Technical Paper:
Software Defined Radio for the Purpose of FM Transmission

STS Thesis:
The Societal Effects of Radio Piracy and Regulation

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
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Bachelor of Science, School of Engineering

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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

I. INTRODUCTION

The invention of radio was one of the greatest developments of the 20th century. Information could now be communicated in any direction, to any number of listeners, without the limitations of transmission lines. However, with any great leap in technology, ethical challenges came into question. Due to the physical nature of electromagnetic waves, there is a limited amount of 'radio real estate', i.e. frequencies at which one can transmit. Who has the rights to broadcast at a certain band? How far should they be allowed to transmit? What information should they be able to transmit? In the early 20th century, the American government approached these ethical dilemmas through regulation. The electromagnetic spectrum was divided up, and bands were allocated for different purposes. Only transmissions licensed by the government were considered lawful.

As expected, there were individuals and organizations which did not comply with the law. These 'pirate radio' stations did not have the licenses to broadcast, or they exceeded the power and range at which they were licensed to transmit. Often times, legal radio stations in one country were considered pirate radio in another. Using radio to overstep national boundaries was even used as propaganda tactic during the Cold War.

This topic was inspired by the author's capstone project, which uses a software-defined radio to transmit audio to an FM frequency. While this device operates within the legal range of transmitted power, it could easily be modified to transmit to a wider area: effectively becoming a tool for pirate radio.

The thesis will analyze the effect illegal radio transmission had on society throughout the world. The author will conduct research on the effects regulatory agencies had on the industry,

and how pirate radio subverted these effects. Additionally, the thesis will explore the philosophical nature of broadcasting rights and whether a framework of property rights can be applied to the electromagnetic spectrum. Radio technology has had a huge effect on the world, and with it has come great government interference. The ultimate goal of the thesis is to understand how pirate radio has had an impact on history, law, and society.

II. TECHNICAL TOPIC

While many of today's automobiles are equipped with Bluetooth capabilities and audio aux ports, there are still older models which lack these features. The driver may have no way to play audio from their phone to the car speakers. The author's capstone project offers a solution to this problem by transmitting the audio over a radio frequency, allowing the car to play the audio via the FM radio.

To begin, the device searches the current FM radio band for an empty frequency. This ensures that no outside signals will interfere with the transmitted one. The established frequency will be displayed on an LCD screen, allowing the user to tune the car radio to receive the signal. The device has an audio input via a regular 9mm stereo jack. The audio signal is modulated onto the established frequency and transmitted to the car radio. The user can re-scan for an empty frequency at any time with a reset button.

The device accomplishes these tasks with a microcontroller and a transceiver chip. The microcontroller acts as the brain of the device, sending commands to the transceiver chip and LCD display. However, the actual radio technology is within the transceiver chip. This component digitally processes incoming and outgoing radio signals. In order to find an empty

frequency, the transceiver sweeps through the entire FM band, and selects the spot with the lowest power, communicating with the microcontroller. The chip also mixes the audio input with the outgoing frequency and sends this signal to be broadcast by the antenna.

III. STS TOPIC

There are three primary topics that this thesis will explore. The first will explore the effects regulation of radio signals had on the development of technology and society. Afterall, a radio station only becomes 'pirate' when it is broadcasting illegally. Therefore, it is important to understand how pirate radio stations came to fruition with the advent of these policies. Additionally, this topic will explore how regulation shaped the way legal radio stations developed. Because broadcasting licenses were approved by government organizations, there is an argument that radio stations naturally evolved to be uncritical of the state. This contrasts printed publications, which in America, cannot be stifled by regulation.

