(DRAFT) REGIONAL TRAFFIC SIGNALS EXISTING CONDITIONS

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CMAP

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Introduction

The Chicago Metropolitan Agency for Planning is considering opportunities to improve arterial 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.

It has been said that, in the past, arterial expansion projects were a de-facto signal improvement program. 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 modern signal technologies. In fact, many may have old controllers subject to frequent failures, malfunctioning detection, and communication 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. In reality, that requires investments in communication, hardware, software and staff to accomplish. Today, Lake County Division of Transportation serves as a shining example to the region in this arena, but only 3% of the region's traffic signals are located in Lake County.

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 maintained by the northeastern Illinois county departments of transportation, the City of Chicago, and the Illinois Department of Transportation in the CMAP region, and represents the majority of traffic signals on the most heavily traveled roadways. Statistics presented here were calculated from the regional Highway Traffic Signal Inventory which represents 2016 data collected from system operators in 2017.[1] An effort to inventory municipal signals is currently underway, but the descriptive information provided by municipalities does not extend beyond geographic location in most cases.

Signal population

How many signals are currently operating in northeastern Illinois? The region's primary system operators (IDOT, City of Chicago, county DOTs) manage a little more than 7,000 signals. Region wide, the Illinois Department of Transportation submitted information for 3,137 (44%) signals, but was indicated as maintainer for 2,688 (38%). The Chicago Department of Transportation submitted 2,748 (39%), but was listed as owner or operator for the same number. The Chicago Department of Transportation therefore operates slightly more signals in northeastern Illinois than the Illinois Department of Transportation and together they 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. (*Table 1: Records submitted to inventory*)

When location is compared with maintenance jurisdiction, one finds that multiple organizations operate traffic signals within each county (*Table 2: Traffic signals by county location and maintenance jurisdiction*). 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

[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.

are maintained by IDOT, and one-half or less are maintained by the county department of transportation.

Signal controllers

The signal controller is the brain of the traffic signal system directing the lights to change. The preponderance of the region's controllers were manufactured by Econolite (20%) or Traffic Control Technology (31%). Agencies submitted signal information where controller manufacturer was "blank" for 38% of signals. (*Table 5: Controller manufacturer percent by maintenance jurisdiction*) Additionally, 34% of the records submitted did not include the signal controller model. (*Table 6: Regional controller model number counts and percentage*) While controller year is not part of the dataset, 55% of the Econolite controllers and 100% of the Siemens controllers are models that are out of production. At least three general statements can be made about this information. First, good asset management practices require accurate information about existing equipment. Second, maintaining equipment that is out of production is more difficult than newer equipment. Third, old equipment is likely to fail more frequently than newer equipment. The good news from this information is that the 631 (34%) ASC/3, Cobalt, and EPAC M60 series controllers have high-resolution data capabilities needed for Automated Traffic Signal Performance Measures (ATSPMs). ATSPMs 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] A planned traffic signal needs analysis will explore this subject in more depth in the coming months.

Most recent signal modification date

Traffic signal modification is a big category and includes simple activities such as installing a new controller, new pan-tilt-zoom camera, new battery backup, etc., up to completely reconstructing the signal. The terminology varies by agency. (*Table 10: Most recent signal modification date by maintenance jurisdiction, percent*) 20% of signals were last modified before 2010, and 50% did not include information on last signal modification date. The remaining 28% were modified in 2010 or more recently, with the highest number of modifications in 2011 (11%) six years prior to this data collection.

Traffic signal responsiveness

The extent and method by which signals respond to traffic conditions varies over the region, and depends on the technology available to the signal and the environment where the signal is located. Signals can respond to traffic conditions based on technology at the signal, such as detecting vehicles, or the response can be been programmed in by traffic engineers to reflect usual conditions.

Controller type

Traffic signal control falls into three basic categories – pre-timed, semi-actuated, and fully actuated. Pre-timed signals are those where the "(o)ccurrence and duration of all timing intervals, both vehicle and pedestrian, in all phases are predetermined."[3] This is "appropriate for isolated locations where detection is not available or in coordinated systems where traffic is consistent, closely spaced

[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.
[3] "Traffic Control Systems Handbook: Chapter 7 Local Controllers - FHWA Office of Operations," 7, accessed September 18, 2019, https://ops.fhwa.dot.gov/publications/fhwahop06006/chapter_7.htm.

