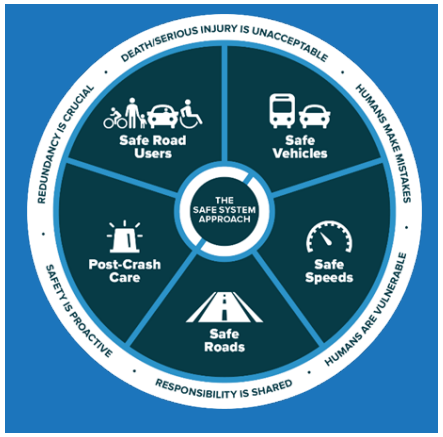
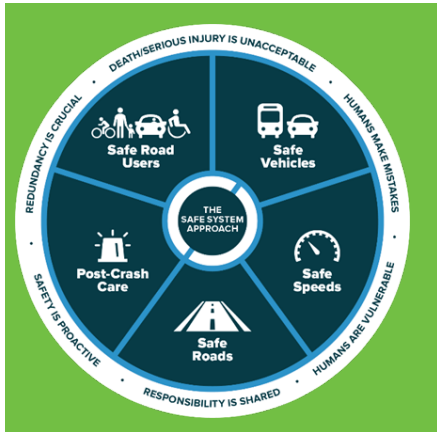
National Center for Rural Road Safety

Improving Rural Road Safety with the Safe System Approach





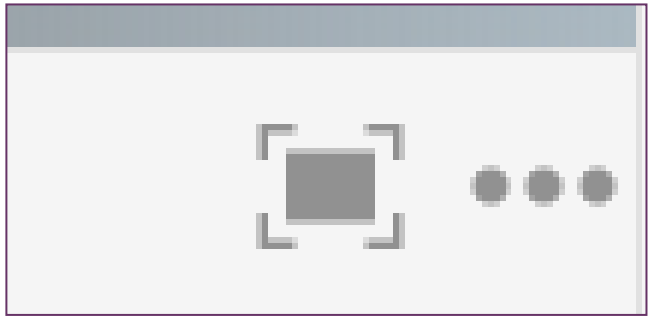
A 6-part Webinar Series

Part 3: Safe Vehicles

Presented by:

- Eric Jackson PhD, Executive Director, Connecticut Transportation Institute, Director, Connecticut Transportation Safety Research Center
- Tyler Weldon, State Maintenance Engineer, Colorado DOT
- Randy Johnson, KC Scout Manager, Missouri DOT

Webinar Logistics



- Duration is 11:00 AM - 12:30 PM Mountain
- Webinar – recorded and archived on website. For quality of recording, phone will be muted during presentation
- If listening on the phone, please mute your computer
- To maximize the presentation on your screen, click the "window box" in the top right of the presentation
- At the end of each section, there will be time for Q&A
- There is a handout pod at the bottom of the screen
- Please complete follow-up surveys; they are vital to assessing the webinar quality

Certificates of Completion/CEUs

Survey Link –

https://lp.constantcontactpages.com/sv/48DCGTk

- Survey closes 2 weeks after webinar
- Expect certificate/CEU form approx. 4-6 weeks after webinar
- Return CEU form to ContinuingEd@montana.edu **NOT** Rural Safety Center
- Request a verification of completion form


National Center for Rural Road Safety
Certificate of Completion
is hereby granted to
XXX
to certify that he/she has completed to satisfaction the course
Pedestrian Treatments for Uncontrolled Locations
Granted: January 18, 2018 11:00 AM - 12:30 PM MST
Instructors: Yan Qi and Kyle Armstrong
Jaime L Sullivan
Safety Center Manager

Today's Presenters

Eric Jackson PhD
Executive Director
Connecticut
Transportation Institute

Tyler Weldon
State Maintenance
Engineer
Colorado DOT

Randy Johnson
KC Scout Manager
Missouri DOT

Goals of this Webinar

Once you have completed this webinar, you will have:

an understanding of the Safe Vehicle element in the Safe System Approach through the lens of actions agencies can take.

Learning Outcomes

To achieve the webinar goal, you will learn to:

- Explain how connected and automated vehicles work and list actionable items you can take to prepare for automated, connected, and electric vehicles in rural areas.
- Name the benefits of using an autonomous attenuator truck in rural areas.
- Define how a real-time digital warning system works.

National Safety Efforts: Intertwining Concepts

Foundation

Framework

Goal

Graphic Source: ARA

Safe System:

- Holistic Approach
- Aims to eliminate fatal and serious injuries for all road users
- 5 Elements
- 6 Principles

Eric Jackson PhD
Executive Director
Connecticut Transportation Institute

National Center for Rural Road Safety

Explain how connected and automated vehicles work and list actionable items you can take to prepare for automated, connected, and electric vehicles in rural areas.

Name the benefits of using an autonomous attenuator truck in rural areas.

Define how a real-time digital warning system works.

Terms to Know?

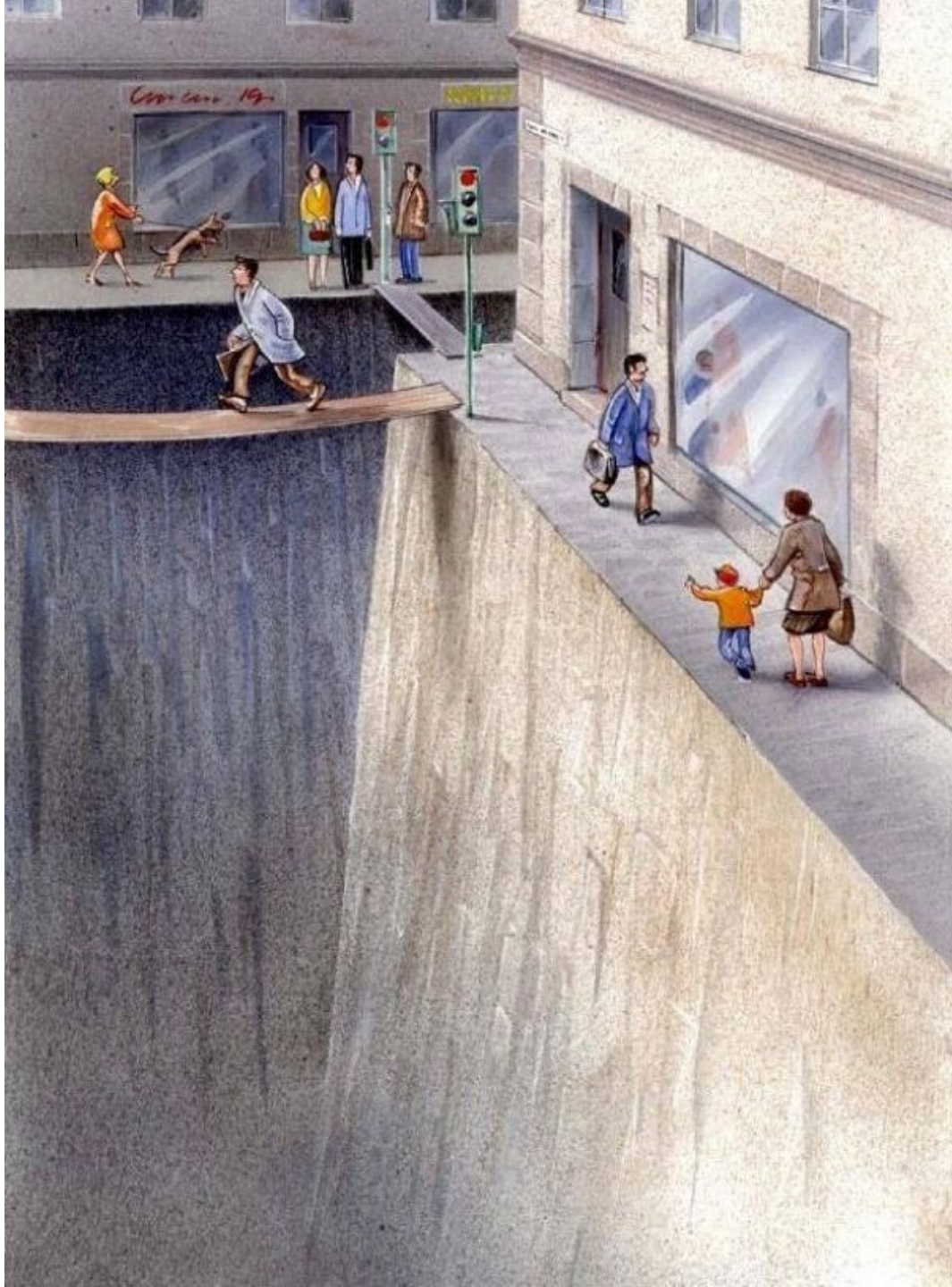
- Autonomous
- Automated
- Connected
- LIDAR (Light Detection and Ranging)

https://3seconds.org/

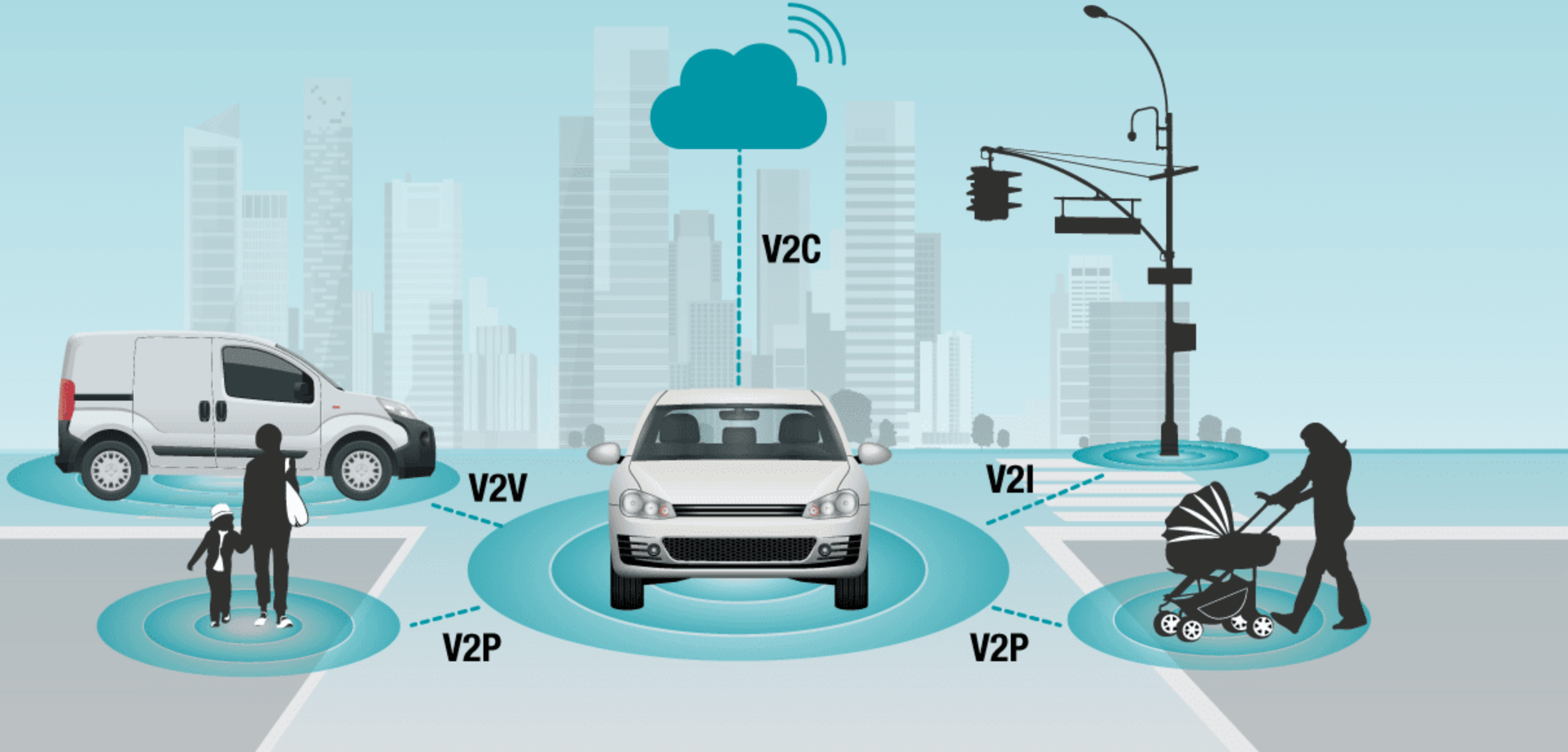
Motivation

Where Have We Been? Where Are We Headed?

