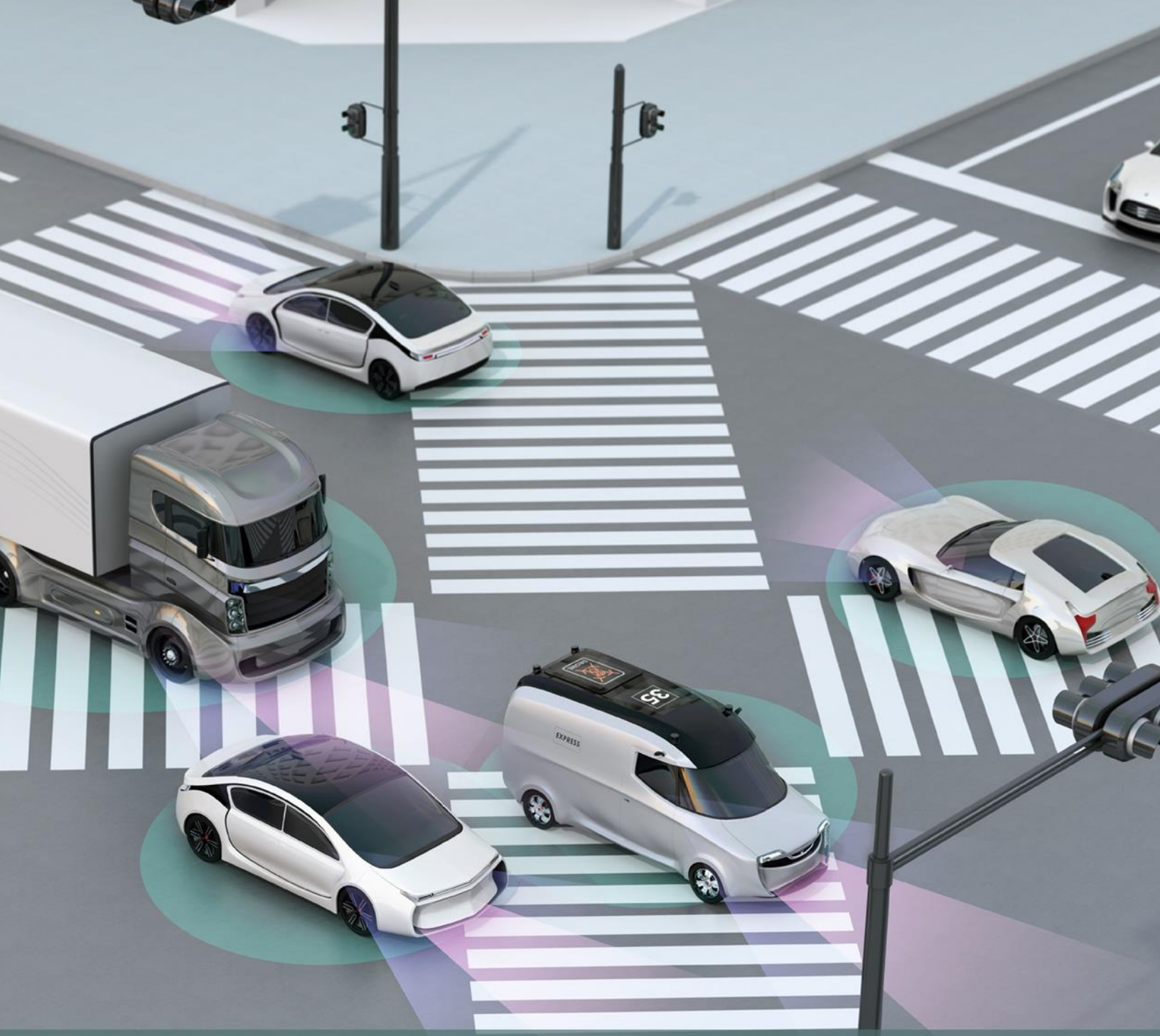

U.S. DEPARTMENT OF TRANSPORTATION

ROUNDTABLE ON DATA FOR AUTOMATED VEHICLE SAFETY

SUMMARY REPORT

U.S. Department of Transportation

Foreword

In September 2017, the United States Department of Transportation (USDOT) released new federal guidance for *Automated Driving Systems (ADS): A Vision for Safety 2.0*. This guidance calls for industry, state and local governments, safety and mobility advocates, and the public to lay the path for the deployment of ADS, also commonly referred to as automated vehicles.

Within and across all modes of transportation, data exchanges will be key to accelerating the safe deployment of automated vehicles in the United States. This includes the mutually beneficial exchange of data among private sector entities, infrastructure operators, and policy makers from various levels of government.

