

## 5G: The Big Picture

Increasingly intense exposure of the natural environment and all living creatures, including ourselves, to more and more electromagnetic radiation.

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Theme: [Environment](#)

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### *5G From Space*

*In November of 2018, the United States Federal Communications Commission (FCC) authorised the rocket company SpaceX, owned by the entrepreneur Elon Musk, to launch a fleet of 7,518 satellites to complete SpaceX's ambitious scheme to provide global satellite broadband services to every corner of the Earth.*

The satellites will operate at a height of approximately 210 miles, and irradiate the Earth with extremely high frequencies between 37.5 GHz and 42 GHz. This fleet will be in addition to a smaller SpaceX fleet of 4,425 satellites, already authorised earlier in the year by the FCC, which will orbit the Earth at a height of approximately 750 miles and is set to bathe us in frequencies between 12 GHz and 30 GHz. The grand total of SpaceX satellites is thus projected to reach just under 12,000.

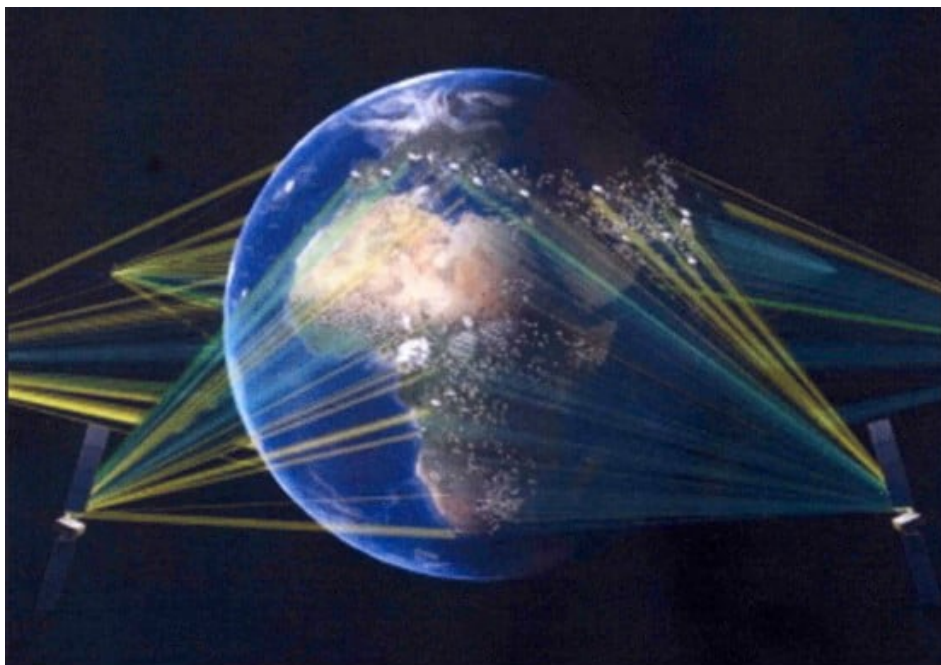


FIGURE 1: Satellites beam down 5G. (ZdNet.com)

There are at present approximately two thousand fully functioning satellites orbiting the Earth. Some beam down commercial GPS (or "SatNav"), some provide TV, some provide mobile phone services, and some bounce radar back and forth to produce images for meteorologists and military surveillance. The Earth is thus already comprehensively irradiated from outer space.

But the new SpaceX fleets will constitute a massive increase in the number of satellites in the skies above us, and a correspondingly massive increase in the radiation reaching the Earth from them. The SpaceX satellite fleet is, however, just one of several that are due to be launched in the next few years, all serving the same purpose of providing global broadband services. Other companies, including Boeing, One Web and Spire Global are each launching their own smaller fleets, bringing the total number of projected new broadband satellites to around 20,000 – every one of them dedicated to irradiating the Earth at similar frequencies (fig. 1).<sup>1</sup>

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Why is there this sudden flurry of activity? The new satellite fleets are contributing to a concerted global effort to “upgrade” the electromagnetic environment of the Earth. The upgrade is commonly referred to as 5G, or fifth generation wireless network. It has become customary in tech circles to talk about the introduction of 5G as involving the creation of a new global “electronic ecosystem”. It amounts to geo-engineering on a scale never before attempted. While this is being sold to the public as an enhancement of the quality of video streaming for media and entertainment, what is really driving it is the creation of the conditions within which electronic or “artificial” intelligence will be able to assume an ever greater presence in our lives.

