Implementation of Improved AODV Protocol Based on WiMax using Network Simulator 2

Lovenish Kumar, Sunita Rani

Abstract— Wireless Bandwidth allocation and routing mechanisms are two main parameters that decided the quality of service (QOS) in wireless sensor network. Monitoring, surveillance and many other military and civilians needs are main area of wireless sensor networks. Security mechanism for the sensor network must be energy efficient because sensor has limited power. Energy efficiency protocol must require self configuration and autonomic functionality to operate properly. In this paper improve the AODV protocol (IAODV) by creating a Cycle on a node where the congestion probability is high i.e. at near sink node to find all those nearer nodes where buffer occupancy is high and proposed to minimize the delay, increase the throughput and increase the packet delivery Fraction (PDF) as compared to AODV protocol.

Index Terms— Wireless sensor network, WiMax 802.16, AODV, IAODV, PDF.

I. INTRODUCTION

WiMax is the known IEEE 802.16 standard and most reliable access technology. It provide high bit rate and reaching large area with a single base station to end user in an economical way.[1] The main consideration of Mobile Wimax is to achieve seamless handover such that there is no loss of data. In Wimax both mobile station (MS) and base station (BS) scans the neighboring base stations for selecting the best base station for a potential handover. The key property of Mobile WI Max is the all-IP (both IPv4 and IPv6) platform which leaves out the traditional circuit switched alternatives. This allows financial saving as there is no need to maintain both types of core networks. The WI Max Forum has established a Network Working Group (NWG) that defines the

1. MS is Mobile Station or user equipment.
2. BS is Base Station.
3. ASN is Access Service Network. It is also known as Network Access Provider (NAP).
4. CSN is Connectivity Service Network
5. ASN-GW is Access Service Network Gateway. It is also known as Access Concentrator (AC).

The architecture of mobile WI MAX is consists of mobile stations (MS) that communicate freely via radio link with base stations (BS) which act as relays with the terrestrial infrastructure of IP network. The base stations themselves are connected to the network element called ASN that manages their connection with the IP network.

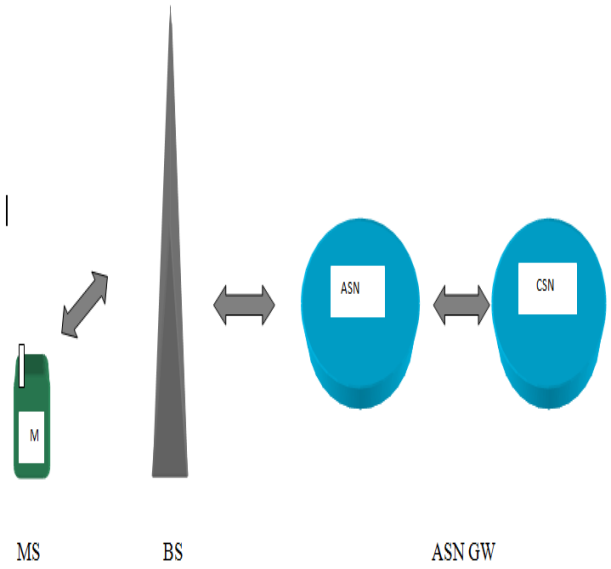

Figure 1. Architecture of WiMax

II. WIRELESS SENSOR NETWORK

A wireless ad-hoc network is a collection of mobile/semi-mobile nodes with no pre-established infrastructure, forming a temporary network. Each of the nodes has a wireless interface and communicates with each other over either radio or infrared. Laptop computers and personal digital assistants that communicate directly with each other are some examples of nodes in an ad-hoc network.[2] Each node consists of processing capability (one or more DSP chips) and also contain multiple types of memory , RF transceiver, power source (e.g., batteries), and accommodate various sensors and actuators. There are two types of wireless sensor networks.

A. Infrastructure Networks

This network creates a wireless network to a wired Ethernet network. A wireless access point serves as the central WLAN communication station to attach mobile clients. It can move from one base station to the range of another when communicating.

