Please stand by for realtime transcript.

Good afternoon my name is Andrew and I will be a conference operator today. At this time I would like to welcome everyone to the smarter work zones seminar. All lines have been placed on mute to prevent any background noise. After the speaker's remarks, there will be a question-and-answer session. If you would like to ask a question press star then the number one on your telephone keypad. If you like to withdraw your question press the pound key. Thank you. You may begin your conference.

At afternoon for good morning depending on where you are. Welcome to the second webinar in the smarter work sales webinar series implementing technology application solutions. My name is Nicole Coene and I will moderate today's webinar. Before I go further I would like to let most be note -- let all of you know you need to meet your computer speakers or you will hear your audio over the computer as well. Today we have two presenters. Todd Peterson of the federal highways administration office of operations, and Jerry Ullman, Texas a and M transportation Institute. Todd Peterson is a transportation specialist on a work zone management team in federal highways office of operations. He specializes in data-driven management of traffic operations and innovative strategies, improving work zone safety and mobility. Currently the lead champion in promoting ITS strategies to the smarter work sales initiative. Jerry Ullman is a senior research engineer in regions fellow at the Texas A&M transportation Institute. Leaves the work zone and dynamic message signs research programs at TTI. Since joining in 1984 he has been the principal investigator for numerous studies pertaining to work zone safety and mobility, traffic control device effectiveness, freeway operations and traveler information systems. He was the primary author of FHWA publication work zone ITS implementation guide, and is a member of FHWA every day counts work zone implementation team. Today's seminar will last 90 minutes. 60 minutes allocated for the speakers and 30 minutes for audio questions and discussion. Gift during the presentation you think of a question, you can type it in the chat area. Please make sure you send your question to everyone and indicate which presenter your question is for. Presenters will be unable to answer your questions during the presentation, but we will pause halfway through the presentation to answer questions typed into the chat box. Will answer questions again at the end of all the presentations. In addition of time allows we will open the phone line for question and comments. The PowerPoint presentation used during the seminar

is available for download in the file download box in the lower right corner of your screen. It will also be available online within the next few weeks, along with the recording and transcript. We will notify all attendees once these materials are posted online. FHWA does not certify participation in online training courses for continuing education credit. It may still be possible to claim credit towards professional development hours, please contact your professional certification Board for reporting requirements. Registration confirmation is the only proof of attendance we will be able to provide. We will now turn it over to Todd Peterson of the federal highways administration.

Good morning or afternoon, thank you, Nicole. Welcome to the second in our biweekly series of smarter work zone webinars. We are pursuing these webinars to present topics that are of the best interest of the practitioners trying to target these to the audience to convey information that will be useful to other agencies and other practitioners in executing smarter work zones in your own area. Like I said this is the second webinar in the series. The first was the overview conducted earlier in the month, that has been recorded. The link is on the slide and you see below the schedule of those we have upcoming. We will talk about quarter coordination next and go back to technology applications which is today's topic again in webinar number 4 and the remaining webinars after that. The full agenda for those is at the link at the bottom of the screen. Afraid a check on that occasionally for updates.

Today's webinar is really to give a general overview of work zone intelligent transportation systems implementation guide, which is the guiding document behind the technology application side of smarter work sales. We will talk about, real briefly about smarter work sales technology application initiative, what it means when we talk about technology applications. I will then turn it over to Jerry to give an overview of the work zone ITS implementation guide. Finally, we will wrap up a brief discussion of case studies. Moving along, the technology application initiative is one side of smarter work zone.

Generally speaking when you say smarter work sales, it sounds like smart work zones like smarter highways. You are thinking ITS. But it is smarter work zone, so a little more than ITS. We will talk about that in a bit but generally speaking it is a set of policies and practices that are geared towards a next generation approach to managing work zone operations. Using data to reduce work zone crashes and delays to identify changes in traffic conditions and to provide better information both drivers and traffic managers to help them make better decisions. There is two parts to smarter work sales. The first is project coordination which in a nutshell is a proactive strategy for managing multiple projects to minimize the collective impact of work zone congestion. In the second part of smarter work zones is what we are calling

technology applications which in a word is ITS. Dynamic management of work zone traffic impact. We will talk about examples of that and what we will talk about today.

