AUTOMATED MOBILITY-ON-DEMAND VS MASS TRANSIT

A MULTI-MODAL ACTIVITY-DRIVEN AGENT-BASED SIMULATION APPROACH

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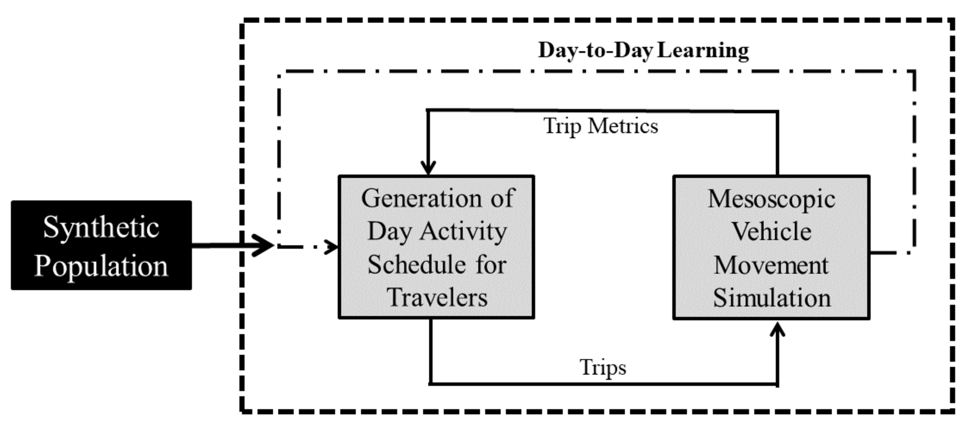
INTRODUCTION

- Automated Mobility-on-Demand (AMoD) combines benefits of MoD with AVs – low operational cost; superior energy efficiency; reduction of negative externalities; increased road network utilization; decrease in insurance and parking cost
- Most literature focuses on efficiency of AMoD and AVs in terms of on-road movement and fleet management
- *How will AMoD impact an urban transportation system?*
- Requires a holistic integrated research approach → demand and adoption coupled with supply and movement
- **Two-fold contribution:**

1. Introduction of a flexible framework, developed in SimMobility
2. Case study: role of mass transit in future urban transportation systems

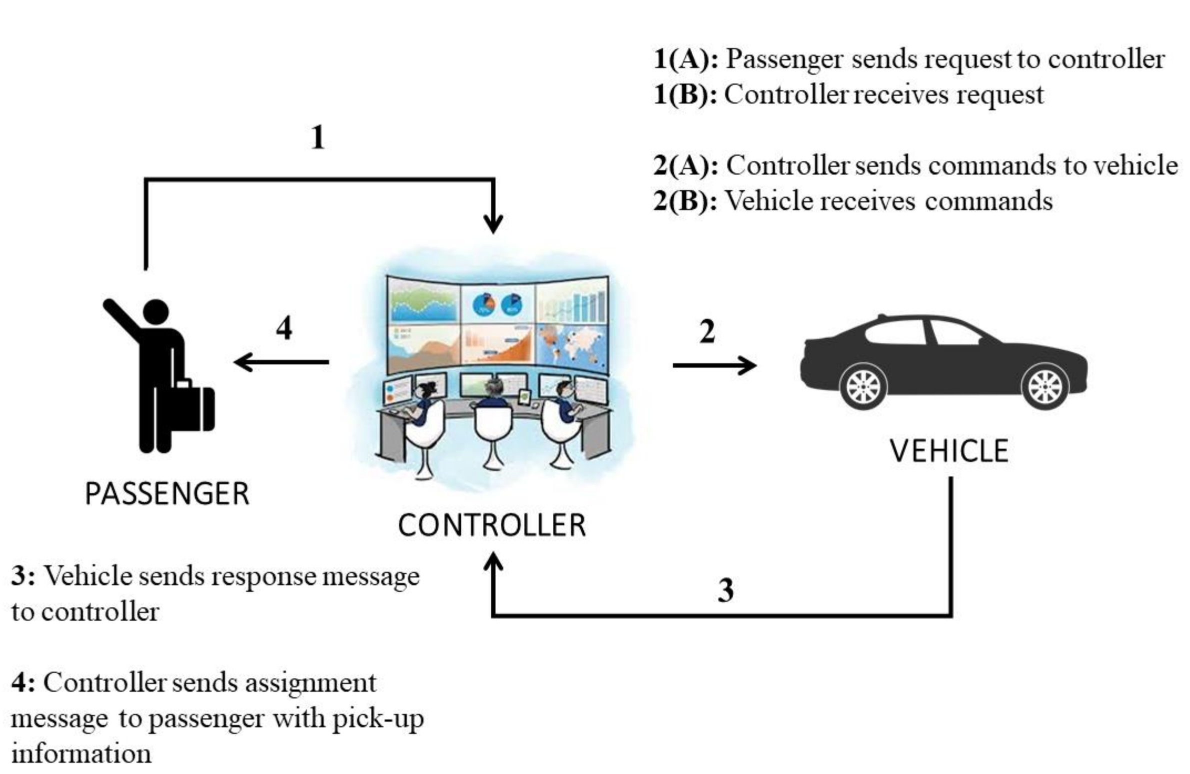
SIMMOBILITY



- Open source transportation systems simulator: agent based, multi-scale, multi-modal, integrated (demand and supply are simulated)
- Mesoscopic supply and microscopic demand simulator → Mode choice, Route choice, Activity pattern

