Network Testing & Emulation Solutions

WiFi 6E Test Solution

sales@candelatech.com
1-360-380-1618

6E Test cases Covered

6E Throughput Benchmark

This test gives the 6E performance with different packet sizes, channel BWs, traffic types, MIMO types.

Client Capacity

WiFi Capacity test is designed to measure performance of an Access Point when handling several 6E WiFi Stations.

Near/Far Clients, Band Steering

Measure the performance and stability of the 6E clients based on low and high RSSI levels

Tri-band Performance

Running traffic on 2.4, 5 & 6Ghz clients simultaneously.

6E RvR and RvO

This test measures the 6E performance over distance and different antenna orientation of the access point.

OFDMA Performance

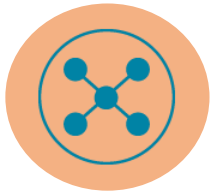
This test gives the downlink and uplink OFDMA performance for the multiple 6E clients. Sizes of RUs allocated to different users

Latency

This test intends to verify latency under low, high and maximum AP traffic load with multiple stations

Airtime Fairness, QoS

Airtime Fairness Test intends to verify the capability of Wi-Fi device to ensure the fairness of airtime usage.



MU-MIMO

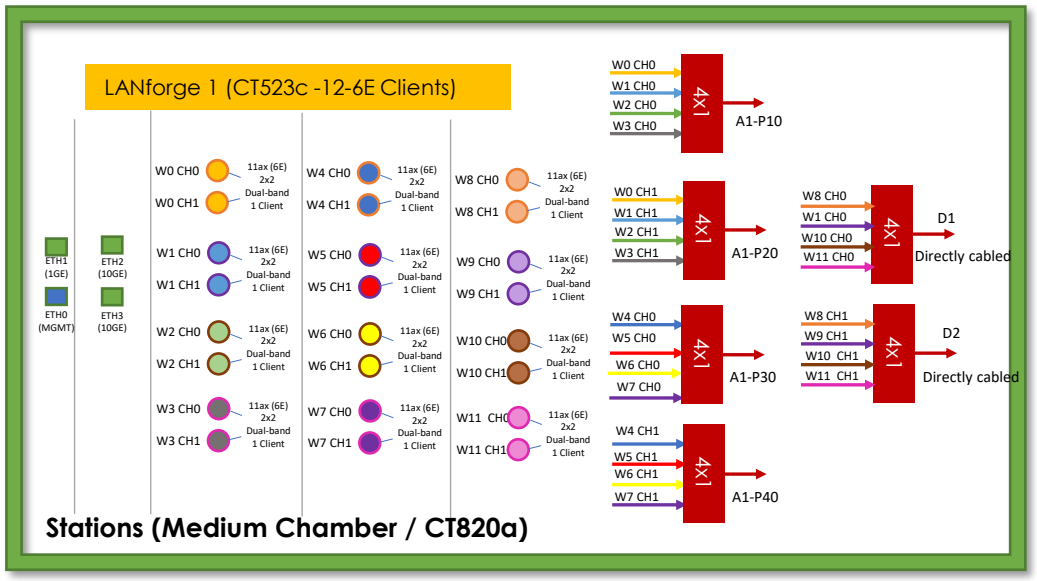
This test measures the 6E Downlink and uplink multiuser, multi input, multi output

