Project eems074
Urban Science Pillar

U.S. DEPARTMENT OF ENERGY
SMARTMOBILITY
Systems and Modeling for Accelerated Research in Transportation

Cities Topology – Curbs and Parking

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Argonne NATIONAL LABORATORY | INL Idaho National Laboratory | BERKELEY LAB | OAK RIDGE National Laboratory | NREL NATIONAL RENEWABLE ENERGY LABORATORY

OVERVIEW

Timeline

- Project start date: Mar 2019
- Project end date: Sep 2019
- Percent complete: 20%

Barriers

- Emerging mobility services barely (if at all) represented in transportation modeling

Budget

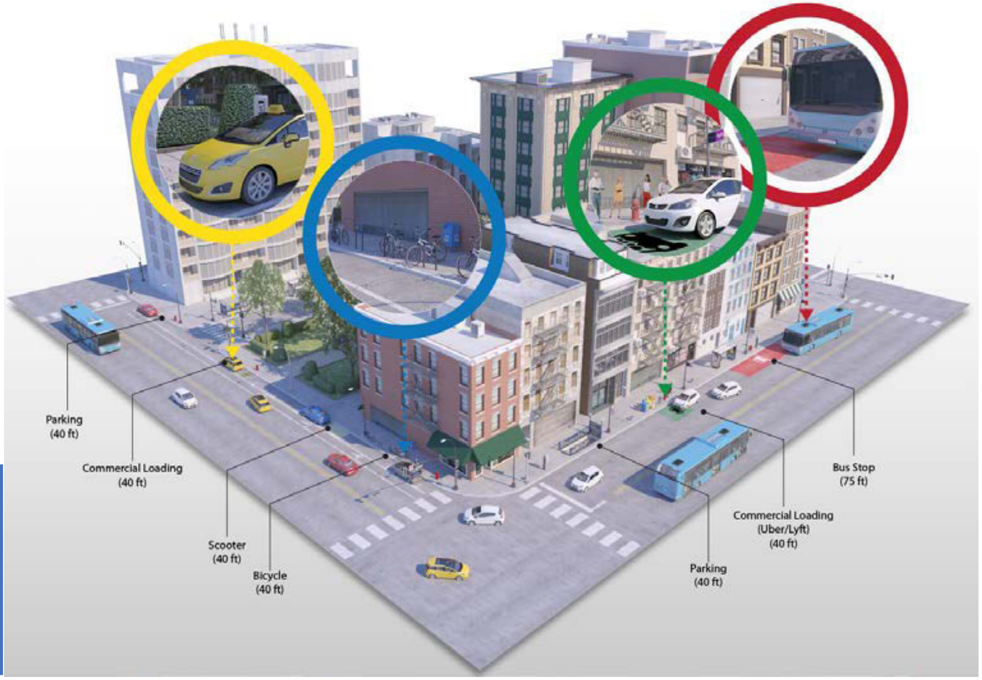
- FY 2019: $350k

Partners

- National Renewable Energy Lab
- Oak Ridge National Lab
- Transpo Group
- Academia

RELEVANCE

- Transport Network Companies (e.g. Uber, Lyft) impose a unique mix of demands on the road network and wider transportation system infrastructure
- Given different mobility demands for curb space, research is needed to understand the potentially far-reaching consequences for urban development patterns (and hence energy consumption)
- Research needs to optimally allocate space for on-street parking and pick-up/drop-off (PUDOs) zones to minimize mobility impacts and energy use
- A need to update prevailing transportation models to account for increasing competition for curbside space



Curb Topology

Optimized curb design & management for mobility – productivity – energy

MILESTONES

Date	Milestone	Status
FY19 Q2	Review of practice and literature	Complete
FY19 Q3	Optimization Framework	On Track
FY19 Q4	Report/publication and presentation at conferences	On Track

APPROACH

Literature Review (FY2019 Q2)

- Review of studies on how academics and practitioners are modeling curb activity (including TNCs), as well as impacts on land use and urban infrastructure

Interviews (FY2019 Q3)

- Interview experts (within cities, metropolitan regions, airports, providers) with parking, curbside, land use, and emerging modes responsibility. The intent is to understand the key requirements and priorities for quantitative methods

Optimization Framework (FY2019 Q3)

- Develop mathematical models to optimally allocate/manage curbside space.

