The National Connected Vehicle SPaT Deployment Challenge

Frequently Asked Questions

What is the National Connected Vehicle SPaT Deployment Challenge?
The American Association of State Highway Transportation Officials (AASHTO), the Institute of Traffic Engineers (ITE) and ITS America (ITSA) working together through the V2I Deployment Coalition have challenged state and local public sector transportation infrastructure owners and operators (IOOs) to work together to achieve deployment of roadside Dedicated Short Range Communications (DSRC) 5.9 GHz broadcast radio infrastructure to broadcast signal phase and timing (SPaT) real-time at signalized intersections on at least one road corridor or street network (approximately 20 signalized intersections) in each of the 50 states by January 2020. This is commonly called the 20/50/20 Challenge or, more simply, the SPaT Challenge.

The National Highway Safety Traffic Administration (NHSTA) is in the process of requiring all new light vehicles sold in the US to be equipped with DSRC radios which can continuously and anonymously transmit basic information about the location, speed and critical operation of the vehicles. These radios will also be able to receive agency transmitted data, such as SPaT, with the intent to support safer, more efficient operations.

The National Connected Vehicle SPaT Deployment Challenge is being led by the V2I Deployment Coalition. The AASHTO Board of Directors passed a formal resolution of support, and is working with the V2I Deployment Coalition through their AASHTO Connected and Autonomous Vehicles Working Group.

Why should I do this now?
The SPaT message is relatively simple to deploy and fundamental to a number of V2I applications. It can be obtained from a traffic signal controller via a standard query protocol and can be broadcast by most DSRC roadside devices as a standardized data message. The SPaT broadcasts must be accompanied by the broadcast of a data file of the physical intersection geometry (MAP). For some future applications, global navigation satellite differential correction information, as standardized by the Radio Technical Commission for Maritime Services (RTCM), will also need to be broadcast to enable applications on the vehicle to properly reference and interpret the MAP information being broadcast.

Deploying the SPaT, MAP, and RTCM data message broadcasts in a number of locations around the country will provide state and local transportation agencies with a tangible first step for deploying V2I Applications, promote future more advanced V2I applications, and demonstrate a commitment to the DSRC-based V2I deployments that are being planned by automobile manufacturers.

The net result of deploying SPaT will be to accelerate V2I application deployment by the automobile manufacturers, the private sector, and the public sector. IOOs are encouraged to work with other agencies within their region to identify deployment partnership opportunities.
**Will this work with my controllers?**

There are three approaches to deploy SPaT at a controller (see Figure 1).

1. Insert an SPaT control board into the controller
2. Install a “black box” (such as an inexpensive Linux computer board) between the controller and the DSRC radio which translates the signal out of the controller so it is broadcast compatible.
3. Use a DSRC radio which has SPaT data translation built in.

Which option is best for you will depend on your controllers, so contact the manufacturer of your equipment and discuss the best option. The “V2I Hub” software created by the FHWA will work well in approach #2.

Please see the *Guidance for Selecting Corridors* document for additional information.

**Do my signals need to be interconnected and do they need to communicate back to a central system?**

Ideally the chosen location for deployment will be where there are interconnected signals that are monitored at a central system. This will ensure the ability to monitor the operations and performance of the system and learn from that performance. However, SPaT can be installed at signals that are neither interconnected nor communicate to a central system and still be functional.

**What type of hardware and software do I need to deploy?**

A DSRC radio will need to be installed at each signalized intersection. Older signal controllers may need to be replaced to allow for the necessary SPaT information to be generated. DSRC radios are often referred to as Road Side Units (RSU) in V2I literature and are required to be licensed by the Federal Communications Commission (FCC) when they are put into operation. When licensing the DSRC, location information (latitude / longitude) will be needed.

Please see the *Implementation Guidance* document for additional information.

V2I Applications rely on two required supporting data broadcasts to enable vehicle equipped applications:

- The SPaT message, based on information obtained from the signal controller, and
- The broadcast of a data file of the physical intersection geometry (MAP).

Some V2I applications also require global navigation satellite differential correction information, as standardized by the RTCM, to achieve accurate vehicle positions.

