Advanced Air Mobility and Unmanned Traffic Management @ IETF

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AI
AI

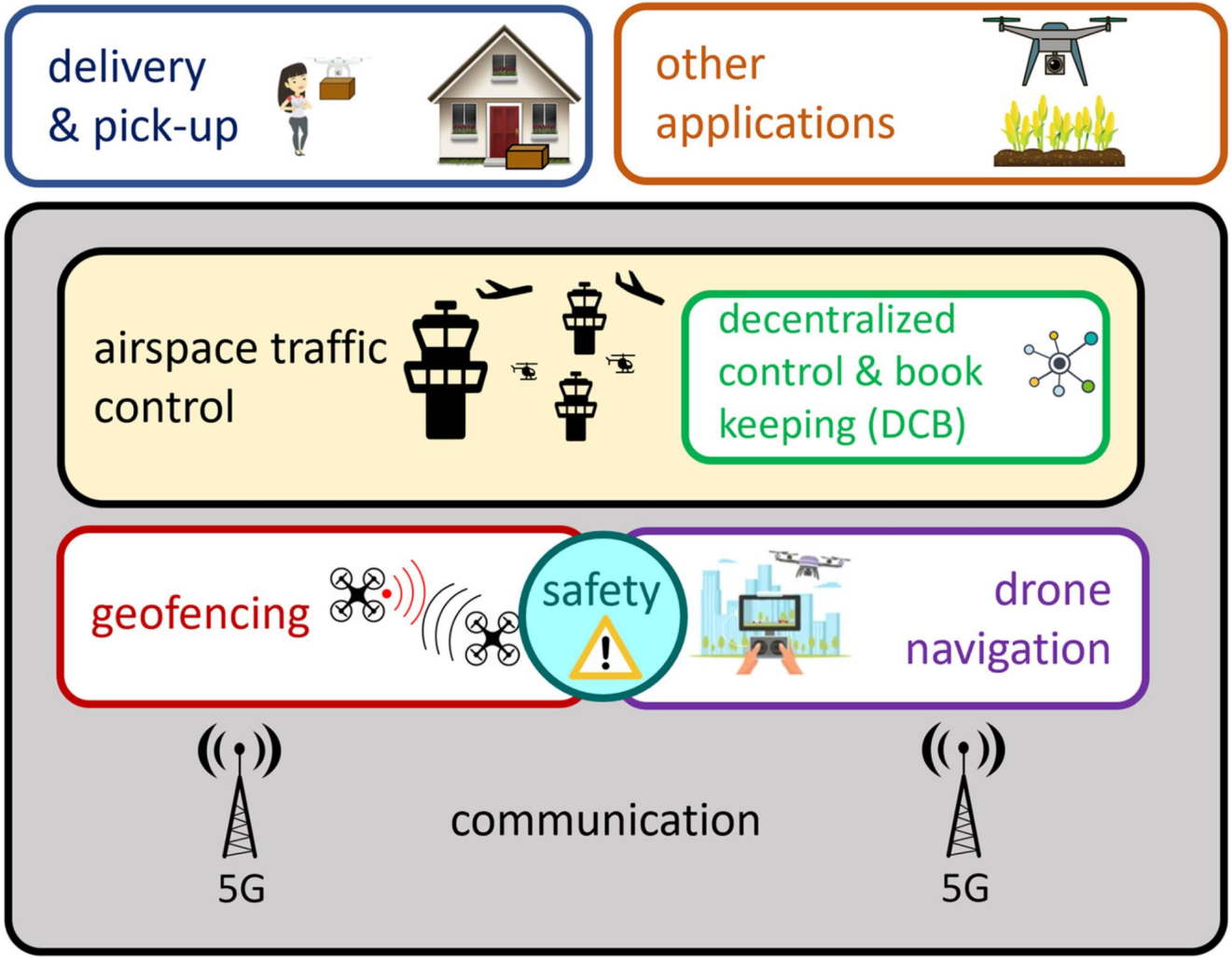
In summary

