



DATE: September 15, 2016

TO: Transportation Commission & Transportation Sub-Committee on Technology

FROM: Peter Kozinski, RoadX Program Director, Amy Ford, Director of Communications, Ryan Rice, Director, Transportation Systems Management and Operations

SUBJECT: RoadX Update

Purpose

To inform the Transportation Commission and Transportation Sub-Committee on Technology about progress the RoadX Program has made to date and a vision for how we become a leader in integrating innovative technologies into our transportation system.

Action

Information only

Background / Overview

In the fall of 2015, CDOT launched the RoadX Program, Colorado's bold commitment to team with public and industry partners to be a national leader in using innovative technologies to improve the safety, mobility and efficiency of the transportation system - fostering Colorado's continued economic vitality.

To achieve our mission, RoadX knew it would need to develop a business model not to dissimilar to that of a startup business. During our first year we focused on four (4) key areas - program awareness, partnerships, innovative approaches to current problems and program delivery.

Details

To move the RoadX Program forward and achieve our mission we assembled a team to support CDOT's Vision and Mission while understanding the RoadX Program needs to be agile and progressive addressing our Commuting, Sustainability, Transport, Safety and Connection priorities. In September, 2015 Peter Kozinski was selected to serve as the RoadX Program Director and quickly assembled a team of CDOT champions representing all Regions within CDOT. To augment the CDOT Team an innovative RFP process was initiated and garnered interest from a wide spectrum of industry partners. In the end AECOM, Atkins and CH2M were selected as they provided the most creative idea(s), 40% of the RFP score, to a known problem.

Program Awareness

RoadX Program quickly recognized that if it wanted to attract the "partners" that would make us successful we would need to build program recognition outside to Colorado. With the support of the Executive Director, Shailen Batt, the RoadX Program developed and engaging the thought provoking series of presentations that were ultimately delivered at over 30 national speaking engagements. The message



“Colorado is open for Business” was well received by industries and word even spread to other countries (Australia, Japan, United Kingdom).

Partnerships

The space around “technology in transportation” is fairly small at this point and there is a synergy that is formed when a DOT announces it is looking for partnerships to improve the safety, mobility and efficiency of the transportation system. One need not look much further than the FHWA “Smart City Challenge” to appreciated industries of all kinds are interested in meaningful partnerships. RoadX has be very successful in developing new partnerships / relationship. The following list of organizations is not intended to be all inclusive but provides a glimpse of the partnerships / relationships RoadX is fostering:

NREL	OTTO	HERE	Panasonic	Hyperloop One	Galvanize
CO Energy Office-Electrification			Denver Smart City Challenge		OEDIT-Broadband

Innovative approach to current problems

Innovation and RoadX go hand in hand - form the issuance of the innovative RFP to our views on partnership, RoadX is eager to try new way to address our current problems.

Program Delivery

RoadX with the support of the Regions plans to launch multiple projects in FY17. They include but are not limited to:

- Smart 25: Advanced traffic sensors will feed a state of the art algorithm that will improve traffic flow and safety.
- Smart Truck Parking: Use detection and cloud-based software to improve truck mobility and reduce wear on our system.
- Smart 70 from Golden to Vail: Deploy a connected vehicle environment to allow drivers to make better decisions.

Budget & Programing of Funds

RoadX was allocated \$10 million from the TC contingency fund in FY16 and \$12.1 Million as part of the FY17 budgeting cycle. As of today, RoadX estimates encumbering \$20.55 million of the \$22.1 million provided.

Next Steps

The Program envisions next logical steps as being in-depth conversations with the Technology Committee in the areas above and RoadX governance structure, policy implications, sustainable funding models and five year work plan / vision.

Attachments

RoadX Presentation, Autonomous Mobility White Paper, Connected Vehicle & Data White Paper



