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Review Article

Comparative Study of on Demand Routing Protocols in Wireless Sensor Networks

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ABSTRACT

In Wireless Sensor networks, on demand routing protocols play a very important role for communication between sensor nodes using WSNs Protocol stack. This paper presents substantial study and analysis of WSNs protocol Stack using Bellman-Ford routing algorithm to check the flow of data between the layers. In this paper we compare the existing on-demand routing protocols like AODV, DSR, DYMO, FSR, IARP are made on the basis of performance matrices- throughput (bits/s) and average end to end delay(s) in order to find the Quality of Service routing which can meet requirement of users in WSNs. The result shows that AODV satisfies QoS requirement as the numbers of packet transmitted in a given time is more as compared to others routing protocols.

Keywords: Sensor nodes; Wireless Sensor Network; AODV; DSR; Bellman Ford

INTRODUCTION

In Wireless Sensor Networks many routing protocols work for communication between sensor nodes. These routing protocols should be energy-efficient and should also satisfy QoS demands of different applications. If a sensor node wants to sense and sends the data to some another sensor node then this protocol searches the route in an on-demand manner and build the connection in order to transmits and receives the data. On-demand routing protocol [1,2] do not maintain routing information at the sensor nodes if there is no communication. The route discovery usually occurs by flooding the route request packets throughout the networks. On demand routing protocols use two different processes to find and maintain routes: first is route discovery process and the second is route maintenance process. A number of on-demand routing protocols have been developed for the WSN till today. Wireless Sensor Networks are to find ways for improvement of energy efficiency and reliable transmission of sensed data to the Sink. In this chapter analysis of existing on-demand routing protocols DSR, AODV, DYMO, FSR and IARP are carried out. If a node wants to send a packet to some another node then routing protocol searches for the route in an on-demand manner and build the connection in order to transmit and receives the packet [3,4].

EXISTING ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORKS

AODV (Ad-hoc On-demand Distance Vector Routing)

An Ad Hoc On-Demand Distance Vector (AODV) is a routing protocol designed for wireless and mobile ad hoc networks. This protocol establishes routes to destinations on demand and supports both unicast and multicast routing. The AODV protocol [5,6] was jointly developed by Nokia Research Center, the University of California, Santa Barbara and the University of Cincinnati in 1991. AODV is a reactive routing protocol based on DSDV. AODV is designed for networks with tens to thousands of sensor nodes. One feature of AODV is the use of a destination sequence number for each routing table entry [5]. The sequence number is created by the destination node. AODV uses routing tables, with one route entry per destination where each entry stores next hops towards destination. It broadcast route request (RREQ) packets and this RREQ is uniquely identified by the sender address, destination address and request ID.

After processing the RREP packet the node forwards it towards the source. AODV is a packet routing protocol designed for use in WSN and intended for networks that may contain thousands of sensor nodes. The route discovery mechanism is invoked only

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if a route to a destination is not known [7]. The node can later update its routing information if it discovers a better path or route. The primary objectives of AODV protocol are:

- To broadcast discovery packets only when necessary.
- To distinguish between local connectivity management and general topology maintenance.
- To disseminate information about changes in local connectivity to those neighboring sensor nodes those are likely to need the information.

AODV [8] uses a broadcast route discovery method. Path discovery process is initiated when a node requires in communication with a node for which it has no route by broadcasting a route request packet containing the source address, source sequence number, broadcast-ID, destination address, destination sequence number, hop-count to its neighbors. Hop-Count is initially 0 and is incremented by each sensor node as it forwards the route request towards the destination.

DSR (Dynamic Source Routing)

Dynamic Source Routing (DSR) [9] is an on-demand routing protocol in Wireless Sensor Networks. It is a reactive routing protocol which is able to manage WSNs without using periodic table update message like table driven routing protocols do [10]. It uses source routing, which is a technique in which the sender of a packet determines the complete sequence of sensor nodes through which the node has travelled. It was specifically designed for use in multi-hop Wireless Sensor Networks. The Dynamic Source Routing protocol is simple, efficient and highly reactive routing protocol [8-10]. The Dynamic Source Routing protocol (DSR) allows any host to dynamically discover a source route to any destination in the network. In DSR the sender determines the whole path from the source to the destination node and deposits the addresses of the intermediate nodes of the route in the packets. In DSR protocol the nodes don't need to exchange the routing table information periodically and thus reduces the bandwidth overhead in the network. In Dynamic Source Routing, each source determines the route to be used in transmitting its packets to selected destinations. There are two main components, called Route Discovery and Route Maintenance. Route Discovery determines the optimum path for a transmission between a given source and destination. Route Maintenance ensures that the transmission path remains optimum and loop-free as network conditions change, even if this requires changing the route during a transmission.

