

Event ID: 2788431

Event Started: 11/12/2015 12:23:56 PM ET

Please stand by for realtime captions

I would like to welcome everyone to --

Good afternoon or good morning depending on where you are. Welcome to the webinar series. My name is Nicole Coene. I do want to let those of you know who are calling into the teleconference know that you will need to mute your computer speakers. Josh [Indiscernible] and Chris Rex -- as a member of the [Indiscernible]. Todd Peterson promotes adoption and [Indiscernible]. Todd is a licensed PE and a certified PPL we. He received his Master's degree from Virginia Tech. Josh [Indiscernible] graduated from [Indiscernible] University in 2001. And started with the Utah Department of Transportation...Josh is currently the project control engineer for the state of Utah. Supporting construction crews for cost and budget control as well as the project whenever for the cloud base construction software of Department of implementing. Chris is Department of education has been at the department for seven years he worked in the University region where he gained. Chris is a member of the FHWA every day smart account works on team. He has a bachelor's degree and civil engineering. Today's seminar will last 90 minutes. 60 minutes allocated for speakers, and 30 minutes for sessions. If you think of a question you can type it into the chat area. Send your questions to everyone and indicate which presenter your question is for. Presenters will not be able to answer questions during presentation. We will answer questions again at the presentation in addition of time allows we will open up the phone lights for questions and comments. The PowerPoint presentation is available for download in the right-hand box at the lower bottom of your screen. I will notify all attendees once these materials are posted online. HW a does not certify participation on online education courses for continuing. Please contact your professional certification Board for recording requirements. Your registration confirmation is your only prove of attendance we will be able to provide. I am now going to turn it over to Todd.

Thank you Nicole. Good morning everybody. This is the six webinar. We are going to focus on variable speed limits. We have had five webinars to date on this. Both from project coordination and technology application site. These materials and recordings from prior webinars are all unavailable at the link at the bottom of your screen. We also have two more coming up in our schedule series in December. Those will cover project coronation -- coordination if you have not been attending each of these and you do not know what technology application is we will discussed in a minute. We are going to dig into some examples on variable speed limit applications. And dynamic

lane merge applications. The smart work initiative is something that the federal highway got started up with third round of [Indiscernible]. This is a program to accelerate innovation among states for innovative technologies. For smarter work sounds we are really trying to focus on promoting policies, and practices to improve work some operations. Reduction of delays, and reduction of crashes. The way we are approaching that is through two areas. One is project coordination which is the pro active management of projects to minimize the collective impact of work sounds on safety and congestion. The other half of it is technology application which is works in ITS and is geared towards managing dynamic management of works on traffic impacts. Those types of technologies both for better guidance to drivers and better communication of data and current status back to the agencies running the systems. As far as EDC is concerned we are working through a couple of state goals here. By the end of next year we have 35 state DOT is incorporating is this processes for deployment of work some ITS on their projects. That can be based on the works of the ITS implementation guide. The second goal is, by December of next year we will have 35 state [Indiscernible]. Those are two goals. We are always looking for anybody that is interested. We will take as many people as are willing. To the topic of today's speech on are able speed limit and dynamic lane merge. Those are two components to the technology applications that's target specific meets. Variable speed limit you have probably heard of. The typical application of a variable speed limit is maybe a time-based thing. Where there is some peeking during commuting times. The speed limit drops accordingly. For this application it is a little bit different. We are wanting to use a series of BLS systems to both measure the speeds that are happening downstream, and relay that information back upstream to variable speed limit so we can convey -- the conditions that are happening further downstream. If there is a slow down a streaming to it works own the system is picking up a work some -- sewn. There are two different kinds of yes else you can have. Advisory units, and that can depend a little bit on the local regulations whether a state has provisions and its legislation for enforcement and variable speed limits. What you use and what is appropriate might just depend on the law in your area. There is the dynamic BSL's which are actually based on information collected in the field. Versus those that are [Indiscernible] to a time base. Some of the benefits of variable speed limits are the reduction of crashes. One of the biggest contributed to crashes is speed differential. If you can target what is causing differences in speed and encourage the harmonization of speeds from a higher speed condition to a lower speed condition you will reduce those local speed differentials, and thereby improve your safety. We are trying to anticipate where the congestion is going to be downstream. And to provide guidance and enforceable speed limits to drivers. That is the basic concept behind variable speed limits. Dynamically merge is another similar tactic that takes a different approach to smoothing down the interaction of traffic on the approach to capacity constraint conditions and it works own -- zone it encourages traffic to either merge

early or merge late. The speed be used in two different situations. In a low-volume high-speed situation, if you have capacity constraint such as a link to her, upstream of a work some, you will have of the traffic that needs to move into a single lane you want to encourage those merges to happen early. If you have the high-speed traffic and you have people coming right up to the merge point they have to make a high-speed last-minute lane change without any time to react. That is a dangerous situation. When you have those higher speed and higher volumes you want to encourage that early March. And a higher volume lower speed situation you want you have the opposite problem. Too much traffic lots of people bunching up, but what you don't want to do is you do not want to have everybody cram into the 19 the 192 early and have a real long queue. The best way is to use those lanes right up until the merge point. That way there is no question about the right away and things like that. That avoids a situation where you have high-volume and a line of traffic with people decided to merge over early, and another population of drivers that say I will just use this open lane until the merge point. Then the people who have moved over early get mad because the other people are budding and line. It reduces frustration and provides clarity that makes everything go a little smoother. With that a brief introduction I will turn it over to Josh who is going to tell us a little bit about what Utah has been doing with their SSL development.

