



Network
Testing &
Emulation
Solutions

Testing As a service Test plans and reports



sales@candelatech.com



1-360-380-1618

Test Suite Details

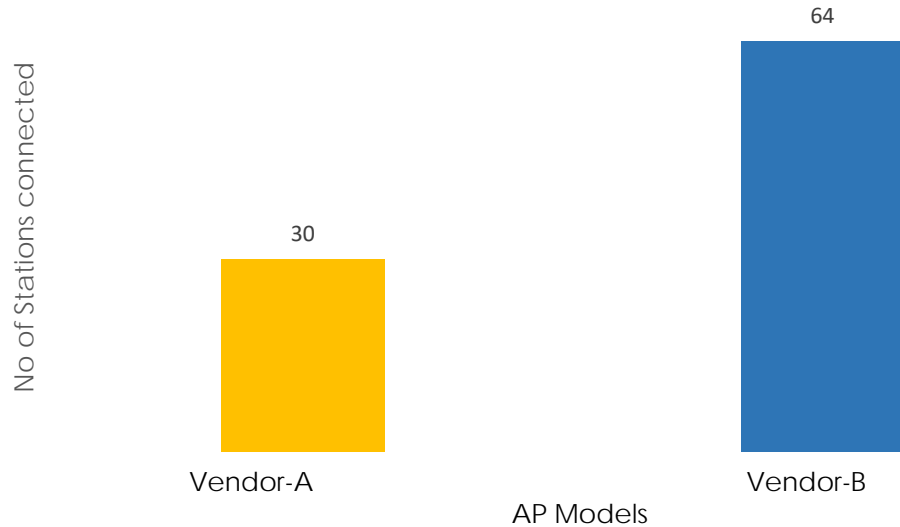
SI No	Test Catageory	Test Case	No of Testcases
1	Basic Testing	Client Connectivity -2.4 & 5 GHz	17
2		Throughput with client capacity - 2.4 & 5 GHz	
3		Multi Band Throughput	
4		Data Plane - 2.4 & 5 GHz	
5		Port Reset	
6	Advanced Testing	Quality of Service	34
7		Dynamic Frequency Selection	
8		Performance Over Distance (RVR)	
9		Performance Over Orientation (RVO)	
10		File Transfer Protocol	
11		Interference (ACI/CCI)	
12		MU-MIMO	
13		OFDMA	
14		Airtime Fairness	
15		Roaming	
16		Long Term Stability	
17	TR-398 Testing	TR-398 issue-2	15
18	Coverage and Capacity test house	Coverage, roam and capacity with 40+ devices	5

Results Summary

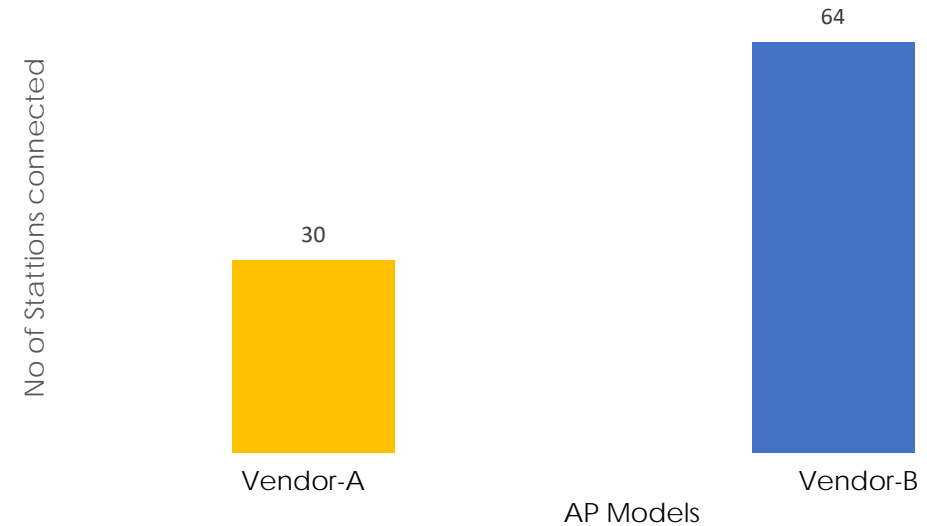
Num	Tests	Vendor A	Vendor B
1	Basic Client connectivity – 2.4 GHz	Good	Excellent
2	Basic Client connectivity – 5 GHz	Good	Excellent
3	Client Capacity – 5 GHz TCP UL	Good	Excellent
4	Client Capacity – 5 GHz TCP DL	Good	Excellent
5	Client Capacity – 5 GHz UDP UL	Good	Excellent
6	Client Capacity – 5 GHz UDP DL	Poor	Excellent
7	Client Capacity – 2.4 GHz TCP UL	Good	Excellent
8	Client Capacity – 2.4 GHz TCP DL	Poor	Excellent
9	Client Capacity – 2.4 GHz UDP UL	Excellent	Good
10	Client Capacity – 2.4 GHz TCP DL	Poor	Excellent
11	Data Plane – 2.4 GHz	Excellent	N/A
12	Data Plane – 5 GHz	Excellent	N/A
13	Port Reset	Excellent	N/A
14	Quality of Service – 5 GHz	Good	N/A
15	Dual Band Testing – 5GHz TCP Upload	Good	Excellent
16	Dual Band Testing – 5GHz TCP Download	Poor	Excellent
17	Dual Band Testing – 5GHz UDP Upload	Poor	Excellent
18	Dual Band Testing – 5GHz UDP Download	Poor	Excellent
19	FTP – 2.4 GHz	Excellent	Excellent
20	FTP – 5 GHz	Poor	Excellent
21	DFS	Excellent	N/A
22	Rate vs Range	Good	Good
23	Rate vs Orientation	Poor	Good

Basic Client Connectivity

Client Connectivity on 2.4 GHz band



Client Connectivity on 5 GHz Band



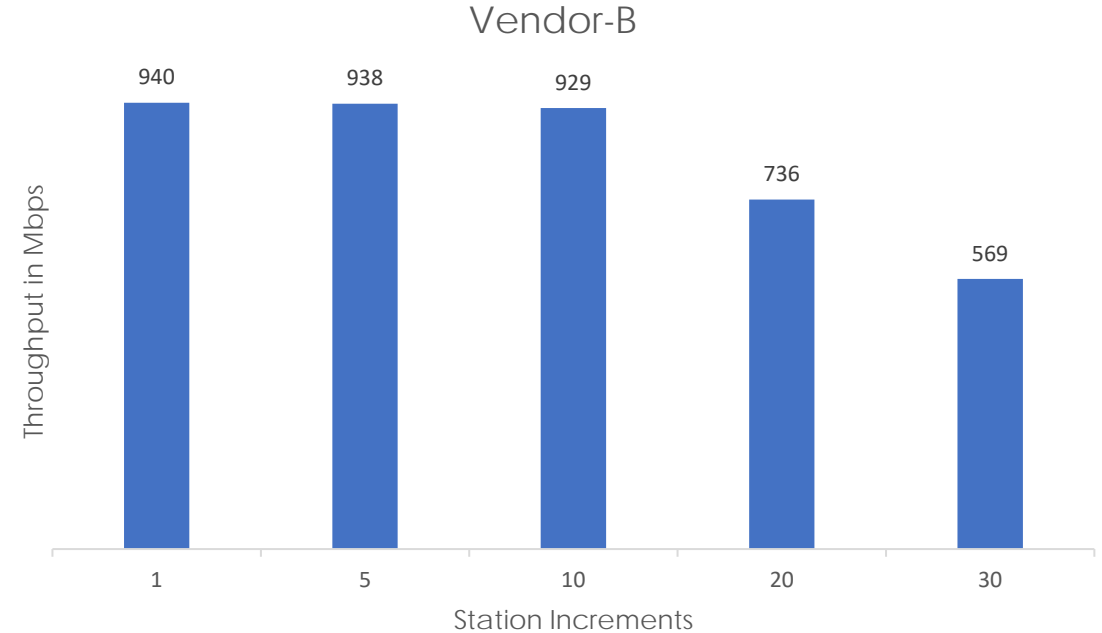
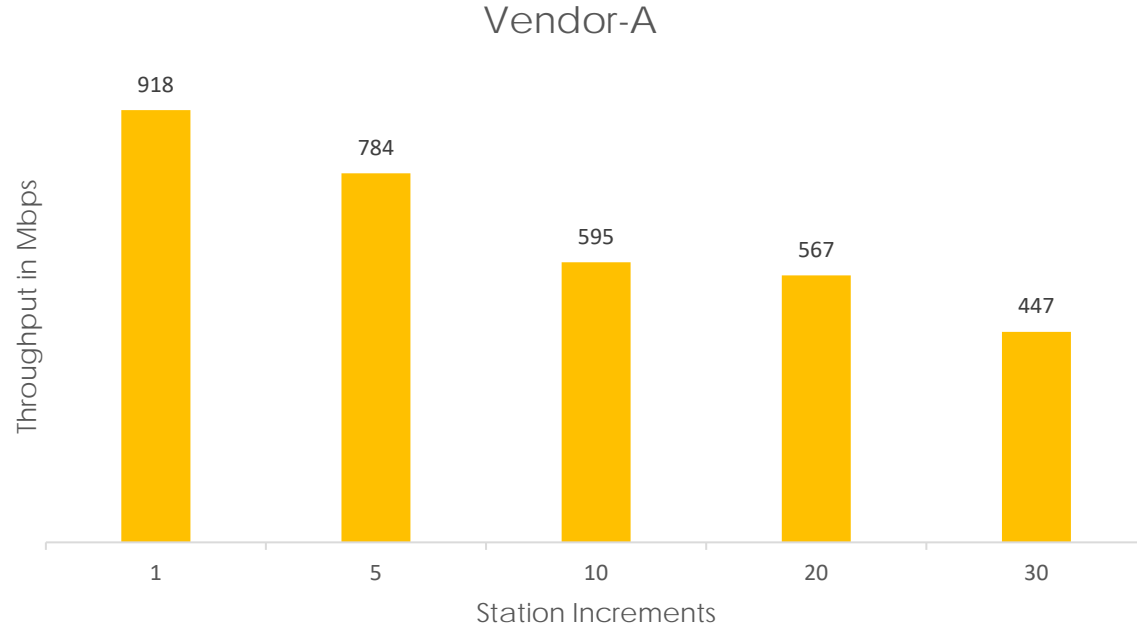
Test Description:

- DUT in ideal test conditions. No interfering APs and a good signal to the stations.
- All 2.4 GHz clients are connected in 3*3 with ax mode.
- All the 5 GHz clients are connected in 4*4 with ax mode.

Results Observations:

- In both bands, more clients are connecting to Vendor-B.

Client Capacity – 5 GHz TCP UL



Test Description:

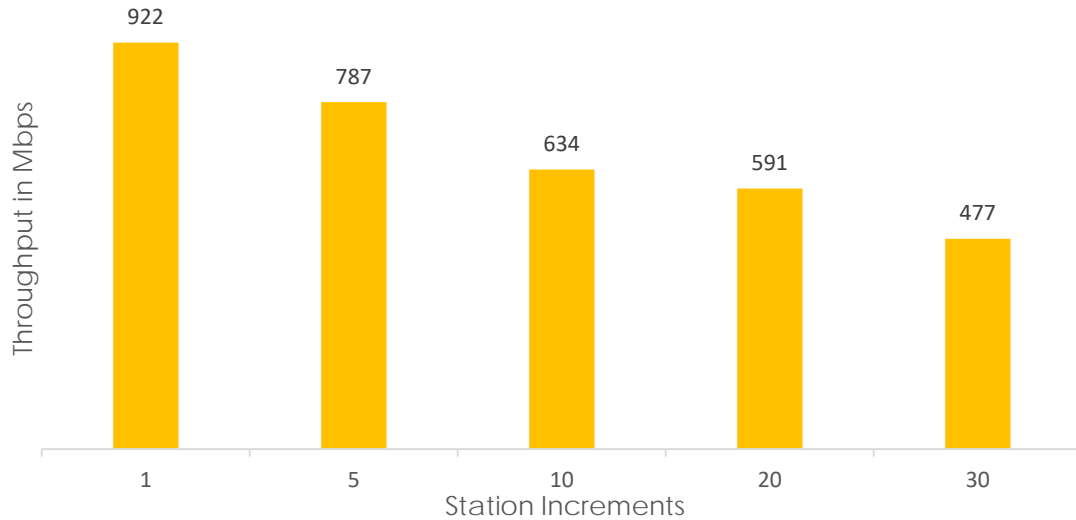
- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with upstream, TCP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

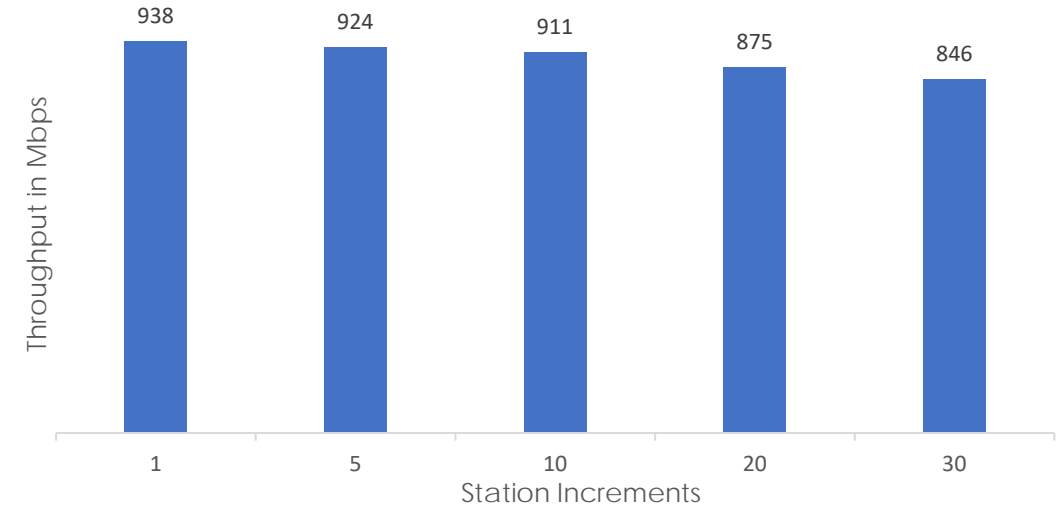
- Vendor B AP, good achieved throughput for single station and increments as well

Client Capacity – 5 GHz TCP DL

Vendor-A



Vendor-B



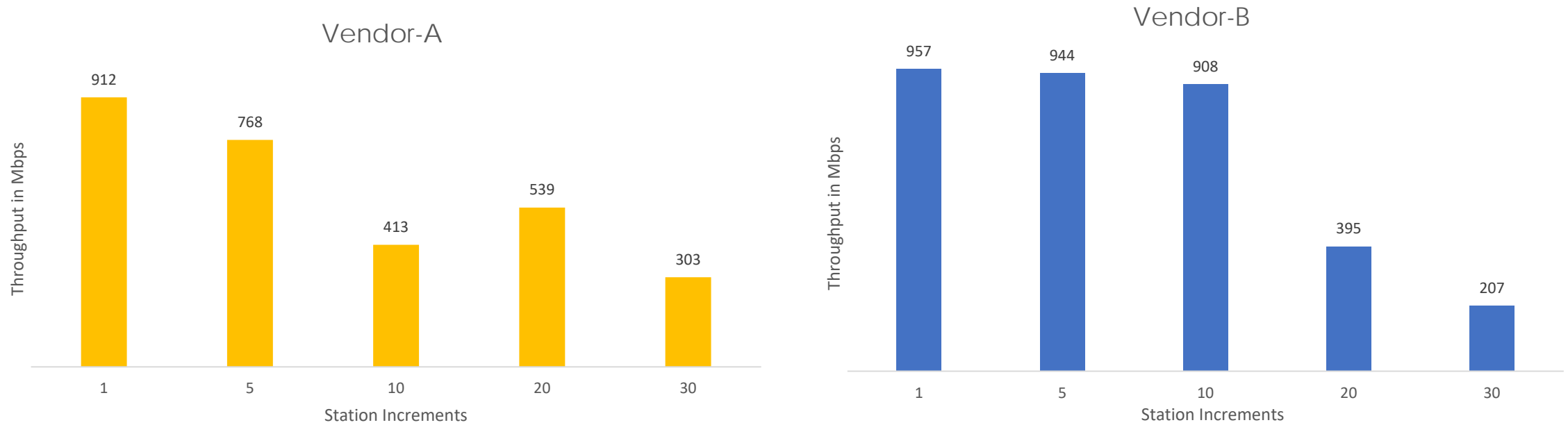
Test Description:

- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with downstream, TCP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

- Vendor B AP, good achieved throughput for single station and increments as well

Client Capacity – 5 GHz UDP UL



Test Description:

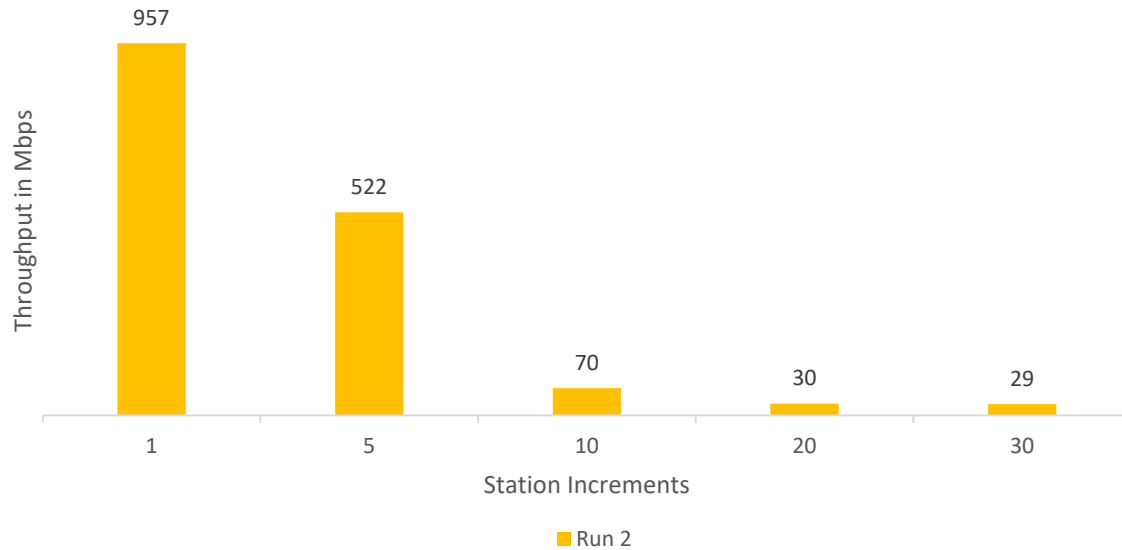
- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with upstream, UDP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

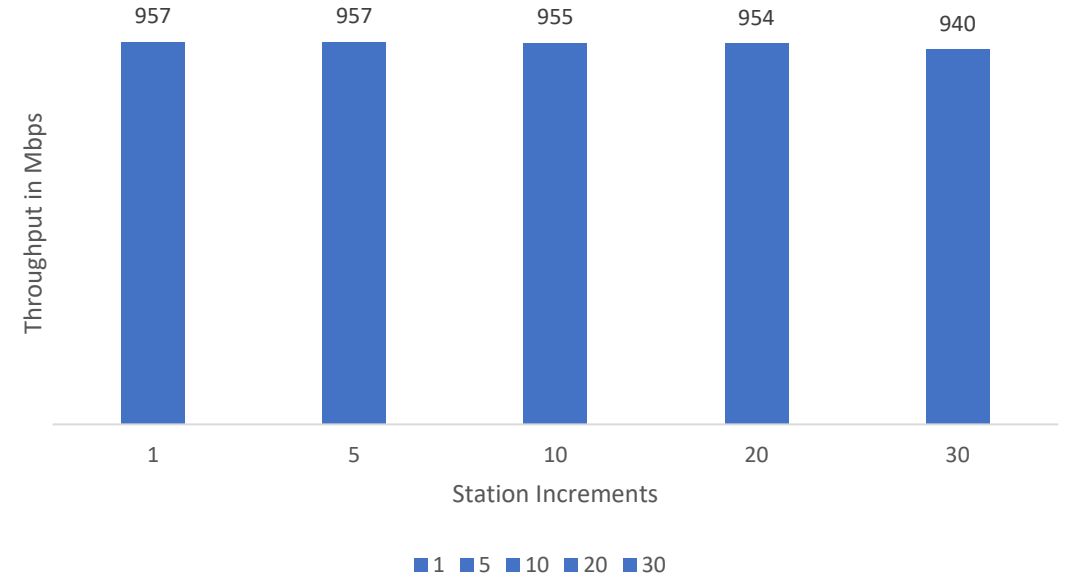
- Vendor B AP, good achieved throughput for single station and increments as well.
- Conflict at the point of 30 clients.