B. Infrastructure less network

This network creates wireless devices to communicate directly with each other. It allows peer to peer communication without involving central access point. It is used by two PCs to connect each other as well as for wireless mesh networks.

Manuscript Received December, 2013.

Mr. Lovenish Kumar, His Electronics and Communication Engineering, YCOE, Talwandi Sabo, Bathinda, India.

Er. Sunita Rani, His Electronics and Communication Engineering, YCOE, Talwandi Sabo, Bathinda, India.

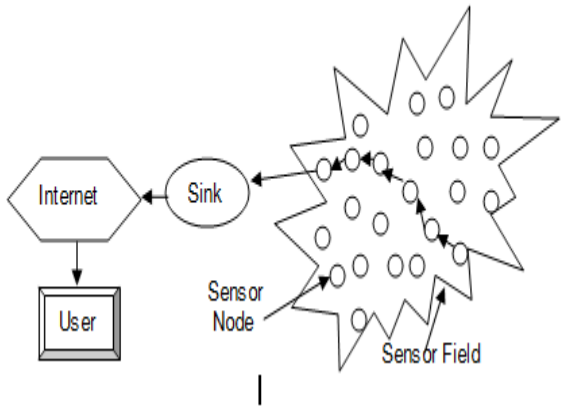

Figure 2. Architecture of Wireless Sensor Network

Bandwidth estimation techniques is combined with route discovery and set up in order to find a best route to increase the throughput and bandwidth utilization in AODV(R..Murali Prasad and P.Satish (2010)). Hybrid scheme comprising WBAODV and DSD protocol to minimize the delay, increase throughput and increase the PDF as compare to AODV to WBAODV and DSDV protocol. (Deepak Kumar Garg, Balraj Singh, Darshan Singh Sidhu(2013)).

III. PROTOCOL USED IN WIRELESS AD-HOC NETWORK

The protocol are being used; On Demand (Reactive), Improved Ad-Hoc on demand distance vector (IAODV). The Brief details are discussed below.

A. On Demand (Reactive) Protocol

Ad-Hoc on-demand distance vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. Unicast and multicast routing both are supported by AODV. It is an on demand algorithm and maintains a route whenever source wants to be. These routes are maintained as long as they are needed by the sources. AODV is loop-free, self-starting and uses sequence numbers to ensure the freshness of routes.

It uses a route request / route reply query cycle for established the route when a route is not established between Source and Destination Node. It broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet, update their information and set up backwards pointers to the source node in the route tables. The RREQ contains the source node's IP address, current sequence number, broadcast ID and update sequence number for the destination. On receiving the RREQ node may send a route reply (RREP) if it is either the destination or if it has a route to the destination. In this case, it unicast a RREP back to the source Otherwise it rebroadcasts the RREQ. RREP propagates back to the source and set up the route. Once the source node receives the RREP, it start to forward data packets to the destination. As long as the packet is transmitting from source to destination, the route is active otherwise route is deleted and nodes propagates the error message (RERR). If the source node still want the route, whole process start again. [4]

B. IAODV Protocol

Improved Ad-Hoc on demand distance vector routing protocol is efficient and superior of the standard AODV routing protocol in performance. It is used to balance load to avoid congestion inside novel scheme of flow control. The center dot to separate compound units, e.g., "A·m^2."

IV. PROPOSED ALGORITHM

The AODV Routing protocol is based on on-demand approach for finding routes, a route is established only when source node want to be transmit the data packet to the destination. The Improved AODV protocol is used to enhance the stability of a network and also improve the efficiency in wireless sensor Ad-hoc network.

A. Techniques used in IAODV

The AODV protocol is improved by creating a Cycle on a node where the congestion probability is high i.e. at near sink node to find all those nearer nodes where buffer occupancy is high. Near sink node and nodes nearer to it contains the routing table including information about its own I.P. address, I.P. address of nearer neighbour nodes, distance between the nodes, & queue length of each node as shown in Figure 3. The dynamic nature of wireless sensor network cause the topology to automatically change due to change in topology each node automatically updates its information in its own routing table & the routing table of the nearer node regarding its buffer length, its distance from other nodes, its I.P. address.

