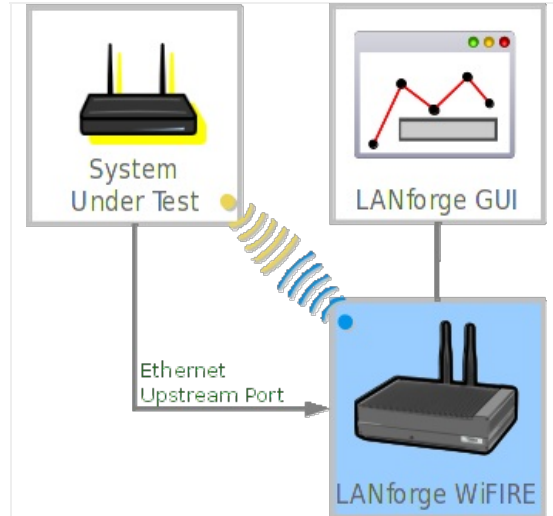
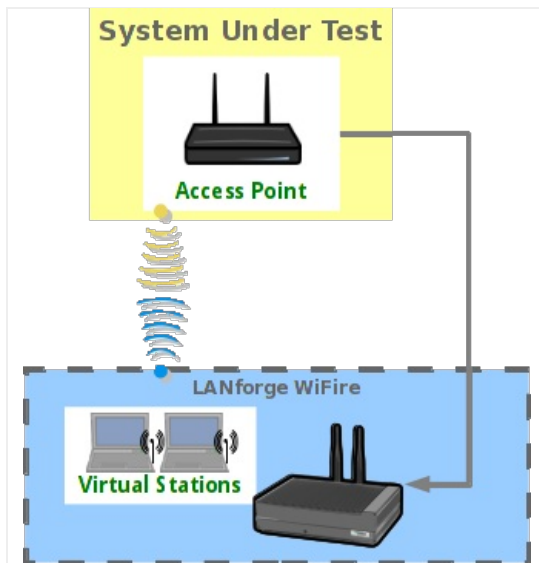


Test WiFi station upload throughput.

Goal: Test WiFi station upload throughput with various numbers of stations.

Test WiFi station upload throughput with various numbers of stations. This example uses a pair of LANforge CT520 systems, but the procedure should work on all CT521, CT522, CT523, CT525 and similar systems. Encrypted throughput (WPA2) will perform better on the CT523 and higher systems because their CPUs are more powerful. This test assumes you have already created a virtual AP on system 1 and configured it to act as a router and give out DHCP.



1. Test TCP upload throughput with one station (Open)

- A. Go to the Port Manager, select the **wlan0** interface on the second system, and click **Modify**. Set the SSID to match the VAP on system 1.

wlan0 (brent-521) Configure Settings

Port Status Information
Current: LINK-DOWN GRO NONE
Driver Info: Port Type: WIFI-STA Parent: wiphy0

Port Configurables

Standard Configuration | Advanced Configuration | Misc Configuration | Custom WiFi

Enable

- ☐ Set IF Down
- ☐ Set MAC
- ☐ Set TX Q Len
- ☐ Set MTU
- ☐ Set Offload
- ☐ Set PROMISC

Services

- ☐ HTTP
- ☐ FTP
- ☐ RADIUS

Low Level

- ☐ PROMISC
- ☒ TSO Enabled
- ☐ UFO Enabled
- ☒ GSO Enabled
- ☐ LRO Enabled
- ☒ GRO Enabled

General Interface Settings

☐ Down ☐ Aux-Mgt

☐ DHCP-IPv6 ☒ DHCP Release DHCP Vendor ID: None

☒ DHCP-IPv4 DHCP Client ID: None

DNS Servers: 10.97.1.1 Peer IP: NA

IP Address: 0.0.0.0 Global IPv6: AUTO

IP Mask: 0.0.0.0 Link IPv6: AUTO

Gateway IP: 0.0.0.0 IPv6 GW: AUTO

Alias: MTU: 1500

MAC Addr: 00:0e:8e:3d:30:f8 TX Q Len: 1000

Rpt Timer: faster (1 s) WiFi Bridge: NONE

WiFi Settings

SSID: ben-138 AP: DEFAULT

Key/Phrase: Mode: 8 (8)

