A Comparision of Node Detection Algorithms Over Wireless Sensor Network

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Abstract—MANET is standing for Network as Mobile Ad-hoc which is a self-directed mobile handlers group that communicates over relative bandwidth-constrained wireless channels. Many services with different classes of Quality of Services (QoS) could be provided through the MANET such as data, voice, and video streaming. Thus, efficient packets routing is an essential issue especially over this kind of burst channel. To settle this issue, many scheduling techniques are proposed to reduce the packets dropping and channel collision when a huge demand of data is transferred from a sender to a receiver. In this paper, four MANET scheduling algorithms are selected and investigated in mobile ad hoc networks which are Strict Preference (SP), Round Robin (RR), Weighted Round Robin (WRR), and Weighted Fair (WF). The network simulator EXata 2.0.1 is used to build the scenario which is consist of 50 nodes and performed the simulation. The results showed the performance metrics difference of the network such as the throughput and the end-end delay as well as queuing metrics like peak queue size, average queue length, in queue average time, and dropped of whole packets. Regrading throughput, the SP algorithm has a greater throughput than WF, RR, and WRR by 4.5%, 2.4%, and 1.42%, but WRR has outperformed others regarding the end-end delay. Moreover, WRR represents the best scheduling algorithm regarding both peak queue size since its greater than RP, WF, and WRR by 10.13%, 9.6%, and 5.32%, in order, and average output queue length, in contrast, WRR worsts more time in queuing but it is the best in preventing the packets from dropping.

Keywords—secure detection, MANET, Ad-hoc network, strict preference, round robin, weighted round robin (WRR), weighted fair

1 Introduction

A network as wireless ad hoc is a wireless stations congregation that is capable of configuring itself to establish a network with no whatever infrastructure assistance as shown in Figure 1. It is needed that in a wireless network (WN), the stations that are sharing channels of communication as the same must be offered a reasonable chance as a fair one for accessing the medium. Fairness is considered as the main issue where the whole wireless network ad hoc should tackle [1]. Unfairness takes place if few stations are grabbing the channel's bandwidth mostly whereas others are starving [2].

The channels in wireless ad hoc networks are characterized by bursts and location-dependent errors. Such subjects are handled via scheduling algorithm as fair packets. Many packet scheduling algorithms for WNs could be found in [3]. It's worth mentioning that optimum packets scheduling will lead to fewer packets collisions in networks especially when a single channel is shared among the wireless nodes. Ad hoc networks and mobile of single-channel are suffering from the sender being hidden, the receiver as hidden, sender as exposed, and receiver as exposed difficulties and thus need operative mechanisms for packet scheduling to avoid collision and let all packets fairly transfer through the channel [4].

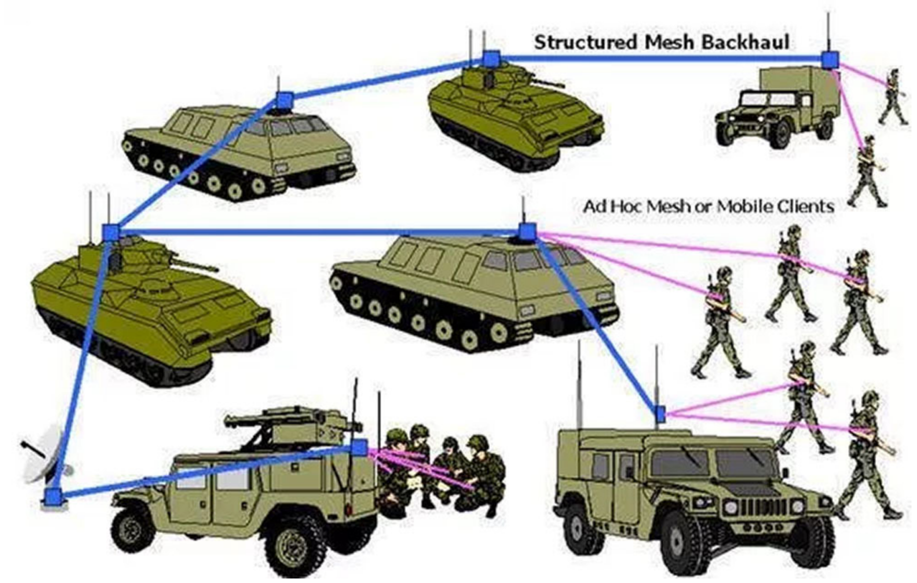

Fig. 1. Mobile ad hoc in military application [5]

