The Day Activity Schedule Approach
of Bowman, Ben-Akiva and Bradley: 1994-2008

Innovations in Travel Modeling 2008

A Transportation Research Board Conference

June 22-24, 2008

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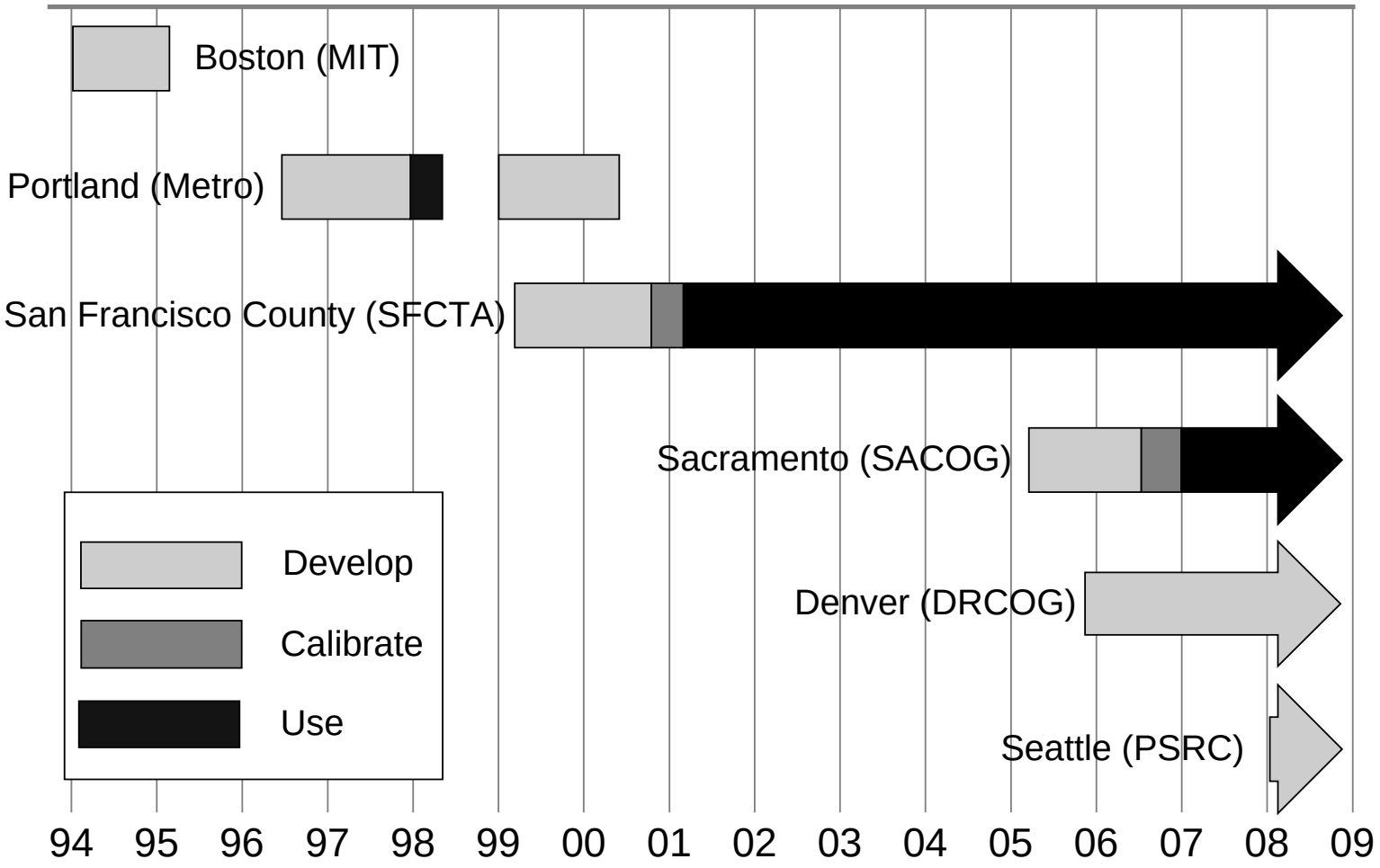
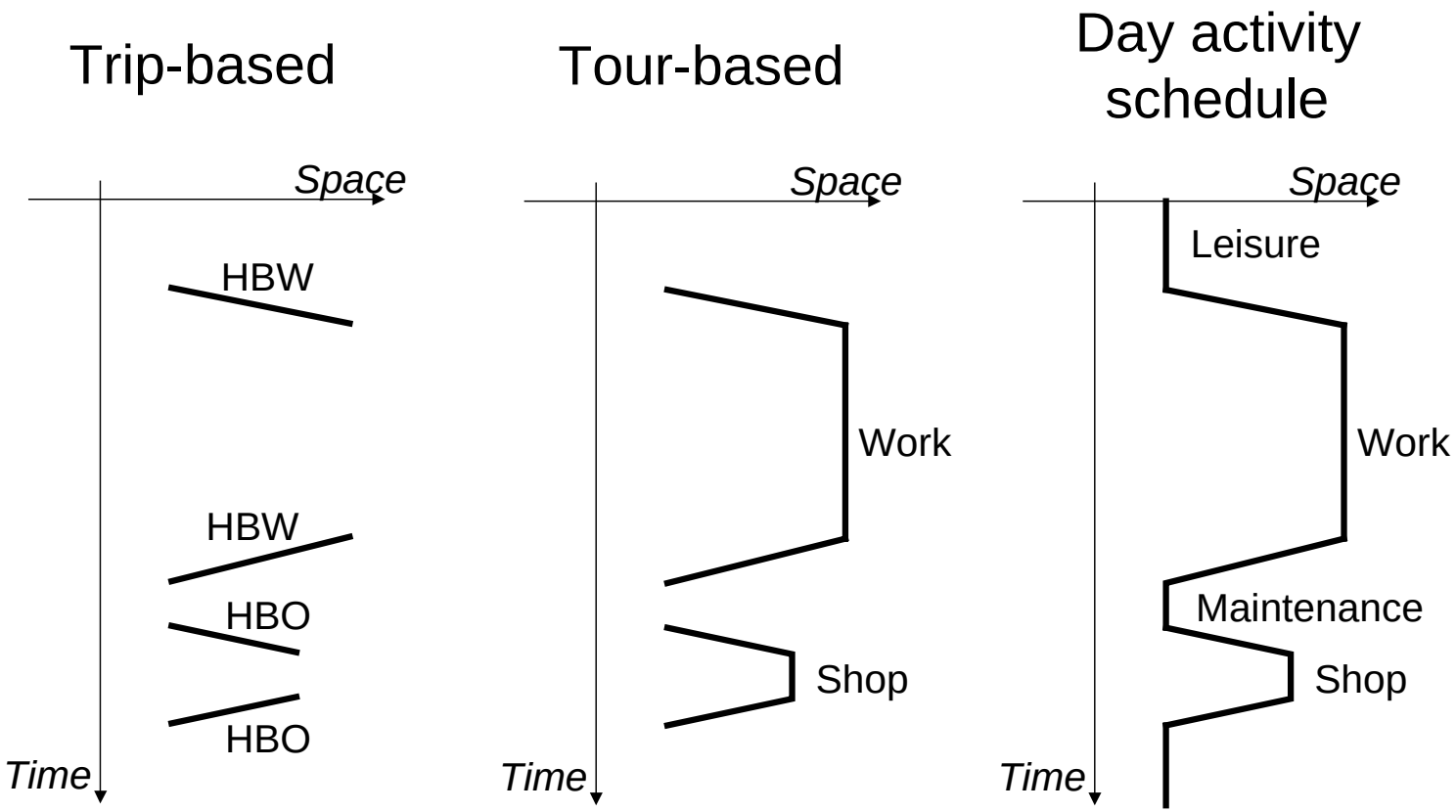
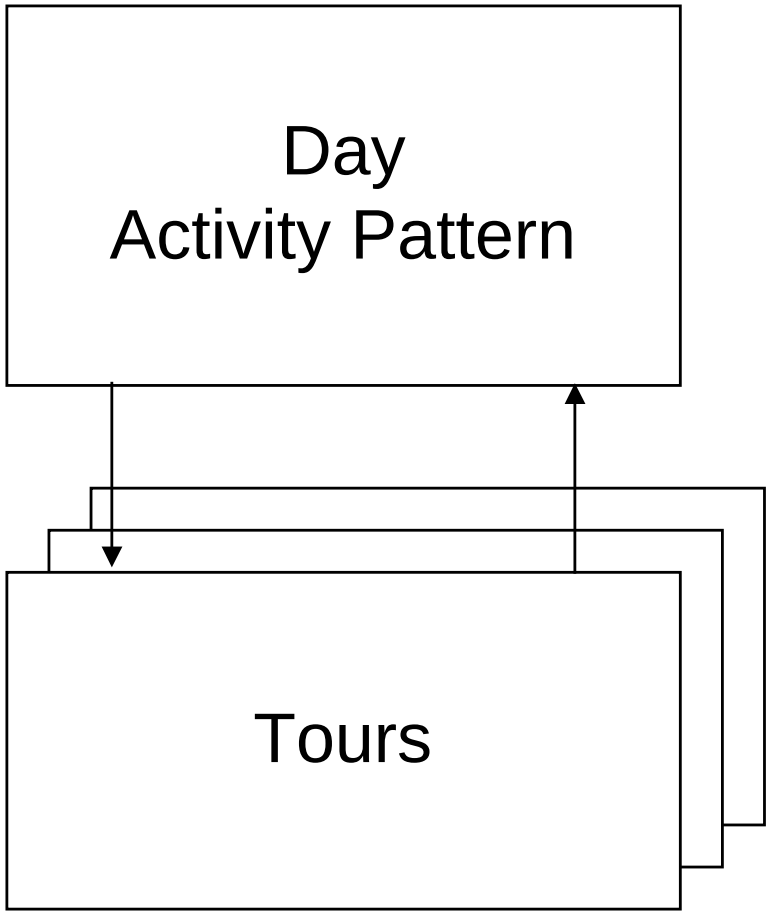
Implementations



