STUDY AND ANALYSIS OF PROACTIVE ROUTING PROTOCOLS USING NS2

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Abstract- The present paper is to evaluate the performance of prominent on demand routing protocols, which are Ad Hoc On -Demand Distance vector Routing(AODV),Destination -sequence Distance vector Routing(DSDV),for wireless networks Results obtained from simulations. The performance differentials are analyzed using varying network load and network size using PHENOM ATTRIBUTES & NS-2.24 is used as a platform for simulating DSDV, AODV under various conditions. Here in this paper we are going to compare, analyze and discuss two mobile ad-hoc routing protocols DSDV and AODV where the first one is a proactive protocol depending on routing tables which are maintained at each node. The other one is a reactive protocol, which find a route to a destination on demand, whenever communication is needed. Considering the delay, drop and delivery ratio in both DSDV and AODV routing protocols, DSDV is best suited for only smaller networks and AODV is suited for general Ad-hoc networks.

Keywords: AODV,DSDV,Ad Hoc networks.

I.INTRODUCTION

Wireless network refers to any type of computer network that is not connected by cables of any kind. It is a method by which homes, telecommunications networks and enterprise (business) installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical level (layer) of the OSI model network structure.

Wireless networks use some sort of radio frequencies in air to transmit and receive data instead of using some physical cables. The most admiring fact in these networks is that it eliminate the need for laying out expensive cables and maintenance costs. The telecommunications network at the physical layer also consists of many interconnected wireline Network Elements (NEs). These NEs can be stand-alone systems or products that are either supplied by a single manufacturer, or are assembled by the service provider (user) or system integrator with parts from several different manufacturers.

Wireless NEs are products and devices used by a wireless carrier to provide support for the backhaul network as well as a Mobile Switching Center (MSC).Reliable wireless service depends on the network elements at the physical layer to be protected against all operational environments and applications.

What are especially important are the NEs that are located on the cell tower to the Base Station (BS) cabinet. The attachment hardware and the positioning of the antenna and associated closures/cables are required to have adequate strength, robustness, corrosion resistance, and rain/solar resistance for expected wind, storm, ice, and other weather conditions. Requirements for individual components, such as hardware, cables, connectors, and closures, shall take into consideration the structure to which they are attached.

Wireless networks serve as the transport mechanism between devices and among devices and the traditional wired networks (enterprise networks and the Internet). Wireless networks are many and diverse but are frequently categorized into three groups based on their coverage range: Wireless Wide Area Networks (WWAN), WLANs, and Wireless Personal Area Networks (WPAN).

The frequencies in the RF band cover a significant portion of the EM radiation spectrum, extending from 9 kilohertz (kHz), the lowest allocated wireless communications frequency, to thousands of gigahertz (GHz). As the frequency is increased beyond the RF spectrum, EM energy moves into the IR and then the visible spectrum. Wireless technologies, in the simplest sense, enable one or more devices to communicate without physical connections without requiring network or peripheral cabling.Wireless technologies use radio frequency transmissions as the means for transmitting data, whereas wired technologies use cables.

Wireless technologies range from complex systems, such as Wireless Local Area Networks (WLAN) and cell phones to simple devices such as wireless headphones, microphones, and other devices that do not process or store information.

Wireless technologies are designed to reduce the time and different type of obstacles created by the cables. Therefore, wireless networks have more convenient working as compared to other type of wired networking. Wireless network is the type of the computer networking in which computer is connected with the different telecommunication devices wirelessly. It is used for the sake of different purposes such as communication or data transmission etc. These all types of transmission that is related to the wireless networks are carried out with help of different types of waves which have micro wavelength in nature.

Wired network is very costly to install because to install the coaxial cables we need lot of money and time. So, nowadays its alternative technology i.e. peer to peer is used to reduce the expenses and also increase the reliability and networking. So point to point management is install instead of those costly cables everywhere. Common examples are Ethernet or wired LAN etc.