Designing optimum packet scheduling algorithms is a challenge for mobile ad hoc networks (MANET). Since weak scheduling algorithm led to severe packets collision over the channel which is the reason for wasting a considerable amount of radio resources and dropping packets especially when the frame size is big [6]. The source nodes looking to transmit the packet completely whatever the channel conditions which is the main cause of performance degradation if no scheduling is implemented. Moreover, the packet priorities do not have meaning when the channel push out the first in without considering which one is more important than others. In some MANET applications, safety data have the privilege to send before any other data since it carries critical information [7]. Thus, designing and developing scheduling algorithms with low complexity offering significant fairness and potential differentiation among the data flow is important in MANET.

This study mainly aims to investigate and make a comprehensive overview of four, RR (WRR). These algorithms are examined in mobile ad hoc networks in terms of average throughput, delay as End-End, queue size peak, queue length as average, average queue time, and total packet dropped. Other factors that are affecting the wireless network such as security and battery life have not been examined in this paper and set as fixed parameters. This paper focuses only on the accuracy and ease of packet transmission without losing any information. The QualNet is the simulation from which all simulation figures are turned up.

1.1 Scheduling algorithms

Selecting the proper packet to transfer over a channel among all sored packets in a specific buffer is called the scheduling technique. It is mainly looking to serve and optimize the quality of service of the network in which a variety of services are existing [8]. The following section briefly describes some scheduling algorithms.

SP. SP queuing adopts that traffic types capable of differentiation and preferentially treated. Queues as separate FIFO are formed for every definite level of preference and the traffic that arrives is arranged into its appropriate queue as it reaches. Therefore, the 1st configuring task as SP queuing is for determining the traffic organizations. Extra queues signify further complexity in algorithm running [9].

At the queue service side, the rule of processing is easy: greater FIFO queues as preference are processed always to end before queues of lower preference are processed; i.e., in the system as 3-queue, when the 2 maximum queues as the preference of no buffered packets, so the lowermost queue of preference would be repaired. The moment where a greater preference packet arrived in its queue as FIFO; nevertheless, servicing the lesser preference packets would be hindered in greater preference queue favour. SP queuing is standard as gold for high preference traffic.

The greatest detriment links to the approach SP queuing treating queues. High-preference packets are processed always before such of less preference. When the high-preference amount of traffic is excessive, other queues may never be unfilled, causing a worse accomplishment for the low and medium-preference traffic in comparison to the case where a queue as a single FIFO were utilized [10].

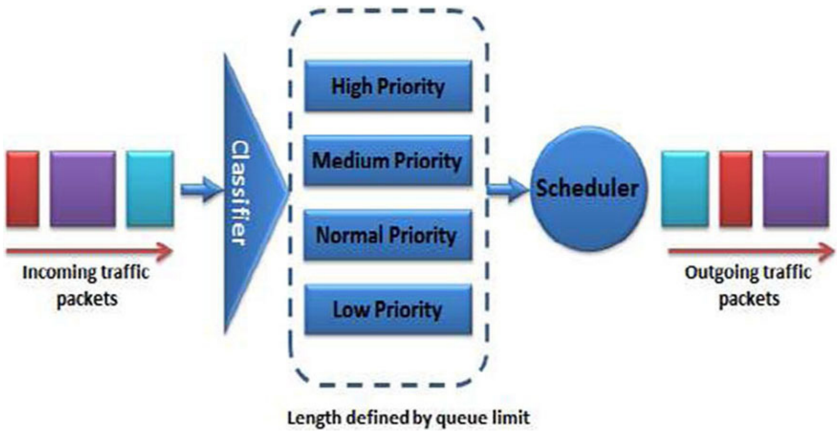

Fig. 2. SP scheduler [11]

Scheduling of RR. The scheduler algorithm of the RR packet is the simplest one which is distributing the turns of scheduling similarly among all utilizers of active MANET, irrespective of the condition of the radio channel and the QoS application running requirements. The system resource fairness in time-sharing is forming unfairness to such UEs that are of conditions of good radio and is starving for throughput [12].