intersections and where the cross street is consistent."[4] All City of Chicago Department of Transportation signals are described as pre-timed, and no other operator submitted information indicating pre-timed signals. Semi-actuated signals use traffic detection on the lower volume street of an intersection to trigger the traffic light. This is appropriate where the major road has a posted speed of less than 40 miles per hour and the cross road carries light traffic demand. [5] At 105 (89%), Kane County reported the highest number of semi-actuated signals. In total, only 2% of the region's signals were reported to be semi-actuated. Fully-actuated signals use detection on all signal approaches and are appropriate on roadways with posted speeds of more than 40 miles per hour at locations without nearby signals or at the intersection of two arterials. This method responds to changing travel patterns. [6] Lake County reported 100% fully-actuated signals. Region wide, 8% of signals were reported as fully-actuated. 51% of the regional signals were reported as "blank" control where the submittal was either blank or the information reported was not one of the three categories. (*Table 8: Controller type percentage by maintenance jurisdiction*) Adaptive signal control is a relative new method of allowing traffic signals to monitor and respond to traffic in real time. Kane and Lake County have installed a total of 13 adaptive controlled signals as of the end of 2016. There are more instances planned in those counties. (*Table 14: Adaptive signal control implemented*)

Vehicle detection type

A traffic signal that can respond to the presence of waiting vehicles must have a system in place to detect them. The inventory shows 20% of signals as having detection. Region wide, the most common type of detection is the inductive loop at 11%, followed by video at 5%. Video detection is widely used by Kane (49%), Lake (57%), and McHenry (79%) County DOTs. 80% of regional signals listed no detection or were blank. (*Table 17: Vehicle detection type percent*) Even where the signal is pre-timed, the availability of vehicle detection information is important to support new technologies such as Automatic Traffic Signal Performance Monitoring. The data collection did not ask for information on how detection function was verified. Inductive loops are installed in the pavement, so improper installation can contribute to pavement quality decline, and declining pavement condition over time can contribute to detection failures. [7]

Signal coordination communication type

Traffic signals can be designed to allow traffic to form platoons and travel along corridors smoothly by ensuring that the traffic signals turn green as the group of vehicles arrive. This can be achieved by coordinating the timing of stand-alone signals, linking signals in a corridor together in a "closed loop" signal interconnect system or having them controlled from a central location. (*Table 12: Coordination communication type percent*). Stand-alone signal coordination can work well if the internal clocks of each signal are synchronized and register the same time. "Clocks in controllers tend to drift over time and need to be reset periodically. If the controller is connected to a master or central computer, the

[4] Office of Operations Federal Highway Administration, "Traffic Signal Timing Manual: Chapter 5 - Office of Operations," accessed September 18, 2019, https://ops.fhwa.dot.gov/publications/fhwahop08024/chapter5.htm#targetText=Traffic%20signals%20operate%20in%20either,that%20are%20fixed%20in%20duration.

[5] Federal Highway Administration.

[6] Federal Highway Administration.

[7] Office of Operations Federal Highway Administration, "Traffic Control Systems Handbook," October 2005, https://ops.fhwa.dot.gov/publications/fhwahop06006/fhwa_hop_06_006.pdf.

clock can be reset automatically."[8] 18% of the region's traffic signals were listed as having central control or were part of a closed loop system that could maintain clock coordination. 3% were "stand alone" coordination, which means their clocks are not automatically synchronized. 79% of regional signals were listed as "blank" coordination communication type. Agencies also submitted information about the extent to which signals were interconnected. Interconnected signals are coordinated by communicating with a grouping of signals, usually along a corridor. (*Table 18: Signal Interconnect*) Although the data submitted listed 21% of signals as having coordination communication type, 48% were identified as being part of an interconnected signal system which would necessarily have coordination communication type of some sort. This is good news, for it means that there are communication capabilities associated with a large number of the region's signals. The quality of the communication infrastructure was not collected, whether the condition is good or even know, and if it is copper telephone wire, fiber optic cable, or wireless technology.

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 communication 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 (*Table 13: Pan-tilt-zoom camera available*) Lake County DOT has the highest proportion, at 73%, with Kane County DOT following at 54%.

Blankout signs

A blankout sign is a changeable message sign displaying one or more alternative messages. At intersections they are commonly used to show turn restrictions, for example no left turn from 7-9 am. Fewer than 1%, or 63 intersections were reported to include them. Fifty-two of them were at IDOT interchanges. (*Table 15: Blankout sign*)

Safety

All traffic signal components contribute to safety, but a few can be considered as special safety features.

Flashing yellow arrow

The flashing yellow arrow is a newer feature authorized for use by the Federal Highway Administration in December 2009. In northeastern Illinois. (*Table 22: Flashing yellow arrow*) The flashing yellow arrow is intended to make left turns safer by informing turning drivers that they may turn left but are not

[8] "Traffic Control Systems Handbook: Chapter 8 Systems Control - FHWA Office of Operations," 8, accessed September 19, 2019, https://ops.fhwa.dot.gov/publications/fhwahop06006/chapter_8.htm#targetText=The%20database%20for%20the%20system,to%20the%20local%20intersection%20controllers.&targetText=The%20architecture%20contains%20one%20or%20more%20field%20master%20controllers.&targetText=The%20local%20intersection%20controller%20controls%20the%20traffic%20signal%20displays.

protected from oncoming traffic. Kane County DOT, reporting 11 locations, was the first and only agency to implement them.

