Issues and Challenges Integrating Activity-Based Demand Models with Dynamic Traffic Assignment Procedures

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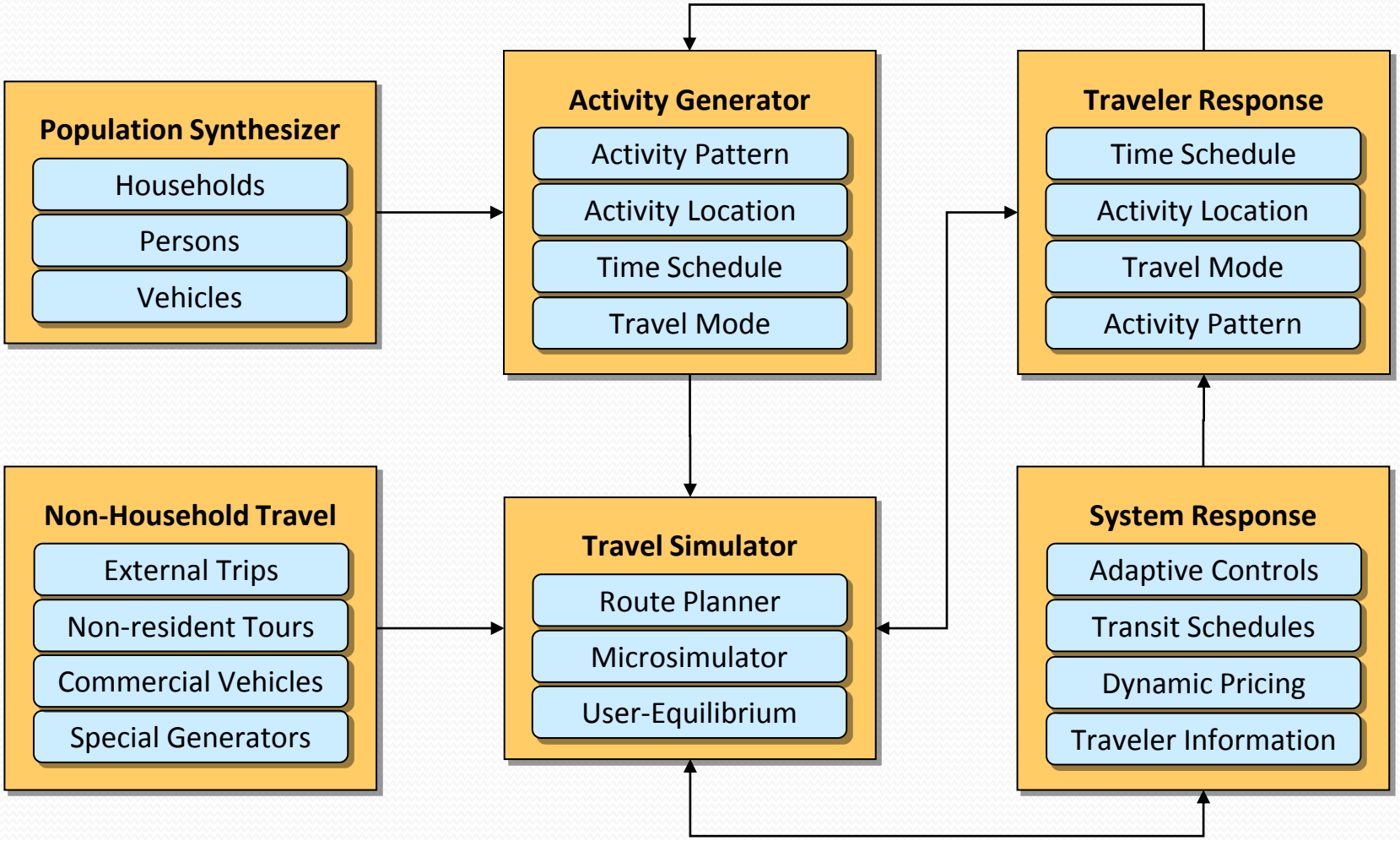
Next Generation Travel Models

- Interaction of network operations and performance with changes in behavior that affect activity patterns, travel schedules, and mode and location choice
  - Finer resolution of space and time dimensions
  - Traveler decisions in the context of household activities
  - Operations of specific streets and facilities
  - Regional simulation of individual vehicles and persons to evaluate system performance

