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Prioritizing Vehicles that Carry Important Characters (Political) WhenCrossing SignalizedIntersections

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ABSTRACT

When the lights turned green at the previous intersection in the urban transportation network, a string of cars moved forward practically in unison to reach the next intersection. The intersection's efficiency will enhance and the overall delay and stop of cars will decrease if the signal of the related route comes at the same time as the group. The similar approach was used on the political cars in the research to cut down on their wait and halt times. This research takes into account a segment of the route taken by political vehicles on their way from Saad-Abad Palace to the president's office on Pasteur Street. In this research, many methods were devised for giving cars in the Aimsun simulator program higher priority. Two IDs, one before the intersection was erected and one after, were then inserted to detect the arrival of these cars at the intersection. The following are some of the findings from this investigation: In a scenario where there is more green time, the average journey time rises by 10 seconds on average. In the 10-second green-time extension scenario, delays averaged 7 seconds, whereas in the 15-second extension, they averaged 6 seconds. In both circumstances, the average number of stops per vehicle increased by 0.1.

Key words: Road intersection, Prioritization, Political Vehicle, Decreasing travel time.

1. INTRODUCTION

Character protection is all that is needed to keep them safe from assault, kidnapping, assassination, and other similar dangers (1). Personality, particularly honor and majesty, and in the political realm of characters are the selected individuals of a country or nation who are responsible for running the country at a given time, or in terms of social standing, as the elite and national capital of a country. They also need to be safeguarded against harm in this regard. Movement-based precautions, public assembly-based precautions, workplace-based precautions, and home-based precautions and protections are all examples of precautions that may be taken to safeguard individuals' identities (2). The most well-known tool for managing traffic and enhancing safety is the traffic signal. Although traffic lights prohibit vehicles from crossing the intersection in the wrong direction, they reduce delays for vehicles on average provided the right timetable is computed (3). While traffic lights are typically used alone at each junction, they may be linked together at certain points along a route when doing so is both necessary and efficient. And in sync (four to six). There are traffic lights that can be altered to accommodate varying volumes of traffic, with the resulting adjustment to the green time range of each phase. Indicators placed at predetermined distances from the stop line and in all directions leading up to the junction (7, 8) determine how long the green light will be on for each set of lights. No prioritizing studies have been conducted in the field of public access protection in regards to the safety and security of conservation research. Hence, this subsection analyzes the priority structure for relief vehicles worldwide (9, 10). A clever technology was developed to provide buses preferential treatment in urban traffic. In this scenario, both the traffic signals and the buses have computerized intelligence. Time is the most important consideration. The connection in this setup is the ambassador for the road,

It is characterized by factors such as its length, capacity, flow, and passing traffic volume, and whose junctions are characterized by a network of nodes (11). The junction factor (12, 13) is crucial because it coordinates the timing of traffic lights, receives and sends signals, and attempts to improve bus factor time reservations. The best moment to use the green light to evacuate the links is during the phase associated with the junction factor. In most cases, this strategy gives buses precedence (saving 24–28% of journey time) (14). The objective of traffic lights is to prioritize public and private cars, according to a research titled "Multi-functional system to control the traffic of personal and public transport vehicles." Both

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the direct technique, where the bus agent is kept at the station to adjust the priorities of the buses, and the indirect way, where the priorities are adjusted by other means, are effective. The multi-factor technique implemented here has been shown to reduce delays for both private automobiles and buses (by 38 percent for the former and 51 percent for the latter) at traffic signals (15). To better understand how various priority schemes are implemented at intersections, Hong Chow and his colleagues at the California Department of Transportation performed an inquiry. In the end, no prioritizing requirements were taken into account for the simulation based on satellite positioning systems, which investigated delivering the request with 15, 20, and 30 seconds till the junction. The eight possible outcomes are as follows:

One, There Is No Order Of Precedence
At least 15 seconds before the bus reaches the junction, call for priority service (2 AVL).
Third, when the bus is 20 seconds away from the junction, dial AVL (20) to request priority service.

If you want to get on the bus first, you should call it at AVL (25) when it's less than 25 seconds from the junction.
When the bus is 30 seconds from the junction, press AVL (30) to seek priority.
Six, put the vehicle detector in place 150 meters in front of the intersection (SVD (150)).
Seven, SVD (200), put the car detector in place two hundred meters before the crossroads.
Place the vehicle detecting device (SVD) 250 meters in advance of the junction.
The best results were achieved in reducing intersection wait times by using the AVL25 and SVD200 scenarios. When the average delay time for each vehicle under non-priority conditions is about 135 seconds, and the highest delay time for conditions with priori- ty is 60 seconds, the latter is less than half the latency in no-priority mode, it is clear that the numbers expressed in the two aforementioned scenarios are an average of de- lays. Additionally, tests conducted on the Ringer junction found that a 35% reduction in vehicle travel time and a 57% reduction in intersection delays were obtained (16). Keitelson and his coworkers in Seattle studied the effects of the priority system's adoption at three crossings as part of a research commissioned by the US National Consultative Commission and the US Transportation Research Commission. Early implementation of the greening system in this study resulted in a 24 percent decrease in bus stops at the studied junctions, an 8 percent decrease in travel time, and a 24 percent decrease in vehicle wait time at the studied crossings (17).