In a previous article for [New View](#), (“Radiation, Robot Bees and 5G”, *New View*, 85, Autumn 2017), I described how the introduction of 5G will require hundreds of thousands of new mini mobile phone masts (also referred to as “base stations”) in urban centres throughout the UK, and literally millions of new masts in cities throughout the rest of the world, all emitting radiation at frequencies and at power levels far higher than those to which we are presently subjected.

These new masts are much smaller than the masts we currently see beside our motorways and on top of buildings. They will be discreetly attached to the side of shops and offices or secured to lampposts. The 20,000 satellites are a necessary supplement to this land-based effort, for they will guarantee that rural areas, lakes, mountains, forests, oceans and wildernesses, where there are neither buildings nor lampposts, will all be incorporated into the new electronic infrastructure. Not one inch of the globe will be free of radiation.

Given the scale of the project, it is surprising how few people are aware of the enormity of what is now just beginning to unfold all around us. Very few people have even heard about the 20,000 new satellites that are due to transform the planet into a so-called “smart planet”, irradiating us night and day. In the national media, we do not hear voices questioning the wisdom, let alone the ethics, of geo-engineering a new global electromagnetic environment.

But the question we should ask is whether we also want increasingly intense exposure of the natural environment and all living creatures, including ourselves, to more and more electromagnetic radiation.

Instead, there is a blithe acceptance that technology must continue to progress, and the presence in our lives of increasingly “smart” machines and gadgets that each year become cleverer and more capable is an inevitable part of this progress. And who doesn’t want progress? Almost everyone *loves* their sleek and seductively designed phones, pads and

virtual assistants, and regards them as an indispensable part of their lives.

But the question we should ask is whether we also want increasingly intense exposure of the natural environment and all living creatures, including ourselves, to more and more electromagnetic radiation. Is it likely that this does not entail any adverse health consequences, as both government and industry claim? If the electromagnetic waves that connect our smartphones to the Internet travel through brick, stone and cement, then what happens when these same waves encounter our bodies?

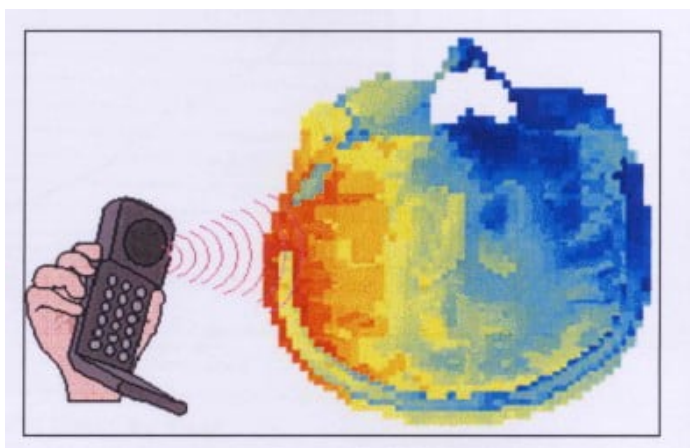


FIGURE 2: The colours indicate the Specific Absorption Rate (SAR) of mobile phone radiation. The SAR is the amount of power absorbed by tissue, measured in watts per kilogram, shown here with red as the highest value, blue the lowest. (2)

Be assured that they do not just bounce off us! They travel into the human body. The degree to which they are absorbed can be precisely measured in what is called the Specific Absorption Rate, expressed in Watts per kilogram of biological tissue. When we fill our houses with Wi Fi, we are irradiating our bodies continuously. When we hold a smartphone to our ear, electromagnetic waves irradiate our brains (fig.2). Do we really believe this could be completely harmless?