Ultimate Objective

- Fully integrated dynamic travel choice and network performance tool
  - Models both supply and demand in a consistent and compatible way (i.e., similar level of detail)
  - Disaggregate – all model components track the location of each individual throughout the day
    - Detailed positions (e.g., link-lane-offset)
    - Detailed time steps (e.g., minutes or seconds)

High Level Components



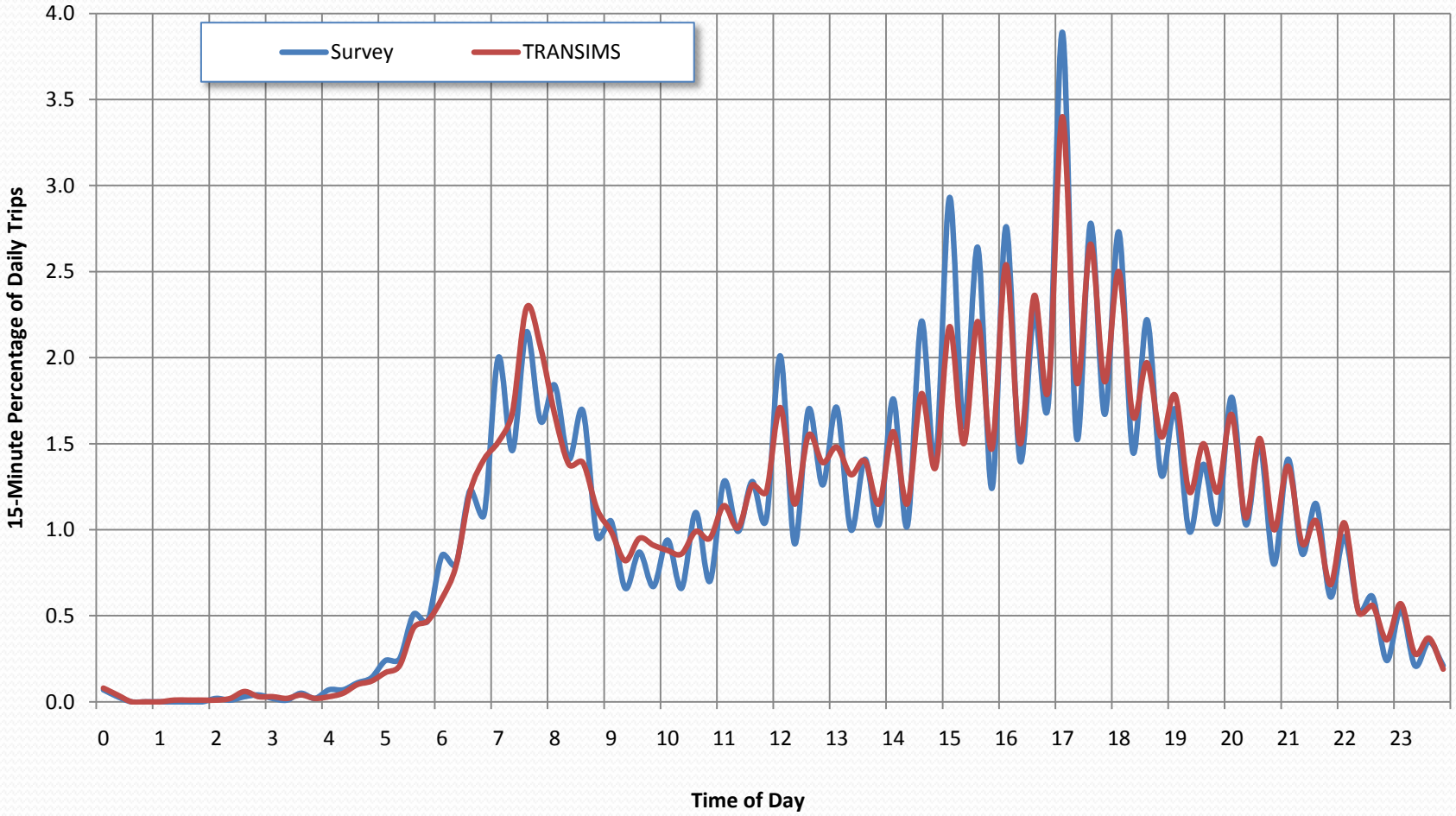
Case Studies

- TRANSIMS activity model simulation for Portland
  - Survey-based (activity-patterns, schedules, and modes)
  - Activity locations (~6/link) and seconds of the day
- DaySim activity model and TRANSIMS routing
  - Sacramento and Jacksonville
  - Parcel-based with 4 to 22 time periods (30+ minutes)
- Columbus tour model (PB) and TRANSIMS simulation
  - Zone-based, 4 to 18 time periods (60+ minutes)
  - Up to two intermediate stops on tours and sub-tours

