DRAFT
Standard Development Report
for
Recommended Standard
Connected Work Zone (CWZ)
Implementation Guide and Standard
v00.23

June 20, 2024

The following Standard Development Report (SDR) is made in accordance with the ITE- A Community of Transportation Professionals procedures for standards development.

Contents

1 Latest Version of the Draft Proposed Standard

This Standard Development Report references Recommended Standard (RS) Connected Work Zones (CWZ) Implementation Guide and Standard v00.23 (henceforth, RS CWZ Standard). RS CWZ Standard, when Jointly Approved, will be a new ITE/AASHTO/NEMA standard, and will be designated and cited as CWZ v01. Jointly Approved means that the standard was balloted and approved separately by the three cooperating standard development organizations (SDOs): the American Association of State Highway and Transportation Officials (AASHTO), the ITE- A Community of Transportation Professionals, and the National Electrical Manufacturers Association (NEMA).

2 Summary Status

RS CWZ Standard has been accepted as a Recommended Standard of the Connected Work Zones Working Group (CWZ WG). The CWZ Standard specifies the logical interface between centers that manage, collect, and distribute work zone information, and defines the information that may be exchanged across this interface. The CWZ Standard follows a Systems Engineering Process (SEP) approach, including user needs, requirements, and system design details that enable information exchanges to support those user needs and requirements, including data objects and metadata, and the relative structure of that data, necessary to fulfill the requirements.

RS CWZ Standard is distributed to the members of the ITE- A Community of Transportation Professionals, the American Association of State Highway and Transportation Officials (AASHTO), and the National Electrical Manufacturers Association (NEMA) for balloting and approval. After all three standards development organizations (SDOs) have individually approved RS CWZ Standard; it is a Jointly Approved Standard and published, with the designation (and to be cited as) CWZ v01.

3 Status Report

RS CWZ Standard was developed following a Systems Engineering Process (SEP). The stages of development leading to a RS are identified below:

- Concept of Operations (ConOps)
- Functional Requirements (FR)
- System Design Details (SDD)
- User Comment Draft (UCD)
- Recommended Standard (RS)

Comments (written inputs) were submitted and addressed during each stage of development. Notably, approximately 70 comments were received and addressed during the public comment period known as the User Comment Draft (UCD) stage. Significant review of the comments and discussion by the CWZ WG during each phase of development led to a successful vote accepting the recommended standard during RS Stage.

The CWZ WG accepted draft RS CWZ Standard v00.21 as a Recommended Standard via a vote that closed on May 3, 2024 with a vote of 8 yeas, 0 nays, and 0 abstention out of 13 total members. Minor editorial comments provided during the May 3rd meeting (e.g., spelling, formatting) were subsequently addressed resulting in RS CWZ Standard v00.22 dated June 7, 2024. During final review of the JSON Schemas (MIB/ASN.1 equivalent), an error was discovered in the text of the RS CWZ Standard, which was corrected, resulting in RS CWZ Standard v00.22 dated June 18, 2024.

4 Comments Listing

The ITE and CWZ WG received and addressed during each of the SEP development stages. The result were 4 written reports as follows:

- CWZ Standard Concept of Operations (ConOps) Comment Resolution Report, May 28, 2023
- CWZ Standard System Requirements Specification (SRS) Comment Resolution Report, August 24, 2023

- CWZ Standard System Design Details (SDD) Comment Resolution Report, March 20, 2024
- CWZ Standard User Comment Draft (UCD) & Proposed Recommended Standard (pRS), June 7, 2024

5 Committee Objectives

The objective of the CWZ WG is to develop implementation guidance and a standard that specifies the protocols and data definitions to allow centers to exchange work zone information. In addition, the WG identified relationships with data objects and methods contained in other ITS standards.

6 Committee Members

The RS CWZ Standard has been developed by the Connected Work Zones Working Group (CWZ WG), which is made up of representatives from the American Association of State Highway and Transportation Officials (AASHTO), the ITE- A Community of Transportation Professionals, and the National Electrical Manufacturers Association (NEMA).

