

TR-398 Issue 4

WiFi Performance Test Plan

Wed Nov 12 19:34:26 IST 2025



Test Setup Information		
Device Under Test	Name	TPLINK
	SSIDs	TPLINK_2G TPLINK_5G TPLINK_6G TPLINK_MLO
	Passwords	Password@123 Password@123 Password@123 Password@123
	BSSIDs	
	Notes	[BLANK]
Estimated Run Time	0 ms	
Actual Run Time	10.379 m	

Objective

The TR-398 Issue 4 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, Long-term Stability and Mesh performance 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 test system. The user can select from the list of tests available. Most tests can run fully automated, though some require user interaction. Measurements are made and compared to the specified PASS/FAIL criteria in the TR-398 test plan and this report will show the summary PASS/FAIL results followed by more detailed results for each test.

Summary Results

Test	Result				Candela Score	Elapsed	Info
6.5.7 MLO STR Test	BW	n/AC	AX	BE	118	10.266 m	Passed 0 / 0 5g Download : Reported: 1,121.31 Mbps Required: 800.00 Mbps 5g Upload : Reported: 1,045.08 Mbps Required: 800.00 Mbps 6g Download : Reported: 3,769.69 Mbps Required: 3,000.00 Mbps 6g Upload : Reported: 3,531.33 Mbps Required: 3,000.00 Mbps 5g+6g Download : Reported: 4,827.00 Mbps Required: 4,401.89 Mbps 5g+6g Upload : Reported: 4,736.37 Mbps Required: 4,118.77 Mbps
	2.4Ghz						
	5Ghz			Pass			
	6Ghz			Pass			
	MLO			Pass			

6.5.7 MLO STR Test

Summary

802.11be (Wi-Fi 7) supports multi-link operation (MLO) which is similar to channel aggregation in the cellular technologies. MLO enables Wi-Fi operation in multiple bands, simultaneously, without knowledge of, or interruption to, applications running above the Wi-Fi layers.

One version of MLO is known as multiple link, multiple radio (MLMR) operation, in which multiple Wi-Fi radios are used to communicate on multiple Wi-Fi bands simultaneously. There are two versions of this operation, one in which the transmit periods and receive periods on the different bands must be coordinated (non-simultaneous transmit/receive), and one in which those periods are independent (simultaneous transmit/receive). It is the last mode which is of most market interest, currently, and it is the focus of this test. This is simultaneous transmit/receive multi-link, multi-radio operation, commonly known in the industry as STR.

Test Setup

1. A traffic generator to send Ethernet packets connects to the LAN port of the DUT AP.
2. The peer STA and DUT are placed at the AAV as calibrated in section 5.2.5 based on the profile under test. Since MLO uses multiple bands, the AAV used shall be the value for the highest band in use.
3. One MLMR-STR capable STA, configured for 2 spatial streams on all bands connects to the DUT AP.
4. If the test STA can control what MLO links it allows, then the AP does not need to be re-configured for the different MLO Link combinations.

Test Procedure

1. DUT AP is set to default TR398 test settings for 802.11BE on all 3 bands.
2. Connect Single-Link STA on 2.4Ghz band to DUT AP.
3. Measure and record the STA downlink TCP throughput, using a test time of 120 seconds.
4. Connect Single-Link STA on 5Ghz band to DUT AP.
5. Measure and record the STA downlink TCP throughput, using a test time of 120 seconds.
6. Connect Single-Link STA on 6Ghz band to DUT AP.
7. Measure and record the STA downlink TCP throughput, using a test time of 120 seconds.
8. Configure DUT AP to enable MLO STR on 2.4 and 5Ghz bands.
9. Connect Multi-Link STA to DUT AP.
10. Measure and record the STA downlink TCP throughput and per-MLO-Link throughputs, using a test time of 120 seconds.
11. Repeat steps 9-10 for each of these band combinations: 2.4GHz + 6GHz, 5GHz + 6GHz, 2.4GHz + 5GHz + 6GHz.

Pass/Fail Criteria

1. Passing values for this test require that the MLO-STR throughput be at least 90% of the sum of the single-link throughput for the bands used in the test step.
2. Each MLO Link must utilize at least 90% of the SLO throughput for that link.
3. SLO throughput must be at least: 200Mbps for 2.4Ghz, 800Mbps for 5Ghz, 3Gbps for 6Ghz.

