(DRAFT) REGIONAL TRAFFIC SIGNALS EXISTING CONDITIONS

December 13, 2019

CMAP

Contents

Introduction

The Chicago Metropolitan Agency for Planning is considering opportunities to improve arterial traffic operations. Traffic signals are a critical yet often underappreciated contributor to arterial performance. Modern, well-timed traffic signals contribute to better traffic flow, reduced delay, improved safety and air quality, and reduced maintenance and operating cost. Appropriate traffic signal technologies can support community livability, multimodal travel, and accessibility for people with disabilities.

Signal improvements were often part of arterial highway expansion projects. Once roadways were expanded, however, the signals often received little further attention. As time passed, signals aged and their capabilities did not keep up with current traffic or community needs. In fact, many may have old controllers subject to frequent failures, malfunctioning detection, and communications that can only take place by calling the signal on the telephone. Modern signals can be monitored for performance and condition, optimized, and coordinated from a central location in real time. But the development and operation of modern traffic signal systems require investments in communications, hardware, software and staff.

To understand how the region's traffic signal systems can be improved, however, a basic understanding of existing systems must be developed. This existing condition report describes the traffic signals in northeastern Illinois. Descriptive statistics were derived from data provided by county departments of transportation, the City of Chicago, and the Illinois Department of Transportation in the CMAP region, for the regional Highway Traffic Signal Inventory in 2017.[1]

Signal population

The region's primary system operators (IDOT, City of Chicago, county departments of transportation) own and manage more than 7,000 signals. The Illinois Department of Transportation owns 44% of the signals, but maintains fewer due to agreements in place for other jurisdictions to maintain some of them. The Chicago Department of Transportation owns or maintains 39% of the region's signals. Within the City of Chicago, there are many IDOT traffic signals maintained by the Chicago Department of Transportation along marked and unmarked state highways. The Chicago Department of Transportation therefore operates slightly more signals in northeastern Illinois than the Illinois Department of Transportation. Together, these two agencies account for 77% of the region's signals. Cook County Division of Transportation and Highways (Cook DOTH) and DuPage County Division of Transportation follow by owning and operating 5% each. The remaining county departments of transportation own and operate 3% or fewer signals. Multiple organizations operate traffic signals within each county. For example, in Cook County, 56% of signals are maintained by the Chicago Department of Transportation, 31% by IDOT, and 7% by Cook DOTH. In other counties, about one-half or more signals are maintained by IDOT, and one-half or less are maintained by the county department of transportation. Outside the City of Chicago, municipalities own approximately 1,000 signals, bringing the regional count of signals to about 8,000.

[1] "Highway Traffic Signal Inventory for Northeastern Illinois - CMAP Data Hub," accessed September 16, 2019, https://datahub.cmap.illinois.gov/dataset/highway-traffic-signal-inventory.

Three critical elements

Three critical elements form the foundation of traffic signal systems: controllers, detection, and communications. The existence, type, age, design, and condition of these elements determine signal capabilities and the ability to apply modern operations methods to traffic signal systems.

Controllers

Modern signal controllers are computer units with software, timing plan databases, and communications ports, hardened for roadside use. The controller is housed in a locked roadside cabinet to protect it from weather and tampering, and is responsible for changing the traffic signals. The controller model is one of the primary elements determining traffic signal capabilities. Older models with minimal capabilities provide for reliably changing the signals between green, yellow, and red. A new signal with maximum capability provides for the collection of high resolution data that can be used by the operator to improve signal operations, software to support a variety of traffic signal operations strategies, and an Ethernet communications port to support networking the device. A summary of the traffic signal inventory controllers where the model was known showed that 75% were old enough that they do not provide opportunities for modern signal operations and manufacturers may no longer support them, 18% conform to more recent Advanced Traffic Controller (ATC) standards and can provide most capabilities, and only 6% provide all desired capabilities.

A master controller is a special type used to coordinate a group of traffic signals on a corridor called a "traffic signal interconnect." Master controllers send the coordination timing plans and any traffic responsive plans to the slave signals, synchronize the clocks of all intersections, and provide a single point of communications. Over the last few decades, the region has invested heavily in traffic signal interconnects. The result is that over half the regional signals are integrated into traffic signal interconnect systems. Unfortunately, master controllers are no longer manufactured and as these components age and fail, their functions must be assumed by other technology, most likely central systems. Some traffic signal interconnects already include communications between the master controller and a central system, but most do not.