Client Capacity – 5 GHz UDP DL

Vendor-A



Vendor-B



Test Description:

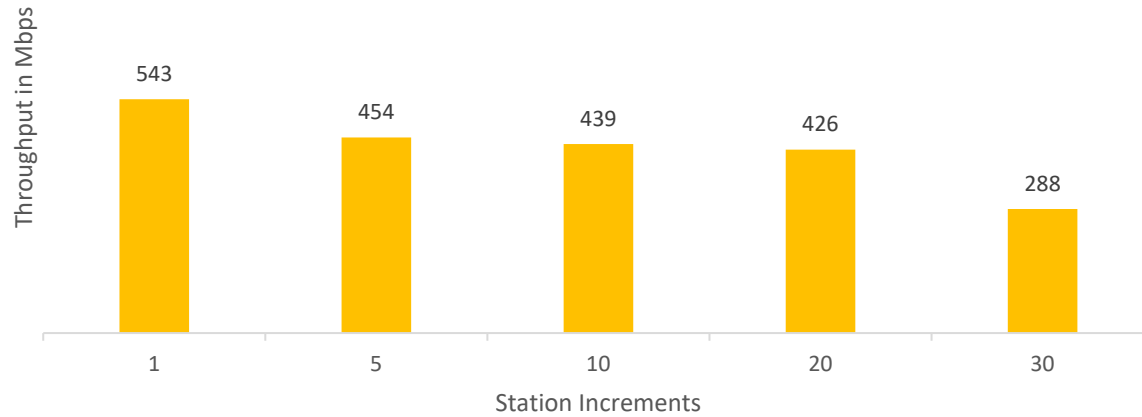
- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with downstream, UDP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

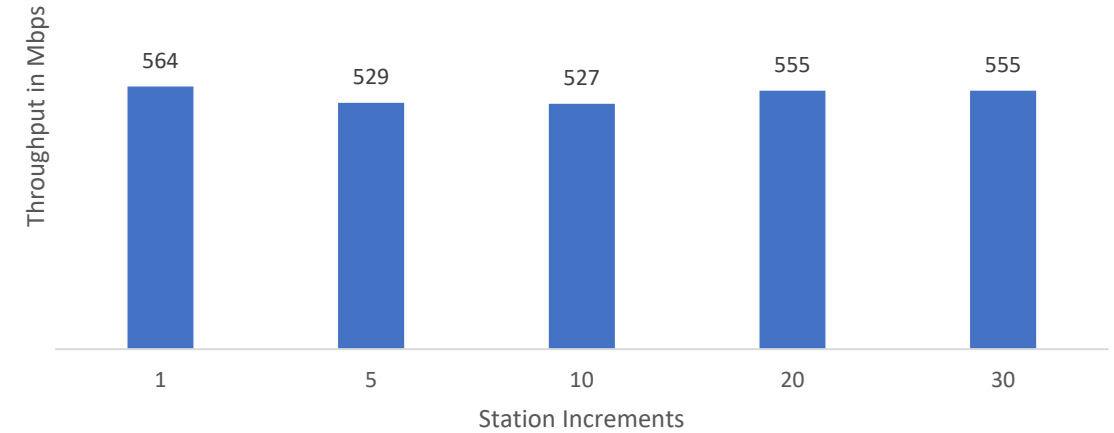
- Vendor B AP, good achieved throughput for single station and increments as well

Client capacity- 2.4GHz TCP-UP

Vendor-A



Vendor B



Test Description:

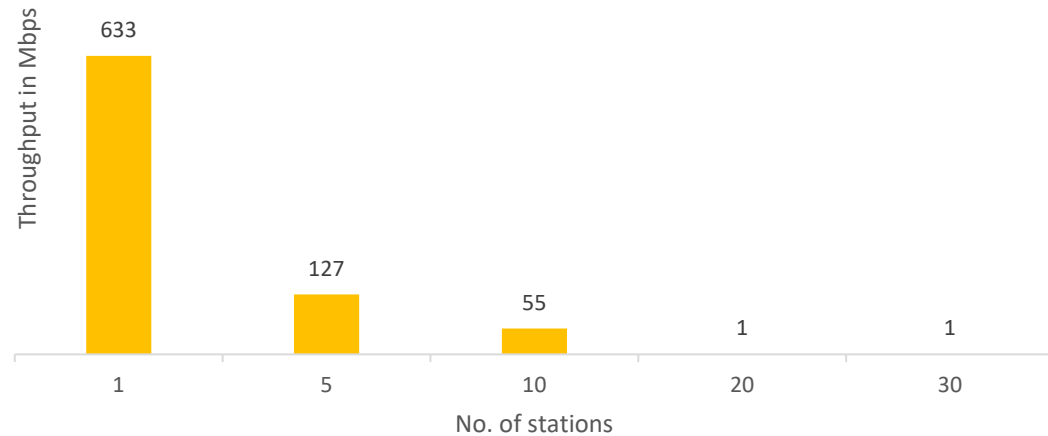
- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 3NSS, 40Mhz BW
- Test run for 60 sec trials for different station increments with upstream, TCP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 2.4GHz on channel 1

Results Observations:

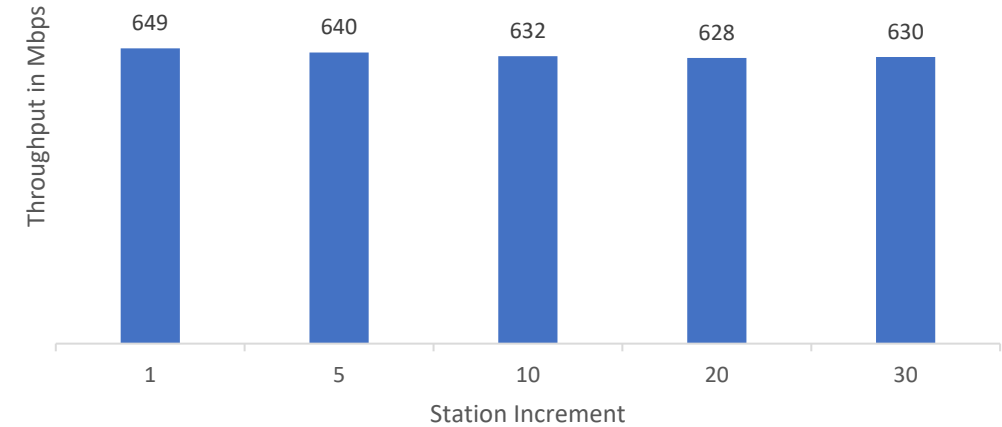
- Vendor B AP, good achieved throughput for single station and increments as well

Client capacity- 2.4GHz TCP-DL

Vendor-A



Vendor B



Test Description:

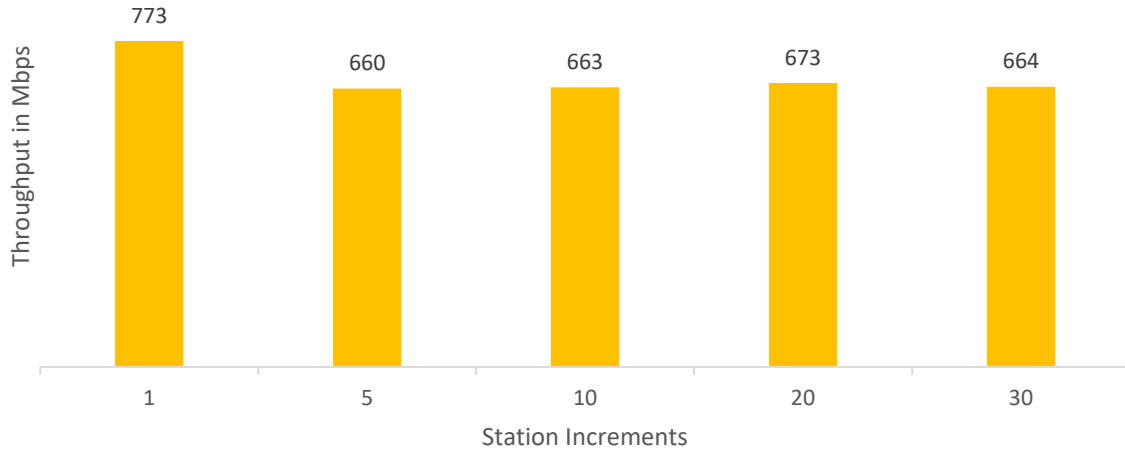
- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 3NSS, 40Mhz BW
- Test run for 60 sec trials for different station increments with downstream, TCP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 2.4GHz on channel 1

Results Observations:

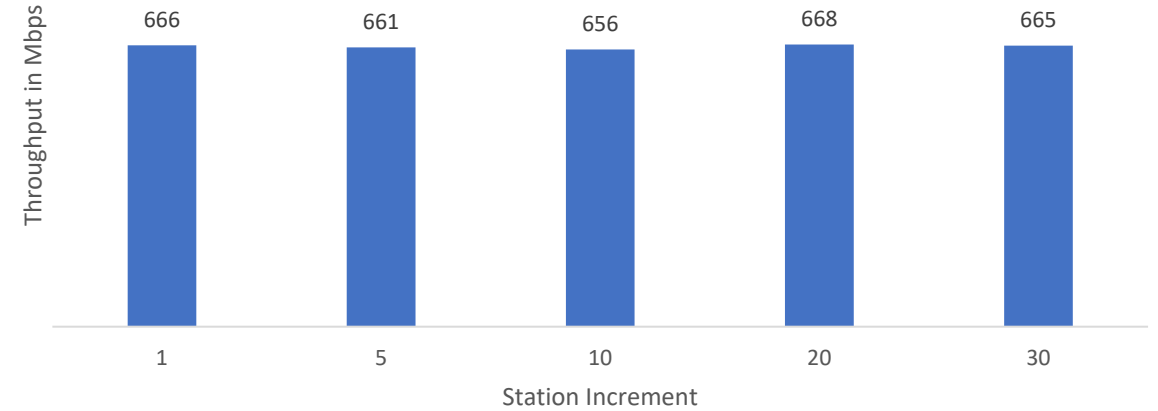
- Vendor B AP, good achieved throughput for single station and increments as well

Client capacity- 2.4GHz UDP-UL

Vendor-A



Vendor B



Test Description:

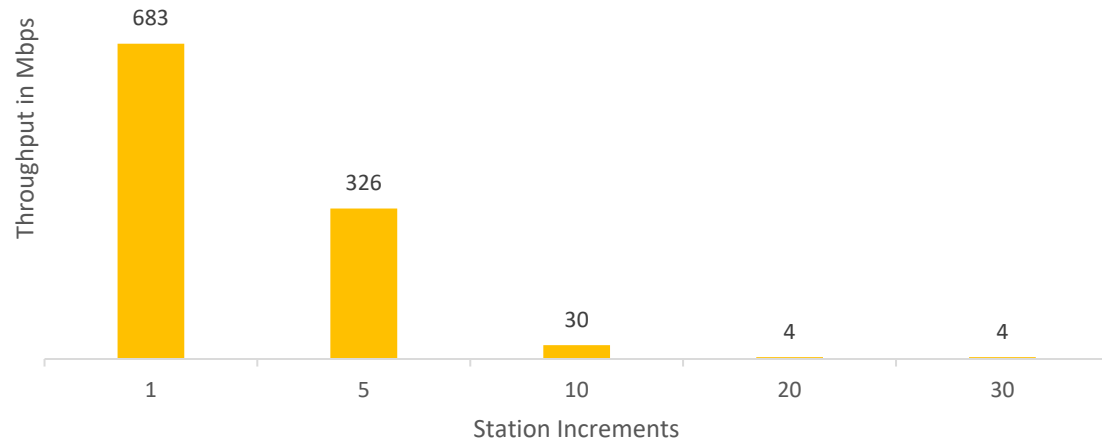
- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 3NSS, 40Mhz BW
- Test run for 60 sec trials for different station increments with upstream, UDP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 2.4GHz on channel 1

Results Observations:

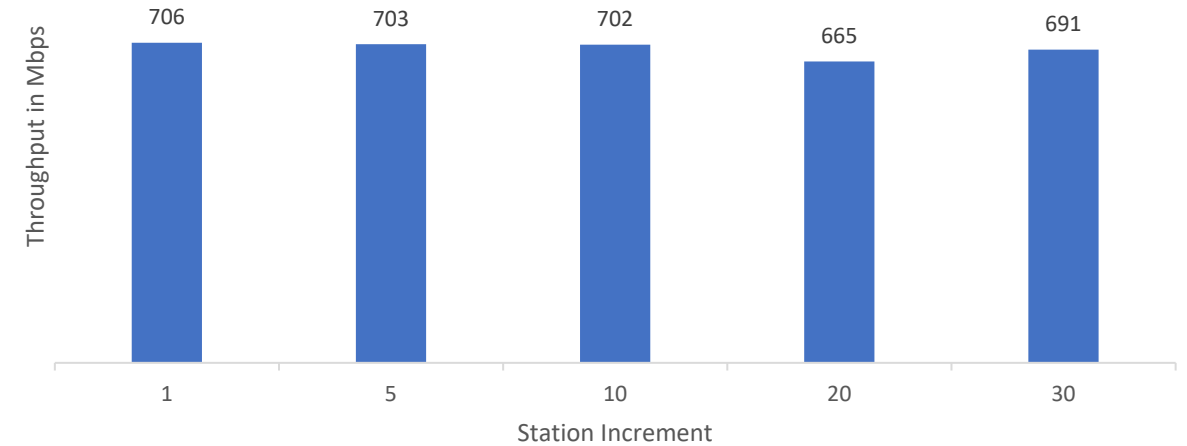
- Vendor-A, good achieved throughput for single station and increments as well
- Conflict by means of increase in throughput as the stations increase.

Client capacity- 2.4GHz UDP-DL

Vendor-A



Vendor B



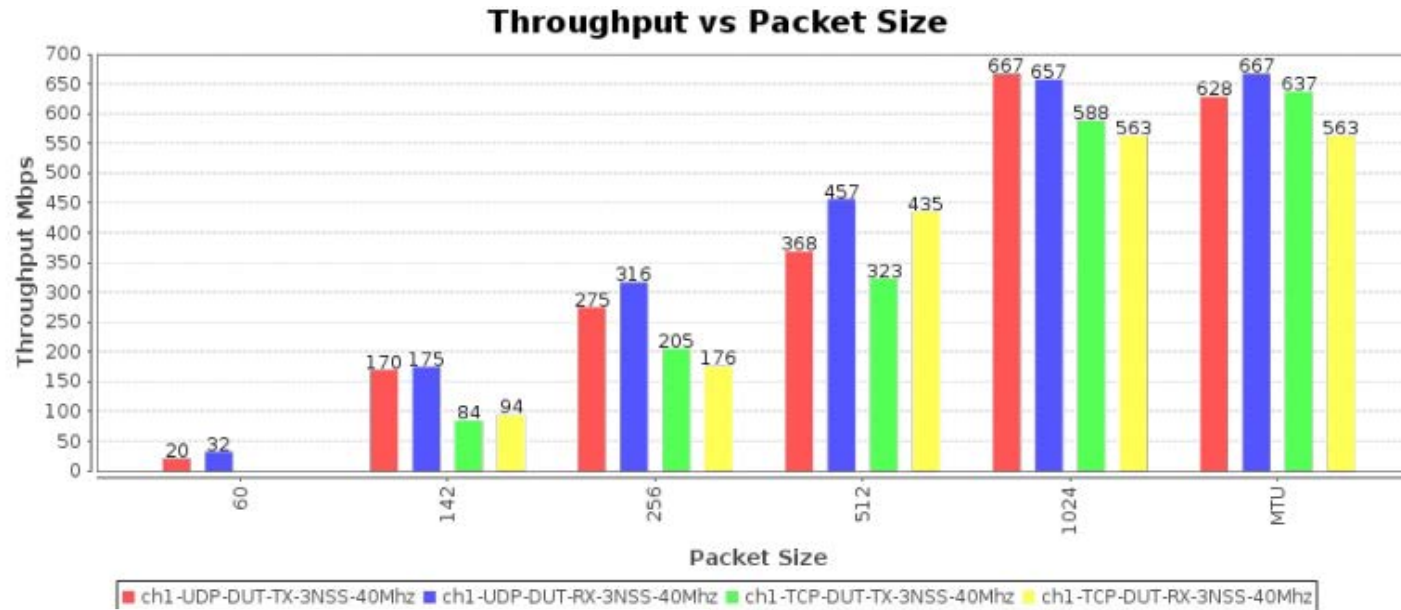
Test Description:

- DUT in ideal test conditions. No interfering APs and a good signal to the stations
- Intended load set to 1 Gbps rate for 3NSS, 40Mhz BW
- Test run for 60 sec trials for different station increments with downstream, TCP traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 2.4GHz on channel 1

Results Observations:

- Vendor B AP, good achieved throughput for single station and increments as well

Data-Plane test 2.4GHz



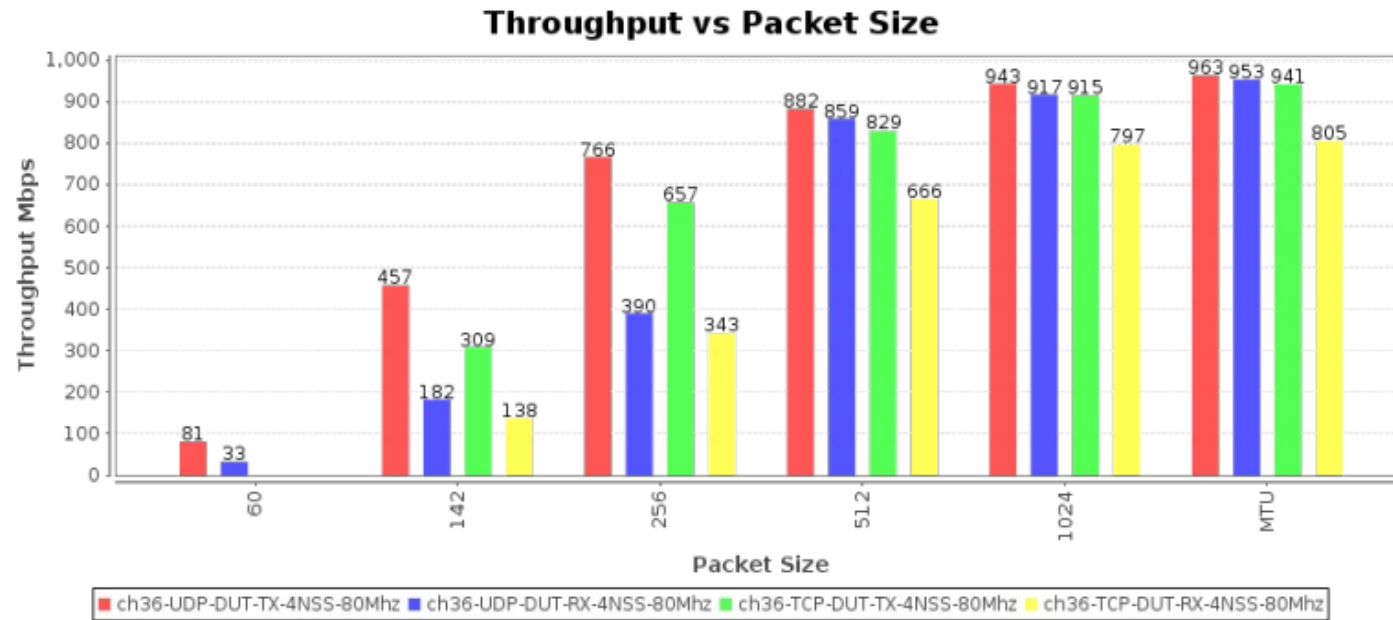
Test Description:

- In this scenario, the throughput is calculated by means of various kinds of packet sizes.
- Here we create a single client and check what is the maximum throughput at each point.
- Test run for 60 sec trials for different station increments with downstream and upstream traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 2.4GHz on channel 1, 3NSS.

Results Observations:

- Vendor-A, is performing good at the data-plane test but is relatively not as per MCS index.

Data-Plane test 5GHz



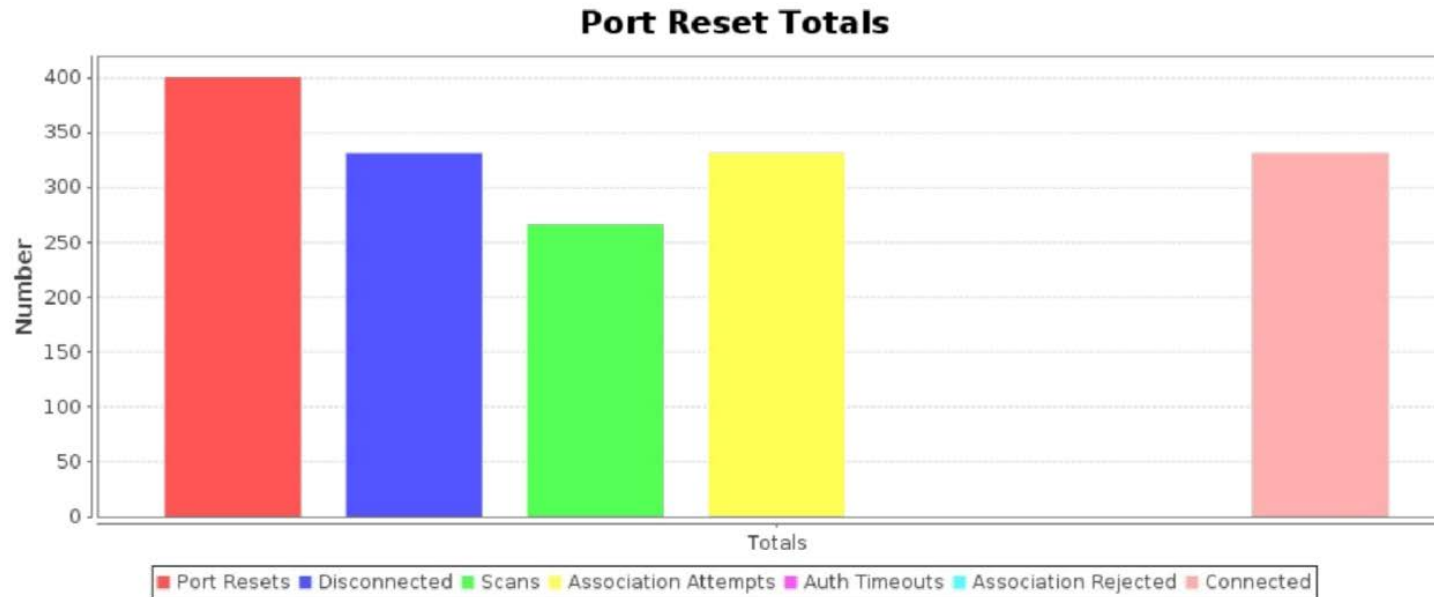
Test Description:

- In this scenario, the throughput is calculated by means of various kinds of packet sizes.
- Here we create a single client and check what is the maximum throughput at each point.
- Test run for 60 sec trials for different station increments with downstream and upstream traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36, 4NSS.

Results Observations:

- Vendor-A, is performing good at the data-plane test but is relatively not as per MCS index.

Port Reset-2.4GHz



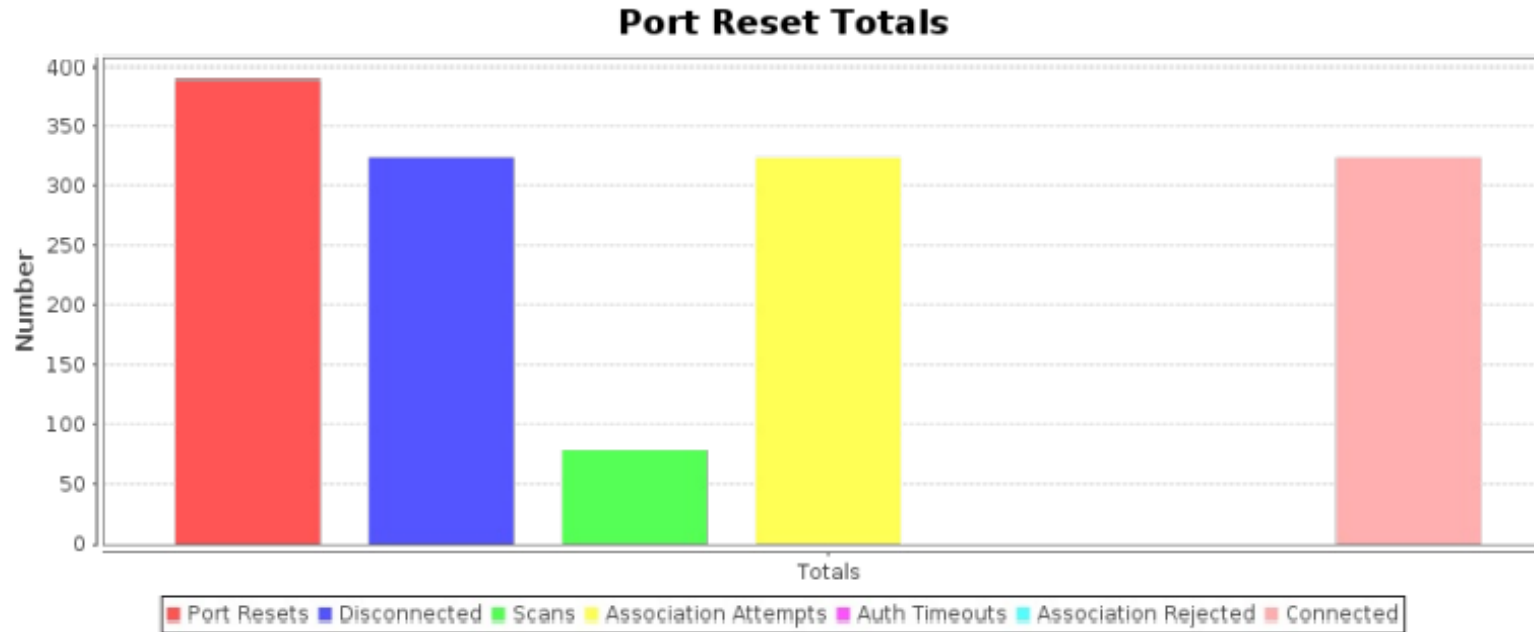
Test Description:

- In this scenario, the port reset time and association time is calculated
- Here we create 30-clients and check what is the maximum rate of port reset at each point.
- Test run for 60 sec(min) and 120(max) trials for different port intervals.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Port reset test run in 2.4GHz on channel 1, 3NSS.

Results Observations:

- Vendor-A, is following good port reset count for 30-clients in the span of 1 hour.

Port Reset 5GHz



Test Description:

- In this scenario, the port reset time and association time is calculated
- Here we create 30-clients and check what is the maximum rate of port reset at each point.
- Test run for 60 sec(min) and 120(max) trials for different port intervals.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Port reset test run in 5GHz on channel 36, 4NSS.

