WiFi COVERAGE AND EXTENSION

Project on Expanding the Existing Wireless Network

Site: - Sharjah Seaport Security Camp

A project was taken on behalf, to extend the WiFi signal coverage from a small to a medium area for the benefit of the security personal to provide a WiFi signal to each and everybody.

Network Type :- SOHO (Small Office Home Office)

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With help from

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After arriving at Sharjah port I found out that the camp we are residing in Sharjah Port Authority (SPA) did not have internet facilities. But after some understanding the camp beside us also called the Lamprell camp had internet connection, and one can apply for the connection there. A brief description regarding the location and the details of the camp that I am living in, is given here under. The Room that I am residing is in No. 88. I found out that at Room No. 112 which happens to be one of my friends room did receive a fair Wi-Fi signal. My challenge was that, I needed that signal to travel up till my room No. 88. A point is to be noted that the signal being received in Room No. 112 was being transmitted from Lamprell Camp. The distance between the two buildings is roughly around 4 meters. Now the signal

Target Room No 88

Room No. 112 →

Corridor

Figure 1.1

received at Room No. 112, had to travel through the walls and finally to room No.88. It has to pass through a minimum of three walls and various obstacles like Television, Fridges etc. I have provided a rough Sketch with the exploded Eagle view diagram of the camp and the rooms (figure 1.1).

Therefore I started gathering information regarding the locations, the propagation of the Wi-Fi signals and how it would behave, in the present location. Below I am giving my results. Since the 802 * 11 x signals are sussecpted to a lot of interference and the capabilities of penetrating walls is also very low. Moreover the FAA has limited the transceivers (broadband routers) to limit their output power to no more than 500mWatt, which is the highest power the routers can use. Unfortunately the router used at Lamprell camp even did not had that much of power, it was around 200mWatt.

Then my next step was to measure the power that was being transmitted to room No. 112. The power of the signal in dBm. (figure 2.1). I used a android software as well as a PC software named (*i) Wi-Fi Scanner (ii) Network snooper*. As in the Sketch, I marked particular points where I will be measuring the power of the transceiver in dBm. A first hand survey revealed that the present signal in the room No. 112 was very weak to be retransmitted up till room No. 88. I was able to measure at around -70 to -80 dBm within the room 112. When I came out of Room No. 112, after a wall, there was a huge drop in the signal which I was able to measure around -90dBm to -94dBm. Therefore it was impractical for me to extend the existing signal to the other side of the room.

Figure 2.1
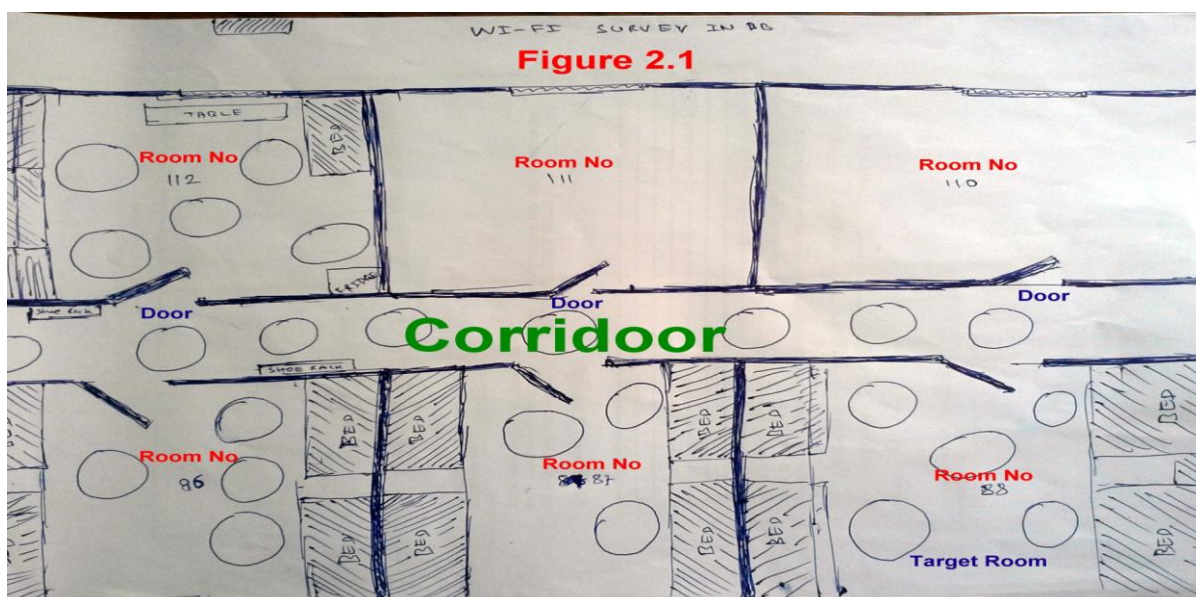
Then after some research in the Internet, I decided to install an external router outside Lamprell Camp. I was able to get a TP-Link outdoor router, with a good antenna. WA-510G (as shown in Diagram). It was suitable to be installed outside. Then only thing was that, I needed to install the router in the originating point of the signal, connected to the router which was in the camp of Lamprell. In doing so I would achieve the highest signal from the Lamprell camp, to our Sharjah Port Authority Camp. That was the only option for me to achieve a better signal from the source itself. The source signal is around 10Mbps. Then the access point that I had selected had a speed of 54Mbps which I thought would handle the speed of the source signal of around 10Mbps. Therefore I finalized my point and installed the router TL-WL510G outside (figure 4.1).
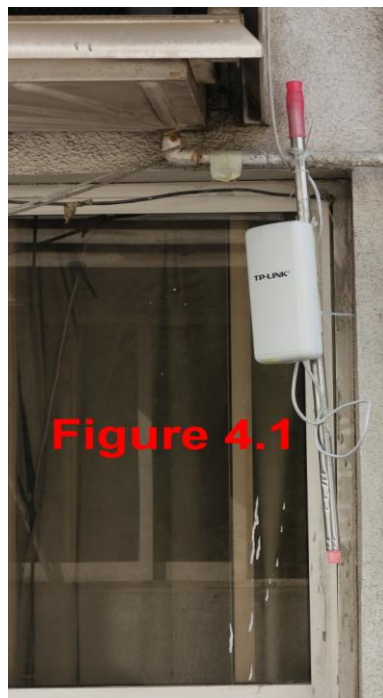

