

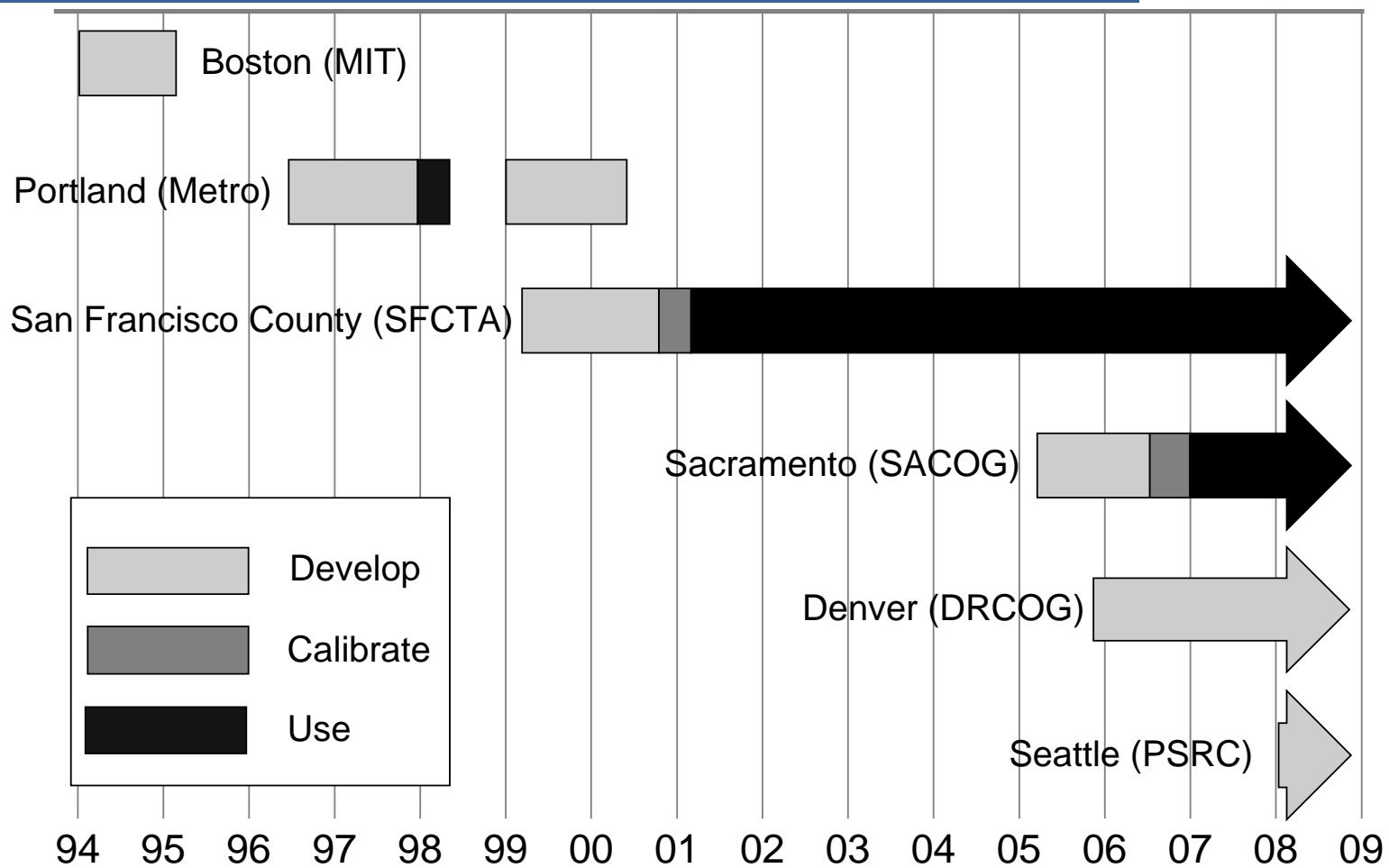


The Day Activity Schedule Approach of Bowman, Ben-Akiva and Bradley: 1994-2008

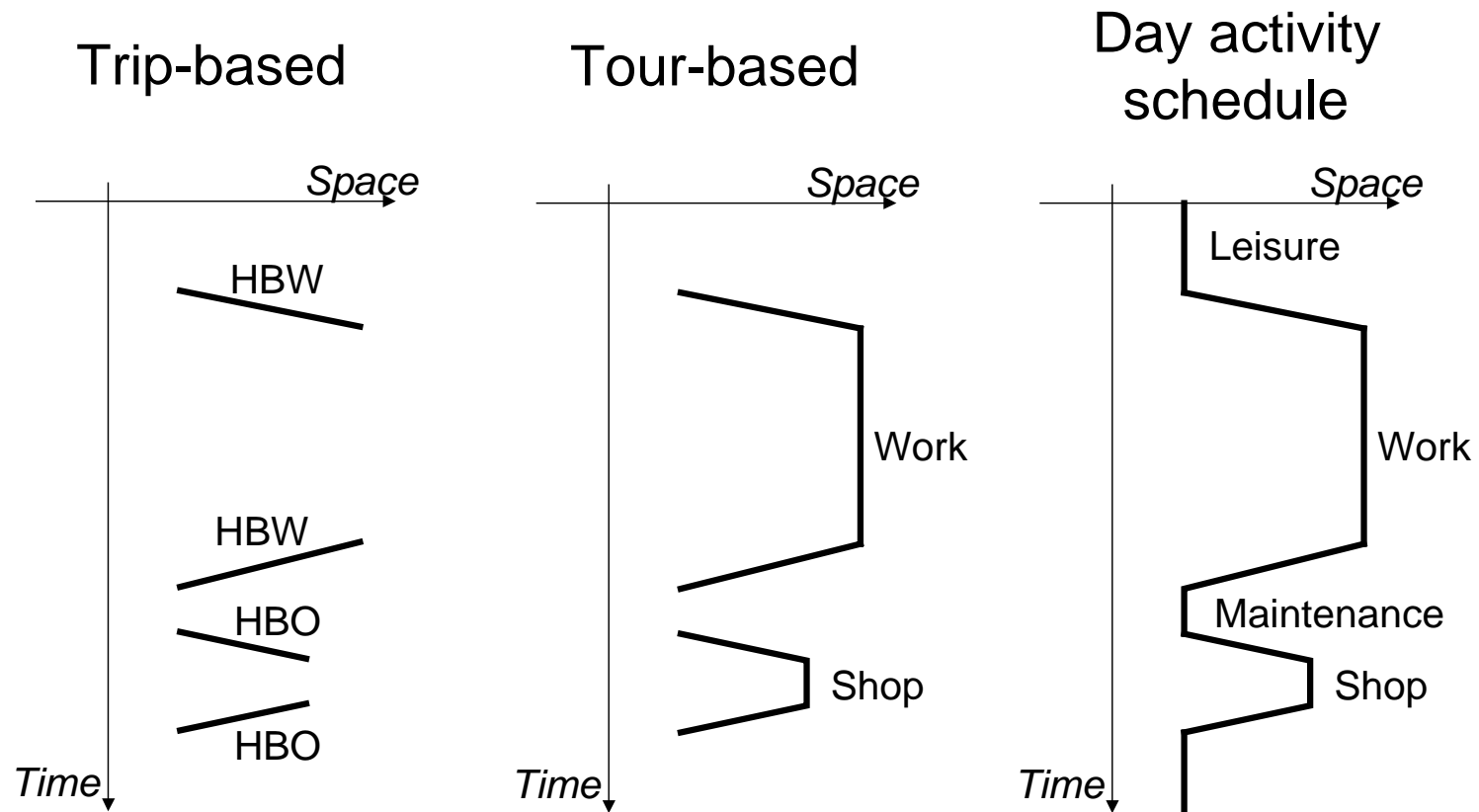
Innovations in Travel Modeling 2008
A Transportation Research Board Conference
June 22-24, 2008

