Project eems074
Urban Science Pillar

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

Cities Topology – Curbs and Parking

P.I.: STAN YOUNG (NREL)
PRESENTER: SCOTT LE VINE (TRANSPO GROUP)
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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%

Budget

- FY 2019: $350k

Barriers

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

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

San Francisco Curb Study (Uber and Fehr & Peers, 2018)

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 (FY19 Q2)

- Review of studies on how academics and practitioners are attempting to model TNC activity, as well as impacts on land use and urban infrastructure

Practitioner Interviews (FY19 Q3)

- Interview experts (city managers, operators) with parking, curbside, land use, and new modes responsibility. The intent is to understand the key requirements for quantitative methods

Optimization Framework (FY19 Q3)

- Develop mathematical models to optimally allocate/manage curbside space in the presence of TNC activity

Microsimulation Analysis (FY19 Q3)

- 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)

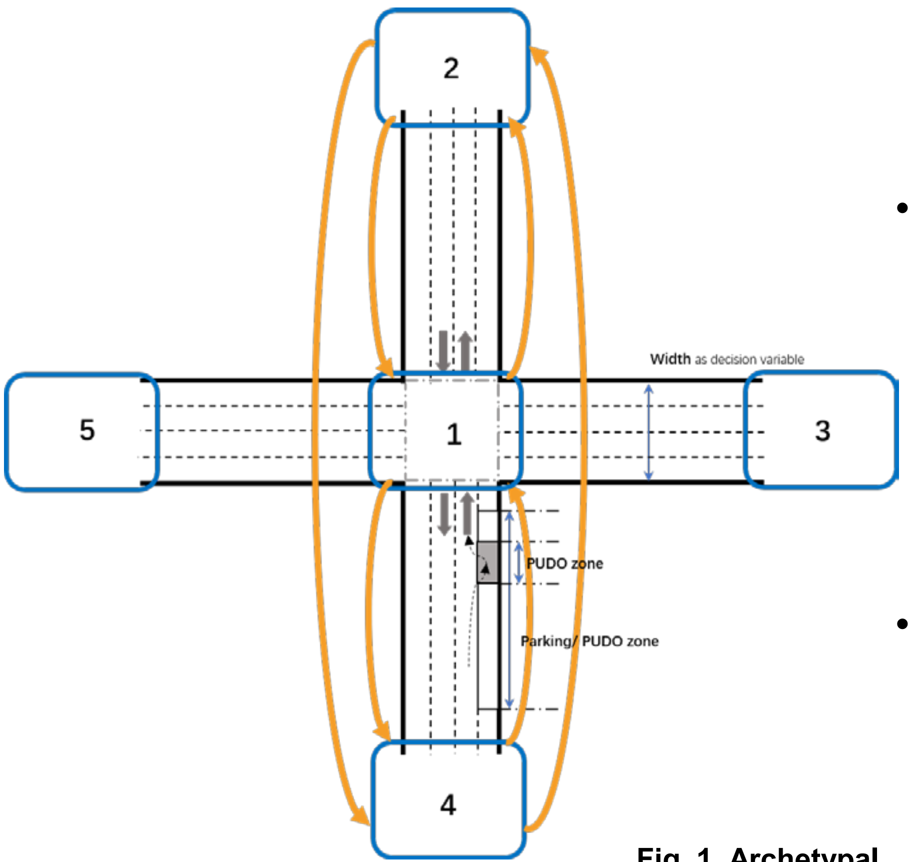

Fig. 1. Archetypal system (You Kong)

- Various modes seeking *Mobility* ('through' movements) and/or *Accessibility* (to local land uses) compete for scarce space within the public right-of-way
- The archetypal system (Fig. 1) has 5 zones (blue rectangles), with an Origin-Destination (O-D) travel demand matrix. Some trips (e.g. from zone 2 and 4) are 'through' and others are starting or ending at the centrally located Activity Center (Zone 1). A major signalized intersection at core of this Activity Center
- The cross-section of the street rights-of-way is limited, hence width can be flexibly allocated to travel lane(s), on-street parking, bus lane(s), TNC PUDO, commercial loading zone(s), or others (sidewalks, scooter/bikeshare, etc.); constrained by overall width

