ED KNAPP
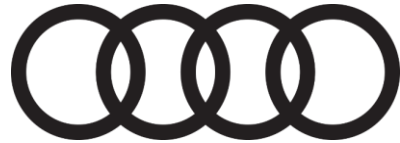
CTO,
American Tower
Corporation

ANUPAM MALHOTRA

Director of Connected
Vehicles and Data,
Audi of America

JIM MISENER

Senior Director, Product
Management and Global
C-V2X Ecosystem Lead,
Qualcomm

CATHY MCGHEE

Director, Virginia
Transportation Research
Council

20 min	**Presentations: C-V2X and the Power of Partnership**	Anupam Malhotra, Director for Connected Vehicles and Data, **Audi of America** Jim Misener, Senior Director, Product Management and Global C-V2X Ecosystem Lead, **Qualcomm** Ed Knapp, CTO, **American Tower Corporation** Cathy McGhee, Director, Virginia Transportation Research Council, **VDOT**
20 min	**Interactive Panel Discussion with all Speakers**	Moderator: Dr Shane Rooney, Executive Director, IoT Networks, **GSMA**
15 min	**Live Audience Q&A with all Speakers**	Moderator: Dr Shane Rooney, Executive Director, IoT Networks, **GSMA**

The Socio-Economic Benefits of Connected Vehicles

GSMA

Road Traffic Accidents

In the top 10 causes of death globally across all age groups

1.35 million lives lost every year

Over 90% of vehicle collisions caused by human error

Over 500 Million Connected Cars on the Road by 2025

Yearly Benefits of Connected Cars by 2025

11,000 lives saved

260,000 fewer accidents

400,000 tones of CO_2 emissions avoided

280 million hours of driving saved

VEHICLE TO INFRASTRUCTURE
Timing of traffic signal color changes transmitted to vehicle

VEHICLE TO PEDESTRIAN
Pedestrians phones transmit status, can warn drivers of potential risks

Sources: Ford

- **Commercially available** globally, leveraging the secure and established 4G LTE network infrastructure

- Seamless and sustainable evolution from **4G to 5G** while upholding **backwards compatibility**

- Superior levels of **security, range, latency and reliability** that vastly exceed the capabilities of alternative solution DSRC/802.11p

- Backed by a **global ecosystem** of 130+ leading mobile operators, vendors, automotive manufacturers, suppliers and companies from the wider industry

- C-V2X **security** is based on internationally recognised interoperable standards leveraging the security services provided by mobile networks, including eSIM

- **Mobile operators** are the experienced, trusted and licensed providers of an already established network infrastructure and are best placed to provide and manage connected vehicle solutions with the necessary scale, coverage, reliability and end-to-end security

- The GSMA is working with mobile operators, automotive OEMs and suppliers, industry associations and regulatory bodies to accelerate the growth of the connected vehicle market by agreeing a common approach to security, regulatory and infrastructure solutions.