Figure 1 shows a basic layout of the equipment and information flow to enable SPaT transmission via DSRC at an intersection.
Is the needed equipment deployment ready?
DSRC radios are manufactured by several companies and are readily available. The RSUs should meet an existing federal standard. The software that control DSRC radios is still evolving, and is being updated regularly. When you purchase the radio get assurances from your vendor that they have the latest software and expect that it will need to be updated in the future, so understand the unit’s software update process.

Does it matter how I currently operate my signals (fixed time, actuated, adaptive)?
Yes, SPaT has been deployed on both fixed and actuated signal systems and been shown to work fine. There have not yet been any deployments done on adaptive systems so there is currently no established understanding on how SPaT will work with such systems.

Do I really need to deploy at 20 intersections?
The goal is to achieve DSRC infrastructure deployment of SPaT, and MAP broadcasts, in at least 20 signalized intersections in each of the 50 states by January 2020, and to commit to
operating the SPaT broadcasts for a minimum of 10 years. In situations where a corridor of this size is not available, or the local technical or financial environment can only support a smaller number of intersections, deployments are still encouraged. The most important aspect is to achieve some deployment within each state.

**Will future changes and revisions to hardware and software impact the deployment I do today?**

Probably. As is typical with technology-based systems, there will likely be changes. The RSU hardware has been standardized, and that standard is relatively stable for the near future. The software for applications is still being developed. As more systems are deployed and experience is gained, refinements and additional functionality will be needed. Manufacturers and application providers will refine their products and services to meet these evolving expectations. Hardware and data standards will also evolve to meet future needs. Eventually, equipment replacements may be needed.

**Is the data/system safe and secure?**

SPaT deployment under this Challenge should be considered as a test deployment designed to help an agency learn about the benefits and risks of deployment. Initially, data disseminated by the DSRC broadcast at a SPaT-enabled intersection will be a “one-way transmit only” broadcast (i.e. there will be no vehicles broadcasting data back to the DSRC), therefore the risk of a security breach by inappropriate data being sent to the DSRC antenna is minimal, provided configurations are done correctly.

Additionally, a Security Credential Management System (SCMS) can be used which maintains the integrity of sent messages and when properly configured it provides safeguards to protect against the message being recycled or rebroadcast by others outside the operating agency. A SCMS is being developed by the automakers for the federal government and is expected to be available by the mid-2017. Therefore, the risk of non-authorized systems transmitting false data is very low provided configurations are done correctly. It is recommended that SPaT be installed on signals that communicate with a central signal control software to best monitor their performance and note any anomalies. At this point not all of the security issues are understood, but as more systems are installed both under this challenge and at national pilot deployments, they will become more apparent and addressable.

**How much will this cost?**

Costs are dependent on the signal hardware that currently exists at an intersection. SPaT deployment depends on the controller’s ability to translate and send SPaT data to a broadcast radio. The amount of equipment needed at the controller to do this will vary depending on the model and age of the controller. It is assumed that power is already available at the intersection. Cost estimates based on limited early deployments indicate that installation of a working system at an intersection can vary from $15k to $50k. More recent installations suggest that the cost can be as low as $5k per intersection if modern controllers are already in place. In addition, it is desirable to have the intersection report back to a central monitoring station, so back haul communications should be considered and its cost calculated if needed.

**Is there funding to do this?**

There is no dedicated funding that has been established to fund SPaT deployment. Agencies are expected to fund the effort using resources currently available to them and are encouraged
to look at locations there they are already planning to do intersection and signal work and see if the SPaT work can be included. Agencies may consider existing ITS budgets, CMAQ funds, ATCMTD grant opportunities, and other such sources.

Is there federal and industry support for this challenge?
NHTSA issued a notice of rulemaking which proposes the idea of requiring DSRC communication on all new light vehicles starting near 2021. This will enable a broad range of V2I applications in addition to the V2V applications that those cars will have on board. The SPaT Challenge supports that deployment and prepares us, as infrastructure owners, to take advantage of these life-saving features and mobility enhancements.