Figure 4.1

I wanted to see how the signal behaved while being propagated within our premises and how it would disperse within our rooms with the various orientation of the router. I first installed it Horizontally and took the measurements with both of the routers mentioned above, at various points. The results are in shown in the figure 5.1. Then I changed the orientation to Vertical polarization and the observation recorded. (Figure 5.2.)

Figure 5.1

Figure 5.2
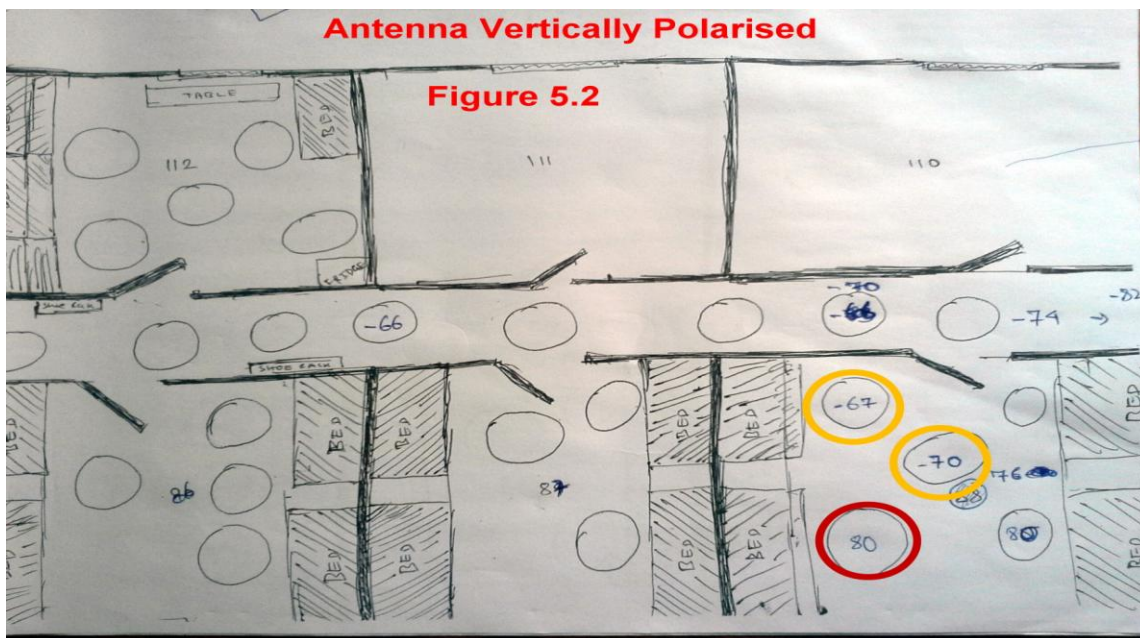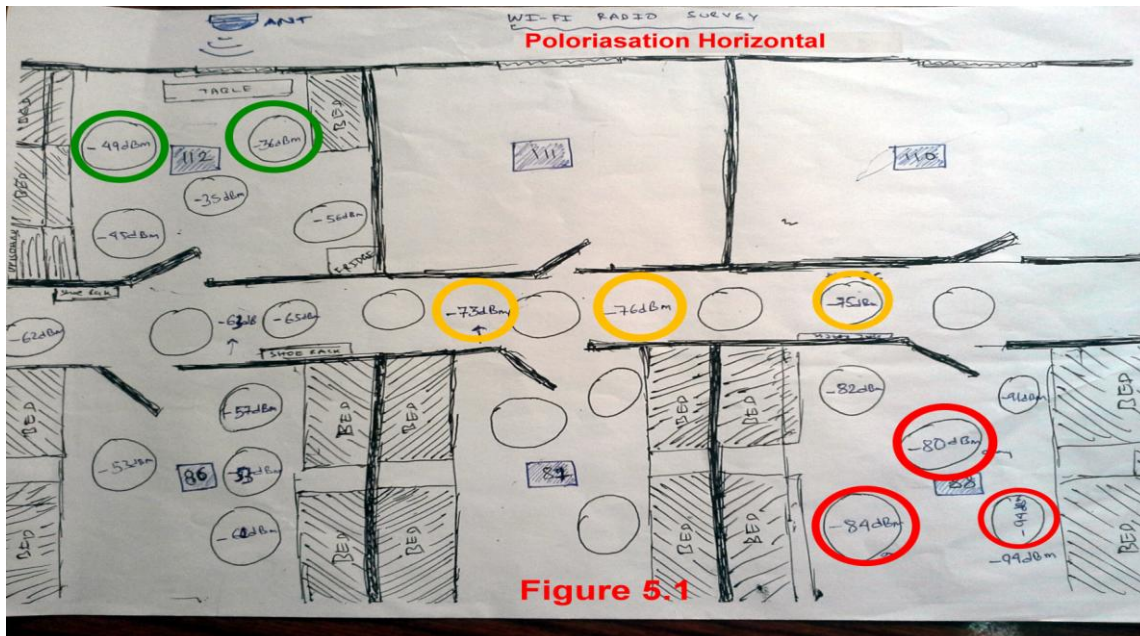
The results were pretty clear. The results clearly showed that the propagation of the Wi-Fi wave within our premises, if being transmitted vertically would help me manage to get a signal to the target location (Room No. 88). It was also observed that the signals were good in the corridor area and I was able to connect, and surf the internet while I was in the corridor area. But again inside Room No. 88 (target location) I was not able to receive a good signal, and it was getting difficult to connect to the source signal. But up till here, I had made a great success in bringing the signal near my door step in front of Room No. 88. I was back to my drawing broad brainstorming on my next step, which I had to take in order to achieve my goal of getting the signal to my room No. 88. Again researching on the internet and reading about extending wireless range of Wi-Fi, I decided of implementing a repeater near the fringe signal which I was receiving at the corridor near my room. This repeater would take the existing signal and boost it out till my room. But one drawback was that the signal would be reduced to 50%, while in the repeating