Recent Advances and Future Directions for Blockchain-empowered 6G

Sungho Lee
School of Electrical & Electronic Engineering
Yonsei University
Seoul, Korea
seuho2003@gmail.com

Jemin Lee
School of Electrical & Electronic Engineering
Yonsei University
Seoul, Korea
jemin.lee@yonsei.ac.kr

Abstract—The massive connectivity among heterogeneous devices such as IoT is recognized as a prominent feature in 6G ecosystems. As the connectivity increases attack surfaces and security vulnerabilities, blockchain has been expected to play a key role in the aspects of security and availability in 6G. However, when blockchain processes data, transferred by head nodes over wireless channels, the low performance remains as an urgent issue to resolve for blockchain-empowered (BCE) wireless networks. In this paper, we analyze the timely update probability (TUP) in BCE wireless networks, and then provide design insights for the optimal deployment of BCE wireless networks, compared to conventional networks.

Keywords—Blockchain, 6G, unmanned aerial vehicles, data integrity.

I. Timely Update Probability (TUP)

We first consider UAVs that transfer data from various devices to base stations (BSs) for ledger updates. The delivered data are included into transactions to update the ledger for data integrity, as done in previous works on BCE 5G networks [1-3]. Therefore, the total latency that the data experience consists of the date transmission latency and the blockchain latency. In conventional UAV-related works [4], the optimal UAV height has been explored for the successful transmission probability (STP). In this work, however, we focus on the optimal UAV height for the TUP, which is defined as the probability that the sum of the data transmission latency and the blockchain latency is less than a target latency.

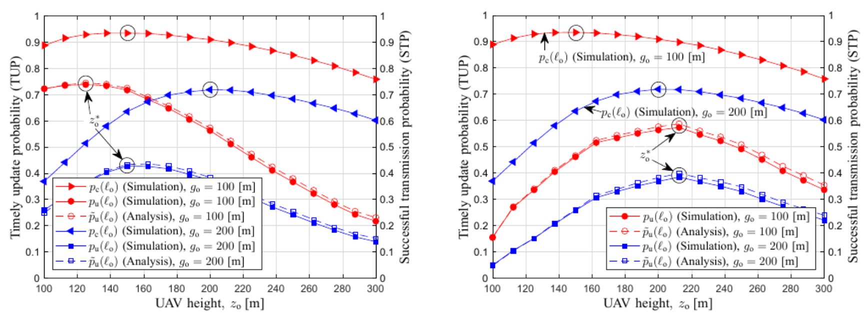

Figure 1. TUP and STP as functions of UAV height for different values of horizontal distance and transaction size.

In Fig. 1, the lines with triangle markers show the STP, and the ones with circle and square markers show the TUP. The transaction size is 20 and 10 [kB] in the left and right figures, respectively. We can see that the optimal UAV height for the TUP can be different from the one in the conventional UAV networks since the blockchain latency increases and decreases depending on the communication performance. We can also see that when more data are included into transactions, the TUP can be higher since the transaction generation rate decreases. Therefore, different from previous works, UAVs need to be deployed higher or lower to achieve better performance in BCE wireless networks.

II. Conclusions and Future Works

In this paper, we consider BCE wireless networks, where UAVs deliver data to blockchain over wireless channels. We then achieve higher performance in blockchain-empowered wireless networks, using significantly different solutions from the ones in conventional works. As future work, we will consider more communication and blockchain parameters for analysis.

[1] D. Saraswat et al., "Secure 5G-assisted UAV access scheme in IoBT for region demarcation and surveillance operations," IEEE Commun. Stand. Mag., vol. 6, no. 1, pp. 58-66, Mar. 2022.

[2] T. Hewa, A. Braeken, M. Liyanage, and M. Ylianttila, "Fog computing and blockchain-based security service architecture for 5G industrial IoT-enabled cloud manufacturing," IEEE Trans. Industr. Inform., vol. 18, no. 10, pp. 7174-7185, Oct. 2022.

[3] C. Feng, B. Liu, K. Yu, S. K. Goudos, and S. Wan, "Blockchain-empowered decentralized horizontal federated learning for 5G-enabled UAVs," IEEE trans. Industr. Inform., vol. 18, no. 5, pp. 3582-3592, May 2022.

[4] M. Kim and J. Lee, "Impact of an interfering node on unmanned aerial vehicle communications," IEEE Trans. Veh. Technol., vol. 68, no. 12, pp. 12150-12163, Dec. 2019.