

TR-398 Issue 4

WiFi Performance Test Plan

Fri Oct 17 10:26:04 PDT 2025



Test Setup Information	
Device Under Test	TR398 AP
Estimated Run Time	30 m
Actual Run Time	5.008 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	138	4.853 m	Passed 0 / 0 5g Download : Reported: 1,689.94 Mbps Required: 800.00 Mbps 6g Download : Reported: 5,267.21 Mbps Required: 3,000.00 Mbps 5g+6g Download : Reported: 6,941.93 Mbps Required: 6,261.43 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

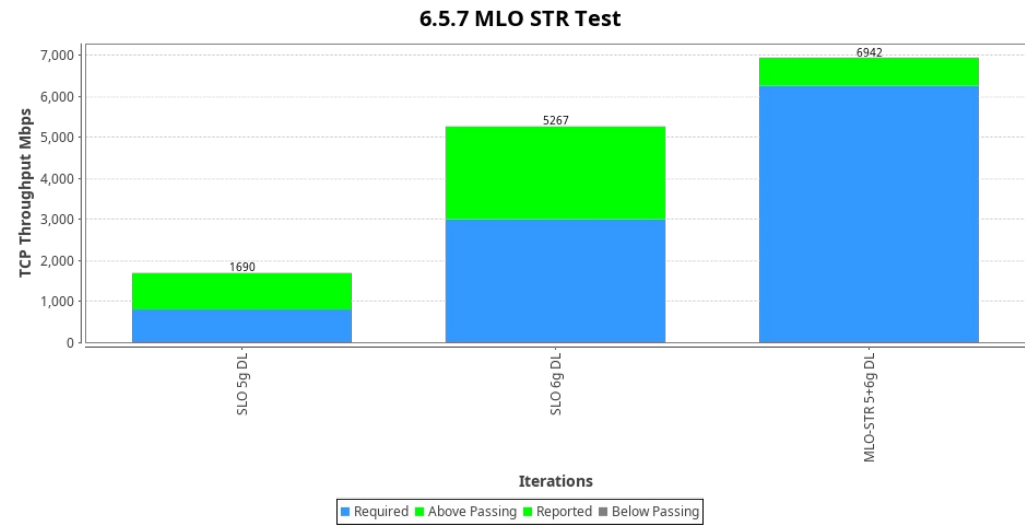
The score is (total achieved MLO-STR throughput divided by the pass/fail throughput, for all tests) * 100.0

6.5.7 MLO STR Test Results

Type	Result	Value	P/F Value	Notes
Configuration NOTE	Warning			Configured to skip Upload traffic test.
SLO 2.4g	Warning			Channel combination configured to be skipped.
Total SLO 5g DL throughput	PASS	1,690	800	Sum-total DL: 1,689.94 Mbps Requires: 800.00 Mbps STA-RSSI Data/Beacon: -32/-27 Rx-Rate: 2.402G Tx-Rate: 1.297G 802.11an-BE-80-4x4 149
Total SLO 6g DL throughput	PASS	5,267	3,000	Sum-total DL: 5,267.21 Mbps Requires: 3,000.00 Mbps STA-RSSI Data/Beacon: -33/-34 Rx-Rate: 7.686G Tx-Rate: 9.608G 802.11a-BE-320-4x4 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	6,942	6,261	Sum-total DL: 6,941.93 Mbps Requires: 6,261.43 Mbps STA-RSSI Data: -37 Rx-Rate: 7.781G Tx-Rate: 9.608G 802.11an-BE-320-4x4 37e
MLO-STR 5g+6g DL 5GHz Link DL	PASS	1,689	1,521	5GHz Link DL Reported : 1,688.78 Mbps Requires: 1,520.94 Mbps

