



21 MADBURY RD, SUITE 100 DURHAM, NH 03824 +1-603-862-0090

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## TR-398 SUITE TEST REPORT

NATHAN CANNON  
UNH-IOL  
NCANNON@IOL.UNH.EDU

### DEVICE AND TEST PLAN INFORMATION

Device Under Test (DUT)	Sample DUT
Test Specification/Suite	Broadband Forum, WT-398 Issue 1

### CONTACT INFORMATION

Wireless LAN Consortium	+1 (603) 862-0090	<a href="mailto:wclab@iol.unh.edu">wclab@iol.unh.edu</a>
Testing Completed by	Nathan Cannon	<a href="mailto:ncannon@iol.unh.edu">ncannon@iol.unh.edu</a>
Report Created by	Reviewer	<a href="mailto:wclab@iol.unh.edu">wclab@iol.unh.edu</a>
Report Reviewed by	Reviewer	<a href="mailto:wclab@iol.unh.edu">wclab@iol.unh.edu</a>

Please see Appendix 2 regarding digital signature information

## SUMMARY OF RESULTS

The following table contains a summary of results other than PASS. The definition of result types can be found in the Result Key.

TEST NUMBER & LABEL	RESULTS
No Non-Passing results Were Uncovered During Testing	

## REVISION HISTORY

The following table contains a revision history for this report.

REVISION	DATE	AUTHOR	EXPLANATION
1.0	9/4/18	N. Cannon	Initial Version

## DEVICE UNDER TEST AND INITIALIZATION INFORMATION

The following table contains the state of the DUT during testing.

COMPONENT	DESCRIPTION
UNH-IOL Device Identification Number	00000
Hardware Version	1.0
Firmware Version	1.0
Software Version	1.0
MAC Address	00:11:22:33:44:55
Link-Local Address	FE80::1234:2345:3456:4455
Serial Number	ABCDE12345

## TEST TOOL AND ENVIRONMENT INFORMATION

The following table contains the test tool and suite versions used during testing.

TOOL	VERSION
IOL Test Sentinel Version	4.0.0.1
Wireshark Version	10.0.0
Wireless Tools Testing Suite Version	v1.0
Test Specification	TR-398 Test Specification Core Protocols, Version 4.0.6, April 26, 201

## TARGET DEVICE / INTEROP PARTNER INFORMATION

DEVICE	DESCRIPTION
Company	octoScope MPE270422-02
Firmware Version:	3.2.22
Ethernet MAC address:	70:B3:D5:EF:32:FC

DEVICE	DESCRIPTION
Company	octoScope QA70717-36
Firmware Version:	3.2.22
Ethernet MAC address:	2C:27:9E:90:04:B3

DEVICE	DESCRIPTION
Company	octoScope QA40707-07
Firmware Version:	3.2.22
Ethernet MAC address:	70:B3:D5:EF:30:24

DEVICE	DESCRIPTION
Company	octoScope Pal24-81001-07
Firmware Version:	13106
Ethernet MAC address:	00:13:95:27:E8:F6
Wi-Fi MAC address:	2C:27:9E:90:46:91

DEVICE	DESCRIPTION
Company	octoScope Pal5-80516-06
Firmware Version:	13106
Ethernet MAC address:	00:13:95:2C:6C:F2
Wi-Fi MAC address:	2C:27:9E:90:05:0B

DEVICE	DESCRIPTION
Company	octoScope iGen-IG50524-01
Firmware Version:	12954
Ethernet MAC address:	70:B3:D5:EF:30:AA
Wi-Fi MAC address:	04:F0:21:18:04:8A

## DETAILED TEST RESULTS

### GROUP 1: RF Capability (OPTIONAL)

1.1.1 – RECEIVER SENSITIVITY TEST IN 802.11n	PARTS	RESULTS
Receiver Sensitivity Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the receiver’s ability to receive and demodulate weak signal with little to no error. This test intends to find the attenuation at which the PER is greater than 10%.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
<ul style="list-style-type: none"> <li>a. No issues were observed while testing.</li> <li>b. No issues were observed while testing.</li> </ul>		

RECEIVER SENSITIVITY RESULTS IN 802.11n (dB)				
TEST INDEX	MCS INDEX	MODULATION	REQUIRED	MEASURED
1	0	BPSK	56	<b>65</b>
2	7	64-QAM	38	<b>52</b>

