Welcome to the Adaptive Signal Control technology: Managing Risks, Achieving Objectives webinar. I would now like to turn the conference over to your host.

Hello, my name is Eddie Curtis with the Federal Highway administration I am your host today. The program today is on the topic of Adaptive Signal Control technology: Managing Risks, Achieving Objectives. If you joined this Web conference and you were thinking this would be about technology and adaptive control in terms of speaking about products, that is not what we are going to do today. We are going to talk more about successful strategies for implementing what we consider a proven technology. Electric vehicles are a good analogy. There are many products, GM, Toyota, Chevy, etc. how do you select among these products that utilize the same general technology? How do you choose which one is right for you, that will work within your limitations? We have a great list of speakers that are going to present including myself. I would like to give a quick thank you to Jeff Zaharewicz, Byron Lord, Julie Zirlin, and Maria. A special thank you to them. There were many hands working on this. A special thank you, as well, to the presenters.

The agenda for today -- An overview of the technology and talking about operational objectives and a strategy for implantation. The city of Alpharetta will show you their experience with this project and show you how they implemented this.

We will have local discussions for 20 minutes and then 15 minutes of questions and answers. What you discuss in your local location, if there are things that need to be resolved or you have questions, these will come back to the speakers. We will respond to these.

Then, we will go on -- with New Mexico. And this will be followed by Anaheim. Then we will do a round of discussions and questions and answers and wrap-up.

I will now start my presentation. Let me introduce myself. I will introduce each speaker before they do their presentation. My name is Eddie Curtis and I have been involved with the management and operation of this signal systems 1995 when I began my career with the city of Los Angeles. I have also worked in the private sector and I joined FHWA in 2006. My current role with Federal Highway -- I manage the arterial management program where I’m responsible for guiding research and doing training and outreach all with the objective of advancing traffic management and operations practices. Recently I have been involved with the 2012 report card and the signal timing and I am also the team leader for an adaptive control technology initiative and I also work in the resource Center part-time. I am also a member of the TRB signal systems committee and I share a joint committee on regional traffic signals.

In keeping with the theme of every day counts, the benefits of adaptive control are consistent with the theme of better, faster, and smarter.

We had about 20 years of experience with this technology to gain and demonstrate these benefits. The benefits are well documented. The benefits to road users are usually in the form of travel time and fuel reduction and reduction in emissions. Agencies are saving money because they are not doing a lot of the typical mundane tasks of collecting data and doing signal optimization via software, only then to go and implement those changes out on the street.

It is faster because usually the signal re-timing process takes on the order of somewhere from 3 to 5 years is what’s typical and best practice. This reduces it down to a matter of minutes.

Let's talk about how adaptive control is able to achieve this better, faster, smarter form of benefits.

I will show you a graph and talk about how adaptive control works. On the vertical axis I have delay and on the horizontal we’ve got variability in delay. If you are familiar with the Highway Capacity Manual, that formula at the top is the Delay equation shown here. There are three variables related -- the first is the uniform delay. The second is the variable and the last is due to things like unpredictable things like vehicles coming out of driveways and startup losses. All of these things contribute to the total delay problem. If we don't do anything -- the delay tends to go up in terms of very ability. The way that most agencies find out is that they get complaints. We found out that complaints are the predominant performance measure used by agencies to assess how effective their traffic signal operations are. The way that agencies respond to complaints is that they will go out and periodically re-time the traffic signals. This creates effectively an instantaneous reduction in delay. But, as traffic conditions change, the delay tends to go up as conditions change in response to variability. Most signal timing is developed by inputting volume data into a signal optimization software and most of these are based on the highway capacity manual to some degree. These models tend to focus on that peak 15 minutes even though you are putting in two or three hours of data. Most of the timing is very responsive -- developed to respond to that peak 15 minute period.

What does adaptive control do? It is basically collecting the data that agencies would normally collect on the 3 to 5 year basis. It is collecting this data continuously and it is updating and fine tuning signal timing parameters in response to that data. That is a general description of how all adaptive systems work. It doesn't matter which one you select. All of them tend to work on this principle. As you get into specific technology, there are some differences and how they function.

In terms of benefits, obviously if we do re-timing, usually we do it before and after a floating car study, and we would identify the reduction in delay as these yellow parallelograms under the curve here. So what does adaptive provide in addition to that? So, in addition to re-timing, or say if you hadn’t done any re-timing, you’re benefit – or reduction in delay – relative to your adaptive control would be either the triangles (the purple area) if you had good timing, and if you did not, it kind of uncovers it’s shell area here. And the longer you go without re-timing, or should I say the longer that interval is, the larger the benefit you would tend to see.

So, if you start to look at benefits to adaptive control, and many of those are available, you can go on to RITA or Rhythm Engineering has several. If you go to the website, you can find these reports and they range in travel time reduction on a range of 10 to 90%. A lot of this depends on the timing was out in the field before the adaptive system was deployed.

In terms of saving cost, again, we are losing a lot of the costs associated to collecting data, and manually performing optimization.

Let's talk about where adaptive control has been implemented and how we gain the information to understand how it works. Since the mid-1980s we have seen about 70 implementations of adaptive control in the US. A large number of these deployments were considered demonstration or experimental implementation. This is important to note them as demonstrations is when agencies do these projects, the reasoning behind the demonstration project is to typically to learn something about the technology. Typically, there is no long-term commitment to operate the system. We implemented it to learn. The agency may not have the resources required to maintain the system over a long period. For that reason, on this map there are probably about 65 individual implementations, about 45% of these were in the demonstration category and not maintained. So, while we have learned a lot, the number of implementations from 1980 through 2010 is not as large as it could be if they were not labeled as demonstration projects.

