

**Board Buddies Remote Othello Game System**

**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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## **Introduction**

By the end of 2025, it is estimated that the number of devices connected to the Internet of Things will be 75.44 billion (Rana, Taneja, & Saluga, 2021). This number puts into scale how integrated into our lives smart devices have become. The magnitude of this increase is heightened even more by the introduction of the 5G network, which will greatly increase the data rate at which these devices are sent. While some may try to downplay the significance of the change from 4G to 5G, the 5G network is vastly different from 4G. The 5G network is estimated to have a data rate of around 100 Gbps with a minimum of 1ms latency (Malathy et al., 2021), whereas the older 4G network only supported data rates up to 1 Gbps (Rana, Taneja, & Saluga, 2021). Because of the massive increase in data transfer enabled by the 5G network, as well as the continuous expansion of the Internet of Things, it is important to analyze and alleviate the possible consequences of the 5G network. For the technical topic, the physical aspect of the 5G network will be explored through the design of an IoT device that can securely connect to the 5G network. The STS topic will explore the more social aspect of the 5G network, analyzing the public perception of 5G.

### **Technical topic: Secure 5G smart home security**

One example of an Internet of Things device that can operate on the 5G network is smart home technology. For my technical research, I will be designing a secure smart home security system that operates through the 5G network. When considering such a piece of technology, it is important to account for the risks of connecting a device to the 5G network. The first aspect that must be acknowledged is the 5G network's vulnerability to various cyber-attacks such as routing

and wormhole attacks (Jose & Malekian, 2017). Because of these vulnerabilities, there has been a reported rise in home burglaries over the past decade (Jose & Malekian, 2017). While smart home technology is originally intended to provide homeowners with added protection and an increased sense of security, it seems to be having the opposite effect due to the added risk of being hacked. For my technical project, the secure smart lock I design will primarily address security on the 5G network to reduce the risk of being hacked. One method to secure a 5G IoT device is to develop an encryption standard for the data sent by the device to prevent hackers from reading the information the smart lock is sending to the network (Tawalbeh, Muheidat, Tawalbeh, & Quwaider, 2020). Because of the interconnectivity of the Internet of Things, a data breach in a single device (such as a smart lock) could provide hackers a path to more sensitive private information (Tawalbeh et al., 2020). Thus, it is important to develop security measures to prevent hackers from accessing the contents of the smart lock. Jose & Malekian (2017) detail a potential design for a smart home security system that can be used as a basis for the 5G secure smart home system I am designing. A literature review can be conducted on this source as well as others to discover typical implementations for smart home systems.

A possible extension of this project would be to develop and implement an energy efficient algorithm for the smart lock system and to observe how much energy is saved. Shafique et al. (2020) states that energy efficiency may be another area of improvement for 5G. Because so much more data must be processed across the 5G network at a much faster rate, the data centers that process these must be highly efficient to reduce energy consumption. This is a valuable area to be looking into when designing a smart home system, as energy efficiency will also have environmental benefits as well as reduce power consumption. Research methods for

the project will mainly include literature reviews of different smart home technology designs and data processing algorithms.

### **STS Topic: Public Perception of 5G network**

Despite the many benefits promised by the new 5G network (such as higher data rates, lower latency, and increased capacity of base stations) the reception to the new technology has been relatively controversial (Ahmed et al., 2020). This ties very closely to the concept of culture lag, which Glade (1952) refers to as a differential between a socio-political structure and advancement in technology.

This section will begin with an analysis on the negative reception to the 5G network in the United Kingdom as described by Ahmed, et. Al (2020) in the PMC journal. In January of 2020, a growing belief that 5G was a cause of COVID-19 (which is a theory that has since been disproven) began spreading on social media in the United Kingdom (Ahmed et al., 2020). These beliefs became so strong that 5G masts were torched in Birmingham and Merseyside, United Kingdom (Ahmed et al., 2020). This case describes an example of culture lag, in which the 5G network has been ready for consumer use in the form of 5G masts and stations. However, the spread of false information and conspiracy theories had caused an incorrect characterization of 5G, leading to push back and criticism in the adoption of this technology. The theory of culture lag suggests that before 5G can become widely accepted and more seamlessly integrated into our daily lives, there must be a period of lag for it to be accepted in this era of social media.

It would be useful to conduct more research on other cases of public rejection of 5G technology similar to the example in the UK. An in-depth case study and literature review can be done on the analysis of Ahmed et al (2020) as well.

Privacy and security are another aspect of 5G networks that greatly influences public perception. In a report by Microsoft Bing Ads, 41 percent of people stated that they did not trust digital assistants and 52 percent stated that they were worried that their information was not secure (Vimalkumar et al., 2021). While this survey was not conducted solely on the 5G network, it is important to recognize that digital assistants and other smart technologies operate on the mobile network and will be transitioned to the 5G network in the future. As mentioned in the introduction, 5G will vastly increase the data rate and data transfer through the network, which will further justify any privacy and security concerns, since the amount of sensitive data that will be processed on the network will increase. Once again, we see a culture lag in society where society has not fully accepted the use of smart technologies to be used in day-to-day life. While it may be argued that the lag in the adoption of 5G is more so due to technological lag in the form of cyber vulnerabilities, it is important to note that security breaches and hacking itself can also be seen as culture lag since there are many ethical and social aspects of cybersecurity and privacy. Tang et al. (2021) analyzes a concept of “privacy fatigue”, which describes how a person may become less susceptible to privacy concerns as these technologies become more integrated in our lives. This concept of privacy fatigue is fairly new concept and fits very nicely with the sociotechnical framework of culture lag described by Glade (1952), where people are slowly becoming numb to the privacy issues surrounding modern day technology, which is slowly allowing for a wider acceptance of personal information being exposed on the mobile network. The research methods of this study will include a literature review of Tang et al. (2021) to better understand the concept of privacy fatigue. Surveys such as the one from Microsoft Bing Ads (Vimalkumar et al., 2021) can also be analyzed as case studies to better understand the public view of privacy and security for 5G and IoT devices.

## **Conclusion**

The 5G wireless network poses a very interesting dilemma. The technology itself will greatly increase the data rate for users and allow for more data to be sent over a larger frequency bandwidth. However, because it is released in the current age of social media, misinformation, and privacy, it is important to continue to observe the 5G networks as it is nearing the end of roll out. Because of the peculiar reaction to the rollout of the 5G network, it is worth analyzing further what impacts the public perception of the 5G network. The technical thesis can provide insight into the vulnerabilities and protection systems in smart devices connected to the 5G network. The STS thesis can provide more insight into the reason why the roll out of the 5G network has faced so much controversy.

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