World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:18, No:06, 2024

Reconfigurable Intelligent Surfaces (RIS)-Assisted Integrated Leo Satellite and UAV for Non-terrestrial Networks Using a Deep Reinforcement Learning Approach

Authors : Tesfaw Belayneh Abebe

Abstract : Integrating low-altitude earth orbit (LEO) satellites and unmanned aerial vehicles (UAVs) within a non-terrestrial network (NTN) with the assistance of reconfigurable intelligent surfaces (RIS), we investigate the problem of how to enhance throughput through integrated LEO satellites and UAVs with the assistance of RIS. We propose a method to jointly optimize the associations with the LEO satellite, the 3D trajectory of the UAV, and the phase shifts of the RIS to maximize communication throughput for RIS-assisted integrated LEO satellite and UAV-enabled wireless communications, which is challenging due to the time-varying changes in the position of the LEO satellite, the high mobility of UAVs, an enormous number of possible control actions, and also the large number of RIS elements. Utilizing a multi-agent double deep Q-network (MADDQN), our approach dynamically adjusts LEO satellite association, UAV positioning, and RIS phase shifts. Simulation results demonstrate that our method significantly outperforms baseline strategies in maximizing throughput. Lastly, thanks to the integrated network and the RIS, the proposed scheme achieves up to 65.66x higher peak throughput and 25.09x higher worst-case throughput.

Keywords : integrating low-altitude earth orbit (LEO) satellites, unmanned aerial vehicles (UAVs) within a non-terrestrial network (NTN), reconfigurable intelligent surfaces (RIS), multi-agent double deep Q-network (MADDQN)
Conference Title : ICCWNC 2024 : International Conference on Cognitive Wireless Networks and Communications
Conference Location : Montreal, Canada
Conference Dates : June 13-14, 2024