

Beyond Cars: Technology Solutions to Advance Integrated Mobility

Jake Sion

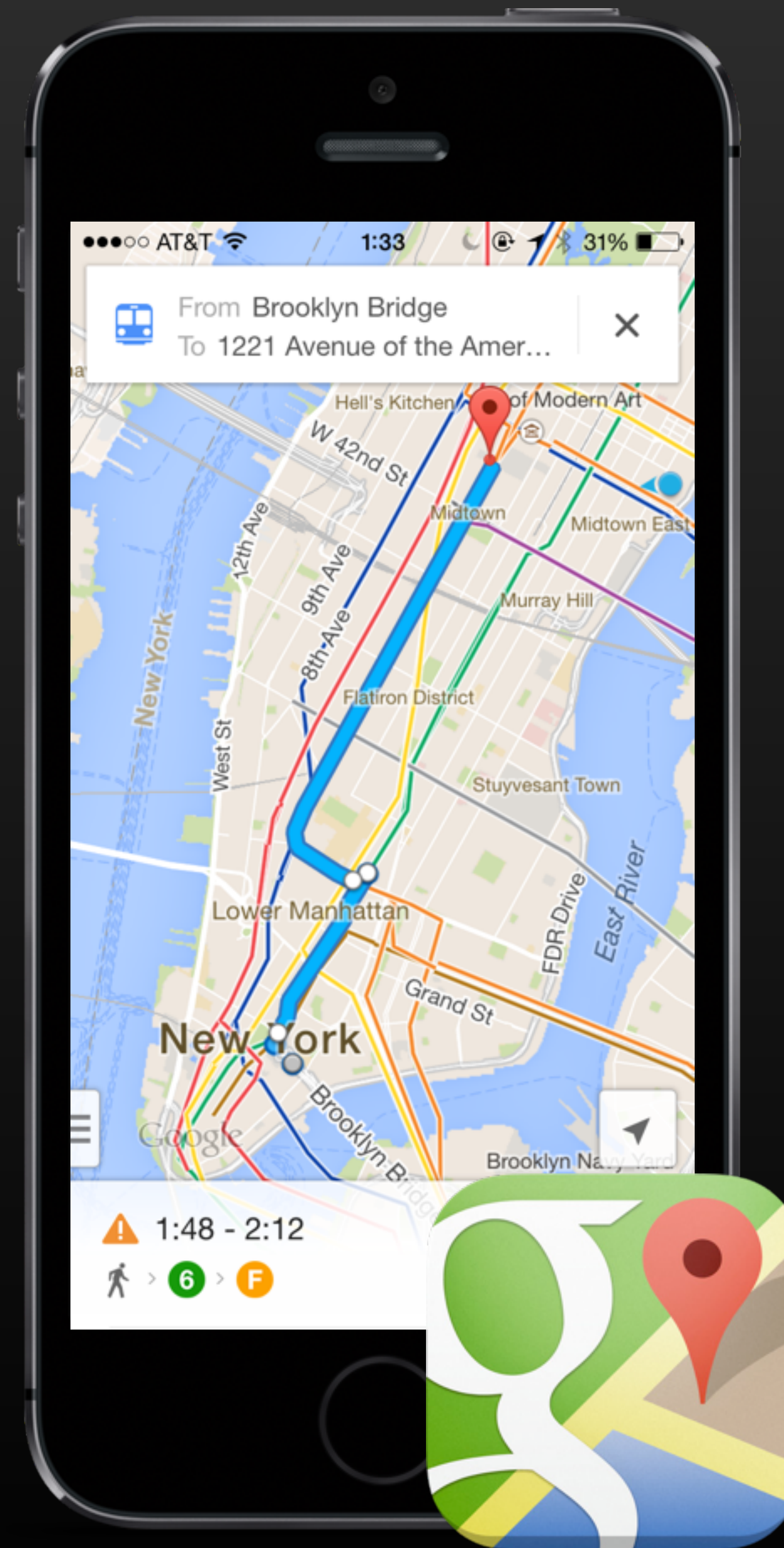
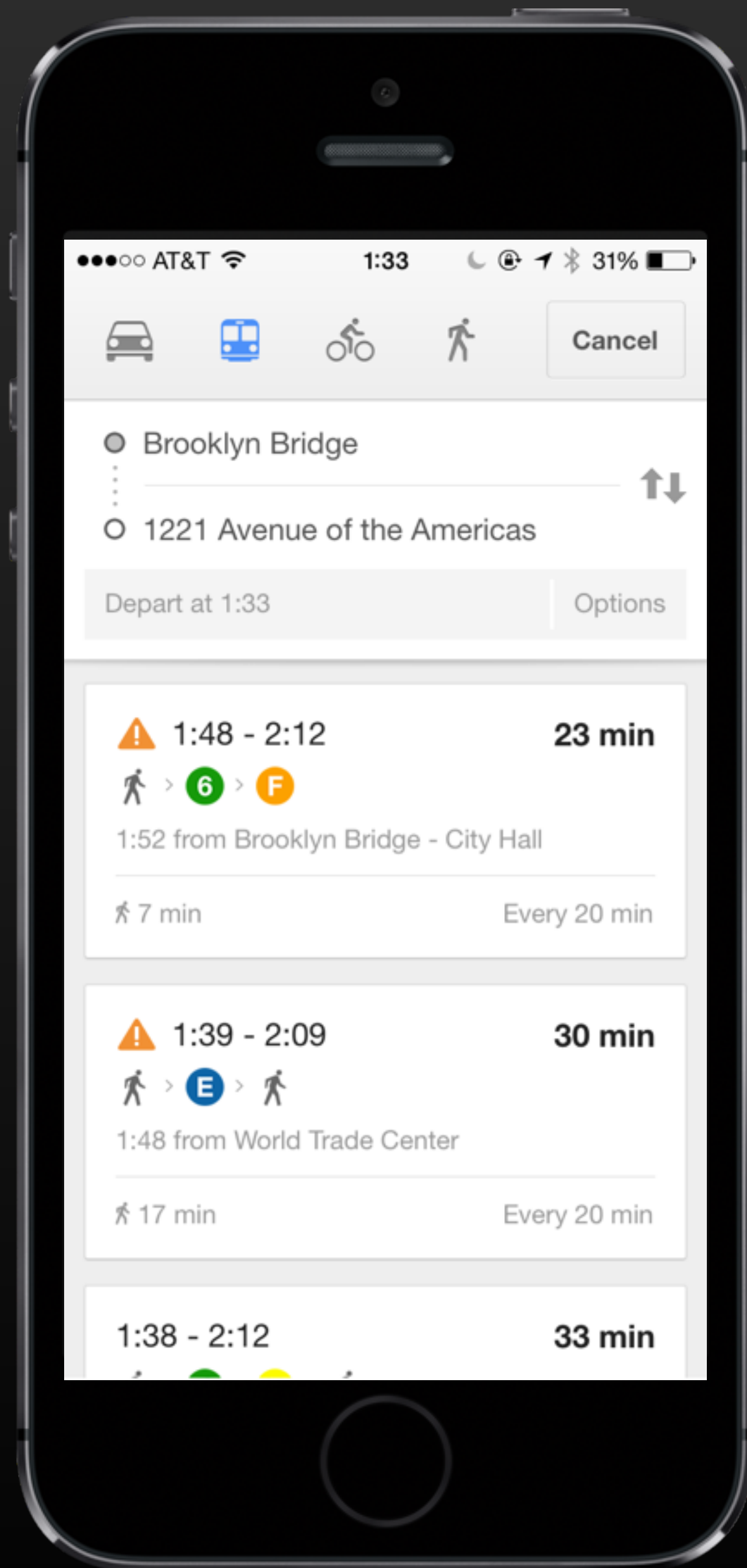
March 2016



