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ITS Midwest NEWSLETTER

Illinois, Indiana, Kentucky and Ohio

www.itsmidwest.org

President's Message

Congratulations! ITS Midwest held its Annual Meeting on September 28-29, 2017 in Columbus, Ohio. I would like to congratulate the organizing committee for their hard work. They should be proud of their accomplishments. I think this year's meeting was one of our most successful. Attendance was the highest in many years. Exhibitors and Sponsors `exceeded our expectations. The theme this year, "Connecting Smart Cities" coincided with the City of Columbus being awarded the Smart Cities Project. I also want to thank the speakers for taking time out of their busy schedules to provide our membership with timely and informative topics, such as connected and autonomous vehicles.

Congratulations are in order for our Project of the Year recipients. This is the first time we had a tie for Project of the Year. I would like to congratulate the City of Naperville for its Centralized Transportation Management System (CTMS) and the Indiana Department of Transportation/ Kentucky Transportation Cabinet for their Ohio River Bridges Projects. We had seven projects submitted for consideration this year. All agencies should be proud of their accomplishments.

The ITS World Congress 2017 was held October 29, - November 2, 2017 in Montreal Quebec Canada. As one of the highlights of the Congress, ITS Midwest was recognized by ITS America as the Outstanding State Chapter Division I for 2017. Congratulations to the ITS Midwest membership for their participation and contribution towards winning this award.

I strongly encourage each of the four state chapters to get involved with the ITS Professional Capacity Building (PCB) program being offered by ITS America and the U.S. Department of Transportation. There are 12 programs available. Please feel free to contact Carlos Alban calban@itsa.org or me, ken.glassman@jacobs.com for additional information.

Finally, I want to congratulate and welcome Shaelin Bhatt for his appointment to President and CEO of ITS America. Shaelin currently serves as the Executive Director for the Colorado Department of Transportation and will assume the duties of President and CEO of ITS America in December. I had the opportunity to talk with Shaelin at the World Congress and offered the assistance of ITS Midwest.

ITS America awards ITS Midwest the Outstanding State Chapter (Division I) for 2017

Ken Glassman, President of ITS Midwest

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Annual Meeting Summary

ITS Midwest 2017 Conference – Columbus, Ohio
September 28-29, 2017 at the Crowne Plaza Hotel in downtown Columbus, Ohio
by ITS Midwest Staff

The ITS Midwest 2017 Annual Meeting was held at the Crowne Plaza Hotel in downtown Columbus, Ohio on September 28 and 29, 2017. The ITS Midwest Annual Meeting was again combined with the Great Lakes Regional Transportation Operations Coalition (GLRTOC) Annual Meeting, which allowed a great opportunity to leverage the strengths of both organizations for the benefit of all of our membership.

The theme for the 22nd Annual Meeting of the Intelligent Transportation Society of the Midwest (ITS Midwest) was "Connecting Smart Cities." This reflected the emerging emphasis on connectivity across vehicles and with infrastructure towards the ultimate goal of autonomous vehicles. Research has shown that such a future will reduce crashes, injuries, and deaths on our roads and highways.

Keynote Speaker Jim Barna of ODOT addresses the assembly

The two day event included a "Brewcadia" Thursday evening social event, which allowed participants to sample a wide variety of local craft beers while playing vintage arcade games. This was a wonderful event which highlighted the hospitality of our host State of Ohio.

The technical tour was an exciting guided visit to the Ohio Center for Automotive Research (CAR) of The Ohio State University. The tour highlighted the various automotive fuel efficiency, speed, electrification and alternative fuel projects being pursued by the staff and the Ohio State students who participate in the Center's programs. CAR's mission is to prepare the next generation of automotive leaders, and is recognized for advanced experimental facilities and interdisciplinary focus on systems engineering.

The heart of the event was a terrific program with nearly 25 technical presentations and 27 exhibitors. In addition to connected and autonomous vehicles, there were presentations on Smart Cities, multi-state collaboration, transportation systems management and operation, commercial vehicle operations, safety innovations, incident management, work zone ITS, transit applications, federal updates, and new and innovative technologies.

Our President, Ken Glassman, opened the meeting and noted this was one of the largest ITS Midwest Annual Meetings, with over 130 registered attendees. He then introduced Keynote Speaker, Mr. Jim Barna, Chief Engineer of the Ohio Department of Transportation (ODOT).

Mr. Barna currently serves as Assistant Director & Chief Engineer for ODOT overseeing policies and program direction for all highway divisions including Planning, Engineering, Construction, Jobs and Commerce, Legislative Affairs and Innovative Delivery including Public Private Partnership Procurement. He oversees ODOT's policy, research and deployment of connected vehicle technologies.

Mr. Barna spoke of initiatives currently underway within the State of Ohio, especially those that involve connecting transportation using ITS technology. He noted that Ohio is pursuing development of a State-

Luncheon Speaker Jason Goldman, Vice President for External Affairs and Stakeholder Engagement at the Intelligent Transportation Society of America (ITS America) addresses ITS Midwest wide Center for Connected Vehicles and Infrastructure.

Our Luncheon Speaker was Jason Goldman, Vice President for External Affairs and Stakeholder Engagement at the Intelligent Transportation Society of America (ITS America). Jason oversees ITS America's relationships with its state chapters. To further ITS America's public policy agenda, Jason engages in coalition-building that involves outreach to state and local governments as well as third-parties. As part of his work managing the ITS America Advocacy Trust initiative related to bringing thought leadership to transportation technology issues emerging over the next three-to-five years, Jason is focused on the policies needed to advance the creation of smart communities. Additionally, Jason serves as the legal policy counsel for the ITS America Cybersecurity Task Force, and contributes his extensive policy expertise to ITS America's legislative and regulatory efforts.

Mr. Goldman provided a preview of the upcoming ITS World Congress in Montreal, with over 11,000 ITS professionals expected to be in attendance. He also provided an overview of ITS America's programs and priorities.

The State of the States update was introduced by our President Ken Glassman. Presentations were made by Justin Potts (Illinois), Dan Shamo (Indiana), Jennifer Walton (Kentucky), and Ed Williams (Ohio). These representatives briefed the assembly on the progress of ITS projects within their respective States over the past year, and provided a preview of next year's initiatives. The Illinois Highlighted accomplishment was the I-90 Tollway corridor in Illinois. In Indiana, the installation of DMS and CCTV in the Indianapolis and Seymour areas, and Truck Parking as part of the TIGER funded project were highlighted. In Kentucky, noted projects included CVO Parking project using TIGER funds, the Ohio River Bridges project, and using 'ITS Big Data' to pursue Work Zone safety project using WAZE data. Ohio is completing the US 33 Smart Corridor, as well as innovations at the Transportation Research Center.