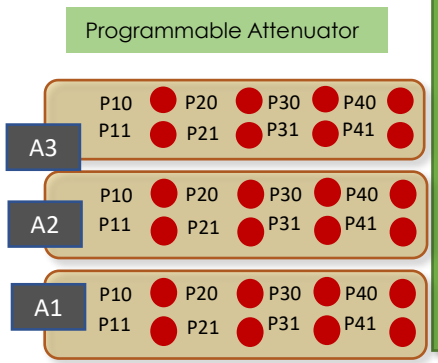
6E Testbed Images

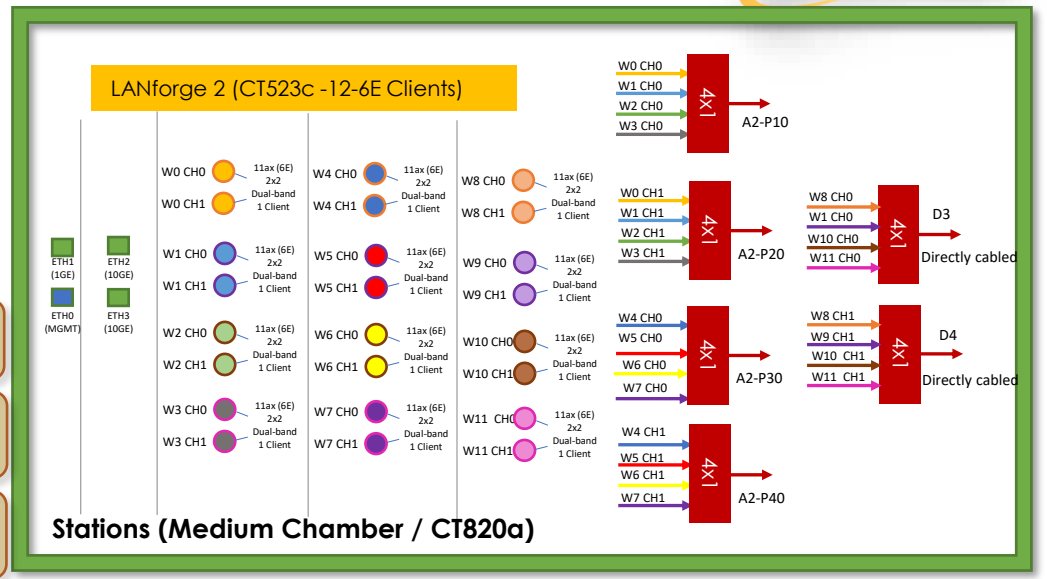
Outside

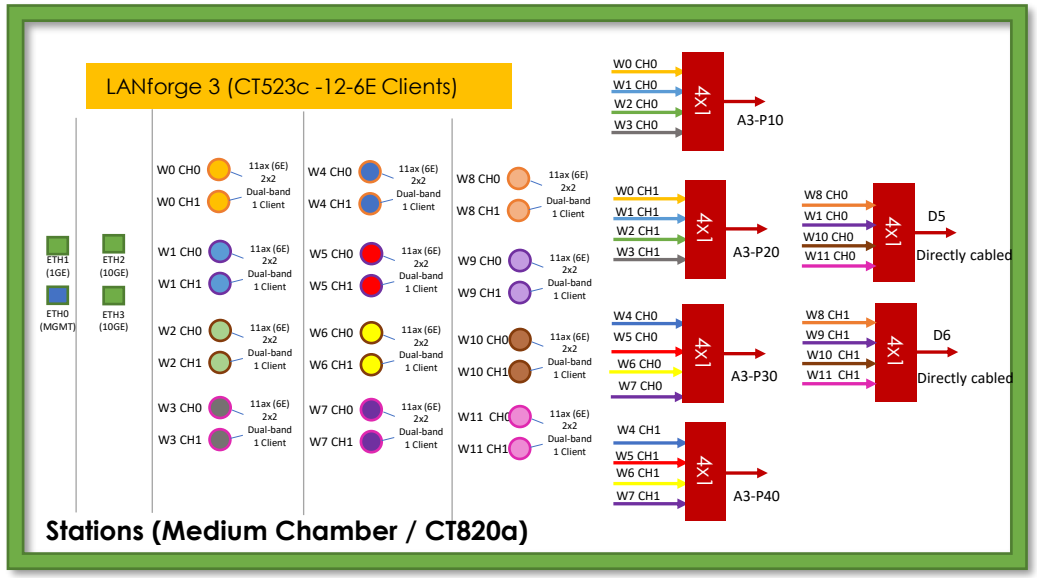
Inside

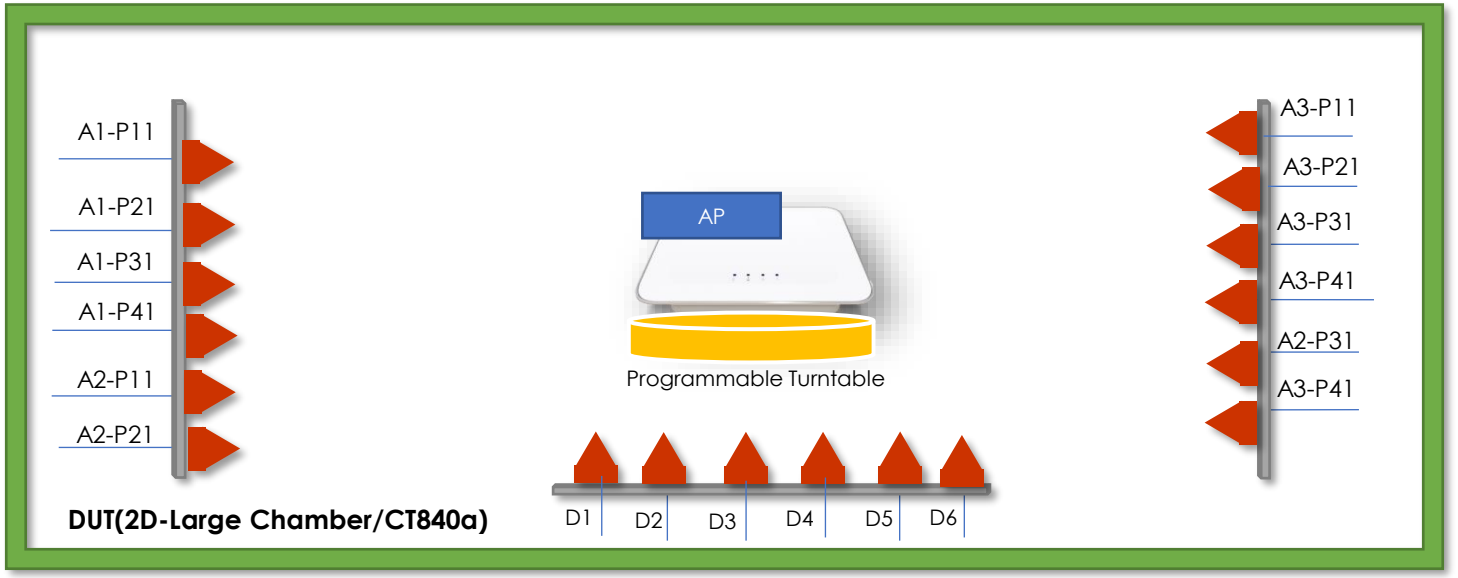
WiFi 6E Testbed Wiring Diagram





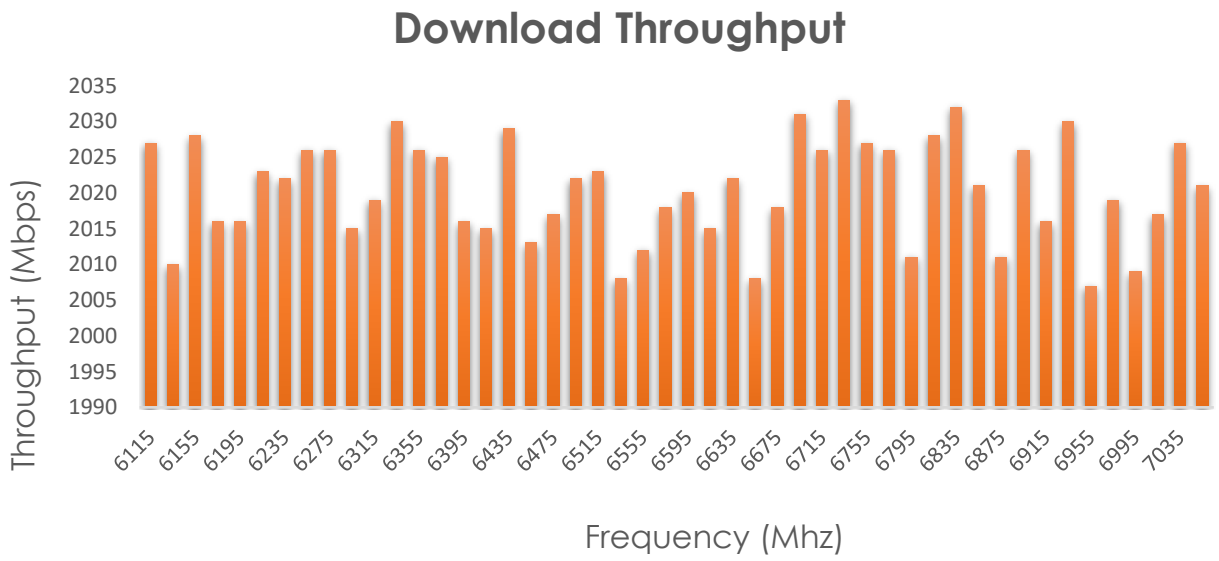


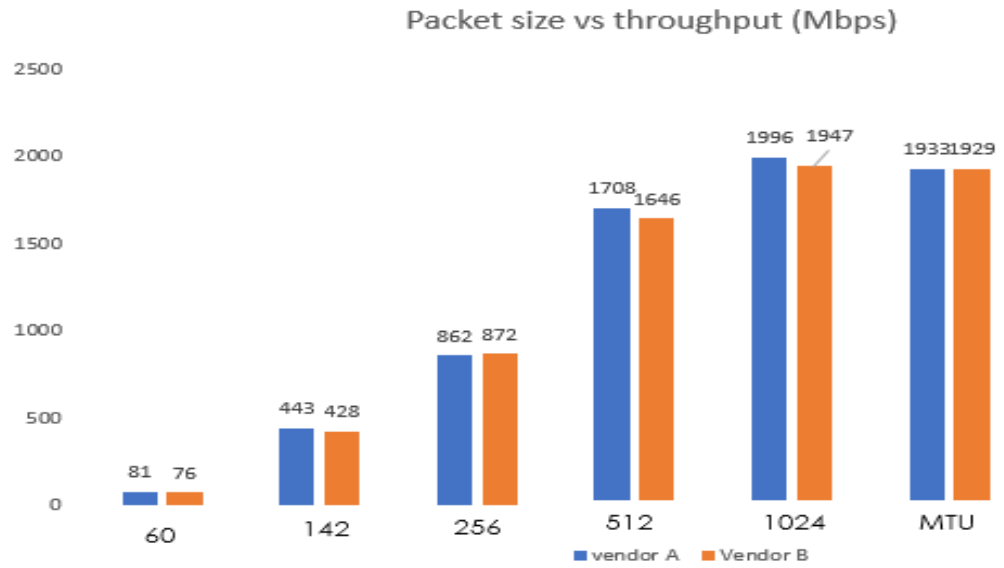




6E Throughput Benchmark

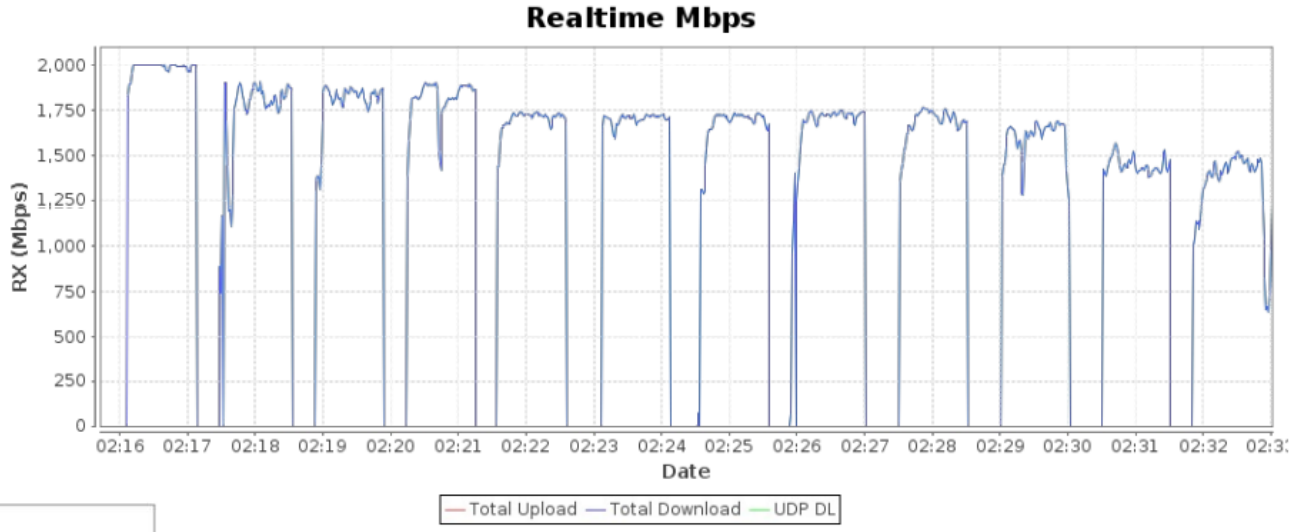
The Candela WiFi data plane test is designed to conduct an automatic testing of all combinations of station types, MIMO types, Channel Bandwidths, Traffic types, Traffic direction, Frame sizes etc… It will run a quick throughput test at every combination of these test variables and plot all the results in a set of charts to compare performance. The user is allowed to define an intended load as a percentage of the max theoretical PHY rate for every test combination. The expected behavior is that for every test combination the achieved throughput should be at least 70% of the theoretical max PHY rate under ideal test