

Disruptive Technology and Mobility Change

What it Might Mean for Urban Transportation

Ed Regan

Senior Vice President

June 1, 2018



**CDM
Smith.**

Presented at
Transport Chicago

Ed Regan, SVP, CDM Smith



- 43-year veteran of transportation planning and finance
- Led the CDM Smith tolls practice for 25 years
- Managed landmark studies and contributed to the development of many world “firsts” in tolling and operations:
 - World’s first use of all-electronic tolling (Hwy 407 in Toronto)
 - World’s first managed lane facility (SR 91 in Orange County, CA)
 - World’s first use of dynamic pricing (I-15 in San Diego, CA)
- Today involved in CDM Smith R&D to identify “alternative futures” in urban mobility
 - An effort to develop and adapt analytical tools and procedures which will help our cities better plan for coming major changes in urban mobility of the future

Big Change in Mobility is Coming: Are We Ready??

- Disruptive technology change is coming to transportation
 - Whether we want it or not
- Not just technology change, but also sweeping social and cultural changes are occurring
- It will bring great challenges, requiring America's urban regions to redefine urban mobility as we know it

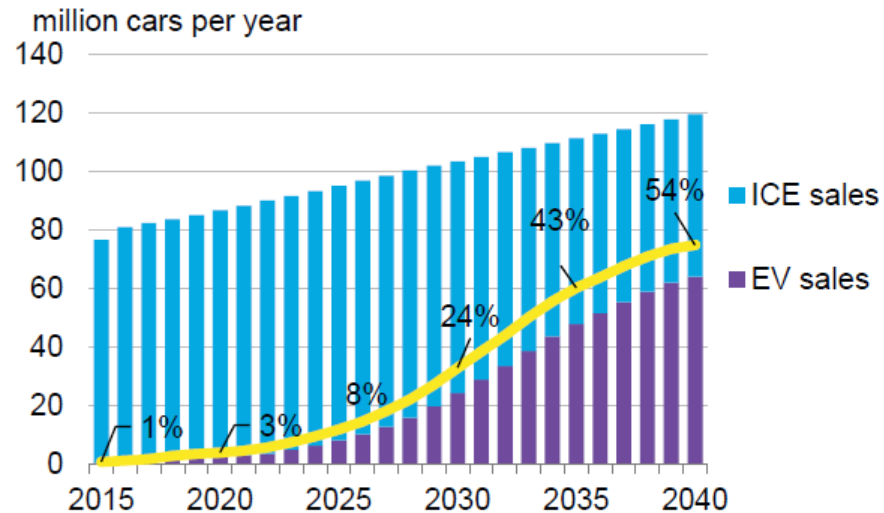
5 Disruptive Changes Which Will Dramatically Change Urban Mobility in the Future

- 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
 - Cost of ownership of fully EV will match traditional ICE vehicles by 2022 or 2023
 - Will have a major impact on how we raise funding for transportation (so long gas tax)
- 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 decisions people make about how they travel, and whether they own a car
- 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

