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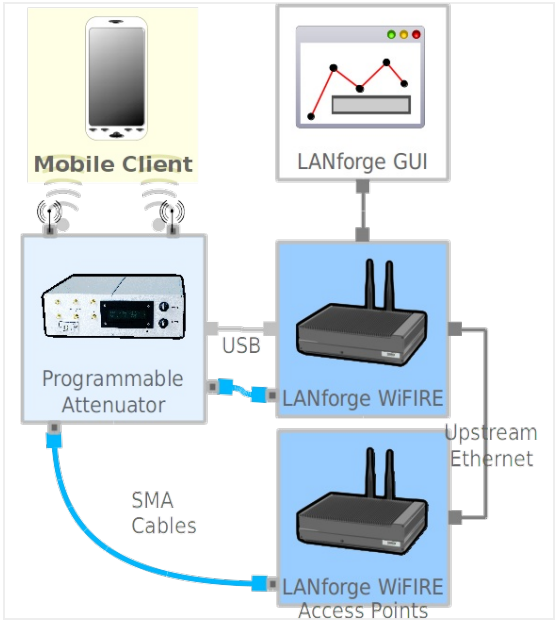
Emulating Station Motion with a Programmable Attenuator

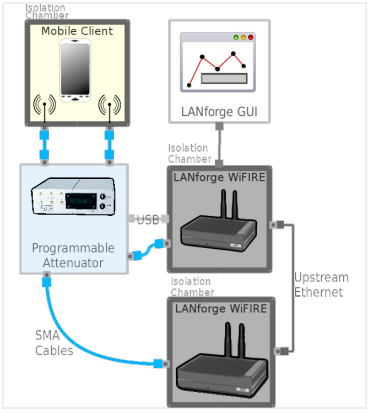
Goal: Test the AP migration of a station by changing the attenuation of two or more APs.

By changing the apparent distance of multiple APs, we provide an environment that emulates moving through a series of AP coverage areas. We can set the rate of change to emulate the speed of the station's movement. We can set the emulated distance for APs so it appears that the APs are further apart or closer together.



This cookbook scenario illustrates a minimal motion emulation setup: two Candela CT520 systems are providing a 1x1 AP signal to a CT703 Programmable Attenuator. A cell phone is sitting near the attenuator. (Illustration at right.)

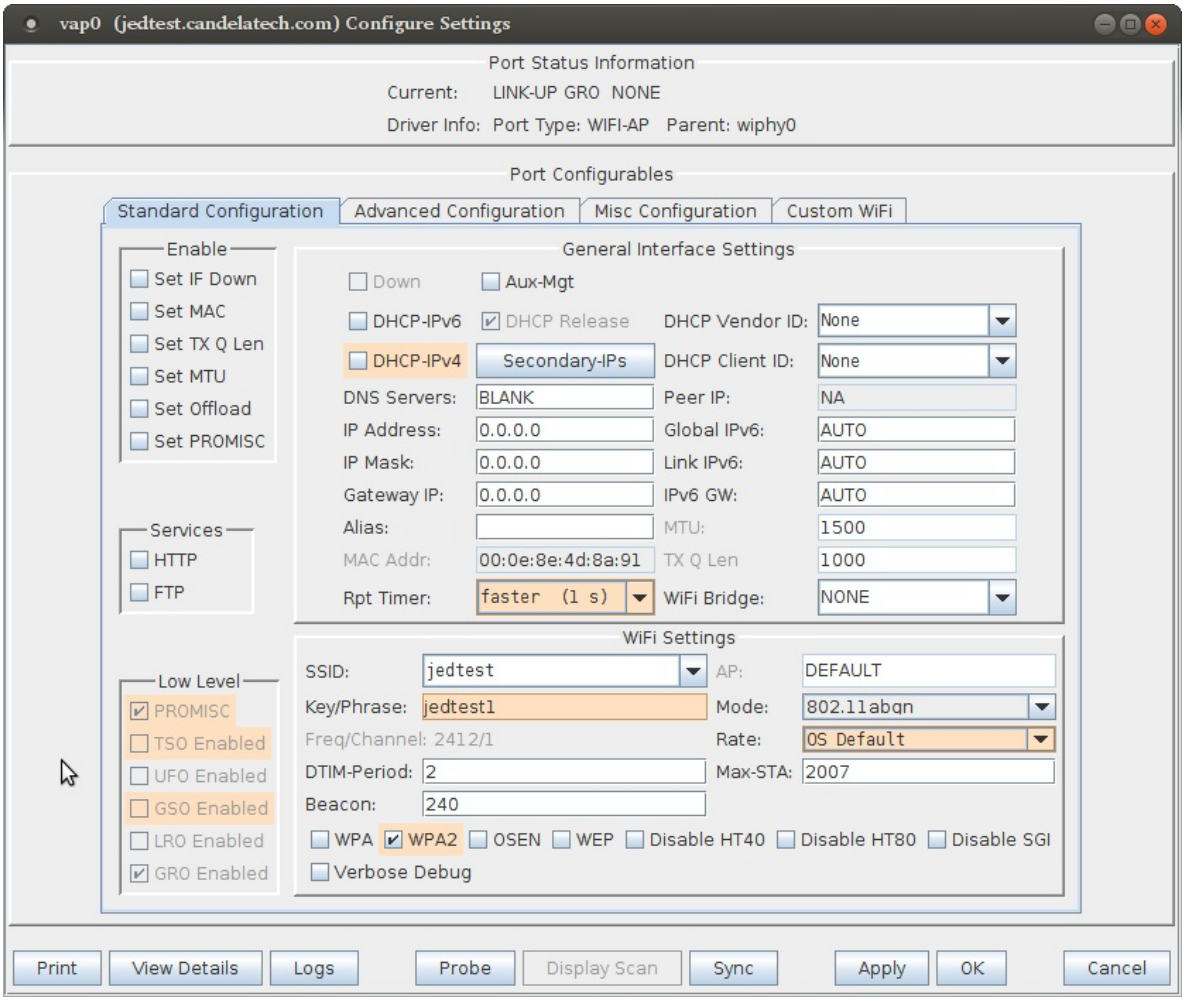
There are many possible testing scenarios. One ideal method would be to place each AP and phone into isolation chambers, and wire a programmable attenuator to each AP, placing the antennas in the phone's isolation chamber. (Illustration below.)



