Improved, But Not Enough: Analyzing the Contentious Rollout of the 5G Network

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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The Current State of 5G

Despite launching a couple of years ago, the 5G networks' implementation into society has been met with mixed responses from the public and has still not been fully realized. While 5G promises faster data rates (Malathy, 2021), the rollout of the technology has not been as successful as originally planned.

Looking through the history of cellular wireless networks, it is clear that much of today's society is shaped by the mobile industry. From the 1G network that introduced the world to mobile telecommunications, to the 4G network that is still widely used today, the 30-year transformation of the mobile industry has transformed society through the advancements shown in Figure 1 (Attaran, 2021). 5G promises to build off the growing industry by introducing vast improvements in latency and speed.

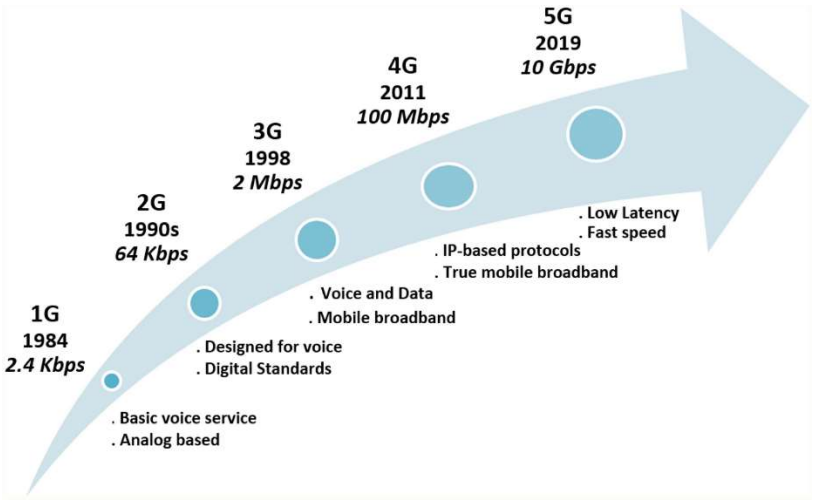

Figure 1 Broad overview of the history of the mobile industry (Attaran, 2021, p. 2)

Due to its reliance on the mobile industry, Internet of Things (IoT) devices are particularly affected by the rollout of the 5G network. It is estimated that in 2021, roughly 28

billion smart devices would be connected to the internet and that this number will increase to 75.44 billion in 2025 (Rana, Taneja, & Saluja, 2021). With its rapid spread across different industries, IoT requires improvements in "wireless coverage, ultra-low latency, and mass connectivity" (Attaran, 2021, p. 8). Since 5G offers 10Gbps data speed as well as a low latency of 1ms (Attaran, 2021), it can play a vital role in supporting the future of IoT.

Regardless of the promises of an improved mobile network, 5G has not been as widely accepted as originally planned. One of the technological reasons for the slow rollout of 5G is that the improvement of 5G is not as significant as was originally promised. It is reported that that in 2021, the United States delivers the slowest average speed in the top 15 leading 5G markets, averaging a speed of only twice as fast as 4G (Cage, 2021). While 5G has not fully lived up to the technical prowess it promised before launch, the bigger issue at hand is the failure to meet societal demands, causing massive pushback over privacy and health concerns.

To determine the reasons for the slowdown of the rollout of 5G, a variety of sources are analyzed and discussed in the following sections, particularly regarding privacy, social media, and alleged health concerns of 5G. Analysis on the concept of cultural lag (Glade, 1952) and Multi-Level Perspective (Geels, 2011) is conducted with regards to the rollout of 5G.

The 5G Controversy's Connection to Misinformation and Privacy

To begin analysis of the public perception of the 5G network, it is helpful to first identify benefits of 5G and the motivation for its implementation. One of the most advertised promises of the 5G network is faster speeds. It is stated that the 5G network has a data rate of around 10 Gbps, which is a massive increase from the 100 Mbps of 4G as seen in Figure 1 (Attaran, 2021, p. 2). Due to the sheer volume of devices connected to the network, as well as the fact that the

field of Internet of Things is growing at an alarmingly fast rate, it is clear that an upgrade from 4G is necessary in order to sustain the increasing volume of mobile devices. Yet, much of the discourse surrounding 5G continues to be divisive.

