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Evaluation of Ad-hoc Routing Protocols with Different Mobility Models for Warfield Scenarios

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Abstract

In Warfield, it is impossible to have a pre-installed infrastructure networks, the only way to overcome the problem is to create a wireless infrastructure less networks. In order to communicate between the mobile nodes in the Warfield, each node must have a coverage distance of 200 meters. In this paper, we have chosen ad hoc network as a best infrastructure less networks and incorporated with three different routing protocols like Destination sequenced Distance Vector (DSDV), Ad-hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR) in each node. These protocols were tested at two different scenarios such as Army navy force movement scenario and Army land force movement scenario. The performance metrics such as Packet delivery ratio, Average end to end delay, Average throughput, Jitter, Dropping ratio, Total energy consumed, and overall residual energy are obtained from simulated result.

Keywords: DSDV, AODV, DSR, Army navy force movement, Army land force movement

1 Introduction

A mobile ad hoc network is a network consisting of a set of wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The mobility models represent the realistic movement of each mobile node in the MANETs. Each device in a MANET is free to move independently in any direction, therefore change its links to other devices frequently [1].Ad-hoc routing protocols typically have two routing strategies Proactive Approach (DSDV) and Reactive Approach (DSR and AODV)

1.1 Destination Sequenced Distance Vector

DSDV is a table driven algorithm where each node maintains a table that contains the routes to all destinations is readily available at all times. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops. The table updates are of two types: Incremental updates and Full dumps. The end node of the broken link initiates a table update message with the broken link weight assigned to infinity. Each node upon receiving an update with weight infinity quickly disseminates it to its neighbors in order to propagate the broken link information to the whole network. When a neighbor node perceives the link break, it sets all the paths passing through the broken link with distance as infinity [2]. Those neighbors detecting significant changes in the routing tables rebroadcast it to their neighbors. In this way, the broken link information propagates throughout the network.

1.2 Dynamic Source Routing

DSR is an On demand routing protocol that is based on the concept of source routing. It is designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks. The basic approach of this protocol is when it has data packets to be sent to that destination, it first consults the route cache of the source node to determine whether it has route to destination if it has route to the destination it will use this route to send the data packet .If source node does not have such a route it initiates a route request packet. Each node, upon receiving a route request packet, rebroadcasts the packet to its neighbors if it has not forwarded already or if the node is not the destination node. Sequence numbers are used to avoid multiple transmissions of same RREQ packets [3]. A destination node, after receiving the first route request packet, replies to the source node with a Route reply packet through the reverse path the route request packet had traversed. Here route maintenance is accomplished with help of route error packets and acknowledgements.

1.3 Ad hoc On Demand Distance vector

AODV routing protocol uses an On demand approach for finding routes, the route is established only when it is required by a source node for transmitting data packets. AODV is an improvement on DSDV because it typically minimizes the number of control packet required. The major difference between AODV and DSR is which a packet carries the complete path to be traversed in DSR. However in AODV the source node and the intermediate nodes record in their route tables the address of neighbor from which the first broadcast packet is received, there by establishing the reverse path [4]. The source node broadcast a Route request packet to all nodes in a network to find the destination node. After the destination node receives the Route request packet it replies the source node with a Route reply packet in a traversed way that a Route request packet has travelled. Associated with each route entry is a route timer which will cause the deletion of the entry if it is not used within the specified life time. Link failure is informed to the upstream neighbors with help of link failure notification message (RREP with infinite metric) for erasure of the part of the route.

1.4 Random waypoint model

A mobile node (MN) waits for a specified pause time as the simulation begins. After the pause time expires, the mobile node moves to a random destination with random speed uniformly distributed between 0 m/s and V_{max}. The MN waits again for a pause time seconds before choosing a new way point and move with uniform speed before reaching the destination point[5].

1.5 Reference point group mobility

In every RPGM model, each group has a centre node which is called group leader node. The mobility behavior of entire group depends on the movement of group leader. The group leader node is called reference point (RP).Within a simulation area, the group leader chooses a new destination at every second and it is followed by their subordinate mobile nodes [5].

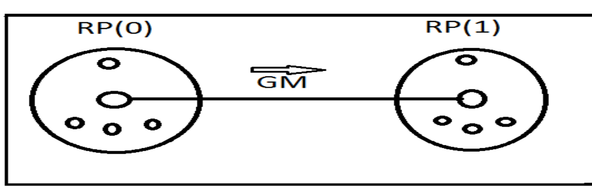

Fig.1 Reference point group mobility

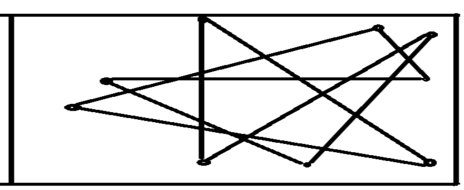

Fig.2 Random waypoint model

2 Simulation Model

In Warfield environment we use three kinds of forces such as Army Ground force, Army Navy force, Army Air force. For defining movement to land and navy forces, here we have chosen the Random Waypoint mobility model and Reference point group mobility model. These scenarios are tested with three different routing protocols AODV, DSR and DSDV respectively.

