

# SCAG Activity-based Model Update

SCAG Modeling Task Force

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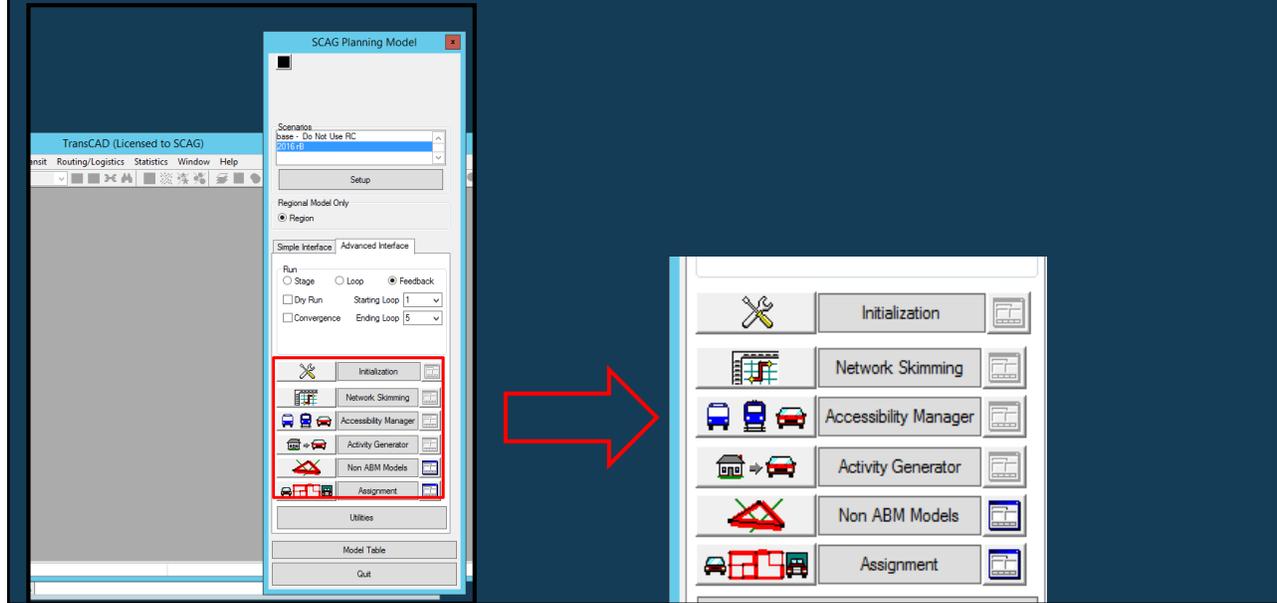