1.1.2 – RECEIVER SENSITIVITY TEST IN 802.11ac	PARTS	RESULTS
Receiver Sensitivity Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the receiver’s ability to receive and demodulate weak signal with little to no error. This test intends to find the attenuation at which the PER is greater than 10%.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
<ul style="list-style-type: none"> <li>a. No issues were observed while testing.</li> <li>b. No issues were observed while testing.</li> </ul>		

RECEIVER SENSITIVITY RESULTS IN 802.11ac (dB)				
TEST INDEX	MCS INDEX	MODULATION	REQUIRED	MEASURED
3	0	BPSK	46	<b>54</b>
4	9	256-QAM	21	<b>36</b>

## GROUP 2: BASELINE PERFORMANCE

2.1.1 – MAXIMUM CONNECTION TEST FOR 802.11n	PARTS	RESULTS
Packet Error Rate Measurements	a	<b>PASS</b>
Throughput Measurements	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify that the DUT can support connecting multiple stations simultaneously while functioning as normal.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
<ul style="list-style-type: none"> <li>a. No issues were observed during testing.</li> <li>b. No issues were observed during testing.</li> </ul>		

MAXIMUM CONNECTION TEST IN 802.11n						
Station No.	Required PER	Observed DL PER (%)	Observed UL PER (%)	Required Throughput (Mbps)	Measured DL Throughput (Mbps)	Measured UL Throughput (Mbps)
0	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
1	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
2	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
3	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
4	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
5	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
6	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
7	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
8	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
9	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
10	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
11	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
12	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000

13	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
14	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
15	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
16	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
17	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
18	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
19	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
20	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
21	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
22	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
23	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
24	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
25	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
26	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
27	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
28	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
29	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
30	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
31	<1%	<b>0.000</b>	<b>0.000</b>	N/A	2.000	2.000
Total	N/A	N/A	N/A	63.66	<b>64</b>	<b>64</b>



2.1.2 – MAXIMUM CONNECTION TEST FOR 802.11ac	PARTS	RESULTS
Packet Error Rate Measurements	a	<b>PASS</b>
Throughput Measurements	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify that the DUT can support connecting multiple stations simultaneously while functioning as normal.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
<ul style="list-style-type: none"> <li>a. No issues were observed during testing.</li> <li>b. No issues were observed during testing.</li> </ul>		

MAXIMUM CONNECTION TEST IN 802.11ac						
Station No.	Required PER	Observed DL PER (%)	Observed UL PER (%)	Required Throughput (Mbps)	Measured DL Throughput (Mbps)	Measured UL Throughput (Mbps)
0	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
1	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
2	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
3	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
4	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
5	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
6	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
7	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
8	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
9	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
10	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
11	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
12	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
13	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
14	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
15	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000

16	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
17	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
18	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
19	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
20	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
21	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
22	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
23	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
24	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
25	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
26	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
27	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
28	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
29	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
30	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
31	<1%	<b>0.000</b>	<b>0.000</b>	N/A	8.000	8.000
Total	N/A	N/A	N/A	253.44	<b>256</b>	<b>256</b>

2.2.1 – MAXIMUM THROUGHPUT TEST IN 802.11n	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the maximum throughput performance of the DUT. This test is conducted with short distance air interface, testing the actual utilization of Wi-Fi.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

MAXIMUM THROUGHPUT IN 802.11n (Mbps)		
Direction	Required	Measured
DL	100	<b>126.358</b>
UL	100	<b>146.346</b>

2.2.2 – MAXIMUM THROUGHPUT TEST IN 802.11ac	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the maximum throughput performance of the DUT. This test is conducted with short distance air interface, testing the actual utilization of Wi-Fi.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

MAXIMUM THROUGHPUT IN 802.11ac (Mbps)		
Direction	Required	Measured
DL	560	<b>584.194</b>
UL	560	<b>576.429</b>

2.3.1 – AIRTIME FAIRNESS TEST IN 802.11n	PARTS	RESULTS
Throughput Variations	a	<b>PASS</b>
Throughput Summations	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify the capability of the DUT to guarantee the fairness of airtime usage.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing. b. No issues were observed while testing.		