Freq/Channel: 5180/36 Rate: OS Default

☐ WPA ☐ WPA2 ☐ OSEN ☐ WEP ☐ Disable HT40 ☐ Disable SGI

Print View Details Probe Display Scan Sync Apply OK Cancel

- B. Go to Layer-3 tab and click **Create** to build a TCP connection. Select the Protocol, ports, rates, PDU sizes, Send & Receive buffer sizes.

tcp-se - Create/Modify Cross Connect

+ - All Display Sync Batch-Create Apply OK Cancel

1 Cross-Connect

CX Name: tcp-se

CX Type: LANforge / TCP

Resource: TX Endpoint 1 (lec2010-ath9k-1) RX Endpoint 3 (t520-6157)

Port: TX Endpoint 15 (vap0) RX Endpoint 4 (vlan0)

Min Tx Rate: TX Endpoint Zero (0 bps) RX Endpoint 0C12 (622.08 Mbps)

Max Tx Rate: TX Endpoint Same RX Endpoint Same

Min PDU Size: TX Endpoint UDP Pld (1,472 B) RX Endpoint 65535 (65,535 B)

Max PDU Size: TX Endpoint Same RX Endpoint Same

IP ToS: TX Endpoint Best Effort (0) RX Endpoint Best Effort (0)

Pkts To Send: TX Endpoint Infinite RX Endpoint Infinite

2 Cross-Connect

Report Timer: Fast (1 s)

Pid Pattern: TX Endpoint Increasing RX Endpoint Increasing

Min IP Port: TX Endpoint AUTO RX Endpoint AUTO

Max IP Port: TX Endpoint Same RX Endpoint Same

Min Duration: TX Endpoint Forever RX Endpoint Forever

Max Duration: TX Endpoint Same RX Endpoint Same

Min Reconn: TX Endpoint 0 (0 ms) RX Endpoint 0 (0 ms)

Max Reconn: TX Endpoint Same RX Endpoint Same

Multi-Conn: TX Endpoint Normal (0) RX Endpoint Normal (0)

Script

3 Cross-Connect

Test Manager: default_tm

Quiesce: 3

IP Addr: TX Endpoint AUTO RX Endpoint AUTO

Replay File: TX Endpoint ☐ RX Endpoint ☐

Loop: TX Endpoint ☐ RX Endpoint ☐

Dest Mac: TX Endpoint ☐ RX Endpoint ☐

Filename: TX Endpoint RX Endpoint

Dest MAC: TX Endpoint 00 0e 8e 32 12 cf RX Endpoint 80 01 02 03 04 05

4 Cross-Connect

Send Buff Size: TX Endpoint 2MB (2 MB) RX Endpoint 2MB (2 MB)

Rcv Buff Size: TX Endpoint 2MB (2 MB) RX Endpoint 2MB (2 MB)

Send Bad FCS: TX Endpoint zero (0%) RX Endpoint zero (0%)

Src MAC: TX Endpoint 80:01:02:03:04:05 RX Endpoint 00:0e:8e:32:12:cf

Use-Proxy: TX Endpoint ☐ RX Endpoint ☐

Proxy Addr: TX Endpoint 10.97.1.207 RX Endpoint 10.97.1.1

Proxy Port: TX Endpoint 33003 RX Endpoint 33003

Socket Priority: TX Endpoint 0 RX Endpoint 0

Payload

5 Cross-Connect

Min: TX Endpoint DEFAULT RX Endpoint DEFAULT

Max: TX Endpoint DEFAULT RX Endpoint DEFAULT

Max Segments: TX Endpoint DEFAULT RX Endpoint DEFAULT

Conn Timeout: TX Endpoint 10s (10 s) RX Endpoint 10s (10 s)

