Connected Vehicle Certification Program

Task 4 – Gap Analysis

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EXECUTIVE SUMMARY

As a USDOT national initiative, the 'Connected Vehicle' is part of the overall Intelligent Transportation System Program as broadly planned at the federal level. However, the deployment of Cooperative System and Connected Vehicle technologies will be implemented at a local level with many of the intricacies of infrastructure management and interoperability falling to state and local transportation operating authorities. These deployments are expected to include vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) applications. Automakers are actively designing and incorporating V2V connected vehicle components into their next generation of automobiles. While V2V advancements are happening at a relatively fast rate, V2I deployments have been limited to a handful of pilot projects for experimentation. *While automakers possess research and development resources as part of their normal business model, infrastructure owner/operators do not*. A number of other differences between these groups and the specific needs of operating authorities are also factors that continue to impact the advancement and progress of V2I systems. Within this context, it is important that the needs of these operating authorities are considered and reflected in initiative planning and implementation tactics.

A critical component to the overall success of national, interoperable Cooperative System and Connected Vehicle deployments is a robust independent third party certification process that ensures performance and interoperability of said technologies and systems. This project has investigated the current landscape of certification activity in this space, assessed the needs of state and local infrastructure owners, and identified the gaps that exist between current activity and state local needs. As a result of this effort, an actionable certification-related set of recommendations that further promote state & local efforts to deploy cooperative and connected transportation systems – that work – was created for the identified gaps.

INTRODUCTION

Throughout this project, the needs of the state and local transportation operating authorities have been gathered, analyzed, and documented. The final stage of the project is to take the identified gaps, analyze them and develop recommendations for closing those gaps.
The objective of Task 4 is to provide an understanding of the connections and disconnections between the needs of the state/local authorities and the current Connected Vehicle initiative. This task was accomplished using the results of Task 3 as the starting point to conduct a gap analysis of the current work and future direction of Connected Vehicle initiatives and the needs of the state/local entities. Specifically, the project:

- Addressed how well the proposed work in certification tracks with the needs of the state and local authorities.
- Identified key actions to promote the state/local position and continue to move the certification program toward deployment.
- Developed a foundational strategy of how to assure that a certification program meets a state's needs.

To perform the gap analysis, the following activities were undertaken:

1. Use accepted analysis methods to compare current state of Connected Vehicle certification efforts (in terms of addressing state and local needs) against the state's and local agency's actual needs as identified through the efforts of Task 3; and
2. Develop recommendations and proposed next steps to close the gaps and extend the states' and local agency's needs into the Connected Vehicle certification efforts

There are five general items associated with the gap analysis performed on this project.

1. Determine the gap analysis focus.
2. Identify the current baseline based on metrics or attributes.
3. Identify the goals.
4. Identify the gaps between current baseline and the goals.
5. Develop recommendations to fill the gaps.

Each phase of the PFS project has contributed to, informed and enabled Task 4.

Task 1 comprised of an initial summary of the interconnected initiatives that comprised the connected vehicle community and was developed using a software product called Mindomo (see box). The major activities of Task 1 were as follows:

Mindomo is a web-based software product that produces interactive, multimedia-rich "mind maps" of information relevant to a topic. The maps employ hyperlinks and other internet-style navigation tools. The Connected Vehicle mind map site enables users to click through various branches of the Connected Vehicle universe and open web pages, videos, audio files, papers, and presentations – all with information relevant to certification. The map's branches can be updated to reflect the real-time changes in the industry.

- Conference call with PFS which set the course for the development of a dynamic and actionable work product. The team selected Mindomo as the tool of choice.
- Literature search, web-based research, and analysis were performed to indentify the branches and leaves of the Mindomo maps.
- The Mindomo maps were designed based on this research. Three main branches were identified; USDOT's Connected Vehicle Focus areas, Non-DOT Connected Vehicle Projects, and USDOT/RITA's Connected Vehicle Suppliers.
- Using the data gathered, the Mindomo maps were created and shared with the PFS.

