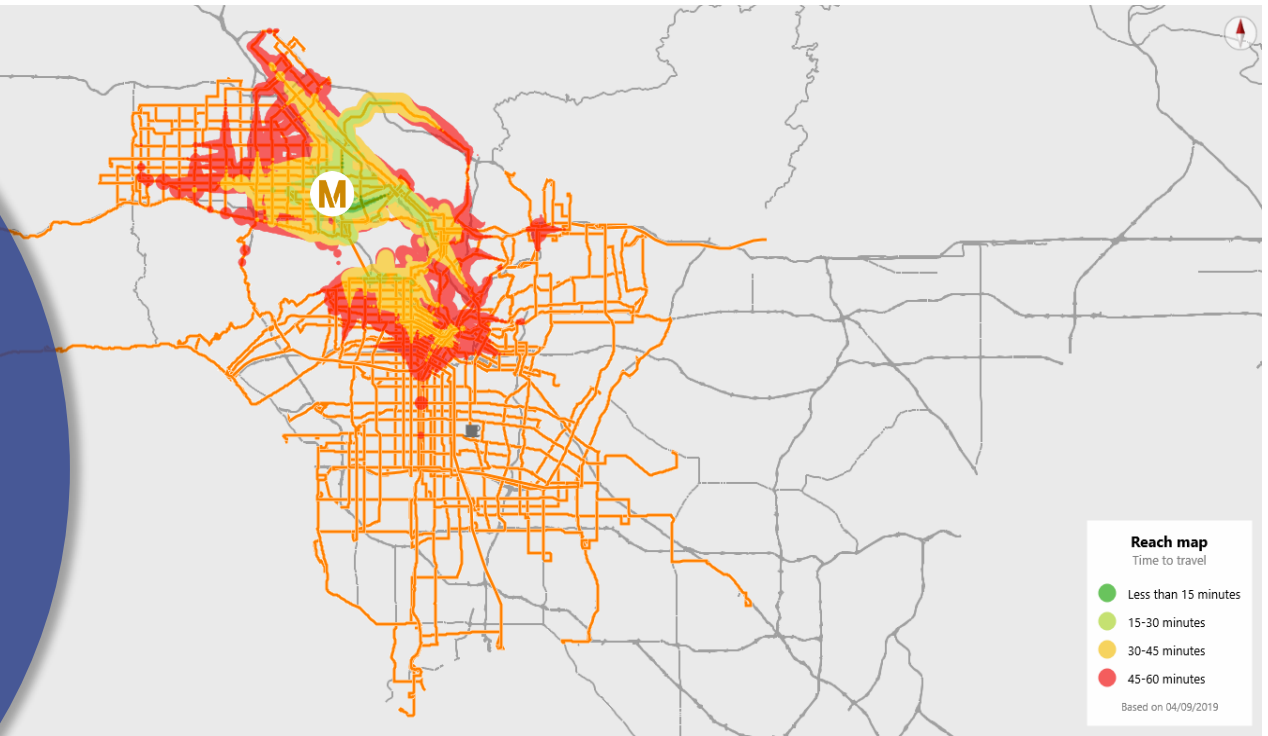
## Reach Map

Where can I go from...

N Hollywood Station @ 12:00PM

In...

|           | Population |
|-----------|------------|
| >15 min   | 115,522    |
| 15-30 min | 477,188    |
| 30-45 min | 937,667    |
| 45-60 min | 1,164,953  |



