# Descriptive Study and Analysis of Ad-Hoc Networks Routing Protocols for Different Parameter

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***Abstract* — Without any centralized administration or already existing network infrastructure, a Network which is form spontaneously by the collection of wireless nodes called Mobile Ad-hoc Network (MANET).Study and analysis of different Ad-Hoc networks routing protocols viz. DSDV, AODV & DSR on the basis of different performance criterion such as PDR, Throughput, Packet Drop and routing overhead is main objective of this paper. A discrete event packet level simulation tool NS-2 is used where Tool Command Language (TCL) is used as a front end language and C++ is used as back end language for simulation of varying parameter for routing algorithm. Importance of selection criteria of routing protocols in dynamic environment is illustrated in the result of this work.**

***Index Terms*— NS2, DSR, DSDV, AODV.**

## I. INTRODUCTION

The technology that allows user to access the services and information electronically regardless of their geographic position. Classification of wireless network could be in two type- Infrastructure networks and Infrastructure Less networks or Ad-hoc Networks [6].

**Infrastructure Networks: -** The basis of cellular concept which consists of fixed and wired gateway present in Infrastructure Network. Base station is function as a bridge network where the mobile host connects to the network through this bridge in infrastructure network. The mobile host can move geographically while it is communicating. The Handoff process is required; where if the mobile host is not in the range of one BS the handoff is processed to automatically connect to new BS to continuing the communication. In this proceeds the base station are fixed and exist somewhere. [7].

**Infrastructure less (Ad-hoc) Networks: -** Infrastructure-less or Ad-hoc networks are commonly known as Mobile Ad-hoc Networks (MANET) [1]. To exchange the information between nodes without using any pre-existing network infrastructure, a new dynamically network is formed using collection of wireless nodes, this dynamically formed network is MANET. The situation when none existing or damaged communication infrastructure network exist and rapid deployment of network is needed, the best solution is MANET. This is also a very important part of communication technology that supports truly pervasive computing, because in many contexts information exchange between mobile nodes cannot rely on any fixed network infrastructure, but on rapid deployment of a wireless connections on-the-fly [1]. Now wide area of research and applications, instead of being just a complement of the infrastructure based system is wireless Ad Hoc network.

To decide best suitable path for packet transmission from one place to another place is Routing. In this paper an attempt has been made to evaluate the performance of proactive and reactive routing protocols. Ad-hoc network flat routing protocols may classify as:-

**Reactive (On-demand) routing protocols:-**In this type of protocols, when route required it created. If a sender wants to send to a receiver, the route discovery mechanism is invokes to find the path to the receiver. Once a sender is found all possible route permutation has been examined this process is finish. Once a route has been discovered and established, some form of route maintenance procedure to maintain discovered route until either the receiver becomes inaccessible along every path from the sender or route is no longer desired.

**Proactive routing (Table-driven) protocols:-**Up-to date routing information from each node to every other node in the network is maintained by this type of protocols. The basic requirements of this protocols is that one or more tables to store routing information is maintained by each node and to maintain consistent network view, they respond to change in network topology by propagating route update throughout the network .

With the increase of portable of devices as well as progress in wireless communication, Ad-hoc network gaining importance with the increasing number of widespread application. The following point shows the importance of ad hoc networks:

- **Remote Areas**
- **Disaster Relief**
- **Effectiveness**
- **Instant Infrastructure**

Due to their quick and economically less demanding deployment, this network finds applications in several areas. Some of these include: military applications, collaborative and distributed computing, emergency operations, wireless mesh networks, wireless sensor networks, and hybrid wireless network [6].

MANET has the following features:

- **Self Autonomous Terminal:** The leading property of MANET is that each of its nodes is autonomous node.

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Each node work as a host as well as a router. It means that, each mobile node not only provides basic functionality as host, but it can also work as mobile router. So it is very difficult to distinguish end nodes and switches in MANET [17].