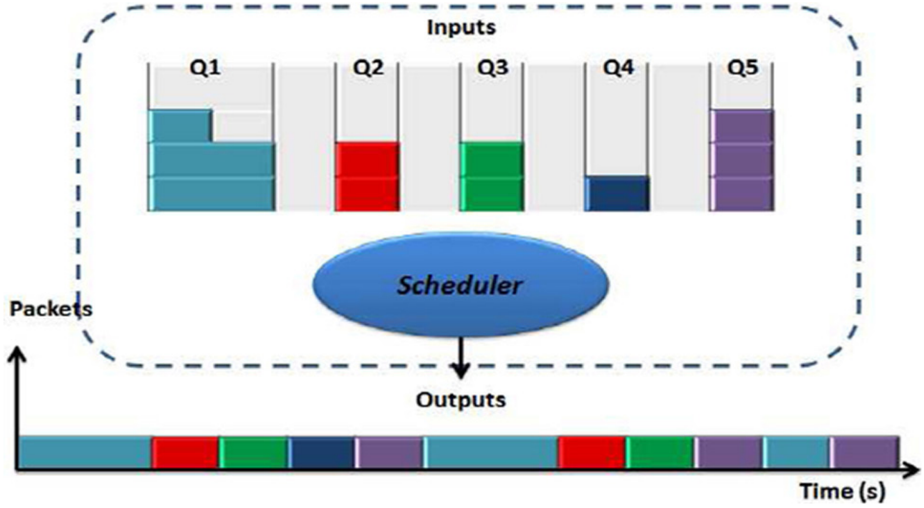

Fig. 3. Round-robin scheduler [11]

WF. WF Queuing (WFQ) is a technique of packet scheduling permitting services as guaranteed bandwidth [13]. The WFQ purpose is to allow numerous sessions sharing links to be the same. Generalized Processor Sharing (GPS) is approximated by WFQ. It relies on a model of fluid; thus, it adopts that the traffic input is markedly separable and all sessions capable of being served at the time being the same. As long as every session has its queue, a session that is ill-behaved (that is conveying numerous data) will just 'punish' itself and not another session [14]. Such is a server of work-conserving, and it assures that every session obtains the rate of service as a minimum in which r is the rate of server and θi is the weight for the ith session. The scheduler takes a minor piece of information from every session and conveys it to the link of output. From the stand point of implementation, the slow methods of scheduling are of a lower complexity degree compared to fast ones of schedule, due to that the latter needs the data of support rate from the measurements of UE channel quality for whole utilizers in the cell, and later compute their [15].

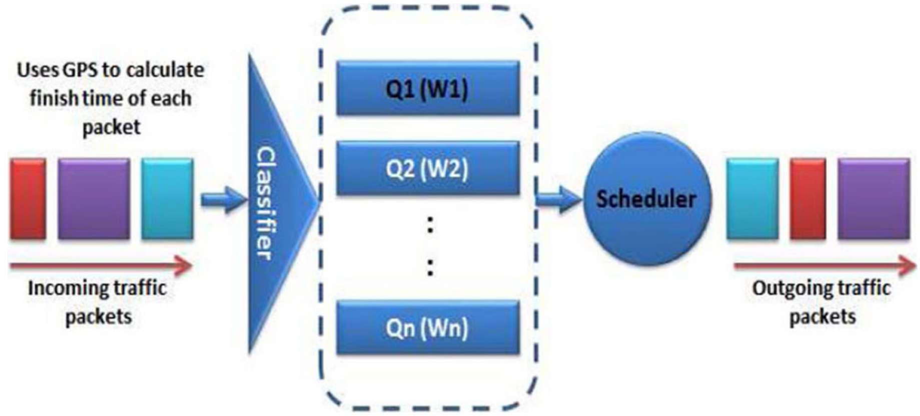

Fig. 4. WF queuing scheduler [11]

WRR. In the procedure of WRR, packets are classified into diverse service groups and then assigned to a queue which capable of assigning various bandwidth and served according to RR order as illustrated in Figure 5. The algorithm works by giving priority to the packet with lower bandwidth. Such an algorithm tackles the starvation issue by assuring that all service groups can access a minimum few configured network bandwidth amounts.