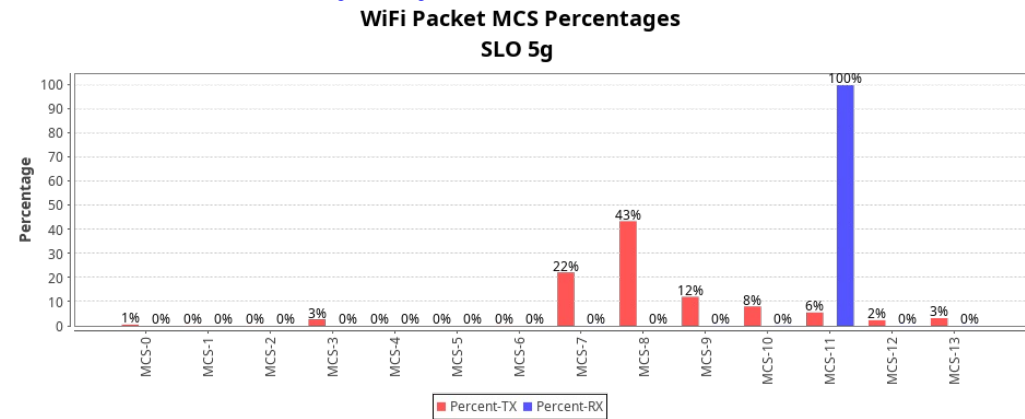
MLO-STR 5g+6g DL 6GHz Link DL	PASS	5,577	4,740	6GHz Link DL Reported : 5,577.09 Mbps Requires: 4,740.49 Mbps
MLO-STR 2.4g+5g+6g	Warning			Channel combination configured to be skipped.

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



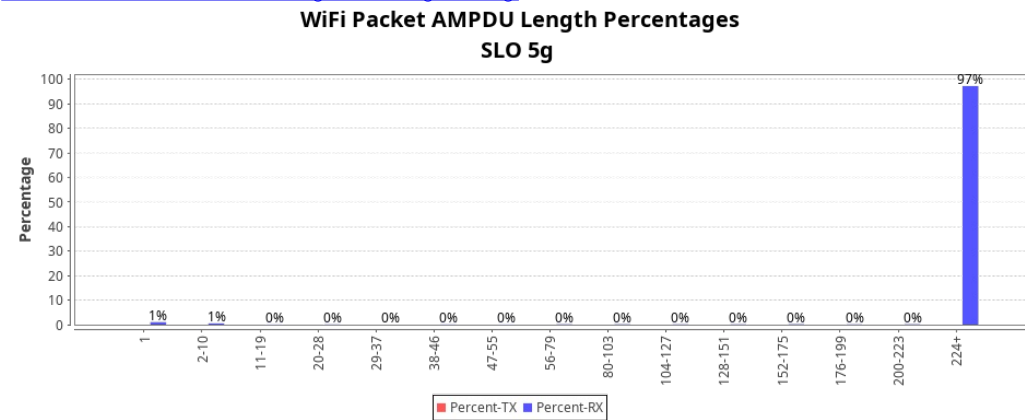
Histogram for WiFi MCS for packets sent and received by the wifi radios in the test.

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



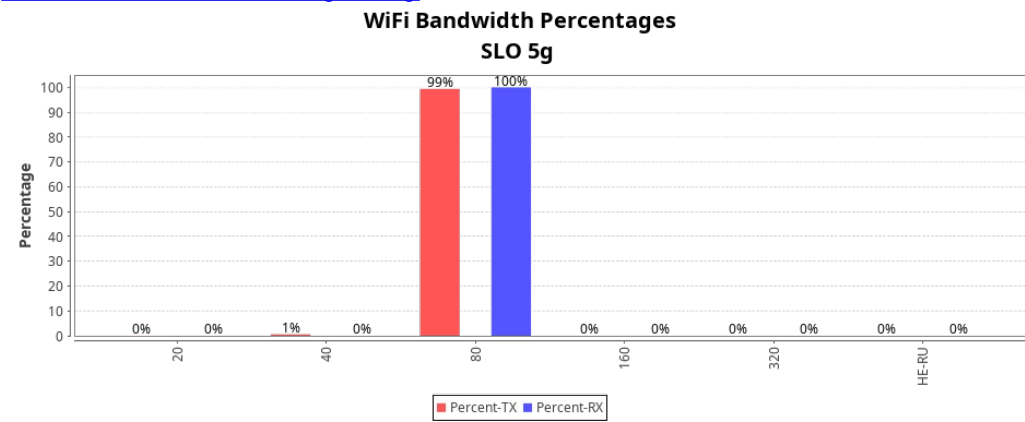
Block-Ack allows a series of frames to be sent in one transmit opportunity. This series of packets is known as a series of AMPDU frames. Having more frames in each AMPDU series normally improves throughput, but may increase latency or decrease airtime fairness. This histogram provides some visibility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

