

# National Connected Vehicle SPaT Deployment Challenge

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## Guidelines for Selecting Corridors – Version 1.0

### 1. Introduction

The goal of the SPaT Challenge is to encourage state or local agencies throughout the United States to deploy Dedicated Short Range Communications (DSRC) broadcasts of Signal Phase and Timing (SPaT) at approximately 20 intersection locations, typically in a corridor or network setting.

While the SPaT Challenge defines a goal of 20 intersections, agencies are encouraged to deploy whatever number of intersections is most appropriate for their initial deployment. In some states, this may only be a small number of intersections initially.

The guidance offered in this document is intended to help with any number of intersections considered by agencies, with the emphasis on identifying intersections that are most suited to SPaT deployment, and most likely to benefit from the V2I Applications that would be deployed to utilize the SPaT deployments.

The intent of this resource document is to provide guidelines to assist agencies accepting the SPaT Challenge in selecting their corridor or network. The selection of a corridor/network for an initial SPaT deployment involves at least two high level types of decisions:

- ***Need for V2I Applications.*** Selecting a corridor with an understood current or impending need for eventual Vehicle to Infrastructure (V2I) Applications that will be deployed and make use of the SPaT broadcast; and
- ***Infrastructure Compatibility.*** Selecting a corridor with infrastructure that is ready and compatible for SPaT deployment, either now or prior to 2020.

The remainder of this document is structured around these two high level decision factors.

### 2. Needs Based Selection of a SPaT Deployment Corridor

While the goal of the SPaT Challenge is to encourage near-term deployment of a limited number of SPaT broadcasts, agencies accepting the SPaT Challenge are encouraged to select corridors or networks where there is a high probability that the SPaT broadcasts will be used in the future to support one or more V2I Applications. The Connected Vehicle Field Infrastructure Footprint Analysis Deployment Scenarios document describes deployment concepts for Connected Vehicles and overall selection guides, including suggestions on value proposition. Depending upon the agency, a formal user needs assessment accompanied by a system engineering analysis or a higher level preliminary sketch planning assessment of needs may be used in the corridor selection.

This section identifies questions for agencies to consider when identifying the corridor(s), and offers lessons learned and/or suggestions based on other Connected Vehicle deployments.

## ***Questions to Support the Needs Based SPaT Deployment Corridor Selection:***

1. **Is there a corridor that follows a transit route that either currently has transit signal priority (TSP) operational or where TSP is being considered for future deployment?**
  - a. A SPaT deployment now could enable a current or future V2I based TSP system, offering additional benefits to the current TSP functions that may include more sophisticated decision making about priority requests than are possible without knowing the SPaT situation, and could include feedback sent to the driver regarding whether the priority request was accommodated (using DSRC messages beyond SPaT messages).
  - b. A future deployment of TSP might equip the transit fleet with vehicle to roadside communications, enabling the TSP to benefit from the SPaT broadcast regardless of the penetration of V2I equipped passenger vehicles.
2. **Is there a corridor or network of signalized intersections operating traffic volumes at or near capacity during peak periods where congestion relief is desired?**
  - a. A SPaT deployment now could enable Intelligent Signal Systems that benefit from information from the vehicle to operate the actuated controller more effectively (e.g. a message from the vehicle that the right turn arrow is on could avoid the controller extending the green time, recognizing that the vehicle will have the option of turning right on red).
3. **Is there a corridor, network, or isolated intersection that is in close proximity to a freeway exchange, and therefore might be considered for an Integrated Corridor Management (ICM) approach in the near future?**
  - a. An Intelligent Signal System (which could be supported by SPaT data) could be an effective component of an ICM deployment and help facilitate ICM rollout.
4. **Is there a corridor or network with heavier than normal emergency vehicle traffic that currently utilized emergency vehicle pre-emption?**
  - a. A SPaT deployment now could enable V2I based emergency vehicle pre-emption, increasing the functionality over current pre-emption systems.
5. **Is there a corridor with higher than normal red light violations and/or crashes related to red light violations?**
  - a. A SPaT deployment now could enable V2I based Red Light Violation Warning Applications, to warn drivers who are not stopping in advance of a red light.
6. **Is there a corridor with higher than normal commercial vehicle / freight traffic?**

- a. A SPaT deployment now could enable future commercial vehicle applications to address unique aspects of freight mobility, such as the Freight Signal Priority Application that provides traffic signal priority for freight and commercial vehicles.
7. **Is there a corridor with a major event venue that attracts major events where special event timing plans may be created now or in the future?**
- a. A SPaT deployment now could support adaptive or reactive special event signal timing and traveler information dissemination systems to address large volumes of predictable traffic on the network.

