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Random Construction of Adhoc Network Scenarios for Wireless Nodes with Restricted Mobility Matter

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Abstract:

A Wireless Network can be the best technological solution that consists of numerous unattended, resource-constrained, and low power battery nodes, which are of two types: mobile node, and mobile gateway or base station (BS). The mobile node has the basic capabilities of signal sensing, processing, and communicating. The objective of the proposed work is to investigate and explore the routing problems as raised in wireless ad hoc network scenarios with respect to the random structural configurations. We discuss an outline structure of mobile adhoc network, where the mobile nodes formulate the adhoc structure for the purpose of data communication. In this work, we formulate an adhoc network scenario through Destination-Sequenced Distance-Vector routing (DSDV) protocol in order to analyze the data communication competence through different network parameters. Further, we analyze and compare the packet reception rate and packet reception statistics in both AODV and DSDV Manet structure and find that DSDV has the better packet reception rate as compared to AODV in a randomly configured mobile adhoc environment. Alternatively, DSDV have a dramatic decrease in performance when mobility is high, but in restricted mobility matter DSDV has better performance as compared to AODV.

Keywords — **AODV, DSDV, MANET, random structure, packet reception rate, and packet reception statistics.**

I. INTRODUCTION

An ad hoc wireless network consists of a set of mobile hosts operating without the aid of an established infrastructure of centralized administration [1], [2], [3]. Wireless networks provide yet another realm in which cooperation among groups of entities can be attained, provided that the right framework can be designed and implemented. Cooperative communication has become one of the fastest growing areas of research in wireless communication in recent years [4], [5], [6], [7], [8]. The key idea in user-cooperation is the resource-sharing among multiple nodes in the network, which would often lead to savings of overall network resources. A Wireless Network can be the best technological solution that consists of numerous unattended, resource-constrained, low power and memory nodes, which are of two types: mobile node, and mobile gateway or base station (BS) [9], [10], [11], [12]. The mobile node has the basic capabilities of signal sensing, processing, and communicating. However, the mobile gateway or BS has more functionality besides these basic capabilities. It can collect, analyse, and process signals and be connected to the Internet to share the data world-wide. Based on the two types of nodes, a wireless network normally constitutes a wireless ad hoc device network. The adhoc mobile nodes send data directly to the BS if the node is within the communication range of BS or through other nodes using multi-hop routing. Finally, data from BS reach end users through divergent communication networks [13], [14], [15], [16], [17], [18].

In proactive routing protocols like DSDV, a table of source destination pair should be maintained between all pairs of nodes in the network. When a connection breaks, the path maintenance procedure is initiated. For large networks, sharing of such tables generates huge network congestion. Also these protocols suffer from count to infinity problem. This movement prediction helps it to find a new path before actual path break. Existing reactive topology based routing protocols like DSR and AODV establish dedicated paths from source to destination for data transmission. The source floods route request messages in the entire network. On receiving request message, the destination replies with a reply message following the path of the request message. When the source receives the reply message, it sends the data packet along the path established by the request-reply mechanism. But it is witnessed that such established paths break early with variable speed of intermediate nodes and change in direction of vehicles. For those broken paths, maintenance procedure is necessary which depends on the flooding. Broadcast storm problem may arise due to such phenomenon [19], [20], [21], [22], [23]. Network performance may be greatly affected by the interoperability of the data delivery model and the routing protocol employed in wireless adhoc network. For example, in an adhoc network application for the detection of certain event, the event-driven model and flooding routing scheme are used, such that if the event is detected, the devices in mobile nodes broadcasts the emergency signal to its neighbours who rebroadcast this message until it reaches the remote centre. In this scenario, multiple nodes may intellect this event and send the message simultaneously, which potentially increases the likelihood of packet collisions in wireless communication and the loss of this critical information [24], [25]. The latency of information reporting in this scenario is also a critical concern. Nodes can communicate with their neighbours within a physical distance limited by wireless communication methods, typically of the order of metres but almost always less than the physical diameter of the network. Each sensor node broadcasts a hello packet, including its ID, periodically to announce its existence in the network. When a mobile node leaves the range of its cell more than a predetermined threshold time, it will announce it's leaving status. The threshold time is to prevent the mobile node from moving back and forth across the boundary of its cell. When a coordinator moves to a new cell, it will get a new node identifier from the new cell and consider the following two cases. The first case is that the original cell has at least one member. The coordinator will choose one of the members with the smallest identifier to become the new coordinator of the cell. Then the moving coordinator sends the remaining available node identifiers and six Pond sets' information to the new coordinator. The new coordinator will change its node identifier to the coordinator node identifier. The second case is that the cell does not exist any member. The moving coordinator will send its Pond sets information to the coordinator of the new cell. Note that, if the new cell is empty the moving coordinator will become the coordinator of the new cell. When a member mobile node moves to a new cell, we consider the following cases. If the new cell is empty, the member sensor node will become a coordinator at the cell and deliver a control message to notify its original coordinator. The original coordinator receiving the notification packet will reclaim the node identifier from the member that is moving out. If the moving sensor node is still a member in the new cell, it does not need to change its node identifier. However, the member sensor node will send a packet to inform the original coordinator to shift its node identifier to the new coordinator. Both coordinators will record this node identifier in their corresponding Pond sets [26], [27], [28], [29].

