PERFORMANCE ANALYSIS OF THE RSS VALUE FOR THE VIDEO TRANSMISSION USING WIFI NETWORK

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Abstract— **Wifi coverage is frequently be an issues in any household with internet services subscriber. As to ensure user gain mobility when using the internet services, Wifi is consider as the best medium to be used in most premises be it in small houses like apartments until the spacious office floor area. In this paper, the studies continue to investigate the quality of Wifi coverage in average double story houses and how the Receive Signal Strength (RSS) value affects the performance of the services. From the study, we able to identify maximum acceptable RSS value from every type of respective bandwidth in DSSS and OFDM modulation.**

Keywords—Wifi; Coverage; houses; Receive Signal Strength.

I. INTRODUCTION (*HEADING 1*)

Recently, according to statistic the numbers of internet users is reaching nearly to 3,424,971,237 (estimated as of June 2016) users which translate to 46.1% of human population worldwide [1]. In definition, the internet users are describing as individual who can access the Internet at home, via any device type and connection [1]. The global mobile data traffic has been increased tremendously. According to Cisco Visual Networking Index, mobile data traffic will grow at a CAGR (Compound Annual Growth Rate) of 66 percent from 2012 to 2017, reaching 11.2 Exabyte per month by 2017, and overall mobile data traffic will increase 13-fold between 2012 and 2017 [6]. The medium of accessibility to internet at home is typically via Wifi which the signal is broadcasted by modem/router with embedded Wifi functionality. Usually the internet services provider will provide basic functionality of Wifi modem/router as bundled devices upon subscribing onto its services. Throughout the services offering, the services provider facing various types of complaints lodges by their customer on the internet services especially on Wifi signal and coverage. As Wifi signal and coverage are fully dependent on devices edge in the premises, service provider unable to classify actual root of problems lodged by the customer which mostly complain on poor services experience. The unpleasant facts on poor services experience are from the poor Wifi signal and coverage to reach at some point of angle in house area. The typical devices literally propagating the signal out from the antenna in omni-directional forms however a house is built with wall, isolated rooms and multiple floors. The wifi signal may be blocked by thick wall or unable to reach some floors due to some limitation of distance the signal can traverse [5]. The popular solutions available in the market nowadays are to upgrade the devices edge with higher quality or performance. There is multiples list of devices types and brands in the market which proclaimed their devices as a sole solution to the problems but nevertheless most of the solution is leaning on increasing the signal power to ensure the Wifi signal can traverse farther. In layman perspective the solution is consider as a good option but technically is it an optimum solution?

II. WIFI NETWORK INFRASTRUCTURE

1) Wifi Network Infrastructure

WiFi is a technology that uses radio waves to provide network connectivity. A WiFi connection is established using a wireless adapter to create hotspots - areas in the vicinity of a wireless router that are connected to the network and allow users to access internet services. Once configured, WiFi provides wireless connectivity to your devices by emitting frequencies between 2.4GHz - 5GHz, based on the amount of data on the network [2]. Wifi is usually enabled in internet modem/router installed in customer premises. The modem/router will perform Point to Point over Ethernet (PPOE) dialing to get authenticated and provisioned (there are many other ways to provision internet service besides using PPOE method). After authenticated, the provisioned line will be assign with Public IP and Network Address Translation (NAT) into Public Network. To enable Wifi in modem/router, user shall create Service Set Identifier (SSID) for assigning wifi radio, allocate IP range for end users and enable NAT-ing functions.

2) Factors that Affect Wifi Quality

These are the commons factors that affect the quality of Wifi [3].

