Virginia Connected Corridor

NATMEC 2016

Mike Mollenhauer
Director, Center for Technology Implementation
Virginia Tech Transportation Institute

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Virginia Connected Corridor

- In 2014, VDOT and VTTI introduced the Virginia Connected Corridors (VCC) initiative
- Includes the Smart Road in Blacksburg, VA, and the Northern Virginia Connected-vehicle Test Bed in Fairfax Co., VA
  - NoVA is one of the most congested corridors in the U.S. (I-66, I-495, U.S. 29, and U.S. 50)
  - Considerable transportation challenges
- 47 Roadside equipment units (RSEs) installed that enable CV communication
- Provides test environment for new connected and automated vehicle technologies
- Current data flow includes live transmission of incidents, weather, work zone and variable dynamic message sign messages from VDOT TOC

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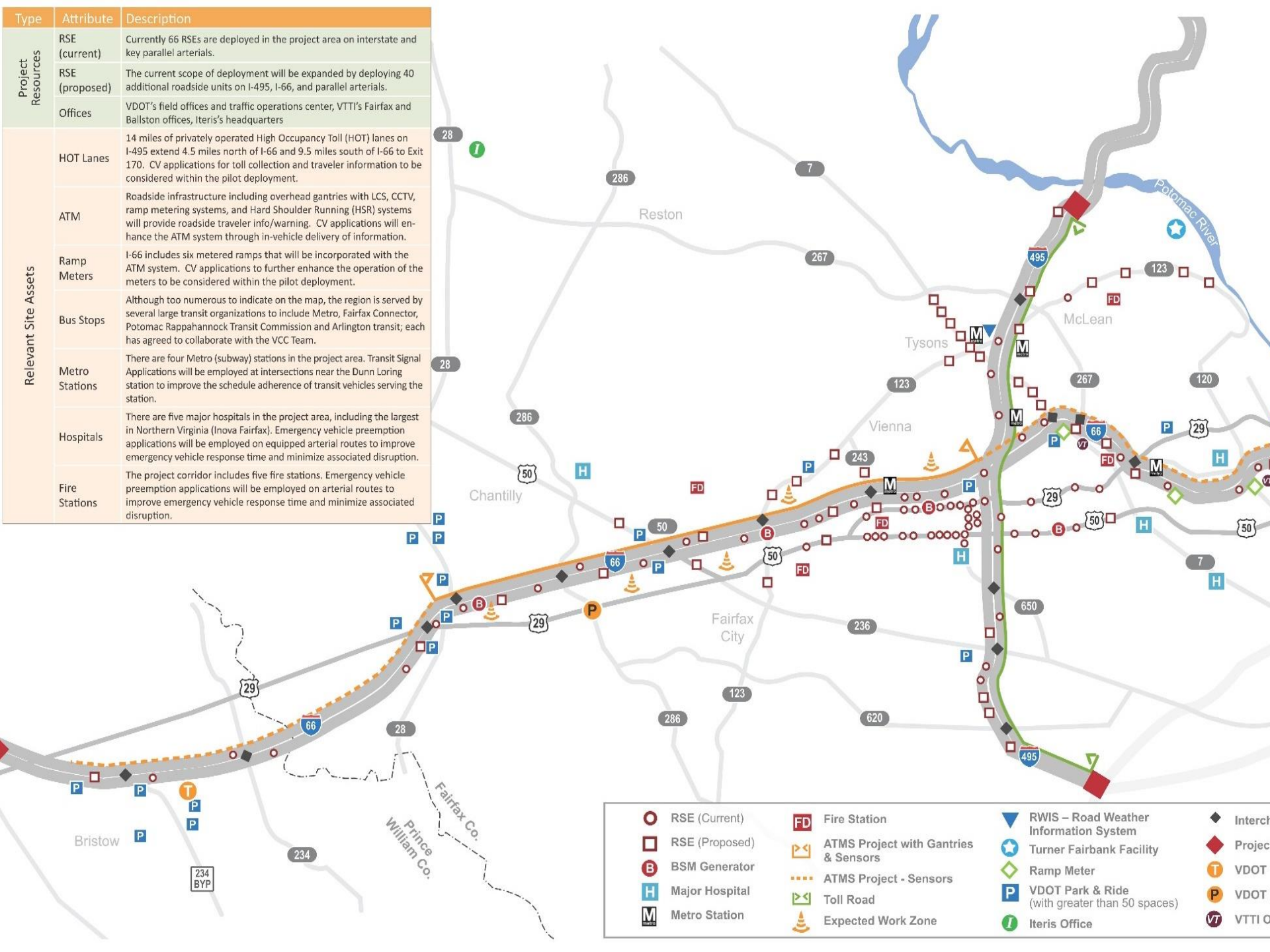
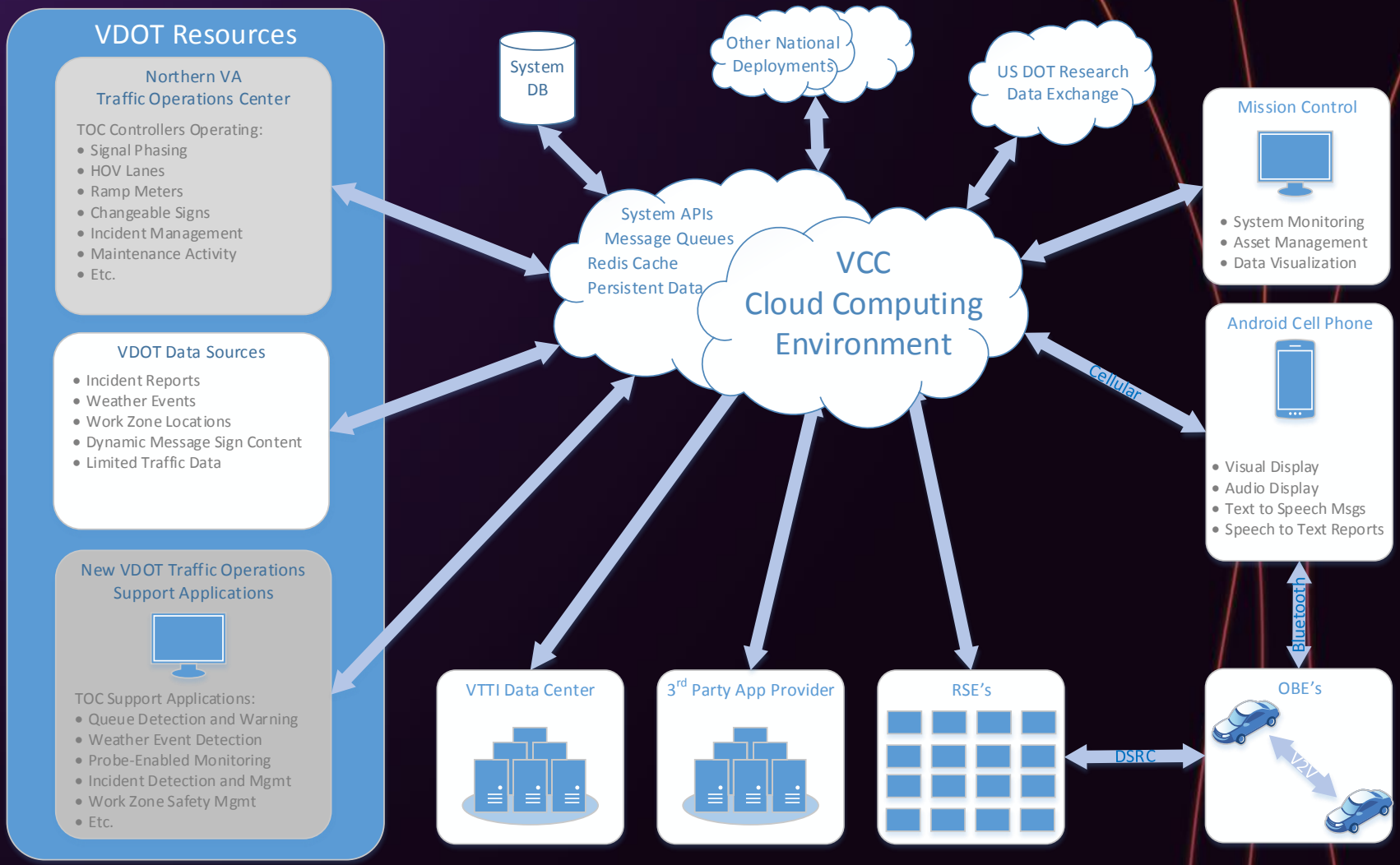
Type	Attribute	Description
Project Resources	RSE (current)	Currently 66 RSEs are deployed in the project area on interstate and key parallel arterials.
	RSE (proposed)	The current scope of deployment will be expanded by deploying 40 additional roadside units on I-495, I-66, and parallel arterials.
	Offices	VDOT's field offices and traffic operations center, VTTI's Fairfax and Ballston offices, Iteris's headquarters
Relevant Site Assets	HOT Lanes	14 miles of privately operated High Occupancy Toll (HOT) lanes on I-495 extend 4.5 miles north of I-66 and 9.5 miles south of I-66 to Exit 170. CV applications for toll collection and traveler information to be considered within the pilot deployment.
	ATM	Roadside infrastructure including overhead gantries with LCS, CCTV, ramp metering systems, and Hard Shoulder Running (HSR) systems will provide roadside traveler info/warning. CV applications will enhance the ATM system through in-vehicle delivery of information.
	Ramp Meters	I-66 includes six metered ramps that will be incorporated with the ATM system. CV applications to further enhance the operation of the meters to be considered within the pilot deployment.
	Bus Stops	Although too numerous to indicate on the map, the region is served by several large transit organizations to include Metro, Fairfax Connector, Potomac Rappahannock Transit Commission and Arlington transit; each has agreed to collaborate with the VCC Team.
	Metro Stations	There are four Metro (subway) stations in the project area. Transit Signal Applications will be employed at intersections near the Dunn Loring station to improve the schedule adherence of transit vehicles serving the station.
	Hospitals	There are five major hospitals in the project area, including the largest in Northern Virginia (Inova Fairfax). Emergency vehicle preemption applications will be employed on equipped arterial routes to improve emergency vehicle response time and minimize associated disruption.
	Fire Stations	The project corridor includes five fire stations. Emergency vehicle preemption applications will be employed on arterial routes to improve emergency vehicle response time and minimize associated disruption.