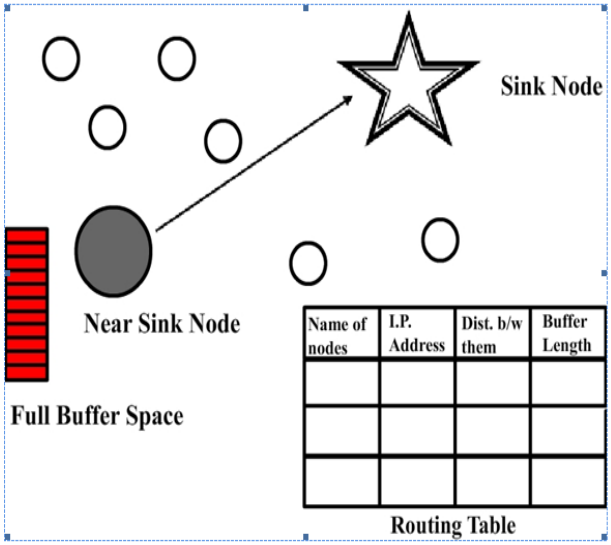

Figure 3. Congestion effected node with its routing table

There are following steps to be followed during this process:

1. Firstly the Hop-by-Hop algorithm is to be implemented on congestion affected node. This algorithm check's the routing table of congestion affected node to find all the nodes nearer to it with minimum response length time i.e. it must have maximum buffer occupancy to accommodate the load of congestion affected node.
2. After finding the node with free buffer space Hop-by-Hop algorithm make that node as the child node of the congestion affected node and the alternate routes from the congestion affected node to the nearer node will become active to transmit data so as to utilize its buffer space.

3. As soon as the time period during which child node receives the packets in its buffer space from the congestion affected parent node it will store them in its buffer for a short time interval.

On receiving the packets from congestion affected node by the nearer node at the same time this node will immediately implement the Hop-to-Destination algorithm to forward the packets to the destination i.e. Sink Node base station within the finite amount of time. The scenario for this whole process is shown in Figure 4.

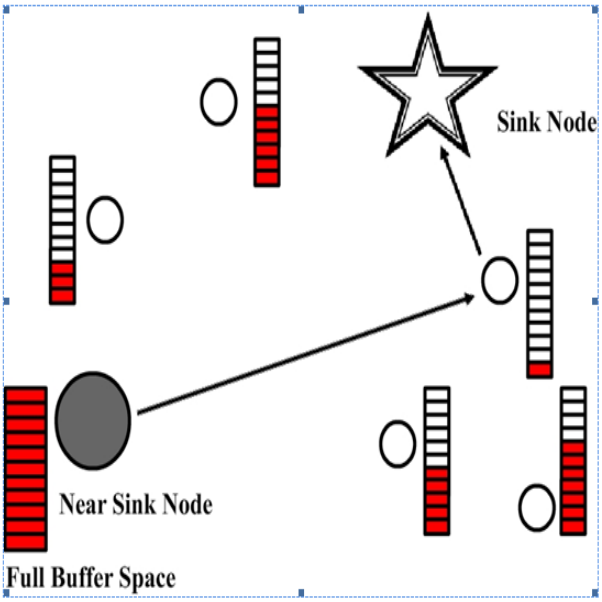

Figure 4. Node's with free space transmitting packet to sink

V. SIMULATIONS AND RESULTS

We have simulated the various parameters by Network Simulator 2 (NS2) and compared with AODV. The main objective of our simulations is to show that IAODV protocol has significant improvement as compare to AODV Protocol.