### 3. Corridor Selection Based on Existing Infrastructure Capabilities

In addition to selecting a corridor where it is likely that V2I Applications will be deployed in the future to benefit travelers, transit providers, and emergency responders, there are additional factors that should be considered when selecting a corridor. If SPaT deployment is to be achieved by 2020, the infrastructure must either be compatible for SPaT deployment now, or there should be plans in place to upgrade the infrastructure as part of the deployment. The following questions, and insight, are intended to help select the corridor from the perspective of infrastructure compatibility.

#### *Questions to Support the Infrastructure Compatibility Based SPaT Deployment Corridor Selection:*

1. **Does your traffic signal controller and software include the feature of outputting the SPaT message?**
- a. **Yes:** The intersection is capable of supporting a SPaT broadcast.
  - b. **No:** If this intersection is selected, you would need to upgrade the hardware and/or software to allow this to happen.
  - c. **I don't know:** Contact your controller manufacturer or local distributor to determine if they can provide this information. Output of 1202

Additional information is also being developed as part of the SPaT Challenge Implementation Guide. This is intended to report available information about the capabilities of signal controllers and software to support the SPaT output.

2. **Is your traffic signal controller and software able to receive and process messages, or does the signal controller only allow information to be sent out?**
- a. **Only supports outgoing information:** With the current signal controller, you would be limited to V2I Applications that do not send commands to the signal controller.
  - b. **Supports both outgoing and incoming information:** This intersection and controller would be compatible with V2I Applications that receive information/messages and send commands to the signal controller.

- c. **I don't know:** Contact your controller manufacturer or local distributor to determine if they can provide this information.

The basic premise of a SPaT broadcast is a one-way push of information describing the current signal phase and timing, however some of the V2I Applications that may be deployed to utilize the SPaT broadcast may involve the receipt of information from vehicles and determining a change to the phase and timing based on the information. In these scenarios, the ability for signal controllers to accept input would be valuable.

**3. Is there space in the existing signal controller cabinet to allow additional equipment?**

- a. **Yes:** No additional action is required regarding space in the controller.
- b. **No:** Before proceeding with selecting this intersection, it is important to determine if existing items can be relocated or space added to the controller.
- c. **I don't know:** As part of a detailed site survey, it is important to open and examine the signal controller. Visual inspection of the space in the controller should allow field staff to determine the space available.

It is important to consider the degree to which the equipment you procure for SPaT deployment is "off-the-shelf" final products compared to experimental products. Off-the-shelf products may slot directly into spaces in the controller while experimental products may not yet be packaged for final installation (e.g. a desktop modem may be used).

**4. Are there available ports in the traffic signal controller?**

- a. **Yes:** This intersection and controller has capacity to add the SPaT connection.
- b. **No:** If this intersection is selected, you would need to add port capacity to connect to the DSRC antennae (or intermediate server).
- c. **I don't know:** As part of a detailed site survey, it is important to open and examine the signal controller. Visual inspection of ports should be accompanied by a test to verify that the port is functioning.

If other applications (such as transit signal priority) are already deployed, there may be limited available ports for the SPaT broadcast to connect to.

**5. Is there capacity in the infrastructure in and around the intersections being considered for additional cabling to support backhaul communications to the signal controller?**

- a. **Yes:** This intersection would allow the addition of cables as needed.
- b. **No:** Prior to selecting this intersection, a more detailed analysis should be conducted to determine if additional conduit or space for cabling can be added or if existing cables can be repositioned.

- c. **I don't know:** As part of a detailed site survey, it is important to assess the capacity for additional communications to the controller from a central Traffic Management Center (TMC) using existing fiber or other communications mediums.

The basic SPaT broadcast can be accomplished locally at the signal controller, and therefore to achieve SPaT deployment backhaul communications is not required. However, several V2I Applications that may build upon the SPaT broadcast would require backhaul communications to/from the intersection. Depending upon the communications to/from the intersection, additional cables may be required.

**6. Have you determined where the DSRC antennae will be positioned?**

- a. **Yes:** The remaining questions will address antennae details.
- b. **No:** In order to answer the remaining questions, it is important to conduct the site survey and identify the location and supporting infrastructure for the antennae (either on an existing or planned pole or other structure).

