

CMAP's Activity-Based Model with EMME

Chicago Area Travel Model User Group, October 2011



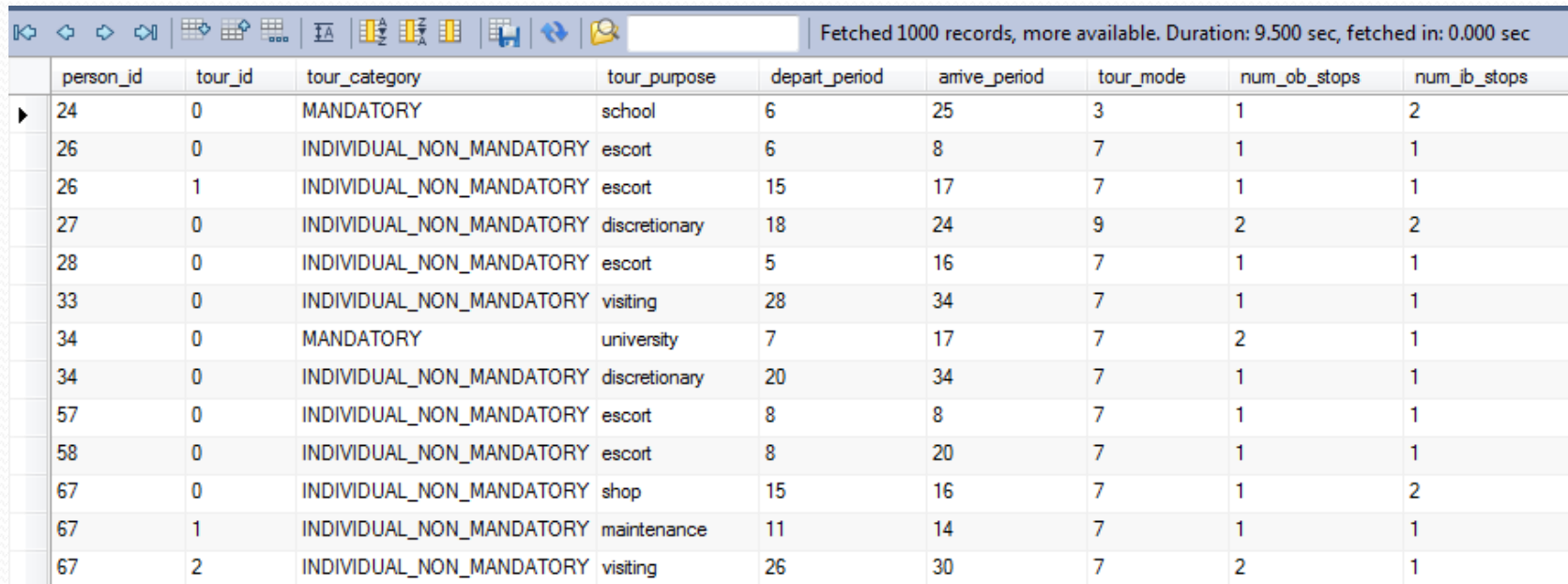
What It Is

- Based on CT-RAMP by Parsons Brinckerhoff
 - Currently used in 7 other regions
 - Columbus, Tahoe, San Francisco, Atlanta, Phoenix, San Diego



What It Does

- For all Chicago area residents
 - Creates travel schedules
 - Estimates individual value of time
 - Realistically predicts travel choices

