Performance Comparison Of Different Routing Protocols Over Wireless Sensor Network

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Abstract— **Wireless sensor network (WSN), is a distributed network of sensor nodes which performs critical tasks in many applications. The efficiency of WSN strongly depends upon the routing protocol used. The routing protocols developed for these networks need to exhibit good performance. To create a better understanding of the performance of various existing routing protocols it is very important to analyze their performances in detail. In this paper we have analyzed four different types of routing protocols: the AODV, DSDV, DSR, and AOMDV using NS-2 and compared in terms of throughput and normalized routing overhead (NROH), by varying pause time, maximum speed and rate. They also compared with IEEE802.11 and IEEE802.15.4. On comparison, the throughput of DSDV of IEEE802.11 and NROH of DSDV of IEEE802.15.4 are observed to be better.**

Keywords—**Wireless Sensor Network, Routing Protocols**

I. Introduction

The Wireless Sensor Networks (WSN) consists of many sensor nodes, having wireless channel to communicate with each other. It can transfer signals to the physical world without any predefined communication link. All the nodes are capable to act either as source node or sink node. Due to small in size they have a limited processing power, which limits the capacity of processor and size of battery. They are deployed at high density in regions requiring surveillance and monitoring, at a cost much lower than the traditional wired sensor system.

The efficient transmission of data packets is the main goal in a wireless sensor network. The sensor nodes collect the information, process it and send it to the base station. Different performance parameters like throughput, end to end delay, packet delivery fraction, packet loss, NROH, residual energy are the most significant factor for assessing the Quality of Service.

The routing is an important issue in WSN. There are many routing protocols available but in this paper the four important protocols AODV [3][4], DSDV [4][7], DSR [3][5], AOMDV [2][6] are compared and analyzed.

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II. Routing Protocols

In a network the routing protocols depends on the network architecture and application. The sensor nodes have limited available power. Therefore the energy efficient routing protocols are truly crucial for WSN. The routing protocols are designed to achieve collision avoidance, faster data transmission, energy efficiency and lower latency.

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

The AODV is a reactive routing protocol which establishes a route to its destination only on demands. It is loop free and self starting protocol. It is suitable for unicast and multicast routing.

In AODV, the source broadcasts a Route Request (RREQ) message to find a path to its destination. The neighbors in turn broadcast the packet to their neighbors till it reaches the destination. A node discards a RREQ packet that it has already seen. The RREQ packet uses sequence numbers to ensure that the roots are loop free. It also makes sure that if the intermediate nodes reply to the source request, they reply with the latest information only. When a node forwards a packet to its neighbors, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet [3] [4].

The AODV uses only the symmetric links because the Route Reply (RREP) packet follows the reverse path of RREQ packet. As the RREP packet traverses back to the source, the nodes along the path enter the forward route into their tables. If the source moves then, it can reinitiate route discovery to the destination. If one of the intermediate nodes moves, then the neighbor of the moved node realizes the link failure and sends a link failure notification to its upstream neighbors and so on till it reaches the source upon which the source can reinitiate route discovery if needed.

B. Dynamic Destination-Sequenced Distance Vector Routing (DSDV)

The DSDV is a proactive routing protocol. It is based on the idea of the classical Bellman-Ford Routing Algorithm [4]. Here, every mobile station maintains a routing table that lists all the available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish the routes and thus avoids the formation of loops. A station periodically transmits its routing tables to its immediate

neighbors, if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven.

The routing table updates can be sent in two ways: a "full dump" or an "incremental update". A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet [4] [7].

C. *Dynamic Source Routing (DSR)*

It is a source-routed on-demand routing protocol. A node maintains route caches containing the source routes that it is aware of. The node updates the entries in the route cache as and when it learns about new routes. The two major phases of the protocol are: route discovery and route maintenance [4]. When the source node wants to send a packet to a destination, it looks up its route cache to determine if it already contains a route to the destination. When it finds the existence of an unexpired route to the destination, it uses this route to send the packet. But if the node does not have such a route, then it initiates the route discovery process by broadcasting a route request packet. The route request packet contains the address of the source and the destination, and a unique identification number.

