



ODOT Rural AI Traffic Signal Upgrades for Increased Safety and Mobility

Applicant: Oklahoma Department of Transportation

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SMART Request Amount: \$1,800,000

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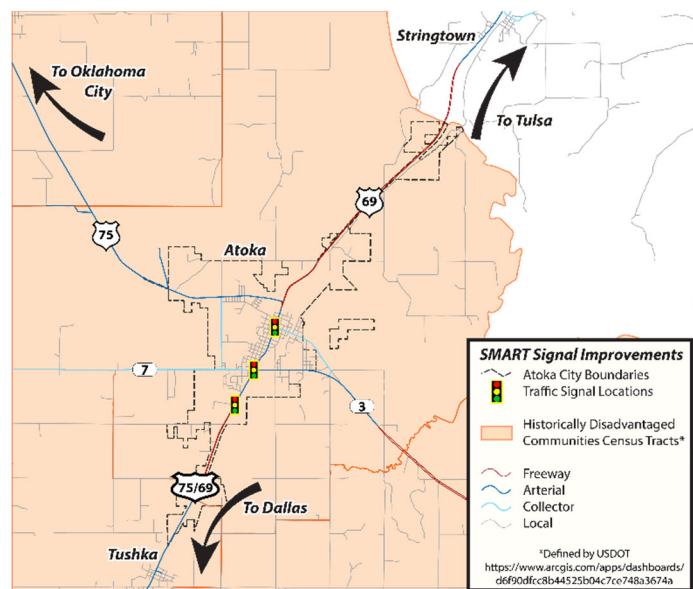


Project: ODOT Rural AI Traffic Signal Upgrades for Increased Safety and Mobility

Overview/Project Description

The Oklahoma Department of Transportation’s (ODOT) goal is to improve and upgrade rural traffic signals to increase safety and mobility for all users. ODOT will use the SMART grant funding to design, implement, and analyze performance metrics for a state-of-the-art signalized corridor along a vital highway in southeastern Oklahoma.

US Highway 69 (US-69) is a heavy north-south freight corridor that ultimately connects Dallas to Kansas City – not to mention the various direct and indirect connections possible throughout Oklahoma. Given the large traffic volumes, the heavy truck traffic it serves, and the community-identified operational issues, the US-69 corridor in Atoka, OK is an ideal corridor for an innovative pilot project corridor. The pilot project, referred to as the Project throughout this narrative, will include signal equipment upgrades with high-resolution detection, artificial intelligence (AI) equipment, connected vehicle hardware, and a unique commitment to monitoring and responding to Automated Traffic Signal Performance Measures (ATSPMs). Results of the pilot project (Phase 1) will be applied to other rural community corridors throughout the state (Phase 2).



Atoka Signal Locations

The Project focuses on upgrades of three signalized intersections along US-69 in Atoka between Redbud Lane and Court Street. The 2-mile corridor is lined with shopping centers, an adjacent school, grocery stores, hotels, restaurants, various commercial buildings, and neighborhoods. US-69 is a 5-lane undivided street through Atoka and carries approximately 24,000 vehicles per day. This 2-mile stretch in Atoka is a major employment corridor for residents of the community. Safely accessing their jobs from the adjacent neighborhoods is a critical piece to the signal upgrade project. The funding from this grant would give the city the opportunity to provide accessible signal crossings for all residents and visitors – not only making crossing the street safer but also encouraging more active transportation trips.

US-69 is a heavy freight corridor, often intimidating to vulnerable road users. In addition, ODOT traffic signal specialists have partnered with the City of Atoka over the past five years to adjust the existing signals manually, particularly during holiday travel and special events. City staff need assistance and expertise from ODOT to make the adjustments. By upgrading these signals,



the City and ODOT staff will move toward automated signal timing adjustments and improved travel times across the corridor. The new signals are adjusted from a traffic management center in response to prevailing traffic conditions and will include high-resolution vehicle detection, vehicle classification, pedestrian/bicycle detection, turning movement data collection, AI solutions to support detection, AI/machine learned timing improvements, and Vehicle-to-everything (V2X) communications.