Microsimulation Analysis (FY2019 Q4)

- The models will then be implemented using SUMO open source traffic microsimulation software. A range scenarios will be developed and analyzed, to expose the properties of the proposed models

APPROACH: Initial Conceptual Model (Micro-scale; Mixed Integer Nonlinear Programming)

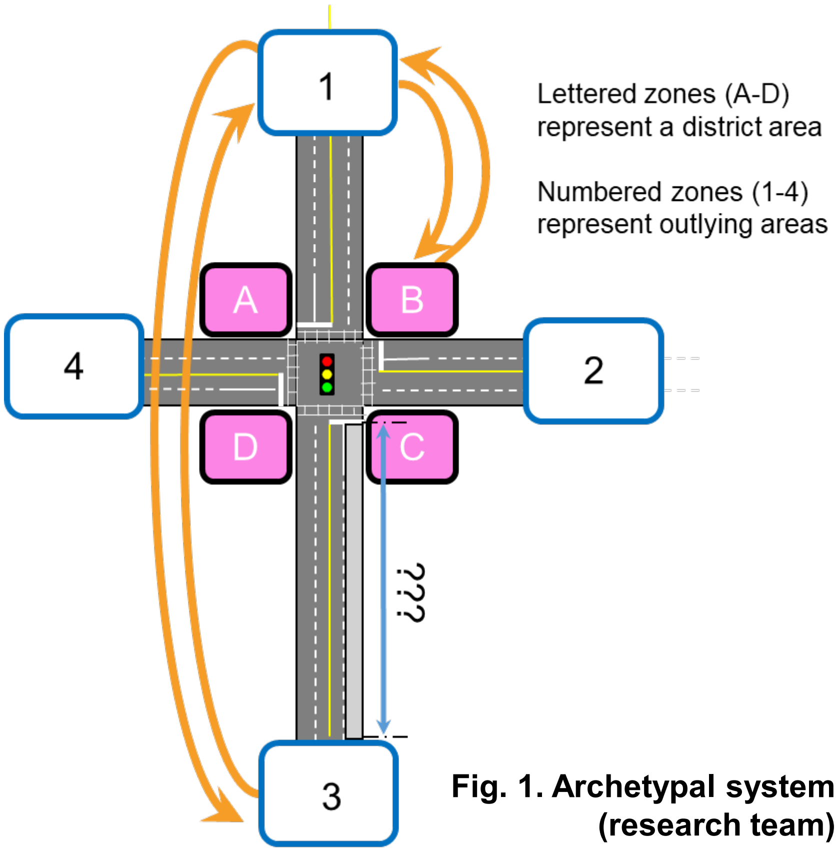
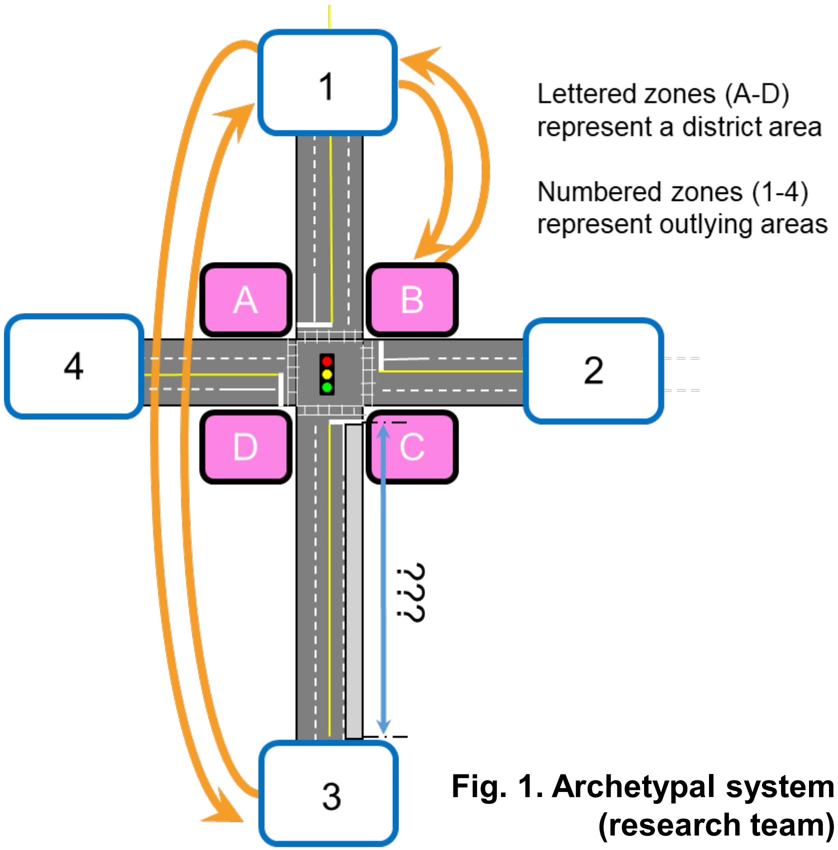


Fig. 1. Archetypal system (research team)

- Various modes seek Mobility (‘through’ movements) and/or Accessibility (to local land uses). The basic system has both outlying and district zones with an Origin-Destination travel demand matrix. Some trips (orange lines) are ‘through’ (e.g., from zone 1 to 3) and others start or end in a district area (e.g., start or end on zone B). In this simple-geometry example, a major signalized intersection is at core of the district zones A-D.