VCC Open Cloud Environment



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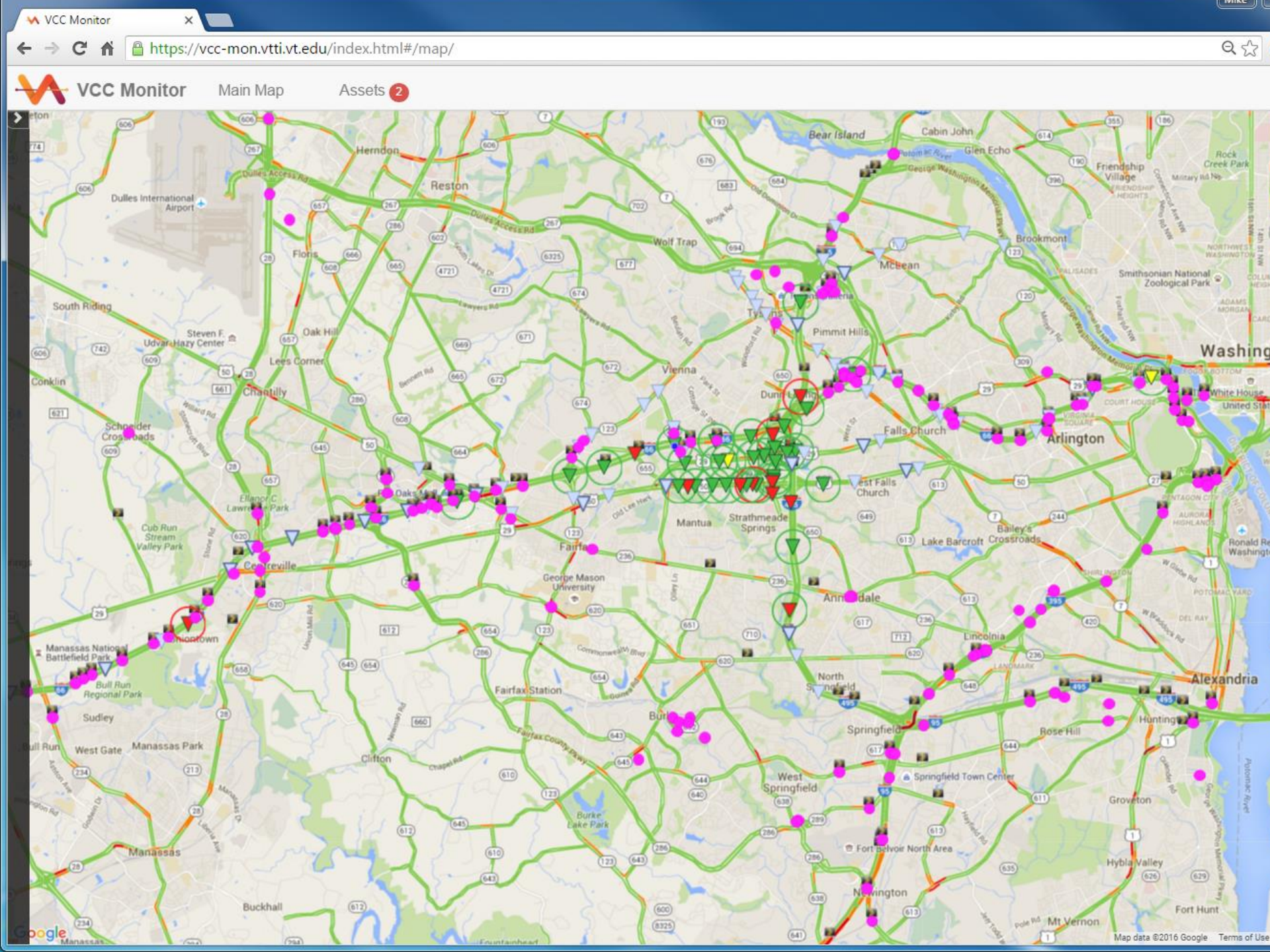
VCC Monitor
https://vcc-mon.vtti.vt.edu/index.html#/map/
VCC Monitor
Main Map
Assets 2
Herndon
Reston
Dulles International Airport
Floris
Wolf Trap
Bear Island
Cabin John
Glen Echo
Brookmont
McLean
Smithsonian National Zoological Park
Friendship Village
Rock Creek Park
South Riding
Steven F. Udvar-Hazy Center
Oak Hill
Lees Corner
Chantilly
Conklin
Schneider Crossroads
Vienna
Pimmit Hills
Falls Church
Arlington
Washing
White House
Mantua
Strathmeade Springs
Lake Barcroft
Bailey's Crossroads
Cub Run Stream Valley Park
Centreville
George Mason University
Annandale
Manassas National Battlefield Park
Bull Run Regional Park
Fairfax Station
Lincolnia
Alexandria
Sudley
West Gate
Manassas Park
Clifton
Springfield
Rose Hill
Springfield Town Center
West Springfield
Groveton
Burke Lake Park
Fort Belvoir North Area
Hybla Valley
Manassas
Buckhall
Mt Vernon
Fort Hunt
Google
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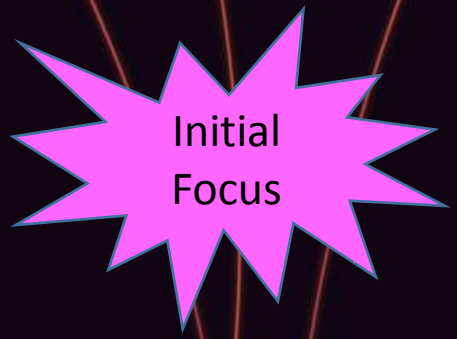
Terms of Use

