**National Transportation Operations Coalition (NTOC)**

**Talking Operations Webinar Series**

**Weather Responsive Traffic Signal Management**

**May 31, 2012**

**Jocelyn Bauer**

Hello and welcome to the NTOC Talking Operations webinar on Weather Responsive Traffic Signal Management, hosted by the National Transportation Operations Coalition (NTOC). I will be giving a brief introduction to the web conferencing environment before turning the session over to our speakers.

Today's session will last approximately 90 minutes, with 60 minutes allocated for the presenters and the final 30 minutes for audience a question and answer. Please be advised that our webinar is being recorded. During the presentations, if you think of a question type, it into the text box in the chat area on the left side of your screen. Please make sure you send your questions to everyone rather than just the presenters. The presenters will not be able to answer your questions during their presentations, but we will do our best to address all questions during the Q&A session in the last 30 minute of the webinar. A file containing the audio and visual recording of the webinar, a transcript, and the presentation files will be posted on the NTOC website approximately one week from today. I will type the address of the webinar archive page into the chat box. Attendees will be notified via email of the availability of these materials online. We encourage you to direct others in your office who are not able to attend this webinar to access the recording on online. The presentations used today are available for download in the file download box on the left side of your screen. To download a file, click with your mouse on the name of the file you would like to download and click the button on the bottom of the download box that says “save to my computer.”

During today’s webinar, you will hear four presentations today on the topic of weather responsive traffic signal management. First you will hear from Dr. Roemer Alfelor from the Federal Highway Administration (FHWA) Office of Operations with an overview of weather responsive traffic management. Next, Kevin Balke of the Texas Transportation Institute will expand on weather responsive traffic signal measurement and set the stage for our two guest practitioner speakers. Shawn Gotfredson, a senior civil engineer from the City of Overland Park, Kansas will talk about his city’s approach to using weather responsive traffic signal management. Jamie Mackey, a statewide signal engineer from the Utah DOT will give the final presentation on snow and signal timing in Utah.

Now I would like to introduce Dr. Roemer Alfelor. He is a member of the FHWA Road Weather Management Team. He has been leading the Weather Responsive Traffic Management program for the last several years. He has been with FHWA for 11 years – the first 3 years in the Office of Infrastructure structure before moving on to the Office of Operations. He holds a BS, MS, and PhD in civil engineering.

**Roemer Alfelor**

Thank you, Jocelyn, and good afternoon everyone. I want to thank NTOC and Jocelyn from SAIC, our contractor for organizing webinar. I also want to thank our speakers today: Kevin Balke, Jamie Mackey, and Shawn Gotfredson.

This is the third in a series of NTOC webinars on weather responsive traffic management. The first two were held in March and April. We don't have a topic for the fourth webinar yet, but if you have any suggestions, you can type them in the chat box. As Jocelyn said, this webinar is being recorded, and we have the archives of the PowerPoint presentations, audio recordings, transcripts, and chat box transcripts from the first two webinars. You can see those at web link shown at the bottom of this page.

Weather responsive traffic management is one of the three major program areas of the Road Weather Management program of FHWA, which is one of the programs led by the Office of Transportation Operations. The other two program areas in the Road Weather Management Program are Road Weather Data Capture/Management and Road Weather Dynamic Mobility Applications. For those of you who are familiar with the ITS Connected Vehicles Program, you can see that our program areas are very much in line with that program.

This pie chart shows why we are working on weather responsive traffic management and why this program exists. As you can see from the chart, weather one of the major causes of congestion on the highway system; 15% of all congestion is due to bad weather, and 25% of all nonrecurring congestion – which is congestion not due to traffic volume – can be attributed to bad weather.

The vision and goals for weather responsive traffic management (WRTM) at FHWA are: get a better understanding of how weather impacts traffic flow and operations; develop, promote, and implement strategies and tools to help agencies mitigate negative weather impacts; have transportation agencies use current and forecast weather and traffic conditions to manage traffic flow and highway operations; have motorists receive and respond to both road weather and traffic information; and have weather impacts incorporated into traffic analysis and engineering models.

The diagram shows the framework we are using for the WRTM program area. At the core of the framework are the WRTM strategies themselves, which I will talk a little bit about in a moment. The other boxes show the different areas that we are working on in the WRTM program. We are looking at traffic and weather data collection and integration; traffic analysis models; behavioral/human factors associated with weather responsive traffic management; and how the strategies affect the safety, mobility, and performance of the highway system.

There are three types of strategies that can be used by agencies for WRTM. Advisory strategies inform or warn travelers about the current or impending weather conditions. Control strategies are used to regulate and optimize the flow of traffic, and that includes signal timing. Treatment strategies seek to minimize or eliminate the obstructions caused by weather events. Kevin is going to talk in detail about these strategies.