For Task 2, the objective was to provide a summary view of the efforts and outcomes specific to certification for the Connected Vehicle program. The purpose was to create an understanding of what is envisioned and what states and local operators will likely have to interact with when deploying certified connected vehicle systems. The major activities of Task 2 were as follows:

- Modeled currently successful and relevant product certification programs in hopes of gleaning the features and attributes that contribute to their sustainability.
- Researched with three currently successful certification programs and examined them through several perspectives; Structural Elements (Organizational Design, Technology Infrastructure, Financial Models), Addressing User Needs, and Program Attributes.
- Described the organization, processes and technical requirements of the Connected Vehicle Certification System.

In Task 3 OmniAir interviewed select PFS stakeholders to gather data critical to determining the current status of the stakeholder's connected vehicle activities and their long term needs and desires for connected vehicle devices and certification. Major activities of Task 3 included:

- Developed a set of interview questions to be used for the PFS stakeholder interviews.
- Conducted interviews with the PFS group to determine the status of Connected Vehicle and certification activities.
- Combined the responses into a single, generic set of answers for each question.
- Developed a set of online survey questions. The survey could be provided to other agencies to gain similar input on the most critical issues identified in the interviews.
- Documented the findings and presented the findings to the PFS stakeholders.

Using the results of Task 3, Task 4 established the current certification baseline, ascertained the stakeholders' certification goals, identified gaps and developed recommendations for closing these gaps.

PART I – IDENTIFIED GAPS

This document is divided into three sections. Part I describes the gaps that have been identified based on differences between the baseline and the goals. Part II discusses the analysis performed and the findings uncovered as a result of the analysis of these gaps. Part III provides a set of recommendations on how these gaps could be closed and/or removed altogether.

A number of state and local user needs were uncovered and described during Task 3. Those needs have been considered and compared against the current certification baseline and the desired goals. The baseline and goals were employed in Part II and Part III to analyze the gaps and develop and document recommendations to close these gaps.

OmniAir is in a unique position to provide a deep understanding of the multiple and interrelated activities that are currently underway in the Connected Vehicle arena. Its membership includes individuals and companies active in various sectors of the transportation operations and technology community, both from industry and government. In addition to their participation in OmniAir, they are directly involved in several Connected Vehicle Program projects addressing policy and architecture design, system design and implementation, device qualification and product certification. Their experience ranges from the inception of the ITS program in the 1990's, the 1999 FCC allocation of 5.9GHz DSRC for connected vehicle activities, the subsequent vehicle infrastructure integration program, IntelliDrive and most recently, the USDOT Connected Vehicle Safety Pilot. OmniAir members are contributing and shaping the future adoption of connected vehicle technologies and the applications this technology is expected to support.

The ongoing participation and activity of OmniAir members in many facets of the Connected Vehicle program allowed the group involved with the development and review of this report to consider and contribute from a wide variety of perspectives. This is particularly important considering the multiple stakeholders impacted by the Connected Vehicle initiative. While the focus of this study is on state and user needs, it is critical that they not be studied in a vacuum without involvement and review by contributors with other pertinent backgrounds and unique but complementary perspectives.

As part of Task 3, PFS stakeholders were interviewed in depth. OmniAir documented that according to the group, there is a need for:

- USDOT oversight of a Connected Vehicle Certification Program
- A global certification/interoperability entity
- Promoting public awareness of CV/CS
- Addressing backward compatibility of CV/CS equipment

- A continuing Connected Vehicle standards development program
- Direct communication with USDOT
- Guiding principles on procurement, deployment and operations and maintenance
- Awareness of other connected vehicle implementers and their activities
- Incorporating CV/CS into the National ITS Architecture
- National policy and guidance resources to limit deployers' liability.
- Simplifying the concept for road operators to increase understanding/acceptance.

