

# Wireless LAN Throughput Performance

**Submitted to**  
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**Prepared by**

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**Internet Technologies and Applications (ITS 413)**

**Sirindhorn International Institute of Technology**

# Table of Contents

<b>Topic</b>	<b>Pages</b>
<b>Table of participation</b>	<b>3</b>
<b>Part A</b>	<b>4</b>
<b>Part B</b>	<b>16</b>

# Table Of Participation

Task	Natchanan	Atjima	Hutchaganit
1	33	33	33
2	33	33	33

The result in Part A

# First Floor

**INFIRMARY ROOM**

**ROOM**

**\*4\***  
 

**AP** Access point  
**\*#\*** Where we test

**NETWORK LAB**

**\*1\***  
 

**XEROX ROOM**

**SECURITY GUARD**

**\*5\***  
 

**MY CUP**

**AP**

**\*3\***  
 

**SENIOR ROOM**

**ROOM**

**\*2\***  
   

**AP**

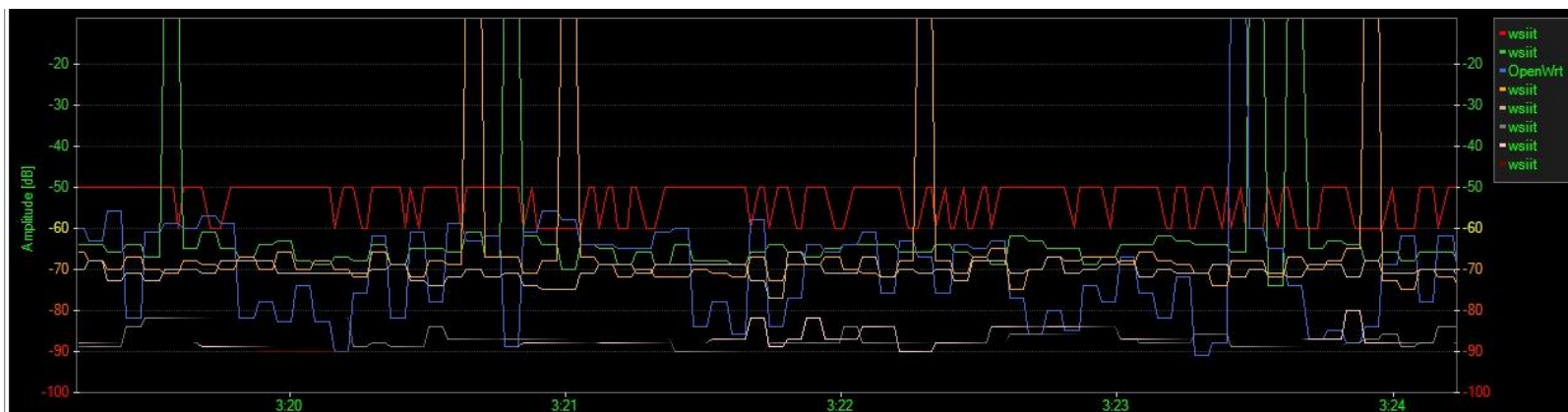
**REST AREA**

# THE RESULT FROM INSSIDER PROGRAM

## In front of Network Lab

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*1*	wsiit	-50	7	None	54	Infrastructure
	wsiit	-69	3	None	54	Infrastructure
	OpenWrt	-72	1	None	54	Adhoc
	wsiit	-74	5	None	300(N)	Infrastructure
	wsiit	-72	11	None	54	Infrastructure
	wsiit	-84	8	None	54	Infrastructure
	wsiit	-88	5	None	54	Infrastructure
	wsiit	-90	10	None	54	Infrastructure

**Table1: the result of strength/weakness of signal in Network lab**



**Figure1: the relationship between the strength of the signal in decibel and SSID in the area in front of Network Lab**

## Rest Area

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*2*	wsiit	-63	5	None	54	Infrastructure
	wsiit	-70	5	None	54	Infrastructure
	wsiit	0	7	None	54	Infrastructure
	OpenWrt	-57	1	None	54	Adhoc
	wsiit	-60	2	None	300(N)	Infrastructure
	wsiit	-71	6	None	54	Infrastructure
	wsiit	-88	10	None	54	Infrastructure
	wsiit	-84	9	None	54	Infrastructure
	wsiit	-79	3	None	54	Infrastructure
	SGoffice	-88	11	RSNA-CCMP	54	Infrastructure
	wsiit	-84	11	None	54	Infrastructure
	wsiit	-81	9	None	54	Infrastructure
	wsiit	-83	7	None	11	Infrastructure
	wsiit	-84	7	None	54	Infrastructure
	wsiit	-84	11	None	54	Infrastructure
	wsiit	-87	11	None	11	Infrastructure
	wsiit	-80	8	None	54	Infrastructure

Table2: the result of strength/weakness of signal in the rest area

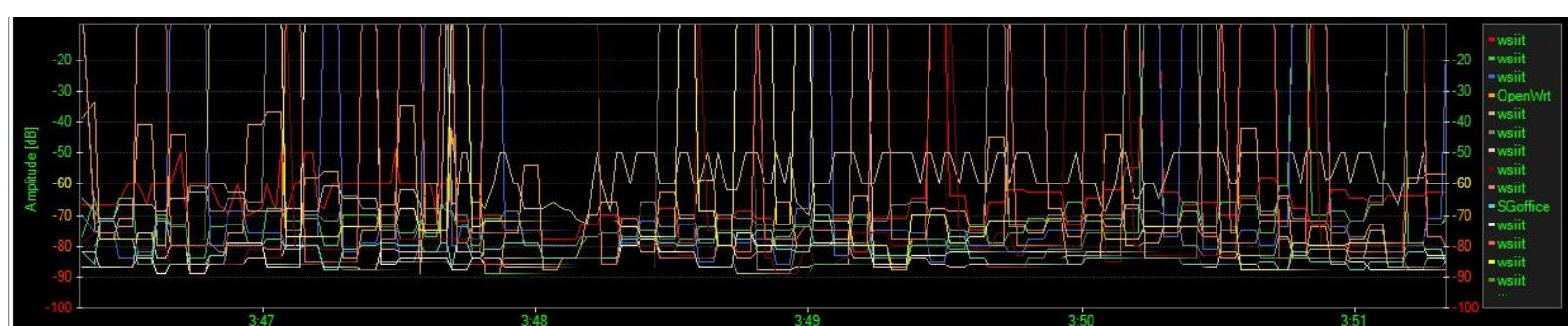
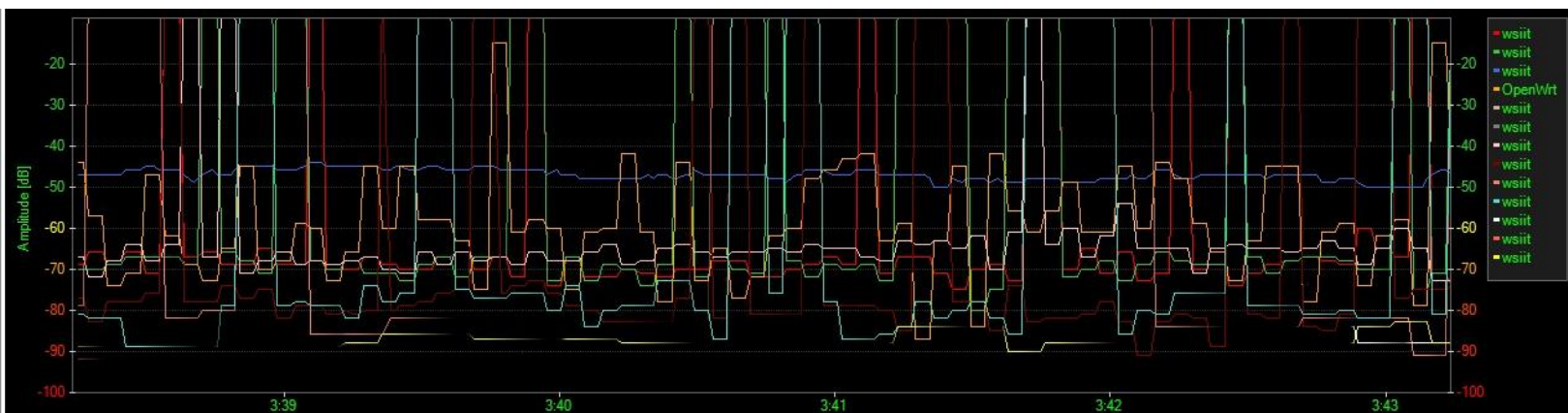


Figure2: the relationship between the strength of the signal in decibel and SSID in the area in the rest area in front of 2nd building

## In front of MY CUP

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*3*	wsiit	-74	7	None	54	Infrastructure
	wsiit	0	3	None	54	Infrastructure
	wsiit	-47	5	None	54	Infrastructure
	OpenWrt	-47	1	None	54	Adhoc
	wsiit	-79	8	None	300(N)	Infrastructure
	wsiit	-89	10	None	54	Infrastructure
	wsiit	-73	5	None	54	Infrastructure
	wsiit	-74	9	None	54	Infrastructure
	wsiit	0	9	None	54	Infrastructure
	wsiit	0	7	None	54	Infrastructure
	wsiit	-88	2	None	300(N)	Infrastructure
	wsiit	-92	6	None	54	Infrastructure
	wsiit	-88	11	None	54	Infrastructure

**Table3: the result of strength/weakness of signal in front of My Cup**



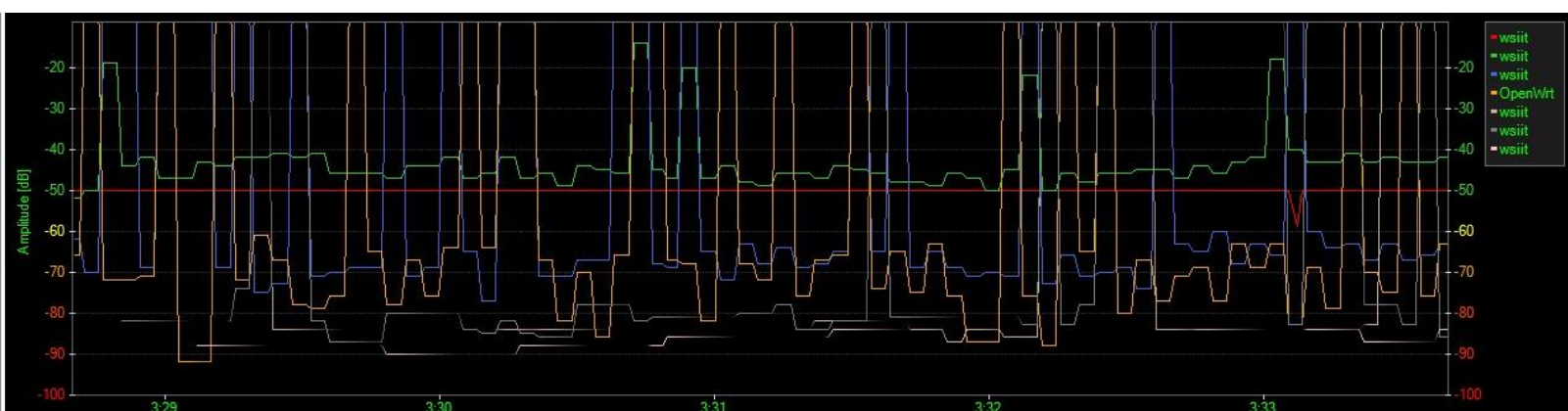
**Figure3: the relationship between the strength of the signal in decibel and SSID in the area in front of My Cup**



