Evaluating the Performance of various Routing Protocols in WSN

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Abstract - WSN is comprised of large number of resource constrained sensor nodes. A reliable transmission of sensor data, with low latency and high energy-efficiency is mandatory for wireless sensor networks. Routing protocols are key ingredients in the protocol stack of a sensor node and determine the efficency of the WSN. Hence, careful selection of the routing protocol to achieve maximum efficiency is required. This paper compares and analyzes AODV, DSR and Bellman-Ford on QoS parameters like throughput, delay, energy consumption, packet drop etc. The results discussed can be helpful while choosing a particular routing protocol for WSN. The simulations have been carried out in Qualnet simulator.

***Keywords*-Wireless Sensor Network (WSN), Routing Protocols , AODV Protocol, Bellman-Ford Protocol**

I. INTRODUCTION

Wireless sensor networks consist of large number of sensor nodes having limited resources in terms of battery, processing power, storage capacity etc. These sensor nodes have to operate in complex harsh environments autonomously without any human intervention. WSN's consist of battery-operated sensor devices with computing, data processing, and communicating components. These nodes usually are deployed in an area for information gathering with certain application specific goal. Energy efficency being an important parameter in WSN, the choice of appropriate routing protocol becomes a very important criteria. In general the routing protocols can be classified either as proactive or reactive. Proactive protocols maintain and keep routing information (routes to all nodes) in routing tables irrespective of whether that information is required or not at that instance of time. On the contrary, in reactive protocols path information is calculated on demand basis i.e. whenever a node has some data to send, thus reducing the overhead of maintaing uncesssary information. In WSN, reactive protocols are optimal as these networks have to operate under strict energy constraints.

In this paper a comparison has been drawn between proactive and reactive protocols by selecting a protocol from each type . The effect of choosing these protocls on various parameters like Battery Consumption, End-to-End Delay, throughput. has been analysed and discussed.

II. ROUTING PROTOCOLS

A routing protocol specifies a process for establishing communication paths within a network between source and the destinations keeping the qulaity of service parametrs in consideration. Routing nodes (FFDs) may communicate with each other to provide route information to nodes in the WSN. This process is performed at the layer 3 of OSI model. The routing protocols choosen for comparison in this study are discussed below:

Bellman-Ford:

Bellman Ford is an instance of distance vector routing protocol. In this protocol the routing information is stored in distance tables which provides the shortest path link to the every other node in the network. This routing information is calculated by the information which is received from the neighbouring nodes. This protocol is prone to count to infinity problem but generally performs well in wired networks.

AODV:

AODV is a reactive routing protocol and a route from source node to destination node can be found only when required. A process known as Route Discovery is inititated each time a node wishes to send data towards the destination node. Route Discovery process starts with source node broadcasting a Route Request message. Each intermediate node in the network forwards the Route Request (RREQ) message until it reaches the destination node. The destination node responds to the RREQ message by transmitting the Route Reply (RREP) message. Thus Routes are maintained only between communicating nodes.

III. METHODOLGY

Simulation study in Qualnet consists of three stages [6]. In the first stage, a simulation model is created based on the domain and application parameters. Qualnet architect is

used for creating simulation models. In second stage, results are collected based on various parameters which are configurable. In the final stage, analysis of these parameters is done to deduce results and inferences.

A wireless sensor network scenario is created in qualnet architect which consists of the fixed sensor nodes. A simulation model for comparing AODV and Bell-Man Ford is shown in figure 1 below.

