A Biologist's Guide to the Biology of Mobile Phone Signals

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Perhaps the best way to explain this is to think of an old-fashioned analog radio station broadcasting speech or music at a particular spot on the dial (frequency). It does this by modulating (i.e. varying the strength of the radio signal in time with the original audio signal). Your radio set demodulates this so that you hear a true reproduction of the original sound on its loudspeaker. But that sound might be quite complex, e.g. those made by a whole array of orchestral instruments or people speaking with many different accents etc. The human ear and the brain, to which it is connected, can easily tell the difference between a flute and a violin and respond to them all at once. It is in effect a sensitive parallel processing spectrum analyzer.

An analog transmission gives the highest fidelity, but it takes a lot of space on the dial because it generates "sidebands" on either side of the nominal radio frequency equal to the highest audio frequency to be transmitted. This limits the number of stations that can be broadcast in any location and would certainly not be adequate for running multiple phone calls and data transmissions from a single cell tower.

Digital transmissions make more efficient use of the limited bandwidths allocated by our governments. They do this by taking very brief samples of the original analog signals, turning them into numbers and storing them temporarily in a "buffer" for subsequent transfer to the receiver.

The advantage is that one base station can cope with several phones at once since they can all take turns in transmitting, receiving and reconstituting their digital information. This is how 2G and DECT cordless phones work. The quality of the reconstituted signal depends on the sampling rate, is usually poor but adequate for most phone calls and limited data transmissions. The downside is that the obvious pulsations may be intolerable at close range, even if you are only mildly EHS.

Later generations of mobile phones transmit their data embedded in a continuous stream of pseudo random numbers, with the beginning and end of each "packet" of information being identified by a code sequence, just as the beginning and end of a gene in DNA is identified by a particular sequence of nucleotides. This form of coding removes some of the more obvious pulsations in the mobile phone signal, but you can still hear it as an unpleasant low-frequency background noise due to fluctuations in the digital traffic. It is also accompanied by a constant high-pitched whistle. This is used by the phone to measure the signal strength and tell it when to switch (seamlessly) to a cell tower with a stronger signal when this is needed. Nevertheless, it should still be classed as low-frequency modulation with respect to its likely biological effects.

Most of the later phone generations also use "sub-carriers" to cram more data into the signal. Here, the original modulated microwaves are modulated further in a piggy-back fashion to carry yet more information and this can happen more than once so that the signal becomes more and more complex as more sub carriers are added.

As if this were not enough, the system uses "spread spectrum", where even the original carrier frequency is constantly varying, with only the phone and the cell tower knowing how to decode it. This makes your phone calls very secure, but it also adds to the complexity of the signal and increases further the amount of potentially biologically active low-frequency components. If this is already happening with 4G, heaven alone knows what will happen with full blown 5G.

The take-home story is that the human brain behaves like a sensitive parallel processing spectrum analyzer that can respond to all of these frequencies simultaneously. It can be affected and possibly permanently damaged by their sum total and should be avoided as far as possible. As a very rough guide, if you can hear it on an Acousticom or similar, the signal will most likely be harmful.

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