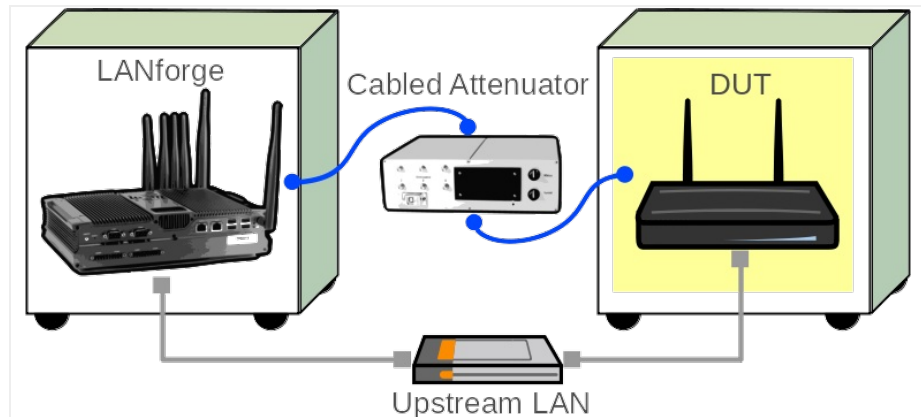


Testing AP with automated TR-398 scenario

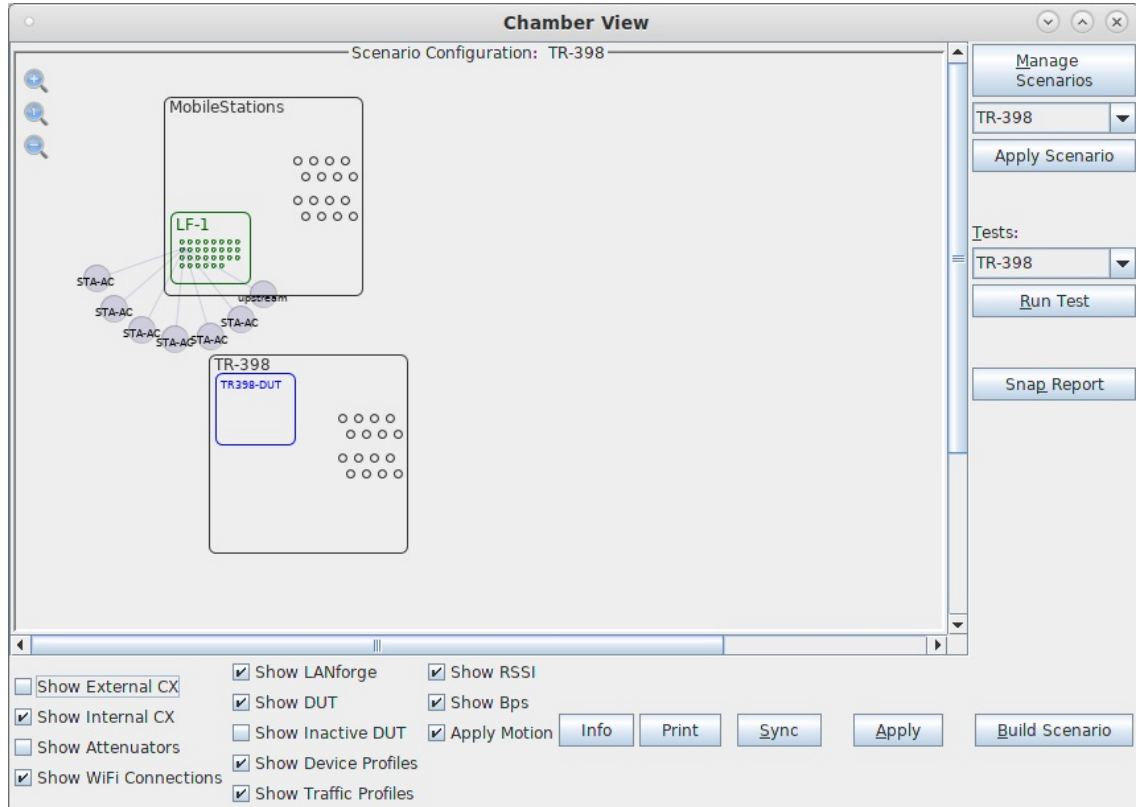
Goal: Setup and run a TR-398 test for an AP using a 6-radio version of the LANforge CT523c or similar system in order to test how well the AP can handle the various test cases specified in the TR-398 test document.