### In front of Infirmary room

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*4*	wsiit	-50	7	None	54	Infrastructure
	wsiit	-42	3	None	54	Infrastructure
	wsiit	-63	5	None	300(N)	Infrastructure
	OpenWrt	-63	1	None	54	Adhoc
	wsiit	0	11	None	54	Infrastructure
	wsiit	-86	8	None	54	Infrastructure
	wsiit	-84	10	None	54	Infrastructure

**Table4: the result of strength/weakness of signal in front of My Cup**



**Figure 4: the relationship between the strength of the signal in decibel and SSID in the area in front of infirmary room**

## In front of 1<sup>st</sup> floor stair

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*5*	wsiit	-70	5	None	54	Infrastructure
	wsiit	-84	5	None	54	Infrastructure
	OpenWrt	-70	1	None	54	Adhoc
	wsiit	-69	7	None	54	Infrastructure
	wsiit	-88	3	None	54	Infrastructure
	wsiit	0	9	None	54	Infrastructure
	wsiit	-82	7	None	54	Infrastructure
	wsiit	-87	11	None	54	Infrastructure

Table5: the result of strength/weakness of signal in front of 1<sup>st</sup> floor stair

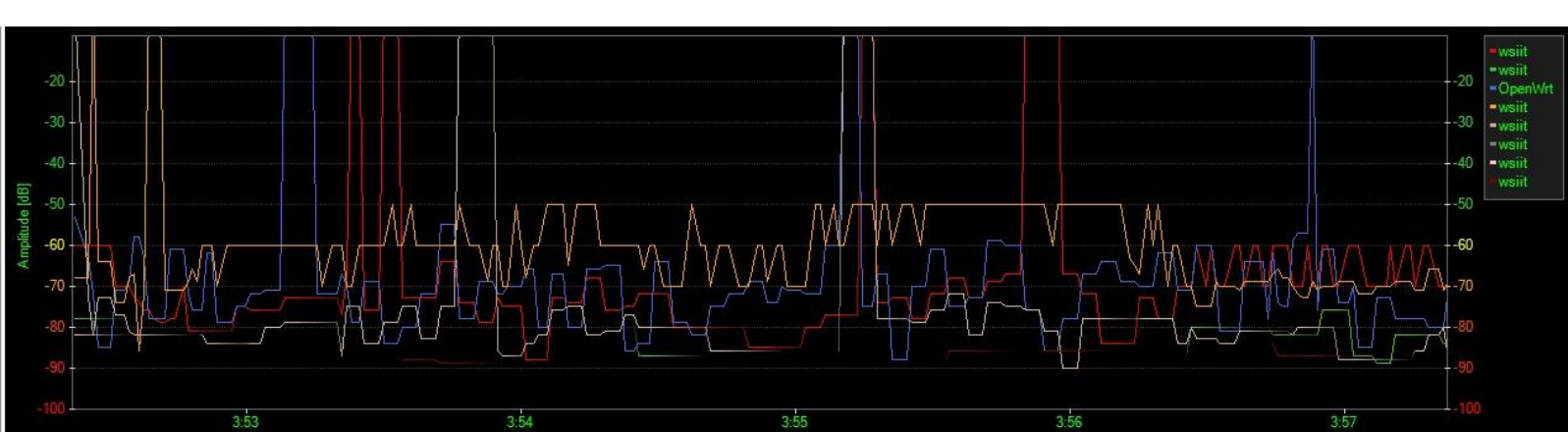


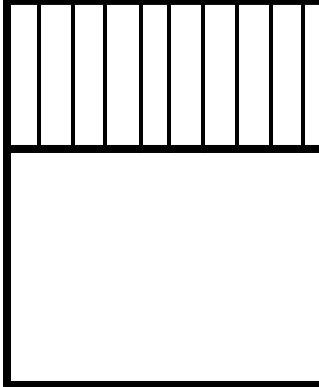
Figure 5: the relationship between the strength of the signal in decibel and SSID in the area in front of 1<sup>st</sup> Floor stair

# Second Floor

wsit openwrt  
scopiee \*9\* cyberpoint  
@/2 Uobdoor

**FINANCIAL**

**LIFT**



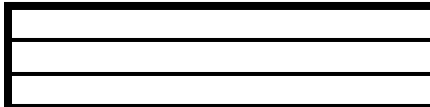
\*7\*  
wsit openwrt

AP

wsit openwrt  
\*6\*

wsit openwrt  
\*8\*

AP



**STAIR**

**STUDENT AFFAIR &  
ACADEMIC SERVICE**

**DIRECTOR  
ROOM**

AP Access point

\*##\* Where we test

# THE RESULT FROM INSSIDER PROGRAM

## 2<sup>nd</sup> Floor stair

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*6*	wsiit	-62	7	None	54	infrastructure
	OpenWrt	-65	1	None	54	Adhoc
	wsiit	-85	3	None	54	Infrastructure
	wsiit	-50	11	None	54	Infrastructure
	wsiit	-85	8	None	54	Infrastructure
	wsiit	-80	5	None	54	Infrastructure
	wsiit	0	5	None	300(N)	Infrastructure
	wsiit	-87	9	None	54	Infrastructure
	wsiit	-90	7	None	54	Infrastructure

Table6: the result of strength/weakness of signal in front of 2<sup>nd</sup> floor stair

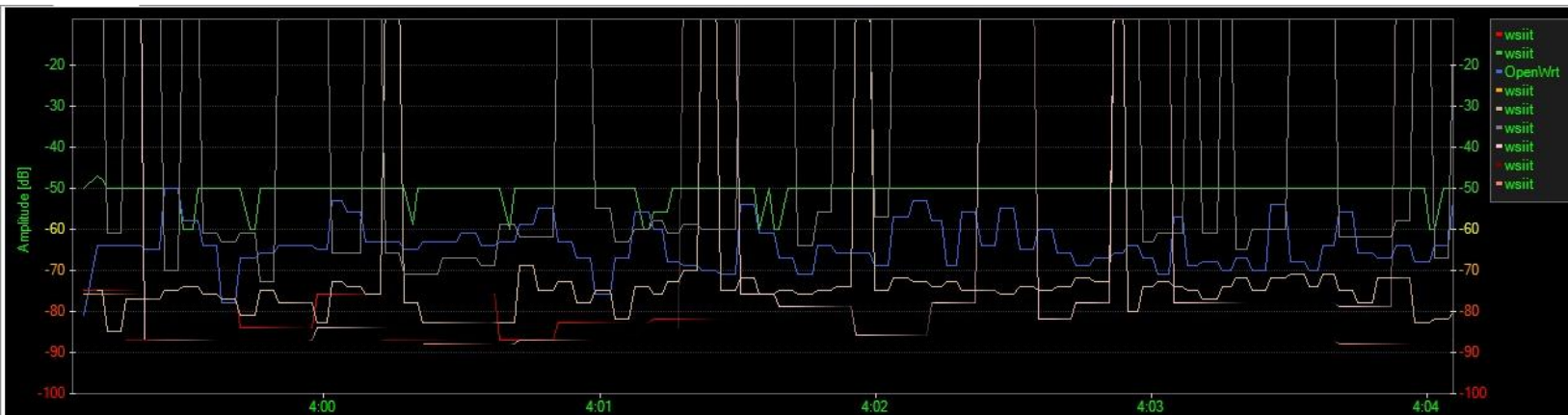


Figure6: the relationship between the strength of the signal in decibel and SSID in the area in the 2<sup>nd</sup> floor in front of the stair

### In front of financial room

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*7*	wsiit	-50	11	None	54	infrastructure
	wsiit	-24	7	None	54	infrastructure
	OpenWrt	-37	1	None	54	Adhoc
	wsiit	-71	5	None	54	Infrastructure
	wsiit	-66	5	None	54	Infrastructure
	wsiit	-90	10	None	54	Infrastructure
	wsiit	-75	7	None	300(N)	Infrastructure
	wsiit	0	8	None	54	Infrastructure
	wsiit	-81	9	None	54	Infrastructure
	wsiit	-91	9	None	54	Infrastructure
	wsiit	-92	12	None	300(N)	Infrastructure
	wsiit	-90	11	None	54	Infrastructure
	wsiit	-87	3	None	54	Infrastructure
	wsiit	-92	7	None	54	Infrastructure

**Table7: the result of strength/weakness of signal in front of financial room**



**Figure7: the relationship between the strength of the signal in decibel and SSID in the area in front of financial room**

## In front of Student Affair

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*8*	wsiit	-50	11	None	54	infrastructure
	wsiit	-91	11	None	54	infrastructure
	wsiit	-61	5	None	54	Infrastructure
	OpenWrt	46	1	None	54	Adhoc
	wsiit	-86	2	None	54	Infrastructure
	wsiit	-47	7	None	54	Infrastructure
	wsiit	-78	8	None	300(N)	Infrastructure
	wsiit	-89	7	None	54	Infrastructure
	wsiit	-84	12	None	54	Infrastructure
	wsiit	-83	5	None	54	Infrastructure
	wsiit	0	9	None	54	Infrastructure
	wsiit	-89	9	None	300(N)	Infrastructure
	wsiit	-87	3	None	54	Infrastructure
	wsiit	-87	10	None	54	Infrastructure

**Table8: the result of strength/weakness of signal in front of student affair room**

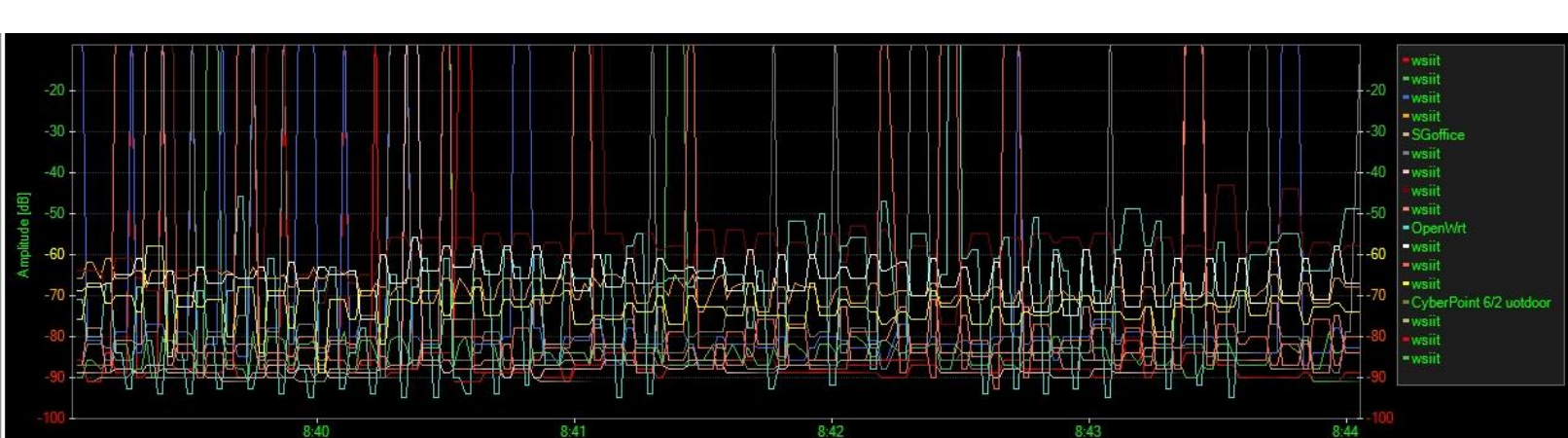


**Figure8: the relationship between the strength of the signal in decibel and SSID in the area in front of student affair room**