Candela Score

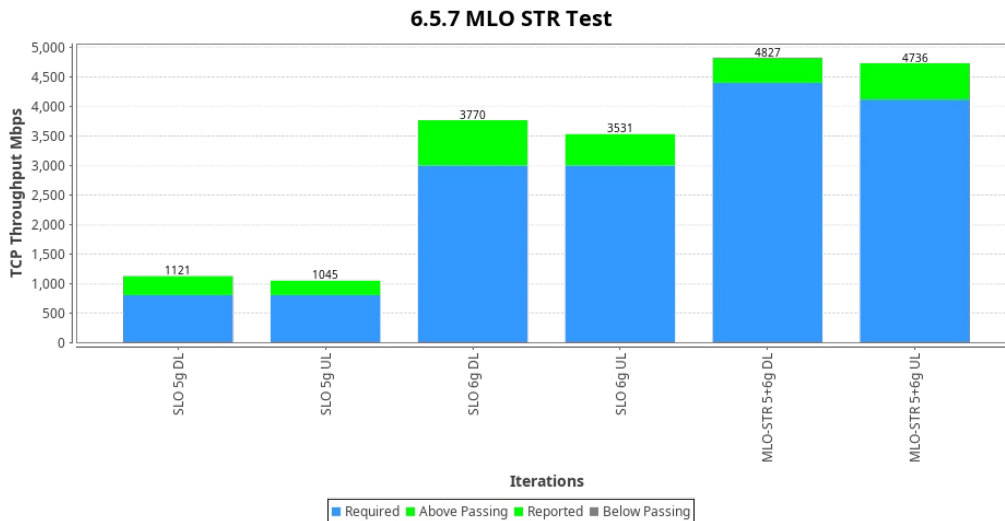
The score is (total achieved MLO-STR throughput divided by the pass/fail throughput, for all tests) * 100.0

6.5.7 MLO STR Test Results

Type	Result	Value	P/F Value	Notes
SLO 2.4g	Warning			Channel combination configured to be skipped.
Total SLO 5g DL throughput	PASS	1,121	800	Sum-total DL: 1,121.31 Mbps Requires: 800.00 Mbps STA-RSSI Data/Beacon: -31/-28 Rx-Rate: 1.441G Tx-Rate: 1.441G 802.11an-BE-80-2x2 153
Total SLO 5g UL	PASS	1,045	800	Sum-total UL: 1,045.08 Mbps Requires: 800.00 Mbps STA-RSSI Data/Beacon: -33/-28 Rx-Rate: 1.441G Tx-

throughput				Rate: 1.441G 802.11an-BE-80-2x2 153
Total SLO 6g DL throughput	PASS	3,770	3,000	Sum-total DL: 3,769.69 Mbps Requires: 3,000.00 Mbps STA-RSSI Data/Beacon: -30/-41 Rx-Rate: 5.765G Tx-Rate: 5.187G 802.11a-BE-320-2x2 37e
Total SLO 6g UL throughput	PASS	3,531	3,000	Sum-total UL: 3,531.33 Mbps Requires: 3,000.00 Mbps STA-RSSI Data/Beacon: -30/-41 Rx-Rate: 4.804G Tx-Rate: 4.323G 802.11a-BE-320-2x2 37e
MLO-STR 2.4g+5g	Warning			Channel combination configured to be skipped.
MLO-STR 2.4g+6g	Warning			Channel combination configured to be skipped.
Total MLO-STR 5g+6g DL throughput	PASS	4,827	4,402	Sum-total DL: 4,827.00 Mbps Requires: 4,401.89 Mbps STA-RSSI Data: -30 Rx-Rate: 5.765G Tx-Rate: 5.187G 802.11an-BE-320-2x2 37e
MLO-STR 5g+6g DL 5GHz Link DL	PASS	1,136	1,009	5GHz Link DL Reported : 1,135.56 Mbps Requires: 1,009.18 Mbps
MLO-STR 5g+6g DL 6GHz Link DL	PASS	3,912	3,393	6GHz Link DL Reported : 3,912.05 Mbps Requires: 3,392.72 Mbps
Total MLO-STR 5g+6g UL throughput	PASS	4,736	4,119	Sum-total UL: 4,736.37 Mbps Requires: 4,118.77 Mbps STA-RSSI Data: -30 Rx-Rate: 5.187G Tx-Rate: 5.765G 802.11an-BE-320-2x2 37e
MLO-STR 5g+6g UL 5GHz Link UL	PASS	1,060	941	5GHz Link UL Reported : 1,060.38 Mbps Requires: 940.57 Mbps
MLO-STR 5g+6g UL 6GHz Link UL	PASS	3,969	3,178	6GHz Link UL Reported : 3,968.70 Mbps Requires: 3,178.19 Mbps
MLO-STR 2.4g+5g+6g	Warning			Channel combination configured to be skipped.

