Technical Brief on Connected Work Zones

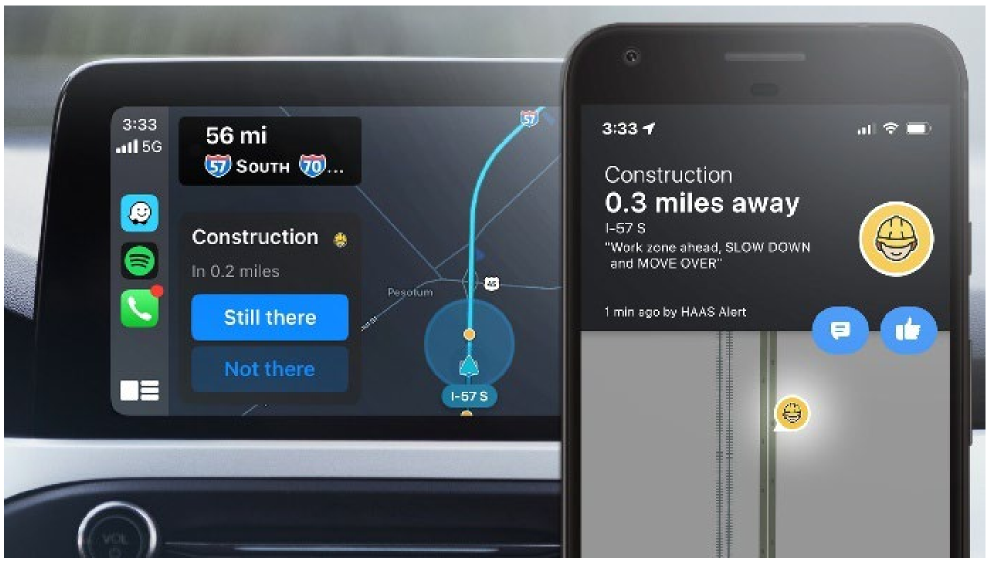

Image Source: HAAS Alert

Developed by the American Traffic Safety Services Association

ATSSA
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Introduction

Over the past several decades, agencies have implemented smart work zone systems that collect field data, process information, and communicate real-time messages to road users through technologies such as queue warning systems and portable changeable message signs. These systems, also referred to as work zone intelligent transportation systems (ITS), continue to provide operational and safety benefits by helping reduce congestion, delay, and crash potential approaching or within work zones.

In recent years, advances in communications and connected technologies have further expanded the capabilities of work zone management and operations. Agencies are increasingly deploying connected devices that transmit real-time information to centralized servers, enabling in-vehicle systems and other platforms to relay alerts and work zone conditions directly to drivers. These technologies support the concept of the "connected work zone," which consists of technologies and infrastructure used to generate, collect, distribute, and communicate work zone information to both the traveling public and connected vehicles.[1]

The concept of the fully connected work zone has continued to evolve, and agencies have developed specifications and guidance supporting full connected work zone deployment. However, agencies interested in implementation may choose to begin with a single connected device, such as a smart arrow board, before deploying a fully connected system. In many cases, deployment of connected work zone technologies is also supported by vendors and manufacturers that provide both technical solutions and implementation guidance to assist agencies during the adoption process.

This document is intended to assist state and local practitioners by summarizing available guidance and providing considerations for implementation of connected work zone devices and systems. It highlights field applications of connected technologies, summarizes considerations for broader deployment of connected work zones, and provides resources for practitioners interested in implementing connected work zone technologies. This document is part of a series of products developed under the 2023 Federal Highway Administration (FHWA)-sponsored American Traffic Safety Services Association (ATSSA) Work Zone Safety Grant.

Work Zone Data and Information Processing

The Work Zone Data Initiative (WZDI) was launched in 2016 in response to the need for more consistent access to information regarding work zone activity. In 2018, the FHWA created the Work Zone Data Exchange (WZDx) Specification through a collaborative,

[1] https://www.ite.org/technical-resources/standards/cwz/

community-driven process involving Federal and State transportation leadership, institutional partners, and industry. The purpose of the WZDx was to streamline communication of work zone data between infrastructure owners and operators and third party data consumers, in service of a broad range of uses including interjurisdictional operations management, traveler information, analytics and research, and navigational guidance for automated driving systems (ADS). The process of creating the WZDx encouraged transportation agencies to upgrade traditional dissemination methods (such as through 511 systems) to produce WZDx-compliant feeds. This approach was well-received as part of a shared goal towards improved safety, mobility, and efficiency on public roadways through ubiquitous access to data on work zone activity. As of June 2026, approximately 25 State and local agencies are producing data feeds based on this specification.