- What is an AV and how do they work?
- How far away are AVs?
- What are some of the challenges?
- How will this technology change our lives?
- Will you own one?



Connected



Automated


Profitability
Growth
23 %
2018
2024
2030
Places
436
Engagement (7D)
48%
73.564

Autonomous

The route to the autonomous car

Frank J. Goguen, CFA®[1], senior research analyst and John D. Connolly, writer at The Boston Company Asset Management LLC[2] explore the future economic and social potential of driverless cars.

The Boston Company Asset Management, LLC

Advantages

Safety

90%

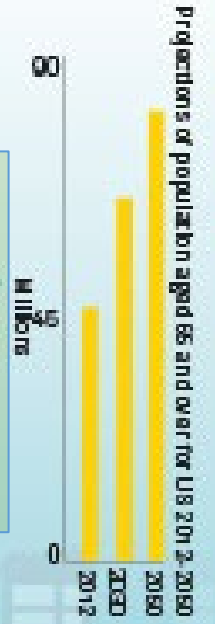
of road traffic accidents are currently caused by human error.[1]

Driverless cars could translate into approximately **36,000** lives saved each year and approximately **US$ 488 billion.**

Social

Greater mobility provided to elderly and disabled people.

People over the age of 65 expected to double in US by **2050.**[2]



Economic

Morgan Stanley estimates Autonomous cars will result in **US$ 1.3 trillion** savings every year for the US economy, globally this translates into **US$ 5.6 trillion.**[3]

Economic benefits for drivers

- Fuel costs
- Productivity gains
- Accident costs

Potential obstacles

Liability

Who accepts responsibility in the case of an accident?

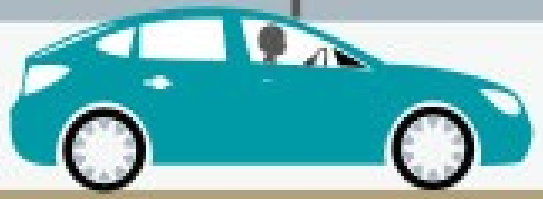
Legislation

US infrastructure deficiencies mean that **US$ 10.8 billion** had to be found to keep the Highway Trust Fund solvent until May 2015.[4]

Consumer adoption

Once people accept and trust the systems, adoption rates are expected to climb.

Welcome to the autonomous car



2030

AUTOMATION LEVELS OF AUTONOMOUS CARS

LEVEL 0

There are no autonomous features.

LEVEL 1

These cars can handle one task at a time, like automatic braking.

LEVEL 2

These cars would have at least two automated functions.

LEVEL 3

These cars handle "dynamic driving tasks" but might still need intervention.

LEVEL 4

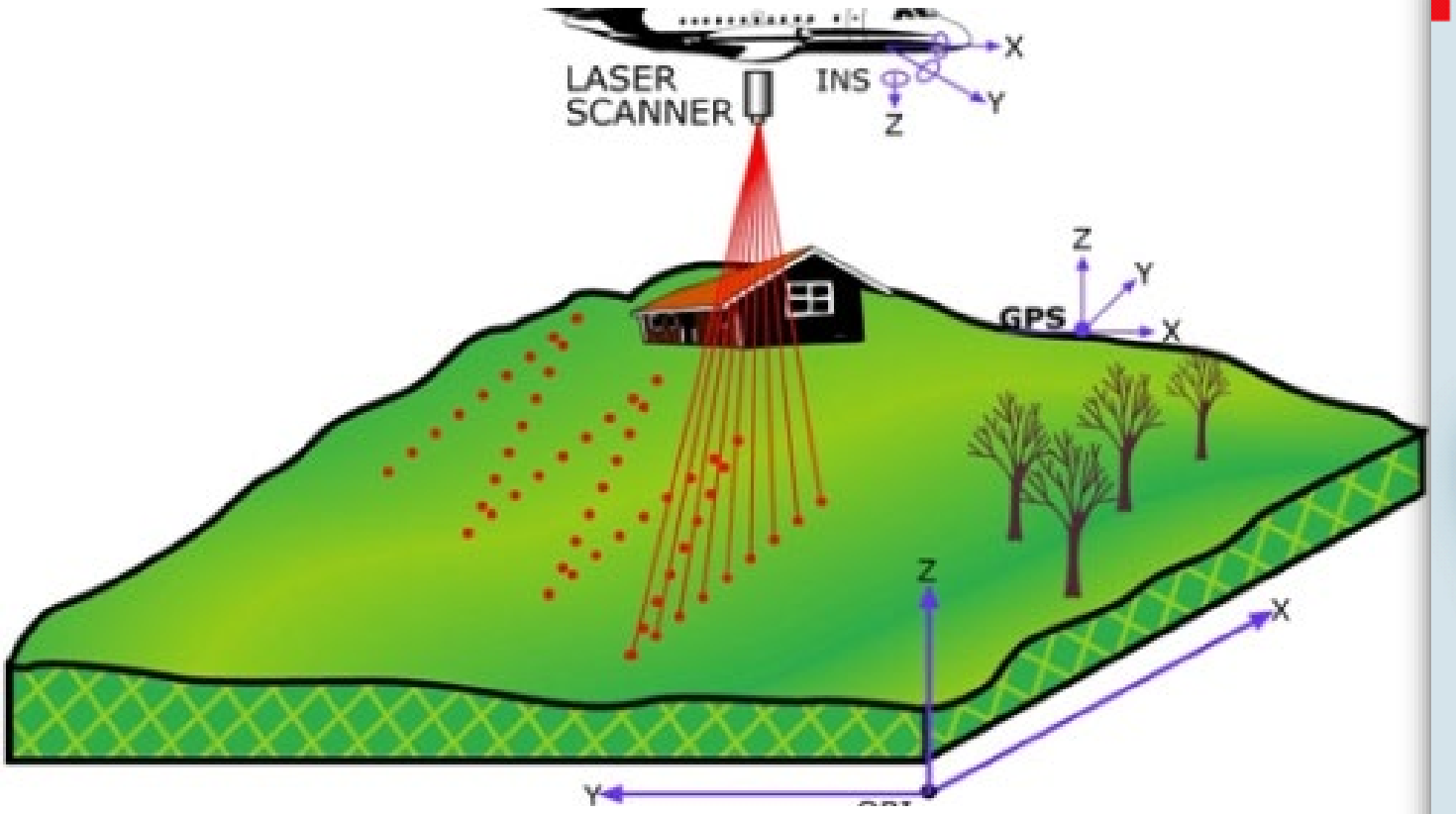
These cars are officially driverless in certain environments.

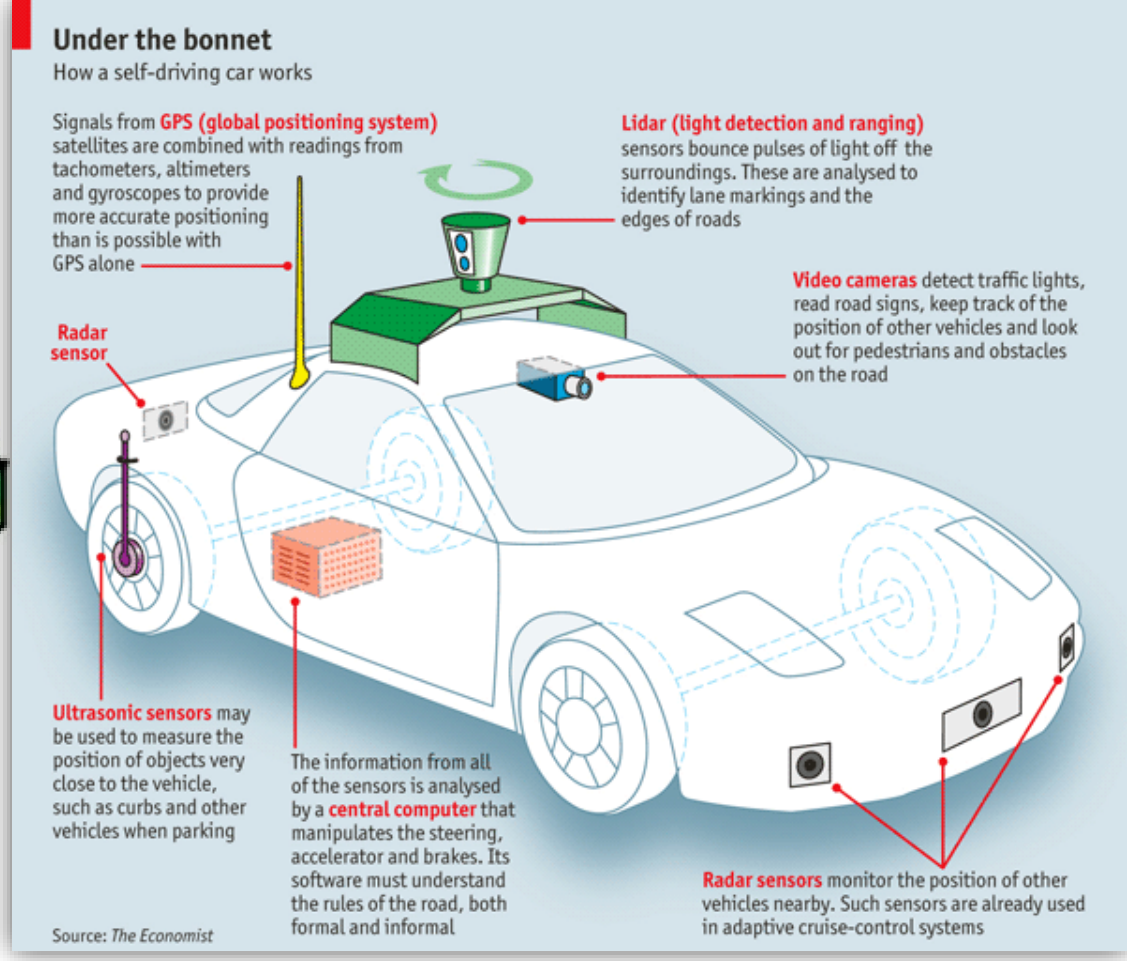
LEVEL 5

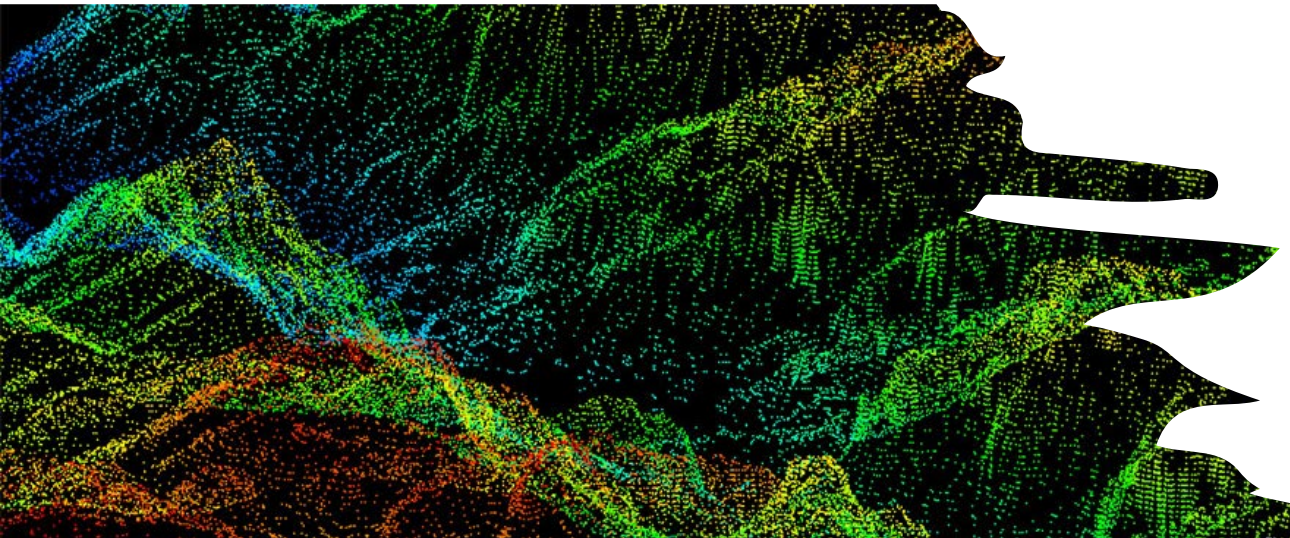
These cars can operate entirely on their own without any driver presence.

