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Comparative Performance Analysis of AODV, DSDV and DSR for Wireless Devices

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Abstract— Routing is the task of directing data packets from a source node to a given destination. The On-demand protocol performs better than the table-driven protocol.In this project we have analyzed and compared three routing protocols i.e. AODV, DSR, DSDV implemented in ns-2. The protocols are simulated in a wireless environment with routing protocols and varying pause time in a simulation environment of 100 nodes. We investigated the performance metrics namely Packet Delivery Ratio (PDR), Average end-to-end delay, energy spent and throughput through NS-2 simulation. The performance of protocol is one of the interesting issue.

Index Terms— AODV, DSR, DSDV, NS-2 Simulator, packet delivery ratio, end-to-end delay, energy spent, throughput, source, destination

1 Introduction

In recent year the establishment of IEEE 802.11 wireless protocol has allowed users to roam freely within a wireless local area network by communicating with the access point in the LAN. However, this protocol utilizes a centralized topology for communication

In typical wireless LAN environment, illustrated in Figure 1, client utilizes access point (AP) in network to connect with other clients. Information is first sent from sender to the AP and then forwarded to the receiver. This approach still retains deficiencies if the traditional centralized system eg the failure of AP will have a catastrophic effect on the overall network [1].

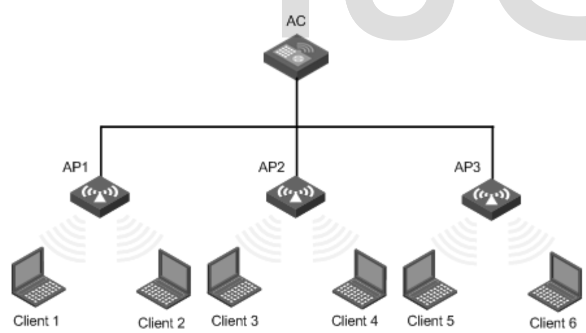

Fig 1. Wireless Local Area Network (LAN)

1.1 A Better Network: Distributed System

A distributed computer system consists of multiple software components that are on multiple computers, but run as a single system. The computers that are in a distributed system can be physically close together and connected by a local network, or they can be geographically distant and connected by a wide area network. A distributed system can consist of any number of possible configurations, such as mainframes, personal computers, workstations, minicomputers, and so on. The goal of distributed computing is to make such a network work as a single computer [1].

Distributed systems offer many benefits over centralized sys

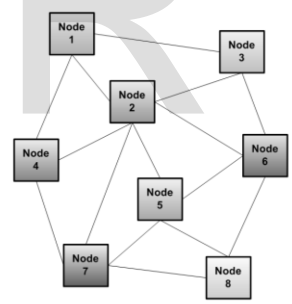

Fig 2. Distributed System Topology

tems, including the following:

- Scalability-The system can easily be expanded by adding more machines as needed.
- Redundancy- Several machines can provide the same services, so if one is unavailable, work does not stop. Additionally, because many smaller machines can be used, this redundancy does not need to be prohibitively expensive.
- Connectivity- Unlike a centralized system, a distributed system does not have a single point if failure. When a node fails in distributed environment, information is simply routed around the failed node and continues its path to the receiver node. The distributed system will maintain its functionality as long as there is an alternate path available [1].

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1.2 Routing Protocols

An individual packets needs to be routed to its destination node through one of many available paths in the network. Nodes themselves can behave as routers and forward packets onto the next node. When a new node joins the network, additional possible routes are created and thus add to the complexity of route discovery and selection.