Along with Emergence of EVs; A Big Shift to Electric Vehicles

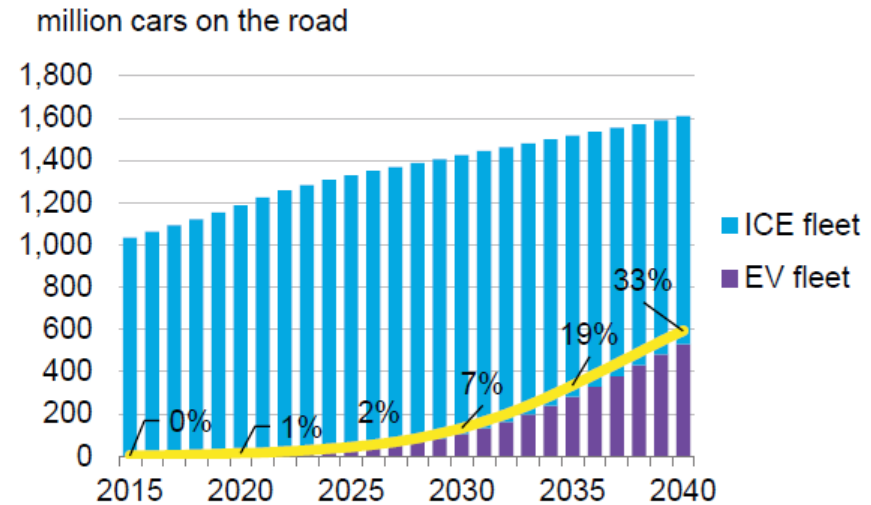
- Greatly effects vehicle useful life and overall efficiency, but
- Will also greatly impact transportation funding if we continue to rely on the gas tax for revenue
- *Bloomberg Energy* now estimates new sales of fully electric vehicles will exceed cars with internal combustion engines by 2038

Figure 1: Annual global light duty vehicle sales



Source: Bloomberg New Energy Finance

Figure 2: Global light duty vehicle fleet



Source: Bloomberg New Energy Finance

Defining the Spectrum of Vehicle Automation

SAE Levels of Vehicle Automation

Level 1: Driver Assistance

Mode specific driver assistance systems such as steering or accel/decel; driver does all else

Level 2: Partial Automation

Driver assistance systems for both steering and accel/decel, but driver still in overall control

Level 3: Conditional Automation

Automated / dynamic driving in most cases assuming driver takes control when needed

Level 4: High Automation

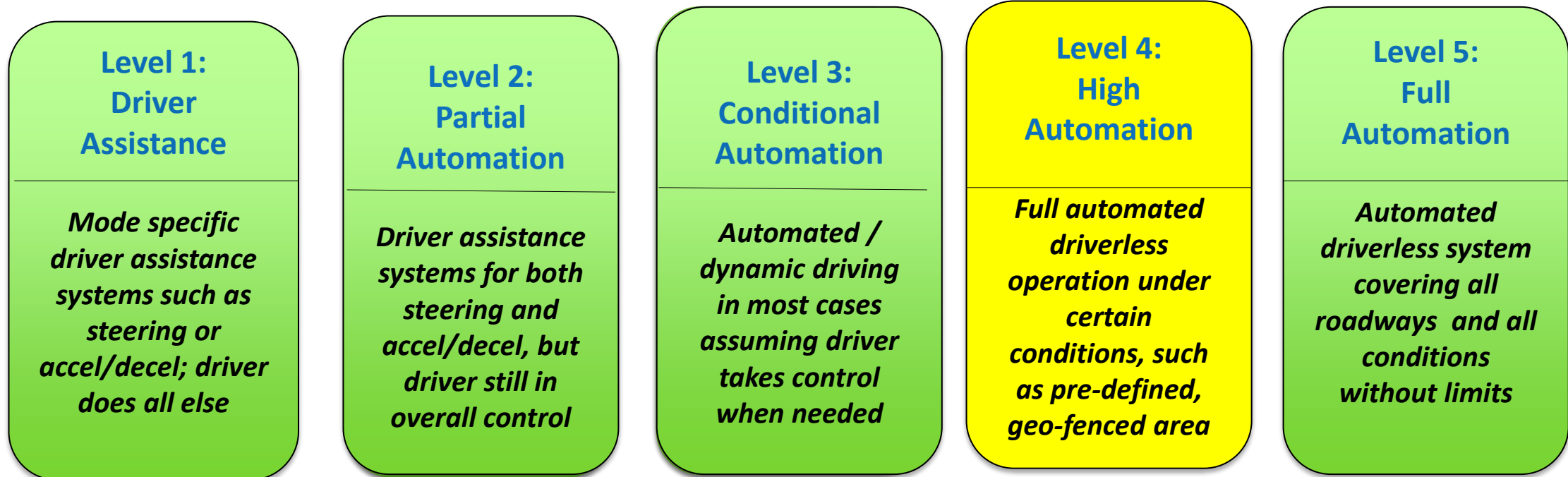
Full automated driverless operation under certain conditions, such as in pre-defined, geo-fenced area

