SHRP2 C10

Partnership to Develop an Integrated Advanced Travel Demand Model and a Fine-grained Time-sensitive Network

RSG INC.
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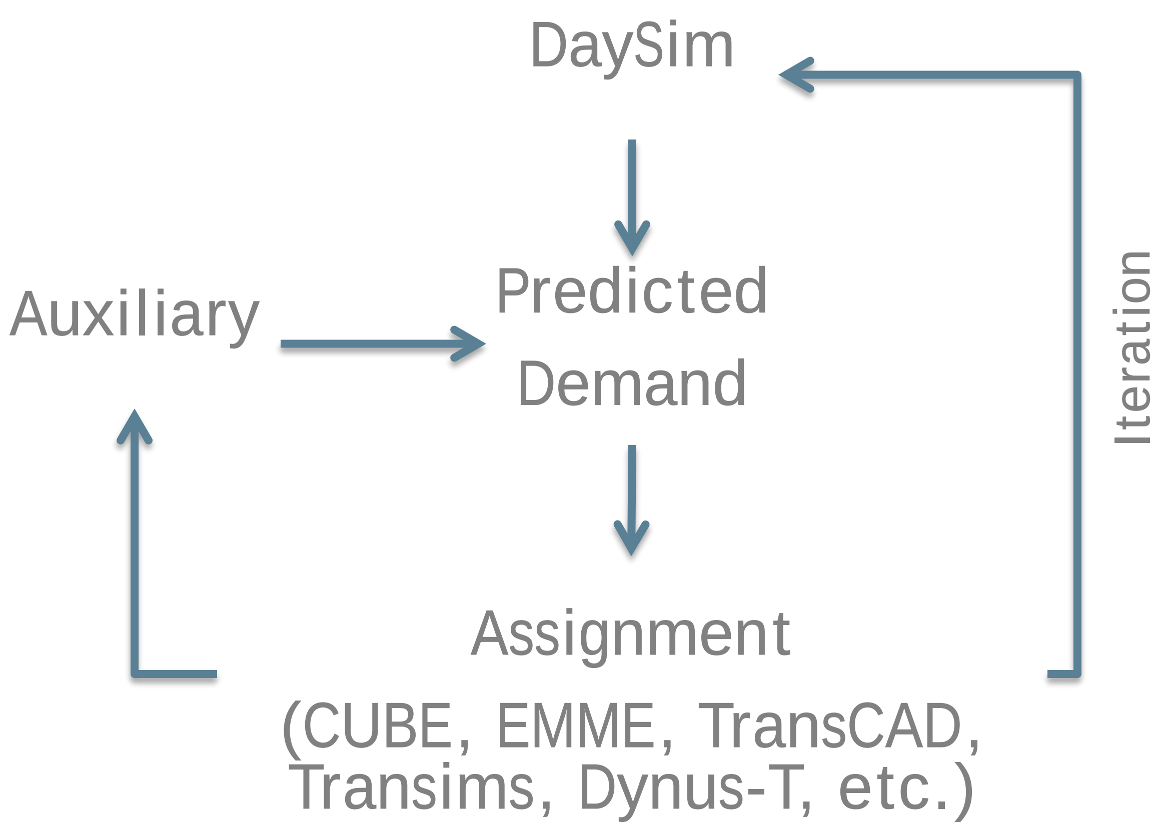
Innovations in Travel Modeling Conference
April 30, 2012
Tampa, FL

DaySim Model System



DaySim—An Evolving Tool

DaySim-
"Classic"

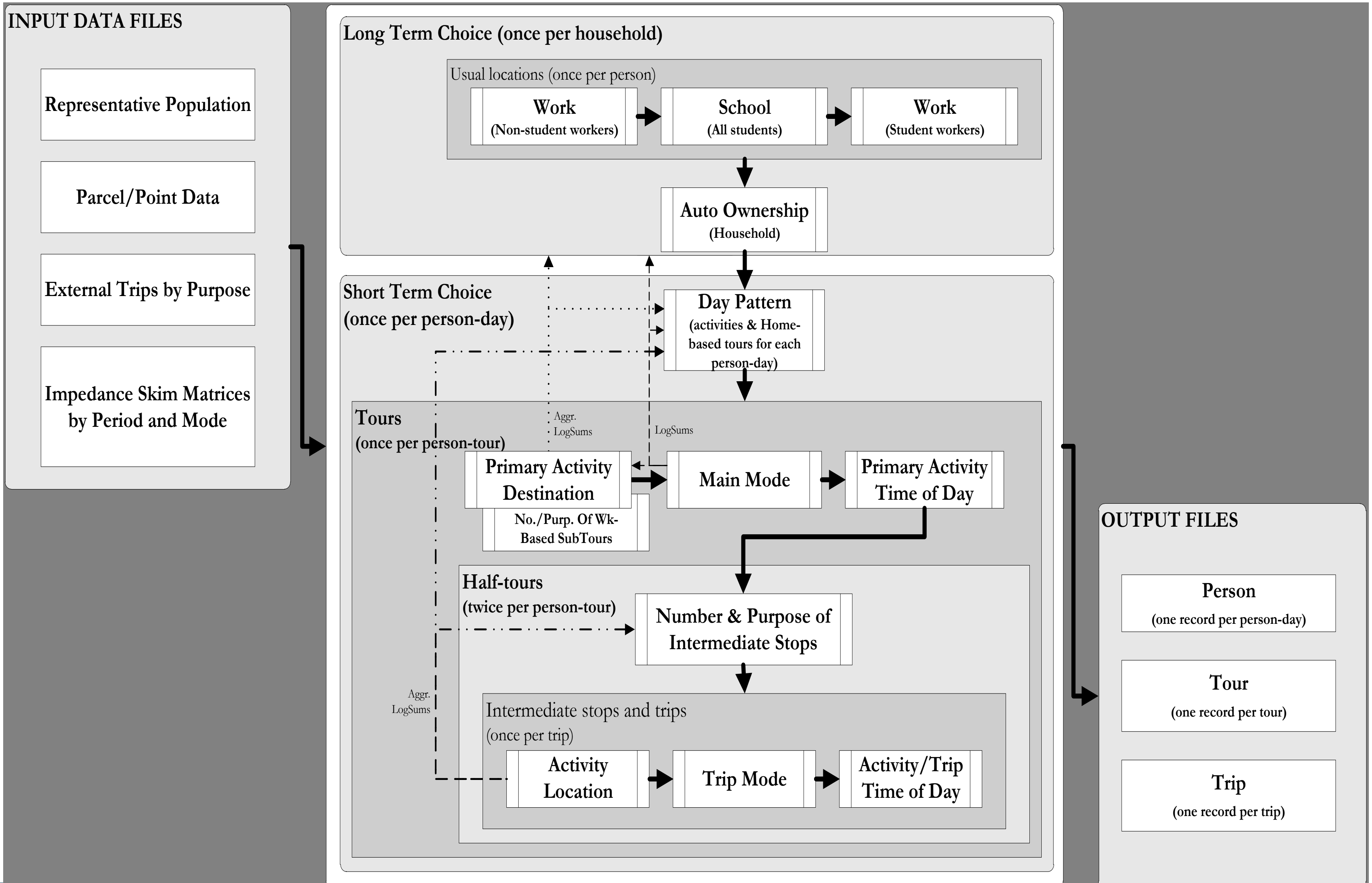
↓

DaySim-
Enhanced

↓

DaySim-Household

DaySim Classic



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DaySim Classic—Features

- Spatial Detail—Parcels
  - Location choice
  - Measurement of short distances
- Temporal Detail—30 minute time periods modeled (simulated to 1 min.)
- Integration—Upper level models sensitive to impedance
(all modes, all locations, all times of day)

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DaySim-Classic Sites

Classic
Jacksonville (2010)
Burlington (2009)
Seattle (2009) Denver (2009) **
Sacramento (2006)
San Francisco (2000) *
Portland (1997) *

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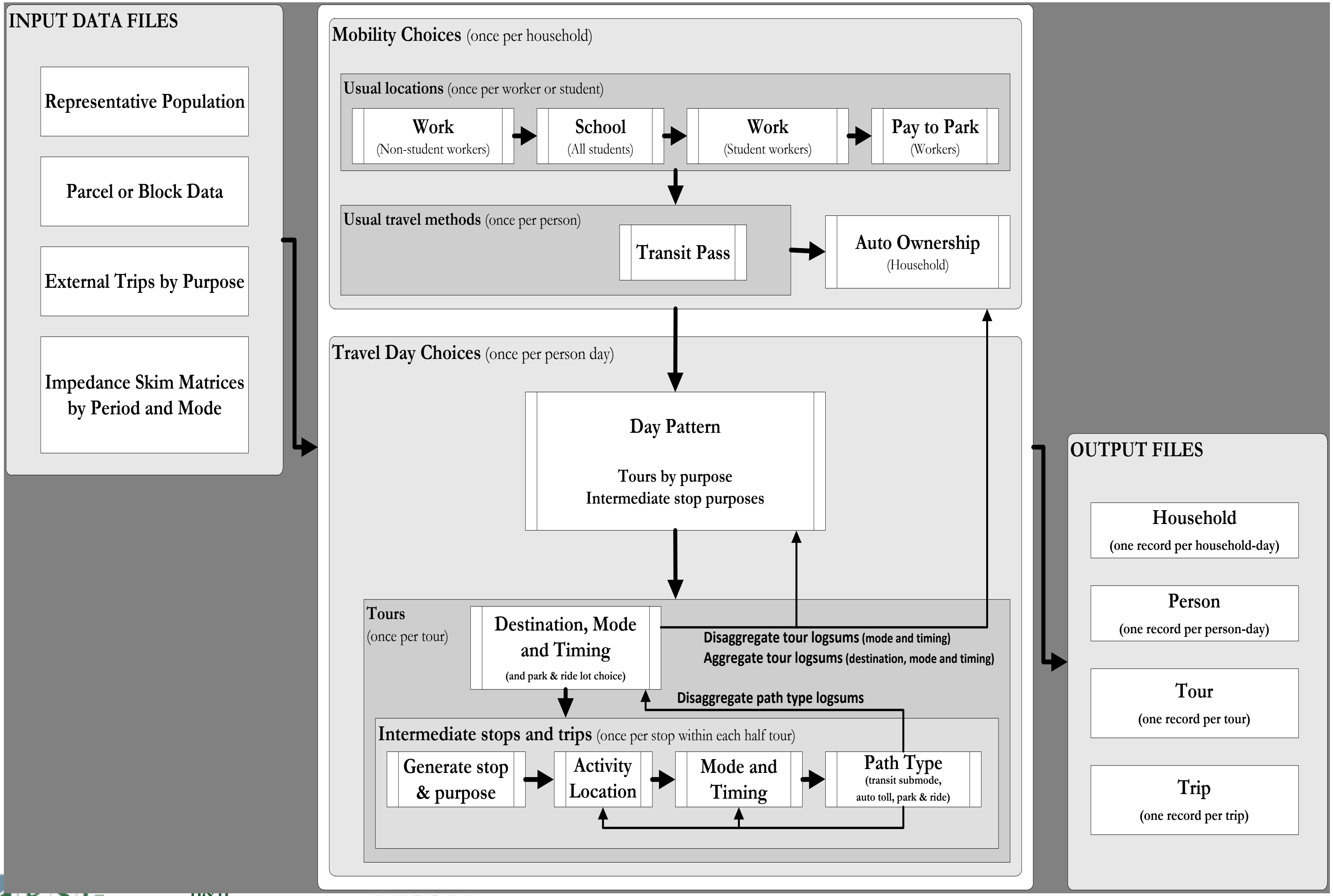
DaySim-Enhanced—Features

- Enhanced parcel-based features
  - Short distance trips use parcel-to-parcel street network distances
  - Buffering uses distance decay functions
- More rigorous time window accounting / time-space effects
- Enhanced treatment of network skims for transit and road pricing
- New model components (pay to park at work; transit pass)
- Use the DaySim code for model estimation and application
- New C# code base – object-oriented, multi-threaded
- Run time: 2.2 million people, 1.5 hr on a $1,500 computer