I think this technology is mature enough that we could learn from these other agencies. We want to move this technology into the mainstream category meaning that when the conditions are right and the resources are sufficient, the agency would have this technology available and implement it with the commitment to operate it over a long period of time.

What we learned? Adaptive control systems produce substantial benefits. I mentioned these. We know that they are very effective when demand conditions are variable or unpredictable. We have a lot of retail, where there are special events and we have incidents. Anywhere when you are developing a signal timing plan you had some uncertainty about when a plan should start and end. The split times are often changing during peak times and you wish you could move the time around because you are getting complaints about left turns and side streets or vehicles stopping too frequently. You just can't seem to keep up. These are arterials that seem to work well with adaptive control. We have also learned that many arterials did to be the best location for this to be implemented. When it is a tight grid, so there some of the research shows that the time of day -- fixed signal timing works best. You want predictable patterns of progression. Also, under-saturated conditions is huge. Most of these systems operate under a single objective and maybe that is progression. Maybe it is throughput or minimizing delay. But, those are objectives that can be achieved in an under-saturated environment. If you are oversaturated and in the congested regime, you need to start managing queues. And there are only a few systems that have algorithms that detect congestion and shift from other strategies to managing queues.

What do we know about us? I was involved in the traffic signal report card. There have been three of them. One area where we have shown a potential for improvement is traffic monitoring and data collection. In 2005 and 2007 and 2012, we scored an F nationally, in traffic monitoring and data collection. And this is because agencies are really not collecting any performance data, we’re using complaints as our primary performance measure. So often as I’ve done workshops with agencies, obviously the Engineers that work on these, and the Technicians – they understand the traffic conditions, but in a lot of cases, it’s not well documented. And something else that’s not well-documented are what the Agency’s objectives are, and objectives plus understanding of the problem is really what should guide the solution that’s implemented.

There are over 16 adaptive systems available. In 2010 the NCHRP 403 synthesis study was done, the systems listed on the left are those available at the time the report was published. On the right are the ones available since 2010. There are 16 systems. How do you identify which one will work for your situation? How do you make this selection? There are a lot of questions that need to be answered. Not answering those questions represents risk. How do we deal with risk? Federal Highway Administration has developed an app for that. We have a process that we call systems engineering. This helps to better understand the problem and this is through a process of documenting needs and requirements. Needs identify what the agency would like to accomplish with or without the system, really. You need to understand in the presence of certain traffic conditions what you would do in this situation. You want to write that down as a need. Then, in response to that, you will decide how you would do that. Those are your requirements. The requirements describe what the system will do. By doing this and documenting it, it empowers you to develop a set of requirements and specifications to procure a system because ultimately adaptive control -- we will probably not develop any new systems. We want to procure an existing systems. We want the needs and requirements to guide this. In terms of managing risk, a key risk is that if we go with the sole source -- if we do the consumer reports method and say I have a system that I really like, how do we ensure that an unsuccessful bidder who did not have an opportunity to bid does not challenge that procurement? That is a huge risk.

More importantly, for these projects, systems engineering is required by federal regulation. That is rule 23CFR940.11.

What is the application we have developed? We have a document called the FHWA Model Document for systems engineering document for ASCT. The objective is to help you build that set of requirements. We pose questions about your situation, the problem, and about you. Then, we provide you with a list of answers to the questions to help craft your response—write these things down. We expect you to tailor those models or examples to your specific situation and there is also a set of companion requirements that you can go through and tailor as well so that what you put out is a set of requirements -- this will represent your needs and specific situation.

What does this allow you to do? It helps you to evaluate your needs against the available solution. I think it helps the vendors -- they know exactly what you need and you can in a very competitive environment allow them to propose their various solutions. You go through this process and keep tailoring your requirements and your concept of operations. Several questions need to be answers in terms of existing equipment -- do you maintain your existing controllers? Do you replace them? Is this gonna work with my central system? How do you group signals? We put together a great panel of experts. We have done over 20 workshops where we have gained the input of your peers and we just updated this document. It is available now in its draft form, but the final updated version will be available at the beginning of September.

Who has used our process? We have a host of states that have gone through this process and developed system engineering documentation or are in the process. Several of these states are in the procurement process. You will hear from a couple of them today. Hopefully, I did not miss anybody. I don't want to leave anyone out. “No State Left Behind,” I hope.

Here is my contact information -- if you would like a copy of the document, you can go to this link and download it. If you would like support in writing your system engineering documentation, we have been holding workshops all over the country to support agencies through this process. We are available for this. You can contact your division office or contact me directly. We are definitely in the business of supporting you as you go through that process. That is it for me.

Next I want to turn it over to Eric Graves.

Eric is the city traffic engineer with the city of Alpharetta. He has over 18 years of experience in design, management, and operation. He joined the city of Alpharetta in 2004 and is currently responsible for overseeing traffic operations, planning, and mitigating traffic impact due to new development. Prior to joining -- he was in the private sector, as a Transportation Design and Traffic Engineer. He is a registered P. E. and holds a BS in civil engineering from the University of Utah and has a master's degree in Public Administration from Georgia State University. Welcome, Eric.

Thank you, Eddie.

The city of Alpharetta is a suburb north of Atlanta. We have a similar bedroom community problem that many other suburban cities have. A little bit about Alpharetta -- we service about 50,000 residents. The daytime population is estimated to exceed 100,000 with large employers such as ADT, Hewlett-Packard, UPS, etc. We service a regional mall as well as the downtown area.

We also accommodate four interchanges with the Georgia 400 which is a limited access freeway. We manage over 120 traffic signals all on the GDOT standard ATC platform, which consists of 332 cabinets, 2070 controllers running the Seimen’s SEPAC firmware. We were one of the first to transfer to Ethernet communications and we have over 60% of our signals communicating with this.

