Operational Implementation of the TASHA Agent-Based Microsimulation Travel Model System in the Greater Toronto-Hamilton Area

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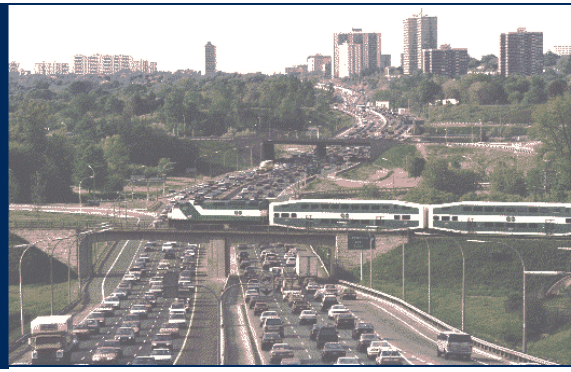

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Presentation Outline

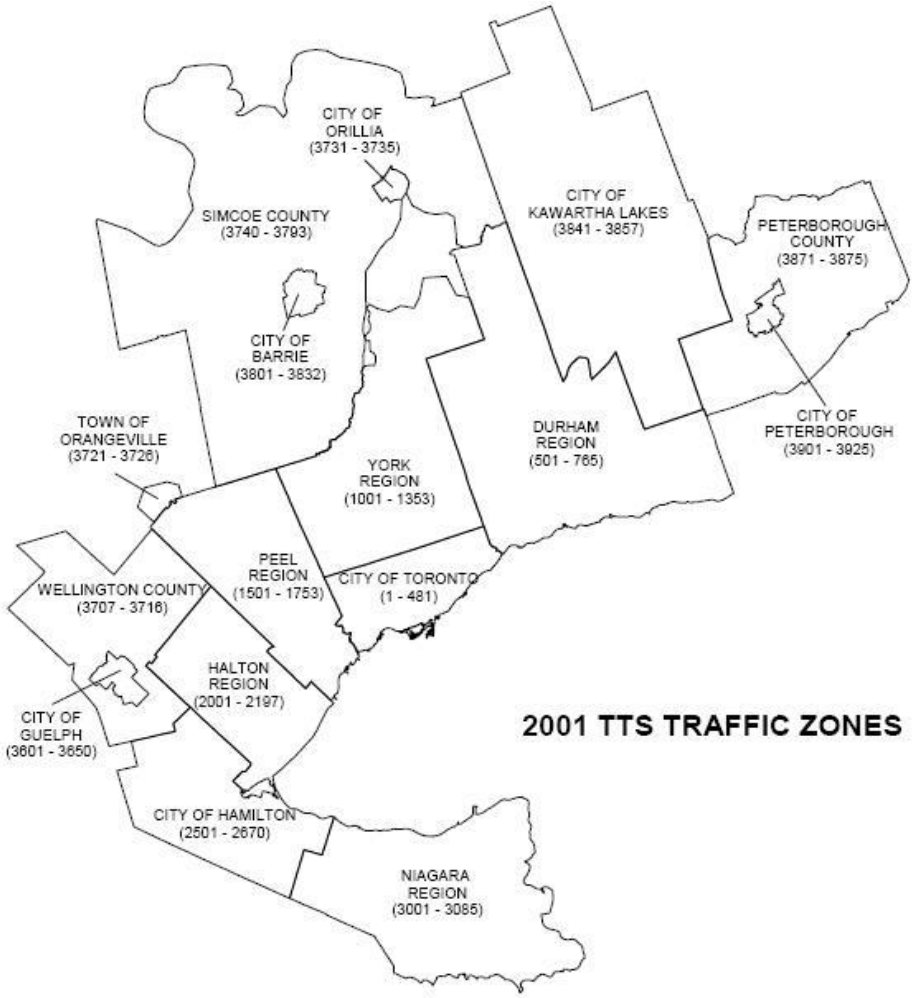
- The University – Public Agency Nexus
- TASHA Overview
- The GTAModel V4.0 Implementation
- Current Status; Next Steps

The University – Public Agency Nexus

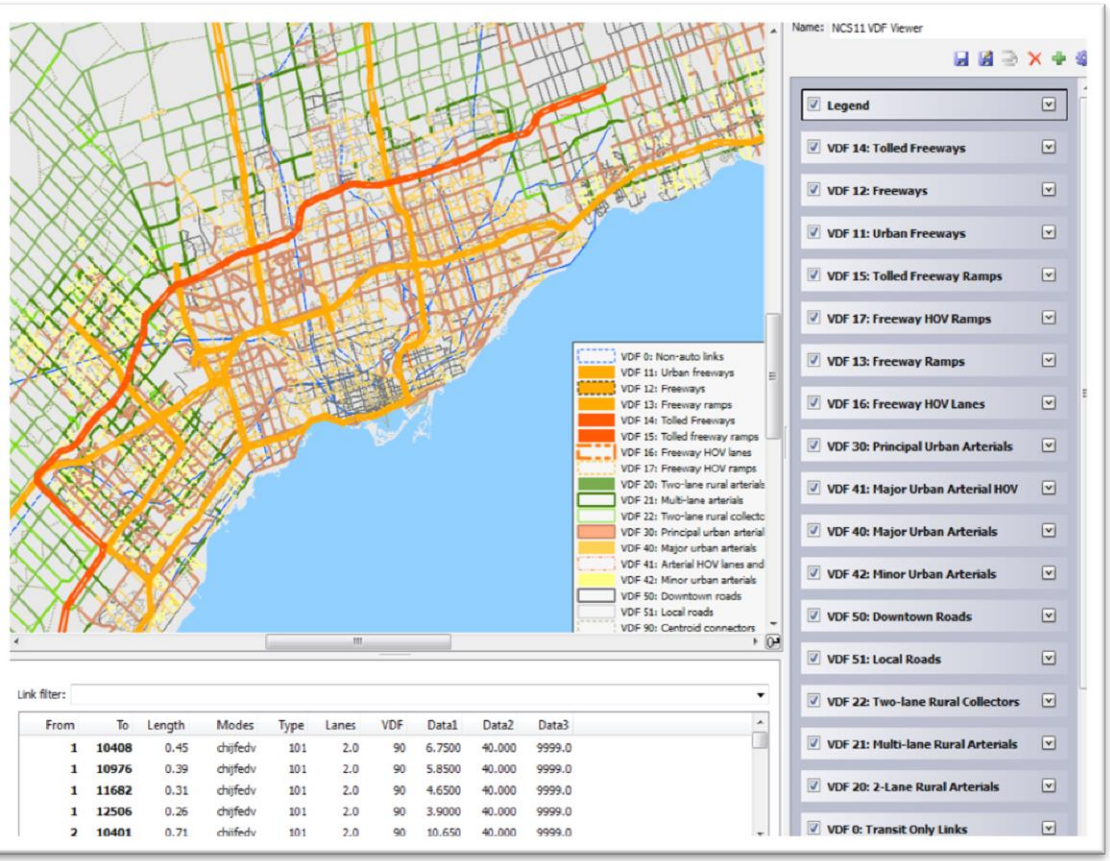
- The University of Toronto has a 30-year history of collaboration with local, regional and provincial transportation planning agencies in support of:
  - Travel demand surveys & data management
  - Transportation network modelling
  - Travel demand modelling

Transportation Tomorrow Survey & The Data Management Group (DMG)

- Starting in 1986, one-day travel surveys of 5% of GTHA households has been undertaken every 5 years.
- The DMG at UofT has managed these surveys on behalf of the regional agencies and has managed the resulting time series survey database.
- Approximately 150,000 households are surveyed over a 3-4 month period in the fall of the survey year.
- TTS provides an excellent database for transportation planning analysis and travel demand modelling



