ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

A QOS-BASED SCHEDULING ALGORITHM IN VANETS

[1]MARYAM ASGARI, [2]MOHAMMAD SHAHVERDY , [3]MAHMOOD FATHY

1Computer Engineering Faculty, Islamic Azad University, Tafresh, Iran

2Computer Engineering Faculty, Islamic Azad University-Tafresh branch and University of Science and Technology, Tehran, Iran

3Computer Engineering Faculty, University of Science and Technology Tehran,Iran

Emails: [1]shahverdy@iautb.ac.ir, [2]asgari@iautb.ac.ir, [3]mahfathy@iust.ac.ir

ABSTRACT

Vehicular Ad hoc Network (VANET)is a kind of mobile Ad Hoc networks (MANETs)that is applied for progress of intelligent transportation system (ITS).Vehicles get various types of data from road-side units (RSUs)including voice, video and emergency data. Since the number of vehicles as well as the number and size of files are potentially large and with regard to the types of files can be various, QOS-based scheduling is a challenge. We inquire the scheduling algorithm problems of file distribution from RSUs to vehicles in an urban environment and propose a new scheduling scheme which considers the types of data and improved the performance of network. Request of vehicles are inserted in to 4 queues: 1) Data-queue 2) voice-queue 3) video-queue 4) emergency-queue. Some scheduling policies are used to choose one queue and serve the vehicles. Furthermore, we gave high priority to some requests such as video and emergency data to achieve high quality. In this regard, Simulation results indicate that the proposed approach provides required performance and quality of service.

Keywords: *Vehicular Ad Hoc Network (Vanet); Scheduling Algorithm; Quality Of Service (QOS); Jitter ; Delay*

1. INTRODUCTION

Recently people are interested in the use of vehicular ad hoc network especially those who want to download and use multimedia data or other kind of data from road side unit (RSU) such as 802.11 access point [1, 2, 3, 4 and 5]. Looking back at the review of literature of Vehicular ad hoc network, it has mainly two type of communication: vehicle to vehicle and vehicle to roadside. Vehicles can download the data that is stored in the RSUs or connect to the internet through these RSUs [5, 6].This article peruses a wide group applications of vehicular ad hoc network consist of comfort and safety applications which specially relay on vehicle-to-roadside unit communications. In this way RSUs can act as the buffer point among vehicles or work such a router for vehicles to access the internet or even get online video and voice. In addition, the RSUs may act as a server and therefore they can prepare diverse types of information to vehicles on roads. The following cases are some examples of RSU applications:

- Web Applications: The travelers can connect to the internet and use its services such as surfing on web checking Email or chatting.
- Real Time Traffic Report: Vehicles can report real time traffic seeing to RSUs. Then the traffic data transferred to a traffic control center for analyzing. The consequences of analyzed traffic data are returned to RSUs and they can be accessible to the vehicles.
- Digital Map Downloading: When vehicles driving to a new region, they may want to update map data locally for trip guidance such as altering unilateral and deadlock roads or adding new paths.
- Online TV or Radio: RSUs can broadcast internet TV or radio and vehicles can receive them.
- Informing important messages: safety or emergency data can be uploaded on RSU by police or other vehicles then RSU distributes the message to vehicles.

One of the most important goals in scheduling scheme is that it serves more requests and specially served most important requests as far as possible. This challenge will be more important when number of requests increased. Another

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

challenge is quality of service which RSU prepares for vehicles. This challenge will be fundamental when types of services are video or audio. It means that when a vehicle asks for the online video, RSU should give high priority to these services because online video should be delivered without delay or jitter. Furthermore emergency message should be sent with minimum delay otherwise this type of message loses its real value.

In most prior papers deadline constraints of the request were ignored (e.g., worst-case/average waiting time and throughput) [7, 8, 9 , 10 and 11]. Nevertheless, some others ameliorated performance by deadline concept[3, 12]. All these works don't consider that vehicles move out from RSU in an efficient area. A novel approach recently presented in a which allows vehicles to continue its download from the next RSUs. Finally the algorithm presented a two-step scheduling scheme that improves performance and scalability [3].

