Disruptive Technology and Mobility Change

What it Might Mean for the Toll Industry

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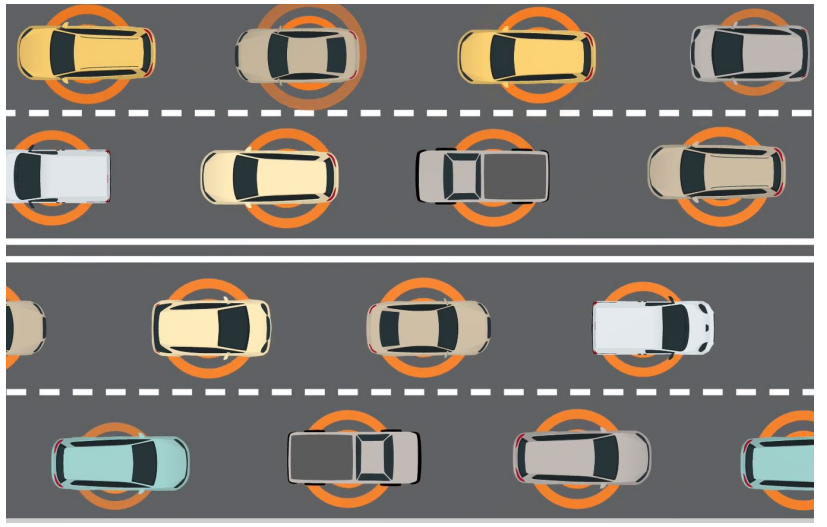
5 Disruptive Changes Which Will Dramatically Change Urban Mobility in the Future

- Emergence and growth in Mobility as a Service (MaaS) – *Shared Mobility*
  - Services such as Uber and LYFT – still a small share of total travel but growing
  - Changing mobility preferences for younger generation – less need for owning your own car
- Coming rapid shift to electric vehicles
  - Battery cost decline – increasing battery capacity
  - Will have a major impact on how we raise funding for transportation
- Vehicle automation – moving toward a "driverless" technology
  - -- Question is not "if" but "when"… and maybe exactly "how"
- Changing Economics of Travel
  - The convergence the first three trends above will result in a huge change in the cost of travel
  - And in the number of personal cars people own
- Big Data Analytics:
  - As we become more automated and move toward more "mobility systems", routing decisions will also become more automated to optimize the use of all available capacity

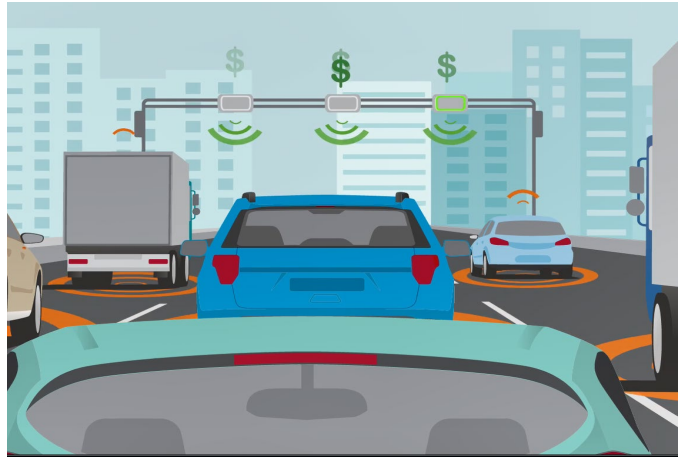
The Big Picture

- Probably fewer vehicles
- Probably an increase in vehicle miles of travel
  - Could also decrease in some scenarios
- Much greater use of shared mobility
  - Increasingly automated/driverless
- Smarter and more optimized routing
- Increased ride-sharing and higher vehicle occupancies
- Closer vehicle spacing and increased effective capacity



So What Might All This Disruptive Change Mean to the Toll Industry?

- Will we still need toll roads?
  - Even more so; as the shift to electric vehicles kills the gas tax we will see increased reliance on user fees
- How will it impact toll facility usage and revenue? That depends…
  - On how technology emerges
  - On how mobility service providers compete
  - On the choices people make in the future
  - On the type of toll facility and the market it serves