### Beside Account room

Position	SSID	RSSI	Channel	Privacy	Max Rate	Network Type
*9*	wsiit	-78	11	None	54	infrastructure
	wsiit	-69	11	None	54	infrastructure
	SGoffice	-91	9	None	54	Infrastructure
	wsiit	-82	7	None	54	Infrastructure
	wsiit	-89	5	None	54	Infrastructure
	wsiit	-63	5	None	54	Infrastructure
	wsiit	-73	10	None	54	Infrastructure
	OpenWrt	-59	1	None	54	Adhoc
	OpenWrt	-56	8	None	54	Infrastructure
	wsiit	-80	9	None	54	Infrastructure
	wsiit	-70	7	None	54	Infrastructure
	wsiit	-87	2	None	54	Infrastructure
	wsiit	-80	11	None	300(N)	Infrastructure
	CyberPoint6/2uotdoor	-86	12	None	54	Infrastructure
	wsiit	-88	9	None	300(N)	Infrastructure
	wsiit	-89	8	None	54	Infrastructure

**Table9: the result of strength/weakness of signal beside financial room**



**Figure9: the relationship between the strength of the signal in decibel and SSID in the area beside financial room**

## The result in Part B

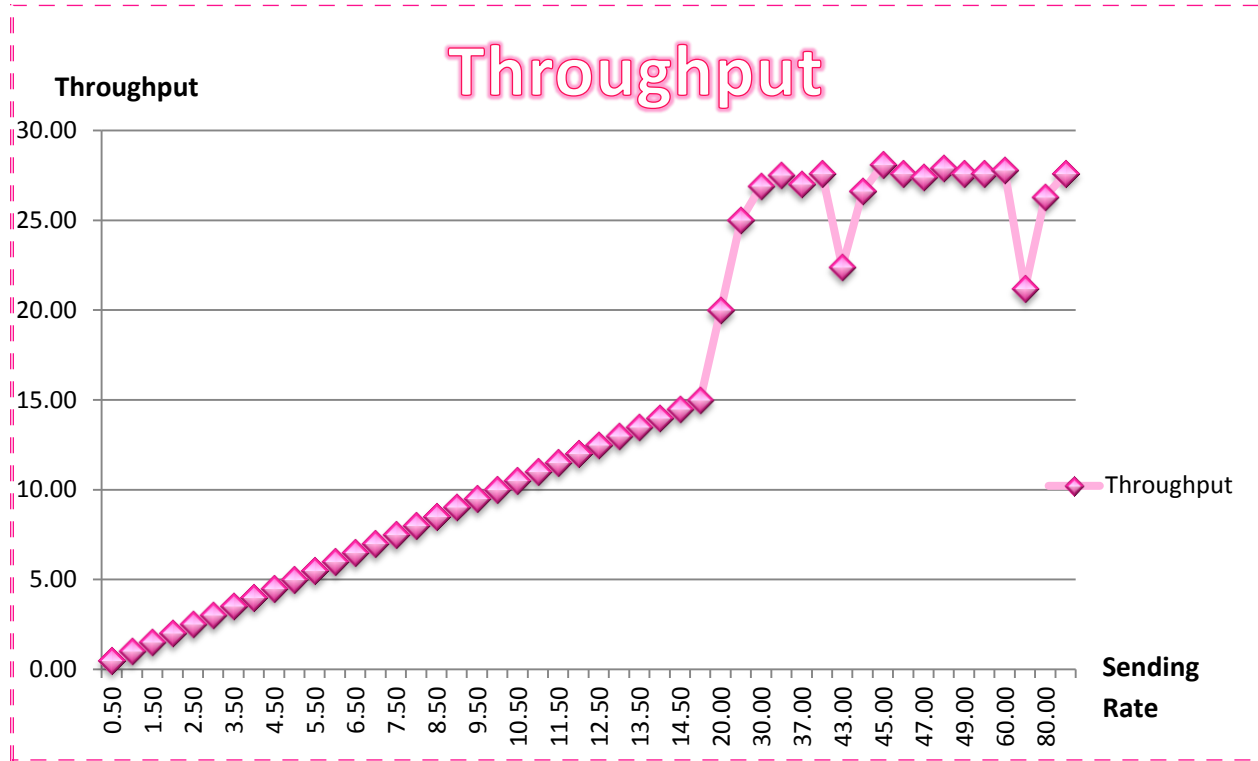


# MIXED

Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
0.50	M	0.61	Mbytes	0.50	Mbits/sec	0.094 ms	0/427	0%
1.00	M	1.19	Mbytes	1.00	Mbits/sec	0.494 ms	0/852	0%
1.50	M	1.79	Mbytes	1.50	Mbits/sec	0.118 ms	0/1277	0%
2.00	M	2.39	Mbytes	2.00	Mbits/sec	0.248 ms	0/1701	0%
2.50	M	2.98	Mbytes	2.50	Mbits/sec	1.790 ms	0/2126	0%
3.00	M	3.58	Mbytes	3.00	Mbits/sec	0.147 ms	0/2552	0%
3.50	M	4.17	Mbytes	3.50	Mbits/sec	0.113 ms	0/2977	0%
4.00	M	4.77	Mbytes	3.98	Mbits/sec	3.133 ms	0/3402	0%
4.50	M	5.37	Mbytes	4.50	Mbits/sec	0.128 ms	0/3827	0%
5.00	M	5.96	Mbytes	5.00	Mbits/sec	0.261 ms	0/4252	0%
5.50	M	6.56	Mbytes	5.50	Mbits/sec	0.100 ms	0/4678	0%
6.00	M	7.16	Mbytes	6.00	Mbits/sec	0.214 ms	0/5103	0%
6.50	M	7.75	Mbytes	6.50	Mbits/sec	0.067 ms	0/5528	0%
7.00	M	8.35	Mbytes	7.00	Mbits/sec	0.071 ms	0/5054	0%
7.50	M	8.94	Mbytes	7.50	Mbits/sec	0.093 ms	0/6378	0%
8.00	M	9.54	Mbytes	8.00	Mbits/sec	0.104 ms	0/6803	0%
8.50	M	10.10	Mbytes	8.50	Mbits/sec	0.138 ms	0/7231	0%
9.00	M	10.70	Mbytes	9.03	Mbits/sec	0.080ms	0/7657	0%
9.50	M	11.30	Mbytes	9.51	Mbits/sec	0.076 ms	0/8085	0%
10.00	M	11.90	Mbytes	10.00	Mbits/sec	0.304 ms	0/8505	0%
10.50	M	12.50	Mbytes	10.50	Mbits/sec	0.357 ms	0/8930	0%
11.00	M	13.10	Mbytes	11.00	Mbits/sec	0.083 ms	0/9355	0%
11.50	M	13.70	Mbytes	11.50	Mbits/sec	0.069 ms	0/9785	0%
12.00	M	14.30	Mbytes	12.00	Mbits/sec	0.163 ms	0/10205	0%
12.50	M	14.90	Mbytes	12.50	Mbits/sec	0.026ms	0/10639	0%
13.00	M	15.50	Mbytes	13.00	Mbits/sec	0.091 ms	0/11062	0%
13.50	M	16.10	Mbytes	13.50	Mbits/sec	0.112ms	0/11481	0%
14.00	M	16.70	Mbytes	14.00	Mbits/sec	0.036 ms	0/11905	0%
14.50	M	17.30	Mbytes	14.50	Mbits/sec	0.044 ms	0/12331	0%
15.00	M	17.90	Mbytes	15.00	Mbits/sec	0.190 ms	0/12756	0%
20.00	M	23.80	Mbytes	20.00	Mbits/sec	0.019 ms	0/17007	0%
25.50	M	29.80	Mbytes	25.00	Mbits/sec	0.064 ms	0/21277	0%
30.00	M	32.50	Mbytes	26.90	Mbits/sec	0.130 ms	0/2315	0%
35.00	M	33.10	Mbytes	27.50	Mbits/sec	1.392 ms	0/23150	0%
37.00	M	32.60	Mbytes	27.00	Mbits/sec	0.708 ms	0/23218	0%
40.00	M	33.30	Mbytes	27.60	Mbits/sec	0.365 ms	0/23752	0%
43.00	M	27.30	Mbytes	22.40	Mbits/sec	1.406 ms	0/19442	0%
44.00	M	32.10	Mbytes	26.60	Mbits/sec	0.574 ms	0/22893	0%
45.00	M	33.90	Mbytes	28.10	Mbits/sec	0.921 ms	0/24202	0%
46.00	M	33.20	Mbytes	27.60	Mbits/sec	1.023 ms	0/23680	0%
47.00	M	33.10	Mbytes	27.40	Mbits/sec	1.394 ms	0/23612	0%
48.00	M	33.60	Mbytes	27.90	Mbits/sec	1.212 ms	0/23946	0%
49.00	M	33.20	Mbytes	27.60	Mbits/sec	1.299 ms	0/23702	0%
50.00	M	33.30	Mbytes	27.60	Mbits/sec	1.202 ms	0/23747	0%
60.00	M	33.60	Mbytes	27.80	Mbits/sec	1.257 ms	0/23956	0%

70.00	M	25.60	Mbytes	21.20	Mbits/sec	1.002 ms	0/18226	0%
80.00	M	31.70	Mbytes	26.30	Mbits/sec	1.271 ms	0/22602	0%
100.00	M	33.20	Mbytes	27.60	Mbits/sec	0.410 ms	0/23714	0%