Some of the most recent and current activities that we have in the WRTM program include the 1st National Workshop/Stakeholder Meeting on WRTM that we held last October in Portland, Oregon, which was a very successful meeting. Almost 30 states were represented at that meeting. We came up with action items we need to focus on in our program to address the needs of transportation agencies in the area of managing traffic during adverse weather. We are in the process of developing Guidelines for Disseminating Road Weather Information. We developed preliminary guidelines and we are now in the process of updating or revising those guidelines based on the work that we did with some of the agencies that evaluated them. We're also developing weather responsive traffic estimation and prediction models, or dynamic traffic assignment models that incorporate weather impacts. Recently, we initiated a project to develop, implement, and evaluate advanced WRTM strategies. The three types of strategies we will be developing are traveler information system, active traffic management, and traffic signal control. We will be working with some of the agencies to develop advanced strategies, implement them and evaluate them.

If you have any questions about WRTM, feel free to give me a call or send me an e-mail.

**Jocelyn Bauer**

Thank you, Roemer. Next, we will be hearing from Kevin Balke. He is a research engineer and program manager with the Texas Transportation Institute, a research arm of Texas A&M University. He has over 25 years of experience conducting transportation operations research at National, State, and local DOTs. His areas of expertise are in intelligent transportation systems, traffic signal operations, incident management, and weather responsive traffic management. He’ll be speaking today on part of a research project conducted with the Battelle Memorial Institute and McFarland Management for the FHWA Road Weather Program on the developments in weather responsive traffic management strategies.

**Kevin Balke**

Thank you, Jocelyn. What I would like to focus on is what do we mean when we talk about weather responsive traffic management? FHWA has looked at several strategies for managing weather during weather events. When we talk about weather responsive, we’re really talking about the implementation of three types of treatments that happen on the roadway. Those could be advisory strategies, where we’re informing motorists to take action; control strategies, where we might be alternating some sort of physical traffic control device to manage traffic; or treatment strategies, which are needed to help improve the roadway itself. These are in direct response to or in anticipation of worsening roadway and visibility conditions because of weather. The key point with weather responsive is try to be as proactive as possible and do things to help manage the event in real-time and to keep the roadways from deteriorating beyond the point where you start experiencing operational issues. When we talk about weather responsive, that’s really what we are trying to do; we are trying to be proactive in managing our facilities to keep traffic moving as safely and efficiently as possible during these weather events.

What are the types of strategies that could possibly fit into weather traffic response? Here is a list of nine different categories of what we have classified as weather responsive management traffic management strategies. These can range anywhere from issuing advisories, alerts, and warning information about specific weather conditions, to implementing things like speed restrictions or vehicle restrictions, to telling trucks to go a different route because of high wind events. A whole host of different strategies potentially could be deployed. The one we will focus on today deals with these traffic management strategies, and I would like to highlight some of the things we’ve found in the research we have been working on with FHWA related to these traffic management strategies.

The reason why this has come up is that we have done a research project for FHWA specifically about weather responsive traffic management strategies. We reviewed strategies that States were using to implement different types of improvements, and we looked at how we could potentially expand and improve upon the types of strategies that were being implemented by agencies. We went as far as developing concepts of operations on how to improve these and expand the proactive nature of managing traffic during weather events. We also looked some of the strategies and techniques for evaluating the different approaches. We focused on all none of those different categories, and all of this information is contained in a report that was produced and is available on the FHWA website.

I want to focus on some of the things we found looking at traffic signal operations and setting the stage for our next presenters to talk about and give you specific examples of how they are doing things. One of the things that we found as we were looking at the research related to traffic signal systems and deployment efforts related to traffic signal systems was that detection systems tend to have some problems during weather conditions. Usually, we design our detection system for perfect operations where we can see lane lines and things like that, but as weather sets in and roadway conditions deteriorate, our detection systems are no longer in place where traffic is actually moving. There is a need to look at how to modify detection systems in response to developing weather conditions. One of the common strategies that operators use to address detection problems is to place their detection systems or signal systems on a recall for individual phases so that phases are guaranteed to provide service even if demand is not there. I think the potential exists to be more proactive and more aggressive in the way that we manage things. Because technology is increasing, there are other things we could potentially do, such as changing some of the detector settings to reflect lower speeds that might exist, or coming up with new detection schemes and patterns that can be implemented based on past behavior that results from what is happening on the roadway during weather events.

Another area that where we as traffic signal operators can look at making potential improvements is in the vehicle and pedestrian clearance intervals that exist. During weather events, the roadway conditions start to deteriorate or speeds start to change. Speeds on the approaches start to differ from what we originally planned for in terms of our clearance intervals.

We also run into problems where some signal indications might become obstructed, so we need to start thinking about different ways to adjust our operating strategies, looking particularly at the pedestrian intervals and providing some increased separation between conflicting movements. When we looked at the practice, we didn’t find many agencies that were doing anything related to pedestrian clearance intervals. Again, because of the technology that exists and the ways that we have of monitoring conditions on the roadways, perhaps there are strategies we could implement to dynamically alter clearance intervals to reflect deteriorating traffic conditions. Some traffic signal manufacturers now have features that might be able to be used to help us provide extra clearance separation between vehicles on conflicting movements. That is another potential strategy that you can look at.