2. METHODOLOGY

Eleven statisticians and three observers were utilized in this study to track the process of polling statisticians about their issues and needs. This was done to prevent any difficulties with the statistics and keep people from leaving the site. These watchers might stand in for anyone if required. There are three tiers at which the traffic light's priorities can be adjusted:

1) Minimal Coverage: This level of the network has just a few of nodes and their associated intersections.

The second level, "route," encompasses a string of connecting passageways.

Three-dimensional coverage that makes extensive use of all available network lines.

Timing and prioritizing of all lines would result in the rejection of the traffic flow in some crossings because of the huge volume of cars, the high mobility of public transit, and their placement in relation to other intersections. There will be crossroads close together. Each of these tiers necessitates a different analysis of the route's network health and junction characteristics. Three-phase scheduling is used at all three of the junctions in this analysis. The volumes were collected in 12 phases at each junction using data gathered from field-by-field tracking of a standard automobile. According to the data, nighttime is the busiest time at all three crossroads. The volume during this time was used for modeling purposes.

2.1. Different priority scenarios

Prioritization was taken into account in the phasing of both approaches, and it was indicated at the level of one in this research. In order to do so, we analyzed three distinct priority scenarios:

2.2. First scenario: give the intended vehicle the right of way at all three junctions.

2.3. Prioritization at two Mir- Az Shirazi and Shahid Motahari junctions is the second possible outcome.

2.4. In a third situation, Mirza Shirazi prioritizes at the hub intersection.

2.5. First, the scenario with the shortest delay for these automobiles is prioritized, and then the scenario with the shortest delay at each intersection is prioritized.

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2.6. Case study

Security for carriers transporting political figures is hampered by the heavy traffic in major cities. Improving service and performance can be accomplished by lowering travel time by giving these vehicles priority at signalized junctions. In this analysis, we consider a segment of the route taken by political vehicles on their way from Saad-Abad Palace to the president's office on Pasteur Street. Shahid Beheshti Street meets Ghaem Farahani Street, Mirza Shirazi Avenue meets Shahid Beheshti Street, and Valiasr Street meets Shahid Motahari Street, as seen in Figure 1.

Figure 1. Case Study Area

Alternatives for prioritizing the route's three junctions are analyzed. The best possible scenario is selected based on the output of the simulation program. The results of the simulations and the analysis of the researched region are shown below. Tables 1, 2, and 3 show the volume of intersections and simulations are run to help with this. The findings are then discussed and analyzed in further depth.

Table 1. The circulation traffic volume at the intersection of Shahid Beheshti and Qa'im Farahani

Intersection	*Approach*	*North*	*East*	*West*	*south*
Shahid Beheshti and Qa'im Farahani	North	-	-	112	225
	East	132	-	340	145
	West	-	-	-	-
	south	238	-	98	-

Table 2. The circulation traffic volume at the intersection of Shahid Beheshti and Mirza Shirazi

Intersection	*Approach*	*North*	*East*	*West*	*south*
Shahid Beheshti and Mirza Shirazi	North	-	-	102	241
	East	111	-	324	119
	West	-	-	-	-
	south	241	-	92	-

Table 3. The circulation traffic volume at the intersection of Valiasr-Shahid Motahhari

Intersection	*Approach*	*North*	*East*	*West*	*south*
Valiasr-Shahid Motahhari	North	-	126	145	268
	East	-	-	-	-
	West	-	259	-	167

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	south	-	-	-	-

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3. RESULTS AND DISCUSSION

In order to prioritization in the Aimsun simulator software,the vehicles were equipped and then to detect the arrival ofthese cars at the intersection, two detectors were installed,one before the intersection and the other after it, and the detector was set up to After 3 seconds, submit the request for priority passage. At these 3 intersections, traffic vol- umes were often used to reach the intersection of the vehi- cle, even if the lights were green, it took 3 seconds to leave the intersection. Simulations were performed for the statusquo and three scenarios, and averaged over three times for

each mode. In the Table 4, Table 5, Table 6 and Table 7, asummary of the simulation results is presented.

Table 4. Information on the status quo of the case study area

status quo			
Total delay (Sec / Km)	Delay to cars (Sec / Km)	Delay to the intended vehicles (Sec / Km)	Average overall length of the queue (Veh)
132.65	100.07	32.58	184.26

Table 5. Information on the first scenario in the case study area

First Scenario			
Total delay (Sec / Km)	Delay to cars (Sec / Km)	Delay to the intended vehicles (Sec / Km)	Average overall length of the queue (Veh)
169.36	136.07	18.08	205.64

Table 6. Information on the second scenario in the case study area

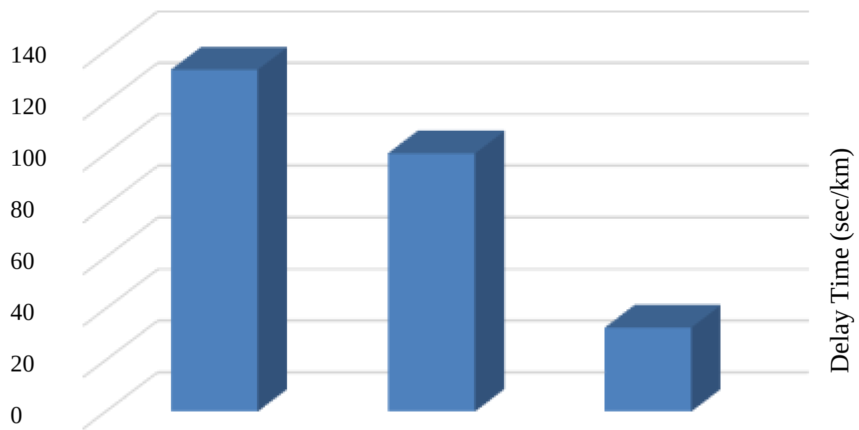
Second Scenario			
Total delay (Sec / Km)	Delay to cars (Sec / Km)	Delay to the intended vehicles (Sec / Km)	Average overall length of the queue (Veh)
161.47	129.54	21.61	203.58