**Reach map**  
Time to travel

- Less than 15 minutes
- 15-30 minutes
- 30-45 minutes
- 45-60 minutes

Based on 04/09/2019





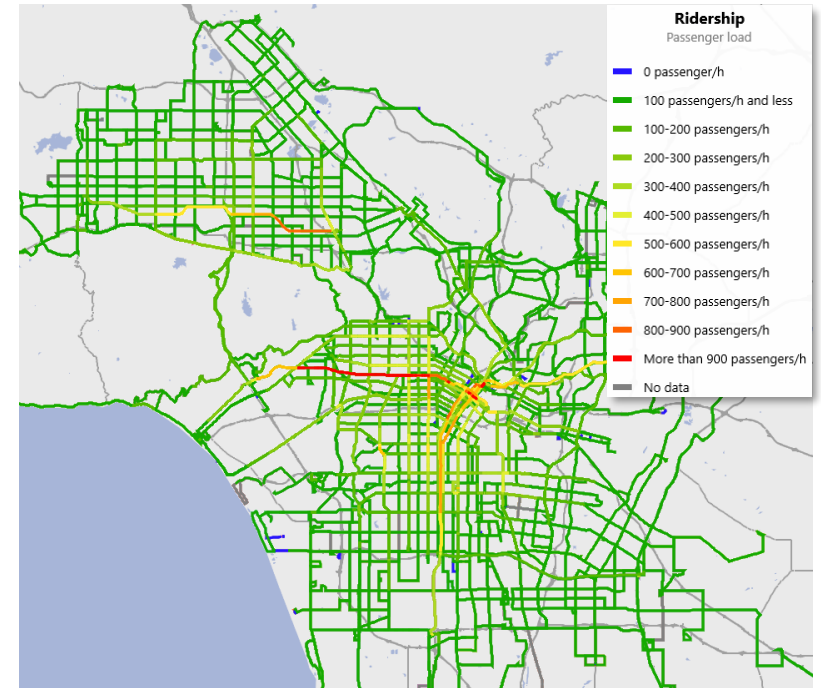
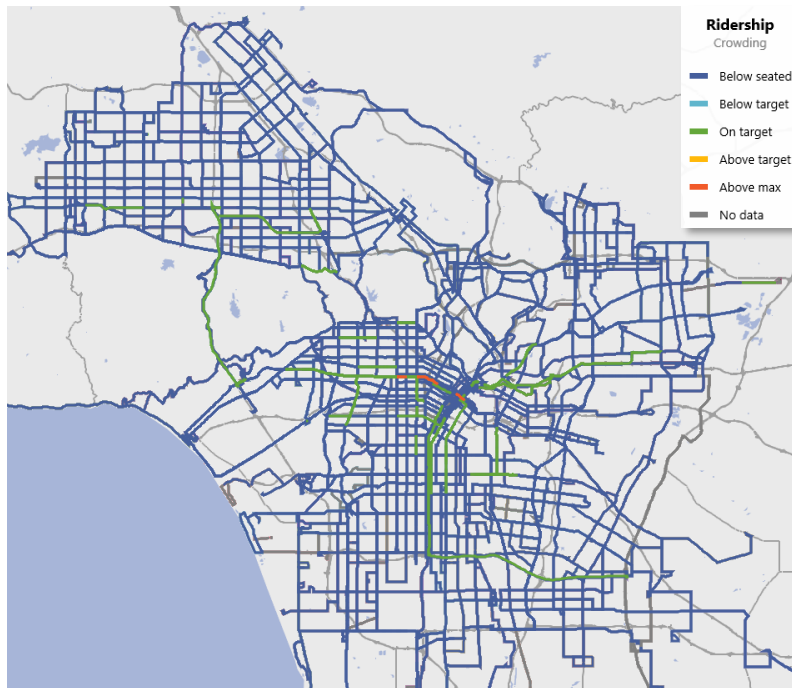
# ANALYZING ESTIMATED RIDERSHIP – BY ROUTE

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios





# ANALYZING ESTIMATED RIDERSHIP – BY STOP

Model calibration

Building scenarios

**Analyzing scenarios**

Comparing scenarios



# ➤ COMPARING SCENARIOS – WHO IS IMPACTED?

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios

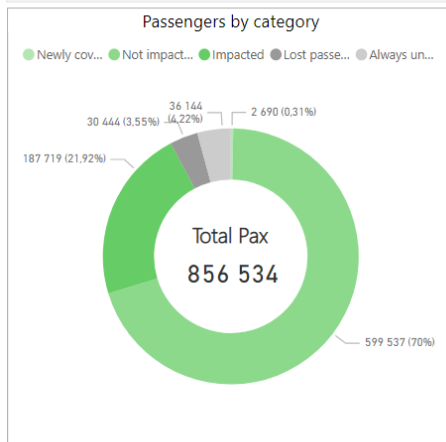
## Customer Impact Simulator (CIS) - Overview

