SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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D-RAISE: A PROPULSION SYSTEM FOR GEO SATELLITE PLATFORMS TO REDUCE OPERATIONAL RISKS AND TIME TO ORBIT.

Abstract

The present satellite era is characterized by a radical step change on satellite engineering and on how satellites are launched, financed, operated and commercialized. One of the main satellites differentiating factors is directly linked with the possibility of building, launching and operating lighter satellites for geosynchronous applications. Satellite communication GEO platforms using chemical propulsion typically weight about 6 tons, where about half of the total weight is propellant. Two thirds of the on-board propellant is dedicated to the transfer maneuver to geostationary orbit. In order to reduce the lift-off satellite mass, chemical propulsion systems are being substituted with electrical propulsion systems. Today, satellite operators identify, case by case, the best ideal satellite platform for their mission considering different factors, as the time to operation and the costs at launch. Options for satellite architectures include full-electric, full-chemical and hybrid electric-chemical propulsion platforms. In this paper, after presenting advantages and disadvantages of GEO satellite platforms based on different propulsion technologies, the authors focus on the benefits of a "flexible hybrid orbit raising" strategy, which tailors the acceleration of perigee raise, during satellite transfer orbit, up to a predetermined optimal altitude, thus taking advantage of the performance of a full electric platform while reducing the time to orbit and decreasing the operational risks. A comparison of a hybrid orbit raising strategy based on liquid bipropellant/electric propulsion against a hybrid orbit raising strategy based on solid/electric propulsion indicates that commonly adopted hybrid solutions, based on liquid bipropellant propulsion, are competitive only for "full-range" solutions, where most of the perigee raise is done via chemical propulsion. For all the other "mid-range" cases the ideal solution is in the adoption of an architecture based on solid/electric propulsion. Notwithstanding the high flexibility featured by the solid propulsion solution, the paper pauses on 2 customized device applications, called D-Raise, which address two specific class of requirements: 1. a GTO perigee altitude raise above 500 km, which reduces technical risks and complexity of operations while the satellite transition the atmosphere layers; 2. a GTO perigee altitude raise up to 10,000 km, which reduces operational risks in the Van Allen belt most critical area and significantly reduce the satellite transfer time to GEO.