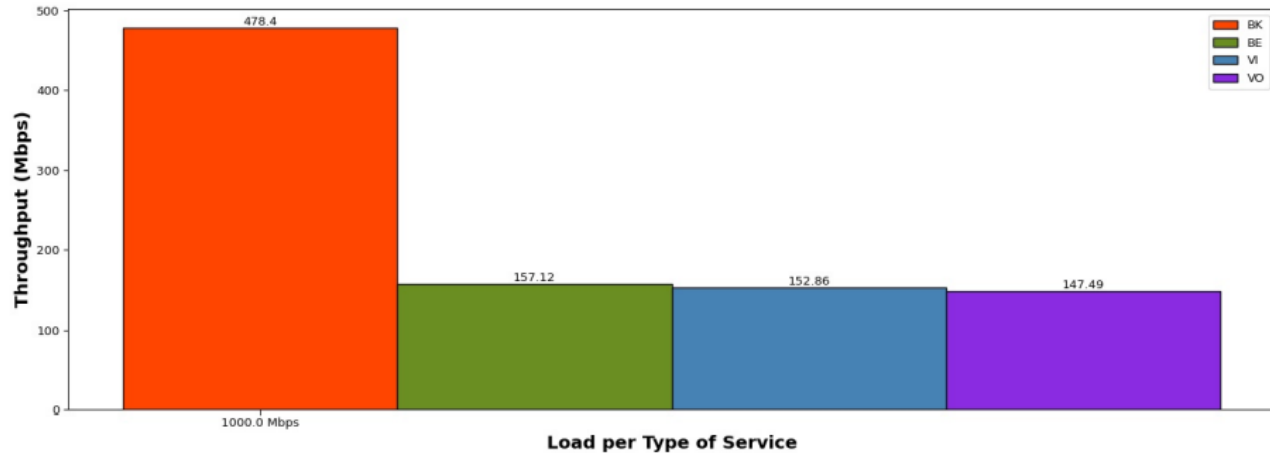
Results Observations:

- Vendor-A, is following good port reset count for 30-clients in the span of 1 hour.

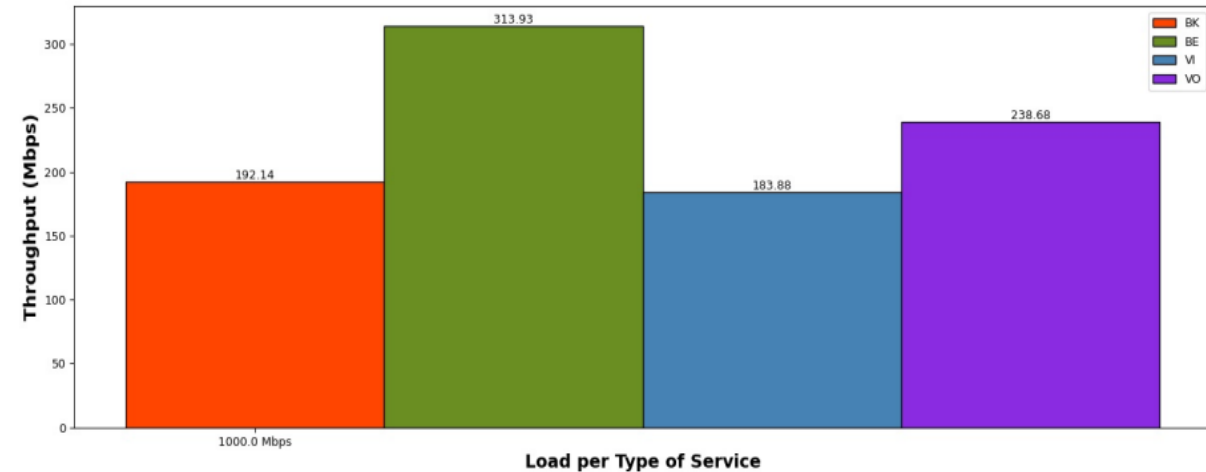
Quality of Service for 5GHz

1-Client and 2-clients

Overall download throughput - BK,BE,VO,VI traffic streams



Overall download throughput - BK,BE,VO,VI traffic streams



Test Description:

- In this scenario, the Quality of Service is observed by means of running various kinds of traffic:- VOICE, VIDEO, BACKEND, BEST EFFORT.
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with downstream, QoS traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

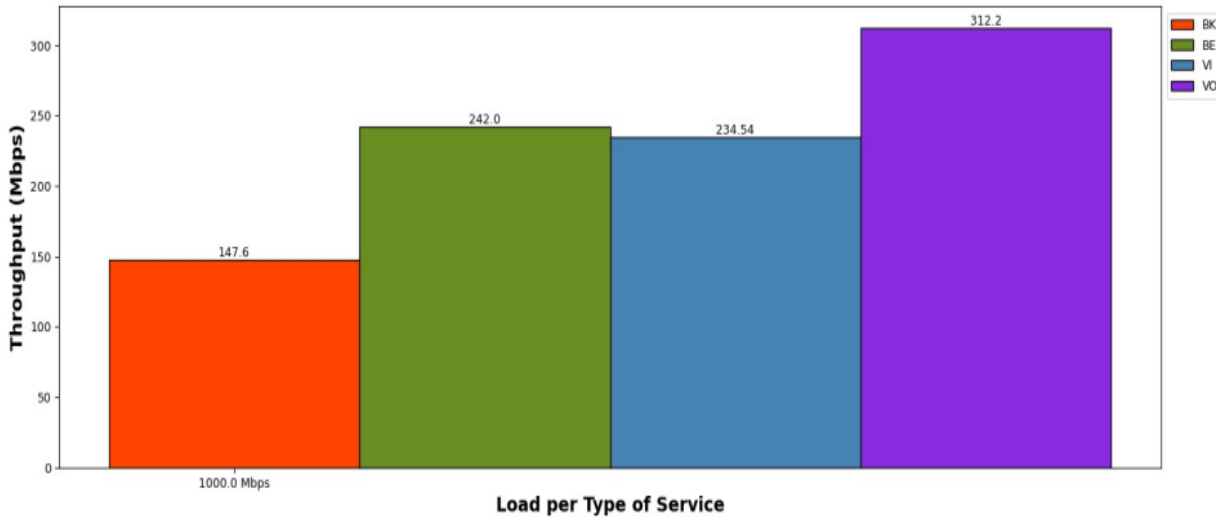
Results Observations:

- Vendor-A, is not following the precedence of QoS for both 1-client and 2-clients.

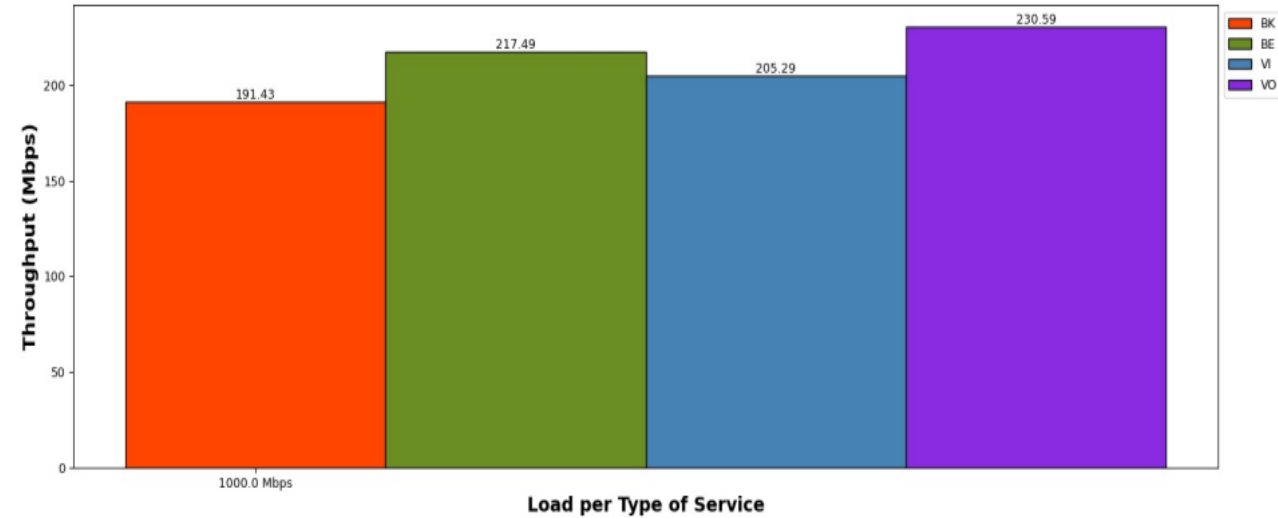
Quality of Service for 5GHz

5-Clients and 7-clients

Overall download throughput - BK,BE,VO,VI traffic streams



Overall download throughput - BK,BE,VO,VI traffic streams



Test Description:

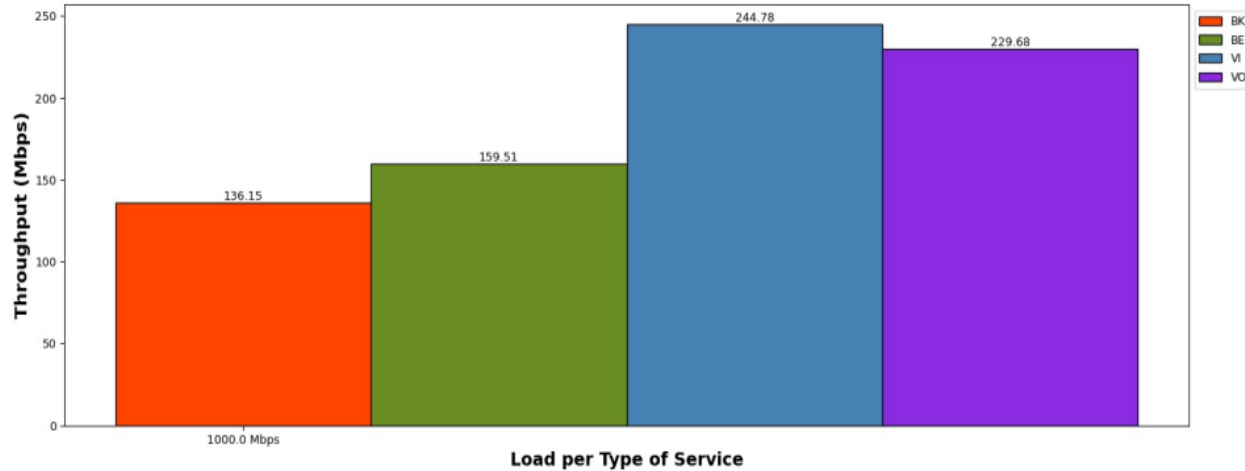
- In this scenario, the Quality of Service is observed by means of running various kinds of traffic:- VOICE, VIDEO, BACKEND, BEST EFFORT.
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with downstream, QoS traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

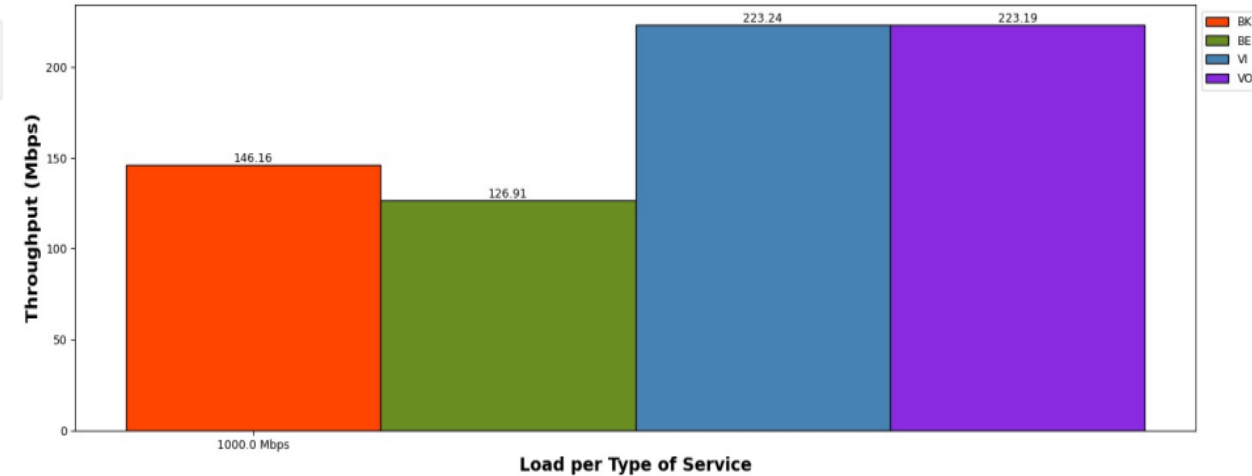
- Vendor-A, is not following the precedence of QoS for both 5-client and 7-clients.

Quality of Service for 5GHz 10-Clients and 15-clients

Overall download throughput - BK,BE,VO,VI traffic streams



Overall download throughput - BK,BE,VO,VI traffic streams



Test Description:

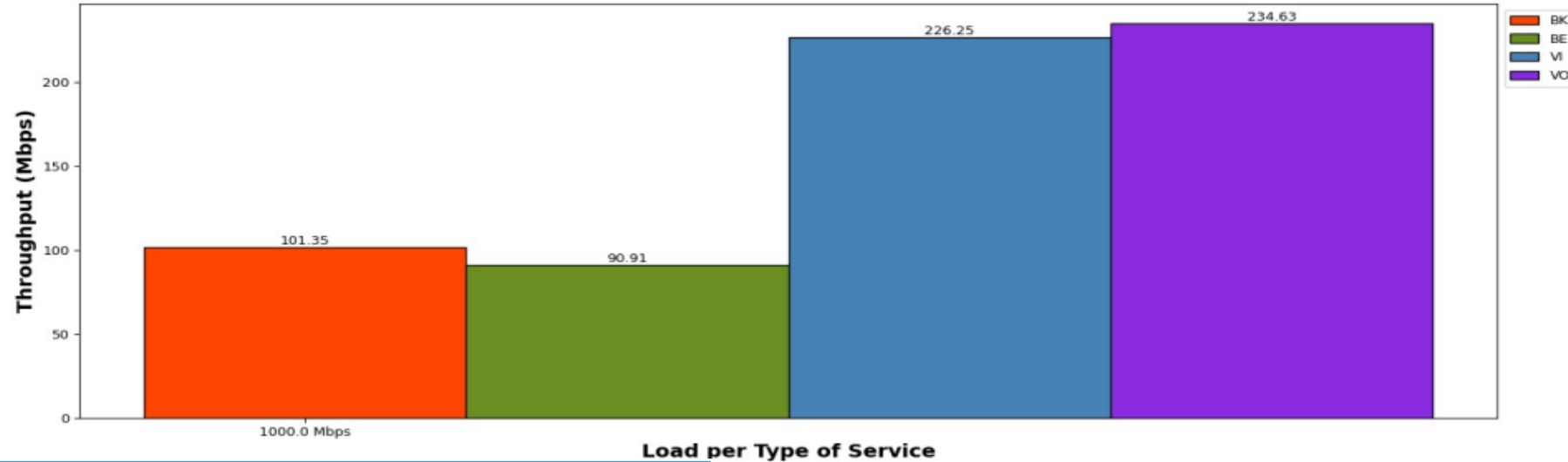
- In this scenario, the Quality of Service is observed by means of running various kinds of traffic:- VOICE, VIDEO, BACKEND, BEST EFFORT.
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with downstream, QoS traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

- Vendor-A, is not following the precedence of QoS for 10-clients and is following for 15-clients.

Quality of Service for 5GHz 19-clients

Overall download throughput – BK,BE,VO,VI traffic streams



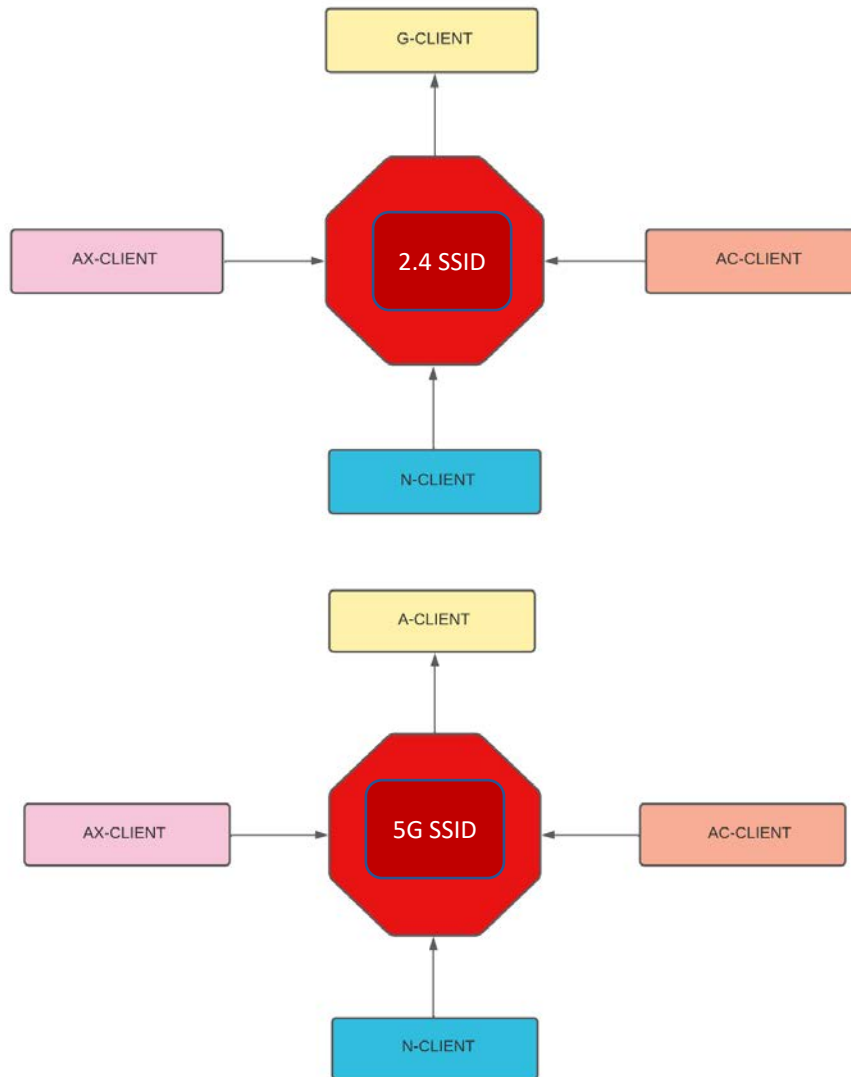
Test Description:

- In this scenario, the Quality of Service is observed by means of running various kinds of traffic:- VOICE, VIDEO, BACKEND, BEST EFFORT.
- Intended load set to 1 Gbps rate for 4NSS, 80Mhz BW
- Test run for 60 sec trials for different station increments with downstream, QoS traffic.
- DUT-TX is from AP to Client and DUT-Rx is from Client to AP.
- Throughput test run in 5GHz on channel 36

Results Observations:

- Vendor-A, is following the precedence of QoS for 19-clients.

Airtime Fairness testing:



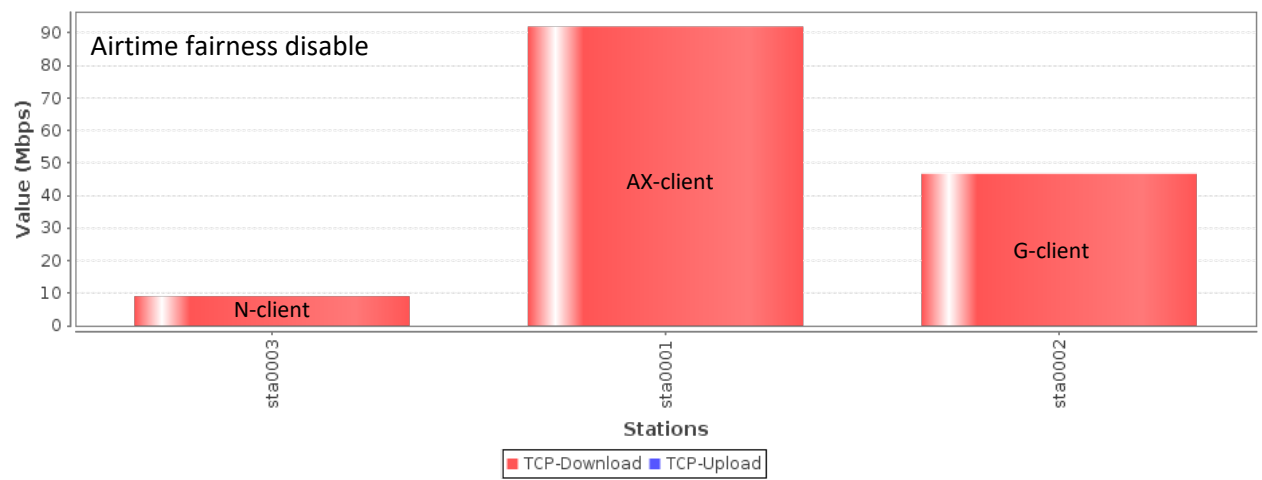
Test procedure for Airtime fairness test:

- In this testcase we create 4 different kind of clients, and connect them to the Vendor-A at the same time.
- We set the maximum traffic as 1Gbps, and run the traffic together for all the 4 clients.
- We also consider the network time as a constraint and monitor the throughput difference when Airtime Fairness is enabled.
- Airtime fairness can be observed only in the downlink traffic.

