

# GEODA-SARAS: Multi-Phased Array Planar Antenna for Satellite Communications

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## I. INTRODUCTION

Nowadays, earth stations have as a common feature the use of large reflector antenna for downloading data from satellites [1]. Large reflectors have impairments such as mechanical complexity, low flexibility and high cost. Thus, the feasibility of other antenna technologies must be evaluated, such as conformal adaptive antennas based on multiple planar active arrays [2]. In the scenery under study, the capability to track several satellites simultaneously [3-4], higher flexibility, lower production and maintenance cost, modularity and a more efficient use of the spectrum; are the most important advantage to boost up active antenna arrays over large dishes.

## II. ARRAY GEOMETRIC STRUCTURE

The GEODA-SARAS is an evolution of GEODA and GEODA-GRUA [5-10]. This antenna consists of a flat array system in the S-band covering the transmission band (2.025-2.12GHz) and reception band (2.2-2.3GHz), on which each of the radiating element must be capable of generating two crossed polarizations and working simultaneously in transmission and reception.

The radiating elements are grouped into “cells” or subarrays which contains five elements arranged in a grid so that they can be integrated into a bigger antenna. The selected cell is performed by grouping five elements to form a trapezoidal shape as is shown in the Figure 1. Each of the cells must have the corresponding elements to add the signal coming from the radiating elements with the selected phase and polarization. The final input and output radiofrequency ports in a cell group the signal from all the radiating elements in the cell.

The set of the integrated cells into a “panel” forms a mechanically robust set and sealed in such a way that it can support weather conditions and have the necessary points of entry and exit of the information signals, control and calibration signals and power input. In this antenna the selected panel is a triangular array of 45 elements grouped in five element modules as shown in Figure 2.

## III. RADIOFREQUENCY CIRCUIT FUNCTION DIAGRAM

Each one of the radiating elements has associated an RF circuit which allows working in both circular polarizations, either in transmission or in reception modes simultaneously.

Furthermore, we must have into account two simultaneously receivers which can work with the same or different polarization and with different pointing direction of the overall antenna.

The antenna element works in two orthogonal linear polarization modes and we need a combination through a 90 degree hybrid circuit to obtain the desired circular polarization. The position of this hybrid in the RF chain is important if we want to obtain good polarization quality and low noise receivers. Finally the RF schematic of the RF chain is shown in Figure 3.

## IV. FREQUENCY CONVERSION

The RF output from each antenna module is connected to the frequency conversion block through a beam switching block. The function of this beam switching block is to select the appropriate beam and size of the final array to be connected to each receiver or transmitter system. Each panel will include a frequency conversion block with nine converter chains. Nine Intermediate Frequency (IF) outputs will be connected to the digital receivers.

The overall antenna will be provided by fifty four digital receivers and the fifty four frequency conversion chains are going to be implemented in six conversion blocks. The main schematic diagram of the frequency conversion block is shown in Figure 4. It is important to remark that the local oscillator is the same and in phase for the nine receivers in a block.

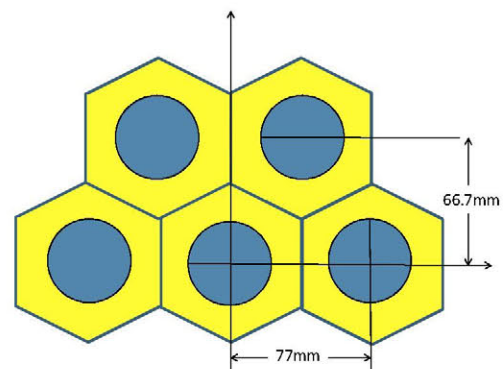


Figure 1. Cell module with five radiating elements

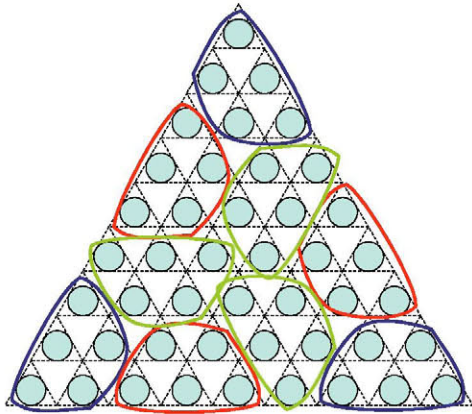


Figure 2. Triangular panel with nine cells and forty five radiating elements

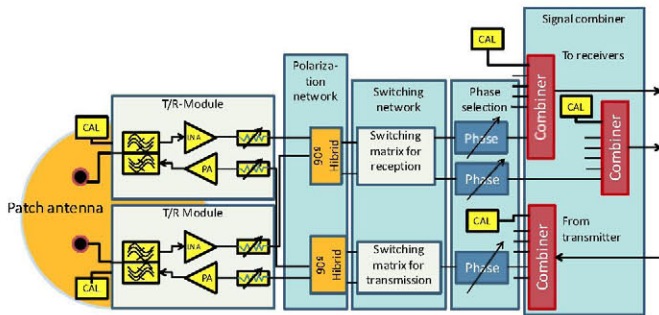


Figure 3. Transmission and reception diagram

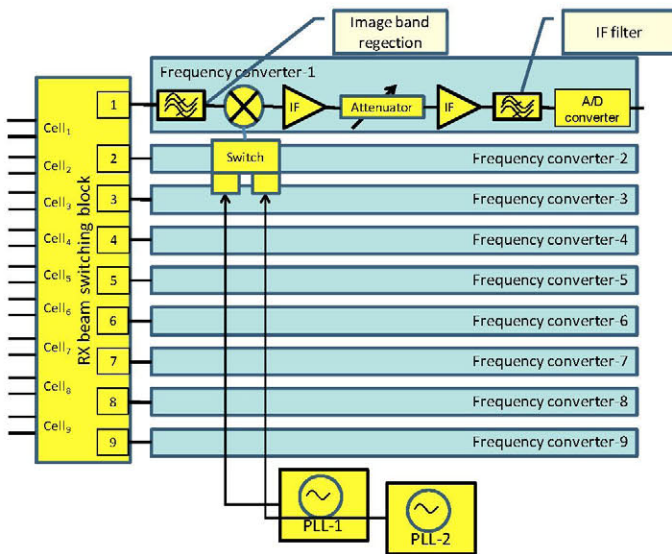


Figure 4. Frequency conversion diagram

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