

CHARACTERISTICS AND APPLICATIONS OF MULTIBEAM
SPACECRAFT ANTENNAS

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Summary

The basic characteristics and the potential benefits of multi-beam antennas for spacecraft applications are analyzed in terms of performance improvement, spectrum utilization and cost.

The high gain associated with directive, narrow beams can be traded to achieve higher capacity, reduced satellite power, or the reduction of the terminal gain. The identified advantages of multiple isolated beams are the efficient spectrum utilization to increase the effective bandwidth (see Fig.1), the capability of reducing earth-based interference, and the reduction of terminal cost.¹

Specific design examples are shown for a number of different antenna configurations such as

multiple feed reflector antennas, lens antennas, and phased arrays (Fig.2)².

Relative cost and performance parameters are established, and total systems cost savings are estimated for multi-user satellite systems for communications, air traffic control and television broadcasting applications.

References

- 1.) Y. Tamura, "Basic Characteristics and Benefits of Multibeam Antennas", (Private Communication).
- 2.) K.G. Schroeder, "Technology Trends in Spacecraft Phased Arrays", EASCON '70 Convention Record, pp. 113-120

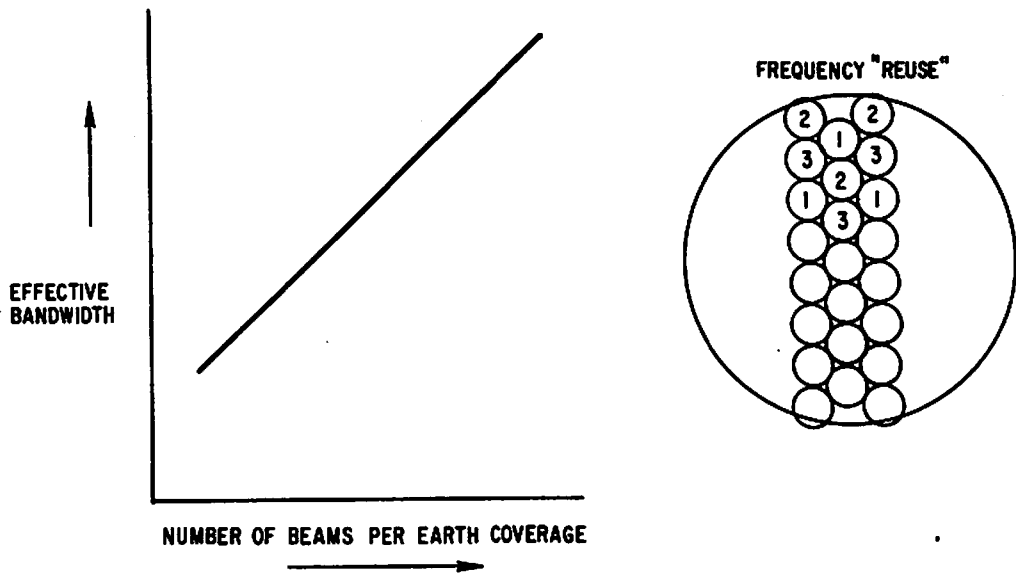


Fig. 1: Effective Bandwidth Increase by Frequency Re-Use

TYPES CHARACTERISTICS	REFLECTOR TYPES		PHASED ARRAY APERTURE		LENS (MULTIPLE FEEDS)		HYBRID REFLECTOR-PHASED ARRAY	
	PRIME FOCUS	CASSEGRAIN	CORPORATE FEED	BOOTLACE LENS (OPTICALLY FED)	LUNEBERG	WAVEGUIDE	CASSEGRAIN GEOM.	OFFSET GEOM.
REMARKS	MULTIPLE FEEDS	MULTIPLE FEEDS	GAIN LOSS	CONSTRAINED LENS TYPE	SPHERICAL LENS	CONSTRAINED LENS	PARABOLIC REFLECTOR WITH REFLECT-ARRAY	CONFOCAL PAR. REFLECTORS WITH ARRAY
SCAN CAPABILITY / FIELD OF VIEW	LIMITED BY COMA & BLOCKAGE	LIMITED BY BLOCKAGE & COMA	LARGE	LARGE	NONE	ADEQUATE	LIMITED BY BLOCKAGE	ADEQUATE
NUMBER OF BEAMS	LIMITED BY SCAN	LIMITED BY SCAN	MULTIPLE STEERABLE BEAMS	MULTIPLE FIXED BEAMS	MULTIPLE FIXED BEAMS	FIXED BEAMS	LIMITED	ADEQUATE
WEIGHT	LIGHT	LIGHT	HEAVY FOR FULL PHASED ARRAY	HEAVY FOR FULL PHASED ARRAY	HEAVY	LIGHT	ADEQUATE	ADEQUATE
SIZE	LARGE	LARGE	ADEQUATE	ADEQUATE	LARGE	LARGE FOCAL LENGTH PROBLEM	LARGE	PROBLEMS
SIDELobe LEVEL DB	-20	-20	-30	-25	POOR	-20	-25	-25

Fig. 2: Summary of Multiple Beam Antenna Configurations