SOURCE: SAE International

BUSINESS INSIDER

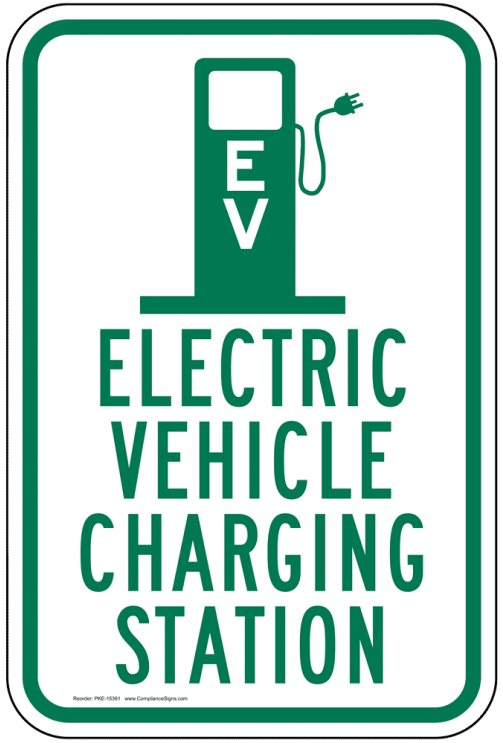






LiDAR

Light Detection and Ranging



HOW UBER'S FIRST SELF-DRIVING CAR WORKS

Top mounted **LiDAR** beams 1.4 million laser points per second to create a 3D map of the car's surroundings.

There are **20 cameras** looking for braking vehicles, pedestrians, and other obstacles.

A **colored camera** puts LiDAR map into color so the car can see traffic light changes.

Antennae on the roof rack let the car position itself via GPS.

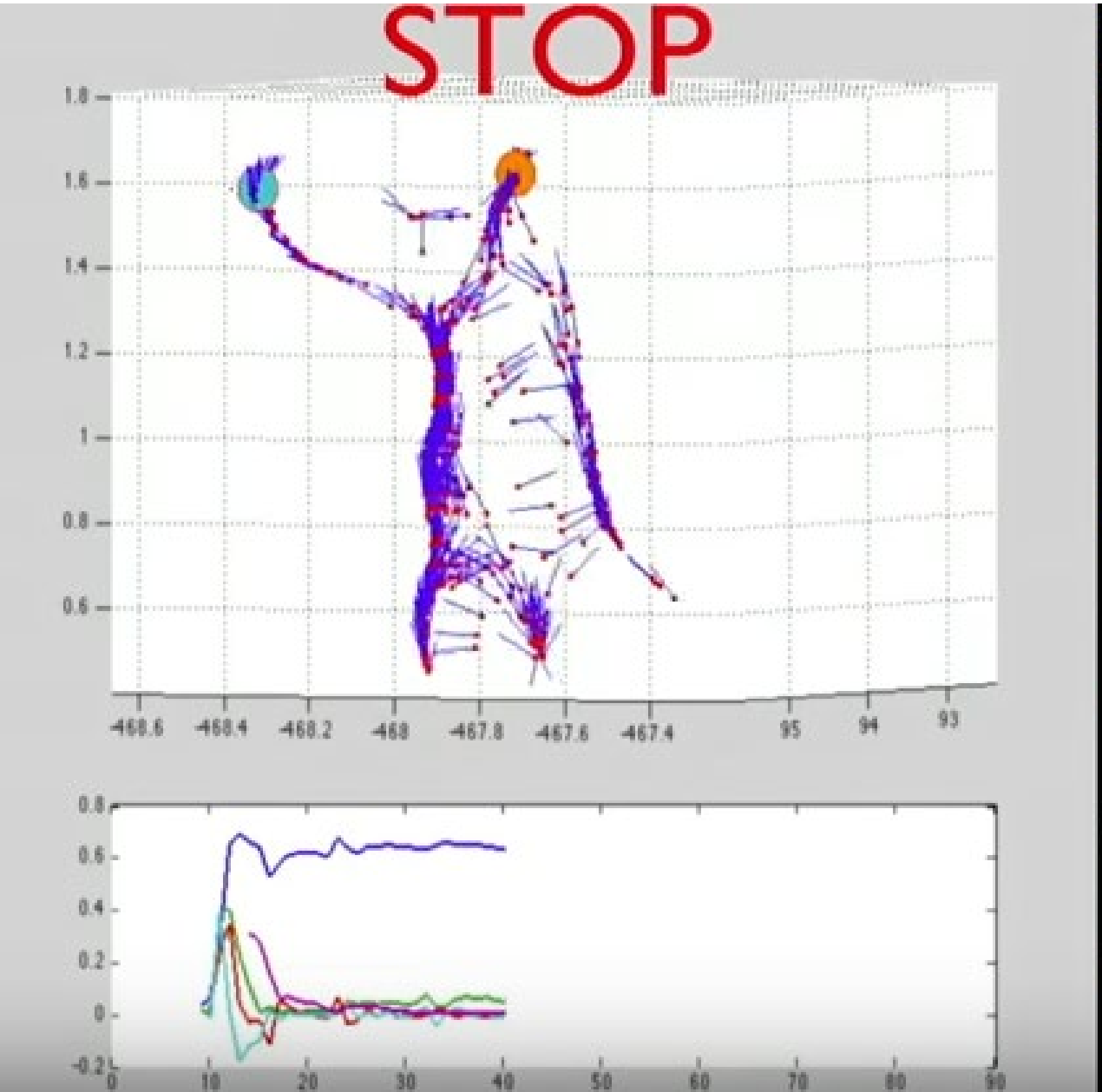
LiDAR modules on the front, rear, and sides help detect obstacles in blind spots.

A cooling system in the car makes sure everything runs without overheating.

