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REPORT: CONTROVERSIAL TOPICS
REPRESENTED IN MEDIA



Does 5G technology pose any health risks?

SUB-REPORT

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1. Definition of topic and period of analysis

Several scholars have argued that emerging technological innovations are socially constructed and reconstructed by diverse stakeholders with different interests, expertise and knowledge on the technologies in the matter (Funtowicz & Ravetz, 1995; MacKenzie & Wajcman, 1999; Taebi et al., 2014). This social shaping of technology explains an increasing number of public debates on “contested technologies” highlighting their potential impact on people or the necessity of regulating them (Hopke & Simis, 2017; Lidskog, 2008). 5G technology is an ideal example of contested technologies (Burrell, 2018). In its essence, the wider deployment of 5G, which is the fifth generation of wireless technology for digital cellular networks has only begun in 2019 (Scholz, 2019). In turn, its large-scale deployment has caused a massive wave of questions about whether the new technology poses health risks.

With the social opinion divided into supporters and opponents of 5G technology, the topic has been also intensively represented in the mainstream media, especially during the last year (Decker, 2019; Loughran, 2019; Soler & Busilo, 2019). However, discussion around the topic often lacks scientific argumentation, while evidence-based statements are also replaced with “fake news” contributing to the misinformation of the public audience.

The present sub-report, conducted by the Cyprus University of Technology, provides the current state on the topic and highlights concrete examples of how research results might have been misrepresented in mainstream media, covering the time span of 2019 (January 2019 to December 2019).

2. General Introduction

As its name reveals, 5G technology can be defined as the fifth generation of mobile phone services including phone (voice) calls, data communication and access to the Internet. In its essence, 5G is the descendant of the prior 1-4G technologies. As such according to Soler and Busilo (2019) 5G technology is the more recent evolution in a technology path which started in the 80's with mobile analogue telephony (1G), upgraded in the 90's to digital telephony with short text messages (2G), continued with the evolution of fast data transmission and Internet access from 14Mb/s to 28 Mb/s (3G), which was even more upgraded and released for commercial use in 2009, as the 4G version allowed data transmission rates even up to 300 Mb/s.

The number of European providers investing in 5G technologies is growing significantly as the telecommunications industry is rapidly moving towards the commercial introduction of 5G technologies. Major providers in Europe have already announced first pilot results as well as their plans for further exploitation of specific 5G features. At the same time, the *5G for Europe Action Plan* has already been launched in several countries, prompting the European Union countries to reach the 5G development milestones, as set by the European Commission. These include, in particular: Defining a 5G strategy for each EU country by 2018, commencing the commercial use of the 5G network in a selected city of each member state by 2020, and finally having a fully operational 5G network covering all the urban areas by 2025 (European Commission, 2018).

To date, 181 5G pilot networks have been reported in 23 European countries, according to the European *5G Observatory* (European Commission, 2019).

As 5G heads into the market for wide deployment by the public, it is expected to address consumer needs for lower latency (dead time) in transmission, higher data transfer rates and interconnectivity of much more devices per square kilometer (Ministry of Health – New Zealand Government, 2019). In particular, data transmission rates are expected to become 60x faster (up to 20Gb/s); according to these rates, high-resolution videos and movies could be downloaded on smart phones in about 10 seconds as opposed to 10 minutes today (Mobile UK, 2019; Maisch, 2019). At the same time, 5G technology can allow transmission in the radio network with little lag or buffering, from 50 milliseconds in 4G down to one millisecond in 5G (Soler & Busilo, 2019). This in turn leads to applications which today are not possible such as factory automation ushering in the fourth industrial revolution, multiplayer mobile gaming, and any other tasks which require quick responses (Mobile UK, 2019). Lastly, the increased interconnectivity affordances of 5G technology (up to one million devices per square kilometre for 5G in comparison to up to one thousand for 4G) provide the basis for the *Internet of Things* (IoT) allowing multiple devices to be connected including smart household appliances such as TVs and entertainment equipment, washing machines, dryers, thermostats, refrigerators, lighting fixtures, home security systems, etc. (Maisch, 2019; Soler & Busilo, 2019).

The implementation of the 5G technology is expected to have a radical impact on society. It is considered as a true game changer technology which will provide the infrastructure needed for the invention of new products and services, such as autonomous transportation, manufacturing automation, telemedicine, smart cities and homes today (Mobile UK, 2019). According to Soler and Busilo (2019) 5G technology will be also deployed for military purposes providing a competitive advantage to the countries using it, and as such it could be the cause for the so-called information war. However, as 5G heads into the market for its deployment by the public, several voices are supporting that while all its technological affordances and promises may become true, everything comes with a price tag.

The deployment of a 5G technology requires the expansion of the radio access infrastructure and an increase in the number of base stations (Ge et al., 2016). According to Chiaraviglio et al. (2019, p. 1), “this unavoidable practice is creating a controversy about the potential issues for the public health that new radio base stations may entail”. These concerns are also disseminated via the mainstream media and are often driven by the fear that industries and governments are focused on their own interest neglecting the risks on the public health. However, publications and reports around the topic often lack scientific basis, while evidence-based statements are also replaced with “fake news” contributing to the misinformation of the public audience (Decker, 2019; Loughran, 2019; Soler & Busilo, 2019). With the social opinion divided into supporters and opponents of the 5G technology, this topic is considered highly controversial and as such was deemed suitable for performing the predicted analysis. In the next section of this report we focus on the presentation, analysis and discussion of the main health-related arguments against the installation of 5G radio base stations, underpinning the misrepresentation of the topic and contributing to the misguidance of the public.

3. Desk Research

According to the Cisco Annual Internet Report 2018–2023 (2020), the total number of global mobile subscribers will grow from 5.1 billion (66 % of the population) in 2018 to 5.7 billion (71 % of the population) by 2023. The same report indicates that the number of devices connected to IP networks will be more than three times the global population by 2023, the fastest growing mobile device category is machine to machine (M2M) followed by smartphones, while M2M connections will be half of the global connected devices and connections by 2023. Based on these network statistics, one can easily observe that the mobile traffic is expected to present an exponential growth at a global level. However, as Agiwal, Roy, and Saxena (2016) have stated, supporting this rapid and enormous increase in data usage and connectivity is an extremely daunting task in present 4G networks. Likewise, Rappaport, Roh, and Cheun (2014) have argued that it will be unlikely to sustain this ongoing traffic explosion in the near future.

In light of this situation, the fifth generation of telecommunication technologies seems to be a fundamental cornerstone in satisfying the exponential rise in user and traffic capacity in mobile broadband communications. In particular, 5G as the generation of mobile phone services, will respond to consumer needs for higher data transfer rates and capacity, and lower latency (Ministry of Health – New Zealand government, 2019). According to Constantinou (2019) what is unique about the 5G network is not the amount of information it will transfer, but the response time of the devices connected to 5G. As Constantinou (2019) also states it will transfer 1000 times more information, but the crucial point is that it will be transferred so fast that often the machines that receive the information will respond faster than human reflexes.

At the same time, 5G technology will provide the basis for the advancement of various domains (i.e. manufacturing automation, autonomous transportation, smart cities and homes and telemedicine or agriculture), while new products and services will also be invented (Soler & Busilo, 2019). Indicatively:

- **Virtual Reality (VR) and Augmented Reality (AR) technologies:** Although VR and AR technologies are already in use in many countries, their capabilities will be fully unlocked only with the widespread adoption of 5G. With VR we will have the opportunity to deepen our lives into an unlimited virtual reality. In turn, this will radically transform the way we learn and communicate. While VR creates a whole new digital world, AR superimposes digital information and images on our natural environment, enhancing our perception. AR is expected to rapidly change our entertainment venues, the way we shop, work and consume various services.
- **Telemedicine:** With the 5G network, telemedicine becomes a reality, allowing patients to be diagnosed remotely and giving access to specialists who would otherwise be inaccessible. 5G allows instant, real-time data sharing to enable remote patient monitoring, even remote robot surgery, while improving emergency response. Lives could be saved due to long-distance surgeries.
- **Autonomous driving:** The 4G network has allowed us to share status and updates as we get stuck in the city's daily traffic jams. But it cannot support autonomous driving. Self-driving cars use hundreds of sensors, which need a reliable network to analyse huge loads of real-time data so that they can mimic human reflexes. Connecting vehicles to 5G

enables them to make critical decisions. In this context, lives will be saved as cars will communicate with each other to avoid accidents and collisions.

- **Agriculture:** With the deployment of 5G technology, farmers will not only plant seeds in their fields, but also small chips that will control everything from sowing to irrigation and harvesting with automated tractors. Overall, through specialized equipment farmers will be able to monitor their crops and intervene immediately when something is wrong.
- **Industry and manufacturing:** With the emergence of 5G technologies, new professions will be created while others will disappear. 5G is certainly in line with business requirements, as new products and technologies require fast internet and other networks to deliver the maximum of their product and services.
- **Policing:** A 5G drone equipped with high definition cameras can provide the necessary information to the police in crime investigation cases or may even intervene in hostage incidents.

In this context, 5G has been referred to as ushering in the fourth industrial revolution (Maisch, 2019). In its essence, the exploitation of 5G networks is likened by many to the control of oil pipelines that has defined the geopolitical reality of the post-war West (Delezos, 2019). Despite the advancement in various domains, as presented above, in fact, what everyone admires and fears at the same time is the affordances of 5G control of information, which has resulted in various concerns about data surveillance. China, which is currently considered the world leader in 5G networks, has deployed an extensive network of surveillance cameras for its people. At the same time, 5G opens the road for data interception. Both aspects, data surveillance and data interception could be used as a powerful weapon by governments. However, in this new "Cold War" of 5G networks, the "blocks" are not yet fully defined. On the one hand there are the governments of Australia, New Zealand, Canada and Japan, which are aligned with the US. On the other hand, the European Union does not present an unanimous stance, with some member-states like Germany and France keeping the pace and others left behind.