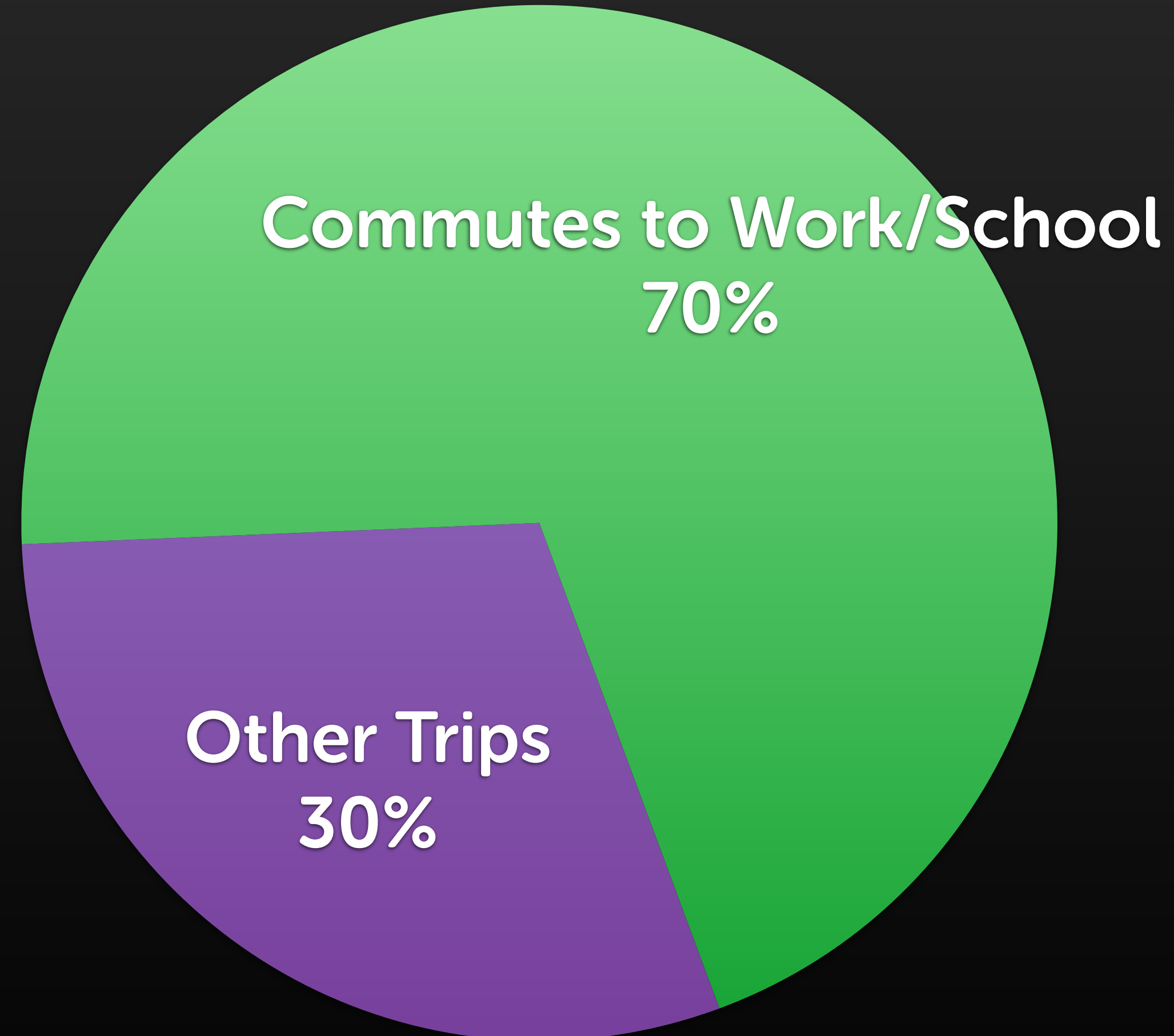
30 40

Public Transit Apps in 2011



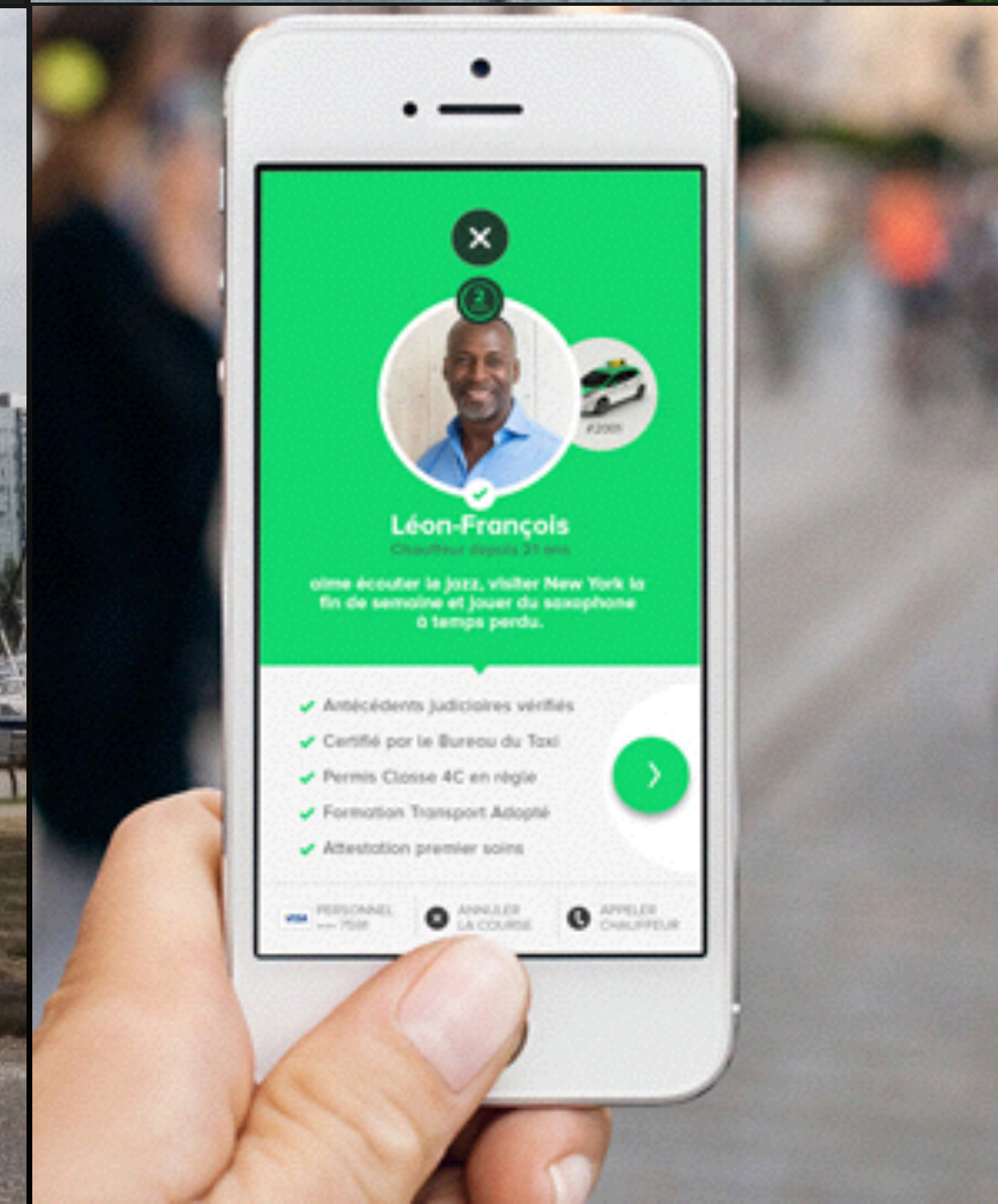


Share of Transit Trips USA*









Navigation



STM



BIXI



Communauto



Uber



AutoMobile



Hailo



car2go



CycleMap



AMT Chrono

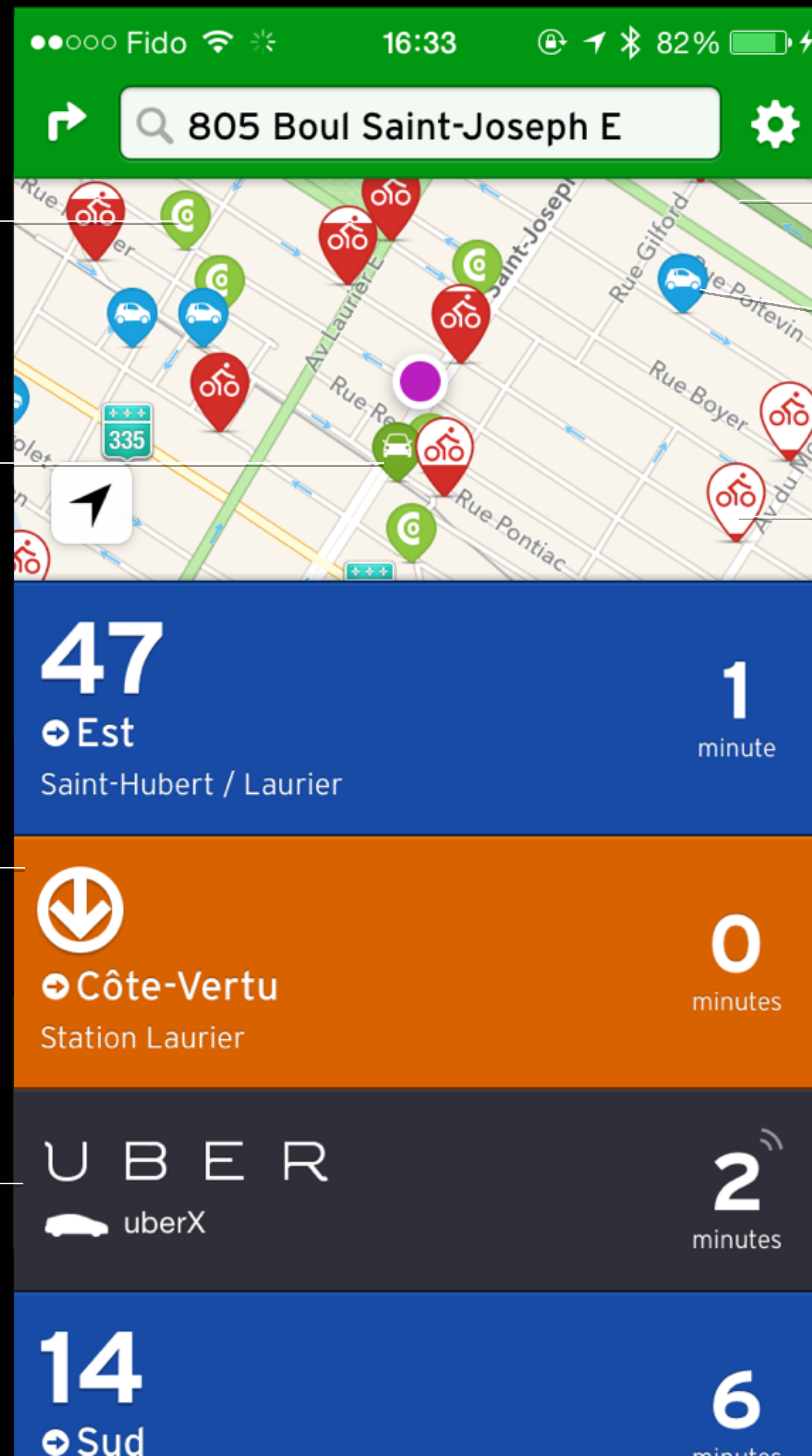


Communauto

Auto-mobile

Public Transit

Uber



Bike Paths

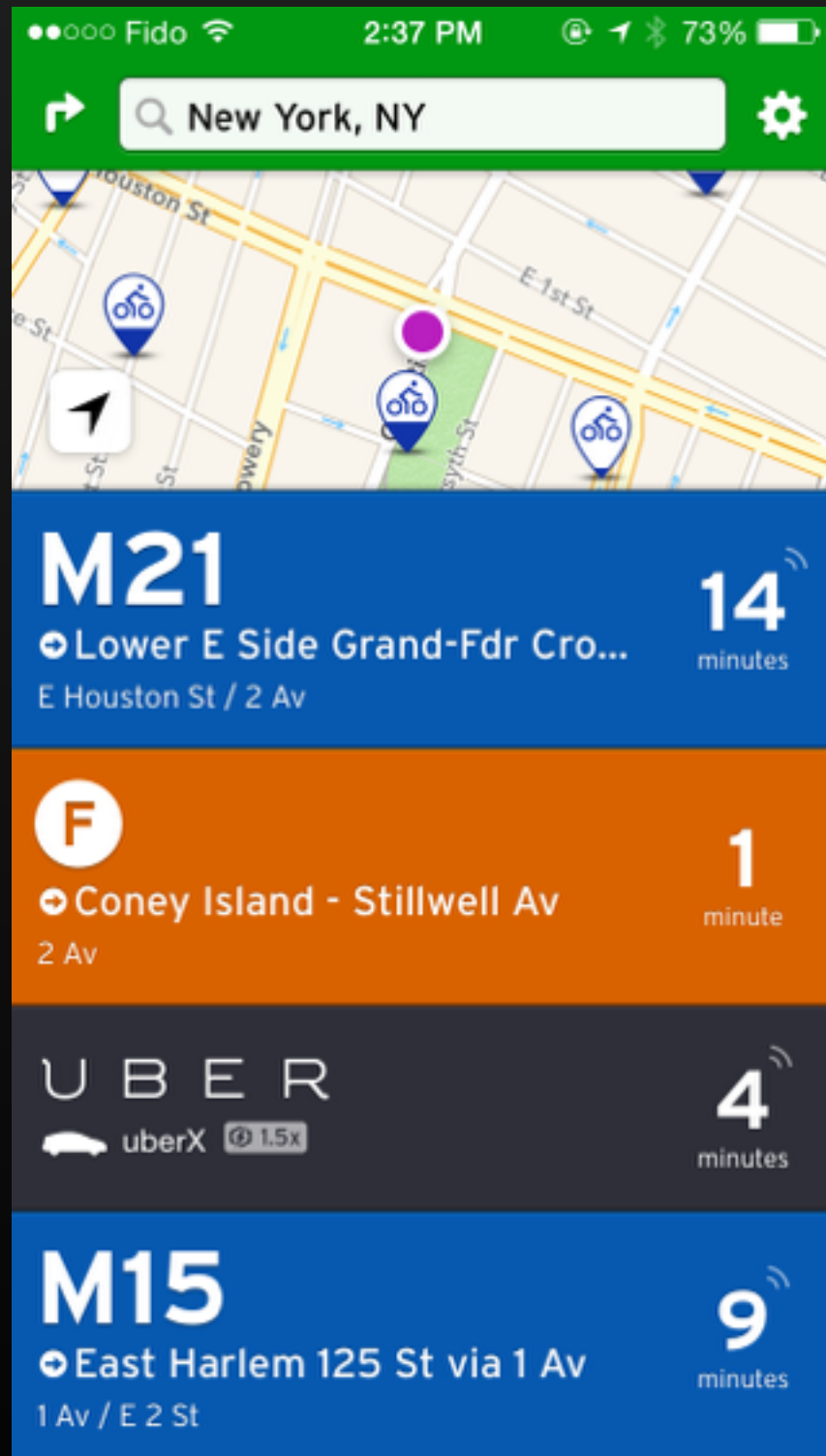
car2go

Bixi

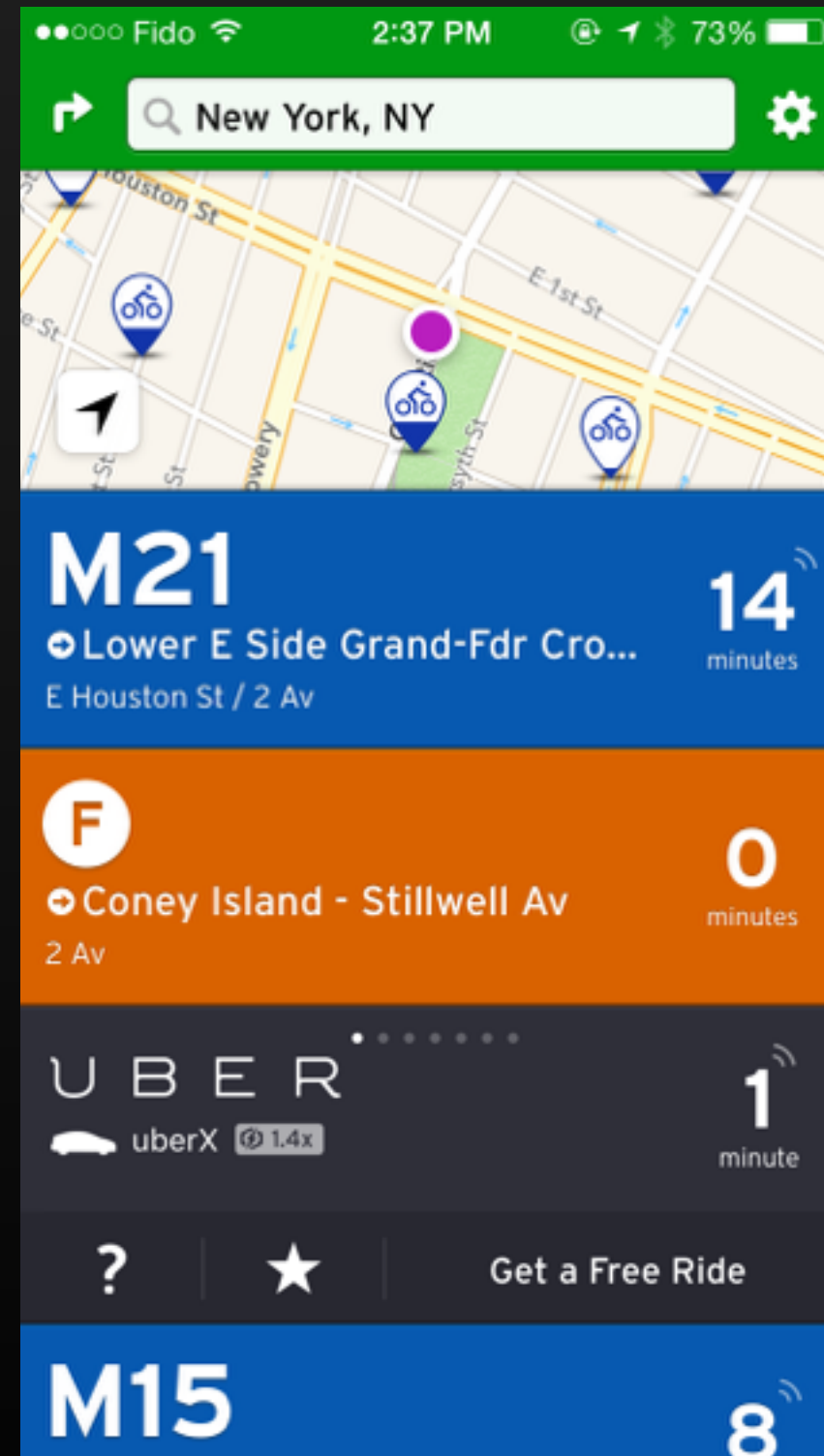
Uber Integration: Compare or Discover

Compare

Home screen

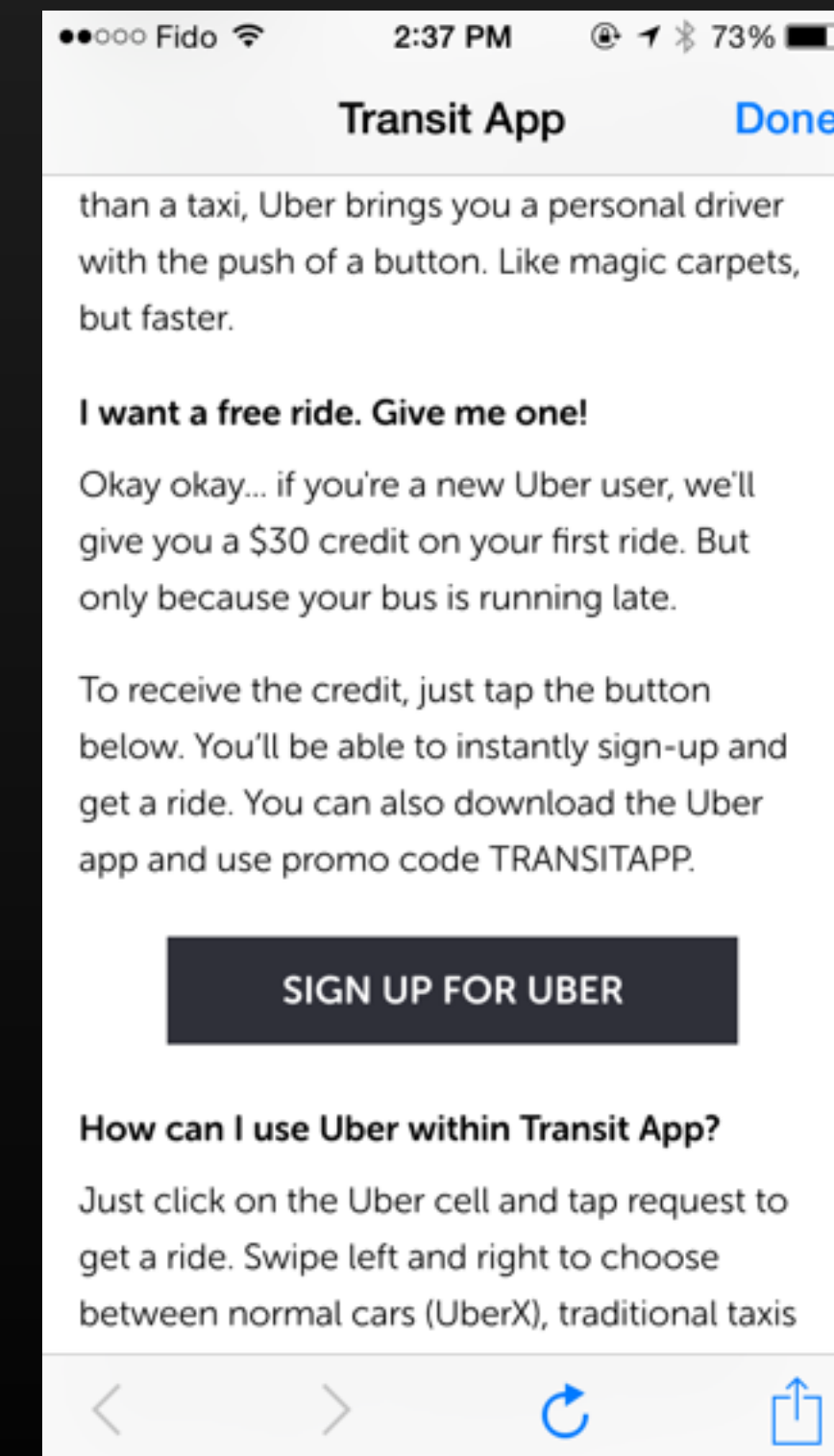


Tap Uber

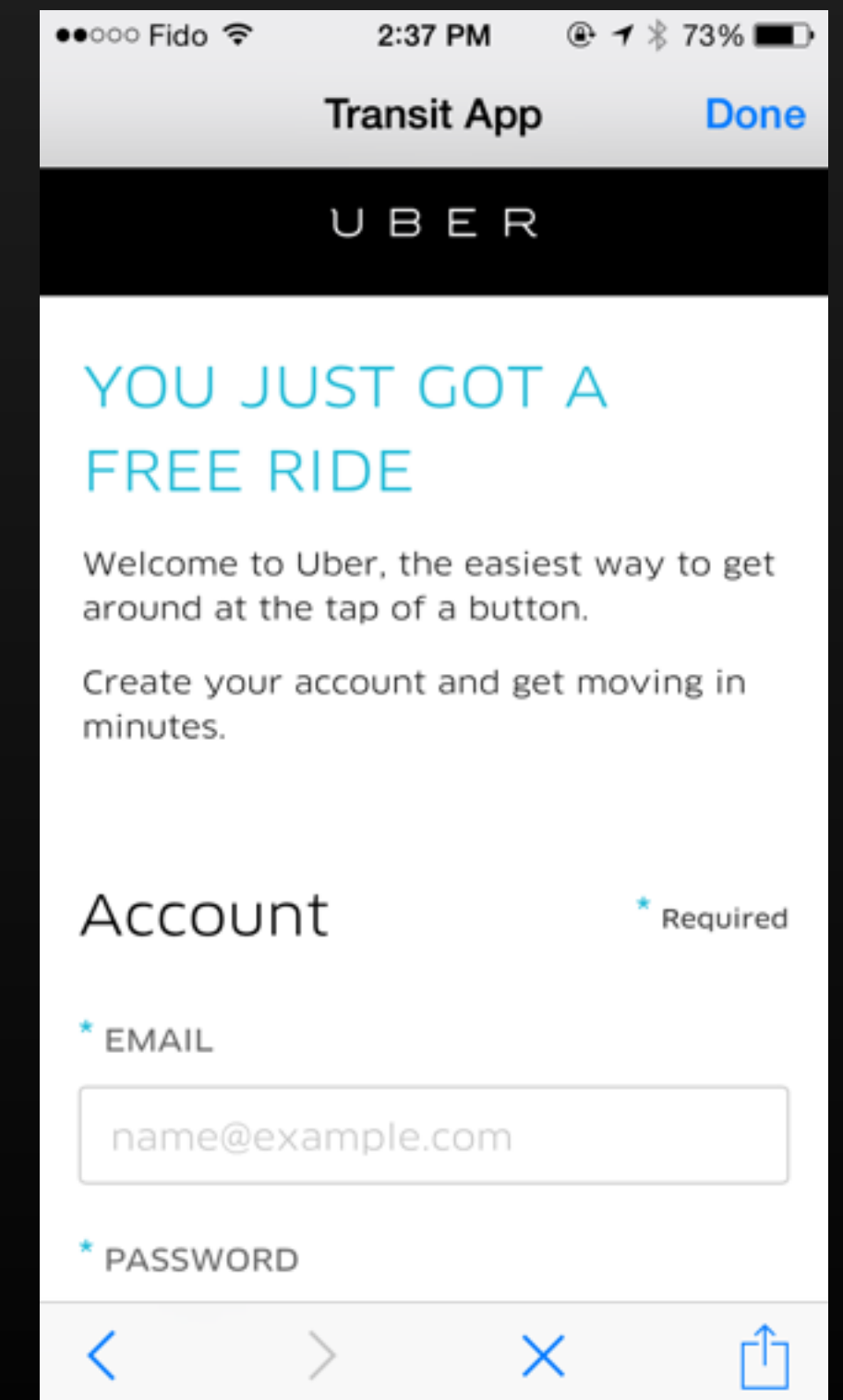