From an operations standpoint, we have two public works crews. We have a traffic signal systems engineer and a traffic engineering technician all focused primarily on operations.

Our signal systems engineer was brought on in 2004 and we developed a traffic signal timing maintenance program where we do a systemic timing of our major corridor send traffic signals every 2 to 3 years. We detail our before and after travel time measurements. Our goal is to provide these -- this information to the citizens with a reporting system online.

Why would the city of Alpharetta look into adaptive solutions? We’ve worked diligently trying to come up with a state of the practice operations program. The fact of the matter is that we do not have any more funding for capacity improvement. Our systems are on the verge of being at capacity several times of the day. Our city is also built out and we are surrounded by other local city restrictions. We are landlocked. We do not have a lot of excess land to develop new roadways.

We have determined that it is essential that we do everything possible within our technology and our field to operate our system as efficiently as possible.

Why adaptive? Specifically, traffic was a top concern and still is even with the new initiatives with a system maintenance program. One of our council members was reading the paper and came across an article covering Cobb county’s SCATS system and directed staff to review how we could use this in Alpharetta.

My staff and I tried to determine when adaptive makes sense. It makes sense when you have unpredictable traffic flows specifically from high sustained traffic close three-way interactions with overcapacity freeway systems and both of these situations occur in Alpharetta.

We also discovered that adaptive requires a high agency capability -- and capacities as well. Our public works technicians -- they are IMSA certified. We keep our detection up and running. We probably have about 98% available at all times. We also have strong communications with our Ethernet system.

We also have some pretty significant engineering other capabilities in our organization. Even though we are a small city, we have 2 professional traffic engineers in-house and Atlanta is pretty well known for its engineering talent for traffic signals and systems engineering.

Once again, going back to the original box, we want to make sure that it is optimized as much as possible all the time. If the tools are available to do a better job, we want to pursue this.

We are looking at which adaptive system to pursue -- we tried to get down to the roots of what it meant. We came through with the thought process that a well-timed system is a well-timed system, whether it is done by a computer or completed by a systems timing engineer. We want cycle lengths that are appropriate for the volume's on the road, we want the split percentages that are balanced and prioritize based on the roadway. We want to make sure that we have provided the best progression as possible.

Our expectations were not some lofty outcome -- we want to save 20% travel time on all of our corridors. We didn't believe that was actually achievable because of how well maintained our system is. What we came down to – we wanted to find a system that would perform as close to our manual optimization as possible. We also wanted to make sure that we utilized our existing equipment as much as we could, and we wanted to make sure that we were able to provide some queue management and optimize progression and we needed to be aware of crossing arterials. We knew we were not going to be able to implement adaptive throughout all 120 traffic signals on day one of any implementation program. We needed to make sure that the system was functioning and providing benefit to the city before we went ahead and recommended that the city procure additional equipment. We knew we needed to be able to coordinate with the other systems that were not a part of the adaptive deployment.

The solutions we identified; we identified SCATS from Cobb County. It’s a well-known system and has been working for many years.

Similarly, SCOOT was available and we looked at ACSLite, and we also looked at IniSync. From our identified solutions, we actually performed (2) five-signal pilot projects across two different interchanges. Not necessarily at the same time but within a couple of years. InSync, we tried out both and SCOOT, and the results of our demo projects indicated we could find an adaptive solutions that would mimic our manual program pretty close actually, for the corridor that worked well -- travel times were not quite as good as manual timing, but they were within the realm of satisfactory. We did not have any of the key performance measures -- the complaint calls on the corridor during the SCOOT implementation.

The other systems we also looked at were SCATS, OPAC and ACSLite. All of these did not utilize our existing system as best we were hoping to do. At this point, we were sure that we could find something that would provide benefits.

What was the next step? We were in the process of an ITS program with three other jurisdictions and agencies. State Route 9 runs through the cities of Sandy Springs, Roswell, and Alphareatta, and it’s a State highway so it’s under the jurisdiction of GDOT. It is an 18 mile corridor that is a collector route in the northern suburbs and it parallels with Georgia 400. It is the primary backup.

The project management team for the highway nine order project identified adaptive systems as one of the ITS strategies.

Based on our experiences in Alpharetta with some of the testing we performed, we made -- they considered a performance specification, once again trying to utilize our existing hardware is much as possible and be compatible with the existing central systems. These were some of the key criteria.

When he came back for review from FHWA and GDOT, there was a sole source of specification and there were worries of protests from some other vendors.

So, FHWA stepped forward and said we have a solution for you. It is called Systems Engineering. The project team went through and did an additional Systems Engineering document for the adaptive solution within the ITS project. We had done a previous systems engineering report covering all of the ITS solutions, but for adaptive specifically, we came back to the drawing board and went through the process that Eddie mentioned earlier.

This identified pretty much the same functional requirements as the Alpharetta test projects. We wanted to make sure it was compatible with some of our hardware and we wanted to make sure that we were able to coordinate the non-adaptive crossing arterials.

This project was very successful. The process was also able to help us come forward and bring on board the other jurisdictions and cities to the same conclusions that Alpharetta had. Basically, SCOOT was going to do all of the those that we were hoping to accomplish.

The project has recently been given notice to proceed. It is going to be a construction project covering 33 signals and 18 miles. We are going to have two SCOOT systems that will be hosted in two separate cities communicating with access to the Georgia Department of Transportation.

If you have any questions on our experiences, my signal engineer, Eli Veith and my e-mail is attached as well.

That is my presentation. Thank you very much.

Thanks, Eric. Great presentation.

I will introduce Richard Mobarak with Bernalillo County, New Mexico.