- Distance from the Access Point - The further away you get from an AP, the more the signal strength drops.
- Physical obstacles - Unfortunately 2.4 GHz is not great for penetrating solids. This has both bad and good effects. In a building sub-divided into rooms you can cover only a fairly small number of rooms with a single AP – meaning you need more APs to cover, for instance, an entire school. On the plus side, the walls help form boundaries to allow APs on the same channel to co-exist in relative proximity to each other without interference.
- Interference from other Wireless LANs - This is becomingly increasingly common in built-up city areas. In major cities it's not uncommon to be able to see in excess of twenty Wireless LANs from a single spot. It pays in designing and running your network to understand other businesses around you and work with them to avoid interference, to mutual benefit.
- Non-WLAN interference / noise - Interference at 2.4 GHz is common, either from transient background sources or by other technologies which share unlicensed band – Bluetooth, some cordless phones etc. Even to such things as faulty microwave ovens.

However, the accuracy of present WiFi-based localization approaches is not satisfactory especially those based on received signal strength (RSS) because it is detrimentally affected by multi-path effects including reflection, refraction, and diffraction, especially in non-line-of-sight (NLOS) conditions when the received signal contains no direct line-of-sight (LOS) component [4].

III. METHODOLOGY

In this study, the Wifi simulation environment will be developed in NS3 using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency Division Multiplexing (OFDM) modulation scheme.

The simulation will be carried using Network Simulator NS3 using Wifi Module.

There are two nodes with each of them represents user devices and access point respectively

The data is simulated by using Evalvid video module. In this module, the Evalvid server which hosts the video application will be configured at Access Points as in figure below. The Evalvid client will configured at user devices terminal to initiate the video application request

Figure 1

1) DSSS and OFDM Values

To simulate DSSS modulation for the following value

DSSS	OFDM	
DSSS 1MBPS	OFDM 6MBPS	OFDM 24MBPS
DSSS 2MBPS	OFDM 9MBPS	OFDM 36MBPS
DSSS 5.5MBPS	OFDM 12MBPS	OFDM 48MBPS
DSSS 11MBPS	OFDM 18MBPS	OFDM 54MBPS

2) Receive Signal Strength (RSS)

Each value will be simulated using list of RSS value and certain parameter will be captured upon the simulation. The RSS value start with -50dbm until maximum RSS value that allowed video packet to transverse. The RSS value is to translate the situation as in figure below.

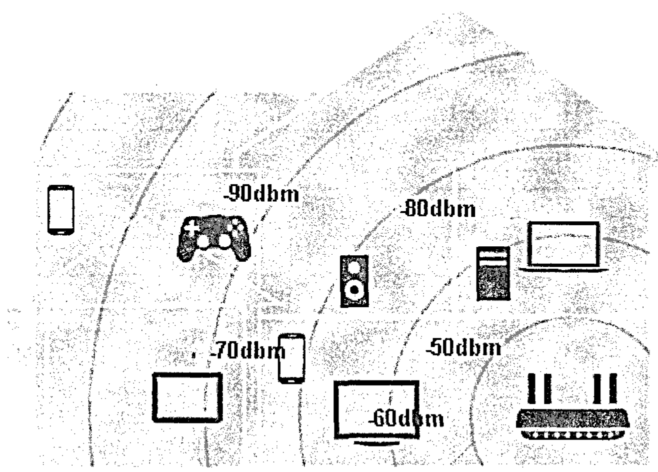

Figure 2

3) Tools

- The RSS value was depicted from inSSIDer. It is a free software used to measure the RSS value at specific location
- NS 3 Simulator (for wifi environment)
- Laptop
- Wifi (to get RSS value from actual environment)

4) Equations

The equation used for calculating signal strength on Wi-Fi devices,

Initial step is to measure the power of the signal received by the antenna in dBm.

$$P=E^2_{RMS}/R$$

$$L_{dBm}=10\log_{10}(P/0.001W)$$

Conversion from path-loss to an RSS is derived as:

RSS (d) = P − PL d (2)

Where RSS (d) is the received signal strength at the distance of d and P_t is the transmitted power in dBm[5].