What is technology applications? Do a little deeper dive in what we mean by that. Really, everybody is familiar with ITS and we have all used ITS to some degree on works on projects. But, for the smarter work zone's initiative, we are thinking of ITS as getting beyond dragging out of PCMS to a work zone and flashing roadwork ahead of there . The idea is using data from the field to generate actionable information that can actually guide driver behavior so they can react better to work zone related congestion. And also provide a tool for traffic managers to better understand what is happening out in the field and what they can do to better manage the work zone or measure the performance of work zones for future reference. It is more of a data focused strategy on managing work zone and congestion. So we have two goals associated with the technology application side of the smarter work zone initiative. The first goal is that by December 2016, we are encouraging states, we would like to have 35 state DOTs to have implemented business processes for work zone ITS technologies. What we mean by documenting business processes is integrating the principles of the work zone ITS implementation guide into their business process and policy. As we go to the discussion of the guide, I think how we intend that to happen will become clear.

The second goal is that by December, 2016, we hope 435 state DOTs to have utilized at least one work zone ITS technology application. This is actually the hardware side of it. The first one is a policy side, this is more of an actual implementation hardware focus. Hardware in the field implementation that works in ITS for dynamic management of work zone impact. Having gone to the process talked about in the guide, this goal would be the next step. This is actually implementing the steps of the guide to put work zone ITS in the field. That is an overview. We will move on to talk about the ITS implementation guide in the bits. Jerry Ullman was instrumental in putting the guy together, I can think of a better person to talk about it the first we will turn this back over to Nicole and see if there is any questions at this point.

Thank you, Todd. At this time we do not have any questions so we will move on to Jerry Ullman of TTI.

Thanks. I appreciate everyone coming on today and participating in listening to this webinar. I think Todd did a great job introducing the topic, the federal highways initiative, the goals and what we want to do for the next few minutes is talk about the work zone implementation guide. As Todd said, federal highways is using that as one of the primary documents to drive in guide the smarter work zone's technology application initiative here. It is intended to provide users, state DOTs and agencies, contractors, other industry stakeholders, a little bit of a map on how to go about

getting work zone implementation, smarter work zone implementation going. It is developed around a six step process. From a systems engineering, basically engineering problem-solving approach here. A website link to it you can see down there if you want to look at it online at your convenience.

It is a fairly straightforward process here that consist of six basic steps. They should not, for most everyone, should seem pretty straightforward. And we will talk about each of these steps in some detail here in the next few minutes. The level of effort required in each of these steps is going to depend on each agencies contractor deployment. Smaller applications, some steps might be fairly simple Thomas straightforward. Other cases, a more complex regional customize design. It might be -- take quite a bit of effort in one or more of these steps. I think as Todd had said, Federal Highways is, for those states implementing the smarter work zone initiative technology application, they are going to need to follow this step or show how they have addressed these steps in terms of meeting their intended goal for EDC three smarter work zone deployment. Let's go through the steps in a little detail here.

The first one, that of assessing user needs. Really, five key things to keep in mind when looking at needs assessment or user needs. The first of course is looking at what are the user needs for a particular project. This actually should be done, as part of the overall transportation management planning process. The idea of being you should not be at this point already identifying, I want to put in X product, smart work zone product A, because that is a cool product. You want to step back and look at what's really are going to be the expected impacts I am worried about. When, where, how are they going to develop. What kinds of things are going to be going on in my work zones that will lead to safety and mobility issues or concerns that I will need to or want to address in some part. Also at this point, you are looking at in addition what are other special regulatory requirements or restrictions on what I can or can't do as an agency or contractor. Specific policies, those kinds of things. And to some extent it may be also looking at the physical capability limitations of the project itself. Am I going to have places to work or is this going to be a project where I have limited right-of-way and my contractor's equipment is going to be constantly in and out and moving around, going to create certainly a user need and from the standpoint of having that space available, to working, would be another example.

