

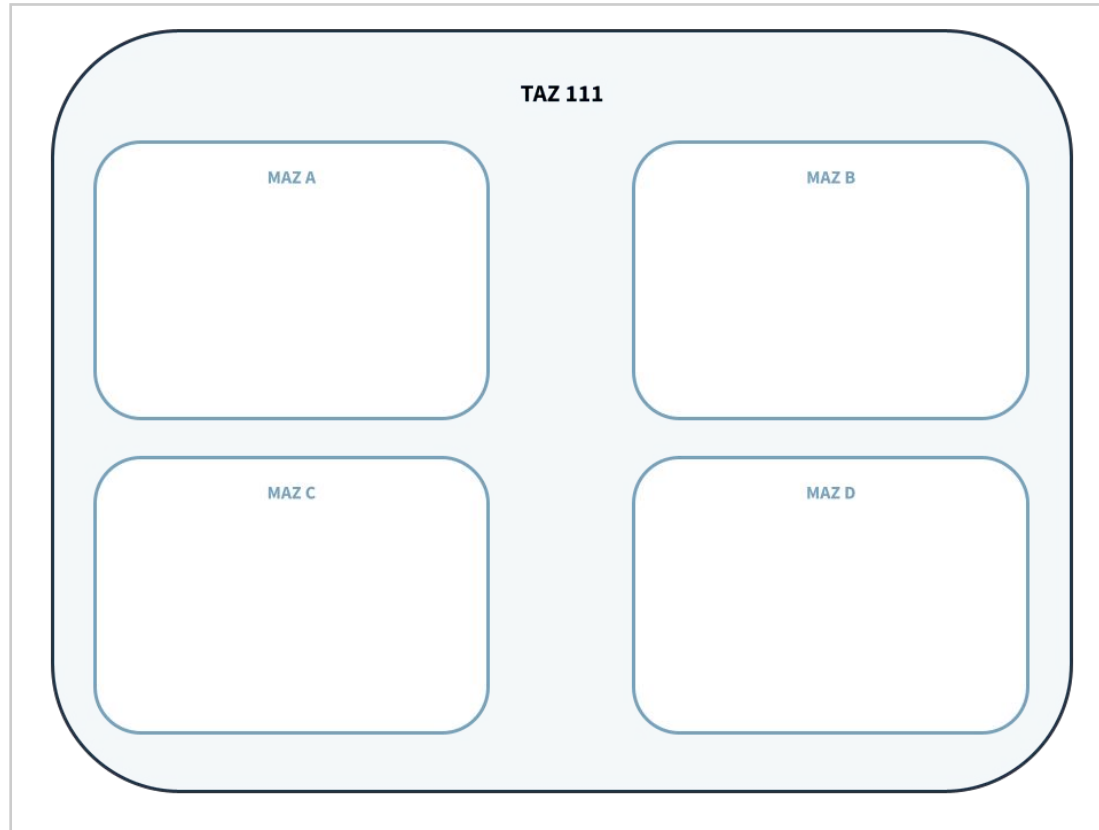
Pros and Cons of Transit Access Points

Presentation to ActivitySim Consortium
July 19, 2022
David Ory, WSP

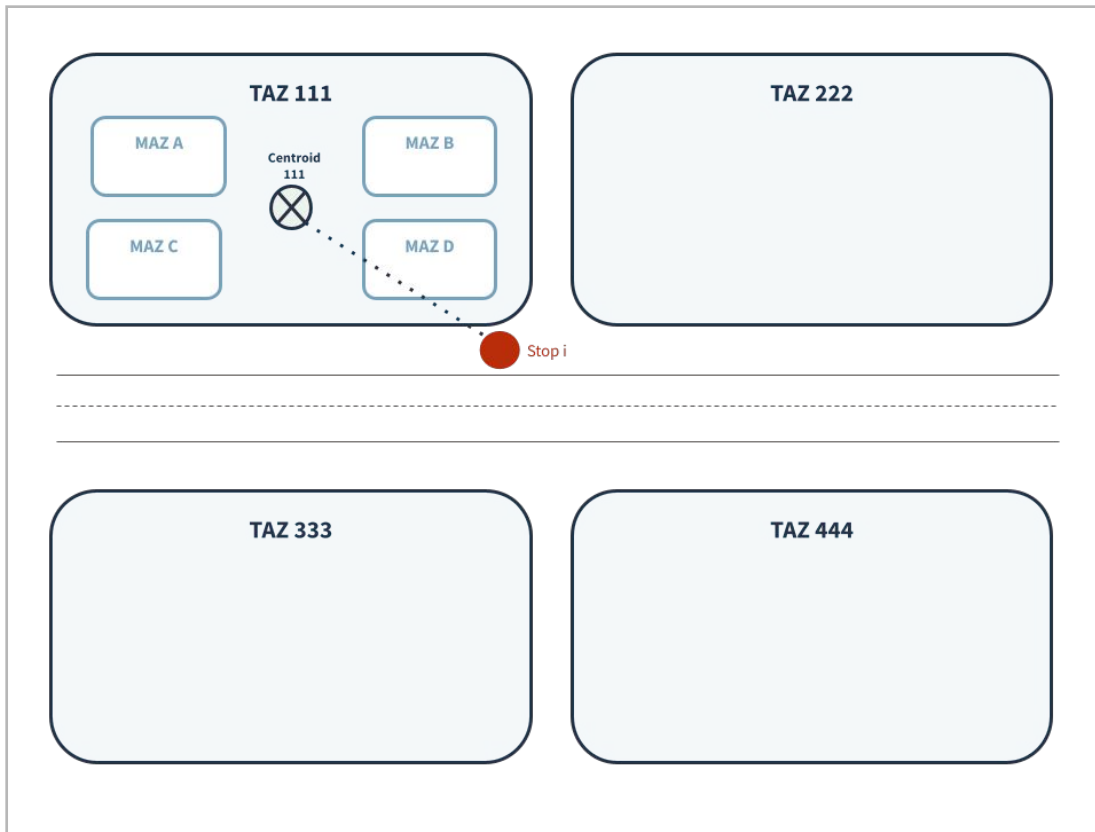
Agenda

1. What, why, and how of TAPs (5 minutes)
2. An Alternative to TAPs (2 minutes)
3. Comparison — Statistical Assessment (10 minutes)
4. Comparison — Assessment of Hypotheses (20 minutes)
5. Conclusions & Recommendations (5 minutes)

