Enhancing Work Zone Safety through Connected and Automated Vehicles

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Virginia Connected Corridors
**Transportation Needs**

- **Reduce recurring congestion**
  I-66 corridor currently experiences average travel speeds of approximately 40 mph during the peak periods.

- **Increase travel reliability**
  I-66 has a PTI value over 3 during both the morning and evening peak periods.

- **Reduce non-recurring congestion**
  Incident duration in the Northern Region has averaged 52 minutes over the last year.

- **Reduce crashes**
  Facilities within the VCC experienced 2961 crashes (5 fatal and 70 severe injury crashes) in 2014.

**VDOT Performance Measures & Goals**

- **Delay**
  Vehicle Hours of Delay
  GOAL: Reduce this.

- **Reliability**
  Planning Time Index
  GOAL: Reduce PTI.

- **Duration**
  Incident Duration
  GOAL: Reduce incident duration by 5 min in 5 years.

- **Safety**
  Number of crashes
  GOAL: Reduce fatal & injury crashes by 3% per year (from 2010 baseline).

**CV Applications**

(Priority indicated within parenthesis)

- **Advanced Traveler Information**
- **Work Zone Alerts for Drivers and Workers**
- **Incident Scene Alerts for Drivers**
- **Red Light Violation Warning System**
- **Queue Warning**
- **V2V – Forward Collision Warning**
- **V2V – Emergency Electronic Brake Light**
- **Parking Availability**
- **Probe Enabled Traffic Monitoring**
- **Integrated Traffic Signal System**
- **Transit Signal Priority**
- **Emergency Vehicle Preemption**
VCC Mobile App

- Smart Phone App (Android-only for now)
- Cellular + DSRC (requires link to OBE)
  - All advisory level information
  - Warning alerts
  - High-rate BSM
- Cellular-Only
  - Advisory level information
  - Low-rate BMM
- Messaging to Support:
  - Work Zone Details
  - Weather Advisories
  - Traffic Incidents
  - Dynamic Message Sign Content
  - Driver Reported Issues
- No geographical limitations
  - Basic capability works state-wide, nationally
  - Practical limitation is source data for messages
Mobile App Capabilities

- Geo trigger of message presents full message text with optional text to speech annunciation
- Message queue shows upcoming content with short description, distance to, and type classification
- Swipe messages to delete from queue
- Press button to make verbal reports of incidents and conditions (uses AI intent mapping algorithm and training system)
- Captures driver usage logs for safety analysis
- Deployed through Google Play Store
VCC Work Zone App

- Workers could carry 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
  - Service vehicles
  - Emergency services
  - School buses
• 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
Design Challenges

- Lightweight and durable
- Positioning accuracy
  - Standard GPS not precise enough for imminent crash warning
  - Explore alternate localization options
- Battery life / power expansion
- Antenna occlusions
- Communications mode
  - DSRC – fast, accurate, may require infrastructure
  - Cellular – ubiquitous coverage, no additional infrastructure, latency may be issue with alerting
- Cost to procure and maintain
Questions?