Table 7. Information on the third scenario in the case study area

Fourth Scenario			
Total delay (Sec / Km)	Delay to cars (Sec / Km)	Delay to the intended vehicles (Sec / Km)	Average overall length of the queue (Veh)
154.91	106.22	29.67	191.25

According to Figure 2, delays are reported for different vehicles, which is expected to be higher than the expected overall delay of the vehicles and delays to the political vehicles. In Figure 3, the same is true, but the delay of the

intended vehicles is very low and the delay of other vehi- cles is greatly increased, which according to the decision maker can choose or refuse this scenario.



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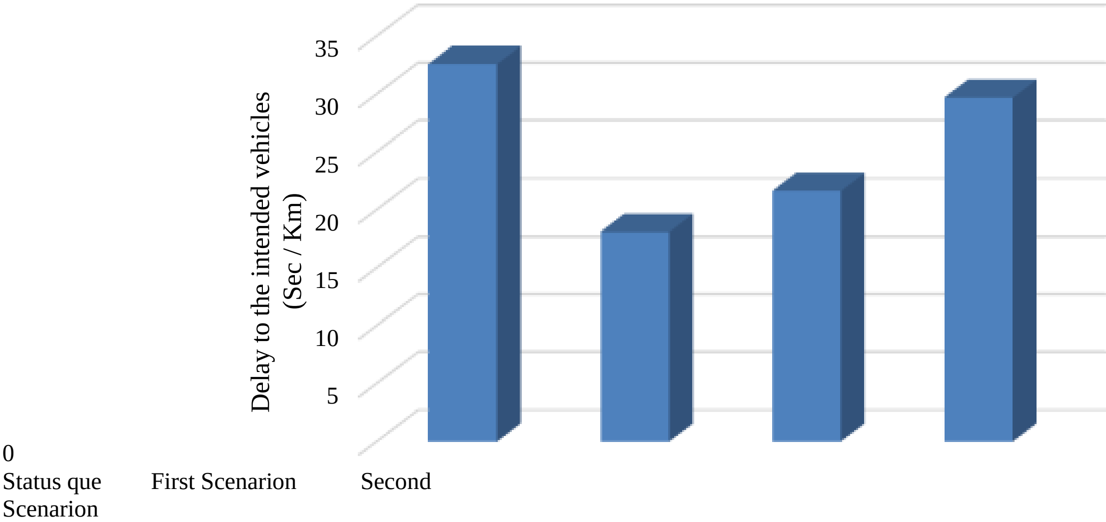
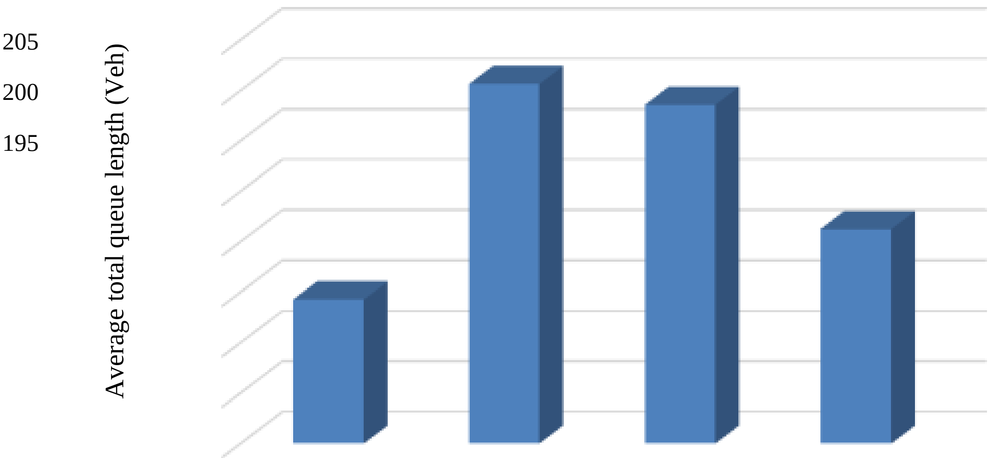
According to Figure 8, the delay time for the vehicles in the first scenario is lower than the rest, and this option can be the preferred one. However, as shown in Figure 9, the

overall queue length in this scenario is high.





190**Figure 9. The queue length in different scenarios**

Simulation in this section resulted in the following:

1This scheme is an excellent technique to improve the service of these vehicles and save travel time since the Priority Guideline significantly reduced the wait time imposed on the system by the traffic signals.

Two, these automobiles' upgraded systems and increased safety make implementing the priority design a more cost-effective option than competing strategies.

Third, in order to give these cars priority at the lights along each route, simulation must be performed according to the requirements of each simulator, and the most efficient design must be extracted for each route.

