Evolution of technology for commercial vehicle safety

Peter Sweatman
Principal, CAVita LLC

CAVita

Giving life to transformational technology in transportation

Agenda

- A technological tipping point
  - Brought about by CAV
- Imposed on a century-old transportation system
  - The rate of change has *changed*
- The process of deployment
- Heavy commercial vehicle safety technology, then and now
- CV and AV have specific significance for heavy vehicles
- *Embracing "heavy vehicle CAV"*

A technological tipping point

- Connected vehicles and infrastructure (CV)
- Automated vehicles (AV)
  - Including highly-automated vehicles (HAVs)
- Surrounded by:
  - **Shared Mobility (SM), Big Data, Smart Cities & Communities**, Cybersecurity, Internet-of-Things
- Enabled by:
  - Sensors, software, cloud services, computation, robotics, artificial intelligence, consumer electronics

Technology and Policy Driving Mobility

TRB Partners in Research Symposium: Transformational Technologies

Detroit, Michigan – October 31 – November 1, 2016

Century-old transportation system

- Drivers, vehicles and infrastructure
- Tremendous incremental progress
  - For example, crash rates continue to decline
- But not sustainable for another century
- New technologies cut right across the old silos
  - Safety, traffic efficiency, emissions, energy, economics
- The 21st Century mobility system is connected, automated and shared
- Vehicles will be tailored to *operating domains* and *use cases*

Key transformational metrics

- Fatalities and injuries
- Delay in traffic
- Energy consumption
- Carbon emissions
- Customer satisfaction
- Supply chain efficiency

The rate of change has *changed*

- Conventional R&D model is linear: research, protoyping, testing, modification, deployment
- We now need rapid learning cycles based on large deployments
  - This has been the successful model of the auto industry
  - Commercially successful products require multiple cycles of deployment with increasingly large groups of users
- The same model applies to CAV; in addition it becomes a public-private activity, or set of activities
  - There is no rule book for “public-private learning cycles”
  - Current examples include pilots, demos, model deployments, field operational tests, challenges, etc

The process of deployment

- Model deployments (eg. Safety Pilot, Ann Arbor)
- Fake cities
  - Mcity
  - Willow Run (MI), RELLIS (Tx), GoMentum (CA)
- CV pilots
  - NYC, Tampa, Wyoming
- Advanced Transportation and Congestion Management Technologies Deployment Program (ATCMTD)
  - Marysville OH
- Public-private consortia
  - Safety Pilot, Mobility Transformation Center (MTC), American Center for Mobility, RELLIS (Tx), GoMentum, Virginia Automated Corridors, I70 Mountain Pilot
- Smart City Challenge
  - $50M prize
  - One winner out of 78 cities: Columbus


