Taming the Autonomous Vehicle: New Futures for Cities



Avfutures.NLC.org

Presented by the National League of Cities Center for City Solutions

Supported by Bloomberg Philanthropies as part of the Bloomberg Aspen Initiative on Cities and Autonomous Vehicles

We took a fresh look at the driverless future

These scenarios are designed to imagine how AVs could help address city challenges. This ensures that the needs of people, rather than the needs of technology, come first in the transition to AVs.

There is no shortage of published scenarios exploring the future of autonomous vehicles. However, existing scenarios have failed to articulate a palette of possibilities focused on the concerns, capabilities and constraints of cities.

The six scenarios presented here paint a rich and nuanced picture of how these technologies might be woven into the many facets of our cities.



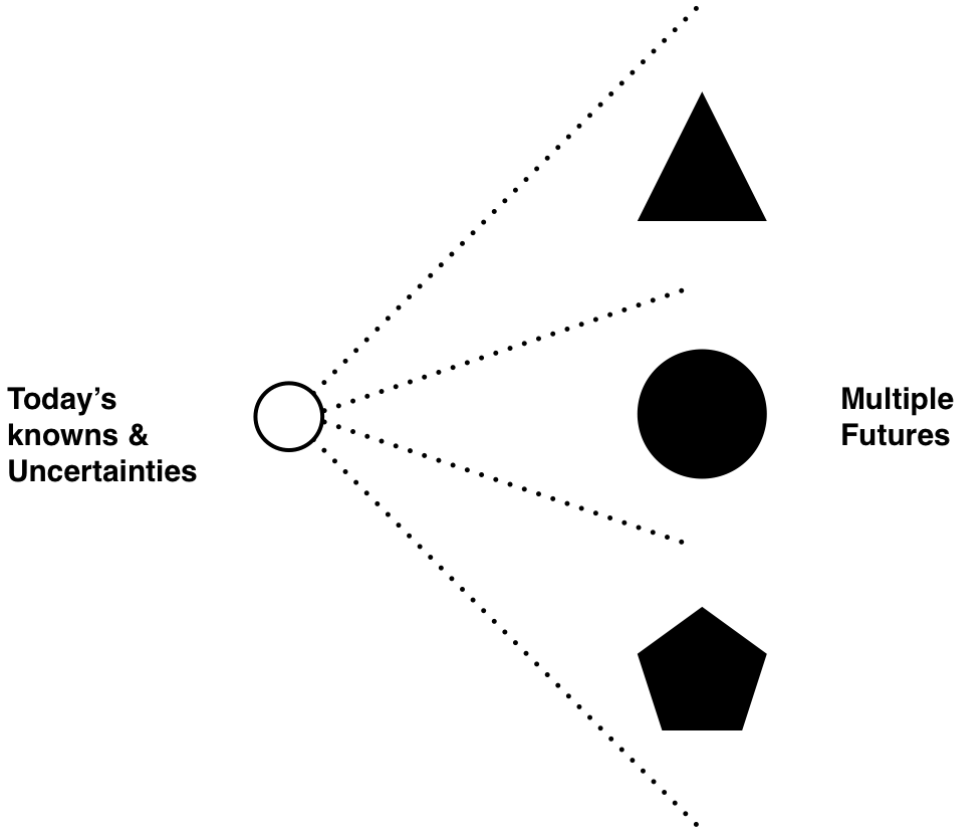
Image: Dash Marshall

Scenarios provide a structured way to think about the future

Scenarios are tools for thinking about the future in a structured way. They push us beyond our present knowledge, comfort zone, and control.

The scenarios described in this brief are triggered by innovations in AV technology. But these changes have ripple effects on urban society, the economy, and the built environment. We look at what the technology could mean in the short term and then explore key uncertainties and how they might interact to shape the future.

Keep in mind that scenarios are not blueprints to be copied as-is. They're designed as thinking, planning, and discussion tools to help you anticipate future possibilities and danger zones.



Putting scenarios to work for your city

There are many ways you can use these scenarios as a tool to have conversations with key stakeholders from across your city as you establish your own vision and goals for your city with AVs.

On the following slides we provide three suggested formats that can be used to facilitate conversation in your city about AVs. We strongly encourage you to convene people with diverse backgrounds, ranging from the mayor and executive leadership to city agency leadership and front-line staff from departments of transportation, land use, economic development, and health and human services - as well as academic experts, business leaders, and the public.



Image: Dash Marshall

Three ways to use this content:

45 Minutes
Scenario Discussion

90 Minutes
Scenario Speed Dating

3 Hours
Scenario Workshop

Option 1: Scenario Discussion
45 minutes

If you want to have a preliminary discussion, focus it on discussing your “preferred future.” Answering two questions first: What’s the big vision you have for your city? How can AV technology play a role in helping you get there?

Review the Scenarios
12 minutes

Use the slides in this innovation brief. The “Challenge” and “Solution” slides from each deck allow you to explain the scenarios quickly.

Prioritize
3 minutes

Take a simple vote to select one scenario that you will focus on for the discussion.

How do they measure up against your city?
30 minutes

Customize a strategy to deal with the unique assets, opportunities, and challenges of your city. You may find that fragments of the other scenarios naturally work their way into your discussion. That’s ok too.

Option 2: Scenario Speed Dating
90 minutes

To quickly share the scenarios with a larger group of people use a high-energy “speed dating” setup, which requires minimal advance preparation.

Invite a good mix of people

You’ll need an even number of people to make this work. Twelve is a good headcount to target, but you can do it with as many as thirty. It’s best to invite people from a variety of different departments so you have a mix of perspectives.

Pose 3 Questions

Bring three questions that will be the starting point for one round of speed dating. They might be things such as “what excites you the most about this scenario?” or “What would be the biggest challenge to bring this scenario to life in our city?”

Pair Off (3 Rounds)
70 minutes

Ask people to pair off for the first round. Announce the discussion topic and give a clear time limit of 20 minutes. Repeat this two more times, asking people to find a new partner before each round.

Report Back
20 minutes

Before everyone departs, spend a few minutes as a large group discussing the points of agreement and disagreement that emerged during the speed dating.

Option 3: Scenario Workshop
3 hours

If you're ready to roll up your sleeves and start developing a more comprehensive vision, a half-day workshop can be a good tool to do just that.

Stick to a small team of 8-10 people

With a larger group it can be challenging to keep the group together in a single conversation.

Start with the vision of your city

AV technology is a means, but not an end. Before diving into a discussion about the technology, spend some time as a group reminding yourselves of the stated vision or big picture goals of your city government.

Focus on needs

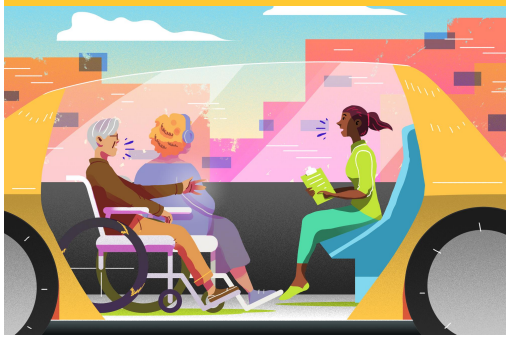
Unexpected ideas come from a deep understanding of needs, and a willingness to creatively address those needs. Spend some time in the beginning of your workshop brainstorming the big issues in your city. Encourage people to use anecdotes and experiences from residents.