It is possible to use third-party access points, but then the LANforge would not be able to report as many statistics, and would be used mostly for just operating the programmable attenuator(s). Third-party APs may be able to provide their own reporting to make this scenario more useful.

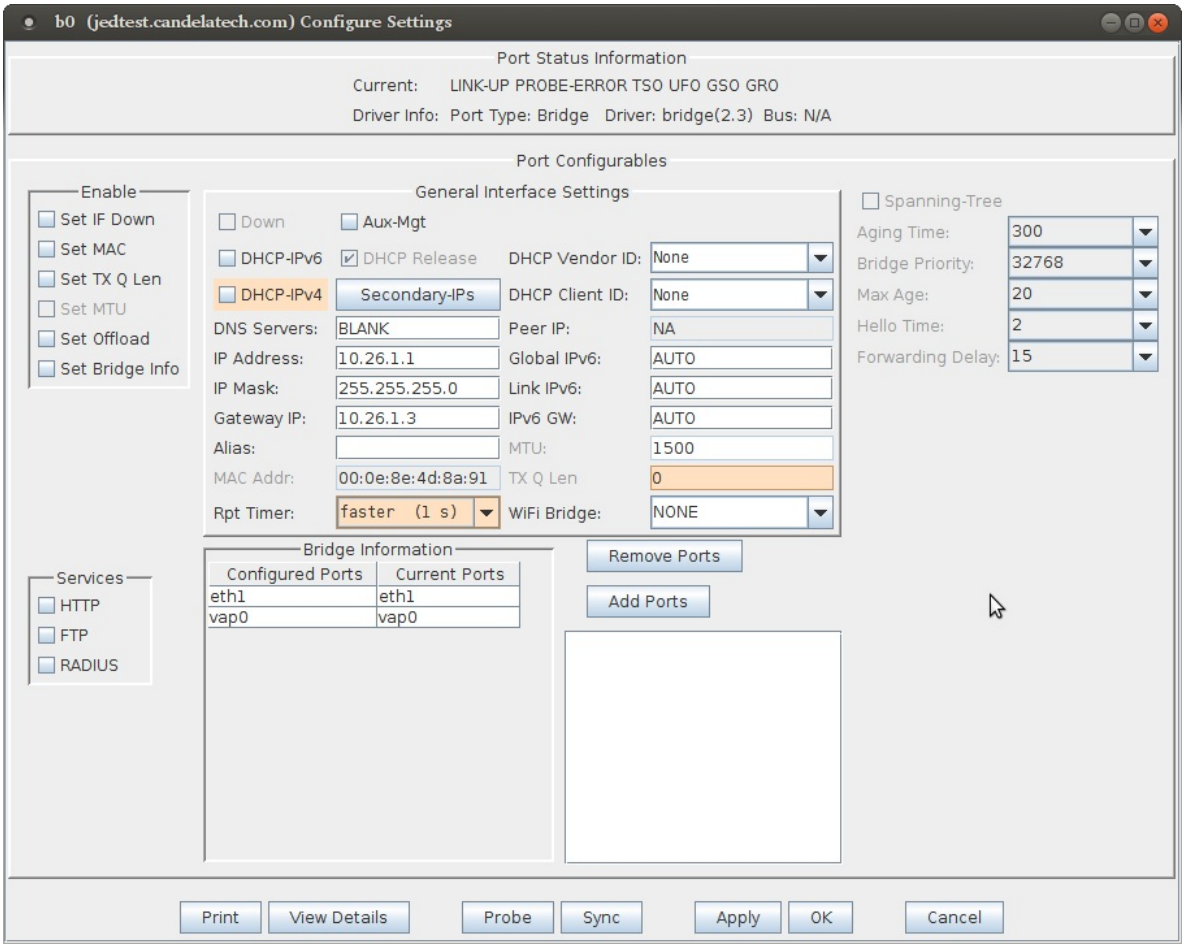
1. Setup two LANforge units. The LANforge manager unit will connect to a CT703 attenuator via USB cable for control and provide a virtual AP. The LANforce resource unit will provide a second AP isolated from the first.
2. Configure Networking on Manager node:
   A. In **Ports** tab, On Manager resource, Create bridge `b0` and add `eth1` to it.
   B. Set the address and mask of **eth1** to 0.0.0.0

C. Select **wiphy0** and create Virtual Access Point `vap0` with:



A. channel: **1**
B. SSID: **jedtest**
C. passphrase: `jedtest1`
D. mode:**ABGN**
E. IP: `0.0.0.0`
F. Mask: `0.0.0.0`
G. Enable **WPA2**
H. Click **OK**