However, despite the promise of 5G technology there is also a growing movement to stop the implementation of 5G due to the potential risks on public health. In particular, a section of the scientific community – mainly a minority of independent researchers in medical sciences and doctors – argue that there are potential negative impacts from electromagnetic fields (EMF) exposure and that these will increase even more with the implementation of 5G (Karaboytcheva, 2020). It is also worth mentioning that a “5G appeal” was also presented to the United Nations in 2015, and to the European Union in 2017, with an increasing number of scientists' signatures (268 scientists and medical doctors as of December 18th, 2019). The signatories support that the 5G network can only be achieved by developing a very dense network of antennas and transmitters, which means constant exposure to EMF for the whole population, including children. In addition, the appeal supports that there is an increasing number of scientific publications (see for instance: Betzalel, Ishai, Feldman, 2018; Di Ciaula, 2018; Russel, 2018) which illustrate several EMF exposure effects such as an elevated risk of cancer, genetic damage, learning and memory deficits, neurological disorders, etc. (Karaboytcheva, 2020).

Are these concerns justified and empirically substantiated? Is there strong scientific evidence in support of these claims? To further investigate this matter, we present and discuss the main claims against the deployment of 5G technology stemming from its potential health risks, as provided by 5G opponents. Our investigation and discussion of the topic is conducted mostly from a technical point of view, which is radically different from the one adopted in existing research with a pure medical and clinical focus. Therefore, as in the study of Chiaraviglio et al. (2019), our aim is to address the potential hazards to better contextualise potential health risks with respect to the actual engineering of 5G networks.

To begin with, the main argument that the opponents of 5G raise is that exposure to the EMFs of 5G radio base stations increases the risk to develop specific classes of tumours.

This claim is usually supported with references on different exports studies and reports released by non-profit private organisations and research institutes (e.g. the USA-based *National Toxicology Program*, the *Ramazzini Institute* in Italy). These reports provide experimental evidence suggesting that exposure to high levels of radiation, like those used in 2G or 3G mobile networks, is responsible for the emergence of heart tumours in laboratory rats (Falcioni et al., 2018; National Toxicology Program, 2018a, 2018b). However, a closer look at these reports and other experimental studies on the topic reveals that these studies are very heterogeneous in terms of their experimental settings and more importantly, from a methodological point of view they fall short of supporting these claims. For instance, in a recent review study Simkó and Mattsson (2019) analysed and discussed 90 empirical studies resulting that with regard to the power densities used, “about half of the studies were carried out in the range up to 10mW/cm². This value is ten times higher than the current ICNIRP exposure guideline for the general population” (Simkó & Mattsson, 2019, p. 14). As such, the settings adopted in these studies result in EMF much over and above the European and international EMF limits. In addition, according to Chiaraviglio et al. (2019) these studies often include (a) rats being placed at a very short distance from the radio base station and (b) the adoption of power-inefficient and outdated 2G technologies. As a consequence, the aforementioned experimental settings do not permit the generalisation of these results to current base stations found in developed countries, as they are generally located far away from users and use the more updated 3G and 4G technologies, which radiate much lower EMF compared to the prior 2G technologies.

In addition, this claim is often supported by the International Agency for Research on Cancer (IARC), which in 2011 classified non ionising waves as “possibly carcinogenic (Level 2B) to humans” (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2013). The IARC further explains that this category is used when “a causal association is considered credible, but chance, bias or confounding cannot be ruled out with reasonable confidence” (IARC, 2011). Based on these premises, the World Health Organization (WHO) has not proposed any changes to the exposure limits for wireless networks and devices, while according to Chiaraviglio et al. (2019) it is not expected that the IARC will change the classification of EMFs from “possibly carcinogenic” to “probably carcinogenic” (Level 2A) any time soon given that existing health studies have severe limitations which cannot allow empirical substantiation to the carcinogenicity of radio-frequency EMFs generated by radio base stations. Besides, as they continue “even for carcinogens at the maximum level (level 1), the dose plays a crucial role in determining the carcinogenicity of the substance /mixture/exposure. For example, a low dose of a carcinogen may have no impact on health”

(Chiaraviglio et al. 2019, p. 8). In this context, taking into account the distance of users from the radio base stations (of dozen meters and more) as well as the received EMFs, which are much lower than the EMF limits set at European and international level, there is no strong evidence that the exposure to EMFs generated under realistic conditions is hazardous for human health. On the same page Public Health England's main advice about radio waves from base stations is that: "The guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) should be adopted for limiting exposures. After reviewing the evidence, ICNIRP set guidelines to avoid excessive heating of the body, an established impact of exposure which can have detrimental effects. The ICNIRP guidelines apply to frequencies up to 300 gigahertz and cover exposures arising from new 5G base stations as well as from older technologies." (Public Health England, 2019). In addition, in its latest publication of January 2015, the European Commission Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) supported that there is lack of evidence that EMF radiation contributes to an increase in cases of cancer in adults and children.

The development and piloting of 5G networks is also believed to be harmful for human health given that there is no previous research in the area and that 5G networks is an under-investigated invention. In many cases, opponents of 5G highlight that there is a risk to experience the same tragedy as with smoking, where at first it was said to be safe but then it was found to be carcinogenic. However, according to Constantinou (2019) there are two main differences: (a) that when it comes to radiation, radiation in relation to human health has been studied more than anything else; (b) in contrast to smoking which affects mainly the smoker, it would be difficult to lie about something like 5G that harms directly not only the user but also his/her children.

Another indicative argument provided by opponents of 5G networks is that 5G will have a dramatic impact on our health claiming that our skin might even burn. To support this claim, they mention that pilot experiments have indicated that birds die, trees are destroyed, and fires are starting nearby antennas (Maisch, 2019). This claim cannot bear scrutiny as according to Constantinou (2019) birds and trees withstand the sun's radiation, which is hundreds - up to millions of times - larger than that of an antenna. In a different vein, several studies have looked at how radio waves affect tissues isolated in the lab, and misinterpreted the results as applying to cells deep inside the human body (e.g. Mehdizadeh & Mortazavi, 2019). The analysis conducted in these studies though failed to recognise the protective effect of human skin. At higher radio frequencies, the skin acts as a barrier, shielding the internal organs, including the brain, from exposure (Broad, 2019). Human skin blocks even the higher frequencies of sunlight.

The 5G network is also accused in relation to its potential effect on human health given that it will use a completely new and untested technological infrastructure as well as new frequencies, called millimeter waves (mmWaves), which have not been employed before and whose impact on health is not known. However, such statements do not bear scrutiny.

Initially, 5G will mainly occur on bands that are largely used by previous generations of mobile networks (Loughran, 2019). On the same page, according to Chiaraviglio et al. (2019) the largest investment of the operators for 5G was not on the mmWaves, but on the 700 [MHz] and 3700 [MHz] frequencies. As Chiaraviglio et al. (2019) continue, these two options appear to be the most promising ones for the operators compared to the mmWave at 26 [GHz]. Instead, mmWaves are planned to be used in the future, only where high data rates or capacity

are needed or to accommodate communication for niche services in 5G (Loughran, 2019; Ministry of Health – New Zealand Government, 2019). But still, according to the New Zealand Government report “Millimetre waves have been widely used for many years for point-to-point communication links. Existing research into the health effects of RF fields covers all the frequency bands proposed for 5G“. Indeed, in their review study, Agiwal et al. (2016) have also supported that radio astronomy, radars, airport communications and many military applications have already been using the mmWave bands over the last few decades.

At the same time, the use of mmWaves is also non-ionising, as the microwaves used in prior networks, and range from around 10 to one millimetre. While this is a very effective spectrum with large bandwidth, its transmissions may be more prone to being blocked by external variables such as walls, trees or even rain (Maisch, 2019; Rappaport et al., 2013). To overcome this barrier the 5G network will inevitably require the installation of antennas capable of beam-forming massive inputs and outputs too close to one another, while due to higher frequencies and shortened ranges, the number of base stations is also expected to increase in order to provide complete coverage and avoid “not-spots” (Karaboytcheva, 2020).

While several people support the misleading view that these two factors will lead to higher exposures, the reality is actually quite different (Loughran, 2019). First, instead of transmitting fixed radio beams which cover a wide sector, 5G antennas usually produce a large number of discrete radio beams which cover a much smaller area, and they are only activated and directed where and when they are needed. In other words, the overall layout of 5G wireless networks moves towards a device centric topology, breaking the rules of the Base Station centric cellular concept (Boccardi et al., 2014). Put simply, according to the Ministry of Health of New Zealand (2019): “When a user is downloading data from the 5G network, the radio signal carrying the data is directed towards that user, and is not spread out over a wide area – mostly in directions where it is not needed – as currently occurs. The beam is turned off when the data has been transferred.” This can be attributed to the affordances of 5G beamforming antennas to control the phase and amplitude of signal, thus enhancing electromagnetic waves in the desired direction, while cancelling in all other directions (Korakis, Jakllari & Tassiulas, 2003). It seems, therefore, that this will contribute not only to the faster rate at which the data is transferred, but also to the lower exposures at EMF in comparison to the existing technologies being used.

In addition, even though, as already mentioned, the implementation of the 5G network will inevitably result in the deployment of a large number of radio base stations in a given territory. Contrary to a common misconception, this will allow to steadily reduce the transmitted power of each base station, compared to the case in which few base stations are installed. For instance, Chiaraviglio et al. (2019) have proven mathematically via a sequence of simple numerical examples that when the number of base stations is increased the emitted power from each base station is reduced by a factor k^{γ} [A detailed explanation of this factor and its calculation can be found in the study of Chiaraviglio et al. (2019)]. Therefore, according to Loughran (2019) a larger number of base stations will not only result in a more efficient network, but “this means that mobile phones can operate at reduced power, which is likely to result in reduced overall personal exposure” (Chiaraviglio et al., 2019, p. 2).

