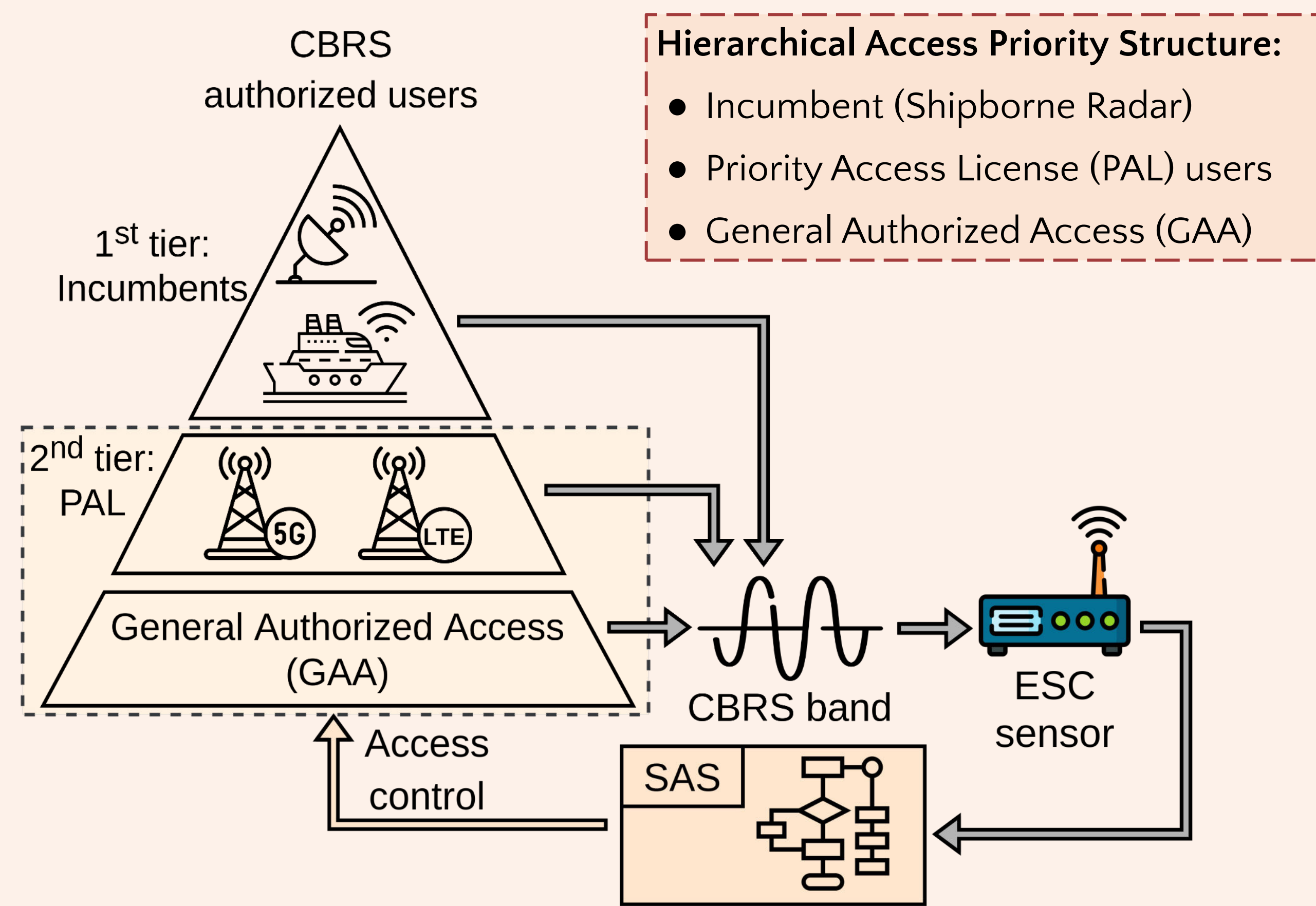


MEDUSA: Mid-band Environmental sensing capability for Detecting incUmbents during Spectrum shARing (NSF CNS # 2229444)

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*Institute for Wireless Internet of Things at Northeastern University, #The University of Texas Arlington, \$University of Oklahoma

Spectrum Sharing in CBRS



- Citizen Broadband Radio Service (CBRS) components:**
- Environmental Sensing Capability (ESC): RF sensors deployed in coastlines.
 - Spectrum Access System (SAS): Central entity that grants spectrum access.
 - Whisper zone: Regions near ESC sensors where Radar signals must be protected.

