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Link Quality Based Traffic Queue Management at 5.8 GHz

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Abstract— Vehicle queue in the traffic light based link quality in wireless networks often optimizes their performance by real time measuring the quality of intelligent traffic light management system. However, measuring and describing link-quality is a challenging task due to the nature of residential area in Bandar Baru Bangi. This paper proposed the aspects of link-quality measurement in realistic networks to be taken into consideration when designing a LOS for wireless system. The objective of this study is to present the vehicle management based quality control to maximize the probability of successful transmissions while minimizing the end-to-end delay. The study involved the traffic junction parameters requirement, lane changing and traffic signal responding logic with detailed traffic networks implementation experiences. By analyzing the statistical properties of link-quality, such as received signal strength and packet transmission rates, the statistical distribution across different links status were predicted. In addition, the default of signal strength mainly found to be the reason for the irregularity in the packet received values provided the measured link-quality and statistical analysis to better adapt their link behavior.

Keywords- traffic light; link quality; LOS; signal strength; packet transmission rates.

I. INTRODUCTION

Wireless communication has a strong potential to improve traffic light flow, traffic safety and driver comfort (Median et al. 2005). It can be used to provide warning information to the driver, for example at intersections, or can be used to automate task like lane merging or as traffic junction control system.

Urban Transport Management System (UMTS) developed and constructed by Universiti Kebangsaan Malaysia (UKM) to mentor urban traffic light in Bandar Baru Bangi (BBB) area, based on real time intelligent traffic light management systems. The system control the traffic flow using CCTV camera at each side of the junction by counting the car queue in order to give the priority time for attention, hence the traffic jam can be avoided.

ITLMS has been introduced to the field of transportation technology as a respond to many problems that they are already starting to resolve [Ganiyu et al 2011]. In fact, this technology has been very useful in such aspects as traffic management including accident, efficiency in transportation industries and different technical aspects relating to traffic management [Jensen et al. 2007]. As these are probably the most important considerations relating to traffic managements system, their enhancement through ITMLS constitutes a major motivation to the development of a collaborative traffic management system. This paper presents a condition to estimate the levels of the environmental effect for such systems operating at 5.8 GHz point to point and multipoint distribution service for intelligent traffic light management system.

II. INTELLIGENT TRAFFIC LIGHT MANAGEMENT AND CONTROL

The Intelligent Urban Traffic Light Management Systems (IUTMS) have been developed in connection with increasing needs of the passengers demanding more and more efficient functioning of urban area. The IUTMS consists of a group of innovative tools created assuming information technology, wireless communication and automotive electronic solutions. Owing to the access to information on current conditions in Bangi traffic, light junction in real time, the competent authorities as well as transport services and the driver are better informed and therefore, are able to make the optimal decisions in the field of transport. It is also contributed to an improvement in urban transport. They increase the comfort of driver's work and travel comfort for passengers as well as reduce its negative impact on the environment, using the wireless communication with continuous data updating. Furthermore, the information on the real times of car traffic flow in the traffic light is accessible in control room. Figure 1 show the directional antenna fixed in one of the traffic light junction for traffic monitoring.

Figure 1 Directional antenna fixed in traffic light for monitoring

III. TRAFFIC LIGHT CONTROL MODEL

Traffic junction control is a very important for economic needs. Many of the modern cities suffer the serious traffic problems in the traffic junction control in Bandar Baru Bangi Malaysia. Due to costs, lack of available space and environmental impairments, it is impossible to extend the current traffic infrastructure in many of the cases. So it is a required to optimize traffic strategies to obtain better performance based on the existing traffic infrastructure. The measurement, conducted to address the traffic simulation problem based on the ITLMS theory, because of ITLMS's flexible and comprehensive modeling ability and its support to distributed simulation (Zeigler et al. 1999).

IV. LINK QUALITY BASED ITLMS CONTROL

ITLMS developed as a hierarchical intelligent system model for vehicles in traffic light management system. This has facilitated analysis of control tasks for the vehicles queue. The proposed link quality carried out the control tasks performed for the vehicles applied the proposed system model. In many conditions due to the high costs and safety concern, field tests and evaluations may not be applicable. Therefore, we evaluate and analyze the traffic link network via computer simulations. In this chapter, the data analysis concerned to acknowledge the development of the traffic link simulator, which is designed for aiding driver and traffic control studies, such as testing, verification, evaluation leading to improvement of vehicle flow control methods and traffic management strategies [Askerzade and Mustafa 2002].

In addition, the plan for traffic control system can be simply installed and applied to the existing traffic light infrastructure considering propagation impairment and within a reasonable time. Table 1 show the link successful rate for wireless connection, based on received signal strength indicators and packet received.

