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Behaviour and Analysis of MANET Routing Protocols for an Emergency and Rescue Scenario

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***Abstract*— A collection of wireless mobile nodes, without a fixed infrastructure or central administration is termed as a Mobile Ad-Hoc Network (MANET). These characteristics of MANET make it suitable for an emergency and rescue scenario which requires effective communication. Routing strategies: proactive, reactive and hierarchical are considered, under which DSDV, DSR, AODV and CBRP are simulated and analysed for better performance in an emergency and rescue topography. NS2 simulator has been used for the study. From the comparative analysis of routing protocols it can be shown that the hierarchical routing strategy has a better performance in terms of parameters such as throughput, end to end delay, packet drop and packet delivery ratio for an emergency and rescue scenario.**

***Keywords*— AODV, DSDV, DSR, CBRP, MANET, ERS**

I. INTRODUCTION

A Mobile Ad Hoc Network (MANET) is a collection of wireless nodes that can dynamically configure a network to exchange the information without using any fixed network infrastructure[5]. MANETs do not need any pre-existing network infrastructure or base stations to create a network[4]. As the network does not consist of routers, each mobile device will not only act as source and destination, they also act as router routing the information from one node to another and because the structure of the network can change quickly and unpredictably the network will be able to adapt to the changes very quickly making it ideal for emergency and rescue scenarios where communication is expected to occur with minimum loss and in an energy efficient manner.

This paper aims to determine which one of the MANET routing strategies: proactive, reactive or hierarchical, performs better in an emergency and rescue operations with respect to random waypoint mobility model to provide uninterrupted service to the mobile users irrespective of the geographical location and the speed at which the mobile user is moving and to provide information to service providers helping them decide and implement a well suited and robust communication protocol during emergency and rescue scenarios.

II. RELATED WORK

Routing is considered to be a parameter for effective communication in an ERS. This paper makes a comparative analysis of routing protocols under three categories: proactive, reactive and hierarchical in an ERS.

A. MANET routing protocols

Proactive/table driven routing: All the mobile devices which are a part of the network will exchange routing information or routing table periodically. The route is maintained at all the nodes and it reacts to the addition of a new node into the network. The main idea is to distribute the information periodically though the networks in order to pre calculate all the possible paths and changes are propagated to all the nodes. Too much of updating may cause over loading which directly affects the utilization of bandwidth and energy efficiency. But the proactive protocols are better in terms of performance and packet delivery fraction and are most suitable in static topology. Eg: DSDV, CGSR, WRP etc

Reactive/source initiated routing: The paths for the devices will be decided when the source makes a request for transmission that is, routing table exchange does not take place. It allows the update of the tables on demand. This can be done in two parts: Route discovery which occurs when node wants to communicate with the specific destination and Route maintenance which is used to maintain the path failure caused by mobility of nodes. The drawback of these protocols is the latency to initiate communication. Reactive protocol would be energy saving during communication, since a non-constant network update improves energy saving on mobile devices. Eg: DSR, TORA, ABR, AODV etc.

Hierarchical routing: The protocol divide the MANET into groups of nodes called clusters, where in a cluster head is responsible for distribution of information across the network generated in its cluster. Such a routing protocol is essential for an emergency and rescue scenario as there is a central administrator for each cluster, thus providing faster communication, saves energy and bandwidth, and has better network performance. Proactive protocol DSDV, reactive protocols AODV and DSR and hierarchical protocol CBRP was chosen under the following considerations:

AODV and DSDV were chosen because they showed the best performance in their categories[3]. CBRB is a protocol which uses DSR as a back end; hence there is a need to evaluate the performance of DSR with CBRP. CBRP a reactive protocol shows significant advantage in energy consumption, bandwidth and network performance[2]. To evaluate the performance of the above mentioned protocols for an ERS, the parameters throughput, end-to-end delay, packet drop and packet delivery ratio are considered.

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B. Methodology for performance analysis of routing protocols

The analysis is carried out in three phases: preparation, study and analysis, results and conclusion. Preparation involves creation of scenario with mobile nodes followed by study and analysis of protocols with respect to number of nodes and parameters. The final phase includes results generation as shown in figure1.

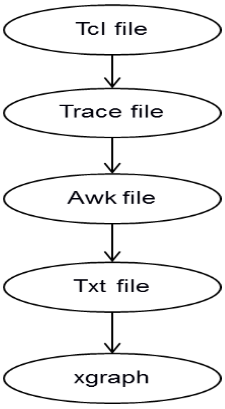

Fig 1: Method for result generation

C. Proposed Scenario

Simulation is carried out considering the scenarios with 25, 50, 75 and 100 nodes.
To define the simulation scenarios the basic values and parameters for different protocols are as shown in Table1.