TCP MSS: TX Endpoint OS Default RX Endpoint OS Default

Endp Name: TX Endpoint tcp-se-A RX Endpoint tcp-se-B

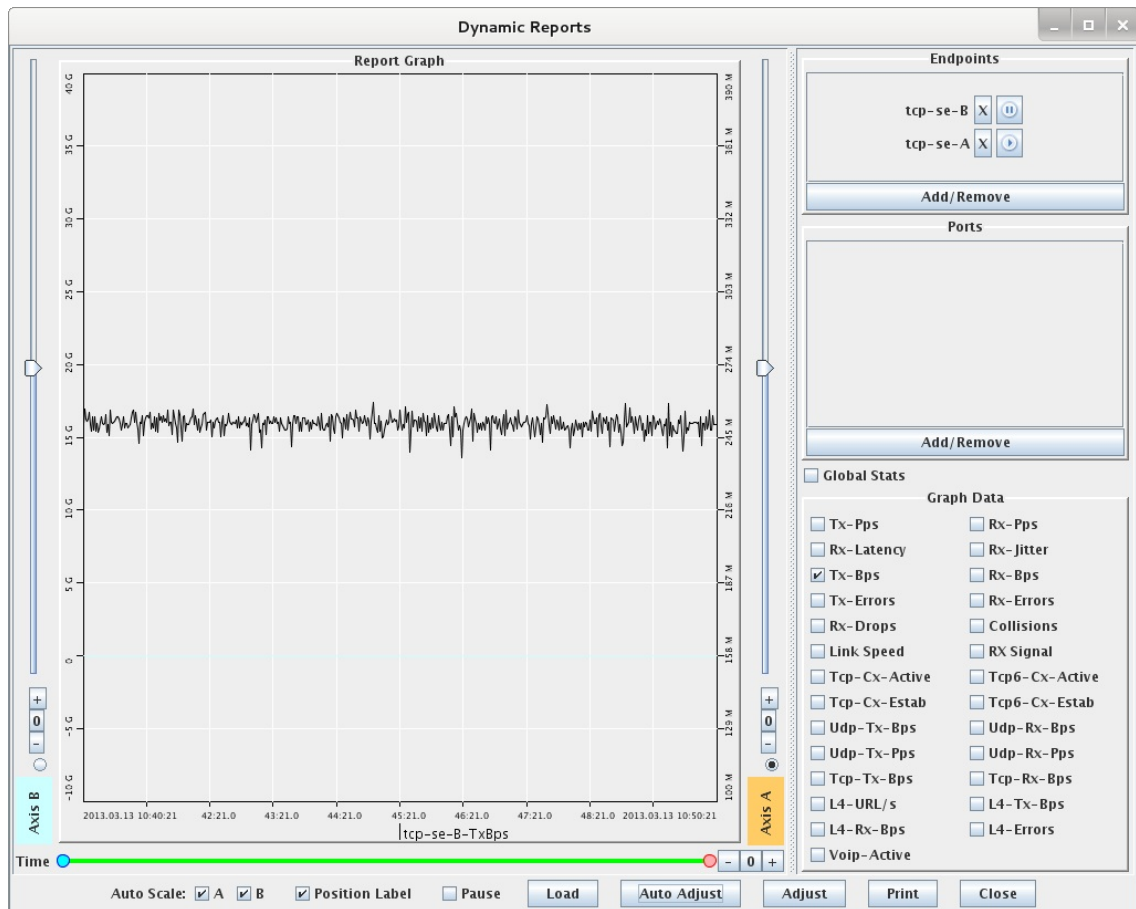
TX Endpoint Delayed ACK Settings

TX Endpoint Checksum ☐ UnManaged ☐ Duration Quiesce ☐ Quiesce-After-Range ☐ TCP_NODELAY ☐ Clear-Port-On-Start ☐ Linear-IP-Ports ☐

RX Endpoint Delayed ACK Settings

RX Endpoint Checksum ☐ UnManaged ☐ Duration Quiesce ☐ Quiesce-After-Range ☐ TCP_NODELAY ☐ Clear-Port-On-Start ☐ Linear-IP-Ports ☐

- C. Start the test by selecting the **tcp-se** row and click **Start**. Right-click and select **Dynamic Report** to get a real-time graph of the throughput. We see about 250Mbps of TCP throughput.