Fulle
DODGE
DAKOTA
4x4

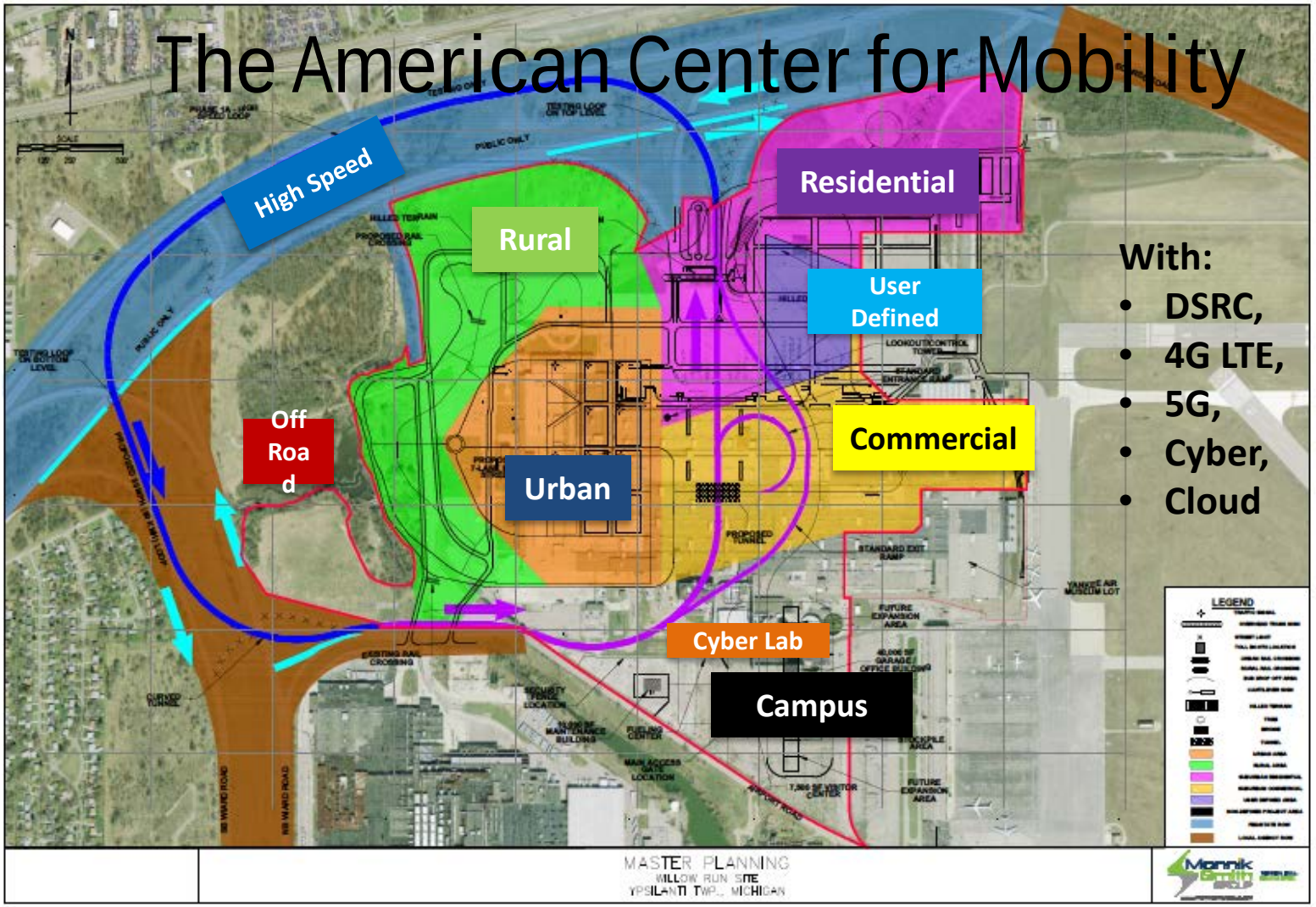
Mcity: opened by U-M and MDOT July 20, 2015

Streetscape in Downtown **Mcity**

MDOT Michigan Department of Transportation

MTC

The American Center for Mobility



Confidential

RELLIS Campus at Texas A&M

CV and AV can proceed independently on parallel paths but will converge to produce "connected automation"

Path to CV

Connected Vehicles

- Voluntary fitment of V2V and I2V by OEMs
- Aftermarket fitment
- Introduction of V2V rule
  - NPRM released December 2016
- Significant penetration by 2025