Than the next is try to define again technology independent, what would I want to do from a goals and objective standpoint to address those user needs. I would like to reduce the frequency of crashes I think I am going to see a spike in, or I would like to get some drivers to change when and where they are going to travel, move away from my project limits. Or, if it is simply I want to make them more aware, or aware of upcoming slowdowns and delays so they can decide whether they want to stop for gas or a break prior to entering my work zone. All those things come in to there . Agency

policies, stakeholders, identifying stakeholders involved in this or could be involved in this work zone or set of work zones if you're looking at it from a broader perspective. From their you might want to start to make decisions or think about from that group who would be on your project team, to help make decisions and assess options and those kinds of things. When it gets down to further analysis. Finally, one of the key things in the early steps is recognizing and identifying what do I have already within the area, maybe not within my project but possibly adjacent to it, from an existing ITS resource standpoint. Many urban transportation centers operating in covering a significant portion of the transportation network. A project might be not on one of the routes under surveillance, but adjacent to it and I think it would be an opportunity to leverage what kind of capabilities that system has in terms of operating stuff and such things that leaking those, or considering that in the ultimate design, might be a good idea.

We are aware of examples where that was not done in a smart work zone system put in for a project, just outside the limits of a transportation management Center. And while it did what it was supposed to and it worked, -- it worked okay, it was very apparent that was somehow connected or linked in with the TMZ center, could've been much more -- done from a monitoring Sam's point and from management -- monitoring standpoint and from the use of the system in response to unexpected events that occurred and those kinds of things. That is a very important part to consider in that.

From step one, which if you have started thinking out, not the end of the project so much as far as the end of where you want to get with respect to your transportation management solution, addressing mobility, safety impacts of the work zone, kind of a vision of what we want to accomplish. At this point you should also start to have some thoughts and expectations and a direction towards a more coordinated approach. An approach that is connected to the overall transportation management planning for the project or set of projects you are looking at. Step two is the concept, development and feasibility assessments.

Here is where you start to move from I have got some issues and some things I want to try to do to address those issues, to looking at well is the best solution a work zone ITS solution. The concept of operations is one of the first substeps you would do here, try to use work tone -- work zone ITS, steps I will be doing. Communicating certain things, delays, concerns about stopped traffic, upcoming events that I have automatically entered in to a system. Notifications. Those kinds of things. It should be what I will call solution agnostic which basically means you see how information flows, you pick up what information flows will be going where and when and what kinds of actions will be occurring, but you have not decided on specific technologies. And that kind of thing just yet.

Assessments of what you think your benefits will be from this. CONOPS is another sub step. Start to obtain buy-in from stakeholders and other -- basically stakeholders that you will be working with, making sure that folks are on board with the concept. This looks like this is something we will address -- we truly need to address on this project. Starting early on, trying to come up with what -- any potential challenges to meeting and addressing the concept that you can think of. At this point, you start to look at what solutions are available. I think most of you are probably aware that there are a number of standalone -- COTS stands for commercial off-the-shelf product -- basically what I will call the communication system engineering aspects of a particular solution have been done. They are pretty much at a drop-in, configure a little bit and they start to do what they are intended to do. There are also customize solutions, which are more device -- you put them in and develop your concept of operation software. How are you potentially integrate your team would be an example of a customized solution, designing it on a piece by piece of you will. And thirdly, you will see more and more in terms of just third party services either for data or for the development and implementation of a system, sort of an all call basis -- on call basis. Penned -- potential deployment costs and you start to look at the feasibility of an ITS solution at this point. Does the expected benefit I think I might be able to achieve by putting something in is it enough to offset within my standard way of assessing benefits to the cost it will take to the project and at the last, starting to look at the legal and policy issues that are involved or potentially involved by your solution. Quickly here I think an example from the guide of some various types of benefits, different types of systems.

As you can tell there are quite a range of system work zone ITS systems available. Some of them are fairly similar in terms of the types of issues being addressed. But if they are applied in different ways, you can see that there is evidence in most cases of the work zone solution in particular allocation and having real, measurable effects on motoring traffic or other aspects of a benefit analysis. Key takeaways under step two, this is the point where you have reached the point of yes, we need a work zone ITS solution here. At this point one of the key things going to the steps is recognition that it may be good and useful if you have not already, make sure that your ITS staff whether they are in-house or consultants, that you rely on for ITS in general, having them involved in your work zone ITS planning can be beneficial. Because of those potential leveraging of permanent infrastructure you have as well as awareness and knowledge of current data in terms of technologies and systems in place there.

