

# Circularly Polarized Conical Array for ADS-B Applications in LEO Satellites

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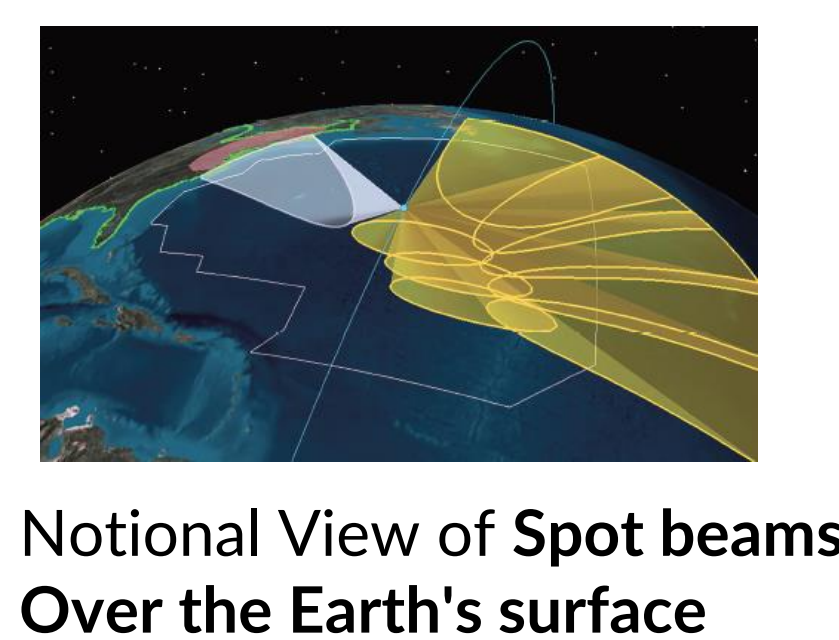
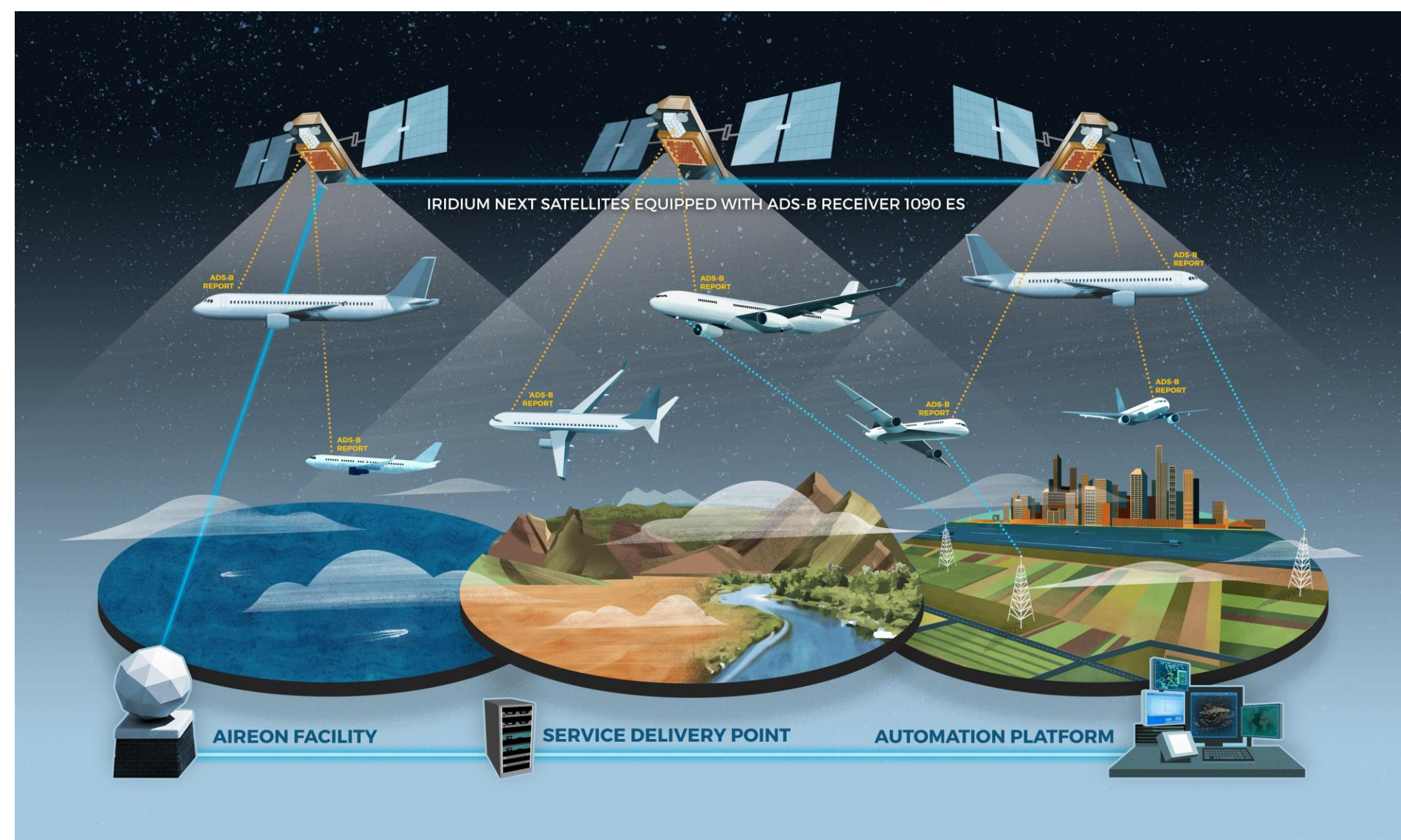
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## ABSTRACT

This paper presents the design of a **dual-layer conical antenna array** tailored for **Automatic Dependent Surveillance-Broadcast (ADS-B)** applications intended for integration into **Low Earth Orbit (LEO)** satellites. The proposed antenna system comprises two vertically stacked layers, each comprising six magneto-electric dipole antennas arranged in a circular configuration. Each antenna element covers a sector of  $\pm 30^\circ$  in azimuth, providing comprehensive coverage for **real-time aircraft tracking** over wide geographical regions. The array operates within the L-band spectrum (**960–1164 MHz**), making it suitable for ADS-B communication in remote areas with **limited ground station coverage**, such as oceans and deserts.

## AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) SYSTEMS



### ADS-B operational requisites

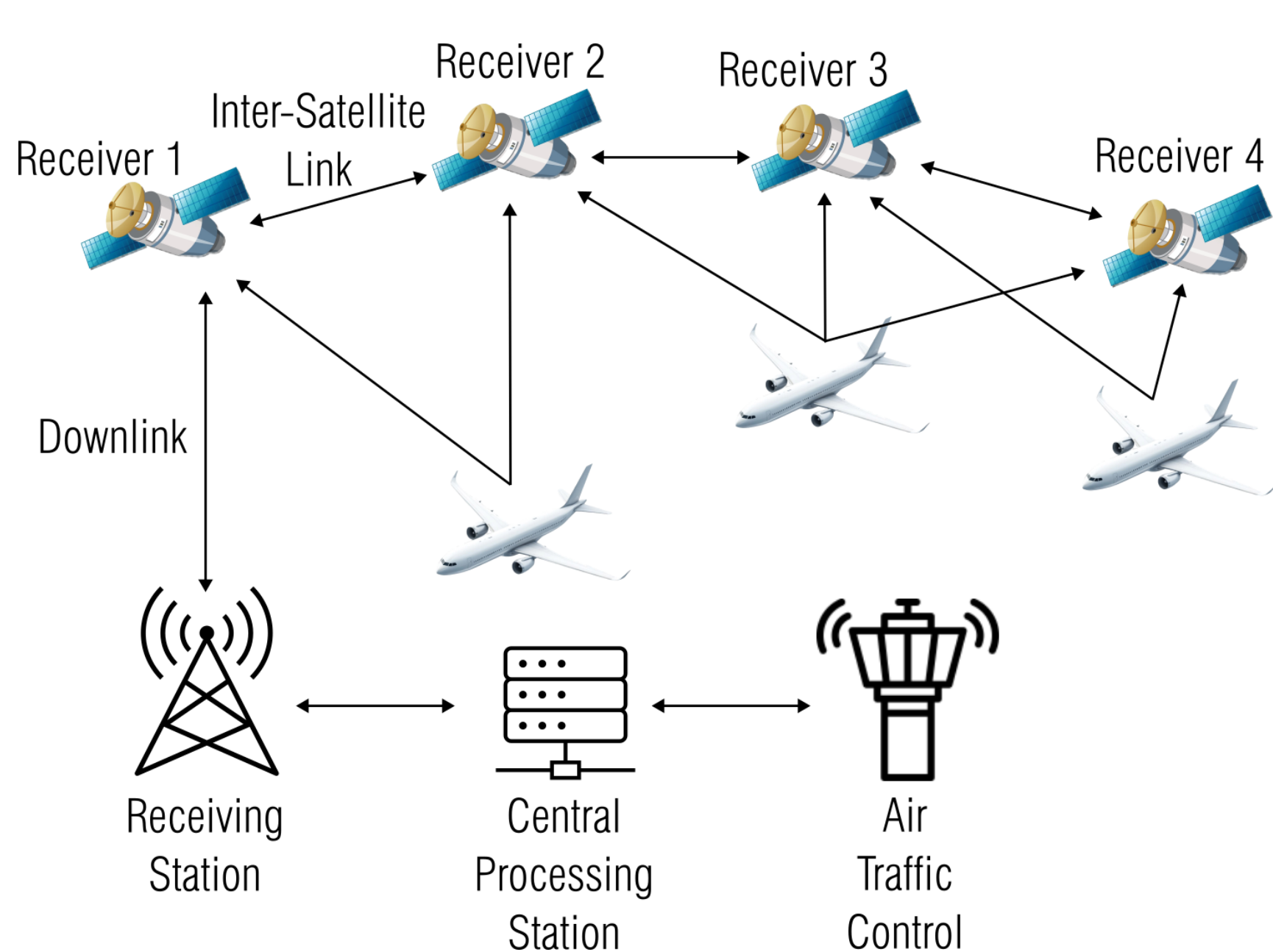
#### Antenna design constraints

- ADS-B signals tx in L-band: 960 – 1164 MHz
- Center frequency of 1090 MHz
- Limited volume onboard the satellite (1m x 0.5m)

#### ADS-B communication performance

- Signals transmitted @ 1 Mbps
- Pulse Position Modulation (PPM)
- Combination of ToA, FoA and AoA to detect aircrafts
- Mode S (Select) interrogations to aircrafts