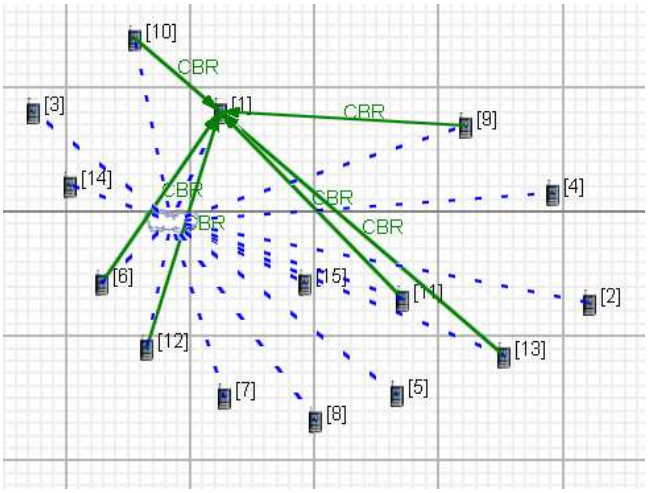

Fig. 1: Deployment Scenario

This scenario consists of 15senosor nodes, configured to act as FFD's (Full Functional Devices). In this scenario, node 1 is configured to act as sink which collects data from all the sensor nodes. A CBR application is connected between sink and 6,7,9,10,11,12,13 with sink node as CBR server.
The simulation was run twice with only one change. Routing protocol was kept as AODV in the first run and was changed to Bellman-Ford in the second run
The simulation parameters considered are listed in table I:

Number of Nodes	15
Energy Model	MicaZ
Battery Model	Linear
Radio Type	802.15.4
Transmission Power	0 dbm
Routing Protocol	AODV/Bellman Ford
Simulation time	2 Hrs
Deployment Area	1500 x 1500 (meters)

TABLE I: Simulation Parameters

IV. RESULTS AND DISCUSSION

In this section, we present the results of simulation and then discuss them briefly.

A. Energy Consupmtion

Energy consumption is greatly influenced by the duty cycle employed in a sensor node. A node can either be in receive, idle, or transmit mode. Routing protocls can greatly effect the amount of time a node spends in each of these states. In reactive routing algorithms, the energy consumed is less as compared to proactive routing algorithms because the route discovery processs is initied on-demand. The energy consumed in the receive and tr ansmit mode is shown in fig 2 and fig 3. The amount of time spent in transmit and recieve mode is shown in fig 4 and fig 5 respectively.