conditions. This test provides a way to go through hundreds of combinations in a fully automated fashion and very easily find patterns and problem areas which can be further debugged using more specific testing. The below chart shows the throughput with all the 6E channels

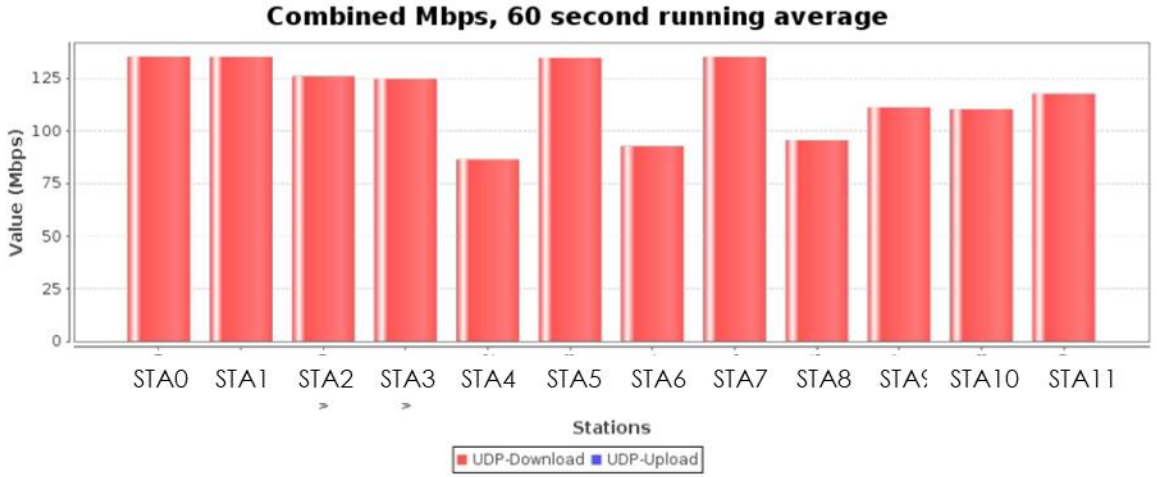




WiFi Capacity Test

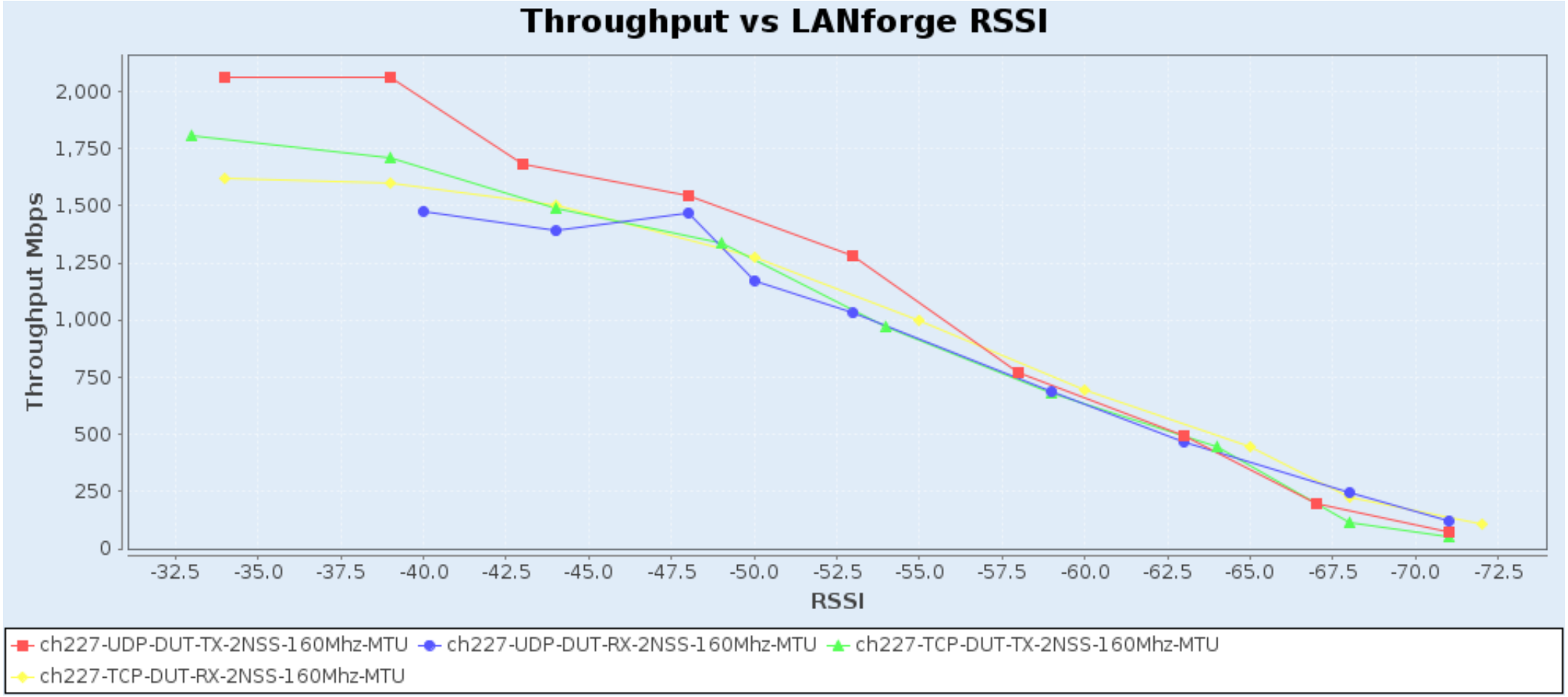
The Candela WiFi Capacity test is designed to measure performance of an Access Point when handling several 6E WiFi Stations. The test allows the user to increase the number of stations in user defined steps for each test iteration and measure the per station and the overall throughput for each trial. Along with throughput other measurements made are client connection times, % packet loss, DHCP times and more. The expected behavior is for the AP should be able to handle several stations (within the limitations of the AP specs) and make sure all stations get a fair amount of airtime both in the upstream and downstream.





