

# Enabling Trust and Deployment Through Verified Connected Intersections

## Dataset and Contact Information

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Please provide as much of the the following information as possible:

1. Name of the project;
2. Grant number;
3. Name of the person submitting this DMP;
4. ORCID of the person submitting this DMP (need an ORCID? Register here: <https://orcid.org/>);
5. Email and phone number of the person submitting this DMP;
6. Name of the organization for which the person submitting this DMP is working;
7. Email and phone number for the organization;
8. Link to organization or project website, if applicable; and,
9. Date the DMP was written.

1. Project Name: "Enabling Trust and Deployment Through Verified Connected Intersections"
2. Grant number: 69A3552341007-SMARTFY22N1P1G53
3. Name of person submitting this DMP: Jeremy Schroeder
4. ORCID of person submitting this DMP: 0000-0002-5751-9861
5. Email and phone of person submitting DMP: schroeder@acconsultants.org, 2028091900
6. Name of organization for which the person submitting this DMP is working: Utah Department of Transportation (DOT)
7. Email and phone number for the organization: bleonard@utah.gov, 8018873723
8. Link to the organization or project website, if applicable: <https://transportationtechnology.utah.gov/>
9. Date the DMP was written: 12/15/2023, updated 8/11/2025

## Data Description

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Please provide as much information as possible:

1. Provide a description of the data that you will be gathering in the course of your project or data from a third party that you will re-use, if any;
  1. If there will be no data collected or re-used from another source, state that this is case;
2. Address the expected nature, scope, and scale of the data that will be collected, as best as you can at this stage;
3. As best as you can, describe the characteristics of the data, their relationship to other data, and provide sufficient detail so that reviewers will understand any disclosure risks that may apply;
  1. If data might be sensitive, please describe how you will protect privacy and security, if you know that now;
  2. You may need to update your DMP later to add more detail;
4. Discuss the expected value of the data over the long-term.

1. Data for this evaluation include data outputs from signal controllers at connected intersections (CIs) and data broadcast by the CIs, as well as the data reported by testing tools developed by a combination of this project and the SAE Connected Transportation Interoperability Committee (CTIC) Phase 2 project efforts. The data gathered and retained in this project will be the final datasets collected during the Field Validation "runs" that are conducted to assess the CI compliance with requirements that project partners agree are acceptable for nationwide CI deployment and Vehicle-to-Everything (V2X) communications (note that any data used or collected during tool development will not be retained or archived). Data collected on CI corridors for testing and verification include:
  - Field Validation of Signal Phase and Timing (SPaT):

- Signal Controller Output (data elements output from the signal controller, Metadata format: as defined in the National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) 1202 Standard, Data format: .csv files)
  - Roadside Unit (RSU) SPaT Output (data elements describing the broadcast by the RSU, Metadata format: as defined in the SAE V2X Communications Message Set Dictionary J2735\_2023 Standard, Data format: PCAP files)
  - Output of SPaT Test Tool (summary reports comparing various SPaT data elements. Data format: .png and .csv files)
  - Field Validation of the MAP Message will consist of:
    - MAP message data (encoded in ASN.1; output in JSON and PCAP files, Metadata format: as defined in the SAE V2X Communications Message Set Dictionary J2735 MAP message standard, Data format: PCAP files)
    - Light Detection And Ranging (LiDAR) collected lane data (meta data as defined in the SAE V2X Communications Message Set Dictionary J2735 MAP message standard; Data format: .csv files)
    - Output of MAP Test Tool (summary reports comparing various MAP data elements. Data format: .csv files).
  - No additional data from other sources beyond this project are anticipated at this time.
2. The data to be collected and retained in this effort will be collected only for the short periods of time when testing tools are active and the project team is conducting test “runs” to compare data broadcasts by the CIs as compared to the actual data (i.e., signal controller data and infrastructure position data). The number of “runs” collected and retained will depend on the number of attempts to fully validate the intersection(s) and understand the readiness of test tools and processes. Only data used by the final test tools will be retained; any data collected or used during test development will not be retained.
  3. A significant amount of data from this effort is generated by public infrastructure operated by Utah DOT. The only remaining data will be from testing tools that are either developed within this project or developed by the USDOT funded SAE CTIC. There are no expectations that the outputs of these tools will represent sensitive data.
  4. Test results will be used to assess both test tools and CI performance. Reports will describe the test results. There is no significant long-term value anticipated from the data itself. The value will be in the availability of the test tools for other agencies to use in validating CIs.