Richard has worked for the last 16 years in the Mexico department of transportation and Bernalillo County public Works division where he currently serves as the technical planning manager with an infrastructure planning and Geo Resources department.

His activities include traffic engineering, planning, traffic operations and she is responsible for many areas of ITS including control devices, communication systems, detection technology, and traffic signal optimization.

He earned his bachelor degree at Stetson University in Deland Florida and he is completed additional undergraduate courses at the University of New Mexico. He is a registered PE in the state of New Mexico. Please join me in welcoming Mr. Mobarack.

Good afternoon, and thank you for the introduction.

I will start by explaining the signal systems in our area. The Albuquerque Metropolitan Planning Area which is the acronym that you see in the first bullet -- AMPA. This consists of more than 700 signals that are operated and maintained by several different jurisdictions. Bernalillo County – which is the agency I represent -- operates only 57 of those signals, but close to 90% of them are located along major corridors in the metropolitan area.

This is a map of AMPA and it shows the area that it encompasses. We plan to install our adaptive system on Alameda Boulevard. This shows the area. This white area that you see is an unincorporated area of Bernalillo County.

This is a densely populated area. The current daily traffic on Alameda ranges from about 22,000 to 38,000 vehicles per day. This traffic is expected to grow to 54,000 vehicles per day by 2015 and to about 70,000 vehicles per day by 2035.

This is the river crossing. It is the same situation that Eric references. It serves as a bedroom community and it is a major commuter route for those living on the west side and working on the east side of the river.

This corridor also experiences a substantial amount of truck traffic. There is another major arterial to the south of Alameda and there are truck restrictions on that arterial. We do end up with a lot of talk traffic on Alameda. This adds to the demands along the corridor.

Alameda Boulevard starting at US 550 -- I will show a map here later -- there is a total of 34 signals that go through multiple jurisdictions. It starts up in Rio Rancho, goes to the City of Albuquerque, and then goes into our section Bernalillo County, and then back to the City of Albuquerque. It is listed as one of the most congested corridor is in AMPA.

After we implement the adaptive system in the county area with some success with the system that we expect to get, we are hoping to expand the system into the other jurisdictions.

For our section, we have seven signals. They interconnect right now is twisted pair. And it functions as an actuated, closed-loop system. The cabinets are fairly old -- they are TS 1, NEMA cabinets, running Econolite controllers.

If the project goes the way we expect it to, we should have fiber-optic interconnect installed, along this corridor. And also have that fiber optic internet coming all the way back to the office. Right now, we don't have that. If it doesn't occur before this project occurs, we will have a DSL phone line drop to the master cabinet and communicate with the system via that until we get the fiber installed.

This gives you a better picture of the Alameda corridor. Up here in the upper left is in the city of Rio Rancho. This comes out then turns back to the east. This is the city portion of the Alameda corridor. The unincorporated area is here starting at traffic signal number 6. We have these 7 signals here all the way through the traffic signal number 12. This is where we are going to start the implementation of the adaptive system. As I said earlier, with some success here and with cooperation from the city, we are hoping that we could expand this adaptive system all the way to I 25 -- right here. And then also to the west, there are some traffic challenges. This is a densely populated area. There is a possibility we might wipe try to encompass from here to here.

We will just concentrate on our area at present.

Which is shown clearly here. Signal number 6 through 12.

A little bit about the traffic demands -- there is nothing different here for a densely populated area. We do have some pretty strong directional splits. It is about 75/25 eastbound/westbound with some heavy left turn call you on the Main line and the side streets.

We have a school at fourth street, where we do actually have some pedestrian issues because there is a lot of pedestrian traffic crossing the Main line. We are hoping to see with the adaptive system that it recovers more effectively from the pedestrians across the Main line than the existing closed loop system -- the existing closed loop system.

I mentioned that we have some high side street volumes especially on Rio Grande Blvd. This is to the west. We have a lot of high side street volumes there. We also experiences left turn spill over which reduces our two thru lane arterials into one arterial. We do have an issue with queue management.

Our objectives with the adaptive system are to improve travel time during the peak periods and the off-peak times. One of the peak periods that we will look at is the school egress which occurs in about 3:30. During this, we expect to see better recovery from the pedestrian calls across the Main line.

In the future we are looking at this as a transit priority corridor possibly with 2 jumper lanes and we are interested to see how we could implement that with our adaptive system.

Some of the challenges that we are facing with our project :

First, we have committed a fair amount of funding to this project.

Also, a fair amount of time and effort. We are asking ourselves -- will it work? We have every expectation that it will work, but it remains to be seen.

At present, the project has been awarded to a contractor, we do not have a notice to proceed.

Other items -- Acceptance by the signal staff -- how complicated it is the system and how difficult to maintain?

Acceptance by the traveling public.

Also, the recurring cost issue.

As far as a system failure, we will look particularly at how well the system jumps back to an actuated coordinated timing plan when the adaptive system fails, if it does. Our hope is that it doesn't. But, we will look at that.

Also, along this corridor we do have some interference from the adjacent system. At times, on the west side, traffic backs up into our corridor. We are somewhat concerned about this.

At Bernalillo County we did use the FHWA model systems engineering document to prepare our systems engineering document for the Alameda corridor. The goal was for use for the development for the bid document.

We started with the capabilities of our existing system, identified the needs that the existing system couldn't satisfy which brought us to what we saw as our envisioned system.

From that, we identify the type of system that would work best in our area which helps us develop system requirements which we used particularly for specifications.

The final phase of the system engineering document -- verification and validation process. This led us to the development of a performance-based spec. The reason we went this way is that I was somewhat constrained to go as a request for bid, and not do this as a request for proposal. I felt a way to get the best system to suit our needs was to use a performance based spec.

