Performance Analysis of WSN based Technologies: Zigbee and Wimax

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ABSTRACT
Wireless Sensor Network is composed of hundreds or thousands of sensor nodes scattered in a geographical area and one or multiple sinks collecting information or transmitting it through wireless channels. Zigbee and WiMAX are the most advancing communication technologies of Wireless Sensor Network. WiMAX is a standard IEEE 802.16 based technology which supports internet access and VOIP application whereas Zigbee is the only standard IEEE 802.15.4 based technology designed to address the unique needs of low cost, low power WSNs which provide high data rate at complexity and costs. In this paper, a comparative analysis of Zigbee and WiMAX technologies is made in a 100 node network scenario, by incorporating different routing protocols and studying the affect on the QoS parameters such as throughput and PDR(Packet Delivery Ratio).

Keywords
WiMAX, Zigbee, QOS, Throughput, PDR.

1. INTRODUCTION
Wireless technologies have become essential much more quickly during the last four decades and they are key element of societal progress for the foreseeable future. The transmitted distance can be anywhere between a few meters (for example, a television's remote control) and thousands of kilometres (for example, radio communication). [5].

In distinction to WLANs (Wireless- Local area network) and WPANs (Wireless-personal area network), WSN (Wireless Sensor Network) [1] seems to be substantial scaled, self-arranging, and strictly usage specific instead of quantified area of a propagation cell. So that the coverage can be increased from a few meters to many meters and further kilometers, therefore network will extend to numerous numbers of nodes whereas the data rates will remain in bits/s. The interpretation of network is quantified by its potential to provide service to the enforced applications. In comparison to the basic communication networks such as Local Area network, Metroplitan Area Network, Inter-network etc, it has no pre-decided vital layout which compulsorily gets attached with single topology. Expedient should be less in the terms of size, expense, memory, and specially power usage, that is considered to be the most restrictive aspects for operations.

Sensor networks are basically ad hoc networks but they can be different and based on the following points [5]:

- Sensor networks are data-concentrated so that data can be timely delivered at various locations.
- Sensor networks are always operation familiarized and perform a particular task.
- The credentials of every single sensor node are restricted, but the practicality of network relays on mutual exertion of the nodes

Wireless Sensor Network is newly created and growing set of wireless technologies that has recently attracted a lot of interest in commercial, industrial, scientific and educational research, and that is meant to administer huge rise market in future WSNs comprise of interrelated, jointly, extremely expedient-clasped nodes that are able to judge, modify, save, and forth the data. Table 1.1 conveys the common categorization which is as per the Institute of Electrical and Electronics Engineers (IEEE).

TABLE 1.1. Wireless Communication Technologies Categorization [1]

Class	Data Rate	Radio Coverage	Applicat-tion	Technologies
WWAN	More than 10 Mbps	Less than10 km	Telephony, Mobile internet	GSM, UMTS, satellite
WMAN	More than 100 Mbps	More than 10 km	Broadband internet	IEEE 802.16,HIPERMAN
WPAN	More than 10 Mbps	More than 10 m	Data transfer	Bluetooth, IEEE 802.15.3
WSN	More than 1 Mbps	More than 1 km	Monitoring control	IEEE 802.15.4

The ZIGBEE is standard for devices whose requirements are elongated lasting power, less data rate, reliable communication. Zigbee has high quality and simplicity as compared to above mentioned wireless standards. It is based on the IEEE 802.15.4 standard for wireless personal area networks (WPANs). IEEE 802.15.4 [1] is a protocol whose motive is to attain simple functionality, low expense, low speed and less energy usage along with the capability to work for long duration with standard commercial batteries. The

standard will incorporate two layers they are the MAC and the physical layer. It employs the three license-free frequency sections. These sections incorporates 27 channels which are further divided into 16 channels at 2.4GHz with speed of 250 kbps, 10 channels at 902 to 928MHz with speed of 40 kbps, and one single channel at 868 to 870MHz with a speed of 20 kbps. 2.4-GHz band is the only band which works worldwide whereas other bands are regional band which can be incorporated locally [10].

