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Performance Analysis of AODV & IPAODV Routing Protocols in Zigbee Cluster Tree Network

Prabhakar D Dorge and Shruti F Shende

Department of Electronics & Telecommunication Engineering, YCCE, Nagpur, India
prabhakar_dorge2007@rediffmail.com

ABSTRACT

This study introduces a routing model which has the ability to detect the zigbee cluster tree network in two ways. The comparison between two protocols introduce how it can improve the parameters, basically zigbee is distinctive communication criterions principally aimed to be deployed for WPAN. The nodes collecting the sensed data are appropriated depending on the traffic load demands such a framework. Performance metrics such as packet delivery ratio, throughput, and end-to-end delay are evaluated using NS-2. Simulation results shows reactive type protocol is best than proactive type protocol.

Keywords: AODV, IPAODV, Zigbee Cluster Tree, Routing

INTRODUCTION

The Mobile ad hoc networks have consisted of the nodes which are freely displaced. In other words, this network has dynamic topology. Routing protocols find route of forwarding data packets from the source node to the destination nodes. The IEEE 802.15.4 is a new standard defined for LR-WPAN which provides a low cost and very less complicated solution. The targeted applications are wireless sensors networks (WSN), interactive toys, home automation and remote controls. ZigBee is one of the newest technologies developed by ZigBee Alliance; enabling Wireless Personal Area works (WPAN). ZigBee is the name of a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4 standard. Networking plays a very important role in ZigBee core technologies. There are basically two type routing algorithms used in the ZigBee network AODV and the Tree Based Routing Algorithm. An improved routing algorithm is proposed by analyzing the network topology, configure, formation, address assignment and routing protocol of ZigBee [1-2].

In these networks, each node plays role of a router. Military networks, crime management networks etc. can be among the examples of mobile ad hoc network. One of the most important issues in ad hoc networks is routing. There are different types of routing protocols such as AODV and IP-AODV routing protocols. This paper analyzes and evaluates these two protocols with NS-2 simulator. The routing protocol is required whenever the source needs to transmit and delivers the packets to the destination. Many routing protocols have been proposed for mobile ad hoc network. In this paper we present a number of ways of classification or categorization of these routing protocols and the performance comparison of an AODV, IPAODV routing protocols [3].

METHODOLOGY

ZigBee, which is based on the IEEE 802.15.4 standard, defines the network (NWK) layer and the application layer (APL) in the protocol stack. There are three types of device in a ZigBee network: a coordinator, a router, and an end device. A ZigBee network is comprised of a ZigBee coordinator and multiple ZigBee routers/end-devices. The coordinator provides the initialization, maintenance, and control functions for the network. The router has a forwarding capability to route sensed data to a sink node.

ZigBee is the only routine-founded technologies that approach the unusual demand in the watching detecting the device in the network application. The ZigBee routine occurred expanded for direct ensuing requires: Low cost, Reliable and self-recovery, Flexible and expansive. The physical layer of Zigbee combines relatively low cost with a high level of integration, solving many issues created historically by the lack of such a set of standards in the past. The media access control, or MAC layer, features a simplified [4-5].

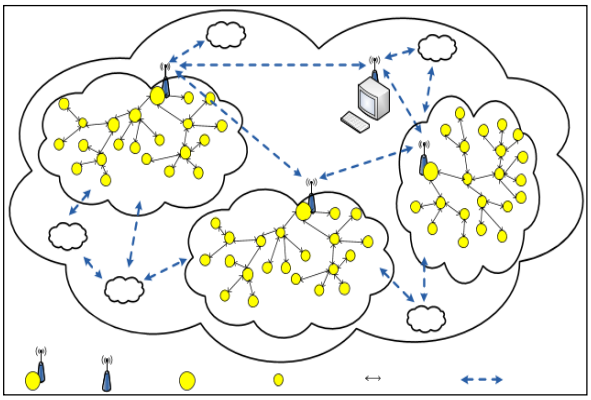

Fig. 1 Zigbee cluster tree [4]

Power management system. This system does not require multiple modes, and allows for reduced functionality devices (or RFDs) that don't require a great deal of ROM or RAM. This comes in contrast to the Bluetooth system, which features multiple modes of operation. Using Zigbee, data is transferred in packets over a distance of up to 230 feet or longer if data is relayed across nodes in a network.

