

WiFi sensing (802.11bf)

May, 2021



What is CSI?

Channel carriers

20MHz channel -> 56 carriers

40MHz channel -> 114 carriers

Carrier state -> $a + bj$ (2 x 8-10 bits)

Channel State Information (CSI)

1 channel CSI is = 1x56 or 1x114 complex numbers

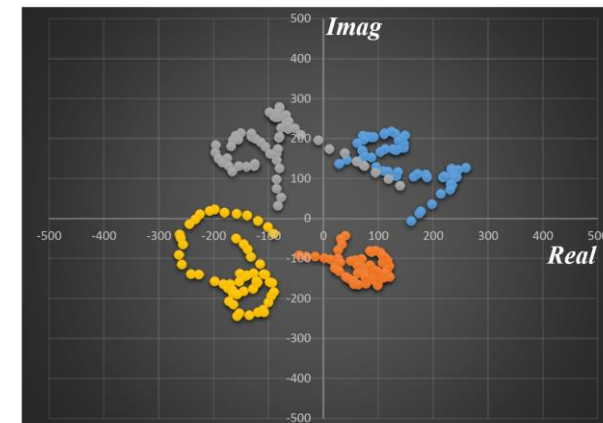
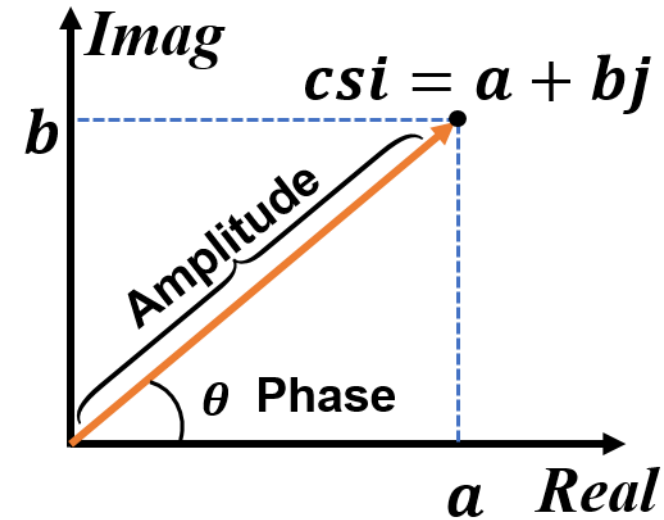
Multiple stations -> multiple CSI complex vectors

- 1 receiver 4 transmitters -> 1x4x56 CSI values

Sensing applications

Data can be used for environment sensing

SENS IEEE project -> WiFi 802.11bf (2024)



The distribution of four complex CSI matrix (1x56) in complex plane

What can be sensed?

Humans

Presence and motion detection, counting

Activity and gestures and emotion recognition

Attention tracking, sleep monitoring

Identification and tracking

Objects

Smart home

Factory floor scenarios

Agricultural (humidity, rodents etc)

Does that work with ESP32?

Yes it does!

ESP32 CSI toolkit

Remote sensing with low-cost ESP32 and 802.11n

Through wall person identification

802.11bf

Why the push?

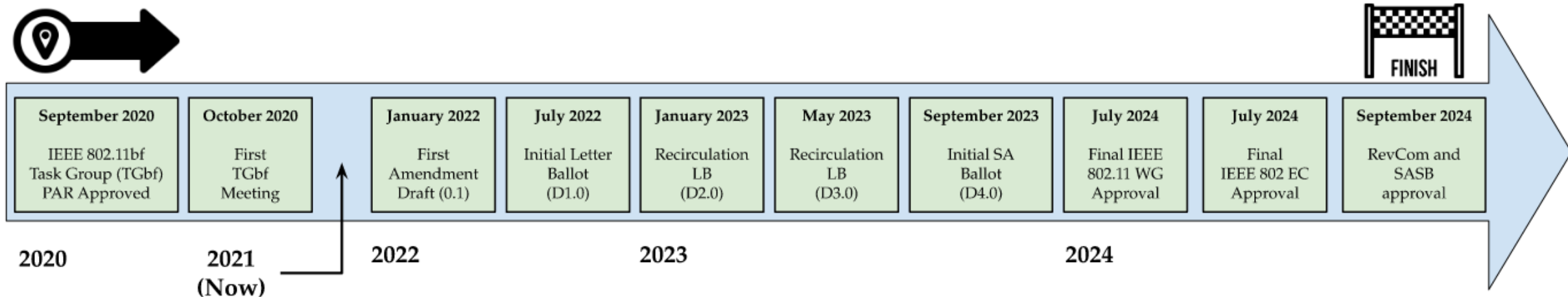
Ubiquitous WiFi

6x in public WiFi hotspots from 2016 to 2021 (~540M)

What is covered?

PHY and MAC layers

Interoperability



Where to find more information?

<https://arxiv.org/pdf/2103.14918.pdf>

<https://wands.sg/research/wifi/AtherosCSI/>

[Amazon Sidewalk](#)

[CSI murder project](#)