WIMAX [8] is intercommunication automation and the main aim of this automation is to hand over the wireless data travel through protracted distance which is arrived from different paths. It can be offer peer to peer or cellular phone link brand admittance. The term WIMAX is forge by WIMAX forum was contrive in June 2001 to espouse high level performance & interoperability of the standard. The conference construe WIMAX as staple based automation enables the shipment of last mile wireless broadband access as surrogate to cable and DSL. WIMAX [1] may be appellation coined to explain normal, practical employment of wireless nexus IEEE like the Wi-Fi employed for practical employment of wireless computer nexus normal. It is extremely different from Wi-Fi operative additionally as performance [4] .

- Connection of wireless fidelity asperity with one integral to another integral for web.
- Rendering a automation different to wire & telephone link walk Brabant access
- Rendering information & automation service speedily
- Rendering a diversity of web properties as predicate business cohesion.
- Rendering unsettled property.

In this paper, we have evaluated the performance of AODV, DSDV, AOMDV in WiMAX and Zigbee networks and studied various performance parameters for such networks. The remainder of this paper is organized as follows: section 2 gives a brief introduction to DSDV, AODV and AOMDV routing protocols are presented quality of service parameters. In section 3, details of Quality of Service Parameters are presented. The performance analysis of the three routing protocols in WiMAX and Zigbee networks has been carried out in section 4. Finally, the conclusion of our work is summarized in section 5.

2. ROUTING PROTOCOLS

In WSN based technologies there are many routing protocols that could be used ie AODV, DSR, DYMO, ZRP, IERP DSDV, AOMDV. Several routing protocols have been developed for ad hoc mobile networks to deal with typical limitations including high power consumption, low bandwidth and high error rates. They can be categorized in two routing protocol ie reactive or On-Demand Routing protocol and Proactive or Table-Driven routing protocol. But these three protocols are briefly described below AODV, DSDV and AOMDV routing protocols are presented in both cases WiMAX and Zigbee.

2.1 DSDV (Destination-sequenced distance vector)

DSDV [6] is among the table-driven routing protocols that will be based on the Bellman-Ford routing mechanism. In table-driven routing protocols, the main objective is to steadfastly keep up consistent and up-to-date routing information from each source node to other destination nodes in the network. Each node maintain more than one tables to store the mandatory routing information. These tables are updated in accordance with changes in network topology by propagating update information throughout the network. Two important components are essential such protocols, one is the amount of routing tables and another is the update method being used. Two types of update packets exist in DSDV based networks. The first one which is infrequently transmitted is called the total dump. This type of packet carries all available routing information. The second type called incremental packet is used to forward only that information which has changed since the last full dump. Both update packets have fixed size network protocol data unit (NPDU).

2.2 AODV (Ad-hoc On-Demand distance vector)

The AODV routing protocol [6] is dependent on source-initiated on-demand routing that produces routes only when it's desired by the source node. Route discovery process starts on demand by the source. This method is completed once a route is located or all possible routes have now been explored. It gives unicast, broadcast and multicast communication in ad hoc mobile networks. Routes are maintained provided that they're needed by the source node. AODV nodes maintain a route table by which next hop routing information for destination nodes is stored. Whenever a source node desires to send a data to a destination node and no route information is available, a path exploration process to obtain the destination node takes place. It broadcasts a route request (RREQ) packet to adjacent nodes, which in turn, forward the request with their adjacent nodes, and so on, before destination node is found. Each node maintains a routine number and a broadcast ID. The broadcast ID is incremented for every generated RREQ. The RREQ packet includes the node sequence number, broadcast ID and the most recent sequence number it's for the destination node. Only those nodes answer the RREQ which have their sequence numbers greater than or equal compared to that contained in the RREQ [9].