In this test scenario, the LANforge CT523c is used to emulate different station and AP scenarios and generate and receive traffic through an AP. This example assumes you have some experience with Chamber View, and that you have an appropriate LANforge system, programmable attenuators like the CT714 and two isolation chambers like the CT820a and CT840a. The AP should be in the chamber with the 2D turntable, the LANforge system is in the other chamber, and the attenuators are cabled between them. This feature requires LANforge version 5.4.1 or higher and the LANforge TR-398 automation software license.



1. Configure Chamber View for TR-398 and Similar Tests.

- A. Open Chamber View by clicking on the 'Chamber View' button in the LANforge-GUI. If you have an appropriate scenario already created, then skip to the next section, otherwise you will need to build a scenario that matches your system. You can right-click in Chamber View to create various objects. In this example, the 'MobileStations' chamber holds the LANforge, and the TR-398 chamber holds the Device Under Test. Your configuration should look like this when these steps are complete.



- B. Create a Device Under Test (DUT) Profile that matches your AP. The BSSID is important to be configured so that LANforge knows when it is connected to the correct AP.

Name	TR398-DUT		
Image file	NONE	Choose Image	x
SW Info		HW Info	
Model Number		Serial Number	
Serial port		WAN	
LAN		API version	0
SSID-1	s-lanforge5	Password-1	lanforge123
SSID-2	s-lanforge2	Password-2	lanforge123
SSID-3		Password-3	
Mgt IP	0.0.0.0	Ant-1	0
Ant-2	0	Ant-3	0
BSSID-1	00:00:00:ff:b4:ad	BSSID-2	00:00:00:ff:b4:aa
BSSID-3	00:00:00:00:00:00	<input checked="" type="checkbox"/> Active	<input checked="" type="checkbox"/> AP DUT
<input type="checkbox"/> STA DUT	<input type="checkbox"/> WEP	<input type="checkbox"/> WPA	<input checked="" type="checkbox"/> WPA2
<input type="checkbox"/> WPA3	<input type="checkbox"/> 802.11r	<input type="checkbox"/> 802.1x EAP-TTLS	<input checked="" type="checkbox"/> Provides DHCP on LAN
<input type="checkbox"/> Provides DHCP on WAN			
Notes			

- C. Create a chamber object to hold the DUT, and add the DUT to that chamber. If you have no chambers, you can create a fake chamber, but your test will not be isolated and may not function as desired. The turntable configuration is different for different models of chambers, this example (bare IP address) is for the CT840a chamber.

Create/Modify Chamber

Name: TR-398 Width: 150 Height: 150
 Chamber Type: 2D Large (3) Isolation: 80 Speed (rpm): 3.0
 Turntable Type: CT840A (2) Turntable: 192.168.100.10 Position (deg): 0.0 Tilt (deg): 0.0
 Managed By: 1 (mobilestations) Turntable Rpt: Position: 0.0 Tilt: 0.0 RPM: 3.0 Connected Virtual Open

DUT-1: TR398-DUT DUT-2:
 DUT-3:
 DUT-4:
 LANforge-1: None LANforge-2:
 LANforge-3: None LANforge-4:
 Int CX A Int CX B Int Atten Ext CX A Ext CX B Ext Atten Atten Floor Zero-Atten RSSI 2.4Ghz Zero-Atten RSSI 5Ghz

Int CX A	Int CX B	Int Atten	Ext CX A	Ext CX B	Ext Atten	Atten Floor	Zero-Atten RSSI 2.4Ghz	Zero-Atten RSSI 5Ghz
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)
						Cable (100 ddb)	None (0 ddb)	None (0 ddb)

Sync Apply OK Cancel

- D. Create a chamber object to hold the LANforge system, and add the LANforge to it. Add connections from this chamber to the DUT chamber, specifying the proper Attenuator modules. Please note we use the 'OTA' attenuation floor since we have OTA connection between DUT and antennas inside the DUT chamber. Please view our other cookbook on [setting up attenuator connections in LANforge](#).

