

# TR-398 Issue 2

## WiFi Performance Test Plan

Wed Oct 13 17:13:19 PDT 2021



Test Setup Information	
Device Under Test	Anonymous AX AP: brand-102
Estimated Run Time	18 m
Actual Run Time	36.034 m

## Objective

The TR-398 Issue 2 WiFi Performance test plan by the Broadband forum provides a comprehensive set of tests to qualify the performance of WiFi access points (APs) designed for residential and small office environments. Radio performance, Throughput, Connection Stability, Airtime Fairness, AP Co-existence, Mu\_MIMO Performance, Spatial Consistency and Long-term Stability are some of the test areas covered in this test plan. The test plan is designed for service providers deploying in home WiFi APs to qualify the APs in the lab before deployment and for equipment makers to test during the development of the APs. Candela Technologies offers a fully automated TR-398 Issue 2 test system. The user can select from the list of 11 tests available in the GUI and all selected tests are run fully automated at one click of a button. Measurements are made and compared to the specified PASS/FAIL criteria in the TR-398 Issue 2 test plan and this report will show the summary PASS/FAIL results followed more detailed results for each test.

## Summary Results

Test	Result	Candela Score	Elapsed	Info
Calibrate 802.11AX Zero Attenuation RSSI	Skipped	0	0	
Calibrate 802.11AC Zero Attenuation RSSI	Skipped	0	0	
6.1.1 Receiver Sensitivity Test	Skipped	0	0	
6.2.1 Maximum Connection Test (32-STA)	Skipped	0	0	
6.2.2 Maximum TCP Throughput Test	Skipped	0	0	
6.2.3 Airtime Fairness Test	Skipped	0	0	
Issue-3 Airtime Fairness Test	Skipped	0	0	
Issue-3 Quality of Service Test	Skipped	0	0	
Issue-3 Latency Test	5Ghz FAIL	148	35.922 m	Total CX Passing Throughput: 98 / 99 98.99% Total CX Passing 2.4 N: 35.0 / 99.0 35.354%
Issue-3 Multicast Test	Skipped	0	0	
6.2.4 Dual-Band Throughput Test	Skipped	0	0	
6.2.5 Bidirectional UDP Throughput Test	Skipped	0	0	
6.3.1 Range Versus Rate Test	Skipped	0	0	
6.3.2 Spatial Consistency Test	Skipped	0	0	
6.3.3 AX Peak Performance TCP Throughput Test	Skipped	0	0	
6.4.1 Multiple STAs Performance Test	Skipped	0	0	
6.4.2 Multiple Association / Disassociation Stability Test	Skipped	0	0	
6.4.3 Downlink MU-MIMO Performance Test	Skipped	0	0	
6.5.2 AP Coexistence Test	Skipped	0	0	
6.5.1 Long Term Stability Test	Skipped	0	0	

## Issue-3 Latency Test

## Summary

The Latency test intends to verify latency under low, high, and maximum AP traffic load, with 1 and 32 stations. Traffic load is 4 bi-directional TCP streams for each station, plus a low speed UDP connection to probe latency.

## Test Procedure

DUT should be configured for 20Mhz on 2.4Ghz and 80Mhz on 5Ghz and stations should use two spatial streams.

1. For each combination of: 2.4Ghz N, 5Ghz AC, 2.4Ghz AX, 5Ghz AX:
2. Configure attenuators to emulate 2-meter distance between stations and AP.
3. Create 32 stations and allow one to associate with the DUT. The other 31 are admin-down.
4. Create AP to Station (download) TCP stream, and run for 120 seconds, record throughput as 'maximum\_load'. Stop this connection.
5. Calculate offered\_load as 1% of maximum\_load.
6. Create 4 TCP streams on each active station, each configured for Upload and Download rate of offered\_load / (4 \* active\_station\_count \* 2).
7. Create 1 UDP stream on each active station, configured for 56kbps traffic Upload and 56kbps traffic Download.
- 8.
9. Start all TCP and UDP connections. Wait 30 seconds to let traffic settle.
10. Every 10 seconds for 120 seconds, record bi-directional latency over the last 10 seconds for each UDP connection. Depending on test equipment features, this may mean you need to start/stop the UDP every 10 seconds or clear the UDP connection counters.
11. Calculate offered\_load as 70% of maximum\_load, and repeat steps 6 - 9 inclusive.
12. Calculate offered\_load as 125% of maximum\_load, and repeat steps 6 - 9 inclusive.
13. Allow the other 31 stations to associate, and repeat steps 5 - 11 inclusive with all 32 stations active.

## Pass/Fail Criteria

1. For each test configuration running at 1% of maximum load: Average of all UDP latency samples must be less than 15ms.
2. For each test configuration running at 1% of maximum load: Maximum of all UDP latency samples must be less than 25ms.
3. For each test configuration running at 70% of maximum load: Average of all UDP latency samples must be less than 25ms.
4. For each test configuration running at 70% of maximum load: Maximum of all UDP latency samples must be less than 45ms.
5. For each test configuration running at 125% of maximum load: Average of all UDP latency samples must be less than 55ms.
6. For each test configuration running at 125% of maximum load: Maximum of all UDP latency samples must be less than 105ms.
7. For each test configuration: Each UDP connection upload throughput must be at least 1/2 of requested UDP speed for final 10-second test interval.
8. For each test configuration: Each UDP connection download throughput must be at least 1/2 of requested UDP speed for final 10-second test interval.

