**Software Defined Microwave for Network Analysis**

(Technical Paper)

**Integrating Media Studies Into the STS Curriculum**

(STS Paper)

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia
In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

Connor Roos
Fall, 2019

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

Signature _____ Date _____

    Connor Roos

Approved _____ Date _____

    Harry Powell, Department of Electrical and Computer Engineering

Approved _____ Date _____

    Kathryn A. Neeley, Department of Engineering and Society

Introduction

If we could look up the information that tech companies have on us, we would notice some concerning trends. Facebook knows who your exes are, Google has seen every disease you ever tried to self-diagnose, and Amazon is probably trying to sell you everything you have ever searched. The topic that motivates my project is the regulation of large technology companies and the results of "breaking up" these companies. In many ways, the fate of the entire industry is at stake. The topic is a bipartisan issue, with politicians such as Ted Cruz (R) and Elizabeth Warren (D) explicitly using the language of "breaking up" (Lowry 2019, Warren 2019). This bipartisanship likely means that there is more than one stakeholder that benefits from splitting up and regulating these companies more. There also exists the possibility that these politicians' actions do nothing. According to industry analyst Bruce Kushnick, "A regulated company will always renege on promises to provide public benefits tomorrow in exchange for regulatory and financial benefits today," showing that actions against these companies might do little in the long run (Kushnick, 2015). A great deal of the discussion concerning these companies stems from technological determinism, as they have become significant and influential enough to control people's everyday lives and behavior.

The technical topic is research on finding a way to make future research and testing of radio technologies less expensive. This research consisted of creating a new invention that would have the same capabilities as one of the most accurate radio measurement devices at a fraction of its price. This invention would be able to be replicated at research institutions to decrease the costs associated with radio research, which would allow more organizations to be able to afford their research, allowing for the field to grow. These two projects are related as they both concern the spread, development, and control of media. Although a group could jam radio signals, our device

could be expanded upon to create a radio that tracks if its message is being jammed, and switch to an open frequency.

Technical Topic

One of the essential devices for any research and development involving radio waves is a network analyzer, a tool that provides information in the magnitude of multiple radio frequencies at the same time. Most network analyzers used today are Vector Network Analyzers (VNAs), which give not only the magnitude but the phase of various radio signals. VNAs, while extremely important to researching radio technologies, are also extremely expensive. VNAs are necessary for testing many electronic components, including amplifiers, converters, and transceivers (Keysight Technologies 2015). Manufactures such as Keysight and Schwartz and Rohde do not provide MSRP for these devices and instead negotiate directly with companies and large research institutions to give a quote. The lab this project is being worked on in, bought their VNAs for around $400,000 each. This massive price has been one of the most significant limiting factors in expanding research in radio technologies.

What makes VNAs so interesting, though, is the fact that they only cost so much because of the software they use. A VNA is a much cheaper device, a Software Defined Radio (SDR), that has proprietary code that is not accessible to the public. SDRs are devices that generate and monitor individual radio signals based on parameters set in code. The SDR in the lab is the NI USRP X310, only costs $10,000, but is as accurate as of the VNAs in the lab. By creating open-source code for the NI USRP X310 to act as a VNA, radio research can expand to include smaller companies and research institutions.

The Far Infrared Receiver Laboratory in the Electrical and Computer Engineering Department has developed a Reflectometer setup for the SDR that allows for it to act as a VNA. The capstone project consists of testing to characterize the NI USRP X310 if used as a VNA. This project will consist of using the device to characterize passive electrical components that are seen by a coupler connected to the device. This setup, created by Ph.D. student Dustin Widmann and his advisor Robert Wiekle will be tested for this research, in which the device's ability to measure reflected radio will be applied to see if it can characterize passive electronic components (Widmann 2019). Dustin Widmann is the advisor for this research, as it will complement the work he has already done on the project. The research also includes developing wireless control for the device. Wireless control will allow for the device to both run on the internet and to automate testing for the project and any further research on the device.

## STS Topic

The question posed for this research at first seems trivial; who cares about whether or not Google, Amazon, Facebook, etc., get split up? But these companies and the technology they have developed had determined how society is evolving and changing all around us. When was the last time you searched a physical encyclopedia to answer a question or drove to the store to buy appliances? These technologies and the discussion that they bring are a perfect example of Actor-Network Theory, defined by Darryl Cressman: "Actor-network theory examines the mechanics of power through the construction and maintenance of networks (both human and non-human). Actors become involved in networks through the process of translation" (Cressman 2009). These companies serve as actors in the network by facilitating the control of translation,

which means that they have massive control over the translation between individuals everywhere.

The most significant factor in determining what governments should do in this situation is the risk that these companies pose, and the inherent dangers in trying to remove, splinter, or even fine them. As precedent, the breakup of standard oil in 1911 and AT&T in 1984 led to very different results due to the nature of the litigation against the companies (The Economist 1999, Kushnuck 2018). Standard Oil was broken up into various smaller companies, of which many have started to coalesce, such as ExxonMobil representing many of the former companies made from Standard Oil. However, competition in the market allowed other companies, such as Chevron, British Petroleum, and Shell, to compete with Standard in the United States (Yeboah, 1999). Technology companies of today can be contrasted with these companies, as they do not necessarily control one good, but different related products.