During interviews conducted for Task 3, stakeholders were asked to share their current work, experiences and concerns as they pertained to Connected Vehicle activities and certification. Answers ranged from "not doing much (or anything at all)" to "implementing test beds". Taking into consideration all the responses and evaluating where the majority of the stakeholders were positioned, the current baseline was established. The following list is considered to be a summary of the current baseline (for more detail, see the Task 3 deliverable):

- Local stakeholder /USDOT Interaction occurs largely through the PFS Group whose members attend USDOT sponsored webinars and public meetings and initiate their own meetings with USDOT.
- Local stakeholders have limited test facilities and in-house technical expertise. Though they may test ITS technologies, no local stakeholders have formal certification programs for connected vehicle technologies. USDOT has no single certification program or entity to develop and manage the certification processes required to ensure interoperability for connected vehicle/cooperative systems.
- Local stakeholders have limited formal published standards for connected vehicle and they indicated they do not intend to develop their own. They believe that only national standards (perhaps international) would support successful, interoperable systems. USDOT also has only limited standards. What exists is either largely developed based upon, or relies upon, adoption of other standards and the efforts of other standards development organizations and groups such as the Society of Automotive Engineers' Message Set Standard 'J2735.'
- Local stakeholders have no formal outreach programs to inform the public about connected vehicle technology, use cases, interoperability or certification. USDOT's national outreach is limited and for Connected Vehicle, is in its infancy (for instance, the Connected Vehicle Driver's Clinics currently being conducted).
- Local stakeholder information sharing is minimal outside of the PFS; national information sharing is limited and typically done through public meetings.

Examination of the stakeholder needs showed that there were groups of needs that could be combined together into a single goal. These goals are the ones that stakeholders are looking at

to achieve the level of satisfaction and confidence needed for certification of connected vehicle devices. These goals are identified in the first column of the table below. The second column identifies the needs that created the goal.

Goal	Identified Needs
High level of USDOT interaction	USDOT Oversight of Certification Program Direct communication with USDOT Guiding principles on procurement, deployment and operations and maintenance National Policy and Guidance resources to limit liability of local agencies that deploy connected vehicle systems
Single certification entity	Global Certification/Interoperability Entity
Utilize the Systems Engineering process	Develop standards Address backward compatibility of CV/CS equipment Incorporate CV/CS into ITS Architecture
Perform outreach and education	Promote Public Awareness of CV/CS Simplify the concept for road operators
Knowledge sharing	Awareness of other connected vehicle implementers and their activities

These goals are mapped to the current baseline in the table below:

Current Baseline	Goal
Local stakeholder /USDOT Interaction is largely through the PFS and attendance at USDOT sponsored webinars and public meetings	High level of USDOT interaction
Local stakeholders - test facilities; national – no single certification/interoperability entity/set of processes	Single certification entity/set of processes
Local stakeholders – no standards. National standards such as J2735 for developers	Utilize the Systems Engineering process
Local outreach - none; national outreach limited	Perform outreach and education
Local information sharing is minimal; national information sharing done through public meetings	Knowledge sharing

PART II – GAP ANALYSIS

The purpose of gap analysis is to determine the differences (gaps) between what stakeholders say they need (recommendations) versus what they say they have (current baseline). Below are detailed observations made during the execution of Task 3 and the analysis performed in Task 4.

USDOT Leadership

In studying the interview responses, stakeholders expressed a strong desire to have the USDOT provide significant leadership (vision, guidance, and support) in connected vehicle activities and certification while also respecting local and regional input and diversity. The stakeholders expressed that USDOT must champion certain high-level governance issues and be the catalyst for further development and deployment of emerging technologies and products. USDOT needs to regulate certifications, provide guidance (and funding) for operating and maintaining devices, provide vetted national standards for easy adoption by state and local agencies, and support stakeholders' need for consistency and enforceability. Having national guidance and defined national best practices is also important to local stakeholders because it offers a degree of liability protection in much the same way as other national standards and guidelines (such as AASHTO standards, the MUTCD, and others). USDOT is working with the Crash Avoidance Metrics Partnership (CAMP) using the J2735 standard communication protocol to perform vehicle to vehicle (V2V) communications. This same protocol is used to communicate from in-vehicle devices to roadside equipment (RSE). This is an example of the type of USDOT leadership needed; where the USDOT is ensuring that private sector companies are complying with the established standards of the program.

