

Simulation of Energy Efficient Routing Protocols

Purneshwari Varshney¹, Sanjay Bhandari²

¹Research Scholar, Department of Electronics & Communication Engineering,
MBM Engineering College, JNVU, Jodhpur, India

²Associate Professor, Department of Electronics & Communication Engineering,
JIET, Jodhpur, India

Abstract—Swarm Intelligence is an emerging area that has recently captured much attention in the field of network routing. In addition to conventional approaches, many new researches have proposed the implementation of Swarm Intelligence for WSN routing. Routing based on SI, is adaptive and dynamic in nature. In this paper, bio-inspired routing protocols have been discussed. In this work a study and evolution has been done on the behavioral aspect of different swarm based routing protocols like ASAR (Ant-based service-aware routing algorithm) and PSO (Particle Swarm Optimization) using the NS-3 simulation tool.

Keywords – WSN, ASAR, SI.

I. INTRODUCTION

A wireless sensor network is a collection of nodes organized into a network. Each node consists of processing capability, may contain multiple types of memory, have a RF transceiver, a power source and accommodate various sensors and actuators. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. Swarm Intelligence is the study of collective behavior in decentralized, self-organized systems. Swarm intelligence was introduced by Beni & Wang in 1989, in the support of cellular robotic systems. It boost complex and intelligent behavior through simple, unsupervised interactions between a total numbers of independent swarm members. Swarm Intelligence is subfield of Computational Intelligence which provides solution for complex optimization problems which are not easily tackled by other techniques. Swarm is defined as a set of mobile agents that collectively solve troubles.

II. PROTOCOLS BASED ON SI

In this section, we review selected SI routing protocols for WSNs and highlight their properties with respect to the taxonomy of routing protocols. In the following subsections, we discuss ACO and PSO.

A. Ant Based Routing Protocol

ANT Based Routing Protocol has taken the inspiration from real ants which are wandering around their nests to forage for search of food. Upon finding food they will return back to their nests and simultaneously deposit pheromone trails along the paths. The ant selects its next hop based on the amount of pheromone deposited on the path to the next node. The problem of finding shortest paths maps quite well to the problem of routing in networks.

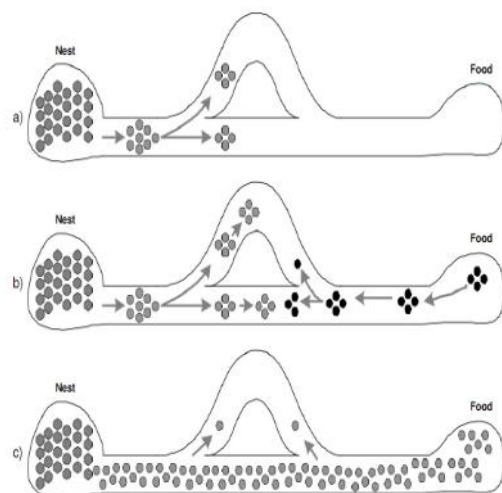


Fig. 1 : Ants take the shortest path^[8]

B. Particle Swarm Optimization

Particle Swarm Optimization exploits the behavior of swarms for the solution of complex problems. The

particle swarm optimization natured algorithm maintains a swarm of particles. Particle Swarm Optimization exploits the mutual intelligence and information sharing capacity of swarms. PSO applies the idea of social interaction for the solutions of hard and optimization problems. It was developed^[1] in 1995 by James Kennedy and Russell Eberhart. In PSO each particle individually emerges a potential solution for the hard problem to be solved.

III. SIMULATION ENVIRONMENT

There are number of quantitative metrics that can be used for evaluating the performance of routing protocols in WSN.

A. Performance Matrices

1) Delay (second): It is defined as the time taken for a data packet to be transmitted across a wireless network from source to destination.

2) Energy Consumption: After transmitting or receiving data to /from neighbours, some energy of nodes gets dissipated.

B. Simulation Setup

The mobility model used is Random waypoint mobility model because it models the random movement of the mobile nodes. For all the simulations, the same movement models were used and simulation time is varied.

IV. RESULTS

In Fig. 2, if simulation time increases, delay of ASAR is high while in PSO delay is less. So PSO is better. In Fig. 3 ASAR shows high energy consumption and PSO shows lowest value for this. So again PSO is better.