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



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

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



SLO 5g DL Snapshot

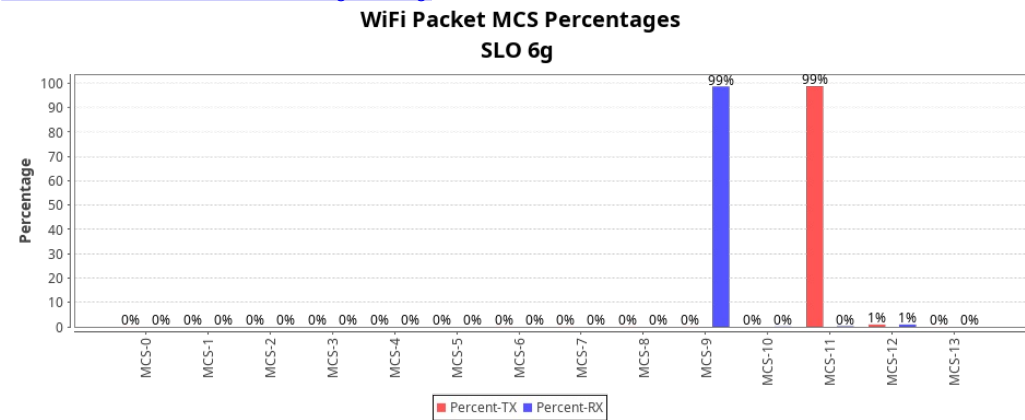
Port	Tx-Bps 1m	Rx-Bps 1m	Tx-Fail %	Tx Link-Rate	Rx Link-Rate	Mode	Channel	Last CX-Time (ms)	RSSI (dBm)	AP	IP	MAC
1.1.16 wlan4	39.054 Mbps	1.768 Gbps	4.294	1297.2 Mbps	2.402 Gbps	802.11an- BE 80 4x4	149	0	-32	[hidden]	10.0.185.223	38:f8:f6:75:d1:aa

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.3.2 eth2 (ROOT-AP-LAN)	1.773 Gbps	41.426 Mbps	10 Gbps	10.0.239.14	9c:69:b4:61:e5:b4

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-3.2-1.wlan4--1.0.0-A	0 bps	596.504 Mbps	0	68248	-33.359	-33.359	866	0	0	0	0
cv_tcp-3.2-1.wlan4--1.0.0-B	596.163 Mbps	0 bps	68225	0	0	-33.359	0	0	0	0	0
cv_tcp-3.2-1.wlan4--1.0.1-A	0 bps	511.984 Mbps	0	58452	-34.670	-34.670	212	0	0	0	0
cv_tcp-3.2-1.wlan4--1.0.1-B	515.156 Mbps	0 bps	57990	0	0	-34.670	0	0	0	0	0
cv_tcp-3.2-1.wlan4--1.0.2-A	0 bps	582.411 Mbps	0	67160	-34.298	-34.298	724	0	0	0	0
cv_tcp-3.2-1.wlan4--1.0.2-B	592.28 Mbps	0 bps	66672	0	0	-34.298	0	0	0	0	0

