United States Department of Transportation
Annual Modal Research Plans FY 2022
Program Outlook FY 2023

Intelligent Transportation Systems Joint Program Office (ITS JPO)

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Executive Summary

The Intelligent Transportation Systems Joint Program Office (ITS JPO) was created as a result of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) Public Law 102-240 (December 18, 1991). ISTEA established a federal program to research, develop and operationally test Intelligent Transportation Systems (ITS) and to promote ITS implementation. The ITS Program is designed to facilitate the deployment of technology to enhance the efficiency, safety, and convenience of surface transportation resulting in improved access, saved lives and time, and increased productivity.

The ITS JPO serves as the U.S. Department of Transportation's (USDOT) multi-modal technology research program, working toward improving transportation safety, mobility, and efficiency; and enhancing productivity through the integration of innovative technologies within the nation's transportation system. Through these efforts, the ITS JPO serves as a Departmental leader in addressing innovation. The **Vision** of the ITS JPO is to "Accelerate the use of ITS to transform the way society moves." That vision is executed through leading collaborative and innovative research, development, and implementation of intelligent transportation systems technologies to improve the safety and mobility of people and goods. By undertaking the research and deployment of advanced and innovative technologies, the ITS JPO serves as the USDOT's organizational resource for avoiding duplication and ensuring the Department is on the forefront of advancing technologies to make certain our transportation system is safe and efficient.

The ITS JPO will continue to provide a focused role for the Department in supporting development and deployment of new technologies as well as adopting and adapting innovative technologies from other industries to meet the specific needs of the surface transportation system. By working with industry partners, academia, and stakeholders through cooperative agreements and grant programs, the ITS JPO will continue to develop intelligent and advanced technologies that address some of the more intractable transportation-specific problems. However, the ITS JPO's broad mission is neutral to any particular technology or platform that meets performance and interoperability requirements.

To fulfill its mission, the ITS JPO is guided by the ITS JPO Strategic Plan 2020-2025 which outlines a focused set of strategies to lead collaborative ITS research, development, and implementation across USDOT operating administrations and with the private and public sector.

The ITS JPO continually assesses the feasibility, maturity, and benefits of ITS technologies and approaches, and shepherds' transportation solutions from inception to implementation. The ITS JPO capitalizes on past investments in key research areas including automation, connectivity, and data access and exchanges. The ITS JPO will continue to augment such efforts with our USDOT partners to focus on new emerging technologies that will impact and transform transportation.

The ITS JPO includes a portfolio of research and technology deployment support programs focused on diverse systems and technologies geared towards producing the greatest public benefit from transportation's increasing technological transformation. The ITS JPO is responsible for coordinating the ITS Program and initiatives among the various USDOT operating administrations:

Federal Highway Administration (FHWA); Federal Motor Carrier Safety Administration (FMCSA); Federal Transit Administration (FTA); Federal Railroad Administration (FRA); National Highway Traffic Safety Administration (NHTSA); Maritime Administration (MARAD) and the Great Lakes St. Lawrence Seaway Development Corporation (GLS). In addition, close collaboration with current industry and academic leaders in technology and innovation is a cornerstone of the ITS Program. The research builds on and leverages the technology and applications developed across all modes delivering cross cutting research activities and technology transfer that support all modes in the USDOT.

Through our research activities the ITS JPO serves two distinct roles within the USDOT, as both the project lead and as a multi-modal coordinator, working to ensure effective ITS research and technology deployments are successful. The ITS JPO serves as the lead in forward looking and emerging work that is not limited to just one mode and undertakes emerging projects where cross cutting capabilities are required to manage them. This includes connected data systems and large-scale pilot deployments. In our multi-modal coordinator capacity, the ITS JPO ensures that capabilities across the USDOT are harnessed to bring about the greatest good. An example of a major multimodal initiative led by the ITS Joint Program Office through partnerships with OST, FTA, and FHWA, is the Complete Trip - ITS4US Deployment Program. In 2021 the Program made up to $40 million available to enable communities to showcase innovative business partnerships, technologies, and practices that promote independent mobility for all travelers. The Program leverages innovative technologies and facilitates public private partnerships to allow for a traveler-centric approach that improves mobility options for all travelers, including travelers with disabilities, travelers from rural areas, and lower income travelers. The Program is designed to bring publicly and privately sponsored research together to create large-scale, replicable deployments that generate increased multimodal mobility options for all travelers regardless of location, income, or disability.

In the near term, vehicles with various levels of driving automation systems that enter the market may potentially offer new benefits in travel comfort, convenience, and affordable accessibility. There is a clear government role in both ensuring public safety as these vehicles are introduced into service, and in ensuring that these vehicles are integrated into the road network in a manner that improves the efficiency of the system, and provides equitable mobility for all. The private sector is leading technology research and development focusing on vehicles that will behave in a way that works best for their own travel needs but with limited consideration for wider impacts to the road network. As more vehicles are deployed, coordination through connectivity could ensure that the continued introduction of automated driving technologies produces system-wide mobility and congestion-reduction benefits in addition to vehicle-level improvements in safety, comfort, and convenience.

The ITS JPO Automation Program's collaborative and multi-modal research portfolio provides cross-cutting support across the USDOT. Through the development of cooperative and standards-based technologies and comprehensive, stakeholder-driven policies, ITS JPO works to ensure the safe and efficient adoption of automated vehicles across the transportation system.

In addition, securing transportation's critical assets and infrastructure against cyber threats is a shared responsibility of both the public and private sectors. A common vision and a framework for achieving that vision are needed to guide the public-private partnerships that will secure transportation systems. Presidential Executive Order 13800 (issued May 11, 2017) on Cybersecurity of Federal Networks and Critical Infrastructure, holds heads of Departments accountable for managing cybersecurity risk of their ecosystem.

The USDOT has an important role to play in pursuing research and analysis in the area of cybersecurity for ITS to deliver public benefit. USDOT leadership can support needed research and coordinated stakeholder-driven development and implementation of best practices that can then in-turn be adopted by the diverse community of Infrastructure Owner Operators (IOO) including State, Tribal, Territorial and local agencies, private and public-private facility operators as well as vehicles and other mobile participants in the transportation system. Individual IOOs often have limited capabilities in this area; USDOT led collaboration can support both nationwide interoperability as well as development and implementation of best practices.

The ITS Cybersecurity Research Program supports USDOT cybersecurity research. This research maps to the Cybersecurity Technical Research Working Group's (TRWG) Groups team scope and annual goals to close gaps, facilitate information sharing, and the coordinate on the use of common risk models. This research is coordinated with our modal partners who actively participate in management of specific projects, and includes areas such as the adaptation of the NIST Cybersecurity Framework for the transportation sector. This research will facilitate developing the capacity of our partners and will inform the skilled workforce that the USDOT must support who proactively and effectively implement of sound transportation cybersecurity practices. The research will also assist in our efforts to appropriately identify suitable standards and system architecture approaches, that when combined with suitable operational practices can maximize the security and cyber-resilience of ITS installations and operations nationwide.

The ITS JPO is uniquely positioned to work across the USDOT with our modal partners to develop and coordinate multimodal projects that are central to cybersecurity research. These efforts should include convening and facilitating the transportation ecosystem around shared priorities, facilitating the development of related policies, identifying and addressing cross-modal issues, sharing best practices and information, and eliminating "silo" activities.

Communications technologies – both wired/fiber and wireless - are critical to the safe, secure, and efficient operations of ITS. Based on specific needs, transportation agencies have incorporated a wide variety communications into their operational environments (i.e., field systems, management centers, and public fleets); vehicle manufacturers are increasingly including multiple types of wireless communications capabilities on their vehicles; and travelers are increasingly using portable devices to interact with transportation communications to increase safety, mobility, and accessibility into their travel. New and emerging communications technologies will continue to have significant impacts on the transportation system. The USDOT has an important role to play in pursuing research and analysis regarding suitability, and issues of latency and interference as new

forms of telecommunications are proposed for delivery of public benefit. USDOT's role allows State and local agencies to confer with telecommunications experts and to translate use cases and requirements that cross market boundaries and ensure interoperability.

The Emerging and Enabling Technologies Program primarily focuses on identifying, assessing, and implementing new technology such as Artificial Intelligence (AI) for ITS as well as data and computing resources needed to promote AI for further investigation by the ITS JPO and our modal partners. Likewise, this program also focuses research on emerging communications for ITS; such as Dedicated Short Range Communications (DSRC), Long-Term Evolution Cellular Vehicle-to-Everything (LTE-CV2X), or the upcoming 5G as well as future "Gs". This research provides USDOT with a significant understanding of the potential benefits and disruptions these technologies could represent to the transportation system. This research also incorporates an understanding of how the electromagnetic radio frequency spectrum is used by transportation and whether transportation has unique needs with regard to spectrum. Spectrum is a crucial resource needed to facilitate the exchange of vast data quantities that support cutting-edge technologies from autonomous vehicles and telemedicine to advanced public safety communications networks.[1] As noted in 2019 in two documents from the White House—***Ensuring America Reaches Its 5G Potential*** and ***Research and Development Priorities for American Leadership in Wireless Communications***—efficient spectrum use and spectrum availability are fundamental to the Nation's security and prosperity, requiring a "whole-spectrum solution" that encompasses and addresses scientific research, technology, policy, legislation, operations, and economics.[2] The ITS JPO participates in the Federal cross-Agency/Department efforts to implement secure 5G; and further monitors break-through research in using currently under-utilized spectrum to understand whether there are opportunities for transportation.

Under the Emerging and Enabling Technologies Program, Artificial Intelligence (AI) has been identified as an area of prioritization, both for the benefits it promises and the opportunity to extend those benefits across modes within USDOT. On February 11, 2019, an Executive Order was issued on Maintaining American Leadership in Artificial Intelligence[3] (AI) to promote sustained investment in Research and Development (R&D) in collaboration with industry, academia, and other non-Federal entities to generate technological breakthrough in AI. The Executive Order directs heads of agencies to consider Artificial Intelligence as a Research and Development priority with respect to federal investment, an agency's mission, and research priorities. The ITS JPO is seeking to consider prioritizing R&D research with a focus on AI in ITS as well as data and computing resources need to promote AI per the Executive Order. Moreover, the ITS JPO Strategic Plan[4] has established AI in Intelligent Transportation Systems (ITS) as Emerging and Enabling Technology research area.

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[1] Quoted from https://www.whitehouse.gov/articles/ensuring-america-reaches-its-5g-potential/
[2] From: https://www.whitehouse.gov/articles/ensuring-america-reaches-its-5g-potential/ and https://www.transportation.gov/sites/dot.gov/files/2020-02/EnsuringAmericanLeadershipAVTech4.pdf.
[3] https://www.whitehouse.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/
[4] An internal document which is currently under review for approval so it will be provided at a future date

In FY22 the Emerging/Enabling Technologies Program plans to support reengagement with its modal partners on research activities in support of Departmental goals related to climate change and the environment. The program intends to leverage past and current research in this area, including the research accomplished in the AERIS (Applications for the Environment: Real-Time Information Synthesis) Research Program, the ToSCO (Traffic Optimization for Signalized Corridors) Phase 1 Project currently underway at Turner Fairbank, and the truck platooning research also underway at Turner Fairbank.

The Data Access and Exchanges Program focuses on enabling access to core transportation data across the ITS ecosystem, including data and source code generated through the USDOT's ITS research investments, to accelerate deployment of new ITS technologies, cut the time from research to insight and policy-making, and drive secondary research results. While enabling broader ITS research and deployment activities, these investments drive implementation of various Federal and USDOT directives on increasing access to data, source code, and federally funded research results. Between FY2018 and FY2021, the ITS JPO incubated a consultative Research Data Access implementation support team and technical platforms to enhance access to data and source code produced through multi-modal ITS research investments. In FY2022, the ITS JPO will maintain mature capabilities and coordinate with the appropriate long-term owners within the Department and remain users of, and investors in, these capabilities. Consistent with the ITS JPO Strategic Plan, this research area will also continue to help identify, prioritize, monitor, and – where necessary – address multi-modal data exchanges across traditional organizational boundaries.

The Accelerating Deployment Program will take the lead in building evidence-based decision-making capacity both inside and outside of USDOT and supporting activities that work to accelerate the deployment of ITS, including: data acquisition about the costs, benefits and extent of deployed ITS, knowledge transfer/Professional Capacity Building, system interoperability and standards, and enhanced communication with our stakeholders.

The ITS Deployment Evaluation Program will continue to generate data and analyses related to the benefits, costs, and extent of deployed ITS. These data have been instrumental in understanding trends in deployment technologies and emerging priorities in agencies' ITS deployment plans. The ITS JPO has been collecting data on the benefits, costs, and extent of deployed ITS for over 20 years. These unparalleled, globally unique data resources offer the ITS JPO an extraordinary opportunity to support Departmental goals related to evidence-driven and data-based decision making.

The ITS JPO will continue to use the data it collects to:

- Assess the current state of ITS deployment and communicate the benefits that might be accrued by deploying them;
- Highlight technologies that have had particular success in solving common transportation problems;
- Highlight technologies that enjoy widespread use and show how they have been successfully deployed over time;

- Identify opportunities for strategic action and more intensive tech transfer, training, support, and data collection; and
- Identify gaps or needs that the ITS JPO and its modal partners can address with respect to ITS deployment data.

The Accelerating Deployment Program is also the ITS JPO's primary mechanism for educating the public sector's transportation workforce about ITS. The ITS JPO will continue to support activities that deliver multimodal ITS learning opportunities to the public-sector workforce by coordinating outreach related to the ITS JPO's research initiatives and providing technical assistance. The ITS JPO has developed and delivered technology transfer in close coordination with partners including the National Highway Institute (NHI), Intelligent Transportation Society of America (ITSA), Institute of Transportation Engineers (ITE), National Operations Center of Excellence (NOCoE), National Association of Development Organizations (NADO), universities and other stakeholders. The public-sector participants representing State DOTs, Metropolitan Planning Organizations (MPOs) and local agencies have benefited from this partnership. Participants have favorably evaluated the ITS JPO technology transfer for its delivery of much needed training and technical assistance with feedback indicating that participants use the training to improve grant applications, purchasing decisions, procurement designs, or systems operations and management. Evaluators have also mentioned a reassessment of infrastructure vulnerability including information technology (IT)-data management improvements as a result of technology transfer events provided by the ITS JPO.

The Accelerating Deployment Program also supports efforts to ensure system interoperability. The ability to allow transportation system users to access ITS services anywhere they may travel is essential to maximize safety, mobility, environmental, and connectivity benefits from rapidly advancing ITS technologies. To support interoperability, ITS JPO maintains and evolves a reference system architecture along with companion software tools. ITS JPO supports the development of ITS voluntary technical standards as well as identifying, specifying and adapting Information and Communications Technology (ICT) to enable efficient, safe and secure ITS deployments and support vendor-independent component replacement for lowered life-cycle costs. ITS JPO cooperates with stakeholders to evolve this architecture reference – currently supporting tailorable implementations of over 150 ITS services – to accommodate, and when appropriate lead, technological evolution. ITS JPO cooperates with stakeholders to develop needed ITS voluntary technical standards and to specify and adapt appropriate Information and Communications Technology (ICT) standards to support customized local ITS infrastructure implementations as well as large-scale interoperable integration of automation and connectivity technologies. ITS JPO also provides architecture and standards technical support including reference implementations of key standards to assist State, Tribal and Territory as well as local implementers of ITS technologies. ITS JPO works closely with the Office of the Assistant Secretary for Aviation and International Affairs (OST-X) to support advocating active use of U.S. ITS architecture and standards products in other nations; and to continue support of cross-jurisdictional border and North American interoperability efforts that seek to maximize benefits of multi-regional approaches to architecture and standards.

