Introduction

This research presents a real-time OFDM-based Integrated Sensing and Communication (ISAC) system that uses a single wireless waveform for both data transmission and human sensing. A 16-QAM OFDM signal carries communication data while its known pilot carriers are reused to detect human presence and monitor respiration, without interrupting the communication link or requiring a separate radar or wearable device. The system is implemented using GNU Radio and software-defined radios, with live communication outputs including spectrum, constellation and video transmission, alongside real-time breathing waveform and respiration-rate estimation. The key message is that existing wireless signals can provide sensing capabilities in addition to connectivity. This shared-waveform approach can reduce hardware, cost and complexity, while enabling future applications in contactless healthcare, occupancy-aware smart buildings and sensing-enabled 6G networks.

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Beyond Data Transfer: Real-Time OFDM-Based ISAC for Wireless Sensing

One waveform, Two Functions, Real-time operation

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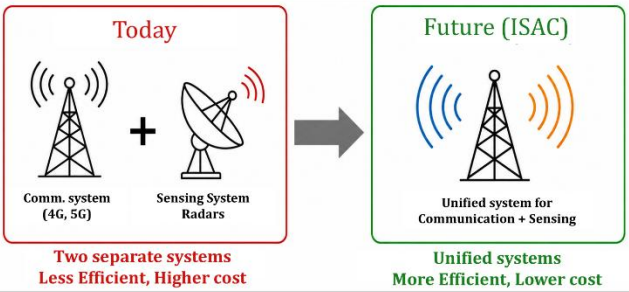
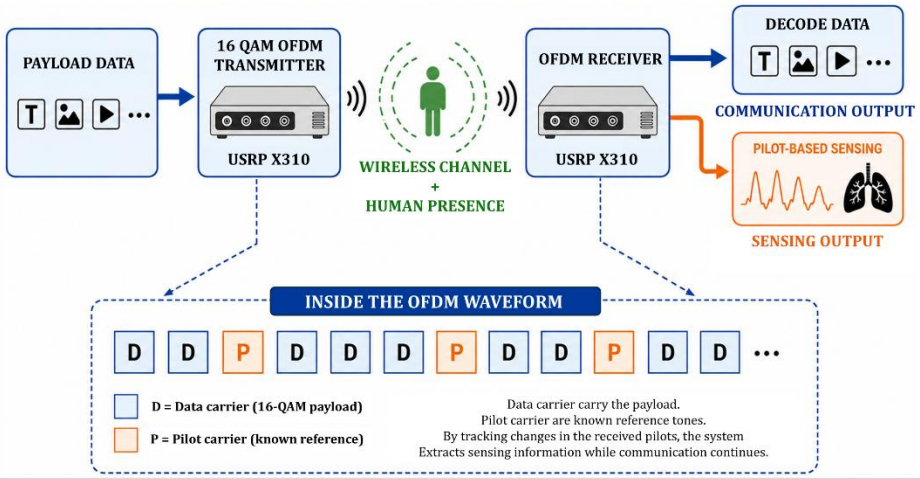
Why this Matters

Wireless systems are traditionally designed for data transfer, while sensing often requires separate radar or wearable devices. Future 6G and smart environments need shared wireless infrastructure that can communicate and sense at the same time.



HOW SYSTEM WORKS

A 16-QAM OFDM waveform is transmitted.
The same waveform carries data and provides pilot references for sensing.

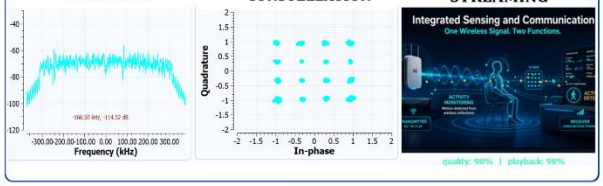


REAL-TIME DEMONSTRATOR

The demonstrator runs live in GNU radio using software-defined radios

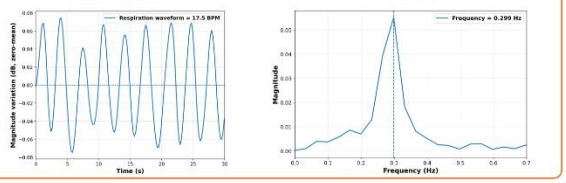
LIVE COMMUNICATION DASHBOARD

OFDM SPECTRUM | 16-QAM CONSTELLATION | VIDEO STREAMING



LIVE SENSING DASHBOARD

BREATHING WAVEFORM | RESPIRATION RATE



KEY TAKEAWAYS

Realtime OFDM Communication
16-QAM payload transmission demonstrate with live monitoring.

Pilot-based Wireless Sensing
Known OFDM pilots reused to detect human presence and breathing.

Single Shared Waveform
Known OFDM pilots reused to detect human presence and breathing.

IMPACTS

Smart Healthcare
Contactless Vitals monitoring in realtime.

Smart Buildings
Occupancy aware And energy efficient environments.

6G Networks
Sensing as a Built-in wireless service

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