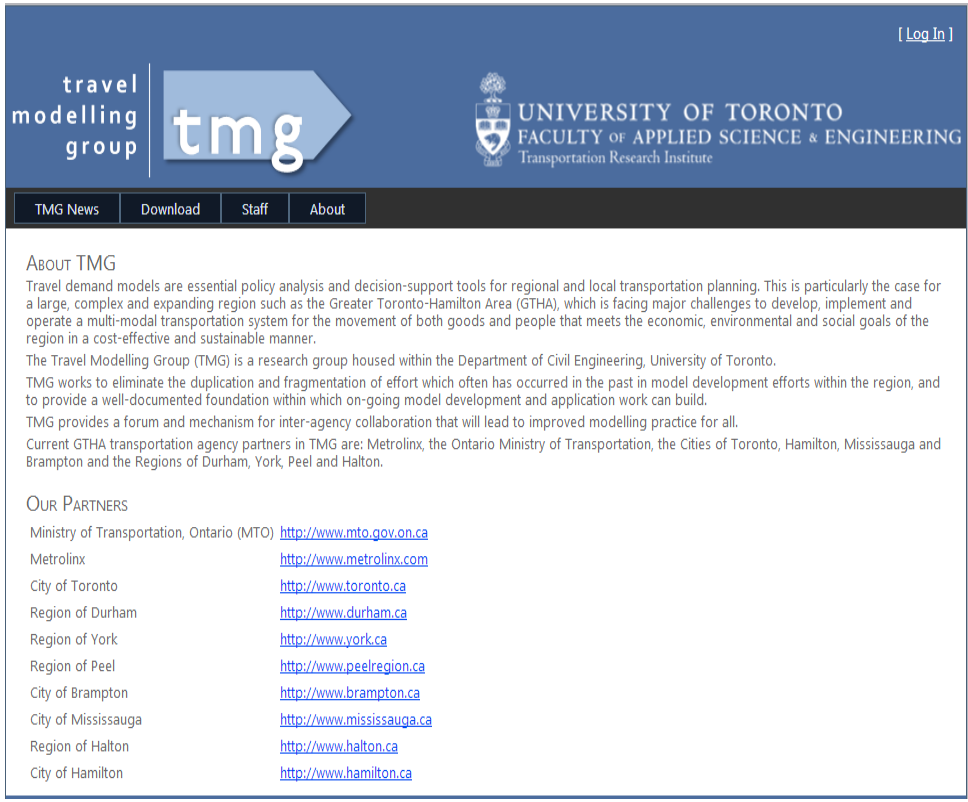
Transportation Network Modelling



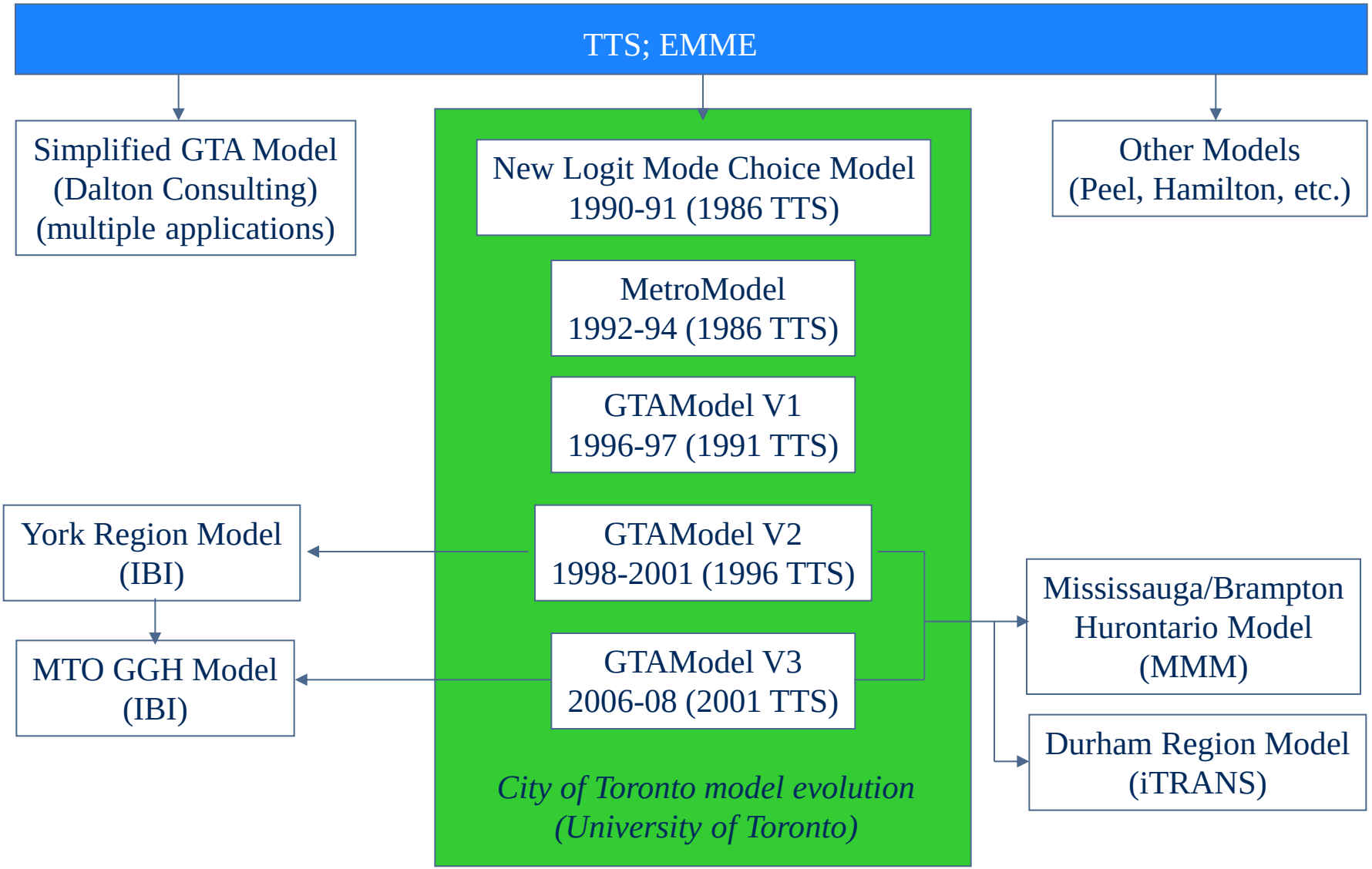
- All transportation planning agencies use Emme as their standard network modelling software.
- Starting in the late 1980's DMG maintained the Emme software, established common network coding standards, and developed base TTS year road and transit networks for agencies' use.
- Since 2011, the Travel Modelling Group (next slide) has taken over the coding standards and base network development tasks.

Travel Demand Modelling & The Travel Modelling Group (TMG)