D. Create bridge `b0`



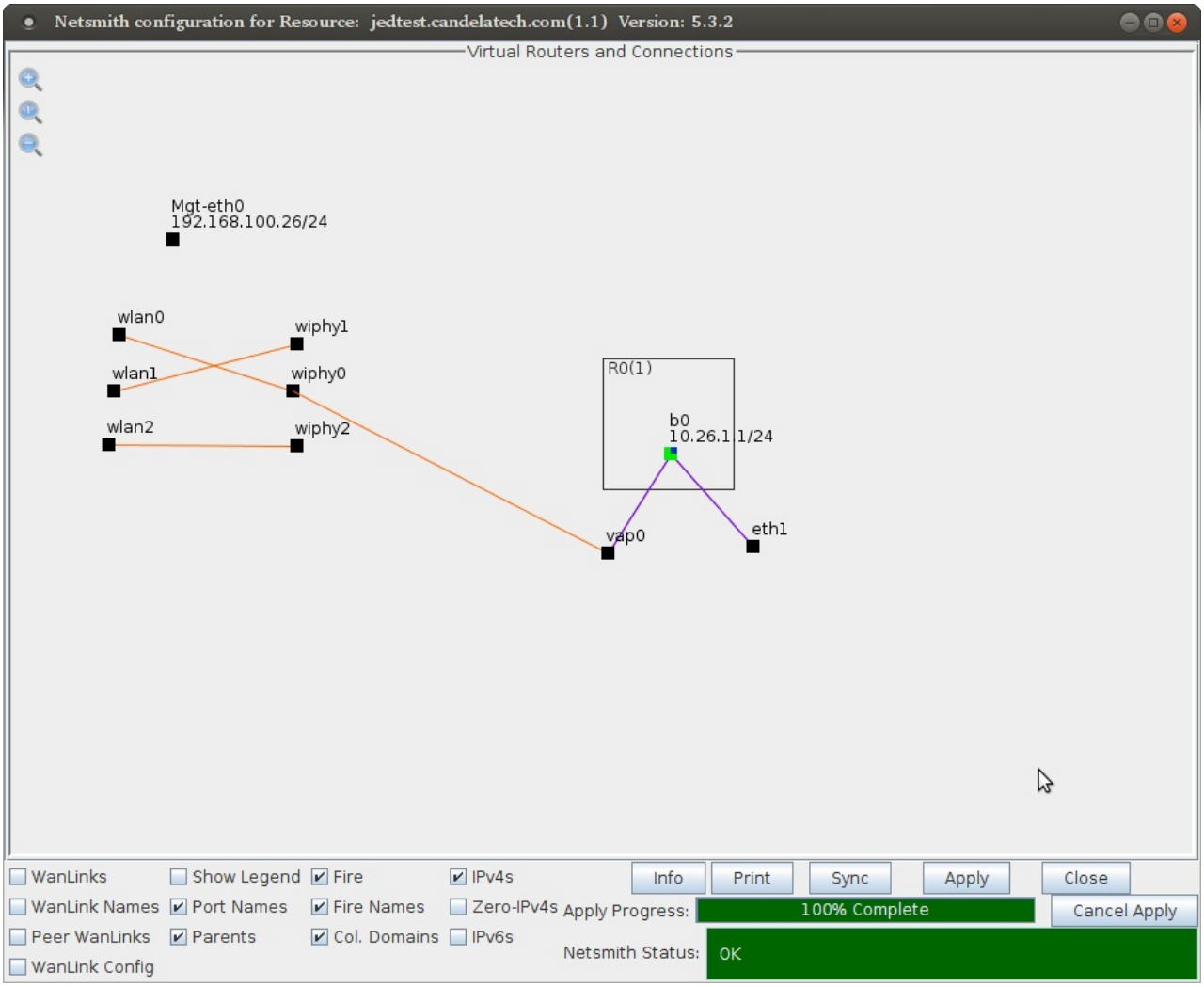
A. Assign address of `10.26.1.1` to bridge
B. Set gateway to `10.26.1.3`
C. Add `vap0` to bridge `b0`

E. In **Netsmith**, create a virtual router.

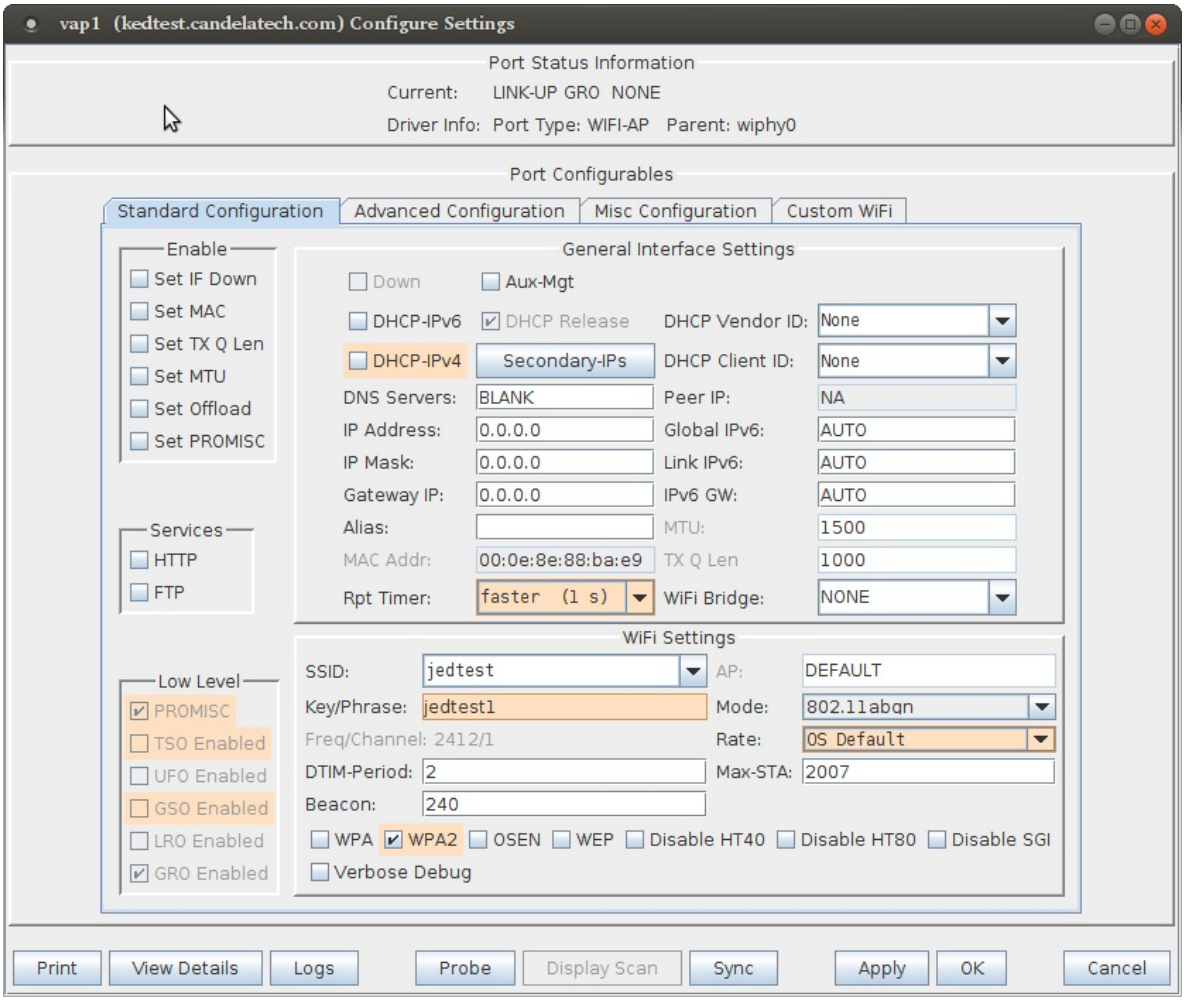
F. Add bridge `b0` to virtual router, click **Apply**

G. **Right click → Modify** `b0` in the router, and enable **DHCP**. Create a DHCP pool with time:**1200**, starting address: `10.26.1.20`, ending address: `10.26.1.200`. Click **Apply**, close window. Close Netsmith.