Our scheduling scheme was implemented in application layer whereas others were implemented on other layers [1, 2 and 4]. In [1] authors demonstrated that WLAN can use for drive-thru internet access, wherein, they concentrated on transport protocol, network layer mobility and naive WLAN connectivity. In [4] researchers use of MAC layer concept to improve the vehicle to roadside communication.

In [13] authors improved the download rate of large sized files by use of chunk scheduling algorithm and in [14] authors improved the data delivery rate by the data replica in RSUs but they ignored the data type and quality of service.

In[15] authors improve the performance of beacon safety message dissemination by studying the effects of three parameters including message transmission's interval time, message payload size and vehicle's transmission range.

Neither of previous scheduling schemes attends to data types which propagate from RSU to vehicles. They act similarly with various types of data therefore they don't give high performance. We present scheduling algorithm on application layer that improves performance and specially prepares high service rate and quality of service.

We propose a new scheduling scheme which attends to above challenges. In this scheme we implement four queues in each RSU: 1) Data_queue 2) Voice_queue 3) Video_queue 4) Emergency_queue. When a vehicle asks for a service, it inserts to a specific queue according to its type. Each queue can have specific policy and then serves the request which leads to high performance. Simulation result shows that the proposed approach outperforms other previously scheduling approaches in sense of service rate and quality of service.

To fulfill the aim of this research following sections will be organized meticulously as: In section 2 we discuss on system model and assumptions. In section 3 we propone the queue of RSU is developed to four queues with particular priority. In section 4 we offer a two-step scheduling scheme. In section 5 we evaluate the performance of the offered scheme by means of simulation. Finally in section 6 we conclude the paper and outline some open problems for future works.

2. SYSTEM MODEL AND ASSUMPTION

We consider an intersection which their streets plump together and there is traffic congestion. All streets have 2 lines. One RSU was devised in intersection. Figure 1 shows our scenario. A number of vehicles receive the data from the RSU when they enter into RSU's coverage range. All vehicles can send request to the RSU if they want access the data. Each request is characterized by a 4-tuple: <v-id, d-id, type-data, deadline> where v-id is the identifier of the vehicle, d-id is the identifier of the requested data item, type-data is type of data that vehicle asks for it. We classified data to 4 types: 1) ordinary 2) audio 3) video 4) emergency data. And deadline is the time constraint which beyond it the vehicles move out from RSU area. The vehicles are equipped with a GPS (Global Position System), hence vehicles detect their own geographic positions and driving velocity. Then vehicles can estimate their leaving time, which mentioned above as service deadline.

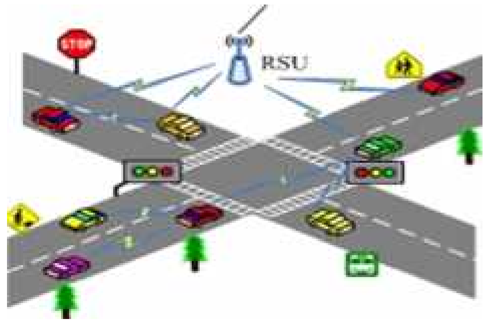


Figure 1: The System Model Architecture [3]

Journal of Theoretical and Applied Information Technology
31st July 2015. Vol.77. No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

The following metric criteria for assessing the scheduling algorithm are applied:

Service Ratio: It is defined as the ratio of the number of vehicles which download the requested data completely to the total number of vehicles that requested the data. A good scheduling algorithm should serve as many requests as possible in a specific time bound.

Quality of Service (QOS): For online video or audio is to receive data without jitter and for emergency data is to receive data without delay. A good scheduling scheme should prepare high quality of service.

Jitter Estimate: This problem happens when consecutive part of online video or audio is received with variation beyond an acceptable delay that is lead to jitter. One of the effective agents in this parameter is queue delay that happens when a vehicle waits for service in queue. We can estimate the Jitter based on the following formula:

$$Jitter = (T_{pn} - T_{pm}) / (n-m) \quad (1)$$

Where T_{pn} is the received time of nth part of video, T_{pm} is the time that m'th part of video received successfully; m, n is sequence number of parts of video.