Planning and executing such exchanges can be difficult. Data are often siloed, and the term itself often means different things to different people. The USDOT can serve as a convener and facilitator to encourage collaboration in overcoming these challenges. By bringing together thought leaders in their respective areas of expertise, we can collectively consider what voluntary data exchanges should look like and how they can be leveraged to accelerate the safe rollout of automated vehicles.

To act on this vision, the Department recently hosted the Roundtable on Data for Automated Vehicle Safety. This multimodal event brought together over 60 participants from federal, state, and local government; the private sector; non-profit organizations; and research centers to discuss the data exchanges that these participants believe are most critical to the safe deployment of automated vehicles. This roundtable was a key step toward developing a shared understanding of the data to be collected and exchanged, the purpose, and the federal government's unique role in facilitating voluntary data exchanges.

This report summarizes key discussions from the roundtable and includes materials, such as the draft *USDOT Guiding Principles on Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles,* that were the basis for discussion. You will see that participants identified several data exchanges as part of the critical path toward deployment.

The Department is already moving forward with some of the key actions identified through discussions at the roundtable, many of which align with initiatives already underway. Our next steps will focus on enabling critical-path, voluntary data exchanges and considering the role of data in the Department's automated vehicle policies. We are excited to work across the ecosystem of data generators and users in the coming months to accelerate the safe rollout of automated vehicles.

Derek Kan
Undersecretary for Transportation Policy
U.S. Department of Transportation
January 23, 2018

Table of Contents

Executive Summary

On Thursday, December 7, 2017, the United States Department of Transportation (USDOT) hosted the Roundtable on Data for Automated Vehicle Safety. The roundtable demonstrated multimodal alignment around the "One DOT" approach to federal automated vehicle policy and marked the beginning of a new phase of dialogue with public and private sector stakeholders to accelerate the safe deployment of automated vehicles. The roundtable brought together over 60 participants from federal, state, and local government; businesses; nonprofit organizations; universities; and research centers to:

1. Gather feedback on the USDOT's draft *Guiding Principles on Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles* and draft *Framework for Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles* (see Appendix D)
2. Identify near-term, critical-path voluntary data exchange use cases to accelerate the safe rollout of automated vehicles.

During the roundtable, participants provided initial feedback on the draft *Automated Vehicle Data Principles* and draft *Framework*. Participants provided their own views on these issues, and the Department did not seek or encourage any consensus. Roundtable participants also discussed what they believed should be the near-term priorities for voluntary data exchanges to accelerate the safe deployment of automated vehicles. Over the course of the day's discussions, the following high-priority use cases for data exchange were identified:

- Monitoring Planned and Unplanned Work Zones
- Providing Real-Time Road Conditions
- Diversifying Automated Vehicle Testing Scenarios
- Improving Cybersecurity for Automated Vehicles
- Improving Roadway Inventories
- Developing Automated Vehicle Inventories
- Assessing Automated Vehicle Safety Features and Performance.

For each high-priority area, roundtable participants identified specific goals, data types and datasets, key stakeholders, challenges and proposed solutions, as well as relevant models for consideration in developing these near-term, critical-path voluntary data exchanges. Roundtable participants also outlined proposed federal roles in enabling these voluntary data exchanges over the next 6 to 12 months.

This report summarizes the discussions on these issues raised by the various participants. It does not reflect the USDOT's views on these issues. However, the USDOT anticipates considering these ideas, along with feedback on the draft *Automated Vehicle Data Principles* and draft *Framework* and all other relevant information, to inform immediate policy and investment strategies, including the development of the next version of federal automated vehicle guidance (version 3.0) and the USDOT's long-term strategy on automated vehicles.

Chapter 1. Introduction and Background

Within and across all modes of transportation, data exchanges are key to accelerating the safe deployment of automated vehicles. The USDOT is committed to engaging stakeholders during the development of the next version of federal automated vehicle guidance (version 3.0).

On Thursday, December 7, 2017, the USDOT hosted the Roundtable on Data for Automated Vehicle Safety. The roundtable represented one key step in USDOT efforts to collaborate on defining the federal role in enabling data exchanges to accelerate the safe deployment of automated vehicles. The roundtable brought together over 60 participants from federal, state, and local government; businesses; nonprofit organizations; universities; and research centers to:

1. Gather feedback on the USDOT's draft *Guiding Principles on Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles* and draft *Framework for Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles*
2. Identify near-term, critical-path voluntary data exchange use cases to accelerate safe rollout of automated vehicles.

Participants represented a mix of public and private sector stakeholders that are actively involved in road-based automated vehicle rollout. The roundtable was held under the Chatham House Rule[1], and participants were not asked to develop consensus recommendations but to share their own observations and suggestions.

[1] For more information on the Chatham House Rule, visit: https://www.chathamhouse.org/about/chatham-house-rule.

