International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 5, Issue 07[Aug. 2016] PP: 56-59

Performance Evaluation of Routing Protocols In Wireless Sensor Networks Using Mannasim

T Nishitha, V K Aravinda
Computer Science and Engineering Vasavi College of Engineering Hyderabad, India
Computer Science and Engineering Vasavi College of Engineering Hyderabad, India

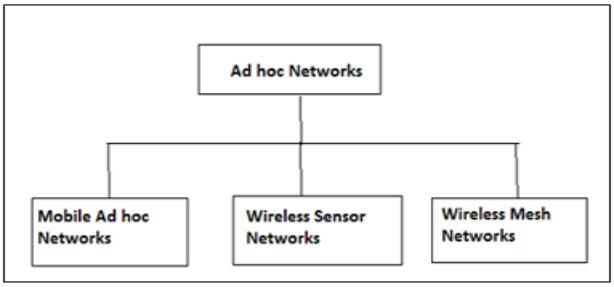
***Abstract*:-** Wireless Sensor Networks (WSN) are a specific category of Ad hoc Networks. They have limited transmission range, storage and processing capabilities. Hence routing in these kind of networks is challenging. In this paper, we compared three existing routing protocols i.e. AODV, DSDV and LEACH by using different performance metrics such as Routing Overhead, End-to-End delay, packet delivery ratio, Throughput. Experimental results are obtained from NS-2 simulator with Mannasim tool**.**

***Keywords*—** *Wireless sensor networks (WSN), routing, performance,mannasim,ns-2, AODV, DSDV and LEACH.*

I. INTRODUCTION

An ad hoc network is a collection of mobile devices which form a communication network with no pre-existing wiring or infrastructure. Routing in ad hoc networks is challenging since there is no central coordinator that manage routing decisions. Ad hoc Networks are classified as Mobile Ad hoc Networks (MANETs), Wireless Sensor Networks (WSNs) and Wireless Mesh Networks (WMNs).

Fig 1: Classification of Ad hoc Networks



Mobile ad hoc networks (MANETs) is a collection of mobile nodes with no pre-existing infrastructure. Each node in MANETs acts as host and router at the same time and hence these are called self organizing networks.

A wireless sensor network typically consists of a large number of low-cost sensor devices with limited battery energy deployed in an unattended manner. A wireless sensor network (WSN) is a special kind of wireless ad hoc network with distributed sensing and processing capability. The goal of WSNs is the detection/estimation of some events of interest, and not just communication. Routing and data dissemination are an important issue in wireless sensor networks (WSNs). The main function of a WSN is to monitor a phenomenon in physical environment and report sensed data to a central node called sink, where additional operations can be applied to the gathered data. Routing techniques in WSNs is one of the important area of research in sensor networks. Some early routing protocols in WSNs like AODV, DSDV are actually existing routing protocols for MANETs. These protocols are designed to support general routing requests in MANETs, without considering specific communication patterns in WSNs.Hence in this paper, we compare a WSN routing protocol that is LEACH with preexisting MANET routing protocols that is AODV and DSDV.

Wireless Mesh Networks (WMNs) are also a special category of Ad hoc networks and are gaining popularity these days because of its unique features. The mesh topology of WMNs provides many alternate paths for a data transfer session between a source and destination, resulting in quick reconfiguration of the path when the existing path fails due to node failures. WMNs provide the most economical data transfer capability coupled with the freedom of mobility. These networks have features such as: multi-hop, auto configuration, easy deployment, self-healing and self-organization. The nodes in a WMN often act as both relays, forwarding traffic to or from other mesh nodes, or providing localized connectivity to mobile or pervasive wireless devices, such as laptops, desktops and other mesh clients (MCs). A WMN combines the fixed network (backbone) and mobile network. Every node in WMNs can act as a router and is able to forward the packet to other nodes. A node

which didn't have access to the backbone network can establish connection by routing the packets from a neighboring node that has a backbone network connection. MCs in WMNs connect to the internet using gateways which act as a relay nodes.

II. LITERATURE REVIEW

The main aim of designing a routing protocol is not only to reduce power consumption, time of transmission and packet loss rate control but also take into consideration the energy consumption, routing overhead, maximize throughput and minimize the end-to-end delay.

In previous research papers and projects all focused only on power consumption and time of transfer only by considering few nodes such as 10, 20, 30, and 50.

