Effect of varied wireless standards and properties towards wireless network bandwidth

Wooi King Soo¹*, Teck-Chaw Ling¹ and Keat-Keong Phang¹

¹ Faculty of Computer Science and Information Technology, University of Malaya, Kuala Lumpur, Malaysia

E-Mails: wksoo79@gmail.com, tchaw@um.edu.my, kkphang@um.edu.my

* Tel.: +60-03-8312-5350;

Abstract: IEEE 802.11 provides multiple wireless networking (WLAN) standards with each new standard attempting to improve overall performance whilst remaining backward compatible to older ones. The current practise of setting up WLANs is to use non-overlapping channels and high signal strengths to provide optimum performance for stations in the network. In this paper, we try to show that the common practises may not be enough to ensure the best performance in a WLAN and stations themselves may be responsible for affecting network performance. Preliminary results are obtained are based on experiments executed in a simple test model using the 802.11g standard.

Keywords: wireless network; wlan; bandwidth; throughput; 802.11g; 802.11b.

1. Introduction

WLANs are now the norm to setting up and providing quick access to network based services for multiple users in a enclosed location causing the unlicensed ISM 2.4GHz range to become saturated with multiple networks, each fighting to claim airtime which has since become a precious ‘commodity’ to transfer data efficiently and reliably. The negative impact of running varied wireless networks within range of each other is often discussed and justifications have been provided to promote the current practise of implementing non-overlapping channels as and whenever possible. One factor often disregarded is the effect of the stations themselves in a WLAN. While there are many write-ups, guides and papers that tell about the impact of neighbouring WLANs, there is little about how the users associated within a single WLAN can actually affect each other’s experience either due to a user misconfiguration or other
uncontrollable factors. This paper will identify the effects of several common factors that stations themselves exhibit and measure its impact on other users in an attempt to prove (or disprove) these common practises.

2. Methodology

Tests were conducted in a controlled environment in which two laptops representing stations are associated with an 802.11g access point (AP) whilst a desktop computer is connected via 100 Mbps wired ethernet and designated as the server. Stations remain stationary during tests and are mains powered to circumvent power-saving functions from affecting hardware capabilities. The test network is isolated from other networks and Internet connectivity to prevent applications from inadvertently adding unwanted traffic. Each wireless station is setup to broadcast at its highest transmission power capable and run with the latest drivers installed and WPA2 security. TCP traffic is generated with iPerf 2.0.5 and to measure results, measurements are taken from the iPerf logs generated as traffic passes. During each test, stations transmit as much traffic as possible towards the server which responds by transmitting back to the station – thus establishing two-way data transfer. Tests are repeated and averaged to get the final results. This paper focuses solely on the impact towards bandwidth based on varying other conditions – other metrics like jitter and delay are not shown since they irrelevant with TCP traffic due to packet retransmissions and reordering. To simplify representation, up and download bandwidths are aggregated into just a single value for each station.

3. Results

Mixing wireless standards are known to affect performance in a wireless network because all associated stations downgrade their connections to the lowest denominator for compatibility reasons. As opposed to a normal transmission rate of an 11g station and 11b station [2,3], the mere association of an 11b station in the ESS negatively impacts the bandwidth of the 11g station. With both stations associated, the 11g station only manages a maximum throughput of around 12Mbps which represents a near 45% performance hit. When the 11b station begins its transmissions, the resulting effect is very obvious as both stations are dragged down to share the 5.5Mbps maximum as shown in figure 1(a) below. When using the same wireless standards, all stations share the maximum throughput fairly. This is of course in regards to the signal strength of each station as a weaker station will experience a drop in its own throughput but the overall total bandwidth in the ESS remains the same. When the stations in the setup are roughly equal in RSSI the bandwidth is almost halved equally between them. The first station experiences almost another 45% drop in bandwidth when two stations are present as indicated in figure 1(b).
Stations that transmit slowly are often blamed for the slow overall performance of a network [4]. Although proven true when stations are using older wireless standards, it does not fully apply when stations are on equal footing. When using similar standards and at roughly similar signal strength, a station which is transmitting slowly actually affords other stations more bandwidth transmission opportunities thus resulting in higher throughput but the same overall total bandwidth for the network. Figures 2(a) and (b) below show that when the second station transmits at a limited lower bandwidth the earlier station retains a higher throughput by seizing the extra unused time to transmit its data thus negating the results from [4].

Figure 2 (a) and (b). Bandwidth measurements on stations with bandwidth limited traffic.

RSSI plays a major role in determining network performance but other unpredictable factors may also impact the performance to a large degree. For example, the choice of transmission chipset can affect performance – with one station using an Intel ABG chipset whilst the other is running an Atheros5007 chip, even with a stronger RSSI (96% against 80%), the station running the Intel chipset experiences a dramatic drop of over 90% when the second station begins its transmissions. Swapping the order of transmissions brings the same results with the Intel station being negatively impacted by the other station’s communications and cannot even reach the 22Mbps baseline measurements. These results are shown in figures 3(a) and (b) below.
4. Conclusions

The preliminary results presented have shown that there are other factors within an ESS which can dramatically affect station performance. The mere presence of an older standard device in the network drastically reduces the throughput of all stations even though the device is not actively transmitting. The belief that just because a station transmitting slowly reduces overall network performance is also debunked and proven false. Note that if the station is experiencing slowdowns because of RSSI, then it remains partially true but the impact is not as great. Finally, implementing the best practises in setting up a WLAN may fail due to the differences in hardware, and possibly software, which can break all rules of WLAN configuration and fine-tuning.

References


© 2013 by the authors; licensee Asia Pacific Advanced Network. This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/3.0/).