Signal Optimization and Improving Traffic Flow in the District

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The District of Columbia as a humanistic, people-friendly city is first and foremost an accessible city, where mobility is possible for all. Many cities today are plagued by traffic congestion, and in densely populated city areas the fastest ways of getting around are often on mass transit, by walking and bicycling.

Under Mayor Vincent C. Gray's Sustainable D.C. initiative, our goal is to continue to switch commuters from driving alone, to bicycling, walking, and carpooling by making mass transit more appealing. Our goal is to have 75% of our morning commutes to start and end using these transportation modes.

Creating this balance starts with improving our transportation network and one key factor is traffic optimization for all modes of transportation. Toward these aims, The District Department of Transportation (DDOT) is overhauling the District's traffic signal management program through using advanced computer software.

Traffic signal management can be defined as using new technologies and equipment to make existing traffic signal control systems operate more efficiently. Improved traffic signal has many benefits including improving air quality and reducing fuel consumption; reducing congestion and creating efficiencies for commercial and emergency vehicles, and buses. This can also reduce the number of serious accidents; reduce aggressive driving behavior, including red-light running and postponing and eliminate the need to construct additional road capacity.

The DDOT system is comprised of traffic lights, stop signs, and various other control devices designed to control competing flows of traffic. It is designed to efficiently manage vehicles, pedestrians, cyclists and public transit. The 1,600 traffic signals in D.C. collectively form DDOT's comprehensive signal program. Traffic signal re-timing and management is a cost-effective way to provide safe and efficient traffic flow throughout the city.

Signal Timing

Signal timing is a special technique that traffic engineers use to manage traffic flow and determine who has the right-of-way at

signalized intersections. DDOT traffic signal engineers manage traffic signal systems operations in connection with capital improvement projects, sight clearance inspections and responses to residents' inquiries.

The central objective of signal timing is to coordinate the competing demands of motor vehicles, public transit, bicycles and pedestrians in an efficient manner. Signal timing strategies are designed to minimize stops and delays, minimize fuel consumption and air pollution emissions and optimize traffic flow and progression along major arteries. Signal lights are designed to coordinate a process in which lights respond to the traffic demand based on the time of day. The current signal timing is determined by the preset movements of traffic.

DDOT's comprehensive plan to improve the flow of traffic is a coordinated 5-year project. It is well underway and several important changes have already been implemented at nearly 600 intersections. This part of the program (Phase I) is the first step in building a solid foundation to enhance and improve traffic flow. DDOT is replacing the old and outdated traffic controller software in the field during Phase I. More extensive changes will come in Phase II which is scheduled over next three years and will include all 1600 traffic signals in the District.

The scope and scale of this project is far more comprehensive than any previous DDOT effort. DDOT is on the forefront and cutting edge of managing traffic flow to respond to our population growth and improve safety and efficiencies.

DDOT's ultimate program goals are to make DC traffic signals safer and friendlier for pedestrians, vehicles, public transit, and cyclists, and to reduce traffic congestion, improve bus travel, and reduce harmful emissions.

DDOT's traffic engineers collect data on traffic patterns, volume, speed, lane-use, and timing of signals at intersections with the goal of utilizing the data to optimize traffic flow and better manage traffic movement in the District of Columbia. Using advanced computer technology has enhanced DDOT's abilities to manage traffic flow efficiently.

DDOT uses off-line software model that can emulate real-life traffic conditions. It evaluates and optimizes traffic signal timing plans based on traffic volume and geometric conditions. And it captures data based on capacity performance and level of service at signalized intersections.

Data is based on the time of day and organized around AM drive-time peak hours on weekdays from 7-9:30, mid-day peak from 11-1, and PM drive-time peak hours from 3 to 7. On weekends, the traffic flow is different and the data collected creates a separate pattern, from 11am to 4pm. The analysis takes the existing traffic conditions, then optimizes or creates an optimized plan to improve the flow of arterials by all users. The small changes in Phase I have largely gone unnoticed to the general captures data based on capacity performance and level of service at signalized intersections. Data is based on the time of day and organized around AM drive-time peak hours on weekdays from 7-9:30, mid-day peak from 11-1, and PM drive-time peak hours from 3 to 7. On weekends, the traffic flow is different and the data collected creates a separate pattern, from 11am to 4pm. The analysis takes the existing traffic conditions, then optimizes or creates an optimized plan to improve the flow of arterials by all users.

The small changes in Phase I have largely gone unnoticed to the general public but are fairly extensive. The updated traffic controller computer software includes several features. One of the most important features allows traffic engineers to modify signal timing to improve bus progression. DDOT, working in partnership with WMATA, is also planning improvements to assist in the operations and efficiencies of WMATA's bus fleet. The WMATA/DDOT effort will improve bus routes through the implementation of a Transit Signal Priority in the various heavy bus corridors.

Another feature of DDOT's program in the traffic controller computer software upgrade is Adaptive Traffic Signal Control Technology which will utilize real-time traffic information to adjust the timing of lights to accommodate changing traffic patterns and ease traffic

congestion. In cooperation with the Federal Highway Administration, DDOT will begin testing this new technology on New York Avenue, Pennsylvania Avenue SE and Rhode Island Avenue corridors in 2014. This feature will work to improve overall traffic flow.

The new traffic controller software will simplify the tedious process of designing new traffic signal timings and utilize the most modern computer technologies to create efficiencies. Increased traffic flow and a growing population mean DDOT must continually find new and innovative ways to manage traffic flow. The new software goes a long way towards assisting and driving this effort.

DDOT has built a complex traffic signal timing computer model that is being specifically adapted to DC's local driver population, roadway network, and traffic flows. The traffic signal timing computer model was vital in helping DDOT evaluate various signal timing options and make quick signal timing changes in the Wisconsin Avenue corridor in August this year.

A concrete example of the program's early success is during the afternoon rush hour. Traffic engineers report that drivers making the trip along the full length of Wisconsin Avenue, a major traffic artery, are saving time. Drivers commuting between Georgetown and Friendship Heights on Wisconsin Avenue are saving up to 5 minutes in their daily commute. More quick-relief, traffic signal re-timing experimental projects are planned for Georgia Avenue, another major traffic artery in the coming months. And more extensive changes are scheduled for these two corridors as part of the Phase 2 implementation in 2015.

Phase 2

Phase 2 will result in more noticeable changes to the coordinated traffic signal timings. Engineers will complete the redesign of coordinated signal timings for the first 200 signals to be implemented east of the Anacostia River and along M Street in the Southeast/Southwest corridor before the end of 2013.

The next phase of the project is re-timing over 600 signals in the downtown area—which is undergoing a massive influx in development (for example, CityCenterDC and the Marriot Marquis)—by late 2014 or early 2015. Re-timing downtown signals has some unique challenges with high volume traffic all competing for the same space and the same green lights.

Traffic signal re-timing will improve downtown traffic flow by timing the signals so that groups of vehicles (referred to as platoons) can travel through the series of signals with minimal stoppage. Importantly, traffic signal optimization also improves safety because traffic flow is smoother and vehicles stop less often. This reduces the probability for rear-end crashes, reduces vehicle emissions and lowers our carbon footprint. It also reduces travel costs by reducing the amount of time stopped at red lights, saving us money at the gas station.

A bicyclist crosses at one of several HAWK signals that DDOT recently installed in the District.

DDOT is at the forefront of modernizing traffic flow and utilizing the most advanced computer software to improve traffic flow and safety. This important effort will improve the quality of life for citizens and commuters in the District of Columbia and be an important component of Mayor Gray's Sustainable D.C. program.

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