A large proportion of existing controllers are no longer manufactured or supported. Maintaining them is more difficult because parts and software upgrades are unavailable. Unfortunately, older equipment is likely to fail more frequently than newer equipment. In general, municipalities have the oldest equipment in the region, with some towns struggling to keep 50 year old signals operating.

Nine percent of the controllers have the high-resolution data capabilities needed for Automated Traffic Signal Performance Measures (ATSPMs). The use of ATSPM systems is an emerging performance-based traffic signal management capability that supports "objectives and performance-based maintenance and operations strategies that improve safety and efficiency while cutting congestion and cost."[2]

The traffic signal inventory does not include information about what type of cabinet houses the controller. A new controller can be installed for $3,000 – $5,000. However, not every cabinet can accommodate a new controller. The cost of replacing an older signal cabinet with one that can house a modern controller and communications is $14,000 – $30,000.

[2] "EDC-4: Automated Traffic Signal Performance Measures (ATSPMs) | Federal Highway Administration," accessed September 19, 2019, https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/atspm.cfm.

Detection

A traffic signal that can respond to the presence of waiting vehicles or other users must have a system in place to detect them. Over half of the regional signals include vehicle detection. The signals without detection are largely in the City of Chicago. Region-wide, the most common type of vehicle detection is the inductive loop,[3] while video detection is widely used by Kane, Lake, and McHenry County DOTs.

Many signals have multiple detection systems. Many signals have pedestrian detection, which often adds time to a signal phase to assure the pedestrian has sufficient time to cross the street; pedestrians are usually detected with push-buttons, but video detection is also available to passively detect pedestrians. Detectors are also installed to facilitate emergency vehicle pre-emption, transit signal priority, and railroad signal preemption systems.

Additionally, there are many ways to design detection around the signal. Intersections listed as including detection may have more or fewer detectors and the placement of detectors varies. Today, even at locations where the signal is pre-timed, the availability of detection is important. When the data can be saved and accessed later it supports analysis of traffic signal performance and retiming efforts. While some detection may be "present" at most locations outside the City of Chicago, the design is often adequate for its original purpose but inadequate to support current desired data collection or operational goals.

Communications

The original method to communicate with a traffic signal was the simple telephone wire. Many traffic signals had a telephone number which could be called directly. This method is still widely used in northeastern Illinois to monitor IDOT signals, which are contacted each day. "Without this surveillance, controller databases are subject to unauthorized changes, malfunctioning equipment, as well as unanticipated breakdowns in communications."[4] Telecom companies do not believe it to be cost effective to maintain the landline telephone system and are actively working to eliminate it.[5] To this end, they are using cost to encourage customers to switch to other methods of communications[6], and local agencies agree that this legacy communications method should be replaced with something more useful and effective.

Why is communications with a central location important? Communications between a central location and signals in the field provides not only for coordination, but for many other signal management opportunities such as performance monitoring, remote software maintenance, and adjusting coordination and timing in response to unexpected incidents or special events. Central communications

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[3] Inductive loop detection involves a wire loop installed in the pavement, connected to a tuner. A vehicle passing over the loop reduces the impedance of the circuit, which is detected and indicates the presence of the vehicle for the signal controller.

[4] "IDOT District 1 Traffic Signal Controller and Data Monitoring," *Gewalt Hamilton Associates, Inc.* (blog), accessed December 13, 2019, https://www.gha-engineers.com/portfolio-item/idot-district-1-traffic-signal-controller-and-data-monitoring/.

[5] Robert Channick, "Illinois OKs End of Landlines, but FCC Approval Required," chicagotribune.com, accessed December 13, 2019, https://www.chicagotribune.com/business/ct-att-landline-end-illinois-0706-biz-20170705-story.html.

[6] Robert Channick, "AT&T Ends Monthly Federal Subsidy for Low-Income Landline Customers," chicagotribune.com, accessed December 13, 2019, https://www.chicagotribune.com/business/ct-biz-att-landline-cut-low-income-discount-20181019-story.html.

can reduce the cost and time associated with signal monitoring, maintenance, and optimization. Other forms of communications are available using a mix of fiber optic cable, wireless, and cell phone technology. Today, 9% of traffic signals are under central control, leaving the rest either with a telephone connection or no communications at all.

Importantly, the traffic signal interconnects necessitated installation of communications links between signals, either copper wire or fiber-optic cable. Today, most of the copper wire has been replaced with fiber-optic cable which might be repurposed to form links in a regional fiber network to serve the transportation system. There are XX miles of roadway with traffic signal interconnects.

