International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 3 Issue 5, August 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# Performance Comparison of Different Routing Protocols for Wireless Sensor Network in Air Pollution Area

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***How to cite this paper***: Khaing Khaing Maw "Performance Comparison of Different Routing Protocols for Wireless Sensor Network in Air Pollution Area" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-5, August 2019, pp.1756-1759, **https://doi.org/10.31142/ijtsrd26760**

IJTSRD26760



**ABSTRACT**

Wireless sensor network is a wireless network consisting of small nodes with sensing, computation, and wireless communication capabilities. One of the most important issues in Wireless sensor networks (WSNs) is collecting and processing data perceived from the environment and sending that data to be processed and evaluated. Routing data towards the destination node is a fundamental task in WSNs. The data exchange is supported by multihop communications. Routing protocols are in charge of discovering and maintaining the routes in the networks. In this research work, the performance of the different routing protocols in wireless sensor network based on air pollution area is derived. Sensor nodes are deployed in two types of scenario: grid and random. And, simulation result outcomes are evaluated using the different routing protocols like Ad hoc On Demand Distance Vector (AODV) Destination-Sequenced Distance-Vector Routing (DSDV) and Dynamic Source Routing (DSR) in two scenarios. This system is implemented in Network Simulator (NS2). The main focus of this paper is to evaluate the performance of the different routing protocols in random scenarios. The comparison between three different routing protocols is simulated between 10, 50 and 100 nodes.

***KEYWORDS:*** *WSN, AODV, DSDV, DSR, Air Pollution Area, NS2*

## 1. INTRODUCTION

Wireless sensor networks have emerged as an important new area in wireless technology. Wireless sensor network is a collection of nodes organized into a cooperation network

A wireless network consists of tiny devices which sense and monitor physical or environmental conditions such as temperature, pressure, motion or pollutants, etc. [1]. These sensor nodes are autonomous devices using a variety of sensors to monitor the environment in which it is deployed [2]. Wireless sensor networks are used in various types of applications like seismic sensing, military applications, health applications, home applications and environmental applications. There are two main applications of wireless sensor networks which can be categorized as: monitoring and tracking and other commercial applications [3].Basic features of sensor networks are self-organizing capabilities, dynamic network topology, limited power, node failures and mobility of nodes, short-range broadcast communication and multi-hop routing, and large scale of deployment. The strength of wireless sensor network depends on the flexibility and scalability of nodes [4].In general, the two types of wireless sensor networks are: unstructured and structured. The structured wireless sensor networks are those in which the sensor nodes deployment is in a planned manner whereas unstructured wireless sensor networks are the one in which sensor nodes deployment is in an ad-hoc manner. As there is no fixed infrastructure between wireless sensor networks for communication, routing becomes an issue in large number of sensor nodes deployed along with other challenges of manufacturing, design and management of these networks [5]. Sensor network applications only required the successful delivery of messages between a source and a destination [6]. Routing protocols are a key feature of any network. They enable each node to learn about the other nodes in order to find a link to their destination. Because some nodes could be mobile in wireless sensor networks (WSNs), routes between nodes change very often. Therefore, it is not possible to establish fixed paths and infrastructure between nodes [7]. These routing protocols differ depending on the application and network architecture of the WSN [8].

## 2. Overview of proposed system

### A. Ad hoc On Demand Distance Vector

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks [9] [12]. AODV is capable of both unicast and multicast routing [10]. It is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. Additionally, AODV forms trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. AODV uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes [6]. AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it uncast a RREP back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID [11]. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. As the RREP propagates back to the source, nodes set up forward pointers to the destination. Once the source node receives the RREP, it may begin to forward data packets to the destination. If the source later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count, it may update its routing information for that destination and begin using the better route.

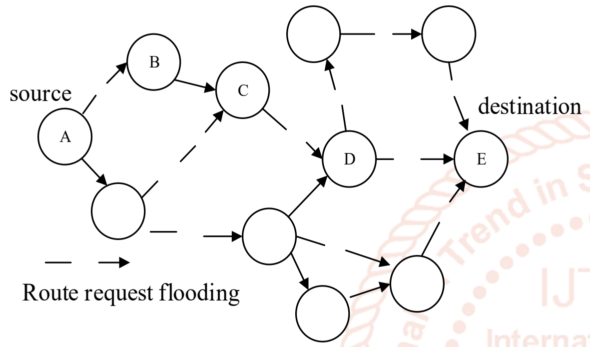


**Fig 2.1: Route Request (RREQ) flooding**

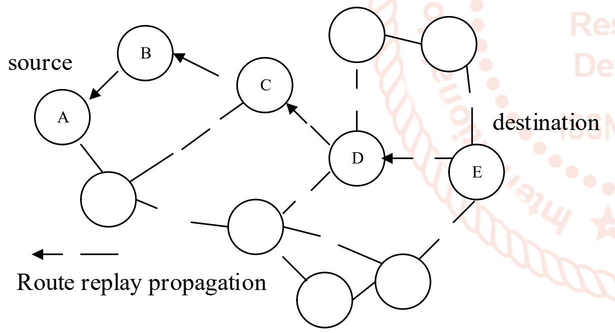


**Fig 2.2: Route Reply (RREP) propagation**

As long as the route remains active, it will continue to be maintained. A route is considered active as long as there are data packets periodically traveling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node

