CS120

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1 Project 1

The CS120 Project 0 and Project 1 encompasses three interconnected tasks aimed at exploring audio signal processing and communication. The first task revisits and reinforces the tools and methods from Project 0, ensuring foundational skills are in place. The second task delves into generating sound waves of varying frequencies and power levels, emphasizing understanding audio sampling frequency and using tools for sound analysis and visualization. The third task focuses on establishing a data link using sound waves for message transmission, addressing the challenges of interpreting sound wave information amidst distortions and noise, and exploring modulation methods and frame structure design for efficient and error-resistant data communication. This progression from basic tool understanding to advanced sound manipulation and communication underlines the project's comprehensive approach to audio signal processing.

In the nuances of the project, a significant challenge arises from the inherent noise and interference present in audio channels, which complicates the accuracy of data transmission. This, combined with the variability of sound card characteristics across different computers, makes it particularly challenging to maintain a consistent communication standard. Furthermore, the task of designing a preamble that is distinct and detectable amidst various types of environmental and system noise adds another layer of complexity. These challenges underscore the importance of developing advanced signal processing techniques and robust error-correction algorithms to ensure reliable data communication in a diverse range of acoustic environments.However,despite successfully implementing algorithms like FEC (Forward Error Correction) and OFDM (Orthogonal

Frequency-Division Multiplexing), which allowed for self-transmission and reception on a single computer, the system faltered when attempting communication between two different computers. The inability to find an effective preamble meant that, while one computer could transmit and receive data successfully on its own, the communication process encountered problems when expanded to a two-computer setup, indicating a critical limitation in our approach to handling diverse acoustic environments and hardware inconsistencies.

2 Project 2

In Project 2, we encountered several significant challenges. Firstly, ensuring physical layer stability with USB sound cards and audio cables was crucial for consistent analog signal transmission, a task that demanded careful calibration and testing. Secondly, the project's complexity was heightened by the need to develop an efficient acknowledgment system for managing transmission errors, a process complicated by non-real-time scheduling and the propensity for decoding errors in a shared cable environment. Lastly, the implementation of the Carrier Sense Multiple Access (CSMA) protocol presented a sophisticated challenge. It required the integration of mechanisms for effective collision detection and the implementation of random backoff strategies, essential for managing data transmissions among multiple nodes in a shared audio communication system.What's more,another significant hurdle we faced was identifying an appropriate carrier frequency for the system. This task was critical for ensuring clear signal transmission and reception across different devices in the shared audio communication system. Selecting the right carrier frequency required a delicate balance between minimizing interference and maximizing signal clarity, which was particularly challenging given the diverse range of hardware and environmental conditions involved in the project.

3 Project 3

The key challenges in CS120 Project 3 include implementing ICMP Echo for network testing, which involves understanding and correctly handling echo requests and replies. Another challenge is enhancing a node to function as a router, requiring efficient management of IP datagram forwarding and network traffic. Implementing Network Address Translation (NAT) poses difficulties in modifying IP datagram headers and payloads for external network communication. Finally, addressing NAT traversal to enable local IP addresses to be accessible from external networks presents a complex problem in network connectivity and security.These tasks collectively aim to integrate the Aethernet network with broader internet-based systems, leveraging IP for effective network communication.

4 Project 4

The Project 4 involves upgrading the Domain Name System (DNS) capabilities. The task revisits the NAT implemented in Project 3, Task 3, with an upgrade to support TCP and UDP. It requires configuring a local DNS server on NODE1 to NODE2.IP or public DNS servers, enabling NODE1 to resolve domain names. This task is crucial for facilitating communication between network nodes and the broader internet, allowing for domain name resolution and efficient network traffic management.