process. But I thought since the source signal was 10Mbps, and my router was capable of delivering 54Mbps, it would pass all the 10Mbps to the rest of the repeater and my repeater would repeat to half the signal of around 5Mbps which would be sufficient to surf the internet from my room. This was my general calculation. After having a thought on this calculation I implemented the repeater (Shown in the figure). It is a mini repeater and has a 2dBi internal antenna. After some research I found out that such kind of repeaters are very useful while in the indoor and the configuration of the repeaters are very simple. But again a situation had aroused. The mini repeater had to be plugged in some kind of A/C outlet as it did not

had any wires running through it, and that had also created a situation as we did not any power outlet in the corridors. The solution was that I had to modify the mini repeater. In doing so I was able to achieve two objectives (I) The repeater could be installed anywhere within the corridor, and (ii) I could orient the mini repeater any way I could like, in order to receive the source signal properly. Therefore I started to modify

the router and was installed just near my door with two screws (figure 6.2). This was the final phase of implementation of the hardware. After finalizing configuration and commissioning of the network, time had come to test its reach. As I saw, the network bar in my Samsung tablet was full. I was very eager to get into the network and see its speed.

I was able to surf the internet, but I was seeing some lag in opening the pages. I did not want to jump into conclusion; therefore I wanted to test the network for a week.