**Table 10: The sampling data of mixed type wireless for single user**

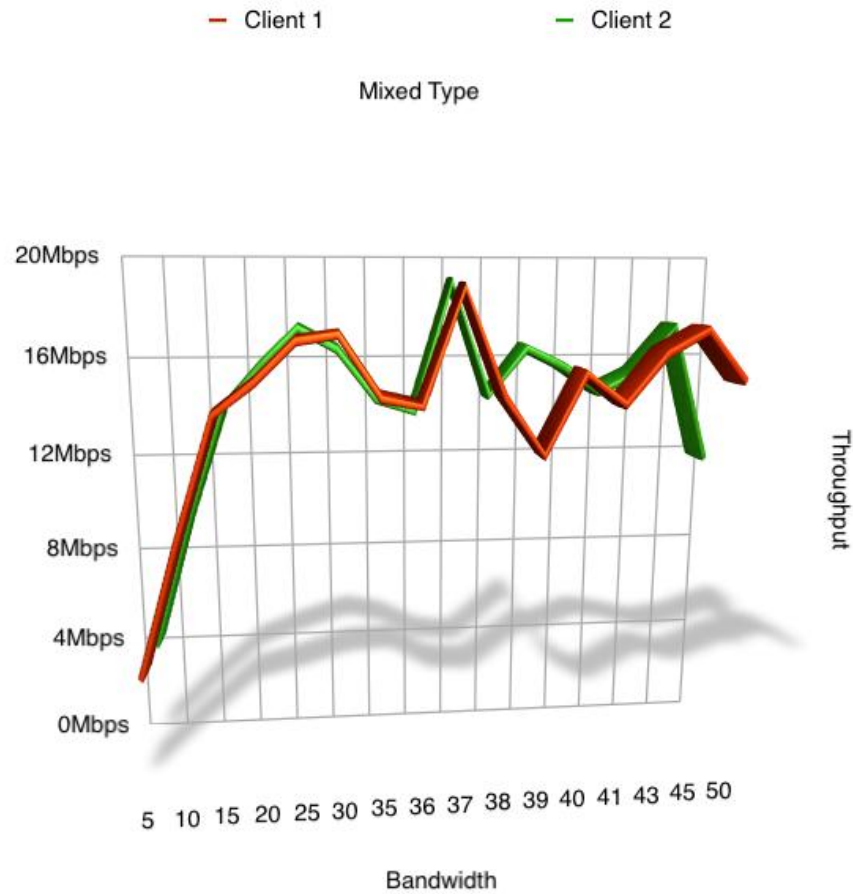


**Figure 10: The relationship between sending data rate and throughput for Mixed type wireless of single user**

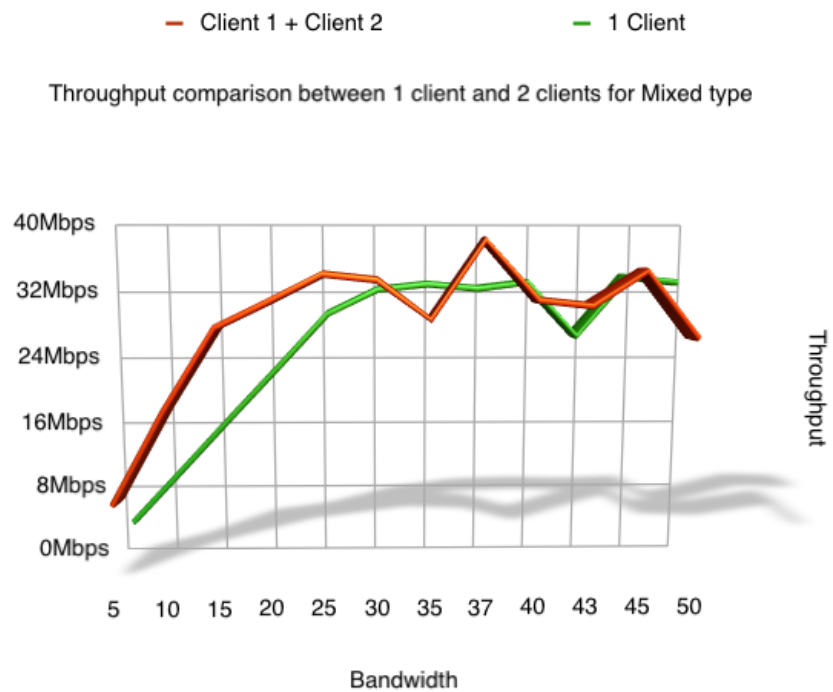
Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
1.00	M	1.19	Mbytes	1.00	Mbits/sec	0.032 ms	0/852	0%
1.00	M	1.19	Mbytes	1.00	Mbits/sec	0.014 ms	0/852	0%
5.00	M	5.96	Mbytes	5.00	Mbits/sec	0.214 ms	0/4252	0%
5.00	M	5.96	Mbytes	5.00	Mbits/sec	0.391 ms	0/4252	0%
10.00	M	11.90	Mbytes	9.97	Mbits/sec	0.538 ms	0/8476	0%
10.00	M	11.90	Mbytes	10.00	Mbits/sec	0.376 ms	0/8504	0%
15.00	M	17.60	Mbytes	14.50	Mbits/sec	0.678 ms	0/12573	0%
15.00	M	17.10	Mbytes	14.30	Mbits/sec	0.028 ms	0/12189	0%
20.00	M	19.10	Mbytes	15.60	Mbits/sec	0.728 ms	0/13596	0%
20.00	M	19.00	Mbytes	15.90	Mbits/sec	0.03 ms	0/13530	0%
25.00	M	20.70	Mbytes	17.00	Mbits/sec	2.606 ms	0/14797	0%
25.00	M	20.70	Mbytes	17.30	Mbits/sec	0.066 ms	0/14741	0%
30.00	M	20.90	Mbytes	17.20	Mbits/sec	2.554 ms	0/14941	0%
30.00	M	19.90	Mbytes	16.50	Mbits/sec	0.275 ms	0/14182	0%

35.00	M	18.30	Mbytes	15.00	Mbits/sec	2.952 ms	0/13033	0%
35.00	M	17.70	Mbytes	14.60	Mbits/sec	0.207 ms	0/12591	0%
36.00	M	17.90	Mbytes	14.70	Mbits/sec	2.675 ms	0/12751	0%
36.00	M	17.10	Mbytes	14.10	Mbits/sec	2.185 ms	0/12162	0%
37.00	M	22.90	Mbytes	18.80	Mbits/sec	2.432 ms	0/16364	0%
37.00	M	23.00	Mbytes	19.00	Mbits/sec	0.416 ms	0/16382	0%
38.00	M	18.20	Mbytes	15.00	Mbits/sec	2.507 ms	0/13012	0%
38.00	M	17.80	Mbytes	14.70	Mbits/sec	0.255 ms	0/12666	0%
39.00	M	15.90	Mbytes	12.90	Mbits/sec	1.895 ms	0/11338	0%
39.00	M	19.90	Mbytes	16.50	Mbits/sec	1.446 ms	0/14217	0%
40.00	M	19.30	Mbytes	15.80	Mbits/sec	2.376 ms	0/13786	0%
40.00	M	19.10	Mbytes	15.80	Mbits/sec	1.362 ms	0/13616	0%
41.00	M	18.10	Mbytes	14.70	Mbits/sec	1.761 ms	0/12876	0%
41.00	M	17.90	Mbytes	14.80	Mbits/sec	0.819 ms	0/12755	0%
43.00	M	18.90	Mbytes	15.50	Mbits/sec	2.815 ms	0/13499	0%
43.00	M	18.70	Mbytes	15.50	Mbits/sec	1.222 ms	0/13325	0%
45.00	M	21.20	Mbytes	17.30	Mbits/sec	3.162 ms	0/15093	0%
45.00	M	20.80	Mbytes	17.30	Mbits/sec	1.206 ms	0/14854	0%
45.00	M	18.80	Mbytes	15.50	Mbits/sec	2.259 ms	0/13436	0%
45.00	M	19.80	Mbytes	16.50	Mbits/sec	0.917 ms	0/14156	0%
50.00	M	18.70	Mbytes	15.50	Mbits/sec	1.198 ms	0/13348	0%
50.00	M	14.70	Mbytes	12.10	Mbits/sec	1.737 ms	0/10489	0%

**Table 11 : The sampling data of Mixed type wireless for 2 user**



**Figure 11 : The relationship between sending data rate and throughput for Mixed type wireless of 2 user**



**Figure 12 : Comparison throughput between 1 client and 2 clients of Mixed type wireless**

## B – Wireless

Bandwidth(Sent )	Transmission Rate	Bandwidth	Jitter	Lost/Total	Datagrams
5.00 M	5.96 Mbytes	5.00 Mb/s	0.055 ms	0/4252	0%
10.00 M	7.68 Mbytes	6.14 Mb/s	5.887 ms	0/5478	0%
12.00 M	7.82 Mbytes	6.25 Mb/s	5.264 ms	0/5575	0%
13.00 M	6.43 Mbytes	5.04 Mb/s	11.998 ms	0/4589	0%
14.00 M	7.55 Mbytes	6.03 Mb/s	5.925 ms	0/5388	0%
15.00 M	7.92 Mbytes	6.34 Mb/s	3.675 ms	0/5652	0%
16.00 M	7.79 Mbytes	6.23 Mb/s	5.620 ms	0/5555	0%
17.00 M	7.97 Mbytes	6.36 Mb/s	5.649 ms	0/5684	0%
18.00 M	7.90 Mbytes	6.30 Mb/s	5.769 ms	0/5635	0%
19.00 M	7.72 Mbytes	6.17 Mb/s	5.562 ms	0/5503	0%
20.00 M	7.88 Mbytes	6.27 Mb/s	5.760 ms	0/5622	0%
21.00 M	7.37 Mbytes	5.88 Mb/s	5.623 ms	0/5254	0%
25.00 M	7.86 Mbytes	6.26 Mb/s	6.205 ms	0/5607	0%
30.00 M	7.86 Mbytes	6.26 Mb/s	5.496 ms	0/5605	0%
50.00 M	7.84 Mbytes	6.22 Mb/s	7.045 ms	0/5591	0%

Table 12 : The sampling data of B type wireless for single user

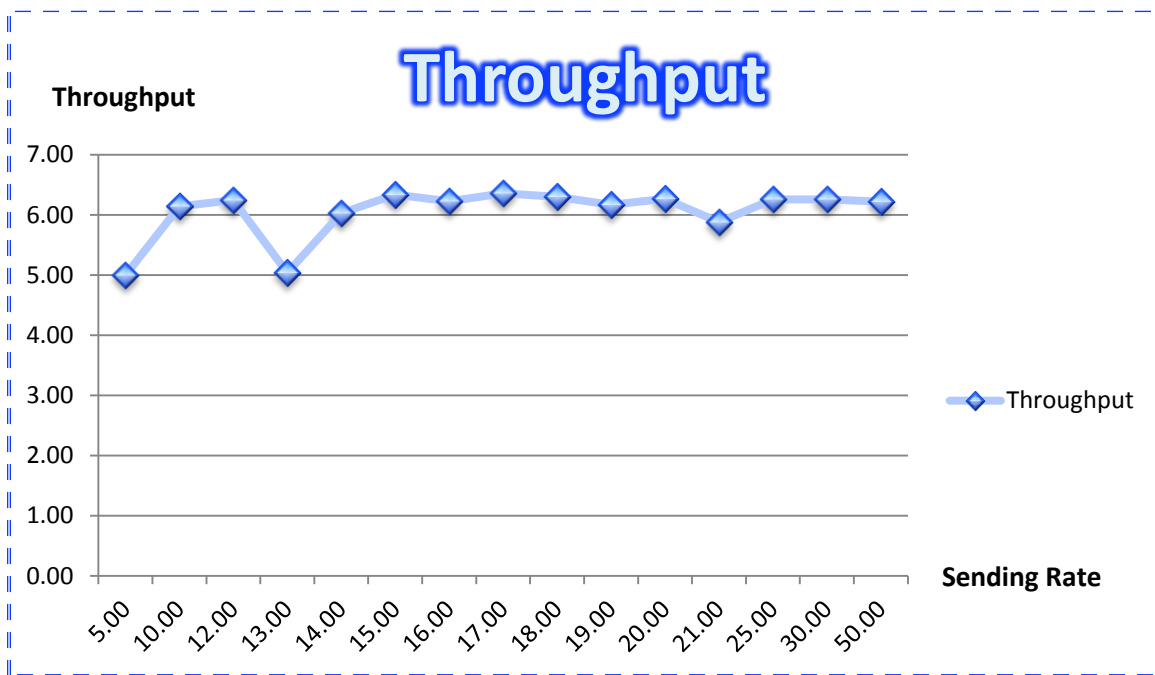
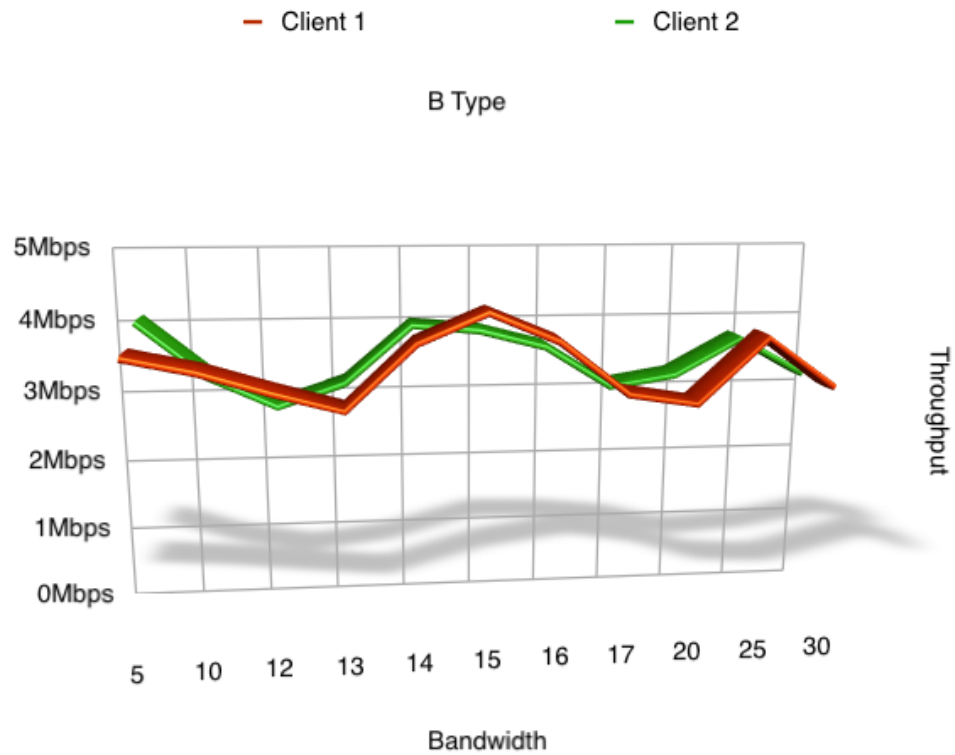


