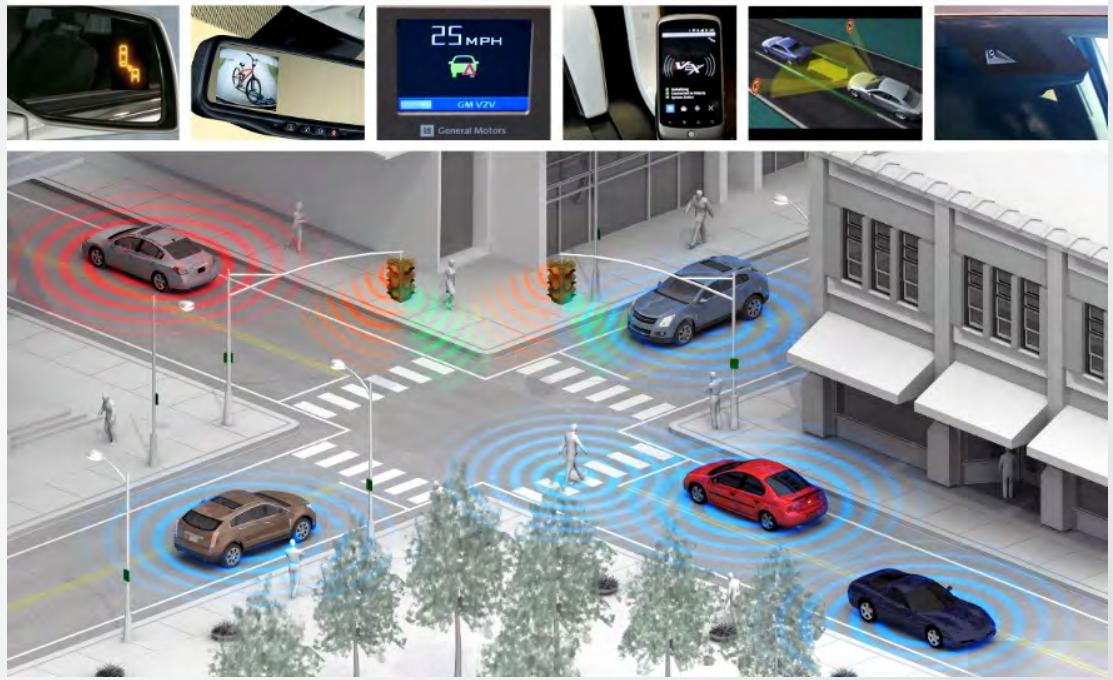
ACEC

American Council of Engineering Companies of South Carolina

SCDOT



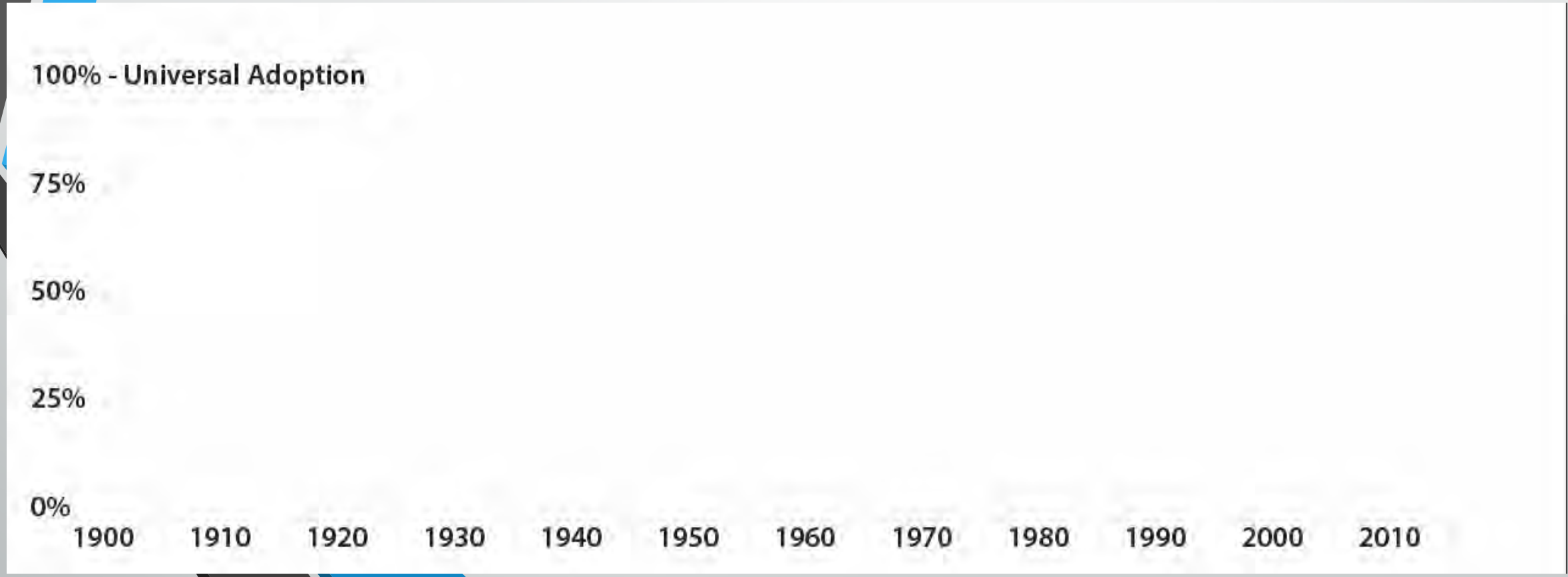
Automated Vehicles

Annual Meeting and Trade Show

December 2, 2015

Automated Vehicles?

Technology Adoption Rate



Play 'button' hides here →

Evolution of the Automobile

1886

2015

NHTSA's Impact on Safety

1909

Vehicle Design Standards

1933

1958

seatbelts

1966

1973

Cruise control (efficiency)

1989

Supplemental Restraint System (SRS)

1998

airbags

2008

Electronic stability control

2014

V2V (2017) ?

So why Automated Vehicles?