Airtime Fairness : TCP-DL[2.4GHz]

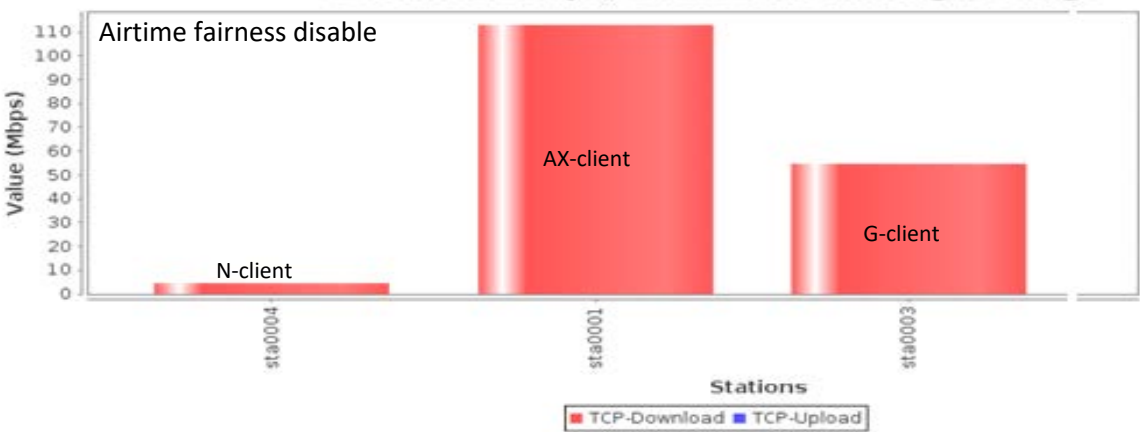
Vendor-A

Combined Mbps, 60 second running average

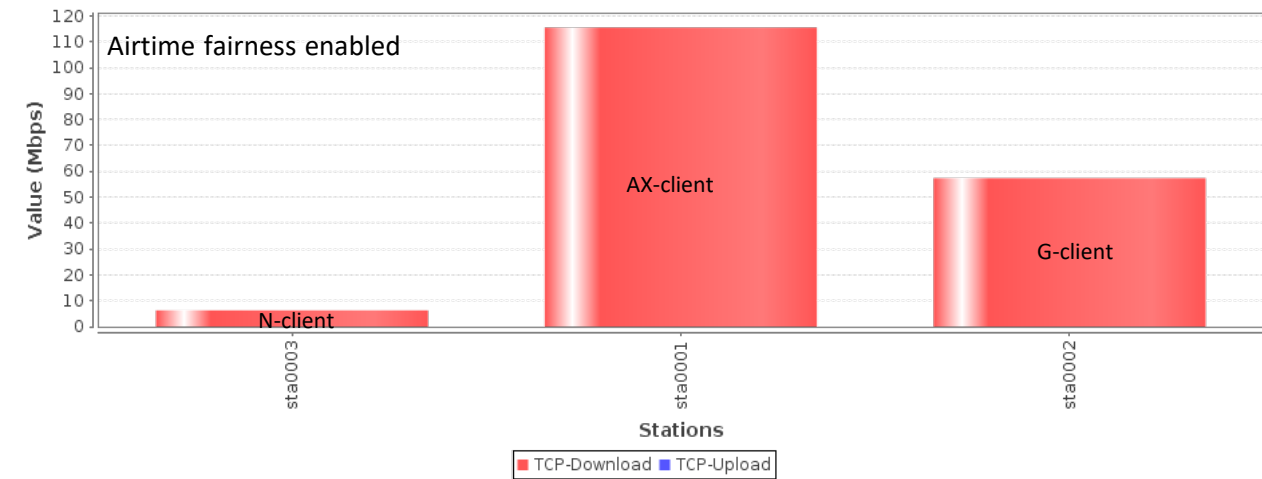


Vendor-B

Combined Mbps, 60 second running average

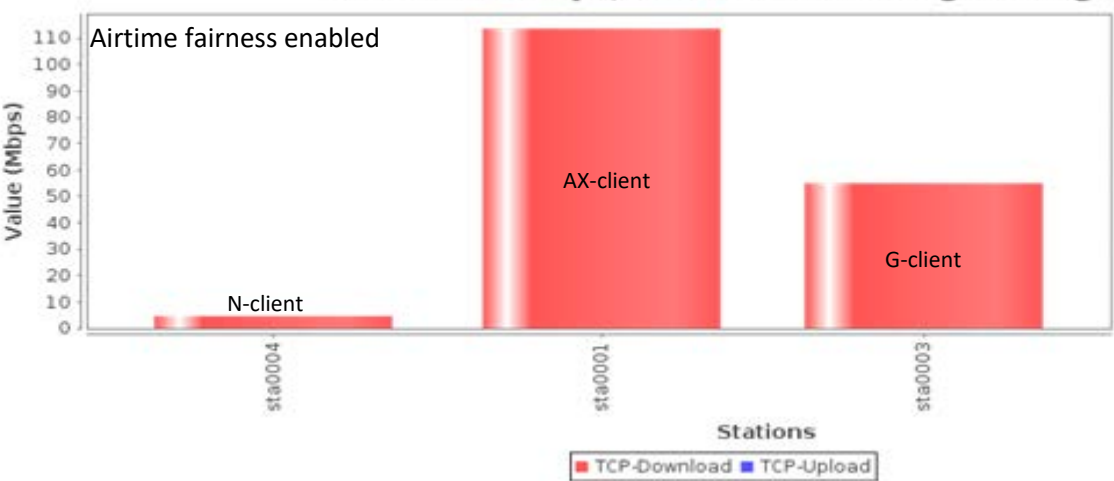


Combined Mbps, 60 second running average



AC-client

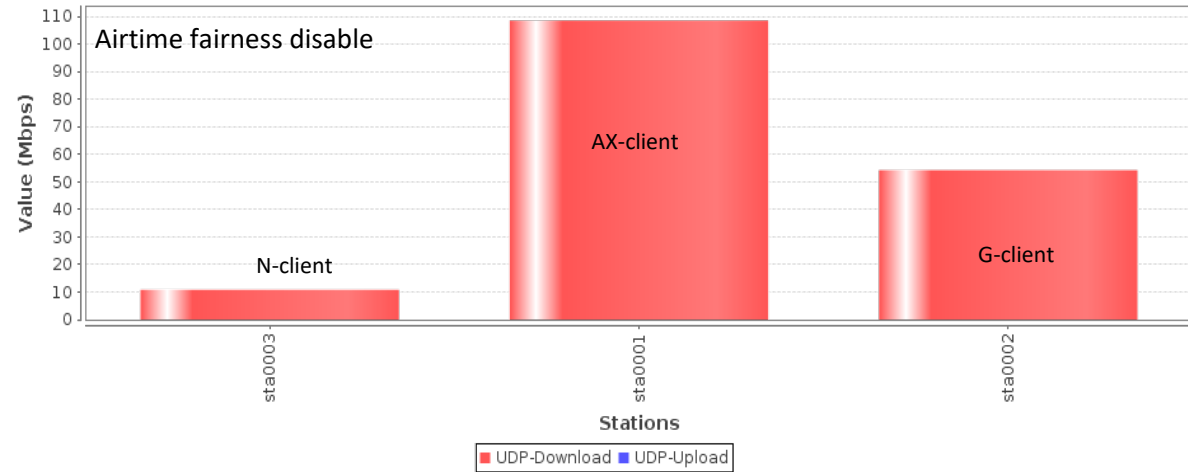
Combined Mbps, 60 second running average



Airtime Fairness : UDP-DL[2.4GHz]

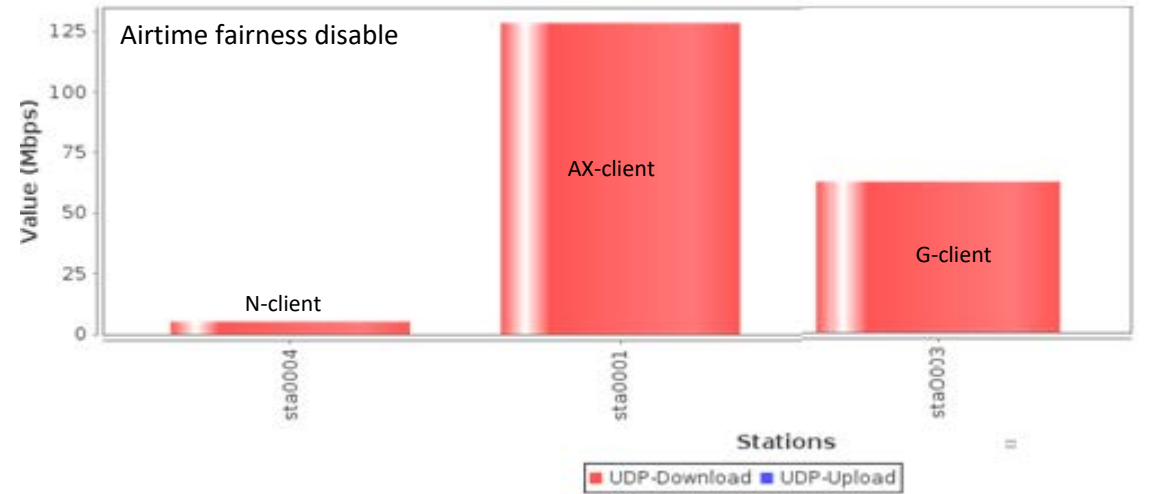
Vendor-A

Combined Mbps, 60 second running average

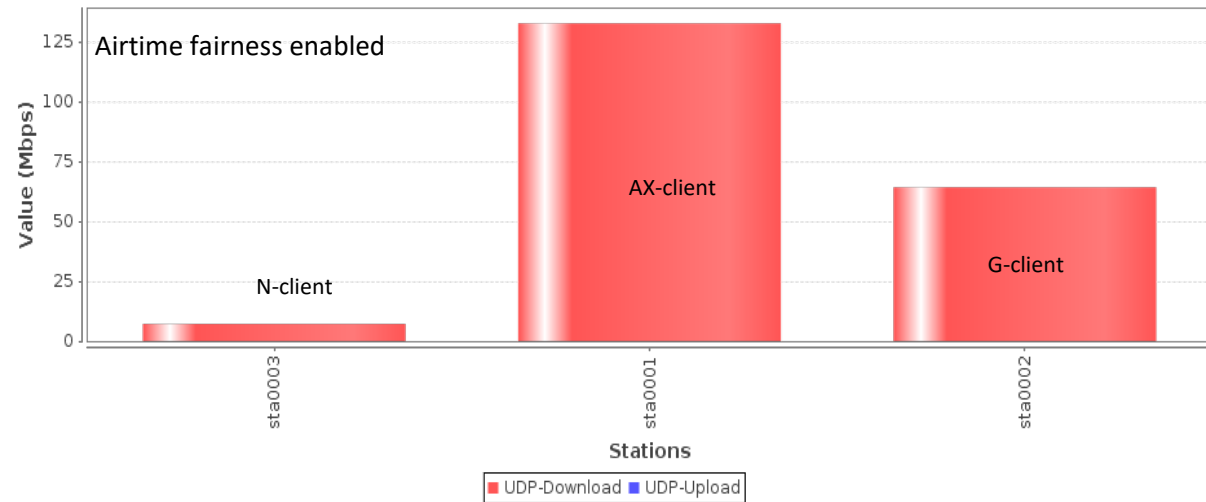


Vendor-B

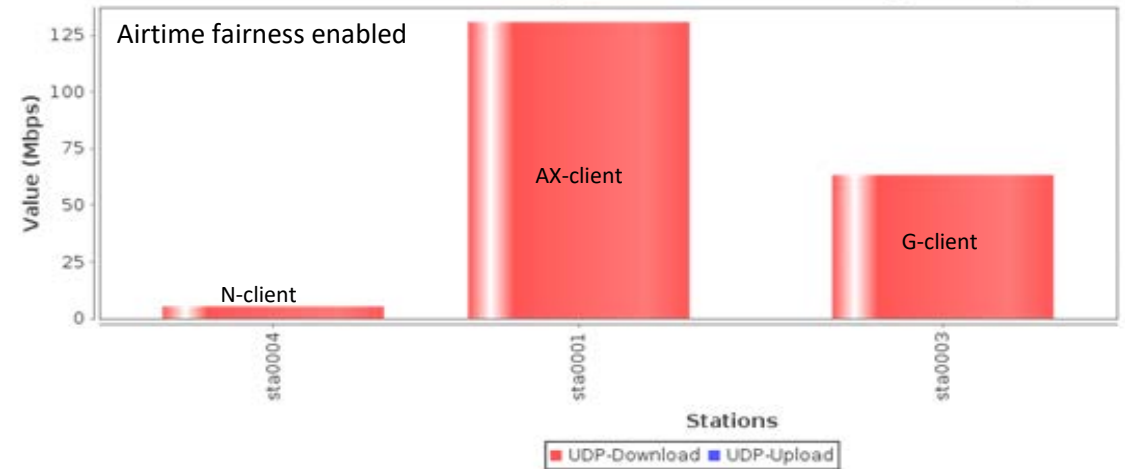
Combined Mbps, 60 second running average



Combined Mbps, 60 second running average

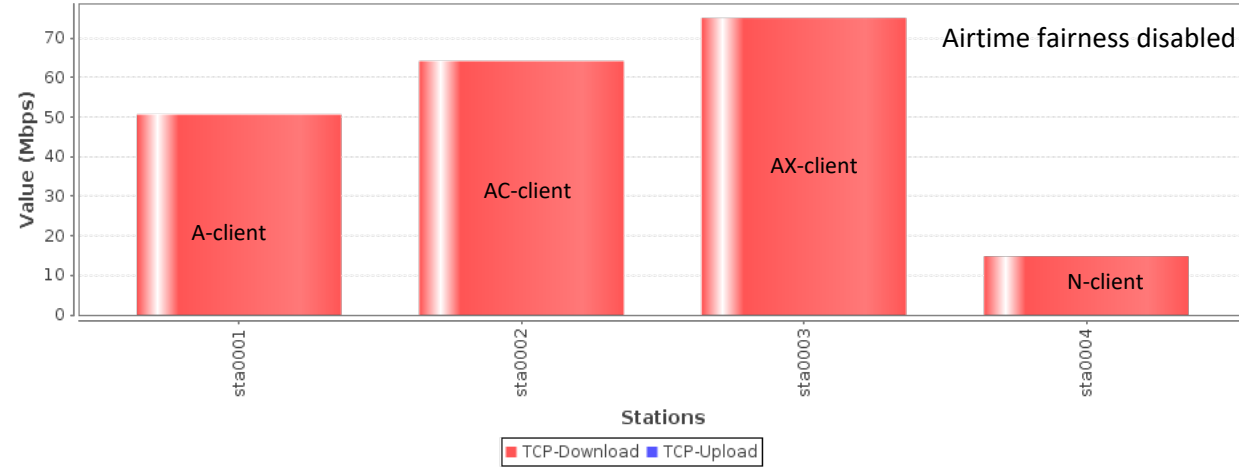


Combined Mbps, 60 second running average

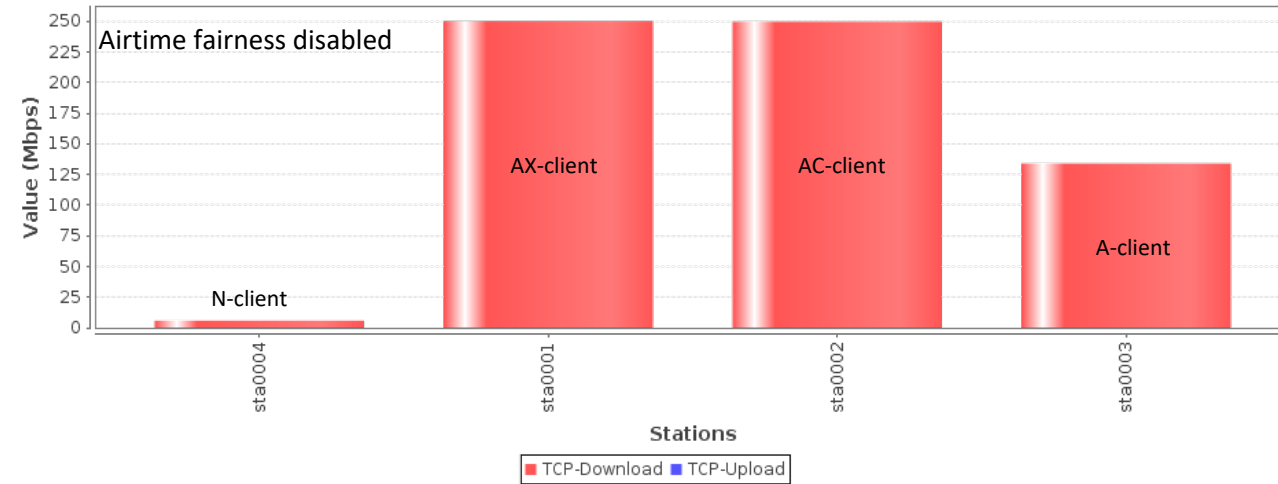


Airtime Fairness : TCP-DL[5GHz]

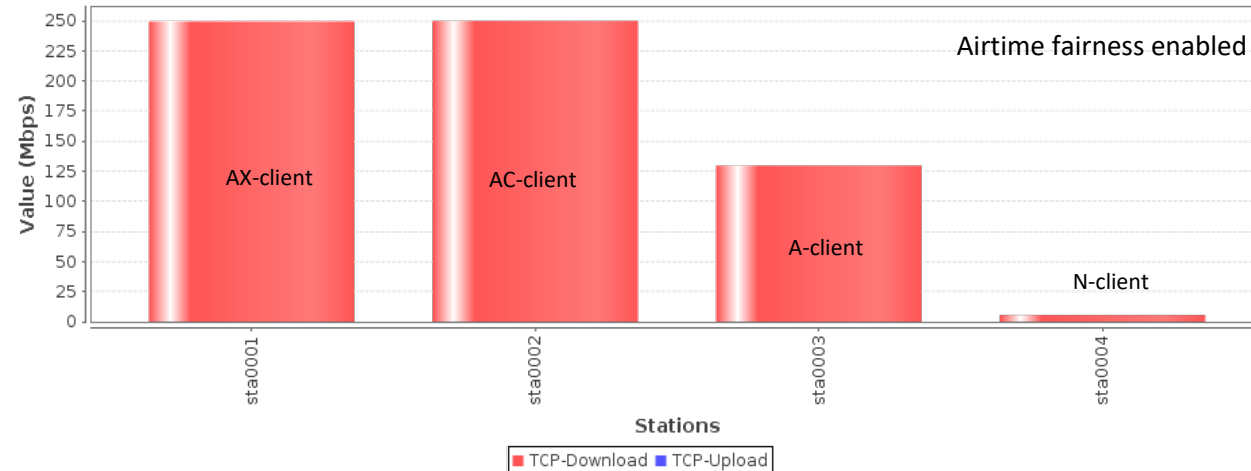
Combined Mbps, 60 second running average



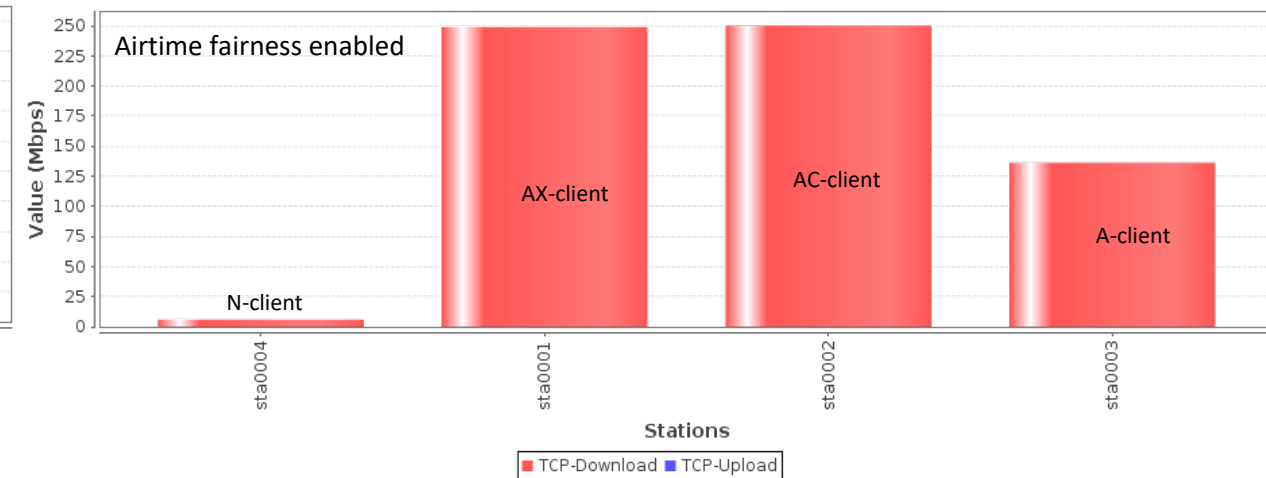
Combined Mbps, 60 second running average



Combined Mbps, 60 second running average

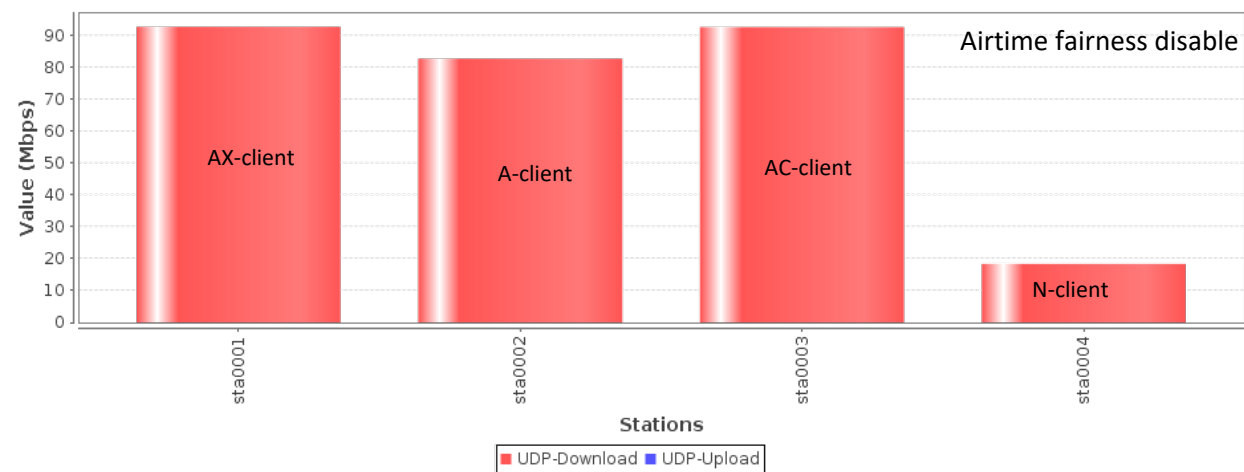


Combined Mbps, 60 second running average

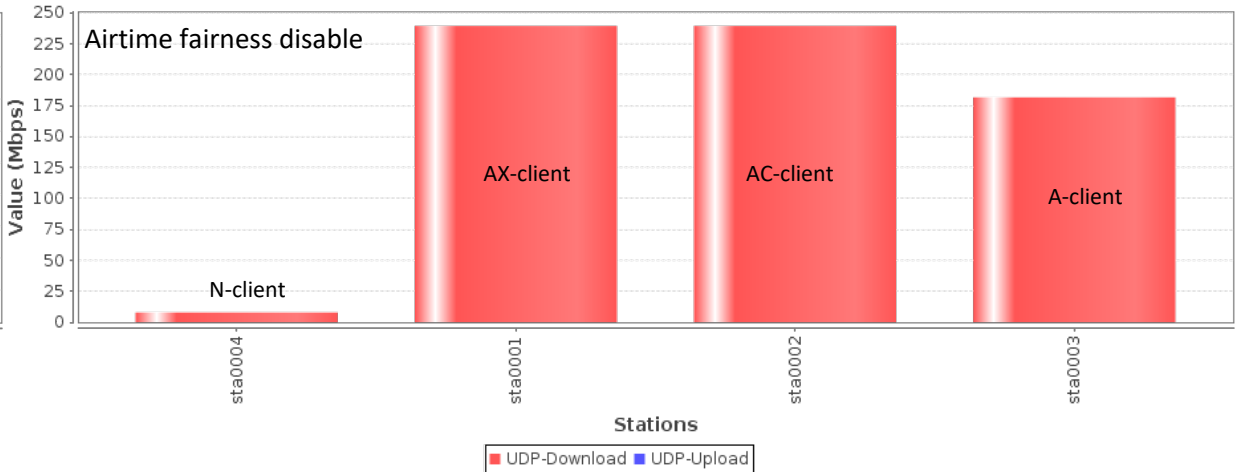


Airtime Fairness : UDP-DL[5GHz]

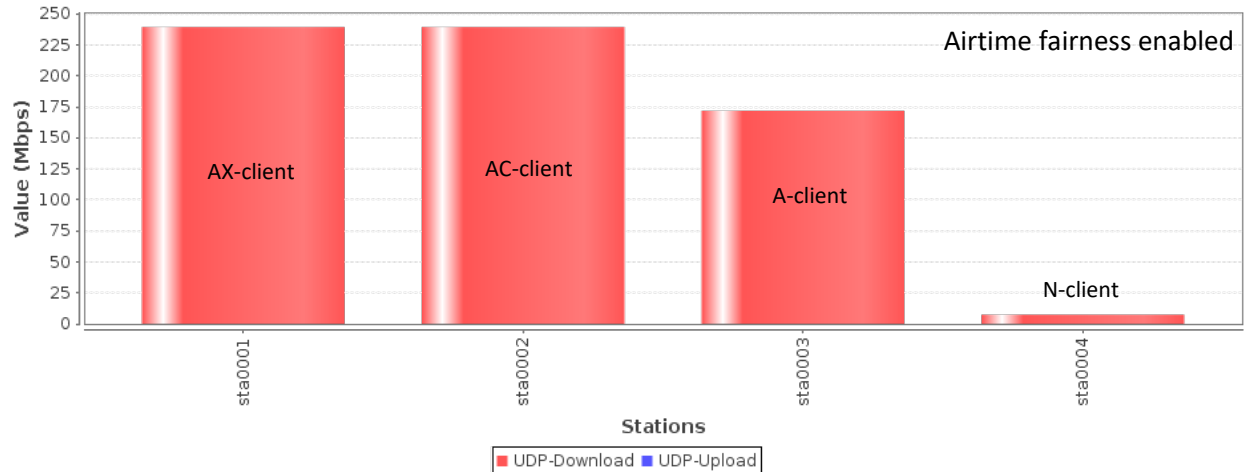
Combined Mbps, 60 second running average



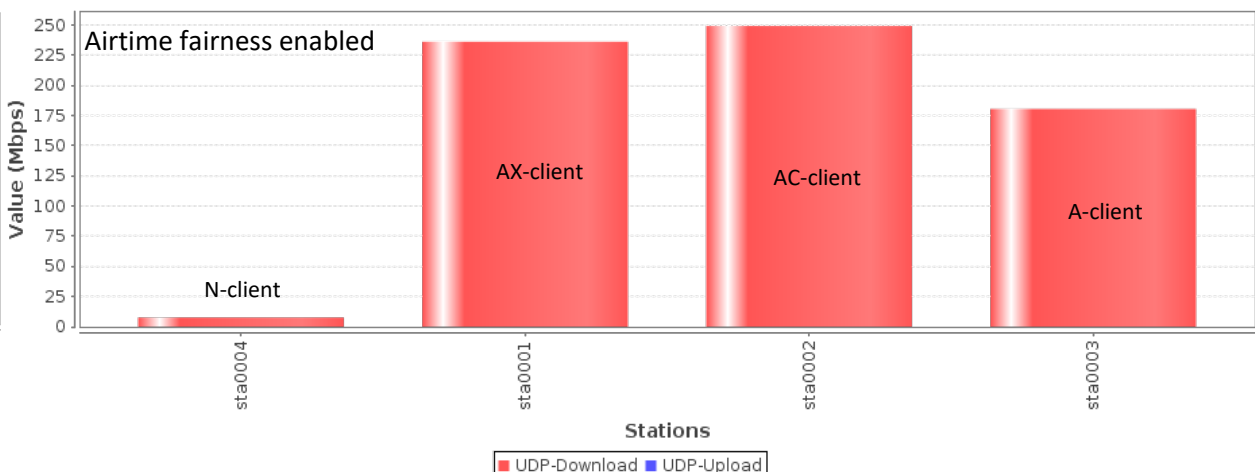
Combined Mbps, 60 second running average



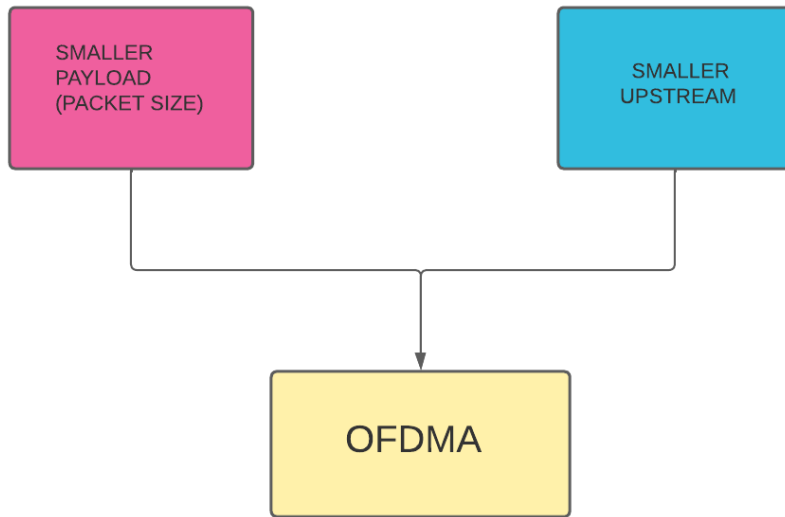
Combined Mbps, 60 second running average



Combined Mbps, 60 second running average



OFDMA testing:



TEST PROCEDURE for OFDMA(Orthogonal Frequency Division Multiple Access):

- It works only for 802.11ax clients.
- We have fixed the packet size to 64 bytes, and the upstream traffic to 100mbps, such that we can create the perfect scenario and observe the wire-shark captures.
- The objective of the testcase is to check the captures and ensure we are getting HE_MU packets in data frames while we enable OFDMA, and HE_SU packets in data frames while we disable OFDMA, and observe the throughput variations.