2015 VDOT Application Priorities

- Work Zone Alerts for Drivers and Workers
- Signal-Related Applications (SPaT enabled)
  - Red Light Violation Warning
  - Emergency Vehicle Preemption (expanded)
  - Integrated Traffic Signal Systems and EcoDrive
  - Transit Signal Priority
- Real Time In-Vehicle Dynamic Messaging
- Incident Scene Alerts for Drivers
- Road-weather applications/information
- Queue Warning (V2I and V2V)
- Probe Enabled Traffic Monitoring (to support anomaly detection)

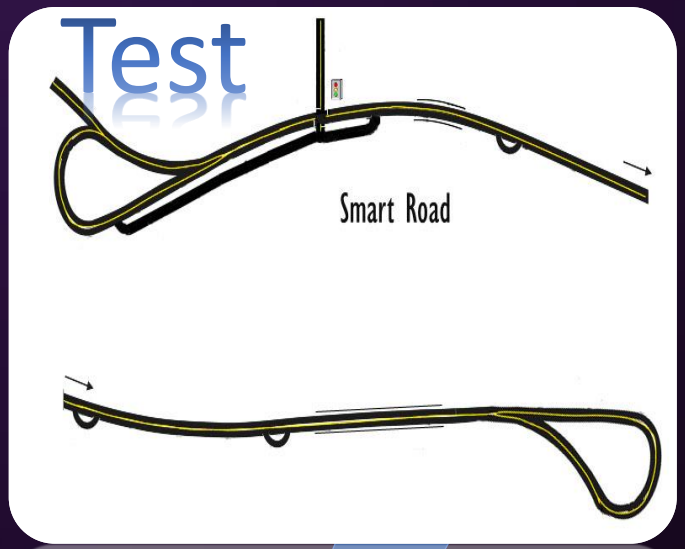


Deployment Challenges

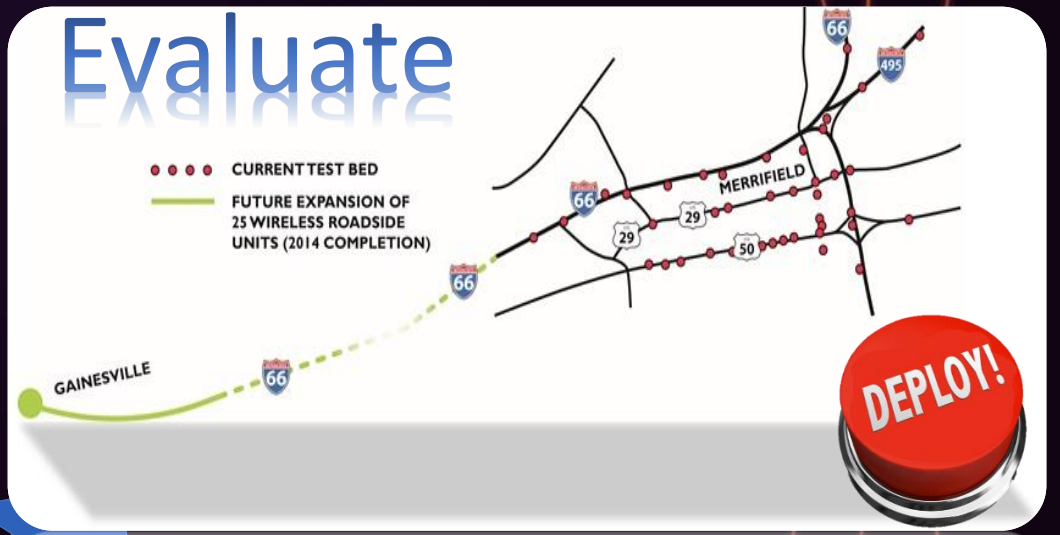
- Classic problem for DSRC penetration levels
  - Many apps need larger numbers of installed units to deliver value
  - Drivers need to identify value before installing units
- Managing deployment concerns with stakeholders
  - Little margin for error in the target deployment environment
  - Conservative system
  - Optimizing for who / what
  - Guarding against unintended consequences
  - Performance and security concerns