By constantly engaging with the transportation industry and maintaining ties with national and international practitioners, the ITS JPO research efforts identifies transportation problems worth solving and facilitates our engagement within the transportation industry to address market failures including system safety, multimodal improvements, interoperability, underserved populations, and other long-term challenges.

As ITS technologies continue to evolve and adapt in the coming years, the targeted research and development undertaken by the ITS JPO will continue to serve as a proving ground and accelerator for multimodal efficiency, safety, and reliability of surface transportation systems.

Topical Research Working Groups

The ITS JPO is actively engaged with the USDOT topical research working groups (TRWGs). These groups are designed to break the siloed, "modal-centric" approach of the past and, instead, establish a truly multimodal, "One DOT", research endeavor. A coordinated topical-driven approach will enable the Department to respond to new research needs that span one or more modes, guard against duplication of research efforts, and provide a resource for the modes and DOT leadership on a wide range of research topics. Each working group is assigned to a DOT agency or OST office and chaired by a representative for that agency/office. Working group membership is composed of representatives from each mode and OST office working within that topic area, with members selected based on recognized expertise within the topic area and/or broad awareness of their agency's activities within the topic area. The groups are designed to leverage existing cross-modal coordination bodies where possible. The ITS JPO actively engaged in and/or chairs/co-chairs five working groups:

1. Automation: The goal of this working group is to "Enable the safe integration of Automated Vehicles and Unmanned Aircraft Systems into the transportation system."
2. Emerging/Enabling Technologies: The goal of this working group is to "Advance the development of emerging/enabling practices and technologies."
3. Data: The goal of the Public Access Implementation TRWG, with the Data Access Task Force under it, is to "Ensure access to high-quality data to support data-driven technologies, operations, and decision making."
4. Cybersecurity: the goal of this working group is to "Develop approaches for maintaining the cybersecurity of the transportation system."
5. Environmental Stewardship Working Group: The goal of this working group is to "Advance environmental, operational and process analyses and scientific research to improve environmental performance, including developing analytical models, accelerating technology maturation and deployment, evaluating fuels, institutionalizing efficient operational processes and procedures, and informing policy development"
6. Technology Transfer (T2) and Evaluation Working Group: The T2EWG is established to advise and develop guidance on the management and measurement of T2 and Program Evaluation scoping of R&D activities across the Department and to oversee the implementation of new Department-wide T2 processes.

Non-duplication effort

The ITS JPO, utilizes the USDOT topical research working groups, the ITS JPO coordinates existing and new research needs across the department to guard against duplication of research efforts, and provide a resource for the modes and USDOT leadership on ITS research topics. Also, the ITS JPO actively coordinates the ITS Program and initiatives among USDOT operating administrations: Federal Highway Administration (FHWA); Federal Motor Carrier Safety Administration (FMCSA); Federal Transit Administration (FTA); Federal Railroad Administration (FRA); National Highway Traffic Safety Administration (NHTSA); Maritime Administration (MARAD) and the Great Lakes St. Lawrence Seaway Development Corporation (GLS). This close collaboration includes building awareness of current industry and academic leaders research activity in technology and innovation and is a cornerstone of the ITS Program.

	FY 2021 Enacted ($000)	FY 2022 Pres. Budget ($000)	FY 2022 Bipartisan Infrastructure Law ($000)*
R&DT Program Total	100,000	100,000	110,000

*The recently enacted Bipartisan Infrastructure Law (BIL) authorized R&DT totals differ from the detail in this AMRP. The total funding amounts are shared in this table while a continued effort is underway to assess and implement use of these fund.

Table 1 - FY 2022 RD&T Program Funding Details

RD&T Program Name	FY 2022 Pres. Budget* ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Complete Trip - ITS4US		$15,000				
Automation		$8,000				
Emerging/Enabling Technologies		$7,000				
Cybersecurity for Intelligent Transportation Systems		$5,000				
Accelerating Deployment		$16,300	$5,000			
Data Access and Exchanges		$4,000				
Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD)			$21,000			
Small Business Innovation Research (SBIR)		$2,200				
Program Support		$7,000				
*Estimated Budget Authority Rescission		$9,500				
Totals	**$100,000**	**$74,000**	**$26,000**			

FY 2022 President's Budget ($100M) adjusted for 9.5% rescission of budget authority "lop-off"

Table 2 - FY 2022 RD&T Program Budget Request by DOT Strategic Goal

RD&T Program Name	FY 2022 Pres. Budget* ($000)	Safety ($000)	Climate and Sustainability ($000)	Economic Strength and Modernization ($000)	Equity ($000)	Transformation ($000)	Organizational Excellence ($000)
Complete Trip - ITS4US					$15,000		
Automation						$8,000	
Emerging/Enabling Technologies			$1,000			$6,000	
Cybersecurity for Intelligent Transportation Systems						$5,000	
Accelerating Deployment					$5,000	$16,000	
Data Access and Exchanges						$4,000	
Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD)					$21,000		
Small Business Innovation Research (SBIR)				$2,200			
Program Support							$7,000
*Estimated Budget Authority Rescission				$9,500			
Totals	**$100,000**		**$1,000**	**$11,700**	**$41,000**	**$39,300**	**$7,000**

FY 2022 President's Budget ($100M) adjusted for 9.5% rescission of budget authority "lop-off"

Chapter 1 – FY 2022 RD&T Programs

Complete Trip- ITS4US Deployment Program
($15,000,000)

Program Description:

The Complete Trip - ITS4US Deployment Program is a multimodal effort led by the Intelligent Transportation Systems Joint Program Office (ITS JPO) through partnership with the Office of the Secretary of Transportation (OST), Federal Transit Administration (FTA), and Federal Highway Administration (FHWA). The Program makes $40 million available to enable communities to deploy innovative technologies, partnerships, and practices that promote independent mobility for all, regardless of location, income, or disability. The program is designed in three phases (planning, design and testing, and operation and evaluation) to bring publicly and privately sponsored research together to create large-scale, replicable, and integrated ITS and other emerging technology deployments to address the challenges of planning and executing all segments of a complete trip. The Program leverages innovative technologies that improves mobility options for all travelers, including travelers with disabilities, travelers from rural areas, and lower income travelers. In 2021, the USDOT awarded 5 contracts for the planning phase (Phase 1) to 5 communities across the US as a way of supporting the increase of multimodal mobility options for all travelers.

Safety, equitable economic strength, rebalancing investments to meet racial equity and economic inclusion goals are all supported by ensuring complete trips for all travelers. In order to address transportation needs of all travelers, and specifically travelers of transportation underserved communities, the entire trip from conception and planning to execution and from origin to destination must be considered. The USDOT has defined the Complete Trip Concept to capture the idea that a trip can be composed of several parts or segments and any individual traveler must be able to execute every part of their trip from origin to destination regardless of location, income, or disability. A complete trip can be made up on any combination of trip segments such as: trip planning, outdoor navigation, intersection crossing, boarding and using vehicles, transferring between vehicles, modes and payment services, using stops and stations, indoor and outdoor transitions, indoor navigation and completing travel to destination. The different segments of the trip may have unique challenges that can be addressed to support a successful complete trip. If the infrastructure is not available or in a state of good repair or if one segment of the trip is inaccessible, unreliable or inefficient, then access to subsequent segments is broken, and the trip cannot be completed. This Program will help local partners develop and deploy integrated mobility solutions to achieve complete trips for all travelers.

Program Objectives:

The Complete Trip - ITS4US Deployment Program aims to solve the mobility challenges of all travelers, regardless of location, income, or disability, in accessing jobs, education, healthcare, and

other activities. The objective of this program is to develop multiple large-scale, replicable, real-world deployments of integrated innovative technologies to address the challenges of planning and executing complete trips.

- **Vision:** Innovative and integrated complete trip deployments to support seamless travel for all users across all modes, regardless of location, income, or disability.
- **Mission:** Facilitate the integration and deployment of emerging technologies, along with innovative and replicable, traveler-centric partnerships, business models and practices to foster reliable, spontaneous, independent, safe, affordable, accessible, and efficient mobility options for all travelers.

The Complete Trip-ITS4US Deployment Program has developed four Guiding Principles for deployers to consider while planning and designing their complete trip deployments:

1. *Integrated, Innovative and Emerging Technologies:* Design flexible and integrated systems with innovative and emerging technologies that combine multiple technologies, modes, operators and payment systems to facilitate the Complete Trip vision with efficient and optimized travel, for spontaneous or planned trips.
2. *Inclusive Design:* Plan, design and deploy for the mobility and safety needs of all travelers. Ensure that all technologies, systems, modes, and infrastructure are universally accessible, affordable, and user friendly.
3. *Long-term Viability and Partnerships:* Develop robust, replicable business models and identify funding sources that allow successful deployments to continue beyond the pilot phase. Encourage strong partnerships, both public and private, to expand opportunities for innovation and integration.
4. *Open and Secure Data and Standardization:* Establish or enhance public access to open data platforms. Encourage civic engagement and development of third-party solutions along with ensuring the security of sensitive information. Adopt the use of standards, specifications, and best practices for implementation of infrastructure and technologies.

Anticipated Program Activities:

The Complete Trip-ITS4US Deployment Program is funding multiple large-scale, replicable deployments of integrated innovative technologies to address the challenges of planning and executing all segments of a complete trip. The USDOT has awarded 5 teams with Phase 1 funding to support the development of their deployment concepts. The 5 deployment projects include:

- University of Washington - Transportation Data Equity Initiative
- California Association of Coordinated Transportation - Trip Planning for All
- Heart of Iowa Regional Transit Agency - Health Connector for the Most Vulnerable
- ICF International, Inc. - Complete Trip Deployment in Buffalo
- Atlanta Regional Commission - Safe Trips in a Connected Transportation Network

The program is conducting deployments through a phased approach with decision gates at the end of each phase. In FY21, the program began Phase 1 which included the complete trip concept development and system requirements. In FY22, successful Phase 1 teams will be eligible to move

to Phase 2 and Phase 3 after successfully completing their complete trip deployment plans. Phase 2 will be the designing, building, and testing phase and it is expected to take up 24 months. Phase 2 also includes the planning for evaluation of the deployment.

An Independent Evaluation of the deployments will run concurrent with the three deployment phases of the program. In addition, an evaluation of the overall Complete Trip-ITS4US Deployment Program will also be conducted.

In FY22, the program will continue stakeholder engagement and outreach activities. This program includes continuous outreach and stakeholder engagement activities and technical services support activities providing visioning, program management, project technical assistance and procurement support. In FY22, the USDOT will finalize and release the Notice of Funding Opportunity (NOFO) for procuring the work for the Phase 2 and 3, where the successful sites will leverage their deployment concept developed in Phase 1 and move to systematically design in detail, build, and test (Phase 2) and operate and evaluate (Phase 3).

Technical services activities in FY22 will include assisting USDOT in managing and integrating the portfolio of deployment projects ensuring that the projects produce actionable results while remaining on schedule and on budget. This includes, but not limited to, performing technical program management functions, including roadmap development, meeting coordination and note taking, quick-response scanning and on issues and challenges, assistance in stakeholder coordination and collaboration, preparing technical training and templates, validation and verification of other project deliverables, white paper development, drafting responses to data calls, and procurement life-cycle support. This technical services support is needed to assist in oversight and management due to the complex technical nature of this program. If the program is going to be successful, additional technical services support is a vital part of ensuring that occurs. Technical services support is envisioned to last the duration of the Complete Trip-ITS4US Deployment Program.

Expected Program Outcomes:
The flagship effort of the Complete Trip Program will be the demonstration of a "Complete Trips for All" for one or more underserved populations. The program is designed to bring publicly and privately sponsored research together to create large-scale, replicable, and integrated ITS and other emerging technology deployments to address the challenges of planning and executing all segments of a complete trip.

The goals of the Complete Trip-ITS4US program are to:

1. Spur high-impact integrated Complete Trip deployments nationwide. Assist the transportation industry in tackling the difficult challenge of providing complete trips for all travelers nationwide by streamlining and expediting solution development through pilot deployments. High impact, replicable, integrated solutions developed by pilot deployments will reduce the cost of future deployments of these critical personal mobility enhancements.

2. Identify needs and challenges by populations. Identify the transportation challenges and needs of communities to support mobility options for all travelers regardless of location, income, or disability. Populations within each community have different needs and challenges in accessing transportation options to improve their quality of life.
3. Develop and deploy mobility solutions that meet user needs. Support and encourage communities to take revolutionary steps to integrate advanced technologies – especially those that enable adaptive and assistive transportation technologies – into the management and operations of the transportation network, including non-motorized modes. Engage key partners, within the federal government, the research community, stakeholder organizations, and private industry to support development of potential solutions for all travelers.
4. Measure impact of integrated deployments. Quantify and evaluate the impact of the integration of these advanced technologies, strategies, and applications towards the improved safety and mobility of all travelers. Quantified impacts support communication of technology benefits to future deployers and decision makers.
5. Identify replicable solutions and disseminate lessons learned. Determine which technologies, strategies, applications, and institutional partnerships demonstrate the most potential to address identified barriers to providing Complete Trips to all travelers in a variety of communities and built environments. Disseminate lessons learned from replicable solutions developed by deployment sites to catalyze additional deployment.

The vision of the program is to support seamless travel for all users across all modes, regardless of location, income, or disability. ITS4US works to enable efficient and equitable transportation options for all travelers. ITS4US recognizes that in order to address transportation needs of all travelers, and specifically travelers of transportation underserved communities, the entire trip from conception and planning to execution and from origin to destination must be considered. This enables the USDOT to develop a role in enabling interoperability between innovations and fostering adoption of technology standards and cross-modal integration.

The Program supports the mobility and underserved communities. The research maps to the mobility research working group's scope and annual goals to address market failures associated with transportation for all travelers, including travelers with disabilities, travelers from rural areas, and lower income travelers. This research will be coordinated with our modal partners across multiple agency disciplines and will develop the capacity of our partners to make improvements in this often-overlooked area.

Collaboration Partners:
The Complete Trip - ITS4US Deployment Program is a multimodal effort led by the Intelligent Transportation Systems Joint Program Office (ITS JPO) through partnership with the Office of the Secretary of Transportation (OST), Federal Transit Administration (FTA), and Federal Highway Administration (FHWA). The Program is a part of the USDOT's Complete Trip portfolio. The Complete Trip portfolio consists of several efforts including: The FTA's Mobility for All Pilot Program, the Inclusive Design Challenge, and this Complete Trip - ITS4US Deployment Program.

This effort obtains input from a range of interagency Federal partners including the Departments of Health and Human Services (DHHS), Labor (DOL), Defense (DOD), and others.

Automation Program
($8,000,000)

Program Description:
The ITS JPO, in collaboration with FHWA, NHTSA, FMCSA, FTA, MARAD, and other USDOT modes, as well as State and local public agencies, academia, industry, and other surface transportation stakeholders, will conduct automation research that has the potential to transform safety, mobility, energy, and environmental efficiency; increase productivity; and facilitate freight movement within our nation's transportation system. Many of the activities in this program will be executed by modal partners and some will be jointly funded with them.

The ITS JPO's automation research supports the development of the technical foundation and policy analyses to enable USDOT to pursue its strategic agency goals as new technologies enter the transportation system. Cross-modal research in human factors related to driving automation is a key component of our safety mission. Cross-cutting impact assessment, including economic impacts, supports understanding of the positive and negative outcomes for all users.