D. Performace Metrics

In order to determine a better protocol for an ERS, the following parameters were considered:

- Throughput: It is a significant measure for an ERS, it describes the rate of successful delivery of message over a communication channel, measured in bits per second. Fig 1 demonstrates high throughput value of CBRP protocol compared to DSDV,AODV and DSR even with the increase of the number of nodes.
- Packet drop: It is the number of packets dropped by intermediate nodes due to mobility, link breakage, expiration of time etc. Fig 2 shows the erratic behaviour of packet drop in CBRP for 75 nodes due to different speeds of nodes and mobility, but is the least packet drop compared to the other protocols for the other sets of nodes.
- Packet Delivery Ratio: It is the ratio defining the number of packets sent verses the number of packets received. Higher packet delivery ratio indicates better the performance. Fig 3 shows a significant high packet delivery ratio in CBRP across the increasing number of nodes.
- End-to-end delay: It is the time taken by the packet to arrive at the destination which includes route discovery time, queueing time, propagation time. Lower end-to-end delay indicates better performance. Fig 4 shows CBRP demonstrating a moderate end-to-end delay across the increasing number of nodes when compared to the variations in the other protocols.

Table 1. Basic Values and Parameters

Variable	**Value**	**Observations**
set val(chan)	Channel/WirelessChannel	channel type
set val(prop)	Propagation/TwoRayGround	radio-propagation model
set val(netif)	Phy/WirelessPhy	network interface type
set val(mac)	Mac/802_11	MAC type
set val(ifq)	Queue/DropTail/PriQueue	interface queue type
set val(ll)	LL	link layer type
set val(ant)	Antenna/OmniAntenna	antenna model
set val(ifqlen)	25	max packet in ifq
set val(nn)	25,50,75,100	number of mobilenodes
set val(rp)	DSDV, AODV,DSR, CBRP	routing protocol
set val(x)	1000	X dimension of topography
set val(y)	750	Y dimension of topography
Set val(stop)	100	Simulation time

Table 2. Throughput

No. of nodes	AODV	CBRP	DSDV	DSR
25	220.221	232.229	215.37	220.485
50	218.009	223.309	214.577	213.671
75	180.157	237.134	213.834	216.411
100	213.728	221.701	22.4975	214.132

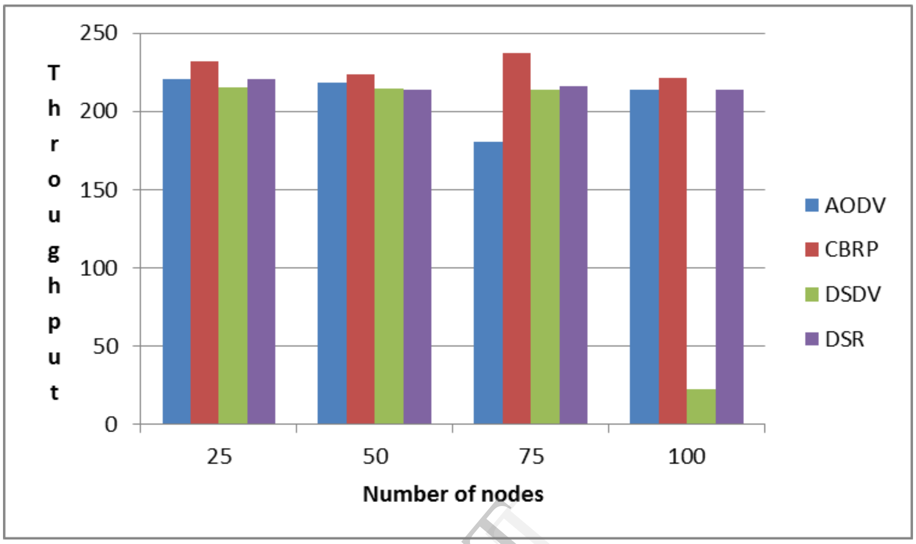

Fig 2. Throughput

Table 3. Packet Drop

No. of nodes	AODV	CBRP	DSDV	DSR
25	14	5	31	7
50	22	11	13	37
75	3	29	36	6
100	17	17	5	20