Stakeholders. ODOT recognizes the value and need for partners, users, and stakeholders for the success of the Project. The Project includes the following stakeholders: ODOT Traffic Division, ODOT Intelligent Transportation Systems Division, ODOT District Engineers, Department of Public Safety, Economic Development Authority, Downtown District, Atoka County, and Atoka City representatives, including public works and police/fire departments, and representatives from the Kiamichi Technology Center who work directly with the public schools to provide access to training and jobs along the corridor. Some students do not have transportation and are pedestrians traveling the corridor to class or work.

Outcomes. The Project will provide accessible pedestrian signals and detection for bicyclists and pedestrians, improving safety for all users. The improved travel time and reliability will result in a reduction in commuter and freight congestion. Initial research shows up to 40 percent improvements in wait times are also expected, which decreases greenhouse gas emissions.¹ In addition, the Project will include an analysis of before/after performance measures for the improvements within Atoka that will evaluate effectiveness of the new signals. The Project will make the corridor safer for all road users by reducing the number of crashes due to fewer stopping events and facilitating much prompter responses to changes in traffic demands.



Other outcomes of the project include local community input from stakeholders to enhance access to jobs, training, and adjacent neighborhoods. The improved safety at the crossings allows all residents and visitors an equitable way to travel safely to jobs and services, which increases the economic impact to the community.

Ultimately, at the end of the Phase 2 project installations, ODOT should have both a well-tested playbook for engagement with rural agencies and a template for future signal upgrades and approximately 15 percent of the state's rural signalized corridors set up with high-resolution detection capabilities, ATSPM monitoring, and connected vehicle communications.

¹ Source: <https://vivacitylabs.com/tackling-traffic-congestion-pollution-smart-junctions/>



Project Location

Atoka is a small rural town located in southeast Oklahoma. Atoka is the county seat of Atoka County, Oklahoma. The town has a population of just over 3,000 people and is entirely defined as a Historically Disadvantaged Community.

Census Tract 5877 in Atoka County has indicators of being Transportation, Health, Economy, and Resilience Disadvantaged, and is an Opportunity Zone.

The city of Atoka is part of a regional economic partnership with the Choctaw Nation. Four highways intersect in Atoka including US Highway 69, US Highway 75, State Highway 3, and State Highway 7. The Phase 1 Project focuses on upgraded traffic signals in Atoka. The three traffic signals are located along US-69 at Redbud Lane, SH-3/SH-7 (13th Street), and Court Street. Pending the analysis and review of Phase 1 performance measures, the AI signal upgrades will be applied to other rural areas across Oklahoma using a prioritization framework.



Project Location – Atoka, OK

Community Impact

The Project provides many benefits to Historically Disadvantaged Communities (HDCs) in the rural town of Atoka. First, the upgraded signals will have accessible crossings for all users, accommodate traffic demands, and improve traffic flow, making it easier for people to navigate through the town. This holds true for public transit riders too who will have faster trip times to their destination. Second, the upgraded signals will improve safety, making it less likely for people to get in crashes, especially for vulnerable road users, i.e., children and elderly residents. Atoka and the surrounding region are located in an HDC, which will benefit from the reduced traffic congestion and emissions. The community impact of the upgraded AI traffic signals in Atoka will be measured over time by assessing the reduction in traffic congestion, increased usage of vulnerable users, and improved traffic flow. Additionally, the level of noise and air pollution can be monitored to gauge the extent to which they have been mitigated.



Technical Merit Overview

Criterion #1: Identification and Understanding of the Problem to Be Solved

Signal operations and transportation management on rural Oklahoma highways has been a challenge for many town leaders who do not have the funding or the technical expertise necessary to manage traffic operations. This is true for Atoka. City staff and the Mayor have numerous reported cases of needing ODOT's assistance because the signal timing goes out of repair and no monitoring capability, or the pedestrian running across the street under dangerous conditions, or the freight truck running a red light because caught in the dilemma zone. ODOT, the City of Atoka, and the many local partners understand improvements to the traffic signals with innovative technologies and solutions will improve the existing conditions and be a model for other rural communities for improvements for all users.