Program Objectives:
Automation is a key component of the ITS JPO's Strategic Plan. The Program's goal is to enable safe, efficient, and equitable integration of automation into the transportation system. To achieve this goal, the research in FY 2022 will support the federal role in automation by funding cross-modal research in vehicle automation safety, infrastructure and interoperability, and policy analysis.

Anticipated Program Activities:
The Automation Program coordinates cross-modal research and builds on FY21 activities to achieve program objectives. It also provides a platform for internal USDOT research coordination and exchange, contributing to better outcomes across the Department.

Safety activities will improve understanding of safe automated vehicle operations and generate actionable data and decision support results for the broader stakeholder community. Human factors research, such as simulator or naturalistic driving studies, is fundamental to safety. The ITS JPO will partner with NHTSA, FHWA, and FMCSA to support this research. Together, we will continue to study automated vehicle safety issues related to transportation system management and operation, highway infrastructure, and vehicles. Activities related to adoption for technologies with proven safety benefits may also be supported through this area.

Network Efficiency activities support assessment of roadway capacity and reliability, research to further the development of cooperative driving automation (CDA) to support more efficient traffic operations and understanding of how automation's implications for future infrastructure design and investment decisions.

Socio-economic Benefits activities include research related to equity and accessibility; analysis, modeling, simulation, and system dynamics; and policy and planning. These activities focus on developing and using new analysis methodologies to support assessment of how the benefits and

disbenefits of new technologies may be experienced across the transportation system and different populations. Potential benefits may not be realized without sufficient consideration of varied needs. Analysis of both regulatory and non-regulatory policy issues can contribute to clarification of research needs and assumptions regarding future adoption.

Cross-Cutting activities support all areas by researching emerging technologies, providing research coordination activities both internally and externally, and engaging with a broad variety of stakeholder groups to inform better selection and prioritization of research as well as dissemination of results.

Expected Program Outcomes:
Safety outcomes will include results from driving simulator and field experiments to better understand the human factors issues related to the adoption of automation in varied modes, use cases, and settings. They will also inform understanding safety issues related to automated vehicle interactions with transportation systems management and operations (TSMO) functions, as well as infrastructure.

Network Efficiency outcomes will demonstrate the benefits of automated driving technology combined with connectivity to enable CDA. This will include collection and analysis of results from test track and field test results from CARMA, Traffic Optimization on Signalized Corridors (TOSCo), and truck platooning projects conducted in partnership with FHWA.

Socio-economic Benefits outcomes will include the necessary data to support development of modeling capabilities that will enable analysis, modeling, and simulation (AMS) tools to assess the changes in traffic that will occur as automated vehicles and CDA-capable vehicles enter the fleet. The program will also deliver system dynamics (SD) models that address the underlying decision-making processes on the part of both service providers and consumers. It can help to identify market failures and how policy makers can respond. The analyses, coordination, and outreach will inform cross-modal policy development.

Cross-cutting activities outcomes will improve information dissemination, identification of emerging needs, and research coordination across internal and external actors.

Collaboration Partners:

The ITS JPO facilitates multimodal automation research in collaboration with the Office of the Secretary and Operating Agency partners, including NHTSA, FHWA, FTA, FMCSA, and MARAD. Responding effectively to automation requires a cross-modal effort, as the expertise on various aspects of automation—both regarding technology and transportation systems impacts—resides in many parts of the Department. Cross-cutting tools such as evaluation methods, data access and exchanges, and development of other decision-making tools support these three areas.

External partners include stakeholder communities such as Transportation Research Board (TRB) standing committees, the National Cooperative Highway Research Program (NCHRP), the

Association of American State Highway and Transportation Officials (AASHTO), and Standards Development Organizations (SDOs), such as SAE International.

By collaborating extensively, the ITS JPO is able to improve the quality and comprehensiveness of Automation Program research by providing diverse and informed perspectives and subject matter expertise and expand outreach to inform the transportation community regarding Automation Program work products.

Emerging and Enabling Technologies Program
($7,000,000)

Program Description:

The Emerging/Enabling Technologies Program focuses on cultivating the next generation of transportation systems. As the scale of Intelligent Transportation Systems (ITS) increases, vehicle manufacturers, infrastructure providers, innovators, and entrepreneurs discover new opportunities to use technology and the data that will be generated. These technological advances, along with new functionality, new applications, new operational concepts, and disruptive innovations, need to be tracked and planned for by the USDOT. Current examples of these Emerging/Enabling technologies include Artificial intelligence (AI), Next Generation Dedicated Short-Range Communications (DSRC), Long-Term Evolution Cellular Vehicle-to-Everything (LTE-CV2X) technologies, and 5G communications, all of which have the potential to greatly impact transportation networks. This Program would also work to address areas related to climate change and resilience by leveraging past and current research into new opportunities for technological innovation in this critical area. As such, there is a need to determine technological, market, and demographic trends across the globe and across industries to seek, evaluate and sometimes incubate emerging capabilities that demonstrate the potential to transform transportation. Moreover, it will be critical to evaluate potential risks posed by these emerging technologies, including where risks and/or benefits may inequitably impact citizens of different racial groups, socioeconomic backgrounds, or other demographic characteristics.

The USDOT will be positioned and engaged as a partner to guide research, development, and technology adoption in a systematic manner. The USDOT recognizes the need to advance the adoption and use of emerging practices and technologies for transportation—particularly, where they play a key role in providing public benefits to Americans. The ITS JPO will coordinate and conduct investigations and exploratory research into emerging technologies across government, academia, and the private sector. This research will provide the USDOT with a significant understanding of the potential benefits and disruptions these technologies could represent to the transportation system. Through multi-modal coordination, the ITS JPO works to avoid duplicative ITS work and to ensure the efficient allocation of ITS resources.

The Emerging and Enabling Technologies Program is focused on supporting research, development, and technology efforts. A few examples are highlighted below.

Safety. Communications technologies are critical to the safe, secure, and efficient operations of transportation systems across the nation. Emerging communications technologies such as cellular-vehicle-to-everything (C-V2X) and 5G could have significant impacts on transportation systems. For example, C-V2X is being developed as a potential replacement for the DSRC system used by many ITS communications technologies today. 5G technology could drastically increase the speed at which information is communicated between vehicles and other entities, like roadside infrastructure, other vehicles, or even pedestrians with smartphone applications. AI could be used to improve safety, reduce fatalities, and secondary crashes. For example, AI could help detect

multimodal failures and incidents before they put users' safety at risk. AI could potentially be used by agencies for emergency management. For example, AI could be used to identify high-risk crash locations, identify populations vulnerable to natural calamities, and plan for evacuation needs of specific population groups.

Equitable Economic Strength and Improving Core Assets. High quality roadways and other core assets that provide adequate transportation options to all users are essential for robust economic activity. AI could potentially help save existing federal, state, and local investments and provide cost-effective approaches in asset management and roadway construction and maintenance. For example, agencies could use AI to detect or even predict the health of roadway and infrastructure assets, thus allowing them to more efficiently and equitably allocate resources. This could result in better roads and assets at lower costs, with fewer crashes, and safer operations for their maintenance crews.

Rebalancing Investments to Meet Racial Equity and Economic Inclusion Goals. An equitable transportation network successfully delivers all roadway users safely, securely, and efficiently to their destinations. To be equitable, the transportation system must be accessible and accountable to users of all abilities and backgrounds, living in all geographic locations. AI could potentially enhance the capability of users to execute independent travel for all links in their travel chain safely and reliably. For example, AI could support trip planning, wayfinding, situational awareness, and intersection crossing especially for underserved communities. This would allow underserved communities greater access to economic opportunities that had previously been unavailable to them.

Climate and Resilience. Emerging technologies in ITS, such as AI, are enabling more efficient, data-driven operations to better optimize multiple objectives, including reducing overall emissions. For example, by predicting demand, AI could optimize services across modes to meet the demand for the entire transportation network, helping to reduce emissions. Additionally, AI could support data-driven decision making to Build Back Better, more efficient, and sustainable transportation infrastructure.

Transformation and "Future Proofing." The ramifications of ITS have already begun to transform the transportation sector. Vehicle manufacturers, infrastructure providers, innovators, academics, entrepreneurs, and other groups are invested in the safe implementation and efficient usage of ITS technologies. ITS can help "future proof" infrastructure and assets so the overall transportation system can adapt to changing circumstances and perform better for longer. ITS offers opportunities to extend the useful life of existing assets in a variety of ways, such as by predicting when preventative maintenance should occur, preventing crashes and damages, and distributing positive impacts to the system more equitably.

Program Objectives:
This research program focuses on cultivating the next generation of transportation systems. As emerging technologies offer the potential to enter the transportation environment, ITS JPO will

evaluate their fit in meeting transportation needs and work with agency modes to extend resulting benefits from these technologies across the transportation system.

Given the magnitude of impacts that transitioning to the next generation communications can have on transportation, the ITS JPO proposes the establishment of a focused research initiative. There are four proposed research objectives that will concern the USDOT moving into the future:

A. *Institutional adoption of next generation communications technologies:*
- Promote adoption with State and local agencies by gathering needs, analyzing impacts, and coordinating transition planning.
- Analyze the additional skills/knowledge needed by transportation workers to manage each next generation of communications technologies, equipment, and systems.
- Work with transportation private sector equipment manufacturers and application developers to facilitate transition of safety-critical elements and interoperability.

B. *Safety and security framework development:*
- Develop and maintain a set of transportation communications threshold requirements associated with safety against which any new technology can be assessed and tested including cost and lifecycle expenses.
- Test new communications technologies for their suitability for the transportation environment, including testing for interference challenges or other harms to existing operations.

C. *Public sector representation:*
- Conduct necessary research and analysis in partnership with operating administrations and stakeholders to gather public sector needs and requirements.
- Create transportation safety use cases to facilitate the incorporation of transportation safety requirements into each next generation of communications technologies.
- Participate in and leverage existing relationships with US-based globally relevant SDOs (e.g., SAE, IEEE) along with international (e.g., ISO, ITU, 3GPP) SDOs to ensure that the transportation needs are represented in each next generation communications systems.

D. *Environment and Climate Change:*
   a. Leverage past and current ITS and environmental research into new, innovative research and analysis opportunities in partnership with operating administrations and stakeholders.

Anticipated Program Activities:
The Emerging and Enabling Technologies Program area is focused on the following planned activities:

- **Identify** research needs and opportunities by exploring federal, state, local, private, and academic research on technologies
- **Research** and test communications technologies to support transportation connectivity, enabling cooperative ITS and connected and automated transportation
- **Investigate** future spectrum use models that support transportation safety and system efficiency
- **Develop** new institutional models to help accelerate adoption of technology innovations

- **Transfer** technologies from exploratory research to development and deployment when appropriate

The ITS JPO and its modal partners have been leaders, collaborating on fundamental problems in safety, mobility, productivity, efficiency, equity, and climate change by leveraging emerging technologies, such as Artificial Intelligence (AI) and next generation communications technologies.

Artificial Intelligence: In support of the White House American Artificial Intelligence (AI) Initiative the ITS JPO has been supporting a coordinated Federal Government strategy and participating in the National Science and Technology Council (NSTC) on Machine Learning and Artificial Intelligence (MLAI) sub-committee. Since our world is being increasingly shaped and optimized by the transformative power of AI, the U.S. government elevated AI as one of its key priority science and technology areas.

In ITS, AI can be used to augment actions of field, handheld and remote sensing devices, connected and autonomous vehicles, Traffic Management Centers operators, transit and freight operators, decision-makers, and travelers. For example, AI can be used to identify objects and images, recognize speech and audio, process large amounts of data to recognize patterns, learn from experience, and adapt to new environments to predict traffic phenomena, provide situational awareness, assist drivers with maneuvering, recognize unsafe driving conditions in real-time, identify or isolate malfunctioning or misbehaving system entities, improve cyber-security, operate infrastructure devices and vehicles, monitor pavement and support decision-making. AI can be embedded in any system entity (vehicle, mobile device, roadside infrastructure, or management center) or be distributed among many entities in the system.

The ITS JPO sees significant potential in AI for the future of transportation and ITS. Therefore, the ITS JPO initiated the AI for ITS Program within the Emerging and Enabling Technologies Program area. The AI for ITS Program's vision is to advance next generation transportation systems and services by leveraging trustworthy, ethical AI (including ML) for safer, more efficient, and accessible movement of people and goods. The AI for ITS Program identifies, develops, implements, evaluates, and coordinates technology and policy research to advance the contextualization and integration of AI (including ML) into all aspects of the transportation system. The AI for ITS Program's goal is to cost effectively build and deploy AI for ITS capabilities in real-world modal use.

In support of the program vision, mission, and goal, the AI for ITS Program has sought to understand the landscape of AI for ITS over the past two years. This effort included developing three reports to: (1) define broad categories of AI for ITS and summarize existing and potential applications of AI for each category, (2) illustrate real-world transportation scenarios for possible deployment of AI-enabled ITS applications to address specific ITS needs, and (3) outline an initial five-year roadmap for the AI for ITS Program. On May 12, 2021, the USDOT held a webinar providing an overview of the AI for ITS Program to share program information and anticipated next steps. These anticipated program activities include:

- **Issuing a Sources Sought Notice (SSN)** in the Summer of 2021 with the purpose of conducting market research to shape potential Federal investment in the development, testing, pilot deployments, and evaluation of applications leveraging AI to address transportation needs, specifically in ITS. These include improving the transportation system and users' safety, mobility, accessibility, productivity, efficiency, and environmental impacts of the transportation system and users. Information gathered from the SSN and other multimodal stakeholder engagement activities will help to inform anticipated procurement activities.
- **Awarding deployments of mature AI-enabled ITS applications** to demonstrate the potential of AI in the short term. Influenced by the SSN responses, the program will target ready-to-deploy applications to demonstrate the near-term potential of AI. The goal is to pilot transferable, mature solutions that can be replicated and speed broader deployment across the nation. These deployments will be initiated in FY22.
- **Launching the AI for ITS Innovation Challenge Initiative** to foster innovation and build emerging AI for ITS capabilities for the longer term. For promising but less mature applications, the program intends to launch an innovation challenge initiative that targets strategic areas of high-value AI applications. This initiative will create the R&D foundation on which future, long-term deployments may be built. This innovation challenge initiative is also planned for an initial launch in FY22.

In developing our research initiatives, we are looking at technology neutral approaches to support fair market competition, understand the liability implications, consider privacy, bias, ethics, equity, data and infrastructure readiness, and impacts on the workforce.

Connectivity/ Spectrum: USDOT monitors and assesses wireless technologies and available devices to determine their capabilities to support a wide range of transportation system communications requirements regarding safety, effectiveness, and other capabilities. These technical research and assessment activities provide data-driven inputs to the USDOT policy decision-makers. Currently, ITS JPO is testing whether the next generation DSRC, LTE-CV2X, dual-mode, or 5G New Radio (NR) technologies can meet the requirements for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) safety-of-life and public safety systems; as well as whether these emerging communications technologies are interoperable with existing technologies which currently support these systems. Based on evolving industry standards, there is a need to assess newly available commercial off-the-shelf (COTS) devices as well as prototype devices with any of these technologies if we expect to continue an uninterrupted and seamless advancement toward the greater safety that these technologies might provide. For example, the 5G capabilities are relatively undefined at this time and it is not clear if transportation needs and requirements are being taken into consideration especially the needs of rural communities.