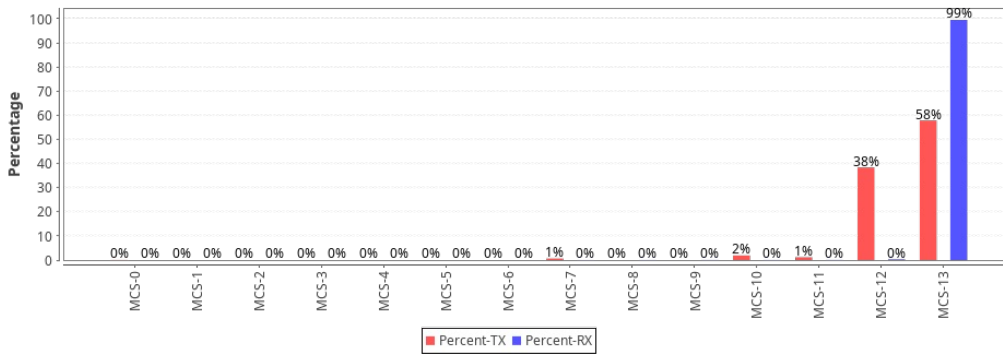
[CSV Data for 6.5.7 MLO STR Test](#)



Histogram for WiFi MCS for packets sent and received by the wifi radios in the test.

[CSV Data for WiFi Packet MCS Percentages SLO 5g](#)

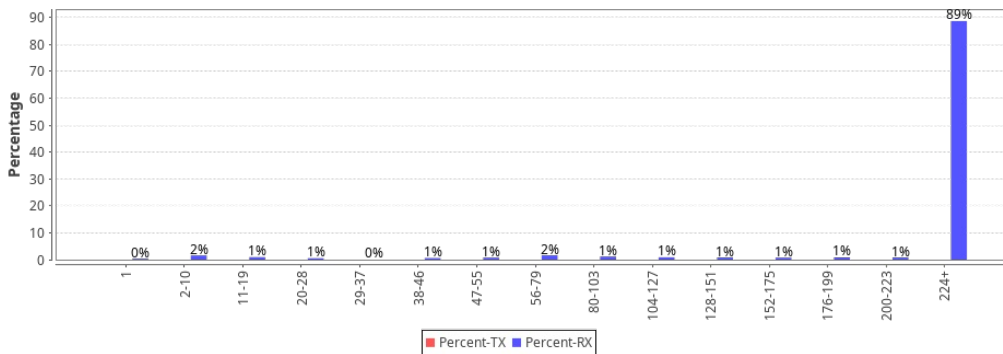
WiFi Packet MCS Percentages
SLO 5g



Block-Ack allows a series of frames to be sent in one transmit opportunity. This series of packets is known as a series of AMPDU frames. Having more frames in each AMPDU series normally improves throughput, but may increase latency or decrease airtime fairness. This histogram provides some visibility into the AMPDU chain length used in this test.

[CSV Data for WiFi Packet AMPDU Length Percentages SLO 5g.](#)

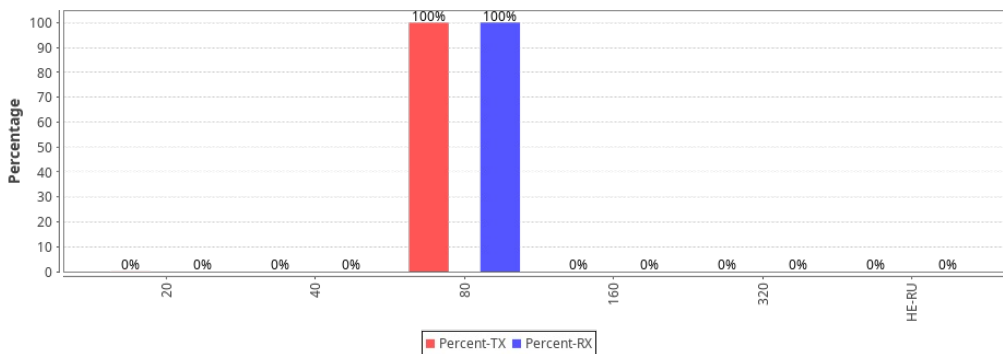
WiFi Packet AMPDU Length Percentages
SLO 5g



Histogram for WiFi bandwidths for packets sent and received by the wifi radios in the test.