We installed Bluetooth travel time devices along the Alameda corridor and those are in the process of getting up and running right now.

We will look at the situation and look at the closed loop time and turn the adaptive system off – and the closed loop timing system in place, measure travel time along the corridor. Then turn the adaptive system on, and measure travel time.

We are also going to look at the amount of delay on the side streets and expect the delay to not increase significantly. Between the adaptive on and off, in order for 100% payment of the project, we are expecting to see a travel time reduction of 10%.

The low bid award was difficult for the adaptive system. The performance based spec helped a lot. Another comment about the systems engineering model document is that we did feel it was somewhat more detailed than what we needed for the type of system we planned to install.

For your information, the project is awarded although it is not gone through the commission meeting yet. We did award the project to a local signal contractor and they will install the InSync system.

Moving forward -- we will monitor the ongoing satisfaction with the system and the benefits to keep it up and running versus the effort to maintain it. Hand in hand with this is the complexity of the system. We do have a training regimen planned as part of the contract. We will be looking at the reliability of the system. This is also important -- public acceptance and policymaker acceptance of the system.

The bottom line is that Bernalillo public works is committed to improving traffic flow on the Alameda corridor including possibly expanding it into other jurisdictions with the implementation of the Adaptive signal control.

And that completes my presentation. If you have questions, feel free to contact me by phone or e-mail.

Thank you.

Thank you, Richard. Great presentation. I’m going to go ahead and go to John Thai with the City of Anaheim.

He has 24 years of experience. He has held positions with the city of Los Angeles and Irvine. He is currently the city traffic engineer with the city of Anaheim where he has worked since 1997. His current position is responsible for everything regarding operating and managing the city’s traffic signal system. There are some significant special events -- consider that you have the Ducks, Angels, Disneyland, convention centers, etc. He has a lot of events to deal with.

In spite of that, he still finds time to contribute and he is currently serving as the co-chair of the advanced traffic controller working group. He is also the chair of the NT CIP -- national transportation communications ITS protocol.

He also chaired the panel that recently developed the study that developed the guidelines for yellow and all red intervals. He is registered PE in electrical and traffic in California.

Welcome, John.

Thank you, Eddie

I would like to talk today about implementation of adaptive lights in the city of Anaheim. To give you a feel for the city of Anaheim, we have about 340,000 residents. It is home to Disneyland resorts. Major league baseball -- the Angels, and the NHL’s Ducks and recently the US women's national volleyball team that competed in the Olympics. We also have the Anaheim convention center -- the largest on the West Coast. With all these activities, we get over 20 million annual visitors. Regarding our system, there are approximately 320 single light intersections communicating over a star configured, single-mode fiber optic network.

We also control full-size 15 matrix dynamic message signs to guide visitors to parking facilities during special events.

This network of devices is controlled at the traffic management center, where we are staffed from 7 AM to 6 PM and we also cover all special events that meet an attendance threshold. Our staff consists of three full-time engineers, several full-time signal technicians and part-time event operators that come in during part-time during these hours.

Our specialty is active event management.

This is a snapshot of the resort and stadium events area. It consists of a series of fine-tuned arterial networks including Ball Road and Katella for East/ West, and Harbor, Anaheim, and State College Blvds for North/ South.

These projects were recently completed as a part of the traffic light synchronization program. And in this slide, the arterials are optimized to run AM, midday, PM, and weekend plans. And signal timing plans are locked at key intersections where the arterials cross.

The new thing to happen in this area that made us consider adaptive control is there is a new Disney Toy Story lot on the southeast corner and on this facility, they added 2600 additional spaces. There are shuttle buses to Disneyland to accommodate varying tourists conditions and there will be varying Park hours it will change week by week. There is talk of a new theme park built on the southeast corner also just south of the parking lot.

We have our work cut out for us.

Regarding these objectives, we looked at this and said, really there is no other way to control traffic other than active traffic management, but what we are not staffed and when conditions occur that we are unaware of, what is the best way to do this? We are hoping that adaptive signal control will accommodate our needs. We looked at our objectives and our needs and what we wanted was a straightforward algorithm and user-friendly interface so that operators can operate during times when we are not here. We want a straight forward integration, and cost effectiveness. We want to maintain system integrity and importantly, also, we want the staff to buy into this and it is not a flavor of the month kind of thing.

Needs and objectives -- in the adaptive solution objectives, we wanted a do no harm if poor detection policy. We do not have a crew on board. It is important that an adaptive algorithm must be able to not do too much damage in case detection is poor. This is until we can get a chance to repair it.

What we wanted, also, in the system is that did not want the cycle length to be changed -- altered because we just had all of these arterials than just having those five intersections with varying cycle length will do more damage than good.

We also want the algorithm to fine-tune the splits to accommodate varying demands and to fine tune the offsets to accommodate for varying platoon arrivals.

The adaptive solution must have a user-friendly interface. This means that we have a lot of part-time operators to come in to work events. These part-time operators may come in two or three times a month. Their familiarity and the learning curve is a must for us.

The adaptive solution must have a lot of MOE so we can monitor and see how well it is working so we can stand up event and turn it off if necessary if it doesn't perform as expected.

The cost effectiveness -- and system integrity – we are concerned with per intersection cost as well is the central license cost. This must be cost-effective for us, because we do not want to find out later on that we have to add a bunch of additional modules that we were prepared to do. So, we wanted to get it in with our infrastructure is much as possible -- what do we have in the traffic management centers systems wide and what do we have in the field that will give us the ability to integrate this smoothly? Importantly, ongoing maintenance -- will maintenance staff embrace it? Is this so difficult that they can't do this, or is it something we have to get extra expertise from outside?