## Candela Score

The Candela Score for Latency Test is calculated as:

1. 50 multiplied by the ratio of average latency compared to the pass/fail threshold.
2. 0.25 multiplied by the percentage of individual UDP connections that passed the pass/fail latency threshold.
3. 0.25 multiplied by the percentage of individual UDP connections that passed the pass/fail throughput threshold.

## Issue-3 Latency Test Results

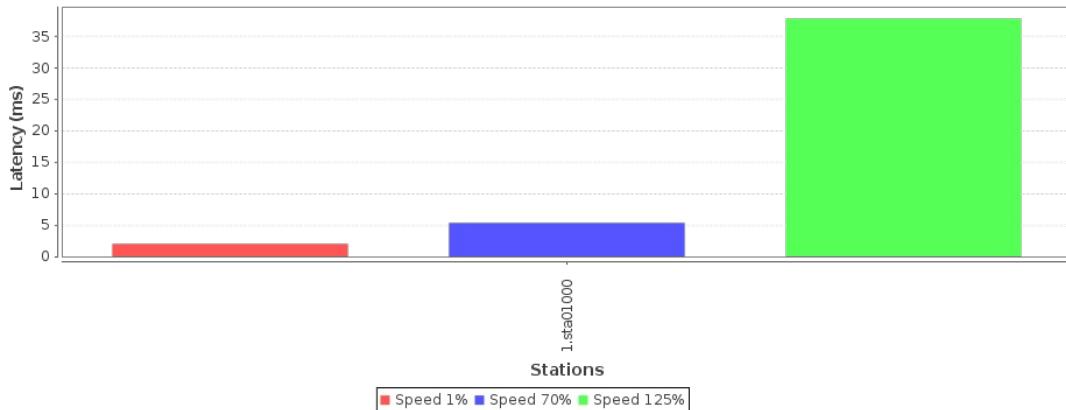
Type	Result	Value	P/F Value	Notes
Configuration NOTE	INFO			Configured to skip 2.4Ghz band test.
Configuration NOTE	INFO			Configured to skip AX test.
Configuration NOTE	INFO			Configured to skip 2.4Ghz band test.
AC 5Ghz STA1	INFO			Reported TCP throughput: 717.24 Mbps
AC 5Ghz Sta-Count 1 Speed 1%	PASS	2.00	15.00	Average UDP DL Latency: 2.00 Amount Stations passing Latency: 1 / 1 Amount Stations passing Throughput: 1 / 1 Min Sample Latency: 2.00 Max Sample Latency: 2.00
AC 5Ghz Sta-Count 1 Speed 70%	PASS	5.33	25.00	Average UDP DL Latency: 5.33 Amount Stations passing Latency: 1 / 1 Amount Stations passing Throughput: 1 / 1 Min Sample Latency: 5.00

				Max Sample Latency: 6.00
AC 5Ghz Sta-Count 1 Speed 125%	PASS	37.83	55.00	Average UDP DL Latency: 37.83 Amount Stations passing Latency: 1 / 1 Amount Stations passing Throughput: 1 / 1 Min Sample Latency: 35.00 Max Sample Latency: 47.00
AC 5Ghz Sta-Count 32 Speed 1%	PASS	4.25	25.00	Average UDP DL Latency: 4.25 Amount Stations passing Latency: 32 / 32 Amount Stations passing Throughput: 32 / 32 Min Sample Latency: 2.00 Max Sample Latency: 11.00
AC 5Ghz Sta-Count 32 Speed 70%	FAIL	131.12	45.00	Average UDP DL Latency: 131.12 Amount Stations passing Latency: 0 / 32 Amount Stations passing Throughput: 31 / 32 Min Sample Latency: 57.00 Max Sample Latency: 463.00
AC 5Ghz Sta-Count 32 Speed 125%	FAIL	475.37	105.00	Average UDP DL Latency: 475.37 Amount Stations passing Latency: 0 / 32 Amount Stations passing Throughput: 32 / 32 Min Sample Latency: 66.00 Max Sample Latency: 3,890.00

AC 5Ghz UDP Two-Way Latency (ms) for single station.