2. Test TCP upload throughput with one station (WPA2)

- A. Modify the VAP to use WPA2 instead of being open. Go to Port-Mgr tab, select vap0, and click **Modify**

The **vap0 (brent-523) Configure Settings** window displays configuration options for the VAP. The top section shows **Port Status Information** with **Current: LINK-UP GRO NONE** and **Driver Info: Port Type: WIFI-AP Parent: wiphy0**. The main section is divided into several tabs:

- Standard Configuration:** Includes checkboxes for **Set IF Down**, **Set MAC**, **Set TX Q Len**, **Set MTU**, **Set Offload**, **Set PROMISC**, **Services** (HTTP, FTP), and **Low Level** (PROMISC, TSO Enabled, UFO Enabled, GSO Enabled, LRO Enabled, GRO Enabled).
- Advanced Configuration:** Includes checkboxes for **Down**, **Aux-Mgt**, **DHCP-IPv6**, **DHCP Release**, **DHCP-IPv4**, **DNS Servers**, **IP Address**, **IP Mask**, **Gateway IP**, **Alias**, **MAC Addr**, **Rpt Timer**, **DHCP Vendor ID**, **DHCP Client ID**, **Peer IP**, **Global IPv6**, **Link IPv6**, **IPv6 GW**, **MTU**, **TX Q Len**, **WiFi Bridge**, **WiFi Settings** (SSID, Key/Phrase, Freq/Channel, DTIM-Period, Beacon, Mode, Rate, Max-STA), and **WPA** (WPA2, WPA, OSEN, WEP, Disable HT40, Disable HT80, Disable SGI, Verbose Debug).
- Misc Configuration:** (Empty)
- Custom WiFi:** (Empty)

At the bottom, there are buttons for **Print**, **View Details**, **Logs**, **Probe**, **Display Scan**, **Sync**, **Apply**, **OK**, and **Cancel**.

- B. Configure wlan0 to use the same settings so it can connect to the VAP using WPA2 authentication.
- C. Go to the Layer-3 tab, start the **tcp-se** connection, right-click and select **Dynamic Report** to get a real-time graph of the throughput. We see about 43Mbps of TCP throughput. LANforge currently does the WPA encryption in software on the CPU, so it is much slower than un-encrypted traffic.

3. Test TCP throughput with 50 stations (Open)

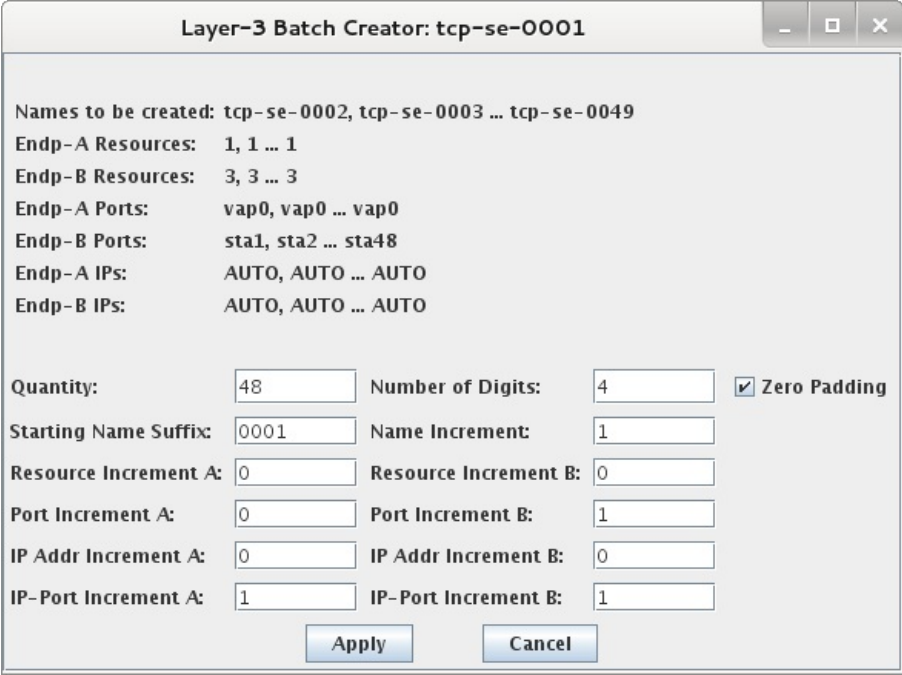
- A. Go to the **Port-Mgr** tab, select the existing wlan0 and vap0 interfaces, click **Modify**, un-select WPA2 on each of them, and click Apply. This changes wlan0 and vap0 back to Open mode.
- B. Go to the **Port-Mgr** tab, select the wiphy0 interface on the second system, and click **Create**. Select **Wifi STA**, enter starting MAC, quantity of 49, select DHCP-IPv4, STA ID of 0, SSID, and Key/Phrase. When properly configured, click **Apply**

- C. You should now see all 50 stations associated with IP addresses.