2.3 AOMDV(Ad-hoc On-demand multipath distance vector)

The motivation for designing AOMDV is to compute multiple loop free and link disjoint paths in highly dynamic ad hoc networks where the link breakage occurs repeatedly. It is the extension of AODV routing protocol [7]. AOMDV maintains a routing table for each node containing a list of the next-hops and its associated hop counts. Every next hop has similar sequence number for maintaining of a route. To send route advertisements, each node maintains the advertised hop count of the destination. If any node's hop count is less than the advertised hop count, then loop freshness is guaranteed for that node by receiving alternate paths to destination. In the case of a route failure, AOMDV uses alternate routes. In AODV routing protocol, a route discovery procedure is needed for each link failure. Performing such procedure causes more overhead and latency also. In the case of AOMDV, new route discovery process is required only when all the routes fail [7]. In AOMDV, a source initiates a route discovery process if it needs a communication route to a destination. The source broadcasts a route request (RREQ) along a unique sequence number so that duplicate requests can be discarded. After receiving the request, an intermediate node record previous hop. If it has a valid and fresh route entry to the destination in its routing table, then it sends a reply (RREP) back to the source. If it has no valid and fresh route entry, it rebroadcast the RREQ. The nodes on reverse

route towards source update their routing information by establishing multiple reverse paths. Duplicate RREP on reverse path is only forwarded if it contains either a larger destination sequence number or a shorter route found.

3. QUALITY OF SERVICE PARAMETERS

Quality of service is overall network performance. It does not refer to single parameter. Quality of Service is an indispensable element to determine the outcome and activity of a network. We are working on parameters they are: Throughput and PDR. Same parameters are taken for both technologies for comparison. QOS verily is the capability of network component of having a degree of conviction that the traffic and demanded conditions would be satiate [1].

3.1 Throughput

Throughput is the number of bits passed through a network in one second. It measures how fast data can pass through an entity (such as a point or a network) [2]. The throughput of a node is measured by first counting the total number of data packets successfully received at the node and computing the number of bits received, which is finally divided by the total simulation runtime. The throughput of the network is finally defined as the average of the throughput of all nodes involved in data transmission. Therefore, throughput can be stated as:

$$Tn=Tbr/Sr \quad (1)$$

Where,

Tn = Throughput of a Node

Tbr = Total Data Bits Received

Sr = Simulation Runtime

Similarly the throughput for the network can be defined as:

$$Tnn=\sum Tn/Nn \quad (2)$$

Where

Tnn=Network Throughput

∑Tn/Nn= Sum of Throughput of Nodes Involved in Data Trans

Nn=Number of Nodes

3.2 Packet Delivery Ratio (PDR)

The packet delivery ratio [3] is the ratio of the number of delivered data packet to the destination. Eq (3) illustrates the level of delivered data to the destination.

$$PDR=\sum \text{Number of packet receive} / \sum \text{Number of packet send} \quad (3)$$

4. SIMULATION RESULTS

Simulation were performed in Network Simulator NS2 to compare WSN technologies ie Zigbee and WiMAX on the basis of different protocols AODV, DSDV, AOMDV with quality of service parameter like throughput and PDR and 100 number of nodes scenario.

4.1 Comparative Analysis on the basis of AODV protocol

The comparison between Zigbee and WiMAX on the basis of AODV Protocol with different Quality of Service parameter like Throughput and PDR. Table 4.1 represents the comparative study of Zigbee and WiMAX with awk parameters of AODV protocol that are delivery, Average throughput amd parameter.awk. This table gives the number of packets sent, number of packets received, cbr traffic, start and stop time.