AMOD FRAMEWORK

- AMoD is made available in the pre-day as a viable mode
- A-priori values of generalized travel cost set according to literature; updated later using day-to-day learning module
- Travelers adjust their travel choices (mode, route, etc.) based on these values
- Flexible enough to allow testing of different hypotheses (adoption rate, price, service)

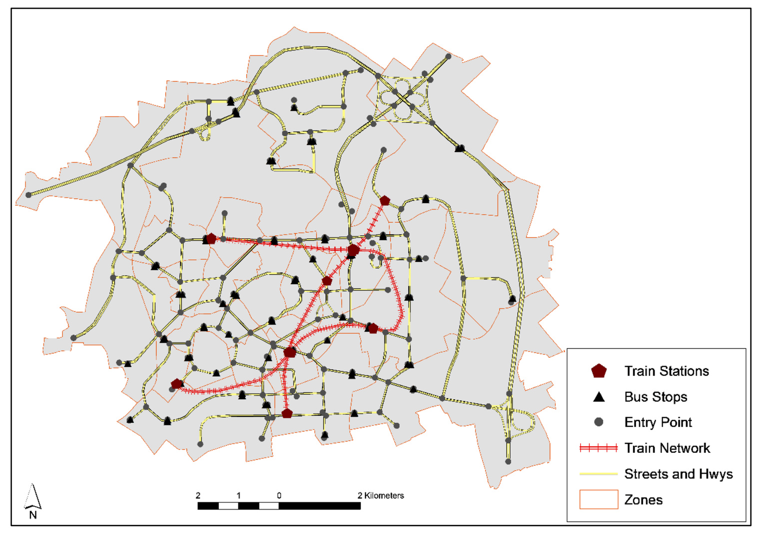


- Design in supply simulator has three components: *passenger*, *vehicle* and *controller*
- Ride-matching algorithm is capable of matching different requests to the same vehicle under these two constraints:

1. *Waiting time* of all passengers already included in the schedule, as well as of the new passenger, must be below a certain threshold [10 mins for case study]
2. *Additional delay*, which accounts for detours due to ride-sharing must be below a certain threshold [10 mins for case study]

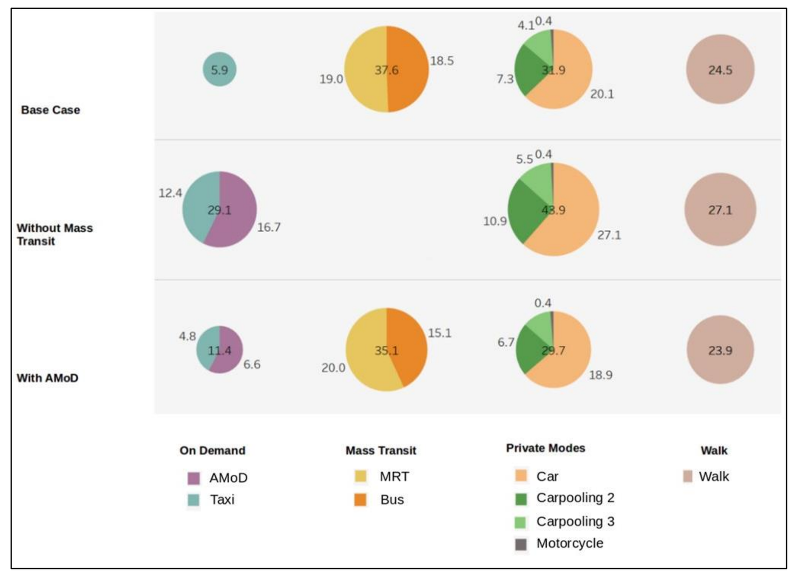
EXPERIMENT DESIGN

- A prototypical city - ***Virtual City***, which resembles land use patterns, travel behavior, and activity patterns observed in Singapore
- **Total population:** 351,000 (~10% of Singapore)
- **Network:** 95 nodes, 286 segments, 12 bus lines, 86 bus stops, 4 MRT lines, 20 MRT stations
- **Available modes:** single occupancy car (*Car*), pooling with one extra passenger (*Carpooling 2*), sharing with two extra passengers (*Carpooling 3*), public bus (*Bus*), Mass Rail Transit (*MRT*), traditional taxis (*Taxi*), motor-cycle (*Motorcycle*) and walking (*Walk*)