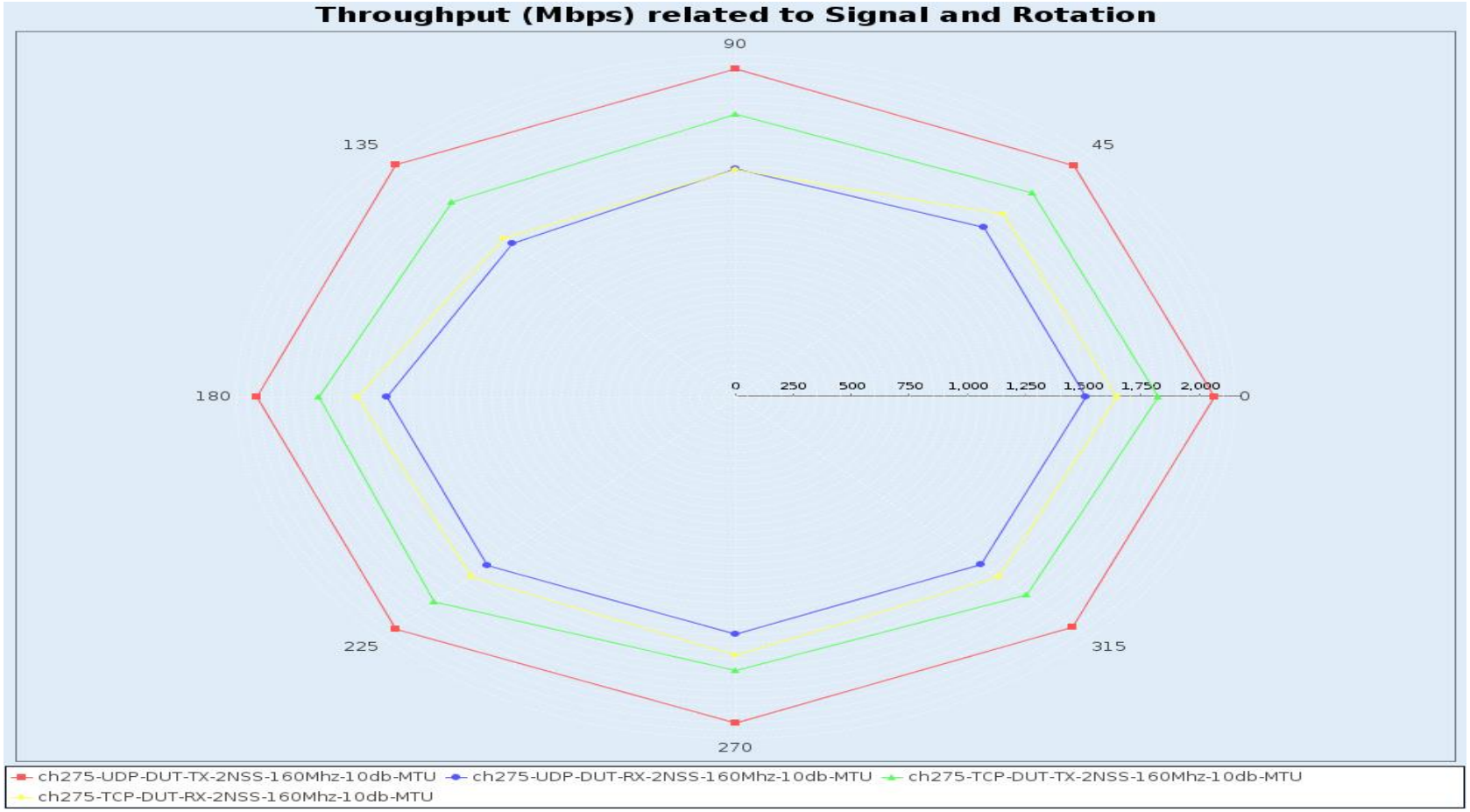
6E Rate vs Range Test

This test measures the performance over distance of the Device Under Test. Distance is emulated using programmable attenuation and a throughput test is run at each distance/RSSI step and plotted on a chart. The test allows the user to plot RSSI curves both upstream and downstream for different types of traffic and different station types. The below chart runs with the channel 227.



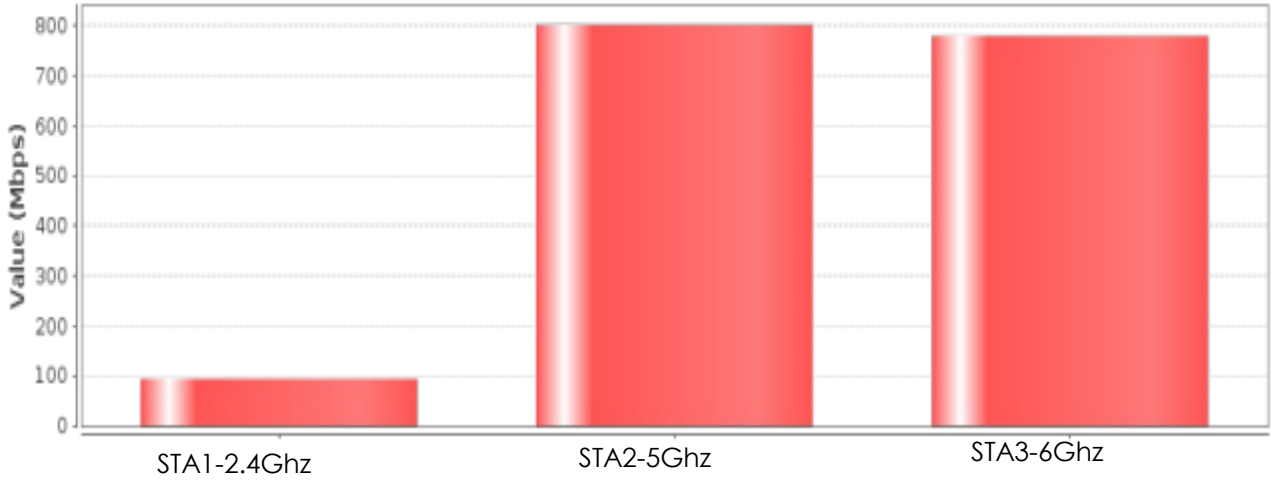
6E Rate vs Orientation Test

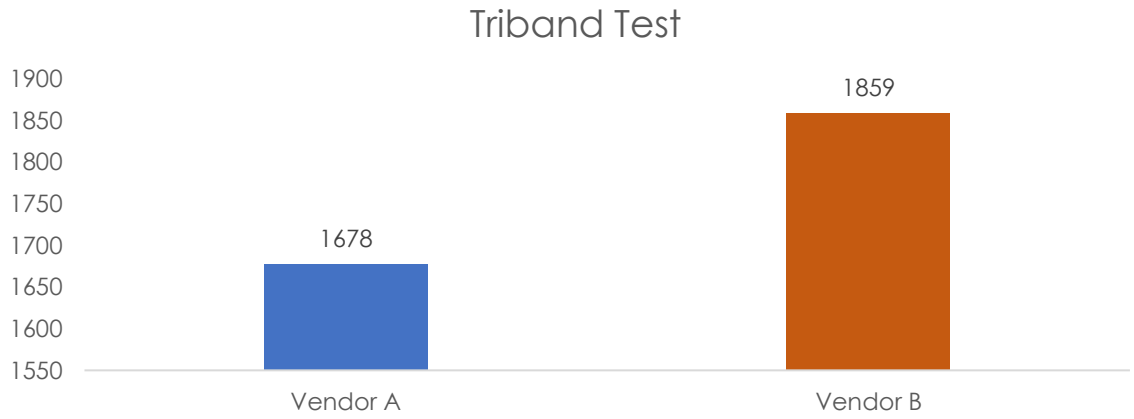
This test measures the performance of the DUT at different antenna orientations. Different antenna orientations of the transmitter will respect to the receiver may results in huge variations of performance caused by antenna nulls and dead spots . Using a large chamber with a programmable turntable, the DUT is rotated to various angles and upstream/downstream throughput is measured at each orientation and the results are plotted on a polar plot