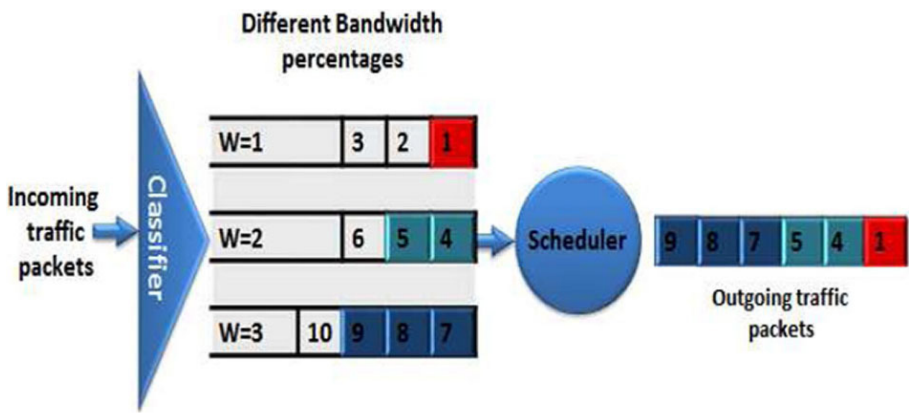

Fig. 5. The scheduler of weighted RR [11]

1.2 Problem statement

Selecting the scheduling algorithm in MANET is essential to mitigate packet losing and dropping [16]. Since the Scheduling algorithms are accountable for sharing in distributing manner network properties among all nodes in the MANET and offer them a greater QoS guarantee [17].

Many scheduling algorithms are proposed and developed. Research has been done on joint routing and link scheduling where they found increasing in the throughput regardless of the power consumption [18]. Other research was done based on a time division multiple access allocation scheme which increases the performance of the MAC protocol [19]. A model that simplifies packet routing and scheduling by allowing nodes to arrive and leave arbitrarily has been proposed [20]. Nevertheless, performance evaluation to select some of them still lack and need more investigation. In this research, four scheduling algorithms are selected and investigated in the mobile ad hoc network [21]. Two of them are classified as slow scheduling algorithms which are RR and SP scheduling algorithms [22]. Then, fast scheduling algorithms are examined also which are WF queuing and weighted scheduling algorithms. The selection of four scheduling algorithms comes from they are famous and reliable scheduling in MANET [23].

2 System model

The main idea of this paper is to compare four selected scheduling algorithms in ad hoc networks and mobile in which 50 nodes are randomly distributed. Firstly, an extensive literature review is conducted in terms of the definition of mobile ad hoc networks, their advantages, their applications, and their issues. Next, designing the proposed scenario using EXata V. 2.0.1 which is a network emulator. Then, implementing the four selected scheduling algorithms (RP, WF, RR, WRR) consequently [24, 25]. Finally, run the simulation and extract the results to analyze them in terms of many performance metrics either for the overall network performance such as the average throughput and end-end delay or for the queuing performance metrics i.e., size of peak queue, queue length as average, in queue average time, and whole dropped packets. Figure 6 depicts the overall methodology of this paper.