[CSV Data for AC 5Ghz UDP Two-Way Latency for single station](#)

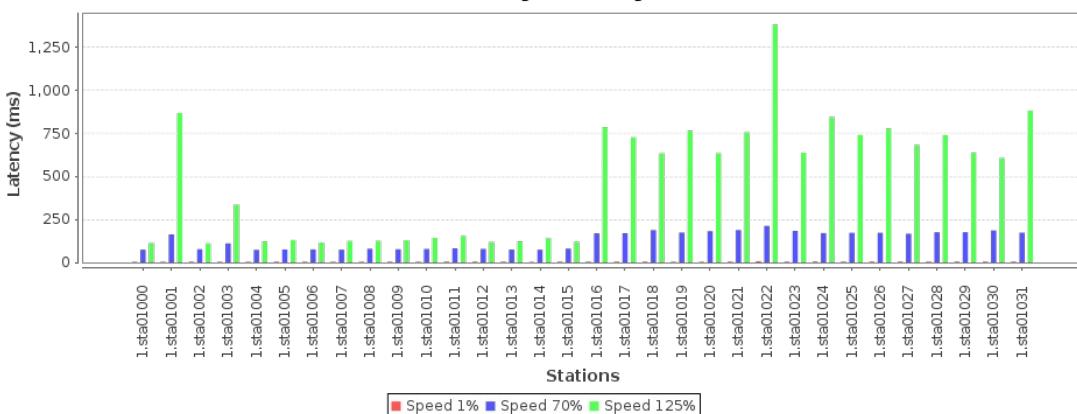
### AC 5Ghz UDP Two-Way Latency for single station



AC 5Ghz UDP Two-Way Latency (ms) for each station.

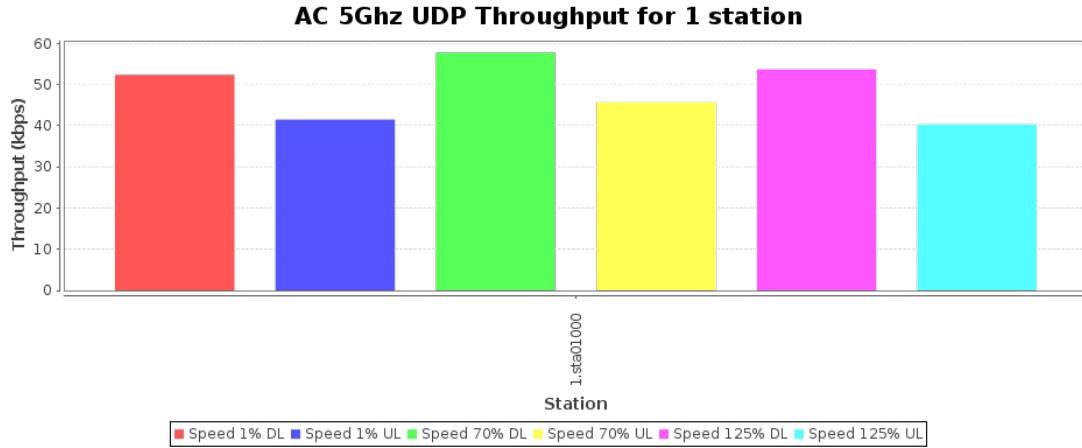
[CSV Data for AC 5Ghz UDP Two-Way Latency for 32 stations](#)

### AC 5Ghz UDP Two-Way Latency for 32 stations



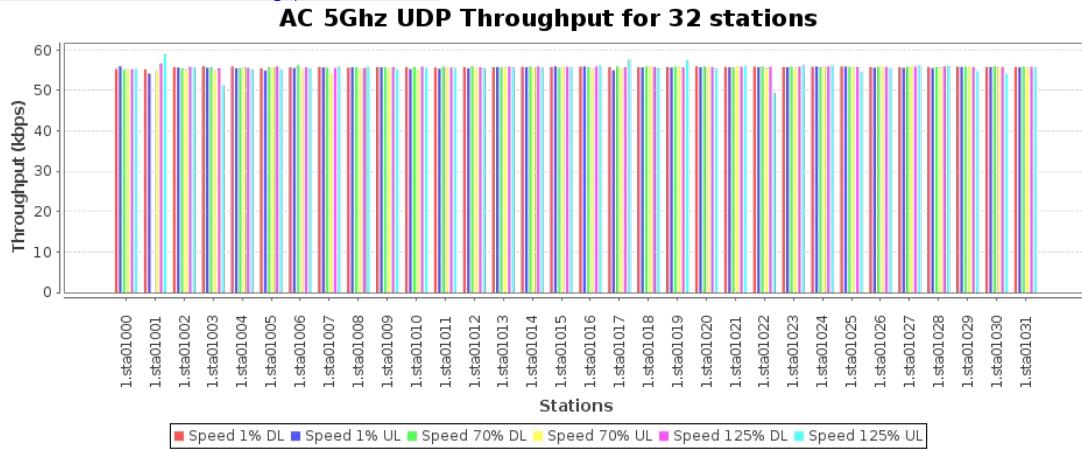
AC 5Ghz UDP Throughput (kbps) for each station.