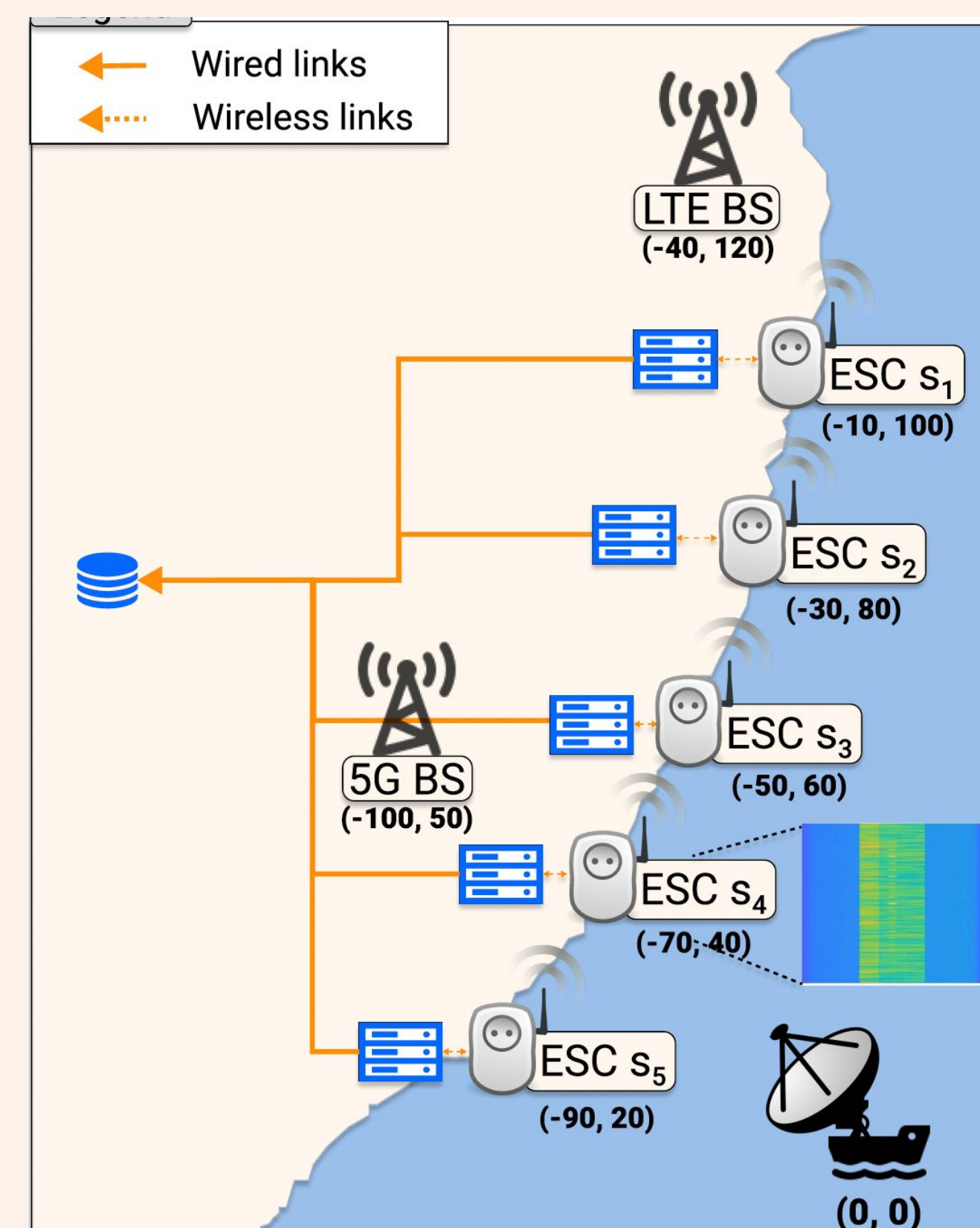
Motivation

Problem: FCC opened up CBRS band to solve the spectrum scarcity, but severely limits the transmission power for LTE/5G operators, enforcing the *whisper zones*.

Impact: Concern of timely detection of Radar has stymied opening remaining 3.1-3.55GHz band.

