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MANAGEMENT METHODOLOGY FOR SATELLITE-TERRESTRIAL INTERCONNECTED SYSTEMS WITH FLEXIBLE SATELLITE PAYLOADS

Abstract

In this paper, we propose a management methodology for satellite and terrestrial interconnected (STI) systems with flexible satellite payloads and verify the effectiveness of our proposed methodology in a numerical simulation.

Combining non-terrestrial networks (NTN) and terrestrial networks (TN) in the STI system can expand communication coverage in future wireless communications systems. However, to efficiently manage the STI systems and allocate limited NTN resources to NTN and TN users, we have to cope with differences between NTN and TN systems, such as link quality, traffic variation period, and required control period. Moreover, we mainly focus on NTN nodes that implement flexible payloads with a multi-beam antenna. The flexible payloads include a digital channelizer for frequency flexibility, which can flexibly change frequency assignment for each beam, and a digital beamformer for area flexibility, which can flexibly change beam position and size. Therefore, the STI system's management system also has to include a control procedure for these flexible functions.

This paper proposes a methodology to efficiently manage the STI system with the flexible functions. We first model the STI system by defining system components and their roles. Then, we assume that when NTN and TN users request communication services, they present quality of service (QoS) parameters such as resource type, guaranteed bandwidth, priority, and allowed delay. We investigate some algorithms implemented in the management system to determine network configuration and resource allocation to meet users' requirements by utilizing these QoS parameters. Furthermore, a congestion control scheme is included in the proposed methodology to maximize the number of users receiving the NTN resources and communication services. The proposed procedure can cope with multiple users sharing NTN resources by prioritizing the users based on the QoS parameters.

Finally, we verify the effectiveness of the proposed management methodology in a numerical simulation. In this simulation, we model the STI system with multiple NTN and TN users who share the NTN resources and focus on frequency flexibility as the flexible payload. As a result, we confirm that our proposed methodology works in the STI system with the frequency flexibility and increases the performance of the STI system.