The automakers have been testing, evaluating, and developing DSRC systems for over a decade, in anticipation of the NHTSA rulemaking. A group of automakers has also been developing a set of V2I applications. Deployment of DSRC infrastructure which broadcasts SPaT, MAP and RTCM supports the eventual deployment of these applications. A few of the automakers have specifically supported the concept of the SPaT Challenge.

What are the direct benefits to my agency?
The SPaT Challenge is fundamentally about installing DSRC units to broadcast SPaT and MAP messages. This is a one-way broadcast and there are currently no in-vehicle applications which will use this data. The benefits of this challenge are: to gain experience with this new technology, to lay the groundwork for installation of specific software applications, and to demonstrate to the auto industry that the infrastructure owners are committed to building infrastructure to support V2I applications and entice them to move forward this those applications. Ultimately, many safety and mobility benefits will result from V2I applications, but those will not be realized from the SPaT Challenge alone.

Are there optional efforts that I can pursue to increase the value of my deployment?
In some situations, agencies may decide to begin with the SPaT broadcast alone, and add MAP and RTCM as funding is allowed. This is recognized as a valid approach as long as the understanding is that MAP and RTCM will be required before vehicle equipped applications recognize the benefits of the broadcast.

In some cases, agencies will choose to deploy applications beyond the SPaT, MAP, and RTCM broadcasts. While this will be encouraged, and could yield short-term benefits, it is not expected as part of the challenge. To maintain a uniformity around the country and provide a base for broad-scale application deployment, the SPaT, MAP, and RTCM messages will eventually need to be an element of every deployment. Some examples of the types of additional applications that agencies may decide to add to leverage their SPaT, MAP, and RTCM deployment are:

- **Transit Signal Priority Applications** use SPaT and MAP data, allowing more sophisticated decisions regarding priority requests and ultimately reducing delay of all vehicles at these intersections. An agency could equip a bus fleet with on-board DSRC units and make this operational in the near term.

- **Red Light Violation Warning (RLVW) Applications** could warn drivers of an approaching signalized intersection when the potential of running a red light is determined based on the SPaT, MAP, and RTCM data received from the infrastructure and the vehicle data. The automakers are working on this application.
• *Intelligent Signal Systems (ISIG) Applications* would require integration of DSRC broadcasts from the vehicles with the SPaT broadcasts from the infrastructure improving signal timing.

• *In-vehicle displays of countdowns* describing green or red time remaining for in-vehicle or mobile hand-held applications informing the drivers approaching intersections of when the green light phase will end.

Can I work with a 3rd party and provide my SPaT data from my central control system for them to distribute to meet the SPaT Challenge?

Several startup companies are beginning to obtain SPaT data directly from agencies’ central signal control system. Typically, this is done using a device that interfaces with the central signal control computer which can gather and transmit high density real-time traffic signal data to selected third parties and then transmitted to the vehicle by cell communication. The connection to the central signal control computer is typically done through Ethernet ports. Vehicles use the SPaT data to help drivers anticipate signal changes and maintain efficient speeds.

This approach avoids the need to install intersection level equipment but is only viable if an agency has a centrally controlled and/or monitored signal system. With this approach there are concerns about data rebroadcast latency, which will be dependent on how the central control system communicates with the signals and how the provider rebroadcasts the data. These companies may also have some prearranged data sharing agreements with other parties that may influence with whom you may ultimately be able to share the data.

In contrast to this approach there are additional benefits for implementing the SPaT Challenge at the intersection level:

• V2I safety applications such as Red Light Violation Warnings require SPaT broadcasts at a very high frequency of 10 broadcasts per second, which has been proven using DSRC but cannot be achieved with other methods.

• Operating DSRC at signalized intersections will open up the opportunity for two way communications between the vehicle and the infrastructure. At some point this will allow vehicles to communicate the lane they are traveling in to allow the signal controller to consider this as part of adaptive control. Similarly, transit or emergency vehicles may use the DSRC communications to send priority requests to the signal controllers.

For these reasons the SPaT Challenge is specifically focused on requiring the transmission of SPaT data at the intersection via DSRC.

**Need to Know More?**

Go to the National Operations Center of Excellence for a comprehensive list of resources which will help you in your quest to take the Challenge:  [http://transportationops.org/spatchallenge](http://transportationops.org/spatchallenge)