VCC Supports Deployment Process

Design & Test



Deploy & Evaluate



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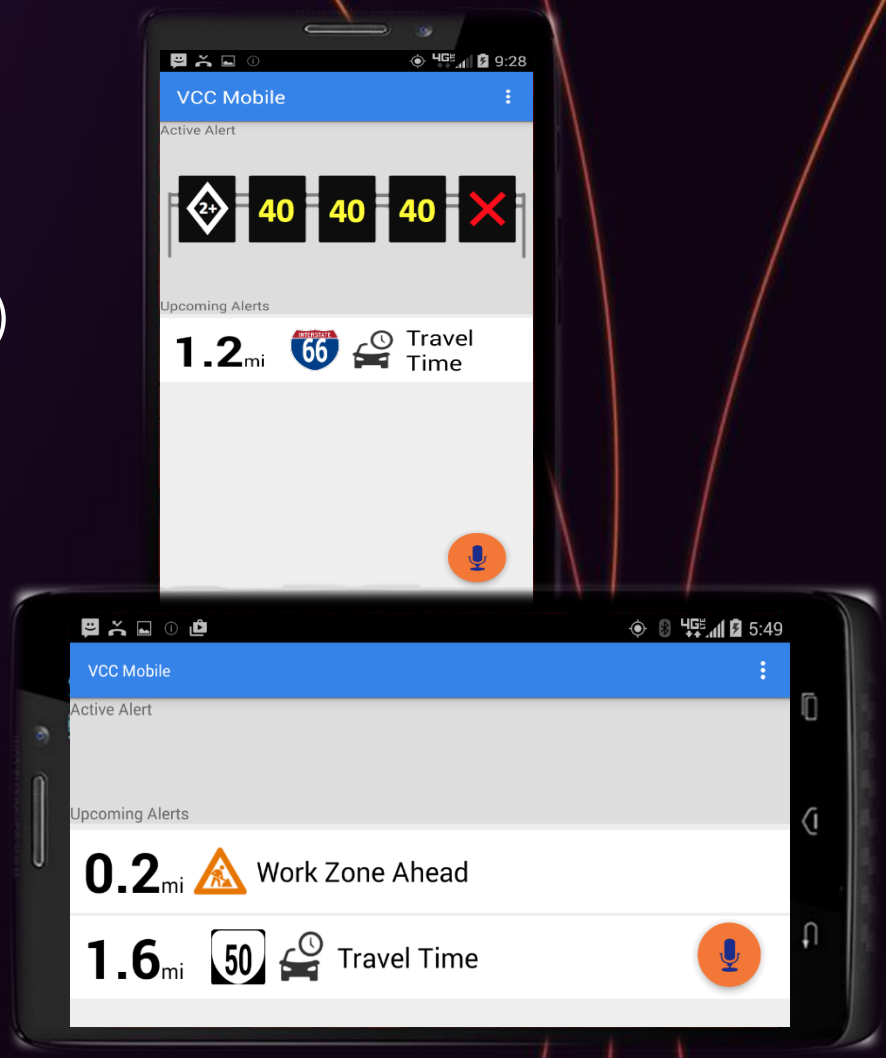
VCC Mobile App

- Smart Phone App
  - Cellular + DSRC (requires link to OBE)
    - All advisory level information
    - Collision warning alerts
  - Cellular-Only
    - Advisory level information
- VDOT TOC messaging:
  - Work Zones
  - Weather Advisories
  - Traffic Incidents
  - Dynamic Message Sign Content
  - ATM / HOV Status and Alerts
  - Driver Reported Conditions
- No geographical limitations
  - Basic capability works state-wide
  - Practical limitation is source data for messages
- Available on Google Play for invited users