### Satellite-based ADS-B architecture

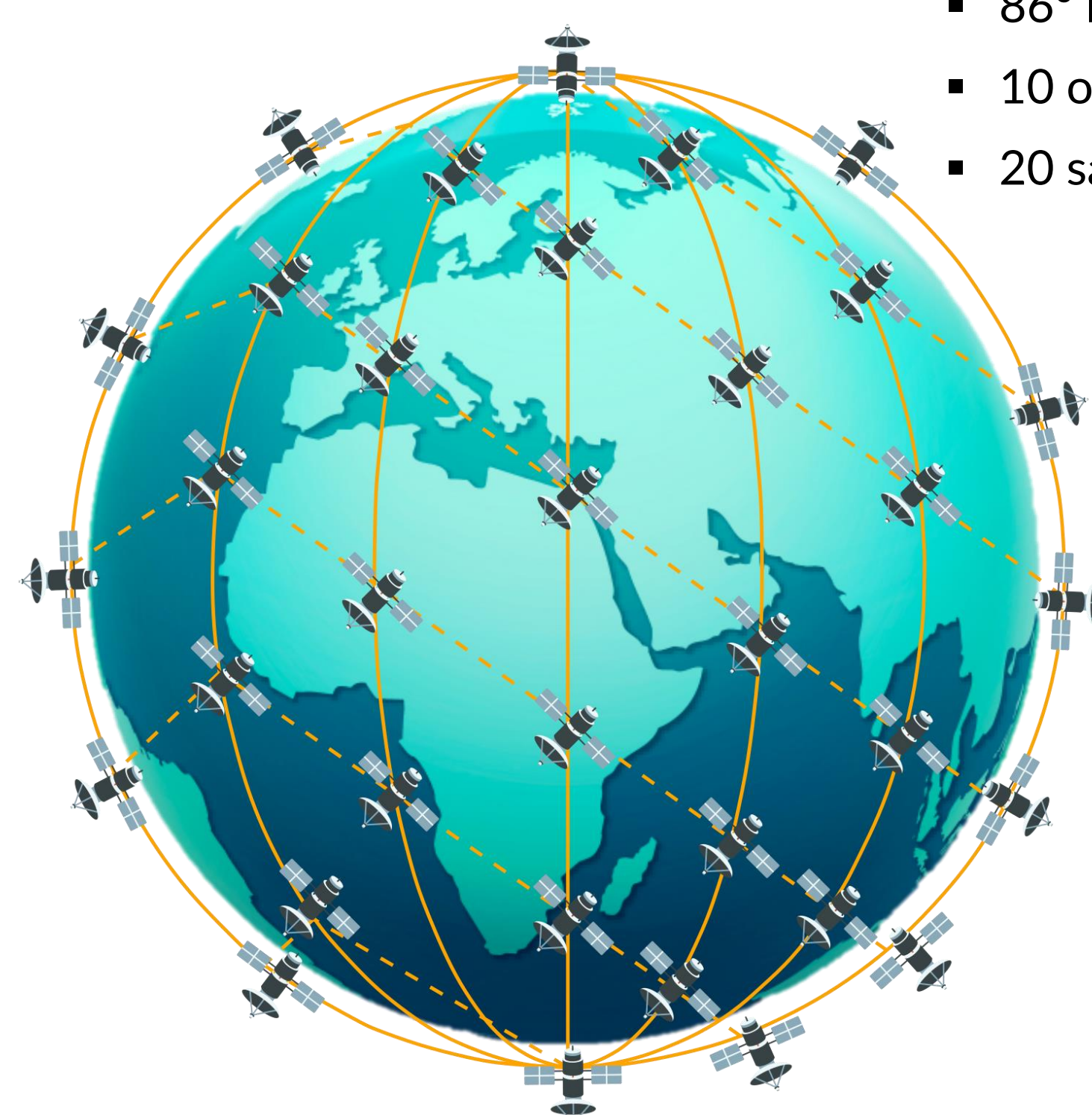


## SATERA

Space-based composite Ads-b and multiteration system validation through scalable simulations