861 people killed in South Carolina in 2015

Transportation Challenges

SAFETY

32,675 highway deaths in 2014
2.3 million people injured in automobile crashes
6.1 million police reported crashes

MOBILITY

5.5 BILLION Hours of travel delay
$121 BILLION in cost for urban congestion ($186 B in 2030)

ENVIRONMENT

2.9 BILLION gallons of wasted fuel
56 billion pounds of additional CO_2

Distracted Driving

A person texting while driving is ***6 times*** more likely to cause an accident than a drunk driver

Driving has become the distraction…

Potential of Automated Vehicles

Vastly Improve Safety

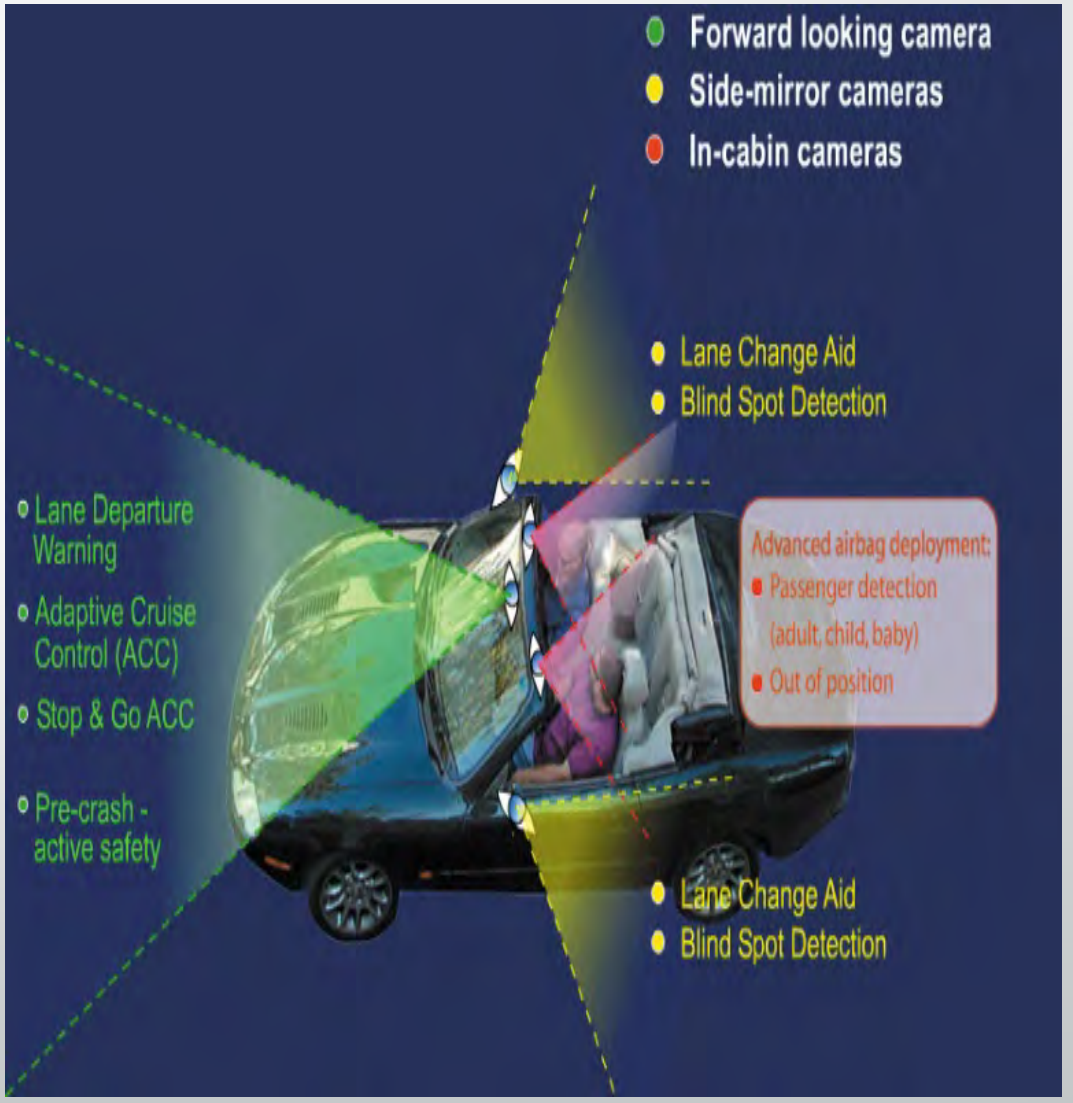
Greatly Reduce Congestion

No other set of technologies have been able to offer double-percentage point reductions in congestion and/or improvements in safety


Volkswagen Electronics Research Lab
Powered by Diesel.
Volkswagen Automotive
Innovation Laboratory
A research initiative of the Volkswagen Group,
Electronics Research Laboratory and Stanford University
STANFORD
UNIVERSITY

