Representing Capacity Constraints on Park and Ride Facilities — 3 ways

David Ory, WSP
Presentation to Utah Model User's Group
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Agenda

- Problem (5 minutes)
- Solution 1: Shadow Pricing in Mode Choice (10 min)
- Solution 2: Simulation with Re-planning (10 min)
- Solution 3: Network-based (10 min)
- Questions and Discussion (15 min)

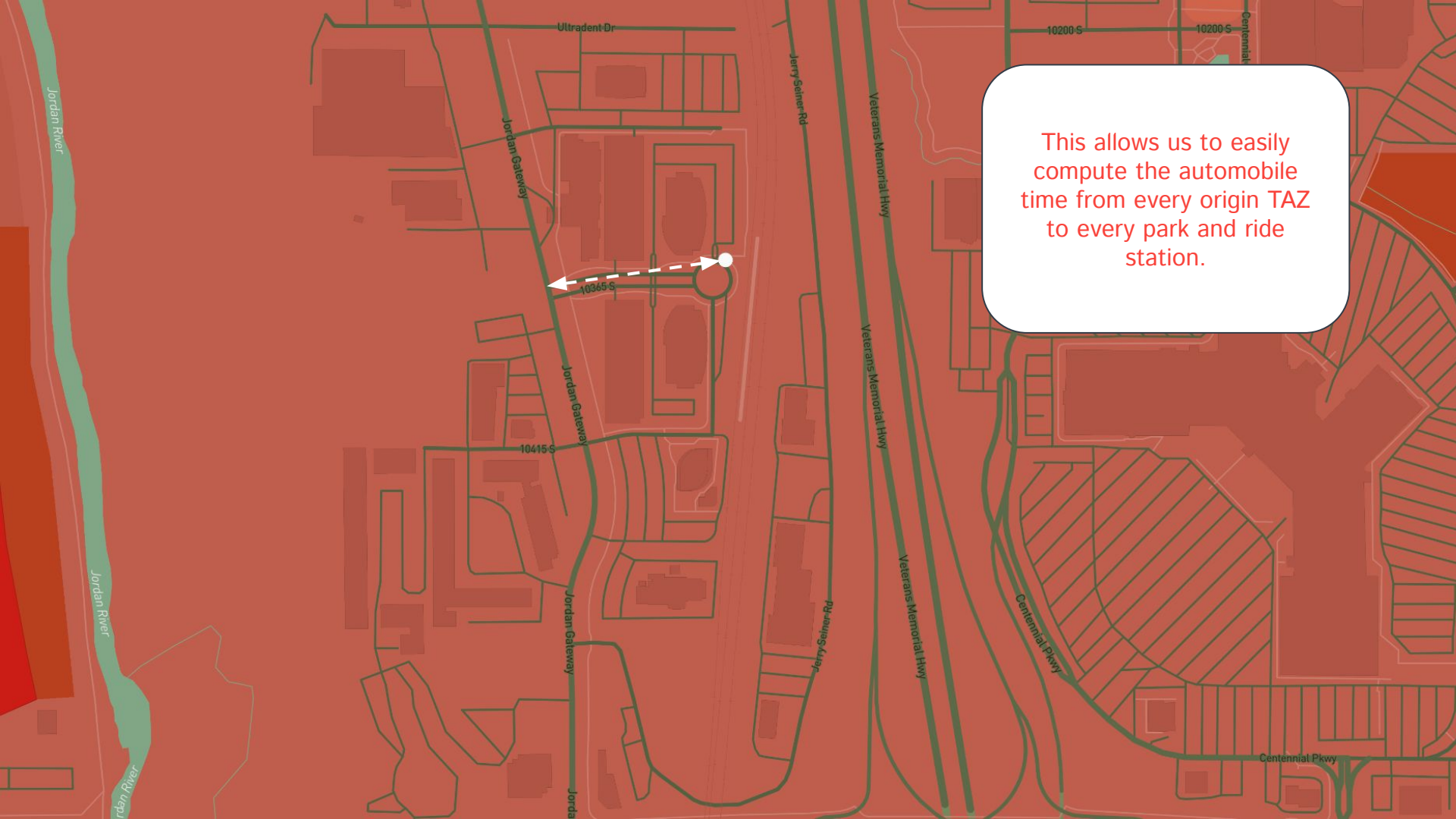
Problem

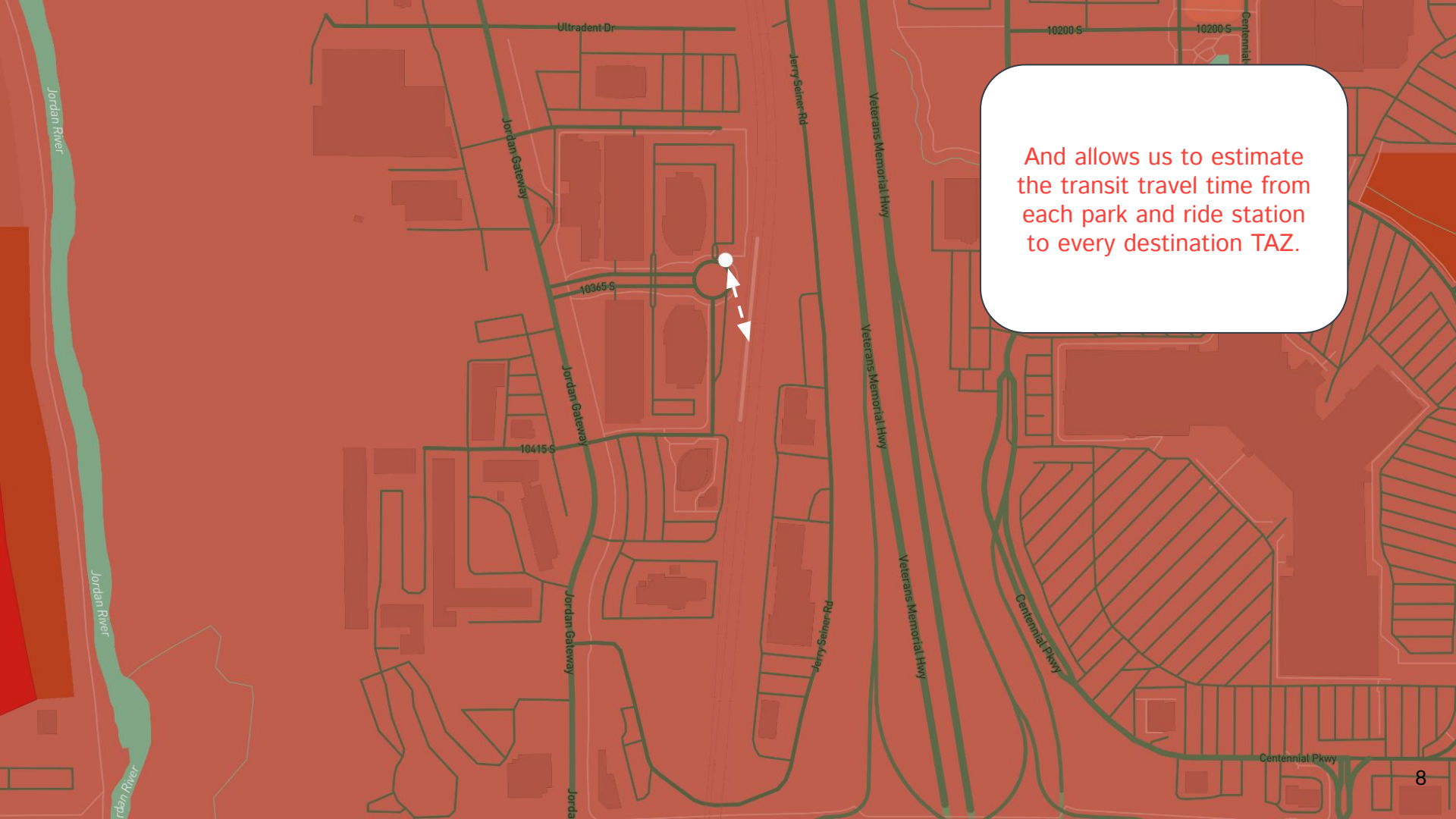
Transit ridership is often constrained by the capacity of park and ride lots. In order to systematically assess the benefits of investments to expand and/or add and/or price park and ride lots, the regional travel model must understand the role capacity plays in transit mode and route choice decisions.