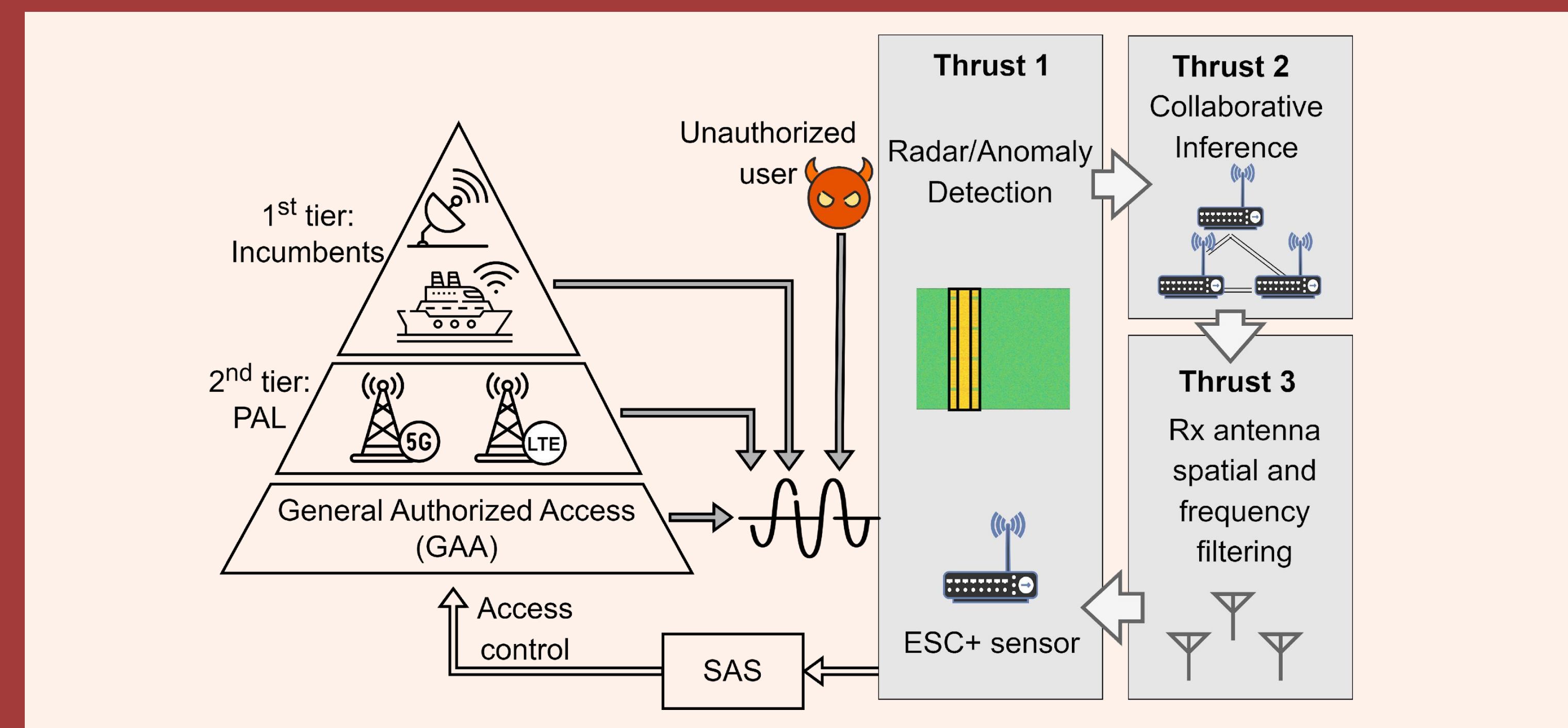
Vision of MEDUSA: Design improved ESC sensors, namely ESC+ to detect radar pulses within existing 5G/4G-LTE signal with powers stronger than FCC-mandated levels by 5 dB.

Potential advantage: Approximately 1120, 2250, 3250* more users can potentially be served by each PAL base-station when the proposed ESC+ sensors are deployed along the coastal regions of Massachusetts, New York, and New Jersey, respectively.