Communication technologies are evolving at an increasingly rapid pace f which has the potential to disrupt transportation operations. As such, there is a need to determine the impact of technological, market, and demographic trends throughout the globe and across industries to seek, evaluate and

sometimes incubate emerging capabilities that demonstrate the potential to transform transportation.

5th Generation (5G) Wireless Technology: The deployment of 5G cellular networks is quickly reaching nationwide status with many metropolitan areas achieving full 5G coverage. Within the transportation community, both automotive original equipment manufacturers (OEMs) and infrastructure owner operators (IOOs) are interested in understanding how this technology can be utilized for transportation specific use cases and how it compares to existing technologies such as LTE C-V2X and DSRC. The two main research objectives for FY2022 are to: 1) secure 5G testing service agreements for modeling and simulation, laboratory testing and field testing services and 2) procure 5G devices to start conducting testing with.

In FY2021 this program released a 5G Testing Sources Sought notice that received 27 responses and identified commercial and industry partners that can meet the USDOT's needs for 5G testing. In FY2022 this program will contract with government and industry testing partners for modeling/simulation, laboratory testing and field testing services. These testing services will look at overall performance of 5G technologies, focusing primarily on 5G New Radio Vehicle-to-Everything (NR-V2X), also called 5G Sidelink. This technology is specifically meant to support the transportation community and is analogous to LTE C-V2X and DSRC. Testing will focus on different wireless interference scenarios, performance when in the range of hundreds of vehicles, interoperability between 5G device and demonstration of ITS use cases including both vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) safety applications such as emergency electronic brake light (EEBL) and red light violation warning (RLVW) at both small and large scale.

In FY2020 a request for information (RFI) was released asking the wireless device vendor community for information on product availability of LTE C-V2X and 5G NR-V2X devices. Multiple responses were received for LTE C-V2X devices, however no responses were received for 5G NR-V2X devices. In FY2022, with the maturity of the underlying 5G standards (3GPP Release 16 and 17), 5G devices with the 5G NR-V2X capability are expected to be available to support the previously mentioned 5G testing activities.

Environment/Climate Change: In FY22 the Emerging/Enabling Technologies Program plans to support reengagement with its modal partners on research activities in support of Departmental goals related to climate change and the environment. The program intends to leverage past and current research in this area, including the research accomplished in the AERIS (Applications for the Environment: Real-Time Information Synthesis) Research Program, the TOSCo (Traffic Optimization for Signalized Corridors) Phase 1 Project currently underway at Turner Fairbank, and the truck platooning research also underway at Turner Fairbank. The program also plans to develop a roadmap for new environment- and climate-oriented ITS research activities moving forward. Leveraging past and current research into new opportunities for technological innovation in this critical area.

While activities in this area are just ramping up at the end of FY2021, in FY 2022 this research area hopes to undertake the following:

- Reinvigorate open dialogue with DOT stakeholders on new ITS and climate change research needs/gaps
- Revisit and reinvigorate next stages of Glidepath research/prototyping/modeling
- Revisit and reinvigorate partnerships (including MOUs) with other federal agencies, particularly the Department of Energy
- Assess current baseline of state of the practice and state of the art in the field of ITS and climate change, particularly regarding vehicle connectivity, automation, and electrification
- Develop new models and modeling techniques for climate change impacts of CV/AV technologies
- Develop performance measures and associated evaluation methodologies for ITS and climate change in CV/AV deployments
- Develop plans for examining and modeling the relationship between vehicle connectivity (especially v2I), vehicle automation, and vehicle electrification
- Revisit MOU between the ITS JPO and the European Commission and reinvigorate ITS and environmental joint activities/research
- Reinvigorate ITS and environmental joint activities/research with Japan MLIT/METI
- Work with international standards community as appropriate to consider environmental goals and requirements in relevant CV/AV standards and architectures

Expected Program Outcomes:

In regards to AI in ITS, the primary program outcome is to cost effectively build and deploy AI for ITS capabilities in real-world modal use. To do so, the program must assess the state of real-world, existing and/or planned AI-enabled applications for ITS needs. There are several real-world applications of AI that are being deployed within particular modes across State and local transportation agencies. The ITS JPO seeks to understand the landscape of how AI in transportation is currently being leveraged, and how potential investment in the future can help address transportation challenges. This objective will be used to assist ITS JPO in prioritizing research and development investment in transportation to support the Department's priorities.

Communication technologies research will analyze and provide input to the evolution of ad hoc environments communications to achieve "swarm intelligence" as LTE-CV2X and 5G capabilities are added to existing cellular, Wi-Fi, satellite, microwave, and DSRC environments; and will assess the impacts to the transportation system including an assessment of mitigations that might accelerate reliable and successful incorporation into operational environments.

The primary outcome for 5G Wireless Communications Technology will be to contract with government and industry test partners and start conducting 5G testing activities. For FY2022 it is anticipated that most activities would focus on modeling and simulation of 5G NR-V2X communications including propagation and interference analysis and simulation of communications for dense/congested traffic scenarios. Initial laboratory testing of 5G devices is also anticipated assuming that USDOT is successful in procuring 5G NR-V2X devices.

With respect to the environment and climate change, the primary outcome is to develop and eventually prototype, test and deploy ITS technologies, systems, and applications – particularly

focused on vehicle connectivity and automation - to reduce fuel use throughout the surface transportation system

Collaboration Partners:
The private sector, academia, and governments around the world have formulated questions associated with whether new communications technologies can reliably support interoperable, safety-critical applications, provide crash avoidance, and facilitate safe integration of automated vehicles and infrastructure. Chipset and vehicle manufacturers are working on prototypes to prove out the concept while experts are working to design performance-based test procedures that demonstrate the capabilities as well as the gaps that still need to be addressed.

One of the lessons learned from previous deployments is that the transportation environment introduces unique requirements for telecommunications; for instance, users and equipment move at high speeds—over 80 miles per hour, which has effects on the basic safety message signals and transmissions. Because the communications are used for safety, there are additional requirements associated with the high frequency and high reliability of the signals. Another is that any viable communication technology needs to scale to allow hundreds of nearby devices to communicate without causing channel congestion.

We have also learned that the telecommunications industry evolves at a rate that is dramatically different from the deployment of these technologies in State, regional and local transportation system operations. The replacement cycle within the telecommunications industry is typically 18-24 months whereas the replacement cycle within transportation system operations is typically 10-15 years. This disparity is impacting how transportation agencies decide to invest in and procure communications and connectivity in both the near term as well as in their longer-term investment planning.

With these requirements in mind, USDOT, modal partners, and stakeholder partners (e.g., National Telecommunications and Informational Administration) have invested in research and analyses including:

- Development of a spectrally efficient and effective band plan for the 5.9 GHz part of the spectrum which the Federal Communications Commission (FCC) is seeking to change and which requires further analysis of those changes.
- Testing of new technologies as they become available to gauge the suitability for high speed, rapidly moving and changing environments that may also be subject to land elevation, urban canyons, and other challenges.
- Assessment of out-of-band and adjacent channel interference from other users of the nearby spectrum to ensure that the transportation safety messages cannot be suppressed with the transmitting device or corrupted in transmission, or that the receiving device cannot hear or receive the messages.
- Analysis of the role of the immediate reporting of timing and location through GPS on devices and assessment of how the communications can continue to operate during any loss of GPS.

With respect to environmental and climate change activities, the ITS JPO expects to engage modal partners across the Department to address this Department-wide priority. The ITS JPO also expects to engage with partners and stakeholders at other Federal agencies, including the Department of Energy. The ITS JPO also hopes to reengage with its international counterparts on topics related to international coordination

Cybersecurity for Intelligent Transportation Systems (ITS) Program
($5,000,000)

Program Description:

The USDOT cooperates across a diverse range of stakeholders to address ITS cybersecurity research needs. In addition, the USDOT works to support secure ITS deployments and to develop the necessary cybersecurity culture among deployers that is essential for secure and resilient ITS deployments.

Security and resiliency are a necessary precondition to deploy and maintain interoperable, safe, effective and efficient ITS operations. To facilitate secure, nationwide interoperable ITS, the USDOT ITS Cybersecurity Research Program supports research needed to facilitate adaption and implementation of cybersecurity best practices across diverse ITS infrastructure deployments. USDOT leadership is uniquely positioned to support needed research and coordinated stakeholder-driven development and implementation of best practices. These efforts can then in-turn be adopted by the diverse community of Infrastructure Owner Operators (IOO) including State, Tribal, territorial and local agencies, private and public-private facility operators as well as vehicles and other mobile participants in the transportation system. Individual IOOs often have limited capabilities in this area; USDOT led collaboration can facilitate bringing options to stakeholders to use in their planning and operations of their system as well as any recovery needed from a cyber attack. This is a complex challenge - ITS system architectures are systems of systems that vary greatly across jurisdictions, with diverse current approaches to security and a broad range of equipment in service – some new, some decades old.

Current research continues to translate the National Institute for Technology and Standards (NIST) Cybersecurity Framework into the ITS environment. The tenets of cybersecurity that relate to transportation operations and equipment include: identify, protect, detect, respond, and recover. The NIST Framework provides a process that assists entities in understanding their mission-critical cybersecurity risks within the context of their needs and business practices, and how to best manage risks via combination of approaches to security and resiliency.

Cybersecurity considerations are an essential part of good engineering practice, and thus should be included in any transportation systems deployment. The ITS Cybersecurity Research Program seeks to address ITS cybersecurity needs, supporting the development and deployment of secure, well-engineered ITS systems that maximize the public benefits of ITS.

Program Objectives:

The overall objectives for the USDOT's ITS Cybersecurity Research Program are to support the widespread implementation of cybersecurity best practices, and to provide the capabilities for deployers to assure that ITS deployments remain secure. This security is a necessary precondition for their efficient, effective and safe operation. ITS systems need to be both resistant to cyber-attacks and resilient, allowing for a quick recovery from cyber-attacks that are not prevented. Complex Information and Communications Technology (ICT) systems, of which ITS is one example,

require extensive and adaptive technical and institutional solutions to remain both appropriately secure and sufficiently resilient to recover from attacks and other disruptions.

The National Institute of Standards and Technology (NIST) has developed and maintained a Cybersecurity Framework (CSF) along with other guidance documentation on securing ICT systems. Many Standards Development Organizations (SDO) have developed standards products that support secure ICT systems; the USDOT's ITS Standards Program adopts when appropriate, adapts based on transportation requirements, and develops new security standards as needed. ITS supporting infrastructure, including connected and automated physical systems where failures can have severe consequences, require a greater level of care to both maximize public benefit and to minimize the risk of harm.

The long-term goal of this research is to establish a multimodal intelligent-transportation system that is both resistant to cyber-attacks and resilient to those cyber-attacks that occur. ITS JPO will undertake and support cross-modal research to identify and create an improved awareness of good cybersecurity practices, and translate these practices to the ITS environment to develop a cyber-resilient ITS system.

Anticipated Program Activities:
The Cybersecurity for ITS Research Program works to adapt and leverage ICT best practices to benefit the unique requirements of ITS, identify and fill-in gaps; and support implementation of best practices across ITS deployments:

Adaption Cybersecurity Best Practices and the NIST Cybersecurity Framework (CSF) to ITS: ITS infrastructure, connectivity and automation services represent a complex system of systems which must remain secure in order to provide the safety and mobility benefits promised by rapidly-evolving ITS technologies. Recently completed efforts include translating the NIST CSF into a candidate Connected Vehicle cybersecurity profile to support V2X communications and systems. An effort to apply the CSF to the much more complex and diverse ITS infrastructure environment began in FY20 and will continue through FY22. These ITS environments vary greatly across jurisdictions, with differing approaches to cybersecurity in general, along with diverse uses of wired, fiber and communications technologies; and with equipment ranging from new to some decades old that was never intended to be connected via any network, much less to the public internet. Analyses will be conducted to identify an optimal path forward to develop sufficiently detailed best practices information that is also sufficiently flexible to accommodate the diverse needs of implementers.

Identification and Addressing of Gaps via Analysis and Testing: Research is being conducted to identify and fill cybersecurity gaps that are unique to ITS and thus not easily addressed by available ICT solutions without further adaptions. Gaps are identified via analyses of system architectures and other means identified in the CSF as well as via penetration testing of deployed systems in cooperation with IOOs. System-wide needs, such as the ability for multiple security certificate issuers – Security Credential Management Systems (SCMS) – to coordinate secure movement across National and jurisdictional borders, are being documented with analysis being performed to

identify efficient, effective candidates for large-scale, interoperable, secure deployments of rapidly advancing ITS infrastructure, connectivity and automation technologies.

5G Cybersecurity Analysis: Research is being conducted to analyze the emerging specifications for 5G NR (fifth generation new radio cellular wireless) and assessed against the unique needs for a transportation environment to identify gaps. This project is assembling the data and information associated with 5G specifications, the worldwide working groups (such as those in 3G Partnership Project (3GPP) or International Telecommunication Union (ITU)), and emerging transportation use cases to identify security and gaps from a transportation perspective. This research will assess issues that may occur if key features, such as use of GNSS/GPS, are hacked or unavailable. The project also supports expert participation in the specifications and standards development organization working groups as well as coordinated collaboration with other US Government (USG) agencies with overlapping interest in 5G communications security. Last, the project work will perform precursor research on the integration of transportation 5G-based services with smart city/smart community systems to identify new types of threats and vulnerabilities; and to research and test new mitigation solutions once prototype devices are available. This project will utilize the ITS architecture reference, ITS standards, and ITS tool sets to provide a holistic analysis to identify where 5G may support transportation information flows, field devices, vehicle fleets, back-hauls, back-office systems, and other component elements of a transportation environment.

Cybersecurity for Transportation System Users: This research will identify critical concerns for privacy and security of individual transportation system users, particularly vulnerable road users (VRU) (e.g., pedestrians, cyclists, people with disabilities) in connected/automated vehicle environments and integrated mobility systems. In an integrated mobility system, the personally identifiable information (PII)/sensitive data gathered takes the form of payment information, saved addresses or phone numbers, disability status, or any other data that may be required for a user to engage mobility services. Individually some of these elements may not need special protections, but when they are all co-located and correlated within an application or database these efforts may require stricter protections. This project will identify best practices related to sensitive data, reviewing legal and regulatory requirements and restrictions, and clarifying previous Federal guidance. VRUs are more likely to use assistive mobility devices that would be connected to the transportation network. However, the use of an assistive mobility device such as a cane, wheelchair, or stroller, should not jeopardize a traveler's safety or privacy. This project is intended to develop a framework where the privacy and cybersecurity considerations of personal-to-everything (P2X) devices for pedestrians and cyclists, including those with mobility aids, are created to begin the integration of those devices into existing security mechanisms such as the SCMS.

Cybersecurity for the Advanced Transportation Controller Standards Family: The Institute of Transportation Engineers (ITE) Advanced Transportation Controller (ATC) family of standards includes interoperable requirements for ATCs, the ATC Application Programming Interface (API) and the ATC (formerly ITS) Cabinet. These standards provide key interfaces between the transportation infrastructure and connected vehicles as ATCs provide the signal, phase and timing information that can be used for vehicle-to-infrastructure (V2I) safety applications such as Red

Light Violation Warning. These standards provide physical dimensions, environmental/electrical requirements, as well as the ports and protocols supported by these devices, however the security requirements associated with these devices have not been fully addressed to date. As these devices are critical interfaces to Connected Vehicle communications as well as attack surfaces for the ITS infrastructure, standardized security requirements and guidance is necessary to ensure future secure ITS infrastructure systems. This effort will develop new security requirements for all of the standards in the ATC family via a holistic security approach that covers all of the critical attack surfaces.

