

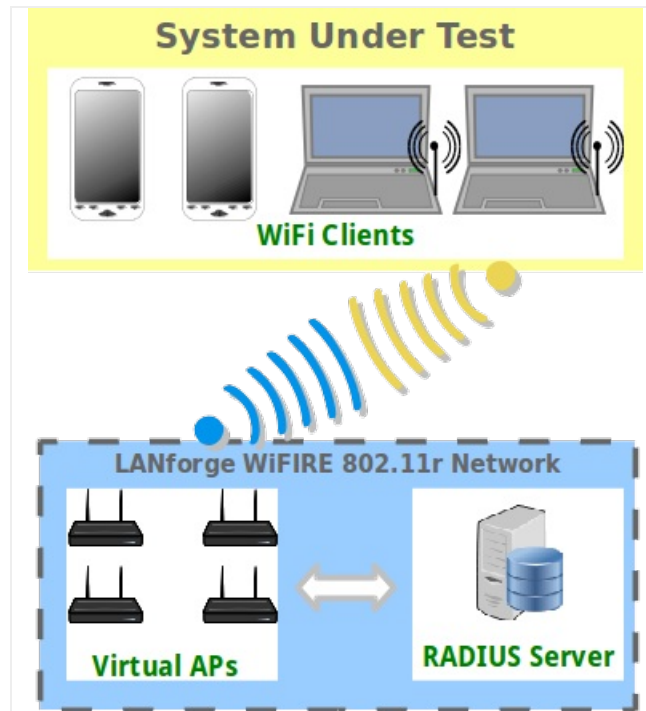
LANforge WiFi Access Point Network with 802.11r

Goal: Configure four virtual APs in an 802.11r network to test fast transition (FT) clients.

Configure four virtual Access Points to use 802.11r with FT-EAP. This example uses a LANforge CT525 system but a similar procedure will work on all multi-radio systems.

The wifi clients under test are also 802.11r enabled so that they can initiate FT Requests and roam. Here we are using another LANforge WiFi as the system under test to emulate 802.11r stations and force them to roam.

In LANforge, each virtual access point will be running its own hostapd process configured to enable 802.11r and bridged to other virtual access points. The bridged VAP network will emulate the Distributed System (DS) for FT over-the-DS roaming.



1. Setup a virtual access points on a wifi NIC and configure it for a channel and SSID.

- A. Go to the Port Mgr tab, select the parent device such as wiphy0, select Create, then fill out appropriate information and create a virtual access point.

Create VLANs on Port: 1.1.06

1 MAC-VLAN 802.1Q-VLAN Redirect Bridge GRE Tunnel
 WIFI STA WIFI VAP WIFI Monitor WIFI Virtual Radio

2 Shelf: 1 Resource: 1 (ben-5pci) Port: 6 (wiphy0)

3 VLAN ID: DHCP-IPv4
 Parent MAC: 04:f0:21:20:37:00 DHCP Client ID: None
 MAC Addr: xx:xx:xx:*:*:xx IP Address: Global IPv6: AUTO
 Quantity: 1 IP Mask or Bits: Link IPv6: AUTO
 Gateway IP: IPv6 GW: AUTO
 #1 Redir Name: #2 Redir Name:
 STA ID: 0 SSID: roamer
 WiFi AP: Key/Phrase:
 WPA WPA2 WEP

4 Down

Apply Cancel Ready

- B. Modify the new vap, select the **Advanced Configuration** tab in the Port-Modify window and check the box Advanced/802.1x and fill in the RADIUS IP/Port/Secret. Here the RADIUS server will be a freeradius process configured on localhost. The default RADIUS secret is **lanforge** and the default login is **testuser/testpasswd** when freeradius is installed via `lf_kinstall.pl --do_radius`.

vap0 (ben-5pci) Configure Settings

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

Port Configurables

Standard Configuration **Advanced Configuration** Misc Configuration Custom WiFi

Advanced WiFi Settings

Select 'WPA2' on the Standard Configuration screen to enable Advanced/802.1x and enable Advanced/802.1x to enable most of these. Enabling 802.11u enables others.

Ignore Probes: zero (0%) HESSID: 00:00:00:00:00:00
 Ignore Auth-Assoc: 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 Metrics RADIUS Port: 1812
 leee80211w: Disabled (0) RADIUS Secret: lanforge
 Venue Group: Unspecified (0) Venue Type: Unspecified (0)
 Network Type: Private (0) Address Types: Not Available (0)
 Network Auth: 3GPP Cell Net:
 Use 80211d Use 80211h Short-Preamble
 Advanced/802.1x HotSpot 2.0 Disable DGAF
 Enable 802.11u 802.11u Internet 802.11u ASRA 802.11u ESR 802.11u UESA

Print View Details Logs Probe Display Scan Sync Apply OK Cancel

- C. Repeat above steps A and B to create a single vap on wiphy1, wiphy2 and wiphy3 for a total of four virtual access points.

Create VLANs on Port: 1.1.07

1 MAC-VLAN 802.1Q-VLAN Redirect Bridge GRE Tunnel
 WiFi STA WiFi VAP WiFi Monitor WiFi Virtual Radio

2 Shelf: 1 Resource: 1 (ben-5pci) Port: 7 (wiphy1)

3 VLAN ID: DHCP-IPv4
Parent MAC: 04:f0:21:20:37:03 DHCP Client ID: None
MAC Addr: xx:xx:xx:*:*:xx IP Address: Global IPv6: AUTO
Quantity: 1 IP Mask or Bits: Link IPv6: AUTO
Gateway IP: IPv6 GW: AUTO
#1 Redir Name: #2 Redir Name:
STA ID: 1 SSID: roamer
WiFi AP: Key/Phrase:
 WPA WPA2 WEP

4 Down
 Ready

Create VLANs on Port: 1.1.08

1 MAC-VLAN 802.1Q-VLAN Redirect Bridge GRE Tunnel
 WiFi STA WiFi VAP WiFi Monitor WiFi Virtual Radio

2 Shelf: 1 Resource: 1 (ben-5pci) Port: 8 (wiphy2)

3 VLAN ID: DHCP-IPv4
Parent MAC: 04:f0:21:20:37:06 DHCP Client ID: None
MAC Addr: xx:xx:xx:*:*:xx IP Address: Global IPv6: AUTO
Quantity: 1 IP Mask or Bits: Link IPv6: AUTO
Gateway IP: IPv6 GW: AUTO
#1 Redir Name: #2 Redir Name:
STA ID: 2 SSID: roamer
WiFi AP: Key/Phrase:
 WPA WPA2 WEP

4 Down
 Ready

Create VLANs on Port: 1.1.09

1 MAC-VLAN 802.1Q-VLAN Redirect Bridge GRE Tunnel
 WiFi STA WiFi VAP WiFi Monitor WiFi Virtual Radio

2 Shelf: 1 Resource: 1 (ben-5pci) Port: 9 (wiphy3)

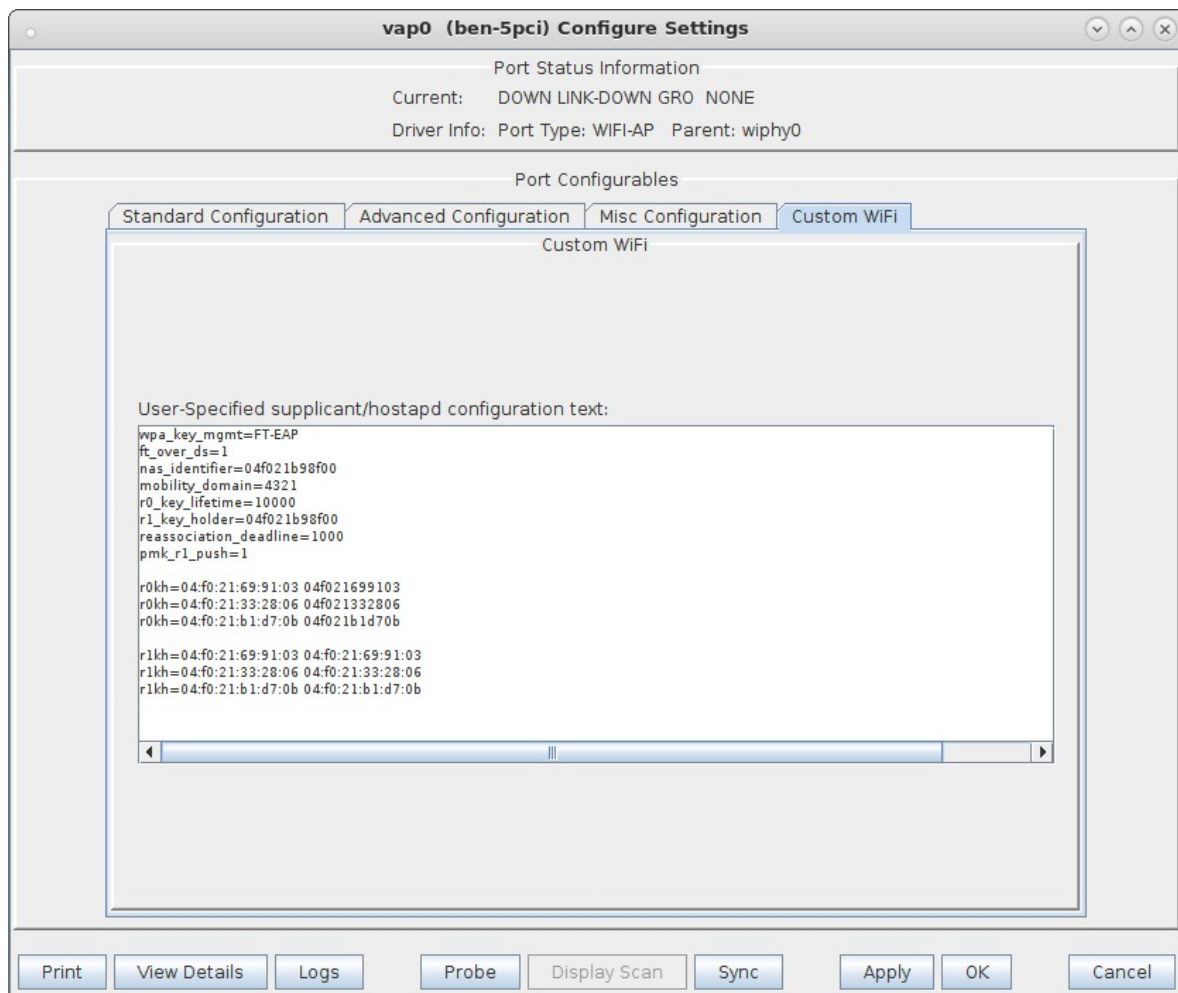
3 VLAN ID: DHCP-IPv4
Parent MAC: 04:f0:21:20:37:0b DHCP Client ID: None
MAC Addr: xx:xx:xx:*:*:xx IP Address: Global IPv6: AUTO
Quantity: 1 IP Mask or Bits: Link IPv6: AUTO
Gateway IP: IPv6 GW: AUTO
#1 Redir Name: #2 Redir Name:
STA ID: 3 SSID: roamer
WiFi AP: Key/Phrase:
 WPA WPA2 WEP

