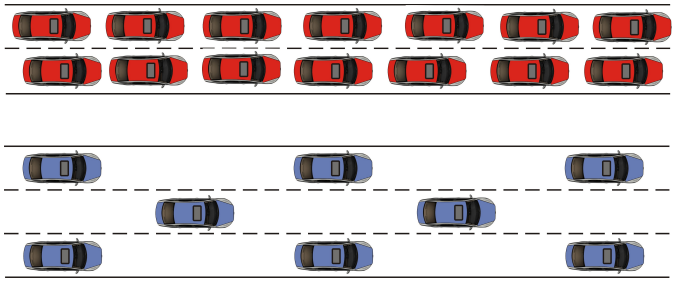
Roadway Capacity Implications of Connected and Autonomous Vehicles



Erik Ruehr, VRPA Technologies, Inc.

ITE Joint Western & Texas District Meeting
June 25, 2018
Keystone, Colorado

Outline

- Background
- Operational Analysis
- Planning Analysis
- Future Research
- Conclusion

Public Perception of Capacity Implications

- San Diego Union Tribune. October 11, 2016
  - "say no to SANDAG: reject backward looking Measure A"
  - "… projects that may not be necessary in a future in which networks of autonomous vehicles reduce congestion"
  - "… no one has a firm grasp on what those needs will be in five or ten years time"

The San Diego Union-Tribune

$2.77

TRUMP WANTS RUSSIA IN G-7

President proposes reinstatement after expulsion in 2014

RULING SHIELDS SEALS AT LA JOLLA BEACH

State court reverses block on closure in pupping season

Speaking language of success

Hoover High School holds quilt ceremony to honor graduates of English Language Development program

TRUMP SIGNALS SUPPORT FOR POT MEASURE

Bipartisan legislation would ease federal ban on marijuana

CELEBRITY CHEF, CULINARY ADVENTURER

NATIVE ROOTS

North County Buick GMC SUMMER SIZZLERS!!