Create/Modify Chamber

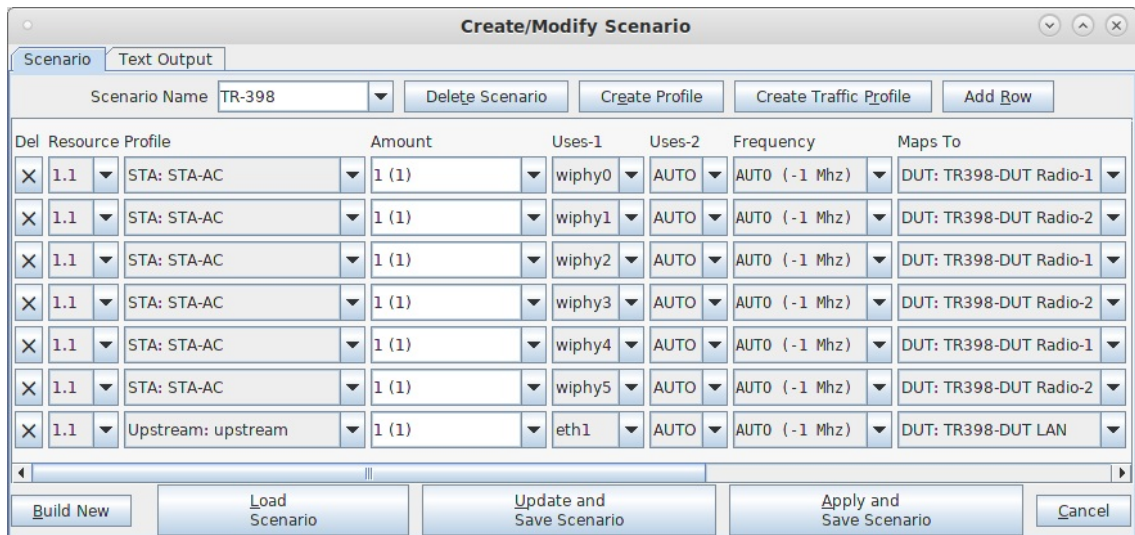
Name: MobileStations Width: 150 Height: 150
 Chamber Type: Medium (1) Isolation: 80 Speed (rpm): 0.0
 Turntable Type: CT850A (0) Turntable: Position (deg): 0.0 Tilt (deg): 0.0
 Managed By: None Turntable Rpt: Position: 0.0 Tilt: 0.0 RPM: 0.0 Virtual Open

DUT-1:
 DUT-2:
 DUT-3:
 DUT-4:
 LANforge-1: 1 (mobilestations) LANforge-2:
 LANforge-3: None LANforge-4:
 Int CX A Int CX B Int Atten Ext CX A Ext CX B Ext Atten Atten Floor Zero-Atten RSSI 2.4Ghz Zero-Atten RSSI 5Ghz

Int CX A	Int CX B	Int Atten	Ext CX A	Ext CX B	Ext Atten	Atten Floor	Zero-Atten RSSI 2.4Ghz	Zero-Atten RSSI 5Ghz
None	None		Chamber.MobileStations.0	Chamber.TR-398.0	1.1.85.3	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.1	Chamber.TR-398.1	1.1.85.2	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.2	Chamber.TR-398.2	1.1.85.1	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.3	Chamber.TR-398.3	1.1.85.0	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.4	Chamber.TR-398.4	1.1.1002.3	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.5	Chamber.TR-398.5	1.1.1002.2	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.6	Chamber.TR-398.6	1.1.1002.1	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		Chamber.MobileStations.7	Chamber.TR-398.7	1.1.1002.0	OTA (0 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)
None	None		None	None		Cable (100 ddb)	None (0 ddb)	None (0 ddb)