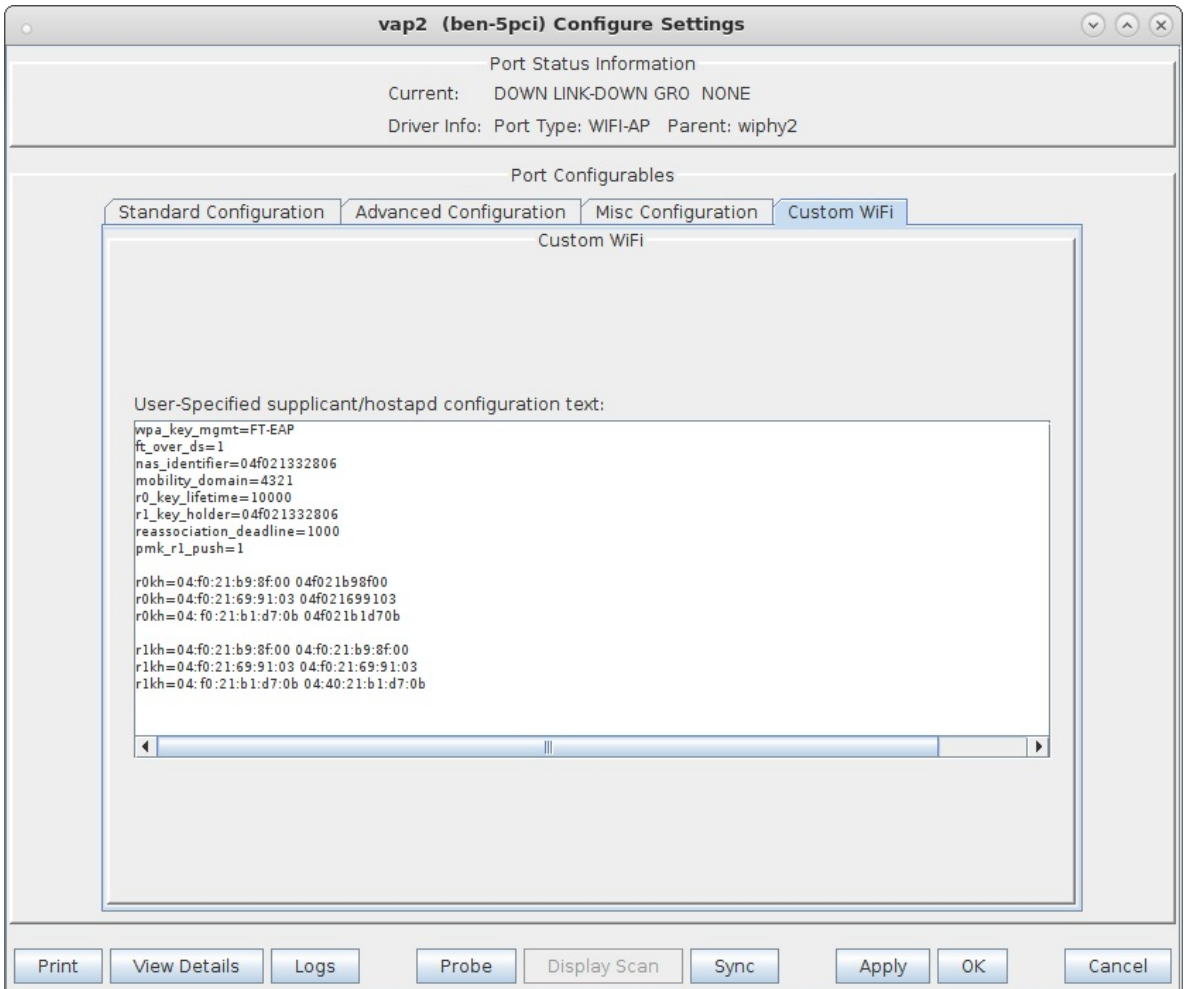
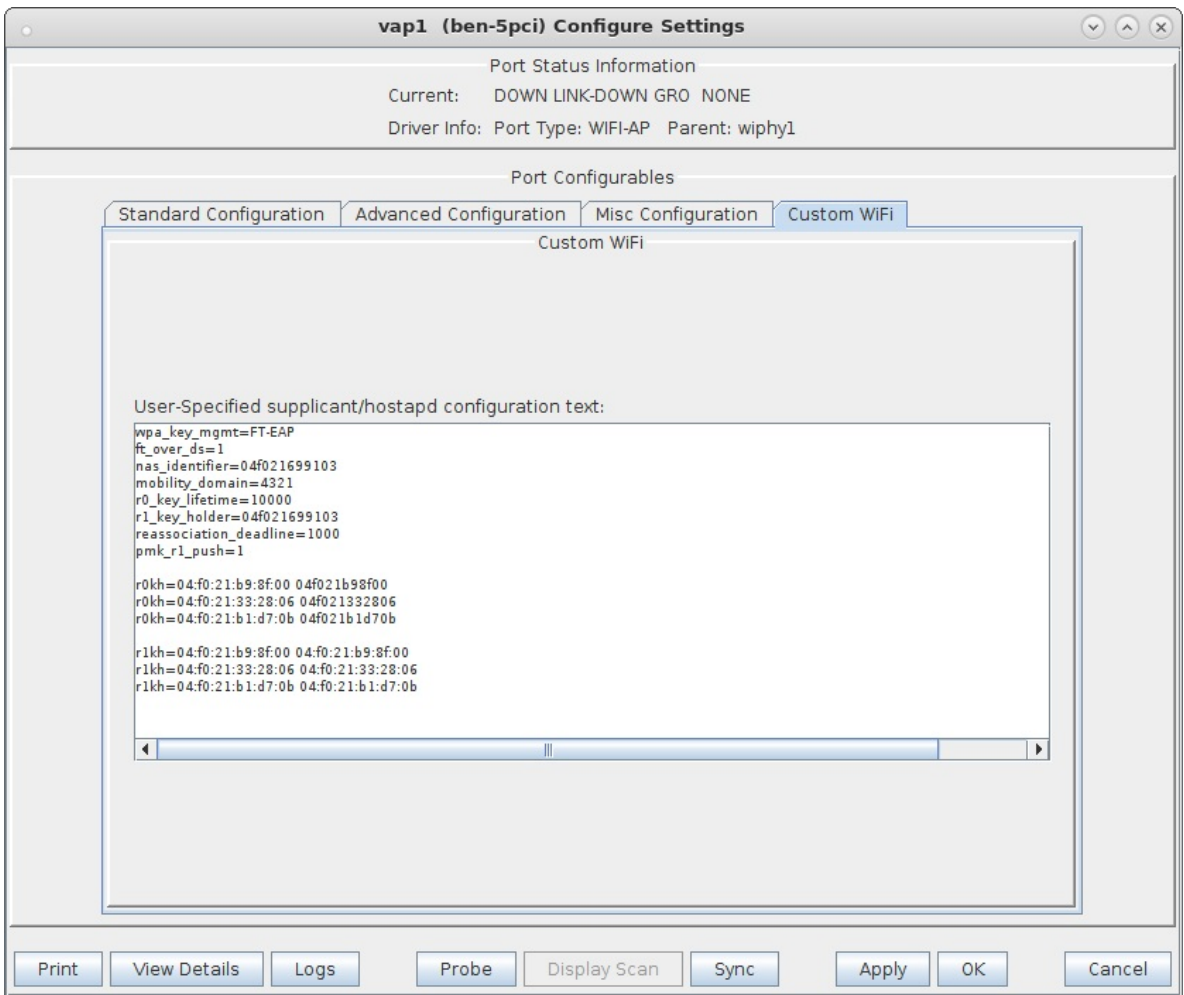
4 Down
 Ready