ITS Midwest Past President David Zavattero (center) accepted the ITS Midwest Excellence in Service Award from current President Ken Glassman (left) and Recognition Chairman Dan Shamo (right)

Upon the conclusion of the State of the States segment, the ITS Midwest Business Meeting was held. The Election of Officers results were announced, with the selection of a new Board Member (Abraham Emmanuel). All other officers remained the same. The ITS Midwest proposed by-law changes were approved as submitted. Past President David Zavattero was presented with the ITS Midwest Excellence in Service Award for his many years of promoting ITS initiatives and programs.

The luncheon was held at the conference site, the Crowne Plaza Hotel. The 2017 ITS Midwest "Project of the Year" awards were announced. The 2017 ITS Midwest "Project of the Year" award for the Most Outstanding ITS Project had strong contenders this year, including:

- Illinois Department of Transportation project to determine the safety effect of adaptive traffic signal systems;
- Illinois Department of Transportation Chicago Area Arterial Construction Tracking System (ACTS);
- The City of Chicago's Advanced Traffic Management System (ATMS);
- The City of Naperville, Illinois Centralized Traffic Management System (CTMS);
- Evanston, Illinois Emerson Street and Green Bay Road signal interconnect project;
- The Ohio Department of Transporta-

ITS Midwest Vice President Dan Shamo (left) of AECOM presents ITS Midwest Project of the Year Award to Tom Szabo (right) of Christopher B. Burke Engineering, Ltd, accepting on behalf of the City of Naperville, Illinois

ITS Midwest Indiana Vice President Dan Shamo (left) of AECOM presents ITS Midwest Project of the Year Award to Todd Hood (center) and Tim Emington (right), accepting on behalf of the State of Kentucky

tion US 33 Smart Mobility Corridor project, and

- The joint submittal from the Indiana DOT and the Kentucky Transportation Cabinet for the Ohio River Bridges project which constructed two new bridges over the Ohio River between Indiana and Kentucky.

And the winner was … A tie between the City of Naperville, Illinois Centralized Traffic Management System (CTMS), and the Ohio River Bridges projects! These two deserving projects shared the 2017 ITS Midwest "Project of the Year"!

ITS Midwest Indiana Vice-President Dan Shamo (left) presents ITS Midwest Project of the Year to Dan Shamo (right) of AECOM, accepting on behalf of the State of Indiana.

On Thursday afternoon a roundtable discussion on "The Future of ITS in the Midwest" was moderated by ITS Midwest President Ken Glassman, and other notable presentations included "The Future of Connected and Automated Vehicle Testing" by Ron Burton of the Ohio Trans-

In Session 4 – "New Technologies," Patrick Coyle of CITEL discussed how to protect field-deployed ITS equipment from surges and electronic degradation. The event concluded on Friday with closing remarks by our Conference Chairman, Ed Williams, who thanked the assembly for their attendance and their support.

The ITS Midwest Annual Meeting provides a forum where members and vendors can showcase their progress in planning and deploying state of the art technology Intelligent Transportation Systems.

ITS has grown from a fledgling industry to a major factor in the future of transportation in the United States and around the world. ITS Midwest and our members can take pride in the contributions being made through technology to achieve safer, more informed, and more efficient travel. Yet, much remains to be accomplished.

Thanks and appreciation goes out to all of our vendors who exhibited, and special thanks to our sponsors including our Gold Sponsor Jacobs Engineering, our Give-A-Way Sponsor M H Corbin, LLC, and our Silver Sponsors Baldwin and Sours, CHA Design/Construction Solutions, Christopher B. Burke Engineering, Ltd., and ITSE.

Brewcadia social event mixed pizza, beer and video games

The Ohio Center for Automotive Research staff and Ohio State students show off their fuel efficiency project for the ITS Midwest Annual Meeting attendees

2017 Solar Eclipse Blocks Sun and Lanes

by ITS Midwest Staff and Peter Rafferty, P.E., PTOE, AICP
University of Wisconsin Traffic Operations and Safety (TOPS) Laboratory

The total eclipse of the sun on August 21, 2017 provided a glimpse into both the operations of our solar system and the operations of our transportation systems. The eclipse path of totality ran from Oregon's western border and moved through Idaho, Montana, Wyoming, Nebraska, Iowa, Kansas, Missouri, Illinois, Kentucky, Tennessee, North Carolina, Georgia, and finally exited from South Carolina.

Original pre-eclipse estimates of attendance varied in their apparent accuracy, with some areas of the nation experiencing greater volumes than expected, and turnout lower than expected in others. Traffic impacts also varied from place to place, with some areas experiencing volumes only slightly above normal and other areas overwhelmed with unusually high volumes.

Northwest USA

In Oregon, from Friday through Sunday in the three days before the event, slightly over 600,000 vehicles entered Oregon via five of the busiest border crossings: Interstates 5, 82, and 205 from Washington into Oregon, I-5 from California into Oregon, and I-84 from Idaho into Oregon. Those figures were 9.7 percent higher than the same three-day span last year, when 555,516 vehicles crossed those points, Oregon DOT traffic counts showed: (see table below)

In addition to these routes, many motorists could have entered the state on less heavily traveled roads, such as Highway 97 at the California-Oregon border or I-82 at the Washington-Oregon border.

While the traffic counters couldn't distinguish eclipse watchers heading to Oregon from commuters passing between southern Washington and Portland, the data do show heightened travel activity across much of the state compared with a year ago, especially from California.

On the Monday afternoon after the eclipse, there were substantial traffic backups reported on Interstate 5, state highways, and local streets. State Department of Transportation cameras showed stop-and-go traffic on northbound I-5 and southbound I-5, within minutes of the moon completely blocking out the sun along the path of totality.

By early afternoon, traffic was bumper-to-bumper on I-5 north from Salem to Portland and south from Salem to Eugene. This heavy traffic continued through Monday afternoon and into the evening. By about 9:30 p.m. traffic along I-5 had finally dissipated.

The Great Lakes Regional Transportation

Oregon and Idaho Interstate Congestion, 1:00-2:00 PM Local Time


Midwest States, 3:00-4:00 PM Local Time

Oregon Department of Transportation

Roadway	2017	2016	% Change
Interstate 5 (California to Oregon)	55,422	30,645	+80.9 %
Interstate 84 (Idaho to Oregon)	37,389	33,196	+12.6 %
Interstate 205 (Washington to Oregon)	239,608	232,089	+3.2 %
Interstate 5 (Washington to Oregon)	222,017	206,518	+7.5 %
Interstate 82 (Washington to Oregon)	54,952	53,068	+3.6 %
Total	609,388	555,516	+9.7 %

I-57 at Midnight

ISP D-10 Pesotum @ISPDistrict10 Aug 21
Northbound I-57 is still very thick. Please travel safe and use caution.

Operations Coalition (GLRTOC) undertook an analysis of traffic impacts on the Interstate system arising from the eclipse. GLRTOC, with the University of Wisconsin-Madison, leveraged the National Performance Management Research Data Set (NPMRDS) and previously developed algorithms to identify and graphically depict anomalous traffic conditions. While GLRTOC is focused on Midwest states, the analysis was extended nationwide for purposes of the eclipse analysis.