Problem

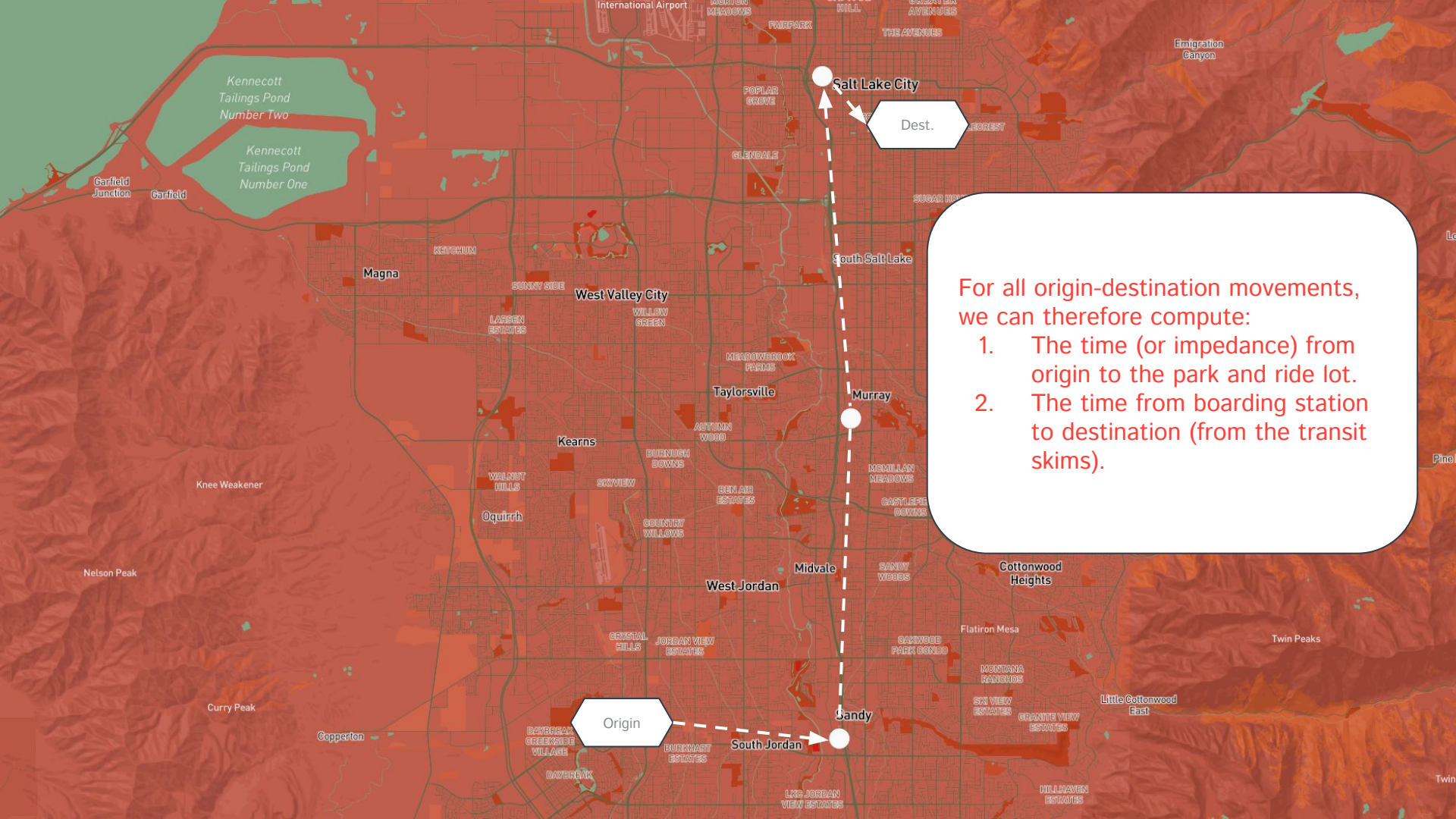
Solution 1: Shadow Pricing in Mode Choice