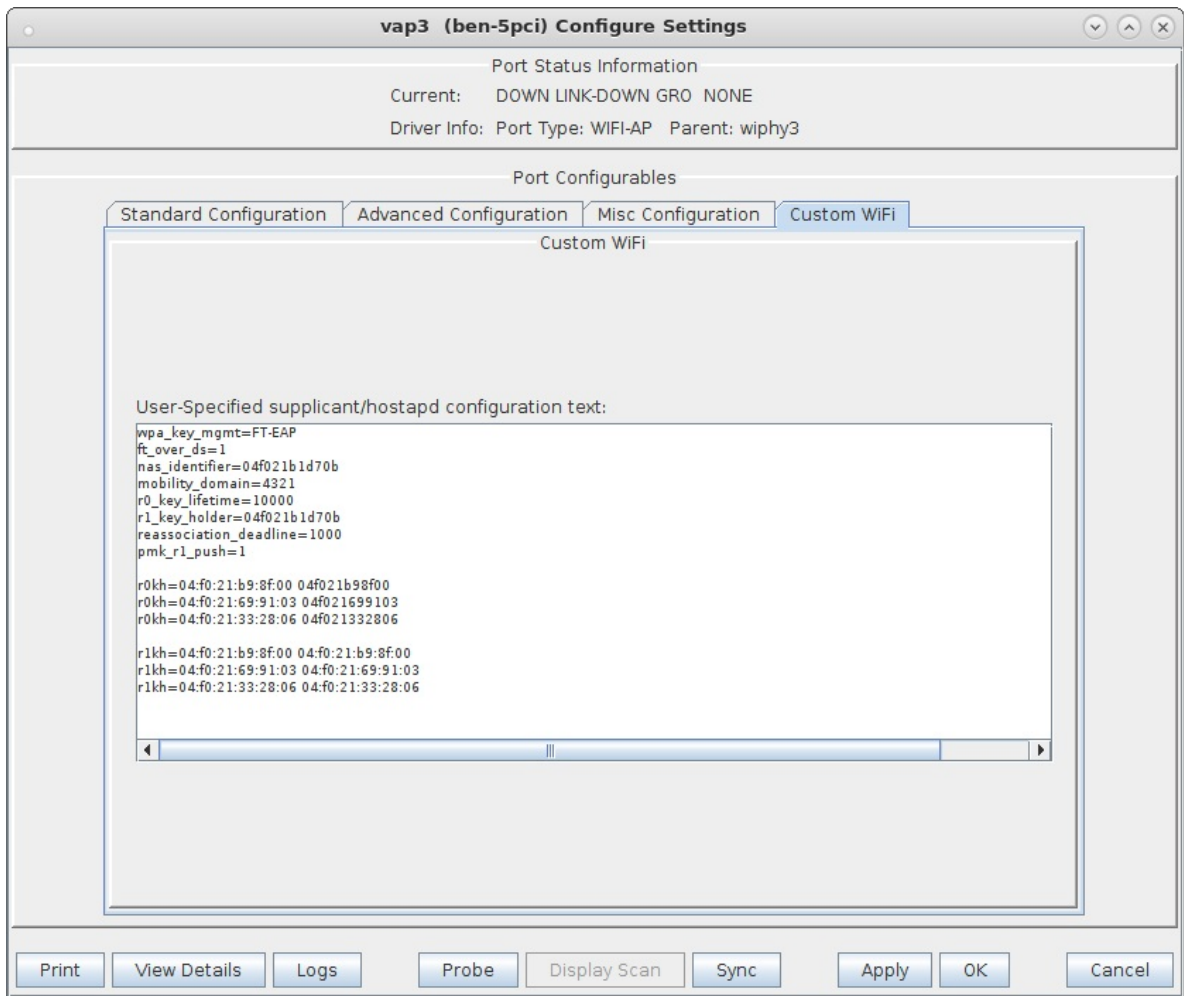
2. Modify each vap, select the **Custom Wifi** tab and enter the additional lines that will be appended to each vap hostapd configuration file.
 - A. For each vap, fill in the first 8 lines to enable 802.11r as well as the **first** part of the 3 r0kh entries and 3 r1kh entries for neighboring vap's.

The first part of the **r0kh** is the neighboring vap MAC address and NAS identifier which in this example is the MAC without colon delimiters.

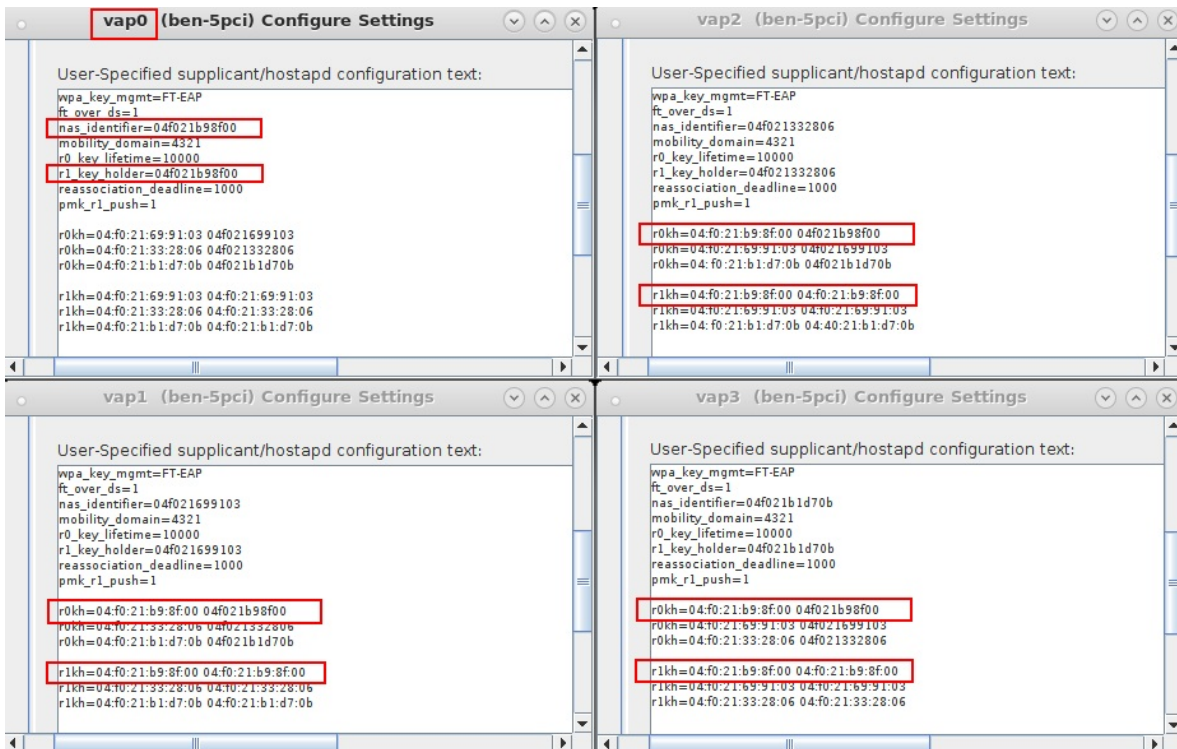
The first part of the **r1kh** is the neighboring vap MAC address and r1kh-id which in this example are the same.