Figure 6.2

A/C Wire running to Repeater

During my testing within the given period of time, I was able to find out various challenges that I had to tackle in future. Firstly it was observed that during the day and in the evening the speed were very slow, and even opening the normal web pages seemed very difficulty. Then at night time after 11pm, it seemed that the speed would be very steady and I could even see YouTube videos and call and chat in Skype and other voice applications. This situation being created was very surprising, and then I came to know that at times when traffic in the network was high i.e. when there were so many laptops and mobile
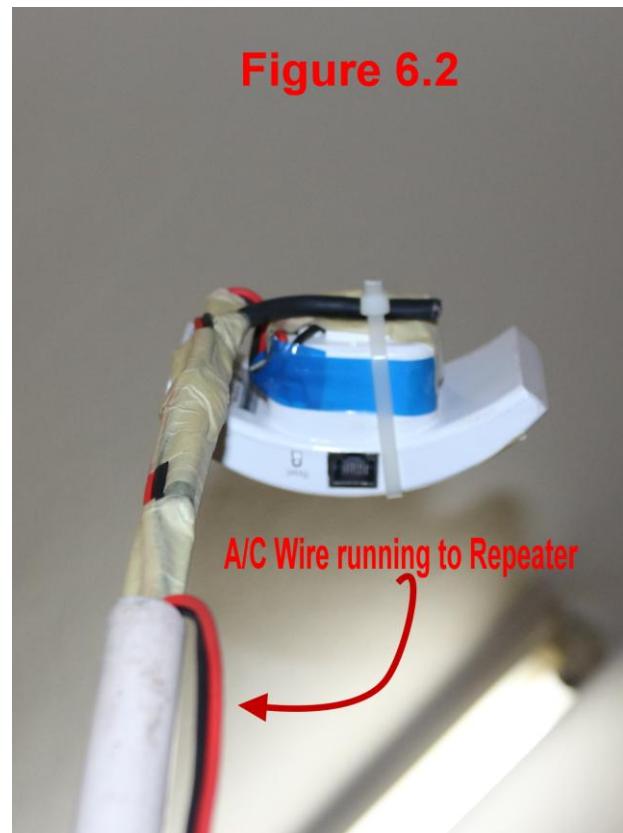
logged to the network, the router and the network would automatically slag and fall behind and this in turn would hamper the speed in the router operation. Moreover I also found out that the full speed at night time when there was no traffic was only around 2Mbps. And in the day and evening time it would come to around 350Kbps, which was very slow. But the point to point network between the device and the repeater was very good as I was getting full Wi-Fi bars. But still the connection speed within the tunnel was very slow. As an example. I had laid a large pipe, but the water flowing through the pipes were very slow (no pressure in the water).

I was back to my project board thinking and finding what I could do to improve the above situation. Again reading and going on through the Internet, I found out that specification of the router speed in general did not depict the original speed it produces. A 54Mbps router in real life scenario was only able to produce around 8-10Mbps of speed. That was the main situation in hand; the second situation was that, there was a lot of Laptops and mobile device connected to the network which would greatly reduce the remaining speed of the network. This are the two challenges that I need to tackle and the solution that I intend to take are as follow.

Firstly I would try to reinstall another router probably a high speed outdoor updated to 300Mbps, which I guess would do the job of handling the traffic. Secondly I would try to convince my friends to increase the source speed from 10Mbps to 20Mbps.
Now I am using the current network and in future I will definitely achieve a goal of reaching 5Mbps speed till my room No. 88. This is my goal at the present moment.

Therefore a plan was placed and various thought given. The plan was to as quoted before to place a central powerful router to the main source signal. I was at the beginning planning to put a 150Mbps TP link router, and was also ready to purchase the router, but I got feedbacks from my friend Rakesh, that I should buy a powerful router and that cost would not matter, I gave a thought and yes it was true, because as the router would be handling to more traffic, I needed to install a more powerful router. I then started researching in the Internet, finding out routers having more bandwidth and I stumbled upon a D-Link router (DAP-3310). After going through the specifications I was able to find out that it had all the necessary options that we wanted. The primary was the speed, which this router was able to handle 300Mbps speed. That was the primary concern and this router would handle very easily. Had a facility to be kept outside, and had an antenna gain of 10 dBm. It was a very good router and therefore I made up my mind to get and install in our network. The amount I had to invest in the router was around 500 Dhs, therefore I had to collect money from rest of the people who would use the router, and also explain them regarding the benefits. I was able to convince them and the money was collected. I ordered the product and when it came I also configured it and installed it to the existing access point.