Delay Estimate**:** Delay is the time between request time and the time when vehicle starts receiving data. This concept is expressed as the following formula:

$$Delay = T_{start\text{-}service} - T_{request} \quad (2)$$

3. SCHEDULING SCHEME

Each vehicle which needs a specific data item sends a request to the nearest RSU then request inserts into queue of RSU. For more control on different types of requests we use four queues: 1) Data-queue 2) voice-queue 3) video-queue 4) emergency-queue. These queues are implemented for ordinary, voice, video and emergency data respectively and these queues help us to use of different scheduling policy. In the next step the head of four queues are compared and a request which lead to high performance is served.

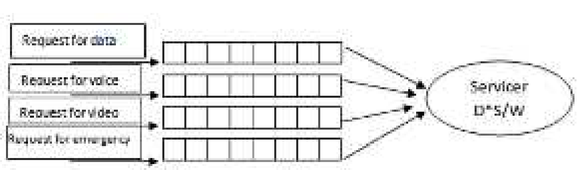


Figure2: Queue structure

3.1. Scheduling Policies

The main purpose of this model is serving more and important requests which come off with two metric as mentioned before: the service ratio and quality of service. We opt three fields from the 4-cupled request that can help us for the goal of scheduling scheme:

- Data Size: Based on the data size and data rate concept we can determine how long the requested service will last.
- Deadline: request of the vehicle with earlier deadline is more urgent than the request of the vehicle with a later deadline due to the first one may go out from RSU area earlier.
- File type: some requests need higher priority to achieve higher quality of service for vehicles.

With due attention to three mentioned parameter.

our scheduling scheme includes two following phases:

1. In first step: requests of the vehicles are detached separately in four queues based on the file type. Within scheduling policy in each queue is FCFS.
2. In second step: RSU chooses one request from the head of four queues with D*S/W scheduling algorithm and serves it.

Note that various scheduling algorithms can be used in each queue. First Come First Serve (FCFS), First Deadline First (FDF), Smallest Data Size First (SDF), Smallest Deadline*Data size first (D*S) [12] and D*S scheduling with Resuming technique [3] are some instance of scheduling policies.

Data size and request deadline are ignored in FCFS. Data size is ignored in FDF. Also SDF does not consider the request urgency. D*S scheduling scheme attends to Data size and request deadline simultaneously but does not consider vehicle leaving from RSU area which Shahverdy et al (2010) solved it.

We opt one of the four queues with D*S/W scheduling method and serve the request, where D stands for deadline of the request, S stands for size of the requested data item and W stands for the weight of the specific queue.

Journal of Theoretical and Applied Information Technology
31st July 2015. Vol.77. No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

We give different weight to each queue based on our expectation of a service. These weights are listed in table1.

*Table 1:Weight of queues in D*S/W Scheduling scheme*

Queue	Weight
Data_queue	1
voice_queue	2
Video_queue	10
Emergency_queue	∞

Above weights were estimated based on data types and our expectation of services. For minimum jitter the Video_queue should have high priority. We suppose that if delay between consecutive parts of online video lasts for less than 0.1 sec then jitter will be acceptable. So, we estimate weights of video_queue (W_{video_queue}) with the following coordination which equal to 10:

$$W_{video\_queue} \sim 1/T_{no\text{-}jitter} \quad (3)$$

Where Tno-jitter is time that if delay between consecutive parts of online video lasts for less than it, video shows without jitter.

$$W_{voice\_queue} \sim 1/T_{no\text{-}disruption} \quad (4)$$

Where $T_{no\text{-}disruption}$ is the time that if delay between consecutive parts of online voice takes less than it, voice receives without any disruption.