Base scenario

JUN19Base TAP

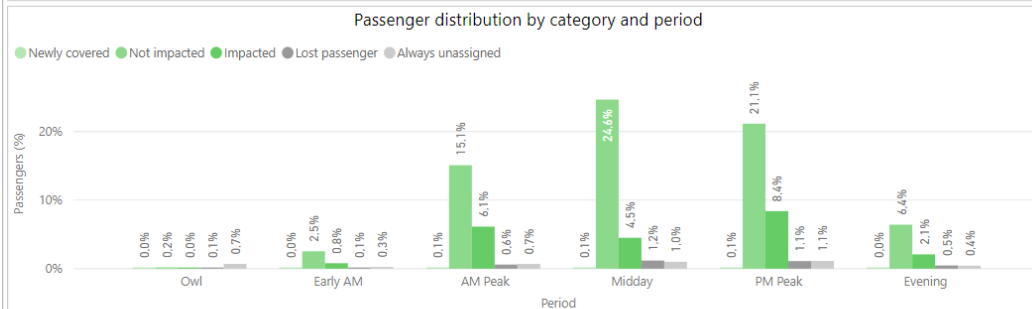
Base scenario

191217\_TF\_TAP

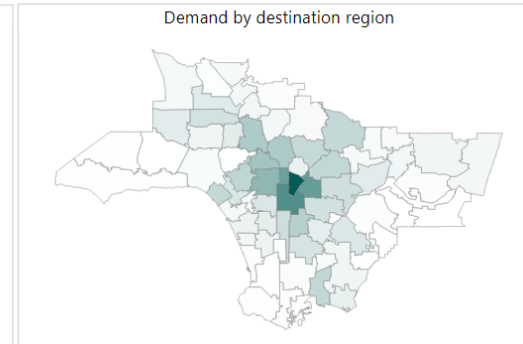
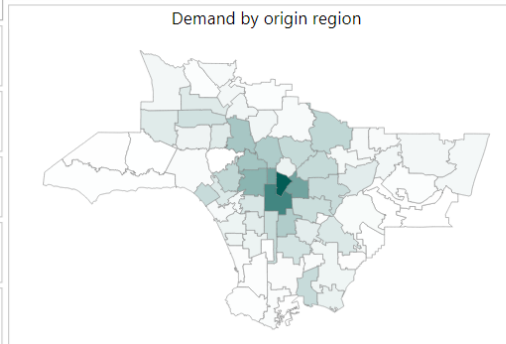


Total demand per period

| Period | Owl   | Early AM | AM peak | Midday  | PM peak | PM peak |
|--------|-------|----------|---------|---------|---------|---------|
| Demand | 8,525 | 31,755   | 193,367 | 269,176 | 272,915 | 80,795  |



|                             |                             |
|-----------------------------|-----------------------------|
| <b>789,946</b><br>Assigned  | 2,690<br>Newly covered      |
|                             | 599,537<br>Not impacted     |
|                             | 187,719<br>Impacted         |
| <b>66,588</b><br>Unassigned | 30,444<br>Lost passenger    |
|                             | 36,144<br>Always unassigned |





# COMPARING SCENARIOS – IMPACT ON TRAVEL TIME

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios

## Customer Impact Simulator (CIS) - Travel time impact

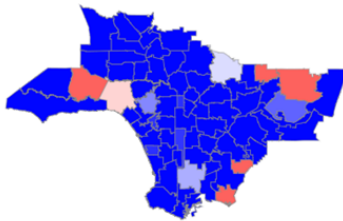
NextGen Plus 8 Pct TAP vs JUN19 Base TAP

Origin Region :

Alhambra-South Pasadena

Angeles National Forest

Average travel time impact by origin region



356,680

Advantaged

-2,049,668

Total min gained

-6

Min / Advantaged

240,081

Penalized

1,105,806

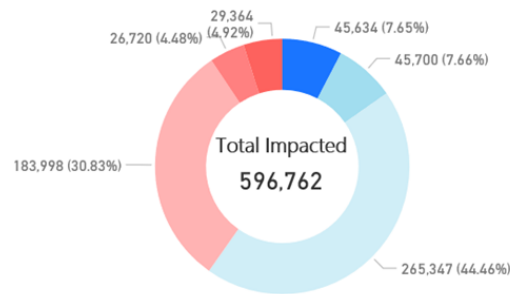
Total min lost

5

Min / Penalized

Passenger distribution by travel time impact (in minutes)

(Adv. - / Pen. +) ● -5] ● ]-5 to -2] ● ]-2 to 0[ ● ]0 to +2[ ● ]+2 to +5[ ● ]+5...

