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Virginia Transportation
Research Council

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Connected Work Zone Efforts in Virginia

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Connected Work Zone Activities in Virginia

- Work zone safety remains a top priority for VDOT.
- The Virginia Tech Transportation Institute is a key partner for VDOT for work in the CAV space.
- VTTI and VDOT have been working together to improve work zone safety for more than 15 years through the innovative use of technology.

Connected Work Zone Systems

- Smart Work Zone Field System
  - Base Station
  - Smart Vest
  - Smart Helmet
  - Smart Cone
  - Equipment Unit
- Move Over Law System
- Work Zone Builder Application
- Automated Truck Mounted Attenuator (ATMA)

Base Station

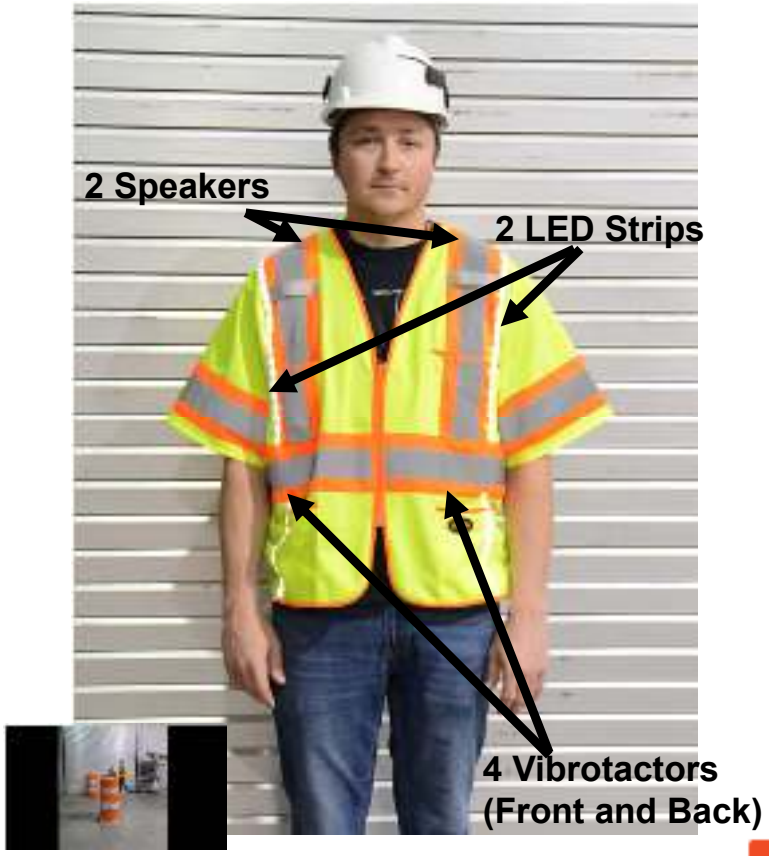
- Wireless mesh network integrates with other devices
- 4G module for communications to cloud
- GPS+RTK module
- Can be mounted on vehicle, infrastructure, or temporary trailer
- C-V2X roadside unit functionality broadcasts worker presence and collision warnings to passing vehicles

Smart Cone

- Wireless mesh network integrates with base station, extends communications range
- GPS+RTK module
- Auto-defines boundaries of geo-fenced safe area
- Currently not MASH tested
- A portable geo-plotter can also be used to define the “safe zone” for the system

Smart Vest

- Wearable ANSI Class 3 system to localize and communicate with roadside workers
- Wireless mesh network integrates to base station
- GPS+RTK module
- Inertial measurement unit
- Redundant modes of warning
  - Vibrating motors
  - Chirping buzzer
  - LED illumination
- 8 oz, 22 hours battery life



Smart Helmet

(Under Development)

- Wearable system that integrates with Kask helmets
- Does not interfere with other accessories
- Wireless mesh network integrates to base station
- GPS+RTK module
- Inertial measurement unit
- Redundant modes of warning
  - Vibrating motors
  - Chirping buzzer
  - LED halo illumination over visor
- 6 oz, 16 hours battery life

