**Utilizing Li-fi as a More Secure Tool to Access the Internet**

**Understanding how Countries Regulate Data Collection**

A Thesis Prospectus

In STS 4500

Presented to

The Faculty of the

School of Engineering and Applied Science

University of Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science in Computer Science

By

Jaden Carroll

October 27, 2022

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.

ADVISORS

Kent A. Wayland, Department of Engineering and Society

# Prospectus

## General Research Problem

The internet is an essential network that connects billions of computers and other devices. This network of networks allows for the exchange of a variety of information that can be used to accomplish a variety of different tasks. Over the past years, users have become more and more dependent on the internet whether it's in the business world or their personal lives. The internet has become a massive source of data, that can be collected and used in a multitude of different ways. Companies could use this information to advertise their different products depending on the user, while cybercriminals could use the internet to gather sensitive information on victims. Overall, consumers have become more concerned with their privacy and security on the internet.

Security systems are constantly often being developed and improved to counteract attackers and protect consumers of the internet. However, most people connect to the internet using Wi-Fi which can be dangerous if cyber criminals manage to breach the Wi-Fi network. A promising new development in wireless networks is the light-based Li-Fi which makes use of light instead of radio waves which can in turn establish more security to a user's internet access. For my technical paper, I will discuss Li-Fi as an alternative to Wi-Fi, which provides consumers with a more secure connection to the world wide web. Consumers often stress about their personal data being collected online, and desire regulations to ensure their safety and security on the internet. They desire more control over their identity and personal information as companies use this data to gain profit. For my STS research, I will examine how different social and cultural values of different countries, may influence how different governments address the issue of

regulating data collection. Through this research, we can develop a better course of action to securely manage consumer data on the internet.

## Utilizing Li-Fi as a More Secure Tool to Access the Internet

*How can Light Based Li-Fi Networks provide a Safer Alternative to Wi-Fi Networks?*

Wireless Fidelity or Wi-Fi has been around since 1997 when it was first made available to consumers. Over the years it has since been established as an integral part of the internet network giving users around the world the ability to connect to the internet. Every day, approximately half a million new users access the internet across the globe. In order to support the tremendous amount of internet users, Wi-Fi makes use of radio frequencies (RF) to transmit data between our devices and wireless routers to grant access to the internet. Wi-Fi routers make use of these RF waves to provide consumers with a long range of connectivity to different networks. The problem with Wi-Fi lies in these radio frequencies as radio waves can pass through walls which creates a security risk as attackers can easily intercept sensitive data from users. Cybercriminals often utilize man-in-the-middle attacks to target Wi-Fi users as they pose as an anonymous proxy that can eavesdrop and intercept information communicated between users and the internet.

One emerging solution to this security issue is to use Light Fidelity or Li-Fi which instead utilizes visible light communication (VLC) to broadcast its signal. “VLC not only provides indoor illumination but also offers broadband connectivity by modulating information onto the intensity of the light”(Bao et al.). This works by having ordinary light-emitting diodes (LED) serve as signal transmitters where they send binary data to photo-diodes that act as signal receivers. The LED bulbs themselves serve as an access point for network-connected devices that are in the bulb’s illuminated range. This fact improves the overall security of the network as

outsiders of a specified location cannot interfere with or intercept the data that is passed in the network as VLC cannot pass through opaque walls. The light-based Li-Fi has some practical applications in environments that are especially vulnerable to radio frequencies such as airplane cabins, underwater vehicles, and hospitals, among others. These environments often utilize equipment that radio frequencies can interfere with such as radio signals and MRI machines.

Li-Fi still has its challenges as it is in its earlier stages of development as it is difficult to send and receive data from LED lights by quickly turning the bulbs on and off. The technology also has difficulties dealing with outside light such as sunlight which interferes with the LED light. The range of Li-Fi also has a limited range due to it often being confined to a single room. These are some of the current challenges being faced by Li-Fi engineers today, as they hope to improve the technology to be suitable for larger-scale applications whether in an office or at a residence. Although Li-Fi is not yet available for large-scale implementations, Li-Fi can provide an access point that is less vulnerable to outside attackers and can be applied to multiple smaller-scale environments such as airplane cabins or hospital rooms.

## Understanding How Countries Regulate Data Collection

*How different social and cultural factors may influence how countries manage and regulate data collection?*

Today, 2.5 quintillion bytes of data are generated every day by consumers using the internet (Price). The type of data can vary from a personal photo someone posts to the time of day a customer purchased a particular product. Companies gather data to better understand their targeted customers and adapt their marketing strategy. Data collection helps businesses gain more customers which leads to more profit. Company data collection is here to stay as the big

data industry “shot up from $169 billion in 2018 to $274 billion in 2022 — a 62% increase” (Albertson). Data about citizens is also collected and monitored by various government organizations for use in law enforcement, immigration control, and enhancing user interactions with government sites. Data collection also has its benefits for consumers as they get filtered content designed to fit their unique interests. This does not change the fact that many users are becoming more concerned about companies exploiting “their” data for monetary gains, and the potential security risks it poses. To address this, different countries have developed regulations to manage the way companies collect consumer data in hopes of improving the overall security of the internet. It is essential to analyze the relationship between consumers and large businesses to fully understand the issue of how to best regulate big data collection. In the STS research, I will examine different cases of how countries regulate data collection and how certain cultural aspects and events have played a role in regulating data collection.

