

# 5G in Ireland

An investigation into claims that fifth-generation mobile phone technology is a major threat to human health

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[www.uplift.ie](http://www.uplift.ie)

## Introduction

The advent of fifth-generation – or 5G – mobile phone networks comes with promises of ultra-high speed internet access. But 5G is also the subject of widespread and growing fears around the world about the dangers it may pose, in particular to human health.

Here in Ireland, numerous anti-5G groups have been set up in recent months, primarily organising on social media. This activity is informed by warnings from many sources internationally – including credible scientific sources – but also by a huge amount of misinformation and scaremongering. The resulting confusion and fear is being exploited by at least one far-right organisation, which has been hosting local meetings around Ireland, advertised as being about 5G.

There has been which has been pointed to by some as evidence of a “media blackout” of the issue.

Uplift commissioned this short investigation in order to separate myth from fact, and scaremongering from science.

Cybersecurity concerns around 5G – centred on the role of Chinese firm Huawei's role in the technology – are not part of this investigation.

## **Executive summary**

5G mobile phone technology is not yet being rolled out in Ireland. A trial site for 5G in one small area of Dublin has been operated by Vodafone Ireland since November 2018. The first commercial rollout of 5G networks in Ireland is due to begin in late 2019 or early 2020.

There is no evidence that recent tree-felling is connected to 5G.

The advent of 5G technology has revived a long-running debate among scientists around the world about whether radiation from mobile phones may cause cancer. Thousands of studies have been conducted over several decades, but scientists disagree about what the overall conclusions from this body of research should be.

This debate has taken on a new level of intensity with the planned introduction of 5G, with claims by some scientists and other experts that the higher frequencies of radiation from 5G transmitters will subject humans – and other species – to dangerous levels of radiation.

5G networks will require many more base-stations (transmitters) than is the case with 4G and earlier networks. However, as transmitters will be much closer together, they will transmit at a much lower power (i.e. lower wattage).

Also (separately from the power output), 5G networks in Ireland will use low frequencies – around 3.6 GHz (gigahertz) – that are already in use here. Higher frequencies, from 20 GHz to 300 GHz, which have been the main focus of health concerns internationally, are not due to be used in Ireland or the EU for several years.

This means there is still time for the Irish Government to commission research into 5G technology, and the claims about the risks to human health and the environment; and also time for a debate about what new telecoms technology we want to allow here.

Most of the academics and engineers consulted for this investigation said they did not feel there was enough evidence at this stage to suggest that 5G

technology would expose people in Ireland to an increased health risk, compared to existing technology, but that more research was needed.

However, in relation to existing mobile phone technology, despite what media coverage and public attitudes might suggest, many experts internationally do warn of the health risks of using mobile phones. This includes a warning from Ireland's Chief Medical Officer that children and young people should use mobile phones for essential purposes only and should make only short calls; and that all users should keep mobile phone use to a minimum and should not keep their phone in their pocket.

The fears about 5G and the campaigns against the new technology have the potential to become a major distraction and diversion – particularly for those who care about the environment and social justice – from issues that we already know with certainty pose a huge and very urgent risk to humans and the natural world – for example, climate breakdown.

## **What is 5G?**

5G refers to the fifth generation of mobile phone networks and technology. This technology is currently being trialled in many cities around the world, including Dublin. Five private companies are due to begin building 5G networks in various parts of Ireland in late 2019 or early 2020.

5G is said to offer a range of benefits, from super-fast data services, to supporting self-drive cars, to enabling 'smart cities' and the 'Internet of Things'. When the first 5G handsets arrive, they will facilitate ultra-fast video downloads, streaming services and voice calls.

<https://www.rte.ie/brainstorm/2018/0616/970909-perks-and-challenges-a-guide-to-5g/>

As is the case in many countries, the Irish Government is supporting and promoting the switch to 5G. The then minister for communications, Denis Naughten, told the Dáil in October 2017: “Ireland is the first country to have successfully concluded a spectrum auction to facilitate the roll-out of 5G. We are therefore in the vanguard of Europe in deploying 5G nationally.”

<https://www.oireachtas.ie/en/debates/question/2017-10-04/24/>

## **Is 5G technology being 'rolled out' across Ireland?**

No, 5G is not being rolled out yet. Aside from a trial site in Dublin, no 5G networks have yet been deployed in Ireland, according to ComReg (Ireland's Commission for Communications Regulation). This was corroborated privately by engineers working in the sector.