Wire-shark captures-OFDMA[Enabled].

192.168.200.31:1 (ct523c-ccaa:1 (lanforge)) - VNC Viewer

Applications Places System

2g dl tcp.pcapng

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	PPDU Format
1	0.000000000	802.11	238 HE_MU	802.11	238	HE_MU
2	0.000000027	802.11	238 HE_MU	802.11	238	HE_MU
3	0.000000045	802.11	238 HE_MU	802.11	238	HE_MU
4	0.000000029	802.11	238 HE_MU	802.11	238	HE_MU
5	0.000000045	802.11	238 HE_MU	802.11	238	HE_MU
6	0.000000050	802.11	238 HE_MU	802.11	238	HE_MU
7	0.000000027	802.11	238 HE_MU	802.11	238	HE_MU
8	0.000000047	802.11	238 HE_MU	802.11	238	HE_MU
9	0.000000048	802.11	238 HE_MU	802.11	238	HE_MU
10	0.000000043	802.11	238 HE_MU	802.11	238	HE_MU
11	0.000000084	802.11	238 HE_MU	802.11	238	HE_MU
12	0.000000142	802.11	238 HE_MU	802.11	238	HE_MU
13	0.000000159	802.11	238 HE_MU	802.11	238	HE_MU
14	0.000000135	802.11	238 HE_MU	802.11	238	HE_MU
15	0.000000109	802.11	238 HE_MU	802.11	238	HE_MU
16	0.000000152	802.11	238 HE_MU	802.11	238	HE_MU
17	0.000000167	802.11	238 HE_MU	802.11	238	HE_MU
18	0.000000179	802.11	238 HE_MU	802.11	238	HE_MU
19	0.000000186	802.11	238 HE_MU	802.11	238	HE_MU
20	0.000000090	802.11	238 HE_MU	802.11	238	HE_MU
21	0.000000070	802.11	238 HE_MU	802.11	238	HE_MU
22	0.000000198	802.11	238 HE_MU	802.11	238	HE_MU
23	0.000000215	802.11	238 HE_MU	802.11	238	HE_MU
24	0.000000393	802.11	238 HE_MU	802.11	238	HE_MU
25	0.000000258	802.11	238 HE_MU	802.11	238	HE_MU
26	0.000000270	802.11	238 HE_MU	802.11	238	HE_MU
27	0.000000290	802.11	238 HE_MU	802.11	238	HE_MU
28	0.000000315	802.11	238 HE_MU	802.11	238	HE_MU
29	0.000000317	802.11	238 HE_MU	802.11	238	HE_MU
30	0.000000356	802.11	238 HE_MU	802.11	238	HE_MU
31	0.000000358	802.11	238 HE_MU	802.11	238	HE_MU
32	0.000000373	802.11	238 HE_MU	802.11	238	HE_MU
33	0.000000406	802.11	238 HE_MU	802.11	238	HE_MU
34	0.000000425	802.11	238 HE_MU	802.11	238	HE_MU
35	0.000000447	802.11	238 HE_MU	802.11	238	HE_MU
36	0.000000468	802.11	238 HE_MU	802.11	238	HE_MU
37	0.000000479	802.11	238 HE_MU	802.11	238	HE_MU
38	0.000000480	802.11	238 HE_MU	802.11	238	HE_MU
39	0.000000493	802.11	238 HE_MU	802.11	238	HE_MU
40	0.000000502	802.11	238 HE_MU	802.11	238	HE_MU
41	0.000000514	802.11	238 HE_MU	802.11	238	HE_MU
42	0.000000530	802.11	238 HE_MU	802.11	238	HE_MU
43	0.000000539	802.11	238 HE_MU	802.11	238	HE_MU
44	0.000000512	802.11	238 HE_MU	802.11	238	HE_MU

Frame 1: 238 bytes on wire (1904 bits), 238 bytes captured (1904 bits) on interface mon18a, id 0

- Radiotap Header v0, Length 68
 - Header revision: 0
 - Header pad: 0
 - Header length: 68
 - Present flags
 - MAC timestamp: 566536361
 - Flags: 0x00
 - Channel frequency: 2412 [80 1]
 - Channel flags: 0x0480, 2 GHz spectrum, Dynamic CCK-OFDM
 - Antenna signal: -20dBm
 - Rx flags: 0x0000
 - timestamp information
 - HE information
 - HE Data 1: 0x02e2, PPDU Format: HE_MU, data MCS known, data DCM known, Coding known, STBC known
 - ...0... = PPDU Format: HE_MU (0x2)
 - ...0... = BSS Color known: Unknown
 - ...0... = Beam Change known: Unknown
 - ...0... = UL/DL known: Unknown
 - ...1... = data MCS known: Known
 - ...1... = data DCM known: Known
 - ...1... = Coding known: Known
 - ...0... = LDPC extra symbol segment known: Unknown
 - ...1... = STBC known: Known
 - ...0... = Spatial Reuse 1 known: Unknown
 - ...0... = Spatial Reuse 2 known: Unknown
 - ...0... = Spatial Reuse 3 known: Unknown
 - ...0... = Spatial Reuse 4 known: Unknown
 - ...0... = dat BW/RU allocation known: Unknown
 - ...0... = Doppler known: Unknown
 - HE Data 2: 0x0012, GI known, TxBF known
 - HE Data 3: 0x2b00, Coding: LDPC
 - HE Data 4: 0x0000
 - HE Data 5: 0x0000, GI: 0.8us, LTF symbol size: 2x
 - HE Data 6: 0x0001, NSTS: 1 space-time stream
 - Antenna signal: -22dBm
 - Antenna: 0

0000 00 00 44 00 2b 40 c0 a0 20 08 00 a0 20 08 00 00 ...D...
0010 a9 a8 c4 21 00 00 00 00 00 00 5c 09 80 04 ec 00 ...1...
0020 00 00 00 00 00 00 00 00 e5 3d 13 02 00 00 00 00 ...+...
0030 16 00 11 03 e2 02 12 00 00 2b 00 00 80 00 01 00 ...-B...
0040 ea 00 e0 01 88 42 82 00 64 6e e0 cf c3 8f c8 99 ...\$...
0050 b2 17 ce 24 00 60 e0 84 cc ab 00 0d 40 00 e1 49 ...@...
0060 00 20 02 00 00 00 aa aa 03 00 00 00 00 45 00 ...E...
0070 00 80 e9 a2 40 00 40 06 cd cc c0 a8 00 e6 c0 a8 ...@...

Packets: 4244271 · Displayed: 4244271 (100.0%) Profile: Default

ASUS Wireless Router GT-AX6000 - Professional - Mozilla Firefox (as superuser)

2g dl tcp.pcapng

LANforge Manag... sta0001 (ct523c... Mate Terminal ASUS Wireless R... [WiFi Capacity T... ofdma [(as superuser)] [(as superuser)] [(as superuser)] 2g dl tcp.pcapng

Wire-shark captures-OFDMA[Disabled].

192.168.200.31:1 (ct523c-ccaa:1 [lanforge]) - VNC Viewer

Applications Places System

1.pcapng

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	PPDU Format
1	0.000000000			802.11	438	HE_SU
2	0.000001492			802.11	438	HE_SU
3	0.000004220			802.11	438	HE_SU
4	0.000005711			802.11	438	HE_SU
5	0.000018942			802.11	438	HE_SU
6	0.000021150			802.11	438	HE_SU
7	0.000023250			802.11	438	HE_SU

Wireshark - Packet 2 - 1.pcapng

- Channel flags: 0x0140, Orthogonal Frequency-Division Multiplexing (OFDM), 5 GHz spectrum
- Antenna signal: -22dBm
- RX flags: 0x0000
- timestamp information
- HE information
 - HE Data 1: 0x42e0, PPDU Format: HE_SU, data MCS known, data DCM known, Coding known, STBC known
 - HE Data 2: 0x0012, GI known, TxBF known
 - HE Data 3: 0x2b00, Coding: LDPC
 - HE Data 4: 0x0000
 - HE Data 5: 0x0002, GI: 0.8us, LTF symbol size: 2x
 - HE Data 6: 0x0002, NSTS: 2 space-time streams

Antenna signal: -22dBm

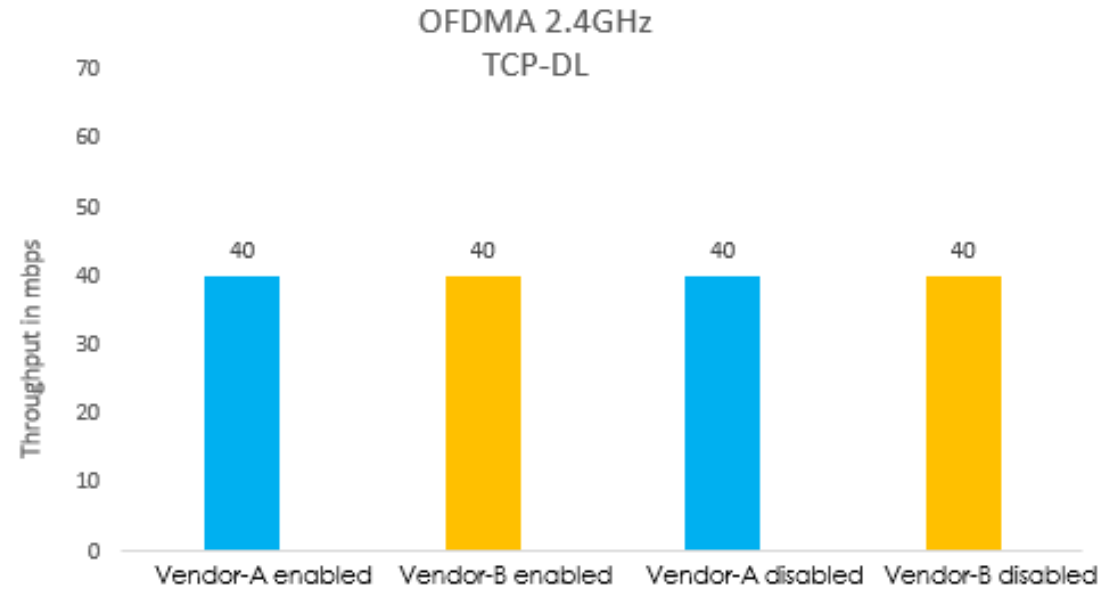
Antenna: 0

Packets: 363 - Displayed: 363 (100.0%)

Profile: Default

LANforge Manager sta0001 [ct523c-cc... Mate Terminal ASUS Wireless Rout... [WiFi Capacity Test] 5G DL OFDMA [(as superuser)] 1.pcapng Wireshark - Packet

OFDMA: TCP-UL[2.4GHz]



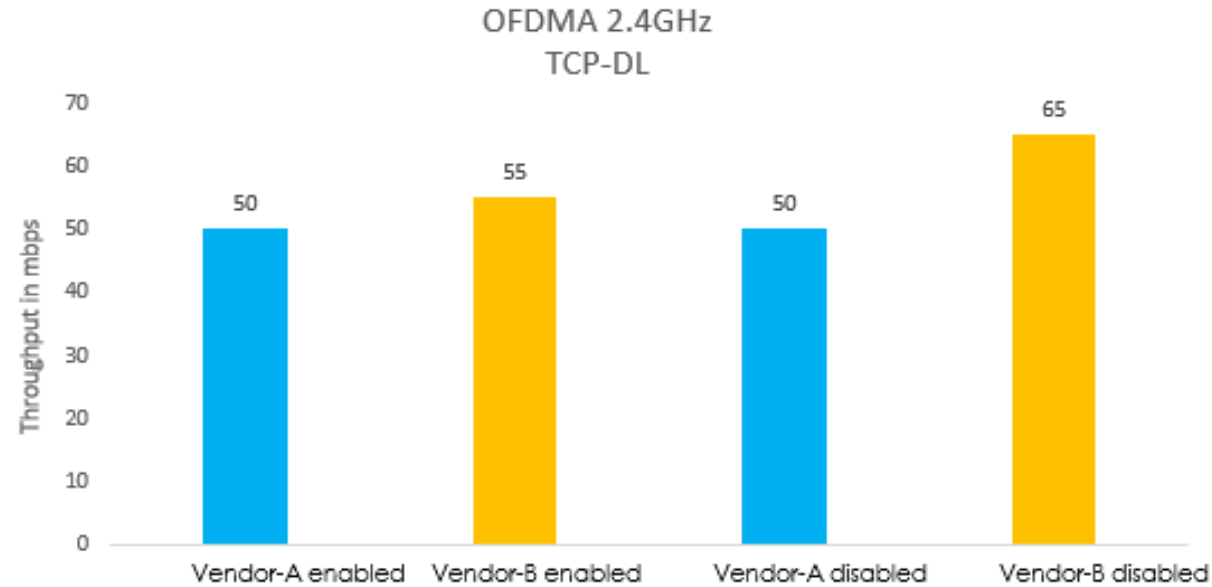
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The Vendor-B is also having no variation in the throughput at both the scenarios.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- Both are showing similar outputs.

OFDMA: TCP-DL[2.4GHz]



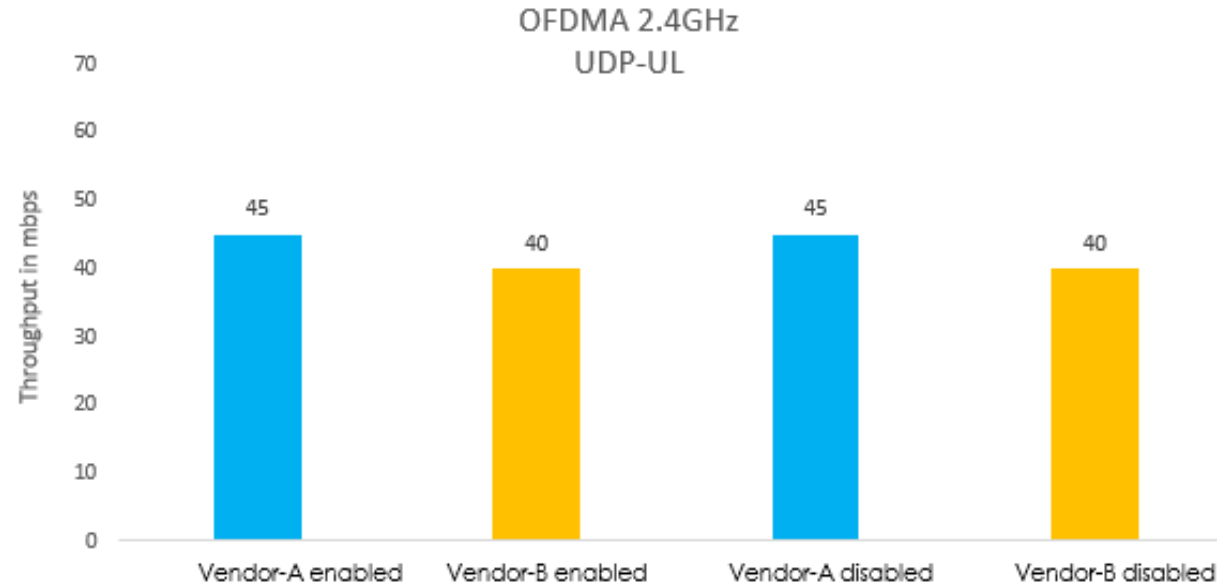
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The Vendor-B AP has OFDMA option and the throughput varies by enabling and disabling OFDMA

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- But Vendor-B is showing higher throughput.

OFDMA: UDP-UL[2.4GHz]



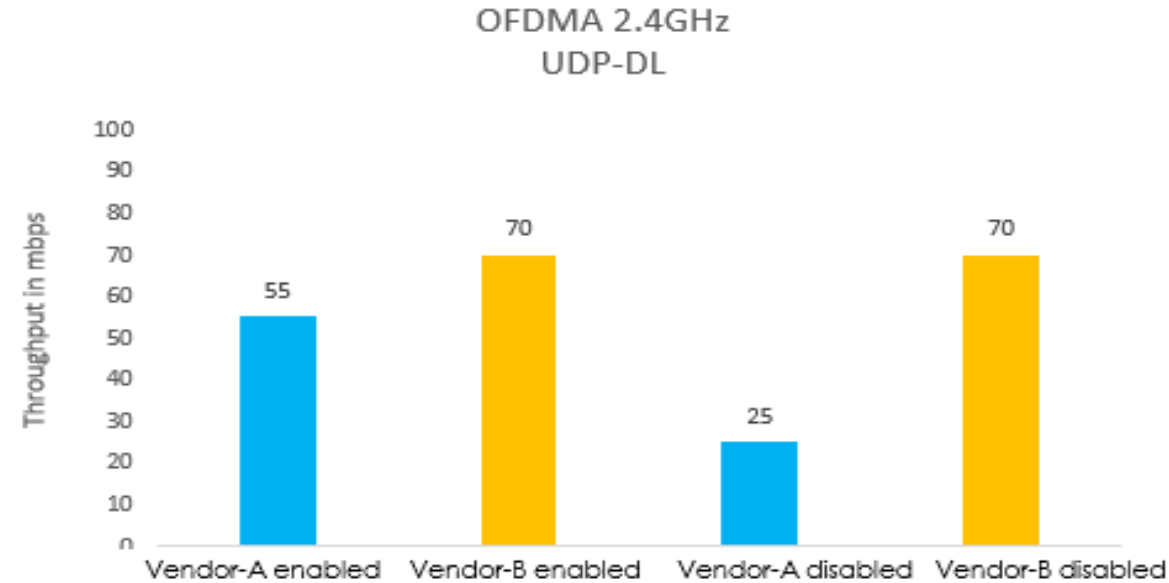
Test description:

- The OFDMA is by default enabled for Vendor-A, and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The Vendor-B has OFDMA option and the throughput varies by enabling and disabling OFDMA.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- Vendor-A is working better in this scenario.

OFDMA: UDP-DL[2.4GHz]



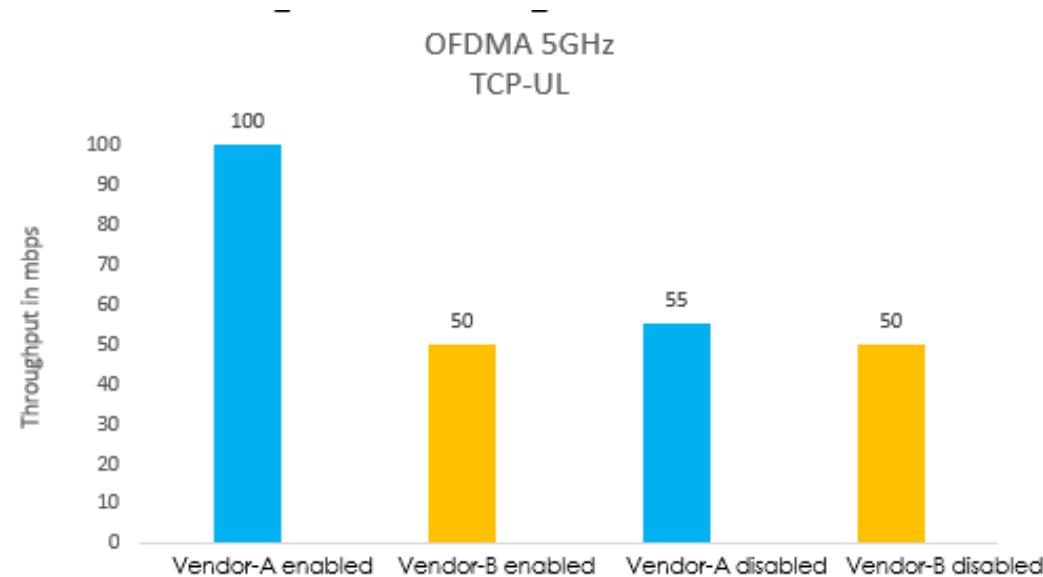
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The Vendor-B has OFDMA option and the throughput varies by enabling and disabling OFDMA.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- But Vendor-B is showing higher throughput.