- **Limited wireless transmission range:-**In wireless network the radio band will be limited and hence data rates it can offer are much lesser than what a wired network can offer. This requires an optimal manner by keeping the overhead as low as possible [6].
- **Multi-hop Forwarding:** Depending upon the routing protocols, different attributes and the link layer, data is transfer from sender to receiver in single hope or in multi hope. It is assumed that single hop MANET is better and simpler, when it comes to its architecture and implementations. But in multi-hop, the in-path routers and nodes can be used for forwarding the data packet, when source and destination are out of the wireless transmission range of each other [17].
- **Dynamic Network Topology:** Ad-hoc network is also known as dynamic network topology. It is a reconfigurable type of network which can operate without the need of any fixed network infrastructure [12].
- **Light-weight Terminals**: Basically, the MANET nodes are mobile devices like mobile phones, PDA, hand-held and wearable computers etc. which having less processing capability, small memory size, and low power storage etc. So, these devices need some relevant algorithms and mechanism to implement the computing and communication functions between them [12].

## II. CHALANGES OF MANET

The major issues that affect the design, deployment, performance of an ad-hoc network wireless system are as follows:

**Routing overhead:-**In Ad hoc networks, nodes often change their location within the network. So stales route are generated in the routing tables which lead to unnecessary routing overhead

**Packet losses due to transmission errors:-**Mobile ad hoc network experiences a much higher packet losses due to some factors such as high bit error rate (BER) in the wireless channel, increased collision due to the hidden terminal problem, presence of interference, location dependent contention, unidirectional links, frequent path break due to node mobility and the inherent fading property of wires medium [6].

**Route changes due to mobility:-**The network topology in an ad-hoc wireless network is highly dynamic due to mobility of nodes; hence an on-going session may suffer from frequently path breaking. This session often leads to frequent route changes therefore mobility management itself is very vast research topic in ad-hoc networking [7].

**Security issues: -** The radio channel is used for ad-hoc wireless network is broadcast in nature and is shared by all the nodes in the network. Data transmitted by a node is received by all the nodes within its direct transmission range. So attacker can easily snoops the data being transmitted by a node in the network. Here the Requirement for confidentiality can be violated if an adversary is able to interpret the data gathered through snooping [6].

**Potentially frequent network partition: -** The randomly moving nodes in an ad- hoc can lead to network partition. In major cases the intermediate nodes are the one which are highly affected by this partitioning [7].

**Asymmetric links:-**Most of the wired networks rely on the symmetric links which are always fixed. But this is not a case with ad hoc networks as the nodes are mobile and constantly changing their position within network. Consider a MANET where node c sends a signal to node B but does not tell anything about the quality connection in the reverse direction [8].

## III. CLASSIFICATION OF ROUTING PROTOCOLS

Ad-hoc network routing protocols may be classified in many ways depending on their routing algorithm, network structure communication model, and state of information etc, but most of the protocols depending on their routing algorithm, and network structure [3][10] .

Based on the network structure ad-hoc network classify as Flat routing, hierarchical routing, geographical position assisted routing. Flat routing covers two types of routing protocols based on routing algorithm.

Based on the Routing algorithms, routing protocols are classified as Proactive routing protocols and Reactive Routing protocols.

- Proactive Routing: DSDV (Destination Sequence Distance Vector Routing) etc.
- Reactive Routing: AODV (Ad-hoc on-demand distance vector routing protocol), DSR (Dynamic source routing) etc.

**DSDV: -** A table driven routing protocol which algorithm based on the classical Bellman –Ford routing mechanism is DSDV Destination Sequenced Distance Vector routing protocol. The avoidance of routing loops for mobile network of nodes is the main improvement in this protocol. Each and every node in mobile network which made routing information more easily and readily available are maintain routing table for all possible destinations within the network and the number of hops to each destination node. Each entry is marked with a sequence number, number assigned by the destination node Routing table updates are periodically transmitted throughout the network in order to maintain table consistency.

Large amount of network traffic, route updates can employ in two types of packets they are first is the “Full Dump” and second is the “Incremental routing”. A full dump sends the full routing table to the neighbors and could cover 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. When the network is relatively stable, incremental updates are sent to avoid extra Traffic and full dump are relatively infrequent. In a fast changing network, incremental packets can grow big, so full dumps will be more frequent [13].

**AODV: -** The AODV is a Reactive on demand ad-hoc distance vector routing algorithm. By creating routes on demand basis as opposed to maintaining a complete list of routes, as in the DSDV algorithm it (AODV) typically minimizes the number of required broadcasts. That’s why

this can be seen as an improvement of DSDV. When a source node desires to send a message to some destination node and does not already have a valid route to that destination, it initiates a path discovery process to locate the destination. In AODV each router maintains route table entries with the destination IP address, destination sequence number, hop count, next hop ID and lifetime [11].