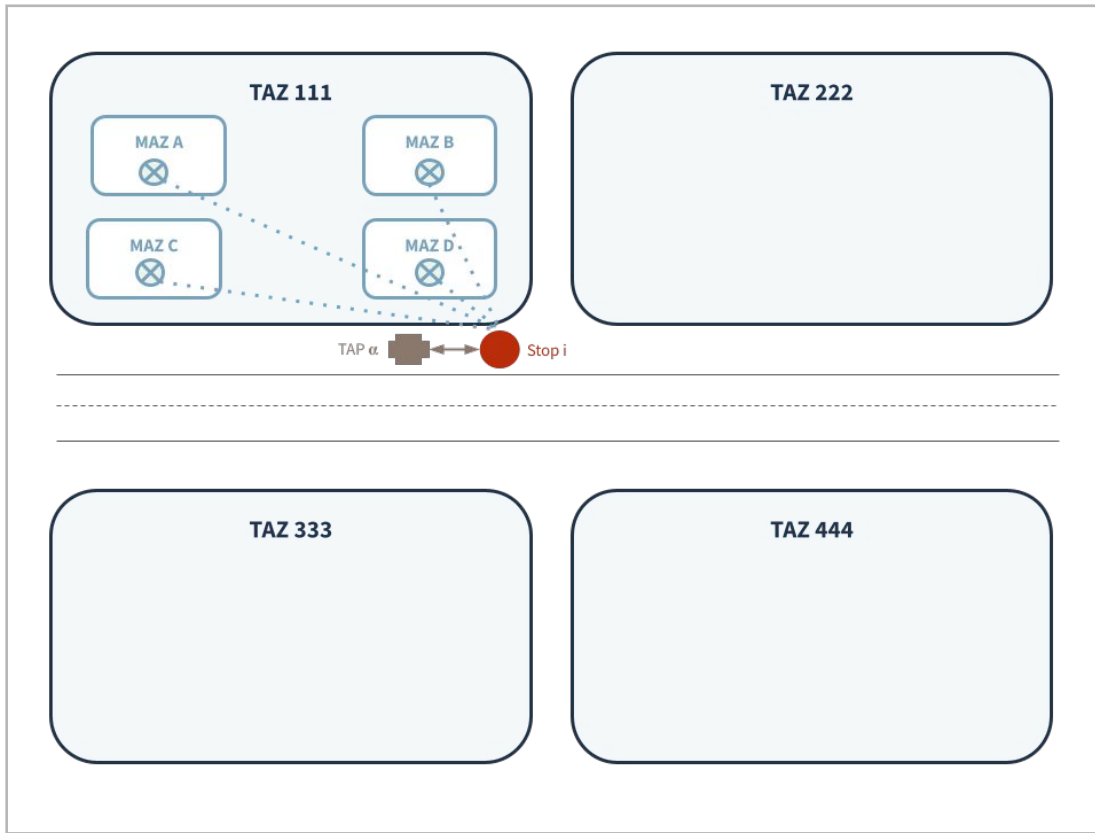
What, Why, How



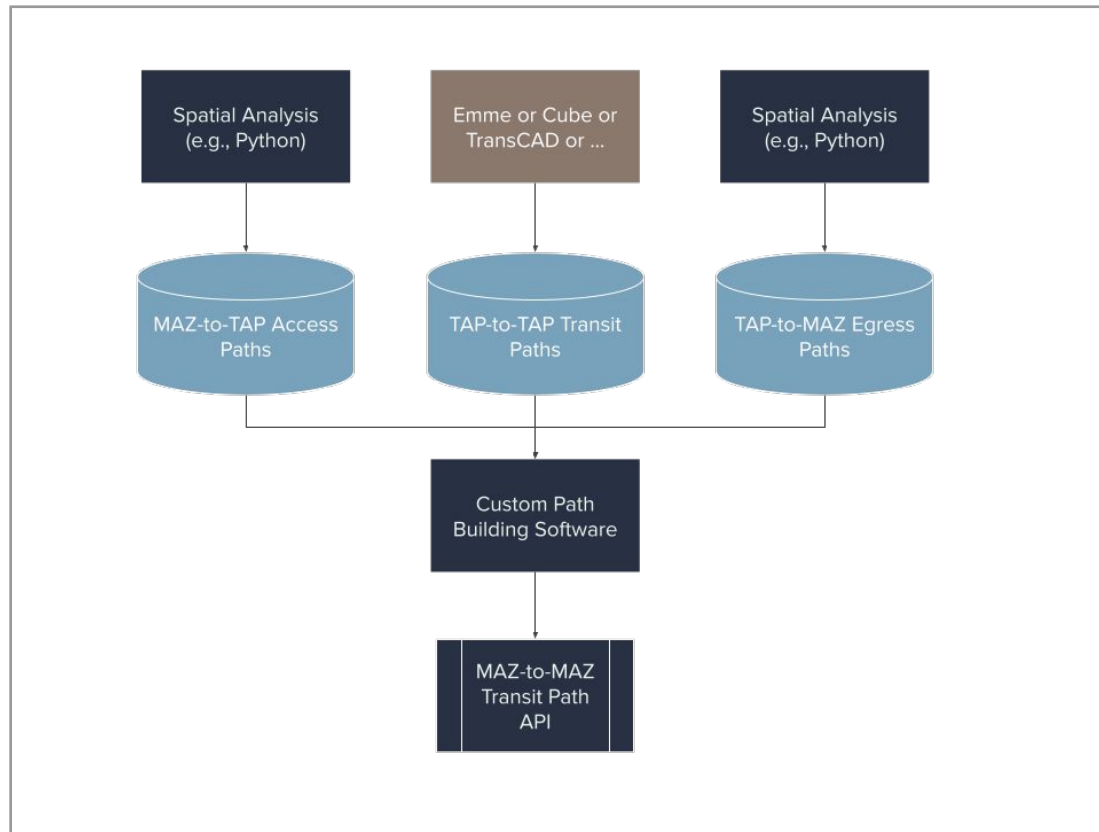
What, Why, & How of TAPs



What, Why, & How of TAPs



What, Why, & How of TAPs



What, Why, & How of TAPs

Pros of TAPs

- Creates consistent MAZ to MAZ paths
- Computational efficient when transit operates in a subset of the region
- Overcomes limitations with simple commercial path builder

Cons of TAPs

- Creates coding, path debugging and path builder calibration overhead
- Spatial distortions possible if multiple stops are connected to a single TAP
- Requires custom software

**In the San
Francisco Bay
Area, do the Pros
of TAPs outweigh
the Cons?**

Alternative

Alternative

1. Start with existing TAZ and MAZ boundaries
 2. Create TAZ-scale assignment/skimming procedures
 3. Use MAZ-scale geographies and the TAZ assignment outcomes to approximate MAZ-scale walk access and egress times for use in **mode choice & accessibility** calculations
 4. Use MAZ-scale impedances and demand to inform TAZ centroid connector impedance for **path building & assignment**
- Similar to methods used in numerous travel models

Pros of Alternate Approach

- Relies on commercial software for assignment & skimming → Easier to use and debug
- Informed by MAZ geographies

Cons of Alternate Approach

- Does not create consistent MAZ-to-MAZ paths → Creates an approximation
- Aggregation bias: gets MAZ impedance and paths wrong when MAZ demand patterns are different from parent TAZ patterns

Statistical Assessment

Objective

Can we generate similar aggregate estimates to the TAP approach with the alternative approach?

Statistical Assessment — Ideal v. Actual

Ideal

- Fully calibrate the TAP approach to on-board survey data.
- Fully calibrate the non-TAP approach to on-board survey data.
- Examine all outliers to identify network errors.

Actual

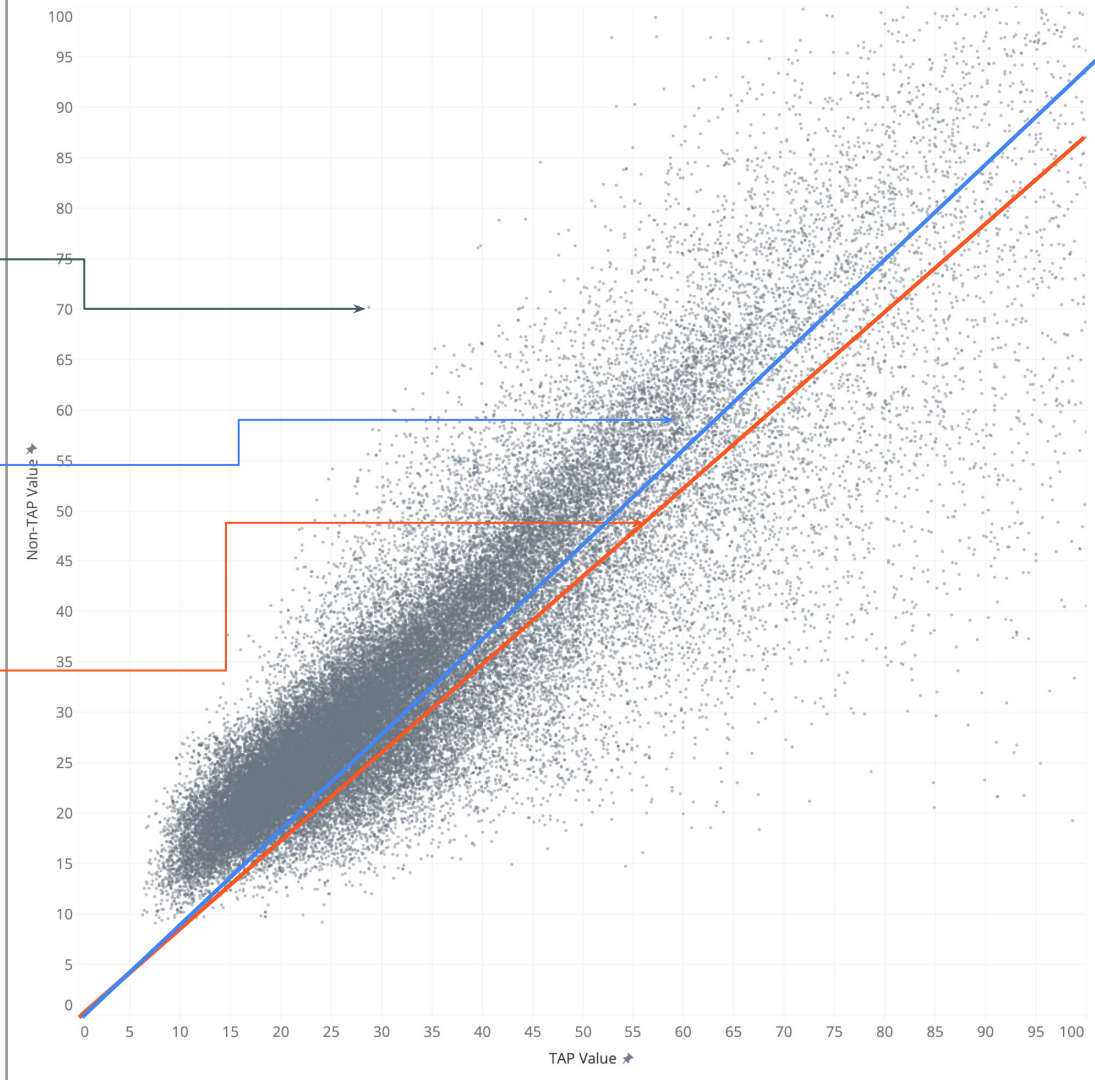
- Initial calibration of the TAP approach to on-board survey data.
- Minor adjustments to the non-TAP approach to align outcomes with the TAP approach.
- Did not examine outliers to identify network errors.

Total Time

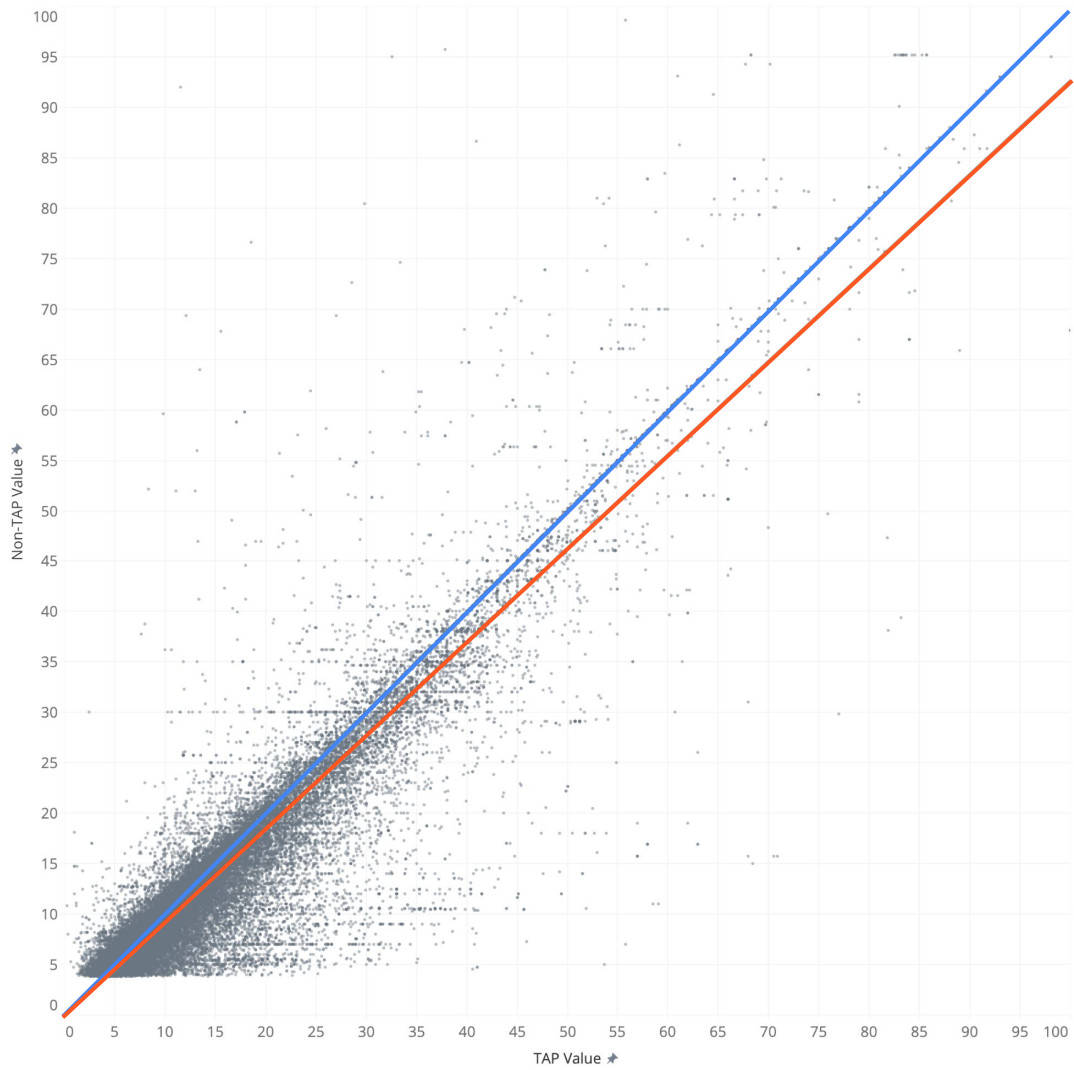
Each point is one on-board survey record