Even if a failure in the cables occur then it will be very hard to replace that particular cable as it involved more and more costs. When using a laptop which is required to be connected to the network, a wired network will limit the logical reason of purchasing a laptop in the first place. So With wireless you can move around with a computer compared to wired when you have to be close to a router or a switch. It is cheaper to connect more people to a network where as with wired you keep having to buy switches to expand the network.

The main aim of the project is to compare the performance metrics of two routing protocols Ad-hoc On-Demand Distance Vector (AODV) Protocol and Destination Sequenced Distance Vector (DSDV) Protocol which includes the parameters rate_drop, rate_delay and rate_delivery ratio.

DSDV protocol is based on the Bellman-Ford routing algorithm. It is a proactive protocol and belongs to the table-driven family. Routes between the nodes in the network are always being maintained and updated. Each node in the network maintains a routing table which contains information about how old the route is, the shortest distance as well as the first node on the shortest path to every other node in the WSNs.

AODV is an improvement on the DSDV algorithm. It is a reactive routing protocol that uses an on-demand approach to find and establish routes. AODV maintains routes as long as they are needed by the source nodes and it is considered one of the best routing protocols in terms of power consumption and establishing the shortest path. However, it is principally used for ad-hoc networks, but nowadays it is widely used in WSNs as well.

In AODV, each node periodically broadcasts HELLO messages to its neighbouring nodes and then uses these neighbours to establish routing and send messages.

All simulations have been carried out using the NS simulator programme version 2.34 under Linux platform. NS2 is an open source simulator software and used by a lot of institutes and researchers. The main goal of the NS2 simulator is to provide support to education and research in networking. It is one of the best programmes in terms of comparing different routing protocols and designing new ones. NS2 has been written in two languages: Object oriented variant of Tool Command Language (OTCL) and object oriented language C++ .

The two routing protocols named DSDV and AODV are simulated and compared under specific scenarios with WSNs environment. With the help of the NS2 simulator programme, DSDV and AODV are evaluated in respect of rate_delratio, rate_delay and rate_drop.However, the simulation results reveal that there is no one protocol which is better than the other. Each protocol has its own advantages as well as its disadvantages making it suitable for some applications and not for others.

Hence, an efficient routing protocol should be selected that suits the desired sensing task. Under packet delivery fraction, AODV has better performance than DSDV in the considered scenarios. PDF increases with an increase in the pause time for both protocols. As far as throughput is concerned, AODV performs by far better compared to DSDV.

AODV suffers from delay. Regardless of the period of pause time, it shows longer average rate_delay in comparison with DSDV in the considered scenarios. However, the rate delay fluctuates in DSDV protocol with an increase in pause time. On the other hand, rate_ delay increases in AODV with increasing pause time.

II.LITERATURE REVIEW

The history of wireless networks and of wireless networking goes hand in hand. Without the discovery of technology such as the radio, wireless technology would not exist at all today. The history of wireless networking goes as far back as the 1800's with the advent of radio waves. The advent of more technology grew throughout the years and expanded to what we communicated with today. In 1888, a Hamburg, Germany born physicist named Heinrich Rudolf Herz produced his first radio wave ever. An Italian inventor named Marches Guglielmo Marconi then expanded the radius of radio wave sending to two miles, becoming the "father of the radio." By 1899, this form of telecommunication could travel pretty far for its time.By 1901 the communication area became immense. Marconi could send signals across the entire Atlantic Ocean.World War II became a big stepping stone for the radio wave. The United States was the first party to use radio waves for data transmission during the war. This use of radio waves could have quite possibly won the war for the Americans. The use of radio wave data communication lead to a lot of speculation to whether the radio signals could be expanded into something bigger than it currently was. In 1971, a group of researchers under the lead of Norman Abramson, at the University of Hawaii, created the first "packet-switched" radio communications network entitled "Alohanet." Alohanet was the first wireless local area network, otherwise known as a WLAN. The first WLAN was not much, but it was a large discovery. The Alohanet WLAN was comprised of seven computers that communicated to each other. In 1972, Alohanet connected with the WLAN system Arpanet on the mainland. This length of connect was ground breaking in telecommunications between computers.

