Candela Technologies Jed Reynolds 2015-02-06



Comparison of Station Association and Portal Login Scenarios

Summary Table

Tests performed on a pair of LANforge CT523 systems are summarized in the following table.

	5 simultaneous	10 simultaneous	20 simultaneous	30 simultaneous
DHCP Bring-Up, open WiFI	1	1.75	1.75	
DHCP Bring-Up, WPA2	1	1.75	1.75	
DHCP Bring-Up, 802.11x	1	1.75	1.75	
Static IP Bring-Up, open WiFi	1.0/sec	1.75/sec	1.75/sec	
Static IP Bring-Up, WPA2	1.25/sec	1.5-2.5/sec	1.3-4.6/sec	
Portal Login HTTP	16/sec	24/sec	32/sec	
Portal Login, HTTPS	16/sec	16/sec	12-18/sec	
Migration, WPA2	Yes	yes	yes	yes
Migration, WPA2 802.11x	yes	yes	yes	yes

What follows is technical discussion..

Summary Discussion

The LANforge CT523 three radio system can emulate at least 20 wireless users simultaneously logging in and logging out and 30 roaming. Simultaneous portal logins are fast, but ultimately limited by SSL key negotiation. We see a limiting range of 12-18 portal logins during 20 simultaneous station logins over HTTPS. HTTP is faster at 32 logins with 20 stations. This rate can probably be increased with scale-out of more LANforge client emulators.

Overt the air DHCP interface bring-up (DHCP, static IP, WPA2+RADIUS combinations) involve considerably more negotiation. Smaller simultaneous groups of stations do not associate faster than high numbers: groups of five stations associate between 0.5-3 stations a second. Both DHCP and WiFi negotiation incorporate timeouts and back-off strategies. DHCP tends to make association half as fast as a static IP assignment. At 20 simultaneous stations, a good DHCP+RADIUS association burst rate is 2.5 stations a second; a good static-ip and RADIUS association burst rate is 3. Open WiFi static-IP association is not much better, a good burst rate for Open WiFi static bring-up was a burst to 3.3 interfaces a second. The *average rate* for small simultaneous bring-up groups ranges between 0.5-0.75 event/second; for 10 and 20 stations we see an average of 0.75-2 events per second.

The association times we are seeing are not governed by encryption latency, rather the over the air method of station association. Actual captive portal speed or RADIUS authentication latencies below 100ms would not show any influence in this environment.

Roaming behavior is best if we let radios take turns. If we stampede all the stations from one radio to the other, performance and efficacy are poor. If we shuffle stations between BSSIDs so that station radios alternate and access points alternate, we get excellent results. Radio scan buffers also need to be taken into account. To reach 30 migrations a second, we can set a dwell time between commands of 32 milliseconds and ask for a roughly every 2500 milliseconds. This appears to avoid scan timeout related roaming failures.

Portal Scenario Setup

These steps illustrate how to create the routing and test parameters. We start with the a 3 radio a/b/g/n system. Radio wiphy0 is the virtal AP (vap0), and radios wiphy1 and wiphy2 host virtual stations. The name of the access point SSID is led0test. To emulate a login portal, another machine running Apache was hosting a very simple PHP page to behave like a login page. This login resource is called portal-test, at http://portal-test/, placed in the LANforge machine's /etc/host file (an IP could have been used as well).

1) Create virtual AP on radio 0:

Select radio wiphy0 and click the **Create** button.

Set the *SSID* to led0test, the IP to 10.11.44.252, the subnet mask to 255.255.254.0, and the Mode to 802.11a/b/g/n.

<u></u>	vapo (ct321-ii201304007323) coningure settings	
	Port Status Information	
	Current: LINK-UP GRO NONE	
	Driver Info: Port Type: WIFI-AP Parent: wiphy0	
	Port Configurables	
Standard Configura	ion Advanced Configuration More Advanced Configuration	
Enable	General Interface Settings	
Set IF Down	DHCP-IPv6 🖌 DHCP Release 🗌 Down 🗌 Aux-Mgt	
Set MAC	DHCP-IPv4 Secondary-IPs DHCP Client ID: None	
🗌 Set TX Q Len	DNS Servers: BLANK Peer IP: NA	
Set MTU	IP Address: 10.11.44.252 Global IPv6: AUTO	
Set Offload	IP Mask: 255.255.254.0 Link IPv6: AUTO	
Set PROMISC	Gateway IP: 0.0.0.0 IPv6 GW: AUTO	
	Alias: MTU: 1500	
Services—	MAC Addr: 00:0e:8e:db:d2:68 TX Q Len 1000	
	Rpt Timer: medium (8 s) 🔻 WiFi Bridge: NONE 💌	
	WiFi Settings	
	SSID: LedOtest 🔽 AP: DEFAULT	
PROMISC	Key/Phrase: Mode: 802.11abgn	
TS0 Enabled	Freq/Channel: 5180/36 Rate:	
UFO Enabled	DTIM-Period: 2 Max-STA: 2007	
GS0 Enabled	Beacon: 240	
LR0 Enabled	Use WPA Use WPA2 Use WEP Disable HT40 Disable SGI	
✓ GRO Enabled	Verbose Debug	
,		

2) Create virtual stations on radio 1 and 2:

Create stations named sta100-164: set quantity to 164, Station ID 100, and SSID to led0test and check DHCP IPv4. Then click Apply.

*			Create VLANs o	n Port: 1.1.104		
0	○ MAC-VLAN	○ 802.1Q-VLAN ○ Re ○ WiFi VAP ○ WiFi Mon	direct O Bridge itor O WiFi Virtus	⊖ GRE Tunnel al Radio		
2	Shelf:	1	Resource: 1 (ct	521-lr201304007329) 🔻	Port: 104	(wiphyl)
B	VLAN ID:		DHCP-IPv4			
8	Parent MAC:	00:0e:8e:44:07:49	DHCP Client ID:	•		
	MAC Addr:	X0CXXCXXCXXC*:* 💌	IP Address:		Global IPv6:	AUTO
	Quantity:	164	IP Mask or Bits:		Link IPv6:	AUTO
			Gateway IP:		IPv6 GW:	AUTO
	#1 Redir Name:		#2 Redir Name:			
	STA ID:	100	SSID:	ledOtest	•	•
	WiFi AP:		Key/Phrase:			
	Use WPA	Use WPA2	Use WEP			
4	Down					
	Apply 📐	<u>C</u> ancel				

Create stations named sta300-464: Change the Port dropdown to wiphy2. Set station ID to 300. Then click Apply.

*			Create VLANs o	n Port: 1.1.104			_ 🗆 🗙
0	○ MAC-VLAN● WIFI STA	○ 802.1Q-VLAN ○ Re ○ WIFI VAP ○ WIFI Mon	direct O Bridge itor O WiFi Virtu:	⊖ GRE Tunnel al Radio			
2	Shelf:	1	Resource: 1 (ct	521-lr201304007329) 🔻	Port: 3 (wiphy2)	•
B	VLAN ID:		DHCP-IPv4				
	Parent MAC:	00:0e:8e:4e:59:20	DHCP Client ID:	•			
	MAC Addr:	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	IP Address:		Global IPv6:	AUTO	
	Quantity:	164	IP Mask or Bits:		Link IPv6:	AUTO	
			Gateway IP:		IPv6 GW:	AUTO	
	#1 Redir Name:		#2 Redir Name:				
	STA ID:	200	SSID:	ledOtest	•	-	
	WIFI AP:	WiFi virtual station	number, for instanc	e: The 5 in sta5.			
	Use WPA	Use WPA2	Use WEP				
4	Down						
	Apply	<u>C</u> ancel		Re	eady		

3) Configure DHCP on vap0

Open the Netsmith window, right click, select New Router. Click Apply. Drag vap0 into the Router. Click Apply. Drag eth1 into router. Click Apply.

<u>\$</u> ,		Netsmith configur	ation for Reso	urce: ct521	-lr201304007329	(1.1) Version:	5.3.1	_ _ ×
			Virtua	al Routers and	Connections			_
0		Mgt-eth0 192.168.100.43/24 ■						
	wlan0		W	/iphy0	R0(1) va	p) .11.44.252/23		=
	wlanl	wiph	yl		ot	-		
	wlan2	wiphy2			10	.26.1.5/24		
						_		
•								
W	anLinks	Show Legend	✓ Fire	✓ IPv4s	Info Print	Sync	Apply	Close
W	anLink Nam	es 🗾 Port Names	🔲 Fire Names	Zero-IPv4s	Apply Progress:	100% Comple	te	Cancel Apply
Pe	er WanLink	s 🔽 Parents	Col. Domains	IPv6s				
_ Wa	anLink Con	ig			ivetsmith Status:	UK		

Right click on vap0 and select Modify.



<u></u>	Create/Mo	ity connection	×
		Interface-Cost:	1
Port 1-A:	108 (vap0)	RIP-Metric:	1
		OSPF Area:	0.0.0.0
Port 1-B: 🗹 Skip	<auto create="" new="" port=""></auto>	VRRP IP:	
WanLink: 🕑 Skip	<auto create="" new="" wanlink=""> 💌</auto>	VRRP ID:	
Port 2-B	<auto create="" new="" port=""></auto>	VRRP Priority:	
		VRRP Interval:	
Port 2-A: 🗹 Skip	<auto create="" new="" port=""></auto>	Next-Hop:	0.0.0.0
DHCP Lease Time:	43200	Subnets (a.b.c.d/xx):	
DHCP DNS:	0.0.0.0 Maximum DHCP leas	e time (in seconds.)	
DHCP Range Min:	0.0.0.0		
DHCP Range Max:	0.0.0.0		
DHCP Domain:			
DHCPv6 DNS:		Next-Hop-IPv6:	
DHCPv6 Bange Min:		IPv6 Subnets (aaa::0/xx):	
DHCPu6 Range May			<u> </u>
DUCEd Coefig Files			ļ
Dhena config File:			
NAT DHCP	DHCPv6 Custom DHC	VRRP Cand-RP	
	OK	Cancel	

Select DHCP, configure DHCP Lease Time to 120 seconds, and the DHCP range from 10.11.44.10 to 10.11.45.250. Click OK.

<u></u>	Create/I	мос	inty Connection	×
			Interface-Cost:	1
Port 1-A:	108 (vap0)	-	RIP-Metric:	1
			OSPF Area:	0.0.0.0
Port 1-B: 🗹 Skip	<auto create="" new="" port=""></auto>	-	VRRP IP:	0.0.0/24
WanLink: 🗹 Skip	<auto create="" new="" wanlink=""></auto>	-	VRRP ID:	
Port 2-B: Skip	<auto create="" new="" port=""></auto>		VRRP Priority:	
			VRRP Interval:	1
Port 2-A: 🗹 Skip	<auto create="" new="" port=""></auto>		Next-Hop:	0.0.0.0
DHCP Lease Time:	120		Subnets (a.b.c.d/xx):	
DHCP DNS:	0.0.0			
DHCP Range Min:	10.11.44.10			
DHCP Range Max:	10.11.45.250			
DHCP Domain:				
DHCPv6 DNS:			Next-Hop-IPv6:	
DHCPv6 Range Min:			IPv6 Subnets (aaa::0/xx):	
DHCPv6 Range Max:				
DHCPd Config File:				·
NAT 🗹 DHCP	DHCPv6 Custom D	HCF	Cancel	1

Station Association and Portal Login

4) Configure DHCP Release on the stations. In the Ports tab, highlight all the stations, and click Batch Modify. Change DHCP Release to OFF. Click Apply.