Network Topology

SNs can be either thrown in as a mass or placed one by one in the sensor field. They can be deployed by dropping from a plane, placing in factory, placing each one by one either by a human or by a robot etc. Topology changes during the phase of post-deployment are due to node failures and nodes position changes because of the mobility. During the phase of re-deployment, additional nodes are deployed in the network. This can happen at any time.

Operating Environment

SNs are densely deployed either very close or directly inside the phenomenon to be observed. Therefore, they usually work un attended in remote geographic areas. They may be working in busy intersections, interior of large machinery, bottom of an ocean, in a battlefield beyond the enemy lines, large building, attached to animals etc.

Transmission Media

In a multi-hop sensor network, communicating nodes are linked by a wireless medium. These links can be formed by radio, infrared or optical media. To enable global operation of these networks, the chosen transmission medium must be available worldwide. RF communication is used by WSNs developed by TUV for the WSSN project, and by the SNs developed by the University of California, Los Angeles (University of California, Los Angeles-UCLA) for Wireless Integrated Network Sensors (WINS) project.

Power consumption

The wireless SN can only be equipped with a limited power source. In some application scenarios, replenishment of power resources might be impossible. SN lifetime, therefore, shows a strong dependence on battery lifetime. In a multi-hop ad hoc sensor network, each node plays the dual role of data originator and data router. The disfunctioning of few nodes can cause significant topological changes and might require packets rerouting and network re-organization. Hence, power Conversation and power management take on additional importance. The main task of a SN in a sensor field is to detect events, perform quick local data processing, and then transmit the data. Power consumption can hence be divided into three domains: sensing, communication, and data processing [6-8].

Routing Protocols

Even through, there are many routing protocols for WSN, there is still a great need for new protocols that can prolong the lifetime of the network and can be easily implemented in the nodes using the currently technology, and also can be used for networks with different size. Topology based routing protocols depend on the information about existing links in the network and use them to perform packet forwarding. The topology based routing protocols can be further subdivided into proactive, reactive, and hybrid protocols.

Ad-hoc on demand Vector Protocol (AODV)

It uses route discovery process to cope with routes on demand basis. It uses routing tables for maintaining route information. It is reactive protocol; it doesn't need to maintain routes to nodes that are not communicating. AODV handles route discovery process with Route Request (RREQ) messages. RREQ message is broadcasted to neighbour nodes. The message floods through the network until the desired destination or a node knowing fresh route is reached. Sequence numbers are used to guarantee loop freedom RREQ message cause by passed node to allocate route table entries for reverse route. The destination node uncast a Route Reply (RREP) back to the source node. Node transmitting a RREP message creates routing table entries for forward route. Figure 1 show, AODV routing protocol with RREQ and RREP message.

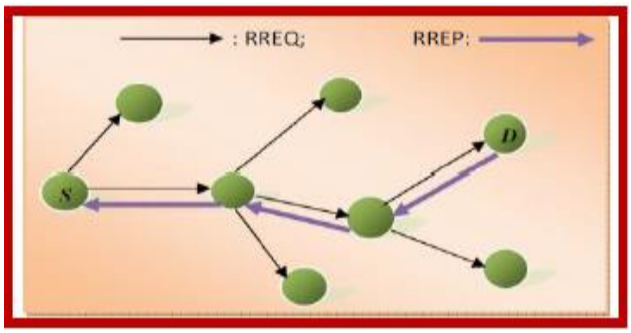

Fig. 2 RREQ and RREP message [13]

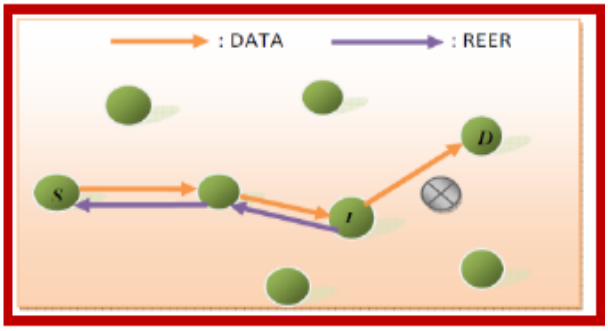

Fig. 3 RRER message [13]

