BU Initiative on Cities: Beyond Congestion

Matthew Raifman

Senior Manager, Ford Smart Mobility

Why do we care about congestion?

- Time (travel time, predictability)
- Greenhouse Gas Emissions (CO, CO_2, NOx)
- Health (stress, exposure to PM)
- Vehicle costs

What is Congestion?

Boston Globe

What is Congestion?

Excess of vehicles on a portion of roadway at a particular time resulting in a reduction below the total possible throughput.

What is Congestion? What can we do about it?

More roads

Fewer vehicles

Excess of vehicles on a portion of roadway at a particular time resulting in a reduction below the total possible throughput.

Spread demand over time

Improve the overall efficiency of the roadway

What is Congestion? What can we do about it?

More roads

Excess of vehicles on a portion of roadway at a particular time resulting in a reduction below the total possible throughput.

How might we access more roadway?

- Build more roads
- Repurpose greenspace, bikelanes, and sidewalks

"If you build it, they will come" induced demand on Boston Artery

How might we access more roadway?

- Build more roads

- Repurpose greenspace, bikelanes, and sidewalks

What's the right mix of green lanes, roads, sidewalks, parking, and dedicated bus lanes to optimize throughput?

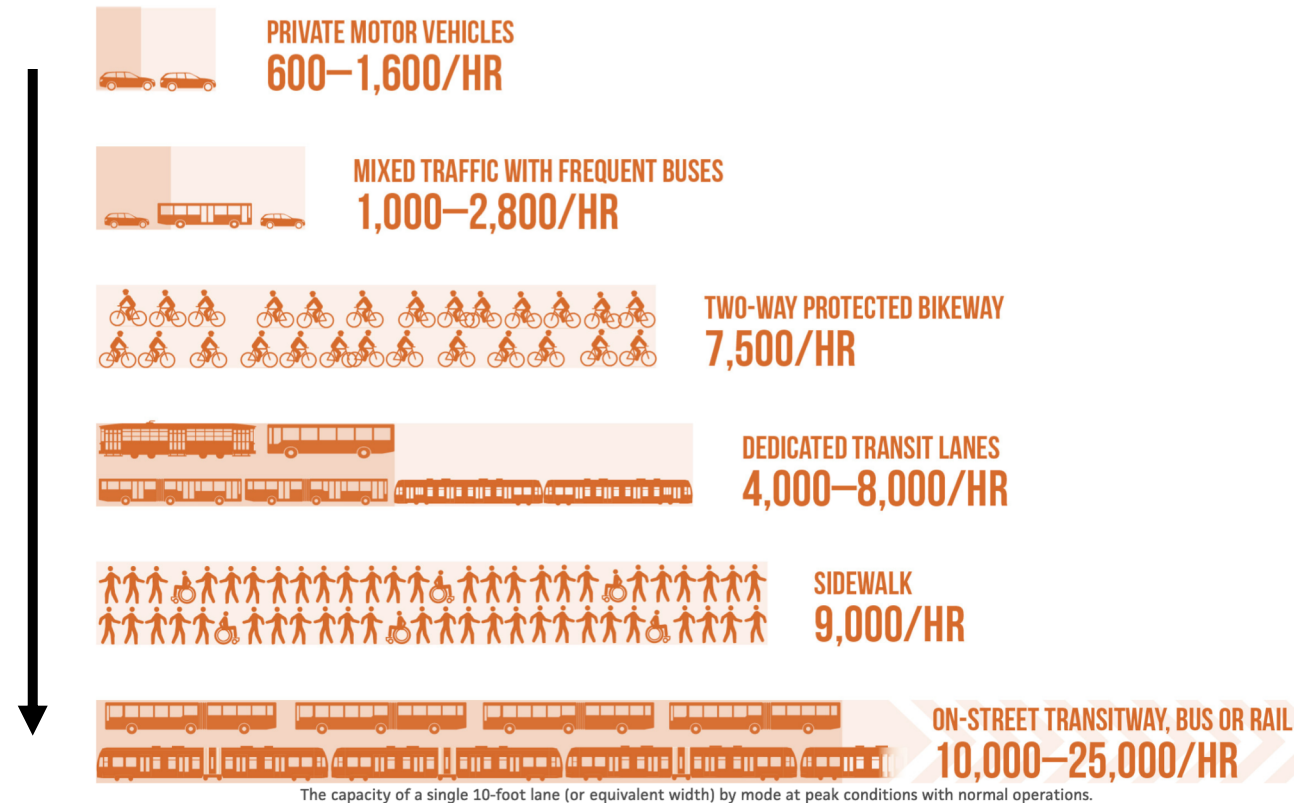# What is Congestion? What can we do about it?