THROUGHPUT VARIATIONS IN 802.11n (Mbps)			
Throughput	Minimum Accepted	Maximum Accepted	Measured
STA 1, Throughput 1	102.573	113.370	<b>108.246</b>
STA 2, Throughput 1	102.573	113.370	<b>106.348</b>
STA 1, Throughput 2	91.776	124.167	<b>109.657</b>
STA 1, Throughput 3	91.776	124.167	<b>107.635</b>

THROUGHPUT SUMS IN 802.11n (Mbps)		
Throughput Sums	Minimum Required	Measured
STA 1_TP 1 + STA 2_TP1	80	<b>214.594</b>
STA 1_TP 2 + STA 2_TP 2	54	<b>199.618</b>
STA 1_TP 3 + STA 3_TP 3	50	<b>204.698</b>

2.3.2 – AIRTIME FAIRNESS TEST IN 802.11ac	PARTS	RESULTS
Throughput Variations	a	<b>PASS</b>
Throughput Summations	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify the capability of the DUT to guarantee the fairness of airtime usage.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing. b. No issues were observed while testing.		

THROUGHPUT VARIATIONS IN 802.11ac (Mbps)			
Throughput	Minimum Accepted	Maximum Accepted	Measured
STA 1, Throughput 1	228.152	252.167	<b>246.314</b>
STA 2, Throughput 1	228.152	252.167	<b>236.487</b>
STA 1, Throughput 2	204.136	276.183	<b>243.519</b>
STA 1, Throughput 3	204.136	276.183	<b>234.318</b>

THROUGHPUT SUMS IN 802.11ac (Mbps)		
Throughput Sums for...	Minimum Required	Measured
STA 1, Throughput 1 + STA 2, Throughput 1	475	<b>482.801</b>
STA 1, Throughput 2 + STA 2, Throughput 2	280	<b>456.234</b>
STA 1, Throughput 3 + STA 3, Throughput 3	230	<b>428.349</b>

### GROUP 3: COVERAGE

3.1.1 – RANGE VS RATE TEST IN 802.11n	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the baseband and RF chain performance of the DUT as attenuation is applied to the network.  The DUT should meet the requirements listed in the table below. The DUT is allowed to fail 2 of the 32 data points.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

THROUGHPUT MEASUREMENTS IN 802.11n (Mbps)				
Attenuation (dB)	DL		UL	
	Required	Measured	Required	Measured
0	100	<b>109.941</b>	100	<b>114.276</b>
10	100	<b>107.175</b>	100	<b>112.349</b>
21	100	<b>104.567</b>	100	<b>109.432</b>
24	100	<b>104.168</b>	100	<b>105.492</b>
27	100	<b>103.842</b>	100	<b>102.364</b>
30	100	<b>103.615</b>	100	<b>103.486</b>
33	100	<b>101.548</b>	100	<b>100.482</b>
36	95	<b>100.487</b>	95	<b>97.482</b>
39	80	<b>97.246</b>	80	<b>96.712</b>
42	75	<b>92.145</b>	75	<b>92.184</b>
45	50	<b>85.642</b>	50	<b>86.482</b>
48	45	<b>81.426</b>	45	<b>79.134</b>
51	35	<b>74.681</b>	35	<b>64.231</b>
54	25	<b>69.534</b>	17	<b>48.137</b>
57	14	<b>50.426</b>	12	<b>37.124</b>
60	9	<b>20.864</b>	7	<b>26.412</b>
63	8	<b>15.843</b>	4	<b>19.475</b>



3.1.2 – RANGE VS RATE TEST IN 802.11ac	PARTS	RESULTS
Average Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
<p>To measure the baseband and RF chain performance of the DUT as attenuation is applied to the network.</p> <p>The DUT should meet the requirements listed in the table below. The DUT is allowed to fail 2 of the 28 data points.</p>		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

