THE FLYING SENSOR GRID – A COMPARISON TO CONVENTIONAL AIRBORNE EARLY WARNING

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Introduction

- **RA**dio **D**etection **A**nd **R**anging
- 3D-Localization
  - Distance sensor ↔ object
  - Angles to object
    - Azimuth
    - Elevation
- Day & night
- All-weather
- Alternative or additional capabilities

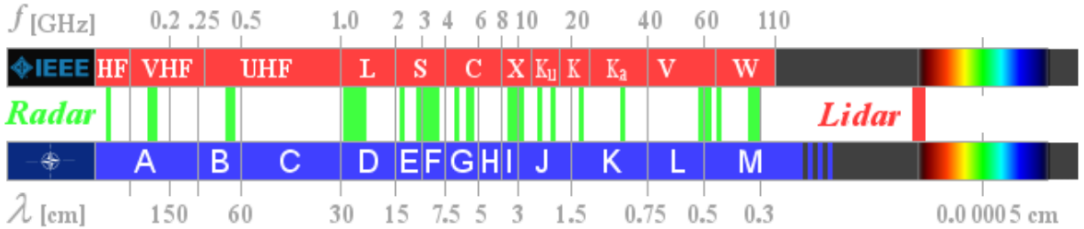
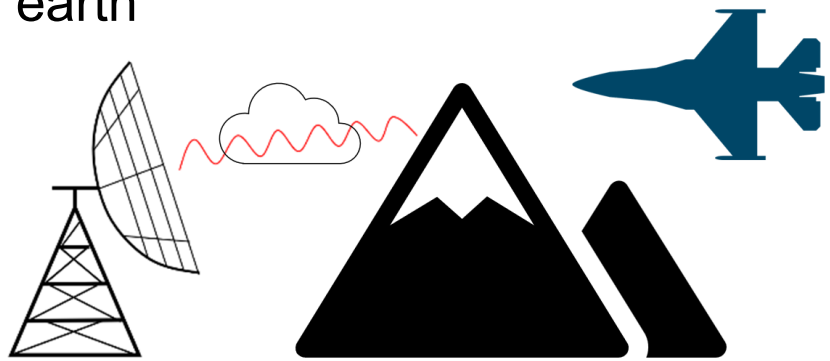


Image: Radartutorial.eu

Radio Line-of-Sight

- Curvature of the earth
- Terrain



Signal Strenght

Sufficient reflected
EM power at receiver?

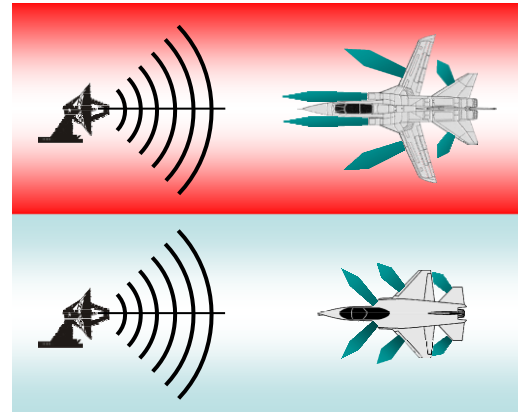


Image: V. Gollnick: Luftfahrzeugentwurf II

State of the Art

- Large aircraft
- High-performance radars (up to ~ 1MW power supply)
- Relatively high altitudes

