BUS PERFORMANCE VERSUS NORMAL TRAFFIC SIGNAL OPERATIONS

TRAFFIC SIGNAL TIMING CONCEPTS
FOR
ARTERIAL BUS OPERATIONS

INTRODUCTION

Several traffic timing concepts have been deployed in an effort to improve transit on-time performance along arterial roadways. These concepts have varying degrees of impact on vehicular and pedestrian traffic along the arterials. This white paper identifies three traffic signal timing concepts and discusses how each impacts bus on-time performance and normal traffic operations.

FACTORS IMPACTING BUS US ON-TIME PERFORMANCE

There are many factors that impact bus on-time performance and buses may encounter one or more of these factors on a daily basis. These factors include the following:

- Traffic – high traffic volumes, accidents, construction, special event traffic, etc.
- Passenger boarding/alighting – higher than normal boarding/alighting at stations
- Weather
- Unrealistic schedules – Assumed travel speeds too high, station dwell times too short
- Traffic signal timing - out-of-date and uncoordinated timing along the arterial.

NORMAL TRAFFIC SIGNAL OPERATIONS

Normal traffic operations optimize the movement of vehicles (i.e. cars, trucks, buses) and pedestrians through an intersection. Sufficient time is provided to each vehicle and pedestrian movement to safely maneuver through the intersection and minimize delay. Along an arterial, timing is coordinated to allow the progressive movement of vehicles along the arterial, minimizing stops and travel time. Any departure from normal, optimized traffic signal operations increases delay for all vehicles at an intersection.

POSSIBLE TRAFFIC SIGNAL OPERATIONAL CONCEPTS FOR TRANSIT

Traffic signal concept discussed in this white paper include the following

- Traffic Signal Preemption
- Transit Signal Priority
- Intermodal Traffic Signal Optimization

These three concepts are discussed in the following paragraphs and include a description of the concept, impact on normal traffic signal operations, and under what conditions each concept works best to optimize travel along an arterial for all vehicles.

TRAFFIC SIGNAL PREEMPTION

Traffic signal preemption provides certain classes of vehicles the right-of-way through a signalized intersection by suspending normal signal operations and implementing a special preempt control mode. Vehicle classes that typically utilize signal preemption include trains and emergency vehicles.

Traffic signal preemption is not transit signal priority since it suspends normal traffic signal operations during a preemption event.

Preemption is initiated using several types of technologies to detect the approaching vehicle. When initiated, preemption interrupts normal signal operations and assigns right-of way (ROW) for the approaching vehicle. The assignment of ROW (through a green indication for the approaching vehicle) is accomplished by truncating and/or omission of the normal vehicle and pedestrian phases on other approaches.

Traffic signal preemption has a significant negative impact of traffic operations. These impacts include increased vehicle and pedestrian delay caused by the following:

- Truncation or omission of traffic signal vehicle and pedestrian phases
- Loss of coordination along the arterial.

The recovery to the normal signal cycle caused by preemption events vary between one (1) and four (4) normal traffic cycles. Assuming a cycle of 120 seconds, a maximum preempt event could last over seven minutes. Successive preemption events less than seven minutes apart could cause normal traffic operations to be suspended over a long period of time

Because of its impact on vehicle and pedestrian traffic, traffic signal preemption is best suited for the occasional preemption event such as a train or emergency vehicle passing through an intersection. The characteristics of traffic signal preemption is not conducive to recurring or regular preemption events such as bus operations. The City of Houston does not plan to allow the use of Traffic Signal Preemption for purposes other than emergency vehicle response along the Post Oak corridor.

TRANSIT SIGNAL PRIORITY (TSP)

Transit signal priority (TSP) is different from traffic preemption in that a TSP event does not suspend normal traffic operations. TSP works within the normal traffic signal plan to modify the existing timing without interrupting coordination along the arterial. Modifications typically include extending or initiating early green indications on the intended phase, changing phase sequences, and/or including special phases to facilitate bus operations through the intersection. In Houston, TSP only extends or initiates an early green indication on the intended phase.

TSP requires communication between the transit vehicle and traffic signal so that TSP can be implemented in the traffic signal controller. Through the communication link, transit vehicles request TSP from the traffic signal. In some cases, the request for TSP may only be made by the transit vehicle if it is behind schedule or some other defined condition. If a request is made, it may or may not be granted by the traffic signal based on parameters such as a maximum number of TSP events during a specified time period.

Since TSP does not suspend normal traffic operations, coordination along the arterial is not impacted by a TSP event. However, since TSP alters signal timing and/or phasing sequence at an individual intersection,

delay at individual intersections may be increased. Typically, the additional time provided for a transit vehicle to pass through an intersection is taken from the time allocated to side street, causing additional delay to side street traffic. Successive TSP events that reduce side street phase times can significantly increase intersection delay, especially during peak hours.

To avoid impacting vehicle traffic, TSP is best suited to assist transit vehicles regain adherence to published schedules. Full time transit priority, especially along arterials with two-way transit operations and short headways, should be avoided due to the impact on vehicular traffic.

Currently, in Houston, TSP is activated only when the buses are at least 5 minutes behind schedule. When the on-board systems recognize that the bus is 5 or more minutes behind schedule, the system turns on the TSP emitter. The TSP emitter cannot be turned on by the bus operator. Once the TSP emitter is active, the green can only be initiated early or be extended by no more than 5 seconds. TSP is currently in use along Post Oak Boulevard.

INTERMODAL TRAFFIC SIGNAL OPTIMIZATION

Intermodal Traffic Signal Optimization (ITSO) is a new term that develops traffic signal timing plans that consider all modes including buses. Properly designed ITSO can allow buses to travel non-stop between stations. Timing plans are developed that take into consideration bus operating characteristics (i.e. travel speeds, acceleration/deceleration, etc.), maintaining coordinated travel along the arterial for vehicles, and optimizing timing at individual intersections to minimize vehicular and pedestrian delay. Buses travel between stations alongside other vehicles using the normal coordinated timing along the arterial. When entering a station, the bus is detected by the traffic signal system which will either hold the bus at the station or release it so that it will reach the next intersection during the green phase for other traffic on Post Oak Blvd. ITSO may consider the use of TSP, queue jumping and the modification lead/lag protected left turn phasing placement within the cycle; however, the use of such tools is not currently planned for use along Post Oak Blvd.

To reiterate, ITSO is not intended to impact other vehicular traffic since normal traffic operations are not suspended. It merely promotes non-stop travel between stations and provides information to the bus on when to leave the station to travel to the next station without stopping.

ITSO is best suited for arterials where two-way bus operations, short headways, and relatively short distances between stations are present. Additionally, arterials with exclusive bus lanes where bus performance is not impacted by other traffic is also ideal for ITSO.