[CSV Data for AC 5Ghz UDP Throughput for 1 station](#)

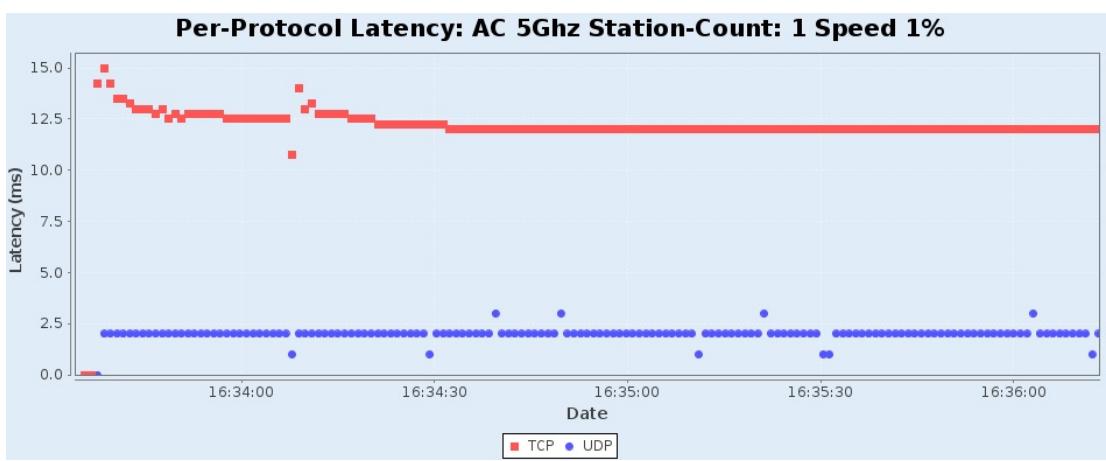


AC 5Ghz UDP Throughput (kbps) for each station.

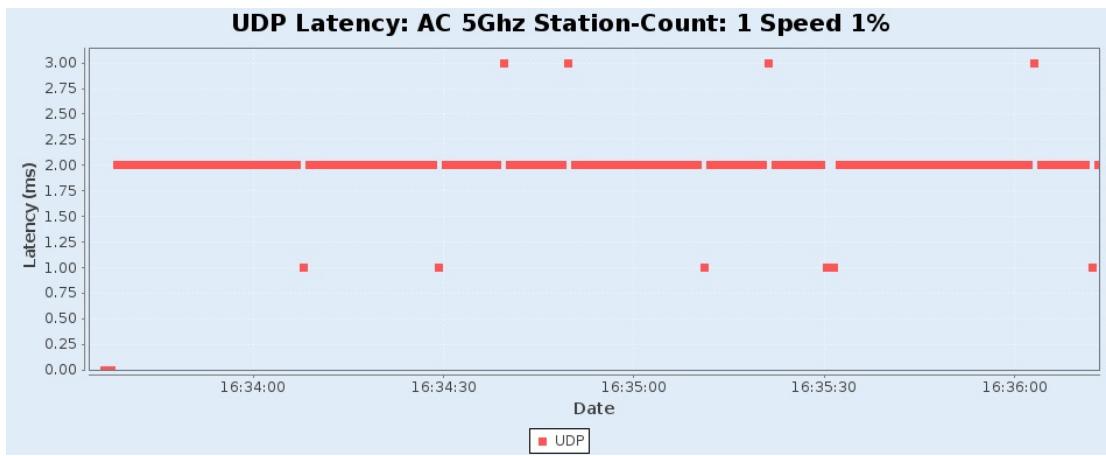
[CSV Data for AC 5Ghz UDP Throughput for 32 stations](#)