Image: af.mil

NATO E-3 Sentry AWACS @ 30k ft

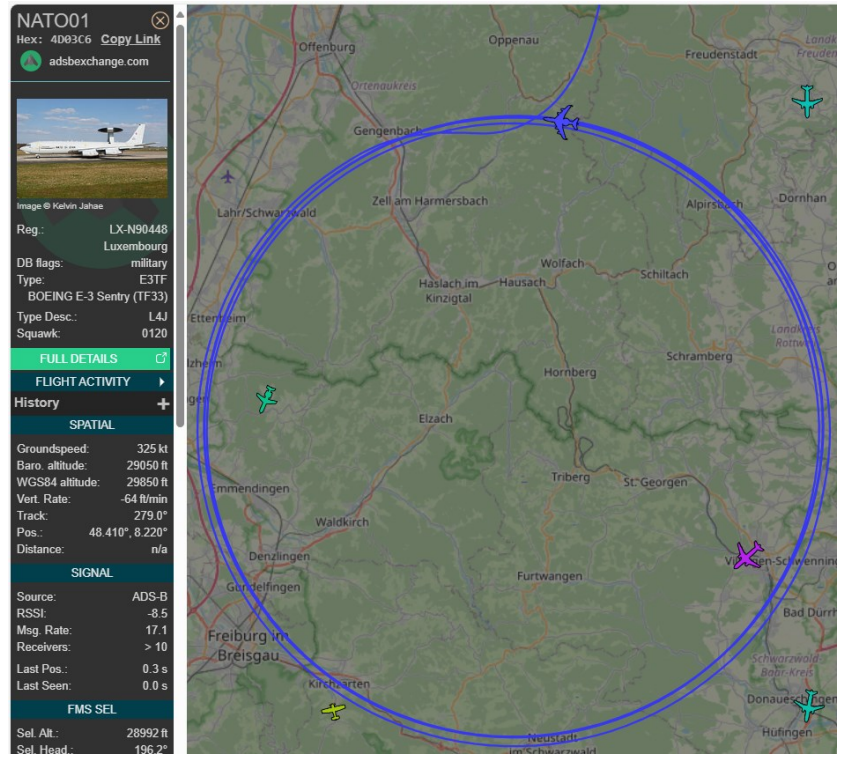
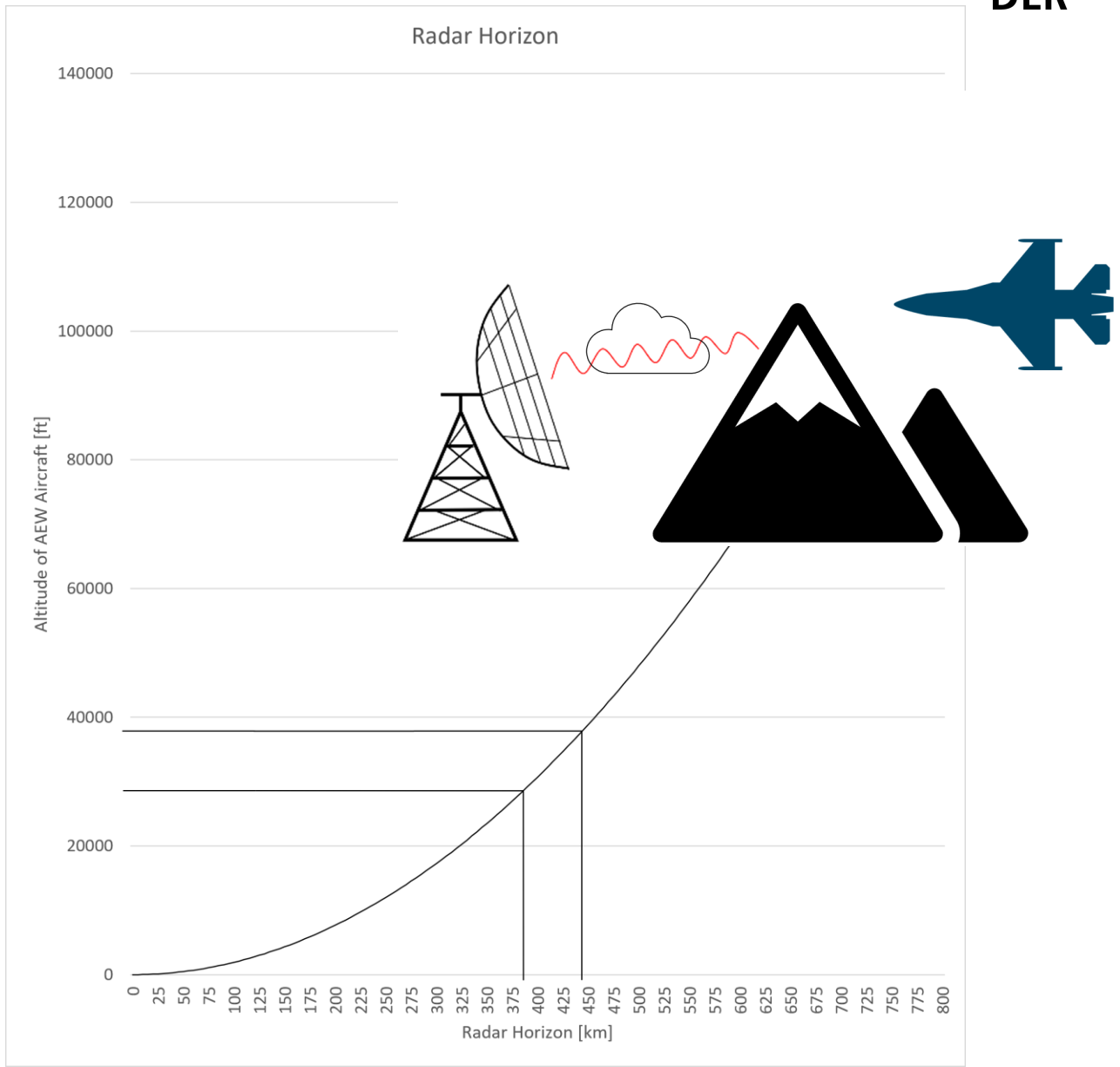