Thank you Todd. I will spend the next couple minutes what we have done, and where we hope to be going. Like Todd said the SL can have two different applications that static assembly and also the endemic assembly. We have done some static assemblies. I will explain those in a minute. I will get into how we are moving toward the dynamic. The goal of variable speed limits has always been to improve safety for the construction personnel and the traveling public. You will notice at the word significant an active work sound -- zone. Those are the keywords for me. Utah has a lot of 80 mile in our roads. We have been reducing speed limits on these roads in our states down to 45 or 50 miles an hour. A reduction from 80 A reduction from 8270 that is still a fast-moving semi-when you only have a barrel between you and that semi-. In the active work some it's that public understanding that you are reducing that speed for a reason. Think of it as a schools on. Schools alone zone are effective . They only reduce the speed when kids are going and leaving school. If you use that concept in a construction zone reducing the speed limit from 8254 a 10 mile project where you only see one crew working at mile nine you have lost that confidence from the traveling public. They need to see the reason why they should slowdown. The confidence of the public of why you are doing this. And that the speed limit is actually there for a reason. You can set the speed limit to whatever you want. What you care about is what people are actually driving in the work some. That is why the word significant an active are critical in our goal. Some of the concerns with [Indiscernible] we have looked primarily at projects where queuing is not a risk. This is our static

assemblies low-tech. If you have roughly 1800 vehicles for our, per lane and no significant grades you have a low risk of queuing. We have analyze speed harmonization. Like Todd mentioned speed harmonization is really important. You want basically all the vehicles going plus or minus 15 miles per hour from that [Indiscernible] percentile speed. This has been an important metric for us. That a car is not approaching at 50 miles per hour faster than the car in front of it. Research shows that plus and minus 15 is reasonably unsafe. Because we are changing the regulatory speed and needs to be enforceable. We need to know where the sign is located, and what the sign was displaying an ever given time and those changes. We haven't been challenging [Indiscernible] to date on enforcement, but we have all of the data and hopefully we never do, that if we do we will be ready. Those are the three big concerns with PB SL's. We have done this now on our static assembly on five different projects. They are primarily in southern Utah. You can see the picture from the bottom. This is from when they maintenance crews took it out. They were doing some patching. It is not the greatest pitcher. You can see that it is a standard lack on white sign. That is freeway size, and it has 18 inch numbers on it. It is not [audio cut out] single axle trailer. I have move these trailers by hand. They are pretty light. They are about 500 pounds. 5 foot mounting height so they meet all any [Indiscernible] requirements. It is a portable variable speed limit sign. These signs you do need to change them. You can do it via a modem if you are in cell service coverage. Or you can do it via Bluetooth. If you are in a 50 foot window within -- with your laptop. If you enter a pass code you can go in and manually change the sign. And all of these current projects each side would manually change by somebody on-site. I just want to talk about the beaver Ridge climbing lame projects. This again, the crews were moving the trailers daily and manually changing the signs. It was originally posted prior to the work some. It was posted at 80 miles per hour. At the front of the works on they dropped it to 65 miles an hour. I personally went out and did a couple of spots bead studies on two different dates. 500 feet downstream from the trailer we have percentiles of 67 miles per hour and 70 miles per hour. They are in success of the 65, but even a 10 miles per hour reduction is exciting. They are doing some structure work where they were not working behind positive protection. The traffic engineering order that the project was issued allowed them to drop the speed limit to 45 miles per hour for that -- about a third of a mile. Upstream of the structure once they got across the structure it went back to 65 miles per hour. That was a very short distance. The 85th percentile was 50 mine -- 51 miles per hour. Getting people to go from 80 miles per hour to 50 miles per hour is a significant reduction. The important thing here is we have that speed harmonization factor. As long as you are plus or minus 15 of the 80th of the 80th percentile you have a relatively low risk of rear end accidents. On this particular example it was plus or minus 12 miles per hour. Within 15 Within 15 miles per hour I felt great about those results. The interesting thing is this is actually the high-speed harmonization number we have seen for any of our spot speed studies.