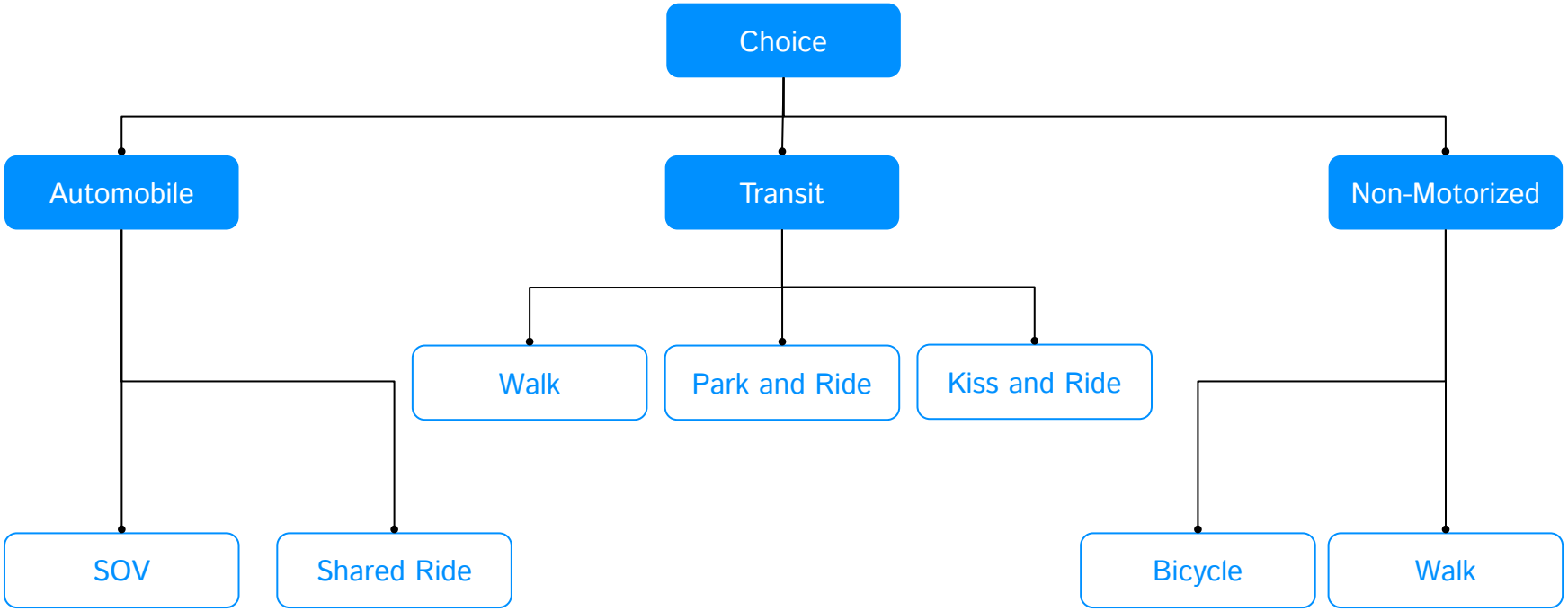

Step 1:
Add “dummy” travel analysis zones (TAZs) at each of the park and ride stations.
Great Salt Lake
Farmington Bay
Great Salt Lake Desert
Bear River
Lyman
Mountain View
Morgan
Henefer
West Valley City
Park City
Heber City
Tabiona
Utah Lake
Duchesne


This allows us to easily compute the automobile time from every origin TAZ to every park and ride station.
Ultradent Dr
10200 S
10200 S
Jordan Gateway
Jerry Seiner Rd
Veterans Memorial Hwy
10365 S
Jordan Gateway
Veterans Memorial Hwy
10415 S
Jordan River
Jordan Gateway
Jerry Seiner Rd
Veterans Memorial Hwy
Centennial Pkwy
Centennial Pkwy
Jordan River
Jordan River

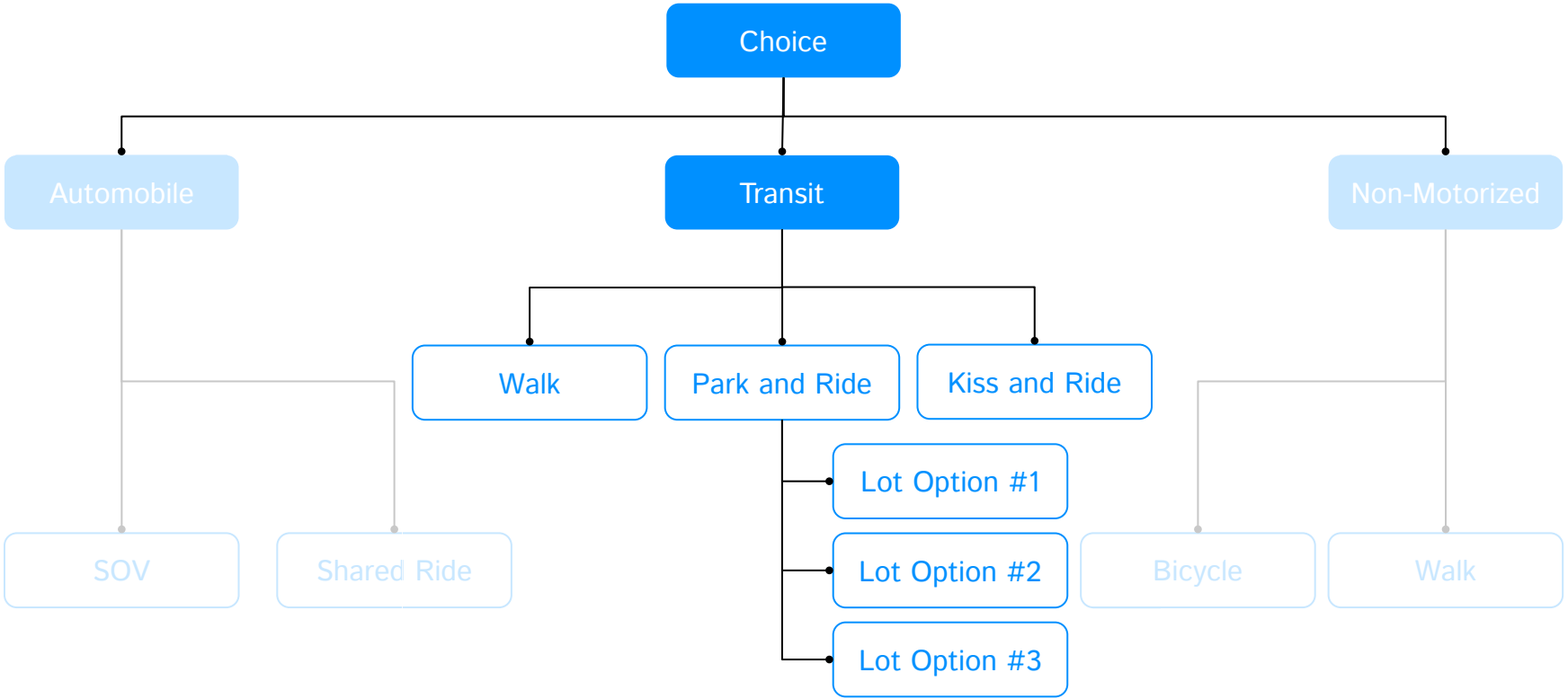


And allows us to estimate the transit travel time from each park and ride station to every destination TAZ.