## SATERA PROJECT AND CONSTELLATION

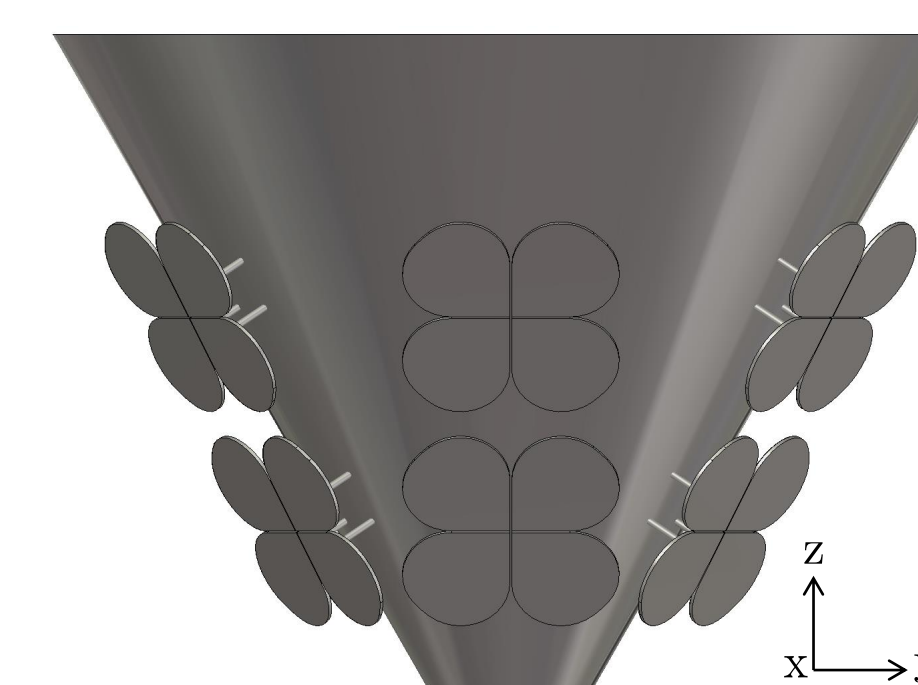
### Constellation proposal



### Walker-Star Constellation

- 700 km height
- 86° inclination
- 10 orbits
- 20 satellites per orbit

### All-metal conical array



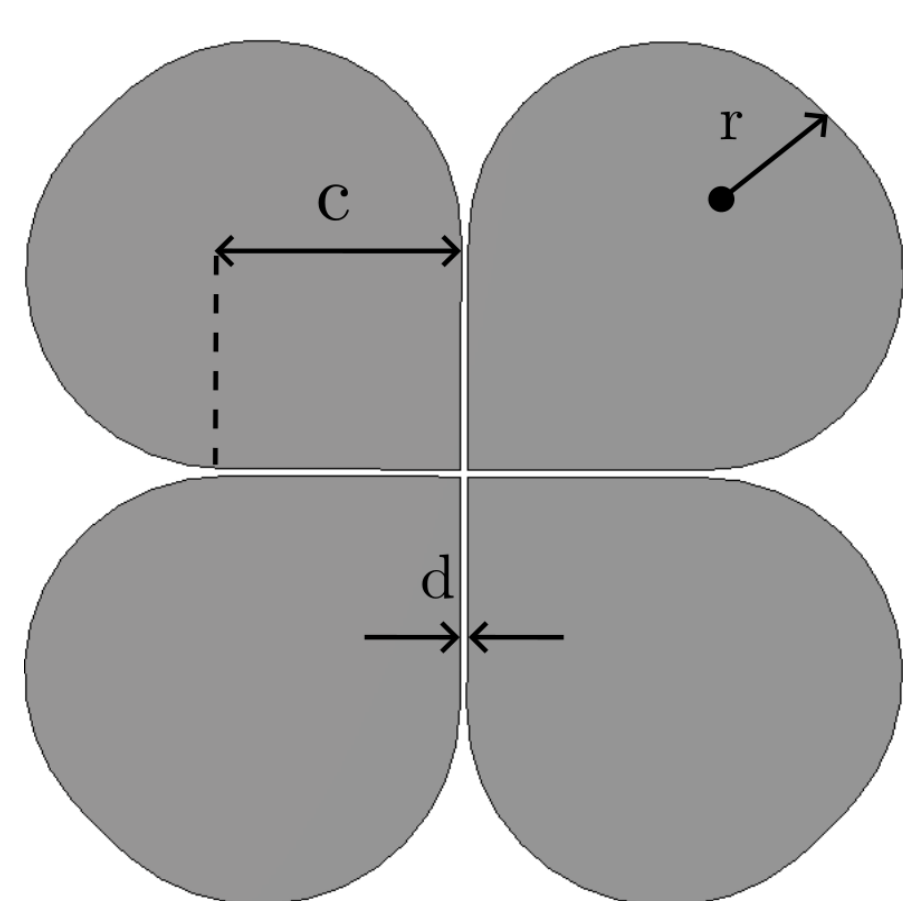
- High-efficiency circularly-polarized magneto-electric dipole array for ADS-B L-band radiolinks with aircrafts.
- Can also be used for LDACS applications.
- Full 360-degree azimuth coverage.
- Array easily reconfigurable.
- Very simple coaxial feeding.
- 60-degree inclination to maximize Earth coverage.