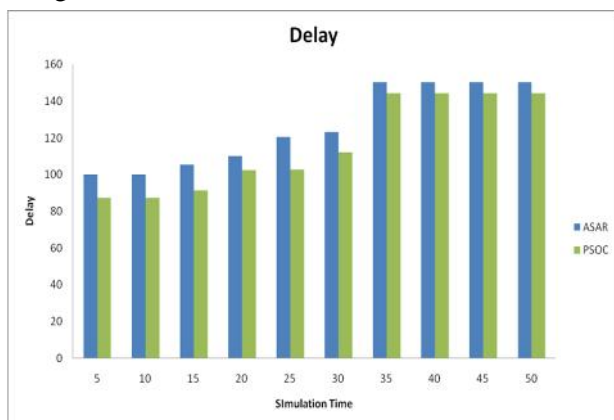


Fig. 2 Delay for ASAR, PSOC

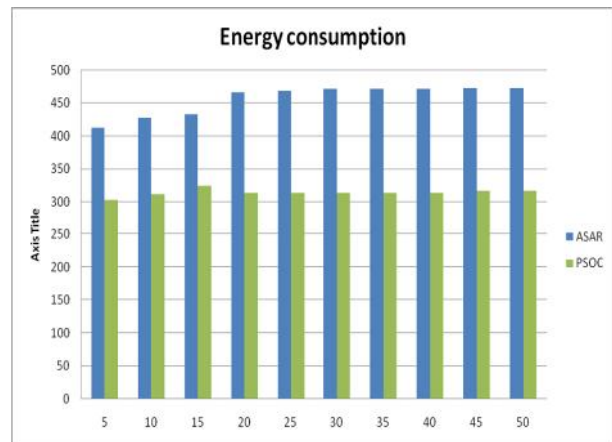


Fig. 3 Energy Consumption for ASAR, PSOC

By both the results, we can say that the PSO is more energy efficient than ASAR.

VI. CONCLUSION

In this paper, we present a comparison of the different swarm based routing techniques for WSNs from the recent work. In this paper, clustering using modified firefly algorithm has been done. The simulation results shows that the one protocol (PSO) provides low energy consumption and high network lifetime than the other protocol.

REFERENCES

- [1] Kennedy J, Eberhart R C., "Particle swarm optimization", IEEE International Conference on Neural Networks, Perth, Australia, 1995, 4: 1942-1948.
- [2] K. M. Sim, W. H. Sun, "Ant Colony Optimization for Routing and Load-Balancing: Survey and New Directions", IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, Vol. 33, No. 5, September 2003.
- [3] K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, vol. 3, no. 3, pp. 325--349, 2003.
- [4] Jamal N. Al-Karaki and Ahmed E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey", Wireless Communications IEEE, Vol. 11, Issue 6, pp. 6-28, December 2004.
- [5] C. Ramachandran, S. Misra, M.S. Obaidat, "A probabilistic zonal approach for swarm-inspired wildfire detection using sensor networks", Wiley InterScience International Journal of Communication Systems 21 (10) (2008) 1047-1073.

-
- [6] *Y. Sun, H. MA, L. Liu, Y. Zheng*, “ASAR: an ant-based service-aware routing algorithm for multimedia sensor networks”, *Frontiers of Electrical and Electronic Engineering in China* 3 (1) (2008) 25–33
- [7] *Zulfiqar Ali and Waseem Shahzad* “Critical Analysis of Swarm Intelligence based Routing Protocols in Ad hoc and Sensor Wireless Networks”, *IEEE International Conference on Computer Networks and Information Technology (ICCNIT)*, pp. 287-292, July 2011.
- [8] *Saleem, Caro, Farooq*, “Swarm intelligence based routing protocol for wireless sensor networks: Survey and future directions”, *Information Sciences* 181 (2011) 4597–4624.
- [9] *E. Bonabeau, M. Dorigo, G. Theraulaz*, “Swarm Intelligence: From Natural to Artificial Systems”, Oxford University Press, New York, USA, 1999.
- [10] *Millonas, M. M.*, “Swarms, phase transitions, and collective intelligence”, C. G. Langton, Ed., *Artificial Life III*. Addison Wesley, Reading, MA (1994).
- [11] *M. Dorigo, G.A. Di Caro*, “The ant colony optimization metaheuristic”, in D. Corne, M. Dorigo (Eds.), *New Ideas in Optimization*, McGraw-Hill, 1999, pp.11–32.
- [12] *M. Dorigo, T. Stützle (Eds.)*, “Ant Colony Optimization”, MIT press, 2004.
- [13] *C. S. Raghavendra, K. M. Sivalingam, and T. Znati*, “Wireless Sensor Networks”, Springer Academic Publishers, 2004.
- [14] *Christian Blum, Daniel Merkle*, “Swarm Intelligence: Introduction and Applications”, Springer, Berlin, 2008.
- [15] *A. Boukerche, M. Ahmad, B. Turgut, D. Turgut*, “A taxonomy of routing protocols in sensor networks”, A. Boukerche (Ed.), *Algorithms and Protocols for Wireless Sensor Networks*, Wiley, 2008, pp. 129–160.
- [16] *Xin –She Yang*, “Nature- Inspired Metaheuristic Algorithms: Second Edition”, Luniver Press, UK, 2008.