National Transportation Communications for ITS Protocol (NTCIP) Security Updates: This effort will execute the NTCIP security update roadmap completed in FY2021 under the Infrastructure System Security Assessment (ISSA) effort. The NTCIP standards developed by ITE, American Association of State Highway and Transportation Officials (AASHTO) and National Electronics Manufacturers Association (NEMA) started development in the 1990s when the industry standard network management protocol (Simple Network Management Protocol Version 1 (SNMPv1)) did not support robust cybersecurity mechanisms. To meet the cybersecurity challenges of today, the industry has recognized the need to move to SNMPv3 which provides modern cybersecurity mechanisms. This program will update the NTCIP standards, starting with the most used and critical standards, in accordance with the guidance developed during the ISSA effort.

Cybersecurity Best Practices for the Transportation Sector: This research will document best practices for information sharing across the ITS transportation-ecosystem and with other sectors with a focus on infrastructure systems, as well as identify organizational preparedness training needs for transportation professionals. This includes identifying training content and technology transfer to strengthen the cybersecurity skills and practices of relevant ITS stakeholders.

Working with FHWA and other infrastructure stakeholders, the program facilitates development of prototype cyber-incident management protocols and best practices with the goal of eventually developing a Transportation Cyber Assessment Tool for IOO use. The tool will assist transportation professionals in assessing their organizational cyber risk and providing ways to mitigate risk in line with the NIST Cybersecurity Framework.

The best practices also include procurement guidance. Due to the current capabilities of transportation sector organizations, many transportation organizations will need to procure transportation equipment that meets cybersecurity requirements and/or they will need cybersecurity technical assistance or services. The procurement guidance will provide information on the provisions to include in the procurement requests and subsequent contracts to support obtaining the appropriate cyber functionality or services.

Cybersecurity Awareness and Cybersecurity Culture: Making available tools and best practices to support secure and resilient ITS deployments is necessary, but not sufficient, to meet national needs. The Program will work to develop broad understanding of new and emerging cybersecurity concepts and analyze their effectiveness as best practices or tools applicable to ITS cybersecurity noting that IOO ITS deployments are sufficiently complex and diverse – keeping in mind also the

rapidly evolving threat landscape - such that it would not be possible to effectively "prescribe" a nationally-applicable solution. Rather, developing the capacity of deployers to implement and maintain secure deployments is essential; for these to remain effective, a cybersecurity culture needs to be established that integrates security consideration rather than treating these as an 'add-on.'

Expected Program Outcomes:
The desired outcome of the USDOT ITS Cybersecurity Research Program is to support the efforts of the broad stakeholder community in their implementation of, secure nationally interoperable ITS systems that ensure broad access to the safety and mobility benefits of ITS while remaining resilient to quickly address threats and attacks, minimizing any disruptions to services and system performance. Specific program outcomes that support the required stakeholder actions include developing and making available best practices information to support IOO and other stakeholders' actions to appropriately secure their ITS systems along with the Professional Capacity Building and deployment support needed to help them achieve and maintain secure deployments.

Collaboration Partners:
By definition, cybersecurity is a cross-cutting challenge, effectively requiring collaboration across all stakeholders in ITS.

Within USDOT collaboration extends to modal partners with ITS interests as well as security, policy, research and international programs organizations in the Office of the Secretary of Transportation (OST). Intergovernmental Federal cooperation includes the Department of Homeland Security (including CISA), the National Telecommunications and Information Administration (NTIA) and NIST via direct relationships and well as participation in cybersecurity coordination activities of the National Security Council.

IOO cooperation includes collaboration via associations such as AASHTO as well as with individual State/ local ITS deployers. Extensive cooperation is conducted with the ITS Architecture and Standards Program, and their broad stakeholder groups of researchers, deployers, industry and academia to assure that standards products meet security needs and the reference architecture appropriately encompasses cybersecurity. International cooperation opportunities are leveraged when beneficial to US interests.

Accelerating ITS Deployment
($21,300,000)

Program Description:

As new Intelligent Transportation Systems (ITS) technologies and systems evolve into market-ready products, the primary goal of the Accelerating Deployment Program is to provide research, analytics, and services that support adoption and deployment of ITS technologies. Other goals of the Accelerating ITS Deployment Program are: (1) to speed up the transformation of ITS research and prototypes into market-ready technologies that are commercially viable and adopted by the transportation community, and (2) to provide the tools needed for interoperable deployment of ITS technologies and systems across the nation.

The Accelerating Deployment Program provides communication and education support to facilitate awareness, understanding, acceptance, adoption, and deployment of ITS technologies across stakeholder groups and ensures effective partnerships are fostered and developed at various levels – executive, program, and project. The Program provides knowledge transfer, and supports technical assistance, training, outreach, program evaluation, and other stakeholder engagement. The Program supports advancing ITS research, to initial adoption, and subsequently on to wider scale deployment in coordination with other stakeholders at the federal, state, regional and local levels.

The Accelerating ITS Deployment Program includes work in four key areas:

- Professional Capacity Building
- Deployment Evaluation
- Communication and Outreach
- Interoperability (formally known as "Architecture and Standards")

Professional Capacity Building: As Automated Vehicles (AV) and Vehicle Connectivity (VC) Technologies progress, the workforce will need new knowledge, skills, and abilities to drive implementation. The ITS Professional Capacity Building (PCB) Program will continue developing courses and offering opportunities to advance the ITS workforce. The PCB Program will share ITS knowledge and lessons learned from AV/VC deployments to internal and external stakeholders. This Program supports transportation worker's outreach through a variety of different kinds of webinars, online trainings, workshops, and peer events. These activities are offered both in-person and virtually. The ITS PCB Program supports knowledge and technology transfer in key areas within the USDOT as well as with the National Operations Center of Excellence (NOCoE), Institute of Transportation Engineers (ITE), ITS America (ITSA), National Association of Development Organizations (NADO) and a host of other stakeholders. The ITS PCB Program also offers the Early Deployer Technical Assistance Cohorts. These cohorts enable communities of practice among active early deployers who opt-in to work iteratively and collaboratively with each other and the U.S. Department of Transportation to make their projects successful while incrementally producing detailed documentation and shared software and data that the broader ITS community can use to

deploy their own state-of-the-practice, interoperable solutions. The Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Grant Recipients currently meets on a monthly basis. A Rural ITS Cohort group will commence regularly scheduled meetings in August 2021. In addition, the ITS PCB's Academic Initiatives has a number of working groups underway, or soon to be stood up that focus on: (1) ITS training in community colleges; (2) educator-employer pathway connections; and (3) specialized ITS trainings at historically black colleges (HBCUs), tribal schools, secondary STEM programs (middle schools and high schools), and educational institutions serving rural and small metro areas.

Deployment Evaluation: Provides information to decision makers of all types, both inside and outside of the Department, to help plan, procure, and assess effectiveness of ITS investments (both current and future investments) and supports future deployment by tracking the extent of ITS deployment, disseminating data on benefits, costs, best practices/lessons learned related to deployed ITS, and analyzing data related to deployment trends, adoption trends, and effectiveness of ITS JPO and government interventions. This area is responsible for conducting the ITS Deployment Tracking Survey, acquiring data for ITS benefits/costs databases, and undertaking analytics to support evidence-based deployment and market development.

Communications and Outreach: Updates and maintains the ITS JPO website and develops communications channels, including social media, email messaging, meeting planning, website development, trade shows, publications and speaking engagements. It also provides communications support for any ITS JPO-funded research project. This includes presentations, articles, and fact sheets about connected vehicle, automated vehicle and all other ITS activities. These materials are used to educate the public and provide stakeholders with the tools they need to promote deployment of ITS technology. The program also provides communications and outreach support for the CARMA program, the Safety Band campaign and automated vehicle policy initiatives sponsored by the OST. A goal of the program is to ensure that the technical research conducted by ITS JPO is easily accessible and understood by stakeholders and the general public through the development of easy-to-understand content that is in plain English.

Interoperability Program Area: Provides a reference system architecture framework along with voluntary technical standards, tools and deployment support to guide safe, secure, efficient interoperable deployment of infrastructure, connected and automated ITS technologies. The ITS reference architecture (www.arc-it.net) provides IOOs and deployers access to options for deploying more than 130 ITS public-benefit services and applications. The ITS reference architecture is accompanied by software tools for developing and customizing regional and project architectures to meet local needs while also ensuring necessary nationwide interoperability. The reference architecture identifies interfaces for standardization and recommends suitable ICT and ITS standards – identifying and enabling multiple suitable technology choices whenever viable. The standards portion of the program supports the development of needed ITS-specific standards as well as evaluation; and when beneficial, customization of ICT standards to most effectively meet ITS deployment needs. The program also conducts extensive technical and implementation support along with systems engineering and architecture implementation workshops to State and local

customers nationwide. The Program also funds foundational research that advances ITS reference architecture and standards, cyber security options, and human factors guidelines that support safe, secure, and interoperable large-scale deployments of ITS; and support regulatory decision-making. Furthermore, the Interoperability Program provides support to deployment test beds and pilot deployments.

Each of these four "key areas" are considered individual Programs themselves under the Accelerating Deployment Program

Program Objectives:
The objectives of the Accelerating ITS Deployment Program are to provide the research, analytics, products, tools and services to enable rapid, interoperable deployment of ITS infrastructure, connectivity and automation technologies to maximize public benefits. The intent is to define and improve evidence-based decision making, collaboration, harmonization, standardization, and communication mechanisms and targets to encourage public and private investment in ITS; to develop comprehensive training and analytic tools that allow deployers to understand the financial and operational benefits and costs of new technologies and systems; and to establish the tools that deployers can use to help make more informed investment and planning decisions regarding ITS deployment.

Anticipated Program Activities:

Professional Capacity Building Activities FY 2022:
The ITS JPO's Professional Capacity Building (PCB) Program is the primary mechanism for educating the current and future transportation workforce about ITS. One of the ITS JPO's PCB teams' primary objectives is to promote technology transfer and education to accelerate deployment of ITS research and technologies. The ITS PCB Program will continue coordinating with Federal program offices, educational organizations, and professional associations and continue reaching out to build the community. In FY2022, the ITS PCB Program will continue delivering multimodal ITS learning opportunities through:

1. Webinars (e.g. Talking Technology and Transportation (T3) Webinars – approximately 18 per year)
2. Workshops (e.g. ITS State Chapter Workshops – 10 to 14 per year)
3. Online Training Modules (e.g. 91 ITS Standards modules)
4. Technical Assistance (e.g. Connected Vehicle Deployment Technical Assistance (CVDTA) Cohorts Program, CVDTA Equipment Loan Program, ITS Help Line, ITS PCB Peer Program)
5. Classroom / Courses (e.g. National Highway Institute's ITS courses)
6. Educational Materials (e.g. ITS Knowledge Resources Databases, 16 ITS ePrimer online modules)
7. Academic Support (e.g. ITS University and Community College Workshops and Academic Communities of Practice projects, Academic Speakers' Bureau, ITS case studies, ITS project and career profiles, student research webinars)

In FY22, the ITS PCB Program will expand the online, on-demand training offerings for both the internal and external transportation workforce. Expanding the offerings available will reach a broader audience. Working with the National Highway Institute (NHI), academic community, and other training partners, activities will include converting in-person ITS workshop materials and existing courses to online opportunities in a variety of formats (i.e. microlearning). Expanding the online presence of the ITS PCB Program will increase learning opportunities for the current and future transportation workforce including student, rural, and tribal audiences.

The ITS PCB Program seeks to provide training and educational products that do not conflict with and should enhance Department priorities. Safety is always a topic intertwined with most or all PCB products. Climate and resilience are also topics incorporated in many ITS PCB teaching and educational products. Ensuring that all products (or events) are free and the majority are accessible through the ITS PCB website supports the equity priority. The ITS PCB's Academic Initiatives likewise target educational institutions that serve underserved populations or areas. Finally, the nature of ITS encompasses transformational technologies, networks, or applications. The ability to intertwine knowledge sharing products on the new transportation technologies with efforts to make the material available to a wide audience work to cover all Department priorities.

ITS Deployment Evaluation Activities FY 2022:

Benefits/Costs Databases: The Deployment Evaluation Program continues to continuously improve the operation and content of the benefits/costs/lessons learned databases and how their data are presented to the public. This would include obtaining data from new sources and addressing benefit and cost data gaps, especially in the areas of the environment and equity. The Program will also continue to create compelling data visualization products and development of planning tools to support our stakeholders in their efforts to make evidence-based decisions about their ITS investments. The Program is also conducting its activities in very close coordination with the ITS PCB Program to leverage partnerships and ensure continued value of these data resources.

ITS Deployment Tracking Surveys: The Program completed its most recent ITS Deployment Tracking Survey in 2021 and will work to analyze the results of the data, and communicate those results to the public. The Program is also planning the next major ITS Deployment Tracking Survey and actively seeking stakeholder input into new questions and topics. Further, the Program will continue its analytics work using longitudinal ITS deployment data to explore market trends and identify technologies that might be lagging, reaching maturity, or just emerging as deployment-ready for early-adopters.

Analytics: The Deployment Evaluation Program is continuing its long-term strategic effort to clearly articulate for our stakeholders the success stories of ITS deployment. The extensive longitudinal data in the benefits, costs, and deployment tracking databases offer the ITS JPO an extraordinary opportunity to undertake creative analyses of those data in order to show quantitatively the benefits of proven ITS technologies and guide the ITS JPO on how best to accelerate ITS deployment of newer technologies.

The Program will also continue to work more extensively with ITS JPO's modal partners to advance true innovation in management of the performance of deployed ITS projects across the nation, especially with early ITS adopters. The extensive and growing pipeline of these projects have the potential to be a major driver of the US economy in the future, and cover all areas of the country from urban areas to rural environments. Therefore, in 20222022, the ITS JPO will continue to support accelerating ITS deployment through building evidence-based decision making capacity in the ITS JPO and with our modal partners, and by supporting early-stage ITS deployments.

This presents an opportunity for the ITS Deployment Evaluation Program to address the following critical issues in the coming years:

- Supporting the development of robust, clearly articulated methods to compare deployment information and results across ITS deployment projects to enable more effective comparison, for example, of the results of a deployment in City X and City Y (as a hypothetical example) even if they are essentially deploying the same types of technologies to address similar problems. It is likely that they are looking at different KPIs, or even if there are similar KPIs, each might be using different data or methodologies to address them. This makes it exceedingly difficult to compare deployment and evaluation results with accuracy.

- Supporting the development of robust, clearly articulated methods to compare and contrast performance metrics/measures, evaluation methodologies, or the relative success of similar (yet subtly different) uses of technologies and applications. For example, if two sites are both deploying a similar application but use different methods of deploying it, those different methods make it difficult to parse differences in performance results.

- Supporting the development of robust, clearly articulated set of integrated best practices that the Department can currently offer connected vehicle or automated vehicle deployers and future deployers that would make these types of complex deployments less risky, more efficient, and less costly, and improving the ability of these projects to maximize performance and improve benefit/cost ratios.