## Overview

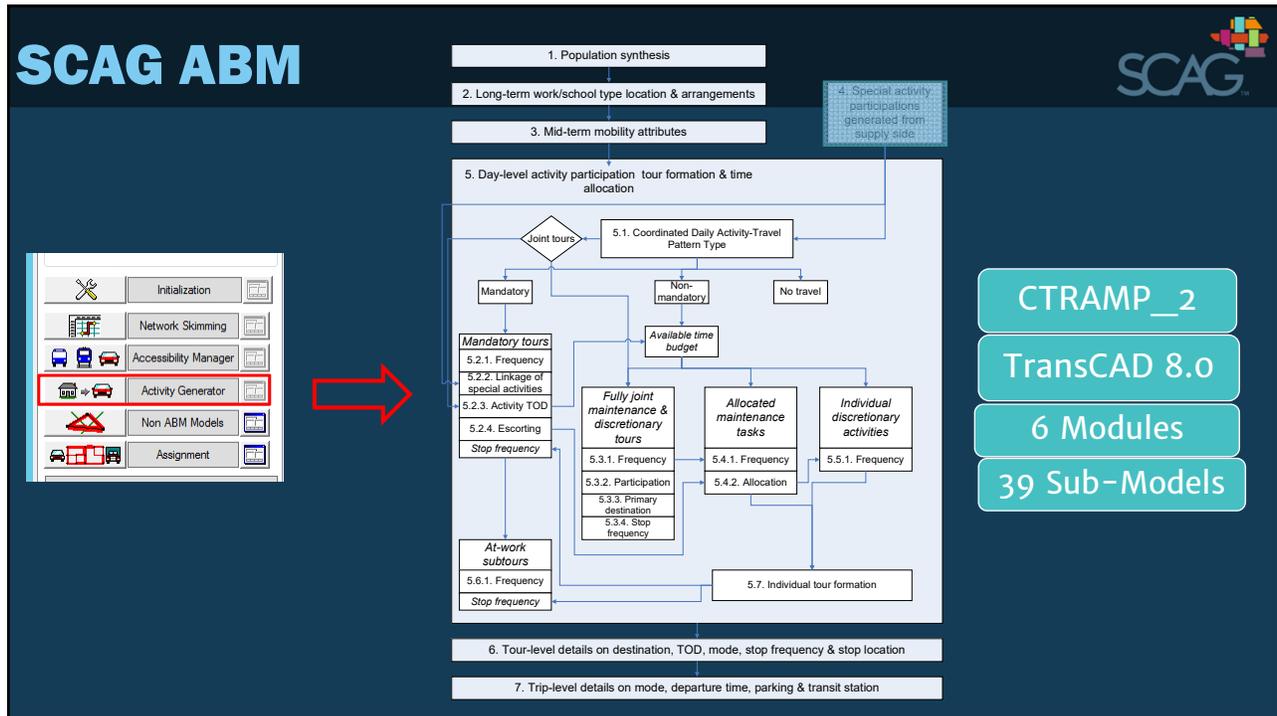


- ❑ 2020RTP/SCS Regional Travel Demand Model
- ❑ CT-RAMP2 (Coordinated Travel & Activity Modeling Platform)
- ❑ Implemented for the Phoenix ABM (MAG) and Ohio 3C (MORPC, NOACA, OKI)
- ❑ Activity-travel related choices are simulated for each person and household
- ❑ Central unit of analysis for ABMs are “*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



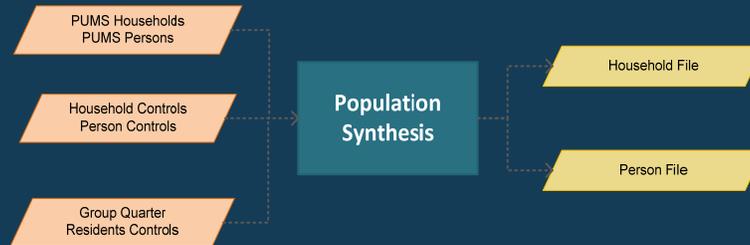
# SCAG ABM



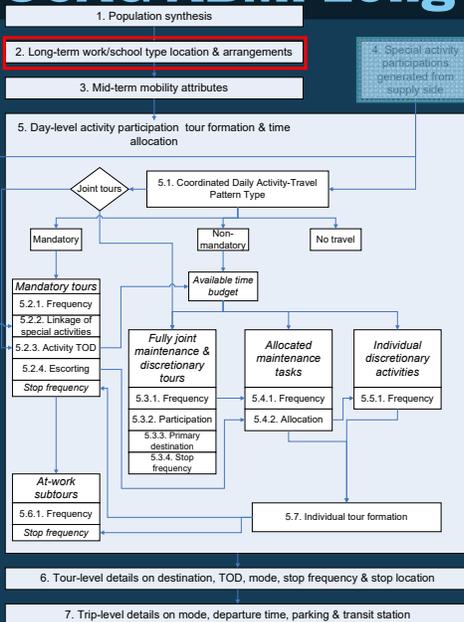
# SCAG ABM: Population Synthesis



- 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.