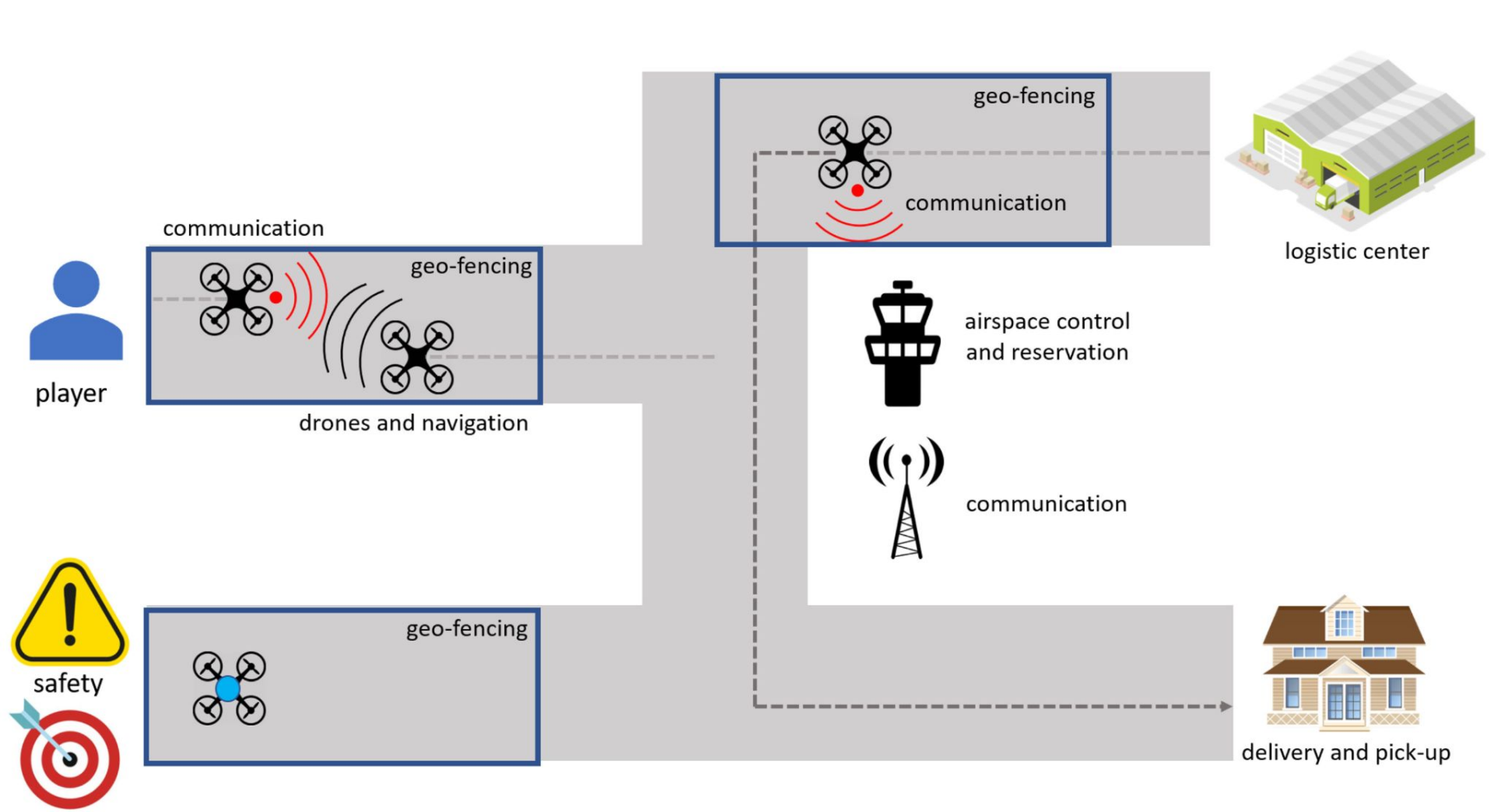
Advancements in AI

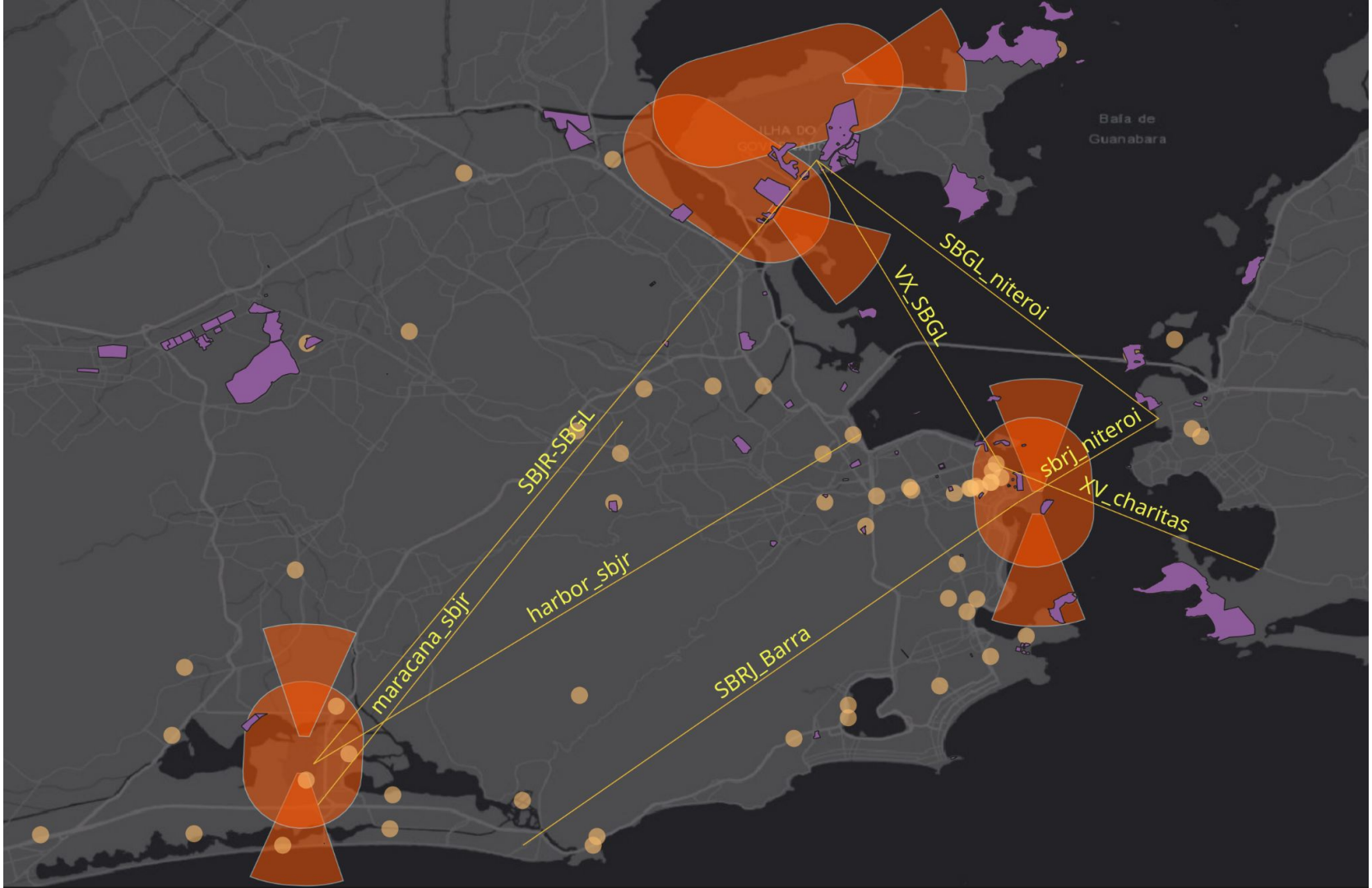
Intelligent Transportation Systems

New industry and solutions: unexplored vertical

But… how to implement it?