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

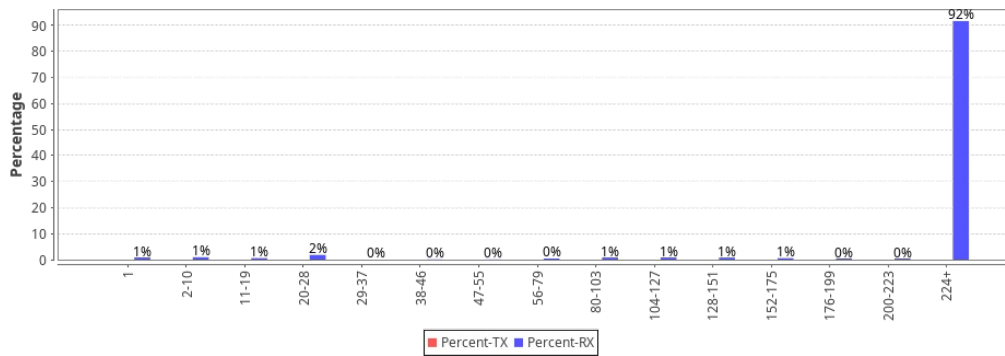
[CSV Data for WiFi Packet MCS Percentages SLO 6g](#)



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](#)

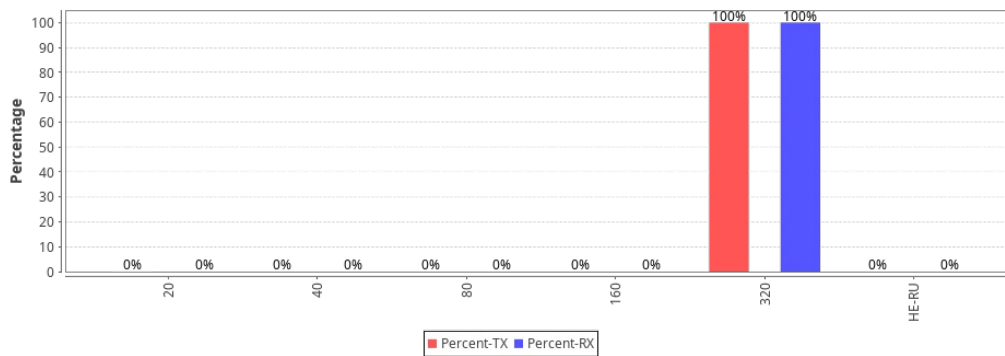
WiFi Packet AMPDU Length Percentages SLO 6g



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

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

WiFi Bandwidth Percentages SLO 6g



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
1.1.16 wlan5	76.625 Mbps	5.511 Gbps	1.427	9607.7 Mbps	7.686 Gbps	802.11a-BE 320 4x4	227	0	-33	[hidden]	10.0.185.219	38:f8:f6:75:d1:a6

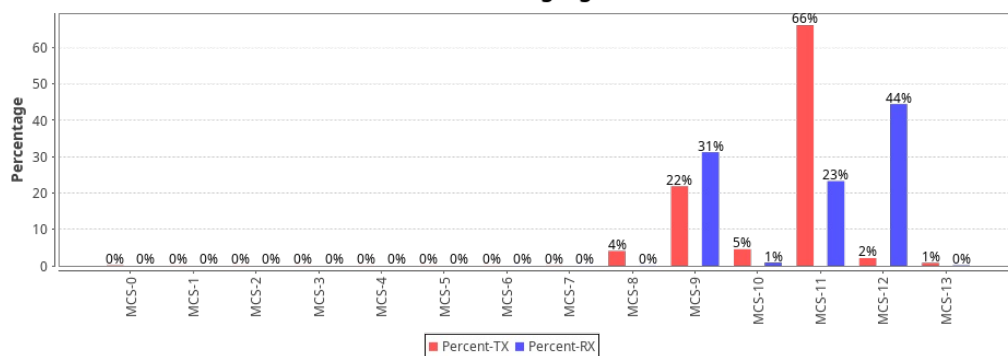
Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.3.2 eth2 (ROOT-AP-LAN)	5.53 Gbps	81.237 Mbps	10 Gbps	10.0.239.14	9c:69:b4:61:e5:b4