Brainstorm opportunities

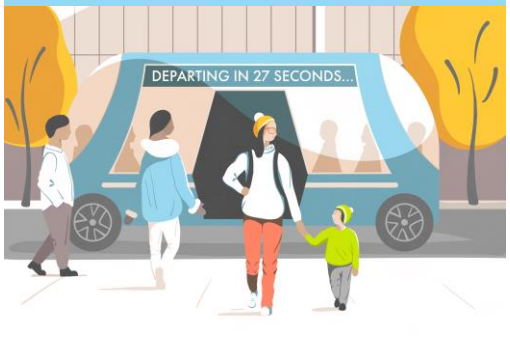
With a list of needs itemized you can set to work brainstorming ways that AV technology might apply. Start by working on a long list of ideas on an "anything goes" basis. After a while you can select a few as a group and refine them. Focus on how you can utilize the unique assets of your city.

Scenario Innovation Briefs

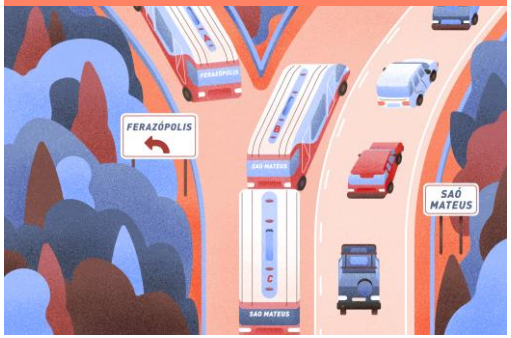
A-to-Z Taxis



Microtransit Mesh



Software Trains



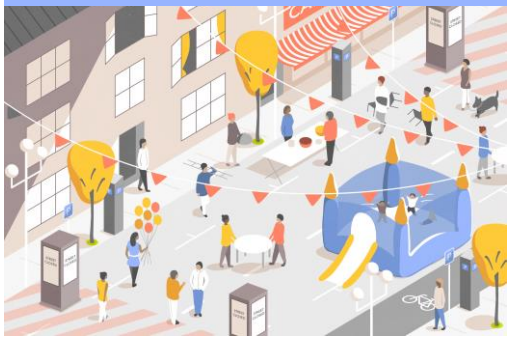
Last Mile Rovers



Conveyors & Porters



Urban Ushers



A-to-Z Taxis

Expanding and innovating ride-for-hire for underserved groups



Challenge:

People need affordable, specialized travel options when they can’t use mass transit

Taxis and ride-for-hire vehicles fill a crucial niche in urban transportation, but aren’t accessible to everyone:

- People with disabilities and special needs
- Those who live outside service areas
- People on fixed incomes

The AV-enabled expansion of ride-for-hire could also cause other challenges for cities:

- Worsen congestion
- Create unfair competition with transit

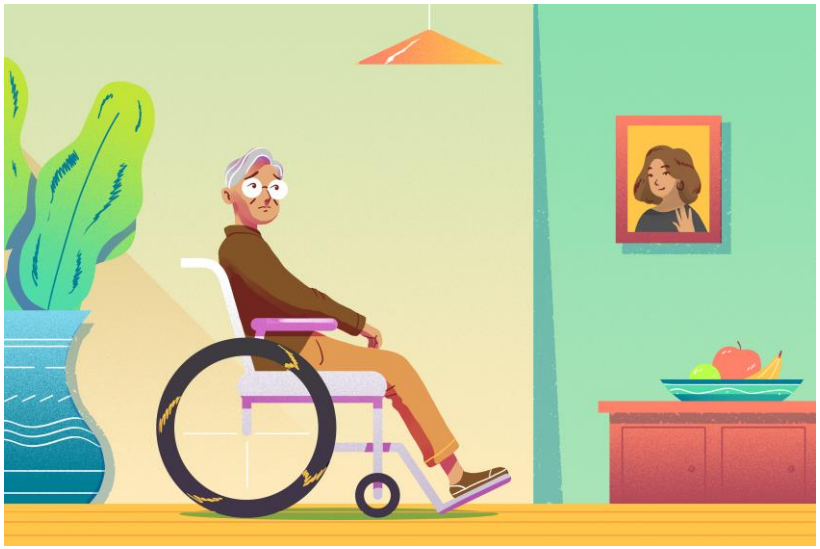


Image: Nick Iluzada

People with disabilities often fall between the cracks in the transportation system - transit can be difficult to use or too far away, dial-a-ride services too unreliable and inconvenient, and taxis too expensive.

Solution:

Cross-subsidize ride-for-hire for disadvantaged niches

Cities could introduce distance-based and congestion-based tolling on for-hire vehicles.

The raw data for setting tolls is collected by AVs that track their own movements and traffic conditions. A software system is responsible for analyzing road use and calculates distance- and congestion-based charges to smooth out traffic.

Toll revenues can be redirected to underwrite subsidized fares for special needs passengers and to fund the creation of new taxi services that serve vulnerable groups.

This approach would also help manage the growth in ride-for-use by providing a price signal to manage demand.

This solution is feasible in the next 0 to 5 years.

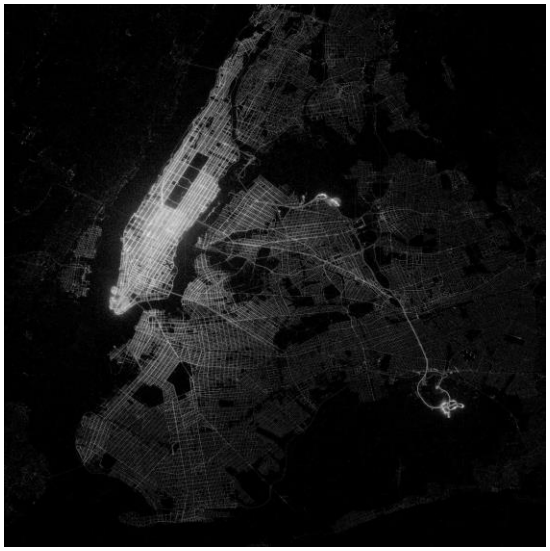


Image: http://minimaxir.com

Taxis already produce large streams of activity data, including records of individual trips. With even more instrumentation, AVs can contribute to citywide, real-time, responsive tolling schemes.

Use Cases:

Dial-a-ride meets on-demand, food runs, assisted rides, access to work

Dial-a-ride services could take advantage of periods of low demand, allowing operators to increase vehicle utilization and providing riders lower fares and shorter advance booking windows.

In **urban food deserts,** free or reduced-price trips to grocery stores could improve access to healthy and affordable food.

Assisted rides that replace drivers with trained attendants could provide door-to-door assistance for special needs passengers at a similar cost.

Access to Work. Cities could target subsidies for economically disadvantaged groups, such as single working parents or job seekers.

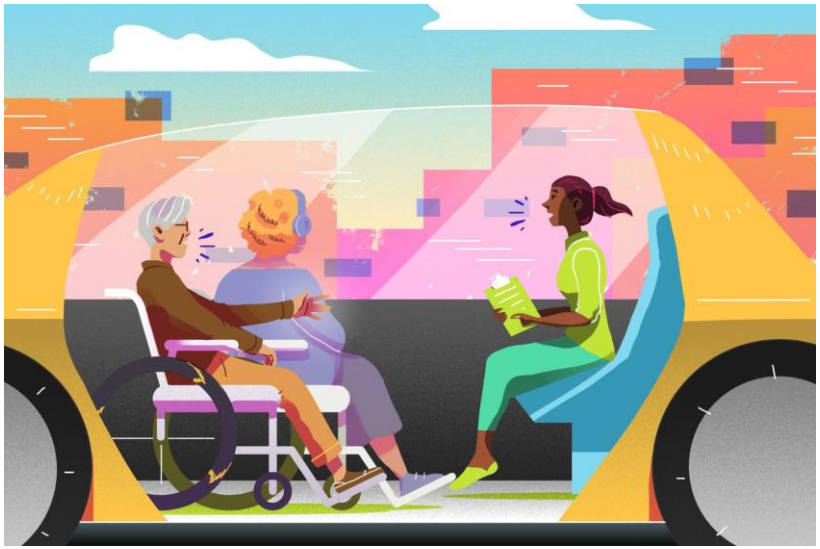


Image: Nick Illuzada

By swapping a driver for a ride attendant, specialized ride-for-hire services could target groups for whom taxis are unusable or unaffordable today.