In Phase 1 for this Project, the project team will install and evaluate the use of both traditional and AI-improved traffic signal systems/components, as well as connected vehicle communications technology to identify appropriate solutions to deploy across Oklahoma supporting gains in both safety and operations. The infrastructure at each of the three signals will be upgraded for sidewalks, pushbuttons, etc. to make the crossings ADA compliant and pedestrian friendly.

AI traffic signal monitoring and detection solutions will identify patterns in traffic and accurately identify users at intersections. With such rich information available in near-real-time, priorities can be adjusted as needed to protect vulnerable users. The primary purpose for the system is to optimize traffic operations for various users, as well as innovative strategies to protect and better serve vulnerable users. With the presence of heavy freight vehicles on this corridor, vulnerable road users' exposure where pedestrians, cyclists, children, and older and disabled people are at a greater risk of injury will be addressed. Other key road users include emergency vehicles, with preemption to be installed. Another consideration for the upgraded signals is high speed signalized approaches and associated dilemma zones.

The detection upgrades and the use of advanced transportation controllers (ATC) will use Automated Traffic Signal Performance Measures (ATSPMs) to track the performance of the applied strategies and gives a benchmark for comparing with other locations, other signal equipment, and conditions before signals were improved. This element will be key to the successful evaluation of the system. In Phase 1, the implementation categories of the Project involve priority to roadway users, pedestrian and bicycle users, freight signal priority, truck platoon signal priority, safe termination of green interval, speed mitigation, malfunction monitoring/alerts, power conductors reset from overhead to underground, and future signal priority.



Criterion #2: Appropriateness of Proposed Solution

The proposed technology solutions to mitigate the issues listed above include identifying signal technologies and key types of users. Over the past decade, advance detection technologies have matured beyond simple pulse from advance inductive loops. This Atoka Project is unique due to the extensive rural area, heavily used freight corridor, and multiple users within the community. The project team will evaluate what technology is both effective and feasible for rural areas and can be deployed statewide or at a regional scale. The Project will give us the intelligence need to determine prioritization criteria on how to deploy statewide over time based on specific benefits and cost of each evaluated technology/strategy.

AI is a powerful tool that will be used in Atoka to improve traffic signal crossings for all users, improve traffic flow, and reduce congestion within the community. The proposed project for Atoka is to have a scalable solution to meet the city's needs. AI offers the flexibility to add or remove additional capabilities as needed, such as SaaS-based solutions (e.g., Econolite Centracs Mobility, NoTraffic, Surtract, etc.)

Safety, environmental (fuel consumption, emissions, noise levels), operations (stops, delay, travel time reliability), and life cycle costs due to reduced operations and maintenance needs (i.e., less wear and tear on pavement due to excessive braking by heavy vehicles), fewer crashes due to adjustments to the dilemma zone during termination green are some of the demonstrable improvements over the existing conditions.

Criterion #3: Expected Benefits

The implementation of AI technologies in Atoka is consistent with the FY 2022-2026 USDOT Strategic Plan and the program priorities. The expected benefits rely on the use of advanced data, technology, and applications to improve safety and reliability, resiliency, equity and access, and integration of a system to benefit all road users.

Expected benefits include the improvement of safety and reliability, such as identify and correct errors in data and systems, and ensure the systems operate safely and reliably. The updated signals will improve resiliency, help systems recover quickly from failures, and adapt to changes in the environment or in traffic demand, which improves equity and access. The signals ensure everyone has an equal opportunity to benefit from the technology and improve integration.

One main benefit of the Project is the result of implementing new technologies and the ability to conduct before-and-after performance metrics to evaluate the effectiveness of the new technologies, such as travel time, number of stops, and intersection delay, which will be monitored and summarized in Phase 1. The upgraded traffic signals will also share data securely and keep data safe from cyberattacks, as well as protect it from unauthorized users.

