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## Planning for our Future

Implementing DSRC Technology

June, 2019

#### What Are Connected Vehicles?

#### Vehicle-to-Vehicle (V2V)





Vehicle-to-Infrastructure (V2I)

#### **Benefits of Connected Vehicles**



#### Anticipated Impacts

- A 30-50% penetration of DSRC equipped vehicles on the roadway can have a significant impact on safety for all vehicles
- Vehicle Manufacturer Case Study Toyota



\*Median vehicle fleet age estimated to be 11.5 years. Therefore, assume an additional 23 years for turnover of the existing fleet

#### Effects of CAV

#### TABLE 8: HAV UNCERTAINTY

COULD DECREASE DUE TO	IMPLICATION	COULD INCREASE DUE TO
Vehicle sharing, higher vehicle costs	Vehicle Ownership	Smaller, lighter-weight vehicles lower cost, new types of vehicles
Increased travel willingness / better use of in-vehicle time	Land Use Density	Network effects, shared & transit vehicles, less parking
Vehicle sharing, denser development	VMT / Trips	Lower operating costs, zero-occupant trips, mode shift, expanded mobility for non-drivers, increased travel willingness
Follows all road rules / defensive driving	Road Capacity / Speed	Reduced headways, smoother traffic flow, shorter signal lag times, fewer crashes, and real-time route optimization
Machine precision	Crashes	Hacking, complex human-machine interactions
Low-emission vehicles, right-sized vehicles, eco-driving	Air and Noise Pollution	More travel, larger vehicles
Vehicles avoid deficiencies, smoother traffic flow	Pavement Distress	Platooning / closer vehicle spacing, increased VMT
AI (deep learning) displaces workers	Jobs	Technology creates more new high-skill jobs than the lower-skill ones it disrupts

Source: DVRPC, 2017. Adapted from Bryant Walker Smith, How Governments Can Promote Automated Driving, New Mexico Law Review, forthcoming, March 17, 2016, https://papers.ssm.com/sol3/papers. cfm?abstract\_id=2749375; and Johanna Zmud, Ginger Goodin, Maarit Moran, Nidhi Kalra, and Eric Thorn, Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies, National Cooperative Highway Research Program; Transportation Research Board, National Academies of Sciences, Engineering, and Medicine, 2017, http://nap.edu/24872.

## Other CAV Planning Considerations

- Congestion zero occupancy vehicles
- Parking decreased demand, future use of existing facilities
- Transit automated buses, decreased use of conventional public transit
- Land Use sprawl or more densely developed communities
- Other?

#### Means of Connection



Dedicated Short Range Communication (DSRC)

#### 5G Communication



#### DSRC Pros

- Tested and verified
- Mature technology; available today
- "Open air" broadcasting no need for a subscription
- Deployed nationwide; significant resources available
- Interoperability confirmed.
- Bandwidth protected (dedicated for safety applications)
- Supported by developed standards (SAE, USDOT)
- Widely accepted by infrastructure owners & operators / automobile companies
- "Guaranteed" low-latency (high speed) communications



#### DSRC Cons

- Some V2I applications require deployment of Road Side infrastructure
- New technologies may compete with (or compliment) DSRC
- Limited national technical experience
  - Configuration
  - Maintenance



#### **DSRC** Implementation Requirements

- Installation of roadside units and supporting infrastructure
- Upgrade existing hardware and software
- Trusted communication



## 5G Connective Vehicle Communications

#### Pros

- Public perception
- Can utilize 5G cellular infrastructure

#### <u>Cons</u>

- Not a proven technology
  - Lose 5-8 years of benefits by delaying DSRC
- Private network

#### **Implementation Requirements**

- 5G and the required infrastructure need to exist
- Additional infrastructure required for connected vehicles
  - Units in vehicles, Roadside units



## PennDOT Initiatives for Technology Development

- PennDOT Publication 646 ITS Design Guide
  - New projects
  - Retrofitting existing roadways
- Collaboration with Educational Institutions
- Installation of fiber conduit in all new construction projects
- Inclusion of PennDOT Central Office on all CV related projects
  - Coordinate cv deployments
  - Ensure no big gaps exist
- Conduct Pilot Projects
- Challenges



## Signal Timing and Phasing Challenge (SPaT Challenge)

 Challenges state and local public sector transportation Infrastructure Owners & Operators (IOOs) to deploy DSRC infrastructure in at least one coordinated corridor or network (approximately 20 signalized intersections)









## Defining the CV Technology

- Amendment to <u>Regional Transportation Plan</u>
- What are Automated Vehicles
- What are Connected Vehicles?
- Role of Communication Technologies for CVs
  - DSRC & 5G Technology comparisons
    - Pro's
    - Con's
    - Implementation Requirements



#### Assess Likely Impacts and Priorities for CV Deployment

- Identified Priority Vehicle to Infrastructure (V2I) CV applications
  - Safety Environment
  - Mobility 
    Agency Data
- Projected Penetration Rate Scenarios & Anticipated Impacts
  - Rural and Urban Corridors
- Corridor Prioritization
  - Interactive GIS Map to assist in the preliminary selection of corridors in PennDOT District 8
- Long Range Plan Integration



## Cost and Design Considerations

- Project Selection
  - V2I component Integration
  - Project Types
- Design Considerations
  - Compatible Infrastructure
  - Unit Placement
- Cost Overview
  - Element Cost Breakdown for One DSRC Unit
  - Deployment Cost Scalability
- Ownership and Maintenance Responsibilities
- Project Examples



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