Drivers to Scale:

The ‘long tail’ of the ride-for-hire market

The ‘long tail’ refers to the large number of products or services in any given market that sell in small quantities. As ride-for-hire services move away from standard taxi models, growing demand for specialized ride-for-hire services will come from:

- Aging populations
- Shifts in travel behavior away from transit routes and peak service periods
- The growing prevalence and awareness of physical disabilities and impaired mobility will increase the need for specialized taxis.
- Limited funding to expand transit services to underserved areas.

Automation will reduce barriers to innovation and growth across all of these emerging markets.

SilverRide
GET THERE WITH CARE

HopSkipDrive

GO GO
GRANDPARENT

City Strategies:

Incentivize the right kind of ride-for-hire innovation

The Right Uses of Automobiles:
Expanding taxi use will require curbing private auto use more aggressively, and promoting shared use.

Transit Innovation:
Ride-for-hire innovation will raise the bar for transit, which must also improve how it serves special needs riders.

Policing Cherry-Picking:
New, specialized services will cherry-pick customers—often in unforeseen and unprecedented ways—unless compelled to behave otherwise.

Third-Party Certification:
Third-party certification (e.g. “AARP-Certified Taxi”) helps raise awareness and could reduce need for direct oversight of many a growing variety of services.

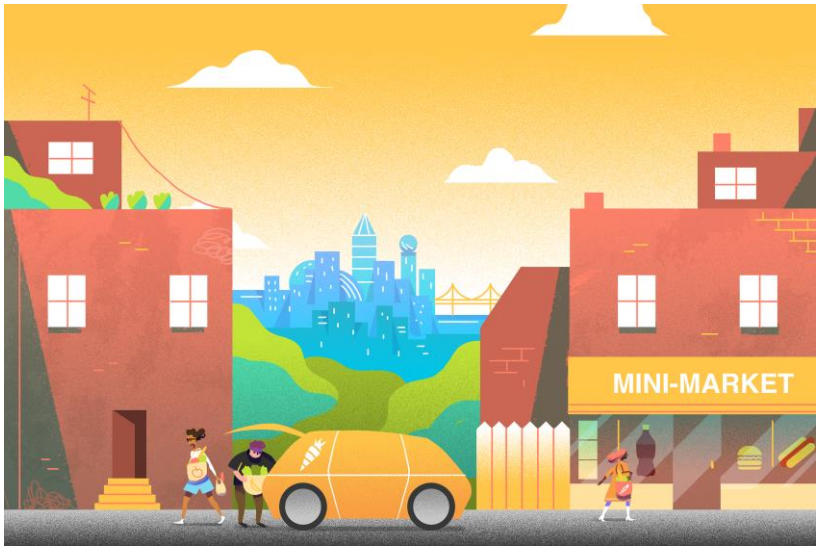


Image: Nick Illuzada

Cities can use AV ride-for-hire toll revenues to catalyze investment in services targeting transit and food deserts.

Maturity:

Increased economic activity and reduced congestion

At scale this could drive the following outcomes:

Increased

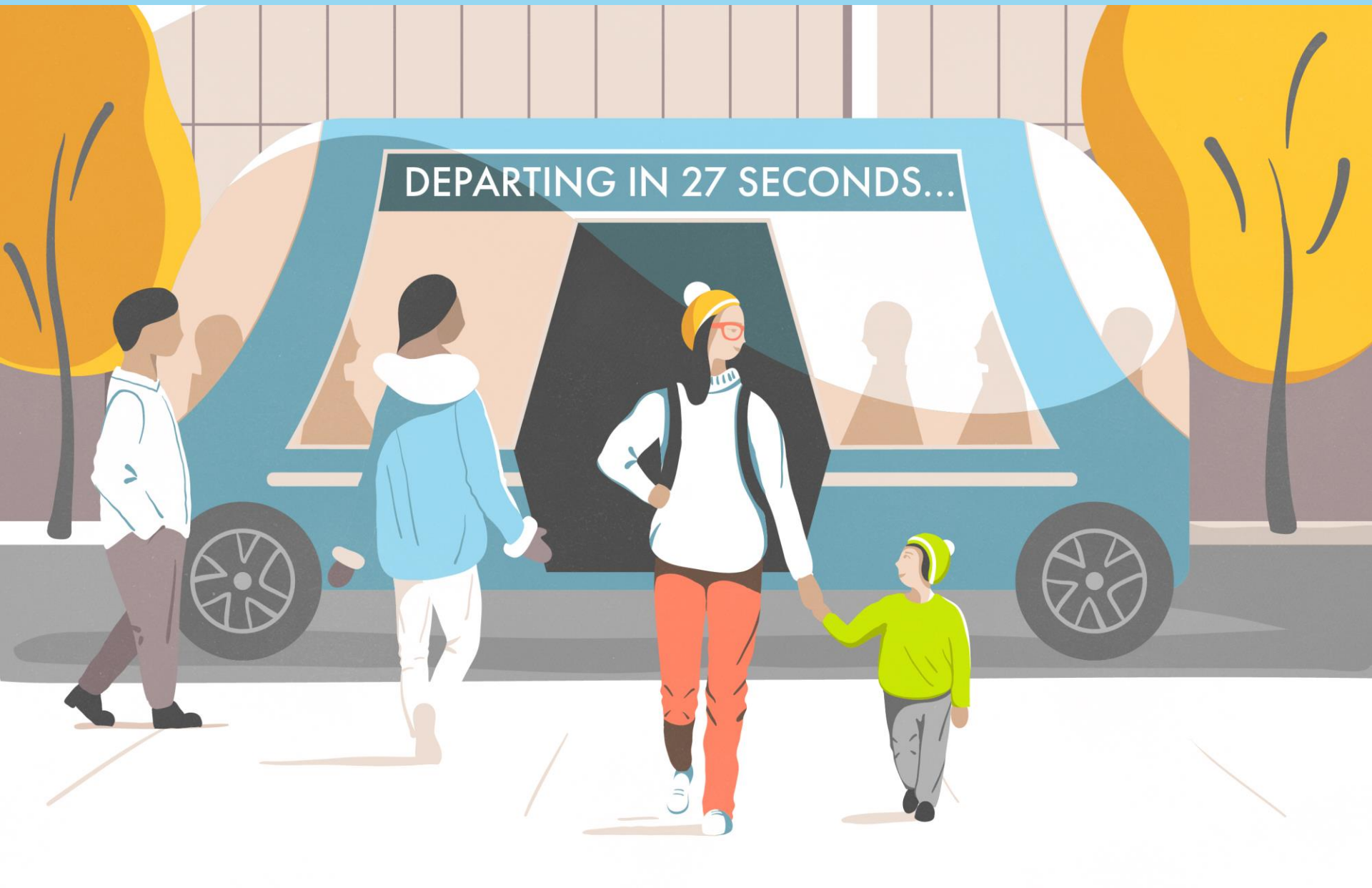
- Number of special needs taxis available
- Variety of special needs served by taxis
- Perceived quality, convenience, and personalization of taxi services

Decreased

- Mobility-challenged persons with difficulty accessing transportation
- Percentage of medical appointments missed
- Taxi vehicle miles travelled (VMT) in congested areas during peak hours

Microtransit Mesh

Taming the unsustainable sprawl of private shuttles



Challenge:

Automation will fuel the growth of overlapping, exclusive private shuttle services

Private shuttles are an increasingly popular amenity provided by employers, housing associations, and other destinations, creating congestion and competing with public transit.

AV minibuses, or driverless shuttles, are coming to market quickly at a compelling price point and low operating costs.

Automation of private transit could unleash an inefficient and inequitable expansion of private shuttles.

