The Future of Transportation Technology: What to Expect

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Agenda

- Automated Driving
- Ride Hailing
- Technology and Transit
- Sharing Economy

Goals

1. Understand how technology is reshaping transportation across globe
2. Discuss tech's potential and limitations
3. Create insights into how technology will affect transportation here

About Eno

Presentation Summary

1. Technology and transportation has limitless opportunities

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2. Much of it is nacent, untested, unproven

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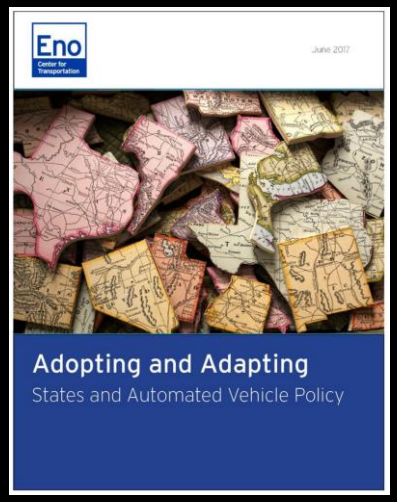
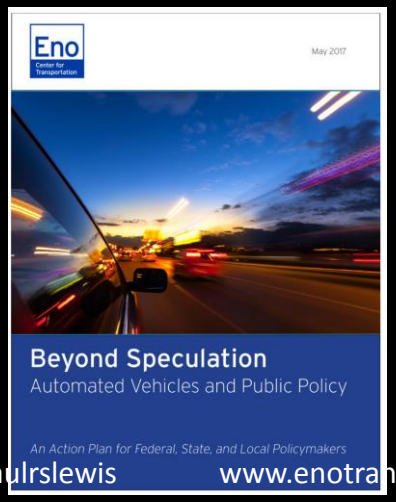
2. Much of it is nascent, untested, unproven
3. Concerted effort needed to plan to achieve the optimal outcomes for communities

References

- Reports available on Eno's website
  - *Beyond Speculation*
  - *Adapting and Adopting*
  - *Emerging Trends in Transportation Technology*
  - *Eno Transportation Weekly*





AV Summary

AV Summary

- AV has advanced rapidly on the “easy” part of the problem
- Safety (in rural areas) has most to gain in short term
- The future is far from known, but we can begin planning now

What is an automated vehicle?

- Self-driving?
- Driverless?
- Driver assist?
- Automated?
- Autonomous?
- Cars? Trucks? Buses?

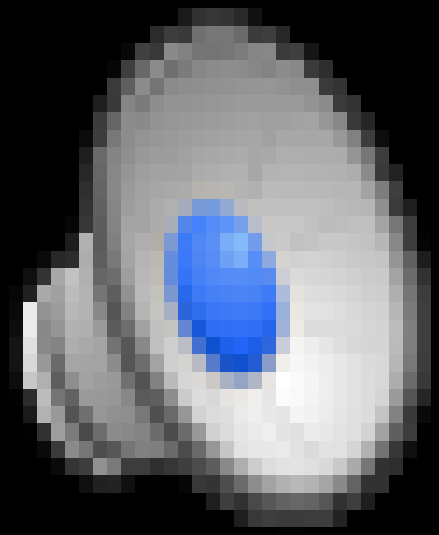
SAE Levels of Automation

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

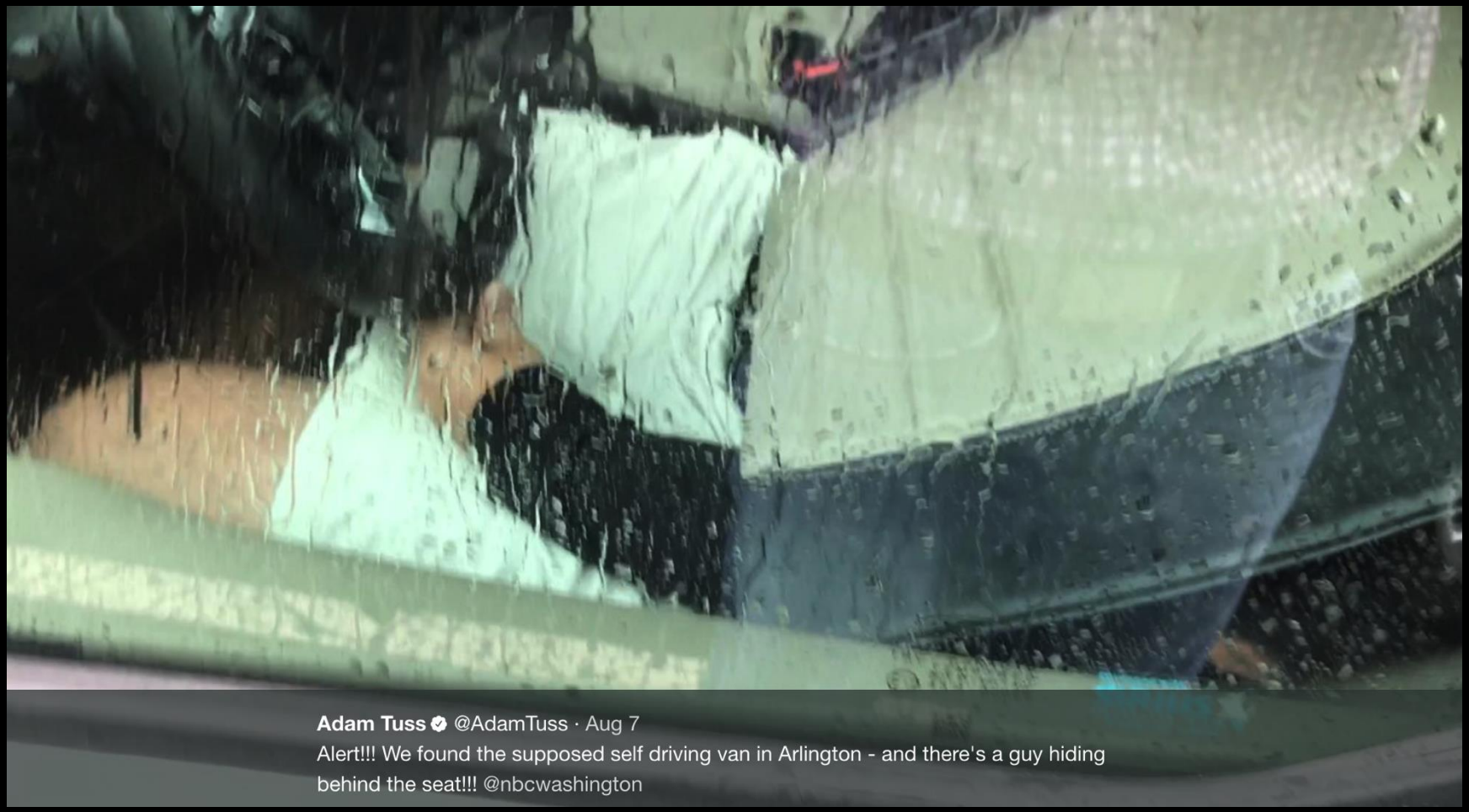
What will happen?