Traffic Light synchronization

Shahid Beheshti Street is reproduced at its two junctions with Qa'm-e-Magham and Mirza Shirazi in order to study the two

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basic and inverse synchronization techniques. During rush hour, this roadway is completely jammed. This is why its intersections are arranged using the inverse as a coordinate system. This road functions as a sub-saturation during off-peak times, when just basic synchronization (a positive phase difference) is required. Initially, the network was modeled in Synchro software (18), and from there, optimizations were made to the cycle duration and intersection phases. The table below displays the arterial delay time in the saturation and sub-saturated modes of Synchro software. (Table 8).

Table 8. Delay time of Shahid Beheshti Street in two modes of saturation and sub-saturation in the fourth scenario

Queue length (Veh)	*Delay Time (Sec/Km)*			
	Total delay (Sec / Km)	Delay to cars (Sec / Km)	Delay to the intended vehi-cles (Sec / Km)	Total Queue length (Veh)
Saturation	157.49	130.54	36.82	186.69
Sub Saturation	114.51	92.47	20.49	177.27

The cycle length and phasing obtained from Synchro are used in the next step in AIMSUN software. At this stage, by plotting different scenarios for two conditions of satura- tion and sub-saturation, different phases are tested. Ac-cording to the delay criterion, the best phase difference is determined for the two conditions. The following tablesummarizes the results of this simulation (Table 9).

Table 9. Determination of the phase difference using the delay time criterion in the sub saturation and saturation conditions

Delay (Sec/Km)		*Phase difference (sub saturation)*	*Delay (Sec/Km*		*Phase difference (satura-tion)*
Total	Average		Total	Average	
150.29	148.62	10	148.44	147.26	-5
145.12	142.95	15	143.57	142.81	-10
146.54	144.28	25	142.36	141.51	-15

Taking into account the minimum delay criteria, it becomes clear that a phase difference of -15 is optimal for saturation. By simulating a network in AIMSUN with a fuzzy difference of around 15 seconds as the optimum phase difference with the least delay criterion, Synchro software produces a second phase difference as an ideal phase difference under saturation conditions.U is constrained to be between 1 and 0, and U = 0 indicates a perfect match between the observed and simulated data. Additionally, the fuel coefficient may be represented by three inequalities: the biasUM, the varianceUS, and the covarianceUc.
performance-enhancing tools. Provides a numerical measure of the simulator's root mean square error, with bigger errors at higher.

rates than minor mistakes do. Calculating the average square root using the formula:

The correlation coefficient (r) between two data series is defined as follows: (1)Where Y and S are the means and standard deviations of the series. The prejudice re-

Where Yobs and Ysim are observations and simulations of the systematic error, and the variance is the degree of that error.

The simulation model sheds light on how effective the

delay in taking measurements at time instant i. You may learn how significant the relative error is in the observed data by looking at the U-value. Both should be very near to zero, and the covariance value should also be small.

Table 10. Calibration data capacity at AM peak hours

RMSNE %	*RMSE*	*Theils coefficient, U*	*Correlation, ρ*	
EB	EB	EB	EB	AM Peak
11.99	7.6308	0.0522	0.9837	7:15
7.35	6.5425	0.0340	0.9877	7:30
9.24	9.7266	0.0434	0.9831	7:45
7.05	8.8380	0.0328	0.9858	8:00
10.55	12.5099	0.0505	0.9571	8:15
10.31	11.7016	0.0473	0.9844	8:30
7.44	8.1474	0.0355	0.9912	8:45
12.89	13.8082	0.0635	0.9734	9:00
9.6	9.8632	0.0449	0.9811	Average
2.25	2.5629	0.0265	0.0114	STD DEV

Table 11. Calibration data capacity at PM peak hours

RMSNE %	*RMSE*	*Theils coefficient, U*	*Correlation, ρ*	
EB	EB	EB	EB	AM Peak
8.21	11.4079	0.0398	0.9665	4:15
7.51	11.3279	0.0374	0.9858	4:30
11.79	18.7055	0.0589	0.9704	4:45
8.10	13.3189	0.0385	0.9710	5:00
11.90	20.2415	0.0599	0.9894	5:15
9.31	16.0248	0.0453	0.9547	5:30

12.59	20.0144	0.0581	0.9651	5:45
16.20	23.7540	0.0742	0.9651	6:00
10.69	16.8495	0.0514	0.9710	Average
2.99	4.5655	0.0136	0.0116	STD DEV

Table 12. Calibration data capacity at AM peak hours (Theil coefficients)

Theils Covariance, U^c	*Theils Variance, U^s*	*Theils bias, U^m*	
EB	EB	EB	AM Peak
0.5735	0.0016	0.4395	7:15
0.8771	0.0445	0.0445	7:30
0.7325	0.1892	0.0927	7:45
0.8958	0.0311	0.0742	8:00
0.8791	0.0927	0.0270	8:15
0.5184	0.5066	0.410	8:30
0.4099	0.5695	0.0227	8:45
0.3752	0.1644	0.4560	9:00
0.6576	0.1999	0.1497	Average
0.2165	0.2192	0.1859	STD DEV

Table 13. Calibration data capacity at PM peak hours (Theil coefficients)

Theils Covariance, U^c	*Theils Variance, U^s*	*Theils bias, U^m*	
EB	EB	EB	AM Peak
0.9051	0.0809	0.0149	4:15
0.4238	0.0064	0.5839	4:30
0.3666	0.2705	0.3730	4:45
0.7275	0.0925	0.2121	5:00
0.1430	0.0704	0.7871	5:15
0.9099	0.0681	0.0143	5:30
0.3888	0.0984	0.5458	5:45
0.2179	0.2989	0.4819	6:00
0.5105	0.1231	0.3766	Average
0.2995	0.1041	0.2780	STD DEV

3.1. Average travel time Validation

The average trip time westbound utilizing a moving floating vehicle was gathered during the morning and evening rush hours. Table 14 displays the results of comparing the simulated trip time with the actual data. The simulation model of Shahid Beheshti Street during rush hour on the western route is 44 seconds faster than the observation trip. In the evening, the Western route simulation model was 25 seconds faster than actual journey time. Since data on time travel was gathered from the field, we can calculate the time difference between simulator and observation data was +/- 1 minute accurate.