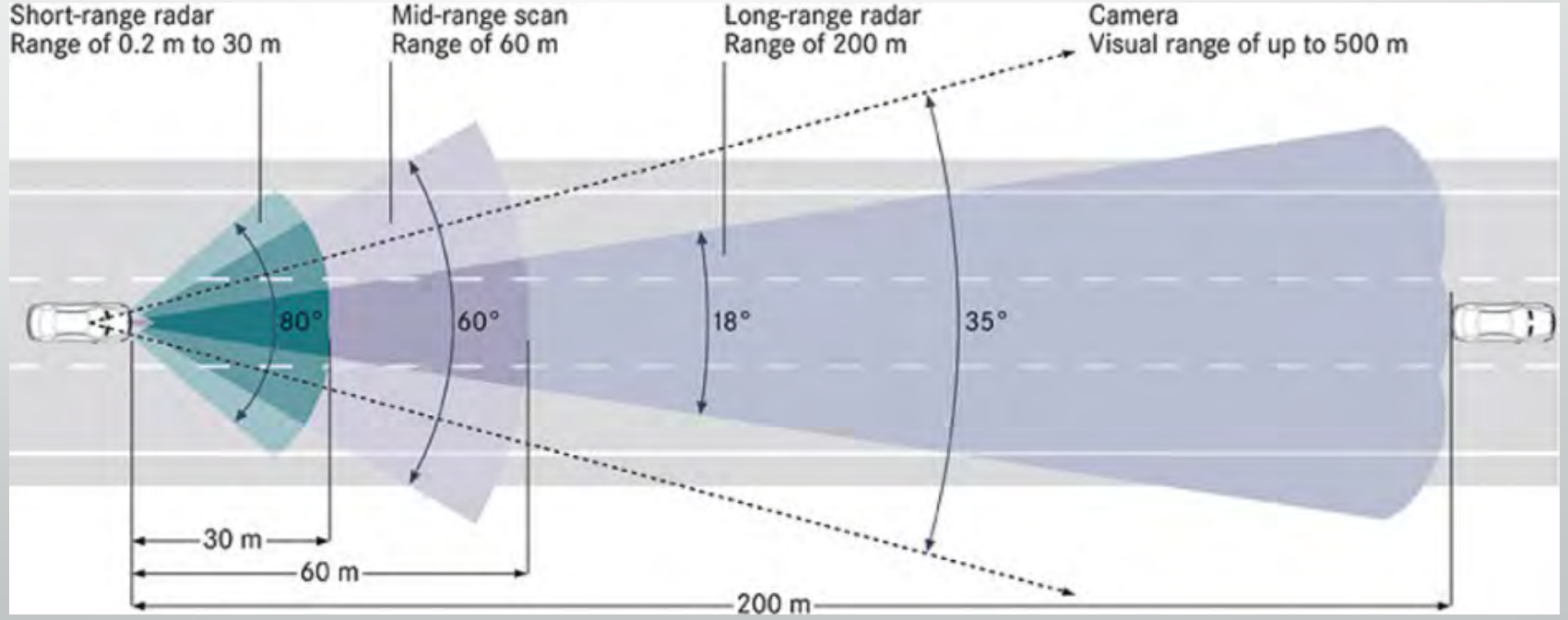
Technologies making a car autonomous

- Anti-lock brakes(ABS)
- Electronic stability control (ESC)
- Adaptive Cruise Control
- Lane Departure Warning System
- Self Parking
- Automated Guided Vehicle Systems



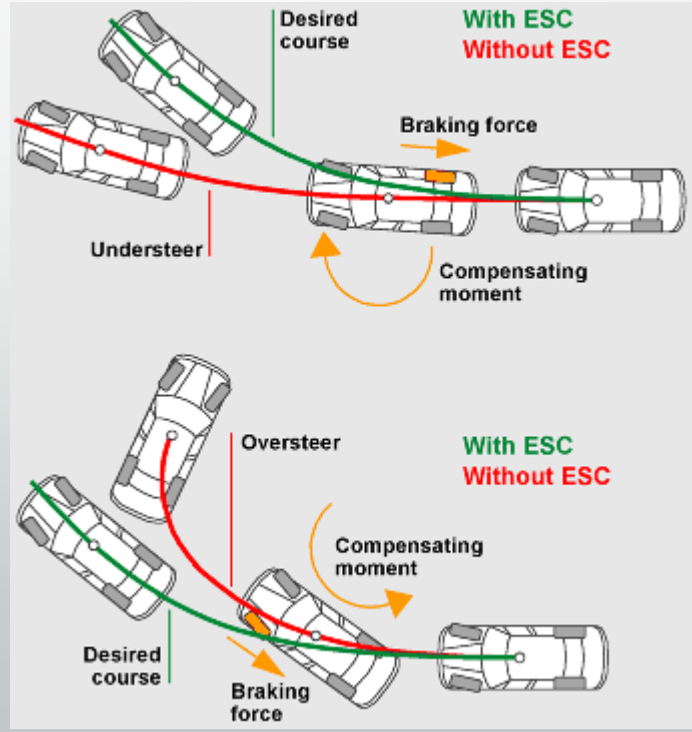
Automatic Braking System

- Senses an imminent distance with another vehicle or a velocity related danger.
- Responds by either precharging the brakes or by applying the brakes to slow the vehicle without any driver input.
- Detects by radar, video, infrared, ultrasonic, GPS sensors.
- Introduced by Toyota.



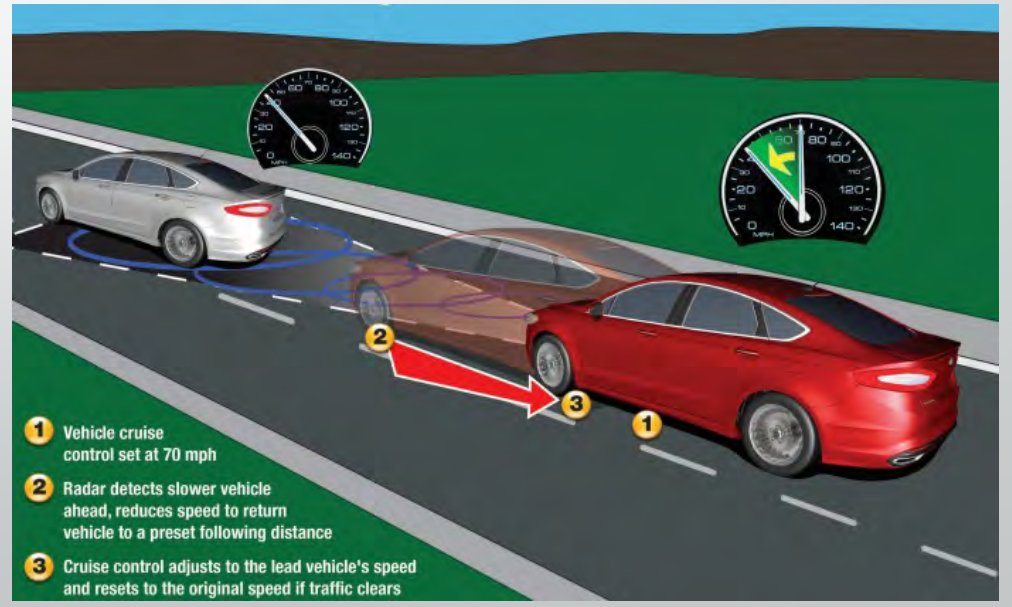
Electronic Stability Control

- A computerized technology improves vehicle's stability by detecting and minimizing skids.
- Automatically applies the brakes.
- Helps to minimize a loss of control.
- ESC compares the driver's intended direction to the vehicle's actual direction



Adaptive Cruise Control

- Uses either a radar setup allowing the vehicle to slow when approaching another vehicle and accelerate again to the preset speed when traffic allows
- Mercedes was the first company to offer ACC to the world wide market in 1999.
- Lexus was the first company to offer ACC to the US market