ComReg confirmed to Uplift:

“To date, no fifth generation (5G) networks have yet been deployed in Ireland. 5G networks are being developed worldwide and are likely to be rolled out in Ireland in the coming years. Precisely how and when this will happen will largely be determined by commercial investment decisions, made by network operators.”

As is the case in several European cities, 5G is being trialled in one area in Dublin city. In November 2018, Vodafone Ireland launched Ireland's first live 5G network site in Dublin's docklands, which the company says it is using to test 5G hardware, software and services.

<https://www.irishtimes.com/business/technology/5g-arrives-in-ireland-as-vodafone-launches-test-site-in-dublin-1.3704608>

In March 2019, Vodafone announced it was extending its live 5G network testbed coverage.

<https://www.independent.ie/business/technology/news/boost-for-5g-as-vodafone-grows-docklands-trial-37924427.html> “It is going to cover all of the docklands, around the Convention Centre and down to the port,” Vodafone Ireland head of networks, Max Gasparroni, explained.

In terms of a wider commercial roll-out of 5G in Ireland, a Vodafone spokesperson told Uplift, “All telecoms operators in Ireland, including Vodafone, are aiming to rollout 5G towards the end of 2019 or the start of 2020.”

Aggressive marketing may have contributed to the impression that 5G is being rolled out already. For example, internet service provider Imagine has been marketing its “5G ready” network, and this branding can be seen on the company's vans. <https://www.imagine.ie>

## **Have thousands of trees been felled to make way for 5G technology?**

No. There is no evidence of tree-felling for 5G. To date, the only installation of 5G infrastructure has been for a trial in part of Dublin's docklands.

There have been numerous reports of tree-felling in recent months. The Department of Communications, Climate Action & Environment was unable to say what was the cause of recent tree-felling. There have been media reports that an increase in tree-felling by county councils is partly due to insurance companies offering lower premiums if trees are removed which might constitute a present or future claim hazard.

<https://www.irishtimes.com/news/environment/rigorous-policy-of-cutting-down-trees-prompts-protest-in-tipperary-1.3781964>

Waterford City and County Council, which received many complaints about tree felling, said tree maintenance is undertaken is "to ensure public safety and minimise hazards posed by trees", and that its tree pruning or removal was due to trees being dead or visibly in decline; road signs, street lights being obscured by trees; or if a tree is damaging roads and footpaths.

<https://waterfordcouncilnews.com/2019/03/07/statement-from-council-on-recent-tree-felling-pruning/>

## **How will 5G be regulated in Ireland?**

The roll-out of 5G technology in Ireland is being regulated by the Commission for Communications Regulation (ComReg).

The Department of Communications, Climate Action & Environment has responded to queries about 5G, by saying:

"Irish policy on non-ionising radiation, including 5G, is informed by a substantial volume of internationally-recognised scientific research and evidence. This includes the guidelines set down by the International Commission on Non-Ionising Radiation Protection (ICNIRP).

“These are internationally accepted guidelines on exposure limits, which have been recommended by the European Commission to its Member States. They provide scientifically-based exposure limits that are applicable to both public and occupational exposure from electromagnetic fields (EMF) including 5G. ICNIRP guidelines apply up to a frequency of 300 GHz, well above the maximum frequencies being considered for 5G (a few tens of GHz). ICNIRP guidelines are based on a weight of evidence review from all peer-reviewed scientific literature and not on the conclusions of any single scientific paper, event, or other source.”

The ICNIRP is a German-based NGO (non-governmental organisation).

## **Has 5G been halted in some countries?**

Yes. The roll-out of 5G has been halted in several European cities, including Brussels and Geneva. In early April 2019, the government of the Brussels region of Belgium halted a 5G trial due to concerns that the new technology would not meet the city's strict radiation rules. The region's environment minister, Céline Fremault, said: “I cannot welcome such technology if the radiation standards, which must protect the citizen, are not respected, 5G or not. The people of Brussels are not guinea pigs whose health I can sell at a profit. We cannot leave anything to doubt.”

<http://www.brusselstimes.com/brussels/14753/radiation-concerns-halt-brussels-5g-for-now>

It's worth noting that the Brussels region has particularly strict radiation standards for telecom applications, which previously led to problems with providing fast mobile internet via 4G.