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Image: Provide Station of the Construction of the Construction

5) Configure login scripts on stations

Set the Post IF-UP script to:

portal-bot.pl -b bp.pm -a http://portaltest/ -s http://portal-test/ -n login.php -o login.php -t login.php -u bob -p bob

Click C	K.
---------	----

<u></u>	LANforge Port	Batch Modifier	
+ - All		<u>Apply</u>	<u>O</u> K <u>C</u> ancel
Clear DHCP	Up	Down	Down Logout
Portal Re-login	Portal Logout	Portal Login	
0			
Up/Down	NA 🔻	DHCP Release	OFF 🗨
DHCP-IPv4	NA 🔻	DHCP Client ID	NA
DNS Servers	NA	IPv6 GW	
Reset Port IP	NA 🗸	Global IPv6	
IP Mask	NA	Link IPv6	
Attempt to apply cha Gateway iP	inges, but do not cl	ose the current windo DHCP-IPV6	ow to allow more changes
Alias		MTU	NA
MAC	NA 🗸	TX Q Len	NA
Rpt Timer	NA 💌	WiFi Bridge	NA
FTP	NA 🗸	HTTP	NA
2			
SSID	led0test	WiFi AP	NA
Key/Phrase	NA	Mode	NA 👻
Freq/Chan		Rate	NA
RTS		Tx-Power	
AMPDU-Factor	NA 👻	AMPDU-Density	NA
Max-AMSDU	NA 👻	br ip	
Use WPA	NA 🔻	Use WPA2	NA
Use WEP	NA 👻		
Disable HT40	NA 👻	Disable SGI	NA
Scan Hidden	NA	Allow Migration	NA
Verbose Debug	NA		
Post IF-UP Script	portal-bot.pl -b bp.pm -a l	http://portal-test -s /login.pl	hp -i /login.php -t/login.php

6) Configure Apache and portal script

On the Apache machine, create a simple virtual host like so:

```
<VirtualHost portal-test:80>
ServerName portal-test.candelatech.com
ServerAlias portaltest portal-test
ServerAdmin root@jed-shuttle.candelatech.com
DocumentRoot /var/www/basic-portal

    CDirectory /var/www/basic-portal>
    AllowOverride All
    Options +Indexes +ExecCGI +MultiViews +FollowSymLinks
    Require all granted
    DirectoryIndex index.php
    </Directory>
</VirtualHost>
```

We will also need an SSL version of the site. Create some self-signed keys:

```
openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout /etc/ssl/private/portal-test.key -out /etc/ssl/certs/portal-test.crt
```

Add another virtual host:

```
<VirtualHost portal-test:443>
ServerName portal-test.candelatech.com
ServerAlias portaltest portal-test
ServerAdmin root@jed-shuttle.candelatech.com
DocumentRoot /var/www/basic-portal
```

```
SSLEngine on
SSLCertificateFile /etc/ssl/certs/portal-test.crt
SSLCertificateKeyFile /etc/ssl/private/portal-test.key
```

```
<Directory /var/www/basic-portal>
    AllowOverride All
    Options +Indexes +ExecCGI +MultiViews +FollowSymLinks
    Require all granted
    DirectoryIndex index.php
  </Directory>
</VirtualHost>
```

Create a login script /var/www/basic-portal/login.php:

```
<!DOCTYPE html>
<html>
<head>
   <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
   <title>Login</title>
</head>
<body>
   <?php if ($_SERVER['REQUEST_METHOD'] == 'POST') { ?>
      <?= $_POST['username'] ?> access granted.
   <?php } else { ?>
      <form method="post" action="">
         Login:<input type="text" name="username" value="" /><br />
         <input type="submit" name="login" value="Login" />
      </form>
   <?php } ?>
</body>
```

</html>

This creates an effectively instant website interaction.

7) Configure routing between portal-test and virtual stations

First, configure the apache server to see a route to the stations gateway:

route add -net 10.11.44.0/23 gw 10.26.1.5

Possibly necessary: in Netsmith add route to eth1 in the virtual router. Highlight the eth1 port and click Modify. Under the Next Hop box, add the netmask for the stations: 10.11.44.0/23. Click Apply.

8) Verify the setup: we should be able to ping from stations to apache:

\$ ping -I 10.11.44.160 10.26.1.254

We should be able to use a modified copy of portal-bot.bash from LANforge to exercise the login/logout commands:

```
PBOT_NOFORK=1 ./portal-bot.pl -i sta100 \
         bp.pm ∖
   -b
   --ip4 10.11.44.160 \
   --dns 192.168.100.1 \
   --ip6 NA \
   --mgt /dev/null \
   - u
         bob ∖
         "secret" \
   -p
         "http://portal-test/" \
   -a
         "http://portal-test/" \
   - S
         "login.php" ∖
   - n
         "login.php" \
   -0
         "login.php" ∖
   - t
   -v -d $*
```

Scenario: 5 simultaneous users, http transport

1) In the **Ports** tab, highlight all stations. From the top menu bar, select *Plugin->Port Bringup Test*.



In the **Port Bringup Test** window, Set *Concurrent Ports to Bringup* to 5 ports, *Minimum Time Between Bringups* to 5s, *Maximum Time Between Bringups* to 5s, select *Do Logout*, select *Only Do Portal Login/Logout*, select *Random Port Selection* and click **Start**.



The results we see for this test are: about 16 interface events ave per second.

Scenario: 10 simultaneous users, HTTP portal

We change the batch size to ten. Average interface activity is now 24 events per second:



Scenario: 20 simultaneous users, HTTP portal

We set the batch size to 20 and we see an average of about 32 events per second:



Scenario: 5 simultaneous users, HTTP portal

We need to modify the port settings to do https transport. In the **Ports** tab, highlight all stations, click **Batch Modify**, and edit the *Post IF-UP* text box to say:

portal-bot.pl -b bp.pm -a <u>https://portal-test/</u>
-s <u>https://portal-test/</u> -n login.php -o
login.php -t login.php -u bob -p bob



And click **OK**.

Leave the stations highlighted, and repeat the testing process with *Port Bringup Test*.

🛓 🧧 Port Bringup	Test + _ 🗆 ×
Concurrent Ports to Bringup:	Five (5) 💌
Minimum Time between Bringups:	ls 💌
Maximum Time between Bringups:	2s 💌
🗹 Do Portal Logout	Random Port Selection
🗹 Only Do Portal Login/Logout	Show Events
Ports S	Selection
Ports in Use 1.1.2 sta100 1.1.4 sta101 1.1.5 sta102 1.1.6 sta103 1.1.7 sta104 1.1.8 sta105 1.1.9 sta106 1.1.10 sta107 1.1.11 sta108 1.1.12 sta109 1.1.12 sta	Free Ports 1.0.0 eth0 1.1.0 eth1 1.1.1 eth1 1.1.3 wiphy1 1.1.104 wiphy2 1.1.268 wiphy0 1.1.270 wlan1 1.1.271 wlan2 1.1.272 vap0
	Start Close

We will see up to 16 interface events per second in the graph.



Scenario: 10 simultaneous users, HTTPS portal

We will start the Portal Bringup Test with batch size of 10.

Our report will show average 16 events per second.



Scenario: 20 simultaneous users, HTTPS portal

We will start the Portal Bringup Test with batch size of 10.

Our report will show an average of 12-18 events per second.



Scenario: 5 simultaneous users, DHCP, RADIUS (802.1x)

We do not use the portal services in this scenario because RADIUS is an authentication system. This radius authentication scenario is using WPA-EAP Key management but not HotSpot 2.0. Moving the virtual access point used for testing to a separate machine with the RADIUS service allows more processing power for the station emulation. We follow steps similar to To configure this authentication scenario, we follow these steps:

1) Delete the vap0 virtual access point on the first LANforge machine.

2) Create a vap1 virtual access point on a second LANforge machine. Configure the AP with the IP 10.11.44.2, netmask 255.255.254.0, SSID led0test, Mode 802.11abgn, check Use WPA2.

<u><u>ش</u></u>	vap1 (med	test) Configure S	ettings		+ _ O X
		Port Status Informa	ation		1
	Current:	LINK-UP GRO NONE	E		
	Driver Info	: Port Type: WIFI-AP	Parent: wiphy2		
		Port Configurable	es		
Standard Configuration	n Advanced (Configuration More	Advanced Confi	guration	
Enable		General Int	erface Settings	1	
Set IF Down	DHCP-IPv6	☑ DHCP Release	🗌 Down	Aux-Mgt	
Set MAC	DHCP-IPv4	Secondary-IPs	DHCP Client ID:	None 💌	
Set TX Q Len	DNS Servers:	BLANK	Peer IP:	NA	
Set MIU	IP Address:	10.11.44.2	Global IPv6:	AUTO	
Set DROMICC	IP Mask:	255.255.254.0	Link IPv6:	AUTO	
Set PROMISC	Gateway IP:	0.0.0.0	IPv6 GW:	AUTO	
	Alias:		MTU:	1500	
	MAC Addr:	00:0e:8e:3d:30:56	TX Q Len	1000	
FTP	Rpt Timer:	fast (3 s) 🔻	WiFi Bridge:	NONE	
,		WiFi	Settings		
Low Level	SSID:	led0test 🖵 🗛	DEFAULT	-	
	Key/Phrase:	M	ode: 802.11a	ban 💌	
TSO Enabled	Freq/Channe	l: 2412/1 Ra	ate: OS Defau	ult 💌	
UFO Enabled	DTIM-Period:	2 Ma	ax-STA: 2007		
GS0 Enabled	Beacon:	240			
LRO Enabled	🗌 Use WPA	🗹 Use WPA2 📃 Use	WEP 📃 Disable	HT40 🗌 Disable SGI	
🗹 GRO Enabled	🗌 Verbose 🛛	Debug			
,					
Print View Details Logs	Prol	be Display Scan	Sync	Apply OK	Cancel

On the **Advanced** Tab, configure 80211w disabled, *RADIUS IP* to 127.0.0.1, *RADIUS port* to 1821, *RADIUS secret* to **lanforge**, check *Use 80211d*, check *Advanced/802.1x*. These settings provide the minimum necessary processing for WPA2 RADIUS authentication.