THROUGHPUT MEASUREMENTS IN 802.11ac (Mbps)				
Attenuation (dB)	DL		UL	
	Required	Measured	Required	Measured
0	560	<b>610.237</b>	560	<b>687.181</b>
10	530	<b>588.026</b>	530	<b>707.044</b>
21	420	<b>526.523</b>	420	<b>709.012</b>
24	400	<b>433.520</b>	400	<b>699.435</b>
27	360	<b>463.891</b>	360	<b>636.135</b>
30	300	<b>403.752</b>	300	<b>528.962</b>
33	220	<b>281.983</b>	220	<b>530.611</b>
36	150	<b>284.255</b>	150	<b>434.510</b>
39	125	<b>190.761</b>	125	<b>327.857</b>
42	100	<b>134.991</b>	100	<b>280.614</b>
45	45	<b>93.273</b>	45	<b>175.444</b>
48	25	<b>67.040</b>	25	<b>136.809</b>
51	5	<b>28.700</b>	5	<b>85.262</b>
54	1	<b>19.785</b>	1	<b>6.490</b>

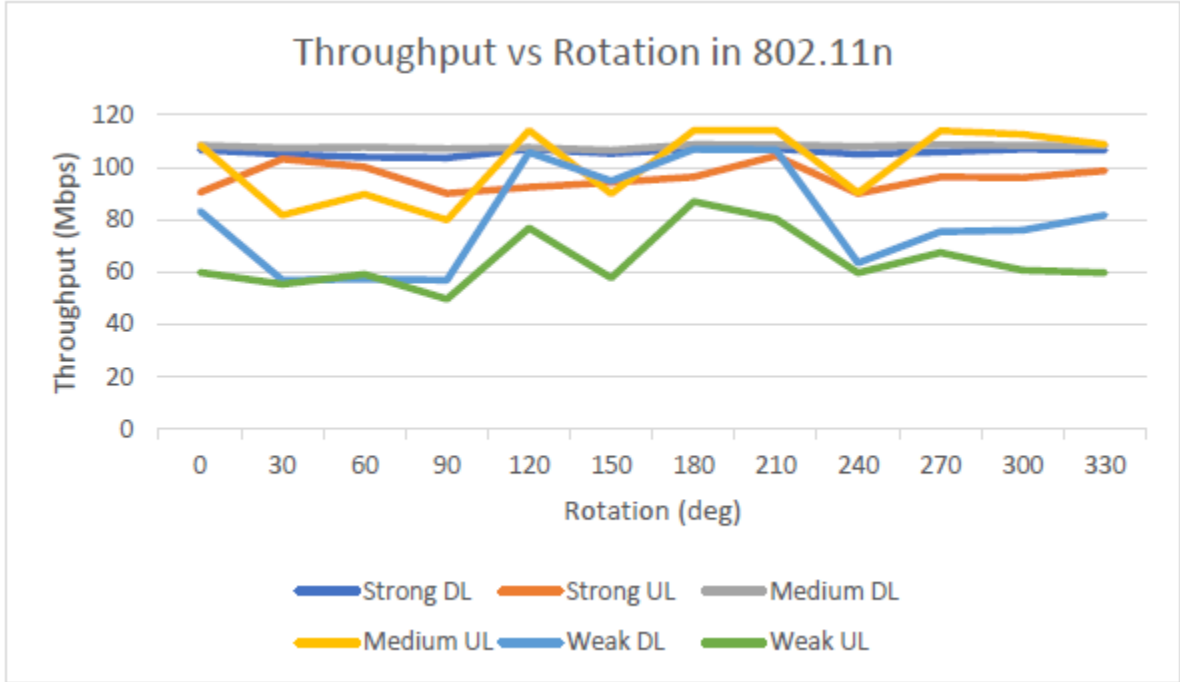
3.2.1 – SPATIAL CONSISTENCY IN 802.11n	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
Variation Measurements	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify the Wi-Fi signal consistency in spatial domain.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
<ul style="list-style-type: none"> <li>a. No issues were observed during the test.</li> <li>b. No issues were observed during the test.</li> </ul>		