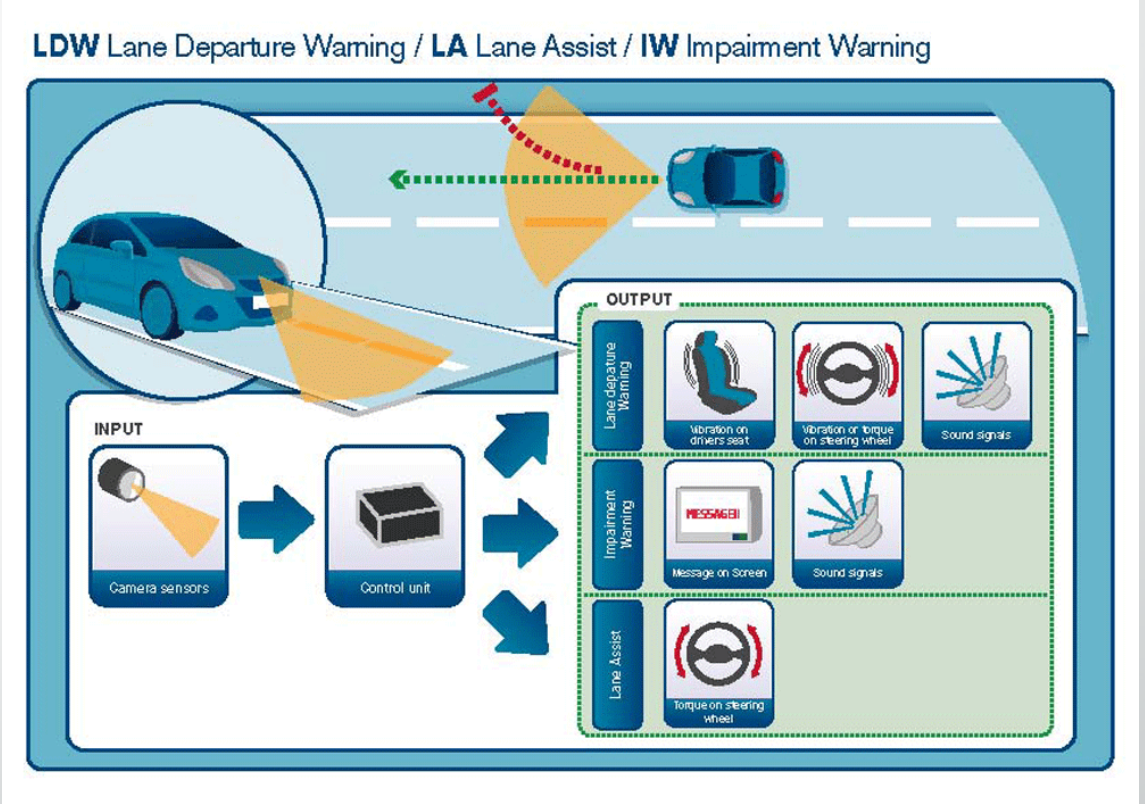


Automotive Night Vision

- Increases a vehicle driver's perception and seeing distance in darkness or poor weather beyond the reach of the vehicle's headlights.
- Uses a thermographic camera.
- Cadillac first offered this worldwide in 2000.

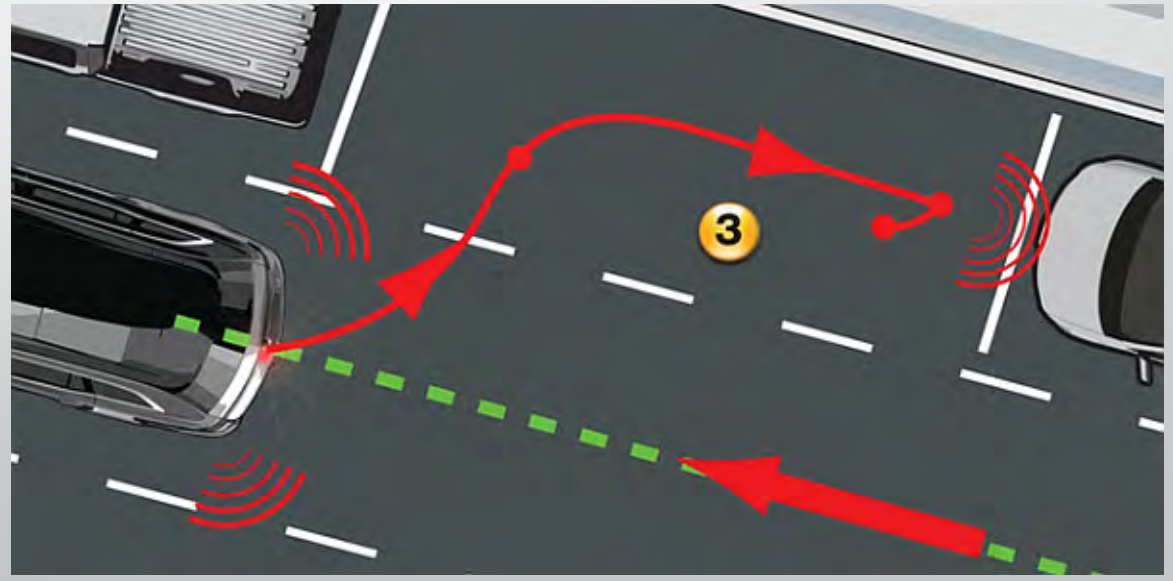
Lane Departure Warning System

- A mechanism designed to warn a driver when the vehicle begins to move out of its lane
- Designed to minimize accidents by addressing the main causes of collisions: driving error, distraction and drowsiness.
- Mitsubishi offered in Japan only in 1992
- In 2005 Infiniti offered to US market.



Parking Assist

- System uses sensors all around the car to guide it into a parallel parking space
- Lexus LS 460 L with Advance Parking Guidance System
- The driver has to find a parking space,
- Position the car next to it, and use the in-cabin navigation screen to tell the car where it should go.
- The parking space needs to be 6 feet (1.8 meters) longer than the car



Automated Vehicles

Connected Vehicles

Technology

- Direct Short Range Communications (DSRC) (5.9 Ghz)
- Cellular Network
- Satellite Communications

Data Gathering/Information Exchange

- Vehicle-to-Infrastructure (V2I)
- Vehicle-to-Vehicle (V2V)

Safety Critical Functions (steering/throttle) ***Not*** **Affected** (Operator is in control at all times)

Autonomous Vehicles

Technology

- Sensors, Lidar, Radar, Cameras, GPS
- Advanced computing and algorithms

Various Levels of Automation (defined by NHTSA)

Connected Vehicle technology is not required

Safety Critical Functions (steering/throttle) **Affected Without Direct Driver Input**