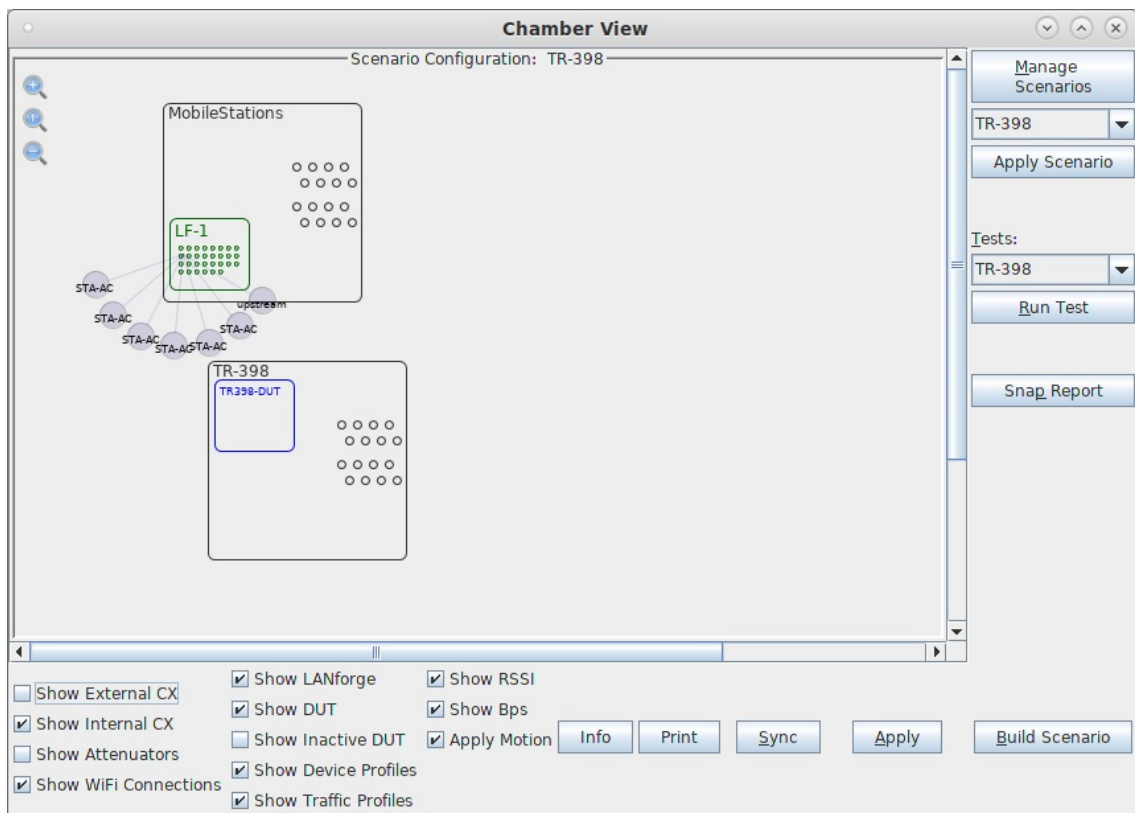
Sync Apply OK Cancel

- E. Configure a Chamber View Scenario and add the STA profile (mapped to desired wiphyX radio and DUT). Add an upstream profile mapped to DUT LAN side (or possibly WAN side if that is more appropriate for your DUT).