Level 5: Full Automation

Automated driverless system covering all roadways and all conditions without limits

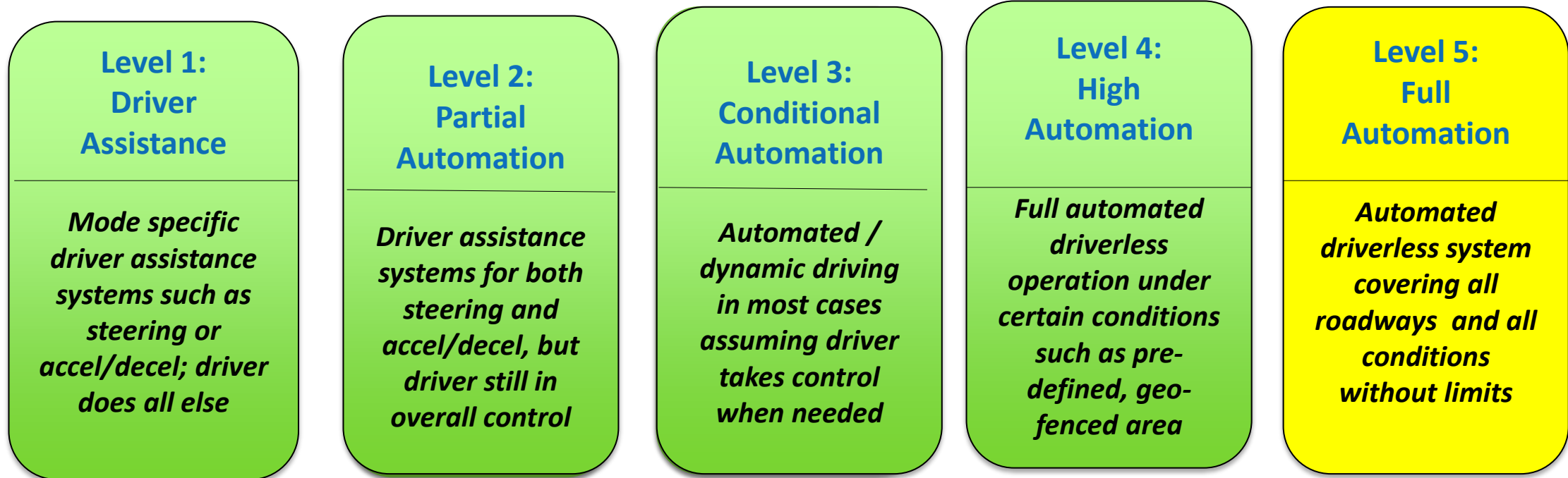
Defining the Spectrum of Vehicle Automation