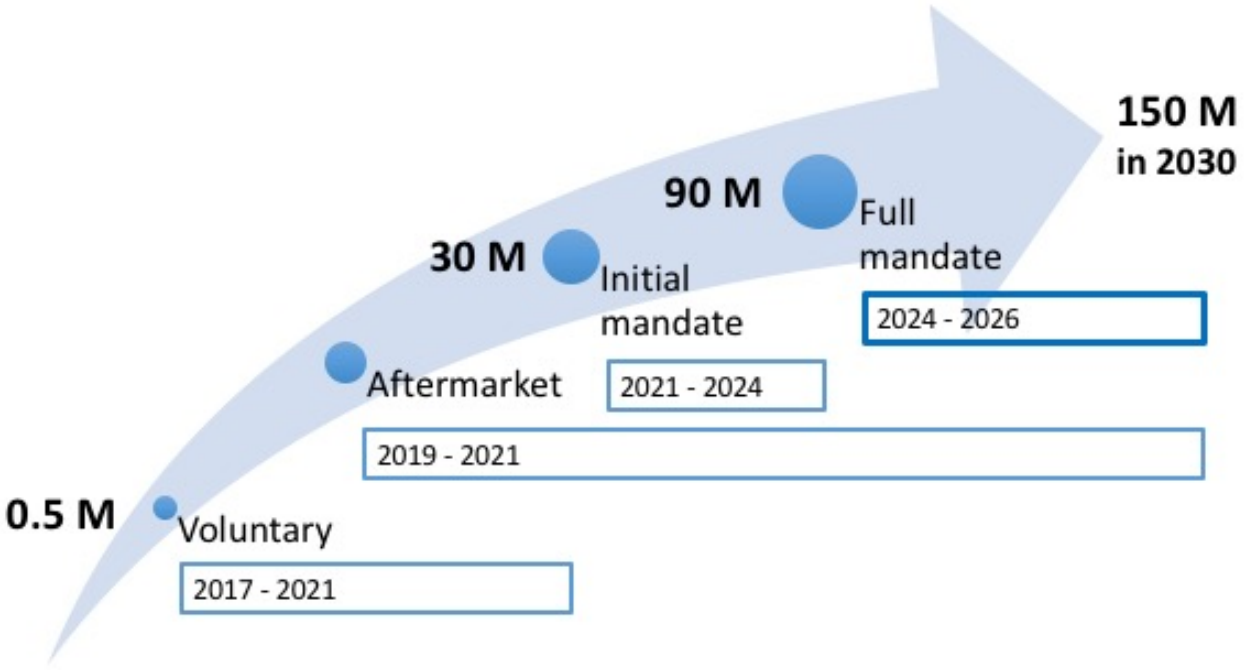
Connected Infrastructure

- V2I guidance from FHWA
  - Anticipated soon
- V2X pilots (NYC, Tampa, Wyoming)
- AASHTO SPAT challenge
- Actions by State DOT's, MPOs and cities
- Significant penetration of signalized intersections by 2025