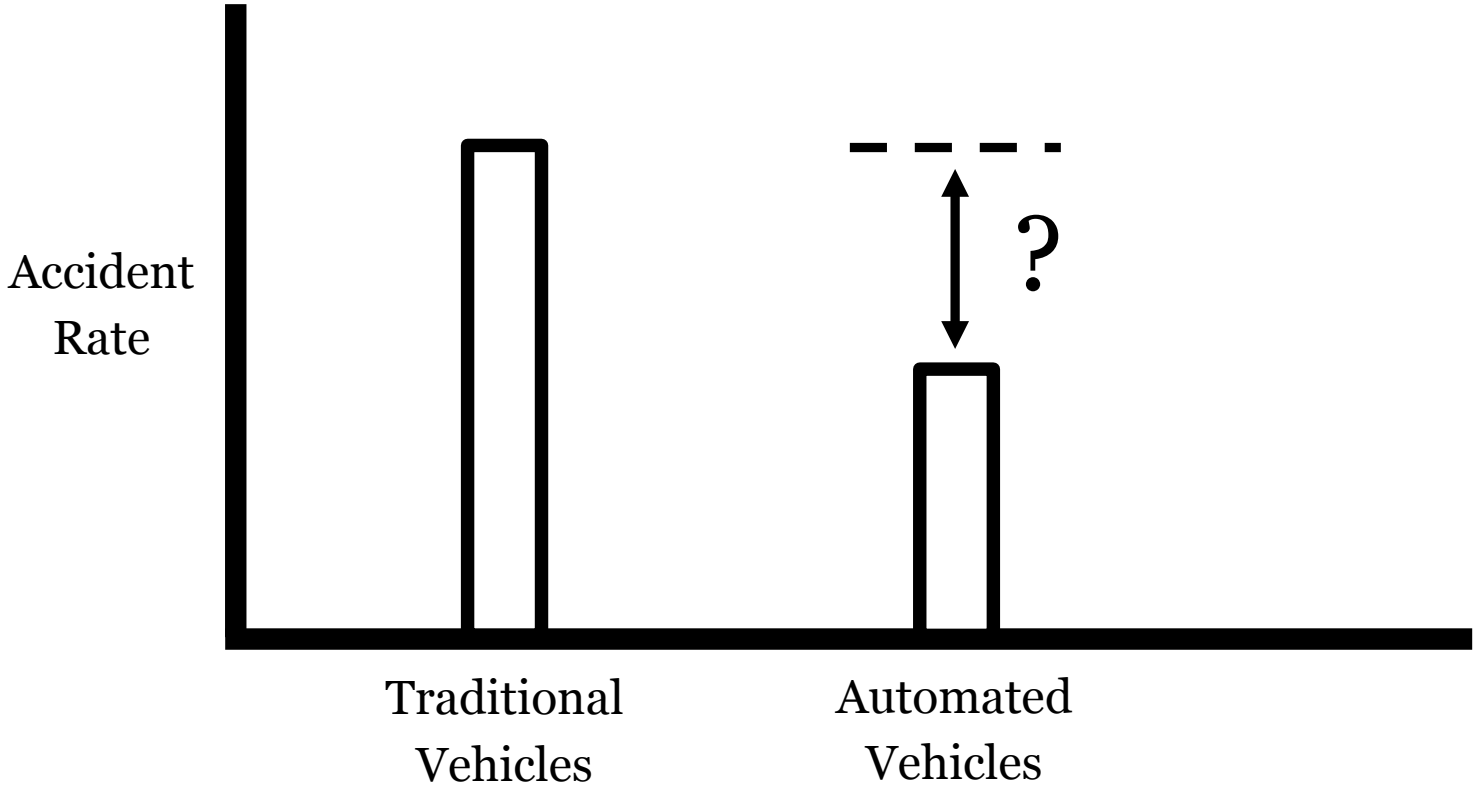
2018 GMC CANYON $18,995

2018 GMC TERRAIN $199/MO