SAE Levels of Vehicle Automation



Defining the Spectrum of Vehicle Automation

SAE Levels of Vehicle Automation



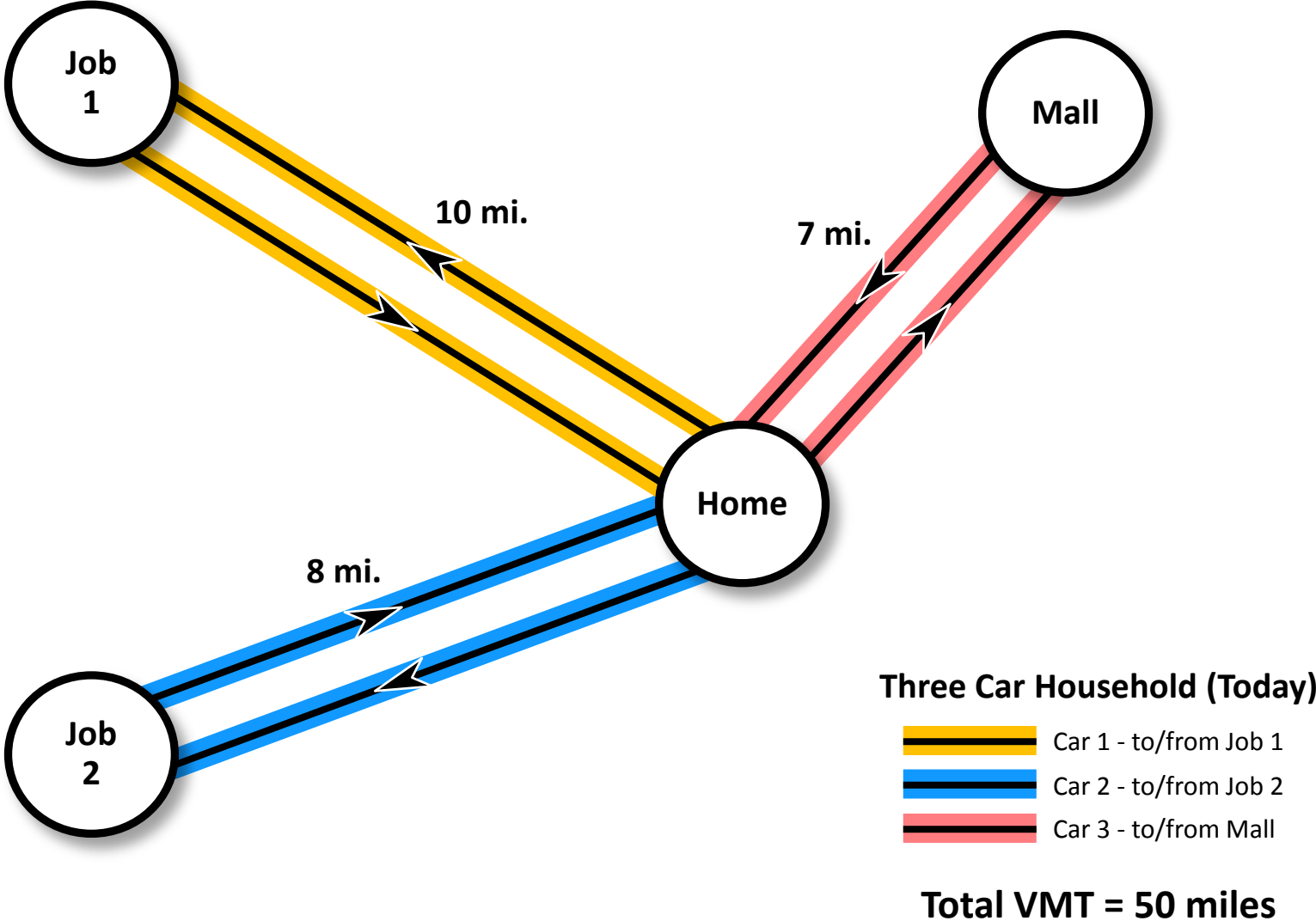
In the Long Term – Three Choices for Auto Drivers

- **Option A:** Continue driving a privately owned low autonomy vehicle (eg. L2 or L3)
 - This will be the choice of folks who like to drive, or those who fear loss of control
 - May be preferred option in rural areas for decades
- **Option B:** Privately owned driverless autonomous vehicle (L5)
 - Will likely reduce the number of vehicles per household
 - AV can be programmed to return home to take someone else to a different destination
 - Could be a significant choice in urban markets
- **Option C:** Rely fully on 3rd party *Shared Mobility* services using driverless L5 vehicles for all travel
 - Decline to replace household vehicles as they age out
 - Essentially the new “no car” households, where all trips are made using phone apps (like Uber)
 - This will be quite likely in larger urban areas – majority of future urban travel