- Vehicle miles traveled
- Congestion
- Safety
- Liability
- Privacy
- Ethics

Automated Driving

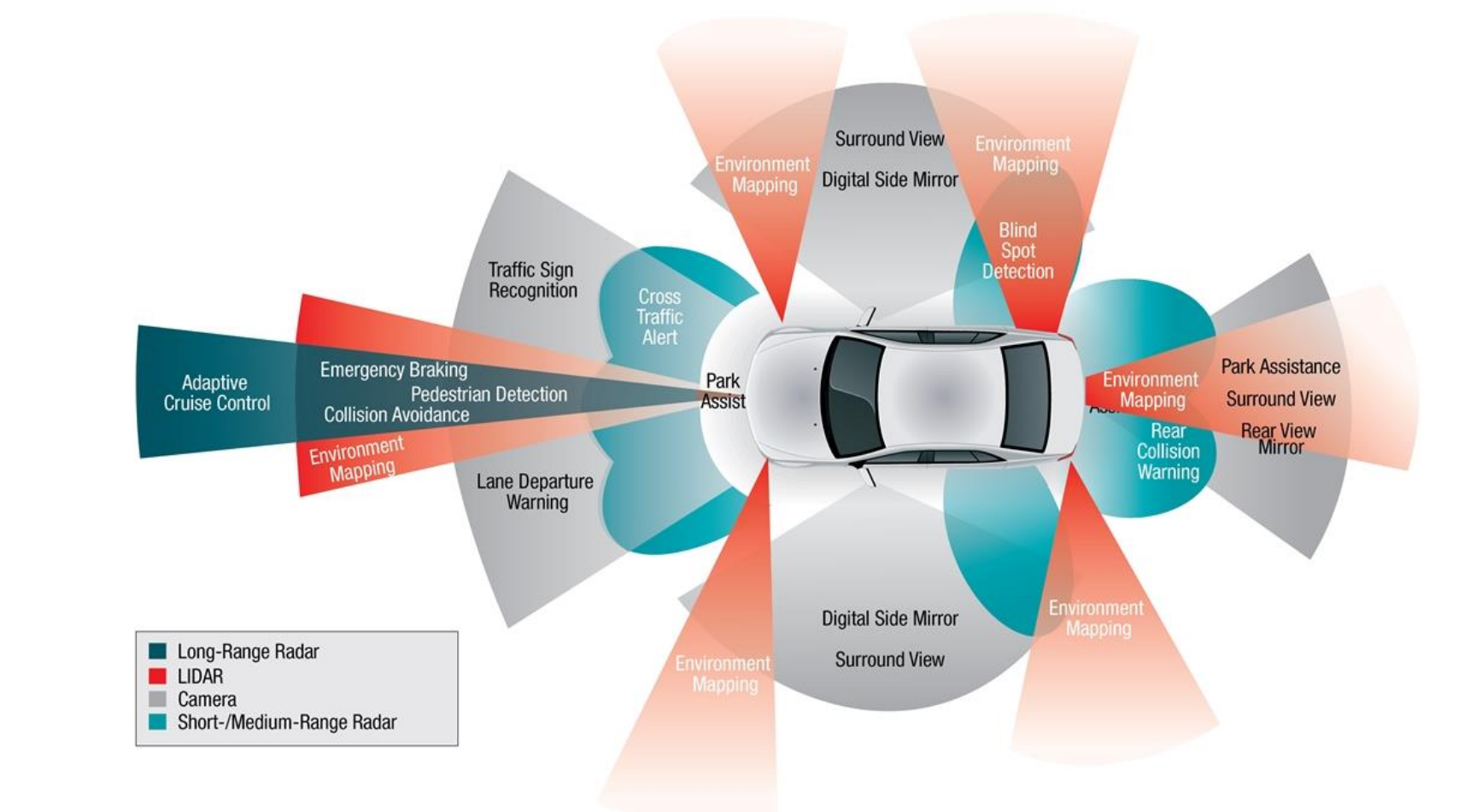


AVs in Arlington



Approach to Automated Tech

Current AV approach



Expected Commercial Availability

Table 2: Expected Commercial Availability of Level 3 or Higher Vehicle Automation, by Select Organization

Organization	Year	Type of Organization	Automation Level
Ford Motor Company	2021	Vehicle Manufacturer	Level 4
Uber	2021	Transportation Network Company	Unspecified
Volvo	2021	Vehicle Manufacturer	Level 4
General Motors	2020	Vehicle Manufacturer	Unspecified
Tesla	2018	Vehicle Manufacturer	Level 3 or 4
Google	2020	Technology Company	Level 4
Victoria Transport Institute	2020-2030	Research Organization	Unspecified
National Association of City Transportation Officials	2020	Association	Level 4
IHS Markit	2020	Market Research Company	Level 4 and 5
ABI Research	2021	Market Research Company	Level 4 and 5
Juniper Research	2025	Market Research Company	Unspecified

Source: Endnotes 10 – 20.