	vap1 (medtest) C	onfi	igure Setting	S	+ <u>-</u>	
	Port S	tatus	Information			
	Current: LINK-L	JP GF	NONE			
	Driver Info: Port 1	ype:	WIFI-AP Paren	t: wiphy2		
	Por	t Con	figurables			
Standard Configura	tion Advanced Configura	ation	More Advan	ced Configuration		
	Advan	ced۱	WiFi Settings		1	
Select 'WPA2' on th and enable Advance	e Standard Configuration s ed/802.1x to enable most	scree of the	n to enable Advesse. Enabling 8	vanced/802.1x 02.11u enables others.		
Ignore Probes:	zero (0%)	•	HESSID:			
Ignore Auth-Assoc:	zero (0%)	▼ F	Realm:	0,lanforge.org,13[5:6],21[2:4][5:7]		
Ignore Assoc:	zero (0%)	- I	MSI:			
Ignore Re-Assoc:	zero (0%)	•	lilenage:			
Corrupt GTK:	zero (0%)	-	Domain:	lanforge.org		
HS20 Capabilities		0	Consortium:			
HS20 Oper Class		F	RADIUS IP	127.0.0.1	j 📔 👘	
HS20 WAN Metrics)0 F	RADIUS Port	1812	j 📔 🛛	
leee80211w:	Disabled (0)	▼ F	RADIUS Secret	lanforge	j 🛛 🛛	
Venue Group:	Business (2)	• \	/enue Type:	Private Residence (1) 🔷 🔻		
Network Type:	Personal (4)	-	Address Types:	Public IPv4 (4) 🗸 🗸		
Network Auth:		3	GPP Cell Net:			
🕑 Use 80211d	Use 80211h 🛛 Short-F	ream	nble			
Advanced/802.1	K HotSpot 2.0 Dis	sable	DGAF			
Enable 802.11u	🕑 802.11u Internet 🗌	802	2.11u ASRA	802.11u ESR 📝 802.11u UESA		
		_			_	

3) In the **Ports** tab, delete the previous virtual wifi stations.

4) Create new virtual WiFi stations: Select radio ledtest wiphy1, click Create.

In the Create window, select WiFi STA, Quantity 164, check DHCP-IPv4, Station ID 100, check Use WPA2, check

Use WPA2, check Down.

Then change the Port from wiphy1 to wiphy2 and create the next 164 stations. Start at station 300.

\$		(Create VLANs on	Port: 1.1.03		t _ = X
0	○ MAC-VLAN● WiFi STA	○ 802.1Q-VLAN ○ Re ○ WiFi VAP ○ WiFi Mon	direct O Bridge itor O WiFi Virtu	⊖ GRE Tunnel al Radio		
2	Shelf:	1	Resource:	1 (ledtest) 💌	Port: 3 (w	iphy1) 💌
B	VLAN ID:		DHCP-IPv4			
	Parent MAC:	00:0e:8e:44:07:49	DHCP Client ID:	•		
	MAC Addr:	xxx:xx:xx:xx:xx:xx:xx:xx:xx:xx:xx:xx:xx	IP Address:		Global IPv6:	AUTO
	Quantity:	5	IP Mask or Bits:		Link IPv6:	AUTO
			Gateway IP:		IPv6 GW:	AUTO
	#1 Redir Name:		#2 Redir Name:			
	STA ID:	100	SSID:	ledOtest		
	WiFi AP:		Key/Phrase:			J
	Use WPA	Use WPA2	Use WEP			
4	✓ Down					
	<u>A</u> pply	<u>C</u> ancel				

Highlight your new stations in the **Ports** tab, and click **Batch Modify**:

<u>چ</u>			LAN	orge N	Aanag	ег	Version(5.3.1)				l	î 🗆	×
<u>C</u> ontrol <u>I</u>	Control Reporting Tear-Off Info Plugins														
	Stop All Restart Manager Refresh HELP										LP				
Layer-4 Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr Messages															
Disp: 192	Disp: 192.168.100.27:0.0 Sniff Packets Clear Counters Reset Port Delete														
Rpt Timer:	fas	ter (1 s) 🔻	Apply	/		7	/iew Details	6	0	Cr <u>e</u> ate	<u>M</u> oc	lify	<u>B</u> atch	i Modi	fy
			All Et	hernet	Interfa	ces	(Ports) for a	all Res	sourc	es. —					—
Port	Down	IP	Alias	Parent Dev	RX Err	rors	TX Errors	Re	set	Status		AP		Si	iç
1.1.07	12	0.0.0.0	stal04	wiphy1		0	0	Comp	lete	NONE	Not-As	sociat	ed	0 dB	
1.1.06	1	0.0.0.0	stal03	wiphyl		0	0	Comp	lete	NONE	Not-As	sociat	ed	0 dB	31
1.1.05	14	0.0.0.0	stal02	wiphyl		0	0	Comp	lete	NONE	Not-As	sociat	ed	0 dB	31
1.1.04	14	0.0.0.0	stal01	wiphy1		0	0	Comp	lete	NONE	Not-As	sociat	ed	0 dB	81
1.1.02	14	0.0.0.0	sta100	wiphyl		0	0	Comp	lete	NONE	Not-As	sociat	ed	0 dB	8
1.1.01		10.26.1.5	ethl			0	0	Comp	lete						
1.2.1		10.26.1.6	ethl			0	0	Comp	lete					_	_=
1.1.00		192.168.100.43	eth0			0	0	Comp	lete					_	
			loth()				0	Comp	loto					•	1
Logged in	n to:	ledtest:4002 as:	Admin												-

Click **Batch Modify.** Configure the stations to authenticate via RADIUS. In Box (2): set the *SSID* to led0test, set *Mode* to 80211abgn, set *Use WPA2* to ON.

2			
SSID	led0test	WiFi AP	NA
Key/Phrase	NA	Mode	802.11abgn 🔻
Freq/Chan		Rate	NA 💌
RTS		Tx-Power	
AMPDU-Factor	NA 👻	AMPDU-Density	NA 💌
Max-AMSDU	NA 👻	br ip	
Use WPA	NA 🔽	Use WPA2	ON 👻
Use WEP	NA 👻		

In Box (3): set *Key Management* to EAP, set *Pairwise Ciphers* to CCMP TKIP, set *Group Ciphers* to ALL. Set *EAP Methods* to EAP-TTLS. The preconfigured user name and password in the preinstalled LANforge RADIUS server is next: set *EAP Identity* to **testuser** and *EAP Password* to **testpasswd**.

The RADIUS protocol is talking over TLS, so we need certificates. Set *Private Key* to:

/home/lanforge/client.p12

And set Client Cert to:

/home/lanforge/ca.pem

For our tests, we copied these files from ledtest to medtest; so they would be identical between AP and stations. When testing with your own AP, copy these files from your AP to

Key Management	EAP 💌	HESSID	0:00:00:00:00:00	
Pairwise Ciphers	CCMP TKIP 🔻	Realm	NA	
Group Ciphers	All 🔻	Client Cert	NA	
WPA PSK	NA	IMSI	NA	
EAP Methods	AP-TTLS	Milenage	NA	
EAP Identity	testuser	Domain	NA	
EAP Anon Identity	NA	Consortium	NA	
EAP Password	testpasswd	Phase-1	NA	
EAP Pin	NA	Phase-2	auth=MSCHAPV2	
Private Key	anforge/client.p12	PK Password	lanforge	
CA Cert File	e/lanforge/ca.pem	PAC File	NA	
Network Auth	NA			
Advanced/802.1x	ON 🔻	PC/SC & SIM/USIM	NA 🔻	
Enable 802.11u	OFF 🔻	HotSpot 2.0	NA 🔻	
Enable PKC	NA 🔻			
Custom WPA Cfg	NA 🔻	WPA Cfg	NA	
Network Type	NA (-1) 🗸	Address Types	NA (-1) 💌	

your LANforge hosting virtual stations. Set *Phase 2* to auth=MSCHAPV2, and to use the private key file we need to set *PK Password* to **lanforge**.

We do not need 80211u for this test, so we make sure it is off. Set *Enable 802.11u* to OFF.

Click the **Apply** button to configure all the stations.

Scenario: DHCP, RADIUS Authentication, 5 simulateous users

In the **Port** tab, highlight all stations. Open *Plugins->Port Bringup Test*. Set *Concurrent Ports to Bring Up* to 5, *Minimum Time Between Bringups* to 1s, and set *Maximum Time Between Bringups* to 1s. Check *Random Port Selection*. We will not use the "Do Portal Logout" or "Only Do Portal login/logout" feature because we are not doing captive portal authentication.

🙆 🛛 🛛 Port Bringi	up Test _ ≜ _ ¤ ×
Concurrent Ports to Bringup:	Five (5) 💌
Minimum Time between Bringups:	l seconds (l s) 🗸
Maximum Time between Bringups:	l seconds (l s) 💌
🔲 Do Portal Logout	Random Port Selection
🔲 Only Do Portal Login/Logout	Show Events
Ports S	election
Ports in Use 1.1.2 sta100 1.1.4 sta101 1.1.5 sta102 1.1.6 sta103 1.1.7 sta104 1.1.8 sta105 1.1.9 sta106 1.1.10 sta107 1.1.11 sta108 1.1.12 sta109 1.1.12 sta110	Free Ports 1.0.0 eth0 1.1.0 eth0 1.1.1 eth1 1.1.3 wiphy1 1.1.268 wiphy0 1.1.269 wlan0 1.1.270 wlan1 1.1.271 wlan2 1.2.0 eth0
	Start Close

We see that the authentication rate is much slower, closer to 1 interface event per second.

Testing the RADIUS server in this test from the command line, the average authentication time was 32ms. Analyzing the DHCP negotiation time, we saw about 23ms. So at best we have average 55ms accounted for. More investigation into this needs to be done.

Different behaviors can be seen during different runs. Some times there are long periods of timeouts and also some speedy bursts where we see up to 6 interface events per second.





Scenario: DHCP, RADIUS, 10 simultaneous users.

Set *Concurrent Ports to Bringup* to 10 and try the test again. We see slightly better results. This might be accounted by the increased probability of a DHCP retry occurring sooner with more stations trying simultaneously.

We see average closer to 1.3 interface events events a second, but we see groups at the start of the test associating between 2-4/sec. Near the end of the test we see laggard retry group of interfaces that have taken many retries to associate.



Scenario: DHCP, RADIUS, 20 simultaneous stations.

Set *Concurrant Ports to Bringup* to 20 and run the test again. We see association rates with a higher average this time.



Scenario: DHCP, WPA2 auth, 5 simultaneous stations

The stations and virtual AP are deleted and recreated with only static WPA2 PSK authentication.

1) Create virtual access point on medtest radio wiphy2. Assign WPA2 and passphrase.