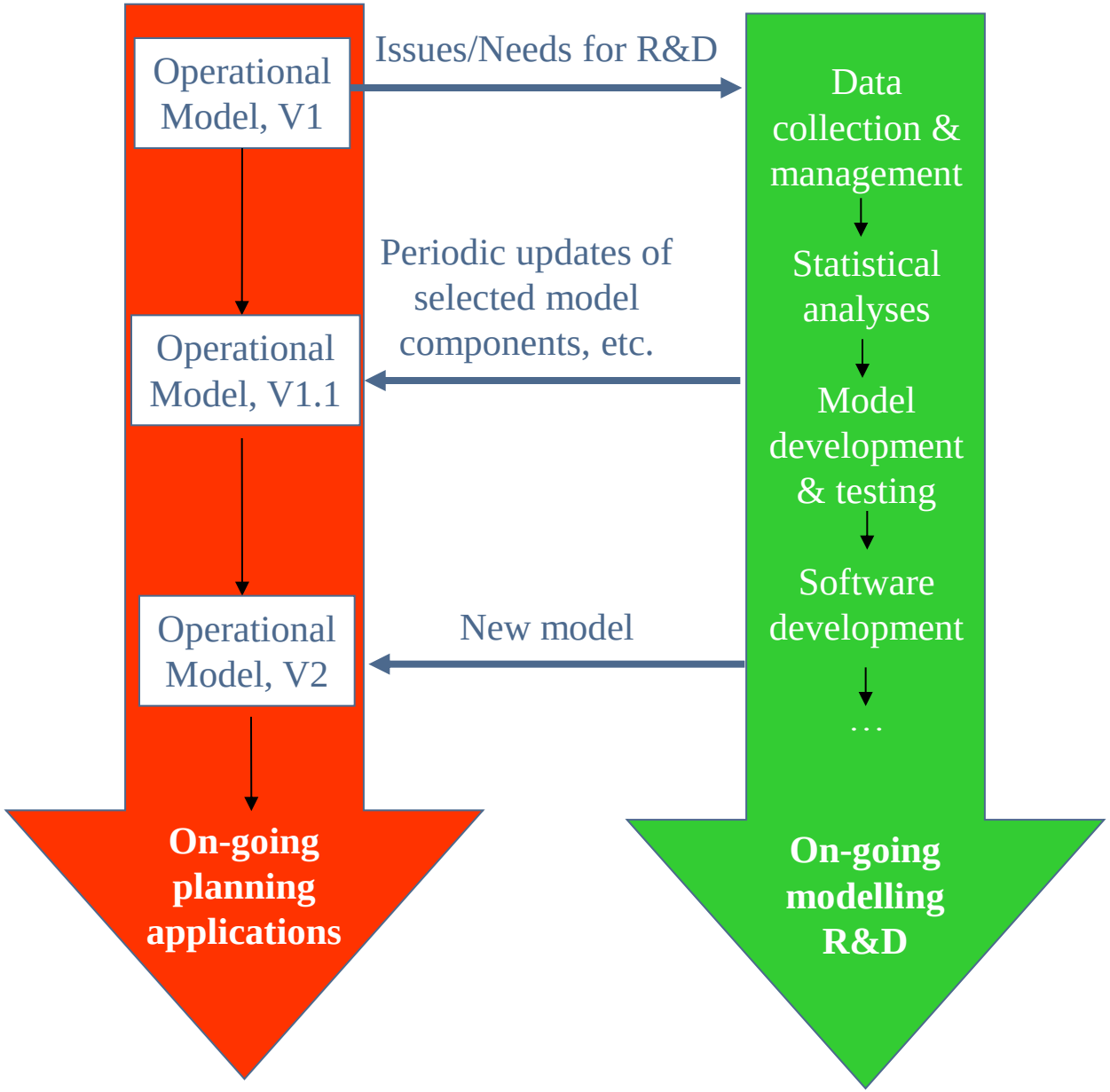
- Since 1990 UofT has worked with the City of Toronto (formerly Metro Toronto), the Ontario Ministry of Transportation (MTO) and other regional agencies on developing improved 4-step travel demand modelling capabilities in the GTHA.
- In 2011 this relationship was formalized and expanded to include all transportation planning agencies in the GTHA through the formation of the Travel Modelling Group (TMG).



GTAModel Evolution & Contribution to GTHA Travel Demand Modelling



Parallel Model Application & Development Processes



An operational model always exists. It is used on an on-going basis to address current policy/planning issues. In so doing it builds confidence in & support for models as part of the planning process.

At the same time, modelling R&D is also continuously underway, addressing short- & long term improvements. As these improvements are developed and tested, they are implemented into the operational model. Since the R&D is "off-line" from day-to-day planning deadlines risk is minimized & R&D efficiency and effectiveness is maximized.

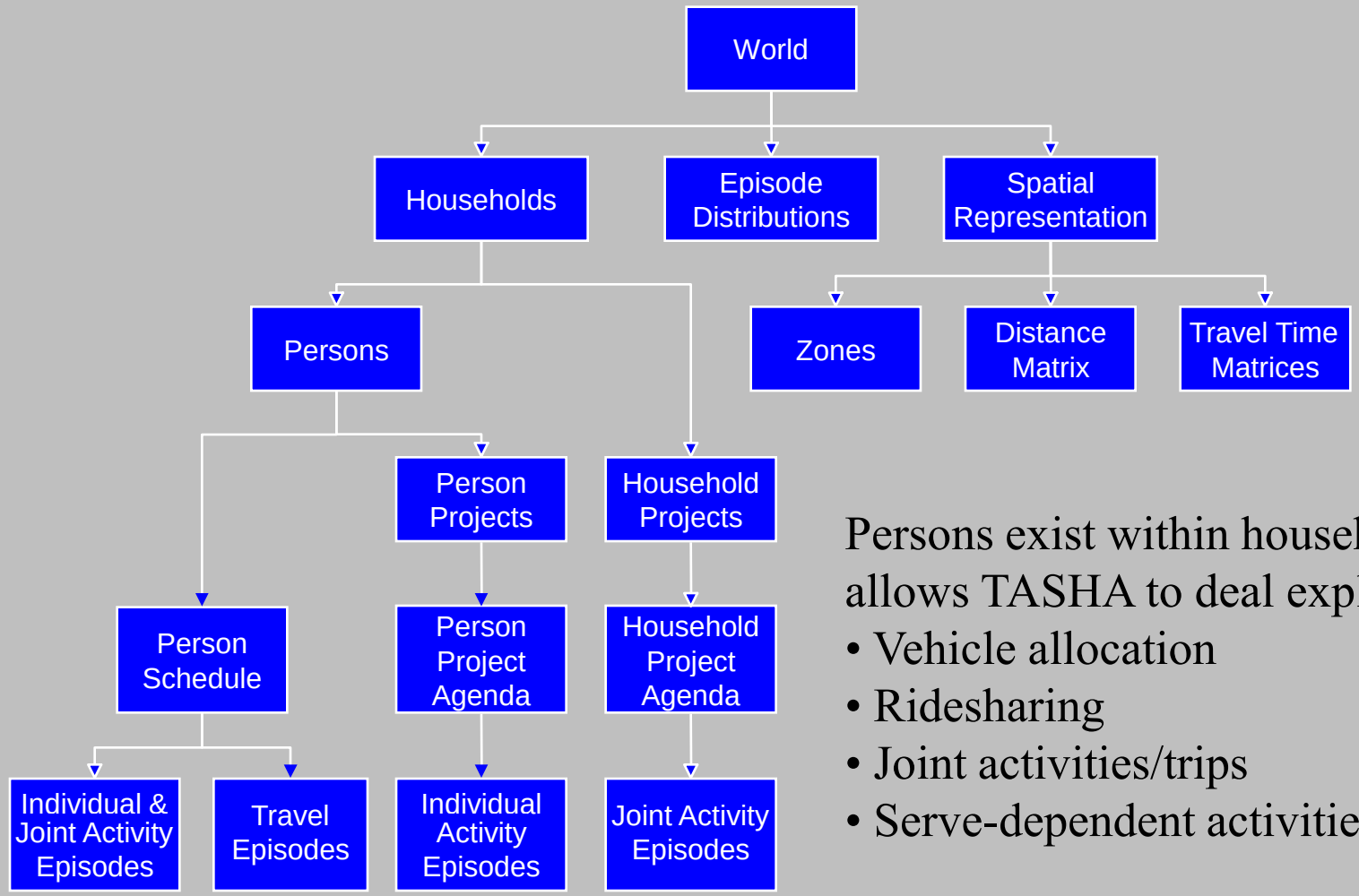
TASHA

TASHA (Travel/Activity Scheduler for Household Agents) has been developed at the University of Toronto. A validated version of the model is now operational and is being re-estimated/calibrated for operational use by the City of Toronto.

