Wi-Fi Parameter Measurements and Analysis

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Abstract. *This paper describes the measurements of the Wi-Fi signal strength and measurements performed in a real-life example WLAN available in most homes today. The idea was to present how the signals were measured, analysed and conclusion was based on that analysis. The paper shows how an ordinary tablet device along with a couple of applications and the tablet's built-in Wi-Fi antenna can be used for such measurement purposes. Several measurements were conducted – showing the influence of different factors on the strength of the Wi-Fi signal and on the download and upload speed.*

Keywords: Wi-Fi Network, Signal Strength Measurement, Mobile Applications

1. Introduction

The Wi-Fi network is a wireless local area network (WLAN) which is intended to be used in local premises like a business building or on headquarters of an institution which consists of more building in a same place. The purposes of using WLAN networks are: wireless connection of computers into a network; providing mobility of computers [1]. A wireless local area network (WLAN) system is a system that includes the distribution system (DS), access points (APs), and portal entities. It is also the logical location of distribution and integration service functions of an extended service set (ESS). A WLAN system contains one or more APs and zero or more portals in addition to the DS [2]. The quality of Wi-Fi network depends on distance from the router, the used antenna and quality of the device. Wireless telecommunications networks are implemented and administered using radio communication, *(*physical layer of OSI model network structure [3]. The IEEE so far has defined nine protocols for the 802.11 technology. The used device in this paper supports Wi-Fi 802.11 b/g/n and Bluetooth. The Table 1 bellow shows an overview of the most important technical specifications of the standards 802.11 a/b/g/n [4-6].

2. Measuring device and applications

The device used for measurements was the Google Nexus 7 tablet (due to availability of device and since it is used for writing the Diploma thesis). It supports Wi-Fi 802.11 b/g/n as well as Bluetooth. It operats on 4.2 Android operating system (Jelly Bean).

Table 1. Overview of the 802.11 a/b/g/n standards.

Standard name	802.11a	802.11b	802.11g	802.11n
Standardization date	January 2000	December 1999	June 2003	June 2009
Maximum bandwidth	54 Mbps	11 Mbps	54 Mbps	600 Mbps
Modulation technique	OFDM	DSSS, CCK	DSSS, CCK, OFDM	DSSS, CCK, OFDM+
RF band	5 GHz	2.4 GHz	2.4 GHz	2.4 or 5 GHz
Channel bandwidth	20 MHz	20 MHz	20 MHz	20 or 40 MHz

Two Android applications installed on the measuring device were used, the first being the "Wi-Fi Analyzer" (Fig. 1.). It helps the user to select a better channel. Wi-Fi Analyzer scans nearby wireless access points and shows spots with best signal strength and least traffic.

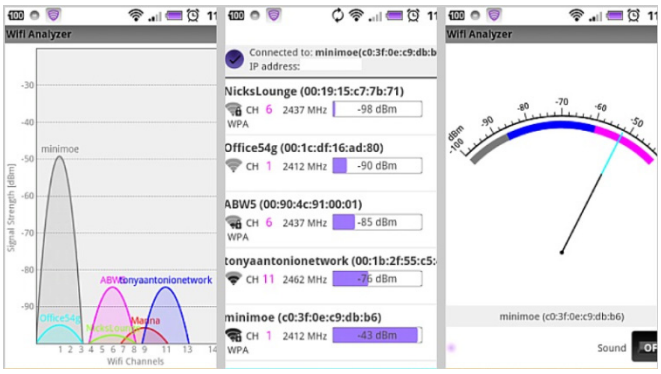

Fig. 1. Wi-Fi Analyzer application.

The second application used was the "Speedtest.net" (Fig. 2.). It measures the network download and upload speed.

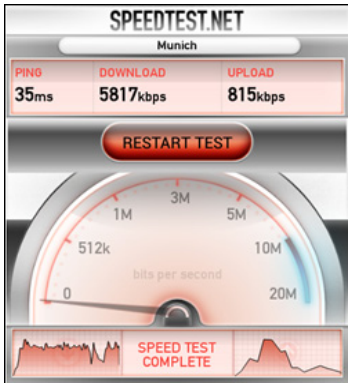

Fig. 2. Speedtest net application.