0	Create VLANs on Port: 1.2.2									
0	O MAC-VLAN O Redirect O Bridge O GRE Tunnel O WiFi STA Image: WiFi Wap O WiFi Monitor O WiFi Virtual Radio									
0	Shelf:	1	Resource:	2 (medtest) 💌	Port: 2 (v	viphy2) 🔻				
a	VLAN ID:		DHCP-IPv4							
	Parent MAC:	00:0e:8e:3d:30:e8	DHCP Client ID:							
	MAC Addr:	XX:XX:XX:XX:XX:* 🔻	IP Address:	10.44.11.2	Global IPv6:	AUTO				
	Quantity:	1	IP Mask or Bits:	255.255.254.0	Link IPv6:	AUTO				
			Gateway IP:		IPv6 GW:	AUTO				
	#1 Redir Name:		#2 Redir Name:							
	STA ID:	1	SSID:	ledOtest		·				
	WiFi AP:		Key/Phrase:	ledOtest1						
	Use WPA	✓ Use WPA2	Use WEP							
a	Down									
	Apply	Cancel			-					

2) Create 164 stations on ledtest radio wiphy1 and another 164 stations on wiphy2. The first batch of Ids start at 100, the second batch start at 400. Stations are created in Down state for speed of configuration.

ccess	documents, folde	rs and network places	ANforge Manager	Version(5.3.1)		(\mathbf{v}, \mathbf{A})
d :0			Create VLANs o	n Port: 1.1.3		\odot \otimes \otimes
ิด	O MAC-VLAN	○ 802.1Q-VLAN ○	Redirect 🛛 🔾 Brid	dge 🛛 🔾 GRE Tunnel		
F	WiFi STA	🔾 WIFI VAP 🔷 🔾 WIFI	Monitor 🛛 🔾 WiFi	Virtual Radio		
2	Shelf:	1 💌	Resource:	1 (ledtest) 🔻	Port: 3 (v	viphy1) 💌
B	VLAN ID:		DHCP-IPv4			
	Parent MAC:	00:0e:8e:44:07:49	DHCP Client ID:	•		-
	MAC Addr:	xx:xx:xx:*:*:xx 💌	IP Address:		Global IPv6:	AUTO
ī.	Quantity:	164	IP Mask or Bits:		Link IPv6:	AUTO
Η			Gateway IP:		IPv6 GW:	AUTO
Ē	#1 Redir Name:		#2 Redir Name:			
i i	STA ID:	100	SSID:	ledOtest		
H	WiFi AP:		Key/Phrase:	led0test1		
H	Use WPA	☑ Use WPA2	Use WEP			
i i						
i a	✓ Down					
L.~~	Apply	<u>C</u> ancel				

acopini noosare namagor

3) In the **Ports** tab, select all the stations and click **Batch Modify**. Assign them *Mode* **80211abgn**.

4) Click Apply.

5) Scroll to top and click the **Down** button to make sure none came up. This makes the start of the *Port Bringup Test* go faster.

0	LANforge P	ort	Batch Modifier					$\odot \odot \otimes$	
+ - All			-	Apply		<u>о</u> к	<u>C</u> a	ncel	
Gateway IP	NA		DHCP-IPv6	;	NA		-	4	
Alias			MTU		NA				
MAC	NA	-	TX Q Len		NA				
Rpt Timer	NA	-	WiFi Bridg	e	NA		-		
FTP	NA	-	нттр		NA		-		
2									
SSID	led0test		WiFi AP		NA				
Key/Phrase	led0test1		Mode		802	.11abgn	-		
Freq/Chan			Rate		NA		-		
RTS			Tx-Power						
AMPDU-Factor	NA	-	AMPDU-De	ensity	NA		-		
Max-AMSDU	NA	-	br ip						
Use WPA	NA	-	Use WPA2	2	ON		-	=	
Use WEP	NA	-							
Disable HT40	NA	-	Disable S	GI	NA		-		
Scan Hidden	NA	•	Allow Mig	ration	NA		-		
Verbose Debug	NA	-							
Post IF-UP Script	NA								
							10		

The results look very similar.



Scenario: DHCP, WPA2 auth, 10 simultaneous stations

Set Concurrent Ports to Bring Up to 10 and start the test again.



Scenario: DHCP, WPA2 auth, 20 simultaneous stations

Set the *Concurrent Ports to Bring Up* to 20 and start the test again.



Scenario: WPA2 PSK, Static IP, 5 simultaneous stations

A lot of the bringup times for these previous events have been primarily influenced by DHCP. We will now perform a series of tests with static IP addresses in order more clearly see latency that might be brought on by authentication protocols.

We delete our previous set of stations and turn off the DHCP service on vap1. Next we create 128 stations on each radio with static IP addresses.

- 1) Delete stations in the ports tab.
- 2) Go to vap1 in Netsmith and uncheck DHCP.



Click **OK** in the **Modify** window and **Apply** in the **Netsmith** window.



Station Association and Portal Login

3) Create 164 stations on ledtest radio wiphy1. Set the *IP address* to 10.44.11.10, *netmask* 255.255.254.0, set *Quantity* 164, set *Gateway IP* to 10.44.11.2, the *STA ID* to 100, check *Use WPA2*, set *SSID* is **led0test**, set *Keyphrase* is **led0test1**. Click **Apply**.

Change port to wiphy2, set STA ID to 300, change IP Address to 10.44.11.174, click **Apply**.

Next, down the ports and set the radio Mode to 80211abgn using the **Batch Modify** tool.

○ LANforge Port Batch Modifier 🔍 🔿							
+ - All		 Apr 	ply <u>O</u> K <u>C</u> ar	ncel			
Clear DHCP	Up 🗼	Down	Down Logout	^			
Portal Re-login	Portal Logout	Portal Login					
	NΔ						

Click **apply**.