DYMO (Dynamic MANET On demand)

Dynamic MANET On-demand (DYMO) routing protocol is similar to AODV routing protocol and its benefits are similar to AODV routing protocol. Basically DYMO routing protocol easy to implement and DYMO is enhancement of AODV. DYMO is energy-efficient routing protocol that are used both as a pro-active and as a reactive routing protocol. In DYMO route can be discovered by sensor node when they are needed. In DYMO routing protocol when sensor node discover route then sensor node send a route request(RREQ) message to the destination and then destination send routing reply(RREP) message to source sensor node. DYMO routing protocol contain two operations similar to AODV routing protocol that are: route discovery and route maintenance [13]. Route discovery is performed at source node to a destination for which it does not have a valid path. And route maintenance is performed to avoid the existing obliterated routes from the routing table and also to reduce the packet dropping in case of any route break or node failure.

The DYMO routing protocol [6] is successor to the popular Ad hoc On-Demand Distance Vector (AODV) routing protocol and shares many of its benefits. DYMO is a reactive routing protocol that computes unicast routes on demand or when required. It employs sequence numbers to ensure loop freedom. It enables on demand, multi-hop unicast routing among the nodes in a mobile ad hoc networks.

FSR (FISHEYE STATE ROUTING)

Fisheye is an implicit hierarchical routing protocol. It is a proactive protocol and is a link state based routing protocol that has been adapted to the Wireless Sensor Networks. Fisheye provides route information instantly by maintaining a topology map at each node. It reduces the size of information that is send and receives by sensor nodes in Wireless Sensor Networks. Fisheye maintains a topology map at each node. Fisheye is a table-driven Wireless Sensor Networks and its mechanisms are based on the Link State Routing protocol used in Wireless Sensor Networks. Fisheye routing protocol is used to minimize the routing overhead. Fisheye routing protocol reduces the routing information at every sensor node. By using fisheye routing protocol, every sensor node has knowledge about other sensor nodes and route information.

IARP (INTRAZONE ROUTING PROTOCOL)

The Intrazone Routing Protocol (IARP) is used to maintain routes to destinations within a local neighborhood, which is referred to as a routing zone. More precisely, a node's routing zone is defined as a collection of nodes whose minimum distance in hops from the node in question is no greater than a parameter referred to as the zone radius [2] [8]. Each node maintains its own routing zone. An important consequence is that the routing zones of neighboring nodes overlap. In IARP each node monitors the changes occurs in neighborhood and avoids the global route discovery to local destination. IARP's routing provides enhanced, route maintenance after routes have been discovered. The proactive maintenance of routing zones also helps improve the quality of discovered routes, by making them more robust to changes in network topology. Once routes have been discovered, IARP's routing zone offers enhanced, real-time, route maintenance. Link failures can be bypassed by multiple hop paths within the routing zone.

PERFORMANCE ANALYSIS OF AODV, DSR, DYMO, FSR, IARP

Energy efficiency is big issue in Wireless Sensor Networks as Sensor nodes have low energy efficiency. In WSNs, routing protocols communicate data between sensor nodes and sensor nodes transfer sense data to the base station. This chapter compares the different WSNs routing protocol i.e. Ad-hoc On-

demand Distance Vector Routing (AODV), Dynamic MANET On demand (DYMO), Dynamic Source Routing (DSR), Intrazone Routing Protocol (IARP) and Fisheye Routing Protocol (FSR) using 20 sensor nodes. For studying the Quality of Service (QoS) parameters in Wireless Sensor Networks we have analyzed the performance of these routing protocols on the basis of Performance Matrices - throughput (bits/s) and average end to end delay(s). Since deployment of large sensor nodes is very difficult in real world environment so we develop a simulation environment to verify throughput and average end-to-end delay factor of routing protocols. For this purpose we have used QualNet 5.0.2 simulation modeling tool. In Simulation setup, the initial position of the nodes is random in the 100m x 100m Area. In this work all sensor nodes cooperately passes their data to the base station and from there data is forward via internet or satellite to the task manager node or end user which want to monitor the sensing area. For same Scenario we check performance of AODV, DYMO, DSR, IARP, and FSR. Parameters that are used in this simulation are shown in (Table 1).