It is an activity-based, agent-based, microsimulation model of weekday activity/travel in the Greater Toronto-Hamilton Area (GTHA). Key features include:

- Household-based
- Activity *scheduling*
- Treatment of tours and modes
- Treatment of time
- Flexibility in development and application

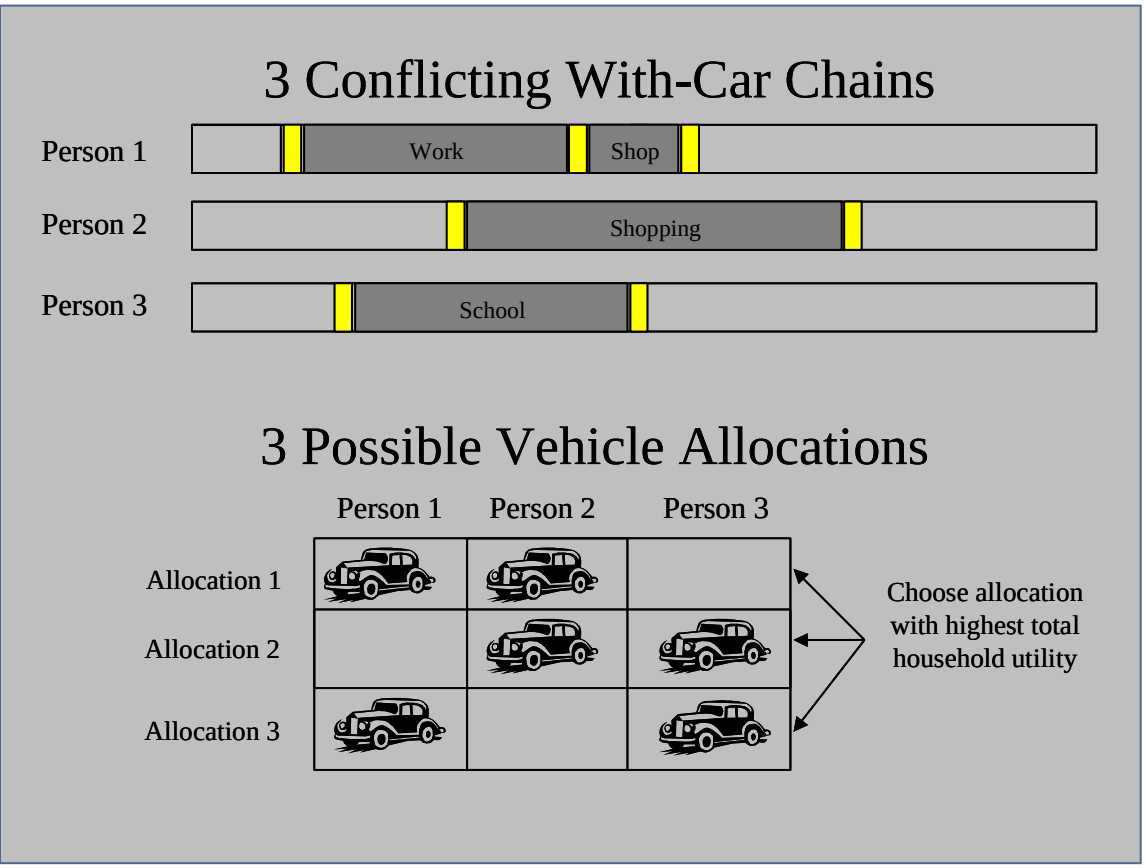
Key Features 1: Household-Based



Persons exist within households. This allows TASHA to deal explicitly with:

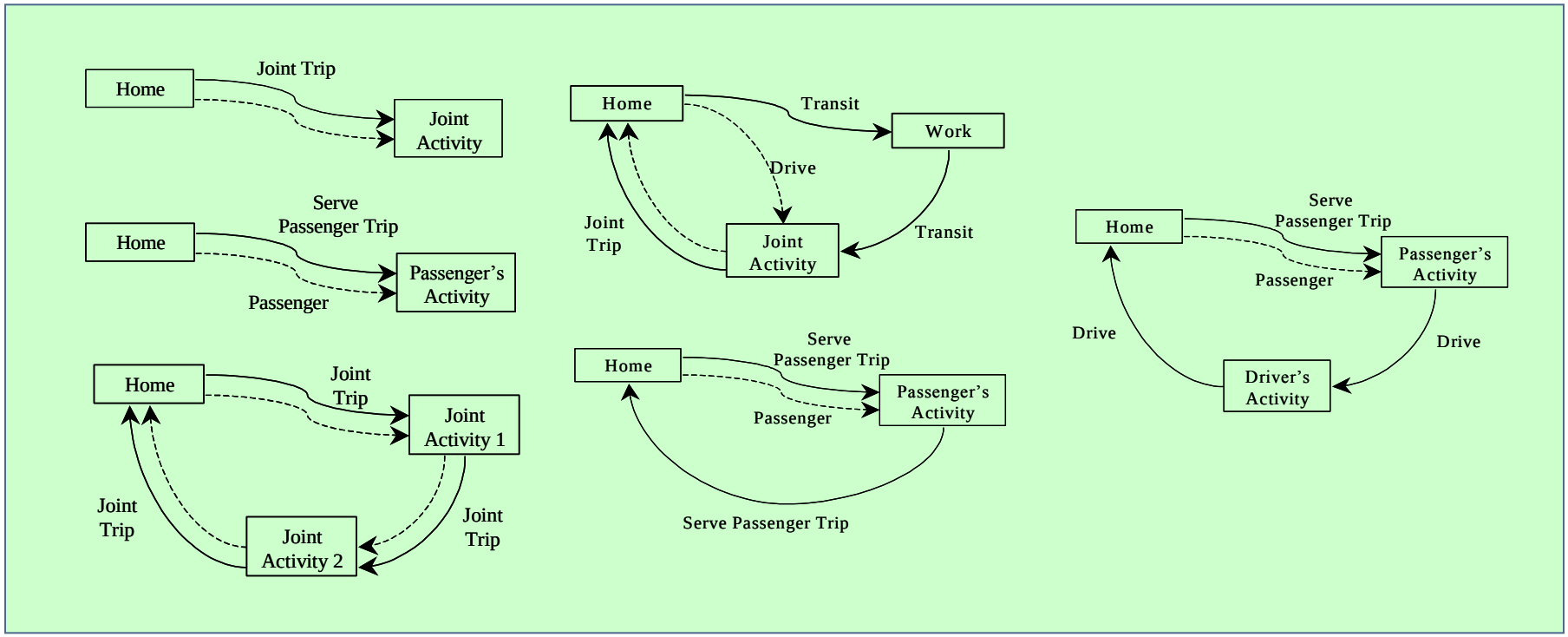
- Vehicle allocation
- Ridesharing
- Joint activities/trips
- Serve-dependent activities/trips

Vehicle Allocation within TASHA



TASHA assigns household vehicles to drivers based on overall household utility derived from the vehicle usage. Drivers not allocated a car must take their second-best mode of travel.

