

ITEM 12 - Information

March 18, 2009

Status Report on Traffic Signal Optimization in the Washington Region

Staff

Recommendation: Receive briefing on the status of traffic signal optimization in the region as requested by the TPB at the January 28 meeting.

Issues: None

Background: Ensuring traffic signals that are optimally timed can reduce delays and emissions, and improve safety.

National Capital Region Transportation Planning Board

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Item #12

MEMORANDUM

TO: Transportation Planning Board

FROM: Edward D. Jones
Prince George's County Department of Public Works and Transportation
and Chair, Traffic Signals Subcommittee

Andrew J. Meese
COG/TPB Staff

DATE: March 11, 2009

SUBJECT: Status Report on Traffic Signal Optimization in the Washington Region

Background

At the January 28, 2009 meeting, the Transportation Planning Board requested a status report on traffic signal optimization in the region. This request was in the context of the annual update of the regional Constrained Long Range Transportation Plan (CLRP), which is currently under discussion. Previously, the TPB discussed the topic of signal optimization in the region in November 2005, in conjunction with the completion of the 2002-2005 Transportation Emissions Reduction Measure (TERM) addressing optimization. This memorandum will examine what it means for a signal to be optimized and what the current status is of maintaining traffic signal optimization in the region.

What Is Signal Optimization?

Signal optimization is a traffic engineering concept whereby traffic signals (often groups of signals in corridors and/or isolated systems) are (re-)timed to reduce delay for vehicles on the roadway system while ensuring safety. Engineers use a combination of traffic volume counts, in-car and in-field travel time observations, control center observations, and computer analysis to determine signal timings given the complex interactions of traffic flows. The results for any one driver on any one trip may not appear to be "optimal", due to high traffic loads, cross-traffic, pedestrian movements, and other factors, but overall system delay should be minimized. An engineering rule-of-thumb recommends checking signal timing at least every three years because traffic patterns evolve.

Traffic signals allot time at intersections for safety, traffic flow, pedestrians, and other factors; an individual signal's timing needs to be balanced for these factors. Multiple nearby signals can be analyzed as a system to coordinate timings. Under certain conditions, a corridor with a predominating flow and direction can be timed for "progression", reducing delays for traffic in that flow. Signals generally have three or more timing plans, usually including morning peak period, midday, and evening peak period, and frequently additional plans such as weekend or overnight plans.

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“Optimized”, however, does not mean “without delay”. The motorist may still experience delays even after signal or corridor optimization, if, for example:

- There are high traffic volumes / left and right turns / high cross-traffic volumes
- The motorist is traveling in the opposite direction of predominant flow
- The safety of and sufficient crossing time for pedestrians necessitate extra time.

It is overall system delay, not necessarily the delay experienced by a given individual motorist, which is minimized in optimization.

What is the Process of Optimization?

Once the signal, corridor, or area to be optimized has been identified, engineers generally go through the following steps:

1. “Before” field observations are taken by technicians, including travel time runs, current signal timings, and traffic volumes (including cross traffic and left and right turns).
2. Data is entered for a computer analysis with specialized software, outputting suggested timings and estimated benefits.
3. Engineers interpret and adjust the computer results, and fine-tune and implement the new set of timings. Professional judgment based on experience is used in adjusting signal timings, not relying solely on the raw computer output.
4. “After” field observations are undertaken for the retimed signals, with readjustments if necessary.
5. Over time, engineers undertake ongoing observations spot-checking for problems and adjustments, and investigate timings in response to public inquiries or complaints.

An engineering rule-of-thumb recommends that signals be reanalyzed for optimization about once every three years on average, more often for coordinated signals and less often for more isolated signals. Regular observations in the field or from control centers can help determine whether a re-optimization is needed.

How does the engineer know that signals are optimized? Engineers do not rely solely on the raw computer output. Before and after field observations help verify that the optimization process has been successful. Ongoing field observations and monitoring from the traffic control center are important, with fine-tuning if necessary. These monitoring and spot checks activities, as well as responding to citizen inquiries and complaints, all help ensure the system remains working properly.

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Survey of Signal Optimization in the Region

TPB staff conducted a survey of member agencies in February and March 2009 to obtain feedback on optimization. As in 2005, the format of the survey is self-reporting by the jurisdictions and agencies that own and operate traffic signals. Responses received were classified in one of four categories:

- Signals re-timed/optimized during the three-year period of calendar years 2006 to 2008 using a computer and data-based process. A common methodology is the use of a combination of two traffic engineering software packages, Synchro and SimTraffic.
- Signals checked and (if necessary) adjusted during the period of calendar years 2006 to 2008 by means other than traffic signal optimization software. This included signals that were checked whether or not they ended up needing a timing adjustment, and excludes any signals that were optimized by computer software analysis during the same period.
- Signals not analyzed or checked during the period of calendar years 2006 to 2008.
- Signals for which no report was received.
- Certain signals are not subject to optimization and were not included in the survey. Examples include firehouse emergency signals and pedestrian crosswalk flashers.

Table 1. 2006 – 2008 Regional Signal Optimization Reported Results

All figures are approximate.

Total Signalized Intersections	Total Signals Optimized or Checked/Adjusted				Signals Not Analyzed or Checked 2006 to 2008		Signals for which No Report Received	
	Signals Optimized 2006 to 2008 (by Computer Analysis Methods)		Signals Checked and If Necessary Adjusted 2006 to 2008 (by Methods Other than Computer Analysis)		Number	Percentage	Number	Percentage
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
5,400	3,000	56%	1,300	24%	1,000	18%	100	2%
	4,300 – 80%							

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Status Report

The results of the brief TPB staff survey on signal optimization in the region are shown in Table 1. The results indicate that 80% of the signals were either computer optimized (56%) or spot-checked (24%) by signals officials in the 2006 to 2008 time frame. A relatively small proportion of the region's signals, about 18%, were not checked in the 2006 to 2008 period. Likely these are signals that are less critical for optimization, such as signals in isolated locations or where there were no significant changes to traffic volumes and patterns. At this time, no reports have been received from systems estimated to account for about 2% of the region's signals.

How is the region doing on optimization compared to 2005? For the 2002 to 2005 TERM, a weighted average methodology was used to describe results, giving half weights to non-computer methods. If the 2005 methodology is applied to the 2008 data, the percentage of optimized signals remained the same in 2008 as it was in 2005 (a weighted average of 68%). However, we are doing better than that may indicate because:

- The most critical signals in many cases are being checked and optimized even more frequently than once every three years.
- All major agencies (with more than 50 signals) reported that they had optimized or checked significant numbers of their signals within the reporting period; no major agency reported not optimizing or checking.
- There are anecdotal reports of more resources annually being put into optimization in recent years than in previous years – this will be beneficial if continued.

Outlook

There is ongoing awareness and commitment to safe and effective signals operations among the transportation agencies of the region. There is continuing interagency coordination through the Traffic Signals Subcommittee and other forums. There are benefits of providing sufficient resources to ensure good signals operations, and it is hoped that these resources can continue to be devoted. As of now, the vast majority (80%) of the region's traffic signals are being optimized or checked on a frequent basis.