However the value of RSS was directly retrieved from inSSIDer within range -50dbm until -95dbm

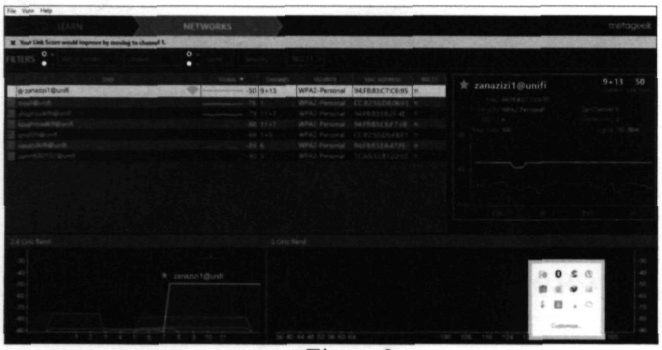

Figure 3

IV. RESULT

From the simulation, the result varies in term of duration of video (complete sent and received packet), delay and RSS value. From the result pattern, DSSS and OFDM bandwidth value is inversely proportional with RSS value.

1) *DSSS 1Mbps*

DSSS 1Mbps	Timestamp			
RSS	Last Packet Sent	Last Packet Received	Packet ID	Delay
50	67.5382	67.5587	2106	19.0ns
60	67.5382	67.5587	2106	19.0ns
70	67.5382	67.5587	2106	19.0ns
80	67.5382	67.5587	2106	19.0ns
90	67.5382	67.5587	2106	19.0ns
92	67.5382	67.5587	2106	19.0ns
94	67.5382	67.5587	2106	19.0ns
95	67.5382	67.5589	2106	19.0ns
96	X	X		

Table 1

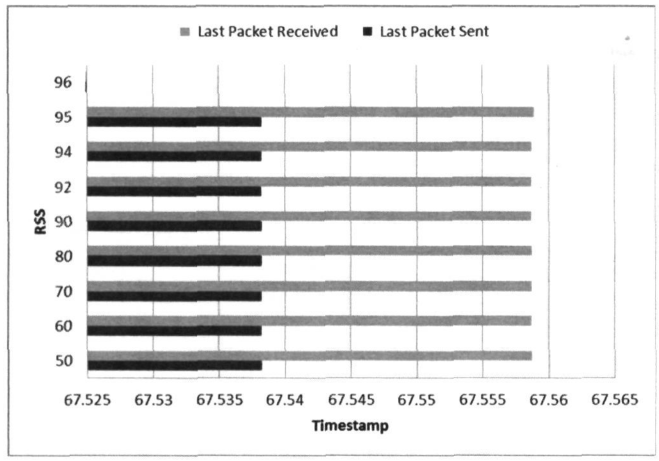

Figure 4

The result shows that maximum permitted RSS value for video is -95dbm. The transmission rate from RSS -50dbm to -94dbm runs constantly. At -95dbm value the jitter value increased and at -96dbm the transmission is truncated.

2) *DSSS 2Mbps*

DSSS 2Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.537	67.5491	2106	11.0ns
60	67.537	67.5491	2106	11.0ns
70	67.537	67.5491	2106	11.0ns
80	67.537	67.5491	2106	11.0ns
90	67.537	67.5492	2106	11.0ns
92	67.537	67.5502	2106	12.0ns
94	67.5388	67.5949	2106	61.0ns
95	67.5402	X		

Table 2

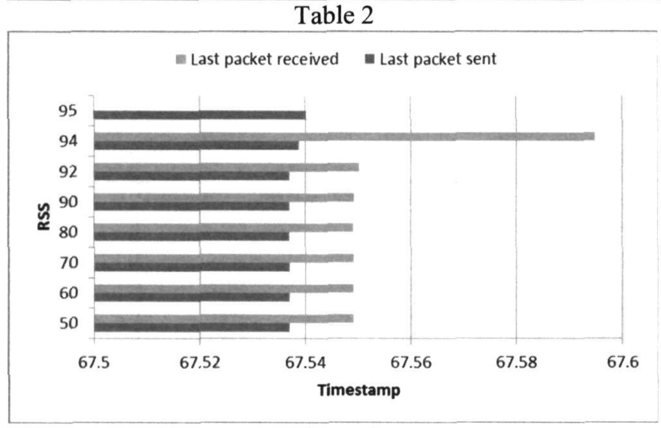

Figure 5

The result shows that maximum permitted RSS value for video is -94dbm for DSSS 2Mbps. As shown in the graph above, RSS value of -95dbm only permit send packet from the server to pass through but unable to reach the receiver. It shows major packet loss occurred at this RSS value.