Figure 13 : The relationship between sending data rate and throughput for B type wireless of single user

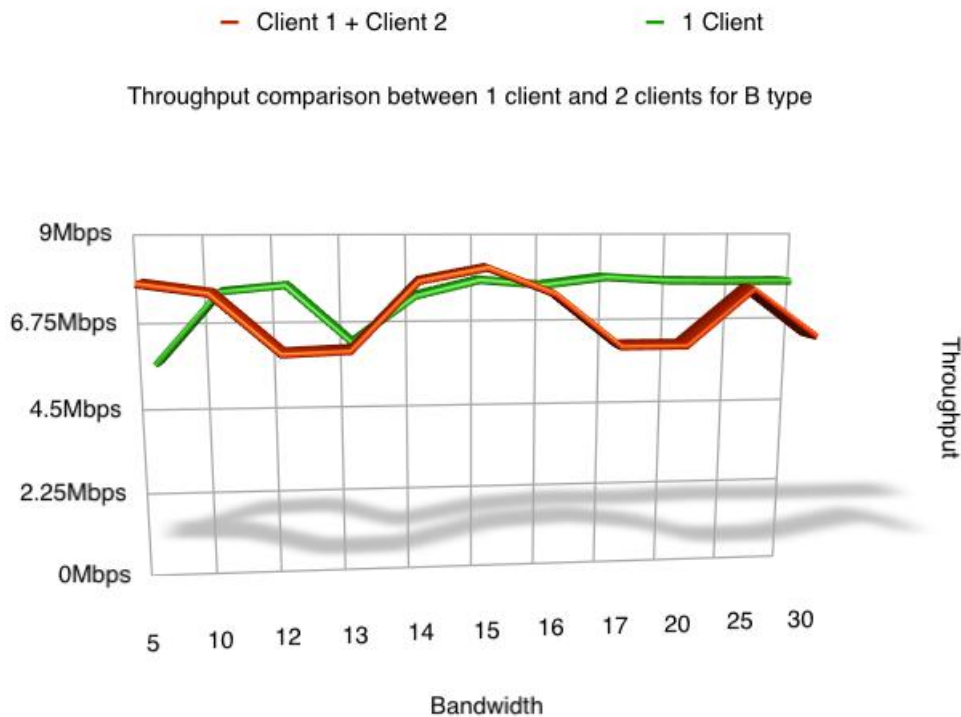
Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
5.00	M	5.05	Mbytes	3.85	Mbits/sec	5.314 ms	0/3604	0%
5.00	M	4.94	Mbytes	4.14	Mbits/sec	0.027 ms	0/3523	0%
10.00	M	4.77	Mbytes	3.66	Mbits/sec	9.463 ms	0/3402	0%
10.00	M	4.30	Mbytes	3.41	Mbits/sec	2.868 ms	0/3065	0%
12.00	M	4.37	Mbytes	3.39	Mbits/sec	8.589 ms	0/3115	0%
12.00	M	4.18	Mbytes	3.00	Mbits/sec	17.212 ms	0/2982	0%
13.00	M	4.11	Mbytes	3.15	Mbits/sec	11.161 ms	0/2931	0%
13.00	M	4.32	Mbytes	3.30	Mbits/sec	10.923 ms	0/3084	0%
14.00	M	5.16	Mbytes	3.97	Mbits/sec	12.219 ms	0/3681	0%
14.00	M	5.08	Mbytes	4.05	Mbits/sec	5.438 ms	0/3626	0%
15.00	M	5.64	Mbytes	4.34	Mbits/sec	9.406 ms	0/4020	0%
15.00	M	4.96	Mbytes	3.97	Mbits/sec	5.591 ms	0/3536	0%
16.00	M	5.17	Mbytes	3.97	Mbits/sec	9.317 ms	0/3688	0%
16.00	M	4.70	Mbytes	3.74	Mbits/sec	2.093 ms	0/3351	0%
17.00	M	4.29	Mbytes	3.29	Mbits/sec	10.817 ms	0/3057	0%
17.00	M	4.18	Mbytes	3.19	Mbits/sec	9.325 ms	0/2982	0%
20.00	M	4.17	Mbytes	3.15	Mbits/sec	13.12 ms	0/2974	0%
20.00	M	4.32	Mbytes	3.33	Mbits/sec	9.735 ms	0/3083	0%
25.00	M	4.12	Mbytes	3.98	Mbits/sec	35.356 ms	0/2940	0%
25.00	M	4.84	Mbytes	3.81	Mbits/sec	10.094 ms	0/3452	0%
30.00	M	4.38	Mbytes	3.34	Mbits/sec	13.478 ms	0/3123	0%
30.00	M	4.23	Mbytes	3.33	Mbits/sec	10.000 ms	0/3019	0%
200.00	M	4.45	Mbytes	3.39	Mbits/sec	11.639 ms	0/3172	0%
200.00	M	4.36	Mbytes	3.45	Mbits/sec	8.023 ms	0/3106	0%

**Table 13 : The sampling data of B type wireless for 2 user**



**Figure 14 : The relationship between sending data rate and throughput for B type wireless of 2 user**

### Compare between 1 and 2 clients

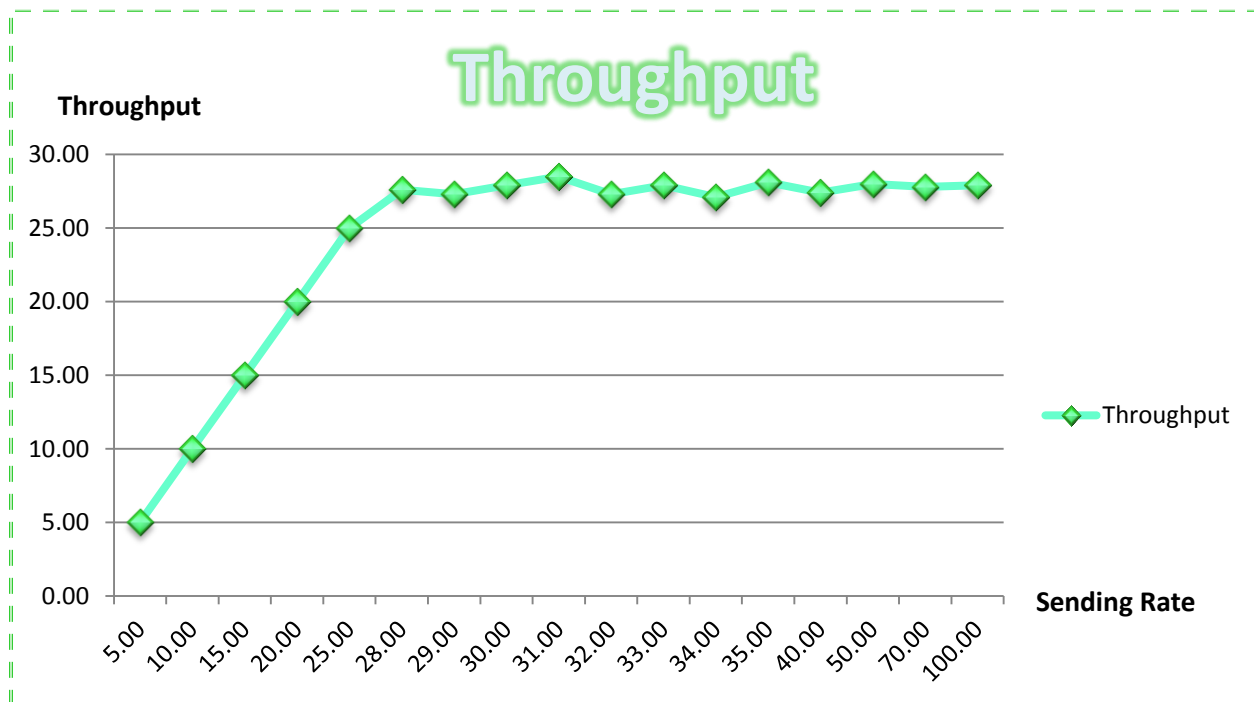


**Figure 15 : Comparison throughput between 1 client and 2 clients of B type wireless**

# G-Wireless

Bandwidth(Sent )	Transmission Rate	Bandwidth	Jitter	Lost/Total	Datagrams
5.00 M	5.96 Mbytes	5.00 Mbits/sec	0.050 ms	0/4252	0%
10.00 M	11.90 Mbytes	10.00 Mbits/sec	0.345 ms	0/8504	0%
15.00 M	17.90 Mbytes	15.00 Mbits/sec	0.020 ms	0/12756	0%
20.00 M	23.80 Mbytes	20.00 Mbits/sec	0.201 ms	0/17007	0%
25.00 M	29.80 Mbytes	25.00 Mbits/sec	0.055 ms	0/21277	0%
28.00 M	33.20 Mbytes	27.60 Mbits/sec	1.597 ms	0/23707	0%
29.00 M	32.90 Mbytes	27.30 Mbits/sec	0.225 ms	0/23468	0%
30.00 M	33.70 Mbytes	27.90 Mbits/sec	0.808 ms	0/24009	0%
31.00 M	34.30 Mbytes	28.50 Mbits/sec	0.619 ms	0/24486	0%
32.00 M	32.90 Mbytes	27.30 Mbits/sec	1.565 ms	0/23479	0%
33.00 M	33.60 Mbytes	27.90 Mbits/sec	0.301 ms	0/23995	0%
34.00 M	32.70 Mbytes	27.10 Mbits/sec	0.316 ms	0/23317	0%
35.00 M	33.90 Mbytes	28.10 Mbits/sec	0.484 ms	0/24149	0%
40.00 M	33.00 Mbytes	27.40 Mbits/sec	0.493 ms	0/23571	0%
50.00 M	33.80 Mbytes	28.00 Mbits/sec	1.047 ms	0/24085	0%
70.00 M	33.50 Mbytes	27.80 Mbits/sec	1.284 ms	0/23907	0%
100.00 M	33.70 Mbytes	27.90 Mbits/sec	1.554 ms	0/24041	0%

