

End to End Solution for Campus Environment to Improve the WLAN Network Performance and Security

Siti Mursalina Bt Mohamad Ali¹, Mohd Raziff Abd Razak², Ahmad Roshidi Amran², Safyzan Salim² & Muhammad Ghazali Mohd Tahir²

¹Universiti Teknologi MARA, Shah Alam, Selangor

²Universiti Kuala Lumpur British Malaysian Institute

Corresponding email: mrziff@unikl.edu.my

Abstract: This paper briefly introduce the implementation of finding and survey result pertaining to the performance of wireless network or WiFi services in education institutes. To achieve this objective, the research performed at UniKL BMI Gombak that consists of 1,274 total numbers of students staying in hostel for both female and male blocks. Based on the finding, 2 major issues need to discuss further in this paper which are: 1) The wireless service bandwidth capacity and signal coverage; 2) Bonding Equipment and Security. These 2 points are mandatory aspects that need to be covered and resolved so that the students or the WiFi users are satisfied with the performance of Wireless Local Area Network service in their campus.

Keywords: WiFi, Security, WLAN, Coverage, Bandwidth Capacity, Access Point, Throughput, QoS.

1.0 INTRODUCTION

Since the wireless coverage service has developed widely and rapidly over the past several years, the accessibility to the Internet become more important in any individual daily lifestyle. WiFi or wireless service also become the priority and necessities in line with the growing number of people using Mobile Cloud Computing (MCC) as the new IT communication technology together with the trends of Bring Your Own Device (BYOD). These trends allow people to have mobility to access to the Internet at any time and at any place as long as the connectivity to the Internet is available by using any of electronic devices such as notebook, iPad, smartphone, tablet that equipped with wireless technology as a standard built in features. So, in today's Internet based education system also force everyone to depend more and more to the latest IT connectivity that require more versatile network accessibility. Wireless solution is now becoming a necessity because of easy and faster deployment capabilities, despite the advantages of WLAN there are numerous ways the performance of

wireless network service can degrade. Wireless network is more vulnerable to network attacks than wired networks even though it is the popular type of communication channel in which wireless signal can leaks beyond building via the configured access point.

2.0 IMPLEMENTATION OF CAMPUS WLAN

UniKL BMI needs to enhance the quality of existing WLAN due to a number of issues, as each student has paid a certain amount of fees to access the wireless service. UniKL BMI also needs to manage its wireless Internet usage bandwidth performance as it continues to expand its infrastructure and the most important to serve high quality WiFi accessibility to student for them to access E-Learning portal to download and upload notes, do their online research or completing their online assessment. As such, ensuring high speed performance of WLAN is an obligatory commitment. Campus also needs to manage its wireless Internet usage to provide wireless access for more than 1000 students over the dedicated 10 Mbps WiFi, the

current Internet bandwidth capacity. A number of issues have cropped up that caused the usage of the wireless to be less optimum. Based on these requirements, campus requires focusing and addressing the following points:-

- i. How the performance impact, scalability and the signal coverage to manages and handles thousands of users with minimum latency and to increase signal strength in every room or level in each hostel blocks.
- ii. How to control students from accessing inappropriate websites that can lead to exploits or vulnerabilities such as websites that contain spyware or malware, phishing attacks, virus, unauthorized file transfers and be able to block applications and internet services that lead to decrease in productivity and network bandwidth drain.
- iii. How to avoid nearby area accessing the campus WLAN.
- iv. How much reasonable bandwidth capacity needed to increase in order to optimize the WLAN service performance.

Coverage and Bandwidth Capacity

The previous placement of the Access Point (AP) in the locations as shown below in Figure 1, describe that the signal penetration is not fully optimally broadcast to all area from the centralized main building to the surrounding location for both hostel blocks. Due to the structure of the building which consist of inch-thick concrete this might be posed a problem in certain hostel rooms as the signal may not reach inside the room therefore resulting in a loss of communication between APs and clients within the hostels.

