COMPARATIVE ANALYSIS OF PERFORMANCE PARAMETERS OF ROUTING PROTOCOLS IN AD-HOC NETWORK

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A Network which is form instinctively by the collection of wireless nodes without any integrated administration or already existing network infrastructure called Mobile Ad-hoc Network (MANET). Performance evaluation of different Ad-Hoc networks routing protocols i.e. AODV, DSR and DSDV, on the basis of four parameter such as throughput, packet delivery ratio, packet drop and routing overhead for different number of nodes is main objective of our research paper. NS-2, which is a distinct event simulation tool, is used in which The Tool Command Language (TCL) is used for simulation of varying parameter for routing algorithm. Importance of selection measures of routing protocols in vibrant environment is shown in the result of this work. MATLAB is used for plotting all the comparative graphs.

Index Terms – Throughput, Packet Drop, Packet Delivery Ratio, AODV, DSDV, and DSR.

I. INTRODUCTION

Wireless Networking technology allows user to access the services and information electronically irrespective of their geographic position. Classification of wireless network could be in these two type- Infrastructure networks and Infrastructure Less networks or Ad-hoc Networks [1].

Infrastructure Networks: The origin 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 travel geographically while it is communicating. The Handoff method is required; where if the mobile host is not in the range of one base station the handoff is handled to automatically connect to new base station to ongoing the communication. In this proceeds the base station are fixed and exist somewhere [2].

Infrastructure Less (Ad-Hoc) Networks: Infrastructure-less or Ad-hoc networks are generally known as Mobile Ad-hoc Networks (MANET) [3]. To interchange the information between nodes without using any pre-existing network infrastructure, a new dynamically network is formed using assembly of wireless nodes, this dynamically formed network is known as MANET. The situation when none existing or impaired communication infrastructure network exist and speedy 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, since in many contexts information interchange between mobile nodes cannot rely on any fixed network infrastructure, but on rapid deployment of a wireless connections on-the-fly [3]. 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 appropriate path for packet transmission from one place to another place is Routing. In this research paper an attempt has been made to select the best protocol based upon the different parameter for different nodes. Ad-hoc network routing protocols may categorize as follows:

Reactive (On-demand) Routing Protocols: In this category of protocols, when route is 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. 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 [2].

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 necessities 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 [2].

MANET has the following features:

- **a.** Self-Autonomous Terminal
- **b.** Vibrant Network Topology
- **c.** Light-weight Terminals
- **d.** Restricted wireless transmission range
- **e.** Multi-hop Forwarding

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 like Remote Areas, military applications, collaborative and distributed computing, emergency operations, wireless mesh networks, wireless sensor networks, and hybrid wireless network, Instant Infrastructure, Disaster Relief etc. [8].

II. CHALLANGES OF MANET

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

1. ***Routing overhead:*** In Ad-hoc networks, nodes often change their location. So stales route are generated which leads to unnecessary routing overhead.

2. ***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 [1].
3. ***Potentially frequent network partition:*** The randomly moving nodes in an ad- hoc can lead to network partition. In most cases the intermediate nodes are the one which are highly affected by this partitioning [2].
4. ***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 A sends signal to node B but does not tell anything about the quality connection in the reverse direction [4].
5. ***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 recurrent route changes therefore mobility management itself is very vast research topic in ad-hoc networking [2].

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 [5][6].

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

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

Destination Sequence Distance Vector Routing (DSDV): A table driven routing protocol which algorithm based on the classical Bellman-Ford routing mechanism is DSDV. The evasion 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 [6].

Ad-hoc On-demand Distance Vector Routing (AODV): 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 [3].

RREQ's route requests and RREP's 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 [2].

Dynamic Source Routing (DSR): It 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 repeatedly updated as when new routes are discovered. The DSR routing protocol consists of two major phases: Route discovery and Route maintenance [1].

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 [2].