**Table 14 : The sampling data of G type wireless for single user**

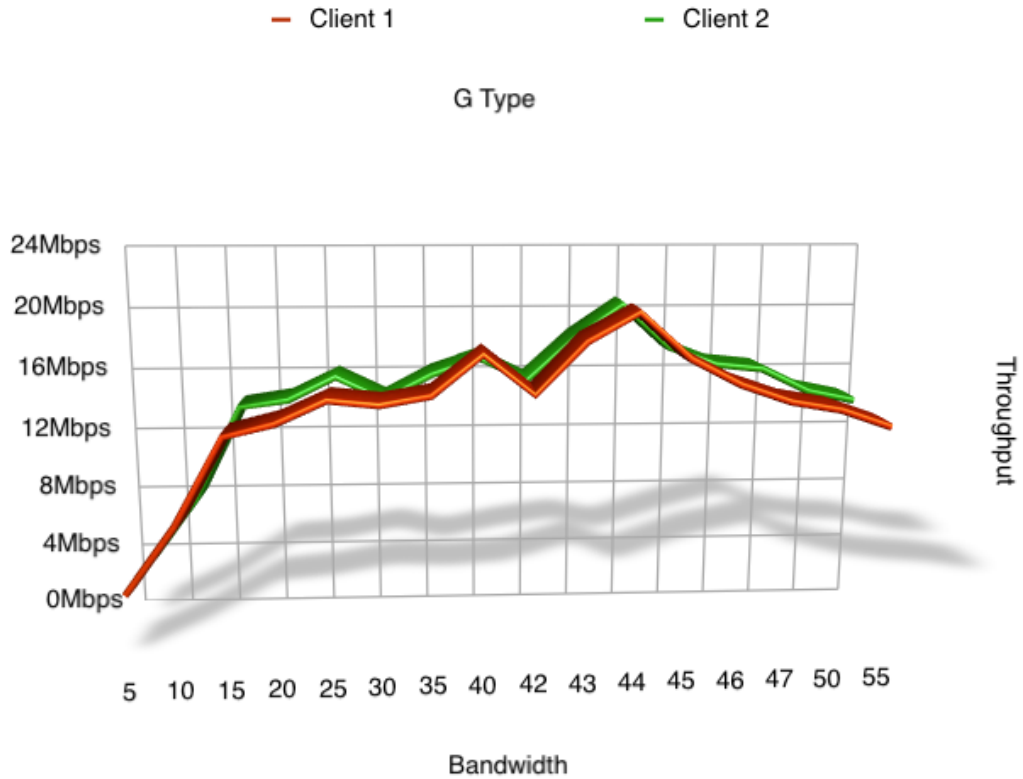


**Figure 16 : The relationship between sending data rate and throughput for G type wireless of single user**

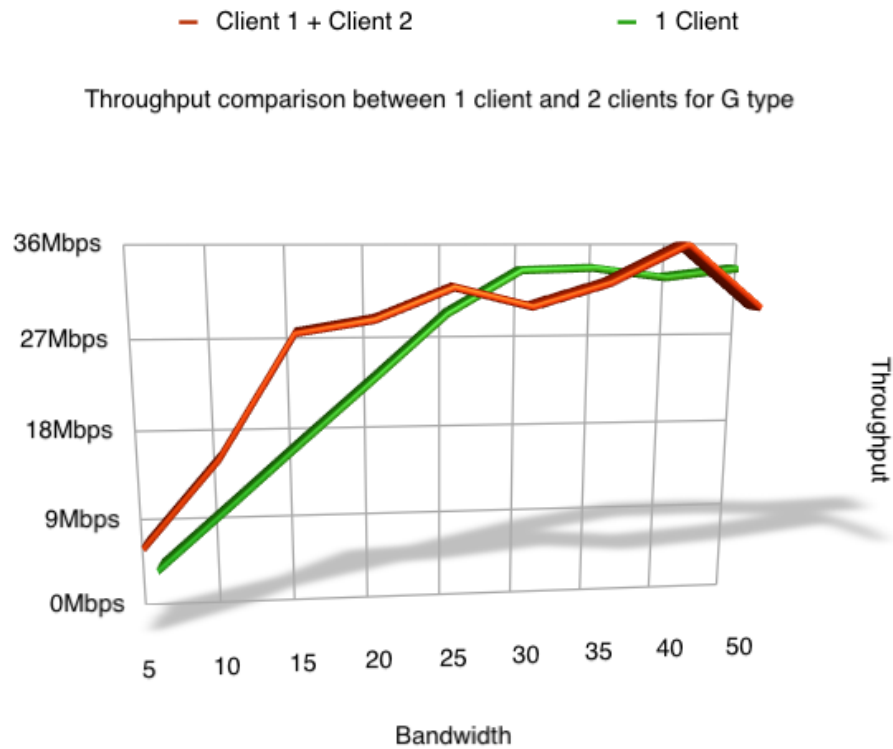


Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
5.00	M	5.96	Mbytes	5.01	Mbits/sec	0.09 ms	0/4253	0%
5.00	M	5.96	Mbytes	5.01	Mbits/sec	0.25 ms	0/4252	0%
10.00	M	11.30	Mbytes	8.96	Mbits/sec	1.935 ms	0/8026	0%
10.00	M	10.90	Mbytes	8.91	Mbits/sec	9.327 ms	0/7785	0%
15.00	M	17.10	Mbytes	14.10	Mbits/sec	1.376 ms	0/12229	0%
15.00	M	17.50	Mbytes	14.60	Mbits/sec	0.123 ms	0/12452	0%
20.00	M	18.10	Mbytes	14.80	Mbits/sec	0.863 ms	0/12898	0%
20.00	M	17.80	Mbytes	15.00	Mbits/sec	0.041 ms	0/12726	0%
25.00	M	19.60	Mbytes	16.10	Mbits/sec	3.073 ms	0/13945	0%
25.00	M	19.50	Mbytes	16.40	Mbits/sec	0.076 ms	0/13925	0%
30.00	M	19.30	Mbytes	15.80	Mbits/sec	3.404 ms	0/13732	0%
30.00	M	18.10	Mbytes	15.00	Mbits/sec	1.25 ms	0/12911	0%
35.00	M	19.90	Mbytes	16.30	Mbits/sec	3.836 ms	0/14206	0%
35.00	M	19.90	Mbytes	16.50	Mbits/sec	0.242 ms	0/14184	0%
40.00	M	22.60	Mbytes	18.60	Mbits/sec	1.62 ms	0/16099	0%
40.00	M	21.10	Mbytes	17.50	Mbits/sec	1.241 ms	0/15017	0%
42.00	M	19.90	Mbytes	16.30	Mbits/sec	2.531 ms	0/14183	0%
42.00	M	19.40	Mbytes	16.10	Mbits/sec	1.198 ms	0/13869	0%
43.00	M	23.60	Mbytes	19.30	Mbits/sec	2.671 ms	0/16891	0%
43.00	M	22.60	Mbytes	18.70	Mbits/sec	1.601 ms	0/16088	0%
44.00	M	25.50	Mbytes	20.90	Mbits/sec	2.303 ms	0/18162	0%
44.00	M	25.00	Mbytes	20.70	Mbits/sec	1.154 ms	0/17043	0%
45.00	M	22.30	Mbytes	18.30	Mbits/sec	2.379 ms	0/15873	0%
45.00	M	21.80	Mbytes	18.10	Mbits/sec	1.418 ms	0/15534	0%
46.00	M	20.50	Mbytes	16.80	Mbits/sec	2.543 ms	0/14629	0%
46.00	M	20.50	Mbytes	17.00	Mbits/sec	0.643 ms	0/14657	0%
47.00	M	19.50	Mbytes	15.80	Mbits/sec	4.428 ms	0/13913	0%
47.00	M	20.20	Mbytes	16.70	Mbits/sec	1.247 ms	0/14375	0%
50.00	M	18.60	Mbytes	15.30	Mbits/sec	2.363 ms	0/13249	0%
50.00	M	18.40	Mbytes	15.30	Mbits/sec	0.612 ms	0/13155	0%
55.00	M	17.40	Mbytes	14.30	Mbits/sec	2.612 ms	0/12426	0%
55.00	M	17.70	Mbytes	14.70	Mbits/sec	1.187 ms	0/12614	0%
200.00	M	17.10	Mbytes	14.00	Mbits/sec	2.929 ms	0/12212	0%
200.00	M	16.30	Mbytes	13.50	Mbits/sec	1.256 ms	0/11646	0%

**Table 15 : The sampling data of G type wireless for 2 user**



**Figure 17 : The relationship between sending data rate and throughput for G type wireless of 2 user**



**Figure 18 : Comparison throughput between 1 client and 2 clients of G type wireless**

We have conducted certain experiments which related to throughput measurement on wireless LAN link by using the tool called 'iperf' in order to attain our goal. By the definition of throughput, it is the rate of data transfer from one place to another place. Alternatively, we can say that throughput is the bandwidth measurement that will occur in a specified amount of time. Idealistically, we usually think that throughput will be equivalent to bandwidth that we measure. However, actually throughput is equivalent to maximum bandwidth. In order to obtain maximum bandwidth, we run several tests which the steps that we performed can be summarized following:

❖ **Preparation step**

1) Three laptops are required for our group. One laptop attached to the wire interface of an access point. In order to attach the physical device, we merely plug the LAN Cable into the port in access point.

2) Set SSID to make it easy for finding the access point by entering the website which allows us to change configurations such as SSID, network mode vice versa. In order to change default SSID, firstly, we need to enter type in 192.168.1.1 in our browser, the user name should be blank and then put the default password is admin and then when we log in, there are options to change our Wireless name. To configure the wireless portion of a wireless router, we only click on "Wireless Tab". Under the wireless tab, there is network mode which is designed to be combo box which has four options available such as disabled, B-only, G-only and mixed. The default option is mixed.



**Figure 19 : The content which inside the wireless tab**

After we have chosen the Wireless Network Mode that we desired to test, then we pressed the Save Settings button in order to confirm. (Three network types are chosen to test which are mixed type, B type and G type respectively).

#### ❖ Connection step

1) On the source laptop that attached to the wire interface of an access point will run iperf in server mode and on the destination laptop you run iperf in client mode

2) You start the server by typing “iperf -u -s” which -u means UDP and -s means server. It will start waiting for the clients. After that we start the clients sending UDP packets by typing “iperf -u -c xxx -b yyyM” which xxx means your server’s IP address (You can find by typing “ifconfig”) and yyy means which rates of bandwidth that will specify by you.

### ❖ Measure step

- 1) In order to find the maximum throughput you need to run tests for increasing values of sending rate (in iperf called bandwidth) ,first try bandwidths of 5,10,15,20,25 Mbps and if you find the measured throughputs are 5,10,12,11,12 Mbps then you may guess that the maximum throughput is about 12 Mbps
- 2) You should make sure that what you guess is right by try running more tests for bandwidth of 11,12,13,14 Mbps.
- 3) Record the result into paper.
- 4) Gather all information and do discussing the result.

### ❖ Summarize

According to the result of the experiment, the general meaning of throughput is the same meaning as bandwidth. Alternatively, sometime throughput is called “effective bandwidth”. With the term of throughput: it is the actual speed over link. The unit of the throughput can be measured in bit per second.

In wireless communication, we can classify the bandwidth to be two types which are: dedicated bandwidth and shared bandwidth. The term of dedicated bandwidth can be described as the network service that is dedicated to only single user. While shared bandwidth is not dedicated to only single user. Multiusers also allow leasing or unlicensed that shared bandwidth. With the dedicated bandwidth, since it is user limited. Therefore, that user who has privileged is able to get his chance to transfer the data until it reaching to the maximum throughput. At the point of maximum throughput, no matter we will input more bandwidth, however, the throughput that is displayed will not be fluctuated. Otherwise it can be said that it is stable or saturated at the maximum point. No collision occurs for this type of bandwidth.

In order to find the maximum throughput of mixed type, we start from input the small amount of bandwidth and then ever-increasing. The result of this can be illustrated by Figure 10. It can obviously be seen from the graph that the throughput is ever-growing until at 27 Mbps of sending data rate, the graph is explicitly shown that it is likely fluctuate. The maximum throughput can be seen when we set the bandwidth approximately 45Mbps. At that point, it gives out the throughput approximately 28.1 Mbps. There are some error occur during the experience. One of these errors can be seen in table 10. The sending data rate at 43 Mbps and 70 Mbps, the throughput dramatically lower. The reason of this result may cause from while we try to do the experiment by using our access point. There may possibly some people surrounding us doing something such as sending the file or using the internet with other access point nearby which that access point were being used at the same channel as our access point. Hence, it may lead the performance of the throughput become

lower than we expect. Theoretically, the more we increase sending data rate, the more packet loss. However, this scenario doesn't occur in this experiment.