The rest of this paper is organized as follows. The methods considerations are deliberated in section **II**. Section **III** highlights the scenarios analysis and discussion. Finally, section **IV** concludes this paper along with the future work.

II. METHODS CONSIDERATIONS

The objective of the proposed work is to investigate and analyse the routing problems as raised in wireless ad hoc networks with respect to randomly configured topological adhoc environment. Many routing protocols have been developed to compete with sudden changes that may arise due to nature of the networks. Route discovery, route maintenance and sudden change in the topology are the major barriers for routing protocols in MANET [30], [31]. Due to these problems several routing protocols have been developed that can meet the dynamic nature of ad hoc network. Existing routing protocols are generally categorized in topological-based and position-based routing. Topological based routing makes use of global path information and link information to forward packets. Position-based routing does not keep global network information but requires information on physical locations of the node. Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad hoc networks. It uses in ZigBee – a low power, low data rate wireless ad hoc network. There are various implementations of AODV such as MAD-HOC, Kernel-AODV, AODV-UU, AODV-UCSB and AODV-UIUC [32], [33]. Ad hoc on demand distance vector routing (AODV) is an example of pure reactive routing protocol. AODV belongs to multi-hop type of reactive routing. AODV routing protocol works purely on demand basis when it is required by network, which is fulfilled by nodes within the network. Route discovery and route maintenance is also carried out on demand basis even if only two nodes need to communicate with each other. AODV cuts down the need of nodes in order to always remain active and to continuously update routing information at each node. In other words, AODV maintains and discovers routes only when there is a need of communication among different nodes. AODV updates the information of active nodes in the routing table. This feature can help maintaining the routing tables with the related number of entries. And Nodes only have the information of currently active routes for communication. AODV reduces flooding of messages in the network as compared to proactive routing protocols so AODV reduces the network overhead. AODV also minimizes the route redundancy and large memory requirements [34], [35], [36].

Destination sequence distance vector routing (DSDV) uses Distance Vector shortest path routing algorithm, and provides loop free single path to the destination. DSDV sends two types of packets “full dump” and “incremental”. In full dump packets, all the routing information is sent while in incremental only updates are sent. The incremental only updates decreases bandwidth utilization by sending only updates instead of complete routing information. These incremental packets are so frequent that makes it unsuitable for large scale networks. Distance vector routing is sometimes referred to as Bellman-Ford, after the people who invented the algorithm. In the distributed Bellman-Ford algorithm, every node i maintains a routing table which is a matrix containing distance and successor information for every destination j, where distance is the length of the shortest distance from i to j and successor is a node that is next to i on the shortest path to j. To keep the shortest path information up to date, each node periodically exchanges its routing table with neighbours. Based on the routing table received with respect to its neighbours, node i learns the shortest distances to all destination from its neighbours. Thus, for each destination j, node i selects a node k from its neighbour as the successor to this destination (or the next hop) such that the distance from i through k to j will be the minimum. This newly computed information will then be stored in node i’s routing table and will be exchanged in the next routing update cycle [37], [38], [39], [40].