### Waves and Frequencies

At present, mobile phones, smartphones, tablets, most Wi Fi and so on all operate at under 3 GHz in what is called the “microwave” region of the electromagnetic spectrum. If you could see and measure their wavelengths, you would find that they are many centimetres (or inches) long. A smartphone operating at 800 MHz, for example, sends and receives signals with wavelengths of 37.5 centimetres (just under 15 inches). Operating at 1.9 GHz, the wavelengths are 16 centimetres (just over 6 inches). Wi Fi uses the 2.4 GHz frequency band with 12 centimetre wavelengths (just under 5 inches long).

The introduction of 5G will entail the use of considerably higher frequencies than these, with correspondingly shorter wavelengths. Above 30 GHz, wavelengths are just *millimetres* rather than centimetres long. The millimetre waveband (from 30 GHz to 300 GHz) is referred to as Extremely High Frequency, and its wavelengths are between 10 millimetres and 1 millimetre in length.<sup>3</sup> Up to the present time, Extremely High Frequency electromagnetic radiation has not been widely propagated, and its introduction marks a significant step change in the kind of electromagnetic energy that will become present in the natural environment (fig.3).

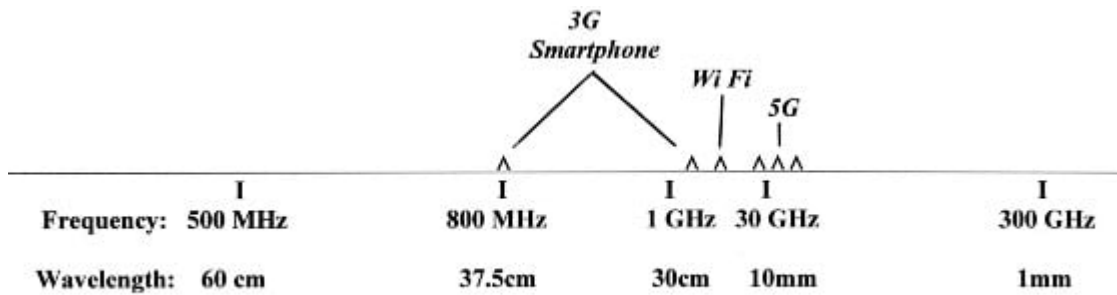


FIGURE 3: Frequencies and wavelengths of smartphone, Wi Fi and 5G.

The reason why millimetre waves are to be used for 5G is that much larger bands of spectrum are available in the Extremely High Frequencies than at lower frequencies. This means that there can be much broader “bandwidth”. Broader bandwidth means that larger quantities of data can be transferred and the speed of transfer of the data will be significantly faster.

One of the effects of this is that it reduces what is called “latency”, or time-lag, in the system, so it improves the quality of video streaming. But in so doing, it also enables a greater seamlessness between the data accessible from virtual sources and our perceptions of objects in the real world, as is required, for example, in Augmented Reality applications. Greater seamlessness means that we more effortlessly inhabit the natural and the electronic worlds as if they were a single reality.

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One of the technical problems of using frequencies in the millimetre region of the spectrum is that, because the waves carrying the data are so tiny, being only millimetres long, they are less able to pass through physical barriers, like walls and trees, than are the longer waves of lower frequencies. This is why it is necessary to have so many more new phone masts or “base stations”. They will need to be spaced at 100 metres apart in cities because beyond this distance their signals weaken and are therefore less able to penetrate buildings, and connect with the devices inside. As well as being more closely spaced, the 5G base stations will operate at much higher power than current phone masts, in order to ensure that the signals are sufficiently strong.