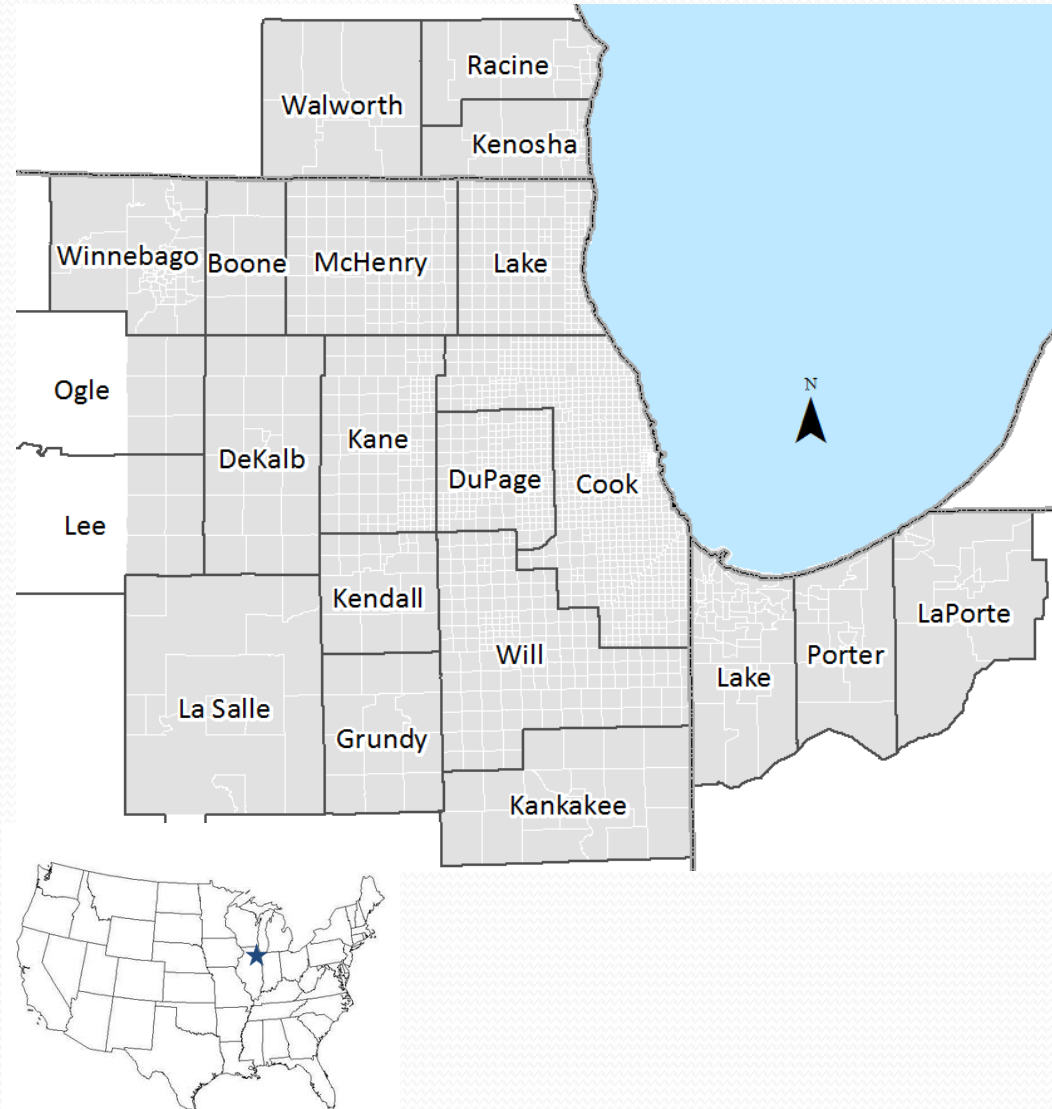


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	person_id	tour_id	tour_category	tour_purpose	depart_period	arrive_period	tour_mode	num_ob_stops	num_ib_stops
▶	24	0	MANDATORY	school	6	25	3	1	2
	26	0	INDIVIDUAL_NON_MANDATORY	escort	6	8	7	1	1
	26	1	INDIVIDUAL_NON_MANDATORY	escort	15	17	7	1	1
	27	0	INDIVIDUAL_NON_MANDATORY	discretionary	18	24	9	2	2
	28	0	INDIVIDUAL_NON_MANDATORY	escort	5	16	7	1	1
	33	0	INDIVIDUAL_NON_MANDATORY	visiting	28	34	7	1	1
	34	0	MANDATORY	university	7	17	7	2	1
	34	0	INDIVIDUAL_NON_MANDATORY	discretionary	20	34	7	1	1
	57	0	INDIVIDUAL_NON_MANDATORY	escort	8	8	7	1	1
	58	0	INDIVIDUAL_NON_MANDATORY	escort	8	20	7	1	1
	67	0	INDIVIDUAL_NON_MANDATORY	shop	15	16	7	1	2
	67	1	INDIVIDUAL_NON_MANDATORY	maintenance	11	14	7	1	1
	67	2	INDIVIDUAL_NON_MANDATORY	visiting	26	30	7	2	1