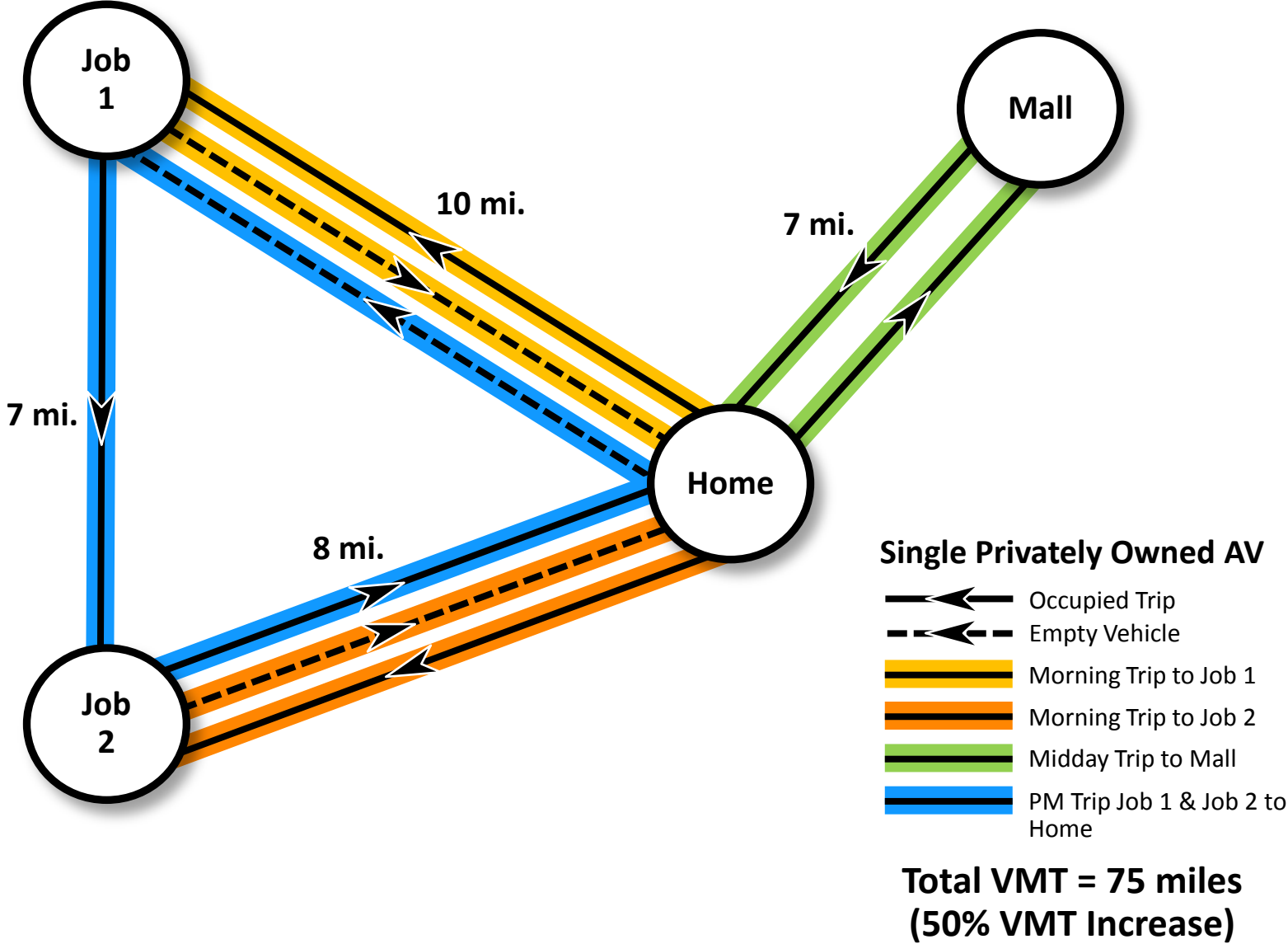
The Most Likely Choice in the Long Term: Option C