To understand the contentious nature of 5G, a common case that I have found in the literature is the popular conspiracy theory that 5G is directly linked to the spread of the Covid 19 virus. According to Mazar and Ball, "updated to April 2021, 332 arson attacks have been reported in 21 countries in the past year" (2021, p. 2). This is an alarming figure, especially during the height of the Covid pandemic, where "telecommunication networks have played a fundamental part in securing countries' resilience during the COVID crisis" (Mazar & Ball, 2021, p. 2). Ahmed et al. attempt to analyze the nature of the spread of misinformation, using the 5G/Covid scenario as the basis for their analytics (2020). The conclusion from this experiment was that authorities should tackle fake new "head-on at the time that it occurs" (Ahmed et al., 2020, p. 6).

A common thread that is seen in the articles concerning the controversies of 5G is misinformation. Many try to determine the best ways to combat misinformation such as the kind that spreads conspiracies about the relationship between Covid and 5G. However, there does not seem to be a consensus, or much research done on why 5G has attracted so much misinformation.

Another aspect that is causing hesitation towards the implementation of 5G stems from privacy and security concerns. In one study by Microsoft Bing Ads, 41 percent expressed distrust in digital assistants and 52 percent worried that their personal information is not secure (Vimalkumar, 2021). Due to the nature of the internet, it is understandable that people may be cautious with concerns about their data. Especially with the increasing presence of smart devices

and the Internet of Things, it is clear that privacy is a reason for hesitation. To better understand the concern for privacy, it is important to determine why privacy is such an important subject for so many people. According to the University of California San Diego, privacy is defined as "the right to be let alone, free from interference or intrusion" (What is Privacy?, p. 1). It further states, that there is a clear distinction between privacy and confidentiality, since privacy entails having control of "domains" and having knowledge of who has access to those "domains" (What is Privacy?). This definition gives a good look as to why privacy is so important to people. While many companies claim that apps and smart devices only collect unimportant data, people still value having private access to their own information.

One concept that is interesting in the analysis of privacy with regards to 5G and the internet in general is "privacy fatigue" (Tang, Akram, & Shi, 2021). This concept is described as people's increasing unwillingness to care about keeping their information personal (Tang et al., 2021), which is caused by exceptionally high number of ways that personal data is circulating on the internet. One example that is given by Tang et al. is the example of app stores forcing users to accept permissions prior to installing apps (Tang et al., 2021). Despite the app store stating everything a private user's data will be used for and what type of data of the user is recorded, it is unlikely that many users take much notice of these agreements and instead, do not take much notice. This can be largely attributed to the way that privacy policies are written and presented to consumers. Litman-Navarro explains that Facebook's privacy policy takes around 18 minutes to read completely and, like privacy policies from other companies, is filled with legal vocabulary that is difficult for consumers to completely understand (Litman-Navarro, 2019). The creation of privacy fatigue due to these privacy policies that obscure the true intent of companies with

regards to data collection is a large factor that can cause distrust of the public towards companies that collect data and is likely to contribute to pushback against 5G.

With 5G, there is a similar phenomenon occurring as well, in the form of smart devices and IoT devices. Much of the user's concerns of privacy involve the fear of data breaches and cyberattacks. It is reported that there were 6543 data breaches in 2019 with 12.6 billion leaked records, with this number only increasing through the years (Tang et al, 2021). Because of this, 5G networks and devices that operate on the 5G network need to work towards security and protection of the information streaming on 5G.

Another cause for the negative perception of 5G stems from the massive expansion of social media, and along with that, misinformation. A perfect case study that illustrates this point is the example of the '#5GCoronavirus' hashtag which went viral on Twitter in March of 2020 in the UK (Ahmed, Vidal-Alaball, Downing, & Seguí, 2020). This scenario began in January of 2020, where social media users pointed to 5G as a reason for the rapid spread of Covid 19 (Ahmed et al., 2020). These social media posts became so popular that 5G masts were torched in the United Kingdom (Ahmed et al., 2020). This became even more serious when one of the 5G masts at Nightingale hospital was torched, causing a disruption in the mobile network of the hospital (Ahmed et al., 2020). While it was later stated Full Fact that the conspiracy of 5G causing Covid was not true (Ahmed et al., 2020), there had already been much damage done to the infrastructure of 5G. While social media is a great platform for social discussion, the spread of misinformation as well as people impulsively acting such information can lead to unfortunate results.

While it is clear that social media is a major factor contributing to the spread of distrust for 5G, it is unclear as to why the conspiracy of 5G causing health problems spread so easily.