Additional safety features

All traffic signal features contribute to intersection safety, but a few can be considered as special safety features. Some features are appropriate at a limited number of locations, for example the advance active or passive warning flasher, or railroad preemption, but others could be applied in more widespread locations. While safety may be improved, additional equipment or functions may also increase the signal maintenance cost. This is an overview of how frequently these features appear in northeastern Illinois.

Advance active warning and passive warning flasher

Advance warning flashers warn traffic approaching a signal that they should be prepared to stop. These are useful at locations where, for example, unsignalized roadways revert to signalized roads, where the sightline prevents drivers from seeing a traffic signal, or to warn drivers that the traffic light will soon change to red on a higher-speed signal approach. A passive warning flasher is on all the time, while an active warning flasher turns on and off depending on conditions. This equipment is rare in northeastern Illinois, with only a handful of instances reported.

Advance vehicle detection

Advance vehicle detection uses the same technology as the vehicle detection discussed in the previous section. As the name suggests, this relies on a detection design that can see vehicles approaching further from the intersection. The information can be used for a "dilemma zone protection system" by extending the green time to reduce abrupt stopping or vehicles entering the intersection on red. This system is commonly used on higher-speed locations especially where heavy vehicles need additional deceleration time, or where left turning traffic needs more than 150 feet of storage. Region wide, there are 230 (3%) intersections where advance vehicle detection was in place. Kane County DOT reported advanced detection at 22% of its intersections, Lake County DOT at 83% and McHenry County DOT at 98%. At these locations, advance vehicle detection is installed, but reporting does not indicate whether dilemma zone protection is implemented. However, detection design opens opportunities to change how the signal operates.

Automated red light enforcement

Many arterial crashes happen at intersections, often resulting in serious injury or death. Automated red light enforcement is intended to reduce the most dangerous crashes where a vehicle enters the intersection during the red phase and collides with a vehicle having the right-of-way. Highway operators review permit applications from municipalities and approve or deny requested locations based on agency criteria. For example, IDOT rejected a number of locations, "said Tridgell, 'due to not meeting the threshold of an average of three red light-running crashes per year,' which he called a 'longtime, standard policy.'"[7] When approved, municipalities own the equipment, while the red light companies install and maintain the systems in return for a portion of the ticket revenue. Region wide, 5% of traffic signals are reported as having automated red light enforcement. IDOT and CDOT jurisdiction roadways host the highest number of installations, with a combined 315 locations.

Emergency vehicle preemption (EVP)

Emergency vehicle preemption changes traffic signals to allow safe passage of emergency vehicles, including fire trucks, police, and ambulances. These systems reduce the amount of time it takes to respond to an emergency and also protect emergency vehicles from intersection crashes.[8] Outside the City of Chicago, 72% of traffic signals include emergency vehicle preemption. Emergency vehicle detection devices are mostly, but not in all cases, owned by public safety agencies. The City of Chicago does not install emergency vehicle preemption because of the special conditions in the city. In congested conditions, widespread within the City of Chicago, traffic signal preemption may disrupt traffic flow more than just the emergency vehicle would. Additionally, because of the dense grid pattern, and the potential for multiple emergency vehicles to approach an emergency from several directions, using preemption may actually slow emergency response times.

Flashing yellow arrow

The flashing yellow arrow[9] is a newer feature authorized for use by the Federal Highway Administration in December 2009. The flashing yellow arrow is intended to make left turns safer by informing turning drivers when they are "permitted" to turn left but are not protected from oncoming traffic (left turns are often, but not always, given "protected" signal phases). There are fewer than twenty instances in the region. Kane County DOT was the first agency to implement them.

Railroad coordination and pre-signal at railroad crossing

Northeastern Illinois is the rail hub of the United States, home to more than 1600 public at-grade rail crossings and 1260 daily freight and commuter trains. Between 2013 and 2018, there were 395 collisions at grade crossings in the CMAP area.[10] Many locations have traffic signals nearby which can affect traffic flows in ways that lead to increased or decreased possibility of train/car crashes. In a coordinated signal system, information on the approach of trains can be transmitted to nearby traffic signals which respond accordingly with an appropriate signal plan. Pre-signals are also coordinated and are specially placed signals that stop traffic from entering the crossing area and are timed to allow traffic to clear the railroad tracks before the train arrives. There are a fewer than 200 locations with railroad

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[7] "IDOT Rebuffs Riverside Red-Light Cameras | Articles | News | RBLandmark.Com," accessed December 12, 2019, https://www.rblandmark.com/News/Articles/8-13-2019/IDOT-rebuffs-Riverside-red_light-cameras/.