Furthermore Emergency_queue should have the highest weight because the messages in this queue are the most important than other requests. We match weight of Emergency_queue to infinite (a large number is assumed instead of infinite weight in simulation). It means that if a message exists in Emergency_queue, it has highest priority and other queues cannot get service while a request wait (is waiting) in this queue. Weight of Data_queue set to 1 because it has the lowest importance. Above parameters are composed with following formula:

$$D! \quad \_v \quad = (D \quad - C \quad) * \\ D \quad ze/W \quad ht \quad (5)$$

In other words, each queue's head which have less DSW_value, is served first.

4. PERFORMANCE EVALUATIONS

We simulated our scheduling scheme with ns-2[16, 17]. The simulation region contains a 600*600 square with one intersection which is made of vertical and horizontal two way roads (each road has 300 meter length and two lanes). We supposed a usual traffic with 210 vehicles which travel with various speed from 0 to 40 km/h. vehicles movement is real for example they stop behind the traffic light slowly.

Vehicles density in the intersection can be expressed with Poisson distribution function. We assume X is a random variable then it has Poisson distribution with μ parameter that $\mu=\bar{x}$ where $\bar{x}$ is the average number of vehicles which request data in RSU area. Probability density function of X is [18]:

$$f(X = x) = \frac{\mu^x * e^{-\mu}}{x!} \text{ , } x = 0, 1, 2, \ldots$$

The $\bar{x}$ in the intersection equal to 7.4 which is computed by simulation software. Then

$$f(X = x) = \frac{7.4^x * e^{-7.4}}{x!} \text{ , } x = 0, 1, 2\ldots$$

The number of vehicle which probably exists in intersection and ask for a data can be expressed by mentioned formula. According to the above equations and parameter setting in this simulation, probability of existence the number of 7.4 vehicles which request data is highest.

Table 2: Simulation Setup Parameters

Parameter	**Value**
Simulation time	100 second
Number of vehicle	210
Transmission rate	64 kb/s
Vehicle speed	0-40 (km/h)
Wireless coverage	200 m
Packet size	1000 Byte
Data item size	100 -250-500-1000 KB
Window size	100
Routing protocol	AODV
Ratio propagation model	Two ray ground
Mac type	IEEE 802. 11
Antenna model	Omni antenna
Traffic type CBR(UDP)	CBR(UDP,TCP) video(RTP/RTCP)

Vehicles move in different directions and they do not leave the simulation area. When a vehicle arrives at the junction, it may stay behind the traffic light or it can choose its path among three different directions with various probabilities. Base on different workload and depending on the scenario, one or several requests are issued by each vehicle. However, for various service workload scenarios, the number of service

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

request can be changed. We listed some other simulation parameters in table2.

4.1. Service Ratio Evaluation

Primary aim of a data distribution system is to serve as many requests as possible that is achieved by scheduling policies. In this section three scheduling schemes which are used for selecting one of queues are compared as follows: 1) D*S/W scheduling scheme with four queues 2) SDF scheduling scheme with four queues and 3) FCFS scheduling scheme with one queue.

Figure 3(a) illustrates the video service ratio of various scheduling schemes. The X-axis is the simulation time. As it is clear from the figure, the first scheme leads to serving more video requests in comparison to the other two schemes.

Figure 3(b) illustrates the emergency data service ratio of various scheduling schemes. We can find from this diagram which the first scheme presents the best service ratio.

The voice service ratio of various scheduling schemes is compared in Figure 3(c). We can find from this diagram which the first scheme presents the best service ratio. The ordinary data service ratio of various scheduling schemes is compared in Figure 3(d). The first schemes could not serve more requests in comparison with the other two policies; it is obvious because our algorithm concentrate on quality of service.

4.2. Quality of Service Evaluation

Second goal of scheduling scheme is quality of service which prepares from RSU. In our approach we specially attend to QOS and improve it for video, voice and emergency data. In this section also three scheduling policies which listed above are compared and show in figure 4. Figure 4(a) shows average of video jitter and figure 4(b) shows average of video delay for several vehicles, obviously the first policy leads to low jitter and delay for video in comparison to the other two schemes. Figure 4(c) shows average of emergency data delay for each vehicle, which the first policy leads to low delay for emergency data in comparison to the other two schemes.