- To find out more, visit www.gsma.com/automotive

Find Out More:
gsma.com/automotive

Get in Touch:
automotive@gsma.com

Stay Up to Date:
gsma.com/iot/newsletter

Leveraging C-V2X and the Power of Partnership to Create Safer Roads

GSMA IoT WebTalk
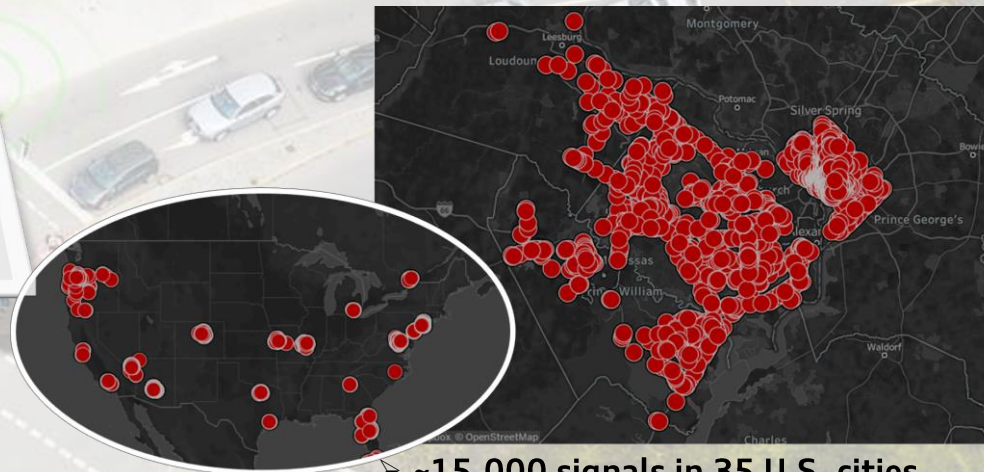
September 28, 2020

Anupam Malhotra
Director, Connected Vehicles & Data
Audi of America

Audi of America, Virginia DOT and Qualcomm Announce Initial C-V2X Deployment in Virginia

Audi Traffic Light Information

➢ ~15,000 signals in 35 U.S. cities
➢ Time-To-Green + GLOSA via LTE

Virtuous Cycle of Benefits

Funding & Buildout

Societal Benefits

Business Case for OEM

Business Case for City

Technical Solution

VDOT
Virginia Department of Transportation

VirginiaTech
Transportation Institute

AMERICAN TOWER®
CORPORATION

Qualcomm

Workers ahead !
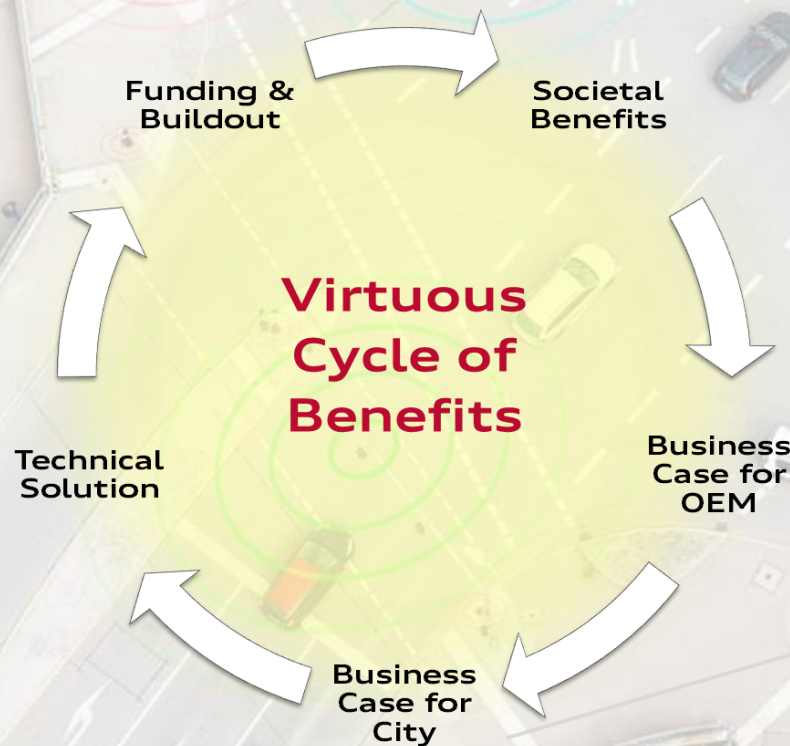
➢ Embedded C-V2X
➢ Work Zone Warnings
➢ Vulnerable Road Users
➢ Enhanced TLI with Red
   Light Violation Warning

Cellular Vehicle-to-Everything (C-V2X) Showcase

Summary

V2X is an Enabler

› Next gen connectivity brings Active Safety services to life

› Huge opportunity to address the 615K crashes, 36K fatalities, and $800M in economic harm annually on American roads

Roadmap to the Future

› Initial deployment of C-V2X on Virginia Roadways enables Work Zone Warnings, Construction Worker Alerts, and Enhanced TLI

› Technologies will eventually move into personal devices allowing Vulnerable Road Users to be safer (bicyclists, pedestrians, etc.)

› Deployment by OEMs and cities builds the presence needed for future V2V automated vehicle use cases

Collaboration is Necessary

› Services like TLI build a foundation for collaboration between OEMs, Traffic Agencies, & I/F providers

› Collaboration with Qualcomm, VDOT, VTTI, American Tower is aiming to create a microcosm for a broader deployment model

Audi and the Volkswagen Group are committed to the auto safety imperative of the 5.9GHz spectrum that the FCC wisely invested in 20 years ago!