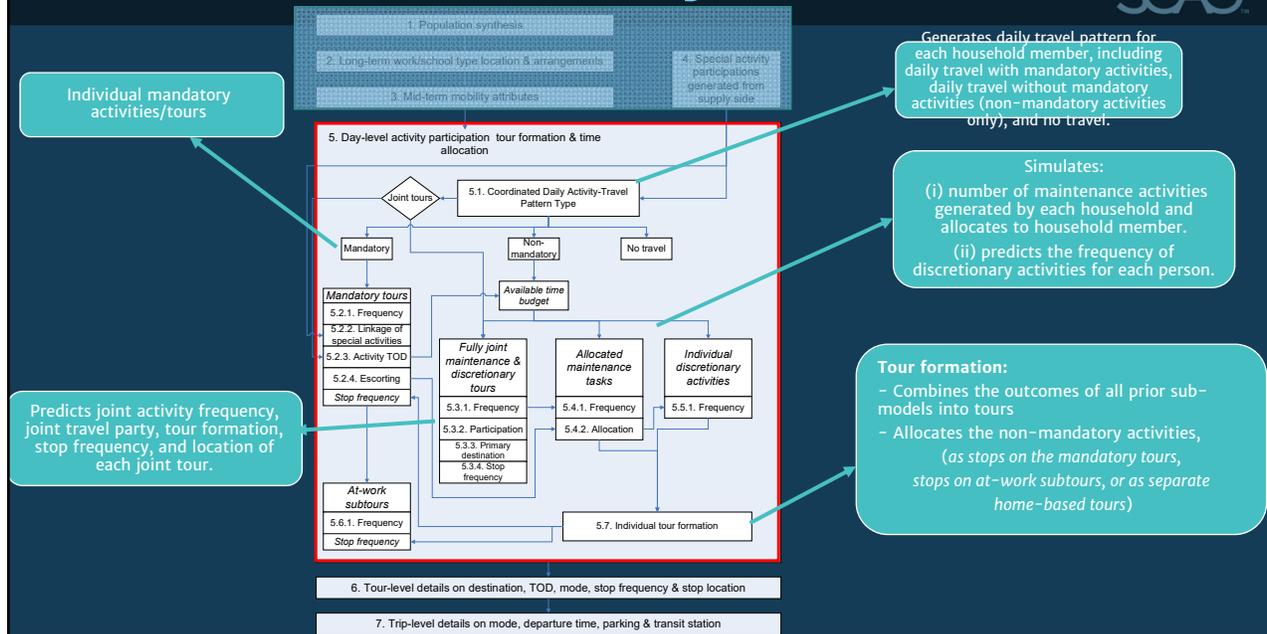
Applies to all persons 16 years old and older.