Fewer vehicles

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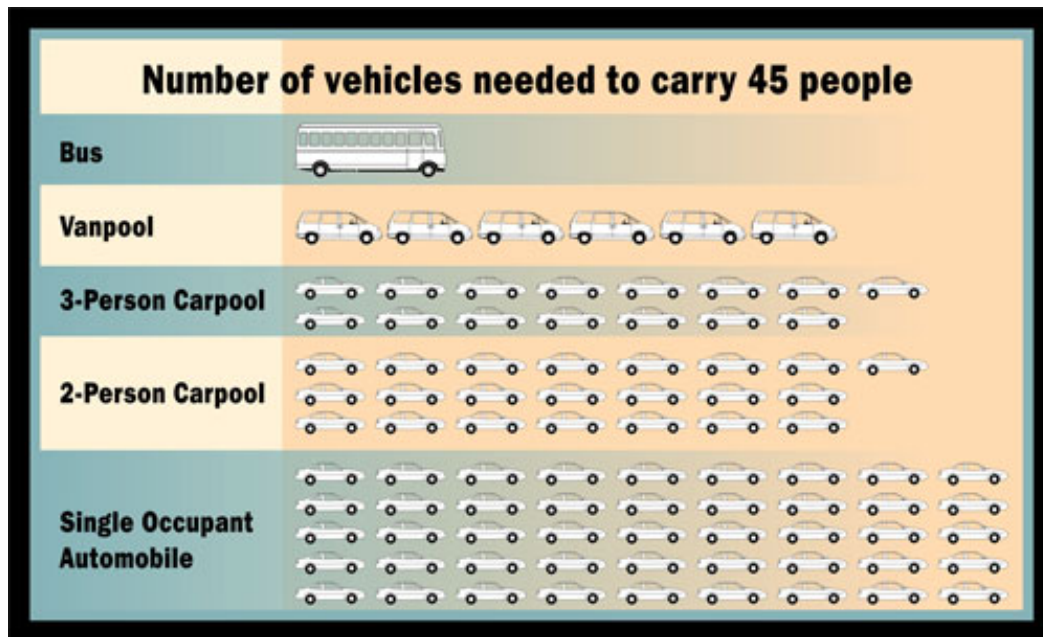# How might we reduce the number of vehicles on the road?

- Shift commuters from private vehicles to more efficient modes

PRIVATE MOTOR VEHICLES
600–1,600/HR

MIXED TRAFFIC WITH FREQUENT BUSES
1,000–2,800/HR

TWO-WAY PROTECTED BIKEWAY
7,500/HR

DEDICATED TRANSIT LANES
4,000–8,000/HR

SIDEWALK
9,000/HR

ON-STREET TRANSITWAY, BUS OR RAIL
10,000–25,000/HR

The capacity of a single 10-foot lane (or equivalent width) by mode at peak conditions with normal operations.

NACTO, Designing to Move People Guide

How might we reduce the number of vehicles on the road?

- Pool people and goods

USDOT FHWA

Curbed; Shutterstock

How might we reduce the number of vehicles on the road?

- Shift from cars to more efficient modes

- Pool people and goods

- Don't drive in the first place

What is Congestion? What can we do about it?

Excess of vehicles on a portion of roadway at a particular time resulting in a reduction below the total possible throughput.

Spread demand over time

Spread demand over time?

- Workplace policies (staggered arrival times)

- Off hour goods delivery

- Technology-enabled routing across time

What is Congestion? What can we do about it?

Excess of vehicles on a portion of roadway at a particular time resulting in a reduction below the total possible throughput.

Improve the overall efficiency of the roadway

How might we improve the overall efficiency of the system?

- Avoid unnecessary stopping (e.g. tolls, parking)

- Optimize speed to maintain throughput

- Dynamically reroute based on traffic conditions

Summary

- Behavior change away from single occupancy vehicles

- Technology can potentially enable behavior change… but policy, regulation, and pricing play a key role

- Technology can improve overall efficiency of system on the margins, but it is not a silver bullet

From Data to Models and Proposed Solutions

Yannis Paschalidis

yannisp@bu.edu, http://sites.bu.edu/paschalidis/

CISE — CENTER FOR INFORMATION & SYSTEMS ENGINEERING

BOSTON UNIVERSITY

Department of Electrical and Computer Engineering,
Division of Systems Engineering,
Department of Biomedical Engineering,
and Center for Information and Systems Engineering
Boston University

March 26, 2019
Forum at IOC

The problem

- Traffic congestion responsible for 20% of fuel consumption and 90% of CO in large urban areas.
- Cost of traffic congestion will reach $2.8T in the US by 2030 ($\approx$ annual tax revenue).
- On a per-driver basis, cost of traffic congestion is $1740 annually in US/Europe.
- Boston recently made news being declared #1 in hours lost in rush-hour traffic per driver in 2018.