Image: adsbexchange.com

Strenghts of conventional AEW

- Excellent detection capabilities
  - Primary surveillance radar
  - All-weather, day & night
  - Altitude provides wide horizon
  - High-performance radar detects threats from standoff-distance
    - High electrical power available
    - Space and mass budget
- Flexibility
  - On-station
    - Altitude
    - Advanced or rear position
    - Lateral position
  - Moving target for opponent



Weaknesses of conventional AEW

- Costs
- Rarity
- Attractive target
  - Not survivable on stand-in position
  - Easy target on ground

Image: The Telegraph

Research Gap

AEW strengths w/o weaknesses?

- High radar performance, wide horizon by altitude & flexible stations
- Less expensive, more available, less vulnerable & flexible basing

PLA‘s WZ-9

Images: Maxar Technologies & South China Morning Post

Methods – PSR Radar Range Equation

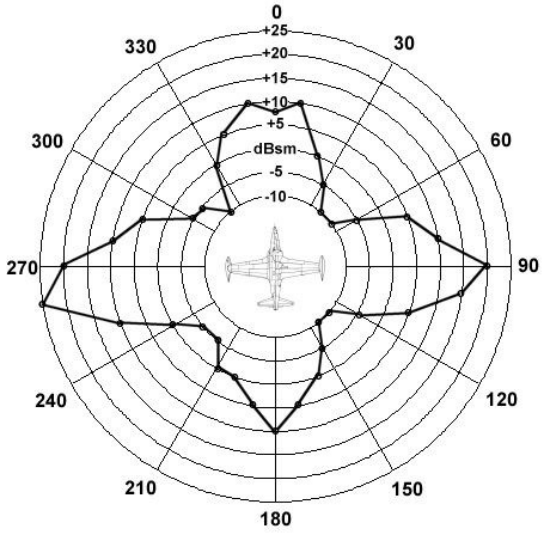
$$R = \sqrt[4]{\frac{P_T G^2 \lambda^2 \sigma}{P_R (4\pi)^3}}$$

Methods – RCS & Radar Performance Parameter

Simplification

$$R = \sqrt[4]{\frac{P_T G^2 \lambda^2 \sigma}{P_R (4\pi)^3}} = \sqrt[4]{C_{Radar}\sigma}$$

$$C = \frac{R^4}{\sigma}$$



$$\ldots ir + R_{preposition}$$

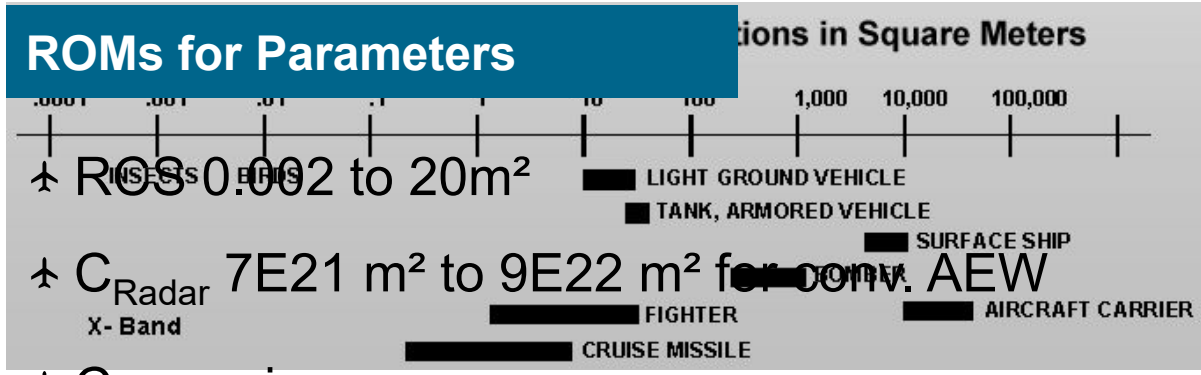
$$\ldots_{total} - \sqrt[4]{C_{Radar}\sigma}$$