Thank you

Jim Misener
Senior Director, Product Management
Qualcomm Technologies, Inc.

C-V2X

Standards complete, commercially available, deployment begun

Broad industry support with 5GAA

Initial focus on basic safety use cases

5G roadmap expands functionality

Rich sensor sharing
Vehicles share intent and perception

On-the-fly connectionless groups
Enabled by reliable multicast

Benefits in addition to safety
Coordinated driving brings reduced congestion, shorter trip time, and energy savings

V2V
Vehicle-to-vehicle
e.g., collision avoidance safety systems

V2I
Vehicle-to-infrastructure
e.g., roadside traffic signal timing/priority

V2P
Vehicle-to-pedestrian
e.g., safety alerts to pedestrians, bicyclists

V2N
Vehicle-to-network
e.g., real-time traffic/routing, cloud services

C-V2X enables network independent communication

Direct safety communication independent of cellular network

Low latency Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), and Vehicle to Person (V2P) operating in ITS bands (e.g. 5.9 GHz)
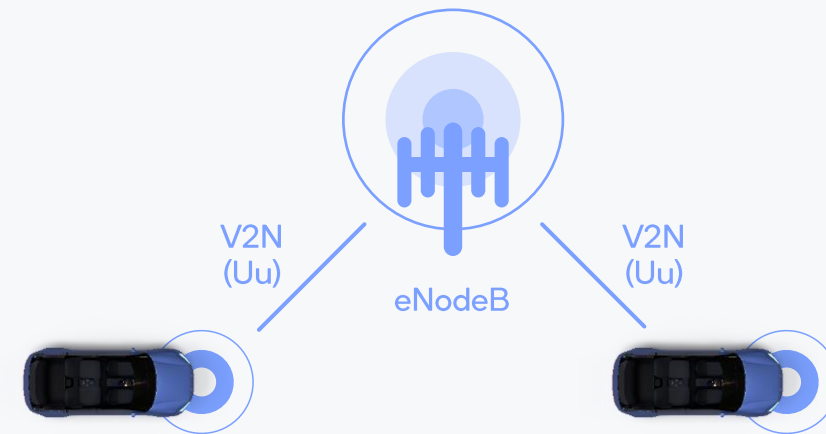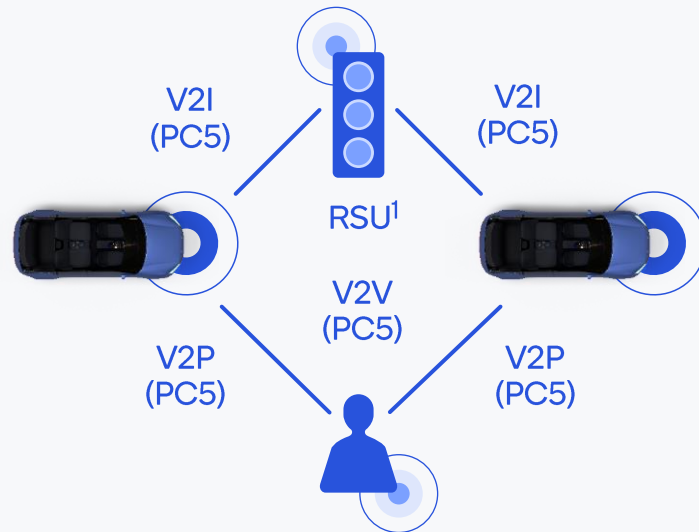
Direct PC5 interface
e.g. location, speed, local hazards

Network communications for complementary services

Vehicle to Network (V2N) operates in a mobile operator's licensed spectrum

Network Uu interface
e.g. accident 2 kilometer ahead

Bringing a comprehensive ecosystem together

Driving the future of smart transportation

City-highway
Hyperlocal services

Pay-as-you-use parking

236
Occupied

42
Available

$472
Revenue per 30 mins

Recommended toll routes

Mobile network operators

Access to roads and road users

Network densification using small cells / RSUs

Road operators

Mobile operators

Road users

Hazard alert

Ad services: Restaurant location

Vehicle OEMs

Cloud service providers
Security framework

Data and security[1]

1 Uptane Alliance, General Data Protection Regulation (GDPR)

Strong C-V2X momentum globally

Sep. 2016
5GAA founded. Qualcomm Incorporated was the founding member

Jan. 2017
ConVeX trial in Germany announced

Feb. 2017
Towards 5G trial in France announced

Mar. 2017
Rel-14 C-V2X spec finalized

Sep. 2017
First C-V2X chipset introduced

Oct. 2017
San Diego Regional C-V2X trial

AT&T
NOKIA
Ford
McCain

Apr. 2018
First multi-OEM demo in D.C.