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-3.2-1.wlan5--1.0.0-A	0 bps	1.989 Gbps	0	228445	-34,126	-34,126	411	0	0	0	0
cv_tcp-3.2-1.wlan5--1.0.0-B	2.005 Gbps	0 bps	226200	0	0	-34,126	0	0	0	0	0
cv_tcp-3.2-1.wlan5--1.0.1-A	0 bps	1.685 Gbps	0	192985	-34,806	-34,806	108	0	0	0	0
cv_tcp-3.2-1.wlan5--1.0.1-B	1.691 Gbps	0 bps	190790	0	0	-34,806	0	0	0	0	0
cv_tcp-3.2-1.wlan5--1.0.2-A	0 bps	1.597 Gbps	0	182300	-34,890	-34,890	34	0	0	0	0
cv_tcp-3.2-1.wlan5--1.0.2-B	1.604 Gbps	0 bps	180935	0	0	-34,890	0	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 MLO-STR 5g+6g](#)

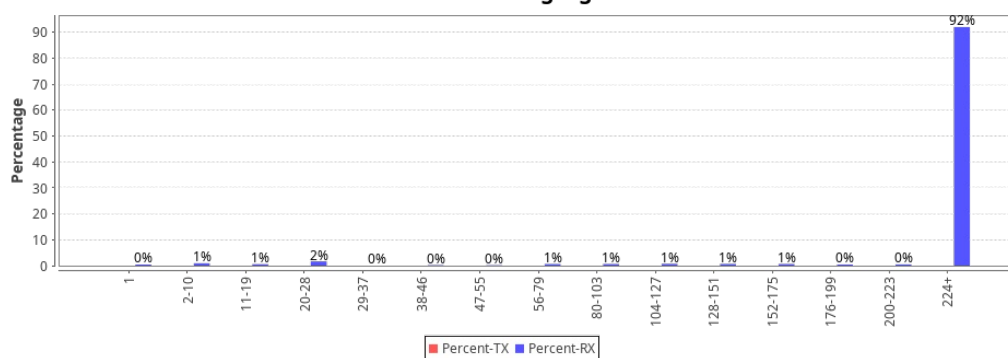
WiFi Packet MCS Percentages
MLO-STR 5g+6g



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 MLO-STR 5g+6g](#)

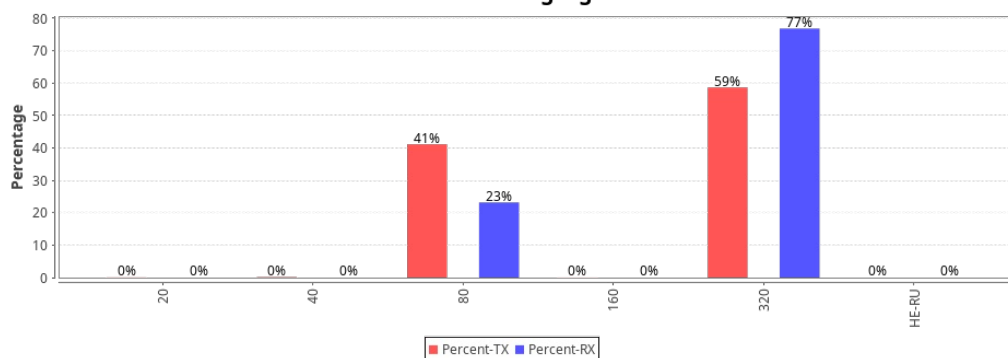
WiFi Packet AMPDU Length Percentages
MLO-STR 5g+6g