Pretty much everyone is proceeding through the work some at relatively the same speed. I thought these were great numbers, and we had this for all of these projects. I have scores of data points that did not want to bore everybody here. This is the proof that people are slowing down, and they are driving at a space speed relative to each other. This is really positive for us to see these results. That is where we are. Where are we going. Obviously these simple static system, the manual entry, and works so now we want to take it to the next level and get to the dynamic system that Todd was talking about. Back in May 2014, I applied, for an eight grant and we were awarded just over \$775,000 in December 2014. Grants require a 20% state match which of course we came up with. We have total project budget of just over \$900,000. An important note here aid grants require implementation within six months. They were okay with not doing our test projects until next summer, and extending that six months out. Anybody who is aware of those requirements we did get a little bit of a variance on that partially due to the time it was a boarded -- awarded. [audio cut out] we do not get a heck of a lot of meaningful construction done between Halloween and March 15 for the majority of the state to be completely honest. We were awarded the eight -- aid grant December 2014. In June 2015 Kimley-Horn was given notice to proceed. They have Avenue consulting as one of their subcontractors. This is one of the local firms that helps me with [Indiscernible] and our simple assembly. Project objectives, again, we want a portable and dynamic system. We will test to projects and 2016. Look at our results to revise our specs. Test on two more projects in 2017, and bid into future projects after that. After those for projects we can see our results, and understand how the system works ultimately the department does not want to be in the equipment rental business. We want our contractors to secure this equipment, and running in the field. We should not be renting equipment. Goals and objectives, we have two main categories, we obviously have feel personnel and that we have borderless -- motorist. The system needs to be simple. The basic assembly is missing. A requires some of you to go in and manually do the work. We talked about speak compliance. Do workers legitimately feel safer out there because of this technology. The system needs to be simple. You need to be able to set it up and change the speeds. You do not need to be a electrical engineer to set it up and operated. It needs to be simple to learn the technology. It cannot be to come located. The system has to be cost effective. If it requires \$1 million to set this up, it is really going to be is on projects, it has to be cost effective and simple. From the public standpoint we need to reduce the number of crashes within the works on. The public has to understand why we are doing it and be okay with that. We recognize we have a pretty significant TI component associated with getting that compliance. The links for which the speed is reduced we talked about 10 miles per hour example. That is a real example that we have here in Utah. It was a disaster for confidence within the public, it probably got the support I needed for my [Indiscernible] project. Of course every motorist is delay worried about delay through the works on. [Indiscernible] system that is actually more

internal and making sure the system is functioning and does not have its own little glitches that required to be turned off. Needs and wants of a portable BSL system. I specifically change the word need and wants. I recognize that this project is incredibly prone to scope [Indiscernible]. We need to adjust the speed limits based on the detected speeds and [Indiscernible]. We need to provide real-time detections so we can actually generate those recommended speeds. We need those in the active workspace and in advance of the workspace. We did to provide the notification [Indiscernible]. Let them understand what we are doing and what the anticipated delay is. If they understand why we are doing something that compliance will be so much better. I go back to the school zone example. Once, these are things if we have the budget we will incorporate, but then again they are not required for the system. The ability for surveillance and monitoring capability and the works of, and also [Indiscernible]. We just had a pretty decent snowstorm here in Utah on Monday. In the works of many of our construction managers would have liked to seen the rate at which it is snowing. Need worse versus wants. We are utilizing the system engineering process. This is pretty standard as we are going to these processes. I will talk about each of these sub five bullets in more depth. Obviously you saw in the previous side our goals and objectives. Our operational parameters and limits. Stakeholder roles and responsibility matrix, operational scenarios, and user and system needs. Parameters and limits. This seems pretty obvious the increments that you would raise and lower the speed. You are probably going to do 5 miles per hour. You do 10? Could you lays the speed limit from 45 to 55. This is where I have required a lot on our traffic and safety people within our group. The frequency of the posted speed changes. If you have one slow-moving vehicle should you change the speed limit for the entire works of based on that? No you should not do that. If changing the speed limit every two minutes appropriate, is a five minutes, or is it 10 minutes. We are leaning on the 10 minute range. We need the ability to set the works zone based on prevailing conditions. Are there other hazards that would require a user override. Basically something that the system does not know that the construction manager of the crews and contractor see out there. The spacing between the signs. We can set these signs up every hundred yards down the length of the 10 mile project so they never had be made. That is not really cost-effective. We are trying to find a balance between [Indiscernible] use, and balancing the cost with it. That is unique to the type of project. We have really been looking at that. Also BMS communication. A good -- we are developing basically [Indiscernible] messages that we can push to those variable message signs so the motorist understand what is going on. Basically you just hit select option settings. Getting good information out to the public is one of our big goals of this project. This is a pretty standard set up detail sheet that we have use. Many states look identical. You can see that left most circle above it is a W dash three 3-5. We have added the option of that notification being on the VMS sign as shown in that circle. We have also gotten approval to use its black on yellow sign that