3. Your networking in resource 1 would look like:

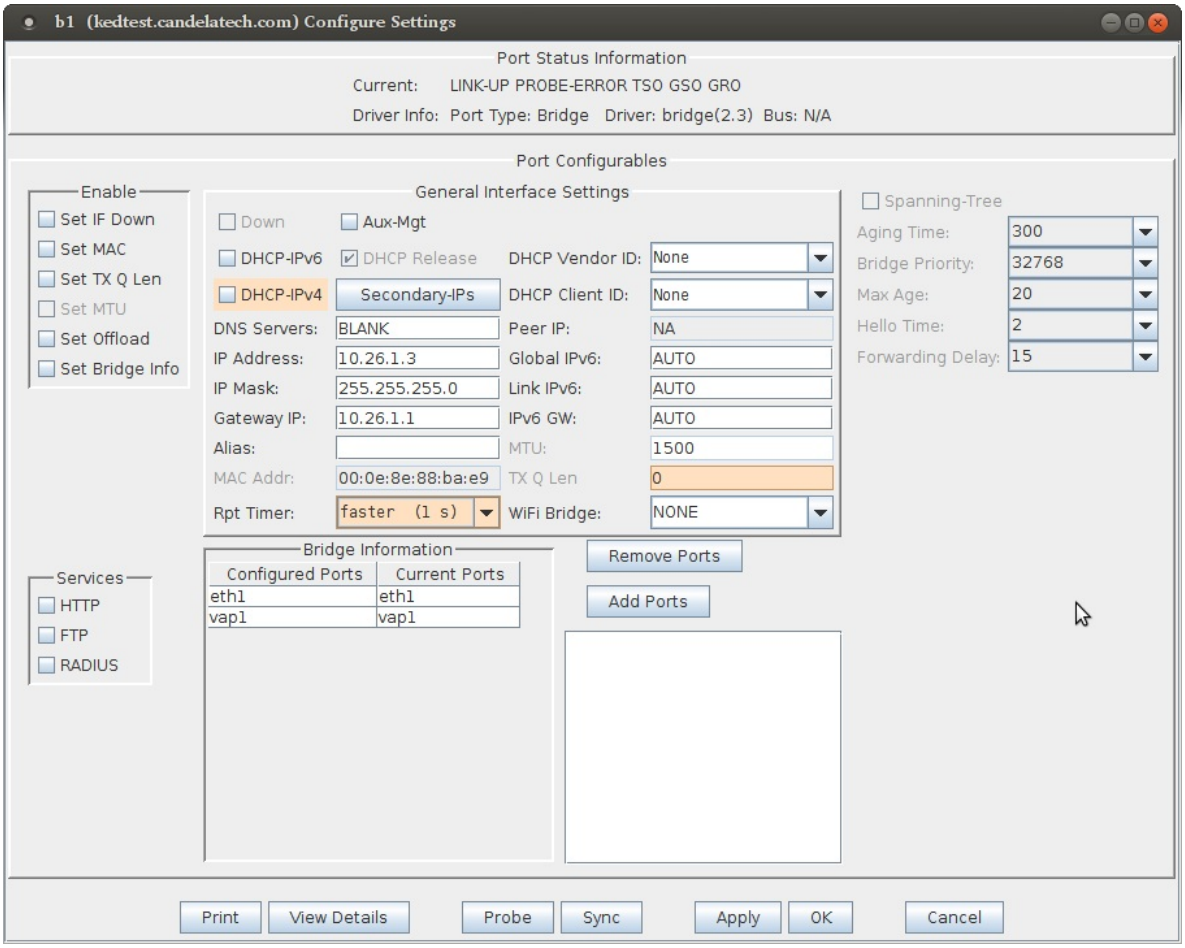


4. In **Ports** tab, for resource 2 node:
   A. Set address and mask of **eth1** to 0.0.0.0
   B. Select **wiphy0** and create Virtual Access Point `vap1` with:



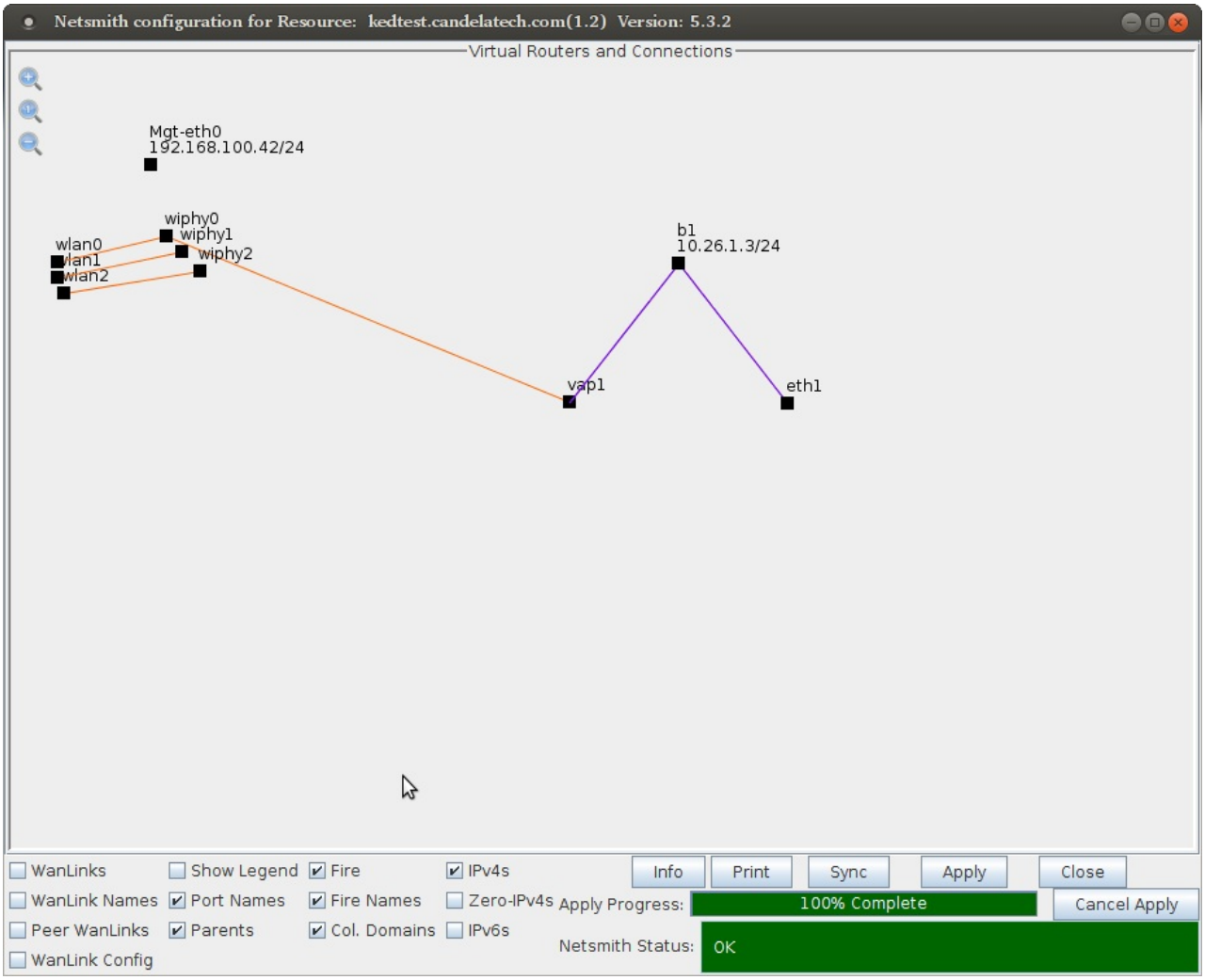
A. channel: **1**
B. SSID: **jedtest**
C. passphrase: `jedtest1`
D. mode:**ABGN**
E. IP: `0.0.0.0`
F. Mask: `0.0.0.0`
G. Enable **WPA2**
H. Click **OK**