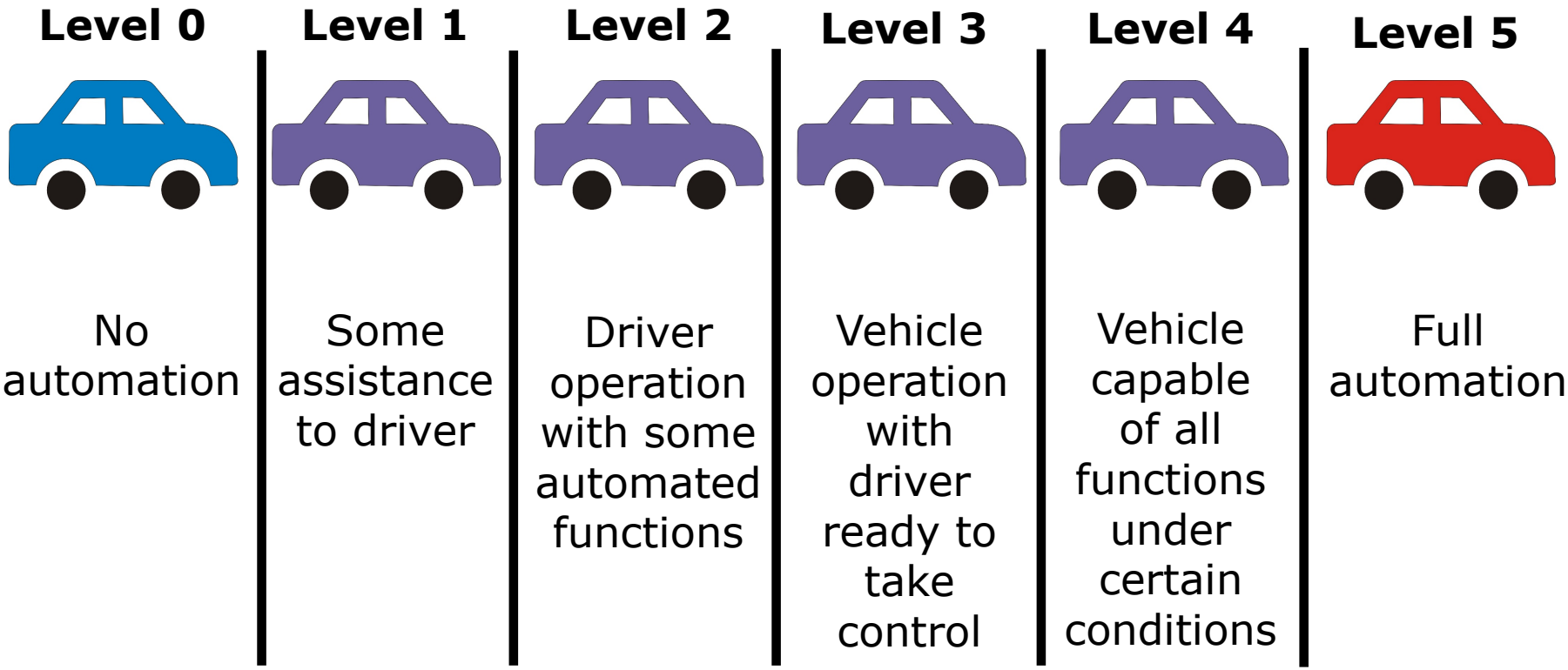
2018 GMC SIERRA CREW CAB 1500 SLT $13,000 TOTAL SAVINGS FROM MSRP