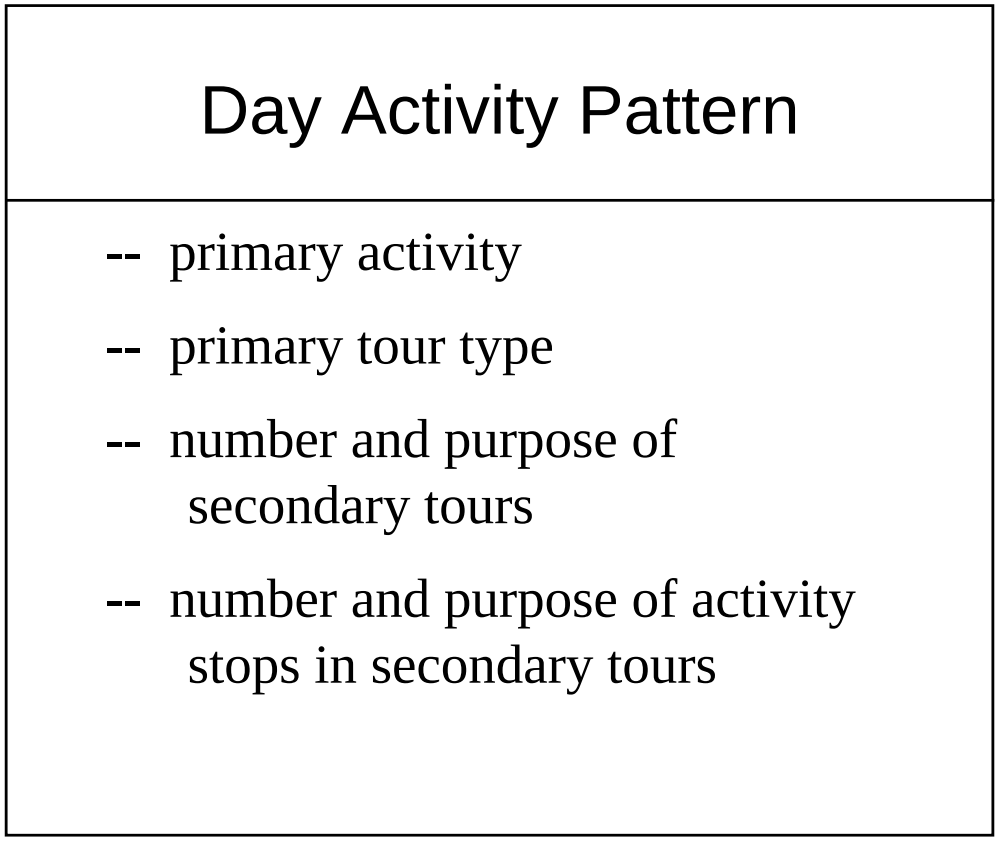
Discrete Choice Approaches



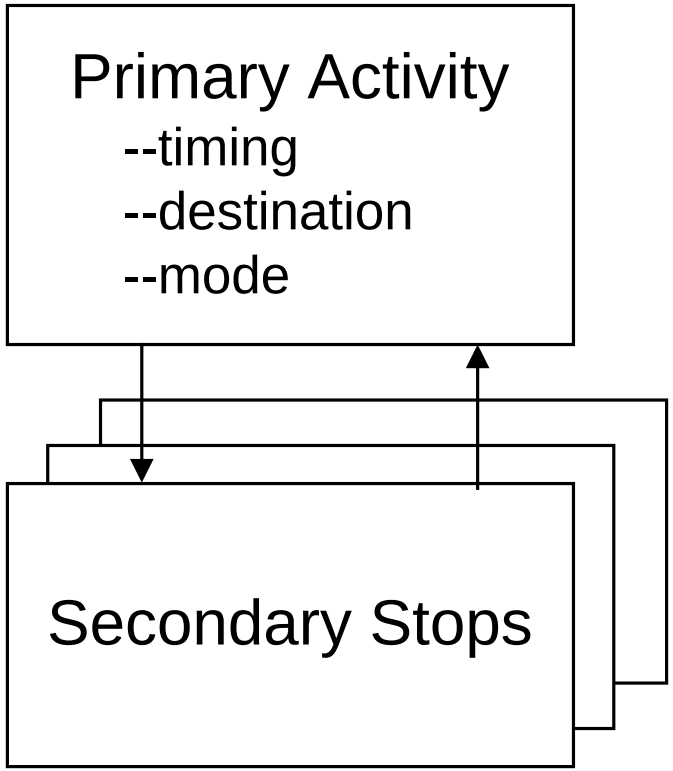
The Day Activity Schedule
(TRB January 1994)