basically says variable speed limit ahead. That is not reflected on this detail sheet. And that red circle, we are showing the PBS sign at the end of the [Indiscernible]. That's an can also be upstream again with the associated warning device if you want to do -- 4Q detection. In this situation this gives details of where that Debbie you-3-5 sign. We have some basic detail sheets. The square and the lower rate scare -- right side. The contractor or the department needs to move the signs with the active work signed. For candidate projects the projects we have done to date have been low-volume, low risk, rural roads, you need to be careful. Anything untested you generally do not try in front of the capital. Because of that confident in these more rural settings we are ready to go to higher profile roadways. We are stepping it up into higher volume roadways. We are looking primarily at four-lane divided or three or four lane undivided roadways. With single or dueling closure. If you are looking for significant speed reductions it is that 70 mile-per-hour or 80 mile-per-hour roads that we will get the best bang for our buck we have some higher-speed roadways that go through mountainous canyons. Limited sight distance with significant horizontal and vertical curves. That is where we will start with. A good example is roadway resurfacing, slab replacement, and patching projects. Slap replacements are really great projects because you will have link closure is for significant length because of curing slabs. You may only have a at that is Jack Kemery or removing a slab in one portion. This is a great tool for projects like that. Some of the feature VSL considerations. Higher profile roadways you generally shy away from. More complexed sight distances, and more curves. We need to make sure that the system works. I need to take some of these variables else out. We would use the portable VSL finds. We have eight of those that we have [Indiscernible] already. That is not to say we are the manufacturer. We have been very happy with their products, but again as we are putting this additional burden on the system we may need a more robust device. Portable variable message signs, we talked about the importance of that PI interface. We need to have modem capability so we can change those signs as needed remotely. Mainline detection by lane. You cannot be dynamic if you don't know where traffic is doing both in zone and upstream. We are trying to figure out what specific devices. We have a list of these. For this test project we are going to rely on cellular communication through an off-site computer. What you start putting a computer on-site and using radios you start worrying about how we need a generator to run the. For us we will be limited by areas of the state that have cell phone service. We would like to get remote weather information systems or CCTV's included. We will have to see how we are on our budget. I do not want to spend too much time on this. You can see that our site control system, we will collect all of these status device -- this will make recommendations through the variable devices. And this first phase we will have this site control system basically send a text to the on-site person. The system will say recommends changing the speed limit to 55 miles per hour . Replied yes to change speed limit. We want a human and it. That is a safety net for the first two projects that we have committed to.

If everything goes great we will continue with that. Out of the gate I wanted that safety net ultimately the system will just perform that task for you. This is simply the enforceability login the device location and what the speed out was. That is tied with the central archive. Typical signage, this again, is the schematic of the signs we would have. There may be VSL science upstream if you're anticipating queuing within your project. It would repeat that regulatory sign and another upstream. You can see that detection by link component here. A downstream set up, again, this is in a longer works on. A speed reduced at the head of the keeper -- caper. This is where we are looking at going. We have are [Indiscernible] report and draft right now. We are actually getting together to assemble the contact group of state employees in conjunction with our [Indiscernible] partners. We will talk about the pros and cons of using a system together versus looking at a single vendor to provide all the devices and the algorithm. Methodologies have their on we will decide that today. Hopefully a late-season project. We are on track and on budget. We continued to see simple set up. The fact that our maintenance guys have embraced it in conjunction with our can -- construction guys. That is the real proof in the putting. They feel that the system is simple enough today that they want to keep using it. That is why we are going to phase 2, and trying to implement a dynamic system and taking this to the next level. We have had great success with it. That is where we are and that is where we are going. With that I will headed back to Nicole.

Thank you. We will go ahead and pause for a moment to answer some questions, and to do a couple whole questions poll questions. Is your agency considering use of variables the limits and work sounds? If you answered yes is your agency considering using regulatory variable speed limits or advisory variable speed limits? If everyone will take a moment to answer those questions that would be greatly appreciated. In addition we will start looking at the questions in the chat box. Are the speed reductions done with the regulatory signing or advisory?

We have decided we are going to go regulatory. Again I wanted some [Indiscernible] in this. You may have noticed in my introduction that I spent the first 12 years of my career as a construction manager in the field. This is a pause on a project that is very near and dear to my heart. I am a huge component of doing regulatory. Everybody is better than average. Advisory signs, everybody says that just applies to low average people. I can drive faster than this be limit. To get that compliance regulatory is our best bet.

Thank you. The next question comes from [Indiscernible]. Have you contacted Dr. Jerry [Indiscernible] on TTI of dynamic language. We have worked with him on a number of document projects.

I have not talked to him. I have had the opportunity to meet him. We talked a little bit about that process. Guess we have been in touch. Extensive discussions now. I am hoping to run into Jerry in the near future, hopefully next week at the smarter work some [Indiscernible] exchange in Colorado. If I do not see him there I will definitely give him a call.