AVERAGE THROUGHPUT IN 802.11n AT SHORT RANGE (10 dB) (Mbps)				
Rotation (Degrees)	DL		UL	
	Required	Measured	Required	Measured
0	90	<b>106.627</b>	90	<b>90.422</b>
30	90	<b>104.980</b>	90	<b>103.225</b>
60	90	<b>103.929</b>	90	<b>100.122</b>
90	90	<b>103.606</b>	90	<b>90.001</b>
120	90	<b>107.004</b>	90	<b>92.325</b>
150	90	<b>105.330</b>	90	<b>94.265</b>
180	90	<b>107.071</b>	90	<b>96.365</b>
210	90	<b>107.097</b>	90	<b>104.329</b>
240	90	<b>105.026</b>	90	<b>90.023</b>
270	90	<b>105.765</b>	90	<b>96.325</b>
300	90	<b>106.900</b>	90	<b>95.951</b>
330	90	<b>106.514</b>	90	<b>98.654</b>
Variation	<30%	<b>2.093</b>	<30%	<b>29.989</b>

AVERAGE THROUGHPUT IN 802.11n AT MEDIUM RANGE (38 dB) (Mbps)				
Rotation (Degrees)	DL		UL	
	Required	Measured	Required	Measured
0	70	<b>108.379</b>	70	<b>108.504</b>
30	70	<b>107.310</b>	70	<b>81.703</b>
60	70	<b>107.653</b>	70	<b>89.697</b>
90	70	<b>107.128</b>	70	<b>79.885</b>
120	70	<b>107.554</b>	70	<b>114.035</b>
150	70	<b>106.510</b>	70	<b>89.790</b>
180	70	<b>108.645</b>	70	<b>114.056</b>
210	70	<b>108.614</b>	70	<b>114.032</b>
240	70	<b>107.900</b>	70	<b>90.305</b>
270	70	<b>108.575</b>	70	<b>113.907</b>
300	70	<b>108.397</b>	70	<b>112.621</b>
330	70	<b>108.217</b>	70	<b>108.735</b>
Variation	<30%	<b>1.294</b>	<30%	<b>21.248</b>

AVERAGE THROUGHPUT IN 802.11n AT LONG RANGE (48 dB) (Mbps)				
Rotation (Degrees)	DL		UL	
	Required	Measured	Required	Measured
0	35	<b>83.203</b>	35	<b>59.838</b>
30	35	<b>56.957</b>	35	<b>55.423</b>
60	35	<b>57.364</b>	35	<b>59.172</b>
90	35	<b>56.942</b>	35	<b>49.675</b>
120	35	<b>105.714</b>	35	<b>76.762</b>
150	35	<b>94.777</b>	35	<b>57.712</b>
180	35	<b>106.886</b>	35	<b>86.895</b>
210	35	<b>106.703</b>	35	<b>80.318</b>
240	35	<b>63.537</b>	35	<b>59.691</b>
270	35	<b>75.445</b>	35	<b>67.473</b>
300	35	<b>75.973</b>	35	<b>60.746</b>
330	35	<b>81.657</b>	35	<b>59.673</b>
Variation	<40%	<b>29.203</b>	<40%	<b>22.923</b>

PLOT 1: SPATIAL CONSISTENCY IN 802.11n



3.2.2 – SPATIAL CONSISTENCY IN 802.11ac	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
Variation Measurements	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify the Wi-Fi signal consistency in spatial domain.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
<ul style="list-style-type: none"> <li>a. No issues were observed during the test.</li> <li>b. No issues were observed during the test.</li> </ul>		