In order to find the maximum throughput of mixed type for multiuser, we also start from input the small amount of bandwidth and then try increasing the bandwidth. The consequence of this can be illustrated by Figure 11. It can obviously be seen from the graph that the maximum throughput can be seen when we set the bandwidth approximately 37 Mbps. At that point, it gives out the throughput approximately 18.8 Mbps for client 1 and 19 Mbps for client 2.

In order to find the maximum throughput of B type, we start from input the small amount of bandwidth and then ever-increasing. The consequence of this can be illustrated by Figure 13. It can obviously be seen from the graph that the throughput is ever-growing until at 6 Mbps of sending data rate, the graph is explicitly shown that it is likely oscillate. The maximum throughput can be seen when we set the bandwidth approximately 17 Mbps. At that point, it gives out the throughput approximately 6.36 Mbps. There are some error occur during the experiment in figure 13 can be demonstrated by table 12 at the sending data rate of 13 Mbps. Throughput is dramatically slightly diminish. There is no specific reason that can tell something wrong in this graph. However, one of the causes of the problem may be similar to the problem of Figure 10.

In order to find the maximum throughput of B type for multiuser, we also start from input the small amount of bandwidth and then try increasing the bandwidth. The consequence of this can be illustrated by Figure 14. It can obviously be seen from the graph that the maximum throughput can be seen when we set the bandwidth approximately 15 Mbps. At that point, it gives out the throughput approximately 4.34 Mbps for client 1 and 3.97 Mbps for client 2.

In order to find the maximum throughput of G type, we also do the same as we do in Figure 10 and Figure 13. The result of this can be illustrated by Figure 16. It can explicitly be seen from the graph that the throughput is ever-increasing until at 27 Mbps of sending data rate, the graph is explicitly shown that it is likely fluctuate. The maximum throughput can be seen when we set the bandwidth approximately 31 Mbps. At that point, it gives out the throughput approximately 28.5 Mbps. As you can see from table 14, error cannot be found in this experiment. Conversely, for shared bandwidth, the maximum throughput for each user to occupy is less than the maximum throughput for dedicated bandwidth since single user who uses dedicated bandwidth, he can use bandwidth so that it reach to maximum throughput. In case of shared bandwidth, users can use only their quota given.

In order to find the maximum throughput of G type for multiuser, we also start from input the small amount of bandwidth and then try increasing the bandwidth. The consequence of this can be illustrated by Figure 17. It can obviously be seen from the graph that the maximum throughput can be seen

when we set the bandwidth approximately 44 Mbps. At that point, it gives out the throughput approximately 20.9 Mbps for client 1 and 20.7 Mbps for client 2.

In network technology, MAC (Medium access control) is used to provide efficient, robust and fair data transfer. It aims to allow all stations get an equal share of wireless medium. For perfect environmental, it should be equal share. However, According to the experiment, it explicitly shows that it is really difficult to distribute bandwidth equally. The example the unequally sharing of throughput can be illustrated by Figure 12,15,18 that show the abnormality of sharing throughput since the summation of two clients who share the same bandwidth is greater or less than the bandwidth that is occupied by only single client. In spite of the usual scenario, the summation of two clients should be a bit less than or equal to single client usage.

For the case that summation of two clients who share the same bandwidth is greater or less than the bandwidth that is occupied by only single client, it is hard to identify the root of this problem. However, the causes may come from

- 1) There are some people nearby us that using the internet in other access point that use the same channel with us that might make throughput from single client lower than it should be

- 2) Some collision occur between data transmission that if 2 nodes transfer at the same time or there may choose the same random number of back-off period. Thus, they will interfere each other which can make a receiver can't successfully receive either of them then, the collision may occur. The result of collision can lead to retransmission which can lead to lower throughput. Alternatively, our access point may use the same channel with other access point that can increase more chance of collision.

- 3) The error may come from hardware or software. For the portion of hardware, it may have the delay or packet loss between iperf and wireless card. For the portion of software, it may from the behavior of iperf or Operating System that will limit speed of sending

- 4) The output that we got is not an average output since we only measure one time but the output can be variances due to many factors so the output that we got maybe a bit less or a bit greater than an average one

# 1 client

## MIXED

Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
0.50	M	0.61	Mbytes	0.50	Mbits/sec	0.094 ms	0/427	0%
1.00	M	1.19	Mbytes	1.00	Mbits/sec	0.494 ms	0/852	0%
1.50	M	1.79	Mbytes	1.50	Mbits/sec	0.118 ms	0/1277	0%
2.00	M	2.39	Mbytes	2.00	Mbits/sec	0.248 ms	0/1701	0%
2.50	M	2.98	Mbytes	2.50	Mbits/sec	1.790 ms	0/2126	0%
3.00	M	3.58	Mbytes	3.00	Mbits/sec	0.147 ms	0/2552	0%
3.50	M	4.17	Mbytes	3.50	Mbits/sec	0.113 ms	0/2977	0%
4.00	M	4.77	Mbytes	3.98	Mbits/sec	3.133 ms	0/3402	0%
4.50	M	5.37	Mbytes	4.50	Mbits/sec	0.128 ms	0/3827	0%
5.00	M	5.96	Mbytes	5.00	Mbits/sec	0.261 ms	0/4252	0%
5.50	M	6.56	Mbytes	5.50	Mbits/sec	0.100 ms	0/4678	0%
6.00	M	7.16	Mbytes	6.00	Mbits/sec	0.214 ms	0/5103	0%
6.50	M	7.75	Mbytes	6.50	Mbits/sec	0.067 ms	0/5528	0%
7.00	M	8.35	Mbytes	7.00	Mbits/sec	0.071 ms	0/5054	0%
7.50	M	8.94	Mbytes	7.50	Mbits/sec	0.093 ms	0/6378	0%
8.00	M	9.54	Mbytes	8.00	Mbits/sec	0.104 ms	0/6803	0%
8.50	M	10.10	Mbytes	8.50	Mbits/sec	0.138 ms	0/7231	0%
9.00	M	10.70	Mbytes	9.03	Mbits/sec	0.080ms	0/7657	0%
9.50	M	11.30	Mbytes	9.51	Mbits/sec	0.076 ms	0/8085	0%
10.00	M	11.90	Mbytes	10.00	Mbits/sec	0.304 ms	0/8505	0%
10.50	M	12.50	Mbytes	10.50	Mbits/sec	0.357 ms	0/8930	0%
11.00	M	13.10	Mbytes	11.00	Mbits/sec	0.083 ms	0/9355	0%
11.50	M	13.70	Mbytes	11.50	Mbits/sec	0.069 ms	0/9785	0%
12.00	M	14.30	Mbytes	12.00	Mbits/sec	0.163 ms	0/10205	0%
12.50	M	14.90	Mbytes	12.50	Mbits/sec	0.026ms	0/10639	0%
13.00	M	15.50	Mbytes	13.00	Mbits/sec	0.091 ms	0/11062	0%
13.50	M	16.10	Mbytes	13.50	Mbits/sec	0.112ms	0/11481	0%
14.00	M	16.70	Mbytes	14.00	Mbits/sec	0.036 ms	0/11905	0%
14.50	M	17.30	Mbytes	14.50	Mbits/sec	0.044 ms	0/12331	0%
15.00	M	17.90	Mbytes	15.00	Mbits/sec	0.190 ms	0/12756	0%
20.00	M	23.80	Mbytes	20.00	Mbits/sec	0.019 ms	0/17007	0%
25.50	M	29.80	Mbytes	25.00	Mbits/sec	0.064 ms	0/21277	0%
30.00	M	32.50	Mbytes	26.90	Mbits/sec	0.130 ms	0/2315	0%
35.00	M	33.10	Mbytes	27.50	Mbits/sec	1.392 ms	0/23150	0%
37.00	M	32.60	Mbytes	27.00	Mbits/sec	0.708 ms	0/23218	0%
40.00	M	33.30	Mbytes	27.60	Mbits/sec	0.365 ms	0/23752	0%
43.00	M	27.30	Mbytes	22.40	Mbits/sec	1.406 ms	0/19442	0%
44.00	M	32.10	Mbytes	26.60	Mbits/sec	0.574 ms	0/22893	0%
45.00	M	33.90	Mbytes	28.10	Mbits/sec	0.921 ms	0/24202	0%
46.00	M	33.20	Mbytes	27.60	Mbits/sec	1.023 ms	0/23680	0%



47.00	M	33.10	Mbytes	27.40	Mbits/sec	1.394	ms	0/23612	0%
48.00	M	33.60	Mbytes	27.90	Mbits/sec	1.212	ms	0/23946	0%
49.00	M	33.20	Mbytes	27.60	Mbits/sec	1.299	ms	0/23702	0%
50.00	M	33.30	Mbytes	27.60	Mbits/sec	1.202	ms	0/23747	0%
60.00	M	33.60	Mbytes	27.80	Mbits/sec	1.257	ms	0/23956	0%
70.00	M	25.60	Mbytes	21.20	Mbits/sec	1.002	ms	0/18226	0%
80.00	M	31.70	Mbytes	26.30	Mbits/sec	1.271	ms	0/22602	0%
100.00	M	33.20	Mbytes	27.60	Mbits/sec	0.410	ms	0/23714	0%

## B

Bandwidth(Sent )		Transmission Rate		Bandwidth		Jitter	Lost/Total	Datagrams	
5.00	M	5.96	Mbytes	5.00	Mbits/sec	0.055	ms	0/4252	0%
10.00	M	7.68	Mbytes	6.14	Mbits/sec	5.887	ms	0/5478	0%
12.00	M	7.82	Mbytes	6.25	Mbits/sec	5.264	ms	0/5575	0%
13.00	M	6.43	Mbytes	5.04	Mbits/sec	11.998	ms	0/4589	0%
14.00	M	7.55	Mbytes	6.03	Mbits/sec	5.925	ms	0/5388	0%
15.00	M	7.92	Mbytes	6.34	Mbits/sec	3.675	ms	0/5652	0%
16.00	M	7.79	Mbytes	6.23	Mbits/sec	5.620	ms	0/5555	0%
17.00	M	7.97	Mbytes	6.36	Mbits/sec	5.649	ms	0/5684	0%
18.00	M	7.90	Mbytes	6.30	Mbits/sec	5.769	ms	0/5635	0%
19.00	M	7.72	Mbytes	6.17	Mbits/sec	5.562	ms	0/5503	0%
20.00	M	7.88	Mbytes	6.27	Mbits/sec	5.760	ms	0/5622	0%
21.00	M	7.37	Mbytes	5.88	Mbits/sec	5.623	ms	0/5254	0%
25.00	M	7.86	Mbytes	6.26	Mbits/sec	6.205	ms	0/5607	0%
30.00	M	7.86	Mbytes	6.26	Mbits/sec	5.496	ms	0/5605	0%
50.00	M	7.84	Mbytes	6.22	Mbits/sec	7.045	ms	0/5591	0%