delivery
& pick-up
other
applications
airspace traffic
control
decentralized
control & book
keeping (DCB)
geofencing
safety
drone
navigation
communication
5G
5G


geo-fencing
communication
logistic center
communication
geo-fencing
player
drones and navigation
airspace control
and reservation
communication
safety
geo-fencing
delivery and pick-up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Guanabara
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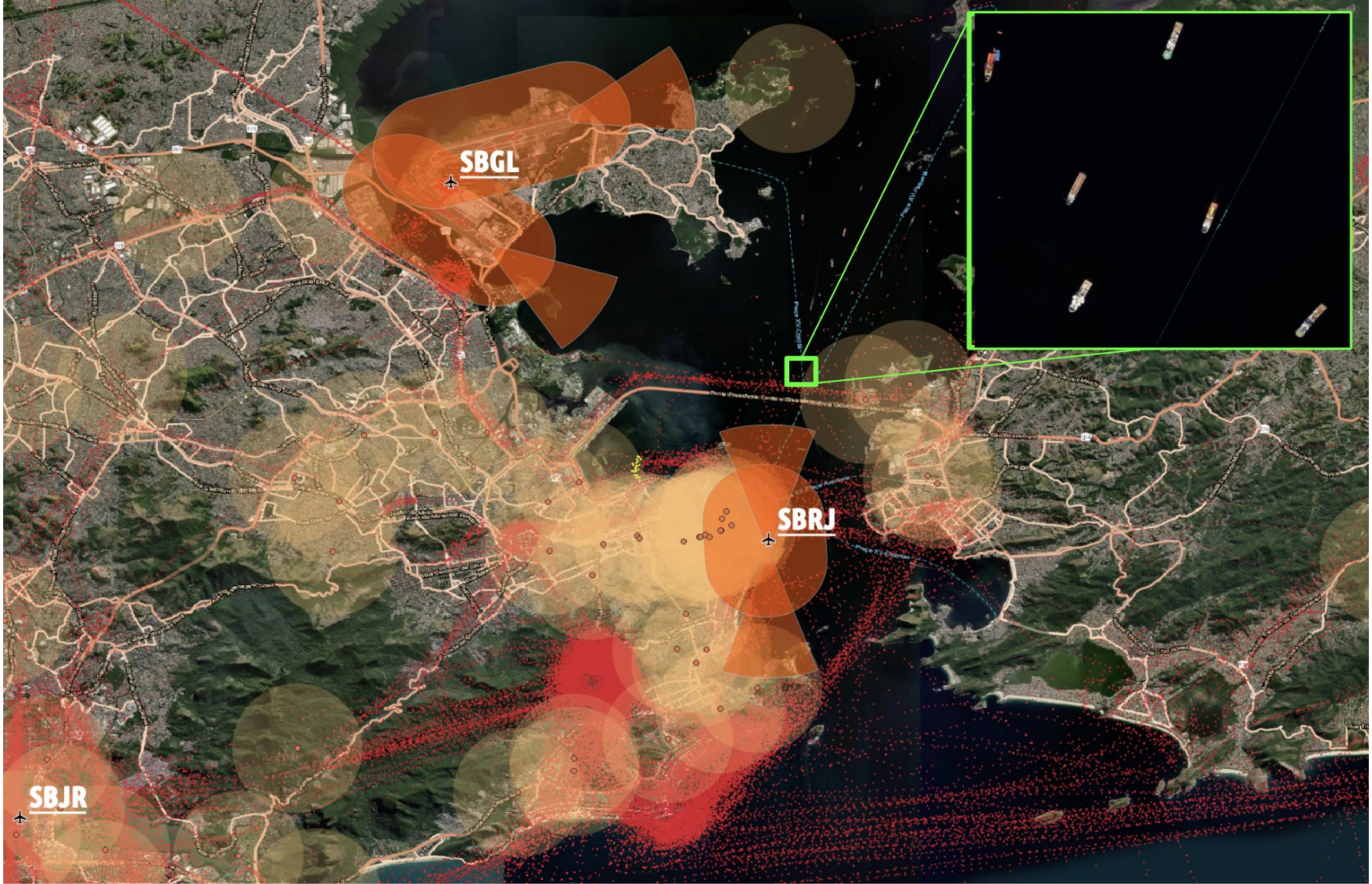
VX_SBGL
SBJR-SBGL
sbrj_niteroi
XV_charitas
