# Chapter 10
# Congestion Avoidance and Delay Minimization in Energy Aware Routing of Dynamic ieee 802.11s WMN:
## Wireless Mesh Networks Under Mobility Conditions

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## ABSTRACT

*Minimization of delay in collecting the data at any base stations is one of the major concerns in cluster based Wireless Mesh Networks. several researches have proposed algorithms to control congestion considering static nature of a node. Mobility of a node results in high congestion due to frequent link breakages and high energy consumption due to re-establishment of route during routing process. Hence, the authors consider dynamic nodes with single hop inside the static cluster. The proposed model includes four modules namely, Cluster head selection, slot allocation, slot scheduling and data collection process. the cluster head selection is based on the maximum energy, number of links and link duration. Slot allocation is based on the available energy () and the required energy (). Slot scheduling is carried out based on the link duration. Data at the base station will be collected as they are scheduled. Model is tested using Network Simulator-3 (NS3) and results indicate that the proposed model achieves least delay besides reducing the congestion compared to the existing methods.*

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## INTRODUCTION

Wireless mesh networks (WMN) are collection of highly distributed autonomous mesh stations (STA) that work cooperatively, monitor the physical conditions and transmit the data to required destination. As in IEEE (2011) amendment meshes STA are capable of gathering information through other connected nodes in the wireless mesh network and send to the base station. Base station is composed of transceiver which is a mesh-less node connected to the host computer and acts as the interface between BS and mesh node. In the cluster based approach clusters are formed and a node will be selected as cluster head (CH) which plays an important role in data transmission and reception. A number of approaches have been proposed for the selection of cluster head by Nikos Dimokas et al. (2010). Wireless mesh networks are battery powered devices and hence energy saving is always a challenging task. In recent days, many algorithms are proposed to overcome energy saving problem. Wireless mesh networks are mainly battery powered devices. This type of network includes nodes which are mobile and has the ability to withstand the harsh environmental changes or conditions and handle node failures. One of the major constraints in the WMN is the power consumption by the nodes to transmit or receive data. The energy constraint plays a major role in WMN because it is difficult to recharge the energy for each node in the network. However, data collection efficiency is usually compromised in order to gain longer network lifetime. The two main operations of mesh nodes are data dissemination, the propagation of data throughout the network and data gathering, which is the aggregation of data from source to base station. Data collection efficiency is affected by the delay that can occur during transmission from mesh nodes to base station. Delay is the latency in the arrival of the packet to the destination from its source. It comprises of transmission delay, propagation delay, nodal delay and queuing delay which affects the performance of data collection. Thus, the basic motivation is to reduce the delay that occurs during the transmission of packets between source and destination. There is a need to consider the link duration of nodes while scheduling by which delay can be minimized. The clustering of nodes will reduce energy consumption to some extent. In the existing models, the delay in transmission is the main threat which may result in losing of data. If delay factor is concerned, then alteration in energy consumption might occur. A new model must be designed with the consideration of delay minimization and efficient use of energy at nodes which results in boosting of performance of data transmission.

In the data collection process delay minimization plays a vital role. Thus, an approach is made to minimize delay in wireless nodes. Nodes are battery powered hence to minimize the energy consumption nodes in the network are clustered and in each cluster, a cluster head is selected which collects data from the remaining members of the cluster directly or in multi hop manner. Data collected at the cluster head will be fused and thus reducing traffic. The proposed model is for static multi hop topology and it takes T x 3 unit time to transmit data to Base station. This is illustrated in Figure 1.

In order to deliver maximum data collection efficiency number of nodes in network is restricted to 2p where p=1,2, …. n numbers. Members in the cluster will be given rank which will be between 1 to p. A node with rank k will form k-1 data links with k-1 nodes, while these k-1 nodes are with different ranks starting from 1, 2, ….. k-1. Each node with rank k will have k-1 child nodes. The cluster head is the one with the highest rank in the network. Cluster head will form the data link with the base station. Using this method distribution of rank is done. Figure 2 indicates the time needed for allocating slot for n level cluster need 5T time to send data to the BS.