Port	Phen...	Down	IP	SEC	Alias	RX Bytes	RX Pkts	Pps RX	bps RX	TX Bytes	TX Pkts	Pps TX	bps TX
1.3.01			0.0.0.0	0	eth1	0	0	0	0	0	0	0	0
1.3.02			10.97.3.25	0	sta0	1,452	6	0	0	1,012	8	0	0
1.3.03			0.0.0.0	0	wiphy0	1,343,3...	145,931...	851	644,416	180,125...	3,472,7...	20,012	245,850...
1.3.04			10.97.1.207	0	wlan0	2,830,0...	73,507...	841	444,084	178,910...	1,793,7...	19,969	245,032...
1.3.05			11.97.1.1	0	vap0	7,092	50	0	0	13,848	89	0	0
1.3.06			10.97.2.248	0	sta1	42,654	437	0	0	1,012	8	0	0
1.3.07			10.97.3.18	0	sta2	42,654	437	0	0	902	7	0	0
1.3.08			10.97.3.17	0	sta3	42,564	436	0	0	902	7	0	0
1.3.09			10.97.2.251	0	sta4	42,564	436	0	0	902	7	0	0
1.3.10			10.97.2.252	0	sta5	42,486	435	0	0	902	7	0	0
1.3.11			10.97.3.2	0	sta6	42,318	433	0	0	1,012	8	0	0
1.3.12			10.97.2.249	0	sta7	42,228	432	0	0	1,012	8	0	0
1.3.13			10.97.2.250	0	sta8	42,060	430	0	0	1,012	8	0	0
1.3.14			10.97.2.254	0	sta9	41,196	426	0	0	950	7	0	0
1.3.15			10.97.2.255	0	sta10	41,712	426	0	0	902	7	0	0
1.3.16			10.97.2.253	0	sta11	41,712	426	0	0	902	7	0	0
1.3.17			10.97.3.0	0	sta12	40,938	423	0	0	950	7	0	0
1.3.18			10.97.3.3	0	sta13	40,938	423	0	0	840	6	0	0
1.3.19			10.97.3.4	0	sta14	41,622	425	0	0	902	7	0	0
1.3.20			10.97.3.1	0	sta15	41,532	424	0	0	1,012	8	0	0
1.3.21			10.97.3.5	0	sta16	41,442	423	0	0	1,012	8	0	0
1.3.22			10.97.3.7	0	sta17	31,500	336	0	0	950	7	0	0
1.3.23			10.97.3.6	0	sta18	31,416	334	0	0	840	6	0	0

- D. Go to the **Layer-3** tab, modify the 'tcp-se' connection. Change the name to tcp-se-0001, and change the RX Endpoint side's port from wlan0 to sta0. Click **OK** to create the new connection.

- E. Now, create 48 more copies. Modify the tcp-se-0001 connection and click **Batch-Create**. Set quantity to 48, and Port Increment A to 0. Click **Apply** to create the 48 TCP connections, one on each of the 48 stations.