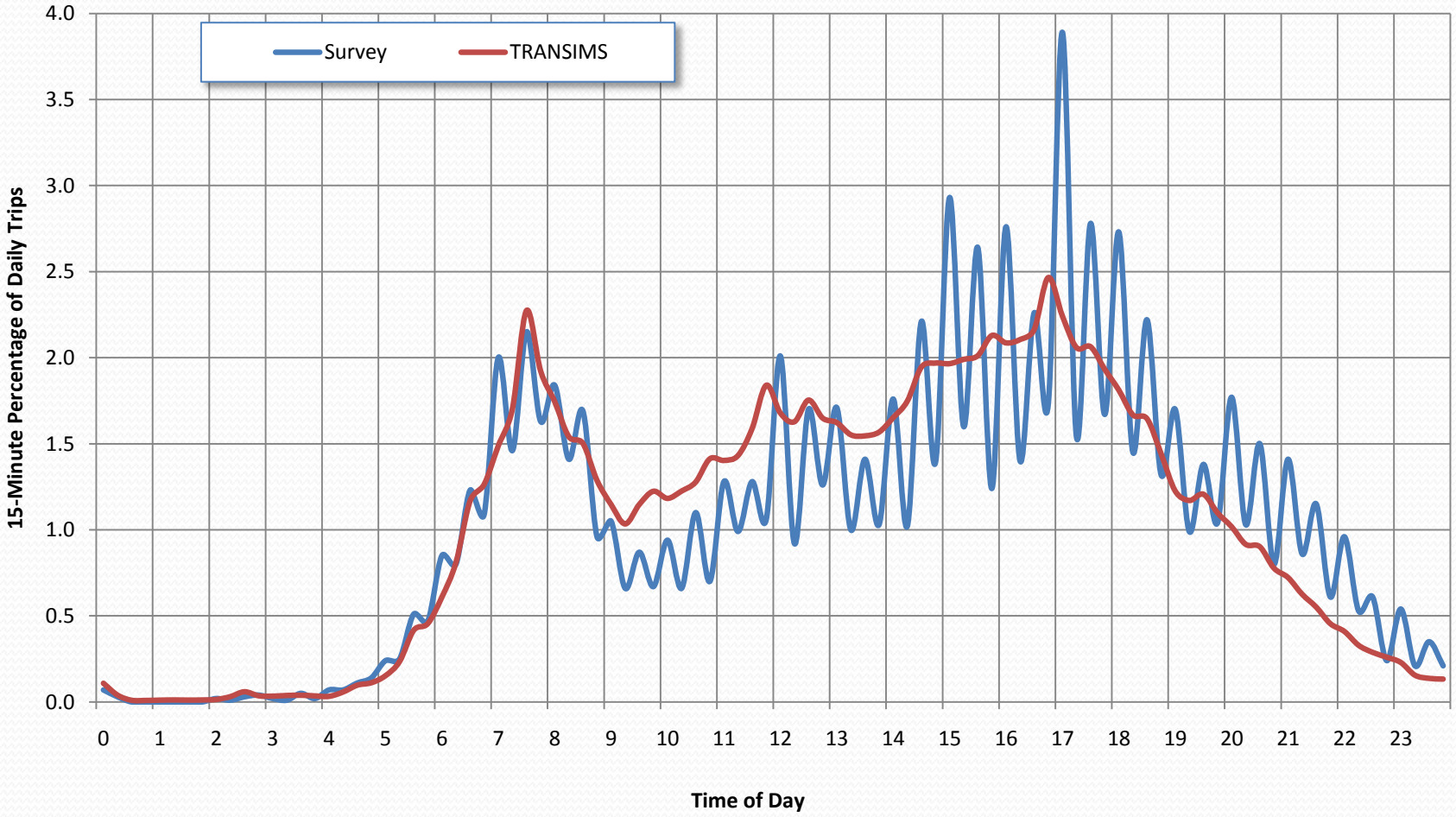
Issues and Challenges

- TRANSIMS ActGen
  - Household survey activity patterns copied ~130 times
    - MUST be internally consistent and accurate
    - 45% of ActGen problems caused by coding or reporting inaccuracies in the household survey
  - Simple (standard) location choice models failed to consider schedule constraints and destination capacity
    - Schedule shifts / compression could not “fix” complex tours
  - Time reporting bias overloaded the Microsimulator
    - Random time shift needed (+/- 15 minutes)