<http://www.brusselstimes.com/brussels/14753/radiation-concerns-halt-brussels-5g-for-now>

Also in April, in the Swiss city of Geneva, a moratorium on 5G was declared, which halted a planned upgrade to the new technology.

<https://www.heise.de/newsticker/meldung/Schweiz-Vorlaeufiges-Verbot-von-5G-Mobilfunkantennen-in-Genf-4398114.html>

## **What are the health concerns about 5G?**

Among the many credible sources warning about 5G is a leading expert on environment policy in Germany, Prof Ernst von Weizsäcker, who has called for the deployment of 5G to be delayed until its risks are understood:

“We do not know for sure whether the mobile data transmission technology poses health risks, but we cannot yet exclude it either. Thus, we must insist that the health risks associated with the omnipresent radio-frequency radiation for mobile devices are studied before we expose the whole population with ever-rising levels of the electromagnetic fields from this technology.”

<https://www.computerweekly.com/feature/Mobile-phones-and-health-is-5G-being-rolled-out-too-fast>

The introduction of 5G is only beginning – it has not yet been widely deployed anywhere in the world. The technology is largely untested. No scientists claim to know definitively whether 5G is dangerous. For this reason, the scientific debate about 5G and human health has, for the most part, been focused on existing mobile phone technology and whether it can be linked to increased rates of cancer. See below.

## **Is existing mobile phone technology safe?**

Thousands of studies have been conducted over several decades into mobile phone use and human health, and there are conflicting views among scientists and health experts as to whether or not this body of research points to a significant risk of cancer from using mobile phones.

In 2011, the International Agency for Research on Cancer (IARC), part of the World Health Organisation, classified the radio-frequency radiation (RFR) emitted by mobile phones as “possibly carcinogenic” to humans.

[http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208\\_E.pdf](http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf) In other words, there is some evidence that this radiation may have the potential to cause cancer in humans. It's worth pointing out that “possible carcinogen”, which is IARC's Group 2b, is a relatively low level of risk. Group 2b also includes coffee, aloe vera, pickled vegetables and working as a dry cleaner.

[https://en.wikipedia.org/wiki/List\\_of\\_IARC\\_Group\\_2B\\_carcinogens](https://en.wikipedia.org/wiki/List_of_IARC_Group_2B_carcinogens)

In 2018, a report by a group of scientists in the US argued that IARC should re-categorise the radiation from mobile phones to Group 1: carcinogenic to humans.

<https://www.ncbi.nlm.nih.gov/pubmed/30196934> Also in 2018, two separate studies, one in the US and one in Italy, found that radio-frequency radiation increases the risk of cancer in the brains and hearts of rats. These studies were by the US National Toxicology Program (NTP) <https://ntp.niehs.nih.gov/results/areas/cellphones/index.html> and Italy's Ramazzini Institute.

Here in Ireland, Tom Butler, a Professor of Business Information Systems at University College Cork, specialising in semantic and regulatory technologies, wrote an article for RTE's Brainstorm website recently, in which he argued that "the weight of objective scientific evidence has always indicated significant risks to human health" from the radiation from mobile phones and other devices, and that "these risks are magnified significantly where children are concerned."

<https://www.rte.ie/brainstorm/2019/0417/1043133-why-everyday-wireless-technology-poses-a-health-risk-to-children/>

However, many scientists and experts disagree. To take just one example, Kevin McConway, professor of applied statistics at the Open University in the UK, and a specialist in medical sciences, says that without further research, the jury is still out on whether there is a definitive link between mobile phones and cancer.

"My tentative conclusion from recently published research studies is that nothing has really changed since 2011. There have been a few more studies but the study quality has not been high, partly because it is difficult to research, and what we still have is rather weak evidence that there might be an association for long-term or heavy users."

<https://www.computerweekly.com/feature/Mobile-phones-and-health-is-5G-being-rolled-out-too-fast>

### **A powerful industry**

Critics argue that the multi-billion-dollar mobile phone industry has obstructed our understanding of the current science, helped by governments and agencies that have prioritised commercial interests over human health and news organisations that have failed to inform the public about what the scientific community really thinks.



<https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/>

Investigate Europe, an NGO, recently conducted an in-depth investigation into the close links between the mobile phone industry and the European bodies that regulate that industry, and revealed what it called a “closed club”. This research was published by several prominent media organisations across Europe.

