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A Novel Approach to Allocate Channels Dynamically in Wireless Mesh Networks

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***Abstract*—**Wireless mesh networking is rapidly gaining in popularity with a variety of users: from municipalities to enterprises, from telecom service providers to public safety and military organizations. This increasing popularity is based on two basic facts: ease of deployment and increase in network capacity expressed in bandwidth per footage; WMNs do not rely on any fixed infrastructure. Many efforts have been used to maximizing throughput of the network in a multi-channel multi-radio wireless mesh network. Current approaches are purely based on either static or dynamic channel allocation approaches. In this paper, we use a hybrid multichannel multi radio wireless mesh networking architecture, where static and dynamic interfaces are built in the nodes. Dynamic Adaptive Channel Allocation protocol (DACA), it considers optimization for both throughput and delay in the channel allocation. The assignment of the channel has been allocated to be co-dependent with the routing problem in the wireless mesh network and that should be based on passage flow on every link. Temporal and spatial relationship rises to re compute the channel assignment every time when the pattern changes in mesh network, channel assignment algorithms assign channels in network. In this paper a computing path which captures the available path bandwidth is the proposed information and the proficient routing protocol based on the new path which provides both static and dynamic links. The consistency property guarantees that each node makes an appropriate packet forwarding decision and balancing the control usage of the network, so that a data packet will traverse through the right path.

***Keywords*—**Wireless mesh network, spatial time division multiple access, hybrid topology, timeslot allocation.

I. Introduction

WIRELESS MESH NETWORKS (WMNs) is covering the sizable geographic area, like Wi-Fi, with very much less wireless routers. In recent years WMN has been done in an active research field and has been focused on various routing protocols for multi hop on the security area mostly unexplored. A major challenge is the channel allocation of interfaces to maximize the network capacity. There are two approaches used in allocation of channel

1) Static Allocation
2) Dynamic Allocation

In dynamic allocation interface is switching frequently. But in static channel allocation is permanent. Both have their merits and demerits. Static allocation does not require switching of interfaces and have lower overhead. Dynamic allocation have higher overhead than static allocation. Due to high overhead in dynamic allocation and inflexibility of static allocation, we use hybrid architecture. One interface use dynamic strategy and other use the static strategy for channel allocation in router.

Hybrid wireless mesh network has the following issues 1) the mesh router containing both static and dynamic interfaces and coordinates in channel allocation to improve the efficiency 2) allocation of the dynamic channel is based on the Multichannel MAC Protocol (MMAC) and is the most efficient allocation protocol. MMAC is considering only throughput. In our paper, we use Dynamic Adaptive Channel Allocation Protocol (DACA), and it considers both delay and throughput in allocation of channel. ADCA protocol reduces delay without degrading throughput of the mesh network. 3) Hybrid architecture is used for both static and dynamic interfaces and Congestion Aware Routing Protocol (ICAR) is used for balancing the network.

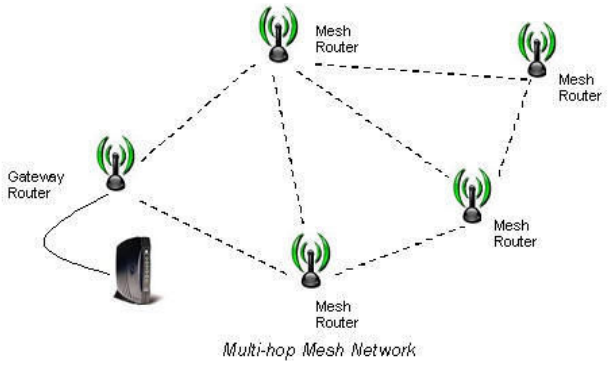

Fig. 1 Wireless Mesh Network

II. Related Work

Wireless mesh networking is an upcoming technology that enables in many application including network, internet, etc...A survey has been given in [7]. A major problem in multihop wireless network is the reduction of the capacity due to interference among wireless link. Many studies assign limited channels to minimize interference and maximize throughput [4]. They differ in assumption, model and solutions. Two basic strategies have been studied1) static allocation 2) dynamic allocation.