Before Temporal Smoothing

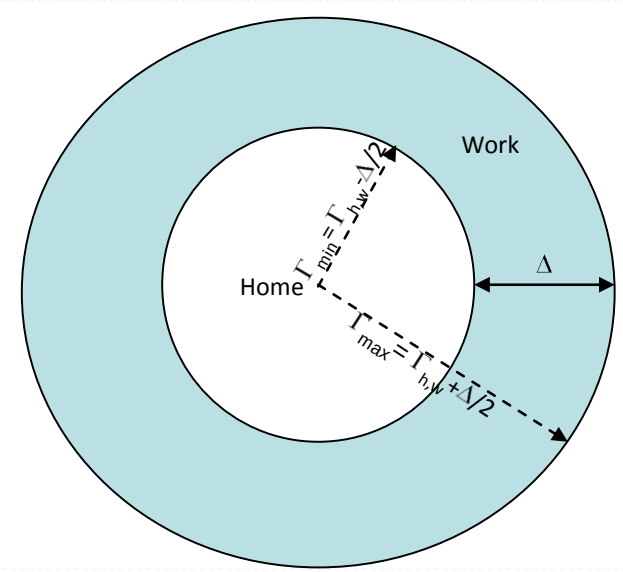


After Temporal Smoothing

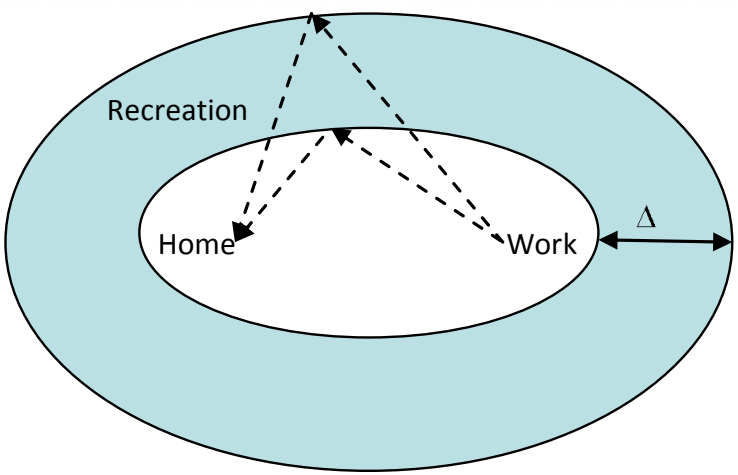


Location Choice Constraints

- Time budget constraints select destinations that are logically consistent with the activity pattern/schedule