Because of this, it is worthwhile to analyze an example of theory to determine whether these claims hold truth to them. In June 2021, John William Frank released an article titled "Electromagnetic fields, 5G and health: what about the precautionary …" (Frank, 2021) which details the many potential health issues created by 5G. The main focus of this paper is the alleged toxicity of Radio Frequency Electromagnetic Fields (RF-EMF) which are produced with the new network (Frank, 2021). Frank cites that the RF-EMF exposures may produce consequences that affect the "reproductive/teratogenic, oncological, neuropsychiatric, skin, eye, and immunological body systems" (Frank, 2021, p. 6). He further argues that further precautions should be taken in observing the effects of 5G before fully embracing it (Frank, 2021). While Frank's argument seems compelling, there is also much evidence proving that 5G does not cause significant health concerns. In a literature review done by Simkó and Mattsson in 2019, the authors analyzed 94 publications performing in vivo and in vitro investigations on the health impacts of millimeter waves, specifically 6-100 GHz, which is around the range that 5G operates in. The conclusion from this review is that the effects of millimeter waves are not dependent on the power density, exposure time or frequency of the waves (Simkó & Mattson, 2019). This means that it is likely that 5G and millimeter waves are not too likely to cause health hazards and that it should not be much different than the 4G network in terms of health.

Viewing 5G as a Socio-Technical system

When analyzing the topic of the 5G rollout, a framework that can be used to analyze the evidence is culture lag (Glade, 1952). The definition of culture lag that will be used in this study is the one described by Glade in 1952: "cultural lag refers to the discrepancy between the sociopolitical structure and technological advances" (Glade, 1952, p.428). From this definition, it is understood that culture lag attempts to explain the reason for delays in the implementation of

technological advances due to sociopolitical reasons. Glade mentions two different developments that occur while a piece of technology is being adopted: “socio-politico-economic structure” and “technology, science, technological arts” (Glade, 1952, p.428). These two categories of development occur simultaneous, but the development of the socio-politico-economic structure is slowed down by lag while the technological aspect continues to develop as seen in Figure 1 from Glade (Glade, 1952, p.428). As applied to the case of 5G, the technological advancement can be determined to be the 5G technology itself. Despite the backlash, it is evident there are many aspects of 5G that are ready to be implemented into society, with promises of faster speeds and lower latency.

To further elaborate on the reasons for culture lag, it is useful to observe six reasons as mentioned by Glade: “Scarcity of invention in the adaptive culture…, Mechanical obstacles to adaptive changes …, The heterogeneity of society…,The closeness of contact with material culture…, The connection of the adaptive culture with other parts of culture…, Group valuations” (Glade, 1952, p.431). Of these six reasons, the one that stands out the most on a surface level in the case of 5G is “the heterogeneity of society” (Glade, 1952, p. 431), which Glade describes as the fact that technological change may be felt by only one class, when a change to society must be made in order to adopt the change (Glade, 1952).

For the 5G network, the network is mainly beneficial to companies in the Internet of Things industry as well as other technology companies. This is because 5G is mainly implemented to increase the speed and capacity of the mobile network, which is mostly necessary because of the massive increase in devices connected to the network. Factors such as speed of data transfer (especially when the change is not too noticeable) are not going to provide much of an incentive for the public to be in support of the 5G network, as these changes are most

likely not as noticeable. The incentive for faster network speeds is vastly outweighed by social aspects of 5G, one of which is privacy. As defined previously, privacy is a completely social concept. It is a social construct which is valued by many people and incentivizes people to protect their own information. Because 5G further enables the implementation of the Internet of Things, it can be argued that people would have an adverse reaction to the mass implementation of 5G due to the fact that 5G will increase the spread of the Internet of Things and increase the amount of personal data available to private companies and other parties.

Figure 2 describes the model from Glade, where the development of 5G is currently in the socio-politico-economic stage of lag despite the actual development of the technological aspect.

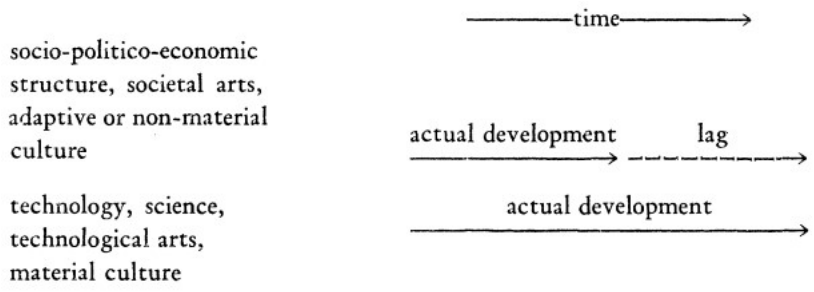

Figure 2. Comparison of timelines between technology and socio-politico-economic structure (Glade, 1952, p.428)

As shown in Figure 2, it is clear that the timelines for a socio-technical system consists of two developments that are running simultaneously and offset by lag. The reasons for this lag can be further understood through the lens of the multi-level perspective framework.