Tri-Band Test

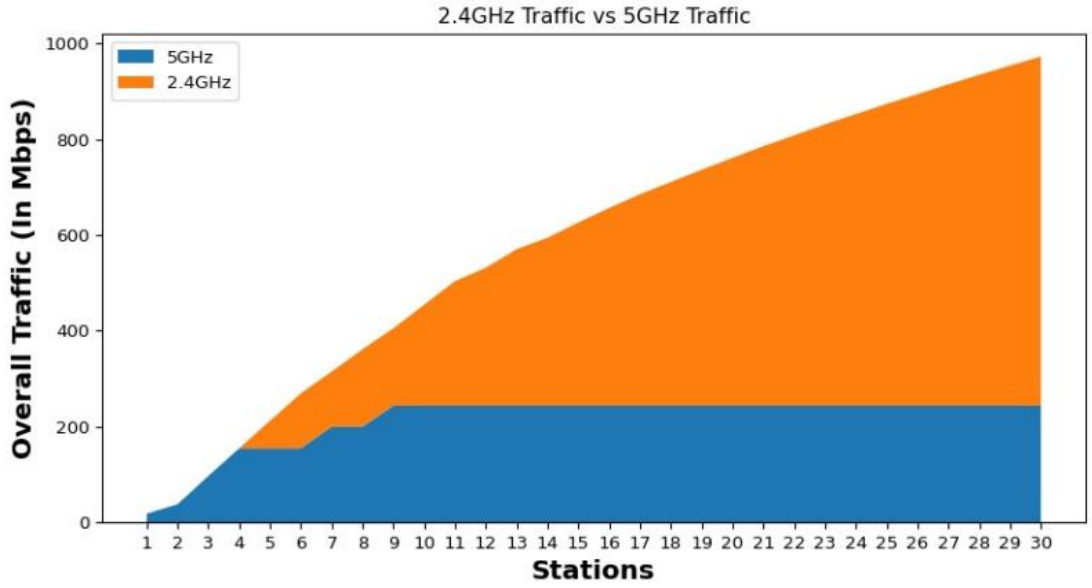
This test creates each client on 2.4, 5 and 6Ghz bands and run the traffic simultaneously. The Multi Band Performance test intends to verify that the Wi-Fi AP throughput with multiple bands active with a single station on each band. The configured speed will be 20% higher than the passing value for MTU sized frames in the throughput test. If the throughput test was skipped, then fixed values will be used.

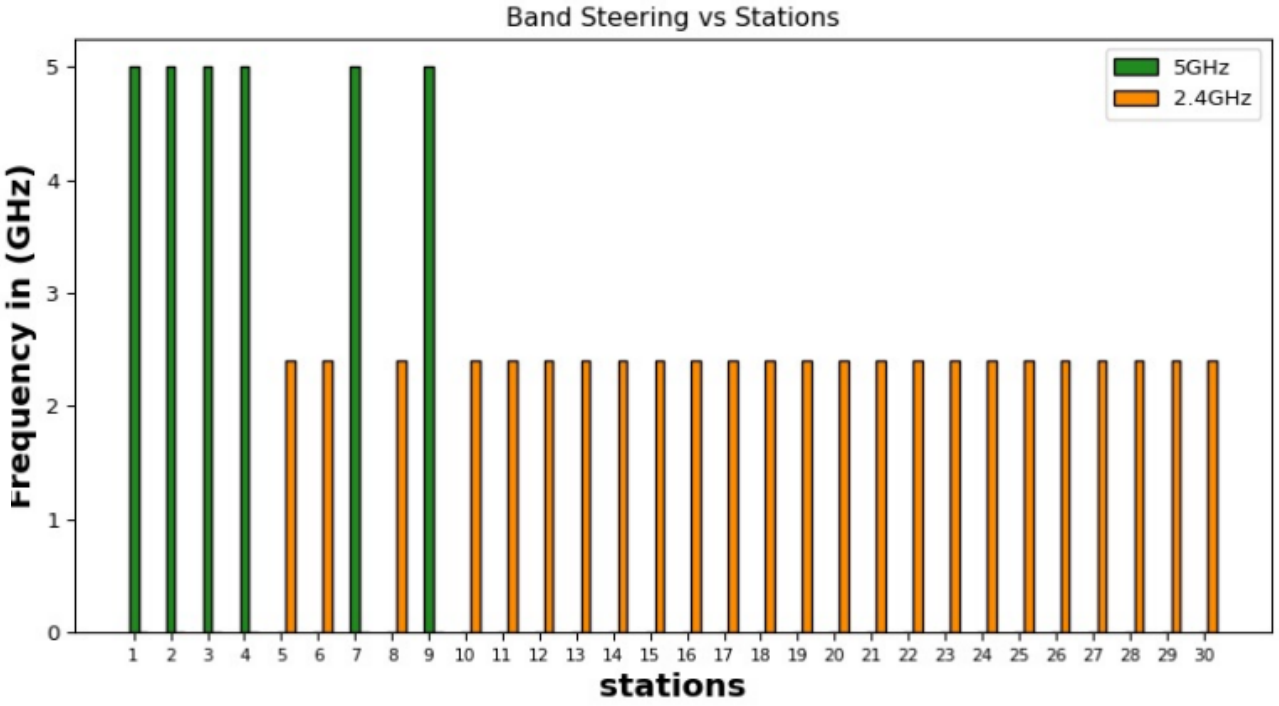




Band Steering Test

Through this test, clients get steered from one band to another based on RSSI levels or load based. The below chart shows the auto selected band of a station which is created on each iteration, Based on the overall load on the access point the next station will be created on a band which is having less load.