3. Results

For a more complete overview of the influence of different factors on the Wi-Fi signal, there were six measurement points. For the 1st measurement, the device was placed close to the WLAN router (30 cm away) with no obstacle or interference with the Wi-Fi signal. In the next measurement points, the distance from the router was increased, from 4 meters to 12 meters of distance. Distances of 8 and 12 meters included the concrete wall as well. Furthermore, the measurements included the interference from microwave owen and Bluetooth devices (measuring points 3 and 4).

For 2nd measurement, with distance from router of 4 m, a drop in the signal strength (of approx. 25 dB) has been noticed and a very slight drop in the upload and download speed. In the 3rd measurement, the same distance was used as in the 2nd measurement but with interference of a 500 W microwave owen. A slight drop of signal strength (approx. 3 dB) was noticed but a yet bigger drop in the speedtest than in the 2nd measurement.

In the 4th measurement, the distance from router was 4m as in the 2nd measurement, but with the Bluetooth interference (two cell-phones sending files over Bluetooth next to the measuring tablet). The results showed further drop in the Wi-Fi signal strength (approx. 3 dB), with no significant download and upload speed change. In the 5th measurement, the

distance from the WLAN router was increased to 8m. In this case there was an obstacle – a concrete wall inbetween. The results have shown further Wi-Fi signal strength drop compared to the 2nd measurement (approx. 7 dB) but a more significant download and upload speed (approx. 1.4 Mbps of download and 0.120 Mbps of upload). In the 6th measurement, the distance from the WLAN router was 12m. Compared to the 4th measurement, the Wi-Fi signal strength has slightly dropped (approx. by 6 dB). The upload and download have on the other hand showed the best results compared to other measurement points. Table 2. shows the results of the measurements.

Table 2. Power levels, upload and download speed of measured Wi-Fi network.

Measuring point	Power (dBm)	Download (Mbps)	Upload (Mbps)
30 cm from WLAN router	-30	5.745	0.797
4 m from WLAN router	-55	5.674	0.765
4 m from WLAN router with 500W microwave interference	-58	5.441	0.703
4 m distance from router with Bluetooth interference	-61	5.712	0.824
8 m from WLAN router with wall interference	-62	5.609	0.750
12 m from WLAN router with wall interference	-68	5.468	0.778

Fig. 3. shows dependence of the power (dBm) vs distance from the router (m). The measurements on 8 and 12 m include the wall barrier.

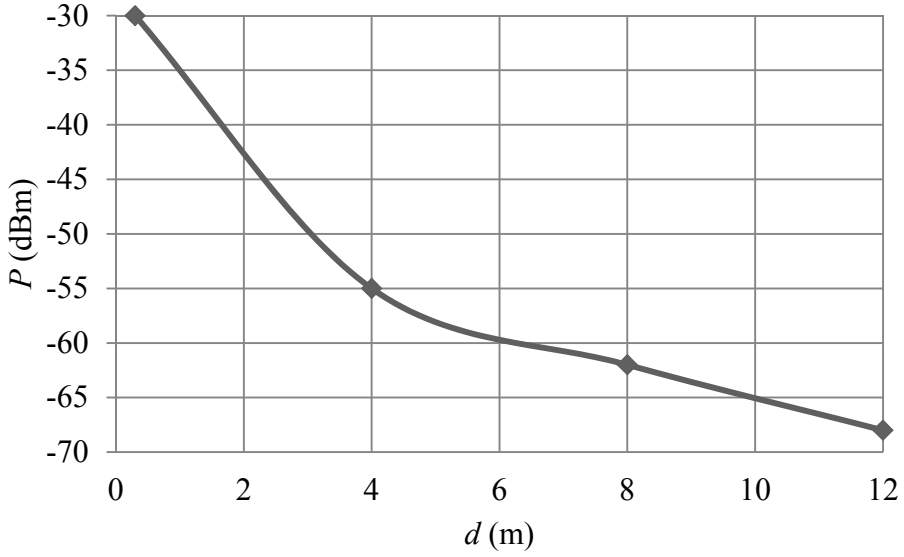

Fig. 3. Power depending on the distance from the router.