The routing process is further complicated by the mobility of wireless nodes. In a wireless distributed system, nodes communicate wirelessly and thus have the ability to roam freely as long as it is within the signal proximity of at least one other node in the network. In other words, Routing is the process of selecting paths in a network along which to send network traffic. Routing in ad-hoc network is different then wired network due to mobility of the nodes. Routing protocols are basically classified as following [3]:

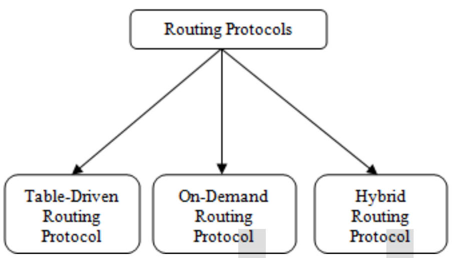

Fig 3. Types Of Routing Protocols

1.2.1 Proactive (table-driven) routing protocols

They are similar to the connectionless schemes of traditional datagram networks. These protocols employ classical routing strategies such as distance-vector (e.g. DSDV) or link-state (e.g. OLSR) routing and any changes in the link connections are updated periodically throughout the network. Proactive protocols maintain routing information about the available paths in the network even if these paths are not currently used. The main disadvantage of these protocols is the maintenance of unused paths may occupy an important part of the available bandwidth if the network topology changes frequently [6].

1.2.1.1 Destination Sequenced Distance Vector – DSDV

DSDV is a hop –to –hop distance vector routing protocol. In this protocol, each node has a routing table that stores the next hop, number of hops for all the reachable destinations. Each node broadcast routing updates periodically. The advantage of DSDV over traditional distance vector routing protocols is that DSDV guarantees loop-free routing [6].

1.2.2 Reactive (on-demand) routing protocols

(e.g. AODV, DSR) employ a lazy approach whereby mobile nodes only discover routes to destinations on-demand. These protocols maintain only the routes that are currently in use, thus reducing the burden on the network when only a few of all available routes is in use at any time. Reactive protocols often consume less bandwidth than proactive protocols, but the delay in determining a route can be substantially large. In reactive protocols, since routes are only maintained while in use, it is typically required to perform a route discovery process before packets can be exchanged between nodes. Therefore, this leads to a delay for the first packet to be transmitted. Another disadvantage is that, although route maintenance is limited to the routes currently in use, it may still generate a significant amount of network traffic when the network topology changes frequently. Finally, packets transmitted to the destination are likely to be lost if the route to the destination changes [6].

1.2.2.1 Dynamic Source Routing (DSR)

DSR allows the network to be completely self- organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two main mechanisms of “Route Discovery” and “Route Maintenance”, which work together to allow nodes to discover and maintain routes to destinations in the ad hoc network. An advantage of DSR is that nodes can store multiple routes in their route cache, which means that the source node can check its route cache for a valid route before initiating route discovery and if a valid route is found there is no need for route discovery [6].

1.2.2.2 Ad-Hoc on Demand Distance Vector- AODV

The ad hoc on demand distance vector (AODV) is based on distance vector routing algorithm. However, unlike distance vector, it is a reactive protocol i.e. it requests the route when needed. It does not require nodes that maintain routes for destinations, which are not actively used in communication. The features of AODV routing protocol are loop-free routing and immediate notification is to be sent to the affected nodes on link breakage. The algorithm uses various messages to maintain and discover links. These are route request (RREQ), route reply (RREP), and route error (RERR) [6].

2 Performance Metrics

In this project, we are most interested in the following performance metrics[4]:

- Packet Delivery Ratio $= \dfrac{\text{Number of Packets received Successfully}}{\text{Number of Packets sent}}$
- Throughput $= \dfrac{\text{Number of delivered packet* Packet size* 8}}{\text{Total Duration of Simulation}}$
- Average End to End Delay = ”Sum (for each i equal to packet number, (packet i received time- packet i sent time))”
- Energy Spent = $\dfrac{\sum_{n}^{i} (\text{Initial energy } y_i - \text{Final energy } y_i)}{\text{Total no. of nodes}}$

3 Simulation Parameters

For this project, we create a square flat platform of finite dimensions for simulation. Various parameters are kept permanent while others are varied to help us analyze the performance of the three protocols.

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3.1 Variable Parameters

Three parameters are varied in this project: routing protocols, total number of nodes in the network, and the pause times of the nodes. There will be three variances of each parameter, as outlined in the following table [1].