RREQs route requests and RREPs route replies are the two message types defined by the AODV. When a route to a new destination is needed, the node uses a broadcast RREQ to find a route to destination. A route can be determined when the request reaches either the destination itself or an intermediate node with a fresh route to the destination. The route is made available by unicasting a RREP back to the source of RREQ. Each node maintains its own broadcast id, sequence number. The broadcast ID is incremented for every RREQ packet. Since each node receiving the request keeps track of a route back to the source of the request, the RREP reply can be unicast back from the destination to the source, or from any intermediate node that is able to satisfy the request back to the source [10].

**DSR: -** The Dynamic Source Routing protocol is an "On-Demand Routing Protocol" that is based on the concept of source routing. In DSR routing protocol, the mobile nodes are required to maintain route caches that contain the source routes of which this mobile nodes are aware. Entries in the route cache are continually updated as when new routes are discovered. The DSR routing protocol consists of two major phases: Route discovery and route maintenance [17].

In route discovery mechanism, when a mobile node wants to send data packets to a destination node, firstly it consults with its route cache to find whether it has already a route to the destination or not. If it has an unexpired route to the destination then it will use this route to send data packets otherwise find new routes. It means that, if the node does not have a valid route to the destination, it initiates a route discovery mechanism by broadcasting a route request packet throughout the network. This route request contains some field like address of destination node, address of source nodes and a unique identification number. A route reply packet is generated in response to a route request packets, when the route request reaches either the destination node itself or an intermediate node whose route cache contains an unexpired route to the destination is found [20].

Route maintenance is a procedure, which maintains transmission of packets in the routing with the help of using route error message packets and acknowledgment packets. The route error packets are generated at a time; when in a node a data link layer encounters a transmission problem or some error. In DSR, acknowledgment packets are also used to verify the correct operation for the transmission of outgoing route link.

Basically, DSR uses a reactive routing approach which eliminates the need of periodically flooding of the table update messages in the network, which are mostly required in the table-driven routing approach. In this approach, the intermediate nodes also maintain the route cache information, for efficiently reduce the routing overhead. The disadvantage of DSR is that, the route maintenance mechanism does not locally repair a damaged link. Another disadvantage is that, the connection setup delay is higher than the table-driven protocols. Even if the protocol performs well, in static and low-mobility environments, the performance of the protocol degrades rapidly with increasing of nodes mobility, that means nodes mobility affect these routing protocol most. In DSR, considerable routing overheads are required, due to the source- initiated routing approach. This routing overhead is depends on the total path length between the nodes [20].

## IV. SIMULATION BASED ANALYSIS

This section described the simulation tool, network setup, Simulation parameters and simulation results. The performances of proactive and reactive routing protocols are evaluated on the basis of three performance metrics: Throughput, Packet delivery ratio, Routing overhead.

*Simulation Tool:*

In this paper simulation of proactive and reactive routing protocols is done by using network simulator (NS2) tool due to its simplicity and availability. NS is a discrete event Simulator targeted at networking research. NS provides substantial support for simulation of TCP, routing, and multicast routing protocols over a wired and wireless network. NS2 is written in C++ and OTCL. C++ is back end language while OTCL is front end language. NS2 include a network animator called nam which provides visual view of simulation. NS2 preprocessing provides traffic and topology generation and post processing provide simple trace analysis. AWK programming is used for trace file analysis.

*Network Setup and Simulation Parameters:*

The following network setup and simulation parameters are used in this paper to analyze the performance of proactive and reactive routing protocols.

This topology is consists by 26 nodes, where 13 nodes are senders and remaining are receivers. All the senders start traffic at different time. So the transmitting node share the channel bandwidth with other previous transmitting nodes. This topology is generated by the network animator, by considering the following simulation parameters table.