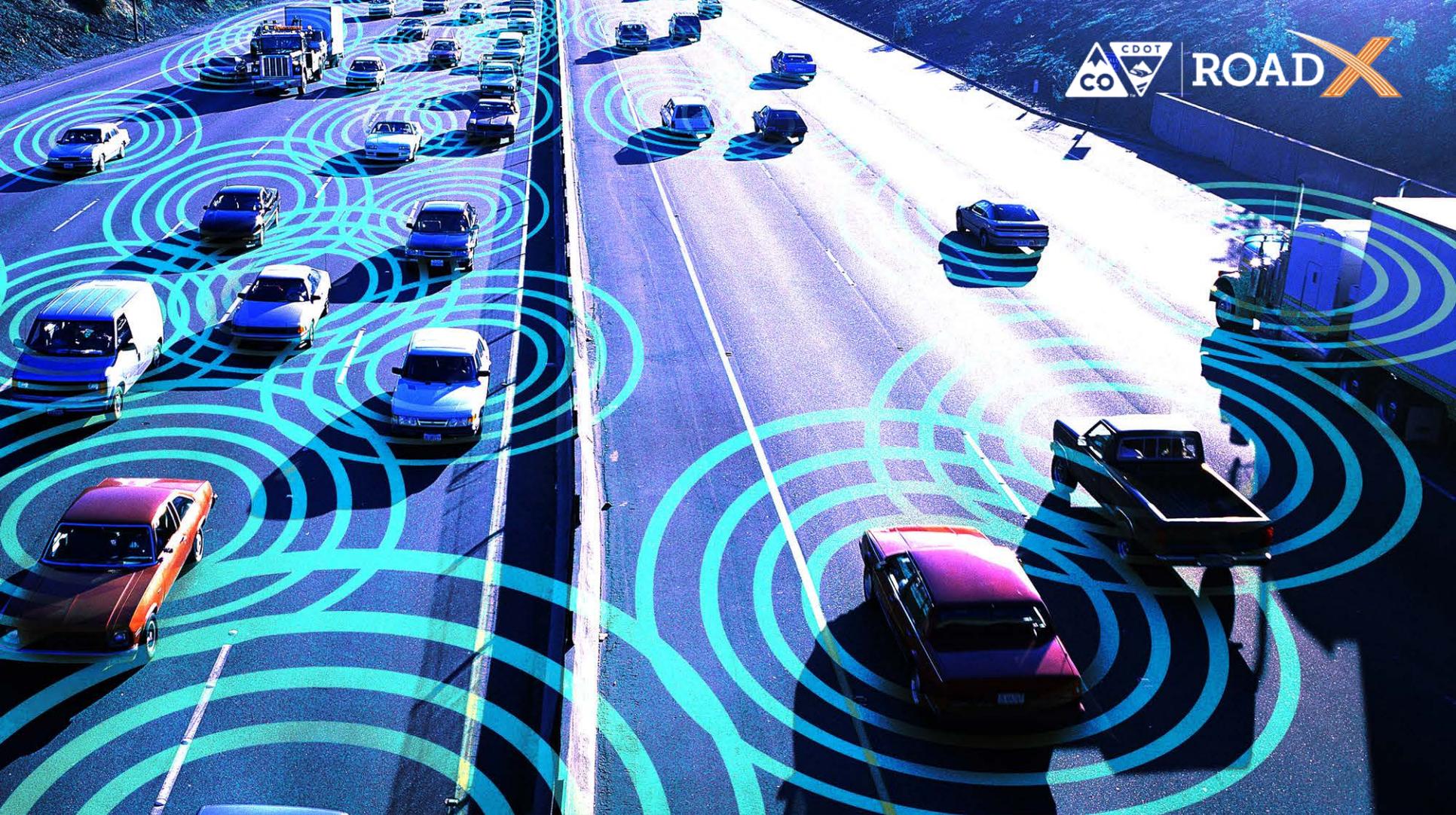


Colorado's ROAD Accelerating Technology





ROAD X



Why RoadX?

CDOT RESPONSIBILITIES

ADMINISTERS
\$208
MILLION
EACH YEAR IN FEDERAL
GRANTS



3,454

BRIDGES

CDOT
MAINTAINS & OPERATES
23,000
 **TOTAL**
LANE MILES
OF HIGHWAY

 **DIVISION OF
TRANSIT
AND RAIL**
ADMINISTERS FED/STATE
GRANTS AND OPERATES
BUSTANG

6.1 MILLION
MILES
PLOWED
OF SNOW PER YEAR 

 **35** **MOUNTAIN
PASSES**
OPEN YEAR-ROUND

**AIRPORT
PLANNING** 
INTERFACE WITH FAA

Source: Colorado Department of Transportation, 2014

\$1.43 BILLION BUDGET

Purpose

Provide Freedom, Connection, and Experience through Travel



2015

Summit

Best Department of Transportation in the Nation

Peaks

Technology

People

System

Help Our People with Technology

Improve Travel Experience with Technology

Internal Customer Focus

Improve the Customer Experience

Base Camps

Big Data

Develop Leaders

Asset Condition

From
2013
to
2040



Population

+47%


**7.8 MILLION
COLORADANS**



Vehicle Travel

+47%


**41.8 BILLION
MILES TRAVELED**



**Avg. Traffic Delay
on congested corridors**

**2 to 3
TIMES**


**DURING
PEAK HOURS**
(if we do nothing)

Transportation Impacts Us All



Vision
for the
Future



Safety &
Reliability



Economic
Vitality



Rapid
Technological
Advancement



Funding

WHY XCELERATE TECHNOLOGY?