After WZDx adoption by several agency and industry participants, FHWA turned to the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), the National Electrical Manufacturers Association (NEMA), and SAE International (formerly the Society of Automotive Engineers) to formalize the principles established for WZDx as an official standard. ITE published the Connected Work Zones (CWZ) Implementation Guide and Standard to provide guidance to enable deployment of consistent CWZ environments across institutional and organizational boundaries. A broad group of stakeholders provided guidance, input, and review of the Implementation Guide, ultimately providing a document that focuses on interoperable data exchanges between the various components of the connected work zone. The transition from the WZDx effort toward the ITE Connected Work Zone Standards was largely driven by the need to move from a data specification concept into broader real-world deployment and operational guidance, and accommodated the introduction of both an "event feed" to describe work zone activity, and a "device feed" to standardize communication of information by connected hardware devices.

Figure 1 shows how the data exchange architecture is designed. The standard includes two types of data feeds as shown below.

WorkZoneFeed – Provides high-level information about events on roadways related to work zones that impact the characteristics of the roadway and involve a change from the default state (for example a lane closure).

DeviceFeed – Provides information (location status, dynamic data) about field device deployed on the roadway in work zones. Primarily intended for devices owned by

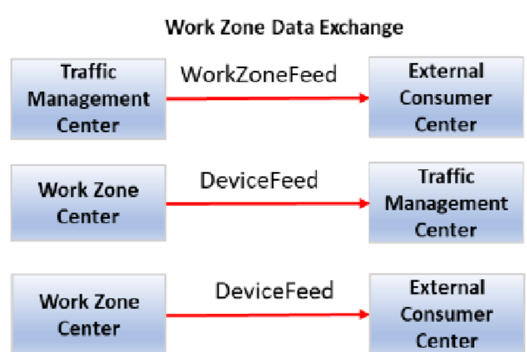

Figure 1. Connected Work Zone Standard Data Exchange Architecture (Image: ITE)

contractors to improve accuracy and situational awareness. Does not provide ability to control devices (view only).

The Implementation Guide defines several common terms for connected work zones, including the following examples.

Components: Hardware or software (may be subdivided into other components).

Interoperability: The ability of two or more systems or components to exchange information and to use the information that has been exchanged.

Work Zone Devices: Devices and electronic systems that monitor and affect work zone operations on a roadway, such as arrow boards, location marker devices, and connected vehicle (CV) roadside units.

Work Zone Center: Centers that directly collect information from field devices, users, or vehicles to generate a composite view of work zone status and field conditions.

Work Zone Vulnerable Road User (WZVRU): A class of persons at risk of harm in a work zone that are unprotected by an outside shield. In part, WZVRUs include workers wearing devices that are able to communicate with a work zone center, work zone equipment, and/or vehicles.

The Implementation Guide provides an overview of key stakeholders (transportation and IT related), a concept of operations and related operational scenarios, and a physical architecture for data collection and distribution. In addition, the document describes data exchange needs for the work zone, including information on devices, vulnerable users, activity status, speed limit, open and closed lanes, and work zone location.

Agency Implementation of Connected Work Zone Devices

A fully connected work zone can include elements such as work zone start and end markers (within the advance warning and termination areas), arrow boards (e.g. at a merging taper), speed limit displays (on approach to the activity area), speed feedback displays (within the activity area), and worker presence indications (within the work space). Each device typically has its own cellular communications equipment to provide location and status information to a central location such as a Traffic Management Center (TMC). The data is then pushed to the WZDx, third party applications, mapping and navigation tools, and other traveler information systems such as 511 as shown in Figure 2.