Probably the biggest area where a lot of agencies are doing some improvements is coming up with weather responsive traffic signal timing strategies. These are plans that are designed specifically for managing traffic during weather events. They take into account and develop a new timing strategies and new coordination schemes by looking at what happens and how to better manage traffic demands and flows during weather events. Weather results in lower speeds, different travel demand patterns, and things like that on the roadway that we can look at and more dynamically adjust as traffic conditions start to deteriorate. We can dynamically adjust the coordination schemes and call in different phasing patterns and things like that to better account for and operate traffic signal systems during these weather events. Our two speakers today are going to talk about how they are doing some of this during weather events.

As part of our research project, we’ve looked at these different strategies and placed them together in what we call a Weather Responsive Signal Operations Concept of Operations (ConOps). This ConOps looks at marrying the information that is available through weather detection systems, filtering that through some type of decision support system, and integrating that into traffic management system software to better and more dynamically manage what happens on the roadway in a proactive fashion. This is all rolled together into a ConOps as part of the research project that I mentioned before. As Roemer mentioned, we are in the process of working with various agencies to see how we can actually deploy all or part of this ConOps as we move forward in deployment.

That was setting the stage and letting everyone know what we are thinking about in terms of weather responsive traffic signal operations. I want to turn it over to our two speakers who will talk about what their specific agencies are doing to better manage operations of traffic signal systems directly in response to different weather events. Shawn Gotfredson from Overland Park, Kansas is going to talk about what they do in their area, and Jamie Mackey is going to talk about from the Utah perspective about what is happening in their area. Jocelyn, I’ll turn it back over to you.

**Jocelyn Bauer**

Thank you, Kevin. As Kevin mentioned, our next presenter is Shawn Gotfredson, a senior civil engineer with the City of Overland Park, Kansas. He has worked for the city for 11 years and has managed the upgrade of the city’s traffic signal systems and communications infrastructure.

**Shawn Gotfredson**

Thank you. I was asked to give you an overview of what the City of Overland Park does in response to different weather events. I thought I would start out with a brief overview of Overland Park. We are a suburb of Kansas City in the southwest portion of the metro area. We are part of Johnson County, Kansas, and there approximately 175,000 residents. The 2010 Money Magazine said we are a great place to live. We have 264 signals; 185 are coordinated and 225 have communications. The ones that don't have communications are older signals in the older part of town, which run just fine by themselves. This is a little bit of detail about some of the hardware we use. We are a 332 shop and almost all of our communications is Ethernet-based. For detection, we primarily use video detection; on all of our new signals and any overlay, we have been putting in video detection. For our dilemma zone advance detection, we use radar.

In Overland Park we are fortunate to have communication infrastructure; we are able to closely monitor signals with our central system; we have cameras to watch live video; and we have staff and a Traffic Operations Center to monitor and actively manage all of our signals. For our communications, it is a fiber optics backbone. It is hard to see, but the gray lines represent our hundred miles of fiber optics cable, which connects our city facilities, traffic signals, CCTV cameras, arterial DMS, a few sprinkler systems, and a number of weather sensors as well. Most of the weather sensors come over wireless.

The MPO developed a Regional Signal System called Operation Greenlight. As part of that, we selected to use a central system by Transcore called TransSuite, and that is what the agencies use to monitor their signals. We are a remote TOC of Operation Greenlight; we have our own servers and everything, but we can communicate back and forth. We’re also working on sharing vehicle and weather data with our freeway operation system, KC Scout, which is operated by MODOT and KDOT.

There are 115 CCTV cameras that we use to monitor intersections, and we have been bringing back our video detection as well, which allows us to monitor things a little bit closer. We have a video monitoring system that allows us to record our video. We record our video 24/7 and we keep four days’ worth of storage. We are able to share the video from snow events or different weather events with police and other agencies in the area. There are quite a few agencies that use the same system, so we are able to share video back and forth.

As far as staffing, we have four signal technicians in the field, and on the operations side, we have two engineers and two traffic engineering technicians. We are fortunate to have a staff to take care of and actively manage our system. Our Traffic Operations Center is co-located with dispatch and emergency operations; we are on the other side of the glass from dispatch. In our TOC, we actively monitor the police radio and computer-aided dispatch as well. At the bottom is a screenshot showing you what we can see from the CAD, and we can monitor the accidents and things that are impacting our arterials.

This is a brief overview of some of the weather in Overland Park. We probably don't get as much snow as people up north. We have two or three major events – which probably aren’t major anywhere else besides Kansas – which we consider 4 inches or more. We’ll have six or more light snows during the year and two or three ice storms. For us, sometimes the light snows cause more havoc on traffic than heavier snows. Last winter we had a small dusting and we had 85 accidents in the AM peak commute, while typically we will have five or six. Unfortunately, the people in Kansas don't always remember how to drive in the snow. Every once in a while we will have heavy rain in the spring and the fall, and we have only had tornado watches and warnings in the area lately.

For snow events, we will see motorists sliding around and taking longer to get to us in the morning. Some of the large employers in town let people leave work to try to beat the traffic home, but it ends up causing more congestion because everyone is leaving at the same time to avoid the storm coming. We have issues with detection. The snow blows and messes up the camera views and things like that. Also in the Midwest, we will have issues with stuck pedestrian buttons on some of our mechanical buttons that we have out in the field, and there is nothing like a stuck pedestrian button to mess up your coordination.