Discover

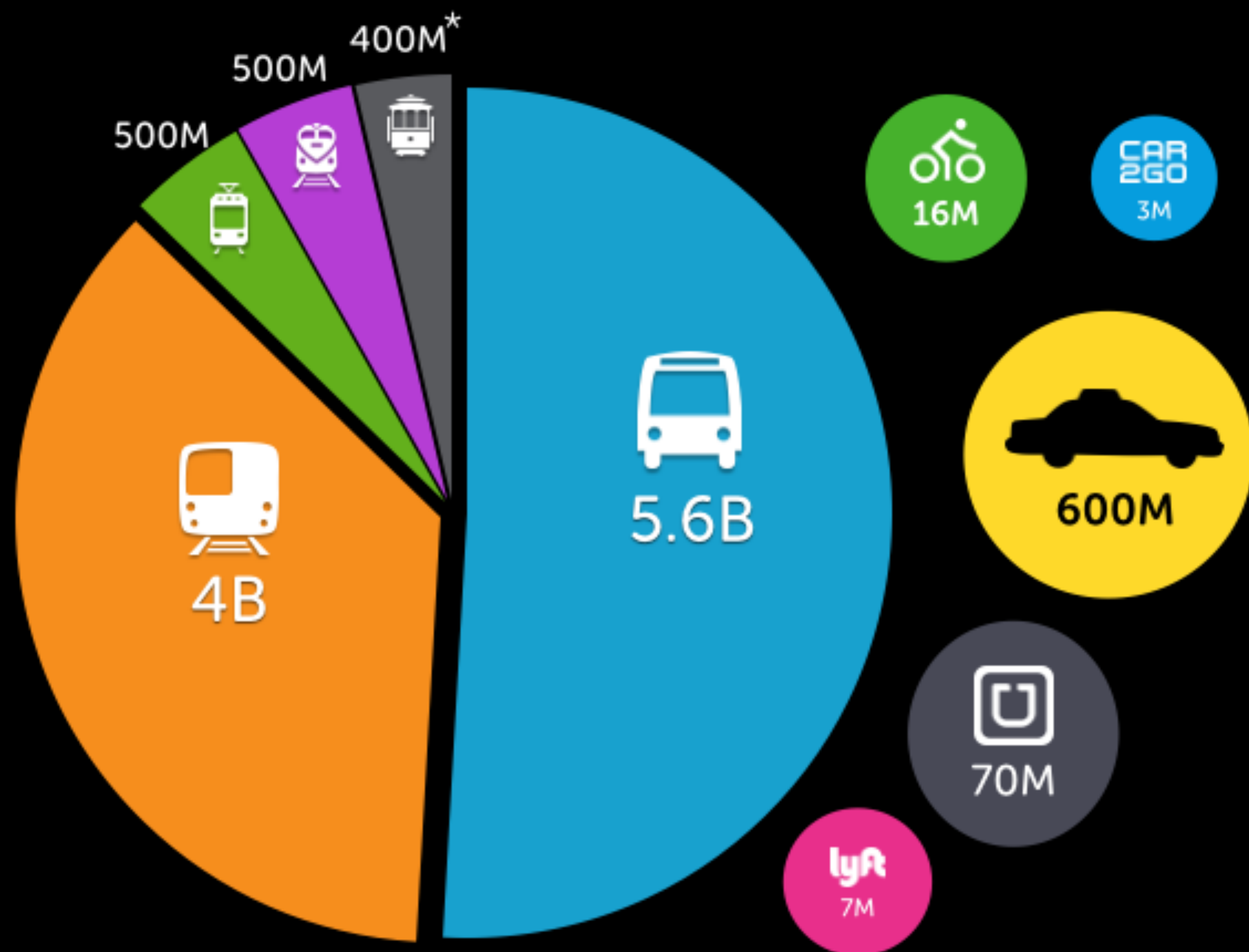
Learn more



Sign up w/Uber



Approximate yearly trips in US (2014)



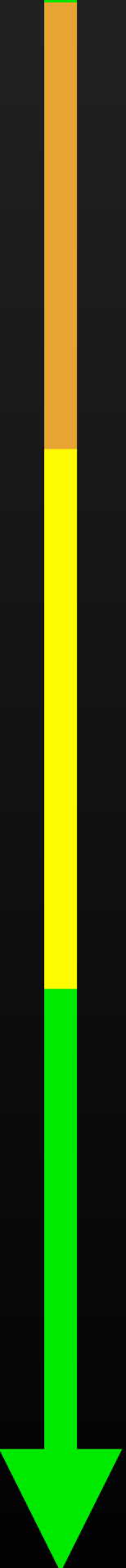
* Streetcar + all other transit modes (e.g. ferry)

Super Sharer

Someone who uses 3 or more shared modes (incl. public transit) is significantly less likely to own a car than those who use just 1 or 2.*

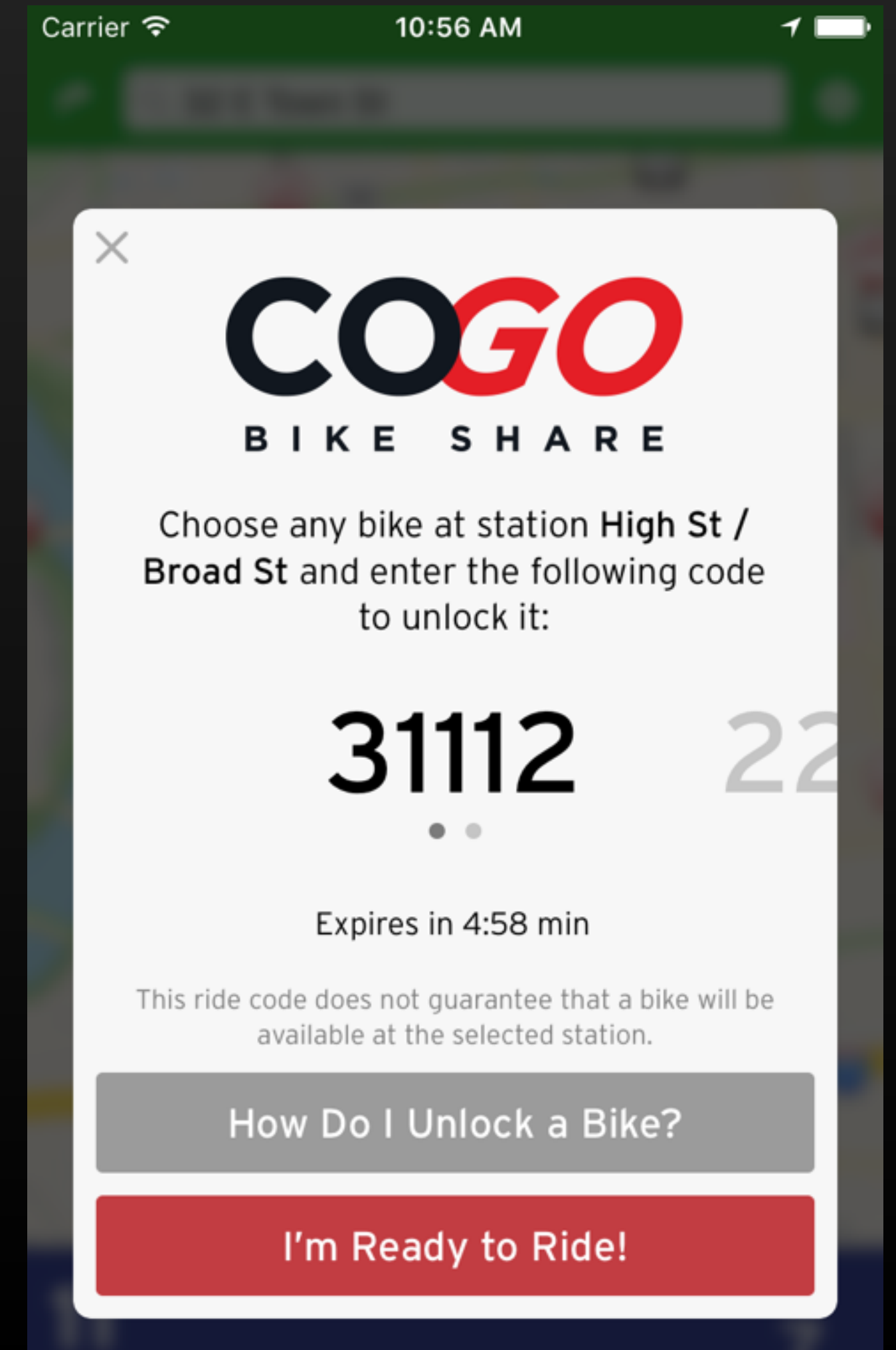
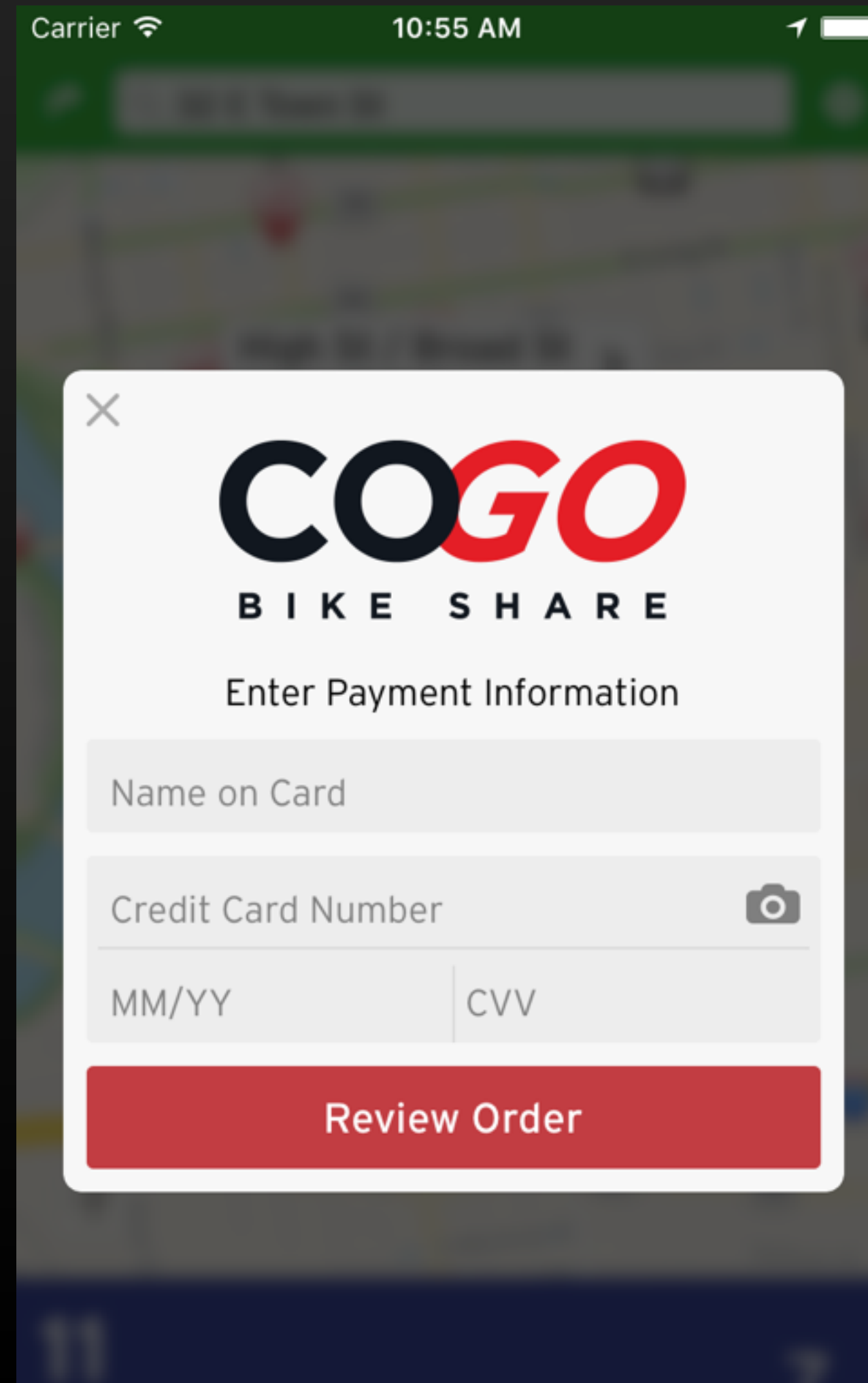
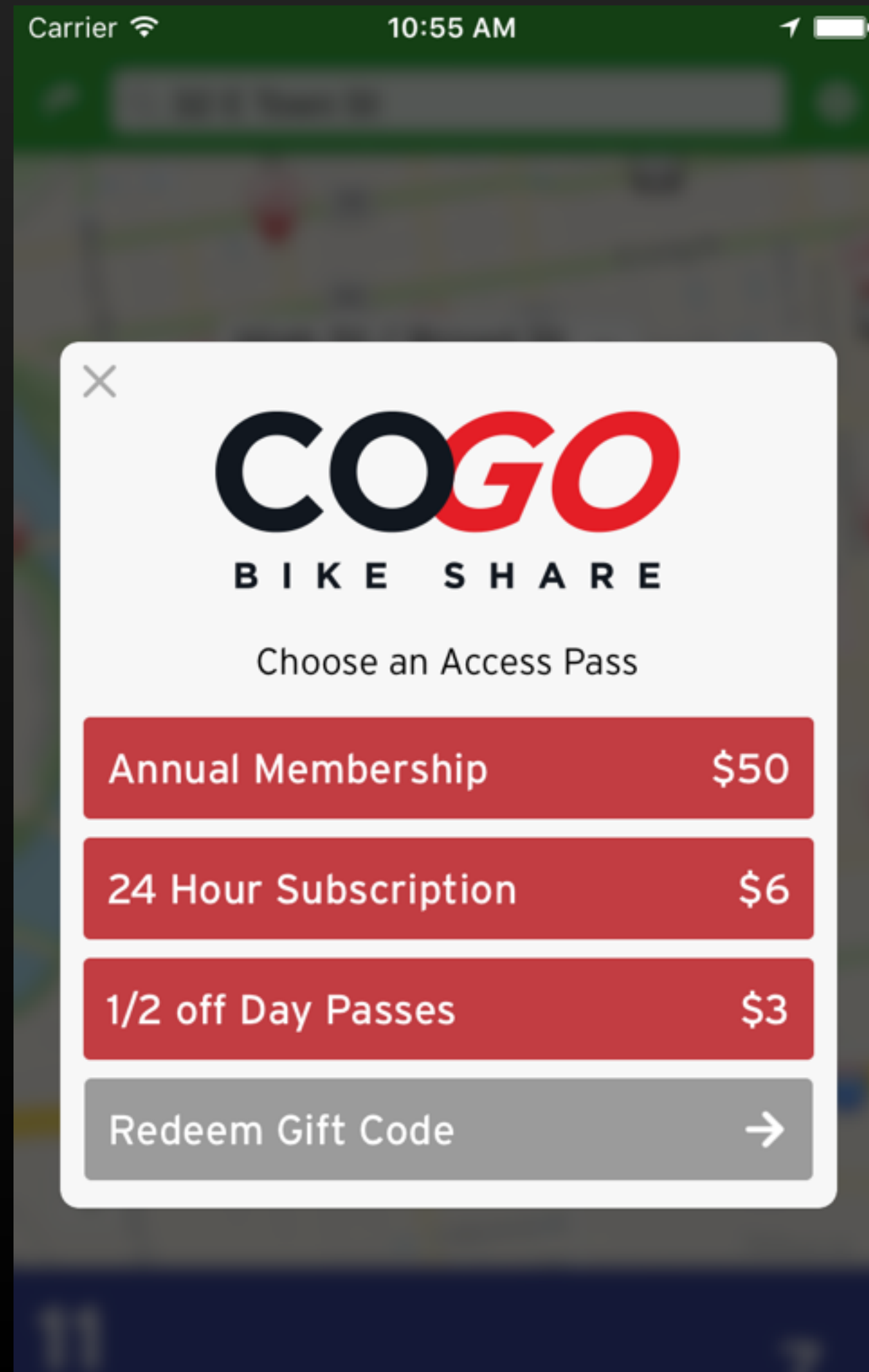
* Research completed by Shared Use Mobility Center — full report to be released this spring