Chapter 2. Highlights of the Roundtable

The roundtable opened with keynote presentations and an executive multimodal panel discussion on the USDOT's draft *Automated Vehicle Data Principles* and draft *Framework*. The roundtable proceeded with interactive breakout sessions and lightning talks, followed by a presentation of highlights from each breakout table and closing remarks.

Opening Keynotes

The roundtable opened with keynote presentations from senior officials from the USDOT Office of the Secretary of Transportation and the White House Office of Science and Technology Policy (OSTP), and remarks from the Secretary. The USDOT reinforced the value of voluntary data exchanges for the safe deployment of automated vehicles and the importance of efforts across USDOT, which will be reflected in the next version of federal automated vehicle guidance (version 3.0). OSTP shared the current administration's priorities, which include empowering Americans to innovate, protecting American technologies abroad, and promoting emerging technologies such as automated vehicles. The USDOT also highlighted the benefits of automated vehicles for safety, mobility, and economic growth, reaffirming that data must be managed efficiently and effectively, made available to all stakeholders, and used to inform future policies.

Executive Multimodal Panel Discussion on Automated Vehicle Data Principles and Framework

The panel discussion demonstrated executive support for and understanding of the draft *Automated Vehicle Data Principles*, and shared multimodal urgency for enabling critical-path voluntary data exchanges. The panelists, who included senior officials from the Federal Highway Administration (FHWA), Federal Motor Carrier Safety Administration (FMCSA), Federal Transit Administration (FTA), and National Highway Traffic Safety Administration (NHTSA), conveyed their collective commitments to the "One DOT" approach to federal automated vehicle policy. The panelists also highlighted specific opportunities for multimodal collaboration, including cybersecurity, infrastructure, mobility, and public safety.

Lightning Talks: Voluntary Data Exchange Use Cases

The roundtable featured several brief presentations on successful models of voluntary data exchanges, inside and outside of the transportation sector, to frame the day's discussions on automated vehicle-related data exchanges to accelerate the safe rollout of automated vehicles. These models included:

- Auto-Information Sharing and Analysis Center (ISAC): Operates a central hub for sharing, tracking, and analyzing intelligence about potential cyber threats, vulnerabilities, and incidents related to the connected vehicle.[2]
- The Federal Aviation Administration (FAA) Aviation Safety Information Analysis and Sharing (ASIAS) system: Integrates and analyzes data to plan for potential safety concerns in aviation, convening public and private sector partners.[3]
- National Transit Map: Collects, synthesizes, and displays public data using a common format to create a comprehensive map of fixed transit options in the U.S.[4]
- Nexar NEXET Dataset: Publicly available dataset of over 50,000 images from all over the world, with bounding box annotations of the rear of vehicles collected from a variety of locations, lighting, and weather conditions.[5]

Breakout Sessions

The roundtable also featured interactive breakout sessions to encourage facilitated discussions among participants, organized around the day's objectives. The breakout sessions aimed to:

1. Gather feedback on the USDOT's draft *Guiding Principles on Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles* and draft *Framework for Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles*
2. Identify near-term, critical-path voluntary data exchange use cases to accelerate the safe rollout of automated vehicles.

[2] For more information on AutoISAC, visit their website at: https://www.automotiveisac.com/.

[3] To visit the website for FAA ASIAS, go to: http://www.asias.faa.gov/pls/apex/f?p=100:1:.

[4] For more information on the National Transit Map, visit: https://www.bts.gov/content/national-transit-map.

[5] For more information on the NEXET dataset, visit: https://www.getnexar.com/challenge-2/.

Chapter 3. Feedback on the Automated Vehicle Data Principles and Framework

Background on the Automated Vehicle Data Principles and Framework

To help bring government and industry stakeholders together for meaningful conversations around automated vehicle-related data exchanges, the USDOT developed the draft *Guiding Principles on Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles* (Appendix D). The guidelines assert common principles to plan and execute data exchanges to provide a common language across modes and streamline activities—resulting in better policies, reduced costs, and better outcomes, faster.

The USDOT also developed the draft *Framework for Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles* (Appendix D). The framework defines key categories of data exchange, their purpose and participants, and highlights specific data exchanges that may be part of the near-term critical path to safely deploy automated vehicles. These categories apply to all transportation modes where common patterns for executing data exchanges may be possible.

The following summarizes the roundtable participants initial feedback on the draft *Automated Vehicle Data Principles* and draft *Framework*. Considering this feedback, the USDOT will refine the *Automated Vehicle Data Principles* and *Framework* in the months ahead and use these planning tools to prioritize activities with potential data exchange partners.

Feedback on the Principles

Participants' suggestions on the principles included:

- Clarify the voluntary nature of data exchange activities throughout the principles
- Develop a clearer definition of safety to capture multiple meanings of safety in different contexts
- Distinguish privacy, safety, and cybersecurity as objectives in individual principles
- Add other objectives—such as mobility, efficiency, innovation, and economic growth—to create a more comprehensive approach
- Identify the need for data standards and quality (e.g., timeliness, accuracy, granularity) to ensure the near-term development of high-value data exchanges.