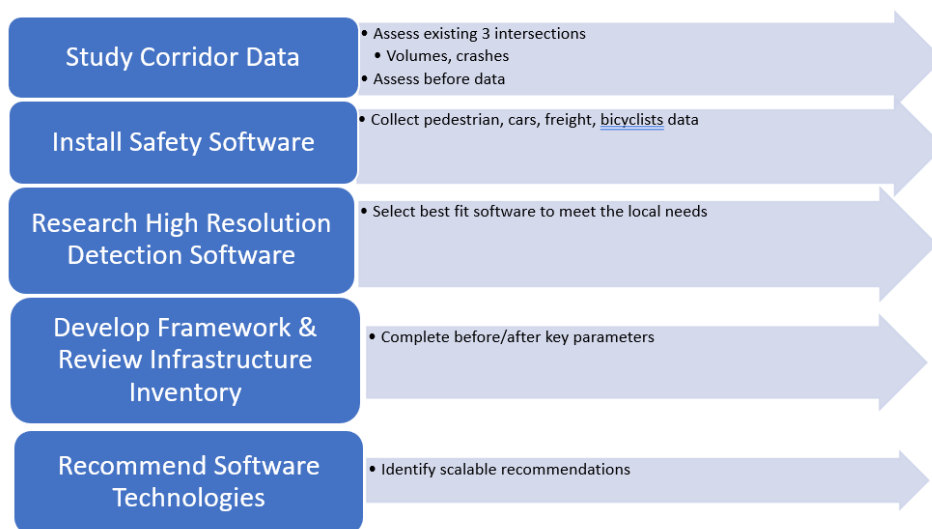
The Project impacts the local and regional workforce and economic development by providing an advanced technology within the community for the Kiamichi Technology Center to partner with to learn about the system and what training is needed to support it.



Project Readiness Overview

Criterion #1: Feasibility of Workplan

The Atoka traffic signals system upgrade project is designed to improve traffic flow and safety and is the first of its kind in the state. ODOT is applying for \$1.8M to complete the Phase 1 Project, which will be used to install AI upgraded traffic signals at three intersections in the town of Atoka with a project duration of up to 18 months. During the 18-month period, the project team will complete an infrastructure inventory of signals in the state to set up baseline data for Phase 2 this grant application.



ODOT, in coordination with the city of Atoka and local stakeholders, are undertaking the project. The Project will be an innovation for the state, and the city of Atoka is committed to partnering with ODOT to ensure the new signal meets all applicable legal, policy, and regulatory requirements. When Atoka successfully completes the project, it will be a model rural community for other small towns and cities across the state to upgrade signals.

ODOT, in partnership with the city and the key stakeholders, will determine the appropriate technology and upgrade for the signals and the implementation. Phase 1 will review cost and the benefits of the new AI signals. A workforce development plan is included as a deliverable for this Project, which will provide training and education programs with potential partnerships with the Technical Center and help meet the needs of Atoka. The plan will also promote inclusion in the workforce. Subsequently, there is also a plan to include strong labor standards in the Project to create good-paying jobs with a free and fair choice to join a union. This shows the project benefits for the community.



Criterion #2: Community Engagement and Partnerships

Phase 1 of this Project includes ODOT coordinating with the city of Atoka and multiple stakeholders from ODOT and the local community to learn about the project, identify concerns, and provide feedback for the upgraded traffic signals. The proposed AI upgraded smart signals demonstrate a community-centered model that includes meaningful, continuous, accessible approach with a diverse group of private and public stakeholders. The Project also includes a plan for ongoing communications and collaboration with the community and key stakeholders, which is essential for the success of the project. The updated signals will adapt to the current traffic flow, adjusting the timing of the signal to optimize traffic flow. The Traffic Responsive (TR) and Adaptive Traffic Control Systems (ATCS) will also be evaluated with the Project. TR and ATCS are most effective when traffic patterns are unpredictable. The advantages and disadvantages will be identified and weighed during the recommendations phase.

