Traffic Signal Operational Improvements

Chairman Callegari and Members of the Committee:

I appreciate the opportunity today to come before this subcommittee on Traffic Improvement. My name is Christopher Poe, Assistant Director at the Texas Transportation Institute (TTI). I have been asked today to give a brief overview on traffic signal operation and the potential benefits to safety and mobility. As background, TTI has been conducting research on traffic signal operation for over 50 years. The research has ranged from how best to detect vehicles at traffic signals to how to optimize arterial streets and networks for optimum traffic signal operation. In the 1970’s, TTI developed software to optimize the timing of traffic signals for progression of vehicles along arterial streets. For decades this software was used as an industry standard on evaluating and timing traffic signal systems. Today, TTI is working on better vehicle detection at intersections, performance measures to help agencies operate traffic signals more efficiently, improved signal operation for trucks and emergency vehicles, and operation of traffic signals in proximity to light-rail transit and near railroad grade crossings.

Traffic signal operation is a complex control strategy attempting to allocate traffic signal “green time” to competing traffic streams as well as pedestrians and bicyclists. In developed urban areas, there is no “extra” green time in the rush hours. Green time must be given to some...
drivers and not others. What local and state agencies attempt to achieve is the optimal allocation of green time that minimizes the impact to the most users.

There is no doubt that attention to signal operations provides mobility, environment, and safety benefits. Some of the statistics from leading publications are as follows:

- Basic signal retiming improvements can result in 10-15% improvements in mobility.
- More advanced improvements can increase speeds or decrease travel time by 25%.
- Signal retiming can achieve approximately 10% reduction in fuel consumption.
- Benefit-to-cost ratio of traffic signal retiming projects can reach 40:1 – signal retiming is a relatively low cost improvement that offers significant benefits. The Institute of Transportation Engineers recommends spending $1,000 per signal per year for retiming.

To achieve these benefits, an agency must first be able to accurately determine the input to the traffic signal system – that is, accurately count the cars – and it is not only counting cars at the intersection, but counting the cars approaching the intersection that is necessary to get a picture of the true demand. The industry standard utilized to count cars for years has been inductive loops in the pavement – and when installed properly-- they are a reliable technology. However, putting electronics in the pavement has challenges, such as having to shut lanes down for installation and maintenance, as well as the general wear and tear traffic and weather can put on pavement. If not monitored and maintained, it would not be uncommon for a significant percentage of detectors to be out of service (say, 30%). However, TTI has done considerable research on commercially available detectors that don’t require placement in the pavement nor require the closing of lanes. In addition, many local agencies are having good experience with video and other types of detection technologies as an alternative to inductive loops.
Another important aspect of good signal operation is proper communication to signalized intersections and between signalized intersections. Traffic signal communications are essential for monitoring for equipment failures, for updating signal operation in a timely fashion due to traffic volume changes, for adjusting operation in a real-time response to incidents, and to maintaining time synchronization along coordinated corridors. As corridors become more developed, municipalities may be experiencing increased difficulty in getting good telecommunications installed. Many cities are exploring alternative wireless communication technologies.

The technology that actually controls the traffic signals has evolved over time and has considerable functionality. There are some additional techniques available to improve traffic signal operation:

- **Innovative traffic signal phasing** – The industry is continually looking at improvements, and the successful applications are included in the state and national manuals for traffic control devices. Best practices for use are needed for some of these innovative traffic signal strategies to gain greater acceptance. For example, the flashing yellow arrow for permissive left-turn operation is now included in the Manual on Uniform Traffic Control Devices. This operation creates more efficient use of the signal green time and eliminates motorist confusion.

- **Better measures of effectiveness** – TTI has been researching how to monitor both the traffic signal hardware and arterial street travel time to produce real-time measures of effectiveness. This technology would allow monitoring performance at anytime of the day and monitoring multiple intersections at one time.
• Better use of advanced features on signal hardware – many of the signal manufacturers have features on the traffic signal hardware that can be used to improve operation

Traffic signal operation has a direct relationship with safety. While research has shown that installation of traffic signals can increase the total number of crashes – signals tend to decrease the more severe crashes, such as “t-bone” or right angle crashes. The types of crashes that do increase are rear-end collisions that tend to be less severe than right-angle crashes. To further help eliminate some of these severe crashes, TTI has been working with the Metropolitan Transit Authority of Harris County on in-pavement lighting at the intersection stop bar that works in conjunction with the traffic signal to illuminate the stop bar when the signal indication is red. This, along with illuminating the back plate around the traffic signal head helps to prevent vehicle and light-rail transit vehicle collisions.

In trying to improve safety at signalized intersections, it is important to be able to study past crashes to determine the appropriate mitigation strategies. There is concern over the inconsistency of available crash reporting to create usable information that allows for crash trend detection. In addition, there is no statute that requires the peace officer crash report (that is the “blue form”) to be submitted. Many smaller – mainly property damage-only crashes -- go unreported and thus, cannot be analyzed to try and improve safety of a signalized intersection.

In Texas, we are fortunate to have an outstanding transportation community with some of the top traffic engineers in the country responsible for transportation and traffic signal operation. However, the emphasis on traffic engineering has been decreasing. Thirty years ago, every large city in Texas had a traffic engineering department – and that was when there was considerably less traffic. Today, state and local transportation agencies are being asked to do equal or more
with less staff. At TTI, we hope to help develop the next generation workforce by giving undergraduate and graduate students experience on the best practice in traffic signal operation.

In summary, technology is not the impediment to improving today’s traffic signal operation. Technology can be used to get more out of the existing traffic signal systems. However, having the people and the financial resources to properly operate and maintain these traffic systems is what will do the most to improve the mobility and safety for the people of Texas.

Mr. Chairman, I have provided your staff with some additional information on publications and websites on traffic signal operation.

That concludes my prepared remarks and I would be happy to answer any questions.

**Publications & Websites:**