RCS

$$RCS[dBsm] = 10\log_{10}(RCS[m]^2)$$

$$RCS[m^2] = 10^{\frac{RCS[dBsm]}{10}}$$

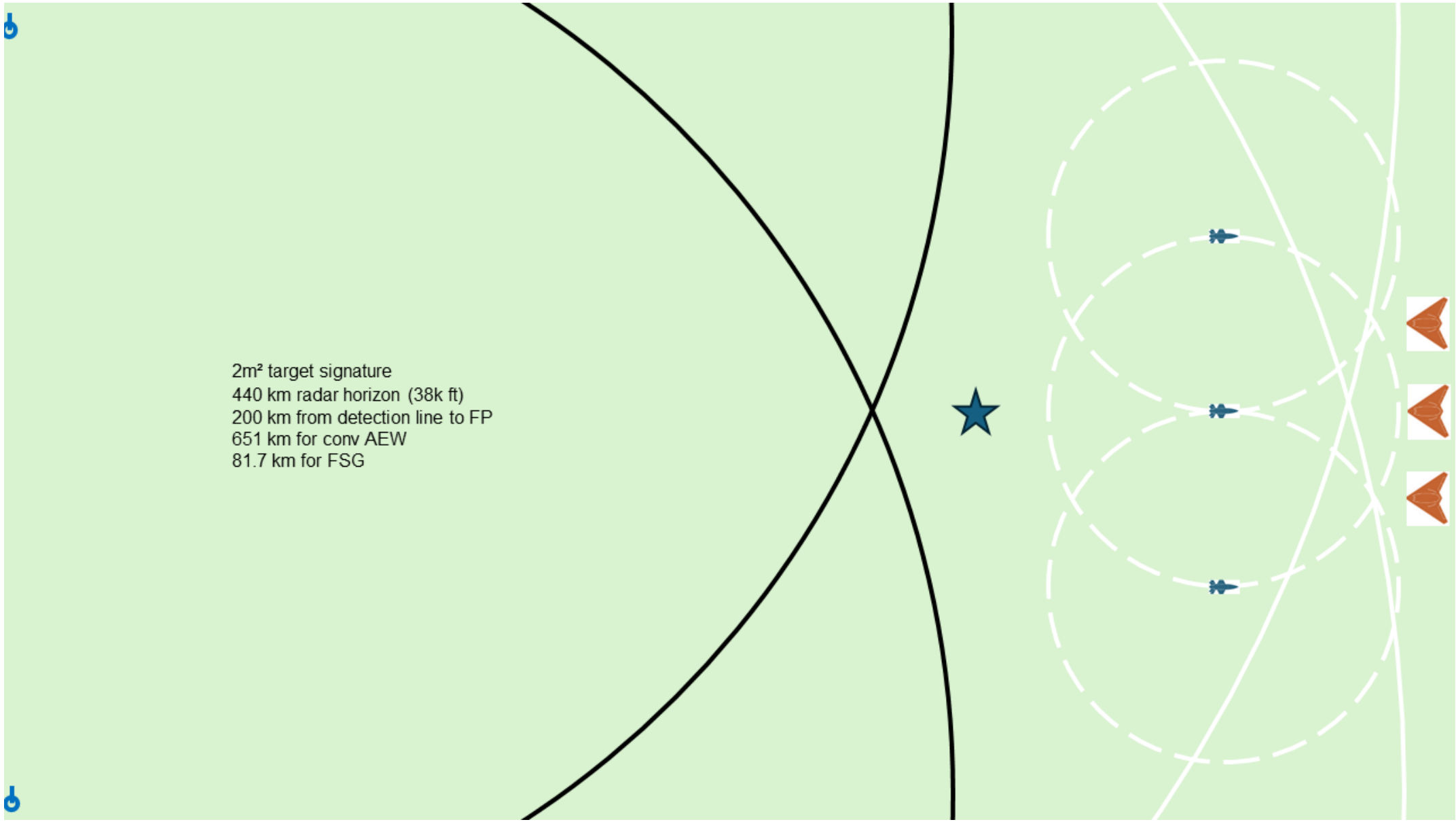
ROMs for Parameters



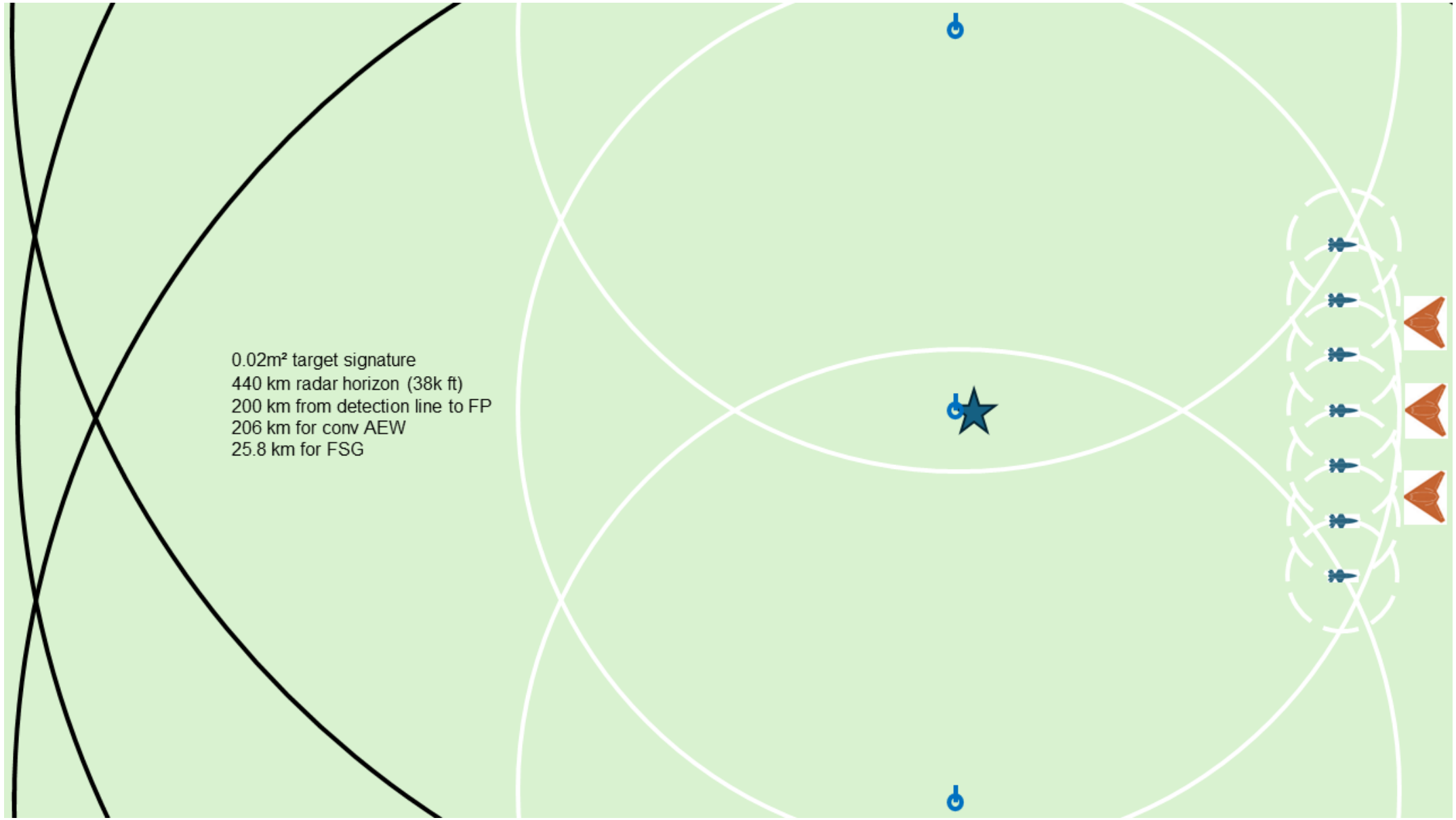
Images: aerospaceweb.org

- RCS 0.002 to 20m²
- C_{Radar} 7E21 m² to 9E22 m² for conv. AEW
- Comparison
  - Conv. AEW w/ C_{Radar} = 9E22 m²
  - FSG w/ 0.1% elec Power and half gain

