

Performance Analysis of AODV & DSR Routing Protocols in Wireless Sensor Networks

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ABSTRACT

As deployment of sensor networks are increasing either manually or randomly to monitor physical environments in different applications such as military, agriculture, medical transport, industry etc. In monitoring of physical environments, the most important application of wireless sensor network is monitoring of critical conditions. The most important in monitoring application like critical condition is the sensing of information during emergency state from the physical environment where the network of sensors is deployed. A big challenge to sensor networks is a fast, reliable and fault tolerant channel during emergency conditions to sink (base station) that receives the events. Our focus is to discuss and evaluate the performance of two different routing protocols like Ad hoc On Demand Distance Vector (AODV) [1] and Dynamic Source Routing (DSR) for monitoring of critical conditions with the help of important metrics like network load and media access delay in different scenarios for both stable and mobile nodes. On the basis of results derived from simulation a conclusion is drawn on the comparison between these two different routing protocols with parameters like media access delay and network load.

Keywords - Ad hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Media access delay, Network load, OPNET.

1. INTRODUCTION

The advancements in wireless communication technologies enabled large scale wireless sensor networks (WSNs) [2] deployment. A Wireless Sensor Networks consists of spatially distributed sensor to monitor physical or environmental conditions. As from the name rather than gathering sensed data through wired data buses WSN employs a wireless backhaul to transmit sensor reading to central location for aggregation and further processing.

Wireless Sensor Networks can be generally described as a network of nodes that cooperatively sense and may control the environment enabling interaction between persons or computers and the surrounding environment. The design of energy efficient communication protocols is a very peculiar

issue without significant precedent in wireless network history. The nodes can be mobile or immobile, location-aware or location-unaware and homogenous or heterogeneous. Sensor nodes are limited in energy supply and bandwidth. These constraints combined with scalability determine the design and management of sensor networks. The issues related to physical and link layers are unique for all kind of sensor applications, therefore the research on these areas has been focused on system-level power awareness such as dynamic voltage scaling, radio communication hardware, low duty cycle issues, system partitioning, energy aware MAC protocols.

One of the necessary requirements of a wireless sensor network is to deliver data reliably against the dynamic and lossy nature of wireless transmissions. In wireless sensor networks the energy dissipation in transmission of data directly depends on the routing algorithm. Hence, resource constraint Sensor Networks requires an optimum algorithm for routing.

2. ROUTING PROTOCOL

A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network, the choice of the route being done by routing algorithms. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbours, and then throughout the network. This way, routers gain knowledge of the topology of the network. The term routing protocol may refer specifically to one operating at layer three of the OSI model, which Similarly disseminates topology information between routers. As we are comparing AODV and DSR routing protocols for mobile and stable nodes in wireless sensor networks are discussed below:

AODV (Ad hoc On-demand Distance Vector):

AODV is a reactive routing protocol and a route from one node to another node can be found when required. 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.

As the RREP flows through the network, it determines the route from source node to destination node. The sequence number is increased by each originating node and used to determine whether the received message is the most recent one. The older routing table entries are replaced by the newer ones. Active nodes in the networks are determined by broadcasting a "Hello" message periodically in the network. If a node fails to reply a link break is detected and a Route Error (RERR) message is transmitted which is used to invalidate the route as it flows through the network. A node also generates a RERR message if it gets message destined to a node for which a route is unavailable.

Types of messages in AODV:

1. Route Request (RREQ) message: It is used to form a route from one node to another node in a network.
2. Route Reply (RREP) message: It is used to connect destination node to source node in a network.
3. Route Error (RERR) message: It is used to indicate any route broken or node failure.
4. HELLO message: It is used to determine the activeness of the network.

The transmission of data depends on route discovery and route maintenance in AODV. The route discovery depends on RREQ and RREP messages, if a node initiate's request of route it will form route after getting the RREP. The route will be maintained by sending HELLO messages to neighbour nodes, if any link failure it will indicate using RERR message

(TEEN) Threshold - sensitive Energy Efficient sensor Network protocol:

TEEN is a reactive protocol proposed for time-critical applications. BASE STATION broadcasts the attribute, Hard Threshold (HT) and Soft Threshold (ST) values to its cluster members. The sensor nodes starts sensing and transmits the sensed data when it exceeds HT. HT is the minimum attribute range above which the values are expected. The transmitted sense value is stored in an internal variable called Sensed Value. The cluster nodes again starts sensing, when its value exceeds the ST. The minimum change in the sensed value it switches on its transmitter and transmits. The energy is conserved since the sensor nodes in the cluster senses continuously but transmits only when the sensed value is above HT. The ST further reduces the transmission which could have been occurred when there is a little change or no change in sensed attribute. As the cluster heads (CH) need to perform extra computations it consumes more energy compared to other nodes. The main drawback of this protocol is that the transmission from nodes to CH will not be there when the sensed value is not greater than HT, hence the CH will never come to know

even when any one of the sensor node dies. Accurate and clear picture of the network can be obtained by fixing the ST as smaller value even though it consumes more energy due to frequent transmissions [3].

3. SIMULATION AND ENVIRONMENT

In simulation the different types of scenarios are consider based upon mobile and fixed nodes on OPNET simulator. OPNET(Optimized Network Engineering Tool) Modeler. 14.5 is used for the design and implementation of this work.

3.1 OPNET

OPNET is a network simulator that provides virtual network communication environment. It is appropriate for the research studies, network modeling and engineering, R & D Operation and performance analysis. OPNET Modular 14.5 [4] is chosen because it is one of the leading environments for network modeling and simulation. It offers easy graphical interface, possibility to develop and run this simulation environment, validity of the simulation results. This tool is highly reliable, robust and efficient [8]. It supports large number of built-in industry standard network protocols, devices, and applications.

3.1.1 OPNET Features

- It provides virtual real time environment for networks with GUI.
- Useful in evaluation of designs for new network models and architectures.
- Good for performance study of existing systems based on users conditions.
- Easy for understanding the network behaviour in various scenarios.

3.2 Simulation Steps

Simulation with OPNET is generally divided into four parts, network model design, applying statistics, run simulation and then to view results and to analyze the results, if the results are not correct then it has to be re-modeled and then to apply new statistics. The basic work flow of OPNET [5] can be seen in the flowchart shown in figure 1.

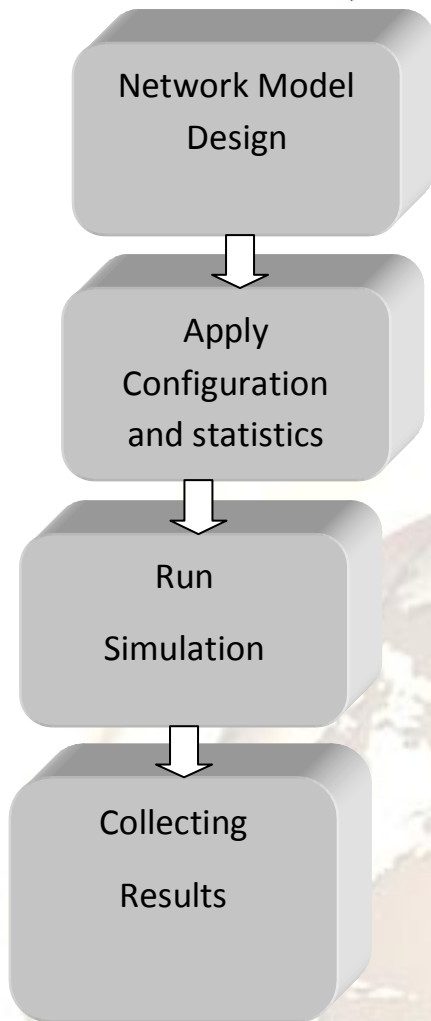


Fig 1: Simulation Steps

3.3 Simulation Environment & Parameters

In this research work the simulation tool OPNET Modeler 14.5 is used, which is very common in practice now a days. This simulation study focuses on the performance of routing protocols with fixed and mobile nodes. Therefore, eight simulation scenarios consisting of 20 nodes each (mobile and fixed) are considered for two routing protocols AODV & DSR. The area chosen for this setup is 100*100 meters. FTP (File Transfer Protocol) traffic is generated using the Application and Profile Configuration. The simulation parameters used in this study are as below:

Table 1: Simulation Parameters

Attribute	Value
Maximum Simulation Time	600 sec
Interface Type	Wireless(ad-hoc)
Network Area	100*100 meters
Mobility Model	Random Way Point
Data Rate(bps)	11Mbps
Transmit Power(W)	0.030
Buffer Size(bits)	256000
No. of Nodes	20
Protocols	AODV, DSR
Traffic Generation Application	FTP