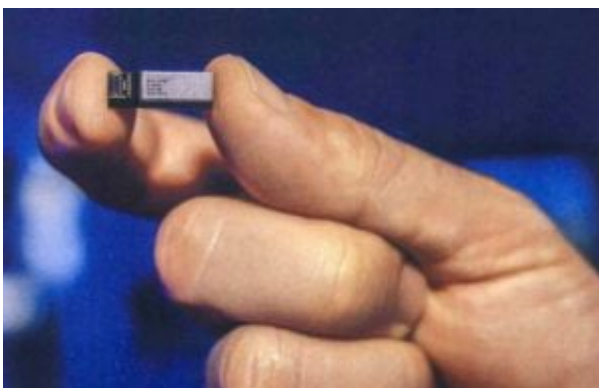


FIGURE 4: Qualcomm’s millimetre wave antenna array module for a 5G smartphone. It has four antennas that can accurately point towards the nearest 5G base station. Phones will have four of these modules, i.e. sixteen antennas. (4)

Because the wavelengths are so much smaller, the antennas transmitting and receiving them will also be much smaller than those of current phone masts and electronic devices. A single 5G transmitter/receiver will have a large number of tiny antennas, grouped together in one unit. An array of just over a thousand such antennas measures only four square inches, so will easily fit into a small base station on a lamppost, while the smartphone in your pocket will probably have sixteen (fig.4).

But it also means that any living creature that gets in the way of such a concentrated beam will be subjected to a powerful dose of extremely high frequency radiant electricity.

Both 5G satellites and 5G land-based masts will use a system called the “phased array”. In the phased array, groups of antennas are co-ordinated to radiate pulses in a specific direction and in a specified time sequence. This allows a concentrated beam of radio waves to be exactly aimed at designated targets, to enable signals to be sent or received. Because the beams are concentrated in this way, this adds to their power, which means they are able more easily to penetrate buildings.

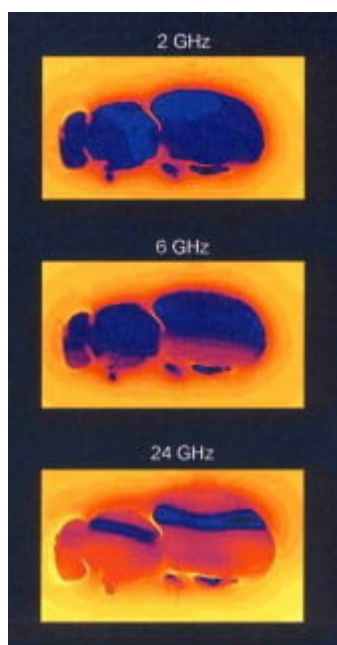


FIGURE 5: Illustration of the absorption of Radio Frequency electromagnetic radiation in the Honey Bee. At currently used frequencies between 2 GHz (top) and 6 GHz (middle), the wavelength is relatively large compared to the insect. But at 24 GHz, (bottom) the wavelength is closer to the insect's size and the radiation penetrates further.<sup>7</sup>

But it also means that any living creature that gets in the way of such a concentrated beam will be subjected to a powerful dose of extremely high frequency radiant electricity. A study published earlier this year demonstrated that certain insects, because of their small body-size, are particularly vulnerable to the millimetre waves of the higher frequencies to be utilised by 5G (fig. 5).<sup>5</sup> Other studies have shown that bacteria and plants are also



vulnerable, and so also (as one might expect) are the skin and the eyes of animals including, of course, human beings.<sup>6</sup>

As well as its ability to concentrate power in focused beams, phased array technology has a further complicating factor. Either side of the main beam, the time intervals between the pulses are different from the time intervals between those of the main beam, but they may overlap each other in such a way as to produce extremely rapid changes in the electromagnetic field. This can have a particularly detrimental effect on living organisms, because instead of the radiation decaying when it is absorbed into living tissue, it can be re-radiated within the body.

The moving charges streaming into the body effectively become antennas that re-radiate the electromagnetic field and send it deeper into the organism. These re-radiated waves are known as Brillouin precursors, named after the French physicist Leon Brillouin, who first described them in 1914. Research suggests that they can have a significant and highly detrimental impact on living cells.<sup>8</sup>

#### The Un-reassuring Assurances of Government and Industry

The Government body charged with protecting public health, Public Health England, advises us that there is no convincing evidence that Radio Frequency radiation (which radio, television, mobile phones, smartphones and 5G all use) has any adverse health effects on either adults or children.