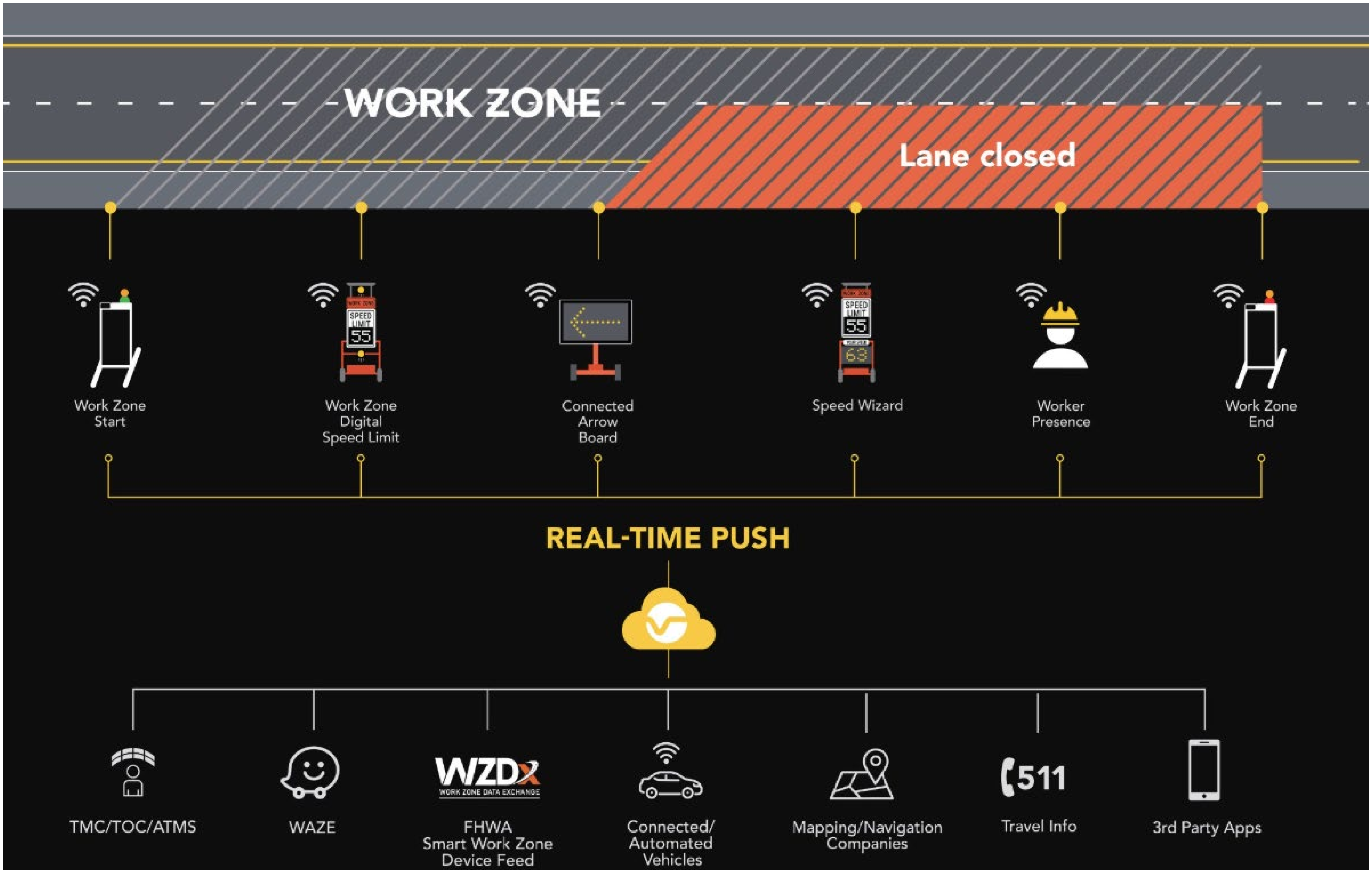

Figure 2. Example of a Fully Connected Work Zone (Image Source: Ver-mac)

While several vendor options are currently available for connected work zones and devices, it is important to note that interoperability of hardware and software can be achieved without preference for one device over another. This approach allows agencies to deploy connected work zone technologies while still providing for a competitive market for devices and other hardware and software. In addition, some agencies outsource processing of all transportation-related data to a third party, and systems can be designed to ensure compatibility with any provider.

The following sections outline considerations for agencies interested in deploying connected work zones. While some vendor-specific examples and photos are included, no preference is indicated or implied. The examples are only used to illustrate the concepts outlined. The examples are separate by level of deployment.

Level 1: Single Connected Device. Some agencies elect to implement connected work zones by starting with one device – typically a connected arrow board. Starting simple will allow for early benefits and establishment of lessons learned. The features of an arrow board can be used to provide information about the work zone. For example, if the arrow board is in an appropriate mode to indicate a lane closure (flashing or sequential arrow, sequential chevron, or double arrow mode), the data can be processed into specific messages. The device may also send data showing the caution mode application, such as for shoulder closures or other locations where lanes are not closed but work activity may be present. These messages alert drivers to better plan routes or to increase attentiveness and awareness of capacity restrictions that may have safety risks due to queuing.

Develop a specification for the device. In order to deploy connected devices such as arrow boards, agencies develop device specifications based on the desired outcomes. These specifications can also be expanded as more experience is gained. For example, the Iowa DOT developed a Smart Arrow Board Guidance Document that links to their specification for use. In addition to the arrow board mode information, the connected arrow board uses global positioning system (GPS) technology for latitude and longitude within 30 feet of the device location. The arrow board uses defined technical communications protocols to send information to a central server for processing. Agencies can use specifications for other devices as they expand implementation.