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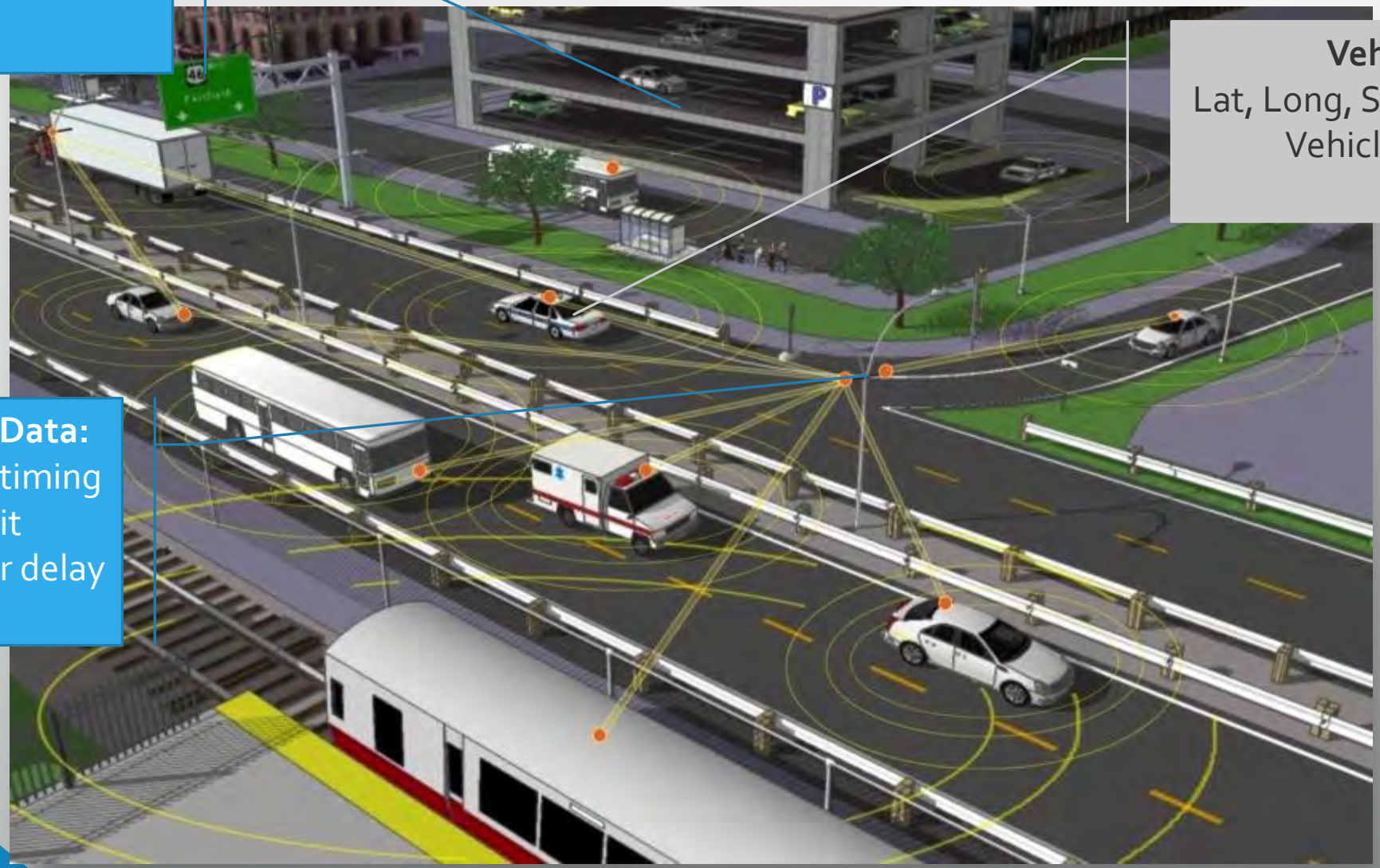
Connected Vehicles

Infrastructure Data:
Available space count,



Vehicle Data:
Lat, Long, Speed Brake Status,
Vehicle separation,

Infrastructure Data:
Signal phase or timing
Speed Limit
Average corridor delay

Connected Vehicles

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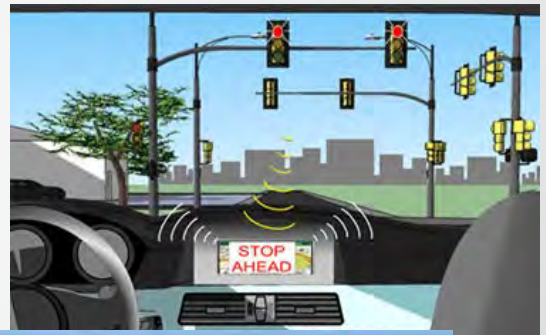
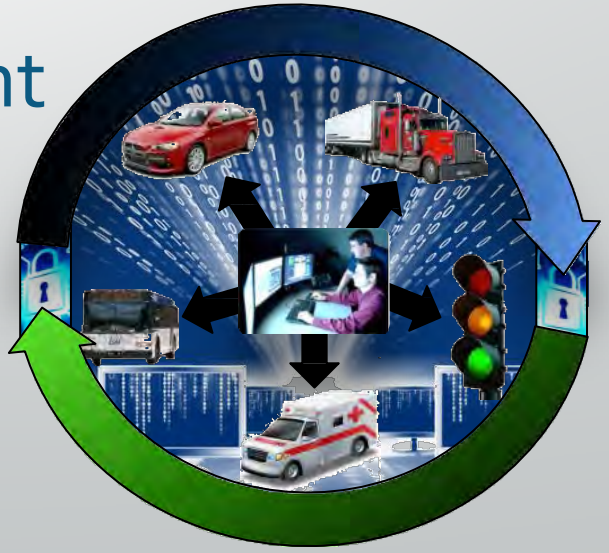


DSRC Technology: How it Works

- Data is transmitted 10 times/sec (300m range)
- Privacy is built-in (vehicle location is NOT intended to be recorded or tracked)
- Wi-Fi radio adapted for vehicle environment
- Inexpensive to produce in quantity
- Original FCC spectrum allocation in 1999, revised in 2004 and 2006



Connected Vehicle Communications Technology: Benefits and Challenges

- Benefits of the DSRC communications technology:
  - Reduced price
  - Improved reliability → fewer false alarms
  - Increased performance → addresses more crash scenarios
- Challenges of the DSRC communications technology:
  - Both parties (vehicle/vehicle or vehicle/infrastructure) need to be equipped
    - to gain benefit
  - Requires security infrastructure

Connected Vehicle Applications

SAFETY

Vehicle 2 Vehicle (V2V)
Vehicle 2 Infrastructure (V2I)