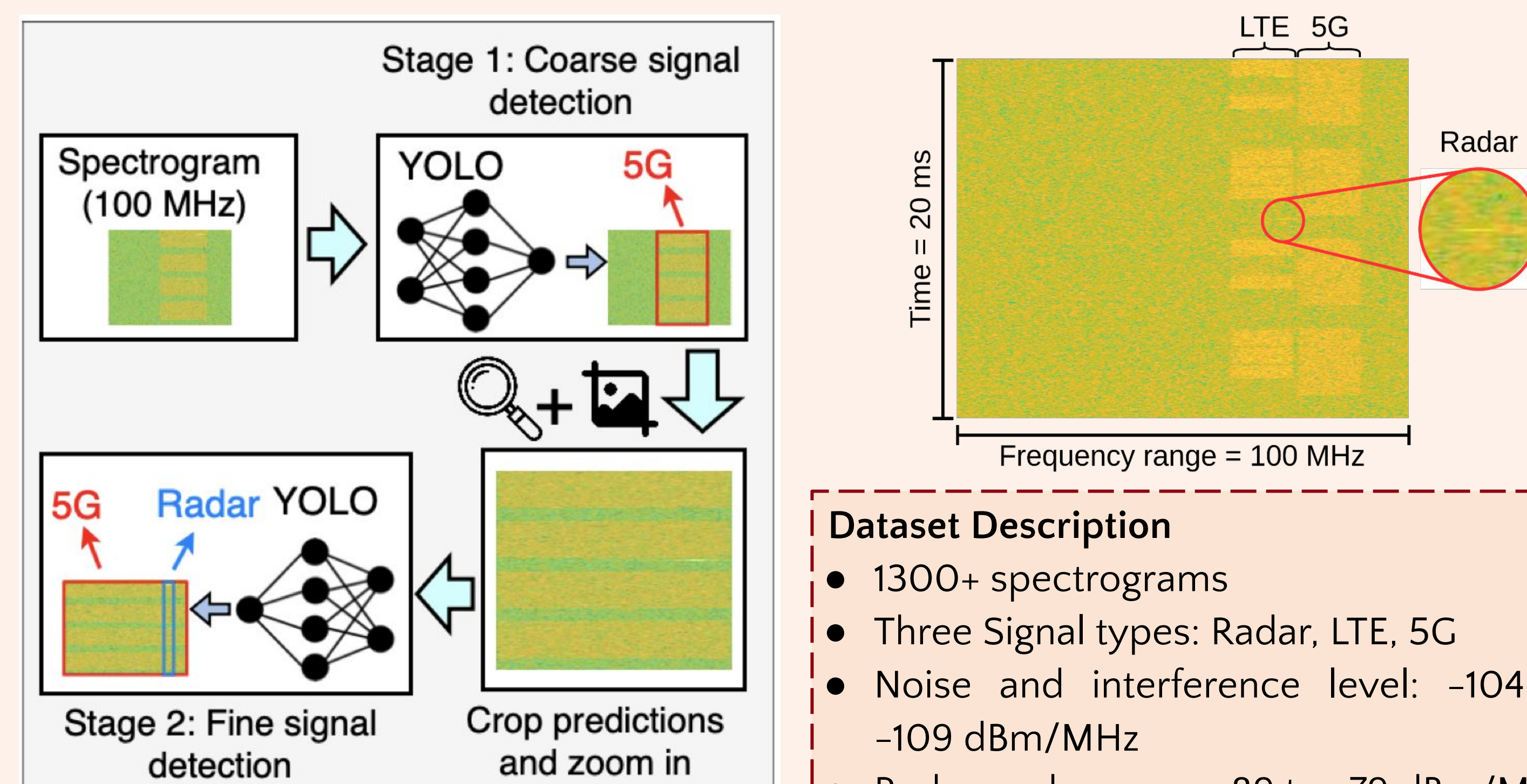
*Using free-space path loss model and publicly available US census data.

MEDUSA Thrusts



Thrusts 1: Radar/Anomaly Detection

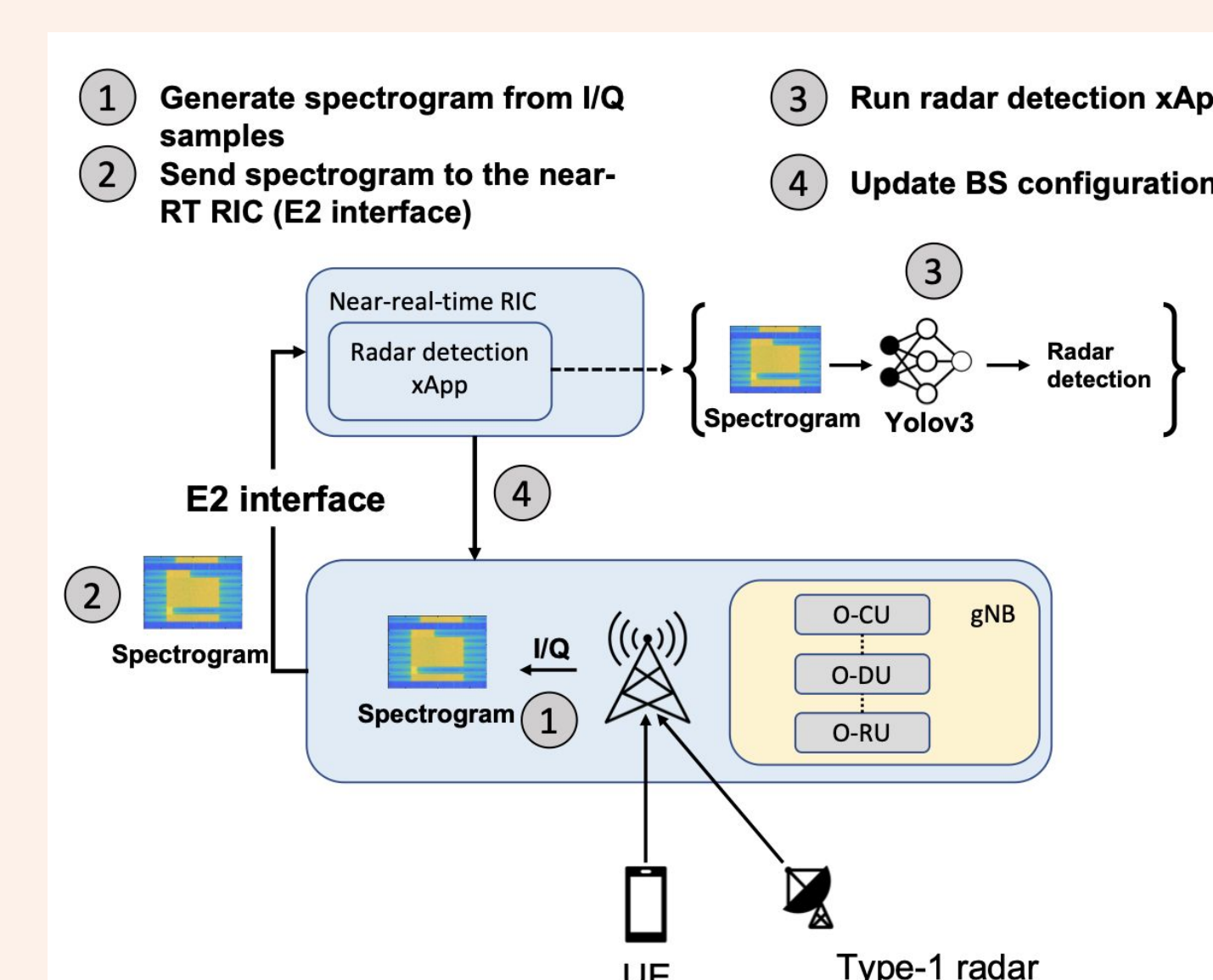
Vision: Interference-resilient and privacy preserving ML for radar and anomalous signal detection in high signal-to-noise ratio (SNR).