The Wisconsin DOT integrated connected work zone requirements into the agency's approved products list. The requirements cover connected arrow boards, connected arrow board retrofit kits, and connected work zone location markers. These devices are used under a provisional approval process. The requirements include cloud-based data storage, a WZDx compliant data feed (specification 4.2), data updates every minute (minimum), and arrow board status indication requirements.

Level 2: Multi-Device Integration. Agencies can also specify work zone start and end location markers for stationary work zones (Figure 3). This allows for real-time reporting of work zone locations and documentation of exposure for use in work zone performance assessment and programmatic reviews. The location markers are equipped with similar cellular communications technology to the connected arrow boards. The starting marker is typically placed near the first advance warning sign, and the ending marker may be placed near the end road work sign or near the last channelizing device in use. The beginning and end of the work zone can be communicated to users through an audible notification based on the data sent by the markers. These messages typically include "work zone ahead" and "work zone start" or "work zone end."

Figure 3. Work Zone Location Marker (Image Source: Ver-mac)

Establish a work zone posted speed limit. Work zone speed limits may change based on the conditions and activity or inactivity to garner greater user compliance. By placing a digital speed limit trailer in the advance warning area, personnel can activate the reduced work zone posted speed limit as appropriate for the conditions. For example, nighttime paving operations may include a ten mile per hour reduction in posted speed limit as communicated by the device, but only during periods when workers are present and operating.

Traditionally, when posted speed limits change during the activity period, a field worker would activate the speed limit display. Agencies can automate this process or change the speed limit remotely by using the connected digital speed limit device, thereby reducing worker exposure. Technology allows for efficiency in the process and more consistent application to maximize user compliance with posted speed limit reductions.

Provide real-time feedback to motorists. Agencies specify speed feedback displays for providing visual cues to motorists on their speed relative to the posted speed limit. The connected speed feedback device can also send data to a central server to capture information for measuring work zone performance, as applicable and as related to existing agency-developed performance measures. This feedback keeps drivers alert and draws attention to the reduced speed limit in the active work zone.

Power needs and device maintenance. Devices must be maintained to ensure proper power and uninterrupted connectivity. Connected work zone devices are typically charged using solar technology, and will operate for extended periods due to energy efficient technology (including common DSL communications devices). Wearable devices rely on battery power and typically need to be recharged manually.

Level 3: Automated Activity Status. Accurate communication of work zone activity status is essential for enforcement, compliance, and worker safety, especially when deployed zones alternate between active and inactive periods. To communicate the activity status to users, workers may wear connected apparel (also referred to as wearables) or use devices placed in their pocket that indicate the activity status. In addition, technologies on equipment can detect and verify activity status and provide similar information to the central processing server (Figure 4). These activity monitoring techniques can all result in real-time messages to users as they navigate the work zone. This concept can improve worker and road user safety by alerting the presence of workers and work equipment. It can also reduce worker exposure by eliminating the need to cover and uncover posted speed limit signs when the work changes between active and inactive status.

Local laws and agency policies may also indicate definitions for “workers present” in that there may be additional penalties that apply for certain violations. The definition may include locations where workers are near the roadway and not protected by a barrier or similar positive protection device.

Another technique for capturing work zone activity status is through a smart phone application accessed by workers on-site. For this process, workers “check in” on the application on their phone to indicate that work activity has begun. Workers then “check out” to indicate that work activity is now inactive. Though, this process relies on human intervention, and the application must be toggled correctly to ensure accurate information can be provided to users.

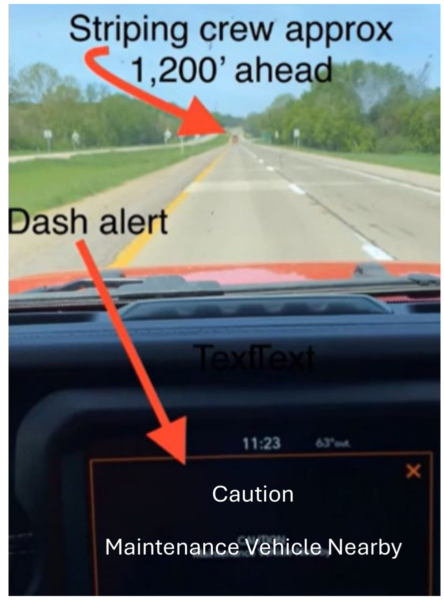

Figure 4. Example Real-Time Alert Messages (Image: Michigan DOT)

Level 4: Fully Integrated Interoperable Work Zone. Other devices that are typically used in work zones can also be part of the fully connected work zone concept. For example, real-time information on one-lane, two-way work zones that use portable traffic signals (PTS) or automated flagger assistance devices (AFAD) can also be communicated to motorists. Using the connected devices, applications can alert motorists of the presence of the work zone based on the location of the PTS or the location of the AFAD. In addition, processing systems can generate specific alert messages based on the type of work zone and device in use. For the AFAD, the notification message may be “road work ahead” and the audible message to drivers may say “prepare to stop.” Portable changeable message signs (PCMS) can also be integrated into the fully connected work zone. By expanding implementation of other connected devices, agencies can deploy multiple devices to establish a fully connected work zone.