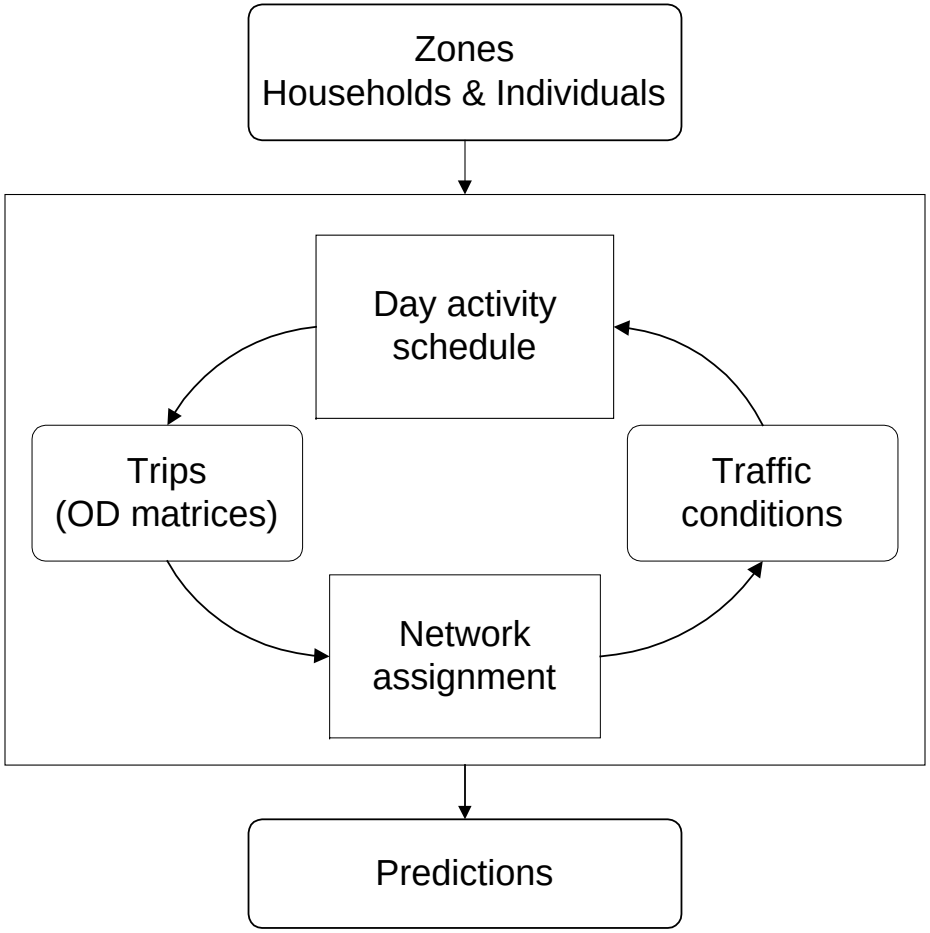
Day Activity Pattern



Tours


Primary Activity
--timing
--destination
--mode
Secondary Stops

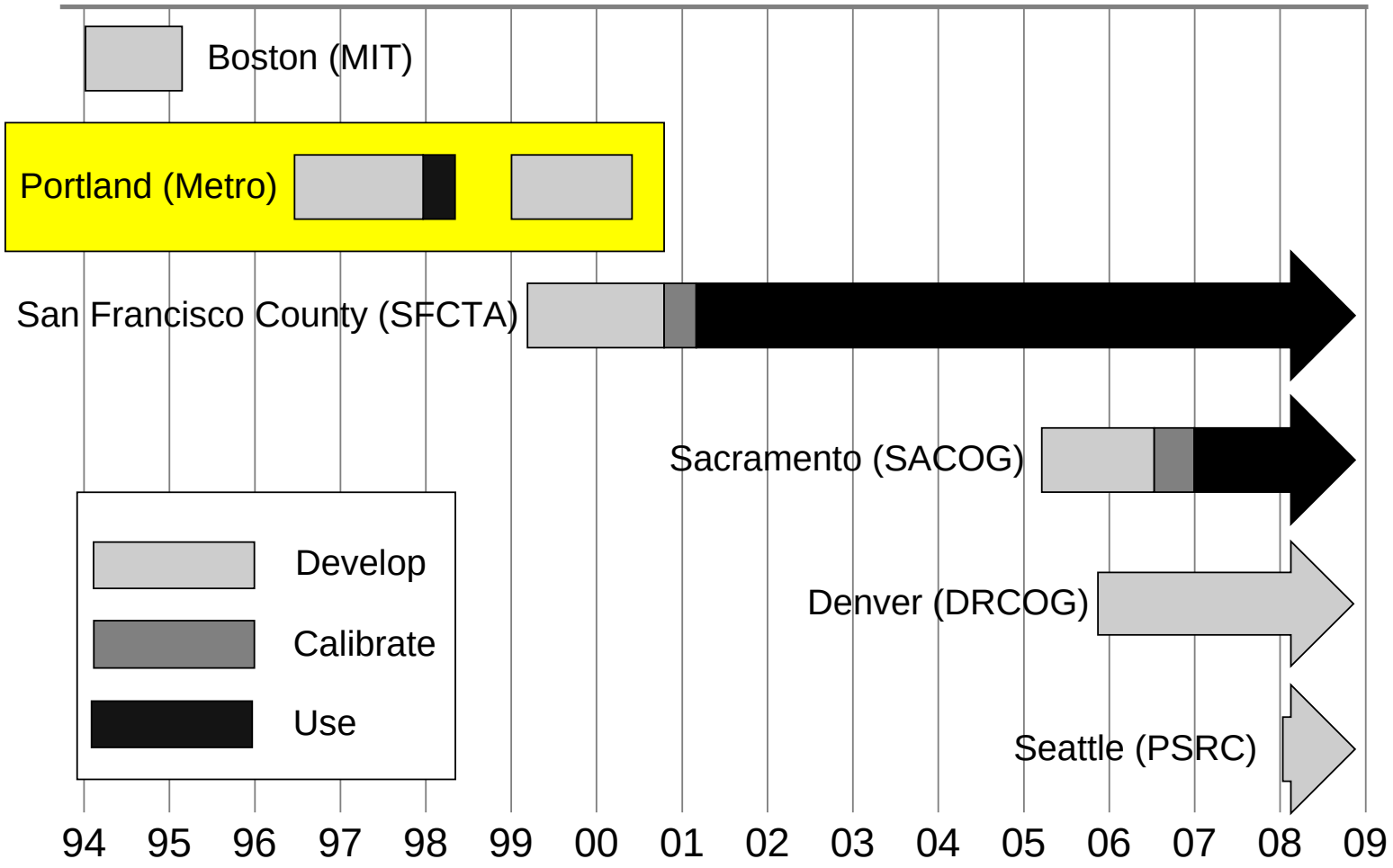
Model Application



Jan 1995: MIT Prototype

- 😐 operational for forecasting and policy analysis
- ☺ available data and discrete choice methods
- ☺ integrated system of daily activity and travel choices
  - ☺ tours in a daily activity pattern
  - 😐 activity time of day

Implementations



1996-1998: Portland Metro

- Features not in MIT prototype
  - Detailed activity purposes (8)
  - Detailed spatial resolution (block face)
  - Usual work and school location
  - Work-based subtours
  - At-home activities
  - Intermediate stops on tours
  - Integration with assignment models
- Used model for policy analysis

Early Application Results (Portland 1998)

Effect of Change in Auto Variable Costs (AVC)			Double AVC all times of day		Double AVC in peak periods	
Purp	**Mode**	**Time of day**	**% chg Tours**	**% chg Miles**	**% chg Tours**	**% chg Miles**
Work						
	All	All	-0.8	-9.4	-0.6	-5.5
	SOV	All	-5.8	-14.6		
		AM peak			-5.9	-13.1
		Off-peak			+1.0	0.0
Maint	SOV	All	-8.7	-21.5	-1.2	-3.6
Discr			-10.7	-23.1	-1.3	-3.2

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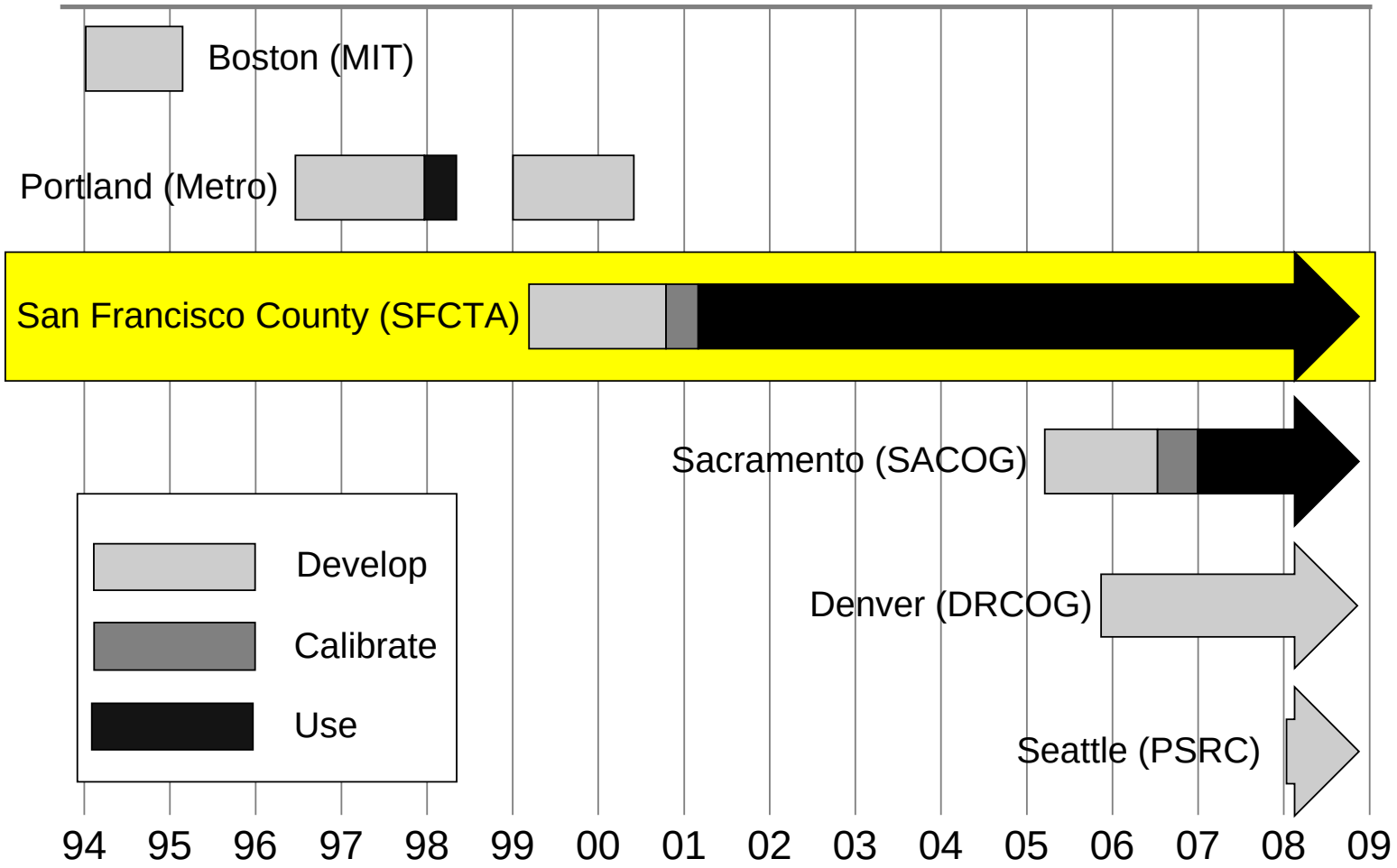
Implementations