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 2 passive and 5 active instances reported. (*Table 23: Advance active warning flasher , Table 24: Advance passive warning flasher*)

Advance vehicle detection

Advance vehicle detection uses the same technology as the vehicle detection discussed in the previous section, but differs in location and purpose. As the name suggests, the detection is installed further from the intersection. "The Advanced Dilemma-Zone Detection system enhances safety at signalized intersections by modifying traffic control signal timing to reduce the number of drivers that may have difficulty deciding whether to stop or proceed during a yellow phase. This may reduce rear-end crashes associated with unsafe stopping and angle crashes due to illegally continuing into the intersection during the red phase." [9] 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, these work with the traffic signal software to extend the signal's green time. Region wide there are only 230 (3%) intersections where this technology has been implemented. However, Kane County DOT reported this technology at 22% of its intersections, Lake County DOT at 83% and McHenry County DOT at 98%. (*Table 25: Advance vehicle detection*)

Railroad coordination and pre-signal at railroad crossing

Northeastern Illinois is their rail hub of the United States, home to more than 1600 public at-grade rail crossings. 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. Even though the region hosts a large number of at-grade crossings, there are a small number of these systems in place. The City of Chicago DOT operates 28 of the 36 coordinated signals as well as 27 of the 29 pre-signals. (*Table 26: Railroad coordination, Table 27: Pre-signal at railroad crossing*)

[9] "Advanced Dilemma-Zone Detection System - Safety | Federal Highway Administration," accessed September 23, 2019, https://safety.fhwa.dot.gov/intersection/conventional/signalized/tech_sum/fhwasa09008/.
[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.

Automated red light enforcement

Many arterial crashes happen at intersections. Automated red light enforcement is intended to reduce the most dangerous crashes where a vehicle enters the intersection during the red and collides with a vehicle that has the right of way. Region wide, 5% of traffic signals are reported as having automated red light enforcement. IDOT leads the way with 165 locations (6%) and the Chicago DOT with 150 (5%). (*Table 28: Automated red light enforcement*)

Emergency vehicle preemption (EVP)

Emergency vehicle preemption changes traffic lights 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.[11] Outside the City of Chicago, 62% of traffic signals include emergency vehicle preemption. (*Table 29: Emergency vehicle pre-emption*) The City of Chicago does not provide 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 approaches an emergency from several directions, using preemption may actually slow emergency response times.

U-turn signal

The u-turn signal provides a safe environment for vehicles wishing to make a u-turn at an intersection. No agencies reported having a u-turn signal.

Multimodal features

Traffic signals serve all users at the intersection, including buses, bicycles and pedestrians. Additional technology can be deployed to make the intersection work for these users.

Transit signal priority (TSP) and bus queue jump signal

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 Departments of Transportation, Pace, CTA and the Regional Transportation Authority are working to implement a system of transit signal priority corridors.[12] Only the Chicago DOT reported 45 intersections with TSP, or 2% of traffic signals. (*Table 20: Transit signal priority*)

"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."[13] (*Table 21: Bus queue jump signal*) A queue jump signal is appropriate in locations where

[11] 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.
[12] "RTAMS - Transit Signal Priority," Regional Transportation Authority Mapping and Statistics (RTAMS), accessed September 23, 2019, http://www.rtams.org/rtams/transitSignalPriority.jsp.
[13] 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/.

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.

Bicycle Signal Head

Bicycle signal heads are lights installed specifically improve safety for bicycle riders by guiding and protecting bicycle movements. They are often installed at road intersections where a dedicated bike route crosses, where a bike path crosses a street, or where there are high numbers of bicycle/motor-vehicle crashes, among other locations. [14] The City of Chicago reported 24 bicycle signals with bicycle signal heads. No other locations were reported. (*Table 33: Bicycle signal head*)

Pedestrian Signal

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 indicating stop. 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 detection. The signal should provide enough time for the pedestrian to cross the street. These signals are expected anywhere there are pedestrians may be found. (*Table 31: Pedestrian signal*) Region wide, 67% of signals include a pedestrian signal with a high of 95% for the City of Chicago DOT, and a low of 0% for Will County DOT.

Pedestrian Countdown

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. (*Table 32: Pedestrian countdown*)

Accessible Pedestrian Signal

Accessible pedestrian signals are signals designed to provide assistance to visually impaired individuals through sound or vibration. The audible clues tell the pedestrian when the walk signal is displayed. (*Table 34: Accessible pedestrian signal*) They are relatively rare, installed at less than 1% of the region's signal locations. DuPage County DOT has 84, and the Chicago DOT has 9.