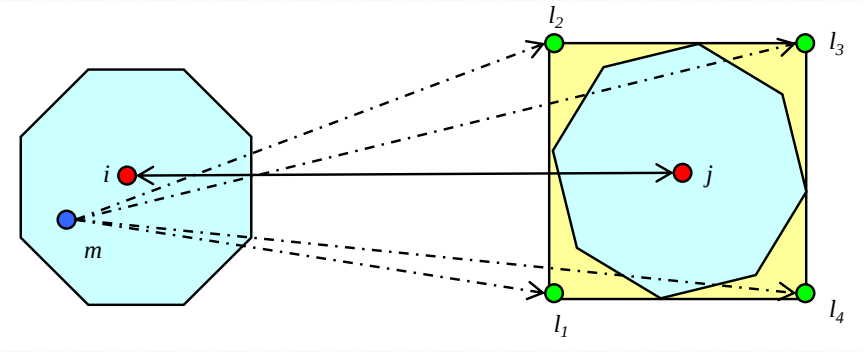
Anchor Location



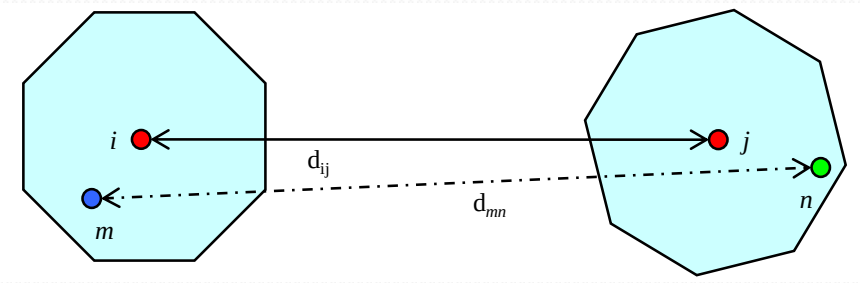
Intermediate Stop

Travel Time Refinements

- Zone-to-zone travel times by time period and mode
  - Need accurate intra-zonal "skim" data (especially walk)
  - Time budgets need travel time range for zone selection
  - Scheduling needs refined location-to-location times
    - Relative location of activities to zone centroids



Travel Time Range



Activity Schedule Estimate

Time Disaggregation

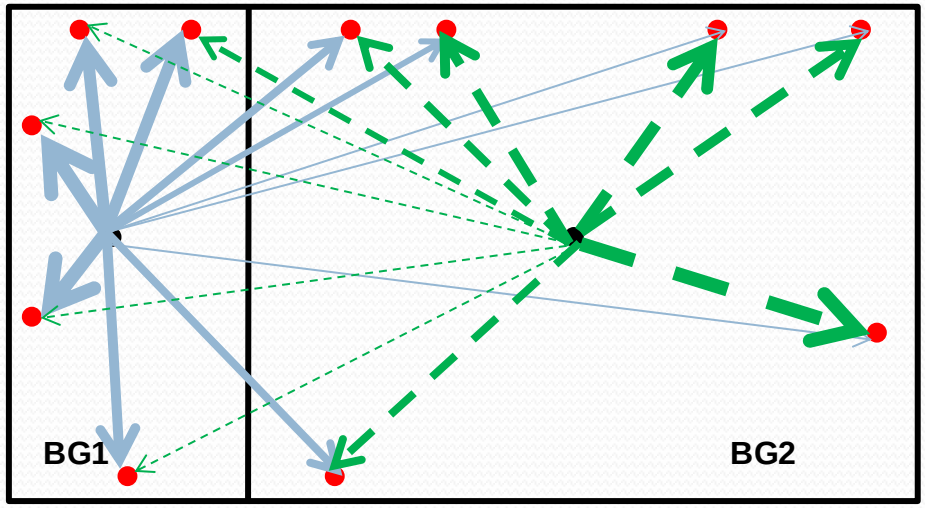
- Activity schedule times
  - DaySim – 22 time periods (30+ minutes)
  - MORPC – 18 time periods (60+ minutes)
- Diurnal distributions within each period – random?
  - Need to coordinate/restrict times within each time period given other trips/tours and travel times
- MORPC complications
  - Subtours defined separately – need trip/tour sorting
  - Intermediate stop and subtour durations are undefined

Spatial Allocation

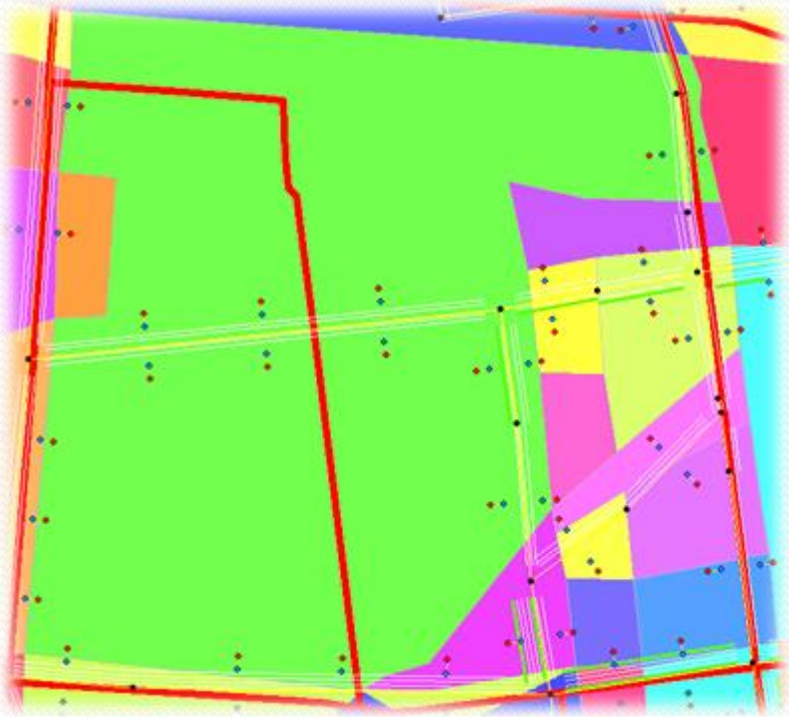
- MORPC – zones, ActGen – links, DaySim – parcels
  - Disaggregate zones and aggregate parcels
- Match activity locations between tours and travelers
  - Synchronize household members and shared activities
    - Home, work and school locations for joint tours and subtours
- MORPC complication
  - Household vehicles are not assigned or coordinated
  - Shared rides are not explicit
    - Driver / passenger role is undefined
    - Household shared rides may not generate a vehicle trip

