HandPass: Wi-Fi CSI-Based Contactless Biometric Authentication for Access Systems

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Problem statement

Lack of interoperable proximity evidence

E.g.: under a credit card transaction, physical attestation of the holder

Relay/replay threat: physical fingerprinting of the entity presence

We saw local/proprietary solutions in the wild

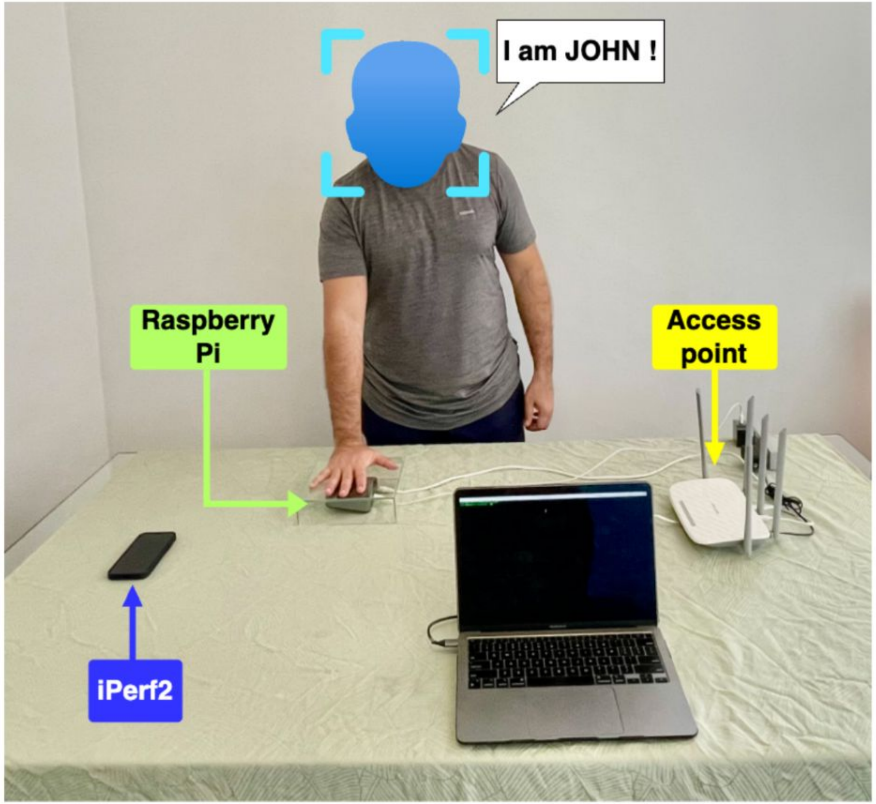
Alongside we can observe …

→ Wi-Fi is everywhere

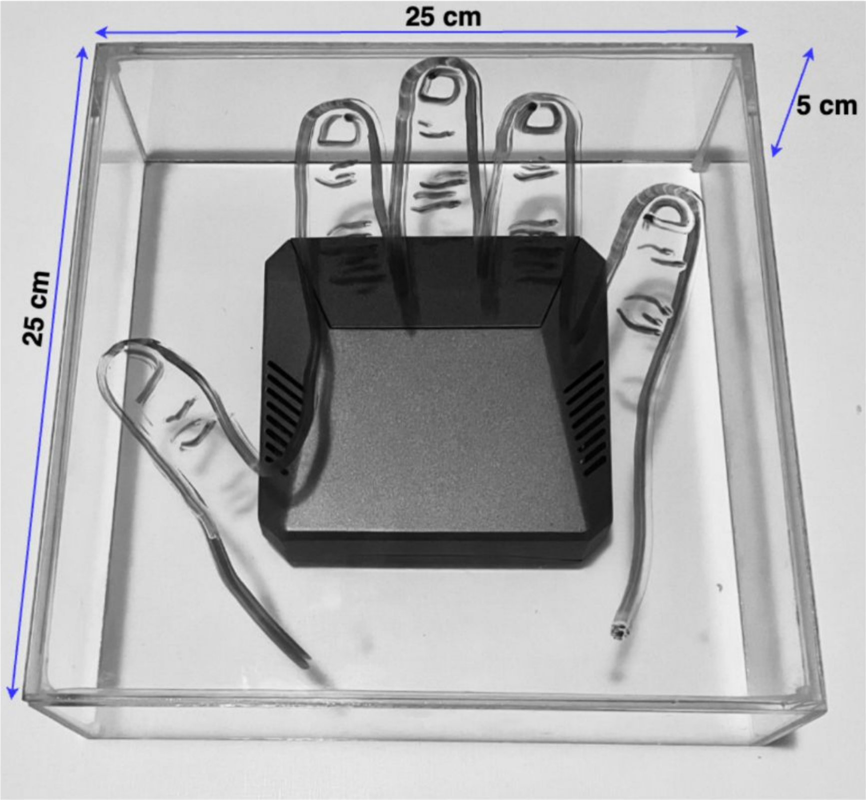
→ Wi-Fi Sensing (802.11bf) is out there

In other words: future minimal instrumentation or even none

What HandPass is?