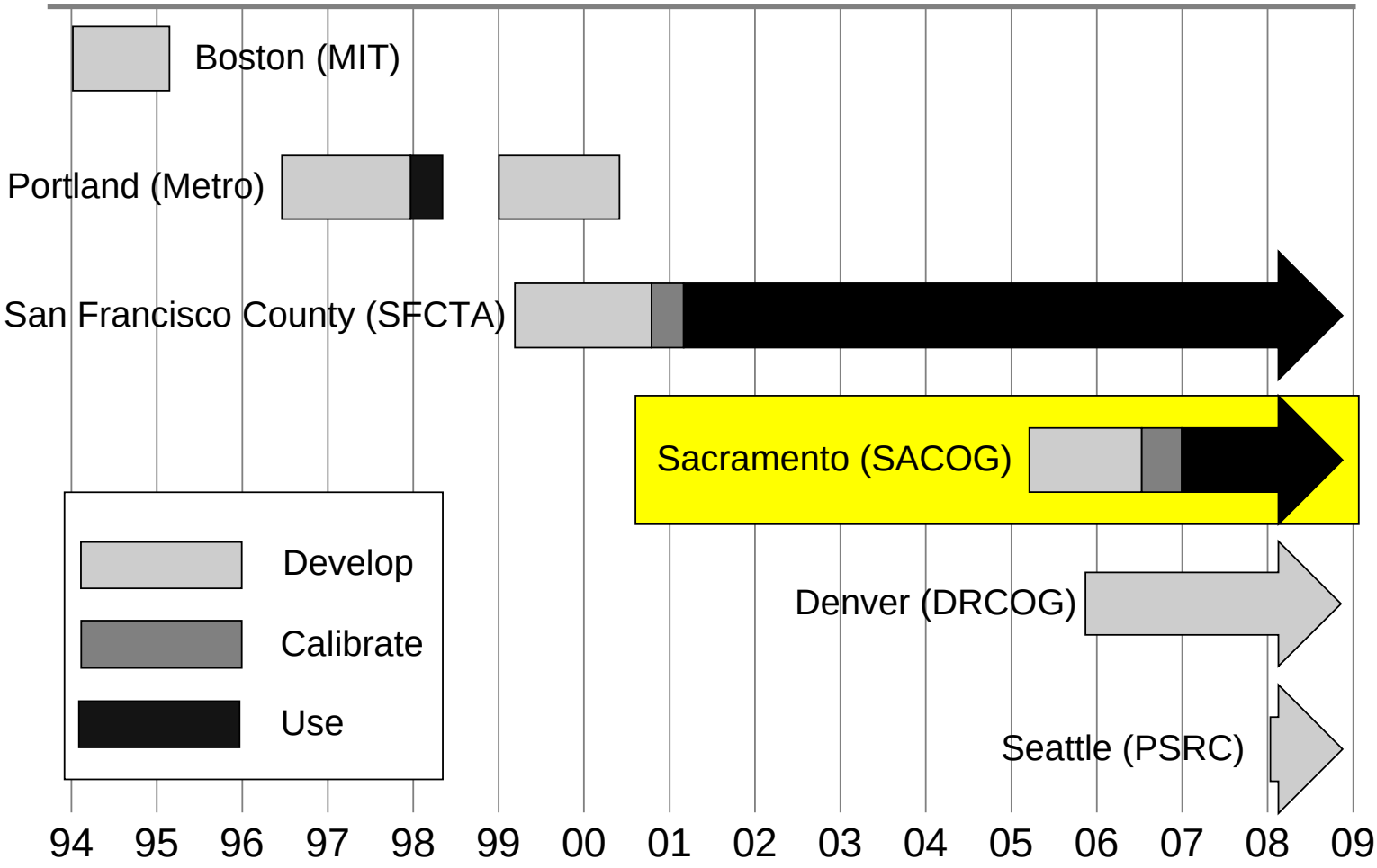
1999-2001: SFCTA

- Ongoing use for policy analysis
  - Development Impact Analysis
  - Countywide Transportation Plan
  - Central Subway New Starts
  - Equity analysis
  - Many more
- User benefits calculation for New Starts (SUMMIT) analysis

2007: SFCTA

- Mode choice using tolled versus free paths
- Distributed values of time

Implementations



2005-2006: SACOG

- **Respecified day activity pattern**
- High resolution
  - purpose (7)
  - time (1/2 hr)
  - space (parcel)
- Improved integration
- Equilibration techniques
- Scenario comparison techniques

Reformulated Day Activity Pattern

- Seven specific tour and stop purposes
- No placement of stops at specific points on tours

2005-2006: SACOG

- Reformulated day activity pattern
- **High resolution**
  - purpose (7)
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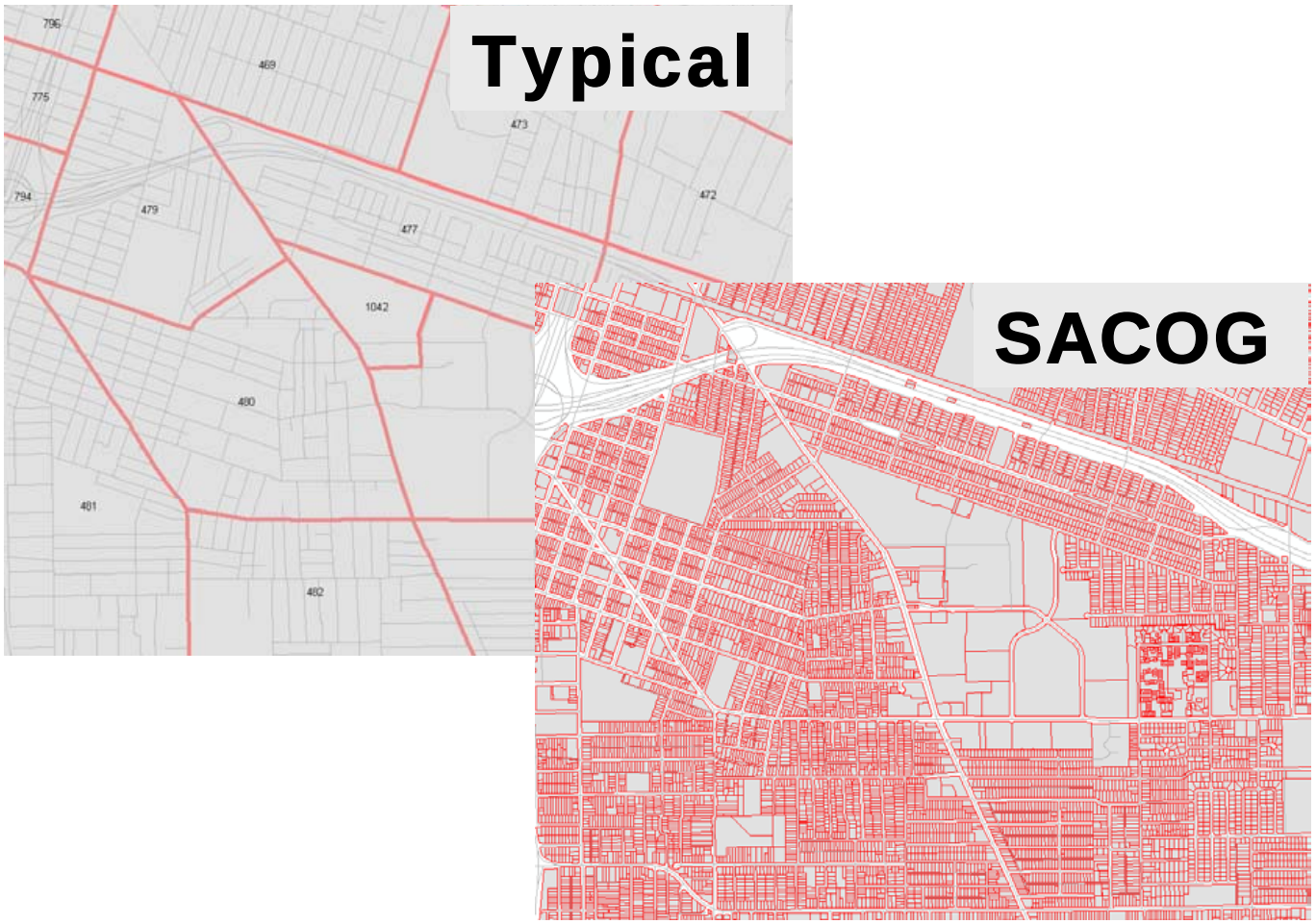
Disaggregating Purpose

Typical	**SACOG**
Work	Work
School	School
Maintenance	Escort
	Personal Business
	Shopping
Discretionary	Meal
	Social/recreation

Disaggregating Time

Typical	**SACOG**
AM peak Midday PM peak evening night & early AM	48 half-hour periods

