# A Review on different channel assignment and routing strategies over Multi radio Multi Channel WMNs

**Er. Hema[1],Er. Amarpreet Singh [2]**

[1] Dept. of Computer Science and Engg.
GNIT, Mulana (Haryana), India .
[2] Asst. Professor, Dept. of Computer Science and Engg.
GNIT, Mulana (Haryana), India

## Abstract

*In the near future, Wireless Mesh Networks (WMN) are believed to be a highly promising technology and will play an increasingly important role in future generation infrastructureless mobile ad hoc networks. Wireless Mesh Networks have emerged as a highly reliable, flexible, and cost efficient solution for wirelessly covering large areas and for providing low-cost Internet access through multi-neighbor communications. Amount of packets lost due to collision and time taken due to interference in a multi hop mesh network with limited capacity can significantly reduced through the end-to-end channel assignment strategies. In this paper, the effect of different MAC based channel and routing strategies is examined scheme over multi-radio multi-channel wireless mesh network.*

**Keywords –** *WMN, MAC.*

---

## I. Introduction

Wireless Mesh Network (WMN) is a highly growing wireless technology for several rising and commercially fascinating applications such as broadband networking in homes or corporate offices, networking with community and neighborhood, coordinated network management, intelligent transportation systems. WMNs aim to offer high-speed coverage at a significantly lower deployment and maintenance cost. WMNs use multi-hop wireless relaying over a partial mesh topology for its communication. Each node in the WMN should operate not only as a a relay, that forward the data to and from the Internet-connected central gateway on behalf of other neighboring nodes. Fig. 1 depicts a multi-hop wireless mesh network, where only the gateway node has a wired connection to the Internet and likewise other nodes access to the gateway via a multi-hop wireless communication.

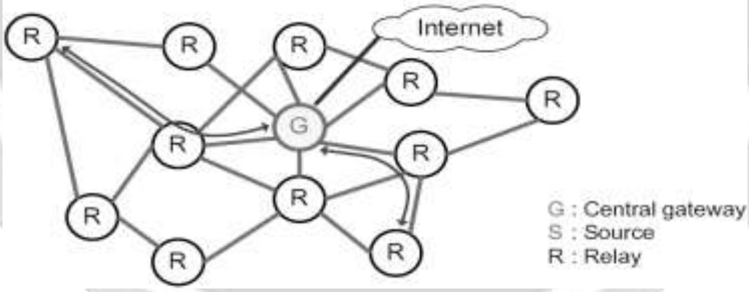


Figure 1: Wireless Mesh Network

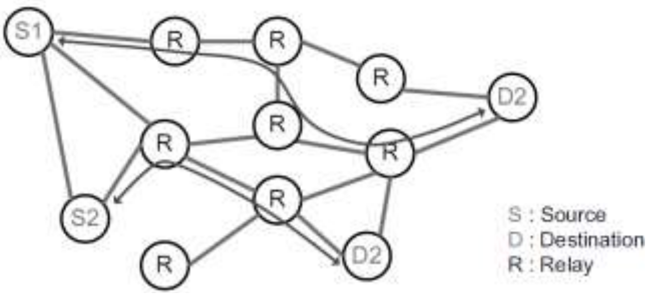


Figure 2: Wireless Ad hoc Network.

WMNs aim to diversify the capabilities of ad hoc networks. On the one hand, ad hoc networks can actually be considered as a subset of WMNs. They share common features, such as multi-hop, wireless, dynamic topology, and dynamic membership. On the other hand, meshes may have a wireless infrastructure backbone and have less mobility. The security schemes that are in existence proposed for ad hoc networks and could be adopted for WMNs.

*B. Wireless Mesh Networks Architecture*

WMNs consist of mesh routers and mesh clients as shown in Fig. 1, In this architecture, static mesh routers form the wireless backbone, and mesh clients access the network through mesh routers as well as directly meshing with each other. Wireless mesh network (WMN) is an essential network form of the ever developing wireless networks that grades the variance from the traditional centralized wireless systems such as cellular networks and wireless local area networks (LANs). The primary reward of a WMN lie in its inherent fault tolerance against network failures, simplification in setting up of a network, and the broadband competence. WMNs consist of two types of nodes: Mesh Routers and Mesh Clients.

