Policy and Planning Implications for Automated Vehicles

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Presentation Outline

- Overview of different technologies
- Top-down versus bottom-up approach, which wins?
- Realistic scenario in 2030
- Lessons for Planning and Policy
- Implications for TIPs and LRPs (Add Back to Future Slide)

30 Years Ago

Definitions and Explanations

- V2V: Wireless exchange of data among vehicles traveling in the same vicinity
- V2I: Wireless exchange of data between vehicles and roadside infrastructure
- DSRC (Dedicated Short-range Communications): Two-way short-medium range safety application. For past 15~ years 5.9 GHz band dedicated to ITS technologies.
- Technology mostly driven by National Highway Traffic Safety Administration, Government primarily concerned with safety but other (productivity, gaming) benefits

NHTSA

www.nhtsa.gov

Two Different Approaches

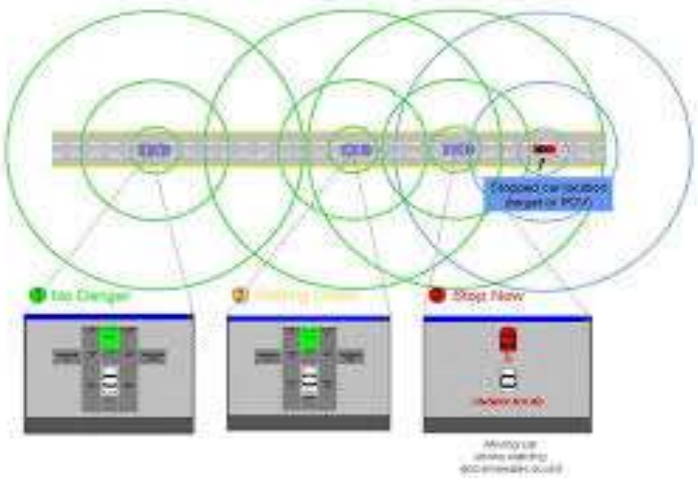
- Old School Automakers (GM, Toyota, Mercedes)
  - Top-down vision with role for government
  - Rigid structure with focus on precautionary principle
  - Mandates add certainty and level playing field
  - Need to connect to other vehicles, and offer wireless communications
  - Top-down leads to profits
- Technology Innovators (Google, Apple, startups)
  - Bottom-up process
  - Limited structure with focus on innovation
  - Mandates lock in sub-optimal technology and limit future options
  - Include connectivity in car, use 4G, 5G cellular networks, ATSM, in-vehicle phone like device
  - Bottom up leads to profits

Google's Thought Process

- Supremely confident, maybe too confident
- Vision that they can change the world for the better/transportation software success
  - Google Earth
  - Google Maps
- Data that can be used to sell stuff may be more important than vehicle
- Continual fear of becoming too corporate
  - Example) Continued growth leads fears about lack of innovation.
  - Changed organizational structure to Alphabet to focus more on conventional business and Google X dynamic projects such as automated vehicles

Affect of Government Policy/Regulation on Automation

- Government policy
  - Connected vehicle mandate, V2V required while V2I likely (automakers not a fan)
  - Preference to use 5.9 Gigahertz spectrum
  - Insists on choosing communication technology (DSRC) today
    - Subtle threat of lawsuit if spectrum not dedicated to DSRC
  - With differing views future is likely a mix of top-down/bottom-up/mandates



Example How Different Mandates/Strategies Affect Automation

- Roadway Capacity
- Traditional Top-down approach: V2V, V2I, DSRC could lead to 200% increase in (3 vehicles where 1 today) in roadway capacity
  - However not until 2070; by 2070 DSRC obsolete
  - Only in places with complete connectivity
- Bottom-up approach: Google style circa 2015 decrease current roadway capacity by 5% because automated vehicles more cautious than humans
  - However technological advances likely to lead to increases in capacity by 2070
- Which is better: personal decision
- Reality is we will get a combination

Variables Influencing Automation Deployment

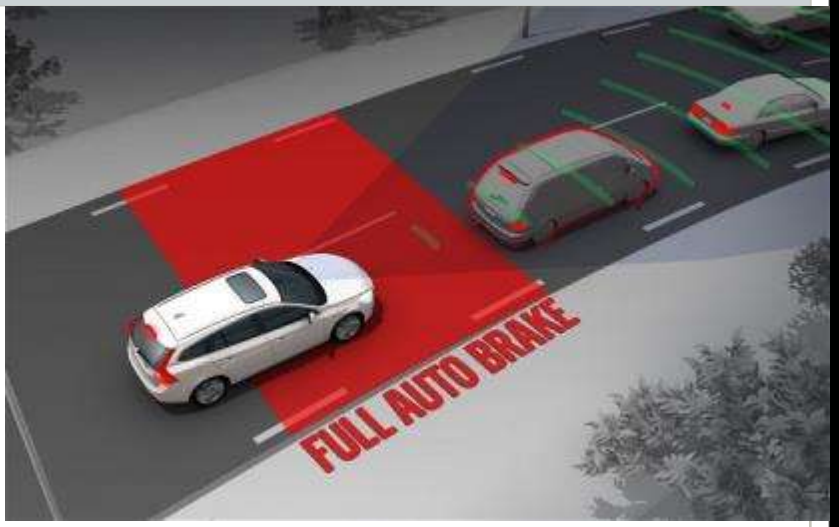
- Income/Preferences that lead to rate of consumer purchases
  - Cost of implementing various technologies
  - Average age of vehicle on road
  - Attractiveness of automated technologies
  - New technologies
  - General uncertainty
  - Early technologies start with affluent move down income scale