45 degree line

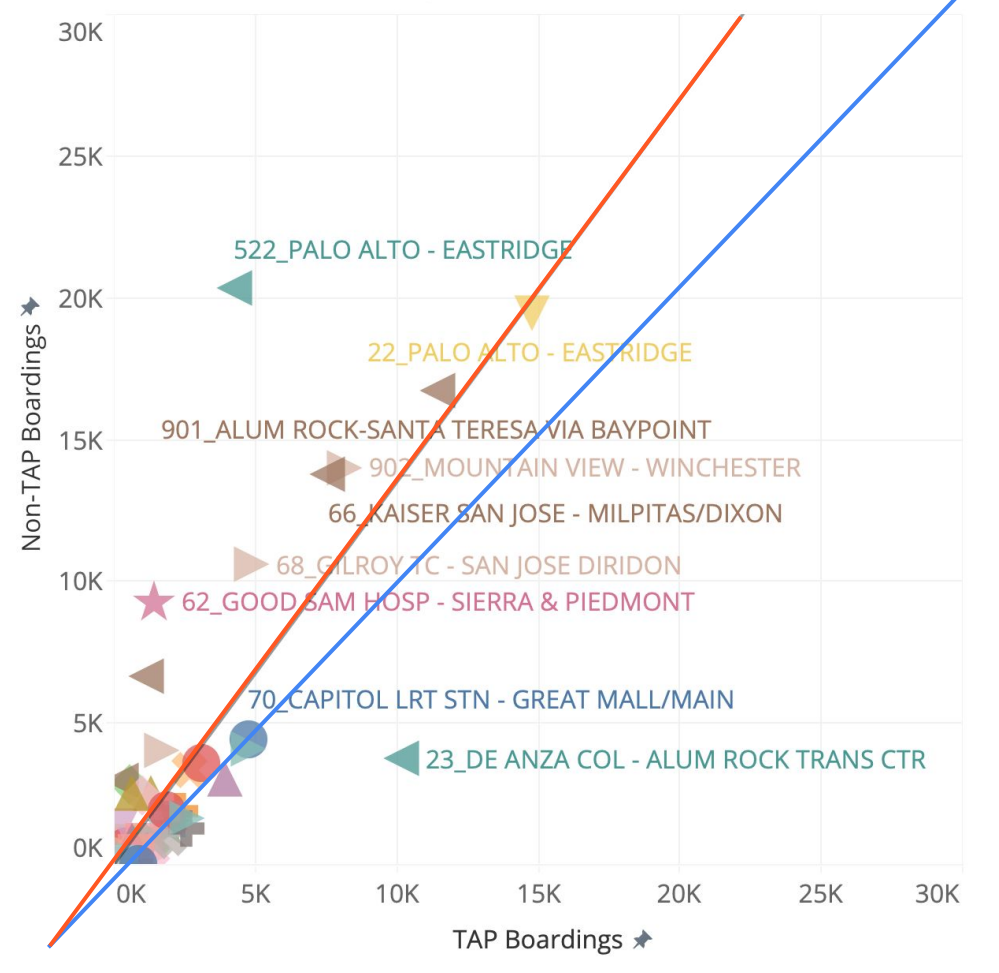
Regression



In-vehicle Time

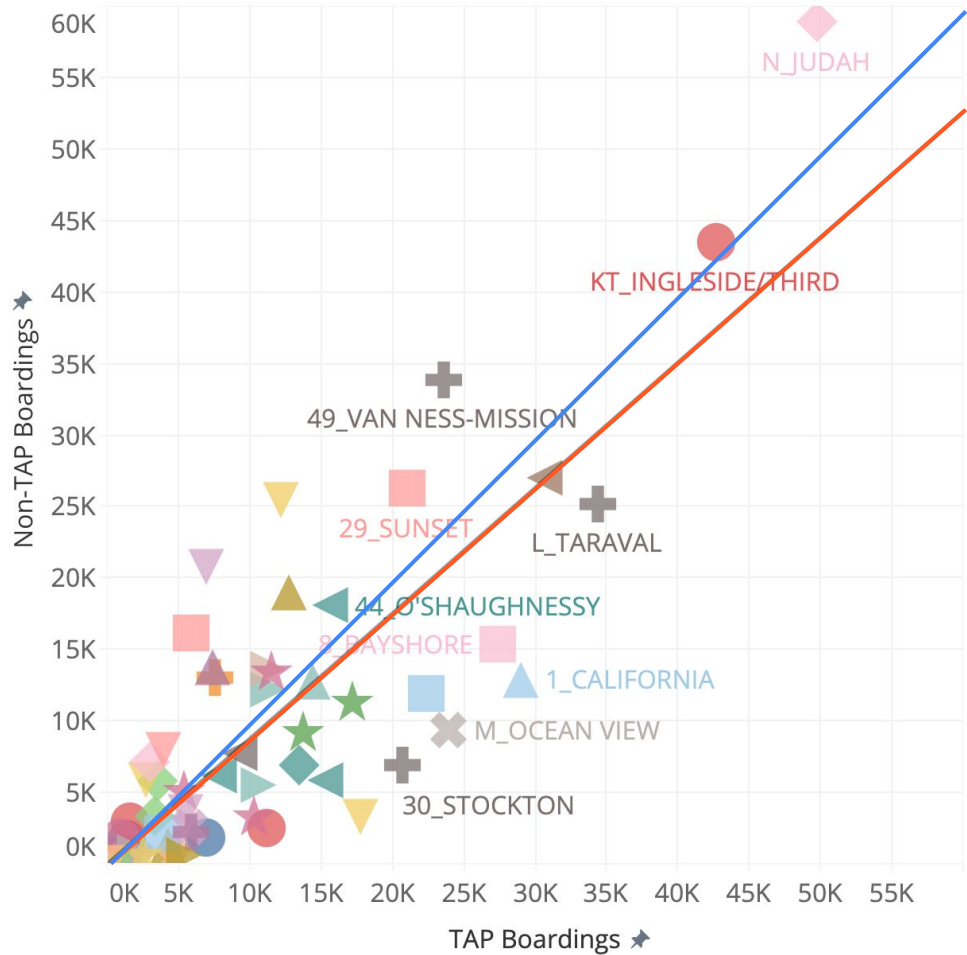


Santa Clara VTA Boardings by Route



Santa Clara VTA Boardings

San Francisco MUNI Boardings by Route



SF Muni Boardings

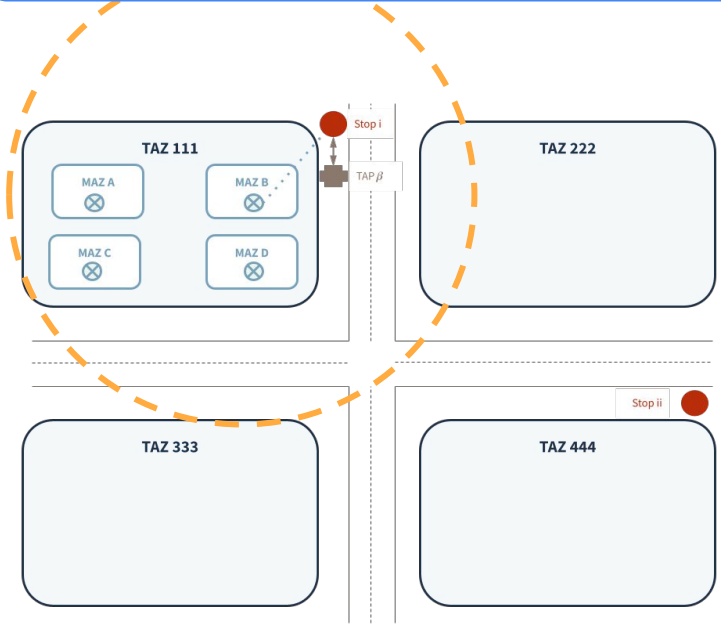
| Skim Table | TAP (Mean) | Non-TAP (Mean) | Difference |
|-------------------|-----------------------|---------------------------|-------------------|
| Perceived Time | 80.1 | 71.1 | 9.0 |
| Time | 41.1 | 36.7 | 4.4 |
| Wait Time | 10.2 | 6.9 | 3.2 |
| In-vehicle Time | 14.8 | 13.7 | 1.1 |
| MAZ Walk Access | 6.6 | 5.8 | 0.8 |
| MAZ Walk Egress | 6.8 | 5.8 | 0.8 |
| Initial Wait Time | 7.2 | 6.4 | 0.8 |
| Transfers | 0.3 | 0.1 | 0.3 |
| Transfer Wait | 3.0 | 0.5 | 2.4 |
| Auxiliary Walk | 2.8 | 7.0 | -4.3 |

Summary

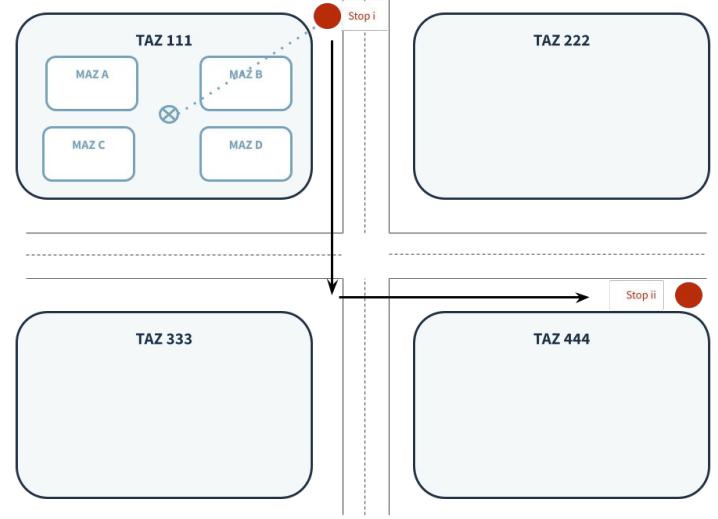
| Skim Table | TAP (Mean) | Non-TAP (Mean) | Difference |
|-------------------|-----------------------|---------------------------|-------------------|
| Perceived Time | 80.1 | 71.1 | 9.0 |
| Time | 41.1 | 36.7 | 4.4 |
| Wait Time | 10.2 | 6.9 | 3.2 |
| In-vehicle Time | 14.8 | 13.7 | 1.1 |
| MAZ Walk Access | 6.6 | 5.8 | 0.8 |
| MAZ Walk Egress | 6.8 | 5.8 | 0.8 |
| Initial Wait Time | 7.2 | 6.4 | 0.8 |
| Transfers | 0.3 | 0.1 | 0.3 |
| Transfer Wait | 3.0 | 0.5 | 2.4 |
| Auxiliary Walk | 2.8 | 7.0 | -4.3 |

Summary

TAP Approach allows/requires user to set strict walk access boundaries.



