Enhanced AODV Routing Protocol for Wireless Sensor Network Based on ZigBee

Dilip Kumar Ahirwar, Prashant Verma, and Jitendra Daksh

Department of Electronics and Telecommunication, SVNiT, Sagar, India
{dilipahirwar03,prashantverma80,jitendra.daksh}@gmail.com

Abstract. ZigBee is a very important technology for Wireless Sensor Networks which is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. It is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. In this paper we will discuss about the performance of enhanced AODV in wireless sensor networks based on ZigBee.

Keywords: ZigBee, Sensor Networks, AODV, IEEE 802.15.4, Simulation Analysis.

1 Introduction

Recently, a variety of wireless solutions with different parameters in terms of coverage, data rate, network topology, mobility etc. the concepts of wireless sensor networks[1] has been increasing day by day in terms of short range wireless technologies. ZigBee [2] is one of such technology that is being populated. Especially ZigBee using IEEE 802.15.4[3] is very important wireless sensor network technology [4] since it needs supporting of frequent movement.

The scope of this paper is to analyze a set of performance parameters on AODV [5] routing protocol modified named as enhanced AODV because of their simplicity and performances when implemented in ZigBee. The paper concentrates on the performance analysis of AODV for better understanding of protocol efficiency and flexibility. the paper is organized in two sections as follows.Section I describes about the overview of technology and protocols [6], which explains the protocol mechanisms used in the analysis. Section II explains the related work of comparing two protocols. Section III gives the simulation scenario and show results by ns-2[7].

Section I

2 ZigBee Technology

ZigBee is one of wireless network technologies which are widely used from the low power environment. So it was organized very simple structure and offered low price.

N. Meghanathan et al. (Eds.): CCSIT 2012, Part I, LNICST 84, pp. 97–102, 2012.

Physical and MAC(Medium Access Control) layer of ZigBee was used to IEEE 802.15.4 standard. MAC layer was access to wireless channel through CSMAICA mechanism. Application and Network layer had been constituted ZigBee alliance. Application layer is made up APS (Application Support Sublayer), ZDO(ZigBee Device Object) and application framework[7]. Network layer does exchange the information between terminal nodes.

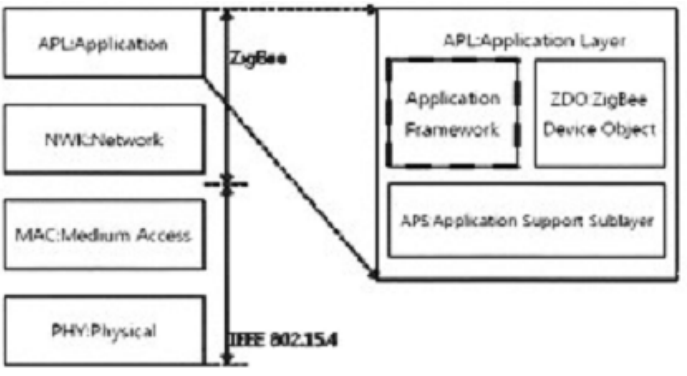

Fig. 1. ZigBee Alliance Structure

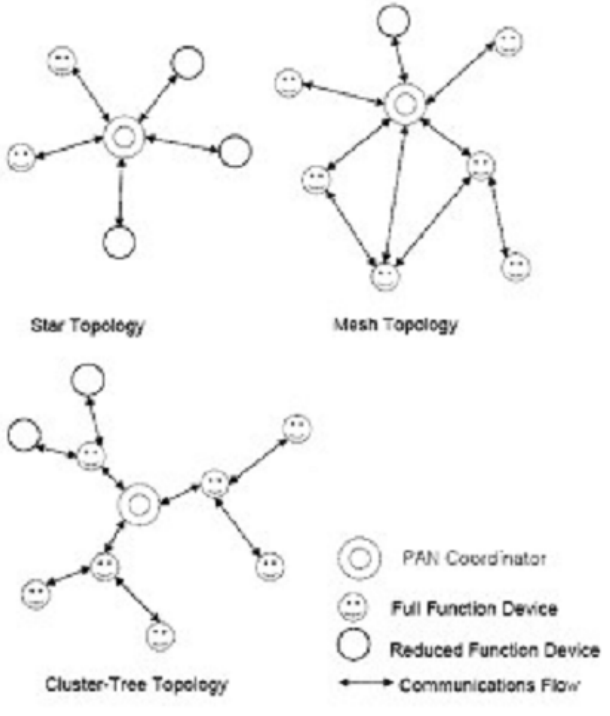

Fig. 2. ZigBee network topologies

Section II

3 Route Discovery of EAODV

AODV (Adhoc on demand distance vector routing) is a kind of route protocol[8], which is based on distance vector algorithm[9]. It only request route when necessary, and do not need nodes maintaining routes that are not in use currently, which means available route only related with notes that are communicating but not AODV.