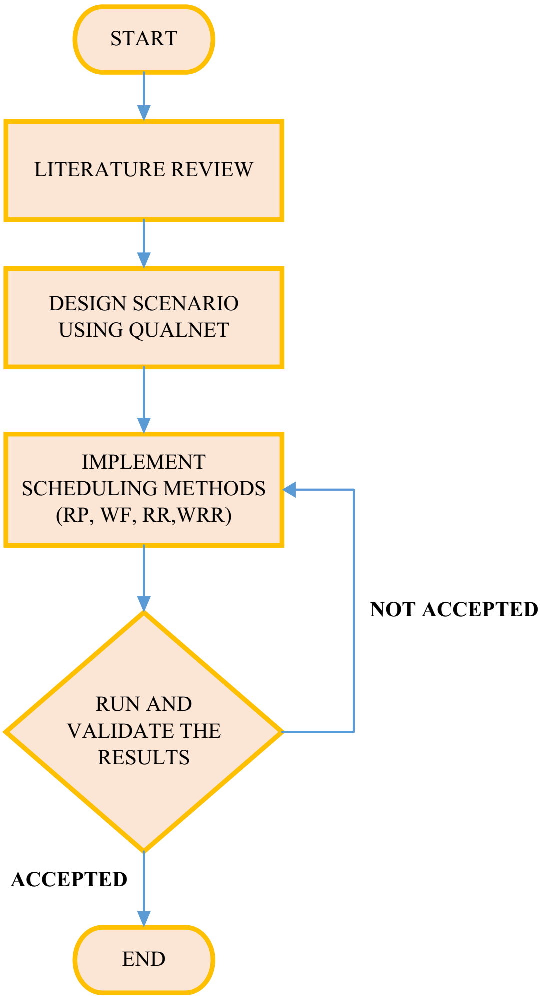

Fig. 6. Overall methodology

3 Simulation and validation

There are many simulation parameters related to the proposed scenario that need to be adjusted before running the simulation. Table 1 represents simulation parameters that must be adapted and checked for proper simulation results.

Table 1. Parameters of simulation

Parameters	Value
Network kind	Ad hoc WN
Nodes #	50
Terrain:	1500–1500
Time of simulation	100 sec
Application of traffic	CBR
CBR #	20
Sended items	100
Size of packet	512 B
Interval	1 sec
Start-end of CBR	1–25 sec
Protocol of Network	IPv4
Protocol of MAC	IEEE 802.11
Model of mobility	Random Waypoint
Speed (Min-Max)	(0–3) m/s
Time of pause	10 sec
Model of physical layer	PHY 802.11b
data rate	1,2,6,11 Mbps
Transmission power	25 dBm
Noise factor	10.0
Received sensitivity	83.0
Channels #	1
Wireless frequency of channel	2.4 GHz
Protocols of routing	AODV
Scheduling	RP, WF, RR, WRR

Followed by the simulation scenario which is consist of 50 nodes and is built by EXata software: as shown in Figure 7.

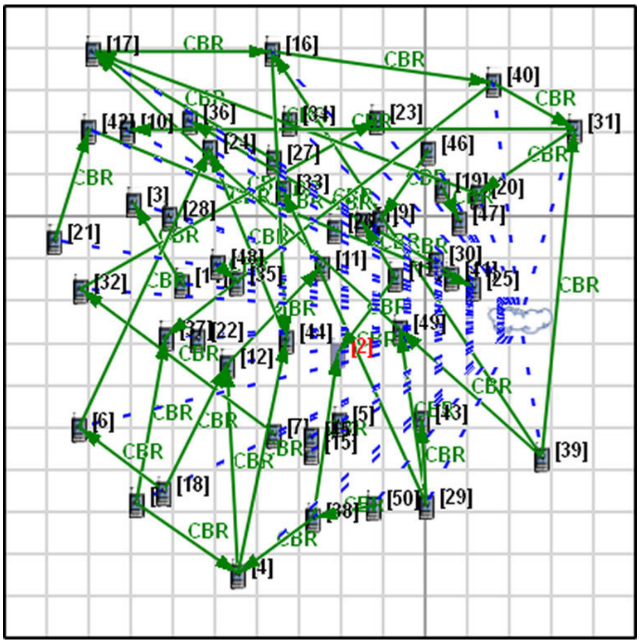

Fig. 7. Simulation scenario

For each parameter, its values are changed by selecting the related tab at the output view in the EXata view. Next, the elements in the respective tab are selected, right clicked and the properties area is opened [26].

After all the parameters have been set up, the simulation is running through action button clicking and then the play button. Figure 8 shows the menu from which we can select the scheduling algorithms [27].

