Date: 9 Dec 2025

Session: Tue PM Tech Session

New Compact Sensor Technologies that Enable RF ISR-T From Small UAS in Denied Environments

The Evolution from Large Platforms to Small UAS

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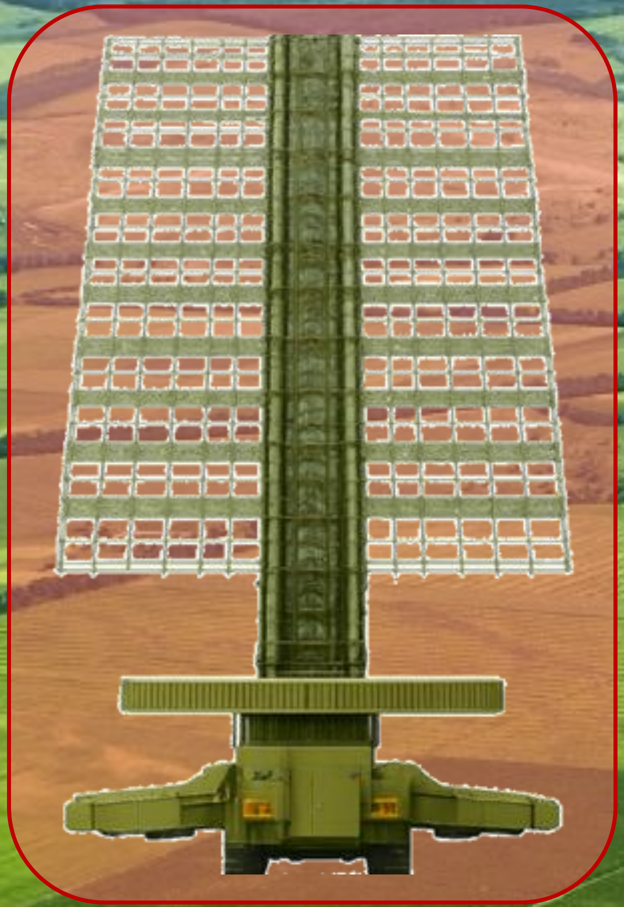
Environments Saturated with RF Threats

Denial Focused Threats

● Air Defense Radar ● Search ● Engagement ● Counter Stealth ● Counter Battery Radar
● Navigation Jammers ● Communication Jammers

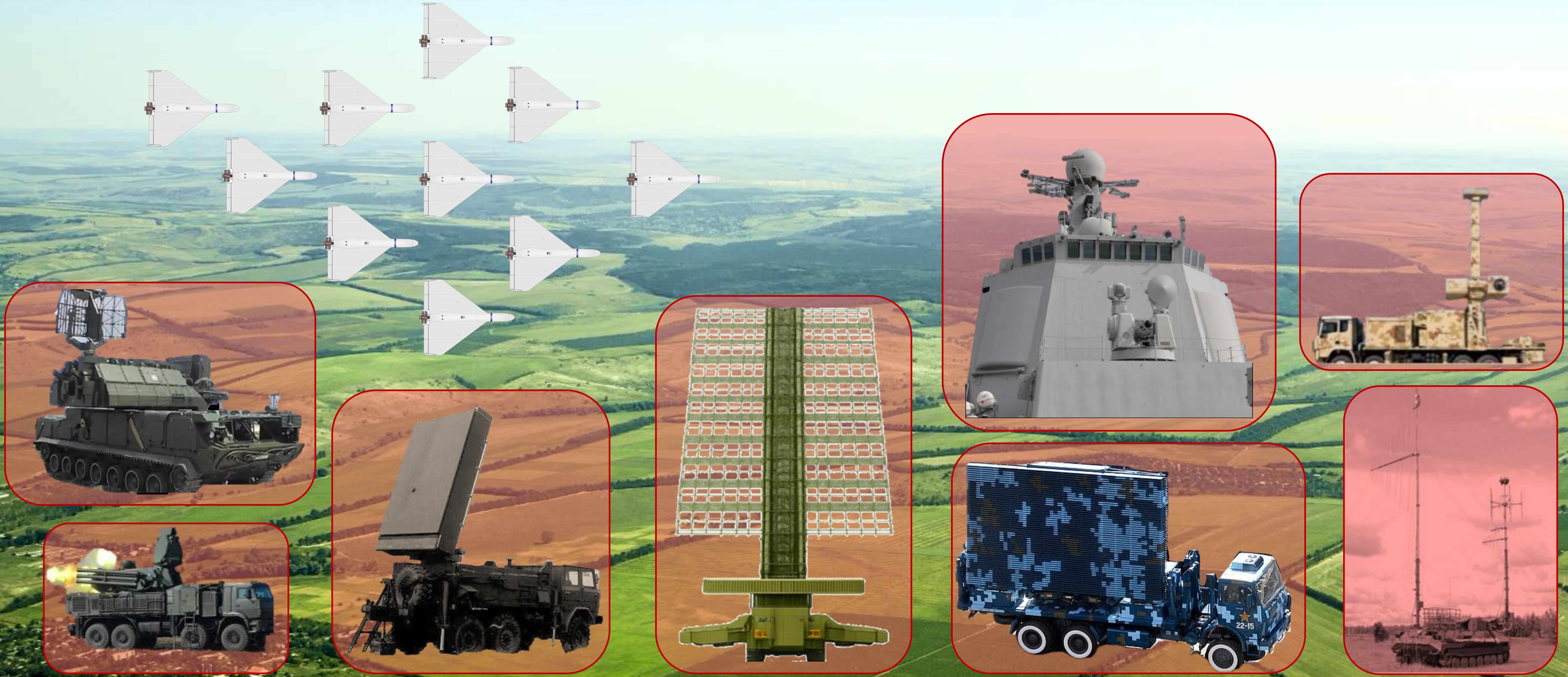
Result is Contested, Anti-Access/Area-Denial, Exclusionary Environments