Single Certification Body / Program – But Preserve Some Autonomy for States

Stakeholders also strongly expressed a desire to have a single certification body that would develop the standard certification processes, oversee device certification using these processes, and report directly to the USDOT. This baseline activity is also related to the desired "high level involvement" of USDOT. Stakeholders concurred that having a single certification entity was acceptable, but there would be a need for multiple certification testing labs. Some stakeholders who have testing facilities indicated they would consider being a certification facility. These stakeholders said that regardless of the devices being certified, they would test them in their facilities to qualify the devices just as they do many other traditional traffic control devices, such as signalized intersection equipment and intelligent transportation system (ITS) device. By comparison, USDOT does not have an official single certification program or a single certification entity (under contract or otherwise). Currently, the OmniAir Consortium is

under contract with USDOT to develop test processes, test procedures, the test apparatus, and qualify the performance of Vehicle Awareness Devices for interoperable deployment in the Safety Pilot Model Deployment (SPMD). USDOT has additional entities (i.e., BAH, SAIC, Battelle, Cambridge Systematics) under contract to test/qualify other types of SPMD devices and all entities work cooperatively.

The Public – Key to Acceptance

Stakeholders also held a common belief that a successful cooperative system/connected vehicle deployment is highly dependent on gaining the public's acceptance and confidence in connected vehicle technologies and applications. To date, there has not been a significant marketing effort by USDOT to publicize connected vehicle to the general public. There has been limited public exposure by way of press releases and media interest regarding trade show activities and other industry showcase forums, but not a concerted effort for public outreach.

However, the pilot projects and implementation of V2V technology by automakers is fast approaching a point where a significant outreach campaign may be appropriate and necessary. Over the past six months prior to this report, CAMP (in conjunction with the USDOT) has conducted six driver clinics around the country to gauge how the general driving public reacts to the safety systems developed by the Original Equipment Manufacturers (OEM) members of CAMP.

As stakeholders begin to deploy connected vehicle technology, educating the driving public will be crucial to gaining acceptance of the technology and the desire by the driving public to adopt and utilize features that are enabled by the technology. The National Highway Transportation Safety Administration (NHTSA) must also play a pivotal role educating the driving public should it rule favorably in 2013 to require that all vehicles be equipped with a connected vehicle device. Since local agencies will be largely responsible for the deployment of the technology and interfacing with their constituents, they will need resources and support that allows them to effectively communicate the benefits of the technology to the public at large. In addition to the benefits, they must also be able to gain public trust and acceptance of the security and safety of connected vehicle devices and applications.

Communications

Connected Vehicle is a national deployment. While there will be early adopters and implementations that are performed somewhat in isolation, this technology is ultimately expected to permeate all vehicles and all portions of the country. Communication between the operating agencies deploying the technology, the USDOT, and the OEMs who will both deploy (in vehicle) and utilize the technology (for instance, infrastructure supported information) is critical to the success and acceptance of the technology. Currently, information is disseminated

by the USDOT through outreach and public meetings. OEMs that are part of CAMP periodically disseminate information through the USDOT. Local agencies are either planning or have only recently deployed test bed and demonstration systems.

Being able to share information with the USDOT and CAMP is important, but equally important is communication between the local agencies that are planning connected vehicle deployments. The PFS Group is potentially an important mechanism for agencies to exchange information and ideas especially regarding device certification, a critical precursor to effective connected vehicle / cooperative system technologies. However, what body or forum will serve to facilitate exchange and solicit input from local and state operators in moving forward? Such coordination and stakeholder input forums will be necessary throughout the lifespan of connected vehicle. Agencies have to be confident that devices moving into and out of their jurisdictions are interoperable. To this end, they will need a program framework that supports and addresses this, and other, future needs. Future certification entities and programs such as those envisioned and proposed by OmniAir (based on widely accepted and successful models from other industries) are also important catalysts. Vigilant guardians are needed to ensure that devices meet specifications, function properly (i.e. in an interoperable manner), are safe, and meet the needs set forth by the USDOT, state departments of transportation, local agencies that deploy equipment, and other stakeholders.