## G

Bandwidth(Sent )		Transmission Rate		Bandwidth		Jitter	Lost/Total	Datagrams	
5.00	M	5.96	Mbytes	5.00	Mbits/sec	0.050	ms	0/4252	0%
10.00	M	11.90	Mbytes	10.00	Mbits/sec	0.345	ms	0/8504	0%
15.00	M	17.90	Mbytes	15.00	Mbits/sec	0.020	ms	0/12756	0%
20.00	M	23.80	Mbytes	20.00	Mbits/sec	0.201	ms	0/17007	0%
25.00	M	29.80	Mbytes	25.00	Mbits/sec	0.055	ms	0/21277	0%
28.00	M	33.20	Mbytes	27.60	Mbits/sec	1.597	ms	0/23707	0%
29.00	M	32.90	Mbytes	27.30	Mbits/sec	0.225	ms	0/23468	0%
30.00	M	33.70	Mbytes	27.90	Mbits/sec	0.808	ms	0/24009	0%
31.00	M	34.30	Mbytes	28.50	Mbits/sec	0.619	ms	0/24486	0%
32.00	M	32.90	Mbytes	27.30	Mbits/sec	1.565	ms	0/23479	0%
33.00	M	33.60	Mbytes	27.90	Mbits/sec	0.301	ms	0/23995	0%
34.00	M	32.70	Mbytes	27.10	Mbits/sec	0.316	ms	0/23317	0%
35.00	M	33.90	Mbytes	28.10	Mbits/sec	0.484	ms	0/24149	0%
40.00	M	33.00	Mbytes	27.40	Mbits/sec	0.493	ms	0/23571	0%

	50.00	M	33.80	Mbytes	28.00	Mbits/sec	1.047	ms	0/24085	0%
	70.00	M	33.50	Mbytes	27.80	Mbits/sec	1.284	ms	0/23907	0%
	100.00	M	33.70	Mbytes	27.90	Mbits/sec	1.554	ms	0/24041	0%

## 2 clients Mixed

Bandwidth(Sent )	Transmission Rate	Bandwidth (Receive)	Jitter	Lost/Total	Datagrams
1.00 M	1.19 Mbytes	1.00 Mbits/sec	0.032 ms	0/852	0%
1.00 M	1.19 Mbytes	1.00 Mbits/sec	0.014 ms	0/852	0%
5.00 M	5.96 Mbytes	5.00 Mbits/sec	0.214 ms	0/4252	0%
5.00 M	5.96 Mbytes	5.00 Mbits/sec	0.391 ms	0/4252	0%
10.00 M	11.90 Mbytes	9.97 Mbits/sec	0.538 ms	0/8476	0%
10.00 M	11.90 Mbytes	10.00 Mbits/sec	0.376 ms	0/8504	0%
15.00 M	17.60 Mbytes	14.50 Mbits/sec	0.678 ms	0/12573	0%
15.00 M	17.10 Mbytes	14.30 Mbits/sec	0.028 ms	0/12189	0%
20.00 M	19.10 Mbytes	15.60 Mbits/sec	0.728 ms	0/13596	0%
20.00 M	19.00 Mbytes	15.90 Mbits/sec	0.03 ms	0/13530	0%
25.00 M	20.70 Mbytes	17.00 Mbits/sec	2.606 ms	0/14797	0%
25.00 M	20.70 Mbytes	17.30 Mbits/sec	0.066 ms	0/14741	0%
30.00 M	20.90 Mbytes	17.20 Mbits/sec	2.554 ms	0/14941	0%
30.00 M	19.90 Mbytes	16.50 Mbits/sec	0.275 ms	0/14182	0%
35.00 M	18.30 Mbytes	15.00 Mbits/sec	2.952 ms	0/13033	0%
35.00 M	17.70 Mbytes	14.60 Mbits/sec	0.207 ms	0/12591	0%
36.00 M	17.90 Mbytes	14.70 Mbits/sec	2.675 ms	0/12751	0%
36.00 M	17.10 Mbytes	14.10 Mbits/sec	2.185 ms	0/12162	0%
37.00 M	22.90 Mbytes	18.80 Mbits/sec	2.432 ms	0/16364	0%
37.00 M	23.00 Mbytes	19.00 Mbits/sec	0.416 ms	0/16382	0%
38.00 M	18.20 Mbytes	15.00 Mbits/sec	2.507 ms	0/13012	0%
38.00 M	17.80 Mbytes	14.70 Mbits/sec	0.255 ms	0/12666	0%
39.00 M	15.90 Mbytes	12.90 Mbits/sec	1.895 ms	0/11338	0%
39.00 M	19.90 Mbytes	16.50 Mbits/sec	1.446 ms	0/14217	0%
40.00 M	19.30 Mbytes	15.80 Mbits/sec	2.376 ms	0/13786	0%
40.00 M	19.10 Mbytes	15.80 Mbits/sec	1.362 ms	0/13616	0%
41.00 M	18.10 Mbytes	14.70 Mbits/sec	1.761 ms	0/12876	0%

41.00	M	17.90	Mbytes	14.80	Mbits/sec	0.819 ms	0/12755	0%
43.00	M	18.90	Mbytes	15.50	Mbits/sec	2.815 ms	0/13499	0%
43.00	M	18.70	Mbytes	15.50	Mbits/sec	1.222 ms	0/13325	0%
45.00	M	21.20	Mbytes	17.30	Mbits/sec	3.162 ms	0/15093	0%
45.00	M	20.80	Mbytes	17.30	Mbits/sec	1.206 ms	0/14854	0%
45.00	M	18.80	Mbytes	15.50	Mbits/sec	2.259 ms	0/13436	0%
45.00	M	19.80	Mbytes	16.50	Mbits/sec	0.917 ms	0/14156	0%
50.00	M	18.70	Mbytes	15.50	Mbits/sec	1.198 ms	0/13348	0%
50.00	M	14.70	Mbytes	12.10	Mbits/sec	1.737 ms	0/10489	0%

## B

Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
5.00	M	5.05	Mbytes	3.85	Mbits/sec	5.314 ms	0/3604	0%
5.00	M	4.94	Mbytes	4.14	Mbits/sec	0.027 ms	0/3523	0%
10.00	M	4.77	Mbytes	3.66	Mbits/sec	9.463 ms	0/3402	0%
10.00	M	4.30	Mbytes	3.41	Mbits/sec	2.868 ms	0/3065	0%
12.00	M	4.37	Mbytes	3.39	Mbits/sec	8.589 ms	0/3115	0%
12.00	M	4.18	Mbytes	3.00	Mbits/sec	17.212 ms	0/2982	0%
13.00	M	4.11	Mbytes	3.15	Mbits/sec	11.161 ms	0/2931	0%
13.00	M	4.32	Mbytes	3.30	Mbits/sec	10.923 ms	0/3084	0%
14.00	M	5.16	Mbytes	3.97	Mbits/sec	12.219 ms	0/3681	0%
14.00	M	5.08	Mbytes	4.05	Mbits/sec	5.438 ms	0/3626	0%
15.00	M	5.64	Mbytes	4.34	Mbits/sec	9.406 ms	0/4020	0%
15.00	M	4.96	Mbytes	3.97	Mbits/sec	5.591 ms	0/3536	0%
16.00	M	5.17	Mbytes	3.97	Mbits/sec	9.317 ms	0/3688	0%
16.00	M	4.70	Mbytes	3.74	Mbits/sec	2.093 ms	0/3351	0%
17.00	M	4.29	Mbytes	3.29	Mbits/sec	10.817 ms	0/3057	0%
17.00	M	4.18	Mbytes	3.19	Mbits/sec	9.325 ms	0/2982	0%
20.00	M	4.17	Mbytes	3.15	Mbits/sec	13.12 ms	0/2974	0%
20.00	M	4.32	Mbytes	3.33	Mbits/sec	9.735 ms	0/3083	0%
25.00	M	4.12	Mbytes	3.98	Mbits/sec	35.356 ms	0/2940	0%
25.00	M	4.84	Mbytes	3.81	Mbits/sec	10.094 ms	0/3452	0%
30.00	M	4.38	Mbytes	3.34	Mbits/sec	13.478 ms	0/3123	0%
30.00	M	4.23	Mbytes	3.33	Mbits/sec	10.000 ms	0/3019	0%

200.00	M	4.45	Mbytes	3.39	Mbits/sec	11.639 ms	0/3172	0%
200.00	M	4.36	Mbytes	3.45	Mbits/sec	8.023 ms	0/3106	0%

## G

Bandwidth(Sent )		Transmission Rate		Bandwidth (Receive)		Jitter	Lost/Total	Datagrams
5.00	M	5.96	Mbytes	5.01	Mbits/sec	0.09 ms	0/4253	0%
5.00	M	5.96	Mbytes	5.01	Mbits/sec	0.25 ms	0/4252	0%
10.00	M	11.30	Mbytes	8.96	Mbits/sec	1.935 ms	0/8026	0%
10.00	M	10.90	Mbytes	8.91	Mbits/sec	9.327 ms	0/7785	0%
15.00	M	17.10	Mbytes	14.10	Mbits/sec	1.376 ms	0/12229	0%
15.00	M	17.50	Mbytes	14.60	Mbits/sec	0.123 ms	0/12452	0%
20.00	M	18.10	Mbytes	14.80	Mbits/sec	0.863 ms	0/12898	0%
20.00	M	17.80	Mbytes	15.00	Mbits/sec	0.041 ms	0/12726	0%
25.00	M	19.60	Mbytes	16.10	Mbits/sec	3.073 ms	0/13945	0%
25.00	M	19.50	Mbytes	16.40	Mbits/sec	0.076 ms	0/13925	0%
30.00	M	19.30	Mbytes	15.80	Mbits/sec	3.404 ms	0/13732	0%
30.00	M	18.10	Mbytes	15.00	Mbits/sec	1.25 ms	0/12911	0%
35.00	M	19.90	Mbytes	16.30	Mbits/sec	3.836 ms	0/14206	0%
35.00	M	19.90	Mbytes	16.50	Mbits/sec	0.242 ms	0/14184	0%
40.00	M	22.60	Mbytes	18.60	Mbits/sec	1.62 ms	0/16099	0%
40.00	M	21.10	Mbytes	17.50	Mbits/sec	1.241 ms	0/15017	0%
42.00	M	19.90	Mbytes	16.30	Mbits/sec	2.531 ms	0/14183	0%
42.00	M	19.40	Mbytes	16.10	Mbits/sec	1.198 ms	0/13869	0%
43.00	M	23.60	Mbytes	19.30	Mbits/sec	2.671 ms	0/16891	0%
43.00	M	22.60	Mbytes	18.70	Mbits/sec	1.601 ms	0/16088	0%
44.00	M	25.50	Mbytes	20.90	Mbits/sec	2.303 ms	0/18162	0%
44.00	M	25.00	Mbytes	20.70	Mbits/sec	1.154 ms	0/17043	0%
45.00	M	22.30	Mbytes	18.30	Mbits/sec	2.379 ms	0/15873	0%
45.00	M	21.80	Mbytes	18.10	Mbits/sec	1.418 ms	0/15534	0%
46.00	M	20.50	Mbytes	16.80	Mbits/sec	2.543 ms	0/14629	0%
46.00	M	20.50	Mbytes	17.00	Mbits/sec	0.643 ms	0/14657	0%
47.00	M	19.50	Mbytes	15.80	Mbits/sec	4.428 ms	0/13913	0%
47.00	M	20.20	Mbytes	16.70	Mbits/sec	1.247 ms	0/14375	0%

50.00	M	18.60	Mbytes	15.30	Mbits/sec	2.363 ms	0/13249	0%
50.00	M	18.40	Mbytes	15.30	Mbits/sec	0.612 ms	0/13155	0%
55.00	M	17.40	Mbytes	14.30	Mbits/sec	2.612 ms	0/12426	0%
55.00	M	17.70	Mbytes	14.70	Mbits/sec	1.187 ms	0/12614	0%
200.00	M	17.10	Mbytes	14.00	Mbits/sec	2.929 ms	0/12212	0%
200.00	M	16.30	Mbytes	13.50	Mbits/sec	1.256 ms	0/11646	0%