In this slide we are talking about how ACS lights it into our system. Here is a signal plan at Harvard Blvd. and Katella Ave. Video detection zones are set at the stop bar detectors. And detector lead cables are used for system detectors. ACSlite operates best when lane by lane detection is available. Phase utilization manages the space lifts by leveraging vehicle extension and gapped out logic of the controller. It aims to balance the degree of utilization across all phases. As for flow profile, system detectors measure approximately recurring patterns of flow arrival to the signal. The ACS lite looks at the beginning of the green interval (at the adjacent signal) and at platoon arrival at the current signal to fine tune the offset. This is straightforward and it is something we can understand and that operators can pick up quite readily.

The question we want to ask is how well does adaptive perform against free mode and optimized timing plans. We want to look at travel times that we can measure directly -- delays, average speed, and stops and emissions that we will estimate from the CMEM model –that’s the Comprehensive Modal Emissions Model developed by UC Riverside. In our evaluation methodology, we collaborated with the University of California at Irvine to perform data collection and perform evaluation. We used GPS data loggers to collect over 450 runs for Harbor Blvd, and over 330 runs for Katella Avenue.

Field runs were collected from 8 AM to 7 PM to look at three operations and optimize coordination plans and optimize coordination plans with ACSLite on top of it.

The GPS data was downloaded to traffic software to assess performance and estimate the vehicle emissions.

So, you can see from this one that for East/ West there are 56 runs that were collected for free mode, 58 for coordinated plans, and 55 for ACS light for westbound.

Here are the results.

We found that for the most part, ACSLite does work as we predicted. It works very much in unison with a coordinated timing plan. Sometimes, adaptive will perform better and sometimes slightly less. This is to be expected because what we did with our timing plans was we only gave the lights maybe six or 8 seconds to maneuver. It does not have much time to work with. We see that in general ACS performed much better. As long as I'm on this slide -- I may as well bring up that the green data line that was collected for Katella was corrupt so we did not include it on the slides.

Delays -- you also see that ACS light performed relatively consistently with time plans. There are times that it will perform as well as sometimes it doesn't perform as well.

But, always those are pretty close.

Re: speed -- you can see that during the busy time of day, the ACSlite tends to do better than a coordinated timing plan for northbound. For southbound, it doesn't do quite as well for the free mode during off-peak.

This is the fuel consumption model that we talked about. In this model, we also see the ACS lite performs well. In some instances, like Katella eastbound, it consumes less gas than coordinated mode.

Our preliminary findings -- we are encouraged to see that the selected system tried to do the right thing. It is hard to see from the snapshot, but this is an actual flow profile snapshot and if you look at the blue lines that marked underneath -- what shows is that this is the time that the detectors detect the arrival -- the amount of actuations. There are three lanes. The green bars on top represent the time at which the signal is green for that movement. What you are seeing -- we want the majority of the blue stripes to be underneath the green stripes. As you can see, the ACSLite does this pretty well in trying to adapt to this so the offsets capture the arrival of the platoon.

We also found out that not much can be gained from adaptive control if a system is perfectly tuned and well-maintained. This is true because suppose you have an operator that is constantly aware and on top of system management all the time for all intersections. An system cannot do as well as a live operator who uses cameras and all the tools at their disposal to actively manage traffic.

We also found that we would need a larger study area and sample other than these five traffic signals.

What is ahead for us is that we plan to expand adaptive capability to 24 additional signals. It is the heavily traveled arterial across the city. But, we also need evaluation -- to see how it affects left turns and side streets? We want to look at non-ideal cycle lanes and non-through traffic MOEs, and non-coordinated phases, and correlating adaptive system MOE’s to how it really performs in the field. We want to see how well this represents what we see in the field. I will conclude by saying that this presentation and some of the other preliminary results are posted on this website that you see on the slide here.

That concludes my presentation.

Thank you, John, great presentation.

Hello, this is Eddie Curtis. We will now go to the national Q&A forum, for about the next ten to fifteen minutes. I am going to start with the questions typed into the chat pod.

I will start with one that would ask about maintenance. This was to the city of Alpharetta. The question was -- what did the timing maintenance program consist of?

It consisted of breaking our system into the major corridors and doing a systemic timing of each corridor every 2 to 3 years where we go through and did the standard program of gathering data and manually making timing plans for the corridor's. We are on our fourth iteration of this since our implementation.

Next question would most ACS systems be able to document traffic data to show improvement or where you might need improvement in areas? The general answer to that question is yes. But, going back to the system engineering process that I described, we do address this under performance monitoring and data collection and it system engineering document. This is a question that the agency would describe as they need. The agency would like to monitor the performance of the adaptive system and there would be a series of requirements to put in your specifications so that the vendor could respond and describe how they would accomplish that.

The next question -- since one of the benefits is to reduce fuel consumption, would CMAQ funding be available?

Our highway nine is a CMAQ project. They came forward and offered to pay 100%.

Thanks, Eric.

There is a memo floating around Federal Highway talking about eligibility for operations and maintenance. O & M – many categories of Federal funding will accommodate O & M projects, to include adaptive control.

Next one – O & M – after the system is implemented, they want to know if there are any case studies or information on how to address operation and maintenance.

I would say that that is not well documented; a lot of this goes to my original description of implementations. Most of those were demonstration projects, and I don’t know that Operation and Maintenance was something that was well documented. However there is a study that Indiana DOT is initiating, that will explore this in more detail, and I think as the agency continues to operate their adaptive systems, if they continue that, we will make an effort to document it as part of Every Day Counts. We do have a project that’s looking at that.

Next – do you have any case studies of how multijurisdictional coordination has worked with ACS systems?

I don't know if we have any case studies. Do you want to describe this, Eric?