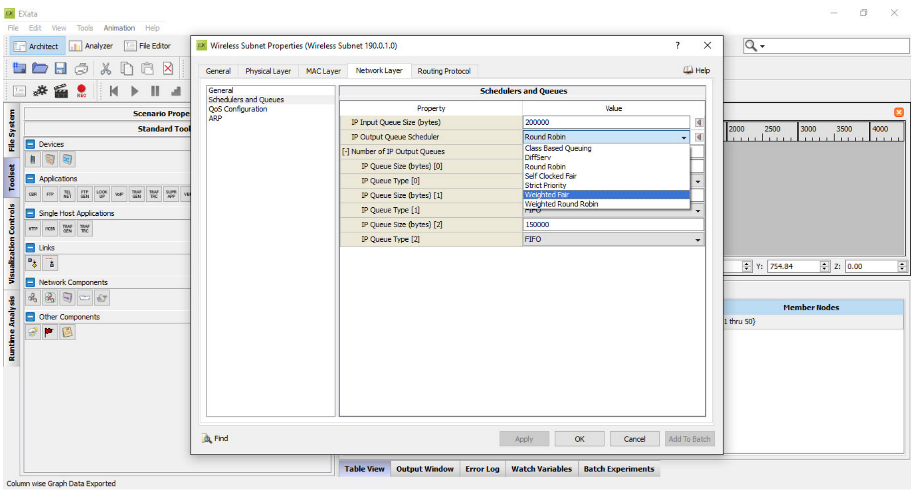

Fig. 8. Selecting scheduling algorithms menu

Then, after finishing the simulation, the button of the analyzer is clicked for viewing the graphs of the simulation. As shown in Figure 9. By exporting the results to a text file, plotting the results figures could be achieved by Microsoft Excel.

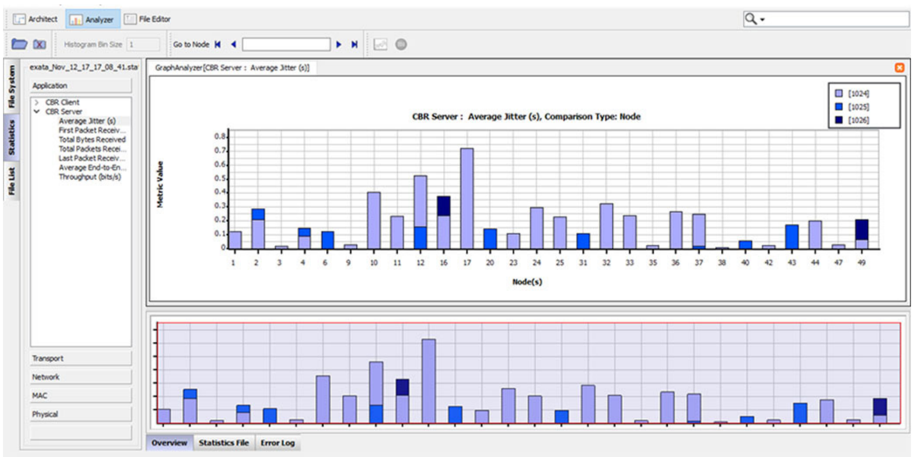

Fig. 9. Analyzer screen to extract the results

4 Results and discussions

This section presents the results and their analysis when different scheduling algorithms are implemented in the mobile ad hoc network. These algorithms are analyzed in terms of average throughput, jitter as average, delay of End-End, size of peak queue, queue length as average, the average time in queue, and whole dropped packets forcibly.

4.1 Throughput as average

The total average packets received through network simulation in kilobit per second is an important metric. Figure 10 depicts the average throughput for the SP, WF, RR, and WRR scheduling algorithms which are 3870.2 Kb/s, 3693.42 Kb/s, 3775.89 Kb/s, and 3815.2 Kb/s, respectively. SR algorithm has a greater throughput than WF, RR, and WRR by 4.5%, 2.4%, and 1.42%, respectively. The restricted mechanism of the RP regarding assigning in order the priorities for the sending packets are the main reason behind that. The lowest throughput is for WF algorithms.

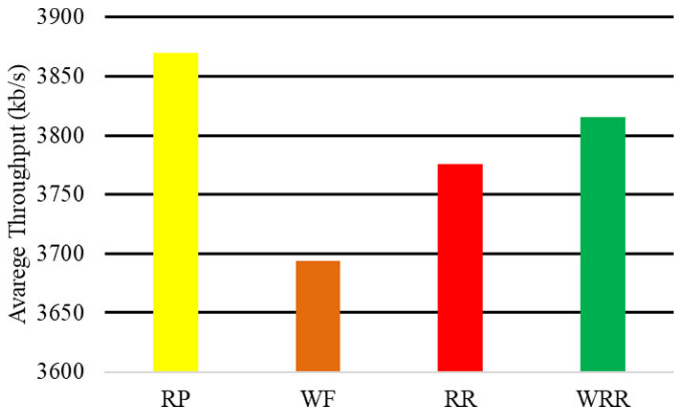

Fig. 10. Average throughput for the selected scheduling algorithms

4.2 End-end delay

The scheduling process is one of the most processes that could make significant delays in the network according to packets arrangements and queuing. The end-end delay or the latency which is the summation of processing delay, queuing delay, transferring delay, and propagation delay need to be investigated. Figure 11 depicts the end-end delay over the selected four scheduling algorithms. WRR has the highest latency comparing to other scheduling algorithms based on its mechanism regarding the categorization and assigning processes as mentioned in the literature, but still shows better performance as will be presented later. The end-end delay is 0.192 s, 0.269 s, 0.284 s, and 0.293 s for the reSP (SP), WF (WF), RR (RR), and Weighted RR (WRR), correspondingly. The lowest delay is shown in SP and it is lower than WF, RR, WRR by 28.4%, 32.18%, and 34.34%, respectively.