PART III – GAP CLOSURE RECOMMENDATIONS

Part III identifies and lists recommendations for reducing gaps between the current baseline and the goals. It should be noted that some of the recommendations will be outside the direct control of the PFS stakeholders, but the PFS can exert its influence to create positive activities to reduce the gaps. Each of the items described below is directly followed by a recommended action that would help close gaps associated with that particular topic.

Recommendations for Gap Closure

Gap #1

With regards to USDOT oversight and leadership, the USDOT is currently leading and championing the program through financial support and direct involvement in several ongoing technical research areas. SPMD is a good example. However, the USDOT's emphasis has been largely on V2V and CAMP. Much less emphasis has been placed on V2I applications and research – items of high importance to road operators. As a result, several agencies have initiated their own plans to study, architect, and implement V2I, and as witnessed by this study, this also includes how to deploy certified devices. These agencies need to voice their concerns to USDOT over the lack of focus on V2I in the program as a whole, and also in terms of certification. V2I system manufacturers have voiced their concerns at multiple public meetings, but with additional support from public agencies, the USDOT is more likely to pick up its pace on involvement, guidance, and leadership with regards to V2I.

***Goal Addressed:* High level of USDOT interaction**

***Recommendation #1:* PFS stakeholders must accelerate dialogue, perhaps with a focus on interoperability assurance, with USDOT through the PFS Group and at USDOT-led public meetings and webinars. Stakeholders could provide white papers, findings, and data to USDOT on their V2I activities that speak to the topics of certification and interoperability assurance needs.**

Gap #2

PFS stakeholders should participate in as many public workshops in person or via webinar as possible and voice their needs and concerns directly to the USDOT. The Connected Vehicle program is being shaped at a national level, and local agencies must strongly voice their input into the concepts that are being considered and developed today. To accomplish this item, some local agencies send representatives to a variety of workshops. These activities range from technical discussions about devices, systems and technologies to workshops that discuss the

development of operational concepts for certain applications. Because of the flurry of work being performed for connected vehicle, it is important for local agencies to reach out to their USDOT and FHWA peers to explore resources and options for active participation. Since interoperability is a fundamental requirement to successful deployments, locals must clearly voice their needs for connected vehicle and CV/CS certification that ensures device compliance to CV/CS standards. We recommend that PFS members (or another capable group with similar interest and/or expertise) work with USDOT to establish and conduct a CV/CS summit. The summit should be a stakeholder forum open to interested local agencies, the USDOT, FHWA, and VOLPE to discuss how to get devices certified and cooperative systems in place to support the technology. AASHTO may be an organization that can also serve to promote or establish such an event, or perhaps another SDO or consortium.

Goals Addressed: ***High level of USDOT interaction; Knowledge sharing***

Recommendation #2: ***The PFS work with USDOT to establish a V2I connected vehicle summit.***

Gap #3

The PFS stakeholders expressed a desire for USDOT to develop a document or set of documents that the local agencies could reference when legal, privacy or other similar questions are raised related to CV/CS. Again, we recommend that the PFS reach out to the USDOT and voice their desire and need for documentation that captures national guidance and recommended best practices in a manner similar to the Manual on Uniform Traffic Control Devices (MUTCD). Likewise, the USDOT should stress the importance of uniform message presentation to automakers and other interface designers that may be unfamiliar with their guidance. For example, graphic design and message consistency for in-vehicle displays should be held to standards of uniformity similar to those that already exist for traditional signage.

