

Thesis Project Portfolio

**The Ghostbusting Brochure:
A Systematic Analysis of Real Time Spectre Side-Channels Detection**
(Technical Report)

The Colonization of Loudoun County through Cloud Computing
(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The infrastructure that scales systems for enormous loads and the security measures that safeguard them are the fundamental cornerstones of our digital world and their increasing dependence on the internet has brought them to the center stage. By focusing on Loudoun County, Virginia, my thesis study examines both the socioeconomic ramifications of expanding cloud infrastructure and the technological aspects of malware detection, combining these two crucial areas. Despite the topics' seeming so different, this synthesis is supported by a common narrative—the advancement of technology and its effects on society. The technical investigation of malware detection dives into the architecture of cybersecurity, highlighting the need to build strong defenses against the complex threats that target our world that is becoming more and more dependent on the cloud. Simultaneously, the STS research component looks at the cloud itself via a sociotechnical lens—examining the moral implications of the physical spread of cloud infrastructure and its socioeconomic effects on a community. When I started these projects, I was not sure what I was going to be doing with either or the similarities they would share. However, I was able to use previous research experience done with the school and my own personal background knowledge of the cloud technology to provide two documents that emphasize the impact of both cybersecurity measures and cloud computing. However, I was happy I was able to in detail talk about these two topics, as it is what I have spent most of my university years researching and being interested in. When taken as a whole, these research endeavors highlight how important STS is to engineering practices as a field that actively influences the social landscape it lives in.

In my STS research, I examined the socio-technical dynamics of Loudoun County's transformation into a data center hub, revealing the cohesion between the technological advancement side and its societal impact. This analysis brought to light the colonial patterns of the big tech companies creating these data centers and their profound influence on local governance, economy, and education; underscoring the ethical responsibility of engineers to consider the long-term societal ramifications of their work. My exploration delved into how these companies, who misused their power in the name of

growth, have not only reshaped the county's landscape but have also created a dependency that mirrors the historical colonists from history, raising questions about ethical development in this era of big data. I provided some insight into what citizens should be aware of is happening to keep them informed so they are not blindsided.

The technical portion of my thesis produced a systematic analysis of real-time Spectre side-channel attacks detection, providing insight into the cutting-edge methodologies to safeguard against such vulnerabilities. The intricate connection between hardware capabilities and software ingenuity highlighted in this project exemplifies the need for engineers to design with foresight, ensuring that systems are resilient not just to known threats but also adaptable to the unforeseen. My work was to create a comprehensive taxonomy of the several ways attacks can be done on different hardware. It provided an overarching view of the landscape of malware detection and emphasized the role of machine learning in creating more robust defense mechanisms for future papers, reflecting a shift towards predictive and adaptive security in computing.

My scientific research into malware detection and the STS exploration of cloud infrastructure in Loudoun County have led to an essential realization: the internet's once-invisible backend has rapidly evolved, acquiring cultural relevance and driving economic transformation. Both studies show how specialized knowledge in cybersecurity and data management has evolved into highly valued skill sets, causing a massive shift in the job market and social status of both fields. Loudoun County, a microcosm of this transition, has been dramatically transformed by the tech corporations that enable mine, and others', research, establishing data centers that have become neighborhood landmarks of the local economy. Through an STS lens, this focus on technical and sociocultural aspects emphasizes an ethical responsibility in engineering. It highlights the significance of respecting the societal context alongside technology advances, guiding us toward making decisions that enhance both community growth and technological advancement in harmony.

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