Feedback on the Framework

Participants' suggestions on the framework included:

- Consider recasting the framework as "Collaborative Data Exchange Opportunities," or something similar. References to the "framework" could be read as having implications for data management and ownership.
- In presenting the framework, acknowledge the overlap between data providers and users, as well as the overlap between identified data exchange categories. For example, some data exchanges are both business-to-business (B2B) and business-to-government.
- Clarify that many stakeholders identified in the framework vary greatly in scale and technical capacity.
- Consider additional data exchange categories, particularly government-to-government and business-to-consumer data exchanges.
- Provide greater clarity on "open training data" and ideas about public data. Clearly define what is and what is not open for public access.

Chapter 4. Near-Term Priorities for Voluntary Data Exchanges

During the roundtable, participants identified priorities for voluntary data exchanges they believed could be executed in the near term.

High-Priority Use Cases

The following high-priority use cases were identified by various participants:

- Monitoring Planned and Unplanned Work Zones
- Providing Real-Time Road Conditions
- Diversifying Automated Vehicle Testing Scenarios
- Improving Cybersecurity for Automated Vehicles
- Improving Roadway Inventories
- Developing Automated Vehicle Inventories
- Assessing Automated Vehicle Safety Features and Performance.

For each high-priority area, roundtable participants identified specific goals, data types and datasets, key stakeholders, challenges and proposed solutions, as well as relevant models to consider in developing these near-term, critical-path voluntary data exchanges.

Monitoring Planned and Unplanned Work Zones

Work zones were identified by some participants as a priority area for multimodal collaboration, signaling the benefits of exchanging real-time information on planned and unplanned work zones to improve the safe navigation and operation of automated vehicles.

Table 1. Monitoring Planned and Unplanned Work Zones

Area	Description
Goal	Track changes in work zone conditions to improve the safe navigation and operation of automated vehicles
High-Value Data	Work zone locations, planned duration of project, updates, planned lane closures, changes in signage, directions, or parking
Key Stakeholders	State and local transit agencies, highway construction businesses, government contractors, technology companies, third-party data aggregators

Area	Description
Challenges and Potential Solutions	Limited information on work zones is available, and much is of poor quality, inaccurate, or out of date. While data is available from existing data aggregators, it is either proprietary or currently only available to federal and state agencies. Potential solutions could include learning from successful pilots and opening access to existing data aggregators for the private sector.
Relevant Models	Certain mapping and smart-infrastructure companies are developing technologies to inform connected vehicles of safety hazards ahead of them in real time.

Providing Real-Time Road Conditions

In addition to data on the stable characteristics of roadways, some participants suggested that automated vehicles would benefit from accurate data on real-time road conditions, which can keep automated vehicles apprised of missing signs and lane markings, weather conditions, or other factors that can affect safety and performance.

Table 2. Providing Real-Time Road Conditions

Area	Description
Goal	Help automated vehicles navigate safely in changing road conditions.
High-Value Data	Parking areas, broken traffic signals, safety-related incidents, double-parked cars, transportation network company (TNC) and taxi drop-off areas, road closures and detours, weather conditions, potholes, real-time traffic congestion variances, missing signs and markings.
Key Stakeholders	Original equipment manufacturers (OEMs), TNCs, state and local transit agencies, map aggregators and validators, citizens, and crowdsourcing applications.
Challenges and Potential Solutions	This area poses challenges in collecting and exchanging timely data, with a need for continuous data validation. Using a standard “311” report or ticket could help speed data collection and ensure data comparability.
Relevant Models	The Weather Data Environment (WxDE) collects and shares transportation-related weather data with a focus on weather data related to connected vehicle applications.[6] The WxDE collects data in real time from both fixed environmental sensor stations and mobile sources.

[6] For more information on the WxDE, visit: https://wxde.fhwa.dot.gov/.

Diversifying Automated Vehicle Testing Scenarios

To ensure safe operation, various participants believed that automated vehicles need to be tested under challenging as well as more common conditions. Automated vehicle testing scenarios also need to include edge cases that represent safety-critical scenarios. There is a need to develop a common framework for data exchanges to enable the industry to diversify automated vehicle testing scenarios and improve safety outcomes.