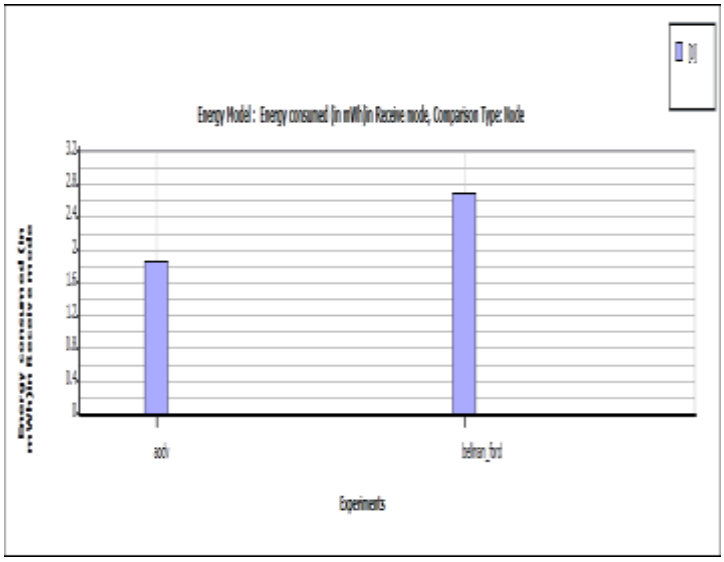

Fig. 2: Enerygy Consumed in Recieve Mode

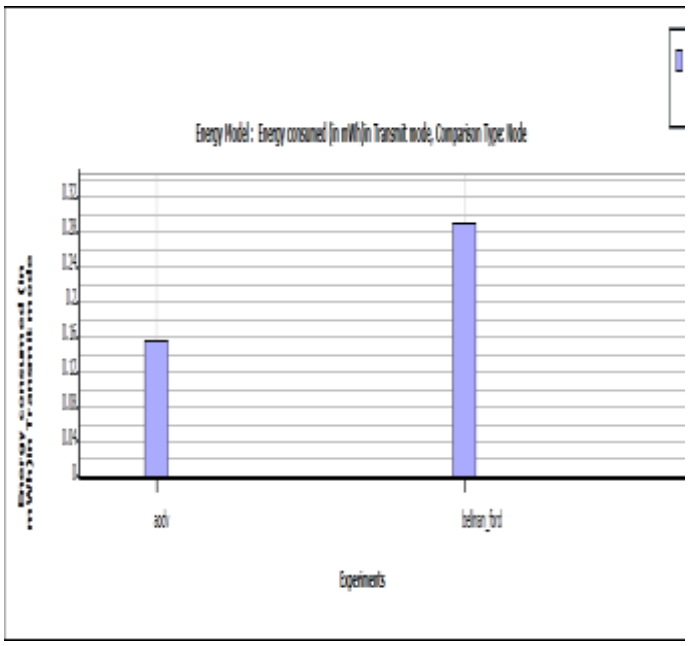

Fig. 3: Energy Consumed in Transmit Mode

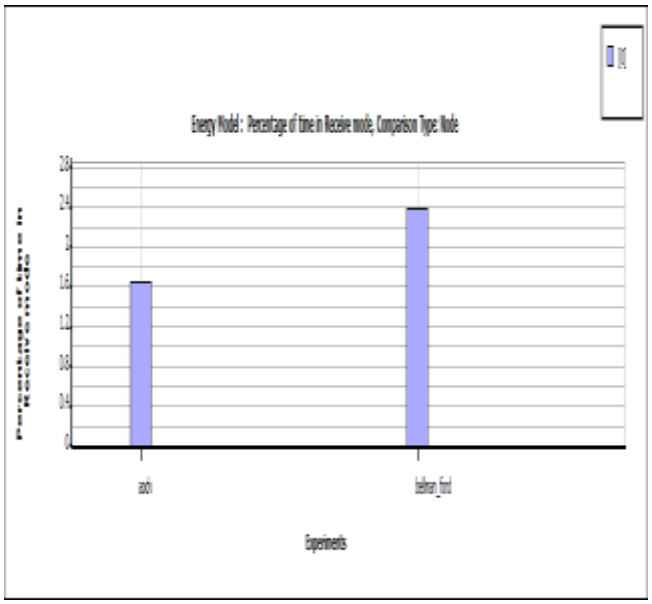

Fig. 4: Percentage of Time In Recieve Mode

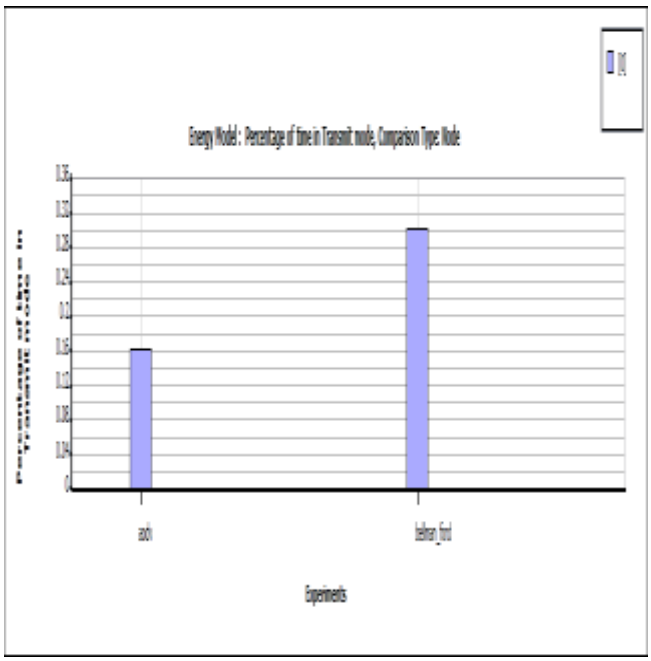

Fig. 5: Percentage of time in Transmit Mode

C. End to end Delay

End to end delay is more in case of aodv than Bellman-Ford, because in reactive protocols route discovery process is initiated each time source node has data to send, thus increasing the lag before the actual data transmission takes place. The comparison is shown in fig 6

