The Impact of Buffer Queue Interface Size to The 802.11 Ad Hoc Network Performances

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Abstract. Radio technology for wireless local area network (WLAN) has been used widely as it is the most popular for internet access point both in houses and buildings. Technology development rapidly changes to improve connection speed from modulation techniques to application layer, such as buffering. Some buffering methods have been employed for application adaptation. Buffer management is able improving network performances. In order to measure how buffering influence the performance, this article examines buffer queue interface impact to 802.11 performance by using network simulator. The evaluation results show that the increment on buffer size from 10 packet to100 packet boosts packet delay and jitter about 121.96% and 17% subsequently. However, packet loss is reduced up to 59%.

1. Introduction

Technology development on wireless radio is aimed at increasing connection speed, by enhancing modulation speed, multiplexing capacity, multiple access performance, network coding to application layer techniques. Modulation techniques such as AM (Amplitude Modulation), FM (Frequency Modulation), and PM (Phase Modulation) exert limited speed[1]. Speed improvement is gained by using digital modulation from ASK (Amplitude Shift Keying), FSK (Frequency Shift Keying) and PSK (Phase Shift Keying), where current development is on M-ary PSK variations[2].

Besides modulation techniques, multiplexing techniques such as FDD (Frequency Division Duplex) and TDD (Time Division Duplex) combinations have significant transmission capacity improvement. Current OFDM (Orthogonal Frequency Division Multiplexing) technology enhances cellular and packet radio speed significantly [3]. OFDM has been used in WiMAX (802.16)[4], WiFi (802.11), LTE and other mobile technologies. Meanwhile, multiple access that manages point to multipoint connections reaches RTS/CTS technology [4].

Some existing techniques employ buffering techniques in medium access, transport and application layers. Wang et al [5]manages medium access layer buffer to tolerate network delay, while transport layer copies [6] increases TCP reliability. Meanwhile queue management in buffer [7] significantly improves 802.11.

The question is what is the basic relation between buffer capacity and network performances. Therefore, this article focuses on examining buffer capacity and network performances relation by evaluating packet delay, jitter and packet loss pattern when buffer queue interface on medium access layer changes. The evaluation is conducted on 802.11 ad hoc networks as multiple access technique on it increases collision probability that results sensitive network performances.
2. Research method

Figure 1 shows steps in evaluating the interface queue buffer. An ad hoc network with the number of users increases from 2 to 10 nodes is set up, link and background traffic models are adjusted, buffer variations from 10 to 100 packets are also implemented. The transmission scenario is set two ways, and transmission control protocol (TCP) is employed.

Figure 1. Research outline.

Traffic is chosen based on the Evalvid framework with certain bit rate sent by nodes. The packet transmission and reception are recorded. Traffic is uniform in all nodes with video bit rate 539 bps. The transmitter is set to cover 1000 m with transmitting power 0.281838 W by using two-ray ground propagation model.

3. Experiment Results

3.1. Delay

The average delay to buffer capacity and delay to number of nodes are plotted in figure 2. Delay increases logarithmically to buffer increment as its value is 52 ms at 10 packet buffer, moves slowly to 115.3 msat 100 packet buffer. It increases about 121.96% or 10 folds buffer increment. The pattern is regressively approximated by using $y=0.0268\ln(x/10)+0.0618$ where $x$ is buffer capacity and $y$ is delay.

Figure 2. (a)Delay to buffer capacity, (b)Delay to number of nodes.
Increasing number of nodes produces more collision probability that causes packet retransmission. Retransmission induces higher delay as plotted in figure 2(b). Average delay increases significantly as number of nodes added. The approximated regression is \[ y = 0.005e^{0.495x} \].

3.2. Jitter
Jitter increases slowly as buffer capacity increases following trend \[ y = 0.0189\ln(x/10) + 0.2046 \], where jitter increases 17.16% when buffer changes from 10 packets (41.7 ms) to 100 packets (48.9 ms). It is shown in figure 3(a). Meanwhile, jitter increases significantly when number of nodes added, following the regression pattern \[ y = 0.0013e^{0.435x} \]. Jitter increases 4868.45% from 38 ms at number of nodes 2 to 187 ms at node 10 (figure 3(b)).

![Figure 3](image1.png)

**Figure 3.** (a) Jitter to buffer capacity, (b) Delay to number of nodes.

3.3. Packet loss
Packet loss increases from about 2.72% for buffer 10 packets to about 1.11% for buffer 100 packet. Losses decrease about 59%. This means, even delay and jitter increase when buffer added, losses can be minimized. Losses increases when new node is introduced. The characteristics of losses are shown in figure 4.

![Figure 4](image2.png)

**Figure 4.** (a) Packet loss to buffer capacity, (b) Delay to number of nodes.

4. Conclusions
To conclude, generally, the increase on buffer size results increments on packet delay and jitter. However, packet loss can be minimized. Delay and jitter increase about 121.96% and 17% subsequently, but packet loss decreases about 59% when buffer size changed from 10 packets to 100 packets. The increase on number of nodes causes network performances poorer.
This research shows that buffer size keeps packet loss low but expands delay. There should be further step to reduce latency, for instance, by applying proper scheduling. This could be of the future work.

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