Todd Foster would like to know do you intend to use Doppler or side fire microwaved attention or a combination? Doppler has inclusion issues and microwave has a temper setup configuration.

That is a great question. The short answer is we are going to be ready to use both. And spec out which one is appropriate for the projects. If we are on a two lane divided where were we are going to close one Doppler will be just fine because if there is only one main then you cannot have inclusion problems. The side fire what you do not have a inclusion problem it is a pain in the butt to set up. They say it will work at a six-foot offset, but that is not really preferred. The real accuracy is at 20 feet. That you have this device either significantly off your shoulder. If you have a drive off there you have problems even with side higher or you have it in the middle of your construction works out. We are taking both factors into account. We would use whichever one is better for the specific project. We have looked at all of those problems, and recognize that has to be a combination of both because of the inclusion issue.

Have there been any citations issued in a BSL VSL zone , have they been challenged in court?

We have any citations issued. We are up to a couple hundred days of the claimant. None have been challenged in court. Part of that maybe because we have interstate because we have Interstate 80 through a mountainous region where they are using VSL for weather. It goes over a mountain past. If you are familiar with the pastor goes over 7000. A lot of the traveling public is aware of VSL. Putting them in a construction zone, this is not the first time they have seen it, for many Utah residents. That may be a part of why we have had less challenges. To date we have not been challenged, but we have tons of citations that a been issued.

Is there a history or a log of what regulatory speed limit was in place at what time, and location?

Absolutely. And are simplified system, sadly I have to go to two places to go get that information, I get the GPS location from one device and then I get this change log from the actual system. And the 2.0 system we will be able to just pulled those two pieces. And how are simplified system we do have it in two places. It does correlate,

and I have tested it. The enforcement was a big deal when I worked with our local law enforcement. We actually have a great relationship. I have no these guys for years. I have worked with many of them for 10 years before we even started this working with Sergeant. [Indiscernible] and Lieutenant. [Indiscernible] they have been great. They have a lot of really good feedback for us. We have been really good partners forest.

Do the crews feel safer with the use of VS signs?

Yes they absolutely do. It is gone to the point where there is one created that will not give up some of the signs. They are not actually bears they are the regions. They keep calling them out on all of their projects. Yes they feel safer. Phase 2, I really need these hard numbers, I want statistics that show that is safer. The bottom line is the reason we are going to 2.0 is because the crews feel safer. I have sat down with both contractor personnel and our internal you.people, and they think there is a lot of diet to reducing that from 80 miles per hour to 50 miles per hour .

To enforce regulatory VSL you create an incident fight issuing citations on-site, any thoughts?

Will we partner with are you HPE counterpart and we will have them there so we asked them to come out we specifically say are they there for enforcement or for presence. We have found that when you see read and blues people slow down. It is instinct for every single driver. I think everybody is the same way. With that being said we have asked them not to issued a citation in the reduce speed or if they are doing it get the person downstream a little bit. If someone is seen someone pulled over that help -- helps with compliance. It is another vehicle on the shoulder but we do need to be ready for it.

How do you get by and from law enforcement. California vehicle called -- code.

I just Randy you HP. They were for it from day one. We have a legislation in place to use it. To be honest I kind of got lucky on that one. The officers definitely see the benefit of the reduce speed through the work zone. We use officers on a lot within our work sense. We pay them to come out for enforcement. None of those statistics were taken when you HP was on-site. That is with out UHP present. They are in harms way just as much as the construction workers. Of course they have a bumper behind them but a 80 mile a 80 miles per hour semi it doesn't matter if you are in a dart's charger Dodge charger.

We want to give Chris enough time to do his presentation. I will turn it over to Chris.