Household Ridesharing Options in TASHA

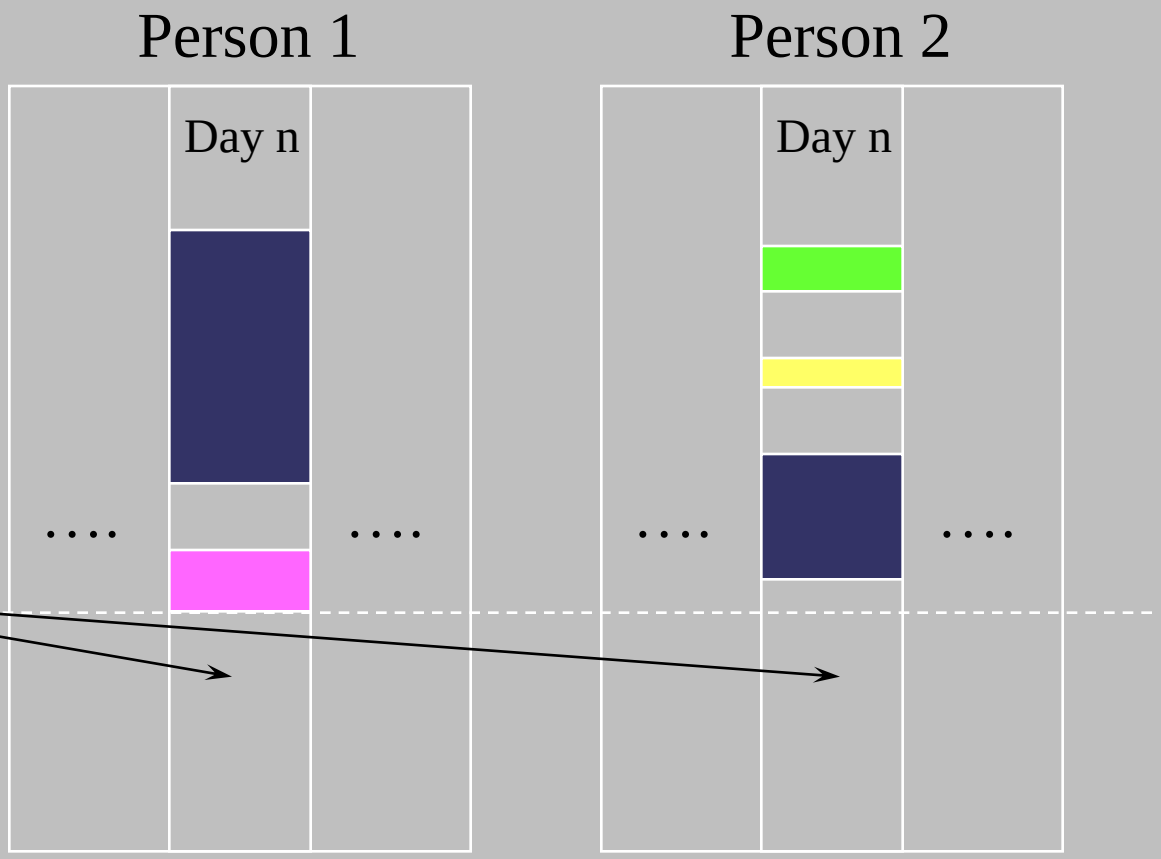


Within-household ridesharing is explicitly handled within TASHA. Drivers will "offer" rides to household members if a net gain in household utility is obtained and feasibility criteria are met.