harbor_sbjr
maracana_sbjr
SBRJ_Barra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SBRJ
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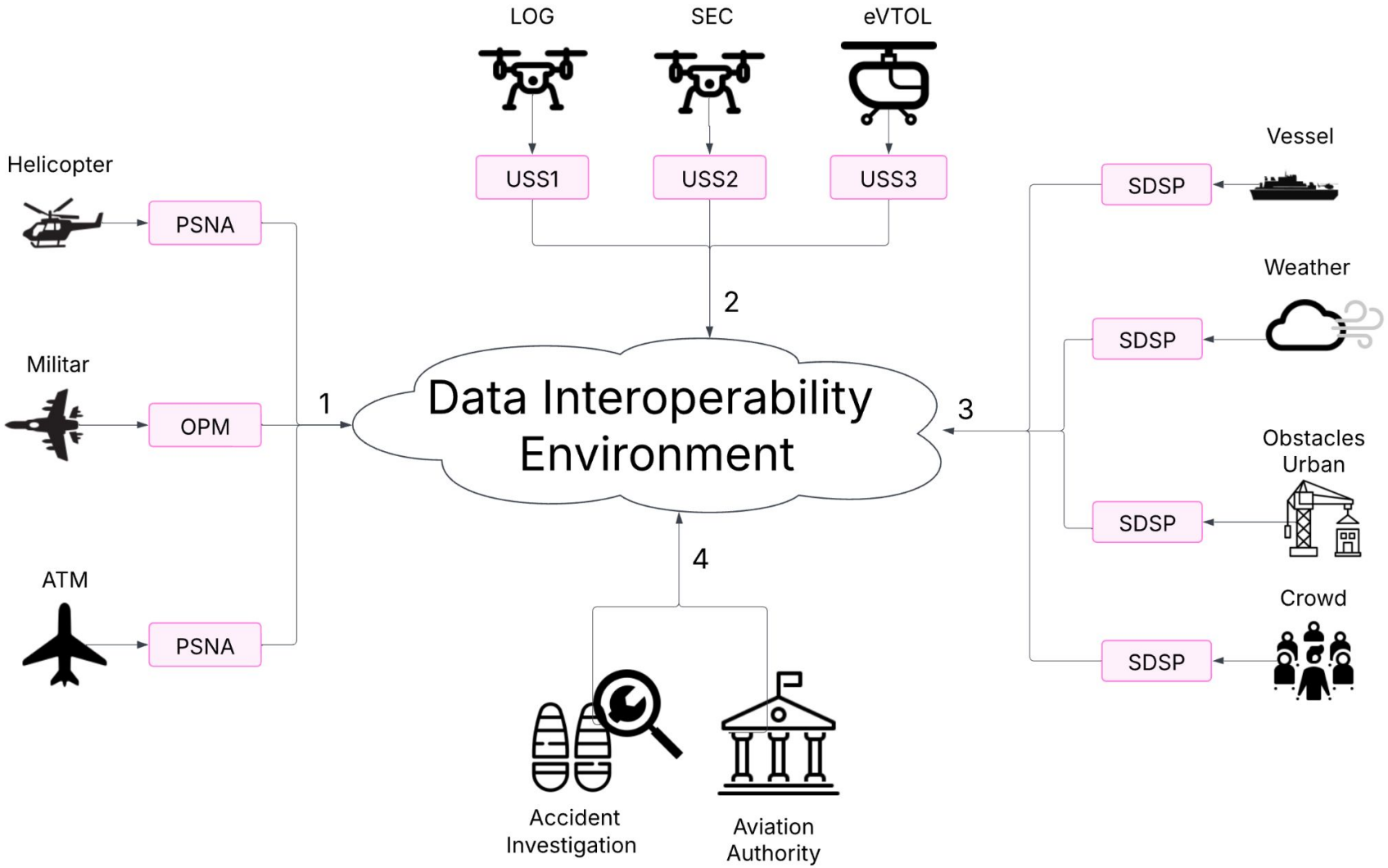
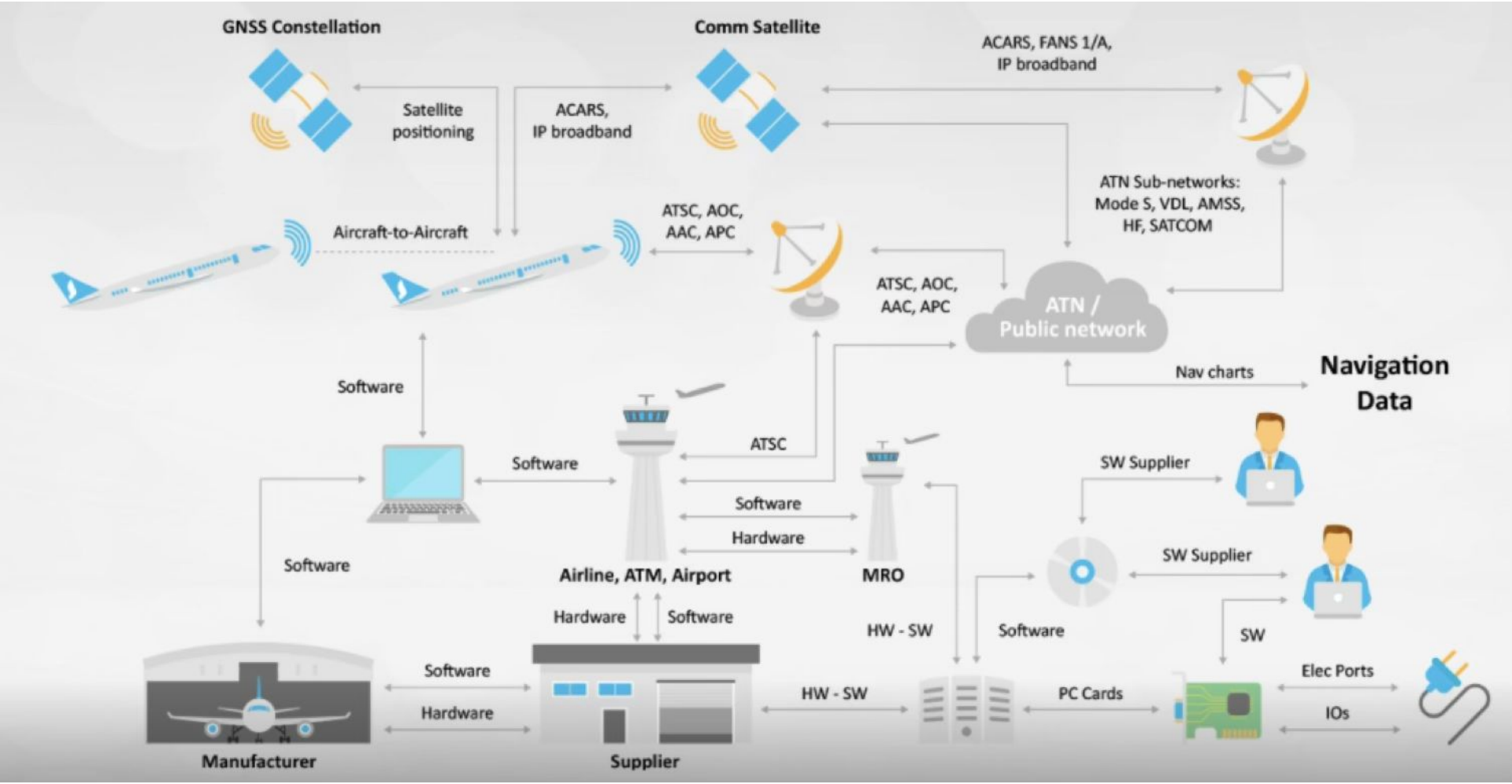
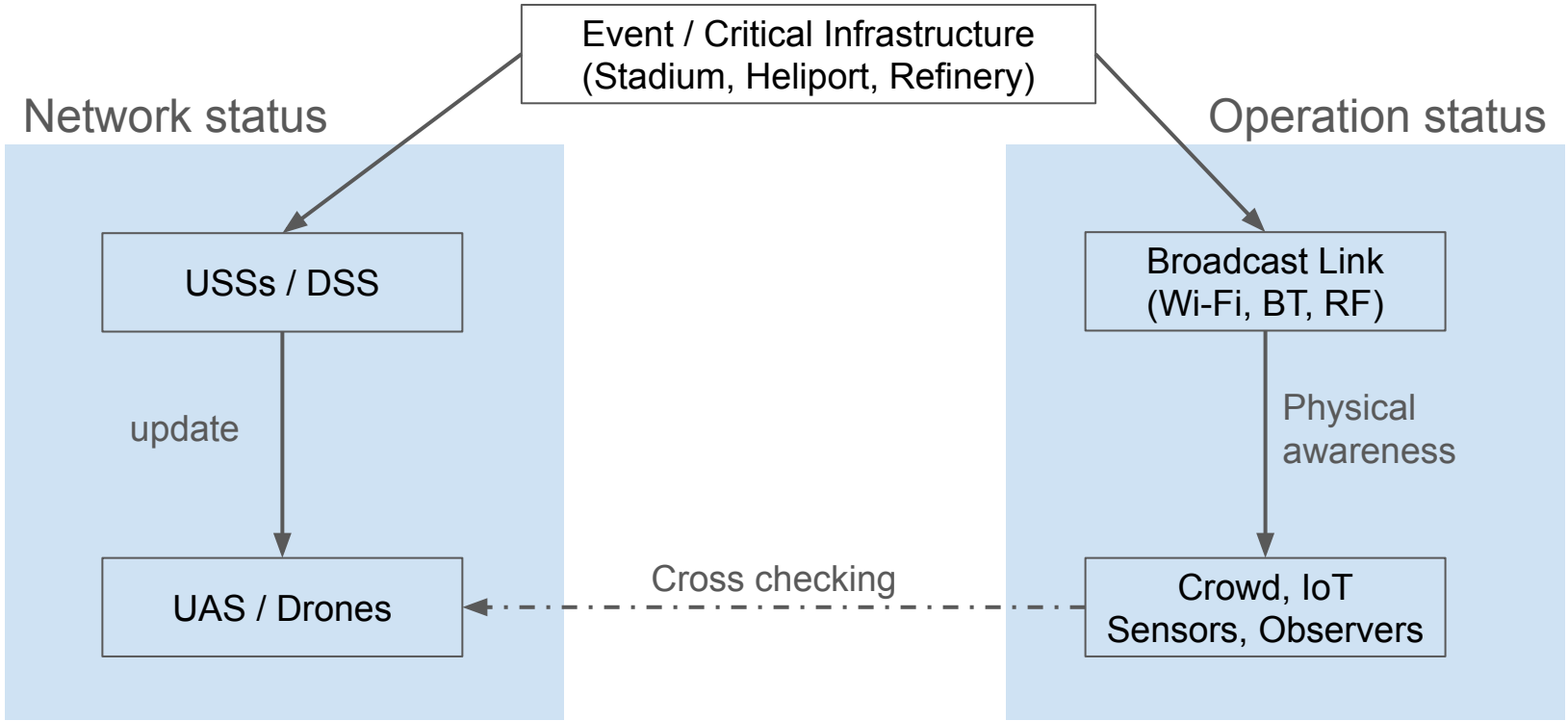