MOBILITY

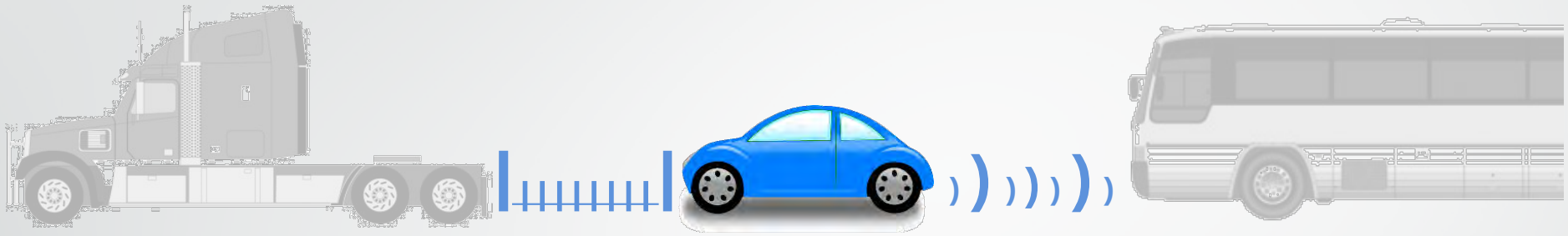
Dynamic Mobility Applications

ENVIRONMENT

AERIES (Application for the Environment: Real-Time Information Synthesis)
Road Weather Applications

SAFETY

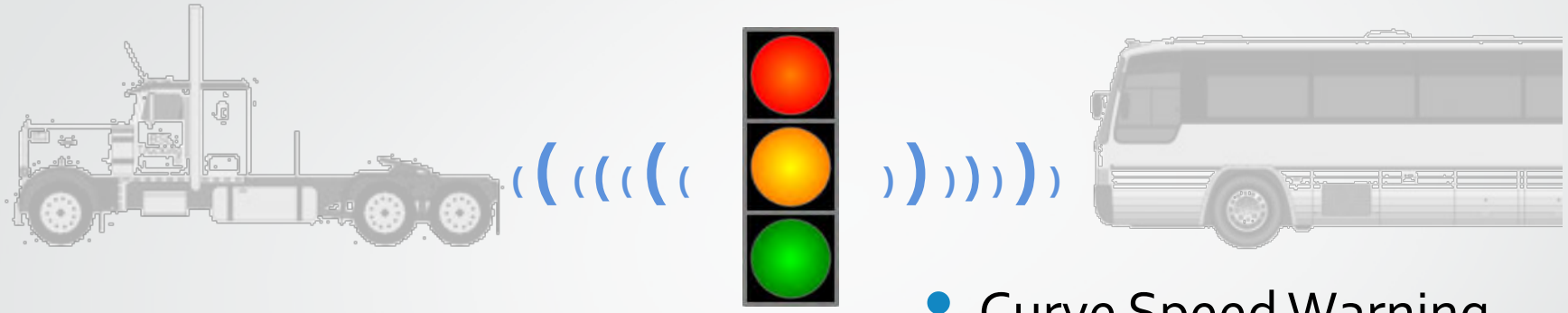
Vehicle 2 Vehicle (V2V)



- Forward Collision Warning
- Emergency Electronic Brake Light
- Blind Spot Land Change Warning
- Do Not Pass Warning
- Intersection Movement Assist
- Left Turn Assist

SAFETY

Vehicle 2 Infrastructure (V2I)



- Curve Speed Warning
- Red light Violation Warning
- Spot Weather Information Warning
- Reduced Speed Zone Warning
- Stop Sign Gap Assist
- Smart Roadside
- Pedestrian Warning