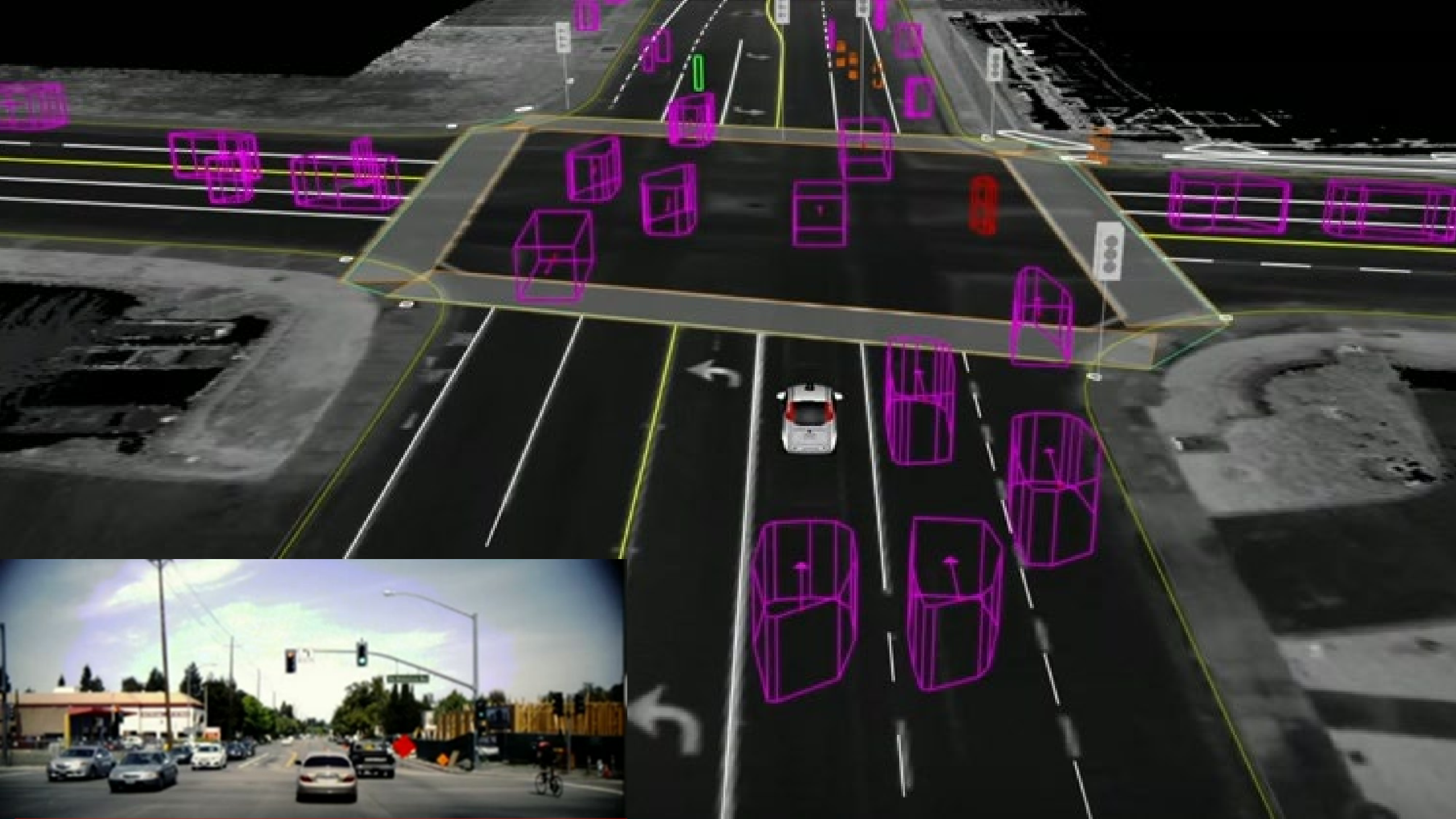
SOURCE: Uber

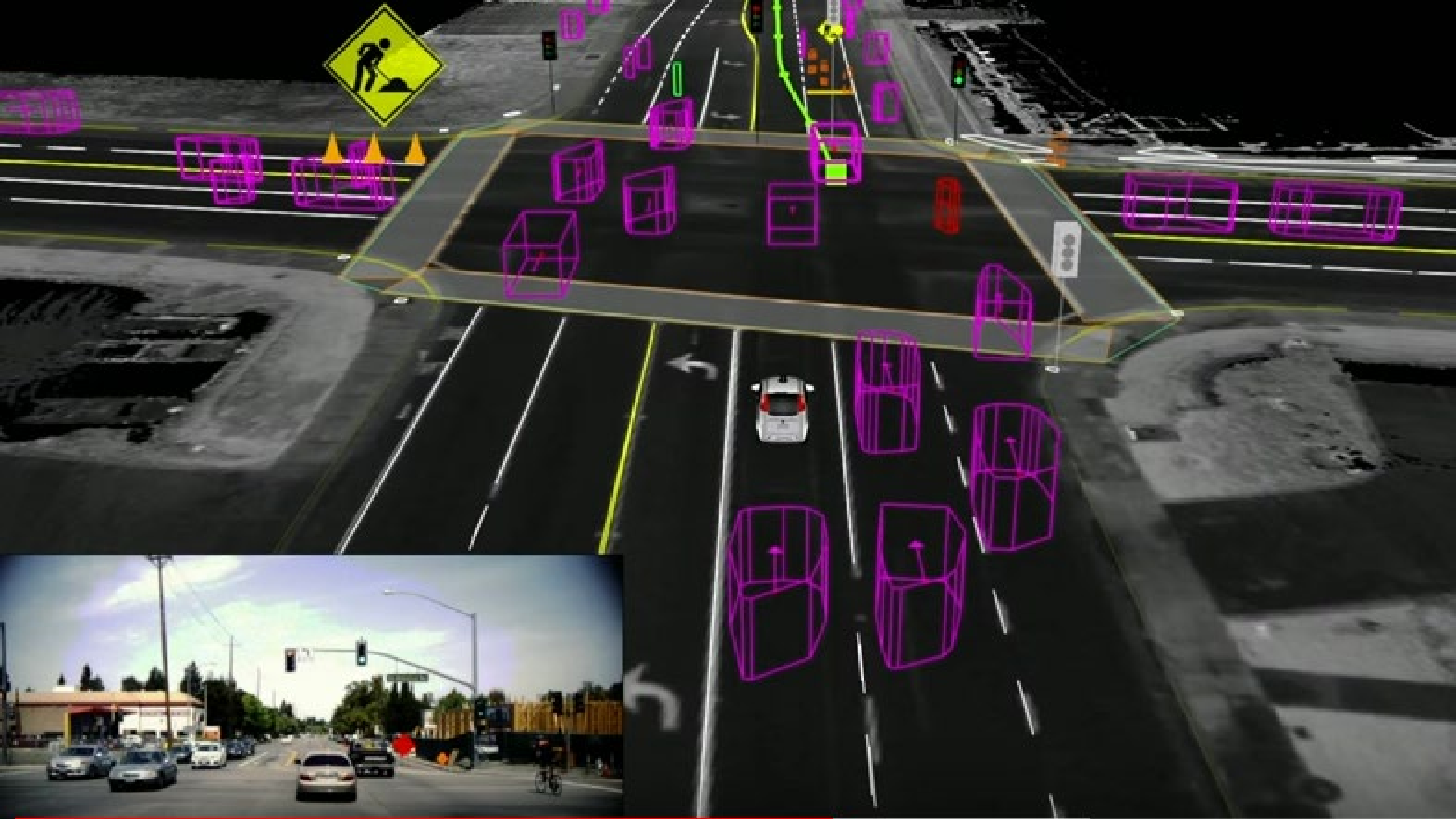
BUSINESS INSIDER

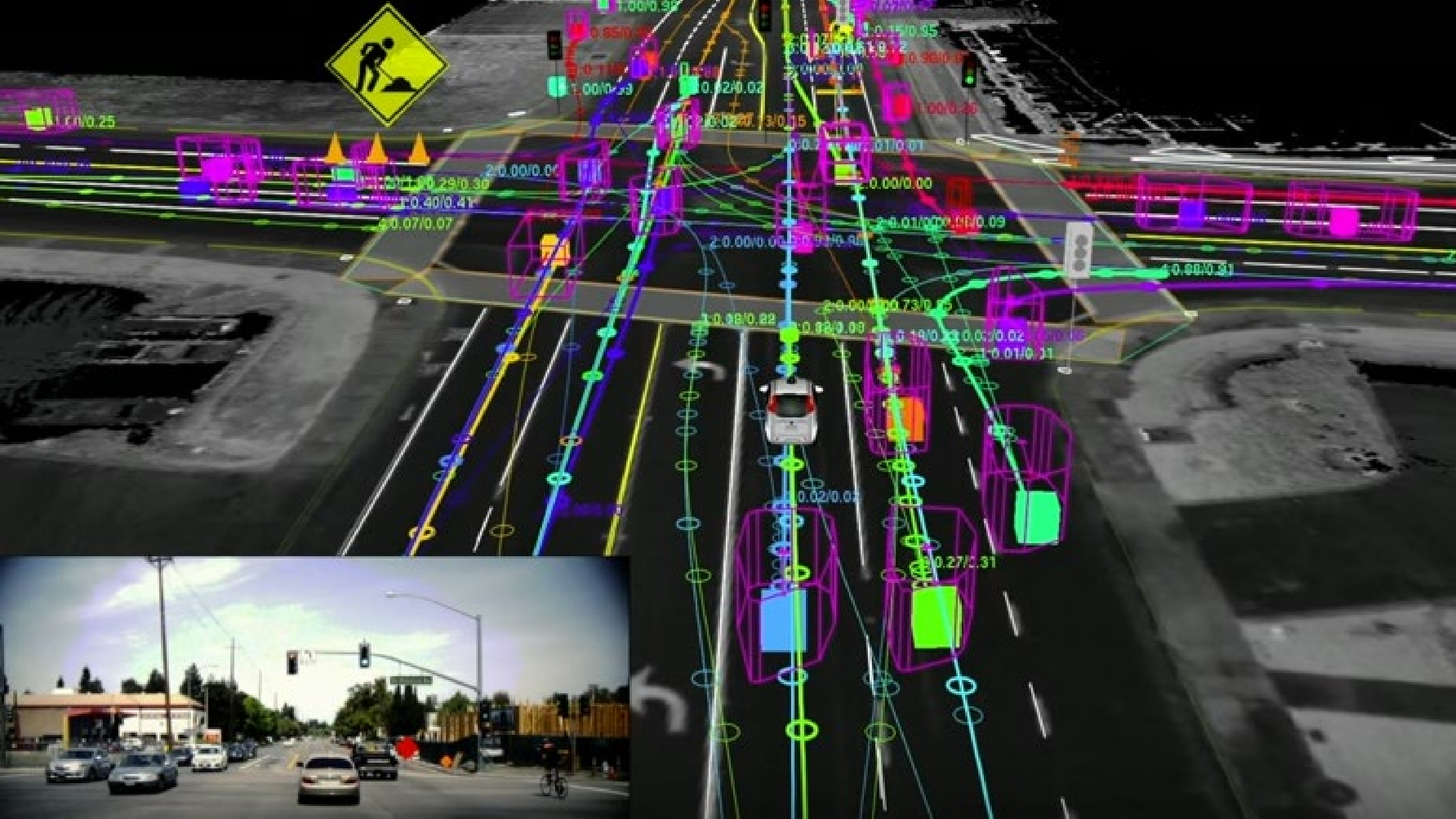
How do AVs “See”

