AN1107 - Net2Air site survey - Using decibels

Net2Air - How do we measure the reliability?

An installer must have confidence in the wireless link between a Net2Air bridge and a Net2 nano.

To get reliable wireless communication, we need the signal between the transmitter and receiver to be of adequate strength to transfer the data and also have some additional margin to overcome any disruption. This additional margin is known as the Link Margin and can be defined as follows:

Link Margin = Transmitted power - (Power required for stable operation + Losses)

The values are calculated in Decibels (dB).

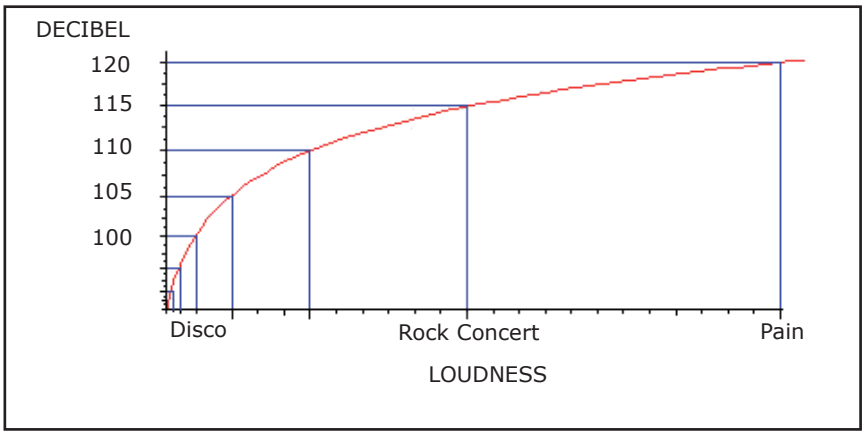
Why Decibels?

The Decibel is used in many similar fields. It represents 1/10 of a Bell unit originally used by the Bell Telephone Co to calculate signal losses in cables.

There are two important factors concerning decibels. Firstly, the decibel is a unit of comparison, like a percentage, as is defines a loss or gain with reference to the original signal. Secondly, it is expressed in a Logarithmic fashion but this can make the values look confusing as they do not increase in a uniform manner.

A more common use of decibels is found in the measurement of sound levels.

Conversation Level	60dB
Typical Disco music	100 dB
Loud Rock Concert	115 dB
Threshold of Pain	120 dB



The difference of 40 dB between conversation and disco music appears to represent a much larger increase in loudness than the 5 dB between concert level and pain but due to the formula used, the values swiftly accumulate as follows.

The smallest audible sound is 0 dB. A sound 10 times more powerful is 10 dB. A sound 100 times more powerful is 20 dB and a sound 1,000 times more powerful 30 dB. The graph above shows this effect.

If we now look at a wireless signal, the same graph produces loss values as follows:

Free space loss @ 10 metres 81 dB
Free space loss @ 100 metres 101 dB
Free space loss @ 1000 metres 121 dB

In general terms, if you move the receiver twice the distance away from the transmitter it will only receive one quarter of the power.

Net2 nano link margin

The aim when designing and installing wireless systems is, amongst others, to retain a decent link margin. This is your safety margin.

Link margin can be improved by the use of power amplifiers (PAs) to increase the power into the transmitting antenna and a low noise amplifier (LNAs) to improve the sensitivity of the receiver.

Net2 nano and both Net2Air bridge products include integrated PAs and LNAs. These have been carefully optimised to maximise the link margin whilst complying with all international radio and safety regulations. For nano products (between bridge and control unit) we start with 117 dB. We can therefore tolerate 117dB of losses before the system becomes unreliable.

Working with the numbers

This is where using logarithms pays off. Adding up logarithms actually multiplies the values together so that we can simulate the complex effect by simple addition.

The following values should prove useful in calculating signal losses:

Re-enforced concrete floor 30 dB
Brick wall 4 dB
Metal door in brick wall 13 dB
Plywood 2 dB
MDF 2 dB
Plasterboard 1 dB
Glass 1 dB

Using the values from the sections above, let's assume we have a building where we want to communicate on the same floor over 10 metres (Free space loss = 81 dB) and passing through two brick walls. (2*4 dB). If we add the values we get 89 dB so that's well short of the 117 dB we have available. It is always a good idea to always aim for spare capacity of at least 10 dB as this is your safety margin.

A word of caution here. The above helps to understand the broad principles, but the practice can be very different. Reflections from racking, desks, etc. will all increase the actual losses.

The Net2Air site surveyor measures the actual site conditions and should be used before every install to save both time and frustration.

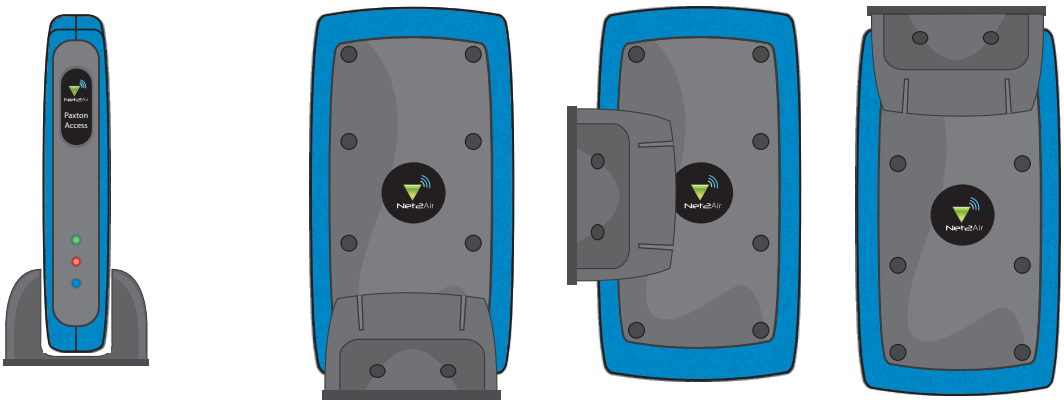
Other factors

Wireless signals do not like metal, water, re-enforced concrete or interfering devices like cordless phones, microwaves and other wireless equipment. It may seem obvious but we must remind ourselves not to mount nano control units in metal cabinets and to keep away from metal objects wherever possible.

Bear in mind that a metal door that is sometimes left open could introduce a temporary obstruction to the wireless communication.

Always keep as much space as possible between Net2Air bridges, control units and other interfering sources. Our wireless protocol has been specifically designed to work well in these environments, especially when used in buildings with Wi-Fi equipment but care and consideration at the installation stage will minimise problems once these products are installed.

If you look closely at the Net2Air USB and Ethernet bridges you will see that the box has been designed so that the stand can be affixed in a number of different positions and the stand has holes so that it can be attached to a surface, wall, ceiling desk etc. You can then position your bridge in the optimum location and orientation for maximum signal strength.



The antenna resides in the top of the box (with LED's at the base). Placing the box upright in this manner usually provides the best result for desk mounting the bridge and placing the ACU cabinet upright ensures that antenna lies in the same plane, again likely to provide the best results.

You can try this first with the Net2Air site surveyor; it shares the same construction as the bridge.