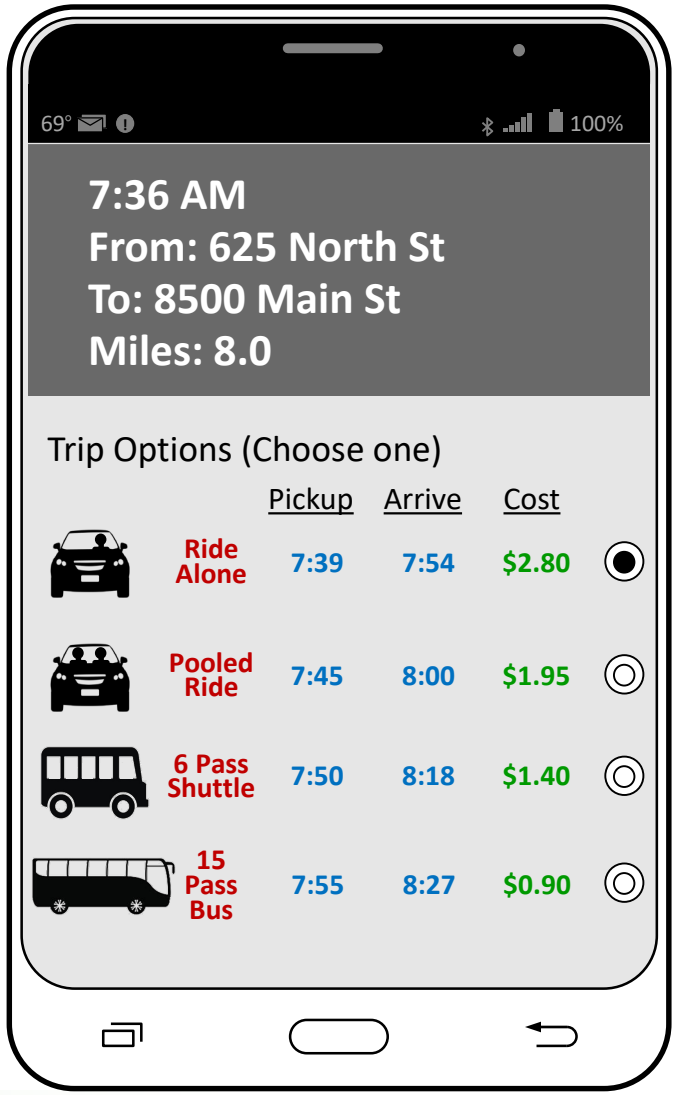
Option A

Option B

Option C

Competing Service Providers Will Offer Multiple Travel Options

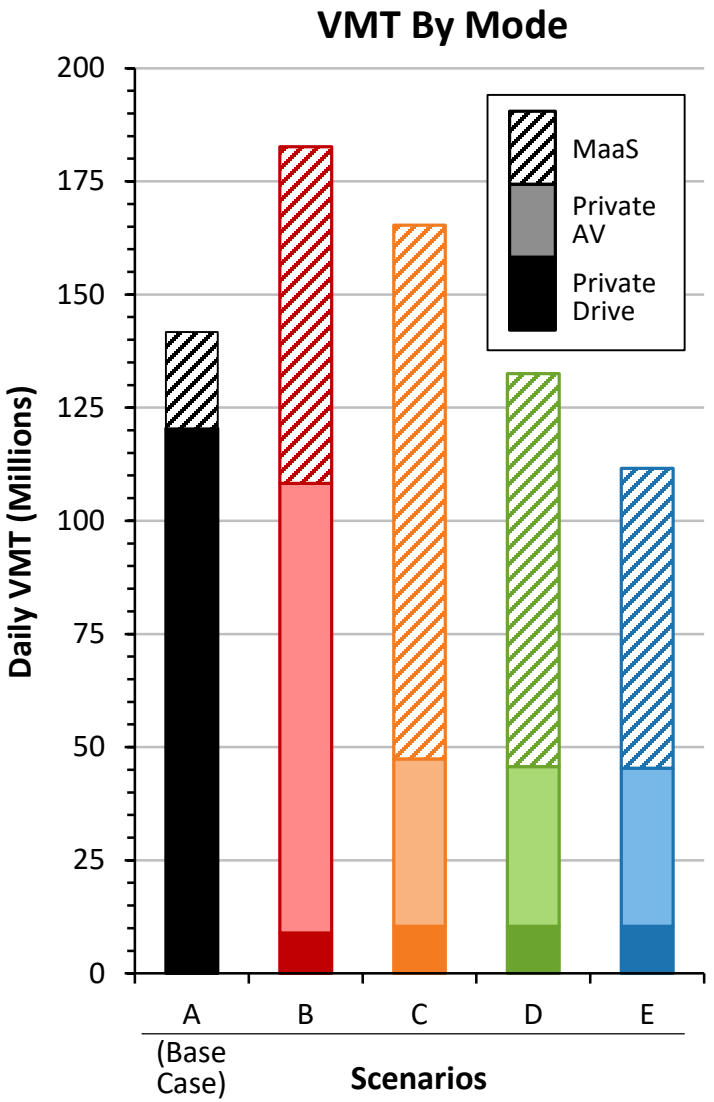
- What if 60% or 75% of the folks in a large city had no access to a car (instead of 5-10%)
  - We all become “dependent” on competing mobility service providers
- Not only will travelers be able to choose ride hailing to get to their destination, they will likely have multiple options to choose from
  - Customer tradeoffs between privacy, travel time and travel cost
- The service choices urban travelers make may significantly impact the overall growth in vehicle travel demand in the future