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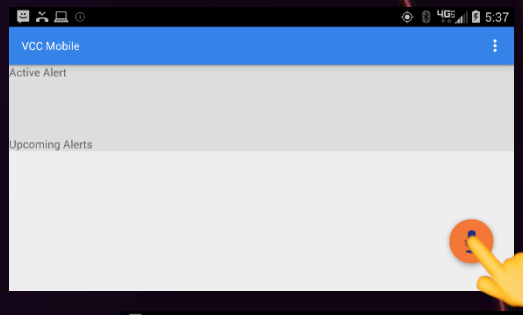
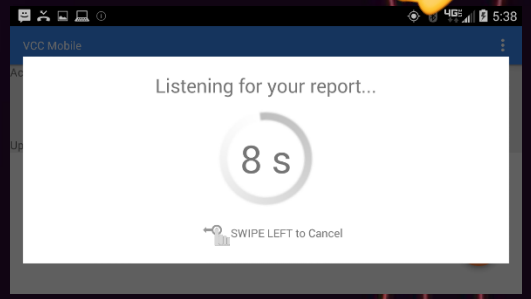
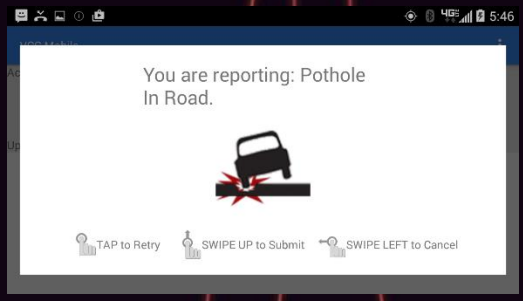
Speech Recognition / Reporting

Reporting Process

1) Driver initiates report via tap
2) Speech to text conversion
3) Text mapped to intent (expandable list of intents)
4) Probability and intent mapping returned to mobile app
5) Intent presented to driver
6) Re-try?
7) If success, transmit intent, location and time to VCC Cloud
8) Event validation
9) VCC Cloud creates TIM







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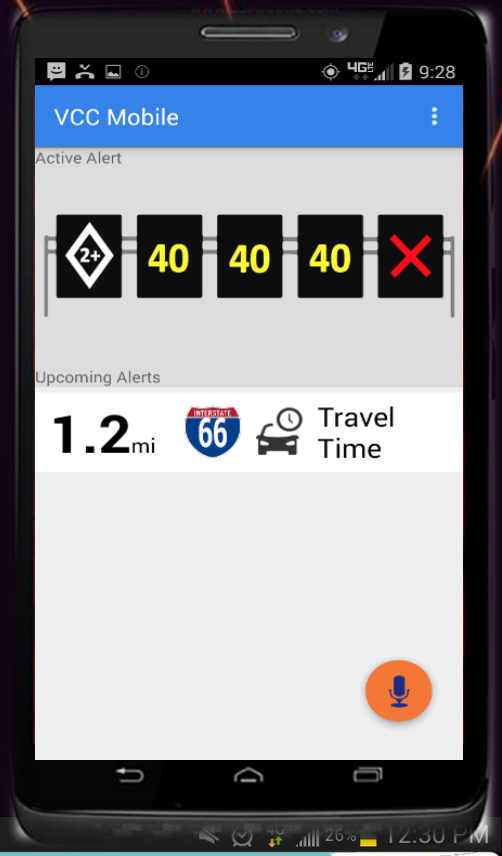
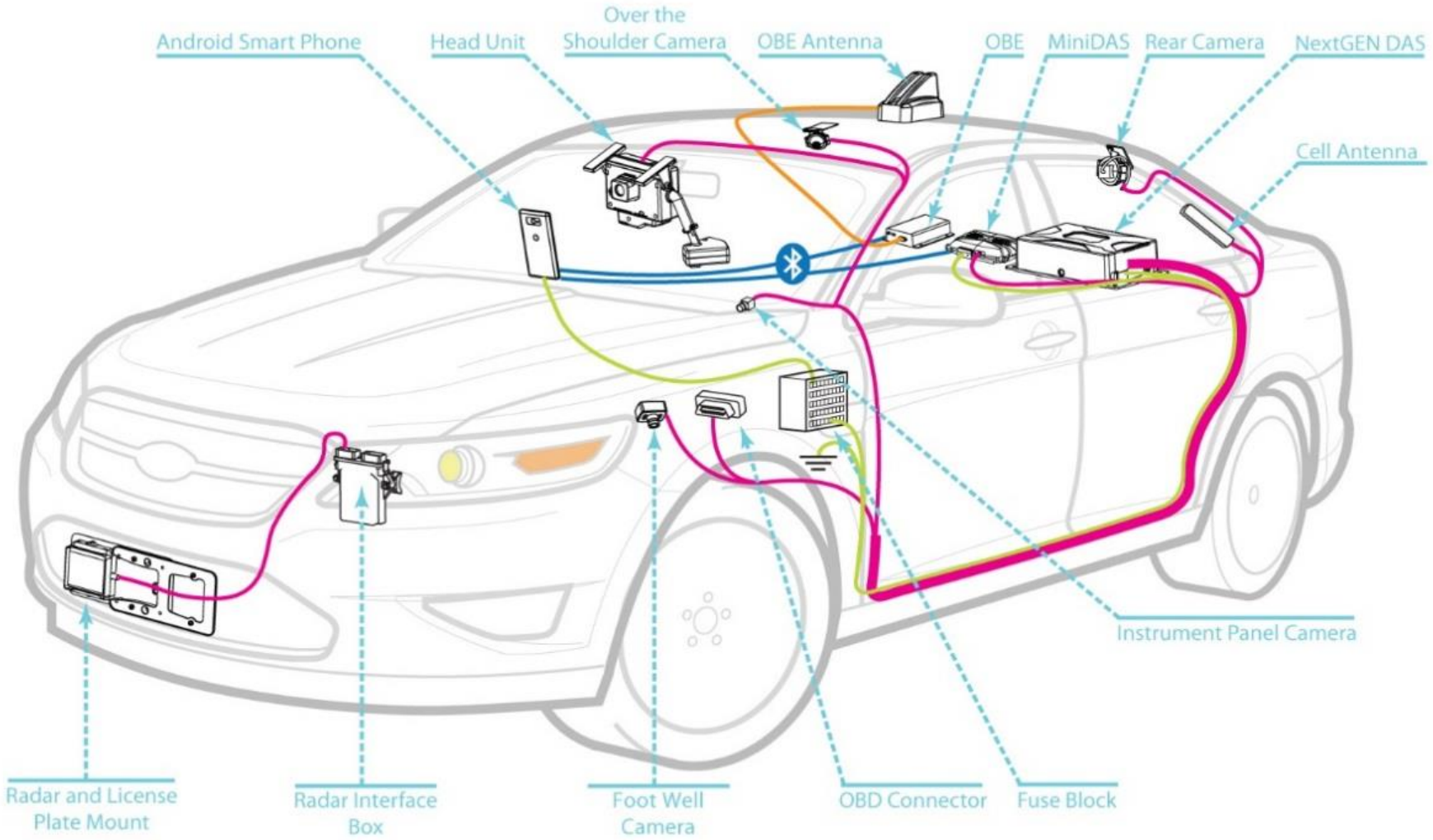
Safety Evaluation