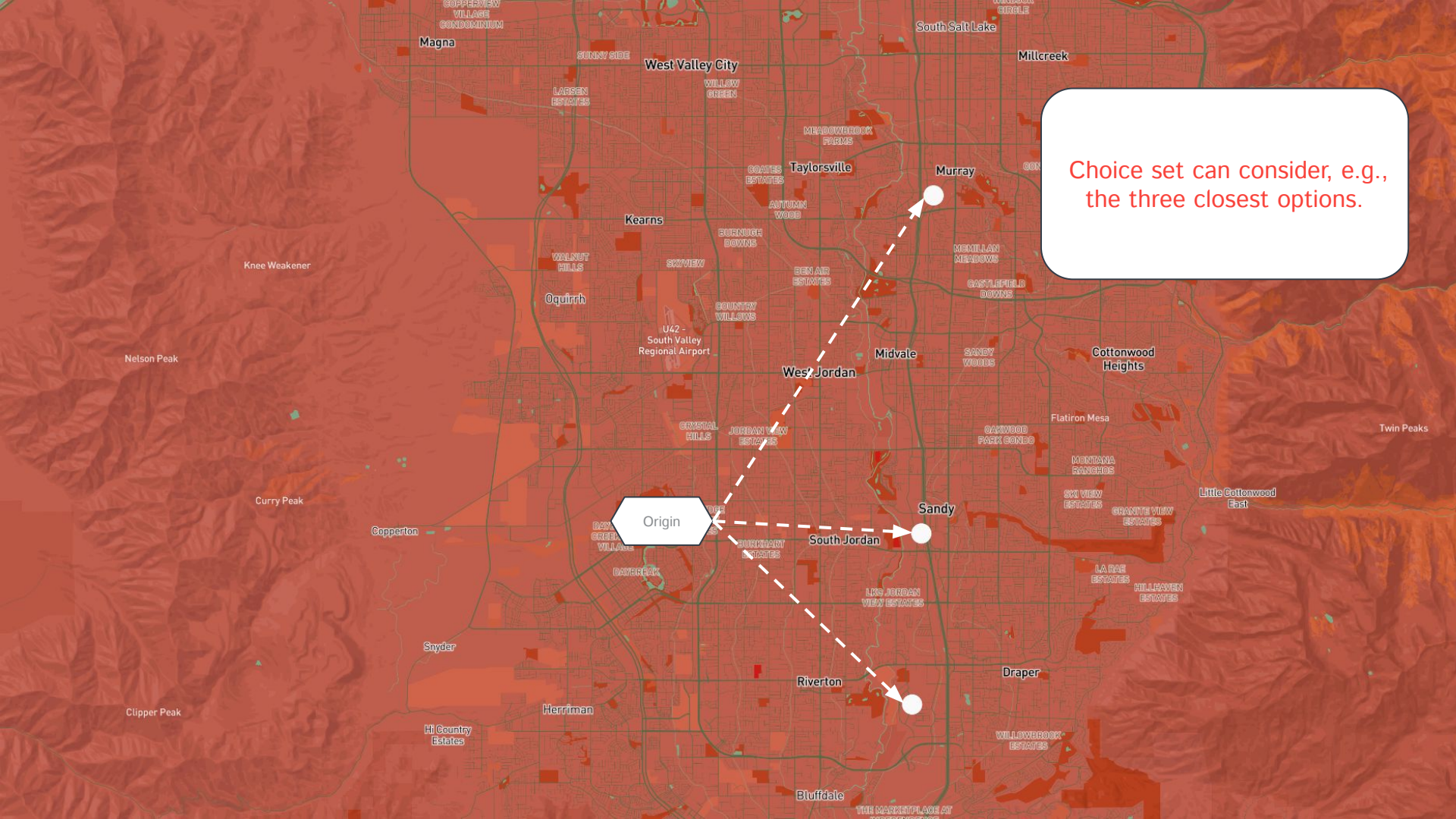

Salt Lake City
Dest.
Origin
Murray
Sandy
South Jordan
West Jordan
West Valley City
Taylorsville
Midvale
Cottonwood Heights
Magna
Kearns
South Salt Lake
Oquirrh
Kennecott Tailings Pond Number Two
Kennecott Tailings Pond Number One
Garfield
Garfield Junction
Knee Weakener
Nelson Peak
Curry Peak
Copperton
Flatiron Mesa
Twin Peaks
Little Cottonwood East
Emigration Canyon
International Airport
For all origin-destination movements, we can therefore compute:
1. The time (or impedance) from origin to the park and ride lot.
2. The time from boarding station to destination (from the transit skims).