Goals Addressed: ***High level of USDOT interaction; Knowledge sharing***

Recommendation #3: ***The PFS should identify the documentation needed for USDOT to support the development of CV/CS and expedite the broad sharing of this documentation.***

Gap #4

When examining the certification process, it is important to the PFS stakeholders that there be a single entity to develop, manage, and operate the certification process under the guidance and oversight of the USDOT. There currently exist a number of testing facilities that can either test connected vehicle devices or could ramp up and be qualified to perform such testing.

Conversely, other than the OmniAir Consortium, there are no entities that have demonstrated the capacity or interest in developing and governing a certification program and framework that ensures consistent, impartial, predictable, and repeatable device certification and interoperability testing. OmniAir is engaged in discussions with USDOT to become a prime connected vehicle device certification entity.

Goal Addressed: ***Single certification entity***

Recommendation #4: ***The PFS should analyze OmniAir and any other identified certification entity and advocate a position. As per the interviews, PFS members reported a desire that a single certification entity become the national connected vehicle certification entity to USDOT.***

Gap #5

The USDOT uses the Systems Engineering (SE) process for the different research areas it is developing. In the case of Dynamic Mobility Applications (DMA), the SE process is being used to develop operational concepts for the application bundles that were selected. The 'Applications for the Environment: Real Time Information Synthesis' (AERIS) is developing its operational concept for its program. These operational concepts are being fleshed out at public meetings where the USDOT is soliciting input from public agencies to guide the development of these research areas. It is important for the PFS stakeholders to be actively involved in these public meetings to ensure that the product being developed can be useful to traffic operations, as local agencies responsible for local and regional transportation systems will likely be tasked or impacted by certain facets of AERIS. Without local agency input, there is the possibility that the systems and applications developed will not be conducive to the way roadway networks are managed. The PFS as a whole could reach out to USDOT and offer to gather and consolidate feedback (from within the PFS and possibly beyond) on AERIS and other DMA, and provide it to the USDOT to help guide further development and research in these areas. Early involvement by local agencies in the SE process will ensure these applications and systems are properly certified to meet the security needs of the local agencies. These applications and systems need to operate on certified connected vehicle devices that would likely involved issues such as backwards compatibility. The PFS' involvement in the development and implementation of these systems and applications is crucial to ensuring successful deployments of certified equipment.

Goal Addressed: ***Utilize the 'Systems Engineering' process***

Recommendation #5: ***The PFS should develop a plan to support the DMA and AERIS research areas and implement the plan with USDOT cognizant of the need for certification of performance and interoperability.***

Gap #6

As the ability to get information inside the vehicle is becoming increasingly easier and mainstream, it is critical that the USDOT mount a campaign to "get the word out" about connected vehicle technology. As the NHTSA 2013 decision draws closer, the need to provide an understanding of the benefits and positive aspects of the technology must get communicated to the driving public. *Otherwise, it is possible that purely commercial interests and OEMs will overtake the technology and it will become more entertainment and infotainment-focused.* Local agencies are going to need the backing of the USDOT to help educate the driving public. Because of privacy and other intangible issues, connected vehicle technology could have a tough road to go before gaining mainstream acceptance. A standard certification body (much like the role Underwriters Laboratory (UL) plays in the electronics industry) could go a long way in helping road operators gain the driving public's confidence in this new technology. In general, people feel safe and confident if an appliance or other electrical device has the "UL" mark. The connected vehicle devices (and applications) need to attain a similar level of consumer confidence and a recognizable mark can help promote and achieve that goal. The PFS stakeholders can solicit the USDOT to move forward with a single certification entity or program that becomes the standard bearer for the safety and compliance of connected vehicle technology in much the same way that UL and other certification bodies have achieved for their respective industries.