Integration with digital temporary traffic control tools. Connected technologies can also integrate with digital temporary traffic control plan development tools to streamline data generation for WZDx feeds and set work zone boundaries for connected alert systems. For example, the Virginia Tech Transportation Institute and the Virginia DOT created the **“Work Zone Builder Application,”** which is a tablet-based application to create and manage work zone plans. There are several benefits to Virginia DOT and contractor application of this tool, including providing a means to source data for the WZDx and third party navigation applications. Within Work Zone Builder Application, users can automatically add geofenced areas that integrate with smart devices such as smart vests that alert workers of potential exposure areas as they approach them.

Together, these deployment strategies demonstrate that connected work zones can be implemented incrementally while supporting interoperability, automation, and real-time data dissemination. Agencies can scale from individual connected devices to fully integrated systems aligned with national standards and performance measurement goals.

Connected Work Zone Lessons Learned

Have a system-level approach using a standard specification. For example, a Massachusetts DOT specification includes the speed wizard in advance of the work space or area of concern for greater awareness. Wisconsin DOT specifications do not include the speed wizard. In addition, consideration may need to be made for a single vendor for all devices to ensure interoperability, unless the agency is using a unified WZDx feed or has the ability to aggregate data from different vendors together in a single interface. As a result, many agencies begin with a single connected arrow board specification as a first step. In addition, payment may be based on a unit day per device type.

Data must be reliable. Third party applications prioritize messages that provide a high level of reliability. If notifications do not reflect actual conditions in the work zone, the applications will not prioritize the notifications that are sent to users. This is similar to how drivers verify that an incident is still in place as they navigate the area through a direct confirmation request from the provider. Also, too many alerts may result in user fatigue and reduced compliance. Maintaining accurate and real-time updates is critical to preserving system credibility.

Automated processes provide greater consistency. Some agencies have tested manual markers and work zone activity indications based on manual worker input. One agency noted that workers are more likely to consistently use the “check in” feature on the smart phone app, but more often delayed or did not use the “check out” status in a timely manner. This can be challenging to accurately represent work zone conditions compared with automated processes. Automated detection methods (e.g., wearable devices or equipment-based sensing) provide more reliable representation of work zone conditions and reduce dependency on human intervention.

Connected work zone data can be tailored to commercial vehicles. Work zones present heightened risks for large vehicles due to limited maneuverability, longer stopping distances, and exposure to lane shifts and queue formation. A key user group for the information from connected work zones is commercial vehicle operators. Fatal commercial vehicle-involved incidents in work zones are overrepresented compared with non-work zone fatal commercial motor vehicle-involved incidents. By providing real-time messages to commercial vehicle drivers, technologies allow for improved safety for this specific user group as well as other users. Drivers can adjust their speed in real-time based on the information provided or can be better aware of complex situations for commercial vehicles such as narrow lanes, lane shifts, and slowed or stopped traffic.

Connected work zone data should support performance measurement. While the connected work zone concept does not guarantee improved outcomes or measure performance directly, agencies have a large quantity of device data that can be used to analyze and report on work zone performance. Connected work zones enable data-driven work zone management by providing additional work zone data such as number of work zones or locations of lane closures. Data streams from connected work zone devices can capture key operational parameters, such as lane closure durations, work zone lengths, posted speed compliance, vehicle queue lengths, and worker exposure time. Agencies can aggregate and analyze this information to identify patterns, assess operational efficiency, and support decision-making for future projects. For example, analyzing travel speeds and queue lengths can inform the effectiveness of traffic control strategies, while device utilization data can guide equipment deployment planning. Such data enable benchmarking performance measures, identification of high-risk locations, and documentation of compliance with safety policies and regulations. By integrating connected work zone data into traffic management and reporting, agencies can move toward fully data-driven work zone management, supporting continuous improvements in safety, mobility, and operational efficiency both at project- and program-levels.

These lessons underscore the importance of reliability, interoperability, automation, and user-focused messaging in connected work zone deployments. To support these objectives, details on some specific types of devices and sensing technologies, including proprietary sensors that provide location information and warning of real-time hazards, are provided in the following sections to accompany the connected work zone process information.

Detailed Connected Work Zone Technology Applications

Example Smart Sign Monitoring Application. The smart sign application (Figure 5) typically includes a small sensor attached to the back of a temporary sign to allow organizations to remotely monitor and manage work zone signing. For example, if a sign is knocked down, the sensor relays that information electronically so that a worker can adequately and quickly maintain the sign. The devices can be linked to a portal that not only shows the status of each sign but can also link a standard plan to the layout in the field to ensure compliance.