Finally, there is a myth that some countries have banned or closed WiFi, e.g. France, due to health risks related to 5G technology. According to Constantinou (2019), this has been done to reduce the use of the internet by students during the courses and not because of the

radiation; in fact, Wi-Fi is still permitted in courses using computers. Likewise, there is another myth which says that some cities in Europe have stopped the installation of 5G equipment. As Constantinou (2019) states, this is true, but this is due to data interception concerns as the equipment purchased by many of the companies is Chinese and is suspected of allowing data surveillance. This was not done due to concerns in relation to the impact of radiation as this cannot be supported.

To conclude, most of the allegations against 5G technology and radio base stations are not supported by strong and solid scientific evidence yet. However, research in relation to the potential health impact of EMFs should continue both in terms of 5G radio base stations and also in terms of low EMFs generated by various devices (e.g., 5G smartphones, tablets and laptops).

4. General information about the sample

As part of this sub-report, a total of 300 articles on the topic has been initially retrieved from online newspapers from Greece and Cyprus (e.g. *Simerini*, *Kathimerini*, *Ta Nea*, *Ethnos*, *Phileleftheros*, *Proto Thema*, *To Pontiki*, *To Vima*, *Reporter*, *SigmaLive*) covering the time span of 2019 (January to December 2019).

A screening of these articles indicated that the vast majority of them focused on the political and financial aspects of the topic providing updates: (a) about the efforts of Cyprus, Greece and other countries in Europe and across the world (e.g. Germany, UK, China, USA) to enact and assess pilot 5G networks at various scales and/or (b) about the financial and political competition around these efforts due to the economic, military and geopolitical consequences. A significant portion of these articles presented also the efforts of several telecommunication providers and technology companies towards the development and testing of pilot 5G technologies and networks as well as the evaluation of its affordances at local and international level (e.g. *Huawei*, *Panasonic*, *MTN*, *Cyta*, *Cosmote*, *Vodafone*, *Telecom*, *Wind*).

Only a minority of the retrieved articles focused on informing the readers about the nature of 5G technology, seeking to communicate (a) what 5G technology is, (b) how 5G technology works, and/or (c) what the perceived consequences of this technological development are (especially for human health). A total of 25 articles were selected and another five articles with the same scope were also selected from international mainstream media (i.e. *The Guardian*, *New York Times*). These articles (n=30) composed the sample of this sub-report and were analysed applying content analysis (more information about the content analysis method can be found in the general methodological report).

Focusing on the general characteristics of the selected articles composing the sample of this sub-report we, next, provide a brief overview according to six dimensions.

- **News source:** The articles (n=30) derived from the following 12 online newspapers: *Phileleftheros* (five articles – 16,7 %), *Reporter* (five articles – 16,7 %), *The Guardian* (four articles – 13,3 %), *Politis* (three articles – 10 %), *Dialogos* (three articles – 10 %), *Ta Nea* (two articles – 6,7 %), *To Pontiki* (two articles – 6,7 %), *i-Eidisi* (two articles – 6,7 %), *Kathimerini* (one article – 3,3 %), *To Vima* (one article – 3,3 %), *Espresso News* (one article – 3,3 %), *New York Times* (one article – 3,3 %).

- **Publication date:** The publication date of the articles indicated that the topic of 5G technology was represented in online newspapers throughout the whole year as follows: February 2019 (two articles – 6,7 %), March 2019 (one article – 3,3 %), April 2019 (two articles – 6,7 %), May 2019 (three articles – 10 %), June 2019 (five articles – 16,7 %), July 2019 (four articles – 13,3 %), September 2019 (six articles – 20 %), October 2019 (five articles – 16,7 %), November 2019 (one article – 3,3 %), December 2019 (one article – 3,3 %). However, most of the selected articles were found in September and October 2019 (11 articles – 36,7 %) as during this period the topic was presented and discussed in the parliament of Cyprus as a highly controversial one.
- **Authorship:** Only about half of the articles were signed by an author (14 articles – 46,7 %), while the signed articles belonged to 12 different authors. More importantly, only two authors (6,7 %) provided more information about their status: in the first case the author signed as an academic/researcher while in the second case, the author signed as a science journalist/senior writer.
- **Section:** The selected articles were published in the following newspaper sections: Science & Technology (13 articles – 43,3 %), Local news (eight articles – 26,7 %), Economy (three articles – 10 %), Opinions (two articles – 6,7 %), Society (two articles – 6,7 %), World news (two articles – 6,7 %). As observed, the majority of articles was published in the “Science & Technology” section, which is reasonable given the topic.
- **Length of the articles:** Focusing on the selected articles’ length the average length of the articles was $m=772,5$ words ($SD=358$ words). The maximum number of words was equal to 1904 words, while the minimum was equal to 317 words.
- **Scope:** Taking into account the scope of the selected articles we divided the articles into categories as those presenting the topic via a narrower and nationally bounded scope and those presenting the topic via a broader and international scope. Based on our analysis we have found that 13 of the articles (43,3 %) adopted a nationally bounded scope, while another 17 articles (56,7 %) adopted an international scope.

5. Style of language and content

The selected articles were analysed in terms of the style of language used and content. What follows is an overview of our findings according to five dimensions.

5.1 Tonality of headlines

In 11 of the analysed articles (36,7 %) the tonality of the headlines was positive and in favour of 5G technologies, highlighting the promise that 5G networks hold in our lives (e.g. “5G technology comes and revolutionizes our lifestyle”, “The 5th generation networks are here and are radically changing our lives”) or the lack of hazards and risks (e.g. “Scientists support that the 5G networks are innocent”, “The 5G health hazard that isn’t”). In 11 of the analysed articles (36,7 %) the tonality of the headlines was negative and against 5G technologies, highlighting the concerns around their potential implications (e.g. “The implications of 5G and the conflicting positions were presented at the Parliament”), the dangers and health risks around the use of 5G technology (e.g. Public health hazards from using the 5G network) or even

protests of citizens and scientists (e.g. “180 scientists from 36 countries around the world warn the European Union about the serious health effects of 5G”, “There is a tsunami of protests due to 5G”). Finally, in eight (26,6 %) of the analysed articles the tonality of the headlines was neutral, without betraying a positive or a negative stance towards 5G technologies (e.g. “What is 5G?”, “5G: What is it and what are its features?”). Overall, taking into account the tonality of the headlines we have identified 19 articles (63,3 %) that misrepresented the topic by using titles that did not reflect the content of the article.

5.2 Type of language

In 12 of the analysed articles (40 %) the language used could be described as polemic expressing an aggressive attack against or in favour of the 5G technology (e.g. “I still think there are health effects ... The federal government needs to look at it more closely”, “The wavelengths that 5G uses and will use are all entirely safe and have been in research and testing for decades. It’s a red herring to say it’s a new technology and therefore hasn’t been tested”). In five of the analysed articles (16,7 %) the language used could be described as emotive seeking to evoke an emotional response around the potential of 5G (e.g. “5G, will be the basis for the most historic technological transformation of human society“, “The fifth generation of mobile networks, or 5G as it is known, will make a giant leap in wireless technology similar to the invention of the desktop computer”). In the rest of the 13 articles (43,3 %) the language used was more neutral.

5.3 Speaking-actors and speech acts

The language used in the articles was also analysed to explore which actors were given a voice in-text (notion of “standing”) as well as the length of the speech acts. As proposed by Saraisky (2016, p. 33) “Speech acts included only speech that is quoted directly, in quotations, in the articles; paraphrases or restatements of comments from people or reports are not included in the analysis”. According to our findings we have identified speech acts only in seven of the analysed articles (23,3 %). The average length of these speech acts was $m=211$ words ($SD=129$ words). The maximum number of words was equal to 106 words, while the minimum was equal to 477 words. Lastly, the speaking actors were mainly politicians (five articles), followed by scientists (three articles) as well as academics/researchers (three articles).

5.4 Use of resources

Only 11 of the analysed articles referred to other resources (36,7 %) while only four of these articles made reference to multiple [more than one] resources (13,3 %). The resources included mainly references to international organisations related to health and drugs i.e. the World Health Organization (nine articles), followed by references to scientific articles and reports (six articles), and political/economic associations such as the European Union (four articles).

5.5 Content

Focusing on the content of the analysed articles, we are interested in investigating whether the selected articles provided information to define what 5G is (definitions), to explain how it functions (functionality) and to bring across its potential impact positive or negative (impact). According to our findings 28 out of the selected articles (93,3 %) provided insights as far as the

potential impact of 5G is concerned, less than half of the articles defined what 5G is for the readers (13 articles, 43,3 %) while less than one third of the articles provided some insights about how 5G functions (nine articles, 30 %).

6. Visualisation

The selected articles were analysed in terms of their visualisations to identify whether and how the topic was visualised. What follows is an overview of our findings according to four main dimensions.

6.1 Use of visuals

As part of our content analysis, we have identified the use of visuals in 29 (96,7 %) of the selected articles. However, only five of the articles (16,7 %) used multiple visuals, namely more than one visual representation.

6.2 Type of visuals

Focusing on the type of visuals, 17 articles (56,7 %) included photos, 14 articles contained images combining real and virtual elements (46,7 %) while only two articles (6,7 %) comprised diagrams.