Goals Addressed: ***Perform outreach and education; Single certification entity***

Recommendation #6: ***PFS should encourage USDOT to utilize a standard certification body that could be used to provide input to efforts to develop connected vehicle public awareness campaigns and perform local public awareness in areas where connected vehicle is being implemented and tested.***

Gap #7

Finally, a key to all of these recommendations is the ability for the local agencies responsible for connected vehicle infrastructure deployment and USDOT to have an effective, open line of communication. It is crucial that local and state agencies have ample opportunity to regularly discuss the technology, applications, certifications, devices and other aspects of the connected

vehicle program with the USDOT. The concept of connected vehicle has grown immensely from V2V and V2I safety applications to a whole host of applications that provide improved safety, improved mobility, entertainment, and infotainment. The PFS should encourage a regular discussion with USDOT on the aspects of the technology that matter most to it. These discussions should include the topics of devices, certifications, applications, data (V2I), OEMs (V2V), driving public acceptance and confidence, among others. The USDOT could establish a blog and secure website where agencies could exchange information with the USDOT as well as other local agencies. In terms of interoperability assurance (testing, certification, etc) the PFS as a group should voice their expectations and concerns to the USDOT in order to ensure that the local deployments do not become islands and can communicate with devices as they enter and cross regions. Connected Vehicle is a large and complex system. It is a dynamic one that grows on an almost daily basis as public agencies and private companies invest in the development of systems and applications. What they are investing in is the promise that connected vehicle holds for improving the safety and efficiency of our roads as well as the myriad other governmental and commercial applications that have been envisioned and explored to date.

Goals Addressed: ***Knowledge sharing***

Recommendation #7: ***PFS should define clear communications channels to USDOT that will enhance the communications between the local agency deployers, the USDOT, and the OEMs.***

IDEAS FOR FUTURE ACTIVITIES

As a result of the recommendations and discussion with the PFS stakeholders, the OmniAir ream offers the following list of recommended activities. These activities are ones that the PFS could perform or have OmniAir for them. They are as follows:

1. Establish a procurement process that recognizes the special nature of standards-based interoperable technology intended for broad adoption

   As the USDOT continues to qualify devices for the Safety Pilot for the purposes of a test that begets data to be used to inform a *future* deployment decision, PFS stakeholders are also looking to procure devices for their own use at this time. While USDOT is working to establish a preferred supplier list, this list will be focused on Safety Pilot and its specific applications.

   Additionally, there are suppliers that have or are developing devices that are not being qualified by the USDOT. To leverage the availability of standards-based interoperable connected vehicle technologies, the PFS should develop a standardized / harmonized procurement process for use by its stakeholders. This process could include allowing suppliers to compete for state procurements regardless of being on a preferred supplier list for USDOT purposes. In effect, for the state there could be a 'PFS' preferred supplier list. In order to create this, the PFS could be the entity to lead the development and publishing of set specifications for each device type (vehicle awareness device, RSE, OBE, ADS) the states are interested in procuring. The specifications should be based off current, credible specifications (such as USDOT specifications for Connected Vehicle technologies), but tailored for the PFS' own use and applications. Another key task, led by PFS, would be to qualify these suppliers' devices via an apparatus that ensures they meet specifications and standards, and for all 'qualified' devices, that they work in an interoperable manner. The PFS would coordinate with USDOT to ensure the device specifications evolve in a way that ensures this.

   The value of this task – procurement standards and a uniform qualification process – is that PFS stakeholders could continue to advance deployment of applications important to them at their pace, rather than at the test-centric, safety-critical-oriented pace of the USDOT Connected Vehicle Program

2. Establish a testing/certification program that reflects the nature of connected vehicle deployment

   As PFS stakeholders prepare to deploy device infrastructure, there will be a need to test the devices selected in a way that reflects the special nature of the technology, i.e. it's

intend to be interoperable nationally. The PFS should take advantage of stakeholders who have testing facilities that can support connected vehicle device infrastructure testing. If stakeholders do not have adequate facilities, PFS should reach out to testing organizations, such as OmniAir, to conduct testing on their behalf. Regardless of where testing is done, it is very important – to ensure interoperability – that a set of processes, procedures, and standard test apparatus be developed that all stakeholders can trust and take advantage of to qualify devices that must work across jurisdictional borders. This is especially important for stakeholders who plan to deploy the same device from multiple suppliers.