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



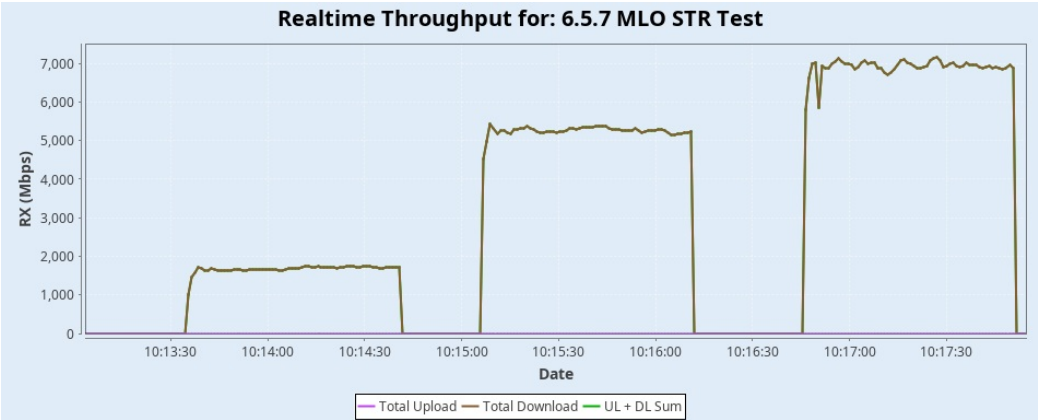
MLO-STR 5g+6g DL Snapshot

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
1.1.16 sta03500	17.805 Mbps	7.265 Gbps	0	9607.7 Mbps	7.781 Gbps	802.11an-BE 320 4x4	227	0	-37	[hidden]	10.0.206.253	38:f8:f6:75:f2:a4
MLO 1.1.sta03500.1	8.609 Mbps	1.689 Gbps	5.147	1,921.50 Mbps	2,401.90 Mbps	802.11-BE 80 4x4	149		-32	78:58:a4:ff:75:61		38:f8:f6:75:f4:a4
MLO 1.1.sta03500.2	12.266 Mbps	5.577 Gbps	1.555	9,607.70 Mbps	7,780.70 Mbps	802.11-BE 320 4x4	37e		-37	78:58:a4:ff:75:69		38:f8:f6:75:f5:a4

Port	Tx-Bps 1m	Rx-Bps 1m	Link-Rate	IP	MAC
1.3.2 eth2 (ROOT-AP-LAN)	7.284 Gbps	18.843 Mbps	10 Gbps	10.0.239.14	9c:b4:61:e5:b4

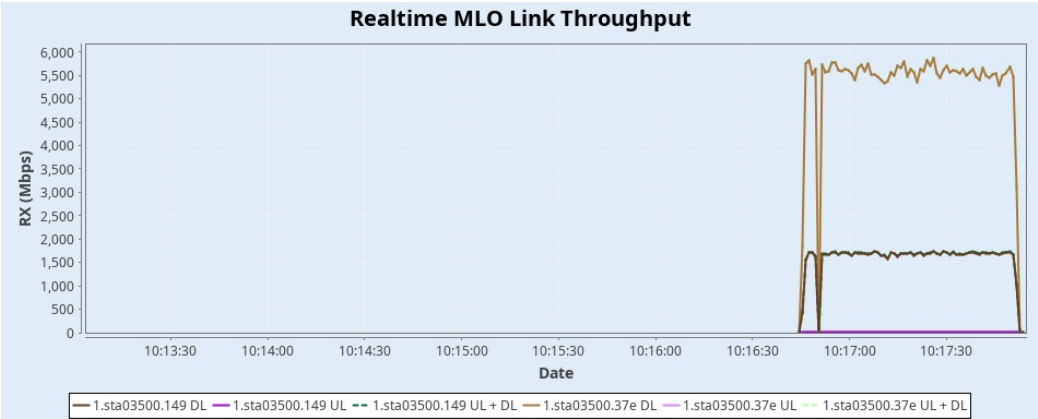
Endpoint	Tx-Bps 1m	Rx-Bps 1m	TxPkts	RxPkts	RX Lat (ms)	RT Lat (ms)	Jitter	Rx Pkt Loss %	Rx OOO %	Rx DUP	Rx Seq Drop
cv_tcp-3.2-1.sta03500-1.0.0-A	0 bps	2.518 Gbps	0	288163	-34,287	-34,287	373	0	0	0	0
cv_tcp-3.2-1.sta03500-1.0.0-B	2.517 Gbps	0 bps	285680	0	0	-34,287	0	0	0	0	0
cv_tcp-3.2-1.sta03500-1.0.1-A	0 bps	2.17 Gbps	0	248374	-34,923	-34,923	124	0	0	0	0
cv_tcp-3.2-1.sta03500-1.0.1-B	2.173 Gbps	0 bps	246650	0	0	-34,923	0	0	0	0	0
cv_tcp-3.2-1.sta03500-1.0.2-A	0 bps	2.25 Gbps	0	260245	-34,590	-34,590	342	0	0	0	0
cv_tcp-3.2-1.sta03500-1.0.2-B	2.279 Gbps	0 bps	257760	0	0	-34,590	0	0	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	false
Duration-120	30
Duration-60	30
Channel 2GHz	AUTO
Channel 5GHz	AUTO
Channel 6GHz	AUTO
Calibrate against LANforge AP	true
LANforge Calibration TxPower-2.4G	20
LANforge Calibration TxPower-5G	20
Multi-Conn	10
Use-IPv6	false
UDP-Burst	false
UDP-GRO	true
Multiple Endpoints:	3
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	1.3.eth2 Firmware: 0x80000aef, 1.1876.0 Resource: ct523c-de7c
Alien Upstream Port	1.2.2 eth2 Firmware: 0x80000aef, 1.1876.0 Resource: ct523c-3b89
Turn-Table Chamber	TR-398
Prefer Virtual STA Radios	true
Opposite-Speed:	20000
1Gbps Throughput Limit:	925000000
2.5Gbps Throughput Limit:	2300000000
5Gbps Throughput Limit:	4600000000
Prefer Group 0	true
Prefer Group 1	true
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	-1 Mhz