CMAP Region

- Population: 10.5 million
- Modeling Region
 - 21 counties in 3 states
 - Neighboring MPOs
 - SE Wisconsin
 - NW Indiana
 - 1,944 TAZs
 - Road Network
 - 15.0K nodes
 - 44.3K links
 - Rail Network
 - 6.6K nodes
 - 19.5K links



Policy Environment

- GO TO 2040
 - Regional comprehensive plan adopted in 2010
 - Recommendations
 - Implement **congestion pricing**
 - Implement **parking pricing**
 - Increase commitment to transit
- Need improved tools for testing pricing policies: ABM

 CMAP **GO TO 2040**

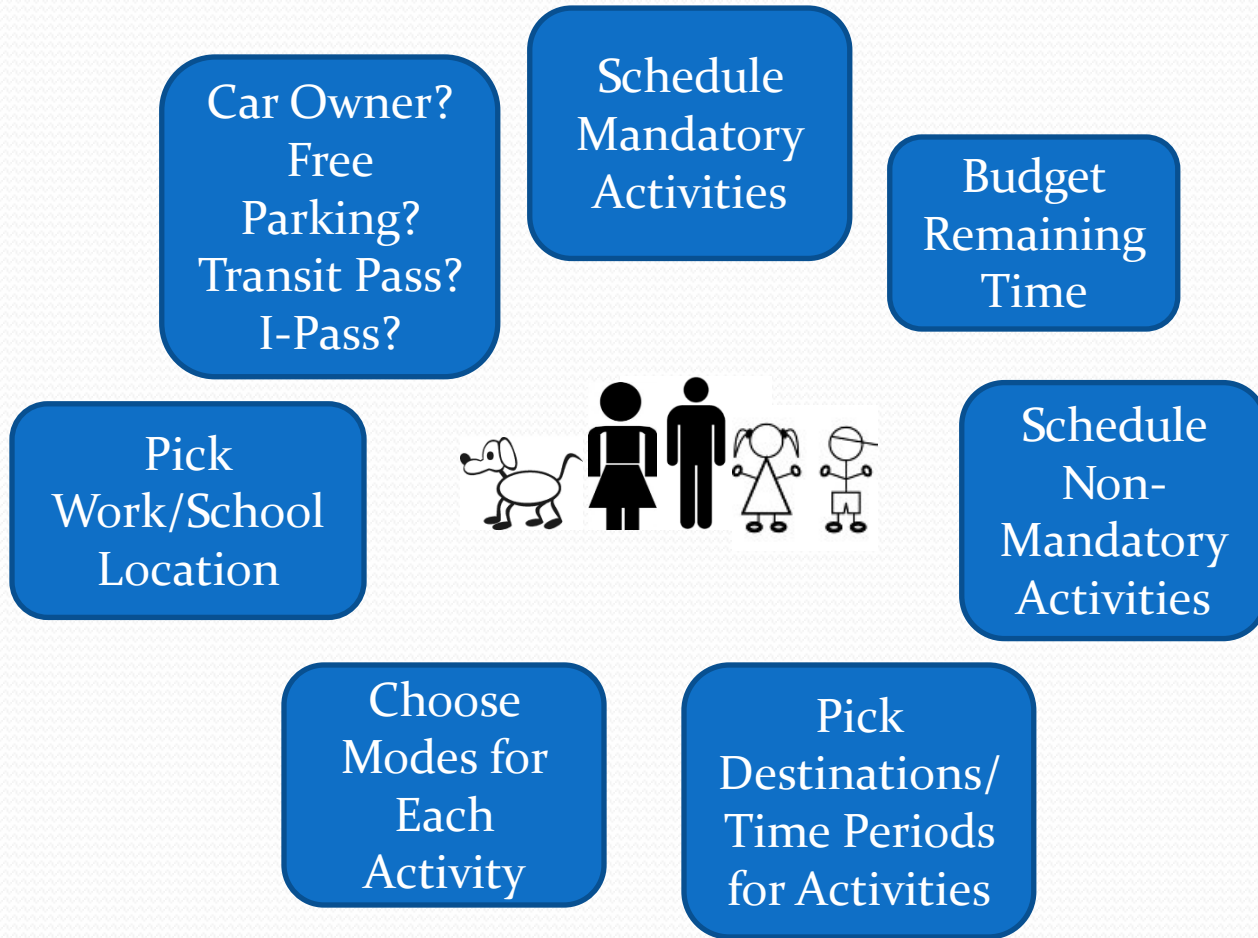
Project

- Develop pricing (demonstration) ABM
- Borrow ABM from other MPOs (Atlanta, San Francisco Bay Area, San Diego, etc)
- Re-estimate/Calibrate key components
 - Destination choice
 - Mode choice
- Develop base year synthetic population
- Integrate with CMAP highway and transit networks
- Prove usefulness of ABM; develop full ABM later