Non-TAP Approach allows a network search to determine walk access boundaries.



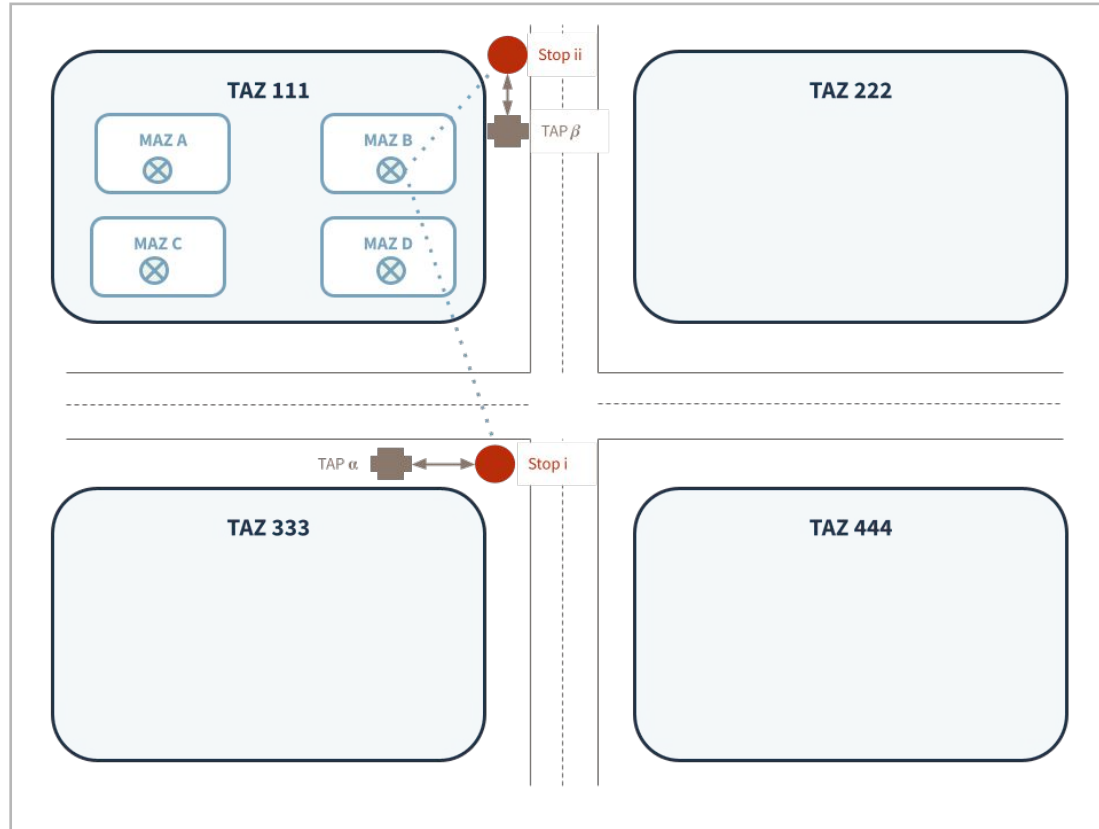
Walking to Transit Stops

**It appears a non-TAP approach
can create very similar
aggregate outcomes to a TAP
approach.**

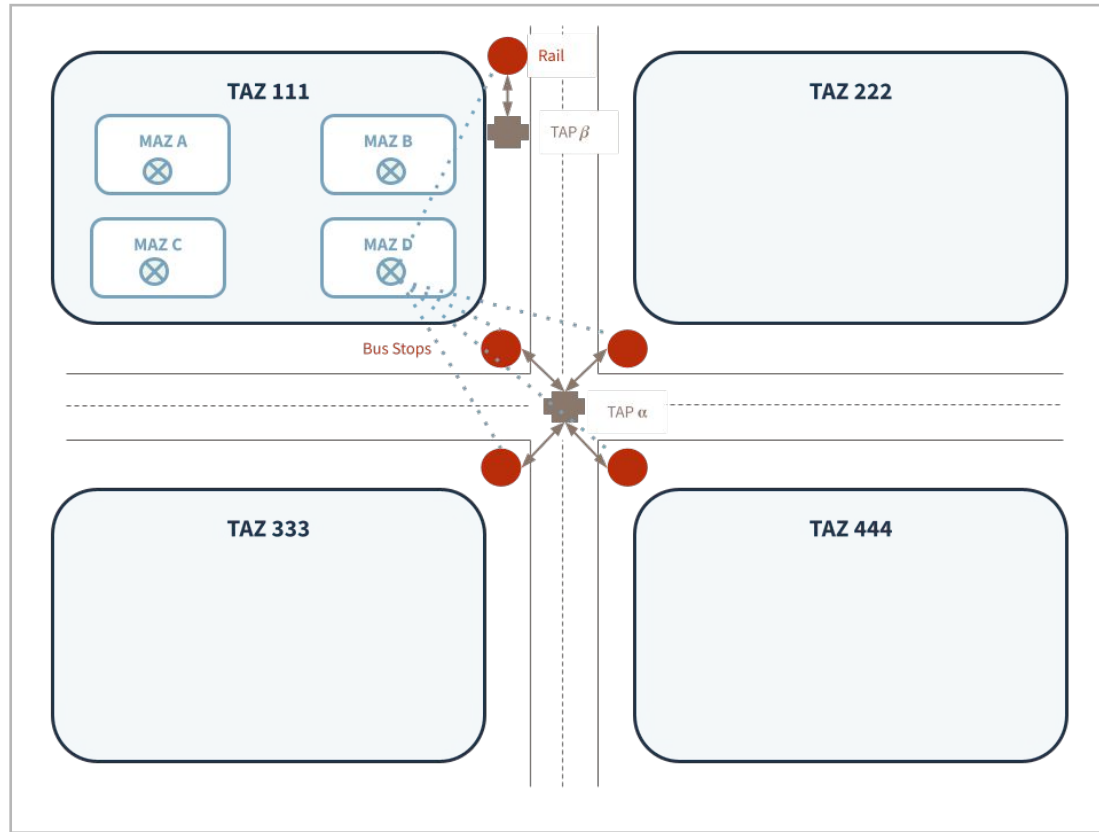
Assessment of Hypotheses

Objective

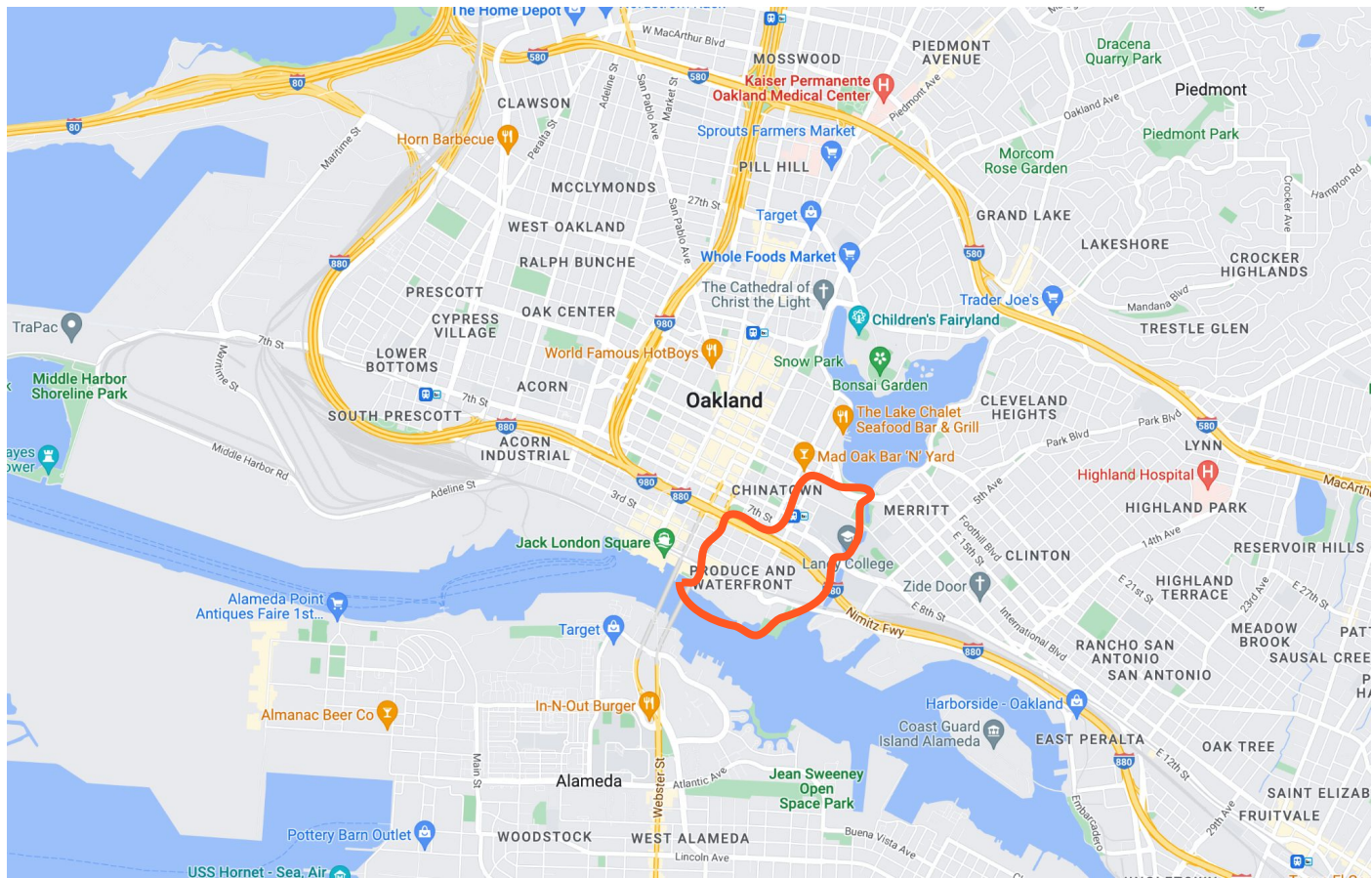
Aggregate comparisons may miss important edge cases