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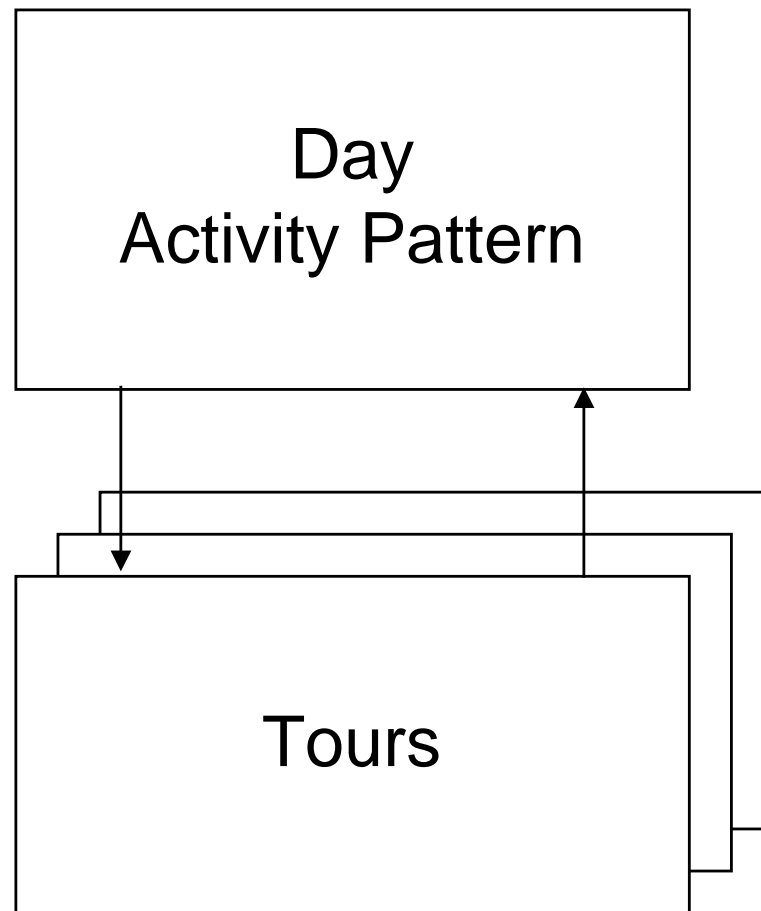
Implementations



Discrete Choice Approaches



The Day Activity Schedule (TRB January 1994)

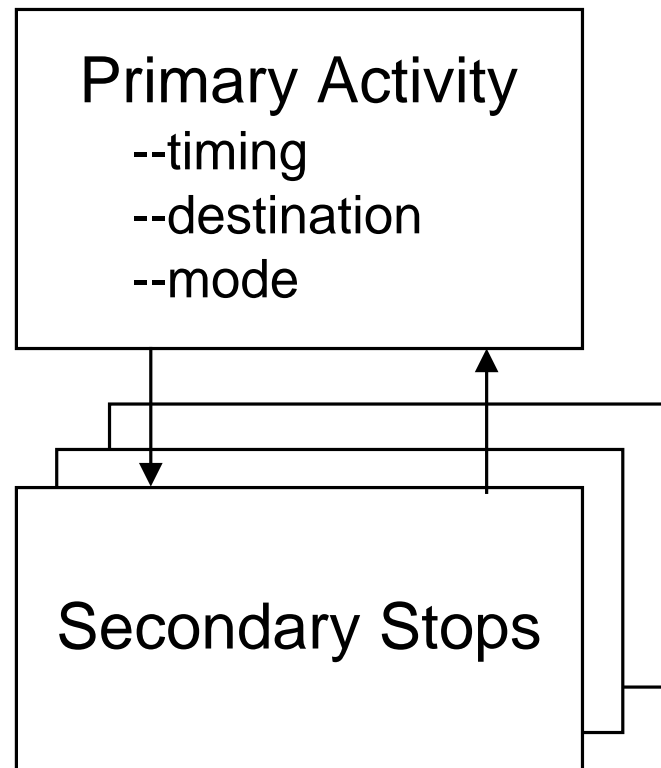


Day Activity Pattern

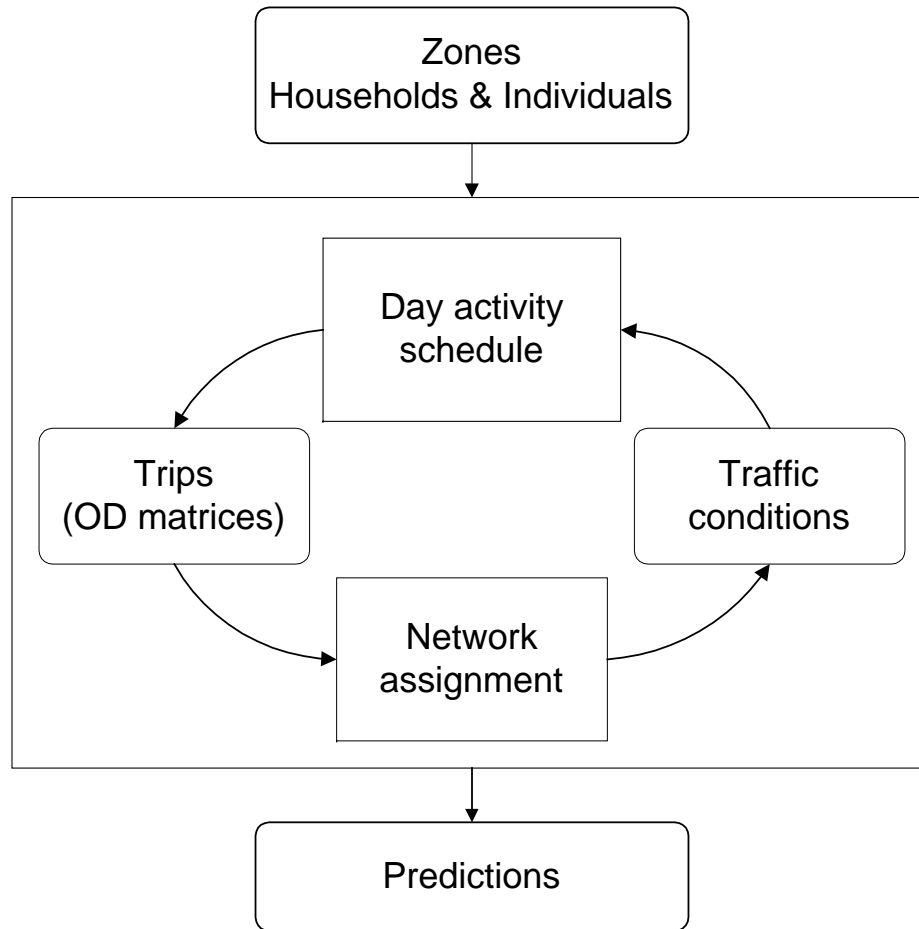
Day Activity Pattern

- primary activity
- primary tour type
- number and purpose of secondary tours
- number and purpose of activity stops in secondary tours