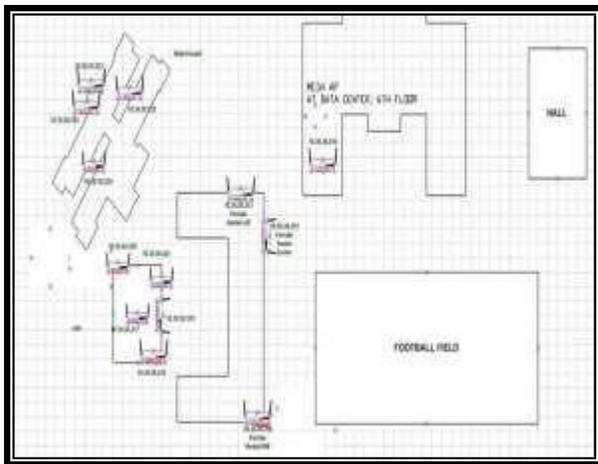


Figure 1: AP Placement before redesign

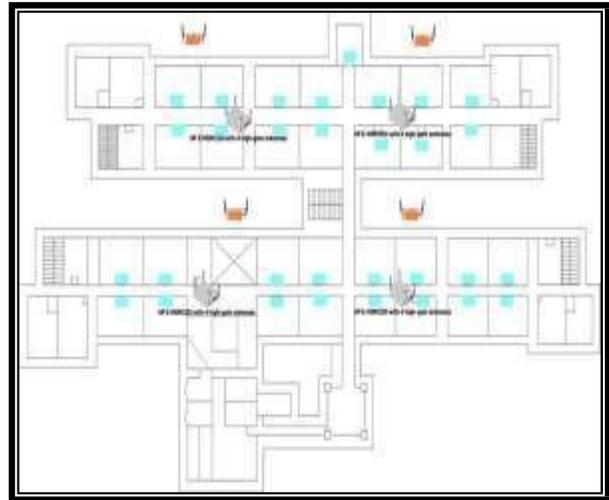


Figure 2: AP Placement after redesign

Figure 2, the proposed of new layout placement of APs at each hostel block consist of new APs of HP brand MSM 320 model, 4 units at each level in addition to the existing 4 units of outdoor APs. The new AP location were confirmed after conducting the speed test and signal test to get the best effort of WiFi signal coverage in each room by using open source software such as Netstumbler and QCheck.

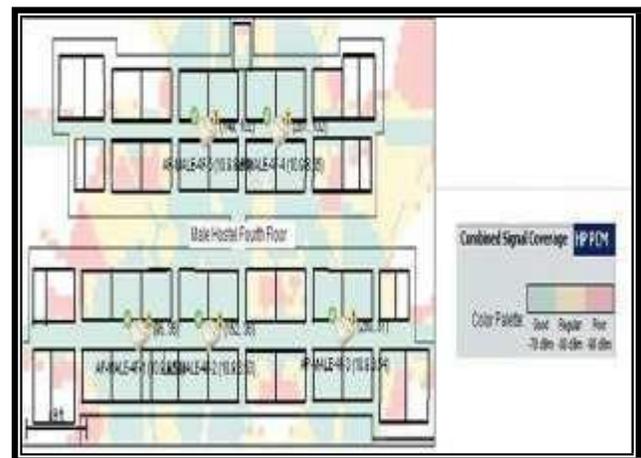


Figure 3: WiFi signal coverage

Figure 3 above shows the signal coverage result after the new placements. The result shows that most of the rooms get a good signal by using new network monitoring system brand HP PCM where the signal coverage shown in green color between -70 dBm compared to previous setup, as we can see room that located closer to the access point received higher WiFi signal penetration.

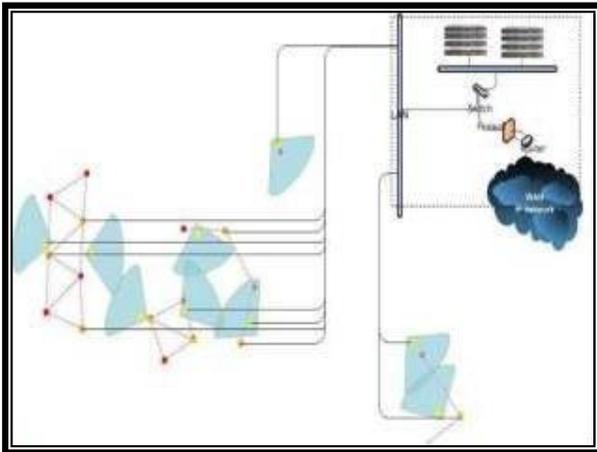


Figure 4: New WLAN Signal Coverage

Figure 4 show the overall top view of the WLAN network signal coverage after the redesign work. Therefore, campus really needs to increase or to add on the number of access point to get the full signal coverage in order to resolve the unreachability signal issues. As for the bandwidth capacity issues, campus needs to add more bandwidth as per calculation below:

Wi Fi total current bandwidth = 10Mbps
Total students at hostel = 1274
Concurrent user > 500 students
Max bandwidth = 384Kbps per user
Estimate no of students using at 10% = 260 students.