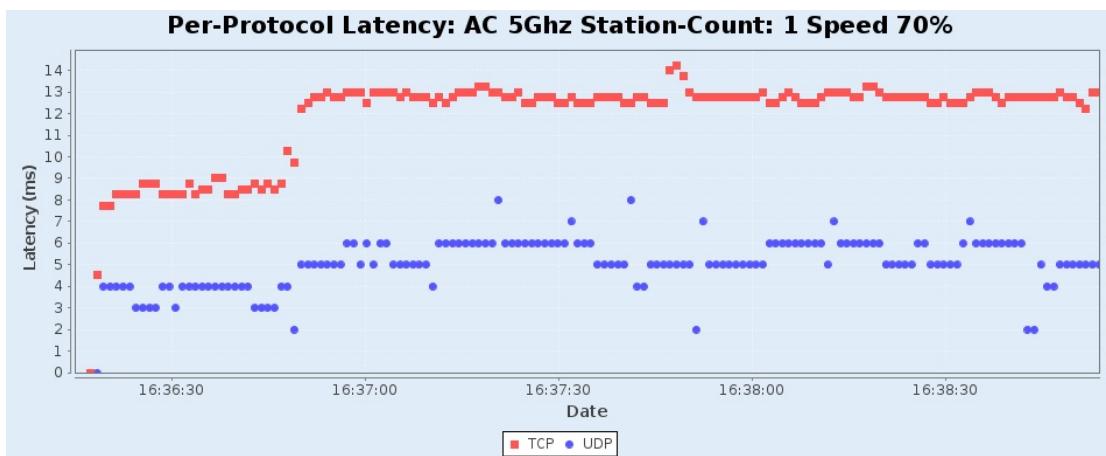
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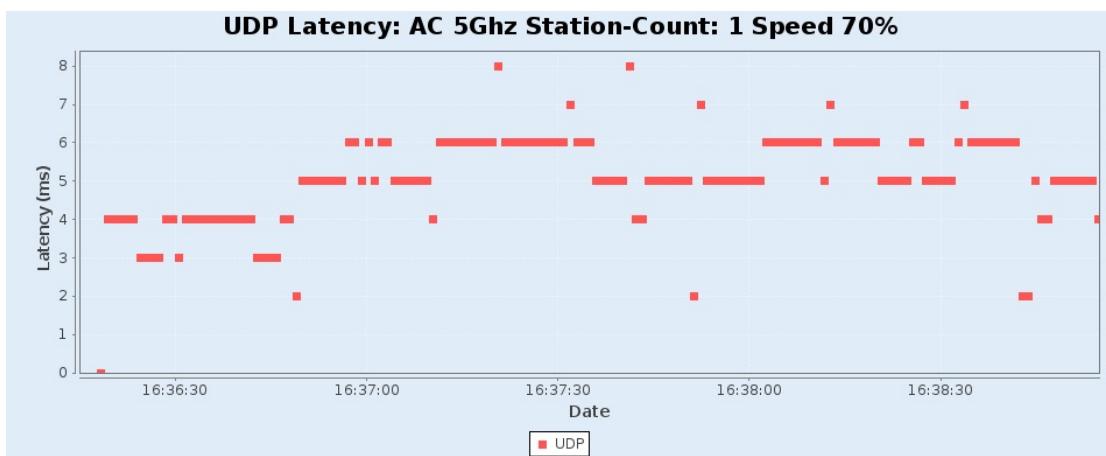
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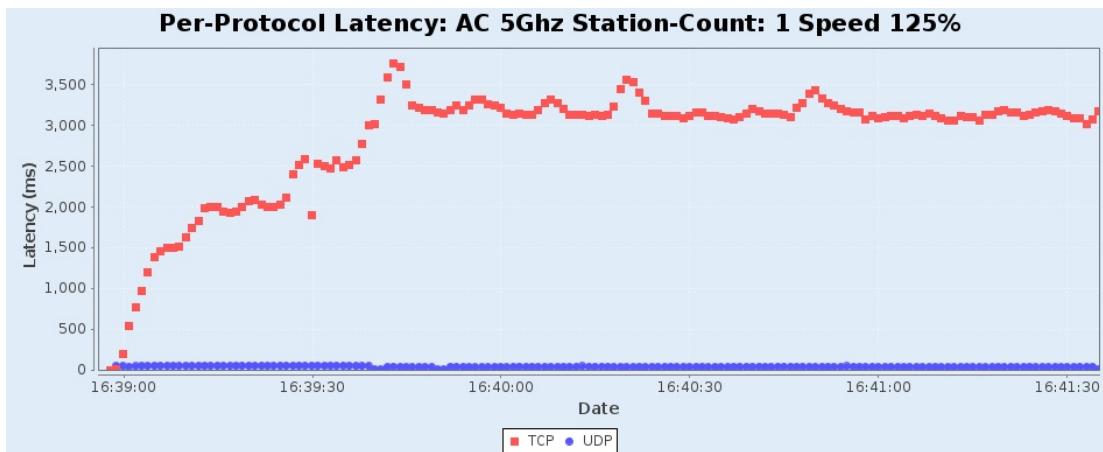
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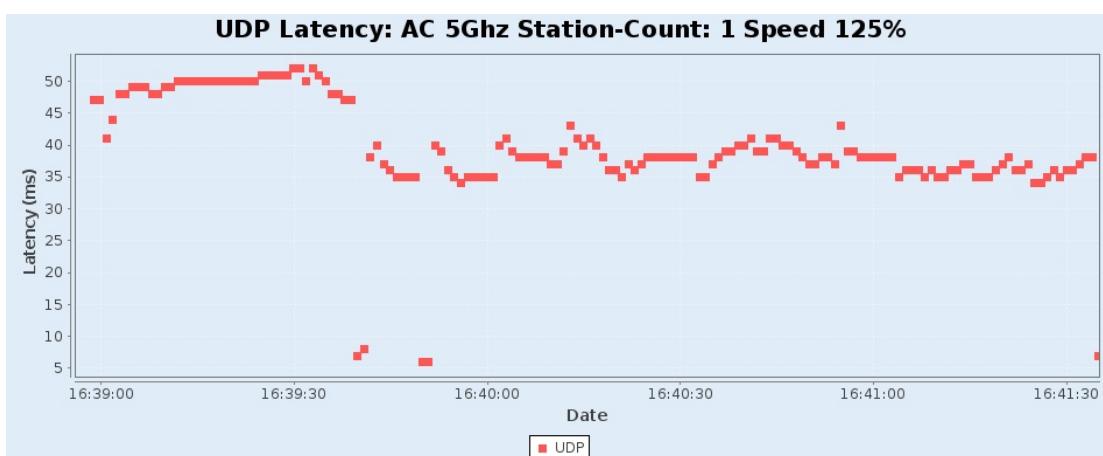
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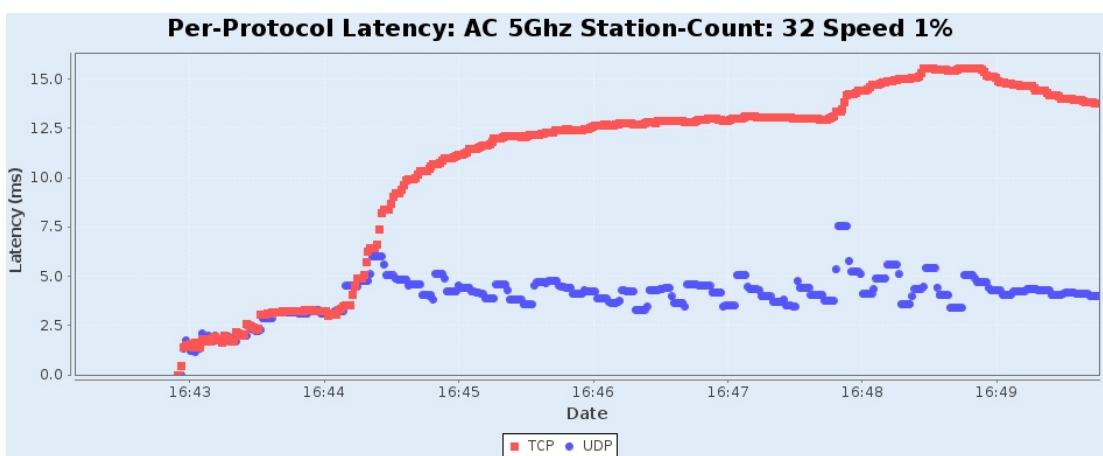
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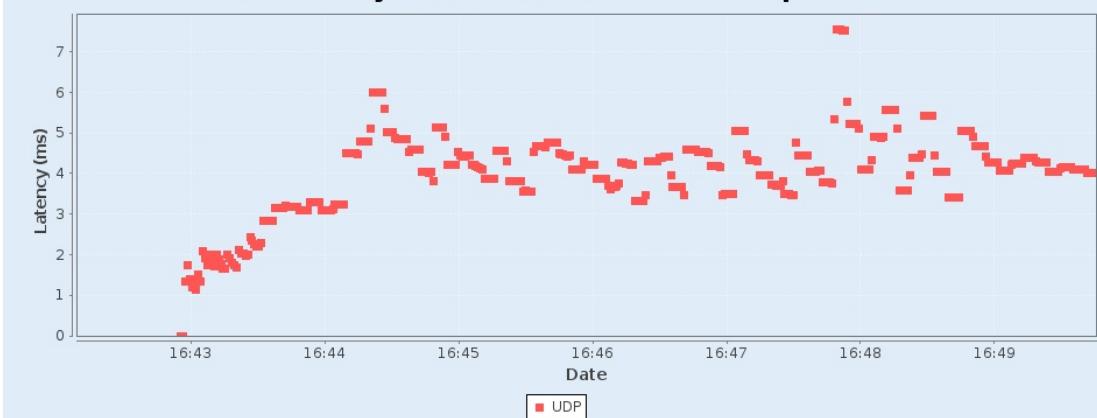