- Wireless mesh router [2] carries additional routing functions to support mesh networking. To further improve the flexibility in mesh networking, a mesh router is usually equipped with multiple wireless interfaces that are built on either the same or different wireless access technologies. In comparison with an unadventurous wireless router, a wireless mesh router can accomplish the same coverage with much inferior transmission power through multi-hop communications. Apart from all these differences, the gateway/bridge functionalities in mesh routers facilitate the assimilation of WMNs with various existing wireless networks such as cellular, wireless sensor, wireless-fidelity (Wi-Fi), worldwide interoperability for microwave access (WiMAX) [1].
- Mesh Clients are the conventional nodes (e.g., desktops, laptops, PDAs, Pocket PCs, phones, etc.) equipped with wireless network interface cards (NICs), and can make connection directly to the wireless mesh routers .

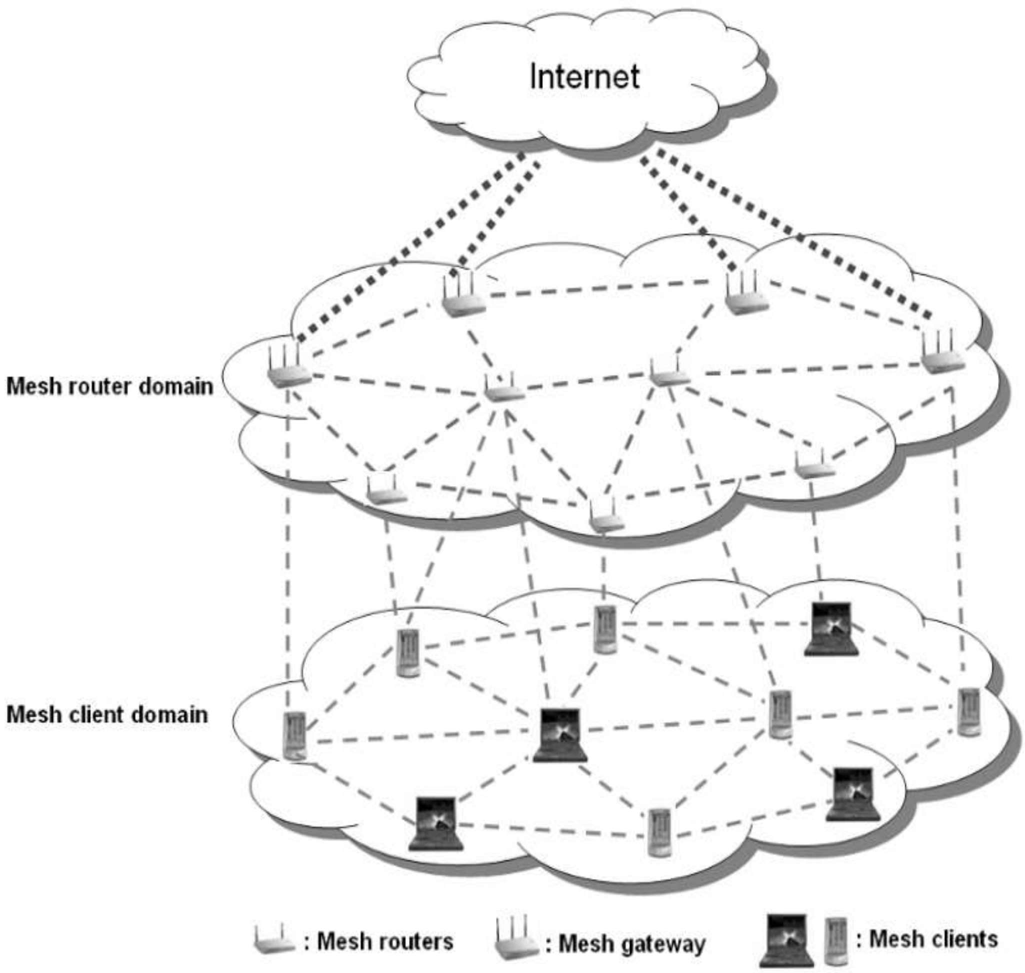


Fig. 1. An illustration of wireless mesh network architecture. **Routing and Channel Assignment Strategies**

By virtue of their robustness, cost-effectiveness, self-organizing and self-configuring nature, WMNs have emerged as a new network paradigm for a wide range of applications, such as public safety and emergency response communications, intelligent transportation systems, and community networks. One fundamental problem of WMNs with a limited number of radio interfaces and orthogonal channels is that the performance degrades significantly as the network size grows. This results from increased interference between nodes and diminished spatial reuse over the network. Routing and channel assignment schemes are most important design issues pertinent to the performance and capacity optimization in WMNs. In this chapter, we have provided a taxonomy of routing and channel assignment strategies for wireless mesh networks.