Creating Strong Integrated Mobility Eco-System With Well-Designed Integrations

- 
- Mobile-friendly sign up
 - "Native sign up"
 - Instant gratification
 - No need to download a new app
 - No need to create a new account

Integrated Bike Share Payment & Unlocking

Aspen, Columbus, Chattanooga, Chicago (4/16)

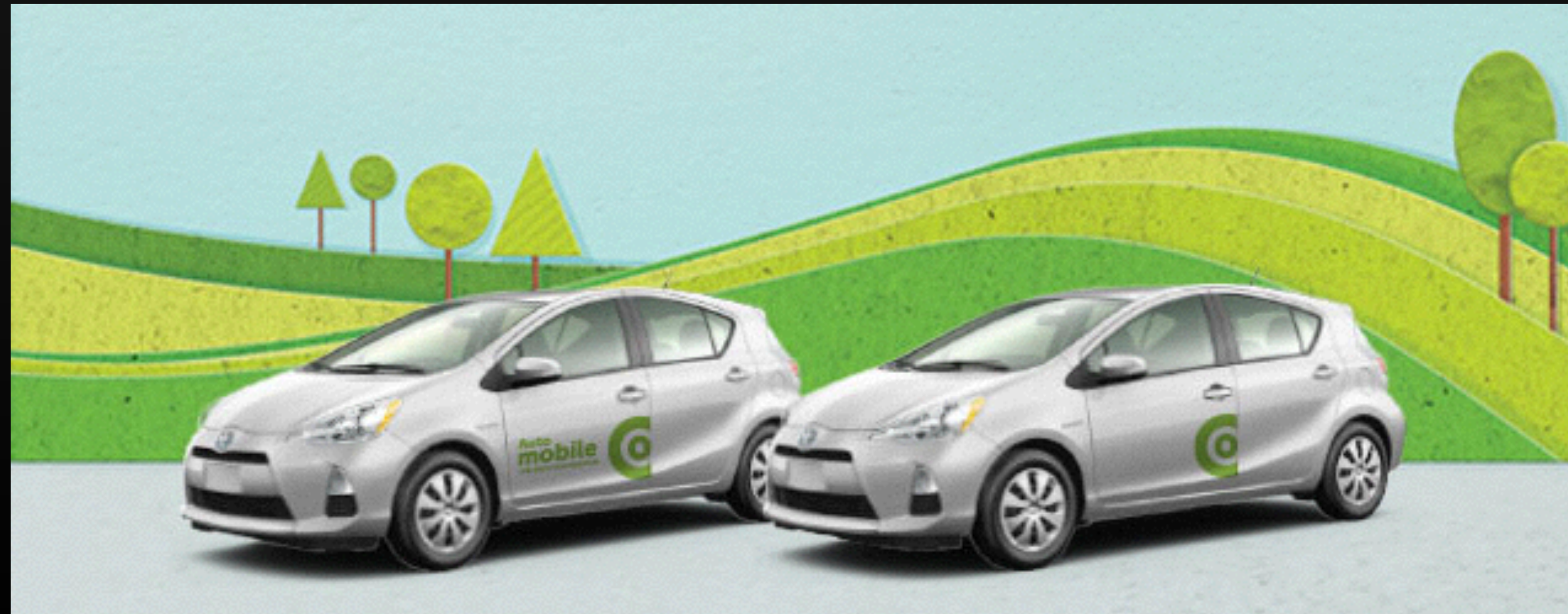


Small/Mid Size Shared Mobility Systems

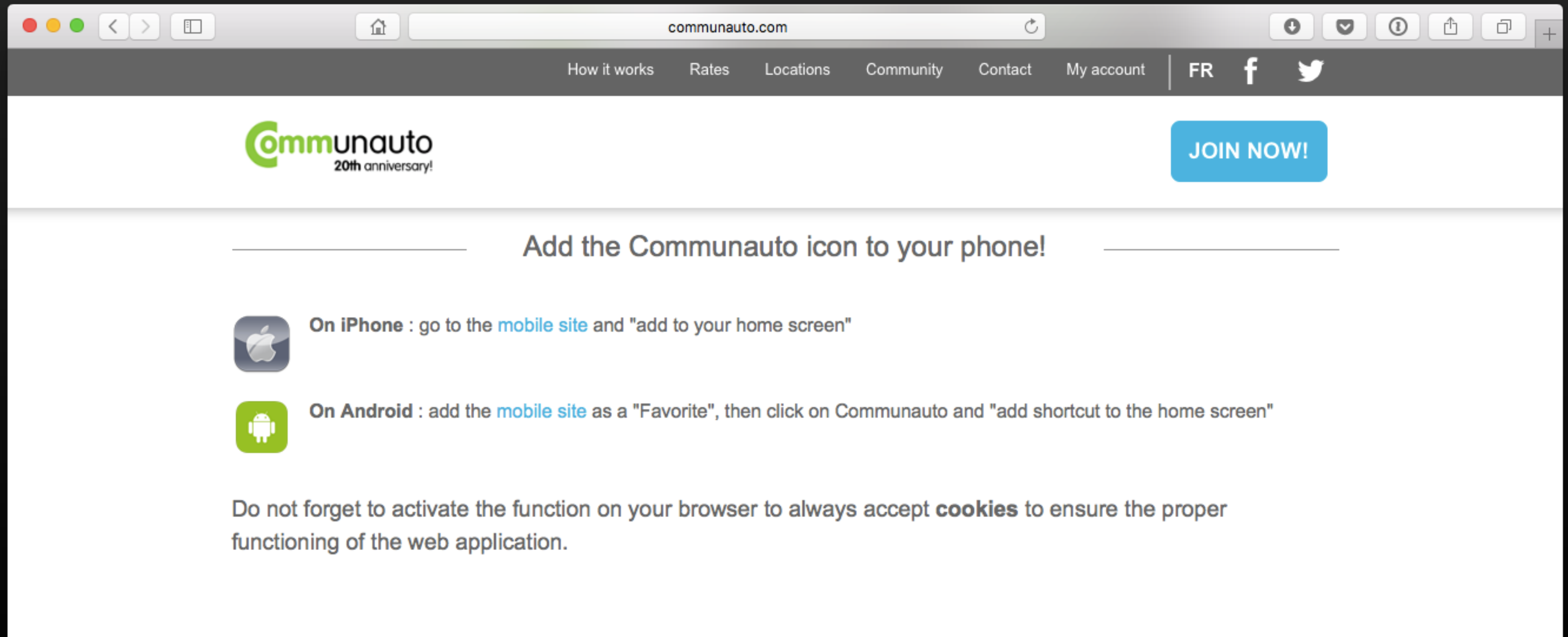
- App development is not a core competency
- Hiring outside firm even for basic solution can be expensive to build and maintain
- App can be slow to deploy
- But users expect all kinds of bells & whistles

Case Study: Communauto

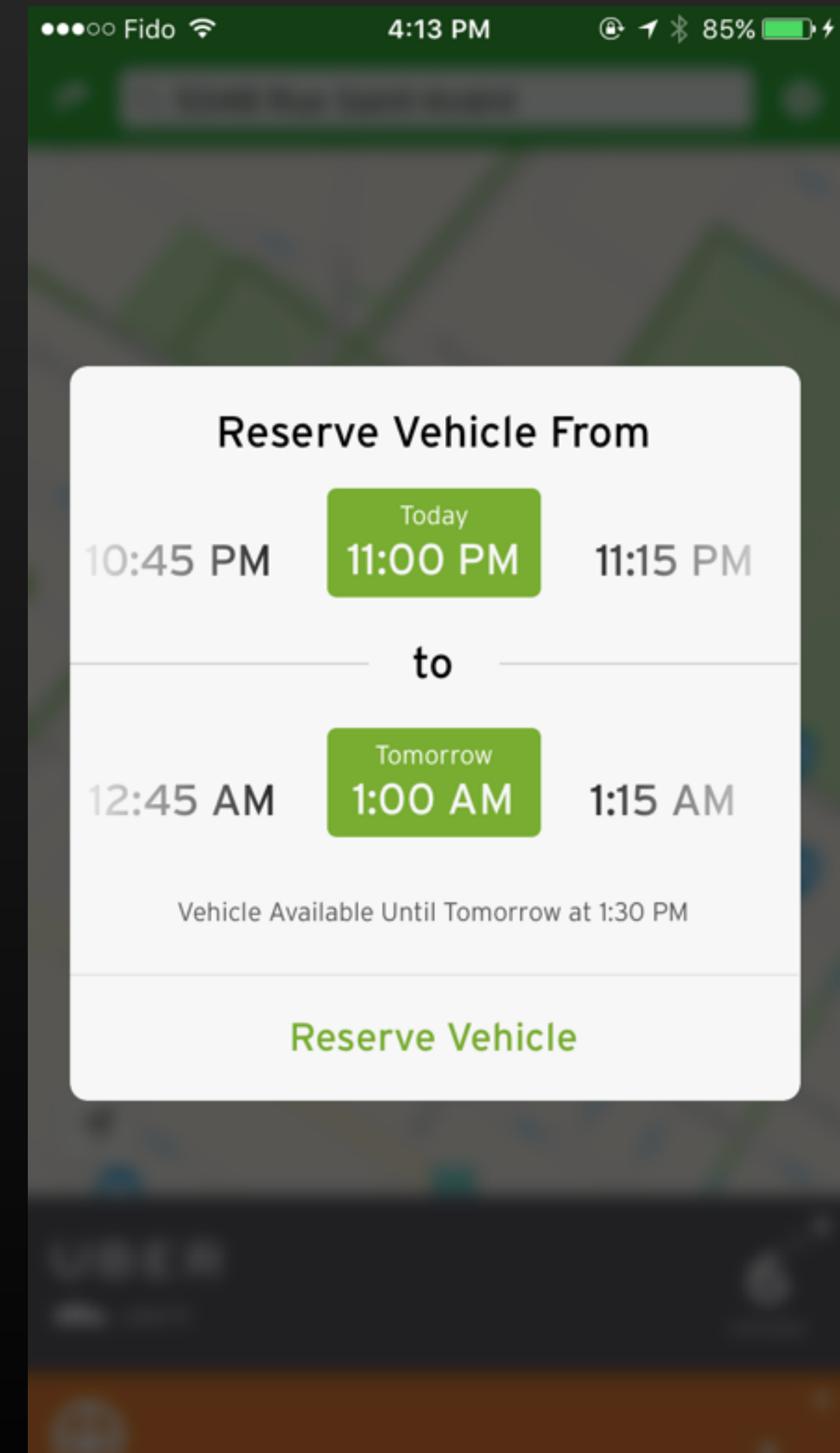
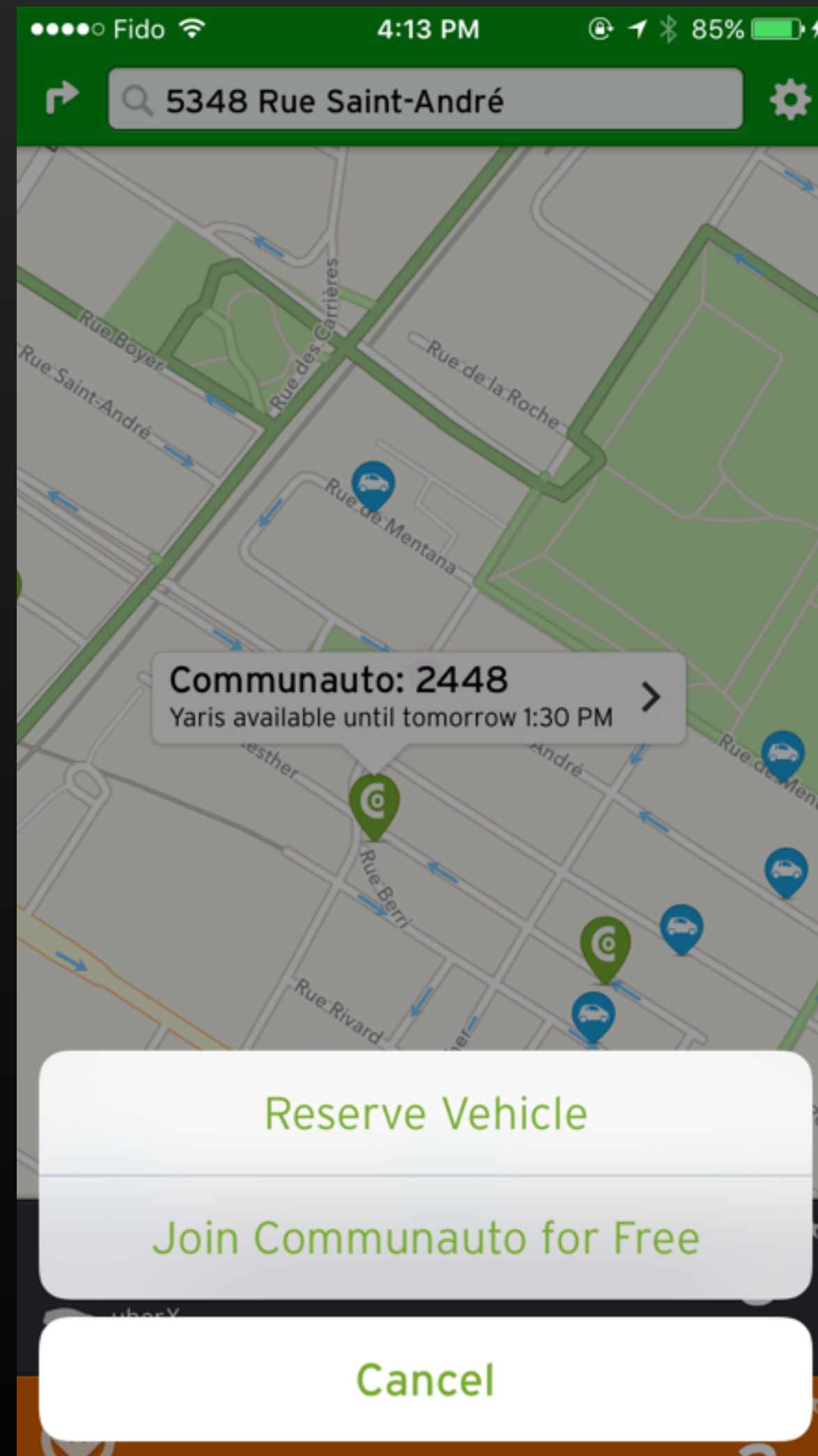
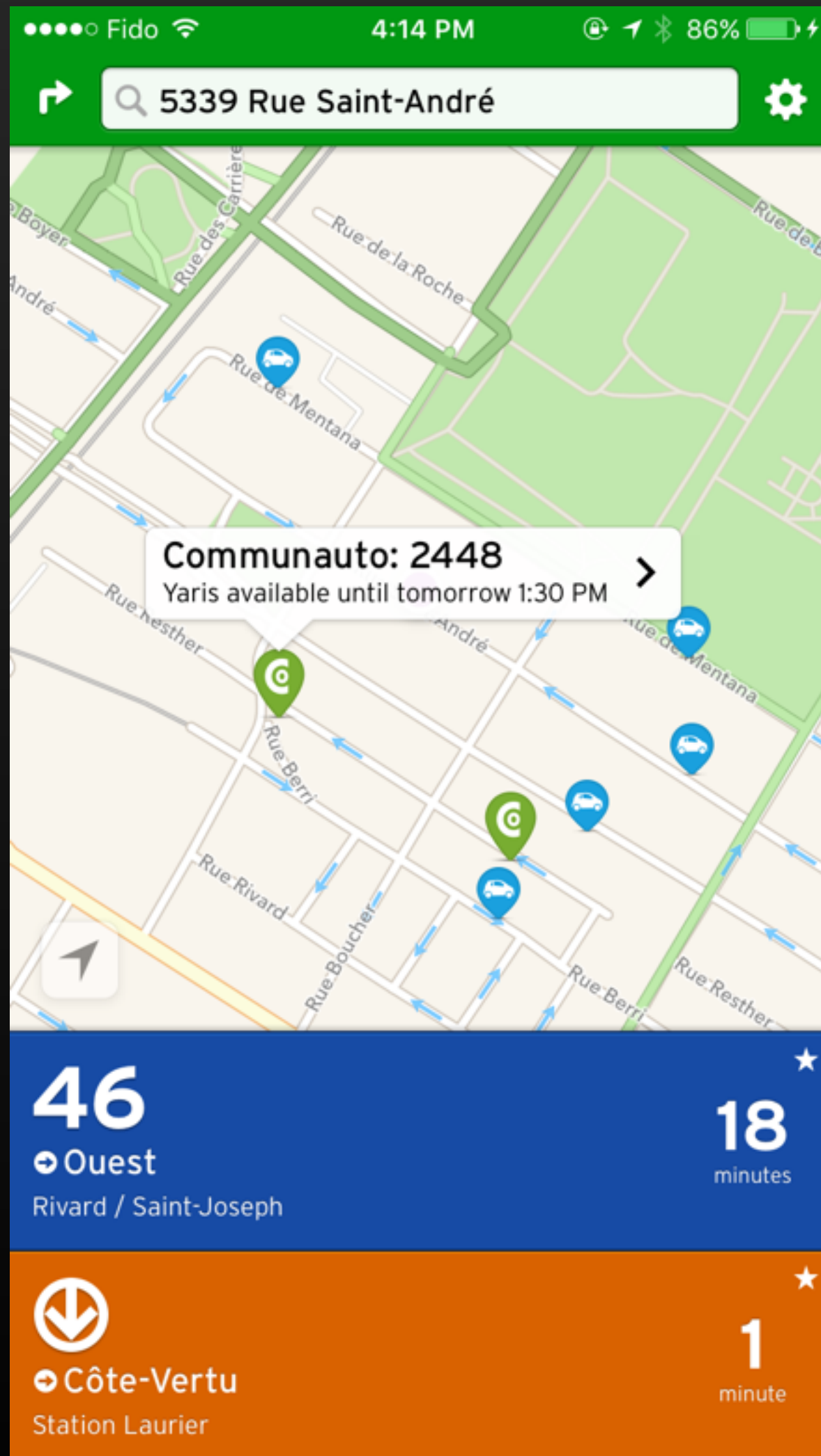
- 1,800 Shared Vehicles: Free Floating + Traditional
- 50,000 Members
- 8 Cities (incl. Montreal, Paris, Ottawa, Halifax)
- Founded in 1994