CONCLUSIONS

We proposed a scheduling scheme for different types of data distribution from RSUs to vehicles. In this regards, a good scheduling algorithm should prepare high service rate with acceptable QOS. In our proposed approach vehicles ask for data from RSU. In a nutshell, request of vehicle insert in to 4 queues: 1) Data-queue 2) voice-queue 3) video-queue 4) emergency-queue. The data for distribution is chosen from one queue based on D*S/W scheduling scheme. Furthermore we give high priority to some data to achieve high quality of service. Simulation result shows that the proposed approach prepares high service rate, desirable performance and high quality of service for video, voice and emergency data as well in comparison with previous approaches.

REFERENCES

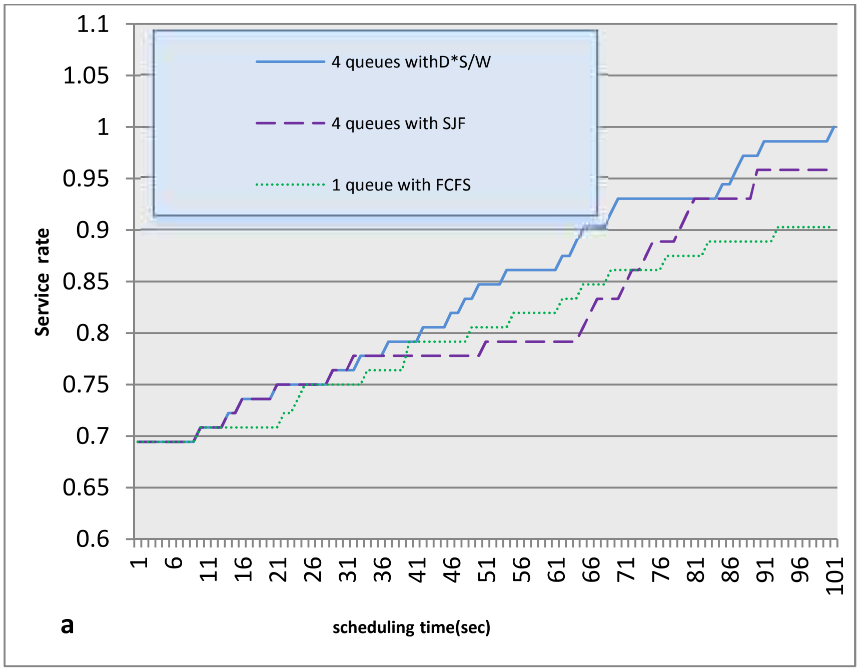
[1] Ott J, Kutscher D. Drive-thru internet. IEEE 802. 11b for automobile users. In Proceedings of Infocom 04'; 2004.
[2] Hull B, Bychkovsky V, Zhang Y, et. al. Cartel: a distributed mobile sensor computing system. In Proceedings of the 4th international conference on Embedded networked sensor systems(SenSys '06); 2006, p. 125-138.
[3] Shahverdy M, Fathy M, Yousefi S. Scheduling Algorithm for Vehicle to Road-Side Data Distribution, ICHCC-ICTMF 2009, Berlin Heidelberg, CCIS 66, 2010, p. 22–30.
[4] Hadaller D, Keshav S, brecht T, et. al. Vehicular opportunistic communication under the microscope. In Proceedings of The 5th International Conference on Mobile Systems, Applications, and Services(MobiSys'07), 2007.
[5] Yousefi S, Mousavi M. S, Fathy M., Vehicular Ad Hoc Networks (VANETs): Challenges and Perspectives, IEEE Proceedings of 6th international con ference on ITS Telecommunications (ITST2006), China, p. 761-766, 2007.
[6] Yousefi S, Chahed T, Mousavi Langari M, Zayer K. Comfort Applications in Vehicular Ad Hoc Networks Based on Fountain Coding, Vehicular Technology Conference (VTC), IEEE 71st, P. 1-5, 2010
[7] Su C,Tassiulas L. Broadcast scheduling for information distribution. In Proceeding of Infocom 97', 1997.
[8] Aksoy D, Franklin M. R*W: A scheduling approach for large-scale on-demand data broadcast. IEEE/ACM Transactions on Networking, volume 7, 1999.