IV. SIMULATION BASED ANALYSIS

This section labeled the simulation tool, network setup, parameters and their results. The performances of proactive and reactive routing protocols are evaluated on the basis of two performance metrics: Throughput, Packet delivery ratio.

Simulation Tool: In this research paper simulation of proactive and reactive routing protocols is done by using network simulator (NS2) tool, due to its simplicity and availability. NS2 provides substantial support for simulation of TCP, routing, and multicast routing protocols over a wired and wireless network. It is written in C++ and OTCL (back end language and front end language). It includes a network animator called nam which provides visual view of simulation. Its 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: This topology consist various nodes (20, 40, 60, 80 and 100), where half 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 1: Simulation Parameters

Channel	Channel/ Wireless Channel
Propagation	Propagation/ Two Ray Ground
Network Interface	Phy/ Wireless Phy
NS Version	Ns-allinone-2.35
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	20 40 60 80 100
Simulation Area Size	700*600
Simulation Duration	60 Second
Routing Protocols	AODV, DSDV and DSR
Performance Metrics	Throughput, Packet Delivery Ratio

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

a. **Throughout**: Data transferred within a specific time is known as throughput generally measured in bps.
b. **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.
c. **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.
d. **Routing Overheads**: The number of control packets generated by each routing protocol.

Simulation Results: The simulation results are shown in the following section in the form of bar graphs. In this research paper an attempt has been made to evaluate the performance of all three well known routing protocols i.e. DSDV, AODV and DSR according to their simulation results. The simulation results are generated through the MATLAB.

