AASHTO Innovation Initiative

[Proposed] Nomination of Innovation Ready for Implementation

# Sponsor

## Nominations must be submitted by an AASHTO member DOT willing to help promote the innovation. If selected, the sponsoring DOT will be asked to promote the innovation to other states by participating on a Lead States Team supported by the AASHTO Innovation Initiative.

1. Sponsoring DOT (State): California DOT

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# Innovation Description (10 points)

## The term “innovation” may include processes, products, techniques, procedures, and practices.

3. Name of the innovation:

**Bus On Shoulder (BOS)**: California DOT delivery of virtual-Transit Signal Priority (vTSP) to Bus Rapid Transit (BRT) fleet vehicles conducting mainline hard-shoulder running, in a post-pandemic peak-spreading event.

4. Please describe the innovation.

The submitted innovation is found in its unique combination of mature technologies. Those being on-vehicle "Driver Assistance Systems", at ramp meter "Transit Signal Priority" services, and use of properly secured Vehicle-to-Infrastructure radios using the transportation safety spectrum. Furthermore, this innovation has delivered operational agreement on pavement quality, road-striping and signage, public outreach, driver-training, and enforcement needs that will enable 60ft Bus Rapid Transit reticulated vehicle to safely traverse the shoulder. Lastly, this innovation has delivered institutional agreement on Pilot phasing, reporting, and performance analysis.

5. What is the existing baseline practice that the innovation intends to replace/improve?

The Interstate 805 is an urban commute corridor which regularly suffers from peak-hour congestion. The existing baseline practice for BRT vehicles (inbound to the city center) on the Interstate 805 is for the operator to enter the project corridor in an open-access High Occupancy Vehicle (HOV) lane, for the first 3 miles where it is available. Due to the lack of transit priority, these HOV lanes often present the BRT-operator with significantly congested conditions, like those in adjacent general purpose (GP) lanes. Operators are required to exit the HOV prior to a freeway-to-freeway connector and navigate the 60-foot reticulated vehicle across five general purpose lanes to enter that connector. In the remainder of the 7-mile corridor, operators are required to travel in general purpose lanes through two additional heavily congested interchanges, with no access to HOV or Transit Priority lanes.

Furthermore, existing practice does not provide drivers with any form of road-monitoring support from driver assistance systems (forward collision \ blind-spot warning \ lane-departure warning for large vehicles) that are commonly found in personal vehicles.

6. What problems associated with the baseline practice does the innovation propose to solve?

It has been a difficult task for rapid buses to keep their schedules reliable and consistent without running behind and generally improving travel times during peak hours. Rapid buses may have fewer stops to decrease travel/route times and buses can circulate through routes without issue when the general-purpose lanes are clear, but the story quickly changes when these lanes are at capacity with nowhere for that rapid bus to go. All these buses can do is wait like everyone else, but ridership becomes an issue if buses are not the more attractive mode of travel, i.e., better travel times than driving in your own car or carpool/vanpool. There are those who can afford to use these other options if they so desire, but this leaves out a segment of the population that has been historically underserved. This population has no alternative, no choice. They are relegated to bus service during commute hours that is not very rapid while others can choose what works for them in terms of personal preference, finance, time, and environmental considerations. However, their choices negatively influence climate change globally and air quality locally that leads to unfair, inequitable outcomes for the underserved communities along the two freeways. Caltrans acknowledges that communities of color and underserved communities have experienced fewer benefits and a greater share of negative impacts associated with our state’s transportation system. Caltrans recognizes our leadership role and unique responsibility in State government to eliminate barriers to provide more equitable transportation for all Californians. By overcoming the rapid bus issues immediately and not waiting for transit priority lanes to be added, we can make progress in this regard right now.

This innovation has needed to address institutional, operational, and technical problems. Institutionally speaking, at the time of project approval, there was no specific regulatory authority for Transit Only Lanes in the California legislature. Operationally, on-time performance is a major barrier to transit reliability in the corridor. The shoulder required minor civil improvements for safe operations and passenger comfort (re-striping to 11'; pavement smoothness; inlet modifications). Lastly, specific signage did not exist, requiring approval from the California Traffic Control Devices Committee for non-standard traffic control device signing (non-standard regulatory static warning and activated ‘blank-out” signing). Lastly, California Highway Patrol (CHP) had expressed significant safety concerns about driver inattention while performing shoulder-running maneuvers. There were also technical problems associated with road geometry (curvature), which would not allow for use of standard transit signal priority equipment. Ramp meter violation is a well-documented and persistent concern so the selected technology would need to minimize the amount of additional delay a ramp would inject to allow the BRT vehicle to traverse the potential conflict zone created.