Disaggregating Location—750,000 parcels



Model Disaggregation

Long Term Choices	**750,000 parcels**
Day Activity Pattern	**7 purposes**
Tour Destination	**750,000 parcels**
Mode	**8 modes**
Time Period	**48 half-hour periods**
No. & Purpose of Stops	**7 purposes**
Stop Location	**750,000 parcels**
Trip Mode	**8 modes**
Departure Time	**48 half-hour periods**

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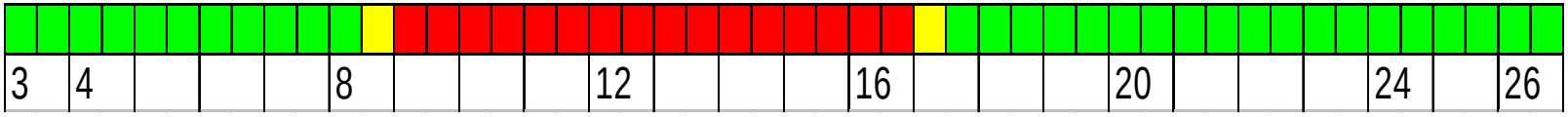
Model System Integration

- Downward integration
  - Conditional lower models
  - Enforce time-space constraints
- Upward integration--Upper levels affected by lower level opportunities
  - mode choice logsums with simulated time of day
  - aggregate logsums

Downward Integration
Time-Space Constraints

- Model
  - arrival and departure periods (approximate duration)
  - 1716 arrival-departure choice alternatives

Work tour scheduled:



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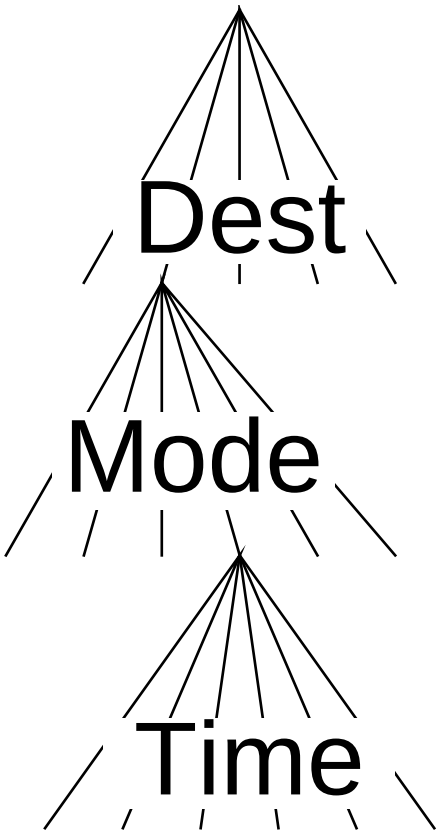
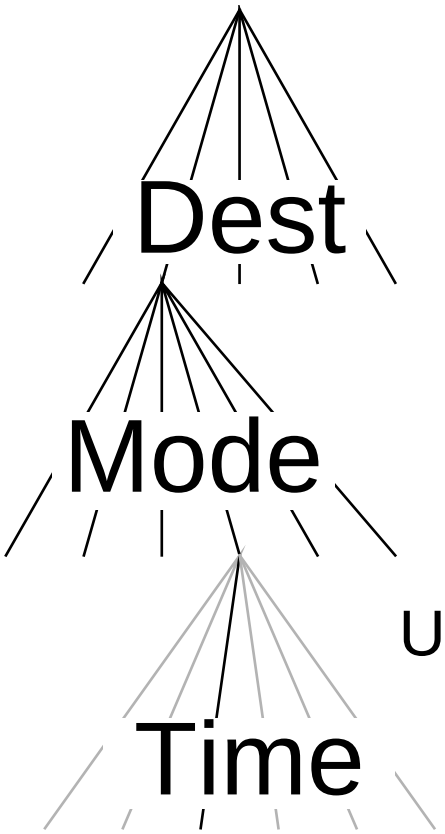
  - aggregate logsums

Upward Integration
Logsums with assumed TOD

Instead of this



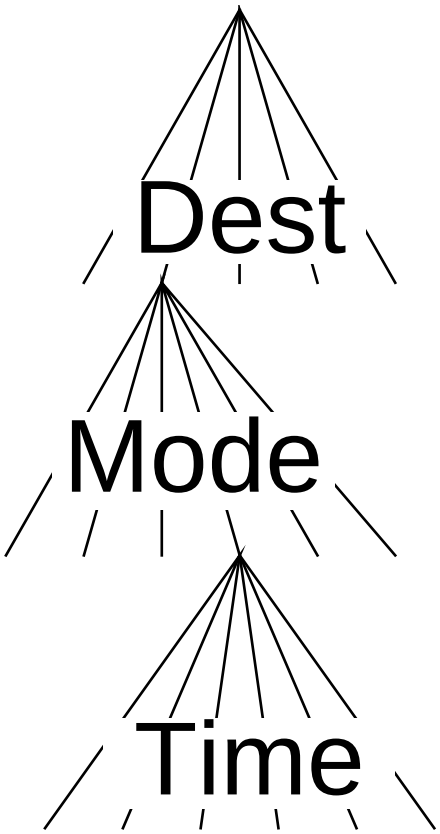
Typical simplification



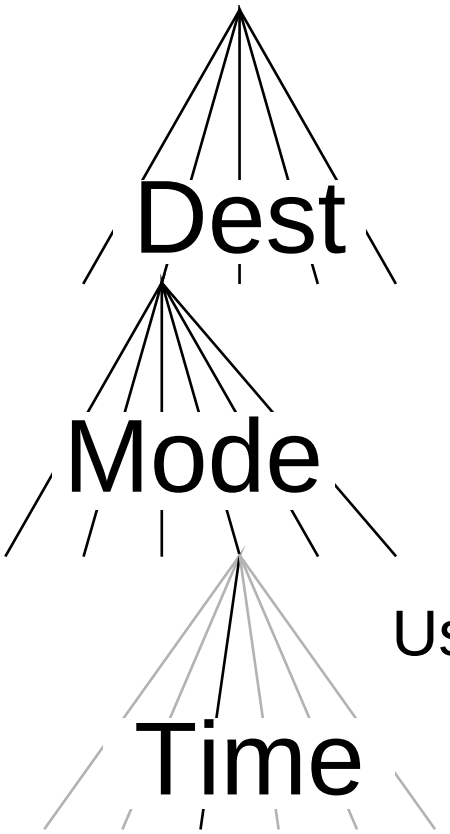
Use assumed time

Upward Integration
Logsums with simulated TOD

Instead of this



Do this



Use simulated time

Upward Integration
Aggregate mode-dest logsums

- 84 pre-calculated per TAZ
  - 7 purposes
  - 4 car availability levels
  - 3 categories of origin proximity to transit

Upward Integration
Intermediate stop logsums

- 4 pre-calculated per TAZ OD pair
  - 2 tour modes (auto & transit)
  - 2 times of day (peak & offpeak)

Upward Integration
Use of logsums in models

Model	**Mode logsums**	**Mode-dest logsums**	**Intermediate stop logsums**
Usual loc.	To usual loc.	At usual loc.	
Auto ownership	To usual locs. of workers & students	At home	
Day Pattern	To usu. locs. for work & school tours	At home for other purps	Between home and usual work loc.
Tour Dest	To tour dest.	At tour dest.	
No. & purp of interm. stops			for auto-based tours