LOG
SEC
eVTOL
Helicopter
PSNA
Militar
OPM
ATM
PSNA
USS1
USS2
USS3
2
Data Interoperability Environment
1
3
4
Vessel
SDSP
Weather
SDSP
Obstacles Urban
SDSP
Crowd
SDSP
Accident Investigation
Aviation Authority


GNSS Constellation
Comm Satellite
ACARS, FANS 1/A,
IP broadband
Satellite
positioning
ACARS,
IP broadband
ATN Sub-networks:
Mode S, VDL, AMSS,
HF, SATCOM
Aircraft-to-Aircraft
ATSC, AOC,
AAC, APC
ATSC, AOC,
AAC, APC
ATN /
Public network
Nav charts
Navigation
Data
Software
Software
ATSC
SW Supplier
Software
Hardware
Software
Airline, ATM, Airport
MRO
SW Supplier
Hardware
Software
HW - SW
Software
SW
Software
Hardware
HW - SW
PC Cards
Elec Ports
IOs
Manufacturer
Supplier

What is the current state at IETF?

Remote Identification - RemoteID



DRIP: Drone Remote Identification Protocol

Security over RemoteID: https://datatracker.ietf.org/group/drip/about/

- Entity TAG (DET) - Authentication
- DRIP DET Public Key Infrastructure - DKI
- DNSSEC - decentralized metadata source

Our proposal

1. Infrastructure for sensing and digital twin

   Integration layer for monitoring and status update
2. Advanced Airspace Availability Protocol (A3P)

   Large-scale operations of smart cities and Intelligent Transportation Systems
3. Ad-hoc operations for specific campaigns

   Firefighters, disasters, and other civilian needs

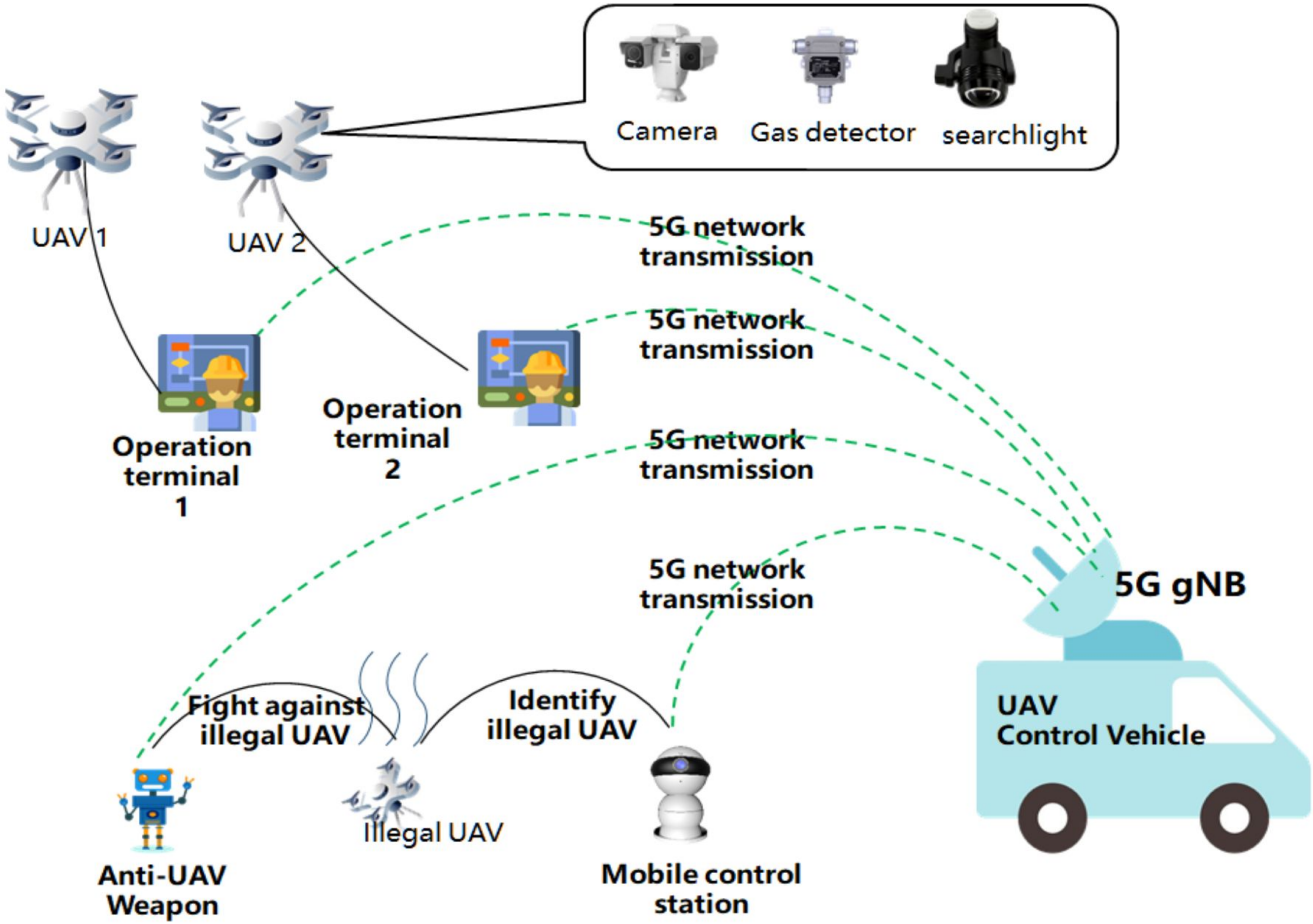


Figure 4.3.1-1: UAV control vehicle application scenario

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Antônia Mayara de Almeida da Silva