Step three is where it gets into actual nuts and bolts. Again depending on the system solution. A lot of this may be done in large case for you. As you can see here, this step includes defining system requirements and specifications, what specifically does the system need to do and how precisely, how accurately you require it to do that. Those

kinds of things. Testing strategies. How are you going to ensure whether your system requirements and specs are going to be met by a solution and verifying, figuring out how to verify if the solution you have selected is meeting your requirements. At this step you start thinking about what it is going to take for it the operation and maintenance over the life of the project and start planning for that. Staffing, ability to move it to another project. Of those things start to be thought about here. Training, if there is going to be out right -- outreach or a public relations standpoint consideration or recognition of system security and those things planning for evaluation is very important as well as getting more finite testaments of both the benefits and costs you anticipate from the specific design being considered at this point.

A couple comments about system requirements we encourage the effective requirements we have seen in a number of applications across the country are those defining the performance requirements and targets being desired and achieved there are in some cases some needs to specify actual design features but in many cases you've got to be -- if you get to the point where you -- specify specific designs, it can become almost a hindrance rather than an you are not sure whether you are going to be accomplishing what you really wanted to do because you are so caught up in the design elements or design aspects of the system. This can also be, in some cases specifying a particular design feature that really isn't tied to what you really want the system to do from a user need standpoint. An example I would use is if you are going to be deploying some system where you are doing lane closures and you specify you are going to have a sensor system that can monitor fog and rain and snow and all those conditions, when you know we won't be doing lane closures under any of those conditions. Specifying a need for that would be a way to get a triple -- a particular type of product in the weather that has any real value to meeting the user needs your trying to meet the that particular application is always a question. Certainly being able to specify requirements that you can monitor and verify and test in some fashion is important.

We bring a planning early in step three here, because it's one of the aspects of a deployment that typically unfortunately gets overlooked. One wants to think, know how their system performed and what benefits they have got out of the system, lessons they learn so they can turn around and learn and do a better job next time. Lets you start thinking about it early in the process and figure out what you will be -- what you will evaluate how you will integrate lessons once you are finished, the efforts to get something out and working you get to the end of the project and realize you have not got what you wanted in terms of information and your ability to translate the information to the next -- essentially learned from your experience is hampered.

Criteria, an example here when looking at evaluation plans or planning for evaluation, basically what is your objective for the evaluation you want to do, generating a

hypothesis for that objective, identifying what measure of effectiveness would be useful to test your hypothesis and figuring out if I want this measure of effectiveness, what data do I need to have to test that hypothesis or hypotheses. Key takeaways. In this point you should have a pretty good set of documents in respect to what you are going to do for system testing, how this will operate, what the design looks like, what kind of public outreach if anything is going to be accomplished and so on. The effective system plans that are most effective occur when the goals and objectives are measured and stated explicitly early on and what was used to drive the system design itself. Procurement becomes step four. It is a significant question for many users and contractors I've got a plan and I know what I want the system to do I even have the system design, what is the best approach to getting it out in the field and the answer is there is a lot of different ways, it really depends on the agency, type of system type of project or projects you are trying to apply these two. That kind of thing.

You can see the basic steps in this -- particular substeps, assessing what your options are based on your particular situation. Figuring out the type of procurement, mechanism and so on. Basically, the procurement approach is possible. Really you can blend, in a number of different ways, one of the key factors is the type of work on ITS if you are looking at deploying. If it is a commercial off-the-shelf product, and you have written a good set of functional requirements and specifications, and plans are in place that are pretty solid, a low bid mechanism might work well. You get into more customized solutions where the goals and objectives may be well-defined, but the system components and how they are going to work and how they are going to interface may be a little tougher to realize strictly on a low bid situation but again it depends on each agency, the laws and regulations that govern each agency in a contracting mechanisms there. You typically see two general types of procurement methods in place. What I would call direct which is one where the agency itself either owns equipment, buys it or release it and they own it, if you will or in a method where they are paying someone else to put the equipment out there whether as part of a construction contract and the contractor either does it itself or gets a subcontractor or perhaps an on-call arrangement where the consultant has equipment and obtained equipment and gets paid to address, on an on-call basis, the locations and work zone situations that the agency calls for.

There is -- we are seeing increased examples where agencies and contractors are actually able to purchase data from a third party, private-sector data provider for what they are trying to accomplish and use that for works and purposes as well. We have covered basically three different ways we are seeing procurement for works on ITS, for the contracting agency, different perspectives. You of the contracting agency he was trying to or desires the works on ITS to plan and occur on a construction contract project, contractor usually responsible for the overall project and has a lot of other

duties in addition to work zone traffic control and work zone, particularly works on ITS deployment but they still are closely integrated into the process and it is either a vendor or on-call consultant providing this work zone ITS solution.

