August 16, 2023

Dr. Robert Hampshire
Acting Assistant Secretary for Research and Technology
United States Department of Transportation
1200 New Jersey Avenue SE
Washington, DC 20590-0001

RE: Potential Research and Development Areas of Interest for the Advanced Research Projects Agency - Infrastructure (ARPA-I); Request for Information, Docket No. DOT-OST-2023-0092

Dear Dr. Hampshire,

As the nation's leading advocate for the technological modernization of our transportation system by focusing on advancing research and deployment of intelligent transportation technology, the Intelligent Transportation Society of America (ITS America) is grateful for the opportunity to comment on the United States Department of Transportation's (USDOT) Request for Information (RFI) on Potential Research and Development Areas of Interest for the Advanced Research Projects Agency - Infrastructure (ARPA-I).

ITS America was founded in 1991 as an advisory council to USDOT on technology innovation and emerging transportation technologies. ITS America is the only organization in the country that represents all sectors – public, private, academic, and nonprofit – to advance transportation technology. Our membership includes state and city departments of transportation, transit agencies, metropolitan planning organizations, automotive manufacturers, technology companies, engineering firms, automotive suppliers, insurance companies, and research and academic universities. Our vision is one of a better future transformed by transportation technology and innovation. Safer. Greener. Smarter. For all. Our work accelerates the deployment of technology that saves lives, promotes sustainability, and advances more equitable transportation.

ITS America strongly supports USDOT's efforts to implement the promise of ARPA-I and agrees with USDOT's assessment that the program offers a "once-in-a-generation opportunity to improve our nation's transportation infrastructure, both physical and digital." This program, coupled with the similarly unique infusion of infrastructure funding within the Infrastructure Investment and Jobs Act, is poised to significantly improve our nation's transportation system by investing in innovative solutions to both longstanding and emerging transportation challenges. We welcome the opportunity to highlight a series of areas in which we believe that ARPA-I is poised to provide benefit in encouraging development and deployment. These areas include

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digital infrastructure, safety improvements, sustainability and resiliency, and other key issues of focus.

Digital Infrastructure

ITS America is a strong proponent of utilizing digital infrastructure solutions to address transportation challenges, and we are pleased that this RFI highlights digital infrastructure as a key component of ARPA-I's mission. The U.S. transportation system has evolved from paved roads and concrete bridges to sensors, data, software, and algorithms. With advances and rapid deployments in automation, connected technologies, mobility on demand, and sustainable and resilient technologies, a future of transportation – the digital infrastructure age – uses technology and innovation to advance future mobility that is safer, greener, smarter, and more equitable. This new era links the physical system to a digital layer, allowing us in real-time to communicate, share, store, analyze, and use information to save lives, provide faster emergency response, help mitigate impacts of extreme weather, improve resiliency, reduce emissions, enhance mobility, and distribute services equitably.

It is our belief that digital infrastructure is the operating system for the future of mobility, and ARPA-I is well-positioned to assist in the deployment of that operating system, both in establishing outstanding characteristics of successful digital infrastructure implementation (in terms of technology best practices and communication layers) and in advancing the use cases specifically enabled by digital infrastructure. Those use cases include aspects such as traffic signal integration, which can enable transit and emergency response vehicles to preempt traffic signals or allow for safer pedestrian travel on U.S. roads. They also include connected vehicle data collection, aggregation, and utilization for real-time traffic updates and to inform infrastructure planning and management, while reducing travel time and improving safety.

Digital infrastructure can enable greater interoperability between infrastructure systems, which helps avoid a patchwork approach to traffic management and transportation solutions. It can enable greater utilization of curb data, thereby reducing idling time, increasing parking access, and allowing for faster deliveries. Additionally, digital infrastructure can amplify multimodal trip integration, bolstering transit through dynamic route planning solutions and improving trip efficiency. Digital infrastructure can leverage simulations and modeling for infrastructure development and maintenance, allowing transportation planners to get the most out of their physical assets. Finally, digital infrastructure is poised to deliver significant benefits to freight efficiency, particularly through the lens of data exchange solutions that can improve on the time it takes to deliver goods from dock to door. These are just some examples of areas where digital infrastructure is poised to provide benefit through all modes of American transportation, and

ARPA-I can help lead the implementation of these solutions through strategic investment in digital infrastructure development and deployment.

Safety

America is facing an epidemic of roadway fatalities, with NHTSA estimating that there were 42,795 deaths on American roads in 2022.[1] Additionally, a report by the Governors Highway Safety Association estimated that drivers struck and killed at least 7,508 people walking in 2022 – the highest number since 1981 and an average of 20 deaths every day.[2] ITS America believes that the status quo approach to road safety is insufficient, and innovative solutions must be undertaken to dramatically reduce pedestrian fatalities.