MOBILITY

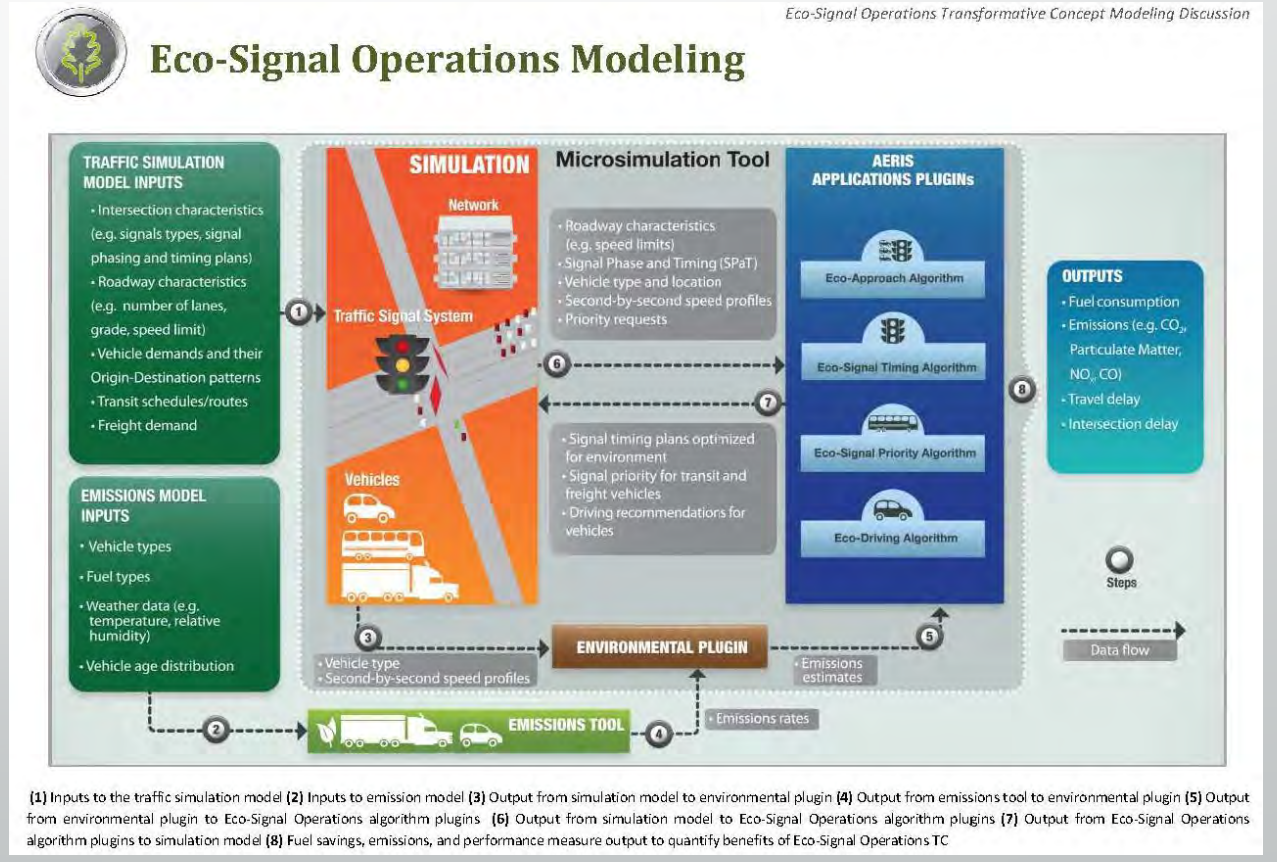
Dynamic Mobility Applications

- Multimodal intelligent Traffic Signal System
- Network Flow Optimization
- Response, Emergency Staging and Communications, Uniform Management, and Evacuation
- Enable Advance Traveler Information Systems
- Freight Advanced Traveler Information Systems
- Integrated Dynamic Transit Operations

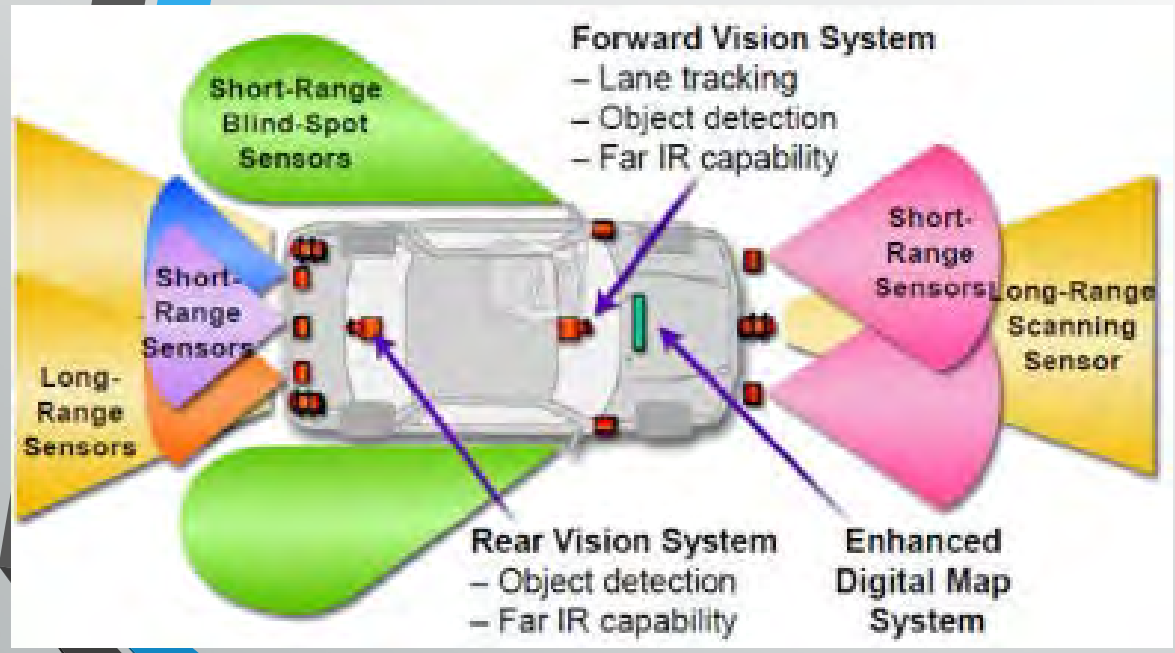
ENVIRONMENT

AERIES

- ECO- Signal Operations
- ECO- Lanes
- ECO – Traveler Information
- ECO – Integrated Corridor Management



Autonomous Vehicles



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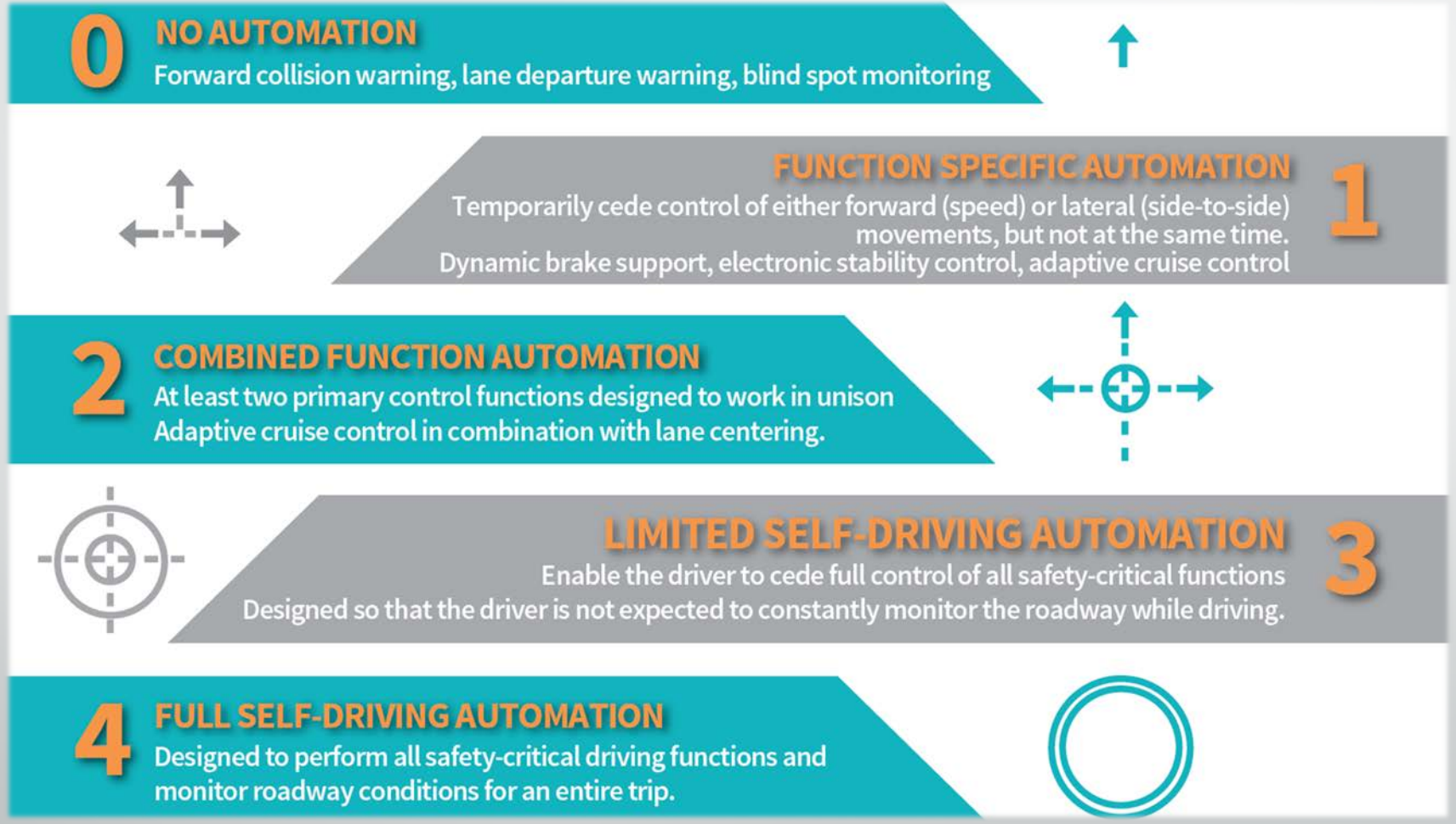
Levels of Automation