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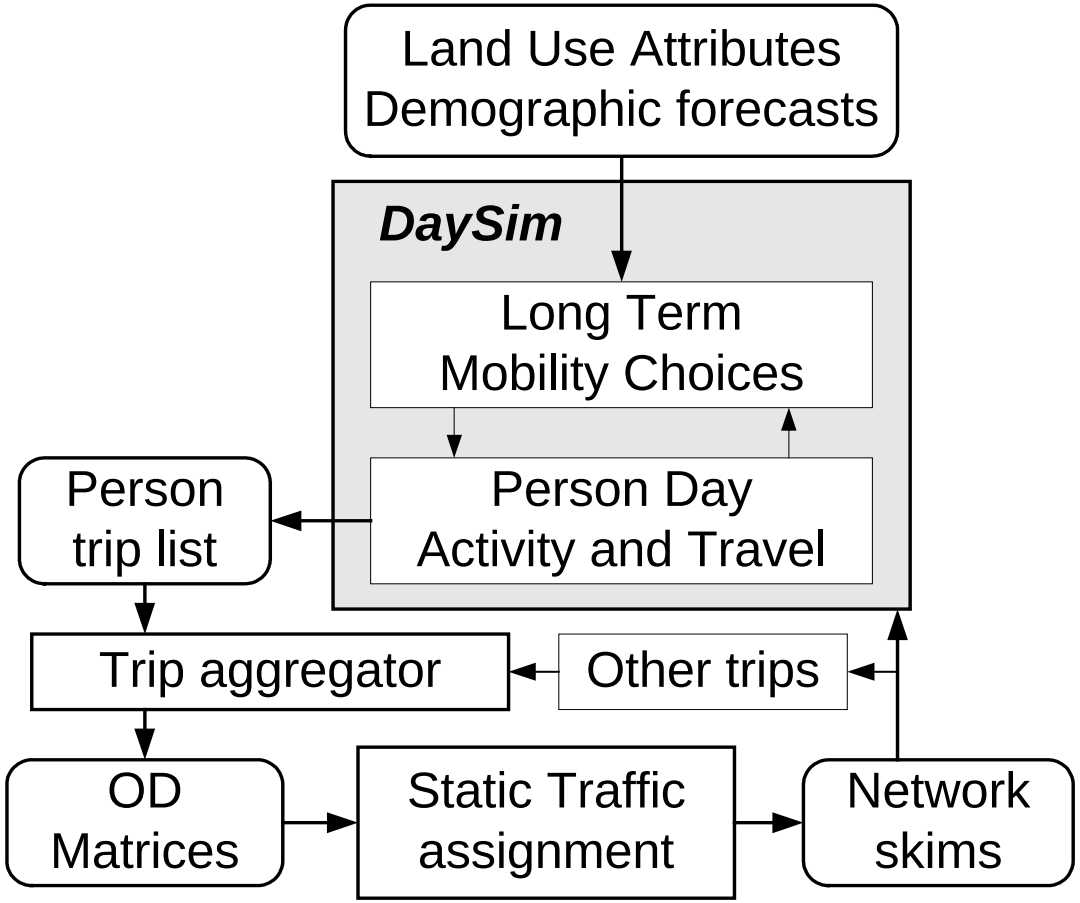
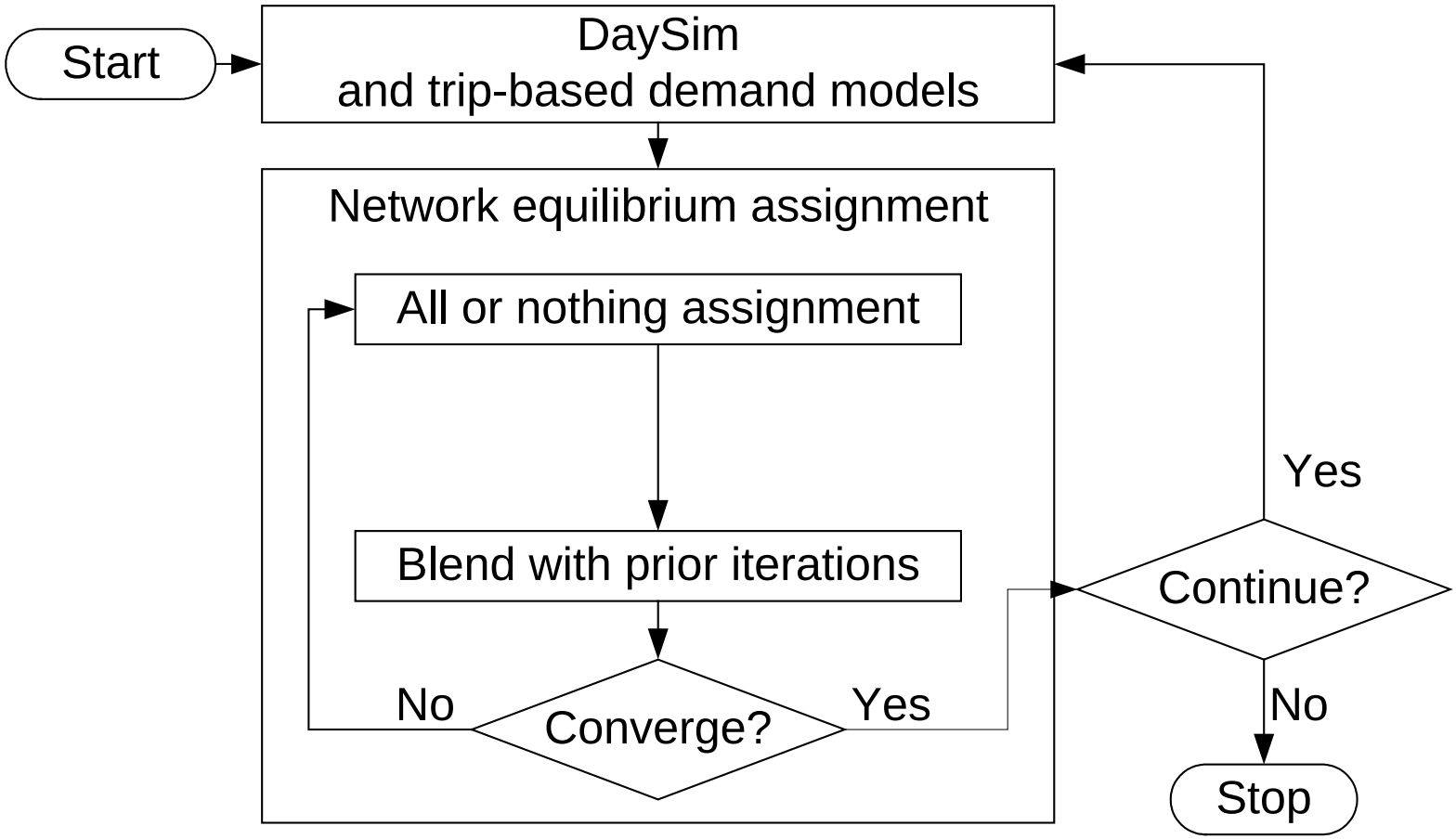
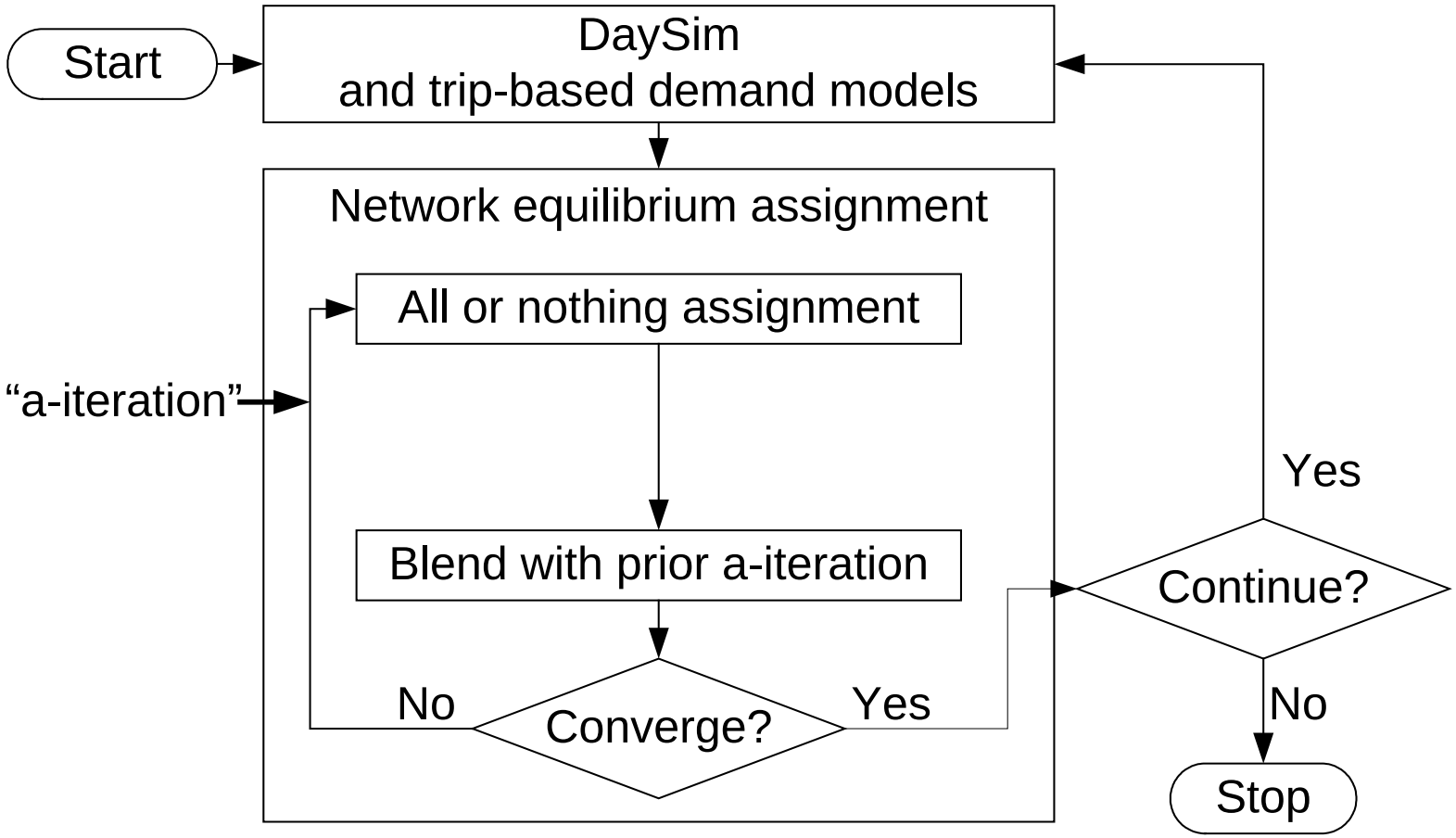
SACOG Model System