Table 4.1: AODV awk Parameters

Sr. no.	ZIGBEE	WIMAX
1. Delivery	Cbr traffic, S= 27691 R=8682 r/s= 0.3135 f= 9086	Cbr traffic S= 28653 R= 6392 r/s= 0.2231 f=9912
2.Avg Throughput	Avg throughput(kbps)= -0.00 Start time= 1.00 Stop time= 0.00	Avg throughput(kbps)= 264.81 Start time= 1.00 Stop time= 99.99
3.Parameter	Generated Packets= 27691 Received packets= 8682 PDR= 31.35 Total Dropped Packet=18968	Generated Packets= 28653 Received packets= 6392 PDR= 22.3083 Total Dropped Packets= 22229

4.1.1 AODV Throughput

Throughput is calculated by division of total number of bits to total delay. Fig 4.1 shows the comparative study of ZIGBEE and WIMAX on the basis of throughput parameter. X-axis represents the time intervals and Y-axis represents the throughput.

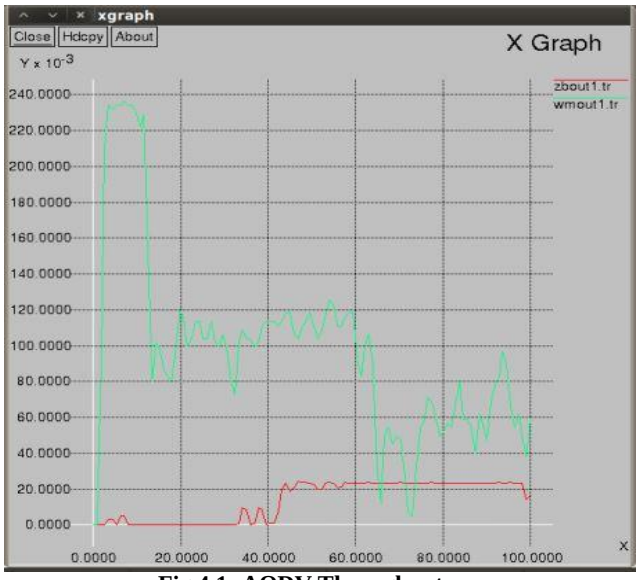

Fig 4.1: AODV Throughput

4.1.2 AODV Packet Loss

Figure 4.2 represents the comparison on the basis of PDR parameter. X-axis represents the Time Interval. Y-axis represents the Loss intervals

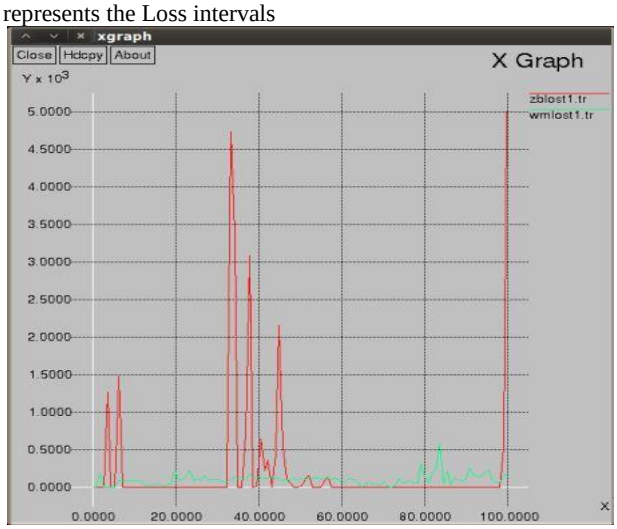

Fig 4.2: AODV PDR

4.2 Comparative Analysis on the basis of DSDV protocol

The comparison analysis of Zigbee and WiMAX on the basis of DSDV Protocol with different Quality of Service parameter like Throughput and PDR. Table 4.2 represents the comparative study of ZIGBEE and WIMAX with awk parameters

Table 4.2: DSDV awk Parameter

Sr. No.	ZIGBEE	WIMAX
1. Delivery	Cbr traffic S= 27691 R= 442 r/s= 0.0160 f=0	Cbr traffic S= 28301 R= 5253 r/s= 0.1856 f=7919
2. Avg Throughput	Avg throughput(kbps)= -0.00 Start time= 1.00 Stop time= 0.00	Avg throughput= 217.47 Start time= 1.00 Stop time= 99.94
3. Parameter	Generated packets= 27691 Received packets= 442 PDR= 1.60753 Total dropped packets=27232	Generated packets= 30406 Received packets= 5253 PDR= 17.2762 Total dropped packets= 23007

4.2.1DSDV Throughput

Figure 4.3 represents the comparison of ZIGBEE and WIMAX with throughput parameter. X-axis represents the Time Intervals. Y-axis Represents the throughput.