To explain the reason why many users have qualms about companies gathering data about them, Cristl and Spiekermann analyze the relationship between consumers and companies. They discuss a clear power imbalance between consumers and companies as it relates to data collection on the internet. Users are required to consent to data tracking if they want access to features many websites offer. For example, a user who does not accept cookies on a shopping website will lose all their items if they refresh. Transparency is another critical part of the issue as consumers usually do not understand what their data is being used for, and companies often are usually not obligated to explain their reasons for data collection. This lack of transparency from corporations causes a rift between these two parties as much of the public has concern over how these companies may be threatening their data security and privacy. Perhaps the main issue discussed in the article is the societal implications it may have on consumers relating to

employment, credit scores, and other risks. Governments have a role to play in this relationship, as they act as a medium that seeks to even out the power imbalances. Government regulations are created to offer a solution to consumers by giving them the right to understand how and why companies use the data they collect.

The goal of my STS research is to learn and understand why particular countries regulate big data collection differently. To do this, I will utilize Actor-network theory (ANT) to understand how the relationships between different actants play a prominent role in the issues of regulating data collection. Understanding the ever-changing relationships between the different parties is crucial to examine how and why the regulations of different countries have formed. To accomplish this, I will analyze different articles demonstrating how India and the European Union have regulated data collection in their respective countries. To better understand the different actants in place for these situations, I will read articles that discuss the opinions of either consumers or company executives to better understand how the different actants perceive the issue of data collection. These articles will need to be from both India and countries in the EU to truly appreciate how cultural beliefs and social norms play a role in how data was regulated in a particular country. Consumer responses to big data regulation will need to be explored in order to learn about the initial response to government data regulations. To achieve this, I will study different surveys demonstrating the overall public opinions of citizens toward the data regulations enacted by their respective governments. These surveys will provide insight into how successful the regulations were in giving more power and peace of mind to the users. These sources among others will not only be used to gain a better understanding of the issues surrounding company data collection but to hopefully offer a solution that will better serve all parties involved.

## Conclusion

Data collection is becoming a major part of how many companies shape their marketing strategies online; the profitable big data industry continues to grow as more and more companies join in on the trend. Figuring out the best way to manage data collection on company websites is an ever-growing issue as consumers hope to gain more control over their personal data. Understanding how different cultural norms and social factors may impact how data privacy is protected can provide important insights into how regulations of data collection were designed. Internet security is another necessary factor to consider as a user of the internet. Although Wi-Fi will likely continue to serve as the mainstream mechanism to connect to the internet, Li-Fi will become a suitable alternative that can give users more security from outside cyber-attacks. Hopefully, by educating more people on the potential benefits that Li-Fi can provide, there will be a greater motivation to invest in this technology so that it can be applied to larger-scale implementations. Internet privacy and security are thoroughly discussed in the two research topics. First, a thorough examination of how different countries have tried to regulate data collection could be used to develop future guidelines to support user data privacy and security. Secondly, Li-Fi is an upcoming technological advancement that will provide users with greater security when connecting to the internet.

## References


Albertson, M. (2018, March 9). Software, not hardware, will catapult big data into a $103B business by 2027. *SiliconANGLE*. https://siliconangle.com/2018/03/09/big-data-market-hit-103b-2027-services-key-say-analysts-bigdatasv/

Bao, X., Yu, G., Dai, J., & Zhu, X. (2015). Li-Fi: Light fidelity-a survey. *Wireless Networks (10220038)*, *21*(6), 1879–1889. https://doi.org/10.1007/s11276-015-0889-0

Cristl, W., & Spiekermann, S. (2016). (rep.). Networks of Control – A Report on Corporate Surveillance, Digital Tracking (pp. 118–130). Vienna, Austria: Facultas.

*Difference between LiFi and WiFi.* (2018, September 26). *GeeksforGeeks*. https://www.geeksforgeeks.org/difference-between-lifi-and-wifi/

*Digital Around the World*. (n.d.). DataReportal – Global Digital Insights. Retrieved October 27, 2022, from https://datareportal.com/global-digital-overview

Kulkarni, S., Konde, K., & Bedekar, M. (2022). Analyzing Data Privacy Concerns in Young Adults - Apprehensions of Engineering Students. Grenze International Journal of Engineering & Technology (GIJET), 8(2), 411–418

Livinus, C. (n.d.). *Top 15 Li-Fi Applications (updated list)*. LiFi. Retrieved October 27, 2022, from https://www.lifitn.com/blog/2019/6/6/top-li-fi-applications-updated-list

Nor, A. M., & Mohamed, E. M. (2019). Li-Fi Positioning for Efficient Millimeter Wave Beamforming Training in Indoor Environment. Mobile Networks & Applications, 24(2), 517–531. https://doi.org/10.1007/s11036-018-1154-4

Price, D. (2015, March 17). *Infographic: How much data is produced every day?* CloudTweaks. https://cloudtweaks.com/2015/03/how-much-data-is-produced-every-day/

Schufrin, M., Reynolds, S. L., Kuijper, A., & Kohlhammer, J. (2021). A Visualization Interface to Improve the Transparency of Collected Personal Data on the Internet. IEEE Transactions on Visualization & Computer Graphics, 27(2), 1840–1849. https://doi.org/10.1109/TVCG.2020.3028946

Selvadurai, N., Kisswani, N., & Khalaileh, Y. (2019). Strengthening data privacy: the obligation of organisations to notify affected individuals of data breaches. International Review of Law, Computers & Technology, 33(3), 271–284. https://doi.org/10.1080/13600869.2017.1379368

Strycharz, J., Smit, E., Helberger, N., & van Noort, G. (2021). No to cookies: Empowering impact of technical and legal knowledge on rejecting tracking cookies. Computers in Human Behavior, 120, N.PAG. https://doi.org/10.1016/j.chb.2021.106750