Figure 5. Guardian Smart Sign (Image: Site2020)

The smart sign application also ensures adequate and consistent signing for each project. The system provides digital documentation of sign placement and condition, allowing for tracking the location and position of signs and ensuring proper sign application and compliance.

Digital solutions for work zone signing also inform CVs of the presence of a work zone ahead. One proprietary example is the *Work Zone Live* system. Through data collected from digital tags placed on work zone devices such as static signs, the system creates a digital representation of the work zone, which then can be referred to for validation and quality control. The exact location of the work zone is shared with various stakeholders. The system is intended to improve availability of real-time information for shorter duration work zones.

A tag is affixed to each sign and can maintain the position for the long term and software can provide a summary of the information so users can monitor deployments. The system also sends information to third-party applications for enhanced traveler information through the WZDx. Worker safety modules generate a trigger in a pre-established digital boundary that allows connected equipment to automatically adjust messages displayed on changeable message signs or work zone speed displays.

Similar to the technology placed on signs, agencies are also using a smart beacon that attaches to work vehicles and provides digital warning to nearby vehicles or in-vehicle systems. This device can transmit location, vehicle-mounted arrow board status, and truck mounted attenuator position (up/down).

Smart Arrow Boards. Smart arrow boards capture data on the location of the beginning of work zone lane closures through position and mode information communicated to a central server. The device is similar to a traditional arrow board, but with the addition of a cellular modem and GPS antenna.

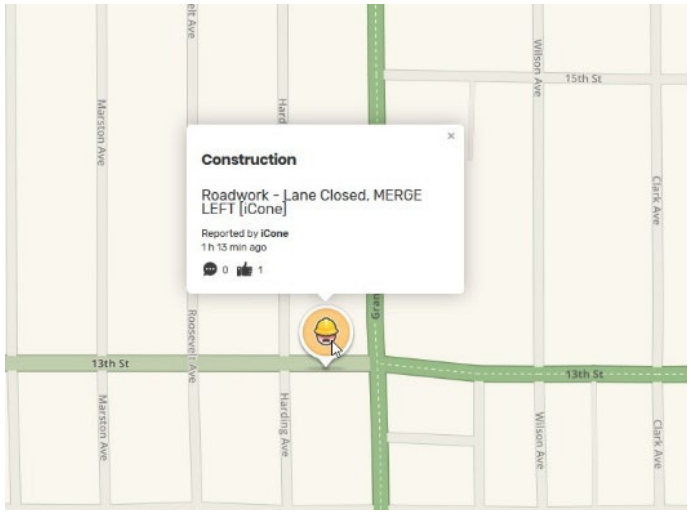

Figure 6. Online Map of Arrow Board Location (Image: Iowa DOT)

Smart arrow boards report latitude and longitude (Figure 6), GPS-lock status, orientation as a compass heading, and information on the display mode (flashing arrow and orientation, sequential chevron and orientation, or caution mode and type). Each device also transmits timestamp, GPS information age, and whether the arrow board is up or down. Third party traveler information applications (Figure 7) can also use the information collected to warn drivers of upcoming lane closures on their routes in real time. Smart arrow boards also provide information that is integrated into 511 traveler information systems.

The Iowa DOT requires smart arrow boards on all freeway contract lettings as of the fall of 2020. Additional smart work zone deployments in Iowa include devices that capture real-time information such as video cameras, detectors, and dynamic message signs. The DOT routes all smart work zone device information through central traffic management software operated within the TMC. Iowa DOT requires all rented work zone devices to be configured for communication with the existing software, so that one electronic tool can pull data from every device in use.

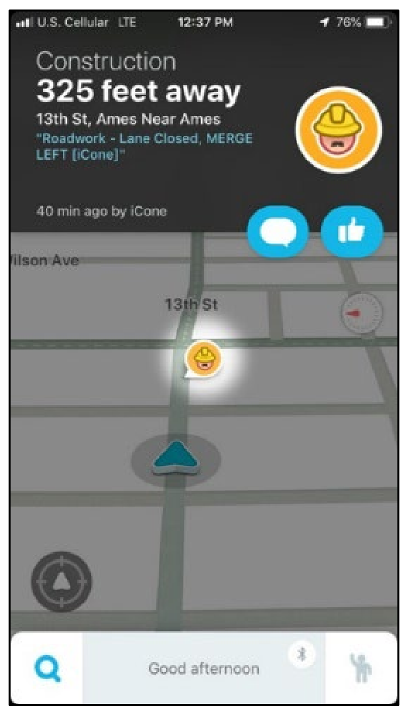

Figure 7. Integration of Data with In-Vehicle App (Image: Iowa DOT)

The smart arrow boards first communicate with the manufacturer's central server and then is accessed by the DOT. A benefit of this approach is that local agencies can access the information in the same manner without specialized software.