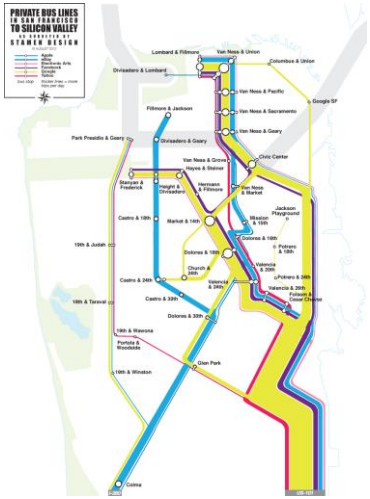


Image: Stamen Design

San Francisco has seen rapid growth and public backlash against corporate shuttles. AVs will expand the range of businesses that can afford to run these services.



Image: Keolis

Driverless shuttles can cut operating costs for on-demand transit by up to 70 percent.

Solution:

A cooperative mesh of private shuttles in the public interest

Opening up private shuttles to public access, and rationalizing overlapping routes, could cut down on low-occupancy shuttle traffic and address equity by closing gaps in public transit.

Digital identity and reputation systems could enable trusted rider programs that reduce operators' reluctance to open private shuttles to non-affiliated riders.

Sharing data more openly on vehicle routes, schedules, and real-time locations would allow for coordination of route planning and transfer points.

Benefits for shuttle operators and riders include access to a larger route network, reduced regulation, potential reductions in operating costs, and improved public relations.

This solution is feasible in the next 0 to 7 years.



AV shuttles might swap transfer riders at fixed stations, predetermined curbside stops, or ad hoc locations.

Image: Kristen Boydstun

Use Cases:

Ridesharing, route planning, and resilience

Shuttle ridesharing lets riders use the most direct shuttle, regardless of who operates it, and easily make needed connections.

Real-time data allows **route planning apps** to integrate shuttle services in the choices they offer users.

The microtransit mesh can be tapped as a **backup public transportation system** during special events, off-peak periods, or disruptions in core public transit services.

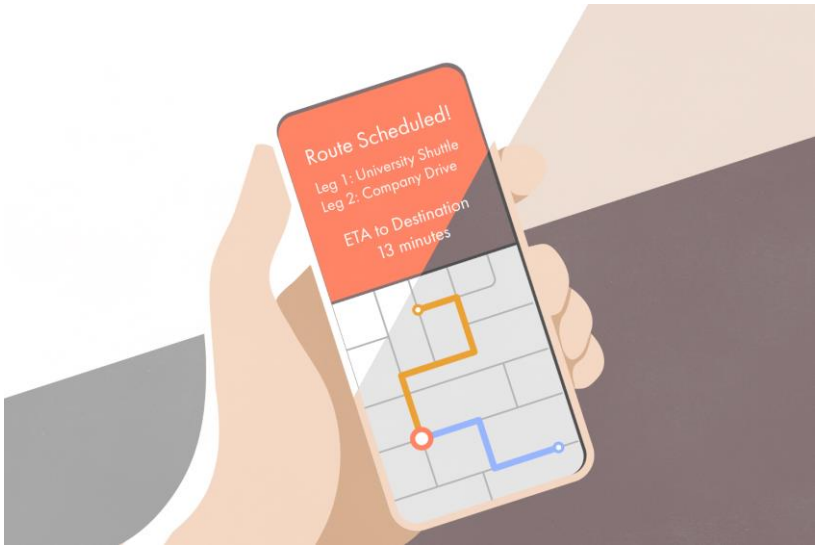


Image: Kristen Boydstun

As the microtransit mesh takes shape, members of the general public who are enrolled in a trusted rider program could start seeing private shuttle trip segments show up as choices in popular route-planning apps.

Drivers to Scale:

Public-private partnerships produce sustainable mobility

As the microtransit mesh grows, it will become an increasingly effective tool to address multiple urban mobility and long-term sustainability issues:

- Increasing traffic congestion in urban areas
- Need to shift to lower emissions travel modes
- Social impact accountability growing at large companies and institutions

It will also leverage powerful consumer trends:

- Desire to use travel time for productivity or leisure
- Technology improvements that make multi-modal trip planning and transactions seamless



As private operators' comfort levels with open access grow over time, it could become commonplace for a variety of members of the general public to hitch a ride on private shuttles.

Image: Kristen Boydstun

City Strategies:

Cities need to incentivize cooperation

Incentives to Operators:
Use operating grants, carbon offsets or other forms of tax relief, land use concessions, or other regulatory relief.

Privacy-Conscious Credentials:
Create, catalyze or connect to offer an identity verification service directly to operators while maintaining anonymity for riders.

Microtransit-Based Development:
Implement compact land use plans that shift people from cars to microtransit and mass transit.



Image: The Daily Iowan

Many universities today make campus bus service available to local community members to improve town-gown relations. Cities could use their authority to encourage more private transportation systems to do the same.

Maturity:

Reduced carbon emissions and congestion

At scale this could drive the following outcomes:

Increased

- Percent of minibus networks participating in data exchanges
- Average number of passengers per vehicle
- Number of apps providing shuttle booking services

Decreased

- Carbon emissions
- Private auto and taxi use
- Redundancy in overlapping minibus routes

Conveyors & Porters

Turning convenience into
a job creation engine



Challenge:

Cities need blue collar jobs that can withstand automation

Shifts in online retailing are creating a surge of local, same-day, and instant deliveries. Many businesses are looking to AVs to slash delivery costs, improve performance, and enable new services.

Cities face a several challenges from AV delivery:

- Enabling innovation and increased convenience of home delivery
- Loss of blue-collar driving and delivery jobs.
- Preventing national and global retailers from gaining a monopoly over local AV distribution.
- Potential conflicts over pedestrian spaces from new kinds of sidewalk-based AVs, or conveyors.
- Containing and mitigating the traffic, noise and pollution from more local deliveries.

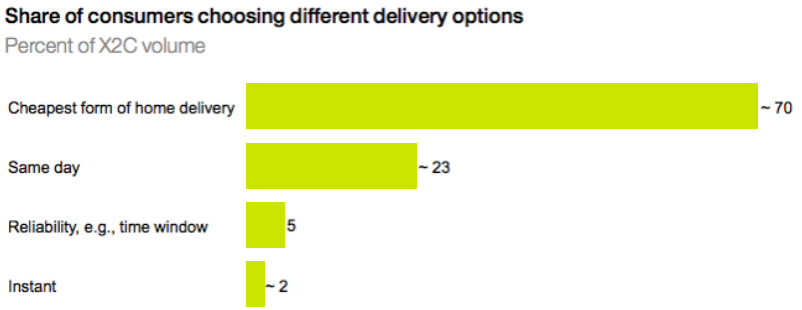


Image: McKinsey & Co.

Analysts project that 20-25 percent of all business to consumer sales will require same day delivery or better.

Solution:

A network of neighborhood porters to manage the ‘last meter’

Cities could work to establish a system of porters who serve a small area and meet the delivery AV at the curb to shuttle goods into buildings. This would:

1. Create jobs to replace those lost to automation in other areas, and reinforce community connections with local businesses.
2. Provide ancillary services: Porters provide other commercial or social services: processing returns, recycling and disposal of packaging, and facilitating the exchange of shared goods.
3. Shift AVs away from pedestrian zones, including sidewalks and crosswalks, potentially by allocating right of way on streets and encouraging logistics companies to develop more roadworthy delivery AVs.

This solution is feasible in the next 0 to 5 years.



Image: Studio Muti

Porters would address multiple problems with an explosion of conveyors - from sidewalk congestion to accessing multi-family and high-rise buildings that robots can’t easily navigate.

Use Cases:

Local food webs, house calls for everything, peer to peer sharing

Local Food Web. Ultra-low cost delivery could support more local food microenterprises, boosting health policy goals, reinforcing local food culture, and strengthening social cohesion.