As an improvement from AODV [3], EAODV Route protocol algorithm inherits many characteristics from its origin, however, they still differs in some aspects. EAODV, similarly, is a kind of on-demand distance vector route protocol and is mainly characterized by the followings: firstly, every node in the network only send route grouping when needing communication but not exchange route information periodically to achieve routes of all other host computers. Secondly, routing tables of nodes only need maintaining the routes between itself and other nodes instead of mastering topology structures of network.

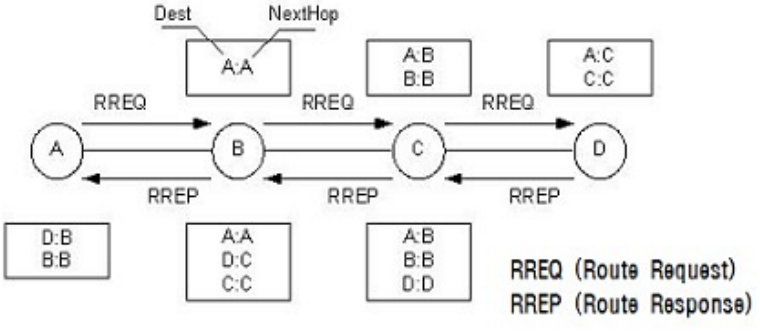

Fig. 3. AODV Route Discovery

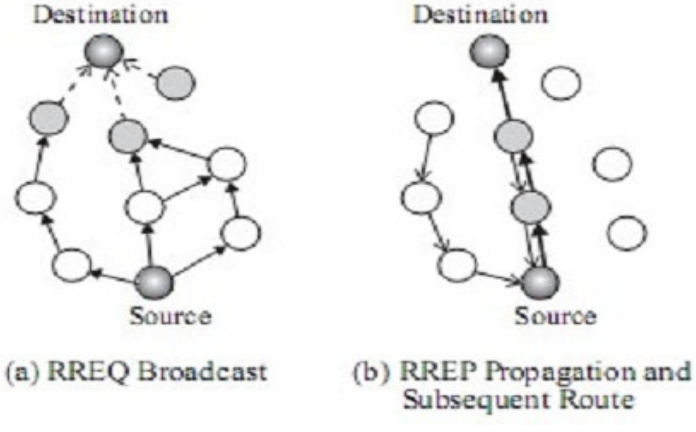

Fig. 4. Route Discovery Cycle

There are just two kinds of message control frames in EAODV route protocol, routing request RREQ and Routing response. Similar to AODV, when source node needing to send data does not have an available route to the destination node, a process of route establishment is started. Firstly, a RREQ bag is broadcasted to the network and transmitted to the destination node by intermediate nodes. Secondly, as return, destination node that received the request should unicast a RREP bag to the source node. After the RREP bag is, conversely against the requesting path, transmitted to and received by the source node, a route between the two nodes is established. In the process of transmission of routing requesting bag to the destination, nodes in the network that can receive the request also establish a return path from destination to source. When destination node receives the routing request and return a routing response, nodes in the return odes in the return path establish the forward route.

The whole process of EAODV route establishment is shown as fig.4. Figure (a) shows the process of the establishment of reverse route. Node s wants to communicate with node d, but there is no route between them. Therefore, node s broadcasts a routing request bag to ask all nodes receiving its bag to transmit the request to node d until it reaches the destination node. In this process, a reverse route is established. Figure (b) shows the process of the establishment of forward route. Receiving the routing request bag from node s, node d should return a routing response bag to node s. Return bag is transmitted along the established reverse route to node s. Lastly, the forward route is established.

Section III

4 The Simulation of Route Protocol EAODV

This paper employed simulation tool NS2 to make a function comparison in network throughput between AODV and it's evolve done EAODV. For the quantitative comparison between the two protocols, a uniform simulation surrounding is necessary [10], which means only halt time can be changed in the simulation. Simulation surrounding is a system of 7 mobile nodes, in which topology range is 500m*500m and node's moving speed is 2m/s.

