Relationship between Link quality and signal level

asattari at site.uottawa.ca asattari at site.uottawa.ca
Fri Dec 8 13:06:34 EST 2006

- Previous message: Relationship between Link quality and signal level
- Next message: kernel 2.6.17.14 & WL 200 & udev
- **Messages sorted by:** [date] [thread] [subject] [author]

---

hello,

In my thesis there was a subsection about this issue, hope it helps you

Yours
Afsaneh

There is an inconsistency in the way terms such as, “signal strength”, “signal quality”, and “signal to noise ratio” are used by researchers, developers and users, when it comes to the 802.11 standard. At the beginning of our test, it was not clear what the signal strength values reported by each of our computers represented or if they were correct. >*From our personal observations, and after researching this subject, we* came to the conclusion that, this confusion arises when common terms are used with inconsistent definition, or misunderstanding of the common terms leads to false conclusions. In [CHIV-4] we find the precise definitions of the above terms (those definitions coming from reliable sources such as 802.11 standards), as follows:

“• Signal strength is defined in 802.11 as the Received Signal Strength Indicator
(RSSI). RSSI, is intended to be used as a ‘relative value’ within the chipset. This is a 1-byte value so that it could have values ranging from 0 to 255, but vendors prefer to use arbitrary scales from 0 to RSSI_Max where the latter is vendor-specific (for instance, Cisco uses 101, Symbol 31, Atheros 60). It is not associated with any particular power scale (e.g. mW) and is not required to be of any particular accuracy or precision. The RSSI value is used internally by the microcode in the adapter and this is why vendors are not forced to use a compatible standard. As an example of its use, if the RSSI value is below some threshold, the NIC knows that the channel is idle. Therefore, the signal strength numbers reported by an 802.11 card will probably not be consistent between two
vendors, and should not be assumed to be particularly accurate or precise (Details are provided below).

• Signal quality is defined very briefly in the 802.11 standard. Common definitions have
arisen, but they are usually incorrect. The correct definition hinges on the term, “PN code correlation strength,” which is a measure of the match (correlation) between the incoming DSSS signal and an ideal DSSS signal.

• Signal to noise ratio is a general term that is used in a novel way by 802.11
administrators. Most usages of the term refer to the strength of the signal relative to thermal noise within a circuit , but many professionals, use the term to refer to the strength of the signal at the receive antenna relative to the
ambient, non-802.11 RF power that is present at the bandwidth occupy by the signal. According to the standard communications systems terminology, SNR is defined as the ratio of received signal power to the power of the additive Gaussian noise that appears at the output of the receiver. While thesedefinitions are not wrong, they may lead to confusion when 802.11 professionals communicate among themselves.

• Receive sensitivity refers to the weakest power level the card's internal thermal noise will allow it to receive. It is unrelated to the ambient, non-802.11 RF energy in the environment. [CHIV-4].

4.2.2 Measurement Units for RF Signal Strength

There are four Units of measurements that are used to represent RF Signal Strength: mW(milliwatts), dBm ("dB"-milliwatts), RSSI (Received Signal Strength Indicator), and a percentage measurement.
Equation (4.1) shows that "dBm" is a logarithmic measurement of signal strength and dBm values can be directly converted to and from mW values.

$$dBm = \log10\ (mW) * 10 \qquad (4.1)$$

RSSI, which has been explained earlier, is an arbitrary integer, with an allowable range of 0-255 (a 1-byte value) defined in the 802.11 standard. This value is used internally by the micro-code of the adaptor and by the device driver. For example, when an adaptor wants to transmit a packet, it is checking whether the channel is clear (i.e.: no one else is transmitting) or not. If the RSSI value is below a certain low value, the chipset knows that the channel is clear [CHIV-6].
No vendors have chosen to measure 256 different signal level values. Each of the 802.11 NIC's vendors adopts and uses a specific maximum RSSI value (RSSI_Max). For example, Cisco chooses to measure 101 separate values for RF energy and their RSSI_Max is 100. Symbol uses an RSSI_Max value of 31. The Atheros chipset uses the RSSI_Max value of 60. In Appendix B, more details information is provided.
When using RSSI as basis for reporting dBm signal strength, it is common to see the signal strength been represented as a percentage. The percentage represents the RSSI for a specific packet, which constitutes practically the division between the measured to the maximum (RSSI_Max) value, multiplied by 100 (in order to derive the percentage). For example, when the signal level is 50%, this is reported with different values of RSSI, depending on the vendor; a Symbol card would convert to an RSSI of 16, because its RSSI_Max =31, Atheros, with RSSI_Max = 60, would convert it to an RSSI of 30, and for Cisco, which is the easiest one because its RSSI_Max = 100, RSSI is 50.
Unfortunately, we still do not know how all vendors map RSSI to signal strength percentage. This lack of consistency between vendors, does not allow for direct comparison of performance evaluation results, performed with equipment of different vendors.