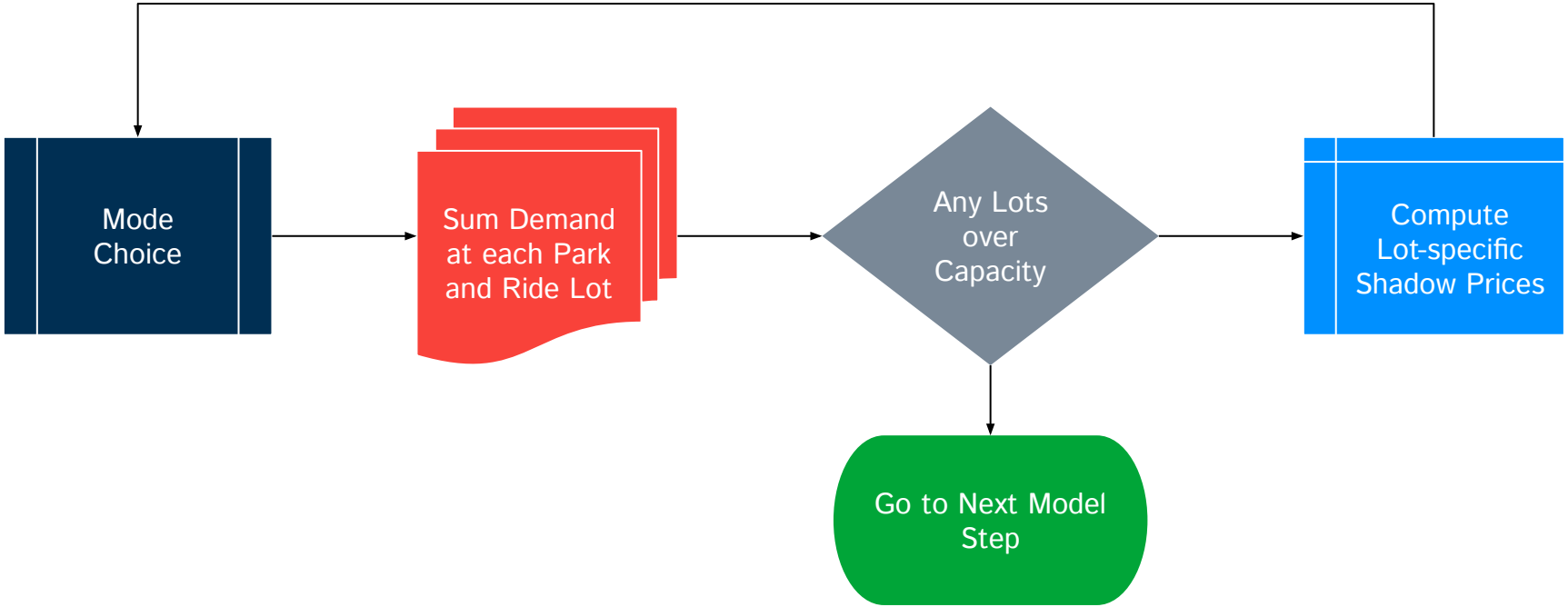


Step 2: Modify Mode Choice Structure



Step 2: Modify Mode Choice Structure


Choice set can consider, e.g., the three closest options.
Origin
Magna
West Valley City
South Salt Lake
Millcreek
Taylorsville
Murray
Kearns
Midvale
West Jordan
Cottonwood Heights
Sandy
South Jordan
Riverton
Draper
Herriman
Bluffdale
Oquirrh
Knee Weakener
Nelson Peak
Curry Peak
Copperton
Snyder
Clipper Peak
Hi Country Estates
Flatiron Mesa
Twin Peaks
Little Cottonwood East
U42 - South Valley Regional Airport



Step 3: Run Mode Choice Iteratively

Pros and Cons

Pros

- Straightforward to implement
- Allows for changes in mode or route

Cons

- Computationally inefficient
- Relies on heuristics (i.e., lot choice formation)
- Does not inform “when do the lots fill up” analyses
- Awkward assumptions for time periods are required

Solution 2: Simulation with Re-planning

Steps

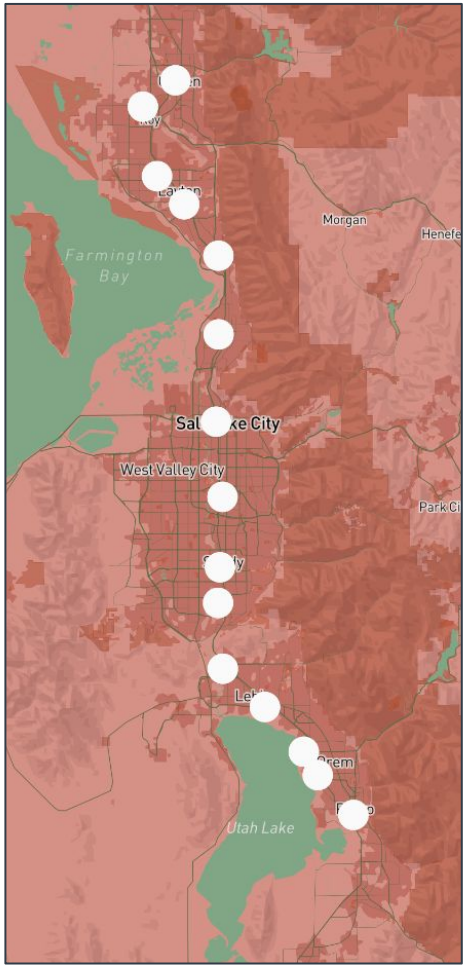
1. For each origin-destination pair, identify a list of possible park and ride stations.
2. Run mode choice using the first best park and ride station.
3. Estimate a departure time for each park and ride trip.
4. Assign each trip to a park and ride lot.
5. Replan “failed” trips.

1

For each origin-destination pair, identify a list of possible park and ride stations.

This can be done with dummy zones plus heuristics, as in Solution #1. In this case, it's probably best to retain all plausible park and ride stations.

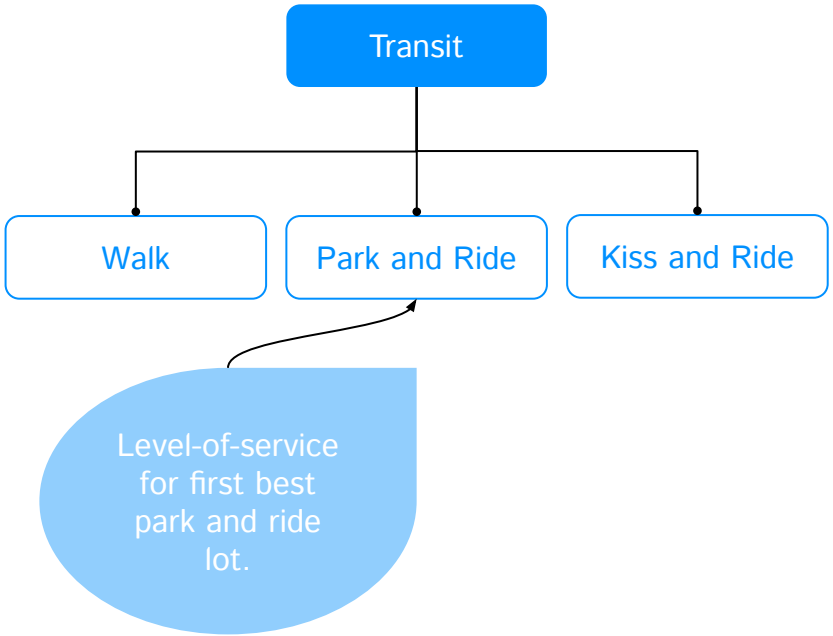
This can also be done by collecting automobile times via point-to-point skimming and using station-adjacent zones for transit travel times (which allows you to not use dummy zones).



Simulation Step 1

2

Run mode choice using the first best park and ride station.



Simulation Step 2

3

Estimate a departure time for each park and ride trip.

More direct in an activity-based model than a trip-based model. In a trip-based model:

1. Enumerate (list with an identifier) each park and ride trip by time of day category.
2. Assign each trip a specific departure from home time, drawing from a uniform distribution that covers the time period (can get more sophisticated, if desired).
3. Compute the arrival time at the park and ride lot based on the automobile time from the origin to the parking lot.

Simulation Step 3

4

Assign each trip to a park and ride lot.