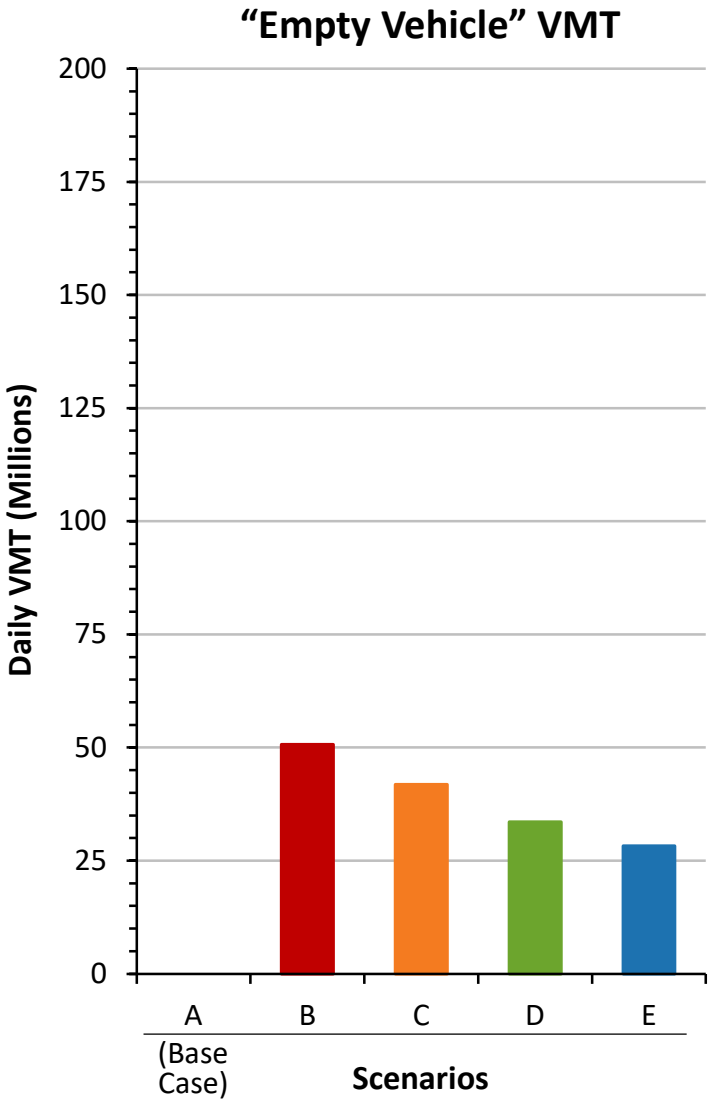


Comparison of Daily VMT Under Alternative Mobility Futures

	Hypothetical Scenarios				
Travel Mode	A(1)	B	C	D	E
Traditional Transit	5%	4%	3%	3%	2%
Drive Private Vehicle	90%	20%	17%	17%	17%
Private Autonomous Veh.	0%	38%	15%	15%	15%
TNC Shared Mobility					
Ride Alone	4%	35%	55%	40%	30%
Pooled Ride	1%	3%	7%	15%	20%
Shared Shuttle	0%	0%	3%	10%	16%

(1) Typical of today's distribution in many cities





Implications of “System” Control and Optimization

- If 75% of trips are served by third party services, primarily in driverless vehicles, most travel will likely be controlled by TNC computer systems:
  - Vehicle routing, both with passengers and empty between customers
- The systems will not only continuously know what traffic conditions are, but will also control and optimize conditions by dictating individual vehicle routings
  - We could have more VMT but less congestion in some areas
- A big question: If most urban trips are made in automated robo taxis, who will make the decision to use the toll road?
  - The passenger … or
  - The “system”

