In 2014, VDOT and VTTI introduced the Virginia Connected Corridors (VCC) initiative. It 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
VCC Open Cloud Environment

VDOT Resources
- Northern VA Traffic Operations Center
  - TOC Controllers Operating:
    - Signal Phasing
    - HOV Lanes
    - Ramp Meters
    - Changeable Signs
    - Incident Management
    - Maintenance Activity
    - Etc.
- VDOT Data Sources
  - Incident Reports
  - Weather Events
  - Work Zone Locations
  - Dynamic Message Sign Content
  - Limited Traffic Data
- New VDOT Traffic Operations Support Applications
  - TOC Support Applications:
    - Queue Detection and Warning
    - Weather Event Detection
    - Probe-Enabled Monitoring
    - Incident Detection and Mgmt
    - Work Zone Safety Mgmt
    - Etc.

System APIs
- Message Queues
- Redis Cache
- Persistent Data

VCC Cloud Computing Environment
- System DB
- Other National Deployments
- US DOT Research Data Exchange

Mission Control
- System Monitoring
- Asset Management
- Data Visualization

Android Cell Phone
- Visual Display
- Audio Display
- Text to Speech Msgs
- Speech to Text Reports

3rd Party App Provider

RSE’s

VTTI Data Center

OBE’s

New VDOT Traffic Operations Support Applications

TOC Support Applications:
- Queue Detection and Warning
- Weather Event Detection
- Probe-Enabled Monitoring
- Incident Detection and Mgmt
- Work Zone Safety Mgmt
- Etc.
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

Current Test Bed
Future Expansion of 25 Wireless Roadside Units (2014 Completion)

GAINESVILLE

DEPLOY!
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
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
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
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.

- 200 ft: Road Work Ahead, Lane Shift Left
- 400 ft: Active Work Area, Workers on Roadside
- 500 ft: Active Work Area, Workers on Roadside
- 1000 ft: Trucks Entering/Leaving Roadway
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

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