Safety

80% of accidents could be reduced or eliminated



Innovative Road Solutions

Could nearly quadruple highway capacity



Saved Time

Could save about 50 minutes per day



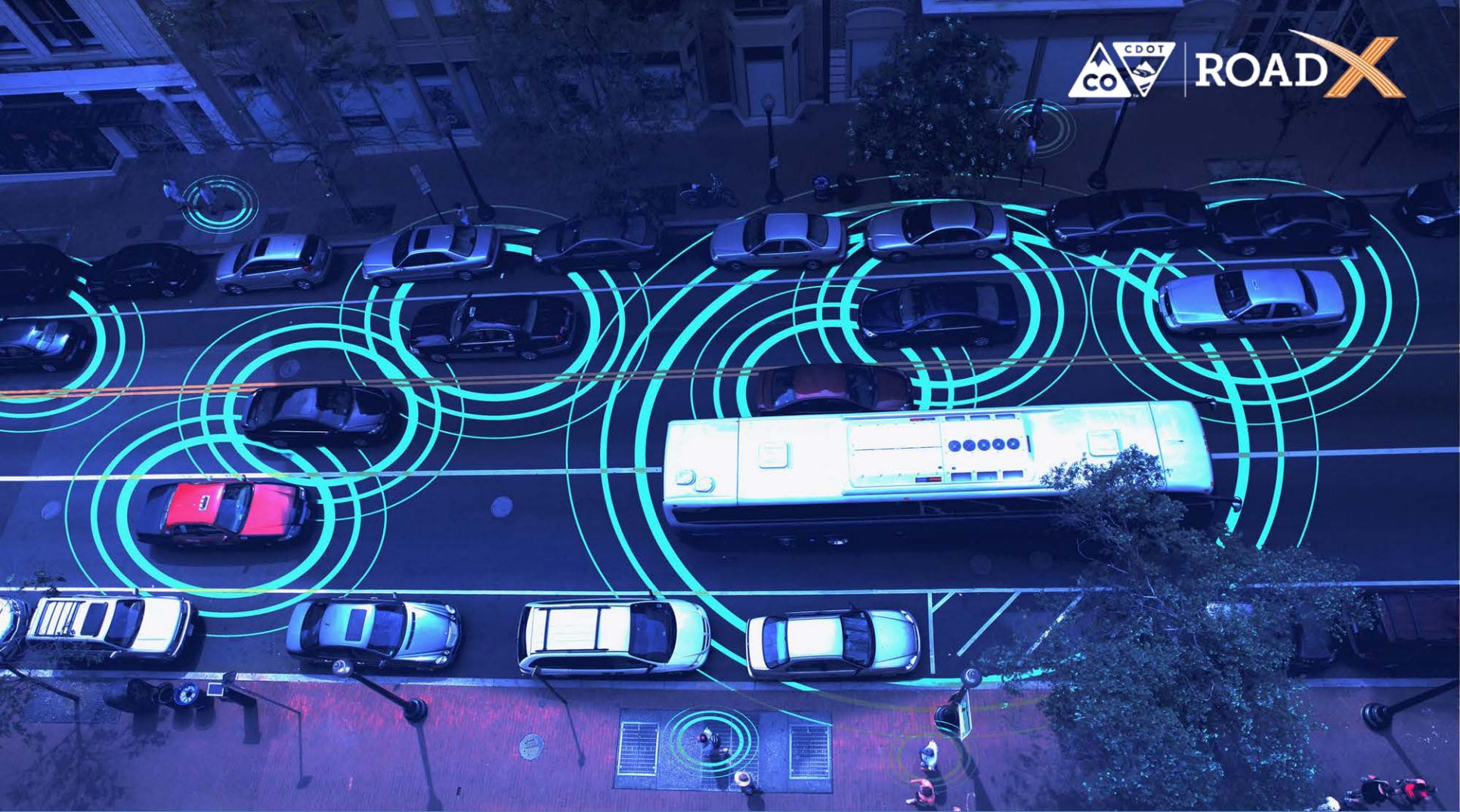
Expanded Mobility

Mobilizes elderly and handicapped populations



Environmental Benefits

Reduces congestion and vehicle emissions



What's happening in transportation technology?