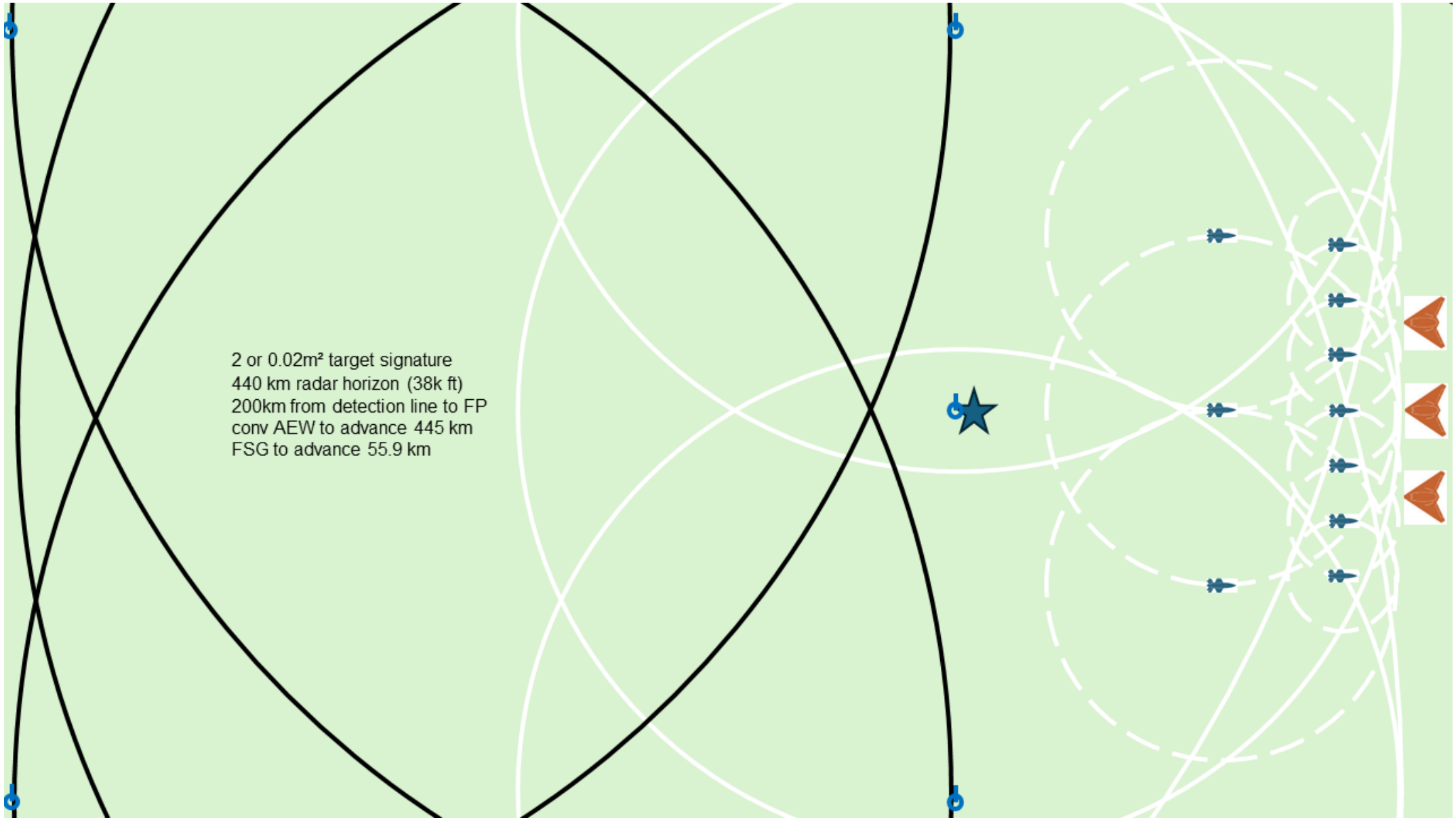
Results 2m² target



Results 0.02m² target



Results overlay



Imprint

Topic:	**The Flying Sensor Grid** **A Comparison to Conventional Airborne Early Warning**
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