DaySim-Enhanced



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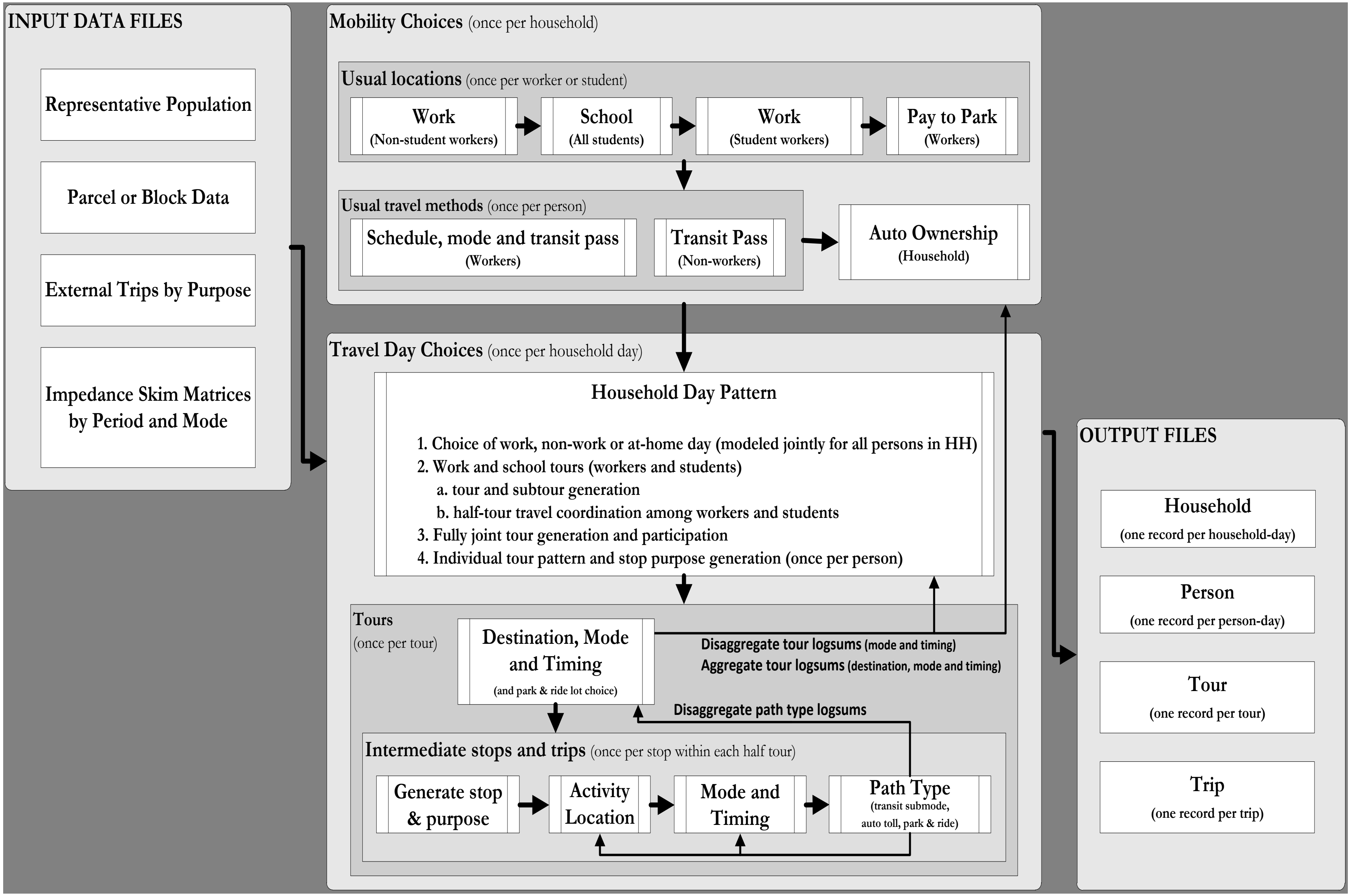
DaySim-Enhanced Sites Installed **and** *In Progress*

Classic	Enhanced
Jacksonville (2010)	*Jacksonville (2012)*
Burlington (2009)	*Tampa (2012)*
Seattle (2009)	
Denver (2009) **	*Shasta, CA (2012)*
Sacramento (2006)	Sacramento (2012)
San Francisco (2000) *	San Joaquin (2012)
Portland (1997) *	Fresno (2012)

DaySim-Household



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DaySim-Household Sites *In Progress*

Classic	Enhanced	Household
Jacksonville (2010)	*Jacksonville (2012)*	*Jacksonville (2013?)*
Burlington (2009)	*Tampa (2012)*	*Tampa (2013?)*
Seattle (2009)		
Denver (2009) **	*Shasta, CA (2012)*	
Sacramento (2006)	Sacramento (2012)	*Copenhagen (2014)*
San Francisco (2000) *	San Joaquin (2012)	*Philadelphia (2013)*
Portland (1997) *	Fresno (2012)	*Seattle (2012)*

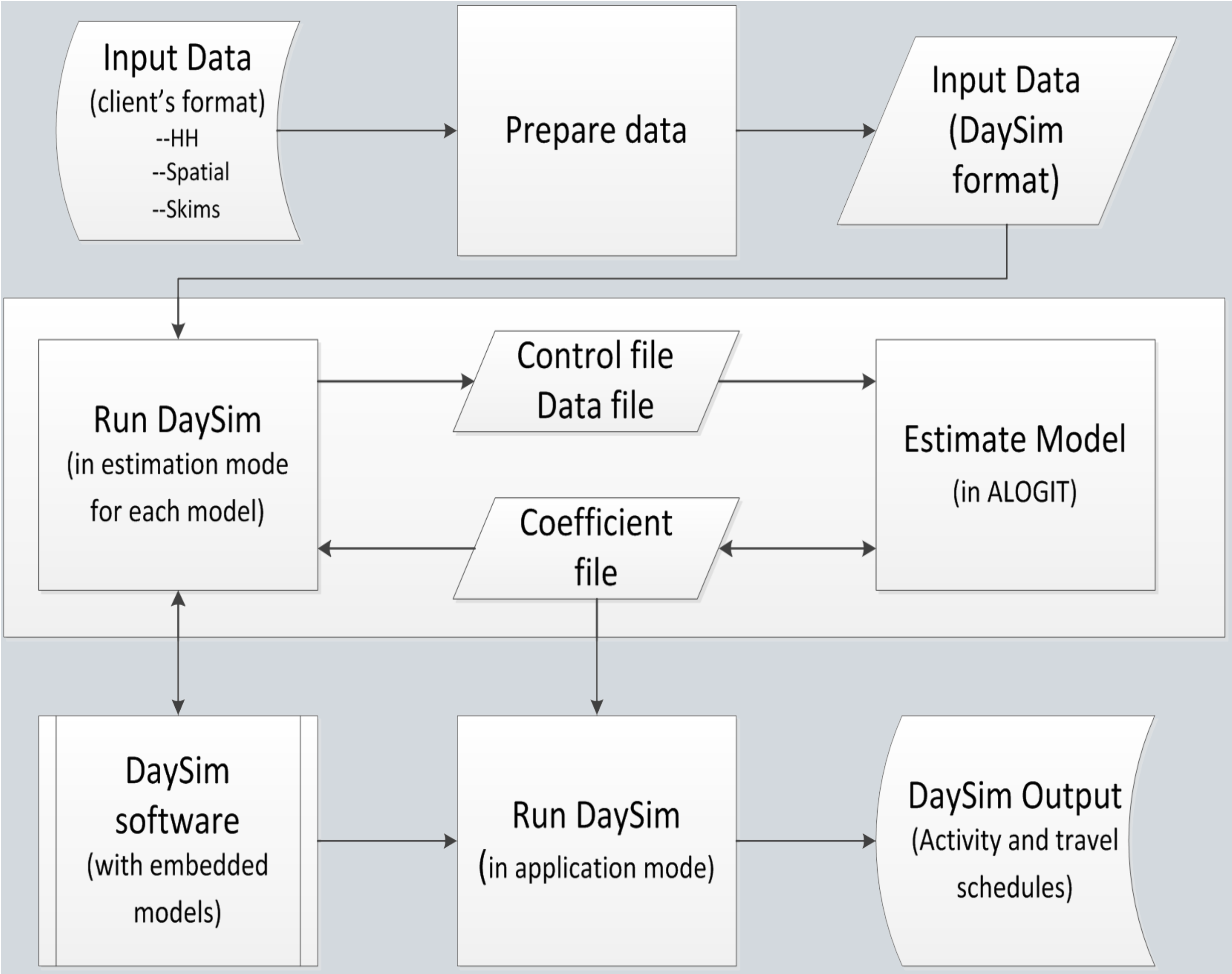
DaySim run together with Transims

Classic	Enhanced	Household
Jacksonville (2010)	*Jacksonville (2012)*	*Jacksonville (2013?)*
Burlington (2009)	*Tampa (2012)*	*Tampa (2013?)*
Seattle (2009)		
Denver (2009) **	*Shasta, CA (2012)*	
Sacramento (2006)	Sacramento (2012)	*Copenhagen (2014)*
San Francisco (2000) *	San Joaquin (2012)	*Philadelphia (2013)*
Portland (1997) *	Fresno (2012)	*Seattle (2012)*

Data required by DaySim

- Household survey data (estimation only)
- Synthetic population (application only)
  - Generated by PopGen (ASU)
- Parcel attributes
- Network impedance skim matrices
- Park and ride lot information

Model Estimation and Application



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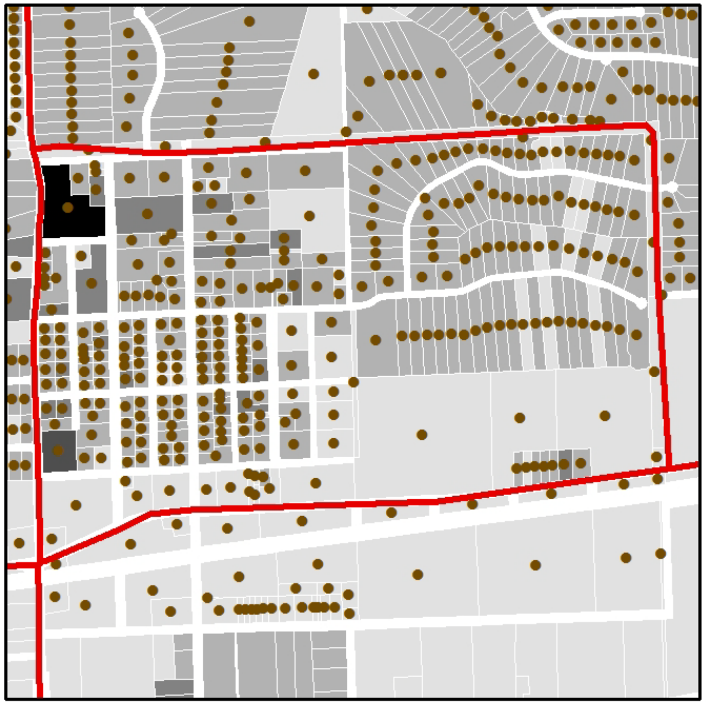
Synthetic Population: Control Data

- 3 segments
  - Permanent residents
  - Seasonal residents
  - Group quarters population
- HH controls
  - Age of head of HH
  - HH size
  - HH workers
  - HH income
  - Presence of children
- Person controls
  - Gender
  - Age

- Data Sources
  - TAZ files
  - parcel files
  - CTPP
  - Census SF1
  - Census PUMS
  - ACS
  - ACS PUMS

Parcel Data

- DaySim uses parcels as a fundamental spatial unit
- Parcel attributes include:
  - Location
  - Area
  - Housing units
  - Enrollment by school type
  - Employment by sector
  - Off-street parking
  - Buffered counts of housing units, enrollment, employment, open space, intersections, transit stops
  - Distance to transit stops by type



Ex. TAZs, parcels, and parcel centroids

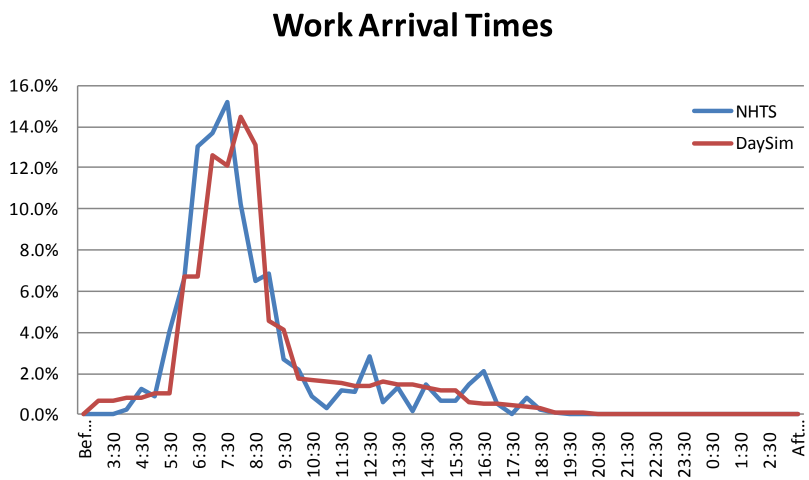
DaySim Outputs

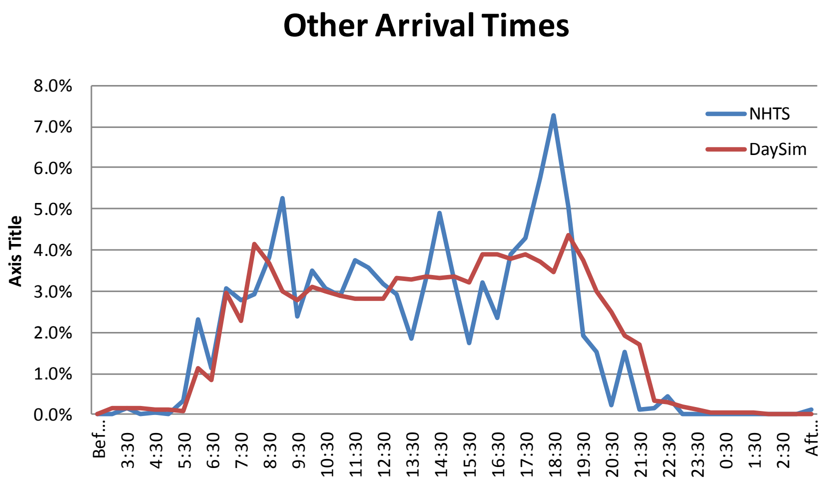
OUTPUT FILES

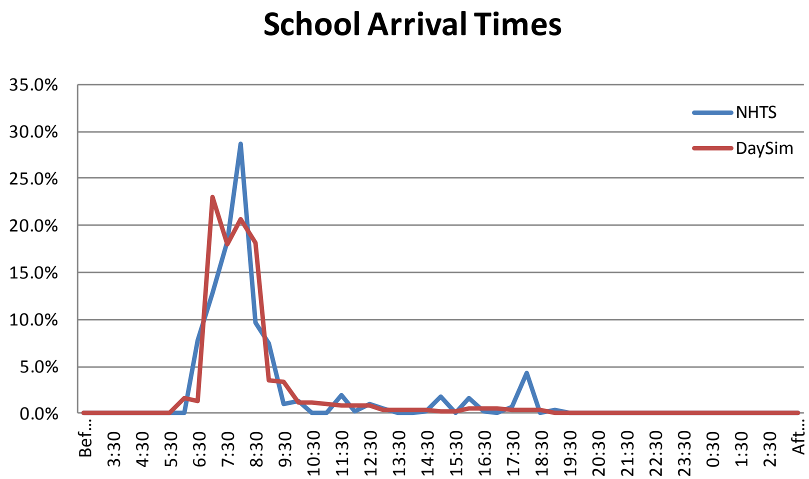
Household (one record per household-day)
Person (one record per person-day)
Tour (one record per tour)
Trip (one record per trip)