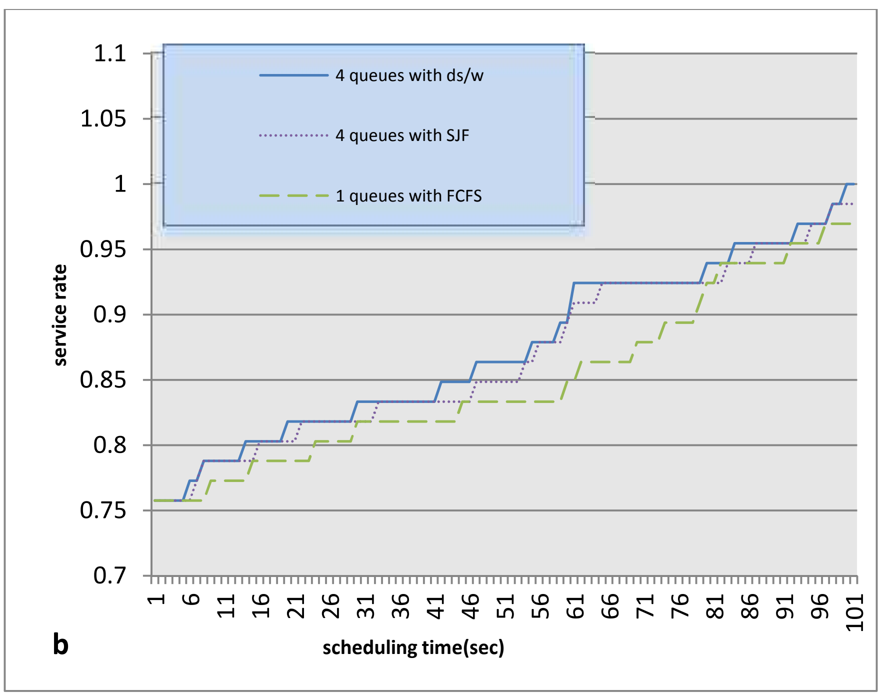
ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[9] Gandhi R, Khuller S, Kim Y,Wan Y. Algorithms for minimizing response time in broadcast scheduling. Algorithmica, 38(4):P. 597-608, 2004.
[10] Acharya S, Muthukrishnan S. Scheduling on-demand broadcasts: New metrics and algorithms. In Proceeding of MobiCom 98', 1998.
[11] Wu Y, Cao G. Stretch-optimal scheduling for on-demand data broadcasts. In Proceeding of the 10th International Conference on Computer Communications and Networks(ICCCN 01'), p. 500-504, 2001.
[12] Zhang Y, Zhao J, Cao G. Service Scheduling of Vehicle-Roadside Data Access. Mobile Netw Appl,15, p. 83–96, 2010
[13] Vijaylakshmi R.S, Masoom BI, Arathi P. Efficient Chunk Scheduling Algorithm for Coporative Download in VANET, International Conference on Electrical, Electronics and Computer Engineering, Mysore, 2013.
[14] Babu G, Uma Maheswari M. Bandwidth Scheduling for Content Delivery in VANET. International Journal of Innovative Research in Computer and Communication Engineering, Vol.2, Issue 1, 2014
[15] Yousefi, S., Fathy, M Benslimane A. Performance of beacon safety message dissemination in Vehicular Ad hoc NETworks (VANETs), Journal of Zhejiang University SCIENCE A, 8(12), 2007
[16]Vanet generator. Available from Internet: <http://www.csie.ncku.edu.tw/ ~klan/move/index.htm>
[17]Network simulator. Available from Internet:<http://www.isi.edu/nsnam/ ns/. >
[18] Schuhl L, Gerlough A. Poisson and Traffic: Use of Poisson Distribution in Highway Traffic & The Probability Theory Applied to Distribution of Vehicles on Two-Lane Highways Daniel, 1955.