2.1 Army Navy Force Movement

The reference point group mobility model (RPGM) is a group type of mobility model; the movement pattern of RPGM is selected as best one and applied to navy boats for giving efficient movement towards the target. In this scenario, we are considering totally 25 boats they are divided into 5 groups. The 1st group consists of 8 boats, the 2nd group contains 5 boats, 3rd group contains 4 boats, and 4th group contains 7 boats. These groups will have their respective heads called Subheads. The 5th group contains only one boat which is considered to be Main head. The main head guides the four subheads with help of ad hoc wireless node; According to the instruction received from the main head the subhead will guide the other boats within the group.

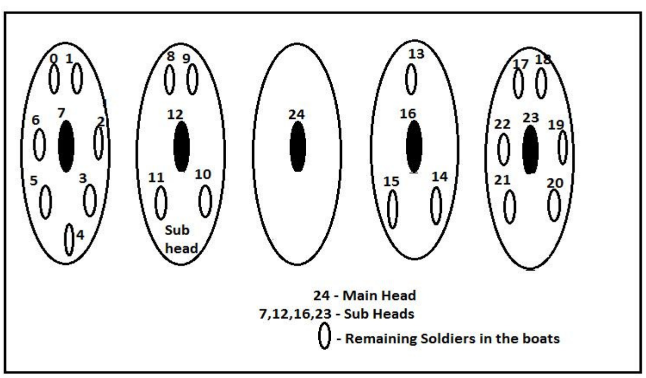

Fig.3. Navy force movement scenario

Parameter		value
Channel type		Wireless
Transport layer Agent		UDP
Application layer Agent		CBR
Packet rate		0.015625 sec
Packet Size		1000 bytes
Main head to each sub head (signal transmission duration)		20 sec
Maximum no of connections		4
Initial energy in joules	Mani head node	400
	All other node	100
Simulation Area		500×500
Simulation duration		150 sec

Table 1: Simulation parameter

2.2 Army Ground Force Movement

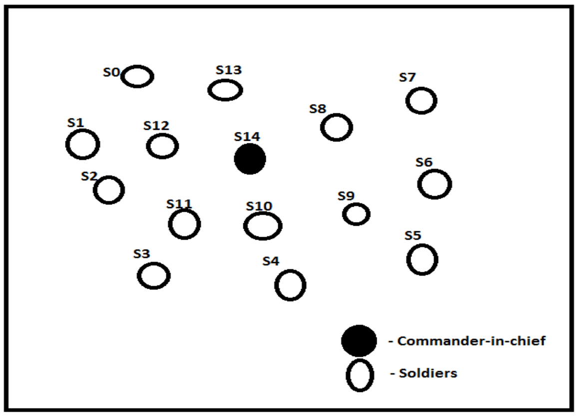

Fig.4. Ground force movement scenario

Parameter		**value**
Channel type		Wireless
Transport layer Agent		UDP
Application layer Agent		CBR
Packet rate		0.015625 sec
Packet Size		1000 bytes
Commander to each Soldier (signal transmission duration)		3 sec
Maximum no of connections		14
Initial energy in joules	Commander	750
	All other node	100
Simulation Area		500×500
Simulation duration		150 sec

Table 2: Simulation parameter

Consider a situation where terrorists entered a big shopping mall and captured group of civilians as hostages. To rescue the civilians from the terrorists, we need military support. In order to give efficient movement to the military troops Random way point mobility model have been selected as a best one and applied to them. Let us assume in this scenario there are fourteen soldiers and one commander-in-chief. The commander-in-chief first gathers complete information about the building then start the rescue operation. During rescue operation the commander-in-chief will give instruction to his soldiers with help of ad hoc wireless node.

3 Performance Metrics

Packet Delivery Ratio:
The packet delivery ratio is the ratio of total number of successfully received packets to the total number of sent packets in the simulation process.PDR= (∑ Number of AGT packets received / ∑ Number of AGT packets send)*100

Average throughput:
The average rate at which the data is successfully delivered over a communication channel is known as throughput. Throughput = (∑ Data packet size in bytes* 8/ (Last data packet arrive time in sec – first data packet send time in sec)

Average goodput: The number of useful information bits delivered by the network to a certain destination in the simulation period. Goodput= $\sum$ Data packet size excluding header size in bytes *8 / (last data packet arrive time in sec – first data packet send time in sec)
The good put is a ratio between delivered amount of information, and the total delivery time.

End to End Delay: The average time in ms taken by an AGT packet to reach the destination. Only the packets that reach the destination successfully are counted. End to end Delay = ($\sum$ (arrive time – send time) / $\sum$ Number of connections)*1000

Jitter: Jitter is the variation in the time in ms between packets arriving the destination. Jitter =$\sum$ (Current time- Last packet received time) *1000/ $\sum$ Number of connections

Dropping Ratio: Dropping ratio is the ratio of number of packets dropped to the total number of packets sent. DR= ((send - recv) / send) * 100

Total Energy Consumption: Total amount of energy consumed in joules by all the nodes in the network during the simulation process. Total energy consumption = $\sum_{i=0}^{N-1}(\text{Initial energy present in a node} - \text{Energy left in a node})$.N-No of nodes in the network.