We have a number of weather sensors; this is just the road weather sensor that we have out there. We put them on our website ([www.stormwatch.com](http://www.stormwatch.com)) and we have pavement, temperature, wind gauges, and things like that on our website. We have the ability to monitor that and we use that information periodically. We use some of the Boschung pavement sensors and recently we have gone to some of the High Sierra laser and infrared. The Boschungs are in the top right and the High Sierras are at the bottom. We’ve been putting those at our new traffic signal intersections. When we build a new signal, we will be putting those in at select locations. The city uses a private local weather service called WeatherOrNot, and that’s what we use to let our people know when to plow the roads.

Our city is fairly aggressive with treating roads. People up north probably would not treat roads as aggressively as we do or they’d have to spend a lot more money. We typically monitor our signals while we are treating the roads. That is the main thing that triggers us to pay attention to the roads, because we start monitoring our signals when we are out plowing.

Most of our verification is through visual observations of our cameras. We’ll look at queues, headways, and cars sliding around, and from our CAD system we’ll look at how many stalled vehicles and wrecks we have. Typically, we command a corridor’s coordinated signals into a plan. This is a graph of some of our corridors. We will put a plan in corridor one and we will tell corridor four to go on a plan, and we’ll monitor it as needed. We tried in the past to have consistent numbering of our coordination plans and we put descriptions on them when possible so we have an easier time putting them out in the field. After we get the corridors going, we will look at individual intersections. Here's a list from our central system that tells us when intersections have detectors that are stuck on or stock off. After we get that list, we will drill down into the individual intersection to see if the detectors are stuck on. At the bottom of the screen, the yellow and magenta diamonds are telling us that detectors are stuck on our stock off. We will be able to see if a phase has skipped and we’ll know whether we need to put that on recall or not. After looking at the intersection level, we’ll put things on minimal recall. Frequently, we’ll put the whole intersection on recall to make sure it is going, and then we will go back through and modify timings at individual intersections. We’ll put things on a max recall and modify the time of day, passage times, and some other things as well. The City of Overland Park does not change yellow or red times on the fly; we do not do that for weather events.

As a last resort, from our central system, we sill sometimes put things on stop time and get things to flush out. We rarely do that for weather because you have to be careful not to get stuck in yellow or red. Typically, we will use that for special events, and mainly where we have CCTV cameras to monitor it. What triggers us to take it out is mainly visual observation when the snow plows are shutting down. Based on that, we will take timings out. Some of the issues we’ve found are sometimes we are shorthanded. Some of our operators have been drafted into the snowplow operations, but sometimes we have been able to negotiate with folks so we are able to have them become dispatchers and they are able to help us with our timings. Then we went through and labeled and re-numbered everything to it would be consistent. Some other issues we have are that sometimes it is difficult to take temporary timings out because people are working in different spots and it is fast and furious when the snow is flying.

Some opportunities we have are improving weather sensor integration into our system and having dedicated timing coordination plans so we can plug those in and adjust for some of the speed differences and different headways that we would normally see. One thing I think as a practitioner that would be nice is if some of the vehicle detector systems would alert the operators when they are seeing poor visibility and differentiate between a snowy lens and a good lens. That is something we can work on as well.

That is my presentation, and here is my contact information if you have any other questions.

**Jocelyn Bauer**

Next, we have up Jamie Mackey who is a statewide signal and generally traffic signal operations group at the Utah Department of Transportation. She has worked with or for the Utah DOT for the past two years but spent the first part of her career in Texas. Jamie, feel free to start when you’re ready.

**Jamie Mackey**

Thank you Jocelyn Bauer. I'm going to discuss how the signal timing group uses weather information to keep streets moving during snow and other severe weather events. Utah has two major population centers. The largest with over 2 million people is called Wasatch Front because it is bounded by the Wasatch Mountains to the east. The Saint George area is much smaller. Snow is concentrated in mountains in the north. Saint George gets little snow which allows us to focus on one region when responding to snow events. On average, the valleys experienced 35 snow events per year, and today I will discuss how we know which events will be significant enough to warrant changes to our signal timing.

First I'm going to give you a better idea of how population is organized. As you can see, the Salt Lake area is bound to the east and west by mountains and lakes. Most of the traffic we work with as long a 90-mile corridor created by these features which is in the yellow shaded area. All of these mountains and that giant lake give us a small scale weather which makes forecasting actually valuable. We also experience strong windstorms from time to time and this can cause a problem with our traffic signals.

So, what kind of internal infrastructure do we have to respond to wind and snow? This is a list of groups and equipment implementing a similar response to weather. First, the operations group which planned the response for such an event. We also have a weather operations groups who alerts us to events and may advise us on our response. We use the traffic cameras to confirm a response is necessary for the operator. The operator at our traffic operations center makes the decision whether to act. Our communications network is then used to implement the plan. An important element of this entire process is that all these components are located together at our traffic operations center.