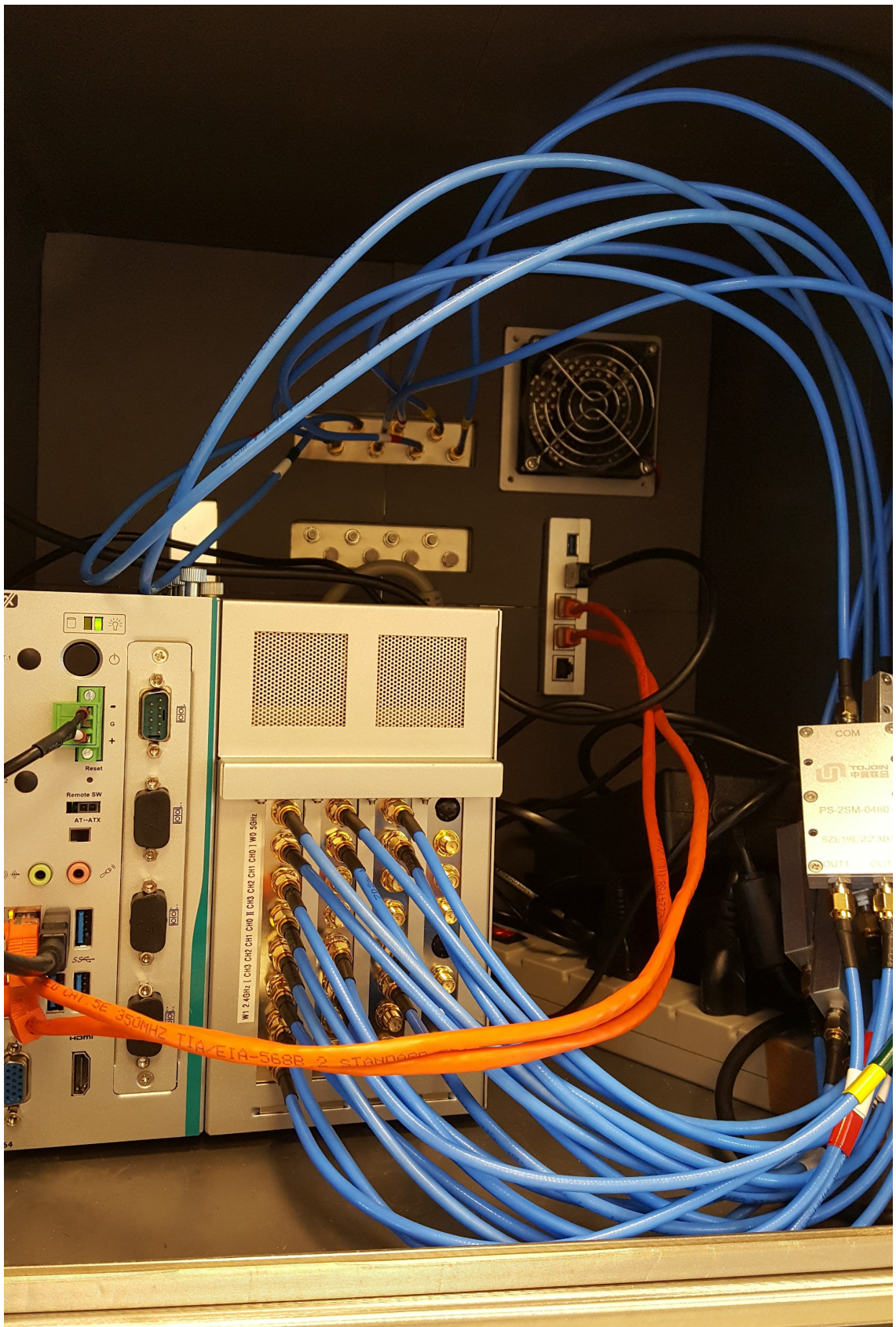


2. Use Chamber View for TR-398 test.

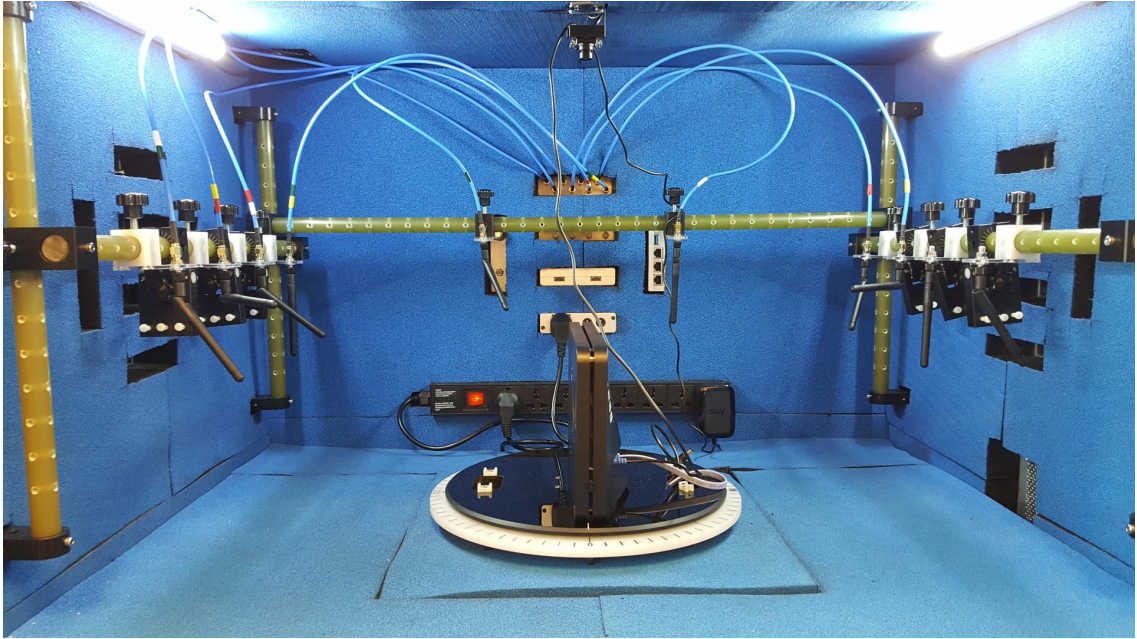
- A. Open Chamber View by clicking on the 'Chamber View' button in the LANforge-GUI. Load appropriate scenario. Apply the Scenario, then Build the scenario.