Thank you Nicole. This is Chris Brooks. I am going to talk to about Michigan's experience with the late merge or commonly referred to as the zipper merge. Why look at dynamic merges? What we found in this traditional merge is that you can see traffic blocking of [Indiscernible] and one name. You get the stragglers, you can see the vehicle trying to keep individuals from passing them. Or you have the renegade trucker that fills the need to block that lane and stop that traffic from passing. It really does cause backup. Those are the things that we wanted to try to improve upon by using queue detection. In the capacity of the volume of the roadway is going to dictate whether you do the early merge or the late merge system as Todd [Indiscernible]. When we started looking at these some of the concerns that we had and Michigan work driver confusion was one of the big ones. People are creatures of habit. They like to do the same thing over and over again. What message are we sending them, and having them do something new and works them we wanted to make sure we clearly conveyed that point. The frustration at that merge point. Some of us did not learn how to share. Some people think they are more important than others. When you do not take turns you do get that frustration at that merge point. When we make matters worse by using the system. Would increase the delay. You have to be willing to take the risk. And take the risk -- look at a new system. We had a construction project on a segment of I-96 which connects -- connects to major hubs. This is a heavily traveled quarter at a.m. and p.m. peaks. As you can see there is not a whole lot of alternate routes. You are pretty much going through this section. When we did this we tried various mitigation measures. Len looked at doing the work with only weekend closures. We looked at additional alternative route messaging. You can see where the red pens -- pins are. We even tried to do the active work at night and allowing the curing during the day. This did help, but we still had extreme delays. One of the last things the office tried to mitigate the delays that were occurring is the late merge or the zipper merge. What we do for this? This is kind of what our normal typical layout is for the signs. As you can see here we have a number of people -- P CMS signs. We added these boards and we put the more -- message boards out there. We do not have sensors to make this a true dynamic merge system. It was not dynamic because we did do this last minute. From that standpoint [Indiscernible]. What happened when we put the system out there. There is a heavy commuter delay going from Grand Rapids to [Indiscernible]. Into fashion the Grand Rapids cover the projects and really focused on it and it was all over the news. The Lansing area do not get the media push that we were hoping for. Huge media push and Grand Rapids not so much and Lance Lansing. To give you an idea if you're not seen it here is a picture from Minnesota. This is what you want the system to look like. You want to's both lanes of traffic. What we did find is in the eastbound direction with the traffic leaving Grand Rapids and going to Lansing where the media push was covered in the motorist knew what to expect, we had a 10 mile average queue length for a weekend link closure turn into less than two hours as you can see from this map here. The far left

here with the existing condition with acute starting at the top and traffic backing up down the page. Versus the far right one with the zipper merge, we went from. Going to the westbound direction the [Indiscernible] Q LDAP was here in the link closure with their. Some of the link closures do not move. As you will see here in this right one we have the zipper merge you see this great out area. We had an incident or crash take place in our work cell. The semi was rear ended because he did not follow the sign. What our conclusion was without the media coverage the Lansing driver did not know what to expect. They were driving a status quo which should -- did not really make this system effective. In the PM peak for Grand Rapids traffic returning we did have little to no build up out there. We do not know if that was tested to people thinking that the freeway was still closed. Unfortunately, we only have one weekend on this project because it was a last-minute ad. As you can see here there are some other ways to explain the data. Eastbound delays were reduced from 24 minutes down to three minutes over existing time. As you can see here the green line is the traditional merge we can closure, and some of the P times we would see, and the yellow is the weekday closure. There is a little bit where it got to capacity, but we do not have the cube build that up. As you can see did not really get the improvement. As you can see with the blue line drops off we did get that freeway closure. It was close from those two points right there. When he did open backup we really didn't see the build up in the queue that we have before. That definitely was a successful deployment. We wish we would have looked at the sooner and done this earlier in the summer. Our next time we were out in this area we had some bridgework and major projects that were going to take place on I-96. The original method was 24 seven closures. Let's try the zipper merger again. Due to some funding issues it switch to -- we are still going to need some closures on Friday and Monday. The contractor came back and said I can do the work from Friday 10 PM to Monday 5 AM. That was wonderful. It removed the need for us to have the dynamic system out there. We just went with the standard static zipper merge. The traditional weekend we were seeing about 5 to 10 minutes of additional people to delays. The first weekend we had the zipper merge out there. We increase our normal delays I two minutes. It was not necessarily the best example, and it was not a huge success. The reason for this was the work was last-minute. The contractor was not sure with whether, it was limited coverage, and there was not much public notification. For the second weekend of work we also went into some modifications as that instead of using our normal typical let's try removing the information of the left link close. This is great during the day, but the reason you want to use the dynamic system. That is why you want to go for the dynamic system over the static system. That was not what our initial goal was due to the scope change of the work we went with what we had. What happened on this weekend was we increase by in other to 23 minutes two to three minutes. That their weekend we said let's get the media back on board. The media picked up the story. They created their own diagram and went with their own how to. Instead of just

removing those left-wing closure signs we created the sign [Indiscernible]. To let people know what was going on to help increase the awareness. The media really like this. Once we did that we had a decrease from our average of one 1 to 3 minutes. In this link closure there was a break in the weekend between the second and the third link closure. It was not consecutive. As you can see the colors and the reduction of the speeds was is not as great as both of the speeds. The zipper merge benefits it reduces speed differential between the two open lanes in advance of the lane closure . It does reduce the queue length. Reduces the frustration because it does not code the tickly -- delay. Ultimately we did see the reduction. We would have liked to have that dynamic system out there. That way later in the evenings we would of given the information of what Lane to use. With that I will pass it over to Todd Peterson.