## 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.

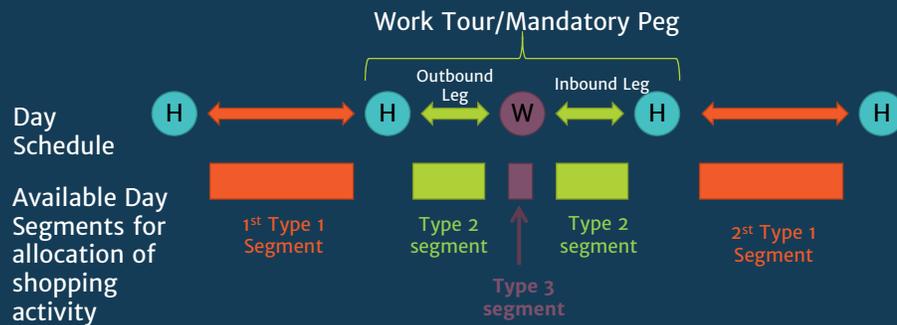
# SCAG ABM: Activity Generation



## Allocation Example



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



## 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



## Computing

- 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

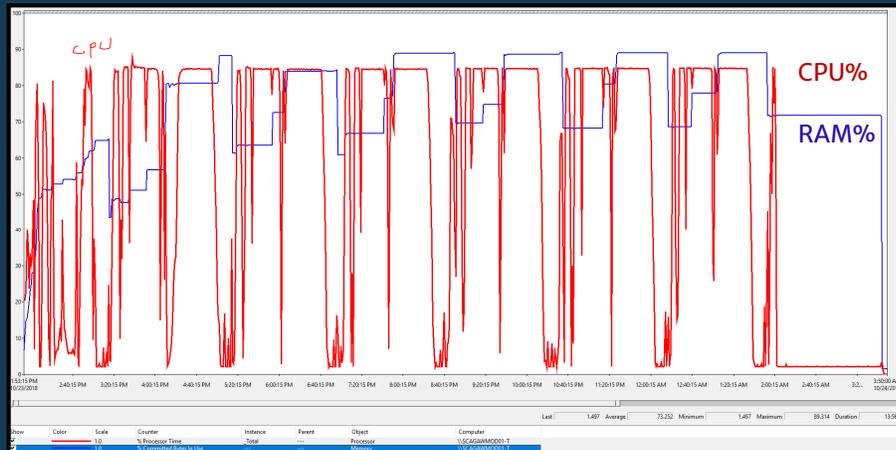
### Reduce run time

AWS - z1d.12xlarge 48 cores @ 4GHz 384GB	Initialization x5	Skimming x5	Accessibility x5	Activity Generator x5	Truck & OD x5	Assignment x5	Emission & Report	Total Hours	Total Days
Single TransCAD	0.2	9.0	3.8	17.0	1.5	3.4	1.0	175.4	7.3
TransCAD with 4 Engines	0.2	2.5	3.8	17.0	1.5	3.4	1.0	142.9	6.0

## Solutions: Computing



Segmentalize input for activity generator  
Reduce peak RAM consuming



## Solutions: Computing



**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

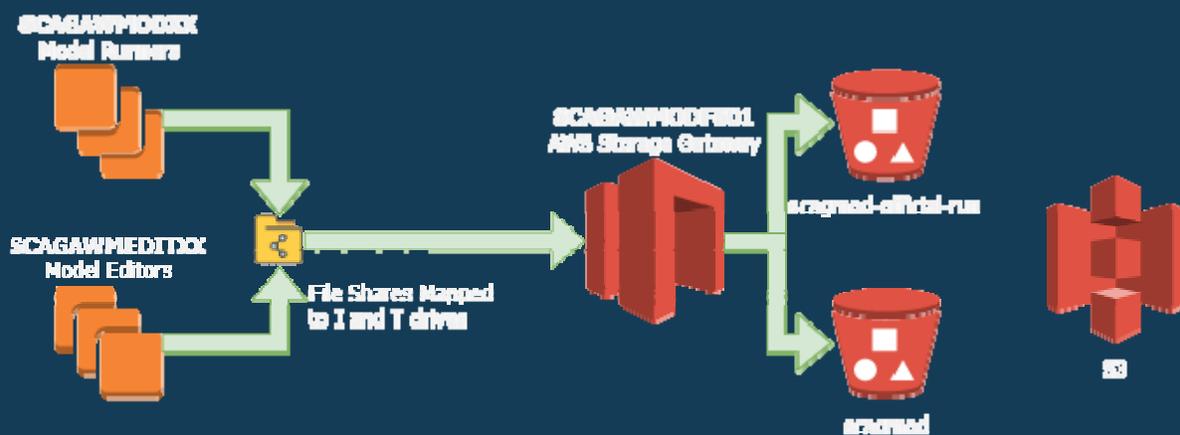
## Solutions: File Storage



### Amazon Storage Gateway backed by Amazon S3

- Multiple Geographically Dispersed Copies. 99.99% Availability, 99.999999999% Durability.
- Unlimited storage space. Pay by data size.
- Super fast data transfer rate between model servers and the storage.