**a) Requirements of routing and channel assignment in WMNs**

Wireless mesh networking and mobile ad hoc networking use the same key concept communication between nodes over multiple wireless hops on a meshed network graph. However, they stress different aspects. Mobile ad hoc networks (MANETs) have an academic background and focus on end user devices, mobility, and ad hoc capabilities. WMNs have a business background and mainly focus on static (often infrastructure) devices, reliability, network capacity, and practical deployment.

The core functionality of wireless multi-hop ad hoc networking as well as Wireless mesh networks is the routing capability. Routing protocols provide the necessary paths through a WMN, so that the nodes can communicate on good or optimal paths over multiple wireless hops. The routing protocols have to take into account the difficult radio environment with its frequently changing conditions and should support a reliable and efficient communication over the mesh network. Since WMNs share common features with wireless ad hoc networks, the routing protocols developed for MANETs can be applied to WMNs. For example, Microsoft Mesh Networks are built based on Dynamic Source Routing (DSR), and many other companies, e.g., are using Ad hoc On-demand Distance Vector (AODV) routing. Sometimes, the core concepts of existing routing protocols are extended to meet the special requirements of wireless mesh networks, for instance, with radio-aware routing metrics as in the IEEE 802.11s WLAN mesh networking standardization. Despite the availability of several routing protocols for ad hoc networks, the design of routing protocols for WMNs is still an active research area for several reasons [1]:

- In most WMNs, many of the nodes are either stationary or have minimum mobility and do not rely on batteries. Hence, the focus of routing algorithms is on improving the network throughput or the performance of individual transfers, instead of coping with mobility or minimizing power usage.
- The distance between nodes might be shortened in a WMN, which increases the link quality and the transmission rate. However, short distances also increase the interference among the hops, which decreases the available bandwidth on each link. Therefore, new routing metrics need to be discovered and utilized to improve the performance of routing protocols in a multi-radio multi-hop WMN.
- In a multi-radio /multichannel WMN, the routing protocol not only needs to select a path between different nodes, but also needs to select the most appropriate channel or radio on the path for each mesh node. Therefore, routing metrics need to be discovered and utilized to take advantage of multiple radios in a wireless mesh network.
- In a WMN, cross-layer design becomes a necessity because the change of a routing path involves the channel or radio switching in a multi-radio multichannel mesh node.

**b) Routing and channel assignment protocols**

Unlike ad hoc wireless networks, most of the nodes in WMNs are stationary and thus dynamic topology changes are less of a concern. Also, wireless nodes in WMNs are mostly access points and Internet gateways and thus are not subject to energy constraints. As a result, the focus is shifted from maintaining network connectivity in an energy efficient manner to finding high-throughput routes between nodes, so as to provide users with the maximal end-to-end throughput. In particular, because multiple flows initiated by multiple nodes may engage in transmission at the same time, how to locate routes that give the minimal possible interference is a major issue.

The issue of locating interference-free (or interference-mitigated) routes can roughly divide into two complementary approaches. First, some of the PHY/MAC attributes have been utilized to define better route metrics that yield high-throughput routes. Note that the conventional route metric is the hop count, and has been used in on-demand, ad-hoc routing protocols such as Ad-hoc On demand Distance Vector (AODV) and Dynamic Source Routing (DSR). Use of this metric renders route that are composed of long links. Due to the path loss effect over the distance, these long links are lossy and of low throughput. The performance of routing protocols can be improved by better defining route metrics and explicitly taking into account the quality of wireless links. Second, each wireless node is usually equipped with one or more radios that can be switched among multiple non-overlapping channels. Use of multi-radios and multi-channels have thus been explored to construct interference-free/mitigated routes on which different channels are associated with different radios in order to eliminate intra- and inter-flow interference [5].