At this point, a lot of the heavy lifting has been done and we are into the executing of the deployment of the system based on the planning and system design. Procurement efforts that have gone on to this point in the level of effort at this point to an agency will really depend on what options selected at this point. A pretty straightforward deployment, pretty localized. The contracting agency may be doing some oversight and most of the deployment occurs within the contracting consultant vendor area with oversight. Of it is more customized solution, the contracting agency might be much more heavily involved in the implementation. One of the key things during deployment is the scheduling of the equipment and system goes in and gets tested. In most cases you do need to make sure that you've got adequate time systems to first of all test and make sure it is performing the way it is desired and also to calibrate and adjust, as projects move along there are field changes for many assets of the project that can influence a work zone ITS deployment and that adjustment in terms of scheduling and changing needs to occur in this part of the process.

As I think I have already said coordination of the deployment of the work zone ITS needs to occur with other aspects of the project. Phasing and, for example implementation of any other TMP strategies being implemented for the project. It should have a solid plan but recognize it is a process in the plan should include the ability to be flexible, depending on what ever other changes have occurred between the time when the planning process started for the system and when deployment actually occurs. Planning is everything, but plans themselves are often less valuable because of the fact you have always got to be flexible and constantly adjusting.

The last step systems operations, maintenance and adjustment. Hopefully by this time it is set up and tested, calibrated, doing what it is intended to do, having the impact, positive impacts that everyone, all stakeholders had anticipated. So at this point basically monitoring, dealing with changing conditions and continuing to monitor is a key thing to take away from this at this point. There are a lot of cases where systems go in and it works great initially but if not enough attention is made to constantly monitor the health of the system, you see things where components start to fail or become the calibrated and it is not picked up. Suddenly, without knowing it, system performance is decreased which then decreases the level of accuracy or system benefits been achieved in those kinds of things.

Final of valuation, where you plan in step three, conducting it occurs throughout the project but particularly at the end. Incorporating lessons learned back into the agency's overall improvement -- continuous improvement process should occur. So that is the

six steps. What we like to cover in a few minutes is all fine and dandy and I have talked in generalities for my project and situation what would that mean. So what we have done here is we have four examples of fairly recent work zone ITS deployment. What we would like to do's through and show you each one is different but the six steps apply to each of them and in different levels of detail and sophistication. So you can get a flavor of the range of what we're talking about here. The first one is the Callahan tunnel rehabilitation project in Boston. They had to do a full tunnel closure which took out a pretty significant artery for them. They were worried about those impacts and so relied on work zone ITS system to help with that. There were actually a couple of projects in Illinois, rural parts of the state, with the applied work tone -- work zone ITS. The third one I-35 widening in central Texas a 96-mile section, several project segments into it that were -- that have gone on simultaneously and so the concerns about the cumulative effect of the multiple projects as well as the individual impacts on any one of those was a concern in the last one is an arterial work zone project for which some work zone ITS was applied. Averting the arterial to add or building three continuous flow intersections in one interchange and another location where they used a different type of ITS solution to meet what issues they had and solutions they came up with.

As far as assessment of needs, listing here I think the Callahan tunnel project listed in fairly general terms worried about closing a tunnel, congestion both peak periods and off-peak. Not only on the approach to the tunnel but also throughout the corridor, alternative fruits and everything. Those additional congestion concerns leading to safety impacts and how to mitigate those as well as how do we overall manage all the traffic and monitor and nowhere hotspots are popping up or have popped up and how to mitigate those was one of the needs they saw in the Illinois interchange project. Being a rural their area -- rural area the Toledo have congestion. The project maintenance traffic plan did restrict the ability to deal with the traffic that goes to the interchange and their concerns were the unpredictable nature that would lead to rear end crashes when they had high-speed traffic for several miles all of a sudden reaching either due to an accident or doodling closure, a backup. How to deal with lengthy delays that occur when those cues to occur. Similarly in I-35 there were concerns about queues that would form. Is a segment of rural areas in some locations in urban areas as well, how to deal with queues that might occur there. The safety implications but as well localized delays generated and how to mitigate those for more local traffic that typically uses the corridor for short segments. For long-haul traffic travel through the entire quarter, the effect of multiple lane closures on the same night and weekends that could lead to significant delays when you cumulate them over the number of projects in place. And also the awareness of the ramps, frontage roads across street closures was a concern. In the fourth project there the effect of the design-build process and project on overall delays but specifically to certain origin

destination pairs from turning in cross street traffic, left turns really messing up here or through traffic or whatever it is they had a real concern about how the project is going to affect the different movement there. In terms of concept feasibility, both the Callahan and Illinois 57/64 projects opted for commercial, off-the-shelf type solutions. The Callahan one was more of a regional model where they put equipment not only on the approaches to the tunnel but also on the alternative routes so there was information being monitored and provided to travel conditions all around the project itself.