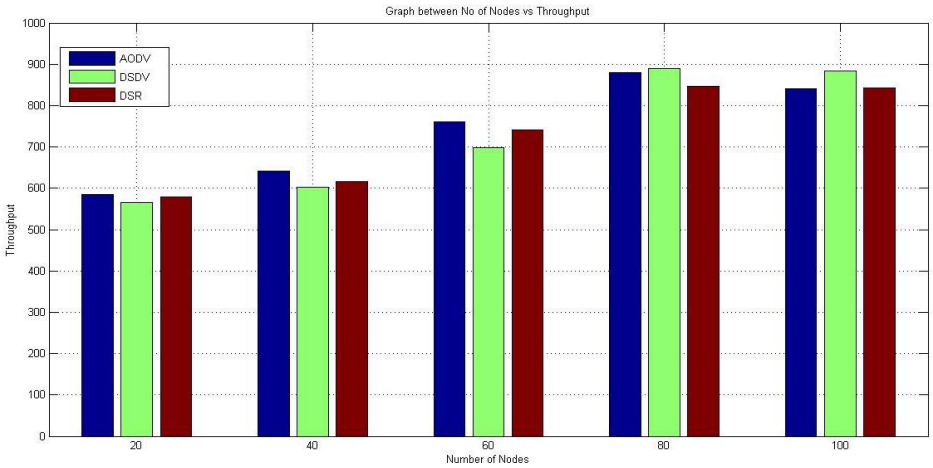

Figure 1: Throughput versus No. of Nodes for AODV, DSDV and DSR

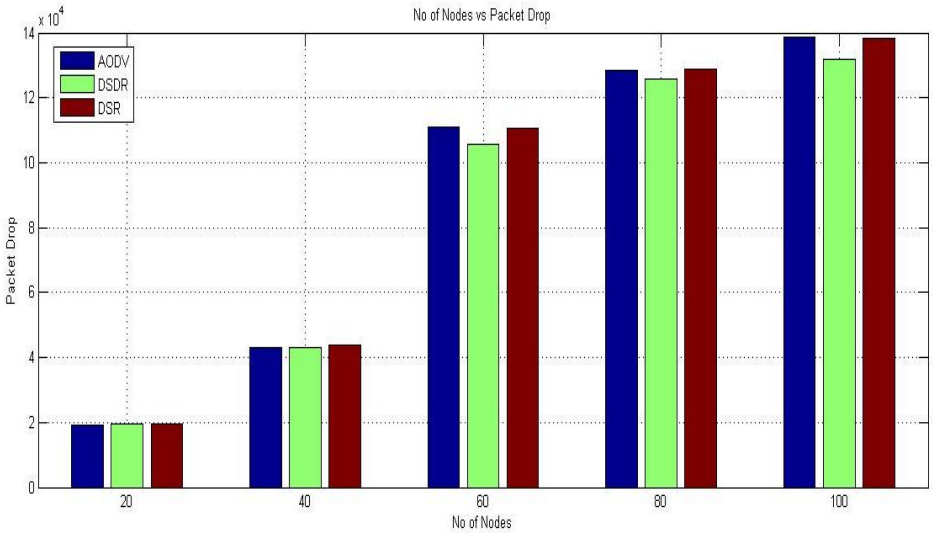

Figure 2: Packet drop versus No. of Nodes for AODV, DSDV and DSR

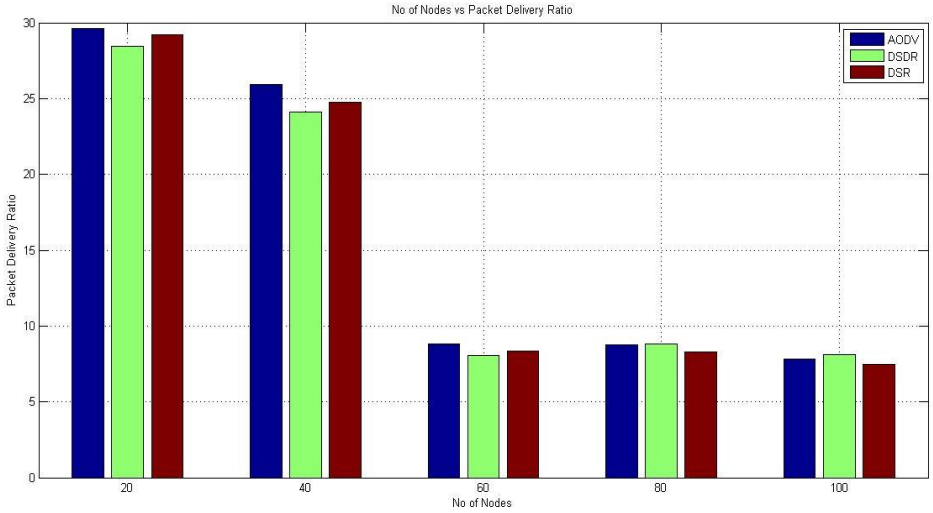

Figure 3: Packet Delivery Ratio versus No. of Nodes for AODV, DSDV and DSR

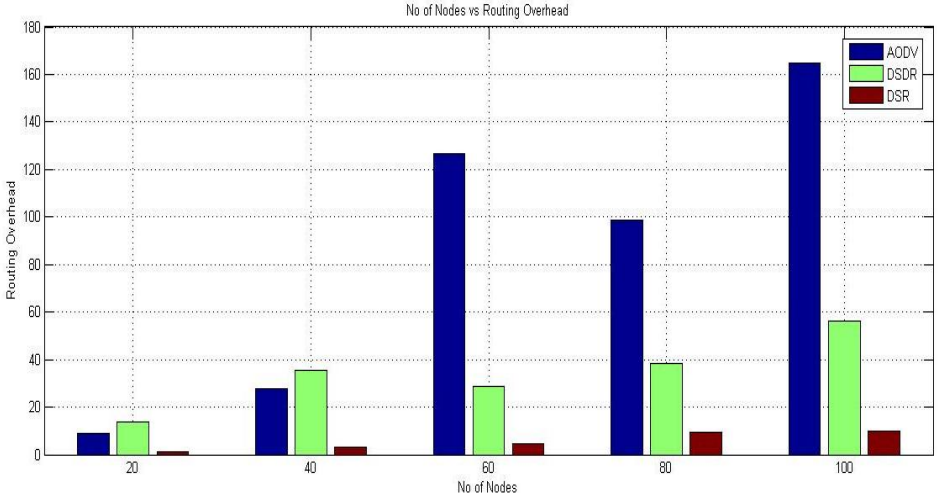

Figure 4: Routing Overhead versus No. of Nodes for AODV, DSDV and DSR

Table: 2 Comparison of all parameters for different nodes and routing protocol

S.N	No of Nodes	Parameters	Protocol		
			AODV	DSDV	DSR
1	20	Throughput	584.48	566.14	579.64
		Packet Drop	19318	19385	19451
		Packet Delivery Ratio	29.6235	28.4753	29.2024
		Routing Overhead	9.08	13.61	1.17
2	40	Throughput	641.87	603.18	616.63
		Packet Drop	43116	43056	43816
		Packet Delivery Ratio	25.9281	24.14	24.7505
		Routing Overhead	27.96	35.52	3.09
3	60	Throughput	761.61	699.18	741.53
		Packet Drop	110954	105809	110703
		Packet Delivery Ratio	8.84223	8.06017	8.33504
		Routing Overhead	126.72	28.72	4.72
4	80	Throughput	879.09	889.31	847.19
		Packet Drop	128599	125949	128967
		Packet Delivery Ratio	8.77144	8.79029	8.31541
		Routing Overhead	98.48	38.32	9.33
5	100	Throughput	841.31	884.16	842.59
		Packet Drop	138702	131989	138457
		Packet Delivery Ratio	7.83282	8.12951	7.47467
		Routing Overhead	164.62	56.06	9.71

V. CONCLUSION

This work carried out the detailed analysis of DSDV, AODV and DSR routing protocols theoretically and through simulation by NS2 on the basis of different performance metrics viz. throughput, packet drop, packet delivery ratio and routing overhead. These performance metrics are analyzed for the three routing protocols for 20, 40, 60, 80 and 100 nodes for 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.