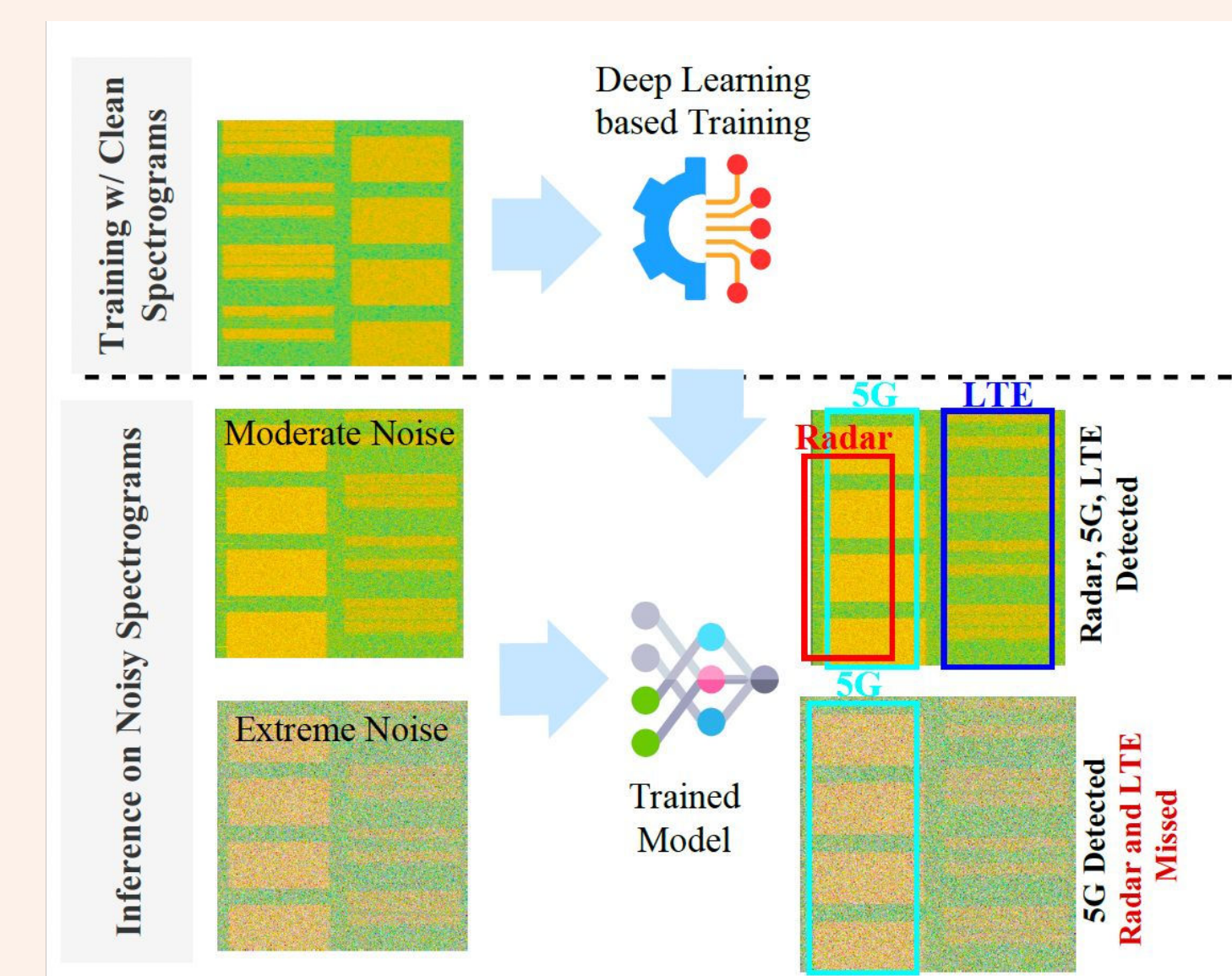
IEEE Globecom '22

Dataset Description

- 1300+ spectrograms
- Three Signal types: Radar, LTE, 5G
- Noise and interference level: -104 to -109 dBm/MHz
- Radar peak power: -89 to -79 dBm/MHz



