

emergency delay, lower emergency packet loss probability and less energy consumption.

ACKNOWLEDGMENT

This work was supported by the project of Real Estate Management System under No.AS214R002. We thank the anonymous reviewers whose comments helped improve the manuscript.

REFERENCES

- [1] Villas LA, Boukerche A, Ramos HS. (2013). DRINA: A lightweight and reliable routing approach for in-network aggregation in wireless sensor networks. *IEEE Transactions on Computers* 62(4): 676-689.
- [2] Ren F, He T, Das SK. (2011). Traffic-aware dynamic routing to alleviate congestion in wireless sensor networks. *IEEE Transactions on Parallel & Distributed Systems* 22(9): 1585-1599. <https://doi.org/10.1109/TPDS.2011.24>
- [3] Nethravathi NC, Ballal PA. (2015). Energy based-genetically derived secure cluster-based data aggregation in wireless sensor networks. *Plos Neglected Tropical Diseases* 121(13): 1093-1100. <http://dx.doi.org/10.5120/21603-4714>
- [4] Joshi S, Jaiswal AK, Tyagi PK. (2013). A novel analysis of T Mac and S Mac protocol for wireless sensor networks using castalia. *International Journal of Soft Computing & Engineering* 2(6): 128-131.
- [5] Wu SH, Chen MS, Chen CM. (2014). Fully adaptive power saving protocols for Ad Hoc networks using the hyper quorum system. *IEEE/ACM Transactions on Networking* 22(1): 1-15. <http://dx.doi.org/10.1109/ICDCS.2008.88>
- [6] Carrano RC, Passos D, Magalhaes LCS. (2014). Survey and taxonomy of duty cycling mechanisms in wireless sensor networks. *IEEE Communications Surveys & Tutorials* 16(1): 181-194. <https://doi.org/10.1109/SURV.2013.052213.00116>
- [7] Garcia-Saavedra A, Serrano P, Banchs A. (2012). Energy consumption anatomy of 802.11 devices and its implication on modeling and design. 8th ACM International Conference on Emerging Networking Experiments and Technologies, Nice, France, pp. 169-180. <https://doi.org/10.1145/2413176.2413197>
- [8] Lu G, Krishnamachari B, Raghavendra CS. (2007). An adaptive energy-efficient and low-latency MAC for data gathering in wireless sensor networks. *Wireless Communications & Mobile Computing* 7(7): 863-875. <https://doi.org/10.1109/IPDPS.2004.1303264>
- [9] Huang P, Xiao L, Soltani S, Mutka MW, Xi N. (2013). The evolution of MAC protocols in wireless sensor networks: A survey. *IEEE Communications Surveys & Tutorials* 15(1): 101-120. <https://doi.org/10.1109/SURV.2012.040412.00105>
- [10] Singh P, Varma S. (2014). An improved TMAC protocol for wireless sensor networks. *International Conference on Signal Propagation and Computer Technology*, pp. 91-95. <https://doi.org/10.1109/ICSPCT.2014.6884921>
- [11] Sunitha GP, Kumar SMD, Kumar BPV. (2015). A preemptive multiple queue based congestion control for different traffic classes in WSN. *International Conference on Circuits, Communication, Bangalore, India*, pp. 212-218. <https://doi.org/10.1109/CIMCA.2014.7057793>
- [12] Söderman P, Grinnemo KJ, Hidell M, Sjödin P. (2015). Mind the SmartGap: A buffer management algorithm for delay tolerant wireless sensor networks, wireless sensor networks. Springer International Publishing 104-119. https://doi.org/10.1007/978-3-319-15582-1_7
- [13] Zeng SG. (2012). Reliability and lifetime research in wireless sensor network. Ph.D. dissertation. East China University of Science and Technology, Shanghai, China.
- [14] Polastre J, Hill J, Culler D. (2004). Versatile low power media access for wireless sensor networks. *International Conference on Embedded Networked Sensor Systems*. Baltimore, USA, pp. 95-107. <https://doi.org/10.1145/1031495.1031508>
- [15] Sun Y, Gurewitz O, Johnson DB. (2008). RI-MAC: a receiver-initiated asynchronous duty cycle MAC protocol for dynamic traffic loads in wireless sensor networks. *International Conference on Embedded Networked Sensor Systems*, Raleigh, USA, pp. 1-14. <https://doi.org/10.1145/1460412.1460414>
- [16] Tang L, Sun Y, Gurewitz O, Johnson DB. (2011). PW-MAC: An energy-efficient predictive-wakeup MAC protocol for wireless sensor networks. *INFOCOM*: 1305-1313. <https://doi.org/10.1109/INFCOM.2011.5934913>
- [17] Li YX, Shi HS, Pang BM. (2012). An energy-efficient MAC protocol for wireless sensor network. *Lecture Notes in Electrical Engineering* 143(9): 163-170. <http://dx.doi.org/10.1109/ICACTE.2010.5579102>
- [18] Fei ZT, Lin SL, Xiao FW, Xia ZW. (2017). An algorithm of fair delay in MAC layer. *Journal of Logistical Engineering University* 33(1): 85-89.