Environments Saturated with RF Threats

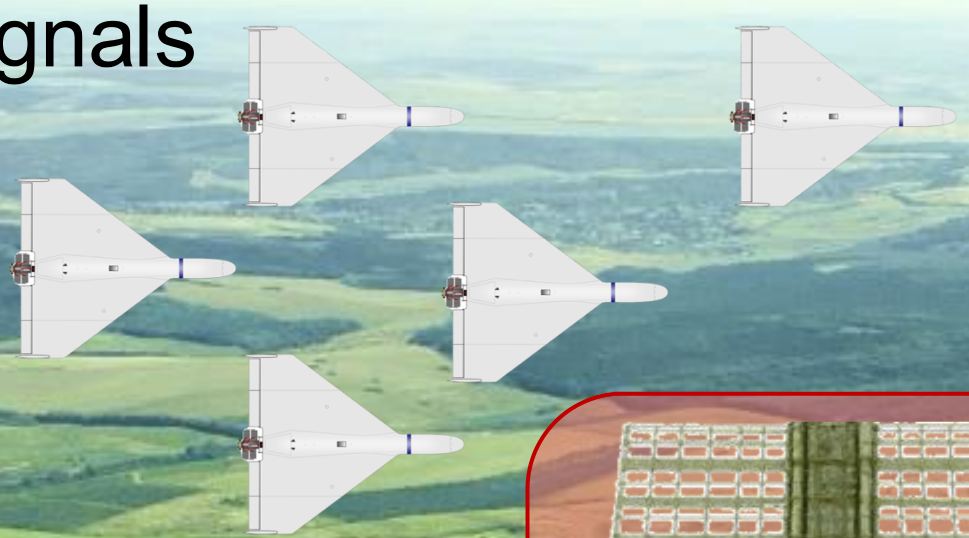
Communication Threats

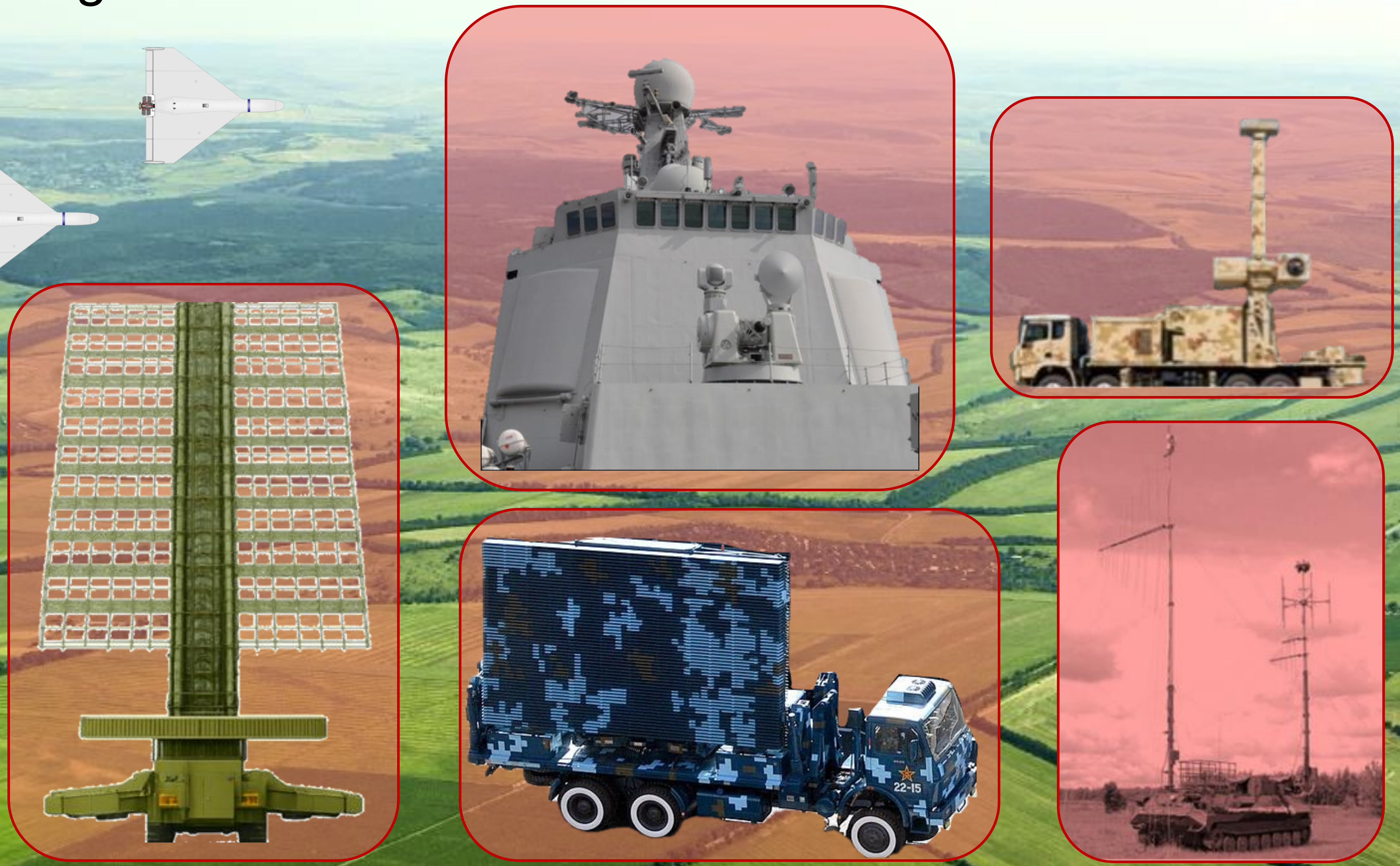
● Collaborative missiles/UAS ● Very fast hopping MILCOM ● Low frequency MILCOM ● TOCs