6.3 Content of visuals

As far as the content of the visuals is concerned, 14 articles (46,7 %) included abstract representations to convey 5G technology, i.e. connectivity webs among buildings and devices, the human hand extending to touch the “5G icon”, light rays into projection to represent the fast speed of 5G networks etc. On the other hand, seven articles (23,3 %) presented real objects such as antennas and cables or 5G mobiles phones. Another five articles (16,7 %) represented relevant actions such as people using mobile phones or other 5G enabled technologies like VR and holograms, or people protesting the 5G network. Only two articles (6,7 %) included symbolic representations such as charts and figures.

6.4 Tonality of the visuals

In 22 of the analysed articles (73,3 %) the tonality of the visuals was neutral, not indicating or communicating either a positive or negative message in relation to 5G technology. In four articles (13,3 %) the tonality of the visuals was in favour of 5G technologies communicating a positive message (i.e. excited users adopting 5G and its applications). Only in three of the analysed articles (10 %) the tonality of the visuals was against 5G technologies bringing across a negative message (i.e. people protesting against 5G technologies, people running to avoid the radiation).

6.5 Placement of visuals

Only in three articles (10 %) the visuals deployed were integrated and placed within the text. In the remaining 27 articles (90 %) the visuals were placed before the main text, right after the headlines.

6.6 Use of captions

Only in six articles (20 %) there were captions providing more insights about the content of the visuals. In four of the cases the tonality of the captions used were in favour of 5G technology, in one case negative and in one case neutral.

6.7 Consonance

Taking into account the neutrality of the visuals used as well as their placement, and the lack of captions, we have also identified that in most of the cases there was also lack of consonance between the visuals and the tonality of the articles. In particular, only in 11 (36,7 %) of the analysed articles there was a relative consonance between the visuals used and the articles' content/language, while in 18 articles there was lack of consonance (60 %).

7. Controversy

The selected articles were analysed to identify whether and how controversial ideas related to 5G technology were presented. What follows is an overview of our findings according to four main dimensions.

7.1 Controversy

While as indicated in the previous sections the topic in general is a controversial one, although it was not presented as a controversial one in all the analysed articles. In particular, the topic was discussed and framed as a controversial one, involving conflicting opinions and positions only in half of the analysed articles (15 articles, 50 %).

7.2 Stakeholders

The stakeholders involved in the controversy were presented in 14 articles (46,7 %). In particular the following specific groups of stakeholders were presented: (a) politicians and policymakers (12 articles, 40 %), scientists and doctors (10 articles, 33,3 %), citizens (10 articles, 33,3 %), telecommunication providers (six articles, 20 %), academics & researchers (five articles, 16,7 %).

7.3 Multiple points of view

Even though 5G technologies were presented and acknowledged as controversial in half of the analysed articles (15 articles, 50 %), only 10 of the articles (33,3 %) presented multiple points of view on the topic (namely, positions from different stakeholders).

7.4 Side-taking

While the topic was presented as controversial in half of the analysed articles (15 articles, 50 %), the authors took side only in six articles (20 %). In half of these articles the authors took a positive stance, in favour of 5G technologies, while in the rest the authors took a negative stance, against 5G technologies.

8. Use of evidence-based research/science and missing facts

The selected articles were analysed to identify whether and to what degree they were presenting basic (evidence-based) facts, incomplete information, misstatements, or omitted information. According to our findings we have identified basic facts in 14 of the analysed articles (46,7 %), incomplete information in 15 of the analysed articles (50 %), misstatements in 16 of the analysed articles (53,3 %), and omissions in 12 of the analysed articles (40 %). What follows below, is an overview of the evidence-based facts, of the incomplete information, the misstatements as well as the omissions we have identified in the analysed articles.

8.1 Evidence-based facts

A total of 11 basic and evidence-based facts were identified and coded in the analysed articles as follows:

- 5G will be based initially on existing frequencies like 4G, in most of the countries, and not in mmWaves (seven articles – 23,3 %).
- Despite the disagreement of a minority of scientists and their opposition to 5G networks, there is a dominant consensus reflected in international organisations e.g. WHO, ICNIRP, etc. (five articles – 16,7 %).
- At a later stage, 5G will be also based (partially) on higher frequencies (mmWaves) which cannot cover long distances or penetrate walls, roofs and windows (five articles – 16,7 %);
- Even though 5G is not a threat for public health, some cities have lowered the frequency limits to mitigate citizens' concerns (three articles – 10 %).
- Some cities in Europe have stopped installing 5G equipment due to data surveillance concerns rather than health concerns (two articles – 6,7 %).
- Even though the use of higher frequencies (26 GHz) is relatively new in telecommunications, these frequencies have been widely used, tested and investigated in the past for the operation of other radio communication services (two articles – 6,7 %).
- EMF is not something unnatural or "artificial". 5G frequencies produce much lower levels of radiation than the sun (one article – 3,3 %).
- Radiation is included among the most investigated topics. There is a huge corpus of research studies on EMF and the MHz and GHz zones which will be deployed as a part of 5G networks (one article – 3,3 %).
- There is not enough and conclusive evidence linking 5G and EMF with health problems (one article – 3,3 %).
- 5G will be based on a denser system of antennas which will result in lower levels EMF as they will be connected with lower power due to the smaller distance between them (one article – 3,3 %).
- The human skin acts as a barrier / human skin blocks even higher frequencies of sunlight, thus protecting humans (one article – 3,3 %).

8.2 Incomplete information

A total of eight incomplete facts/pieces of information were identified in the analysed articles as follows:

- Protection measures implemented by other countries need to be followed, i.e. 5G free zones, ban of WIFI from schools [but without providing any further reasoning] (nine articles – 30 %).
- Technological development is moving faster than knowledge [but without relating this claim to the 5G networks] (seven articles – 23,3 %).
- WHO classifies 5G as “possibly carcinogenic to humans” [but without explaining whether this information is in-favour or against 5G] (seven articles – 23,3 %).
- With the implementation of 5G networks, the number of antennas may increase dramatically [but without explaining what this means in terms of functionality of the 5G networks in relation to human health] (six articles – 20 %).
- Concerns around 5G should be explored via the use of scientific criteria based on scientific studies [implying that there is lack of research on the topic but without providing any further reasoning] (six articles – 20 %).
- Antennas should not be placed nearby schools and hospitals or nearby vulnerable groups [but without providing any further explanation in relation to 5G] (four articles – 13,3 %).
- The placement and installation of new antennas should be regulated by law [but without mentioning that there is already legislation around the permitted limits of 5G] (two articles – 6,7 %).
- Various cities in Europe have stopped installing 5G equipment or have restricted WIFI [but without defining if this is related to the health concerns around 5G] (two articles – 6,7 %).

8.3 Misstatements

A total of ten misstatements were identified in the analysed articles as follows:

- There is conclusive scientific proof that intensive EMF provoked by the activation of 5G networks is responsible for the increase of cancer, fertility issues, DNA destruction especially for young children (14 articles – 46,7 %).
- There is lack of research on 5G radiation, indicating that there is no risk to human health (seven articles – 23,3 %).
- Cancer, which can be caused by 5G radiation, will grow rapidly / these data will soon force the WHO to classify 5G as a carcinogenic technology (four articles – 13,3 %).
- The function of 5Gs is based exclusively on high frequencies (mmWaves) (four articles – 13,3 %).
- With 5G technology citizens will be exposed to high levels of electromagnetic radiation (two articles – 6,7 %).
- There is scientific proof that the negative impact of 5G will expand beyond human health affecting also trees, animals and insects (two articles – 6,7 %).
- Higher frequency means higher absorption from trees, animals, and humans (two articles – 6,7 %).
- 5G will be based on a denser system of antennas which will result in higher levels of EMF radiations (two articles – 6,7 %).

- There will be a negative impact on human skin from mmWaves. All of us will be burned. Dead birds will be falling from above (two articles – 6,7 %).

8.4 Omissions

A total of nine omissions were identified in the selected articles, taking into account the context, as follows:

- It is not expected that the WHO will change the classification of EMFs from “possibly carcinogenic” to “probably carcinogenic” (Level 2A) any time soon as existing health studies do not allow empirical substantiation to its carcinogenicity (11 articles – 36,7 %).
- There is a huge corpus of research studies on EMF which could justify the basis of 5G introduction and use – radiation is a heavily studied area (ten articles – 33,3 %).
- EMF is harmful for humans when it is at much higher levels than the levels allowed by 5G antennas (seven articles – 23,3 %).
- Antennas are only activated and directed where and when they are needed. The radio signal carrying the data is directed towards a particular user and is not spread out over a wide area (five articles – 16,7 %).
- 5G will initially be based on existing frequencies used at 3G and 4G networks (three articles – 10 %).
- Despite the disagreement of a minority of scientists, there is a dominant consensus in favour of 5G networks reflected in international organisations (two articles – 6,7 %).
- The deceleration of 5G in various countries has to do with concerns on data surveillance rather than with health concerns (two articles – 6,7 %).
- Wi-Fi restrictions in several countries at schools have to do with controlling students’ excessive use of internet rather than with health concerns (two articles – 6,7 %).
- Birds and trees are tolerant to 5G radiation, taken into account that the radiation of the sun is about one million times more intense (one article – 3,3 %).

9. Overview of the content analysis

Taking into account the findings of the content analysis presented above in relation to the misrepresentation of the analysed articles we have found that:

- 16 articles (53,3 %) have misrepresented the topic by disinforming
- 12 articles (40 %) have misrepresented the topic by omission of information
- 15 articles (50 %) have provided a one-sided representation of the topic
- 15 articles (50 %) have misrepresented the topic by not providing a critical interpretation or comment on the information shared
- 18 articles (60 %) have provided images and visuals that were not related to the content of the article
- 19 articles (63,3 %) have misrepresented the topic by using titles that did not reflect the content of the article

This overview is also presented in the following table.

Tab. 1: Misrepresentation in analysed articles.

