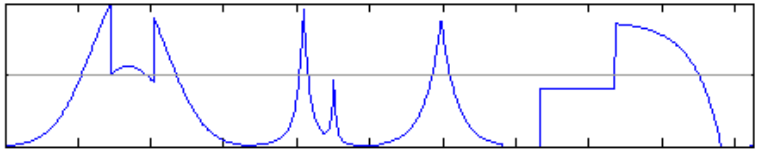
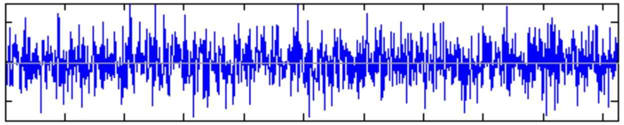
Signal noise

The signal that we need to transmit is very rarely perfect. Somewhere in production or amplification it will have picked up some “noise”. Noise is unwanted, random interference which adds itself to the signal.

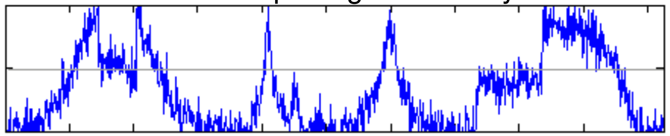
An example is shown below. The top graph is the perfect signal



and the second is the noise from the system.

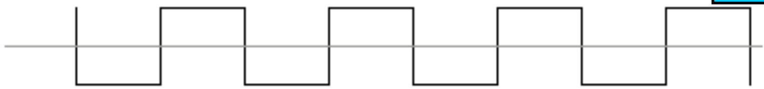


When these two are put together it may look like this:



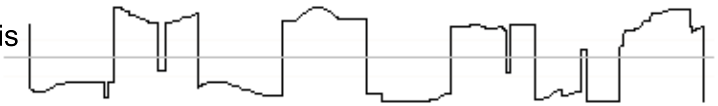
The signal might pick up further noise on transmission. If we are sending a digital signal the square wave picks up interference and is distorted.

So this signal

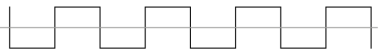


added to this noise

becomes this



but a digital signal is very recognizable and so the receiver can correct it and put it back to the original:

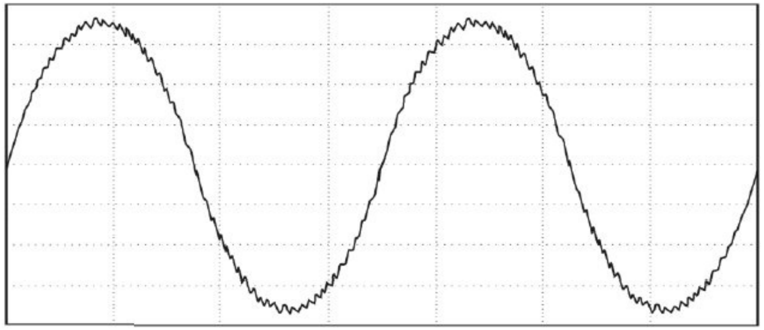


being easily able to correct a digital signal is a major advantage.

Digital Imaging and signaling 3
Noise and sampling
The Fizzics Organization
www.fizzics.org
www.fizzics.co.uk

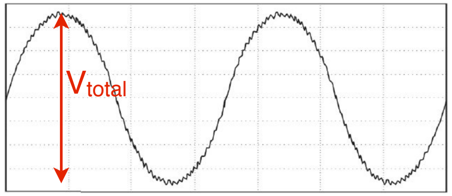
Noise and the maximum number of bits per sample

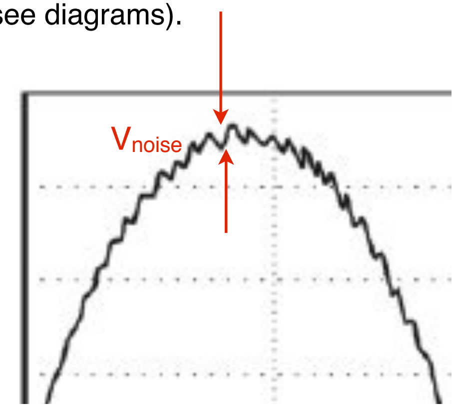
Remembering that we always try to minimize the cost of sending information, if the signal we are sending has already got a lot of noise in it, like this sine wave here:



If the samples of this signal have a high definition, in other words there are lots of possible levels because there are a large number of bits per sample then all we will do is reproduce the noise. There is no point in that so we may as well send fewer bits per sample and save on the quantity of information sent.

The maximum number of bits per sample (b)should be limited by the ratio of the total voltage variation to the noise voltage variation (see diagrams).





Max bits per sample $b = \log_2 \frac{V_{total}}{V_{noise}}$

So if the ratio is 32 then the maximum number of bits per sample it is worth using is $\log_2 32$ which is 5