Congestion Maps for the Boston Area: 2012→2015

https://salomonw.github.io/congestionmaps/DynamicPage/PM/index.html
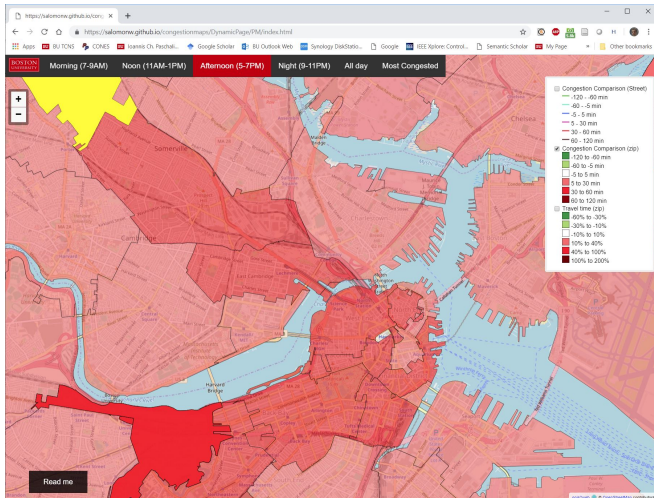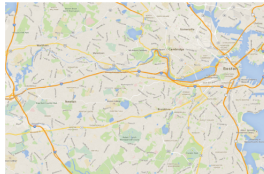
(Salo Wollenstein)

Transportation Network Models
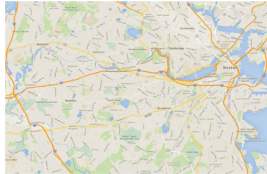
- **Transportation** network modeled as a graph.

- **Dynamics**: Drivers have a congestion function function of flow for each arc and pick the cheapest arcs to traverse. Collective decisions lead to a Nash (Wardrop) equilibrium.

- To control/design we need to build accurate predictive models.

- Data: Traffic flows.

- Can we learn (the congestion function) from data?

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Price of Anarchy[1]

- Having the congestion function allows us to answer many "what-if-questions".

- We can also formulate a problem to obtain a socially optimal equilibrium.

- Price-of-Anarchy:

$$PoA = \frac{\text{Congestion under Selfish Behavior}}{\text{Congestion under Socially Optimal Behavior}}$$

- Useful to assess how good/bad things are, but also to design interventions.

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[1] Zhang, Pourazarm, Cassandras, Paschalidis, CDC 2016, IFAC 2017, Proceedings IEEE 2018.

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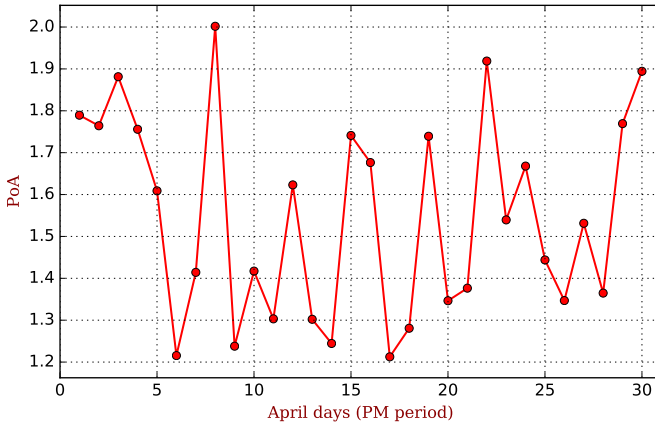
Boston Area Data[2]
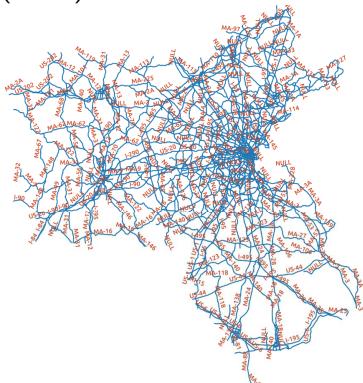
Eastern Massachusetts
(EMA) Network

- Spatial average speeds for 13,000 road segments for each minute of 2012 (50 GB) and 2015 (130 GB).
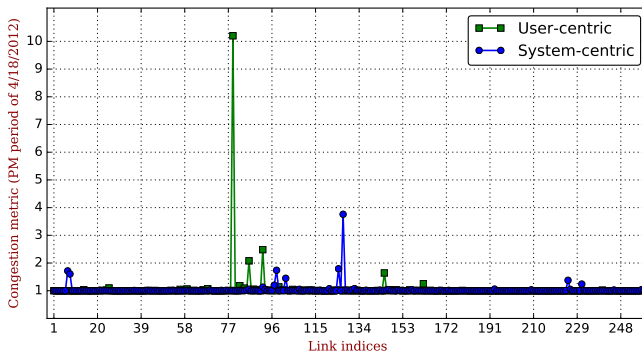- Capacity data in different times-of-day: lanes, peak vehicles counts, etc.