Working through each trip in order by arrival time at the park and ride lot:

1. If the park and ride lot is below capacity, assign the trip to the first choice park and ride lot.
2. If the first best park and ride lot is full, then select the next best park and ride lot if the impedance to the next lot is less than some threshold (e.g., if less than 15 minutes worse).
3. For trips that do not find a satisfactory park and ride lot, place in a “replanning matrix”.

Simulation Step 4

5

Replan “failed” trips.

For the trips in the replanning matrix, re-run mode choice, but do so with the park and ride transit mode set to unavailable.

Simulation Step 5

Pros and Cons

Pros

- Allows for changes in mode or route
- Provides an approximate time at which each lot hits capacity — can be calibrated
- Computationally efficient

Cons

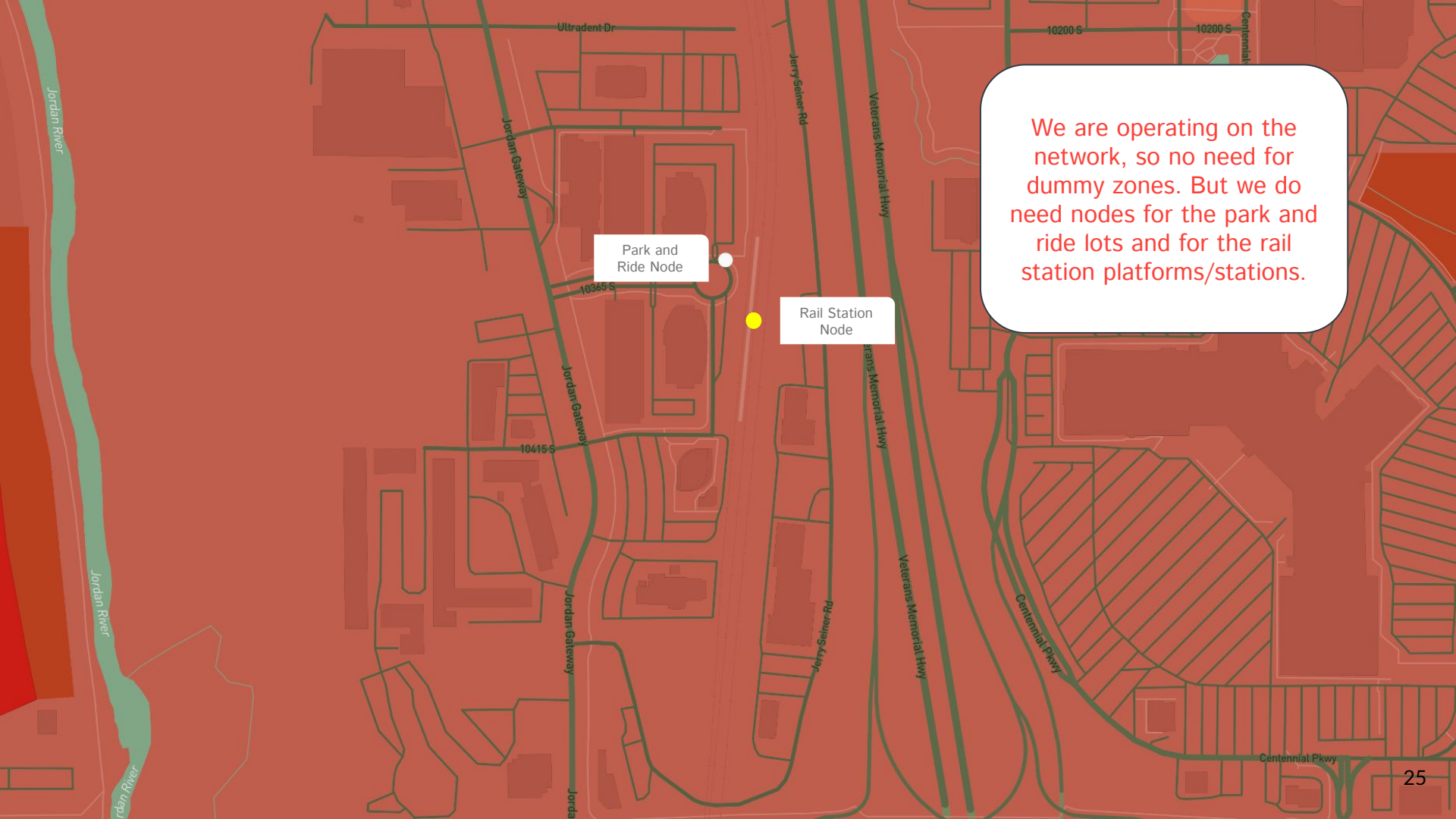
- Relies on heuristics (i.e., lot choice formation)
- Tedious accounting needed to implement

