 ISBN: 978-81-927230-0-9

Comparative Analysis of TCP & UDP Bandwidth for Performance Measurement of Wi-Fi Network in Android Smartphone

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Abstract- The wireless technology that has come to be vital for modern existence. This technology has been allowed for transferring data efficiently over long distances .it is ever developing field, the devices can be developed to support communication with higher data rate and security. The increasing number of wireless devices and slow Internet connectivity which causes the poor Wi-Fi performance. The main reason of such performance degradation includes the channel allocation. In this paper the performance analysis of channel allocation of TCP and UDP protocol are taken into account .Here the IPERF, a software tool that diagnoses the root causes of poor performance of Wi-Fi. We analyze the result of different size of data and number of request for TCP and UDP protocol.

Keywords: Wi-Fi, Android Smartphone's, TCP, UDP Protocol

I. INTRODUCTION

Today wireless technologies are applied in various applications throughout the world. It is common for home appliances to put together in home networks with private wireless router ie access point .so it supports multiple wireless devices.[8] The increasing number of wireless networks which causes the unsatisfactory Wi-Fi performance. Non Wi-Fi devices operates on the same 2.4GHz spectrum. It uses either frequency hopping or direct sequence because of relatively low data rate as compared to Ethernet. In 1999, IEEE published two additional 802.11 standards : 802.11a and 802.11b. The 802.11 operates the physical layer in the 5 MHz radio spectrum with data rate up to 54Mb/s. It covers 50.20 meter range and higher range physical layer as compared to 802.11b.[8,9,13] It has less radio frequency interference with other type of devices. However 802.11 are not compatible with 802.11b and 802.11g as with the initial standards 802.11b operates in the 2.4Ghz radio spectrum but it includes 5.5 and 11Mb/s data rates with the range 30m, but it produces more frequency interference. The 802.11 extends the data rate in 2.4 GHz radio frequency band to 50Mbp/s using orthogonal frequency division Multiplexing. It is the combination of 802.11a and IEE 802.11b [15]. It is appeared offering greater performance on the basis of speed and range.

Another improved standard called 802.11n has yet to be finalized. It has an additional features of MIMO (Multiple inputs and Multiple outputs)[10][It specifies an operation in the 2.4Ghz radio spectrum with an data rate 54Mbps to 600Mbps.The properly working of routers are frequently misidentified. The root causes of poor Wi-Fi network performance is nontrivial because they shows very similar symptoms for the user level and special devices are used to investigate the lower layers of protocol stack.[11,12] We introduce IPERF{(Internet Performance) a software tool that diagnoses the root causes of poor performance of Wi-Fi network[13,14]

II. FACTORS OF PERFORMANCE DEGRADATION

- **Wi-Fi Channel Bandwidth**: Channel sharing by multiple Wi-Fi Devices that Compete to transmit data through an access point. It gives the Interference due to nearby access point that are using the same channel bandwidth[13]
- **Attenuation of Signal**: when the signal is not strong enough due to distance or packets can be corrupted or lost[13]
- **Interference of Wi-Fi**: non Wi-Fi devices using the same spectrum 2.4 GHz as the standard 80211b/g network[13]

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III. EXPERIMENTAL WORK

There many tools available for performance measurement of Wi-Fi network such as Wi-Fi analyzer wireshark, Acrylic Wi-Fi (Windows), AirGrab Wi-Fi Radar (Mac OS X), Cain & Abel (Windows), Homedale (Windows), LizardSystems Wi-Fi Scanner, WirelessNetView , Wireless Diagnostics (Mac OS X Lion and later), SL Speed Test, Wi-Fi Network Analyzer, Wi-Fi Spectrum Analyzer, Wireless Manager and even Wi-Fi Hotspots, InSSIDer, Xirrus Wi-Fi Inspector, Connectify, WeFi, Hotspot Shield,Plug and browse.

These tools can be installed on different operating systems depending on their compatibility. It can run on Windows, Mac OS,Linux,Android [1,2,3,4,5]. The tools which runs on android smartphones are Speedtest.net, 3G 4G WiFi Map & Speedtest, Wifi Analyzer, Network Signal Info, WiFi Expert, WiFi Manager, WiFi Connection Manager [3]. Amongst these tools,iperf tool has been selected for experimental work as this tool runs on the operating systems like windows, linux, Mac OS , Linux, reeBSD, OpenBSD, NetBSD, VxWorks, Solaris [6].