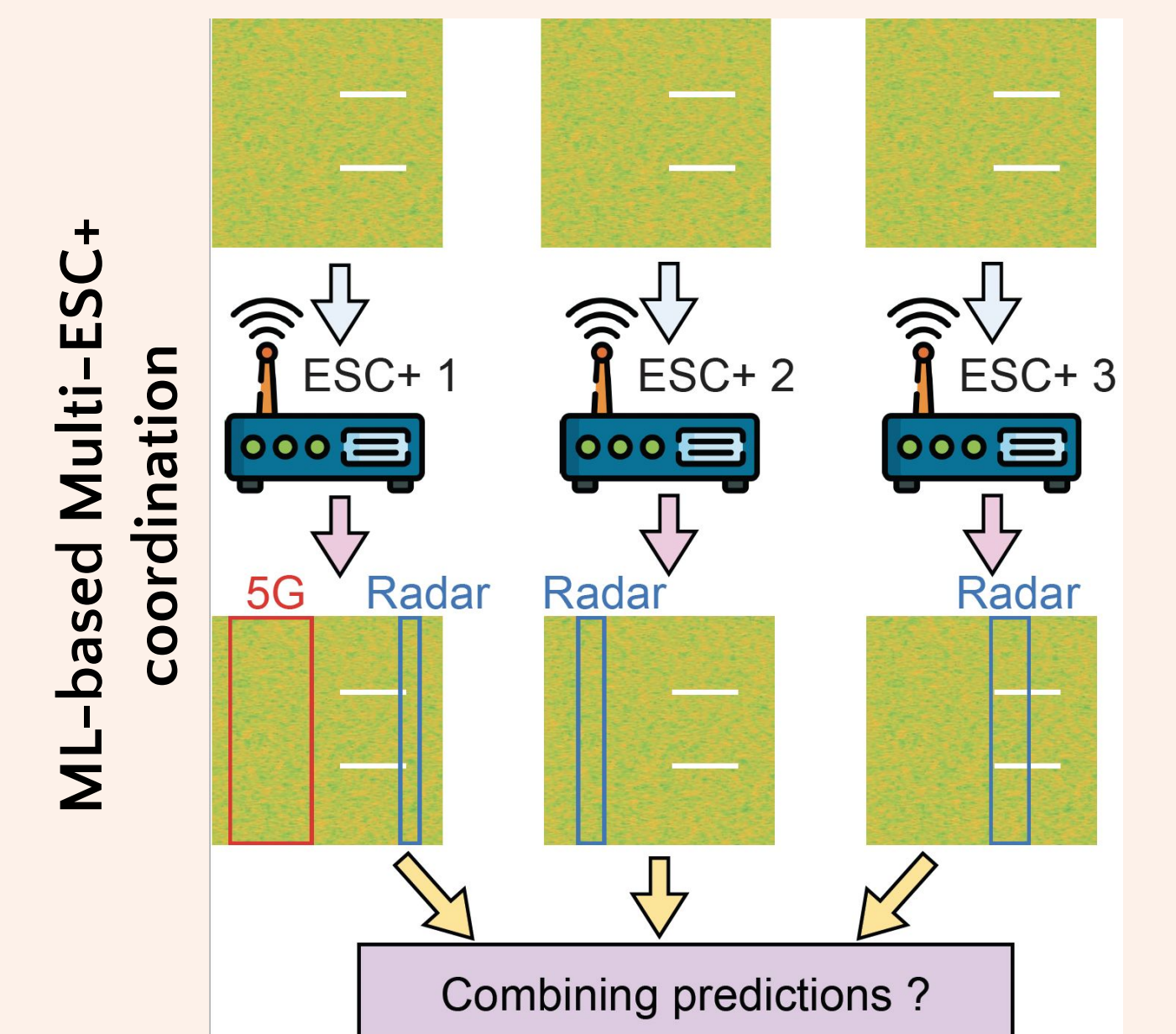
IEEE JSAC '23



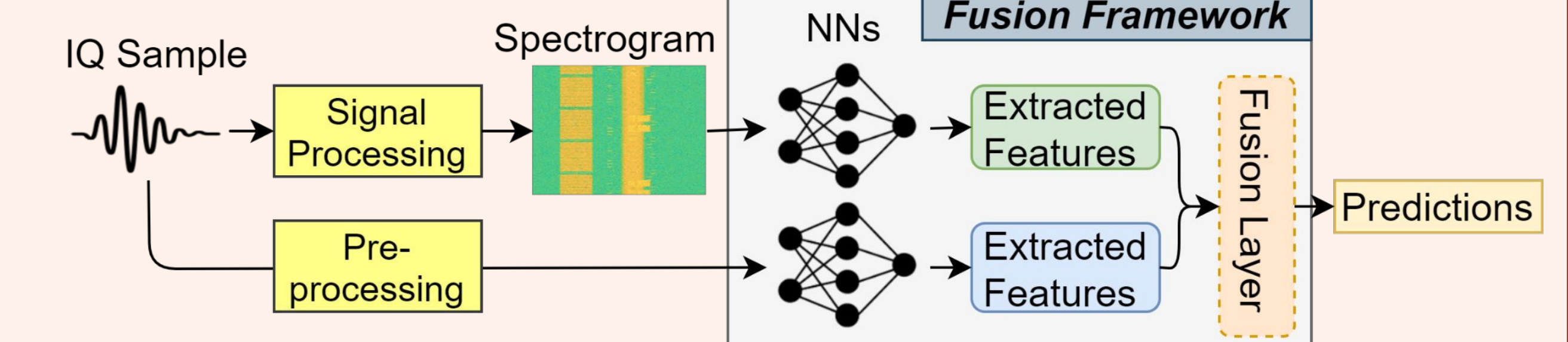
IEEE DySPAN '24

Thrust 2: Collaborative Inference

Vision: Collaborative Inference using Multi-ESC+ coordination for improved performance by trading off the computation cost.



