Abstract

Cellular networks will play an important role in realizing the newly emerging. One of the challenging issues is to support the quality of service (QoS) during the access phase. The random access (RA) mechanism of Long Term Evolution (LTE) networks is prone to congestion when a large number of devices attempt RA simultaneously, due to the limited set of preambles. If each RA attempt is made by means of transmission of multiple consecutive preambles (Code words) picked from a subset of preambles by priority classes, collision probability can be significantly reduced. Selection of an optimal preamble set size can maximize RA success probability in the presence of a trade-off between codeword ambiguity and code collision probability, depending on load conditions. In recent work developed the Load-Adaptive Throughput-Maximizing Preamble Allocation (LATMAPA). LATMAPA automatically adjusts the preamble allocation to the priority classes according to the random access load and a priority tuning parameter. However the latest researches are unsuccessful in the assignment of regulating the parameters of load balancing and delay reducing algorithm and hence, to overcome this issue, a novel approach termed Improved Load-Adaptive Throughput-Maximizing
Preamble Allocation (ILATMAPA) is been introduced in this research work. Bat optimization algorithm based parameter tuning is employed to improve the throughput and an analysis is carried out to quantify the throughput, delay and drop ratio trade-offs of parting the preambles into two disjoint sets. For under loaded systems, realise a “safe” allocating region, in which class I prioritization is comparatively harmless for class II. An experimental result reveals that the proposed method decreases the delay access and increases the throughput.

References

1. Priller, P., Entinger, A., & Berger, A. (2019). U.S. Patent No. 10,193,572. Washington, DC: U.S. Patent and Trademark Office.
2. Khan, I., Belqasmi, F., Gliitho, R., Crespi, N., Morrow, M., & Polakos, P. (2015). Wireless sensor network virtualization: A survey. IEEE Communications Surveys & Tutorials, 18(1): 553-576.
3. Yao, Y., Cao, Q., & Vasilakos, A. V. (2013). EDAL: An energy-efficient, delay-aware, and lifetime-balancing data collection protocol for wireless sensor networks. IEEE 10th international conference on mobile ad-hoc and sensor systems, pp. 182-190.
4. Liu, Q., Wang, Z., He, X., & Zhou, D. H. (2015). Event-based recursive distributed filtering over wireless sensor networks. IEEE Transactions on Automatic Control, 60(9):2470-2475.
5. Yang, X., Deng, D., & Liu, M. (2015). An overview of routing protocols on Wireless Sensor Network. IEEE International Conference on Computer Science and Network Technology (ICCSNT) 1: 1000-1003.
6. Ghosh, R.K. (2017). Mobile Distributed Systems: Networking and Data Management. In Wireless Networking and Mobile Data Management, pp. 3-20.
7. Elhoseny, M., & Hassanien, A. E. (2019). Mobile object tracking in wide environments using WSNs. Dynamic Wireless Sensor Networks, pp. 3-28.
8. Marikkannu, P., & Priyanka, R. (2015). Dynamic Environment Monitoring and Alerting System in WSN. International Research Journal of Engineering and Technology (IRJET), 2(3):156-158.
9. Hassan, F., Roy, A., & Saxena, N. (2016). Convergence of WSN and cognitive cellular network using maximum frequency reuse. IET Communications, 11(5): 664-672.
10. Jin, R., Xu, H., Cai, Y., Hua, Z., Zhu, M., & Wang, L. (2016). A localisation algorithm based on region partition of cellular network in wireless sensor networks. International Journal of Sensor Networks, 20(2): 63-69.
11. Liang, Y., Li, X., Zhang, J., & Ding, Z. (2017). Non-orthogonal random access for 5G networks. IEEE Transactions on Wireless Communications, 16(7): 4817-4831.
12. Du, Q., Li, W., Liu, L., Ren, P., Wang, Y., & Sun, L. (2016). Dynamic RACH partition for massive access of differentiated M2M services. Sensors, 16(4): 1-19.
13. Astudillo, C. A., de Andrade, T. P., & da Fonseca, N. L. (2017). Allocation of control resources with preamble priority awareness for human and machine type communications in LTE-Advanced networks. IEEE International Conference on Communications (ICC), pp. 1-6.
14. Kim, J., & Lee, J. (2017). Exploiting the capture effect to enhance RACH performance in cellular-based M2M communications. Sensors, 17(10):1-22.
15. Saur, S., Weber, A., & Schreiber, G. (2015). Radio access protocols and preamble design for machine type communications in 5G. In 2015 49th Asilomar Conference on Signals, Systems and Computers, pp. 8-12.
16. Wunder, G., Stefanović, Č., Popovski, P., & Thiele, L. (2015). Compressive coded random access for massive MTC traffic in 5G systems. IEEE Asilomar Conference on Signals, Systems and Computers, pp. 13-17.

17. Wu, Y., Kang, G., Guo, Y., Zhu, X., & Zhang, N. (2016). An improved random access scheme for M2M communications. China Communications, 13(6): 12-21.

18. Wu, Y., Zhang, N., & Kang, G. (2017). A new hybrid protocol for random access and data transmission based on two-phase ACB mechanisms for M2M communications. Mobile Information Systems, pp.1-12.

19. Cherkaoui, S., Keskes, I., Rivano, H., & Stanica, R. (2016). LTE-A random access channel capacity evaluation for M2M communications. IEEE Wireless Days (WD), pp. 1-6.

20. Du, Q., Li, W., Liu, L., Ren, P., Wang, Y., & Sun, L. (2016). Dynamic RACH partition for massive access of differentiated M2M services. Sensors, 16(4):1-19.

21. Bello, L. M., Mitchell, P. D., & Grace, D. (2018). Intelligent RACH Access Techniques to Support M2M Traffic in Cellular Networks. IEEE Transactions on Vehicular Technology, 67(9): 8905-8918.

22. Chatterjee, D., Heo, Y. H., Niu, H., Xiong, G., He, H., Khoryaev, A., & Panteleev, S. (2017). U.S. Patent No. 9,788,186. Washington, DC: U.S. Patent and Trademark Office, pp.1-22.

23. Fwu, J. K., Niu, H., Wang, P., Yang, X., & Etemad, K. (2016). U.S. Patent No. 9,398,551. Washington, DC: U.S. Patent and Trademark Office, pp. 1-21.

24. Novlan, T. D., Majmundar, M., & Ghosh, A. (2019). U.S. Patent No. 10,206,232. Washington, DC: U.S. Patent and Trademark Office, pp. 1-32.

25. Vilgelm, M., Guersu, H. M., Kellerer, W., & Reisslein, M. (2017). LATMAPA: Load-adaptive throughput-maximizing preamble allocation for prioritization in 5G random access. IEEE Access, 5: 1103-1116.

26. Yuvaraj, T., Devabalaji, K. R., & Ravi, K. (2018). Optimal Allocation of DG in the Radial Distribution Network Using Bat Optimization Algorithm. In Advances in Power Systems and Energy Management, pp. 563-569.

27. Chakri, A., Khelif, R., Benouaret, M., & Yang, X. S. (2017). New directional bat algorithm for continuous optimization problems. Expert Systems with Applications, 69: 159-175.

28. Sahlol, A. T., Suen, C. Y., Zawbaa, H. M., Hassanien, A. E., & Elfattah, M. A. (2016). Bio-inspired BAT optimization algorithm for handwritten Arabic characters recognition. In 2016 IEEE Congress on Evolutionary Computation (CEC), pp. 1749-1756.

Index Terms

Computer Science

Algorithms
Keywords

Random Access, Collision Probability, Throughput-Maximizing, Preamble Allocation and Prioritization.