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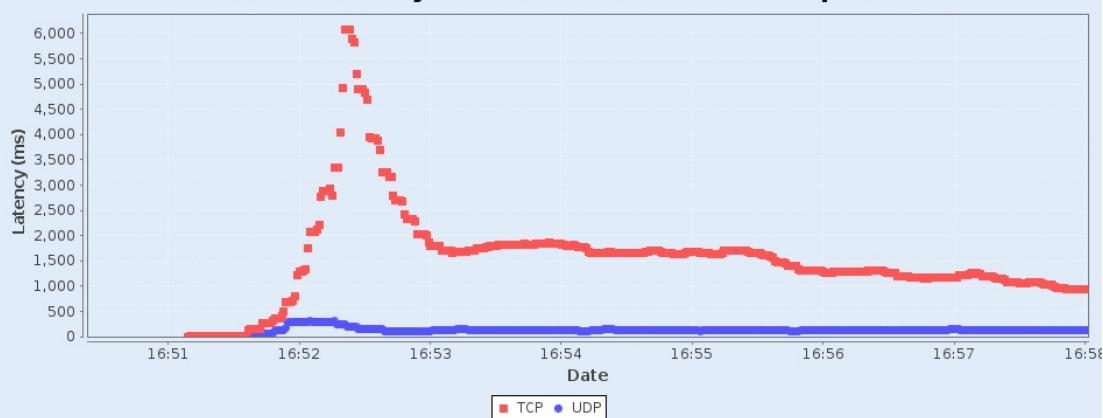
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### UDP Latency: AC 5Ghz Station-Count: 32 Speed 1%



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### Per-Protocol Latency: AC 5Ghz Station-Count: 32 Speed 70%