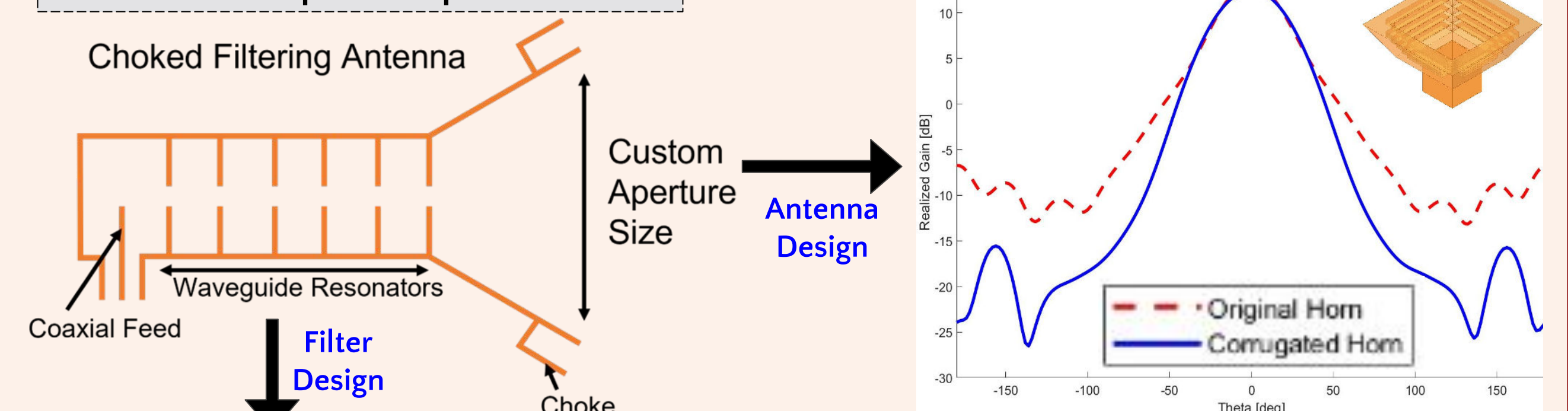
ML-based Multi-modal coordination



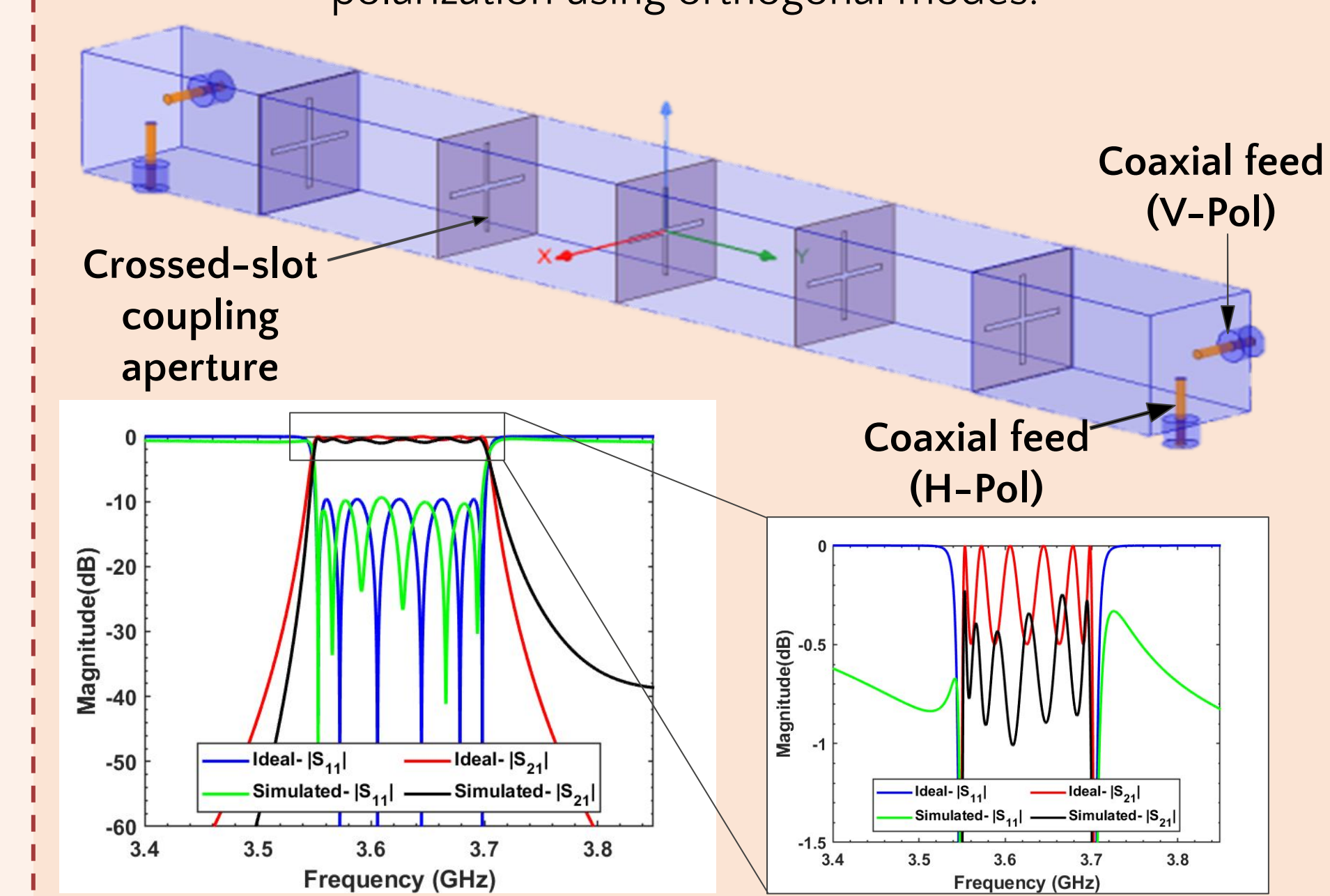
Thrust 3: RX Antenna Beamforming

Vision: Frequency and spatial filtering antennas for physical layer interference resilience and improved sensing capability.

Filterenna Conceptual Implementation



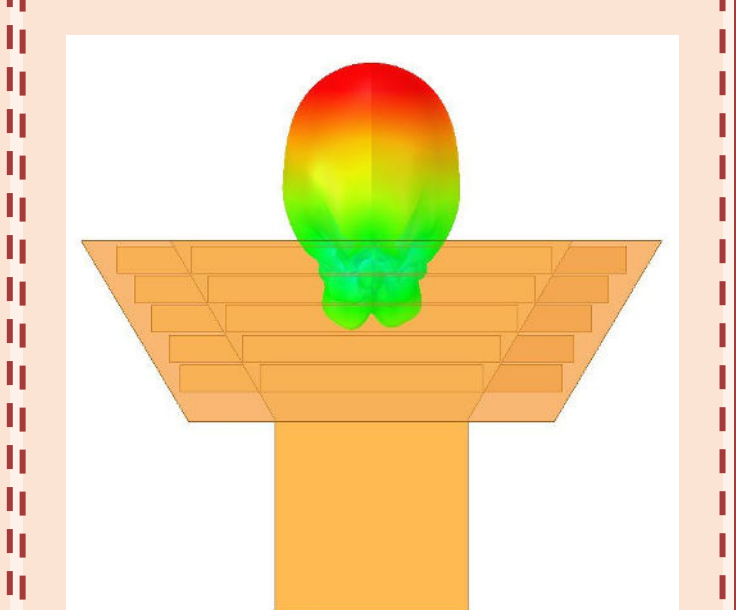
Bandpass Filter Design for enhanced interference rejection: Design of a 6-pole waveguide filter design for an enhanced noise rejection out-of-band, compatibility with vertical and horizontal polarization using orthogonal modes.



Scattering parameters for the six-pole orthogonal mode bandpass filter

Choked Horn Design:

- Corrugated choking structure to reduce the side-lobes, and backplane radiation.
- Current efforts are investigating different methods for complete elimination of the back-lobe radiation



Corrugated Horn Antenna: 3D Radiation Pattern