Implications for RF Sensors on Small UAS

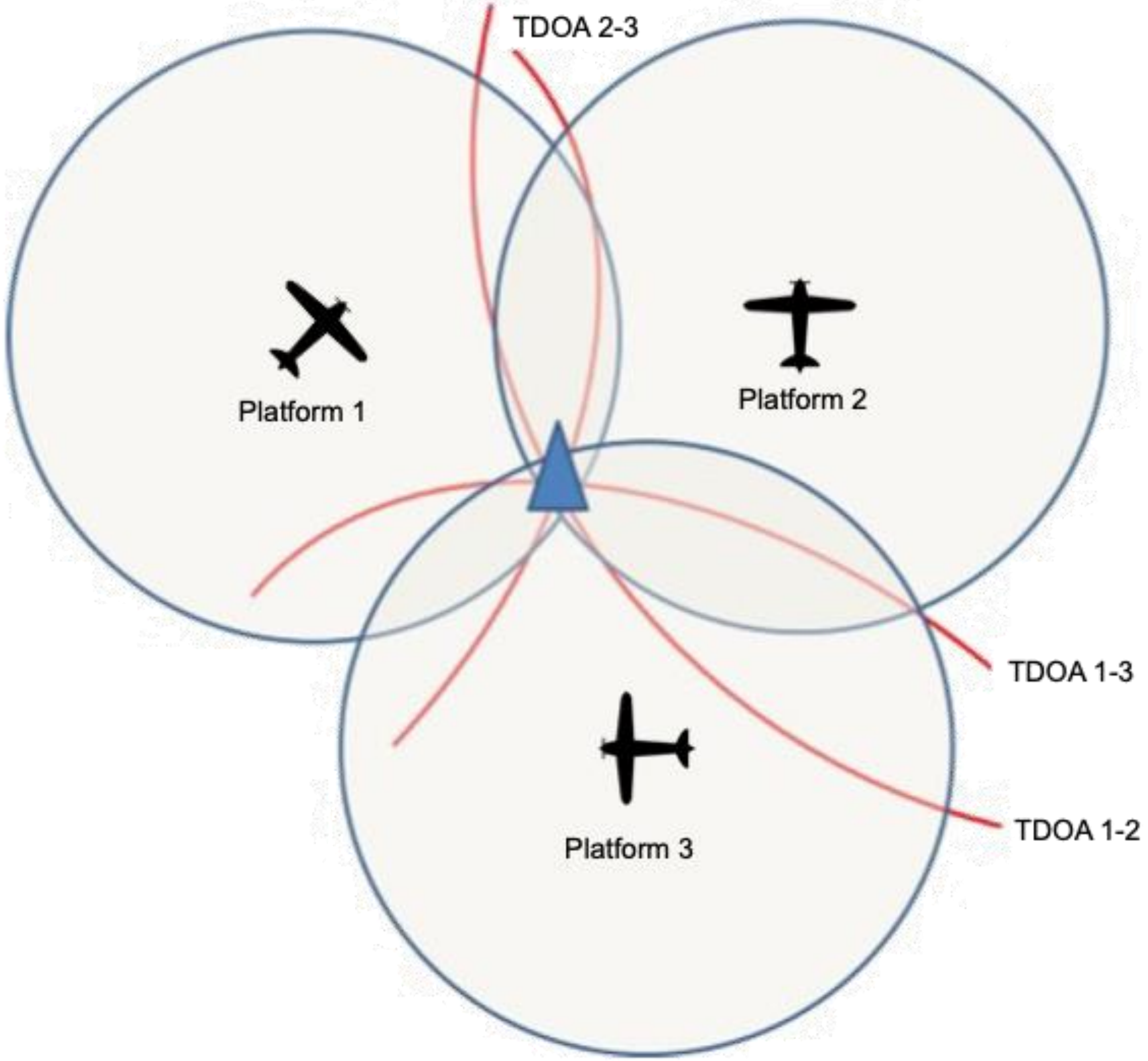
- Contested airspace
- Denied degraded GPS/GNSS
- Degraded communications
- Threats from HF/VHF-Low to Ku and higher
- Dense and complex signals





Multi-Platform RF Geolocation Solutions

- Infer signal direction through distributed geometry
  - **Antennas spatially separated** on **different platforms**
  - Time and Frequency Difference of Arrival (**T/FDOA**)
  - Emerging **AI/ML** distributed techniques
- Multiple aircraft with GPS time-synchronization
- Communication between platforms
- Coordinated maneuver



Vulnerable to degraded/denied GPS & comms ● Constrained by geometry and maneuver

Traditional Single Platform RF DF Solutions

- Infer signal direction through local geometry
  - Phase delays across **antennas spatially separated** on one platform
  - Drives platform size
- Processing techniques
  - Correlative interferometry
  - Commutating/Doppler
  - Emerging AI/ML N-channel DF techniques

Rivet Joint
Fuselage: 136 ft, Wingspan: 130 ft

Large ISR aircraft are too valuable and too few for contested environments

SNITCH

Ultrawideband Electromagnetic Vector Sensors (EMVS)

- New technology for **single platform** RF **direction finding**
- Direction from **local electromagnetic field structure** at the platform
- Flight test proven
  - **HF to 6 GHz**
  - **HF to 18 GHz**

Cylindrical configuration
6"D Common Launch Tube (CLT)
Successful launch/recovery to 135G
6"D x 7L, 4.8 lbs., 40-45W

Mod Payload configuration, **4.5 lbs. 40-45W**
2U internal carriage electronics
4"D x 5"L external carriage antenna