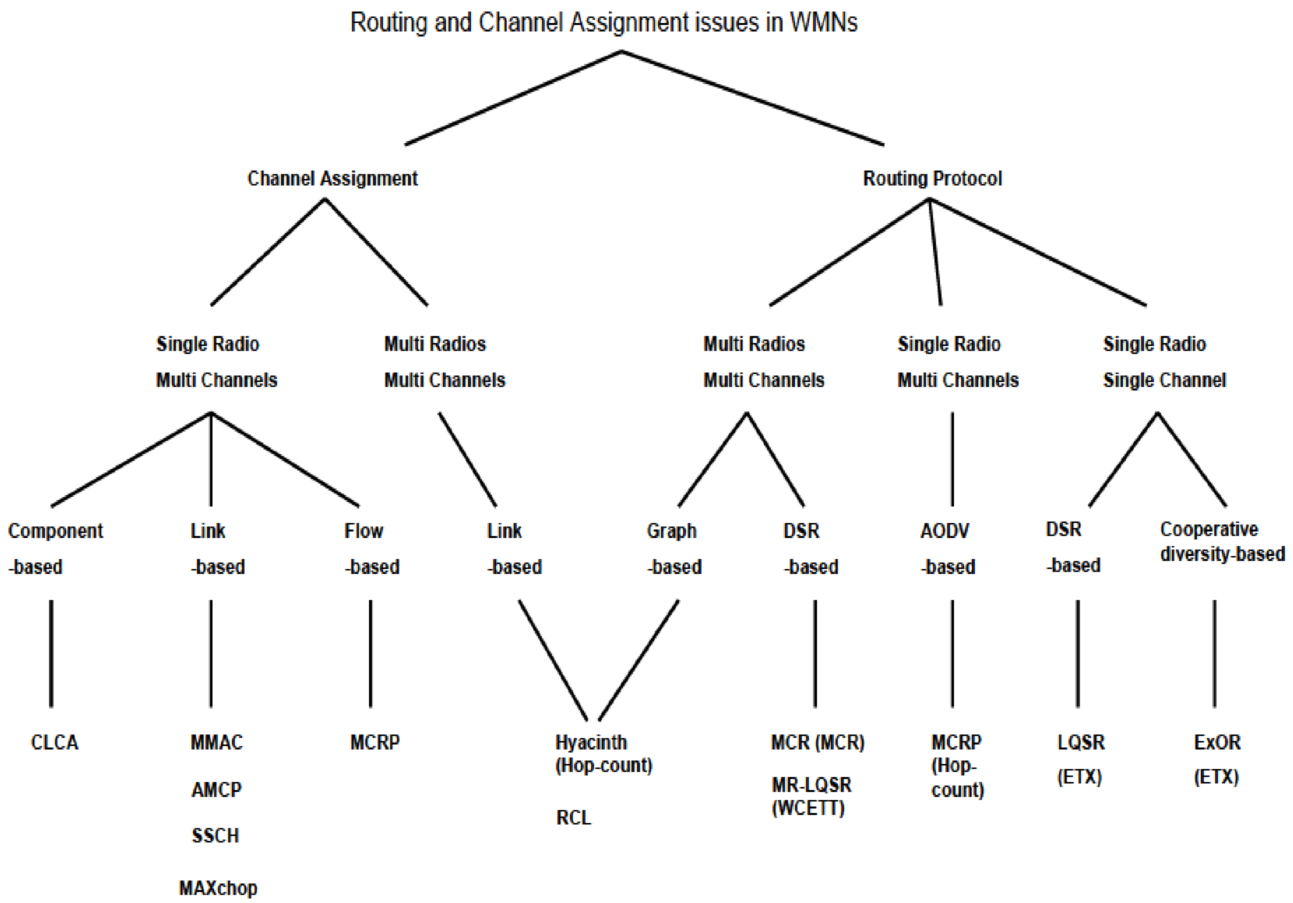


Fig. 2: A taxonomy of routing and channel assignment

protocols for WMNs.

## II. Related Work

Wireless mesh network (WMNs), with multiple hops and mesh topology, has been emerged as a key including broadband home networking, community networking, business organization networking, and metropolitan area network [1]. Traditional WMNs operate in single-radio single-channel (SR-SC) architecture where each mesh router has only one NIC card and all the mesh routers share one common radio channel. In such a networking , the network suffers from low performance and capacity due to frequent packet collisions and back offs, especially for real-time applications such as VoIP transmission across multi hop WMNs [2].

According to [4], The SR-MC architecture can help to reduce the interference and increase network performance. A required function of the SR-MC solutions is there for each router to dynamically switch between channels along with dynamic network traffic, while coordinating between neighboring nodes to ensure communication on a common channel for some period. However, this type of coordination is usually based on tight time synchronization between nodes, which is difficult to realize in a multi hop WMN. It is noted that the latency in switching the channels with the use of commodity hardware 802.11 NICs can be up to 100 ms.

According to [5], IEEE 802.11a band assign 3 and 12 non-overlapping frequency channels, respectively. Though still there exist significant interference between these standard non-overlapping channels in the current IEEE 802.11 hardware, this problem can be handled by providing better frequency filters in hardware for multi-channel use. So, the use of single-radio multiple-channels (SR-MC) has been proposed to enhance the performance of WMNs .

