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A Cross Layer Routing Approach In Self Configurable Wireless Mesh Networks

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Abstract

Efforts to improve the capacity of multi-channel wireless mesh networks have mainly focused on channel Assignment. Here we considered some key issues which help to improve aggregate throughput of networks. The main goal of channel assignment in multi-channel wireless mesh networks is to minimize the overall interference and improve the aggregate network capacity, also assuring the maintaining in the connectivity of the network.

Paper proposes the channel assignment schemes and steps for multi-channel wireless mesh networks based on the traffic flow of the link. Which equally distribute the business flow between nodes so that the distribution through the link is equal.

The paper analyses the packet routing for 20 node scenario network. Network pattern and causes are important in the design of routing protocol and network planning. The contributions of this paper are to improve the throughput and routing performance in the wireless mesh networks.

1. Introduction

WMNs consist of mesh routers and mesh clients. With current wireless technology, the gap between a set of wireless devices and the Internet is bridged by fixed wireless stations, called access points. [1,2] However, the communication range of current commodity wireless LAN technology is limited to a few hundred meters and complete coverage of a city would require a prohibitively high number of access points. Access to Internet for wireless mesh networks is done via special mesh routers, the gateways.

The path should be optimized from the traffic distribution and path distance point. To solve the problem, we consider the multi-channel enabled devices offer so the possibility for utilizing multiple channels to scale up the wireless network capacity [1], through channels assignment. Finding a definite mapping between the given channels between nodes such that the network performance is get improved. Key advantages are low Cost, Ease of deployment [4]. Cross-layer design has been widely used to improve the network performance, particularly in a wireless network. Layered protocol architecture is one of the most important factors so that it has made networking so successful.

There has been a lack of a systematic approach in layered protocol to analyze each other. In this method, protocol layers are integrated into one theory, in which asynchronous distributed computation over the network is applied.

2. System Architecture

Wireless mesh networks appears as a best network where infrastructure is not possible and wired network is not economical.

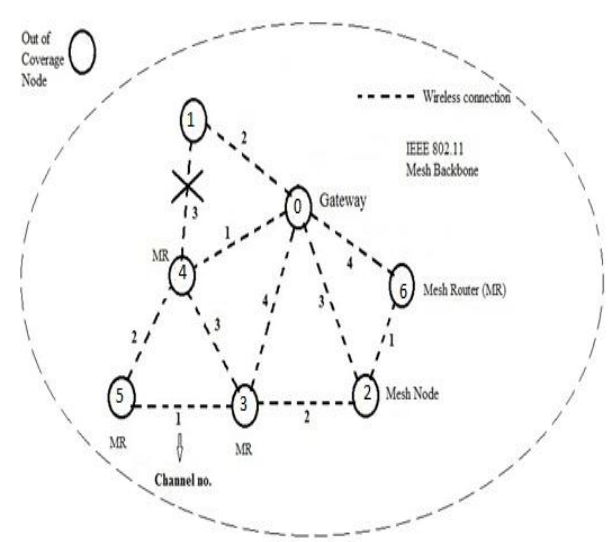


Figure 1: Wireless network architecture.

The system model of WMNs is

G (V, E, C)

Where,

$V = \{v_1, v_2, v_3, \ldots\ldots, v_k\}$

is a set of vertices in graph that represents mesh routers.

$C = \{c_1, c_2, c_3, \ldots\ldots c_k\}$

is the set of available channels.

$E = \{(i, j, k) \mid i, j \in V, k \in C\}$

is set of wireless link between the mesh router i and its neighbor j on channel K.

$l_{ij} = (i, j) \in E$

Wireless link is formed between the two mesh routers.

3. Metric Components

In this section, we identify and discuss the key components that can be utilized to compose a routing metric for multi-channel wireless mesh networks.

A. Number of Hops

Hop count can serve as a routing metric in itself, such as in most WMNs routing protocols. Hop count as a routing metric for wireless mesh networks has significant limitations. It has been shown in [5] that a path with a higher number of high-quality links demonstrates significant performance improvements over a shorter path comprised of low-quality links. Additionally, the authors found that hop count tends to route through a few centrally-located nodes, leading to congestion and hot spots.