House Calls for Everything. Porters could specialize and become on- demand service providers. (e.g. “I’m a porter and also a handyman”).

Peer to Peer Sharing. As trusted local figures, porters could help bridge the trust gap that has been a big barrier to the success of local sharing economy ventures.



Image: Studio Muti

Porters can bridge the trust gap that has been a barrier to the success of local sharing economy ventures.

Drivers to Scale:

Ecommerce adapts to constraints of urban markets

Broadly, the success of this scenario lies in its ability to create a better solution for all stakeholders - meeting industry, citizen, and city needs without imposing undue costs anywhere.

Key trends include:

- Increased pressure to resist or mitigate job losses due to automation.
- Continued high cost / low feasibility of AVs and robots that can navigate dense, high-rise urban environments safely and effectively.
- Increased need to protect pedestrian and cycling space in public right-of-way from vehicles, as transport policy favors human-centered modes.



A local delivery system that puts people and technology to work where each is suited can provide the efficiency and flexibility needed for urban freight.

Image: Studio Muti

City Strategies:

Create a platform for jobs-positive local commerce

Retraining:
It will be necessary to retool workers who lose jobs to automation and acquire the skills and knowledge to become porters, easing the transition from status quo to a jobs-positive future.

Economic Development:
By giving small businesses access to the competitive distribution systems of big online retailers, this scenario could fight the hollowing out of local retailers in downtowns and main streets. Piggybacking services on top of the porter role could create many opportunities for local business and job growth.

Transportation Management:
Public value would come from preserving the character of walkable neighborhoods.



Image: SFGate.com

Cities can steer AV-based delivery services towards outcomes that create jobs and support local businesses.

Maturity:

Increased economic activity and reduced congestion

At scale this could drive the following outcomes:

Increased

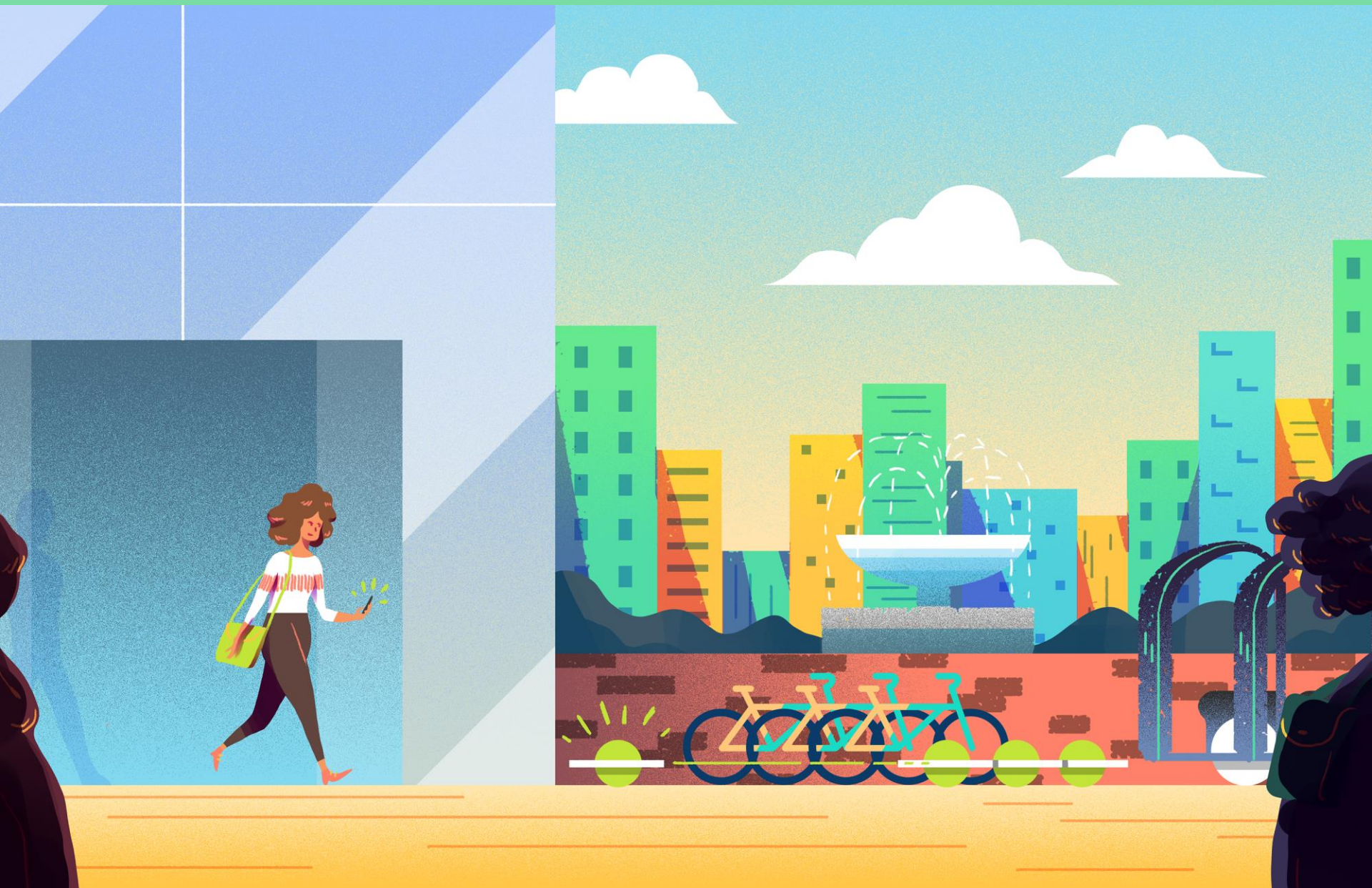
- Employment in delivery services
- Volume and number of deliveries fulfilled
- Local business revenue and jobs

Decreased

- Number of road accidents involving delivery vehicles and pedestrians or bikes
- Average delivery time for local businesses
- Illegally parked delivery vehicles
- Congestion on streets
- Carbon emissions from freight

Last Mile Rovers

Bringing affordable homes and good neighborhoods within reach



Challenge:

People need transportation and housing options that create affordable, human-scale neighborhoods

Cities struggle with rising housing costs. The usual strategies include increasing density in existing built-up areas, and breaking ground on new communities in outlying areas.

Both present transportation challenges. It's often prohibitively expensive to expand transit capacity. The area that can be served by fixed transit is limited by how far people are willing to walk or bike from stations.



Every week brings announcement of new forms of personal electric vehicles, many of which already boast autonomous operating capabilities.

Image: AFP

Solution:

Encourage small automated personal vehicles that stretch the last mile

Human-powered or electric-assist modes in rovers today make it easier for the young and old to participate.

Rovers will dock themselves to recharge at fewer, out-of-the-way locations and users will summon them through an app.

Cities can get more out of existing investments in cycle routes and infrastructure.

With higher sustained travel speeds, rovers will allow more people to access more housing options within easy reach of transit.

This solution is feasible in the next 2 to 7 years.