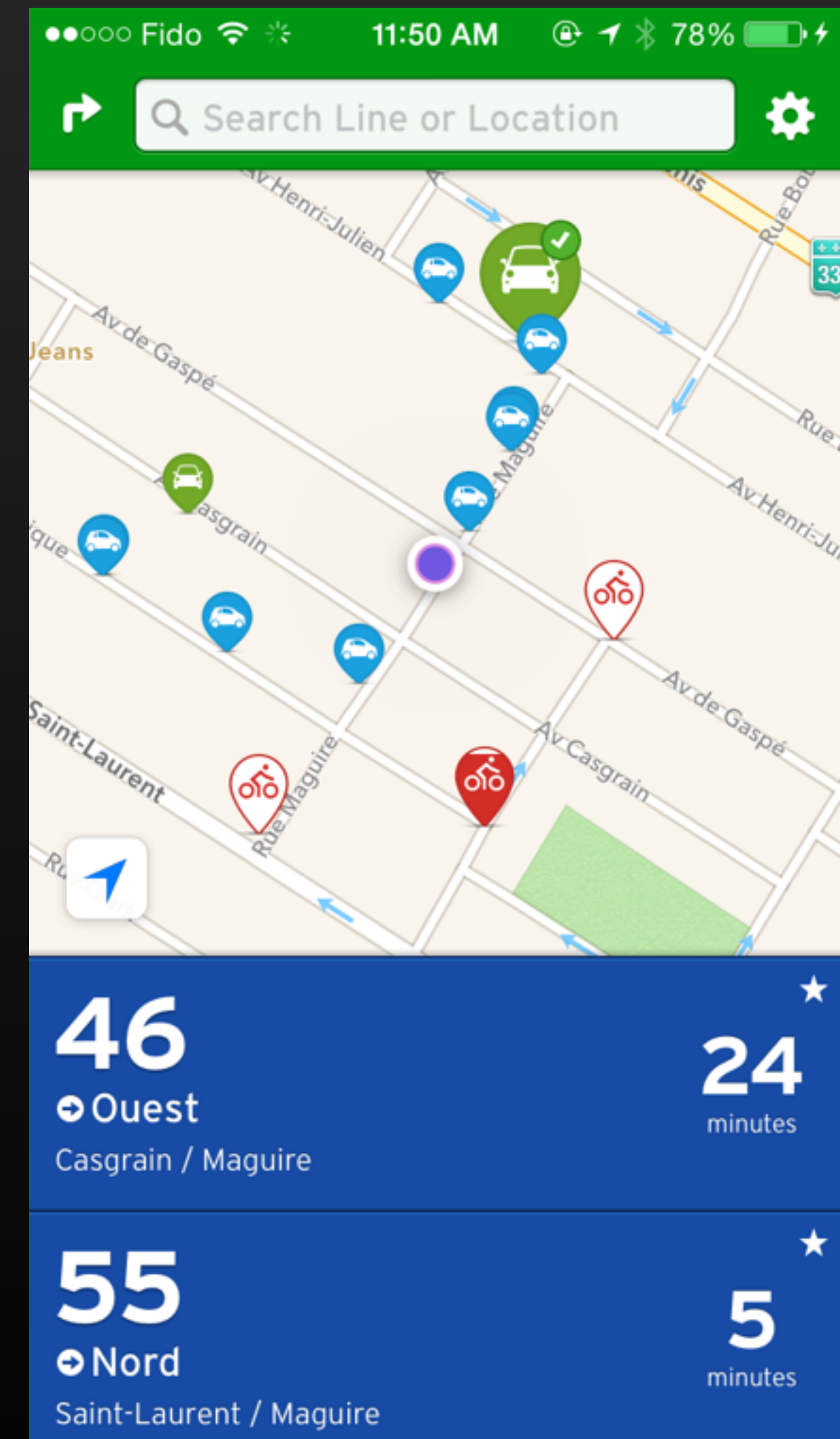
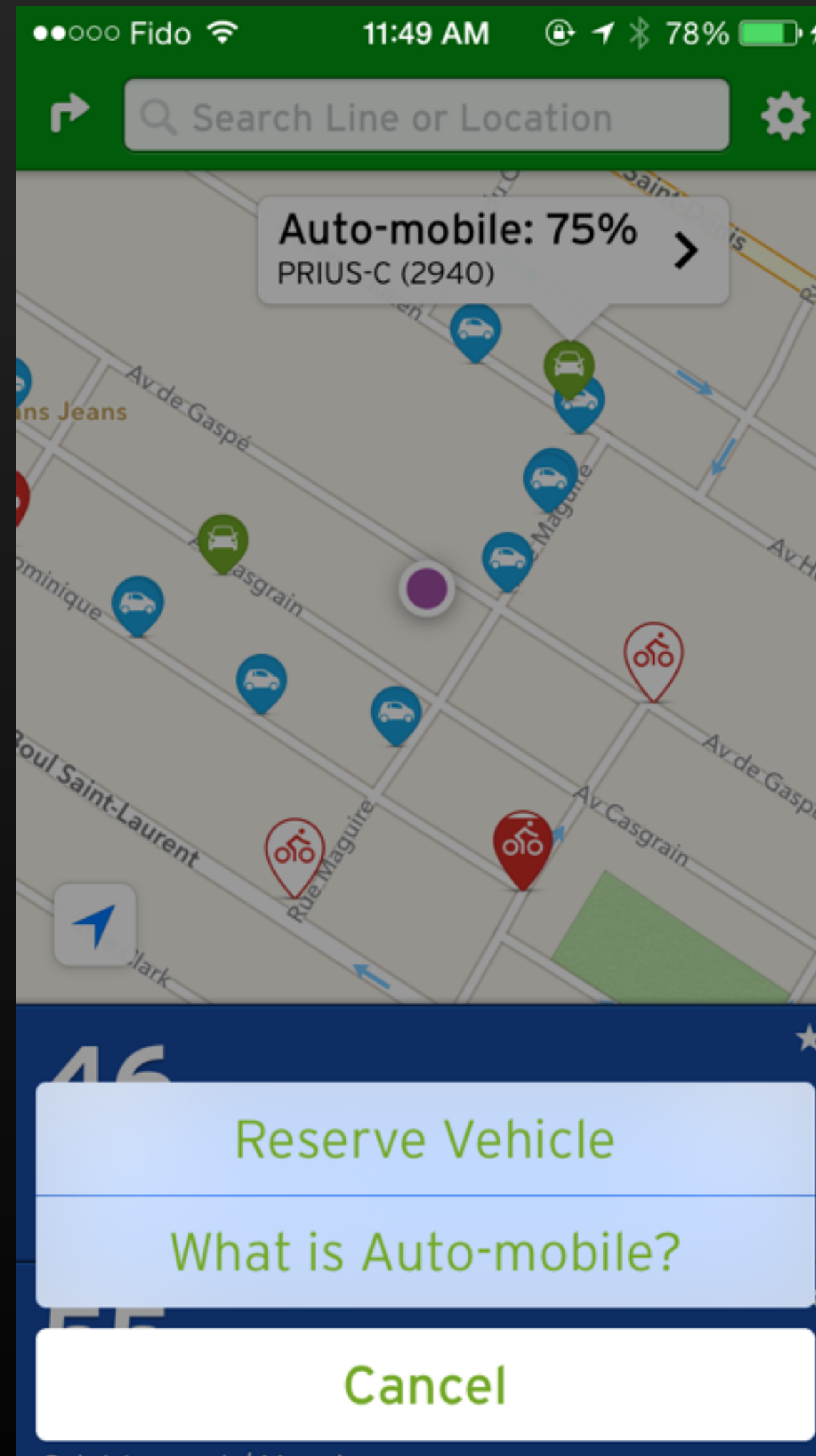
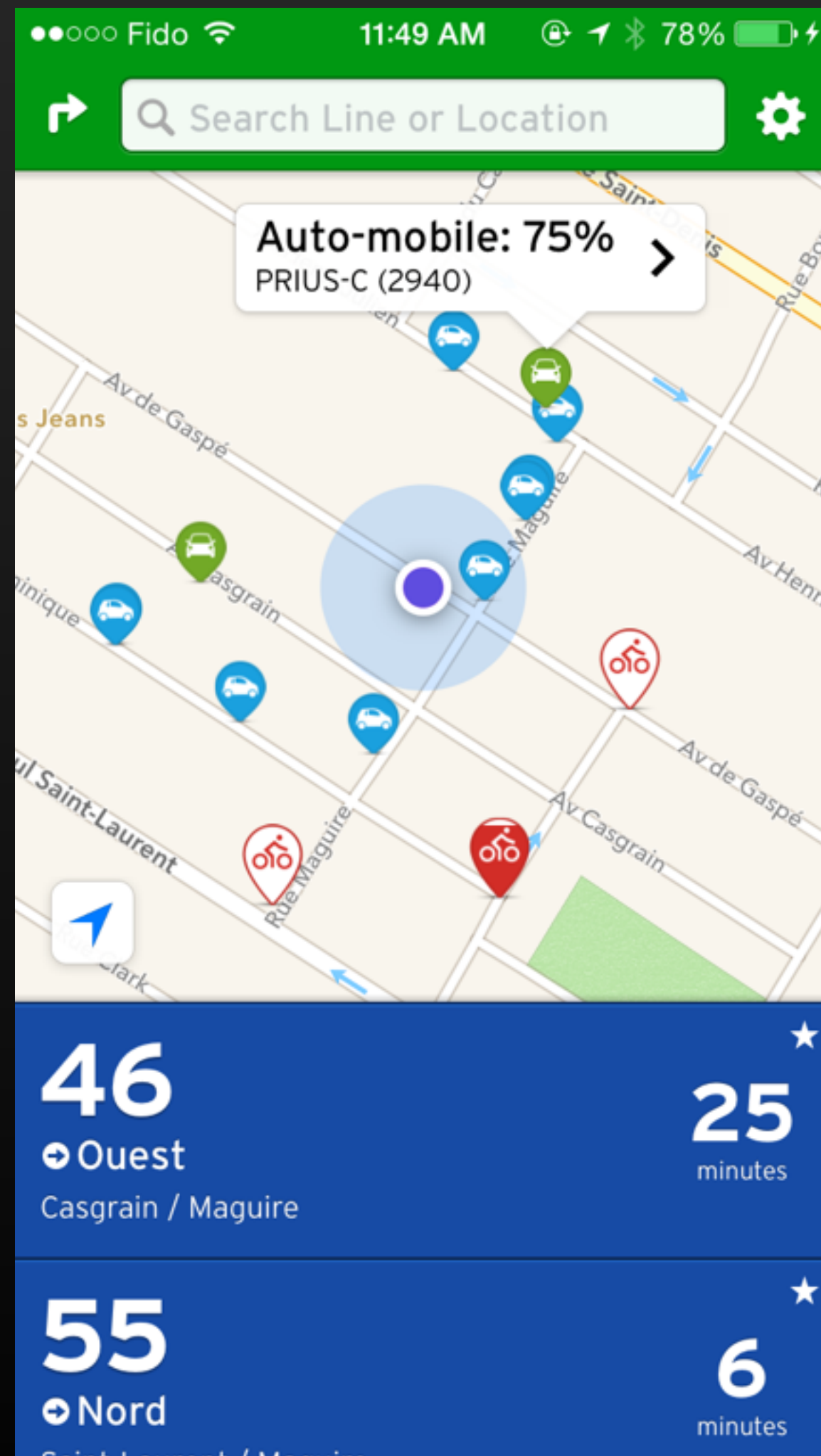
Subpar Mobile Experience



Communauto



Communauto 1-way: Auto-mobile



Appeal for Openness

Municipality / Local Operator

- Procuring bike share system, mobile ticketing solution, car sharing scheme, etc — firmly emphasize open APIs and ability to integrate into other solutions
- Discovery and education is paramount for advancing integrated mobility
- Existing operator: Let your suppliers know that this is important to you! It will help guide their product roadmap, and can reduce costs.