The expected outcome from the signal installation is the autonomy and capability of communicating with other traffic signals in the area and coordinating the flow of traffic throughout the area. The Project includes meaningful engagement with the community, as well as identified stakeholders from the public and private sectors, including organizations representing persons with disabilities and limited English proficient individuals.

The city of Atoka and ODOT will complete a performance measure analysis, as well as support to install and maintain the signal systems. Atoka's mayor, Brian Cathey, is very excited about the new system. *"The City of Atoka has developed a great working relationship over the years with ODOT and know that will always be the case moving forward."* ODOT will engage relevant stakeholders and technical experts to elicit their perspective on implementation of AI traffic signals in the town of Atoka. Private sector stakeholders will include the local Chamber of Commerce, as well as businesses that rely on the flow of traffic to operate. Future engagement includes technical experts consisting of the traffic engineers who design the system.

Criterion #3: Leadership and Qualifications.

ODOT is applying for this SMART grant to upgrade rural traffic signals in Oklahoma, using AI-enabled technology. This grant application demonstrates the relevant and necessary technical expertise of the ODOT leadership team in managing such projects and ready for the project to begin. ODOT seeks the best path forward for the state, particularly to disadvantages rural communities, and will have solid template for implementation. ODOT will continue to work with all rural areas and provide expertise and partnerships to those communities.

The Project provides updated traffic signals to existing signal communications in Atoka. The updated signals will improve traffic flow, increase safety, and provide an accessible pathway for all residents and visitors to the community. ODOT has administered many Federal grant applications and is committed and has the functional capacity to carry out the proposed Phase 1 Project and the implementation steps of Phase 2.

APPENDIX I – Resumes

RESUME- Lauren January

ODOT State Traffic Engineer

Laura leads the Traffic Engineering Division which includes Planning and Analytics Branch, Safety and Collision Branch, Operations, Work Zone Team, Sign Shop, Traffic Data Collection, Sign Programs, and Signal Maintenance. Ms. January has served as the Assistant State Traffic Engineer and an Engineering manager where she led the Geometrics and Operations Design Group, administered and reviewed Interstate Access Justification Reports for the entire state, conducted operational analysis utilizing VISSIM, HCS, and Synchro, and coordinated the update to the ODOT Roadway Design Manual. Ms. January has a Bachelor of Science in Civil Engineering from the University of Oklahoma, May 2008.

RESUME- Alan Stevenson

Assistant State Maintenance Engineer - Oklahoma Department of Transportation

Alan oversees all technology deployed on ODOT's highway system thru the ITS, Smart Work Zones, Fiber Optics and LMR Wireless Branches. Alan has been working in ODOT for the past 34 years, duties included the oversight of the design, operations, maintenance, and development of construction plans for ITS, Smart Work Zones, Fiber Optics and LMR Wireless deployments. Alan is also responsible for the negotiations of public private partnerships with third party Telecommunications Companies and the overseeing of engineering and asset management of all ODOT, OTA and the State's fiber optic inventory in a GIS platform.

RESUME- Cody Hamblin

ODOT Engineering Manager, Planning and Analytics Branch -
Traffic Engineering Division.

Cody has been in this position for the past 2 and a half years. Prior to this he was a member of the Planning and Analytics Branch for 5 years. Responsibilities and duties include analyzing and developing conceptual alternatives across the state for interchange and intersection designs. Cody is also responsible for the development and review of design traffic for analysis, as well as for Annual Average Daily Traffic reporting and pavement design. Cody is also involved in assisting local municipalities with Traffic Signal design and reviewing their operational performance. Cody graduated with a Civil Engineering degree from Brigham Young University and has been with ODOT since 2015.

APPENDIX II – Budget Summary

Design/Community Engagement	\$240,000
Artificial Intelligence (AI) Equipment	\$150,000
Upgrade Intersections	\$1,260,000
Follow up Analysis Recommendations	\$150,000
Total	\$1,800,000