Proof of Presence

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

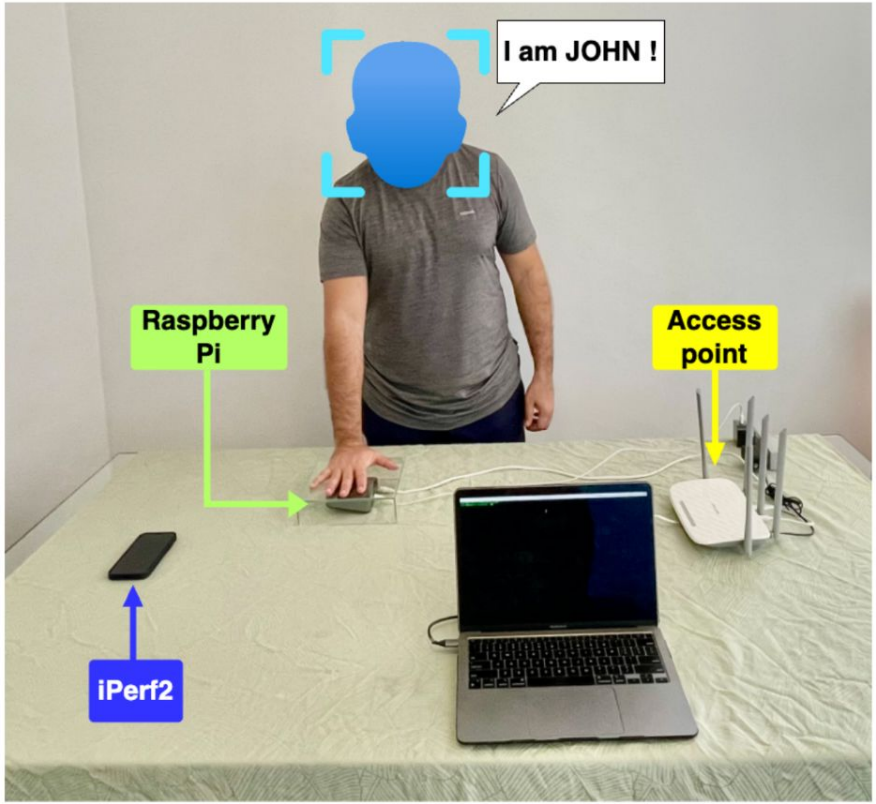
Alongside we can observe …

→ Wi-Fi is everywhere

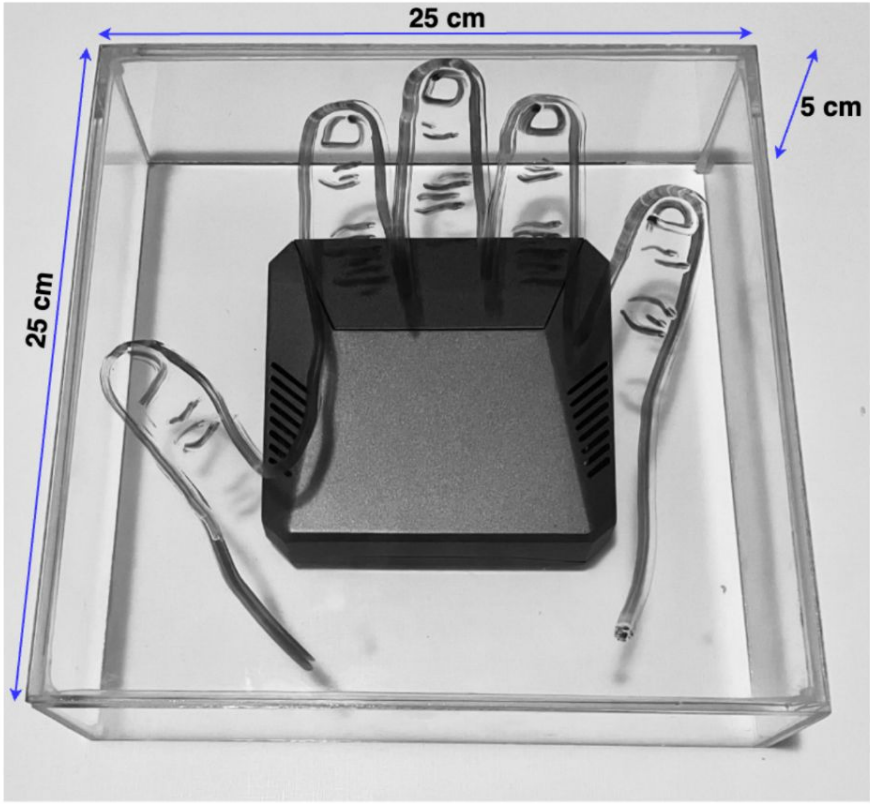
→ Wi-Fi Sensing (802.11bf) is out there

In other words: future minimal instrumentation or even none

What HandPass is?



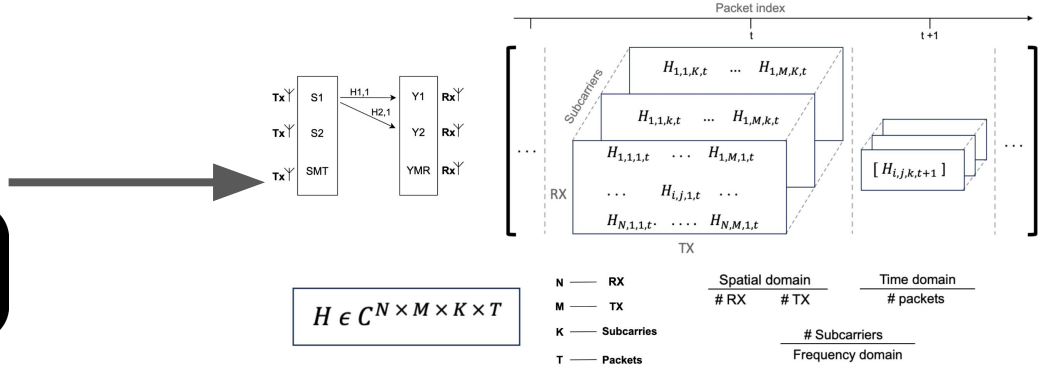
(a) User's hand features capture.



(b) Acrylic Box with Raspberry Pi.