C. Create bridge `b1`

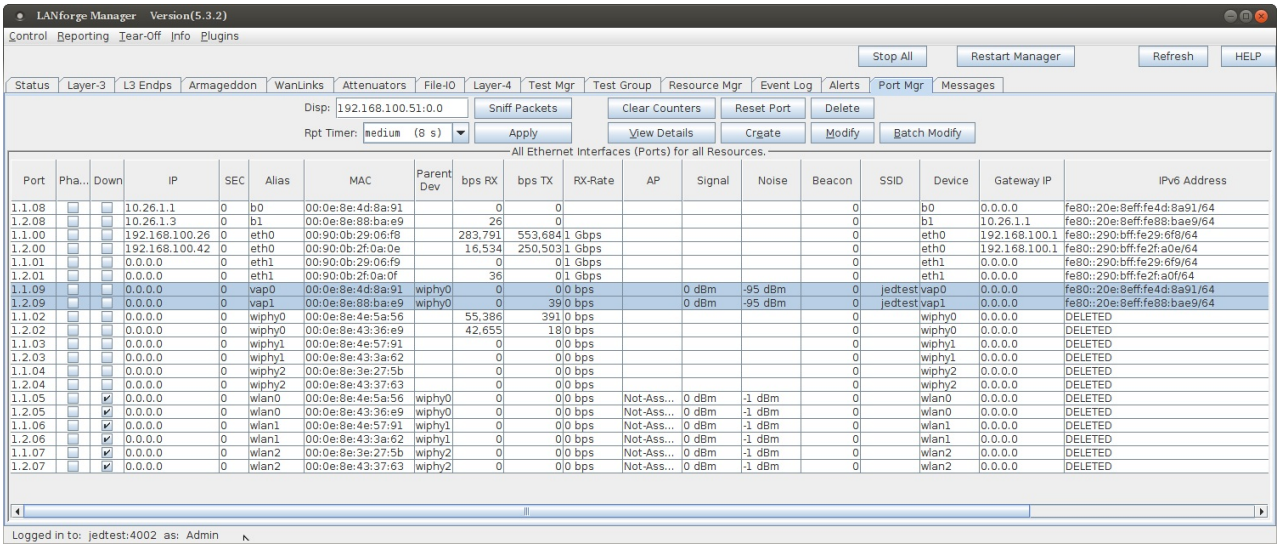


A. Assign address of `10.26.1.3` to bridge
B. Add `vap1` to bridge `b1`
C. and add `eth1` to it.
D. set gateway to `10.26.1.1`