Further, each intermediate node checks whether it knows of a route to the destination. If it does not, it appends its address to the route record of the packet and forwards the packet to its neighbors. In order to limit the number of route requests propagated, a node processes the route request packet only if it has not already seen the packet and its address is not present in the route record of the packet. A route reply is generated when either the destination or an intermediate node with current information about the destination receives the route request packet. A route request packet reaching such a node in its route record contains the sequence of hops taken from the source to this node. If the route reply is generated by the destination then it places the route record from route request packet into the route reply packet. On the other hand, if the node generating the route reply is an intermediate node then it appends its cached route to the route record of route request packet and puts that into the route reply packet. To send the route reply packet, the responding node must have a route to the source. If it has a route to the source in its route cache, then it can use that route. The reverse of the route record can be used if symmetric links are supported. In case symmetric links are not supported, then the node can initiate route discovery to source and piggyback the route reply on this new route request [3] [5].

D. *Ad hoc On-demand Multipath Distance Vector Routing (AOMDV)*

AOMDV is designed to calculate multiple paths during the route discovery in highly dynamic ad hoc networks where the link breakage occurs frequently due to high velocity of vehicles. In AODV routing protocol, a route discovery procedure is needed after each link failure. Performing such procedure results in high overhead and latency. Thus, this defect is overcome by having multiple paths available. In AOMDV, performing the route discovery procedure will be done after all paths to either source or destination fail. In AOMDV routing protocol, it is endeavored to utilize the routing information already available in the underlying AODV protocol. However, little additional modification is required in order to calculate the multiple paths [2] [6]. The AOMDV protocol includes two main sub-procedures:

- Calculating multiple loop-free paths at each node

- Finding the link-disjoint paths by deployment of distributed protocols

III. **Simulation Model**

Our main goal is to analyze the different routing protocols and compare their performances. The simulation is performed by the NS2 simulator. It is the software that provides the simulations of wireless network. It is an open source software. In our simulation we consider a network having 100 number of nodes. For calculating the performance of different routing protocols, we need some performance metrics that are end to end delay, normalized routing overhead, packet loss and residual energy.

A. NROH: NROH= No. of RTR/simulation time
The RTR is total no. of routing packets generated by the routing protocols during the simulation.

B. Throughput: It is defined as the ratio of the number of packets delivered to the total number of packets sent.

Table 1: Parameter Details

| SL NO.	PARAMETERS	DETAILS
1	Channel type	Wireless channel
2	Transmission range	250 m
3	No. of nodes	100
4	Maximum connection	50
5	Simulation time	100
6	Terrain area	500*500
7	Traffic type	TCP
8	Model	Energy model
9	Initial energy	1000j
10	Node movement	Random way point
11	Antenna type	Omni antenna
12	Radio propagation model	Two ray ground
13	Mac type	802.11, 802.15.4
14	Packet size	512 bytes

IV.   Results and Discussions
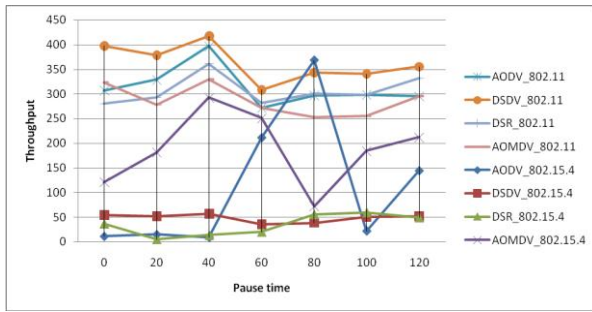
Fig – 1: Throughput vs. Pause time

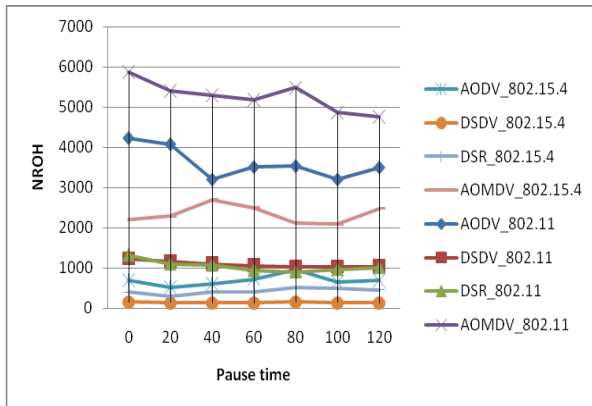This fig shows that the throughput is higher in all routing protocols for IEEE 802.11.

