A New Channel Assignment Algorithm in Wireless Mesh Network

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Abstract. In a wireless mesh network, the purpose of channel assignment is to minimize the interference within the mesh network and to improve the network connectivity. This paper proposes a new algorithm which can predict the degree of busyness of a node according to the link traffic in the networks. So the algorithm can respond to the distribution of data traffic flexibly. In the algorithm, the protocol interference model is used to reduce the interference between the links in the wireless mesh network. Simulation results show that the algorithm can reduce the waiting time while a data frame is transmitting. And the network throughput and stability can be improved significantly.

1 Introduction

Wireless mesh network is an emerging wireless technology for specific commercial applications. And it is also a dynamic self-organizing, self-configuring network which is different from traditional wireless networks. How to reduce the interference among channels while data transmitting and how to allocate channels while the link traffic is not balancing become the major challenges which a multichannel wireless mesh network has faced.

Reference [2] proposed a polynomial-time greedy heuristic algorithm, which computes a priority for each mesh node and allocates channel for each link. However, the algorithm does not consider the problem of flexibility and also can not
resolve a variety of network traffic patterns problem in channel allocation. Reference [3] proposed an interference-aware channel allocation algorithm, which fully takes into account the impact of link traffic, but it only considers the impact of the traffic of external wireless network traffic. For the above problems, this paper proposes a heuristic channel allocation algorithm based on the link traffic. The algorithm uses the Markov chain model [4] to predict the link traffic. The link connecting with node which has a larger busy-degree has the priority to allocate channel. If there are a number of links, according to the protocol interference model [5] then the link with a greater interference degree has the priority to allocate channel.

2 Network Model and the Channel Assignment Algorithm

2.1 Network Model

Wireless mesh network can be represented by an undirected graph \( G = (V, E, L) \), where \( V \) is the node set, \( E \) is a collection of links connecting two nodes, \( K \) is the number of available channels in the graph \( G \) and \( N = |V| \) indicates the total number of users in the wireless mesh network. Assume that the nodes of the wireless mesh network distribute in a plane and each mesh router is configured with a full end to the antenna RF. Also assume that each radio terminal has a coverage \( R \) and the same interference range \( R' \). The range of coverage is less than the range of interference \( (R < R') \). According to the above assumptions, this paper uses undirected graph \( G \) to model the connection between nodes in the wireless mesh network.

2.2 Node Traffic Estimation Model

This paper uses Markov chain model (ON_OFF model) to predict the link traffic. Assume system time is divided into two parts, that no data transmission time and data transmission time. \( TN \) is the average time length of data transmission, \( TF \) is the average time length of no data transmission. Therefore, for any time slot in the ON status, the probability of the next time slot still in the ON status is \( (TN-1)/TN \). The same for any time slot in the OFF status, the probability of the next slot still in the OFF status is \( (TF-1)/TF \). So in a single wireless network, the mathematical expectation \( EQ \) of the following m time slots is defined as follows:

\[
EQ = \left\{ \begin{array}{cl}
(m \times \pi_{\text{on}} + S \times \pi_{\text{off}}) \times B \times \text{ON status} \\
(m \times \pi_{\text{on}} - S \times \pi_{\text{off}}) \times B \times \text{OFF status}
\end{array} \right.
\]

where \( S = \sum_{i=1}^{k} \left( 1 - \frac{1}{TN} - \frac{1}{TF} \right) \), \( \pi_{\text{on}} = \frac{TN}{TN + TF} \), \( \pi_{\text{off}} = \frac{TF}{TN + TF} \), \( B \) is bandwidth of the wireless network.

\( Q(i,j) \) is used to represent data flow from node \( i \) to node \( j \). As links in the wireless network are two-way link, so \( Q(i) = Q(i,j) + Q(j,i) \).