**Table1:- Simulation Parameters**

| | |
|---|---|
| Channel | Channel/ Wireless Channel |
| Propagation | Propagation/ Two Ray Ground |
| Network Interface | Phy/ Wireless Phy |
| NS Version | Ns-allinone-2.31 |
| MAC | Mac/802_11 |
| CBR Packet Size | 512 bytes |
| Interface Queue | Queue/ Droptail/ Priqueue |
| Link Layer | LL |
| Antenna | Antenna/ Omni Anteena |
| Interface Queue Length | 50 |
| No. of Nodes | 4,8,12,26,50 |
| Simulation Area Size | 700*600 |
| Simulation Duration | 60 Second |
| Routing Protocols | AODV and DSDV |
| Performance Metrics | Throughput, Packet Delivery Ratio, Routing Overheads |

*Performance Metrics:*

The following metrics are used in this paper for the performance analysis of AODV, DSDV and DSR Routing protocols. These are:-

**I. Throughout**: - It is the amount of data transferred over the period of time expressed in bits per second.

**II. Packet delivery ratio**: - It is the ratio of the number of data packets received by the destination node to the number of data packets sent by the source mobile node.

**III. Routing Overheads**: - The number of control packets generated by each routing protocol.

**IV. Packet Drop: -** The number of data packets that are not successfully sent to the destination. Basically it is define as the number of packets drop to the total number of packet generated during the simulation time. Lower the packet drop, lower would be the delay in the network.

*Simulation Results:*

The simulation results are shown in the following section in the form of graphs and charts. In this paper an attempt has been made to evaluate the performance of two well known routing protocol DSDV, AODV and DSR according to their simulation results. The simulation results are generate through the Excel graphs according to above mentioned criteria shown in table.

| Number of Nodes | DSDV | AODV | DSR |
|---|---|---|---|
| 4 | 0.5152597 | 0.51157 | 0.5001216 |
| 8 | 0.4946181 | 0.46531 | 0.5982208 |
| 12 | 0.7953755 | 0.79537 | 0.7718912 |
| 26 | 1.0008693 | 1.01782 | 0.9846101 |
| 50 | 0.9309149 | 1.0294 | 1.0007347 |

**Fig. 1: Throughput Comparison**

| Number of Nodes | DSDV Routing Load | AODV Routing Load | DSR Routing Load |
|---|---|---|---|
| 4 | 2.058 | 0.51 | 0.16 |
| 8 | 7.24 | 4.27 | 1.164 |
| 12 | 9.99 | 5.82 | 2.46 |
| 26 | 41.38 | 8.169 | 4.183 |
| 50 | 90 | 13.048 | 16.988 |

**Fig. 2: Routing Overhead**

| Number of Nodes | DSDV PDR | AODV PDR | DSR PDR |
|---|---|---|---|
| 4 | 91.19% | 90.52% | 91.90% |
| 8 | 43.51% | 41.92% | 44.51% |
| 12 | 41.61% | 42.36% | 42.05% |
| 26 | 31.66% | 34.00% | 33.60% |
| 50 | 20.16% | 24.71% | 25.26% |

**Fig. 3: PDR Comparison**

| Number of Nodes | DSDV Drop | AODV Drop | DSR Drop |
|---|---|---|---|
| 4 | 625 | 676 | 561 |
| 8 | 11234 | 9359 | 7326 |
| 12 | 13141 | 12895 | 12970 |
| 26 | 18725 | 17600 | 17662 |
| 50 | 46951 | 40228 | 44132 |

**Fig. 4: No. of packet drop comparison**

According to above all 'Throughput graphs' and 'network topology' first node start traffic at 1.5 second and utilize the full channel bandwidth. So the throughput of first node is gretter than others nodes.

The throughput is calculated at destination node during entire simulation period. In this subsection, throughput for the three routing protocols is calculated for different number of nodes. The variation of throughput with the number of nodes is shown in figure 5.

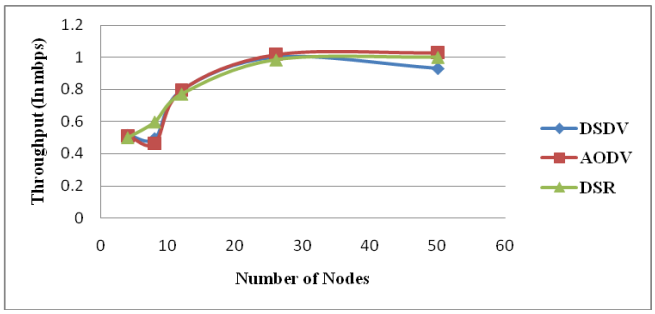


**Fig. 5: Throughput Comparisons for DSDV, AODV and DSR**

The DSR shows higher throughput than the AODV and DSDV for 4- nodes, 8- nodes and 12- nodes scenario. But in case of 20-nodes, 26-nodes and 50-nodes, AODV shows higher throughput than DSDV and DSR.

