Critical Review: On Construction of Precise Positioning System via IEEE 802.11ax

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Abstract— This paper introduces a Wi-Fi positioning system leveraging IEEE 802.11ax and Aruba Networks' ALE for precise device localization. Integrating Wi-Fi signal strength, path-loss modeling, and fingerprinting data, it estimates both horizontal and vertical positions. A web-based 3-D visualization tool presents device data on maps. Performance evaluation covers communication latency, response time, data transmission, and user interface. The system touts low latency, high accuracy, and seamless visualization. However, it lacks comparative analysis with other Wi-Fi positioning solutions, offers unclear system architecture details, and lacks in-depth scalability and robustness assessments.

Index Terms— Wi-Fi positioning, IEEE 802.11ax, ALE, 3-D visualization, system performance.

I. Introduction

The paper by Tsung et al. introduces a novel system aimed at accurately pinpointing Wi-Fi device locations within indoor environments. Leveraging IEEE 802.11ax technology and a 3-D building model, the authors claim their system can achieve high precision, minimal delay, and user-friendly visualization. To substantiate their claims, the paper outlines preliminary experiments evaluating system performance and user experience. This critical review aims to comprehensively assess the paper's strengths and weaknesses while offering constructive feedback for potential enhancements, delving into the motivation behind the research problem, the uniqueness of the proposed solution, the robustness of the methodology and experiments, the clarity of presentation and writing, and the overall significance and impact of the findings. Following a structured approach, the review will provide insights into each aspect, guiding both the authors and readers toward a deeper understanding of the paper's contributions and areas for improvement.

II. Methodology

The main objective of this paper is to propose and evaluate a precise positioning system via IEEE 802.11ax, a new standard for high-efficiency wireless local area networks (WLANs). To achieve this, the proposed system leverages the analysis and locations engine (ALE) provided by Aruba Networks, which is capable of estimating the location of end devices connected to Wi-Fi access points (APs) based on the received signal strength indicator (RSSI) and the path-loss model. Moreover, to enhance visualization and offer additional services, the system integrates Cesium, a JavaScript library that facilitates the creation of 3-D building models on maps. This enables the system to visualize device locations and provide services such as device search, heat map generation, history location tracking, and building information provision. To validate its effectiveness, the proposed system is implemented and tested within a campus environment. This environment features the deployment of several APs, which are calibrated using the fingerprinting process. Subsequently, device information collected by the ALE is transmitted to a web server for processing, where it is seamlessly combined with the 3-D building models. The performance evaluation of the proposed system considers three key perspectives: system response, data transmission, and system latency. Specifically, system response is assessed through measurements of network communication time and frames per second (FPS) on the screen. Meanwhile, data transmission is evaluated by latency measurements between different system components. Lastly, system latency is determined by the time required for processing and visualizing device information.

III. Analysis and Interpretation

The paper introduces a novel Wi-Fi indoor positioning system based on IEEE 802.11ax and ALE, showcasing its ability to achieve high accuracy with low latency. Additionally, a comprehensive evaluation of the system's performance, user experience, and data transmission is provided, highlighting its feasibility and potential across various applications. However, weaknesses are also identified. The paper lacks comparative analysis with other existing WiFi-based positioning methods, such as fingerprinting or trilateration, and fails to address potential limitations such as scalability, security, privacy, or robustness issues. Furthermore, more details on the system's implementation and deployment, including hardware and software specifications and network architecture, could enhance the paper's depth. Despite these shortcomings, the paper makes significant contributions to the fields of IoT and wireless communications. By proposing a precise positioning system via IEEE 802.11ax and utilizing ALE, it advances indoor localization techniques. This suggests that WiFi can serve as a reliable positioning technology in indoor

environments. Moreover, the implications of the paper are noteworthy. It implies that leveraging IEEE 802.11ax and ALE features can enhance WiFi-based positioning systems, offering valuable insights for applications such as network management, user behavior analysis, indoor navigation, and emergency response. Additionally, integration with other IoT devices and platforms could further enrich these systems, contributing to the development of smart and sustainable environments.

IV. Conclusion

In conclusion, Tsung et al.'s paper presents an innovative Wi-Fi positioning system with promising accuracy and visualization capabilities. While the system demonstrates strengths in performance evaluation and user experience, it falls short in comparative analysis and addressing potential limitations. Enhancements such as comparative studies with existing methods and deeper exploration of scalability and security concerns could strengthen the paper. However, the paper's contributions are significant, advancing indoor localization techniques and highlighting the potential of IEEE 802.11ax and ALE integration. The implications extend to various applications including network management, navigation, and emergency response systems. Overall, the paper underscores the value of leveraging Wi-Fi technology for precise indoor positioning, offering valuable insights for future developments in IoT and wireless communications.

References

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Journal Information

Judul *Paper*	: On Construction of Precise Positioning System via IEEE 802.11ax
Jurnal	: IEEE Internet of Things Journal
Volume	: 10
Number	: 14
Tahun	: July, 2023
Publisher	: IEEE
Penulis	: Chen-Kun Tsung, Chao-Tung Yang, Jung-Chun Liu, Chun Hsiung, Shih-Kuang Chang, Ming-Shang Hsu
SJR Categories	: Computer Networks and Communications
SJR	: Q1