ITS America believes it is the responsibility of transportation industry stakeholders to fully utilize all of the tools and strategies available to reduce this trend. Street redesign and changes to the physical infrastructure are certainly important components of a VRU safety strategy, but cannot be the entire strategy. Transportation technology solutions that ARPA-I is poised to champion represent another important pillar of this effort: these include advanced cameras, sensors, radar, LiDAR, connected infrastructure (such as those utilizing C-V2X), artificial intelligence, and many others. They can provide critical warnings to drivers about pedestrians out of the line-of-sight or about to enter the roadway, and can allow infrastructure to act, such as by extending a red light, to avoid crashes. Transportation technologies can also provide much-needed insights to transportation planners about how and where to best utilize and deploy infrastructure solutions, both digital and physical. Through the use of technology and data collected, problematic intersections and corridors can be more readily identified and addressed. Transportation technologies are poised to make orders of magnitude improvements in the safety of transportation users inside and outside of the vehicle.

One area of focus for ARPA-I should be supporting the deployment of connected vehicle technologies, such as vehicle-to-everything (V2X) technologies, which are poised to provide benefits both within the vehicle and as part of a larger infrastructure solution. These technologies allow vehicles to communicate real-time information directly with other vehicles, infrastructure, and vulnerable road users to prevent traffic crashes, amongst other benefits. While numerous aspects of connectivity are poised for deployment today, ARPA-I could help facilitate additional development of advanced V2X applications and message types, such Collective Perception Messages (CPM), which distribute safety information between V2X-enabled vehicles. CPM

[1] NHTSA, Early Estimate of Motor Vehicle Traffic Fatalities in 2022. Available at: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813428

[2] Governors Highway Safety Association, Pedestrian Traffic Fatalities by State: 2022 Preliminary Data. Available at: https://www.ghsa.org/resources/Pedestrians23

provide greatly enhanced situational awareness by allowing one vehicle to instantly share data on a potential safety hazard or other object with a second vehicle which is outside of that hazard's line of sight. This capability has particular benefit for automated vehicle maneuvering. Similarly relevant to automated vehicles are Sensor Data Sharing Message (SDSM), which allows vehicles to rapidly share their planned trajectories, enabling automated vehicles to function cooperatively rather than individually. A third message type to consider would be pedestrian detection-specific message types, which could be a crucial tool in reducing the continued increase in American pedestrian fatalities.

Beyond specific message types and applications, ARPA-I could consider supporting additional research into methods of connectivity, including advanced Road Side Units (RSUs). Specific to RSU technology, methods are being developed that combine an RSU with additional sensors, computation capabilities, and AI analytics to provide pedestrian safety applications and increased traffic management functionality. The additional computation capabilities can provide lower latency, enhanced security, and reduced network congestion.[3] In addition, ARPA-I should consider methods of communication utilizing connectivity outside of dedicated spectrum, where ITS America members have developed and proposed numerous use cases for messages that don't require immediate transmission but still deliver significant safety benefits. In particular, ARPA-I should research the capability of V2X networked cellular communications to support the delivery of safety messages, such as digital alerts, to vehicles and other things on the road. This will enable automakers to unlock V2X functionality over the cellular connectivity already installed in most consumer vehicles. In addition, ARPA-I should research human factors involved in V2X communications, such as driver reaction time to in-vehicle notifications and alerting, to identify opportunities, limitations, and other considerations in the future development of V2X communications. Furthermore, 5G and 6G are areas that are primed to support transportation connectivity, and additional research and development is needed in this category to help establish high fidelity data streams for infrastructure use. This would be an ideal candidate for ARPA-I consideration.

Sustainability/Resiliency

ITS America believes that it is important to act now to enhance the sustainability and resiliency of our transportation system to reduce transportation's outsized impact on the environment and to protect infrastructure from severe weather events and other effects of climate change. There are numerous opportunities for ARPA-I to increase the sustainability and resiliency of the transportation system, including through the advancement of electric vehicles and alternative fuel technologies, charging infrastructure, clean power generation, power grid capability and

[3] An example of this is Intel's Smart RSU solutions: Enhancing Transportation Safety with Intel-based Smart RSU Solutions

resiliency, infrastructure resiliency, roadside management, and advanced materials technologies. Investments in the deployment of technology and workforce development in these areas will also provide significant economic and employment benefits as the U.S. becomes a global leader in sustainable and resilient transportation. A more sustainable transportation system will also improve equity by helping to mitigate the negative environmental impacts of transportation, which are often most acutely felt in low-income and minority communities.