Midwest US

As discussed in the August 2017 issue of ITS Midwest's article on the solar eclipse, Southern Illinois University (SIU) was near the point of greatest duration for the eclipse, located a few miles south of the City of Carbondale. Carbondale and SIU coordinated a large number of special events associated with the eclipse. The city provided for shuttle service and shuttle parking locations to ease travel within the city during the eclipse weekend, and promoted shuttle bus service between the downtown and the Southern Illinois University campus.
An estimated 50,000 people traveled to Carbondale, which was in the area of longest duration, city officials reported the day after the eclipse. Southern Illinois University-Carbondale reported 14,000 tickets were sold for the main eclipse events at SIU Stadium. Traffic volumes on major roads leading to eclipse viewing areas were above average, but reports indicate traffic congestion prior to the eclipse event was not severe.

On the Monday afternoon shortly after the completion of the eclipse, traffic volumes and congestion rose dramatically as large number of motorists crowded the few northbound expressways which connect the eclipse viewing areas to the metropolitan regions in northeastern Illinois, in southern Wisconsin, and in southwest Michigan.

Illinois Department of Transportation (IDOT) spokesman Guy Tridgell said the department warned motorists before the eclipse to anticipate major traffic jams. "We knew it was going to be a busy day," said Tridgell. "The good news, there doesn't appear to have been any major safety issues, and the public deserves a lot of credit for that."

To handle the traffic, lane closures for major state projects in southern Illinois were temporarily lifted during the weekend before the eclipse and the following day, and IDOT used digital message boards to communicate traffic and safety messages.

The eclipse had barely ended, and IDOT was already warning that "traffic is very heavy in the totality area, and backups are numerous." The department was still reporting delays at midnight. "Northbound I-57 is still very thick. Please travel safe and use caution," it warned in a tweet. The Illinois State Police District 10 tweeted a photo just before midnight showing northbound traffic at a standstill near Rantoul on Interstate 57.

Traffic volumes remained elevated from afternoon on Monday August 21 through much of Tuesday August 22. Although construction lane closures for major state projects in the southern Illinois area near the eclipse were temporarily lifted during the weekend before the eclipse and the following day, construction related lane closures far distant from the eclipse caused major traffic delays. In the vicinity of Rantoul, Illinois (about 200 miles north

of the eclipse viewing area) I-57 was down to one lane, and northbound traffic delays were substantial.

Motorists took to social media to commiserate on the length of their return trip. Tweets included:

- "I 57 North is a complete mess all the way from Metropolis to Chicago,"
- "Left metropolis at 2 pm after a wonderful eclipse experience and have been on the road for 13.5 hours and still 120 miles to Chicago."
- "The nightmare road trip is almost over. Blocks from home. For anyone counting, it took us 16 hours to get home."
- "The Disaster on I-57 continues for Ecilpse watchers. Highway down to one lane north of Rantoul. Who thought this was a good idea tonight?"
- "We live in the car. This is our life now. We are one with the seat. (On hour 8 of a 6.5 hour drive. 3 more to go)"

Kentucky

In Kentucky the crowds were generally lighter than expected. Preparations for larger crowds made the work easier for the Hopkins County Emergency Management Agency, Madisonville Police Department and Hopkins County Sheriff's Office. The strategies they had planned to best control large crowds left them well prepared.

After the solar eclipse ended Monday afternoon the few roads out of Hopkinsville were quickly jammed with traffic. As of 3 p.m. Monday, the Pennyrile Parkway, Western Kentucky Parkway and I-69 interchange were jammed for several hours, and drivers were still on the roads trying to get back to Louisville more than seven hours after leaving Hopkinsville.

Missouri

Eclipse traffic in some areas of Missouri was reported to be lighter than anticipated. In Jefferson City eclipse events officially ended Monday evening and the actual turnout was estimated between 20,000 to 30,000, not as high as the expected 50,000 pre-event projections.

Reed said MoDot prepared people for heavy traffic throughout the weekend and on Monday, but it ended up being lighter than expected.

The traffic in Columbia and Boone County picked up shortly after the eclipse was over. Staff at the Boone County Office of Emergency Management said that overall, the eclipse did not severely affect traffic or any other type of emergencies.

Lessons Learned

The August 21, 2017 solar eclipse was a learning experience for all. Some lessons learned:

- Travel-shed analysis can be valuable to identify major travel paths between the event areas and populations centers.
- National data sets make multistate analyses possible, informing future collaboration on performance management. Visit GLRTOC's interactive eclipse map at http://www.glrtoc.org/operations/performance/eclipse/
- Construction closures on major roads along major travel paths should be avoided, even when these closures are far from the event location.
- It's difficult to make accurate crowd projections for such an unusual type of event.
- It's better to over-prepare than to under-prepare for such events.

Lessons learned from this eclipse can be applied to the next total solar eclipse which will be on April 8, 2024, which will include the states of Texas, Arkansas, Missouri, Kentucky, Indiana, Illinois, Ohio, Michigan, Pennsylvania, New York, Vermont, New Hampshire, and Maine.

In Carbondale, Illinois event planners are already looking to the future. This region in southern Illinois is not only in the path of the 2017 eclipse, but also the 2024 eclipse, making it a unique location for being able to perform observations of both eclipses from the same location.

Southern Illinois University officials have already started the online countdown to 1:59 p.m., April 8, 2024, more than 2,400 days away.

Member Spotlight – TrafficCast

That's OD to you - Lexicon and detection technology are important to Origin-Destination study success.

Paul Misticawi - TrafficCast International
Dennis So Ting Fong - TrafficCast International

Bluetooth® re-identification data has enabled traffic engineers to perform origin-destination (OD) studies for years to facilitate data driven decisions. Many exciting projects have been completed, from the simple modeling of an interchange's 12 movements to complex endeavors like modeling I-95 in Pennsylvania from Delaware to New Jersey to understand road and, more specifically, ramp use.

In Illinois, the I-55 (Stevenson Expressway) was modeled from the I-90/I-94 (Dan Ryan Expressway) past I-355 (Veterans Memorial Tollway) to determine if observed usage patterns warranted additional lanes.

Through TrafficCast direct involvement and interaction with our equipment users, we have seen many different kinds of projects confidently and correctly called OD studies or OD analyses. However, in developing software tools to support OD studies, we have come to realize that OD is not a "term of art" with a precise meaning. This lack of precision is typically not debilitating or even troublesome when professionals talk amongst themselves, but poses some challenges when using software, or at times when talking to the outside world.