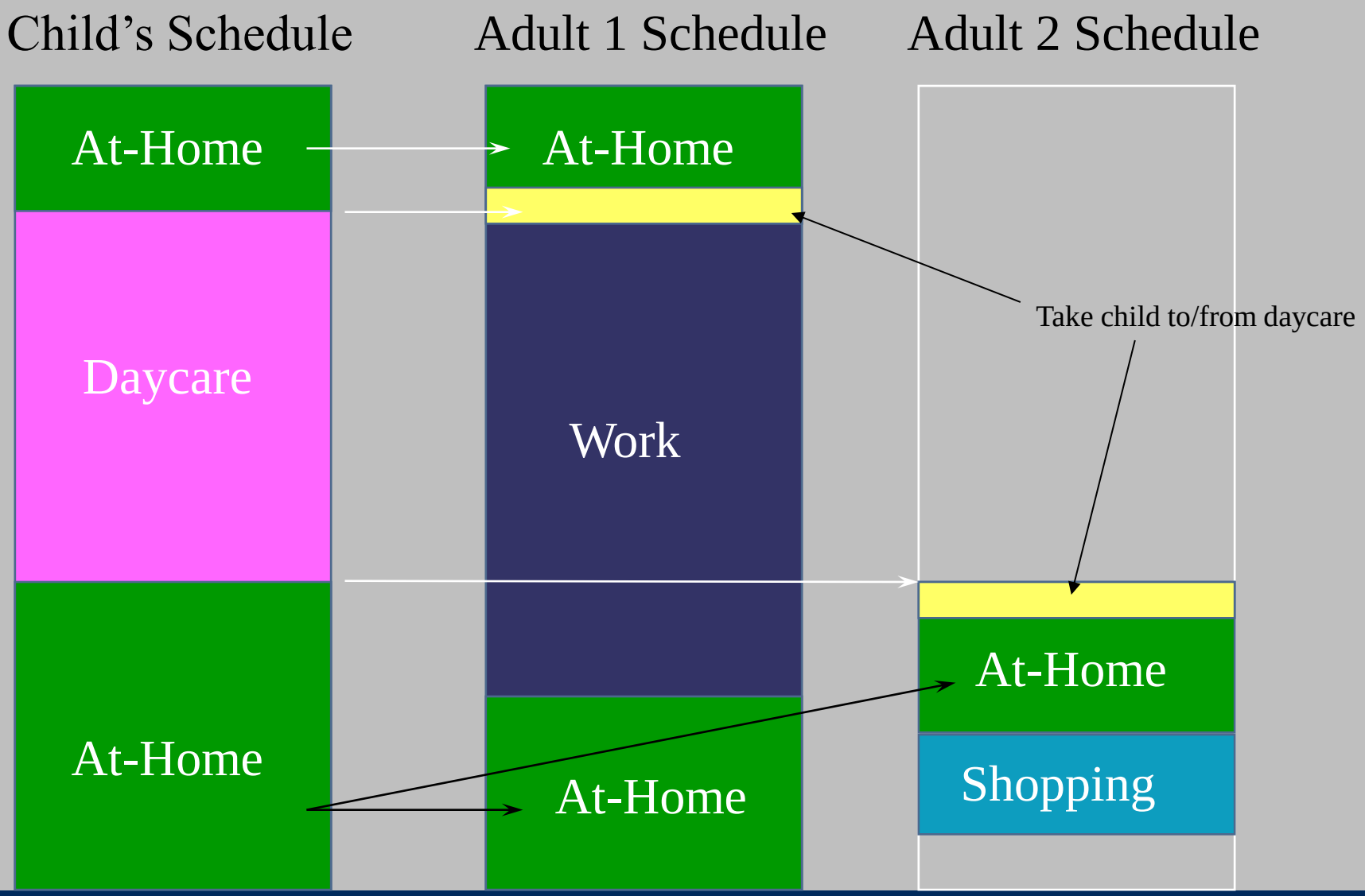
Joint Activities

Joint Shopping
Activity:
Duration: 2 hrs
Location: The Mall

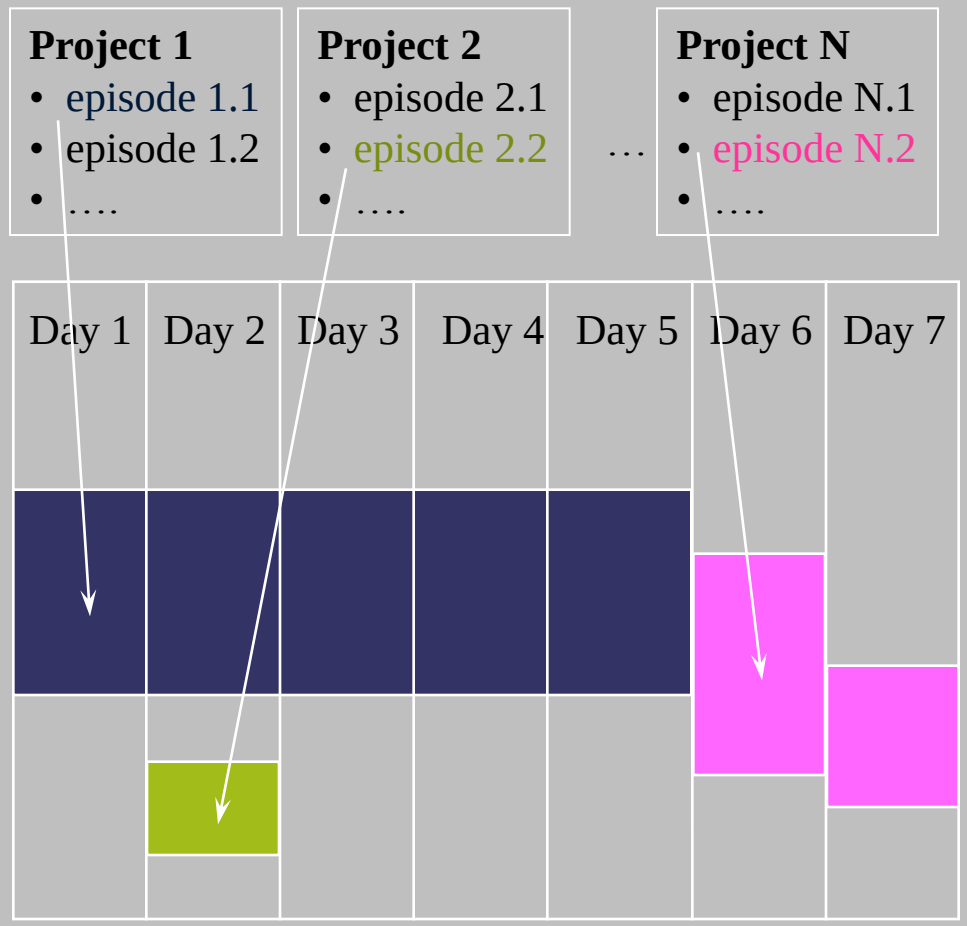
Search for feasible
joint time slot



Serve Dependents

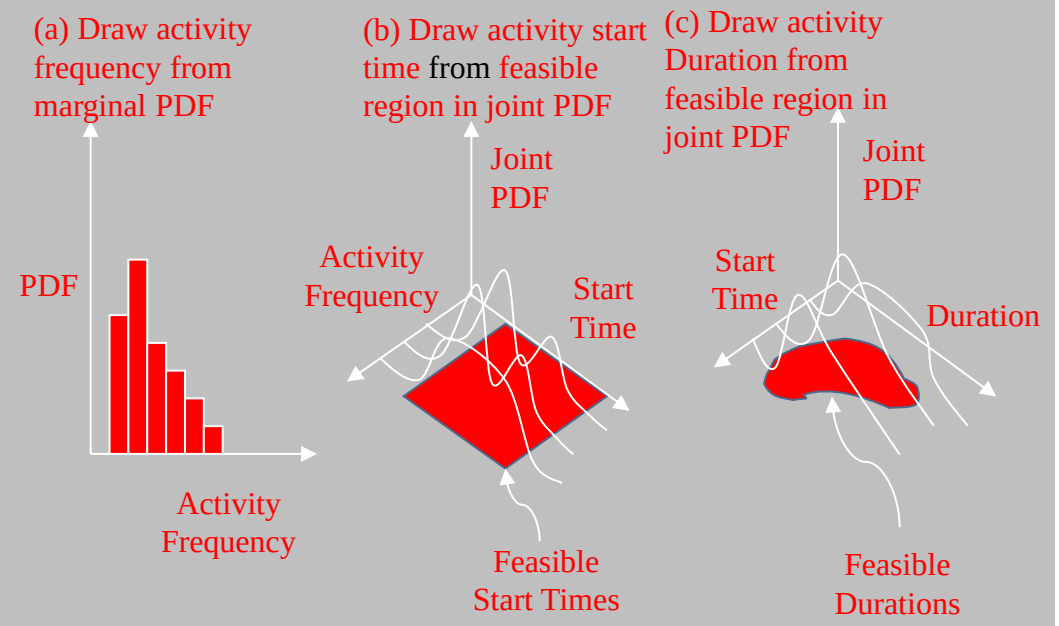


Key Features 2: Activity Scheduling



TASHA is an *activity scheduling* model in which individual activity episodes are generated and then explicitly scheduled. Out-of-home activity patterns and their associated trip-chains (tours) are thus "built from scratch" rather than selected from a pre-specified set of feasible patterns. Thus, travel patterns dynamically adjust to changes in transportation level of service, activity system "supply", changes in household and personal constraints and needs, etc.

Activity Episode Frequency, Start Time and Duration Generation

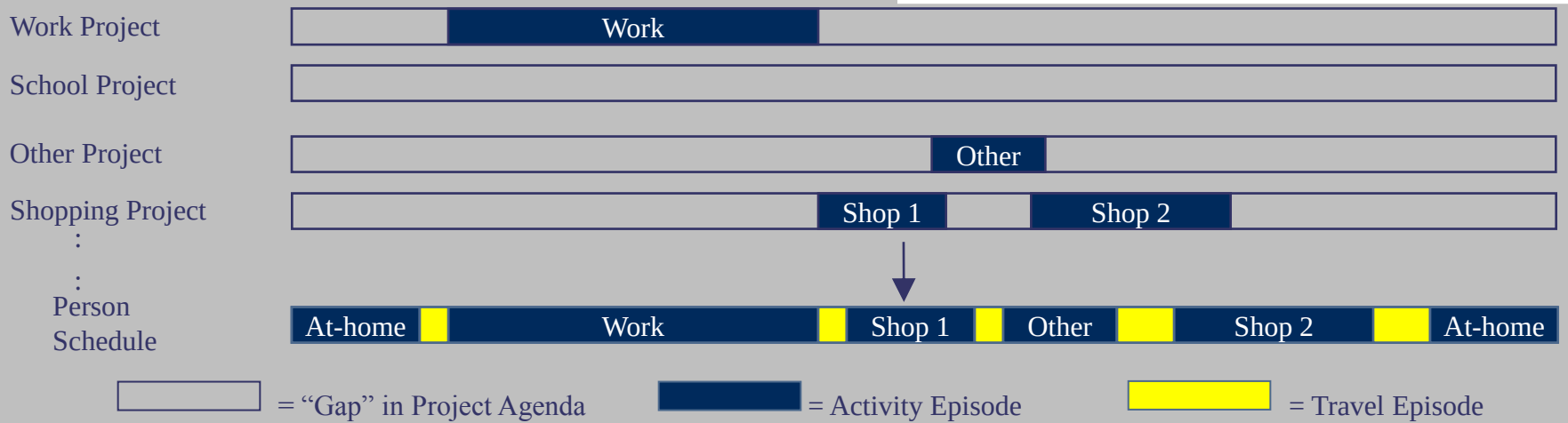


TASHA generates the number of activity episodes from a set of "projects" that a person (or household) might engage in during a typical weekday. It also generates the desired start time and duration of each episode.