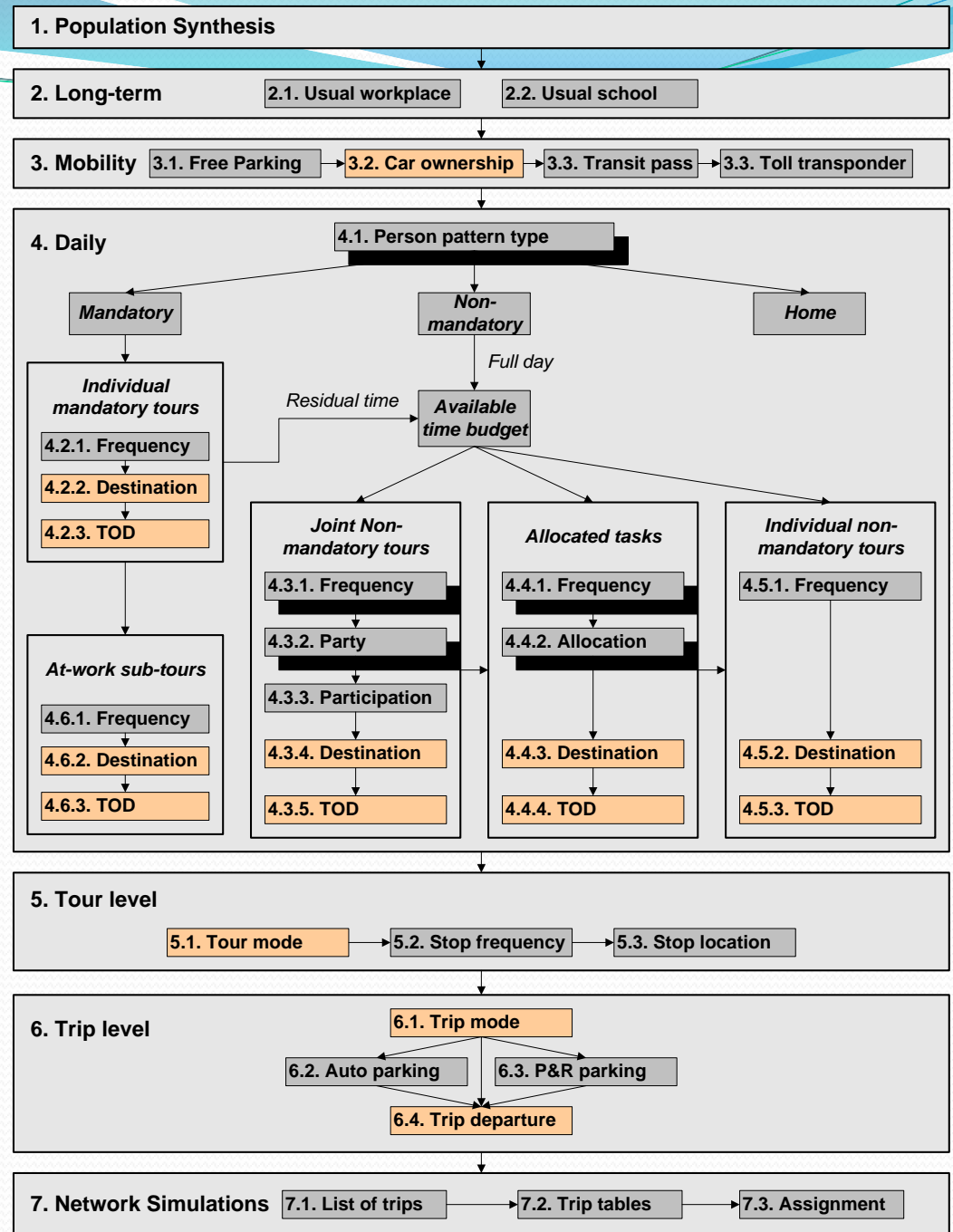
Data Needs

- CMAP
 - Travel Tracker
 - Employment data
 - School enrollment data
 - Parking data
 - Transportation networks
- Census

