Ubiquiti / Mikrotik PowerSettings

Power Measurement Investigation

DISCLAIMER

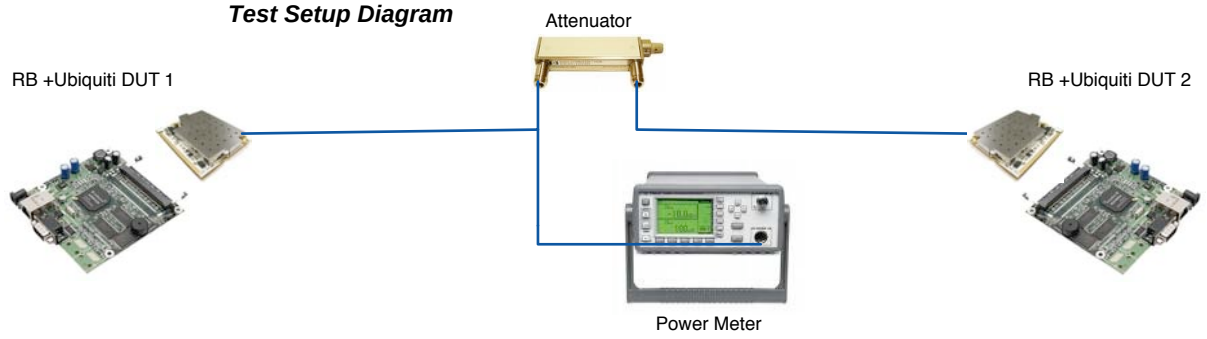
Study Overview and Background

One of the popular topics of discussion concerning Ubiquiti's hi-performance radio card offerings has to do with the driver reported transmit power levels and how they correspond to the actual output power of the card. Because of fixed power limitations in versions of the Atheros Linux MADWIFI driver, Ubiquiti has implemented power "offsets" as a work-around for OEM customers using driver versions with the power limitations to achieve maximum output power. Mikrotik is the only known 3rd party software to take into account Ubiquiti's power offset in their user interface for some, but not all, of Ubiquiti's radio cards. In addition, they have a power override functionality that can increase power of the card beyond the compliance certified and recommended power levels. We will investigate the power "offset" and the power override functionality in this study.

Test Setup

Testing location was Ubiquiti Networks Labs in Silicon Valley, CA. Using a fixed attenuator with 90dB attenuation and a pair of Routerboards, a link was setup. While the power settings were varied on DUT1, the RSSI levels reported in WinBox and the power level reported from the power meter were reccorded.

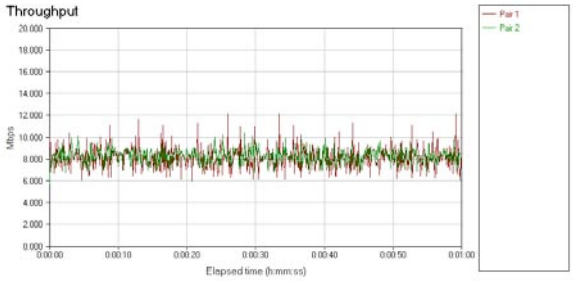
Test Setup Diagram

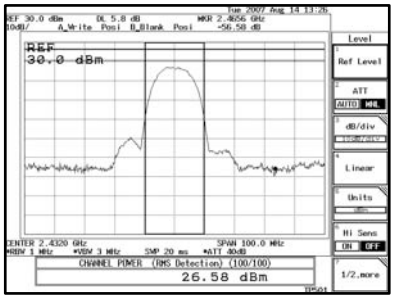


TEST 1: Mikrotik / SR2 Power Setting Investigation

TX Power	RSSI Dut1/Dut2	Measured Power (dBm)
DEFAULT	-68/-68	26.5

Using the default power settings, we see the card is able to link up at full data rate and throughput is smooth. We also see measured average power to be 26.5dBm -- matching specification of SR2.

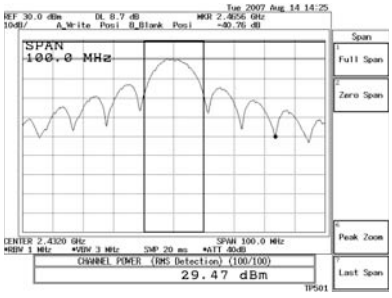


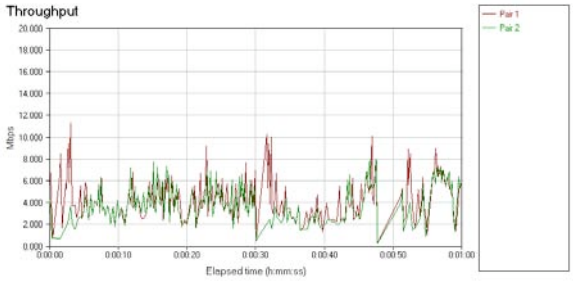


Using ALL RATES FIXED Power Settings

TX Power	RSSI Dut1/Dut2	Measured Power (dBm)	Observations
30dBm	-66/-68	29.1	Throughput poor, major compliance violations, current consumption increase
26dBm	-68/-68	26.5	Throughput slows marginally
25dBm	-69/-68	25.3	Throughput slows slightly more
24dBm	-70/-68	24.1	Throughput slows slightly
23dBm	-71/-68	23.3	OK
22dBm	-72/-68	22.6	OK
21dBm	-73/-68	21.6	OK
20dBm	-75/-68	20.5	OK
19dBm	-76/-68	19.2	OK
18dBm	-77/-68	18.4	OK
17dBm	-78/-68	17.5	OK
16dBm	-79/-67	16.5	OK
15dBm	-80/-68	15.1	OK
14dBm	-82/-67	13.9	OK