- Changing economics of travel
 - Electric vehicles will reduce operating cost of vehicles and increase vehicle life to 500,000-700,000 miles
 - Shared mobility will reduce idle time of vehicles from 90-95% today to 50% or less tomorrow
 - Level 5 autonomous vehicles will enable elimination of the driver from 3rd party services
- Combined effect of these changes will dramatically reduce the typical “cost per mile” of shared mobility
 - From \$2.00 - \$2.50 per mile today
 - To \$0.15-\$0.25 per mile tomorrow
- If owning your own vehicle cost over \$0.50 per mile (including insurance, financing, repairs and fuel); will people still own their own cars, or simply used shared mobility
 - Most analysts (including the auto industry itself) believe they will move away from private car ownership
- This will result in a lot less vehicles but an increase in VMT. Here’s why

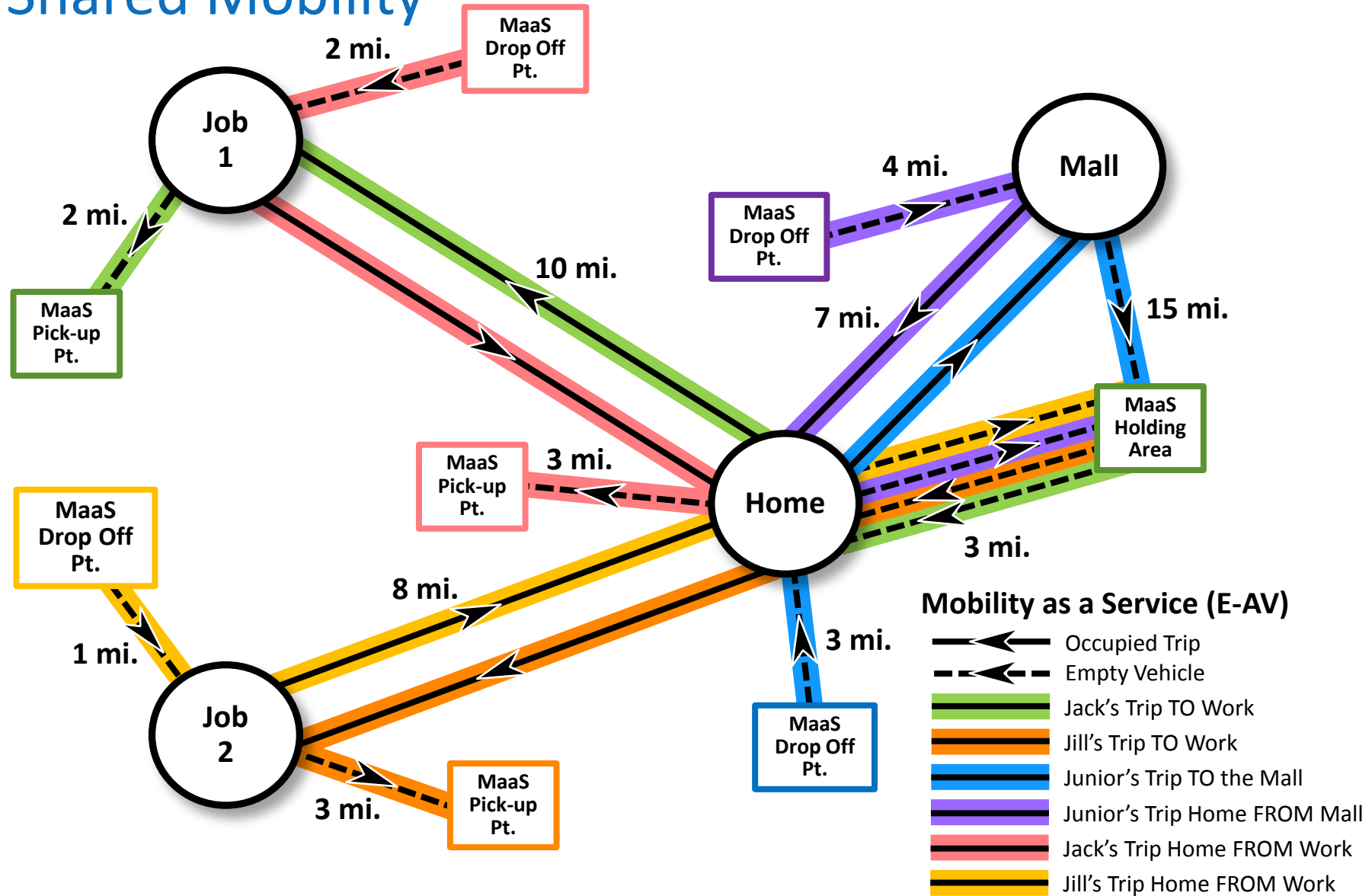
Option A: Continue with Typical 3 Car Household