If we can clear regulatory hurdles based on performance metrics related to safety, we plan on using this innovation as a permanent, equitable solution beyond the demonstration. Operationally speaking, the innovation does what was intended, improve travel times and reliability. South Bay Rapid buses can operate on freeway shoulders during heavy traffic congestion, allowing bus drivers to bypass slow traffic and maintain transit schedules

7. Briefly describe the history of its development.

* 2017-2018 - Began work with Stakeholders - CHP, Caltrans and Metropolitan Transit System (MTS)
* 2018 - Caltrans, SANDAG and MTS sign Decision Document
* 2018 - Charter Document is routed
* 2019-2020 – Construction contracting
* 2020-2021 – Construction
* June 2022: Phase 1 began
* September 2022: Phase 2 begins
* June 2025: Evaluation/End of Demonstration

8. What resources—such as technical specifications, training materials, and user guides—have you developed to assist with the deployment effort? If appropriate, please attach or provide weblinks to reports, videos, photographs, diagrams, or other images illustrating the appearance or functionality of the innovation (if electronic, please provide a separate file). Please list your attachments or weblinks here.

Documents available upon request:

1. Systems Engineering Management Plan - SEMP
2. Communications Plan
3. Architecture Alternatives Analysis
4. Security Management Operational Concept (SMOC) (requires NDA)
5. Software Development Plan
6. User Guides
7. Driver Training Video: <https://youtu.be/JpbYfF1uuaA>

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Attach photographs, diagrams, or other images here. If images are of larger resolution size, please provide as separate files.

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# State of Development (40 points)

## Innovations must be successfully deployed in at least one State DOT. The AII selection process will favor innovations that have advanced beyond the research stage, at least to the pilot deployment stage, and preferably into routine use.

9. How ready is this innovation for implementation in an operational environment? Please select from the following options. Please describe.

[ ]  Prototype is fully functional and yet to be piloted

[x]  Prototype has been piloted successfully in an operational environment

[x]  Technology has been deployed multiple times in an operational environment

[ ]  Technology is ready for full-scale implementation

The pilot program was implemented in late June 2022 and has been performing as planned for the past couple months.

10. What additional development is necessary to enable implementation of the innovation for routine use?

To make TOL implementation routine, the PILOT aims to document lessons learned at the close of the project, which would reveal what worked and what did not. In the interim, there is an immediate need for the US Department of Transportation and the Federal Communications Commission to reach agreement on the 5.9Ghz spectrum allocation. This project would not have been feasible had the project team not had access to this Transportation Safety Spectrum, providing a secure-by-design mode of communications between non-traditional operating partners (i.e. Caltrans and MTS). To move this project forward, many of the institutional discussions that were held required the input of subject matter experts willing to assuage concerns over a wireless communications channel between a moving vehicle and the infrastructure. With a strong position statement from the USDOT and FCC action in kind, we will be able to continue to deliver innovative projects - such as the "San Diego I-805/SR-94 Part-Time Transit Only Lanes Pilot" and continue building industry confidence in a future of secure communications within the transportation space allowing other DOTs to implement a secure partnership with transit systems that use their facilities.

11. Are other organizations using, currently developing, or have they shown interest in this innovation or of similar technology?? [x]  Yes [ ]  No

If so, please list organization names and contacts. Please identify the source of this information.

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| --- | --- | --- | --- |
| **Organization** | **Name** | **Phone** | **Email** |
| Washington State | City of Seattle (2015) | - | - |
| Florida (2005, 2007) | Miami (2005, 2007) | - | - |
| Ohio (multiple) | Columbus (2006); Cleveland (2007); Cincinatti (2008);  | - | - |
| Illinois | Chicago (2011); | - | - |
| North Carolina | Raliegh (2012); | - |  |
| Minesota | Minneapolis (1991) | - |  |

# Potential Payoff (30 points)

## Payoff is defined as the combination of broad applicability and significant benefit or advantage over baseline practice.

12. How does the innovation meet customer or stakeholder needs in your State DOT or other organizations that have used it?

The Pilot will allow Rapid vehicles to operate in transit only lanes along segments of both I-805 and SR 94 during periods of congestion as a bypass to the lanes. Based on other demonstration projects in California and across the country, it is estimated that during congested periods, use of the transit only lanes could save South Bay Rapid passengers between 5 to 15 minutes per trip and increase peak hour trip reliability from 80 percent to more than 90 percent.

The project inclusion of a driver assistance system (for heavy vehicles) has also addressed the human-centered design need to provide drivers with the confidence to travel in these newly designated lanes.