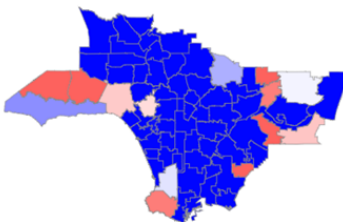


Destination Region :

Alhambra-South Pasadena

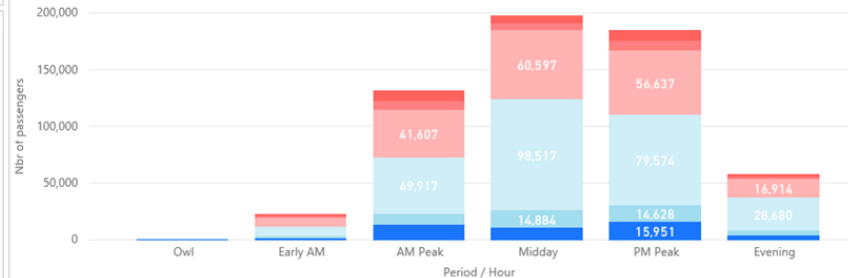
Angeles National Forest

Average travel time impact by destination region



Passenger distribution by time period and travel time impact (in minutes)

(Adv. - / Pen. +) ● -5] ● ]-5 to -2] ● ]-2 to 0[ ● ]0 to +2[ ● ]+2 to +5[ ● ]+5...



Overview **Travel time impact** Region filters Travel steps - Regions Travel steps - Time period and ODs Competitiveness Car/Transit Transfer





# COMPARING SCENARIOS – IMPACT ON TRANSFERS

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios

## Customer Impact Simulation (CIS) - Transfer

Base scenario

Base scenario

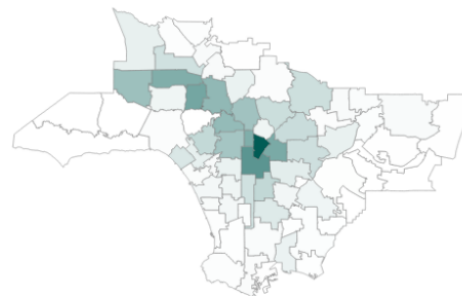
JUN19Base TAP

191217\_TF\_TAP

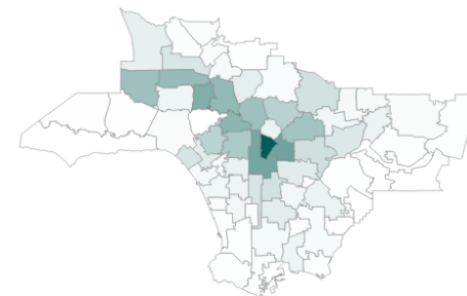
### Impacted passengers (transfer) by period

|          |         |
|----------|---------|
| Owl      | Midday  |
| 60       | 9 420   |
| Early AM | PM peak |
| 1 961    | 14 006  |
| AM peak  | PM peak |
| 9 716    | 2 732   |

### Impacted (transfer) passengers by origin region



### Impacted (transfer) passengers by destination region



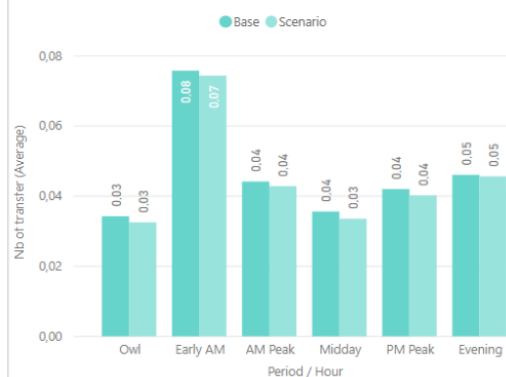
### Passengers transferring in one or both scenarios

| Transfer in base | Impacted passengers | % of total     |
|------------------|---------------------|----------------|
| 0                | 6 001               | 15,84%         |
| 1                | 22 229              | 58,66%         |
| 2                | 9 665               | 25,51%         |
| <b>Total</b>     | <b>37 895</b>       | <b>100,00%</b> |

