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EDITORIAL

Toward Space–Air–Ground Information Networks: Next Frontier for Wireless Communications

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Given the ever-increasing demand for emerging services exemplified by wide-area Internet of Things, submarine communication, etc., flexible and seamless coverage has been regarded as an urgent need for the upcoming sixth generation [1–3]. Therefore, different types of space/air/terrestrial platforms need to be connected to existing terrestrial networks to break the isolation of information islands and provide various services [4,5]. Specifically, as a powerful supplement for terrestrial networks, airborne and space communication infrastructures, such as low-Earth orbit satellite constellations [6,7] and unmanned aerial vehicles (UAVs) [8], are envisioned to be integrated to provide efficient information transmission with expanded coverage and satisfying quality of service, anywhere and anytime [9,10]. However, due to limited resources and the dynamic topology of both satellites and UAVs, there is a need to develop new communication architectures and protocols to complement and extend space–air–ground networks.

This special issue focuses on emerging space–air–ground techniques, aiming to identify critical challenges and propose feasible solutions. Following multiple rounds of review and revisions, 6 papers addressing key technologies in satellite communication and space–air–ground integrated networks have been selected for inclusion in this special issue.

Specifically, some scholars performed a comprehensive study on space–air–ground information networks. To handle end-to-end task processing in satellite edge computing, Qu et al. [11] formulated a joint optimization problem considering computation off-loading, routing, and multiresource allocation, where a binary-particle-swarm-optimization-based algorithm was proposed to reduce network overhead. By analyzing the challenge of synchronization in beam hopping systems, Hui et al. [12] proposed a signaling-assisted fast synchronization method and a high-precision synchronization method based on guide frequency assistance. Xiao et al. [13] divided the resilience enhancement process of a space–ground integrated network into 4 phases, namely, resistance, absorption, recovery, and reconfiguration, where the corresponding enhancement methods for each phase were provided. Zhang et al. [14] developed a multitask learning model based on convolutional neural networks to simultaneously recognize satellite signal types and modulation modes and then constructed a dedicated dataset covering different satellite signal protocols and channel models. Considering reliability, latency, and load, Wei et al. [15] proposed a controller placement method based on spectral clustering, which can optimize network utility function and improve both controller reliability and latency. Liu et al. [16] formulated the UAV path optimization problem in space–air–ground–Internet of Remote Things as a Markov decision process and applied the multiagent deep deterministic policy gradient algorithm to improve system throughput and reduce UAV energy consumption.

In conclusion, this special issue highlights the most recent progress in space–air–ground information networks, offering a comprehensive overview of groundbreaking research globally and sharing perspectives and practices from both Chinese and international researchers.

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