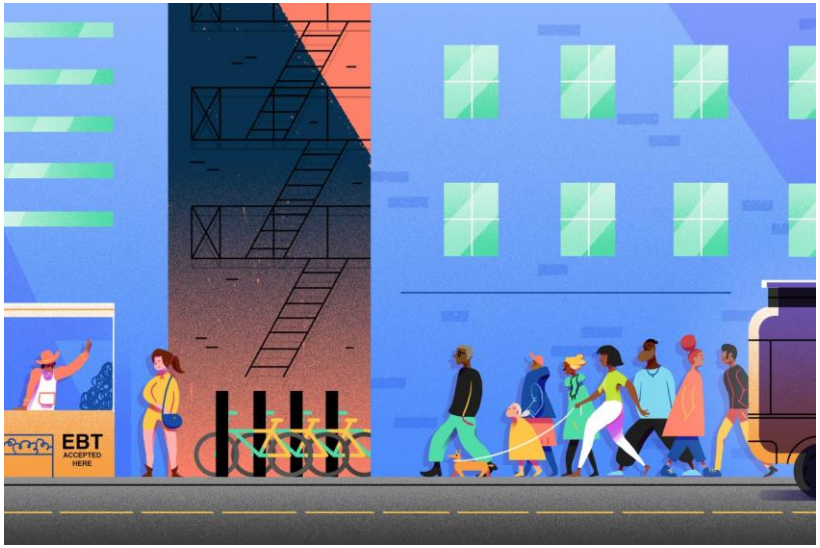


Image: Nick Iluzada

Rovers will dock themselves in out-of-the way locations, freeing up public space currently used for bike share, taxis, and other transportation systems.

Use Cases:

Commute connections, active mobility nudges, guided tours

Commute connections. With travel speeds of up to 15 miles per hour, rovers would extend this radius to 5 miles, a 25-fold expansion of access to transit.

Pre-positioned rovers can serve as an **active mobility options** outside schools, concerts, or other large gatherings of people on a just-in-time basis.

Guided tours. Like any AV, rovers would be able to play back a pre-programmed route. Caretakers of individuals, with early dementia symptoms or early adolescents, could feel secure in knowing that a rover grants a feeling of independence but can always return their passengers safely home.

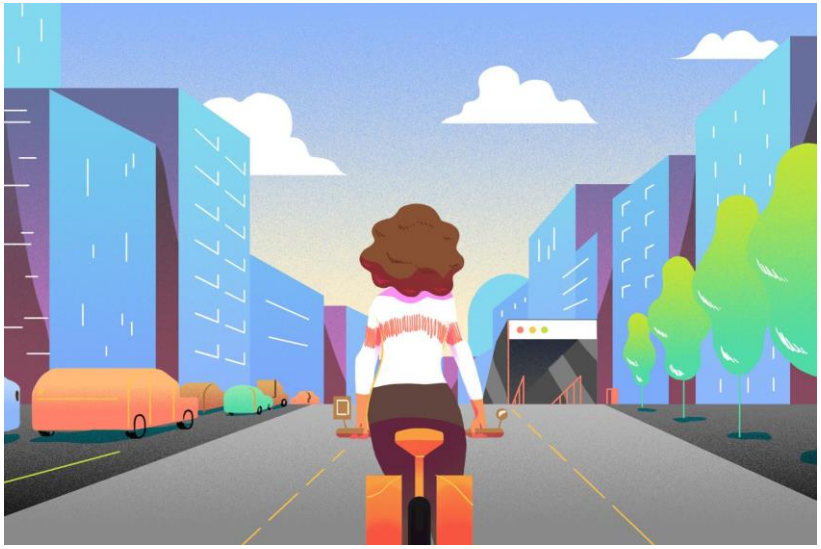


Image: Nick Iluzada

Widespread access to rovers and the higher speed personal mobility they provide could allow a 25-fold expansion in land area for transit-oriented development zones.

Drivers to Scale:

Consumer markets

Rovers could potentially be the way many people first experience AVs. With less regulation than autos, lower entry costs for innovators, and strong crossover potential with consumer electronics rovers will probably develop faster than cars and trucks.

Other trends that will support expansion of this solution:

- Cities are doing a good job creating employment and a poor job increasing the supply of housing.
- The challenges of expanding transit connections into outlying areas
- Environmental concerns about increased auto dependence will all create an insatiable demand for last mile solutions in cities.



Much as electric bicycle sales blossomed suddenly in China a decade ago, consumers could flock to rovers faster than AV automobiles.

Image: Wikimedia Commons

City Strategies:

Exploiting possibilities for larger land use and transportation reform

Upzoning:
Supporting higher intensity land use, consider investments in cycling infrastructure with infill zoning overlays.

Rails and Trails:
Exploit rovers for corridor-based development strategies along repurposed rail lines and urban trails like the BeltLine in Atlanta and Helsinki's Baana.

Urban Core Decongestant:
Expelling cars from the city center and employing a cycle-only zone as a second line of defense after congestion pricing.



Image: publicspace.org

Rovers could be the key to expanded use of non-auto access corridors that link urban cores and outlying areas, such as Helsinki's Banaa corridor.

Maturity:

Bigger, more affordable, human-centered neighborhoods

At scale this could drive the following outcomes:

Increased

- Share of trips taken by human-powered or electric-assist vehicles
- Hours of active exercise per capita
- Number of affordable housing units
- Ridership on rover systems

Decreased

- Share of trips taken by private auto/taxi in target areas
- Wait times for rovers

Software Trains

Boosting corridor capacity
on a budget



Challenge:

Cities need ways to quickly and affordably create transit

There is a growing need for transit services that can be put into operation quickly with low capital requirements.

- Cities are expanding in size, facing changes in travel behavior and coping with fixed infrastructure endangered by sea level rise.
- Bus rapid transit (BRT) has proven effective as a low cost alternative to fixed rail but cities are hungry for ways to expand its potential, and for additional ways to increase high-capacity public transit options.
- Competition from low-cost taxis and microtransit will further increase competition for buses to improve speed and quality.

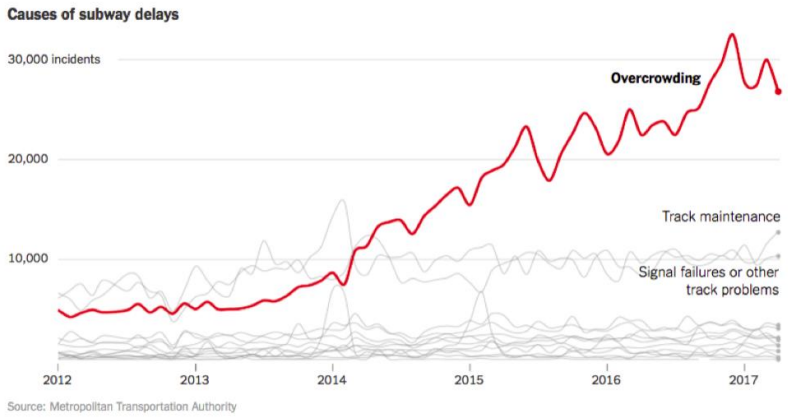


Image: The New York Times

Cities like New York are surpassing the capacity limits of existing transit lines, creating rapid declines in service reliability.

Solution:

Automate bus rapid transit (BRT) systems to enable multi-vehicle platoons

Software trains could boost the capacity of these high-end BRT systems, as well as basic systems that operate in traffic.

Software trains could also prove more resilient, as they are more easily rerouted around or relocated out of vulnerable areas impacted by climate change.

AV technology could also reduce labor requirements, create new design possibilities for interiors, produce smoother more train-like rides, and improve the speed and safety of docking at stations.

This solution is feasible in the next 3 to 10 years.



Current bus systems face capacity constraints, high operating costs, and uncomfortable rides. Automation could power big improvements on all three fronts.

Image: Studio Muti

Use Cases:

Drag and Drop Capacity, Dual-mode lines, Agile Backup

Cities can rapidly deploy **new mass rapid transit routes** with increased capacity and performance with lower operating costs than human-driven BRT. During a major sporting event or convention, cities could also operate a floating fleet of vehicles for temporary services.

‘Dual-mode’ operation would allow software trains to split up at the end of a high-capacity trunk route for onward travel to multiple destinations. Dynamic signage and rider apps would direct riders to board the correct vehicle for their final destination.

After a **major crisis or disruption**, Software trains can be deployed faster than human-driven vehicles after a major crisis or disruption, do not require maintaining a backup pool of drivers, and can learn new routes instantly.