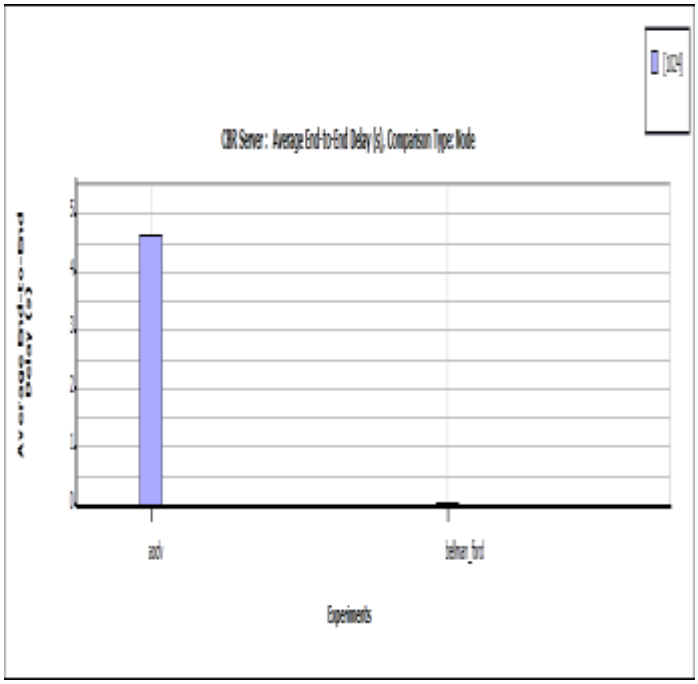

Fig. 6: End to End Delay

D. Througput

Throughput is a measure of number of bits received successfully per second. In case of Bellman-Ford, throughput is less as it continuously broadcasts the route information thus decreasing the available bandwidth for data transmission .

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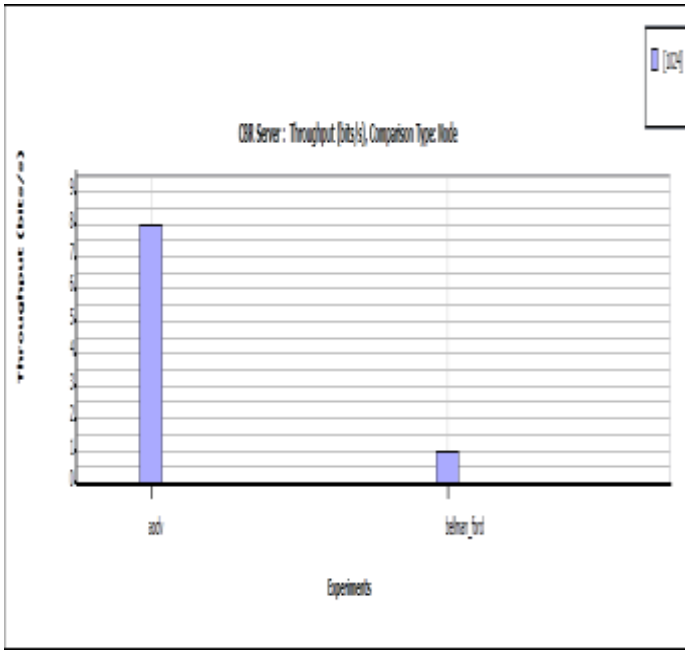

Fig. 7: Througput

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IV. CONCLUSION

In this Paper a comparison between proactive and reactive routing protocols was made. A network of 15 sensor nodes was simulated and comparisons of various determining parameters were drawn between AODV and Bellman-Ford. From the simulation results obtained, it was well understood that proactive protocols are not well suited for WSNs. The results obtained will help in choosing and designing routing protocols for WSN.

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