MULTIKARA (Multibeam Ka-band Receiving Antenna for future “multimedia via satellite, direct to home” systems)

Start date: 01/01/2000  
End date: 28/02/2002  
Action line: IST 1999 - IV.5.4

Main Objectives
To allow European citizens to take advantage of the Information Society, new multimedia services are needed, such as very fast internet, distance learning, tele-medicine etc. To break US monopoly on this market, the European space industry must provide high rate communications via satellites, complying with constraints of user equipment, such as small sized antennae and low power transmitters. The best, most cost-effective solution suggests multi-beam satellite antennae in the Ka band (18-31 GHz), the only non-saturated one available. Development of such a receiving antenna constitutes one of the most technical challenges for successful exploitation of multimedia via satellite systems, for which no satisfactory answer is available today. The MultiKaRa project will design and test innovative multi-beam receiving antenna around 30 GHz with its associated microwave circuits and evaluate its feasibility for future in-flight use.

Example of a grouped European coverage

Technical Approach
Classical receivers with passive multi-beam antennae use a very light reflector with several horns located near the parabola focus, each connected to a separate satellite transponder. Required gain and isolation between spot-beams would need at least 4 receiving antennae and cumbersome motors to compensate for the spacecraft movements. To overcome this problem, two new multi-beam antenna architectures will be evaluated, all permitting to use a single antenna:

- An Active Focal Array Fed Reflector (FAFR) antenna with a single reflector, each horn contributing to several beams. It is electronically steerable for fine pointing. Main advantage is that the high gain is provided by the large reflector, with minimum number of horns. Currently, such antennae have only been implemented only in X or Ku bands, with a very limited number of beams (3 to 8, instead of presently 64).

- A FAFR with multiport amplifiers.

These two antenna architectures require a detailed trade-off phase before choice and associated specifications. However, all use some common basic blocks, which constitute the main critical points for their feasibility, and will be studied in MultiKaRa: Very low noise amplifiers, at about 30GHz/signal matrix combiners with low loss, good amplitude and phase accuracy, together with small volume and mass/controllable MMIC phase shifters and attenuators/ Cold thermal control, for lowering their LNA’s noise figure.

Key Issues
- Completion of the analysis of the different candidate antenna architectures with software simulation.
- Detailed design and result from validation breadboards for the common critical blocks.
- Completion of the demonstrator assembly.
- Analysis of measurements on the critical parts and the overall Demonstrator, optimisation proposals and overall conclusion on the architecture feasibility ad suitability for in-flight purposes.
**Expected Impact**

Assuming that about one third to one half of the Ka-band GEO Systems multimedia projects (extract from the conclusions of the DTT Consulting Ka-band report of 1998) will actually be implemented and that each system comprises 2 to 5 satellites, 20 to 30 multi-beam receiving antennae, as targeted by MultiKaRa, will be open to the competition.

Based on an acceptable market share of 30% this would lead from 2003 to 2010 to an expected impact for multikara partners of:

- around 6 to 7 antennae + front ends
- a turnover of about 100 M€ (including Engineering and qualification models)

In such a case, the return on investment would be $100/4 = 25$.

**List of participants**

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