Model Flow



CT-RAMP Model Structure



Model Re-estimated
for CMAP Pricing ABM

- Auto ownership model
- Destination choice models
- Time-of-day choice models
- Mode choice models

CT-RAMP Person Types

PERSON-TYPE	AGE	WORK STATUS	SCHOOL STATUS
Full-time worker	18+	Full-time	None
Part-time worker	18+	Part-time	None
Non-working adult	18 – 64	Unemployed	None
Non-working senior	65+	Unemployed	None
College student	18+	Any	College +
Driving age student	16-17	Any	Pre-college
Non-driving student	6 – 16	None	Pre-college
Pre-school	0-5	None	None

CT-RAMP Activity Types

PURPOSE	DESCRIPTION	CLASSIFICATION	ELIGIBILITY
Work	Working at regular workplace or work-related activities outside the home.	Mandatory	Workers and students
University	College +	Mandatory	Age 18+
High School	Grades 9-12	Mandatory	Age 14-17
Grade School	Grades K-8	Mandatory	Age 5-13
Escorting	Pick-up/drop-off passengers (auto trips only).	Maintenance	Age 16+
Shopping	Shopping away from home.	Maintenance	5+ (if joint travel, all persons)
Other Maintenance	Personal business/services, and medical appointments.	Maintenance	5+ (if joint travel, all persons)
Social/Recreational	Recreation, visiting friends/family.	Discretionary	5+ (if joint travel, all persons)
Eat Out	Eating outside of home.	Discretionary	5+ (if joint travel, all persons)
Other Discretionary	Volunteer work, religious activities.	Discretionary	5+ (if joint travel, all persons)

Desired Multi-Class Assignment Classes

Vehicle Type & Value-Of-Time	Non-toll SOV	Non-toll HOV ₂	Non-toll HOV ₃₊	Toll SOV	Toll HOV ₂	Toll HOV ₃₊
Auto + external + airport low VOT	1	3	5	2	4	6
Auto + external + airport high VOT	7	9	11	8	10	12
Commercial	13			14		
Light truck	15			16		
Medium truck	17			18		
Heavy truck	19			20		

EMME Implementation Constraints

- Currently multi-class-assignment is limited to 12 classes (will be extended soon to 30)
 - It will be beneficial to consider more than 2 VOT classes, for example (Low, Medium, High)
- Possible implementation scheme:
 - Pre-assign heavy and (possibly) medium trucks since they follow planned routes (4 classes); then assign rest of classes (16)