- Curb space can be flexibly allocated to a travel lane, on-street parking, bus lane, PUDO, commercial loading zone, or other mobility demands (e.g., sidewalk, scooter/bikeshare parking).

APPROACH: Initial Conceptual Model (Micro-scale; Mixed Integer Nonlinear Programming)



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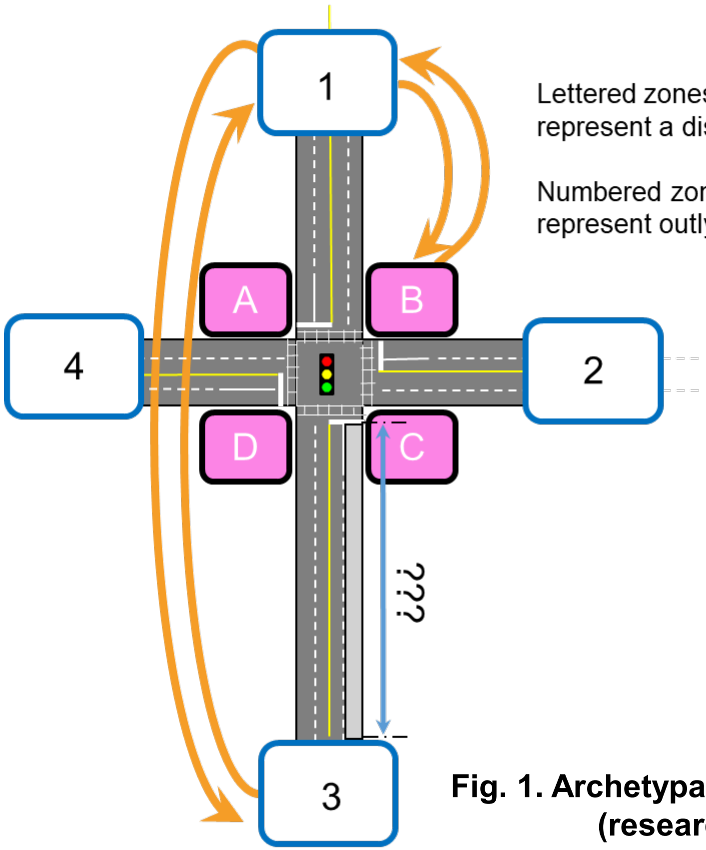
- Each linear foot of curb will provide value to some travelers. For example, a PUDO zone immediately adjacent to the intersection will provide high value to TNC users accessing Zone C, however at the expense of potential delays to travelers going from zone 3 to 1.

- This is a Mixed Integer Nonlinear Programming problem, in which economic welfare (or energy efficiency, travel delays, safety, etc.) is to be maximized and optimized. Allocation/management of each linear foot of curbside space are decision variables. Signal timing is also endogenous to curbside decision allocation.

APPROACH: Initial Conceptual Model (Micro-scale; Mixed Integer Nonlinear Programming)



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- Initial strategy is to get the simplest version of the model to be operational as proof of concept. We will then refine model based on feedback from the interview process and/or include a mode choice component to be influenced by curbside allocation policies and cost Other directions include incorporate urban freight, more complex system with multiple intersections, scale-up to macro level, dynamic testing, and/or priority access to mobility disadvantaged.

TECHNICAL ACCOMPLISHMENTS AND PROGRESS

- Kick-off Work Session held at SUNY New Paltz on March 2019
- Getting contract in place with Transpo in compressed timeframe
- Draft report on Literature Review completed; focus on both academic research and state-of-practice in modeling TNCs and parking in regional travel demand models
- Initial set of topics for practitioner interviews prepared
- Database of TNC curbside policies in preparation
- First-cut of “Initial Conceptual Model” developed

RESPONSES TO PREVIOUS YEARS REVIEWERS COMMENTS

- Project was not reviewed last year (commenced March 2019)

COLLABORATION AND COORDINATION

- National Renewable Energy Laboratory (NREL)
- Oak Ridge National Laboratory (ORNL)
- Industry: Transpo Group
- Academia (SUNY New Paltz, Southwest Jiaotong University)
  - Assistant professor
  - Doctoral student – traffic engineering, simulations