5. Your networking in resource 2 would look like:

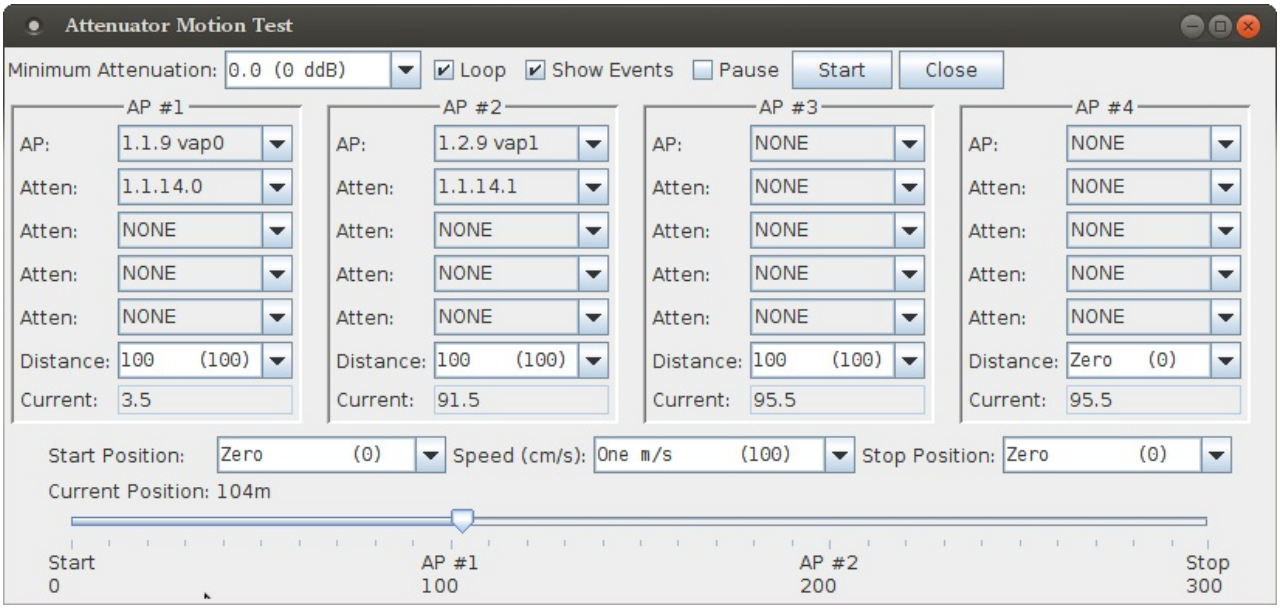


6. Your **Ports** tab would show a b0, b1, vap0, vap1 and two eth1 ports like below:



Port	Pha...	Down	IP	SEC	Alias	MAC	Parent Dev	bps RX	bps TX	RX-Rate	AP	Signal	Noise	Beacon	SSID	Device	Gateway IP	IPv6 Address
1.1.08			10.26.1.1	0	b0	00:0e:8e:4d:8a:91		0	0					0		b0	0.0.0.0	fe80::20e:8eff:fe4d:8a91/64
1.2.08			10.26.1.3	0	b1	00:0e:8e:88:ba:e9		26	0					0		b1	10.26.1.1	fe80::20e:8eff:fe88:bae9/64
1.1.00			192.168.100.26	0	eth0	00:90:0b:29:06:f8		283,791	553,684	1 Gbps				0		eth0	192.168.100.1	fe80::290:bff:fe29:6f8/64
1.2.00			192.168.100.42	0	eth0	00:90:0b:2f:0a:0e		16,534	250,503	1 Gbps				0		eth0	192.168.100.1	fe80::290:bff:fe2f:a0e/64
1.1.01			0.0.0.0	0	eth1	00:90:0b:29:06:f9		0	0	1 Gbps				0		eth1	0.0.0.0	fe80::290:bff:fe29:6f9/64
1.2.01			0.0.0.0	0	eth1	00:90:0b:2f:0a:0f		36	0	1 Gbps				0		eth1	0.0.0.0	fe80::290:bff:fe2f:a0f/64
1.1.09			0.0.0.0	0	vap0	00:0e:8e:4d:8a:91	wiphy0	0	0	0 bps		0 dBm	-95 dBm	0	jedtest	vap0	0.0.0.0	fe80::20e:8eff:fe4d:8a91/64
1.2.09			0.0.0.0	0	vap1	00:0e:8e:88:ba:e9	wiphy0	0	39	0 bps		0 dBm	-95 dBm	0	jedtest	vap1	0.0.0.0	fe80::20e:8eff:fe88:bae9/64
1.1.02			0.0.0.0	0	wiphy0	00:0e:8e:4e:5a:56		55,386	391	0 bps				0		wiphy0	0.0.0.0	DELETED
1.2.02			0.0.0.0	0	wiphy0	00:0e:8e:43:36:e9		42,655	18	0 bps				0		wiphy0	0.0.0.0	DELETED
1.1.03			0.0.0.0	0	wiphy1	00:0e:8e:4e:57:91		0	0	0 bps				0		wiphy1	0.0.0.0	DELETED
1.2.03			0.0.0.0	0	wiphy1	00:0e:8e:43:3a:62		0	0	0 bps				0		wiphy1	0.0.0.0	DELETED
1.1.04			0.0.0.0	0	wiphy2	00:0e:8e:3e:27:5b		0	0	0 bps				0		wiphy2	0.0.0.0	DELETED
1.2.04			0.0.0.0	0	wiphy2	00:0e:8e:43:37:63		0	0	0 bps				0		wiphy2	0.0.0.0	DELETED
1.1.05		✔	0.0.0.0	0	wlan0	00:0e:8e:4e:5a:56	wiphy0	0	0	0 bps	Not-Ass...	0 dBm	-1 dBm	0		wlan0	0.0.0.0	DELETED
1.2.05		✔	0.0.0.0	0	wlan0	00:0e:8e:43:36:e9	wiphy0	0	0	0 bps	Not-Ass...	0 dBm	-1 dBm	0		wlan0	0.0.0.0	DELETED
1.1.06		✔	0.0.0.0	0	wlan1	00:0e:8e:4e:57:91	wiphy1	0	0	0 bps	Not-Ass...	0 dBm	-1 dBm	0		wlan1	0.0.0.0	DELETED
1.2.06		✔	0.0.0.0	0	wlan1	00:0e:8e:43:3a:62	wiphy1	0	0	0 bps	Not-Ass...	0 dBm	-1 dBm	0		wlan1	0.0.0.0	DELETED
1.1.07		✔	0.0.0.0	0	wlan2	00:0e:8e:3e:27:5b	wiphy2	0	0	0 bps	Not-Ass...	0 dBm	-1 dBm	0		wlan2	0.0.0.0	DELETED
1.2.07		✔	0.0.0.0	0	wlan2	00:0e:8e:43:37:63	wiphy2	0	0	0 bps	Not-Ass...	0 dBm	-1 dBm	0		wlan2	0.0.0.0	DELETED

7. Open the Attenuator Motion plugin and configure a scenario. In this scenario, our attenuator is numbered 1.1.14.



A. Change **Minimum attenuation** to `0.0` because we're doing an over-the-air test. You would set a higher minimum when cabling directly to the client station.