A. Simulation Environment

Table 1. Paramter value of Simulation Environment

Simulator	Network Simulator 2.34
Network Size	1000m x 1000m
No. of nodes	50
Simulation Time	50Sec
MAC Type	802.11, 802.16
Bandwidth	4Mz
Traffic Sources	CBR, FTP
Traffic Agents	UDP, TCP
Interface Queue Length	50
Packet Size	512 Byte data
Max speed	10
Interval time b/w Packets	0.05
Max. Packets to be send	10000

The Performance analysis of proposed IAODV Protocol is done by comparing with existing AODV on the basis of the following parameters:

1. End to End delay
2. Throughput
3. Packet Delivery Fraction(PDF)

B. End to End delay Performance Comparison

This includes all possible delay caused by buffering during route discovery latency, queuing at the interface queue, retransmission delay at the MAC, propagation and transfer time. It is defined as the time taken for a data packet to be transmitted across a MANET from source to destination.

$$D = (Tr - Ts)$$

Where Tr is receive Time and Ts is sent Time

The value of End to End Delay should be better performance by using IAODV protocol. It can be found that the End to End Delay is low as compare with the AODV protocol as shown in figure 5.

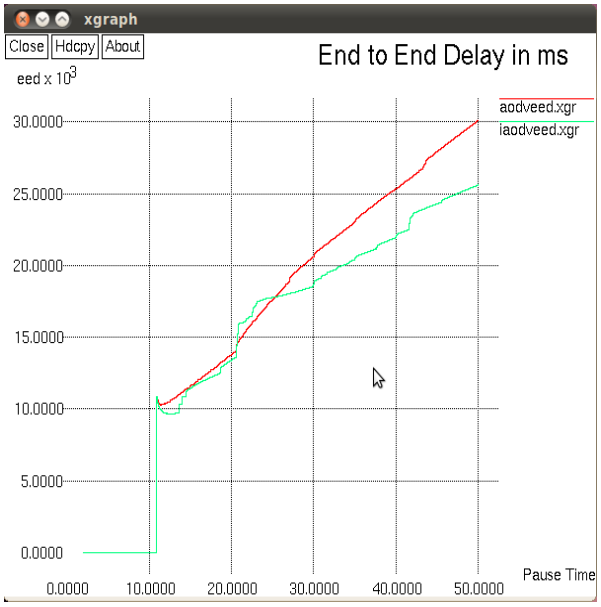

Figure 5. End to End delay Performanve w.r.t pause Time

C. Throughput Performance Comparison

Network performance of any network can be measured in terms of throughput so the throughput is the important parameter to analyze the network. no. of bits transmitted from source to destination to the time
elapsed during this bits. This value should be higher to increase the performance of the network.

$$\text{Throughput} = \frac{\text{(Total Data Bits Received)}}{\text{(Simulation Runtime)}}$$

By using the IAODV protocol. It can be found that the Throughput is high when compared with AODV protocol as shown in figure 6.

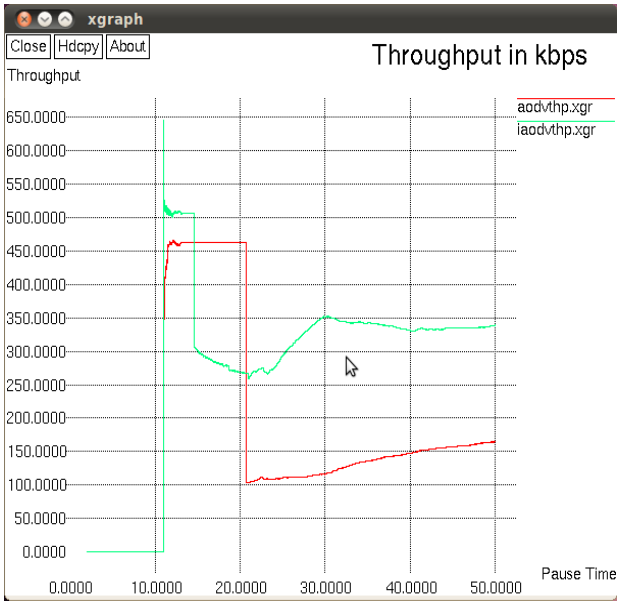

Figure 6. Throughput Performance w.r.t Pause Time

D. Packet Delivery Fraction Performance Comparison

It is the ratio of data packets delivered to the destination to those generated by the sources. It is calculated by dividing the number of packet received by destination through the number packet originated from source.

$$PDF = (Pr/Ps)*100$$

Where Pr is total Packet received
Ps is the total Packet sent.