- Address potential concerns regarding potential driver distraction
  - Current trend towards viewing maps while driving may have safety impact – what alternatives exist?
  - How do drivers respond to additional info?
  - How does prototype user interface/interaction affect safety?
- 50 vehicle deployment and safety evaluation
  - Full naturalistic driving data collection suite
  - 12 months of data collection with baseline period
  - Cameras, sensors, links to app usage logs
  - Evaluate relative crash risk when using the application



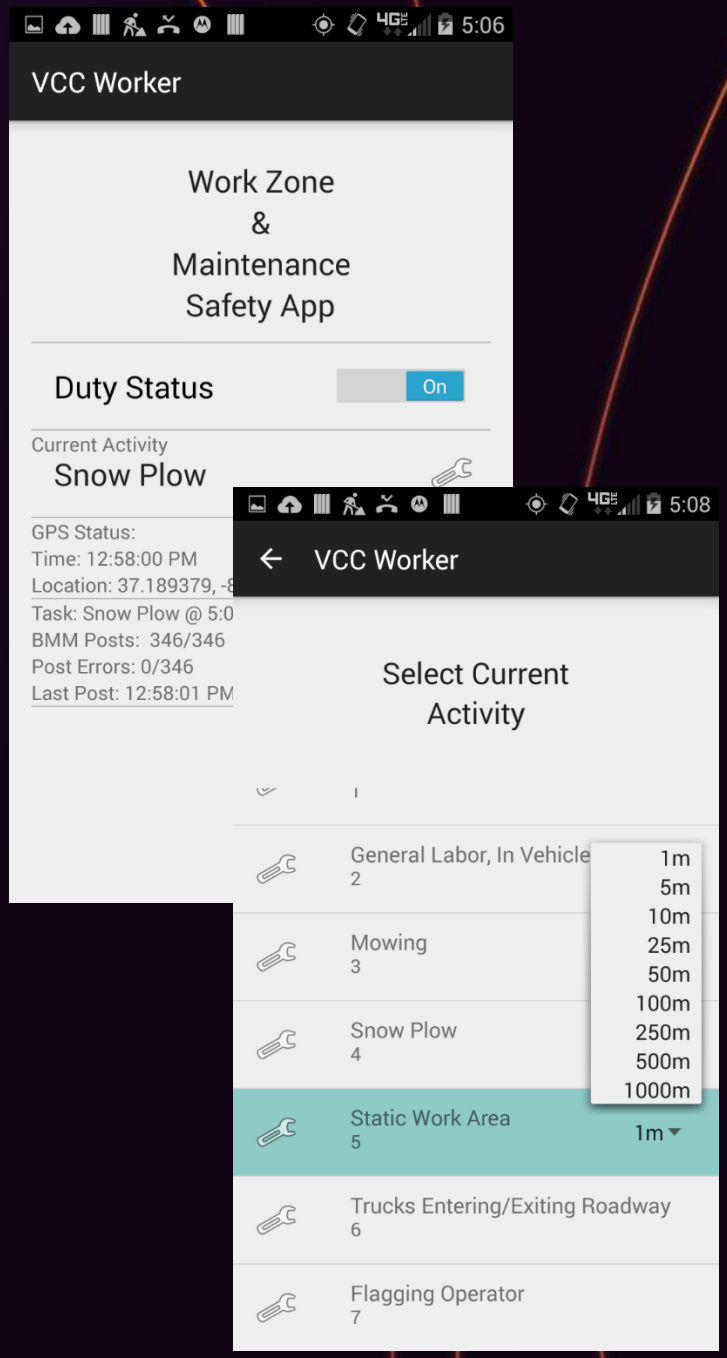
sedan wiring diagram

- Component Cables
- Power and Ground for Components
- OBE Antenna Cable
- Bluetooth Connection



VCC Work Zone App

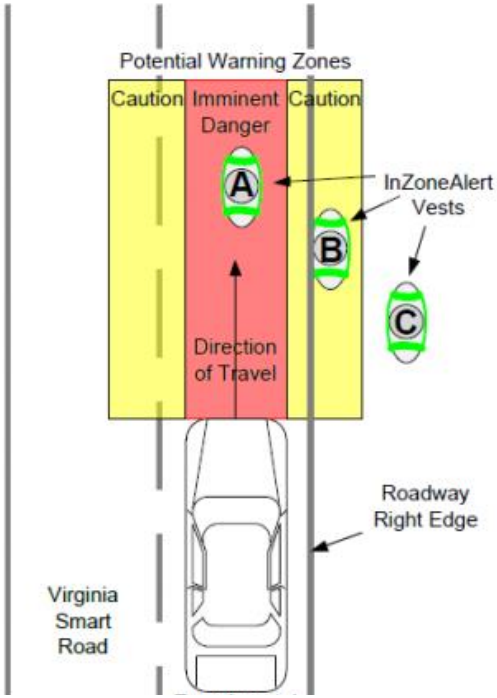
- Location and status updates from smart phone with app (for now)
  - Select an activity
  - Select duty status
- Work Zone app sends position and activity data to VCC Cloud
- VCC Cloud processes messages and creates advisories and streaming alerts for drivers
- Messages are conveyed to VCC Mobile app to display to driver based on position, speed, direction, etc.
- Easily expandable activity set



- VCC Cloud builds dynamic traveler messages and pushes them to drivers via DSRC or Cellular
- Work Zone app clusters multiple workers together if necessary
- When close, locations of individual workers or clusters are streamed to VCC Mobile for higher precision display
- Layout status is updated every 10 seconds

Connected Worker Solutions

- Integrate GPS and DSRC or Cellular into personal protective equipment
- Worker and passing vehicles independently determine and exchange position information
- Calculate likelihood of collision and issue alerts based on the situation
- Warn the worker through audio, flashing led lights, haptic depending on urgency



Data and Access

- Messages collected and archived
  - Basic Safety Message – 10 Hz, Part I and Part II messages