Connected Vehicle
Communicates

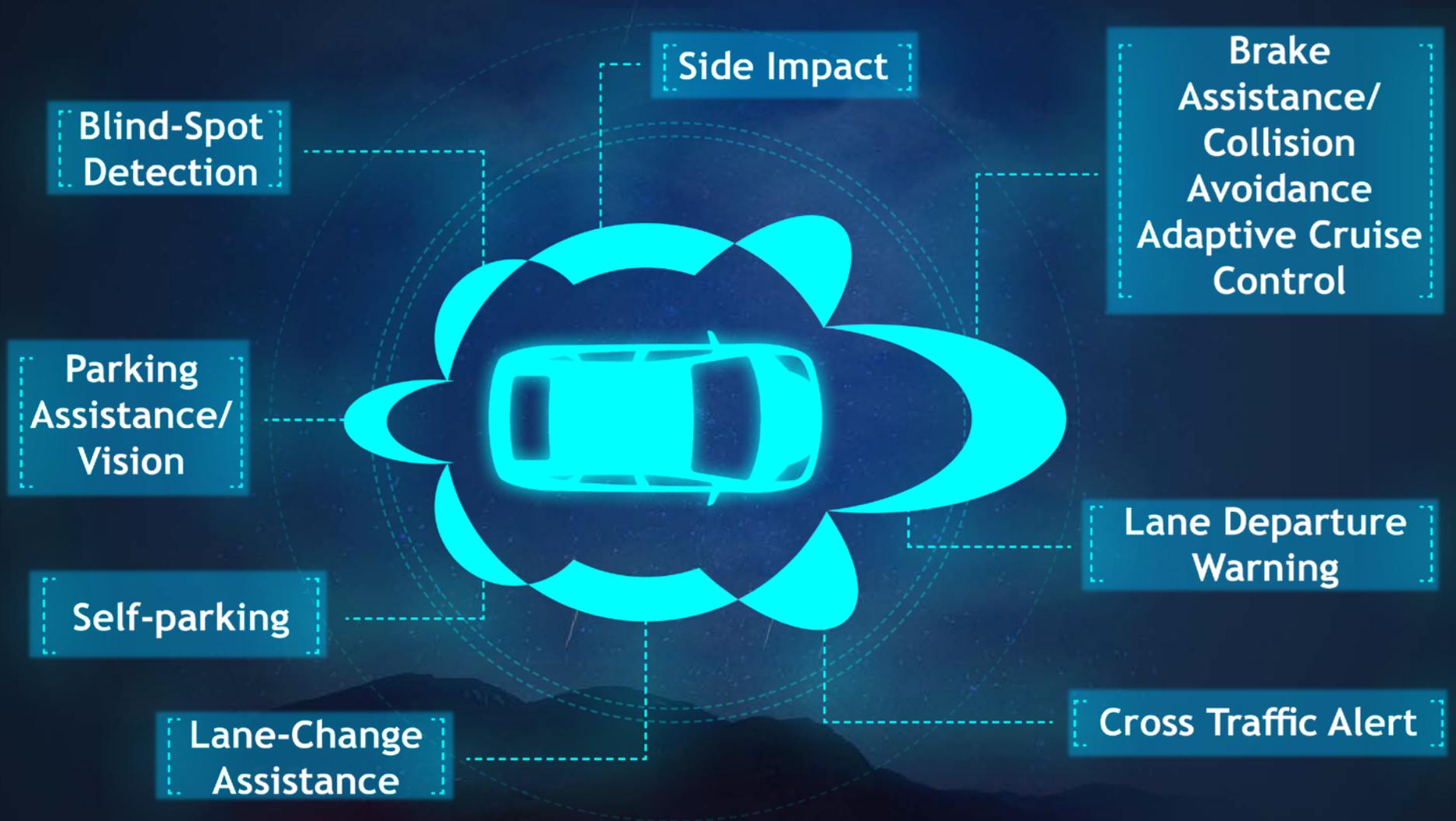


Automated Vehicle
Isolated Operations



Autonomous Vehicle
Self-Driving





Disruptive Technology - displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry.

Is a Modern Vehicle a Disruptive Technology?



TRENDS



ELECTRIFICATION



DIVERSE MOBILITY



CONNECTIVITY



AUTONOMOUS DRIVING

When Will This Happen?

2009 -- Google self-driving cars start testing

2015 -- Tesla introduces Autopilot

2016 -- Uber begins self-driving mobility service

2016 - nuTonomy in Singapore introduces self-driving taxis

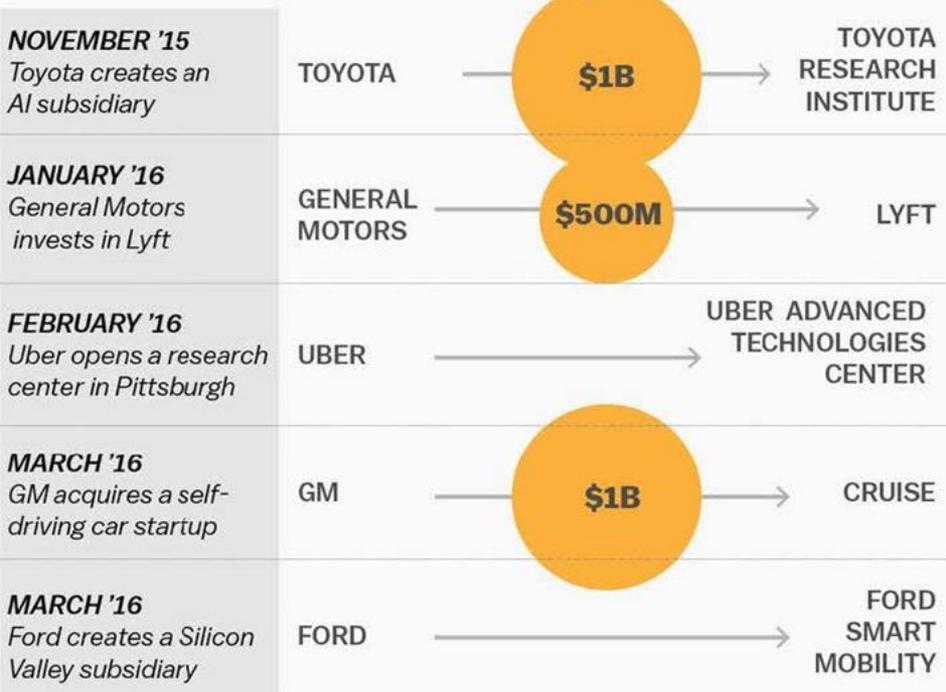
2017 - NHTSA Connected Vehicle mandate

2021 - Date committed to by Ford, Baidu and Volvo to begin selling self-driving cars



