SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Space Communications and Navigation Systems (6)

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SATELLITE PAYLOAD STRUCTURE ANALYSIS FOR BROADBAND SATELLITE COMMUNICATION ON HIGH-SPEED TRAINS

Abstract

The terrestrial mobile communications system for high-speed trains is imperfect due to the high speed and complex terrestrial channel environments. Broadband communication on high speed trains is a vast potential market in China for communication satellites. In this system, passengers can get access to the Internet with laptops or mobile phones via the on-board satellite terminals and broadband communication satellites.

There are great differences between the broadband satellite communication system on High-speed trains(CoHiT) and the traditional one for fixed users, mainly on the communication channel and the mobility of users. As the high-speed trains move along fixed routes according to the schedules, the users have obviously deterministic mobility and locations. These features may affect the optimization of satellite payload structure design. There are mainly two types of payload structures for broadband satellites. One is the traditional design in which one power amplifier is allocated to one beam, such as that of KaSat and ViaSat. Another one is based on the Multiport Amplifier(MPA) structure, in which several power amplifiers are corresponding to several beams. The latter can provide more power flexibility among beam s and is already adopted by WINDS(Wideband InterNetworking engineering test and Demonstration Satellite).

In this paper, we introduce two types of payload structures briefly. According to the characteristics of the high-speed trains' applications, the two structures are compared to show their differences in the CoHiT application. For future analysis, two preliminary payload designs for China are proposed as examples. Simulations are performed according to the high-speed trains' schedule in China. And the results show that, the payload structure with MPA is more suitable for CoHiT, and can save more power for the payload.

Considering the movement regularity of the high- speed trains, a further comparison is performed between 4x4 MPA and 8x8 MPA. A method is proposed to optimize the allocation between the MPAs and beams to satisfy the spatial and temporal distributions. Finally, an optimized payload structure is acquired. Simulation result shows that, the proposed payload design and optimization method can save around 10% power compared to the traditional structure with the same capacity.