OFDMA: TCP-UL[5GHz]



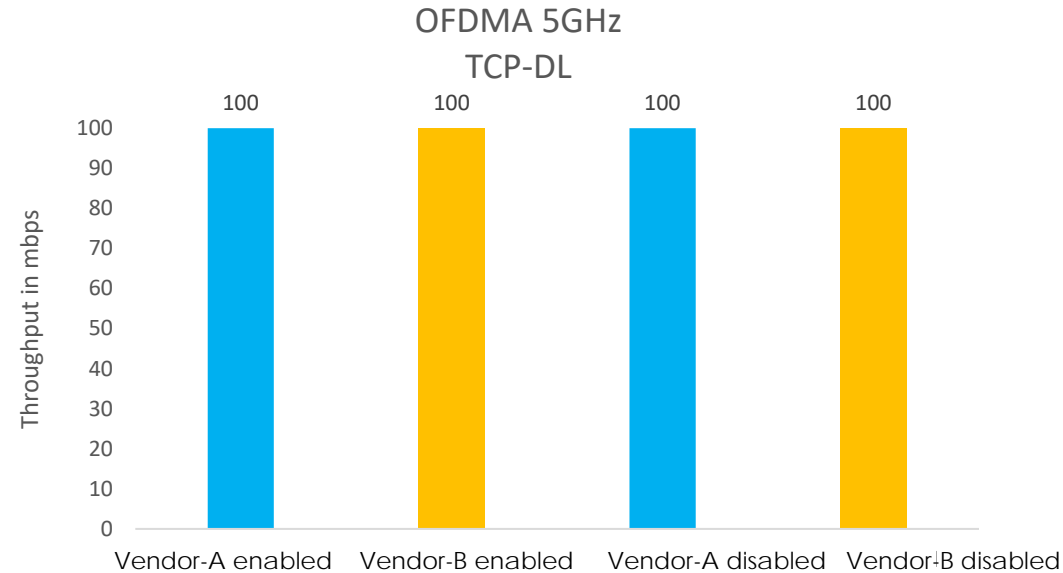
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The maximum throughput is around 70mbps as we have set the upstream traffic is 100mbps.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- Vendor-A is showing higher throughput.

OFDMA: TCP-DL[5GHz]



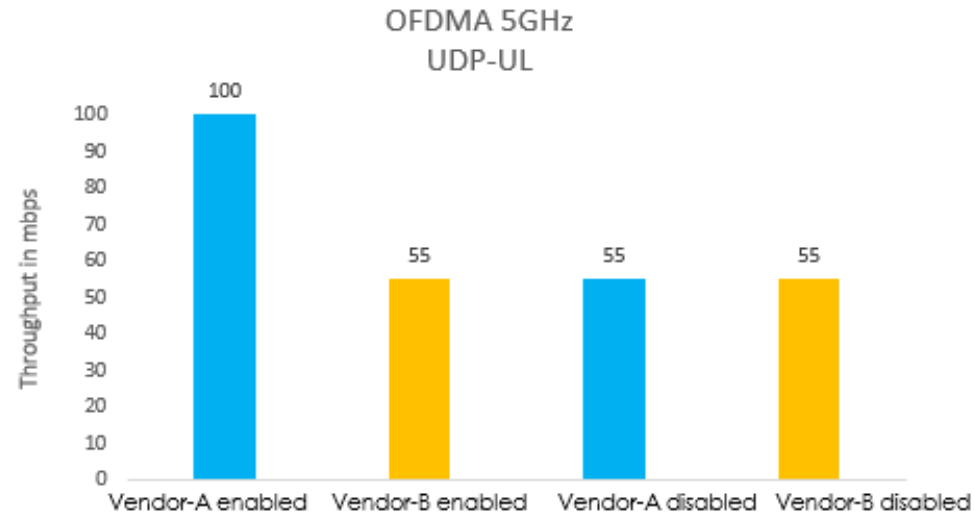
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The maximum throughput is around 70mbps as we have set the upstream traffic is 100mbps.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- Both are showing similar higher throughput.

OFDMA: UDP-UL[5GHz]



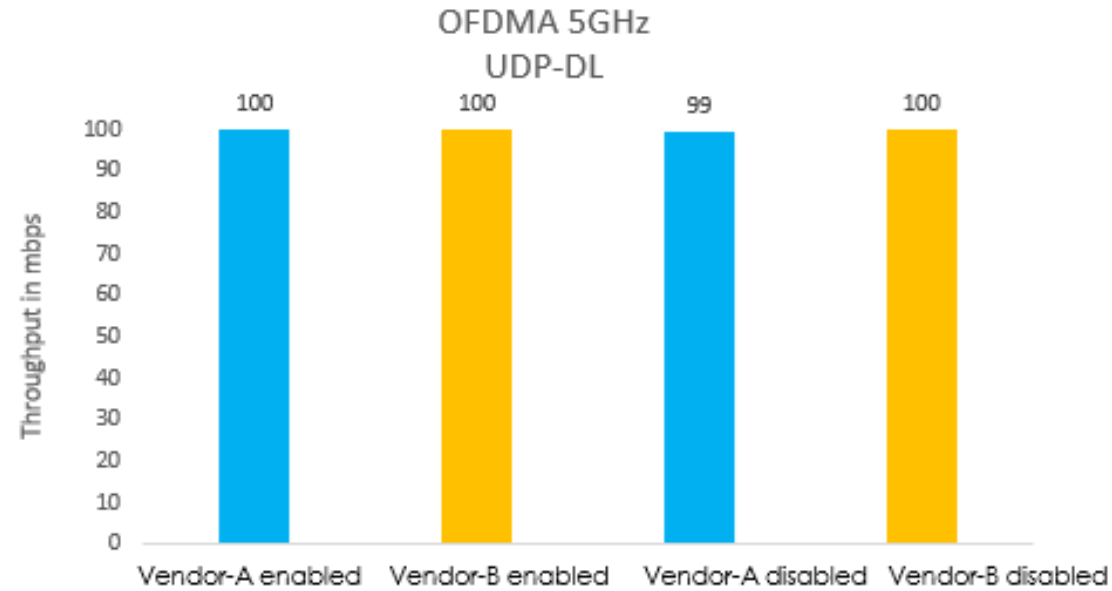
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The maximum throughput is around 70mbps as we have set the upstream traffic is 100mbps.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- Vendor-A is showing higher throughput.

OFDMA: UDP-DL[5GHz]



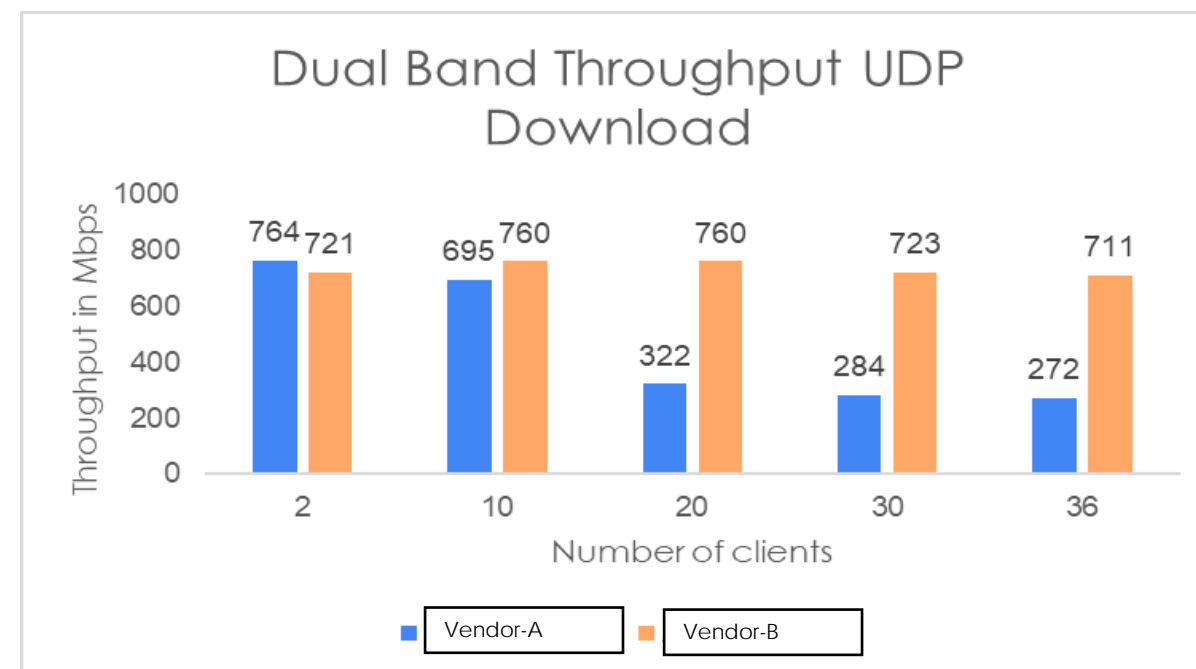
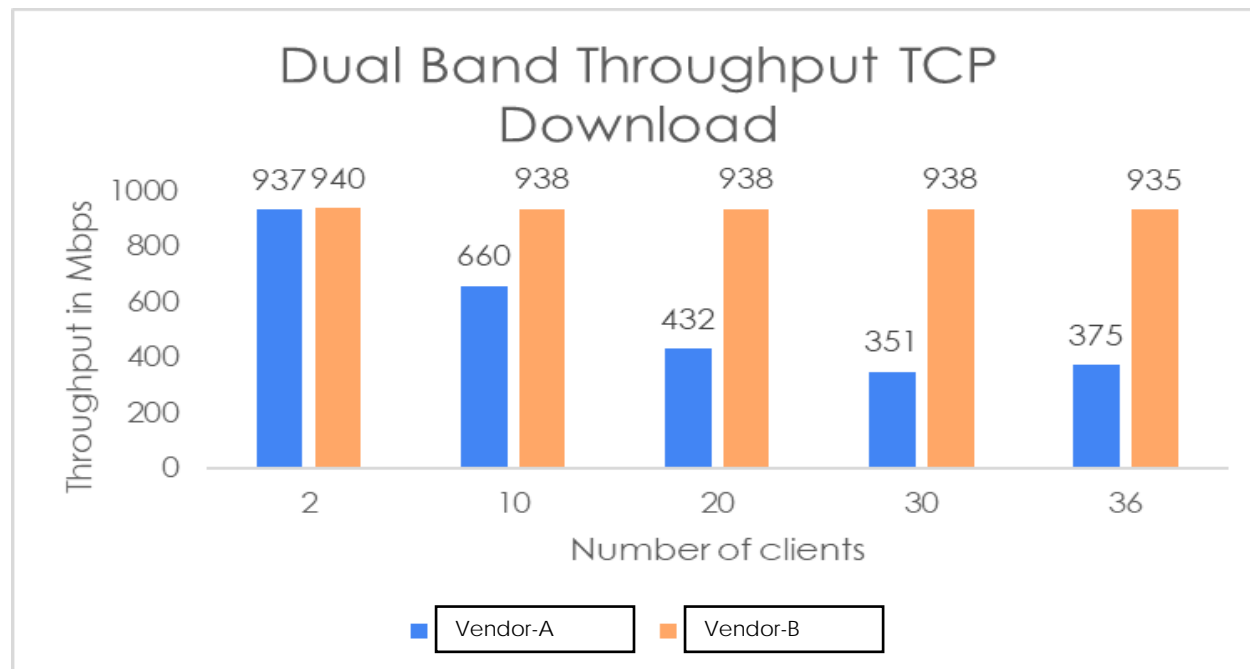
Test description:

- The OFDMA is by default enabled for Vendor-A , and we use the CLI commands to disable the OFDMA.
- The throughput has no variation in both the cases.
- The maximum throughput is around 70mbps as we have set the upstream traffic is 100mbps.

Result observations:

- Both the CPE's are showing HE_MU packets when OFDMA is enabled .
- Both are showing similar throughput.

Dual Band Performance Test



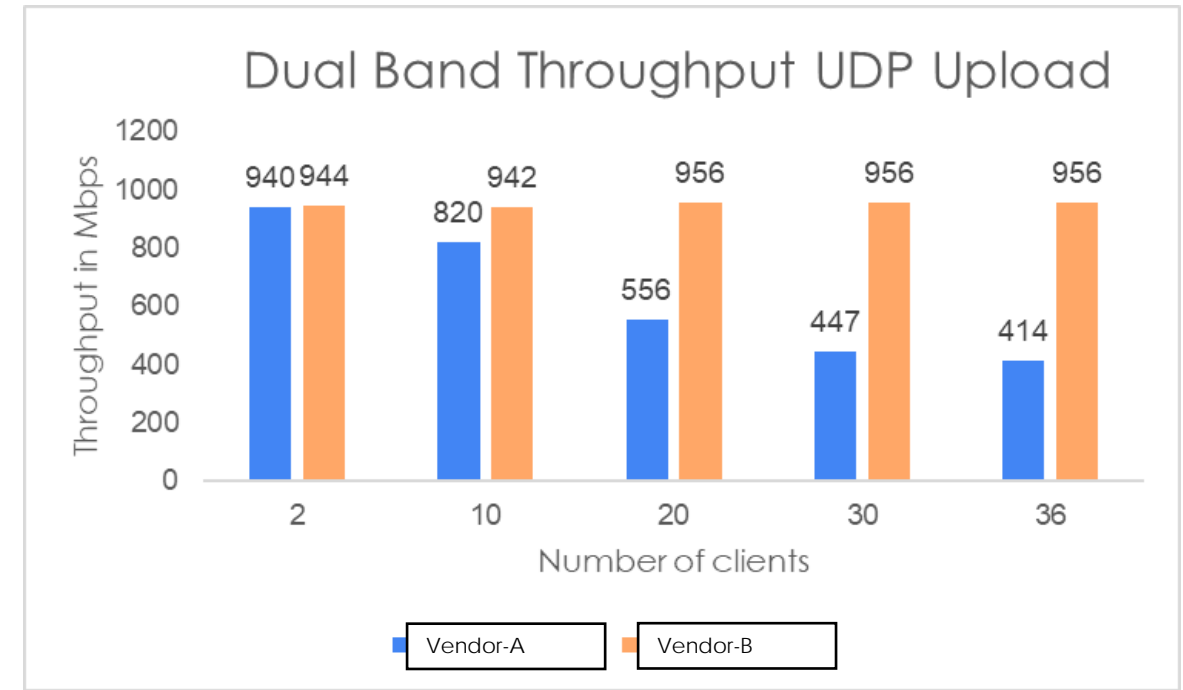
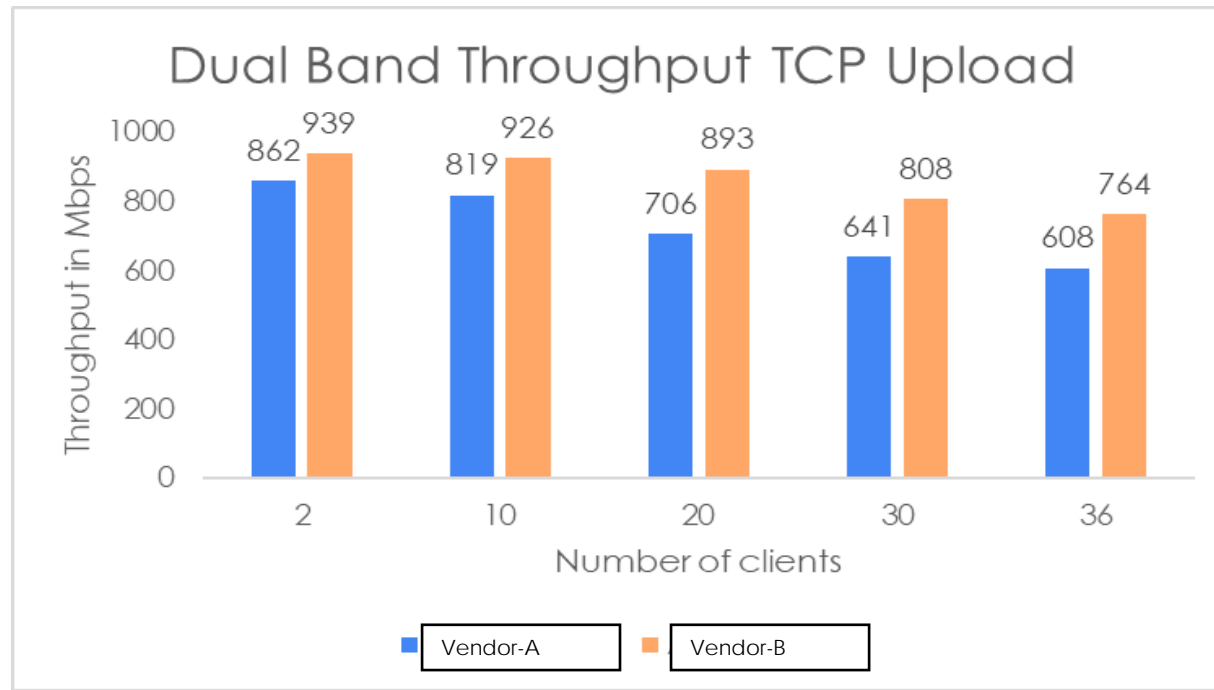
Test Description:

- All 2.4 GHz clients are connected in 3*3 with ax mode. All the 5 GHz clients are connected in 4*4 with ax mode.
- Traffic is running parallelly on both bands.

Results Observations:

- With Vendor-B is giving better throughput.

Dual Band Performance Test



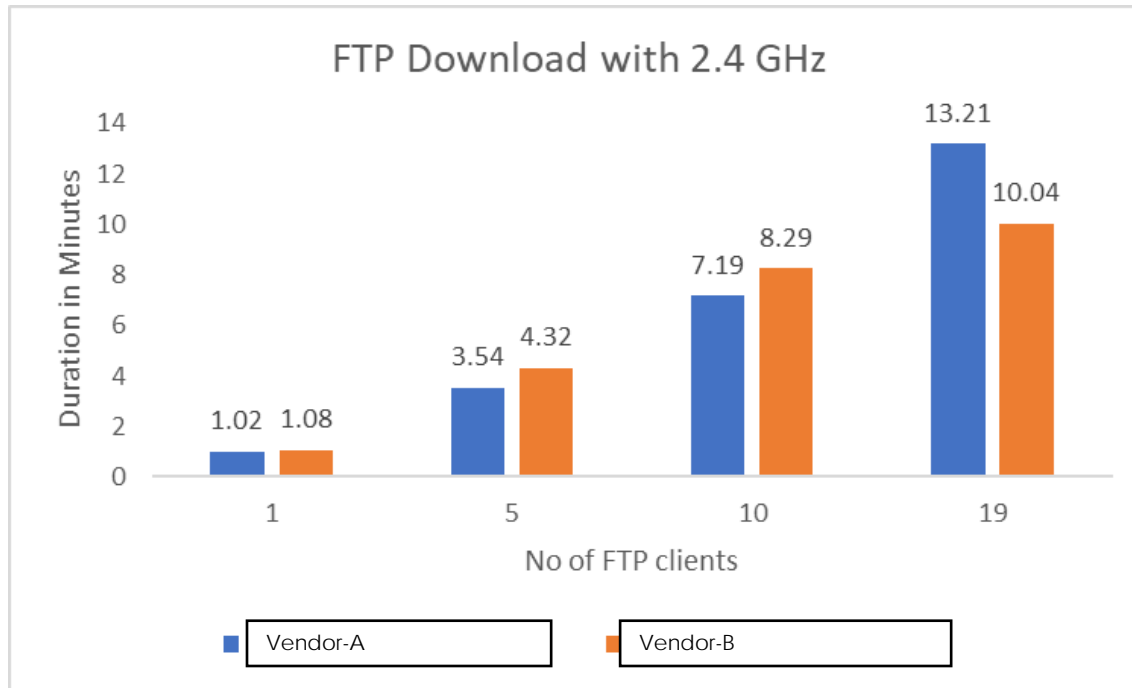
Test Description:

- All 2.4 GHz clients are connected in 3*3 with ax mode. All the 5 GHz clients are connected in 4*4 with ax mode.
- Traffic is running parallelly on both bands.

Results Observations:

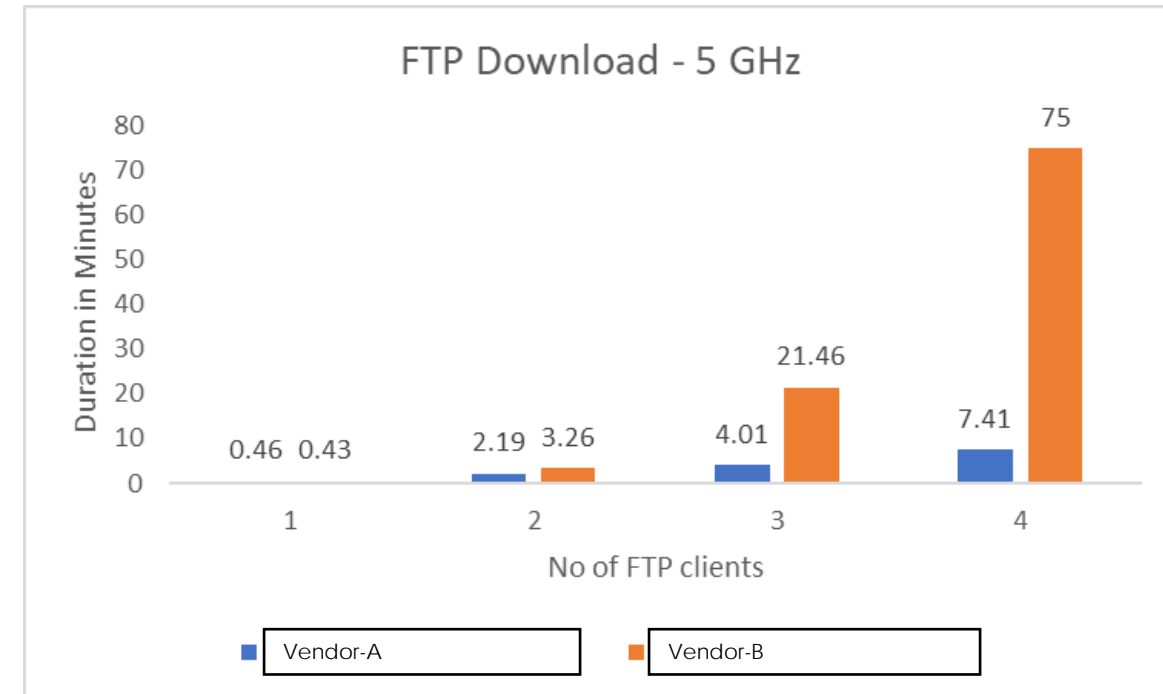
- With Vendor-B is giving better throughput.