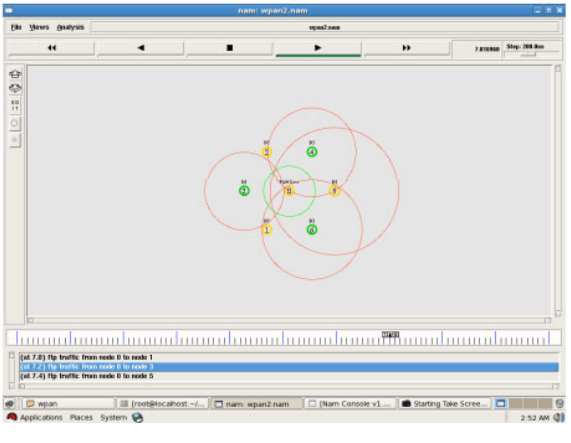

Fig. 5. Simulation Scenario

Table 1. Simulation Parameters

Parameter	Value
Channel Type	Channel/wireless channel
Radio propagation model	Propagation/two ray Ground
Network interface Type	Phy/WirelessPhy
Mac Type	Mac 802_15_4
Interface queue type	Queue/DropTail/Pri Queue
Link layer type	LL
Antenna model	Antenna/OmniAntenna
Max packet in ifq	150
Number of mobile nodes	7
Routing protocol	AODV

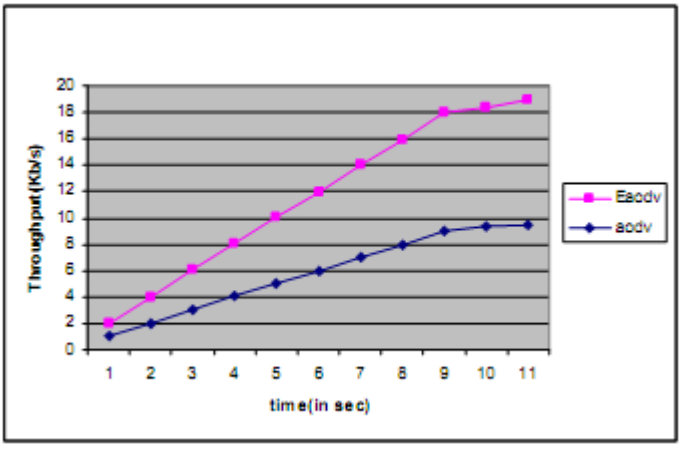

Fig. 6. Graph showing throughput vs. time

5 Conclusion

In this paper, we propose the enhanced AODV routing protocol for optimized path in wireless sensor network based on ZigBee and analyze performance by the simulation program. Enhanced AODV routing protocol is designed for frequency movement. There are many advantages in wireless sensor network, because many sensors are located anywhere and frequency movement be happen. From this simulation results, improved AODV almost shows good performance than original AODV. Especially, it is showed good performance in appointed scenario perfect. However it is not perfect in random scenario. So we will research this situation at future work. If it solve this problem,this is perfect routing protocol for wireless sensor network.

This paper makes an improvement on AODV routearithmetic and the simulation. Since its arithmetic of on-demand searching method, EAODV can rest the sensor

nodes in the most time, which prolong the lives of nodes. Characters, such as simple, easy to adding new nodes and little protocol load, dominate that EAODV is very suitable in some unusual application of wireless sensor network.

References

1. Callaway Jr., E.H.: Wireless Sensor Networks: Architectures and Protocols, 352 pages. CRC Press (August 2003) ISBN 0-8493-1823-8
2. ZigBee Document 053474r13, ZigBee Specification (December 2006)
3. IEEE Publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA
4. Al-Karaki, J.N., Kamal, A. E.: Routing Techniques in Wireless Sensor Networks: A Survey. IEEE Wireless Communication, 6–27 (December 2004)
5. FC3561.AdHoc On-Demand Distance Vector (AODV) Routing. IETF (2003)
6. Fall, K., Varadhan, K.: The ns Manual (formerly ns Notes and Documentation) (2001)
7. Perkins, C.E., Royer, E.M.: Ad hoc On-Demand Distance Vector Routing. In: Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, pp. 90–100 (February 1999)
8. Akkaya, K., Younis, M.: A Survey on Routing Protocols for Wireless Sensor Networks. Department of Computer Science and Electrical Engineering University of Maryland, Baltimore County
9. Zhang, Y., Zhang, H.-X., Liu, L.-K., Guo, H.: A Modified Algorithm for Reducing the Overhead and Delay of AODV in Adhoc Networks. Video Engineering, 165–168 (2005)
10. Xu, L.M., Pang, B., Zhao, Y.: NS and Network Simulation. Postal and Telecommunications House Publishers, Beijing (2003)\