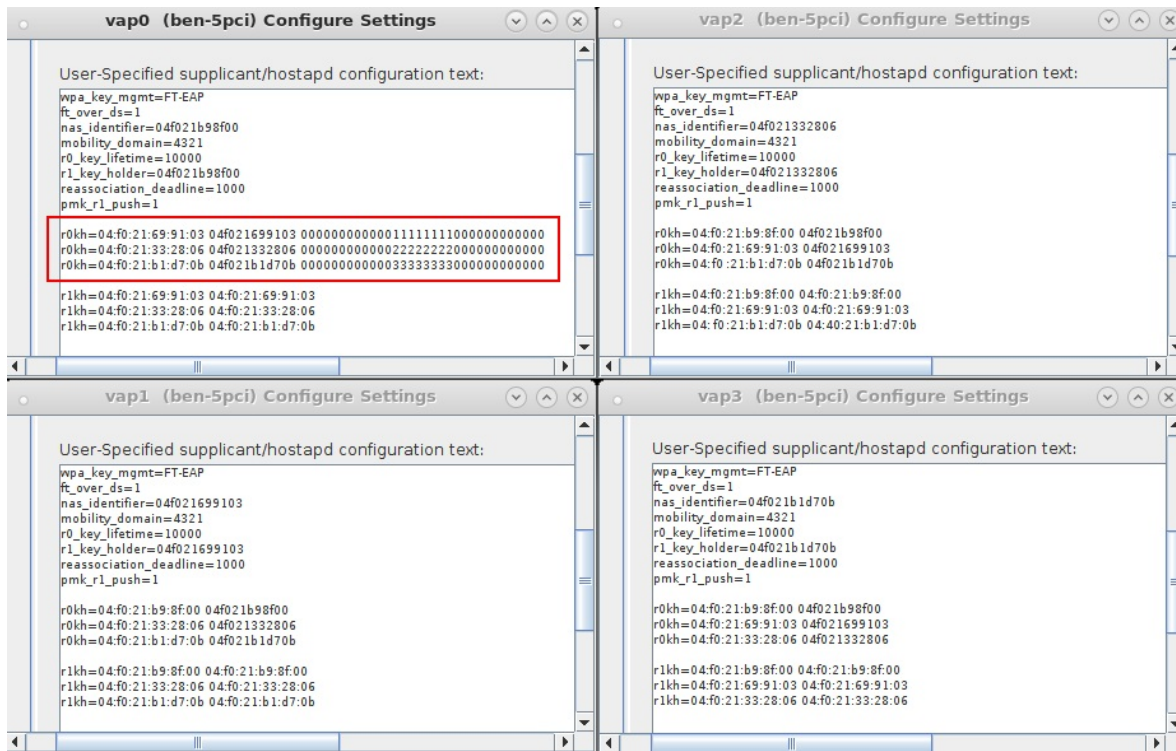




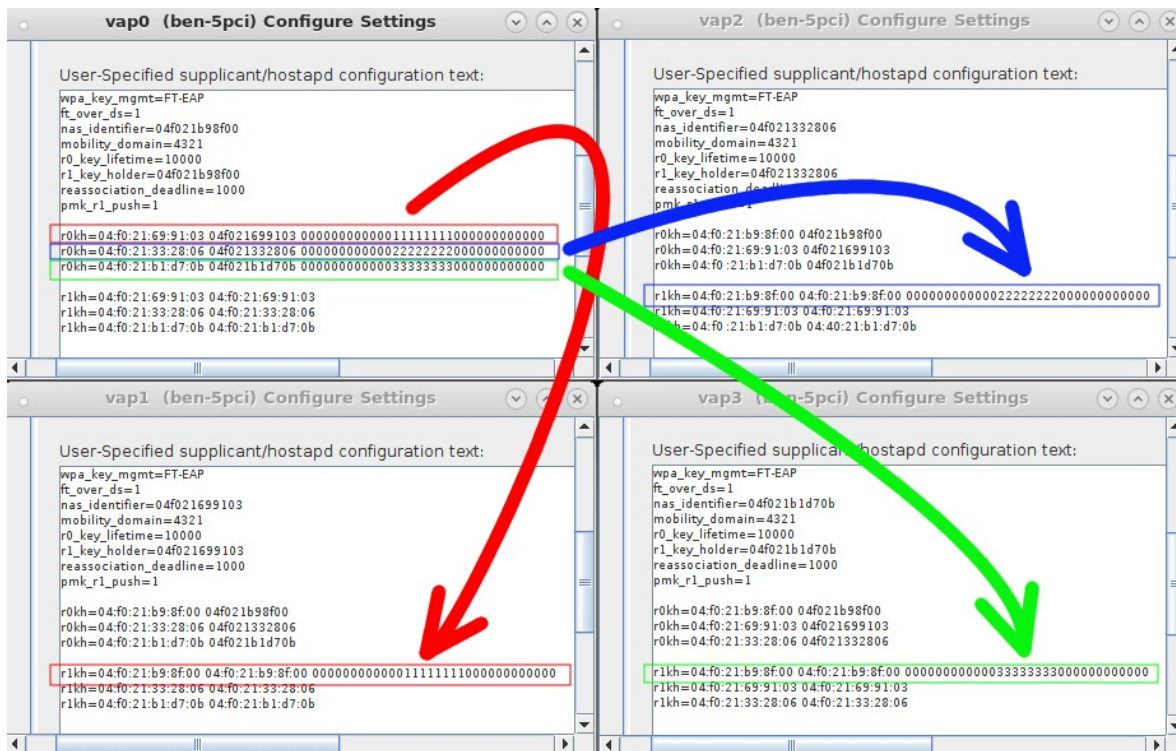
B. Each vap will be represented by a corresponding r0kh and r1kh entry in all of the neighboring vap's custom configuration sections. Here vap0 entries are highlighted.



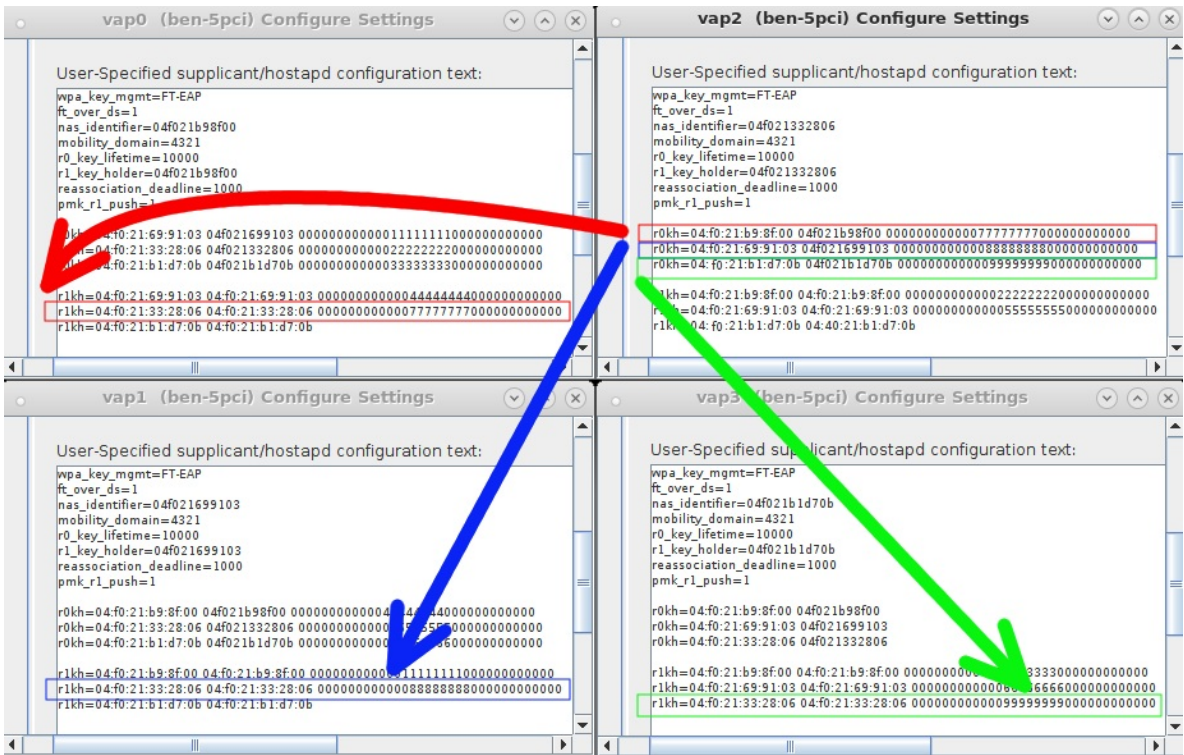
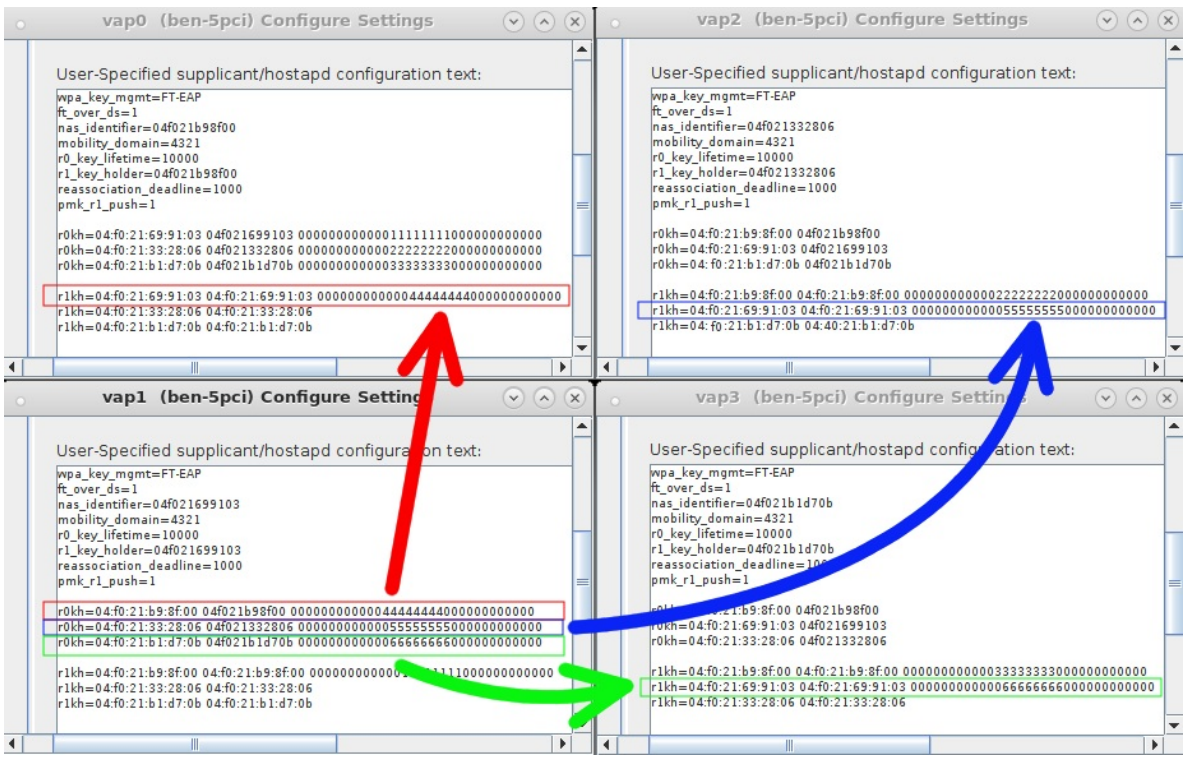
C. Generate a unique 128-bit AES hex key for each r0kh entry in the vap.