NORTH COUNTY GMC BUICK | 888-913-7777 | NCBCG.COM | 1515 Auto Park Way, Escondido

Safety Implications of Automated Vehicles



SAE Levels of Automation



The Challenge of Full Automation

ITE Statement on Connected and Automated Vehicles

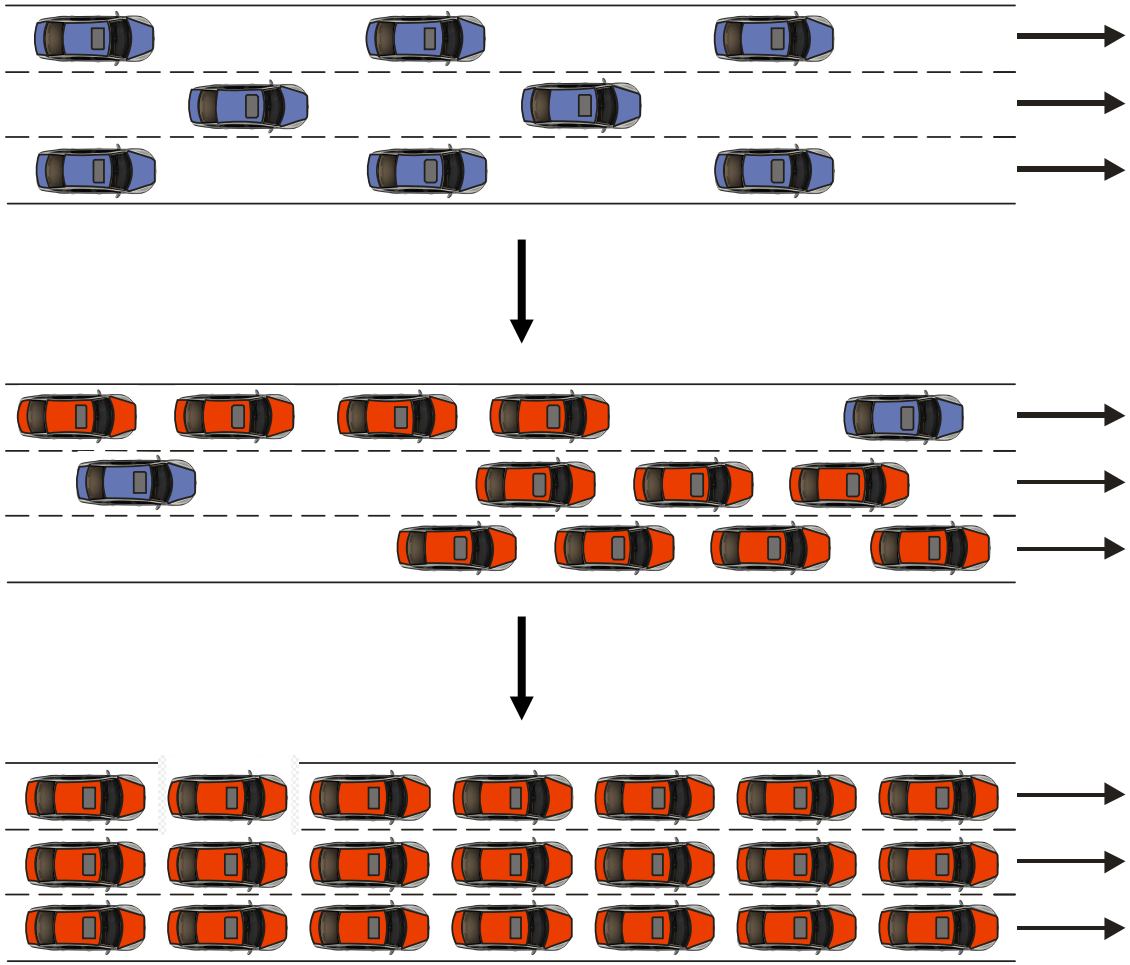
- We will only get to zero fatalities and serious injuries through CV/AV technology.
- We support the rapid adoption of safety assist (SAE Levels 0 and 1) technologies.
- SAE Level 2 systems have not been proven safe for use on the open road, in all intended environments.
- Currently, there is insufficient evidence that SAE Level 3 systems with partial automation can be safely implemented.
- SAE Level 4 systems are the most appropriate as an objective for "driverless vehicles"