For route maintenance nodes periodically send HELLO messages to neighbor nodes. If a node fails to receive three consecutive HELLO messages from a neighbor, it concludes that link to that specific node is down. A node that detects a broken link sends a Route Error (RERR) message to any upstream node. When a node receives a RERR message it will indicate a new source discovery process. Figure 2 shows AODV routing protocol with RERR message [9-11].

Advantages

- Routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
- Lower delay for connection setup.

Disadvantage

- AODV doesn't allow handling unidirectional links.
- Multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead.
- Periodic beaconing leads to unnecessary bandwidth consumption

Route Table Management

The route table in AODV needs to keep track of the following information:

- Destination IP address: - In this field IP address for destination node is stored.
- Destination Sequence Number: - The sequence number for the particular destination.
- Next Hop: - The next neighbor of a particular node in the direction of destination.
- Hop Count: - Number of hops to the destination.
- Active Neighbor List: - Neighbor nodes, which are actively using this route entry.

Improved Ad-hoc on Demand Vector Protocol (IP-AODV)

The Improved Ad-hoc on demand Vector Protocol (IPAODV) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal. IPAODV is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It finds multiple routes from a source node to a destination node. The main feature of IPAODV is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions: Route creation, Route maintenance and Route erasure. IPAODV can suffer from unbounded worst-case convergence time for very stressful scenarios. IPAODV has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions, the protocol is able to detect the partition and erase all invalid routes.

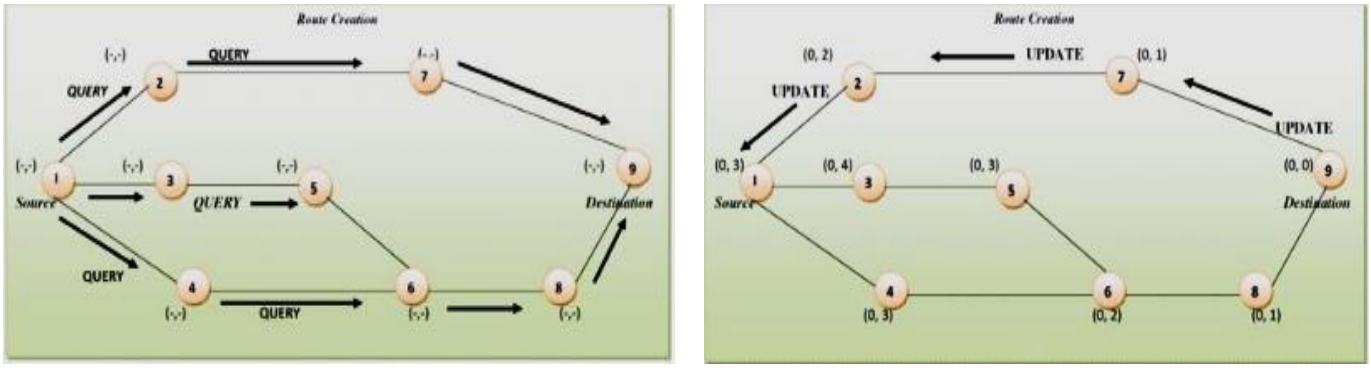

Fig. 4 IPAODV message

Fig. 4 shows, source node (1) broadcasts QUERY to its neighbour's node. Node (6) does not propagate QUERY from node (5) as it has already seen and propagated QUERY message from node (4). A source node (1) may have received a UPDATE each from node (2), it retains that height. When a node detects a network partition, it will generate a CLEAR packet that results in reset of routing over the ad-hoc network. The establishment of the route mechanism based on the Direct Acyclic Group (DAG). Using DAG mechanism, we can ensure that all the routes are loop free. Packets move from the source node having the highest height to the destination node with the lowest height like top-down approach [12-14].