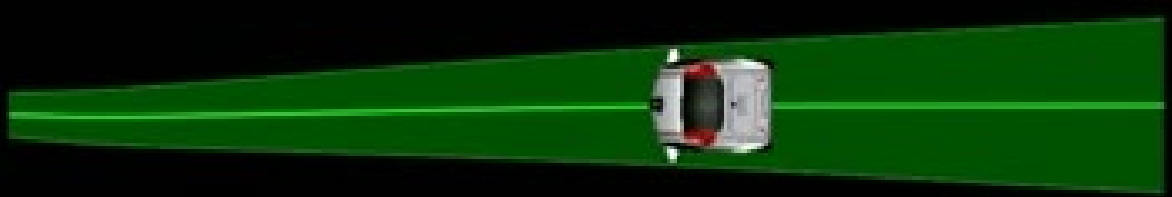


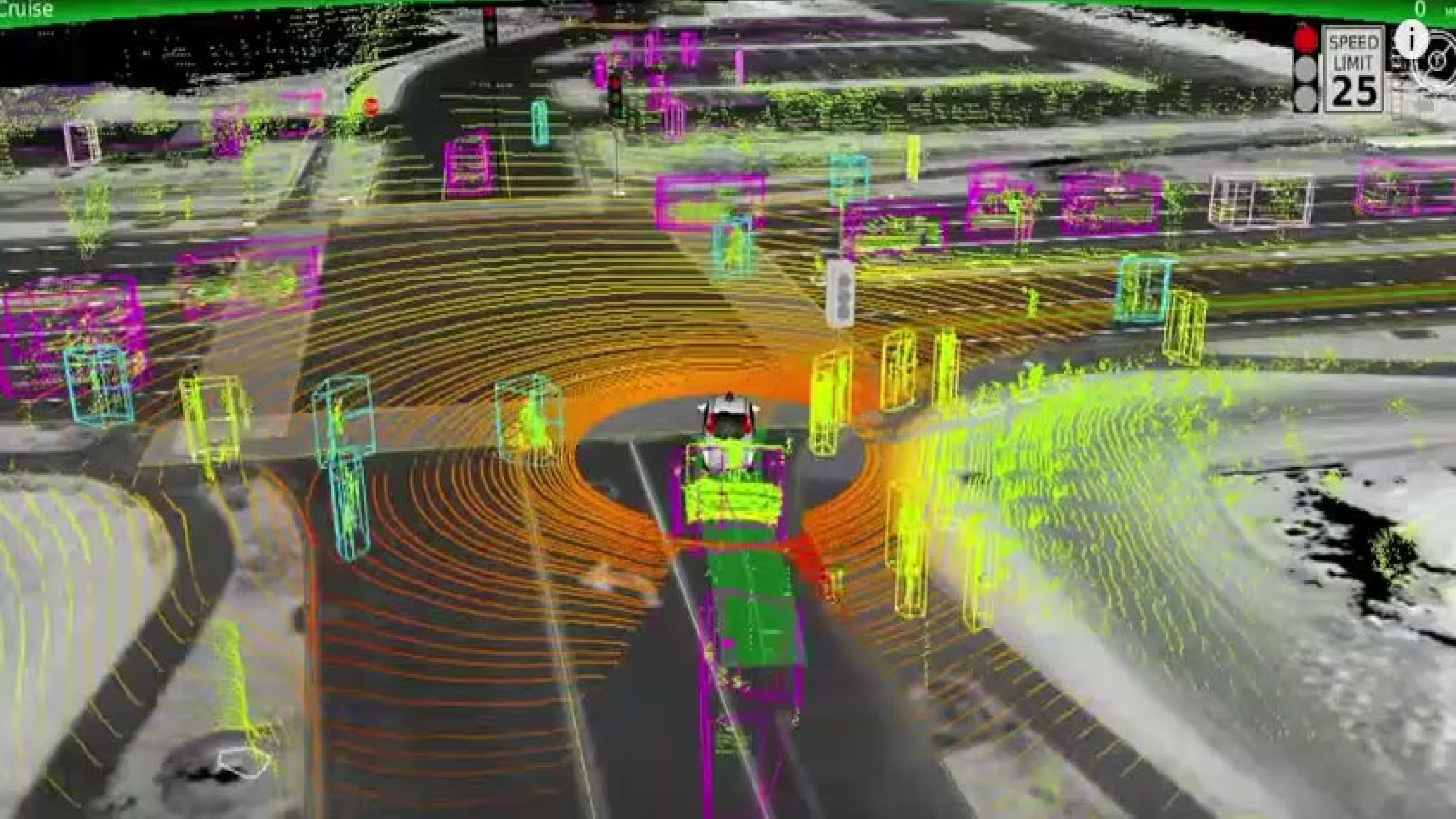
View From the Camera of the Car





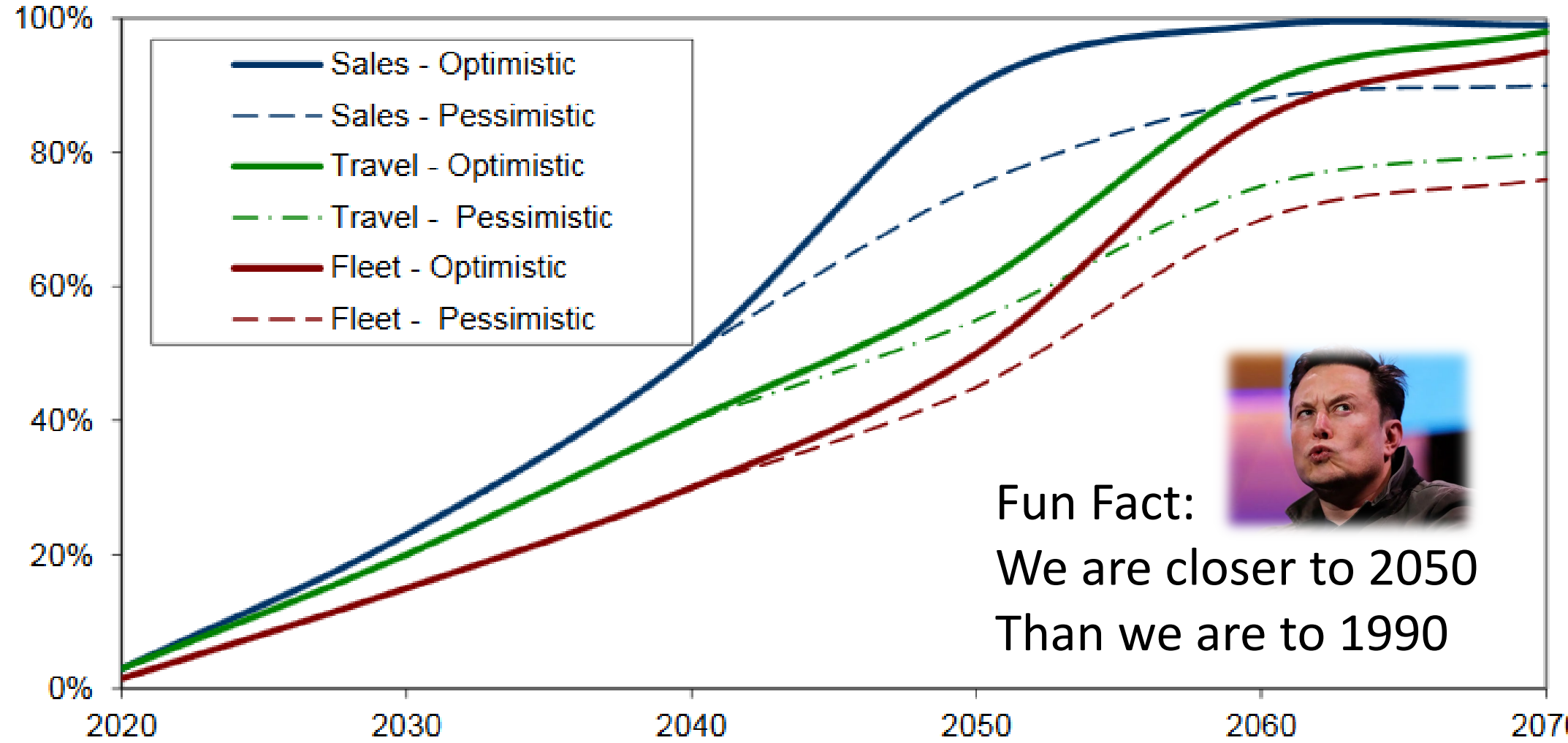





Cruise
SPEED
LIMIT
25

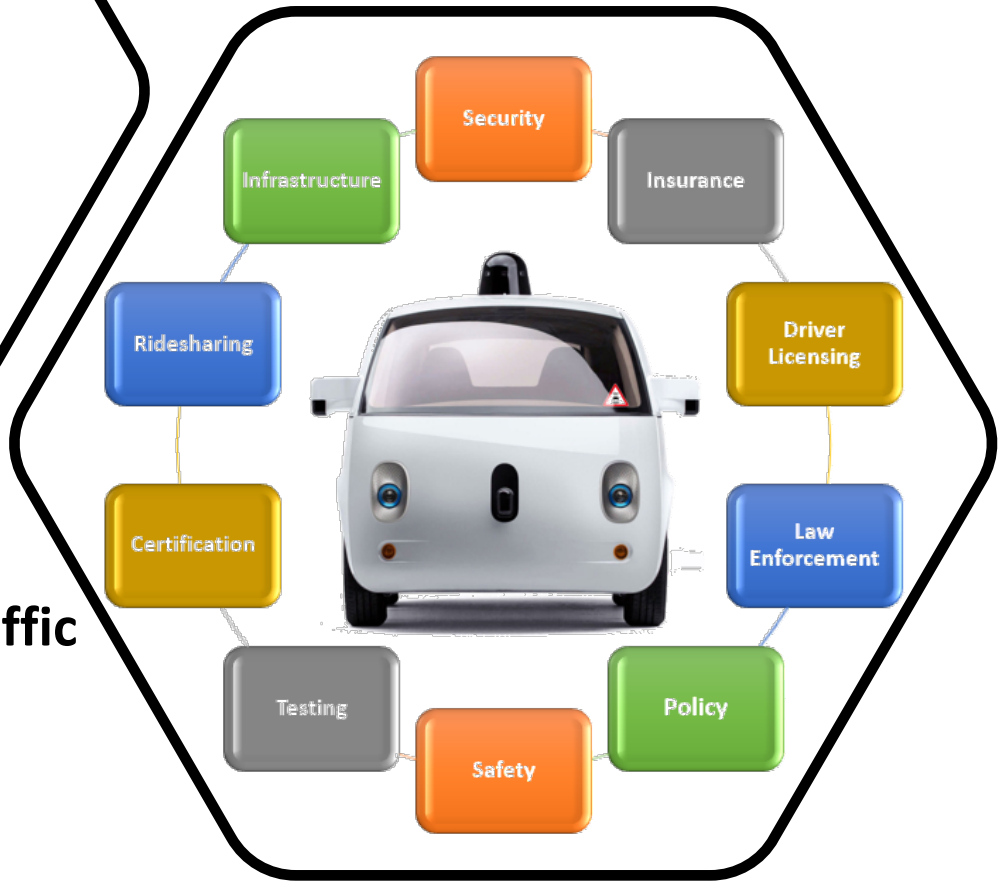
Timeline

Exhibit 15 **Autonomous Vehicle Sales, Fleet and Travel Projections**



Fun Fact:
We are closer to 2050
Than we are to 1990

What Challenges Exist?



- **Driving safely despite unclear lane markings**
- **Reliably recognizing traffic lights that are not working**
- **Making left turns into intersections with fast-moving traffic**
- **Detecting which small objects in the roadway must be avoided**
- **The ability to operate safely in all weather conditions**
- **Cybersecurity. There is no evidence yet that autonomous cars will be any more secure than any other networked computers.**

Rural Areas Action Items

- Install and maintain lane markings
- Accurate mapping of roads
- Electric vehicle charging infrastructure
- Uniform signage that is MUTCD compliant, retroreflective and visible
- Evaluation of “non-engineered” roadways (horizontal and vertical curvature)
- Teslas are coming

Prepare your Workforce

What Will be Required of the Workforce of the Future?

Tech Brief Series Tech Brief - 2018-2

Connected & Autonomous Vehicles

With a host of new vehicle technologies emerging, it's common to see news articles discussing automated and connected vehicle technologies. Though at times these terms are mistakenly used interchangeably, there is a clear distinction between the two concepts. This technical brief provides an overview of the two technologies.

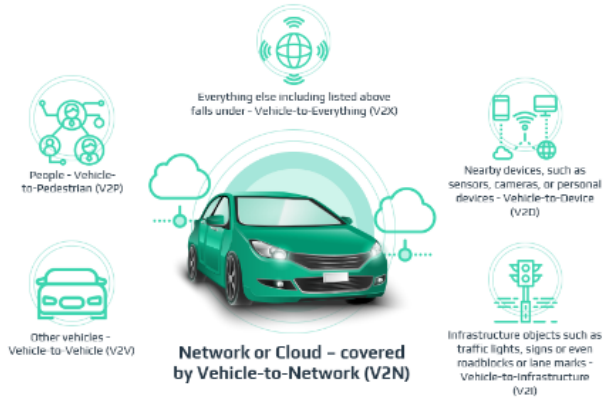
Connected Vehicles

In the simplest sense, connected vehicle (CV) technologies are tools that allow vehicles to communicate with each other and with the world around them. This communication in turn allows drivers to make decisions using information from the surrounding environment. One should note that while using CV technologies, human drivers are still in control of the vehicle.

Connected vehicles may seem like a futuristic concept, but the average driver is already familiar with CV technology in the form of dynamic routing using GPS navigation via the cellular network. Information regarding collisions, active construction and other congestion along a route are communicated to the driver using visual and audio displays, either in the vehicle or on a mobile phone. This information then allows the driver to make an informed decision regarding the best route to take. In the future, connected vehicle technologies may include those shown in the graphic below.

Courtesy Qualcomm

When talking about connected vehicle technologies, the terms V2V, V2I, V2P and V2X are often used. As show in the graphic below, V2V refers to vehicles talking to each other, V2P refers to vehicles talking to pedestrians, and V2I refers to vehicles talking to infrastructure surrounding them.



Courtesy Intellias

One of the biggest issues surrounding CV technologies is ensuring a secure communications network. The Federal Communications Commission (FCC) set aside bandwidth specifically for intelligent transportation systems communication using dedicated short-range communication (DSRC), which is a specialized form of WiFi. A security credential management system (SCMS) for messages sent over DSRC will be tested as part of national connected vehicle pilot deployment projects currently underway in New York City, Tampa and Wyoming.

In the municipal realm, the National Operations Center for Excellence, a partnership of AASHTO, ITE and ITSA with support from FHWA, issued the SPaT Challenge to local agencies. The SPaT Challenge is to implement DSRC and transmit Signal Phasing and Timing (SPaT) data along a corridor in each of the 50 states by 2020. So far 26 states have committed to respond to the SPaT Challenge, with 216 signals currently in operation and 2,121 planned. Look for more in-depth information on the SPaT Challenge in future tech briefs.

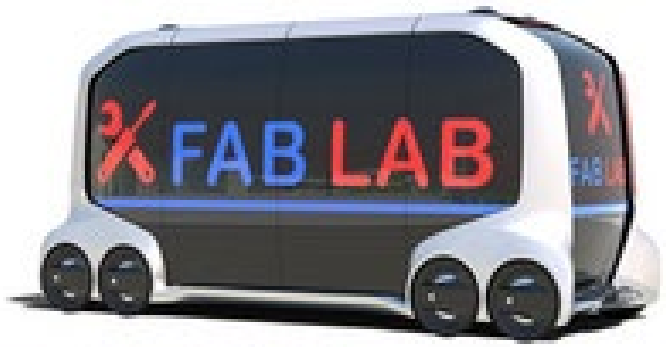
Courtesy NOCoE

Benefits for Rural Areas

- Rural roadways experience a greater number of fatal crashes than urban roadways.
  - Curve Speed Warnings
  - Work Zone Warnings and Crash Alerts
  - Stop Sign Gap Assistance
  - Do Not Pass Warning
  - Maintained mobility for aging population
  - Increased mobility for disabled or younger individuals
  - Reduced need for vehicle ownership

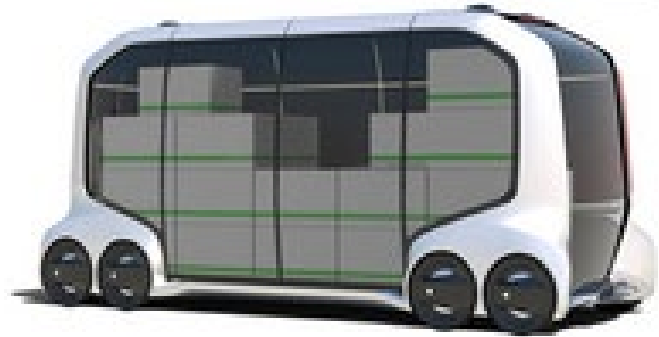
What does the future of AV look like?


REAL
E-COMMERCE


FAB LAB


Pizza


LOGISTICS



Directing Your Questions via the Chat Pod

1. Chat pod is on left side of screen between attendees pod & closed caption pod

3. Answers will appear here unless addressed verbally

2. Type your question or comment here

Tyler Weldon
State Maintenance Engineer
Colorado DOT

National Center for Rural Road Safety

Explain how connected and automated vehicles work and list actionable items you can take to prepare for automated, connected, and electric vehicles in rural areas.

Name the benefits of using an autonomous attenuator truck in rural areas.

Define how a real-time digital warning system works.

Tools for Tomorrow, Here Today

COLORADO
Department of Transportation

CDOT Autonomous TMA Truck (ATMA)

Developed By KRATOS UNMANNED SYSTEMS DIVISION Royal TRUCK & EQUIPMENT INC.

RSC Webinar September 29 2021

CDOT Organization

COLORADO
Department of Transportation

- Maintain 23,000 lane miles of highways
- Maintenance of pavement, bridges, tunnel and pavement markings
- 1800 Maintenance Employees and 279 Patrols
- Highway Maintenance Degree Program at Front Range CC.