IV. IPERF TOOL

iPerf is used for TCP performance tuning and it also measures throughput ,bandwidth and jitter ,data loss in case of UDP tests. There are two components of iperf tool server and client. It is an open source command line tool.[7]

V. SETUP

The parameters for the experiment are no. of requests and size of data. There are three cases in which the experiment was carried out viz. unidirectional, bidirectional (sequential and parallel). The device used for this experiment was Android 6.1 (marshmallow) smart phone.

Following are the different commands used for the experiment of TCP and UDP bandwidth measurements:

a) To send data of different size in one direction:
perf –c 192.168.43.144 -u –n 10
b) To send more no. of requests in one direction:
perf –c 192.168.43.144 –u-r 10
c) To send data from both directions sequentially:
perf –c 192.168.43.144 –u –d –n 10
d) To send data from both directions parallel:
perf –c 192.168.43.144 –u -p -n 10
e) To send no. of requests from both directions sequentially:
perf –c 192.168.43.144 –u –d –r 10
f) To send no. of requests from both directions parallel:
perf –c 192.168.43.144 –u –p –r 10

VI. RESULTS AND INTERPRETATION

Case I-a) Unidirectional-Changing the size of data

Size of data (in KB)	TCP		UDP	
	Client	Server	Client	Server
10	0.38	35.05	1.02	16.0
100	1.03	70.2	1.4	18.7
1000	1.19	121.5	12.5	20.7
10000	0.782	158.2	69.8	69

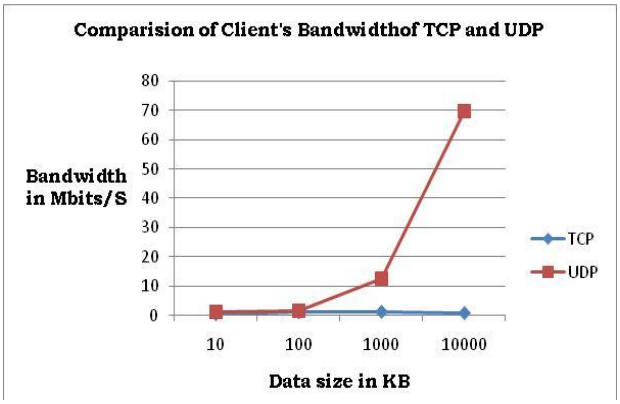

Fig.1: Comparison of client's bandwidth in TCP & UDP unidirectional w.r.t. size of data

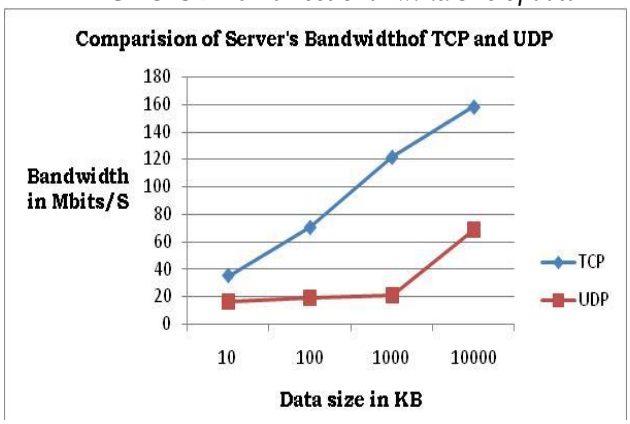

Fig.2: Comparison of Server bandwidth in TCP & UDP unidirectional w.r.t. size of data

Interpretation: From the graphs above it is observed that with increase in data size TCP protocol gives better performance compared to UDP for client device TCP. In case of client device TCP requires almost same bandwidth whereas in server device both protocol it requires more bandwidth with change in size of data.

