Network Testing and Emulation Solutions



Goal: Test WiFi MU-MIMO station Download, one 2x2 station, one 1x1.

Test WiFi MU-MIMO station Download using two MU-MIMO capable radios. One radio will emulate a 2x2 station, and a second will emulate a 1x1 station. When testing MU-MIMO, only a single station can be used per radio. For additional non-MU-MIMO station emulation, additional radios can be configured for multiple station virtual devices. This example uses a system similar to the LANforge CT525 system. It is configured with 4 radios: Two of the 4x4 MU-MIMO radios are used for MU-MIMO testing. The other two are not used in this test scenario. This procedure should work on any system that can support at least 2 of the 4x4 wave-2 radios. The AP in this test is a Netgear R7800 configured in bridging mode. This feature requires 2 wave-2 WiFi network cards and LANforge release 5.3.5





1. Configure Radios and Station devices for MU-MIMO capabilities.

A. Go to the Port Manager, select the **wiphy0** interface, and click **Modify**. Configure the radio for 2x2 MIMO and click Apply.

wiphy0 (2u-9984) Configure Settings	$\odot \odot \odot$
Port Status Information	
Current: LINK-DOWN NONE	
Driver Info: Port Type: WIFI-Radio Driver: ath10k(9984) Bus: 0000:06:00.0	
Port Configurables	1
Standard Configuration RF Patterns Firmware	
Enable —— General Interface Settings	-1
Set IF Down	
Set PROMISC Alias:	
MAC Addr: 04:f0:21:2b:1d:44 TX Q Len 0	
Rpt Timer: medium (8 s) 💌	
WiFi Settings	
Max-VIFs: 50 Max-Stations: 50 Max-APs: 16 Supports: 802.11an-AC	
Country: United States (840)	
Channel/Freq: AUTO (-1 Mhz)	
Antenna: CH 0-1 (2x2) V XXPower: DEFAOLT (-1)	
RTS: DEFAULT Frag: 2346	
Verbose Debug	
Print View Details Logs Probe Sync Apply OK	Cancel

Β.	Select the wiphy1	interface, an	d click Modify.	Configure	the radio	for 1x1	MIMO ai	nd click Apply.
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wiphy1 (2u-9984) Configure Settings	$\odot \odot \otimes$
Port Status Information	
Current: LINK-DOWN NONE	
Driver Info: Port Type: WIFI-Radio Driver: ath10k(9984) Bus: 0	000:05:00.0
Port Configurables	
Standard Configuration RF Patterns Firmware	
Enable General Interface Settings	1
Set IF Down	
Set PROMISC Alias:	
MAC Addr: 04:f0:21:2b:1d:42 TX Q Len 0	
Rpt Timer: medium (8 s) 💌	
WiFi Settings	
Max-VIFs: 50 Max-Stations: 50 Max-APs: 16 Support:	s: 802.11an-AC
Country: United States (840)	
Channel/Freq: AUTO (-1 Mhz)	
RTS: DEFAULT Frag:	2340
Verbose Debug	
Print View Details Logs Probe Sync Appl	y OK Cancel

C. For both wiphy0 and wiphy1 ensure that the firmware is configured properly for MU-MIMO. The Port Status Information section at the top should mention the 9984 chipset, as other hardware may not support MU-MIMO. Normally the best option is to go into the Firmware tab, click the Customize Firmware box, click the top Firmware Defaults for chipset: 9984 button, and then select Allow MU-MIMO. Please note that selecting MU-MIMO disables a feature that allows multiple virtual stations to work properly on a single radio. So, when you are done with MU-MIMO testing, you should probably change this selection back to Software Decrypt settings.

D. Select the **wlan0** interface, and click **Modify**. Configure the station for proper SSID, password, etc, and click Apply. Do the same configuration for **wlan1**.

	wlan0 (2ı	ı-9984) Configure	Settings	\odot \odot						
	Port Status Information Current: LINK-UP GRO Authorized Driver Info: Port Type: WIFI-STA Parent: wiphy0									
Standard Configuration	Advanced C	Port Configurabl	es Configuration C	Custom WiFi						
Enable — Ena	Down	General In	terface Settings	1						
Set MAC	DHCP-IPv6	DHCP Release	DHCP Vendor ID:	None						
Set MTU	DHCP-IPv4	Secondary-IPs 192.168.1.2	DHCP Client ID: Peer IP:	NA Vone						
	IP Address: IP Mask:	0.0.0.0	Global IPv6: Link IPv6:	AUTO						
	Gateway IP: Alias:	0.0.0.0	IPv6 GW: MTU:	AUT0						
RADIUS	MAC Addr:	04:f0:21:2b:1d:44	TX Q Len	1000						
	Rpt Timer:	medium (8 s) ▼ WiE	Settings							
□ TSO Enabled SSID: brent-netgear-5g ▲ R: DEFAULT □ UFO Enabled GSO Enabled brenttest123 Mode: (802.11abgn-AC) ▼ □ LRO Enabled ✓ GRO Enabled WPA OSEN WEP Disable HT40 Disable SGI										
Print View Details	Probe	Display Scan	Sync	Apply OK Cance						

E. In this scenario, we are using eth1 as the upstream port. Ensure it is configured properly. In this example, it is actually configured to serve DHCP using a virtual router and the Netsmith feature in LANforge, but for simplicity, it is normally best if you use the AP as DHCP server or just use fixed IP addresses for eth1 and the wlan interfaces instead of using DHCP.