As number of nodes increasing DSDV shows maximum throughput while for less number of nodes AODV has maximum throughput. In terms of packet drop DSDV has minimum packet drops in all cases. For packet delivery ratio AODV is best for less number of nodes while for large nodes DSDV shows better results. Routing overhead is minimum in DSR for any number of nodes 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.

Based on the above discussion, the selection of the routing protocols for given environment for number of nodes can be done efficiently.

REFERENCES

[1] C. Siva Ram Murthy and B. S. Manoj, "Ad-Hoc Wireless Networks, Architectures and Protocols", Pearson Education, 2007.

[2] G. S. Mamatha1 and Dr. S. C. Sharma "Analyzing The MANET Variations, Challenges, Capacity And Protocol Issues" International Journal Of Computer Science & Engineering Survey (IJCSES) Vol.1, No.1, August 2010

[3] David B. Johnson and David A. Maltz, "Dynamic Source Routing In Ad-Hoc Wireless Networks", Technical Report, Carnegie Mellon University, USA

[4] Chirag Jain, Vikas Raghuwanshi, "Performance Evaluation and Comparative Analysis of Routing Protocols in Mobile Ad-Hoc Network", IJSERT Volume 5 Issue 3 March-2016.

[5] Chirag Jain, Vikas Raghuwanshi, Anshul Maloo, "Matrices Evaluation of MANET Routing Protocols", National Conference On Multidisciplinary Approaches in Engineering, Science and Management (MAESM-2015).

[6] Elizabeth M. Royer and Chai-Keong Toh "A Review of Current Routing Protocols for Ad-Hoc Mobile Wireless Networks", Technical Report, University of California and Georgia Institute of Technology, USA.

[7] C. E. Perkins, E. M. Belding Royer and S.R. Das, "Ad-Hoc on-Demand Distance Vector Routing", IETF (Internet Engineering Task Force), RFC 3561, July 2003.

[8] Krishna Moorthy Sivalingam, "Tutorial On Mobile Ad Hoc Networks".