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[2] https://github.com/jingzbu/InverseVIsTraffic,
https://www.kaggle.com/jingzbu/ematransportation

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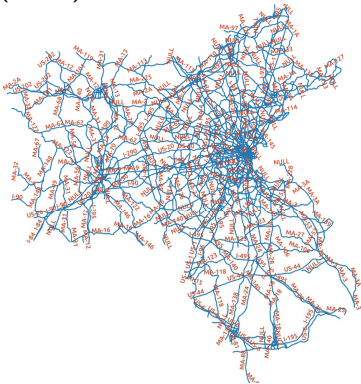
Price-of-Anarchy (2012)

Road Congestion: Socially Optimal vs. User Optimal

"Spreading the traffic" results in:

Control and Interventions

1. **Sensitivities:** Where to intervene?

2. Socially optimal route recommendations: Can be shown that we can achieve the Socially Optimal solution through User Optimal actions if users use a properly modified congestion function!

   - Easier to incorporate in apps, even enforce with autonomous vehicles.

   - Users the chance to do it themselves

3. Change demand! Congestion pricing and incentives!

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Yannis Paschalidis, Boston University

Final remarks

- We have developed a new general framework for modeling driver behavior using data.
- Policy space: How to address traffic allocation issues and prevent NIMBY reactions?

New Skills for New Mobility

Boston University Initiative on Cities
March 2019

Jascha Franklin-Hodge / @jfh

What's new?