In static allocation, it assumes traffic profile is to be known. The continual approach to solve routing problem based on satisfaction of traffic profiles [1]. The Routing Problem is solved by linear programming with fairness [2], [8] other studies are used in the traffic pattern instead of traffic profile. To construct the load balancing tree and then assign channel to

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the link [3]. Dynamic channel allocation is divided into short term and long term strategies. Coordination and switching mechanism is the challenging one.

Dynamic allocation divided into two category 1) Single interface to control [5] and this does not require synchronization 2) No separate interface to control so it require synchronization. Some dynamic allocation algorithm [10], [11] require switching is less. In [9] central server monitors and recalculate route when changes is occur. In [10] distributed channel routing and allocation has been proposed. In [11] autonomously learn information from the neighbor. A hybrid multichannel allocation protocol (HMCP) proposed [12] some interface with static and remaining is dynamic interference. While transmitting data dynamic link share data to static node to other node. It causes high delay. Our method achieves lower delay than HMCP.

III. Network Model

In this paper, we use hybrid architecture for both switching and changing of traffic overhead. Consider G (V, E) be the topology of network, where E is the pair of mesh routers and V is set of mesh routers within communication range. In hybrid architecture one is switched frequently and the other remains the same. Fig. 2 shows the hybrid architecture of mesh network. Most of them have 3 interfaces, and few have 2 interfaces. For each node one is dynamic and remaining are the static interfaces.

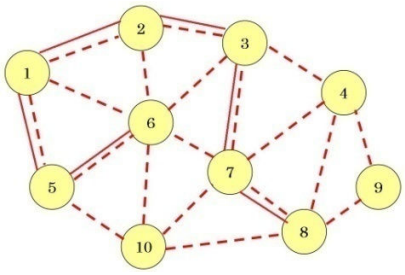

Fig. 2 Channel Allocation

The allocation of channel in static interfaces aims to maximize throughput. Some algorithm [3] has been used to construct the load balancing tree for each gateway, and the main objective is fairly allocating the bandwidth to each user. After the creation of topology, channel allocation in each link has been done. The link closer to gateway is having higher priority and it is to be allocated to less congested channel.

Dynamic interface work is based on demand fashion. Two interfaces negotiate common channel within the range for data transmission. Dynamic allocation uses MMAC protocol [6]. Time is slots have fixed interval. In control interval interface negotiate channel for data interval. In data interval, nodes can send and receive the data within the network. In Hybrid architecture, dynamic allocation has been following consideration; all dynamic interfaces negotiate in control interval and the channel is selected based on less congestion channel in neighbourhood pair.

They cannot know the nearest neighbourhood node usage. Static nature methodology is used to solve "Hidden Terminal Problem". It is not varying frequently manner. It is stable for some time. There are several advantages in using hybrid architecture. Dynamic link is direct the traffic for less load for load balancing.

IV. Proposed Work

Consider the network with 3 nodes and each with only one interface. In this paper, we use MMAC [6] with 2 channels with bit rate 1Mbps. Throughput and packet delay are directly proportion. MMAC protocol tries to use same channel for data transmission for two nodes. 802.11 have lower delay than MMAC. If the traffic rate increases means delay increases in large manner. MMAC works better in hybrid topology. MMAC choose least congested node for data transmission. When 2 nodes choose the same channel, it is optimized for throughput. It is related to time interval. MMAC is works better when the time slot is decreased; it yields to reduce the capacity in transmission. MMAC is change traffic frequently for many reasons. Initially it is very hard to measure in local traffic. Second, the traffic distribution is not uniform so synchronization is difficult. MMAC cause unnecessary packet delay, while the one node is sending the packet in 2 interval means, it waits until it finishes the transmission.