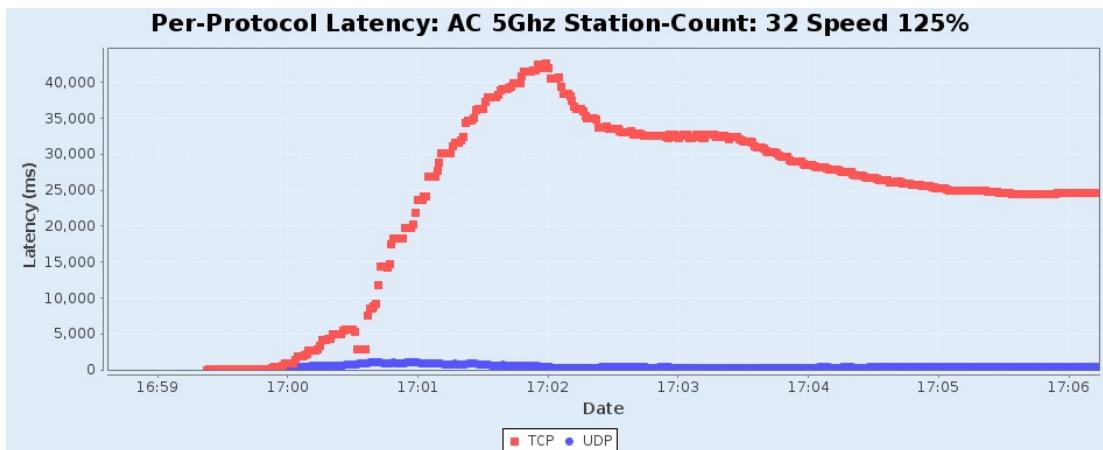


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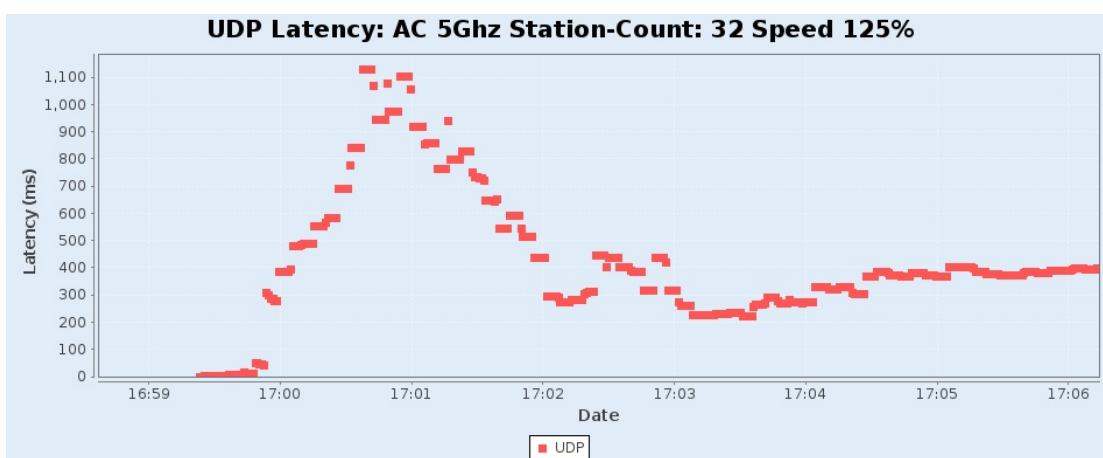
### UDP Latency: AC 5Ghz Station-Count: 32 Speed 70%



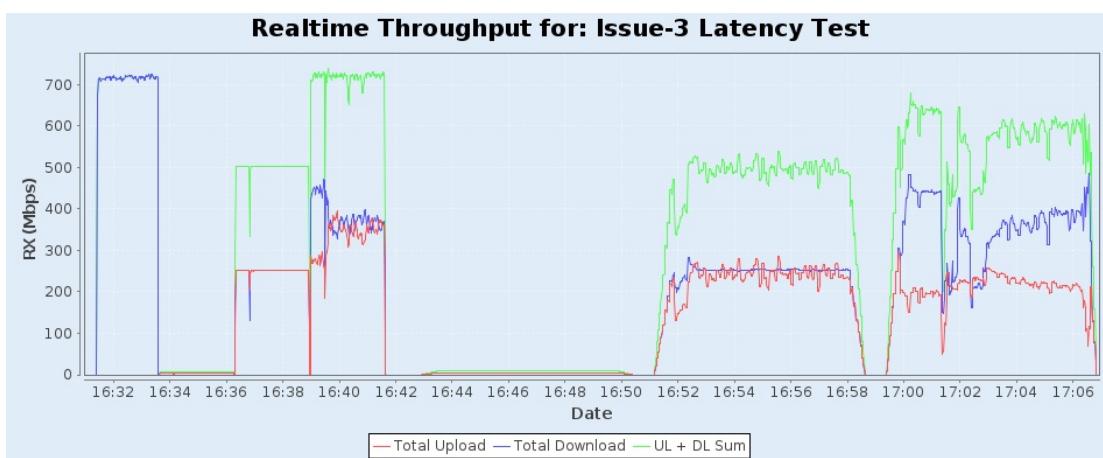
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[Key Performance Indicators CSV](#)

Test configuration and LANforge software version	
Auto-Helper	true
Allow-11w (MFP/PMF)	false
Skip 2.4Ghz Tests	true
Skip 5Ghz Tests	false