The idea that 5G is a socio-technical system can be further expanded using the multi-level perspective framework as outlined by Geels (2011). Geels defines the multi-level perspective (MLP) as a "theory that conceptualizes overall dynamic patterns in socio-technical

transitions" (2011, p. 26). In this theory, socio-technical transitions are described as a result of the interaction of three levels: niches, socio-technical regimes, and exogenous social technical landscape (Geels, 2011). This is demonstrated in the figure shown in Figure 3.

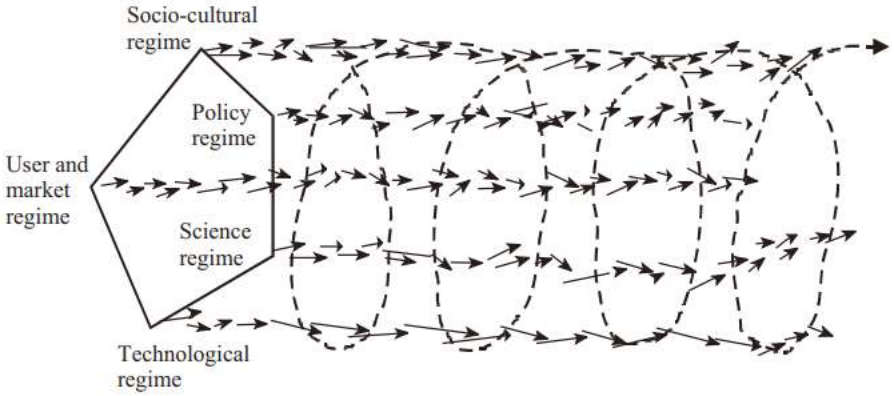

Figure 3 Model of Multi-Level Perspective (Geels, 2011, p.27)

The three different levels of the multi-level perspective framework interact with each other as seen in Figure 3, to gradually introduce changes to the landscape of a socio-technical system.

The socio-technical regime is described by Geels as a structure that stabilizes an existing socio-technical system (Geels, 2011). In the case of 5G, the niche can be assigned to the internet of things market, since companies involved in this industry rely heavily on a strong connection to the mobile network. The current regime of the mobile network is the 4G network, which has continued to stay relevant even despite the efforts of the niche market. In the case of 5G, it is important to determine stabilizing factors are holding the mobile network down to the 4G network. While Geels originally applies MPL to sustainability, I will attempt to utilize the same technique to 5G. Similar to sustainability, the 5G transition shares the characteristic that 5G improvements do not "offer obvious user benefits" (Geels, 2011, p. 25). Buzz words such as

"high speed" and "higher bandwidth" are not impactful or noticeable enough to individual users to overcome the comfort of an already established system that is provided by the 4G network.

Results

Privacy and Security

In the case of privacy and security, it is known that many people have an adverse reaction to the idea of technology collecting too much information. This is seen in the example of the Microsoft Bing survey as mentioned in the previous section. The meaning of privacy as used in this discussion is the one defined by the University of California San Diego: "the right to be let alone, free from interference or intrusion" (What is Privacy?, n.p.). Because this definition describes a concept that is completely subjective (it is impossible to define exactly what it means to be free from interference and intrusion) it can be seen that privacy is a social construct, meaning that it is decided to exist by the society we are today. In an article by the Pew Research Center, it was determined through survey that roughly 62% of Americans believe that it is "not possible to go through daily life without companies collecting data about them" (Auxier, Rainie, Anderson, Perrin, Kumar, & Turner, 2019, n.p.) and 81% of Americans feel like "they have little control over data collected about them by companies" (Auxier et al., 2019, n.p.). One reason for the desire for privacy that the Pew Research Center mentions is fear of identity theft (Auxier et al., 2019). The Pew Research Center reports that roughly 28% of Americans say they have suffered major identity theft problems in the 12 months at the time of the survey (Auxier et al., 2019, n.p.). With situations as serious as identity theft, it is understandable why people would value their privacy when it comes to data on the network. The collection of data in particular relates to the 5G network, because 5G vastly increases the amount of data that can be supported on the network and also increases the speeds in which the data can be transmitted on the