Over all Residual Energy: Amount of energy in joules left in all the nodes after the completion of simulation
Over all Residual Energy $=\sum_{i=0}^{N-1}(\text{Energy left in all the nodes})$.

4. Results and Discussion

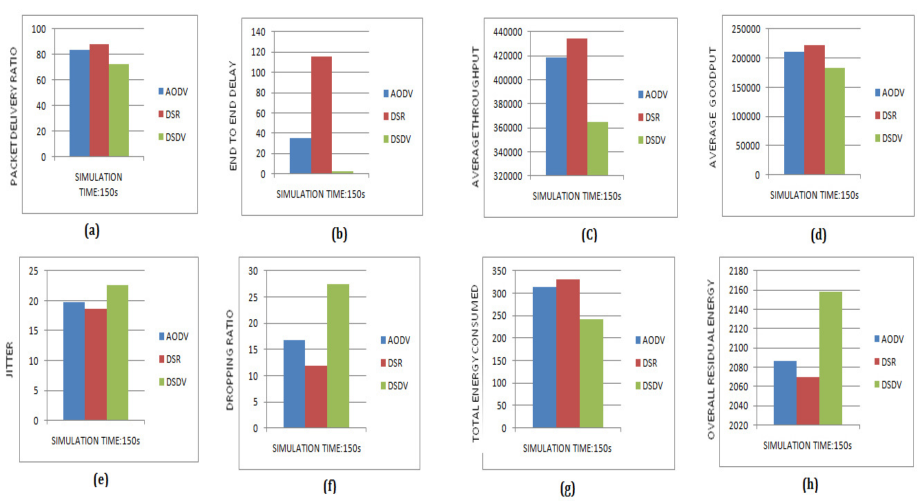

Fig.5. Simulation result for Navy force movement scenario

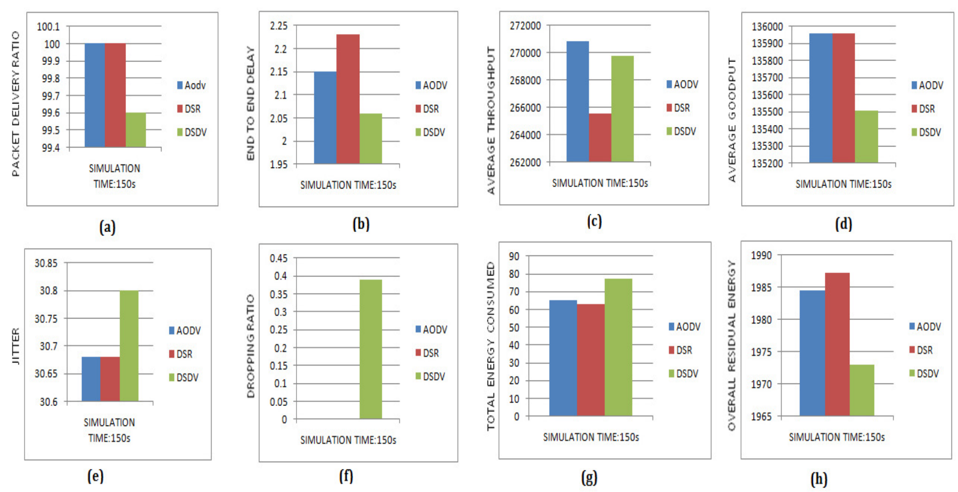

Fig.6. Simulation result for ground force movement

From the simulation results of Navy force movement scenario we found that the DSR possess a highest Packet delivery ratio, average throughput, average goodput and lowest jitter than AODV and DSDV. For the same scenario when you compare in terms of average end to end delay DSDV has a lowest end to end delay than AODV and DSR.DSR is quite efficient for this scenario because it has low dropping ratio. Here total energy consumed by the DSR higher than other two routing protocols. Hence over low overall residual energy available at all the node at the end of the simulation for DSR protocol is very less compare to that of AODV and DSDV. Similarly when you analyses the simulation results of ground force movement scenario both AODV and DSR have high packet delivery ratio, goodput and nil dropping ratio than DSDV. In this environment DSDV protocol have least end to end delay than AODV and DSR. Here the average throughput of AODV is comparatively higher than DSDV and DSR. At the same time we realized AODV and DSR have equally low jitter values than DSDV. During simulation period DSDV consumes high energy lead to low overall residual energy at the end of the simulation than AODV and DSR

5 Conclusions

In this paper, we focused on Evaluation of Ad hoc Routing Protocols with two different Mobility Models for Warfield Scenarios. In both the scenarios DSR provides excellent performance in terms of packet delivery ratio, goodput, jitter and dropping ratio than that of other two routing protocols. Hence DSR is able to correctly deliver almost all originated data packets, even with continuous, rapid motion of all nodes in the network In addition to that DSR has very low routing overhead, it minimize the consumption of bandwidth by the control packets. The limitation of DSR routing protocols in this simulation scenario are its end to end delay is higher than that of AODV and DSDV. In future it can be minimized by modifying the existing DSR protocol.

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