Equipment Unit

- Magnetic base attaches quickly to equipment
- Wireless mesh network integrates with base station
- GPS+RTK module
- Inertial measurement unit
- Provides warnings to workers when they are close and equipment starts moving

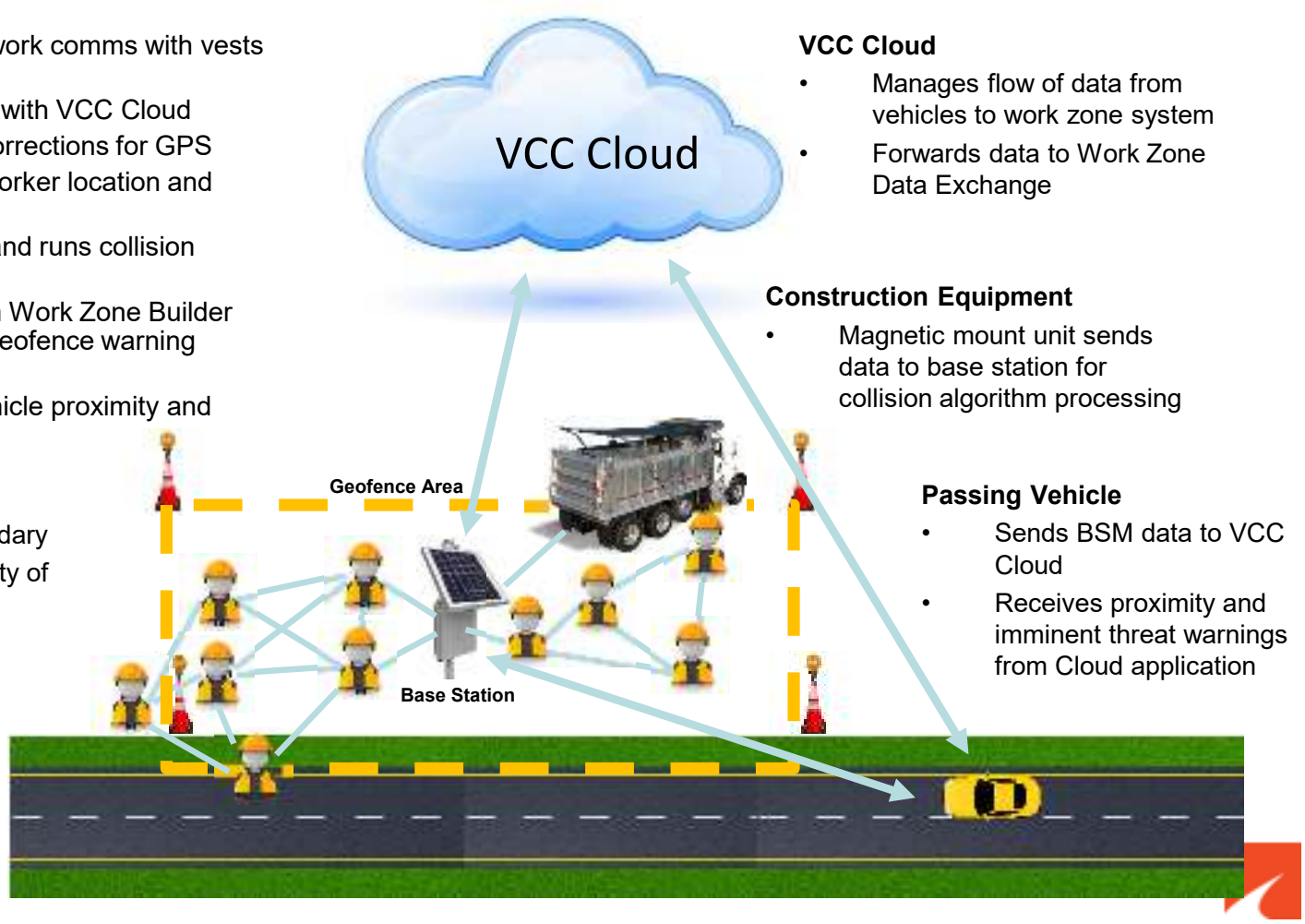
Smart Work Zone Overview

Base Station

- Manages wireless mesh network comms with vests and helmets
- Manages 4G cellular comms with VCC Cloud
- Receives and applies RTK corrections for GPS
- Processes and aggregates worker location and movement data
- Receives vehicle BSM data and runs collision warning algorithm
- Receives geofence data from Work Zone Builder and/or geo-plotter and runs geofence warning algorithm
- Sends vests and helmets vehicle proximity and collision warnings