3) *DSSS 5.5Mbps*

DSSS 5.5Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5363	67.5429	2106	6.0ns
60	67.5363	67.5429	2106	6.0ns
70	67.5363	67.5429	2106	6.0ns
80	67.5363	67.5429	2106	6.0ns
90	67.538	67.5459	2106	7.0ns
92	67.5392	X		
94	X	X		

Table 3

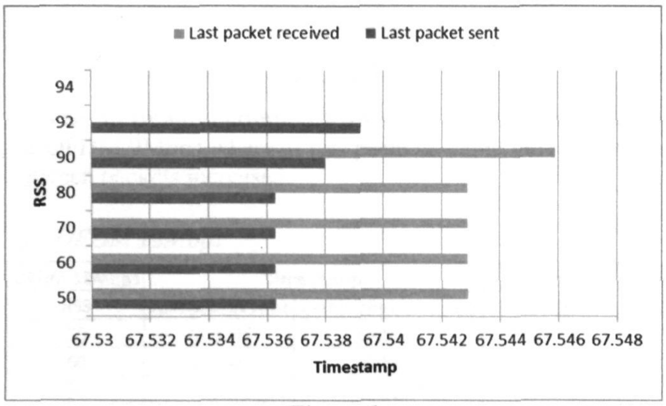

Figure 6

Maximum permitted RSS value for video is -90dbm for DSSS 5.5Mbps. As shown in the graph above, RSS value of -92dbm only permit send packet from the server to pass through but unable to reach the receiver.

4) *DSSS 11Mbps*

DSSS 11Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5362	67.5416	2106	5.0ns
60	67.5362	67.5416	2106	5.0ns
70	67.5362	67.5416	2106	5.0ns
80	67.5362	67.5416	2106	5.0ns
88	67.5377	67.5496	2106	21.0ns
89	67.5389			
90	X	X		

Table 4

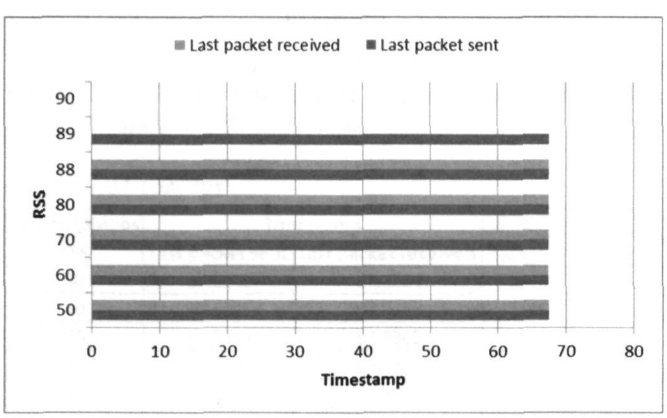

Figure7

Maximum permitted RSS value for video is -88dbm for DSSS 11Mbps. The jitter value increased at RSS value -88dbm. As shown in every graph, every increment of bandwidth of DSSS from 1Mbps to 2Mbps to 5.5Mbps to 11Mbps will reduce the signal strength value to approximately -2dBm.