The first types of WLAN technology used an interface in which became over crowded for communication. Small appliances and industrial machinery caused interference so the technology had to be updated. The second type of WLAN technology to be released ended up being four times faster than its predecessor at 2Mbps per second. We use the third format of WLAN today, though our current WLAN system runs at the same speed as the second system released.In 1990, the 802.11 Working Group was established to work towards a WLAN standard for all computers to communicate from. In 1997, IEEE 802.11works. The technology continues to grow today. Governments and large corporations are constantly looking out for the latest and fastest standard to work from.The expansion of wireless networking will likely continue for decades to come.Wireless infrastructure can be built for very little cost compared to traditional wired alternatives. But building wireless networks is only partly about saving money. By providing people in local communities with less expensive and easier access to information, allows them to directly benefit from what the Internet has to offer. The time and effort saved by having access to the global network of information translates into wealth on a local scale, as more work can be done in less time and with less effort.

III.DESIGN APPROACH

These protocols are also called as proactive protocols since they maintain the routing information even before it is needed. Each and every node in the network maintains routing information to every other node in the network. Routes information is generally kept in the routing tables and is periodically updated as the network topology changes.

Many of these routing protocols come from the link-state routing. There exist some differences between the protocols that come under this category depending on the routing information being updated in each routing table. Furthermore, these routing protocols maintain different number of tables. The proactive protocols are not suitable for larger networks, as they need to maintain node entries for each and every node in the routing table of every node. This causes more overhead in the routing table leading to consumption of more bandwidth.

These protocols are also called reactive protocols since they don't maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery usually occurs by flooding the route request packets throughout the network.

The Ad hoc On-Demand Distance Vector protocol is both an on-demand and a table-driven protocol. The packet size in AODV is uniform unlike DSR. Unlike DSDV, there is no need for system-wide broadcasts due to local changes. AODV supports multicasting and unicasting within a uniform framework.Each route has a lifetime after which the route expires if it is not used. A route is maintained only when it is used and hence old and expired routes are never used. Unlike DSR, AODV maintains only one route between a source-destination pair.DSR includes source routes in packet headers resulting large headers can sometimes degrade performance. particularly when data contents of a packet are small ,AODV attempts to improve on DSR by maintaining routing tables at the nodes, so that data packets do not have to contain routes. AODV retains the desirable feature of DSR that routes are maintained only between nodes which need to communicate.

Unicast route is a route from a source node to a destination node. Like DSR, this protocols uses two types of messages, route request (RREQ) and route reply (RREP).Like DSDV, we use sequence numbers to keep track of recent routes. Every time a node sends a new message, it uses a new sequence number which increases monotonically.

When node S wants to send a message to node D, S searches its route table for a route to D.If there is no route, S initiates a RREQ message with the following components : The IP addresses of S and D,The current sequence number of S and the last known sequence number of D,A broadcast ID from S. This broadcast ID is incremented each time S sends a RREQ message.

Processing a RREQ Message: The broadcast ID, IP address pair of the source S forms a unique identifier for the RREQ. Suppose a node P receives the RREQ from S. P first checks whether it has received this RREQ before. Each node stores the broadcast ID, IP address pairs for all the recent RREQs it has received

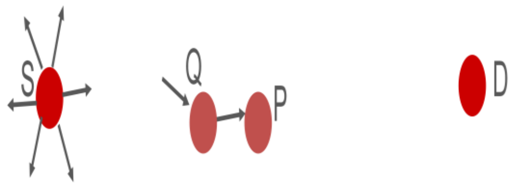

Fig.1: Processing a RREQ Message

If P has seen this RREQ from S already, P discards the RREQ. Otherwise, P processes the RREQ : P sets up a reverse route entry in its route table for the source S.This entry contains the IP address and current sequence number of S, number of hops to S and the address of the neighbour from whom P got the RREQ. A lifetime is associated with the entry in the route table. This is an important feature of AODV. If a route entry is not used within the specified lifetime, it is deleted.A route is maintained only when it is used. A route that is unused for a long time is assumed to be stale.