## Data Format and Metadata Standards Employed

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**Please provide as much information as you can:**

- 1. Describe the anticipated file formats of your data and related files;**
  - 2. To the maximum extent practicable, your DMP should address how you will use platform-independent and non-proprietary formats to ensure maximum utility of the data in the future;**
    - 1. If you are unable to use platform-independent and non-proprietary formats, you should specify the standards and formats that will be used and the rationale for using those standards and formats.**
  - 3. Identify the metadata standards you will use to describe the data.**
    - 1. At least one metadata file should be a DCAT-US v1.1 (<https://resources.data.gov/resources/dcat-us/>) .JSON file, the federal standard for data search and discovery.**
1. Data file formats that are used and retained for this effort are expected to be as follows:
    - Signal Controller Output, Data format: .csv files;
    - RSU SPaT Output, Data format: PCAP files;
    - Output of SPaT Test Tool, Data format: .png and .csv files;
    - MAP message data encoded in ASN.1, Data format: PCAP files;

- LiDAR collected lane data; Data format: .csv files;
  - Output of MAP Test Tool, Data Format: .csv files.
2. The project team anticipates using existing and widely accepted standards as the basis for the metadata, including those developed by SAE, NEMA, AASHTO, and ITE to ensure maximum data utility and expanded use by others.
  3. Metadata standards to describe the data are expected to be as follows:
    - Signal Controller Output, Metadata format: as defined in the National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) 1202 Standard
    - RSU SPaT Output, Metadata format: as defined in the SAE V2X Communications Message Set Dictionary J2735\_2023 Standard
    - Output of SPaT Test Tool, Metadata format: comparison of data as defined in the SAE V2X Communications Message Set Dictionary J2735\_2023 Standard
    - MAP message data, Metadata format: as defined in the SAE V2X Communications Message Set Dictionary J2735 MAP message standard
    - LiDAR collected lane data, Meta data as defined in the SAE V2X Communications Message Set Dictionary J2735 MAP message standard
    - Output of MAP Test Tool, Metadata format: comparison of data as defined in the SAE V2X Communications Message Set Dictionary J2735\_2023 Standard.
    - One metadata file will be a DCAT-US v1.1 (<https://resources.data.gov/resources/dcat-us/>) .JSON file, the Federal standard for data search and discovery.

## Access Policies

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**In general, data from DOT-funded projects must be made publicly accessible. Exceptions to this policy are: data that contain personally identifiable information (PII) that cannot be anonymized; confidential business information; or classified information. Protecting research participants and guarding against the disclosure of identities and/or confidential business information is an essential norm in scientific research. Your DMP should address these issues and outline the efforts you will take to provide informed consent statements to participants, the steps you will take to protect privacy and confidentiality prior to archiving your data, and any additional concerns. In general, in matters of human subject research, your DMP should describe how your informed consent forms will permit sharing with the research community and whether additional steps, such as an Institutional Review Board (IRB), may be used to protect privacy and confidentiality. Additionally, when working with, or conducting research that includes Indigenous populations or Tribal communities, researcher will adhere to the CARE Principles for Indigenous Data Governance <https://www.gida-global.org/care> and make an explicit statement to that effect in this portion of the DMP.**

**Please provide as much information as possible:**

1. Describe any sensitive data that may be collected or used;
2. Describe how you will protect PII or other sensitive data, including IRB review, application of CARE Principles guidelines, or other ethical norms and practices;
  1. If you will not be able to deidentify the data in a manner that protects privacy and confidentiality while maintaining the utility of the dataset, you should describe the necessary restrictions on access and use;
3. Describe any access restrictions that may apply to your data;
4. If necessary, describe any division of responsibilities for stewarding and protecting the data among Principal Investigators or other project staff.

No sensitive data will be collected or used for this effort. The project team is discussing the inclusion of data from the Connected Vehicle Pooled Fund Study (CV PFS) Connected Intersection Message Monitoring System (CIMMS); if this is used, the proper handling, use, and processing of any sensitive data will be addressed at the time. No access restrictions identified at this time.

## Re-use, Redistribution, and Derivatives Products Policies

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Recipients are reminded:

1. Data, as a collection of facts, cannot be copyrighted under US copyright law;
2. Projects carried out under a US DOT SMART Grants is federally funded; therefore, as stated in grant language:
  1. Recipients must comply with the US DOT Public Access Plan, meaning, among other requirements, project data must be shared with the public, either by the researchers or by US DOT;
  2. That by accepting US DOT funding through this grant, recipients have granted to US DOT a comprehensive non-exclusive, paid-up, royalty-free copyright license for all project outputs (publications, datasets, software, code, etc.). This includes all rights under copyright, including, but not limited to the rights to copy, distribute, prepare derivative works, and the right to display and/or perform a work in public; and,
  3. In accordance with Chapter 18 of Title 35 of the United States Code, also known as the Bayh-Dole Act, where grant recipients elect to retain title to any invention developed under this grant, US DOT retains a statutory nonexclusive, nontransferrable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any such invention throughout the world.

Please provide as much information as possible:

1. Describe who will hold the intellectual property rights for the data created or used during the project;
2. Describe whether you will transfer those rights to a data archive, if appropriate;
3. Identify whether any licenses apply to the data;
  1. If you will be enforcing terms of use or a requirement for data citation through a license, indicate as much in your DMP;
4. Describe any other legal requirements that might need to be addressed.
  1. Intellectual property rights are described here for two data types:
    - Infrastructure-generated data: Signal controller output data, and RSU SPaT output and MAP message data will be generated by public infrastructure, so they are the intellectual property of Utah DOT and will be made available for public use.
    - LiDAR collected lane data: Utah DOT procured from Dynamic Map Platform North America.
    - Test tool-generated data: The project team used test tools and approaches developed by the SAE CTIC Project and this effort, both of which are Federally funded; therefore, outputs of SPaT Test Tool and MAP Test Tool data are understood to be available for public use.
  2. No transfer of rights to a data archive were needed.
  3. No licenses apply.
  4. Products developed from the USDOT-sponsored SAE CTIC project are used, which may result in the re-use or regeneration of outputs from that effort.