*Abridged from the National Highway Traffic Safety Administration

GM Announced 'Super Cruise' at ITS World Congress (9/8/2014)

Semi-automated driving technology

Hands free (not mind free) driving at highway cruising speeds

Hands free driving in stop-and-go congestion

"Through technology and innovation, we will make driving safer." Mary Barra, GM CEO

Challenges

- The Public
- Vehicles
- Infrastructure
- Governmental/Regulatory

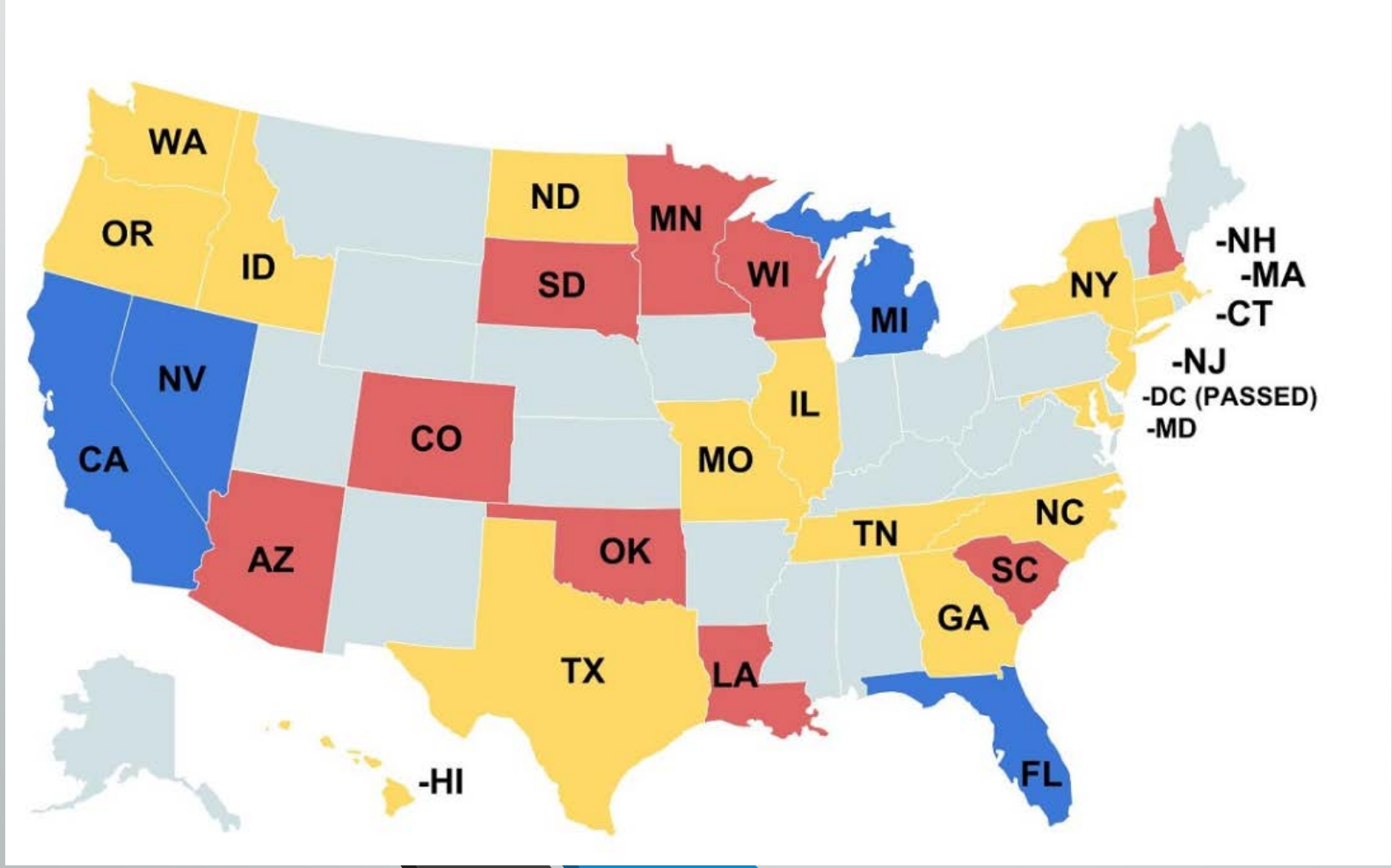
Challenges - Vehicles

- Equipping the fleet – V2V and V2I benefits increase with fleet penetration
- Is a government mandate needed (and in what form)?
- Timing of regulations, timing of installation in new vehicles
- Implementation Pathways
- Security Issues – protection from malfunctioning and compromised units

Challenges - Infrastucture

- What infrastructure is needed to support V2V applications (e.g., for security)?
- What are expectations for a national footprint?
- How will states make decisions on road side unit locations, applications and investment?
- How will infrastructure installation, operation, and maintenance be funded?

Legislation for Testing Automated Vehicles



HB 2015 –Defines "autonomous technology," "autonomous vehicle," "operator," and "manufacturer," expressly permits testing of autonomous vehicles under specified conditions by certain parties, requires manufacturers to apply to and receive approval from the state DMV before operating autonomous vehicles on public highways, establishes minimum manufacturer certifications for approval, establishes requirements for data recording and disclosure, and directs the state DMV to adopt regulations.

Photo source: Stanford Law Center for Internet and Society

Questions?