Connected Work Zones Working Group

- Florida DOT, Raj Ponnaluri (Co-Chair), Md Omar Faruk, Edith Wong
- Arizona DOT*, Adam Carreon
- Massachusetts DOT, Neil Boudreau
- Michigan DOT, Elise Feldpausch, Chris Brookes
- Colorado DOT, Benjamin Acimovic, San Lee
- City of Omaha, Brandon Patocka, Jacob Larson
- Road Commission for Oakland County*, Ahmad Jawad, Rachel Jones
- iCone Products, Ross Sheckler (Co-Chair), Adam Kovar
- Trihydro Corporation, Shane Zumpf
- General Motors, David Craig
- Google, Eric Kolb, Marcel Monterie
- Horizon Signal*, Scott Heydt
- JTI Traffic, Mike Winters
- one.network, Adam Graham
- Ver-Mac, Todd Foster, Serge Beaudry
- Yunex Traffic, Dave Miller

Note: The preceding list includes voting and alternate voting members. Voting members are identified first, followed by one or more alternates. An asterisk '*' indicates a WG voting members that resigned from the group with no suitable replacement identified to fill the position. 3 such member organizations are identified in the above.

7 Other Material of Interest

Normative and Other references cited in RS CWZ Standard are excerpted and follow.

7.1 Normative References

Normative references contain provisions that, through references in this text, constitute provisions of this CWZ Implementation Guide and Standard. Other references in this document might provide a complete understanding or additional information. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this CWZ Implementation Guide and Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed.

Identifier	Title
IETF RFC 7946	The GeoJSON Format, August 2016
IETF RFC 3339	Date and Time on the Internet: Timestamps, July 2002
IETF RFC 4122	A Universally Unique Identifier (UUID) URN Namespace, July 2005
IETF RFC 8259	The JavaScript Object Notation (JSON) Data Interchange Format, December 2017
IETF RFC 9110	HTTP Semantics, June 2022
IETF RFC 3986	Uniform Resource Identifier (URI): Generic Syntax, January 2005
Open Mobility Foundation	Curb Data Specification (CDS), v1.0.0, April 29, 2022
NTCIP 1203 v03	Object Definitions for Dynamic Message Signs (DMS), September 2014 *For the definition of MULTI.

7.2 Other References

The following documents and standards may provide the reader with a more complete understanding of connected work zones; however, these documents do not contain direct provisions that are required by the CWZ Implementation Guide and Standard.

Identifier	Title
U.S. Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)	Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), USDOT, http://local.iteris.com/arc-it/
IEEE Std 610.12-1990	IEEE Standard Glossary of Software Engineering Terminology, IEEE, 1990
IEEE Std 829-2008	IEEE Std 829 IEEE Standard for Software and System Test Documentation, IEEE, 2008
IEEE Std 1016-1998	IEEE Recommended Practice for Software Design Descriptions, IEEE, 1998
IEEE Std 1362-1998	IEEE Guide for Information Technology System Definition - Concept of Operations (ConOps) Document, IEEE, 1998
FHWA MUTCD	The Manual on Uniform Traffic Control Devices for Streets and Highways, 2009.
NTCIP 1218 v01	National Transportation Communications for ITS Protocol Object Definitions for Roadside Units (RSUs), v01.38, 2020.
OMG UML-2007, Superstructure	OMG Unified Modeling Language (OMG UML), Superstructure, V2.1.2, 2007.
SAE J2945/4_202305	Road Safety Applications, May 10, 2023
ITE/AASHTO TMDD Standard v3.1	Traffic Management Data Dictionary (TMDD) Standard for the Center to Center Communications, January 13, 2020
USDOT WZDx v4.2	Work Zone Data Exchange Specification, USDOT, February 2023
NEMA TS 10	Connected Vehicle Infrastructure – Roadside Equipment, NEMA, March 2021
FHWA Work Zone ITS Implementation Guide 2014	Work Zone Intelligent Transportation Systems Implementation Guide - Use of Technology and Data for Effective Work Zone Management, January 2014