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This advice is based on the recommendations of a supposedly independent body called AGNIR (Advisory Group on Non-Ionising Radiation), which produced a report in 2012 on the safety of Radio Frequency radiation. The report stated that there was a lack of “convincing” and “conclusive” evidence for any adverse health effects.<sup>9</sup> It was like giving a blank cheque to the telecommunications industry to move on into the higher frequencies, without any heed for the consequences.

It turns out that far from being independent, AGNIR has a high proportion of members with blatant conflicts of interests, and their report distorted or simply left out of account evidence that should have compelled them to reach the opposite conclusion to the one they arrived at. In a forensic analysis of the report, the environmental health researcher, Sarah Starkey, makes it clear that only a wilful disregard of the available scientific evidence could explain its internal contradictions and apparent incompetence.<sup>10</sup>

Health and safety simply do not feature in Government thinking, despite a veritable mountain of literally thousands of research papers demonstrating adverse health effects ...

And yet it is the basis of current UK Government policy, allowing government to roll out 5G without so much as even a nod towards the need for prior health and safety assessment.<sup>11</sup> Health and safety simply do not feature in Government thinking, despite a veritable mountain of literally thousands of research papers demonstrating adverse health effects, which continues to grow at the rate of roughly 350 per year, on average practically

one every day.<sup>12</sup>

One of the reasons for ignoring this evidence in the hell-for-leather dash to create the 5G electronic ecosystem is the conviction in government circles that, unless we introduce it immediately, we will be “left behind” and our economic growth and competitiveness will be put at risk. There is simply no time to consider the possible health consequences.

The National Infrastructure Commission, whose 2016 report, *Connected Future*, forms the basis of current Government policy, pushed this panicky vision of the UK falling behind other nations and urged the government to ensure that the new digital infrastructure is fully in place by 2025.<sup>13</sup> The NIC report repeatedly points out that the rewards of the “connected future” are to be measured in billions of pounds worth of revenue.

The irony that the “connected” future is one in which dizzying profits stand to be made from technologies that *disconnect* us more and more from the real world is entirely missed.

The mind-boggling amounts involved are well exemplified in a recent estimate that the global media industry alone stands to gain \$1.3 trillion from 5G by 2025, not least because 5G will “unlock the potential of augmented reality (AR) and virtual reality (VR)”.<sup>14</sup> The irony that the “connected” future is one in which dizzying profits stand to be made from technologies that *disconnect* us more and more from the real world is entirely missed.

The sums involved are sufficient to explain why the telecoms industry has for the last twenty-five years done its utmost to ensure that research into the health effects of wireless technologies produce negative or inconclusive results. Since 1993, the industry has financed a large number of studies, saving governments a great deal of expense and at the same time preserving the convenient illusion that the jury is still out on whether exposure to Radio Frequency radiation causes harm.

Earlier this year, *The Guardian* published an article citing research which showed that while 67% of independently funded studies found a biological effect of exposure to Radio Frequency radiation, only 28% of industry-funded studies did. Industry-funded studies are almost two and a half times less likely than independent studies to find health effects.<sup>15</sup> The authors of the *Guardian* article explain that the telecoms industry doesn’t need to win the scientific argument about safety, but simply keep the argument running indefinitely by producing studies with results that fail to verify, or even better contradict, the research that does find adverse health effects.

One of the most notorious is the mammoth, industry-funded “Interphone Study”, which managed to conclude that holding a mobile phone to the head actually *protects* the user from brain tumours!

One of the most notorious is the mammoth, industry-funded “Interphone Study”, which managed to conclude that holding a mobile phone to the head actually *protects* the user from brain tumours! This study, which is full of contradictions and suffers from grievous design flaws, is often quoted as the most authoritative to date, while it has in fact been thoroughly discredited.<sup>16</sup>

Nevertheless, the impression is maintained that there is no scientific consensus, and so there are not sufficient grounds for action to be taken. Needless to say, this suits

Government just as much as it suits industry.

Beyond the health effects there is another level altogether of what the roll out of 5G actually entails. [Read Dr. Naydler's full article.](#)

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Originally posted in [New View](#), 90 (January – March 2019), pp.33-40 as “5G: The Final Assault”.

