

# The Traffic Jam of Robots: Implications of Autonomous Vehicles on Trip-Making

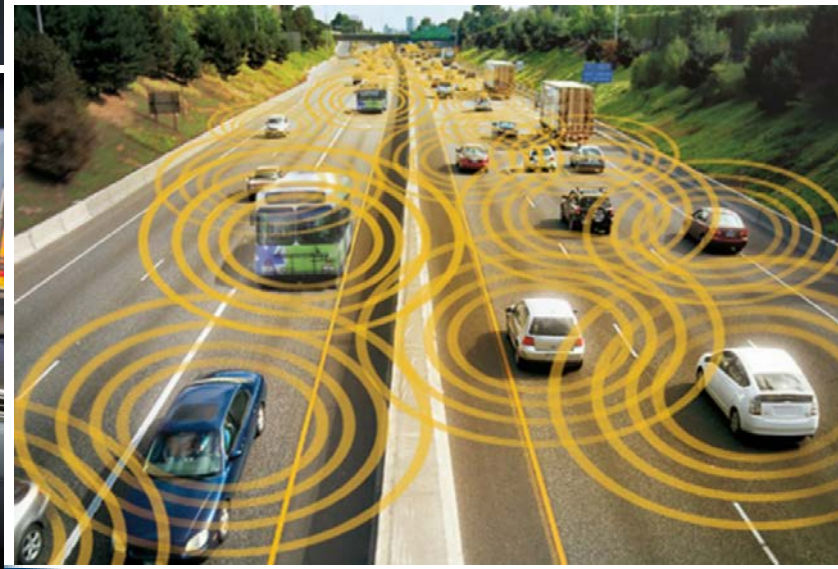
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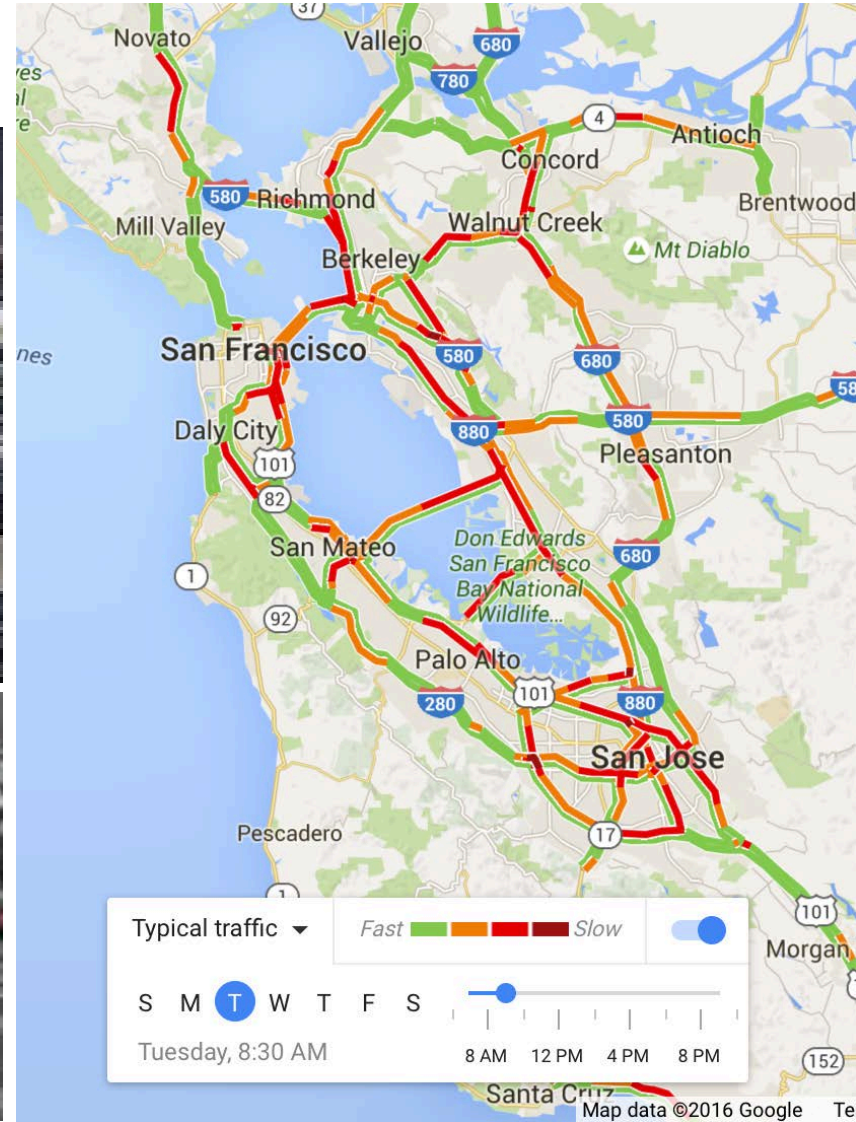
SYMPOSIUM: July 19-21  
ANCILLARY MEETINGS: July 18 & 22  
Hilton San Francisco Union Square