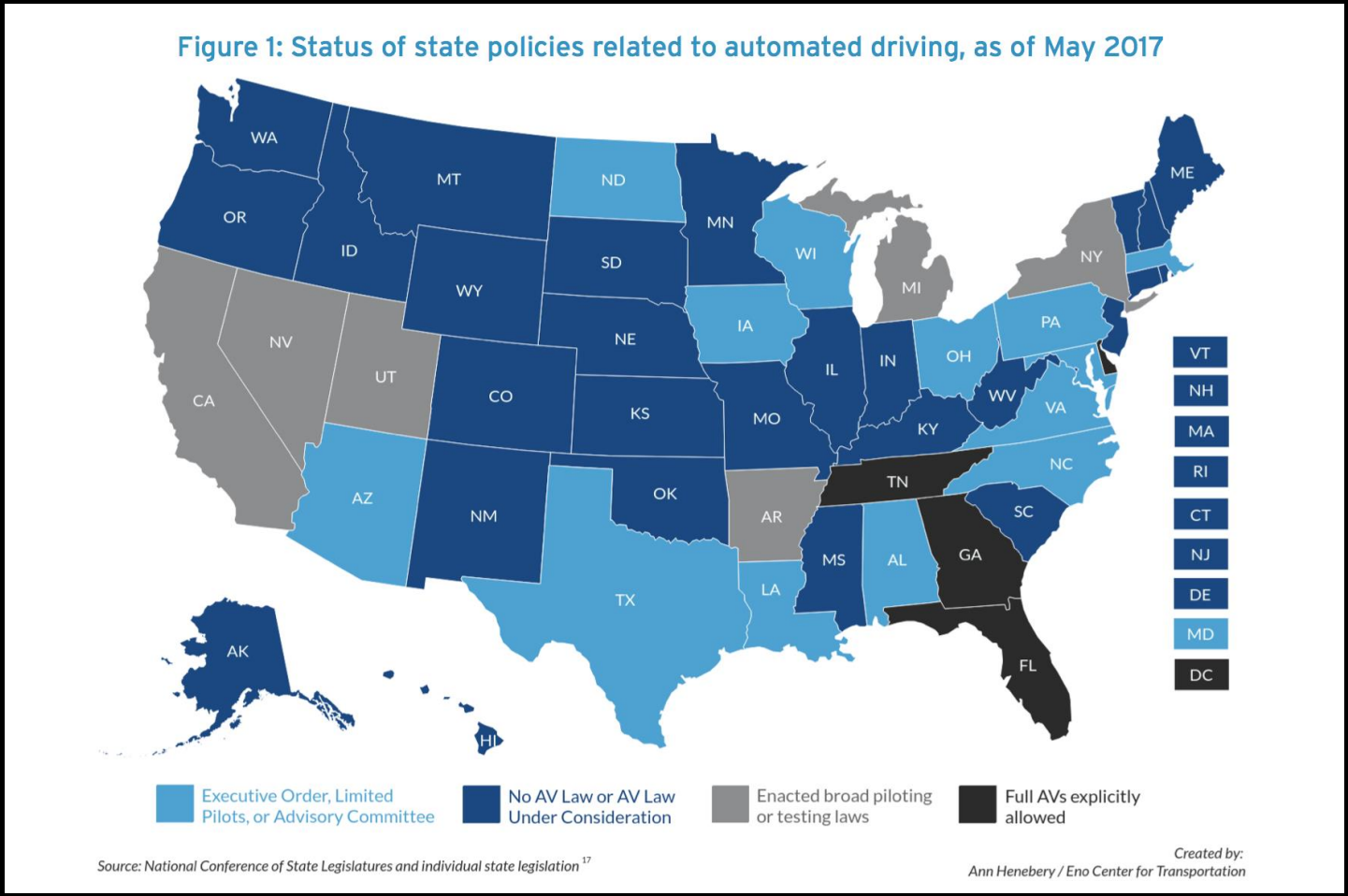
Created by: Ann Henebery / Eno Center for Transportation

Business Model

- Personal AVs
- Shared fleets

Government Role

Government Role



Implications for Transportation

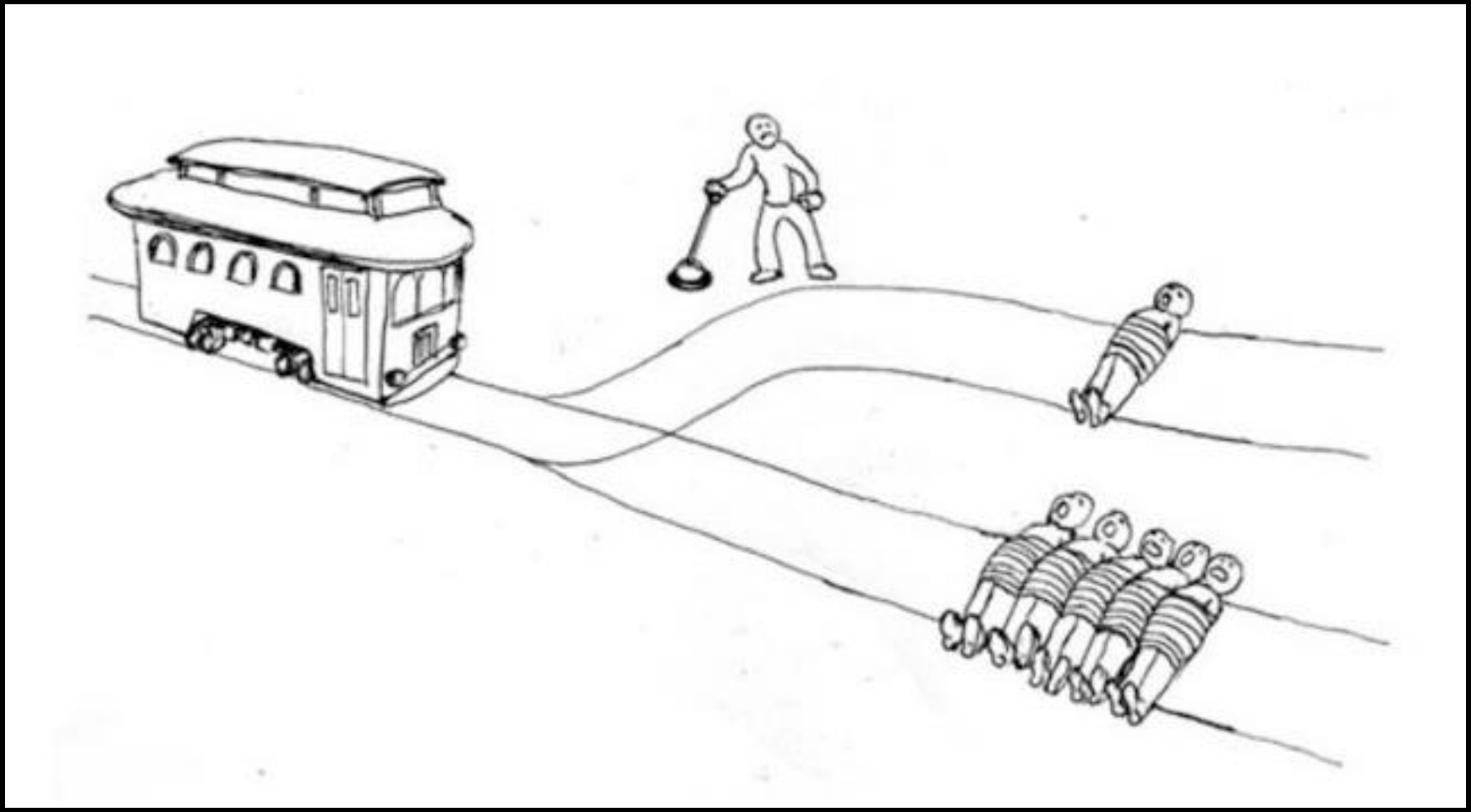
- Certification, liability and insurance
- Ethics
- Cybersecurity
- Privacy
- Infrastructure/funding
- Vehicle connectivity
- Research
- Workforce
- Freight
- Consumers