7.3 Contact Information

7.3.1 ARC-IT Documents

The Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) may be viewed online at:

https://local.iteris.com/arc-it/

7.3.2 FHWA Documents

USDOT Federal Highway Administration (FHWA) documents (with designations FHWA-JPO-…) are available at the USDOT National Transportation Library, Repository & Open Science Access Portal (ROSA P):

https://rosap.ntl.bts.gov/

7.3.3 IEEE Standards

IEEE standards can be purchased online in electronic format or printed copy from the following:

Techstreet
6300 Interfirst Drive
Ann Arbor, MI 48108
(800) 699-9277
www.techstreet.com/ieee

7.3.4 Internet Documents

Obtain Request for Comment (RFC) electronic documents from several repositories on the World Wide Web, or by “anonymous” File Transfer Protocol (FTP) with several hosts. Browse or FTP to the following:

www.rfc-editor.org
https://www.rfc-editor.org/retrieve/

7.3.5 ITE Standards

Copies of ITE standards may be obtained from the following:

ITE- A Community of Transportation Professionals
1627 Eye Street, NW, Suite 600
Washington, DC 20006
(202) 785-0060
www.ite.org/technical-resources/

7.3.6 NTCIP Standards

Copies of NTCIP standards may be obtained from the following:

NTCIP Coordinator
National Electrical Manufacturers Association
1300 N.17th Street, Suite 900
Rosslyn, Virginia 22209-3801
www.ntcip.org
e-mail: ntcip@nema.org
https://www.ntcip.org/document-numbers-and-status/

7.3.7 SAE International Documents

Copies of SAE International documents may be obtained from the following:

SAE International
400 Commonwealth Drive
Warrendale, PA 15096
www.sae.org

8 Declaration Regarding Other Known National and International Standards

This statement confirms that other known national and international standards have been examined with regard to harmonization and duplication of content, and no significant conflicts with other known standards have been identified.

9 Abstract of the Standard

This section is excerpted from the Executive Summary of the RS CWZ Standard, as follows.

9.1 Project Objectives and Scope

The purpose of the ITE's Connected Work Zones project is to develop and publish a Connected Work Zone (CWZ) Implementation Guide and Standard that focuses on interoperable data exchanges between the various components of a connected work zone.

This CWZ Implementation Guide and Standard addresses gaps identified by early deployers and provides guidance for organizations seeking to develop interoperable connected work zones across the United States, especially for automated transportation systems. This document focuses on harmonizing the existing Work Zone Data Exchange (WZDx) Specification, CWZ research and pilot deployments, and related standards activities addressing connected work zones.

This document identifies key aspects of the interoperability needs of connected work zone systems and provides guidance to enable deployment of consistent CWZ environments across institutional and organizational boundaries. The goal of this document is to identify and document the following:

1. **Interoperable Data Exchanges**. Identify and document the needs for interoperable data exchanges. This includes documenting the data formats, data definitions, data structure, and specifications to enable interoperable data exchanges between CWZ systems and components.
2. **Operational Scenarios**. Identify and document system actors, including end-users, data consumers, and data providers, and their interactions that enable interoperable data exchanges between system components.
3. **Institutional and IOO Guidance Needs**. Identify and document institutional guidance needs, operational policies, constraints, and best practices for using this standard so that deployers can maximize the benefits from their deployments.
4. **Technical Expert Guidance Needs**. Identify and document developer and technical expert guidance needs to enable them to develop project specifications and designs that will result in nationally interoperable data exchanges across CWZ deployments from diverse organizations.

Development of the CWZ Implementation Guide and Standard follows a systems engineering process to be followed by a validation phase to verify the requirements and concepts in this guide. A report summarizing the findings from the validation phase will be developed and accompany this guide.

9.2 Background

The USDOT is sponsoring this project to develop, publish, verify, and validate a Connected Work Zone (CWZ) Standard that defines the data elements, capabilities, and interfaces a connected work zone must support to ensure interoperability between components of a connected work zone.

A **connected work zone** is defined as a set of technologies that generates or collects work zone information (whether automatically or manually) and the infrastructure that broadcasts/distributes this information to the public and to vehicles. The CWZ Standard will:

- address ambiguities and gaps identified by early deployers and consolidate multiple independent implementation and standards efforts to lead to the national interoperability of future CWZ deployments across the United States; and
- be published as a Connected Transportation Interoperability (CTI) document.