New mobility is digital
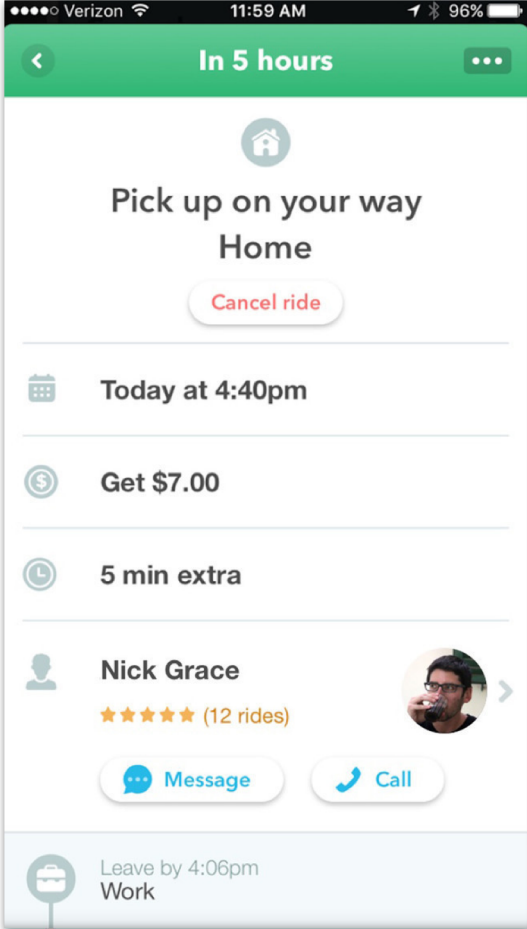
New mobility is market driven.
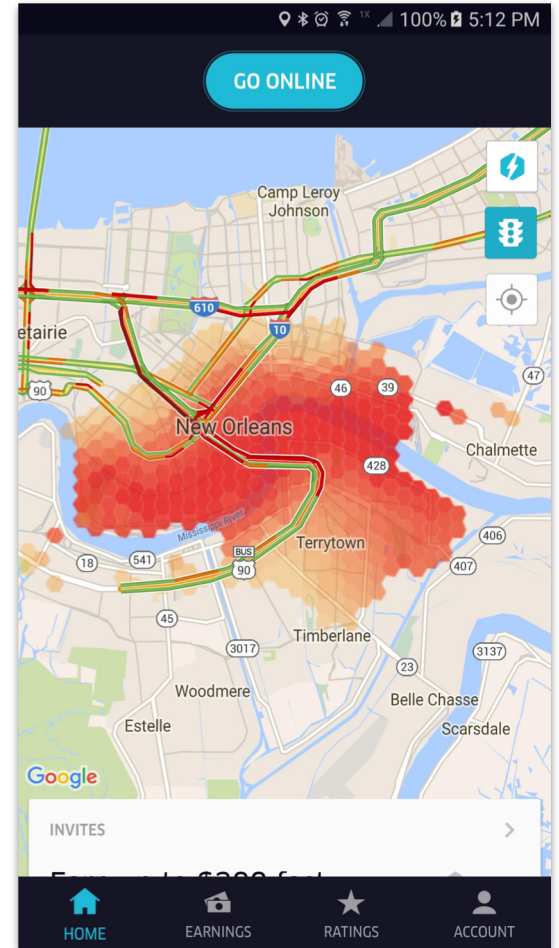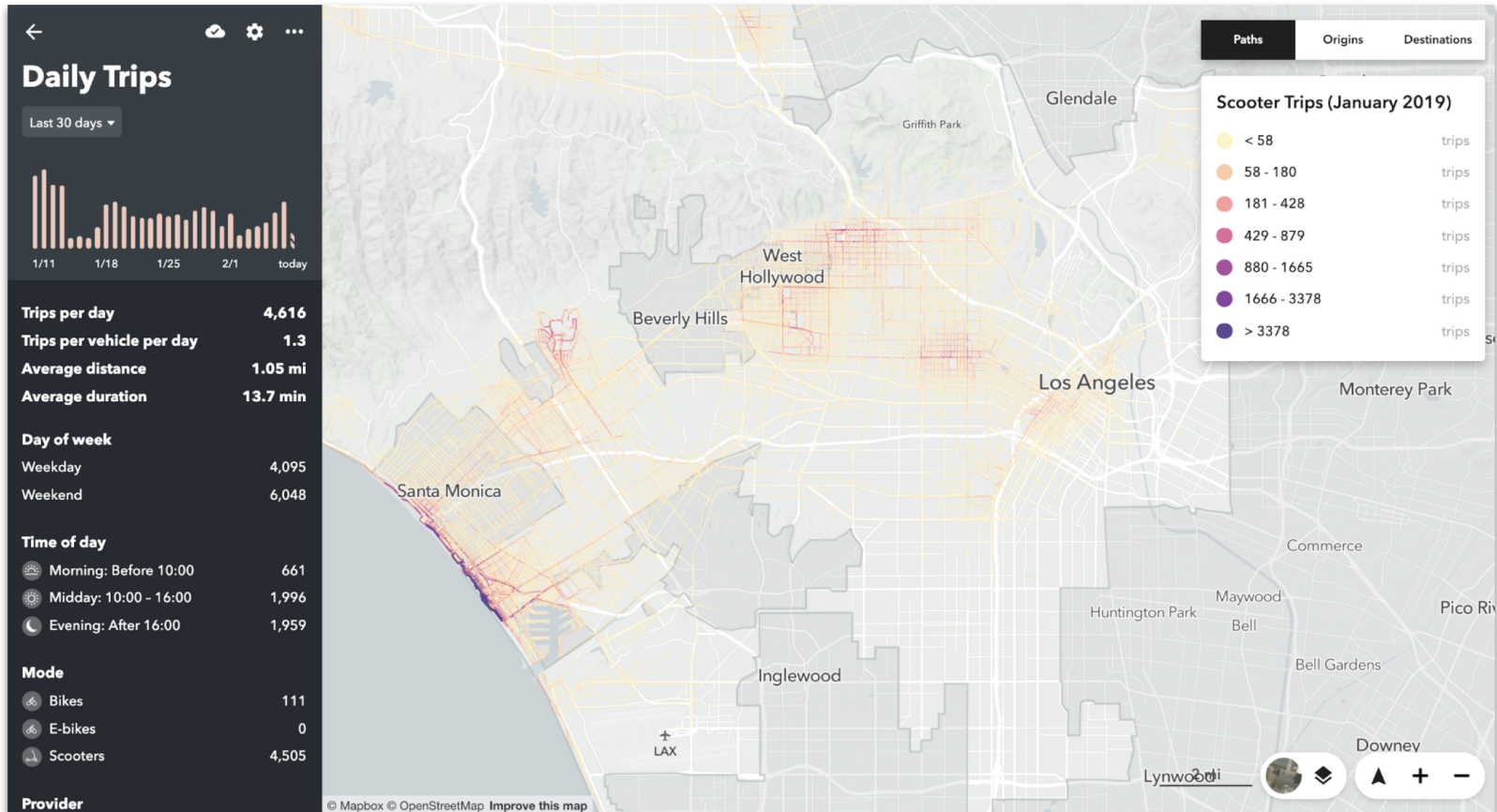
New mobility is dynamic.