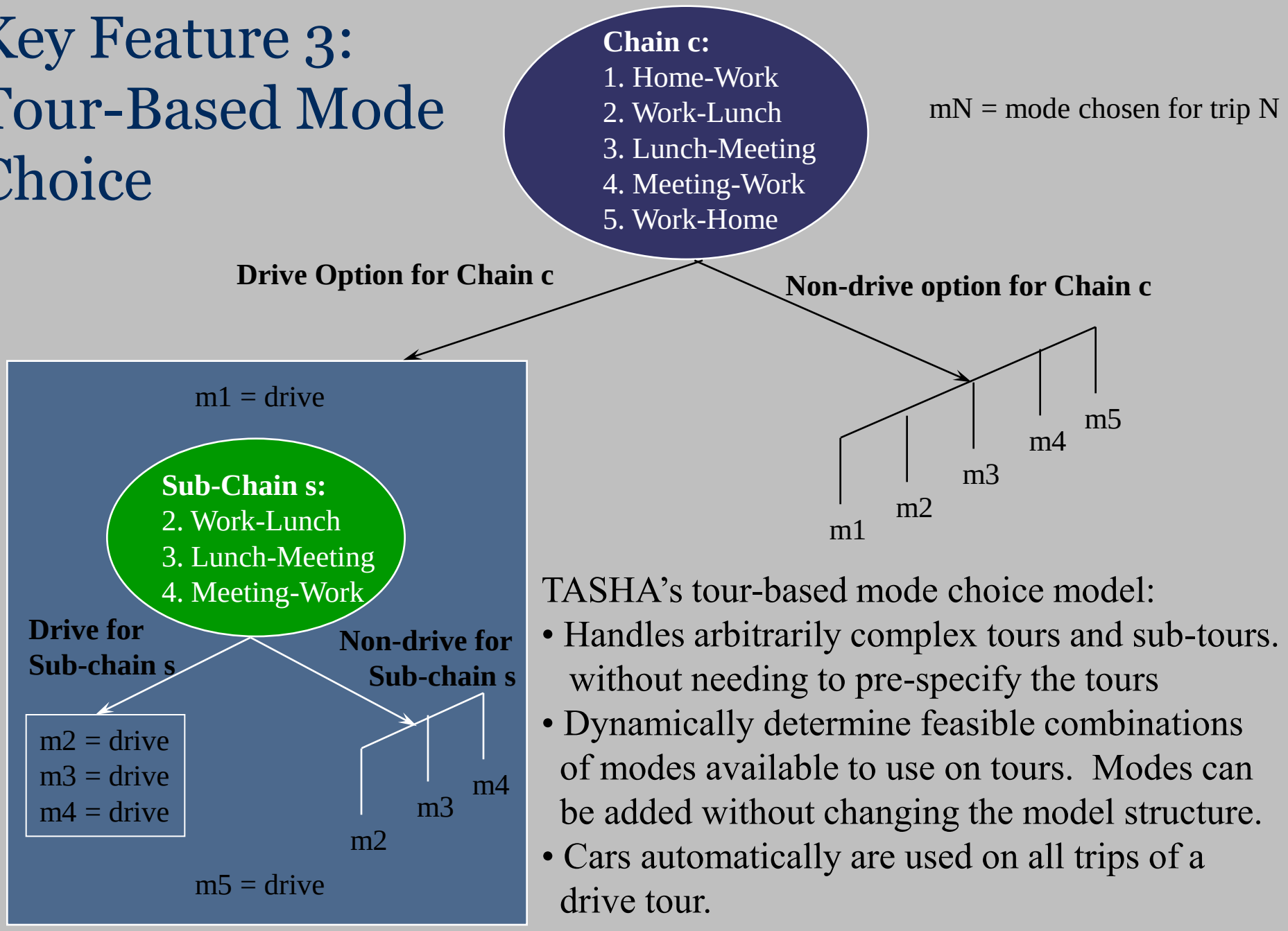
It then builds each person's daily schedule, adjusting start times and durations to ensure feasibility.

Travel episodes are inserted as part of the scheduling process.

Scheduling Activity Episodes into a Daily Schedule



Key Feature 3: Tour-Based Mode Choice



TASHA's tour-based mode choice model:

- Handles arbitrarily complex tours and sub-tours. without needing to pre-specify the tours
- Dynamically determine feasible combinations of modes available to use on tours. Modes can be added without changing the model structure.
- Cars automatically are used on all trips of a drive tour.

Key Feature 4: Treatment of Time

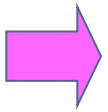
- Models all out-of-home activities and trips for a 24-hour typical weekday
- Minute-by-minute time increments are used for start times and durations/travel times
- Trips can be aggregated to whatever level of temporal detail/categorization is required by the network assignment model
- Deals naturally with “peak-spreading”, etc.
- Provides excellent detail for environmental impact analysis

Key Feature 5: Flexibility

- TASHA has been designed to be very flexible in terms of its development and its application.
- It has been developed using ordinary trip-based survey data for the GTA (but it could also exploit activity-based survey data).

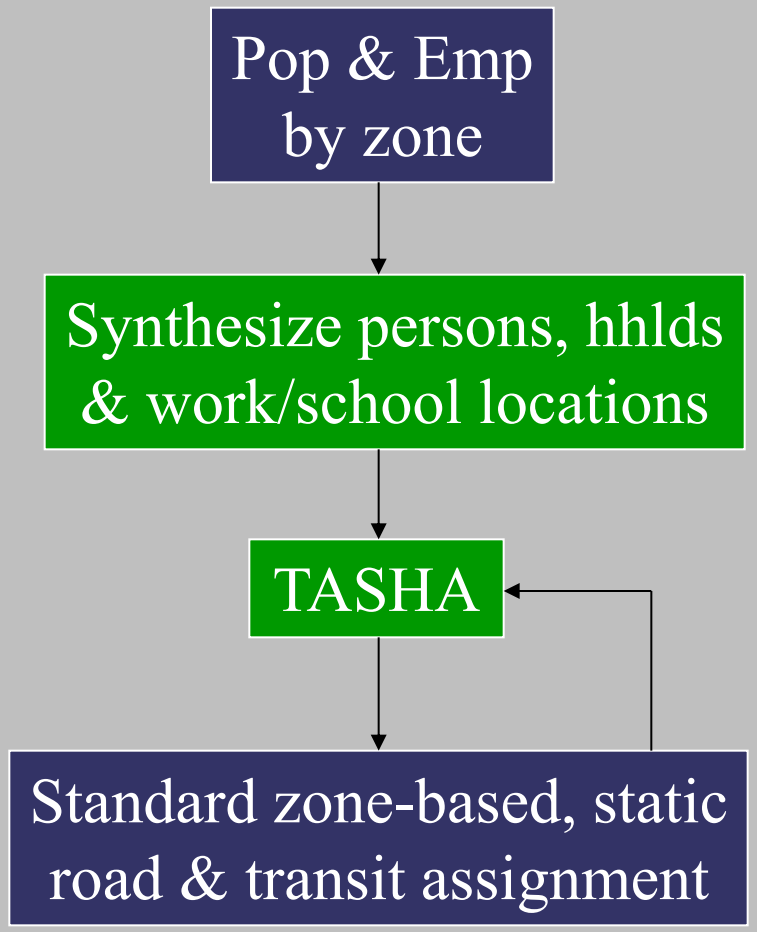
The data requirements for model development are no greater than other current models, including conventional trip-based models.

- It can be used as a direct replacement for the first 3 stages in a 4-step system, or integrated within a full microsimulation model system.



Usable in a variety of contexts, and facilitates the *evolution* of the model system over time from aggregate to microsimulation.

