Decibels in the context of ADSL

19 Jonathan Tue, Jul 25, 2017 Broadband / IC-Air 3603

The decibel

The decibel is a logarithmic unit which specifies the ratio of two powers. It was devised in transmission systems. The original unit was the Bel, and they defined this as:

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Number of Bels = logarithm (base 10) of the ratio OutputPower / I
nputPower.
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Because this was rather too large a unit for many purposes, they specified the decibel (dB) as 1/10th of a Bel. This can be a useful way of specifying a power gain or loss, but it has some advantages:

1. Because of the way that logarithms work, the overall gain of several cascaded stages is found by adding the power ratios of the gains of each stage. This is a lot easier than multiplying and dividing the power ratios.
2. The log of a number less than 1 is negative, so all power ratios here positive dB values. If the input and output powers are equal, then the gain is 0 dB.

Some example values

Decibel value	Arithmetic equivalent
-6 dB	0.25
-3 dB	0.5
0 dB	1
3 dB	2
6 dB	4
10 dB	10
20 dB	100
30 dB	1000

Attenuation

Ordinary twisted pair telephone lines were not designed for the high frequencies used for ADSL and so the signal has to travel a long way before it reaches the exchange and the user. What may surprise you is just how much gets lost between the two points. As at 6 September 2006, the limiting attenuation figure for all UK ADSL installations was 32 dB. Lower levels of attenuation are obviously preferable. A power ratio of about 32 million.

Signal-to-noise ratio

Just to make life even more complicated, for the ratio between the signals and the noise, we use a power ratio. This is called the signal-to-noise ratio, or SNR. The greater this ratio is, the better the signals are. The ratio is expressed in decibels.

The limiting value of SNR is generally taken to be 6 dB (or 0.6 Bel). This corresponds to a power ratio of 4 to 1. Below this, the signal is too weak to be reliably separated out from the ADSL signal. Lower values of SNR will make it very difficult to separate out a clean signal.

It should be noted that ADSL modems and routers generally run with a noise margin (or SNR) of 6 dB. If the measured SNR was 10 dB, then the modem/router would report a noise margin of 4 dB.

Decibels used as power measurement

As described above, decibels specify a ratio between two numbers. For example, converted to dB, and then the power is specified as that number of dBm. For example:

Power	dBm equivalent
1 mW	0 dBm
2 mW	3 dBm
10 mW	10 dBm

100 mW	20 dBm
1 W (1000 mW)	30 dBm
100 W (100,000 mW)	50 dBm

Most modem routers report the upstream and downstream power levels in dBm. The upstream (or remote) power is the power transmitted by the DSLAM or MSAN in the exchange.

Online URL: https://kb2.ic.uk/article.php?id=19