Advantages

- IPAODV supports multiple routes between source and destination. Hence, failure or removal of any of the nodes quickly resolved without source intervention by switching to an alternate route to improve congestion.
- IPAODV does not require a periodic update, consequently communication overhead and bandwidth utilization is minimized.
- IPAODV provides the supports of link status sensing and neighbor delivery, reliable, in-order control packet delivery and security authentication [15].

Disadvantages

- It depends on synchronized clocks among nodes in the ad hoc network.
- The dependence of this protocol on intermediate lower layers for certain functionality presumes that the link status sensing, neighbour discovery, in order packet delivery and address resolution are all readily available. This solution is to run the Internet MANET Encapsulation Protocol at the layer immediately below IPAODV.
- This will make the overhead for this protocol difficult to separate from that imposed by the lower layer [16].

In today's world of high speed applications request of spectrum is increasing quickly, hence it becomes judgmentally important to utilized accessible bandwidth efficiently [17]. The vibrant atmosphere of wireless network familiarizes fashionable challenges similar data management, precision, coverage, safety and software pattern [18].

SIMULATION & RESULTS

Throughput

The amount of data to be transfer from one place to another place in the network**.** In figure 6 we can see that the throughput of the network is better of IPAODV routing protocol as compared to AODV routing protocol. The reason behind it is that though both routing protocols comes under reactive category but IPAODV regularly maintain their link which is not present in AODV routing protocol. The delay of IPAODV routing protocol is less as compared to AODV routing protocol as shown in figure 8. Packet delivery ratio is better for IPAODV routing protocol as shown in figure 10. More number of packets is transmitting in IPAODV routing protocol as compared to AODV routing protocol, so that more data is transmitting. Therefore, number of receiving packets is also more as compared to AODV routing protocol. Hence packet delivery ratio of IPAODV routing protocol is better than AODV routing protocol.

Table - 1 Simulation Parameters

Parameter	Quantity	Parameter	Quantity
Channel type	Channel/Wireless Channel	Routing protocols	AODV, IPAODV
Radio-propagation model	Propagation/Two Ray Ground	Type of antenna	Omni- direction antenna
MAC	Mac/802_15_4	Queue length	50
Interface queue type	Queue/DropTail/PriQueue	Area dimension	50 x 50 m
Number of nodes	25	Simulation time	50 sec