Number of articles that have misrepresented the topic by disinforming (intentional misleading information)	16 (53,3 %)
Number of articles that have misrepresented the topic by omission of information	12 (40 %)
Number of articles that have provided a one-sided representation of the topic (which is as well the fact that they have not reflected the controversy and different issues at stake)	15 (50 %)
Number of articles that misrepresented the topic by not providing a critical interpretation or comment of the information shared	15 (50 %)
Number of articles whose images and visuals were not related to the content of the article	18 (60 %)
Number of articles that misrepresented the topic by using titles that did not reflect the content of the article	19 (63,3 %)

10. Conclusion

The content analysis of the selected articles, as presented in the previous sections, reveals several issues negatively affecting the trustworthiness of the news media and contributing to the misrepresentation of the controversial topic of 5G technologies. An overview of these problematic issues is presented below, following different dimensions, and it is discussed in relation to potential mitigation actions.

DIMENSION 1 – GENERAL CHARACTERISTICS

Focusing on the general characteristics of the analysed articles, we have identified two problematic aspects.

The first one is related to the authorship of the articles. In particular, as already mentioned, about half of the articles were not signed by an author, while most of those which were signed did not provide further details in relation to the author's status and background. In turn, this has a negative impact on the credibility and trustworthiness of the articles. Go, Jung and Mu (2014) have supported that, the author's name, number of comments in, and group identity of online news articles have been shown to influence perceived credibility by the audience. Likewise, according to Sitaula et al. (2019, p. 5) "If a news article does not provide any information on its authors, its credibility can be questioned". However, while this stands true in the case of newspapers it is common that articles are not signed. This can mean that the article represents the point of view of the editorial staff that just wants to launch a public debate around a topic. The same researchers have also observed that the number of authors

of a news article has some correlation to its credibility. According to their findings, if an article has more than one author, it is more likely to be credible. Based on this finding, it is recommended to online news sites that they include sources, especially the author's name, status and occupation.

The second problematic aspect relates to the length of the analysed articles. Taking into account the desk-based research presented in this report, 5G networks not only represent a complex socio-scientific controversial issue, they are also based on a complicated technological infrastructure whose functionality could hardly be conveyed and communicated in short articles of 300 to 500 words. Given that peer-reviewed articles published in scientific journals are usually between 5000 to 7500 words, one could easily understand that there is an outstanding difference between the two formats. Of course, we do not imply that articles published in mass media should be as extensive as scientific journal articles but at least they should be more comprehensive (e.g. 1000 to 1500 words) in order to adequately cover the controversial topic addressed which in our case is 5G technology. Investigating whether the length of online news was an indicator of their credibility, Sitaula et al. (2019) confirmed that articles that misinformed were shorter in terms of number of words, compared to news items including correct information.

DIMENSION 2 – LANGUAGE & CONTENT

When analysing the selected articles, we identified three problematic aspects related to (a) the use of speech acts / speaking actors, (b) the inclusion and citation of other resources, and (c) the content of the articles.

First, we have found that the involved stakeholders were given a voice randomly as in most of the articles analysed there was lack of speech acts, namely of speech that was quoted directly. We argue that articles presenting controversial topics should allow more space for the inclusion of speech acts for various reasons. Speech acts are important indicators for the establishment of (simulated and) direct interaction between the readers and the actors i.e. the stakeholders (Searle, 1976). They provide a sense of directness (see the immediacy-distance-continuum proposed by Koch and Oesterreicher, 2012) and at the same time, they help journalists to keep a more objective stance by separating their position from what is directly supported by the involved stakeholders. Second, we have found that less than half of the articles (11 articles – 36,7 %) have made reference to at least one resource, while only four articles (13,3 %) have made reference to multiple resources in order to support their claims. This finding is aligned with the conclusion of Evers, Jempson and Powell (2011) who stated that despite the growth of online news, a lack of references and links to sources in reports remains. However, as stated by Sitaula et al. (2019, p. 12), “a greater occurrence of numbers or digits may indicate that a news article is well-researched, containing verifiable data; similarly, the occurrence of hyperlinks and URLs may indicate citations suggesting that an article is supported by external sources.” On May 19th, 2011, *The Guardian* journalist Ben Goldacre asked “Why don't journalists link to primary sources?” He claimed that linking to sources, mainly original press releases or academic studies in science reporting, allows readers to check the information, to find out more and to show transparency (Goldacre, 2011). Based on our findings we fully agree to his recommendations.

Lastly, focusing on the content of the analysed articles, what we found really alarming was that while in the selected articles there was an evident overemphasis of the potential impact of 5G, most of the articles neglected the definitional and operational aspects (i.e. what 5G is and how it works). However, according to Theocharides (2019) both aspects are crucial for understanding this controversial topic and the way it is misrepresented. As Theocharides highlights, citizens need to be informed that the 5G network not only requires the installation of more antennas at closer distances. Instead, he argues that it is more important for citizens to be informed that this system with denser antennas will result in less powerful electromagnetic emissions, given that they will be connected to less power due to the shorter distance between them, and will operate at much higher frequencies, which decreases their penetration, f.e. through walls and windows. Overall, while the history of technology development suggests that trying to communicate physics-related details underpinning new technology may not always be the best approach to public education, it may be still adequate to explain the ways through which potential risks are addressed and how safety is ensured (Soler & Busilo, 2019). Grounded on this knowledge basis, citizens will be educated on the topic and thus they will be more able to identify misinformation surrounding it.

DIMENSION 3 – VISUALISATION

The visual features of online news are often neglected. However, several researchers have put much emphasis on the power of visuals in online news, not only in complementing and augmenting the text but also in influencing the trustworthiness of the news or even contributing to misinformation on the topic presented (Kioussis, 2006; Jin et al., 2017; Lago, Phan, Boato, 2019).

As part of our analysis, we have identified several problematic issues in relation to the use of the visuals deployed in the selected articles around 5G technology. First of all, in terms of content the vast majority of articles included photos and images, with only two articles (6,7 %) containing charts and figures. According to Sitaula et al. (2019), this could be perceived as problematic as the use of visuals with numbers and digits provides the article with a more scientific perspective. Likewise, according to Young (2016), visuals such as graphs and charts help readers to better understand the information presented as well as to build trust around the reliability of the news presented. In addition, what we have also found problematic was the loose coupling effect between the text and the visuals. In most of the analysed articles there was a lack of consonance between the tonality of the visuals and the textual information presented, as well as lack of captions contributing to the relatedness of the visuals to the text. Besides, the visuals were also placed outside of the text (before the text, right under the headlines). However, this misalignment between the text and the visuals can contribute to a decrease in trustworthiness of the online news (Lago et al., 2019). In particular, according to Young (2016), when visuals lack context, this can make people more sceptical about the information presented.

Overall, considering our findings in relation to the visualisation of the selected articles it seems of paramount importance for journalists to take into account the instrumental role that visuals can play and therefore to pay close attention to the proper and productive use of visuals in online news.

DIMENSION 4 – CONTROVERSY

One of the core functions of the news media is to critically investigate and present information about social, political, economic, and ideological issues. Some of these issues are controversial as they focus on issues which divide citizens' minds by provoking arguments in which people express strong opposing views and opinions (Clarke, 1990; Martin, 2014). However, while prior research has investigated the presentation of and reporting on controversial topics in traditional media outlets focusing on the routines that print journalists undertake, little is yet known about the practices of online media sources when reporting controversial issues due to the lack of relevant studies (Anderson, Brossard, Scheufele, 2012; Garimella et al., 2017).

As part of our analysis we have found that the topic of 5G which was the focus of this report, was only presented as a controversial one in half of the analysed articles (15 articles – 50 %). Only 10 articles (66,7 %) presented multiple points of views on the topic (namely, positions from different stakeholders). At the same time, despite recommendations for journalists to take special precaution when they report on controversial issues (Mejova et al., 2014) we have found that in only six articles (40 %) presenting 5G technology as a controversial topic, the authors took an explicit position either against or in favour of this technology. According to the literature, it has been argued that journalists can become susceptible to the ideologies, attitudes and pressures of their organisation (Scheufele, 1999) as well as to unstated rules and norms prevalent in their organisation (Entman, 2007). Consequently, this can influence the language used to discuss controversial issues within a particular news source. Based on our findings, it seems that when presenting a controversial issue, journalists should be less biased, more objective and use language carefully in order to present all the aspects of the controversy precisely.

DIMENSION 5 – USE OF EVIDENCE-BASED RESEARCH/SCIENCE

As previously discussed, our desk-based research has indicated that there is no incontrovertible scientific evidence supporting that 5G poses risks for public health. While we second the need for further investigations, we also point out that the analysis of the selected articles has indicated numerous misstatements, incomplete information and omissions resulting in a factual fabrication of fake news on the hazards of 5G for human health. According to Chiaraviglio et al. (2019, p. 1), these fake news “may severely distort the perception of this technology by the population at large”.

Our finding that almost half of the articles (14 articles – 46,7 %) contained misinformation and misstatements on the topic is alarming. Indicatively, most of the misstatements pointed out that there is conclusive scientific proof that 5G networks are responsible for the increase of cancer, fertility issues and DNA destruction especially for young children or that there is lack of research on 5G radiation, indicating that there is no risk on human health.

However, which reasons can be identified to explain why 5G technology, as a topic, is misrepresented? One of the main causes is that in September 2018, 180 scientists published an open letter against 5G – “5G Appeal”. The letter contained general warnings, focusing on potential health and environmental risks of 5G technology and called for a memorandum for worldwide development of 5G networks. However, according to Soler and Busilo (2019, p. 212), “despite the number of signatures suggesting scientific character of the letter it contains

information, which are not actual, not completely true nor accurate. The language is emotional and fear relating not scientific one and proof relating.” This 5G appeal movement has spread around misinformation that several journalists have often published in online news and mass media articles, without first proceeding with fact-checking processes. In this context, aligned with Soler and Busilo (2019, p. 210) we agree that “in order to counteract the disinformation better education of the society is necessary. It should focus on critical valuation of information and their sources and on identification of disinformation and its mechanisms”.