Jun. 2018
1st US deployment in Denver

FICOSA
kapsch >>>
WNC Wistron NeWeb Corp.
SAVARI
Panasonic
CDOT CO
Ford

Jul. 2018
Europe's first multi-OEM demonstration in Paris

Oct. 2018
Multi-OEM performance evaluation of C-V2X

Oct. 2018
C-V2X functional and performance test report published

5GAA

Nov. 2018
Reaches 100 members

Nov. 2018
China-SAE ITS Stack Compatibility

Jan. 2019
Cooperative driving live interactive demos in Las Vegas

Jan. 2019
Announcing C-V2X implementation in Las Vegas

commsignia
RTC

Feb. 2019
C-V2X integrated with Qualcomm® Snapdragon™ Automotive 4G/5G platforms

Feb. 2019
TELEFÓNICA/ SEAT's live C-V2X/ 5G demo at MWC Barcelona

Mar. 2019
SAIC project complete

Mar. 2019
Cross border demo

ConVex

May 2019
C-V2X ecosystem demos

Nov. 2019
Live demos show C-V2X as a market reality

Nov. 2019
CAMP congestion control scenario testing by OEM consortium

Jan. 2020
ETSI European specifications and standards for C-V2X completed

China ICV 2025 Vision published

FCC 5.9 GHz NPRM comments received

Feb. 2020
C-V2X devices passed European Radio Equipment Directive (RED)

Jan. 2020
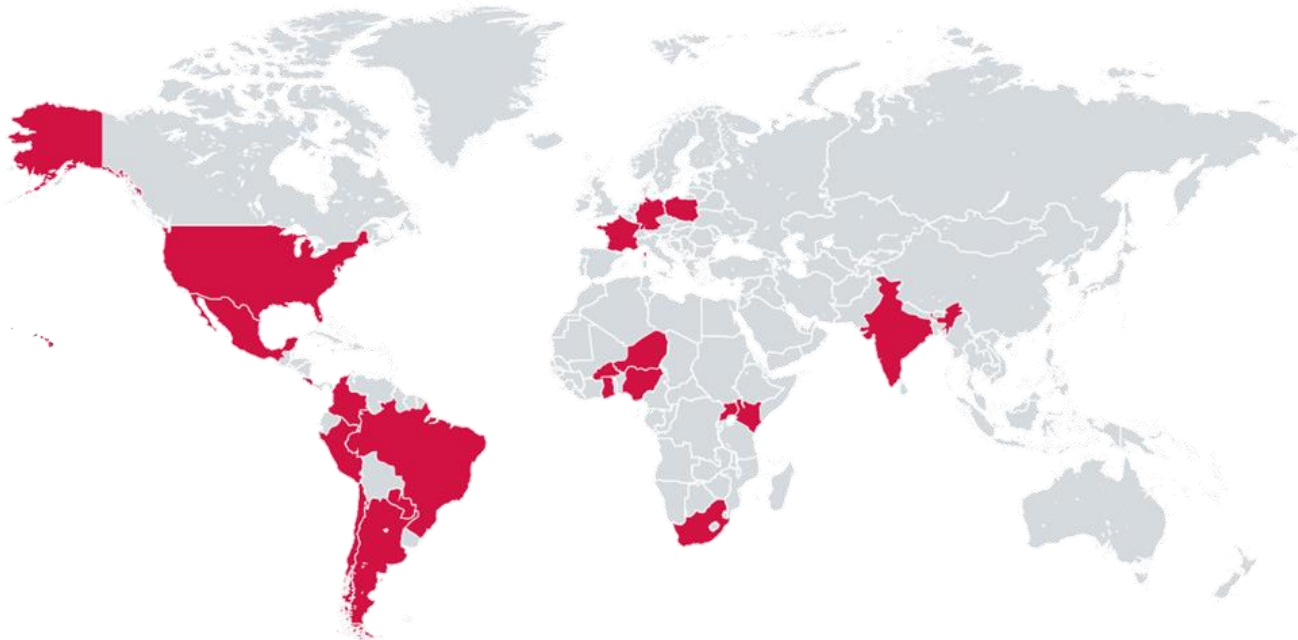C-V2X deployment in Virginia with VaDoT