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0			Create VLANs o	on Port: 1.1.9			\sim \sim \times
a	O MAC-VLAN	○ 802.1Q-VLAN ○ Re	direct 🔾 Bridge	GRE Tunnel			
•	WIFI STA	WIFI VAP OWIFI Mon	itor 🔾 WiFi Virtu	al Radio			
0	Charle (0	2 (1= th == t)	Dest 0	(minimum)	
2	Snem		Resource:	I (ledtest)	Port: 9	(wipny1)	•
A	VLAN ID:		DHCP-IPv4				
	Parent MAC:	00:0e:8e:44:07:49	DHCP Client ID:	•			
	MAC Addr:	00000000****:XXX 💌	IP Address:	10.44.11.10	Global IPv6:	AUTO	
	Quantity:	164	IP Mask or Bits:	255.255.254.0	Link IPv6:	AUTO	
			Gateway IP:	10.44.11.2	IPv6 GW:	AUTO	
	#1 Redir Name:		#2 Redir Name:				
	STA ID:	100	SSID:	ledOtest		-	
	WiFi AP:		Key/Phrase:	led0test			
	Use WPA	✓ Use WPA2	Use WEP				
0	Down						
4)							
4	Apply	<u>C</u> ancel					
4	Apply	<u>C</u> ancel	Create VLANs	on Port: 1.1.9			\odot \sim \times
9	Apply	<u>C</u> ancel ○ 802.1Q-VLAN ○ Re	Create VLANs of original contract O Bridge	on Port: 1.1.9			\odot \otimes \otimes
•	Apply MAC-VLAN WIFI STA	<u>C</u> ancel O 802.1Q-VLAN O Re O WIFI VAP O WIFI Mor	Create VLANS of edirect O Bridge nitor O WiFi Virtu	on Port: 1.1.9 O GRE Tunnel Ial Radio			\odot \otimes \otimes
	Apply MAC-VLAN WIFI STA	<u>Cancel</u> 0 802.1Q-VLAN 0 Re 0 WIFI VAP 0 WIFI Mor	Create VLANS of orderect O Bridge of WIFI Virtu	ORE Tunnel	Port- 3	: (winhv2)	
3 1 2	Apply MAC-VLAN WIFI STA Shelf:	Cancel 0 802.1Q-VLAN Re > WIFI VAP WIFI Mor 1	Create VLANs of edirect O Bridge Nitor O WiFi Virtu Resource:	on Port: 1.1.9 GRE Tunnel ial Radio 1 (ledtest)	Port: 3	(wiphy2)	
	Δpply MAC-VLAN WIFI STA C shelf: VLAN ID:	<u>C</u> ancel O 802.1Q-VLAN O Re O WIFI VAP O WIFI Mor 1 V	Create VLANs d edirect O Bridge litor WiFi Virtu Resource:	on Port: 1.1.9 GRE Tunnel ial Radio 1 (ledtest)	Port: 3	: (wiphy2)	 > > > > > >
9 1 2 3	Apply MAC-VLAN WIFI STA Shelf: VLAN ID: Parent MAC:	<u>Cancel</u> ○ 802.1Q-VLAN ○ Re ○ WFI VAP ○ WFI Mor 1 ▼ 00:0e:8e:4e:59:20	Create VLANs d edirect O Bridge litor WiFi Virtu Resource: DHCP-IPv4 DHCP Client ID:	on Port: 1.1.9 GRE Tunnel ial Radio 1 (ledtest)	Port: 3	: (wiphy2)	× × ×
4 1 2 6	Apply MAC-VLAN WIFI STA VLAN ID: Parent MAC: MAC Addr:	<u>Cancel</u> © 802.1Q-VLAN ○ Re > WFI VAP ○ WFI Mor 1 ▼ 00:0e:8e:4e:59:20 ∞cxcxxe*ftxx ▼	Create VLANS « edirect O Bridge litor O WiFi Virtu Resource: DHCP-IPV4 DHCP Client ID: IP Address:	on Port: 1.1.9 GRE Tunnel GRE Tunnel Il (ledtest) 1 (ledtest) Image: Second Seco	Port: 3 Global IPv6:	(wiphy2)	× × ×
9 1 2 6	Apply MAC-VLAN WIFI STA VLAN ID: Parent MAC: MAC Addr: Quantity:	<u>Cancel</u> 0 802.1Q-VLAN ○ Re 0 WIFI VAP ○ WIFI Mon 1 ▼ 00:0e:8e:4e:59:20 ∞execet*tox ▼ 164	Create VLANs of edirect O Bridge littor O WFI Virtu Resource: DHCP-IPv4 DHCP Client ID: IP Address: IP Mask or Bits:	O Port: 1.1.9 GRE Tunnel Ial Radio 1 (ledtest)	Port: 3 Global IPv6: IP address for th	AUTO	♥ A X
4 1 2 3	Apply MAC-VLAN WIFI STA VLAN ID: Parent MAC: MAC Addr: Quantity:	<u>Cancel</u> ○ 802.1Q-VLAN ○ Re ○ WIFI VAP ○ WIFI Mon 1 ▼ 00: 0e:9e:4e:59:20 peopoce**tox ▼ 164	Create VLANs defined to the vector of the ve	O Port: 1.1.9 ○ GRE Tunnel Ial Radio 1 (ledtest) ▼ 10.44.11.174] 255.255.254.0 [Input an 10.44.11.2	Port: 3 Global IPv6: IP address for th IPv6 GW:	AUTO AUTO AUTO AUTO	v x x
	Apply MAC-VLAN WIFI STA Shelf: VLAN ID: Parent MAC: MAC Addr: Quantity: #1 Redir Name:	<u>Cancel</u> ○ 802.10-VLAN ○ Re ○ WIFI VAP ○ WIFI MOR 1 ▼ 00: 0e:8e:4e:59:20 ∞cxcxc*+xx ▼ 164	Create VLANS of Indirect Or Bridge intor WiFI Virtu Resource: DHCP-IPv4 DHCP Client ID: IP Address: IP Address: Gateway IP; #2 Redir Name:	O GRE Tunnel al Radio 1 (ledtest) ▼ 10.44.11.174] 255.255.254.0 Input an 10.44.11.2	Port: 2 Global IPv6: IP address for th IPv6 GW:	AUTO AUTO AUTO AUTO	
	Apply MAC-VLAN WIFI STA Shelf: VLAN ID: Parent MAC: MAC Addr: Quantity: #1 Redir Name: STA ID:	<u>Cancel</u> ○ 802.10-VLAN ○ Re ○ WFI VAP ○ WFI Mor 1 ▼ ○ 00: 0e: 8e: 4e: 59: 20 ∞cxxcxe.*+xx ▼ 164 300	Create VLANS of Inderect Or Bridge intor Or WiFI Virtu Resource: DHCP-IPv4 DHCP Client ID: IP Address: IP Address: IP Address: Gateway IP: #2 Redir Name: SSID:	On Port: 1.1.9 C GRE Tunnel al Radio 1 (ledtest) • 10.44.11.174] 255.255.254.0 Input an 10.44.11.2 1ed0test	Port: 3 Global IPv6: IP address for th IPv6 GW:	(wiphy2) AUTO ie interface(s) AUTO	 ✓ ✓ ✓ ✓ If desired. Can be an an
	Apply MAC-VLAN WIFI STA WIFI STA VLAN ID: Parent MAC: MAC Addr: Quantity: #1 Redir Name: STA ID: WIFI AP:	<u>C</u> ancel ○ 802.1Q-VLAN ○ Re > WIFI VAP ○ WIFI Mon 1 ▼ 00:0e:8e:4e:59:20 ∞cxcxce**xx ▼ 164 300	Create VLANs / direct O Bridge httor WIFI Virtu Resource: DHCP-IPv4 DHCP Clent ID: IP Address: IP Mask or Bits: Gateway IP: #2 Redir Name: \$SID: Key/Phrase:	on Port: 1.1.9 GRE Tunnel GRE Tunnel Illeado 1 (ledtest) Image: State	Port: Global IPv6: IP address for th IPv6 GW:	(wiphy2) AUTO e interface(s) AUTO	
	Apply MAC-VLAN WIFI STA WIFI STA VLAN ID: Parent MAC: MAC Addr: Quantity: #1 Redir Name: STA ID: WIFI AF: USe WPA	<u>C</u> ancel ○ 802.1Q-VLAN ○ Re ○ WFI VAP ○ WFI Mon 1 ▼ 00:0e:8e:4e:59:20 ∞cxcxxe ⁺ *xx ▼ 164 300 [2] Use WPA2	Create VLANs - direct O Bridge itor WIFI Virtu Resource: DHCP-IPv4 DHCP Client ID: IP Address: IP Mask or Bits: Gateway IP: #2 Redir Name: SSID: Key/Phrase: Use WEP	On Port: 1.1.9 GRE Tunnel ial Radio 1 (ledtest) 10.44.11.174 255.255.254.0 Input an 10.44.11.2 Ledotest Ledotest	Port: 3 Global IPv6: IP address for th IPv6 GW:	AUTO AUTO AUTO	v o x
() () () () () () () () () () () () () (Apply MAC-VLAN WIFI STA Shelf: VLAN ID: Parent MAC: MAC Addr: Quantity: #1 Redir Name: STA ID: WIFI AP: Use WPA	<u>Cancel</u> S02.1Q-VLAN ○ Re WIFI VAP ○ WIFI Mon 1 ▼ 00:0e:8e:4e:59:20 ∞cxcxxe+txx ▼ 164 3000 ↓ Use WPA2	Create VLANs direct O Bridge itor WIFI Virtu Resource: DHCP-IPv4 DHCP Client ID: IP Address: IP Mask or Bits: Gateway IP: #2 Redir Name: SSID: Key/Phrase: Use WEP	on Port: 1.1.9 GRE Tunnel Ial Radio 1 (ledtest)	Port: 3 Global IPv6: IP address for th IPv6 GW:	(wiphy2) AUTO e Interface(s) AUTO	♥ ♠ X
	Apply MAC-VLAN WIFI STA VLAN ID: Parent MAC: MAC Addr: Quantity: #1 Redir Name: STA ID: WIFI AP: USe WPA Down	<u>Cancel</u> 0 802.1Q-VLAN ○ Re WIFI VAP ○ WIFI MOD 1 ▼ 00:0e:8e:4e:59:20 wexxxx:**xx ▼ 164 300 ✓ Use WPA2	Create VLANs direct O Bridge htor O WIFI Virtu Resource: DHCP-IPv4 DHCP Client ID: IP Address: IP Mask or Bits: Gateway IP: #2 Redir Name: SSID: KeyIPhrase: Use WEP	on Port: 1.1.9 ○ GRE Tunnel tel Radio 1 (ledtest) ▼ 10.44.11.174 ↓ 255.255.254.0 [Input an 10.44.11.2 LedOtest LedOtest	Port: 3 Global IPv6: IP address for th IPv6 GW:	(wiphy2) (AUTO ie Interface(s) AUTO	♥ ♠ X

0	LANforge Port	Batch Modifier	\odot \otimes \otimes
+ - All		 Apply 	<u>O</u> K <u>C</u> ancel
Oaceway II		DITCI II VO	
Alias		MTU	NA
MAC	NA 💌	TX Q Len	NA
Rpt Timer	NA 💌	WiFi Bridge	NA
FTP	NA 🔻	HTTP	NA
2			
SSID	led0test	WiFi AP	NA
Key/Phrase	led0test1	Mode	802.11abgn 🛉
Freq/Chan		Rate	NA
RTS		Tx-Power	
AMPDU-Factor	NA 💌	AMPDU-Density	NA 👻
Max-AMSDU	NA 💌	br ip	
Use WPA	NA 🔻	Use WPA2	ON 👻
Use WEP	NA 🔻		

Station Association and Portal Login

Use the *Port Bringup Test* to do a 5 concurrent port bringup, no login or logout:



The results appear to be about 1.25 interface events a second.



Scenario: WPA2 PSK, Static IP, 10 simultaneous stations

Set *Concurrent Ports to Bring Up* to 10 and run the test again.



Looks like about 1.5-2.5 interface events per second.

Scenario: WPA2 PSK, Static IP, 20 simultaneous stations

Set Concurrent Ports to Bring Up to 20 and run the test again.





Looks minimums of 0.5 interfaces a second and bursts up to 4.6 interface a second.

Scenario: RADIUS dot1x, Static IP, 5 simultaneous stations

We will begin by deleting the previous stations and configure the VAP to have no key phrase, but to enable dot1x RADIUS authentication.

1) In the **Ports** tab, highlight all stations and delete them.

2) Double click the vap1 AP. We will keep the WPA2 settings. Click over to the **Advanced Configuration** tab: check Advanced/802.1x, set RADIUS secret to **lanforge**. Click **OK**.

			Current: LIN	NK-UP (GRO NONE				
			Driver Info: Po	ort Type	e: WIFI-AP Paren	it: wiphy2			
				Port Co	onfigurables				
	Standard Configu	ration	Advanced Confi	guratio	More Advan	ced Configura	ation		
e	Advanced WiFi Settings								
	and enable Adva	the Stai nced/80	ndard Configuration 2.1x to enable mo	on scre ost of t	en to enable Ad hese. Enabling 8	vanced/802.1 02.11u enabl	x es others.		
	Ignore Probes:	(0%)	-	HESSID:					
	Ignore Auth-Asso	c: zero	(0%)	-	Realm:				
	Ignore Assoc:	zero	(0%)	-	IMSI:				
	Ignore Re-Assoc:	zero	(0%)	-	Milenage:				
	Corrupt GTK:	zero	(0%)	-	Domain:				
	HS20 Capabilities				Consortium:				
	HS20 Oper Class				RADIUS IP	127.0.0.1			
	HS20 WAN Metric	s			RADIUS Port	1812			
	leee80211w:	Disa	bled (O)	-	RADIUS Secret	lanforge			
	Venue Group:	Unsp	ecified (O)	-	Venue Type:	Unspecified	Unspecified (0)		
	Network Type:	Priv	ate (0)	-	Address Types:	Not Available (0)			
	Network Auth:				3GPP Cell Net:				
	🗌 Use 80211d	🗌 Use	80211h 🗌 Sho	rt-Prea	amble				
	Advanced/802	2.1x	HotSpot 2.0	<u>l Disab</u>	le DGAF				
~	~	~	Create VLANs o	n Port:	: 1.1.9			\checkmark \land \checkmark	
MAC-VU	AN 🔾 802.1Q-VLAN A 🔾 WIFI VAP 🔾	⊖ Re WiFi Mon	idirect 🔾 Bridge itor 🔾 WiFi Virtua	G (U Gal Badio	RE Tunnel				
-		7				_			
\$	Shelf: 1		Resource:	1 (ledt	est) 💌	Port: 9	(wiphyl)		
VLAN ID:			DHCP-IPv4						
Parent MAG	C: 00:0e:8e:44:0	7:49	DHCP Client ID:		-				
MAC Addr:	X00:X00:X00:*:*:X00	-	IP Address:	10.44.1	11.10	Global IPv6:	AUTO		
Quantity:	164		IP Mask or Bits:	255.25	5.254.0	Link IPv6:	AUTO		
an Dealte M			Gateway IP:	10.44.1	11.2	IPv6 GW:	AUTO		
STA ID:	ame:		#2 Redir Name:	ledate	et.				
WIEI AP:	100		Kev/Phrase:	led0tes	st				
Use WP	A Use WPA2		Use WEP						
Down									
Apply	y <u>C</u> ancel								

Port Status Information

3) Create 164 wifi stations on ledtest **wiphy1**.

Start with *IP address* 10.44.11.10, *subnet mask* 255.255.254.0, *Gateway IP*

10.44.11.2, *STA ID* is 100, check *Use WPA2* and set *SSID* to **led0test** and *Key/Phrase* to **led0test1**. You can check Down.

4) create 128 more stations: set Port to **wiphy2**, Set the *IP Address* to 10.44.11.174, and the *STA ID* is 300. Click **Apply** then **Cancel**.