5GHz Channel	-1 Mhz
6GHz Channel	-1 Mhz
Default NSS	4
2.4GHz 2m RSSI	-25
5GHz 2m RSSI	-30
Attenuation Adjustment	0
Extra Download Path-loss	0
2.4Ghz Bandwidth	40
5Ghz Bandwidth	160
6Ghz AX Bandwidth	160
6Ghz BE Bandwidth	320
STA TX Power:	20
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 3	1.1.wiphy4 Firmware: 20250605125803 Resource: ct523c-3b29
Virt-Sta Radio 5	1.1.wiphy5 Firmware: 20250605125803 Resource: ct523c-3b29
Attenuator 0	rssI-0-2.4GHz: -18 rssI-0-5GHz: -38 atten: 1.1.3094.0
Attenuator 1	rssI-0-2.4GHz: -18 rssI-0-5GHz: -38 atten: 1.1.3094.1
Attenuator 2	rssI-0-2.4GHz: -18 rssI-0-5GHz: -38 atten: 1.1.3094.2
Attenuator 3	rssI-0-2.4GHz: -18 rssI-0-5GHz: -38 atten: 1.1.3094.3
Attenuator 4	rssI-0-2.4GHz: -23 rssI-0-5GHz: -52 atten: 1.1.3102.0
Attenuator 5	rssI-0-2.4GHz: -23 rssI-0-5GHz: -52 atten: 1.1.3102.1
Attenuator 6	rssI-0-2.4GHz: -23 rssI-0-5GHz: -52 atten: 1.1.3099.0
Attenuator 7	rssI-0-2.4GHz: -23 rssI-0-5GHz: -52 atten: 1.1.3099.1
Attenuator 8	rssI-0-2.4GHz: -21 rssI-0-5GHz: -49 atten: 1.1.3102.2
Attenuator 9	rssI-0-2.4GHz: -21 rssI-0-5GHz: -49 atten: 1.1.3102.3
Details for Resource: 1.1	Hostname: ct523c-3b29 LANforge ver: 5.5.2 64bit Kernel-Version: 6.15.6+
Details for Resource: 1.2	Hostname: ct523c-3b89 LANforge ver: 5.5.2 64bit Kernel-Version: 6.15.6+
Details for Resource: 1.3	Hostname: ct523c-de7c LANforge ver: 5.5.2 64bit Kernel-Version: 6.15.6+
Show Events	true
Build Date	Fri Oct 17 10:05:48 AM PDT 2025
Git Version	1aa86dd426a1a8aed0bac36da762aa21294108ef

[CSV Data](#)

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

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