Parameters	Values
Simulator	Qualnet 5.0.2
Routing Protocol	AODV, DYMO, DSR, IARP, FSR
Number of nodes	20
Simulation area	100m * 100m
Traffic type	CRB
Node Placement	Random node placement
Simulation Time	120 sec
Channel Frequency	2.4GHz
Antena	Omni Directional

Table 1: Simulation Parameters for on demand routing protocols.

EXPERIMENTAL RESULTS OF ROUTING PROTOCOLS

The Performance of the AODV, DSR, DYMO and IARP are evaluated using QualNet 5.0.2 Simulator. Simulation results are investigated for performance of routing protocols on Quality of Service parameters- throughput and average end to end delay.

Throughput

Throughput [11] is the average rate of successful message delivery in a communication channel. Sensor nodes send packets to base station. Therefore base station receives packets from defend sensor nodes. This data may be delivered over a physical or logical link, or pass through a certain network. Figure 1, shows total number of packets received by base station. Base Station received 1170, 1142, 1095, 1150, 1042 packets (bits/sec) for routing protocols AODV, DSR, DYMO, IARP, FSR respectively.

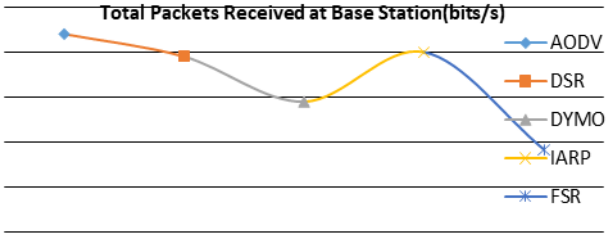

Figure 1: Throughput (bits/s).

Average end to end delay

Average end-to-end delay is the average time in which packets send from sensor node to the base station. When sensor nodes send data to the base station then due to congestion in the communication networks there may be end to end delay. By analyzing five routing protocols we found that the end to end delay is greatest in DSR as compared to the others. Figure 2, shows average end to end delays of five routing protocols [11]. The graph is the figure shows the time (in sec) required for sending packets from sensing field to base station using protocols AODV, DSR, DYMO, IARP and FSR are 3.9s, 4s, 3.4s, 5s, 5.3s.

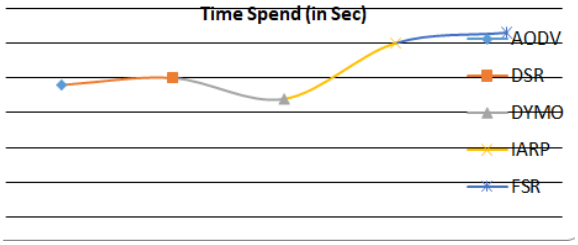

Figure 2: Average End-to-End delay (in Sec).

Routing protocols plays very important role for communication between sensor nodes in Wireless Sensor Networks. By this analysis we find that AODV routing protocol is more energy efficient as compare to others routing protocol. Table 2 shows the analysis of results of the mentioned five routing protocols and also graphical representation of results are shown in (Figure 3).

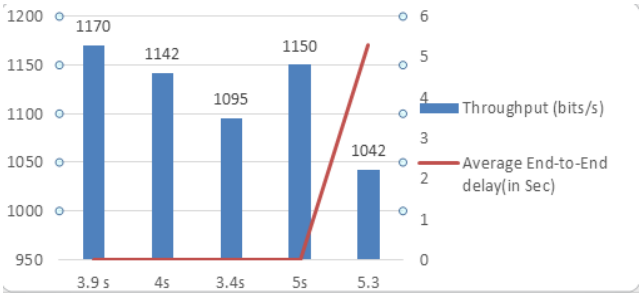

Figure 3: Result analysis of on-demand routing protocols.

CONCLUSIONS

In this paper we have carried out the comparison of the five different on-demand routing protocol using same parameters with 20 sensor nodes. We have analyze the performance of AODV, DSR, DYMO, FSR, IARP on the basis of performance matrices- throughput (bits/s) and average end to end delay(s).The result shows that AODV is more energy-efficient routing protocol as compare to others routing protocols as numbers of packet transmitted is more for the given time than the other routing protocols.

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ETHICS

This Research paper is original and not published in any conferences or in any journal.

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