			Create VLANs o	on Port: 1.1.9				\odot	
1	◯ MAC-VLAN◉ WiFi STA	○ 802.1Q-VLAN ○ Rec WiFi VAP ○ WiFi Moni	direct ○ Bridge tor ○ WiFi Virtu	⊖ GRE Tunne al Radio	el				
2	Shelf:	1	Resource:	1 (ledtest)	•	Port:	8 (wiphy2)		•
B	VLAN ID:		DHCP-IPv4						
9	Parent MAC:	00:0e:8e:4e:59:20	DHCP Client ID:		-				
	MAC Addr:	xxx;xx;*;*;xx	IP Address:	10.44.11.174	I	Global IPv6:	AUTO		
	Quantity:	164	IP Mask or Bits:	255.255.254.0	Input an I	P address for th	ne interface(s) i	f desired.	Can I
			Gateway IP:	10.44.11.2		IPv6 GW:	AUTO		
	#1 Redir Name:		#2 Redir Name:						
	STA ID:	300	SSID:	led0test			-		
	WiFi AP:		Key/Phrase:	led0test					
	Use WPA	✓ Use WPA2	Use WEP						
4	Down								
	Apply	Consol			Po	adv			

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5) In the **Ports** tab, select all the stations. If the stations are not down, use **Batch Modify** to set them Down.

Next, in box **2**, set the **Mode** to 802.11abgn.

Continue to box **3** and set *Key Management* to **EAP**, *Pairwise Ciphers* to **CCMP TKIP**, *Group Ciphers* to ALL, *EAP Methods* to EAP-TTLS, *EAP Identity* to **testuser**, *EAP Password* to testpasswd, *Private Key* to /home/lanforge/client.pl2, *CA Cert File* to /home/lanforge/ca.pem, *Phase 2* to **auth=MSCHAPV2**, *Advanced 802.1x* to ON.

Click **OK** to apply the settings.

1		LANforge Port B	atch Modifier		\sim \times
	+ - All		 <u>А</u>рр 	ly <u>О</u> К	<u>C</u> ancel
E	Clear DHCP	Up	Down	Down Logou	t 📩
1	Portal Re-login	Portal Logout	Portal Login		
1		NΔ		ΝΔ	

•	LANforge Port B	atch Modifier	\odot
+ - All		▼ Apply	<u>O</u> K <u>C</u> ancel
9			
SSID	NA	WIFI AP	NA
Key/Phrase	NA	Mode	802.11abgn 👻
Freq/Chan	,	Rate	NA
RTS		Tx-Power	
AMPDU-Factor	NA 👻	AMPDU-Density	NA
Max-AMSDU	NA 👻	br ip	
Use WPA	NA	Use WPA2	NA
Use WEP	NA		
Disable HT40	NA	Disable SGI	NA
Scan Hidden	NA	Allow Migration	NA
Verbose Debug	NA 👻		
Post IF-UP Script	NA		
2			
Key Management	EAP 💌	HESSID	00:00:00:00:00:00
Pairwise Ciphers	CCMP TKIP 👻	Realm	NA
Group Ciphers	All 👻	Client Cert	NA
WPA PSK	NA	IMSI	NA
EAP Methods	AP-TTLS 💌	Milenage	NA
EAP Identity	testuser	Domain	NA
EAP Anon Identity	NA	Consortium	NA
EAP Password	testpasswd	Phase-1	NA
EAP Pin	NA	Phase-2	auth=MSCHAPV2
Private Key	anforge/client.p12	PK Password	lanforge
CA Cert File	e/lanforge/ca.pem	PAC File	NA
Network Auth	NA		
Advanced/802.1x	ON 💌	PC/SC & SIM/USIM	NA
Enable 802.11u	NA 💌	HotSpot 2.0	NA
Enable PKC	NA 👻		
Custom WPA Cfg	NA	WPA Cfg	NA
Network Type	NA (-1) 👻	Address Types	NA (-1) 💌

6) Leave all the stations highlighted. Open the *Plugins->Port Bring Up Test*, and set *Concurrent Ports to Bring Up* to **5**, turn off *Do Logout* and *Only Do Login/Logout*.



We will get about 1 interface a second.



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Scenario: RADIUS dot1x, Static IP, 10 simultaneous stations

Set *Concurrent Ports to Bring Up* to **10**, and start the test again.



We will get an average of about 1.75 interface events a second.

Scenario: RADIUS dot1x, Static IP, 20 simultaneous stations



Set *Concurrent Ports to Bring Up* to **20**, and start the test again.

We will get an average of about 2 interface events a second.

Scenario: Open WiFi, 5 simultaneous stations

Creating an open WiFi spot is simple enough to do just by the pictures.

			Create VLANs o	on Port: 1.2.2		
D	○ MAC-VLAN○ WIFI STA	© 802.1Q-VLAN ○ Re WIFI VAP ○ WIFI Mor	edirect O Bridge hitor O WiFi Virtu	 GRE Tunnel al Radio 		
2	Shelf:	1	Resource:	2 (medtest)	Port: 2 (wiphy2)
a	VLAN ID:		DHCP-IPv4			
9	Parent MAC:	00:0e:8e:3d:30:e8	DHCP Client ID:	•		
	MAC Addr:	x00000000000000000 💌 💌	IP Address:	10.11.44.2	Global IPv6:	AUTO
	Quantity:	1	IP Mask or Bits:	255.255.254.0	Link IPv6:	AUTO
			Gateway IP:		IPv6 GW:	AUTO
	#1 Redir Name:		#2 Redir Name:			
	STA ID:	1	SSID:	ledOtest		-
	WIFI AP:		Key/Phrase:			
	Use WPA	Use WPA2	Use WEP			
n	Down					
2	Apply	Cancel				



Just don't forget to highlightall the stations in the port tab and apply 80211abgn mode to them.

She	elf: 1	Resource:	1 (ledtest)	Port: 9	(wiphy1)
/					
VLAN ID:		DHCP-IPv4			
Parent MAC:		DHCP Client ID:	•		
MAC Addr:	X00:X00:X00:*:*:X00	IP Address:	10.11.44.10	Global IPv6:	AUTO
Quantity:	164	IP Mask or Bits:	255.255.254.0	Link IPv6:	AUTO
		Gateway IP:	10.11.44.2	IPv6 GW:	AUTO
#1 Redir Nam	ie:	#2 Redir Name:			
STA ID:	100	SSID:	ledOtest		•
WiFi AP:		Key/Phrase:			
Use WPA	Use WPA2	Use WEP			

LANforge Port Batch Modifier Image: Content of the second secon							
+ - All		-	<u>A</u> pply	<u>0</u> K	<u>C</u> a	ncel	
Reset Port IP	NA	Global IPv6				^	
IP Mask	NA	Link IPv6					
Gateway IP	NA	DHCP-IPv6	NA	4	-		
Alias		MTU	N/	4			
MAC	NA	TX Q Len	N/	4			
Rpt Timer	NA 💌	WiFi Bridge	N/	Ą	-		
FTP	NA	HTTP	N/	4	-		
SSID Key/Phrase Freq/Chan RTS	NA NA	WiFi AP Mode Rate Tx-Power	N/ 8()2.11abgr	•	=	
AMPDU-Factor	NA 👻	AMPDU-Dens	sity NA	l .	-		
Max-AMSDU	NA 🗸	br ip					
Use WPA	NA	Use WPA2	N	4	-		
Use WEP	NA						
Disable HT40	NA	Disable SGI	N	4	-		
Scan Hidden	NA	Allow Migrati	on N/	A	-		
Verbose Debug	NA						
Post IF-UP Script	NA				0	-	

Next we do the Port Bring-Up Test with *Concurrent Ports to Bring Up* at 5. Ave appears to be 1.0.



Scenario: Open WiFI, 10 simultaneous stations

Next we do the Port Bring-Up Test with *Concurrent Ports to Bring Up* at 10. Ave appears to be about 1.75.



Scenario: Open WiFI, 20 simultaneous stations

Next we do the Port Bringup Test with *Concurrent Ports to Bring Up* at 20. Ave appears to be 1.75.



Migration between two APs

We expand the radio configuration for migration testing. We will setup the three radios on ledtest and one radio on medtest with these roles:

Computer	Radio	Role
Ledtest	Wiphy0	Virtual AP 0
Ledtest	Wiphy1	Virtual AP1
Ledtest	Wiphy2	Stations 100-263
Medtest	Wiphy2	Stations 300-463

The trick to migration is to not configure a stampede of stations from one AP to another. This will overload the radio drivers in the worst case and in best case roaming rates are very slow. Shuffling stations between radios works very well, and we easily drive 20 station migrations a second.

LANforge Configuration:

1) Configure the eth1 ports for each LANforge server to talk to each other.

→ eth1 (ledtest) Configure Settings _ □ ×									
	Port Status Information								
	Current: LINK-UP 1000bt-FD AUTO-NEGOTIATE Flow-Control TSO GSO GRO								
	Driv	ver Info: Port Type: E	thernet Driver:	e1000e(2.3.2-k) Bu	s: 00	00:04:00.0			
	Port Configurables								
Enable		General Int	erface Settings			Port Bates			
Set IF Down		Contrartar	ionace sectings			O 10bt-HD	Advertise Rat		
Set MAC	DHCP-IPv6	DHCP Release	Down	Aux-Mat		O 10bt-FD O 100bt-HD	I ODT-HD		
Set TX Q Len		SecondanulPe	DHCR client ID:	None	J	O 100bt-FD	V 1000-PD		
Set MTU	DNC Conversion	DLANK	Dens ID:	NA	-	O 1000-FD O 10G-FD	100bt-FD		
Set Offload	IR Addrong	10.42.1.1	Global IBue		-1	Autonegotiate	1000-ED		
Set Rate Info	IP Mask	255 255 255 1	Link IBv6		=1	Renegotiate	10G-FD		
Set PROMISC	Gateway IP:	10.43.1.2	14312 IPv6 GW		TO Restart Xcvr		Flow-Control		
Set Rx-All/FCS	Alias:	10.45.1.2	MTU:	1500	PROMISC				
🗌 Set Bypass	MAC Addr:	00:90:0b:2d:6a:59	TX 0 Len	1000	=1	RX-ALL	Offload		
🔲 Set Bridge Info	Br Cost:	Ignore	Priority	lanore	Ţ.	RX-FCS	ISO Enabled		
Set CPU Mask	Det Times	nadium (D.a)) weeks to a	0	-1	Bypass NOW!	GCC Enabled		
Services —	Rpt Timer:	mentam (9.2)	watchdog:	0		Bypass Power-UP	UDO Enabled		
HTTP	CPU Mask:	NO-SET	WiFi Bridge:	NONE	-	Bypass Power-DOWN	GRO Enabled		
FTP						Bypass Disconnect	Cito Enabled		
	Print Vi	ew Details	Probe Syn	c Apply		OK Cancel			
					_				