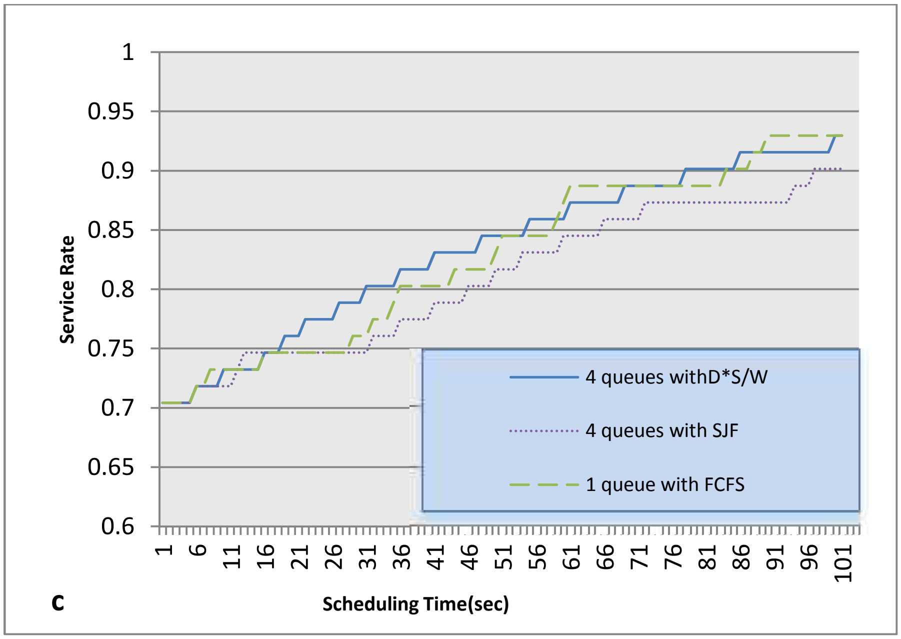
Journal of Theoretical and Applied Information Technology
31st July 2015. Vol.77. No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195





ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195



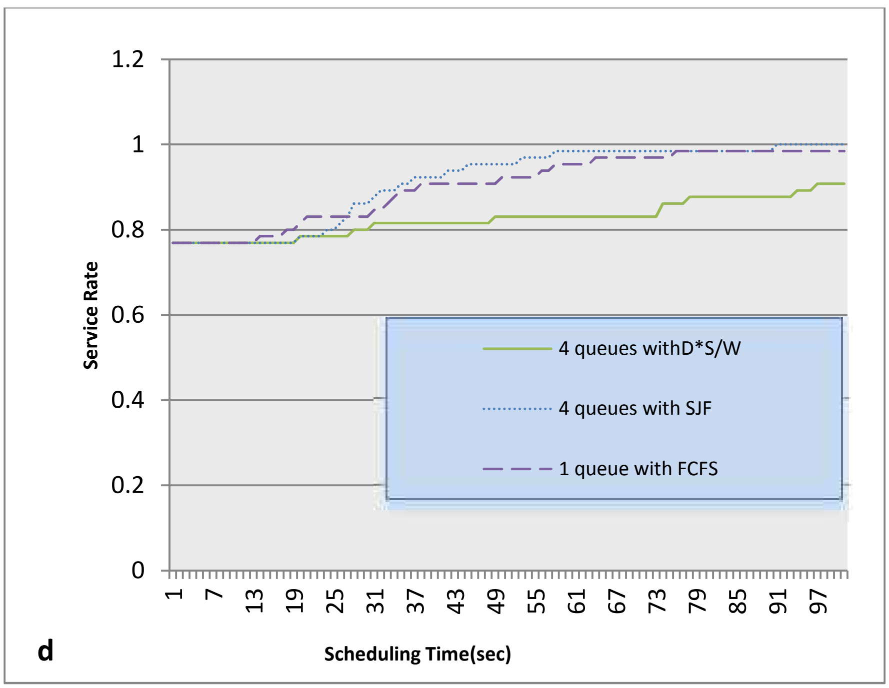


Figure 3: The service ratio of various scheduling schemes (a) Video service Ratio Evaluation; (b) Emergency data service Ratio Evaluation; (c) Voice service Ratio Evaluation; (d) Ordinary data service Ratio Evaluation