The DSRC antennae will need line of sight visibility to vehicles approaching the intersection from all approaches. If this is not possible, multiple antennae may need to be deployed.

**7. Does the infrastructure configuration at the intersection allow cable communications between the controller and the location where the pole to hold the DSRC antennae would be located (either existing pole or new pole)?**

- a. **Yes:** No further analysis on this topic is needed.
- b. **No:** Prior to selecting this intersection, a more detailed analysis should be conducted to determine if it is possible to add capacity for cables directly between the controller and the DSRC antennae(s).
- c. **I don't know:** As part of a detailed site survey, it is important to assess the capacity and access to be able to run a cable between the controller and the antennae.

The selection of the DSRC antenna will be critical to the success of the SPaT deployment, since DSRC relies on line of sight. If the antennae can be mounted on the same pole as the signal controller (and achieve the coverage for advancing vehicles) this is the ideal setting. Otherwise, there will need to be cabling from the controller to the antennae.

**8. Is power available to the pole where the DSRC antennae would reside?**

- a. **Yes:** No further analysis on this topic is needed.
- b. **No:** It is important to arrange for power to be installed to the pole/structure prior to deployment. If it is not possible to bring power to this pole/structure, you should explore whether power over Ethernet is an option, before finalizing site selection.
- c. **I don't know:** As part of a detailed site survey, it is important to assess the availability of power at the structure that will support the antennae.

It is important to remember that the DSRC antennae will require power. In some instances, power over Ethernet can be used.

9. Does the intersection have additional factors that might limit the 'line of sight' functionality of the DSRC antennae?

- a. **No, there are no obstructions:** No further analysis is required, however please be advised that early deployments have found that even small objects (narrow poles) can create shadows where DSRC broadcasts are interrupted. If there is any questions about obstructions, see option 'c' below.
- b. **Yes:** Prior to deployment, consider whether an alternate antennae location is possible, or if it is possible to relocate some of the obstructions (e.g. foliage, banners, etc.)
- c. **I don't know:** As part of a detailed site survey, it is important to assess the line of sight access and determine if any man-made structures (e.g. poles, buildings, banners, decorations) or natural items (e.g. trees, vines) may obstruct the line of site. Please consider all seasons of the year and any annual displays of decorations (e.g. holiday lights or banners) or season changes in foliage.

It is suggested that a site survey be conducted according to the local agencies typical practice for surveying intersections. Other objects such as hanging plants or decorations may obstruct the line of sight DSRC broadcasts and create difficult scenarios to locate a DSRC antennae.

10. Is GPS coverage at the candidate intersection(s) of reliable and good coverage?

- a. **Yes, there is limited "urban canyons" therefore GPS receivers in vehicles are typically able to maintain a location, and we have tested GPS accuracy and found that our location typically has very minor error introduced by atmospheric conditions:** This location could possibly not need RTCM correction, additional resources on RTCM are being provided through a SPaT challenge webinar (Note: eventually insert link to the webinar recording or summary document).
- b. **Yes, there is limited "urban canyons" therefore GPS receivers in vehicles are typically able to maintain a location, but we either do not know about our GPS error or have determined that atmospheric error in this location is typical:** This intersection is still a good candidate for DSRC broadcast of SPaT, However, you should seriously consider RTCM broadcast to enable vehicles to correct their GPS determination. Additional resources on RTCM are being provided through a SPaT challenge webinar (Note: eventually insert link to the webinar recording or summary document).
- c. **No, the buildings or geography are such that vehicles are very often not able to get a good GPS location determination at one or more approaches to this intersection:** This intersection may not be a candidate for all SPaT related applications. Some applications (such as transit priority) may still operate successfully, but applications involving passenger vehicles may be challenged by the vehicles lack of accurate GPS determinations.

11. Does your traffic signal controller operate with a high quality time source (i.e. +/- 250milliseconds or more)?

- a. **Yes:** This should not present an issue with compatibility to the vehicles time source (typically GPS).
- b. **No:** You should explore the options for integrating a high quality time source (e.g. GPS based) at the intersection signal controller before further consideration of this location.

#### 4. Conclusions

The information contained in the previous sections are intended to be resources to help state and local departments of transportation select locations for their initial SPaT deployments, as described in the SPaT Challenge. When possible, insight has been included from agencies who have previously deployed SPaT technologies.

Often the final selection of early technology deployments is as much an institutional decision as it is a technical or cost based decision, and therefore it is expected that each agency opting to accept the SPaT Challenge will select their corridors/networks based on their own decision making process.