"Signal quality" is also reported by vendors' client utilities. Those, who are working with IEEE 802.11 products, are aware that these two parameters, "signal strength" and "signal quality", are the two metrics for assessing the "goodness" of the 802.11 signal. Unfortunately, other that the definition of "signal quality" we provided earlier in section 4.2.1, the 802.11 standard does not offer further information. Based on the definition, the authors of [CHIV-6] conclude that "signal quality" "reflects the amount of signal within the channel formed between the two communicating stations (e.g. an AP and a client). The above description is consistent among the manufacturers. For example a manufacturer might say that an IEEE 802.11b chipset needs a minimum of 20 dBm signal quality in order to achieve 11 Mbps data rate. But the 802.11 standard, does not define a specific method of calculating and reporting the "signal quality", and, as in the case of "signal strength", the vendors measure it using inconsistent methods. The IEEE 802.11 standard defines "Signal to Noise Ratio" (SNR), as can be seen in section 4.2.1. However, since 802.11 cards do not typically report SNR, practically the concept of SNR is not used.

> On Fri, 2006-12-08 at 14:34 +0000, David Goodenough wrote:
>> Why would I get:-
>>
>>   Link Quality:0/92 Signal level:-69 dBm Noise level:-90 dBm
>>
>> from iwconfig? Normally the link quality first number is roughly the
>> difference between the signal level and the noise level, but here is
>> reports 0.
>
> This varies between drivers. But the "correct" way to report link
> quality is:
>
> - Signal level: raw signal level either in dBm or RSSI from the card
> - Link Quality: a subjective measure of how good the link is, including
> signal strength, speed the link is operating at vs. capable speed,
> packet loss, retries, etc.
>
> Link Quality in correctly-written drivers should be a value in the range
> [0, 100] inclusive representing a percentage between "worst" link and
> "best" link.
>
> Signal level is just the raw measure of RF energy received by the radio
> on the card and is one component of link quality.
>
> Link quality in Linux wireless drivers has never been extremely
> reliable, though this is getting much better as time goes on. The ipw
> drivers are good examples of how to do link quality correctly.
>
>> The other end of this link reports a more healthy link quality:-
>>
>>   Link Quality:30/92 Signal level:-79 dBm Noise level:-100 dBm
>>
>> but (I presume because the first one says 0) the current rate is 1Mb/s
>>
>> This link is running ad-hoc, these are the only two stations on this
>> network, and neither end can detect (using iwlist scan) any other users
>> on this channel. There is a clear line of site, and there are virtually
>> no buildings in between to generate any non-802.11 interference.
>>
>> Both ends are using Senao PCMCIA 802.11b cards, prism chipset, both
>> at 1.8.0 firmware.
>
> What kernel version and hostap driver version are you using? The link
> quality is calculated by the _driver_, not by the card or firmware, and
> the different may be due to different driver versions.
>
> Dan
>
>> Any ideas welcome.
>>
>> David
>> ____
>> HostAP mailing list
>> HostAP at shmoo.com
>> http://lists.shmoo.com/mailman/listinfo/hostap
>
> ____
> HostAP mailing list
> HostAP at shmoo.com
> http://lists.shmoo.com/mailman/listinfo/hostap
>

--

"Whatever is deserved to be admired not ought to being plunder"----
Margot Bigel

- Previous message: Relationship between Link quality and signal level
- Next message: kernel 2.6.17.14 & WL 200 & udev
- **Messages sorted by:** [date] [thread] [subject] [author]

More information about the HostAP mailing list