Impact of Node Density on Node Connectivity in MANET Routing Protocols

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Abstract. The functioning of routing protocols in Mobile Ad-hoc Networks depends on factors like node mobility, node failure, broken paths, node connectivity and node density. These factors make the network dynamic. Due to the change in node connectivity, availability of link for data transfer data may vary. This paper discusses about Mobile Ad-Hoc environment with varying node density and its effect on node connectivity among MANET routing protocols. The performance of two routing protocols like DSDV from proactive routing protocols, AODV from reactive routing protocols are analyzed and compared. Quantitative metrics like normalized overhead, packet delivery ratio, number of control packets are evaluated using the Network Simulator NS-2. This paper helps in identifying the impact of varying node densities on the node connectivity in Mobile Ad-Hoc networks. The result of performance comparison can also be helpful in the design of new routing protocols based on topological characteristics.

Keywords: MANET, DSDV, AODV, Node Connectivity, Node Density.

1 Introduction

A Mobile Ad-hoc network is a temporary or short period dynamic network used in battlefields, conference, rescue operation, multimedia games. These networks comprises of a group of wireless mobile nodes which communicate each other without any fixed infrastructure. Routing in MANET is a challenging task as the topology of such networks keeps on changing due to various factors like node mobility, change in the node status and change in node density. Here the nodes act as both host and receiver, who forward packets to other mobile host. Individual node has limited processing capacity but is capable of supporting distributed approach through coordination effort in a network [12]. Initially the node will not have prior knowledge of its neighboring nodes or the topology of the entire network. The nodes sends beacons to neighboring nodes, and listens to the broadcasting message from
neighboring nodes to find the list of current neighbors. This process continues till the node knows about all other nodes and also when a change in the topology of the network is detected. Thus through these neighbors, the nodes can communicate to other nodes outside its coverage area to maintain node connectivity in the network [3].

Knowledge of topological characteristics like connectivity, coverage, maximum inter-node distance and node degree helps in the design of new distributed protocol and also for evaluating the performance of existing routing protocols [12]. The factors that complicate the analysis of the topological characteristics are node mobility and node density [8], [9]. Paolo Santi and Douglas M Blough have discussed the conditions that are needed to ensure that a deployed network is connected initially and remains connected as node migrates [8]. Certain Routing Protocols are found to perform better in densely connected network than in sparse network [1]. There is a lot of work done for evaluating the performance of MANET Routing Protocols under different topological characteristics [1], [12], [2], [8], [9]. In our paper we have evaluated performance of MANET routing protocols under varying node density and how it affects the node connectivity.

This paper analyzes the performance of routing protocols designed for MANET under different node density and its impact on node connectivity. The second sections of this paper discuss the routing protocols designed for MANET and the performance metrics used. The third section discusses the impact of node density in proactive and reactive routing protocols with a comparative evaluation. The forth section presents the environment for simulations in NS-2 for comparing the effect of node density on these two protocols. The fifth section discusses the simulation result and the last section concludes the paper.

2 Routing Protocols and Performance Metrics

Mobile Ad-hoc Routing Protocol is a rule or standard that tells the mobile nodes in the network which way to route the packets. Effective routing protocols are needed to handle dynamic topology, a major problem in MANET routing protocol. Various routing protocols were proposed in the past, depending on routing information, updating mechanism and temporal information used for routing, routing topology and utilization of specific resources [4]. Protocols designed for MANET deal with high power consumption, low bandwidth and high error rates which are the typical limitations of these networks [5].

Main two classifications considered are Proactive Routing Protocols and Reactive Routing Protocols. Proactive Routing protocols stores information about nodes in the network to transfer data between different nodes in the network. These protocols constantly update node information and may react to change in the network topology even if no traffic is affected by the topology modification. This could create unnecessary overhead. Reactive Routing Protocols establish routes between nodes only when they is a request to required to route data packets. There is no updating of every possible route in the network instead it focuses on routes that are being used or being set up.

Both qualitative and quantitative metrics are needed to evaluate the performance of a routing protocol [7]. Qualitative properties of MANET routing protocol includes