Car and tech deals

Automakers and tech companies have been joining forces in the past six months



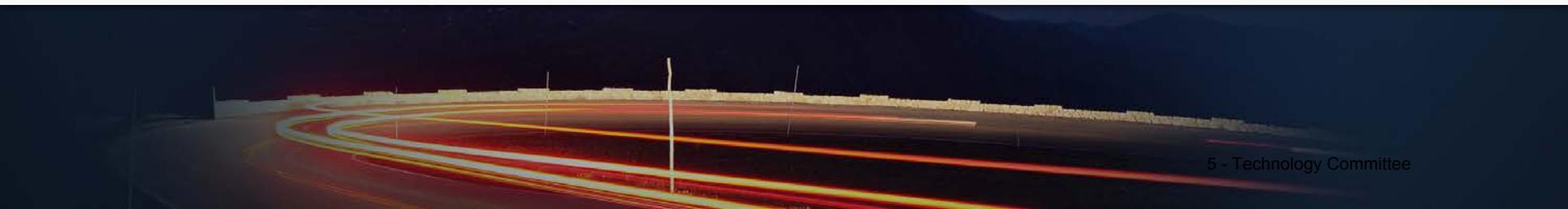
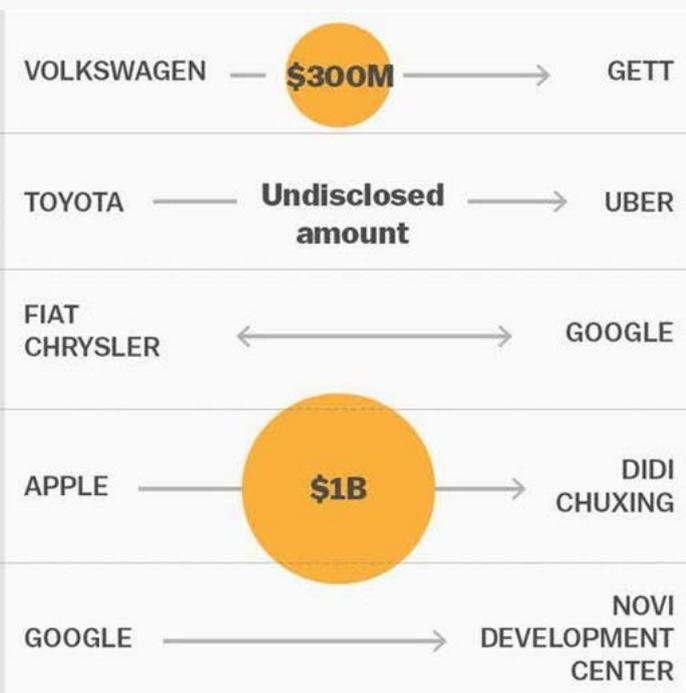
MAY '16
VW invests in a European taxi service

MAY '16
Toyota invests in Uber "strategic partnership"

MAY '16
Working together on a self-driving car

MAY '16
Apple invests in a Chinese ride-hailing service

MAY '16
Google creates a development center in Detroit



Levels of Automation

Currently, some vehicles (Tesla, BMW, Mercedes) are on the road with Level 2 automation and Google, Uber and Volvo are testing Level 4 vehicles in the US and in other countries.

Full Self-Driving Automation

Vehicle performs all safety-critical driving functions and monitors roadway conditions. Driver is not expected to be in control.

Limited Self-Driving Automation

Driver can cede control of safety functions under certain conditions but driver still has control.

Combined-Function Automation

Automation of at least two control functions working together (cruise control with lane centering)