Crazy Concerns Not Happening Until 2050-2070 if Ever

- Full mobility for children and seniors
- Prohibitions on manual driving
- Eliminating crashes/emergency rooms/traffic fine revenue
- Drastically reducing car sales/parking because cars will be shared
- Drastically reducing vehicle weight because they never crash
- Solving limited roadway capacity/decaying roads and rail
- Eliminating fixed-route transit service
- Revolutionizing land use

2030 Realistic Automation Scenario

- High automation but not full automation (Level 4 SAE Chart out of 5)
- All driving mode specific tasks
  - Execution/steering
  - Monitoring driving environment
  - Fallback performance of driving tasks
  - **NOT** full system capability
- Where
  - Campus zones, limited access highways for sure
  - Some urban streets/rural streets likely
- Result
  - Humans will need to take control often
  - Vehicle features will be turned on/off
  - Mix of automated/human-driven vehicles



Summary of Levels of Driving Automation for On-Road Vehicles

This table summarizes SAE International's levels of *driving* automation for on-road vehicles. Information Report J3016 provides full definitions for these levels and for the italicized terms used therein. The levels are descriptive rather than normative and technical rather than legal. Elements indicate minimum rather than maximum capabilities for each level. "System" refers to the driver assistance system, combination of driver assistance systems, or *automated driving system*, as appropriate.

The table also shows how SAE's levels definitively correspond to those developed by the Germany Federal Highway Research Institute (BASt) and approximately correspond to those described by the US National Highway Traffic Safety Administration (NHTSA) in its "Preliminary Statement of Policy Concerning Automated Vehicles" of May 30, 2013.

Level	Name	Narrative definition	Execution of steering and acceleration/ deceleration	Monitoring of driving environment	Fallback performance of *dynamic driving task*	System capability (*driving modes*)	BASt level	NHTSA level
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	Driver only	0
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	Assisted	1
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	Partially automated	2
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	Highly automated	3
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	Fully automated	3/4
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**	-	

Near-Mid Term Automation's Affect: Different Modes

- Type of technology chosen and speed of implementation are biggest factor
  - Land use is another important factor
  - Regional difference:s Atlanta vs Seattle
- Congestion on roadways
  - Recurrent: Routine overloading at peak period travel time
  - Non-recurrent: Specific incidents
- Transit
  - Line haul: Connecting major O/D, termini
  - Spoke patterns: low-density residential to job centers

What MPOs Need to Plan for: Roadways

- Fleet turnover takes 20 years
- Small decrease in vehicle ownership (5-10%)
  - Decrease greater over time but not until 2040
- Moderate decrease in parking needs (15%-30%)
  - Weekday work commute bigger decrease than leisure/weekends
  - Bigger decrease after 2040 but some people will still want to own vehicles
  - Decrease in parking needs does not equal decrease in VMT with parking on city edge
- Moderate increase in congestion (20-40%)
  - Recurrent congestion decreases non-recurrent increases
  - Automated Vehicles more cautious than human drivers
  - Induced Demand

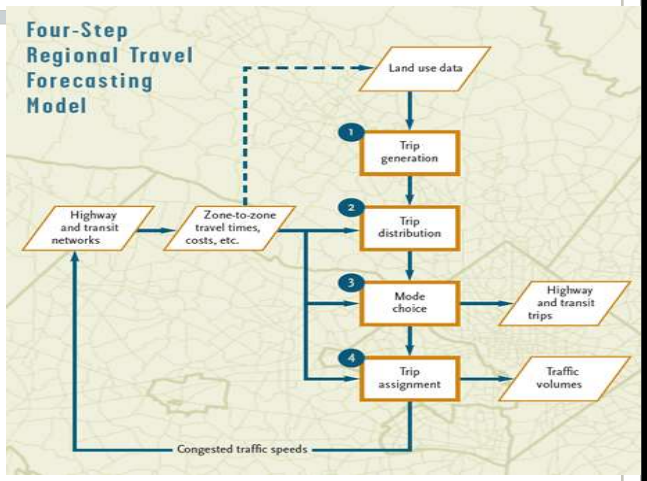
What MPOs Need to Plan for: Transit

- Continued development major transit systems
  - Rail, BRT
  - Slow decrease all types of transit service particularly local bus, limited stop bus
  - Service constant for 10 years, then starts declining
  - Re-evaluate construction of major capital investments particularly those not likely to be competed until 2030 or after

- Moderate increase in casual ridesharing, car sharing substituting for small amount of current driving and increasing larger amount of transit usage
  - Uber, Lyft, Car to Go interface with transit agencies
  - Realistic, cost-effective way to sustain/improve paratransit, exurban and rural transit systems

What MPOs Need to Plan for Other Modes

- Other modes
  - Cycling/Walking biggest effect is safety
  - Telecommuting outnumbers transit in many metro areas
    - Automated Vehicle decrease as commute more tolerable?
- Automated vehicle conflicts
  - Conventional vehicles
  - Streetcars/light rail
  - Bicyclists/pedestrians
    - Issue must be resolved
- Bigger mode changes may occur but not until 2050



ABM Model Components