If the contractor changes the pattern or moves the smart arrow board more than 500 feet, the device provides an update to the data feed within 2 minutes, along with a health check message every 30 minutes. Smart arrow boards may add 10% to 15% to the cost of a traditional arrow board due to added communications hardware, data hosting, and subscription services. Cost considerations include equipment, installation (for retrofit kits), and data costs.

Artificial Intelligence-Based Work and Emergency Vehicle Alert Systems. Artificial intelligence (AI)–enabled road user alert systems use connected vehicle (CV) technologies and cloud-based processing to provide early notifications. One example of an AI based vehicle alert platform provides advance notice (up to 30 seconds) of emergency vehicle or work vehicle presence through connectivity with in-vehicle navigation applications and in-dash infotainment systems (Figure 8). The information provides advance notifications intended to improve driver awareness of nearby work or emergency vehicles.

These systems are installed on emergency vehicles or work vehicles and use a small transponder mounted in the vehicle or may be added to an existing telematics or fleet management platform already in use. Navigation applications also relay alerts to motorists through connected networks. The platform can track incident response times and other statistics, and fleet users have access to a real-time dashboard for vehicle tracking and management. The system benefits many user groups, including construction and maintenance stakeholders, first responders, tow operators and other transportation and fleet organizations. AI-based vehicle alert systems use telematics or transponders to broadcast vehicle presence to connected navigation platforms, providing advance notification of work or emergency vehicles. These systems may reduce sudden braking and improve move-over compliance.

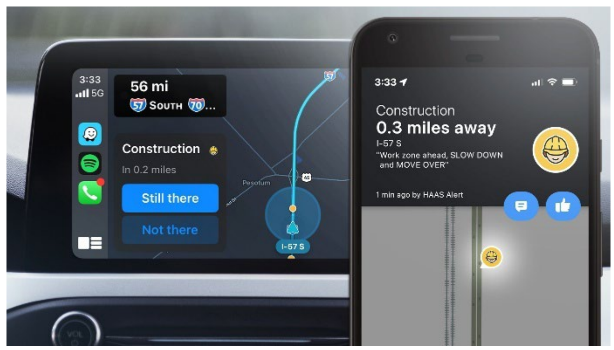

Figure 8. Digital Alert System (Image: HAAS Alert)

Artificial Intelligence-Based Worker Alert Systems. These systems may include wearable devices for haptic, audible, or visual alerts to alert workers of their proximity to a hazard, backing vehicle hazards, or vehicle intrusions into the work space. For example, Zone Command is a proprietary mobile mounted camera system that uses AI-based video analytics to detect potential intrusion conflicts involving approaching vehicles. The system processes video data for each approaching vehicle and analyzes and classifies potential threats. Once the system determines a stopping distance for each vehicle, it evaluates vehicle trajectories and stopping distance thresholds. Using 9 seconds of live video feed data for each vehicle, the system evaluates conflicts. When activated, the Zone Command sounds an alarm and activates flashing colored arrows on the vehicles (once a vehicle is determined to be on a path to potential collision). The system provides audible, haptic and visual alerts to workers.

By monitoring traffic and processing data, the system provides 5 to 10 seconds of notification to allow workers to quickly move to a safe location. The system not only alerts workers in the field but also provides alerts for motorists approaching a conflict so they can make decisions to move over, lower speed or just be more aware of the potential conflict. The system provides alerts with varying urgency based on conflict imminence.

Smart Worksite Access Systems. Agencies also use a system to notify motorists of trucks entering the traffic space from the work space (Figure 9). This system uses a radar sensor on a trailer to detect trucks prior to their entry into the traffic stream and alerts drivers through signs with flashing lights. The sensor in a truck beacon can also map to in-vehicle technology to report information to motorists as they approach. Manufacturer systems may also use a rubber hose in lieu of a sensor to detect trucks as they exit the work space. This system reduces issues with close calls and especially improves awareness of speed variability between motorists and trucks entering the traffic stream.

Figure 9. Truck Entry Warning System (Image: Michigan DOT)

Smart Work Zone Sensors. In addition to the previously mentioned Smart Arrow Boards, agencies are also experimenting with other devices that report the location of key work zone features. For example, Michigan DOT uses “Orange IQ” as part of their smart work zone deployment (Figure 10). This technology can be attached to sign posts to digitally provide a real-time work zone data stream.