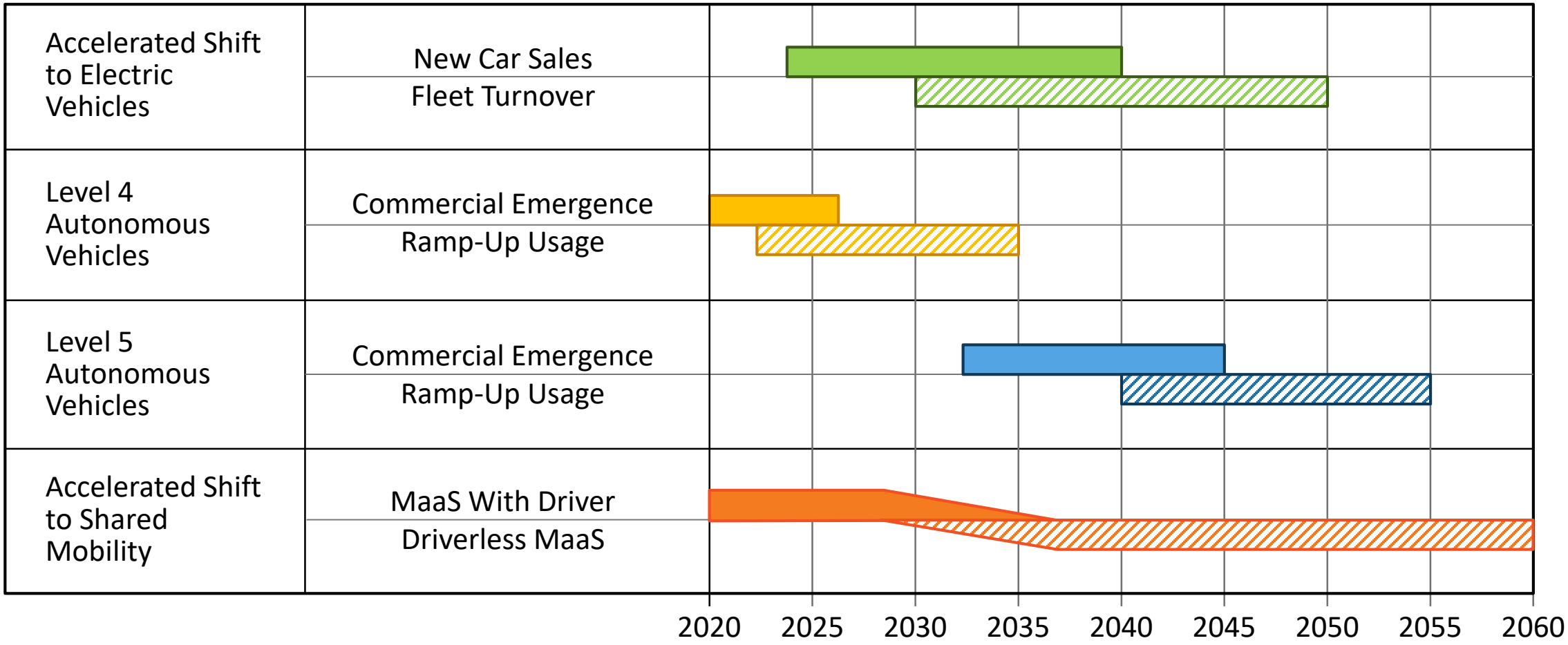
Implications on Value of Time and Willingness to Pay

- Most people choose toll roads to achieve travel time savings.
  - Willingness to pay a toll depends heavily on the value individual motorists place on time savings, or “value of time” (VOT)
- Will time savings be worth as much to travelers if they are riding and not driving;
  - Able to make use of in vehicle time to make calls, emails , texts or even nap?
  - Research to date suggests classic VOT’s may be reduced somewhat with autonomous vehicles
  - What is the VOT of an empty vehicle driving itself around?
- On the other hand… most revenue on urban toll facilities in the long term will be collected through third party service providers
  - Toll charges will be simply added into trip charge and passengers may be less cognizant of the toll cost

Implications on Usage and Revenue Will Vary by Facility Type

- Intercity toll roads– longer distance toll roads may see little impact
- Urban bridges and tunnels – minimal impacts in most cases
- Traditional urban toll roads – impacts may be slightly negative to positive
  - Increasing VMT but possible reduced VOT
- Express lanes / managed lanes – may see the biggest impact; mostly negative
  - Managed lane usage and revenue is driven by congestion in adjacent lanes, time savings and the value drivers place on these savings
  - Shift to CAVs will effectively increase capacity and reduce congestion in the free lanes
  - Ability to use travel time productively may reduce value of time saved
  - Express lanes will still be viable; but technology and mobility change will likely reduce the typical exponential rate of toll rates and revenue growth that ELs sometimes experience

A “Rough” Look at Potential Timing



If It's Still 20-30 Years Off…. Why Does It Matter to Tolling Today?

- Most of the toll industry lives in a world of long term debt
  - Bonds issued today may mature in 2050 or later
  - The disruptive changes in urban mobility we have discussed will likely be in full effect within the life of many existing or future bond terms.
- How do we deal with the revenue forecasting uncertainty of how and when urban mobility will change?
  - **Scenario Testing** – What would happen under various "Alternative Futures" for transportation
  - CDM Smith is developing a range of "alternative future scenarios" regarding mobility change and new and modified tools to estimate potential impacts on tolling

Thank You

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