A more integrated, and leveraged, approach to the evaluation lifecycle of deployment projects will provide value to the Department (and the stakeholder community) by supporting an integrated way to facilitate the meaningful analysis and development of common performance measures as part of a common core set of data, methods, approaches, and best practices developed by and facilitated by the ITS JPO and its modal and Departmental partners. This core set could include:

- Core set of performance metrics that deployers can focus on, in addition to more localized measures, that will enable comparison and dashboarding;

- Core best practices on methodologies for evaluation, based at the micro-level – for example, best practices for data identification and collection related to specific performance measures and hypotheses;

- Core standards and performance specifications for a variety of technologies typically used in deployments; and

- Core Key Performance Indicators (KPIs).

Communication and Outreach Activities FY 2022:

ITS JPO 30th Anniversary: Planned activities in the areas of communications and outreach include a return to in-person meetings and events, release of an ITS JPO 30th Anniversary video and the kick off of a new transportation technology educational program aimed at today's college students.

College Guest Speaker program: The objective of this program is to increase awareness among college student to help them better understand opportunities in the ITS field. The task will require that the contractor identify colleges and universities where USDOT staff and/or contractors can serve as guest speakers. This task differs from the PCB program in that it does not involve training, workshops and other events designed in improving the workforce skills development. It also does not involve developing lesson plans and other materials for teachers.

Event Planning: This task will be used provide program support for major events where USDOT will have a major presence. This includes SXSW, CES and the ITS World Congress. By participating in these events, USDOT is able to connect with non-traditional stakeholders that are outside of the ITS community. This additional outreach will help USDOT to develop new partnership relationships with technology firms and advocacy groups.

New ITS JPO Video: This is a new video that will be on the homepage of the ITS JPO website. It will explain what ITS Technology is and how it impacts the daily lives of the average American. It will also focus on the six areas of the current ITS Strategic Plan.

Interoperability Program Area Activities FY 2022:

In FY22, the Interoperability Program Area will continue to evolve the content of the ITS reference system architecture to more fully accommodate automation, additional connectivity services and advancing new ICT technologies such as 5G which are becoming available in the marketplace. Cooperating internationally, further work will be undertaken to specify access controls for ITS environments in support of cybersecurity; and to develop voluntary technical standards and candidate system architectures to support the secure communication of road signage and regulatory information to automated and connected vehicles. Interface standards to support V2X and cooperative automation are underway and will be continued. Standards for improved connectivity services, including those needed for Roadside Units (RSU) as well as the interoperable broadcast of traffic signal phase and timing (SPaT) information are expected to be evolved to address validation of initial guidance along with initial analyses to support improving security of legacy ITS infrastructure equipment installations. Additionally, standards updates to address changes in wireless spectrum policy are expected. Program efforts will continue to be informed by extensive collaboration with stakeholder groups and Standards Development Organizations (SDO)

to assure that products that are developed meet stakeholder needs in broadly acceptable way to facilitate voluntary deployments.

Expected Program Outcomes:

The Accelerating Deployment Program supports a variety of efforts related to evidence-based decision making and focuses on questions of investment choices, value, and awareness of technologies and their application in the real world. The Accelerating Deployment program cuts across all aspects the ITS JPO's research agenda, and supports all the programs in the ITS JPO.

Professional Capacity Building Program: PCB has identified FY22 outcomes aimed at increasing the scope and reach of the Program. The addition of new courses, as well as the conversion of existing courses, workshops and training materials to an online delivery format will make the training resources available to the larger transportation workforce community. Longtime popular on-demand resources such as the standards training modules and the ePrimer continue to be updated with the assistance of ITE. Updating on-demand training resources afford users the flexibility to access the training at a time convenient for them.

The ITS PCB Academic Team has a robust catalog of training resources. Over the last five years, these have been developed in close coordination with university, college and community college professors and instructors as well as transportation agency hiring officials who regularly participate in the ITS PCB Academic Workshops. Leveraging ITS PCB Community College Working Groups and Workshops and partnering with the Turner-Fairbank Highway Research (TFHRC) ensure that materials, resources and prototypes (i.e. the CAV in a Box) developed will be of value to professors and instructors at a variety of levels educational levels. Both the ITS PCB Community College Discussion Forum and the CAV in a Box project are a direct result of the work done in previous years. Through the Academic Team, the program will continue to collaborate with this larger group to best identify the most useful resources for professors and students.

Deployment Evaluation: Cost/benefit data are cornerstones of any research effort in ITS, whether it be via modeling or prototyping/testing and deployment. Outcomes of this program include the resources, tools and analysis to support data- driven and evidence based research and deployment investment. Making the data available to anyone across the globe, transparently, is another key outcome. Finally, the Deployment Tracking data provide snapshots of how ITS deployment is occurring in the US and allows analysis relating to market development, economic impact, performance assessment, feasibility assessment, and impact assessment. Mobility improvements associated with the deployment of technology are also assessed via evaluation.

The Deployment Evaluation Program's efforts to support ongoing Department-wide activities that will accommodate innovation in evidence-based decision-making is another positive outcome that can result in:

- A renewed focus on integrated, leveraged project-lifecycle approaches to accelerating and improving stakeholder investment in ITS technologies, applications, and services via

evidence-based decision making, information acquisition/management, evaluation, and tech transfer.

- Assistance for stakeholders that will help them to make better quantitative and qualitative decisions regarding investing in and deploying ITS - from pre-deployment/investment planning through to performance measure setting, data collection and management, evaluation, and transfer of results and best practices.

Communications and Outreach Program has a number of outcomes in FY22 that are designed to increase the profile of the ITS JPO. Outcomes include:
1. Creation of a new ITS video that will explain what ITS technology, provide examples of how the technology is used in the everyday life of Americans and how ITS improves safety and mobility.
2. Establishing USDOT's booth presence at the Consumer Electronics Show 2022 and SXSW 2022.
3. Development of the new College Guest Speaker program.

Interoperability Program: Expected outcomes of Interoperability Program efforts include the continued availability of an evolving reference system architecture and software toolsets, updated to accommodate additional automation-related services, enhanced cybersecurity along with other user-identified needs along with deployment support to developers of regional and project architectures. Additional standards products will support secure evolution of legacy ITS equipment, standardized ITS connectivity equipment including roadside units as well as interoperable Signal Phase and Timing (SPaT) broadcast services along with additional cooperative automation standards content. The existing family of ITS standards will be further updated to meet evolving needs, the architecture reference will be updated to reflect appropriate uses of evolving 5G and other ICT standards.

Collaboration Partners:
Each of the elements of the Accelerating Deployment Program area are crosscutting and, as such, have at their core the objective of reaching out to all types of stakeholders, and across all modes.

To ensure that these identified audiences are given necessary knowledge sharing and technology sharing support, the Program works in partnership with professional associations, universities, state, regional and local public agencies, and the training programs of USDOT operating administrations to engage the broad technical and organizational expertise needed to develop and deliver ITS learning. Specific partners include:

- Federal Highway Administration (FHWA)
   o Office of Infrastructure
   o Office of Innovative Program Delivery – Center for Transportation Workforce Development
   o Office of Operations
   o Office of Planning, Environment, and Realty
   o Office of Research, Development, and Technology (RD&T)
   o Office of Safety

- o   Office of Safety Research and Development (R&D)
- o   National Highway Institute
- o   Resource Center
- Federal Transit Administration (FTA)
- Maritime Administration (MARAD)
- American Planning Association (APA)
- American Public Transportation Association (APTA)
- Institute of Transportation Engineers (ITE)
- International Municipal Signal Association (IMSA)
- ITS America (ITSA)
- National Association of Development Organizations (NADO)
- National Network for the Transportation Workforce (NNTW)
- National Operations Center of Excellence (NOCoE)
- National Transit Institute (NTI)
- International Partners (Canada Mexico, European Commission (EC) and Transport Certification Australia (TCA))

Each of these Federal program offices, educational organizations, or professional associations act as a sounding board from which the ITS PCB Program receives information on educational and training needs and also as a distribution channel through which the ITS PCB Program disseminates various ITS educational materials or training courses developed. The ITS PCB Program will continue to enhance coordination efforts with all USDOT modal partners. In FY22, the, The ITS PCB Program will develop a new *ITS PCB Strategic Plan* based on the current *ITS JPO Strategic Plan.* The Program will continue its mission to prepare transportation industry professionals (both current and future) for an ITS and connected automated transportation system. Creating, maintaining, and expanding effective partnerships will remain a critical component of the Program's strategy.

Within USDOT collaboration extends to modal partners with ITS interests as well as security, policy, research and international programs organizations in the Office of the Secretary of Transportation (OST). Intergovernmental Federal cooperation includes the Department of Homeland Security and NIST via direct relationships and well as participation in standards coordination activities of the National Security Council.

Stakeholder cooperation includes activities via associations such as AASHTO as well as with individual State/ local ITS deployers. Extensive cooperation is conducted with the Interoperability Program and their broad stakeholder groups of researchers, deployers, industry and academia to assure that standards products meet security needs and the reference architecture appropriately encompasses cybersecurity. International cooperation opportunities are leveraged when beneficial to US interests via intergovernmental cooperation as well as cooperation via SDOs.

Data Access and Exchanges Program
($4,000,000)

Program Description:
This research area focuses on enabling access to core transportation data across the ITS ecosystem, including data and source code generated through the DOT's ITS research investments, to accelerate deployment of new ITS technologies, cut the time from research to insight and policy-making, and drive secondary research results. This, in turn, increases return on federal investment in research and demonstration projects and accelerates multi-modal, data-driven, trusted evaluations of potential safety, mobility, and other benefits to inform future policy and investment decisions. While enabling broader ITS research and deployment activities, these investments drive implementation of various Federal and USDOT directives on increasing access to data, source code, and federally funded research results.

Program Objectives:
Consistent with the ITS JPO Strategic Plan, this research area will continue to help identify, prioritize, monitor, and – where necessary – address multi-modal data exchanges across traditional organizational boundaries.

Anticipated Program Activities:
Research Data Access **–** ITS JPO remains committed to providing near-real-time access to data and source code generated through its investments, including the various projects described throughout this and past AMRPs. In FY2022, the ITS JPO will continue to refine its data and source code policies, drive implementation among JPO-funded projects in various modes, advise program managers on project-specific data requirements and best practices, evangelize the availability of JPO-funded data and source code, and generate best practices for the broader research and deployment communities. Through these activities, the Research Data Access program will help the Center for Highly Autonomous Systems Safety Center of Excellence, policy and research analysts and evaluators, and other users transform ITS project data into insights for decision-makers. The ITS JPO will also contribute to the broader USDOT research, policy, and technology communities through the Data Access Task Force and other multi-modal forums. The Research Data Access program will pay for ITS JPO-funded projects' use of the Department-wide shared services described below, including use by modal partners managing ITS JPO-funded projects, and work with the shared service providers to define and deliver ITS JPO-specific requirements that meet the needs of the ever-evolving ITS research portfolio.

Between FY2018 and FY2021, the ITS JPO incubated a consultative Research Data Access implementation support team and multiple technical platforms to enhance access to data and source code produced through multi-modal ITS research investments. In FY2021, the ITS JPO handed off mature capabilities to the appropriate long-term owners within the Office of the Secretary and Federal Highway Administration who will operationalize these capabilities as Department-wide shared services. Once these handoffs are complete, ITS JPO will continue to be

involved in funding, using, and helping advance these services via its Research Data Access program (see above). The shared services that ITS JPO anticipates will be operationalized in FY2022:

- Public Access Implementation Support Team. To enhance access to results from the Department's research investments, including data, source code, and reports, this team provides consultative support to USDOT program managers and project delivery teams at key parts of the program design, procurement, execution, and close-out processes. In FY2021, the National Transportation Library (NTL) – the implementation arm of the Department's Public Access Plan – will start providing templates and trainings tailored to the needs of high value, high risk projects such as those funded by the ITS JPO.
- DOT Secure Data Commons (SDC). The SDC enables collaborative research and analysis involving moderate sensitivity level datasets, and is the default system for ITS JPO-funded project data containing personally identifiable or confidential business information as well as shared resources like the Department's Waze data archive. The Office of the Chief Information Officer will take over as SDC manager in FY2021.
- ITS DataHub. ITS DataHub provides a single access point for USDOT's ITS research data via integration with the Department's open data portal (data.transportation.gov), repository and open science access portal (rosap.ntl.bts.gov), and Secure Data Commons, and augments these shared services to support more advanced ITS research requirements. The Office of the Chief Information Officer will take over as ITS DataHub manager in FY2021.
- ITS CodeHub. ITS CodeHub provides a single access point for USDOT's ITS source code and helps projects manage source code repositories and enable code collaboration and re-use. The Office of the Chief Information Officer took over as ITS CodeHub manager in FY2021 to support broader implementation of the Department's source code policies.
- Field Operational Test Data Architecture (FOTDA). The FOTDA enables the efficient movement of data from field operational tests to an environment where it can be analyzed for status and quality assurance, transformed as needed, and transferred to a research analysis environment such as the SDC. The Federal Highway Administration, which stood up this service for CARMA and Spectrum testing via ITS JPO funding in FY2020, will operationalize this shared service to support broader USDOT research in FY2022.

Data Exchanges – ITS JPO continues to help the OST offices and modes identify, prioritize, monitor, and – where necessary – address multi-modal data exchanges across traditional organizational boundaries to accelerate safe and efficient deployment of new technologies in the transportation system. Through this work, ITS JPO also support the development and implementation of Department-wide policies and best practices for establishing data trusts and other critical data exchange enablers. Between FY2018 and FY2020, the ITS JPO's multi-modal *Data for Automated Vehicle Integration* (DAVI) program (transportation.gov/av/data) drove shared understanding of data exchange priorities for AV integration and incubated the multi-modal Work Zone Data Exchange (WZDx) project as an exemplar for addressing data exchanges collaboratively with data producers and users. In FY2021, the Federal Highway Administration took over WZDx deployment

while ITS JPO continues to maintain transportation.gov/av/data, extends the DAVI model to other emerging USDOT priorities, and triages other potential data exchange needs.

Expected Program Outcomes:
ITS JPO expects these investments will result in faster access to higher quality data and source code from the Department's ITS research portfolio. This will increase the quality and timeliness of project evaluations and other analyses which support decision-making within the Department and in the deployment community, and enable external researchers to perform their own analyses, driving additional knowledge-building and economic activity. It will also enable greater re-use of source code generated through the Department's ITS research portfolio, which will reduce costs while improving interoperability and accelerating deployment. These investments will also increase access to data in the deployment community by lowering barriers to voluntary data exchanges.

The Data Access and Exchanges Program supports USDOT research areas. The development of data systems to support data-driven technologies and decision making in real time is one of the overarching themes of USDOT RD&T efforts. Advances in data processing are enabling governments, and private companies alike, to improve transportation services and better target investments. Expected outcomes include positive impacts on innovation, accountability, and safety.

Collaboration Partners:
The Data Access and Exchanges program depends on active engagement with partners inside and outside the Department who help iteratively prioritize the work to be done and serve as beta users for products and services. This approach, and a commitment to agile- and open-source-by-default, helps the ITS JPO ensure that technical and policy tools meet the needs of real users – whether they are federal program managers, external project delivery teams, policy or research analysts, or deployers in the public and private sectors. Engaging users and institutional partners from the earliest stages of projects also accelerates the product development lifecycle, and technical transfer at the end of projects. For example, ITS JPO has enabled multiple software projects to be handed off to users in the deployment community for long-term maintenance, sparked the collaborative development of new open data exchange specifications between public sector roadway operators and private sector automotive mapping companies, and incubated multiple shared services to be handed off to long-term owners elsewhere in the Department. Specific technical transfer partners include, but are not limited to, the ITS JPO's Professional Capacity Building Program, OCIO, NTL, FHWA Turner Fairbank Highway Research Center and Every Day Counts Program, and external groups such as the Work Zone Data Working Group and various Standards Development Organizations.