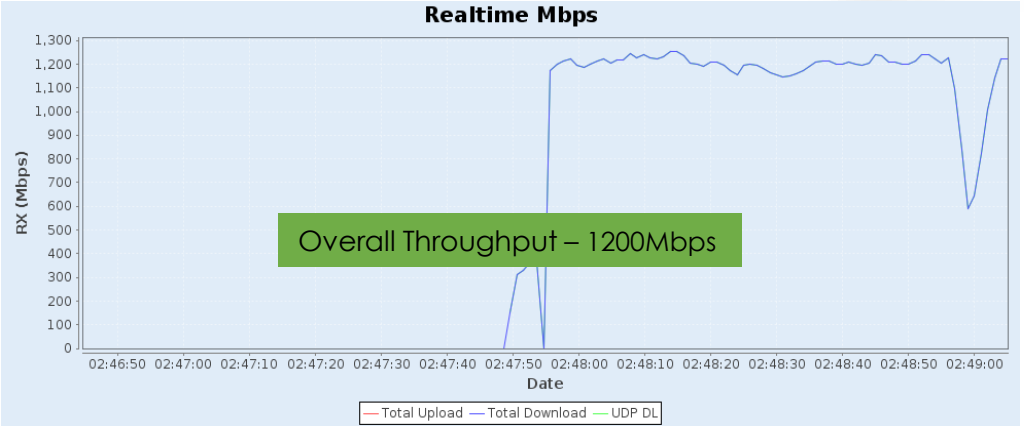




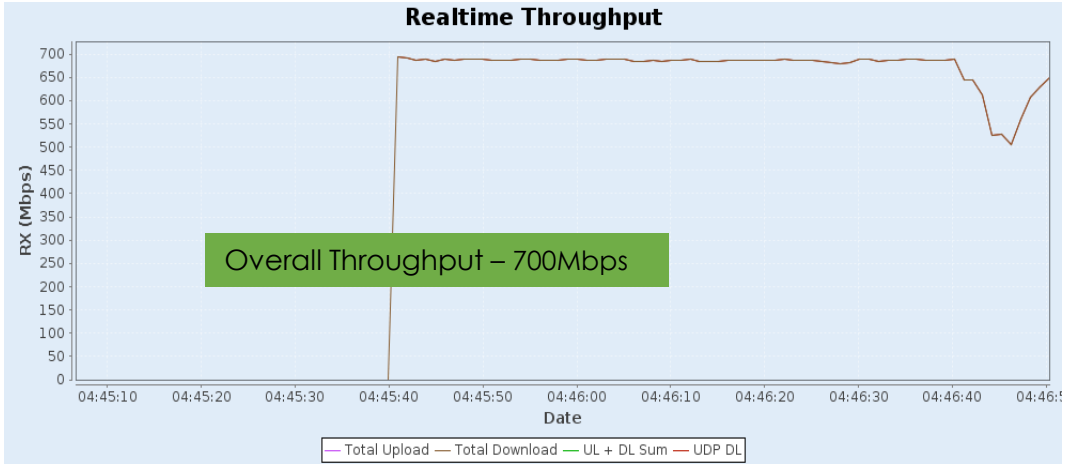
6E MU-MIMO Performance test

Test Description

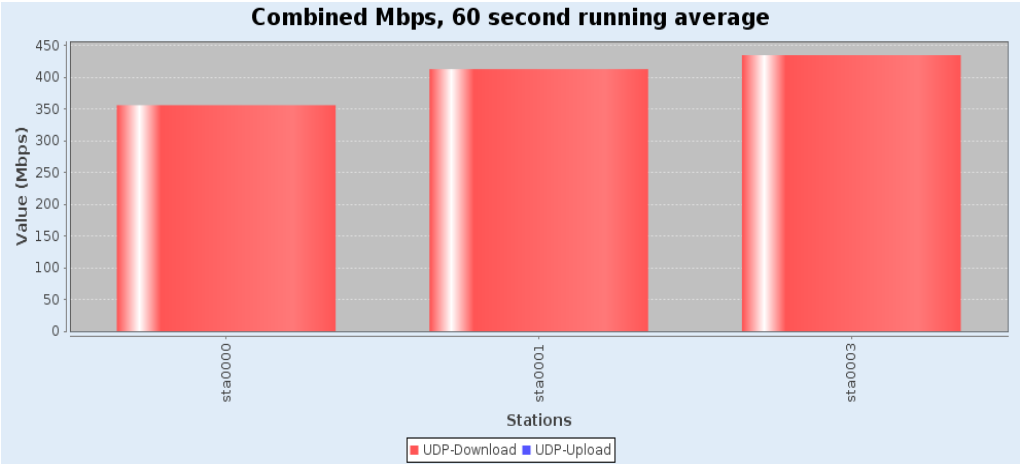
- Test was run with 3 MU-MIMO clients connected to the APs 6GHz radio. Client1 was set to 2x2 MIMO and Client2 and Client3 were set to 1x1 Mode.
- UDP traffic is run at full rate from AP to all three stations.



MU-MIMO Enable



MU-MIMO Disable

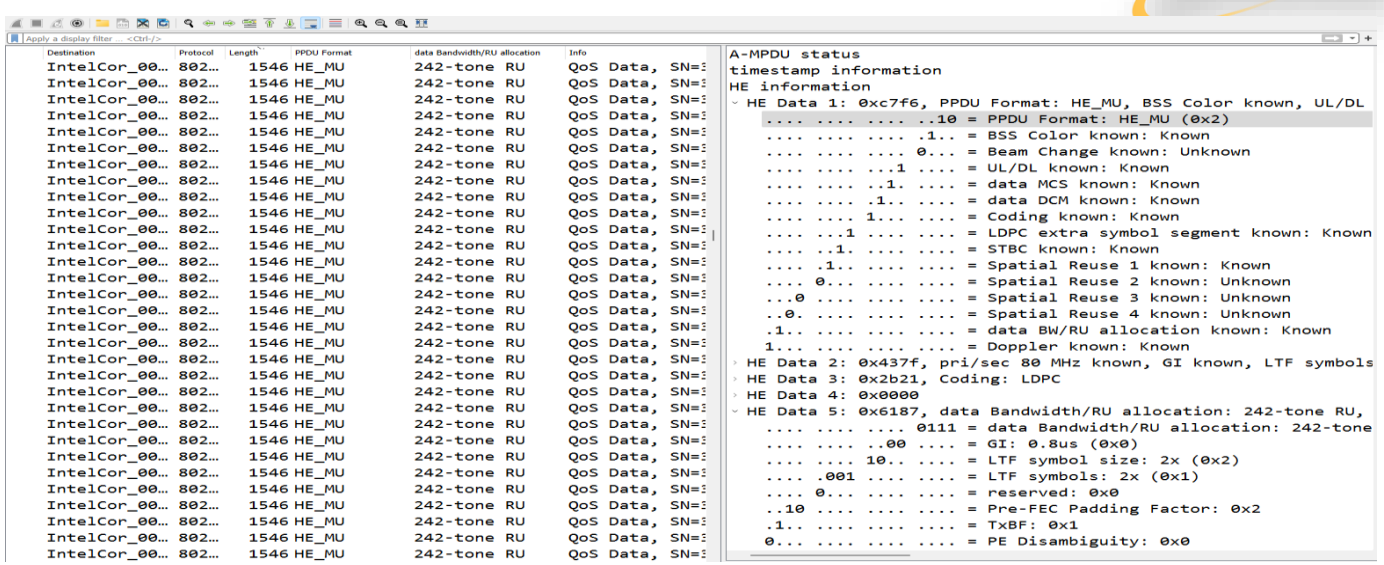


MU-MIMO Enable

6E OFDMA Performance test

Test Description

- Test was run with 4 clients connected to the APs 6GHz radio.
- Four 11ax stations each with a UDP download at 300B payload size which will show that the AP is using OFDMA.
- Packet capture on one of the STA shows AP using HE MU PPDU frame format for sending the QoS data and 242-tone RU is allocated.