Hypothesis #1: Two TAPs, Far Apart, Disparate Travel

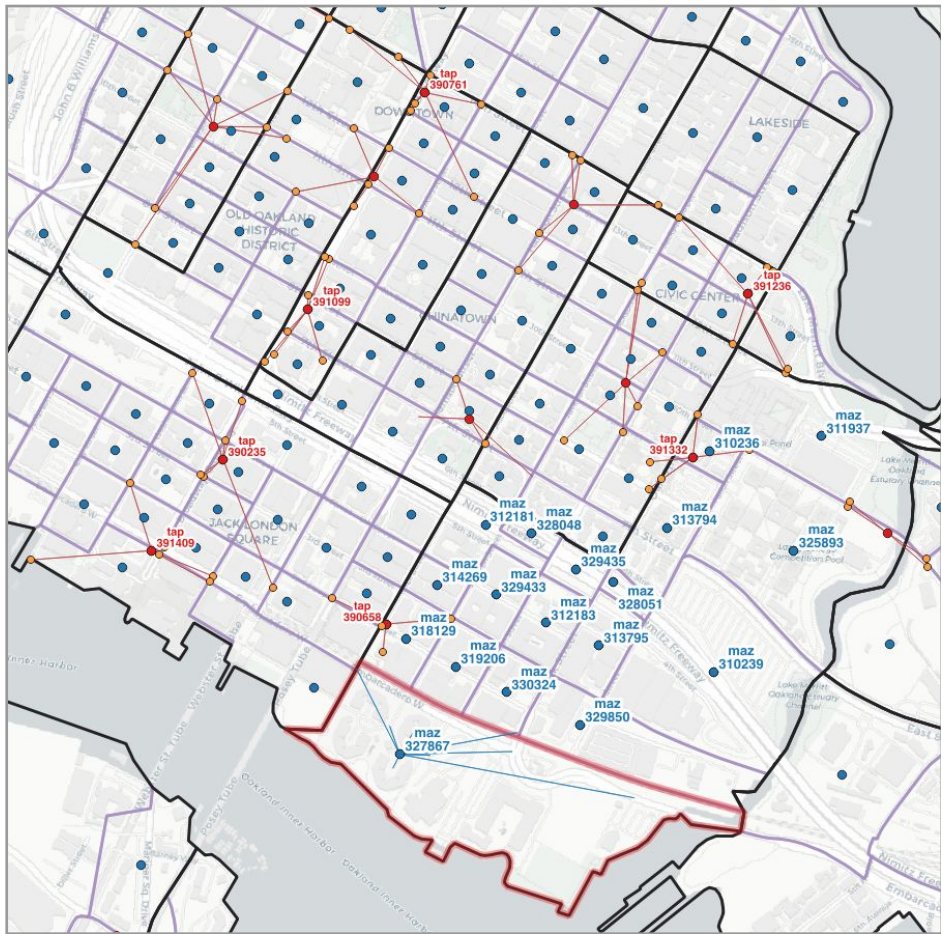


Hypothesis #2: Two TAPs, far Apart, Bus & Rail

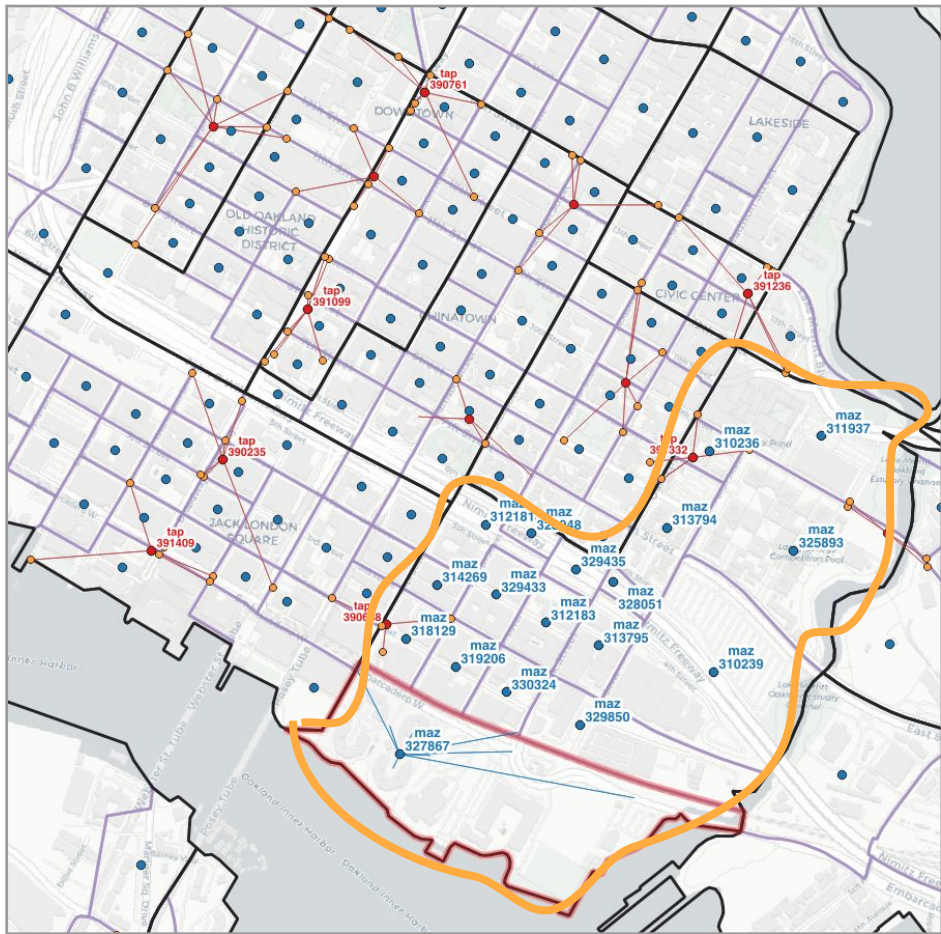


Jack London Square

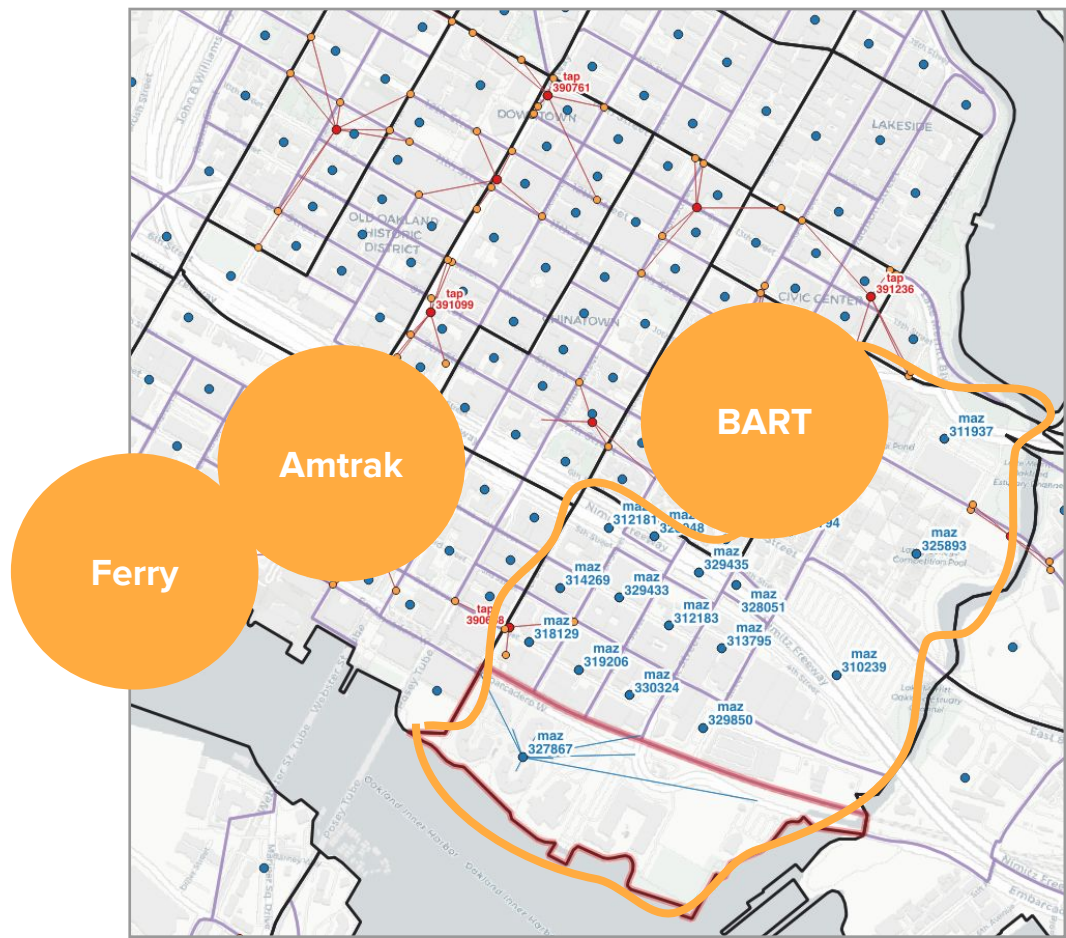
Jack London Square



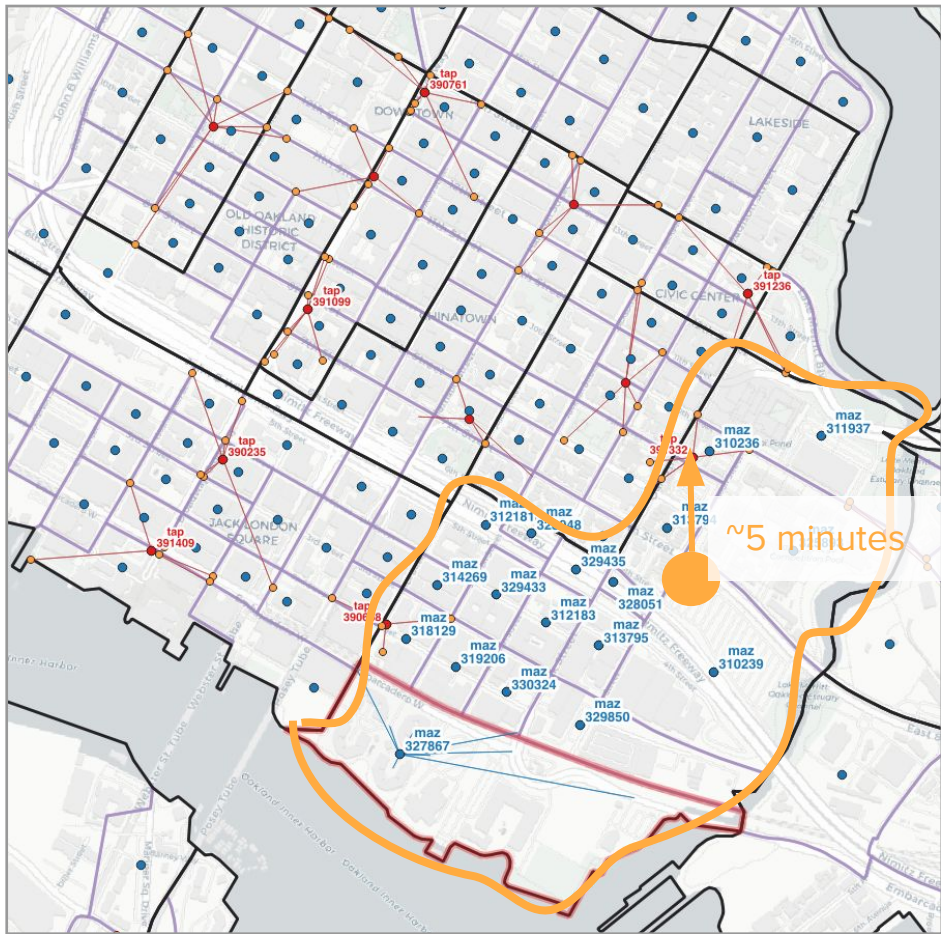
Jack London Square



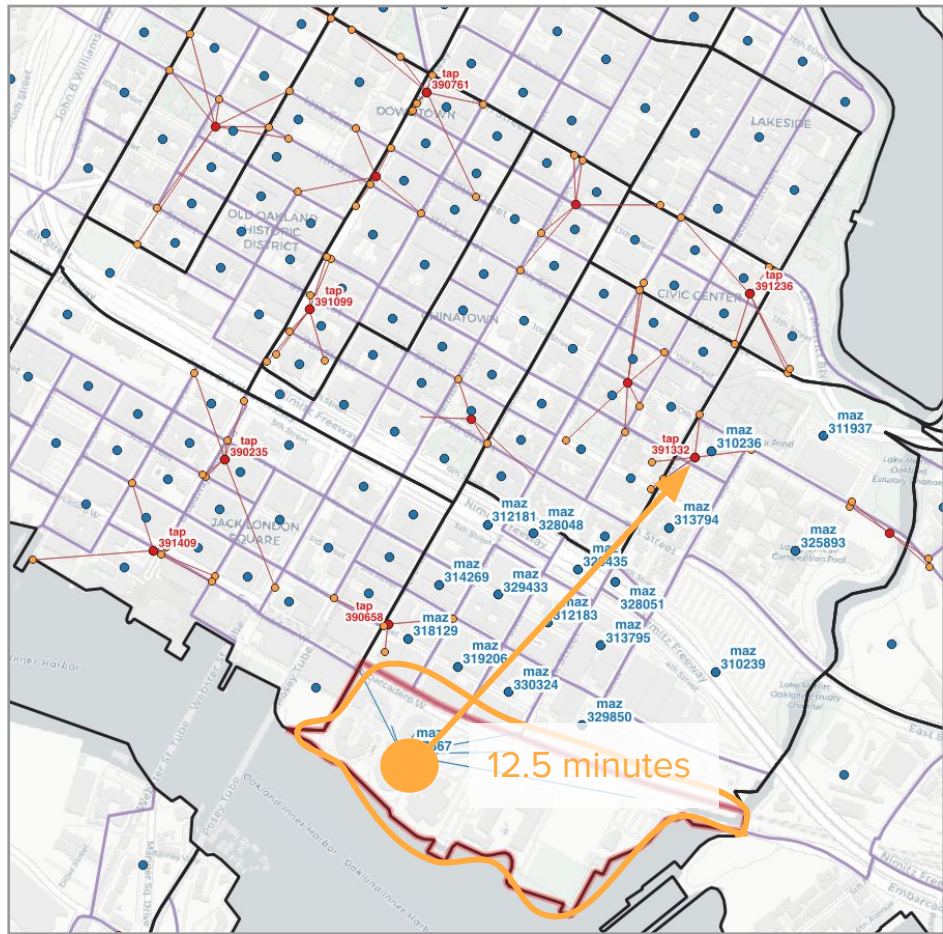
Jack London Square



Jack London Square



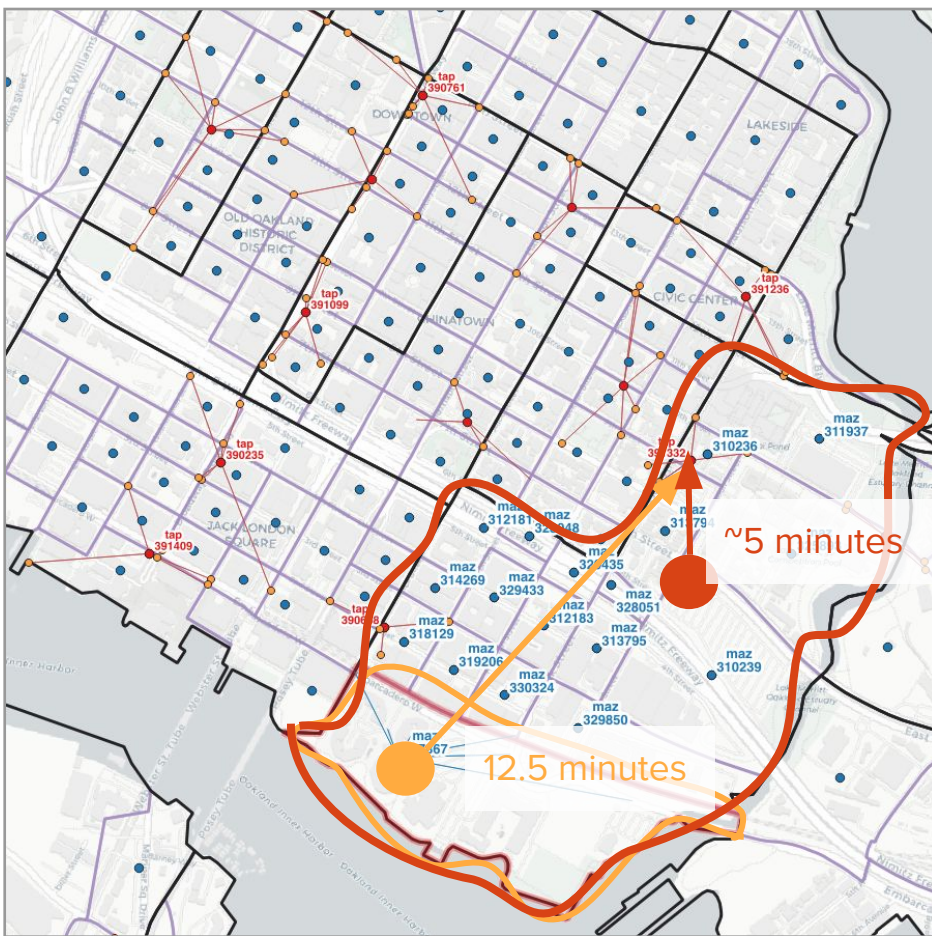
Jack London Square



A TAZ-scale assignment misstates the walk-access time from Jack London Square to Lake Merritt BART.

The MAZ-scale computation of impedance for Jack London square for the “premium” path is distorted by the Amtrak and Ferry options.

The non-TAP solution is to split the TAZ. But splitting is not sustainable if this occurs frequently.