I want to tell you more about our weather group, not just the signal timing group. The weather group is led by a meteorologist and includes several contracted employees located in a room behind the operators. They are present twenty-four hours a day during the winter months. Because they work so closely with the team, they are in tune with their internal customers, which include maintenance operation, Highway Patrol, dispatch, and the signal group.

The weather group utilizes standard weather models to forecast. These are supplemented with data to develop a detailed forecast about road conditions. For example, snow is less significant if the roads are warm enough and the snowfall is light enough that accumulation is unlikely. Because we do communicate frequently and the staff meteorologist attends many meetings, they have a thorough knowledge of how various groups operate. This allows them to elevate the road forecast into an impact forecast. This means they can let maintenance groups know where and if plows will be needed. The operators receive advice on messaging for ice, snow, and wind, and my group might learn that tonight’s snowstorm is no big deal for the signal network. The information they provide is detailed and allows us to focus our efforts. A typical forecast may tell us whether snow will accumulate in the valley or just in the foothills. They can tell us very precisely the time we expect the snow to start and how long it will last. Receiving accurate estimates on the time is important because we will respond differently to an event during the AM PM peak then for a similar event occurring in the middle of the day or at night. They'll be able to tell us what kind of snow it is and whether it will melt as it hits the ground or if it will be slushy with some ice. They can let us know if the plows will be able to keep up with the snowfall or not and whether certain roads will experience slowed traffic. Because they provide such accurate information to the plow drivers, it is possible they might make it unnecessary for us to act at all. During the pre-event briefing, we can discuss the potential impacts on drivers with members of the weather group to decide what action, if any, we need to take.

Another benefit of the in-house team is that they work closely with the local weather service and public information officers. The need for a signal timing response may be reduced if the public is aware that the upcoming storm is one to avoid. UDOT messages this information through the twitter account, the website and our new traffic application. We will occasionally use our signs to warn travelers in advance of significant events.

Statewide, UDOT has 1200 signals and there are about 500 more signals owned by various cities or counties. Unlike most states, UDOT retains ownership of all signals on state routes regardless of city size. Most major commute quarters are operated by the same entity. We have a robust, reliable, and fast communication network that currently connects about 1400 signals state-wide into one central system for remotely managing traffic signals. Our communication network also means that we have access to pan-tilt-zoom cameras on most of our major arterial routes at major intersections, not just on the freeway network. Another important component of our signal system is the operators who work at the TOC. We have a signal desk, staffed 12 hours a day, to respond to incidents and complaints, but after hours, we rely of the TOC operators.

When snow hits, we have four primary concerns that impact signal timing. Slower than normal speeds caused by icy roads or snow can ruin progression on major routes. In this case, it makes sense to use plans that progress traffic at slower speeds. Another problem we have is when snow builds on the roadway and drivers can't tell where the lanes lines are. This can cause some movements to not get a green light if the vehicles stop outside of our detection zone. In this case, we usually run the signals pre-timed by placing max recalls on all phases.

When visibility is reduced, our signals that rely on video detection can have a problem sensing vehicles, so our solution is to put a max recall on phases. Snow is just one of the reasons we have gone away from using video detection so we don't have that much in our state. Another situation that requires special plans is when multiple plow operators are working together as you can see by the picture on the bottom right hand corner of that slide. In order for the lead vehicle to clear the left turn lane, they prefer that the space is empty of vehicles. We have developed plans for certain quarters that bring up the left turns first.

To accommodate these concerns, we usually develop two plans per quarter. A light impact plan uses standard recalls with lower coordination speeds while a heavy impact plan uses lower coordination speeds and maximum recalls on all phases. To develop these plans, we usually have our consultants modify newly implemented peak hour plans using lower speeds. These plans then get put into individual controllers and we create action sets for all the signals on a corridor so that they can be quickly implemented through the central system.

Beyond signal timing concerns, there are also potential maintenance issues brought on by weather. 100 percent of our signal heads are lit with LEDs. One negative of LEDs relevant to incandescent bulbs is that they are so low energy and they do not generate enough heat to melt snow. Fortunately, our weather team is able to tell us when the snow and wind conditions are right to expect snow blowing into the signal heads to stick. They also alert us when wind speeds are high enough to cause damage to the signals themselves. We had a storm last year with 100-mile per hour winds and we were able to schedule our technicians from other regions to be in the affected area first thing in the morning. As with any additional effort there are some challenges. It is not unusual to implement a snow or incident plan and then discover that a signal or two is running free because the pattern is no longer in the controller. If we add a left turn phase and don’t update special plans, it is possible we may skip that movement, which will make the situation worse.

Our operators do an amazing job but they have many responsibilities and it is sometimes difficult to make sure each person has the appropriate training and it is nearly impossible to develop written guidelines that cover all potential scenarios. Evaluating the effectiveness can be problematic. This uncertainty is not unique to the snow plan. Currently the only evaluation we do is to monitor the cameras to make sure we didn’t make the situation worse. We are currently working on a program to develop automated performance measures using signal status data from our central system. We have high hopes that we will be able to use this new resource to evaluate our special event incident and weather plan. That is all I have for today. My name is Jamie Mackey and here is my contact information. I have also included information for Leigh Sturges, our meteorologist. Leigh and I would be happy to answer questions about our weather and traffic signal programs. Thanks for your time. Back to you Jocelyn Bauer.