Function-Specific Automation

Automation of one or more specific control functions

No Automation

Driver has complete control



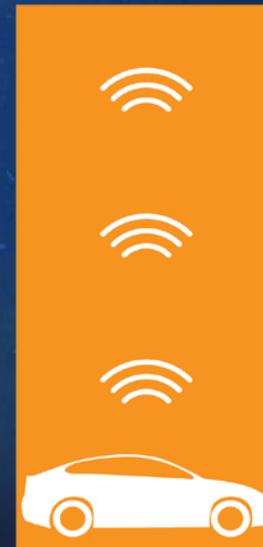
Level 0



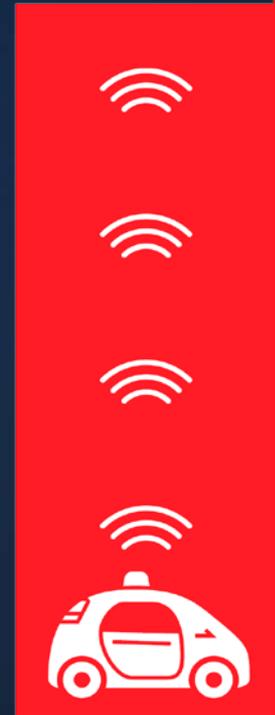
Level 1



Level 2

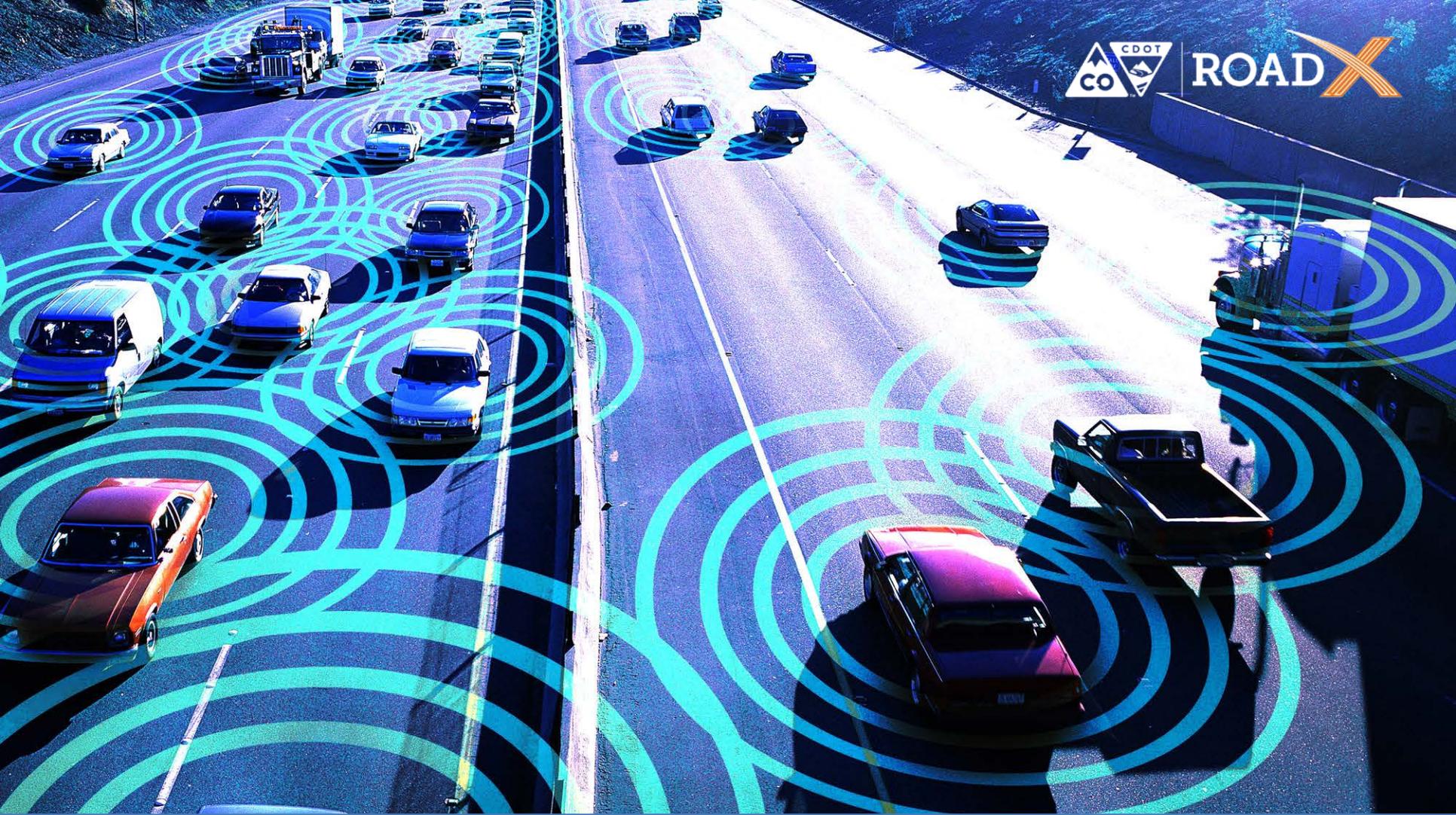


Level 3



Level 4

Increasing Levels of Automation



RoadX Moving Forward

ROAD

RoadX **VISION:** Crash-free, Injury-free, Delay-free and Technologically-transformed travel in Colorado.

RoadX **MISSION:** Team with public and industry partners to make Colorado one of the most technologically advanced transportation systems in the nation, and a leader in safety and reliability.

Colorado Is Open For Business – Colorado invites partners to join us in accelerating the adoption and deployment of technological solutions.



WHAT COLORADANS THINK

Drivers are not yet comfortable with driverless cars (cost and potential for equipment failure).

Acceptance increases with familiarity.

Road and traffic communication technologies are less familiar than car features, but easier to accept.

Privacy is significant concern, but most trust CDOT to manage their data.

Coloradans can visualize benefits of the new technologies.

Support for CDOT taking the lead in education and testing.

National Research Center, 841 respondents, May 2016

COMMUTING



SUSTAINABILITY



TRANSPORT



SAFETY



CONNECTION



COMMUTING

TRANSFORM COLORADO INTO THE MOST RELIABLE TRANSPORTATION SYSTEM FOR COMMUTING IN THE NATION BY DEPLOYING TECHNOLOGY AND INFRASTRUCTURE SYSTEMS TO IMPROVE RELIABILITY OF TRAVEL TIMES AND OPTIMIZE ROUTING AND MOVEMENT OF COMMUTERS.





COMMUTING



TIMING : FALL 2017

SMART 25 - RIDGEGATE TO UNIVERSITY

Colorado will be doing a significant software and traffic sensor upgrade to the aging traffic management and ramp metering systems on the highway. This hyper-smart system will help to better manage the flow with vehicles, which could have the result of effectively adding a new lane on I-25 at a fraction of the cost.

The result?

- More reliable trips and travel times
- Fewer crashes
- Reduction in stop-and-go traffic
- More efficient flow of traffic without expanding the roadway



SUSTAINABILITY

BECOME THE NATION'S LEADER IN ENERGY
CONSERVATION AND EMISSIONS REDUCTION.