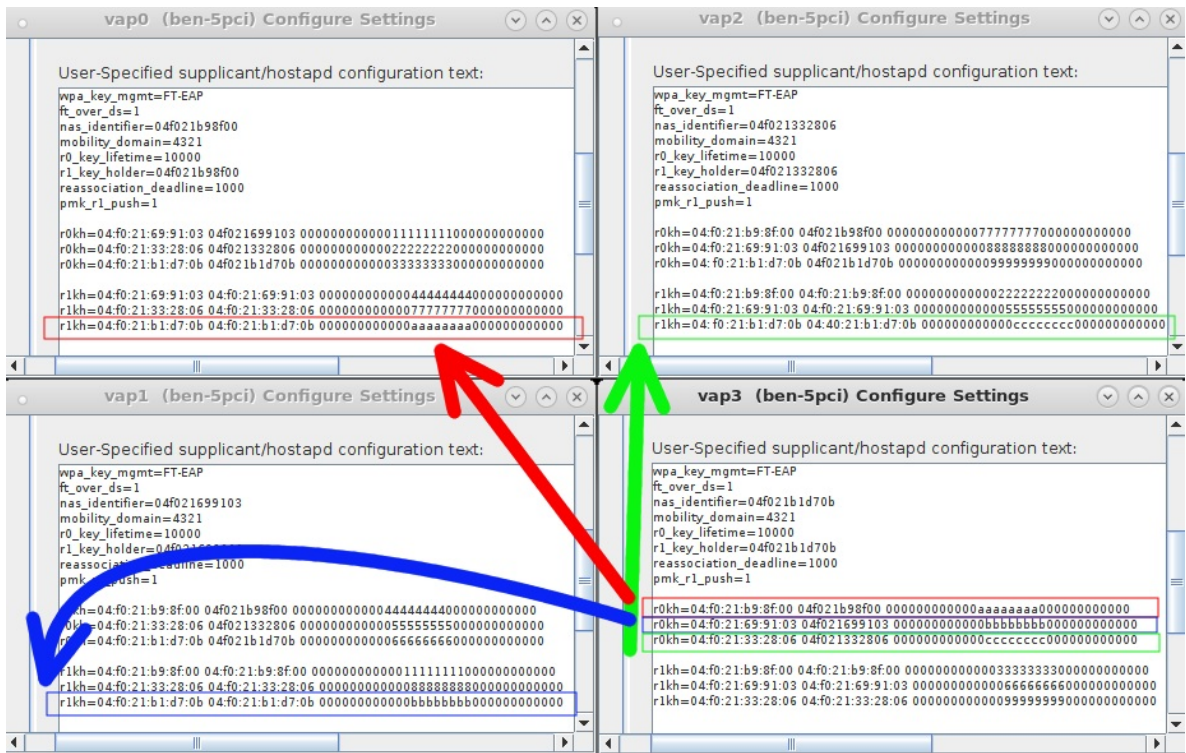


D. Copy the r0kh keys to the r1kh lines that correspond to the vap.



E. Repeat steps C and D for the other three vap's.

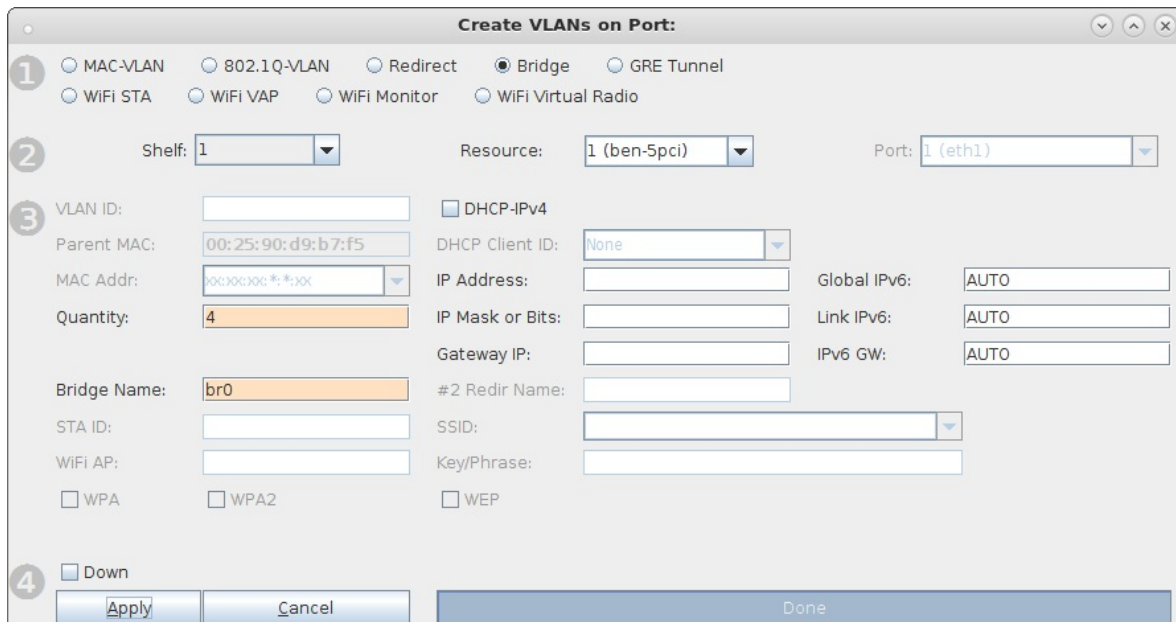




vap0: full hostapd configuration file
 vap1: full hostapd configuration file
 vap2: full hostapd configuration file
 vap3: full hostapd configuration file

For more information see [Two WiFi Access Point Network with 802.11r](#)

3. Create four bridge devices, one for each virtual access point.
 - A. Go to the port manager tab, select Create, then select Bridge and enter Quantity 4 and a Bridge Name, then Apply to create the bridges.



B. Modify each bridge device to add a vap. Netsmith will show a purple line when each vap has been added as bridge member.

Netsmith configuration for Resource: ben-5pci(1.1) Version: 5.3.4

Virtual Routers and Connections

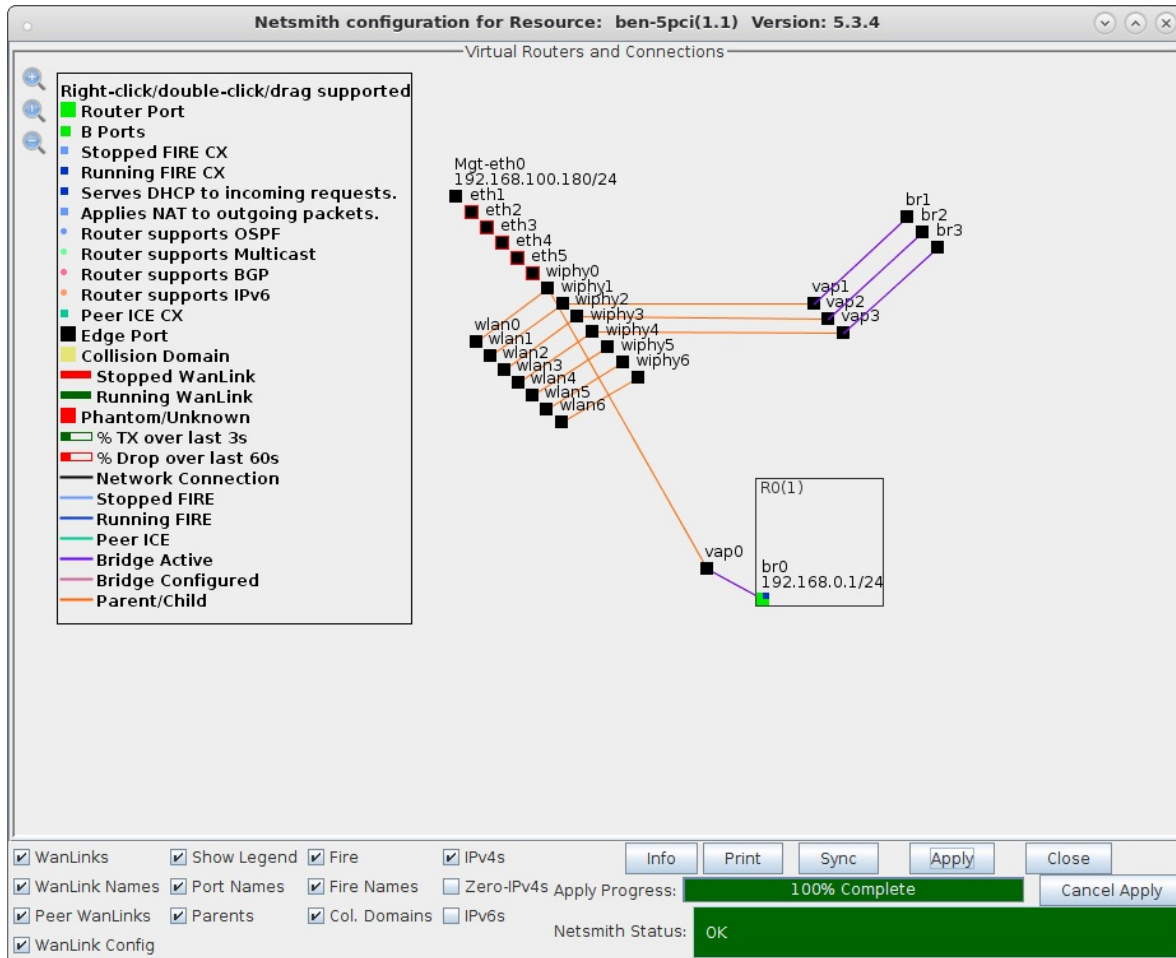
Right-click/double-click/drag supported

- Router Port
- B Ports
- Stopped FIRE CX
- Running FIRE CX
- Serves DHCP to incoming requests.
- Applies NAT to outgoing packets.
- Router supports OSPF
- Router supports Multicast
- Router supports BGP
- Router supports IPv6
- Peer ICE CX
- Edge Port
- Collision Domain
- Stopped WanLink
- Running WanLink
- Phantom/Unknown
- % TX over last 3s
- % Drop over last 60s
- Network Connection
- Stopped FIRE
- Running FIRE
- Peer ICE
- Bridge Active
- Bridge Configured
- Parent/Child

Mgt-eth0
192.168.100.180/24
eth1
eth2
eth3
eth4
eth5
wiphy0
wiphy1
wiphy2
wiphy3
wiphy4
wiphy5
wiphy6
wlan0
wlan1
wlan2
wlan3
wlan4
wlan5
wlan6
vap0
vap1
vap2
vap3
br0
br1
br2
br3

WanLinks Show Legend Fire IPv4s Info Print Sync Apply Close
 WanLink Names Port Names Fire Names Zero-IPv4s Apply Progress: 100% Complete Cancel Apply
 Peer WanLinks Parents Col. Domains IPv6s Netsmith Status: OK
 WanLink Config

- C. Add a single virtual router, drag br0 into the router, then give it an IP address and make it a DHCP server.