As the access point was having the capabilities of transferring the whole bandwidth to the target clients, it did a good job. Side by side, we also had a call from etisalat regarding upgrading the bandwidth of our connection. Here also everyone agreed on increasing the bandwidth of the existing connection from 10Mbps to 20Mbps, therefore a good backbone was created for the network to be processed.

Now the situation at hand was that I had a good internet speed (20Mbps) line a good Access point (DAP – 3310), and a repeater. Now my job was to do everything at hand to take the signals to various rooms.

I started by installing the router to the main unit (Lamprell), through the router, (fig). A detailed technical description is given below, shown in the diagram.

Main router (Etilasat)
IP address   :- 192.168.1.1
SSID   : - DJ boyz
Channel No.   : - 6 (Six)
Password   : - TKP/WPA/WPA2 Auto
Wireless Mode   : -802 * 11b/g/n (Mixed)
DHCP   : - Enable

First Sector Antenna (T-P-Link WA510G)
IP Address   : - 192.168.1.2
SSID   : - First Sector Antenna
Channel No.   : - 1
Password   : - WEP (Tentative)
Wireless Mode   : - 802 * 11b
DHCP   : - Disabled

Third Sector Antenna (DAP-3310)
IP Address   : - 192.168.1.3
SSID   :- Third Sector Antenna
Mode   : - Access Point
Channel No.   : - 11

Mode   :- 802*11n (only)
DHCP   : - Disabled

<u>Repeater</u>
IP Address   : - 192.168.1.4
Mode   : - Repeater
Channel No.   : - 11
Password   :- WPA/WPA2

DAP - 3310 Commissioned

I am receiving a lot of challenges regarding the network, but I am determined to make this network work flawlessly. Whatever I had asked I have received also, the network now has a speed of 20Mbps and I also have a router of 300Mbps, now it is totally on me to have this network running smoothly. I am getting a lot of complains

regarding the connectivity and the network issues, therefore I am always looking for a better opportunity to make this network working with ease. I have noticed a couple of things which are very vital to take into consideration. Firstly I noticed that the main router of Etisalat is only capable of handling 16 stations, and now taking a thought this also might be the reason. Then when I am seeing the ARP table also I can hardly see any address allocation more than 17-18 devices. As registered with me there are around 50 devices, and for the network, it must be able to handle a minimum of 30 IP addressing ARP at a time. I must also look into the matter to have a DHCP addressing system that would be capable of handling the above situation. While on my research I found out that old routers can be modified and installed with *"ddwrt"* firmware, and this firmware can handle the above situation very well. Therefore I am also in a lookout for the application.

Second in line, a great idea has surfaced. Just it was a coincidence that one of the people also using our internet (from Lamprell) happened to meet me. It was because he wanted his password to be reinstalled in the smart phone. An idea struck me about his residence in which room he was located. He replied C-27. I was quick to reply him by requesting him to hang an external router just outside his window. He told me that it would be no issue with him; there I have a green light to put an external router outside window, i.e. outside the window on C-27. By doing so I am achieving various advantages in my network (i) the range between the secondary router (DAP 3310) and the repeater (HooToo) will considerable shrink down, and with this the repeater would be able to receive the signal of "DAP 3310" with ease. (ii) There would be a space created in the old place where DAP 3310 was installed, so that I can install TL-WG510G Access point in its place. (iii) Since the router will be placed considerably near Room No. 88, the signal received in that room will also be considerably good.

Therefore this is the latest plan and will be implemented as soon as the cable will be available.

The cable was bought and the length of the cable was calculated to around 30m. I bought the cable and I did the necessary installation as shown in the diagram. I configured the routers and Access points as described and the network was commissioned. Now the networks is under test and let's see how it would work when the load to the network would increase. The final diagram is shown with the pictures given here under.

Main Router
192.168.1.1

INTERNET

Power Over Ethernet
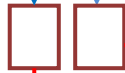
First Sector Antenna
192.168.1.2

Third Sector Antenna
192.168.1.3

Repeater

192.168.1.4

Now as the network is already running and the users are online, there will be various up-gradations during the process, and will be dealt accordingly. Firstly a Network Switch will be replacing the router Lan Cables as, the main router also has to do the switching between the routers. Secondly a plan has also been made in future, a new router will be in place of the old main router, as the load to the main router is very crucial to the network. This are the future plans and as said before will be dealt as the progress and the funding will be available.

Finally I would like to thank the reader, and once again to all of my friends and Security personal supporting me for making me complete this project. Hopefully in future we will definitely be able to make this network a strong and a robust technology for all of our Sharjah Port Security Personal's.