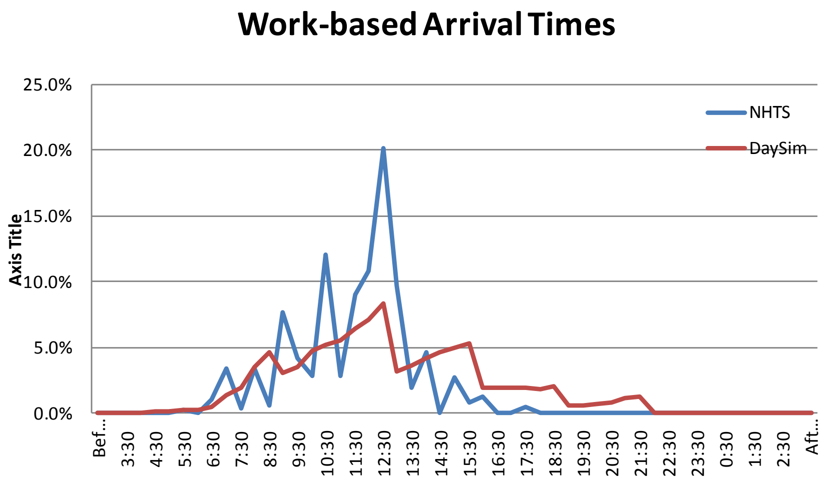
- Similar to household diary data
  - Complete one-day itineraries
  - Much temporal and spatial detail
  - Same input and output format
- List format can be aggregated many ways
  - for reporting (e.g., policy impacts by household income or by subregion)
  - trip O-D matrices for assignment by Cube

Calibration: Tour Arrival Time-Of-Day









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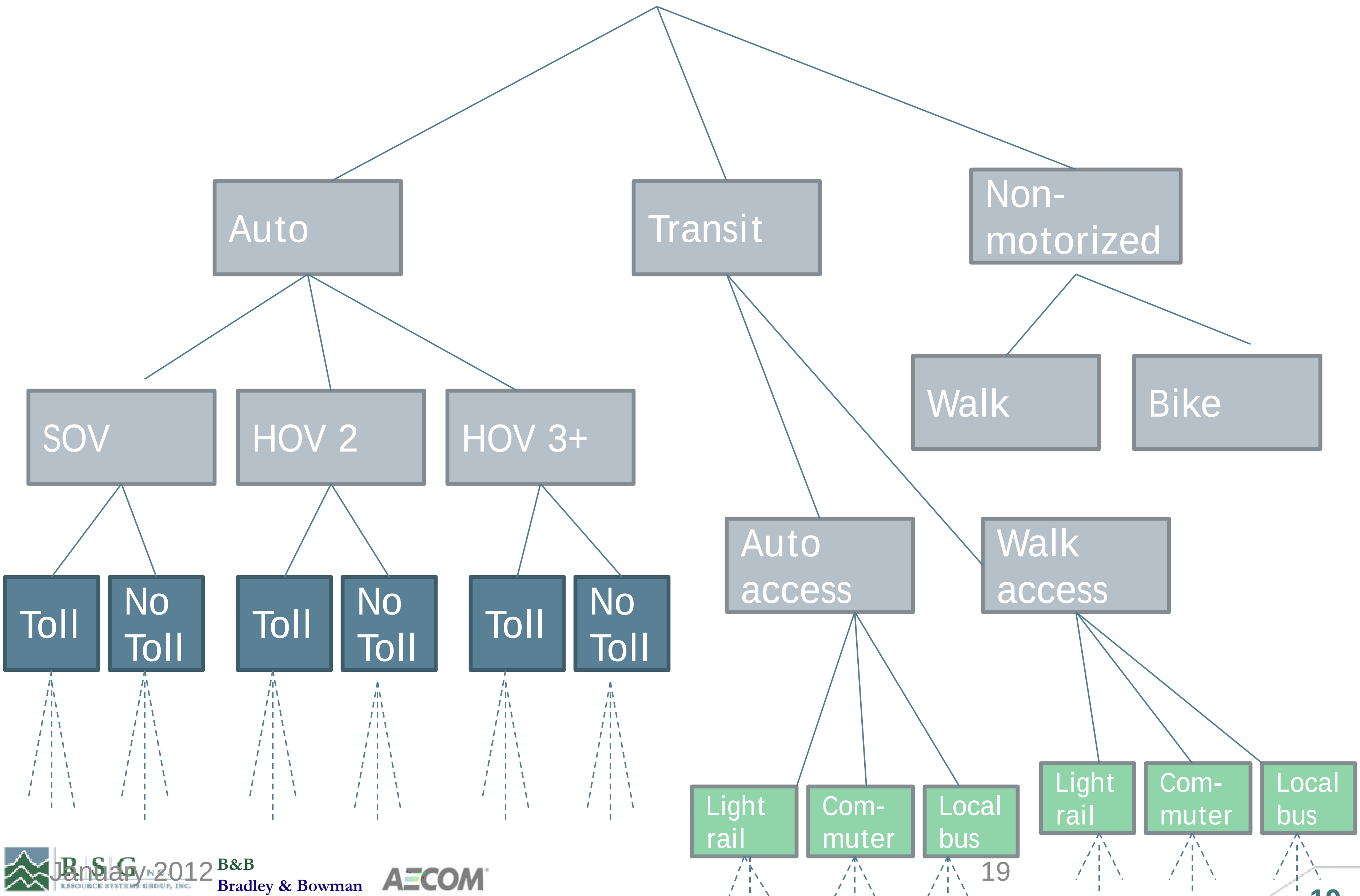
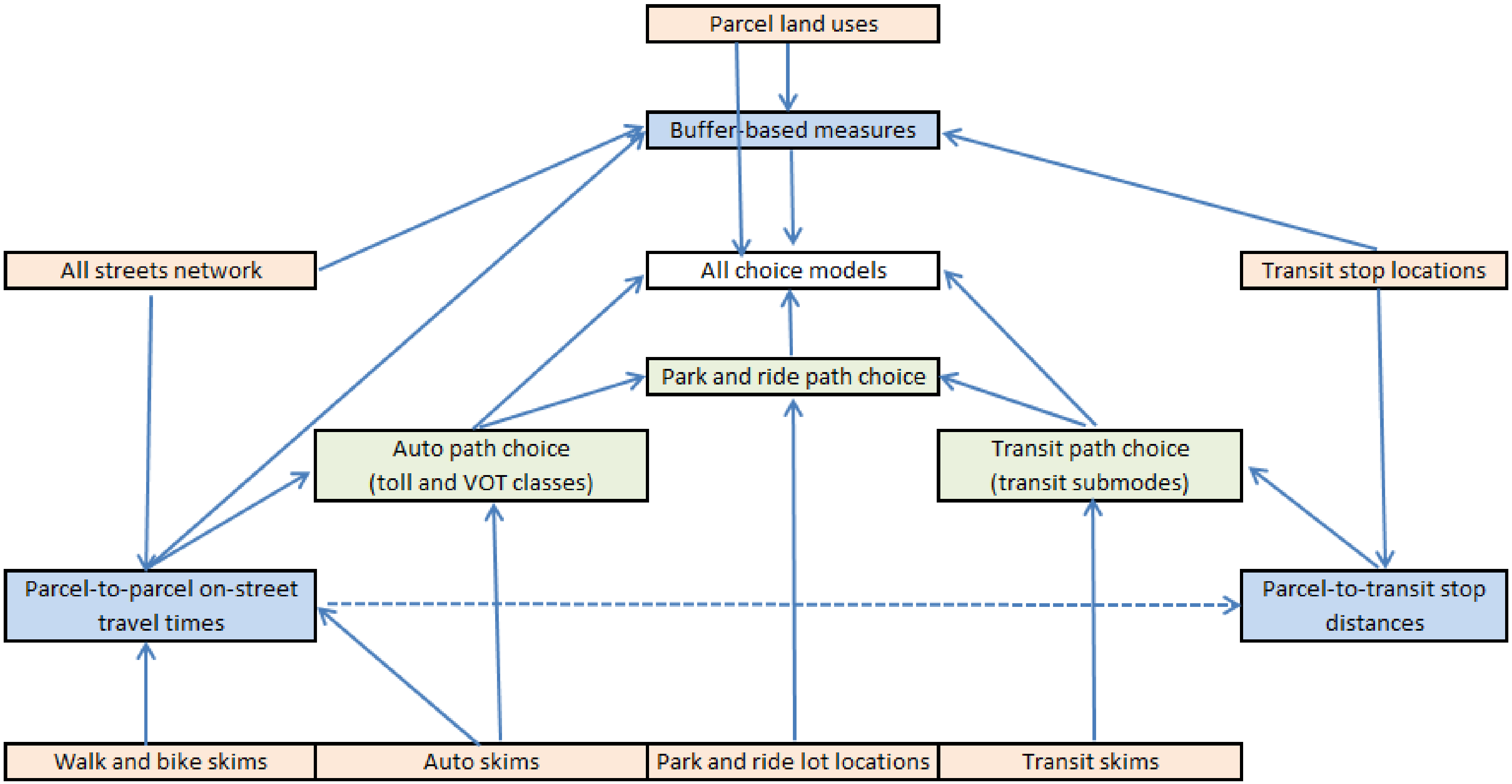
Mode choice structure



Consistent framework for spatial and network data to feed into the models



Auto path choice model

- Use findings from SHRP 2 C04 and C10 projects to include binary toll/non-toll choice model
- All auto skim matrix information "filtered" through this model.
- If no separate priced network, simply gives generalized time of the best path
- Otherwise gives generalized time logsum across best tolled and non-tolled path

Approach in more detail

1. Use Transims to generate time, distance, toll matrices for each combination of :

   Time period: In the range of 20-48 skim periods

   Path type: (1) full network, (2) network excluding tolled links

   VOT ratio: A user-defined number of different values, V_1, V_2, ... V_N

   Occupancy: (1) SOV, (2) HOV 2 (3) HOV 3+ (if necessary)

2. Use DaySim to simulate toll/no toll choice for a given trip, depending on VOT...

   If VOT<V_1, use V_1 skims

   If V_1<VOT<V_2, use V_2 skims, etc.