In particular, what is needed is to:

- Train journalists via strengthening their competences in identifying disinformation and verifying information.
- Support and promote scientific journalism as the practice of including primary sources along with journalistic stories and scrutinising questionable statistics or overinflated claims, while also investigating scientific misconduct, conflicts of interest, and ethical breaches.
- Create bridges between journalists, scientists and the scientific community at large as proper presentation of scientific and technological controversies requires expert knowledge.
- Make results of technology assessment accessible to the public, while also ensuring that these results will be brought across in a plain and understandable language.
- Empower citizens via strengthening their skills to evaluate information and its sources, especially on the internet.
- Provide all stakeholders (scientists/researchers/academics, industry representatives, policymakers, citizens) with equal space for stating their arguments, while always adhering to scientific evidence and documentation.
- Communicate if further studies on technology are necessary, on which aspects and what may be practical implications for the use of technology.

Verrender (2019) mentioned that the debate over adverse health effects from “phone tower anxiety” is being “fuelled [*sic*] by misinformation, scepticism and a complex psychological phenomenon known as the nocebo effect”. If the aforementioned actions are undertaken, then the topic of 5G technology will stop being misrepresented in online news soon enough and the development of 5G networks will continue smoothly.

References

- Agiwal, M., Roy, A., & Saxena, N. (2016). Next generation 5G wireless networks: A comprehensive survey. *IEEE Communications Surveys & Tutorials*, 18(3), 1617–1655. <https://doi.org/10.1109/COMST.2016.2532458>
- Anderson, A., Brossard, D., & Scheufele, D. (2012). News coverage of controversial emerging technologies: Evidence for the issue attention cycle in print and online media. *Politics and the Life Sciences*, 31(1-2), 87–96. <https://doi.org/10.1017/S0730938400014283>
- Betzalel, N., Ishai, P., & Feldman, Y. (2018). The human skin as a sub-THz receiver – Does 5G pose a danger to it or not? *Environmental research*, 163, 208–216. <https://doi.org/10.1016/j.envres.2018.01.032>
- Boccardi, F., Heath, R. W., Lozano, A., Marzetta, T. L., & Popovski, P. (2014). Five disruptive technology directions for 5G. *IEEE Communications Magazine*, 52(2), 74–80. <https://doi.org/10.1109/MCOM.2014.6736746>
- Broad, W. J. (2019, July 16). The 5G health hazard that Isn't. *The New York Times*, <https://www.nytimes.com/2019/07/16/science/5g-cellphones-wireless-cancer.html>
- Burrell, L. (2018). Citizens up in arms against 5G wireless technology roll-out: Are their concerns justified. Retrieved from: <https://humansarefree.com/2018/04/citizens-up-in-arms-against-5g-wireless-technology-roll-out-are-their-concerns-justified.html>
- Chiaraviglio, L., Fiore, M., & Rossi, E. (2019). 5G Technology: Which risks from the health perspective? In M. Ajmone Marsan, N. Blefari, S. Buzzi, S. Palazzo (Eds.), *The 5G Italy Book 2019: a Multiperspective View of 5G*. Consorzio Nazionale Interuniversitario per le Telecomunicazioni. <https://www.5gitaly.eu/2019/en/5g-italy-book-2/>
- Cisco (Last update Feb. 2020). *Cisco Annual Internet Report (2018–2023) White paper*. <https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html>
- Clarke, A. E. (1990). Controversy and the development of reproductive sciences. *Social Problems*, 37(1), 18–37. <https://doi.org/10.2307/800792>
- Constantinou, N. (2019). Ten myths and misconceptions about 5G and WiFi. Paper presented at the *Child and Bioethics* conference organised by the Cyprus National Bioethics Commission.
- Decker, B. (2019). *Adversarial narratives: A new model for disinformation*. Global Disinformation Index.
- Delezos, C. (2019, October 29). The Holy Grail of world technology. *The News*, <https://www.tanea.gr/2019/10/29/economy/to-agio-diskopotiro-tis-pagkosmias-texnologias/>
- Di Ciaula, A. (2018). Towards 5G communication systems: Are there health implications? *International journal of hygiene and environmental health*, 221(3), 367–375. <https://doi.org/10.1016/j.ijheh.2018.01.011>
- Entman, R. M. (2007). Framing bias: Media in the distribution of power. *Journal of communication*, 57(1), 163–173. <https://doi.org/10.1111/j.1460-2466.2006.00336.x>
- European Commission. (2018). 5G for Europe: An action plan.
- European Commission. (2019). European 5G Observatory. 5G Observatory Quarterly Report 2: Up to December 2018.
- Evers, H., Jempson, M., & Powell, W. (2011). Critical citizens online: Adding to or subtracting from conventional media regulation?, MediaAct Working Paper series on Media Accountability Practices on the Internet, 13. http://www.mediaact.eu/fileadmin/user_upload/WP4/WP4_UK.pdf
- Falcioni, L., Bua, L., Tibaldi, E., Lauriola, M., De Angelis, L., Gnudi, F., Mandrioli, D., Manservigi, M., Manservigi, F., Manzoli, I., Menghetti, I., Montella, R., Panzacchi, S., Sgargi, D., Strollo, V., Vornoli, A., & Belpoggi, F. (2018). Report of final results regarding brain and heart tumors in

- Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. *Environmental research*, 165, 496–503. <https://doi.org/10.1016/j.envres.2018.01.037>
- Funtowicz, S. O., & Ravetz, J. R. (1995). Science for the post normal age. In: Westra L., Lemons J. (Eds.), *Perspectives on Ecological Integrity*. Environmental Science and Technology Library, vol 5. Springer, Dordrecht (pp. 146–161). Springer.
- Garimella, K., Morales, G. D. F., Gionis, A., & Mathioudakis, M. (2017, May). *The ebb and flow of controversial debates on social media*. Eleventh International AAAI Conference on Web and Social Media.
- Ge, X., Tu, S., Mao, G., Wang, C. X., & Han, T. (2016). 5G ultra-dense cellular networks. *IEEE Wireless Communications*, 23(1), 72-79.
- Go, E., Jung, E. H., & Wu, M. (2014). The effects of source cues on online news perception. *Computers in Human Behavior*, 38, 358–367. <https://doi.org/10.1016/j.chb.2014.05.044>
- Goldacre, B. (2011, March 19). Why don't journalists link to primary sources? The Guardian, <https://www.theguardian.com/commentisfree/2011/mar/19/bad-science-ben-goldacre>
- Hopke, J. E., & Simis, M. (2017). Discourse over a contested technology on Twitter: A case study of hydraulic fracturing. *Public Understanding of Science*, 26(1), 105–120. <https://doi.org/10.1177/0963662515607725>
- IARC [International Agency for Research on Cancer] Working Group on the Evaluation of Carcinogenic Risks to Humans. (2013). *Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields*. IARC monographs on the evaluation of carcinogenic risks to humans, 102. International Agency for Research on Cancer.
- IARC [International Agency for Research on Cancer]. (2011). IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans. *Press release*, 208.
- Karaboytcheva, M. (2020). Effects of 5G wireless communication on human health. European Parliamentary Research Service, [https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS_BRI\(2020\)646172_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS_BRI(2020)646172_EN.pdf)
- Kiouis, S. (2006). Exploring the impact of modality on perceptions of credibility for online news stories. *Journalism Studies*, 7(2), 348–359. <https://doi.org/10.1080/14616700500533668>
- Koch, P., & Oesterreicher, W. (2012). *Language of immediacy-language of distance: Orality and literacy from the perspective of language theory and linguistic history*. Universitätsbibliothek Tübingen. <http://dx.doi.org/10.15496/publikation-20415>
- Korakis, T., Jakllari, G., & Tassioulas, L. (2003). A MAC protocol for full exploitation of directional antennas in ad-hoc wireless networks. In *Proceedings of the 4th ACM international symposium on Mobile ad hoc networking & computing* (pp. 98–107). <https://doi.org/10.1145/778415.778428>
- Jin, Z., Cao, J., Zhang, Y., Zhou, J., & Tian, Q. (2017). Novel visual and statistical image features for microblogs news verification. *IEEE transactions on multimedia*, 19(3), 598–608. <https://doi.org/10.1109/TMM.2016.2617078>
- Lago, F., Phan, Q. T., & Boato, G. (2019). Visual and Textual Analysis for Image Trustworthiness Assessment within Online News. *Security and Communication Networks*, 2019, 1–14 <https://doi.org/10.1155/2019/9236910>
- Lidskog, R. (2008). Scientised citizens and democratised science. Re-assessing the expert-lay divide. *Journal of risk research*, 11(1-2), 69–86. <https://doi.org/10.1080/13669870701521636>
- Loughran, S. P. (2019). There's no evidence 5G is going to harm our health, so let's stop worrying about it. The Conversation, <https://theconversation.com/theres-no-evidence-5g-is-going-to-harm-our-health-so-lets-stop-worrying-about-it-120501>