American Tower Overview

AMT is a Global Provider of Mission-Critical Communications Infrastructure[1]

20 Countries **~5,500** Global Employees **~181,000** Total Communications Sites

Comprehensive Portfolio

- U.S. (~41,000 towers)
- International (~139,500 towers)
- Indoor DAS (~1,800 global sites)
- Real Estate Connectivity Management
- Partnerships with leading global Mobile Network Operators

Leading Independent Tower Provider and The Largest Neutral Host Infrastructure Provider in the U.S.

[1] Data as of June 2020

Road Operator's: Smart Intersection Roadmap

Basic IoT
Uu IoT

C-V2X enabled safety
Uu Backhaul

C-V2X Direct w/Access
NHN- Multi-Spectrum and Multi-RAT: RSU @ 5.9Ghz +; WiFi6 @ 5 GHz + CBSD@ 3.5Ghz
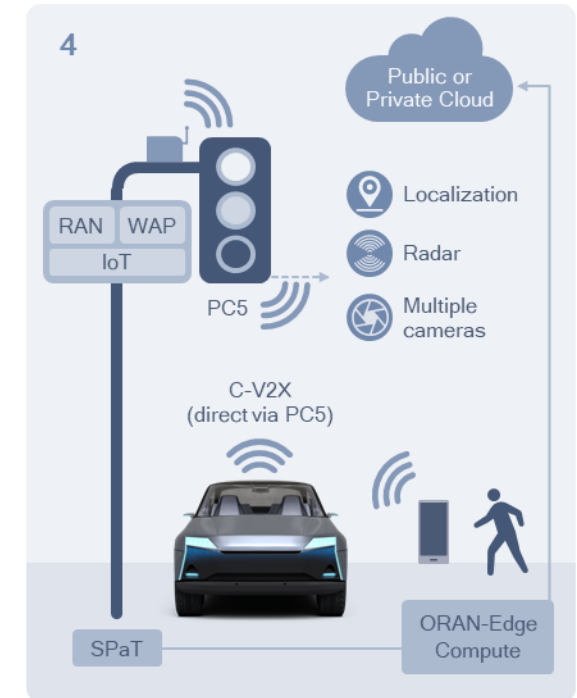
C-V2X Intelligent
NHN- Multi-Spectrum and Multi-RAT: RSU @ 5.9Ghz;+ WiFi6 @ 5 GHz + CBSD@ 3.5Ghz+ IoT Sensors/Cams

Open Neutral Host ITS, cellular and Wi-Fi access plus sensors providing a unified data set for the intelligent intersection

Models for Deployment

- Smart Roadside Infrastructure enables new business models by integrating V2X with 5G access networks, sensors

- Extending the Foundational Safety Use Cases with Infrastructure-as-a-service models

- Goal of accelerating and scaling CV2X deployments through multiple funding sources

Publicly Funded Model (example)