Certification, Liability and Insurance

Certification, Liability and Insurance

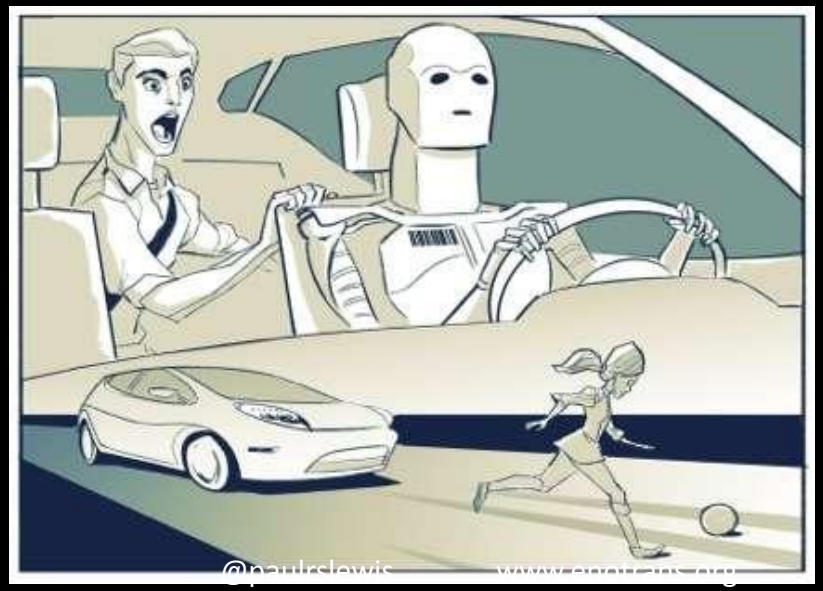
- Federal role
  - Federal Motor Vehicle Safety Standards
- State/local role
  - liability, licensing, insurance
- Harmonization between states

Ethics



Ethics

- German Ethics Commission
  - Public sector must ensure safety
  - AV developers clearly assign responsibility
  - Trolley dilemma is too complex

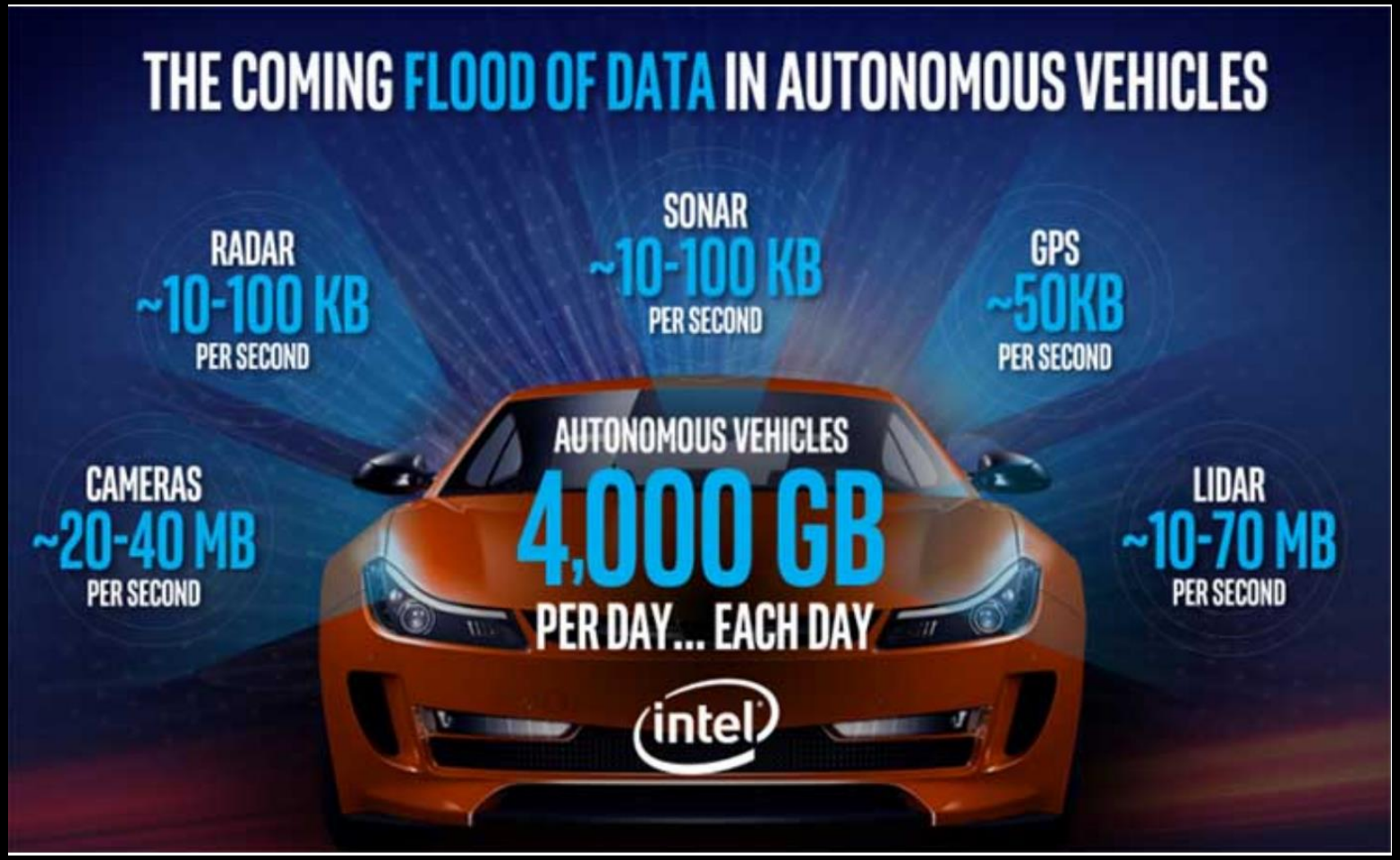


Cybersecurity

Cybersecurity

- Industry-led cyber standards
- Prescriptive regulations do not work
- Limited liability for manufacturers?