Bike Share Growth in the US
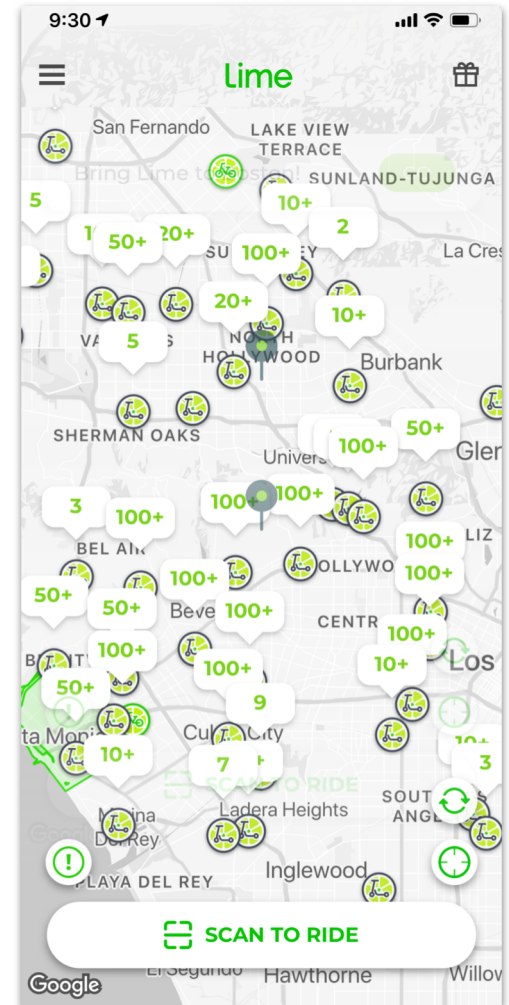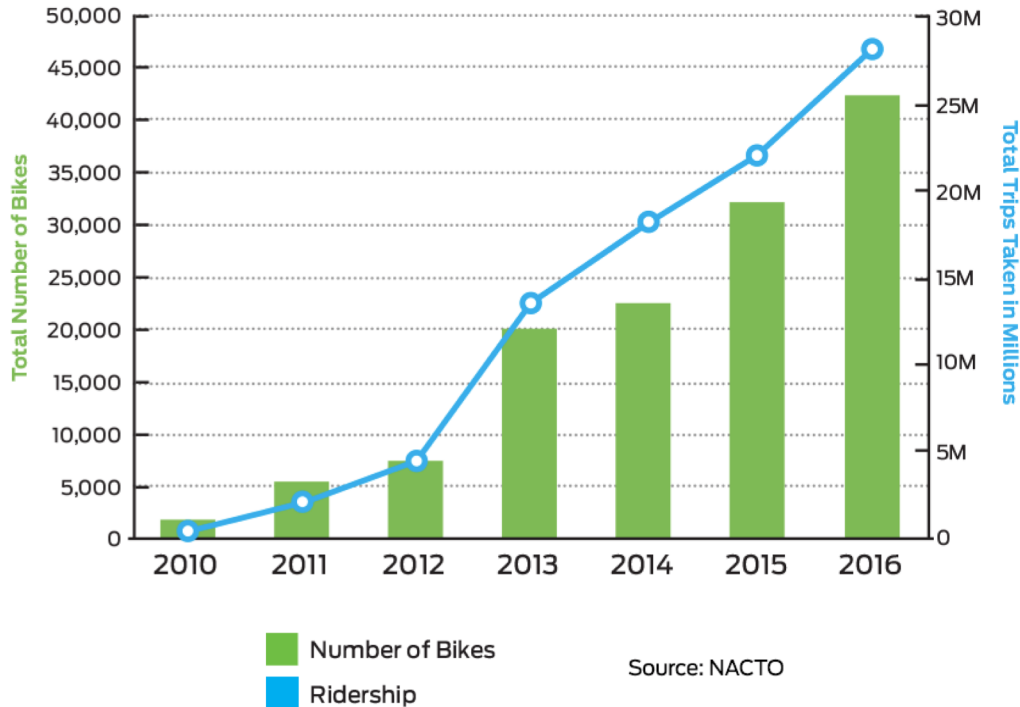
New mobility is dynamic.

New skill: Real-time data for planning

New skill: Data sharing with private sector

New skill: Data sharing with private sector

19104321D

HOUSE BILL NO. 2232
Offered January 9, 2019
Prefiled January 8, 2019
A BILL to amend and reenact §§ 46.2-100, 46.2-800, 46.2-849, 46.2-903, 46.2-904, 46.2-905, 46.2-908.1, 46.2-1015, 46.2-1041, and 46.2-1081 of the Code of Virginia and to amend the Code of Virginia by adding in Chapter 13 of Title 46.2 a section numbered 46.2-1315, relating to motorized skateboards or foot-scooters; operation; local authority.

Patrons—Bagby and Sickles

Referred to Committee on Transportation

Be it enacted by the General Assembly of Virginia:
1. That §§ 46.2-100, 46.2-800, 46.2-849, 46.2-903, 46.2-904, 46.2-905, 46.2-908.1, 46.2-1015, 46.2-1041, and 46.2-1081 of the Code of Virginia are amended and reenacted and that the Code of Virginia is amended by adding in Chapter 13 of Title 46.2 a section numbered 46.2-1315 as follows:
§ 46.2-100. Definitions.
As used in this title, unless the context requires a different meaning:
"All-terrain vehicle" means a motor vehicle having three or more wheels that is powered by a motor and is manufactured for off-highway use. "All-terrain vehicle" does not include four-wheeled vehicles commonly known as "go-carts" that have low centers of gravity and are typically used in racing on