			Port Status In	formation			
	Cui	rrent: LINK-UP 10	00bt-FD AUTO-NEG	SOTIATE Flow-Cor	ntrol TSO	GSO GRO	
	Dri	ver Info: Port Type:	Ethernet Driver:	e1000e(2.3.2-k)	Bus: 00	000:04:00.0	
			Port Config	irables			
Enable		General In	terface Settings			Port Rates	- Advertise Det
Set IF Down			-			O 10bt-HD	Auventise Rac.
Set MAC	DHCP-IPv6	DHCP Release	Down	Aux-Mgt		O 10bt-FD O 100bt-HD	10bt-ED
Set TX Q Len	DHCP-IPv4	Secondary-IPs	DHCP Client ID:	None	-	O 100bt-FD	100bt-HD
Set MTU	DNS Servers:	BLANK	Peer IP:	NA		O 106-FD	100bt-FD
Set Offload	IP Address:	10.43.1.2	Global IPv6:	AUTO		@ Autonegotiate	1000-FD
Set Rate Info	IP Mask:	255.255.255.0	Unk IPv6:	AUTO		Renegotiate	10G-FD
Set PROMISC	Gateway IP:	10.43.1.1	IPv6 GW:	AUTO		Restart Xcvr	Flow-Contro
Set Rx-All/FCS	Alias:		MTU:	1500		PROMISC	
] Set Bypass	MAC Addr:	00:90:0b:2f:0a:21	TX Q Len	1000		RX-ALL	Unicad
Set Bridge Info	Br Cost:	Ignore •	Priority:		-	RX-FCS	UEO Enable
Set CPU Mask	Rot Timen	medium (8 s)	Watchdog:			Bypass NOW!	GS0 Enable
- Services	CRUMarla	NO.SET .	WIEL Bridge	NONE		Bypass Power-UP	LRO Enable
I CTD	or or Hasic	100001	wirr bridge:	Provide Sector		Bypass Power-DOWN	GRO Enable
Jene .						Bypass Disconnect	1

2) Place both ethernet ports in virtual routers

🔊 Applications Places System 🗃 📰 😉 🧐 🛕	Wed Jan 21, 15:20 🔅 US 🧌
v Netsmith configuration for Resource: ledtest(1.1) Version: 5.3.1	▼ Netsmith configuration for Resource: medtest(1.2) Version: 5.3.1 _ □ X
Wittual Routers and Connections	Virtual Routers and Connections A Mgt-ath0 152.168.100.38/24 Image: state s
	-
▲	
✔ WanLinks Show Legend ✔ Fire ✔ IPv4s Info Print	☑ WanLinks Show Legend ☑ Fire ☑ IPv4s Info Print Sync App
🗹 WanLink Names 🗹 Port Names 🔽 Fire Names 🗌 Zero-IPv4s Apply Progress: 🚺 100	🗹 WanLink Names 🔽 Port Names 🖉 Fire Names 🗌 Zero-IPv4s Apply Progress: 100% Complete
🖌 Peer WanLinks 🖌 Parents 📝 Col. Domains 🗌 IPv6s	Peer WanLinks Parents Col. Domains IPv6s
WanLink Config	WanLink Config

3)Create the virtual AP radios. Choose chanel 149 frequency 5745. Mode 802.11abgn for both ledtest wiphy0 and wiphy1.

🔻 wiphy2 (ledtest) Co	nfigure Settin	gs						
	Current: LII Driver Info: Po	Port Status Informa NK-DOWN NONE ort Type: WIFI-Radio	ation Driver: ath9k() E	Bus:	→ wiphy2 (medtest)	Configure Setti Current: LI	ngs — Port Status Inform NK-DOWN NONE	nation
Enable Set IF Down Set MAC Set TX Q Len Set MTU Set Offload Set PROMISC	DHCP-IPV6 DHCP-IPV4 DNS Servers: IP Address: IP Mask: Gateway IP: Alias: MAC Addr: Rpt Timer: Max-VIFs: 20 Country: Channel/Free Antenna: RTS: Verbose	Port Configurable General Int ♥ DHCP Release Secondary-IPs BLANK 0.0.0.0 0.0.0 0	es erface Settings Down DHCP Client ID: Peer IP: Global IPv6: Link IPv6: IPv6 GW: MTU: TX Q Len WIFI Bridge: Settings 48 Max-APs: 8 S 0) \[\nu] Tx-Po Frag:	Aux-Mgt None NA AUTO AUTO O O NONE Upports: 802.11abgn wer: DEFAULT 2346	Enable Set IF Down Set MAC Set TX Q Len Set MTU Set Offload Set PROMISC	Driver Info: PC DHCP-IPV6 DHCP-IPV4 DNS Servers: IP Address: IP Adsk: Gateway IP: Alias: MAC Addr. Rpt Timer: Max-VIFs: 20 Country: Channel/Fred Antenna: RTS:	rt Type: WIFI-Radio Port Configuration General In I DHCP Release Secondary-IPS BLANK 0.0.0.0 0.0.0 0.0	Driver att94 les terface Settir Down DHCP Client Global IPv6. IPv6 GW: MTU: TX Q Len WiFi Bridge: Settings 148 MaxAPs: 00 V F F

4) Create the two virtual APs: do not assign addresses to them, we will be adding them to a bridge.

Port Status Information vapi	1 (ledtest) Configure Settings _ \Box X
Current: IIIK41P GRO NONE	Port Status Information
Driver Info: WIELAP Parent: winhv0	Current: LINK-UP GR0 NONE
	Driver Info: Port Type: WIFI-AP Parent: wiphyl
Port Configurables	Port Configurables
Standard Configuration Advanced Configuration More Advanced Configuration	Standard Configuration Advanced Configuration More Advanced Configuration
Enable General Interface Settings	Enable
Set IF Down DHCP-IPv6 VDHCP Release Down Aux-Mgt	Set IF Down DHCP-IPu6 IZ DHCP Release Down Aux-Mot
Set MAC DHCP-IPv4 Secondary-IPs DHCP Client ID: None	Set MAC
Set TX Q Len DNS Servers: BLANK Peer IP: NA	Set TX Q Len
Set MTU IP Address: 0.0.0.0 Global IPv6: AUTO	Set MTU ID Address 0.0.0.0 Clabel ID C
Set Offload IP Mask: 0.0.0.0 Link IPv6: AUTO	Set Offload
Set PROMISC Gateway IP: 0.0.0.0 IPv6 GW: AUTO	Set PROMISC Gateway IP: 0.0.0.0 Enk IPV6: AUTO
Alias: MTU: 1500	Aliae
Services MAC Addr: 00:0e:8e:91:79:68 TX Q Len 1000	ServicesMAC Addr: 00:0e:8e:73:be:49 TX 0 Len 1000
HIIP Rpt Timer: nedium (8 s) VIFI Bridge: NONE	HTTP Bot Timer Bedium (8 s) VIELBridge NONE
WiFi Settings	FTP WICE Cettinge
SSID: ledOtest 💌 AP: DEFAULT	CCID: lad@test = AD: DECAULT
Low Level Key/Phrase: Mode: 802.11abon	Low Level SSID: Levelest Varia DEPAGE
Trophild	PROMISC Key/Phrase: Mode: 802.11abdn
Iso Enabled DTIM-Period: 2 Max-ST4: 2007	TSO Enabled Fred/Channel: 243//6 Kate: US Detault
Good Enabled Beacon: 240	UFO Enabled Dimmendo: 2 Maxim 2007
Disp Epobled Use WP42 Use WP42 Use WF42 Dispble HT40 Dispble SG	USO Enabled Deacon. 240
	CRO Enabled Use what Use what Use wer Usable Hind Usable Sol
Print View Details Logs Probe Display Scan Sync Apply OK Cancel Print	t View Details Logs Probe Display Scan Sync Apply OK Cancel

5) Create bridge br0. Add both vap0 and vap1 to the bridge. Assign an address to the bridge.

▼ Create VLANs on Port: 1.1.332	🖵 br0 (ledtest) Configure Settings	Ξ×
O MAC-VLAN 0 802.1Q-VLAN O Redirect	Port Status Information Current: LINK-UP PROBE-ERROR TSO UFO GSO GRO Driver Info: Port Type: Bridge Driver: bridge(2,3) Bus: N/A	
VLAN ID: DIC 00:58:14:07:08 DIC 07:89:4 Parent MAD: DIC 00:58:14:07:08 DIC 07:89:14:07:08 Image: State of the state of th	Port Configurables General Interface Settings Set IF Down DHCP-IPv6 Set MAC DHCP-IPv4 Set XQ Len DNS Servers: BLANK Peer IP: NA Set MTU IP Address: 10.11.44.3 Global IPv6: Auro Bridge Info Gateway IP: O.0.0 IPv6 GW: AUTO Allas:	•
Apply Cancel	MAC Addr: 82:36:9c:f0:08:75 TX Q Len 0 Max Age: 20 Rpt Timer: medium (8 s) ▼ WiFi Bridge: NONE Hello Time: 2	•
	Services Add Ports Forwarding Delay: 15 HTTP Frp Is Is	•

6) Create 164 stations on ledtest:wiphy2 and

164 stations on medtest:wiphy2. Set the SSID to **led0test**, the passphrase to **led0test1** and select **WPA2**.

- 0	reate VLANs o	n Port: 1.1.168					_ 🗆 ×			
A	O MAC-VLAN	○ 802.1Q-VLAN ○ Red	lirect 🛛 🔾 Bridge	GRE Tunne	el					
~	WIFI STA	🔾 WIFI VAP 🛛 🔾 WIFI Monit	or 🔷 WiFi Virtu	al Radio						
2	Shelf:	1	Resource:	1 (ledtest)	▼ P	ort: 168 (wiphy2)	-			
e	VLAN ID:		DHCP-IPv4							
e	Parent MAC:	00:0e:8e:4e:59:20	DHCP Client ID:		-					
	MAC Addr:	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	IP Address:		Global IF	v6: AUTO				
	Quantity:	164	IP Mask or Bits:		Link IPv6	: AUTO				
			Gateway IP:		IPv6 GW:	AUTO				
	#1 Redir Name:		#2 Redir Name:							
	STA ID:	100	SSID:	led0test		T				
	WiFi AP:		Key/Phrase:							
	Use WPA	Use WPA2	Use WEP							
				•	Create VLANs on	Port: 1.1.168				_ 0
A	Down			6	O MAC-VLAN	802.1Q-VLAN	direct 📀 Bridge	GRE Tunnel		
	Apply	<u>C</u> ancel			🖲 WIFI STA	WiFi VAP 🔷 WiFi Mor	itor 🛛 🔾 WiFi Virtu:	al Radio		
				2	Shelf:	1 💌	Resource:	2 (medtest) 💌	Port: 2 (v	wiphy2) 💌
				3	VLAN ID:		DHCP-IPV4			
					Parent MAC:	00:00:80:30:30:08	DHCP Client ID:			
					MAC Addr:		IP Address:		Global IPV6:	AUTO
					Quantity:	164	IP Mask or Bits:		LINK IPV6:	AUTO
							Gateway IP:		IPv6 GW:	AUTO
					#1 Redir Name:		#2 Redir Name:			-
					STA ID:	300	SSID:	ledOtest	•	•
					WiFi AP:		Key/Phrase:			
					Use WPA	Use WPA2	Use WEP			
				A	Down					
					Apply	<u>C</u> ancel		R	eady	

Highlight all the stations in the Ports tab. Set them down, **enable** DHCPv4, turn **off** DHCP Release, and set themto Mode **802.11abgn**.