Table 1 Link successful rate, based on RSSI and packet received

Case considered	Packet received	Signal strength (dBm)	Successful rate %
1	1000	> -68	> 100
2	999	> -69	> 97
3	887	> -70	> 85
4	700	> -87	> 63
5	466	> -93	> 41

V. Traffic Queue Management

ITLMS traffic simulators are simulation model that is able to manage traffic conditions to a significant level of accuracy. The principal advantage of this system is that the infrastructure is incorporated directly, and the vehicle queue is modeled based on an intelligent control level. ITLMS designed for modeling of wireless traffic light management with advanced traffic control, monitoring guidance systems, is provided by researchers from University Kebangsaan Malaysia. This study has been investigating different aspects of traffic control and delay specification for wireless communication among traffic lights, especially implications regarding traffic efficiency [Kutil et al 2006, patel et al 2001] based on the design of an intelligent system model as proposed. The original aspect of this analysis was based on traffic junction and car waiting avoidance systems. The plan considered specific data and video for evaluating such an application via the wireless link configuration system. Table 2 shows the time setting due to the expected lane in Warta junction for traffic control.

Numbers of traffic lights have observation cameras installed in urban places in BBB in Malaysia for car surveillance. The transportation group was carried out research and upgraded the camera's observation to be able to monitor traffic flows automatically and scientifically (Rahmat et al. 2002). The camera systems fixed in the traffic light are used for traffic counting, calculate speed, organizing and detect jamming.

Table 2 Traffic junction parameters

Traffic Name	Queue length	Speed limit	Inter car distance	Car cross probability	Time delay
Warta junction West	300m	2m/s	5m	0.1	60 s
Warta junction East	400m	2m/s	5m	0.02	90 s
Warta junction North	100m	1m/s	5m	0.3	30 s
Warta junction South	300m	1m/s	5m	0.1	60 s

Although the model is concerning vehicle movements using a car subsequent queue, lane changing and traffic signal responding logic with detailed traffic networks, The traffic junction network model includes the part of the program related to the traffic management and information system about the link environment, such as signalized traffic loop, length of lanes, and speed determination, which are controlled under traffic lights with the system defined cycling time.

VI. Queue Management based Propagation Impairment

By performing simple measurements the traffic light approach's performance in the worse case is most concepts to run the system successfully. By the reasons of Traffic Controller is extracted from ITLMS, which provides a real-time environment where various types of antennas, control policies, and traffic management strategies can be analyzed, tested and evaluated under different propagation impairments. The simulator can interact with the antennas and controls on a real-time source. Further, in addition to realistic representation of traffic behavior at the traffic junction's points. The simulator is based on a real time simulation scheme, which updates the junction location and allocated time for each traffic junction irregularly. The input traffic light data are defined via presetting the details as shown in table 2 Besides standard traffic data, which includes scenario input, the administrator can input specified intersection control data, such as successful connection. Moreover, antenna's range is also defined by administrator to simulate different types of traffic flow. The data collected from each individually junction characterized is defined the system performance and condition as displayed on the monitor screen as simulation progresses. The outline in figure 6.6 expressed the report of a received signal strength indicators (RSSI) and given details on how the other parameters in the traffic flow could be run concurrently.

```
#> linktest 14 Control Center
local tx rate = 54 Mbps
packet size = 1600 bytes
# of packets per period = 1000
# of Cycle = 20
0>  [tx] 1000 [rx]  660  [rssi] -88  peer: [tx] 1000 ->  32.13 Mbps
1>  [tx] 1000 [rx]  661  [rssi] -100 peer: [tx] 1000 ->  31.20 Mbps
2>  [tx] 1000 [rx]  712  [rssi] -91  peer: [tx] 1000 ->  22.05 Mbps
3>  [tx] 1000 [rx]  712  [rssi] -91  peer: [tx] 1000 ->  22.11 Mbps
4>  [tx] 1000 [rx]  633  [rssi] -99  peer: [tx] 1000 ->  35.25 Mbps
5>  [tx] 1000 [rx]  704  [rssi] -80  peer: [tx] 1000 ->  21.13 Mbps
6>  [tx] 1000 [rx]  627  [rssi] -92  peer: [tx] 1000 ->  25.15 Mbps
7>  [tx] 1000 [rx]  625  [rssi] -105 peer: [tx] 1000 ->  26.12 Mbps
8>  [tx] 1000 [rx]  618  [rssi] -100 peer: [tx] 1000 ->  22.36 Mbps
9>  [tx] 1000 [rx]  705  [rssi] -81  peer: [tx] 1000 ->  12.75 Mbps
10> [tx] 1000 [rx]  747  [rssi] -76  peer: [tx] 1000 ->  13.19 Mbps|
11> [tx] 1000 [rx]  772  [rssi] -72  peer: [tx] 1000 ->  20.31 Mbps
12> [tx] 1000 [rx]  771  [rssi] -86  peer: [tx] 1000 ->  11.15 Mbps
13> [tx] 1000 [rx]  779  [rssi] -91  peer: [tx] 1000 ->  11.14 Mbps
14> [tx] 1000 [rx]  732  [rssi] -101 peer: [tx] 1000 ->  18.68 Mbps
15> [tx] 1000 [rx]  781  [rssi] -67  peer: [tx] 1000 ->  13.05 Mbps
16> [tx] 1000 [rx]  773  [rssi] -96  peer: [tx] 1000 ->  13.55 Mbps
17> [tx] 1000 [rx]  785  [rssi] -82  peer: [tx] 1000 ->  11.65 Mbps
18> [tx] 1000 [rx]  790  [rssi] -80  peer: [tx] 1000 ->  12.85 Mbps
19> [tx] 1000 [rx]  782  [rssi] -85  peer: [tx] 1000 ->  12.54 Mbps

--> [rx]  129 [rssi] -68  peer: [tx] 1000
--> [Local PER]   0.78 %
--> status: Connected
```

Figure 2 RSSI Report in the case of propagation impairment

Figure 2 shows a sample report generated by windows view tester RF link loop back simulator that analyzes the measurement characteristics of link control set, providing all the necessary distributional values via propagation impairment.