Tours



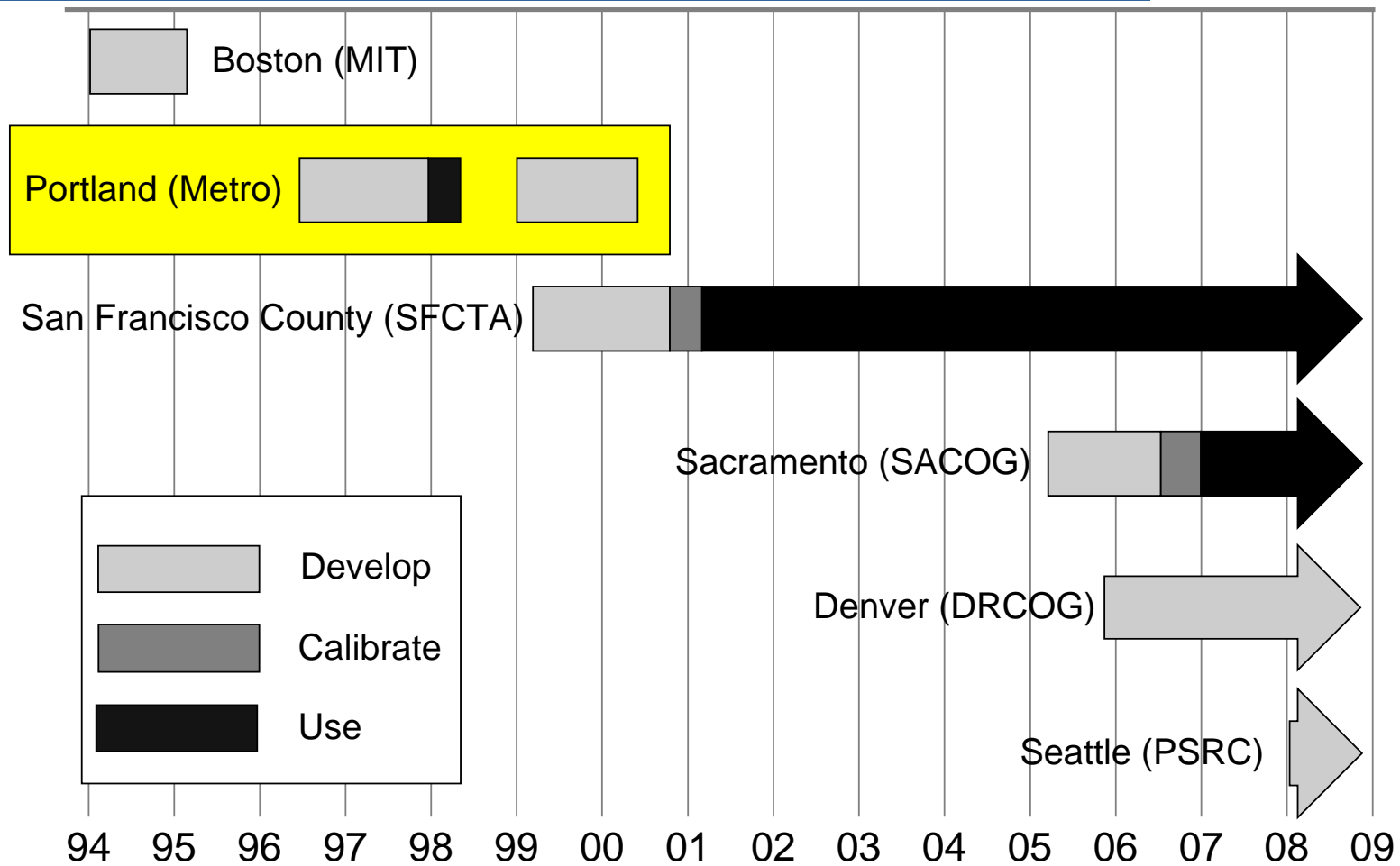
Model Application



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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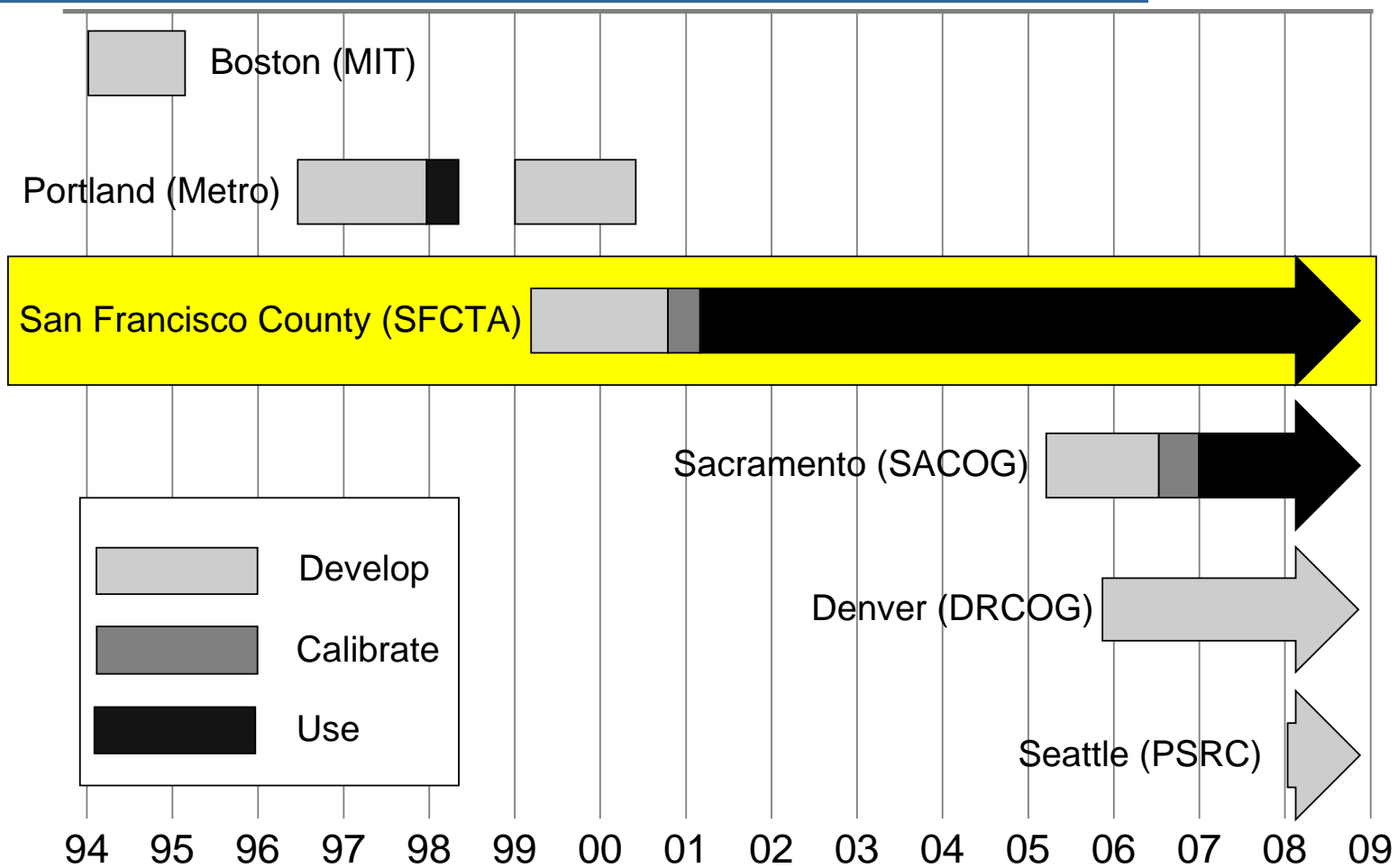
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Implementations