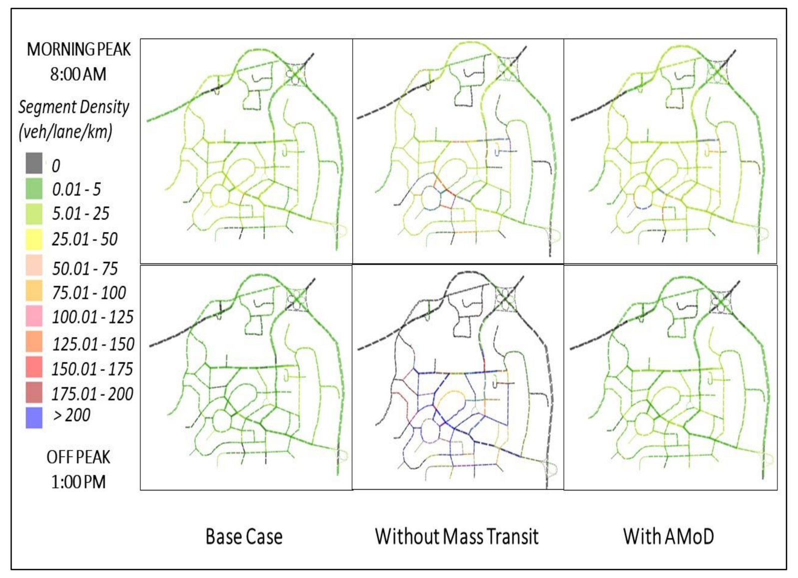


BASE CASE	WITH AMoD	WITHOUT MASS TRANSIT
No smart mobility services	Introduction of AMoD; all other modes kept available	Introduction of AMoD
Available modes are those mentioned above	In addition to door-to-door service, AMoD also provides first and last mile connectivity for mass transit	Removal of mass transit modes, i.e. Bus and MRT

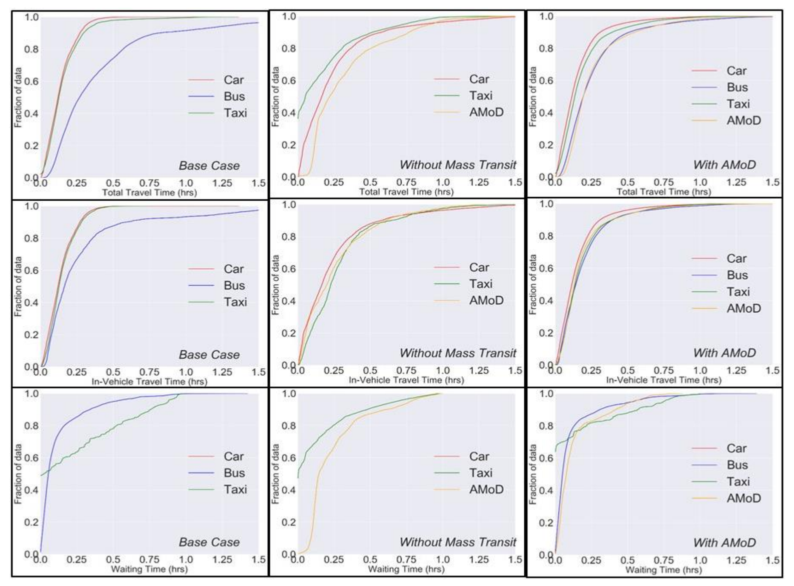
RESULTS



MODE CHOICE



SYSTEM PERFORMANCE



USER PERFORMANCE

- **Mode Choice:** AMoD more preferable to taxi due to lower tariffs; Drop in Bus share is compensated by AMoD; Multi-service AMoD drives increase in MRT share (*With AMoD* scenario)
- **System performance metrics** | *network congestion*: Extremely high levels of congestion without mass transit which does not drain away during off-peak unlike other scenarios
- **User performance metrics** | *travel time*: In-vehicle travel time increases drastically due to congestion; dynamic fleet sizing strategy enables low waiting time for AMoD and taxi
- **AMoD performance metrics** | *sharing and VKT*: Shared trips increase by 30% as demand increases; 40-50% of AMoD VKT while going for a pick-up/parking and empty vehicle cruising

CONCLUSION

- ***Completely replacing mass transit with AMoD might not be possible without adversely affecting user experience and LOS***
- AMoD may help augment mass transit travel by providing first and last mile connectivity
- *Next Steps:* urban vs sub-urban; effect of subsidies for AMoD; more refined ride-matching and fleet sizing algorithms
- *When are we better off without mass transit, and when does mass transit complement AMoD?*

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