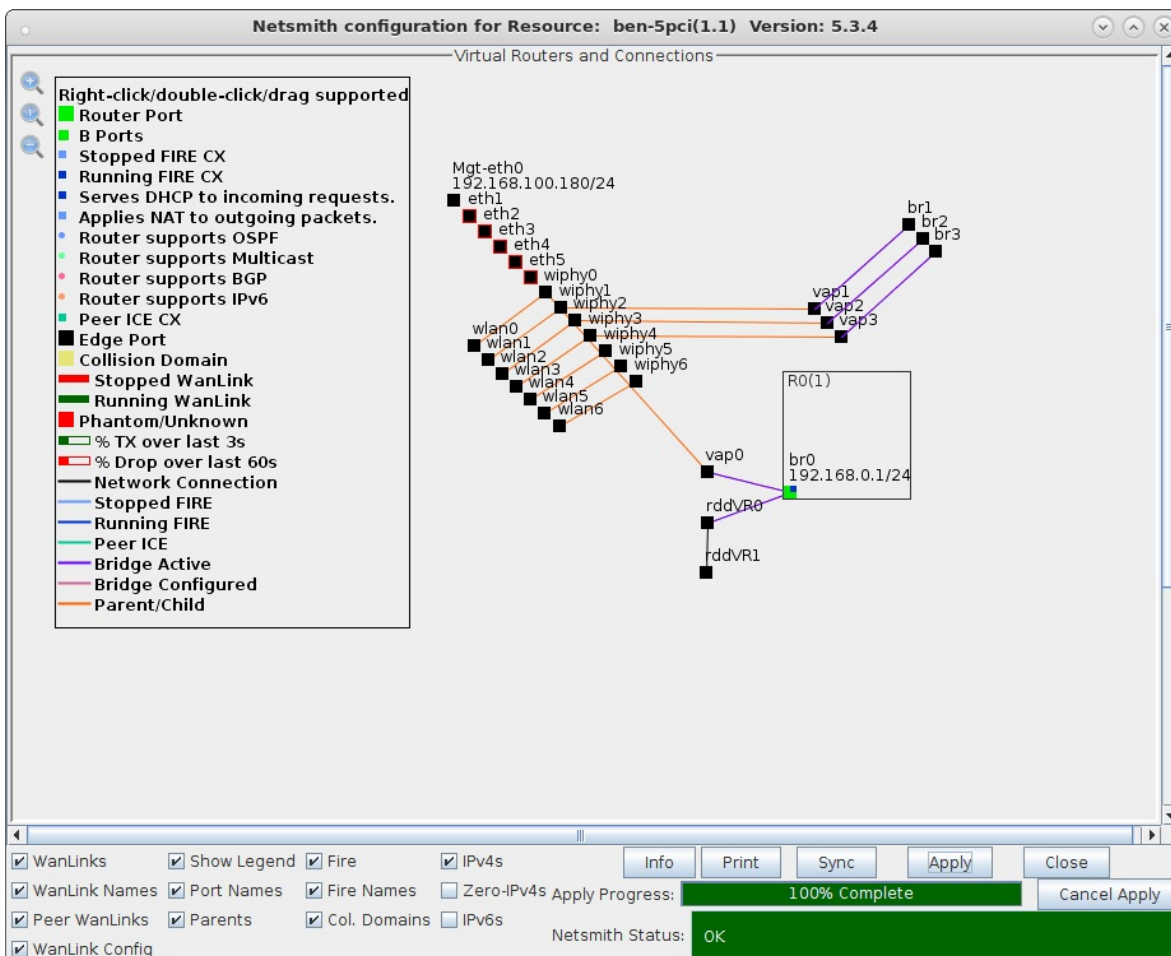


For more information see [Virtual Router with DHCP Cookbook \(skip the wanlink portion\)](#)

4. Each bridge will share a connection to a redirect device (rdd) pair so that FT messages can be sent and received.

- A. In Netsmith, right-click in a free area and select New Connection to create an rdd pair. Select **Skip** for Port 1-B, WanLink and Port 2-B then select OK. Select Netsmith Apply after creating the new connection.

- B. Right-click and select Modify Port br0, then add rddVR0 to br0. Your rddVRX numbering may differ depending on what other Netsmith objects are created.



- C. Right-click and select Modify Port br1, then add rddVR1 to br1. Your rddVRX numbering may differ depending on what other Netsmith objects are created.

Netsmith configuration for Resource: ben-5pci(1.1) Version: 5.3.4

Virtual Routers and Connections

Right-click/double-click/drag supported

- Router Port
- B Ports
- Stopped FIRE CX
- Running FIRE CX
- Serves DHCP to incoming requests.
- Router supports OSPF
- Router supports Multicast
- Router supports BGP
- Router supports IPv6
- Peer ICE CX
- Edge Port
- Collision Domain
- Stopped WanLink
- Running WanLink
- Phantom/Unknown
- % TX over last 3s
- % Drop over last 60s
- Network Connection
- Stopped FIRE
- Running FIRE
- Peer ICE
- Bridge Active
- Bridge Configured
- Parent/Child

Mgt-eth0
192.168.100.180/24

eth1
eth2
eth3
eth4
eth5

wiphy0
wiphy1
wiphy2
wiphy3
wiphy4
wiphy5
wiphy6

wlan0
wlan1
wlan2
wlan3
wlan4
wlan5
wlan6

br2
br3

vap2
vap3

R0(1)
br0
192.168.0.1/24

vap0
rddVR0

rddVR1

vap1
br1

WanLinks Show Legend Fire IPv4s IPv6s

WanLink Names Port Names Fire Names Zero-IPv4s IPv6s

Peer WanLinks Parents Col. Domains IPv6s

WanLink Config

Info Print Sync Apply Close

Apply Progress: 100% Complete

Cancel Apply

Netsmith Status: OK

D. Create two more rdd pairs for bridges br2 and br3.

Netsmith configuration for Resource: ben-5pci(1.1) Version: 5.3.4

Virtual Routers and Connections

Right-click/double-click/drag supported

- Router Port
- B Ports
- Stopped FIRE CX
- Running FIRE CX
- Serves DHCP to incoming requests.
- Applies NAT to outgoing packets.
- Router supports OSPF
- Router supports Multicast
- Router supports BGP
- Router supports IPv6
- Peer ICE CX
- Edge Port
- Collision Domain
- Stopped WanLink
- Running WanLink
- Phantom/Unkown
- % TX over last 3s
- % Drop over last 60s
- Network Connection
- Stopped FIRE
- Running FIRE
- Peer ICE
- Bridge Active
- Bridge Configured
- Parent/Child

Mgt-eth0
192.168.100.180/24
eth1
eth2
eth3
eth4
eth5
wiphy0
wiphy1
wiphy2
wiphy3
wiphy4
wiphy5
wiphy6
wlan0
wlan1
wlan2
wlan3
wlan4
wlan5
wlan6
vap0
vap1
vap2
vap3
br0
192.168.0.1/24
rddVR0
rddVR1
br1
br2
br3
rddVR2
rddVR3
rddVR4
rddVR5