More specifically, ITS America supports President Biden's pledge to lead the global community's efforts to ensure that by 2030, over 50 percent of light-duty vehicles and at least 30 percent of medium- and heavy-duty vehicles (MHDVs) sold globally will be zero-emissions vehicles, and believes that the work being done under ARPA-I's leadership will be a key driver of the success of that pledge. We believe that enhancing electric vehicle range and charging solutions should be a main priority of these efforts, as that remains a consistent hurdle in consumer adoption of electric vehicles. Potential areas of research and investment from ARPA-I to rectify these concerns include electrified roadways and wireless or inductive charging solutions. Michigan has already deployed a public, wireless in-road charging system allowing electric vehicles to charge while in motion and stationary – deploying this solution at scale could be a major step in improving electric vehicle range for all sizes of vehicles.[4] ARPA-I should support measures that improve freight and public fleet electrification, including solutions that increase the proliferation of heavy-duty charging equipment.

There are a number of areas in which ARPA-I should be partnering with Advanced Research Projects Agency–Energy (ARPA-E) to combine subject-matter expertise to solve challenges specific to electrification. Additional attention should be paid to ways to supplement and secure our energy resources in order to support an expansion of electric vehicles. In terms of identifying new energy resources, encouraging research from The Ray indicates that 52,000 acres at exits across the country are available now for solar development and could support up to nearly 36 TWh of clean energy - enough to charge 12 million passenger electric vehicles annually. ARPA-I should work with ARPA-E on determining the ideal way to utilize this opportunity to power our electric vehicle fleet. Similarly, ARPA-I and ARPA-E can partner to protect America's energy grid from security threats enabled by cyber vulnerabilities electric vehicle charging infrastructure, which will require increased coordination between transportation and utility experts. Finally, these agencies should partner on efforts to improve charging efficiency and speeds, utilizing emerging strategies from the energy sector to improve the charging experience for all classes of vehicles.

Advanced Air Mobility

[4] https://www.michigan.gov/whitmer/news/press-releases/2022/02/01/announces-first-in-the-u-s--wireless-electric-vehicle-charging-road-system-contract-aw

Advanced air mobility represents a key component of ITS America's strategy for a safer, greener, and smarter transportation system for all that integrates airspace and surface transportation with all modes. Innovations such as drones are enhancing everything from photography, surveying, time-sensitive medical transfers, infrastructure inspections with 3D imaging, search and rescue with infrared cameras, to package and cargo delivery. They are now performing many public service job-related tasks faster, safer, and in many regards, better and at a lower overall cost. It is not unreasonable to think drones, much like vehicles, will someday soon commonly operate well beyond our visual line-of-sight. The planning currently being undertaken by the Federal Aviation Administration (FAA) in this area, such as reviewing current land use, environmental, and public health requirements; considering airspace constraints; understanding public perception of what's acceptable and/or desirable; evaluating where to position aircraft charging stations; and determining the utility needs – is a worthwhile first step in the policy arena. These plans are not only necessary for future FAA funding for vertiports, but they will become the blueprint for how we connect air and ground transportation in a way that provides access to opportunity for all members of communities, addresses the Americans with Disabilities Act, and avoids labor disruption. These policy efforts, however, are primed for supplementation from ARPA-I's technical contributions.

ARPA-I is well positioned to conduct additional research, development, and deployment of technologies that improve beyond visual line-of-sight (BVLOS) operations, such as Automatic Dependent Surveillance – Broadcast (ADS-B) sensors, an advanced surveillance technology that combines an aircraft's positioning source, aircraft avionics, and a ground infrastructure to create an accurate surveillance interface between aircraft and air traffic control. Additionally, ARPA-I can support efforts to utilize digital twinning for aircraft management at airports and vertiports, enabling increased efficiency for these operations. Finally, ITS America believes that the agency should consider the electromagnetic spectrum and telecommunications infrastructure needs of piloted and autonomous AAM applications in the near, medium, and long term, and assist in identifying ways to meet those needs.