599   1. Require licensees to provide to the locality anonymized fleet and ride activity data for all trips
600 starting or ending within the jurisdiction of the locality on any vehicle provided by the licensee or any
601 company controlled by, controlling, or under common control with the licensee, provided that (i) such
602 data is provided via an application programming interface complying with the format requirements of
603 the Mobility Data Specification and subject to the licensee's license agreement for such interface; (ii)
604 any such data provided shall be treated as trade secret and proprietary business information, shall not
605 be shared to third parties without the licensee's consent, and shall not be treated as owned by the local
606 authority; and (iii) disaggregated ride history data containing GPS location traces of rides taken by
607 users shall be considered personally identifiable information and shall under no circumstances be

41   "Bicycle lane" means that portion of a roadway designated by signs and/or pavement markings for
42 the preferential use of bicycles, electric power-assisted bicycles, motorized skateboards or foot-scooters,
43 and mopeds.
44   "Business district" means the territory contiguous to a highway where 75 percent or more of the
45 property contiguous to a highway, on either side of the highway, for a distance of 300 feet or more
46 along the highway, is occupied by land and buildings actually in use for business purposes.
47   "Camping trailer" means every vehicle that has collapsible sides and contains sleeping quarters but
48 may or may not contain bathing and cooking facilities and is designed to be drawn by a motor vehicle.
49   "Cancel" or "cancellation" means that the document or privilege cancelled has been annulled or
50 terminated because of some error, defect, or ineligibility, but the cancellation is without prejudice and

New skill: Adaptive regulations

3.3.1 Dynamic Cap Adjustment Process

Operators interested in increasing their device cap must submit a request to the City with recent and relevant supporting data that demonstrates fleet utilization levels that meet or exceed the MUR. Data from the first 30 days of the pilot program should not be used in a request for adjustment. Utilization is calculated by dividing the sum of total daily rides within the jurisdiction over a one week period by the number of total devices available daily during the same timeframe. The highest and lowest outliers may be removed from the calculation.

New skill: Dynamic pricing
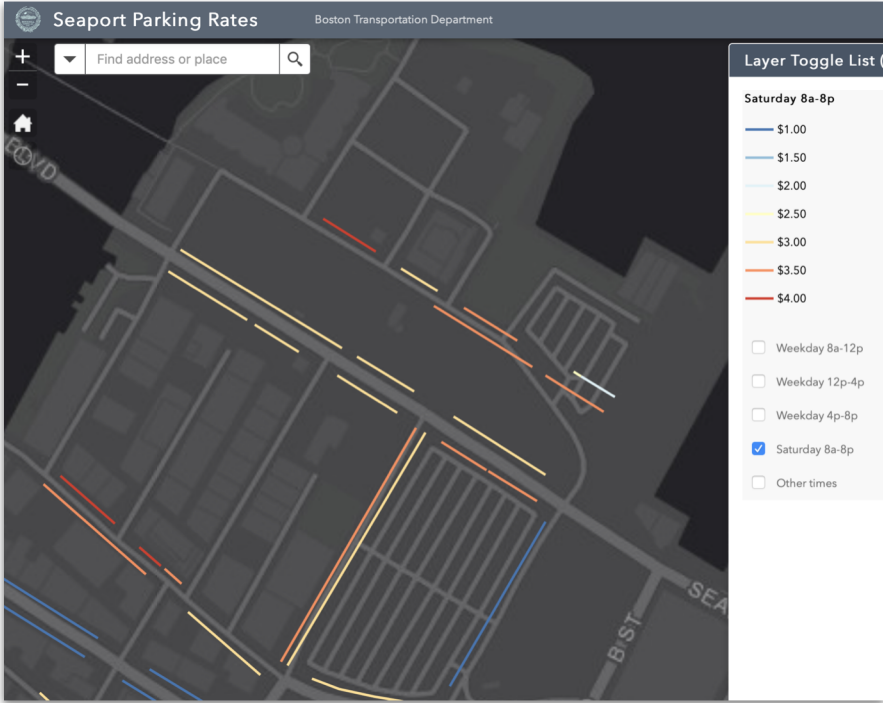
New skill: Incentives for outcomes

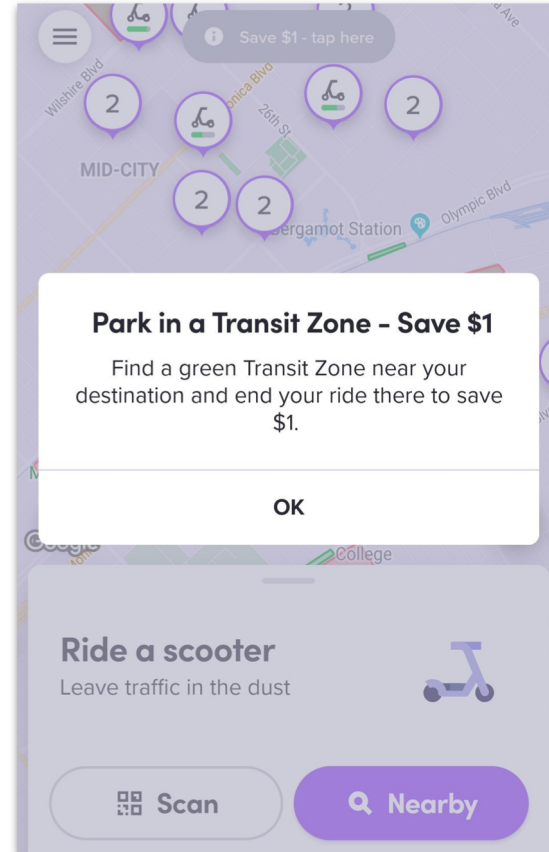
Your Uber and Lyft ride at Logan Airport may soon change