Info Print Sync Apply Close

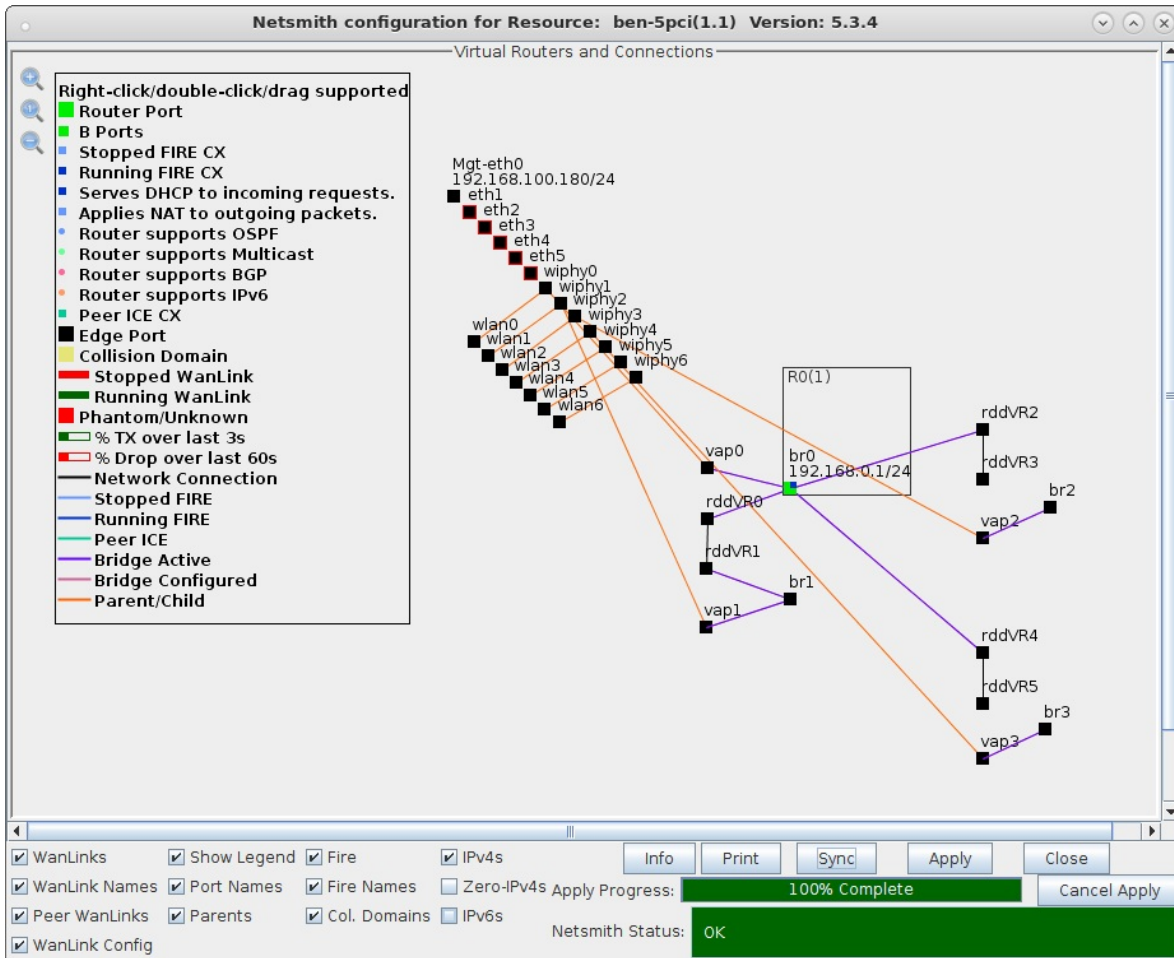
WanLink Names Show Legend Fire IPv4s Zero-IPv4s Apply Progress: 100% Complete Cancel Apply

Peer WanLinks Parents Col. Domains IPv6s

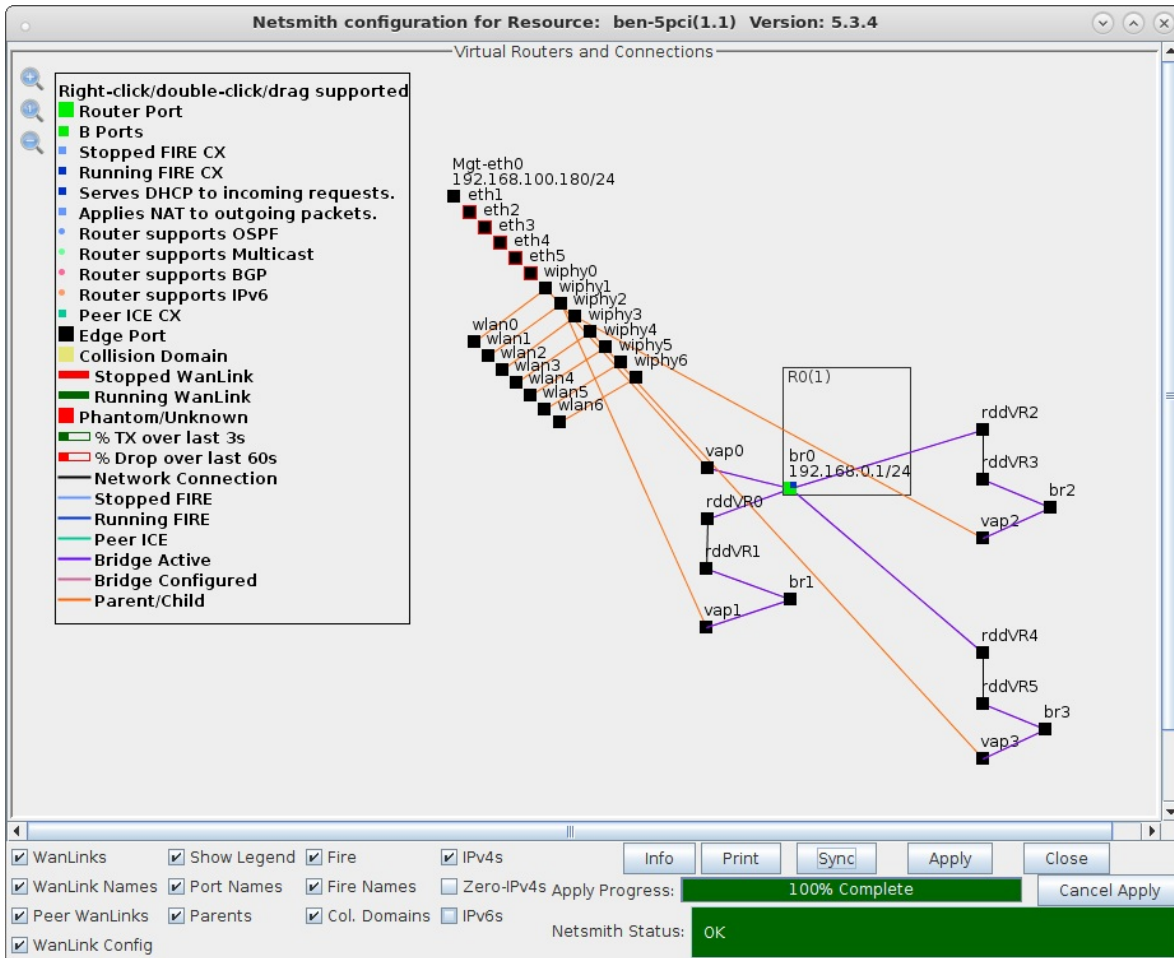
WanLink Config

Netsmith Status: OK

F. The objects vap2/br2 and vap3/br3 can be moved so that their logical relationships can be visualized.
 Add rddVR3 to br2, then add rddVR5 to br3.



- G. The final Netsmith display should show all four of the bridged virtual access points connected by a rdd pair, with br0 as the central bridge.



5. Connect LANforge clients and force them to roam from vap to vap. This can be accomplished with a wpa_cli command for one or two clients or the Mobility Plugin Script for many clients.

A. Client connected to vap0 04:f0:21:b9:8f:00.

LANforge Manager Version(5.3.4)

Control Reporting Tear-Off Info Plugins

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr vAP Stations Messages

Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Attenuators File-I/O

Disp: 127.0.0.1:1.0 Sniff Packets Clear Counters Reset Port Delete

Rpt Timer: medium (8 s) Apply View Details Create Modify Batch Modify

All Ethernet Interfaces (Ports) for all Resources.

I	bps TX LL	Bytes TX LL	bps RX LL	Bytes RX...	Reset	TX-Rate	RX-Rate	Status	AP	Activity	Signal	Noise
0	53	11,670	257	599,001	Complete		0 bps			101		
0	595	191,113	485	18,061,...	Complete		0 bps			101		
0	560	187,718	174	23,413,...	Complete		0 bps			101		
0	613	228,655	84	16,332,...	Complete		0 bps			101		
0	45	24,105	7,156	20,578,...	Complete		0 bps			2,744		
0	0	0	0	0	Complete		0 bps			0		
0	0	0	0	0	Complete		0 bps			0		
0	0	12,211	0	27,071	Complete	6 Mbps	6 Mbps	Authorized	04:F0:21:B9:8F:00	2,737	-14 dBm	-84 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	101	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	850	Complete					0		
0	0	0	0	1,246	Complete					0		
0	0	1,200	0	850	Complete					0		
0	0	2,520	0	8,268	Complete					0		
0	0	2,460	0	60	Complete					0		
0	0	60	0	2,460	Complete					0		
0	0	9,500	0	3,204	Complete					0		
0	0	3,204	1	9,500	Complete					0		

Logged in to: localhost:4002 as: Admin

B. Client roams to vap1 04:f0:21:69:91:03.

```

root@ben-5pci:~
File Edit View Search Terminal Help
[root@ben-5pci ~]# wpa_cli -i wlan4 scan
OK
[root@ben-5pci ~]# wpa_cli -i wlan4 roam 04:f0:21:69:91:03 DS
OK
[root@ben-5pci ~]# iwconfig wlan4
wlan4 IEEE 802.11abgn ESSID:"roamer"
        Mode:Managed Frequency:5.745 GHz Access Point: 04:F0:21:69:91:03
        Bit Rate=6 Mb/s Tx-Power=19 dBm
        Retry short limit:7 RTS thr:off Fragment thr=2346 B
        Encryption key:off
        Power Management:off
        Link Quality=70/70 Signal level=0 dBm
        Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
        Tx excessive retries:0 Invalid misc:0 Missed beacon:0

[root@ben-5pci ~]#

```

LANforge Manager Version(5.3.4)