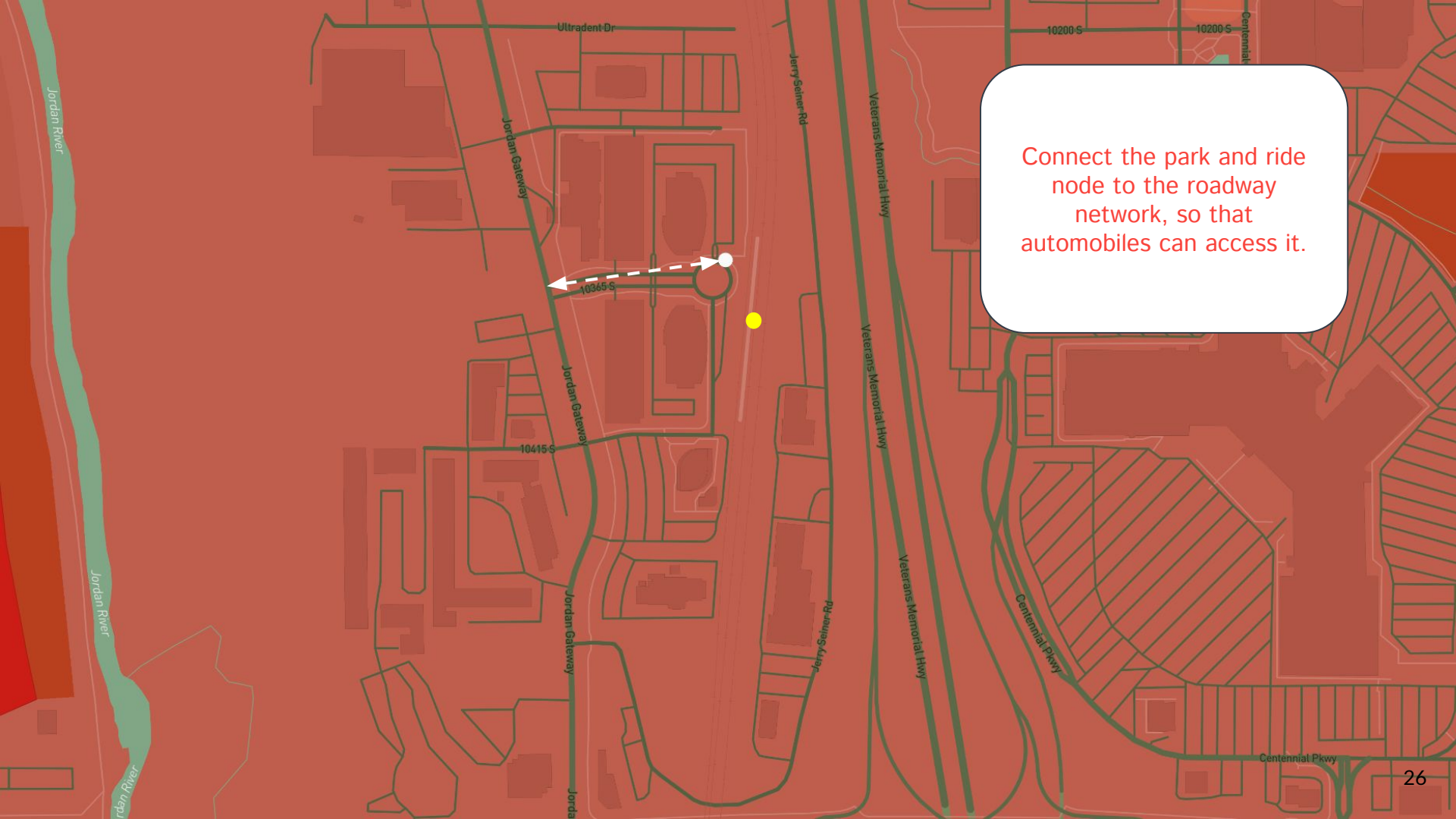
Solution 3: Network-based

Network-based Solutions

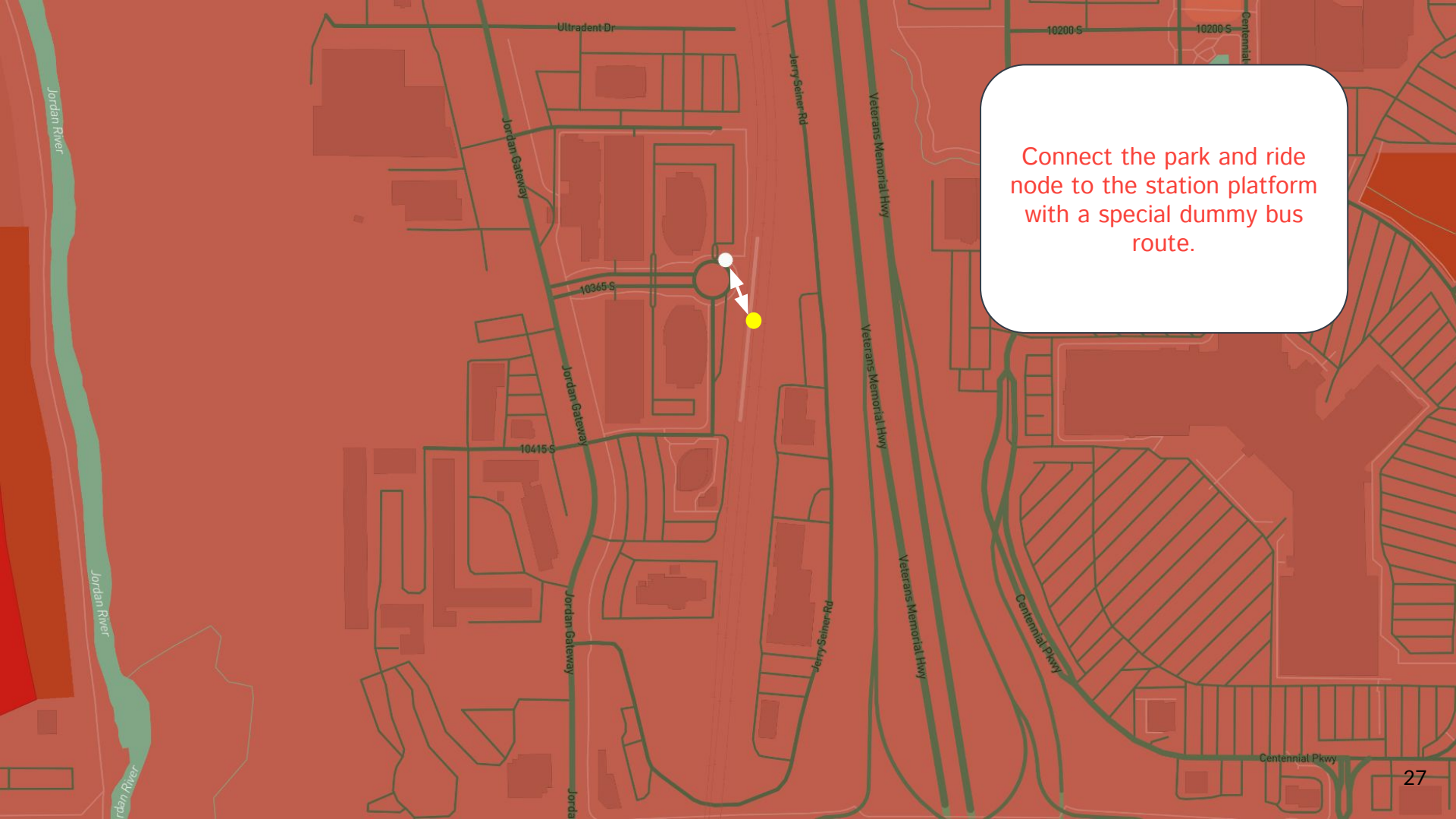
Most commercial travel modeling software packages have some capabilities regarding park and ride location choice, e.g., EMME has a logit-based choice framework that can be implemented in transit assignment. But most have some limitations (e.g., do not allow for explicit capacity constraints).