SacSim Equilibration
Iteration algorithm



Stabilizing iterations



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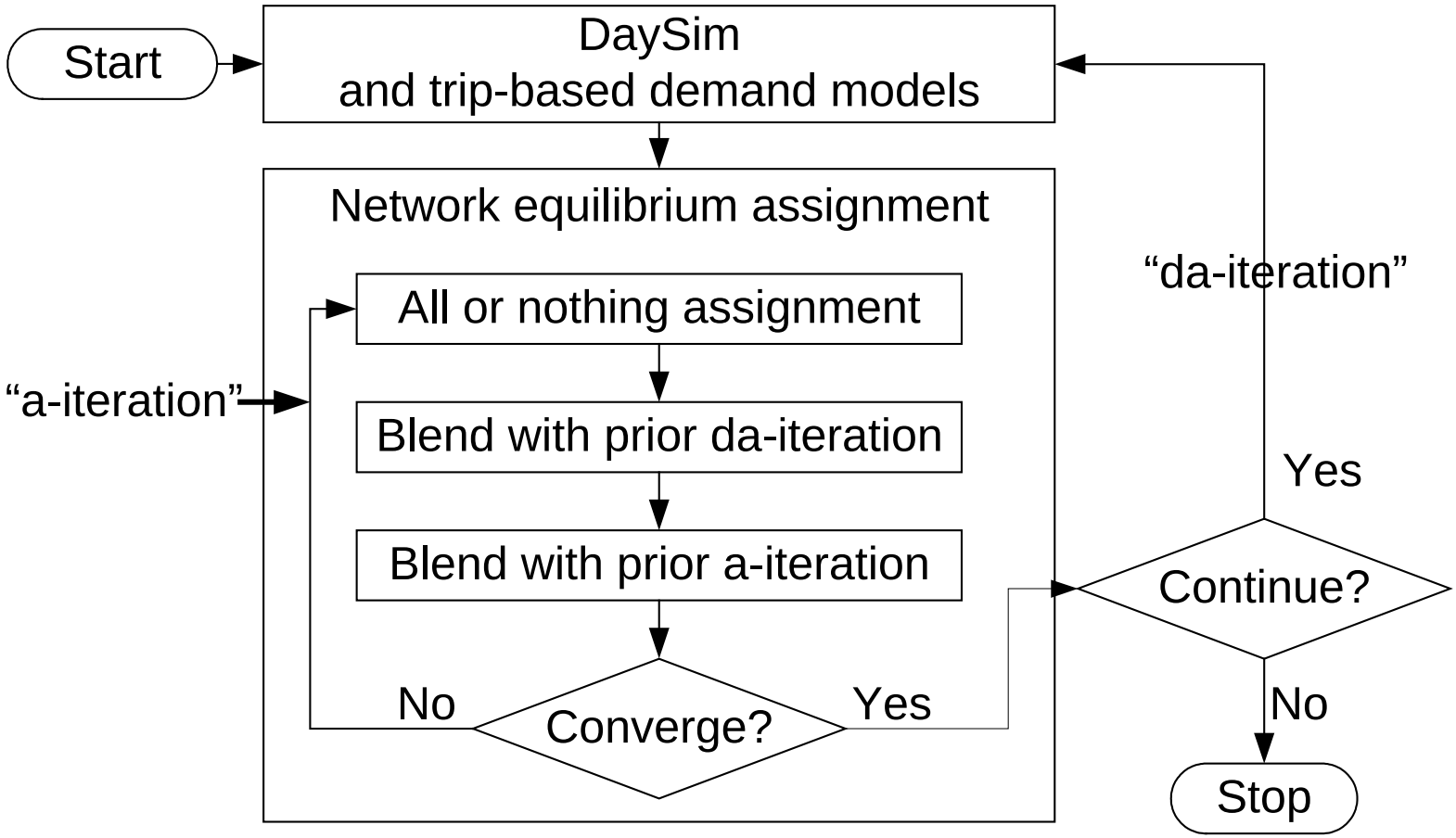

Speeding convergence

da-iteration	1	2	3	4	5	6	7	8	9
DaySim portion of population	2^{-7}	2^{-7}	2^{-6}	2^{-5}	2^{-4}	2^{-3}	2^{-2}	2^{-1}	1

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- Equilibration techniques
- **Scenario comparison techniques**

Comparing Scenarios
Policy Effects or Simulation Error?

- Simulation error confounds with modeled effects
- Possible solutions:
  - average many microsimulations
  - microsimulate with a supersample

Random seed coordination

- generate and save random numbers for every combination of resident, tour, trip and model
- use them in base case and policy scenario

Random seed coordination

- Scenario: cordon pricing: $5 SOV entry fee into CBD during AM peak
- Illustrative
  - models not fully calibrated
  - run without equilibration

Random seed coordination
Changes in simulated schedules

	Cordon pricing	Cordon pricing
Coordinated random numbers?	**Yes**	**No**
No changes in simulated day	98.58%	22.67%
Different # of tours	0.00%	63.80%
Same # tours, but different # stops	0.23%	13.09%
Same # tours & stops, different purpose(s)	0.03%	0.37%
Same tours, stops, purposes / different location(s)	0.21%	0.07%
Same tours, stops, purp, loc. / different mode(s)	0.02%	0.00%
Same except for different departure time(s)	0.93%	0.00%

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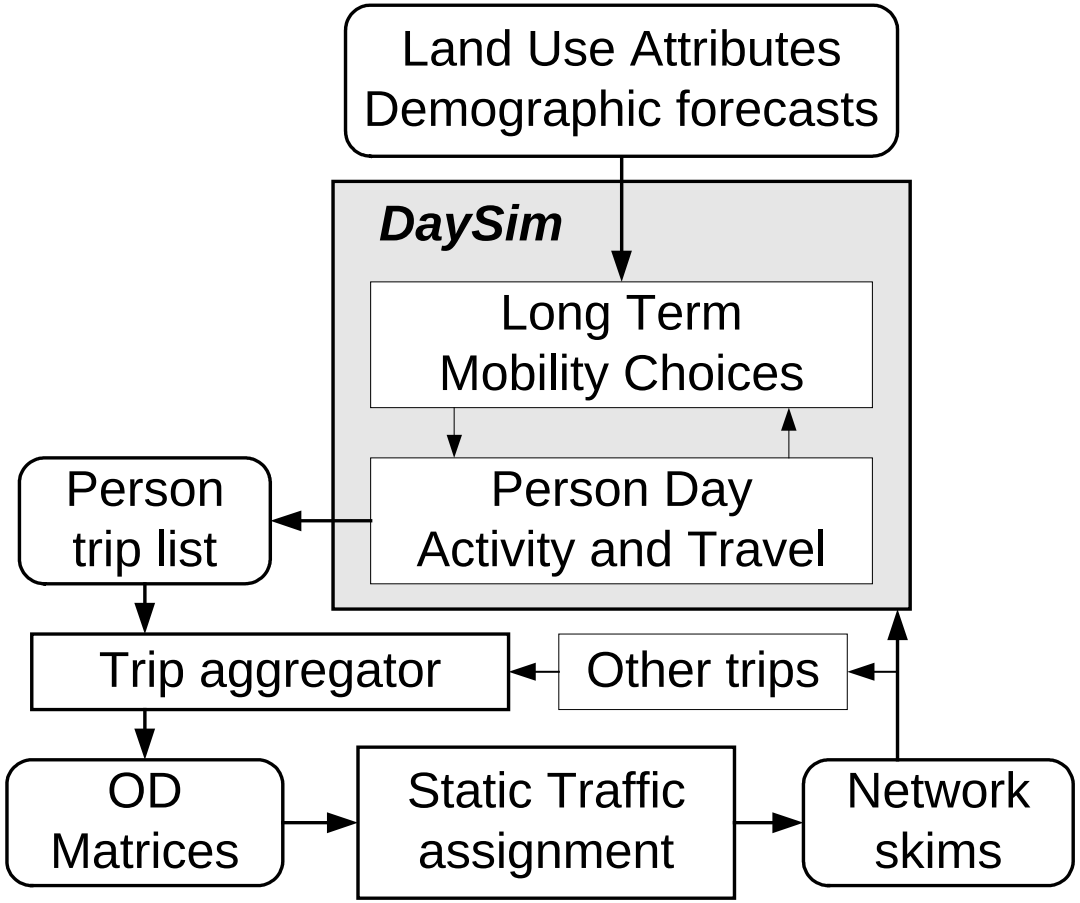
2008: SACOG