Privacy and Data



Privacy and Data

- Data owner = vehicle driver
- Regulations to protect owner privacy
- Cities enact data sharing agreement

Vehicle Connectivity

Vehicle Connectivity

- Maintain existing spectrum
- Create V2X standards
- Test CV technology in pilots

Infrastructure and Funding

Infrastructure and Funding

- ⇊ parking, traffic violation revenues
- ⇊ in fuel taxes
- ⇈ demands for better infrastructure, CV tech

Needed Infrastructure

- State of good repair investments
  - Lane markings, potholes, signage, signals
- Testing of CV

Proposals for Mileage Fee

- Small per-mile fee on Level 3, 4, 5 driving
- Easy administration, significant revenue
- Oregon, Tennessee, Massachusetts

Research and Planning

- AVs in long range plans
- University programs
- Test sites

Workforce

- Truck drivers, taxi drivers, mechanics, bus operators
- “Driver” > 4 million jobs

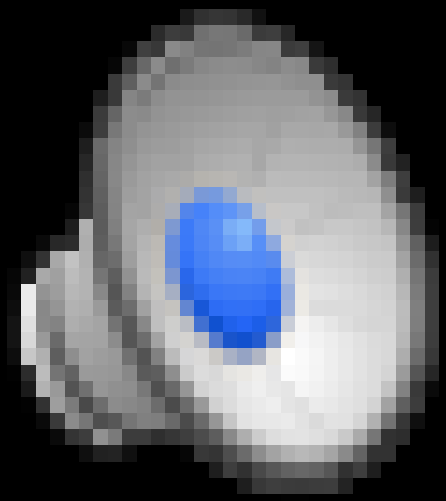
Workforce

- Large scale workforce replacement unlikely because:
  - Driving is only part of the job
  - Perpetual truck driver shortage
  - Public is skeptical
  - Technology is years, if not decades, away

Freight

- Automated ships
- Automated trains
- Automated trucks

Freight – Truck Platooning



Consumer Acceptance

- Consumers are unsure about tech
- Uncomfortable with truck platooning
- Consumers are price sensitive

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- Sharing Economy

Ride Hailing/TNCs

Ride Hailing Summary

- Public demand is strong and growing
- Recent PR problems are unlikely to derail progress
- Can TNCs function profitably in suburban and rural areas?
- Role of automated technologies

Ride Hailing/TNCs

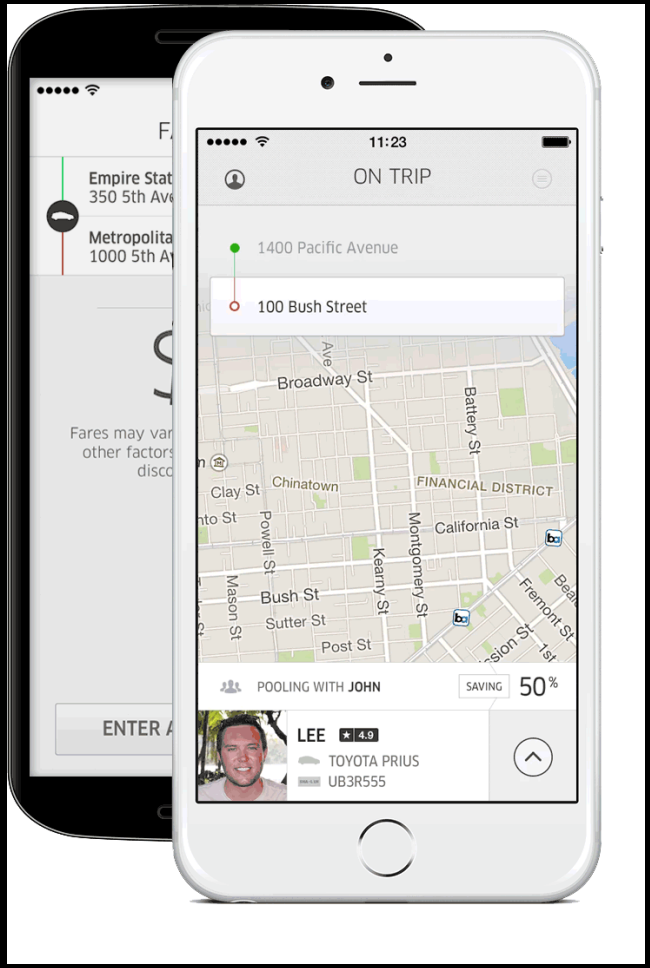
- “Transportation Network Companies”
- Ride-hailing, ride-sourcing ride-sharing, car-sharing?
- The “modern” taxi industry

Taxi-like TNCs

Attributes	Lyft	Uber
Services	TNC, premium, XL	TNC, premium, XL, Family
Driver Background Check	Yes	Yes
Two-Way Ratings	Yes	Yes
Specified Destination	No	No
TNC Driver Compensation	set fares + tip	set fares + tip
TNC Commission	25% for new drivers	20-25 %
U.S Market Share	23 %	75 %
Value	$7.5 b	$50 b
Quarterly Loss	$130 m	$645 m

Carpool TNCs

- Via
- UberPOOL
- Lyft Line
- Gett

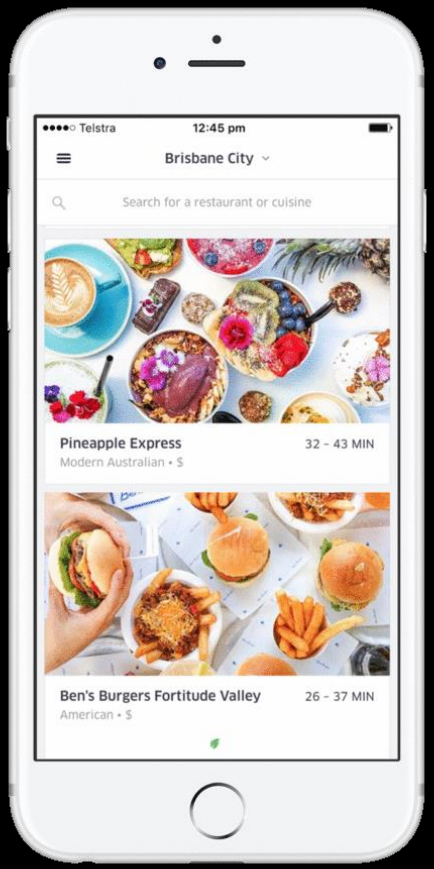


Basic Business model

- Use app to connect drivers and passengers
- Does not own the vehicles
- Surge pricing to manage supply and demand
- Emailed receipt and payment
- Constant experimentation

Platform for Opportunities

- Uber Family
- Uber WAV
- Uber Eats
- Autoplay Music
- Split fares
- Uber Freight
- ETA Status Update
- Credits at select stores