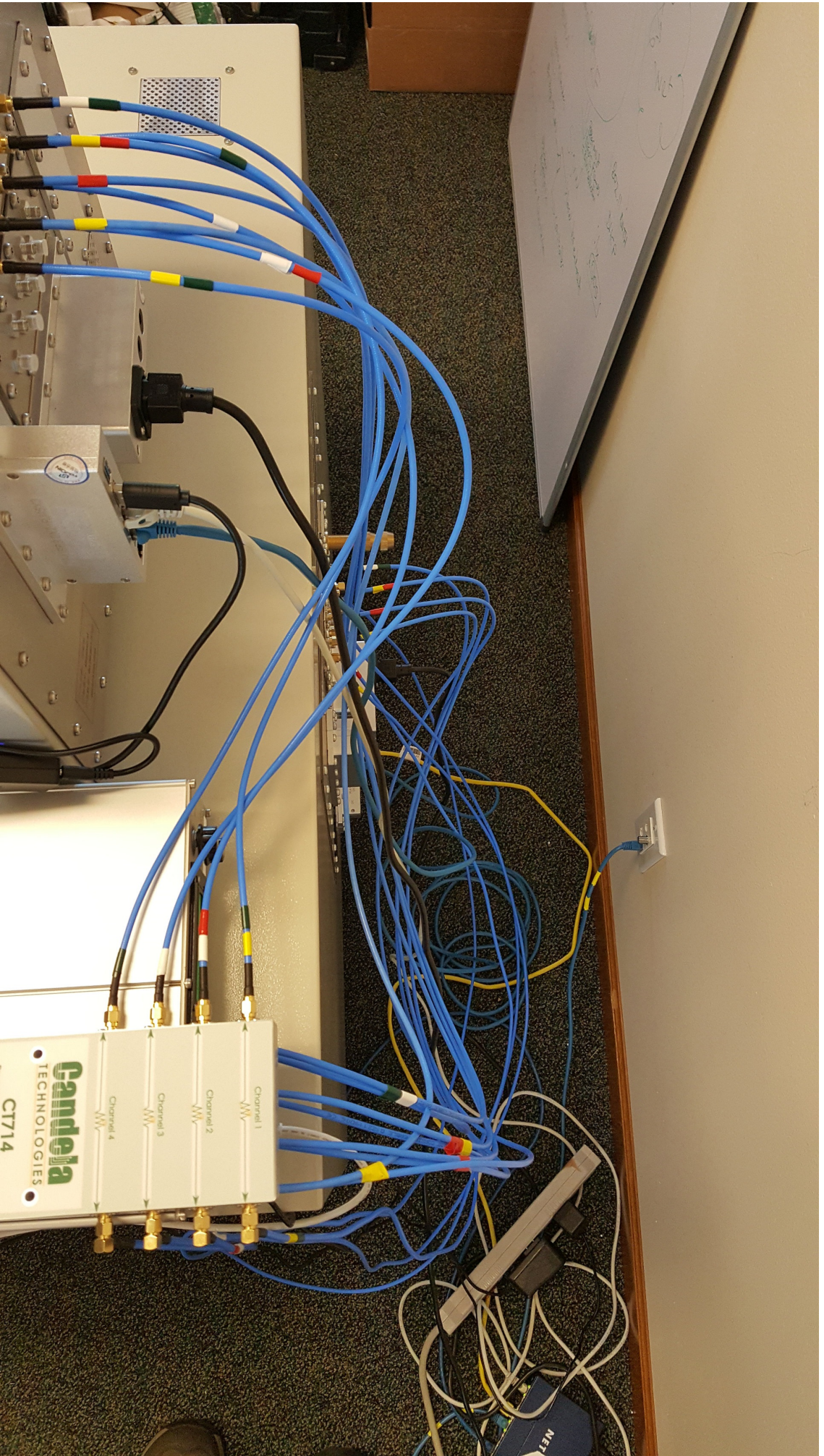
- B. To help make the cable routing easier to understand, you may wish to color-code the cables with tape or other similar markings.. Inside of the LANforge chamber:



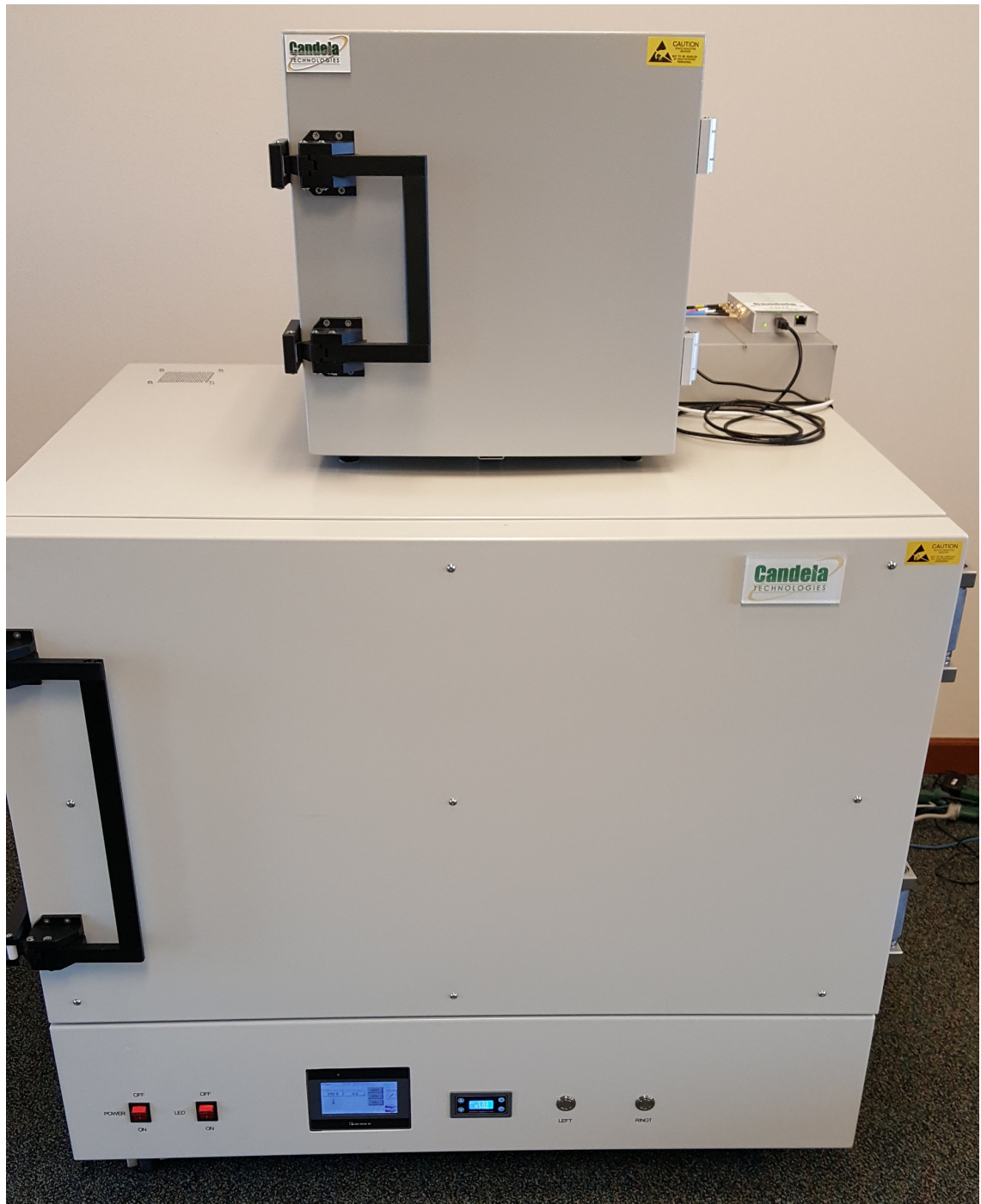
C. Inside of the DUT chamber:



