

# Opportunistic Maximum-Likelihood Channel Assignment in Mesh Based Networks

Amanjot Kaur and Parminder Singh

**Abstract** Wireless mesh innovation is creating itself as entire world under one rooftop. Mesh Networks are proficiently and viably and besides remotely joining urban areas with economical existing innovation. Couple of years back client joined with one another utilizing some wired access focuses or remote hotspots. Stations automatically choose their safest path to travel from one mesh to another. Yet, in today's reality network innovation is serving many clients at one time crosswise over substantial range. The maximum likelihood has been determining the high priority and free channel to send information to multi-hop mesh based networks. This channel assignment approach is investigating and removing channel fading problem. We have been proposing the notion that recognizes the lapses because of increment the interference in the stations.

**Keywords** 802.11 · STA · Noise · Channel · Throughput · Unsaturated throughput

## 1 Introduction

In this paper a novel approach to the channel assignment for mesh based network is discussed. These mesh networks are based on IEEE 802.11 suit of standards. More than two radio interfaces autonomously operate on different channels. Router present in the network can transmit and receive data at the same time. Firstly we initiate the definitions of the basic terms used for wireless mesh networks. Radio spectrum is mainly used to term as the electromagnetic wave frequencies within the scope of near about 3 Hz to 300 GHz. Channels are used to generate a commu-

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A. Kaur (✉)  
IKGPTU Jalandhar, Jalandhar, India  
e-mail: aman.09.jot@gmail.com

P. Singh  
CEC Landran, Mohali, India  
e-mail: singh.parminder06@gmail.com

nication link between source and destination. Radio band is the spectrum range that can have more than one channel. In wireless communication, wireless links with similar data or transmission strike against each other. If channel assignment algorithm would be better, then it can balance the wireless connectivity and bandwidth.

This paper is systematized as follows: Sect. 1 is giving introduction about the topic. We review the Literature in the Sect. 2. Section 3 gives the proposed model. Section 4 describes the performance evaluation and Sect. 5 discusses the results. Section 6 is conclusion for the method proposed.

## 2 Related Work

Different types of works has been done with wireless mesh network for channel assignment. Each paper discussed here has a different work done for the channel assignment. Wu and Wang [1] explained Adaptive Distributed Channel Assignment in a wireless mesh network. This protocol used N number of frames and M number of slots for each and every frame. N is fixed for this implementation, and it was taken as nodes in the network. A channel control table and data channel table was maintained by frame and frame was taken care by the node. M value was not fixed, it was set when frame has not sufficient slots for further connections.

In [2], authors proposed a distributed family-based channel assignment (FCA) protocol with multiple channels to distinct varied data rate links. FCA upgraded the node connectivity by assigning channels for rate division of wireless networks with a new metric and heuristic algorithm. In this protocol node connectivity is improved through direct communication between the nodes and also recovered the channel variation by giving multiple paths. Thus, the protocol saved the network capacity. Channel assignment and link scheduling is used for effective deployment of multi-channel multi radio and wireless mesh networks [3]. The traffic load is varied on wireless networks. To achieve the better throughput channel assignment must recheck the network each and every time when traffic demand changes. This paper [3] proposed the model which did the same task to reconsider the communication when there is any change in traffic. In [4] authors presented a performance evaluation of two distributed channel assignment algorithms in a large-scale wireless multi-radio testbed. They compared the performance of a link-based approach, in which channels were assigned to existing links in the network, with an interface-based approach, where channels were assigned to the network interfaces. These algorithms significantly increased the network capacity in small wireless testbeds with less than 15 nodes. Singh [5] has explained WSN in hostile environment.

Ghahfarokhi [6] explained the QoE aware channel assignment method for WLAN. This paper defined the solution for aggregate QoE (Quality of Experience) and user-level fairness and channel assignment was formulated as the optimization problem on maximizing this index. This paper proposed two QoE-aware channel Assignment schemes to improve both fairness and aggregate QoE. Due to wide-spread use and limited radio spectrum of 802.11 based networks, interference

between collocated networks is an important problem [7]. The aim of this system was to dynamically reduce the total interference and increase the aggregate capacity of the network. In comparison to different routing schemes, the distinctive feature of this approach was the channel assignment and the topology control that can be achieved through it. The goal of [8] was to implement an efficient service for maximum users with less interference. The main concentration was on multimedia servers for distributing the streams on a WMN. YUAN et al. [9] presented a channel assignment scheme with the multi-radio link quality source routing (MR-LQSR) protocol, which was called channel assignment with MR-LQSR (CA-LQSR). In this study a physical interference model was established.