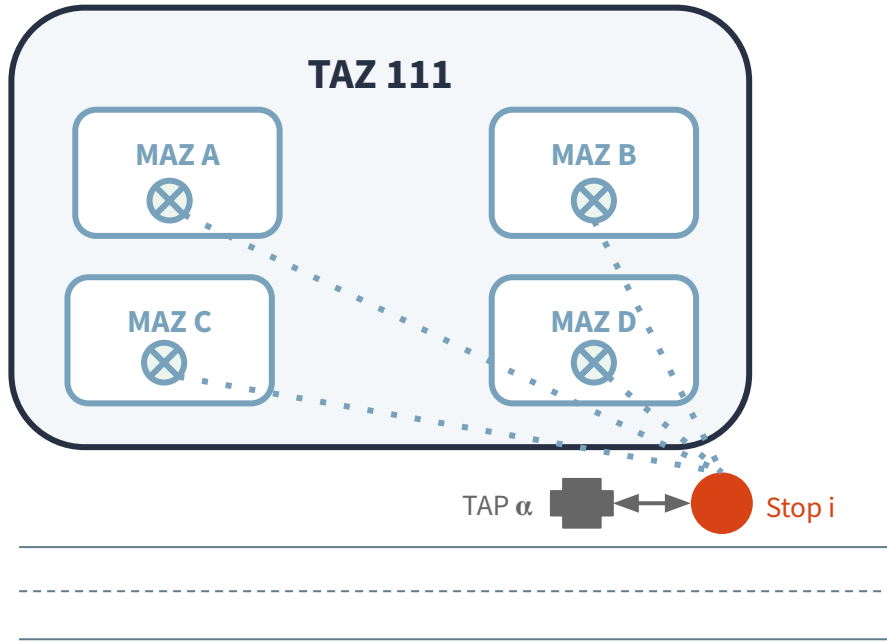


Jack London Square

How common is this?

| Step | Records | Quantity | Share of all MAZs |
|------|--|----------|-------------------|
| 1 | MAZs that are connected to at least two TAPs, with at least one accessing only bus service and at least one connecting to rail service | 25,206 | 63.5% |
| 2 | Of the MAZs in Step 1, the number of MAZs connected to a bus TAP and a rail TAP with distance differences greater than 0.25 miles | 16,411 | 41.3% |
| 3 | Of the MAZs in Step 2, the number of MAZs with non-zero walk to transit trips | 14,087 | 35.6% |
| 4 | Of the MAZs in Step 3, the number of MAZs with more than 100 walk to transit trips. | 494 | 1.2% |
| 5 | Of the MAZs in Step 4, the number of MAZs with very different demand patterns than TAZs | 12 | 0.0% |