***Elimination** of **antenna array baselines** results in **radically smaller** systems*

Wide Range of UAS Enable Layered and Ubiquitous Sensing

Stratospheric Platforms
60,000 ft to 100,000+ ft
Radio Horizon 500 km to 700 km


Aerostar Thunderhead

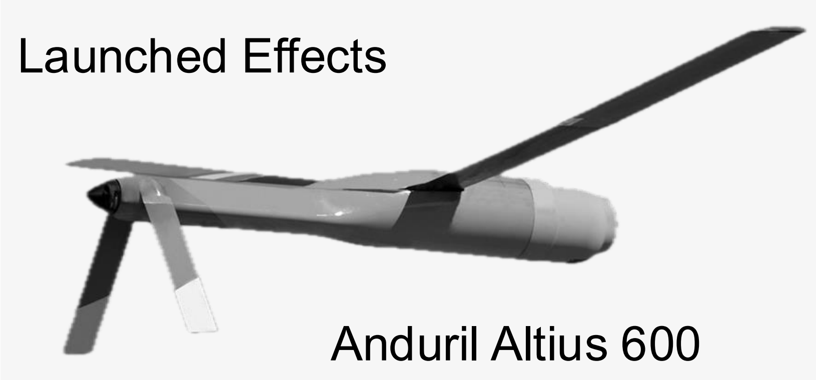

Airbus Zephyr

Medium Altitude Long Endurance
5,000 to 20,000 ft
Radio Horizon 150 km to 300 km


Platform Aerospace Vanilla


Kraus Hamdani K1000ULE

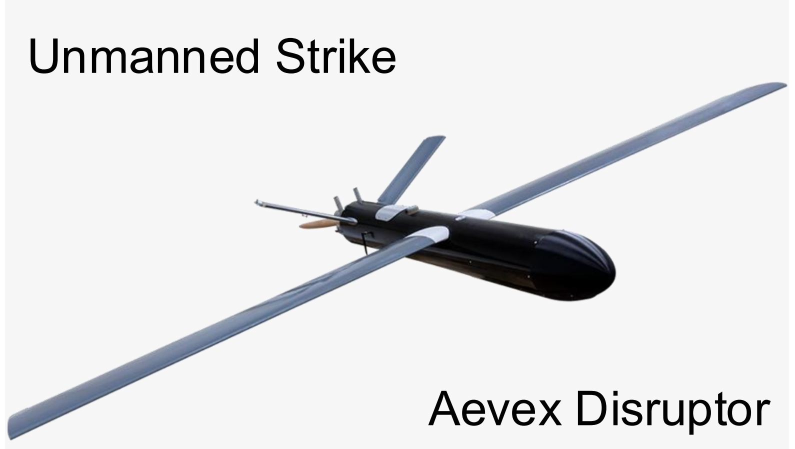
Launched Effects


Anduril Altius 600

Multicopters
500 ft to 10,000 ft
Radio Horizon 50 km to 225 km


Skyfront Perimeter 8
Hybrid fuel-electric UAS

Unmanned Strike


Aevex Disruptor

Tethered UAS