D. Outside, back view:



E. Front view, all closed up and ready to test:



- F. Select the **TR-398** test and click **Run Test**. You should see the TR-398 Test configuration window pop up. It will remember the last configuration for most fields. Select the 2.4 and 5Ghz DUT, turn-table chamber, and carefully associate the radios with correct attenuator modules. For the first run, we will just run the calibration test to auto-configure the path loss by adjusting the attenuators and testing RSSI:

The screenshot shows the 'Settings' tab of the 'TR-398 Automated Test' window. The configuration is as follows:

- Selected DUT 5G: TR398-DUT s-lanforge5, Upstream Port: 1.1.1 eth1
- Selected DUT 2G: TR398-DUT s-lanforge2, Turn-Table-Chamber: TR-398
- 2.4Ghz 2m RSSI: -24, 5Ghz 2m RSSI: -32
- Extra Download Path-loss: 3

Group	Radio	2.4Ghz RSSI 0 Atten	5Ghz RSSI 0 Atten	Attenuator Modules
Group: 0	5Ghz (1.1.2 wiphy0)	-28	-20	1.1.85.3
	2.4Ghz (1.1.3 wiphy1)	-28	-20	1.1.85.2
		-28	-20	1.1.1002.1
		-28	-20	1.1.1002.0
Group: 1	5Ghz (1.1.4 wiphy2)	-20	-42	1.1.85.1
	2.4Ghz (1.1.5 wiphy3)	-20	-42	1.1.85.0
		-20	-42	
		-20	-42	
Group: 2	5Ghz (1.1.6 wiphy4)	-38	-44	1.1.1002.3
	2.4Ghz (1.1.7 wiphy5)	-38	-44	1.1.1002.2
		-38	-44	
		-38	-44	

TR-398 tests to run: Estimated Test Duration: 10 m

- Calibrate Attenuators
- Receiver Sensitivity
- Range Versus Rate
- Downlink MU-MIMO
- Maximum Connection
- Spatial Consistency
- AP Coexistence
- Maximum Throughput
- Multiple STAs Performance
- Long Term Stability
- Airtime Fairness
- Multiple Assoc Stability