Steps in Typical Highway Capacity Manual Process

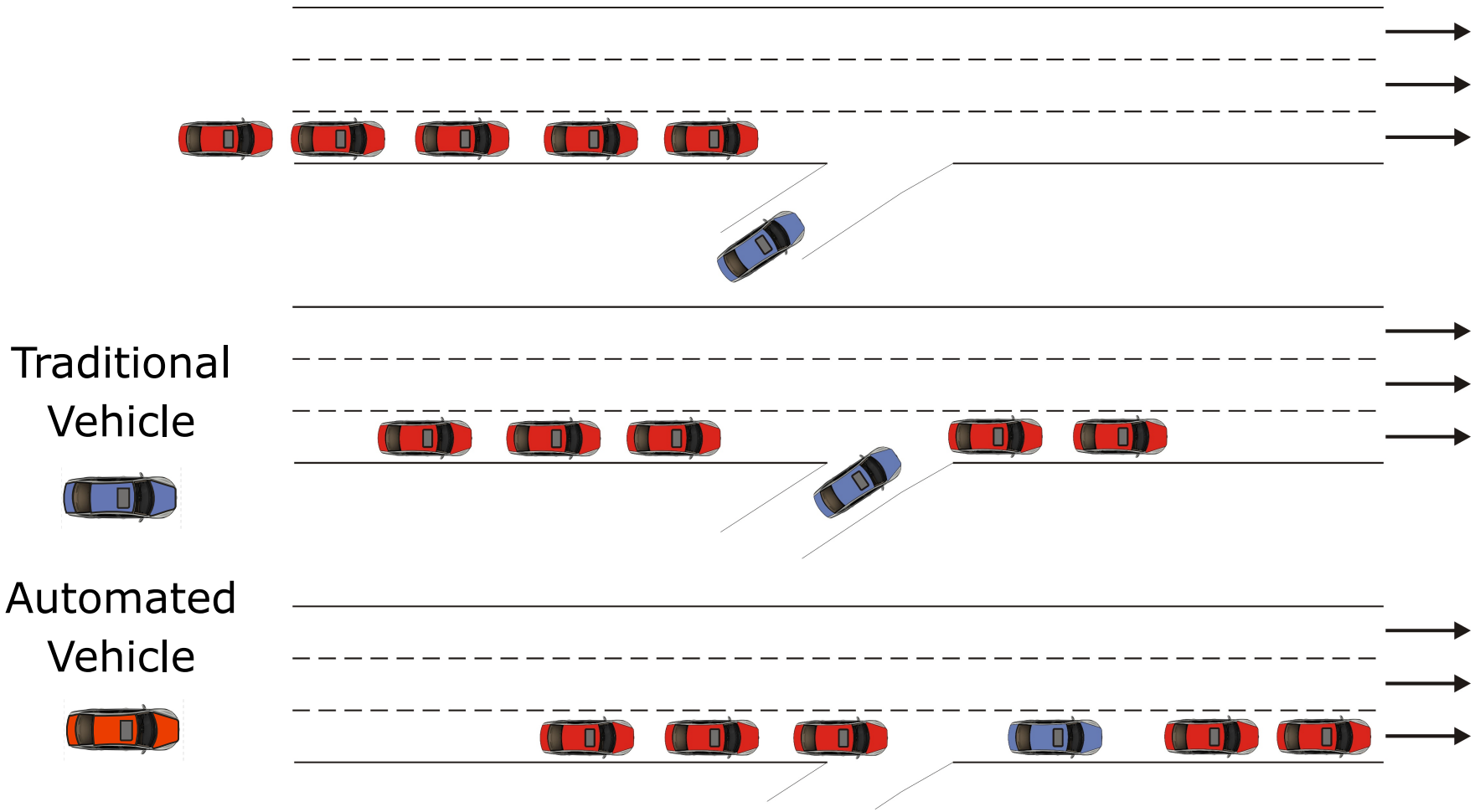
- Observe Operations to Determine Appropriate Parameters
- Data Collection
- Data Analysis to Determine Sensitivity of Input Parameters
- Develop Model
  Analysis Supplemented by Simulation
- Calibrate Model Based on Observed Data
- Validate Model