Duration-120	120
Duration-60	60
Channel 2Ghz	AUTO
Channel 5Ghz	AUTO
Extra Download Path-loss	0
TX Power	20
Multi-Conn	10
ToS	0
Upstream Port	1.1.1 eth1 Firmware: 0. 6-1 Resource: ct523c-ccb0
Turn-Table Chamber	DUT-Chamber
Configured 2m 2.4Ghz RSSI	-26
Configured 2m 5Ghz RSSI	-30
Opposite-Speed:	0
Randomize Offered Load	false
Max-CX Offered Load:	1000000
Max-CX 2Ghz N rate:	2000000
Max-CX 2Ghz AX rate:	3000000
Max-CX 5Ghz AC rate:	8000000
Max-CX 5Ghz AX rate:	10000000
Throughput N 2Ghz rate:	100000000
Throughput AC 5Ghz rate:	560000000
Throughput AX 2Ghz rate:	200000000
Throughput AX 5Ghz rate:	720000000
Throughput AX 2Ghz rate:	300000000
Throughput AX 2x2 5Ghz rate:	1100000000
Throughput AX 4x4 5Ghz rate:	1100000000
ATF Max NSS:	2
ATF Attenuation:	0
Max allowed packet loss%:	0.01
Assoc/Disassoc Traffic %:	99
Requested Rx-Sens Speed	65%
RxSens Rotation Degrees:	45
RxSens Start Step:	8
Attenuation Adjustment	0
Stop RX-Sens at pass	false
Pause on zero throughput	false
Use Virtual AX Stations	false
Auto-Calibrate Interferer	false
Interferer AC 5G-80Mhz:	195.00 Mbps
Interferer AC 5G-40Mhz:	90.00 Mbps
Interferer AC 2.4G-20Mhz:	32.00 Mbps
Interferer AX 5G-80Mhz:	195.00 Mbps
Interferer AX 5G-40Mhz:	90.00 Mbps
Interferer AX 2.4G-20Mhz:	32.00 Mbps
Spatial Rotation Degrees:	30
Test Retries:	0
Stability Duration-180	180
Stability Max-Iterations	16
Stability UDP Duration	15 m
Calibration Mode:	4
Calibration NSS:	1
WiFi Radio 0	1.1.4 wiphy1 Firmware: 10.4b-ct-9984-xtH-13-774502ee5 Resource: ct523c-ccb0
	1.1.3 wiphy0 Firmware: 10.4b-ct-9984-xtH-13-774502ee5 Resource: ct523c-

WiFi Radio 1	ccb0
WiFi Radio 2	1.1.6 wiphy3 Firmware: 10.4b-ct-9984-xtH-13-774502ee5 Resource: ct523c-ccb0
WiFi Radio 3	1.1.5 wiphy2 Firmware: 10.4b-ct-9984-xtH-13-774502ee5 Resource: ct523c-ccb0
WiFi Radio 4	1.1.8 wiphy5 Firmware: 10.4b-ct-9984-xtH-13-774502ee5 Resource: ct523c-ccb0
WiFi Radio 5	1.1.7 wiphy4 Firmware: 10.4b-ct-9984-xtH-13-774502ee5 Resource: ct523c-ccb0
WiFi AX Radio 0	
WiFi AX Radio 1	
WiFi AX Radio 2	
WiFi AX Radio 3	
WiFi AX Radio 4	
WiFi AX Radio 5	
WiFi AX Radio 6	
WiFi AX Radio 7	
WiFi AX Radio 8	
WiFi AX Radio 9	
WiFi AX Radio 10	
WiFi AX Radio 11	
WiFi AX Radio 12	
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WiFi AX Radio 14	
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WiFi AX Radio 16	
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WiFi AX Radio 25	
WiFi AX Radio 26	
WiFi AX Radio 27	
WiFi AX Radio 28	
WiFi AX Radio 29	
WiFi AX Radio 30	
WiFi AX Radio 31	
Attenuator 0	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -33 atten: 1.1.3059.0
Attenuator 1	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -33 atten: 1.1.3059.1
Attenuator 2	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -33 atten: 1.1.3059.2
Attenuator 3	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -33 atten: 1.1.3059.3
Attenuator 4	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -30 atten: 1.1.3034.0
Attenuator 5	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -30 atten: 1.1.3034.1
Attenuator 6	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -30 atten:
Attenuator 7	rssi-0-2.4Ghz: -22 rssi-0-5Ghz: -30 atten:
Attenuator 8	rssi-0-2.4Ghz: -13 rssi-0-5Ghz: -31 atten: 1.1.3034.2
Attenuator 9	rssi-0-2.4Ghz: -13 rssi-0-5Ghz: -31 atten: 1.1.3034.3
Attenuator 10	rssi-0-2.4Ghz: -13 rssi-0-5Ghz: -31 atten:
Attenuator 11	rssi-0-2.4Ghz: -13 rssi-0-5Ghz: -31 atten:
AX Attenuator 0	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 1	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 2	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:

AX Attenuator 3	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 4	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 5	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 6	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 7	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 8	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 9	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 10	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
AX Attenuator 11	AX rssi-0-2.4Ghz: -25 rssi-0-5Ghz: -30 atten:
Show Events	true
Build Date	Wed Oct 13 14:49:30 PDT 2021
Git Version	036ffa54a966f97c1581af019542e3ee47c5dc86

[CSV Data](#)

[META Information for TR-398 Issue 2](#)

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