- MacKenzie, D. & Wajcman, J. (1999). Introduction essay: The social shaping of technology. In MacKenzie, D. & Wajcman, J. (Ed.), *The social shaping of technology* (pp. 3–27). Open University Press.
- Maisch, D. (2019). Community concerns over 5G: Needless anxiety or wise precaution? *Chain Reaction*, (136), Sep. 2019, 46–47.
- Mejova, Y., Zhang, A. X., Diakopoulos, N., & Castillo, C. (2014). *Controversy and sentiment in online news*. arXiv preprint: arXiv:1409.8152.
- Martin, B. (2014). *The Controversy Manual. A practical guide for understanding and participating in scientific and technological controversies*. Irene Publishing.
- Ministry of Health (2019). *5G and Health*. New Zealand Government, https://www.health.govt.nz/system/files/documents/topic_sheets/5g-and-health-aug19.pdf
- Mobile UK. (2019). *5G and Health: Questions and Answers*. Report prepared by the Mobile UK in collaboration with Building Mobile Britain.
- Mehdizadeh, A., & Mortazavi, S. M. J. (2019). 5G Technology: Why Should We Expect a shift from RF-Induced Brain Cancers to Skin Cancers? *Journal of biomedical physics & engineering*, 9(5), 505. <https://doi.org/10.31661/jbpe.v0i0.1225>
- National Toxicology Program. (2018a). *Toxicology and carcinogenesis studies in Hsd: Sprague Dawley sd rats exposed to whole-body radio frequency radiation at a frequency (900 MHz) and modulations (GSM and CDMA) used by cell phones*. NTP Tech. Rep., 595, 384. U.S. Dept. of Health and Human Services.
- National Toxicology Program. (2018b). *NTP technical report on the toxicology and carcinogenesis studies in B6C3F1/N mice exposed to whole-body radio frequency radiation at a frequency (1,900 MHz) and modulations (GSM and CDMA) used by cell phones* (pp. 26-28). NTP TR 596 (Peer review draft). US Dept. of Health and Human Services.
- Public Health England (2019). Mobile phone base stations: radio waves and health. Retrieved from <https://www.gov.uk/government/publications/mobile-phone-base-stations-radio-waves-and-health/mobile-phone-base-stations-radio-waves-and-health>
- Rappaport, T. S., Gutierrez, F., Ben-Dor, E., Murdock, J. N., Qiao, Y., & Tamir, J. I. (2013). Broadband millimeter-wave propagation measurements and models using adaptive-beam antennas for outdoor urban cellular communications. *IEEE transactions on antennas and propagation*, 61(4), 1850–1859. <https://doi.org/10.1109/TAP.2012.2235056>
- Rappaport, T. S., Roh, W., & Cheun, K. (2014). Wireless engineers long considered high frequencies worthless for cellular systems. they couldn't be more wrong. *IEEE SPECTRUM*, 51(9), 34–44.
- Russell, C. L. (2018). 5 G wireless telecommunications expansion: Public health and environmental implications. *Environmental research*, 165, 484–495. <https://doi.org/10.1016/j.envres.2018.01.016>
- Saraisky, N. G. (2016). Analyzing Public Discourse: Using Media Content Analysis to Understand the Policy Process. *Current Issues in Comparative Education*, 18(1), 26–41.
- Scheufele, D. A. (1999). Framing as a theory of media effects. *Journal of communication*, 49(1), 103–122.
- Scholz, N. (2019). Mobile phones and health: Where do we stand. European Parliamentary Research Service, [https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI\(2019\)635598](https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2019)635598)
- Searle, J. R. (1976). A classification of illocutionary acts. *Language in society*, 5(1), 1–23.
- Simkó, M., & Mattsson, M. O. (2019). 5G Wireless Communication and Health Effects—A Pragmatic Review Based on Available Studies Regarding 6 to 100 GHz. *International journal of environmental research and public health*, 16(18), 3406. <https://doi.org/10.3390/ijerph16183406>

- Sitaula, N., Mohan, C. K., Grygiel, J., Zhou, X., & Zafarani, R. (2019). *Credibility-based fake news detection*. arXiv preprint arXiv:1911.00643.
- Soler, U., & Busilo, M. (2019). Education of society as a tool to counteract disinformation in implementing new technologies. On the example of 5G mobile telecommunications network and Warsaw sewage system. *2019 Applications of Electromagnetics in Modern Engineering and Medicine (PTZE)*, 210–214. <https://doi.org/10.23919/PTZE.2019.8781728>
- Taebi, B., Correlje, A., Cuppen, E., Dignum, M., & Pesch, U. (2014). Responsible innovation as an endorsement of public values: The need for interdisciplinary research. *Journal of Responsible Innovation*, 1(1), 118–124. <https://doi.org/10.1080/23299460.2014.882072>
- Theocharides, P. (2019, April 2). There is a tsunami of protests due to 5G? Phileletheros, <https://www.philenews.com/f-me-apopsi/arthra-apo-f/article/680195/erchetai-tsoynami-diamartyrion-log-5g>
- Verrender A. (2019, January 9). Phone tower anxiety is real and we're worrying ourselves sick. ABC News, <https://www.abc.net.au/news/2019-01-09/huawei-small-cell-boxes-fuelling-phone-radiation-anxiety/10701856>
- Young, E. (2016). A new understanding: What makes people trust and rely on news. American Press Institute, <https://www.americanpressinstitute.org/publications/reports/survey-research/trust-news/>

Articles included in the analysis

Greek articles [Ελληνικά άρθρα] (in chronological order)

- N.A. (2019, February 28). 5G technology is coming and revolutionizing our lifestyle [Έρχεται η τεχνολογία 5G και φέρνει επανάσταση στον τρόπο ζωής μας]. Dialogos, <https://dialogos.com.cy/erchetai-i-technologia-5g-kai-fernei-epanastasi-ston-tropo-zois-mas/>
- N.A. (2019, February 28). 5G technology comes and revolutionizes lifestyle [Έρχεται η τεχνολογία 5G και φέρνει επανάσταση στον τρόπο ζωής]. Reporter, <http://www.reporter.com.cy/technology/article/464940/erchetai-i-technologa-5g-kai-fernei-epanastasi-ston-tropo-zois>
- N.A. (2019, March 5). What is 5G after all? [Τι είναι τελικά το 5G;]. Politis, <https://politis.com.cy/politis-news/ti-einai-telika-to-5g/>
- N.A. (2019, April 2). A tsunami protests is coming due to 5G [Έρχεται τσουνάμι διαμαρτυριών λόγω 5G]. Phileleftheros, <https://www.philenews.com/f-me-apopsi/arthra-apo-f/article/680195/erchetai-tsoynami-diamartyrion-log-5g>
- Mandravelis, V. (2019, May 8). The 5th generation networks are here and are radically changing our lives [Τα δίκτυα 5^{ης} γενιάς είναι εδώ και αλλάζουν ριζικά τη ζωή μας]. Kathimerini, <https://www.kathimerini.gr/1022942/article/oikonomia/die8nhs-oikonomia/ta-diktya-5hs-genias-einai-edw-kai-allazoyn-rizika-th-zwh-mas>
- N.A. (2019, May 11). A brave new world networked on 5G [Ένας γενναίος νέος κόσμος δικτυωμένος στο 5G]. To vima, <https://www.tovima.gr/2019/05/11/society/enas-gennaios-neos-lfkosmos-diktyomenos-sto-5g/>
- N.A. (2019, June 10). The new "cold war" of 5G - Who are the "opponents" and what news will it bring [Ο νέος «ψυχρός πόλεμος» των 5G - Ποιοί είναι οι «αντίπαλοι» και τι νέο θα φέρει]. To Pontiki, <http://www.topontiki.gr/article/327152/o-neos-psyhros-polemos-ton-5g-poioi-einai-oi-antipaloi-kai-ti-neo-tha-ferai>
- N.A. (2019, June 16). 180 scientists from 36 countries warn the European Union about the serious effects of 5G on health [180 επιστήμονες από 36 χώρες του κόσμου