The Illinois one was an predominantly the approaches to the interchange reconstruction area. It was a design that provided advanced warning and queues and for traffic detected and farther out as those queues got significantly longer, delays about the amount of delays being experienced. Some traffic may choose to seek out alternative routes and avoid the congested area. The I-35 project is more of a hybrid type of an approach where they relied on -- considered -- included some direct travel time monitoring throughout the corridor and the dissemination of travel times via that data. The collation and monitoring of all lane, ramp in cross street closures and road closures in making that available to the public and all stakeholders on a real-time basis so everyone can know what is going on, how much longer it will be, those kinds of things.

And then some of you all may be familiar with this project in -- pursued the deployment of a highly portable queue warning system consisting of an off the shelf smart work zone system coupled with portable rumble strips deployed only when and where queues were detected as a way to avoid having equipment out where contractors were working and those kinds of things. Detailed plan and design, I think I have covered this as far as the different components of the system here. Both Callahan and interchange projects use commercial off-the-shelf design from a couple of vendors. The tunnel involved some cameras, portable message signs, probe sensor data, monitoring conditions. I 57 similarly they used traffic sensors that they relied on radar -based traffic sensors on the approaches. Portable signs that would provide a slow speed, delay and some extent encouraging use alternative route messages when congestion levels were reached, certain thresholds. I-35 Bluetooth technology, falling sensors portable change science, you can see the list as far as all in that one. Quite a bit -- because it is a longer quarter, a bit more system involved in our. And the Bangerter Highway because of the need to monitor specific travel movements rather than just through traffic in the quarter, they pursued a Bluetooth monitoring solution. It incorporated the ability of monitoring that providing an early warning that delays were exceeding predefined thresholds, making that threshold or warning available to both the contractor and agency. That is their system design.

Procurement. Callahan had a little bit of both lump sum -- some components lump sum, summit bid as a monthly rental of certain equipment. That is how they got their system in place. The I-64 -- 57/64 interchange was actually described and bid as a turnkey system. In the contract bid documents and the contractor found a subcontractor to help them actually get the system are cured, deployed and operated. I-35 more of a hybrid solution. Be used a university agency as more of the on call for development and operation of the overall system. The end of queue systems mentioned earlier were actually initially change ordered into construction contracts, because the contractors were dictated when and where they desire to do lane closures that were going to be the impetus for the queues that would form. So those were initially change ordered in, and if you as the projects came on and bid, they were actually part of the bid documents. The end of queue systems themselves were procured as a mobilization cost for the equipment and a per night deployment cost. Away for the contractor to better estimate and bid the price for that. And Bangerter Highway was a direct purchase of equipment. But they hired an on call consultant to help them actually develop the system, implement it and operate it during the course of the project.

Five and six, these two steps together to highlight a couple key features of the deployment and operation, maintenance and evaluation of these systems are. The Callahan Tunnel project, if they viewed it very successfully. They relied on either negative comments by the press, the public officials and general public as a key measure of effectiveness. They did not have a lot of that so that was a win for them. They did share access to their smart zone work system that allowed much better network management and a sense of partnership for the entire region in their example. The I 57/64 projects the actually, did during to the employment -- during the implement, initial estimates flexible examples what they thought would happen in terms of backups was underestimated what actually occurred. So there was a need to quickly turn around and add additional equipment into the system to address the magnitude of impacts they saw initially. As you can tell it was activated and used quite extensively in that project. I-35, the equipment itself was monitored continuously. They have had some issues in the wintertime of solar equipment not being able to charge enough because of fewer hours of daylight so being aware of that has helped them be proactive in keeping the equipment up and running throughout the duration of the project.