BlueARGUS Origin-Destination 2.0 – An Expanded Data Analysis Suite

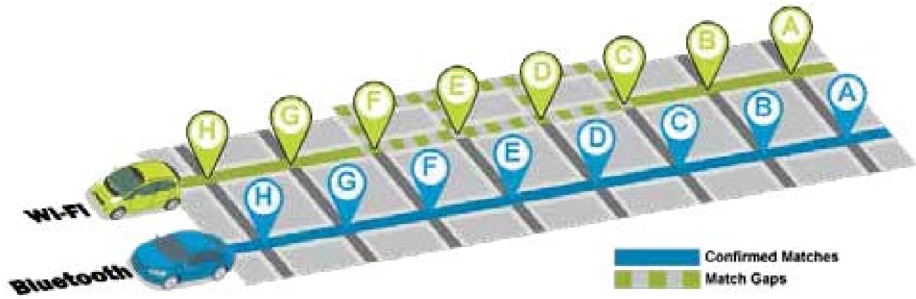
TrafficCast is releasing OD 2.0 on its BlueARGUS platform. OD 2.0 extends the use of the trove of data created by the 24 x 7 x 365 data collection that is going on along many roadways by progressive jurisdictions around the country. Through an easy to use interface, this new tool will allow the analyst to construct the study in advance of data collection setup and without regard to any prior use of the data. The tool provides a practical way to extend the analyses. What had typically been only point to point analysis may now also include zone to zone, zone to point, or point to zone. For example, the analyst may group all the vehicles leaving a campus in order to see the usage paths in all compass directions without having to be concerned with the particular campus exit used by the traveler. In a second example, planners may choose to use the tool to model travel between two suburban shopping areas into their respective surrounding neighborhoods.

The BlueARGUS OD software has no ambiguity about a zone. A site (or sensor) is either inside or outside the defined boundary. If a device is detected by a sensor that is part of the zone, then it is counted for an OD that starts or ends in the Zone. While Zones are likely contiguous geographical areas, the software is unique in that it does not require this constraint. For example, a zone can be defined as the combination of two completely separated geographical areas. We have seen our users be creative in application of the technology, using the tools beyond what we even thought possible. We expect to see the same creative use of the OD feature.

Bluetooth® and Wi-Fi Detection Technology Comparisons

While testing the new OD suite of features, we compared OD studies using both Bluetooth® and Wi-Fi detections. With respect to matches of MAC IDs (the useful data points from re-identification technology), Wi-Fi detection does not meet the quality of Bluetooth® detection even when the raw number of Wi-Fi MAC ID detections significantly outnumbered Bluetooth® raw detections. In re-identification technology, matches (recordings of the same probe detected at more than one location as confirmed by its unique MacID) rather than raw detections (time stamped data recorded

I-55 Managed Lane Study - Veterans Memorial Tollway (I-355) to Dan Ryan Expressway (I-90/94)



by a single device) are the key data.

In our experience, the quality of OD data from Wi-Fi is poor when compared to Bluetooth® because downstream Wi-Fi detection is not as consistent as that of Bluetooth®. In our analysis of data from a number of studies, we found gaps in the Wi-Fi data where several sensors within a route did not report detection, whereas the probability of re-identification for Bluetooth® consistently tests well above 90%. The illustration above shows two example trips along the same, or similar, roadway - one by a Wi-Fi detectable vehicle and one by a Bluetooth® detectable vehicle, each passing the same number of sensors.

For either higher speeds or increased trip lengths, the drop in likelihood of downstream detection with Wi-Fi data appears to significantly worsen; greatly impacting both the magnitude of the matched pair results and the consistency of matched pair detection – both of which greatly impact the quality of the OD analysis.

On longer routes, Wi-Fi detection inconsistency is more apparent. For example, we investigated travel times for each paired Wi-Fi MAC ID and compared the calculated travel time to reasonable travel times on the most direct route, as well as travel times for non-direct routes between the same two end points. In many cases, the combination of roadway type and travel time strongly suggest that the detected Wi-Fi probe vehicle must have taken the direct route yet the probe was not detected at each sensor along the direct route. Logically, if each detected vehicle trip took the time equivalent to the free flow travel time of the direct route than there was not enough time to have taken a longer alternative route. Identifying the likely path for each of the Wi-Fi MAC_IDs confirmed the gaps. The gaps explain why the percentage of vehicles detected at all sensors along the route for the Wi-Fi data was much lower than for the Bluetooth® data.

Data analysis doesn't work perfectly to support explanation of a gap or missing data but based upon the many cases where driver options were limited by the roadway and by travel time, the data strongly suggest a direct uninterrupted trip. Combining evidence of direct uninterrupted trips with significant gaps in Wi-Fi detection, the simplest hypothesis possible is that Wi-Fi has some use characteristics that make it less applicable for OD because the downstream detection rate is highly variable.

Experience Reduces Ambiguity

The Wi-Fi based data anomalies analysis combined with analysis tools developed for a study done along I-55 outside Chicago led to the development of the Trip List function. With the Trip List function, the software follows the probes through the study area and lists the paths taken by trip (referred to as trip chains or paths). A count of like trips taken by vehicles is created. This tool provides the flexibility of being able to look at the data in another dynamic way because the software follows the data and the analyst does not have to anticipate possible behaviors. This functionality was rolled into the new OD as well.

During the I-55 project we came to realize fully the ambiguous meaning of the term 'OD data'. For this project, we processed millions of individual records down to a very typical looking OD table and shared it with the team. Upon review, our partners pointed out that the OD matrix must be wrong because ramps at a particular interchange only allowed exit by northbound traffic and entrance to southbound traffic. After the work was carefully reviewed and no errors were found, some thoughtful discussion with the team and the end user client revealed that the problem was in how each team member defined the term OD, not in the data itself. The real error was misunderstanding which question was being asked: either where did they go or how did they get there?

The most commonly requested OD based upon client usage is what we have named Demand OD. Demand OD provides counts from every start or origin to every sensor or destination in a trip. For example, let's consider an OD with only two trips along a route that had 5 sensors named A, B, C, D & E. If one trip started at A and ended at E and the other trip started at B and ended at D than the OD matrices would look like the very simplified examples shown below. Each row is a start and each column is a destination. Note that in the Demand OD matrix, the trip from A to E also registers trips from A to B, A to C, and A to D and

			Demand OD		
	A	B	C	D	E
A	0	1	1	1	1
B	0	0	2	2	1
C	0	0	0	2	1
D	0	0	0	0	1
E	0	0	0	0	0

			End Point OD		
	A	B	C	D	E
A					1
B				1	
C					
D					
E					

for the trip that began at B and ended at D, it registers trips from B to C and B to D.

We contrast that with a second type we call End-Point OD. In this matrix, only the start and end of trips are noted. End Point OD tells nothing about the routes taken through the network but does illustrate another useful view from the same data set, that of final destination.

These examples, though greatly simplified, illustrate two ways of looking at an OD and underscore the point that simply telling people you are doing an OD study may give them a general idea of your task but tells them little about the issue under investigation.

A shared understanding is the goal of OD, convergence on the precise use of terminology will help us gain some of this understanding while also making software tools easier to use correctly.

Note: Bluetooth® is a mark owned by the Bluetooth Special Interest Group (SIG). The content of this article contains no intention to infringe or establish ground work for any rights in excess of the use rights allowed by the SIG.