### B. Destination-Sequenced Distance-Vector Routing

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. It was developed by C. Perkins and P. Bhagwat in 1994. The main contribution of the algorithm was to solve the Routing Loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. DSDV was one of the early algorithms available. It is quite suitable for creating ad hoc networks with small number of nodes. Since no formal specification of this algorithm is present there is no commercial implementation of this algorithm. Many improved forms of this algorithm have been suggested. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks. (As in all distance-vector protocols, this does not perturb traffic in regions of the network that are not concerned by the topology change.)

### C. Dynamic Source Routing

Dynamic Source Routing (DSR) protocol is specifically designed for multi-hop ad hoc networks. The difference in DSR and other routing protocols is that it uses source routing supplied by packet's originator to determine packet's path through the network instead of independent hop-by-hop routing decisions made by each node.

The packet in source routing which is going to be routed through the network carries the complete ordered list of nodes in its header through which the packet will pass. Fresh routing information is not needed to be maintained in intermediate nodes in design of source routing, since all the routing decisions are contained in the packet by themselves. DSR protocol is divided into two mechanisms which show the basic operation of DSR. The two mechanisms are route discovery and route maintenance.

When a node S wants to send a packet to destination D, the route to destination D is obtained by route discovery mechanism. In this mechanism the source node S broadcasts a ROUTE REQUEST packet which in a controlled manner is flooded through the network and answered in the form of ROUTE REPLY packet by the destination node or from the node which has the route to destination. The routes are kept in Route Cache, which to the same destination can store multiple routes. The nodes check their route cache for a route that could answer the request before propagation of ROUTE REQUEST. The routes that are not currently used for communication the nodes do not expend effort on obtaining or maintaining them i.e. the route discovery is initiated only on-demand.

## 3. System Flow

NS2 is a simulation tool widely used in the network research community. NS2 provides substantial support for TCP, routing and other protocols over different mediums including wired and wireless networks. NS2 simulates the supported protocols which consist of AODV, DSDV and DSR routing protocols, and then these protocol's behaviors can be studied. But the current implementation of routing protocols in NS2 does not allow simulating a desirable topology. The NS2 routing implementation allows a wireless network simulation to simulate the effect of these routing protocols.

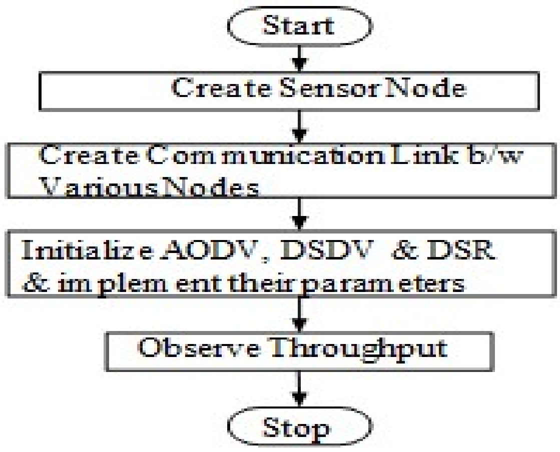


**Figure 3.1: Flow Chart of the Program**

Network simulation is the most useful and common methodology used to evaluate different network scenario (grid and random) without real world implementation. In above scenarios, NS2 was used to perform the simulation of two wireless scenarios that consists of 10, 50 and 100 nodes. From the main function, the input data is generated randomly and the input is passed on to the three functions for AODV, DSDV and DSR. The output is displayed accordingly. The parameters used were two way propagation model, 802.11 as the MAC, Omni directional antenna and drop tail interface queue with length of 50 for every node. The flowchart for the program is shown in Figure 3.1.

## 4. proposed network area and parameter

The Fig 4.1 shows the simulation network area based on air pollution area. This area must be considered as a random. There are network nodes model that are located with random scenarios in the paper. In this paper, the wireless sensor network environment is proposed.

The purpose of this simulation was to measure the ability of the routing protocols to react to the network topology while continuing to successfully deliver data packets to their destinations. To measure this ability, random scenarios are generated by the number of nodes and network size. Simulations are run by considering AODV, DSDV and DSR routing protocols. In order to get realistic performance, the results are averaged for a number of scenarios. Investigators were not attempting to measure the protocol performance on a particular workload taken from real life, but rather to measure the protocol, performance under different range of conditions.

### A. Performance Metrics

The performance of routing protocols is evaluated on NS2 simulator. The goal of this research is to compare the performance of the three protocols under two scenarios. Comparing the different methods is done by simulating them and examining their behavior. It must be considered two parameters for evaluation: throughput and packet delivered ratio.