Hybrid routing combines characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient. Mostly hybrid routing protocols are zone based where the number of nodes is divided into different zones to make route discovery and maintenance more reliable for MANET [41], [42], [43], [44], [45].

III. SCENARIOS ANALYSIS AND DISCUSSION

We articulate an outline structure of mobile adhoc network, where the mobile nodes formulate the adhoc structure for the purpose of data communication.

In this work, we formulate an adhoc network scenario through Destination-Sequenced Distance-Vector routing (DSDV) protocol in order to analyse the data communication competence through different network parameters. Consider thirty mobile nodes formulate a specific adhoc stricture at time T1. Allow data packets transfer using DSDV-MANET with respect to the dissimilar time intervals. We set the simulation time to 100 seconds. Assume that data packets are transmitted at asymmetrical time interval. Now the data packet reception analysis snapshot during the simulated time span 98.8 sec to 99.4 sec is depicted in Figure-1 for further exploration.

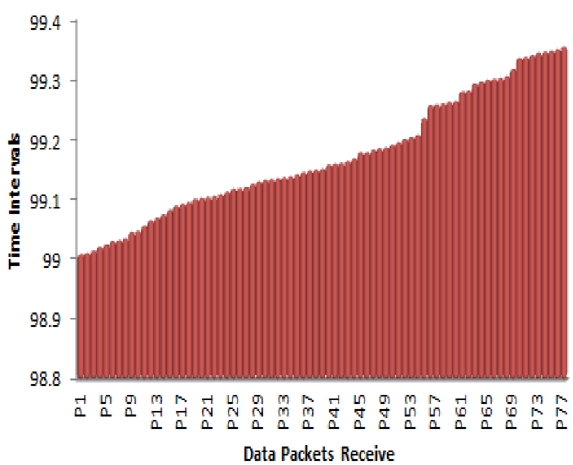

Figure-1: data packet reception analysis snapshot in DSDV-MANET during the simulated time span 98.8 sec to 99.4 sec

Now in the adhoc network structure scenario, out of thirty mobile nodes, we randomly place ten sink nodes and allow data packets transfer using DSDV-MANET with respect to the dissimilar time intervals. We again set the simulation time to 100 seconds. We consider the node Container as nodes, net device container as mobile devices, and Ipv4 interface container as interfaces in this simulated scenario analysis.

In this simulated scenario, thirty mobile nodes are created and allowed for packet transfer through a test case run using nWifis, nSinks, total Time, rate, phy Mode, node Speed, periodic Update Interval, settling Time, data Start, Routing Table. The DSDV helper is used to tune those above parameters. The set up packet receive for sink is configured based on the node's IPV4 address. Based on the above simulated configuration, we analyse receive rate and packet received with respect to time spans.

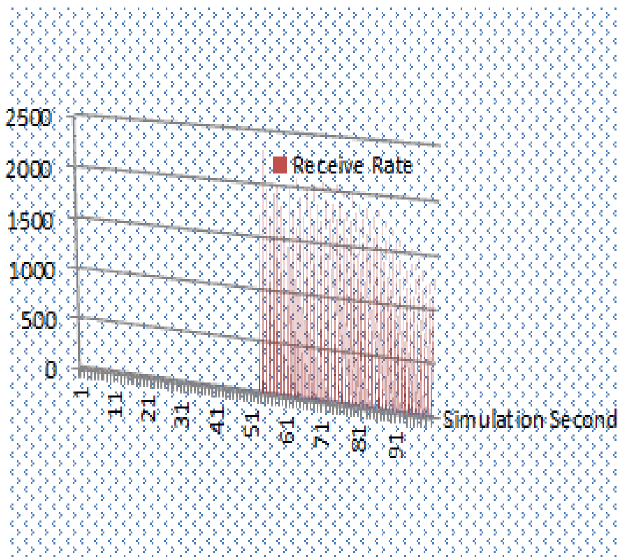

Figure-2. Data packet reception rate analysis in DSDV-MANET w.r.t simulation time frame

In figure-2, we depict the data packet reception rate analysis with respect to simulation time frame for our problem scenario, where a significant observation has been made about the peak reception rate when the simulation time crossed 50 seconds. In figure-3, we analyse the overall data packets reception statistics during total simulated time frame, in which the highest amount of data packet received during the time interval Ti=53 second.