- HCM Procedures
  Planning **(Simple)** and Operations **(Complicated)**

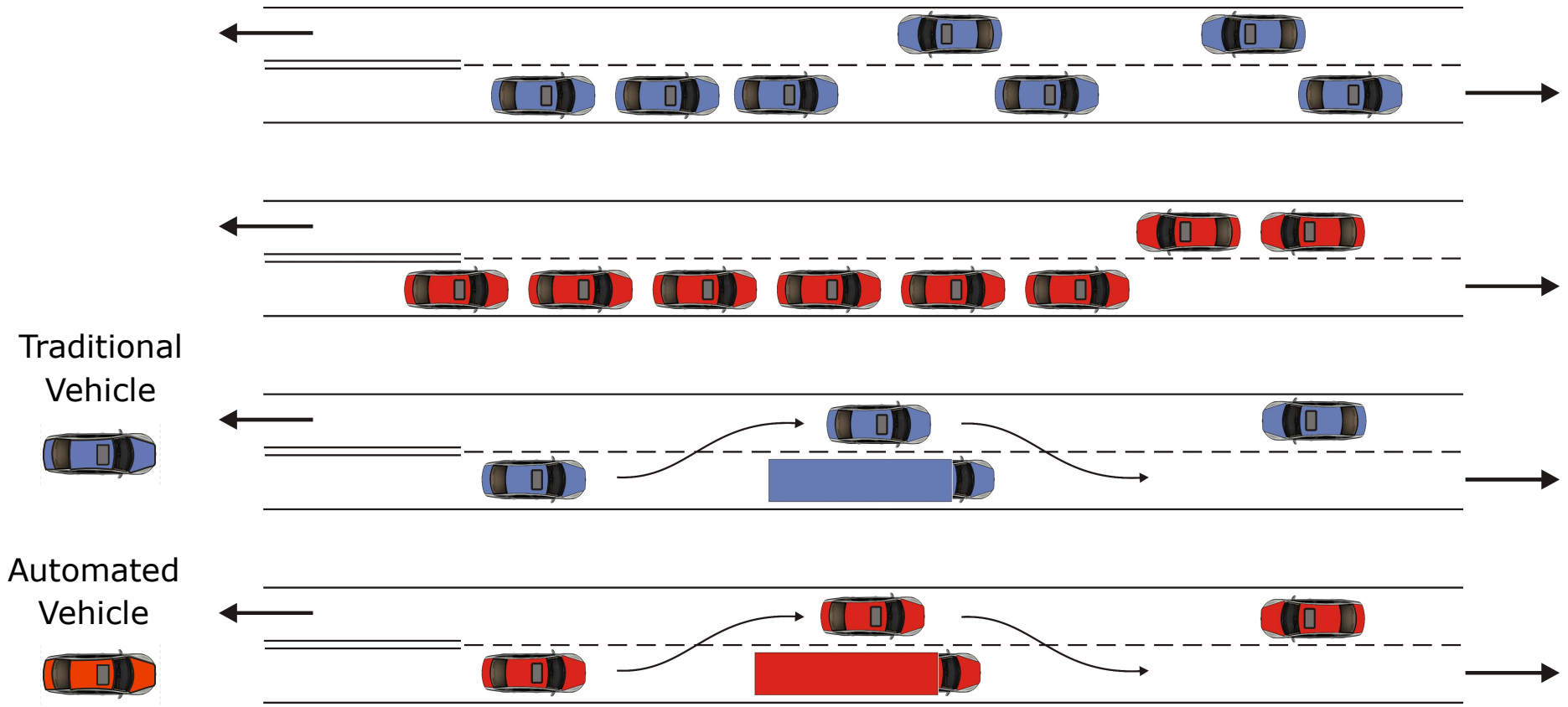
Freeways



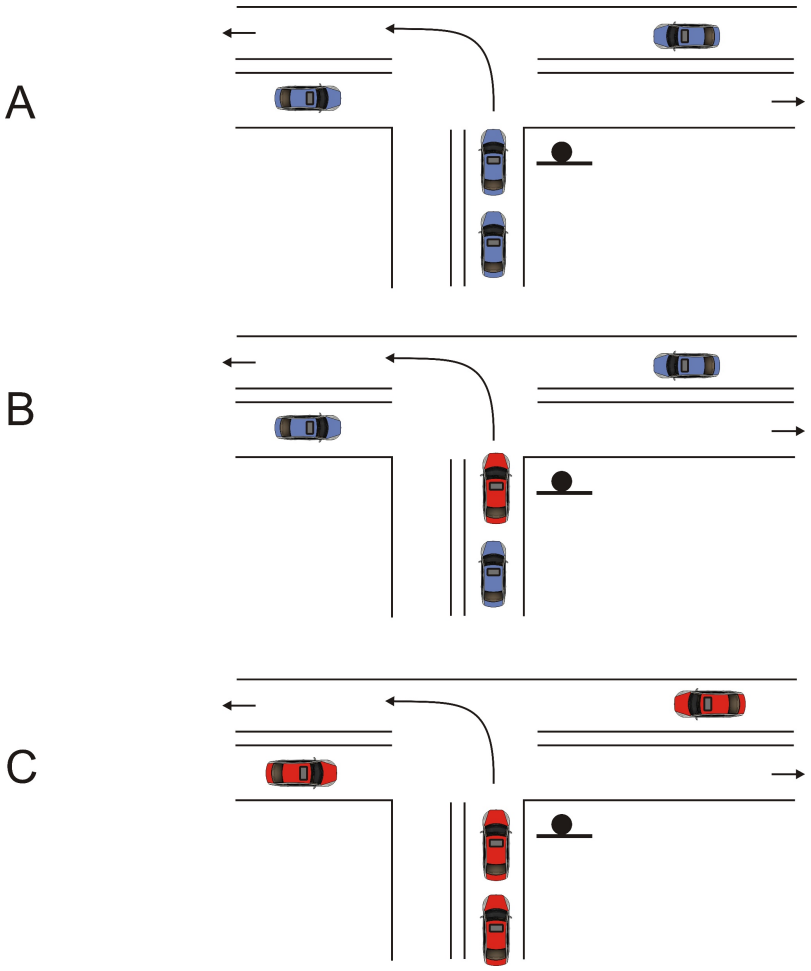
Merge Areas



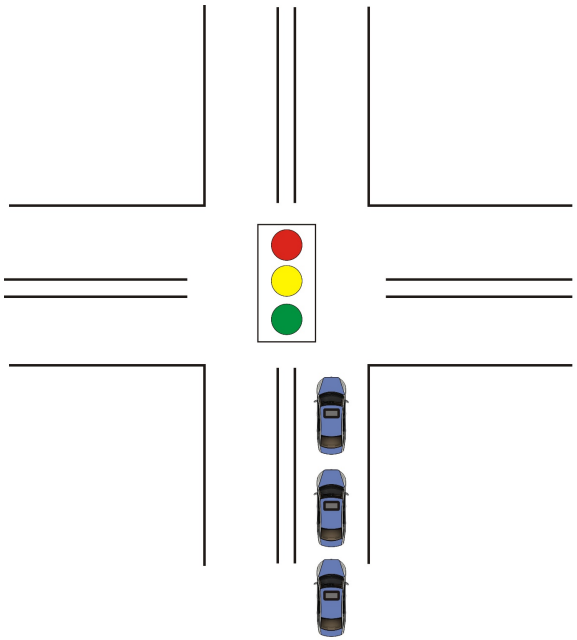