Infrastructure-as-a-Service Model
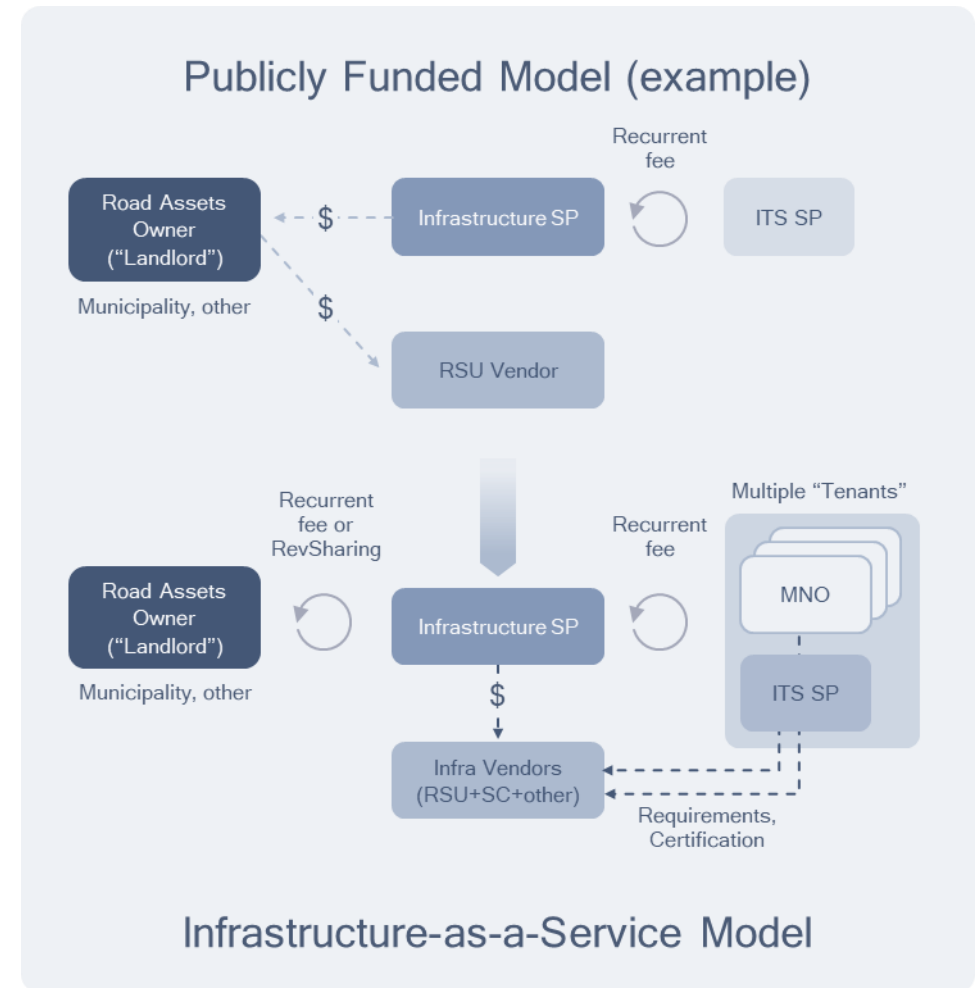
Infrastructure-as-a-Service Models can Augment Any Public Investments

VDOT
CONNECTED AND AUTOMATED VEHICLES PROGRAM

GSMA IoT WEBTALK

Cathy McGhee, PE

Director of Research and Innovation

September 28, 2020

The Virginia Department of Transportation (VDOT) is responsible for building, maintaining, and operating the Commonwealth's roads, bridges, and tunnels.

- 3rd largest state-maintained highway system in the country
- 128,553 lane mile state maintained system
  - Interstate – 5,502 miles
  - Primary – 22,040 miles
  - Secondary – 100,365 miles
- Over 11,900 bridges and 7,550 culverts
- 5 Traffic Operations Centers
- 2 Customer Service Centers
- 3 ferry services
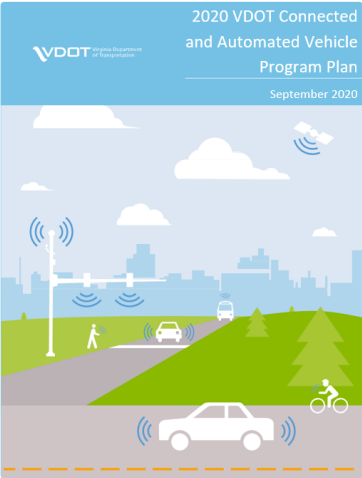- 41 safety rest areas and 12 welcome centers

VDOT continues to research connected vehicle technologies and to prepare the Commonwealth's infrastructure for the deployment of CVs.
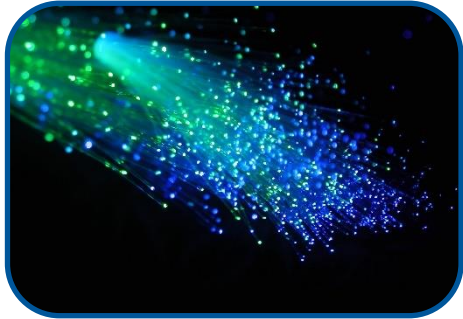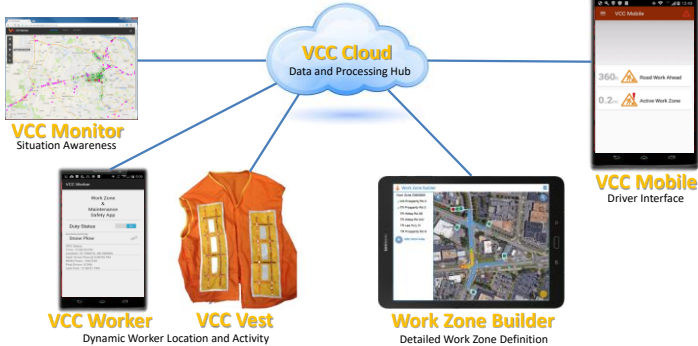