Control Reporting Tear-Off Info Plugins

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr vAP Stations Messages

Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Attenuators File-I/O

Disp: 127.0.0.1:1.0 Sniff Packets Clear Counters Reset Port Delete

Rpt Timer: medium (8 s) Apply View Details Create Modify Batch Modify

All Ethernet Interfaces (Ports) for all Resources.

	bps TX LL	Bytes TX LL	bps RX LL	Bytes RX...	Reset	TX-Rate	RX-Rate	Status	AP	Activity	Signal	Noise
0	70	12,528	331	601,603	Complete		0 bps			101		
0	554	195,854	581	18,066,...	Complete		0 bps			101		
0	492	191,858	503	23,417,...	Complete		0 bps			101		
0	571	233,623	63	16,333,...	Complete		0 bps			101		
0	51	24,715	7,341	20,645,...	Complete		0 bps			2,562		
0	0	0	0	0	Complete		0 bps			0		
0	0	0	0	0	Complete		0 bps			0		
0	0	12,211	0	27,071	Complete	6 Mbps	6 Mbps	Authorized	04:F0:21:69:91:03	2,544	-27 dBm	-84 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	856	Complete					0		
0	0	0	0	1,252	Complete					0		
0	0	1,200	0	856	Complete					0		
0	0	2,520	0	8,274	Complete					0		
0	0	2,460	2	80	Complete					0		
0	2	80	0	2,460	Complete					0		
0	2	9,520	0	3,204	Complete					0		
0	0	3,204	1	9,520	Complete					0		

Logged in to: localhost:4002 as: Admin

C. Client roams to vap2 04:f0:21:33:28:06.

```

root@ben-5pci:~
File Edit View Search Terminal Help
[root@ben-5pci ~]# wpa_cli -i wlan4 scan
OK
[root@ben-5pci ~]# wpa_cli -i wlan4 roam 04:f0:21:33:28:06 DS
OK
[root@ben-5pci ~]# iwconfig wlan4
wlan4 IEEE 802.11abgn ESSID:"roamer"
Mode:Managed Frequency:5.745 GHz Access Point: 04:F0:21:33:28:06
Bit Rate=6 Mb/s Tx-Power=19 dBm
Retry short limit:7 RTS thr:off Fragment thr=2346 B
Encryption key:off
Power Management:off
Link Quality=70/70 Signal level=2 dBm
Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
Tx excessive retries:0 Invalid misc:0 Missed beacon:0

[root@ben-5pci ~]#

```

LANforge Manager Version(5.3.4)

Control Reporting Tear-Off Info Plugins

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr vAP Stations Messages

Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Attenuators File-I/O

Disp: 127.0.0.1:1.0 Sniff Packets Clear Counters Reset Port Delete

Rpt Timer: medium (8 s) Apply View Details Create Modify Batch Modify

All Ethernet Interfaces (Ports) for all Resources.

	bps TX LL	Bytes TX LL	bps RX LL	Bytes RX...	Reset	TX-Rate	RX-Rate	Status	AP	Activity	Signal	Noise
0	42	12,972	63	602,269	Complete		0 bps			0		
0	430	201,473	264	18,070,...	Complete		0 bps			101		
0	486	197,814	148	23,419,...	Complete		0 bps			101		
0	444	239,212	0	16,333,...	Complete		0 bps			0		
0	68	25,443	7,327	20,742,...	Complete		0 bps			2,481		
0	0	0	0	0	Complete		0 bps			0		
0	0	0	0	0	Complete		0 bps			0		
0	0	12,211	0	27,071	Complete	6 Mbps	6 Mbps	Authorized	04:F0:21:33:28:06	2,466	-14 dBm	-84 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	101	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	101	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	862	Complete					0		
0	0	0	0	1,258	Complete					0		
0	0	1,200	0	862	Complete					0		
0	0	2,520	0	8,280	Complete					0		
0	1	2,480	0	80	Complete					0		
0	0	80	1	2,480	Complete					0		
0	0	9,520	1	3,224	Complete					0		
0	2	3,224	0	9,520	Complete					0		

Logged in to: localhost:4002 as: Admin

D. Client roams to vap3 04:f0:21:b1:d7:0b.

```

root@ben-5pci:~
File Edit View Search Terminal Help
[root@ben-5pci ~]# wpa_cli -i wlan4 scan
OK
[root@ben-5pci ~]# wpa_cli -i wlan4 roam 04:f0:21:b1:d7:0b DS
OK
[root@ben-5pci ~]# iwconfig wlan4
wlan4 IEEE 802.11abgn ESSID:"roamer"
        Mode:Managed Frequency:5.745 GHz Access Point: 04:F0:21:B1:D7:0B
        Bit Rate=6 Mb/s Tx-Power=19 dBm
        Retry short limit:7 RTS thr:off Fragment thr=2346 B
        Encryption key:off
        Power Management:off
        Link Quality=70/70 Signal level=-8 dBm
        Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
        Tx excessive retries:1 Invalid misc:0 Missed beacon:0

[root@ben-5pci ~]#

```

LANforge Manager Version(5.3.4)

Control Reporting Tear-Off Info Plugins

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr vAP Stations Messages

Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Attenuators File-I/O

Disp: 127.0.0.1:1.0 Sniff Packets Clear Counters Reset Port Delete

Rpt Timer: medium (8 s) Apply View Details Create Modify Batch Modify

All Ethernet Interfaces (Ports) for all Resources.

	bps TX LL	Bytes TX LL	bps RX LL	Bytes RX...	Reset	TX-Rate	RX-Rate	Status	AP	Activity	Signal	Noise
0	18	13,239	123	603,379	Complete	0 bps	0 bps			101		
0	331	204,845	218	18,072,...	Complete	0 bps	0 bps			101		
0	362	201,600	146	23,421,...	Complete	0 bps	0 bps			0		
0	463	244,547	45	16,333,...	Complete	0 bps	0 bps			101		
0	43	26,074	4,455	20,785,...	Complete	0 bps	0 bps			2,464		
0	0	0	0	0	Complete	0 bps	0 bps			0		
0	0	0	0	0	Complete	0 bps	0 bps			0		
0	0	12,211	0	27,071	Complete	6 Mbps	6 Mbps	Authorized	04:F0:21:B1:D7:0B	2,445	-41 dBm	-85 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	1	874	Complete					0		
0	0	0	1	1,270	Complete					0		
0	0	1,200	1	874	Complete					0		
0	0	2,520	1	8,292	Complete					0		
0	4	2,520	0	80	Complete					0		
0	0	80	4	2,520	Complete					0		
0	4	9,560	0	3,224	Complete					0		
0	0	3,224	3	9,560	Complete					0		

Logged in to: localhost:4002 as: Admin

E. Client roams back to vap0 04:f0:21:b9:8f:00.

```

root@ben-5pci:~
File Edit View Search Terminal Help
[root@ben-5pci ~]# wpa_cli -i wlan4 scan
OK
[root@ben-5pci ~]# wpa_cli -i wlan4 roam 04:f0:21:b9:8f:00 DS
OK
[root@ben-5pci ~]# iwconfig wlan4
wlan4 IEEE 802.11abgn ESSID:"roamer"
        Mode:Managed Frequency:5.745 GHz Access Point: 04:F0:21:B9:8F:00
        Bit Rate=6 Mb/s Tx-Power=19 dBm
        Retry short limit:7 RTS thr:off Fragment thr=2346 B
        Encryption key:off
        Power Management:off
        Link Quality=70/70 Signal level=-17 dBm
        Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
        Tx excessive retries:0 Invalid misc:0 Missed beacon:0

[root@ben-5pci ~]#

```

LANforge Manager Version(5.3.4)

Control Reporting Tear-Off Info Plugins

Stop All Restart Manager Refresh HELP

Layer-4 Generic Test Mgr Test Group Resource Mgr Event Log Alerts Port Mgr vAP Stations Messages

Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Attenuators File-I/O

Disp: 127.0.0.1:1.0 Sniff Packets Clear Counters Reset Port Delete

Rpt Timer: medium (8 s) Apply View Details Create Modify Batch Modify

All Ethernet Interfaces (Ports) for all Resources.

	bps TX LL	Bytes TX LL	bps RX LL	Bytes RX...	Reset	TX-Rate	RX-Rate	Status	AP	Activity	Signal	Noise
0	74	14,047	142	604,267	Complete	0 bps	0 bps			101		
0	374	206,738	55	18,072,...	Complete	0 bps	0 bps			101		
0	416	203,493	111	23,421,...	Complete	0 bps	0 bps			0		
0	411	246,233	55	16,334,...	Complete	0 bps	0 bps			101		
0	56	26,636	2,664	20,802,...	Complete	0 bps	0 bps			2.47		
0	0	0	0	0	Complete	0 bps	0 bps			0		
0	0	0	0	0	Complete	0 bps	0 bps			0		
0	0	12,211	0	27,071	Complete	6 Mbps	6 Mbps	Authorized	04:F0:21:B9:8F:00	2.467	-16 dBm	-85 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	101	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	0	0	Complete	0 Mbps	0 bps	NONE	Not-Associated	0	0 dBm	-1 dBm
0	0	0	1	880	Complete					0		
0	0	0	1	1,276	Complete					0		
0	0	1,200	1	880	Complete					0		
0	0	2,520	1	8,298	Complete					0		
0	4	2,540	0	80	Complete					0		
0	0	80	4	2,540	Complete					0		
0	4	9,580	0	3,224	Complete					0		
0	0	3,224	2	9,580	Complete					0		

Logged in to: localhost:4002 as: Admin

For more information see [Two WiFi Access Point Network with 802.11r](#)

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