Project Vision

COLORADO
Department of Transportation

- Remove driver from TMA truck
- Decrease risk of operations
- Increase efficiency of operations
- Pursue cutting-edge technology to improve highway management

Project Goals

COLORADO
Department of Transportation

1. Installation of system on CDOT piece of equipment
2. Identification of limitations and anomalies in track setting
3. Log open highway miles in striping operation
4. Interchangeability of lead vehicle – sweeper or mower
5. Expand Program



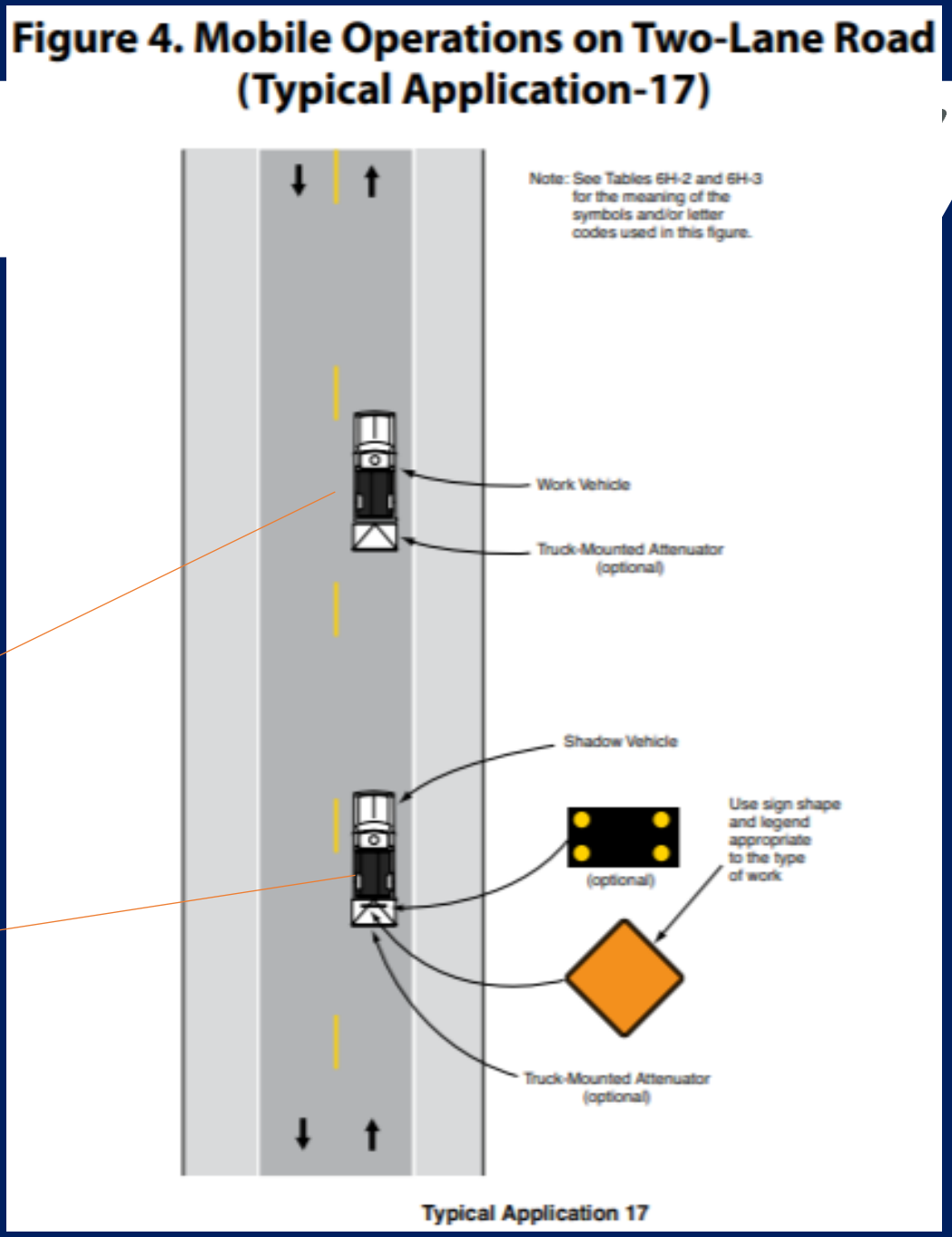
Traffic Mobile Attenuator - TMA

COLORADO
Department of Transportation

- A TMA Truck is used to protect the mobile work zone when putting paint on the highway

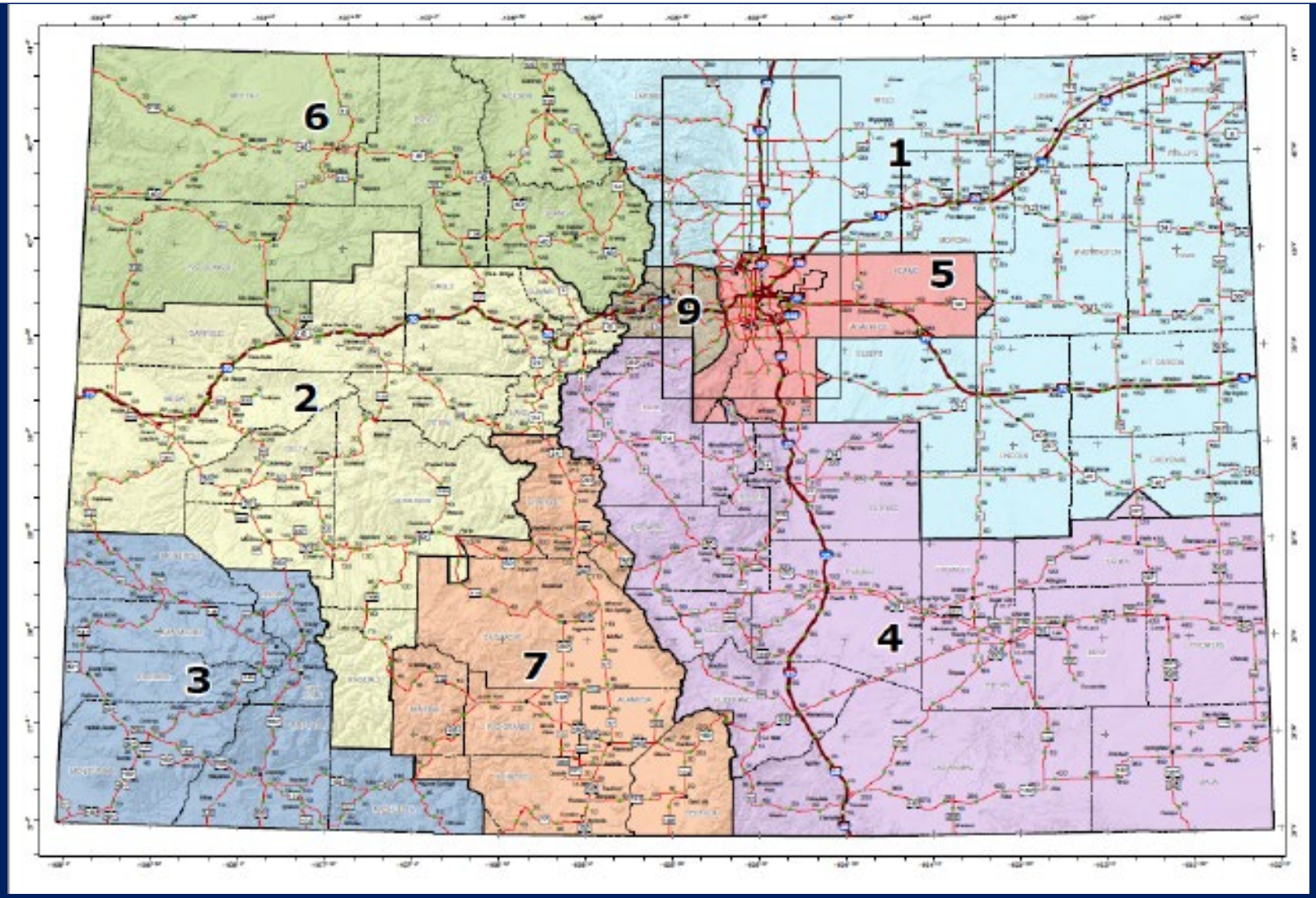
Traffic Mobile Attenuator

- Standard Diagrams from ATTSA for shadow vehicles to protect the workers and slow moving vehicles



Where We Operate

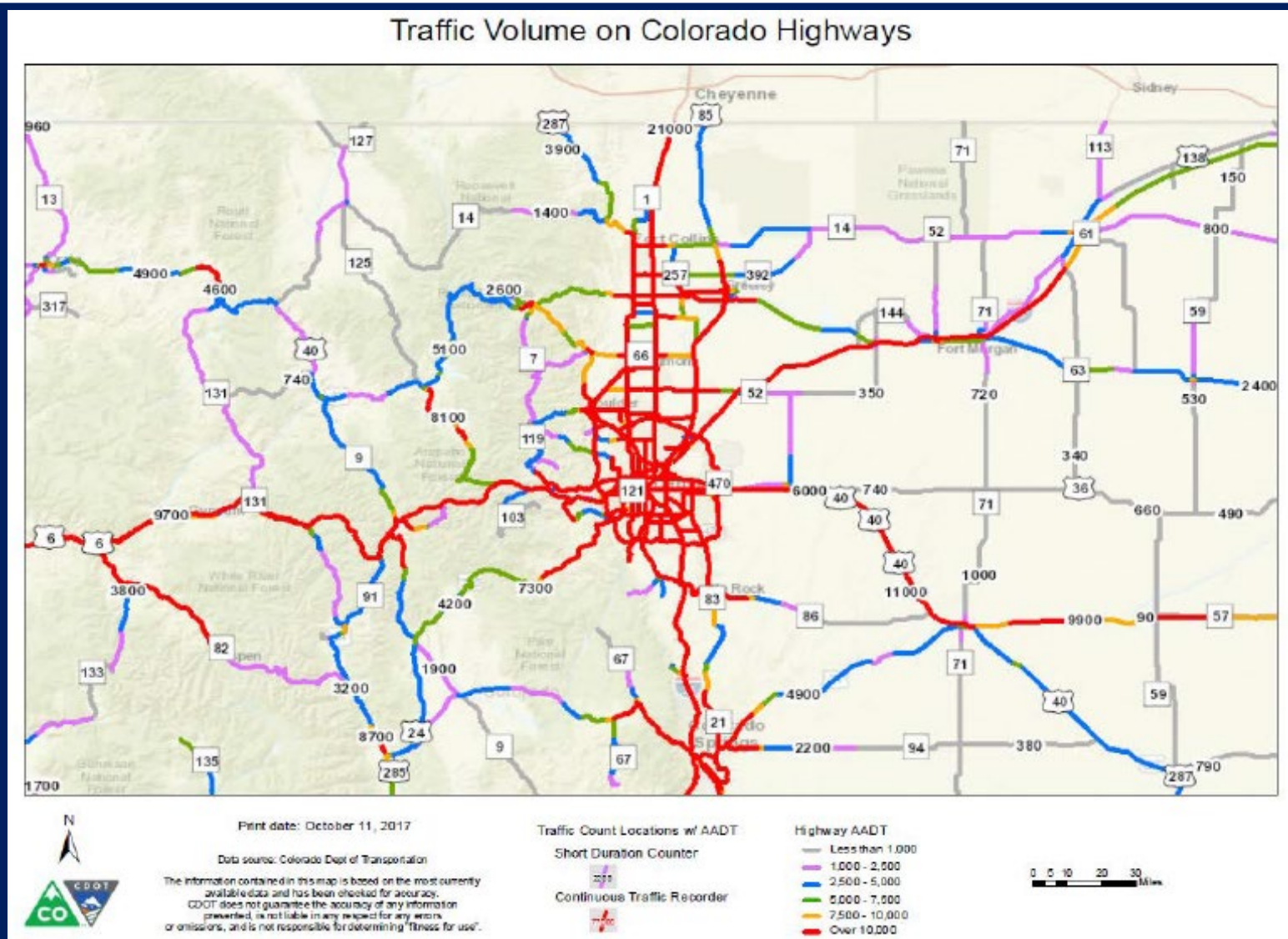
COLORADO
Department of Transportation



CDOT ATMAs approved for operations on **in rural areas of Section 1 and 3 & 7.**

Where We Operate

COLORADO
Department of Transportation



CDOT ATMAs approved for operations on **Blue, Purple, and Grey** roadways.