Thank you Chris. What I want to point out here is a different case than the zipper merge which was a primarily late merge example. The Marilyn Lane merge example is set up to be a dynamic system that alternated between the early merge in the late merge system. It is a little different application. It is a little bit more on the dynamic sign. It is designed to be useful for all traffic environments. The testbed for this project was a segment of on-83 which is a north-south freeway of Oldsmar Baltimore Maryland. It is heavily traveled, and there is good solid traffic volume on here. In this case it is a four-lane divided freeway. It was a two to one type merge. The right lane closure with work and one direction. Again, the traffic is very peaky in this area. That is the type of situation that we are dealing with here. That warranted a dynamic system that was designed to handle both conditions. The way this system was laid out is it combines the standard signing required for Burke a work zone for [Indiscernible] that were designed to display the message is depending on if they were directing people to take an early merge or a late merge. This test in this example here is showing basically an extension of the late merge example. This weight apiece CMS board are not in conflict with the road signage but they provide a supplementary guidance. It gives the guide -- driver direction. The algorithm that the system was designed to operate in it is a similar example to demonstrate the changes in traffic volume. The system is designed to work with a series of different algorithms. It can be an all in or all off type of situation. Using both lanes although we up to the merge point. Or encouraging an early merge. It can also be set to a dynamic reading telling people to use both lanes of to a certain point, and then encouraging a merge based on the volume. It could be set to a time-based situation where in a certain time of day it would switch from one mode of operation to another. It could go from eight early merge type situation to a late merge example. The same pattern could be carried back as far as you needed it depending on the anticipated length of queue. The evaluation that Maryland did for this particular implementation, it utilize both a manual data collection component and a simulated data component. The reason for doing this is they were able to collect manual data for a note dynamic merge condition as a

baseline. Once the dynamic merge system was in place they wanted to be able to compare the observed conditions using the dynamic merge to what they would have had at the dynamic merge not been installed. What they did was they set up a simulation model based on the baseline and calibrated to the baseline based on the manual data collection. The simulation could then be used to model what would have happened given the initial inputs of how much traffic is coming into the works on. They could model anticipated measure of cues for a theoretical note dynamic merge condition for days when they DLM was not an operation. These results are fairly promising. Through input increase significantly in ranging from nine 9 to 34% depending on the day the system was in place. These are manually counting the traffic -- as compared to the simulated throughput based on the calibrated model and the new control condition. The maximum queue links show a similar promise. There is a significant reduction of the queue length. The typical cues without a dynamic merge running up to 1 1/2 to 2 miles. These are kept down between 15 and 20% with the dynamic Lane merge. As Chris's example pointed out the other important element is the uniformity of traffic conditions between the two lanes. It's the question of speed differential, if you have a lot of traffic traveling in one lane at a low speed, and another lane traveling at a high speed there are a lot of safety concerns. The dynamic Lane merge showed a significant improvement in uniform Lane distribution relative to the situation without the dynamic Lane merge. That was another positive finding of this experiment. That is another example of a dynamic Lane merge. What I would like to discuss now are some of the resources that federal resources have prepared. The first [Indiscernible] we have a lane under clearing [Indiscernible] that links to all the tools and publications and guidance that we have prepared to date on the smarter work zone initiative. If you click on that lane you will see links both to the project coordination and technology applications. Each of those will lane accordingly to some of the various tools and techniques that we have discussed today such as variable speed limits and queue warning systems , and dynamic merge, and there is also links to all of the webinars that have been recorded. If you're looking to go back and catch up on some of the webinars if you have not seen them they are accessible through the site. We also have the ITS implementation guide. It was published in January 2014. It lays out a really good approach to implementing work some ITS. Starting with the assessment of need. This goes back to things both Josh and Chris pointed out. In terms of trying to identify what are the objectives of the system. What you want to accomplish so when you go to the trouble of spending the money on the system and designing it that you can actually save what it was intended to do. You can measure how well it serving its intended function, and you are getting your value for the money you are spending on it. Going to some of the questions that Josh proposed as far as an agency, do you buy the hardware? Dubai and rented out? To expect your contractor to have it and deal with it themselves? There are a lot of different options there. Going through those steps you end up evaluating the effectiveness of the

system. That feeds back into what you do the next time around. We have a bunch of other guides, resources, webinars, and tools to lane here. If you download the presentation you will have those links. With that we will wrapup. Again we have the webinar seven and eight coming up in the next couple weeks in December. Josh mentioned we have the regional. Exchange coming up in Denver next week. I will be there and Josh will be there. I believe Jerry will be there. Anybody else that is able to join us track me down and if you have any questions we can talk about it. A couple other links here if there is questions overall feel free to contact [Indiscernible]. And also the implementation lead for smarter work sons. Here is our contact information. I think I have left us with 10 minutes to do questions. I know a lot of people have to get out of here at to a clock -- 2 PM. I will turn it back over to Nicole.

I am going to start the second question session off.'s or agency considering using dynamic Lane merge any work some? The second part if you answered yes is your agency considering using early Lane merge or late Earl -- Lane merge? I will turn to the questions for Chris first. Has Michigan tried super merchants on facilities that were more than a two to one lane merge configuration? She has heard that Minnesota found they were us with a two to one scenario and was not sure if Michigan had tried any.