	Current: LINK- Driver Info: Port	UP 1000bt-FD AUTO- Type: Ethernet Driv	Port Status Info NEGOTIATE Flow-Co er: igb(5.3.0-k) Bu	ntrol TSO GSC s: 0000:09:00) GRO).0 Cur: 2.5(GT/s xl Max: 2.5GT/s xl	
			Port Configur	ables			
		General In	terface Settings		1	Port Rates	Advert Rates
Set IF Down Set MAC	Down	Aux-Mgt				○ 10bt-HD ○ 10bt-FD ○ 100bt-HD	✓ 10bt-HD✓ 10bt-FD
Set TX Q Len	DHCP-IPv6	DHCP Release	DHCP Vendor ID:	None	-	O 100bt-FD	🗹 100bt-HD
Set MTU		Secondary-IPs	DHCP Client ID:	None		0 10G-FD	🗾 100bt-FD
Set Offload	DNC Conversi	DLANK	Deer ID.	NIA		 Autonegotiate 	🗹 1000-FD
Set Rate Info	DNS Servers:					1	10G-FD
Set PROMISC	IP Address:	255 255 255 0				🗌 Renegotiate	40G-FD
Set Rx-All/FCS	Cotowey ID	233.233.233.0		AUTO		🗌 Restart Xcvr	Flow-Contro
Set Bypass	Alion:	0.0.0.0	MTU:	1500		PROMISC) Offload
Set Bridge Info	Allas:	00:04.70:00:02:01		1000		RX-ALL	
Set CPU Mask	MAC Addr:	00:04:78:80:82:81		1000		RX-FCS	
-Services —	Br Cost:	Ignore	Priority:	Ignore		Bypass NOW!	GSO Enable
HTTP	Rpt Timer:	medium (8 s) 🔽	Watchdog:	0	-	Bypass Power-UP	
FTP	CPU Mask:	NO-SET	WiFi Bridge:	NONE	-	Bypass Power-DOWN	
RADIUS						Bypass Disconnect	

- 2. Create Layer-3 UDP Download traffic flows.
 - A. Go to Layer-3 tab and click Create to build a UDP connection. Select the Protocol, ports, rates, and use Multi-Conn 1 so that separate processes are created for optimal throughput performance. Create a second one for the wlan1 interface, with download speed of about 450Mbps since it is only 1x1 MU-MIMO. You may need to adjust the + buttons at top left to show the section containing Multi-Conn settings.

udp-wlan0-dl - Create/Modify Cross Connect 📀 📀 🗞												
+ - All					Display Sync Batch-Create Apply OK							
CX Name: CX Type:	Cross-Connect Judp-wlan0-dl LANforge / UDP	Cross-Connect udp-wlan0-dl LANforge / UDP						Endpoint B	-			
	Endpoint A		Endpoint B	-	Pld Pattern	increasing	•	increasing	-			
Resource:	1 (2u-9984)	•	1 (2u-9984)		Min IP Port:	AUTO	-	AUTO	-			
Port:	10 (wlan0)	-	1 (eth1)		Max IP Port:	Same	-	Same	-			
Min Tx Rate:	Zero (0 bps)	•	650000000 (650 Mbps)	-	Min Duration:	Forever	-	Forever	-			
Max Tx Rate:	Same	•	Same		Max Duration:	Same	-	Same	-			
Min PDU Size:	AUTO	•			Min Reconn:	0 (0 ms)	-	0 (0 ms)	-			
Max PDU Size:	Same	•	Same 💌		Max Reconn:	Same	-	Same	-			
IP ToS:	Best Effort (0)	-	Best Effort (0) 🔻		Multi-Coan:	One (1)	-	One (1)				
Pkts To Send:	Infinite 🖵		inite 🔽 Infinite 🔽			Script		Script				
						Thresholds		Thresholds				

B. Start the test by selecting the connections click Start. We see about 500Mbps on wlan0 (2x2) and 200Mbps on wlan1 (1x1). For best results, you may need to tune orientation of the first two antenna on the wiphy0 radio and the first antenna on wiphy1. In addition, it can take a short amount of time for the rates to reach maximum throughput, so you may wish to clear the counters after around 15 seconds of running to make sure the averages do not include the initial ramp-up time.