Smart Cones

- Auto-define geofence boundary
- Expands range and reliability of mesh network



VCC Cloud

- Manages flow of data from vehicles to work zone system
- Forwards data to Work Zone Data Exchange

Construction Equipment

- Magnetic mount unit sends data to base station for collision algorithm processing

Passing Vehicle

- Sends BSM data to VCC Cloud
- Receives proximity and imminent threat warnings from Cloud application

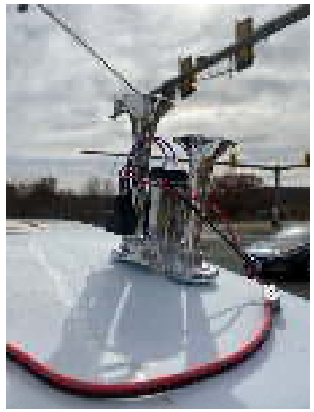
Move Over Law System

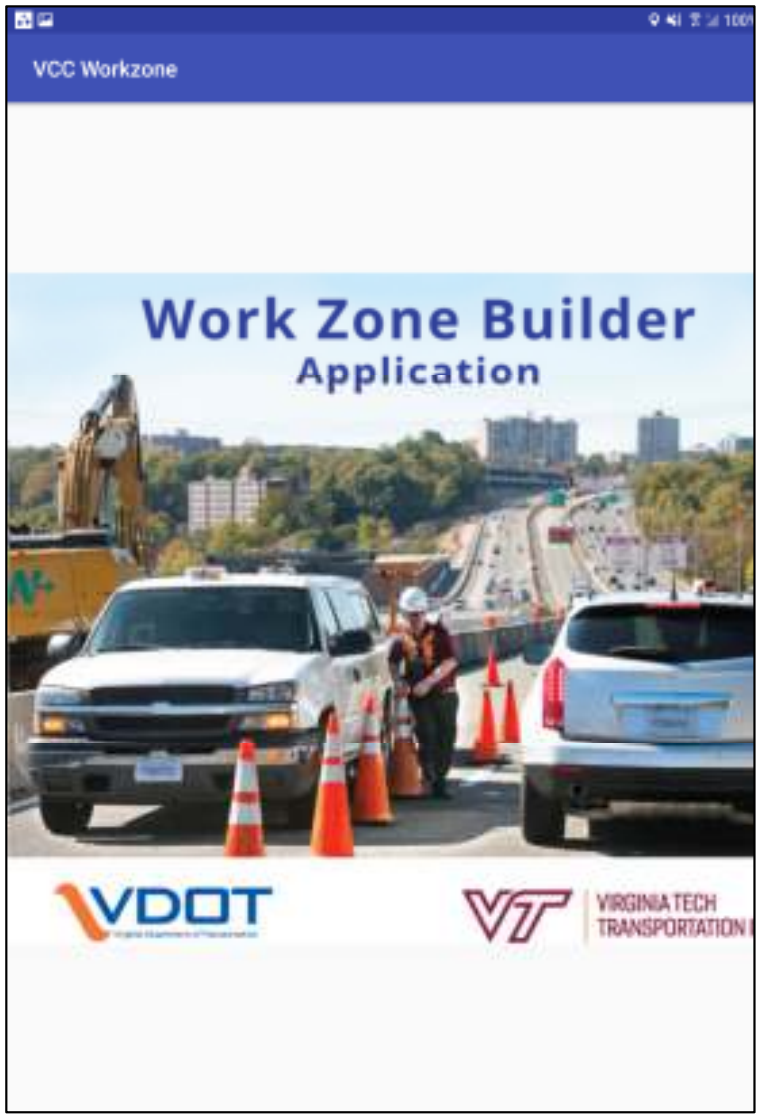
- Develop a system that can be mounted on roadside vehicles to evaluate compliance with VA's Move Over Law requirements and warn workers
- Currently evaluating system under varying traffic and environmental conditions and develop potential warning solution for roadside workers based on trajectory of approaching vehicles