[CSV Data for WiFi Bandwidth Percentages SLO 5g.](#)

WiFi Bandwidth Percentages
SLO 5g



SLO 5g DL Snapshot

Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.24 wlan9	22.196 Mbps	1.173 Gbps	2.347	1441.1 Mbps	1.441 Gbps	802.11an-BE 80 2x2	153	0	-31	78:8C:B5:48:D3:87	192.168.0.10	38:f8:f6:83:3b:1a

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.1.2 eth2	1.176 Gbps	23.581 Mbps	10 Gbps	192.168.0.8	9c:69:b4:63:16:ac

Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-1.2-1.wlan9--1.0.0-A	0 bps	605.039 Mbps	0	69302	1,145	1,145	715	0	0	0	0
cv_tcp-1.2-1.wlan9--1.0.0-B	605.378 Mbps	0 bps	69140	0	0	1,145	0	0	0	0	0
cv_tcp-1.2-1.wlan9--1.0.1-A	0 bps	516.697 Mbps	0	59191	1,024	1,024	469	0	0	0	0
cv_tcp-1.2-1.wlan9--1.0.1-B	517.062 Mbps	0 bps	59025	0	0	1,024	0	0	0	0	0

SLO 5g UL Snapshot

Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.24 wlan9	1.093 Gbps	25.122 Mbps	3.169	1441.1 Mbps	1.441 Gbps	802.11an-BE 80 2x2	153	0	-33	78:8C:B5:48:D3:87	192.168.0.10	38:f8:f6:83:3b:1a

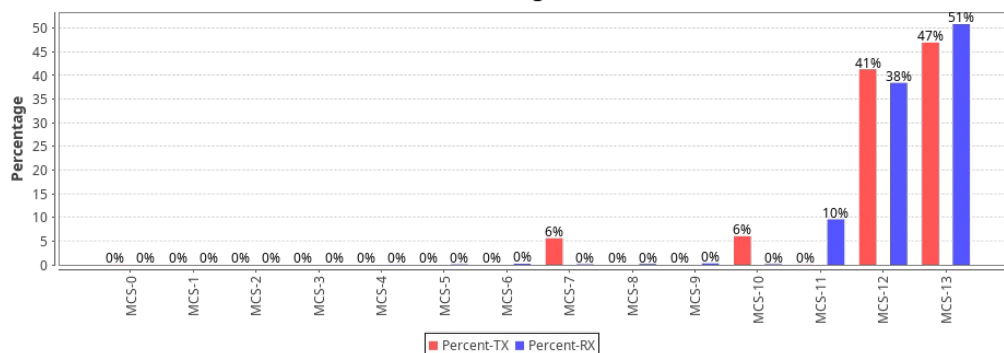
Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.1.2 eth2	26.507 Mbps	1.096 Gbps	10 Gbps	192.168.0.8	9c:69:b4:63:16:ac

Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-1.2-1.wlan9--1.0.0-A	522.739 Mbps	0 bps	59900	0	0	861	0	0	0	0	0
cv_tcp-1.2-1.wlan9--1.0.0-B	0 bps	523.353 Mbps	0	59304	861	861	190	0	0	0	0
cv_tcp-1.2-1.wlan9--1.0.1-A	522.643 Mbps	0 bps	59915	0	0	4,729	0	0	0	0	0
cv_tcp-1.2-1.wlan9--1.0.1-B	0 bps	525.127 Mbps	0	59450	4,729	4,729	257	0	0	0	0

Histogram for WiFi MCS for packets sent and received by the wifi radios in the test.

[CSV Data for WiFi Packet MCS Percentages SLO 6g](#)