They do also provide assessments on a regular basis of the impacts of the deployments and the work activities throughout the contract, various contracts to the DOT on a regular basis for general performance monitoring purposes. As far as Bangerter highway, it was a test. A test application of potential for the DOT to institute performance-based specifications regarding work some traffic control in design-build

projects. They did not actually institute the performance-based specs, but the system was used to monitor the latest and the information was -- monitor delays and information was -- because it was near technology they had some issues they adjusted and overcame. Initially the contractor was not as onboard in the beginning as they were at the end they saw the benefits of the data and the ability to be aware of what is going on out there, and by the time the project was over, they were actually asking the DOT when the next project system would be implemented. That is implementation guide and application sub case studies here. I will turn it back to Nicole -- or Todd?

I believe Todd will speak again.

I wasn't sure if we would do the poll or not. Very good. Jerry, thanks a lot, that was a good discussion. The work zone ITS implementation guide is a really great resource. It has a lot of detail in it and really as a tool, it's there to help practitioners walk through those steps. Basically to help them ask the right questions in the course of implementing ITS hardware from the standpoint, do we want to use it at all the first place to take in the solution and finally arriving at the best way to implement it and procure it. Roll it back into the systems engineering process is sort of the ultimate goal. We can move it in that direction, that is what the guide is intended to do. What I want to talk about is a little of the resources Federal Highways developed and can bring to bear to help agencies work with. ITS application deployment. First of all the clearinghouse is work zone safety clearinghouse, the link here, the page links to the smarter work zones, links to our webinars. A description of both the project coordination and technology applications component. As mentioned before, there will be links to the prior recordings for the webinars we are conducting here. So webinars themselves and recordings will be available and accessible to users that want to look at it.

We also have a number of links here. So you can get a hold of the webinar, the links are available to you. The guide itself is available both as a print and electronic document. We have printed copies you can request through Federal Highways. If you go on the link, go to the website, you can get a printed copy or download the PDF which is fine. The ITS case studies is an electronic only document, available in PDF on the website. The smarter work zone initiative is part of a broader strategy for work zone management, which the link here is to the work some management program website. The work zone mobility and safety program website we are calling the work so management team. And finally, the work zone ITS overview webinar is linked below. That has more information as well. All these resources are available. Feel free to download and look at them. If you have any questions or see a need for additional information, please, there is a link on our website to send feedback to Federal Highways work zone management team. Feel free to do so in one of us will get back to you on that.

Next, coming up on the smarter work zone webinar series on October 15, we will follow up this discussion of the technology applications initiative with a quarter based coordination initiative -- corridor based coordination initiative, motivating -- following that will be webinar number 4 which will be focused on specifically cue warning systems which is a special type of work zone ITS, providing advanced notification to drivers to avoid and of queue crashes in a work zone situation. We are also conducting a number of regional peer exchanges throughout the company coming up in October/November. If you see your area represented there, you can contact us to participate in that. We also have a link to the work zone safety clearinghouse. There is the link there again. Finally, if there is any questions or comments that have not been addressed today feel free to drop a note to Jawad Paracha, are work zone project manager and also the lead for our work zone implementation team. There is his e-mail. Drop, note if there is any questions. I guess now is the time. Nicole?

Thank you, Todd. We currently do not have any questions in the chat pod. You have a question, please type it in now. Also, we can open the phone lines. If you like to ask a question over the phone, please press star one on your touch tone keypad and we can open the phone line to ask a question. We will pause for a moment to give people an opportunity to type of press star one. We are also going to bring up to pull questions -- two poll questions that will give people an opportunity to answer as well. Our first poll, please select one of the following six ITS implementation steps for which he would be interested in attending the future webinar. This is a select one. Our second poll appearing on the bottom, please select the following work zone ITS strategies you would be interested in. In attending a future webinar on. Please select all that apply. We will adjust the sizes for everybody so they can see the choices. At this time if you have a question please type it in the chat pod or press star one on your touch tone phone. Just been filled wanted to know where to find the dates and locations of peer exchanges -- Jeff Benfield wanted to know where to find the dates and locations of peer exchanges?

Did you want me to answer the question on peer exchanges?

Please do.

If he visits the clearinghouse website, workzonesafety.org, go to the homepage. If you look at the left sidebar, there will be smarter work zone's. Go down to under project coordination or technology applications, it will list peer exchanges and workshops. The regional peer exchange workshops, noted as TBD right now because dates and locations are still being finalized but those will be filled in over time.

