Thesis Project Portfolio

Fermilab GlideinWMS Deployment: Automation with Docker, Kubernetes, and Helm

(Technical Report)

Autonomous Foosball Opponent

(Technical Report)

Patterns in IPv6 Adoption

(STS Research Paper)

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Table of Contents

Sociotechnical Synthesis

Fermilab GlideinWMS Deployment: Automation with Docker, Kubernetes, and Helm

Autonomous Foosball Opponent

Patterns in IPv6 Adoption

Prospectus

Sociotechnical Synthesis

My Computer Science capstone project addresses the deployment process of Fermilab's Glidein Workflow Management System (GWMS) software. GWMS is a complex system with several components that must be installed and configured to communicate with each other, so its deployment requires a large amount of time and expertise. For example, the operator must be familiar with a particular operating system's package manager, where in the GWMS configuration to specify the network locations of other components, what authentication options are supported, and how to share authentication configuration between components. To streamline the process, I used Docker, Kubernetes, and Helm to create containerized versions of several GWMS components that can be installed automatically and configured with only a few essential options. It was important to consider the nature and needs of GWMS users to create an effective solution. It must be simple enough to be approachable by the users given their level of technical ability, yet complex enough to allow the various configurations that users need. The solution must reach the right balance between simplicity and flexibility, which requires a good understanding of the users' needs and abilities.

For my socio-technical research, I explored the history of Internet Protocol version 6 (IPv6), the replacement for version 4 (IPv4). Fundamental technical limitations of IPv4 mean that a complete transition to IPv6 will be necessary, but until recently adoption has been slow. I investigated the technical and social reasons for the historically slow growth and recent acceleration of IPv6 adoption. To research this topic, I gathered data from company reports in the tech industry related to individual firms' transitions to IPv6 at different time periods to understand how perspectives have changed over time. To analyze my research, I used Thomas Hughes' theory of technological evolution, in which a system evolves from an initial invention through phases of development and innovation to a system capable of succeeding in the real

world and compatible with other existing systems. As a result, I identified the reasons behind the acceleration of IPv6 adoption and the factors that still hold it back.

Taken together, both the complexity of GWMS deployment and the slow rate of IPv6 adoption illustrate that the existence of a technology is not enough to guarantee its success. Care and hard work must be taken to mold the system into one that works for its users and with a complex web of pre-existing systems.