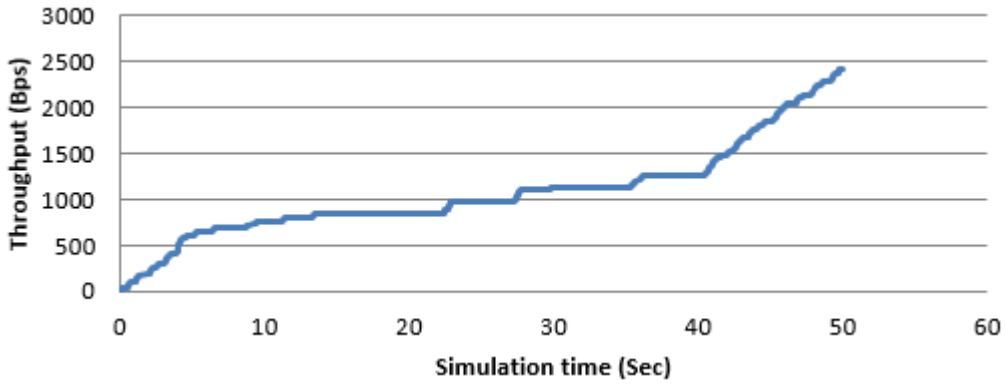

Fig. 5 Throughput of AODV

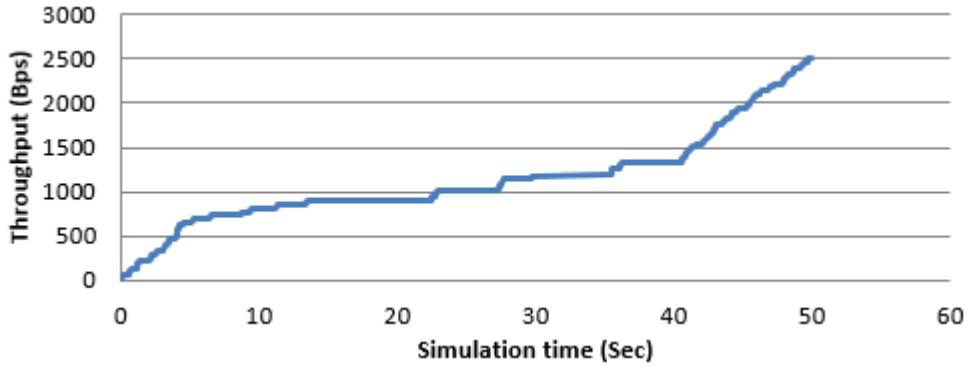

Fig. 6 Throughput of IPAODV

Delay

The average time it takes a data packet to reach the destination.

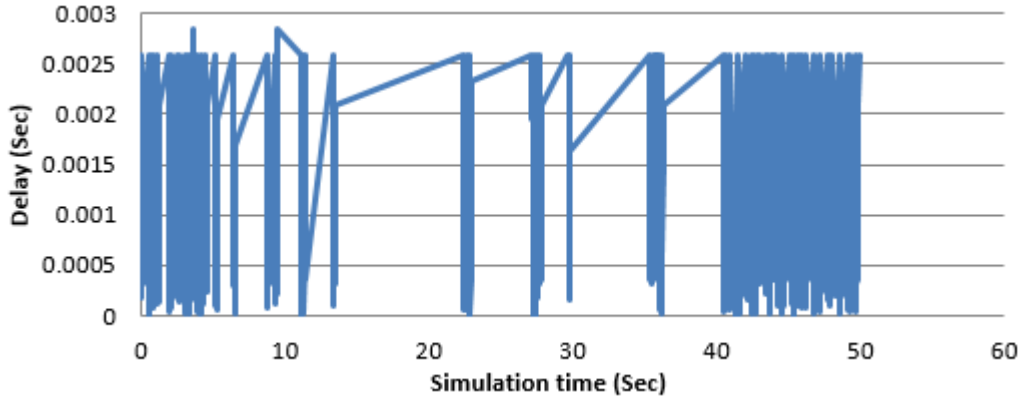

Fig. 7 Delay of AODV

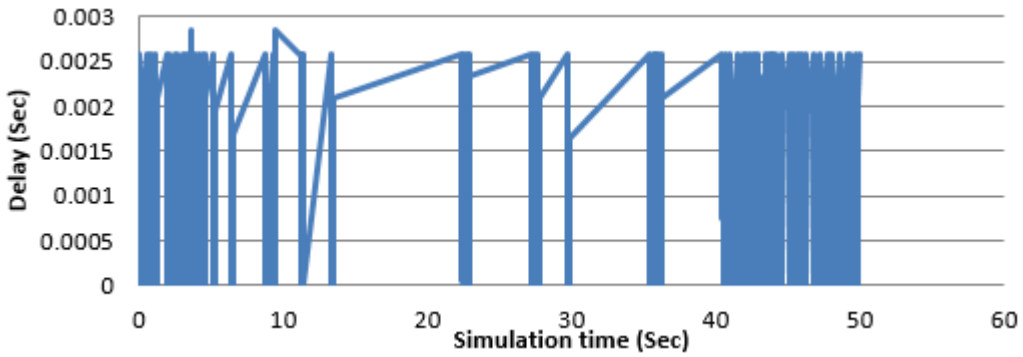

Fig. 8 Delay of IPAODV

PDR (Packet Delivery Ratio)

PDR is the ratio of total number of packet to the total no of packet send in the network.