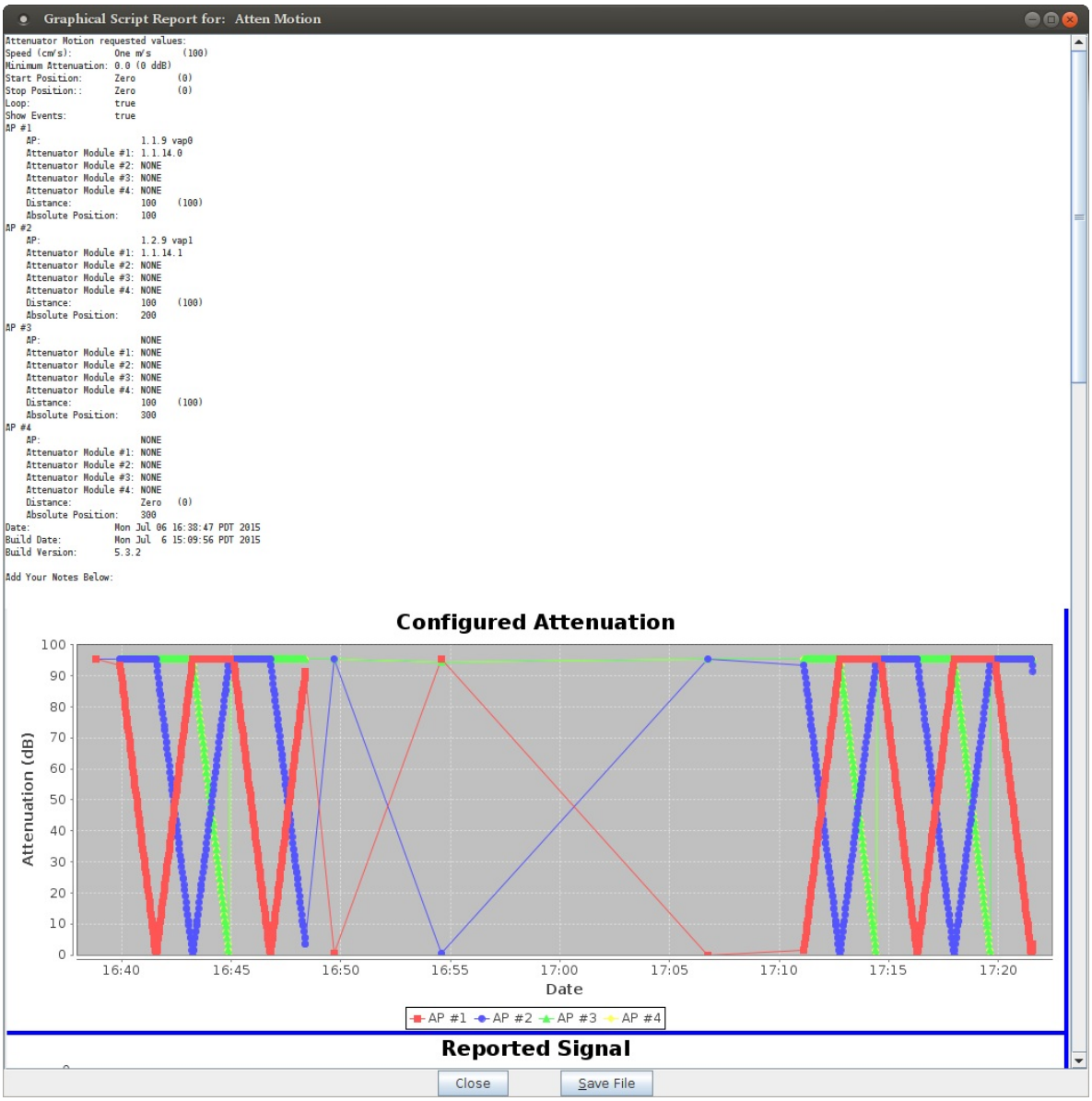
B. Enable **Loop** if desired.

C. Specify the first attenuator module wired to manager radio **wiphy0** as AP #1.
   A. AP: **vap0**
   B. Atten: `1.1.14.0` This indicates attenuator module 1. (Ranges are 0-2 for CT703 and 0-3 CT704 models of programmable attenuators.)
   C. Distance: 100 (Meters)

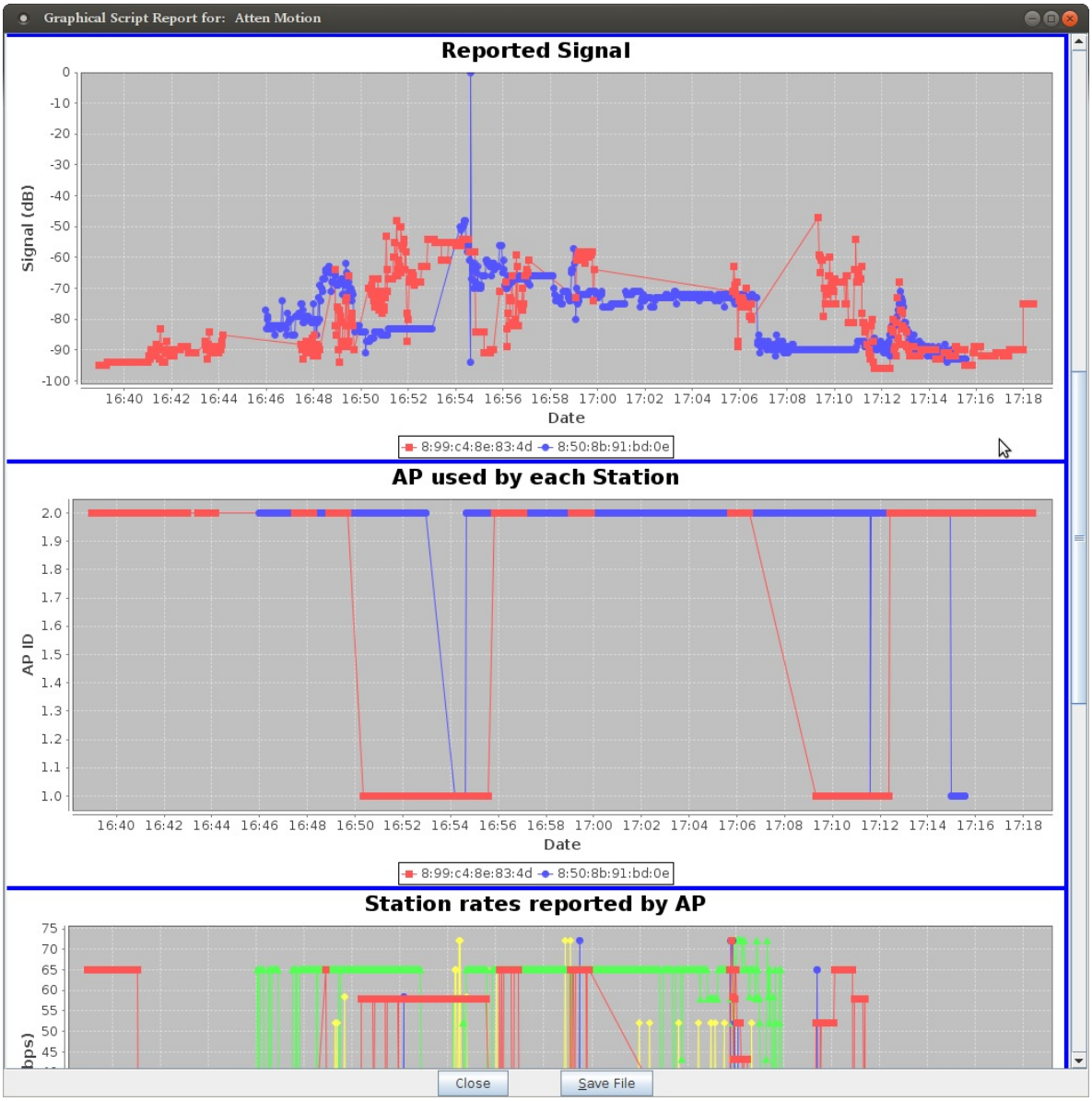
D. Specify the second attenuator module wired to resource 2 radio **wiphy0** as AP #2.
   A. AP: **vap1**
   B. Atten: `1.1.14.1` This indicates attenuator module 2. (Ranges are 0-2 for CT703 and 0-3 CT704 models of programmable attenuators.)
   C. Distance: 100 (Meters)

E. Configure the remaining settings so that looping does not unecessarily pause
   A. AP #3 should be at Distance 100.
   B. AP #4 should be at Distance 0.
   C. Set *Speed* to **1m/s**
   D. Set *Stop Position* to **Zero**.