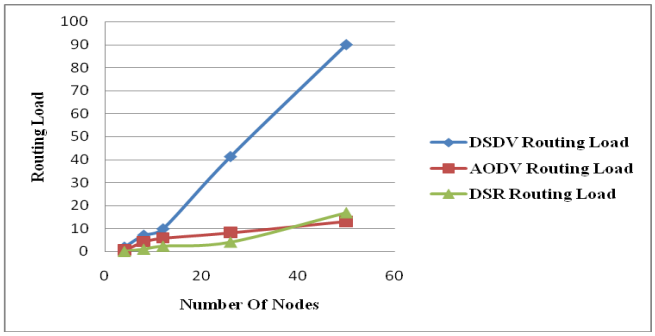


**Fig. 6: Routing overhead of (DSDV, AODV, DSR)**

The routing overheads of DSDV is maximum than AODV and DSR for any number of nodes. [18][19].

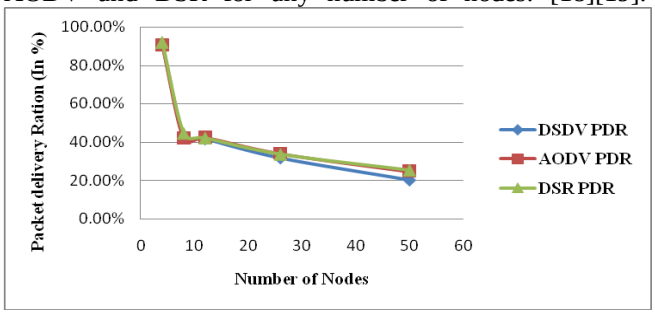


**Fig. 7: Packet Delivery Ratio For (DSDV, AODV, DSR)**

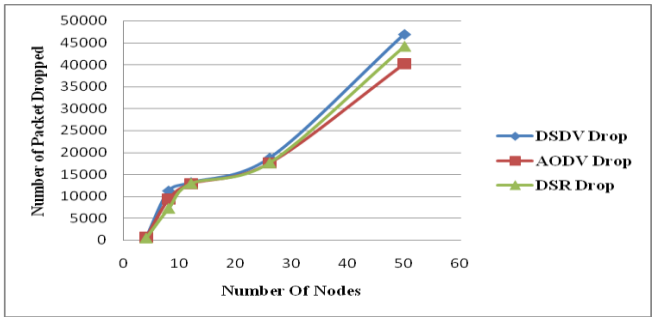

**Fig .8: No of Packet Drop Comparision**

The variation of packet delivery ratio with the number of nodes is shown in figure 7.where DSR shows the best performance for 4-nodes, 8-nodes and 12-nodes scenario as compared to DSDV and AODV. But for 20-nodes, 26-nodes the packet delivery ratio of AODV is maximum. .and then for 50-node DSR has a maximum value among them.

## V. CONCLUSIONS

This work carried out the detailed analysis of DSDV, AODV and DSR routing protocols theoretically and through simulation by NS-2 on the basis of different performance metrics viz. throughput, packet delivery ratio, routing overheads and packet drop. These performance metrics are analyzed for the three routing protocols by varying the number of nodes for fixed environment as well as mobile environment. Simulation of routing protocols provides the facility to select a good environment for routing and gives the knowledge how to use routing schemes in dynamic network. Simulation results show that, as the number of nodes increases in the network, the performance of the routing protocols decreases. Nodes mobility affects the performance of routing protocols most as frequent path break increases with the mobility. According to simulation results as the number of nodes increases, the packet drop and overheads of routing protocol increases whereas throughput and packet delivery ratio decreases. In the analyzed scenario, it is found that the DSR and AODV have the best all round performance than DSDV. DSR is suitable for network with moderate mobility rate. It has a low overhead that makes it suitable for low bandwidth and low power network whereas AODV is suitable for operation in large mobile network having dense population of nodes. In this simulation study, it has been investigated that, when the number of nodes is less and mobility is less, 'DSR' is performing better and when number of nodes is high and mobility is high 'AODV' is performing better. Based on the above discussion, the selection of the routing protocols for given environment for number of nodes can be done efficiently.

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