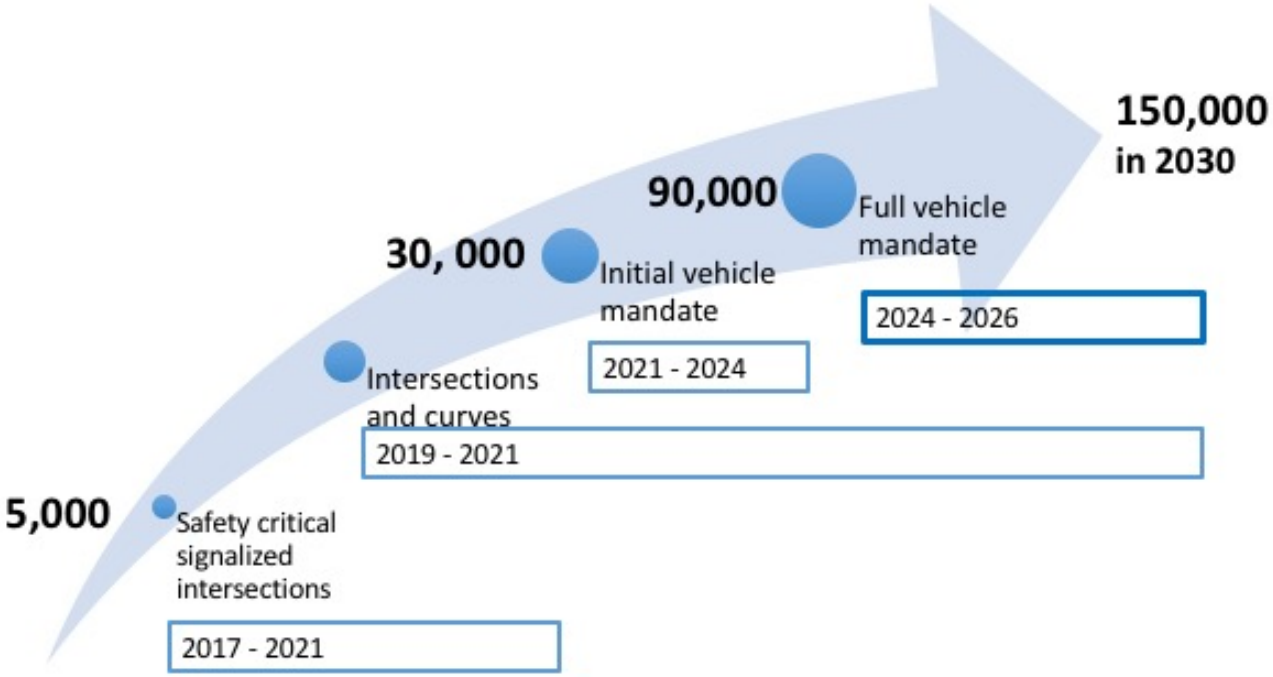
Continuing issues for CV

- Exclusive access to 5.9 GHz spectrum
  - FCC will decide whether to allow multiple uses and to auction part or all of the spectrum (currently reserved for safety applications)
- Cybersecurity & privacy
  - Authority for issuing security certificates
  - Monitoring of security breaches
    - The auto industry has created an Auto ISAC (Information Sharing and Analysis Center) under the Alliance of Automotive Manufacturers

Connected Vehicles



Roadside Equipment (RSEs)



Path to AV

Automated Features

- Voluntary fitment of automated features by OEMs
- Fitment of automated features under NHTSA agreements
- Significant penetration by 2025

Highly-Automated Vehicles (HAVs)

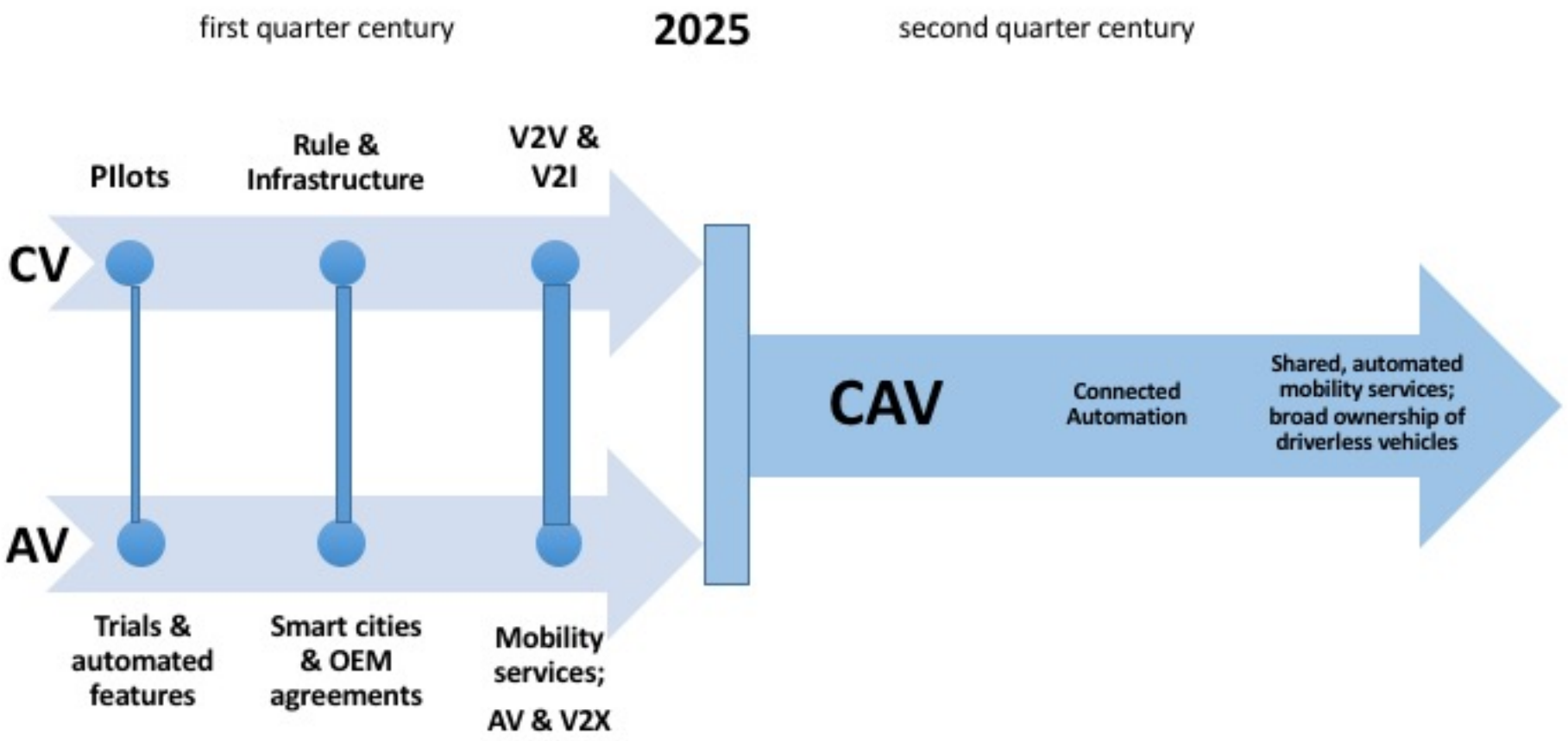
- Rules of the road at state level
- NHTSA issuing AV interpretations of FMVSS
- USDOT field operational tests (FOTs) – to be announced
- Low-speed trials
- Smart cities deployments
- On-demand fleets in precincts and cities
- NHTSA guidance on highly-automated vehicles (HAV's)
- Readiness for on-demand mobility services by 2025

