

**AN INTEGRATED 20/30 GHz MULTIBEAM/MULTIPOINT  
ANTENNA SYSTEM FOR FIXED SATELLITE SERVICES**

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Satellite trunk communications in Europe, such as those presently offered by the Eutelsat organization, are typically operated among a limited number of national ground stations, corresponding to switching centres at the highest hierarchical level of the terrestrial network (International Switching Centres, ISC's).

In order to cope with the future expansion of the Eutelsat service, a satellite system has been envisaged, operating at 20/30 GHz and generating a set of high gain spot beams (City beams) on a number of earth station locations over Europe (figure 1).

The antenna system suitable for this mission has been designed, developed and space qualified by Selenia Spazio under a multiyear R&D contract for the European Space Agency (ASTP 20/30 GHz Multiple Beam Antenna Contract).

Representative components of the antenna are described, such as the feed array, the beam forming network (BFN), adopting an original feed sharing technique (joint ESA-Selenia Spazio patent) and the 3.7 meters foldable tip reflector (figures 2, 3).

The paper also presents a novel adaptive transponder architecture (Patent Pending) based on the use of a Butler matrix multipoint amplifier.

One major drawback of satellite communications at 20/30 GHz is constituted by the high margins for rain attenuation.

In order to guarantee the required downlink availability in worst case condition, TWTA's have to be oversized by a factor equal to the rain attenuation margin.

One effective method of overcoming this problem is the site diversity scheme which, on the other hand, implies a duplication of the number of earth stations.

In the hypothesis of a single earth station per spot beam (which is quite realistic if, e.g., a trunk telephony service over Europe is considered), a more attractive method has been conceived.

The proposed transponder configuration envisages the use of a multipoint amplifier, in order to allow a flexible sharing of the available RF power among the beams, and the implementation of a dynamic control of the EIRP toward each individual spot beam (figure 4).

Such adaptive EIRP control can be achieved either by realizing a coordinated power control of the earth station uplinks, or by varying the setting of variable gain driver amplifiers (VGA's), feeding the multipoint amplifier.

In both cases, the management of the system has to be performed by a Master Control Station, which, according to telemetry messages about the rain attenuation experienced at the earth station locations, will command a different sharing of the on-board RF power among the spot beams.

The described method, taking advantage of the statistics of rain attenuation at non-correlated earth station sites, is able to consistently reduce the RF power demand on-board the satellite, with savings in the order of about 2 dB's (as compared with a "conventional" saturated output amplifier configuration).

A further application of the Multipoint Amplifier is being considered by SES for a multimission domestic satellite aimed at providing HDTV broadcasting at 12 GHz, and programmes relay between transportable terminals, everywhere within the national territory, and Programme Production Centers located in the North, Center or South of Italy.

A 20/30 GHz four channel repeater is being baselined to this last service.

A 2 mt antenna reflector, fig. 5, uses a dichroic subreflector and independent 20 and 30 GHz feed clusters and BFN's to provide three highly overlapped spots over Italy from 19° West.

The payload block diagram is shown in fig. 6.

Full traffic reconfigurability, an important performance factor for this application, is achieved by means of a 3 x 3 I.F. switching matrix and a 20 GHz multipoint amplifier constituted by four 20W TWTA (in a 2 times 2/3 redundancy scheme).

#### REFERENCES

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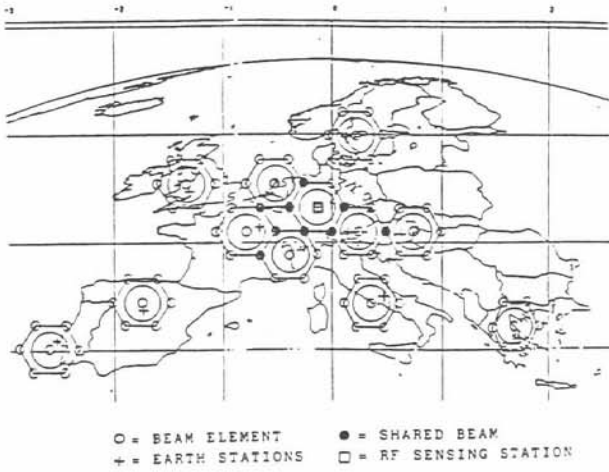