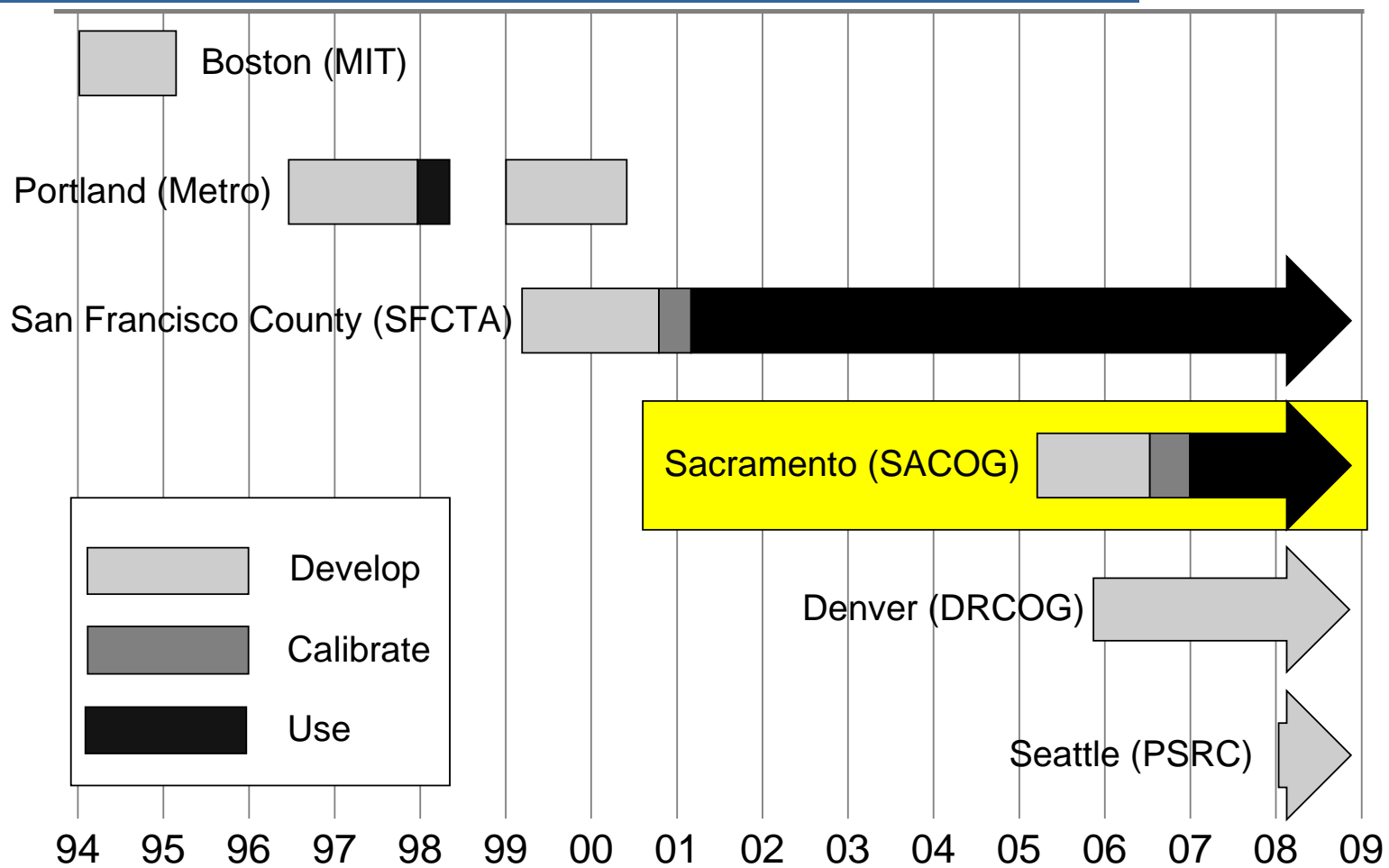
1999-2001: SFCTA

- 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)
 - time (1/2 hr)
 - space (parcel)
- Improved integration
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- Scenario comparison techniques

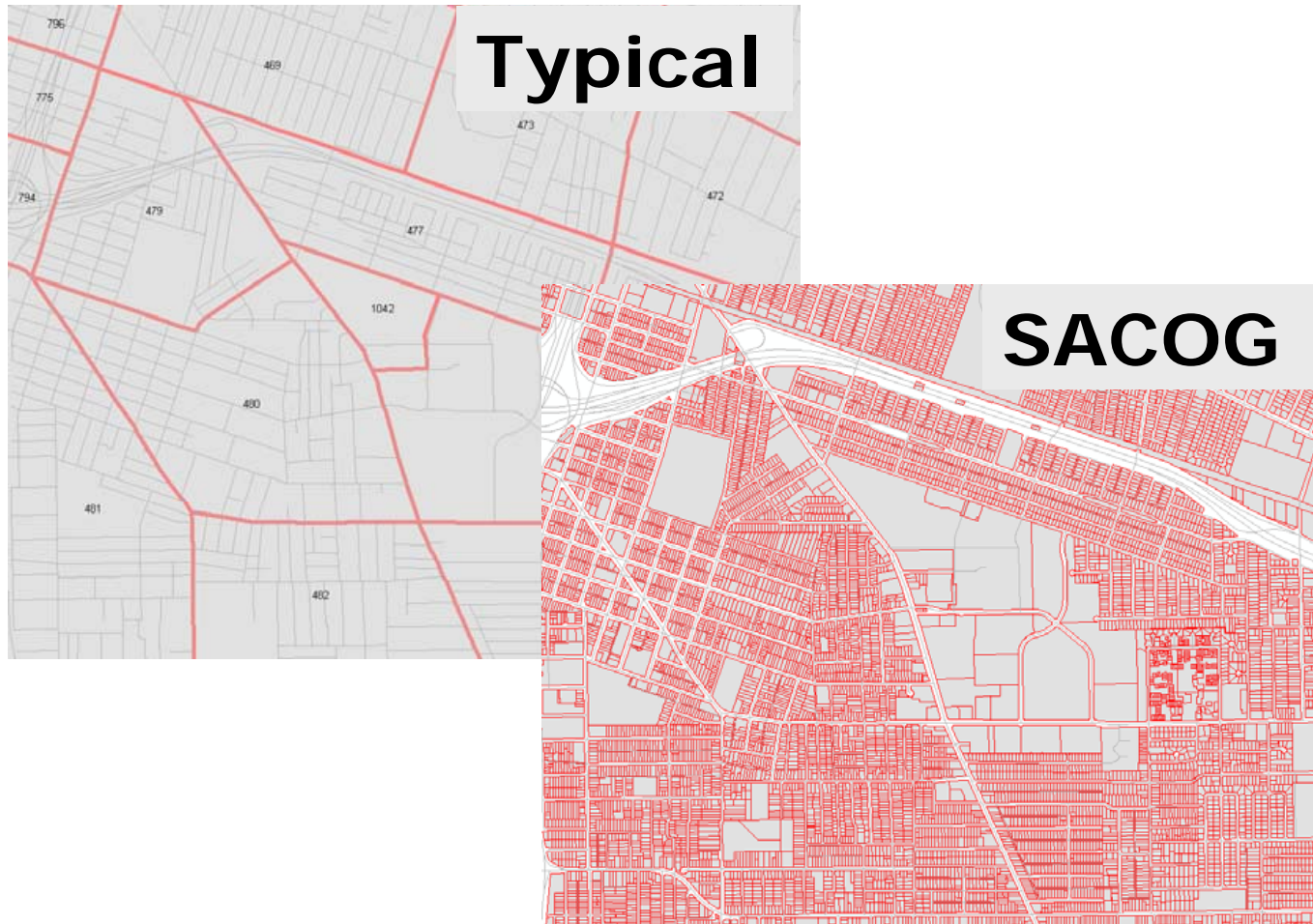
Disaggregating Purpose

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

2005-2006: SACOG

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

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

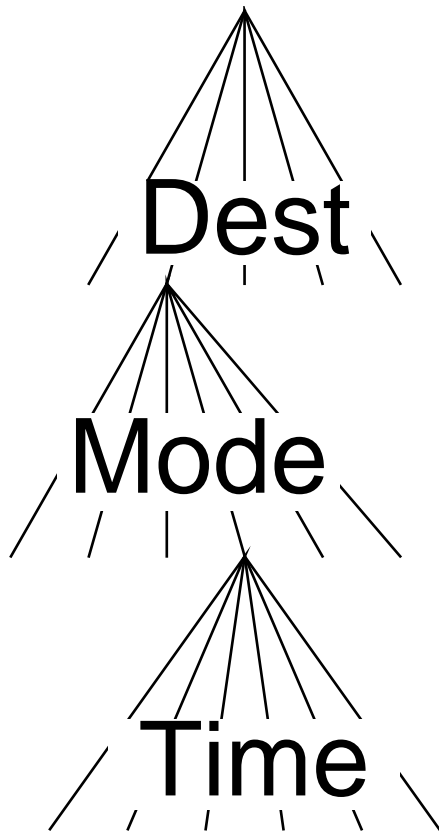
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Upward Integration

