Extract from the 29 September 2010 issue of the *New Scientist* magazine.

Breaking the noise barrier
by **Justin Mullins**

Note: there is a typo in the article below: **n** noise sources can represent 2^n bits.
(The reverse statement is written below as a typo).

In the meantime, noise-based logic may be possible on a much grander scale. For the last couple of years, Laszlo Kish at Texas A&M University in College Station and colleagues have been working on the theoretical properties of a logic system that uses large-scale random noise signals. Their idea is to represent the 0s and 1s of digital signals not using voltage levels as in conventional computers, but using the presence or absence of noise.

Because noise is random, it's easy to imagine that noise created by different sources is identical. In fact the opposite is true - noise has a pattern that is characteristic of its source. It is this that makes it possible to keep track of different noise signals and compute with them, says Kish. What's more, any background noise will be different from the noise signals we are working with, making it possible to subtract its effect.

In Kish's scheme, representing a single bit of information requires two independent sources of noise, one representing a 0 and the other a 1, while a string of *n* bits requires 2^n sources. That's not a problem, Kish says: transistors can be a good source of noise when operated at low voltage, and we can already fit billions of them on a chip.

Earlier this year Kish and his collaborators published a claim more significant still: that noise signals can be superimposed and sent through a single wire without losing their identity. By operating on a composite signal, or superposition, it becomes possible to carry out two or more calculations simultaneously - much the same trick that quantum computers exploit to speed up calculations. Kish says this kind of logic is especially suited to certain types of calculation, but he and his colleagues are still trying to quantify exactly how this can be realised in practice. So far they have simulated basic circuits for generating composite noise signals, as well as noise-based AND and OR logic gates, among other components. Eventually these could provide fast, low-power processing, they say.

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Kish's noise-based logic scheme raises another intriguing prospect. Since natural systems have evolved not only to cope with noise but to exploit it, as neurons do with stochastic resonance, could it be that nature has also learned to compute with noise? Kish and his collaborator Sergey Bezrukov of the National Institutes of Health in Bethesda, Maryland, think so. They say their logic scheme could help explain some of the features of neural activity in mammals, such as the delays that seem to occur in certain neural signals. They also suggest a hypothetical scheme by which the brain could efficiently route and encode information using a superposition of noisy neural signals (*Physics Letters A*, DOI: 10.1016/j.physleta.2009.04.073).

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