Fig.4. shows download and upload rates depending on the distance from the router. While the upload speed has remained almost the same, a slight change in the download speed has been noticed from increasing the distance to 8 m and beyond. During the testing, no other devices (other than the measuring device) were connected to that wireless access point. Therefore, no download/upload speed interference could have been caused by another device.

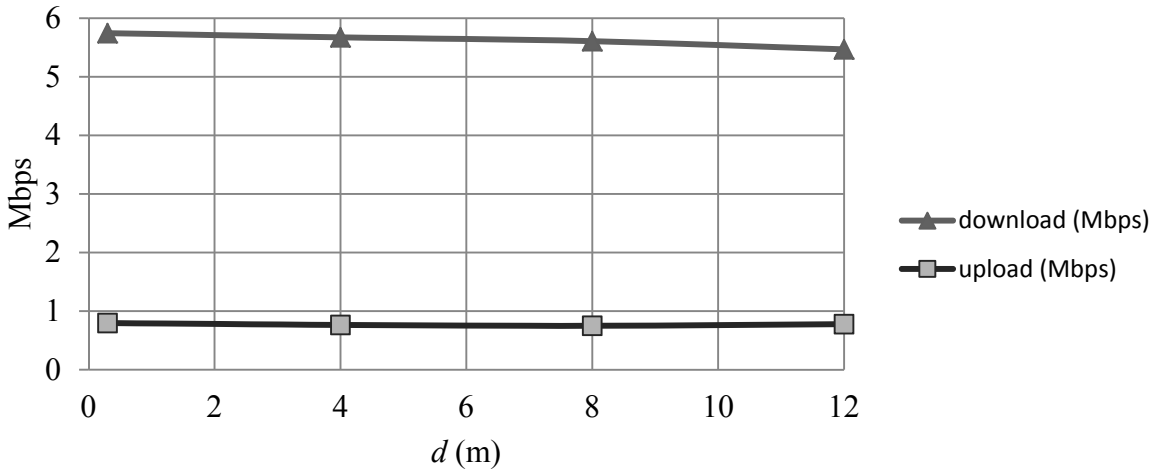

Fig. 4. Download and upload (Mbps) vs distance from the router.

4. Conclusions

Increasing the distance from the WLAN router leads to a drop in the Wi-Fi signal strength, while the download/upload remains nearly the same. The interference from microwave owen and Bluetooth device shows a drop in the Wi-Fi signal strength (the later more the the first), but the upload and download speeds remained almost the same. The interference of a wall between the measuring device and the WLAN router does cause a drop in the Wi-Fi signal strength, although the download/upload remains quite stable (except for 8 m distance where a significant drop of speed was detected). Naturally, numerous other measurements can be made to further show the influence of different objects and factors on the strength of the Wi-Fi signal and on the download/upload. They can include influence of a stronger magnetic field, influence of a stronger electric field, further increase of the distance, influence of other jamming devices (wireless phones, etc). Wi-Fi signal can also be increased by better placement of the WLAN router, replacement of the WLAN router's antenna, adding WLAN signal repeaters, changing the used channel of the WLAN signal of the WLAN router, switching to the 802.11n standard on all devices, using the same manufacturer for the WLAN cards and the router and so on.

References

[1] Radovan M. Računalne mreže. Digital Point tiskara, 2010.

[2] IEEE Std 802.11-2012. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications.

[3] Basavarai P. et all. IP in Wireless Networks. Prentice Hall, 2003.

[4] IEEE Std 802.11b-1999 (Supplement to IEEE Std 802.11-1999). Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: High-speed Physical Layer in the 2.4 GHz Band.

[5] IEEE Std 802.11g-2003. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band.

[6] IEEE Std 802.11n-2008. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 5: Enhancement for Higher Throughput.