Resilience

Heat, ice, lightning or winds can cause blackouts or brownouts, as can power system component failures 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. (*Table 36: Uninterruptible power supply make*) Region wide, 6% of the traffic signals were reported to be equipped with a UPS. The agencies with the highest percent equipped were Kane DOT (92%), Lake DOT (82%), and McHenry DOT (98%). Region wide, only 6% of signals were reported to include UPS.

[14] 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/.

LED signal lamp

Light-emitting diode light bulbs reduce the amount of electricity needed to keep the light on and save agencies 85% of electricity bills to power the signal. [15] In fact, the LED lamp uses only 10% of the electricity needed to power an incandescent bulb.[16] LED lamps also last longer than incandescent bulbs, 6-7 years versus 2 years, also reducing maintenance costs.[17] A reduced need for lamp power allows a traffic signal to remain operational for a longer duration using a UPS during a power outage and even allows for enough power to cycle the lights red/yellow/green. In the past, most UPS signals were set to flash red because of the power demands of the old lamps. (*Table 35: LED signal lamp*) Region wide, 73% of signals use LED lamps.

Signal maintenance, management and asset management

This section should describe some other characteristics of the region's traffic signals that cannot be understood from the traffic signal database.

Maintenance and repair – in-house or contracted out?

Maintenance visit tracking exists? Annual number of maintenance visits by purpose? Scheduled or emergency? Reliance on complaints from the public?

Traffic signal retiming – percent of signals retimed in the last 3 years?

Controller – how many changed in the last 10 years?

Detection – how are detection failures identified

Has a traffic signal system audit ever been undertaken?

Does a traffic signal asset management plan exist? Are there plans to complete one? Is this underway?

Conclusions

(Ideas from RTOC/ATTF on what conclusions might be?)

[15] "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.
[16] "LED Traffic Signals: A Brighter Choice | Blog," *NHSaves* (blog), accessed September 26, 2019, https://nhsaves.com/blog/led-traffic-signals-a-brighter-choice/.
[17] "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.

Appendix of tables

The tables contained here were generated from the Highway Traffic Signal Inventory. The Highway Traffic Signal Inventory (HTSI) is a GIS-based transportation dataset maintained by the Chicago Metropolitan Agency for Planning (CMAP) for use in various regional transportation planning and programming activities. The HTSI includes geographic-based data for highway traffic signals in the Chicago metropolitan area, including Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties in northeastern Illinois. While agencies throughout the region have long maintained their own inventories, consistent and uniform information about signals across jurisdictions was lacking. The HTSI seeks to fill this gap and to facilitate inter-jurisdictional communication and more effective transportation studies. The HTSI is not intended to replace current inventories maintained by individual agencies. Rather, it is meant to supplement and build upon data that is already collected.[18]

Table 1: Records submitted to inventory

	Submitting Agency	%	Signal Owner	%	Maintenance Jurisdiction	%
Chicago DOT	2748	39%	2748	39%	2748	39%
Cook County	364	5%	0	0%	365	5%
DuPage County	335	5%	0	0%	333	5%
IDOT	3137	44%	18	0%	2688	38%
Kane County	127	2%	110	2%	118	2%
Kendall County	21	0%	10	0%	0	0%
Lake County	195	3%	159	2%	195	3%
McHenry County	42	1%	42	1%	42	1%
Will County	81	1%	0	0%	49	1%
Other	0	0%	44	1%	440	6%
Blank	0	0%	3919	56%	72	1%
Total	7050	100%	7050	100%	7050	100%

Observation: Signal owner is blank for many signals. In these cases it is likely that the submitter is the signal owner. "Other" indicates other municipality other than the City of Chicago.

Table 2: Traffic signals by county location and maintenance jurisdiction

	Maintenance Jurisdiction										
In county:	Chicago DOT	Cook	DuPage	IDOT	Kane	Lake	McHenry	Other Muni	Will	(blank)	Total
Cook	2,748 56%	365 7%		1,537 31%				235 5%		15 0%	4,900 100%

[18] "Chicago Metropolitan Agency for Planning Highway Traffic Signal Inventory User Documentation" (Chicago Metropolitan Agency for Planning, February 2018), https://datahub.cmap.illinois.gov/dataset/4718d737-95f5-4e58-acd2-2a5e31683002/resource/b9b4491c-c59b-4e6c-b28a-5a50397cce04/download/HTSIUserDocumentation201802.pdf.