In this paper, we have considered the four main metrics those are packet delivery ratio, end to end delay, throughput and routing overhead with different nodes such as 10,25,50,75,100,200,300,400 and 500 in a large network.With the above metrics we have compared three routing protocols which are AODV, DSDV and LEACH.

A. AODV

Ad hoc On demand Distance Vector (AODV) routing protocol is an on demand or reactive routing protocol, that is it starts finding routes from source to destination only if there is a request for it to transmit data packets. It uses destination sequence numbers to identify the most recent paths and also to avoid count to infinity problem. It uses route request (RREQ) and route reply (RREP) messages for establishing routes to the destination. A broadcast message i.e. Route Request (RREQ) message with a unique RREQ ID (RID) will be sent to all its neighbors, when a node wants to find a route to its destination. When a node receives a RREQ message, it updates the sequence number of source node and it sets up a reverse routes to the source node in the routing tables. If the node is the destination or the node has a route to the destination, it unicasts a route reply (RREP) back to the source node. The source node or the intermediate nodes that receives RREP will update its forward route to destination in the routing tables. Otherwise, it continues broadcasting the RREQ. If a node receives a RREQ message that has already processed, it discards the RREQ and does not forward it. In AODV, sequence number (SN) plays a role to indicate the freshness of the routing information and guarantee loop-free routes. Sequence number is increased under only two conditions: when the source node initiates RREQ and when the destination node replies with RREP. Sequence number can be updated only by the source or destination. Hop count (HC) is used to determine the shortest path and it is increased by 1 if RREQ or RREP is forwarded each hop. When a link is broken, route error packets (RERR) are propagated to the source node along the reverse route and all intermediate nodes will erase the entry in their routing tables. AODV maintains the connectivity of neighbor nodes by sending hello message periodically.

B. DSDV

DSDV was the FIRST routing algorithm MANETs and it is a table-driven routing protocol i e routes to all destinations are readily available at every node at all times. The tables are exchanged between neighbors at regular intervals to keep an up-do-date view of network topology. It is a direct adaptation of distance vector routing, which is at the basis of internet routing protocols such as Routing Information Protocol and Border Gateway Protocol (BGP). One of the main problems with distance-vector methods is that loops can be formed. This is mainly due to the fact that nodes make routing decisions in a distributed way, and possibly do so using stale distance information. Moreover, since nodes base their routing information on estimates provided by other nodes, wrong information can quickly propagate through the network, and even though eventually all routing information should converge to correct values, this might take quite long. As routing information gets out of date really fast in MANETs, this problem can get quite severe. DSDV solves the problem using sequence numbers assigned by the destination node. When faced with multiple route updates, nodes always prefer the fresher information (the newest sequence number). Only when two routes are equally fresh the shorter route is chosen. Another feature in DSDV is the use of incremental updates. In order to avoid that nodes have to broadcast complete routing tables at every topology change (which can be very often), it is possible to report only the changes since the last full table update. Despite the careful adaptations done to the original distance-vector method, DSDV suffers from the earlier mentioned problem usually faced by proactive algorithms: tracking all changes in a dynamic network is inefficient. Simulation studies which compare different routing algorithms confirm that DSDV's performance deteriorates quickly with increasing network mobility.

C. LEACH

Low Energy Adaptive Clustering Hierarchy Low Energy Adaptive Clustering Hierarchy (LEACH) is a hierarchical cluster-based routing protocols for sensor networks. In this routing protocol, all the nodes in the network are divided into clusters and each cluster will have a cluster head. All the nodes within the cluster interact with the cluster head to communicate with other nodes in different clusters. In order to increase the

overall lifetime of the sensor networks, LEACH changes cluster heads periodically. LEACH has two main phases i.e. the set-up phase and the steady-state phase. In the set-up phase, there are two parts, the cluster-head electing part and the cluster constructing part. After the cluster-heads have been decided on, sensor nodes broadcast an advertisement message that includes their node ID as the cluster-head ID to inform non-cluster sensor nodes that the chosen sensor nodes are new cluster-heads in the sensor networks. They use the carrier-sense multiple access (CSMA) medium access control (MAC) protocol to transmit this information. The non-cluster sensor nodes that receive it choose the most suitable cluster-head according to the signal strength of the advertisement message, and send a join request message to register on the chosen cluster-head. After receiving the join message, the cluster-heads make a time division multiple-access (TDMA) schedule for data exchange with non-cluster sensor nodes. Then, the cluster head informs the sensor nodes of its own cluster and the sensor nodes then start sending their data to the base station via their cluster-head during the steady-state phase.