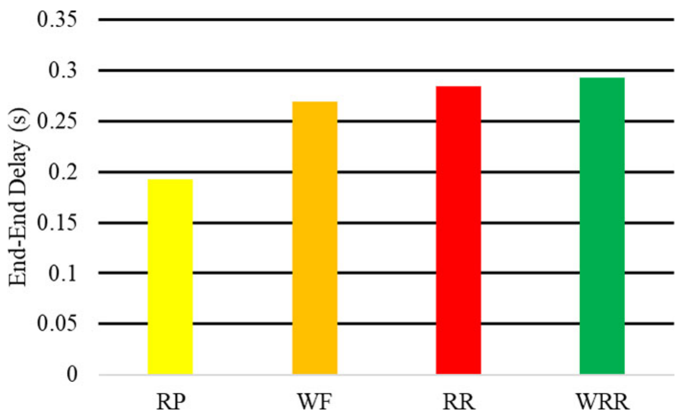

Fig. 11. End-end delay for the selected scheduling algorithms

4.3 Size of peak queue

Figure 12 illustrates the size of the peek queue at the wireless router which is 799.2 bytes, 803.76 bytes, 841.92 bytes, and 889.3 bytes for SP, WF, RR, and WRR, respectively. From the previous values, the most horrible scheduling algorithm at the size of queue 150 KB is SP. WRR represents the best scheduling algorithm since its greater than SP, WF, and WRR by 10.13%, 9.6%, and 5.32%, in order.

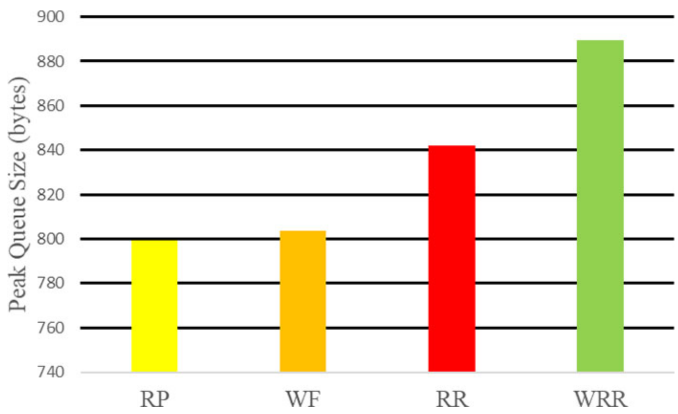

Fig. 12. Peak queue size for the selected scheduling algorithms

From the results, the weighted RR scheduling algorithm can provide a significant queue size at the wireless gateway.

4.4 Average queue length

Average output queue size results for the four selected scheduling algorithms are presented in Figure 13. The measurements are taken placed over all the nodes and calculate on average. The Average output queue size is 10.89 bytes, 11.10 bytes, 11.72 bytes, and 13.73 bytes for the SP, WF, RR, and WRR, in order. The Weighted RR scheduling algorithm shows the highest average output queue size at 13.73 bytes, but the lowest queue size is appeared by the SP scheduling algorithm (11.10 bytes). The WRR is proceeded by 14.64%, 19.09%, and 20.68% compared to RP, WF, and RR, respectively.

