FRACTIONATED SATELLITES: A NEW WAY TO FEED ULTRA HIGH THROUGHPUT SATELLITES

Jean-Didier Gayrard

Thales Alenia Space, 26, avenue J-F Champollion, 31037 Toulouse, France
e-mail: jean-didier.gayrard@thalesaleniaspace.com

Abstract

Ultra or Very High Throughput Satellites (U/VHTS), operating in the Ka-band (20/30GHz), are very large satellite with multi-beam coverage able to provide several hundreds of Gigabits to few Terabits per second of aggregated throughput. The supply of these huge amounts of data to such a satellite is done by hundreds of wideband RF links, called feeder links, which operate in Ka-band (30GHz) and in Q/V-band (40/50GHz) between the satellite and a network of hundreds of ground (feeder/gateway) stations. Moreover, the poor availability of Q/V-band links in wet regions (such as Europe) requires additional back-up gateways (site diversity technique), further increasing the size of the ground network. In short, the cost of developing and operating such large station network becomes the preponderant part of the cost of a VHTS and could become an obstacle to the development of the future generation of UHTS whose ambition is to exceed the Terabit of capacity.

Today, none of the known techniques to reduce the number of gateway/feeder stations gives full satisfaction and have enough room for improvement. Thanks to an ESA supported study, nicknamed MATRIX for “Innovative fractionated satellite system enabling higher reuse of frequency”, Thales Alenia Space was able to describe a very promising solution. This solution aims on one hand at reducing the complexity and cost of the feeder segment infrastructure and on the other hand at allowing its flexible and progressive deployment. It is based on two innovations: the concept of fractionated spacecraft and the use of free space optical (FSO) communication technologies. The fractionation consists of separating the feeder function (links between gateways and satellite) that will be provided by several « Feeder Satellites », from the user function (link between satellite and user terminals) that will be done by « User Satellites ». The links between Feeder Satellites and User Satellites are provided by standardized Optical Inter-Satellite Links (OISL).

This paper presents the concept of fractionated VHTS as developed in the MATRIX study. It demonstrates the technical feasibility and the economic viability of this new product. The main value proposition of this new product is the promise of the gradual evolution from Radio-Frequency and transparent feeder links to optical and regenerative feeder links by tailoring the Feeder Satellites and standardizing the OISL. Optical feeder links will allow increasing the capacity of the system while reducing the complexity of the feeder ground segment.