Driver's Perspective

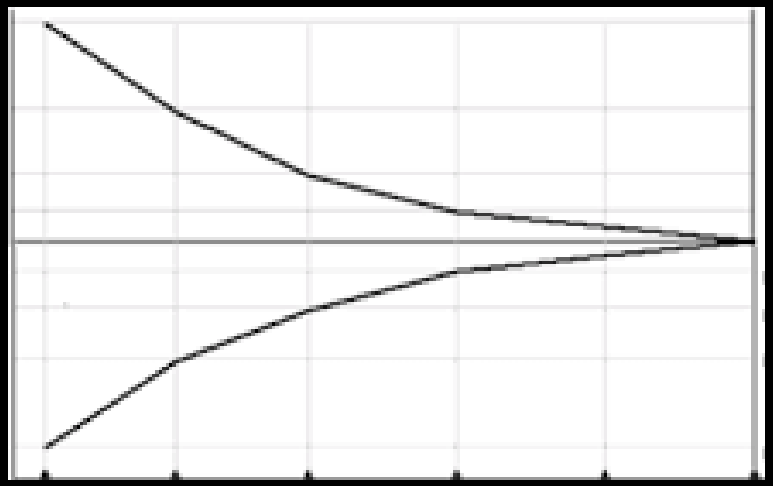
- Independent contractors (1099 employees)
- 20 to 25 percent commission
- New addition of tips on Uber
- Mixed review on satisfaction
- Full or part time

Local regulations

- Cities and states have struggled to regulate
- Traditional taxi services threatened
- Some cities permissive, some ban.

TNCs are the future Taxi Market

- Taxis are over-regulated
- TNCs are under-priced
- Eventually convergence into the new taxi industry



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- **Technology and Transit**
- Sharing Economy

Technology and Transit

- Subsidized partnerships for transit services:
  - First-mile, last mile
  - Paratransit
  - Guidance applications
  - Replace bus networks?

Tech Transit Summary

- Huge opportunity for partnerships
- Problems with marketing, ridership
- Focus on goals, not technology
- More expensive that expected
- Procurement barriers
- Microtransit/TNCs cannot replace high capacity

First Mile/Last Mile “Microtransit”

- Three case studies
  - Uber/LA Metro discounted rides
  - Bridj/KCATA microtransit pilot
  - Pinellas Sun Coast Transit subsidized Uber

Uber/LA Metro

- Opening of new Expo rail line
- Non financial transaction
- Uber provided discounts
- LA Metro provided advertising

Bridj/KCATA

- New commute routes in underserved areas
- High media visibility, low ridership
- Discontinued after 12 months

Pinellas Sun Coast Pilot

- “Direct Connect” replaced poor bus service
- Uber, Lyft, taxi, WAV options
- $5 discount in geofenced area, recently expanded

Other examples

- MBTA Paratransit
- AC Transit 275 Bus line replacement
- Santa Clara VTA
- Federal Transit Administration MOD Sandbox

Other examples

- Phone apps like moovel and google maps
- Open data for NextBus
- Employer incentive applications