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# Vision of Future



# Current Reality



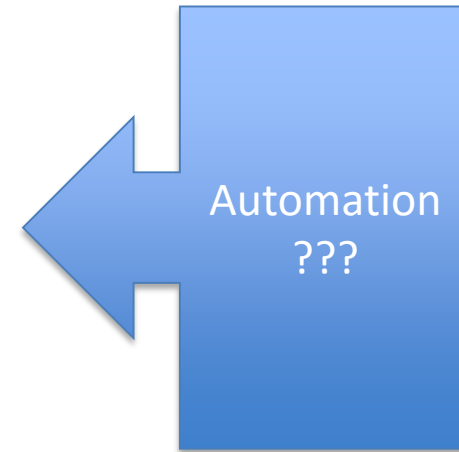


# Future Reality

- Automation will improve efficiency and safety, but not enough to relieve congestion.
- Opposing trends
  - Increasing population (*~30% increase in US by 2060 – census.gov*)
  - Increasing urbanization (*~30% increase in US by 2042 – usmayors.org; 2 mega US cities of 10 million plus today, 5 mega cities in 2042, 9 in 2060; 50 major US cities of 1 million plus today, 70 major cities in 2042 )*)
  - Increasing vehicle miles traveled per capita (*~50% increase in US since 1970—fhwa.dot.gov and dshort.com*)
- Requires behavior change even under optimistic technology scenarios (*Sager et al., 2011; Dray et al., 2012*)

# Travel Behavior

- Congestion exists because
  - We want to be at the same place at the same time
  - The network is constrained
- Travel decisions are based on
  - The need to get somewhere
  - Tangible factors: travel time and cost
  - Intangible factors: convenience, safety
  - Contextual factors: social, emotional, lifestyle



# Simulation Studies Based on Current and/or Hypothesized Travel Behavior

- Autonomous vehicles
  - Can drastically reduce vehicle fleet—by ~90%  
(Fagnant & Kockelman, 2014; Fagnant et al., 2015; OECD, 2015)
  - But vehicle miles traveled increases
    - 8-10% vehicle relocation (Fagnant & Kockelman 2014; Fagnant et al. 2015)
    - 6-90% shared vehicles & rides, transit quality (OECD, 2015)
    - 4-15% multitasking, network efficiency (Gucwa, 2014)

# Behavioral Questions

- Will people
  - Use autonomous vehicles? (Safely?)
  - Share vehicles?
  - Share rides?
  - Change their travel?
  - Send their cars on errands?
  - Change their vehicle type?
  - Increase on-demand delivery needs?

# Potential Travel Changes



*“Hang on—I’ll Uber us a school bus.”*

New Yorker, May 2016

- New demographics traveling by car
- More travel because less onerous
- 0-occupancy trips
- Vehicle configurations
- ... and Freight too

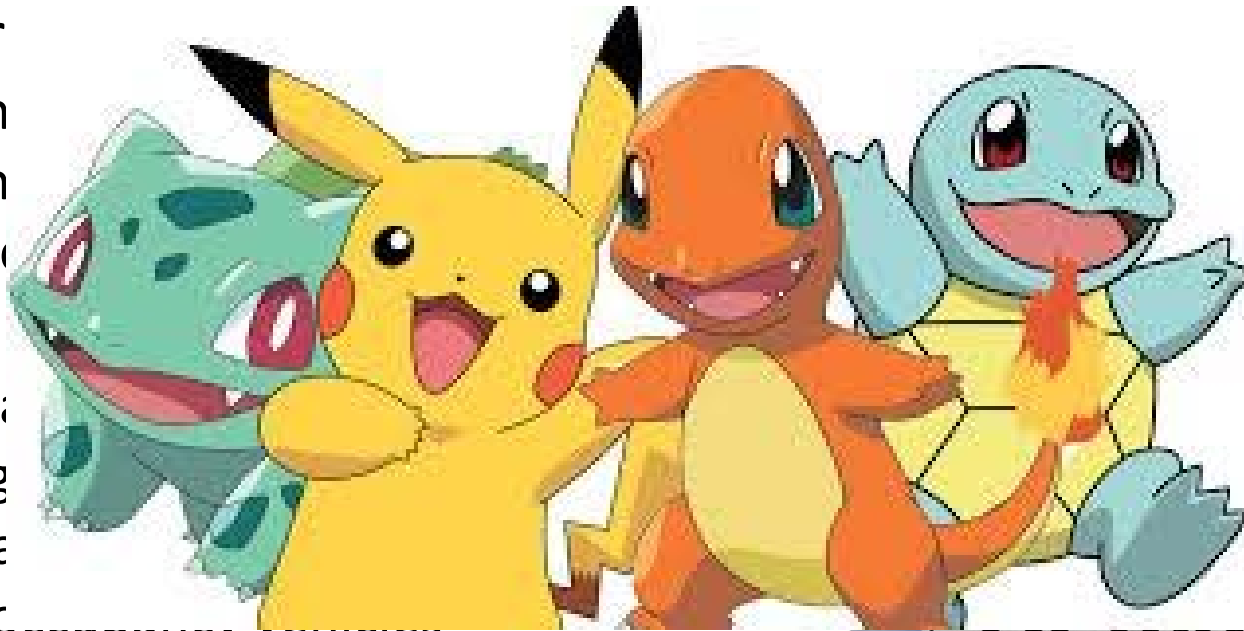


# Predicting Travel Changes

- Rich transport behavior literature
  - Pricing, multitasking, parking, sharing vehicles and rides, travel budgets, modal attitudes, habits, social norms,...
- Requires new behavioral experiments
  - Difficult as the technologies don't exist
- Approaches
  - Simulation-based scenario analysis
  - Survey responses to hypothetical scenarios
  - Virtual reality and gaming
  - Field experiments using analogous modes & prototypes

# Planning For the Future

- Don't underestimate emotional attachment to one's own car
  - If prices are affordable, signs lead to significantly more vehicle miles.
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- Requ
  - Shi
  - Rig
  - Tra
  - 0-occupancy vehicles
  - On-demand economy (goods)



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79 Comments