Case I-b) Unidirectional-Changing the number of requests

No. of Requests	TCP		UDP	
	Client	Server	Client	Server
10	32.5	31.3	1.06	1.06

20	40.5	32.5	13.7	1.05
40	51.0	33.5	16.9	1.05
80	52.5	34.0	19.2	1.05
100	52.9	35.9	21.2	1.05
120	61.5	35.9	27.4	0.82

[

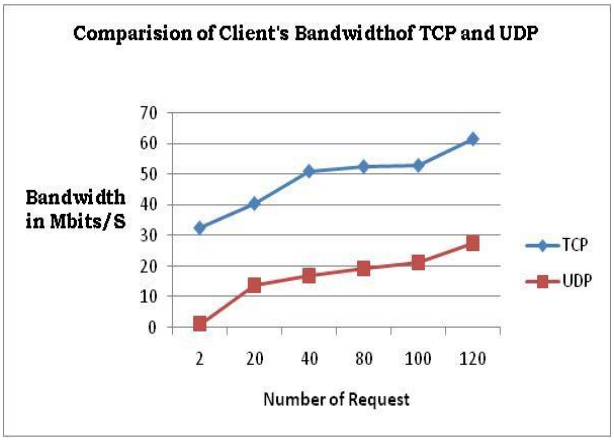

Fig.3: Comparison of client's bandwidth in TCP & UDP unidirectional w.r.t. no. of requests

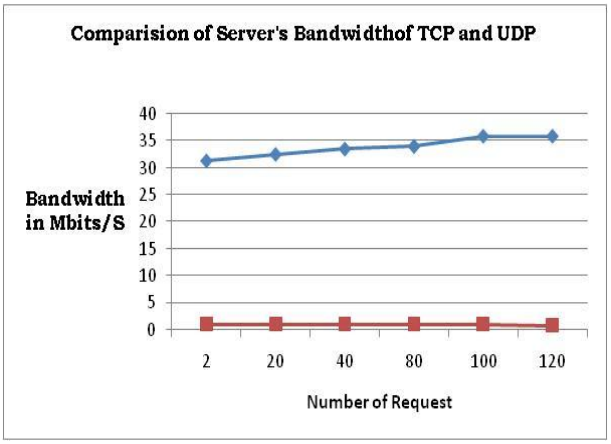

Fig.4: Comparison of Server 's bandwidth in TCP & UDP unidirectional w.r.t. no. of requests

Interpretation: From the graphs above it is observed that with increase in number of request both the protocol requires more bandwidth in client device whereas in server side both protocol it requires same bandwidth with change in number of request

Case II-a) Bidirectional (Sequential) -Changing the size of data

Size of data (in KB)	TCP		UDP	
	Client	Server	Client	Server
10	1.61	9.65	1.02	2.50
100	1.61	11.695	0.932	10.03
1000	1.19	17.85	0.936	16.08
10000	1.81	20.8	0.87	18.6

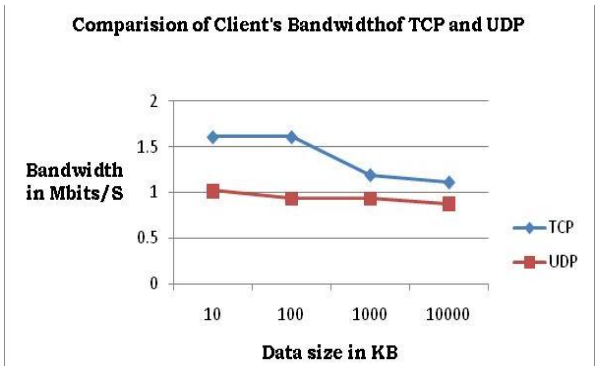

Fig.5 Comparison of client's bandwidth in TCP & UDP bidirectional (sequential) w.r.t. size of data

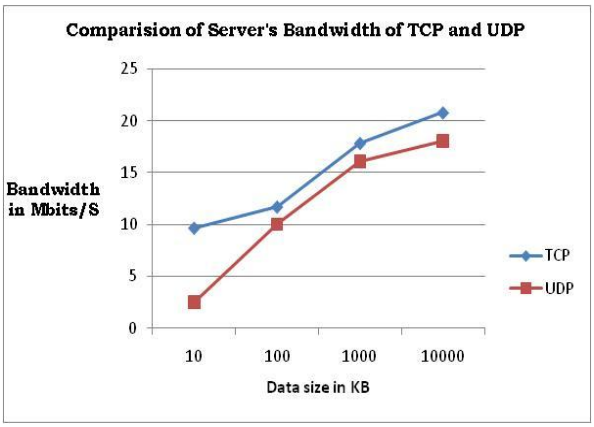

Fig.6: Comparison of Server bandwidth in TCP & UDP bidirectional (sequential) w.r.t. size of data