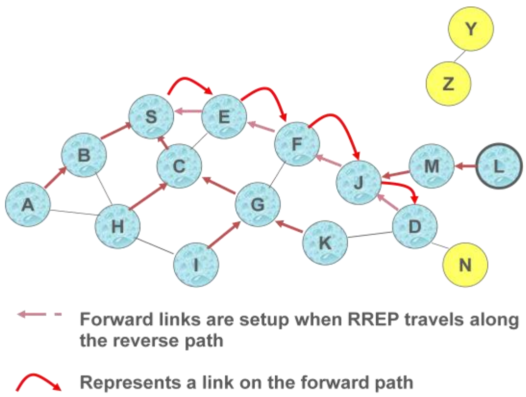

Fig.2.Forward path setup in AODV

Once a unicast route has been established between two nodes S and D, it is maintained as long as S (source node) needs the route.If S moves during an active session, it can reinitiate route discovery to establish a new route to D.When D or an intermediate node moves, a route error (RERR) message is sent to S.

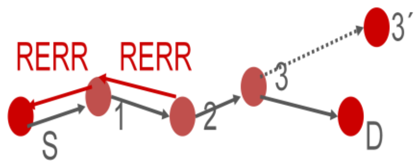

Fig 3.Route error message.

Suppose neighbours 4 and 5 route through 2 to reach D. Node 2 broadcasts RERR to all such neighbours.Each neighbour marks its route table entry to D as invalid by setting the distance to infinity. Suppose neighbours 4 and 5 route through 2 to reach D. Node 2 broadcasts RERR to all such neighbours. Each neighbour marks its route table entry to D as invalid by setting the distance to infinity.Each neighbour in turn propagates the RERR message.Route entries with an infinity metric are not rejected immediately as they contain useful routing information for the neighbourhood.Neighbourhood information is obtained through hello messages. Each node broadcasts a hello message to its neighbours at a regular hello-interval.When a node M receives a hello message from a neighbour N, node M updates the lifetime associated with N in its route table.Hello messages propagate only for one hop, in the neighbourhood of a node.

RREQ and RREP messages are used for multicast route establishment.A multicast tree has two kinds of members.A group member is a node that is part of the multicast group.A tree member is not part of the multicast group, but used to connect the multicast tree.

Each mobile node in the network maintains a route table entry for each destination of interest in its route table. Each entry contains the following info:

- Destination
- Next hop
- Number of hops no
- Destination sequence number
- Active neighbors for this route
- Expiration time for the route table entry

The other useful information contained in the entries along with source and destination sequence numbers is called soft-state information associated to the route entry. The info about the active neighbors for this route is maintained so that all active source nodes can be notified when a link along a path to the destination breaks. And the purpose of route request time expiration timer is to purge the reverse path routing entries from all the nodes that do not lie on the active route.

The concepts of AODV that make it desirable for MANETs with limited bandwidth include the following:

Minimal space complexity: The algorithm makes sure that the nodes that are not in the active path do not maintain information about this route. After a node receives the RREQ and sets a reverse path in its routing table and propagates the RREQ to its neighbors, if it does not receive any RREP from its neighbors for this request, it deletes the routing info that it has recorded.
Maximum utilization of the bandwidth: This can be considered the major achievement of the algorithm. As the protocol does not require periodic global advertisements, the demand on the available bandwidth is less. And a monotonically increased sequence number counter is maintained by each node in order to supersede any stale cached routes. All the intermediate nodes in an active path updating their routing tables also make sure of maximum utilization of the bandwidth.Since, these routing tables will be used repeatedly if that intermediate node receives any RREQ from another source for same destination. Also, any RREPs that are received by the nodes are compared with the RREP that was propagated last using the destination sequence numbers and are discarded if they are not better than the already propagated RREPs.
Simple: It is simple with each node behaving as a router, maintaining a simple routing table, and the source node initiating path discovery request, making the network self-starting.
Most effective routing info: After propagating an RREP, if a node finds receives an RREP with smaller hop-count, it updates its routing info with this better path and propagates it.
Most current routing info: The route info is obtained on demand. Also, afterpropagating an RREP, if a node finds receives an RREP with greater destination sequence number, it updates its routing info with this latest path and propagates it.
Loop-free routes: The algorithm maintains loop free routes by using the simple logic of nodes discarding non better packets for same broadcast-id.
Coping up with dynamic topology and broken links: When the nodes in the network move from their places and the topology is changed or the links in the active path are broken, the intermediate node that discovers this link breakage propagates an RERR packet. And the source node re-initializes the path discovery if it still desires the route. This ensures quick response to broken links.
Highly Scalable: The algorithm is highly scalable because of the minimum space complexity and broadcasts avoided when it compared with DSDV.
Because of its reactive nature, AODV can handle highly dynamic behavior of Vehicle Ad-hoc networks.
Used for both unicasts and multicasts using the 'J' (Join multicast group) flag in the packets.