Well once again the State 9 project covers three local jurisdictions as well as the state agency. So, our study project was initiated with a concept design, a final design, and now a construction implementation. We have all worked well together. So far, so good.

Next question -- people are under the impression that ACSLite is available through FHWA at no cost. Is this true?

John Thai is on the line, with the City of Anaheim -- can you respond to this question?

You need to obtain a license from the vendors that you are buying it from. You can purchase a license for a system and you can also buy an individual -- per intersection basis of 225 at a time.

Eddie: We don't provide this for free. Your cost will be determined by what you negotiate with the vendor.

Next -- how does a local agency determine which software is best for them to implement?

That is precisely the nature of my presentation. I would describe that as systems engineering. Part of the process is and alternatives analysis. So you take your documented requirements and it is like a shopping list. Line them up against all of the available systems and you can determine which systems will meet your needs. We recommend going through and RSP process, a best value method of procurement. Allow the vendors to propose a solution to your needs and requirements.

Next question -- this is for Eric. Do you have any data we can see in terms of before and after studies?

We haven't gotten to the point where we are publishing this data online, but that is the goal. If anyone would want to send me an e-mail or a contact, I would be glad to share some of the studies and things we have put together.

I will add that this presentation will be available on the EDC website in the next day or so.

Let's check with Heather -- any questions on the line?

Yes, there is one. One moment.

Go ahead.

From the United States Virgin Islands --

Okay Virgin Islands.

Here's my question -- the main corridor in Charlotte Amalie (city) is also a tourist area. During the week you might have five or six cruise ships -- can it adjust it to the variable unpredictable in pedestrians that you have several times through the year?

The response to that is that in general I would say yes, adaptive can respond to that.

Your pedestrian requirements -- pedestrians are not an objective that is typically addressed with an adaptive system because we don't have -- we don't optimize for pedestrians, but it should be able to accommodate the needs you identify in optimized vehicle traffic in that context. That goes back to systems engineering. You have to describe and articulate those objectives so that you can have a vendor propose a solution that will meet your needs.

A follow-up question -- if you have a variable space as far as intersections is concerned, does that make a significant difference if you try to do the adaptive system?

Variable spacing -- Eric you want to respond to that? I think that the State Route 9 corridor is not evenly spaced intersections.

Correct. The variable spacing reduces the number of really good solutions available. I don't think it is a limitation of adaptive, but how well the system will function and that type of thing.

Let's go back -- any other questions on the phone?

I do have another question from the phone line.

Ok, let's take that one.

This is Greg Novak of the Nevada division. We’ve been talking to our local folks. The question came up -- detection is important to adaptive signal control. Will the systems engineering process help us figure out what type of detection to use – video? Loops? Others? Or some combination of that?

I don't know that we go into detection. One of the things that we know is important and I think Eric articulated this well -- you have to have a strong maintenance program so that they detection is reliable. Usually the systems are collecting volume and or occupancy information. Some of that data is coming via the controller in the form of contact closures. Other systems may pull that data directly from the detector. I think you need to set a constraint as to whether you want the system to use an existing detection. If you are going to add to detection is a part of the design, then the system engineering process would proscribe how you would install the detection as part of the design.

This is Eddie Curtis I will start off by responding to some of the chat questions. The first one I want to take is from Kansas City. Is system engineering only required when using federal dollars?

I will let Richard respond to that.

We didn't have federal dollars for our project. I needed to develop a good set of specifications for the adaptive system. So, I used the systems engineering document. First, to determine whether or not the adaptive system was appropriate and secondly to lead us to some system requirements that we could use to develop the specifications for the bid document.

That was totally my choice. It was supported by the county. We were not under federal requirements to do a systems engineering document because there were no federal dollars in this budget.

Thanks, Richard.

I will take another question from the chat box related to the use of SCOOT. There were questions about Anaheim's former SCOOT system and the cost of SCOOT.

This is Eric. Our project is an ITS project down the whole corridor to connect it all. The SCOOT itself is coming in at about $30,000 per intersection. A little bit less as you add on to that. From the bid, the initial base system was about $230,000 for 20 intersections. Adding 10 more intersections for the licensing now – is another 35,000. On top of that, you needed to have the system detection for the SCOOT system, so, on average it’s $30,000 a little bit less the more you go up.

John Thai, can you address your former SCOOT system?

Sure. This was done in 1997. As far as the federal field test to evaluate how well SCOOT does without having to construct additional loops required for the system to run well. After the application, we stuck with SCOOT for another five or six years and after that demonstration, we didn't.

Related to a comment I made during my presentation -- field operational tests and demonstrations are not really intended to be long term implementations and often they don't last or stay in place over a long period of time.

Here is a question from Maryland -- when do we NOT do adaptive control? When is it not a solution?

The System Engineering documentation does address that issue, in fact we first asked you to explore your existing operation and other alternatives that have been implemented in response to the issues you are seeing on the street or desiring to mitigate with adaptive controls. We explore this and it is a critical part of the analysis.

Next question -- from Chicago, for Bernalillo County. Who made the decision on the product after the performance spec was measured?

I can answer that. Right now, the system is not in place. But, we already have in the contract that the evaluation is going to be done by our Metropolitan Planning Organization. While we were designing the project we switched from having a private engineering term doing that because we didn't think it would be the most comfortable approach versus having another government agency independent of us to do the evaluation.

Thank you, John.

I have another -- from Massachusetts LTAP-based state roads program. Can you explain how you pay for the system? You purchased, tested, and then were reimbursed correct?

That is for Eric.

Our system is just barely in the construction phase -- the big project – yes, we will be reimbursed for invoices we received from the contractor. We will forward those onto the state to be reimbursed.

I have another question I will throw to Eric since you're on the hot seat. This is from GDOT Atlanta. Does the system engineering process only help determine the type of system? Or can it determine if adaptive is a good system to use?