   If V_{N-1}<VOT, use V_N skims

3. Pass trip-specific VOT and toll/no-toll choice back to Transims for each trip

Advantages of the approach

Advantages of including path type choice in DaySim versus relying on many VOT class skims from Transims:

1. The model is sensitive to small variations in VOT (more disaggregation)

2. The model can provide expected utilities ("logsum") over multiple paths (more consistency with choice theory)

3. The number of VOT classes/skims is less, and can be tailored to the complexity of the pricing scenario (more memory-efficient and flexible)

Binary route type (toll / no toll) choice model

$V(n,i) = s \cdot b(i) * Time(n,i) + s \cdot c(i) * Distance(n,i) * opcost$

$V(t,i) = s \cdot a(i) + s \cdot b(i) * Time(t,i) + s \cdot c(i) * (Toll(t,i) + Distance(t,i) * opcost)$

$P(t,i) = 1 - P(n,i) = exp[V(t,i)] / (exp[V(t,i)] + exp[V(n,i)])$

V(n,i) **and** ***V(t,i)*** **are the systematic logit utilities for the best no-toll and toll routes, respectively, for individual traveler** ***i*****, and** ***P(t,i)*** **and** ***P(n,i)*** **are the corresponding binary logit probabilities.**

Time(n,i), Time(t,i), Distance(n,i), Distance(t,i) **are the travel time and distance along the best no-toll and toll routes, respectively, for traveler** ***I*****, depending on the traveler/trip's origin, destination, time of day, and value of time (VOT) class.**

Toll(n,i) **is the toll along the best tolled route for traveler** ***i*****, depending on the traveler/trip's origin, destination, time of day, and value of time (VOT) class.**

a(i) **is an alternative-specific constant for the tolled route for traveler** ***i***

b(i) **is the travel time coefficient for traveler** ***i***

c(i) **is the travel cost coefficient for traveler** ***i***

s **is a scale factor applied to all coefficients, denoting the scale of this model relative to mode choice**

opcost **is the auto operating cost per mile**

Traveler- & tour-specific model coefficients

Work tours

$c(i)$ = -0.15/$ / [((income(i) / 30,000) ^ 0.6) * (occupancy(i) ^ 0.8)]

$b(i)$ = -0.030/min * draw from a log-normal distribution, with mean 1.0 and std. deviation 0.8

$a(i)$ = -1.00

s = 1.5

Non-work tours

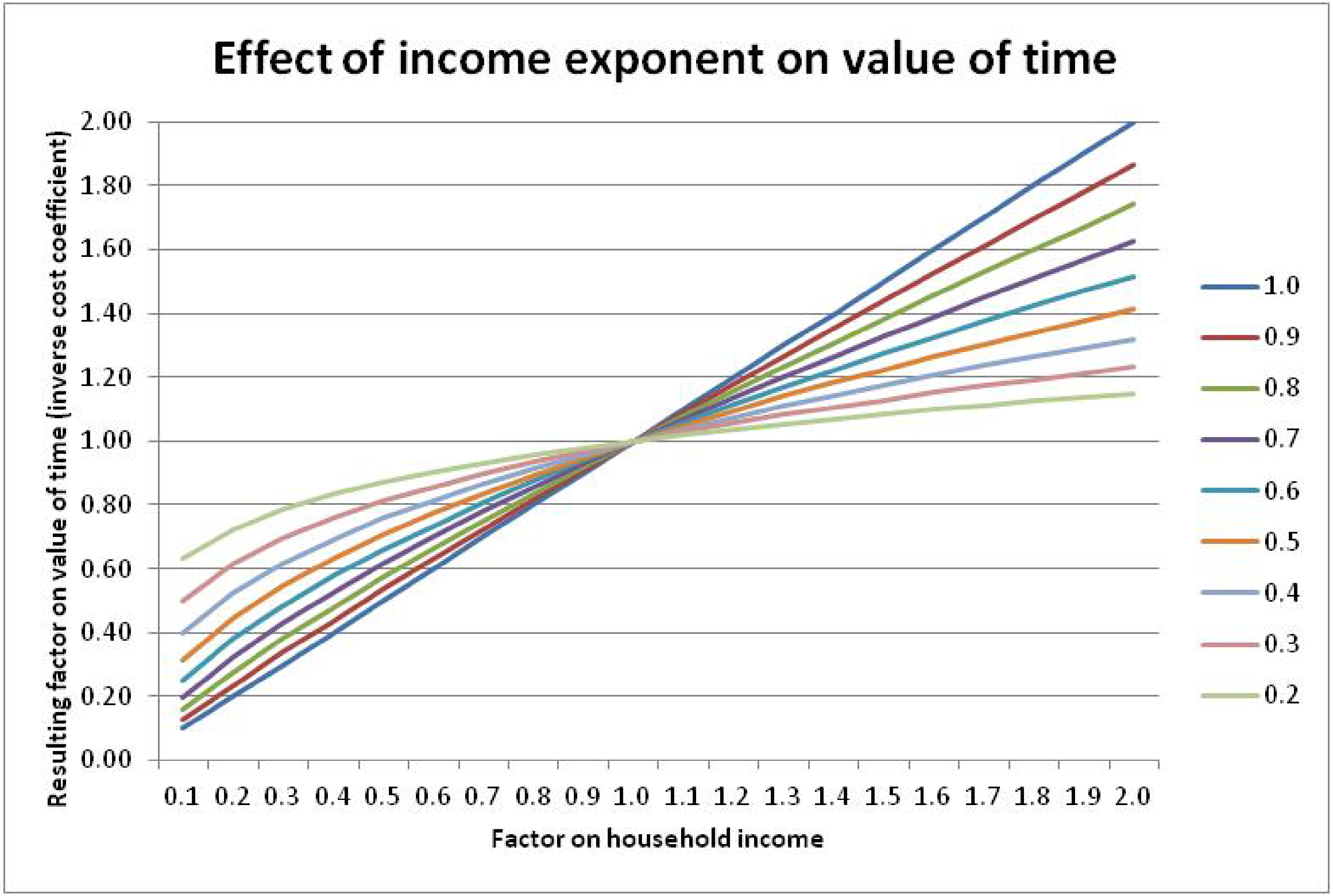
$c(i)$ = -0.15/$ / [((income(i) / 30,000) ^ 0.5) * (occupancy(i) ^ 0.7)]

$b(i)$ = -0.015/min * draw from a log-normal distribution, with mean 1.0 and std. deviation 1.0

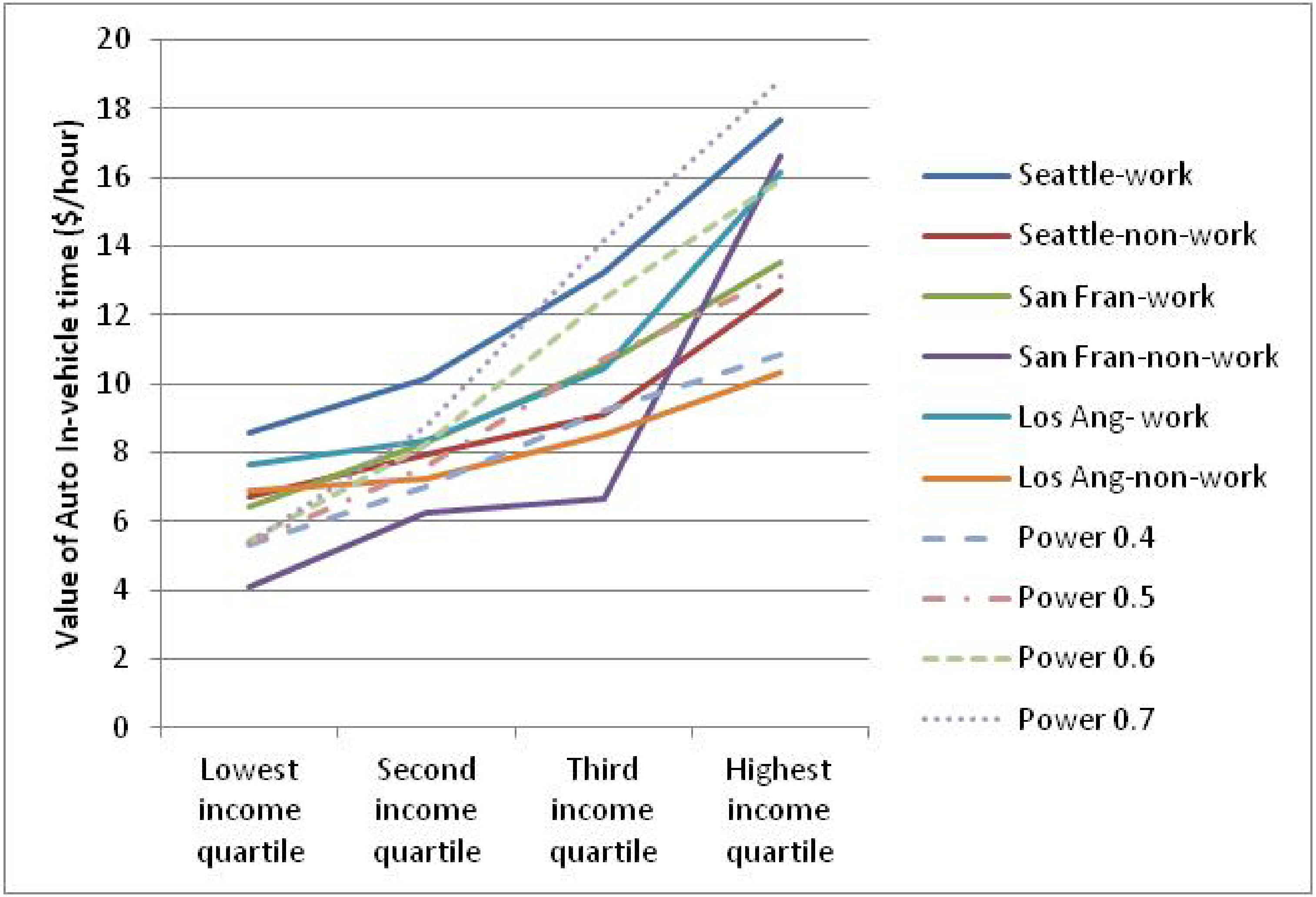
$a(i)$ = -1.00

s = 1.5

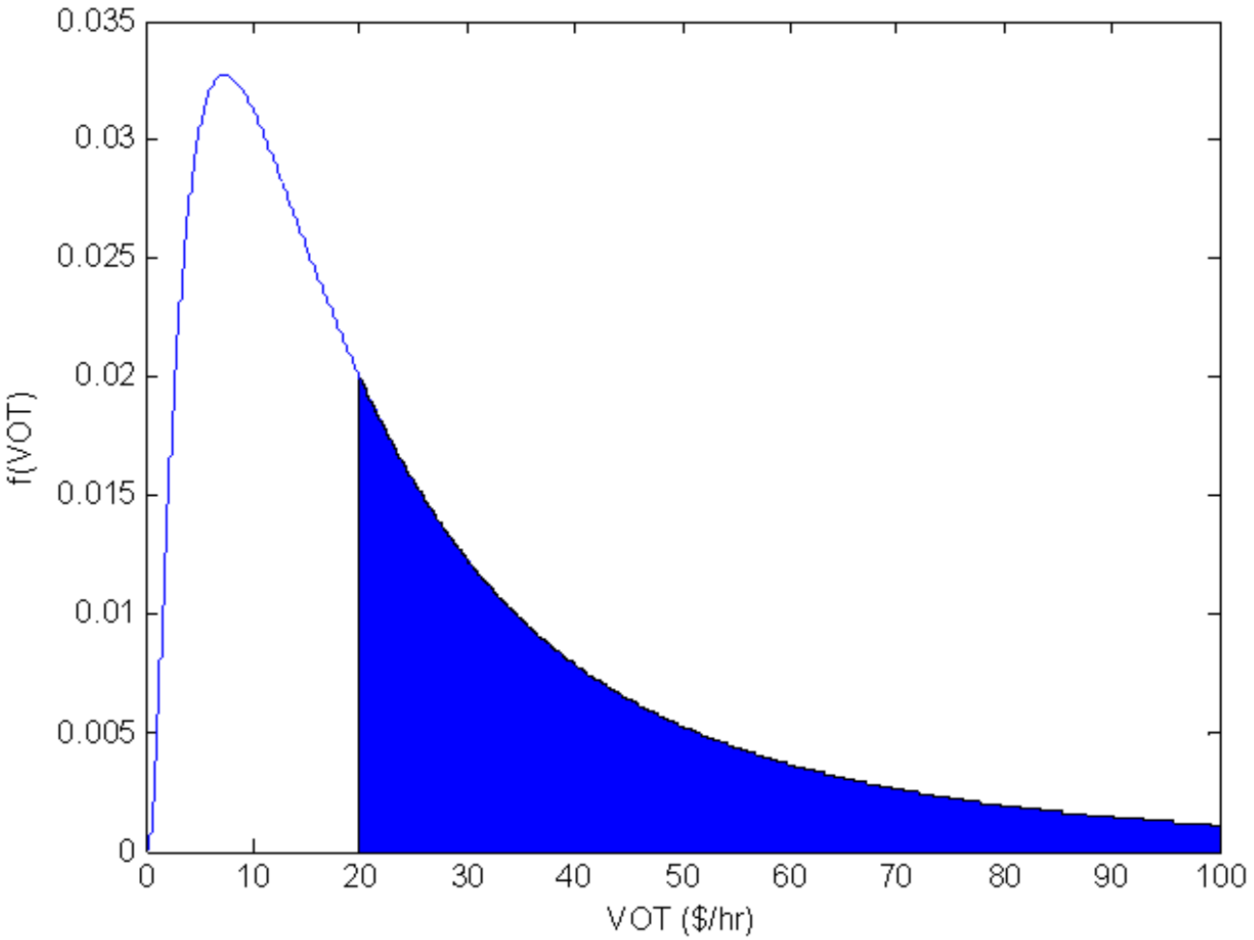
How does VOT vary with income?



