# Design of the Multibeam Reflector Antenna for GEO flexible Satellite

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***Abstract*—This paper presents a multibeam reflector antenna fed by array elements for GEO flexible satellites. The reflector structure is designed within the constraints of satellite mounting. The array feed network with shared elements have close beam spacing, compact volume and light weight. A feed component assembled with a horn and a polarizer is also designed. The antenna composed of a reflector and feed components with optimal feed excitations forms four beams on the Korean Peninsula and surrounding marine areas for universal service.**

***Keywords—reflector, array feed network, horn, polarizer, flexible satellite***

## I. Introduction

Recently, the demand for universal communications and broadcasting services and high throughput satellite (HTS) through geostationary (GEO) satellites is increasing [1]. In addition, the need to respond to the paradigm shift in 5G/6G communication technology is growing [2]. These technologies can perform missions to improve the welfare and convenience of the people, such as strengthening disaster and safety response capabilities in marine and mountainous environments, and resolving fringe areas.

In order to satisfy such service needs, GEO satellites with flexible beam configuration should be able to respond to various service scenarios. This requires a multibeam reflector antenna fed by array elements. In this paper, we present the design results of the multibeam antenna based on the development heritage of Chollian 1 (COMS) communication payload [3].

## II. Multibeam Antenna Design

### *A. Antenna Configuration*

To form a multibeam in the Korean Peninsula, an array-fed reflector antenna type [4] is selected for appropriate gain at edge of coverage (EOC) and high efficiency [5]. The configuration of the reflector antenna should be optimized within the constraints for satellite mounting. The reflector with the array feed network is designed by the optimizing the reflector geometry, array element placement, and feed excitation coefficient. The structure of the mounted reflector antenna with the array feed network is shown in Fig. 1. The reflector and the feed network will be mounted on the lateral panel of the satellite bus.

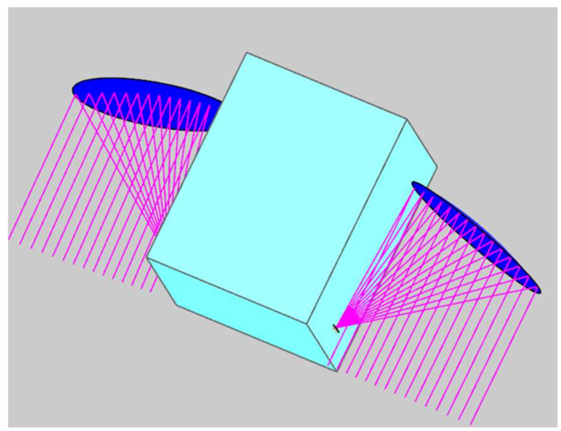


Fig. 1. Structure of Multibeam Rreflector Antenna for GEO Satellite

### *B. Array Feed Network*

The array feed network consists of horns, polarizers, a beam forming network. The feed array elements are arranged in a hexagonal grid [6] as shown in Fig. 2. The distance between array elements is about one wavelength and the axis of array elements is tilted to form the proper beams in the Korean Peninsula. The feed elements of each beam are partially shared so that the spacing between individual beams can be closer and also reduce volume and weight. A single beam is formed by from 7 to 12 elements. The feed excitations are optimized within the signal amplitude range of 10 dB for easy implementation.

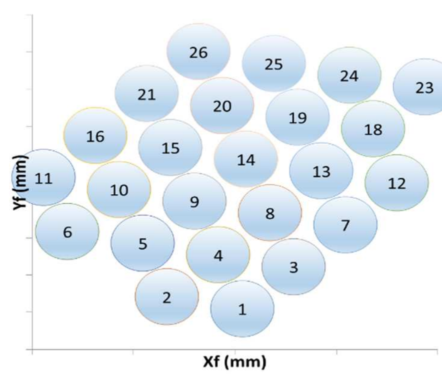
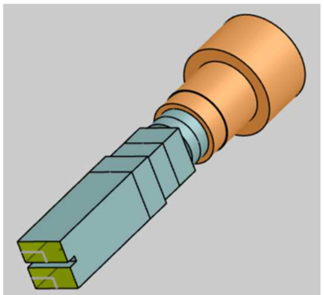
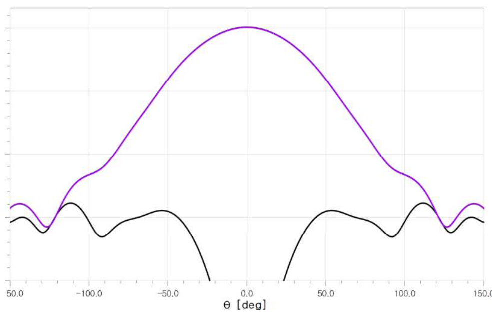



Fig. 2. Layout of Array Feed Network

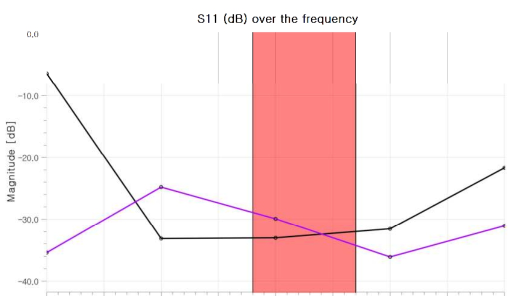
The horn is a pure mode [7] conical horn due to the limited the feed spacing. The polarizer can operate two orthogonal polarizations by a septum. Fig. 3 shows the characteristics of assembly of a horn, a polarizer, and transitions. The simulated radiation patterns of the assembly have a good symmetric characteristic and low cross-polarization level. The return loss is computed above 30 dB in red shaded frequency range.



(a) Assembly Structure




(b) Computed Radiation Pattern of an Assembly (Purple line: Co-polarization, Blcak line: cross-polarization)




(C) Computed Reflection Coefficient of an Assembly (Purple line: Assembly, Black line: Horn-only)

Fig. 3. Assembly of a Horn, a Polarizer, and transitions

### *C. MultiBeam Analysis*

The beam contours are analyzed by the optimally designed reflector and feed network as shown in Fig. 4 [8]. Four beams cover the Korean Peninsula and the maritime area. Gain performance meets the specification over the full operating frequency range, which can increase the service flexibility.

## III. Conclusions

In this paper, the design of the multibeam reflector antenna for GEO satellite was presented. According to the design results, it was confirmed that both the Korean Peninsula and the surrounding maritime area can be serviced. The feed components will be manufactured and tested in the near future to verify the design results.

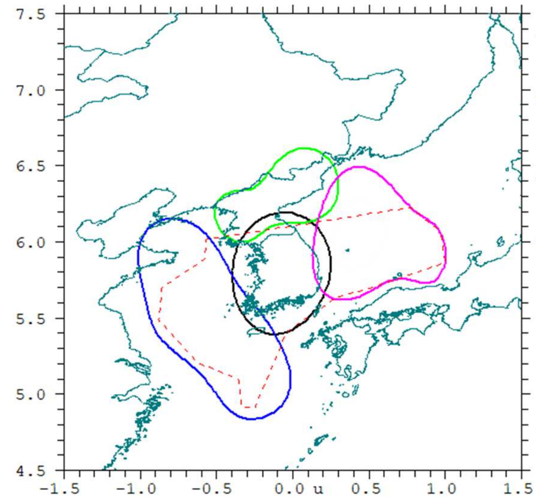



Fig. 4. Beam Contours of the Array Fed Reflector Antenna (Simulated)

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