Current Multi-Class Assignment Classes

Vehicle Type & Value-Of-Time	Non-toll SOV	Non-toll HOV ₂	Non-toll HOV ₃₊	Toll SOV	Toll HOV ₂	Toll HOV ₃₊
Auto + external + airport low & high VOT	1	3	5	2	4	6
Commercial + light truck	7			8		
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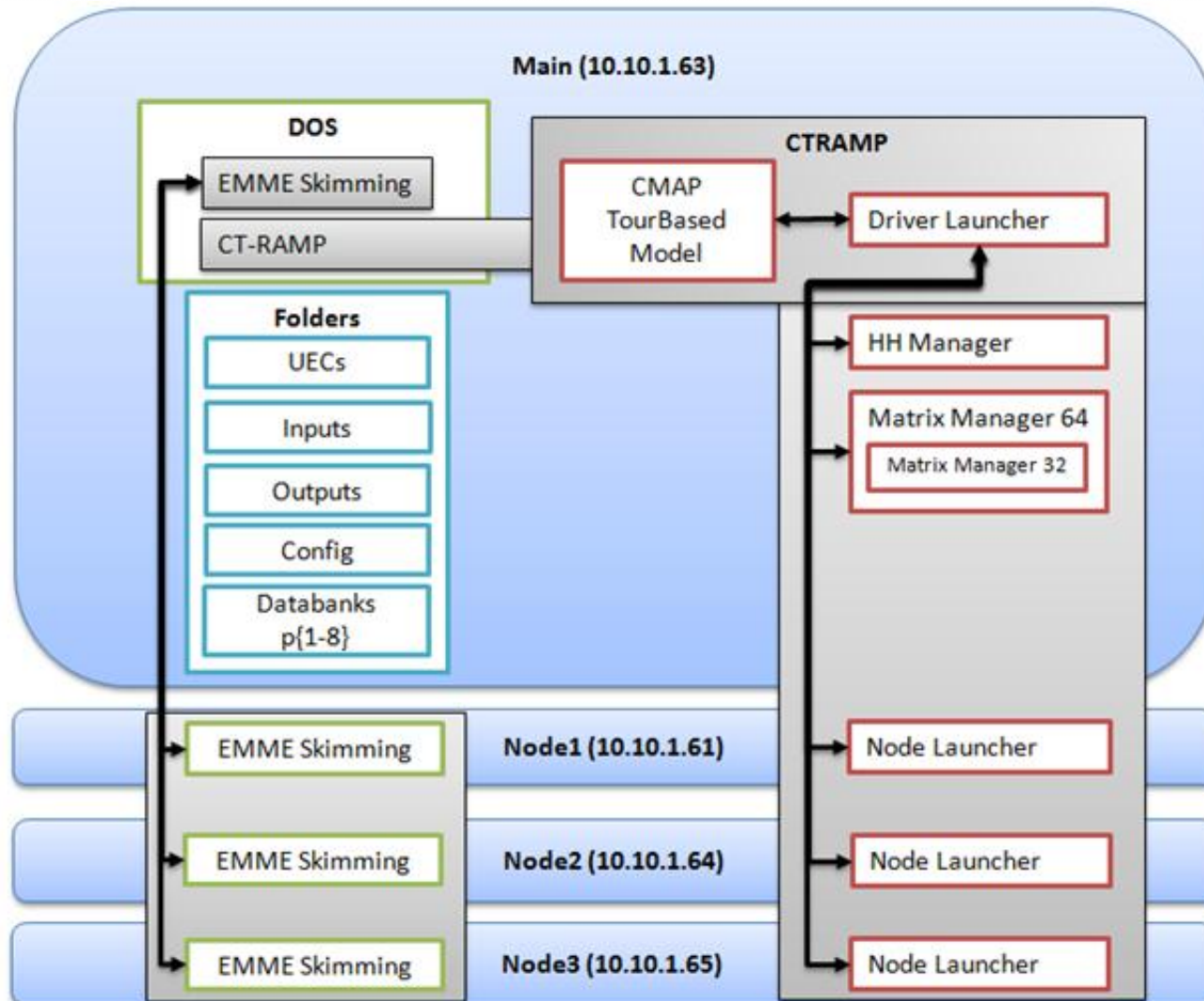
Equilibration Details

- The model system requires 3-4 global iterations to reach a reasonable level of convergence
- Assignment and skimming macro is run before each global iteration (to generate LOS for ABM) and after the last iteration (to assign the final results)
- Assignment and skimming macro requires 4 internal iterations to equilibrate core and non-core components in route type choice

Distributed Modeling System

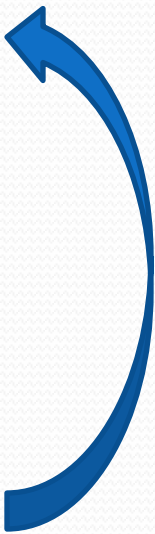
- Main Machine
 - Manages model run system
 - Stores in-memory households, persons, matrices
 - Skimming and assignment for two time periods
 - 2 Six-Core Intel Xeon 2.66 GHz, 144 GB RAM
- 3 Worker Machines
 - Solves model components (for bundles of households)
 - Skimming and assignment for two time periods
 - 2 Six-Core Intel Xeon 2.66 GHz, 144 GB RAM
- Uses Java JPPF to run worker node processes and Microsoft PsExec to run EMME processes on workers

Distributed Model System



EMME Integration

- Eight databanks stored in the project folder on main machine
- PsExec copies two banks to each remote worker machine
- PsExec runs EMME macros remotely
- PsExec copies the banks back to the main machine
- Java-based ABM reads skims directly from the databank
- ABM is run (with sampling)
- ABM writes demand matrices directly to the databank