Based on the above calculation we can estimate that only 260 students will be using Wi Fi service at 10% usage with maximum bandwidth of 384Kbps. Insufficient bandwidth is the main issue to address as each student has paid a certain fee to access the WiFi services, which is a must to increase the wireless network bandwidth so UniKL BMI need to create and allocate some budget to invest and subscribe other bandwidth solutions from Telco provider such as TM UniFi or TIME with at least a subscription of 150Mbps Internet service in order to achieve the average of 2Mbps bandwidth allocation per WiFi users.

Bonding Equipment and Security Upgrading

The study and the redesign work also have unveiled the fact that the existing equipment are not capable enough and have limited and minimum features that can assure security and productivity of users as well as in the capacity management and monitoring of the wireless network traffic. The typical wireless network must consist of the following items beside the new technology of Access Point:-

- i. Firewall & Wireless Controller
- ii. Bandwidth Manager
- iii. Network Management System

A number of security feature allows solution to ensure the system log integrity, hardened Operating System (OS) resistant to known any attacks and exploits, control path encryption of communication between the equipment's and the WLAN platforms and authentication account to ensure the WLAN bandwidth capacity will only be used by the registered accounts or students in the campus. Mobility of users or students increases the security concern in wireless network. Wireless network employ authentication and data encryption techniques on the wireless interface to provide security to its users.

3.0 MEASURING PERFORMANCE ELEMENTS

Availability Constraints

Insufficient bandwidth issue has caused the usage of the accessibility through WLAN to be less optimum with the latest and rich applications such as audio and video streaming through the E-learning system utilized by students, obviously the minimum network delay and reliable bandwidth are desirable. In addition, every student will have more than one electronic gadgets or devices that rely on the wireless connection network.

Utilization Constraints

The utilization usage in campus environment is different with other environment, the usage will be very high when it reach the peak hours from night until midnight, this happened because students stay in their rooms and get connected to the Internet by using WiFi service. Meanwhile, in daytime the bandwidth is not fully utilized because students will be away attending their lectures. Moreover, in every semester break the usage of the network utilization will be at very low percentage.

Throughput

Network throughput can be measured as the number of successful rate or effectiveness message delivery over a communication link.

RAW WIRELESS SETUP
 USER ACCEPTANCE TEST (UAT) SHEET

No	Location	Signal	SNR	DHCP	WLAN Latency / 10 P.P.S.		Modulation Rate / Mbps	Throughput (Gbps/Mbps)
					Avg	% Loss		
1	SB-A-05-15	-71	25.29	(/)	10ms	0%	54M	1.311
2	SB-A-05-20	-72	27.25	(/)	5ms	0%	55M	1.413
3	SB-A-05-23	-69	30.53	(/)	5ms	0%	54M	1.351
4	SB-A-05-27	-60	37.40	(/)	30ms	0%	54M	1.430
5	SB-A-1F-33	-75	21.24	(/)	1ms	0%	54M	1.370
6	SB-A-1F-23	-59	40.43	(/)	5ms	0%	54M	1.390

Legend
 > 2 Mbps: Excellent
 > 101 Kbps < 1 Mbps: Moderate
 < 200 Kbps: Poor

Figure 5: UAT at Hostel

SIGNAL

Colour	1F	2F	3F	4F	TOTAL	%
> -70dB	18	19	14	17	68	87%
> -80dB	2	3	3	1	9	12%
> -90dB	0	0	0	0	0	0%
TOTAL	20	22	17	18	77	100%

SNR

Colour	1F	2F	3F	4F	TOTAL	%
> 20dB	17	15	17	17	66	99%
10dB - 19dB	0	0	0	1	1	1%
> 10dB	0	0	0	0	0	0%
TOTAL	17	15	17	18	67	100%