Continuing issues for AV

- Occasional engagement of human driver
- Mixed driverless/driven vehicles
- Liability
- Cybersecurity & privacy
- Compliance with federal motor vehicle standards

- No national roadmap to HAV deployment
- Too many questions, inhibiting collaboration
- Shared mobility accelerates deployment, but brings more questions

Convergence of CV and AV paths



HCV safety technology in its own right

Advanced Collision Avoidance Systems (ACAS)

Light vehicle

- NHTSA rulemaking
- NHTSA safety advisories
- Consumer awareness and demand

Heavy vehicle

- NHTSA rulemaking
- Fleet safety programs

CV

Light vehicle

- NHTSA rulemaking
- FHWA guidance
- AASHTO policy studies
- Traffic control and aftermarket products
- Personal devices

Heavy vehicle

- Same platform and infrastructure as LV
- HV-specific applications
- Fleet involvement in chain of communication
- Potential for signal priority
- Platooning leads the way
- Convergence of CV and AV has begun

Safety focus

Freight efficiency focus (and safety focus)

Driver Assistive Truck Platooning

- Fuel savings at 60 mph, 11m gap:
  - following truck: 10.0%
  - lead truck: 4.5%

North American Council for Freight Efficiency (2013). *CR England Peloton Technology platooning test Nov 2013.*

AV

Light vehicle

- NHTSA OEM agreement for AEB
- NHTSA Automated Vehicles Policy
- Path to HAV is uncertain

Heavy vehicle

- NHTSA policy applies to HV
- Path to HAV is more uncertain
  - Transitional, security, liability and ethical questions
  - ODDs and OEDRs differ from those for LVs

Use cases considered by Volpe/NHTSA

Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles

Automated Vehicles

- Highway automation
- Driverless valet
- Truck platooning
- Aftermarket highly-automated driverless vehicle kit
- Conventional vehicle with highly-automated OEM kit
- Highly-automated, conventionally designed vehicle

Driverless Vehicles

- Highly-automated vehicle with advanced design
- Highly-automated vehicle with novel design
- Riderless delivery motorcycle
- Driverless delivery vehicle (light duty/heavy duty)

Smart Cities and Communities

Light vehicle

- Avenues for model deployment of CAVs, SM, AFVs and data analytics
- Hard to scale and mainstream nationally

Heavy vehicle

- CAV precincts and corridors are more self-contained and permanent
- Equipped trucks can benefit in multiple locations
- Seeking further accommodations once trucks are equipped

Big Data Analytics

Light vehicle

- HAV data will need to be curated and shared
- New independent roles and trust mechanisms to be established

Heavy vehicle

- Sharing of CV and AV data has a bigger purpose
- Public sector investment in supply chain efficiency
  - Which technologies, which benefits?

The case for embracing “heavy vehicle CAV”

- Heavy vehicle CV addresses efficiency as well as safety
- Heavy vehicle AV concentrates on automated features for safety (rather than HAV)
- Specific aspects of CV and AV are brought together; CV and AV are already converging in the form of platooning
- “Heavy vehicle CAV” has universal application in precincts and corridors
- Precincts and corridors are easier to replicate; data supports supply chain efficiency and investment

Move forward on CAV specific to heavy vehicles in precincts and corridors; Prepare for HAV by reducing uncertainty.