The CWZ Implementation Guide and Standard employs a systems engineering process, referencing design elements from existing standards and solidifying design content that satisfies multiple SDOs. The result is harmonization of standards activities across centers, vehicles, field devices, and vulnerable road users/workers. The systems engineering process involves the production of a Concept of Operations (ConOps), System Requirements, System Design Details, and a validation phase.

The draft completion of each of these deliverables is followed by a review period, a formal walkthrough process, comment resolution, updates, and finally another review period of the updated document. This process allows the document to be fine-tuned and reviewed by all contributors and stakeholders until each detail is deemed technically proficient and approved. This level of detail, accompanied by reviews by the project team, subject matter experts (SMEs), and other contributors, allows for the production of a CWZ Implementation Guide and Standard that contains both technical depth and clarity.

9.3 Purpose of this Document

This document identifies the CWZ deployer needs, sets the requirements, and provides guidance for nationally interoperable connected work zones across the United States. The focus of this document is on system-to-system interfaces to enable interoperable CWZ applications. This document is envisioned to be a living document.

9.4 Who Should Read this Document?

Stakeholders from multiple industries may benefit from this CWZ Implementation Guide and Standard. These industries include IOOs deploying connected work zones, OEMs, third parties such as mobile app developers and navigation companies, work zone device manufacturers, multimodal partners, developers of connected work zone applications, and end users of data and services.

9.5 Document Overview

In addition to this Executive Summary, this document contains five (5) main sections, as follows:

- **Executive Summary.** This section provides a high-level overview of the entire document and how to use the document.
- **Section 1: General Information.** This section provides introductory and background information about the document, its purpose, and why it is needed. This section discusses the scope of work, references to other documentation.
- **Section 2: Concept of Operations.** This section includes the content of the Concept of Operations, including the Architectural and Data Exchange Needs for a Connected Work Zone as well as Operational Scenarios illustrating representative examples of interactions between components of a CWZ.

- **Section 3: System Interface Requirements.** This section includes the System Interface Requirements that satisfy the Architectural and Data Exchange Needs for a Connected Work Zone. A Protocol Requirements List (PRL) is provided, where each need is mapped to all the requirements that satisfy that need.
- **Section 4: System Interface Design Details: Data Exchange Dialogs.** This section includes details on how each data exchange requirement is fulfilled.
- **Section 5: System Interface Design Details: Data Concepts**. This section includes details on how each data content requirement is fulfilled.
- **Section 6: Connected Work Zones Testing.** This section describes the testing required to validate conformance with the normative sections of this CWZ Implementation Guide and Standard and includes example test cases with a Requirements to Test Case Traceability Matrix (RTCTM).

The CWZ Implementation Guide and Standard also includes the following Annexes that provide additional background information on various topics:

- **Annex A: Requirements Traceability Matrix.** This normative annex provides a mapping of each requirement to all the design elements that fulfill the requirement.
- **Annex B: Connected Work Zones Guidance Needs.** This informative annex contains a summary of potential guidance needs topics to help organizations plan development and deployment of connected work zones using this standard.
- **Annex C: Guidance for Deployments Involving Multiple Work Zone Related Standards.** This annex provides guidance for CWZ deployers who may need to use multiple standards.
- **Annex D: Recommendations to SDOs.** This annex summarizes comments and recommendations by the CWZ Working Group or its task forces to Standards Development Organizations on existing standards that are referenced by this CWZ Implementation Guide and Standard.
- **Annex E: User Requests.** This informative annex identifies user needs, requirements, and design details that were identified and considered by the CWZ Working Group but were ultimately not included in this version of the CWZ Implementation Guide and Standard. The rationale on why these needs, requirements, and design details were not included is also provided.
- **Annex F: Listing of Differences between the CWZ Standard and the WZDX v4.2 Specification JSON Schemas.** This informative annex lists differences between the JSON Schemas contained in Section 5 of this standard and the WZDX v4.2 Specification JSON Schemas.