TRANSPORT

DEPLOY EMERGING IN-VEHICLE TECHNOLOGY AND SUPPORTING INFRASTRUCTURE
TO IMPROVE THE SAFETY AND EFFICIENCY OF TRANSPORTING FREIGHT.





TRANSPORT



TIMING : WINTER 2016

PHASE 1 - SMART TRUCK PARKING (PRE-PASS, CELLULAR AND DSRC)

Using detection and cloud-based software that understands and can report available parking spots to truckers, improving:

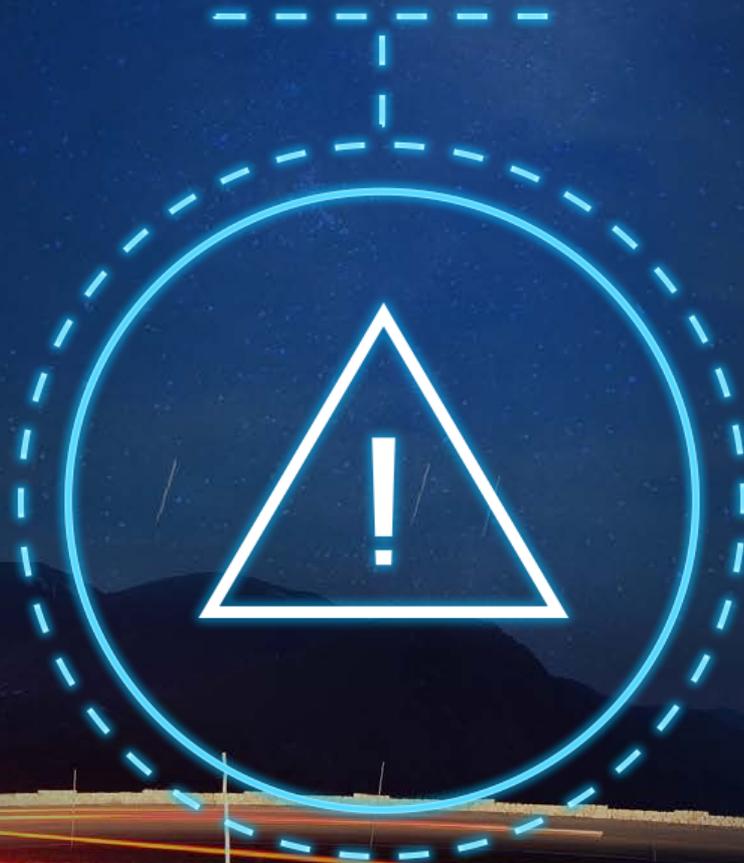
- Truckers wasted time and fuel
- Excess wear and tear on Colorado's roadways
- Excess pollution

The first phase of this project will integrate six existing parking facilities into the Smart Truck Parking System.



SAFETY

MAKE A DRAMATIC LEAP TOWARDS ZERO
DEATHS ON COLORADO ROADWAYS.





SAFETY



TIMING : TBD

SMART PAVEMENT - STRIPING IMPROVEMENTS

CDOT will make improvements in the reflectivity and durability of roadway pavement markings throughout major corridors in the state, allowing vehicles to better use these markings for guidance and lane designations.



CONNECTION

DEVELOP SOLUTIONS TO TRANSFORM DATA INTO ACTIONABLE INTELLIGENCE AND DELIVER TO DRIVERS, CELLULAR/MOBILE APPLICATIONS AND CONNECTED AND AUTONOMOUS VEHICLES.





CONNECTION



TIMING : WINTER 2016

SMART 70 - GOLDEN TO VAIL

CDOT has partnered with an international mapping firm, HERE to provide drivers with the most real-time data possible to allow drivers to make better decisions when traveling through the mountains. Imagine Waze on steroids. Drivers will be equipped with the knowledge of when they can expect critical safety warnings such as:

- Low visibility
- Multi-vehicle pileups
- Sun glare

Smart 70 will accelerate the advancement of autonomous vehicles by giving autonomous systems instantaneous data and warnings from connected vehicles.





CONNECTION



ONGOING

SMART ROADS

Advanced traffic management technology solutions require critical real-time data and analysis that can be delivered to vehicles and software systems to improve traffic flow, trip reliability and safety.

CDOT is deploying a web-based, open source safety, traffic and transportation system data platform capable of communicating with a diverse collection of drivers, cellular/mobile applications, and connected and autonomous vehicles.



NEXT STEPS



People

Educate public



ROI

Invest now in
technology platforms



Privacy

Address security
issues



Technology & Planning

Plan and model
for rapid change



Regulation

Establish consistent policy
direction that supports
autonomous future

RoadX BUDGET:



FOCUS AREA	PROJECTS	TOTAL*	FY16	FY17	FY18	FY19
Commute	Smart 25	\$7.60	\$0.90	\$5.00	\$1.70	
Connection	Smart 70 from Golden to Vail	\$11.20	\$1.00	\$5.75	\$3.25	\$1.20
Transport	Smart Truck Parking	\$0.40		\$0.40		
Connection	Place Global	\$0.02		\$0.02		
Connection	Blynsy	\$0.03		\$0.03		
Program Support						
	Consultant Support	\$1.05	\$0.30	\$0.75	\$0.75	
	PR & Marketing	\$0.20	\$0.05	\$0.15		
	Grant Writing	\$0.05		\$0.05		
	Total Committed	\$20.55				