Fig – 2: NROH vs. Pause time

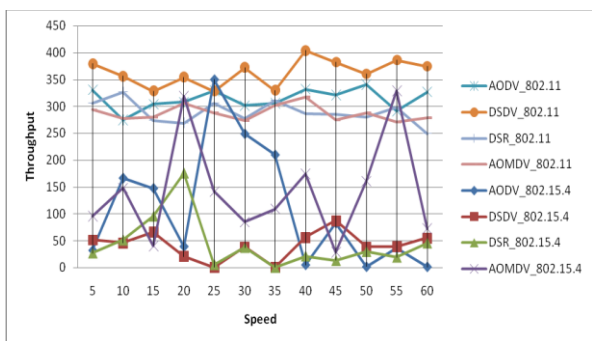This graph shows that the normalized routing overhead is higher in all routing protocols for IEEE 802.15.4.

Fig – 3: Throughput vs. Speed

From Fig – 3 it shows that the throughput of DSDV in IEEE 802.11 is better as compared to all the protocols of IEEE 802.15.4.
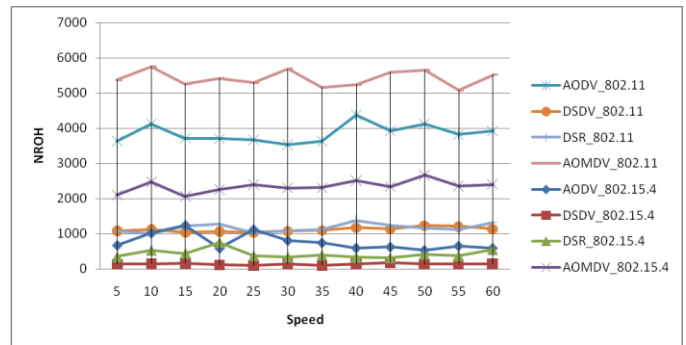

Fig – 4: NROH vs. Speed

From this figure it is observed that the normalized routing overhead in IEEE 802.15.4 of DSDV is better as compared to AODV and AOMDV.
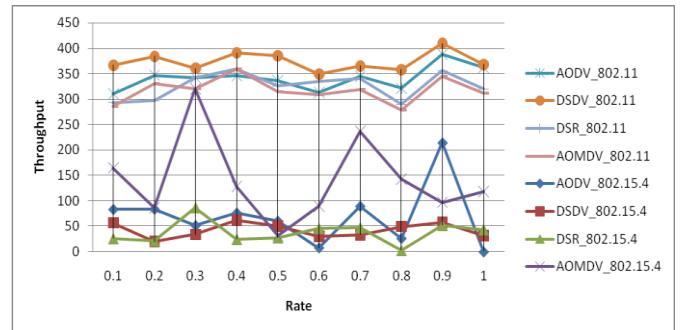

Fig – 5: Throughput vs. Rate

This graph shows that the throughput is higher in all routing protocols for IEEE 802.11 as compared to IEEE 802.15.4.
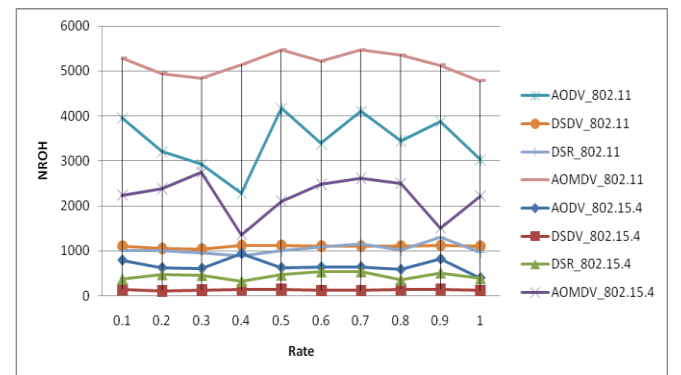

Fig - 6 NROH vs. Rate

It is observed that normalized routimg overhead in IEEE 802.15.4 of DSDV is better as compared to others.

v. **Conclusion**

The Wireless Sensor Network is an important emerging area for industrial control and monitoring applications. In some typical application like, disaster management or environmental control the delay in data transmission is not acceptable. In these applications, the selection of appropriate routing protocol is extremely crucial. Here four protocols i.e. AODV, DSDV, DSR, AOMDV are compared with 802.11 and 802.15.4 IEEE standards. From the results, it is observed that, for application where throughput is vital, then the IEEE 802.11 with DSDV can be the best solution. As far as normalized routing overhead is concerned the DSDV of IEEE 802.15.4 is found to be performing better as compared to others. It is observed that the overall QOS depends on proper selection of the routing protocols, for a particular application of wireless sensor network.

Acknowledgment

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