BikeMoves Illinois -Mobile App Provides Route Data for Planners, Information for Cyclists

Matt Yoder
Transportation Planner
Champaign County Regional Planning Commission

Bicycling is a growing mode of transportation in Illinois, but data about bicycle route choice and the impact of bicycle infrastructure are scarce. Champaign County Regional Planning Commission (CCRPC), in partnership with the Illinois Department of Transportation (IDOT), is working to create an ongoing source of bicycle route data using BikeMoves Illinois, a free mobile app for Android and iOS.

As an app for both cyclists and planners, BikeMoves Illinois serves two related purposes. For cyclists, the mobile app provides an up-to-date source of information about the bike network in their community. It includes the locations of all on- and off-street bicycle facilities in the Champaign-Urbana urbanized area, as well as bike racks and bicycle-related businesses. For planners, BikeMoves Illinois provides key route data to inform bicycle planning. Cyclists can use the app to record and share their routes anonymously with planners, and those routes are automatically compiled and analyzed for use in bicycle planning.

Traditionally, collecting information about bicycle routes has involved asking cyclists where they ride. Planners use surveys or map boards to record the routes that cyclists use most frequently. However, these manual collection approaches suffer from several limitations. Key among these is the problem of memory: cyclists often have difficulty remembering the routes they use, particularly in cases where the trip is infrequent. Digitizing and analyzing routes collected in this manner can be time-consuming, limiting the number of routes that can be collected. In addition, manual collection techniques provide only a single, point-in-time snapshot of cycling activity, and the routes they produce often lack metadata such as the time of day, speed, and rider demographics.

Based on these limitations, some communities have turned to smartphone applications as a means of collecting bicycle routes. The CycleTracks family of apps—first developed in San Francisco, and later customized for Atlanta, Philadelphia, and Austin, Texas—is one of the most influential open source apps designed for this purpose. As it was originally conceived, CycleTracks was designed as a utilitarian tool for recording and sharing routes. Additional features were deliberately excluded to avoid influencing cyclists' route choices.

CycleTracks was implemented as two separate native apps: one for Android, and one for iOS. Since native app development is costly and labor-intensive, however, most of the communities that

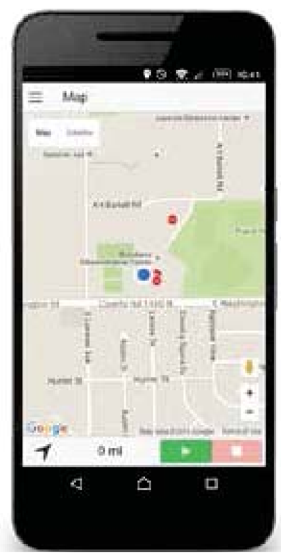


Exhibit 1. Version 1.0 of the BikeMoves Illinois mobile app, released in August 2016.

have used CycleTracks have not continued to maintain and update the apps after the initial development phase.

With BikeMoves Illinois, CCRPC aims to address some of the shortcomings of existing open source cycling apps and create an ongoing source of bicycle route data. BikeMoves allows cyclists to record and share their routes with planners, but it also gives them access to CCRPC's data on bicycle facilities and bike parking. The app is developed using the Ionic Framework, a hybrid platform that uses web

Exhibit 2. Promotional bicycle seat covers. CCRPC staff distributed the seat covers on the University of Illinois campus and at events.

technologies like HTML and JavaScript to create a single codebase for both Android and iOS. These technology choices are designed to make BikeMoves Illinois easier to maintain over time.

For the initial prototype of the BikeMoves app, CCRPC staff partnered with computer science students at the University of Illinois at Urbana-Champaign. Based on the students' work, CCRPC staff continued to develop the app and released the first version in August 2016 (Exhibit 1).

Following the release of BikeMoves Illinois, CCRPC staff promoted the app to raise awareness and increase downloads. The project staff maintained a blog and an e-mail newsletter with updates about the app and used raffles to incentivize e-mail sign-ups. They engaged with the local media to raise awareness about BikeMoves Illinois, resulting in several stories on local television stations and a column in the local daily newspaper.

Along with media outreach, CCRPC used in-person strategies to promote BikeMoves Illinois. Staff designed promotional bike seat covers (Exhibit 2) and distributed 2,500 of them throughout the community. They also distributed promotional materials and talked with cyclists at a variety of bicycle-related events. Social media played an important role in letting cyclists know where they could connect with CCRPC at events (Exhibit 3) and find more information about the BikeMoves app.

Based on feedback received from users of BikeMoves 1.0, CCRPC developed a new version of the app with a variety of improvements. Version 2.0 (Exhibit 4) includes a cleaner user interface with easier navigation. The map uses vector imagery that renders clearly on screens of any size and resolution. The new version features an automatic recording feature, which senses motion and starts and stops the trip without requiring user intervention. It also includes improved charts to help cyclists track their riding over time. Version 2.0 was released in July 2017, and CCRPC continues to refine and improve the app based on user feedback.

While the mobile app is the centerpiece of the BikeMoves project, another important component is a suite of tools for analyzing and visualizing the route data. When users of the BikeMoves Illinois app share a trip with planners, the data arrive on the server as a series of GPS points recorded by the phone. In order to analyze the trip, these GPS points must be matched to the street network. A tool called Open Source Routing Machine processes the GPS points and selects the most likely route based on the time, speed, and location of each point.

In order to detect patterns in cycling behavior, the matched trips are then overlaid on the street network. An analysis tool developed by CCRPC generates statistics for each street segment, including the number of trips, the number of unique users, and the average speed for the segment. These statistics can be mapped to provide a visual representation of cycling activity in the community.

Exhibit 3. CCRPC staff at Urbana Park District's Neighborhood Nights.

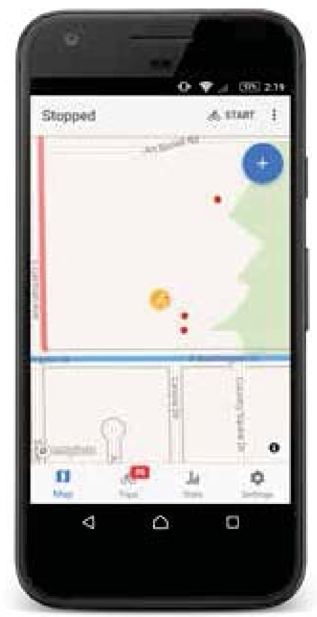


Exhibit 4. Version 2.0 of the BikeMoves Illinois mobile app, featuring an improved map and automatic recording.