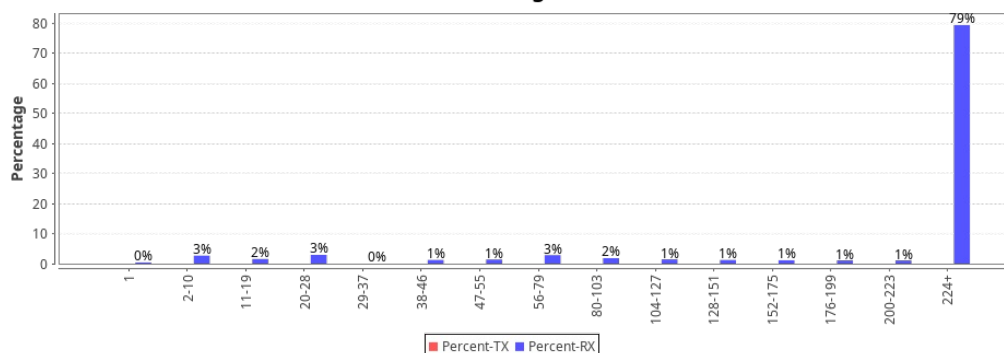
WiFi Packet MCS Percentages
SLO 6g



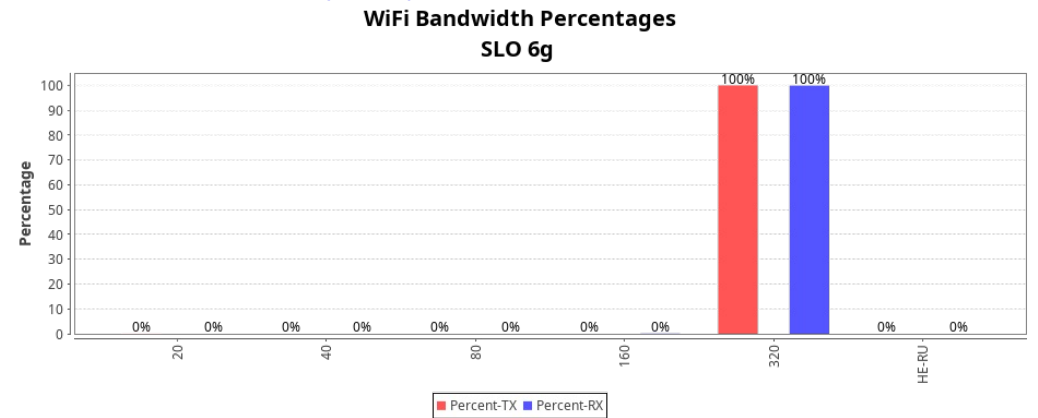
Block-Ack allows a series of frames to be sent in one transmit opportunity. This series of packets is known as a series of AMPDU frames. Having more frames in each AMPDU series normally improves throughput, but may increase latency or decrease airtime fairness. This histogram provides some visibility into the AMPDU chain length used in this test.

[CSV Data for WiFi Packet AMPDU Length Percentages SLO 6g](#)

WiFi Packet AMPDU Length Percentages
SLO 6g



Histogram for WiFi bandwidths for packets sent and received by the wifi radios in the test.



SLO 6g DL Snapshot

Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.24 wlan10	57.26 Mbps	3.947 Gbps	1.136	5187.1 Mbps	5.765 Gbps	802.11a-BE 320 2x2	227	0	-30	5E:8C:B5:48:D3:88	192.168.0.6	38:f8:f6:83:3b:16

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.1.2 eth2	3.958 Gbps	60.735 Mbps	10 Gbps	192.168.0.8	9c:69:b4:63:16:ac

Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-1.2-1.wlan10--1.0.0-A	0 bps	1.872 Gbps	0	214403	819	819	298	0	0	0	0
cv_tcp-1.2-1.wlan10--1.0.0-B	1.872 Gbps	0 bps	211655	0	0	819	0	0	0	0	0
cv_tcp-1.2-1.wlan10--1.0.1-A	0 bps	1.899 Gbps	0	217790	412	412	132	0	0	0	0
cv_tcp-1.2-1.wlan10--1.0.1-B	1.91 Gbps	0 bps	215530	0	0	412	0	0	0	0	0

SLO 6g UL Snapshot

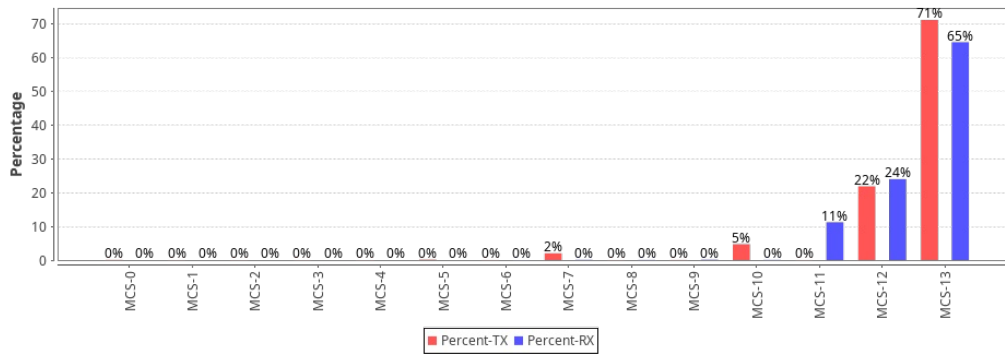
Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.24 wlan10	3.7 Gbps	46.065 Mbps	4.521	4322.6 Mbps	4.804 Gbps	802.11a-BE 320 2x2	227	0	-30	5E:8C:B5:48:D3:88	192.168.0.6	38:f8:f6:83:3b:16