Buttons: Start, Another Iteration, Pause, Cancel

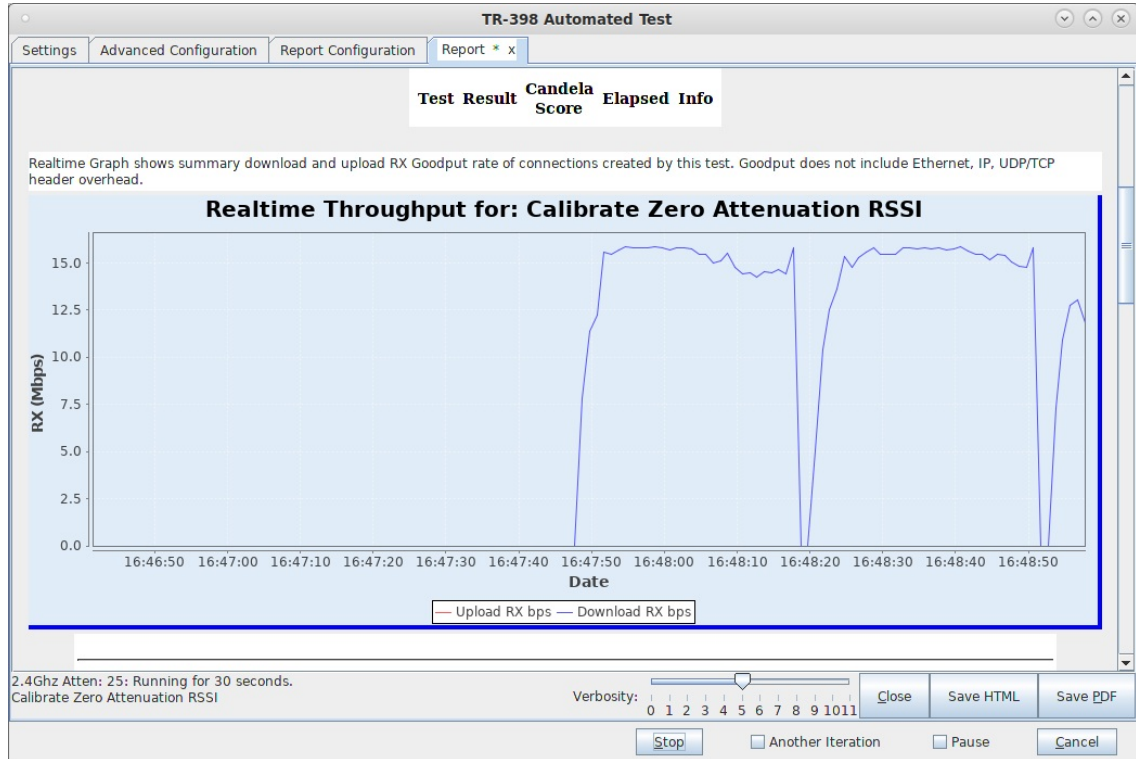
- G. Go to the Advanced Configuration tab and make sure the channels are configured properly, and tune any other settings that you wish to modify.:

The screenshot shows the 'Advanced Configuration' tab of the 'TR-398 Automated Test' window. The configuration is as follows:

- Save: DEFAULT
- Load: DEFAULT
- Delete: DEFAULT
- IP ToS: Best Effort (0), Multi-Conn: 5 (5)
- 2.4Ghz Channel: 11 (2462 Mhz), 5Ghz Channel: 36 (5180 Mhz)
- Skip 2.4Ghz Tests, Skip 5Ghz Tests
- Duration-60: 20, Duration-120: 30
- Attenuation Adjustment: 0, Test Retries: 0
- Stop RX-Sens at pass
- RxSens-Rate: 65%, RxSens Rotation Degrees: 45
- RxSens Start Step: 2
- Auto-Calibrate Interferer
- Interferer 5G-80Mhz: Default (195 Mbps)
- Interferer 5G-40Mhz: Default (90 Mbps), Interferer 2.4G-20Mhz: Default (32 Mbps)
- Spatial Rotation Degrees: 30
- Assoc/Disassoc Traffic %: 99
- Duration-180: 1-min (1 min), Stability UDP Duration: 5-min (5 min)
- Stability Iterations: 5

Buttons: Start, Another Iteration, Pause, Cancel

- H. When the configuration is complete, click the **Start** button (which will change to 'Stop' once start is clicked) to start the test. An interactive report tab will be created and will be updated as the test runs. For the first run, we will just run the calibration test to auto-configure the path loss by adjusting the attenuators and testing RSSI. If the calibration was acceptable, click Start again to save the calculated zero-RSSI attenuation values for future test runs in which you may decide to skip re-running the attenuation:



- I. After the calibration step is complete, select the desired set of test cases and click Start. The test may run for many hours. If you have the webcam configured, you can watch the rotational tests happen using the 'camorama' program (in Linux), or your own preferred USB webcam program. If using the LANforge machine to view camorama, please set the size to small so that it uses less CPU. When you click start, the Report tab is created, you can view that tab to watch the progress.
- J. When the test is complete, click the **Save HTML** button to save an HTML report and generate the PDF. The PDF file will be linked from the HTML page. You can also click 'Save PDF' and the browser will be directed to open the pdf file directly. Please see this [example TR-398 Test Report](#).