The destination sequenced distance vector routing protocol is a proactive routing protocol which is a modification of conventional Bellman-Ford routing algorithm. This protocol adds a new attribute, sequence number, to each route table entry at each node. Routing table is maintained at each node and with this table, node transmits the packets to other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station.

Each node in the network maintains routing table for the transmission of the packets and also for the connectivity to different stations in the network. These stations list for all the available destinations, and the number of hops required to reach each destination in the routing table. The routing entry is tagged with a sequence number which is originated by the destination station. In order to maintain the consistency, each station transmits and updates its routing table periodically. The packets being broadcasted between stations indicate which stations are accessible and how many hops are required to reach that particular station. The packets may be transmitted containing the layer 2 or layer 3 address.

If a new node enters the network, it will announce itself in the network and the nodes in the network update their routing information with a new entry for the new node. During broadcasting, the mobile hosts will transmit their routing tables periodically but due to the frequent movements by the hosts in the networks, this will lead to continuous burst of new routes transmissions upon every new sequence number from that destination. The solution for this is to delay the advertisement of such routes until it shows up a better metric.

Routing information is advertised by broadcasting or multicasting the packets which are transmitted periodically as when the nodes move within the network. The DSDV protocol requires that each mobile station in the network must constantly, advertise to each of its neighbors, its own routing table. Since, the entries in the table may change very quickly, the advertisement should be made frequently to ensure that every node can locate its neighbors in the network. This agreement is placed, to ensure the shortest number of hops for a route to a destination; in this way the node can exchange its data even if there is no direct communication link.

The data broadcast by each node will contain its new sequence number and the following information for each new route:

- The destination address
- The number of hops required to reach the destination and
- The new sequence number, originally stamped by the destination

When the route is broken in a network, then immediately that metric is assigned an infinity metric there by determining that there is no hop and the sequence number is updated. Sequence numbers originating from the mobile hosts are defined to be even number and the sequence numbers generated to indicate infinity metrics are odd numbers.

The transmitted routing tables will also contain the hardware address, network address of the mobile host transmitting them. The routing tables will contain the sequence number created by the transmitter and hence the most new destination sequence number is preferred as the basis for making forwarding decisions. This new sequence number is also updated to all the hosts in the network which may decide on how to maintain the routing entry for that originating mobile host.

After receiving the route information, receiving node increments the metric and transmits information by broadcasting. Incrementing metric is done before transmission because, incoming packet will have to travel one more hop to reach its destination. Time between broadcasting the routing information packets is the other important factor to be considered. When the new information is received by the mobile host it will be retransmitted soon effecting the most rapid possible dissemination of routing information among all the cooperating mobile hosts. The mobile host cause broken links as they move form place to place within the network. The broken link may be detected by the layer2 protocol, which may be described.

The broadcasting of the information in the DSDV protocol is of two types namely: full dump and incremental dump. Full dump broadcasting will carry all the routing information while the incremental dump will carry only information that has changed since last full dump. Irrespective of the two types, broadcasting is done in network protocol data units (NPDU). Full dump requires multiple NPDU's while incremental requires only one NPDU to fit in all the information.