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- **Sharing Economy**

Sharing Economy

zipcar

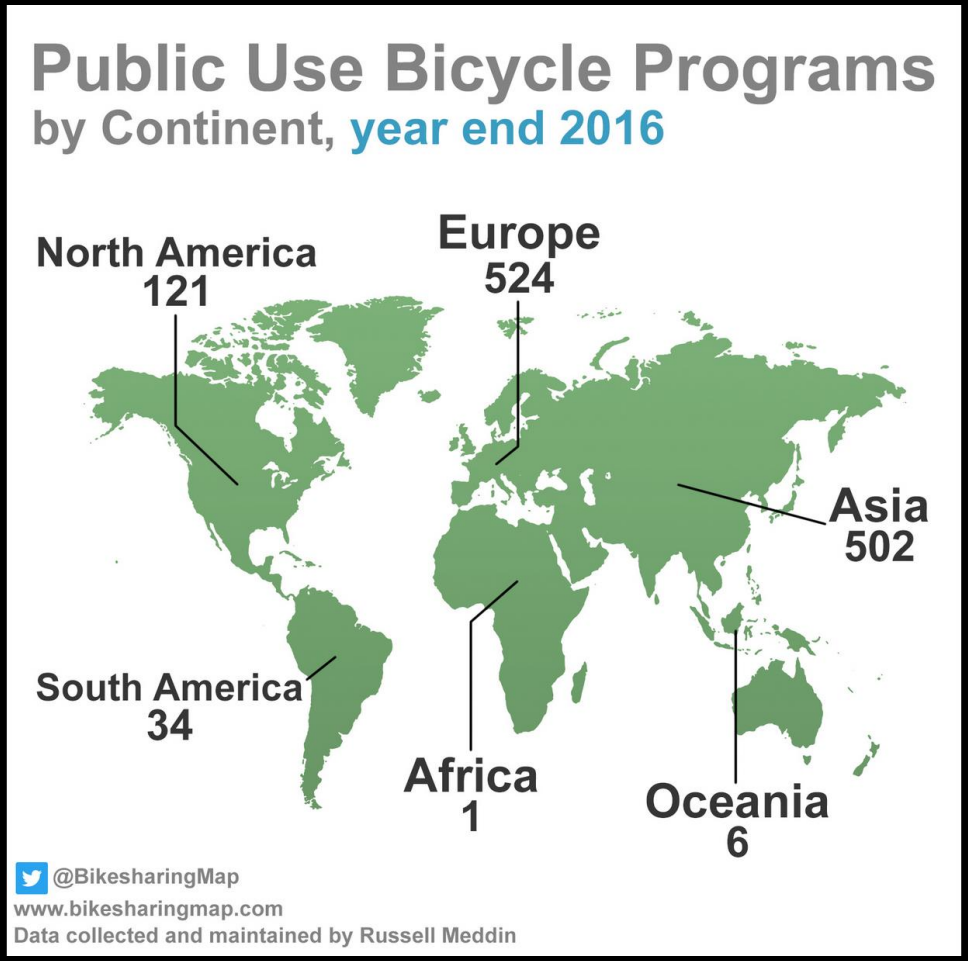
MAVEN

Getaround

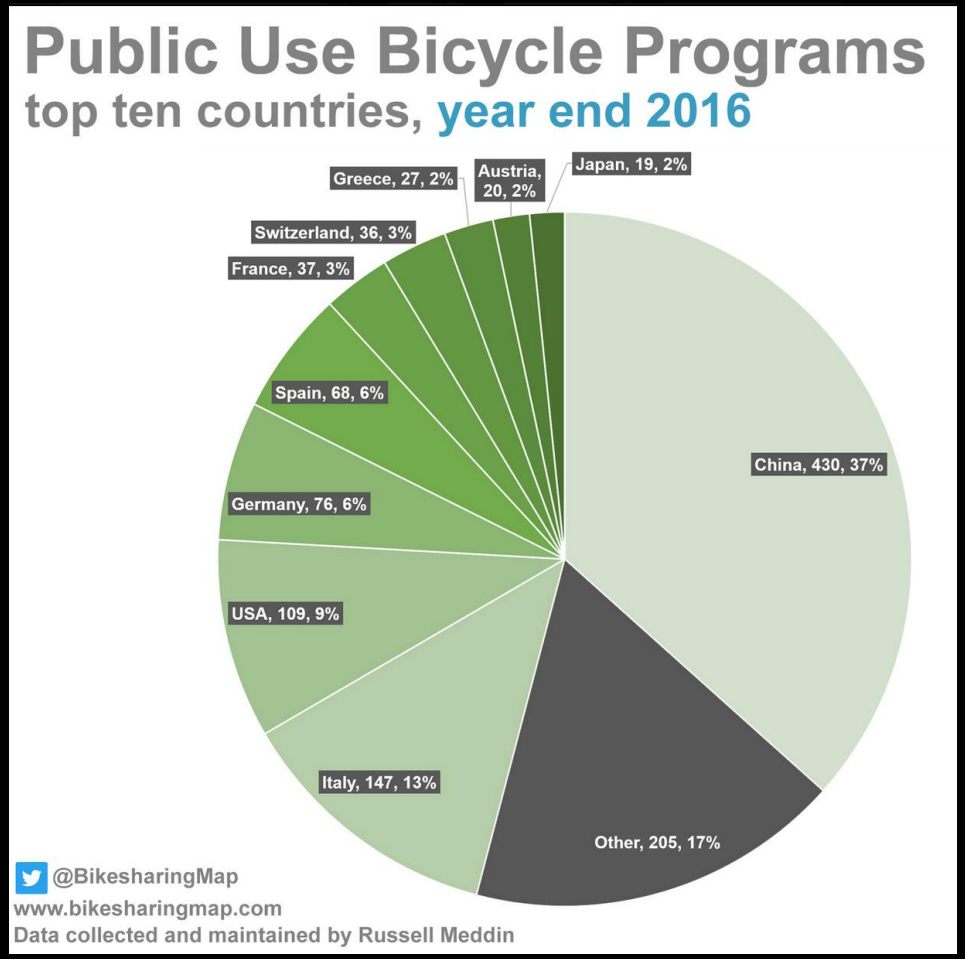
Sharing Economy Summary

- Technology has made sharing easy
- Some revitalization of downtown areas
- Often needs public partnership
- Sharing has to be easy for people to use it

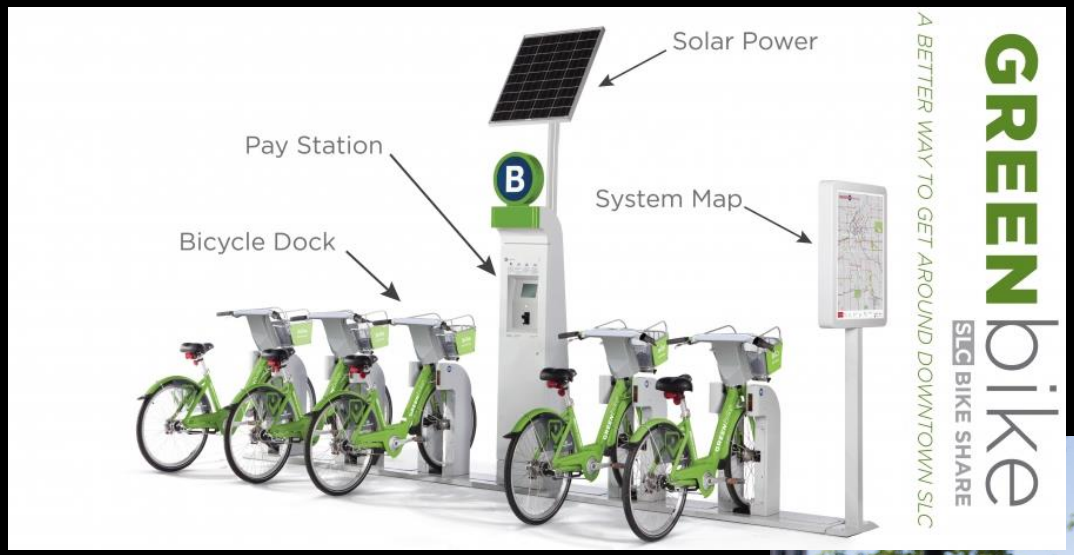
Bikeshare


Public Use Bicycle Programs
by Continent, year end 2016
North America
121
Europe
524
Asia
502
South America
34
Africa
1
Oceania
6
@BikesharingMap
www.bikesharingmap.com
Data collected and maintained by Russell Meddin

Bikeshare


Public Use Bicycle Programs
top ten countries, year end 2016
Greece, 27, 2%
Austria, 20, 2%
Japan, 19, 2%
Switzerland, 36, 3%
France, 37, 3%
Spain, 68, 6%
China, 430, 37%
Germany, 76, 6%
USA, 109, 9%
Italy, 147, 13%
Other, 205, 17%
@BikesharingMap
www.bikesharingmap.com
Data collected and maintained by Russell Meddin