Layer-3 Batch Creator: tcp-se-0001

Names to be created: tcp-se-0002, tcp-se-0003 ... tcp-se-0049

Endp-A Resources: 1, 1 ... 1

Endp-B Resources: 3, 3 ... 3

Endp-A Ports: vap0, vap0 ... vap0

Endp-B Ports: sta1, sta2 ... sta48

Endp-A IPs: AUTO, AUTO ... AUTO

Endp-B IPs: AUTO, AUTO ... AUTO

Quantity: 48 Number of Digits: 4 ☒ Zero Padding

Starting Name Suffix: 0001 Name Increment: 1

Resource Increment A: 0 Resource Increment B: 0

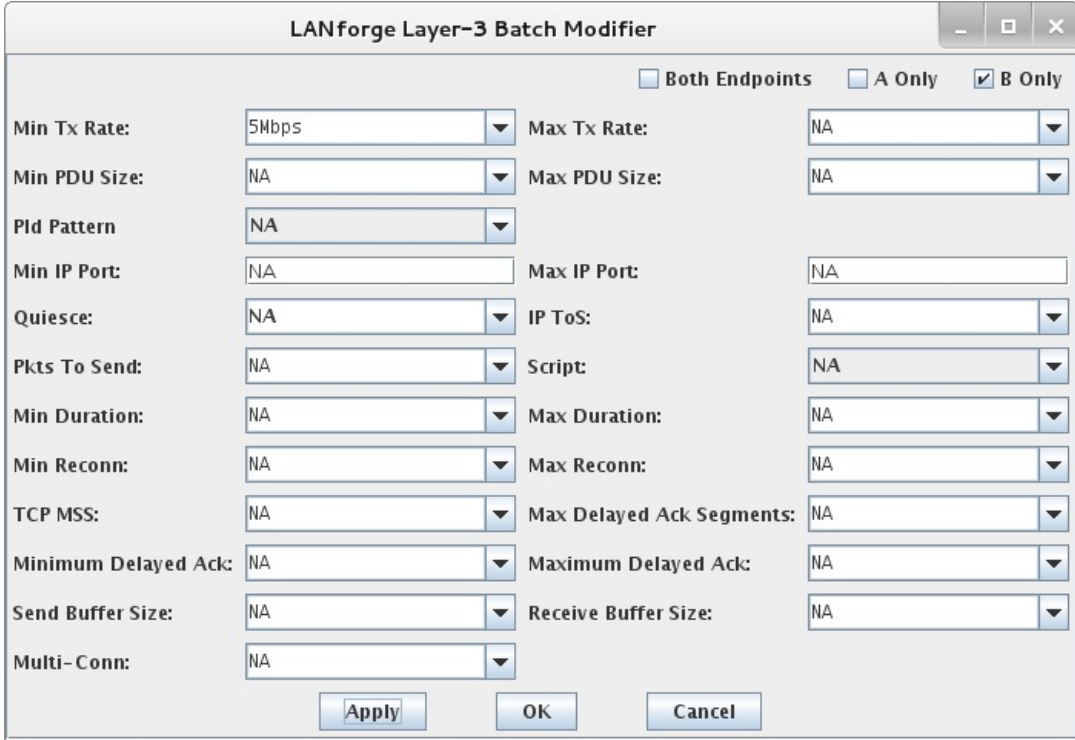
Port Increment A: 0 Port Increment B: 1

IP Addr Increment A: 0 IP Addr Increment B: 0

IP-Port Increment A: 1 IP-Port Increment B: 1

Apply Cancel

- F. Select all of the tcp-se connections and click **Start**. Each of the connections are configured for higher rates than the network can actually handle. This is OK, but it will give un-even throughput results on different stations. So, you may wish to change the rate to something lower. If so, go to the **L3 Endps** tab, make sure all of the tcp-se endpoints are selected, and click **Batch Modify**. Select **B Only** since we want to just modify one side of the connection. Set Min Tx Rate to 5Mbps, and click **Apply**



LANforge Layer-3 Batch Modifier

☐ Both Endpoints ☐ A Only ☒ B Only

Min Tx Rate: 5Mbps Max Tx Rate: NA

Min PDU Size: NA Max PDU Size: NA

Pld Pattern: NA

Min IP Port: NA Max IP Port: NA

Quiesce: NA IP ToS: NA

Pkts To Send: NA Script: NA

Min Duration: NA Max Duration: NA

Min Reconn: NA Max Reconn: NA

TCP MSS: NA Max Delayed Ack Segments: NA

Minimum Delayed Ack: NA Maximum Delayed Ack: NA

Send Buffer Size: NA Receive Buffer Size: NA

Multi-Conn: NA

Apply OK Cancel

G. Go back to the **Layer-3** tab and view the running connections.

LANforge Manager Version(5.2.8)

