Interference Minimizing Channel Assignment Using Partially Overlapped Channels in Multi-radio Multi-channel Wireless Mesh Networks (Non-Refereed)

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Abstract

Channel assignment algorithms revealed so far in the literature for multi-radio multi-channel wireless mesh networks (MRMC-WMN) mainly deals with orthogonal channels (non-overlapped channels). But considering the total number of available orthogonal channels in the case of IEEE 802.11b, which is limited to only 3 channels. Therefore, this lack of availability of assignable channels causes inefficient use of spectrum resources. It is very difficult to design a feasible channel assignment algorithm using only orthogonal channels that is interference-aware and throughput maximizing, whereas it also minimizes switching delay and at the same time makes the best utilization of spectrum resources. We had taken the novel approach of satisfying the above goals through the smartly utilization of partially overlapped channels (POC). We also introduce the notion of a 3D Node-Radio-Channel (NRC) graph model for characterizing the topological structure along with interfaces associated with different channels at each node.

Current research on partially overlapped channels has introduced a new dimension in wireless networks, especially while considering multi-radio multi-channel mesh networks. It has been shown by Mishra *et al* [1] that a systematic approach to exploit partially overlapped channels can lead into better spectrum utilization and maximizing network throughput. The key issue here lies in the fact that, the interference between adjacent channels has to considered such intelligently that ultimately leads to optimization of channel capacity. In our algorithm we considered the physical distance of the nodes while assigning the POCs. Experiments showed that selecting partially overlapped channels with a spectrum separation of 3 or more channels gives the same throughput like orthogonal channels. To characterize the interference model we follow the *Channel Overlapping Matrix* model introduced by A. Hamed *et al* in [2]. The approach we followed is a distributed algorithm where each radio at a node is tuned to a common channel to preserve the original topology, provided that it does not violate the interference constraints with other neighboring nodes. According to our algorithm, we assign channels to radios based on the overall interference optimization criteria as well as making the best use of spectrum resource by utilizing partially overlapped channels.

Our channel assignment algorithm takes the following inputs:

1. Network topology
2. Set of radios at node i, $R_i=\{r_1,r_2,..r_m\}$
3. Set of orthogonal channels, $K^o = \{k_1, k_2, k_3, \dots k_n\}$
4. Set of semi-orthogonal (partially overlapped) channels, $K^p = \{k_1, k_2, k_3, \dots k_n\}$
5. Neighboring node-set, S_i = Set of nodes within the interference range of node i

And outputs a one to one mapping of radios to channels denoted by $f: R_i \rightarrow K$ for all $r \in R_i$
We also denote the channel sets as follows:

K_a^o = Set of available orthogonal channels for assignment
K_a^p = Set of available partially overlapped channels (POCs) for assignment
K_i = Set of all channels assigned to node i
R_a = Set of unassigned radios

Initially, for each node, our algorithm tries to find a best available channel from the orthogonal sets, K_a^o, to be assigned to a radio, based on the interference matrix of that channel superset. It only assigns a channel to a transmitting radio if the intended receiver node is able to receive the signal strength greater than the threshold SINR value through any of its available radios. If it succeeds, then the iteration moves on to next radio, otherwise it attempt to select from the set of POCs. Each time it computes the neighboring nodes' listening channels so that no radio has interfering channel within its transmission range. This ensures that our algorithm minimizes the adjacent channel interference. We are currently evaluating the performance of the algorithm using the Qualnet simulator to compare with other channel assignment schemes.

References:

1. A. Mishra *et al*, "Partially overlapped channels not considered harmful", in Proc. of ACM SIGMetric, June 2006, Saint Malo, France.
2. A. Hamed Mohsenian and Vincent Wong, "Partially Overlapped Channel Assignment for Multi-Channel Wireless Mesh Networks", Proceedings of ICC '07.