You should now see 164 stations in the ledtest Netsmith window.

Drag the bridge into the Virtual Router. Click Apply.





Right click on br0, click Modify, and add a DHCP service to it. Grant lease time of 1200 seconds, and the range 10.11.44.10 – 10.11.45.254. Click OK.

- VNC: medtest:1 (lanforge) Applications Places System ::::::::::::::::::::::::::::::::::::	Wed Jan 21, 15 est(1.2) Version: 5.3.1	▼ Creat	e/Modify (Connection		
	Manager Refr					Interf
R0(1) eth 1043.1124 1	t Mgr Messages inks Attenuators Co ort Delete	Port 1-A:		170 (br0)		
Vering Converter Model Vering	L Salor L Salor L Salor 10 Politication Tx Bytes Tx Bytes Tx Bytes 11 Politication 0 5.552 Tx Bytes Tx Bytes 12 0 0 5.552 Tx Bytes Tx B	Port 1-B:	🗹 Skip	<auto create="" ne<="" td=""><td>ew Port></td><td>VRRP</td></auto>	ew Port>	VRRP
Modiy fort Bit 0 Create Ports 682 0 SoftPort 699 0 Preset Port 884 0 Delete Port 885 0		WanLink:	🗾 Skip	-Auto Create Ne	ew WanLink>	VRRP
Delete Warlink 519 0 130 14222 14323 1439 0 131 14223 14325 1533 0 141 14225 14325 1533 0 141 14325 14325 1532 1537 141 1417 1422 1532 1537		Port 2-B:	🖌 Skip	≺Auto Create Ne	ew Port>	
2 WartLinks Show Lagend Ø Fire Ø Fire X Info Print. Sync. Apply Close 816 0 2 WartLink Names Ø Fort Names Ø Fire Names Z ero 4Pv4s Apply Progress: 100% Complete Cancel Apply 809 2 WartLink Names Ø Fort Names Ø Fire Names Z ero 4Pv4s Apply Progress: 100% Complete Cancel Apply 89 2 WartLinks Ø Parents Ø Col. Domans Profes Netsmith Status 0 814 0	0 8,402 0 7,426 0 6,114 0 9,192 0 6,684 0 7,640	Port 2-A:	🖌 Skip	≺Auto Create Ne	ew Port>	Next-
Dimension Control Contro Control Control <	179 0 0 7,640 166 0 0 5,894 6,645 154 1,234 1,541,120 1,099,8 1,706 282 2,375 1,484.711 1,229,3 0 0 1666	DHCP Lease Time:		1200	Subn	
wedjan 21 54 51 75 705 morter tracks (under the TL card 2) to uncert tracks (under the TL card 2) the current tracks (under the TL card 2)		DHCP DNS: DHCP Range Min:		0.0.0.0		
wwww weigher 11:46(2):257:2035 marchine characteristic provided by the secondary of the secondary of the secondary of the secondary of the the current reset is complete. Interface with many secondary (Ps can take a while for reset. The reset status can be found on the PartNey to in the LAMercy COU.				10.11.44.10		
Pause Close Save Fie		DHCP Ran	nge Max:	10.11.45.254		
📓 🚊 LANforge Manager Ve 🛓 LANforge Messages (L 🗎 LANforge Wireless Eve 🛓 Netsmith configuration 🛓 Netsmith	configuration	DHCP Dor	main:			
		DHCPv6 D	NS:			Next-
		DHCPv6 R	ange Min:			IPv6 s
		DHCPv6 R	ange Max:			
		DHCPd Co	onfig File:			
		NAT	DHCP	DHCPv6	Custom DH	ICP Ca

When you are done with that, click Apply in the Netsmith window. You should see the **br0** port gain a blue rectangle.



7) Bring up all the stations and wait for them to complete their DHCP interaction. This might take a few minutes, be patient.

8) Create a Roaming script. Here is a roaming script created using a January 28 version of the scan-script.html utility. It will roam 10 stations a second, alternating between station radios and shuffling stations from their AP to the opposite AP.

do cli scan 1 1 sta263 NA 'trigger freg 5745 ' do_cli scan 1 2 sta463 NA 'trigger freq 5745 sleep 1 roam 1 sta263 00:0e:8e:91:79:68 roam 2 sta463 00:0e:8e:91:79:68 roam 1 sta262 00:0e:8e:73:be:49 roam 2 sta462 00:0e:8e:73:be:49 roam 1 sta261 00:0e:8e:91:79:68 roam 2 sta461 00:0e:8e:91:79:68 roam 1 sta260 00:0e:8e:73:be:49 roam 2 sta460 00:0e:8e:73:be:49 roam 1 sta259 00:0e:8e:91:79:68 roam 2 sta459 00:0e:8e:91:79:68 sleep 1 roam 1 sta258 00:0e:8e:91:79:68 roam 2 sta458 00:0e:8e:91:79:68 roam 1 sta257 00:0e:8e:73:be:49 roam 2 sta457 00:0e:8e:73:be:49 roam 1 sta256 00:0e:8e:73:be:49 roam 2 sta456 00:0e:8e:73:be:49 roam 1 sta255 00:0e:8e:91:79:68 roam 2 sta455 00:0e:8e:91:79:68 roam 1 sta254 00:0e:8e:73:be:49 roam 2 sta454 00:0e:8e:73:be:49 sleep 1 roam 1 sta253 00:0e:8e:73:be:49 roam 2 sta453 00:0e:8e:73:be:49 roam 1 sta252 00:0e:8e:91:79:68 roam 2 sta452 00:0e:8e:91:79:68 roam 1 sta251 00:0e:8e:91:79:68 roam 2 sta451 00:0e:8e:91:79:68 roam 1 sta250 00:0e:8e:73:be:49 roam 2 sta450 00:0e:8e:73:be:49 roam 1 sta249 00:0e:8e:91:79:68 roam 2 sta449 00:0e:8e:91:79:68 sleep 1 roam 1 sta248 00:0e:8e:73:be:49 roam 2 sta448 00:0e:8e:73:be:49 do_cli scan 1 1 sta247 NA 'trigger freq 5745 ' do_cli scan 1 2 sta447 NA 'trigger freq 5745 ' sleep 1 roam 1 sta247 00:0e:8e:91:79:68 roam 2 sta447 00:0e:8e:91:79:68 roam 1 sta246 00:0e:8e:91:79:68 roam 2 sta446 00:0e:8e:91:79:68 roam 1 sta245 00:0e:8e:73:be:49 roam 2 sta445 00:0e:8e:73:be:49 roam 1 sta244 00:0e:8e:73:be:49 roam 2 sta444 00:0e:8e:73:be:49 roam 1 sta243 00:0e:8e:91:79:68 roam 2 sta443 00:0e:8e:91:79:68 sleep 1

The WiFi Mobility plugin was using this script with the following parameters:

Refresh Interval: **2500ms**,

Pause Between Commands: 85ms,

Pause after Show Port: 2125ms,

Auto-Verify Timer: 2750ms,

Maximum Roam Time in graphs: 1250ms.

Here is a screen shot of the settings in scan-script helper:

	LA	Nforge Roami	n <mark>g Script Help</mark>	er						
	Resource # 1	Station Name sta	First Station # 100	Last Station #	263					
	Resource # 2	Station Name sta	First Station # 300	Last Station #	463					
	Group size 5	Scan Freq 5745	Other Freq]						
	BSSID A	BSSID B								
	00:0e8e9t7968									
	Secs after scan 1	Secs after group roam								
	Scan Timing									
	Millis between commands	Ave Roam in ms (guess)	30ms roams/5sec:							
	85	50	57.76 - 75.76	J						
	Generate Script	Append to script								
Change the average r	oam time guess and command pause	to match your Migration Widge	ıt							
The results her	e help determine where to place scar	o commands so to help not scar	n too often or too seldom.							
We want to sc seconds. If cor JBR: scan logi	an before the scan results time out, a mmand gap is 50ms, and roaming tim c changing to scan every N roams)	nd we need to wait for the scan e is about 75ms, we can possib	to complete. Scan results las bly complete (5000/125)=40 roa	t about 5 ams. (2015-01-21						
	do_cli scan 1 1 do_cli scan 1 2 sleep 1 roam 1 sta263 00 roam 2 sta463 00 roam 1 sta262 00 roam 1 sta261 00 roam 1 sta261 00	sta263 NA 'trigger freq 57 sta463 NA 'trigger freq 57 :0e:8e:91:79:68 :0e:8e:91:79:68 :0e:8e:73:be:49 :0e:8e:73:be:49 :0e:8e:91:79:68	45 ' 45 '							

Scenario: Roaming migration, 10 stations per second, WPA.



This is a section of the report created from the 10/sec roaming report:

Scenario: Roaming migration, 20 stations per second, WPA.

This is a section of the report for roaming 20 stations per second:



We see low system load on the lanforge.

Scenario: Roaming migration, 10 stations per second, RADIUS.

We see similar useful results with RADIUS authentication. (Radius configuration is similar to previous radius configurations in this document.) Pause between commands was 45ms. The errors in this and the next seem related, and I presume there is a problem in the roaming script. However this and the next graph definitely show roaming the desired performance.



Scenario: Roaming migration, 20 stations per second, RADIUS.

Pause between commands was 45ms.



he migration is verified after the Auto-Verify timer has expired. If the migration has not completed in that time, it will be counted as failed



Scenario: Roaming migration, 30 stations/sec, RADIUS

It is possible to reach 30 station migrations per second if you set the pause between commands to 32 ms.



The regular red areas are where the radio scan results begin to expire or where stations fail to finish association because a scan has started too close to their roaming attempt. We saw improved results with migration scripts tuned to assume scan buffers might expire as soon as 2500 milliseconds and the last roam statement before a scan request should be followed by 130ms nap time.

Conclusions

Over the air DHCP performance for bring up is relatively unaffected by types of authentication scheme. The number of back-offs and retries involved in DHCP bring-up seems to be a slow process.

The performance of roaming over WPA2 is excellent. The performance of WPA2+RADIUS shows similar performance. The actual setup for fast roaming performance requires migrations to interleave and avoid radio scan periods. Roaming performance in lab might takes time to tune.

Web Portal login and logout is relatively fast. Possible bottle-necks include SSL and what might be certificate validation latency. There might be ways to speed this interaction up, possibly with methods of certificate caching or local certificate installation.