As the ITS JPO's implementation arm for federal and USDOT data, and source code policies, the Data Access and Exchanges program also collaborates closely with technology leaders in the Office of the Secretary (policy, research, CIO, general counsel), modes (FHWA, FTA, FMCSA, NHTSA, FAA, and others), and inter-agency groups run through the General Services Administration and White House Office of Science and Technology Policy. These collaborative relationships help the ITS JPO to understand and build upon more general technology policies, and provide practical feedback and exemplars to these partners. In addition, the private technology sector and some leading-edge

public agencies, federal innovation centers, and academic programs have well-tested approaches to managing modern technology projects, including data and source code management. The ITS JPO will continue to engage these partners to bring proven innovations into the transportation enterprise and enable the government workforce to procure and manage projects that use these practices. The ITS JPO will also continue to monitor the emergence of data exchanges and adoption of technical data standards in the public and private sectors to avoid duplication of existing, successful efforts.

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD)
($21,000,000)

Program Description:

The ATCMTD is statutorily required in the FAST Act Section 6004, 23 U.S.C. 503(c)(4). The ATCMTD grants are managed by FHWA and the ITS JPO contributes a mandated percentage of funding through FHWA to annually satisfy the requirement.

The USDOT provides a total of $60,000,000 for ATCMTD, with $39,000,000 coming from FHWA and $21,000,000 from the ITS JPO.

The language provided here duplicates the language provided in the FHWA AMRP for consistency.

The Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD) Program is intended to provide funding for eligible entities to develop model deployment sites for large scale implementation and operation of a diverse set of technologies in various geographic regions. As the program is aimed at the rapid deployment of advanced technologies, limited expenditures for infrastructure construction is anticipated in grant application. The stated purpose is to reduce costs and increase return on investments; deliver environmental benefits through increased mobility; enhance transportation system operations; improve safety; improve collection and dissemination of real-time information; monitor transportation assets; deliver economic benefits; and accelerate deployment of connected and autonomous vehicle technologies. Successful proposals will contain quantifiable system performance objectives, use innovative technologies and strategies, and a plan for long term operation and maintenance of the deployed technologies. The U.S. Department of Transportation (DOT) encourages partnering among the private sector, public agencies, research institutions, technology leaders, and other transportation stakeholders.

Program Objectives:
The DOT's vision for the ATCMTD initiative is the deployment of advanced technologies and related strategies to address issues and challenges in safety, mobility, sustainability, economic vitality, and air quality that are confronted by transportation systems owners and operators. The advanced technologies are integrated into the routine functions of the location or jurisdiction, and play a critical role in helping agencies and the public address their challenges. Management systems within transportation and across other sectors (e.g., human services, energy, and logistics) share information and data to communicate among agencies and with the public. These management systems provide benefits by maximizing efficiencies based on the intelligent management of assets and the sharing of information using integrated technology solutions. USDOT shares the advanced technology solutions and the lessons learned from their deployment with other locations, scaled in scope and size, to increase successful deployments and provide widespread benefits to the public and agencies.

Anticipated Program Activities:

In FY21, the ATCMTD program requested proposals for new grant awards, complete the awards under the previous solicitation, and manage the existing grant awards. Additionally, the program will publish first ATCMTD annual report as mandated by the FAST Act.

Key FY22 ATCTMTD Program Activities.

Activity	Period of Performance
Selection of FY20 grant awards and timely implementation of projects.	2021
Continue award of FY19 grants and manage FY16-18 projects.	On-Going
Publish first ATCMTD annual report as mandated by the FAST Act.	On-Going

Expected Program Outcomes:

The ATCMTD Initiative will develop model deployment sites for large scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment. Each ATCMTD project will consist of model technology deployments to help demonstrate how emerging transportation technologies, data, and their applications can be effectively deployed and integrated with existing systems to provide access to essential services and other destinations. This also includes efforts to increase connectivity to employment, education, services and other opportunities; support workforce development; or contribute to increased mobility, particularly for persons with visible and hidden disabilities and elderly individuals.

Collaboration Partners:

ATCMTD is not a research program, rather it is a discretionary grant program established in the FAST Act, however, public and stakeholder input is considered in the development of the annual Notice of Funding Opportunity (NOFO).

To be selected for an ATCMTD award, an applicant must be an eligible applicant. Eligible applicants are State or local governments, transit agencies, metropolitan planning organizations (MPO) representing a population of over 200,000, or other political subdivisions of a State or local government (such as publicly owned toll or port authorities), or a multijurisdictional group or consortia of research institutions or academic institutions. Partnership with the private sector or public agencies, including multimodal and multijurisdictional entities, research institutions, organizations representing transportation and technology leaders, or other transportation stakeholders, is encouraged.

Typically, a consortium is a meaningful arrangement with all members involved in planning the overall direction of the group's activities and participating in most aspects of the group; the consortium is a long-term relationship intended to last the full life of the grant. Any application submitted by a sole research or academic institution and that is not part of a consortium will not be considered for selection.

DOT encourages partnerships with the private sector or public agencies, including multimodal and multijurisdictional entities, research institutions, organizations representing transportation and technology leaders, or other transportation stakeholders.

Numerous ATCMTD awardees include non-governmental partners that traditionally have provided non-Federal matching funds in the form of technical services, hardware, and software.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized in in the table below.

Benefits of Partnership and Partner Contributions to FHWA ATCMTD Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard / Goal Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding	Stakeholder Advice	Education and Awareness
ATCMTD partners are the individual grant recipients (benefits of partnerships are identified in FAST Act Section 6004 and 23 U.S.C. 503(c)(4)). Benefits of partnership and partner contributions are detailed in FAST Act-mandated Secretary's report, May 2020.					X				X		

Small Business Innovation Research (SBIR)
($2,200,000)

Program Description
The SBIR program is a highly competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT. The SBIR program favors research that has the potential for commercialization through products and applications sold to the private sector transportation industry, State DOTs, USDOT, or other federal agencies.

The program is administered by the Volpe Transportation Center. The SBIR Program Office publishes one or two solicitations each fiscal year for proposals on specific research topics of interest to USDOT operating administrations, including the FHWA.

Program Objectives:
To encourage small businesses to engage in research and development (R&D) that has the potential for commercialization and meets federal R&D objectives. The SBIR program is uniquely positioned to support both the interests of FHWA as well as the small business. In this respect, the SBIR programs aims to provide essential funding to small businesses with aim toward commercialization of products that align with FHWA and Departmental Strategic goals. Given that the SBIR program is available to all FHWA RD&T programs, all USDOT Strategic goals are supported as a result.

The SBIR program offers unique services to the small businesses to aid in their technical and commercial development. Specifically, the SBIR program offers a Commercialization Assistance Program to provide consulting services to the SBIR participants to help conduct market research, commercialization plans, and other services. In addition, in FY22 the FHWA SBIR program will continue with a Technology Readiness Level (TRL) assessment program to help the Small Businesses conduct an independent assessment of the technological status of the innovations developed through the SBIR program.

Anticipated Program Activities:
In FY22, the Small Business Innovation Research program will participate in the annual solicitation of topics and support current Phase I, II, and IIB projects. Additionally, the FHWA SBIR program will continue with the Technology Readiness Level (TRL) Assessments at the end of Phase II.

Key FY22 FHWA SBIR Program Activities

Activity	Period of Performance
Technology Readiness Level (TRL) Assessments	2021
Annual Solicitation of Topics	2021

Expected Program Outcomes:
FHWA aims to advance technologies and make problem-solving innovations available to the end user. FHWA will accomplish this by identifying the most promising new innovations, advancing Phase I and Phase II projects that have a clear path to commercialization, and focusing on market-

driven needs. This creates a win-win-win opportunity for the Federal Government, the small business, and the traveling public. The Federal Government advances their strategic goals by investing in promising innovations; the small businesses benefit from the ability to pursue a good idea through Federal seed-funding and, if successful, the sale of their innovative products and solutions; and the public benefits from new innovations in the marketplace that enhance the travel experience.

Collaboration Partners:

The FHWA SBIR program is coordinated internally within USDOT and methods and practices are shared with other modes through the Volpe center, which administers the SBIR programs for USDOT.

Benefits of Partnership and Partner Contributions to FHWA SBIR Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard / Goal Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding	Stakeholder Advice	Education and Awareness
USDOT				X	X	X					

Chapter 2 – FY 2023 RD&T Programs
Complete Trip- ITS4US Deployment Program

Program Description/Activities/ Objectives:

The Complete Trip - ITS4US Deployment Program is a multimodal effort led by the Intelligent Transportation Systems Joint Program Office (ITS JPO) with support from the Office of the Secretary of Transportation (OST), Federal Transit Administration (FTA), and Federal Highway Administration (FHWA). The Program makes $40 million available to enable communities to showcase innovative business partnerships, technologies, and practices that promote independent mobility for all travelers. The Program leverages innovative technologies and facilitates public private partnerships to allow for a traveler-centric approach that improves mobility options for all travelers, including travelers with disabilities, travelers from rural areas, and lower income travelers.

Building from the USDOT's previous and ongoing foundational research work in concert with emerging technologies, practices and other critical inputs gathered from all sources, the Complete Trip - ITS4US Deployment Program is designed to bring publicly and privately sponsored research together to create large-scale, replicable deployments that generate increased multimodal mobility options for all travelers regardless of location, income, or disability.

In order to address transportation needs of all travelers, and specifically travelers of transportation underserved communities, the entire trip from conception and planning to execution and from origin to destination must be considered. The USDOT has defined the Complete Trip Concept to capture the idea that a trip can be composed of several parts or segments and any individual traveler must be able to execute every part of their trip from origin to destination regardless of location, income, or disability. A complete trip can be made up on any combination of trip segments such as: trip planning, outdoor navigation, intersection crossing, boarding and using vehicles, transferring between vehicles, modes and payment services, using stops and stations, indoor and outdoor transitions, indoor navigation and completing travel to destination. The different segments the trip may have unique challenges that can be addressed to support a successful complete trip. If the infrastructure is not available or in a state of good repair or if one segment of the trip is inaccessible, unreliable or inefficient, then access to subsequent segments is broken, and the trip cannot be completed. This Program will have local partners develop and deploy integrated mobility solutions to achieve complete trips for all travelers.

Program Objectives:

The Complete Trip - ITS4US Deployment Program aims to solve the mobility challenges of all travelers, regardless of location, income, or disability, in accessing jobs, education, healthcare, and other activities. The objective of this program is to develop multiple large-scale, replicable, real-world deployments of integrated innovative technologies to address the challenges of planning and executing complete trips.

- **Vision:** Innovative and integrated complete trip deployments to support seamless travel for all users across all modes, regardless of location, income, or disability.
- **Mission:** Facilitate the integration and deployment of emerging technologies, along with innovative and replicable, traveler-centric partnerships, business models and practices to foster reliable, spontaneous, independent, safe, affordable, accessible, and efficient mobility options for all travelers.

Anticipated Program Activities:

In FY23, the program will continue with Phase 2: Design and Testing. Successful Phase 1 teams will be eligible to move to Phase 2 and Phase 3 after completing their complete trip deployment plans. Phase 2 will be the designing, building, and testing phase and it is expected to take up 24 months. Phase 2 also includes the planning for evaluation of the deployment.

In FY23, the program will continue stakeholder engagement and outreach activities and begin the independent evaluation activity as the deployment teams being concept development.

Technical services activities in FY23 will include assisting USDOT in managing and integrating the portfolio of deployment projects ensuring that the projects produce actionable results while remaining on schedule and on budget. This includes, but not limited to, performing technical program management functions, including roadmap development, meeting coordination and note taking, quick-response scanning and on issues and challenges, assistance in stakeholder coordination and collaboration, developing technical templates and trainings, validation and verification of other project deliverables, white paper development, drafting responses to data calls, and procurement life-cycle support. This technical services support is needed to assist in oversight and management due to the complex technical nature of this program. If the program is going to be successful, additional technical services support is vital part of ensuring that occurs. Technical services support is envisioned to last the duration of the Complete Trip-ITS4US Deployment Program.

Automation Program

Program Description:

The ITS JPO, in collaboration with FHWA, NHTSA, FMCSA, FTA, MARAD and other USDOT modes, as well as State and local public agencies, academia, industry, and other surface transportation stakeholders, will continue to conduct automation research that has the potential to transform safety, mobility, energy, and environmental efficiency; increase productivity; and facilitate freight movement within our nation's transportation system. Many of the activities in this program will be executed by modal partners and some will be jointly funded with them. The ITS JPO's automation research is a component of the USDOT's vision of supporting the safe, reliable, efficient, and cost-effective integration of automation into the broader multimodal transportation system.

Program Objectives:

Automation is a key component of the ITS JPO's Strategic Plan. The Program's goal is to enable safe, efficient, and equitable integration of automation into the transportation system. Research in FY23 will continue to support the federal role in automation by funding cross-modal research in safety, infrastructure and interoperability, and policy analysis.

Anticipated Program Activities:

Building on the FY22 research, the Automation Program will continue to coordinate automated vehicle cross-modal research in the areas of safety, infrastructure and interoperability, and policy analysis. The Program will also continue to provide a platform for internal research coordination and exchange, contributing to better outcomes across the Department.

Emerging and Enabling Technologies Program

Program Description:
The Emerging and Enabling Technologies Program focuses on cultivating the next generation of transportation systems. As the scale of Intelligent Transportation Systems (ITS) increases, vehicle manufacturers, infrastructure providers, innovators, and entrepreneurs discover new opportunities to use technology and the data that will be generated. These technological advances, along with new functionality, new applications, new operational concepts, and disruptive innovations, need to be tracked and planned for by the USDOT. Current examples of these Emerging/Enabling technologies include Artificial intelligence (AI), or next generation telecommunications, all of which have the potential to greatly impact transportation operations. networks, and also transportation technologies, approaches and applications to reduce the environmental impact of transportation. As such, there is a need to determine technological, market, and demographic trends throughout the globe and across industries to seek, evaluate and sometimes incubate emerging capabilities that demonstrate the potential to transform transportation. Moreover, it will be critical to evaluate potential risks posed by these emerging technologies, including where risks and/or benefits may inequitably impact citizens of different racial groups, socioeconomic backgrounds, or other demographic characteristics.

The USDOT will be positioned and engaged as a partner to guide research, development, and technology adoption in a systematic manner. The USDOT recognizes the need to advance the adoption and use of emerging practices and technologies for transportation—particularly, where they play a key role in providing public benefits to Americans. The ITS JPO will coordinate and conduct investigations and exploratory research into emerging technologies across government, academia, and the private sector. This research will provide the USDOT with a significant understanding of the potential benefits and disruptions these technologies could represent to the transportation system. Through multi-modal coordination, the ITS JPO works to avoid duplicative ITS work and to ensure the efficient allocation of ITS resources.

Program Objectives:
This research program focuses on cultivating the next generation of transportation systems. As emerging technologies offer the potential to enter the transportation environment, ITS JPO will evaluate their fit in meeting transportation needs and work with agency modes to extend resulting benefits from these technologies across the transportation system.

Given the magnitude of impacts that transitioning to the next generation communications can have on transportation, the ITS JPO proposes the establishment of a focused research initiative. Four proposed research objectives will continue to guide the program into the future, 1) institutional adoption of next generation communication technologies, 2) safety and security framework development, 3) public sector representation., and 4) climate change.