DuPage			333 51%	292 45%				27 4%		3 0%	655 100%
Kane				140 44%	118 37%			36 11%		21 7%	315 100%
Kendall				11 34%						21 66%	32 100%
Lake				424 67%		195 31%		4 1%		6 1%	629 100%
McHenry				93 58%			42 26%	23 14%		1 1%	159 100%
Will				192 53%				117 32%	49 13%	5 1%	363 100%
Total	2,748 39%	365 5%	333 5%	2,689 38%	118 2%	195 3%	42 1%	442 6%	49 1%	72 1%	7,053 100%

Table 3: Submitting agency by signal owner

	Signal Owner								
Submitting Agency	Chicago DOT	IDOT	Kane County	Kendall County	Lake County	McHenry County	Other	(blank)	Total
Chicago DOT	2748								2748
Cook County								364	364
DuPage County								335	335
IDOT								3137	3137
Kane County		10	110				5	2	127
Kendall County		2		10			9		21
Lake County		6			159		30		195
McHenry County						42			42
Will County								81	81
Total	2748	18	110	10	159	42	44	3919	7050

Table 4: Controller manufacturer count by maintenance jurisdiction

	Chicago DOT	Cook County	DuPage County	IDOT	Kane County	Lake County	McHenry County	Other	Will County	(blank)	Total
3M								1			1
EAGLE		104	1	174		13		8		1	301
ECONOLITE		248	331	557	5	182	42	28		8	1401
ECONOLITE/APARE CHIP A-11,A-10		1									1
N/A		2									2
PEEK CO.	302										302
Siemens		3		39	113			6			161
TCT (TRAFFIC CONTROL TECHNOLOGY)	2210										2210
TRACONEX		3									3
TRAFFIC CONTROL TECH		2									2
TRANSYT W/SPARE PRE-EMP BOARD		1									1
(blank)	236	1	1	1918				397	49	63	2665
Total	2748	365	333	2688	118	195	42	440	49	72	7050

Table 5: Controller manufacturer percent by maintenance jurisdiction

	Chicago DOT	Cook County	DuPage County	IDOT	Kane County	Lake County	McHenry County	Other	Will County	(blank)	Total
3M	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
EAGLE	0%	28%	0%	6%	0%	7%	0%	2%	0%	1%	4%
ECONOLITE	0%	68%	99%	21%	4%	93%	100%	6%	0%	11%	20%
ECONOLITE/APARE CHIP A-11,A-10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

N/A	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PEEK CO.	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%
Siemens	0%	1%	0%	1%	96%	0%	0%	1%	0%	0%	2%
TCT (TRAFFIC CONTROL TECHNOLOGY)	80%	0%	0%	0%	0%	0%	0%	0%	0%	0%	31%
TRACONEX	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
TRAFFIC CONTROL TECH	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
TRANSYT W/SPARE PRE-EMP BOARD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
(blank)	9%	0%	0%	71%	0%	0%	0%	90%	100%	88%	38%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 6: Regional controller model number counts and percentage

Model	Count	Percent
8810	1	0%
1800E	1	0%
8130-0300-035	1	0%
ACS 3-1000	4	0%
ASC 2	234	3%
ASC 2-1000	49	1%
ASC 2-200	1	0%
ASC 2-2000	26	0%
ASC 2-2100	109	2%
ASC 2M-1000	1	0%
ASC 2S	1	0%
ASC 2s-1000	251	4%
ASC 2S-2000	1	0%
ASC 2s-2100	48	1%
ASC 3	85	1%
ASC 3-100	7	0%
ASC 3-1000	439	6%
ASC 3-2100	54	1%
ASC 8000	51	1%
ASC3	42	1%
ATC1000	299	4%
Eagle EPAC-300	1	0%
Eagle ET 460	1	0%
EPAC 3/168M52	1	0%
EPAC 300	96	1%
EPAC 300 3808 M42	1	0%
EPAC 300 M40	23	0%
EPAC 300 M41	9	0%
EPAC 300 M42	33	0%
EPAC 300 M50	1	0%
EPAC 300 M52	6	0%
EPAC 310 M42	1	0%
EPAC 3108 M03	1	0%
EPAC 3108 M52	3	0%
EPAC 3168 M52	8	0%
EPAC 360 M41	3	0%
EPAC 3808 M40	4	0%
EPAC 3808 M41	5	0%
EPAC 3808 M42	56	1%

EPAC M42	1	0%
EPAC M52	2	0%
EPAC300	1	0%
HMC1000	1034	15%
KMC 4000	1	0%
KMCE-4000	1	0%
LMD 8000	1	0%
LMD40	1227	17%
LMD9200	6	0%
M41	4	0%
M50	19	0%
M50/143479	1	0%
M52	179	3%
Mechanical	240	3%
N/A	2	0%
TMP 390-83	1	0%
TMP 390-8S	1	0%
TMP-390 W/ SPECIAL FUNCTION FOR PRE-EMP	1	0%
(blank)	2431	34%
Total	7111	100%

Table 7: Controller type by maintenance jurisdiction

Maintenance Jurisdiction	Fully Actuated	Pre-timed	Semi-actuated	(blank)	Total
Chicago DOT		2748			2748
Cook County	354		10	1	365
DuPage County				333	333
IDOT	1			2687	2688
Kane County	11		105	2	118
Lake County	195				195
McHenry County				42	42
Other			6	434	440
Will County				49	49
(blank)				72	72
Total	561	2748	121	3620	7050