5) *OFDM 6Mbps*

OFDM 6Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5348	67.5386	2106	3.0ns
60	67.5348	67.5386	2106	3.0ns
70	67.5348	67.5386	2106	3.0ns
80	67.5348	67.5386	2106	3.0ns
90	67.5348	67.5386	2106	3.0ns
91	67.5352	67.5763	2106	23.0ns
92	X	X		

Table 5

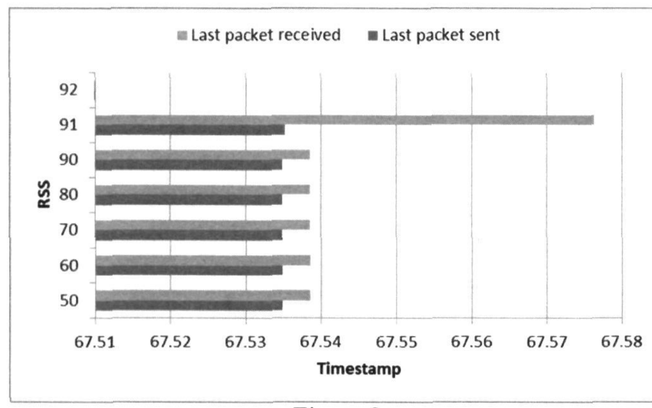

Figure 8

The maximum permitted RSS value for video is -91dbm for OFDM 6Mbps. Jitter value increased ar RSS value -91dbm.

6) *OFDM 9Mbps*

OFDM 9Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5347	67.5375	2106	2.0ns
60	67.5347	67.5375	2106	2.0ns
70	67.5347	67.5386	2106	2.0ns
80	67.5347	67.5386	2106	2.0ns
88	67.5351	67.5396	2106	8.0ns
89	X	X		

Table 6

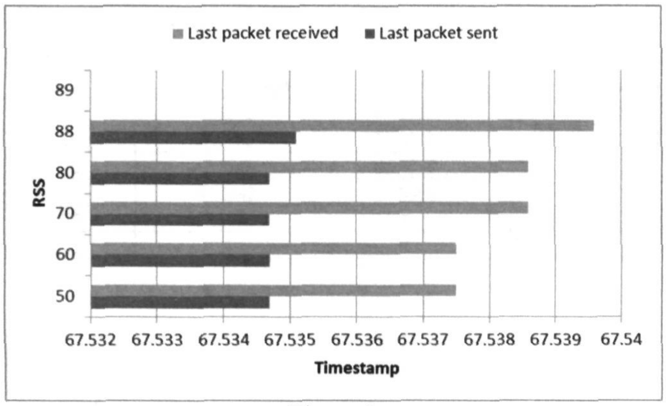

Figure 9

The maximum permitted RSS value for video is -88dbm for OFDM 9Mbps where at this point of value the jitter value between packets increased.

7) OFDM 12Mbps

OFDM 12Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5346	67.5369	2106	2.0ns
60	67.5346	67.5369	2106	2.0ns
70	67.5346	67.5369	2106	2.0ns
80	67.5346	67.5369	2106	2.0ns
88	67.535	67.5887	2106	20.0ns
89	X	X		

Table 7

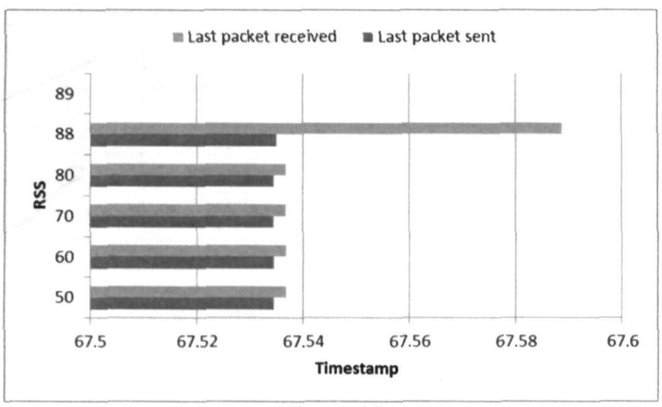

Figure 10

The maximum permitted RSS value for video is -88dbm for OFDM 12Mbps with a spike of jitter value increment as compared against OFDM 9 Mbps.