Jack London Square



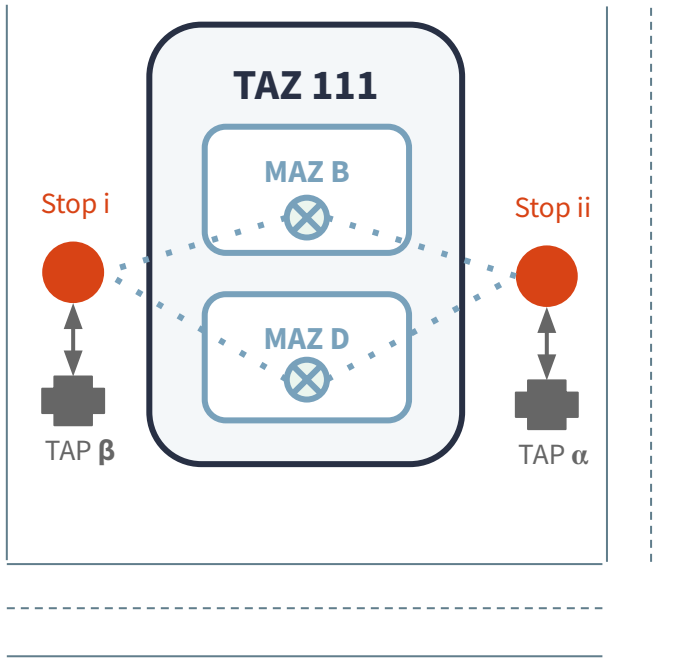
In the non-TAP approach, if there's only one stop:

- Skimming and assignment paths will be correct (TAZ impedance is irrelevant to path choice).
- MAZ impedance will be correct

Jack London Square

| Step | Records | Quantity | Share of all MAZs |
|------|--|----------|-------------------|
| 1 | MAZs that are connected to at least two TAPs, with at least one accessing only bus service and at least one connecting to rail service | 25,206 | 63.5% |
| 2 | Of the MAZs in Step 1, the number of MAZs connected to a bus TAP and a rail TAP with distance differences greater than 0.25 miles | 16,411 | 41.3% |
| 3 | Of the MAZs in Step 2, the number of MAZs with non-zero walk to transit trips | 14,087 | 35.6% |
| 4 | Of the MAZs in Step 3, the number of MAZs with more than 100 walk to transit trips. | 494 | 1.2% |
| 5 | Of the MAZs in Step 4, the number of MAZs with very different demand patterns than TAZs | 12 | 0.0% |

Jack London Square



In the non-TAP approach, if the stops are equidistant:

- MAZ impedance will be correct (only one answer)
- TAZ impedance will be correct → skimming and assignment will be correct.

Jack London Square

| Step | Records | Quantity | Share of all MAZs |
|------|--|----------|-------------------|
| 1 | MAZs that are connected to at least two TAPs, with at least one accessing only bus service and at least one connecting to rail service | 25,206 | 63.5% |
| 2 | Of the MAZs in Step 1, the number of MAZs connected to a bus TAP and a rail TAP with distance differences greater than 0.25 miles | 16,411 | 41.3% |
| 3 | Of the MAZs in Step 2, the number of MAZs with non-zero walk to transit trips | 14,087 | 35.6% |
| 4 | Of the MAZs in Step 3, the number of MAZs with more than 100 walk to transit trips. | 494 | 1.2% |
| 5 | Of the MAZs in Step 4, the number of MAZs with very different demand patterns than TAZs | 12 | 0.0% |

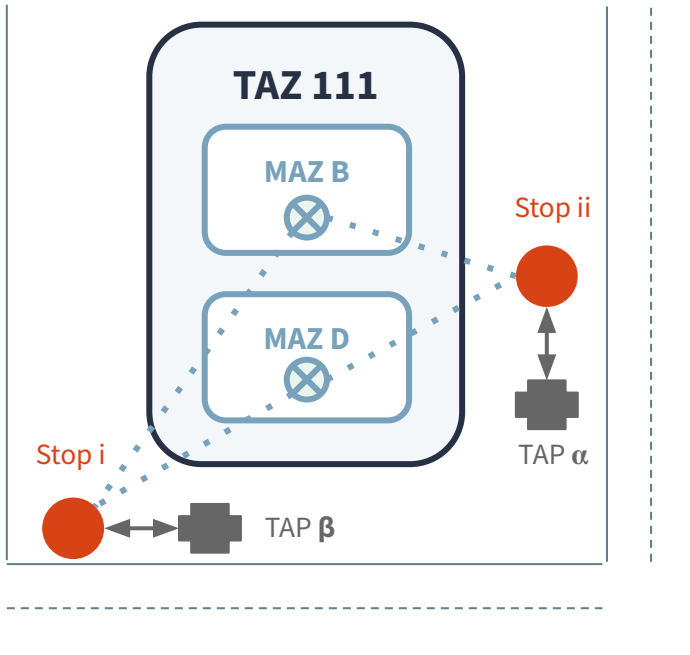
Jack London Square

| Step | Records | Quantity | Share of all MAZs |
|------|--|----------|-------------------|
| 1 | MAZs that are connected to at least two TAPs, with at least one accessing only bus service and at least one connecting to rail service | 25,206 | 63.5% |
| 2 | Of the MAZs in Step 1, the number of MAZs connected to a bus TAP and a rail TAP with distance differences greater than 0.25 miles | 16,411 | 41.3% |
| 3 | Of the MAZs in Step 2, the number of MAZs with non-zero walk to transit trips | 14,087 | 35.6% |
| 4 | Of the MAZs in Step 3, the number of MAZs with more than 100 walk to transit trips. | 494 | 1.2% |
| 5 | Of the MAZs in Step 4, the number of MAZs with very different demand patterns than TAZs | 12 | 0.0% |

Jack London Square

| Step | Records | Quantity | Share of all MAZs |
|------|--|----------|-------------------|
| 1 | MAZs that are connected to at least two TAPs, with at least one accessing only bus service and at least one connecting to rail service | 25,206 | 63.5% |
| 2 | Of the MAZs in Step 1, the number of MAZs connected to a bus TAP and a rail TAP with distance differences greater than 0.25 miles | 16,411 | 41.3% |
| 3 | Of the MAZs in Step 2, the number of MAZs with non-zero walk to transit trips | 14,087 | 35.6% |
| 4 | Of the MAZs in Step 3, the number of MAZs with more than 100 walk to transit trips. | 494 | 1.2% |
| 5 | Of the MAZs in Step 4, the number of MAZs with very different demand patterns than TAZs | 12 | 0.0% |

Jack London Square



In the non-TAP approach, if the demand is identical across MAZs:

- Average TAZ impedance will be correct → skimming and assignment will be correct.
- MAZ impedance estimates will be correct → average is exactly right.

Jack London Square

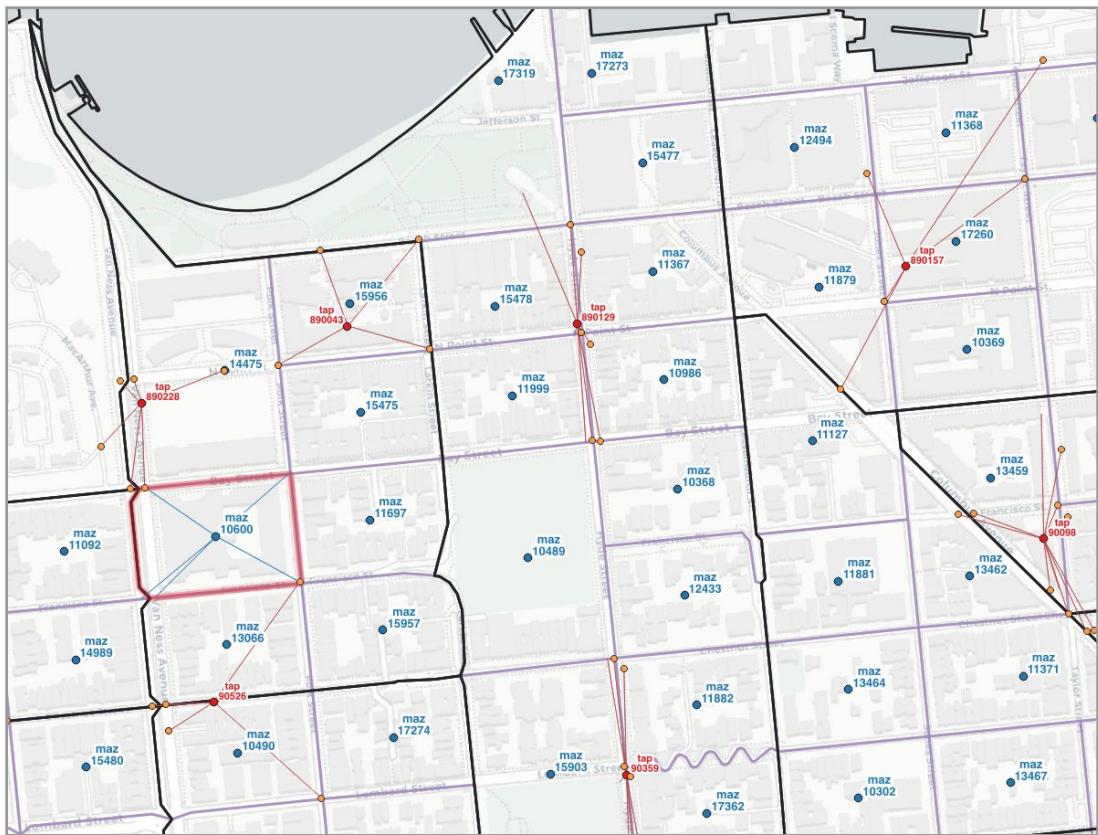
| Step | Records | Quantity | Share of all MAZs |
|------|---------|----------|-------------------|
|------|---------|----------|-------------------|

Can be used as guidance to inform which TAZs may need to be split if a non-TAP approach is selected.

| | | | |
|---|---|----|------|
| 5 | Of the MAZs in Step 4, the number of MAZs with very different demand patterns than TAZs | 12 | 0.0% |
|---|---|----|------|