- Distributed processing
- Multiple run modes
  - long-range
  - short-range
  - FTA New Starts

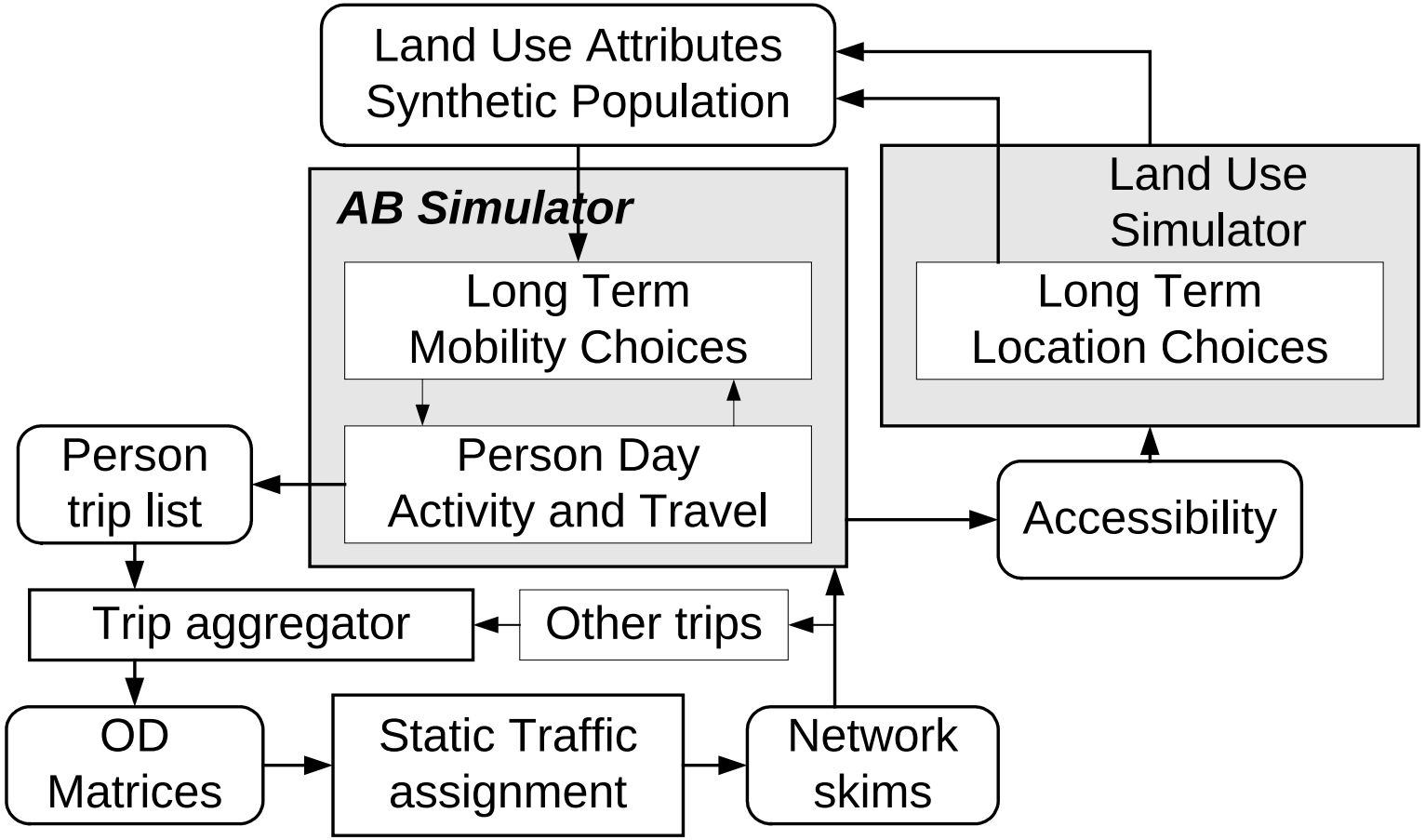
Multiple Run Modes

Short-term Effects	FTA New Starts
Long Term Choices	Long Term Choices
Day Activity Pattern	Day Activity Pattern
Tour Destination	Tour Destination
Mode	Mode
Time Period	Time Period
No. & Purp. of Stops	No. & Purp.of Stops
Stop Location	Stop Location
Trip Mode	Trip Mode
Departure Time	Departure Time

Upcoming Enhancements?



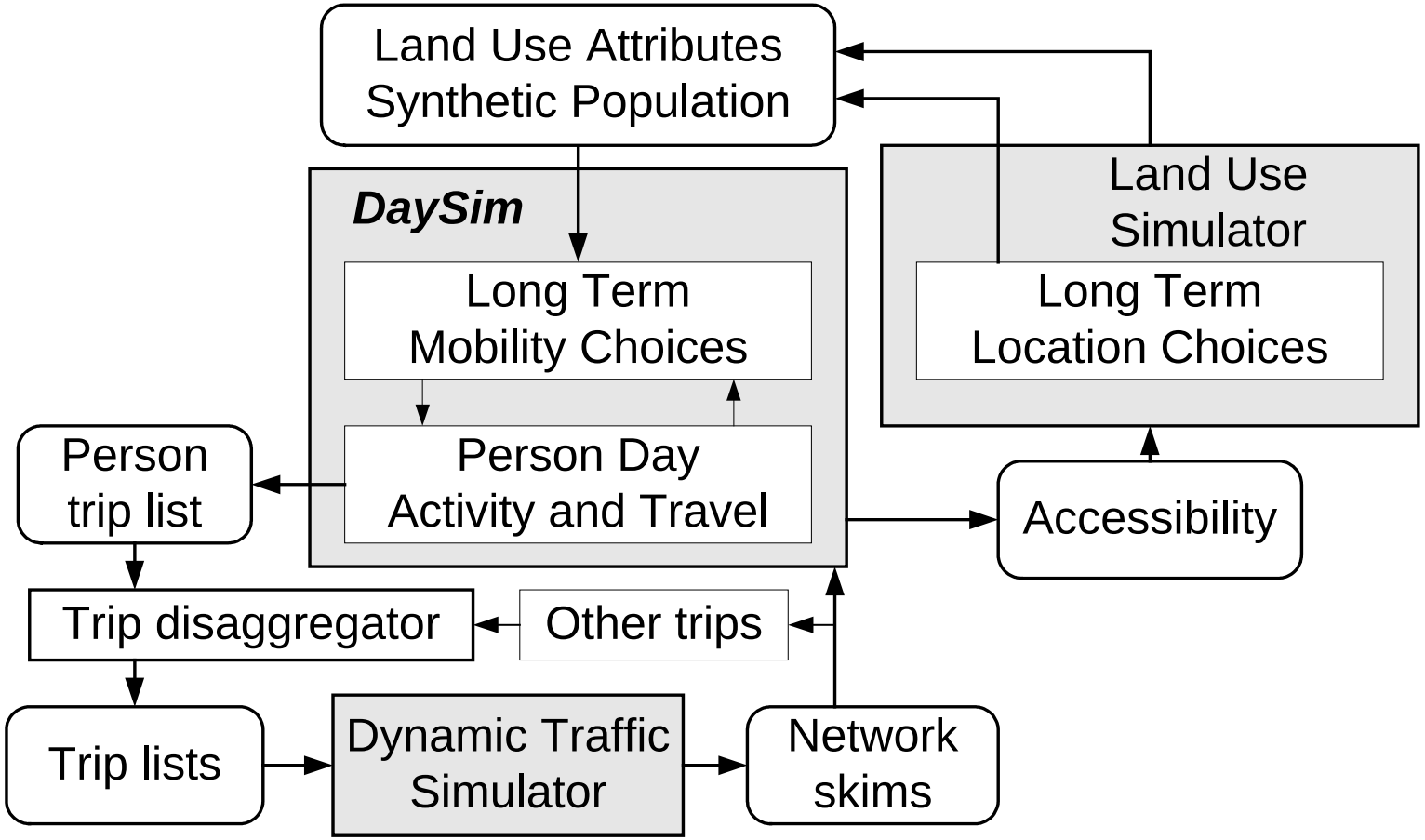
PSRC Design
Integrated Land Use Simulator



PSRC Design
Potential model components

- Long-term mobility models
  - Usual mode to work
  - Transit pass
  - Vehicle type
- Activity schedule models
  - Household day pattern
  - Joint tours
  - Tour vehicle
  - Park and ride lot choice

Future Objective
Integrated Traffic Simulator



More Future Implementations?