- Each time a node like n1 broadcasts its routing table, it adds an increasing sequence number (timestamp) to the broadcast.
- Any node receiving the broadcast rejects old routing information and takes the new information for updating its routing table.
- This avoids looping and counting to infinity.

When an information packet is received from another node, it compares the sequence number with the available sequence number for that entry. If the sequence number is larger, then it will update the routing information with the new sequence number else if the information arrives with the same sequence number it looks for the metric entry and if the number of hops is less than the previous entry the new information is updated (if information is same or metric is more then it will discard the information). While the nodes information is being updated the metric is increased by 1 and the sequence number is also increased by 2.

Address stored in the routing table at the mobile hosts will correspond to the layer at which the DSDV protocol is operated. Layer3 will use network layer addresses for the next hop and destination addresses and layer 2 will use the MAC address for its operation. A difficulty is arised at the layer 3 operation and a way must be provided to resolve these layer-3 addresses into MAC addresses.

Otherwise, problems like broadcast address resolution would be needed and loss of bandwidth would be observed. This loss could be substantial because such mechanisms will require retransmission by every mobile node. The solution here is to provide layer3 protocol information along with the layer2 information at the layer 2 operation. Each mobile node would advertise, reach ability, information about the layer3 protocols at that destination.

DSDV protocol guarantees loop free paths.Count to infinity problem is reduced in DSDV.We can avoid extra traffic with incremental updates instead of full dump updates.Path Selection: DSDV maintains only the best path instead of maintaining multiple.paths to every destination. With this, the amount of space in routing table is reduced.

IV.RESULTS ANALYSIS

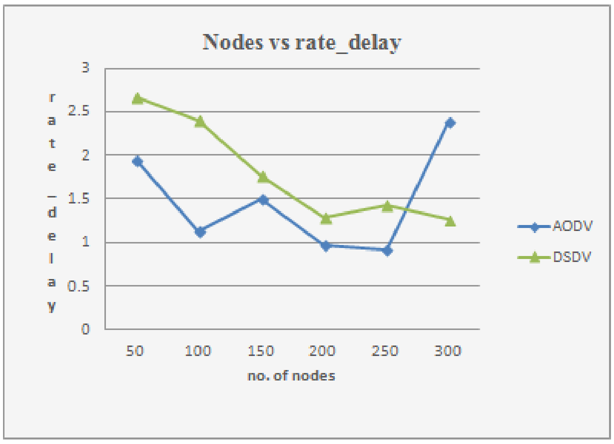

Fig.4.Rate_delay Comparision

Rate delay is the delay experienced by a packet from the time it was sent by the source till the time it was received by the estination.Simulations were run for varying umber of packets with constant packet size and the result is plotted in fig.4.1. The result shows that the delay is more for DSDV at lower no. of packets According to above result, it can be said that AODV outperforms for more number of sources or for more network traffic.Rate delay is the delay experienced by a packet from the time it was sent by the source till the time it was received by the destination.

Packet delivery ratio is the ratio of total number of packets that were successfully transmitted to the intended destination to the total number of packets that were generated.The results plotted in fig 4.2 is that delivery ratio is linearly increasing at lesser no. of packets ,PDR decreases at higher no. of packets in the case of DSDV.PDR is constant for all values in the case of AODV.AODV outperforms than DSDV.