- 27 state highways
- 41 roadway segments

How it Works

COLORADO
Department of Transportation

- ATMA will autonomously follow a leader vehicle
  - Leader transmits position, speed, heading
  - Follower matches leader's movements using steering, throttle, brake actuators

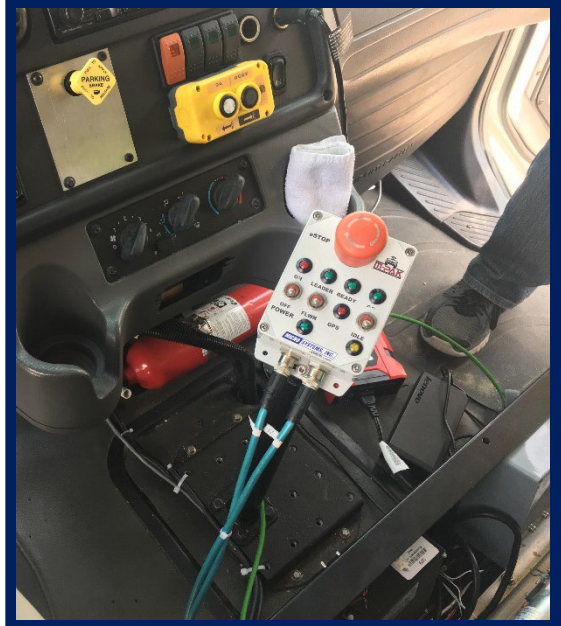
How it Works

- ATMA use's similar technology that is used in surveying GPS total station equipment and multiple satellites overhead.

Retrofit Installation of System

- Retrofit leader vehicle with
  - Antennas
  - Navigation module
  - Communications module
- CDOT striping truck completed in ½ day

Installation of System



- ATMA Follower systems pre-installed
  - Can be retrofitted to existing trucks
  - CDOT purchased truck & technology
- E-Stop Button
- Lead/Follower Controls
- Steering Yoke
- Actuators under passenger seat

Detection Using Radar

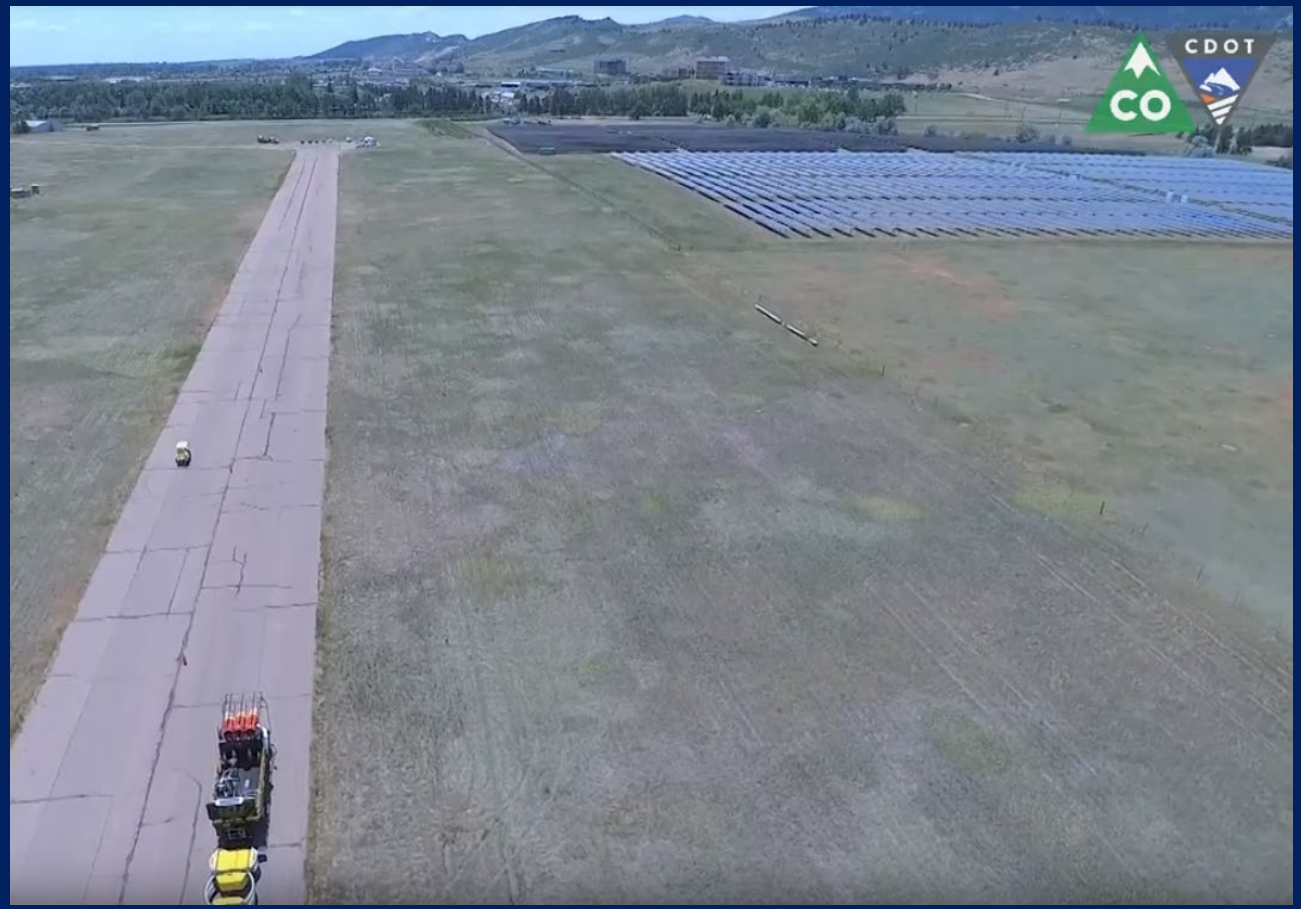
COLORADO
Department of Transportation

- Front mounted radar on follower provides obstacle detection
  - Only reacts to obstacles in the path between leader and follower
  - Emergency stops upon obstacle detection

Performance Evaluation

COLORADO
Department of Transportation

- CDOT developed a set of scenarios to verify the capabilities
- First week of performance evaluation conducted at Colorado State University
- In 2017, 2018 and 2019



Performance Evaluation

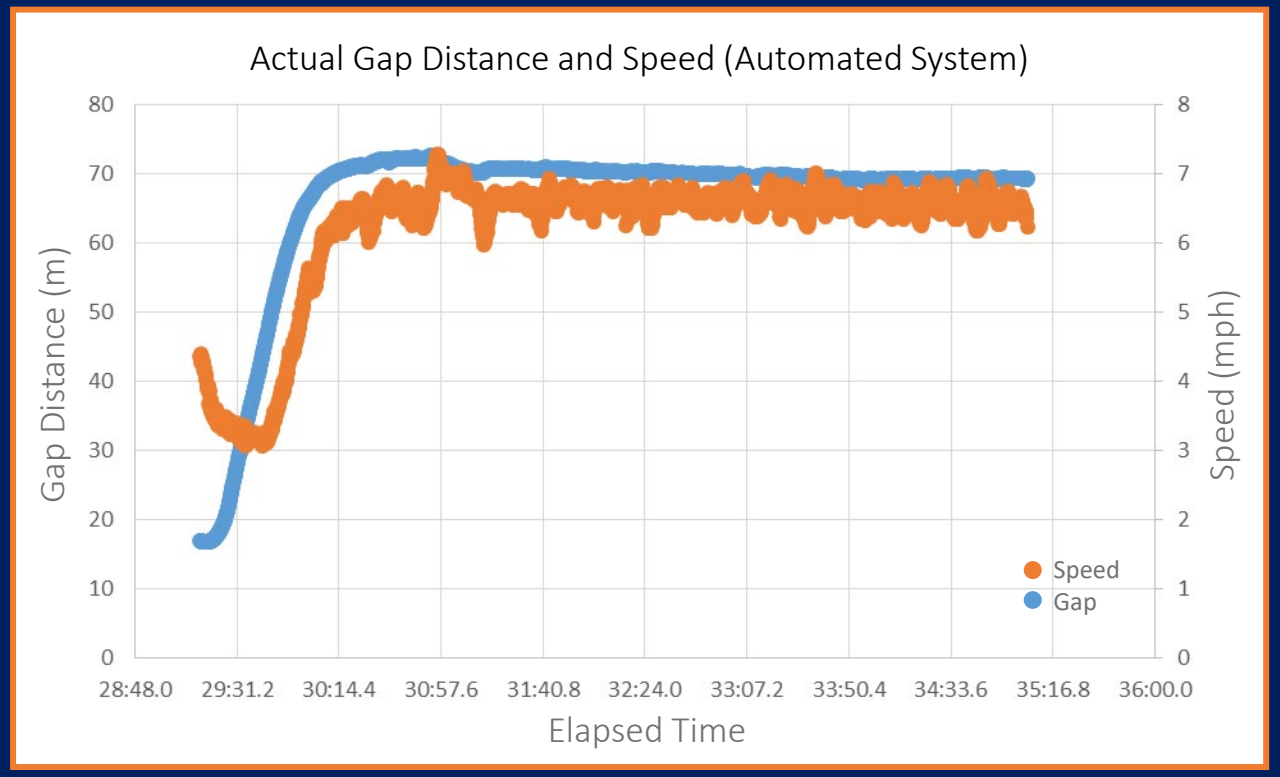
COLORADO
Department of Transportation

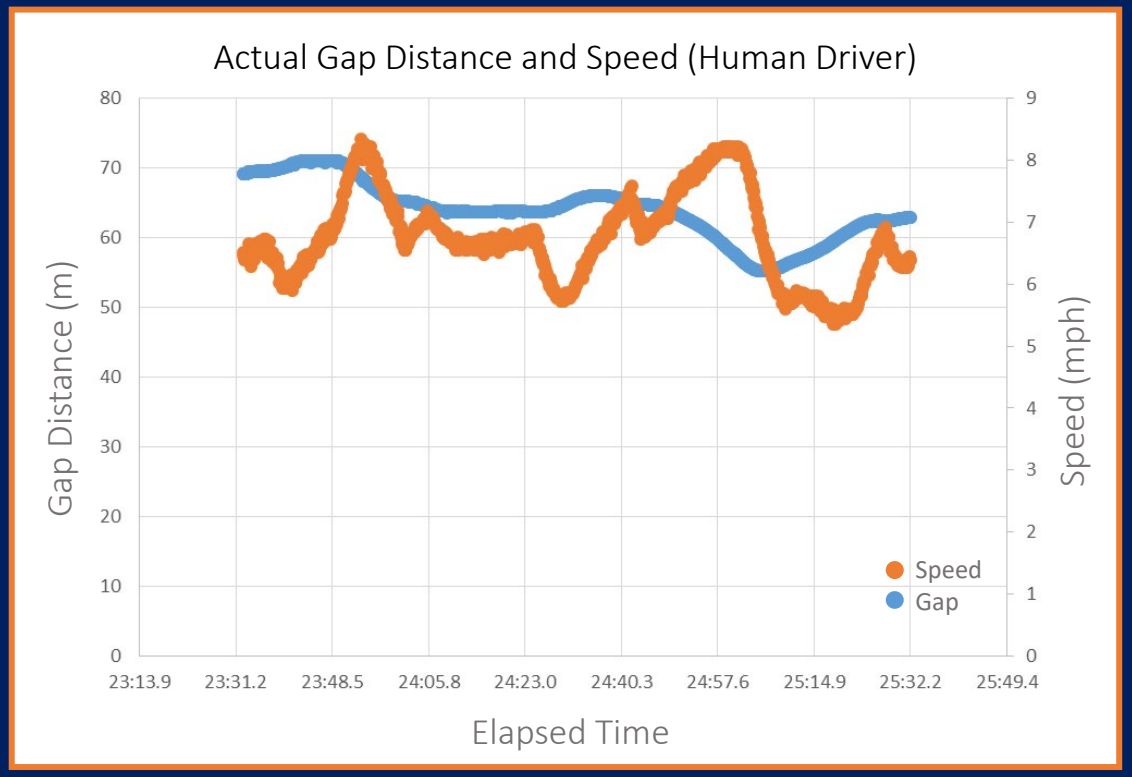
- E-stop Buttons
  - Internal/ External
- Stopping Distance
- Follow Distance
- Lane Accuracy
  - Straight
  - Cornering

Gap Control

COLORADO
Department of Transportation

- Straight line following for 4000’ with desired speed 7 mph (striping operation speed) and desired gap 60m
- Recorded gap is measured antenna to antenna: 60m bumper to bumper is 68.89m antenna to antenna