Table 14. Average travel time comparing

	Average Travel Time		
	Observed	Simulated	Difference
AM Peak	19:00	19:44	0:44
PM Peak	22:21	22:46	0:25

3.2. Travel time Validation of Political vehicles

Delay time of vehicles at intersections and traffic conges- tion make significant changes during their travels. The average travel time of these cars from GPS data is from field observations and traffic simulation taken in Table 15. The travel time of the intended vehicles is longer than the time it was extracted from the GPS data. In the western direction during peak hours of PM, the observed time was 43 seconds more than simulated time. The travel time of the AIMSUN simulator during the AM peak hours in the west was about 24 seconds longer than field observations.

Table 15. Average travel time comparing of the intended vehicles

	Average Travel Time		
	Observed	Simulated	Difference
AM Peak	19:35	18:52	0:43
PM Peak	21:21	22:45	0:24

As shown in Table 16, the average traffic volume in thepeak hours of PM is significantly higher than the peak hours of the AM (increase of 50% and 110%).

Table 16. Average travel time comparing of the intended vehicles in AM and PM

Average traffic volume (Veh / Km)	
322	AM Peak
499	PM Peak

3.3. Analysis of modeling results

Traffic data from the simulation model was collected to compare the effectiveness values of the priority traffic light strategy. The system statistics in the AIMSUN User Guide are defined as follows. The total statistics of the simulated network are shown without using the priority light strategy in Figure 10 and Table 17. During the peak period (4-6 PM), traffic is much heavier than in the morning (7-9AM). There was a 40% increase in the flow of traffic at peak hours at PM. The average speed in the system is reduced by 9% from 19.8 to 18 MPH compared to the AM period. The average travel time, delay time and stopping time in each vehicle at noon rush hour increased by 21%, 31.7% and 25%, respectively.

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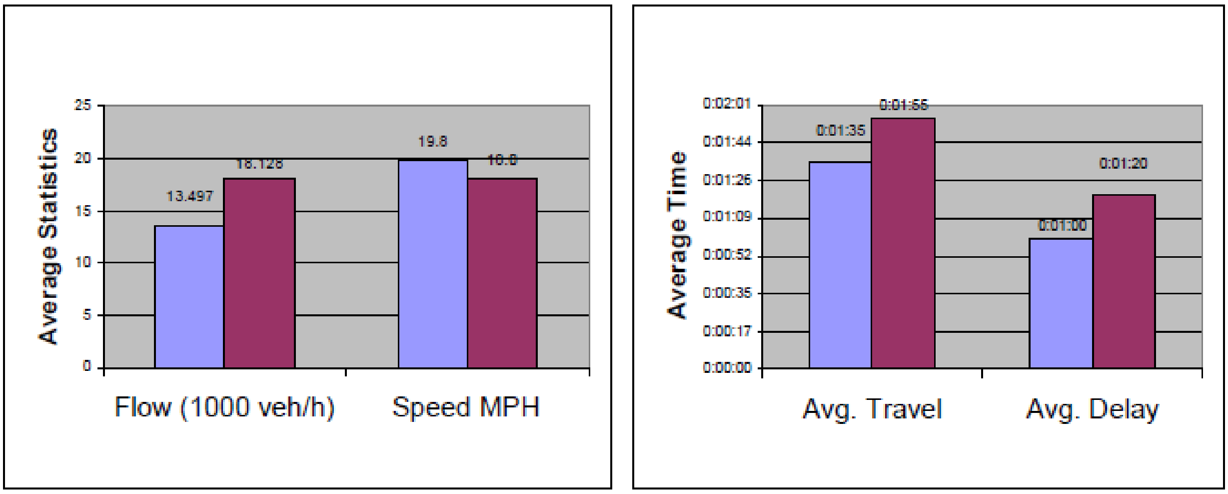

Figure 10. Travel time, network delay, speed and flow at peak hours in the morning and afternoon

Table 17. Network statistics at peak hours in the morning and afternoon

AM vs. PM Network Statistics - No Signal Priority Strategy				
Overall Network Statistics	Flow 1000 veh/h	Speed MPH	Avg. Travel Time hh:mm:ss	Avg. Delay Time hh:mm:ss
AM Peak	13.497	19.8	0:01:35	0:01:00
PM Peak	18.128	18.0	0:01:55	0:01:19
Average Change	4.631	-1.8	0:00:20	0:00:19
Average Change %	34.31%	-9.09%	21.05%	31.67%

3.4. Effect Measurement

The average speed of these vehicles, travel time and stop time during simulations were collected to measure effec- tiveness with a priority strategy without priority. These actions are defined as follows.