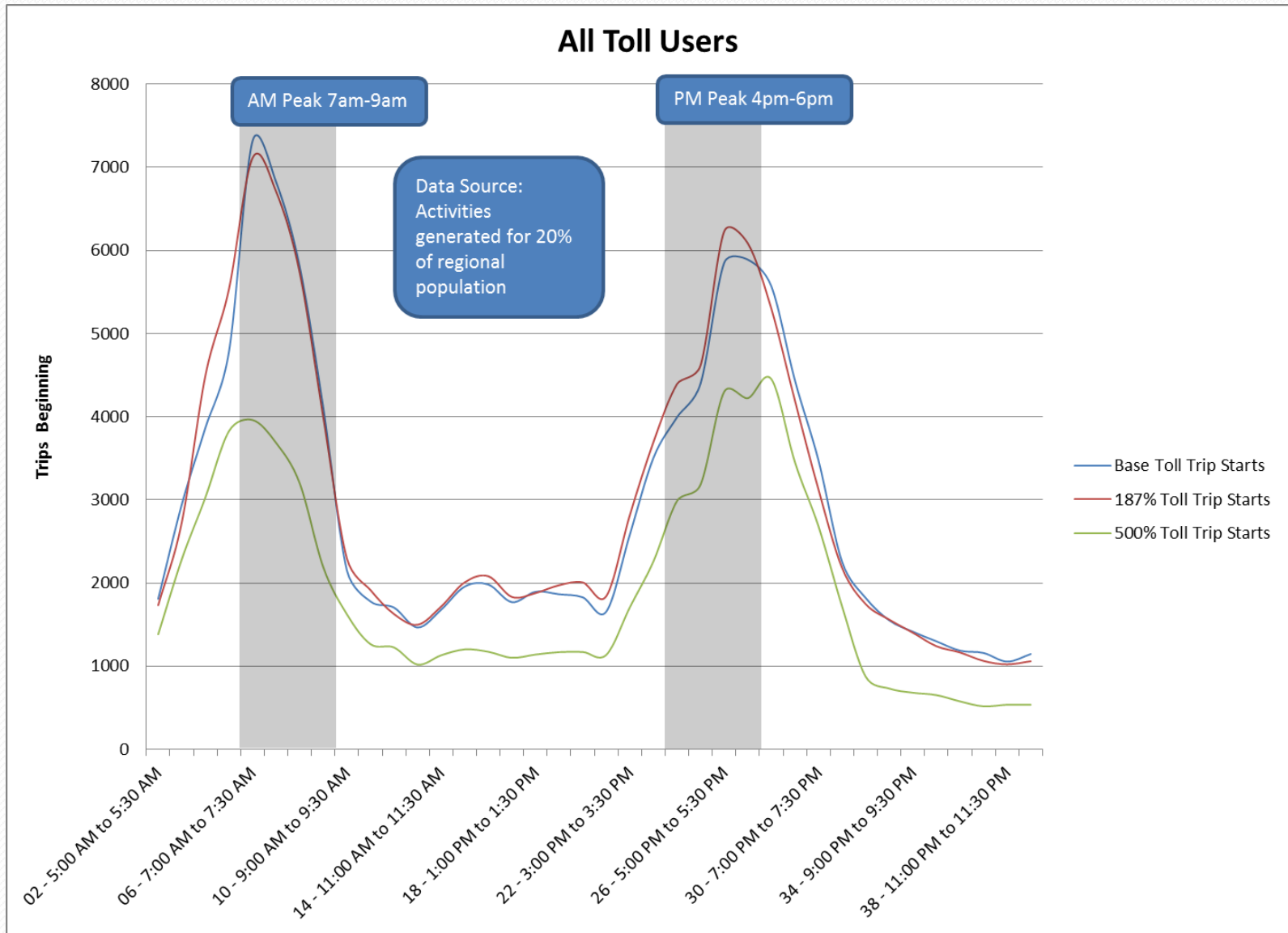


Run Times

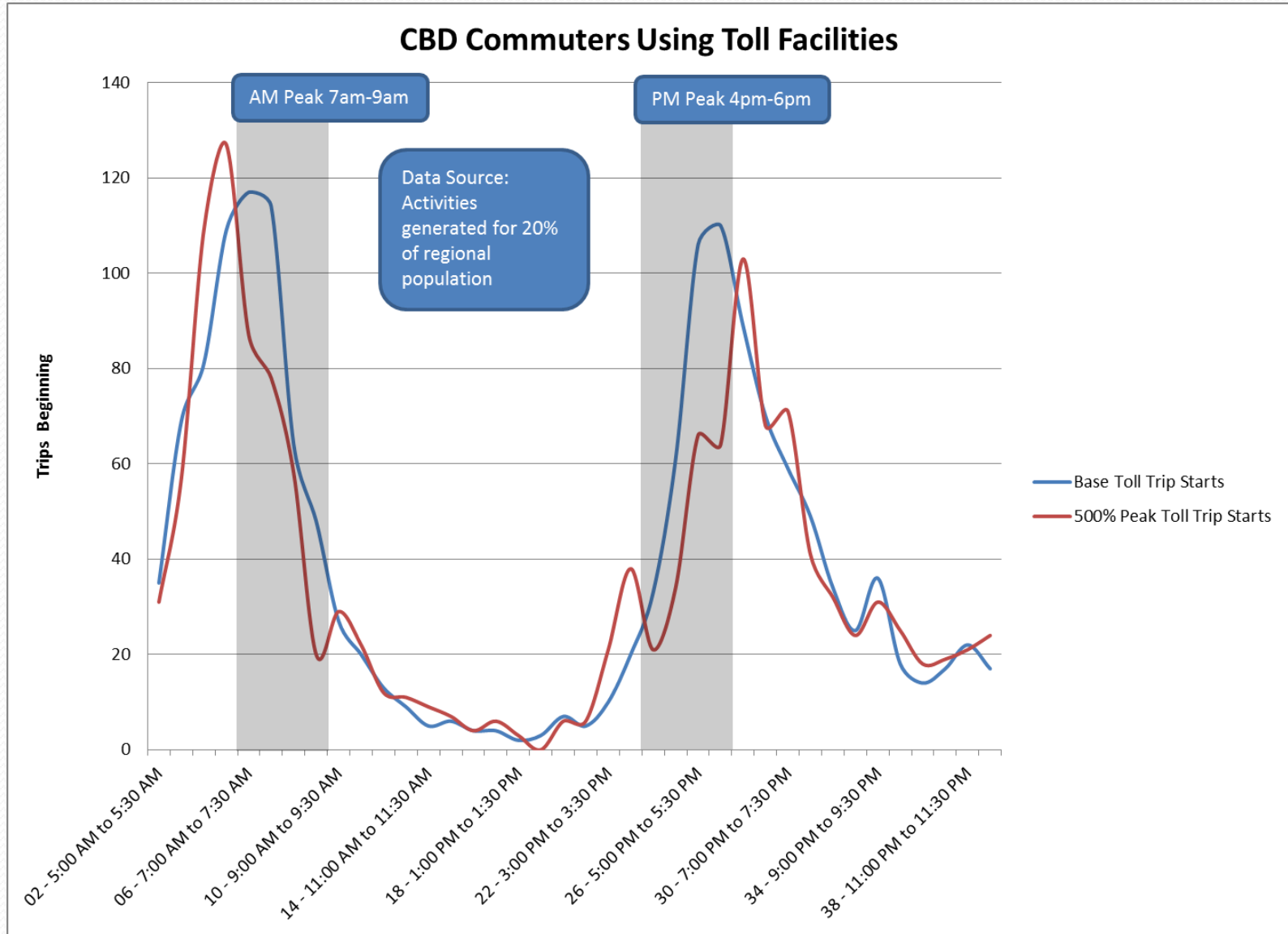
- EMME Skimming and Assignment
 - 8 databanks, 4 machines (12 threads each)
 - Module 5.21: 6 hours
 - 1 thread / databank
 - Module 5.22: 1 hour 20 minutes
 - 12 threads / databank
- CT-RAMP ABM
 - 20% population: 4 hours
 - 100% population: 17 hours
- Total Run Time for 1 iteration
 - 5 hours 20 minute (with 20% sample)
 - Will be reduced with additional machines (which is planned)

*5.22 saves 78% on
skimming and
assignment time!*

Impact of Toll Increases



Impact of Peak Pricing



Next Steps

- Further improve our CT-RAMP application to address...
 - Transit improvements
 - Bike and pedestrian improvements
 - Visualizations and dashboards
- Scenario testing, including corridor specific tests
- Demonstrate usefulness of pricing ABM to policymakers
- Improve run times with:
 - More worker machines
 - Potentially use EMME Modeller for data I/O, overall model running, automated creation of inputs, etc

Questions?



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