Efficient Backscatter with Ambient WiFi for Live Streaming

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I. Summary

The paper discusses about backscatter techniques to provide a battery free way to transfer data which required high data throughput like live streaming. The backscatter communication technique uses WIFI signals already created by other WIFI devices to share data by modulating/demodulating those signals. A major focus of the paper is on the existing drawbacks of backscatter communication, which leads to multiple research ideas, and the authors are primarily interested in two main issues: “How to modulate/demodulate efficiently without redundant coding?” and “How to demodulate the tag data directly from the backscattered signal?". A new WIFI-backscatter technique, Hermit Crab, is presented by proving these two questions. With Hermit Crab, high data throughput is achieved through the optimization of decoding algorithms that support single symbol encoding. Also, the throughput was dramatically increased by removing redundant coding and encoding with multiple symbols. Moreover, the authors explained how these communication techniques have evolved over time. It has been demonstrated that the proposed method is effective in live streaming applications where only a few symbols need to be transmitted, and the receiver can still accurately decode the data. The low cost of this system makes it ideal for a variety of applications involving live streaming.

II. Good things about the paper

In the first place, backscatter communication using an ambient WiFi signal is an excellent idea. As a result, additional hardware and infrastructure will not be required. Using ambient WiFi backscattering reduces energy consumption and bandwidth consumption, making it possible to operate devices without batteries. In addition, it provides a reliable communication link with a low bitrate and error rate. It supports a wide variety of applications since it is easy to use and requires minimal installation. Due to its low cost and availability, it can be deployed quickly, enabling mass adoption. In Hermit Crab, there are multiple problems with backscatter communication that can be solved through the use of a pilot subcarrier with pre-defined data and a single receiver that decodes both tag data and original data at the same time. It is a brilliant idea to use both sub-carriers and one receiver to increase throughput. This paper provides a better understanding of how redundant coding is used in existing systems, resulting in a significant reduction in throughput, and proposes ways to improve throughput by removing redundant coding and changing the way tags are demodulated. Researchers interested in advancing the field of backscatter communication might find this information useful, as it outlines several future directions for research including improving the energy efficiency of the system and exploring multiple frequencies. The new approach is proposed in the paper, along with experimental results that demonstrate its effectiveness. As a result, the authors show that their system achieves high data rates.

III. Major Comments

First, the paper focuses on improving the performance of the backscatter communication system by reducing existing flaws. However, it also opens the door for other issues, which can be caused by using predefined data in the pilot subcarrier. Neither is information provided regarding backscatter communication security, such as interference with other networks, malicious input validation, eavesdropping, and spoofing. Although the application layer is more vulnerable to attacks, no information is provided about these attacks.

Moreover, most of the assumptions made in the experiment may not be true at all times. It is not appropriate to demodulate only using phase information, for example, since other nearfield signals might affect it. When multiple devices with signal-generating capabilities are connected to these, phase information can be easily altered. And the ignorance of the common phase error (CPE), which can be enormous for transmissions over long distances or increase gradually. For example, in live Streaming, if

we include scenarios like stadiums, it includes lot of audience, so the communication must be smooth providing enough bandwidth to all the users. So, CPE can be increased and cannot be ignored in this scenario.

In the paper, the authors do not explain how the proposed system would perform in adverse network conditions, such as when interference is high or when signal strength is low. For backscatter communication to work we should have proper WiFi signals for perform modulation and demodulation but “what if the WiFi signals has weak strength?”, “what if WiFi signals are encrypted?” and “will the WiFi signals are available throughout until the backscatter communication is completed?”.

Readers may have difficulty understanding the technical details of the system because the paper does not provide a detailed description of its architecture. There is no description of how the system is implemented in the paper, only an overview of its design. There is also no information provided on the system's performance about latency, throughput, and other factors. While there are several protocols for backscattering, the paper uses OFDM, which is resistant to interference and fading. However, these details were not provided at least as to why they chose OFDM protocol since it is more useful in the event that backscattering problems arise.

The experimental setup is limited in scope, as it only uses a single WiFi access point for communication and was conducted in a laboratory environment, which does not represent a real-world deployment and therefore may not accurately reflect the performance of the system in a real-world setting. Furthermore, they failed to consider obstacles such as walls and other objects, which can affect signal propagation and thus system performance.

Overall, the paper has a clear view of how the presented problems are solved and the way they introduce Hermit Crab architecture and its overview, but it doesn’t include proper details about the background information and clear analysis of how evaluation done by including all the parameters.

IV. Minor Comments

Overall, the paper provides an interesting and innovative approach to streaming data using backscatter communication. The paper describes a technique for streaming data without power or energy, which could reduce costs and improve performance. The idea of the hermit crab communication technique was explained clearly along with its evaluation. However, it missed multiple scenarios like security issues due to predefined data in the pilot subcarrier. Furthermore, the paper does not provide enough details on how environmental conditions and nearby wireless devices affect ambient WIFI signals. Due to its emphasis on their work instead of providing sufficient background information, and lacks context to the terminology used.