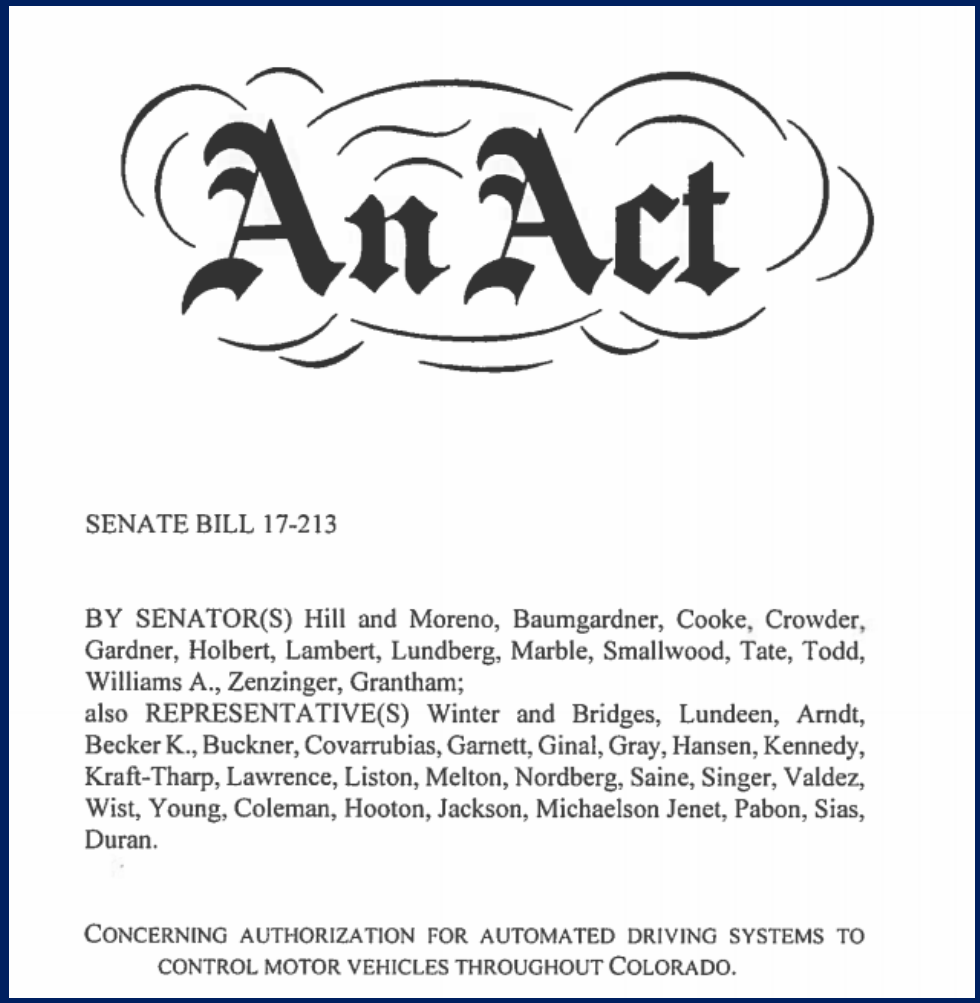
Results

COLORADO
Department of Transportation

- Lane accuracy within +/- 4 in
- Gap distance much more consistent than human driver
- Accurate following in cornering and slalom setups
- Performed turns as tight as 45 ft radius
- Identified software and hardware changes to be made

Colorado Policy - June 2017

COLORADO
Department of Transportation



An Act

SENATE BILL 17-213

BY SENATOR(S) Hill and Moreno, Baumgardner, Cooke, Crowder, Gardner, Holbert, Lambert, Lundberg, Marble, Smallwood, Tate, Todd, Williams A., Zenzinger, Grantham;
also REPRESENTATIVE(S) Winter and Bridges, Lundeen, Arndt, Becker K., Buckner, Covarrubias, Garnett, Ginal, Gray, Hansen, Kennedy, Kraft-Tharp, Lawrence, Liston, Melton, Nordberg, Saine, Singer, Valdez, Wist, Young, Coleman, Hooton, Jackson, Michaelson Jenet, Pabon, Sias, Duran.

CONCERNING AUTHORIZATION FOR AUTOMATED DRIVING SYSTEMS TO CONTROL MOTOR VEHICLES THROUGHOUT COLORADO.

Policy and Operational Usage

- Task Force including CDOT & CSP & Revenue to Review
  - Risk, Public Relations, Operations & Policy
- Autonomous CSP & CDOT Process
  1. Operational Domain
  2. Certifications
     1. Safety Assessment
     2. Driver
     3. Vehicle
     4. Insurance
     5. Special Event
  3. Other

Policy and Operational Usage

CDOT Ops Plan

- Safety Driver
- Visual Contact
- Linear Operation
- AADT less than 2500
- Less than 10mph

COLORADO
Department of Transportation
Division of Highway Maintenance

Autonomous Truck Mounted Attenuator Operations Plan

Contents

Autonomous Maintenance Technology

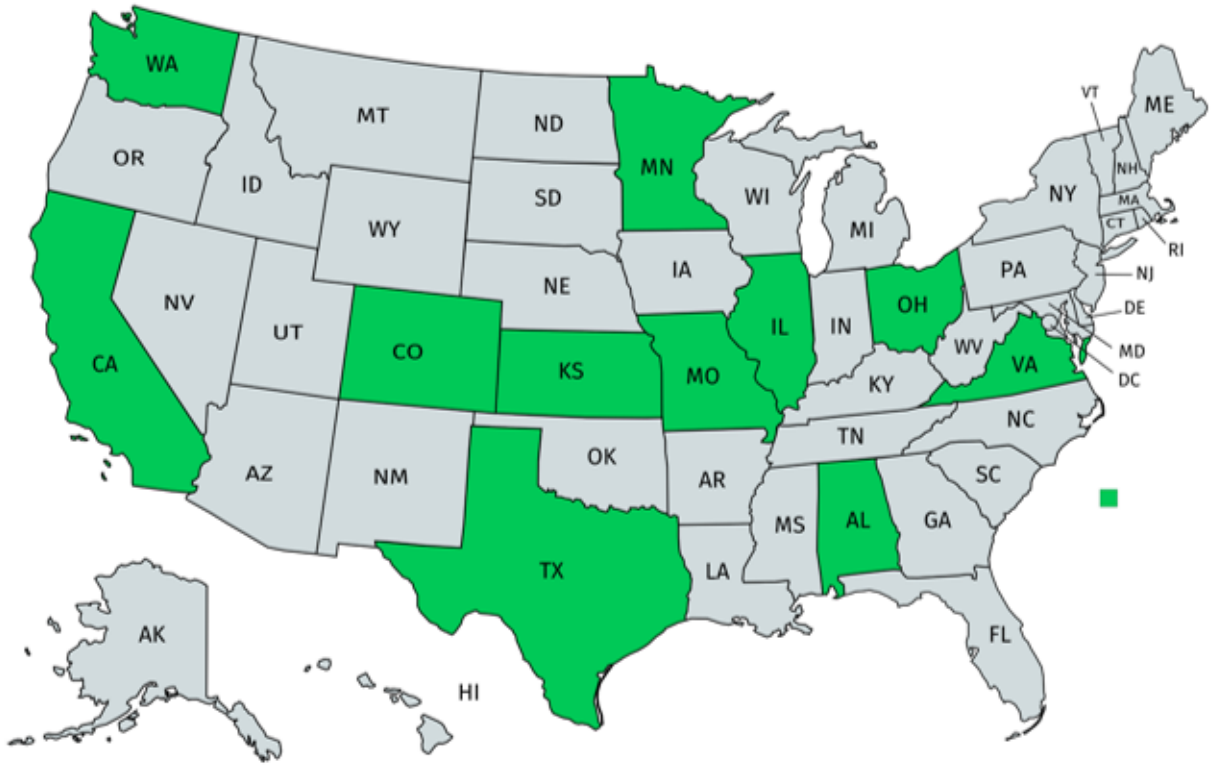
AMT
Autonomous Maintenance Technology

POOLED FUND PROGRAM PARTICIPATION 11 STATES

SCOPE OF WORK

The group will fund research and development efforts to achieve the program goals, with initial proposed research focusing on:

- Improvements on existing ATMA/AIPV platforms (Autonomous Truck Mounted Attenuator/Impact Protection Vehicle)
- Expansion of use of ATMA/AIPV platforms beyond striping
  Refining policy and operational procedures for autonomous work vehicles.
- Investigate additional applications for autonomous vehicles in maintenance operations
- Other New Technology



Created with mapchart.net ©

Autonomous Maintenance Technology

The mission of this pool study is to develop and deploy ATMA or AIPVs to protect highway worker lives by enhancing cooperative inter-agency research that improves the safety and effectiveness of ATMA or AIPV operations, and to facilitate communication between transportation agencies that encounter challenges with implementation.

Vision Mission Operations Document Sept 2018

Cost and Benefit

COLORADO
Department of Transportation

2017 Initial Cost - $300,000 (included Hino truck and original retro kit)

2019 Cost $289,00 (CDOT supplied truck, Next Generation kit, installation in Florida, leader kit installation in Colorado, validation, training and support)

Balance Cost and Safety – What is the cost of one workman compensation claim?

Thank you

COLORADO
Department of Transportation

- CDOT - Presenter
- tyler.weldon@state.co.us

- Kratos (Contact)– Maynard Factor
- mfactor@gomicrosystems.com

- Royal Truck and Equipment (Contact)
- Thomas Pucci
  - tpucci@royaltruckandequipment

- https://www.youtube.com/watch?v=6gKHPG5uOes&t=110s

KRATOS
UNMANNED SYSTEMS DIVISION

Royal
TRUCK & EQUIPMENT INC.

Directing Your Questions via the Chat Pod

1. Chat pod is on left side of screen between attendees pod & closed caption pod

3. Answers will appear here unless addressed verbally

2. Type your question or comment here

Randy Johnson
KC Scout Manager
Missouri DOT

National Center for Rural Road Safety

Explain how connected and automated vehicles work and list actionable items you can take to prepare for automated, connected, and electric vehicles in rural areas.

Name the benefits of using an autonomous attenuator truck in rural areas.

Define how a real-time digital warning system works.

Randy used a Prezi to present, therefore please refer to the webinar recording to see the information he presented.

Directing Your Questions via the Chat Pod

1. Chat pod is on left side of screen between attendees pod & closed caption pod

3. Answers will appear here unless addressed verbally

2. Type your question or comment here

Learning Outcomes

To achieve the webinar goal, you have learned to:

- Explain how connected and automated vehicles work and list actionable items you can take to prepare for automated, connected, and electric vehicles in rural areas.
- Name the benefits of using an autonomous attenuator truck in rural areas.
- Define how a real-time digital warning system works.

New Resources

- **FHWA's 3 Approaches to Safety Video: Site-Specific, Systematic, Systemic**

https://www.youtube.com/watch?v=1Gtz0qjPx0M

- **FHWA and ITE's Safe System Strategic Plan**

https://safety.fhwa.dot.gov/zerodeaths/docs/FHWA-SA-21-088_Safe_System_Strategic_Plan.pdf

- **RTZ's Doubling Down on What Works**

https://www.nsc.org/road/resources/road-to-zero/doubling-down-on-what-works

- **NHTSA's Countermeasures that Work 10th Edition**

https://rosap.ntl.bts.gov/view/dot/57466

Upcoming 2021 Webinars

- Safe System for Rural Areas Webinar Series
  - Part 4: Safe Speeds (Wed. October 27th from 1-2:30 PM ET)
  - Part 5: Safe Roads (November)
  - Part 6: Post-Crash Care (December)
- Driving FoRRRwD to Reduce Curve Crashes with Signing and Marking (Wed. Oct. 13th from 1:00-3:00 PM ET)
- National Transportation Safety Board's Roundtable Series: Safe Roads (Thurs. Oct. 6 from 1:00-3:00 pm ET)

https://www.ntsb.gov/news/events/Pages/2021-safe-systems4-rt.aspx

Contact Information

If you have any questions related to this presentation, please contact:

Eric Jackson – eric.d.jackson@uconn.edu

Tyler Weldon - tyler.weldon@state.co.us

Randy Johnson - Randy.Johnson@modot.mo.gov

Or contact the National Center for Rural Road Safety Help Desk at:

(406) 994-7368 or info@ruralsafetycenter.org

http://ruralsafetycenter.org/