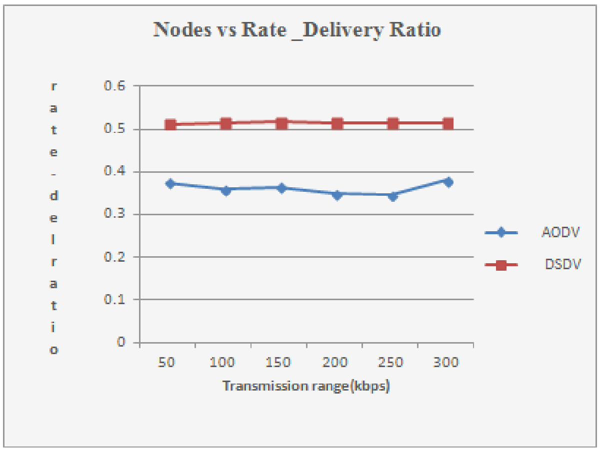

Fig.5.Rate_Delivery Ratio Comparision

Drop rate means number of packets that were not successfully transmitted to the destination.Drop rate is more at less no. of sources in the case of DSDV. Drop rate is almost constant in AODV irrespective of varying load here as shown in Fig 4.3.

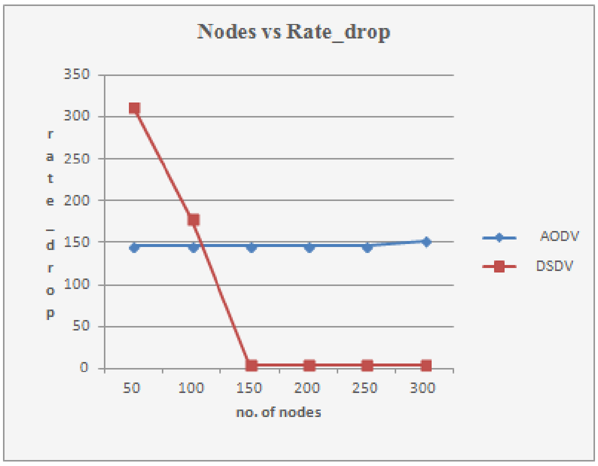

Fig.6.Rate_drop comparision

After reviewing the concept of wireless networks and two routing protocols namely, AODV and DSDV. We would like to make a comparative discussion of both the protocols with their pro's and con's.

DSDV is a proactive routing protocol, which maintains routes to each and every node in the network, while AODV is a reactive routing protocol which finds the path on demand or whenever the route is required.

Broadcasting in DSDV is done periodically to maintain routing updates and inAODV, only hello messages are propagated to its neighbors to maintain localconnectivity.DSDV routing algorithm maintains a sequence number concept for updating the latest information for a route. Even, the same concept is adapted by AODV routing protocol. Due to the periodic updates being broadcasted in DSDV, bandwidth is wasted when the nodes are stationary. But, this is not the case with AODV, as it propagates only hello messages to its neighbours. For sending data to a particular destination, there is no need to find a route as DSDV routing protocol maintains all the routes in the routing tables for each node.While, AODV has to find a route before sending a data. Overhead in DSDV is more when the network is large and it becomes hard to maintain the routing tables at every node. But, in AODV overhead is less as it maintains small tables to maintain local connectivity. DSDV cannot handle mobility at high speeds due to lack of alternative routes hence routes in routing table is stale. While in AODV this is the other way, as it find the routes on demand. Throughput decreases comparatively in DSDV as it needs to advertise periodic updates and even-driven updates. If the node mobility is high then occurrence of event driven updates are more. But in AODV it doesn't advertise any routing updates and hence the throughput is stable.

V.CONCLUSION

The study reveals that, DSDV routing protocol consumes more bandwidth, because of the frequent broadcasting of routing updates. While the AODV is better than DSDV as it doesn't maintain any routing tables at nodes which results in less overhead and more bandwidth. From the above, chapters, it can be assumed that DSDV routing protocols works better for smaller networks but not for larger networks. So, my conclusion is that, AODV routing protocol is best suited for general mobile ad-hoc networks as it consumes less bandwidth and lower overhead when compared with DSDV routing protocol.In this the two routing protocols named DSDV and AODV are simulated and compared under specific scenarios with WSNs environment. With the help of the NS2 simulator programme, DSDV and AODV are evaluated in respect of packet delivery fraction, end to end delay and average throughput.However, the simulation results reveal that there is no one protocol which is better than the other. Each protocol has its own advantages as well as its disadvantages making it suitable for some applications and not for others. Hence, an efficient routing protocol should be selected that suits the desired sensing task.

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