Rural Two-Lane Highways



Unsignalized Intersections

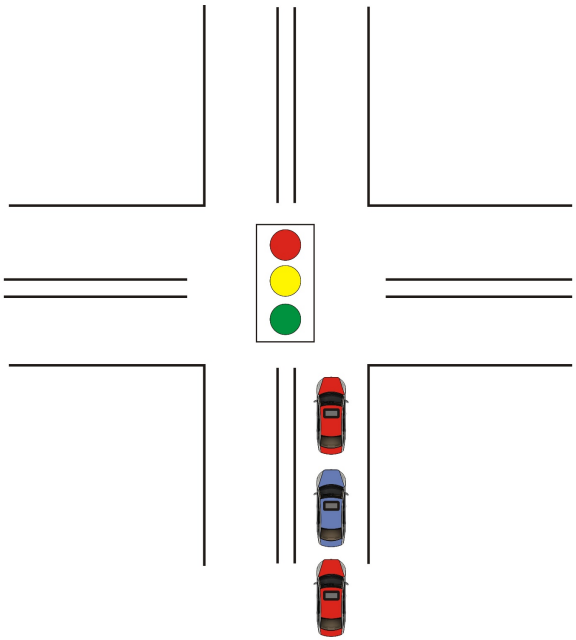


Signalized Intersections

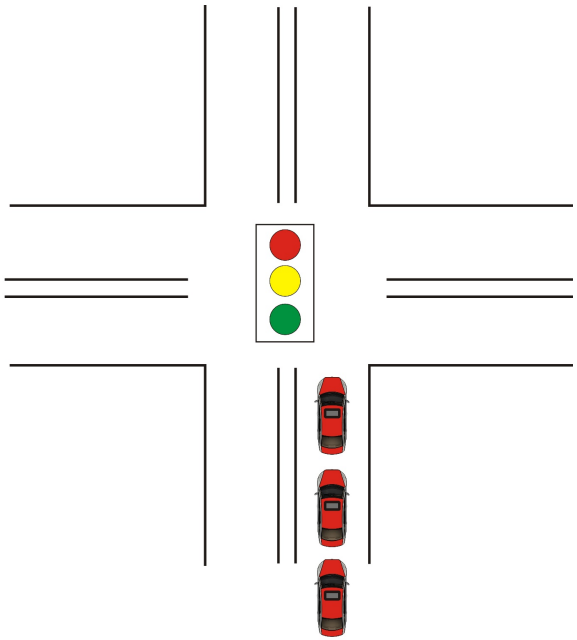


Phase Time = 3.8 + (2.1 x n)