*Totals in millions

RoadX PROPOSED PROJECTS/FUNDING:

FOCUS AREA	PROJECTS	TOTAL *
Connection	Expand Smart 70 Cellular CV	\$4.00
Connection	Smart Roads CV/AV Data Program Blueprint	\$8.5
Connection	Fiber Broadband Office with OEDIT	\$0.75
Sustainability	Ped / Bike Connectivity Challenge	\$0.50
		\$13.75
Safety	Smart Pavement US 285	\$2.75
Transport	Smart City Denver I-70 Peleton	\$2.00
Safety	Rural Safety Challenge	\$2.00
Sustainability	Planning (Working with DRCOG and Mobility Choice	\$1.00
	Total	\$21.50

*Totals in millions

SUPPORTING ROADX

TECHNOLOGY COMMITTEE



POLICY

FUNDING/RISK
STRATEGY FRAMEWORK



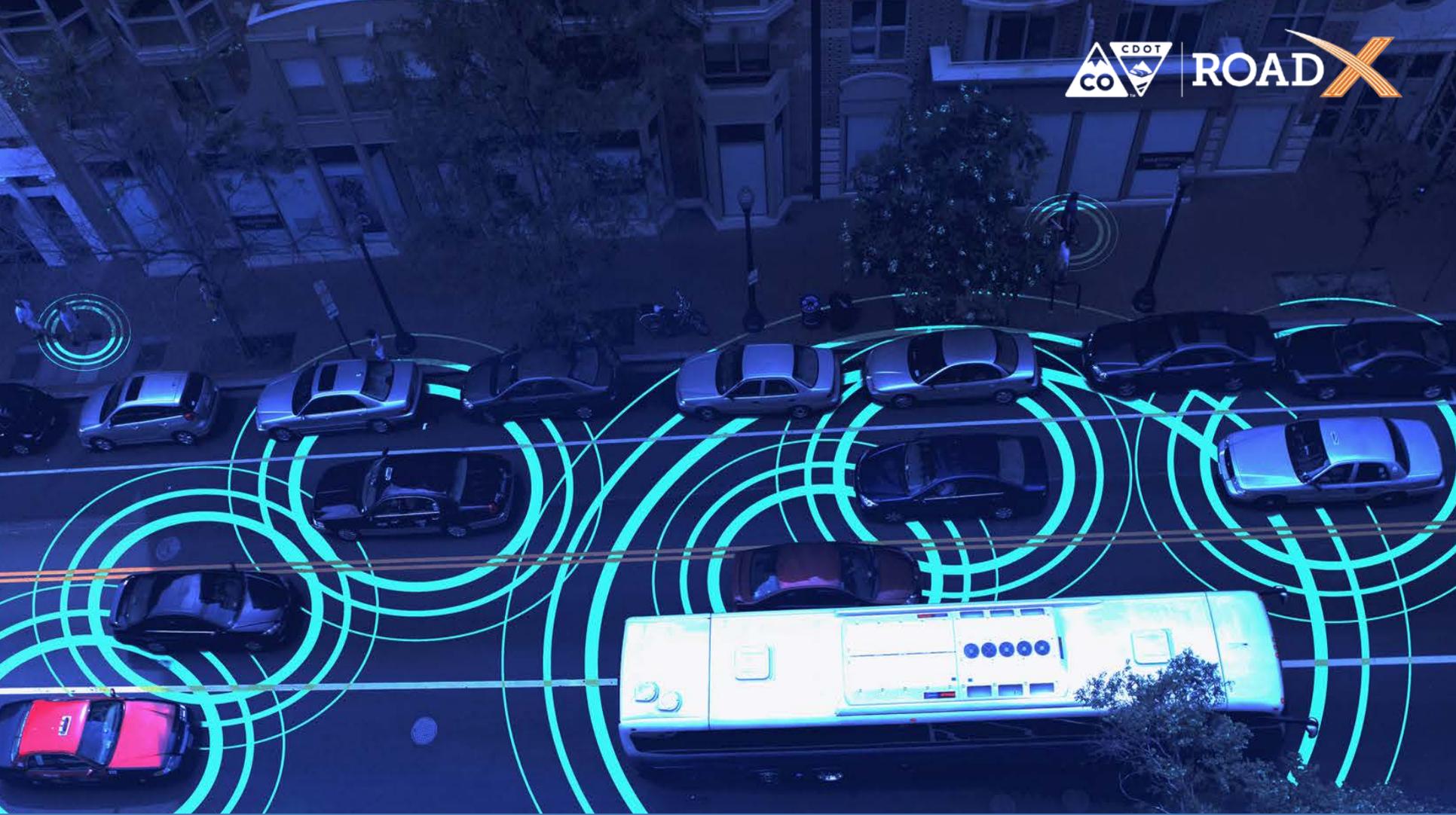
PEOPLE

WORKFORCE OF
THE FUTURE



PLANNING

PROJECT LEVEL DEEP DIVES
FIVE YEAR STRATEGY



Questions?