Aspen We-Cycle

Deploying Kioskless Bike Share Stations = ~1/3 Cost

- We-Cycle expanding to Basalt, a community 18 miles from Aspen, to offer first/last mile connectivity to BRT Corridor.
- System can be accessed solely through the mobile app or by card-carrying pass holders.



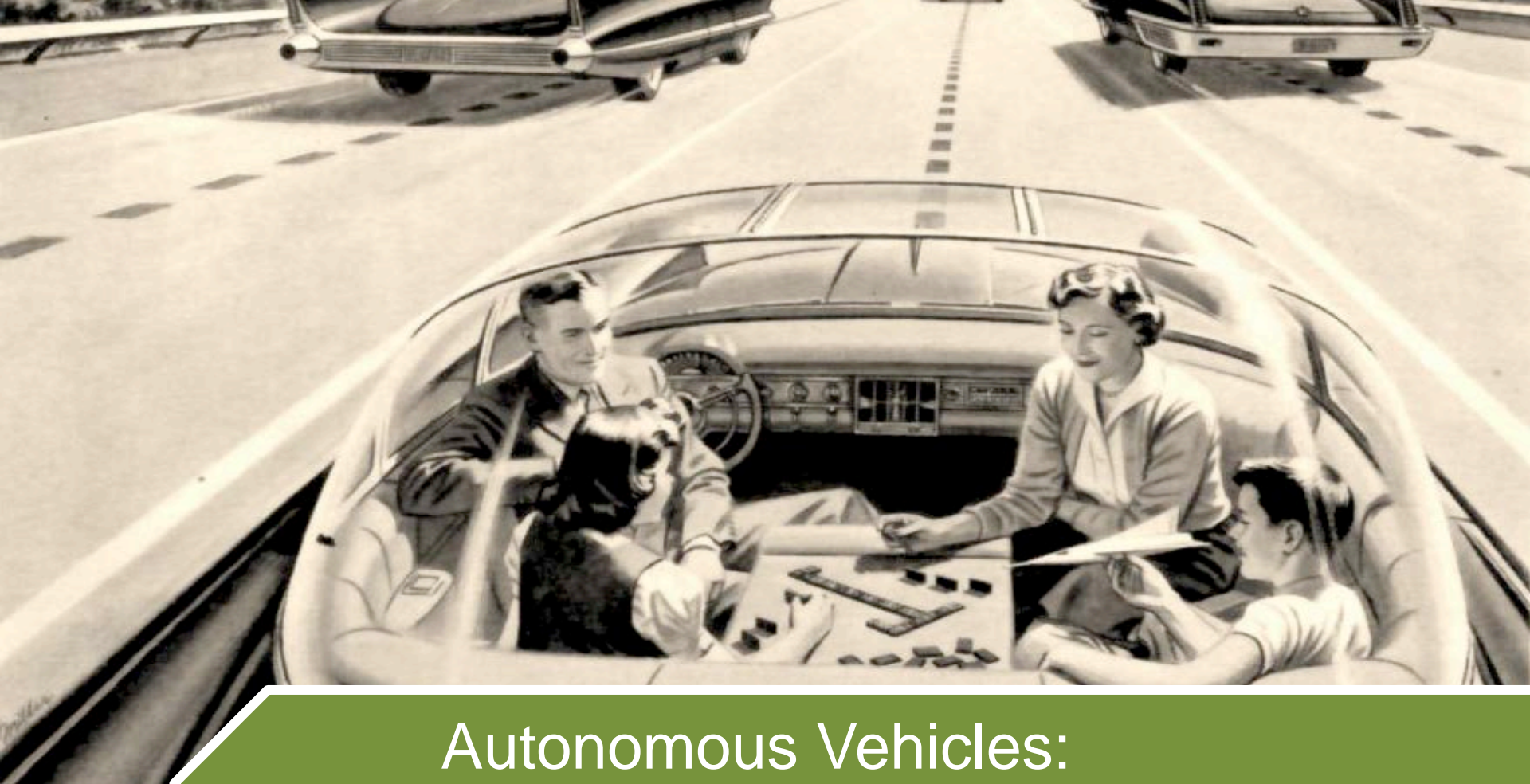
Supplier / Technology Provider

- Improving the customer experience with partners = happier client
- Platform integrations can drive sales and reduce costs
- **PBSC (Bixi)** : Shared APIs. No app development cost. First pilot launched <3 months after agreement.
- **Communauto**: No app development cost. 1/3+ of all free floating bookings now come through partner mobile app.



"A developed country is not a place
where the poor have cars. It's where
the rich use public transportation."

- Enrique Peñalosa, Mayor of Bogotá



Autonomous Vehicles: What could they mean for cities?

Nidhi Kalra

March 2016

RAND Corporation

An autonomous vehicle can drive itself...

- In some conditions, and may request human intervention at short notice
- In some conditions, but does *not* request human intervention
- In all conditions, and may not have a driver

Google X program has logged
1.3 million autonomous miles



Perception capabilities are not yet human...



...neither is the ability to make subtle inferences



How do we safely balance driving
between human and machine?



Despite challenges, every major automaker is developing this technology



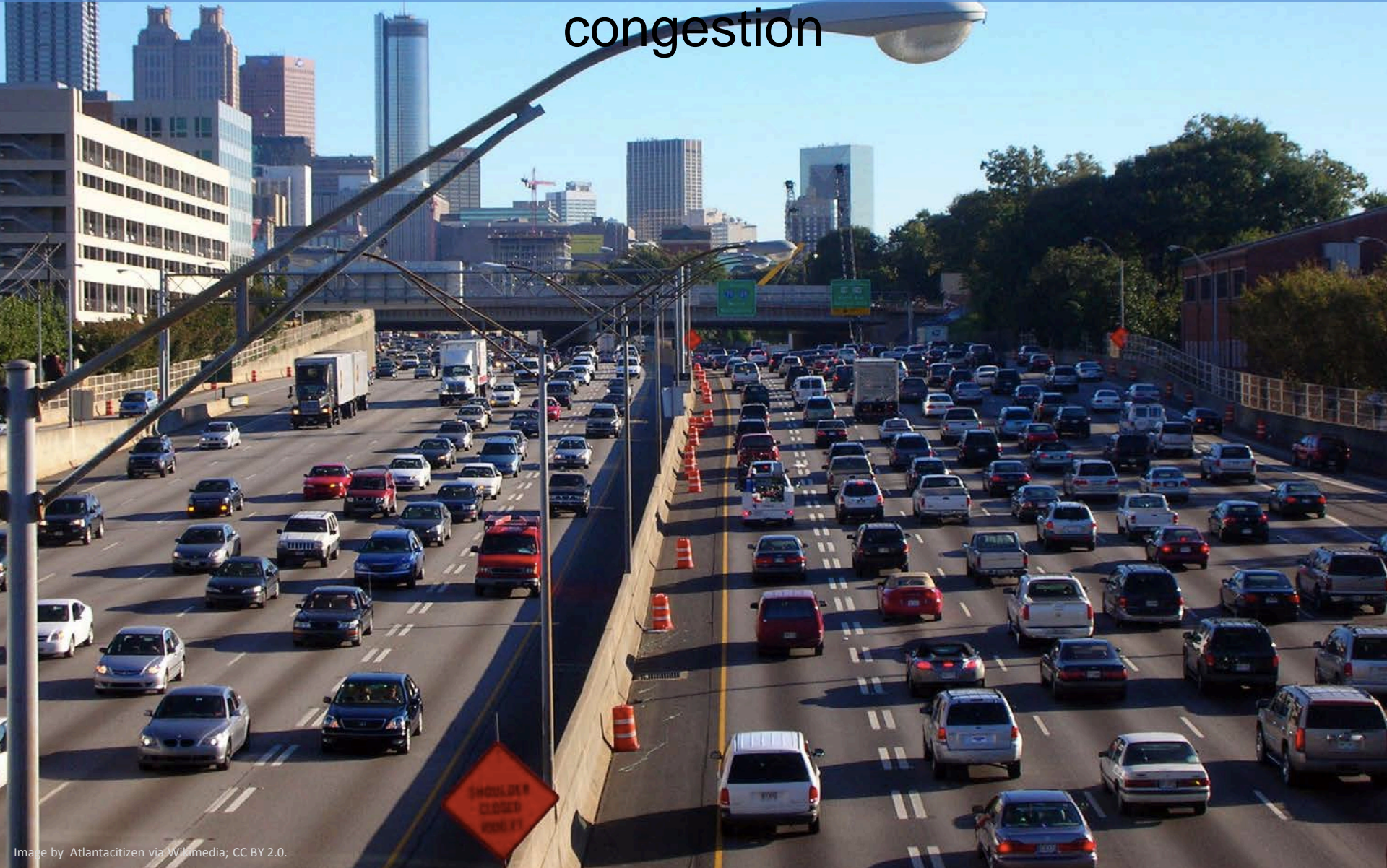
Autonomous vehicles have the potential to save lives...



...and to improve mobility.



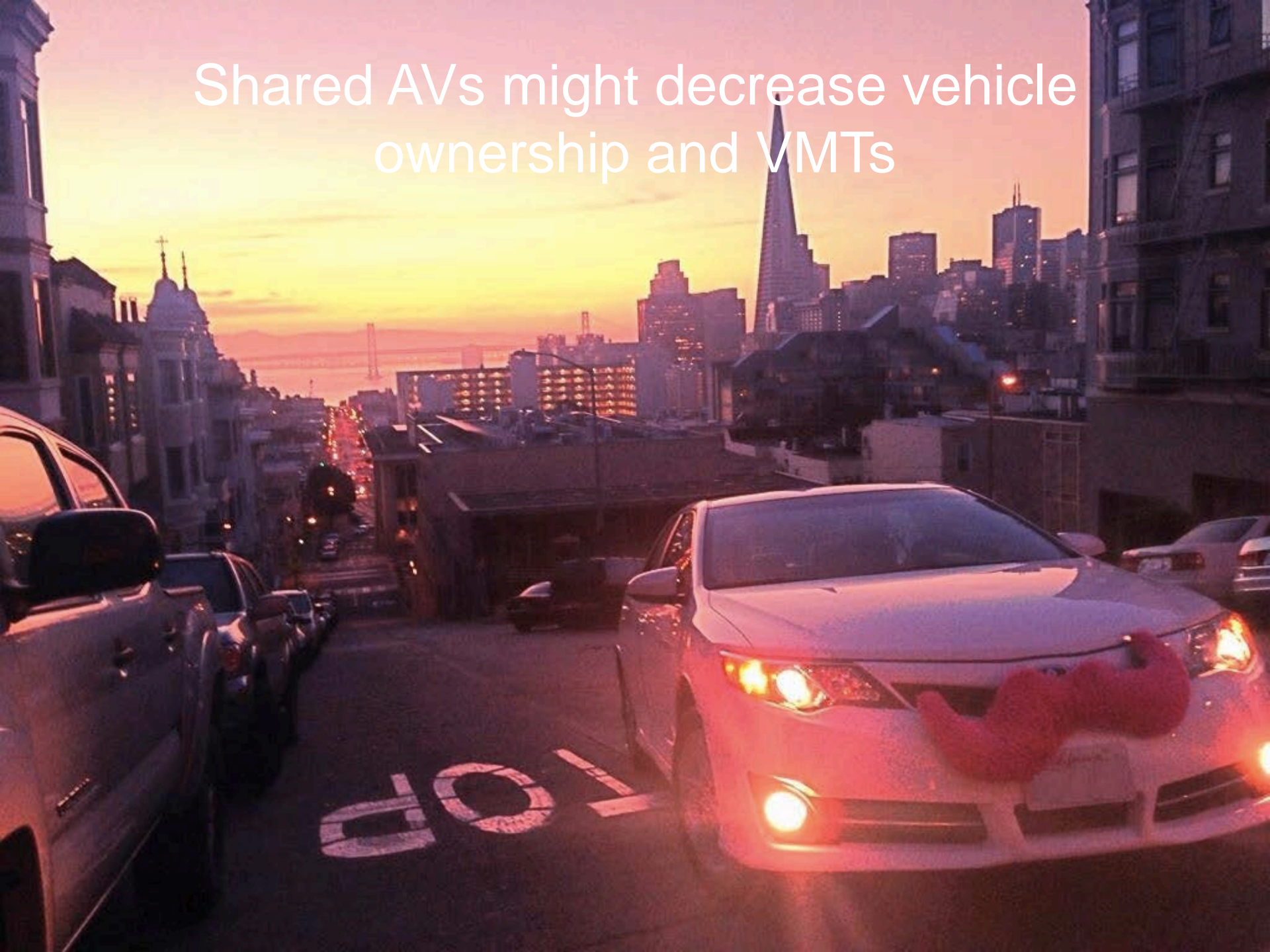
They may have complex effects on cities.
They could reduce cost and incidence of traffic
congestion



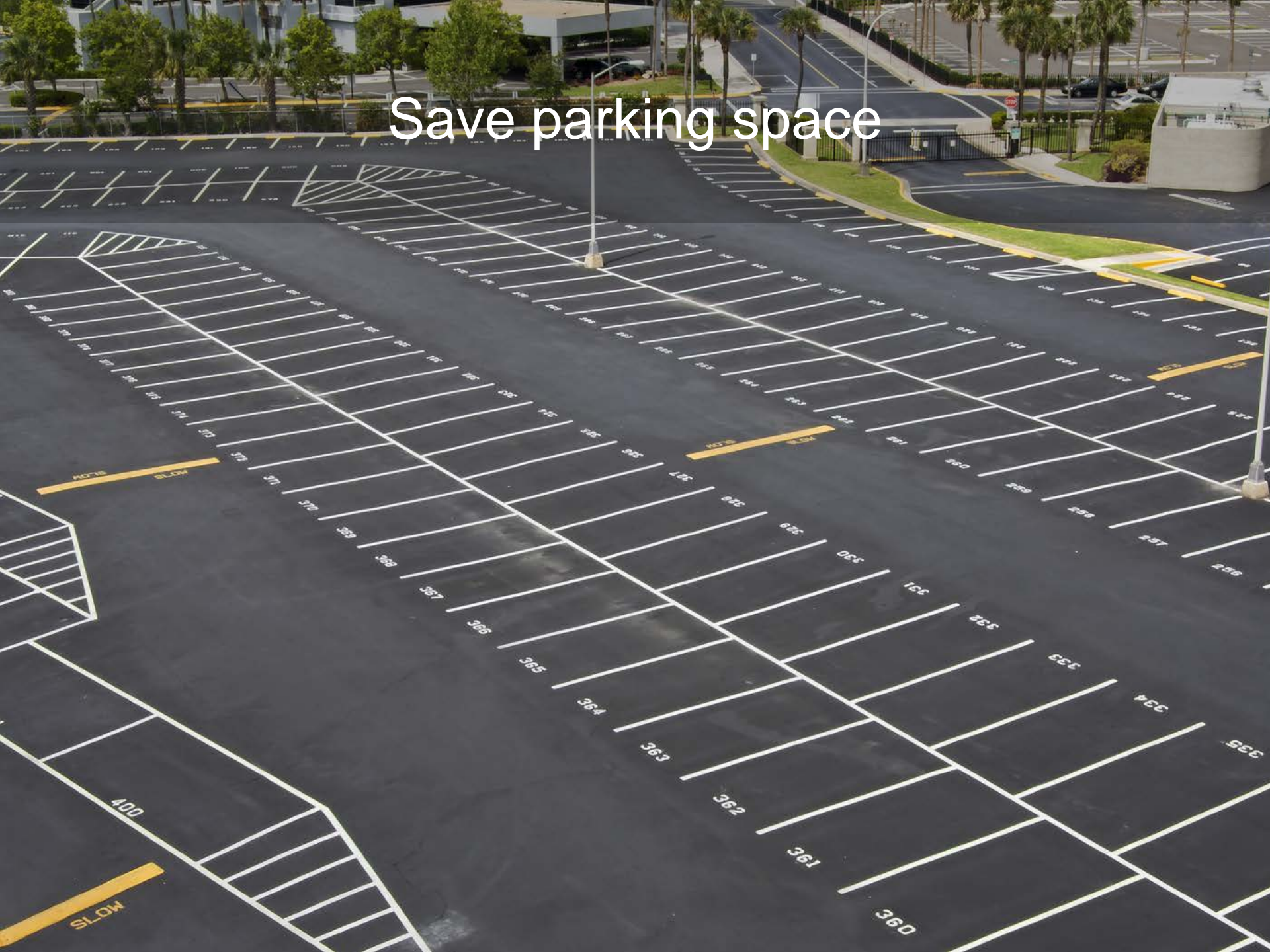
Increase congestion if people drive more and vehicles are larger



Shared AVs might decrease vehicle
ownership and VMTs



Save parking space



Reduce fuel consumption and environmental impacts of driving...