Table 3. Diversifying Automated Vehicle Testing Scenarios

Area	Description
Goal	Using a common framework, exchange large amounts of data from testing scenarios, including edge cases that represent safety-critical scenarios to accelerate machine learning and improve safety outcomes
High-Value Data	Vehicle performance data, including near-misses, crashes, and automated vehicle disengagement and re-engagement; Strategic Highway Research Program 2 (SHRP2) Naturalistic Driving Study (NDS) data
Key Stakeholders	OEMs, industry associations, technology companies, telematics services, research centers, and universities
Challenges and Potential Solutions	There is a need to develop standard definitions of edge cases and near-miss events. There is also a need to develop classifications and data structures for automated vehicle testing scenarios. Industry associations can help make existing data accessible, manageable, and usable. The USDOT can help provide technical solutions by using SHRP2 NDS as a model for data structures and providing data extracts from SHRP2.
Relevant Models	The Nexar NEXET dataset, which is available to the general public as part of the Nexar Challenge, includes over 50,000 images collected from all over the world with bounding box annotations of the rear of vehicles collected from a variety of locations, lighting, and weather conditions.[7] This demonstrates that there are business motivations for voluntarily publishing open training data.

Improving Cybersecurity for Automated Vehicles

Various participants believed that the safe rollout of automated vehicles will require robust resilience to cybersecurity threats and incidents, which may impact individual vehicles or fleets. Data exchanges on cybersecurity threats and incidents are a high priority across the industry, providing benefits for all stakeholders.

[7] To view the NEXET dataset, visit: https://www.getnexar.com/challenge-2/.

Table 4. Improving Cybersecurity for Automated Vehicles

Area	Description
Goal	Improve resilience of automated vehicles to cybersecurity threats and incidents
High-Value Data	Incident type, source, target, duration, implications
Key Stakeholders	OEMs, state and local transit agencies, fleet operators, infrastructure providers/independent owner operators (IOOs), AutoISAC
Challenges and Potential Solutions	Liability risks and other legal concerns may lead to efforts to suppress data on cybersecurity incidents. Creating more inclusive central hubs for cybersecurity, perhaps with federal leadership, would create a larger base of information, resulting in a stronger resilience toward cybersecurity threats and incidents while also improving transparency and buy-in.
Relevant Models	AutoISAC operates a central hub for its members to share, track, and analyze intelligence about potential cyber threats, vulnerabilities, and incidents related to connected vehicles.[8]

Improving Roadway Inventories

Various participants believed that the safe rollout of automated vehicles will require "edge-to-edge" data on roadways, including bicycle lanes, pedestrian walkways, and taxi drop-off zones. Automated vehicles would also benefit from better data on factors including bridge heights, parking, and road elevation. While much of this data is currently incomplete or in need of updating, there are near-term opportunities to develop more comprehensive and accurate roadway inventories.

Table 5. Improving Roadway Inventories

Area	Description
Goal	Develop rich databases with more comprehensive geospatial roadway data to improve the safe navigation and operation of automated vehicles
High-Value Data	"Edge-to-edge," high-definition map elements (e.g., signs and signals, curbs, pavement markings, tolls, express lanes, bridge heights and weight capacities, highway dividers, overpasses, pedestrian areas, bicycle lanes, taxi drop-off zones, quality metrics)
Key Stakeholders	IOOs, OEMs, TNCs, mapping aggregators, suppliers, technology companies, the National Association of City Transport Officials (NACTO), and the American Association of State Highway Transportation Officials (AASHTO)

[8] For more information on AutoISAC, visit: https://www.automotiveisac.com/.

Area	Description
Challenges and Potential Solutions	There is a need to identify the most critical types of high-definition map elements. One possible approach is to ask OEMs what they need to safely operate level 4 and level 5 automated vehicles.
Relevant Models	The National Transit Map, which was originally developed through a voluntary cross-agency collaboration with Google Transit, collects, synthesizes, and displays public data using a common format to create a comprehensive map of fixed transit options in the United States.[9]

Developing Automated Vehicle Inventories

Some participants believed that during the expected, near-term transition from manually operated and connected vehicles to automated vehicles, automated vehicle inventories will be needed to describe the level of automation, if any, of a specific vehicle. These profiles will be critical to interpreting and learning from real-world incidents.

Table 6. Developing Automated Vehicle Inventories

Area	Description
Goal	Exchange information about the technology in each vehicle on the road to more effectively analyze vehicle performance
High-Value Data	Vehicle utilization, safety inspections, built-in and aftermarket technology, software upgrades, automated vehicle features, manufacturing date/year
Key Stakeholders	OEMs, state and local transit agencies, fleet operators, IOOs, TNCs, insurance companies, sellers and resellers of vehicles
Challenges and Potential Solutions	• Vehicles have varying levels of Internet connectivity, which could limit the ability to gather profile data electronically. • Privacy protection will be needed for vehicle owners and fleet operators; this may be managed through data anonymization. • There is a need for a unique identifier for each vehicle to make it possible to present data in a searchable database.
Relevant Models	FAA ASIAS integrates and analyzes data about aircraft across the industry to plan for potential safety concerns in aviation, convening both public and private sector partners.[10]

[9] For more information on the National Transit Map, visit: https://www.bts.gov/content/national-transit-map.