Table 8: Controller type percentage by maintenance jurisdiction

Maintenance Jurisdiction	Fully Actuated	Pre-timed	Semi-actuated	(blank)	Total
CDOT	0%	100%	0%	0%	100%

Cook County	97%	0%	3%	0%	100%
DuPage County	0%	0%	0%	100%	100%
IDOT	0%	0%	0%	100%	100%
Kane County	9%	0%	89%	2%	100%
Lake County	100%	0%	0%	0%	100%
McHenry County	0%	0%	0%	100%	100%
Other	0%	0%	1%	99%	100%
Will County	0%	0%	0%	100%	100%
(blank)	0%	0%	0%	100%	100%
Total	8%	39%	2%	51%	100%

Table 9: Most recent signal modification date by maintenance jurisdiction

Year	(blank)	<2010	2010	2011	2012	2013	2014	2015	2016	2017	Total
Chicago DOT		1258	39	665	287	33	99	49	318		2748
Cook County	39	29	4	60	79	64	65	22	3		365
DuPage County	162	159	2	4		5	1				333
IDOT	2688	0									2688
Kane County	118	0									118
Lake County	3	0		9		1		55	127		195
McHenry County		20	2	5	5	2	4	1	3		42
Other	439	1									440
Will County	49	0									49
(blank)	51	0								21	72
Total	3549	1467	47	743	371	105	169	127	451	21	7050

Table 10: Most recent signal modification date by maintenance jurisdiction, percent

Year	(blank)	<2010	2010	2011	2012	2013	2014	2015	2016	2017	Total
Chicago DOT	0%	46%	1%	24%	10%	1%	4%	2%	12%	0%	100%

Cook County	11%	8%	1%	16%	22%	18%	18%	6%	1%	0%	100%
DuPage County	49%	48%	1%	1%	0%	2%	0%	0%	0%	0%	100%
IDOT	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Kane County	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Lake County	2%	0%	0%	5%	0%	1%	0%	28%	65%	0%	100%
McHenry County	0%	48%	5%	12%	12%	5%	10%	2%	7%	0%	100%
Other	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Will County	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
(blank)	71%	0%	0%	0%	0%	0%	0%	0%	0%	29%	100%
Total	50%	21%	1%	11%	5%	1%	2%	2%	6%	0%	100%

Table 11: Coordination communication type count

Maintenance Jurisdiction	Central Control	Closed Loop	Stand Alone	(blank)	Total
Chicago DOT	231	223		2294	2748
Cook County	34	132	198	1	365
DuPage County	270		4	59	333
IDOT			1	2687	2688
Kane County	103	7	6	2	118
Lake County	178	12	5		195
McHenry County		23	19		42
Other	6	1		433	440
Will County				49	49
(blank)				72	72
Total	822	398	233	5597	7050

Table 12: Coordination communication type percent

Maintenance Jurisdiction	Central Control	Closed Loop	Stand Alone	(blank)	Total
Chicago DOT	8%	8%	0%	83%	100%
Cook County	9%	36%	54%	0%	100%
DuPage County	81%	0%	1%	18%	100%
IDOT	0%	0%	0%	100%	100%
Kane County	87%	6%	5%	2%	100%

Lake County	91%	6%	3%	0%	100%
McHenry County	0%	55%	45%	0%	100%
Other	1%	0%	0%	98%	100%
Will County	0%	0%	0%	100%	100%
(blank)	0%	0%	0%	100%	100%
Total	12%	6%	3%	79%	100%

Table 13: Pan-tilt-zoom camera available

Signal Maintenance Jurisdiction	Yes	NO	(blank)	Total	Percent Yes
Chicago DOT	0		2748	2748	0%
Cook County	8	356	1	365	2%
DuPage County	0		333	333	0%
IDOT	0		2689	2689	0%
Kane County	64		54	118	54%
Lake County	143		52	195	73%
McHenry County	0	42		42	0%
Other	1		441	442	0%
Will County	0		49	49	0%
(blank)	0		72	72	0%
Total	216	398	6439	7053	3%

Table 14: Adaptive signal control implemented

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	2748			2748	0%
Cook County	365			365	0%
DuPage County	333			333	0%
IDOT	2687		1	2688	0%
Kane County	116	2		118	2%
Lake County	184	11		195	6%
McHenry County	42			42	0%
Other	410		30	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Grand Total	6933	13	104	7050	0%

Table 15: Blankout sign

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT			2748	2748	0%
Cook County	365			365	0%
DuPage County	333			333	0%
IDOT	2635	52	1	2688	2%
Kane County	118			118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	400	10	30	440	2%
Will County			49	49	0%
(blank)	47	1	24	72	1%
Total	4135	63	2852	7050	1%