## CONE-SHAPED ARRAY

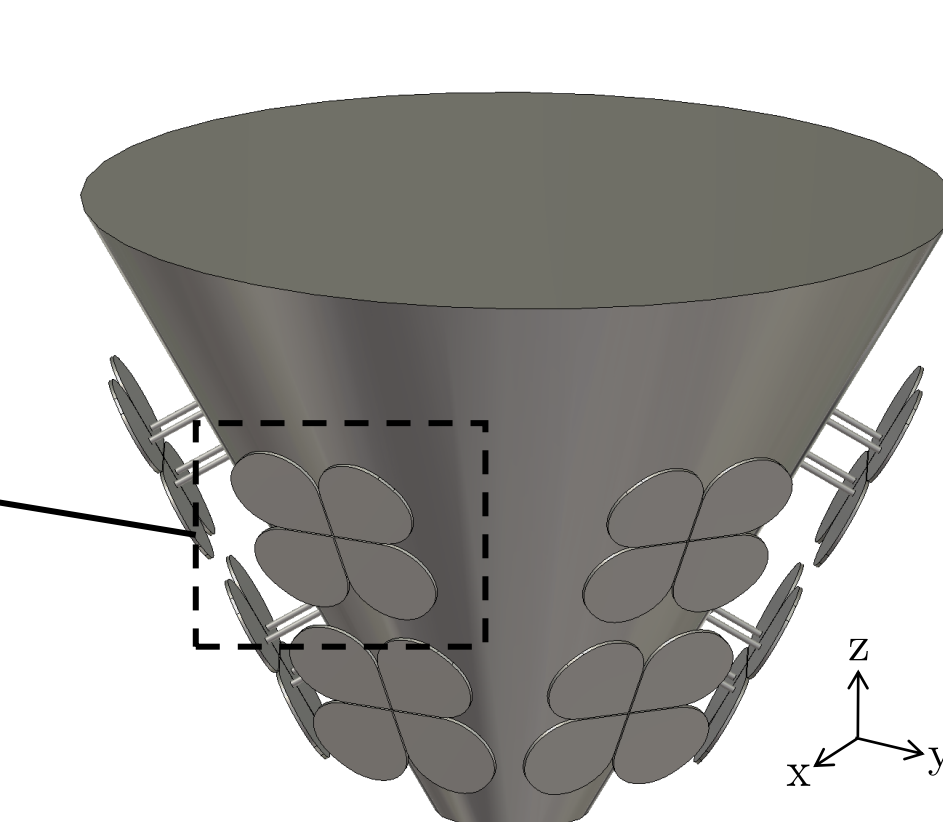
### Unit-cell antenna

Dimensions of unit cell antenna in mm

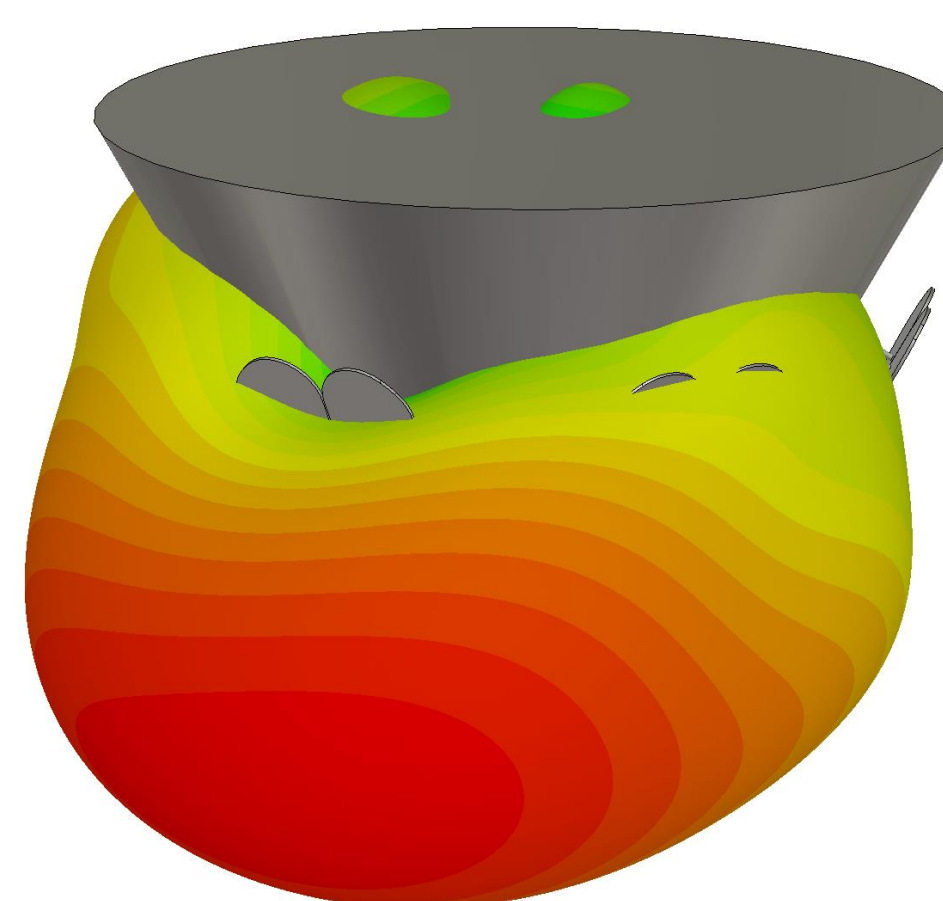