Legend
 > 2 Mbps: Excellent
 > 101 Kbps < 1 Mbps: Moderate
 < 200 Kbps: Poor

Figure 6: Percentage new coverage

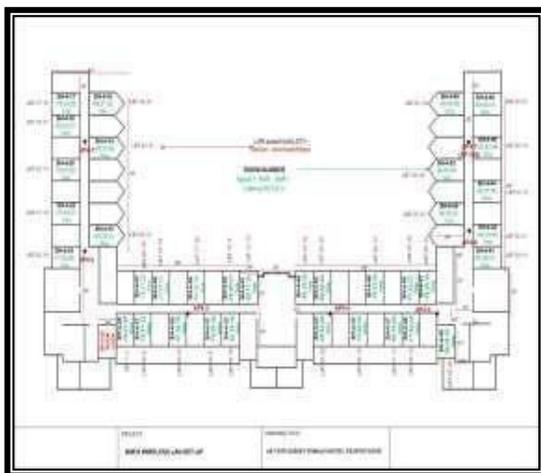


Figure 7: UAT Layout at Hostel

4.0 RESULTS

Figure 5, figure 6 and figure 7 show the result and findings from the User Acceptance Test (UAT) that have been conducted in UniKL BMI campus that measure the performance analysis of the WLAN usage in the hostels. The result show that the signal penetration mostly in good coverage (green color) with the total percentage is 87% and less than -79Db. Meanwhile for the Signal to Noise Ratio, (SNR) is 99% with more than 20dB and most of the throughput is more than 2Mbps, which can be considered as the new solution for signal coverage. This is an evidence of an excellent coverage. Based on the solution discussed in this paper, by increasing the number of APs certainly help the signal coverage to reach any blind spots in the hostels at every floor. Next, we have added more bandwidth capacity from 10Mbps to a minimum of 150Mbps as a starting point to consider, so as supporting more than 1000 users to get better speed performance. Hence, the network availability issue is resolved. When the utilization is high the better response time and throughput can be achieved. Other than that, the web based authentication is also one of the main requirements in WiFi technology to allow authorized users to log-in and access the WiFi service.

The network monitoring system (NMS) also helps network administrator to run and frequently perform remote monitoring and inspection on the APs status and to get alert with the network traffic pattern behavior in real time.

5.0 CONCLUSION

In this study, we conclude that proper and suitable design and implementation contribute significantly in achieving great performance of WLAN service. As stated that WLAN is more susceptible to be attacked that could impact the speed, bandwidth capacity and compromise network security. Measuring number of performance elements such as the WiFi signal availability, the bandwidth utilization per user and also throughput that need to be analyzed to gain the maximum accessibility to the Internet. The end to end solution also will ensure to provide more benefits and improvement such as high gain wireless access point for a better performance network access, complete end to end monitoring solution network, better QoS control, integrated authentication, high network security and better control of bandwidth utilization or bandwidth capping per user or per application. UniKL BMI really needs to carry out capex investment in WLAN so that services

render to students are of highest quality especially with the current trends of e-learning environment. Otherwise, we will keep getting negative feedback on customer satisfaction involving factors such as low level of satisfaction of delay, intermittent connection, and frequent downtime due to unsupported or non-up to date network equipment, as well as bandwidth capacity issues.

REFERENCES

- [1] A. Zafft and E. Agu, "Malicious WiFi Network: A First Look", Local Computer Networks Workshops (LCN Workshops), IEEE 37th Conference 2012.
- [2] Ranjana Shukla, Samad S. Kolahi, Robert Freeth and Avikash Kumar, "Educational Institutes: Wireless Network Standards, Security and Features", ICCIT 2010.
- [3] E. J. M. A. Filho , P. N. L. Fonseca, M. J. S. Leitao, P. S. F. de Barros, "Security versus Bandwidth: The Support of Mechanism WEP e WPA in 802.11g Network", WOCN '07. IFIP International Conference, July 2007.
- [4] M. Srivatsa, "Who is Listening? Security in Wireless Network", Signal Processing, Communications and Networking, 2008. ICSCN '08.
- [5] A. K. Agarwal and W. Wang, "Measuring Performance Impact of Security Protocols in Wireless Local Area Networks", Second International Conference on Broadband Networks (BROADNETS) 2005.
- [6] H. Peng, "WIFI Network Information Security Analysis Research", 2nd International Conference on Consumer Electronics, Communications and Networks (CECNet) 2012.
- [7] Qihua Wang and Cand Jianwu Zhang, "Analyse of the Application Scheme for the Wireless Network Security", The IET International Conference on Wireless Mobile & Multimedia Networks, 2006.
- [8] S. Guo, "Performance Analysis of Wireless Intruders Geolocation in Campus Wireless Networks", MILITARY COMMUNICATIONS CONFERENCE, MILCOM 2012
- [9] Mudassar Ahmad, Sumaira Taj, Tasleem Mustafa, Md Asri "Performance Analysis of Wireless Network with the Impact of Security Mechanisms", International Conference on Emerging Technologies (ICET), 2012.
- [10] Beaulah David, Dr. P. Raviraj, "Performance Analysis of QoS Based Model for Wireless Network Communication", Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT), 2013.
- [11] Shadi R. Masadeh, Shadi Aljawarneh, Nedal Turab, "A Comparison of Data Encryption Algorithm with the Proposed Algorithm: Wireless Security", Sixth International Conference on Networked Computing and Advanced Information Management (NCM), 2010