Next, the use of innovative, informative Bus blank-out signs at the ramp meters, address the Caltrans ramp meter operations team’s concern over receiving calls from an annoyed public not understanding the holdup at the ramp meter.

Lastly, the use of Vehicle-to-Infrastructure (V2I) radios to provide connectivity and timing of the additional ramp meter delay, has built additional confidence in the secure delivery of new functional capabilities.

13. Identify the top three benefit types your DOT has realized from using this innovation. Describe the type and scale of benefits of using this innovation over baseline practice. Provide additional information, if available, using quantitative metrics, to describe the benefits.

|  |  |
| --- | --- |
| **Benefit Types** | **Please describe:** |
| Improved Operation Performance | BOS will help connect users, transportation service providers, and “smart” infrastructure for seamless multimodal travel. |
| Improved Customer Service | Reliable schedules and better travel times for commuters |
| Environmental Benefits | Decreases greenhouse gases and transportation-related pollutants such as Ozone (O3), Carbon monoxide (CO), Small particulate matter (PM2.5, PM10), Nitrogen dioxide (NO2), non-methane hydrocarbon compounds (NMHC), and oxides of nitrogen (NOx) by reducing Vehicle Miles Traveled (VMT) through an increase in rapid bus ridership, taking other modes such as SOV and HOV out of circulation.  |

Provide any additional description, if necessary:

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14 How broadly might this innovation be deployed for other applications. in the transportation industry (including other disciplines of a DOT, other transportation modes, and private industry)?

With many transportation agencies emerging from years of capital constraint, the IIJA Federal reauthorization package is calling for transportation practitioners to engage more fully with emerging technologies, there is an opportunity for this pilot process, not the pilot project specifically, to be replicated for testing new. With a foundational edict for “better use of what we have already have”, many transportation agencies will find value in this pilot approach, and eventual transition into an ongoing operational paradigm.

Market Readiness (20 points)

## The AII selection process will favor innovations that can be adopted with a reasonable amount of effort and cost, commensurate with the payoff potential.

15. What specific actions would another organization need to take along each of the following dimensions to adopt this innovation?

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| --- | --- | --- |
| **Check boxes that apply** | **Dimensions** | **Please describe:** |
| [x]  | Gaining executive leadership support | Leaders at DOT , transit , MPO, and law enforcement as well as federal FTA/FHWA under USDOT |
| [x]  | Communicating benefits | Educate the public on what to expect as transit and vehicular users; educate the drivers to get them onboard not only in terms of their own safety but for operations. Build a website and fact sheets as well as an outreach campaign touting the innovation. |
| [ ]  | Overcoming funding constraints | Click or tap here to enter text. |
| [ ]  | Acquiring in-house capabilities | Click or tap here to enter text. |
| [ ]  | Addressing legal issues (if applicable) (e.g., liability and intellectual property) | Click or tap here to enter text. |
| [x]  | Resolving conflicts with existing national/state regulations and standards | To allow on a permanent basis beyond demonstration |
| [x]  | Other challenges | Breaking away from what standard usage of a shoulder is and expanding it to a travel vs disabled vehicle/clear recovery zone use |

16. Please provide details of cost, effort, and length of time expended to deploy the innovation in your organization.

**Cost**: $30.9 million (includes 17 BRT vehicle purchase)

**Level of Effort**: The Project improves schedule reliability by allowing authorized transit buses to drive on the freeway shoulder by converting it to a TOL, during specific operating conditions, with minimal physical improvements to the roadway. Minor improvements to the existing shoulders such as restriping, signage, concrete barrier modification, drainage, shoulder pavement improvements, and minor widening in limited locations. Technology will be installed at each ramp meter for vehicle-to-infrastructure communications. Improvements were done entirely within the existing freeway right-of-way reducing the level of effort and time related to R/W acquisition. .

**Time**: 3 years

17. To what extent might implementation of this innovation require the involvement of third parties, including vendors, contractors, and consultants? If so, please describe. List the type of expertise required for implementation.

 The technology installed at each ramp meter and on each rapid bus for vehicle-to-infrastructure communications would require involvement of contractors and their subcontractors to install and vendors to procure the equipment as well as consultants with the expertise in developing standard operating procedures for the transit agency and its bus drivers. Enhanced maintenance to keep the shoulder free of debris can be handled by the DOT or outsourced. The implementation involves smart technology to feed the survey speeds from traffic monitoring to the vehicles so they know if the shoulder can be used. Once a vehicle has the green light to go into the shoulder, the monitoring of speeds is constant indicating the max speed of the vehicle and whether it can remain in the shoulder.