Table 1 Project Variable

PROTOCOLS	NUMBER OF NODES	PAUSE TIME
AODV	100	0,5,10,15,25
DSDV	100	0,5,10,15,25
DSR	100	0,5,10,15,25

By varying the number of nodes, we introduce traffic both in terms of data and network configurations packets. With increased number of nodes, more routes are available to reach any given node. It would be interesting to see how each routing protocol behaves with the added overhead of increased route discovery and increased route selections.

3.2 Fixed Parameters

The table below outlines the fixed parameters used in this project and their respective values [1].

Table 2 Project Fixed Parameter

PARAMETER NAME	VALUE
Simulator	NS-2
Simulation Area	1000m X 1000m
MAC protocol	IEEE 802.11B
Packet Size	512byte
Simulation Time	150 sec
Traffic Sources	CBR (UDP)

The simulations were performed using Network Simulator 2 (NS-2.33). The traffic sources are Constant Bit Rate (CBR). The source destination pairs are spread randomly over the network. The mobility model uses 'random waypoint model' in a rectangular field of 1000m x 1000m with 100 nodes.

4 Results Along With Comparison

In this Section, we compare the capabilities of the three routing protocol studied in this paper. To evaluate more reliable performance of AODV, DSDV and DSR routing protocols in same simulation environment (100 mobile nodes). Performance metrics are calculated from trace file, with the help of AWK program. The simulation results are shown in the following section in the form of line graphs. Graphs show comparison by varying different number of sources.[1]

As it can be seen from Fig 4, end to end delay is higher in DSR followed by DSDV and AODV having the lowest and most stable End to End Delay in mobility. DSR is a On-Demand source routing protocol, and this is the major reason for it having a higher End-to-End Delay, where route is looked only when needed and there is a route Discovery mechanism happening every time and it also has to carry a large overhead each time, thus the higher delay. AODV on the other hand has only one route per destination in the routing table, which is constantly updated based on sequence number and DSDV has

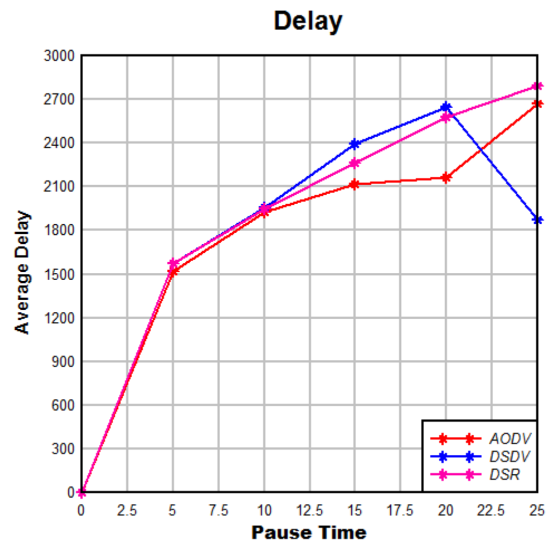

Fig 4. End-to-End Delay with varying pause time

to continuously update the whole routing table periodically and when needed, which leads to a slight delay in delivery.

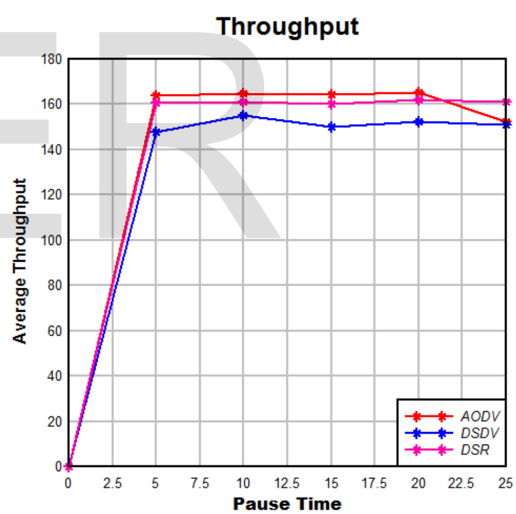

Fig 5. Throughput of network with varying pause time

As the pause time increases, the network becomes more stable and thus a decrease in the overall number of routing-related messages. As a result, the throughput of the network should decrease as the network becomes more stable.