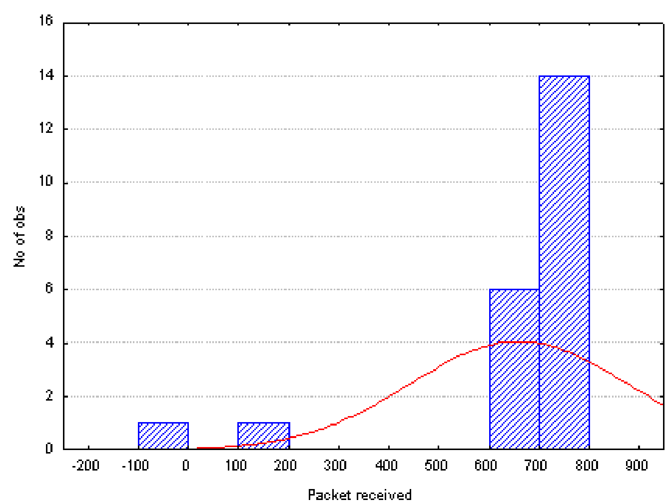

Figure 3 Packet received and its observation

The Packet received and its observation matches in Figure 3 shows the distribution of the average received packet. In general, the maximum value of 800 packets received outliers is expected to be happened when the environment involved the propagation impairment.

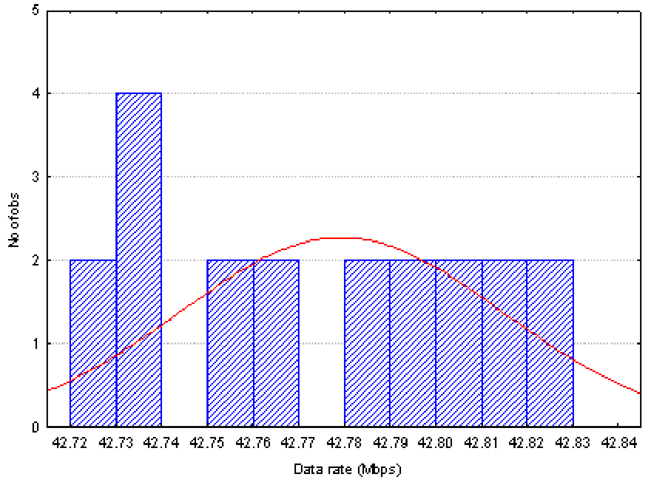

Figure 4 Data rate and its observation

The data rate received in the receiver site and its observation matches in Figure 4 shows the distribution of the average acknowledged of unstable data rate due to propagation impairment. The largest observations are shown as histogram outliers are quite low values expected to be happened in the receiver path.

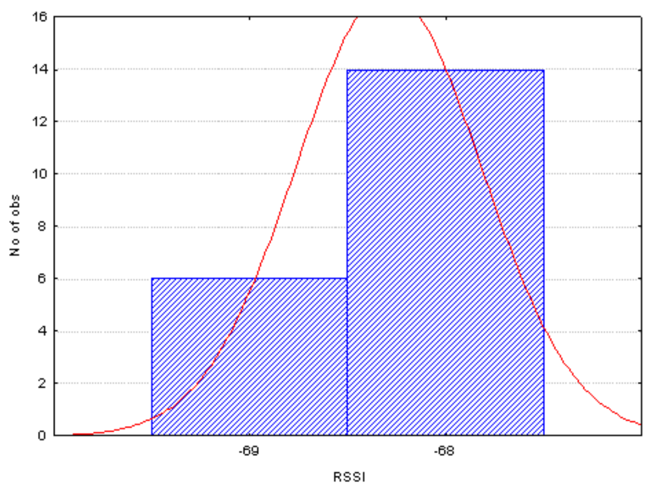

Figure 5. Signal Strength indicators and its observation

The received Signal Strength indicators received and its observation matches in Figure 5 shows the distribution of the average acknowledged of RSSI and packet received. The two largest observations are shown as histogram outliers. In particular, a value of -69 and -68 received outliers are expected to be happened in the receiver track.

VI. Conclusion

This paper discussed the impact of the input queue length variables and the resulted extension time considered. The first stage of the simulation shows the lane changing and traffic signal responding the logic with detailed traffic networks through the effect of the packet received and signal strength due to propagation impairment. These results achieved from using ITLMS simulator which represents the best possible case for computing. This strategy is the slow growing in the time that will added to the cycle which make the traffic situation more stable.

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