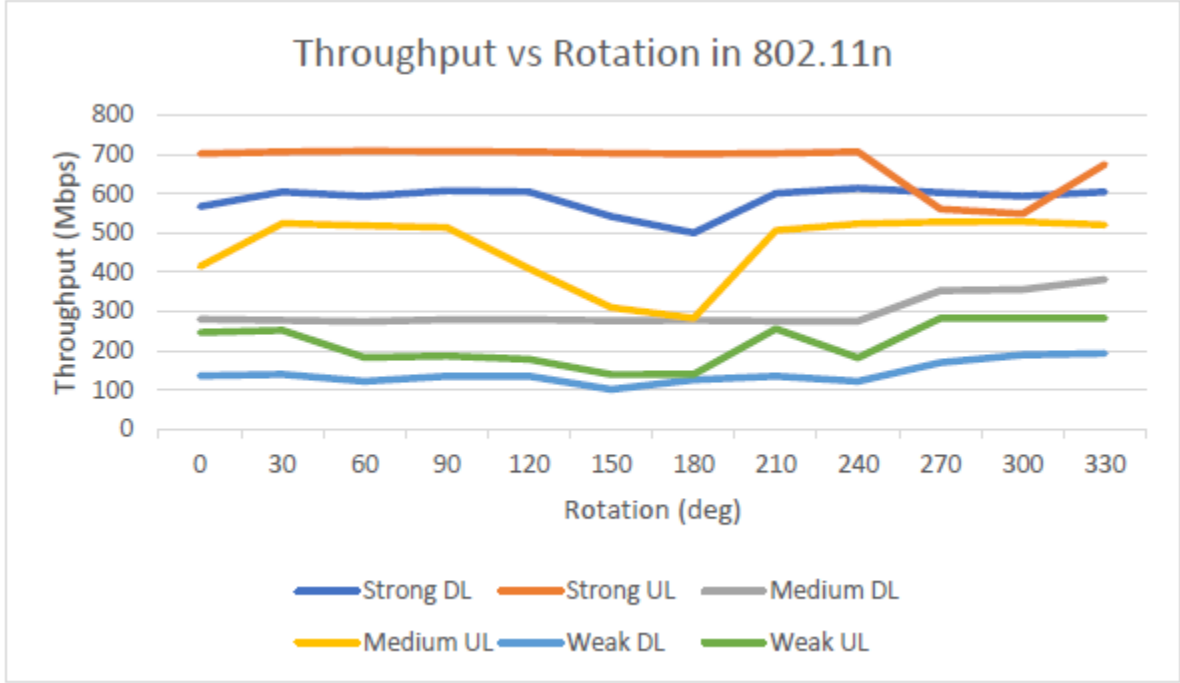
AVERAGE THROUGHPUT IN 802.11ac AT SHORT RANGE (10 dB) (Mbps)				
Rotation (Degrees)	DL		UL	
	Required	Measured	Required	Measured
0	500	<b>567.288</b>	500	<b>701.741</b>
30	500	<b>603.921</b>	500	<b>706.206</b>
60	500	<b>593.478</b>	500	<b>708.193</b>
90	500	<b>606.791</b>	500	<b>707.259</b>
120	500	<b>604.519</b>	500	<b>705.715</b>
150	500	<b>541.526</b>	500	<b>702.194</b>
180	500	<b>500.003</b>	500	<b>700.551</b>
210	500	<b>600.695</b>	500	<b>702.617</b>
240	500	<b>613.703</b>	500	<b>706.125</b>
270	500	<b>602.062</b>	500	<b>559.966</b>
300	500	<b>593.036</b>	500	<b>548.489</b>
330	500	<b>603.970</b>	500	<b>674.492</b>
Variation	<40%	<b>14.663</b>	<40%	<b>18.978</b>



AVERAGE THROUGHPUT IN 802.11ac AT MEDIUM RANGE (32 dB) (Mbps)				
Rotation (Degrees)	DL		UL	
	Required	Measured	Required	Measured
0	200	<b>279.752</b>	200	<b>414.685</b>
30	200	<b>277.656</b>	200	<b>523.818</b>
60	200	<b>274.505</b>	200	<b>518.532</b>
90	200	<b>279.119</b>	200	<b>513.739</b>
120	200	<b>279.473</b>	200	<b>409.100</b>
150	200	<b>276.642</b>	200	<b>310.317</b>
180	200	<b>277.365</b>	200	<b>282.985</b>
210	200	<b>275.485</b>	200	<b>506.569</b>
240	200	<b>275.162</b>	200	<b>523.140</b>
270	200	<b>353.425</b>	200	<b>528.054</b>
300	200	<b>356.022</b>	200	<b>528.307</b>
330	200	<b>381.398</b>	200	<b>520.326</b>
Variation	<40%	<b>35.660</b>	<40%	<b>39.138</b>