8) OFDM 18Mbps

OFDM 18Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5345	67.5364	2106	1.0ns
60	67.5345	67.5369	2106	1.0ns
70	67.5345	67.5369	2106	1.0ns
80	67.5345	67.5369	2106	1.0ns
85	67.5349	67.5442	2106	6.0ns
86	X	X		

Table 8

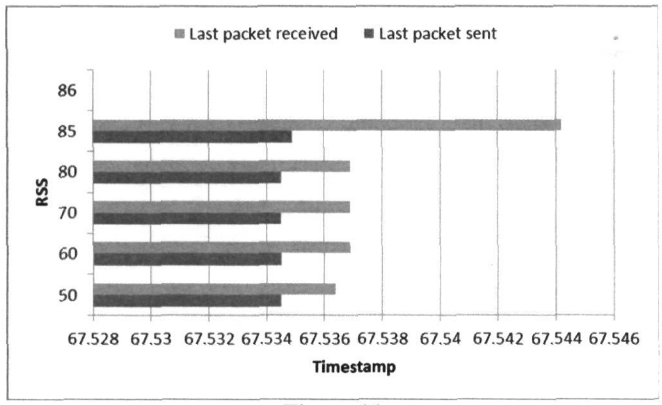

Figure 11

The maximum permitted RSS value for video is -85dbm for OFDM 18Mbps and caused bit delay in sending last packet from server host and the last packet to reach at receiver client with higher jitter value.

9) OFDM 24Mbps

OFDM 24Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5345	67.5361	2106	1.0ns
60	67.5345	67.5361	2106	1.0ns
70	67.5345	67.5361	2106	1.0ns
80	67.5345	67.5361	2106	1.0ns
81	67.5349	67.5368	2106	2.0ns
82	67.5353	66.3114	2066	45.0ns
83	X	X		

Table 9

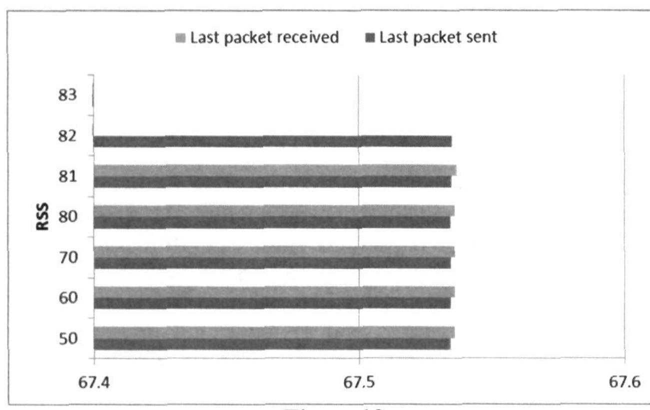

Figure 12

The maximum permitted RSS value for video is -82dbm for OFDM 24Mbps. At this RSS value, there are several packet lost since Packet ID 2106 was lost from receiver end.

10) OFDM 36Mbps

OFDM 36Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5345	67.5358	2106	1.0ns
60	67.5345	67.5358	2106	1.0ns
70	67.5345	67.5358	2106	1.0ns
78	67.5348	67.5368	2106	2.0ns
79	67.5351	X		
80	X	X		

Table 10

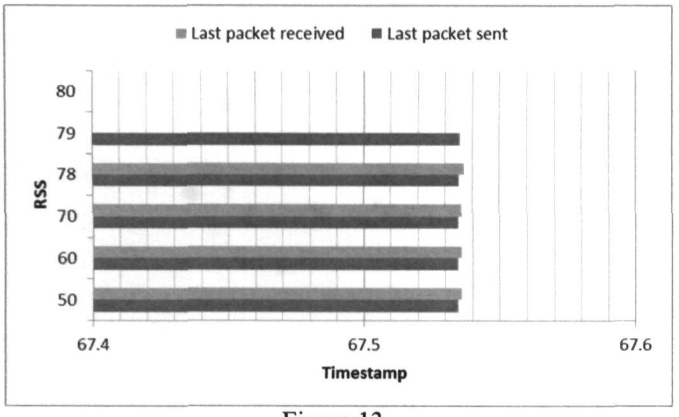

Figure 13

The maximum permitted RSS value for video is -78dbm for OFDM 36Mbps. The packets experience higher jitter value at this RSS value.