3.4.1. AM Peak

The statistics for the simulation with the priority traffic light strategy and without it are shown in Table 18 and Table 19 for peak hours of AM. The time and speed of travel are also depicted in Figure 11 and Figure 12. Two

cases were studied in the AM peak period. The maximum additional green length of 15 seconds and 10 seconds was respectively studied for comparing the reduction of travel time and traffic delay. It took about 20 (19) minutes for an EB vehicle to travel on Shahid Beheshti Street without the priority of the lights. Using the traffic light priority strate- gy with an extra green limit of 10 seconds for the vehicle, the travel time for this vehicle decreased by 2 minutes in EB, or 10% in EB. The delay time is reduced by about 11% ~ 13%.

Table 18. PM Peak statistics

Priority Extension Time = 10 sec					
AM PEAK Statistics		Speed MPH	Travel Time hh:mm:ss	Delay Time hh:mm:ss	Stop Time hh:mm:ss
No Priority	1	9.1	0:19:53	0:14:49	0:10:05
	2	9.2	0:19:08	0:14:08	0:09:30
With Priority	1	10.2	0:17:54	0:12:50	0:08:34
	2	10.1	0:17:30	0:12:29	0:08:08
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]

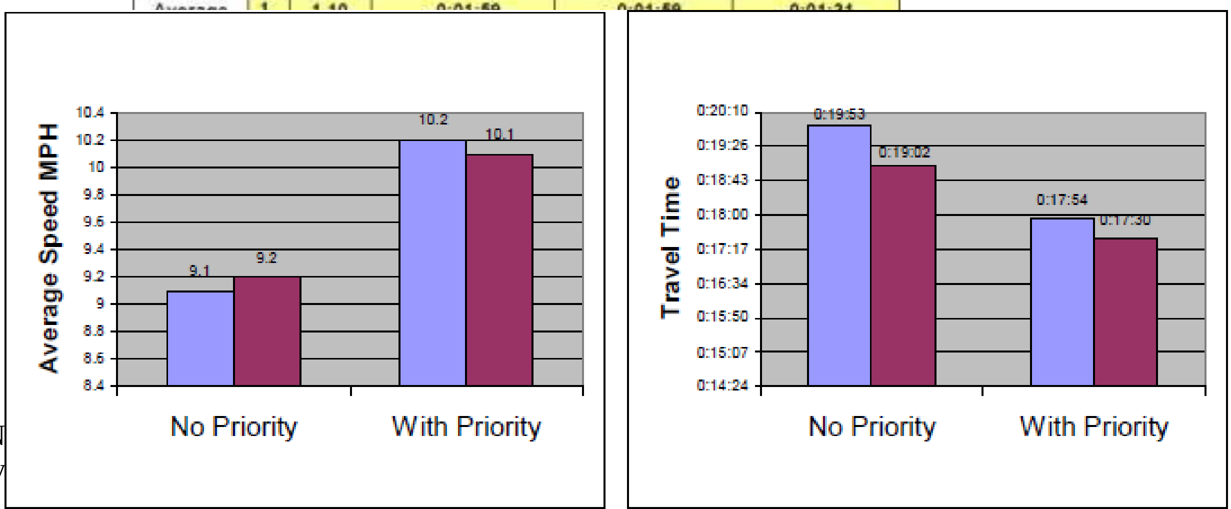

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Figure 11. Travel time values, average network delay time, speed and flow at AM peak hours with green time added 10 seconds

To further investigate the possibilities for cutting down on vehicle travel time, a maximum green time scenario of 15 seconds was explored. There has been a 12% reduction in travel time in EB, or a savings of almost 2.5 minutes. It has previously been established that an EB vehicle will take an additional 10 seconds to reach its destination from a green situation, for an average total travel time of 1 minute (0.5 minutes). Travel times have decreased by around 12% in EB because to the implementation of a traffic signal

Priority Extension Time = 15 sec				
AM PEAK Statistics		Speed MPH	Travel Time hh:mm:ss	Delay Time hh:mm:ss
No Priority	1	9.1	0:19:53	0:14:49
	2	9.2	0:19:08	0:14:08
With Priority	1	10.4	0:17:30	0:12:26
	2	10.7	0:16:27	0:11:27
Average Change	1	**1.30**	**- 0:02:23**	**- 0:02:23**
	2	**1.50**	**- 0:02:41**	**- 0:02:41**
Average Change %	1	**14.29%**	**-11.99%**	**-16.09%**
	2	**16.30%**	**-14.02%**	**-18.99%**

priority scheme that gives these vehicles a maximum green spread of 15 seconds. This train has a 16% 19% shorter delay time.