Control Reporting Tear-Off Info

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Test Group Resource Mgr Serial Spans PPP-Links Event Log Alerts Port Mgr Messages
Status Layer-3 L3 Endps VoIP/RTP Endps VoIP/RTP Endps Armageddon WanLinks Attenuators Collision-Domains File-IO

Rpt Timer: fast (1 s) Go Test Manager all Select All Start Stop Quiesce Clear

View 0 - 200 Display Create Modify Delete

Cross Connects for Selected Test Manager

Name	Type	State	Pkt Tx A->B	Pkt Tx A<-B	Rate A->B	Rate A<-B	Rx Drop % A	Rx Drop % B	Drop Pkts A	Drop Pkts B	Avg RTT
tcp-es	LF/TCP	Stopped	0	0	0	0	0	0	0	0	0
tcp-se	LF/TCP	Run	0	2,222	0	4,999,120	0	0	0	0	13
tcp-se-0001	LF/TCP	Run	0	1,738	0	4,998,346	0	0	0	0	11
tcp-se-0002	LF/TCP	Run	0	2,220	0	4,995,886	0	0	0	0	16
tcp-se-0003	LF/TCP	Run	0	2,222	0	4,997,169	0	0	0	0	18
tcp-se-0004	LF/TCP	Run	0	2,225	0	4,997,485	0	0	0	0	16
tcp-se-0005	LF/TCP	Run	0	2,225	0	4,997,378	0	0	0	0	20
tcp-se-0006	LF/TCP	Run	0	2,225	0	4,997,399	0	0	0	0	24
tcp-se-0007	LF/TCP	Run	0	2,226	0	4,997,590	0	0	0	0	28
tcp-se-0008	LF/TCP	Run	0	2,226	0	4,997,633	0	0	0	0	25
tcp-se-0009	LF/TCP	Run	0	2,226	0	4,997,654	0	0	0	0	34
tcp-se-0010	LF/TCP	Run	0	2,220	0	4,996,122	0	0	0	0	36
tcp-se-0011	LF/TCP	Run	0	2,220	0	4,996,122	0	0	0	0	30
tcp-se-0012	LF/TCP	Run	0	2,225	0	4,997,570	0	0	0	0	35
tcp-se-0013	LF/TCP	Run	0	2,225	0	4,997,592	0	0	0	0	32
tcp-se-0014	LF/TCP	Run	0	2,225	0	4,997,570	0	0	0	0	35
tcp-se-0015	LF/TCP	Run	0	2,225	0	4,997,613	0	0	0	0	45
tcp-se-0016	LF/TCP	Run	0	2,225	0	4,997,656	0	0	0	0	39
tcp-se-0017	LF/TCP	Run	0	2,225	0	4,997,635	0	0	0	0	48
tcp-se-0018	LF/TCP	Run	0	2,225	0	4,997,656	0	0	0	0	46
tcp-se-0019	LF/TCP	Run	0	2,225	0	4,997,677	0	0	0	0	46
tcp-se-0020	LF/TCP	Run	0	2,225	0	4,997,635	0	0	0	0	49

Logged in to: 192.168.100.138:4002 as: Admin

H. Determine total throughput: Select all of the running connections and then Right-Click and select **Calculations**. In this scenario, we see about 230Mbps of total TCP throughput.

LANforge Table Calculations

Totals

Calculation	Pkt Tx A->B	Pkt Tx A<-B	Rate A->B	Rate A<-B	Rx Drop % A	Rx Drop % B	Drop Pkts A	Drop Pkts B	Avg RTT
Sum	0.00	91,792.00	0.00	230,609,918.00	2.60	0.00	2.00	0.00	231,985.00
Mean (Average)	0.00	1,835.84	0.00	4,612,198.36	0.05	0.00	0.04	0.00	4,639.70
Median	0.00	1,990.00	0.00	4,998,776.00	0.00	0.00	0.00	0.00	55.00