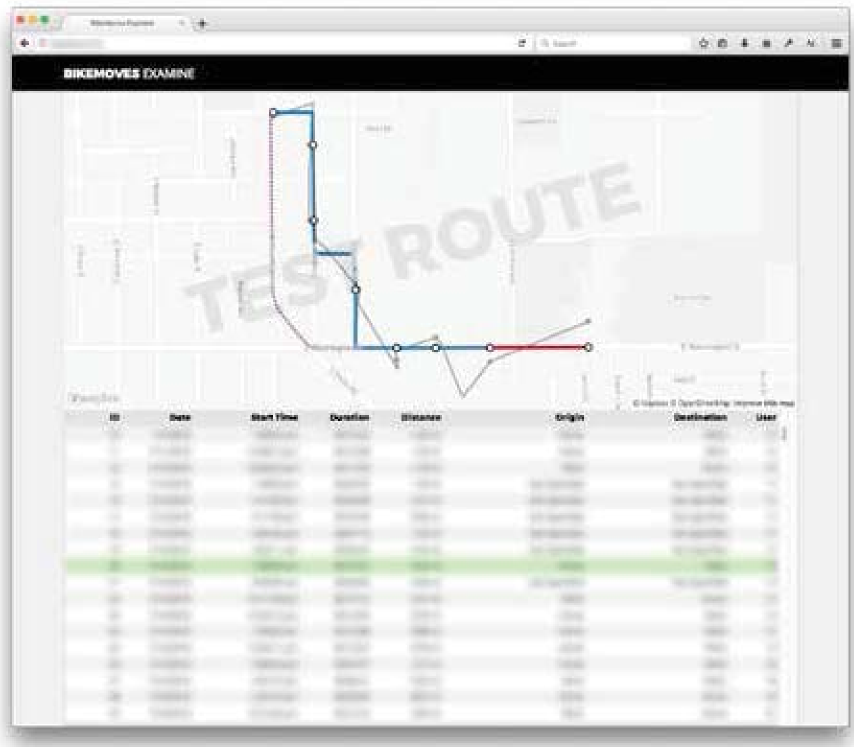


Exhibit 5. Details of a test route in the BikeMoves Examine web tool. Staff can see the GPS points (gray), matched route by speed (blue and red), and alternative routes (purple).

CCRPC is currently developing two web-based tools to visualize the BikeMoves Illinois data. BikeMoves Examine (Exhibit 5) , a private app for CCRPC staff, will allow planners to view the details of individual trips. They will be able to view the route taken and see details for each segment of the route, including the speed the cyclist was traveling. Planners also will be able to see any trip metadata provided by the user, including the origin and destination type.

The second web tool, BikeMoves Explore (Exhibit 6), will allow the public to view aggregated BikeMoves data. It will feature charts showing demographics such as age, gender, and level of cycling experience, reported by users, trips, and distance. BikeMoves Explore will also include an interactive heat map showing patterns of cycling activity in the community.

The BikeMoves project is an ongoing effort, and CCRPC continues to improve both the mobile app and the analysis and visualization tools (Exhibit 7). Currently staff are working to compare alter-

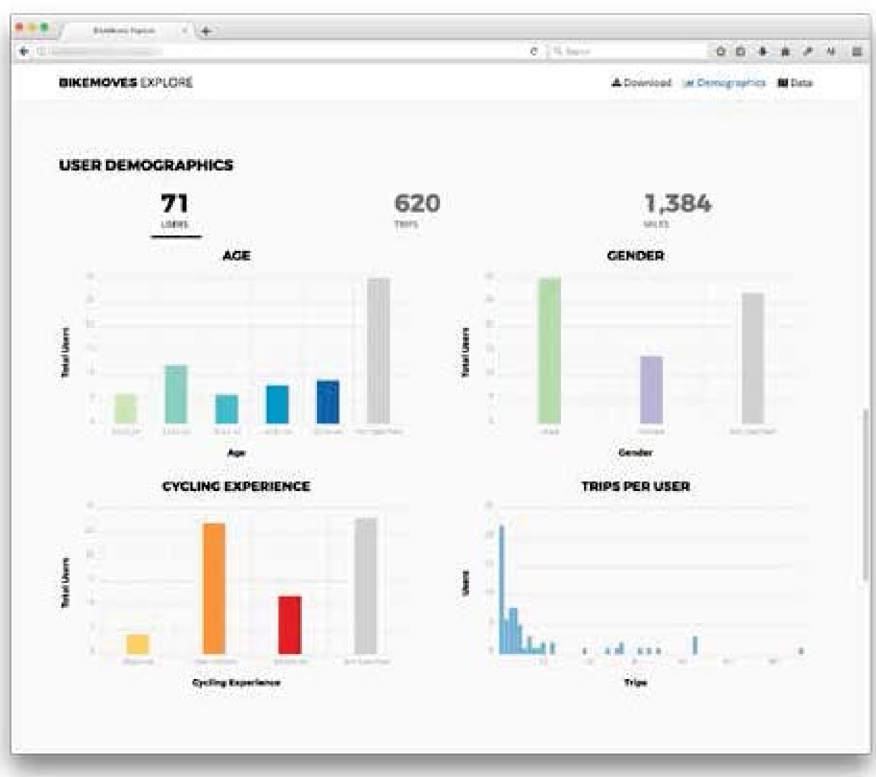


Exhibit 6. Charts showing user demographics in the BikeMoves Explore web tool.

native routes, such as the fastest route, to the actual route taken by the cyclist. This analysis will shed light on which streets and intersections cyclists prefer, and which ones they avoid. It will also allow planners to see whether cyclists go out of their way to use bicycle infrastructure and whether there are locations that could benefit from additional infrastructure or improvements. The data and analysis from BikeMoves Illinois will inform future planning efforts undertaken by CCRPC, including the long range transportation plan, bicycle plans, and trail plans.

The BikeMoves Illinois mobile app is available as a free download through the iOS App Store and the Google Play Store. More information is available at the project website, https://bikemoves.me.

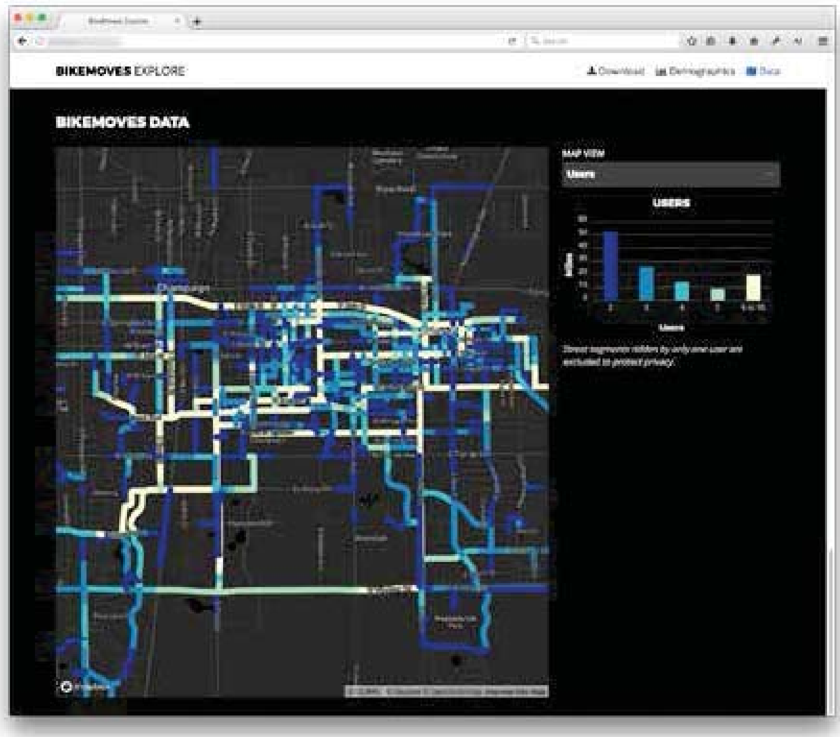


Exhibit 7. A heat map showing the number of users who rode on each street segment in the BikeMoves Explore web tool.