We did have a slide on that at the end we can bring back up to copy those down. Posted have dates and locations for most of them.

I will bring that back up also it is contained in the presentation available for download in the presentation share box. Again we will give it a few more minutes if anybody would like to type a question in to the chat box or ask one over the phone please press star one on your phone keypad and we will open up your line. We have a question on the I-35 project, has any evaluation been made to determine end of queue crashes have been significantly reduced or eliminated?

Good question, yes we have. We are actually in the process of finalizing a fact sheet that should be available soon. We look about over not quite a years worth of nights where the systems were deployed and about the same number where they weren't accounted for. Differences in the court or, volumes, expected crash, injuries, we saw -- our data suggests the crashes were reduced up to 45% for the way the system was deployed which was where we thought there would be a few forming or whether the announcements would suggest. And of queue would be deployed in conjunction with the traffic control for that night lane closure. A fairly significant crash reduction we saw.

Thank you, Jerry. How close are we to the 35 state goal? I think that is for you, Jerry. Cement actually think it is more of a Todd question.

Todd?

I think we are maybe about halfway there as far as getting a number of states that have indicated an interest in doing the technology applications side of smarter work zone's. They are about an even split of folks looking to implement the policies versus those actually implementing the hardware so the goal 1A and 1B. There is a lot of interest out there as far as achieving our goals, it is a matter of getting everybody to develop their implementation plans, figuring out a project for focus project for what they want to do, with their schedule is, what their anticipated project objectives and getting an implementation plan on that so we can start documenting their progress toward achieving the goals. And there in there is any questions on how to develop implementation plans or what specifically we are looking for in that regard, that is definitely something you can let me know or send an e-mail to Jawad Paracha and we can walk you through the process for that. I all means, if you need more information -- by all means if you need more information don't hesitate to ask.

Another question. Any additional information about the automated lane closure system mentioned?

We can. I don't have anything I guess available to send out right now. There are a couple of presentations about the I-35 construction traveler information system that would highlight the process itself. That would be the best place to go to that. If you go to the clearinghouse and look under the technology applications side of things, look at -- I believe it is under the guidance documents or section there, there will be at least one or two on I-35 and have some information on it.

I still see people typing in to the chat box a we will pause for a minute. There is another question. Jerry, in terms of public leverage, has any data or surveys been completed the indicate work zone ITS is something that is viewed favorably by the public? and if so, where could we find this information?

There happen. If you go to -- their have been if you go to the FHWA website Todd mentioned in his presentation, you go to work zone ITS information on the link there a number of reports that have -- evaluation reports have been done several included customer satisfaction, customer utilization surveys. They typically indicate this information was indeed useful. I thought it valuable, those kinds of things. I would encourage you to go crews that -- peruse those documents for examples you might find helpful.

Thank you our next question actually this is a comment, they have done a good deal of work with public servers available on the website in ITS area.

Good point.

Again we will pause for a few minutes I see people typing in the give them time to get there questions into the chat box. If it's easier, press star one on your touch tone keypad to ask a question over the phone. While waiting for the questions I will remind everybody that the recording will be available online in the next two to three weeks and I will send an e-mail to everyone who has registered, once it is available. Also the next smarter work zone's webinar will be held Thursday, October 5 team. The topic is smarter work zone's court order based coordination. -- card or based coordination. He will send an e-mail to every once it is available. At this time it does not look like any more questions are being typed into the chat box so I will wrap things up. Again look for the recordings available in the next two to three weeks. Registration for the next webinar. I want to thank our presenters for presenting today and for everyone attending. -- one last question -- winky warning strategies are addressed, what is the baseline coordination use? For example is the preconstruction condition the baseline or is it the construction pre-queue warning condition use?

For the assessment I talked about on I-35 it was the expected crashes during a queue without an end of queue warning system, compared to the actual crash experiences

during -- when the queue system was displayed when there were queues. I don't want to get into statistical details but there will be -- we have submitted ATR be paper that goes through that methodology in a little more detail. But that is what the 45 percent reduction is based on what we think would have happened if we had not used in the queue warning systems at those particular locations in the analysis.

Thank you again. It does look like we have concluded with our questions in the chat pod. Thank you, everyone for attending. Please enjoy the rest of your day.

This concludes today's conference call. You may now disconnect. [Event concluded]