Yes, that is what we have heard to. We did not go down that road yet. We have talked about it because we do have a lot of scenarios where we do have that. We have get to try that. That is one thing I would personally like to see if it would work. We have not done that yet.

Was the zipper merge on I-96 on weekend or weekday or both to compare to your other data points?

The zipper merge only took place on the weekends. We found that the weekday closures did cause the majority of the problems. Some of the public feedback we got back was more to push it to the weekend. The data points I did compare with a 10 mile queue were mostly the weekend closures, I did have the weekday in their. Unfortunately we did not have the zipper merge during the weekdays. We already had arrangements made with the contractors. It would have been successful during the weekdays but just they work and the duration and last-minute nature of the project did not allow us to do the weekdays as well.

Has the zipper merge sign been approved by FHWA?

I do not believe that one has. That was something we did last-minute. I will look into that in the near future to see if I can get something on that. I do not believe that the office did get FW HD approval before using that.

To use it to get federal highway approval would have to go through an experimental deployment process. That is not officially approved yet.

Where did your speed data for the heat maps come from? You said you did not have detection from I-96.

The speed maps came from [Indiscernible] using Pro data. It was strictly a speed based approach that we looked at. In a perfect world we would've liked to have had sensors out there to give volumes and see what are throughput was. Once again it was just a last-minute nature. It was a Band-Aid type solution. We did see a lot of success from it. That is why we chose to share this one. We did get a lot of good results with that throughput. I wish we would have done it earlier.

Was the Maryland example all modeling-based or signage on signage or an actual dynamic merge system acting on real-time?

It was actually data for the simulation provided information on the anticipated operation in a no control edition. The dynamic Lane merge results are actually based on actual deployment in the field. I don't know that answers the question or not. Basically the simulation modeling was used to assess the relative effectiveness of the dynamic merge -- Lane merge.

We are now going to go back to Josh. Is Utah considering an enforcement policy with the VSL or pardoning with the police ?

I guess the policy is it's a regulatory sign. I don't know how to answer that. Because it is regulatory the police will and for said. Did I answer that incorrectly?

We can give Dustin an opportunity to type more into the chat pod. We will move on to another question. Do you use additional Highway Patrol enforcement for speed violations in conjunction with the VSL ?

No. We use a fair amount of UHP in general. We do not use extra ones for [Indiscernible] projects.

Has anyone tried speed radar enforcement in conjunction with VSL There is a really interesting article and the Canadian Journal of civil engineering last summer about PV SL. They set up a three month [Indiscernible] sticks on in New Brunswick. They tested many things in conjunction. They did not use [Indiscernible] as part of that study. They did test PV SL with five or six different variations. Sadly, I have not seen

any research that shows photo enforcement in conjunction with PBS cell. It is illegal in the state of Utah.

Did you use PV MS with displays of vehicles actual speed and a slow downs message.

Yes we have views that. I think you're talking about radar feedback science. It says your speed is signed. Those are fantastic devices for just getting people's attention in the works on. We have use them in conjunction. Personally I think they work better. The Canadian study that I just mentioned says that it increases the effectiveness. The numbers are displayed I do not want to start skewing them with other devices or enforcement. Adding that feature with your PBS cell is worth the effort for sure.

Do have any data for rear end accidents that may be attributed to the BSL -- VSL due to the speed differential?

We don't. We have not had any rear end accidents. Statistically I cannot say, such a limited sample size because of the five projects, but we have had no rear Enders at this point. I have not been made aware of any rear Enders on the projects that they had been used. Sadly, no, or yes.

What is collected and how long is it retained? Is the data retention required for enforcement of the sign?

Has a great question. Because of our limited sample size, and the fact that we have only been doing it for a year we have kept everything. As this grows and we have more projects managing data is going to become more complicated. That is something that we need to figure out. At this point we do need to figure that out. That is something we are going to have to talk with UHP and see how long do we need to keep it for. Frankly, data storage is cheap. It makes mining it more difficult. We need to figure that out.

Does Utah and 10 to trying the VSL and 8285 mile VSL and 82 85 miles per hour speed reduction on higher volume interstates were there is a risk of queuing?

Absolutely. We are working our way up to it. What we have done and the past is we have had our training wheels on. We took them off with this dynamic system. We are still going slow on the sidewalk. 100,000+ [Indiscernible] and a chance of queuing that is more like a road bike race. We are going to get there but we are doing it cautiously. Hopefully after my for test projects we will be ready. Absolutely, that is the goal. We are moving cautiously.

We have slightly past the end time for our webinar. We will close things out. The recording will be available online in the next 2 to 3 weeks. I will send an email to everyone who has registered once it is available. Registration is now available for the next webinar. The lane is on the site slide up on the screen right now. In addition I will send out an invitation to register within the next day or so. I would like to think are presenters and everyone who attended today. These enjoyed the rest of your day.

This concludes today's conference call you may now disconnect. [event concluded]