City of Naperville, IL Centralized Traffic Management System

Kelly Dunne, PE – Project Engineer
Andy Hynes – PE, PTOE – Deputy City Engineer

Naperville's Existing Traffic Signal System

Located 28 miles west of Chicago, Naperville, IL, is home to over 145,000 people and covers approximately 39 square miles. The majority of the City's signal equipment was installed beginning in the 1980's through the first half of the 2000's. The City maintains 95 of the 165 traffic signals located within the municipal boundary. These signals are typically connected to one of numerous separate interconnected signal systems that are located along arterial routes. The software running each of the City-maintained systems can be remotely accessed from a dial-up phone connection. While still capable of performing essential tasks, this existing traffic signal communication and monitoring system is becoming obsolete and cannot accommodate the newer functions allowed by the current generation of traffic signal management systems.

County-wide Traffic Signal/Intelligent Transportation System Management Strategy

Recognizing the higher levels of congestion on the regional street network as well as the practical limits of infrastructure expansion, a strategic framework for the development of Intelligent Transportation Systems was completed in 2007 to enhance the efficiency and safety of the highway system. This effort was led by DuPage County, IL in cooperation with various stakeholders (including the City of Naperville) and is captured in a document titled the "Transportation Coordination Initiative" (TCI).

The deployment of an integrated traffic signal management system and traffic signal optimization techniques such as adaptive traffic control were identified as priority projects in the TCI. The City programmed a two phase project to implement both a new traffic signal

Exhibit 1 Existing Traffic Conditions in Downtown Naperville

management system as well as adaptive traffic signal control along the Washington Street Corridor (See Exhibit 3). This project involved interconnecting three existing closed loop systems (32 traffic signals with nine miles of fiber optic interconnect) and represents the initial phase of a longer term goal to incorporate all of Naperville's signals into a single network.

DuPage County was also interested in modernizing their traffic signal management system. Naperville and DuPage County coordinated their designs to allow for future center-to-center communication. The City of Aurora's existing system could also be integrated to collectively form a regional virtual traffic management center.

Funding

As the signal system improvements described above involve significant capital costs, the project is contingent upon receiving external funding. The City applied for and received federal Surface Transportation and Congestion Mitigation and Air Quality Funding for the project. These programs covered approximately 75% of the construction and construction engineering costs for the project.

System Engineering Process

In order to receive the federal funds, the preparation of a Systems Engineering report was required to explain the vision and detail key aspects of the project. As DuPage County was simultaneously pursuing similar signal system improvements, Naperville and DuPage County jointly prepared and submitted a Systems Engineering report for the Centralized Traffic Signal Management Project to the Federal Highway Administration. After a few iterations, the Systems Engineering report was approved by IDOT and the FHWA.

Exhibit 2 Traffic Management Software Screenshot

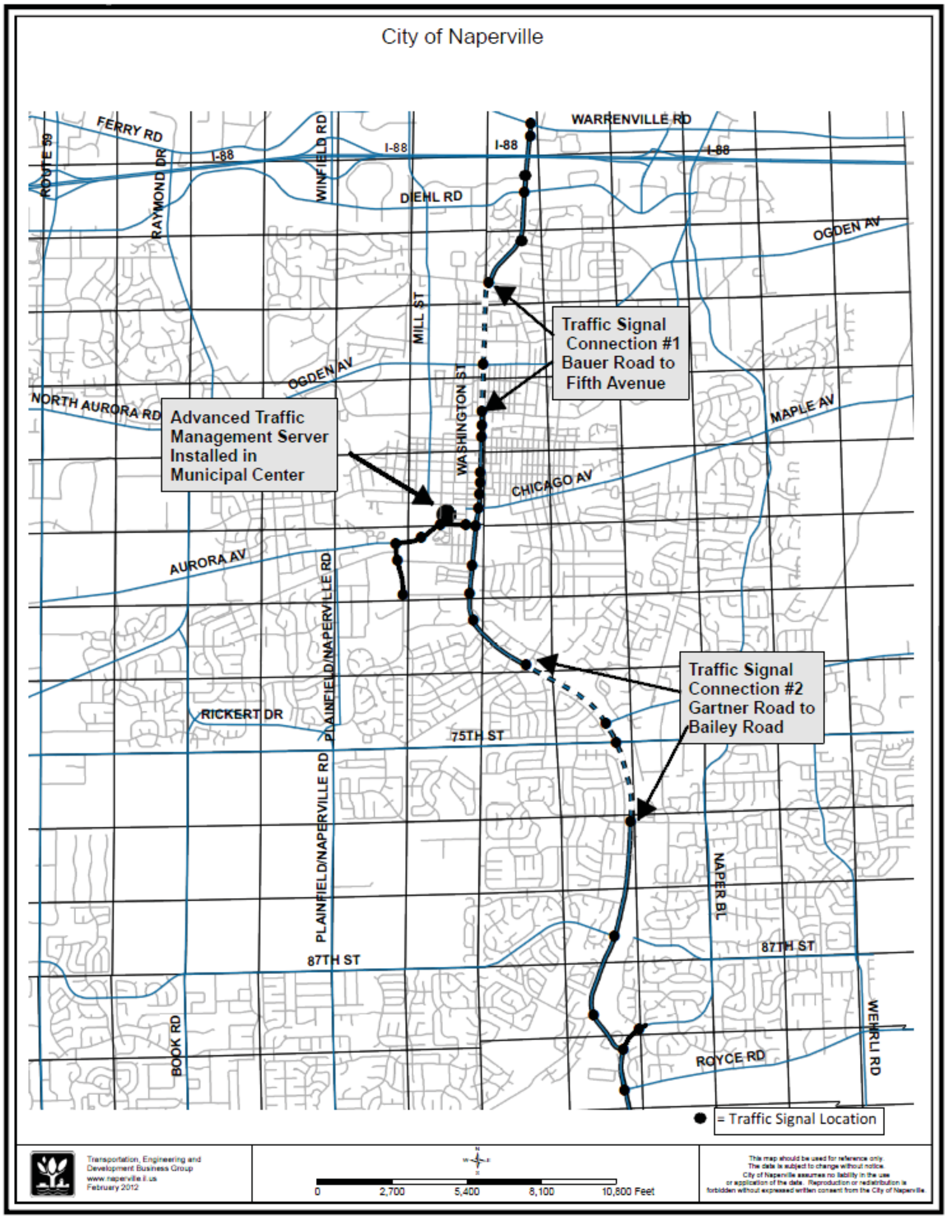


Exhibit 3 Washington Street Corridor Signal Interconnect Map

Software Selection

The traffic management system software is the key to a successful deployment. Numerous "off the shelf" software products are available. However, there are significant differences between them.