Artificial Intelligence

Artificial Intelligence (AI) is another technology poised to solve numerous transportation and infrastructure challenges, and ARPA-I can build on the successful utilization of AI that is already taking place across our transportation system. Artificial Intelligence is being used in states like Nevada to analyze crash data to identify areas so that law enforcement can more readily respond to crashes. Using data from connected vehicles, Las Vegas uses AI to more quickly predict when crashes occur and more rapidly deploy emergency services, resulting in a 2-minute reduction in emergency response times and a 43 percent decrease in speeding and 18 percent fewer crashes

in the corridors of focus. Additionally, AI can be used to improve emergency vehicle response time, both in terms of deciding the appropriate deployment of emergency resources and then through improving the speed with which those resources can reach their designated target. AI can help transportation planners sort through the enormous amount of data provided through connected vehicles and digital infrastructure, allowing for in-depth analysis of transportation trends and opportunities to mitigate safety risks. While the current capabilities of AI are already impressive, further research and investment from ARPA-I will ensure that these capabilities continue to expand, and that the United States remains a global leader in AI technologies in this sector.

Automated Vehicles

Automated vehicles (AVs) have enormous potential to improve roadway safety and performance and contribute to more livable, vibrant, and equitable communities by providing more affordable mobility options; improving transit access by extending its reach; improving freight movement; and freeing up parking for other needs, including transit corridors, bike lanes, and walkable places, including sidewalks and plazas. AVs can provide mobility options for people with disabilities and seniors, as well as access for underserved communities. ITS America looks forward to the safe, widespread deployment of automated vehicles, and believes that there are numerous aspects of automated vehicles that are prime candidates for further research and support through ARPA-I.

We believe that ARPA-I should be considering research into solutions that will prepare for and leverage the expected penetration of level 2 and level 3 automated vehicles to improve safety and efficiency in a mixed-fleet environment. One area of focus could be AI-powered traffic management, which can be designed to reduce instabilities in traffic flow. These solutions, such as those being employed in the Congestion Impacts Reduction via CAV-in-the-loop Lagrangian Energy Smoothing (CIRCLES) project utilize autonomous vehicle technologies and specially-designed algorithms to reduce traffic jams and increase efficiency.[5] This is just one example of a project worth considering for ARPA-I support, but ITS America members across the country are working on numerous additional innovations that could be included, such as those related to truck platooning, automated delivery shuttles, on-demand transit supplementation, and more.

Quantum Computing

Quantum computing for transportation and infrastructure planning purposes is another area of promise. This technology allows for planners of all types to set new boundary conditions for any

[5] https://circles-consortium.github.io/

function they are trying to optimize, thereby bypassing longstanding planning assumptions and expanding the scope of complex problems that we are able to solve. Other Federal agencies are already working to harness the capabilities of this computing method, including the Department of Energy's Office of Science, which has included quantum computing as a focus of the Advanced Scientific Computing Research program since 2017.[6] Congress has demonstrated continued support for research and implementation of quantum computing innovations, particularly since the passage of the National Quantum Initiative Act in 2018.[7]

ARPA-I represents the ideal agency to lead USDOT's efforts to leverage these capabilities from a transportation and infrastructure perspective. USDOT's 2022-2026 Research, Development, and Technology Strategic Plan notes the potential of quantum computing to "transform transportation research and technology and boost connected and automated technologies by enabling real-time decision-making and analytics," which captures an important aspect of what quantum computing can provide.[8] Beyond those components, however, quantum computing has the potential to provide significant benefits to infrastructure planning across the board, including in achieving freight optimization through bottleneck reduction at ports and on our nation's roads, enhancing resiliency planning by working to eliminate single points of failure for critical transportation and energy infrastructure, and bolstering cybersecurity by planning against threats to our digital infrastructure.

Beyond infrastructure planning, there are numerous additional aspects where quantum computing is poised to provide benefit in the transportation sector, including in simulations, encryption, and advanced materials. Each of these areas, though not wholly distinct, can impact how we potentially think about solving different transportation problems -- from data processing (including unstructured/complex data sets) and systems management to materials development, impacting the material used to make vehicles more safe and sustainable. Quantum computing holds enormous promise, and ARPA-I would be well-suited to help deliver the benefits available through quantum computing to the traveling public.

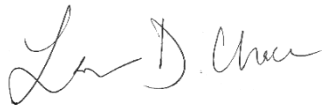
Conclusion

ITS America applauds the vision of Congress and USDOT in standing up ARPA-I, and looks forward with great interest to the innovations and successes that will result from the work done by this agency. If you have any questions about any of our above suggestions or are seeking support on

[6] https://www.energy.gov/science/doe-explainsquantum-computing
[7] https://www.congress.gov/bill/115th-congress/house-bill/6227/text
[8] https://www.transportation.gov/sites/dot.gov/files/2023-01/USDOT%20RDT%20Strategic%20Plan%20FY22-26_010523_508.pdf

your work involving transportation technology innovations, please feel free to contact us through Bobby McCurdy at bmccurdy@itsa.org.

Sincerely,



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