Wi Fi


Wi
Fi


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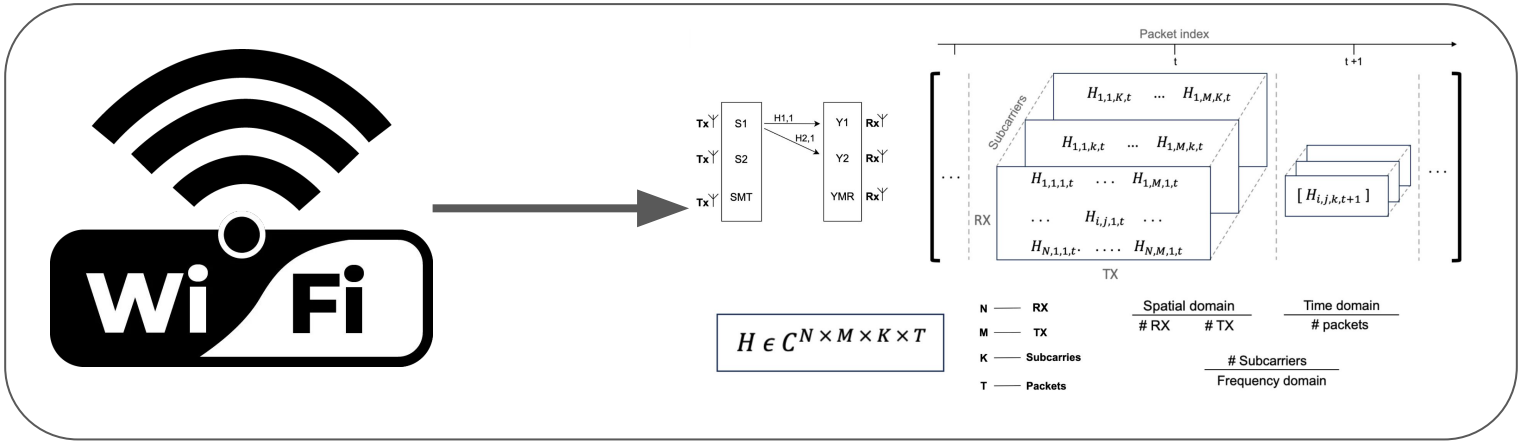
$H_{1,1,k,t}$ ... $H_{1,M,k,t}$
$H_{1,1,1,t}$ ... $H_{1,M,1,t}$
$H_{i,j,1,t}$
$H_{N,1,1,t}$ ..... $H_{N,M,1,t}$
$[\ H_{i,j,k,t+1}\ ]$
$H \in C^{N \times M \times K \times T}$
N RX
M TX
K Subcarries
T Packets
Spatial domain
RX # TX
Time domain
packets
Subcarriers
Frequency domain


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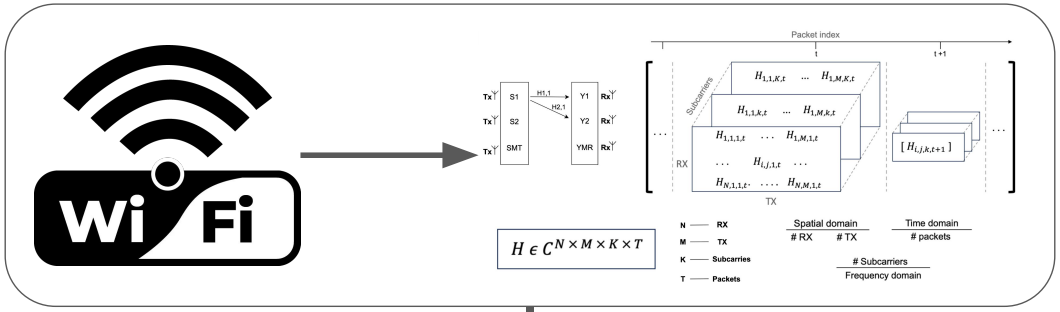
$H_{i,j,1,t}$
$H_{N,1,1,t}$ ..... $H_{N,M,1,t}$
$[\ H_{i,j,k,t+1}\ ]$
$H \epsilon C^{N \times M \times K \times T}$
N — RX
M — TX
K — Subcarries
T — Packets
Spatial domain
RX
TX
Time domain
packets
Subcarriers
Frequency domain



CSI

Monitored Environment

Data Acquisition

1

Math Transformation

Amplitude and Phase extraction

Pre-processing

2

Dimensionality Reduction

Data Normalization

Feature Selection

3

Decision Tree

Most Relevant Subcarriers

Data Calssification

4

Applying Algorithms

Classification

Not Authenticated

Authenticated

Problem Space: gap on physical presence

No IETF specification defines physical proximity as attestation evidence

Existing mechanisms prove key possession, **not presence**

- OAuth 2 DPoP: Demonstrating Proof of Possession
- FIDO: Fast Identity Online
- Trusted Platform Modules

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"

Supplementary

SoK: Security Evaluation of Wi-Fi CSI Biometrics: Attacks, Metrics, and Open Challenges (https://doi.org/10.48550/arXiv.2511.11381)

HandPass: A Wi-Fi CSI Palm Authentication Approach for Access Control (https://doi.org/10.48550/arXiv.2510.22133)

Final thoughts

IETF/IRTF is open for contributions

Pragmatic view: "We believe in running code"

Huge amount of RFCs and requires an integration first

Strong community and good receptivity

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Permissioned Blockchain in Advanced Air Mobility: A Performance Analysis for UTM (https://doi.org/10.48550/arXiv.2511.02171)

SkyLedger: Test Bed para o Gerenciamento do Espaço Aéreo para Sistemas de Transportes Inteligentes (https://doi.org/10.5753/sbrc_estendido.2025.6795)

Benchmarking de Performance de Sistemas Distribuídos Aplicados à Mobilidade Aérea Urbana (https://doi.org/10.5753/courb.2025.9594)