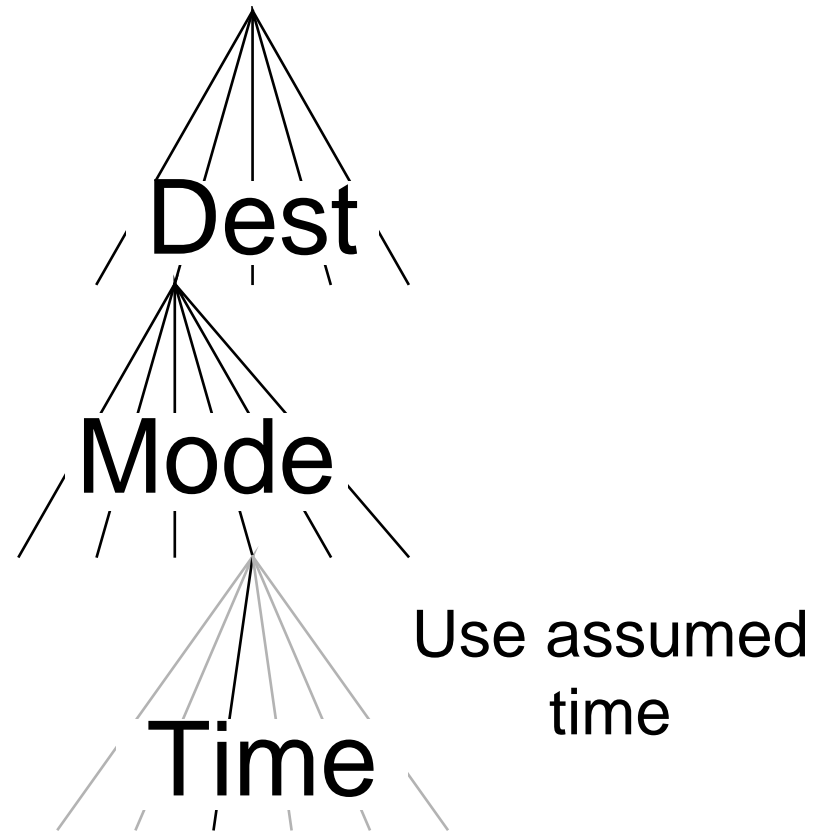
Logsums with assumed TOD

Instead of this



TRB Innovations, June 2008

Typical simplification



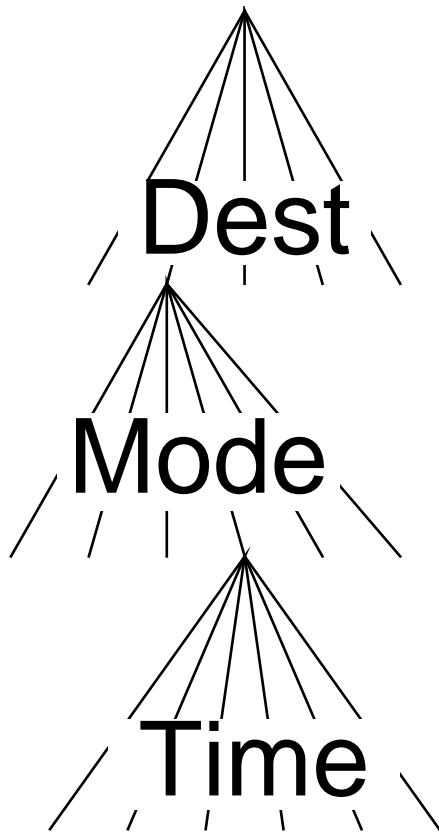
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Upward Integration

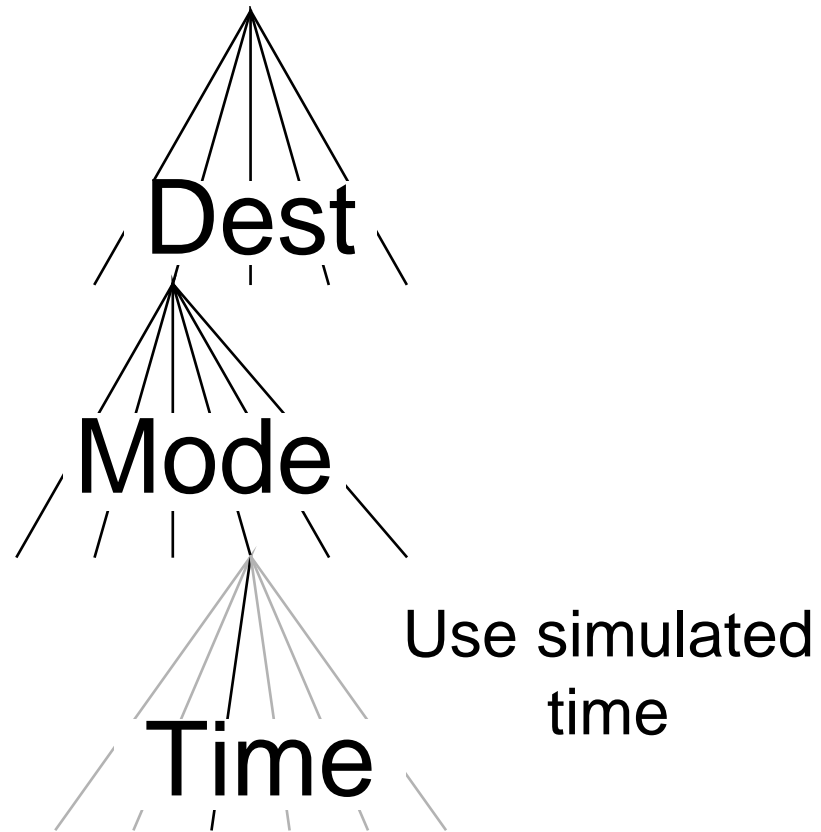
Logsums with simulated TOD

Instead of this



TRB Innovations, June 2008

Do this



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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