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

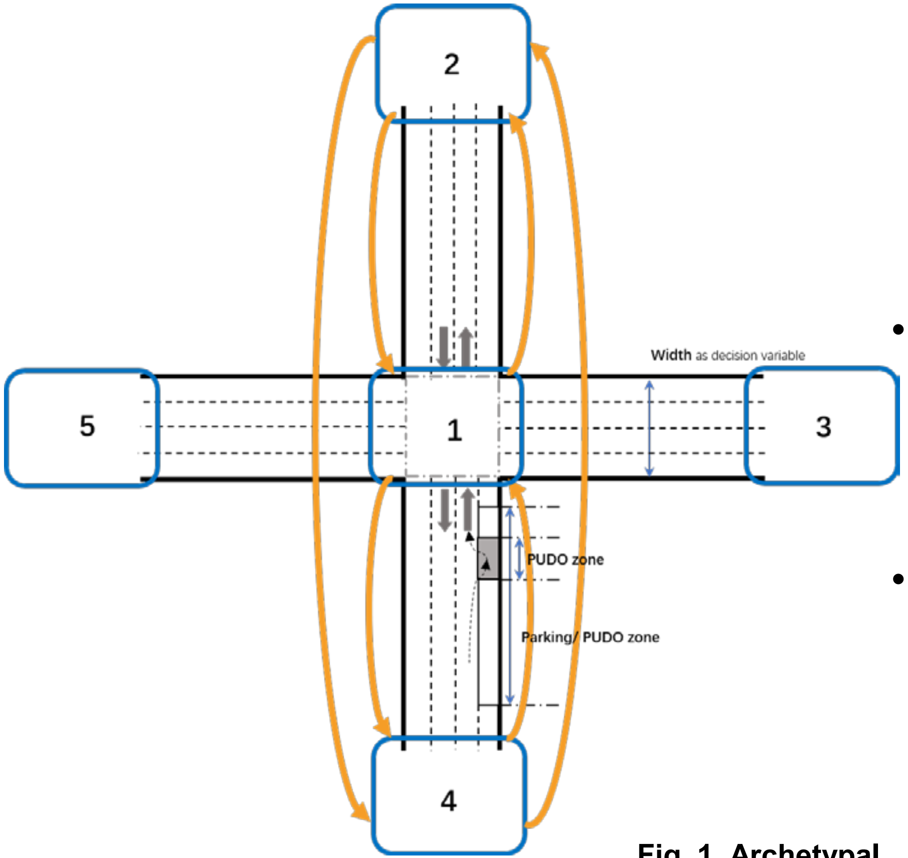

Fig. 1. Archetypal system (You Kong)

- Each linear foot of curbside will provide value to some or all groups of travelers. For example, a curbside TNC PUDO zone immediately adjacent to the intersection provides great value to TNC users accessing Zone 1, however at the expense of potentially delays to other travelers passing through
- This is a *Mixed Integer Nonlinear Programming* problem to be maximized by economic welfare. Allocation/management of each linear foot of curbside space are decision variables
- Signal timing is also endogenous; including variation between short signal phases (to benefit from relatively short distances of “no stopping” on curbsides) and longer signal phases with longer queue lengths may require larger distances allocated to through lanes (i.e. “no stopping”), rather than curbside PUDO

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

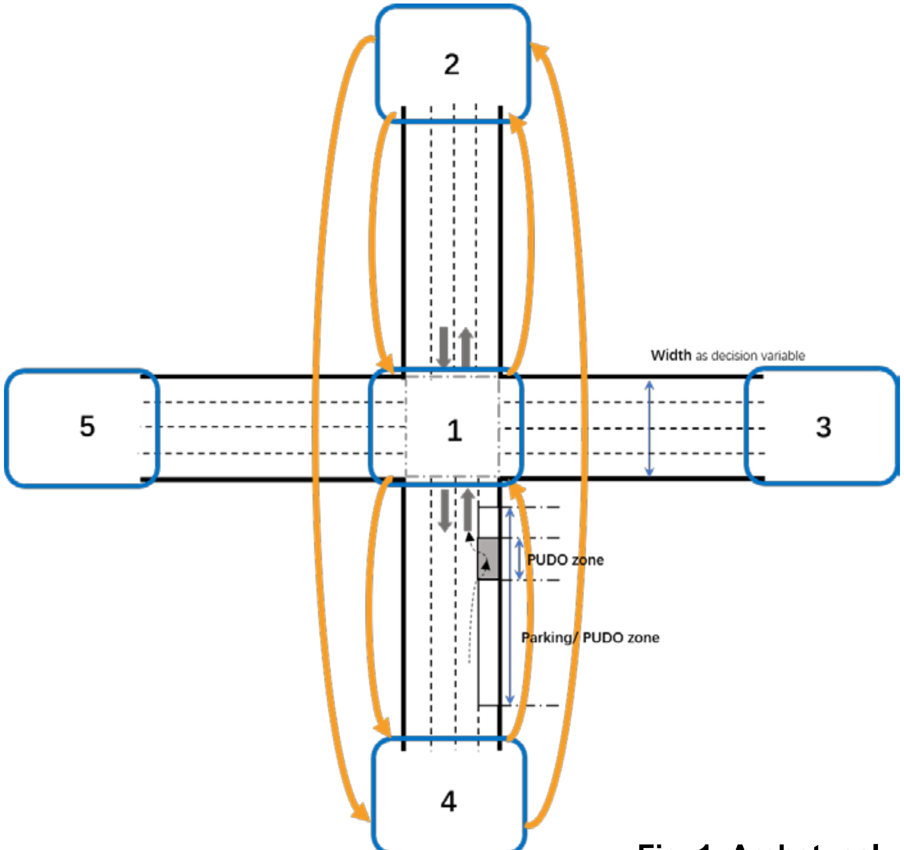

Fig. 1. Archetypal system (You Kong)

- The model will include a mode choice component, thus allowing demand for each mode of transport to 'float' in keeping with the utility that it provides travelers
- The model would allow to test several scenarios (such as frequent bus service that could attract many riders) and therefore increase curbside transit demand near the Activity Center
- Alternatively, changes in the costs and/or accessibility of TNCs (e.g. PUDO zones at longer distance from Activity Center) could result in lower demand for TNC usage

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

- Define "minimum operational version" of microscopic model given complexity (on-demand system integration, network dynamics)
- Refine microscopic 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
- Balance between two perspectives:
  - Impact on the roadway flow as a result of curb management (more vehicles per hour, less friction)
  - Metrics of how efficiently curb can act as a membrane for connecting traveler to final destination (less of a roadway friction, and more of a permeability perspective)
- 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

QUESTIONS?