11) OFDM 48Mbps

OFDM 48Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5344	67.5357	2106	1.0ns
60	67.5344	67.5357	2106	1.0ns
70	67.5344	67.5357	2106	1.0ns
74	67.5351	67.5756	2104	27.0ns
75	X	X		

Table 11

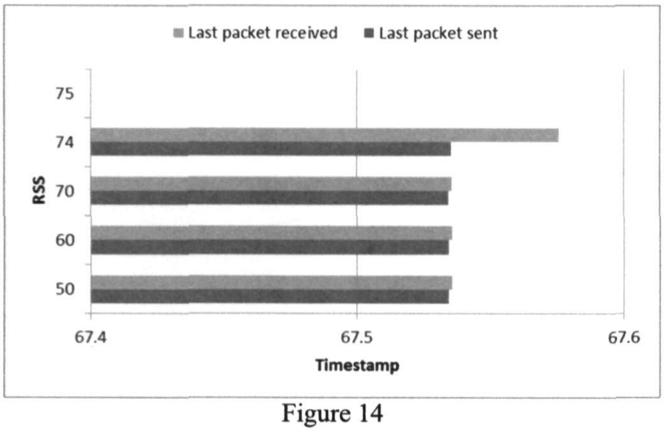

Figure 14

The maximum permitted RSS value for video is -74dbm for OFDM 48Mbps. Jitter is high at this stage and several packets were lost during the transmission.

12) OFDM 54Mbps

OFDM 54Mbps	Timestamp			
RSS	Last packet sent	Last packet received	Packet ID	Delay
50	67.5344	67.5356	2106	1.0ns
60	67.5344	67.5356	2106	1.0ns
70	67.5344	67.5354	2106	1.0ns
72	67.5348	67.5363	2106	1.0ns
73	67.535	X		

Table 12

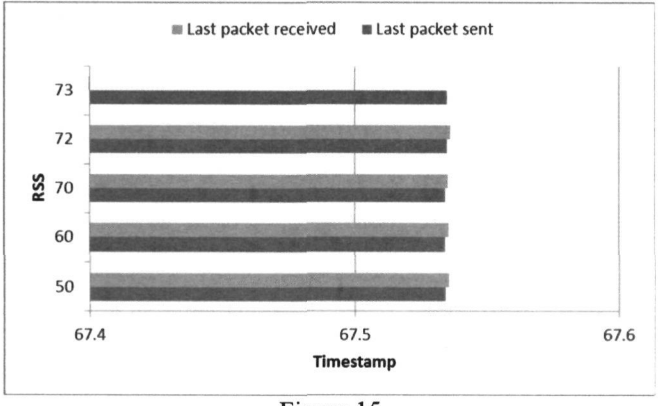

Figure 15

The maximum permitted RSS value for video is -72dbm for OFDM 54Mbps.

CONCLUSION

The increase of RSS value can disrupt the transmission of video packet which can cause jitter and duration of packet to increase and affect the quality of video. The RSS value is simply increase by the factors mentioned earlier which can lead to unpleasant service experience to the users and cause ambiguous complaints.

FUTURE WORK

From the study, it can be concluded that the RSS value shall affect the performance of data/packet transmission through the Wifi. The study shall open up the possibilities of introducing new method to install Wifi in certain area like multiple story of house or office by deploying mesh network using built in house power line circuit. With this method, more area can be covered; optimum value of RSS can be maintained throughout the area and leveraging on current electric circuit for better cost efficiencies.

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