Option B: Privately Own a Single L5 Autonomous Vehicle



Option C: Shared Mobility



**Total VMT = 85 miles
(70% VMT Increase)**

So Imagine the Future of Mobility in Our Cities if Most People Don't Have Cars

- The blurring of the driver vs. transit dependent populations
 - 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
- Data analytics can manage travel resources in a way we can't today
 - Maybe 10,000 people enter their trip destination at about the same time
 - The “system” knows where everyone is and where they are going
 - Trips automatically matched and linked as needed
 - Route selection optimized by advanced computer knowledge of conditions
- Multiple competitive MaaS service providers, offering multiple tiers of service offerings for a hypothetical 8 mile trip to work
 - Private ride (12 minutes to destination) **\$2.65**
 - Shared ride (17 minutes to destination) **\$1.70**
 - Small shuttle group ride (21 Minutes) **\$1.10**
 - Larger E-AV shuttle (30 minutes) **\$0.75**

Some Key Impacts and Questions

- We won't need near as much parking as we have today
- AV's will permit increased operational safety, and improved operational efficiency and throughput
 - May also enable narrower lanes, and closer spacing to increase nominal capacity per lane, which could reduce the future need for widening
- Travel demand modeling will be greatly impacted
 - Today vehicle trip patterns equal person trip patterns
 - In the future AV shared mobility world this will no longer be the case
 - How do we model "vehicle demand" if it differs from "person trip" demand?

The Demise of the Gas Tax

- Rapid deployment of electric vehicles will accelerate the demise of the gas tax
 - States will urgently need to find new sources of revenue, most likely tolls and user fees
- For tolling it will also raise some new uncertainties:
 - What is the value of time of an empty driverless vehicle... will it use the toll road?
 - Will people pay to use managed lanes to get out of traffic if they are not driving and can make use of the time doing things like calls or email?

What Will Transit Look Like in the Future?

- What will transit look like in a world where most people don't have cars?
- Will multi-level, ubiquitous shared mobility provide most transit?
 - Or do we still need high capacity transit corridors?
- Innovative integrated mobility ideas will become common well before the full transition to L5 vehicles
 - L4 driverless vehicles will greatly enhance opportunities for low cost “first mile” and “last mile” integrated services
 - And L4 services will be in use between 2021 and 2025

A Lot of Questions; Many Uncertainties

- The one thing we know for sure: **Urban mobility in the future will be very different from today**
- While we recognize the uncertainties, we also need to recognize a compelling need to take a hard look at the future of urban mobility
 - Major cities today develop mobility plans to meet needs of 2050 and beyond
 - Those plans need to become realistic about future changes in travel; planners and policy makers can't ignore the coming disruptive technology change

Thank You

Ed Regan

reganej@cdmsmith.com