Field Applications

Field testing of base system in live work zone in Wise, Virginia

High speed warning system in Afton, VA



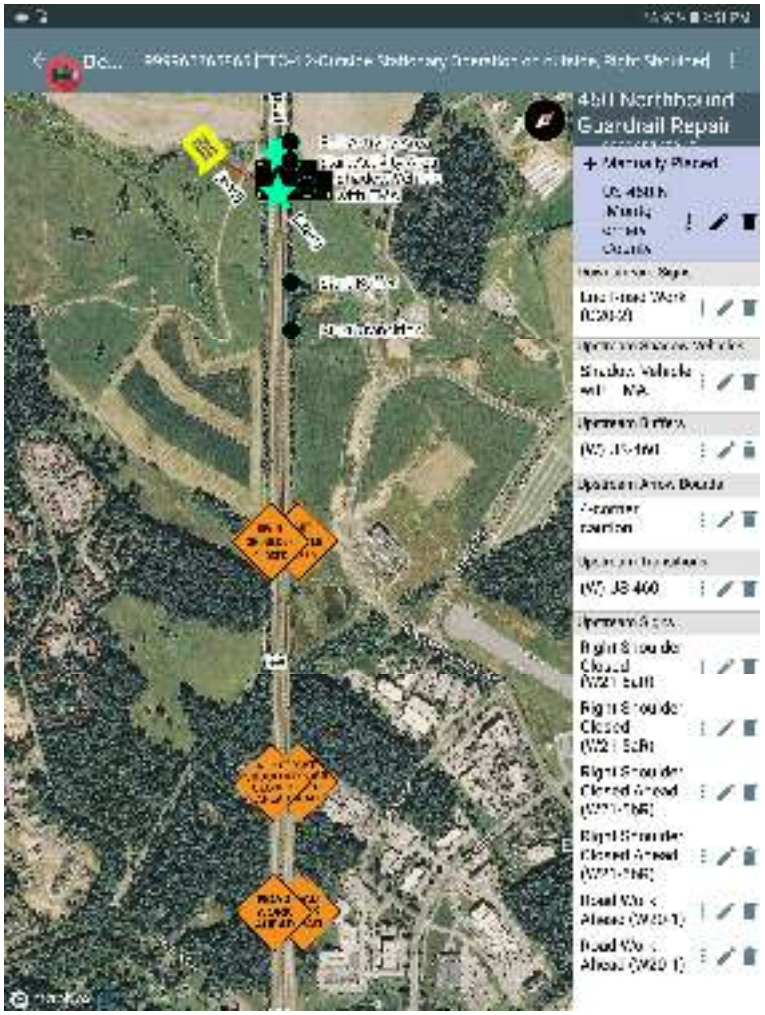


Work Zone Builder Application

- Tablet-based application to create and manage work zone plans
- Produce data that connected and automated vehicles will need to safely navigate work zones
- Streamline submission, review, and approval processes
- Provide a means to source work zone data for **maintenance** activities
- Create an app that work zone managers want to use
- Provide a means to source data for Work Zone Data Exchange and 3rd party applications