100 ft to 300 ft
Radio Horizon 20 km to 40 km

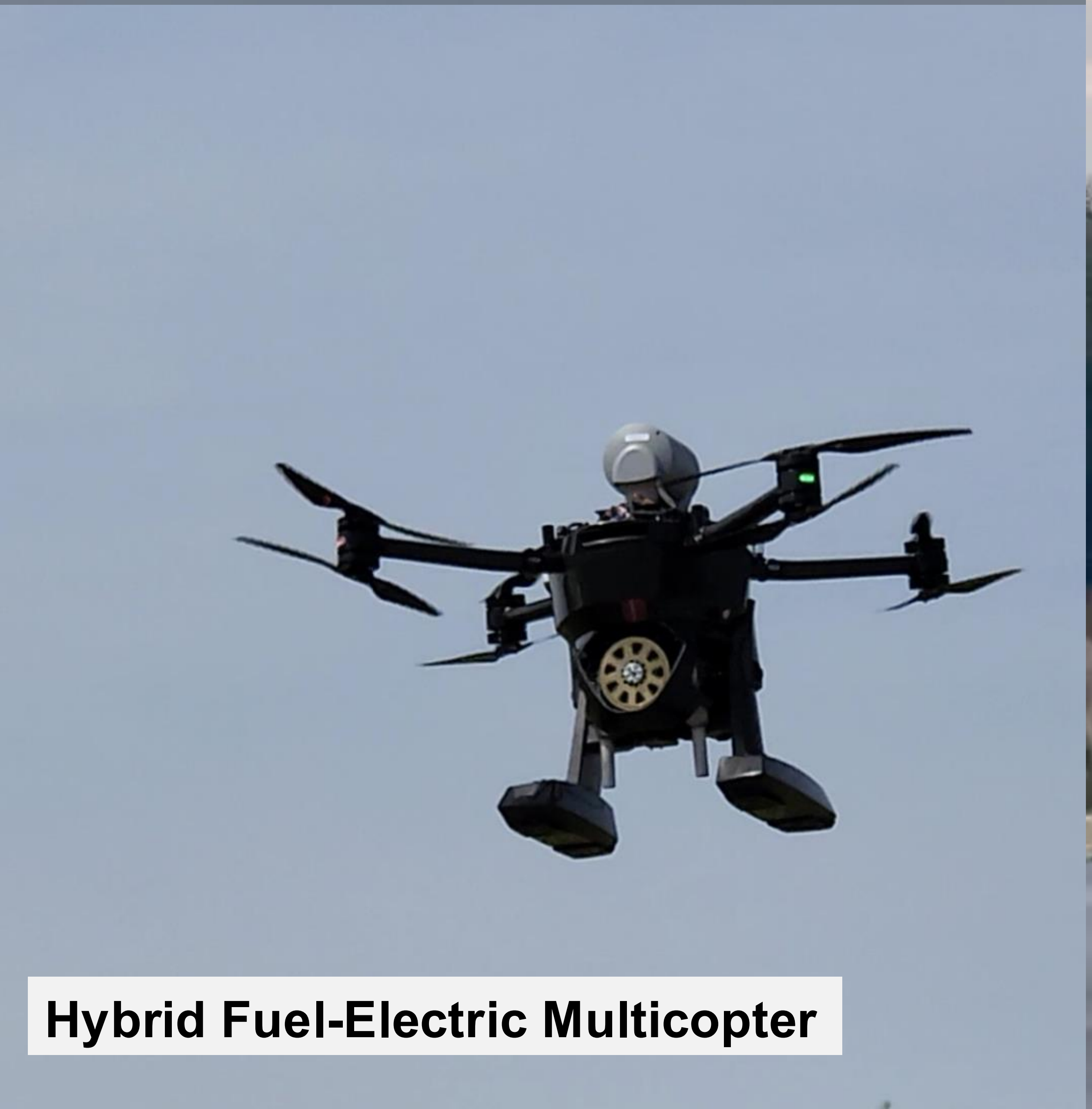

Hoverfly Spectre

Recent EMVS Flight Test Demonstrations

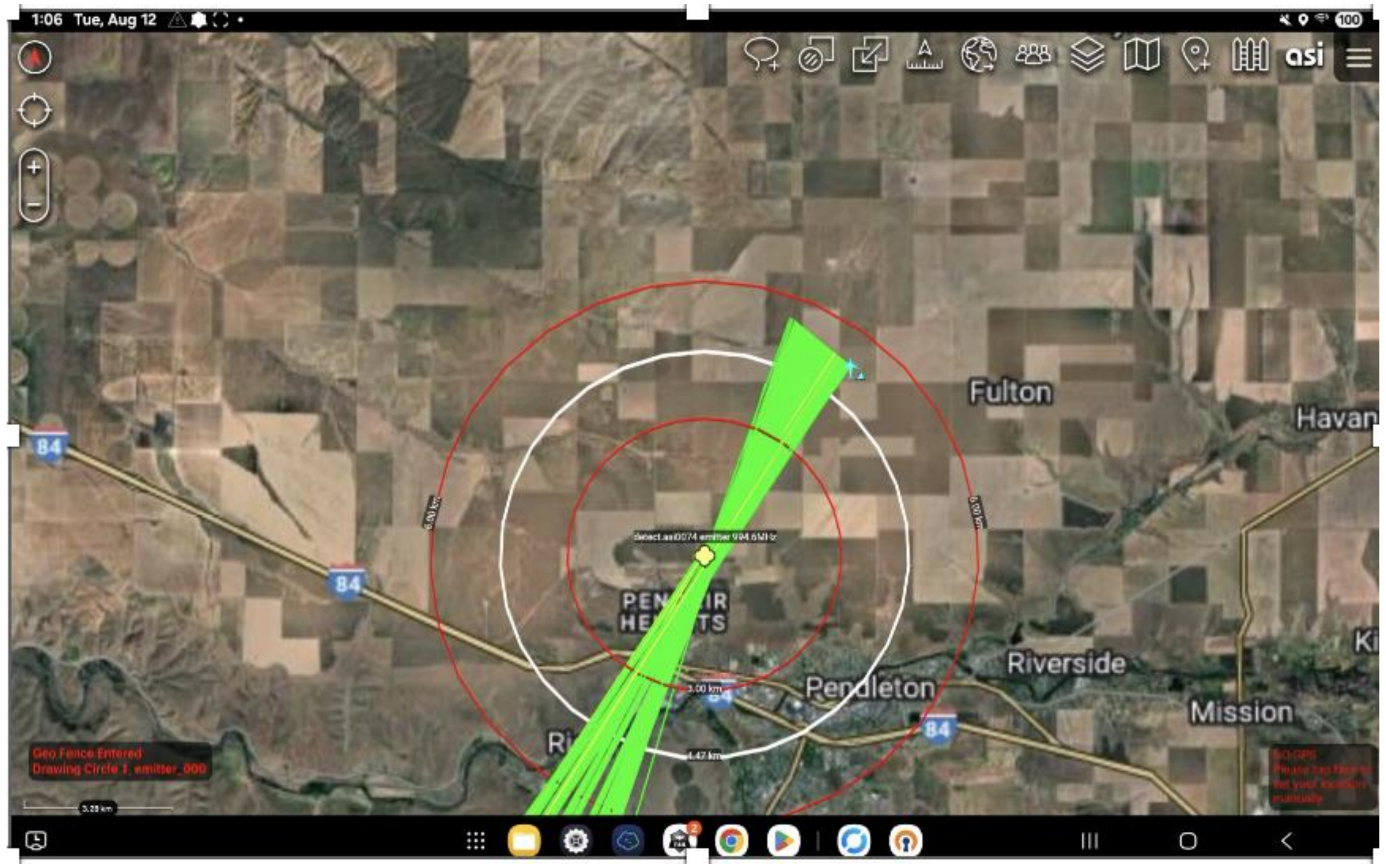

Helicopter UAS


Belly Mount


Anduril Altius 600


Hybrid Fuel-Electric Multicopter

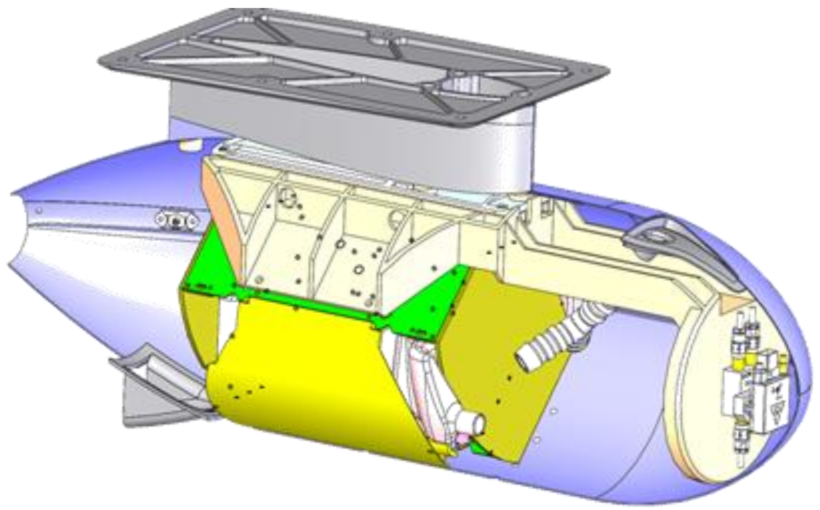
Too Few Specialists
ATAK Interfaces that Enable One Warfighter to Control Multiple Payloads



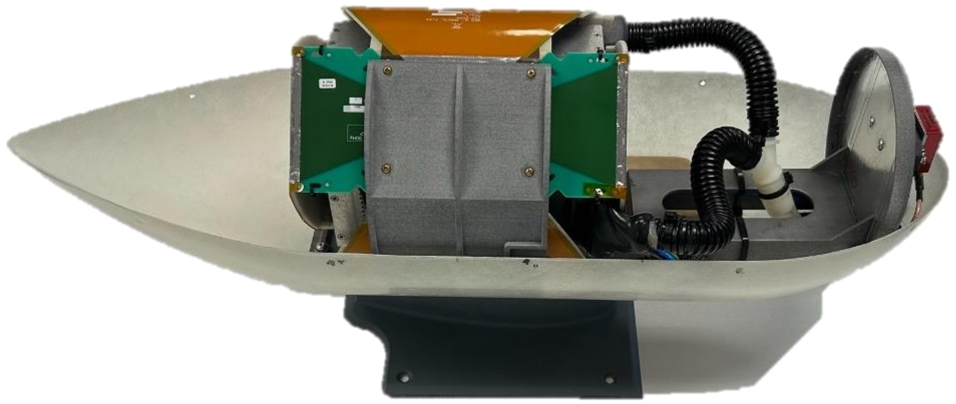
For interactive operation or configuration of autonomous missions
Leverage the specialists, one operator controls and/or configures multiple sensors

Speed of MOSA
SNITCH Integrated and Flight Tested on Platform Aerospace Vanilla in 2 Weeks