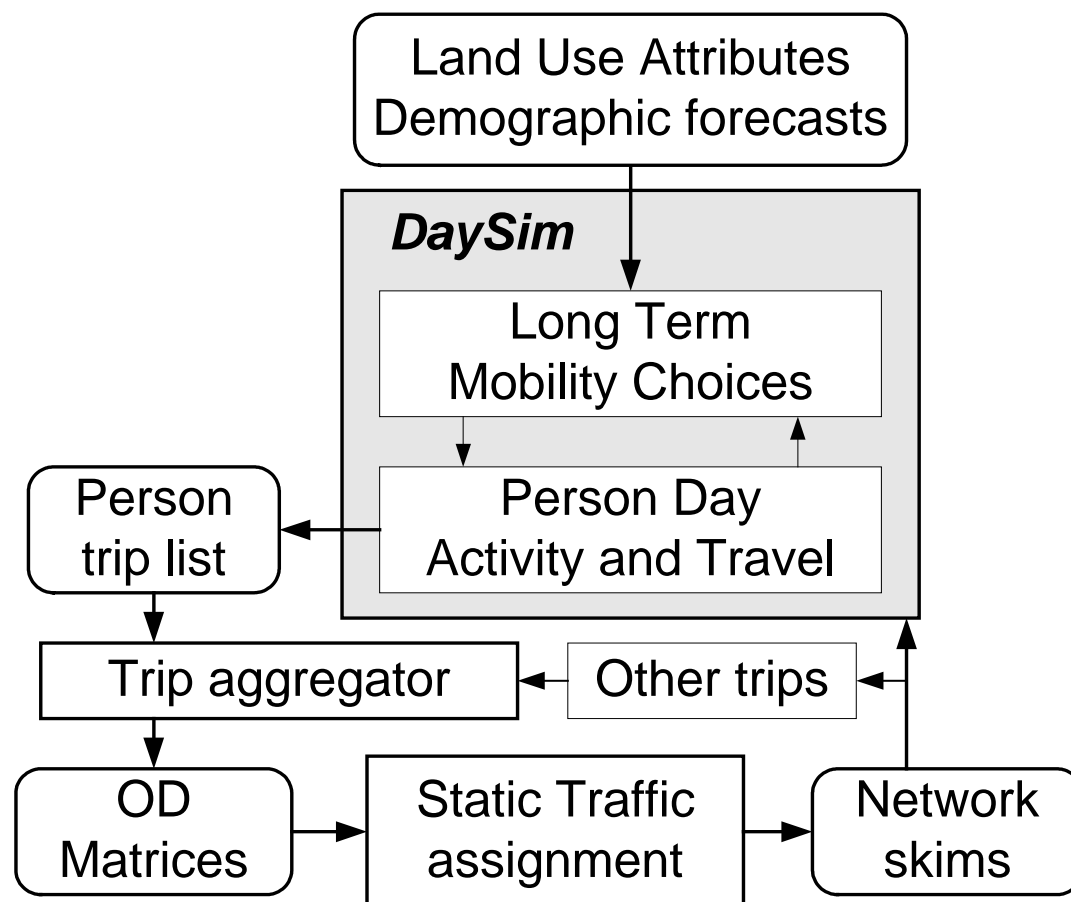
Use of logsums in models

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

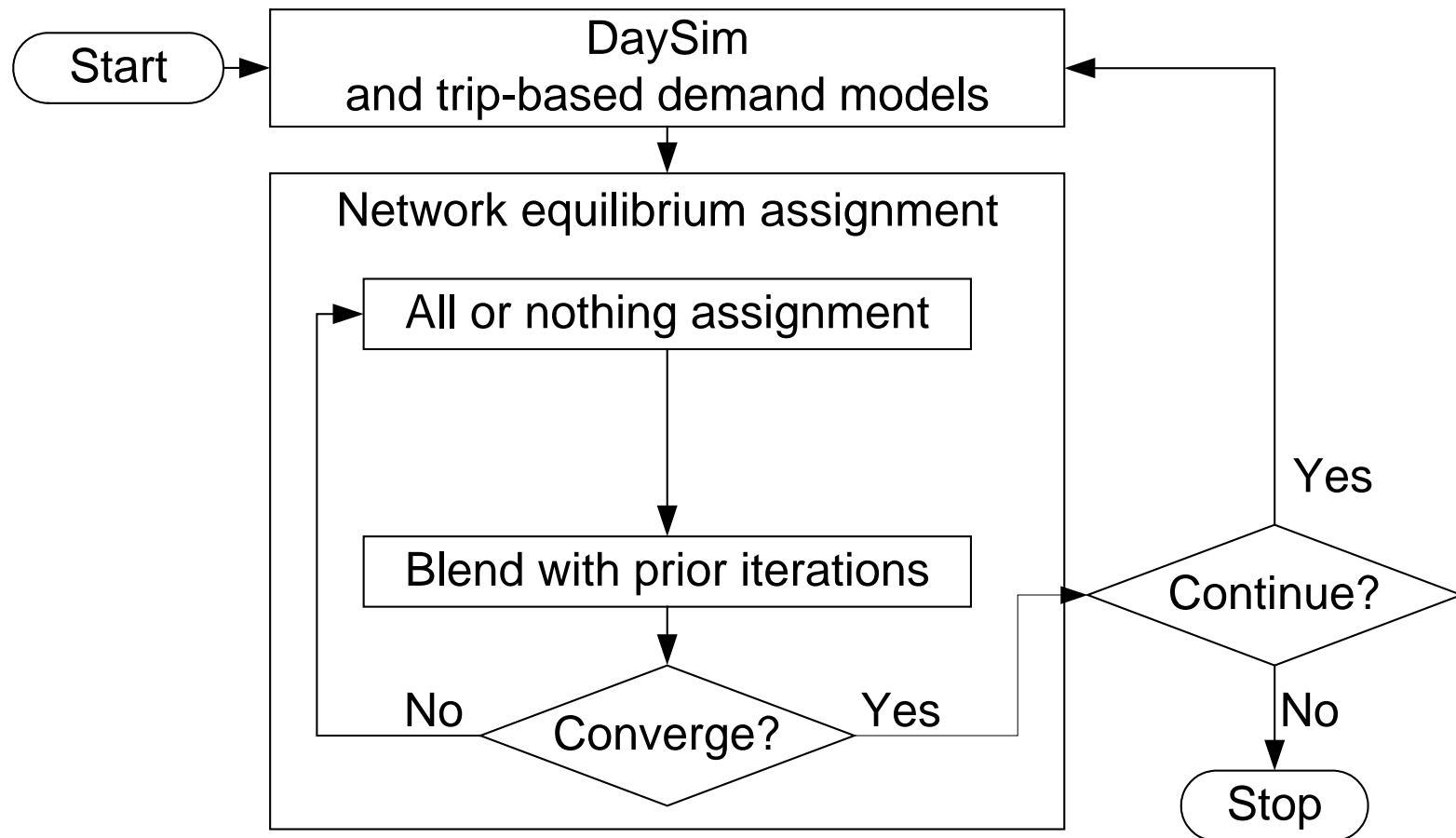
2005-2006: SACOG

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

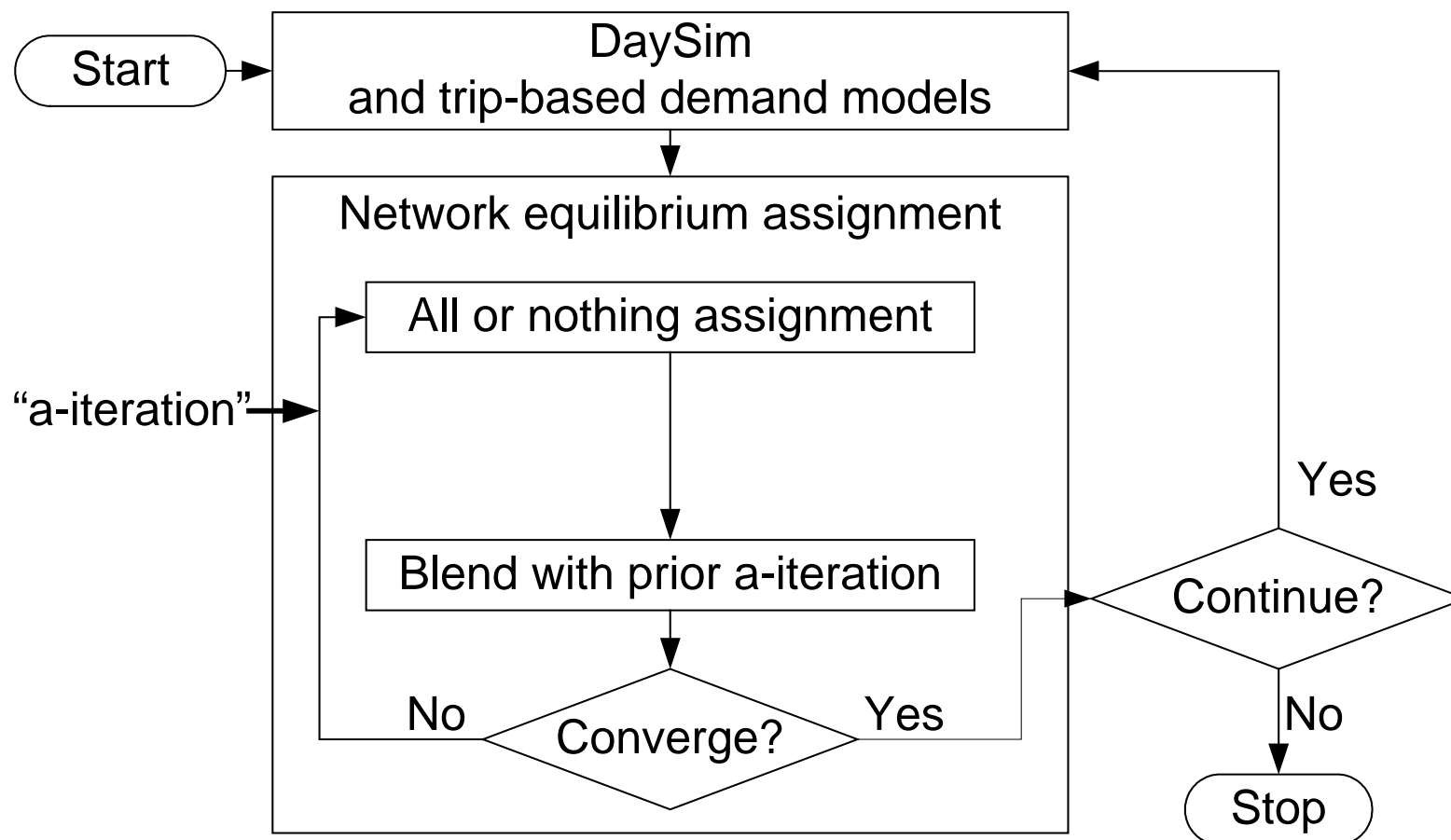
SACOG Model System



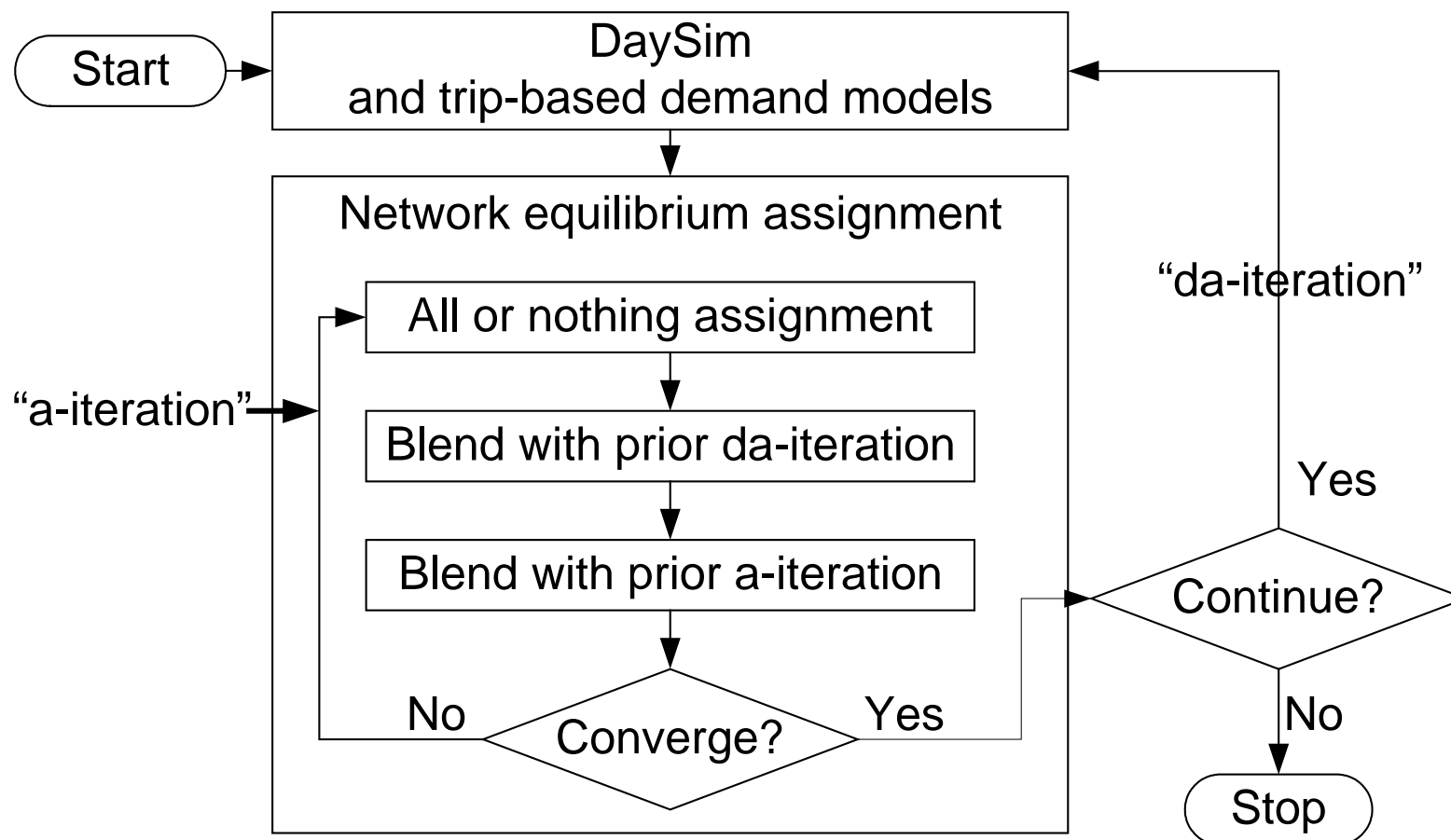
SacSim Equilibration Iteration algorithm