AVERAGE THROUGHPUT IN 802.11ac AT LONG RANGE (42 dB) (Mbps)				
Rotation (Degrees)	DL		UL	
	Required	Measured	Required	Measured
0	100	<b>135.939</b>	100	<b>246.405</b>
30	100	<b>139.603</b>	100	<b>252.094</b>
60	100	<b>121.950</b>	100	<b>182.664</b>
90	100	<b>135.641</b>	100	<b>186.721</b>
120	100	<b>135.680</b>	100	<b>178.024</b>
150	100	<b>101.636</b>	100	<b>139.585</b>
180	100	<b>126.365</b>	100	<b>139.895</b>
210	100	<b>135.292</b>	100	<b>255.785</b>
240	100	<b>121.824</b>	100	<b>182.383</b>
270	100	<b>169.764</b>	100	<b>282.630</b>
300	100	<b>189.209</b>	100	<b>283.016</b>
330	100	<b>193.299</b>	100	<b>283.003</b>
Variation	<40%	<b>37.060</b>	<40%	<b>35.877</b>

PLOT 2: SPATIAL CONSISTENCY IN 802.11ac



## GROUP 4: MULTIPLE STATIONS PERFORMANCE

4.1.1 – MULTIPLE STATIONS PERFORMANCE TEST IN 802.11n	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the DUT’s performance in a real environment circumstance. Multiple stations connect to the DUT with various levels of signals and service types.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

MULTIPLE STATIONS THROUGHPUT IN 802.11n (Mbps)				
Distance	DL		UL	
	Required	Measured	Required	Measured
Short	70	<b>78.246</b>	70	<b>82.145</b>
Short and Medium	60	<b>69.318</b>	60	<b>72.176</b>
Short, Medium, and Long	50	<b>61.124</b>	50	<b>62.179</b>

4.1.2 – MULTIPLE STATIONS PERFORMANCE TEST IN 802.11ac	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the DUT's performance in a real environment circumstance. Multiple stations connect to the DUT with various levels of signals and service types.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

MULTIPLE STATIONS THROUGHPUT IN 802.11ac (Mbps)				
Distance	DL		UL	
	Required	Measured	Required	Measured
Short	500	<b>628.143</b>	500	<b>653.164</b>
Short and Medium	400	<b>584.137</b>	400	<b>612.475</b>
Short, Medium, and Long	300	<b>502.417</b>	300	<b>548.371</b>

4.2.1 – MULTIPLE ASSOCIATION/DISASSOCIATION STABILITY TEST IN 802.11n	PARTS	RESULTS
Throughput Variation	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the DUT's stability under a dynamic environment with frequent changes in connection status.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

THROUGHPUT CHANGE FOR ALL WORKING STATIONS (%) IN 802.11n			
Station	Lowest Interval	Highest Interval	Required
0	<b>3.984</b>	<b>4.000</b>	3.96
1	<b>3.967</b>	<b>3.999</b>	3.96
2	<b>3.964</b>	<b>3.998</b>	3.96
3	<b>3.762</b>	<b>3.979</b>	3.96
4	<b>3.784</b>	<b>3.988</b>	3.96
5	<b>3.999</b>	<b>4.000</b>	3.96
6	<b>3.968</b>	<b>3.999</b>	3.96
7	<b>3.984</b>	<b>3.997</b>	3.96

4.2.2 – MULTIPLE ASSOCIATION/DISASSOCIATION STABILITY TEST IN 802.11ac	PARTS	RESULTS
Throughput Variation	a	<b>PASS</b>
<b>PURPOSE</b>		
To measure the DUT's stability under a dynamic environment with frequent changes in connection status.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

THROUGHPUT CHANGE FOR ALL WORKING STATIONS (%) IN 802.11n			
Station	Lowest Interval	Highest Interval	Required
0	<b>7.936</b>	<b>8.000</b>	7.92
1	<b>7.954</b>	<b>7.999</b>	7.92
2	<b>7.928</b>	<b>7.989</b>	7.92
3	<b>7.986</b>	<b>7.997</b>	7.92
4	<b>7.948</b>	<b>7.999</b>	7.92
5	<b>7.964</b>	<b>7.999</b>	7.92
6	<b>7.983</b>	<b>7.998</b>	7.92
7	<b>7.959</b>	<b>7.999</b>	7.92

4.3 – DOWNLINK MU-MIMO PERFORMANCE TEST	PARTS	RESULTS
MU-MIMO Performance vs Individual Performance	a	<b>PASS</b>
MU-MIMO Enabled vs MU-MIMO Disabled Performance	b	<b>PASS</b>
<b>PURPOSE</b>		
To verify the performance of the DUT when MU-MIMO is applied.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing. b. No issues were observed while testing.		