Interpretation: From the graphs above it is observed that with increase in data size in bidirectional (sequential) both protocol requires almost same bandwidth in the client's device whereas in server device both protocol it requires more bandwidth with change in size of data

Case II-b) Bidirectional (Sequential)-Changing the number of requests

No. of Requests	TCP		UDP	
	Client	Server	Client	Server
2	29.6	28.8	1.05	1.05
20	38.3	29.7	1.05	1.05
40	46.6	30.4	1.05	1.05
80	51.6	34.8	1.05	1.05
100	53.2	35.8	1.05	1.05
120	55.4	38.2	1.05	1.05

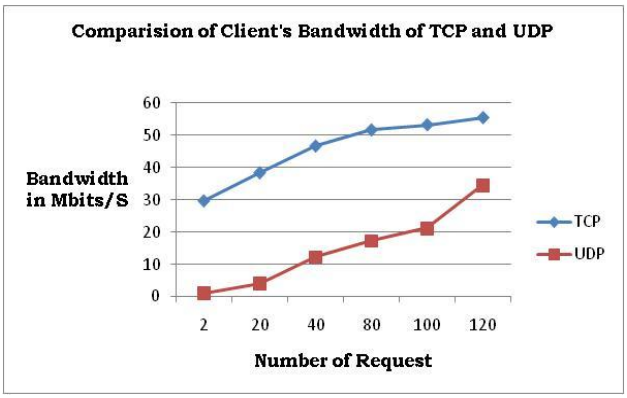

Fig.7 Comparison of client's bandwidth in TCP & UDP bidirectional (sequential) w.r.t..no. of request

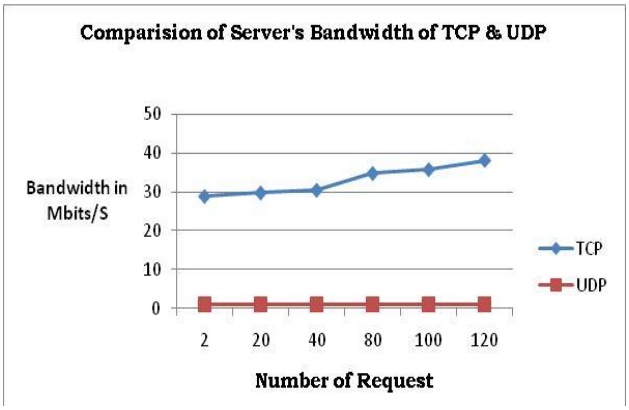

Fig.8: Comparison of Server bandwidth in TCP & UDP bidirectional (sequential) w.r.t. no. of request

Interpretation:

From the graphs above it is observed that with increase in number of request in bidirectional (sequential) both the protocol requires more bandwidth in clients' device whereas in server side both protocol it requires same bandwidth with change in number of request

Case III-a) Bidirectional (Parallel) -Changing the size of data

Size of data (in KB)	TCP		UDP	
	Client	Server	Client	Server
10	1.40	18.2	3.43	5.61
100	1.29	16.2	3.43	5.62
1000	1.54	16.3	3.46	5.68
10000	1.95	17.85	3.77	5.92

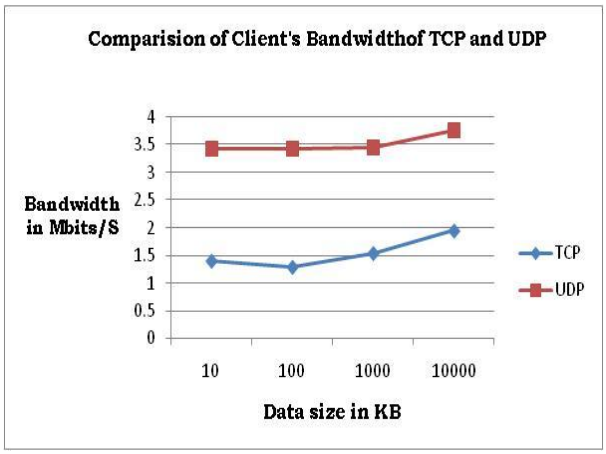

Fig.9 Comparison of client's bandwidth in TCP & UDP bidirectional (Parallel) w.r.t.. size of data