File Transfer Protocol Testing



Test Description:

- All 2.4 GHz clients are connected in 3*3 with ax mode. All the 5 GHz clients are connected in 4*4 with ax mode.
- FTP file (1GB) is transferred from server to wireless client



Results Observations:

- With Vendor-B is performing better with respect of transferring files in 5 GHz mode

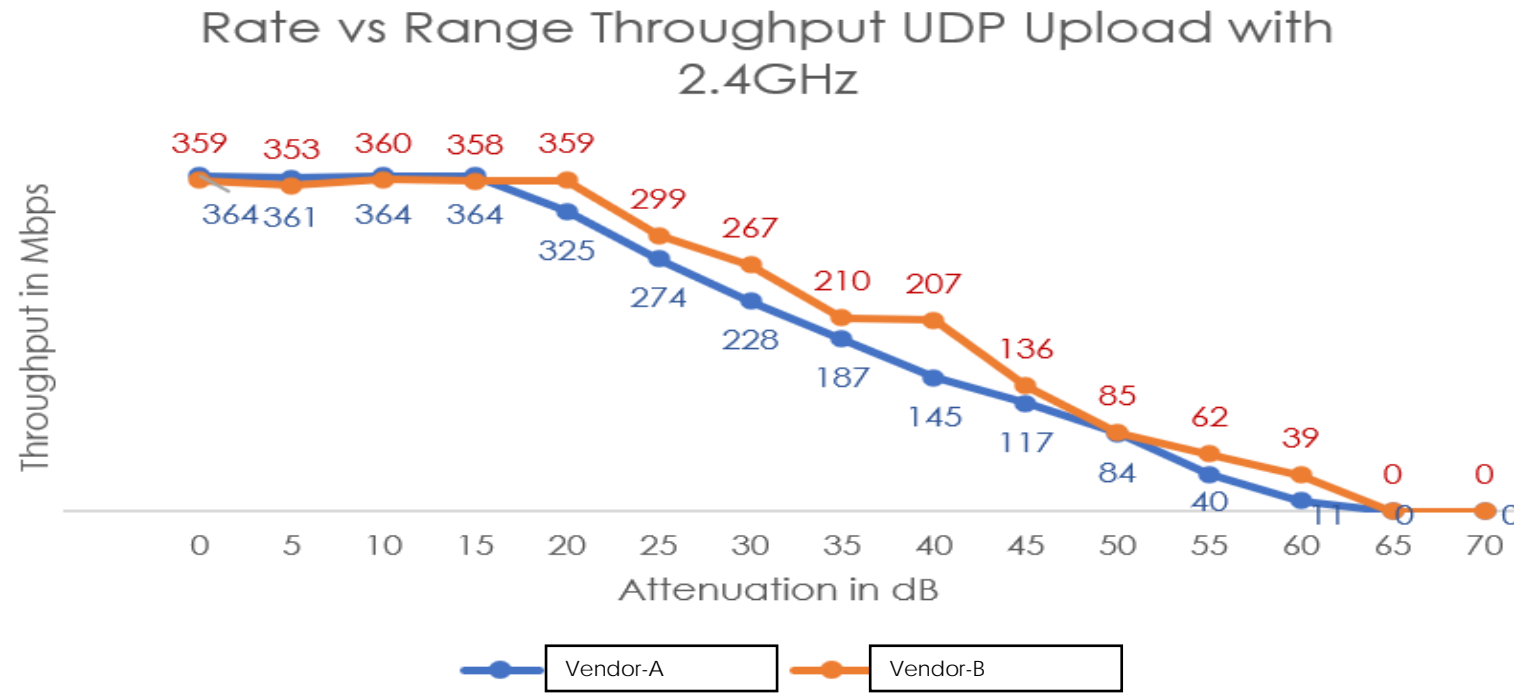
Dynamic Frequency Selection

DFS Channels	52	56	60	64	100	104	108	112	116	120	124	128	132	136	140
Radar Detected	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Channel Shifted	48	40	157	157	157	140	140	144	56	48	36	36	144	144	44

Test Description:

- Clients connected in 5 GHz with 20 MHz band with radar type used here is FCC0

Rate Vs Range – 2.4GHz UDP Upload



Test Description:

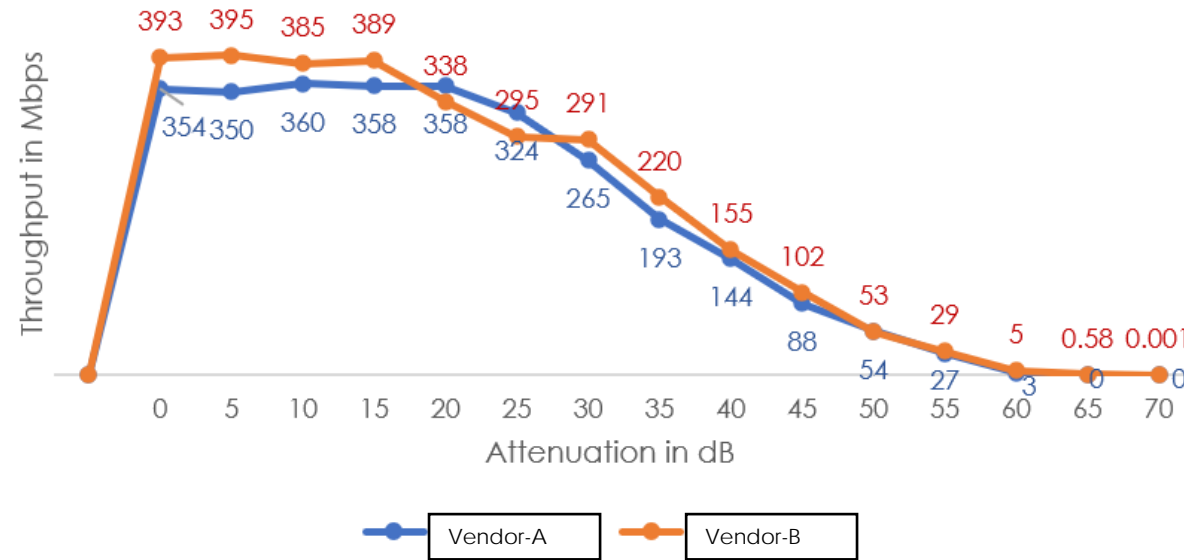
- In this scenario, Station associated and start running traffic when attenuation is 0 dB and gradually increase attenuation 5 dB steps.
- Intended load is set to 1 Gbps with UDP upload traffic with client3NSS, 20Mhz BW in AX mode.
- Traffic from Client to AP and throughput test run in 2.4GHz on channel 1.

Results Observations:

- Vendor-B has more RSSI at zero attenuation compared to Vendor-A.
- Vendor-B is getting more throughput with the increase in attenuation than Vendor-A.
- Vendor-A, Vendor-B have disconnected after 60dB.

Rate vs Range – 2.4GHz UDP Download

Rate vs Range Throughput UDP Download with 2.4GHz



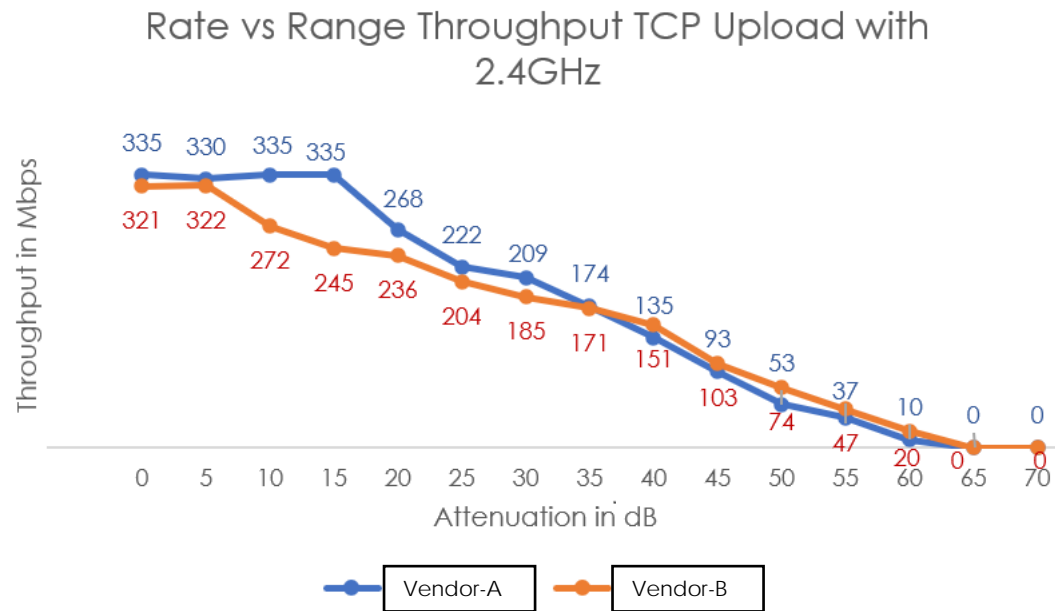
Test Description:

- In this scenario, Station associated and start running traffic when attenuation is 0 dB and gradually increase attenuation 5 dB steps.
- Intended load is set to 1 Gbps with UDP download traffic with client3NSS, 20Mhz BW in AX mode.
- Traffic from AP to client and throughput test run in 2.4GHz on channel 1.

Results Observations:

- Vendor-B has good RSSI at zero attenuation compared to Vendor-A. Vendor-B is getting more throughput with zero attenuation than Vendor-A.
- Vendor-A, Vendor-B have disconnected after 60dB.

Rate vs Range – 2.4GHz TCP Upload



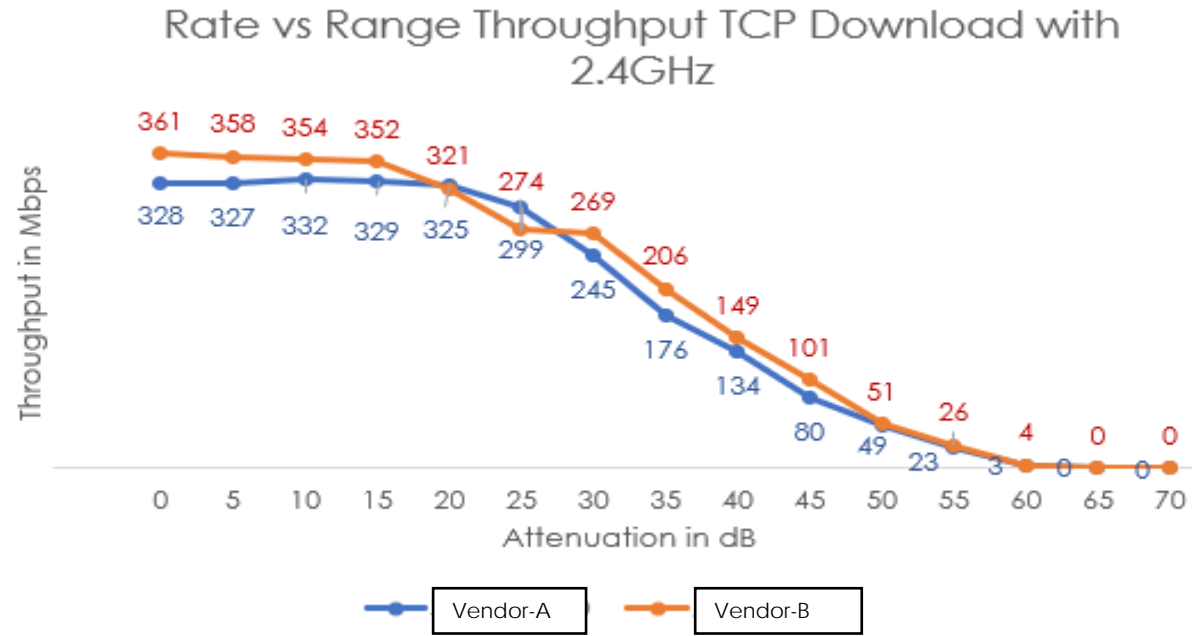
Test Description:

- In this scenario, Station associated and start running traffic when attenuation is 0 dB and gradually increase attenuation 5 dB steps.
- Intended load is set to 1 Gbps with TCP upload traffic with client3NSS, 20Mhz BW in AX mode.
- Traffic from client to AP and throughput test run in 2.4GHz on channel 1.

Results Observations:

- Vendor-B has more RSSI at zero attenuation compared to Vendor-A.
- Vendor-A is getting more throughput with zero attenuation than Vendor-B.
- Vendor-A, Vendor-B have disconnected after 60dB.

Rate vs Range – 2.4GHz TCP Download



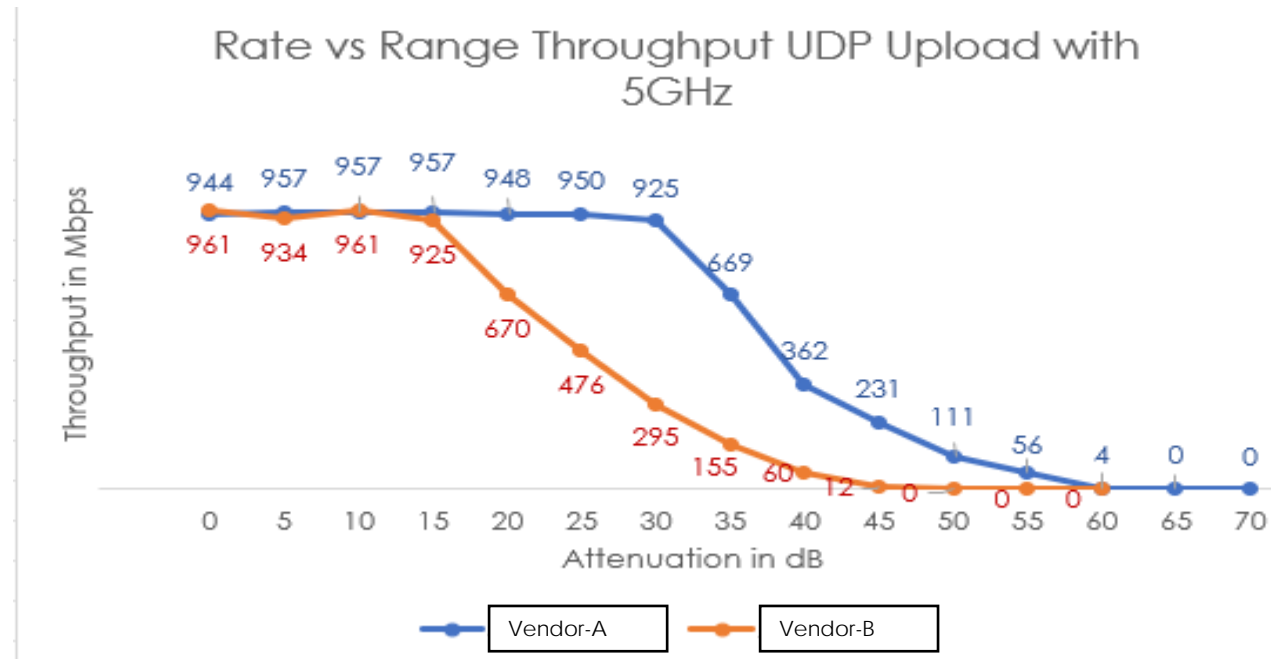
Test Description:

- In this scenario, Station associated and start running traffic when attenuation is 0 dB and gradually increase attenuation 5 dB steps.
- Intended load is set to 1 Gbps with TCP download traffic with client3NSS, 20Mhz BW in AX mode.
- Traffic from AP to client and throughput test run in 2.4GHz on channel 1.

Results Observations:

- Vendor-B is getting more throughput with increase in attenuation than Vendor-A.
- Vendor-A, Vendor-B have disconnected after 60dB.

Rate vs Range – 5GHz UDP Upload



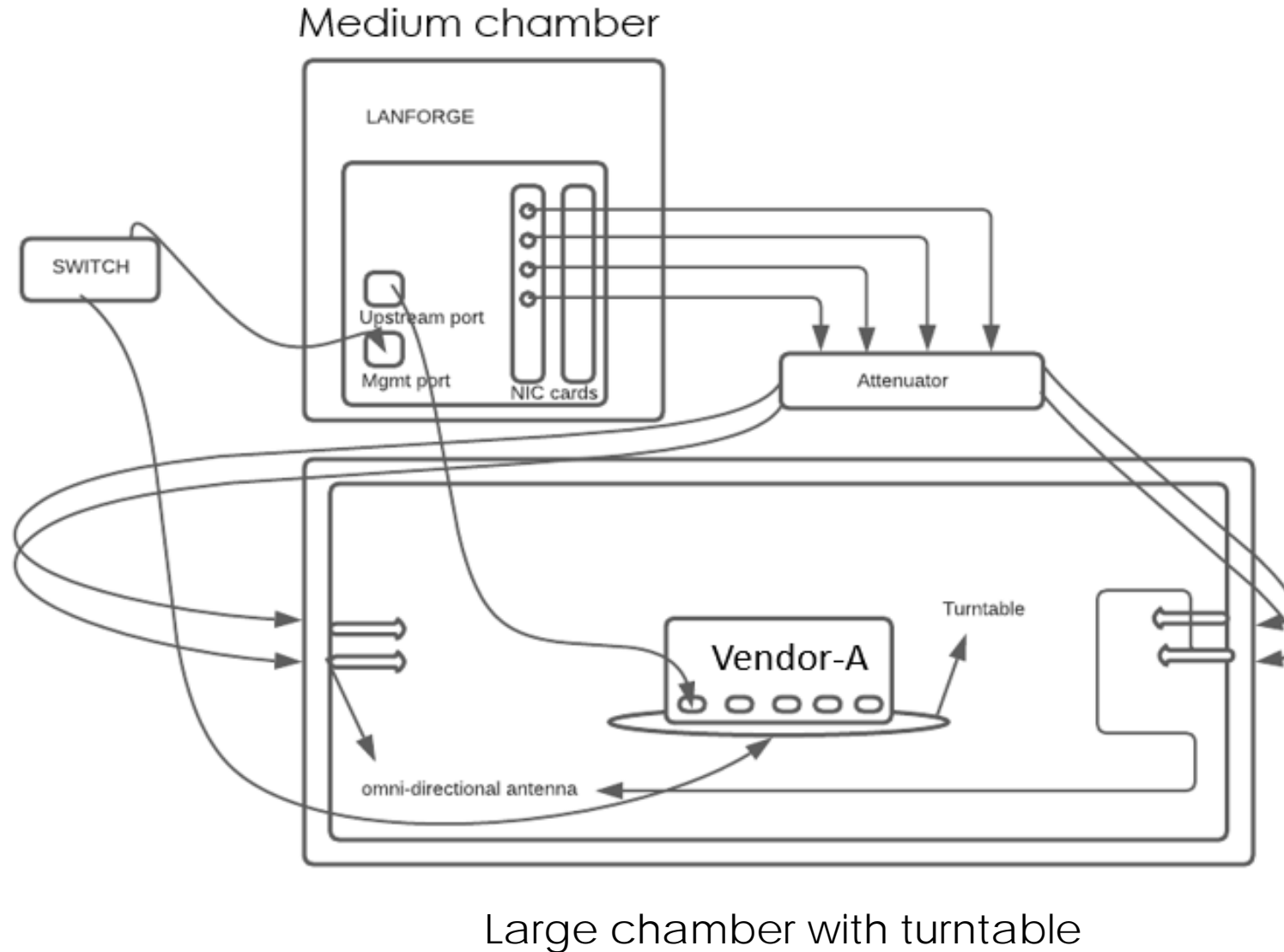
Test Description:

- In this scenario, Station associated and start running traffic when attenuation is 0 dB and gradually increase attenuation 5 dB steps.
- Intended load is set to 1 Gbps with UDP Upload traffic with client 4NSS, 80Mhz BW in AX mode.
- Traffic from client to AP and throughput test run in 5GHz on channel .

Results Observations:

- Vendor-B is getting more throughput with increase in attenuation than Vendor-A.
- Vendor-A, Vendor-B have disconnected after 60dB.

Testbed Setup for Rate vs Orientation:



- We used MTK 4*4 Radios for this test.
- The attenuator which is used can provide maximum 95dbm.
- The turntable provides 0-359 degrees rotation.

Testing images:

V2 192.168.200.201:1 (ct523c-3b63:1 (lanforge)) - VNC Viewer

Applications Places System

LANforge Manager Version(5.4.5)

Control Reporting Windows Info Tests

Chamber View Stop All Restart Manager Refresh

Resource Mgr DUT Profiles Traffic-Profiles Alerts Warnings + Wifi-Messages

VoIP/RTP VoIP/RTP Endps Attenuators RF-Generator File-I/O Gener

Status Port Mgr Extended Port Mgr Layer-3 L3 Endps Layer 4-7 Armageddon WanLi

Crgate Discover Start + Stop - Modify Delete

Attenuators

Name	State	Script	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
1.1.1001	Idle	None	20.0	20.0	20.0	20.0		

Logged in to: localhost:4002 as: Admin

Rate vs Range Test (cv-inst-1)

Settings Advanced Configuration Pass/Fail Report Configuration Report-2 Report-3

Selected DUT: Downstream/WiFi Port: 1.1.4 sta0000 Upstream Port: 1.1.1 eth1

Rate: 1 Gbps Opposite Rate: 0Kbps

Path Loss: 10 AP Tx Power: 0

Channels (STA DUT) Mode Packet Size Custom Packet Sizes

1.1.1001 No-Change 1 2 3 4 5 6 7

802.11a 802.11b 802.11g 802.11abg 802.11abgn 802.11bgn 802.11bg 802.11abgn-AC

Custom 60 142 256 512 1024 MTU 4000 9000

Spatial Streams Security (STA DUT) Bandwidth (STA DUT)

1.1.1001 AUTO Open WEP WPA WPA2 WPA3

1 2 3 4

80 160

Traffic Type Attenuator 1: 1.1.1001 Attenuator 2: NONE (0) Turntable

UDP TCP Arm-UDP

1 2 3 4 5 6 7 8

0..+45..359

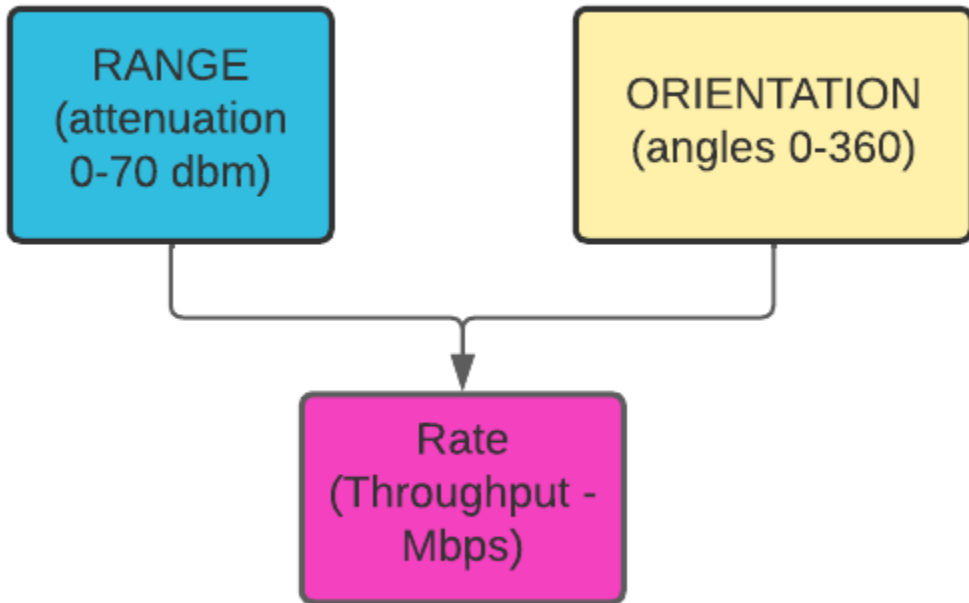
Direction DUT Transmit DUT Receive

15.00 fps - current 9.42 fps - average

Camorama - LRCP 1080P Camera: LRCP 1080P C - 640x480

Stop Skip Another Iteration Pause Cancel

Rate vs Orientation test:

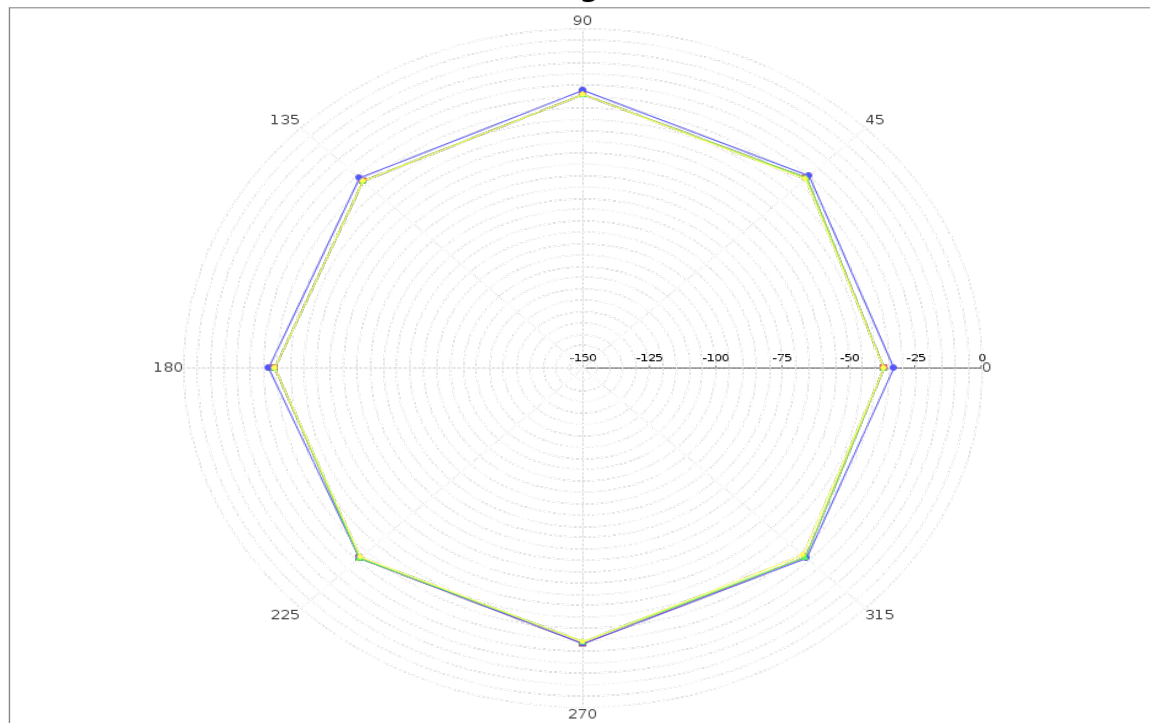


- Here we change both the distance and the angular position of the CPE and calculate the throughput.
- Changing the distance means in terms of increasing the attenuation.
- The maximum attenuation at which the client can connect to the CPE IS 60dbm.
- Changing the orientation means in terms of changing the angle of the turntable.
- The turntable can rotate from 0 to 360 degrees.
- We can run both the TCP and UDP traffics.