CAD



Fabrication



Integration

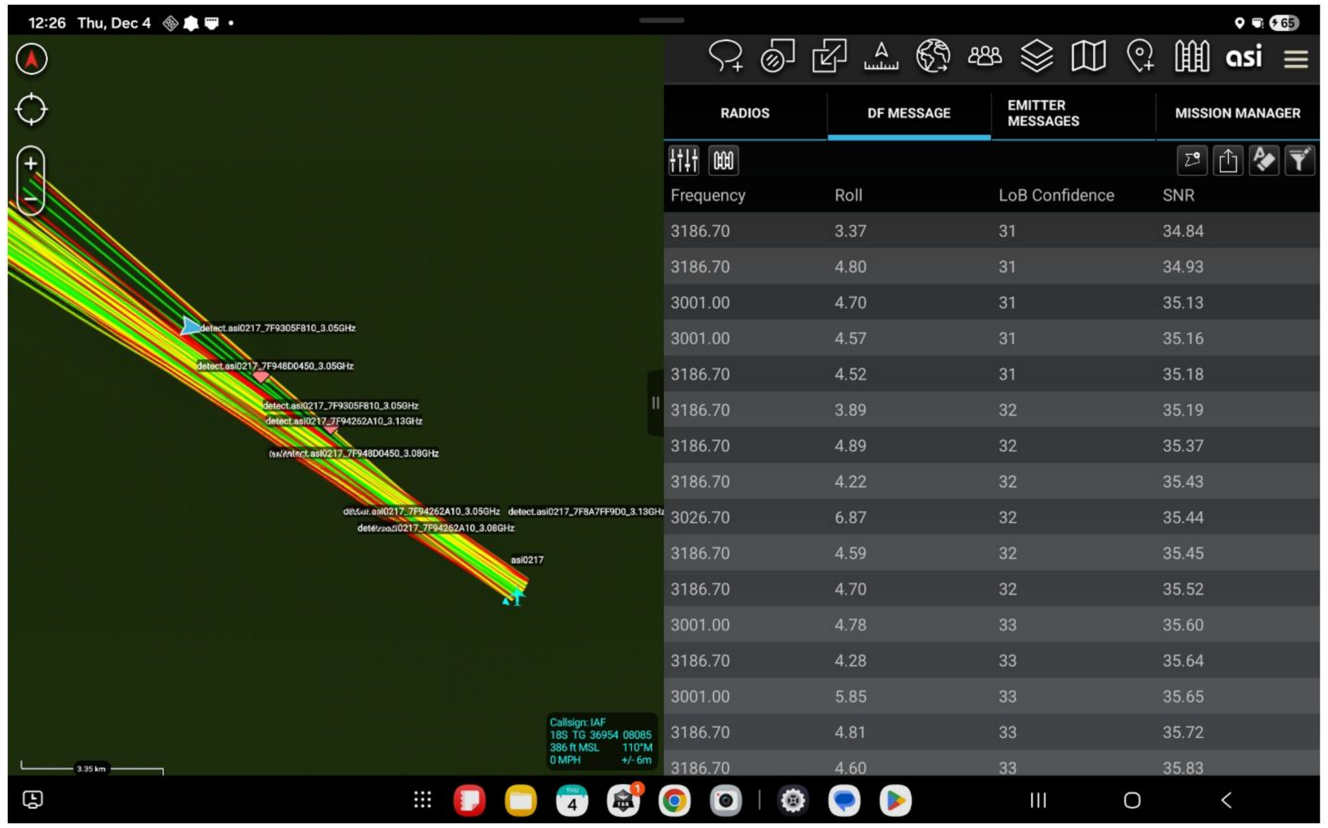
Platform Aerospace Vanilla Ultra-Long Endurance UAS
- 8 days endurance, 15,000 NM range
- Multi-INT ready with EO/IR, SAR and DF payloads
- **MOSA interfaces and data packages enable rapid integration**

ASI SNITCH DF/GEO
- SNITCH HF to 6 GHz integrated onto Vanilla
- EMVS ‘no distributed antennas’ architecture speeds install
- **MOSA interfaces and data packages enabled rapid integration**

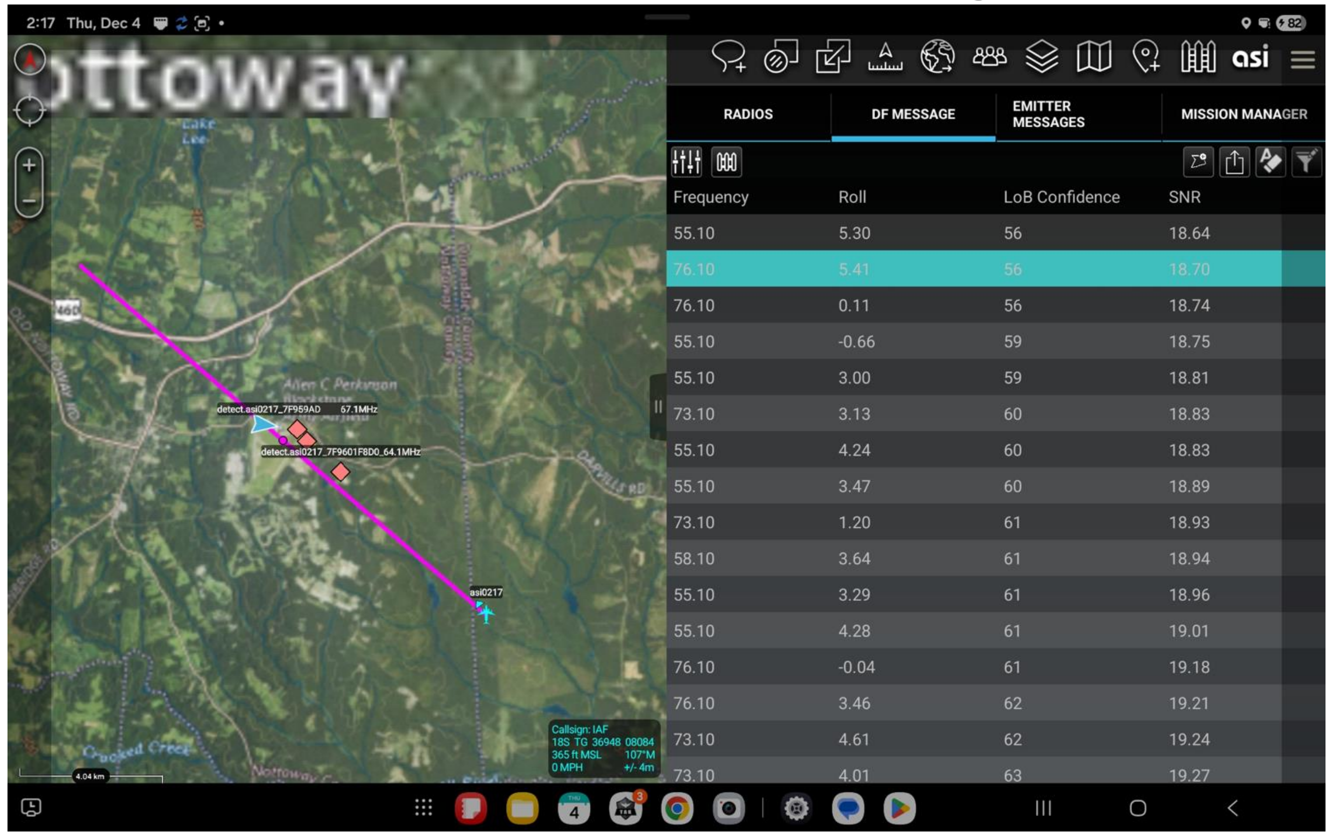
Ready to Fly

Speed of MOSA
SNITCH Integrated and Flight Tested on Platform Aerospace Vanilla in 2 Weeks