The value of this task – establishing a connected vehicle testing program for the state stakeholders can enable states to deploy 'their' applications at their pace and do so in a way – via certification and interoperability assurance – that reduces risk.

3. Conduct a Connected Vehicle Application Education Program

   As states begin to test and ultimately deploy connected vehicle device infrastructure, a targeted outreach program to three key stakeholders: 1) state and local DOT staff, 20 local decision-makers; and 3) the public, could reduce resistance to this 'new technology' – resistance typically stemming from people's misperceptions about it.

   Today, there are many stories, articles, features and press releases that provide the many flavors of what connected vehicle is purported to be. Few of them are targeted to state employees, the local road engineer, the decision makers at local government, or the public in general. It's imperative to reach out to these connected vehicle 'constituents' and educate them on what connected vehicle is and what applications are feasible, what are being tested, where these applications are being tested, and why these applications were selected. Getting these stakeholders' buy in early will go a long way to establishing confidence in connected vehicle as the applications become more sophisticated and safety-critical.

   The value of this task – getting out in front of a new technology with a proactive educational program increases buy-in by people who will make the decisions to fund, procure and even champion the technology to others.

4. Establish standard practices and means for in-vehicle warnings to counter the potential for distracted driving

   One of the most important aspects of connected vehicle technology will be communicating with the driver and/or passengers in an effective manner without distracting them. There are two parts to this issue. First, the data being communicated

to the vehicle which in turn would communicate the data to the driver must be of the same format whether the data comes from another vehicle or from roadside infrastructure installed, operated and often maintained by state of local transportation departments. The OEMs currently are using a common protocol based on the J2735 message set. The local agencies, working with USDOT, must work collaboratively with the OEMs to ensure the standards are adhered to.

Secondly, the OEMs are using this feature as a means to differentiate themselves from their competition. For example, in order to warn a driver of a blind spot vehicle, one manufacturer rumbles/vibrates the driver's seat on the seat surface side corresponding to the side where the vehicle is approaching; another manufacture uses directional lighting to indicate the side where the vehicle is approaching; a third uses a vocal warning; and still others use some combination of these warning types. This inconsistency could lead to more harm than good. A driver whose private vehicle rumbles, but who rents a car with directional lighting may have no idea what the directional lighting means or even pay attention to it. Standards inside the vehicle are going to be critical so that drivers know what actions to take when a warning is issued, be it rumbling, lighting or audible). As stakeholders deploy infrastructure devices, a coordinated approach will benefit both 'sides.' For example, states could collaborate with OEMs, inviting them to bring their vehicles to the test deployment. The states should emphasize to the OEMs that commonality between the OEMs regarding their approaches to specific warnings can be crucial to a successful deployment. The PFS group could offer to host driver clinics for the OEMs to bring their vehicles for selected members of the driving public to test and gain feedback. The bottom line is that automated warnings that require the driver to potentially take evasive action must be implemented the same way as seat belts or airbags were deployed. The devices all work in the same manner and provide the same level of protection, but are consistently built into vehicles in the same manner, producing the same results.

The value of this task – distracted driving is an issue the connected vehicle should not make it worse. Road operators bear the brunt of distracted driver-caused accidents. The states, by leading a standards effort here with OEMs, can help make sure that Connected Vehicle deployments advance safety, not aggravate it.

5. <u>Create a regular exchange with NHTSA to ensure state's recommendations are considered and applied</u>

As state stakeholders design, implement, and support their deployments, a regular dialogue should be held between it, the USDOT and NHTSA. Assuming NHTSA rules favorably in 2013 to require DSRC devices in vehicles, USDOT and NHTSA will continue

to need vast amounts of data and insights that can be used to advance the technology properly.

Value of this task - having a formal means for states to collect and provide their thoughts, opinions, and lessons learned will help shape the future of the connected vehicle technology in ways that benefit states and their constituents. It will help ensure that deployment specifically answers the requirements of the 'infrastructure side' of connected vehicle.