Now, we want to construct an adhoc network scenario under a typical random waypoint mobility model. Allow the simulation runs for 200 simulated seconds, of which the first 50 are used for start-up time. The number of nodes is 50. Nodes move according to Random Waypoint Mobility Model with a speed of 20 m/s and no pause time within a 300x1500 m region. The Wi-Fi is in ad hoc mode with a 2 Mb/s rate (802.11b). The transmit power is set to 7.5 dBm. It is possible to change the mobility and density of the network by directly modifying the speed and the number of nodes.

It is also possible to change the characteristics of the network by changing the transmit power (as power increases, the impact of mobility decreases and the effective density increases). In our simulation, OLSR is used, but specifying a value of 2 for the protocol that will cause AODV to be used, and specifying a value of 3 will cause DSDV to be used. In the simulation, there are 10 source/sink data pairs sending UDP data at an application rate of 2.048 Kb/s each.

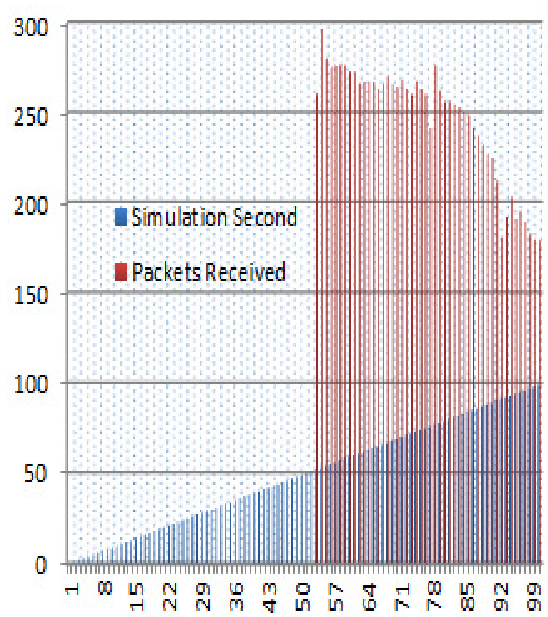

Figure-3. Overall data packets reception statistics in DSDV-MANET during total simulated time frame

This is typically done at a rate of 4 64-byte packets per second. Application data is started at a random time between 50 and 51 seconds and continues to the end of the simulation. So, we analyse some AODV scenarios having transmission power 7.5 dBm, number of sinks are assigned to be 10, and allowable simulated time is 200 seconds.

In figure-4, we analyse the data packet reception rate analysis in AODV-MANET in accordance with the mobility issue and observe that the receive rate increases with the increasing simulation time.

In figure-5, we analyse the overall data packets reception statistics in AODV-MANET during total simulated time frame in accordance with the mobility issue and observe that at initial stage the packet reception rate is very low and increases when the simulation period exceed 100 seconds.

In figure-6, we analyse the overall data packets reception comparison statistics in AODV-DSDV MANET during total simulated time frame with respect to the mobility issue and find that DSDV has the better packet reception rate as compared to AODV in a randomly configured mobile adhoc environment. Alternatively, DSDV have a dramatic decrease in performance when mobility is high, but in restricted mobility matter DSDV has better performance as compared to AODV.