3 GHz S-Band Target

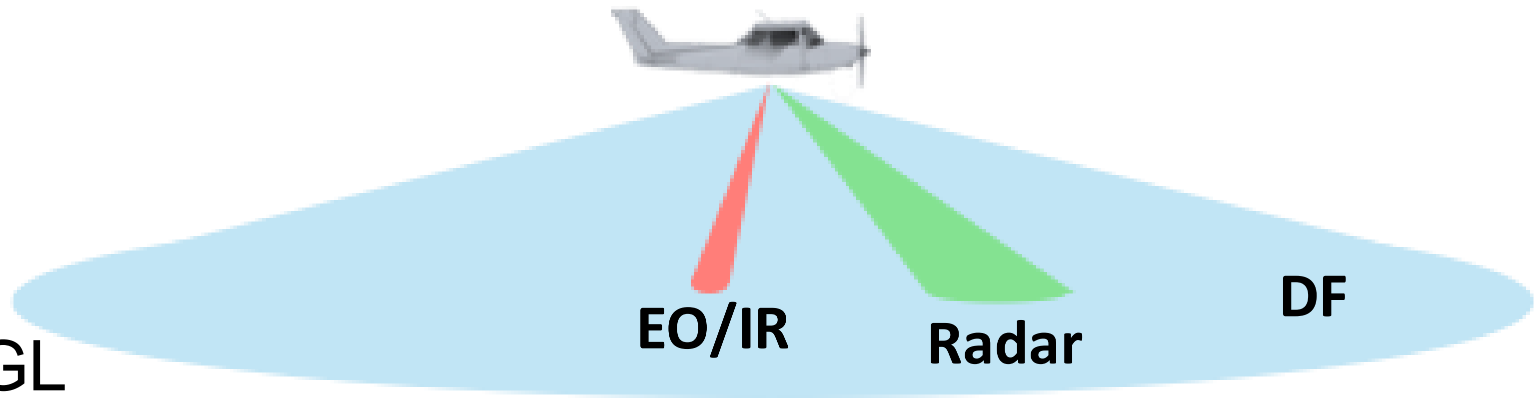


50-80 MHz VHF-Low Target



Emerging Capabilities for Small UAS

- **UAS Multi-INT with Complementary Sensors**
  - EMVS with 360° FOV
    - Radio horizon is **150 km** (**70k km^2** coverage) at 5,000 ft AGL
    - Radio horizon is **450 km** (**600k km^2** coverage) at 40,000 ft AGL
    - Instantaneous DF on all relevant threat emitters in FOV
    - Enables **cueing** of sensor types with **narrow FOV** and shorter standoff
    - Ownship or other-ship **EO/IR**, **SAR**, and **LIDAR**

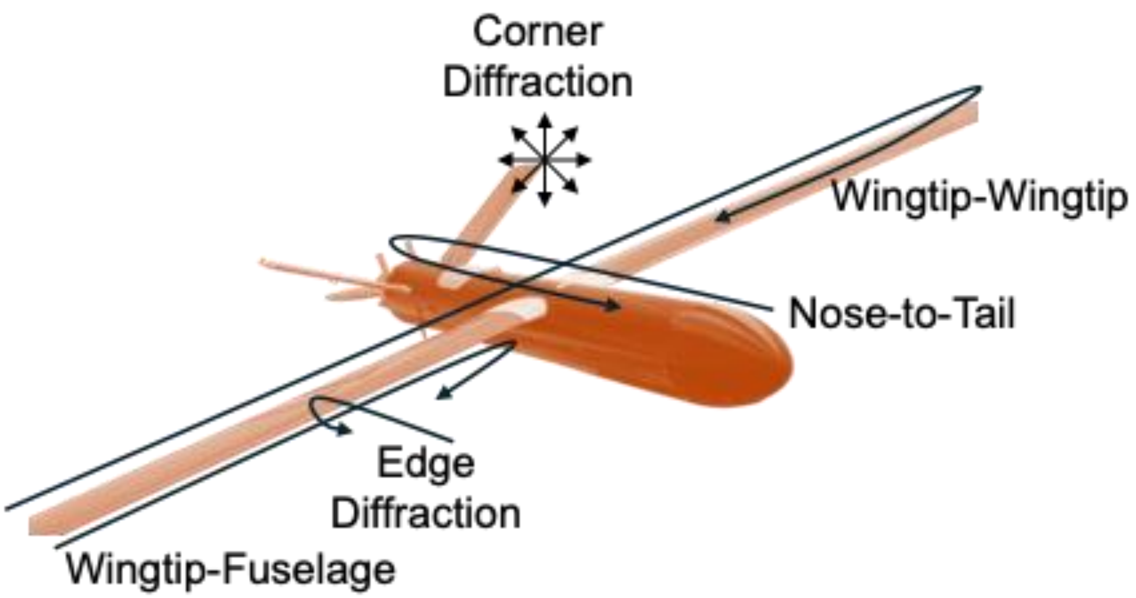


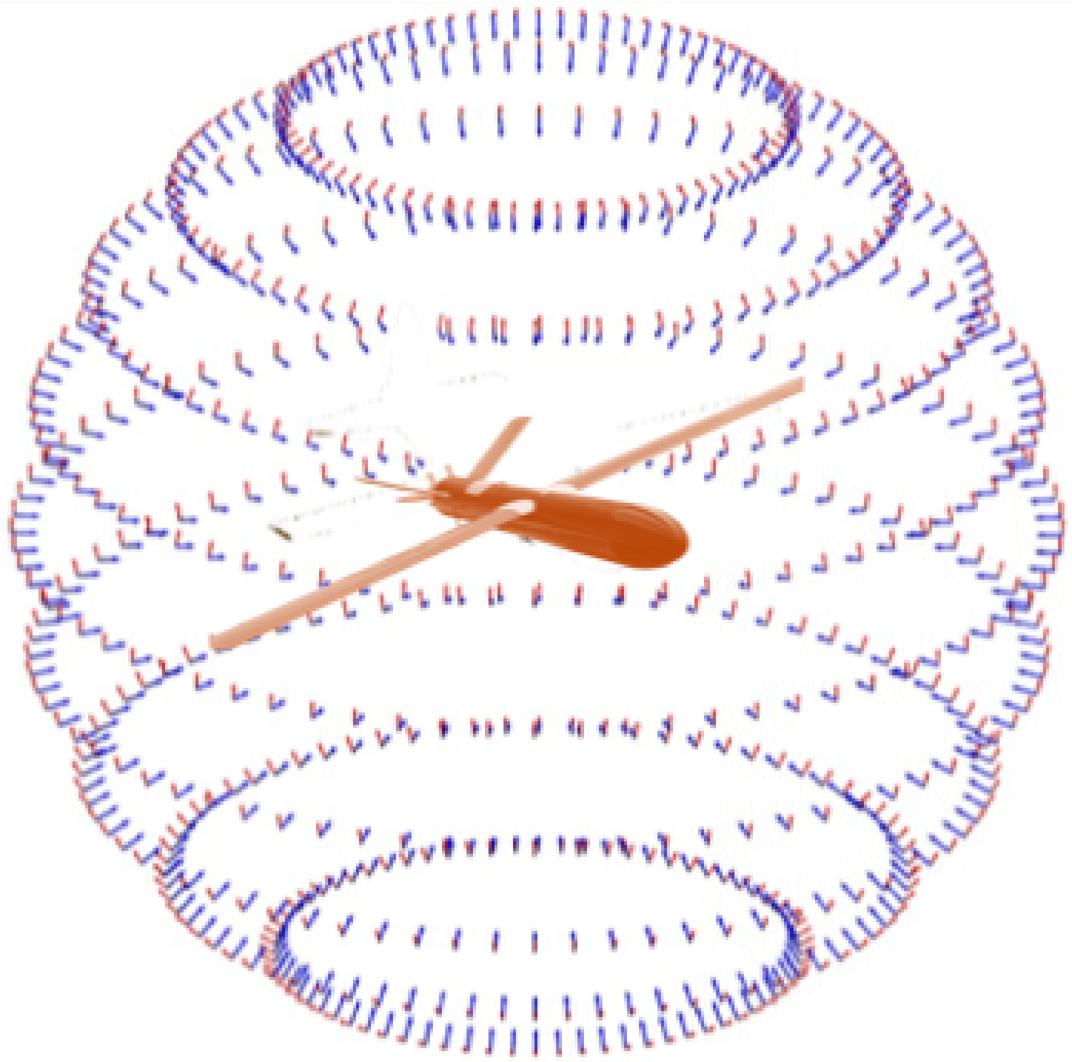
- **Enable Precision GPS Missile/UAS Strike**
  - Realtime DF of **jammers** enables **avoidance**
  - Identify ‘**clean**’ **corridors** in the target deck
  - Target the jammer as fallback