Fig 2: An example of network model design of 20 nodes

1. Media Access Delay

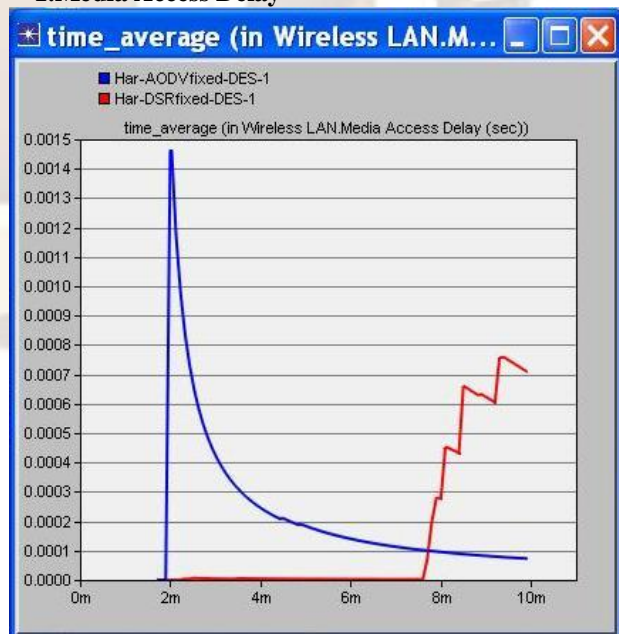


Fig 3: Media access Delay in AODV& DSR for fixed nodes (20 nodes)

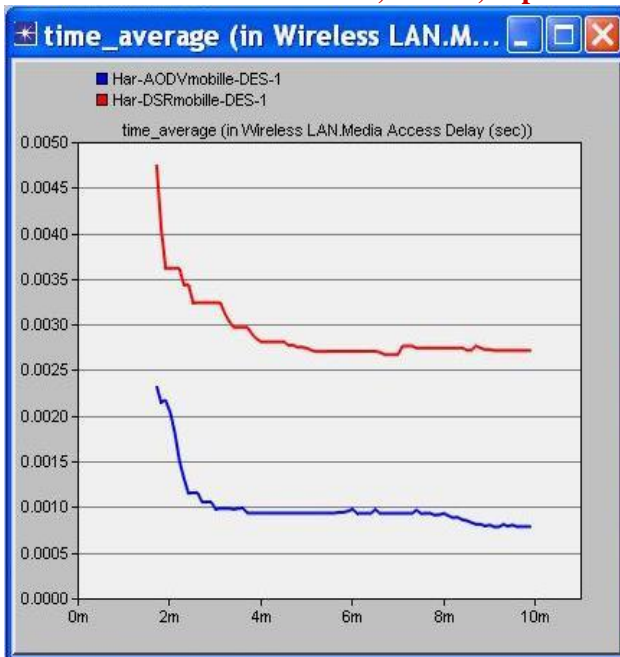


Fig 4: Media access Delay in AODV& DSR for mobile nodes (20 nodes)

As it is clear from the figure 3 that media access delay of AODV protocol is more than DSR in case of fixed nodes but only in the beginning, but as the time increases delay of DSR goes increases than AODV. In figure 4 media access delay of DSR is more than AODV while the nodes are mobile. So AODV protocol performs better than DSR for higher number of nodes in both fixed and mobile nodes because delay is less except the initial state of AODV in case of fixed nodes [5].

The Media Access Delay encountered by the two routing protocols during the simulation period for all scenarios. It is clear from figures that DSR incurs the highest delay, especially on large size of nodes. DSR exhibits large packet delay because its routes discovery takes more time. Every intermediate node tries to extract and record information before forwarding a reply. AODV gives the lower Media Access Delay as compared to DSR.