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.1.2 eth2	48.602 Mbps	3.705 Gbps	10 Gbps	192.168.0.8	9c:69:b4:63:16:ac

Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-1.2-1.wlan10--1.0.0-A	1.788 Gbps	0 bps	204800	0	0	1,447	0	0	0	0	0
cv_tcp-1.2-1.wlan10--1.0.0-B	0 bps	1.791 Gbps	0	204169	1,447	1,447	6	0	0	0	0
cv_tcp-1.2-1.wlan10--1.0.1-A	1.747 Gbps	0 bps	200190	0	0	1,378	0	0	0	0	0
cv_tcp-1.2-1.wlan10--1.0.1-B	0 bps	1,747 Gbps	0	196772	1,378	1,378	88	0	0	0	0

Histogram for WiFi MCS for packets sent and received by the wifi radios in the test.

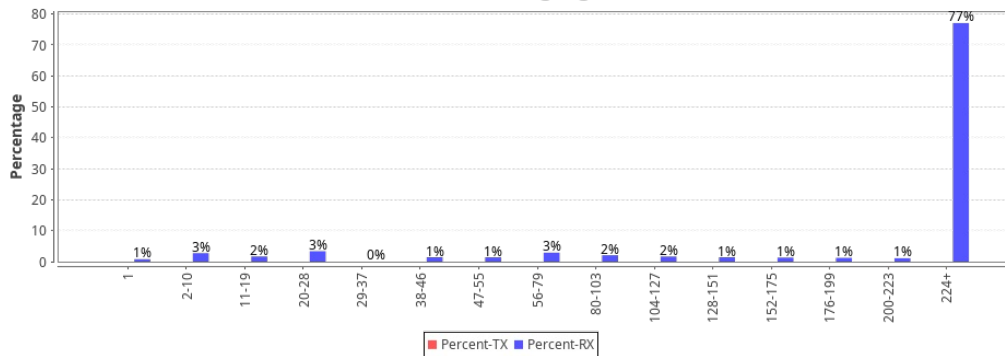
WiFi Packet MCS Percentages
MLO-STR 5g+6g



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[CSV Data for WiFi Packet AMPDU Length Percentages MLO-STR 5g+6g](#)

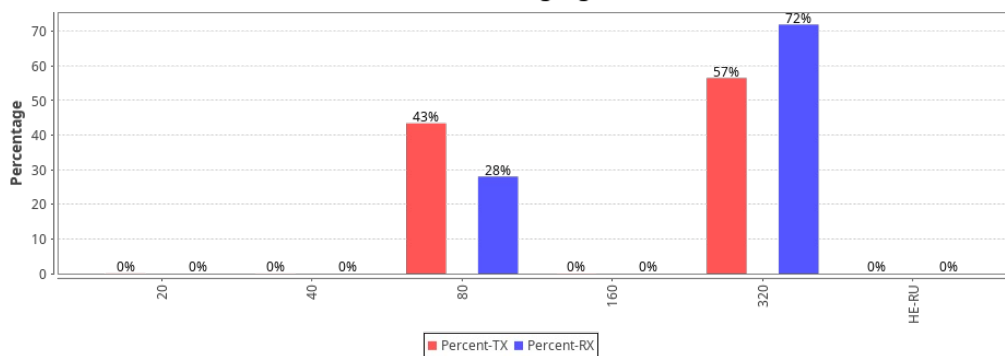
WiFi Packet AMPDU Length Percentages
MLO-STR 5g+6g



Histogram for WiFi bandwidths for packets sent and received by the wifi radios in the test.

[CSV Data for WiFi Bandwidth Percentages MLO-STR 5g+6g](#)

WiFi Bandwidth Percentages
MLO-STR 5g+6g



MLO-STR 5g+6g DL Snapshot

Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.24 sta03500	11.005 Mbps	5.047 Gbps	0	5187.1 Mbps	5.765 Gbps	802.11an-BE 320 2x2	227	0	-30	78:8c:b5:48:d3:89	192.168.0.158	38:f8:f6:83:2d:14
MLO 1.1.sta03500.1	8.446 Mbps	3.912 Gbps	0.644	5,187.10 Mbps	5,764.60 Mbps	802.11-BE 320 2x2	37e		-30	5e:8c:b5:48:d3:89		38:f8:f6:83:2f:14
MLO 1.1.sta03500.2	4.359 Mbps	1.136 Gbps	7.84	1,296.70 Mbps	1,441.10 Mbps	802.11-BE 80 2x2	153		-33	ca:8c:b5:48:d3:87		38:f8:f6:83:30:14