Also, this research needs to determine whether or not these companies constitute monopolies. Some features of these companies indeed lack competition within the tech scene, such as Amazon's retail site, but that does not mean that they are operating as monopolies. Non-tech competitors such as Walmart and Oracle are moving into e-commerce and cloud computing, and according to Wall Street Journal investigative journalist James Grimaldi, "Walmart, Oracle and mall owner Simon Property Group are secret funders behind a nonprofit that has been highly critical of the e-commerce giant" (Grimaldi 2019). These companies control the translation of knowledge between individuals in the Actor-Network Theory, so they have massive control over society. As the onus is on the government to benefit the consumer, it would make sense to prioritize their interests first when drafting litigation against these companies.

Finally, this topic is incredibly popular amongst Americans, as according to Emily Steward for Vox, "Two-thirds of Americans want to break up companies like Amazon and Google" (Stewart 2019). In many ways, it seems that increased litigation might be inevitable due to bipartisan support. Indeed, according to the New York Times:

> The common cause has made for some strange new bedfellows. The left and the right now often have similar anti-tech talking points on cable news and at congressional hearings. Conservatives are showing up at largely liberal conferences, while liberals are going on conservative TV shows (Bowles, 2019).

The likely possibility of splitting these companies through government intervention means that it is the perfect time to investigate whether or not they are monopolies and what impacts, positive or negative, splitting these companies would have on society. Some studies have already shown that there is no particular political bias in the behavior of these companies, including a study by the Economist that showed that Google showed "no evidence of ideological bias in the (its) news tab" (The Economist, 2019). Ultimately even if these companies are not maliciously using their control of web traffic, it is concerning just how much of the internet's traffic that they could influence

Research Question and Methods

.        The research for this STS Thesis will lead to drafting a policy proposal that would protect United States citizens from having their personal information collected and disseminated without the explicit permission of a regulatory board. This board would ensure the safe use and destruction of copies of personal data. This project would serve as a reaction to the inability of U.S. citizens to trust private organizations with personal information. Savi Vaidhyanathan, a

professor in the Media Studies department at the University of Virginia, notes in his book

Antisocial Media that due to Facebook's ability to control political conversations but the

inability to mediate the content on its website "Facebook is just too big to govern. We are

victims of its success" (Vaidhyanathan 2018a). Facebook and Google, to a lesser extent, are

technology companies built around collecting data concerning their users and selling them to a

massive number of advertisers that these companies do not wish to police the content. These

companies are united in their use of personal data collection as the driving technology for their

businesses.

In many ways, these two companies show how technological fixes can harm us by

creating new problems. Indeed, in an article Vaidhyanathan wrote for the New Yorker, he

described a similar theory in Media Studies of techno-fundamentalism: "the unshakable belief

that one can and must invent the next technology to fix the problem caused by the last

technology" (Vaidhyanathan 2018b). The application of technological fixes for this project will

be defining how Google and Facebook's ad technologies are technological fixes and determining

what policy will prevent them from continuing to abuse personal information.


Conclusion

Ultimately for the STS Thesis, a thorough policy proposal will be designed to protect

private data in the United States. The policy proposal will take into consideration feedback from

experts at the University to fix the current situation with private data on the internet. The

Technical research for the project will consist of testing a new Software Defined Radio device

that can also analyze radio networks, allowing for radio technologies that will be cheaper to

research, allowing for a more significant number of organizations to contribute to the field.

References

Bowles, N. (2019, July 14). Fighting Big Tech Makes for Some Uncomfortable Bedfellows. *The New York Times*.

Cressman, Darry (April 2019) A Brief Overview of Actor-Network Theory: Punctualization, Heterogeneous Engineering & Translation

Google rewards reputable reporting, not left-wing politics. (2019, June 8). *The Economist*.

Grimaldi, J. V. (2019, September 20). A 'Grass Roots' Campaign to Take Down Amazon Is Funded by Amazon's Biggest Rivals. *Wall Street Journal*.

Keysight Technologies (2005) *Network Analyzer Basics*

Kushnick, Bruce. (2018, June 11). The Mergers that Created AT&T & Verizon Were Failures. —Time to Break Up AT&T…Again.

Kushnick, B. (2015, February). *Broken Promises: $400 Billion Broadband Scandal & Free the Net*. 581.

Lavretsky, E. (n.d.). Adaptive Control: Introduction, Overview, and Applications. *Adaptive Control*, 185.

Lowry, R. (2019, March 13). Don't Break Up Big Tech. *POLITICO*

Meserole, C. (2018, October 4). What is machine learning? *Brookings Institute*

Yeboah, Y. (1999, December 23.). The Prize Chapter 5: The Dragon Slain: The Breakup of the Standard Oil Trust | EGEE 120: Oil: International Evolution.

Stewart, E. (2019, September 18). Poll: Two-thirds of Americans want to break up companies like Amazon and Google. *Vox*

Vaidhyanathan, S. (2018). Antisocial Media: How Facebook Disconnects Us and Undermines Democracy

Vaidhyanathan, S. (2018, April 21). Techno-Fundamentalism Can't Save You, Mark Zuckerberg | The New Yorker.

Warren, T. (2019, March 8). Here's how we can break up Big Tech.

Widmann D., et al. (2019, July 8). Azbil mm-subWave Spectroscopy Progress Report 3.