Channel Negotiation

Pending Node:
1: Broadcast REQUEST MESSAGE to neighbor pending node.
2: if receiving SWITCHING MESSAGE then
3: Switch to channel c indicated in that message.
4: end if

Sending Node:
1: if its queue length for the receiving node < QUEUETHRESHOLD then
2: Broadcast REQUEST MESSAGE to its neighbors and that message contains traffic load is below saturation level.
3: end if
4: if receiving SWITCHING MESSAGE then
5: if it's receiving node is not negotiating with any other sending nodes then
6: Switch to channel indicated in the message.
7: Notify receiving node to switch to channel c.
8: end if
9: end if

Receiving node:
1: if the queue length of its sending node < QUEUETHRESHOLD then
2: if receiving REQUEST MESSAGE from pending node then
3: Send SWITCHING MESSAGE to the pending node in their channel.
4: end if
5: if receiving REQUEST MESSAGE from sending node then
6: Send SWITCHING message to the sending node including its own channel.
7: end if
8: end if

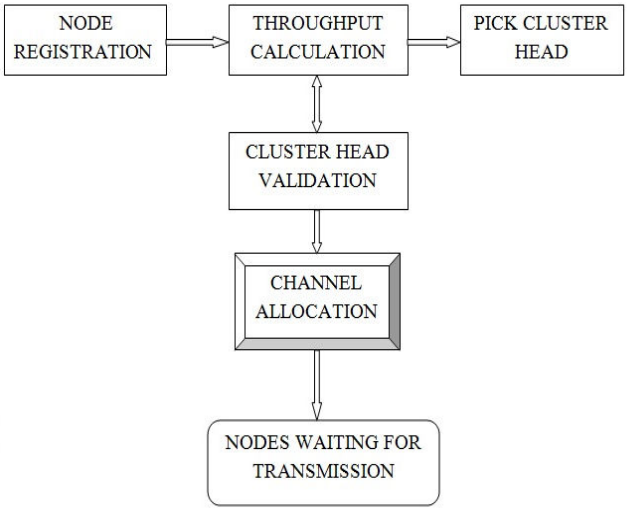

Fig. 3 Channel allocation

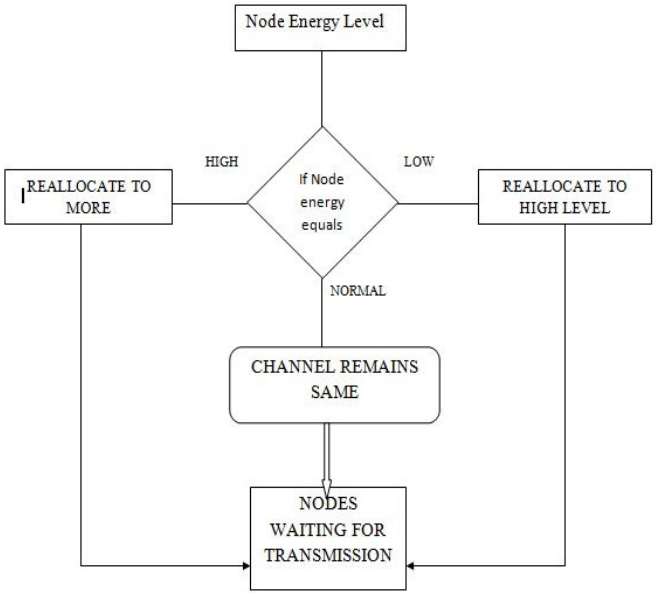

Fig. 4 The slot allotment

Dynamic Adaptive Channel Allocation protocol (DACA) reduces the delay the average delay Di for a packet over link i consists of the queuing delay Yi and transmission delay Ti as

$$Di=E[Yi+Ti]. \quad (1)$$

The minimum number of channel sets N required to serve the entire coverage area is related to the frequency reuse distance D as follows:

$$N = D^2 / 3R^2 \quad (2)$$

The signal transmitting can be done using the formula

$$T = E/N \quad (3)$$

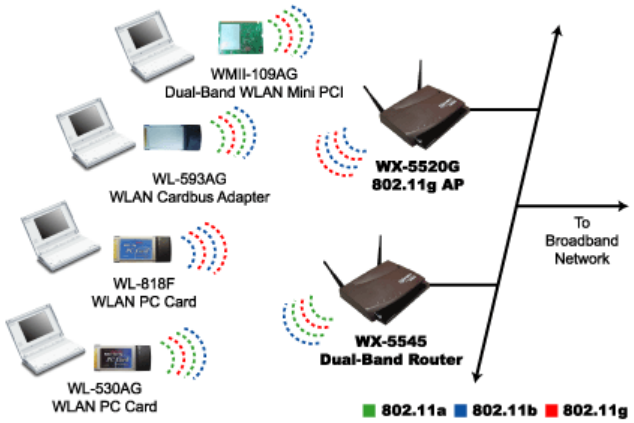

Fig. 5 Data Transmission

V. Performance Evaluation

The network could be constructed in Network Simulator 2. The nodes can be created, in our experiment; we use 300 nodes for the evaluation of this approach. Initially the pending node broadcast the request to other node with in the area. ADCA protocol approach is applied in wireless mesh and it should produce the result relevance to both throughput and delay. Fig. 6 shows the Energy consumed level of existing and proposed work. The previous one is consume more energy because of using either static and dynamic allocation but our proposed work is used both based on the traffic criteria

Throughput is high when compare to previous approach. In previous approach, when two channels are choosing the same channel means, complicity is arise and take special effort to solve this and it is also impact in packet delay. ADCA protocol is used SDMA concept, and compare to previous it should take the timely decision and overcome many previous problem. Its allocation based on timeslot.

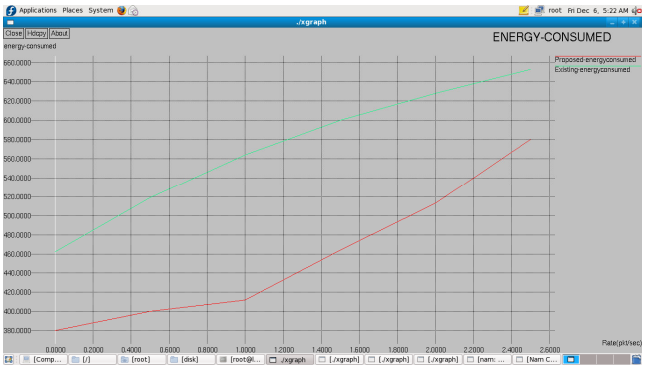

Fig. 6 Throughput in Data transmisson

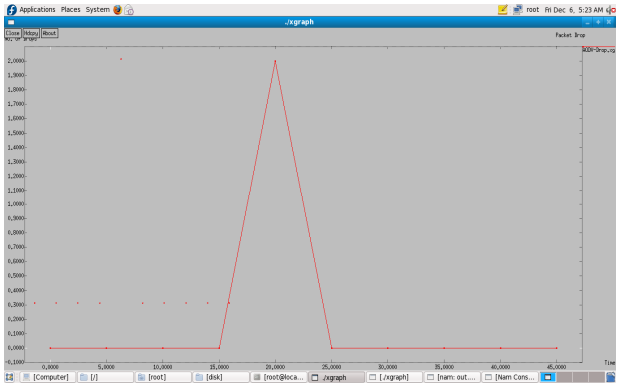

Fig. 7 Packet Drop

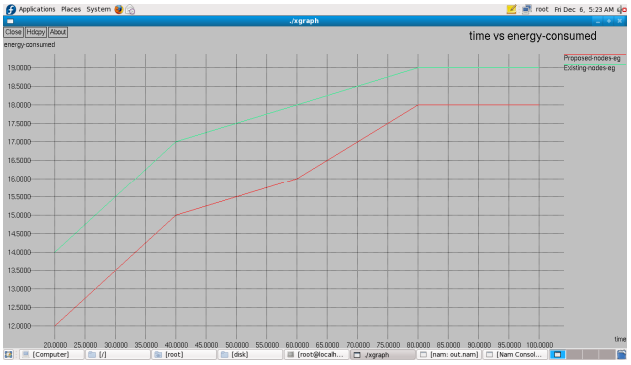

Fig. 8 Time vs Energy Consumed

VI. Conclusion

Simulate an Adaptive Dynamic Channel Allocation protocol (ADCA), which considers optimization for both throughput and delay in the channel assignment based on spatial time division multiple accesses.

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