[8] Office of Safety Design Federal Highway Administration, "Signalized Intersection Safety Strategies- Employ Emergency Vehicle Preemption" (FHWA, 2008), https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa08008/sa5_emergency_vehicle.pdf.

[9] "Flashing Yellow Arrows Found to Reduce Left-Turn Crashes in ICT Study Conducted for IDOT | ICT - Illinois," accessed December 20, 2019, https://ict.illinois.edu/2016/08/22/flashing-yellow-arrows-found-to-reduce-left-turn-crashes-in-ict-study-conducted-for-idot-2/.

[10] Illinois Commerce Commission, "Crossing and Collision Statistics in Illinois," Crossing and Collision Statistics in Illinois, accessed September 23, 2019, https://www.icc.illinois.gov/rail-safety/crossing-and-collision-statistics/C197.

coordination and fewer than 100 locations with pre-signals. These locations are concentrated within the City of Chicago.

Multimodal features

Traffic signals serve all users at the intersection, including buses, bicycles and pedestrians. These features serve all modes and better integrate intersections with the communities they serve.

Buses

Transit signal priority and bus queue jump signals reduce bus delay, increase bus on-time performance and improve reliability, making connections with other services more predictable.

Transit signal priority equipment allows an approaching transit bus to notify the signal and extend the green time so the bus is not delayed by a red light. In the CMAP region, a number of county departments of transportation, Pace, CTA and the Regional Transportation Authority are working to implement a system of transit signal priority corridors that will ultimately include 400 intersections across the region.[11] Today, fewer than 100 intersections, concentrated in the City of Chicago, include transit signal priority. When the TSP system was conceived, it was understood to be a relatively low-cost improvement. The bus on-board hardware and software only costs about $6,000 per bus to purchase and install, but signal system improvements cost about $40,000 per intersection, with one-fourth of the cost being for new controllers and three-fourths for communications.

"Queue jump lanes combine short dedicated transit facilities with either a leading bus interval or active signal priority to allow buses to easily enter traffic flow in a priority position. Applied thoughtfully, queue jump treatments can reduce delay considerably, resulting in run-time savings and increased reliability."[12] A queue jump signal is appropriate in locations where there is space for a bus to use the right turn lane to bypass the queue. The Chicago DOT reported bus queue jump signals at eight locations.

Bicycles

Bicycle signal heads are lights installed specifically to improve safety for bicycle riders by guiding and protecting bicycle movements. They are often installed at road intersections where a dedicated bike route crosses a street, where a bike path crosses a street, or where there are high numbers of bicycle/motor-vehicle crashes, among other locations. [13] The City of Chicago reported 24 bicycle signals with bicycle signal heads. No other locations were reported.

Pedestrians

Pedestrian signals help pedestrians cross the intersection safely. In the past, walk/don't walk words were displayed and are still in place at some locations. Current practice is to use the image of a white lighted person walking or a red lighted hand. The pedestrian signal may use active detection via push-button, passive detection via sensor, or may include a pedestrian walk interval for every cycle with no

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[11] "RTAMS - Transit Signal Priority," Regional Transportation Authority Mapping and Statistics (RTAMS), accessed September 23, 2019, http://www.rtams.org/rtams/transitSignalPriority.jsp.
[12] National Association of City Transportation Officials, "Queue Jump Lanes," accessed September 23, 2019, https://nacto.org/publication/transit-street-design-guide/intersections/intersection-design/queue-jump-lanes/.
[13] National Association of City Transportation Officials, "Bicycle Signal Heads," accessed September 23, 2019, https://nacto.org/publication/urban-bikeway-design-guide/bicycle-signals/bicycle-signal-heads/.

detection. These signals are expected anywhere there are pedestrians may be found. Region wide, 67% of signals include a pedestrian signal. Within the City of Chicago, every traffic signal includes a pedestrian walk interval with no detection. Pedestrian buttons are installed at many locations in Chicago, but maintaining the pedestrian button in good working order on every signal proved impossible. The Chicago Department of Transportation found it safer to automatically provide the walk interval and not depend on a pedestrian to press the button.

The pedestrian signal should provide enough time for the pedestrian to cross the street from curb to curb. For locations where pedestrian detection is used, not only is the pedestrian "walk" signal illuminated, but the signal phasing may be modified to allow sufficient time to cross the major street.