PAT GREENHOUSE/GLOBE STAFF/FILE

By Adam Vaccaro | GLOBE STAFF · MARCH 21, 2019

Those Lyft and Uber rides to and from Logan may be getting more expensive — and they probably won't be dropping you off in front of the terminal anymore.

The Massachusetts Port Authority, which operates Logan Airport, on Thursday unveiled details of its plan to rein in the thousands of Uber and Lyft rides clogging its terminals and narrow roads, and a fee increase that would make its ride-hailing charge among the highest of any airport in the country.

"We have to do something," said Edward Freni, the agency's director of aviation, expressing exasperation about the daily traffic jams at the terminals and in East Boston.

Park in a Transit Zone – Save $1

Find a green Transit Zone near your destination and end your ride there to save $1.

OK

Ride a scooter
Leave traffic in the dust

Scan   Nearby

New skill: Consumer protection

11.02.18 | WORLD CHANGING IDEAS

Why Uber and Lyft want to create walled gardens—and why it's bad for urban mobility

As ride-hailing apps begin to control scooters and bike shares, they're making it harder for people to make the best decisions about how to move around their cities.
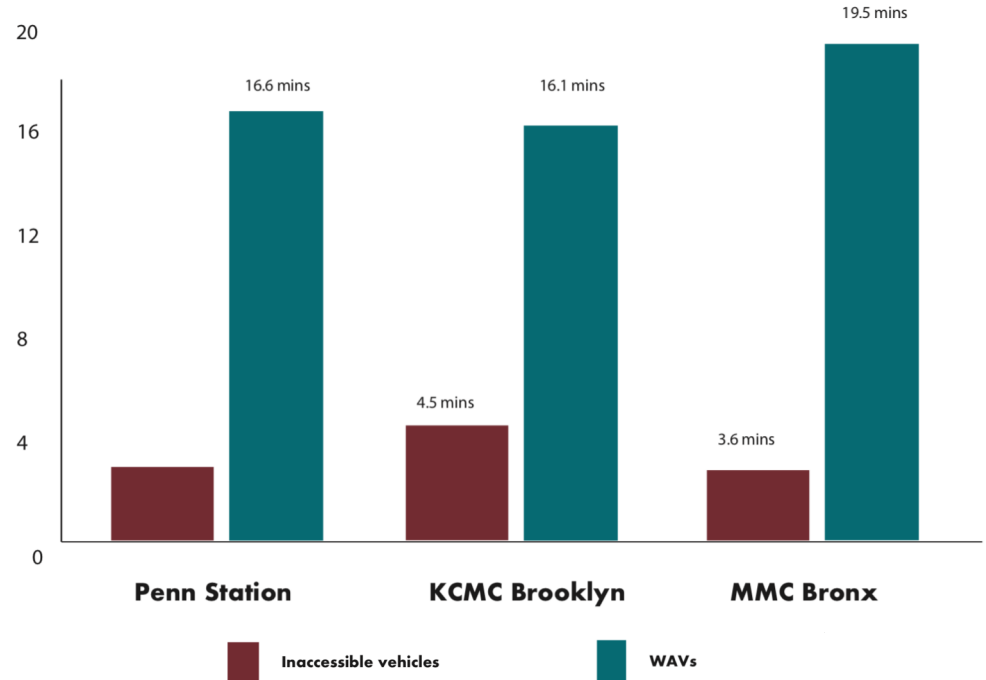
[Photo: Mary Altaffer/AP/Shutterstock]

BY DAVID ZIPPER 6 MINUTE READ

If you're not a techie, you may not have come across the term "walled garden" before. But it's a critical concept these [Why Uber and Lyf...]

FAST COMPANY

Estimated wait times locations for available vehicles (Note No WAVs were available at JFK or LGA Airports)

Penn Station: Inaccessible vehicles ~3.2 mins, WAVs 16.6 mins
KCMC Brooklyn: Inaccessible vehicles 4.5 mins, WAVs 16.1 mins
MMC Bronx: Inaccessible vehicles 3.6 mins, WAVs 19.5 mins

Legend: Inaccessible vehicles, WAVs

The future of the DOT is roads...and code.