<https://www.investigate-europe.eu/publications/the-5g-mass-experiment/>

Foremost among these regulatory bodies is the ICNIRP, a German-based NGO, which has been criticised by a European Parliament special rapporteur for lacking transparency and allegedly having “rather close links with the industries” such as the mobile phone industry.

<http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=13137>

Here in Ireland, Prof Tom Butler of UCC argues that the mobile phone industry has “captured” the agencies that regulate the sector.

<https://www.rte.ie/brainstorm/2019/0417/1043133-why-everyday-wireless-technology-poses-a-health-risk-to-children/>

## **How will 5G be different and what are the risks?**

5G technology will mean large amounts of data can be transferred at speeds many times higher than with 4G, but the signal will only be able to travel shorter distances. This means that 5G will require a “densification” of infrastructure, according to Ronan Farrell, Professor of Electronic Engineering at Maynooth University. In other words, mobile telecoms companies will need to deploy up to 10 times more base-stations (transmitters) than are needed for 4G networks. Most of these will be small, similar to wifi routers.

<https://www.rte.ie/brainstorm/2018/0616/970909-perks-and-challenges-a-guide-to-5g/>

Joel Moskowitz, a scientist at the University of California at Berkeley, says the huge number of new antenna sites will mean “people will be bathed in a smog of radiation 24/7”.

<https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/>

However, Linda Doyle, Professor of Engineering and the Arts at Trinity College Dublin, explains that, as the 5G network cells will be smaller and the base stations (transmitters) will be much closer together than with existing networks, this means the signal can be transmitted at a lower power. In other words, while you might be closer to base stations than before, you will be exposed to lower power signals.

Several academics and engineers confirmed this. Dr Conor Brennan of DCU's School of Electronic Engineering likened this lower-power signal to whispering from nearby, whereas early generation networks were like shouting from a distance.

As well as the big increase in the number of base stations, the other aspect of 5G that is causing concern is the higher frequencies that will be used. See below.

## **What frequencies will be used for 5G and have they been used in Ireland before?**

In May 2017, following an auction, ComReg awarded the 3.6 GHz band/spectrum to five companies: Airspan, Imagine, Meteor, Three, and Vodafone. The 3.6 GHz band is a range of frequencies spanning 350 MHz around 3.6 GHz.

<https://www.comreg.ie/five-winning-bidders-comregs-3-6-ghz-band-spectrum-award/>

Initially, 5G networks in Ireland will use only this 3.6 GHz band. Similar frequency bands have already been in use for several years for 'fixed wireless' broadband in rural areas. Barry O'Donovan, a wireless network engineer working in this sector, says that the 3.6 GHz spectrum licensed by ComReg for the initial phase of 5G, "is not new":

"These frequencies have been in use in Ireland for more than a decade for rural wireless broadband. There are legal limits relating to power, and as long as those are observed, there should be no problem. If people want to reconsider our radio-frequency environment, then that is a political debate, not an engineering one."

Prof Ronan Farrell of Maynooth University says many of the other frequencies that are proposed for 5G networks in the coming years, "are already in use, for point-to-point links, but a 5G use case would be much more widespread". Farrell says many of the concerns relate to the higher frequencies. These are the so-called mm-wave (millimetre wave bands), primarily around the 24-27 GHz and 71-86 GHz ranges. These higher bands have not yet been released for 5G usage in Ireland.

Farrell explains that much of the debate about this has resulted from auctions for the higher frequencies being held by the Federal Communications Commission in the US this year. In the European Union there is currently discussion about those bands and they will eventually be auctioned, but Farrell says that "apart from a few trials, I suspect any large scale deployments in Ireland are at least five years away, if not more."

As it will be several years before these higher frequencies will be deployed in Ireland, there is still time for Ireland to decide whether this should be allowed to happen; and still time for the Government to commission research on whether these higher frequencies may pose a health threat.

Dr Conor Brennan of DCU's School of Electronic Engineering says he hasn't seen "any compelling argument" as to why higher frequencies above 20GHz range would be more harmful, (assuming that they are properly operated within the specified ICNIRP limits). "From what I have read I feel that it is being used, by some parties, as an excuse to re-open the issue of radio-frequency exposure in general."

Most of the academic experts who spoke to Uplift were of the view that there is not enough evidence at this stage to suggest that 5G technology will expose people in Ireland to an increased health risk. However, several of them said more research in this area is needed.