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.1.2.eth2	5.063 Gbps	11.675 Mbps	10 Gbps	192.168.0.8	9c:69:b4:63:16:ac

Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-1.2-1.sta03500--1.0.0-A	0 bps	2.203 Gbps	0	252071	1,234	1,234	314	0	0	0	0
cv_tcp-1.2-1.sta03500--1.0.0-B	2.204 Gbps	0 bps	251960	0	0	1,234	0	0	0	0	0
cv_tcp-1.2-1.sta03500--1.0.1-A	0 bps	2.636 Gbps	0	301566	895	895	530	0	0	0	0
cv_tcp-1.2-1.sta03500--1.0.1-B	2.636 Gbps	0 bps	301110	0	0	895	0	0	0	0	0

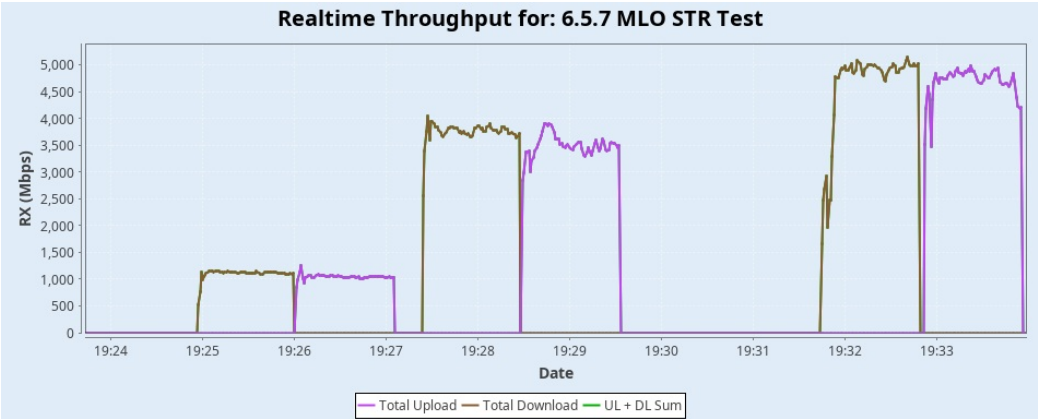
MLO-STR 5g+6g UL Snapshot

Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.24.sta03500	4.959 Gbps	57.041 Mbps	0	5764.6 Mbps	5.187 Gbps	802.11an-BE 320 2x2	227	0	-30	78:8c:b5:48:d3:89	192.168.0.158	38:f8:f6:83:2d:14
MLO 1.1.sta03500.1	3.969 Gbps	29.074 Mbps	1.13	5,764.60 Mbps	5,187.10 Mbps	802.11-BE 320 2x2	37e		-30	5e:8c:b5:48:d3:89		38:f8:f6:83:2f:14
MLO 1.1.sta03500.2	1.06 Gbps	28.01 Mbps	4.824	1,441.10 Mbps	1,441.10 Mbps	802.11-BE 80 2x2	153		-33	ca:8c:b5:48:d3:87		38:f8:f6:83:30:14

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.1.2.eth2	60.143 Mbps	4.967 Gbps	10 Gbps	192.168.0.8	9c:69:b4:63:16:ac