Journal of Theoretical and Applied Information Technology
31st July 2015. Vol.77. No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

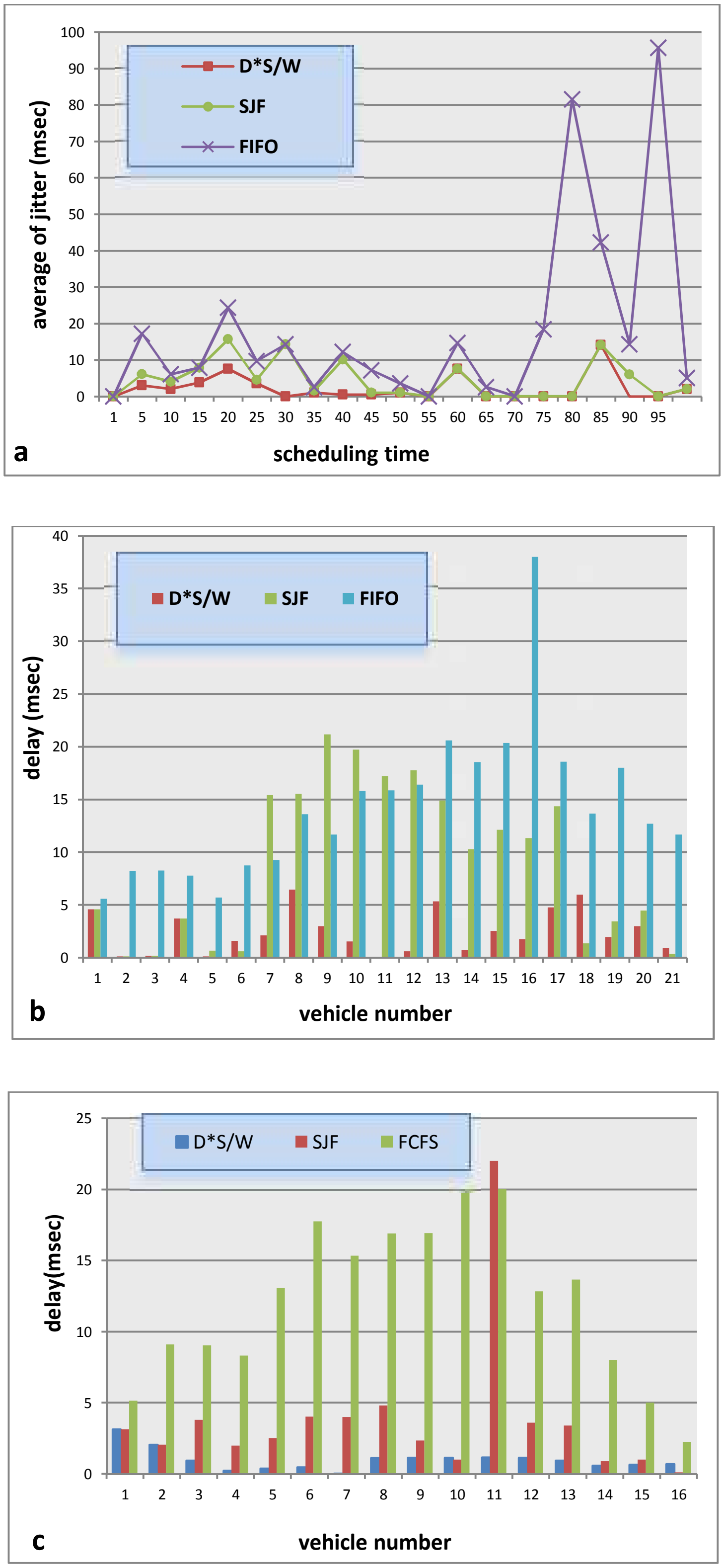


Figure 4: QOS Estimation

(a) Jitter for video data; (b) Delay for video data; (c) Delay for emergency data