REMAINING CHALLENGES AND BARRIERS

- Next version of microscopic model given complexity (on-demand system integration, network dynamics)
- Refine model iteratively to incorporate desired sensitivity
- Scaling up from microscopic model (in which each linear foot of curb space is modeled) to macroscopic level of analysis
- Determine extent to which models are deterministic versus stochastic

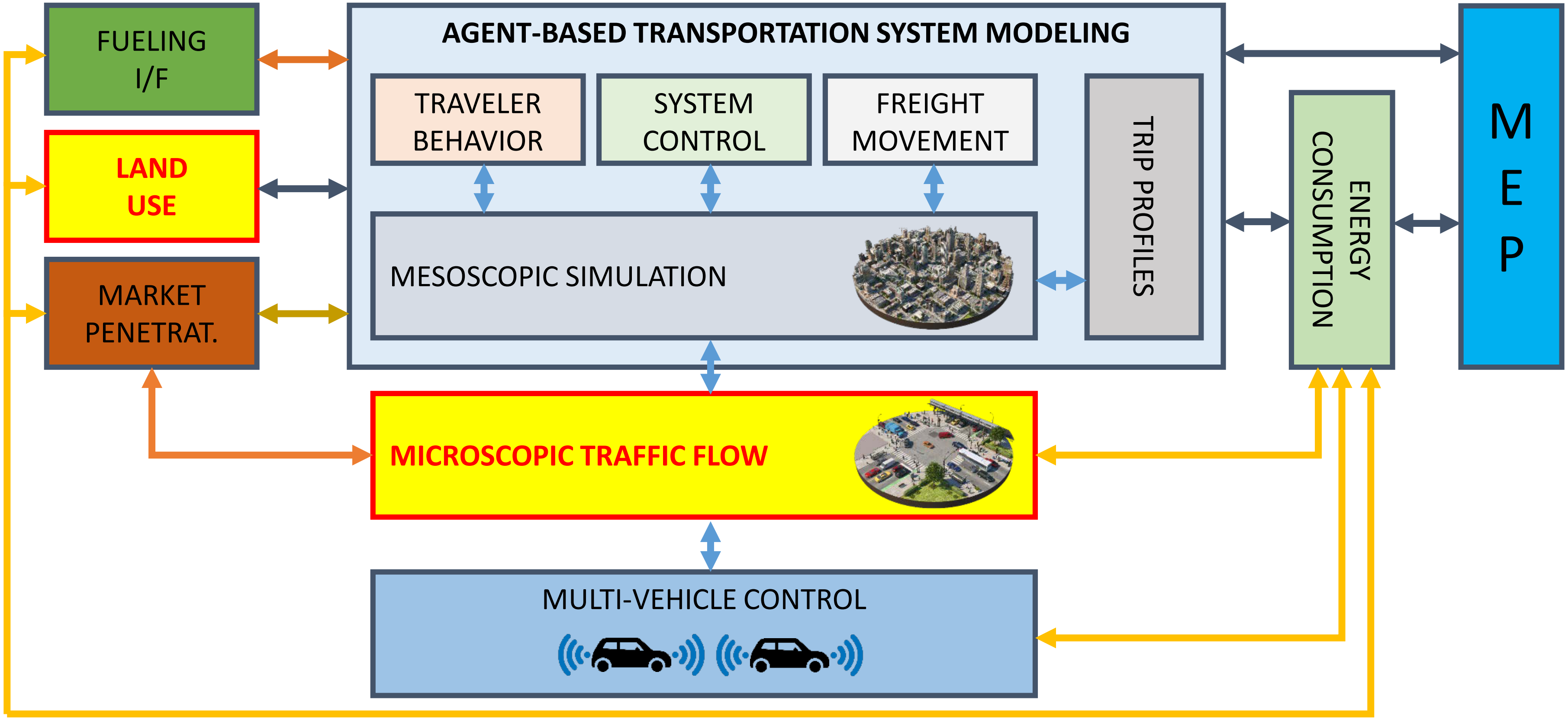
PROPOSED FUTURE RESEARCH

- Many dimensions for future research given the complexity of this research; priorities expected to emerge as current phase proceeds

SUMMARY SLIDE

- Curbside activity has not traditionally been represented in transportation network modeling in high fidelity
- Growing demand for curbside mean that prevailing practices are becoming increasingly untenable
- Builds on “Curb Productivity Metric” introduced in 2018 (Fehr & Peers and Uber) to take into account the overall function of infrastructure for different modes (not just parking) within the transportation system
- In this study, we are developing models that account for curbside activity at both the microscopic and macroscopic levels
- These new models will facilitate curbside allocation for mobility and energy optimization

END-TO-END MODELING WORKFLOW



QUESTIONS?

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