Figure 10. Orange IQ Sensor Application (Image: Michigan DOT)

Such devices are used to:

- Identify the location of a work zone;
- Identify who placed the devices or removed the devices and when;
- Alert appropriate practitioners if a device needs maintenance;
- Document who provided the maintenance activity and when;
- Identify the direction the sign is facing;
- Document if equipment is stored along the roadside; and

- Document the sign type (Manual on Uniform Traffic Control Devices (MUTCD) designation).

Shadow Vehicle Equipped with Automated Driving System. Automated driving systems built into shadow vehicles (with truck mounted attenuators) remove the driver from the vehicle that protects the mobile work operation. By following the work vehicle, the autonomous shadow vehicle uses leader-follower technology (Figure 11) such as LiDAR-based detection to monitor and maintain a safe following distance. The technology in the lead (work) vehicle is also portable and can be transferred to other lead vehicles as needed. One type of technology allows lateral offsets of up to 12 feet and 50 to 400 feet of following distance. This technology can operate independently of continuous GPS connectivity. The vehicle can operate at up to 45 miles per hour and several configurations are available.

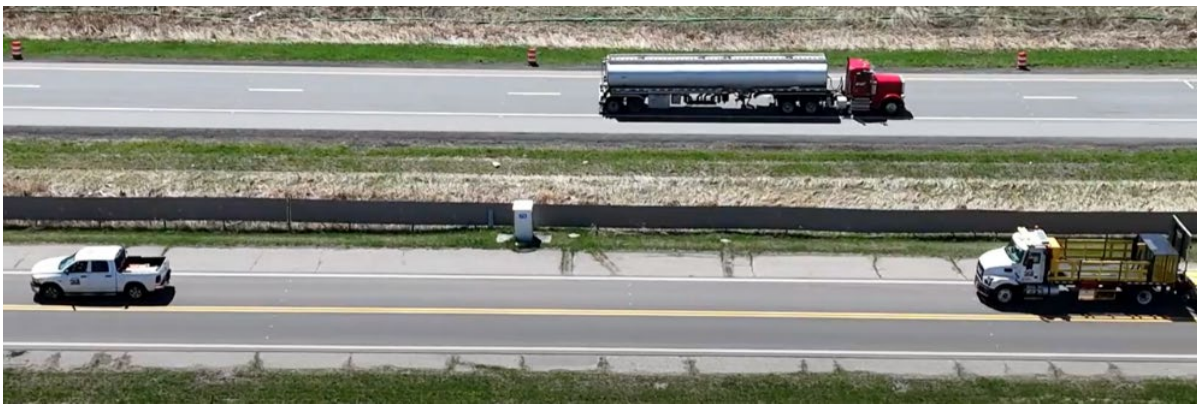

Figure 11. Lead-Follower Autonomous Shadow Vehicle (Image: VTTI)

Most connected work zone devices rely on cellular communications, GPS, cloud-based processing, and standardized data feeds. Integration with centralized traffic management platforms enhances situational awareness and supports information sharing through 511 systems, third-party applications, and the WZDx. Device selection should align with agency objectives, project complexity, staffing capacity, interoperability standards, and cybersecurity requirements. Reliable communications and adherence to data standards are essential to realizing the safety and mobility benefits of connected work zones.

Conclusions

Connected work zone technologies continue to evolve from traditional smart work zone applications toward interoperable systems capable of supporting real-time communication between work zone devices, transportation agencies, third-party platforms, connected vehicles, and road users. Advances in communications, cloud-based processing, and connected device technologies now allow agencies to collect, process, and disseminate work zone information more efficiently and accurately than through traditional methods alone.

As demonstrated throughout this document, connected work zones can be implemented incrementally based on agency goals, available resources, and operational needs. Many agencies begin with a single connected device, such as a smart arrow board or connected location marker, before expanding toward broader multi-device integration and automated activity status monitoring. This phased approach allows agencies to establish specifications, evaluate operational performance, and develop implementation experience while maintaining flexibility for future expansion.

Connected work zone technologies provide opportunities to improve work zone safety, mobility, traveler information, and operational awareness. Real-time communication of lane closures, worker presence, speed management, equipment activity, and changing work zone conditions can support improved driver awareness and more informed decision-making. In addition, connected work zone data can support performance measurement, work zone management, and future planning efforts through increased access to operational and safety-related information.

Successful implementation of connected work zones depends on reliable data, interoperability between devices and systems, consistent communications, and adherence to national standards and specifications. Agencies must also consider staffing, maintenance, cybersecurity, procurement approaches, and integration with existing transportation management systems when deploying connected technologies. As connected vehicle technologies and digital infrastructure continue to expand, connected work zones will likely play an increasingly important role in improving roadway safety, mobility, and operational efficiency for both workers and road users.

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