  - Basic Mobility Message – all, variable rate and content
  - Traveler Information Messages – all messages statewide
  - Probe Data Messages – all, variable rate and content
  - Probe Data Management Message - all
  - Dynamic Interrogative Data Capture – all
  - Driver Reports and Usage Logs
  - VDOT Data Inputs – VDMS, travel times, incidents, work zones, weather
- Open Access, non-PII data
  - Real time - 3rd party public API
    - Message queues and streaming
    - Persistent data storage
  - Data archive
    - DB2 storage archive
    - Internal access with VDOT approval

Summary of VCC Progress

- ✓VCC Cloud is functional
  - Cloud environment is active and running
  - Public interfaces for data to / from the cloud
  - DSRC and cellular enabled
- ✓VCC Monitor provides situation awareness of activity and incidents occurring on the VCC
- ✓VCC Mobile offers a extendable mobile platform that is ready to be tested for safety impact
- ✓VCC is being populated with messages from data sharing site and TOC for presentation to drivers
- ✓VCC Worker Application provides a variety of tools to locate work zone hazards and message passing drivers
- ✓APIs are complete - each component above was built using the APIs and they can be used as 3rd party reference applications
- ✓Pilot deployment and safety evaluation are underway

Future Work

- Complete our work on traffic signal related applications
  - Personal Signal Assistant / Red Light Violation Warning
  - Integrated Signal System
  - Transit Signal Priority
- Expansion of crowdsourced data collection and analytics
  - Infrastructure condition detection
  - Traffic safety hot spots
  - Adverse and unusual condition detection
- Expand work zone safety developments
  - Advanced prototypes and demonstrations
  - Working to implement contractor input
- Automated vehicle deployment support

Thank You

Dr. Michael Mollenhauer
Virginia Tech Transportation Institute
mmollen@vt.edu
(970)227-3373