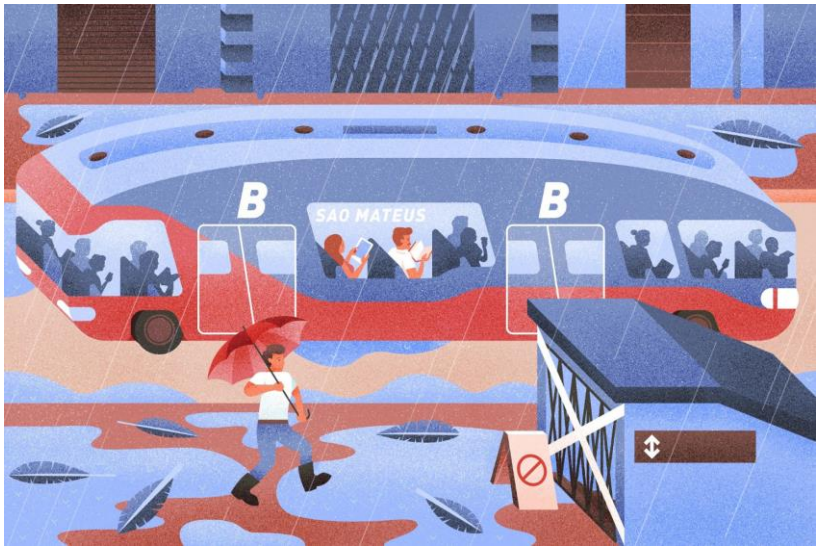


Image: Studio Muti

Software-controlled buses could provide faster, higher-capacity, and even predictive responses to disruptions of other transit services.

Drivers to Scale:

Continued growth in demand for mass transit

Key trends:

- Software trains' popularity will depend on achieving a high and consistent level of service in terms of travel time, reliability, comfort and convenience—all of which will be expected to exceed current standards significantly due to the benefits of automation.
- Over the long term, it could be a prudent choice for coastal cities threatened by sea level rise or other destabilizing impacts of climate change.

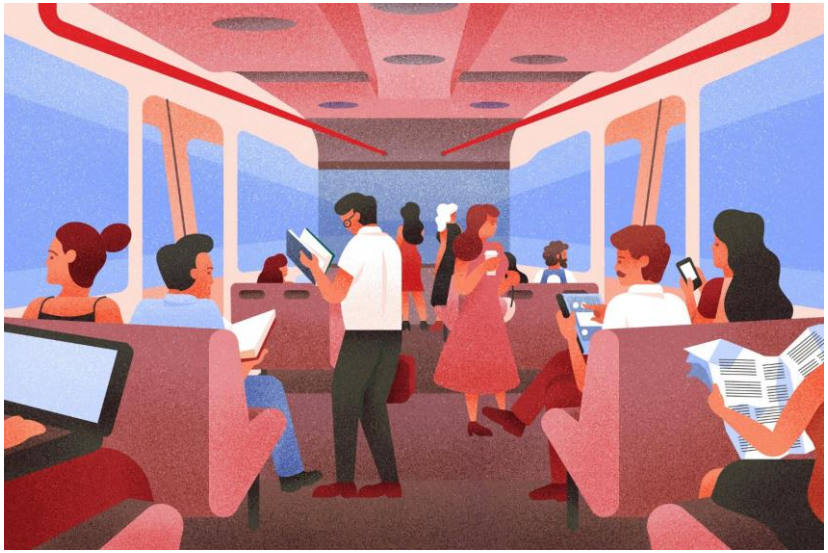


Image: Studio Muti

Software trains will expand as cities exploit automation to deliver more reliable and comfortable service.

City Strategies:

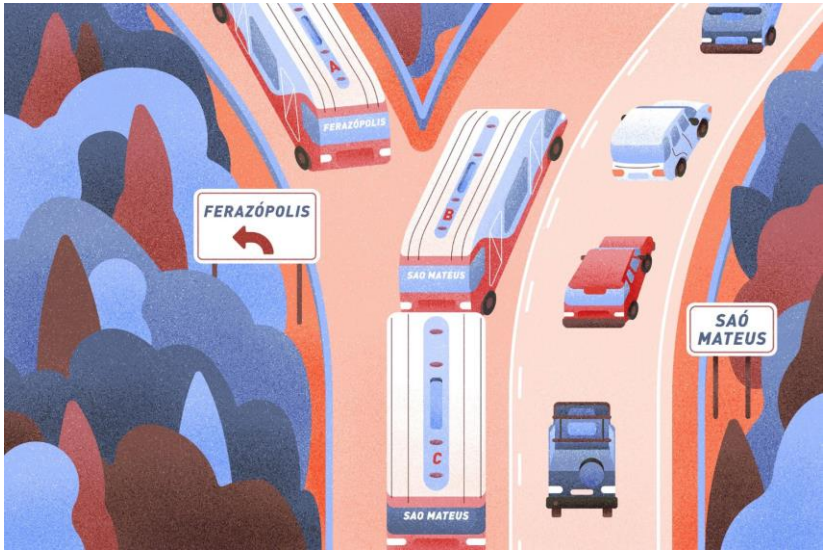
Enabling a more agile approach to transit planning

Software trains could be a tool to completely rethink how cities plan, build, and operate transit:

Choose the First Routes Carefully:
Selecting the right routes, attracting choice riders, and high-profile occasional routes.

A Trojan Horse for Dedicated Busways:
Creating separated and exclusive lanes as a safety precaution

Rethink the Ecosystem Around Buses: AV buses and stations enhanced by related technologies(see our Urban Ushers scenario).



One thing BRT can’t do - branch out to serve multiple endpoints outside the city center - is easy for virtually linked coaches in an AV ‘software train’.

Image: Studio Muti

Maturity:

Increasing returns to scale on bus investments

At scale this could drive the following outcomes:

Increased

- Bus ridership
- Share of trips taken by bus/software train
- Riders per route
- Frequency of buses
- Public opinion of buses
- Commercial/residential development along upgraded corridors

Decreased

- Cost of planning new routes (including fighting NIMBYism)

Urban Ushers

Mobilizing infrastructure to rethink the public realm



Challenge:

People need streets that are safe, pleasant, free-flowing, and fairly shared

Cities are clawing back street space sacrificed to traffic and parking for pedestrians and parks.

Cities have not yet upgraded their tools for managing streets and sidewalks—a clutter of fixtures that were designed to keep us safe but are ineffective, costly, and ugly.

As AVs unleash a surge of pent-up travel demand, new vehicle types and uses, and potentially strange new driving behaviors, these tools will quickly become obsolete.



City streets are littered with a variety of 20th-century street furniture that consumes precious space while leaving big gaps in how public space is regulated.

Solution:

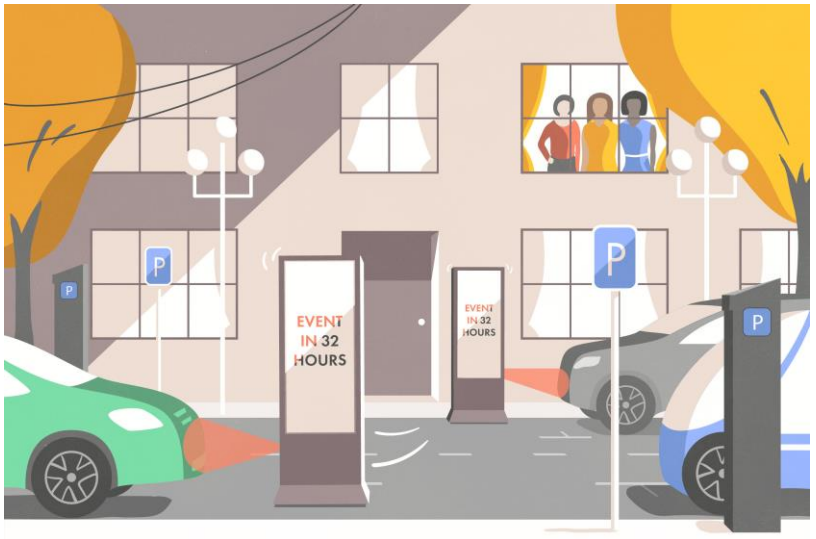
Flexible, capable, and cheaper street fixtures

A new kind of AV street robot, called ushers, could close streets, redirect traffic, collect payments, and provide information to residents and visitors.