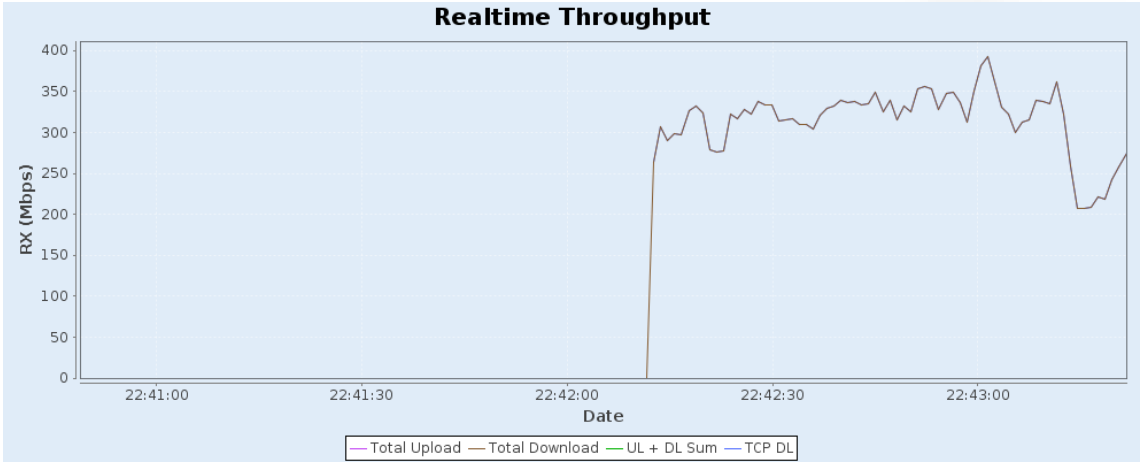


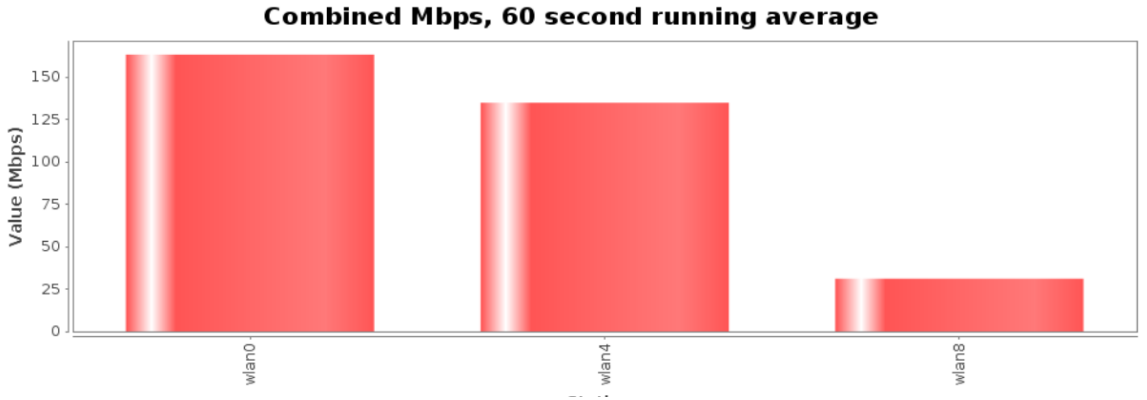
Station Address	PHY Mbps	Data Mbps	Air Use	Data Use	Retries	bw	mcs	Nss	ofdma	mu-mimo
7C:50:79:3F:81:B2	1198.2	44.8	142.8%	24.9%	0.0%	80	11	2	98.4%	0.0%
(overall)	-	179.9	561.8%	-	-					
Station Address	PHY Mbps	Data Mbps	Air Use	Data Use	Retries	bw	mcs	Nss	ofdma	mu-mimo
7C:50:79:3F:8D:BF	1197.7	45.1	146.7%	25.1%	0.0%	80	11	2	99.5%	0.0%
40:1C:83:3C:75:C1	501.4	45.6	115.3%	25.3%	9.0%	80	9.3	1	90.3%	0.0%
14:18:C3:48:AE:77	1197.7	44.5	144.9%	24.8%	0.0%	80	11	2	98.8%	0.0%
7C:50:79:3F:81:B2	1197.4	44.7	141.9%	24.9%	0.0%	80	11	2	98.0%	0.0%
(overall)	-	179.9	548.8%	-	-					
Station Address	PHY Mbps	Data Mbps	Air Use	Data Use	Retries	bw	mcs	Nss	ofdma	mu-mimo
7C:50:79:3F:8D:BF	1196.0	45.2	152.5%	25.1%	0.0%	80	11	2	99.0%	0.0%
40:1C:83:3C:75:C1	479.1	45.4	122.1%	25.2%	7.6%	80	9.0	1	94.4%	0.0%
14:18:C3:48:AE:77	1196.1	44.6	152.3%	24.8%	0.0%	80	11	2	99.9%	0.0%
7C:50:79:3F:81:B2	1195.9	44.8	146.7%	24.9%	0.0%	80	11	2	99.1%	0.0%
(overall)	-	180.0	573.5%	-	-					
Station Address	PHY Mbps	Data Mbps	Air Use	Data Use	Retries	bw	mcs	Nss	ofdma	mu-mimo
7C:50:79:3F:8D:BF	1196.0	45.0	153.5%	25.1%	0.0%	80	11	2	99.2%	0.0%
40:1C:83:3C:75:C1	479.5	45.1	121.2%	25.1%	8.2%	80	9.0	1	94.9%	0.0%
14:18:C3:48:AE:77	1195.9	44.6	152.6%	24.9%	0.0%	80	11	2	99.1%	0.0%
7C:50:79:3F:81:B2	1195.9	44.7	147.0%	24.9%	0.0%	80	11	2	99.4%	0.0%
(overall)	-	179.4	574.3%	-	-					
Station Address	PHY Mbps	Data Mbps	Air Use	Data Use	Retries	bw	mcs	Nss	ofdma	mu-mimo
7C:50:79:3F:8D:BF	1195.1	44.8	155.5%	25.0%	0.0%	80	11	2	99.7%	0.0%
40:1C:83:3C:75:C1	479.4	44.8	120.3%	25.0%	9.7%	80	9.0	1	94.3%	0.0%
14:18:C3:48:AE:77	1195.1	44.7	155.1%	24.9%	0.0%	80	11	2	99.1%	0.0%
7C:50:79:3F:81:B2	1195.2	44.8	150.4%	25.0%	0.0%	80	11	2	99.6%	0.0%
(overall)	-	179.0	581.4%	-	-					
Station Address	PHY Mbps	Data Mbps	Air Use	Data Use	Retries	bw	mcs	Nss	ofdma	mu-mimo
7C:50:79:3F:8D:BF	1199.0	44.7	142.7%	25.0%	0.0%	80	11	2	99.3%	0.0%
40:1C:83:3C:75:C1	562.6	44.8	108.7%	25.1%	7.1%	80	10.4	1	87.1%	0.0%
14:18:C3:48:AE:77	1198.9	44.6	141.4%	24.9%	0.0%	80	11	2	99.0%	0.0%
7C:50:79:3F:81:B2	1198.9	44.8	135.1%	25.0%	0.0%	80	11	2	98.7%	0.0%
(overall)	-	178.9	527.9%	-	-					

6E Near/Far Clients test

Test Description

- Three clients were created, one each on three different LANforge radios.
- Each client is connected to the DUT chamber through a different programmable attenuator allowing for different distances emulated for each client.
- The path loss created for the three clients was 10dB, 25dB and 35dB representing a Near, Medium Distance and Far Clients respectively.
- Test run at full rate TCP downstream from AP to all three clients and throughput is measured for each client.