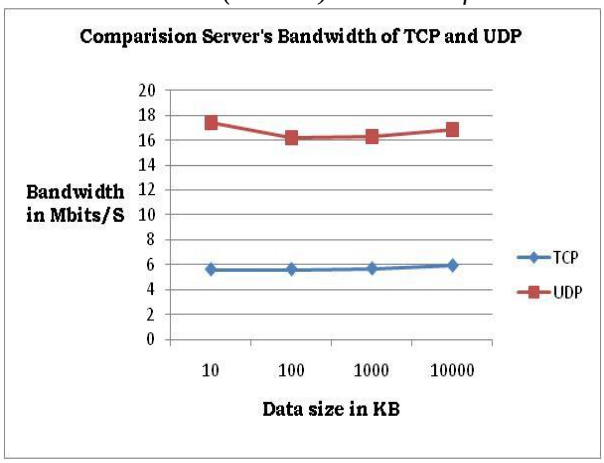

Fig.10 Comparison of Server bandwidth in TCP & UDP bidirectional (Parallel) w.r.t. size of data

Interpretation:

From the graphs above it is observed that with increase in data size in bidirectional (Parallel) both protocol requires almost same bandwidth in the client's device as well as server device with change in size of data

Case III-b) Bidirectional (Parallel)-Changing the number of requests

No. of Requests	TCP		UDP	
	Client	Server	Client	Server
10	20.8	16.2	2.03	18.2
20	37.0	15.2	6.08	15.2
40	41.7	14.3	12.06	16.3
80	44.5	12.85	21.03	15.85
100	43.7	16.2	27.09	17.2
120	56.7	16.2	34.06	16.2

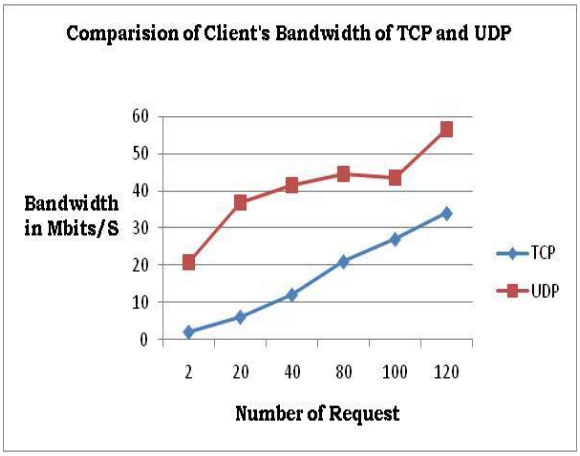

Fig.11 Comparison of client's bandwidth in TCP & UDP bidirectional (Parallell) w.r.t.. no. of request

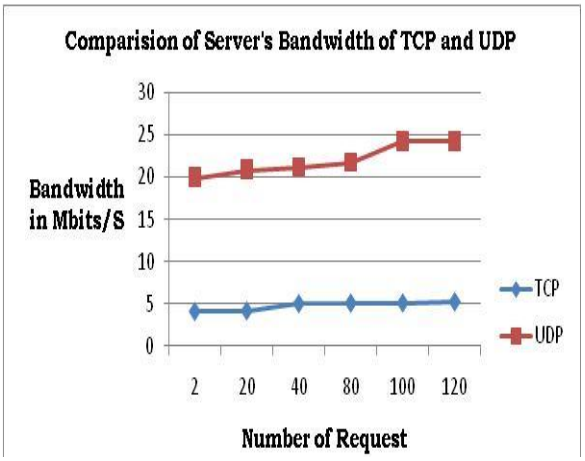

Fig.12 Comparison of Server bandwidth in TCP & UDP bidirectional (Parallel) w.r.t. no. of request

VII. CONCLUSION

From the experimental results, it is concluded that when only client device is sending data to server and data is transferred from client to server &Server to client sequentially with respect to data size. TCP protocol requires more bandwidth than UDP But when data is transferred from client to server and back to client parallel with respect to data size UDP requires more bandwidth.

When only client device is sending data to server and data is transferred from client to server &Server to client sequentially with respect to number of request TCP protocol requires more bandwidth than UDP But when data is transferred from client to server and back to client parallel with respect to number of request UDP requires more bandwidth.

Finally it can be conclude that unidirectional and bidirectional sequentially with respect to data size & number of request UDP protocol is better than TCP But in bidirectional Parallel with respect to data size & number of request TCP protocol is better than UDP

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