network. As Seshadri states on the MasterCard website, “5G will lead to an explosion in the amount of data created, collected, and stored” (Seshadri, 2021, n.p.). Because 5G is associated in a massive increase in data due to increasing speeds, it is understandable that people would feel hesitant towards implementing a newer network that increases the amount of private data that will be collected. This also ties into the concept of culture lag, as the technological aspect of the 5G network is not necessarily the main issue causing the slow rollout but instead, what is causing the slow rollout is related to social issues. In this case, the issue at hand is trust. As mentioned before, the public does not currently trust the people handling the data that is being collected on the internet, whether that is companies or the government. In order for 5G and other technologies that participate in data collection to be accepted by society, it is important to rebuild trust with the public and encourage companies to be more transparent with the data that is being collected and what exactly the data is being used for.

Health Concerns

From the literature review in the earlier section, it is known that much of the slowdown of the 5G rollout is directly related to health and misinformation. When considering the effect of social media on the rollout of 5G, it is useful to once again bring in the example of the #5GCoronavirus hashtag, specifically the incidents that have occurred in the UK due to it. As mentioned previously, culture lag describes a situation in which the technological advancement precedes the societal readiness to accept change. The time between the implementation of a piece of technology and its acceptance into society is offset by lag. In the case of 5G, a major factor in causing this lag is the rampant use of social media in today’s society. In the case study of the United Kingdom, it is known that 5G was already mostly implemented, with masts in various areas to distribute 5G to the public. However, despite the technology already being adapted,

Twitter caused the spread of a conspiracy theory, leading to many believing that the 5G network caused coronavirus. This fact was later proven to be false, but it shows a clear example of cultural lag. With the UK being a country that already had some coverage of 5G at the time of the Covid-19 pandemic, the failure of the network was purely due to society's unwillingness to accept the technology. This has unfortunate consequences, as the conspiracy of 5G causing coronavirus caused much damage of property and a disruption to the operation of local services such as the hospital. In this example, it is clearly shown that, while 5G was proven to have no real correlation with coronavirus cases, the use of social media spread false information, leading to an unwarranted negative reaction towards the 5G network. With the presence of social media continuing to increase, it is no doubt that many technological advancements will be affected. One portion of cultural lag that Glade describes is the concept of the "heterogeneity of society" (Glade, 1952, p.431), which applies to social media as a factor in delaying the rollout of 5G. This is because social media is a platform that allows anyone to express their beliefs, which has had many benefits to society. However, the nature of social media makes it easy for false information to spread and gain popularity, as posts made by people are not heavily checked for accuracy by other users. Because of this, the "heterogeneity of society" (Glade, 1952, p.431) is heavily amplified due to social media, which can cause society to lag on accepting a new form of technology.

Tying it Together

Despite 5G's shortcomings from a technological perspective, the much larger issue at hand is the failure to address societal concerns over health and privacy. As seen in the case of the Covid/5G situation, health is one of the major concerns that has slowed down the rollout of 5G. While it has been proven in many cases that 5G poses no more health risk than previous

networks (Mazar & Ball, 2021), 5G companies and supporters need to do a better job of addressing these concerns during the socio-technical transition of 5G rather than focusing solely on the technical improvements. Just as Geels describes sustainability as a transition that does "not offer obvious user benefit" (Geels, 2021, p. 25), the improvement from 5G to 4G fits in a similar category. In order to disrupt the socio-technical regime, the niche innovations needs to build momentum to change the landscape (Geels, 2021, p.29) and that is not possible until privacy and health concerns are better addressed.

Conclusion

The result from this analysis of the 5G network is that while technological advancements can always benefit the adoption of 5G, it is not likely that 5G will become fully implemented until society accepts the changes made to the network. This is due to the cultural lag induced by social factors including health and privacy concerns. This is important for both the government to enforce better protection of personal data collected by devices on the mobile network, but also depends on the transparency of private companies to convey to users the exact data that they collect and what their data is used for. As the public, it also important to understand that while social media is an excellent platform for sharing information, not all information presented in social is accurate or fact checked. While cultural lag occurs as part of the nature of all sociotechnical issues, much can still be done to help aid in the rollout of 5G so that mobile technology can continue to advance while still satisfying the concerns of the consumer. In order to accomplish this, companies and governments must work together to alleviate public concerns of privacy as well as providing transparency in the way IoT and 5G devices operate.

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