- προειδοποιούν την Ευρωπαϊκή Ένωση για τις σοβαρές επιπτώσεις του 5G στην υγεία]. i-Eidisi, <https://www.i-eidisi.com/2019/06/16/180-epistimones-apo-36-chores-toy-kosmoy-proeidopoioun-tin-eyropaiki-enosi-gia-tis-sovares-epiptoseis-toy-5g-stin-ygeia/>
- N.A. (2019, June 19). What 5G changes in our lives [Τι αλλάζει το 5G στη ζωή μας]. Phileleftheros, <https://www.philenews.com/eidiseis/technologia/article/725671/ti-allazei-to-5g-sti-zoi-mas>
- N.A. (2019, July 17). How our daily life will change with 5G [Πως θα αλλάξει η καθημερινότητα μας με το 5G;]. Phileleftheros, <https://www.philenews.com/oikonomia/epicheiriseis/article/742780/pos-tha-allaxei-i-kathimerinotita-mas-me-to-5g>
- N.A. (2019, July 19). The hard truth about the 5G network and the harmful radiation - Schools, hospitals and neighborhoods in danger [Η σκληρή αλήθεια για το δίκτυο 5G και την βλαβερή ακτινοβολία - Σε κίνδυνο σχολεία, νοσοκομεία και γειτονιές]. Το Pontiki, <http://www.topontiki.gr/article/333067/i-skliri-alitheia-gia-diktyo-5g-kai-tin-vlaveri-aktinovolia-se-kindyno-sholeia>
- N.A. (2019, September 11). 5G technology and the Digital Transformation strategy [Η τεχνολογία 5G και η στρατηγική Ψηφιακού Μετασχηματισμού]. Phileleftheros, <https://www.philenews.com/f-me-apopsi/paremvaseis-ston-f/article/777443/i-technologa-5g-kai-i-stratigki-psifiakoy-metaschimatismoy>
- N.A. (2019, September 18). 5G networks are coming. But how dangerous they are for health [Τα δίκτυα 5G έρχονται. Πόσο επικίνδυνα είναι όμως για την υγεία;]. Espresso, <https://www.espressonews.gr/advertorial/240042/ta-diktya-5g-erchonte-poso-epikindyna-ine-omos-gia-tin-ygia/>
- N.A. (2019, September 19). Risks to public health from the use of the 5G network. . Politis, <https://politis.com.cy/politis-news/epistimi-kai-technologia/kindynoi-gia-ti-dimosia-ygeia-apo-ti-chrisi-toy-diktyoy-5g/>
- N.A. (2019, September 20). The development of the 5G network is undergoing a thorough examination [Πέραν από εξονυχιστική εξέταση η ανάπτυξη του δικτύου 5G]. Reporter, <http://www.reporter.com.cy/local-news/article/560343/perna-apo-exonychistiki-exetasi-i-anaptyxi-toy-diktyoy-5g>
- N.A. (2019, September 20). 5G Changes Lifestyle [Το 5G Αλλάζει τον τρόπο ζωής]. Reporter, <http://www.reporter.com.cy/local-news/article/519664/to-5g-allazei-ton-tropo-zois>
- N.A. (2019, September 20). Severe public health concern due to the 5G network. Dialogos, <https://dialogos.com.cy/entoni-anisychia-gia-ti-dimosia-ygeia-logo-toy-diktyoy-5g/>
- N.A. (2019, September 24). Concerns about the 5G network [Ανησυχίες για το δίκτυο 5G]. Phileleftheros, <https://www.philenews.com/koinonia/eidiseis/article/782922/anisychies-ga-to-diktyo-5g>
- N.A. (2019, October 24). The effects of 5G and the conflicting positions were discussed at the Parliament [Οι επιπτώσεις από το 5G και οι συγκρουόμενες θέσεις απασχόλησαν τη Βουλή]. Reporter, <http://www.reporter.com.cy/local-news/article/579433/oi-epiptoseis-apo-to-5g-kai-oi-syggroyomenes-theseis-apascholisan-ti-boyli>
- N.A. (2019, October 24). Cyprus should not be left alone in 5G, nor should it ignore the concerns [ΕΤΕΚ: Η Κύπρος να μην μείνει ουραγός στο 5G, ούτε και να παραβλέψει τις ανησυχίες]. Reporter, <http://www.reporter.com.cy/local-news/article/579299/etek-i-kypros-na-min-meinei-oyrags-sto-5g-oyte-kai-na-parablepsei-tis-anisychies>
- N.A. (2019, October 24). The effects of 5G and the conflicting positions were discussed by the Health and Environment Committees [Οι επιπτώσεις από το 5G και οι συγκρουόμενες θέσεις απασχόλησαν τις Επ. Υγείας και Περιβάλλοντος]. i-Eidisi, <https://www.i-eidisi.com/2019/10/24/oi-epiptoseis-apo-to-5g-kai-oi-syggroyomenes-theseis-apascholisan-tis-ep-ygeias-kai-perivallontos/>

- Lysandrou, M. (2019, October 25). The scientists argue that 5G is “innocent” [Επιστήμονες «αθωώνουν» το 5G]. Politis, <https://politis.com.cy/politis-news/kypros/epistimonos-athoonoyn-to-5g/>
- N.A. (2019, October 29). The Holy Grail of global technology [Το Άγιο Δισκοπότηρο της παγκόσμιας τεχνολογίας]. Ta Nea, <https://www.tanea.gr/2019/10/29/economy/to-agio-diskopotiro-tis-pagkosmias-texnologias/>
- N.A. (2019, November 17). Mobile phone antennas and 5G [Οι κεραιές κινητής τηλεφωνίας και το 5G]. Dialogos, <https://dialogos.com.cy/oi-keraias-kinitis-tilefonias-kai-to-5g/>
- N.A. (2019, December 5). 5G: What are its features? [5G: Τι είναι και ποια τα χαρακτηριστικά του]. Ta Nea, <https://www.tanea.gr/2019/12/05/science-technology/5g-ti-einai-kai-poia-ta-xarakteristika-tou/>

International articles *(in chronological order)*

- Hern, A. (2019, April 4). What is 5G? The Guardian, <https://www.theguardian.com/technology/2019/apr/04/what-is-5g-fast-mobile-phone-network-technology>
- Gibbs, S. (2019, May 25). What is 5G and when can I get it in the UK? The Guardian, <https://www.theguardian.com/technology/2019/may/25/what-is-5g-and-when-can-i-get-it-in-the-uk>
- Gibbs, S. (2019, June 21). 5G finally launches in the UK – but is it really worth it? The Guardian, <https://www.theguardian.com/technology/2019/jun/21/5g-finally-launches-in-the-uk-but-is-it-really-worth-it>
- Broad, W. J. (2019, July 16). The 5G health hazard that Isn't. The New York Times, <https://www.nytimes.com/2019/07/16/science/5g-cellphones-wireless-cancer.html>
- Hern, A. (2019, July 26). How baseless fears over 5G rollout created a health scare? The Guardian, <https://www.theguardian.com/technology/2019/jul/26/how-baseless-fears-over-5g-rollout-created-a-health-scare>

ANNEX – Summaries of five selected articles in English

5G Changes Lifestyle

[Το 5G Αλλάζει τον τρόπο ζωής]

Reporter, <http://www.reporter.com.cy/local-news/article/519664/to-5g-allazei-ton-tropo-zois>

This article reports that 5G will change our lifestyle. In particular the article supports that the 5G technology will provide the basis for the advancement of various domains while new products and services will also be invented. In particular, the article puts emphasis on the advancement of Virtual Reality (VR) and Augmented Reality (AR) technologies explaining that their capabilities will be fully unlocked with the widespread adoption of 5G. It also supports that 5G will have a significant impact on autonomous driving as connecting vehicles to 5G will enable them to make critical decisions. As argued, in this context, lives will be saved as cars will communicate with each other to avoid accidents and collisions. Finally, the article supports that with the 5G network, telemedicine becomes a reality, allowing patients to be diagnosed remotely and giving access to specialists who would otherwise be inaccessible. In this way, lives will be saved due to long-distance operations.

180 scientists from 36 countries warn the European Union about the serious effects of 5G on health

[180 επιστήμονες από 36 χώρες του κόσμου προειδοποιούν την Ευρωπαϊκή Ένωση για τις σοβαρές επιπτώσεις του 5G στην υγεία]

i-Eidisi, <https://www.i-eidisi.com/2019/06/16/180-epistimones-apo-36-chores-toy-kosmoy-proeidopoioun-tin-eyropaiki-enosi-gia-tis-sovares-epiptoseis-toy-5g-stin-ygeia/>

This article reports that despite the promise of 5G technology there is also a growing movement supporting that there is an urgent need to stop the implementation of 5G due to potential risks on public health. In particular, according to the article, a section of the scientific community argues that there are potential negative impacts from electromagnetic fields exposure and that these will increase even more with the implementation of 5G. In this context, the article highlights that a “5G appeal” was also presented to the United Nations in 2015 and to the European Union in 2017, with an increasing number of scientists' signatures (268 scientists and medical doctors as of December 18th, 2019). The signatories support that the 5G network can only be implemented by setting up a very dense network of antennas and transmitters, which means constant exposure to EMF for the whole population, including children. In this context, the appeal supports that there is an increasing number of scientific publications which illustrate several EMF exposure effects such as an elevated risk of cancer, genetic damage, learning and memory deficits, neurological disorders, etc.

What is 5G after all?

[Τι είναι τελικά το 5G;]

Politis, <https://politis.com.cy/politis-news/ti-einai-telika-to-5g/>

This article introduces 5G and attempts to explain, in brief, how 5G functions. In particular, it reports that with 5G technologies data transmission rates are expected to become much faster. According to these rates, high-resolution videos and movies could be downloaded on smart phones only within a few seconds. At the same time, the article supports that 5G technology can allow transmission in the radio network with very little lag or buffering. As the article states, the deployment of 5G technology requires the expansion of radio access infrastructure and an

increase in the number of base stations. In particular, it is explained that the 5G network can only be achieved by setting up a very dense network of antennas and transmitters. However, as explained, despite this denser system, millimetre waves on which 5G technologies will depend on cannot cover long distances or penetrate walls.

The hard truth about the 5G network and the harmful radiation - Schools, hospitals and neighbourhoods in danger

[Η σκληρή αλήθεια για το δίκτυο 5G και την βλαβερή ακτινοβολία - Σε κίνδυνο σχολεία, νοσοκομεία και γειτονιές]

To Pontiki, <http://www.topontiki.gr/article/333067/i-skliri-alitheia-gia-diktyo-5g-kai-tin-vlaveri-aktinovia-se-kindyno-sholeia>

This article takes a stance against the use of 5G networks. It reports that according to the World Health Organization (WHO) as well as according to an increasing number of research studies there is strong evidence suggesting that exposure to the EMFs of 5G radio base stations increases the risk of developing specific classes of tumours. As the article supports, several scientific studies have examined the relationship between electromagnetic radiation from mobile phone transmitters, routers, mobile phones, tablets, other wireless devices and health. Based on these studies, it has been shown that radiation is harmful even at low and short exposures and affects fetuses and children more. Electromagnetic radiation is carcinogenic, damages DNA, affects fertility and the endocrine system and has serious neurological consequences.

There is a tsunami of protests due to 5G?

Phileletheros, <https://www.philenews.com/f-me-apopsi/arthra-apo-f/article/680195/erchetai-tsoynami-diamartyrion-log-5g>

According to the article, concerns of residents of one or the other neighbourhood about mobile phone antennas and the possible effects on their health, especially of children, have recently returned to the forefront. The article supports that the state, in collaboration with mobile phone companies, should take measures such as organising a transparent code for installing mobile telephony antennas that will ensure that they are installed in accordance to urban specifications. Overall, the article argues that the state in collaboration with the mobile phone companies should convince citizens that there is not even the slightest chance for their health to be affected.