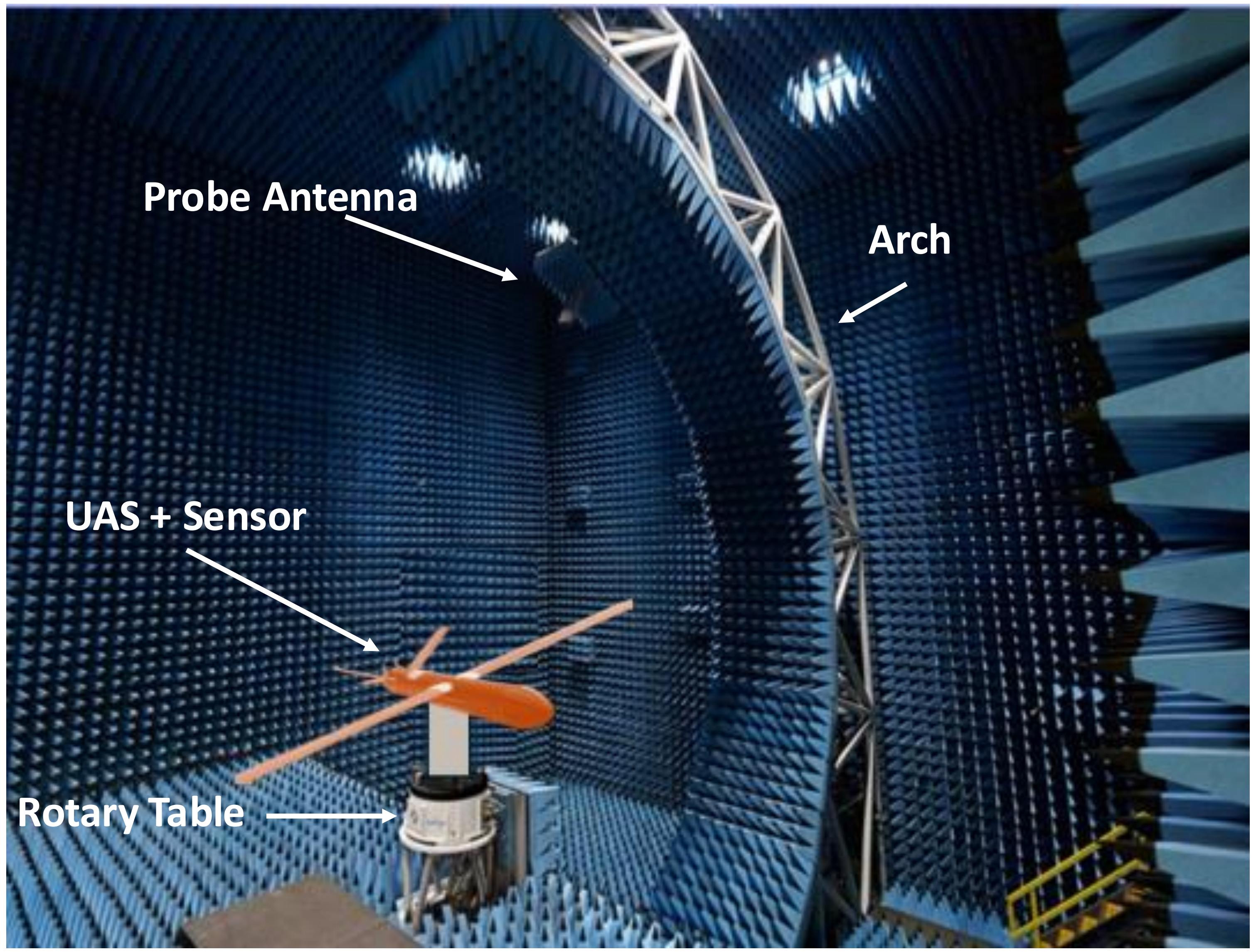
- **Platform survival**
  - **Realtime DF** of air defense **radar** enables **evasion**
  - Identify/update safe ingress/egress routes

Technology Roadmap – Path to Super Precision

- Single platform DF accuracy is approximately equivalent to calibration density
- DF with ≤1° azimuth and ≤1° elevation enables ray-terrain intersection (DTED) for near instant geolocation of low altitude fast-moving threats
- Calibrate in Spherical Nearfield Chamber (SNF)







Outcomes Enables by Small UAS RF ISR-T

- **RF sensing** at scale across a **70,000 to 500,000 km²** area
- Fast **localization of radars, jammers**, and other emitters
- **Distributed**, attritable **EMSO** that for **GPS** and **comms degraded** environments
- **Platform survival** through real-time **radar**-threat **avoidance**
- **Precision strike** enabled by GPS "**clean-corridor**" routing
- Leverage **limited EW specialists** - **one operator** controlling **many** autonomous sensors

asi Applied Signals Intelligence

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