F. Click **Start** and a report window will appear. The image below shows repeated looping and pausing, as well as some manual adjustment.



G. Verify station associations. In the picture below, two cell phones are present for the test. They jump between AP ID 1.0 (AP #1) and ID 2.0 (AP #2). In our testing, it does not appear our phones do a good job of jumping to a higher quality AP when the signal to the current AP is weak. But, it will normally associate properly to the 'best' AP when it looses connection to the old AP.



A. Click **Pause**

B. Drag the position slider to distance **100** to center the station under AP #1.

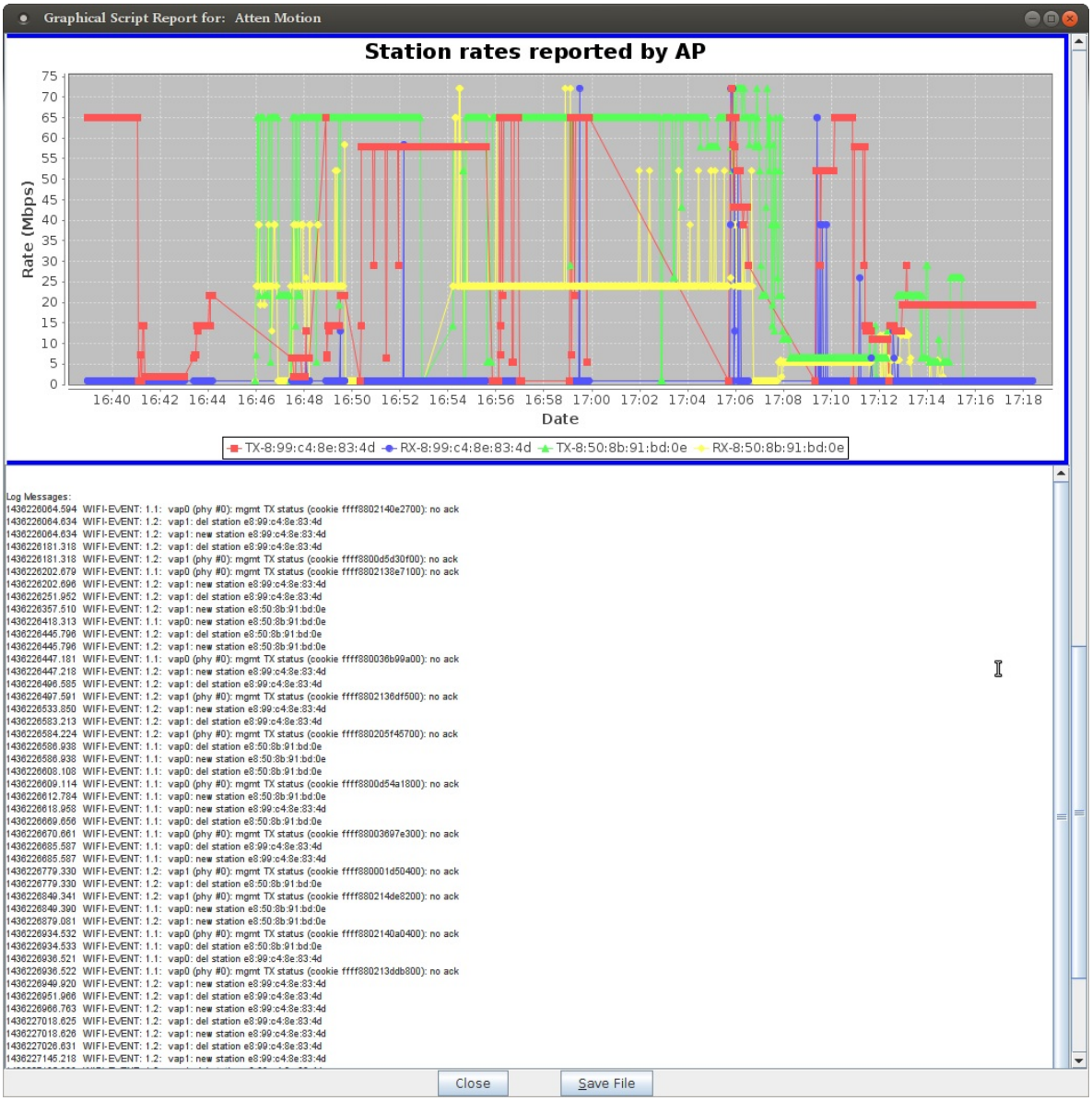
C. Check that the phone associates with AP #1.

D. Disable phone WiFi connection.

E. Drag the position slider to distance **200** to center the station under AP #2.

F. Enable phone WiFi connection, and check that phone associates with AP #2.

H. Run looping test. In graph *Configured Attenuation* above, and the *Station rates reported by AP* graph below, you can see that first cell phone had a difficult time associating to the APs while they were migrating: the reported TX and RX rates for it are zero or very sparse. A steady stream of data (fast ping, iperf download, etc) should be run to or from the phone (DUT) to ensure accurate tx/rx rate reports. That was not done in this scenario.



A. During this test your phone will attempt to roam to anything. In your phone WiFi settings, force the phone to forget your nearby (non-testing) APs. You might have to change the WPA2 passwords kept in your phone WiFi settings for those nearby APs to force them to fail association with APs outside this test.

B. Uncheck **Pause** and the test will resume automatic attenuation of each AP.

C. At Candela Technologies, our testing showed our Android phones were not behaving optimally. Part of the problem is that we were not using isolation chambers, so even the 'out-of-range' APs were visible at around -80db signal level. We concluded that our phones were not smart enough to notice a weak AP and take proactive steps to scan for a better one.