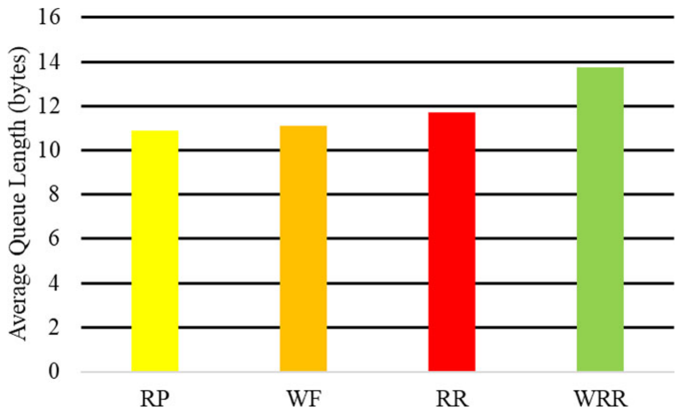

Fig. 13. Average queue length for the selected scheduling algorithms

4.5 Average time queue

Figure 14 depicts the average time in queueing process at the wireless getaway for the reSP (SP), WF (WF), RR (RR), and weighted RR (WRR) scheduling algorithms which are 0.013 s, 0.0125 s, 0.0107 s, 0.0087 s, respectively. The SP waste is more time in queuing comparing to others. Moreover, WRR shows the lowest average time in queuing which mean is the fastest one. By 53.81%, 43.87%, and 23.06%, WRR is reserve more time comparing to SP, WF, and RR, in orders.

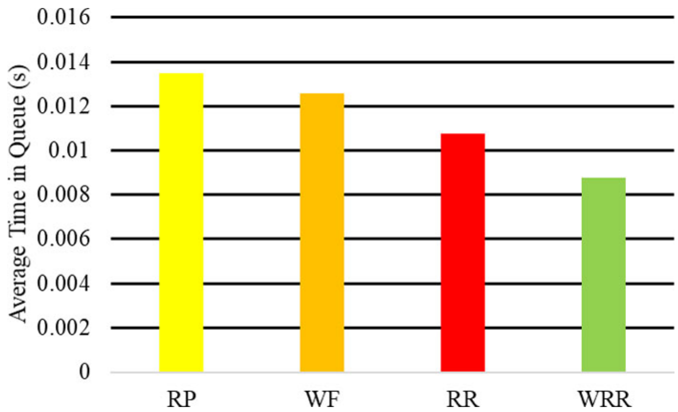

Fig. 14. Average time in queue for the selected scheduling algorithms

4.6 Total package drop

Figure 15 depicts how many packets are dropped by force when memory buffered is full which are 23 packets, 19 packets, 18 packets, and 15 packets for the SP, WF, RR, and WRR scheduling algorithms. From the figure, it is clear that WRR has dropped the least packets when the node buffer becomes full. The highest dropped is achieved by the RP scheduling algorithm since it dropped 23 packets at the same condition of buffering.

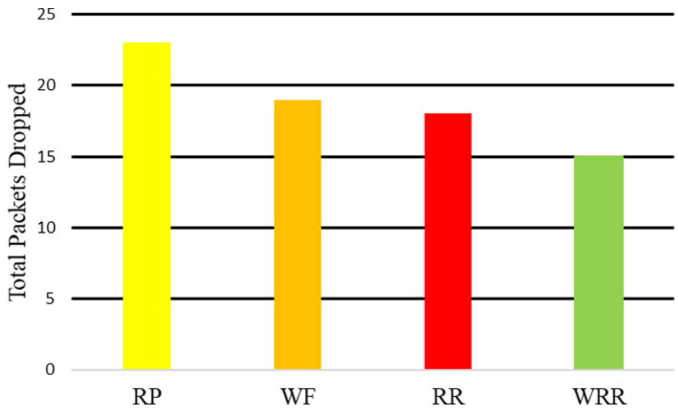

Fig. 15. Total packets dropped for the selected scheduling algorithms

5 Conclusion

Mobile ad hoc networks are emerging recently to ease the communication between distributed nodes without any infrastructure. The goal of this kind of network is to provide telematics services i.e., voice, data, and video with various qualities of service requirements. For this reason, the growing demand for scheduling algorithms that are capable of considering different QoS requirements is imposed to develop a new scheduling algorithm. Moreover, evaluating the performance of existing ones in different scenarios is essential. In this paper, the performance of SP, RR, Weighted RR, WF scheduling algorithms is investigated mainly in terms of network metrics and queue management metrics in ad hoc networks and mobile. The scenario consists of fifty randomly mobile nodes and is built using the network simulator EXata. The results showed that the SP outperformed the others regarding throughput. In contrast, WRR has outperformed the others regarding the reminding metrics end-end delay, size of peak queue, queue length as average, in queue average time, and dropped packets.

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