VOT variation with income – various C04 data sets



Shape of Log-Normal Distribution



"Generalized time" logsum from route choice

$V(n,i) = s \cdot b(i) * Time(n,i) + s \cdot c(i) * Distance(n,i) * opcost$

$V(t,i) = s \cdot a(i) + s \cdot b(i) * Time(t,i) + s \cdot c(i) * (Toll(t,i) + Distance(t,i) * opcost)$

$GT(i) = LN [(exp[V(t,i)] + exp[V(n,i)]] / (s \cdot b(i))$

V(n,i),V(t,i) defined earlier. *GT(i) i*s generalized time

When no toll route is available, this is simply the generalized time for the non-tolled route

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How the route type choice model is used in DaySim

DaySim model	Predicts route type choice?	Uses logsum as generalized auto time?	Used for modes…	Used for periods…	One way or round trip?
Work location	No	Yes	SOV, HOV2, HOV3+***	Assumed***	Round trip***
School location	No	Yes	SOV, HOV2, HOV3+***	Assumed***	Round trip***
Auto ownership	No	Yes	SOV, HOV2, HOV3+***	Assumed***	Round trip***
Day pattern choice	No	Yes	SOV, HOV2 **	Assumed**	Round trip**
Tour destination choice	No	Yes	SOV, HOV2, HOV3+*	Simulated*	Round trip*
Tour mode choice	No	Yes	SOV, HOV2, HOV3+	Simulated	Round trip
Tour time of day choice	No	Yes	Predicted tour mode	All possible	Round trip
Stop generation and location choice	No	Yes	Predicted tour mode	Predicted tour periods	One-way via stop detour
Trip mode choice	Yes	Yes	SOV, HOV2, HOV3+	All possible	One way trip
Trip time of day choice	No	Yes	Predicted trip mode	All possible	One way trip

* via disaggregate tour mode choice logsum, ** via aggregate accessibility logsums, *** via both

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Treatment of transit pricing

- Transit skims contain only full fare.
- If transit pass model predicts a transit pass, then marginal fare for any transit trip is 0.
- Otherwise, apply a factor to full fare based on person type (age and student status)

Skim Data reading and retrieval

- Uses flexible ‘Impedance Roster’
  - Make SACOG/scenario-specific (via simple CSV spreadsheet file)
  - Can change as needed
    - Different time periods
    - Different VOT classes
    - More sophisticated bike skims
    - Different input file format

Skim Roster Entries for Auto In-Vehicle Time

Variable	Mode	Path-type	VOT-group	Start-minute	End-minute	Skim File Name	Field
ivtime	sov	full-network	medium	361	540	2008periodautoskims.txt	3
ivtime	hov2	full-network	medium	361	540	2008periodautoskims.txt	7
ivtime	hov3	full-network	medium	361	540	2008periodautoskims.txt	7
ivtime	sov	full-network	medium	541	900	2008periodautoskims.txt	4
ivtime	hov2	full-network	medium	541	900	2008periodautoskims.txt	4
ivtime	hov3	full-network	medium	541	900	2008periodautoskims.txt	4
ivtime	sov	full-network	medium	901	1080	2008periodautoskims.txt	5
ivtime	hov2	full-network	medium	901	1080	2008periodautoskims.txt	8
ivtime	hov3	full-network	medium	901	1080	2008periodautoskims.txt	8
ivtime	sov	full-network	medium	1081	1380	2008periodautoskims.txt	6
ivtime	hov2	full-network	medium	1081	1380	2008periodautoskims.txt	6
ivtime	hov3	full-network	medium	1081	1380	2008periodautoskims.txt	6
ivtime	sov	full-network	medium	1381	360	2008freeflowautoskims.txt	3
ivtime	hov2	full-network	medium	1381	360	2008freeflowautoskims.txt	3
ivtime	hov3	full-network	medium	1381	360	2008freeflowautoskims.txt	3

Summary: Compatible strengths of AB microsimulation and DTA-type approaches

- Daysim can handle detailed time of day (skim periods as short as 15 minutes) and detailed location (parcels, blocks), without significant increase in run time (but may require a lot more RAM)
- Pricing enhancements (based on SHRP 2 C04), and distributed VOT
- Towards the future – truly integrated activity-based demand and supply models, with fully consistent individual travel patterns and travel trajectories.
- How far have we come with C10A?

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DaySim-Household—Features

- Long-term worker choices
  - Usual mode to work
  - Usual work schedule
- Household Day Pattern Models
  - Main activity of day modeled jointly for household members
  - Travel together to and from work and school
  - Joint tours for non-work purposes
- Mode and time of day choice models estimated jointly (possibly with destination choice as well)

SHRP2 C10A: Jacksonville

C10A Team

PROJECT TEAM

- Resource Systems Group (lead)
- AECOM – current software developers for TRANSIMS
- Mark Bradley – developer of DaySim
- Dr. John Bowman - developer of DaySim
- Dr. Ram Pendyala, ASU – developer of PopGen
- Dr. Chandra Bhat, University of Texas
- Dr. S. Travis Waller, University of Texas
- Dr. Mohammed Hadi, Florida International University

KEY AGENCY PARTNERS

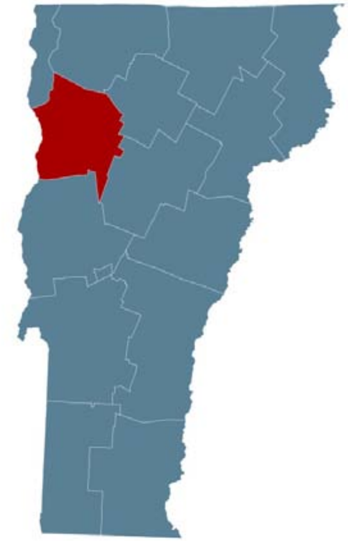
- Florida Department of Transportation
- North Florida Transportation Planning Organization

Project Context

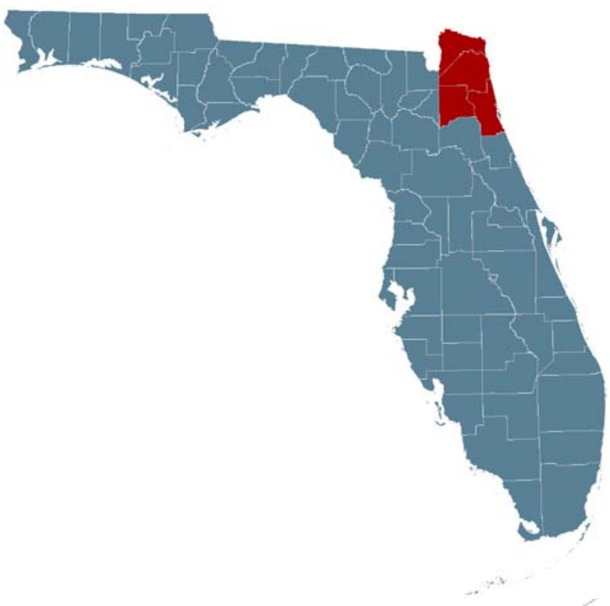
- Travel models are not sufficiently sensitive to the dynamic interplay between travel behavior and network conditions
- Travel models are unable to reasonably represent the effects of transportation policies
    - Road Pricing / Tolling
    - TDM (ie. parking pricing, flexible work schedules)
    - Travel Time Reliability Impacts
- Improve model and network processes in order to address policy and investment questions by dynamically integrating analysis of activities, networks and environment
    - Temporally detailed (reflect variations in supply and demand)
    - Spatially detailed (small scale improvements)
    - Behaviorally detailed (ie.VOTs)
- Research – but also consider transferable product
    - Scalable - implementable

C10A: Two Distinct Project Geographies

- Burlington
  - TRANSIMS network existed from prior project, but required significant revisions, and new assignment methods
  - New DaySim implementation
  - Initial model system in ~ 6 months



- Jacksonville
  - New TRANSIMS implementation (network build and assignment methods)
  - New DaySim implementation
  - Initial model system in ~9 months



- Refinements to both model systems ongoing throughout the project

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Model System Resolution

Spatial Resolution

Level	Fine	Intermediate	Coarse
Basic spatial unit	Specific addresses (e.g. points, parcels)	Activity locations (e.g. block faces)	Zones (e.g. Census tracts, block groups)
Example model systems	DaySim	TRANSIMS	Static equilibrium traffic assignment
Typical number in a region	500,000 – 2,000,000 (600,000 at NFTPO)	10,000 – 40,000 (25,000 at NFTPO)	1,000 – 4,000 (1,350 at NFTPO)

Temporal Resolution

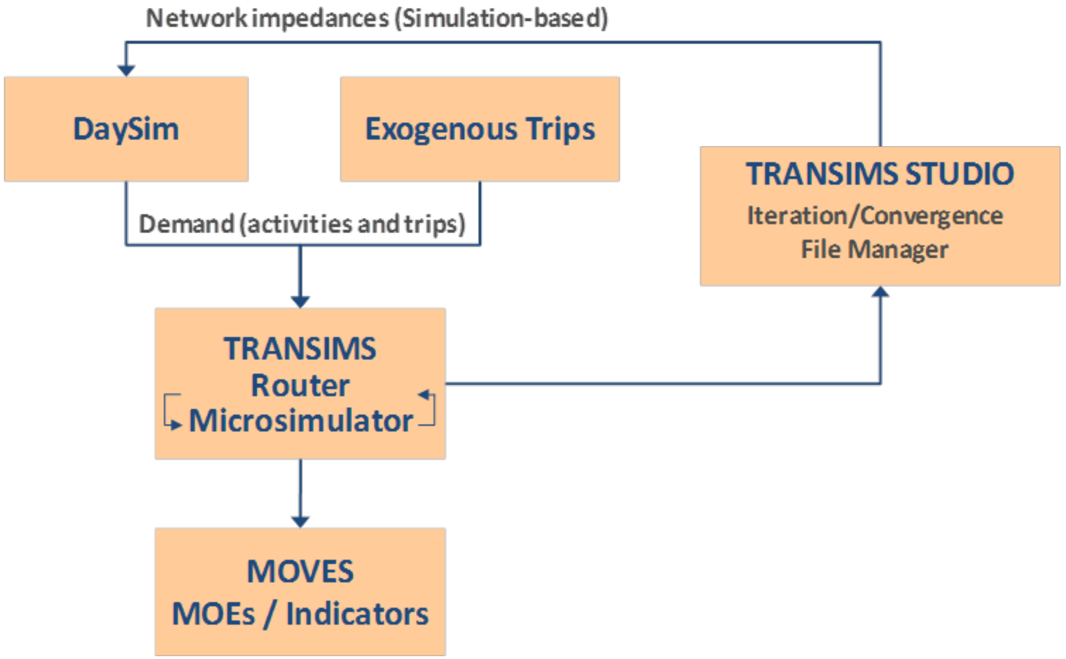
Level	Fine	Intermediate	Coarse
Basic temporal unit	Seconds	Minutes	Hours
Example model systems	TRANSIMS Microsimulator	TRANSIMS Router DaySim	Static equilibrium traffic assignment
Typical interval used	1-10 seconds (seconds in Microsimulator)	1-15 minutes (15 minutes in Router, 1 minute in DaySim - NFTPO)	1-24 hours (2 periods in the day in NFTPO)

Model System Application

- What are the best uses of this tool?
  - Policies expected to impact dynamic demand-supply interaction
  - Policies expected to have detailed temporal, behavioral, spatial impacts
  - Policies that can’t realistically be addressed by other model systems
- Different application modes for different purposes
  - Developed application modes based on experience in model system development and sensitivity testing
- How quickly do you need that answer?

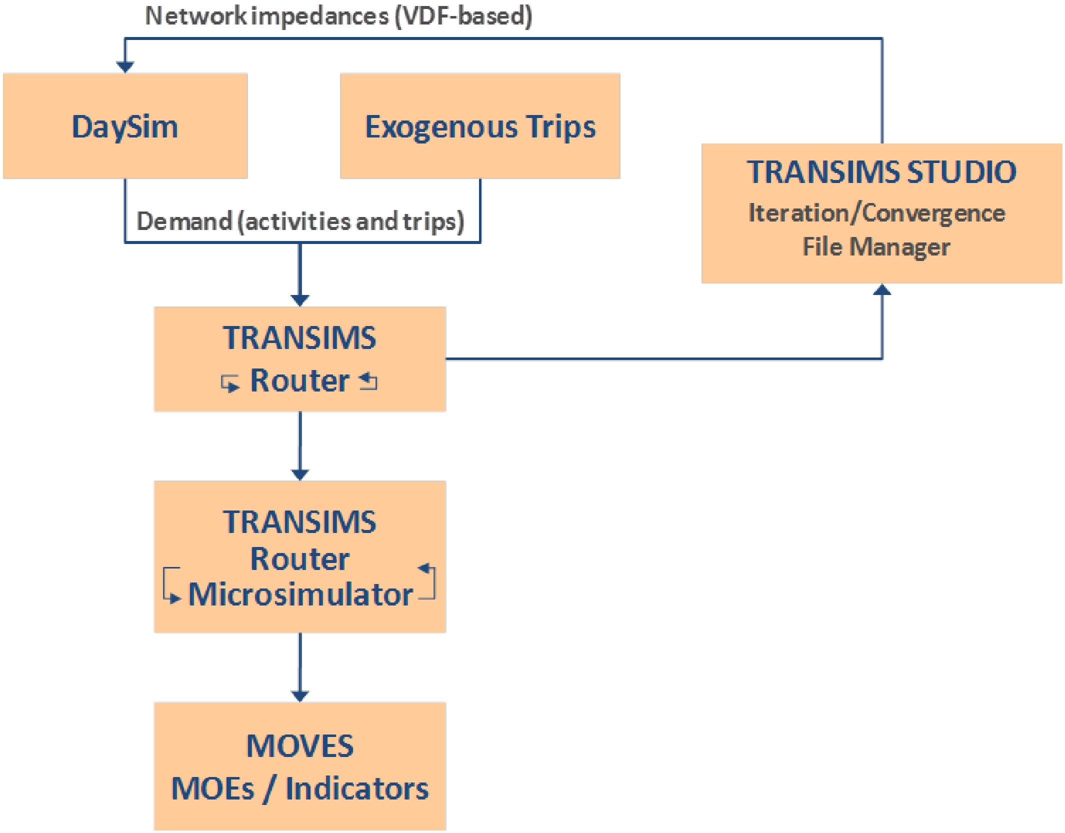
Application Modes: Planning + Operations

- Assess regional-scale changes in demand and traffic dynamics
- Policy sensitivities
  - Pricing
  - Capacity
  - TDM
  - Operations
  - GHG
- Fully integrated regional demand and traffic microsimulation model