Ushers can communicate wirelessly with other vehicles, and with people via signs and speech.

With a variety of sensors and the ability to move around, ushers would produce an abundant supply of real- time data without requiring the same level of capital investment of fixed sensor networks.

This solution is feasible in 5 to 15 years.



Ushers could take a variety of forms, but most likely would be larger than a person and smaller than a car.

Image: Kristen Boydstun

Use Cases:

Block valet, Elastic streets

City agencies could deploy ushers to implement more comprehensive, more fair, and more responsive management of the public right-of-way.

Replacing fixed, flat-rate parking meters with an usher AV would allow **more uniform and efficient enforcement** of parking, and provide the data to fine-tune parking regulations precisely to reflect actual conditions on each block.

Working together as teams, ushers could **reconfigure streets** by acting as barriers, beacons, or signs to cope with shifting traffic patterns. They could expand zones for markets, public events, and other events with social and economic value.



Image: Kristen Boydstun

For city residents and businesses, ushers would be the low-cost, always at the ready, ‘first responders’ that deliver essential city services from street cleaning to public safety patrols.

Drivers to Scale:

Budgetary pressures, Powerful interests, Dynamic Uses

Three converging forces will drive the adoption of ushers:

- Cities face sustained and growing budgetary pressures around the world. Many cities are already struggling to meet their obligations, and widespread conversion to AVs could decimate revenue from parking and traffic enforcement.
- The growing popularity of neighborhood governance innovations suggests that powerful interests would rapidly mobilize to support this solution when it is proven effective.
- Ushers will support the shift toward dynamic uses of the public realm as cities embrace street fairs, markets, and community celebrations.

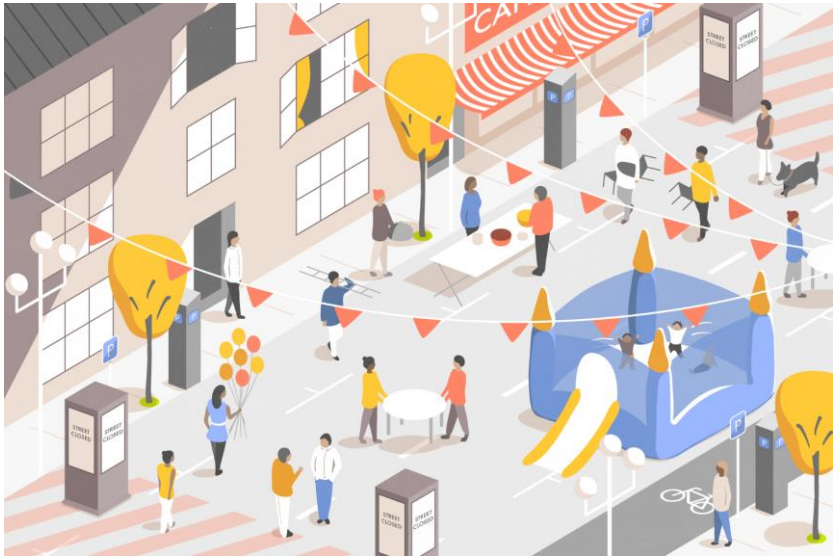


Image: Kristen Boydstun

Ushers will support the shift toward dynamic uses of the public realm as cities embrace street fairs, markets, and community celebrations

City Strategies:

Exploit ushers' potential in the public realm without overstepping political or ethical lines

Equitable Pricing and Enforcement: Cities could gain exceptional powers to price the use of every square inch of the public right-of-way but must balance the desire to manage consumption for roads and parking, revenue generation, and the potential for severely exclusionary and regressive impacts.

Dodges and Nudges: Micro-fines purveyed by ushers to "nudge" people into better behavior would be a dramatic shift from the clear-cut prohibitions used today.

Sidewalk Surveillance State? Ushers would represent a manyfold increase in city government surveillance on streets and sidewalks. Cities will need to be careful to do this in a way that allays concerns about being a police state.



Image: Kristen Boydstun

Ushers could represent a controversial expansion of local government surveillance of public space, and require a new generation of data controls.

Maturity:

Eliminating pedestrian fatalities, clearing the curb and expanding the area for human activity

At scale this could drive the following outcomes:

Increased

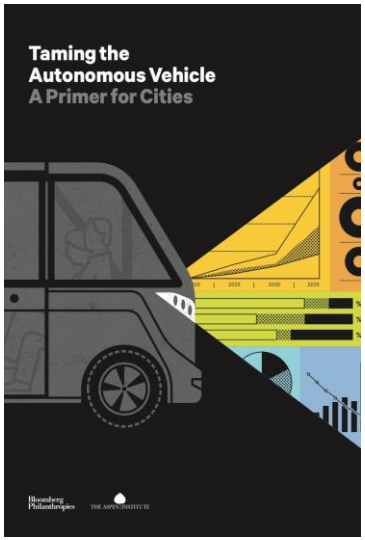
- Share of trips taken by human-powered or electric-assist vehicles
- Hours of active exercise per capita
- Number of affordable housing units
- Ridership on rover systems

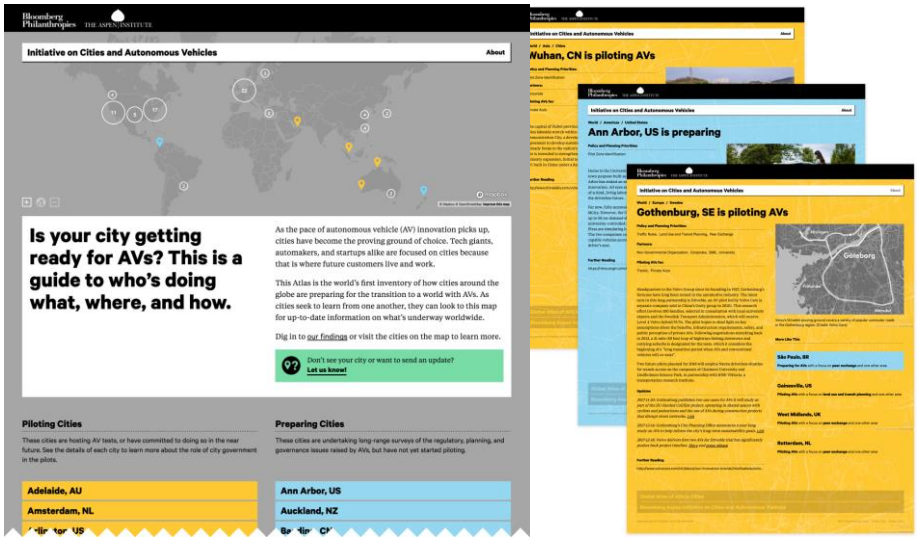
Decreased

- Share of trips taken by private auto/taxi in target areas
- Wait times for rovers

Additional Resources

For more information on AVs and what they could mean to cities, please visit **avfutures.NLC.org** where you will find links to short A Primer for Cities and the Global Atlas of Autonomous Vehicles in Cities.





A Primer for Cities
This provides a briefing on the technology innovations, industry trends developments, and urban policy implications of AVs looking out to 2030.

Global Atlas of AVs in Cities
A collection of pocket case studies on more than 100 cities around the world that are piloting and making plans and policy around Avs.

AV Futures Scenarios developed by Bits and Atoms (bitsandatoms.net) and Dash Marshall (dashmarshall.com)