Anticipated Program Activities:
Artificial Intelligence: The ITS JPO's AI for ITS Program will continue to advance next generation transportation systems and services by leveraging trustworthy, ethical AI (including ML) for safer,

more efficient, and accessible movement of people and goods. The AI for ITS Program will identify, develop, implement, evaluate, and coordinate technology and policy research to advance the contextualization and integration of AI (including ML) into all aspects of the transportation system. The AI for ITS Program will continue to cost effectively build and deploy AI for ITS capabilities in real-world modal use. The anticipated program activities in FY23 include:

- **Building and testing next generation ITS, leveraging mature AI-enabled ITS applications** to demonstrate the potential of AI in the short term. The goal is to pilot transferable, mature solutions that can be replicated and speed broader deployment across the nation.
- **Building AI for ITS prototype innovations** to support emerging AI for ITS capabilities for the longer term. This initiative will create the R&D foundation on which future, long-term deployments may be built.

Connectivity/ Spectrum: USDOT monitors and assesses wireless technologies and available devices to determine their capabilities to support a wide range of transportation system communications requirements regarding safety, effectiveness, and other capabilities. These technical research and assessment activities provide data-driven inputs to the USDOT policy decision-makers. Currently, ITS JPO is testing whether the next generation DSRC, LTE-CV2X, dual-mode, or 5G New Radio (NR) technologies can meet the requirements for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) safety-of-life and public safety systems; as well as whether these emerging communications technologies are interoperable with existing technologies which currently support these systems. Based on evolving industry standards, there is a need to assess newly available commercial off-the-shelf (COTS) devices as well as prototype devices with any of these technologies if we expect to continue an uninterrupted and seamless advancement toward the greater safety that these technologies might provide. For example, the 5G capabilities are relatively undefined at this time and it is not clear if transportation needs and requirements are being taken into consideration especially the needs of rural communities. *5G Wireless Technology:* The 5G Wireless Technology research would continue to focus on testing of 5G NR-V2X devices in FY2023. The ITS JPO anticipates transitioning from modeling and simulation and initial 5G device laboratory testing to 5G device interoperability testing, detailed performance testing and small scale and large scale field testing of 5G devices.

Environment/Climate Change: Based on the strategic priorities outlined by the Office of the Secretary, development and testing of innovative and transformational transportation technologies to address climate change goals will also be a focus of this program.

In developing our emerging technology research initiatives, we will continue looking at technology neutral approaches to support fair market competition, understand the liability implications, consider privacy, bias and ethics, and impacts on the workforce.

Cybersecurity for Intelligent Transportation Systems (ITS) Program

Program Description:
The USDOT cooperates across a diverse range of stakeholders to address ITS cybersecurity research needs. In addition, the USDOT works to support secure ITS deployments and to develop the necessary cybersecurity culture among deployers that is essential for secure and resilient ITS deployments.

Security and resiliency are a necessary precondition to deploy and maintain interoperable, safe, effective and efficient ITS operations. To facilitate secure, nationwide interoperable ITS, the USDOT ITS Cybersecurity Research Program supports research needed to facilitate adaption and implementation of cybersecurity best practices across diverse ITS infrastructure deployments. USDOT leadership is uniquely positioned to support needed research and coordinated stakeholder-driven development and implementation of best practices. These efforts can then in-turn be adopted by the diverse community of Infrastructure Owner Operators (IOO) including State, Tribal, territorial and local agencies, private and public-private facility operators as well as vehicles and other mobile participants in the transportation system. Individual IOOs often have limited capabilities in this area; USDOT led collaboration can facilitate bringing options to stakeholders to use in their planning and operations of their system as well as any recovery needed from a cyber attack. This is a complex challenge - ITS system architectures are systems of systems that vary greatly across jurisdictions, with diverse current approaches to security and a broad range of equipment in service – some new, some decades old. Cybersecurity considerations are an essential part of good engineering practice, and thus should be included in any transportation systems deployment. The ITS Cybersecurity Research Program seeks to address ITS cybersecurity needs, supporting the development and deployment of secure, well-engineered ITS systems that maximize the public benefits of ITS.

Program Objectives:
The overall objectives for the USDOT's ITS Cybersecurity Research Program are to support the widespread implementation of cybersecurity best practices, and to provide the capabilities for deployers to assure that ITS deployments remain secure. This security is a necessary precondition for their efficient, effective and safe operation. ITS systems need to be both resistant to cyber-attacks and resilient, allowing for a quick recovery from cyber-attacks that are not prevented. Complex Information and Communications Technology (ICT) systems, of which ITS is one example, require extensive and adaptive technical and institutional solutions to remain both appropriately secure and sufficiently resilient to recover from attacks and other disruptions.

Anticipated Program Activities:
The Cybersecurity for ITS Research Program will continue to adapt and leverage ICT best practices to benefit the unique requirements of ITS, identify and fill-in gaps; and support implementation of best practices across ITS deployments:

- Conducting research needed to adapt evolving cybersecurity best practices to ITS infrastructure, connectivity and automation deployments and to develop and make available tools and deployment support to enable secure ITS deployments.
- Conducting Professional Capacity Building, outreach and deployment support needed to help IOO and other ITS deployers apply cybersecurity best practices to their own ITS deployments and to evolve an appropriate cybersecurity culture and needed internal capabilities.
- Developing end-to-end reference implementations for secure delivery of key ITS services to support large scale replication and implementation along with candidate approaches to manage secure Nationwide interoperability.
- Continuing to support the development of ITS standards along with identification and adaption of ICT standards and to meet the evolving threat landscape.
- Evolving the ITS reference architecture to expand security-related content and to remain consistent with evolving cybersecurity best practices and available standards.

The program will continue to be executed in cooperation with the broad stakeholder community and will remain flexible to meet unanticipated needs and changing priorities.

Accelerating ITS Deployment

Program Description:
As new Intelligent Transportation Systems (ITS) technologies and systems evolve into market-ready products, the ITS Accelerating Deployment Program is addressing questions associated with adoption and deployment. The goal of the Accelerating Deployment Program is to speed up the transformation of ITS research and prototypes into market-ready technologies that are commercially viable and adopted by the transportation community. This Program provides communication and education support to facilitate awareness, understanding, acceptance, adoption, and deployment of ITS technologies across stakeholder groups; and ensures effective partnerships are fostered and developed at various levels – executive, program, and project. The ITS JPO seeks to spur adoption of technology, and help stakeholders and localities deploy maturing ITS systems. The Program provides knowledge transfer, and supports technical assistance, training, outreach, program evaluation, and other stakeholder engagement, including with historically underserved communities. The Program supports advancing ITS research, to initial adoption, and subsequently on to wider scale deployment in coordination with other stakeholders at the federal, state, regional and local levels. In addition, the program provides communications and outreach services to support ITS JPO-funded research projects. This includes website content, articles, social media support and graphic design elements.

Program Objectives:
The objectives of the Accelerating Deployment Program are to define and improve data driven and evidence-based decision making, collaboration and communication mechanisms to encourage public and private investment; to develop comprehensive cost benefits and analytic tools that allow deployers to understand the financial and operational benefits of new technologies and systems ; and to establish the tools that support the new user base. The Program is also tasked to develop and evolve a comprehensive National ITS reference system architecture to support large scale interoperable ITS infrastructure, connected vehicle, and connected automation deployments across the nation – especially across borders with Canada and Mexico; to develop and maintain an inventory of candidate interfaces for standardization and support standards development efforts for interfaces where there is greatest public interest and benefit, including those interfaces required to support regulatory activity; to cooperate internationally, leveraging common interests to reduce US resource requirements, access broader expertise, speed development and harmonize architecture and standards to support an international marketplace for US vendors; and to facilitate availability of testing and certification processes and procedures. A final goal of the program is to ensure that the technical research conducted by ITS JPO is easily accessible and understood by stakeholders and the general public through the development of easy-to-understand content.

Anticipated Program Activities:
In FY23, the ITS PCB Program will continue to expand the online, on-demand training offerings for both the internal and external transportation workforce. Expanding the offerings available will reach a broader audience. Working with the National Highway Institute, academic community, and

other training partners, activities will include converting in-person ITS workshop materials and existing courses to online opportunities in a variety of formats (i.e. microlearning). Expanding the online presence of the ITS PCB Program will increase learning opportunities for the current and future transportation workforce including student, rural, and tribal audiences. The ITS PCB Program will continue to build community building efforts in that additional cohorts are developed and peer exchanges are offered for the purpose of information exchange and a forum in which to provide technical assistance.

The ITS Deployment Evaluation Program will continue to modernize, and make more efficient, how the benefits/costs/lessons learned databases operate and are presented to the public. The Program will conduct its activities in very close coordination with the ITS PCB Program to leverage partnerships and ensure continued value of these data resources. Further, the Program will continue its analytics work using longitudinal and new ITS deployment data, and continue to populate the databases and manage the online presence of these data. The Evaluation Program will continue to conduct ITS deployment tracking surveys. The Program will also continue work with our modal partners and stakeholders to develop products and services to support data-driven and evidence-based decisions about investing in and accelerating ITS deployment.

Planned activities in the areas of communications and outreach include a return to in-person meetings and events, release of an ITS JPO 30th Anniversary video and the kickoff of a new transportation technology educational program aimed at today's college students.

Planned activities in in the Interoperability Program Area of Accelerating Deployment include continuing to evolve the content of the ITS reference system architecture to more fully accommodate automation, additional connectivity services and advancing new ICT technologies such as 5G which are becoming available in the marketplace. Cooperating internationally, further work will be undertaken to specify access controls for ITS environments in support of cybersecurity; and to develop voluntary technical standards and candidate system architectures to support the secure communication of road signage and regulatory information to automated and connected vehicles. Interface standards to support V2X and cooperative automation will be continued. Standards for improved connectivity services, including those needed for Roadside Units (RSU) as well as the interoperable broadcast of traffic signal phase and timing (SPaT) information are expected to be evolved to address validation of initial guidance along with initial analyses to support improving security of legacy ITS infrastructure equipment installations. Additionally, standards updates to address changes in wireless spectrum policy are expected. Program efforts will continue to be informed by extensive collaboration with stakeholder groups and Standards Development Organizations (SDO) to assure that products that are developed meet stakeholder needs in broadly acceptable way to facilitate voluntary deployments.

Data Access and Exchanges Program

Program Description:
This research area focuses on enabling access to core transportation data across the ITS ecosystem, including data and source code generated through the DOT's ITS research investments, to accelerate deployment of new ITS technologies, cut the time from research to insight and policy-making, and drive secondary research results. This, in turn, increases return on federal investment in research and demonstration projects and accelerates multi-modal, data-driven, trusted evaluations of potential safety, mobility, and other benefits to inform future policy and investment decisions. While enabling broader ITS research and deployment activities, these investments drive implementation of various Federal and USDOT directives on increasing access to data, source code, and federally funded research results.

Program Objectives:
Consistent with the ITS JPO Strategic Plan, this research area will continue to help identify, prioritize, monitor, and – where necessary – address multi-modal data exchanges across traditional organizational boundaries.

Anticipated Program Activities:
Research Data Access **–** ITS JPO anticipates that activities in FY2023 will be analogous to activities in FY2022, with the number of projects requiring data and source code management support increasing while the cost of supporting each project decreases due to improved efficiencies and economies of scale. Whether an increase in funding for new shared services and features is needed in FY2023 will depend on the nature of the research projects launched in FY2021 and FY2022, since new types of research may produce novel forms of data and source code. Funding and activities will also depend on planned activities in FY2022 such as shared service handoffs and establishment of new, related Centers of Excellence elsewhere in the Department. Specific funding levels and activities will be developed in collaboration with the ITS research program managers and shared service partners.

Data Exchanges **–** ITS JPO anticipates that activities in FY2023 will be analogous to activities in FY2022, though new data exchange identified in FY2022 could result in new projects to address those data exchange needs in FY2023.

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD)

Program Description:

The ATCMTD is statutorily required in the FAST Act Section 6004, 23 U.S.C. 503(c)(4). The ATCMTD grants are managed by FHWA and the ITS JPO contributes a mandated percentage of funding through FHWA to annually satisfy the requirement.

The language provided here duplicates the language provided in the FHWA AMRP for consistency.

The Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD) Program is intended to provide funding for eligible entities to develop model deployment sites for large scale implementation and operation of a diverse set of technologies in various geographic regions. As the program is aimed at the rapid deployment of advanced technologies, limited expenditures for infrastructure construction is anticipated in grant application. The stated purpose is to reduce costs and increase return on investments; deliver environmental benefits through increased mobility; enhance transportation system operations; improve safety; improve collection and dissemination of real-time information; monitor transportation assets; deliver economic benefits; and accelerate deployment of connected and autonomous vehicle technologies. Successful proposals will contain quantifiable system performance objectives, use innovative technologies and strategies, and a plan for long term operation and maintenance of the deployed technologies. The U.S. Department of Transportation (DOT) encourages partnering among the private sector, public agencies, research institutions, technology leaders, and other transportation stakeholders.

Program Objectives:

The DOT's vision for the ATCMTD initiative is the deployment of advanced technologies and related strategies to address issues and challenges in safety, mobility, sustainability, economic vitality, and air quality that are confronted by transportation systems owners and operators. The advanced technologies are integrated into the routine functions of the location or jurisdiction, and play a critical role in helping agencies and the public address their challenges. Management systems within transportation and across other sectors (e.g., human services, energy, and logistics) share information and data to communicate among agencies and with the public. These management systems provide benefits by maximizing efficiencies based on the intelligent management of assets and the sharing of information using integrated technology solutions. USDOT shares the advanced technology solutions and the lessons learned from their deployment with other locations, scaled in scope and size, to increase successful deployments and provide widespread benefits to the public and agencies.

Anticipated Program Activities:

In FY23, the ATCMTD program will request proposals for new grant awards, complete the awards under the previous solicitation, and manage the existing grant awards. Additionally, the program will publish first ATCMTD annual report as mandated by the FAST Act.

Small Business Innovation Research (SBIR)

Program Description:

The SBIR program is a highly competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT. The SBIR program favors research that has the potential for commercialization through products and applications sold to the private sector transportation industry, State DOTs, USDOT, or other federal agencies.

The program is administered by the Volpe Transportation Center. The SBIR Program Office publishes one or two solicitations each fiscal year for proposals on specific research topics of interest to USDOT operating administrations, including the FHWA.

Program Objectives:

To encourage small businesses to engage in research and development (R&D) that has the potential for commercialization and meets federal R&D objectives. The SBIR program is uniquely positioned to support both the interests of FHWA as well as the small business. In this respect, the SBIR programs aims to provide essential funding to small businesses with aim toward commercialization of products that align with FHWA and Departmental Strategic goals. Given that the SBIR program is available to all FHWA RD&T programs, all USDOT Strategic goals are supported as a result.

The SBIR program offers unique services to the small businesses to aid in their technical and commercial development. Specifically, the SBIR program offers a Commercialization Assistance Program to provide consulting services to the SBIR participants to help conduct market research, commercialization plans, and other services. In addition, in FY23 the FHWA SBIR program will continue with a Technology Readiness Level (TRL) assessment program to help the Small Businesses conduct an independent assessment of the technological status of the innovations developed through the SBIR program.

Anticipated Program Activities:

In FY23, the Small Business Innovation Research program will participate in the annual solicitation of topics and support current Phase I, II, and IIB projects. Additionally, the FHWA SBIR program will continue with the Technology Readiness Level (TRL) Assessments at the end of Phase II.