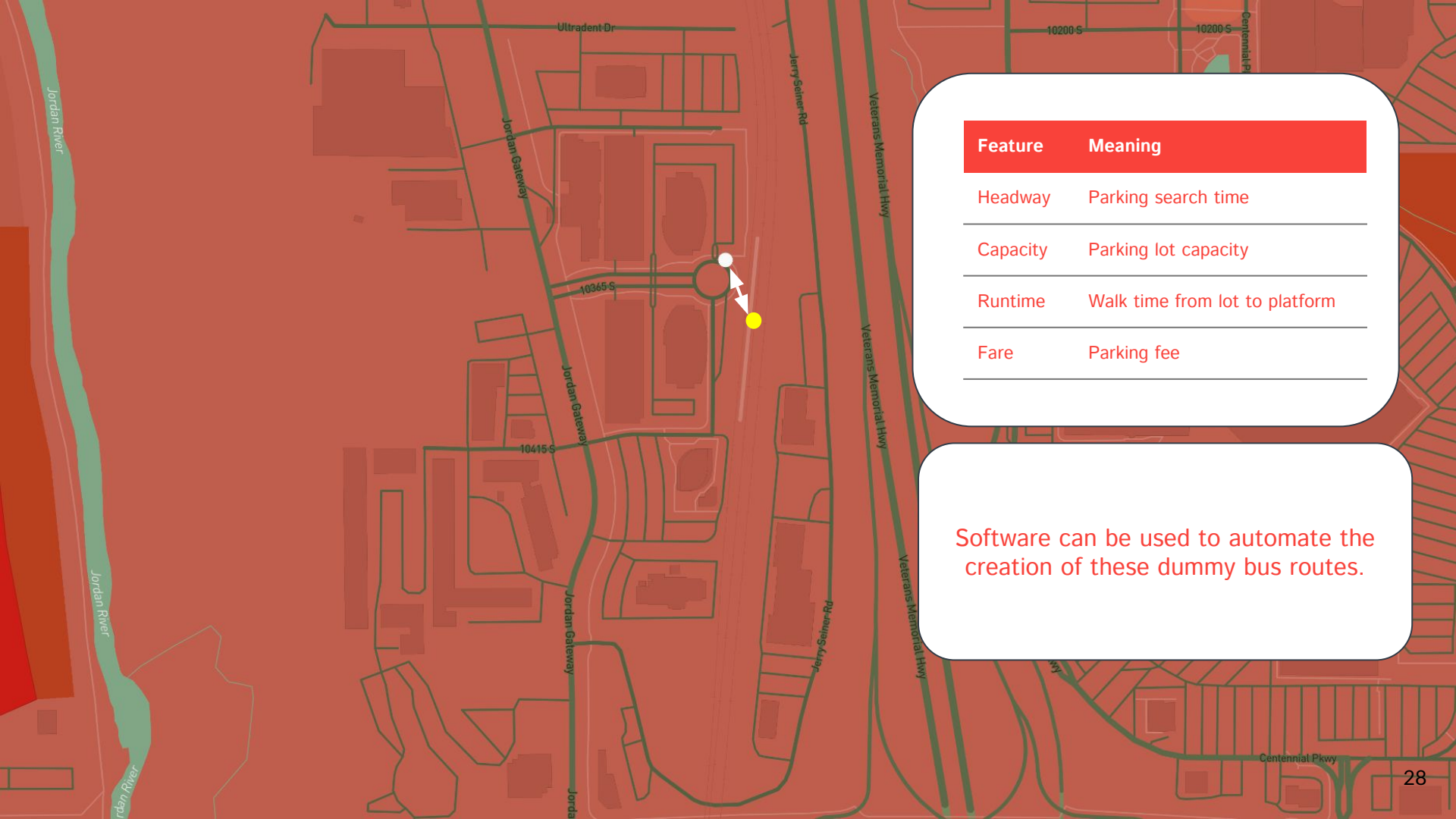
Here's a fun one we did for BART.


Ultradent Dr
10200 S
10200 S
Jordan River
Jordan Gateway
Jerry Seiner Rd
Veterans Memorial Hwy
Park and Ride Node
10365 S
Rail Station Node
Jordan Gateway
10415 S
Jordan River
Jordan Gateway
Jerry Seiner Rd
Veterans Memorial Hwy
Centennial Pkwy
Centennial Pkwy
Jordan River
We are operating on the network, so no need for dummy zones. But we do need nodes for the park and ride lots and for the rail station platforms/stations.



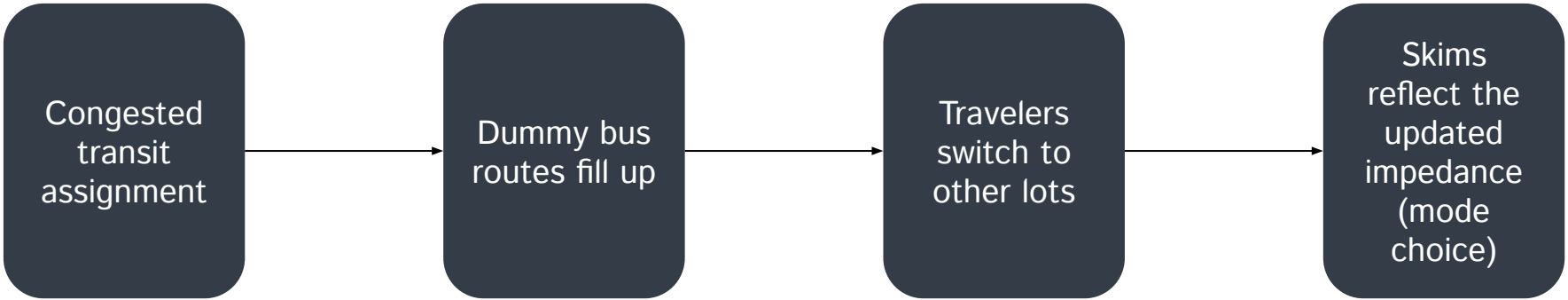
Connect the park and ride node to the roadway network, so that automobiles can access it.


Ultradent Dr
Jordan Gateway
Jerry Seiner Rd
Veterans Memorial Hwy
10200 S
10365 S
10415 S
Jordan River
Centennial Pkwy
Connect the park and ride node to the station platform with a special dummy bus route.



Feature	Meaning
Headway	Parking search time
Capacity	Parking lot capacity
Runtime	Walk time from lot to platform
Fare	Parking fee

Software can be used to automate the creation of these dummy bus routes.



Network-based Solution

Pros and Cons

Pros

- Allows for changes in mode or route
- High-fidelity representation of lot characteristics
- Computationally efficient
- Does not rely on heuristics

Cons

- Does not inform “when do the lots fill up” analyses
- A bit of a hack — probably better to use vendor-specific solutions if they meet your requirements

In Sum

	Solution	Key Takeaway
1	Shadow Pricing in Mode Choice	Tried and true, but computationally inefficient.
2	Simulation with Replanning	Cosmetically attractive, but relies on heuristics and can be tedious to implement.
3	Network-based Solutions	Attractive solution pathways, but will depend on capabilities of commercial software package.

Questions & Discussion