				LANforge M	anager Version(5.3.5)				$\odot \odot \times$			
<u>Control</u> <u>R</u> eport	<u>C</u> ontrol <u>R</u> eporting <u>T</u> ear-Off Info <u>P</u> lugins												
					Stop All	Resta	rt Manager		Refresh	HELP			
Layer-4 Gene	eric T	est Mgr	Test Group	Resource Mgr	Event Log Alerts	Port Mgr	vAP Stations	Message	s				
Status Lay	er-3	L3 Endps	VolP/RTP	VolP/RTP En	dps Armageddon	WanLinks	Attenuat	ors Collis	ion-Domains	File-IO			
Rpt 1	Rpt Timer: default (5 s) 🗸 Go Test Manager all 🗸 Select All Start Stop Quiesce Clear												
View	a a	- 500		🔻 Go		Displa	y Cr <u>e</u> ate	Mo <u>d</u> ify	Delete				
				Cross Con	nects for Selected Te	est Manager—							
Name	Туре	State	Pkt Rx A	Pkt Rx B	Bps Rx A	Bps Rx B	Rx Drop % A	Rx Drop % B	Drop Pkts A	Drop Pkts			
udp-wlan0-dl	LF/UDP	Run	1,619,908	0	506,438,968	C	0.644	0	10,842				
udp-wlan1-dl	LF/UDP	Run	663,837	0	204,113,541	C	53.759	0	771,776				
udp-wlan2-dl	LF/UDP	Stopped	294,414	0	928,003,014	C	2.207	0	6,644				
udp-wlan3-dl	LF/UDP	Stopped	170,632	0	365,073,116	C	61.655	0	274,356				
Logged in to: 1	92.168.	100.141:40	02 as: Admir	1									

C. It can be a bit difficult to know if MU-MIMO is working properly. In general, if you disable MU-MIMO in the AP, then aggregate throughput should decrease significantly. In addition, the current firmware and/or driver is unable to properly report RX encoding rates for MU-MIMO frames, so it always reports low rates. If you see total throughput that is greater than the reported RX Rate, then likely the system is receiving MU-MIMO frames from the AP.

LANforge Manager Version(5.3.5)													×	
Contro	Roportir	ng Toor Off	f Info Pluging											
contro	<u>Reporti</u>	ig Teal-Oli	Ino <u>F</u> idgins										-	
Stop All Restart Manager Refresh														
Louis	Laver-4 Generic / Test Mor / Test Group / Resource Mor / Event Log / Alerts / Port Mor / vAP Stations / Messages													
Layer-4 Generic Testimily Testionary Resource Migr Event Log Alerics Port Migr VAP stations Messages Status Layer-3 L3 Endos VolP/RTP VolP/RTP Endos Armagedon Wanlinks Attenuators Collision-Domains File-10														
Status Layer-3 L3 Endps VolP/RIP VolP/RIP Endps Armageddon WanLinks Attenuators Collision-Domains File-10														
Disp: 10.1.1.14:0.0 Sniff Packets 1 Clear Counters Reset Port Delete														
Rpt Timer: medium (8 s) Apply I View Details Create Modify Batch Modify														
					ernet Interf	aces (Ports) for all Res				_			
										1		1		
Vind	bps TX LL	Bytes TX LL	bps RX LL	Bytes RX	Reset	TX-Rate	RX-Rate	Status	AP	Activity	Signal	Noise	C	
		-												
0	211,201	367,447	24,873	571,441	Complete	1 Gbps	1 Gbps			0		1		
0	999,989	41,176,	40	1,512	Complete	1 Gbps	1 Gbps			0				
0	12	462,449	532,141,214	35,835,	Complete		0 bps			79.499		-		
0	12	527,583	226,048,620	15,832,	Complete		0 bps			87.421				
0	0	219,524	32,275	6,543,4	Complete		0 bps		1 2	91.59				
0	2	314,484	26,334	936,498	Complete		0 bps			0	1.			
0	0	265,614	212	649,699	Complete	6 Mbps	975 Mbps	Authorized	DC:EF:0	100	-14 dBm	-95 dBm		
0	0	219,772	211	6,245,9	Complete	6.5 Mbps	ops	Authorized	DC:EF:0	91.623	-18 dBm	-104 dBm		
0	14	558	210,892,014	8,619,7	Complete	6.5 Mbps	29.3 Mbps	Authorized	DC:EF:0	81.765	-25 dBm	-103 dBm		
0	11	558	521,559,168	21,011,	Complete	175.6 M.	32.6 Mbps	Authorized	DC:EF:0	80.286	-26 dBm	-103 dBm		
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