connected vehicle demos
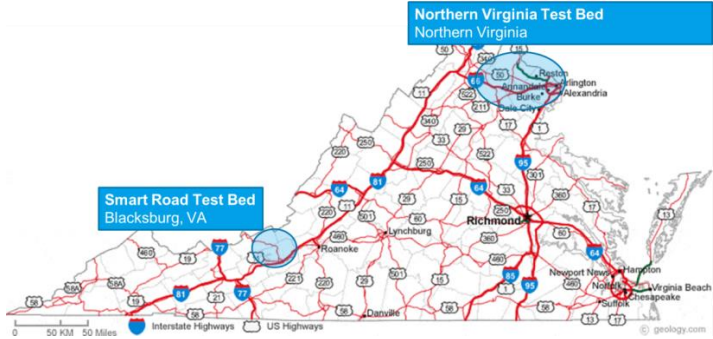
Virginia Connected Corridors Testbeds

connected vehicle applications

Connected and Automated Vehicle Program

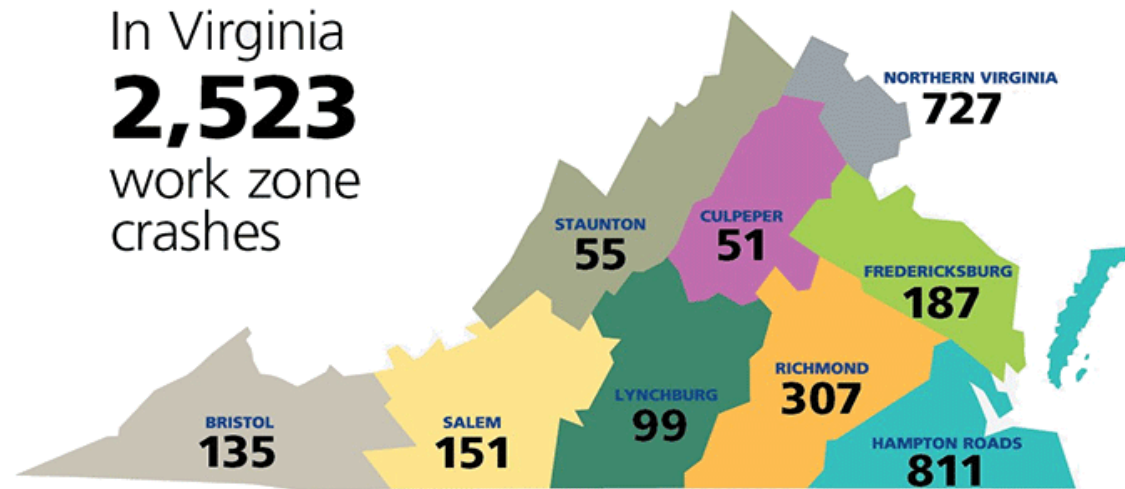improvements to foundational infrastructure

VDOT is particularly focused on utilizing CV2X to improve work zone safety for all road users.

Nationwide:
- Four out of five work zone fatalities are drivers
- One work zone fatality occurs every 15 hours
- One work zone injury occurs every 14 minutes
- Approximately 700 people are killed and more than 35,000 people are injured in work zone crashes each year

Statewide:
- On average statewide, there are 7.3 work zones crashes per day each year

In Virginia
2,523
work zone crashes

NORTHERN VIRGINIA
727

STAUNTON
55

CULPEPER
51

FREDERICKSBURG
187

RICHMOND
307

LYNCHBURG
99

BRISTOL
135

SALEM
151

HAMPTON ROADS
811

Panel and Q&A