**Jocelyn Bauer**

Now we are going to move on to the question and answer portion of our webinar. So there have been several questions and comments coming in, so feel free to continue to type those in as I go through and field the questions to the presenters. One of the first questions that came in, it is a comment as well, just want to see if anyone would like to comment. It’s from Bob Rauch. Although 15 percent of congestion has been attributed to bad weather, how much of this is due to defective road loops that cause actuated traffic signals to max-out on phases with little or no traffic thereby reducing capacity when it rains? My surface street commuting indicates that most of the rain delays are caused by these situations, not the weather itself.

**Roemer Alfelor**

I agree with Bob, in bad weather, traffic signals are not responsive to conditions. Then, you might have a problem with the non-optimized signal settings. I think the 50% congestion attributed to weather pertains to both freeway and arterial streets and I think it is mostly related to speeds. When the speeds go down to a certain level, that is where the congestion occurs. In cases where you have bad weather for example, rain, and the traffic signal is not adjusted due to the rain conditions, then you might have congestion not necessarily due to bad weather but because the traffic signals are not responsive to the weather event. As you can see in the pie chart, about 5 percent of congestion is due to poor signal timing. I don’t have any information about the contribution of both poor signal timing and bad weather combined on the overall congestion. That is a good point.

**Jocelyn Bauer**

The next question comes from Leslie Hart. How well do adaptive and traffic responsive systems serve weather response needs? I will throw that out to any of the speakers.

**Kevin Balke**

That is a very good question. As far as I know, there has not been much work looked at as to how well traffic adaptive systems perform during weather events. Are they sensitive enough to pick up the changes that we are talking about and do they perform that well? I think that it's a good question and an area that we need to do additional exploration. Conceptually, you think those are what the systems are designed to do. However, the issue of traffic adaptive systems is that they rely heavily upon detection. If you have problems with the detection system and if you have issues related to timing parameters that are set based upon the detection, the actual performance could be hurt. That is an interesting question and something that we as an industry need to explore further.

**Jamie Mackey**

I can provide input on that. In UDOT, we have two different traffic adaptive systems that are in two different adjacent mountain valleys. We have a light system that has radar or looped detection. So, as long as the lane lines are visible, our detection shouldn’t be a problem. That one does a good job of adjusting offsets. We don’t really have an evaluation of that but my guess is that one would do a good job of accommodating the slower speeds In Park City, we have a scat system that does not change the offset so slower speeds would not be accommodated in that. I think we mostly have loop detectors there as well. And the splits would be adjusted, but that would only be on balancing traffic. My guess on how well it handles is based on the capabilities of your system and whether it changing just [inaudible] or splits or all three.

**Jocelyn Bauer**

Great. The next question comes from Lyle Landstrom and he is wondering if the video monitoring system is part of the software? That question came in during Shawn’s presentation.

**Shawn Gotfredson**

It is a functionality that is there. We currently do not utilize that. We have that separate. The police dragged me into that system a long time before we even had the system and it works well. They have modules that we integrate with, and we use a system called Omni-cast. They have modules you can integrate that into the central system. We have chosen not to at this time.

**Jocelyn Bauer**

Great. From Jeff Kupko. Do you find any legal issues with recording and storing video? Typically, we do not record because it can be used in court.

**Shawn Gotfredson**

For my first five or six years in the city, I had the same opinion, but we have changed our minds. We model our procedures closely after the police model. The police collect video all the time from their hidden camera and they are required to keep video and not keep video. So, all of our policies mimic that. I can give you a whole presentation but we proactively look for accidents on our video. If we find video, we will attach a snippet of that video to the police accident records so we have a database of police records. If you come into the city and ask for the video, the police records will show you that video. So, we let all of the interface come through our police records people. That keeps me out of the business of answering lots of phone calls. I don't have to answer the phone calls. I always just send them to the records.

**Jocelyn Bauer**

Jamie, anything regarding legal issues with recording or storing video there?

**Jamie Mackey**

We do not record or store video unless it’s on a very small recording, like if someone was interested in a study that was very small. We don't store video. One reason is the file space and then also because we don't have the time to respond to requests about video so it is easy to say, sorry, we don't record video. We do get quite a few requests for it.

**Jocelyn Bauer**

Another question from Glenn. What communication infrastructure suppliers do you use and are there any satellite redundancies within a communication system used? I believe that is for Shawn, but Jamie feel free to chime in you’d like.

**Shawn Gotfredson**

For the city of Overland Park, I will get that fiber fixed. We mainly just rely on our fiber, and I have fiber contractors that will come in and repair the fiber if I have problems. We are pretty quick about getting it back up. We just aren’t that big, so we can be pretty quick with it.

**Jamie Mackey**

We, on the other hand, are rather large in space. I am not 100 percent sure how the fiber network works, but in the past five years, we have started teaming up with private companies who can use our right of way and then we can use their conduit. They have a pretty strong investment in getting things fixed quickly. I also know that we try as much as we can to have redundancy. We are having fewer and fewer lapses in communication.