Wireless mesh capacity can be increased using Multi-radio multi-channel technology [10]. In this paper, authors proposed a cross-layer architecture that provided an efficient end-to-end communication in multi-radio multi-channel WMNs. First, they proposed to perform channel assignment and routing “on-demand” combined. Singh [11] proposed a new technique for the better performance of vehicular ad hoc network using QOS metrics.

### 3 Proposed Model

After discussing the literature survey of issues like channel assignment, transmission errors, problem of facing interference on higher layers, the proposed model exuded confident to solve them interference and channel assignment problems. By assignment the channel inside the network has demonstrated in the Fig. 3. Here, we assume the channel  $c$  is assigned to the pair of nodes  $(i, j)$  and the size of input of each node represented is:

$$\log_2 i + \log_2 j + 2 \tag{1}$$

This binary representation of Eq. (1) should be used in adding more nodes in the network scenario for communication and transmission of information. On the other hand, the size of the network ‘ $n$ ’ is also measuring and computing that has shown in the Eq. (2).

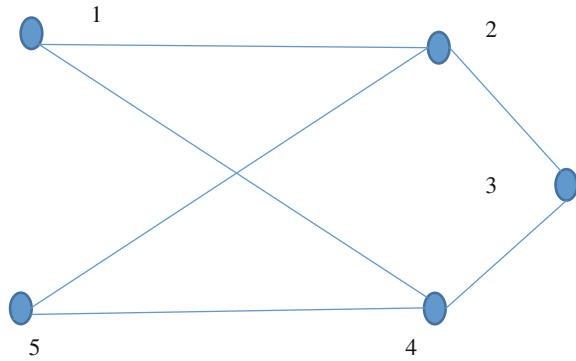
$$n = \sum_{(i,j) \in c} [\log_2 i] + [\log_2 j + 2] + [\log_2 k] + 1 \text{ (if } i < j) \tag{2}$$

From the Fig. 1, as we assumed the channel assignment time to cover all nodes with channel  $c$  to node  $(i, j)$ , if size  $|S|$  of the cover is the number of channel in  $S$ , then Fig. 2 is represented as:

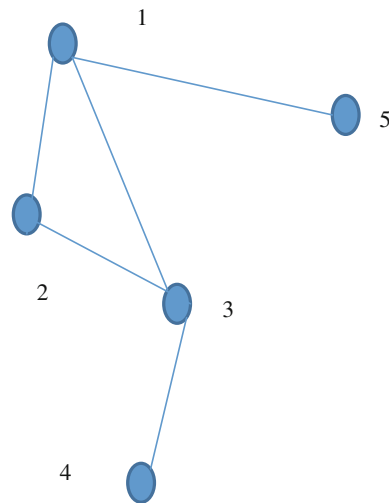


Fig. 1 Proposed model mapping with equations

**Fig. 2** Topology of communicating nodes



**Fig. 3** Topology control of communicating nodes without any effect of channel assignment



From the Fig. 3, we show the topology control that act like a directed graph where each node connected to other node and probably the state is changing and these states change according to control manner and it should be represented in [12]:

$$P_r(X_{n+1} = x|X_n = x_n) \tag{3}$$

The assumption of our model is that we deploying the dynamic network and there has been chances to change the topology. So we drive the whole scenario under control manner and behold the whole results calculated with network simulator (NS2) [13]. We have also face some problems like node forbid more than two nodes to change the x coordinate and y coordinate positions. The probability of interference in the network model is occur rarely but in some cases, if the interference increases or decreases then we used the proposed Eq. (4) and deploying at the time of calculating result as of communication of node.

$$F(x) \triangleq \frac{1}{(j-i)} n(t) = 0 \quad (4)$$

Here,  $n(t)$  is the noise generated during the transmitted signal by the sender node. If the noise is equals to zero that means the noise is nil; otherwise the destination node did not accept the packets and all such packets drop in the network. The physical channel may consist of paths and these paths connect the number of nodes. The delay path is dependent on the accuracy or bandwidth of the network. More the bandwidth available is lesser the delay between the number of stations. It is also been noted that if the single path channel is available then such type of interference can be synchronized. Moreover, multi-path channel assignment is somewhat difficult and can be solved by time division multiplexing; if this multiplexing is added with Eqs. (2) and (4).