## Notes

1 One of the best sources for this information is the website of the Global Union Against Radiation Deployment from Space (GUARDS) at [www.stopglobalwifi.org](http://www.stopglobalwifi.org), and the related Cellular Phone Task Force website at [www.cellphonetaskforce.org](http://www.cellphonetaskforce.org). Both organisations are informed and inspired by the tireless research and campaigning of Arthur Firstenberg, to whom this article is greatly indebted.

2 Source: ISEE/ISEA Conference: *Environmental Epidemiology and Exposure*. Paris, 5/9/2006.

3 The rule is: the higher the frequency at which the wave oscillates, the shorter the wavelength will be.

4 Source: Qualcomm. July, 2018.

5 Arno Thielens et al., “Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz”, *Nature*, 8: 3924 (2018):

“The insects show a maximum in absorbed radio frequency power at wavelengths that are comparable to their body size... The studied insects that are smaller than 1cm show a peak in absorption at frequencies (above 6 GHz), which are currently not often used for telecommunication, but are planned to be used in the next generation of wireless communication systems.”

6 Cindy Russell, “A 5G Wireless Future”, *The Bulletin* (January/February, 2017, pp.20-23 reviews the research, and lists a large number of adverse health effects of millimetre wave electromagnetic radiation including arrhythmia, antibiotic resistance, cataracts, compromised immune system, etc.

7 Source: Arno Thielens et al., “Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz”, *Nature*, 8: 3924 (2018), fig.4.

8 Kurt Oughstun, interview on “Brillouin Precursors”, *Microwave News*, 22, 2 (2002), p.10. According to Oughstun, a professor of electrical engineering and mathematics at the University of Vermont, “A single Brillouin precursor can open small channels through the cell membrane because, as it passes through the membrane, it can induce a significant change in electrostatic potential across that membrane.”

See also Arthur Firstenberg “5G – From Blankets to Bullets” January 17th, 2018), at [www.cellphonetaskforce.org](http://www.cellphonetaskforce.org).

9 Report of the Advisory Group on Non-Ionising Radiation, *Health Effects from Radiofrequency Electromagnetic Fields* (2012).

10 Sarah J. Starkey, “Inaccurate official assessment of radiofrequency safety by the Advisory Group on



Non-ionising Radiation”, *Review of Environmental Health*, 31:4 (2016), pp.493-503.

11 The Department for Culture, Media and Sport and H. M. Treasury, *Next Generation Mobile Technologies: A 5G Strategy for the UK*, March, 2017, which sets out the government’s strategy for the roll out of 5G, does not mention health and safety precautions.

12 One of the best sources for this mountain of research is *The BioInitiative Report* (2012), which helpfully gathers it into manageable sections, and is regularly updated. It can be accessed online at <http://www.bioinitiative.org>. According to the Report, between 2007 and 2012, approximately 1800 new studies demonstrated adverse health effects, i.e. on average 350 per year.

13 National Infrastructure Report, *Connected Future* (December, 2016), p.11. The authors argue that only by so doing could the UK “take full advantage of technologies such as artificial intelligence and augmented reality.” The report is available at [www. nic.org](http://www.nic.org).

14 Ovum, “5G Economics of Entertainment Report” (October, 2018). The report was commissioned by Intel, and a summary is available at [www.newsroom.intel.com](http://www.newsroom.intel.com).

15 Mark Hertsgaard and Mark Dowie, “The inconvenient truth about cancer and mobile phones”, *TheGuardian*, 14th July, 2018. The blatant funding bias was first exposed in 2006 by Louis Slesin, “‘Radiation Research’ and the Cult of Negative Results”, *Microwave News*, 26.4 (July, 2006), pp.1-5. A good summary of the problem is given in “Bias and Confounding in EMF Science”, on the Powerwatch website: [www.powerwatch.org.uk/science/bias.asp](http://www.powerwatch.org.uk/science/bias.asp).

16 The Interphone Study is devastatingly critiqued in L. Lloyd Morgan et al., *Cellphones and Brain Tumors: 15 Reasons for Concern* (2009), available online at [www. electromagnetichealth.org](http://www.electromagnetichealth.org).

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