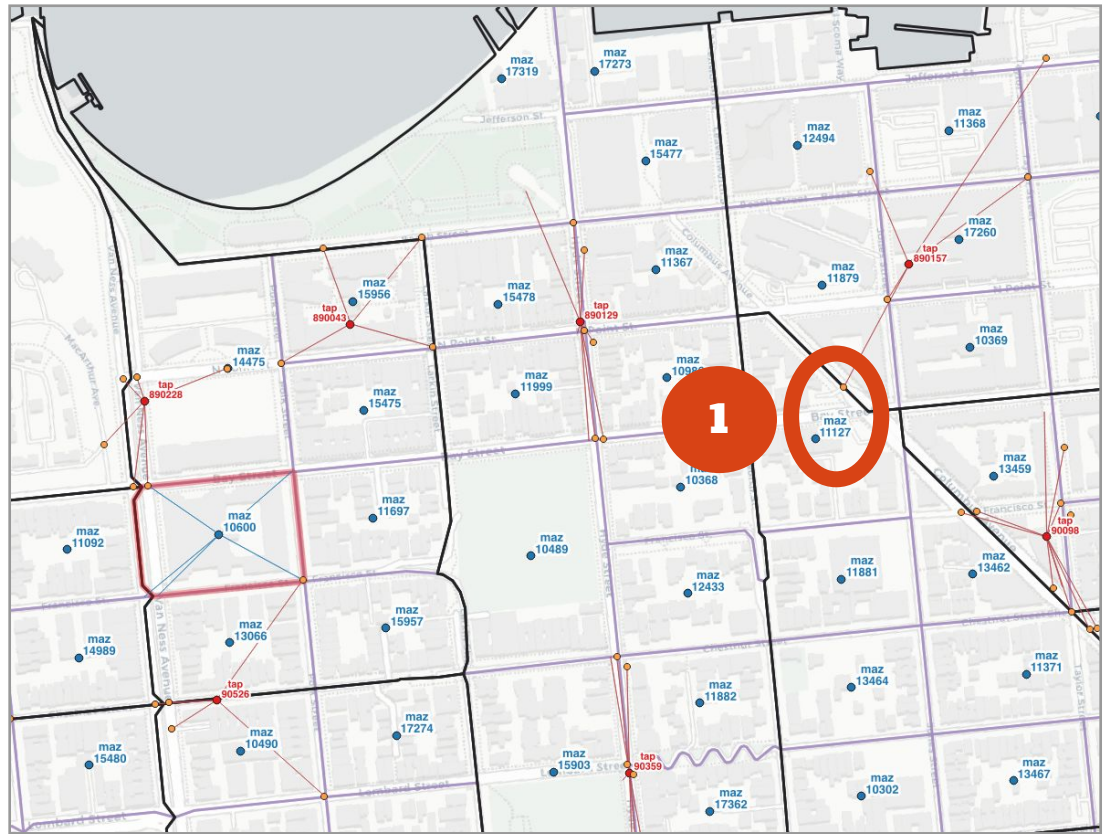
Jack London Square

Spatial Distortions



Spatial Distortions

1. A very short walk from an MAZ to a transit stop.

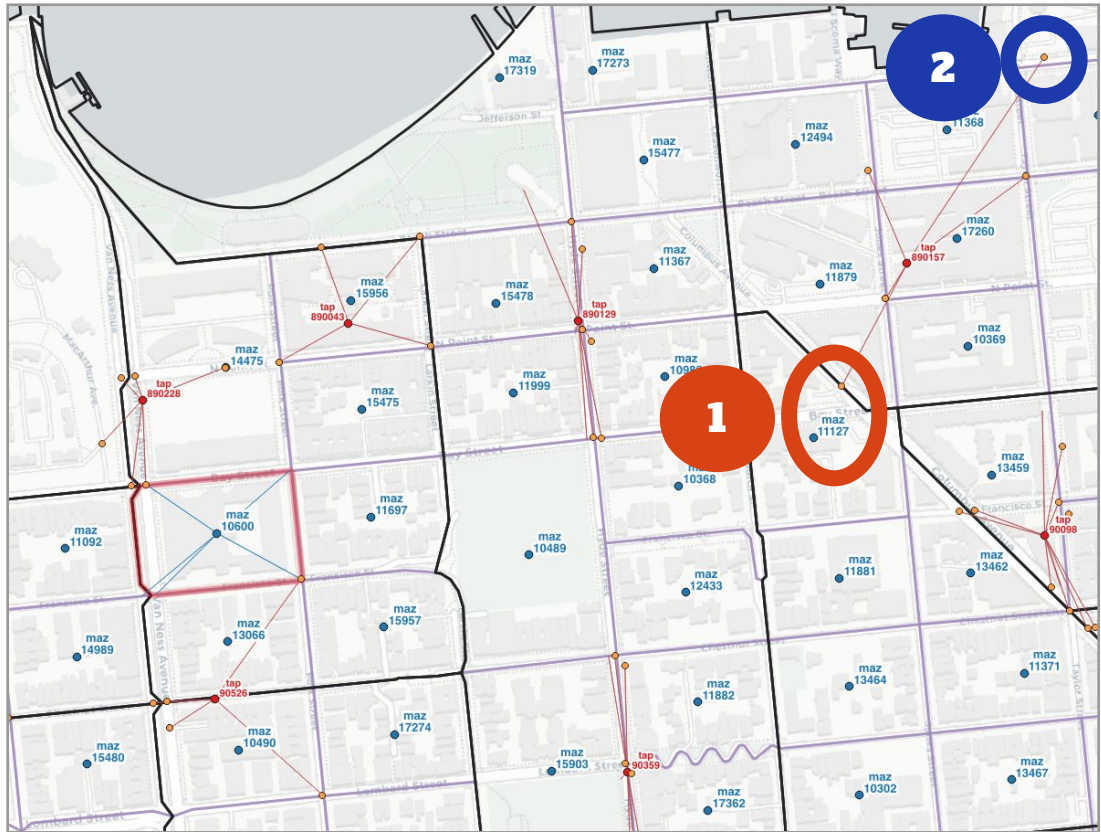


Spatial Distortions

1. A very short walk from an MAZ to a transit stop.

2. Provides access, via the free TAP connections, to transit stops several blocks away.

These distortions reduce the TAP procedures' ability to accurately estimate walk access.



Spatial Distortions

How common is this?

| Step | Records | Quantity | Share |
|------|--|----------|-------|
| 1 | MAZs that have connections, via TAPs, to stops that are more than 0.5 miles away | 24,978 | 62.9% |
| 2 | MAZs that have connections, via TAPs, to stops that are more than 0.75 mile away | 5,763 | 14.5% |
| 3 | MAZs that have connections, via TAPs, to stops that are more than 1.0 mile away | 1,126 | 2.8% |
| 4 | MAZs identified in step 3 that have more than 100 transit trips | 5 | 0.4% |

Spatial Distortions

| Step | Records | Quantity | Share |
|------|--|----------|-------|
| 1 | MAZs that have connections, via TAPs, to stops that are more than 0.5 miles away | 24,978 | 62.9% |
| 2 | MAZs that have connections, via TAPs, to stops that are more than 0.75 mile away | 5,763 | 14.5% |
| 3 | MAZs that have connections, via TAPs, to stops that are more than 1.0 mile away | 1,126 | 2.8% |
| 4 | MAZs identified in step 3 that have more than 100 transit trips | 5 | 0.4% |

Spatial Distortions

| Step | Records | Quantity | Share |
|------|--|----------|-------|
| 1 | MAZs that have connections, via TAPs, to stops that are more than 0.5 miles away | 24,978 | 62.9% |
| 2 | MAZs that have connections, via TAPs, to stops that are more than 0.75 mile away | 5,763 | 14.5% |
| 3 | MAZs that have connections, via TAPs, to stops that are more than 1.0 mile away | 1,126 | 2.8% |
| 4 | MAZs identified in step 3 that have more than 100 transit trips | 5 | 0.4% |

Spatial Distortions

| Step | Records | Quantity | Share |
|-------------|--|-----------------|--------------|
| 1 | MAZs that have connections, via TAPs, to stops that are more than 0.5 miles away | 24,978 | 62.9% |
| 2 | MAZs that have connections, via TAPs, to stops that are more than 0.75 mile away | 5,763 | 14.5% |
| 3 | MAZs that have connections, via TAPs, to stops that are more than 1.0 mile away | 1,126 | 2.8% |
| 4 | MAZs identified in step 3 that have more than 100 transit trips | 5 | 0.4% |

Spatial Distortions

| Step | Records | Quantity | Share |
|------|---------|----------|-------|
|------|---------|----------|-------|

Can be used as guidance to inform which transit stops should be connected to new or different TAPs if the TAP approach is retained.

| | | | |
|---|---|---|------|
| 4 | MAZs identified in step 3 that have more than 100 transit trips | 5 | 0.4% |
|---|---|---|------|

Spatial Distortions

Conclusions & Recommendations

Conclusions

1. A non-TAP approach can leverage MAZ-scale information and replicate, in aggregate, skims and assignment outcomes from a TAP-based approach.
2. The benefits of TAPs are readily observable in cases where TAZ-scale representations fail to capture the walk access nuances of the children MAZs.
3. The benefits of TAPs are ameliorated when multiple transit stops are connected to a single TAP, which causes spatial distortions.

Conclusions

1. A non-TAP approach can leverage MAZ-scale information and replicate, in aggregate, skims and assignment outcomes from a TAP-based approach.
2. The benefits of TAPs are readily observable in cases where TAZ-scale representations fail to capture the walk access nuances of the children MAZs.
3. The benefits of TAPs are ameliorated when multiple transit stops are connected to a single TAP, which causes spatial distortions.

Conclusions

1. A non-TAP approach can leverage MAZ-scale information and replicate, in aggregate, skims and assignment outcomes from a TAP-based approach.
2. The benefits of TAPs are readily observable in cases where TAZ-scale representations fail to capture the walk access nuances of the children MAZs.
3. The benefits of TAPs are ameliorated when multiple transit stops are connected to a single TAP, which causes spatial distortions.

Do not use TAPs if your region has many more transit stops than travel analysis zones.

The benefits of TAPs in representing small scale spatial details are compromised when more than one transit stop is connected to a single TAP.

Other Considerations

TAPs may be a good idea if ...

- You are comfortable with the coding, path building, and software requirements of TAP implementation.
- If transit only operates in a subset of your region.

TAPs are probably a bad idea if ...

- You are not familiar with the coding, path building, and software requirements of TAP implementation.
- You are using, or considering using, a congested transit assignment.

MAZ A

MAZ B

MAZ C

MAZ D

MAZ E

MAZ F

MAZ G

MAZ H

MAZ I

A Way Forward?

MAZ A

MAZ B

MAZ C

MAZ D

MAZ E

MAZ F

MAZ G

MAZ H

MAZ I

Roadway
TAZ 1

A Way Forward?

MAZ A

MAZ D

MAZ G

Transit
TAZ Beta

MAZ B

MAZ E

MAZ H

Transit
TAZ Alpha

MAZ C

MAZ F

MAZ I

A Way Forward?

Thank You!

Contributors: Sijia Wang, Yu-Chu Huang, Lisa Zorn, Bill Davidson, Flavia Tsang

Helpful Comments: Wu Sun, Joel Freedman, Kevin Bragg, Elizabeth Sall