According to [19], In such architecture, every mesh router is equipped with multiple NICs and each NIC can operate on multiple frequency channels. In MR-MC architecture, multiple transmissions/receptions can occur concurrently, and neighboring links allocated to different channels can carry traffic free from interference. However, MR-MC architecture use poses some new issues. In general, these issues include topology control, power control, channel allocation, link scheduling, and routing

According to [8], the number of available channels is limited to 3 or 12 in IEEE 802.11 frequency bands. This implies that some logical links may be assigned to the same channel. In such case, interference occurs if these logical links are closer to each other, and so these interfering links cannot be active on same time. Furthermore, the number of available NICs are also limited, and hence some logical links within a router require to share a NIC to transmit and receive the data packets. Furthermore, the physical topology of the routers and other constraints in MR-MC WMNs, four important issues that needs attention are summarized in i.e., logical topology formation, interface assignment, channel allocations, and routing decisions.

According to [9], the authors considers the issues with the MR-MC architecture, existing communication protocols, ranging from routing, MAC, and physical layers, need to be revised and enhanced. In physical layer, techniques mainly focus on three research areas: enhance transmission rate, enhancing error resilience capacity, and increasing re configurability and software controllability of radios. In order to improve the capacity of wireless networks, many high-speed physical techniques, such as OFDM, UWB, and MIMO, have been discovered.

## III. CONCLUSION AND FUTURE WORK

In this paper, we have identified the key challenges associated with mapping radio channels to an interface in a multi-radio multi-channel wireless mesh networks. Multi- radio interfaces per mobile node permits simultaneous transmission and reception on varying interfaces tuned to available radio communication channels, which can substantially increases multi-hop throughput over Multi Radio Multi Channel WMNs. A major key problem to be addressed in a multi-radio mesh network architecture is the Channel assignment problem that involves mapping channels to radio interfaces to achieve efficient utilization of available channels. After presenting the design issues for WMNs, we have provided a taxonomy of existing channel assignment schemes and summarized this survey with a comparison of the different possible channel and routing architectures for MR-MC WMNs .

## REFERENCES

[1] I. Akyildiz, X. Wang and W.Wang (2005) "Wireless Mesh Networks: A Survey," Computer Networks and ISDN, vol 47, issue 4, pp 445-487.

[2] J Li, C Blake, DS De Couto, HI Lee, R Morris (2001) "Capacity of ad hoc wireless networks" Proceedings of the 7th annual international conference on mobile computing and networking(Italy, Rome, 2001), pp. pp. 61–69

[3] A Raniwala, T-C Chiueh (2005) "Architecture and algorithms for an ieee 802.11-based multi-channel wireless mesh network" INFOCOM'05, vol. 3, pp. 2223–2234.

[4] Steve, Portmann, and Valipuram (2008) "Securing Wireless Mesh Networks," IEEE Internet Computing, vol 12, no 4, pp 30-36.

[5] A. Raniwala, K. Gopalan, and T. Chiueh (2004) "Centralized channel assignment and routing algorithms for multi-channel wireless mesh networkks," ACM Mobile Computing and Communications Review (MC2R).

[6] D. S. J. De Couto, D. Aguayo, J. C. Bicket, and R. Morris (2003) "A high-throughput path metric for multi-hop wireless routing," in Proc. of ACM MobiCom.

[7] P Bahl, A Adya, J Padhye, A Wolman (2004) "Reconsidering wireless systems with multiple radios" ACM Comput. Commun. Rev 34, pp. 39–46.

[8] AHM Rad, VWS Wong (2007) "Joint logical topology design, interface assignment, channel allocation and routing for multichannel wireless mesh networks" IEEE Trans. Wirel. Commun 6(12), pp. 4432–4440.

[9] S Seth, A Gankotiya, A Jindal (2011) "Current state of art research issues and challenges in wireless mesh networks" IEEE Second International Conference on Computer Engineering and Applications, pp. pp. 199–203.

[10] KN Ramachandran, EM Belding, KC Almeroth, MM Buddhikot (2006) "Interference aware channel assignment in multi-radio wireless mesh networks" in Proc, ed. by . of INFOCOM'06 (Barcelona, Spain), pp. 1–12.

[11] PH Pathak, R Dutta (2011) "A survey of network design problems and joint design approaches in wireless mesh networks" IEEE Commun. Surv. Tutor 13(3), pp. 396–428.

[12] Stylianos Karapantazis, Fotini-Niovi Pavlidou, (2009) "VoIP: A comprehensive survey on a promising technology" conference on computer network, Science direct, pp. 2050-2090.