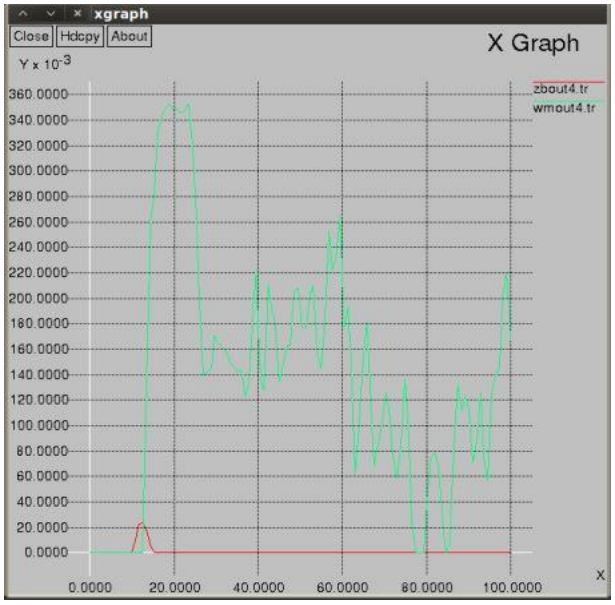

Fig 4.3: DSDV Throughput

4.2.2 Packet Loss Comparison

Figure 4.4 represents the comparison of ZIGBEE and WIMAX with PDR parameter. X-axis represents the Time Intervals. Y-axis represents the Loss intervals.

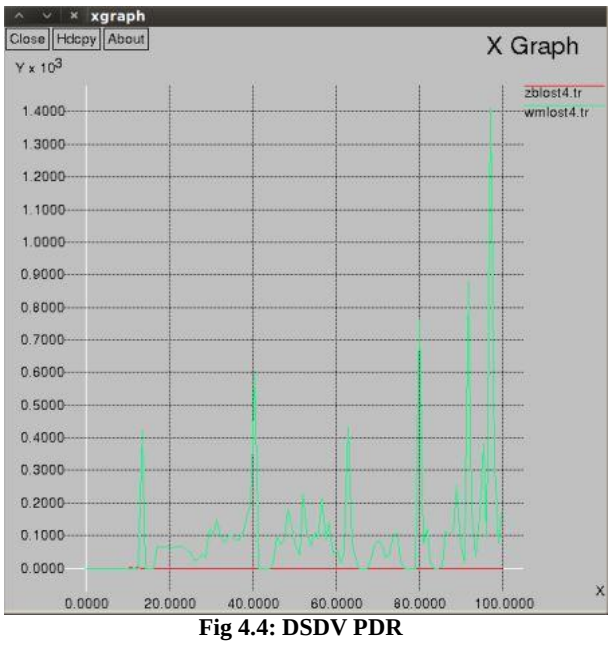

Fig 4.4: DSDV PDR

4.3 Comparative Analysis on the basis of AOMDV Protocol

The comparison analysis of Zigbee and WiMAX on the basis of AOMDV Protocol with different Quality of Service parameter like Throughput and PDR. Table 4.3 represents the

comparative study of ZIGBEE and WIMAX with awk parameters

4.3.1 AOMDV Throughput

Figure 4.5 shows the comparison on the basis of AOMDV with throughput parameter. X-axis represents the Time Interval. Y-axis represents the throughput.