MU-MIMO RESULTS								
Station 1 Throughputs			Station 2 Throughputs			Station 3 Throughputs		
First	Second	Third	First	Second	Third	First	Second	Third
246.315	294.584	263.154	254.815	298.486	258.754	248.548	292.980	278.574
First Throughputs Sum			Second Throughputs Sum			Third Throughputs Sum		
749.678			<b>886.050</b>			800.482		

## GROUP 5: STABILITY/ROBUSTNESS

5.1.1 – LONG TERM STABILITY TEST IN 802.11n	PARTS	RESULTS
Throughput Measurements	a	<b>UA</b>
Packet Error Rate	b	<b>UA</b>
<b>PURPOSE</b>		
To measure the stability performance of the DUT under stress, with a focus on throughput, signal strength, and connection availability.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a-b. This test is currently unavailable.		



5.1.2 – LONG TERM STABILITY TEST IN 802.11ac	PARTS	RESULTS
Throughput Measurements	a	<b>UA</b>
Packet Error Rate	b	<b>UA</b>
<b>PURPOSE</b>		
To measure the stability performance of the DUT under stress, with a focus on throughput, signal strength, and connection availability.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a-b. This test is currently unavailable.		

5.2.1 – AP COEXISTENCE TEST IN 802.11n	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To verify the DUT’s performance with the existence of the of an alien AP.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

THROUGHPUT MEASUREMENTS IN 802.11n (Mbps)				
Baseline	Turned On	Same Channel	Overlapping Channel	Adjoining Channel
136.285	<b>134.489</b>	<b>102.645</b>	<b>98.647</b>	<b>130.675</b>

5.2.2 – AP COEXISTENCE TEST IN 802.11ac	PARTS	RESULTS
Throughput Measurements	a	<b>PASS</b>
<b>PURPOSE</b>		
To verify the DUT’s performance with the existence of the of an alien AP.		
<b>OBSERVED BEHAVIOR &amp; ADDITIONAL COMMENTS</b>		
a. No issues were observed while testing.		

THROUGHPUT MEASUREMENTS IN 802.11ac (Mbps)				
Baseline	Turned On	Same Channel	Overlapping Channel	Adjoining Channel
605.247	<b>598.634</b>	<b>438.342</b>	<b>496.175</b>	<b>597.648</b>

# APPENDICES

## APPENDIX 1: RESULT KEY

The following table contains possible results and their meanings.

RESULT	MEANING	INTERPRETATION
<b>PASS</b>	Pass	The Device Under Test (DUT) was observed to exhibit conformant behavior.
<b>PWC</b>	Pass With Comments	The Device Under Test (DUT) was observed to exhibit conformant behavior, however changes were made to the normal test procedure or the behavior observed requires additional comments.
<b>FAIL</b>	Fail	The Device Under Test (DUT) was observed to exhibit non-conformant behavior.
<b>RTC</b>	Refer to Comments	From the observations, a valid pass or fail was not determined. An additional explanation of the situation is included.
<b>INFO</b>	Informative	Test is designed for informational purposes only. The results may help ensure the interoperability of the DUT, but are not standards requirements.
<b>WARN</b>	Warning	The DUT was observed to exhibit behavior that is not recommended.
<b>N/A</b>	Not Applicable	This test does not apply to the device type or is not applicable to the testing program selected.
<b>N/S</b>	Not Supported	The Device Under Test (DUT) was not observed to support the necessary functionality required to perform these tests or the requirement is optional and not supported by this device.
<b>N/T</b>	Not Tested	This test was not performed and therefore this is not a complete test report. Please see the comments for additional reasons.
<b>UA</b>	Unavailable	The test was not performed due to limitation of the test tool(s) or interoperable systems, or the test methodology is still under development.

## APPENDIX 2: DIGITAL SIGNATURE INFORMATION

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## APPENDIX 3: ABBREVIATIONS INFORMATION

ABBREVIATION	MEANING
<b>DUT</b>	Device under Testing
<b>PER</b>	Packet Error Rate
<b>AP</b>	Access Point
<b>STA</b>	Station
<b>SS</b>	Spatial Streams
<b>DL</b>	Downlink
<b>UL</b>	Uplink