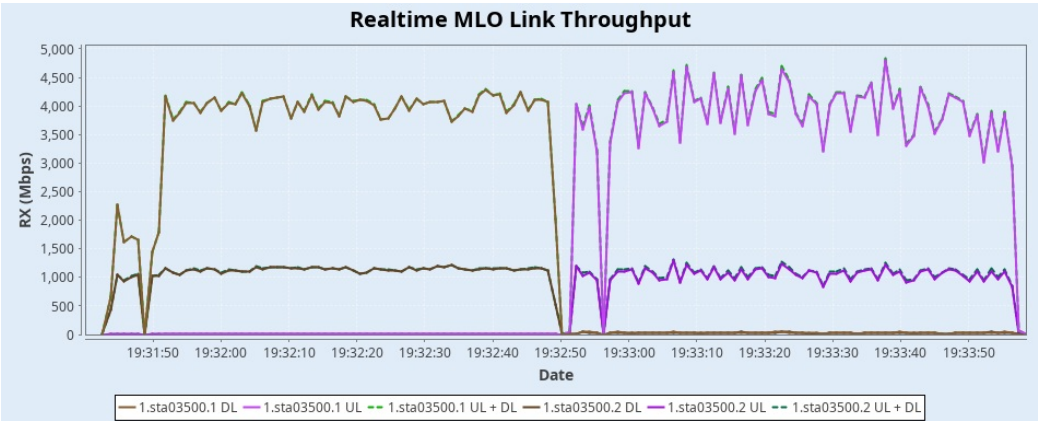
Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-1.2-1.sta03500--1.0.0-A	2.36 Gbps	0 bps	270195	0	0	1,173	0	0	0	0	0
cv_tcp-1.2-1.sta03500--1.0.0-B	0 bps	2.363 Gbps	0	266656	1,173	1,173	112	0	0	0	0
cv_tcp-1.2-1.sta03500--1.0.1-A	2.375 Gbps	0 bps	272130	0	0	1,268	0	0	0	0	0
cv_tcp-1.2-1.sta03500--1.0.1-B	0 bps	2.381 Gbps	0	269764	1,268	1,268	111	0.032	0	0	0

Realtime Throughput for: 6.5.7 MLO STR Test



[CSV For Graph Above](#)

Realtime MLO Link Throughput



[CSV For Graph Above](#)

[6.5.7 MLO STR Test Log](#)

[Key Performance Indicators CSV](#)

Test configuration and LANforge software version	
Auto-Helper	true
Pause on Failure	false
Allow-11w (MFP/PMF)	false
SAE-PWE	2
Disable-MLO	true
TXS All	false
Skip 2.4Ghz Tests	true
Skip 5Ghz Tests	true
Duration-120	60
Duration-60	60
Channel 2GHz	6
Channel 5GHz	36
Channel 6GHz	227
Calibrate against LANforge AP	false
LANforge Calibration TxPower-2.4G	20
LANforge Calibration TxPower-5G	20
Multi-Conn	10
Use-IPv6	false
UDP-Burst	false
UDP-GRO	false
Multiple Endpoints:	2
Default PDU Size:	-1
ToS	0
Pld Pattern	RANDOM_FIXED
UDP Send Buffer Size:	0
UDP Receive Buffer Size:	0
TCP Send Buffer Size:	0

TCP Receive Buffer Size:	0
Upstream Port	1.1.2 eth2 Firmware: 0x80000aef, 1.1876.0 Resource: ct523c-0bdd
Alien Upstream Port	
Turn-Table Chamber	
Prefer Virtual STA Radios	true
Opposite-Speed:	0
1Gbps Throughput Limit:	925000000
2.5Gbps Throughput Limit:	2300000000
5Gbps Throughput Limit:	4600000000
Prefer Group 0	true
Prefer Group 1	false
Prefer Group 2	false
Extra TxStatus	false
Extra RxStatus	false
TXS All	false
Adjust UL Atten with STA TxPower	true
Adjust UL Atten with DUT TxPower	false
Reconfigure DUT BW	false
2.4GHz Channel	2437 Mhz
5GHz Channel	5180 Mhz
6GHz Channel	6135 Mhz
Default NSS	2
2.4GHz 2m RSSI	-25
5GHz 2m RSSI	-30
Attenuation Adjustment	0
Extra Download Path-loss	0
2.4Ghz Bandwidth	20
5Ghz Bandwidth	80
6Ghz AX Bandwidth	160
6Ghz BE Bandwidth	320
STA TX Power:	20
Country:	840
DUT AP Expected TX Power-2.4G:	30
DUT AP Expected TX Power-5G:	30
Virt-Sta Rotation 2.4GHz	0
Virt-Sta Rotation 5GHz	0
Virt-Sta Rotation 6GHz	0
AX Rotation 2.4GHz	0
AX Rotation 5GHz	0
AX Rotation 6GHz	0

Virt-Sta Radio 0	1.1.wiphy9 Firmware: 20250605125803 Resource: ct523c-0bdd
Virt-Sta Radio 2	1.1.wiphy10 Firmware: 20250605125803 Resource: ct523c-0bdd
Details for Resource: 1.1	Hostname: ct523c-0bdd LANforge ver: 5.5.1.1 64bit Kernel-Version: 6.15.6+
Show Events	true
Build Date	Mon Nov 3 12:54:03 PM PST 2025
Git Version	147d4daab5e2d246169f9e6e7794da7126b3a689

[CSV Data](#)

[META Information for TR-398 Issue 4](#)

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