FIG. 1 - BEAMS ELEMENTS TOPOLOGY DEFINITION FOR RF SENSING AND CITY BEAMS

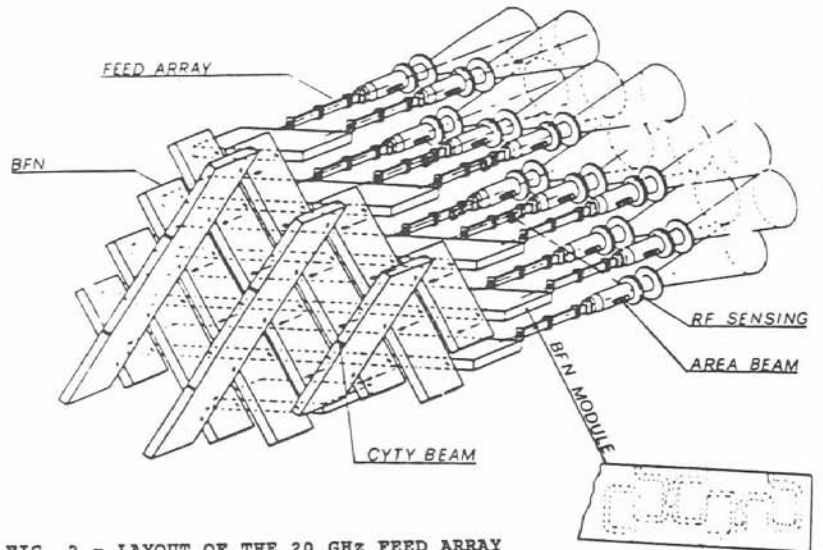


FIG. 2 - LAYOUT OF THE 20 GHz FEED ARRAY

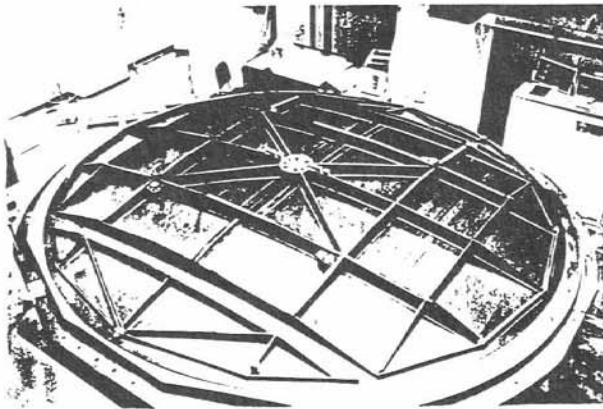


FIG. 3- 3.7m REFLECTOR WITH FOLDABLE TIPS

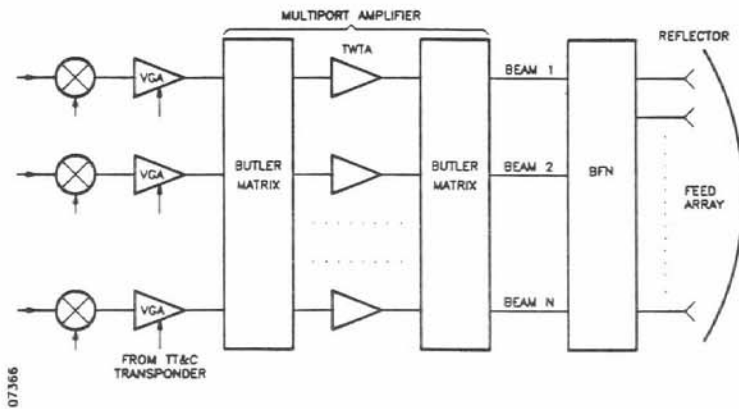


FIG. 4 - ADAPTIVE TRANSPONDER - TX SECTION BLOCK DIAGRAM

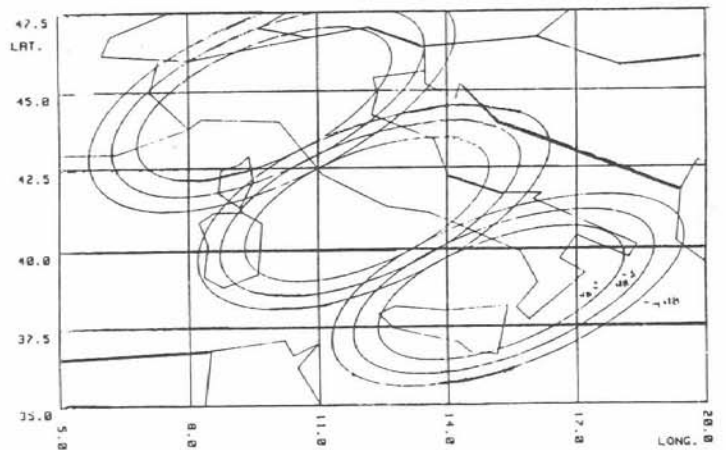


FIG. 5 - SPOT BEAM COVERAGE OF ITALY FROM 19° WEST

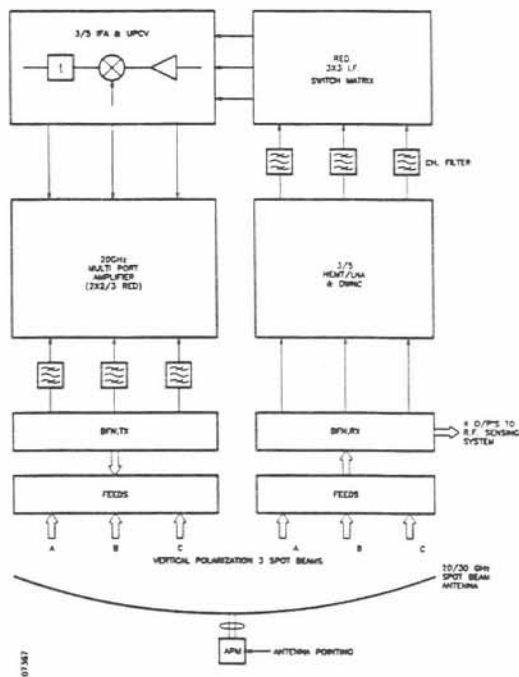


FIG. 6 - WIDEBAND PAYLOAD SIMPLIFIED BLOCK DIAGRAM