## **Have insurers stopped providing cover for radiation from mobile phones?**

Several major insurance underwriters say they treat radiation from electromagnetic fields as a real health risk, and some have reportedly stopped offering cover in this area. In 2015, CFC Underwriting, a

Lloyds-backed insurance firm in the UK, removed from its insurance policy any compensation for claims in relation to electromagnetic fields, specifically “directly or indirectly arising out of, resulting from or contributed to by electromagnetic fields, electromagnetic radiation, electromagnetism, radio waves or noise”.

<https://www.computerweekly.com/feature/Mobile-phones-and-health-is-5G-being-rulled-out-too-fast#Insurance>

Industry body Insurance Ireland told Uplift it was "not aware of any such cover being in place and does not have a view on exposure to electromagnetic fields".

However, the fact that insurers may not offer cover for radiation from mobile phones does not prove that the technology is dangerous.

## **What is the Irish Government's position on mobile phones and cancer?**

In June 2011, following IARC's classification of mobile phones as a “possible carcinogen”, the Chief Medical Officer at Ireland's Department of Health and Children issued a warning about mobile phone use. The Department confirmed to Uplift (in May 2019) that this advice is still valid:

“Research does show that using mobile phones affects brain activity... Children are more vulnerable to radiation from mobile phones than adults. Therefore the sensible thing to do is to adopt a precautionary approach rather than wait to have the risks confirmed... Children and young people who do use mobile phones, should be encouraged to use mobile phones for essential purposes only. All calls should be kept short as talking for long periods prolongs exposure to radio-frequency electromagnetic fields.

“All mobile phone users can reduce their exposure to radio-frequency energy by making fewer calls, reducing the length of calls, sending text messages instead of calling, using cell phones only when landline phones are unavailable, using a wired 'hands free' device so that the phone need not be held against the head and refraining from keeping an active phone clipped to the belt or in the pocket.”

<https://www.hse.ie/eng/services/news/media/pressrel/newsarchive/2011archive/june2011/mobilephonerisk.html>

Mobile phone packaging and other information for the public does not reflect the level of risk warned of in this advice. While the Dept of Health confirmed that the above warning is still valid, it would be useful for the Chief Medical Officer to provide an updated perspective on this issue.

## **Other concerns about 5G**

### **• Interference with the navigation systems of insects and birds**

Some scientists and environmental campaigners have raised concerns about the impact that 5G technology will have on insects and birds. According to an international petition signed by several hundred scientists and health experts, "If the telecommunications industry's plans for 5G come to fruition, no person, no animal, no bird, no insect and no plant on Earth will be able to avoid exposure, 24 hours a day, 365 days a year, to levels of radio-frequency radiation that are tens to hundreds of times greater than what exists today." <https://www.5gspaceappeal.org/the-appeal>

In comparison to the issue of human health, there is relatively little scientific literature about the potential threat from mobile phone technology to insects and birds, and again, 5G technology is too new for there to be any useful research in this area. More research about the potential impact on birds and insects would be helpful.

### **• Interference with weather forecasting:**

"The way 5G is being introduced could seriously compromise our ability to forecast major storms," Tony McNally of the European Centre for Medium-Range Weather Forecasts recently told *The Observer* newspaper.

"In the end it could make the difference between life and death. We are very concerned about this."

<https://www.theguardian.com/world/2019/may/04/5g-mobile-networks-threat-to-world-weather-forecasting>

The frequencies referred to in this article are 23.8 GHz, 36-37 GHz, 50 GHz and 86-92 GHz, none of which are due to be used in the European Union in the initial phase of 5G. However, some of these higher frequencies may be used in several years' time.

## Conclusions

Like many governments, the Irish Government is supporting and promoting the introduction of 5G technology, but neither it, nor the private companies to which it is giving licences to operate this technology, have provided much information to the public about what 5G will involve. The lack of clear information about 5G, and the almost total absence of Irish media coverage of the health concerns relating to 5G, have allowed scaremongering and conspiracy theories to proliferate on social media.

Pushing ahead with 5G technology without a careful process of information and public consultation is likely to further alienate people who already have concerns about its potential dangers.

As the World Health Organisation puts it, "Experience shows that education programmes as well as effective communications and involvement of the public and other stakeholders at appropriate stages of the decision process before installing RF [radio frequency] sources can enhance public confidence and acceptability." <https://www.who.int/peh-emf/publications/facts/fs304/en/>

The Irish Government and private operators should explain to the public what 5G technology will mean, what new infrastructure will be built, and why they believe this is necessary or beneficial.