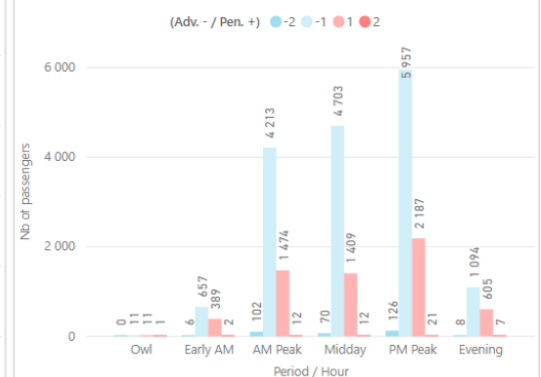
| Transfer in scenario | Impacted passengers | % of total     |
|----------------------|---------------------|----------------|
| 0                    | 13 625              | 35,95%         |
| 1                    | 18 054              | 47,64%         |
| 2                    | 6 217               | 16,40%         |
| <b>Total</b>         | <b>37 895</b>       | <b>100,00%</b> |

| Transfer difference | Impacted passengers | % of total     |
|---------------------|---------------------|----------------|
| -2                  | 311                 | 0,82%          |
| -1                  | 16 634              | 43,90%         |
| 0                   | 14 819              | 39,11%         |
| 1                   | 6 076               | 16,03%         |
| 2                   | 55                  | 0,14%          |
| <b>Total</b>        | <b>37 895</b>       | <b>100,00%</b> |

### Average transfers by time period



### Impacted passengers by time period and transfer impact (in minu...)



# ➤ MAXIMIZING QUALITY OF SERVICE WITH LIMITED RESOURCES

Model calibration

Building scenarios

Analyzing scenarios

Comparing scenarios

## Impact on Resources



Fleet  
Cost  
Operating Constraints



## Impact on Customers



Who is impacted  
Travel time  
Travel experience

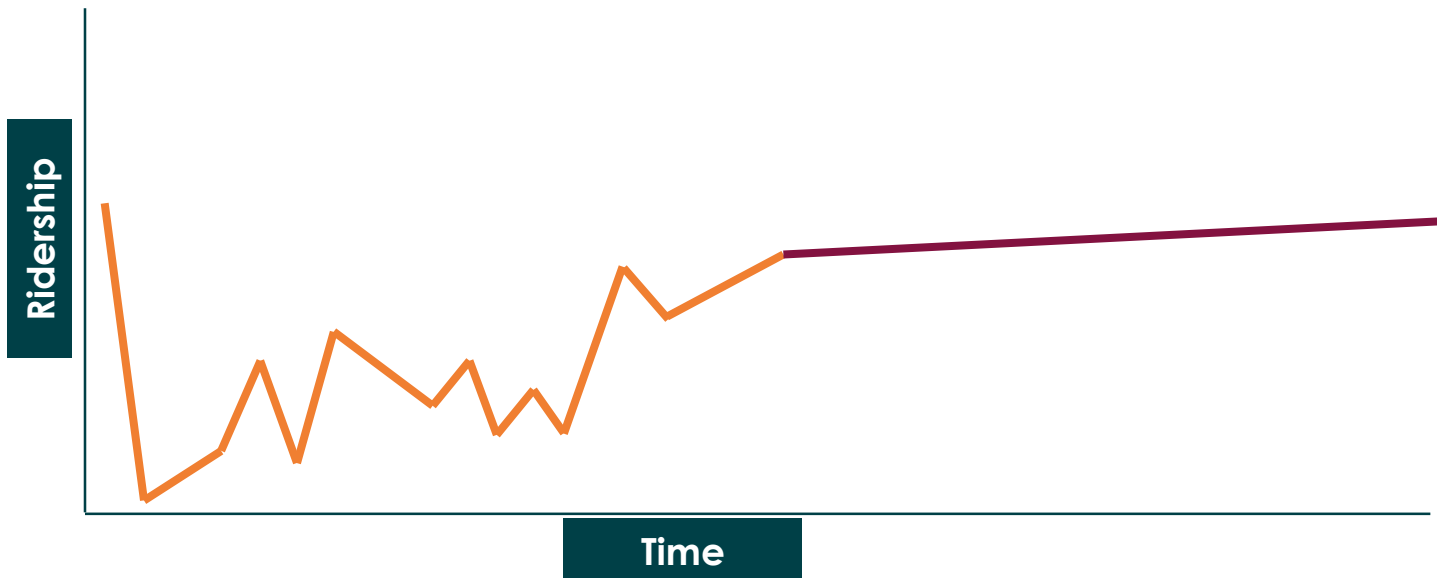




# ➤ IMPLEMENTING FREQUENT AND ITERATIVE CHANGES UNTIL NEW NORMAL IS REACHED

Frequency: Monthly  
Data source: Passenger counting  
Sample size: 2-3 weeks  
Changes: Service level adjustments

Frequency: 3-5 years  
Data source: Multimodal OD matrix  
Sample size: 3-6 months  
Changes: Entire network redesign





# QUESTIONS?



# Thank you!

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