The four submitted vendor proposals were scored based upon the detailed requirements defined in the RFQ/Systems Engineering report by a multi-agency selection committee. After reviewing the proposals and the associated scoring, the selection team decided to only pursue negotiations with the top scoring vendor. The Traffic Control Corporation/ Econolite (Centracs software-Exhibit 2) proposal was the only submittal that met all of the critical system requirements.

The City and County each negotiated a cost and a scope of work for the deployment of the traffic signal management software. A special provision that included the negotiated scope of work and cost was inserted into the construction contract.

System Design

The City hired Christopher B. Burke Engineering Ltd. (CBBEL) to design the overall signal system upgrade and prepare the associated plans and specifications. CBBEL inventoried the existing signal equipment and identified the new components needed to make the system function as envisioned.

Significant coordination was needed with both IDOT staff as well as with technical experts from the traffic signal equipment and software manufacturers to ensure all of the project elements were compatible.

Deployment

The project was let in September of 2015 and construction began in spring 2016. Along with the City, the project team consisted of CBBEL as the design consultant, Econolite as the vendor, Traffic Control Corporation as the supplier, H&H Electric as the general contractor, and HLR Engineering as the construction engineering consultant.

The field work consisted of upgrading the fiber connection within the existing interconnect system, installing new fiber along the corridor between the three existing interconnects, upgrading the controllers, installing other equipment such as layer II and layer III switches in order to provide network functionality, and installing pan-tilt-zoom (PTZ) cameras. Ancillary work conducted throughout summer and fall 2016 served to integrate the system and configure the network. Ongoing coordination between the City's IT department, Econolite, and Traffic Control Corporation was critical in bringing the centralized traffic management system on line.

Centracs was fully functioning in fall 2016 with a system verification and acceptance in October, as was specified in the Systems Engineering report. The vendors provided City staff with several training sessions on using Centracs.

Operations and Functionality

The software for the Centralized Traffic Management System (CTMS) is set up on two work station computers and large display screens (Exhibit 4) in the department's signal room, allowing staff members to monitor intersection operations in real-time.

The CTMS has been crucial in responding to resident concerns. Residents often call into the City to share traffic signal issues that they have experienced while driving in Naperville. Centracs allows staff to easily and thoroughly investigate the timings at a specific signal and diagnose its unusual behavior. The breadth of information collected by Centracs has allowed staff to analyze the intersections at an intricate level of detail. Investigation of new data at several intersections revealed instances where the signals were losing coordination or unnecessarily serving phases. By subtly altering the programming, these issues were resolved and traffic delay was decreased. Without the data gathered by Centracs, the issues would never have been properly diagnosed.

Other monitoring features utilized by staff include automatic alert notifications that send emails to staff and the City's maintenance contractor when a critical event (such as the signal going into flash) occurs; time drift check, which ensures that all of the interconnected signals maintain precise and accurate coordination; detector fault status to identify if a detector stops functioning; and signal comparisons to quickly verify that signal timings in the field match the City's internal database. The six pan-tilt-zoom (PTZ) cameras installed as part of this project are particularly valuable in monitoring traffic conditions, allowing staff a highly-detailed real-time assessment of conditions along Washington Street.

Staff also uses the CTMS to collect and analyze traffic volumes, traffic speeds, and pedestrian volumes. This data can be used in various seemingly small opportunities for optimization, resulting in highly-efficient traffic flow operations.

Exhibit 4 Traffic Management System Workstations

Future Plans

The second phase of this project is the implementation of adaptive traffic signal control. Adaptive traffic signal control technologies adjust signal operations to accommodate current traffic patterns, promote smooth flow, and ease traffic congestion. The system continuously collects traffic data from vehicle sensors. Based on this data, the systems adjust signal cycle lengths and reallocates green time at each intersection in real-time.

Through a similar procurement process, Econolite's Centracs Adaptive was the selected software module. Additional detection was needed along the mainline of the corridor in order for the adaptive system to function. During summer 2017, over 300 wireless magnetometers were installed at intersections throughout the corridor. The adaptive system is expected to go live in fall 2017.

Consistent with the countywide Transportation Coordination Initiative, ongoing expansions of the CTMS are planned. Naperville already has an extensive network of fiber optic cable connecting the various signal corridors and by eliminating several relatively small missing links between these signal corridors, combined with the centralized traffic management software, the City will be able to embrace the benefits of a fully connected traffic signal network.

The first expansions include ten City of Naperville signals with 87 DuPage County signals. These expansion plans will add the new signals to the existing fiber networks and bring them onto an integrated centralized traffic management system, providing center to center communication between the City of Naperville and DuPage County's traffic management centers. The expansions will provide a redundant communication path for traffic signals and PTZ cameras and support regional connections to IDOT and Travel Midwest/Gateway networks. Ultimately, real-time traffic information could be shared with the roadway users via websites, applications, radio, and variable message signs in order to mitigate congestion and improve traffic flow. In spring 2017, funding applications for these expansions plans were submitted. Over the next several years, the City intends to gradually integrate the remaining traffic signals into the new traffic management network.

Latest Member Roster

Member Organizations:

AECOM
Argonne National Labs
AutoBase, Inc.
Carrier & Gable, Inc.
CDM Smith
CH2M HILL
CHA Consulting
City of Chicago
CohuHD
Daktronics, Inc.
Federal Highway Administration
G4S Secure Integration
Global Traffic Technologies, LLC
HNTB Corporation
Illinois Department of Transportation
Illinois Tollway
INRIX
Iron Mountain Systems, Inc.
Iteris, Inc.
ITRCC
J.A. Watts, Inc.
Jacobs Engineering Group, Inc.
Kimley-Horn and Associates,
Lake County Division of Transportation
Mid-West Truckers Association
Northrop Grumman
Pace Suburban Bus Service
Parsons
Q-Free Open Roads Consulting
SDI
SES America
Swarco Traffic Americas, Inc.
TEC Engineering, Inc.
The Ohio Department of Transportation
TMS Engineers
Total Traffic & Weather Network
Traffic Control Corporation
TrafficCast International, Inc
TranSmart Technologies
University of Illinois at Chicago
University of Kentucky
Ygomi, LLC

Individual Members:

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Siva Ayyadurai
Ray Benekohal
Ed Blayney
Chris Carson
Dennis Clark
Darryl Dawson
Scott Fischer
Luis Galimberti
Eric Gannaway
James Gilbert
Thomas Hoene
Jeremy Huffman
Kim Hull
Brent Isenburg
Jiaqi Ma
Jan Neufelder
Mark Newland
Brian Plum
Roman Prikhodko
Steve Reddington
Brian Scifers
Michael Shelley
Charles Sikaras
Douglas Smith
Steve Sours
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