Bike Sharing models



Bike share with dock

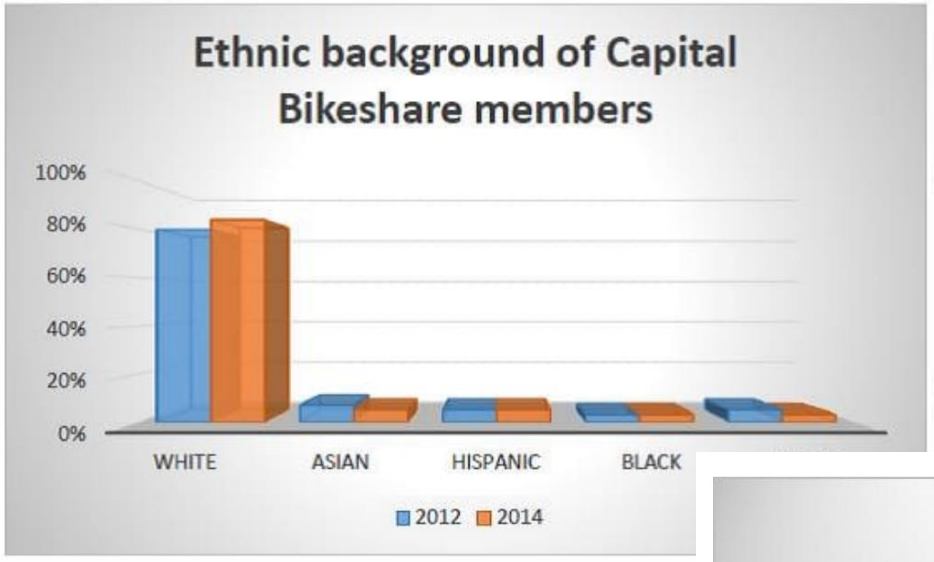
Dockless

Bike Share – Governmental Role

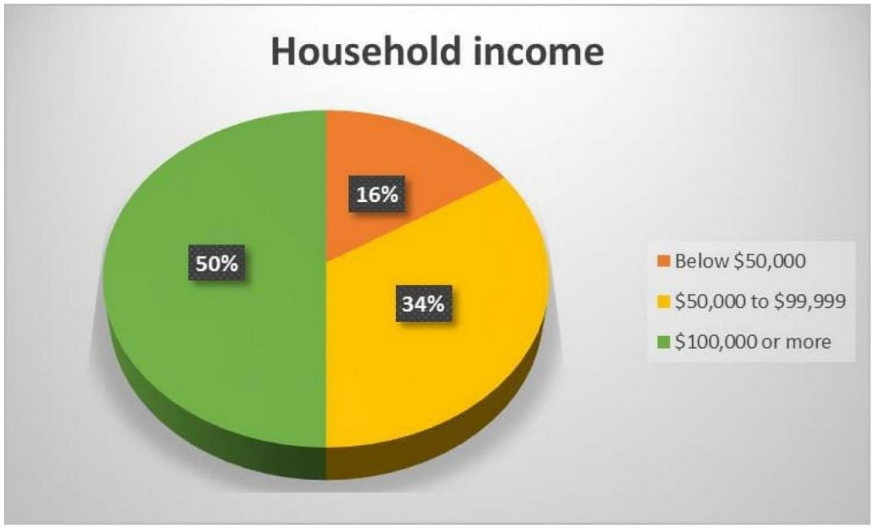
- Requires public subsidy
- Requires public space
- Several companies provide technology

Bike Share Challenges

Bike Share Challenges



Source: Capital Bikeshare (Luz Lazo/The Washington Post)



Source: Capital Bikeshare Fifty percent of Capital Bikeshare users have household incomes of $100,000 or more. (Luz Lazo/The Washington Post)

Car Sharing

- Three models for sharing cars:
  - Cars in designated spaces (ZipCar)
  - One way (Car2Go)
  - Peer to peer (Getaround)
- Insurance, gas, maintenance included
- Internet reservations and payment

Designated-space Car Share

- Zipcar, Maven, Hertz, Enterprise, etc.
- Choice of cars at designated spaces
- Rent by 30 minute segments
- Sometimes requires public parking spaces

One way car share

- Zipcar (in select cities), Car2Go
- Return to any point within the zone
- Charge by the minute
- Requires cooperation by city for street parking

Peer to peer car sharing

- Getaround, Turo (similar to Air BnB)
- Rent out your car to anyone on the internet
- You get paid, company takes a cut
- No city cooperation necessary

Sharing?

Sharing?

Sharing Economy Summary

- Technology has made sharing easy
- Some revitalization of downtown areas
- Often needs public partnership
- Sharing has to be easy for people to use it

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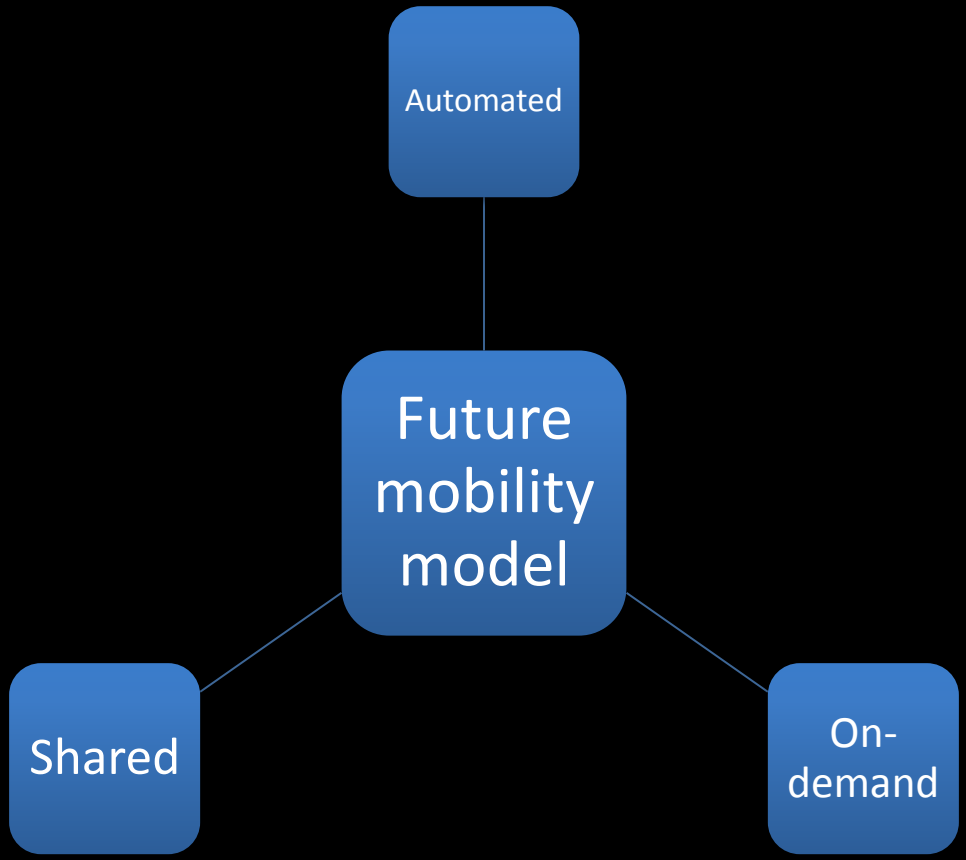
Session wrap up



Presentation Summary

1. Technology and transportation has limitless opportunities
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3. Concerted effort needed to plan to achieve the optimal outcomes for communities

Ultramodern Transportation

- Drone delivery
- Flying cars
- Hyperloop

Ultramodern Transportation

- Drones
- Flying cars
- Hyperloop

- Streets without potholes?
- Buses that run on time?

Questions/Discussion

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