Stabilizing iterations



Stabilizing iterations



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

2005-2006: SACOG

- Reformulated day activity pattern
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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%

Random seed coordination

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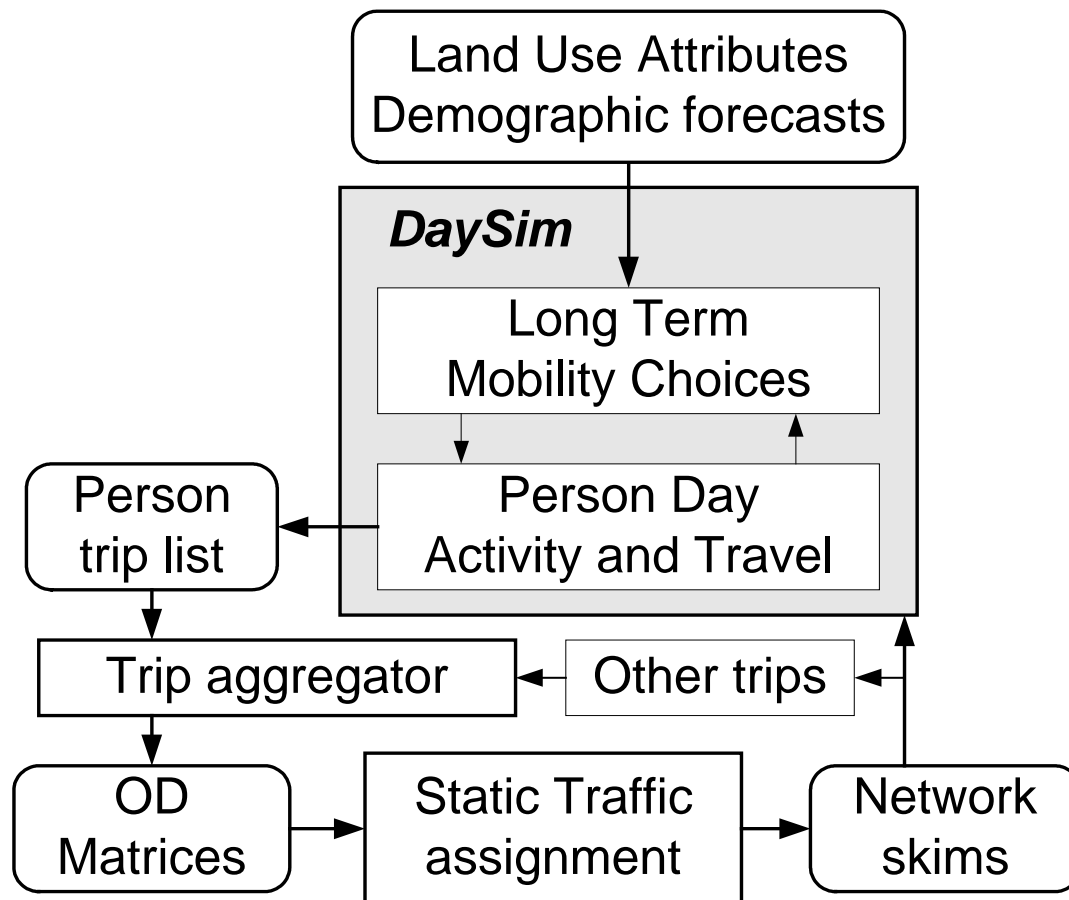
2008: SACOG

