Survey on Standardization of Integrated Sensing and Communication in 6G and IEEE 802.11bf

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***Abstract*—Driven by the advantage of maximizing the utilization of the frequency spectrum, integrated sensing and communication (ISAC) have gained significant research interest in recent years. In this paper, we provide comprehensive overview on the concept of the ISAC. Next, we introduce the expected performance requirements for ISAC in two ongoing communication standardization efforts: the 6G and IEEE 802.11bf. Finally, we address some challenges inherent in devising and assessing a viable ISAC system. These potential research topics encompass trade-offs between sensing and communication performance, privacy concerns, and waveform selection.**

***Index Terms*—Integrated sensing and communication, Dual functional radar and communication, 6G, IEEE 802.11bf**

I. Introduction

Integrated Sensing and Communication (ISAC) systems have emerged as a significant solution for the challenges of separate system coexistence and efficient utilization of radio spectrum [1]. By adopting ISAC systems, it becomes feasible to greatly reduce hardware expenses, form factor, and resource allocation, as opposed to employing distinct communication and radar systems. Leveraging these advantages, 5G utilized ISAC for positioning services. This sensing function has further evolved, leading to its standardization in 6G. A similar trend is also observed in WLAN, where the IEEE 802.11bf task group is solidifying the WLAN sensing procedure to standardize ISAC functionalities.

In this paper, we aim to provide a brief introduction to the concept of ISAC, along with highlighting the ongoing standardization efforts, use cases, and performance metrics in current 6G and IEEE 802.11bf contexts. Furthermore, we investigate several challenges in realizing ISAC systems.

II. Concept and use cases of ISAC

As one of the most well established ISAC system architectures, dual functional radar and communication ISAC studies consider not only the same frequency but also the same device and waveform [2]. These studies involve devices that transmit signals performing both radar and communication functions, thus enabling a dual functionality of radar and communication.

With the concepts of ISAC, IMT-2030 and IEEE 802.11bf task group have started to define use cases and key performance indicators (KPIs) [3], [4]. The use cases in both of 6G and IEEE 802.11bf can be categorized as follows:

- High-accuracy localization and tracking
- Provision of sensing data/information on surroundings
- Environmental monitoring
- Activity detection and movement tracking

III. Challenges and future research topics

ISAC is currently under discussion for standardization by IMT-2030 and IEEE 802.11bf task group. However, there are still several challenges that need to be addressed.

How to quantify the integration gains? In adopting the ISAC concept, performance deterioration in communication due to the trade-off between sensing and communication performance is unavoidable. Consequently, it becomes significantly important to determine how much communication performance can be compromised. However, the metric that qualifies this trade-off has not yet been defined.

How to ensure security and privacy assurances in wireless sensing? While radio frequency (RF) signals do not compromise user privacy, such as facial features or attire, the disclosure of personal information like user location can pose an additional privacy threat.

Which waveform would be utilized? Not only does ISAC go beyond integrating hardware and frequency bands, but it also employs the same waveform for the dual functions of radar and communication. However, in general, these two applications typically employ different waveforms: linear frequency modulation for radar and orthogonal frequency division multiplexing (OFDM) signals for wireless communication.

References

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