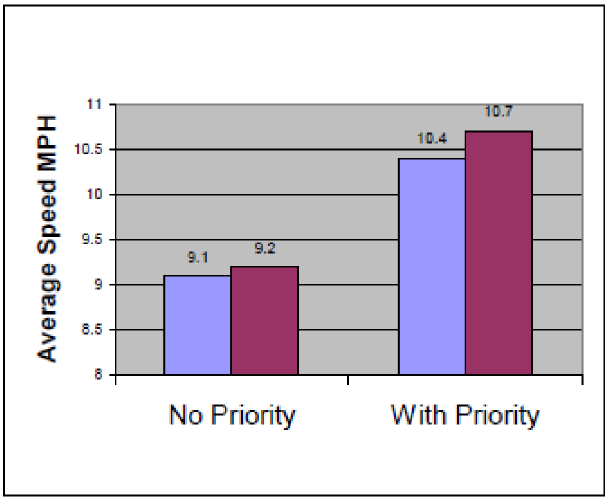
Table 19. AM Peak statistics

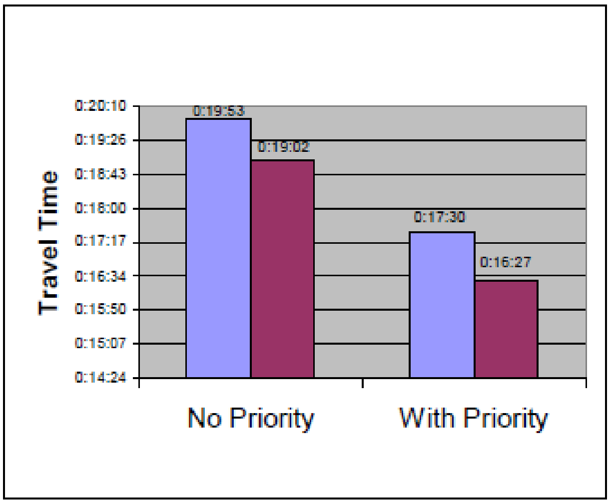
Figure 12. Travel time values, average network delay time, speed and flow at AM peak hours with green time added 15 seconds

The scenario of up to 20 seconds of extra green was also examined. However, the travel time of these cars did not decrease, but caused more traffic delay and stoppage.

3.4.2. PM Peak

As discussed earlier, there is a 40% increase in traffic at PM peak hours. The statistics of these cars are from the simulation with and without the traffic light priority strate- gy in the Table 20 for the peak hours of the PM. The time and speed of travel are also depicted in Figure 13. An addi-





tional maximum green additional time of 15 seconds was used to compare the effectiveness of the traffic light priori-ty strategy with heavy traffic conditions compared to the AM peak period. At PM peak hours, it took about 22 (23) minutes for an EB vehicle to travel in the area surveyed without the priority of the time light. Using the traffic light priority strategy for these cars, travel time is reduced to 2 minutes in EB, or 10.5% in EB. The delay time is reduced by about 9% ~ 14%.

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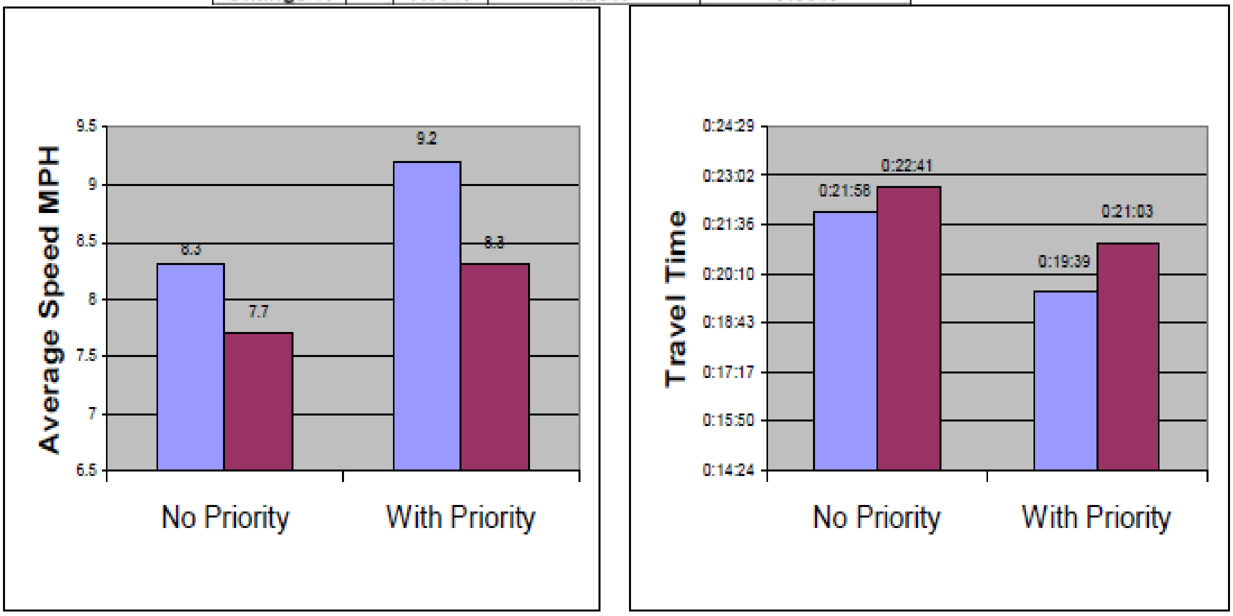
Table 20. PM Peak

Priority Extension Time = 15 sec				
PM PEAK Statistics		Speed MPH	Travel Time hh:mm:ss	Delay Time hh:mm:ss
No Priority	1	8.3	0:21:58	0:16:55
	2	7.7	0:22:41	0:17:41
With Priority	1	9.2	0:19:39	0:14:35
	2	8.3	0:21:03	0:16:02
Average Change	1	0.90	- 0:02:19	- 0:02:20
	2	0.60	- 0:01:38	- 0:01:39
Average Change %	1	10.84%	-10.55%	-13.79%
	2	7.79%	-7.20%	-9.33%



statistics

Figure 13. Travel time values, average network delay time, speed and flow at PM peak hours with green time added 15 seconds

3.5. Analysis of intended intersections

The main intersection criteria for effectiveness are ana- lyzed and discussed. Thus, at the intersections of Farahani and Mirza Shirazi, who had previously had the LOS F at both peaks in the morning and afternoon, the survey was conducted. The average vehicle travel time and delay timein AM peak hours with the prioritization strategy, as pre- sented in Table 21 and Table 22, have not changed. The average number of vehicles stopped in each vehicle is re- duced by 0.03 stop per hour. During PM peak hours, 1.5 seconds and 1.0 seconds, the average travel time and vehi- cle delay will decrease.