The value of PDF should be higher for better performance by using IAODV protocol. It can be found that the Packet Delivery Fraction (PDF) is high as compare with the AODV protocol as shown in figure 7.

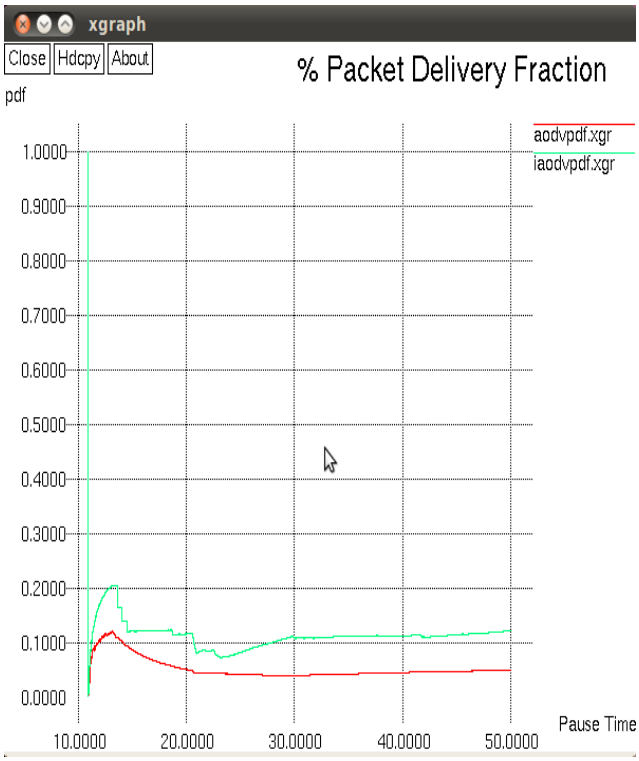

Table 2. Average Value of all Parameter

Protocol / Parameter	AODV	IAODV
End to end delay	20.915	17.951
Throughput	187.22	321.90
PDF	0.04973	0.10725

VI. DISCUSSION & RESULTS

This paper concludes that implementation of Improved AODV protocol by creating a Cycle on a node where the congestion probability is high i.e. at near sink node to find all those nearer nodes where buffer occupancy is high Performance of the protocol varies according to the variation in the network parameters. In this proposed work, the results in terms of end to end delay is lower than AODV, throughput is higher than AODV and Packet Delivery Fraction is greater than AODV. It is concluded that results of proposed protocol are better than AODV protocol.

ACKNOWLEDGMENT

Foremost, I would like to express my sincere gratitude to my Dissertation Advisor Er. Sunita Rani for the continuous support of my MTech study and research for her patience, motivation, enthusiasm, and immense knowledge. I thank my Friend in GKU University: Deepak Kumar Garg. Last but not the least; I would like to thank my Family: My Parents Hansraj and Kamlesh Kumari, for giving birth to me at the first place and supporting me spiritually throughout my life.

REFERENCES

1. M. Castrucci, I. Marchetti, C. Nardini, N. Ciulli and G. Landi, "AFramework for Resource Control in WiMAX Networks", In Proc. of the 2007 International Conference on Next Generation Mobile Applications, Services and Technologies, pp. 316-321, 2007.
2. Pang Yang, "Multi-path Routing Protocol for mobile Ad hoc Network", International Conference on Computer Science and Software Engineering,2008.
3. I. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "A survey on Sensor Networks", IEEE Communications Magazine, vol. 40, Issue: 8, 2002, pp. 102-114.
4. Deepak kumar Garg, Balraj Singh, Darshan Singh Sidhu, "Performance Comparison of AODV, WBAODV, DSDV & Hybrid in WSN using Network Simulator 2", Vol 2, Isuue: 11,Nov 2013, pp. 2744-2748.
5. R Myrali Prasad & P. Satish Kumar, "A Joint Routing and Bandwidth Allocation Protocol for IEEE 802.16 WiMax Networks", Vol 2, Issue: 5, Oct 2010, pp. 442-446.