Table 4.3: AOMDV awk Parameter

Sr. No.	ZIGBEE	WIMAX
1. Delivery	Cbr traffic S= 27691 R=0 r/s=0.00 f=0	Cbr traffic S=28910 R= 5848 r/s= 0.2023 f=8704
2. Avg Throughput	Avg throughput(kbps)= -0.00 Start time= 1.00 Stop time= 0.00	Avg throughput(kbps)= 242.33 Start time= 1.00 Stop time= 100
3. Parameter	Generated packets= 27691 Received packets= 0 PDR= 00.00 Total dropped packets=26691	Generated packets= 28910 Received packets= 5848 PDR=20.2283 Total dropped packets= 23032

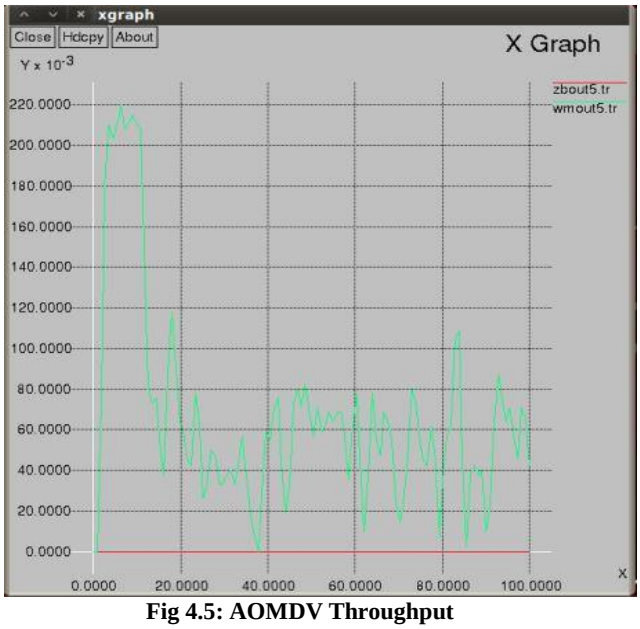

Fig 4.5: AOMDV Throughput

4.3.2 AOMDV Packet Loss

Figure 4.6 shows the comparison on the basis of AOMDV with PDR parameter. X-axis represents the Time Interval. Y-axis represents the Loss intervals.

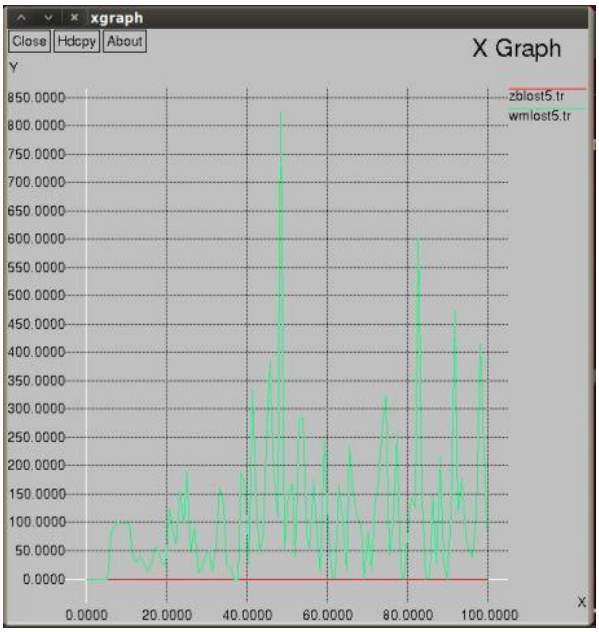

Fig 4.6: AOMDV PDR

5. CONCLUSION

The results obtained from the extensive simulation show that considering the same protocol ie AODV, DSDV, AOMDV, the performance in terms of throughput is better for WiMAX as compared to Zigbee, when the number of nodes deployed are 100 in number. Whereas the performance in terms of PDR is better for Zigbee as compared to WiMAX in the case of DSDV and AOMDV protocol. But in case of AODV protocol WiMAX is better for PDR.

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