The basic working of this flowchart (Fig. 4) is on the basis of proposed equation as shown in (1), (2), (3) and (4). The deployment of considered nodes formed together with IEEE 802.11 standard and the acknowledgment mechanism is activated when the receiver node receive that data from the sending node. The basic principle of calculating interference is to calculating the noise of the channel. We divide channel time into small slots and employing TDMA approach for assigning each slot, so that minimum interference has been achieving.

## 4 Performance Evaluation

The proposed model has been simulated using a NS-2 Network simulator and its performance has been compared with earlier work [14], the proposed equation has been written in c language and mapping together with awk scripts and tcl files together with and align with MAC layer. Initially the queue size is empty and the initial value of  $Q_i = 0$  for all  $n$  nodes i.e. 25. The DATA and ACK packets transmitted in opposite directions. The utility function of every round in communication is:

$$R(\text{Fr}) = \log(\text{Fr} + 0.02) \quad (5)$$

where  $R(\text{Fr})$  is the utility function in which the round of communication has been synchronized way. The assumption of all links should be considered in same PHY data rates (Fig. 4).

### 4.1 Simulation Set-up

We simulated 25 overlapped nodes having radius 250 m, the 50 m as nodes transmission range. The distance between adjacent nodes is 25 m, each of which communicates with its neighboring node and forming routing table. We used 1024