Table 16: Vehicle detection type count

	Loops	Magnet ometer	Micro-wave	No	Video	Yes	blank	Total
Chicago DOT	256				133		2359	2748
Cook County	359				3		3	365
DuPage County				48		285		333
IDOT	1		3		21		2663	2688
Kane County	54	2	2		58		2	118
Lake County	83				112			195
McHenry County	8				33		1	42
Other				2	6		432	440
Will County							49	49
(blank)							72	72
Total	761	2	5	50	366	285	5581	7050

Table 17: Vehicle detection type percent

Maintenance Jurisdiction	Loops	Magnet ometer	Micro-wave	No	Video	Yes	blank	Total
Chicago DOT	9%	0%	0%	0%	5%	0%	86%	100%
Cook County	98%	0%	0%	0%	1%	0%	1%	100%
DuPage County	0%	0%	0%	14%	0%	86%	0%	100%
IDOT	0%	0%	0%	0%	1%	0%	99%	100%
Kane County	46%	2%	2%	0%	49%	0%	2%	100%
Lake County	43%	0%	0%	0%	57%	0%	0%	100%
McHenry County	19%	0%	0%	0%	79%	0%	2%	100%

Other	0%	0%	0%	0%	1%	0%	98%	100%
Will County	0%	0%	0%	0%	0%	0%	100%	100%
blank	0%	0%	0%	0%	0%	0%	100%	100%
Total	11%	0%	0%	1%	5%	4%	79%	100%

Table 18: Signal Interconnect

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	2294	454		2748	17%
Cook County	198	167		365	46%
DuPage County	44	289		333	87%
IDOT	726	1961	1	2688	73%
Kane County	6	112		118	95%
Lake County	17	178		195	91%
McHenry County	1	41		42	98%
Other	268	142	30	440	32%
Will County			49	49	0%
(blank)	38	10	24	72	14%
Total	3592	3354	104	7050	48%

Table 19: Master controller

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT			2748	2748	0%
Cook County	337	28		365	8%
DuPage County	291	42		333	13%
IDOT	576	2111	1	2688	79%
Kane County	115	3		118	3%
Lake County	195			195	0%
McHenry County	37	5		42	12%
Other	174	236	30	440	54%
Will County			49	49	0%
(blank)	7	41	24	72	57%
Total	1732	2466	2852	7050	35%

Table 20: Transit signal priority

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT		45	2703	2748	2%

Cook County	365			365	0%
DuPage County	333			333	0%
IDOT	2687		1	2688	0%
Kane County	118			118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	410		30	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	4198	45	2807	7050	1%

Table 21: Bus queue jump signal

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT		8	2740	2748	0%
Cook County	365			365	0%
DuPage County	333			333	0%
IDOT	2687		1	2688	0%
Kane County	15		103	118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	405		35	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	4090	8	2952	7050	0%

Table 22: Flashing yellow arrow

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	2748			2748	0%
Cook County	365			365	0%
DuPage County			333	333	0%
IDOT	2687		1	2688	0%
Kane County	107	11		118	9%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	408		32	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	6600	11	439	7050	0%

Table 23: Advance active warning flasher

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT			2748	2748	0%
Cook County	365			365	0%
DuPage County			333	333	0%
IDOT	2682	5	1	2688	0%
Kane County	118			118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	408		32	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	3858	5	3187	7050	0%

Table 24: Advance passive warning flasher

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
CHICAGO DOT			2748	2748	0%
Cook County	363	1	1	365	0%
DuPage County			333	333	0%
IDOT	1		2687	2688	0%
Kane County	117	1		118	1%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	6		434	440	0%
Will County			49	49	0%
(blank)			72	72	0%
Total	724	2	6324	7050	0%

Table 25: Advance vehicle detection

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	2748			2748	0%
Cook County	364		1	365	0%
DuPage County			333	333	0%
IDOT	1		2687	2688	0%
Kane County	92	26		118	22%
Lake County		161	34	195	83%

McHenry County	1	41		42	98%
Other	4	2	434	440	0%
Will County			49	49	0%
(blank)			72	72	0%
Total	3210	230	3610	7050	3%

Table 26: Railroad coordination

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	2720	28		2748	1%
Cook County	361	3	1	365	1%
DuPage County	330	3		333	1%
IDOT	1		2687	2688	0%
Kane County	118			118	0%
Lake County	193	2		195	1%
McHenry County	42			42	0%
Other	8		432	440	0%
Will County			49	49	0%
(blank)			72	72	0%
Grand Total	3773	36	3241	7050	1%

Table 27: Pre-signal at railroad crossing

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT		27	2721	2748	1%
Cook County	362	2	1	365	1%
DuPage County	333			333	0%
IDOT	1		2687	2688	0%
Kane County	15		103	118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	3		437	440	0%
Will County			49	49	0%
(blank)			72	72	0%
Total	951	29	6070	7050	0%