The thesis will then explore the foundational topic of pirate radio stations and their effects on society. There are many historical instances of pirate radio stations being used as a tool for underground political movements. For example, the 1980s were a vibrant time for illicit transmission in America. Black Liberation Radio, based in Springfield, Illinois, served as a conduit for information about local police brutality, which consequently led to fewer incidences of police violence (Anderson). Off the coast of the United Kingdom in the 1960s, anchored ships transmitted controversial rock music into the otherwise 'sinless' airwaves controlled by the BBC. This had a major impact on the spread of youth music and culture into mainstream society (Trudel). During the Cold War, there were efforts on both sides to broadcast propagandic

material into the other's airwaves. While not pirate radio stations per se, these broadcasts were often illegal for citizens to listen to, and countries took great strides towards jamming the transmissions. Even today, the American multimedia agency known as the Voice of America broadcasts pro-democracy propaganda in fifty languages throughout the world (Encyclopaedia Britannica).

Lastly, the thesis will explore the philosophical nature of transmission rights and if this can be reconciled with theories of property rights. While the derivation and existence of property rights is a topic complicated enough for its own set of literature, the thesis will refrain from such tangents. The focus will be on the ethics of broadcast regulation, and what it fundamentally means to have a right to transmit. Some philosophers who have developed theories of natural rights have made arguments related to this topic. The father of modern libertarianism, Murray Rothbard, claims that individuals can 'homestead' (i.e. derive ownership by first usage) radio frequencies, just as they can homestead an empty plot of land. Under this belief, any restriction of radio transmission by a government entity would be considered a trespass against natural ethics. The thesis will develop this topic further and analyze how governmental regulation, and pirate radio stations, fit into this framework of philosophy.

IV. RESEARCH QUESTIONS AND METHODS

In order to address the above topics, the thesis will rely on a variety of resources and frameworks. The historical investigation will be best supplied by secondary-sources, but supplementation by primary-sources will reinforce the main ideas. Rather than a reiteration of history, the author will develop a deeper historical analysis and attempt to connect the topic to

issues of the modern age. For example, with the advent of the internet, the usefulness of radio has decreased. However, many of the issues present in the regulation of radio exist in countries with the regulation of the internet. While the internet has allowed diversity of thought to take hold in the west, other countries have controlled the web to bottleneck the flow of information. In this way, the internet has paradoxically improved upon the mission of pirate radio stations and also stifled it.

As far as overarching frameworks, the development of radio technology and the resulting societal reactions can be investigated within the STS theory of co-production. Therefore, *The Co-Production of Science and Social Order*, by Sheila Jasanoff, will be a useful resource for conducting this analysis (Jasanoff). Radio technology developed simultaneously to the laws that restricted it. Therefore, it is logical that this framework may provide insight towards developing the thesis.

V. CONCLUSION

In summary, this thesis intends to examine the societal impacts of pirate radio and broadcasting regulation. Scientifically, the use of the electromagnetic spectrum for communication is a complicated subject. That complexity only deepens when considering the social impacts of the technology. Overall, this topic relates to the author's capstone project, which is an FM transmitting device. The same technology used in the device could be used to illegally transmit without a license, effectively creating a pirate radio station. Pirate radio stations have had an important impact on the history of the last century. Society has shaped radio technology through the power of regulation, and radio technology has shaped society through the

distribution of ideas. This will be addressed through the STS framework of scientific and social co-production. In addition to this historical investigation, the thesis will also address the philosophical nature of radio transmission rights. To conclude, this thesis will examine the historical, legal, and social impacts pirate radio has had on society.

VI. WORKS CITED

Anderson, N. (2016, October 27). Illicit Transmissions: Engaging with the Study and Preservation of Pirate Radio. Retrieved October 31, 2019, from https://www.tandfonline.com/doi/full/10.1080/19376529.2016.1223970?scroll=top&needAccess=true&.

Jasanoff, S. (2010). *States of knowledge: the co-production of science and social order*. London: Routledge.

The Editors of Encyclopaedia Britannica. (2019, March 28). Voice of America. Retrieved from https://www.britannica.com/topic/Voice-of-America.

Trudel, D. (2016, November 30). Alternative Communications Networks Throughout History. Retrieved from https://www.academia.edu/30378983/Alternative_Communications_Networks_Throughout_History_Deliverable_number_D5.1.