III. METHODOLOGY

To test and compare the performance of AODV, DSDV and LEACH protocols we used Mannasim tool. Tcl file is extracted from Mannasim tool and is compiled by using Network Simulator tool i.e ns-2.35. In addition to NS-2, a set of tools, mainly Bash scripts and AWK filters, to post-process the output trace files generated by the simulator are developed. In order to evaluate the performance, multiple experiments have been set up.

A. Mannasim Tool

Mannasim simulation environment for WSN is actually a framework based on foregoing ns-2.It consists of two following parts:

1) Mannasim Framework – The Mannasim Framework is a module for WSN simulation which extends ns-2 introducing new modules for design, development and analysis of different WSN applications.

2) Script Generator Tool – The Script Generator Tool (SGT) is a front-end for TCL simulation scripts easy creation. It is written in Java.

B. Metrics

1) Packet Delivery Ratio

This is the ratio of total no of packets successfully received by the destination nodes to number of packets sent by the source nodes throughout the simulation.

2) End-to-End Delay

It is the cumulative statistical measure of the delays experienced by packets traveling between source and destination.

3) Routing Overhead

It is the ratio of the control packets delivered to data packets delivered.

4) Throughput

Throughput is the ratio of the total amount of data that a receiver receives from a sender to a time it takes for receiver to get the last packet. A low delay in the network translates into higher throughput. Throughput gives the fraction of the channel capacity used for useful transmission and is one of the dimensional parameters of the network.

C. Simulation Results

The following results shows the Packet Delivery Ratio ,End-to-End Packet Delay, Routing Overhead, Throughput of AODV, DSDV and LEACH protocols in UDP environment with varying nodes that is 5,10,25,50,75,100,200,300,400.

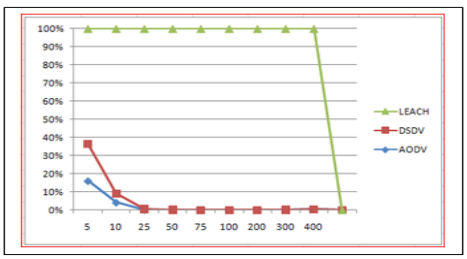


Fig 3.1 Packet Delivery Ratio

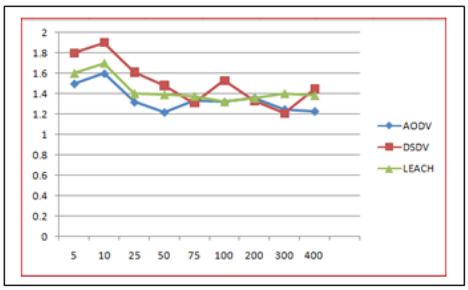


Fig 3.2 Routing Overhead

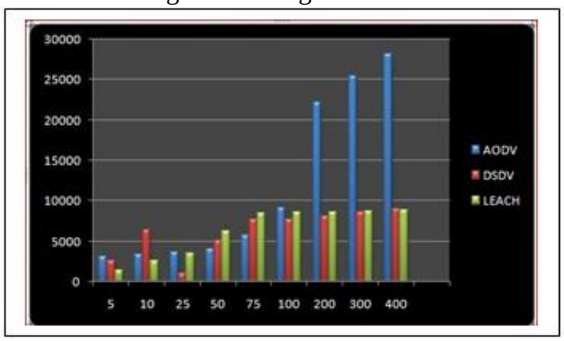


Fig 3.3 End-to-End Delay

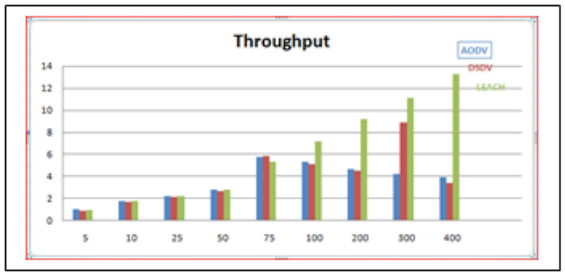


Fig 3.4 Throughput

IV. CONCLUSION

In this paper, we have evaluated the performances of AODV, DSDV and LEACH protocols in large scale by using the simulation tool NS2 (Network Simulator) with Mannasim. From the simulation results, we can conclude that the protocol LEACH has a great performance when compared to AODV and DSDV.

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