**Jocelyn Bauer**

The next question comes from Adam Moser. Which weather sensors do you like better? Laser/infrared or pavement sensors? Maintenance and operations wise?

**Shawn Gotfredson**

I can answer that a little bit. If you want to send me an e-mail, I can get you into contact with people that spend all their time worrying about those kinds of things. I hesitate telling you my experience, because it is limited. I know that pavement sensors, for maintenance, you need to take care of those and make sure they are put in properly at the beginning. The laser infrared is pretty easy to set up, and that is why we are leaning towards those. We can move them around and we do a lot of overlays. An overlay comes through and it does not necessarily mess up your pavement sensors. That is a reason why we went to the nonintrusive video detection in the first place-to stay out of the way of the overlays.

**Jamie Mackey**

At UDOT, we do prefer loops whenever possible but we have a policy against cutting them in. So, if they are not laid down before the pavement is put on, we don’t install them. We have too many free soft cycles here, and we don't use video. Anything optical that relies on being able to tell the difference between pixels and colors, we have found relatively unsuccessful. So, we have pretty much gone to new installs using radar exclusively unless we can put in loops.

**Jocelyn Bauer**

Another question from Lyle Landstrom in North Dakota. Do you have some TS-1 controllers linked to the central system or is everything ACS-3? NTCIP?

**Shawn Gotfredson**

Over on Parkside, everything is basically Ethernet and the ACS-3. We have some of their rack mounts and a few 2070s and we do use NTCIP. All of ours are 332 cabinets. We don't have any [inaudible] cabinets. Everything is linked back to the central system. We use NTCIP protocol for that.

**Jamie Mackey**

We have everything. We have TS-1 cabinets. We have TS-2 cabinets. We have AFC-3s and AFC-2s. I believe on the central system we use all kinds of different hardware to get those connected. We haven't had many problems getting things connected at our differences.

**Jocelyn Bauer**

Dennis Jensen from Idaho would like more information about forecasting to identify if the plow will be able to keep up. I am not sure if there is other information available or if one of you would like to provide or be willing to be contacted regarding that.

**Jamie Mackey**

You can definitely contact Lee Sturgis with UDOT. They have a good understanding of what rate and maybe she has some numbers. They know that if the snow is falling at such and such rate in this canyon, then the plows can do it or they can’t.

**Jocelyn Bauer**

Question from Adam Moser. Are any agencies using pavement sensors connected to inputs in the cabinet/controller to trigger other max green times or other timing parameters (different passage/extensions), or is it all manual operations such as the upload and download of timing?

**Kevin Balke**

We have experienced that there is no one doing a direct interaction between a field sensor directly into the cabinet. This is one of the things we're trying to push the industry to see if that makes sense a little bit. There are still issues that have to be resolved. There are issues about making sure the detection is working correctly and the appropriate measures and things like that. That is where FHWA would like to see the industry push to be more proactive in doing those things directly as opposed to relying so much on operators to make those improvements. That is not to say that the role of the operator will ever be diminished. They are still going to have to be some operator oversight to make sure the system continues to work correctly and function the way we think they are going to.

**Jocelyn Bauer**

A question from Mike. Does anyone change yellow and red times during storm events? And this is open to anyone on the call.

**Kevin Balke**

When we have looked at it and talked to people about doing that, no one is actively trying to do that or does that. I think there are some limitations technology-wise that prevent us from doing that on-the-fly. However, some of the systems are getting to the point where they are adding in new features designed to do things like red light running protection and things like that. We could potentially utilize to help us detect when we have a particular event or when we have two cars coming into an area and we may want to alter some of the clearance separation intervals between vehicles. Not necessarily the yellow change intervals, but maybe just hold that red clearance interval a little bit to allow some increased separation.

**Jocelyn Bauer**

We go to a comment about the key to poor weather video detection is keeping the lenses clean. Else, you’ll get very poor contrast in snow and fog conditions. Apparently, UDOT is keeping Pam cooking spray in use here. People are buying it by the case to keep the snow from sticking on their lenses. Finally, we come to a question by someone in Saint Louis County Minnesota. What are the typical weather condition triggers that prompt an inclement weather timing scheme?

**Shawn Gotfredson**

Go ahead, Jamie.

**Jamie Mackey**

For us, it is very visual. We see cars showing up at the intersection in the wrong spot and not getting a call or just watch them clearly being slow. At this point we have no technological way to do that other than by our own observations or getting a call into our TOC.

**Jocelyn Bauer**

Okay. This next question looks like it is for Federal Highway. Roemer, maybe you have the answer to this. Do you have delays from rain and flooding?

**Roemer Alfelor**

Studies on how rain affects speeds and traffic volumes have been done. There has never been a national study that aggregates all the information and says the percentage of delays that is caused by the rain. In this case, I would look at some of the material on the FHWA program website and you can see some of the work we have done in this area in terms of studies on weather and traffic flow where we looked at the impacts of different precipitation on speed and traffic volumes and capacity. There's also some studies that have been done in the US and other countries that looked at had this problem in determining what the delays that are caused by the rain. For the flooding, I haven't seen any work that looks at the delays caused by flooding. I don't think we have any reference on that one.