[10] To visit the website for FAA ASIAS, go to: http://www.asias.faa.gov/pls/apex/f?p=100:1:.

Assessing Automated Vehicle Safety Features and Performance

Some participants stated that as the number of automated vehicles on the road increases, data on automated vehicle safety features and performance will enable assessment of their impact. This will require both data on the advanced technology features in individual vehicles and data on those vehicles' performance on the road—and analyzing these datasets together to find meaningful correlations.

Table 7. Assessing Automated Vehicle Safety Features and Performance

Area	Description
Goal	Determine the impact of automated vehicle safety features on safety, to improve automated vehicle safety
High-Value Data	Inventory of collision factors and vehicle attributes; crash reports, near-miss events, automated vehicle disengagement and re-engagement, driver distraction
Key Stakeholders	OEMs, fleet operators, state and local transit agencies, law enforcement
Challenges and Potential Solutions	Data providers may have liability concerns, which could be addressed through legal protections and licensing agreements, as well as data privacy concerns, which could be addressed through data anonymization. Similarly, standardized police reports across states may need to incorporate elements regarding ADS usage prior to reported crashes.
Relevant Models	The Fatality Analysis Reporting System (FARS) is a nationwide census that provides NHTSA with yearly public data regarding fatal injuries from motor vehicle crashes.[11]

Overarching Challenges and Concerns

In addition to the specific challenges noted in the seven high-priority areas, participants discussed several overarching challenges that pertain to most types of automated vehicle data exchange. These include:

- The need to host information in a common database in machine-readable formats and maintain a secure IT environment for data exchanges.
- The proprietary nature of data collected by the private sector, which companies may see as part of their competitive advantage. For example, data produced by sensors is linked to proprietary algorithms, so exchanging it is problematic.
- Privacy concerns about data connected to individual drivers
- Concerns about legal liability related to data validation
- The need for common data standards and data formats
- Uneven levels of funding for state and local transit agencies to support data exchanges

[11] For more information on FARS, visit: https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars.

- Limited incentives for industry or state and local transit agencies to exchange data
- Unresolved questions about data ownership.

Proposed Federal Roles

While the federal government cannot address all the challenges outlined, participants urged the USDOT to consider several immediate next steps to help in the development of data exchanges for automated vehicle safety:

- Facilitate the identification of data voluntary exchange priorities as well as key data elements
- Support the development of data standards and data infrastructure through funding and grant provisions, pilot programs, or other means
- Help develop a common language for discussing automated vehicle safety issues, including clear definitions for key terms (e.g., edge cases and near-miss events)
- Help improve interoperability for different data types, including the ability to combine data from different states and localities, industry, and the federal government
- Define methods for assessing automated vehicle safety. For example, what should be the reference benchmarks for incidents, near-misses, crashes, and other metrics?
- Develop legal frameworks for data exchanges, specifically addressing liability and privacy issues pertaining to data exchanges.
- Define and implement requirements for secure data transmission in data exchanges
- Provide additional incentives for state and local governments to exchange data and encourage competition by involving different communities and agencies
- Educate stakeholders and the public about automated vehicle technology and safety
- Convene key stakeholders, including developers and researchers, technology companies, and state and local governments, to discuss these issues through roundtables, workshops, workgroups, or forums.

Chapter 5. Key Takeaways

The Roundtable on Data for Automated Vehicle Safety provided the USDOT with many diverse suggestions for next steps in facilitating near-term, voluntary automated vehicle data exchanges. The wide range of roundtable participants provided their initial feedback on the draft *Automated Vehicle Data Principles* and draft *Framework*, two core documents that the USDOT plans to refine and use to help organize this work and communicate priorities. Collectively, the various roundtable participants discussed seven key areas that can be prioritized for voluntary data exchanges. And, finally, roundtable participants discussed overarching challenges and how the USDOT can help provide solutions.

Much of the day's discussions centered on new initiatives, new technical solutions, and the need for new data. This included not only increasing data collection and management through established channels, but also considering relatively novel approaches. For example, several breakout groups discussed the potential use of crowdsourcing for developing more detailed roadway inventories or real-time incident reporting.

At the same time, some participants noted that there is untapped value in existing data and data exchange models. Many mentioned improving current datasets as an immediate focus to advance emerging automated vehicle technologies. They also suggested studying existing initiatives, such as AutoISAC, that can serve as examples for further work by the government and private sector.

The USDOT Roundtable on Data for Automated Vehicle Safety brought dozens of stakeholders together to discuss challenges, opportunities, and priorities in this emerging field. Their work could be a model for further USDOT convenings and leadership in facilitating the voluntary data exchanges needed to accelerate the safe deployment of automated vehicles.

