

Thesis Portfolio

E2-Chat: A Web-Based End-to-End Encrypted Messaging Service
(CS Technical Report)

Modular Battery Management System (BMS)
(ECE Technical Report)

**The Internet Privacy Paradox: understanding the role online services, governments, and
businesses have on the privacy behavior of individuals**
(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Thesis Prospectus

Sociotechnical Synthesis

Due to increasing technological innovation, new online services have grown rapidly and billions of individuals have signed up to use these online services. The rise of online services over the past two decades has resulted in an unprecedented amount of data that is collected from consumers, often without their knowledge. The STS research paper seeks to explore how consumers' relationships between online services, companies, and the U.S. government affected the privacy attitudes of consumers, resulting in the privacy paradox. Two technical projects were also completed: a web-based end-to-end encrypted messaging service (E2-Chat) and a modular battery-management system (BMS) for the CS and ECE capstone respectively.

Studies have shown that there is a gap between consumers' privacy attitudes and their privacy actions known as the privacy paradox. The STS research paper explored the relationships between consumers, online services, companies, and the U.S. government, which revealed the structural power imbalance between each actor and explained the prevalence of the privacy paradox among consumers. By understanding why the privacy paradox is prevalent among consumers, consumers can take action to fight against the erosion of consumer privacy and ensure that consumers have control over their data.

The ECE technical project involved building a modular BMS to monitor battery packs for powering an electric vehicle. The modular BMS had a wide range of features associated with other battery management systems such as estimating the state of charge in the battery pack and a user interface to view battery pack data. The modular BMS is differentiated from other battery management systems due to its unique modular design that allows a user to easily reconfigure the BMS instead of purchasing a new BMS if the user wants to resize their battery pack. The

modular design of the ECE technical projects enables users to save money and allows them to be flexible with how many battery packs they can monitor on an electric vehicle.

For the CS technical project, a web-based end-to-end encrypted messaging service, E2-Chat was created to enable users to send messages and media to other users using end-to-end encryption (E2EE). Using E2EE, a third party would not be able to read the contents of messages sent between groups of users, highlighting the privacy-focused nature of E2-Chat. E2-Chat differentiates itself from other E2EE messaging services like WhatsApp or Signal by not requiring a smartphone before a user can sign up and use E2-Chat. These features enable users without smartphones to communicate with each other using E2EE, and help ensure that privacy remains a key human right.

The CS technical project and the STS research paper directly tie with each other as the CS technical project created a new messaging service to maintain users' privacy while the STS research paper focuses on the consumers' side of privacy. By working with these two projects together, I obtained a better understanding of the challenges that users face to protect their privacy. From the technical challenges that were involved with creating E2-Chat to analyzing how countless online services overwhelm consumers in my STS research paper, I learned that consumers require a high level of technical understanding of online products to protect their online privacy. Due to major structural factors, these challenges result in a constantly evolving task for consumers to protect their online privacy from the U.S. government and companies.

As the modular BMS will be used to manage the battery packs inside electric vehicles, they are a critical component for the electric vehicle to function. With the rise of smart device functionality in electric vehicles, there are privacy concerns as electric vehicles can send data back to car manufacturers about consumers' habits. Since the STS research paper analyzed

consumers' privacy attitudes and actions, the STS research paper helped me understand how consumers would most likely react with an apathetic shrug in response to data collection in electric vehicles. To change consumers' actions towards their online privacy and ensure that invasive data collection is not normalized throughout society, consumers need to work together to boycott electric vehicles that do not respect consumers' privacy, and advocate for new privacy regulations.