Application Modes: Planning

- Assess regional scale changes in demand
  - Activity generation
  - Destination
  - Mode
  - Time-of-day
  - Route
- Initial screening-level review of:
  - Capacity
  - Operations
  - TDM
  - GHG
- Microsimulator as post-process



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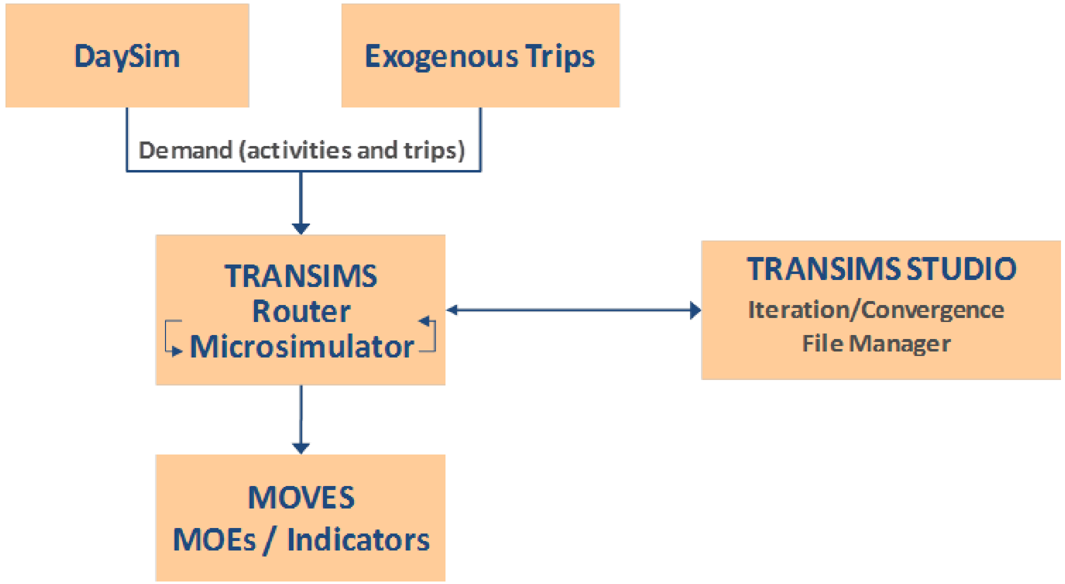
Application Modes: Operations

- Assess local-scale changes in traffic dynamics, assuming fixed demand
- Policy sensitivities
  - Capacity
  - Operations
  - Those **not** significantly influencing non-route choice travel decisions
- Fixed DaySim and exogenous demand



Implementation Issues

- Data development
  - Detailed (intersections, parcels, network resolutions)
  - Debugging, rectifying
- Integration methods
  - Practical
  - Defensible
  - Reasonable runtimes
- Performance assessment
  - Convergence
  - Stability
  - Consistency
- Tool refinement / development
  - Basic integration
  - New capabilities

Conclusions

- Produce an operational model system
  - Yes
- Incorporate fine-grained, time-dependent network
  - Yes
- Demonstrate model system performance
  - Yes
- Ensure a transferable process
  - Yes, but…
  - Requires commitment to implement, apply

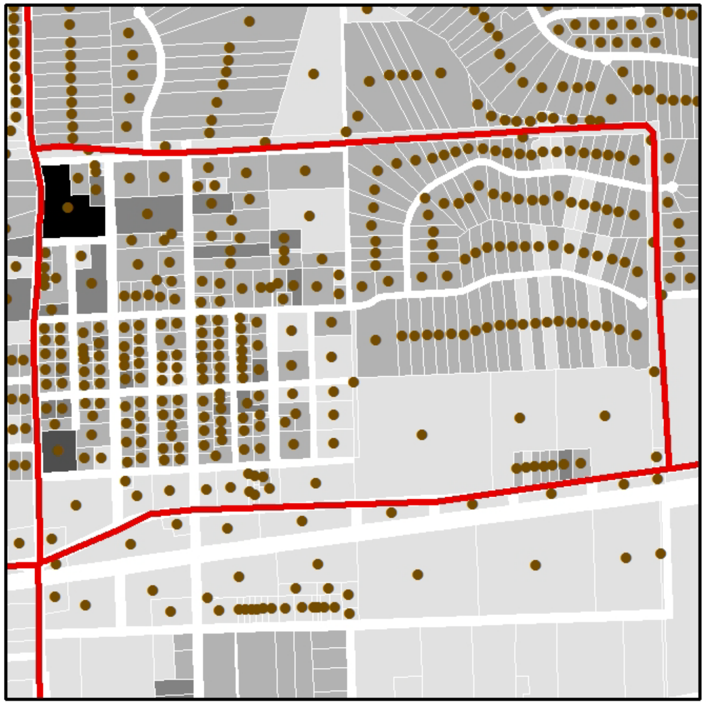
Implementation

Implementation Issues

- Data development
  - DaySim
  - TRANSIMS
- Integrating model system components
  - Capabilities
  - Consistency
  - Convergence
- Using the model system
  - Calibration / validation
  - Sensitivity tests
- Model system refinement

Data Development: DaySim

- Parcels as a spatial unit
  - Housing units
  - Enrollment by school type
  - Employment by sector
  - Transportation network access
  - Urban form measures
  - TAZ-level impedances refined using parcel-level information
- Synthetic population
  - Permanent
  - Seasonal (Jacksonville)
- Data development can be take time



Ex. TAZs, parcels, and parcel centroids

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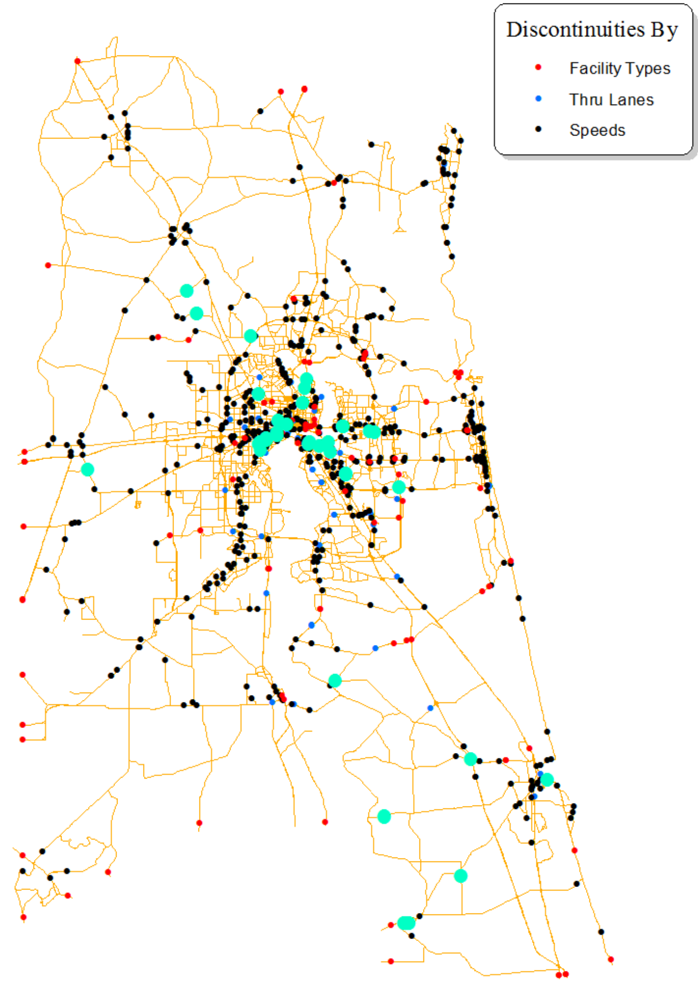
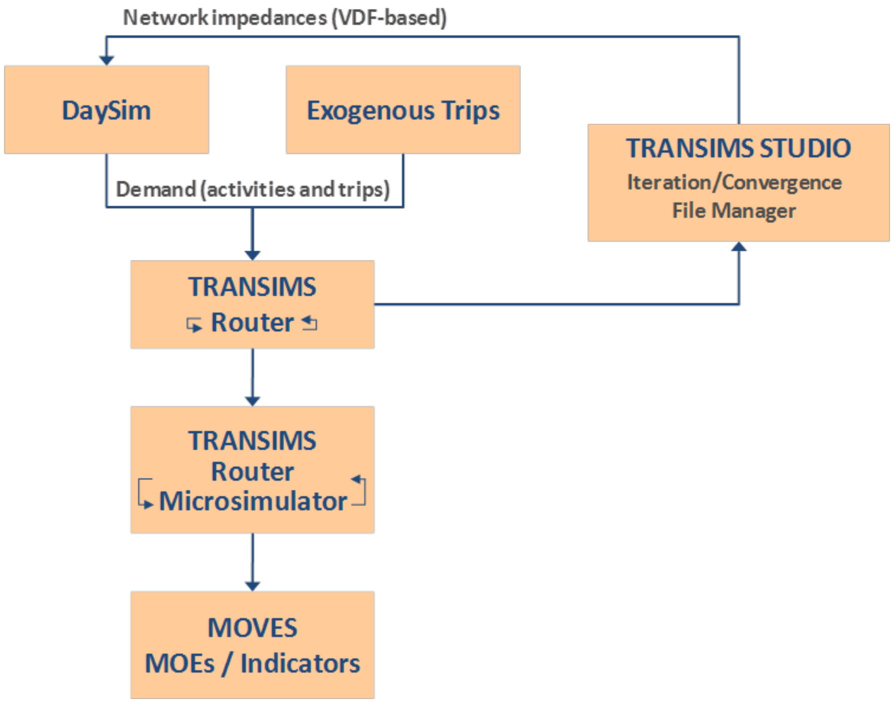
Data Development: TRANSIMS

- Geographically correct networks
- "Activity Locations" as loading points (essentially block faces)
- Intersection geometry (# of approach lanes, lane connectivity, pocket lanes, on street parking)
- Intersection control (signalized intersection timing)
    - Actual vs synthesized
- Multiple network resolutions developed to assessment performance and runtime impacts
- Challenges
    - Debugging network coding problems
    - Calibrating traveler behavior
    - Developing network information by time-of-day



Integrating Model System Components

- More than just a "handshake"
- Consistency highly desirable
- Challenging in the context of ever-increasing detail
  - Temporal
  - Behavioral
  - Spatial
- Convergence intrinsically related to consistency
- Runtimes



Consistency

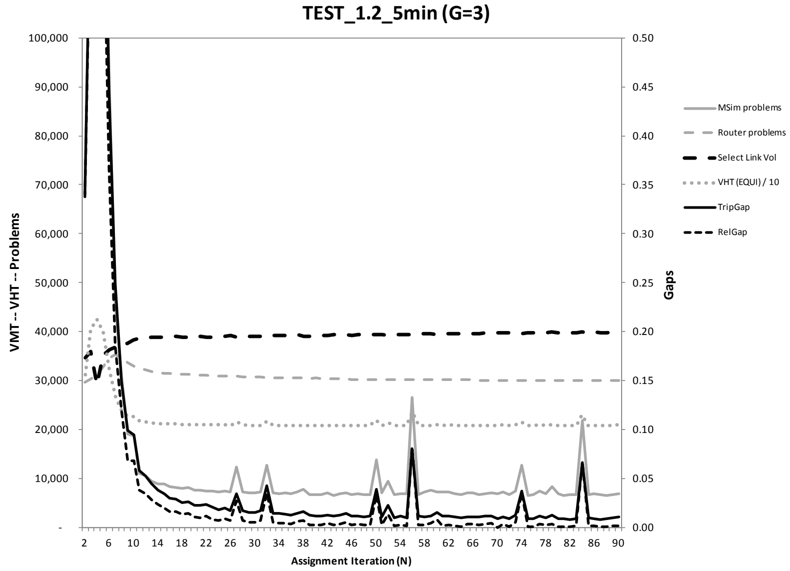
- Choice Dimensions
- Inputs
- Outputs
- Example: Skims
  - Avg conditions over broad time periods vs second-by-second network simulation
- Linkages within / between model system components
  - Individuals / HHs
  - Tours/trips
- Internal DaySim model linkages are largely consistent
- DaySim-TRANSIMS model linkages are partially consistent

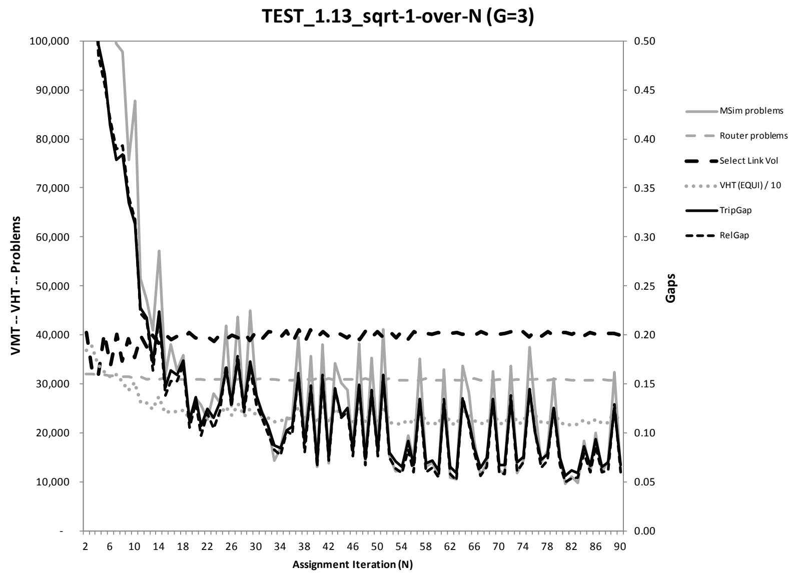
Convergence

- Convergence is necessary to:
  - ensure the behavioral integrity of the model system
  - ensure that the model system will be useful as an analysis tool
- FHWA-funded Sacramento DaySim-TRANSIMS project investigated convergence measures and methods that informed C10A project
- Convergence is context specific
  - Long terms planning analyses vs short term operations analyses
  - Different application models may require difference convergence metrics
- Network convergence
  - General consensus on definition in both static and dynamic assignment
  - Difference between the shortest paths costs based on the latest time-dependent link cost information and the “current” path costs, relative to the shortest path costs
- Model system convergence
  - Not well defined
  - Generally, impedances used as basis for accessibility measures and as key inputs must be similar to impedances produced by final network assignment, but…