It can be seen from Fig 6, the pdf remains the same in all the scenario despite the increase of pause time(decrease in speed) and increase in the number of nodes which could be due to the multihop characteristics of the Ad hoc Routing protocol.DSDV has a slight higher pdf than AODV and DSR in all the scenarios, which could be due to it being a Table-Driven Routing protocol and is slightly more reliable .DSR has slightly more Pdf than AODV as it always looks for the most fresh and reliable route when needed and does not look for it from the routing

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table like AODV.

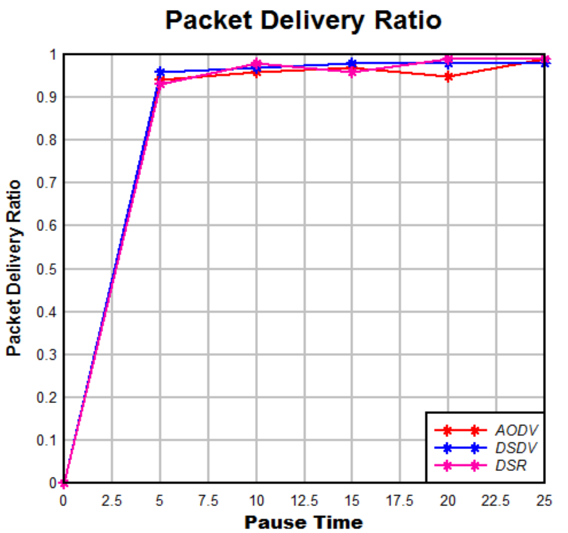

Fig 6. Packet Delivery Ratio with varying pause time

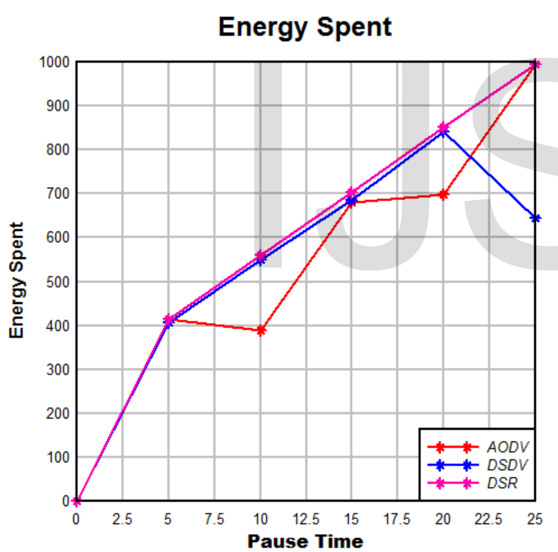

Fig 7. Energy Spent with varying pause time

Fig 7, highlights the energy consumed by routing protocols. DSR offers the best performance while DSDV shows the worst results. Typically on-demand protocols (DSR, AODV) present an energy descendent trend as the motion rate drops, the table-driven protocol (DSDV) presents an energy consumption that remains practically constant as packet sending rate varies.

5 ConClusion

The simulation work illustrates the performance of three routing protocols AODV, DSR and DSDV. The paper presents a study of the performance of routing protocols, used for wireless devices in high mobility case under low, medium and high density scenario. We vary the Pause time of nodes from 0 to 25 in a fixed topography of 1000 x 1000 meters. Moreover, since Random Waypoint Mobility Model has been used in this study to generate node mobility. We find that the performance varies widely across different network sizes and results from one scenario cannot be applied to those from the other scenario. AODV performance is the best considering its ability to maintain connection by periodi c exchange of information. As far as Throughput is concerned, AODV and DSR perform better than the DSDV. DSR and AODV reached approx 100% packet delivery ratio when pause time equal to 25 while DSDV obtained only approx 94% packet delivery ratio. AODV has a stable End to End Delay despite mobility as it has the feature of On-Demand Routing protocol and also maintains a Routing table. The results obtained from the simulations allow us to conclude the following as far as energy consumption refers. Generally DSR performs better than DSDV and AODV.

Thus reactive routing protocol performs better than proactive routing protocol as regards to Packet delivery ratio and energy consumptions.

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