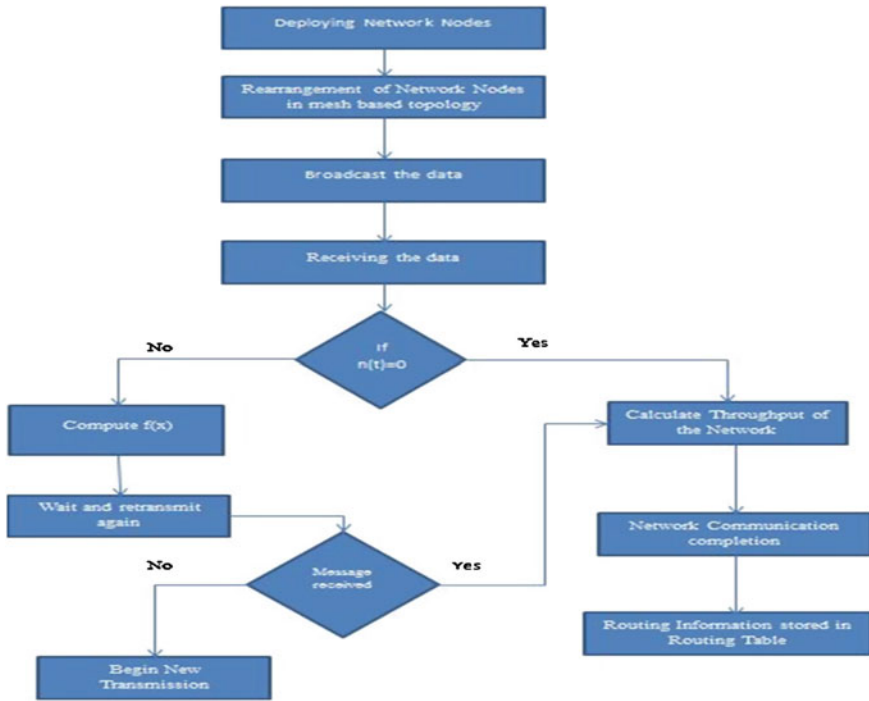


Fig. 4 Proposed flowchart

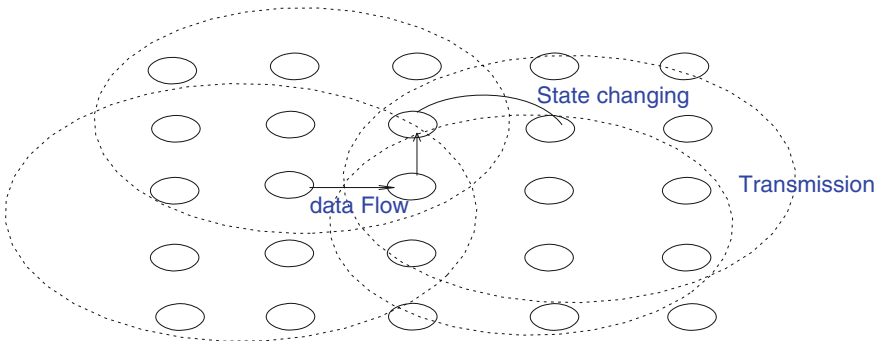


Fig. 5 Proposed scenario

bytes of data with 32 bytes of MAC header where the data rate 11 Mbps is considered for experimental purpose. The simulation scenario is depicted in Fig. 5, which considers the interference among two links in both directions as if the data flow occurs. The proposed scenario has been improving packet flow rate,

decentralizing communication and setting up an independent channel. This scenario was taken up for fulfilling the objectives, they needed to be data flow rate and no interference in the multi-hop communication.

## 5 Results and Discussion

The following results determined from initial layout of the scenario, the scenario can be used to test out. The scenario can be used to see if any interference has been introduced, and to see the interference effects that each station (STA) in the design may be having on its neighboring stations.

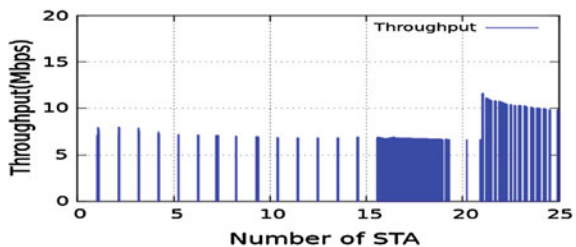
### 5.1 Network Throughput

It has been shown in the Fig. 6, due to heavy traffic, the network throughput will not sharply decline like earlier work. Therefore, we assumed that network resource utilization is significantly improved. In addition, interference is overcoming among this topology network, which is of great practical significance. The number of stations (STA) shows a steady behavior above 5 Mbps and throughput tends to decrease at 150 m where the highest rate 11 Mbps is achievable, whereas at the distance of 200 m. We achieved highest throughput when at the station is 22.

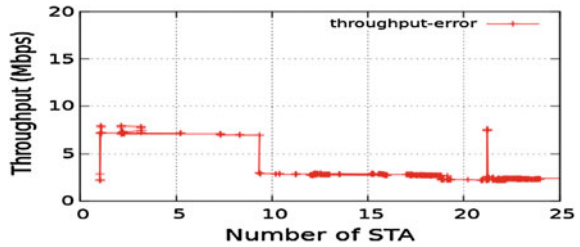
### 5.2 Unsaturated Throughput

Throughput achieved by our proposed scheme in a topology where 25 STAs are placed at a random distance and each STA generates data at 2 Mbps. The results are sorted according to the throughput achieved per STA; where the X-axis shows the Number of STA. As shown in the Fig. 7 within 100 m distance from the STA can use higher data rates, which eventually increases the per node throughput. Whereas nodes 5, 9, 21 and 22 are within 100–120 m distance and do not always

Fig. 6 Network throughput



**Fig. 7** Network throughput versus number of errors



get the highest rate (11 Mbps) for data transmission and nodes that are far away like 1, 20 and 24 achieve the higher data errors as they can transmit only in lower data rates i.e. 500 kbps.

## 6 Conclusion

We have proposed a technique that enhances the performance of network throughput while investigating the interference of the stations. The STC can broadcast the message at the upper layer and afterwards delivers the casings at the MAC layer. The error at the MAC and PHY layer is minimum. We have also examined the fading channel on the basis of interference that is only reason we disengage the framework by the force of every station. The circulation divert task in such a route, to the point that the STA has arbitrarily pick the channel and send the data to recipient side STA. intricacy can be lessened by the task of number of arbitrary channels. The sign quality of every station is high that of transmission stream rate is better between co-stations and co-channels so we enhanced the throughput of the system.

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