Application in a conventional setting

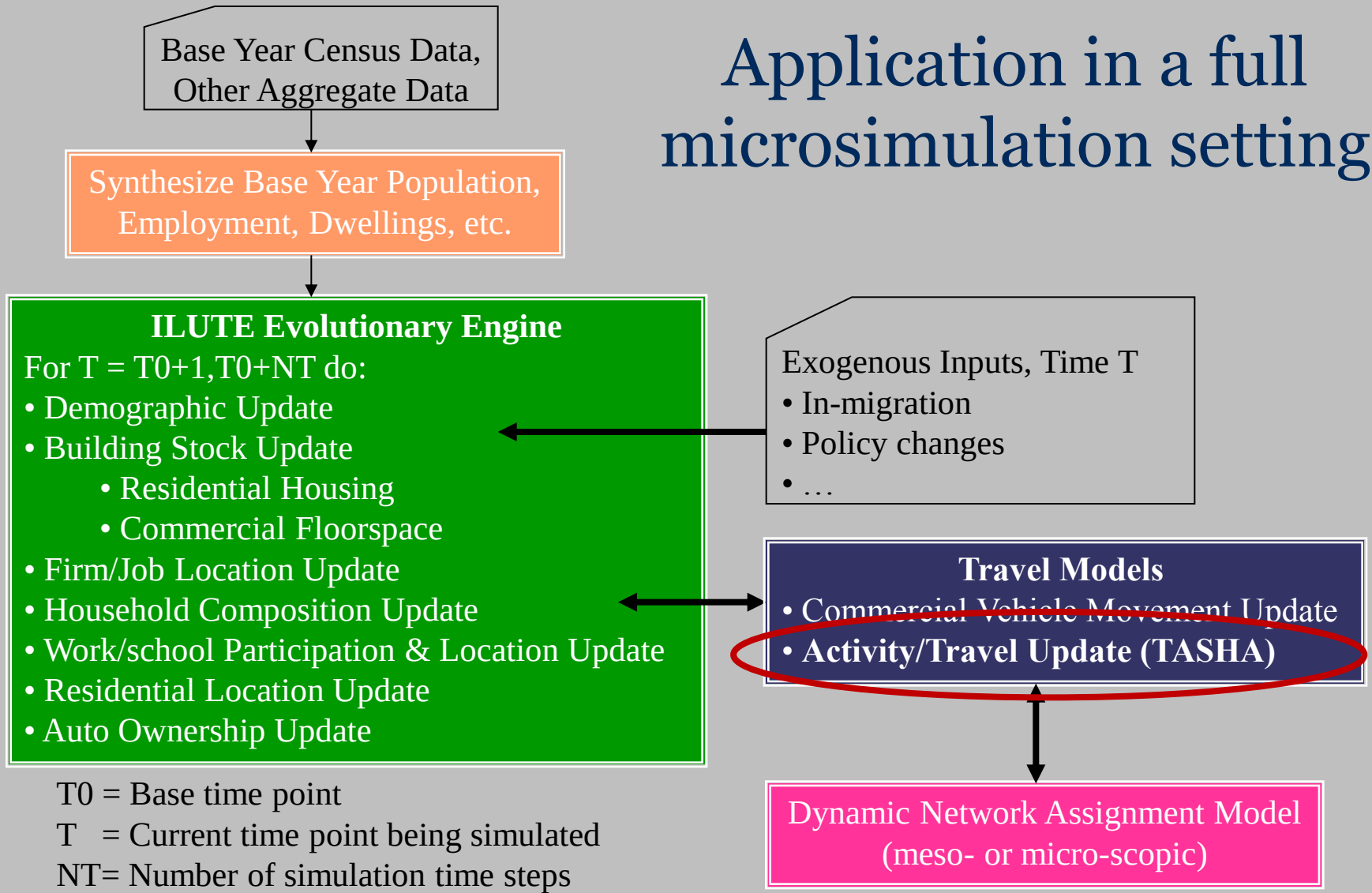


Standard 4-step zone-based inputs

TASHA contains its own synthesis procedures to convert aggregate, zone-based inputs into disaggregated persons, etc. required for microsimulation

Standard network assignment package (EMME, Vissum, etc.)

Application in a full microsimulation setting



T0 = Base time point
T = Current time point being simulated
NT= Number of simulation time steps

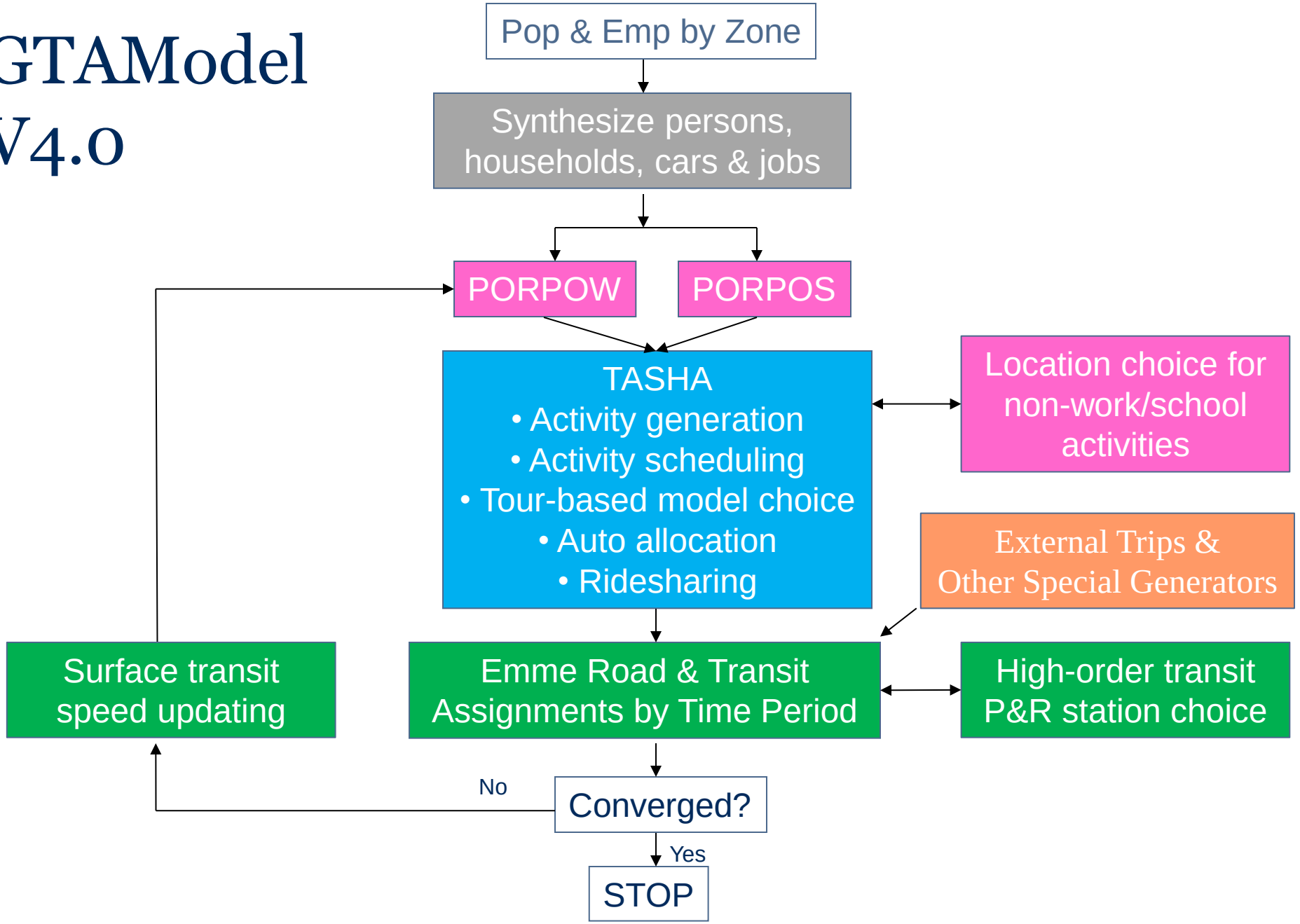
Current Status

- TASHA was developed using 1996 travel survey data for the GTHA.
- The activity scheduler has been validated against 2001 survey data.
- Interfaces with both EMME and MATSIM.
- Has been experimentally applied to Montreal, London & Changzhou, China.
- Currently being re-estimated/calibrated using 2011 TTS data for full operational deployment by the City of Toronto later this year.

City of Toronto Implementation: GTAModel V4.0

- TASHA operates on a list of persons & households possessing known work & school locations, demographics and household auto ownership levels.
- For operational use it needs to be embedded within an overall model system. This model system is designated GTAModel V4.0.

GTAModel V4.0



Some Additional Features of V4.0

- Basic inputs are population & employment totals by traffic zone. Individual persons, households and jobs are then synthesized.
- Work and school locations are synthesized for each worker and student.
- Non-work/school activity episode locations are dynamically determined at the time of episode generation.
- Road assignment includes toll road modelling.
- Transit assignment is stochastic, congested assignment.
- Surface transit line speeds are updated based on roadway congestion.
- A new, detailed model of drive-access to high-order transit stations is being developed that ensures trip-makers return to their access station to retrieve their cars.

Next Steps

- Tour-based mode choice and other demand components currently being estimated.
- Hoping to have a re-estimated system by end of June for detailed testing and validation.
- Already have a list of V4.1 improvements!
- Once implemented this will be the first operational fully agent/activity-based travel microsimulation model system in Canada.

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THANK YOU! QUESTIONS?