**Kevin Balke**

If you're looking for some help in trying to provide some numbers as to the impact of weather on traffic operations, Roemer is right. You can go to the website, and they have a lot of information about those studies. The highway capacity manual has some information related to weather impacts included in it. It is not as comprehensive as I think the industry would like, but there are at least data points here and there that talk about traffic operations and weather impacts.

**Jocelyn Bauer**

I was going to say the last question is from Timothy Simmons, but it is now the second-to-last question. Jamie, what is the Utah Department of Transportation current view of detector pucks in place of loops?

**Jamie Mackey**

We do use detector pucks. It is almost an economical decision. It is one less turn lane that now has a bad loop. If all the other detection on that approach works, it may be cheaper for us to put in pucks selectively instead of installing radar. We don't ever use pucks on a full intersection anymore. We use them for our ramp meters and for other things. I think there are potential problems with people not being exactly over them but in general, we are not opposed to them. We just don't use them widely because we have another form of detection that we prefer. Some of the regions have a preference and we would rather spend extra money to get the kind of detection they are comfortable with. But, we are not necessarily opposed to them.

**Jocelyn Bauer**

Any other opinions on the use of detectors pucks? Well then we will move on to VDOT question. That organization writes in asking: regarding signal timing change during the big snow event, since all phases are maxing out, are you operating signals in operation in coordination or free operations? Since the detectors are maxing out, is it really an optimal situation or is it just to make sure vehicles can get out or through an intersection? Do you find either a long or short cycle link that would help plow trucks to clean the snow more efficiently? And I will open it up to either Jamie or Shawn.

**Shawn Gotfredson**

I was just going to say, that is a good question. I think we found it works better to have them coordinated. At night, we will let everything go free. Between seven to eight or nine, we will keep everything in coordination. Even if it was an isolated intersection, we would have had it free. Our opinion is that it is better to have everything coordinated as much as possible. That way you can get people going and you don't have to stop them as much. That has been our experience, and it has worked pretty well for us. With the snow plows, we have our bigger cycle links in there and we hope the snow plows work. Our snow plow operators, every once in a while, and a couple of cities in the areas have tried to put preamps on the snow plows. You can have an argument on if that is a good idea or not. I, personally, don’t like the idea, but some people have pushed for putting units on snow plows. The snow operators would love that, but I am not sure that that is the best idea.

**Jocelyn Bauer**

Any other comments?

**Jamie Mackey**

We have a policy about keeping things as simple as possible. Just from a maintenance standpoint, we don't tend to do new plans for snow. We like to take the existing a.m. or p.m. peak plans and modify them with offset changes. It makes it easier down the road when we are making changes if we remember to change the snow plans. It is part of our assumption that the splits are appropriate for that movement and, therefore, a max-recall will hopefully make things significantly worse. That goes for cycle link as well. It is what it is and it does tend to be a longer cycle link. I have never heard complaints from our plow drivers, but, again, they are only coming through for a very short amount of time. I guess I don't have any opinion. I think it is a good question but, realistically, I am not sure we are going to look into making our snow plans more complicated than they need to be.

**Jocelyn Bauer**

I think that was our last question. I appreciate Jamie Mackey, Shawn Gotfredson, Kevin Balke and Roemer Alfelor for addressing all the questions. I will move forward in wrapping up this webinar. I would like to give you information on the National Transportation Operation Coalition or NTOC. On this slide, you will see the member organizations of NTOC. We encourage you to go to the NTOC website listed on the following slide to find out more about the organization. The NTOC website contains information about upcoming webcasts, and it contains a great resource-a webcast page with transcripts and recordings from previous webcasts all the way back to 2004. As I mentioned before, we will have the recording, the slides, and the transcript from today’s webinar up within one week. So you can go to the NTOC site and click on the webcast archives. There you can get to the recordings and the transcripts from previous webinars as well as today's webinar within a week. There is also a new discussion forum that started for the talking operations website, and that is listed on the slide on the bottom link. You can also sign up on the website to receive the NTOC newsletters that are emailed out twice a month. Our next NTOC webinar is part of the planning for operation series and will focus on sustaining regional collaboration for transportation operations. It is scheduled to be held on Tuesday, June 12th from 1:30 p.m. until 3:00 p.m. Eastern time. You can register at the link showing on the current slide at the NTOC website. Speakers for that webinar are going to be Wayne Berman from the Federal Highway Office of Operations, Eileen Singleton and Bala Akundi from the Baltimore Metropolitan Council, Robert Case from Hampton Roads Transportation Planning Organization, and Bob Hart from the Southwest Washington Regional Transportation Council. In conclusion, I would like to give a special thank you to our speakers: Roemer Alfelor, Kevin Balke, Shawn Gotfredson and Jamie Mackey. Also, thank you to all of our participations for your active participation and your great questions. We really hope you found this informative and please enjoy the rest of your day.

**Roemer Alfelor**

Thank you. Thank you everyone.