Network Convergence

- General consensus on definition in both static and dynamic assignment
- Tested convergence methods
  - Network impedance resolution
  - Successive iteration feedback
  - Subselection
  - No consensus on acceptable methods
- Tested convergence measures
  - Tripgap
  - Link relative gap
  - Router & Microsimulator Problems
  - VHT
  - Critical links





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Network Convergence Issues

$$Trip\ Gap = \frac{|\sum(CE_x - CA_x\{C_{mt}\})|}{\sum CA_x\{C_{mt}\}}$$

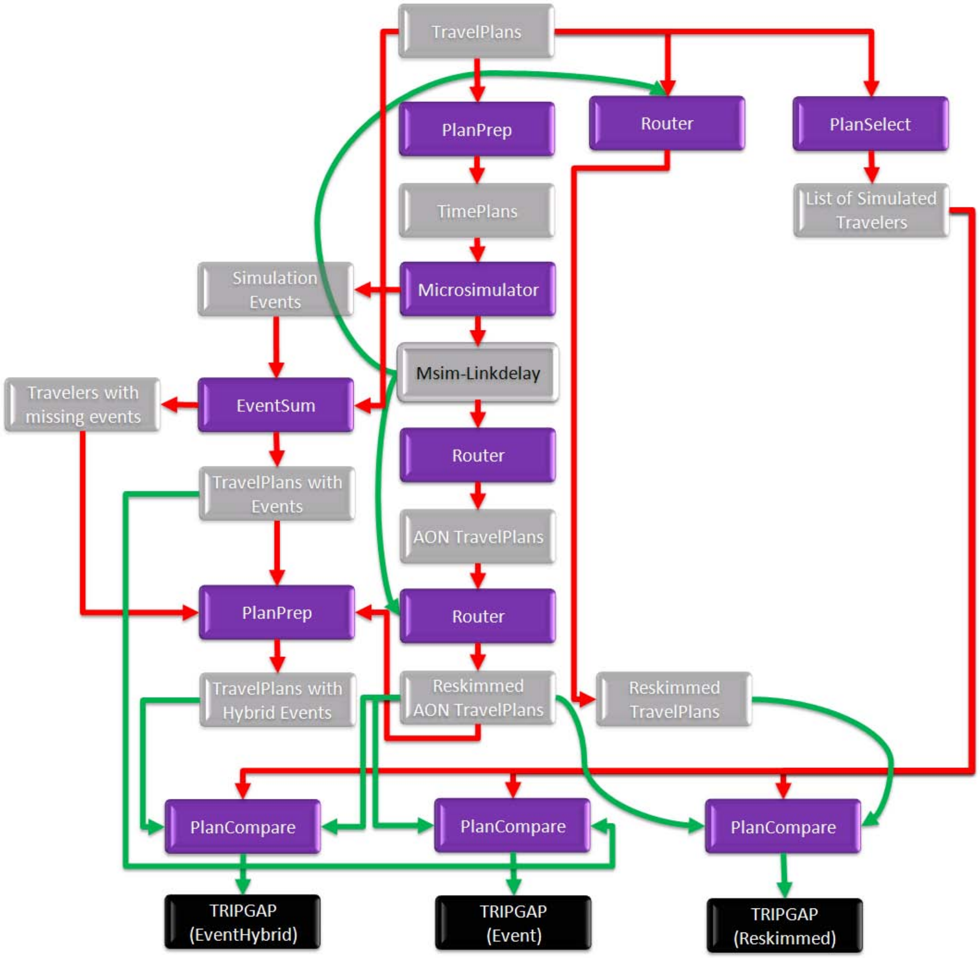
where:

$\{C_{mt}\}$ = *simulated time varying link costs*

CA_x = *AON cost of trip x based on link costs* $\{C_{mt}\}$

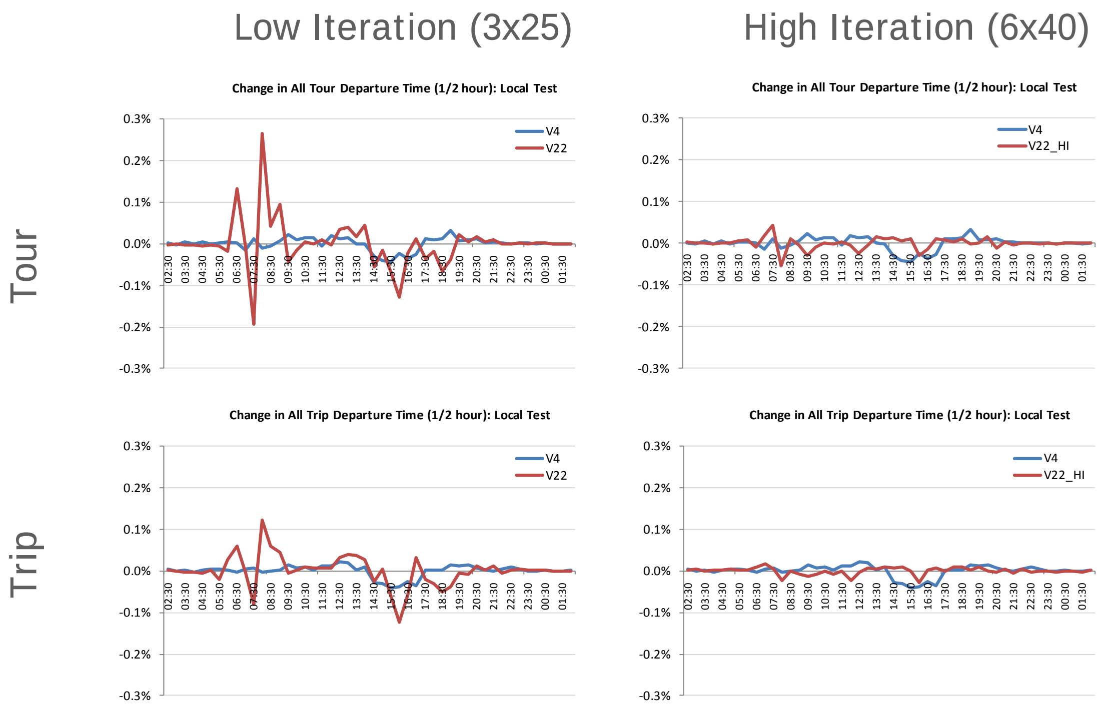
CE_x = *simulated cost of trip x that resulted in link costs* $\{C_{mt}\}$

- Trips lost in simulation (with big delays) must either be excluded or imputed
- Negative gaps can arise in the dynamic simulation context
- Fundamental differences between Microsimulator "experienced" time and average times used by Router



System Convergence

- No unifying defined metrics of system convergence in dynamic demand-supply context
- Equilibration between supply and demand for consistency and stability
- Demand side not typically conceived of as an optimization problem
- Disaggregate demand and supply context provides new opportunities
  - Sampling
  - Feasibility



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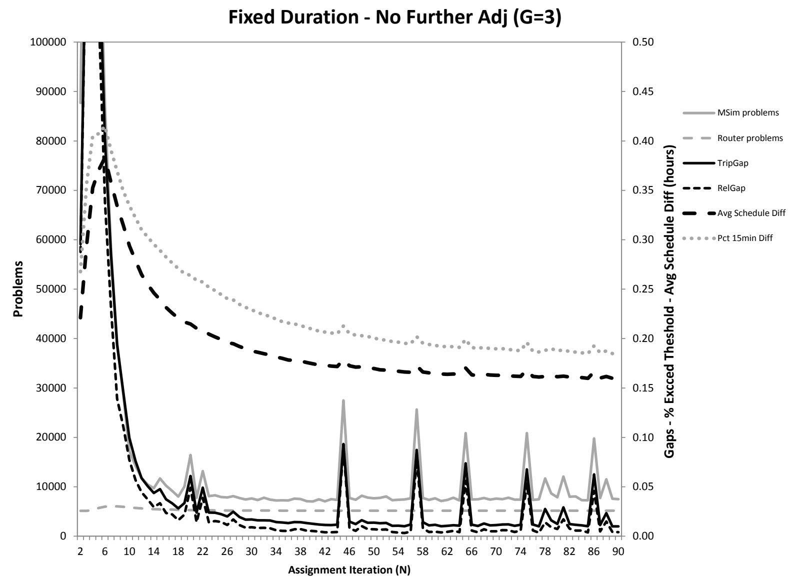
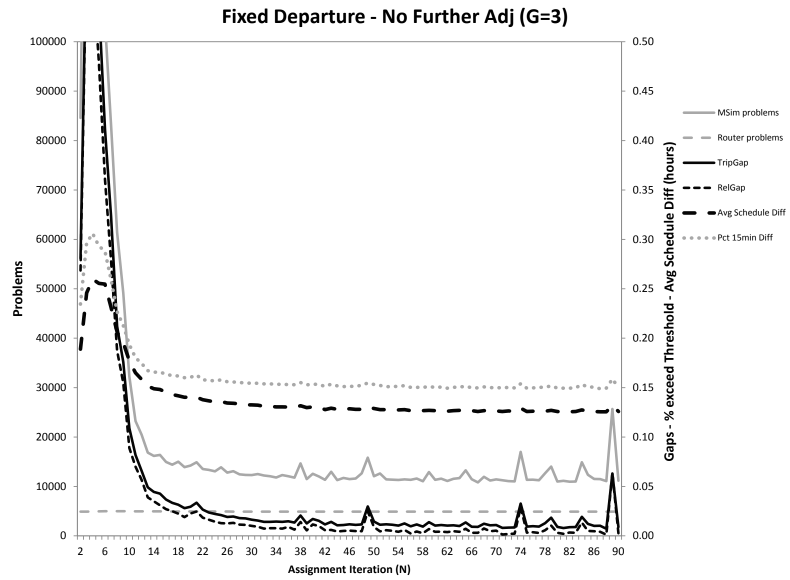
Schedule Consistency

- Inconsistent time-of-day outcomes have been a focus due to increased temporal detail
- Timing and duration of activities predicted by demand model should be consistent with timing an duration of activities in the network simulation
- Impediments
  - Different tools at different scales
  - Skim resolution
  - Network simulation stochasticity
- <u>Overlapping rescheduling capabilities</u>





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Calibration & Validation

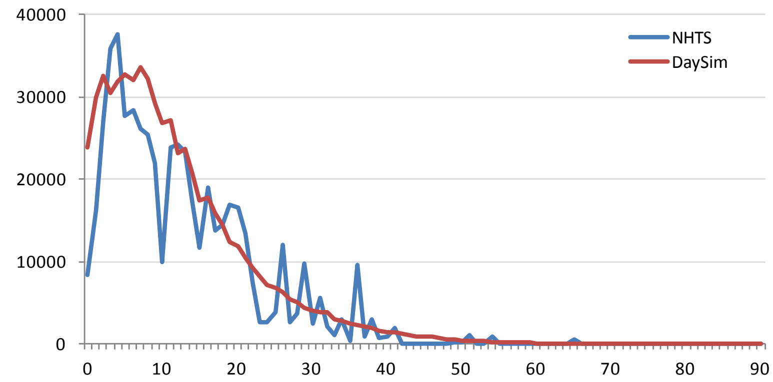
- Calibration / validation of model system is iterative process
  - Incremental adjustments to both DaySim and TRANSIMS
  - Match observed data sources
- DaySim model system transferred from another region
  - Originally estimated and calibrated for Sacramento
  - Necessary to recalibrate core components to reflect observed Jacksonville-specific travel patterns
- Calibration / validation process is on-going
  - Static-based (4-periods)
  - Router-based (4-periods & 22-periods)
  - Misrosimulator-based (22-periods)
  - Warm start vs cold start