c	d	r
32.4	1	30.3



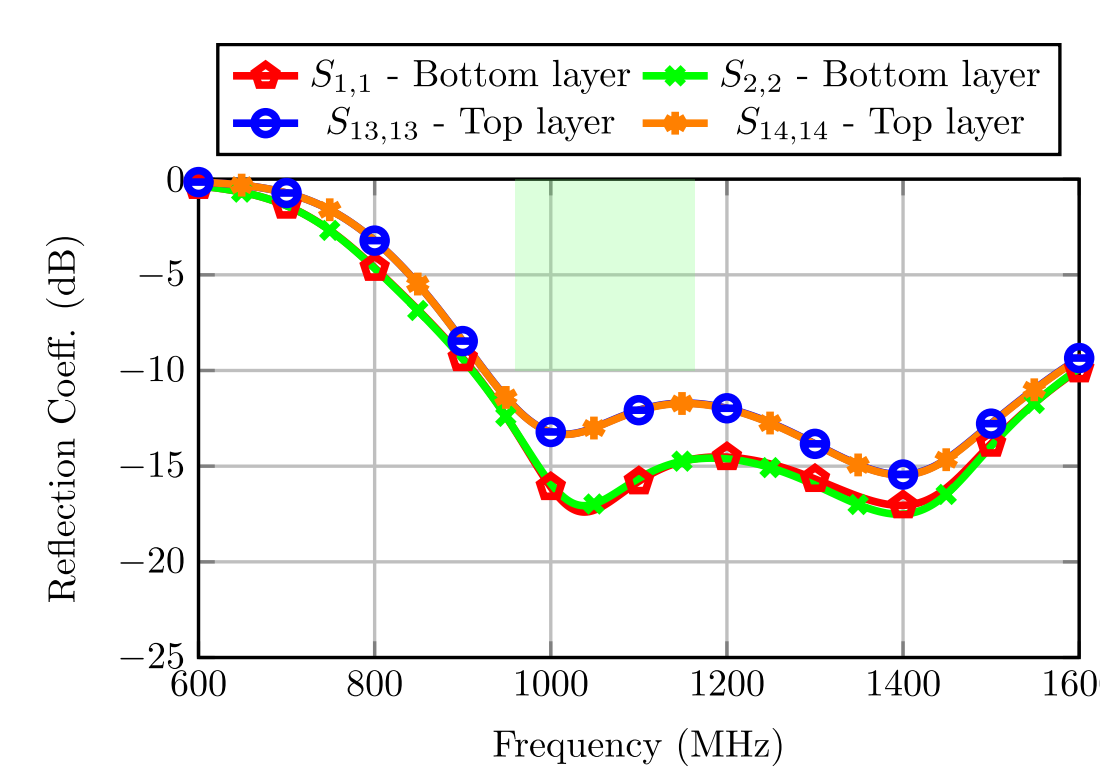
### 6x2 cone-shaped array



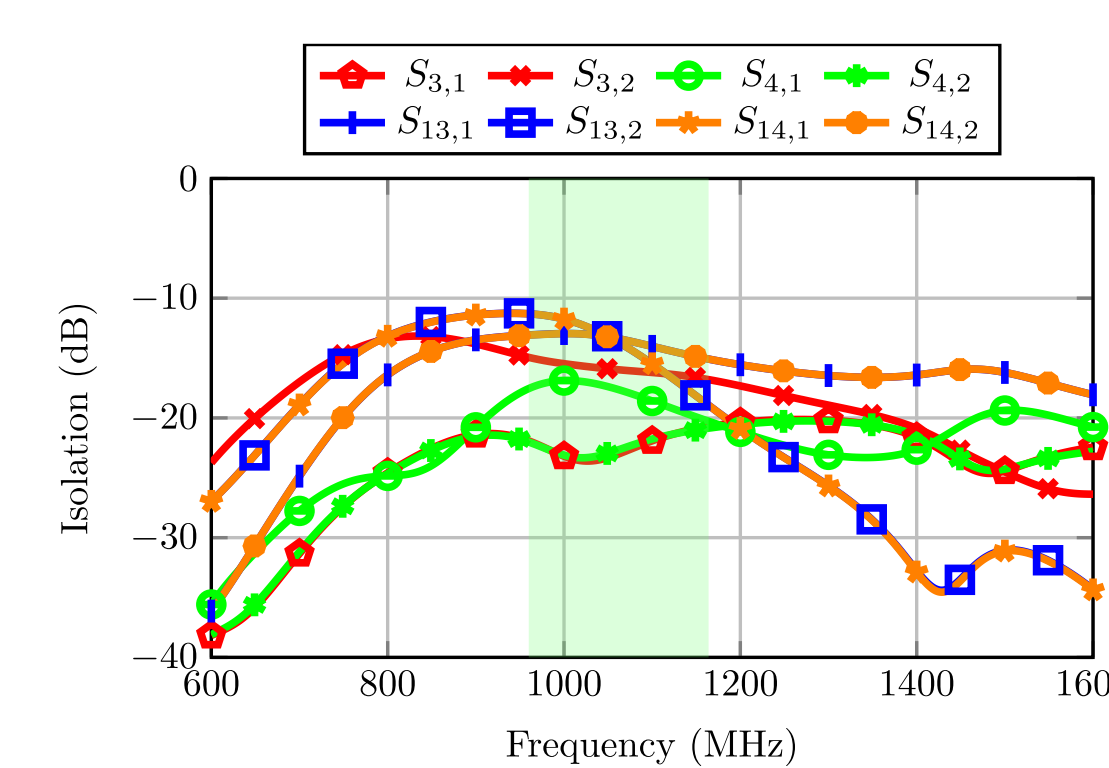
Pattern of 1 sector (60°) - 2x1 array