Near client
10dB Path loss

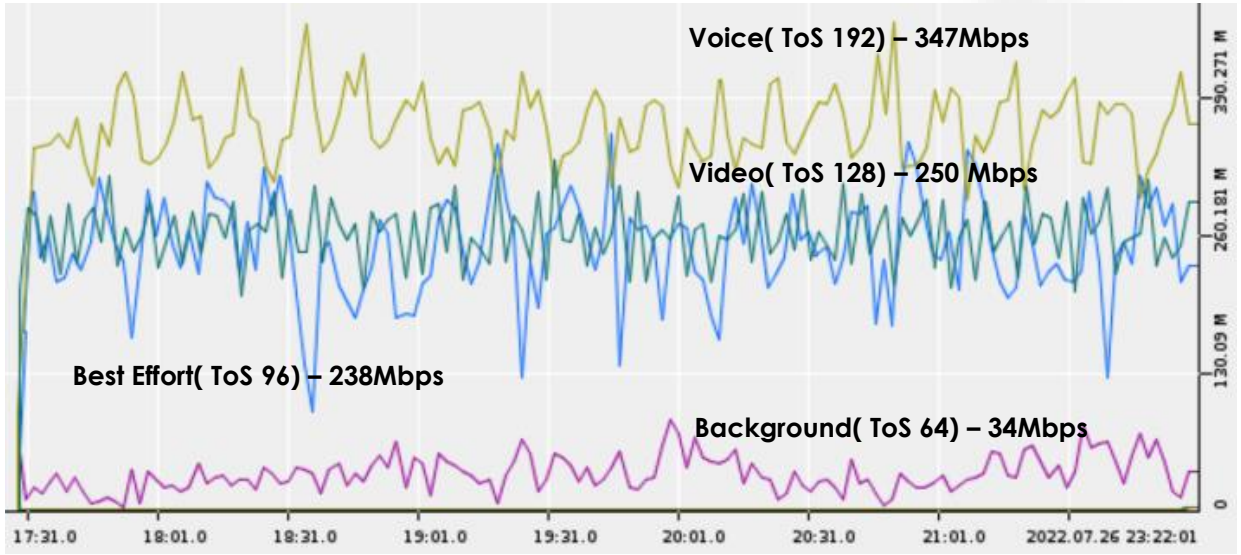
Medium client
25dB Path loss

Far client
35dB Path loss

6E QoS Performance test

Test Description

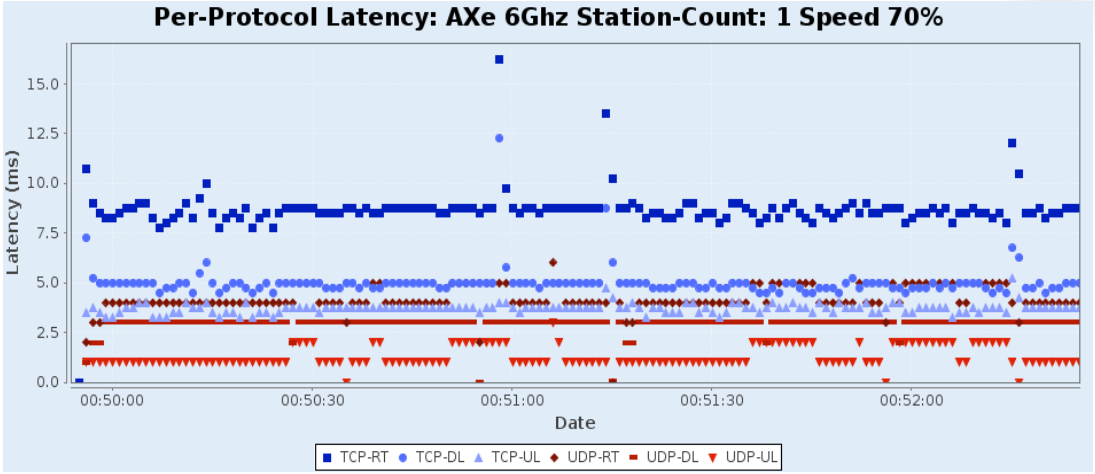
- Test run with 4 clients connected to the 6GHz radio of the AP under test.
- Downlink(AP to client) TCP traffic streams were set up to each client with different QoS access categories to each client Client1: Voice, Client2: Video, Client3: Best Effort , Client4: Background
- All 4 traffic streams were run at full rate.



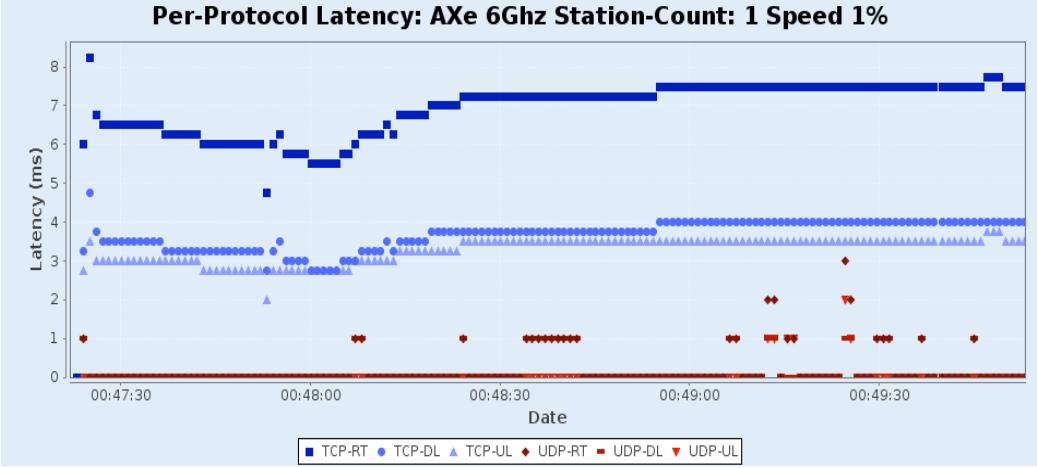
6E Latency test

Test Description

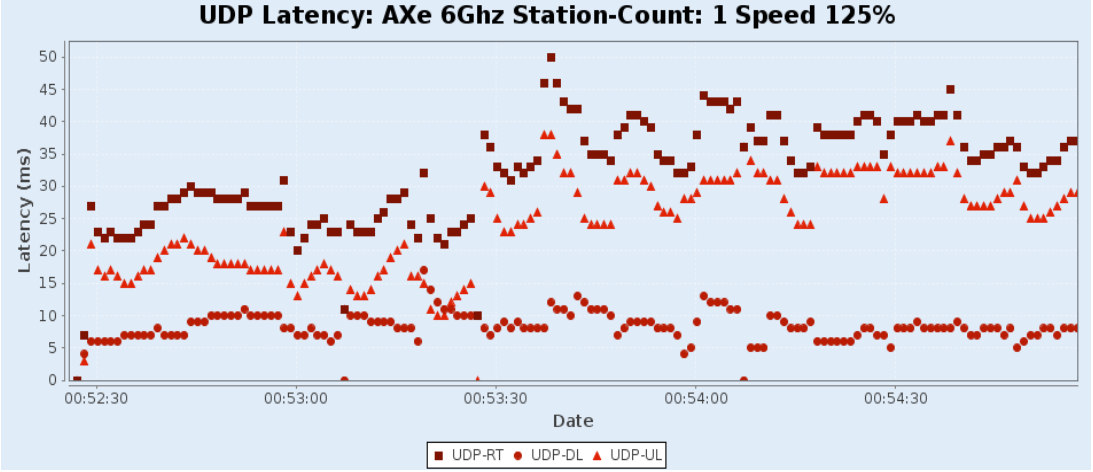
- The Latency test intends to verify latency under low, high, and maximum AP traffic load, with 1 stations. Traffic load is a 4 bi-directional TCP streams for each station, plus a low speed UDP connection to probe latency.
- Low load considered as 1% of max TCP throughput
- Medium load considered as 70% of max TCP throughput
- High load considered as 70% of max TCP throughput



Medium load



Low load



High load

sales@candelatech.com

1-360-380-1618