Promote or undercut public transit



Many of the impacts affect society and are externalities

Societal Impacts

Safety

Mobility

Congestion

Cost of congestion

Energy consumption/
emissions

Land use

Buyer Benefits

Safety (partly)

Mobility

Cost of
congestion

NCHRP 20-102(01) led by TTI is examining the externalities of AVs and CVs

1. What are the externalities of AVs and CVs?
2. What private sector actions create them?
3. How can policy and planning actions be used to internalize the societal impacts?

The NCHRP 20-102 series is addressing variety of issues related to AVs and CVs

- (01) Internalize Externalities
- (02) Transit Operations
- (03) Challenges in Freight
- (06) Road Markings for Machine Vision
- (07) Implications for Motor Vehicle Codes
- (08) Dedicated Lanes for CVs and AVs
- (09) Transportation Modeling of AVs/CVs

How should policy makers anticipate and respond to potential changes?



UNCERTAINTY
AHEAD

USE CAUTION

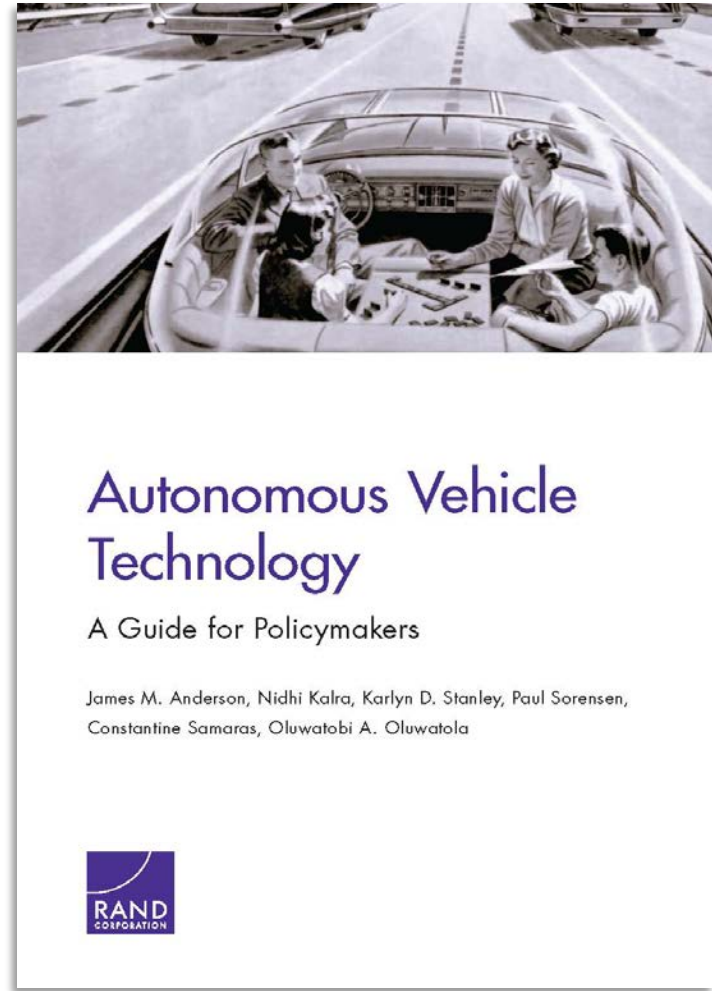
Assess which long term decisions would be derailed with changes from AV adoption

Identify opportunities to evolve along with the technology

Develop a plan to stay abreast of changes that AVs might bring

You can read more about this topic at RAND.org

- State of technology
- Costs and benefits
- Communications
- Current state law
- Liability issues
- Recommendations for policymakers





Cities Beyond Driving: Preparing for AVs

Ryan Lanyon, City of Toronto

March 7, 2016

About Toronto



- Canada's largest city
- Provincial capital
- Population
 - 2.8M (city)
 - 6.1M (metro)
 - 7.3M (region)
- Automotive industry
- Creativity, technology and finance hub
- Fourth-most liveable city (2015)
- Most tax-competitive major city (2014)
- Intelligent Community of the Year (2014)
- Most resilient city (2014)
- Most youthful city (2014)

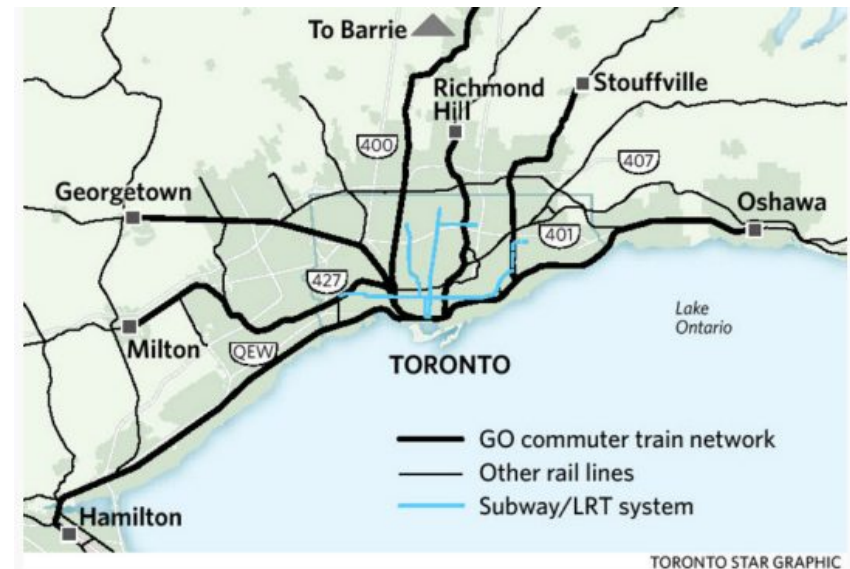
City of Toronto

- Single-tier municipality
- Responsible for a wide range of services
 - Roads and streets
 - Public transit (local bus, streetcar, subway)
 - Urban planning
 - Business licensing (including taxis)
 - Economic development
 - Employment services
 - Fire prevention
 - Police services
 - Ambulances and paramedics
 - Public parking



Toronto Transportation

- Significant expressway network
- Heavy rail, commuter rail, light rail, BRT
- Focus on expanding rapid transit options
- Increased facilities for active transportation
- Expressway expansion in outer suburbs
- Taxis, TNCs
- Car-sharing, electric vehicle charging
- Densification in walkable environments



Year	Auto Driver	Auto Passenger	Transit	Walk	Cycle
2006	63.6	7.5	22.2	4.8	1.0
2011	64.5	5.4	23.3	4.6	1.2

Commute Mode, Statistics Canada

City of Toronto and AVs

The City of Toronto does not have an official policy or position on automated and/or autonomous vehicles.

The views and opinions contained in this presentation do not represent those of the City of Toronto.



City of Toronto and AVs



- Jan 2014 – Monitor AV developments, identifying industry stakeholders
- Dec 2014 – Establish dialogue with other municipalities
- Mar 2015 – Workshop: Stakeholder education (CAVCOE)
- Jul 2015 – Presentation: City of Toronto Senior Management Team
- Jul 2015 – AV Working Group (Transportation Services)
- Sept 2015 – Extensive review (University of Toronto)
- Oct 2015 – “Driving Changes” (University of Toronto)
- Dec 2015 – Workshops: Stakeholder engagement (University of Toronto)
- Jan 1, 2016 – Provincial AV testing permits
- Spring 2016 – City-wide working group and AV preparation plan

City of Toronto and AVs: Impacts

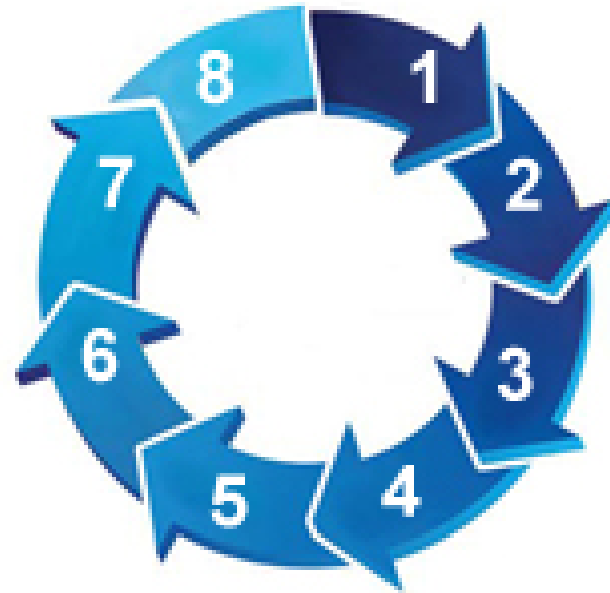


...more?

- Transportation Services
- City Planning
- Municipal Licensing & Standards
- Economic Development & Culture
- City Clerk
- Information & Technology
- Engineering & Construction Services
- Legal Services
- Public Health
- Financial Planning
- Revenue Services
- Fleet Services
- Equity, Diversity & Human Rights
- Employment & Social Services
- Office of Emergency Management
- Solid Waste Management
- Environment & Energy
- Toronto Fire Services
- Toronto Paramedic Services
- Toronto Building
- Toronto Transit Commission
- Toronto Parking Authority
- Toronto Police Services

City of Toronto and AVs: Change Leadership

- Urgency
- Coalition
- Vision
- Dialogue
- Empowerment
- Piloting
- Tipping Point
- Culture



Urgency

- How soon will AVs be introduced? Impactful? Widespread?
- Extent of automation?
- Role of the private sector? Expectations on the public sector?
- Impact on urban mobility?
- New entrants and new business models?



Urgency

Current Trends

- Traffic Congestion
- Mobile Entertainment & Increased Value of Time
- Rising/Inconsistent/Unpredictable Fuel Prices
- Increased Urbanization and Densification
- Changing Paradigm of Driving
- Accessibility and Aging Population
- Improved Modal Choice and Flexibility
- (Partial) automation of human labour

Uncertain Paths

- Technology development and deployment
 - Evolution
 - Revolution
- Market introduction and adoption
 - Individual ownership
 - Transportation-as-a-service or shared use vehicles

Urgency – Evolution or Revolution?

Evolution

- An extension of early features like cruise control, lane centering; step through levels of automation
- Driven by existing automobile manufacturers
- Iterative integration of hardware and software
- Direct to consumer market
- Already here

Revolution

- Redesign of automobile control; jump to SAE automation level 4 or 5
- Driven by technology and transportation network companies; some automobile manufacturers
- Direct to consumer and service replacement markets
- A few – or many – years away

Urgency – Vehicle Ownership and Mobility

Ownership Leads

Mixed

Shared Leads



- 80% trips by owner
- 2.1M vehicles
- Driven by auto industry, commuters

- 80% trips by service
- 0.8M vehicles
- Driven by tech industry, younger workforce

Source: Driving Changes

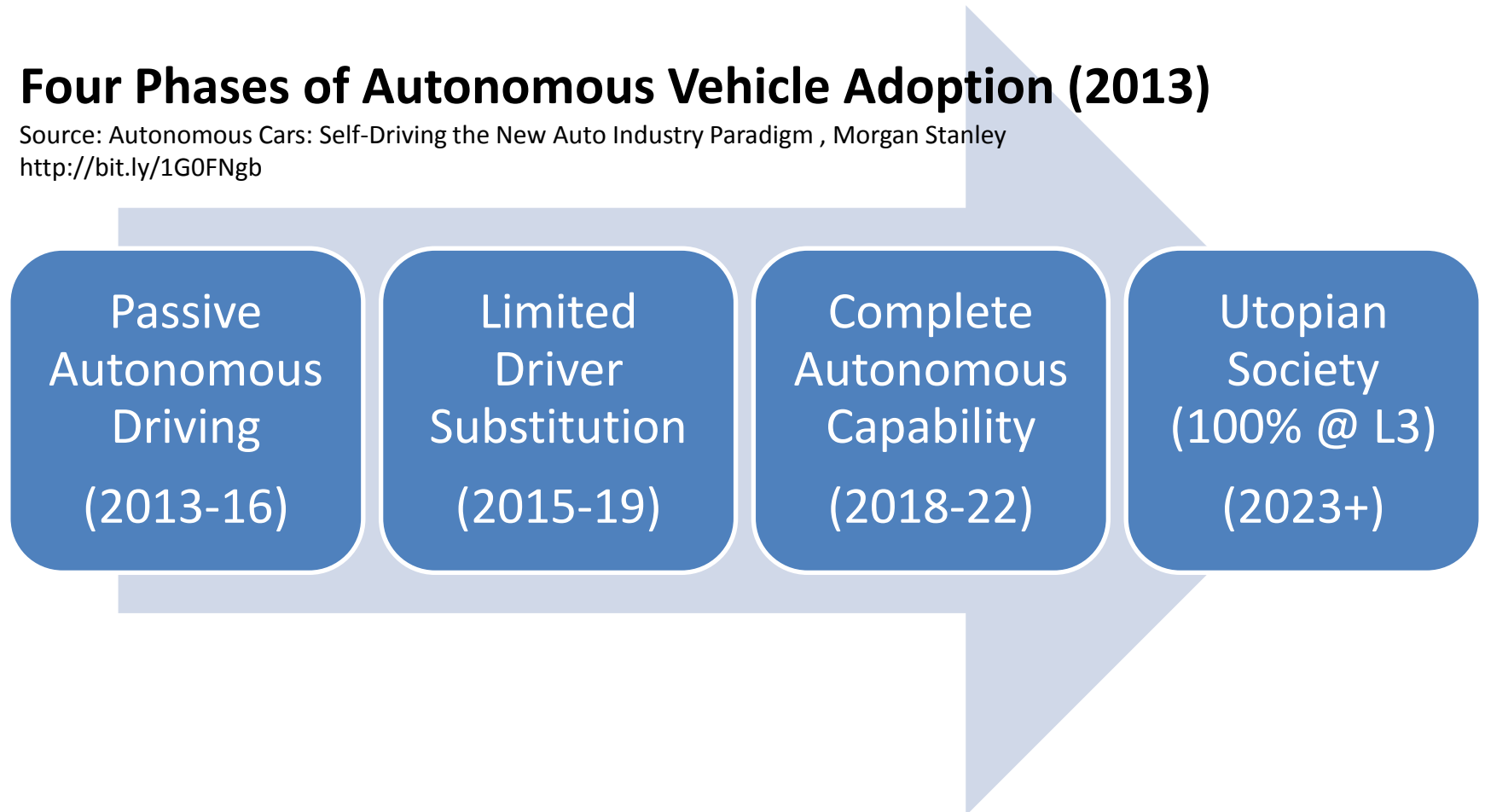
Urgency – Impacts of Private and Shared Leads