Pedestrian safety can be further enhanced through leading pedestrian intervals. Leading pedestrian intervals reduce pedestrian conflicts between pedestrians and right-turning vehicles. Leading pedestrian intervals are widespread in Chicago.

Pedestrian countdown signals decrease the risk of a pedestrian starting to cross when there isn't enough time remaining in the pedestrian cycle to reach the other side of the street. The signal informs the pedestrian of how many seconds are left to cross the street. These are a newer technology, included at 34% of the region's signals.

Accessible pedestrian signals are signals designed to provide assistance to visually impaired individuals through sound or vibration. The audible cues tell the pedestrian when the walk signal is displayed. They are relatively rare, installed at less than 1% of the region's signal locations.

Resilience

Weather, in the forms of excess heat, accumulated ice, lightning strikes, and high winds, can cause blackouts or brownouts, as can power system component failures, crashes, or terrorist attacks. During such events, it is important to protect the mobility and safety of the public and emergency responders.

Uninterruptible power supply (UPS)

The UPS is a battery backup to keep a traffic light from going "dark" if there is a power outage. Each traffic signal requires four to six batteries at around $200 each which must be checked for charge and replaced regularly whether they've been used or not. Region wide, 50% of the traffic signals are equipped with a UPS, with those unequipped concentrated in Cook County and Chicago, with the City of Chicago around 15%.

Pan-tilt-zoom (PTZ) cameras

Cameras have long been used on the expressway system to monitor traffic conditions. More recently, cameras have been installed at arterial intersections for the same reason. With appropriate communications installed so images can be transmitted back to a central location, traffic engineers can observe in real time whether the traffic signal is performing as intended or if there is unusual activity at the intersection, for example higher than expected traffic flows resulting from a nearby road closure. If an agency has the ability to modify the traffic signal timing from a central location, the camera allows the engineer to make the change and observe the results. Region wide, 3% of traffic signals were reported to have a camera, but Lake County DOT has the highest proportion, at 73%, with Kane County DOT following at 54%.

LED signal lamp

Light-emitting diode (LED) light bulbs reduce the amount of electricity needed to keep the light on and save agencies 85% of electricity bills to power the signal.[14] In fact, the LED lamp uses only 10% of the electricity needed to power an incandescent bulb.[15] LED lamps also last longer than incandescent bulbs, 7-15 years, depending on the product, versus 2 years for incandescent lamps. This also reduces maintenance costs.[16] A reduced need for lamp power allows a traffic signal to remain operational for a longer duration using a UPS during a power outage. Over the past few years, an effort has been made to switch to LED lamps and today, 73% of signals use them. A negative effect of LED signals is that, since they produce less heat on the face of the signals, maintenance is sometimes required to clear the signals of snow and ice.

Maintenance

Traffic signal maintenance refers to the activities needed to keep the components in working order and does not include traffic signal timing changes, discussed in the next section. Maintenance can be divided into two categories. First, there is scheduled maintenance needed to ensure that the traffic signal keeps working, including keeping the cabinet clean, changing filters, replacing worn parts, batteries, lamps and light bulbs, communications, detection, and testing the mechanical parts such as push buttons and door locks. The counties and IDOT contract this work to a signal maintenance company using a single cost contract where "incidental" component costs are included. That is, if the contractor finds that a part must be replaced, it is replaced under the contract with no change in contract amount. Battery replacement turns out to be a significant element of incidental cost. Contractors visit each signal monthly to provide basic inspections and repairs. If a trend in failures is detected, the trend is reported to the contracting department of transportation. However, neither the contractor nor the departments of transportation maintain a database of observed condition information that can be used for asset management purposes.

About 70% of municipalities besides the City of Chicago also contract for maintenance. Many of them use contracts that mirror the IDOT and county version that included both scheduled and unscheduled activities. Unfortunately, there are also many struggling municipalities where the scheduled maintenance activities have been eliminated from the contracts and the contractors are "on-call" only. On-call contracts rely on the municipality summoning the contractor for emergency repairs when a signal fails. Signal infrastructure condition in those areas is reported to be quite bad, and getting worse, and includes not only the age and condition of electronic components but extends to supporting poles, cabinets, and foundations. There may be a handful of locations in the region where the equipment is in such disrepair that fixing it has been judged a waste of scarce funds and the signal has been set to permanently flash red. Surprisingly, there are some municipalities one would consider adequately resourced which also use the on-call contract. It is unknown whether these municipalities have staff to

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[14] "C40: LED Traffic Lights Reduce Energy Use in Chicago by 85%," C40, accessed September 24, 2019, https://www.c40.org/case_studies/led-traffic-lights-reduce-energy-use-in-chicago-by-85.