All Rates Fixed = 30dBm

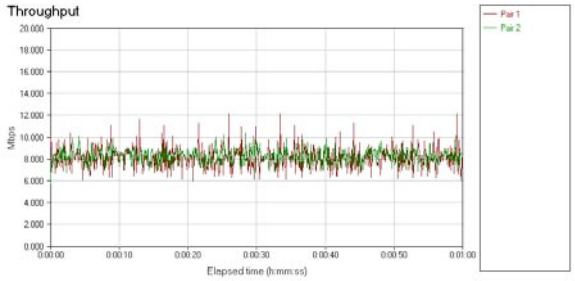




As can be seen above, the power setting override can produce very problematic results including throughput degredation, compliance violations, significant current consumption increases, and potential hardware reliability issues. It is STRONGLY recommended that the default power settings are used at all times. This will force the driver to use the pre-programmed powers for each data rate that are on the EEPROM (memory) of the radio card. These are the power levels Ubiquiti Engineers used during card compliance certification testing and were also found to be the optimum powers to be used following reliability and performance qualification testing.

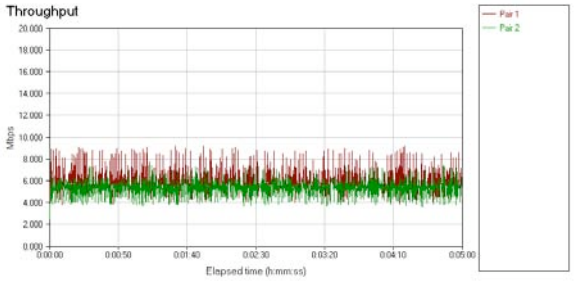
Comparison of Default Setting (Measured 26.5 dBm output power) vs. All Rates Fixed (26dBm)

DEFAULT



Data Rate	Measured Power
1	26.5 dBm
2	26.5 dBm
5.5	26.5 dBm
11	26.5 dBm
6	26.5 dBm
9	26.5 dBm
12	26.5 dBm
18	26.5 dBm
24	**24.2 dBm**
36	**23.0 dBm**
48	**22.5 dBm**
54	**21.7 dBm**

ALL RATES FIXED = 26dBm



Data Rate	Measured Power
1	26.5 dBm
2	26.5 dBm
5.5	26.5 dBm
11	26.5 dBm
6	26.5 dBm
9	26.5 dBm
12	26.5 dBm
18	26.5 dBm
24	**26.5 dBm**
36	**26.5 dBm**
48	**26.5 dBm**
54	**26.5 dBm**

It is important to note that although the Maximum recorded power levels for default setting and the manual all rate fixed setting of 26dBm were identical, the performance of each case is quite different. In the default case, we see the throughput achieves maximum performance the RouterBoard can push and is a smooth curve. In comparison, the all rates fixed 26dBm case, we see the throughput is lower and not as smooth. This is because the default power settings protects the Ubiquiti programmed power values for all data rates. In other words, the maximum power of the card is achieved for lower data rates while the higher data rates requiring lower, more linear output power to achieve error-free performance are also maintained. When the all rates fixed setting is implemented, it will lock all data rates (both low and higher ones) to the same power level and will create problems if these power levels exceed the level Ubiquiti has specified for the higher data rates (36/48/54Mbps).

TEST 2: Mikrotik / XR5 Power Setting Investigation

TX Power	RSSI Dut1/Dut2	Measured Power (dBm)	Obersvations
DEFAULT	-68/-68	26.5	OK

TX Power	RSSI Dut1/Dut2	Measured Power (dBm)	Obersvations
30dBm	-62/-67	31.7	Throughput poor, major compliance violations, current consumption increase
18dBm	-66/-66	28.1	Throughput slows marginally
17dBm	-67/-66	26.9	Throughput slows slightly more
16dBm	-68/-66	26.1	Throughput slows slightly
15dBm	-69/-67	25.3	OK
14dBm	-70/-66	24.1	OK
13dBm	-71/-66	22.9	OK
12dBm	-72/-66	22.0	OK
11dBm	-73/-66	21.1	OK
10dBm	-74/-66	20.3	OK
9dBm	-75/-67	19.2	OK
8dBm	-76/-66	17.9	OK
7dBm	-77/-66	17.0	OK
6dBm	-78/-66	16.1	OK
5dBm	-79/-66	15.2	OK
4dBm	-80/-66	14.3	OK

The results of this test were very similar to the first with the exception here being the Mikrotik software does not have correction for the power offset in XR5. As in the first study, we see the default power setting produces the best results in terms of throughput and power. Going above 18dBm will overdrive card and produce same compliance, throughput, and reliability issues as found in first test.

CONCLUSION

Using power setting override can lead to a variety of problems and it is highly recommended that the default power settings be used for all Ubiquiti cards. The only instance the power settings should be used is to lower the overall power. However, when lowering the power, it is important to note that higher data rate power must be kept at specifications in line with Ubiquiti's datasheets in order to ensure smooth error-free throughput. Below is a table of Ubiquiti cards, power offset information, and whether Mikrotik has implemented correction for the offset (as of 8/2007).

Radio	Max Programmed Power	Max Actual Power	Power Offset	Mikrotik Correction for Offset
SR2	16dBm	26dBm	10dB	YES
SR4	19dBm	26dBm	7dB	NO
SR5	19dBm	26dBm	7dB	YES
SR9	16dBm	28dBm	12dB	YES
XR2	18dBm	28dBm	10dB	NO
XR3	15dBm	25dBm	10dB	NO
XR5	18dBm	28dBm	10dB	NO
XR9	17dBm	27dBm	10dB	NO