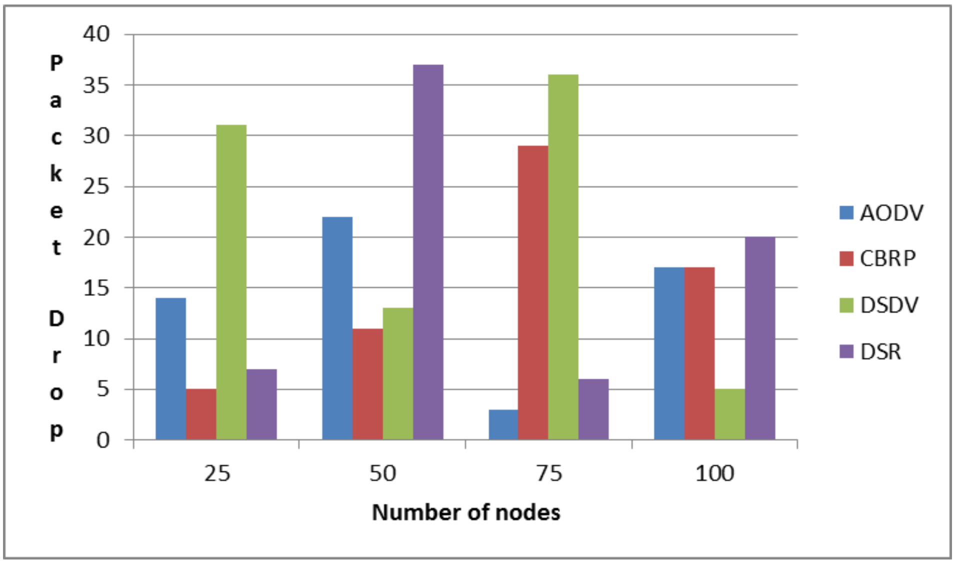

Fig 3. Packet Drop

Table 4. Packet delivery ratio

No. of nodes	AODV	CBRP	DSDV	DSR
25	99.2887	92.2327	85.1192	97.8368
50	99.2068	99.1024	71.887	94.8254
75	99.4537	87.676	61.1444	94.8206
100	99.4207	98.0342	11.2708	94.215517

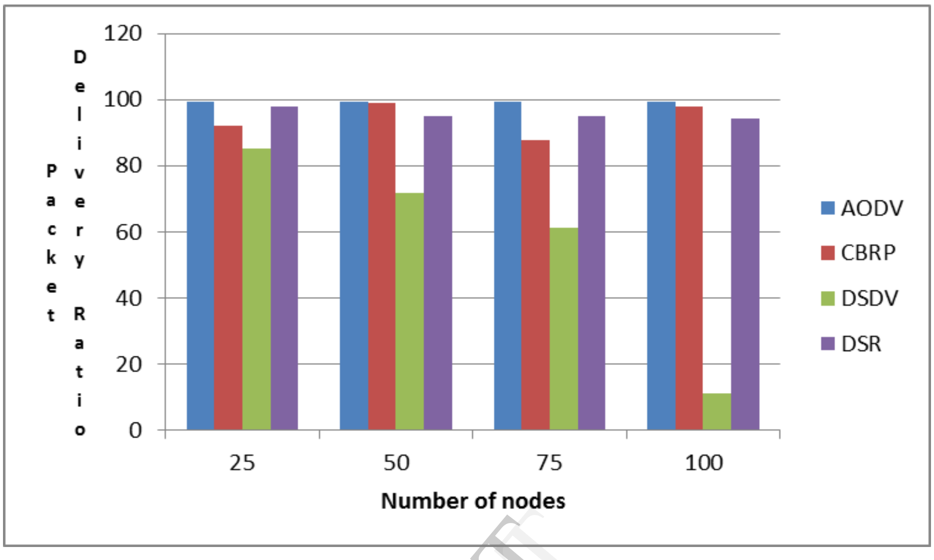

Fig 4. Packet Delivery Ratio

Table 5. End-to-End Delay

No. of nodes	AODV	CBRP	DSDV	DSR
25	175.184	229.133	115.218	258.485
50	170.76	265.542	59.3577	170.354
75	176.144	221.211	12.0779	25.803
100	184.446	272.08	0	270.83

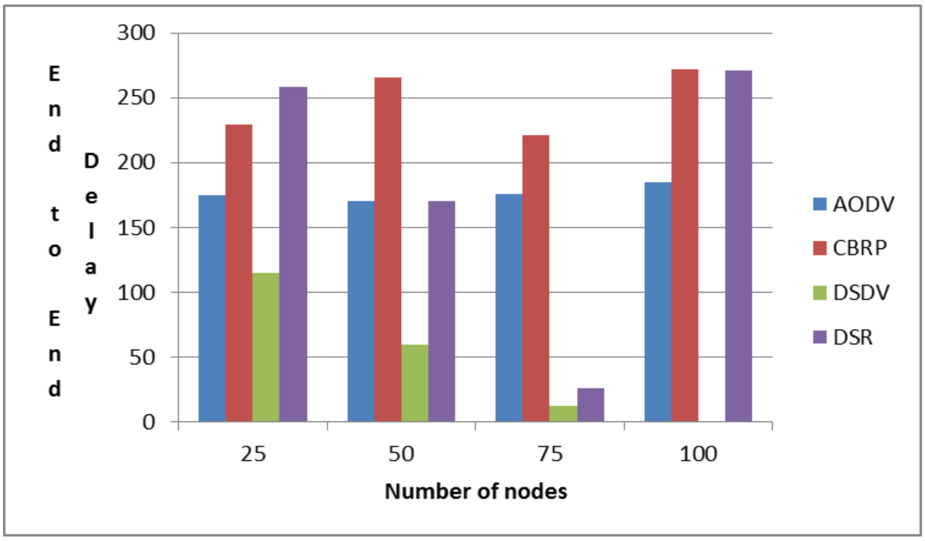

Fig 5. End-to-End Delay

III. CONCLUSION

This study for the evaluation and comparison of DSDV, AODV, DSR and CBRP shows that the best protocol for an ERS is CBRP. Though a little loss of information takes place during routing, and there is fluctuation in the data rates, CBRP performs better in comparison to the other protocols. Hence it can be shown that a hierarchical protocol, CBRP is well suited for an ERS, allowing a better evacuation of persons to an appropriate location.

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