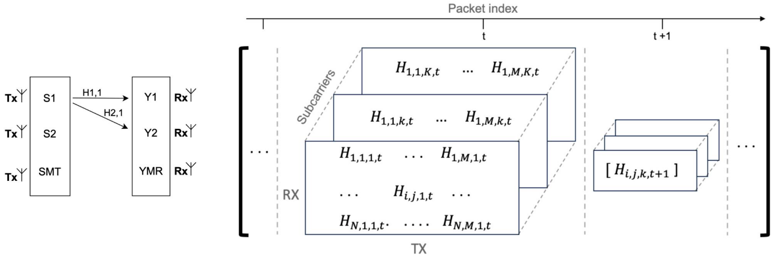


(a) User's hand features capture.



(b) Acrylic Box with Raspberry Pi.

WiFi



$$H \in C^{N \times M \times K \times T}$$

N — RX

M — TX

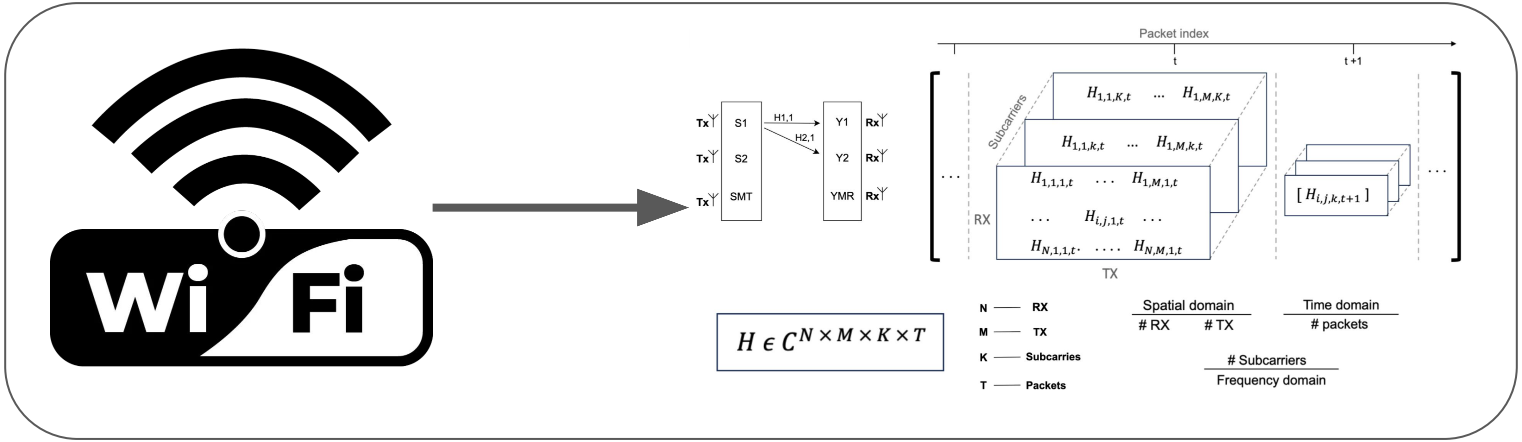
K — Subcarries

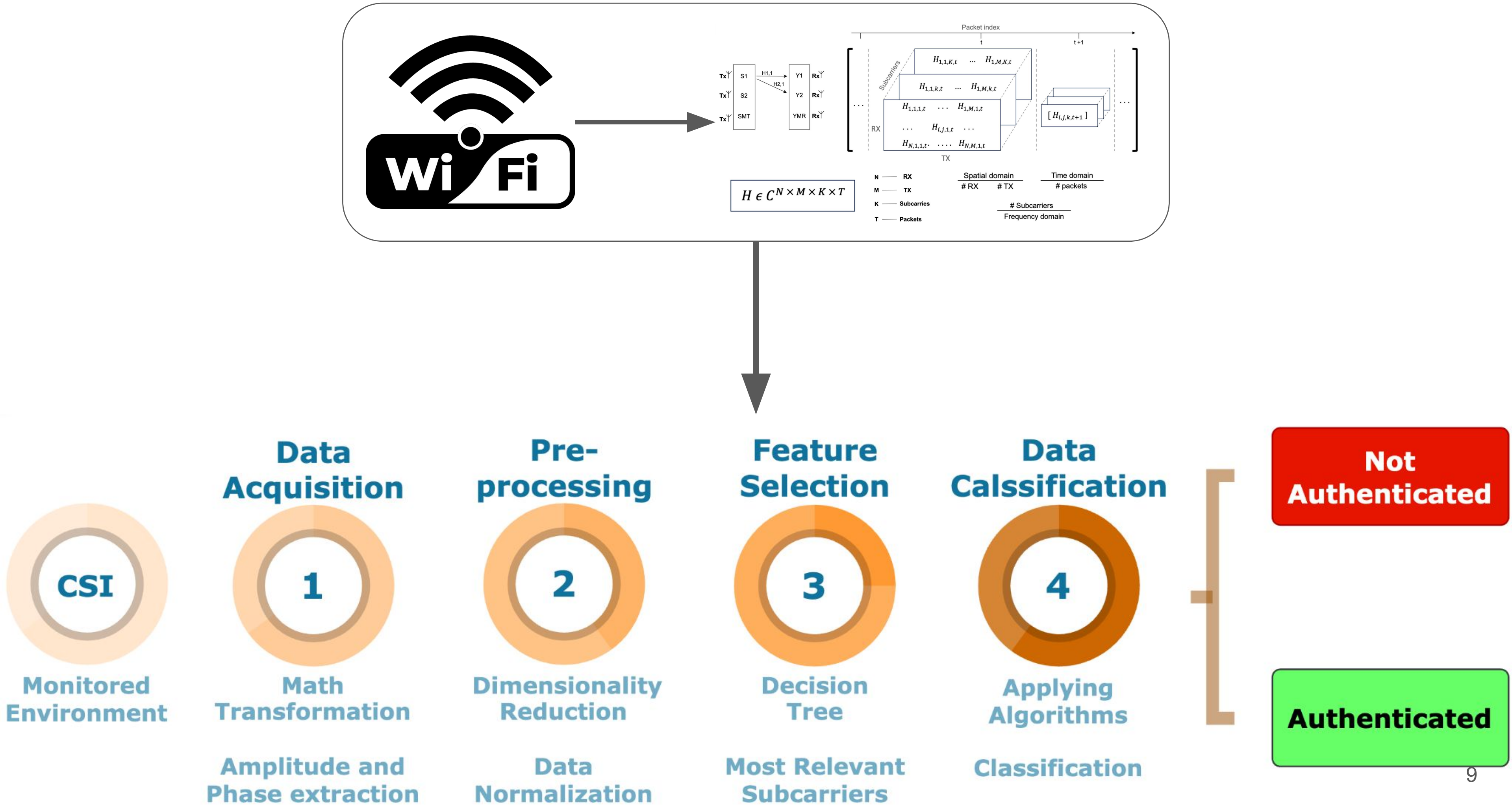
T — Packets

Spatial domain: # RX, # TX

Time domain: # packets

Subcarriers: Frequency domain


Wi Fi
Tx
S1
S2
SMT
H1,1
H2,1
Y1
Y2
YMR
Rx
Packet index
t
t +1
Subcarriers
RX
TX
$H_{1,1,K,t}$ ... $H_{1,M,K,t}$
$H_{1,1,k,t}$ ... $H_{1,M,k,t}$
$H_{1,1,1,t}$ ... $H_{1,M,1,t}$
... $H_{i,j,1,t}$ ...
$H_{N,1,1,t}$ .... $H_{N,M,1,t}$
$[\, H_{i,j,k,t+1} \,]$
$H \in C^{N \times M \times K \times T}$
N RX
M TX
K Subcarries
T Packets
Spatial domain
RX # TX
Time domain
packets
Subcarriers
Frequency domain


Wi Fi
Tx
S1
S2
SMT
H1,1
H2,1
Y1
Y2
YMR
Rx
Packet index
t
t+1
Subcarriers
RX
TX
$H \epsilon C^{N \times M \times K \times T}$
N — RX
M — TX
K — Subcarries
T — Packets
Spatial domain
RX # TX
Time domain
packets
Subcarriers
Frequency domain
Data Acquisition
Pre-processing
Feature Selection
Data Calssification
CSI
1
2
3
4
Monitored Environment
Math Transformation
Dimensionality Reduction
Decision Tree
Applying Algorithms
Amplitude and Phase extraction
Data Normalization
Most Relevant Subcarriers
Classification
Not Authenticated
Authenticated

Problem Space: gap on physical presence

No IETF specification defines physical proximity as attestation evidence

Existing mechanisms (DPoP, TLS channel binding, FIDO, TPM) prove key possession, not presence

IEEE 802.11bf defines how to sense, but not how to attest

Absence of a sensor-agnostic, privacy-aware claim to express "this entity is physically here"

Contribution thoughts: Entity Attestation Token Proximity

Draft a new EAT Profile for Proximity Evidence: new EAT Profile Draft (Informational RFC / BoF Candidate)

Define minimal, interoperable claims: confidence, freshness, provenance, and privacy metadata

Keep sensor-agnostic: applicable to Wi-Fi CSI, UWB, BLE, or acoustic sensing

Bridge IEEE sensing → IETF attestation and identity frameworks

Why it matters

Enables standardized proximity attestation for authentication, IoT, and access systems

AFAIK: no duplications as it complements RATS, OAuth, and FIDO ecosystems

Opens discussion for an eventual BoF or Informational RFC on "Proximity-Aware Attestation"

Suplementary

Preprint: https://arxiv.org/abs/2510.22133

GitHub: https://github.com/c2dc/handpass (soon)

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