Appendix A. Acronyms

AASHTO - American Association of State Highway Transportation Officials

ADS - Automated Driving Systems

ASIAS - Aviation Safety Information Analysis and Sharing

B2B - Business-to-Business

FAA - Federal Aviation Administration

FARS - Fatality Analysis Reporting System

FHWA - Federal Highway Administration

FMCSA - Federal Motor Carrier Safety Administration

FTA - Federal Transit Administration

IOO - Independent Owner Operator

ISAC - Information Sharing and Analysis Center

ITS JPO - Intelligent Transportation Systems Joint Program Office

NACTO - National Association of City Transport Officials

NDS - Naturalistic Driving Study

NHTSA - National Highway Traffic Safety Administration

OEM - Original Equipment Manufacturer

OSTP - The Office of Science and Technology Policy

SAE - Society of Automotive Engineers

SHRP - Strategic Highway Research Program

TNC - Transportation Network Company

USDOT - U.S. Department of Transportation

Appendix B. Key Terms and Concepts

Critical Path: A sequence of essential activities and tasks that must be finished to complete a project.

Data Exchange: This report and referenced materials purposefully use the term “data exchanges” and not “data sharing.” “Data exchanges” suggest two or more parties exchanging data with one another for mutual benefit. This is to be distinguished from “data sharing,” which suggests one-way transfers of data largely for the benefit of the receiver.

Data Standards: Standards for data formats and interfaces can enable interoperability and lower the cost of data exchange. A range of stakeholders in the automated vehicle ecosystem—including vehicle and equipment manufacturers and state and local governments—may voluntarily develop and adopt consensus-based data standards, with the federal government and standards organizations playing a facilitative role.

Edge Cases: A problem or situation that occurs only at the extreme operating parameter.

Near-Miss Events: An unplanned event that does not result in injury or damage—but had the potential to do so.

Society of Automotive Engineers (SAE) Levels of Automation: From 0 to 2, the human monitors the driving environment. From 3 to 5, the Automated Driving System monitors the driving environment.

0 - No Automation **–** The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems

1 - Driver Assistance **–** The driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task

2 - Partial Automation **–** The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task

3 - Conditional Automation **–** The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene

4 - High Automation **–** The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene

5 - Full Automation **–** The full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.

Appendix C. Roundtable Agenda and Participating Organizations

USDOT Roundtable on Data for Automated Vehicle Safety

U.S. Department of Transportation Media Center
1200 New Jersey Ave. SE, Washington, DC 20590

DECEMBER 7, 2017

Objectives for the Day:

- Gather feedback on the USDOT's draft Automated Vehicle Data Principles and draft Framework
- Identify near-term, critical-path voluntary data exchange use cases to accelerate safe rollout of automated vehicles

Table 8. Agenda

Time	Activity
9:00 am	Registration Opens
9:30 am	Welcome & Structure of the Day
9:40 am	Opening Keynote
10:00 am	Executive Panel Discussion: Multimodal Perspectives on the Automated Vehicle Data Principles and Framework
10:30 am	Breakout Session 1: Feedback on the Automated Vehicle Data Principles and Framework
12:00 pm	Lunch & Networking Break
1:00 pm	Lightning Talks: Voluntary Data Exchange Use Cases
1:30 pm	Breakout Session 2: Priorities within the Automated Vehicle Data Framework
3:00 pm	Networking Break
3:30 pm	Breakout Session 3: Identifying Next Steps
4:00 pm	Presentation of Highlights
4:30 pm	Closing Remarks
5:00 pm	Adjourn

USDOT Roundtable on Data for Automated Vehicle Safety

Participating Organizations

3M Connected Roads

Automotive Information Sharing and Analysis Center

City of Boston

City of Columbus

City of Pittsburgh

City of New York

Colorado Department of Transportation

County of Greenville, South Carolina

Daimler Trucks North America

EasyMile

Ford Motor Company

Future of Privacy Forum

General Motors

HERE Technologies

iCone Products

Insurance Institute for Highway Safety

Local Motors

Lyft

Massachusetts Institute of Technology

Nexar

Nissan

NVIDIA

nuTonomy

Peloton

Pennsylvania Department of Transportation

Proterra

San Francisco County Transportation Authority

Tesla

Toyota

Uber

University of Michigan

University of Texas - Austin

USDOT - FHWA

USDOT - FMCSA

USDOT - FTA

USDOT - ITS JPO

USDOT - NHTSA

USDOT - OST-P

Waymo

Waze

Appendix D. Draft Automated Vehicle Data Principles and Framework as Presented at the Roundtable

Draft USDOT Guiding Principles on Voluntary Data Exchanges to Accelerate Safe Deployment of Automated Vehicles

Principle #1: Promote proactive, data-driven safety, cybersecurity, and privacy-protection practices

The USDOT aims to accelerate U.S. deployment of automated vehicles by encouraging private sector innovation while ensuring appropriate safeguards for safety, cybersecurity, and privacy. Proactive safety practices identify and mitigate risks before they cause harm. Such practices require timely data and analysis that cut across traditional silos. To develop appropriate system safeguards, the USDOT, local jurisdictions, and industry partners will need data from early testing and development efforts to inform investments and policies.