ComReg should keep the public informed about which new radio-frequency bands it intends to license to private operators and when this is likely to happen. The private firms operating in this sector should clarify publicly that they are not introducing 5G technology yet, despite what some of their marketing suggests.

The Government should commission research into 5G technology, and into the claims about the risks to human health and the environment. This could take the form of a desk-based literature review by an independent academic. Also, experts could be called before an Oireachtas committee to address public concerns about 5G.

The mainstream media in Ireland has so far largely ignored the health concerns around 5G technology. It would be very helpful to a public understanding of this issue if the mainstream media were to cover this issue, investigate some of the concerns and facilitate a reasoned debate on the issue. Hopefully this research by Uplift will help to inform that debate.

Finally, several academics who spoke to Uplift pointed out that there are serious environmental threats to our health that we already understand, but about which there is little outcry. For example, each year in Ireland, an estimated 1,150 people die from inhaling polluted air.

<https://www.epa.ie/irelandsenvironment/air/> As Barry McMullin, Professor of Electronic engineering at DCU and a member of An Taisce's Climate Change Committee, put it:

“In terms of environmental pollutants, there are things that we already know, with absolute confidence, are causing widespread damage to human health and welfare, and they are currently being allowed to get much worse rather than being effectively regulated against. These are, of course, CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>, NH<sub>3</sub> etc – the greenhouse gases especially, but also the more local air and water pollutants, ammonia, NO<sub>x</sub>, particulates etc. These known effects are on a scale and known with a confidence that completely dwarfs any reasonably conceivable issues with mobile phone radiation.”

For those who care about the environment and social justice, opposing 5G has the potential to be a major distraction and diversion from very serious harms and injustices that we know are real. One example is climate change. While the science on mobile phones and human health is disputed, and the science on 5G and human health is almost non-existent, the science on climate change is as conclusive as it can be.

**9th May, 2019**

## **Further reading**

### **Frequently Asked Questions on electromagnetic fields**

Department of Communications, Climate Action and Environment

<https://www.dccae.gov.ie/en-ie/environment/topics/environmental-radiation/electromagnetic-fields/Pages/Frequently-Asked-Questions-on-Electromagnetic-Fields.aspx>

### **Advice from Ireland's Chief Medical Officer on mobile phone use**

<https://www.hse.ie/eng/services/news/media/pressrel/newsarchive/2011archive/june2011/mobilephonerisk.html>

### **Five Winning Bidders in ComReg's 3.6 GHz Band Spectrum Award**

ComReg press release announcing award of 5G frequencies, May 2017

<https://www.comreg.ie/five-winning-bidders-comregs-3-6-ghz-band-spectrum-award/>

### **Perks and challenges: a guide to 5G**

Article by Prof Ronan Farrell of Maynooth University, June 2018

<https://www.rte.ie/brainstorm/2018/0616/970909-perks-and-challenges-a-guide-to-5g/>

### **Why everyday wireless technology poses a health risk to children**

Article by Prof Tom Butler of UCC, April 2019

<https://www.rte.ie/brainstorm/2019/0417/1043133-why-everyday-wireless-technology-poses-a-health-risk-to-children/>

### **Mobile phones and health: is 5G being rolled out too fast?**

Article in Computer Weekly, April 2019, based on research by Investigate Europe

<https://www.computerweekly.com/feature/Mobile-phones-and-health-is-5G-being-rolled-out-too-fast>

### **The 5G mass experiment**

Research by Investigate Europe

<https://www.investigate-europe.eu/publications/the-5g-mass-experiment/>

### **World Health Organisation: Electromagnetic fields and public health**

<https://www.who.int/peh-emf/publications/facts/fs304/en/>

### **Guardian: The inconvenient truth about cancer and mobile phones**

Opinion piece, 14th July 2018

<https://www.theguardian.com/technology/2018/jul/14/mobile-phones-cancer-inconvenient-truths>



## **How Big Wireless Made Us Think That Cell Phones Are Safe: A Special Investigation**

Article in US newspaper, The Nation

<https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/>

## **The 5G Space Appeal**

Petition signed by several hundred scientists and health experts

<https://www.5gspaceappeal.org/the-appeal>