Table 21. The statistics of intersections of Farahani and Mirza Shirazi at the AM peak

AM Peak				
Intersection Statistics	Flow veh/h	Speed MPH	Travel Time mm:ss	Delay Time mm:ss
No Priority	606.50	24.59	00:57.5	01:20.0
With Priority	605.00	24.86	00:57.5	01:20.0
Average Change	-1.50	0.28	00:00.0	00:00.0
Average Change %	-0.25%	1.12%	0.00%	0.00%

Table 22. The statistics of intersections of Farahani and Mirza Shirazi at the PM peak

PM Peak				
Intersection Statistics	Flow veh/h	Speed MPH	Travel Time mm:ss	Delay Time mm:ss
No Priority	675.00	25.78	01:01.0	01:26.0
With Priority	673.13	25.66	00:59.5	01:25.0
Average Change	-1.875	-0.11	- 00:01.5	- 00:01.0
Average Change %	-0.28%	-0.44%	-2.46%	-1.16%

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3.6. General Network Analysis System

3.6.1. AM Peak

The statistics of the overall network system of the simula- tion with and without the traffic light strategy are listed in Table 23 and Table 24 for the AM peak hours. There is an average 7-second increase in travel time for 10 seconds and 15 seconds. The average delay was 7 seconds for the additional green time scenario of 10 seconds and the aver- age delay of 6 seconds for the sub-scenario of 15 seconds increased. The average number of stops per vehicle in- creased by 0.1 stops per vehicle in both cases.

Table 23. Total network data at the AM peak with a green time added of 10 seconds

Priority Extension Time = 10 sec				
AM PEAK	Speed	Avg. Travel Time	Avg. Delay Time	Avg. Stops
Network Statistics	MPH	hh:mm:ss	hh:mm:ss	#/veh
No Priority	19.8	0:01:35	0:01:00	1.60
Priority	19.1	0:01:42	0:01:07	1.70
Average Change	-0.70	0:00:07	0:00:07	0.10

Table 24. Total network data at the AM peak with a green time added of 15 seconds

Overall Network System, Priority Extension Time = 15 sec				
AM PEAK	Speed	Avg. Travel Time	Avg. Delay Time	Avg. Stops
Network Statistics	MPH	hh:mm:ss	hh:mm:ss	#/veh
No Priority	19.8	0:01:35	0:01:00	1.60
Priority	19.1	0:01:42	0:01:06	1.70
Average Change	-0.70	0:00:07	0:00:06	0.10

3.6.2. PM Peak

As a result of the heavier traffic flow at PM peak hours, the overall network profile of the simulation with and without the traffic light strategy has delayed and further stoppedthe car. As noted in Table 25, the travel time in the PM peak period increased by 22 seconds per kilometer when the priority was given. The average delay increased by 23 seconds, while the average stop in each vehicle with the priority strategy increased by 0.6 stop per vehicle.

Table 25. Total network data at the PM peak with a green time added of 15 seconds

Overall Network System, Priority Extension Time = 15 sec				
PM PEAK	Speed	Avg. Travel Time	Avg. Delay Time	Avg. Stops
Network Statistics	MPH	hh:mm:ss	hh:mm:ss	#/veh
No Priority	18.1	0:01:55	0:01:19	2.00
Priority	16.0	0:02:17	0:01:42	2.60
Average Change	-2.10	0:00:22	0:00:23	0.60

4. CONCLUSION

Traffic along the path of Shahid Beheshti Street in the simulation model takes 44 seconds less than the observa- tion trip at the peak hour on the western route. At PM hours, traffic in the simulation model on the Western route was 25 seconds shorter than travel time. In the western direction during peak hours of PM, the observed time was 43 seconds more than simulated time. The travel time ofthe AIMSUN simulator during the AM peak hours in the west was about 24 seconds longer than field observations. The overall statistics of the simulated network without the use of the priority traffic light strategy indicated that dur- ing the peak period (4-6 PM) traffic was much heavier thanthe morning hours (7-9 AM). There was a 40% increase in the flow of traffic at PM peak hours. The average speed in the system is reduced by 9% from 19.8 to 18 MPH com- pared to the AM period. The average travel time, delaytime and stopping time in each vehicle at noon rush hour increased by 21%, 31.7% and 25%, respectively. The sta- tistics of the vehicles concerned were calculated from the simulation with and without the traffic light priority strate- gy. Two cases were studied in the AM peak period. The maximum additional green length of 15 seconds and 10 seconds was respectively studied for comparing the reduc- tion of travel time and traffic delay. It took about 20 (19) minutes for an EB vehicle to travel on Shahid Beheshti Street without the priority of the lights. Using the LED priority strategy with an extra green limit of 10 seconds forthe vehicle, the travel time for this vehicle decreased by 2 minutes in EB, or 10% in EB. The delay time is reduced by about 11% ~ 13%. There is an average 7-second increase in travel time for 10 seconds and 15 seconds. The average delay time was 7 seconds for the additional green time scenario of 10 seconds and the average delay of 6 seconds for the sub-scenario of 15 seconds increased. The average number of stops per vehicle increased by 0.1 stops per ve- hicle in both cases.

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