Subzone Allocation Weights

- Use Block/Block Group data to allocation zone trip ends to activity locations



Centroid Proximity Weights



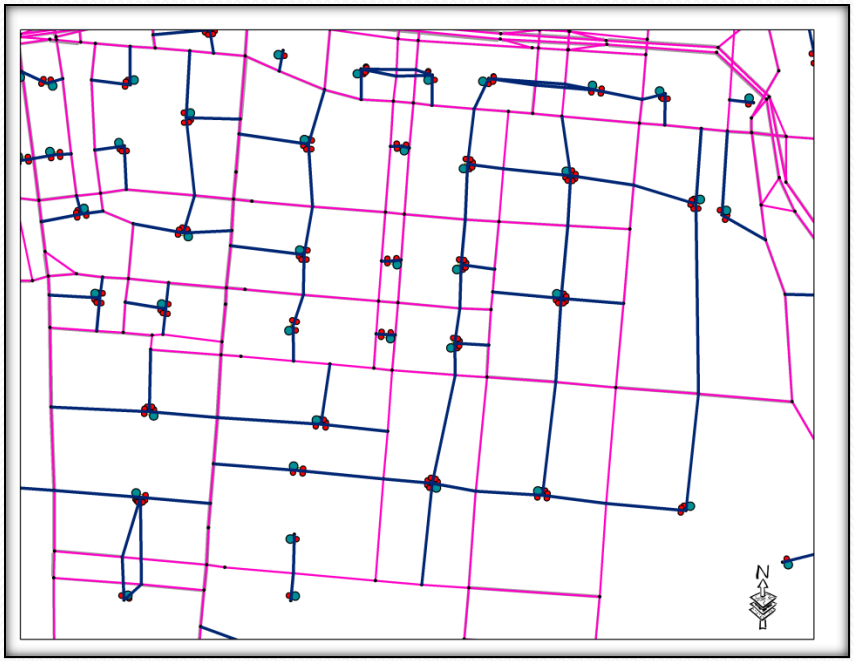
Zone, Block and Network Inconsistencies

Network Resolution

- MPO (>=collector) vs. all-streets vs. in-between detail
  - All work reasonably well for drive trips
    - More detail slows processing time and increases illogical paths (too many local cut-throughs)
    - Less detail overloads collectors and minor arterials
  - Walk and transit trips have problems with MPO detail
    - Not ubiquitous in space or time
      - Schedules / stops / access paths / transfer coordination
    - Paths highly dependent on start and return times
      - Full tour must be feasible using the chosen mode
      - Trip time shifts to “optimize” transit path are important

Intermediate Level of Detail

- Use MPO zone connectors as local streets
  - Options: prohibit cut throughs, add activity locations
  - Check connections at signalized intersections



Point-to-Point Options

- Fully enumerated skims by space and time – too much
- On-the-fly-path building methods
  - One-to-many or many-to-one path building possible if the one-end time of day is fixed or period binned
    - DaySim wants the time fixed at the many-end
  - Sampling or probe methods
- Hybrid multi-step/feedback methods
  - Adjust the level of detail to the sub-model needs
    - Multi-level networks with multiple path builds or skims
  - Probe/search → select/choose → refine/re-do

Conclusions

- Most activity models do not schedule activities at the level of detail needed for tour simulation
  - Start times, activity durations, and travel times need to be flexible but realistic
    - Rules/methods for resolving conflicts are important
- Feeding travel times to activity models at the level of detail needed for accurate scheduling is challenging
  - On-the-fly, multi-level methods show promise
    - Integrates path building into activity generation/location
    - Critical for transit tours and mode choice