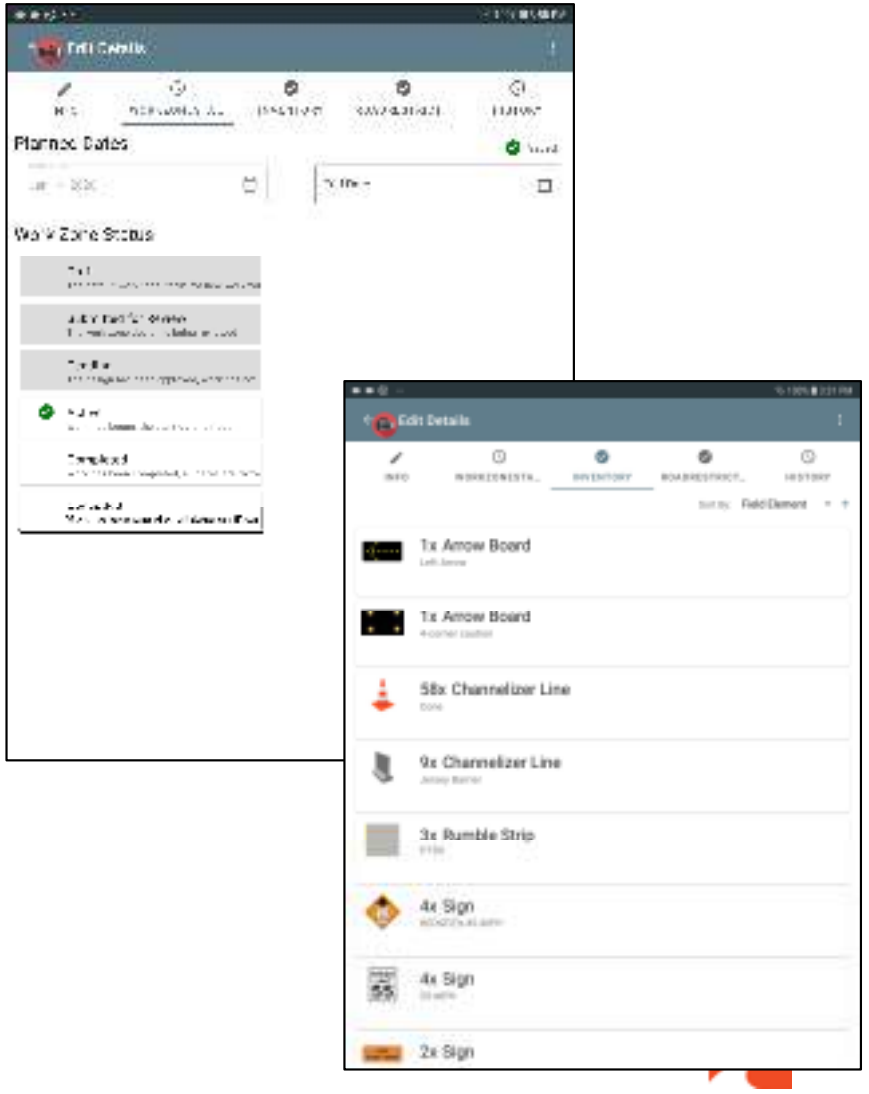
Design Mode

- Select activity area and apply TTC template
- Adjust positions of existing features
- Add new features from palette
- Mirror inside / outside templates
- Clone bi-directional templates
- Add notes to features
- Automatically add geofenced areas that will integrate with Smart Vest system



Management Mode

- View / set status of work zone
  - **Draft**
  - **Submitted for Review** – makes available for VDOT inspector to review
  - **Pending** - automatically sends data to a WZDX and VDOT's lane management systems (minimal integration)
  - **Active** - automatically generates connected vehicle messages for first sign, any lane changes, and activity area. User toggles **Worker's Present** field as appropriate
  - **Completed** – sends notification of complete
  - **Cancelled**
- View work zone inventory
- Set roadway restrictions
- View edit history and audit history
- Update worker presence status



Field Mode

- Use GPS to navigate to, position, and validate work zone features
- Update plans to reflect field adjustments made to address site conditions
- Communicate status electronically to TOC
- Capture imagery to further document the design

Automated TMA Program

- Consortia formed to co-fund development of automated TMA prototype
- Freeway operations, HMI, robust safety features
- Multi-phase program
  - Phase 1: Design, build, and demo leader-follower ATMA System (complete)
  - **Phase 2: GPS-Denied operations and reduced cost (current)**
  - Phase 3: Testing on public roadways in live work zone operations (spring 2023)
- Targeted Outcome
  - IP package suitable for commercialization

VDOT Virginia Department of Transportation

Transurban

DCS DeANGELO CONTRACTING SERVICES

SAFE-D SAFETY THROUGH DISRUPTION

VTTI Work Zone of the Future Video

Questions?

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