n = Number of Vehicles



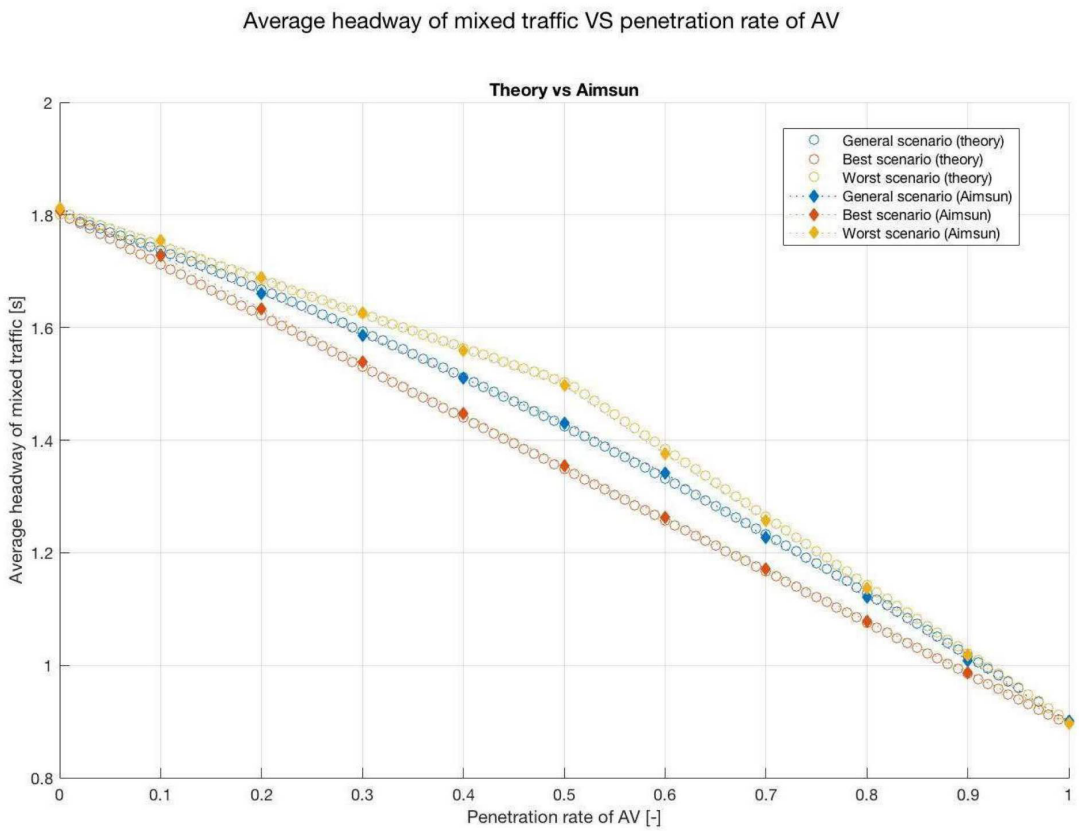
Phase Time = ?



Phase Time = ?

Sample Analysis of Headway Versus Penetration Rate of Automated Vehicles

CAVS & Traffic Signals: Saturation Headway



Planning Analysis

- Typically Analysis of Future Conditions
- Default Values
- Reduced Accuracy of Input Values and Final Results

Future Research

Oregon Department of Transportation

Pooled-Fund Study:
CAV Capacity Modification Factors

TRB
TRANSPORTATION RESEARCH BOARD

Effects of Automated/ Connected Vehicles on Freeway Capacity and Operations

Conclusion

- High Expectations
- Many Unknowns
  - Is SAE Level 5/Full Automation possible in the foreseeable future?
  - When will it occur?
  - What level of safety will be demanded by the public?
  - What will the capacity effects be with a mixture of automated and traditional vehicles?
  - What are the effects of CAV's on travel demand?
  - What are the effects of other innovative technologies such as Mobility as a service
- Current research may provide some answers
- More research needed