Deviations

Name	Pkt Tx A->B	Pkt Tx A<-B	Rate A->B	Rate A<-B	Rx Drop % A	Rx Drop % B	Drop Pkts A	Drop Pkts B	Avg RTT
tcp-se	0.00	150.16	0.00	386,577.64	-0.05	0.00	-0.04	0.00	-4,623.70
tcp-se-0001	0.00	151.16	0.00	386,862.64	-0.05	0.00	-0.04	0.00	-4,620.70
tcp-se-0002	0.00	159.16	0.00	385,405.64	-0.05	0.00	-0.04	0.00	-4,617.70
tcp-se-0003	0.00	150.16	0.00	386,769.64	-0.05	0.00	-0.04	0.00	-4,615.70
tcp-se-0004	0.00	150.16	0.00	386,793.64	-0.05	0.00	-0.04	0.00	-4,613.70
tcp-se-0005	0.00	150.16	0.00	386,793.64	-0.05	0.00	-0.04	0.00	-4,610.70
tcp-se-0006	0.00	151.16	0.00	386,934.64	-0.05	0.00	-0.04	0.00	-4,607.70
tcp-se-0007	0.00	152.16	0.00	387,027.64	-0.05	0.00	-0.04	0.00	-4,604.70
tcp-se-0008	0.00	150.16	0.00	386,865.64	-0.05	0.00	-0.04	0.00	-4,602.70
tcp-se-0009	0.00	150.16	0.00	386,817.64	-0.05	0.00	-0.04	0.00	-4,601.70
tcp-se-0010	0.00	150.16	0.00	386,841.64	-0.05	0.00	-0.04	0.00	-4,600.70
tcp-se-0011	0.00	150.16	0.00	386,841.64	-0.05	0.00	-0.04	0.00	-4,598.70
tcp-se-0012	0.00	150.16	0.00	386,817.64	-0.05	0.00	-0.04	0.00	-4,598.70
tcp-se-0013	0.00	150.16	0.00	386,841.64	-0.05	0.00	-0.04	0.00	-4,595.70
tcp-se-0014	0.00	150.16	0.00	386,865.64	-0.05	0.00	-0.04	0.00	-4,594.70
tcp-se-0015	0.00	150.16	0.00	386,817.64	-0.05	0.00	-0.04	0.00	-4,592.70

Refresh Close

4. Test TCP upload throughput with 50 stations (WPA2)

- A. Modify the VAP and stations to use WPA2 instead of being open. Go to Port-Mgr tab, select vap0, and all of the stations and click **Batch Modify**. Change WPA2 to be 'ON' and enter password in the Key/Phrase box. Leave all other values set to 'NA' so they are not changed.

LANforge Port Batch Modifier

Search: []

Buttons: +, -, All, Apply, OK, Cancel

Buttons: Clear DHCP, Up, Down, Down Logout, Portal Re-login, Portal Logout, Portal Login

1 Up/Down

Up/Down	NA	DHCP Release	NA
DHCP-IPv4	NA	DHCP Client ID	NA
DHCP Vendor ID	NA	MTU	NA
DNS Servers	NA	IPv6 GW	
Reset Port IP	NA	Global IPv6	
IP Mask	NA	Link IPv6	
Gateway IP	NA	DHCP-IPv6	NA
MAC	NA	TX Q Len	NA
Rpt Timer	NA	WiFi Bridge	NA
FTP	NA	HTTP	NA

2 SSID

SSID	NA	WiFi AP	NA
Key/Phrase	ben-138-pwd	Mode	NA
Freq/Chan		Rate	NA
RTS		Tx-Power	
AMPDU-Factor	NA	AMPDU-Density	NA
Max-AMSDU	NA	br ip	
WPA	NA	WPA2	ON
WEP	NA	Disable SGI	NA
Disable HT40	NA	Allow Migration	NA
Scan Hidden	NA		
Verbose Debug	NA		
Post IF-UP Script	NA		

- B. Go back to the Layer-3 tab, select all of the connections, and click **Clear** to clear the counters. Right-Click and select Calculations to view the totals. In this scenario, we see about 50Mbps of TCP throughput.

5. Test TCP upload throughput with 128 stations

- A. Use similar steps to those described above to create 78 more stations. In the Create VLANs window, use STA ID of 49 and Quantity of 78 this time (since stations 0-48 have already been created). When creating more TCP connections, you can click **Modify** on the tcp-se-0049 connection and click **Batch Create**.
- B. In this scenario, we see about 36Mbps throughput with TCP in WPA2 mode, and 28Mbps to 40Mbps in Open mode.