2. Network Load

Figures 5 and 6 show the Network load in both the protocols for stable and mobile nodes. As shown in the figure 5 that Network load of AODV is more in case of fixed nodes as compared to the DSR protocol [6]. It depends upon the number of nodes, more the number of nodes more will be network load in both the cases stable and mobile in DSR protocol. While in the figure 6 Network load of DSR is more in mobile nodes

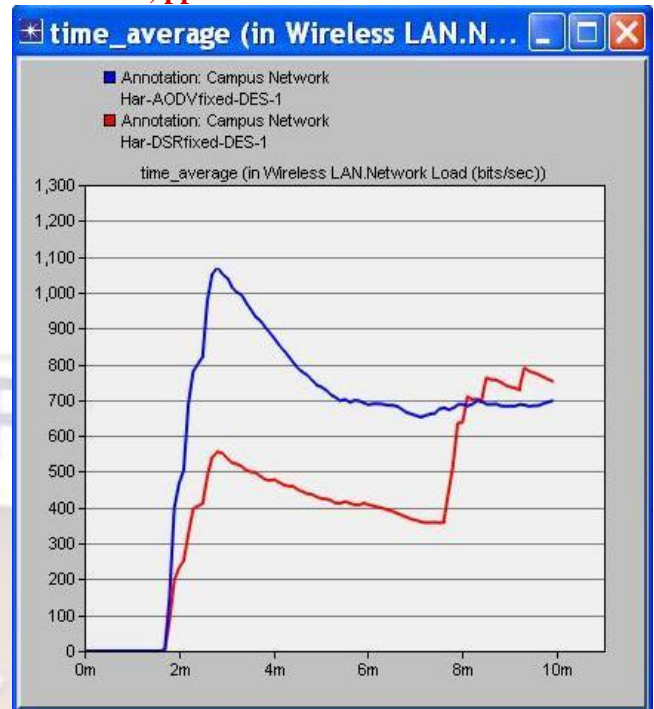


Fig 5: Network Load in AODV& DSR for fixed nodes (20 nodes)

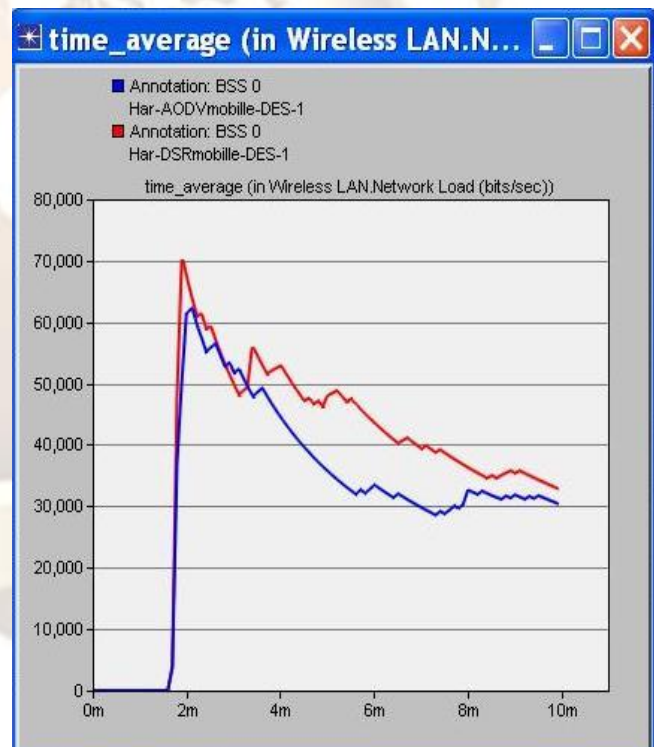


Fig 6: Network Load in AODV& DSR for mobile nodes (20 nodes)

So according to the simulation the performance analysis of DSR is better in aspect of Network load for mobile and stable nodes in lower number of nodes. In aspect of Media

access delay the performance of AODV is better for mobile nodes while for fixed nodes performance of DSR is better in the initial time but as the time increases performance of DSR goes down and AODV perform better.

4. CONCLUSION

In this work the evaluation of the two routing protocols for their responses to network scalability with respect to their network load and media access delay as their performance metrics. DSR and AODV implemented in different scenarios of executing stable nodes and mobile nodes networks. In each scenario all the nodes were used as source nodes of sending data to a common base station. So according to the simulation the performance analysis of DSR is better in aspect of Network load for mobile and stable nodes in lower number of nodes case. In aspect of Media access delay the performance of AODV is better for mobile nodes while for fixed nodes performance of DSR is better in the initial time but as the time increases performance of DSR goes down and AODV perform better. On selected protocols, from the conducted study we conclude that in overall performance one protocol is superior to other protocol. One protocol may be far better in performance than other protocol in terms of media access delay and network load. The size of the networks also matters for the performance of the protocol.

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