	Private	Shared
Collisions	↓	↓
Congestion	↓	↓
Mobility	↑	↑
Equitable Mobility	?	↑
Cost of Private/Semi-private Vehicular Travel	?	↓
Carpooling	?	↑
Passenger Kilometers Travelled	↑	↑
Vehicle Kilometers Travelled	↑	↓
Traditional Public Transit Demand	↓	↓
Trend of Intensification	↓	?
Parking Demand	?	↓
Right-of-way allocated for vehicles	↓	↓
Right-of-way allocated for other things	↑	↑
Residential Building/Lot Size	?	↓
Impervious Areas	?	↓

Urgency – Predictions

Four Phases of Autonomous Vehicle Adoption (2013)

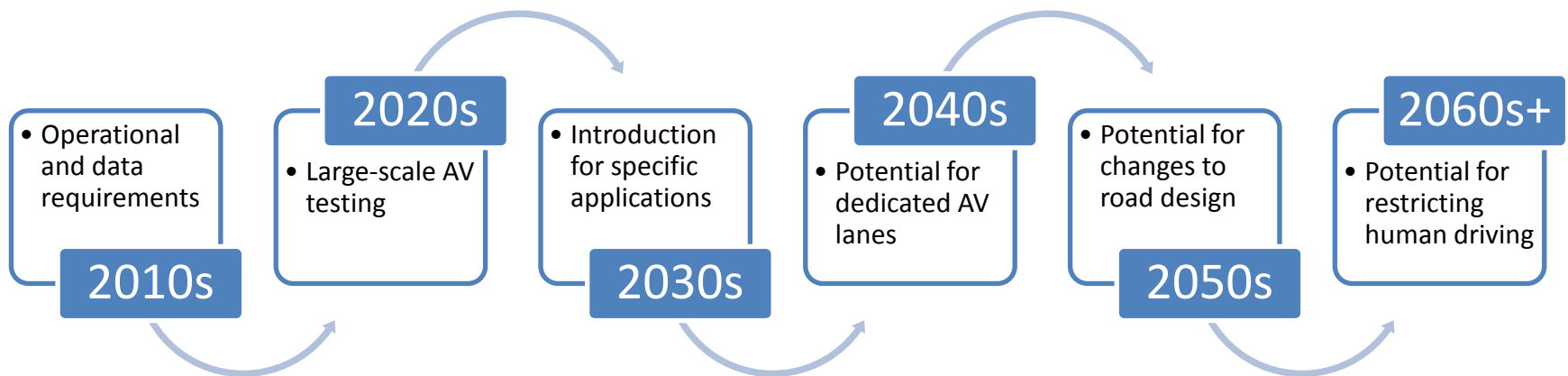
Source: Autonomous Cars: Self-Driving the New Auto Industry Paradigm , Morgan Stanley
<http://bit.ly/1G0FNgb>



Urgency – Predictions

Autonomous Vehicle Planning Impacts Timeline (2015)

Source: Autonomous Vehicle Implementation Predictions, VTPI
<http://www.vtpi.org/avip.pdf>



Urgency – Predictions

Re-Programming Mobility Scenario Highlights (2014)

Source: Re-Programming Mobility: The Digital Transformation of Transportation in the United States, NYU
<http://reprogrammingmobility.org/>

	Growth	Collapse	Constraint	Transformation
Setting	2028 – Atlanta	2030 – Los Angeles	2029 – New Jersey	2032 - Boston
“Headline”	“Doubling down on decentralization”	“Automation run amok”	“Re-inventing transit to implode the suburbs”	“Densification supported by automated logistics”
Impacts	<ul style="list-style-type: none">• More sprawl• Reduced transit	<ul style="list-style-type: none">• Gridlock• Less walking• Suboptimal transit	<ul style="list-style-type: none">• Automated BRT• Nodal dev’t	<ul style="list-style-type: none">• Densification at transit• Innovation in logistics

Vision – Acceptance Spectrum



Vision – Determining Direction

Test statement – Are AVs coming? When?

- Automated and autonomous vehicles (AVs) will have a noticeable presence in the transportation system within the next 25 years.



Vision – Determining Direction

Test statement – Do AVs require action? When?

- Need to prepare for the arrival of AVs – now.



Vision – Determining Direction

Test statement – Will AVs create change? To what extent?

- AVs will create significant change, leading to a paradigm shift in mobility.



Vision – Determining Direction

Test statement – Are AVs an opportunity? How?

- Need to be proactive to ensure that AVs serve to advance existing broad and overall city-building objectives.



Continuing on Change: Preparing for AVs

- Urgency
- Coalition
- Vision
- Dialogue
- Empowerment
- Piloting
- Tipping Point
- Culture



Preparing for AVs

Built Environment

- How might AVs influence or change the Official Plan, Zoning Bylaw, and Building Code?
- How will AVs impact the design of our streets, and be balanced against competing uses?
- Could AVs support City objectives such as improving safety for vulnerable road users and reducing environmental impacts?
- How will AVs impact parking?

Mobility

- Can AVs better support social equity? Access to employment?
- Will AVs contribute to “hypermobility” and greater sprawl, or encourage more density and livability?
- How will AVs impact transit services? When should we consider this in our long-term planning and modeling?
- Will AVs support a growth in electric vehicles? Other fuels?

Preparing for AVs

Information and Data

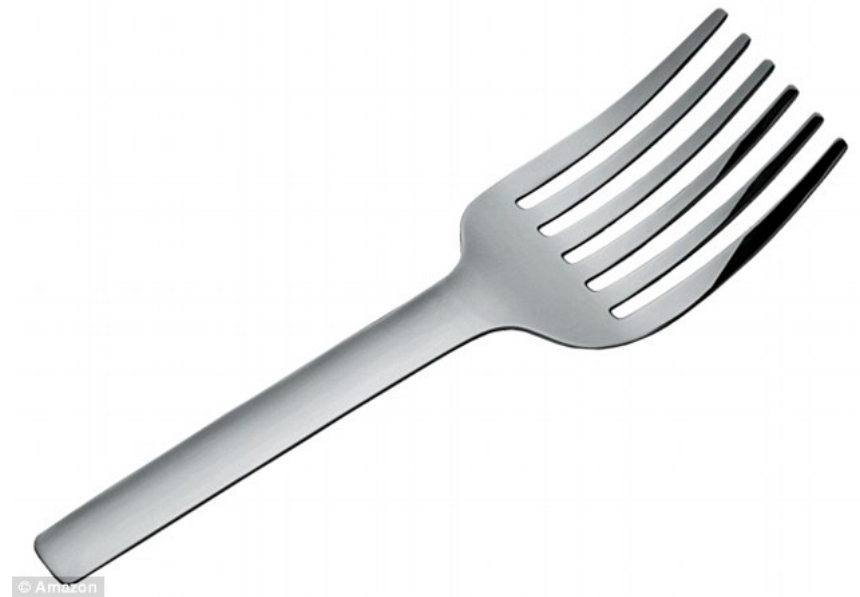
- What data is the City interested in, and how will our role change?
- If data is private, do we risk losing control over mobility planning?
- How do we maintain security and enforcement?
- Will the public understand the data that will be collected, and the implications of it?

Economic Impact

- How proactive does the City want to be in demonstrating leadership in AV adoption?
- Should the City manage or champion change?
- How can the City balance being a leader with the associated financial costs?
- How could falling transportation costs affect other sectors?
- How will AVs affect municipal revenue streams?

Preparing for AVs

- Continue to research
- Acknowledge the forks in the path to AVs
- Work on the “stem” issues
- Plan for multiple “prongs”
- Monitor and review



Thank You



Ryan Lanyon
Chair, AV Working Group
Transportation Services
City of Toronto
416-392-1799
rlanyon@toronto.ca
@ryan_lanyon

Changing the Way We Travel

Mobility and Accessibility
the Autonomous/Connected Way

Webinar – March 7, 2016



On May 5, 2015
Nevada Issued the first license in the world
for an autonomous truck to drive on
public roads

How did we get here?

The **2011** Nevada Legislation Session, **SB 511** authorized the testing and operation of autonomous vehicles and required the DMV to create regulations that:

1. Define insurance requirements
2. Establish minimum safety standards
3. Provide for testing of vehicles
4. Restrict testing to specific geographic areas



The 2013 Nevada Legislation Session passed SB 313 which changed the law in the following areas.

- Definition - “Autonomous technology” means technology which is installed on a motor vehicle and which has the capability to drive the motor vehicle without the ***active control*** or monitoring of a human operator. “
- Insurance requirement - **\$5 million liability.**
- Liability for third party/after market conversion to autonomous vehicle.

Safety Requirements for Testing

- At least two people must be in the vehicle during any testing.
- The two testing operators must be trained in the operation of the autonomous vehicle.
- Vehicle Must have switch to disengage Autonomous Mode
- Must have a system to safely alert the operator to take control of the vehicle if there is a technical failure.
- Must have Mechanism to Capture and Store Technology Sensor Data for at Least 30 Seconds Prior to a Collision.
- Affirm that the autonomous technology does not adversely affect any other safety features of the vehicle which are subject to federal regulations.
- Must submit proof to the DMV that a minimum of 10,000 Miles of Driving in Autonomous Mode has been accomplished prior to applying in Nevada.
- Insurance coverage of \$5 million.



Testing License

Six companies are currently licensed to conduct tests in Nevada:

- Google
- Volkswagen/Audi Group of America
- Delphi Labs
- Daimler/Freightliner
- Hyundai
- Daimler/Passenger



Driver License Endorsement



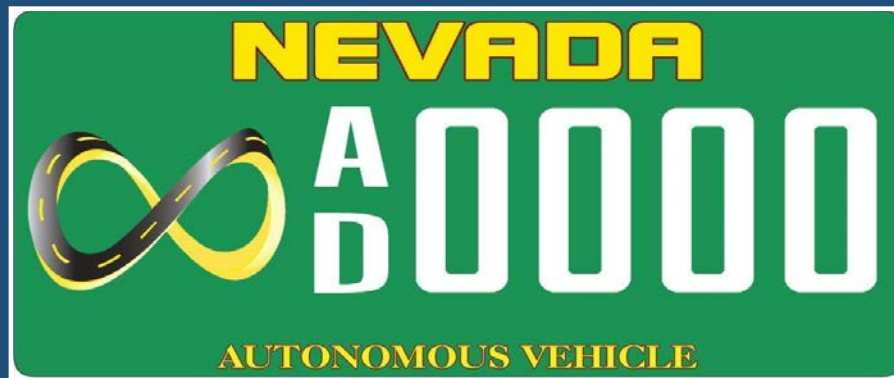
Before operating an AV, a licensed driver must fill out and sign the Departments “G” endorsement application, requiring the driver to acknowledge that he/she is:

- The operator of the AV whether they are physically in the vehicle or not;
- The responsible party who must read and understand the manual provided for their AV;
- Required to operate their AV within the capabilities and limitations outlined in the manual.

Registering Autonomous Vehicles in Nevada

Autonomous Technology Certification Facility (ATCF)

Dealer or after-market technology company provides a certificate to verify the technology meets the safety requirements of the state.



NEXT..... R134-15 Revised Proposed Regulation

Draft Regulations regarding the following subjects:

- Control of an autonomous test vehicle by a natural person
- Expanding the requirements for certain operators of autonomous test vehicles
- Definition of “active control” and “physical control”



What is Next?

In January our Governor created a Center for Automated Vehicles. It resides in the Governor's Office of Economic Development (GOED)

Our Goal: To review, research, determine and address the challenges of implementing autonomous vehicles within our state.

- **AV testing and licensing requirements**
- **Consumer registration and titling requirements**
- **Insurance challenges**
- **Law enforcement challenges**
- **Legal challenges**
- **Security/Data Challenges**
- **Highway Infrastructure challenges**
- **Consumer Education**



Establishing National Policy:

AASHTO and AAMVA Workshops

- Raise awareness of policy issues for various national, state, and local organizations and agencies.
- Gain perspectives of Insurers, Data firms & OEMs on policy and regulatory issues
- Discuss Balance in policy and regulatory framework
- Discuss future form of any automated vehicle public policy forum

Insurance:

- Impacts to non-autonomous drivers with regard to the transitional phase of non-autonomous vehicles to autonomous .
- Gain perspectives of Insurers, Data firms & OEMs on policy and regulatory issues
- Liability determination – who will determine?
- Case law has addressed liability determination in the past, but technology is moving faster

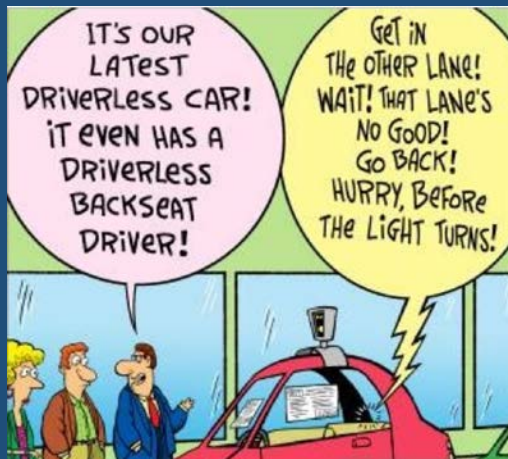


Data:

- Who is responsible for the data?
- There are varying standards for collecting and sharing data. How do you share across multiple platforms?
- Who owns the data? (Public vs. Private)
- Increased need for more refined data?
 - construction zones, lane closures

Original Equipment Manufacturers:

- Regulation vs. Innovation
- How do you handle after market technologies?
- States will need revisit standards (signs, signals). Road design will need to accommodate both autonomous and non-autonomous vehicles.



- How handle driver/operator certification? Will technology updates require updated certifications?

Top Policy Issues:

- Need for National Standards. Challenge of 50 different set of standards.
- Data governance
- Cybersecurity issues (Av and traffic management systems)
- Liability clarification
- Infrastructure clarification
- Process for approving AV for public use.



Connected car
adoption



More autonomous
cars



Smart City integration

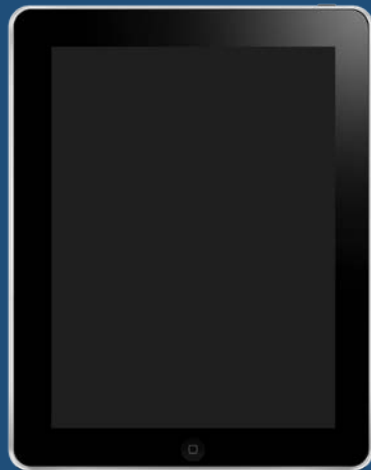


V2I and V2V
connections



Reliance on real-time
data

Connectivity:



The Future Is Here !!

www.dmvnv.com/autonomous

Tracy Larkin Thomason, P.E.
Deputy Director
Nevada Department of Transportation
tlarkin@dot.state.nv.us
702-730-3300

Jude F. Hurin
Management Services and
Programs Division
Nevada Department of Motor Vehicles
jhurin@dmv.nv.gov
(775) 684-4719