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

Multiple Run Modes

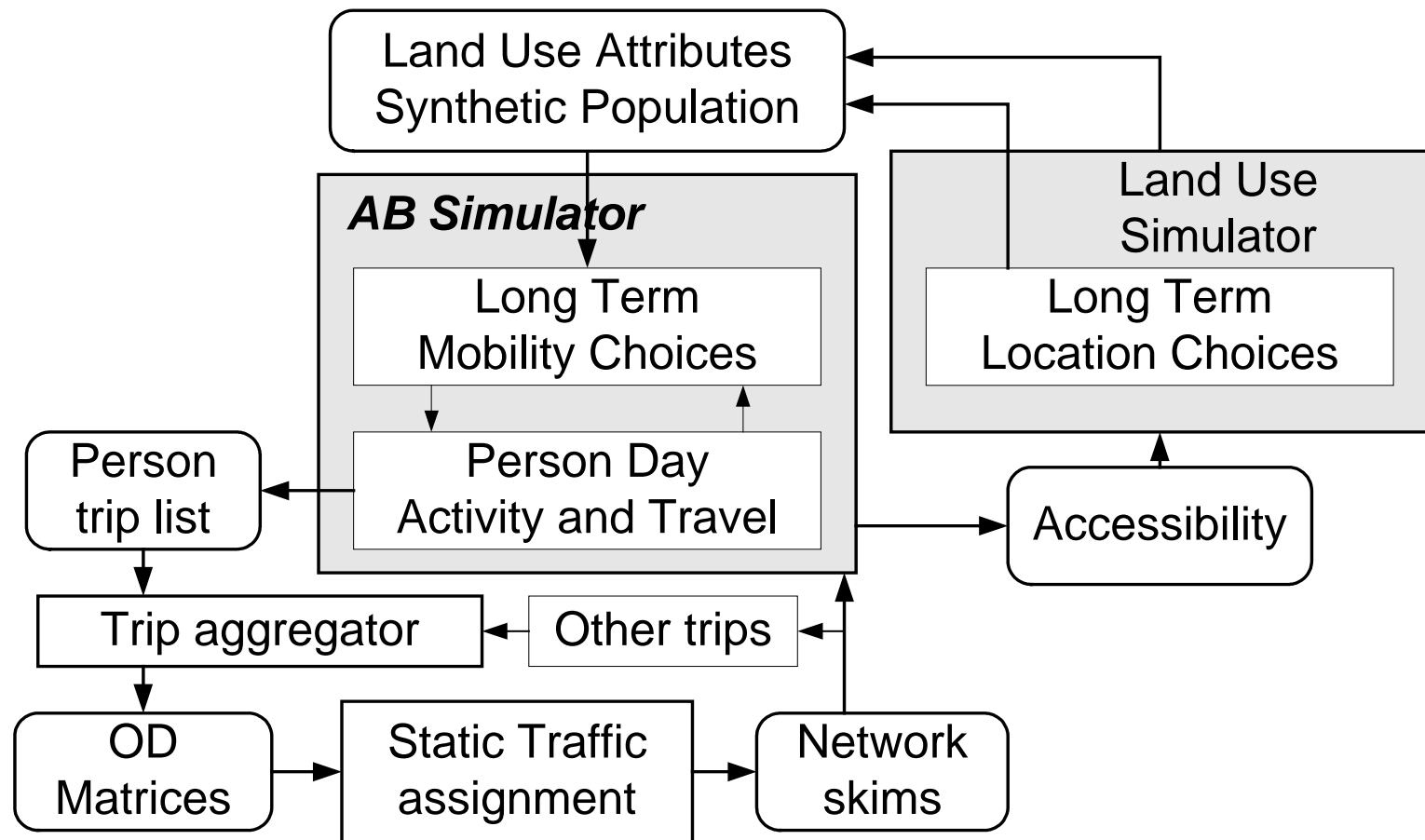
Short-term Effects	FTA New Starts
Long Term Choices	Long Term Choices
Day Activity Pattern	Day Activity Pattern
Tour Destination Mode Time Period No. & Purp. of Stops	Tour Destination Mode Time Period No. & Purp.of Stops
Stop Location Trip Mode Departure Time	Stop Location Trip Mode Departure Time

Upcoming Enhancements?



PSRC Design

Integrated Land Use Simulator

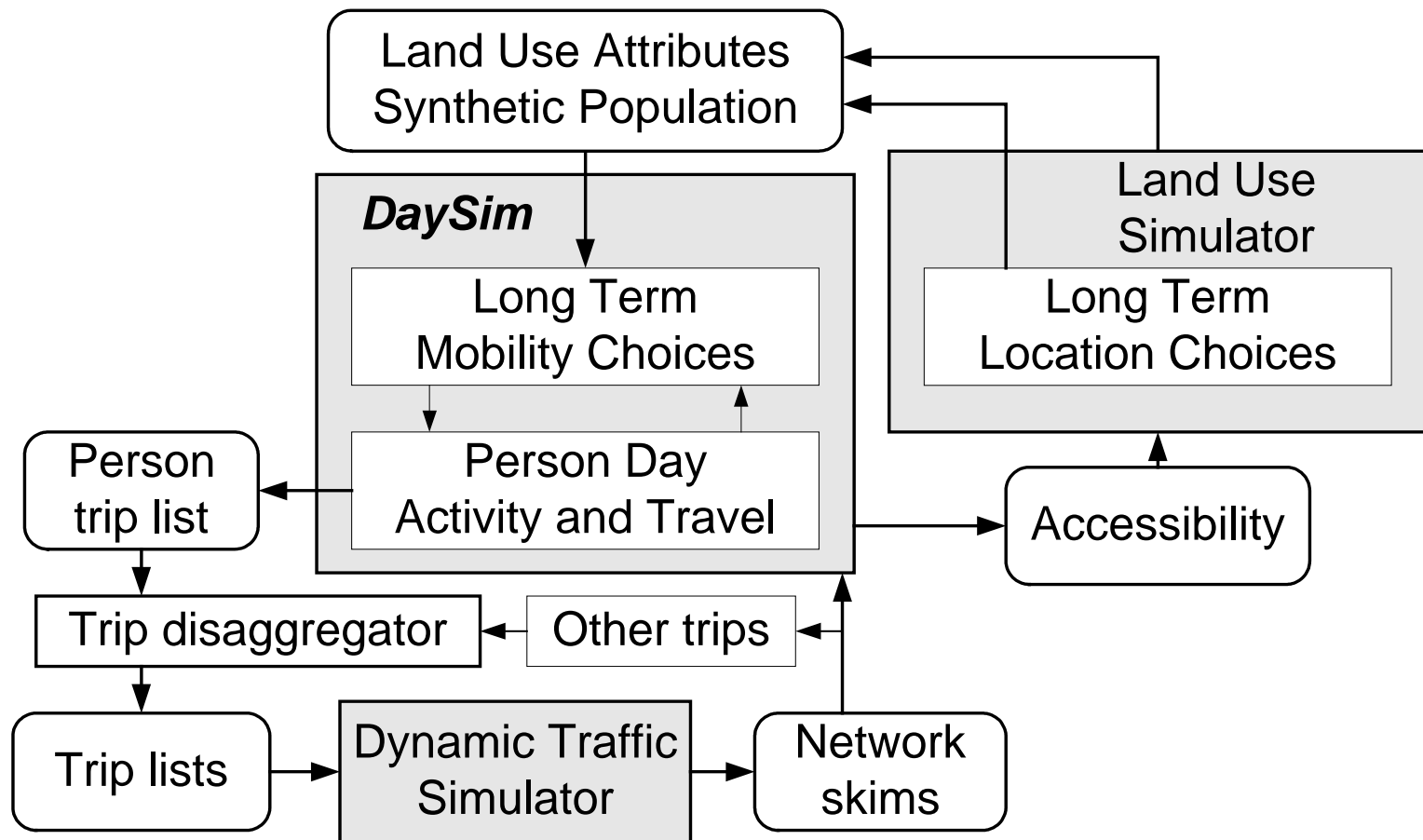


PSRC Design

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?