## Archiving and Preservation Plan

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Please provide as much information as possible:

1. State where you intend to archive your data and why you have chosen that particular option;
2. Provide a link to the repository;
3. You must describe the dataset that is being archived with a minimum amount of metadata that ensures its discoverability;
  1. Whatever archive option you choose, that archive should support the capture and provision of the US Federal Government DCAT-US Metadata Schema  
<https://resources.data.gov/resources/dcat-us/>

- 4. In addition, the archive you choose should support the creation and maintenance of persistent identifiers (e.g., DOIs, handles, etc.) and must provide for maintenance of those identifiers throughout the preservation lifecycle of the data;**
- 5. Your plan should address how your archiving and preservation choices meet these requirements.**

1. Data is archived on a public facing website operated by Utah DOT and publicly accessible. Data is also archived on Zenodo, as recommended by US DOT.
  2. The data can be accessed via the Utah DOT Transportation Technology website (<https://transportationtechnology.utah.gov/verifying-connected-intersections/>). The data collected in this project is also available on Zenodo.
  3. Metadata is based on the national standards definitions of the datasets, including the US Federal Government DCAT-US Metadata Schema <https://resources.data.gov/resources/dcat-us/>.
  4. Per the US DOT Public Access plan, all final data was assigned a persistent identifier that points to its publicly accessible location. DOI: <https://doi.org/10.5281/zenodo.16740843>
  5. Data is archived and preserved on Zenodo per the SMART Grants Final Submission Guidance webpage.
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## Planned Research Outputs

### Dataset - "Connected Intersections Test Dataset"

This dataset contains a series of folders for 8 tested connected intersection (CI) in the reference implementation corridor of the Utah Department of Transportation's Strengthening Mobility and Revolutionizing Transportation (SMART) Grant Phase 1 effort with the United States Department of Transportation. Each tested CI contains the data collected at the CI for Signal Phase and Timing (SPaT) testing and the output reports from the SPaT validation tool (described in the 2024 Crash Avoidance Metrics Partnership (CAMP) 'Assessment of SPaT Accuracy to Support RLVW Application' report), as well as the data collected at the CI for MAP testing and the output reports from the MAP validation tool (described in the 2024 CAMP 'Assessing Node Point Accuracy in the SAE J2735 MAP Message' report). Each folder and file contains the locally assigned values for the intersection it is associated with: 7704, 7705, 7706, 7707, 7708, 7709, 7710, 7720. Each intersection includes the following files (where ##### in the file name represents the intersection the file is associated with):

- #####\_r2 (.csv file, Light Detection and Ranging (LiDAR) field collected data used as input to the MAP validation tool)
- #####\_r2\_MAP\_NP\_report (.csv file, MAP validation tool output: node point accuracy report)
- #####\_r2\_MAP\_PF\_report (.csv file, MAP validation tool output: pass/fail assessment report)
- #####-atspm (.csv file, serial data from the Bus Interface Unit (BIU) / Serial Interface Unit (SIU) on the cabinet's serial bus converted into an Automated Traffic Signal Performance Measures (ATSPM)-like format as collected by the data logging tool)
- #####-rmnet\_data15-ota.pcap (PCAP file, over-the-air (OTA) V2X messages broadcast by connected intersections in range, received by the wireless V2X network interfaces as collected by the data logging tool)
- #####-rmnet\_data15-ota-MAP-0-#####\_Summary\_Report (.csv file, MAP validation tool output: message structure pass/fail report)
- #####-rmnet\_data15-ota-SPaT-0-#####\_Summary\_Report (.csv file, SPaT validation tool output: message structure pass/fail report)
- SPaT\_Msg\_Periodicity\_&\_Histo\_Plot\_##### (PNG file, SPaT validation tool output: periodicity histograms)
- SPaT\_Msg\_YP\_Perf\_Summary\_Report\_##### (.csv file, SPaT validation tool output: yellow phase analysis pass/fail summary)
- TSC\_SPaT\_Msg\_YP\_Duration\_Analysis\_Plot\_##### (PNG file, SPaT validation tool output: yellow phase duration analysis plots)
- TSC\_SPaT\_Msg\_YP\_Perf\_Analysis\_##### (.csv file, SPaT validation tool output: yellow phase analysis data log)
- TSC\_SPaT\_Msg\_YP\_Start\_Time\_Diff\_Analysis\_Plot\_##### (PNG file, SPaT validation tool output: yellow phase time difference analysis plots)

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### Planned research output details

Title	Type	Anticipated release date	Initial access level	Intended repository(ies)	Anticipated file size	License	Metadata standard(s)	May contain sensitive data?	May contain PII?
Connected Intersections Test Dataset	Dataset	2025-08-29	Open	Zenodo		Creative Commons Attribution 4.0 International	DCAT-US	No	No