

# **Thesis Project Portfolio**

## **Expanding on Multiple Cryptocurrency and Wallet Software**

(Technical Report)

## **Reducing the Environmental Impact of Data Centers**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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## **Sociotechnical Synthesis**

The Digital Age has allowed for the rapid development of complex and computationally intensive technologies. These technologies have become embedded into a societal structure built on communication technology and the movement of data. It is critical to examine how these technologies integrate into society to better manage emerging technologies. Increased complexity in underlying technologies brings challenges in architecting software that is effective, accessible, and useable to a large audience. Furthermore, there are structural challenges in designing, maintaining, and powering these technologies that process, collect, and communicate vast sums of data. The technical report focuses on the software design challenge presented by the complexity of cryptocurrency technologies, while the research paper focuses on the environmental implications of large-scale data usage, especially regarding the power usage that bitcoin is infamous for.

The technical report delves into a project to implement a framework that simplifies the interaction with multiple cryptocurrencies within the same software for developers and users. There is a vast array of cryptocurrencies in circulation, with new types still being created. This increases complexity and creates a barrier for users intending to use multiple types. It also creates a problem of scale for software intending to interact with such technology as each currency is somewhat unique due to the lack of uniformity in implementation, wallet, and developer tools. This framework attempted to tackle this complexity through abstraction. It generalizes a transaction into two parts: connecting to the daemon and interacting with the appropriate software wallet. The framework handled the quirks of a specific currency once it is implemented within the framework so that the user may simply input their currency and wallet.

I worked on this project as an intern along a team of full hires and the technical lead who designed the framework. The technical report details the process of understanding the codebase, fixing bugs within an Ethereum implementation, and further research into a potential implementation of Monero within the framework. The framework was able to successfully manage transaction currencies such as Ethereum and could potentially handle others with more research. Such a framework allows this technology to be more accessible by abstracting away the complexities of software for the user for ease-of-use, while still taking an individual approach to the implementation of each currency.

Computing workloads have become more intensive due to the flood of data from new technologies such as cryptocurrency. This has in turn demanded an increase in power usage in the data centers processing this information over the past decade. The research paper focuses on this societal effect of this technology and how interest groups have worked to reduce the environmental impact of data centers. It reviews the sociotechnical techniques such as the policy, programs, and activism that have contributed to a large-scale effort towards improving data center efficiency. The primary participants in the system surrounding data centers are the technology companies responsible for the centers, the governmental agencies regulating them, and the communities who live around them. This paper utilizes both press releases, policy documents, and first-hand accounts as well as academic articles and new reports to delve into these perspectives.

On the large scale, policy and non-governmental initiatives have promoted data center efficiency. Central to these ideas is the free access to information in sharing designs, promoting research, and developing training programs and standards to close the gap between private stakeholders and governmental policy. Creating policy or plans to manage data centers is a

complex affair due to the variety in location, technology, and design of centers. Government policy that takes a voluntary approach over specific restrictions in policy can better manage that diversity and yield more quantifiable results. Similarly, the plans proposed by technology companies to promote sustainability in their centers are often capital intensive and have many complexities in their implementations even as they provide economic benefits. A review of the activism reveals that, like the issue posed by the cryptocurrencies, an individual approach must be taken alongside these large-scale plans. At the smaller scale there can be dissonance between economic policy and environmental initiatives. The environment of the area where data centers are built require special attention to ensure positive outcomes for both the communities living there and the companies stationed there.