[15] "LED Traffic Signals: A Brighter Choice | Blog," *NHSaves* (blog), accessed September 26, 2019, https://nhsaves.com/blog/led-traffic-signals-a-brighter-choice/.

[16] "LED Traffic Signals Save Money, Time and Energy," LEDs Magazine, January 20, 2005, https://www.ledsmagazine.com/smart-lighting-iot/smart-cities/article/16696281/led-traffic-signals-save-money-time-and-energy.

provide basic maintenance and only need emergency help for extensive repairs, or if basic maintenance is being foregone. Focusing resources only on failures while eliminating traffic signal maintenance is inconsistent with a good asset management approach.

Second, there are emergency maintenance visits to repair signal components that are damaged by unexpected incidents such as crashes, weather, and construction, or fail for unknown reasons. This activity includes responding to citizen complaints, which are a primary source of malfunction reports. The region continues to rely mostly on “crowdsourcing” to report on signal performance issues. The contracts include performance standards for timely visit and repairs. As examples, IDOT loses about 52 signal cabinets a year and there may be 1,000 signal knock-downs annually. The conversion of incandescent signal lamps to LED has also led to some additional emergency maintenance to remove snow from signal lenses. Of course, these malfunctions are visible to anyone. Less apparent are communications failures. The regular inspections can detect communications failure, and about four miles of fiber optic cable must be replaced annually, with weather being the primary cause of damage. When this happens in the winter, the communications cannot be repaired until spring provides better weather conditions. There are likely alternative fiber installation methods that could greatly reduce this burden.

The Chicago Department of Transportation maintains traffic signals in-house through the Division of Electrical Operations. The division is responsible for maintaining 3,000 signals and 300,000 street and alley lights. Fewer than 30 signal engineers working on three shifts are responsible for patrolling the city and responding to complaints about signal malfunctions. The 311 reporting system makes it easy for people to report malfunctions, and the signal engineers spend much of their time responding to these. Scheduled regular maintenance is desired but unachievable due to the amount of time spent responding to reported malfunctions.

Retiming

Traffic signal timing plans are designed to efficiently serve the traffic conditions at the time of installation. If local traffic conditions change, they should be re-timed. The process of re-timing a signal or group of signals is resource intensive and requires obtaining traffic volume data on all movements for the signals in question, simulation modeling to develop a proposed signal plan, testing it in the field and observing the impacts, and adjusting it if necessary to make it function better.

In northeastern Illinois, the primary triggers for this activity are 1) if new signal equipment is installed 2) if the roadway is changed for example by adding lanes or reconfiguring the intersection 3) if new development occurs that noticeably changes traffic patterns and 4) people complain about the location.

Because of the time and expense, reviewing performance does not occur on a scheduled basis and many locations are not performing as well as they could, but this condition remains undetected. There isn’t a program or method to monitor traffic signal performance and identify and prioritize locations that should be retimed.

Conclusions

There are parts of the system where significant investments have been made and the signals are consistent with the Vision. However, the overwhelming majority of northeastern Illinois traffic signals fall short of this goal. As the Highway Traffic Signal Inventory reveals, and the state, county, and municipal signal engineers, and maintainers confirm:

The system does not support communications goals

- Telephone landline service that agencies use to communicate with many signals is becoming more expensive and is likely to be unavailable at some point in the future.
- Only a small portion of regional signals can be monitored and controlled from a central system, reflecting a lack of underlying communications infrastructure.

The system does not support improved functionality goals

- 75% of signal controllers don't provide desired functionality and many are no longer manufactured or supported.
- Master controllers used to coordinate interconnected signals are no longer manufactured and will need to be replaced with a different technology.
- Systems that can identify traffic signals that need retiming and also reduce the cost and time to do so have not been implemented.

The system does not support state of good repair goals

- The age of controllers and lack of communications adds significant cost to improvements to serve public transportation and will also impact the ability to serve other emerging technology needs.
- Improved installation methods and maintenance of fiber optic cable is needed to support the system.
- Economically struggling municipalities outside of Chicago are unable to sufficiently maintain their own traffic signals.

The system does not support data use goals

- Vehicle detection was designed and installed to meet historic rather than modern needs.
- Performance monitoring systems have only recently been developed and a tiny fraction of the region's signals are being reviewed for performance using modern monitoring software.

The system does not support asset management goals

- No inventory of traffic signal condition exists.
- Asset management practices have not been applied to the region's traffic signal systems.