Overview

- 2020RTP/SCS Regional Travel Demand Model
- CT-RAMP2 (Coordinated Travel & Activity Modeling Platform)
- Implemented for the Phoenix ABM (MAG) and Ohio 3C (MORPC, NOACA, OKI)
- Activity–travel related choices are simulated for each person and household
- Central unit of analysis for ABMs are “activities”
  - Tour and trips emerge from activity participation and corresponding time–space constraints
- Most ABMs in research/practice treat “tours” as central unit of analysis: Tours are generated initially, details of stops are added later
**SCAG ABM: GUI**

1. Population synthesis
2. Long-term work/school type location & arrangements
3. Mid-term mobility attributes
4. Special activity participations generated from supply side
5. Day-level activity participation tour formation & time allocation
6. Tour-level details on destination, TOD, mode, stop frequency & stop location
7. Trip-level details on mode, departure time, parking & transit station

**SCAG ABM**

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**CTRAMP_2**

TransCAD 8.0

6 Modules
39 Sub-Models
SCAG ABM: Population Synthesis

- Generates a list of households and persons for the entire model area that represents the region's population for each horizon year

SCAG ABM: Long Term Choice

- Choices of work arrangements: Weekly work hours, number of jobs and primary work place
- Usual location of the mandatory activity
- Usual work schedule flexibility
- For each worker and student
**SCAG ABM: Mobility Choice**

**Driver license model:**
Predicts whether an individual holds a valid driver’s license or not.
Applies to all persons 16 years old and older.

**Auto ownership model:**
Predicts the number of households by auto ownership level (0, 1, 2, 3 and 4 or more)
Applies to all households in the synthetic population.

**SCAG ABM: Activity Generation**

Generates daily travel pattern for each household member, including daily travel with mandatory activities, daily travel without mandatory activities (non-mandatory activities only), and no travel.

Simulates:
(i) number of maintenance activities generated by each household and allocates to household member.
(ii) predicts the frequency of discretionary activities for each person.

Tour formation:
- Combines the outcomes of all prior sub-models into tours
- Allocates the non-mandatory activities, (as stops on the mandatory tours, stops on at-work subtours, or as separate home-based tours).

Predicts joint activity frequency, joint travel party, tour formation, stop frequency, and location of each joint tour.

Individual mandatory activities/tours
Allocation Example

✓ 1 workplace activity & 1 individual shopping activity
✓ CDAP–Mandatory

Day Schedule
Available Day Segments for allocation of shopping activity

Work Tour/Mandatory Peg

- Outbound Leg
- Inbound Leg

Type 1 Segment
Type 2 Segment
Type 3 Segment

SCAG ABM: Combinatorial Mode Choice

- Combinatorial Mode Choice
- Final Time of Day

Tour-level Models
Predicts important details related to each tour, including time of day, and tour mode

Trip-level Models
Predicts final details of each trip, trip mode, trip departure time and activity duration
Operation Challenges

- Long model run time — 180 hours for 5 feedback loops
- Large amount of CPU cores for multi-threaded components.
- High memory requirement — 1TB+ RAM for full population.
- Seasonal variation — Large amounts of computing required during certain periods, like production for RTP. 10 scenarios need to be run simultaneously.

File Storage
- Each scenario folder is about 500GB.
- Fast speed to transfer finished model run to central storage.
- Central storage needs the capacity for 60 runs archived securely.

Operation management
- Quickly setup and launch 10 model runs.
- Monitor model runs across multiple servers efficiently.

Solutions: Computing

TransCAD Parallel Engine tech
Reduce run time

<table>
<thead>
<tr>
<th></th>
<th>Initialization</th>
<th>Skimming</th>
<th>Accessibility</th>
<th>Activity Generator</th>
<th>Truck &amp; OD</th>
<th>Assignment</th>
<th>Emission &amp; Report</th>
<th>Total Hours</th>
<th>Total Days</th>
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<td>9.0</td>
<td>3.8</td>
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<td>7.3</td>
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<tr>
<td>TransCAD with 4 Engines</td>
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<td>2.5</td>
<td>3.8</td>
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<td>3.4</td>
<td>1.0</td>
<td>142.9</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Solutions: Computing

Segmentalize input for activity generator
Reduce peak RAM consuming

AWS EC2 – Amazon Web Service
Different instance for a flexible combination of CPU + RAM
Flexible usage schedule

Z1D.12xlarge Instances provide
- x48 cores
- 4.0Ghz Turbo Boost CPU
- 384GB RAM
- 1.8TB local NVMe SSD Storage Performance

Usage
- On-Demand, pay hourly rate
- Reserve a year
- Spot price
**Solutions: File Storage**

Amazon Storage Gateway backed by Amazon S3

- Unlimited storage space. Pay by data size.
- Super fast data transfer rate between model servers and the storage.

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**Solutions: AWS**

Diagram showing the flow of data between model runners, model editors, file shares, and the AWS storage gateway.
Production Flow

1. Copy Inputs to Model Server
2. Config. and Launch Model run on model runner
3. Log model run in management tool
4. Monitor Model Runs
5. Extract summary from finished runs
6. Copy Finished Model to central storage
7. Log model run in management tool
8. Monitor Model Runs
9. Extract summary from finished runs
10. Copy Finished Model to central storage

Modeling Environment Portal

- Copy Inputs to Model Server
- Config. and Launch Model run on model runner
- Log Model Run in Management Tool
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- Extract Summary from Finished Runs
- Copy Finished Model to Central Storage

Solutions: Operation Management

Solutions: Operation Management Portal
**Solutions: Operation Management**

**Modeling Environment Portal**

*SCAG Modeling Server Status*
Updated every 5 minutes

- **SCAGWMMEd100**: stopped
- **SCAGWMMEd101**: stopped
- **SCAGWMMc000**: stopped
- **SCAGWMMc001**: stopped
- **SCAGWMMc002**: changed, Mode:Running, change (d), 5d 14h 41m, 5d 14h 19m, Final, Assignment, SCAG Emissions

**Continuing Challenges**

**Licensing**

- TransCAD requires physical USB dongle for licensing.
- SCAG physical server is used to host TransCAD license.
- A small network hiccup will terminate all TransCAD programs on AWS.
Continuing Challenges

Single Threaded components

- There are still some components are single-threaded procedures associated with very low CPU loading.
- Model should be optimized for parallel processing as much as possible.

Continuing Challenges

Data format:

Current model output data are in csv, TransCAD .bin and .mtx format.

- CSV is not an efficient way to store data with large size. Not support metadata.
- .bin and .mtx are proprietary format. Not convenient for data sharing.

A way to store one-way or multi-dimension table

- Efficient for storing and processing
- Easy to review the content
- Convenient to share
Thank you

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