Table 28: Automated red light enforcement

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes

Chicago DOT	2598	150		2748	5%
Cook County	365			365	0%
DuPage County	333			333	0%
IDOT	2522	165	1	2688	6%
Kane County	118			118	0%
Lake County	193	2		195	1%
McHenry County	42			42	0%
Other	401	9	30	440	2%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	6620	326	104	7050	5%

Table 29: Emergency vehicle pre-emption

Signal Maintenance Jurisdiction	Yes	No	Total	% Yes
Chicago DOT	0	2748	2748	0%
Cook County	319	46	365	87%
DuPage County	0	333	333	0%
IDOT	1924	765	2689	72%
Kane County	94	24	118	80%
Lake County	184	11	195	94%
McHenry County	42	0	42	100%
Other	95	347	442	21%
Will County	0	49	49	0%
(blank)	3	69	72	4%
Total	2661	4392	7053	38%
Outside City of Chicago	2661	1644	4305	62%

Table 30: U-turn signal

Maintenance Jurisdiction	No	(blank)	Total	% Yes
Chicago DOT	2748		2748	0%
Cook County	364	1	365	0%
DuPage County	333		333	0%
IDOT	1	2687	2688	0%
Kane County	15	103	118	0%
Lake County	195		195	0%
McHenry County	42		42	0%
Other	3	437	440	0%
Will County		49	49	0%
(blank)		72	72	0%

Total	3701	3349	7050	0%

Table 31: Pedestrian signal

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	144	2597	7	2748	95%
Cook County	150	215		365	59%
DuPage County	50	283		333	85%
IDOT	1474	1213	1	2688	45%
Kane County	51	67		118	57%
Lake County	37	158		195	81%
McHenry County	23	19		42	45%
Other	246	164	30	440	37%
Will County			49	49	0%
(blank)	19	29	24	72	40%
Total	2194	4745	111	7050	67%

Table 32: Pedestrian countdown

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	1094	1653	1	2748	60%
Cook County	275	90		365	25%
DuPage County	216	117		333	35%
IDOT	2383	304	1	2688	11%
Kane County	101	16	1	118	14%
Lake County	68	127		195	65%
McHenry County	23	19		42	45%
Other	373	37	30	440	8%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	4581	2363	106	7050	34%

Table 33: Bicycle signal head

Maintenance Jurisdiction	**No**	**Yes**	**(blank)**	**Total**	**% Yes**
Chicago DOT	1	24	2723	2748	1%
Cook County	365			365	0%
DuPage County	333			333	0%
IDOT	2687		1	2688	0%

Kane County	22		96	118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	406		34	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	4099	24	2927	7050	0%

Table 34: Accessible pedestrian signal

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT		9	2739	2748	0%
Cook County	365			365	0%
DuPage County	24	84	225	333	25%
IDOT	2687		1	2688	0%
Kane County	118			118	0%
Lake County	195			195	0%
McHenry County	42			42	0%
Other	408		32	440	0%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	3887	93	3070	7050	1%

Table 35: LED signal lamp

Maintenance Jurisdiction	No	Yes	(blank)	Total	% Yes
Chicago DOT	648	2081	19	2748	76%
Cook County	4	361		365	99%
DuPage County	110	223		333	67%
IDOT	730	1957	1	2688	73%
Kane County	10	108		118	92%
Lake County	11	184		195	94%
McHenry County		42		42	100%
Other	240	170	30	440	39%
Will County			49	49	0%
(blank)	48		24	72	0%
Total	1801	5126	123	7050	73%

Table 36: Uninterruptible power supply make

Maintenance Jurisdiction	Alpha	Clary	Dimensions	Novus	Tech Power	TechPower	(blank)	Total	% With UPS
CDOT							2748	2748	0%
Cook County	19				57		289	365	21%
DuPage County							333	333	0%
IDOT	2		1				2685	2688	0%
Kane County	103			5		1	9	118	92%
Lake County	24		4		131		36	195	82%
McHenry County		2	4			35	1*	42	98%
Other	11						429	440	3%
Will County							49	49	0%
(blank)							72	72	0%
Total	159	2	9	5	188	36	6650	7050	6%

*submitted as “none”

Table 37: Uninterruptible supply model

Model	Count
1000TP	3
1100W Series	4
15A BBS	1
DBL	4
DBL777-MX	24
DBL-777-MX	4
DBLMX	1
DBL-MX	46
DBL-MX 1000	17
DBL-MX-700	8
DIMENSIONS	1
FMX1100	1
FXM - 1100	24
FXM100	1
FXM1100	127
ME-XL	31
ME-XL-1000	27
Novus	1
NOVUS 1000	4
Tech Power	4
(blank)	6717
Grand Total	7050