### B. Throughput

Throughput is the total number of packets that have been successfully delivering from source node to destination node. It is measured by bit/sec or packet per second and sometimes in data packets per second. A higher throughput is the most essential factor for network performance.

$$\text{Throughput} = \frac{\text{Total Data Packets Received}}{\text{Simulation Time}} \text{ (bps)}$$

It is described the number of packet that is passing through the channel in a particular unit of time. Total data traffic in bit/sec successfully received and forwarded to the higher layer.

### C. Packet Delivery Ratio

Packet delivery ratio is the ratio of number of packets received at the destination nodes to the number of packets sent from the source nodes. The performance is better when packet delivery ratio is high. The better the PDF, the more complete and correct the routing protocol is. The greater the value of packet delivery ratio means the better performance of protocol.

$$\text{PDR} = \left(\frac{\text{Total Data Packets Received}}{\text{Total Data Packets Sent}}\right) \text{x}100 \text{ (\%)}$$

**Figure 4.1 Simulation Network Area**

Table 4.1 shows the simulation parameter of network area using three protocols with random scenarios for air pollution area.

**Table 4.1 Simulation Parameters**

| No. | Parameters | Random Scenario |
|---|---|---|
| 1 | Protocols | AODV, DSDV,DSR |
| 2 | MAC Protocol | IEEE802.11 |
| 3 | Antenna Model | Omni Antenna |
| 4 | Channel Type | Wireless Channel |
| 5 | Traffic Type | Constant Bit Rate |
| 7 | Number of Nodes | 10,50 and 100 |
| 8 | Environmental Size | 1000m*1000m |
| 9 | Simulation Time | 100 seconds |
| 10 | Queue Length | 50 |
| 12 | Packet Size | 512 bytes |

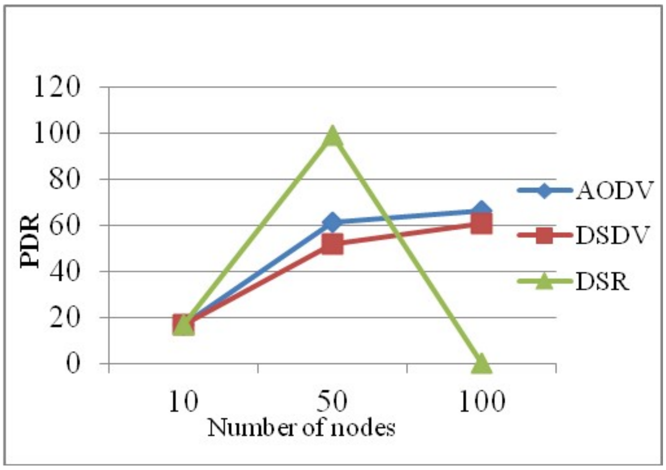


**Figure 4.2 the Comparison of PDR for Three Different Protocols in Random Scenario**

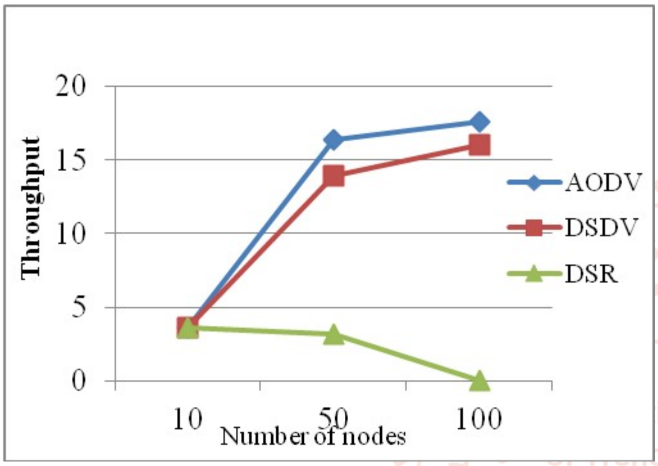


**Figure 4.3 the Comparison of Throughput for Three Different Nodes in Random Scenario**

## Conclusion

Figure 4.2 shows the comparison of result of PDR for three different nodes plan at random. In 50 nodes case, DSR in random scenario has maintained a remarkably higher percentage of packet delivery ratio compared to AODV and DSDV. DSR routing protocol performs unstable because the percentage of packet delivery ratio dramatically drops from 99 % to 0% in 100 nodes case. AODV performs very well compared to the percentage of DSDV which is not increased as much as AODV with packet delivery ratio.

The comparison of result of throughput for three different nodes plan in random is as shown in Figure 4.3. The three protocols have similar performance in term of throughput at all 10 nodes case. The throughput of AODV increases slightly16.4 kbps to 17.57 kbps. The throughput of DSDV increases from 13.88 kbps to 15.99 kbps. The throughput of AODV and DSDV routing protocols increases significantly with increasing node number. AODV routing protocol achieves more throughput than DSDV at different node. The average throughput of AODV is the best performance with 17.52 kbps in 100 nodes. DSR routing protocol performs unstable because the percentage of throughput dramatically drops from 3.153 kbps to 0 in 100 nodes case.

By comparing the simulation results, the percentage of AODV protocol with 100 nodes is the highest with 66.23% packet delivery ratio and 17.57 kbps with throughput. As a result, 100 nodes of AODV protocol is better performance than others.

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