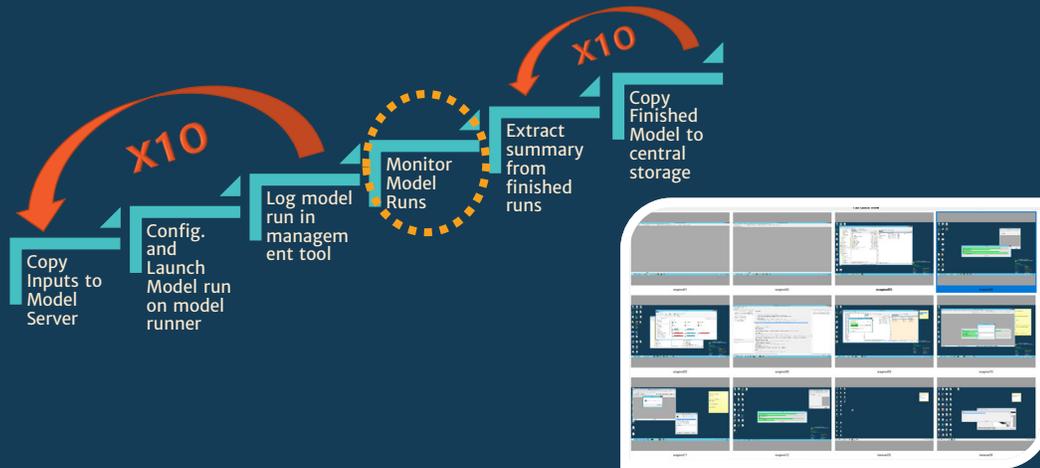
## Solutions: AWS



# Solutions: Operation Management



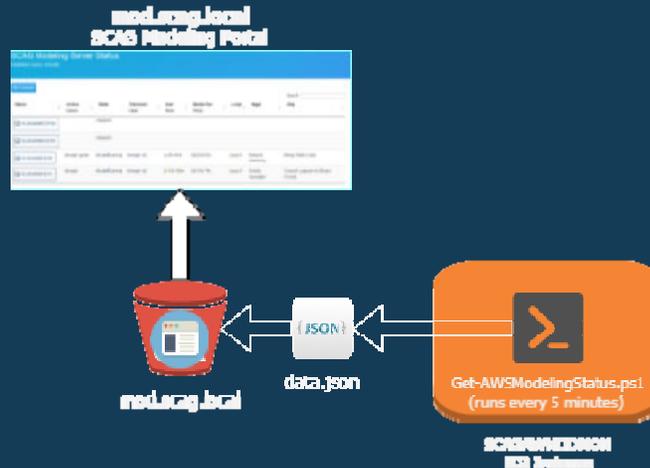
## Production Flow



# Solutions: Operation Management



## Modeling Environment Portal



# Solutions: Operation Management



## Modeling Environment Portal

### SCAG Modeling Server Status

Updated every 5 minutes

Console

Search:

Name	Active Users	State	Transcad User	User Time	Model Run Time	Loop	Stage	Step
SCAGAWMEDIT00		stopped						
SCAGAWMEDIT01		stopped						
SCAGAWMOD00		stopped						
SCAGAWMOD01		stopped						
SCAGAWMOD02	chengh	ModelRunning	chengh (d)	5d 14h 41m	5d 14h 19m	Final	Assignment	SCAG Emission

# 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.

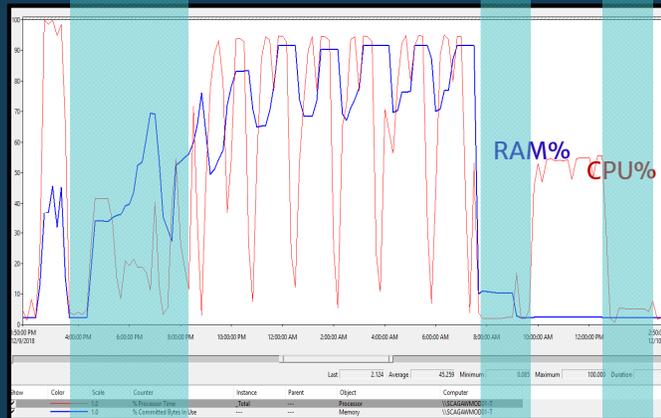


## Continuing Challenges



### 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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