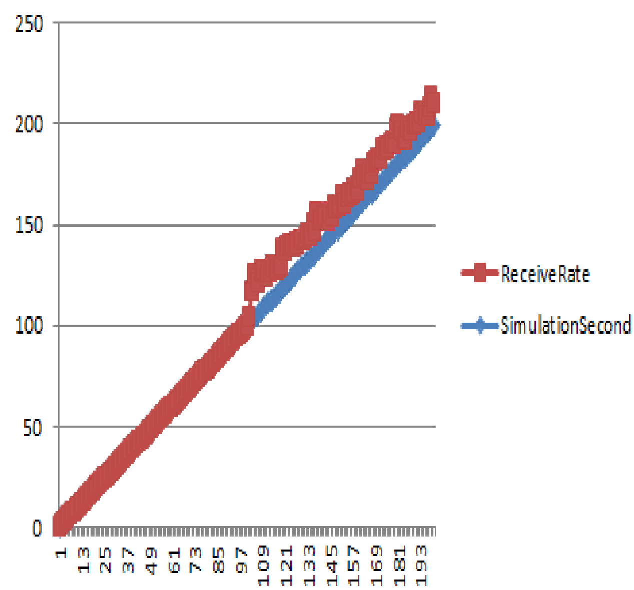

Figure-4. Data packet reception rate analysis in AODV-MANET w.r.t simulation time frame

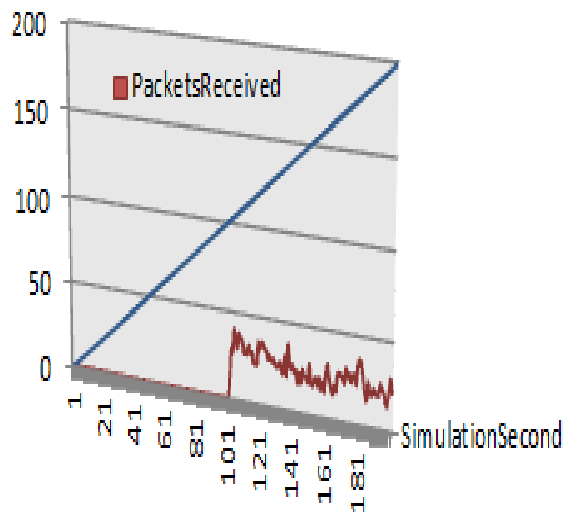

Figure-5. Overall data packets reception statistics in AODV-MANET during total simulated time frame

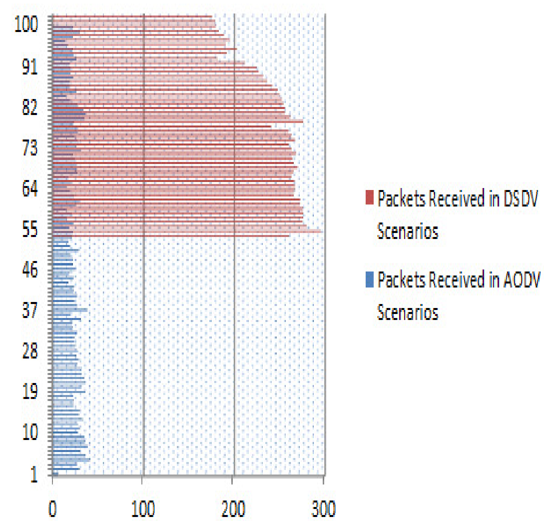

Figure-6. Overall data packets reception comparison statistics in AODV-DSDV MANET during total simulated time frame

IV. CONCLUSIONS

In this work, we discussed the routing issues on Wireless Ad Hoc Networks by considering the random topological structure with restricted mobility matter. Our discussions are mainly highlighted on investigating the random adhoc network construction along with its routing issues for both AODV and DSDV. We analyzed data packet reception rate analysis in AODV- DSDV MANET in accordance with the mobility issue and also the overall data packets reception statistics in AODV- DSDVMANET during total simulated time frame. Furthermore, we compared the performance of AODV and DSDV with respect to the specific configurable adhoc network scenarios and observed that DSDV has the better packet reception rate as compared to AODV in a randomly configured mobile adhoc environment with limited mobility. Alternatively, DSDV have a dramatic decrease in performance when mobility is high, but in restricted mobility matter DSDV has better performance as compared to AODV.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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