Principle #2: Act as a facilitator to inspire and enable voluntary data exchanges

Industry and government share the objective of bringing safer automated vehicles to market more quickly, and recognize the enabling role of data exchanges. The USDOT is uniquely positioned to convene stakeholders around mutually beneficial use cases and common standards. Sometimes, the USDOT will need to directly manage data but often our role will be to enable others to exchange data via a range of mechanisms.

Principle #3: Start small to demonstrate value, and scale what works toward a bigger vision

The USDOT and our stakeholders cannot define all data exchange needs and specific requirements upfront and will need to build policies and capabilities iteratively via agile and collaborative methods. We should start small, and focus initially on areas of clearest public-private benefit and the smallest amount of data exchange necessary to answer critical-path questions—while keeping in mind long-term goals and needs.

Principle #4: Coordinate across modes to reduce costs, reduce industry burden, and accelerate action

Similar types of data exchanges will be needed for similar purposes across all modes of transportation. The USDOT's operating administrations and external stakeholders can learn from each other and share tools and resources to reduce costs and time to deploy capabilities, while improving interoperability. Also, some agencies make duplicative requests for industry information, increasing the cost of partnering with the government. Consolidating and streamlining those requests can reduce costs and increase interest in collaboration.

Table 9. Draft Automated Vehicle Data Framework

Category	Data Generators and Users Participating in the Exchange	Goals	Specific Data to Exchange	Real-World Examples
Business-to-Business (B2B)	• Heavy- and light-duty OEMs • TNCs and fleet operators • Insurance companies	• Mitigate known and emerging cyberthreats • Improve industrywide safety through shared learning in safety-critical and edge case scenarios • Inform future insurance policies	• Cybersecurity incidents • Edge cases • Near-miss events • Performance in safety-critical scenarios	• AutoISAC[12] • Clinical Study Data Request[13]
Business-to-Government ***…and/or Government-to-Business***	• Heavy- and light-duty OEMs • TNCs and fleet operators • Insurance companies • Non-federal government (state, county, municipal) • Federal government (FHWA, FMCSA, FTA, NHTSA)	• Understand performance of rapidly evolving technology during testing phases • Inform policies and investments to improve system safety and efficiency	• Cybersecurity incidents • Near-miss events • Performance in safety-critical scenarios • Crash reconstruction	• FAA ASIAS[14] • Voluntary Safety Self-Assessments (Part of ADS 2.0)[15]

[12] For more information on AutoISAC, visit their website at: https://www.automotiveisac.com/.

[13] For more information on the Clinical Study Data Request, visit: https://www.clinicalstudydatarequest.com/.

[14] To learn more about FAA ASIAS, visit: http://www.asias.faa.gov/pls/apex/f?p=100:1:.

[15] Learn more about safety self-assessments at: https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf.

Category	Data Generators and Users Participating in the Exchange	Goals	Specific Data to Exchange	Real-World Examples
Infrastructure-to-Business ***…and/or Business-to-Infrastructure***	• Infrastructure owners and operators (state, county, municipal, federal, academic) • Infrastructure tech companies • In-vehicle and aftermarket services • Heavy- and light-duty OEMs • TNCs and fleet operators	• Help vehicles navigate safely around obstacles and in adverse weather conditions • Reduce system congestion • Help optimize infrastructure maintenance	• Work zone activities and geometrics • Unplanned utility repairs • Missing signage or broken infrastructure • Curb use rules and availability	• National Transit Map[16] • Waze Connected Citizens Program[17] • Meteorological Assimilation Data Ingest System[18]
Open Training Data	• Government • Industry • Academia	• Improve ADS performance in common safety-critical scenarios • Support basic research and education	• Road, signage, and other infrastructure imagery • Edge cases	• ImageNet[19] • Multimedia Commons[20] • Nexar NEXET[21]

[16] For more information on the National Transit Map, visit: https://www.bts.gov/content/national-transit-map.

[17] For more information on the Waze Connected Citizens Program, visit: https://www.waze.com/ccp.

[18] To learn more about the Meteorological Assimilation Data Ingest System, visit: https://madis.ncep.noaa.gov/.

[19] For more information on ImageNet, visit: http://www.image-net.org/.

[20] Visit the Multimedia Commons at: https://multimediacommons.wordpress.com/.

[21] To view the NEXET dataset, visit: https://www.getnexar.com/challenge-2/.

U.S. Department of Transportation