Calibration & Validation

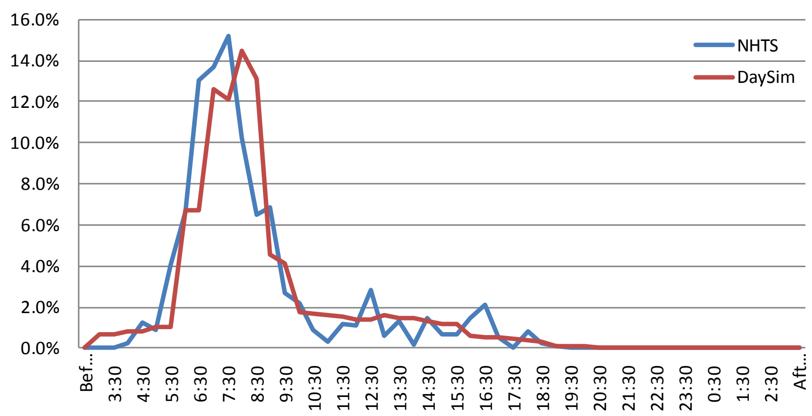
Trips by Destination Purpose

Purpose	NHTS	DaySim	Diff	% Diff
work	730,988	797,150	66,162	9%
school	209,466	189,977	-19,489	-9%
escort	265,299	254,821	-10,478	-4%
pers.bus	251,000	250,055	-945	0%
shop	646,348	651,131	4,783	1%
meal	199,045	203,632	4,587	2%
soc/rec	395,372	375,919	-19,453	-5%
home	1,467,457	1,434,811	-32,646	-2%
Total	**4,164,975**	**4,157,496**	**-7,479**	**0%**

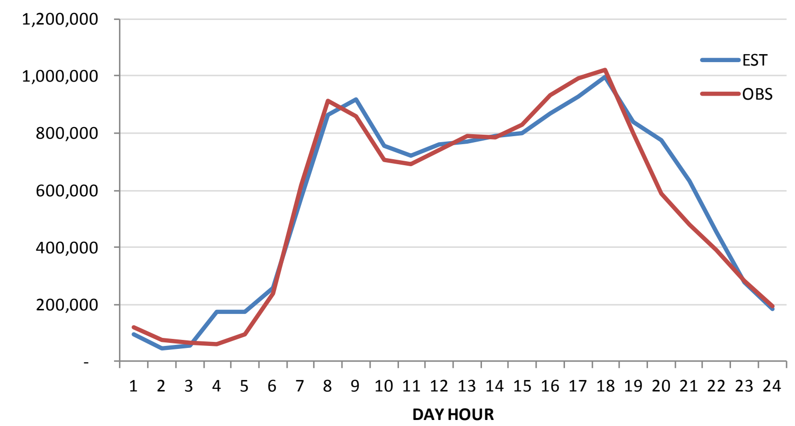
Work Tour Lengths



Work Arrival Times



Volumes by Hour of Day



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Runtimes

- Critical practical concern
- Influenced significantly by application mode
- DaySim runtime directly related to amount of demand
- TRANSIMS runtime related to amount of demand and transportation network detail

Model System Runtime by Application Model (in days)

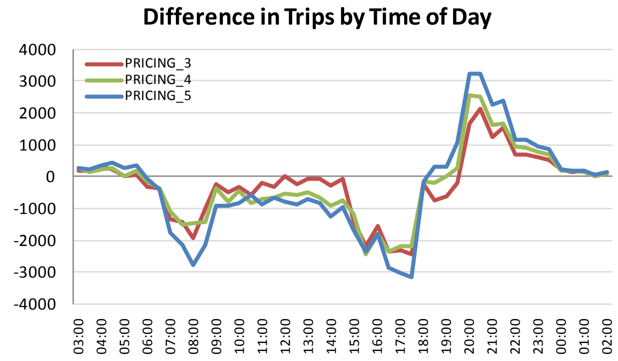
	Planning	Operations	Planning+Operations
V1 Model System	8	10	31
V2 Model System	2.5	3.2	10

Sensitivity Testing

- Assess sensitivity of model system
- Illustrate unique capabilities
- Evaluate all aspects of model system
- Initial sensitivity tests performed using v1 model system in Burlington
- Revised sensitivity tests to be performed using v2 model system in Jacksonville

Sensitivity Testing

- Pricing
  - A series of scenrarios in which freeways were tolled by time-of-day
  - Model responded as expected
  - Clear shifts by time-of-day

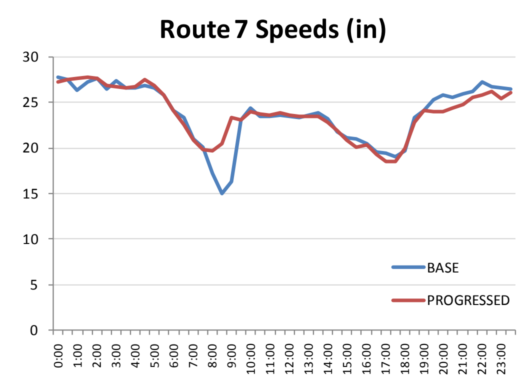


- TDM
  - Asserted workers participate in fewer work activities but have longer work durations
  - Revealed tradeoffs as fewer work activities results in more discretionary activities
  - Observed shifting of the peak

Tours by Purpose (Fulltime Workers)

	Original	Adjusted	Adj/Orig
Work	94,408	78,472	0.83
School	115	140	1.22
Escort	8,070	9,023	1.12
Pers Bus	13,519	16,848	1.25
Shop	10,531	12,938	1.23
Meal	3,817	3,842	1.01
Soc/Rec	13,076	14,360	1.10
Workbased	27,949	23,211	0.83
Total	171,485	158,834	0.93

- Operations
  - Signal coordination along 3 key regional corridors
  - Extensive retiming of signals required to establish base case
  - Ambivalent results



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Tool Refinement

- V1 model established quickly using existing tools
  - DaySim "Classic"
  - TRANSIMS v4
- V2 model incorporates significant changes to both components
  - New DaySim
  - TRANSIMS v5
- V2 model features
  - Reduced runtimes (multithreaded Microsimulator)
  - Trip-specific VOT and associated network process segmentation
  - Further temporal and spatial disaggregation
  - Improvements to handling of network simulation "problems" and calculation of key metrics

Transferability Study

DaySim transferability projects

- SHRP 2 C10A Extension: to test transferability by estimating and transferring models in Jacksonville & Tampa (Yielding production model system)

- FHWA STEP: to test transferability by estimating models jointly and testing region-specific coefficients on data from the 2008-9 NHTS survey (Research)
  - 4 California regions
  - Tampa and Jacksonville

Thanks….

Travel Demand Management

- Strategies to change travel behavior in order to reduce congestion and improve mobility
  - Work-at-home
  - Flexible work schedules (off-peak)
  - Shared ride
- Advanced integrated model system captures interaction between demand and supply models
- Scenario-based approaches necessary
  - Model system captures the effects of TDM policy outcomes
  - Cannot identify which policies will affect flexible work schedules
  - But can estimate the impact on transportation system performance of shift from a 5-day 8-hour work week to a 4-day 9+ hour work week

Travel Demand Management

- "Flexible Schedule" scenario
- Asserted assumptions about:
  - Fewer individual work activities
  - Longer individual work durations
  - Aggregate work durations constant
- Target: Fulltime Workers

Tours by Purpose (Fulltime Workers)

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Work	94,408	78,472	0.83
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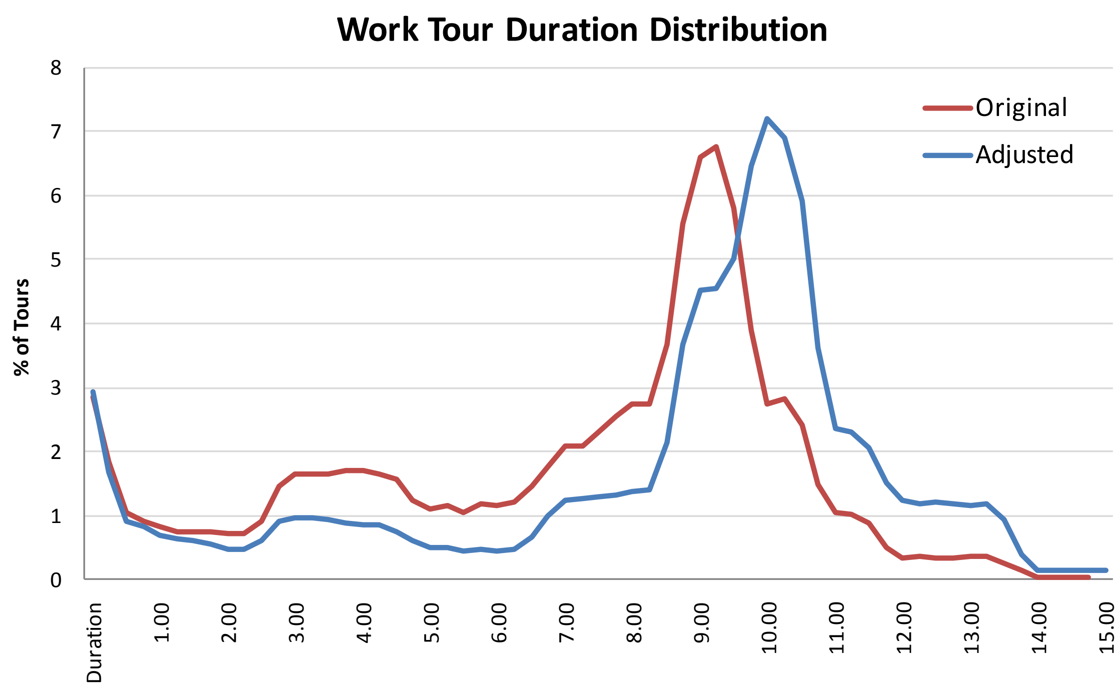
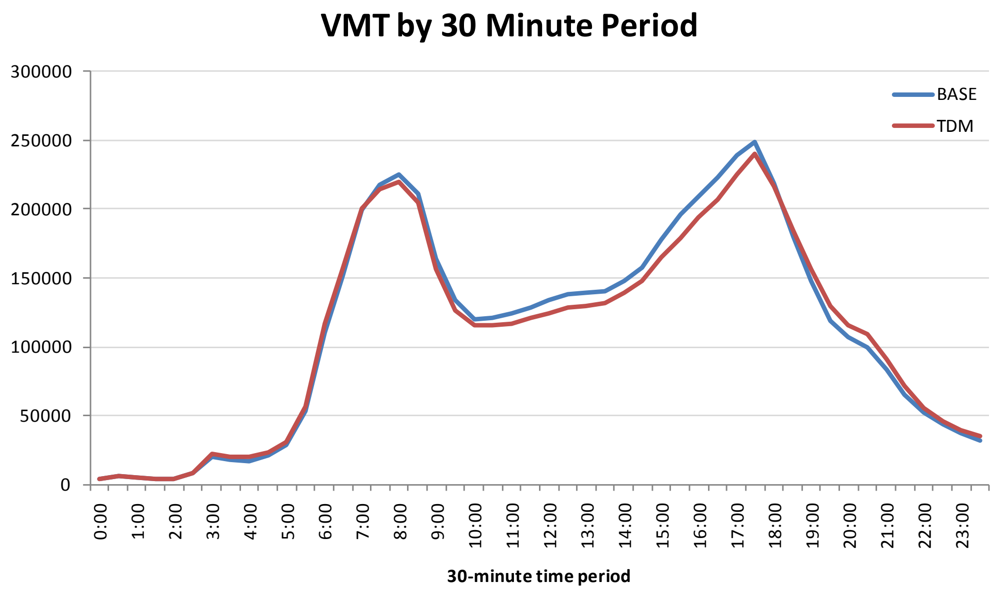
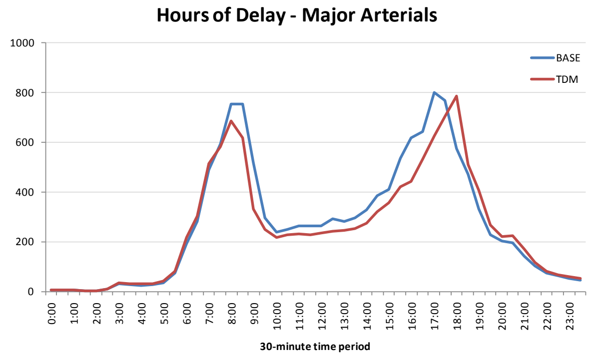
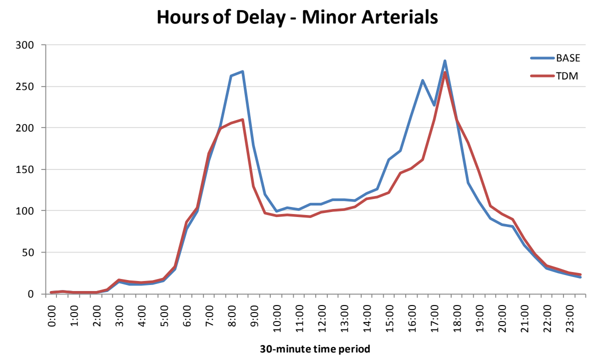


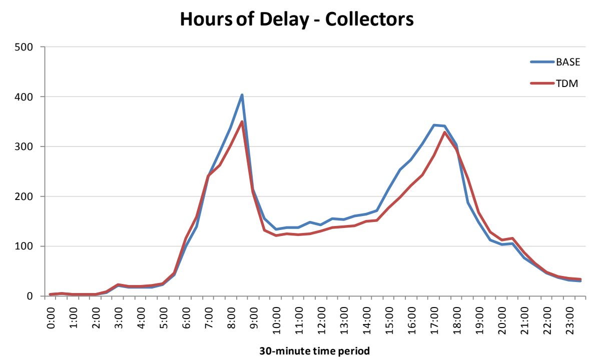
Travel Demand Management: Supply Impacts

- Total VMT declines slightly
- Reduced peak period and midday VMT, increased VMT in evening
- Reduced peak period and midday delay across all facility types, additional delay in the evening









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