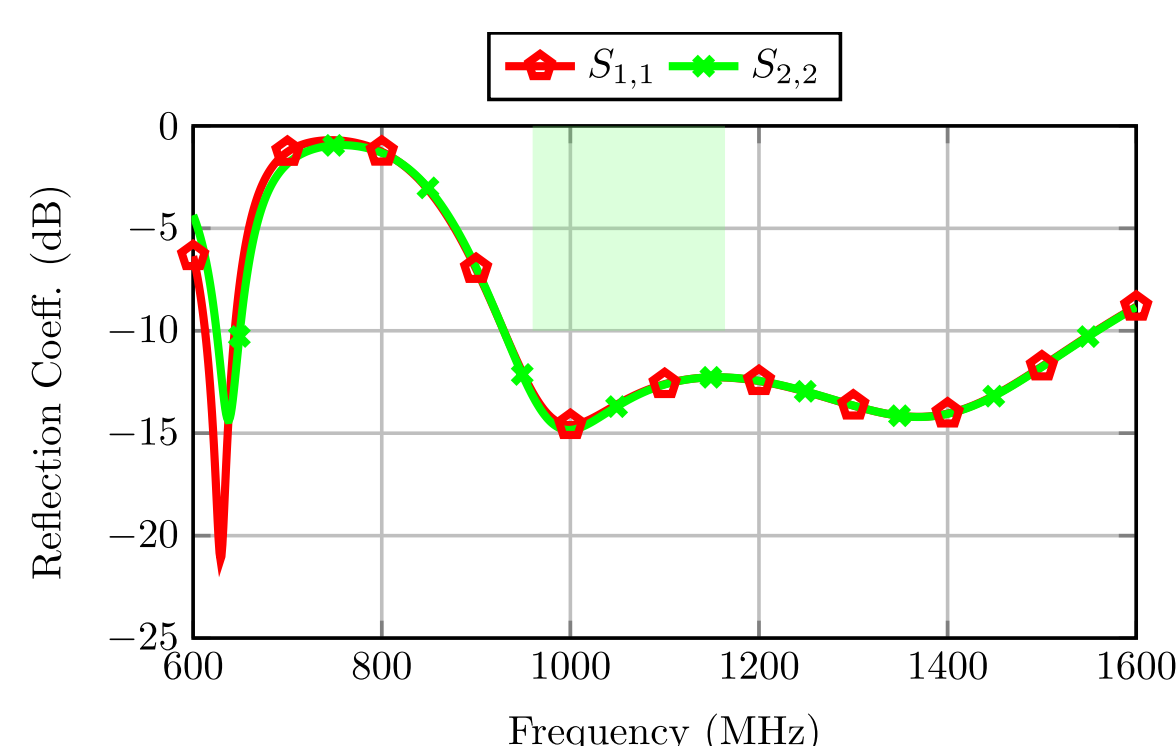
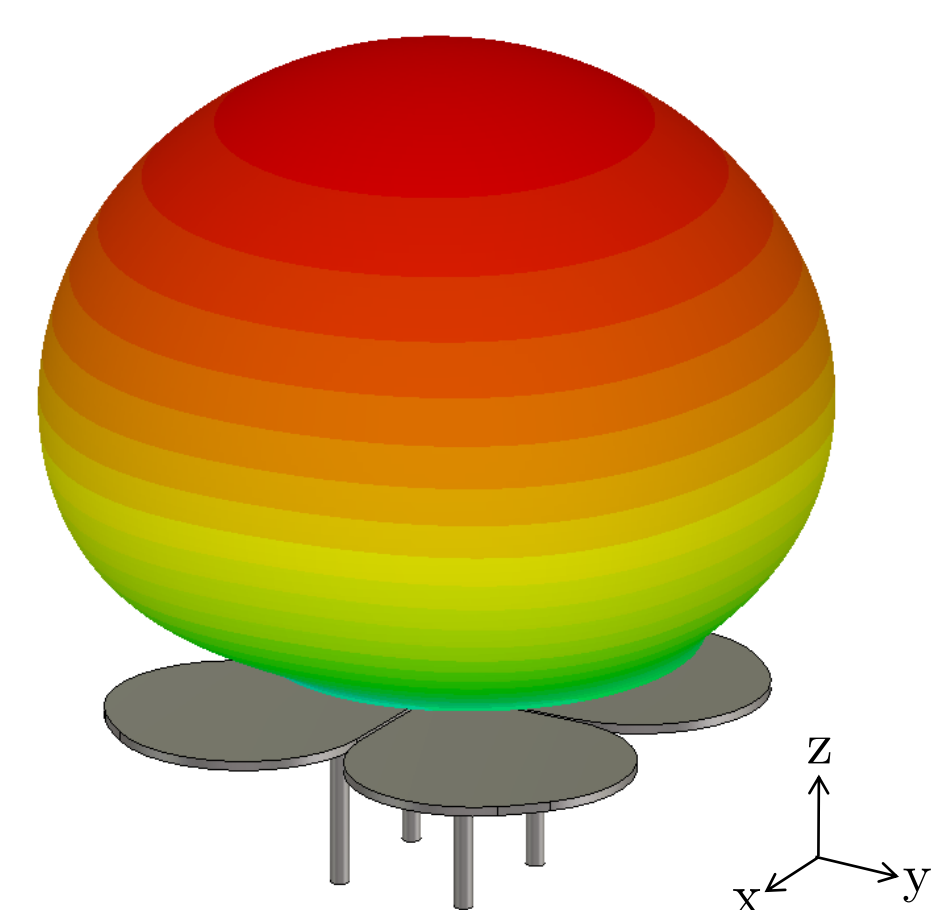
- Directivity = 9.56 dBi
- Radiation efficiency = 92%