When we went through the system engineering process, we also discussed regular timing maintenance as well as traffic response systems and try to evaluate those against the criteria we identified as critical for the corridor.

We felt that we had more advantages with the Adaptive system.

That is similar to another question -- the System Engineering documentation answers does respond to that question.

This one is for Anaheim from Danielle in Michigan. For Anaheim, did you look at InSync as well? Here's another question -- was System Engineering a part of your project?

I would like to answer Danielle’s question -- yes, we did look at the InSync system. Not only InSync but various other adaptive offerings. We concluded that ACSLite was the best and for us the most cost effective.

Regarding the question on the systems engineering, we did do a quick systems engineering process. We did this project before the document was published, so we had our own systems engineering review to make sure that we addressed as many concerns as possible.

Thanks, John. I will add, too -- Richard mentioned that the systems engineering document was detailed. FHWA published the document as a draft back in August 2011. For the last year we have used it in 20 workshops. We brought it back in and we have updated it and that update will be available in early September. We have reduced a lot of the complexity.

Here is another one from New Hampshire. With the system engineering document, does that help identify a good candidate? Or oes it only provide optional requirements after it has determined a good candidate?

I can answer that. It provides you with a list of requirements that allow you to evaluate which available technologies will respond to those requirements. We recommend that the way that the accomplished is through an RFP process and some states actually use an RFI to allow the vendors to respond in advance to give them an idea whether or not the requirements are realistic.

So, we have had to caution some agencies to exercise discipline and not asked for everything because if you do that, there is not a system that meets every single requirement listed in the document.

Heather, any questions on the phone?

There are two callers.

Hello, this is Robert from Puerto Rico. We have a question. We have heard about improvements in delays, travel time, progression, all related to the adaptive signals. Are there any evaluation made with safety -- what to do with the pedestrian crashes? Also the environmental emissions and this kind of performance measures?

There are some studies that look at safety. I haven't seen many looking at pedestrians. In fact, I haven't seen any. Environmental is usually included. With the delay study, you can estimate environmental savings to your emissions. CO2 and whatnot.

Those are available. I don't have a bunch of them on the FHWA website, but they are prevalent and you can do a couple of searches for it. There may actually the some on the website -- RITA website – Research Innovation Technology Administration.

Next Question?

I have a follow-up.

Is anybody using real time measurements in terms of environmental performance? Using equipment on the road?

I will take that one.

There was also a question from MS Ltap.

We use GPS data loggers to collect data out in the field what we did the timing run. We insert that into a model -- a comprehensive model. The Comprehensive Modal Emissions Model, and that one was developed by UCR. I provided a link on the chat box.

They’re very real devices that you plug into the back of the tailpipe and all these fancy electronics. We don’t have access to those, but UC Riverside does. They use these items to develop the model.

Heather, do we have another question on the phone?

We do.

EPA used to be the model of choice. Now, there is some other model which was used in this process. This was the model that provided by somebody other than ETF, probably. You would probably have to divide -- provide a calibration to allow for model verification process.

Yes. My understanding is that the EPA sponsored this program.

Good.

Another question -- you said that the adaptive system is almost the same as a well-timed system. How do you define a system as well-timed ?

John Thai: I am of the school that I know better than a computer. If I use the data coming in coupled with cameras and all my resources, I tend to make better decisions than the computer system. So I’m saying that, if I fine-tune the system and I am constantly actively managing it, I will do better than an adaptive system could. If I fine-tune my system is much as I can, -- we are all taught in traffic engineering to use a low cycle length to reduce delay. We do that, often times there can be five or 6 seconds to spare for the adaptive system to play around with. In the system doesn't change cycle length because it has to play within those parameters, there is only so much you can do. That is one of the questions that we have for the next iteration. Looking at -- if we threw out a non-ideal cycle length -- let's say 120 is ideal and we gave it 140, how well will it do?

Thank you John.

Let's go back to the chat pod. I have one from Virginia. Is system engineering done on a statewide, regional, or individual corridor level?

I think we have seen some variety of each. I think that it can be done on a statewide or regional basis to set some high-level functional requirements. As long as your individual project -- the needs are consistent -- you can use that statewide or regional document and refer back to it. We have seen a few states that said we don't want to do an analysis for every project. Can we do it for certain types of corridors? That is a way to approach it.

I think there was another one on the capabilities of ASC -- whether it can do cycle lenths, and things like that?

John, can you address that one?

Basically, adaptive ACSlite-- there are several flavors of it are available from different manufacturers. There is a manufacturer that is working on making cycle length changes a possibility in the near future. Some other vendors are not as updated on developing ACS lights. So they have the version that’s only splits and offset.

Here's one from Columbus, Ohio. Does anyone have experience using red light camera enforcement within an adaptive system? If so, is very concerned that the onset of a red being variable and challenging to driver expectations?

This is Eric. We do have red light running cameras. At both our tests -- the two test project that we had our adaptive systems on. And we will have one on the highway nine corridor. It is been my experience that the better timed your signals are, the lower occurrence of red light running we had. Prior to this, we made sure that our signals were timed as optimally as possible. I don't think this will have a problem with running in concurrence with adaptive. And driver expectations.

Eric, another quick one. This will be the last questions we can answer. It is from Alabama DOT. Has the SCOOT system improved their interface to more of a Windows type of environment?

The quick answer is that it runs on top of Windows. As far as the interface goes, it is definitely not a modern computer program.

Unfortunately, we are out of time. Questions we were not able to address during the call will be answered in the exchange.

I will bring up the slide as we close that has my contact information and a link to the EDC website. I would like to thank you for participating. Thank you to the presenters, Eric, Richard, and John.