Rate vs Orientation test at 0db (5GHz):

Vendor-A

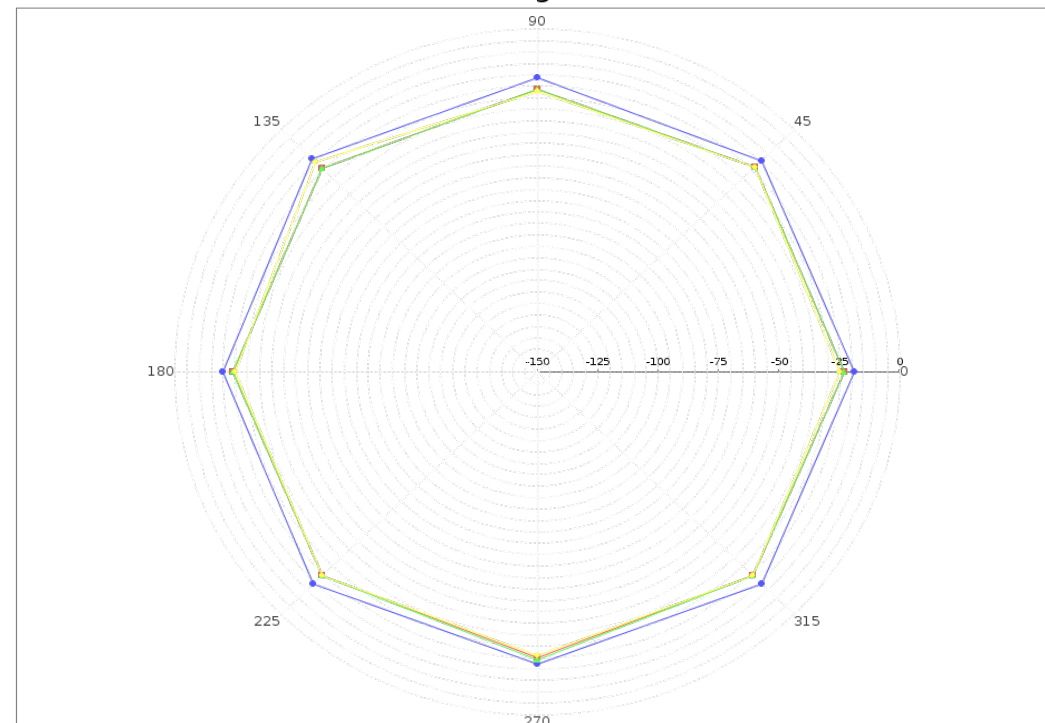
RSSI related to Signal and Rotation



ch36-UDP-DUT-TX-4NSS-80Mhz-10db-MTU ch36-UDP-DUT-RX-4NSS-80Mhz-10db-MTU ch36-TCP-DUT-TX-4NSS-80Mhz-10db-MTU ch36-TCP-DUT-RX-4NSS-80Mhz-10db-MTU

VENDOR-B

RSSI related to Signal and Rotation



ch36-UDP-DUT-TX-4NSS-80Mhz-10db-MTU ch36-UDP-DUT-RX-4NSS-80Mhz-10db-MTU ch36-TCP-DUT-TX-4NSS-80Mhz-10db-MTU ch36-TCP-DUT-RX-4NSS-80Mhz-10db-MTU

Test Analysis:

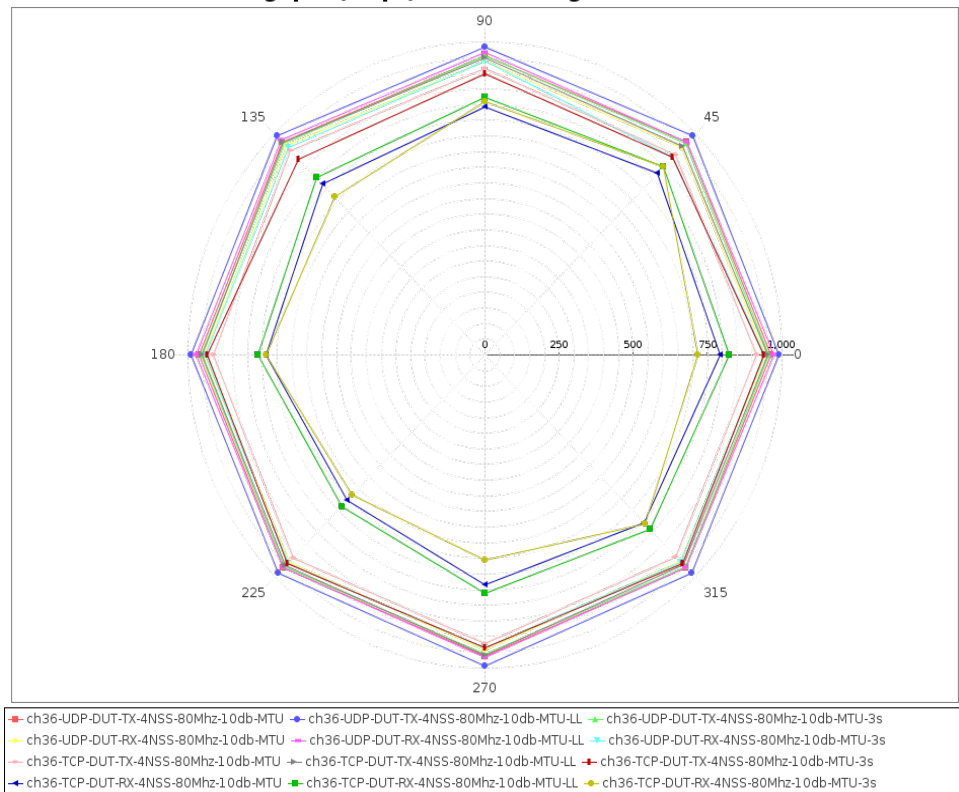
- Attenuation=0db, orientation= 0-360 degrees with an increment of 45degrees.
- Here the RSSI values are between 25dbm to 50dbm for Vendor-A.
- The RSSI values are at 25dbm constantly for Vendor-B.

Result:
Vendor-B is showing good RSSI values.

Throughput at 0db (5GHz):

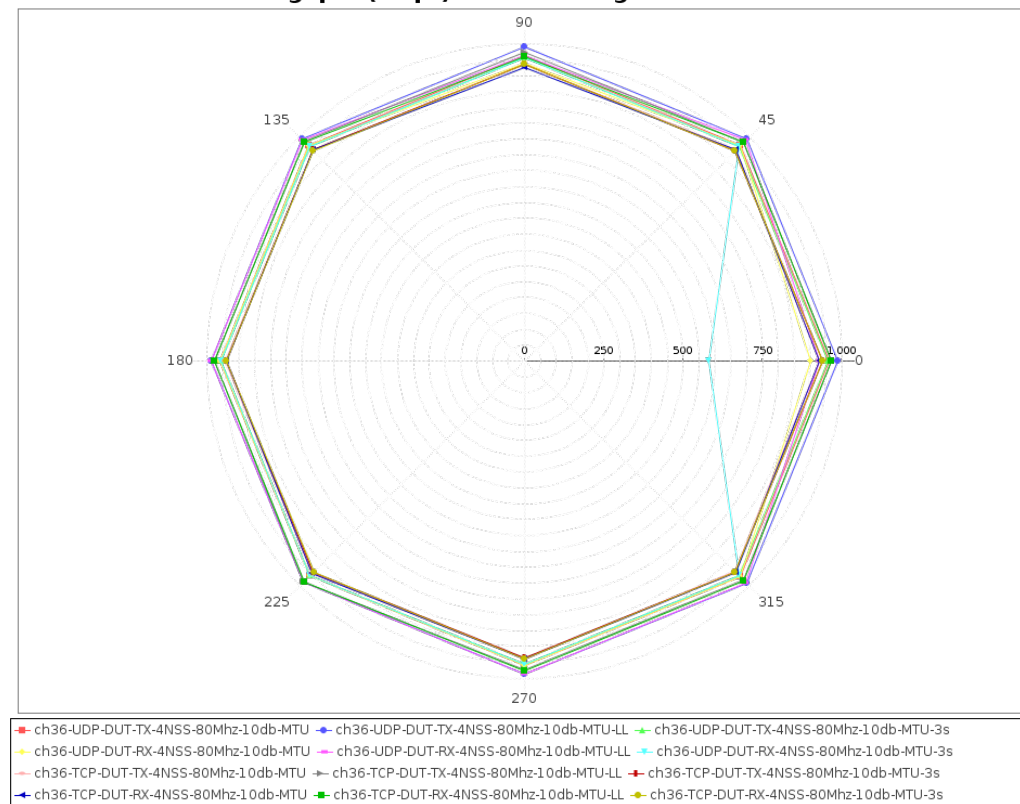
Vendor-A

Throughput (Mbps) related to Signal and Rotation



VENDOR-B

Throughput (Mbps) related to Signal and Rotation



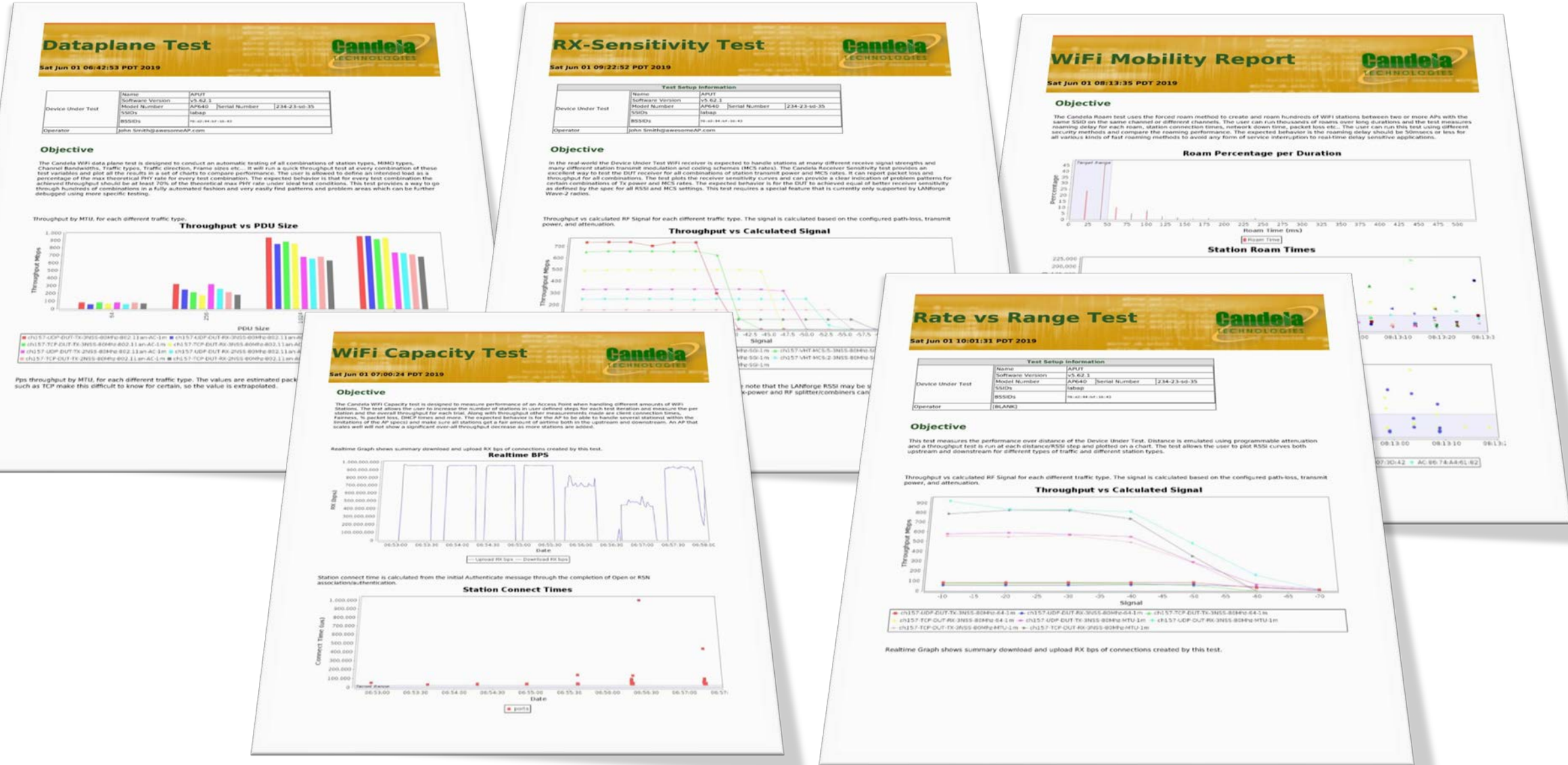
Test analysis:

- Attenuation=0db, orientation= 0-360 degrees with an increment of 45degrees.
- Here the Throughput values are between 730mbps to 950mbps for Vendor-A from 0-360 degrees.
- Here the Throughput 900mbps to 950mbps above for Vendor-B from 0-360 degrees.

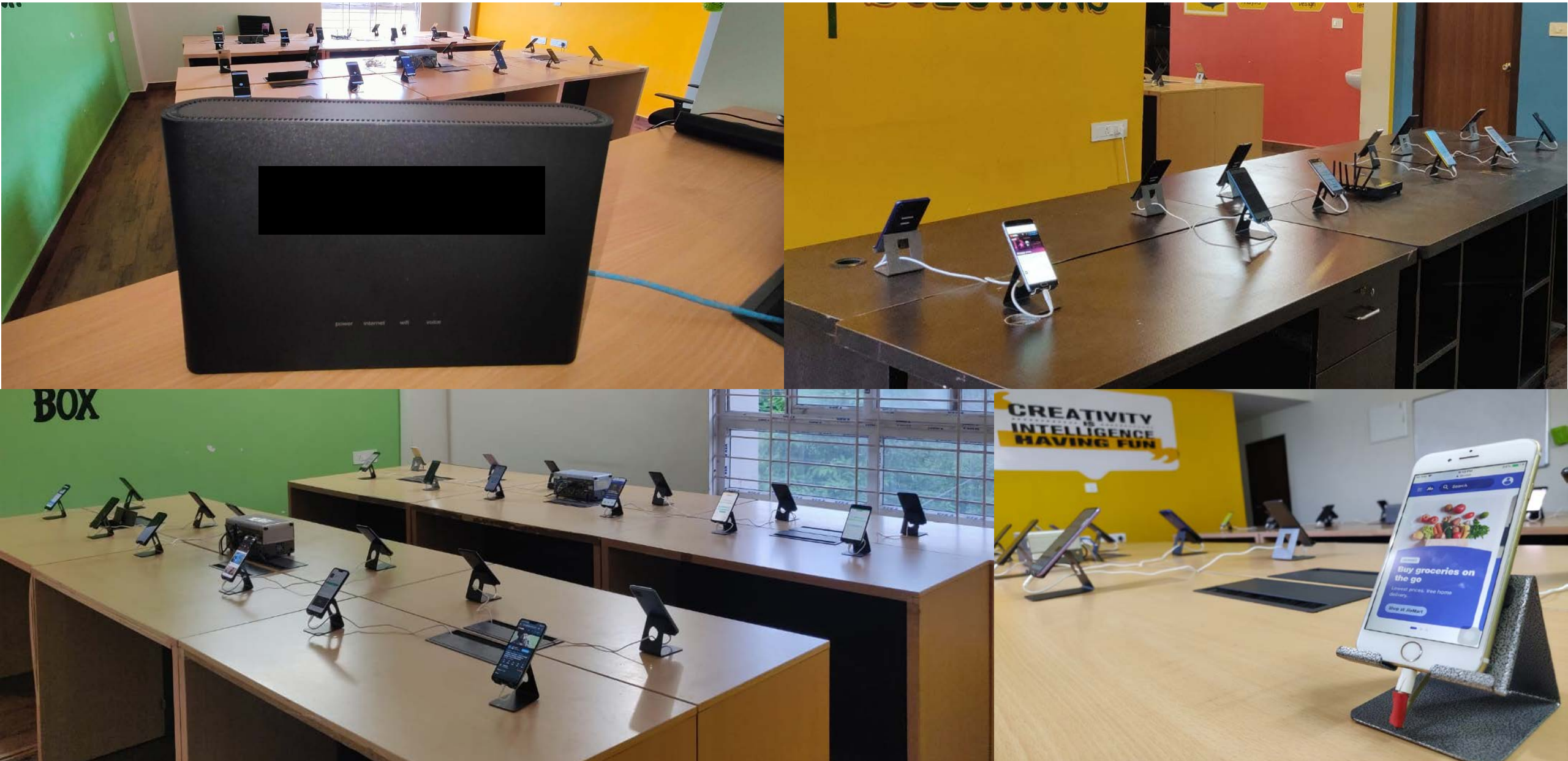
Result:
Vendor-B is showing a consistent performance in throughput compared to Vendor-A.

Report link: <https://www.dropbox.com/s/p925d4qdz8ma996/o-att.pdf?dl=0>

Lots of Tests Run.....



Capacity Test House



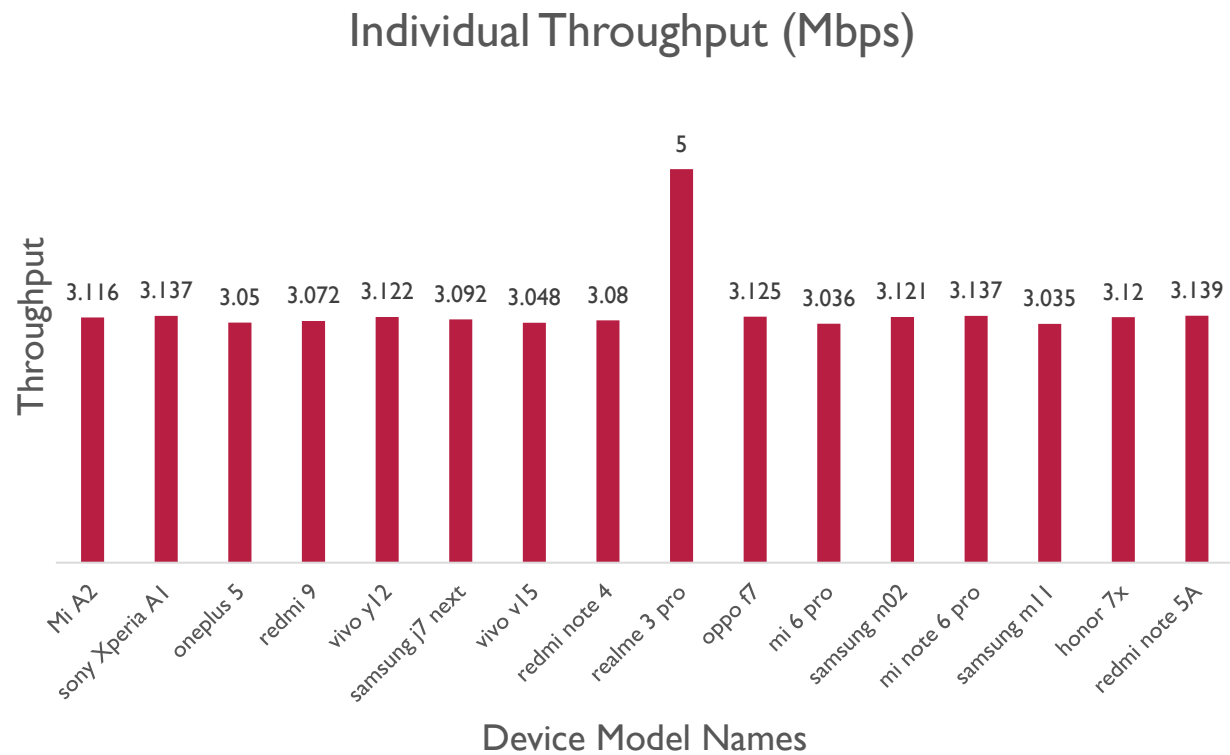
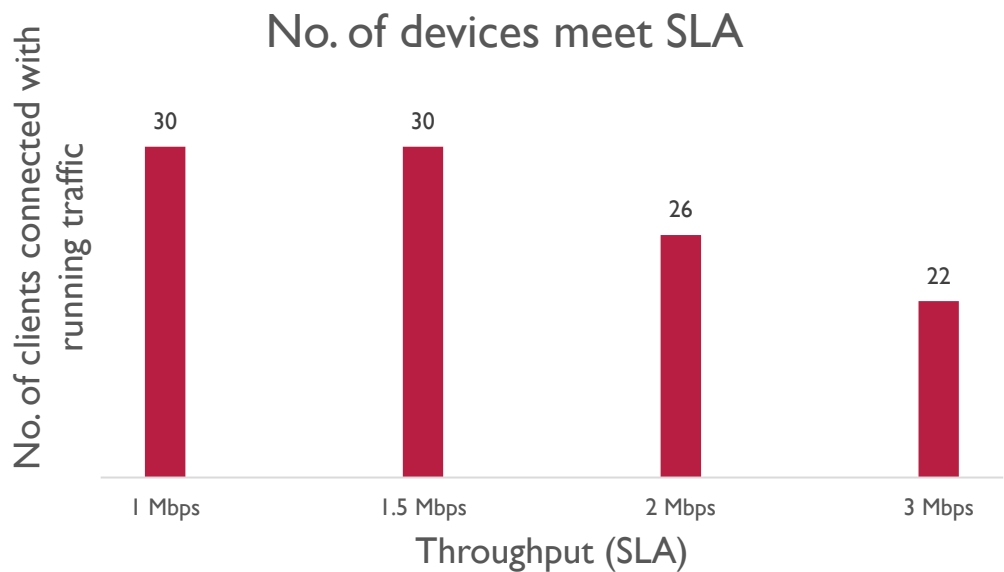
Throughput Capacity Test Results – Wi-Fi Capacity



Test Objective

This Test is to verify the maximum number of clients connected to AP meeting with different throughput SLA.

Client mode	Traffic	Intended traffic	SLA	No. of stations met SLA
5 GHz	UDP DL	2 Mbps	1 Mbps	30
		3 Mbps	1.5 Mbps	30
		4 Mbps	2 Mbps	26
		5 Mbps	3 Mbps	22



Test Results Summary

S. No	Test case name	Vendor-A		
		Pass/Fail		
		2.4G	5G	
1.	Maximum Connection Test	Pass	Fail	This test is failed because Vendor-A supports 30-clients only.
2.	Maximum Throughput Test	Pass	Pass	
3.	Airtime Fairness	Pass	Fail	This test is failed because of the packet error rate.
4.	Dual-Band Throughput	Pass	Fail	This test case is failed because of the throughput drop in the 5GHz.
5.	Bi-Directional Throughput	Pass	Pass	The test is failed with a marginal packet error rate at 1 point (< 0.01%) in 2.4G. So, considering the test is passed in 2.4 GHz.
6.	Multiple Assoc/Disassoc test	Pass	Pass	
7.	AP coexistence test	Pass	Pass	
8.	Receiver Sensitivity test	Pass	Pass	
9.	Rate vs Range	Fail	Pass	Slightly the throughput is decreasing with the increase of attenuation.
10.	Spatial consistency test	Fail	Fail	The throughput drop is observed in both 2.4GHz and 5GHz.
11.	AX Peak Performance test	Pass	Fail	This test case is failed because of the throughput drop in the 5GHz.
12.	Multiple STAs Performance	Pass	Fail	This test case is failed because of the throughput drop in the 5GHz.
13.	Downlink MU-MIMO test	NA	Pass	We didn't perform this test case in 2.4Ghz because CPE supports 3x3 for 2.4Ghz.
14.	Long term stability	Fail	Fail	The throughput drop is observed in both 2.4GHz and 5GHz.
15.	Automatic channel selection test	Pass	Pass	



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