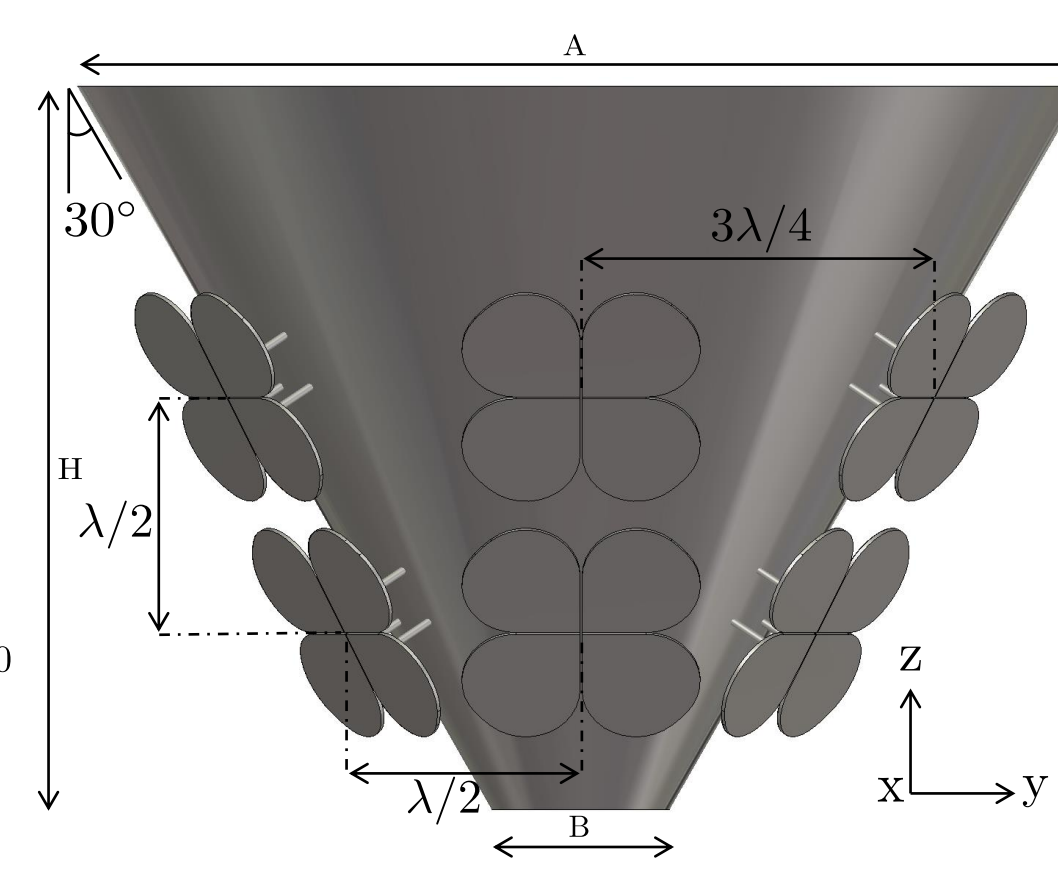
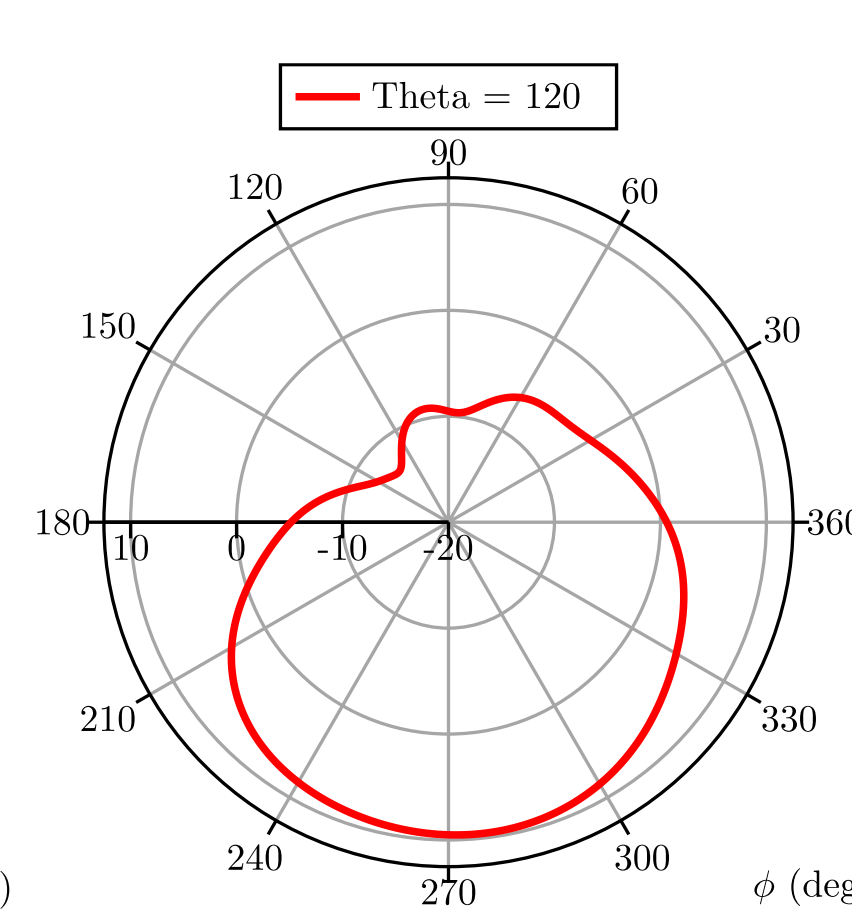
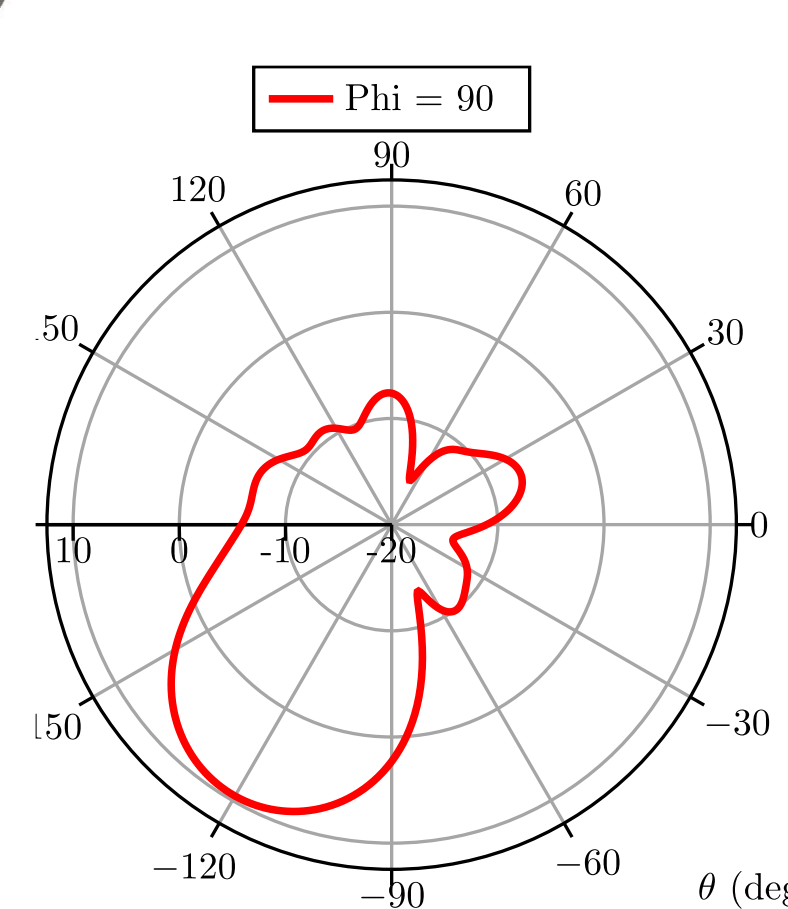
- Adaptation @ 1090 MHz = -12.2 dB
- ADS-B operational band covered
- Bandwidth = 650 MHz



- Coupling @ 1090 MHz = -13.8 dB
- Coupling mostly below -15 dB across ADS-B operational band covered



- Directivity = 9.32 dBi
- Radiation efficiency = 95%
- Adaptation @ 1090 MHz = -16.6 dB
- Bandwidth = 700 MHz



Dimensions of cone array in mm

A	B	H
510	90	366