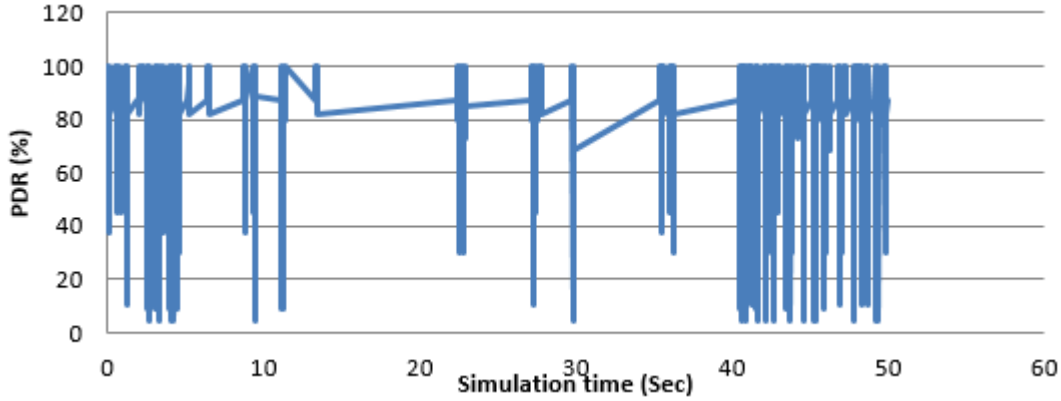

Fig. 9 PDR of AODV

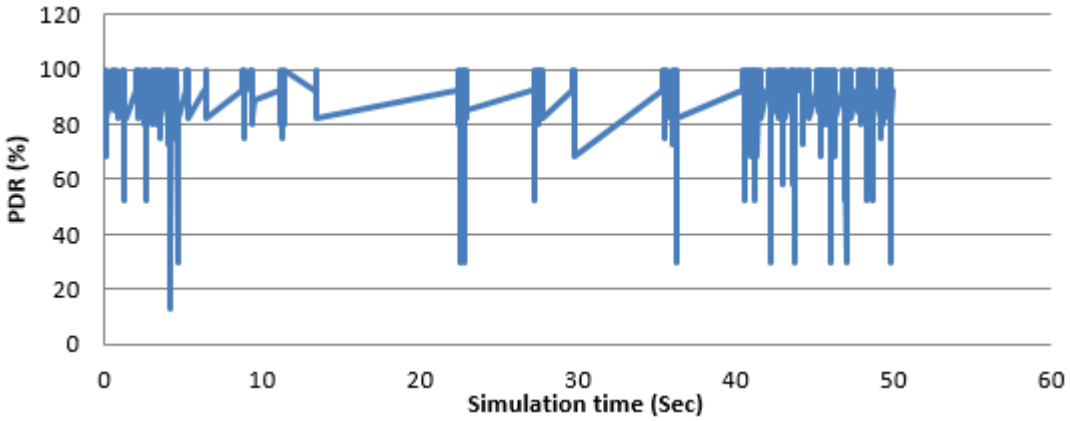

Fig. 10 PDR of IPAODV

Table - 2 Compare AODV & IPAODV

Parameters	AODV	IPAODV
Throughput (Bps)	1221.3681	1281.3159
Delay (sec)	0.000687452	0.000473684
PDR (%)	93.15261341	96.06244099

DISCUSSION

In thise paper 'Performance improvement in zigbee cluster tree network' we have proposed as Enhanced Distributed Adoptive Parent (EDAP) based structure for Zigbee cluster tree networks that control changing traffic weight communication toward granted moment. The nodes collecting the sensed data are appropriated depending on the traffic load demands, In the proposed system we have worked on parameters like the throughput, energy consumption, delay and bandwidth utilization, we have improved the overall performance of the system significantly by improving the utilization of the bandwidth which results in improving the lifetime of the nodes as well.

CONCLUSION

In this paper 'Performance improvement in zigbee cluster tree network', the nodes gathering the sensed statistics are appropriated dependent on the traffic capacity demands, In the proposed scheme we have worked on parameters like the throughput, delay and PDR, we have better the overall performance of the scheme significantly by improving the utilization of the bandwidth which results in improving the lifetime of the nodes as well.,the performance is based on the two routing protocols AODV and IPAODV, Here we find output performance on the basis of throughput, delay, packet delivery ratio. By compare these protocol on the origin of various performance metrics we reach to a conclusion that the performance of IPAODV is better than the AODV protocol.

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