It is the performance measurement parameter in the network. It is of routes found with a minimum hop-count. Throughput is the best path between each pair of nodes, found by while sending data on paths, and select the path with the highest throughput. We can calculate it by total number of received packets,

$$Throughput = \frac{bytes(received\_packets) \times 8}{finish\_time - start\_time} \text{ bits/s}$$

C. Link Quality

Finding high-quality links will greatly improve the overall performance of a path through higher transfer speeds and lower error rates. Link quality can be measured in a number of ways. The most common metric is Packet Loss Rate (PLR). Network routing Quality is nothing but the minimum packet loss data delivery. To know data delivery changes over time scale considered by total no. of packets are lose in the network. It is measured by delivery ratio; each node took a turn sending a series of broadcast packets up to some seconds, and counted the number of packets that reported as transmitted [5]. Packets contained fixed size of data payload. It is calculated by,

$$PDR = \frac{Send\_packets - droped\_packets}{Send\_packets}$$

B. ETX

Expected Transmission Count (ETX) [6] is a measure of link and path quality. It considers the number of times unicast packets need to be transmitted and re-transmitted at the MAC layer to successfully traverse a link.

The ETX path metric is simply the sum of the ETX values of the individual links. ETX considers the number of transmission in both directions of a link, since the successful transmission of a unicast packets requires the transmission of the packet in one direction plus the successfully transmission of an acknowledgement in the reverse direction. ETX is mostly determined by means of active probing, in which the number of successfully received packets is compared with the number of packets sent in a given time window.

Here ETX tends to select links on path with lower rate so that it is the time for a packet to reach its destination. The scalability of a routing protocol is critical if end-to-end delay can become large. Furthermore, even when the path is established, the node states on the path may change. Setting up a routing path in a very large wireless network may take a long time. Delay is to travel a path from its source to its destination. Finally we were considered the total number of delayed packets for its calculation

$$Delay = \frac{Total\_delayed\_paclets}{Total\_received\_packets}$$

Here, ETX does consider the load on a path and will therefore don't route through heavily loaded nodes without due consideration.

4. Algorithm Process

In our paper we considered Routing while the plan of considering the some routing parameters issue. WMNs actively interact with the network and link layers [4]. WMNs accurately monitor the all parameters of each node in distributed manner. Algorithm is based on

routing for Cross layer approach in Wireless Mesh Networks at mesh node (v).
Here first we collect link quality and neighbour node information for routing. Based on available information gateway will select the path for forwarding the packets. If failure occurred in the network then channels are get disturbed for forwarding the packets. So gateway has to be elected using election algorithm for selecting the leader who provide alternate configuration. Once it configured the leader will send reconfigured information to all other nodes.

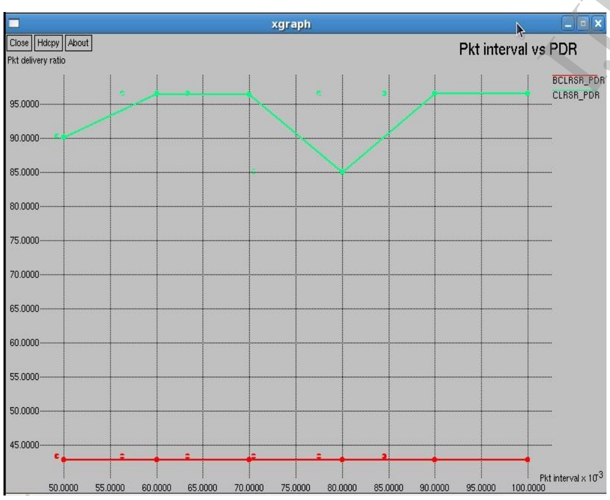
5. Simulation Results

We conduct simulations with ns-2 simulator to compare the performance of the three metrics of hop count, ETX, and link quality. In this simulation we divide a 500 m - 500 m area squares.

According to considered metrics component the detail are Results are generated in consideration of different parameters. The parameter packet delivery ratio (PDR) vs. data rate is in simulation interval.

For the X-axis: packet interval (data rate) in Mbps

Y-axis: Packet delivery ratio

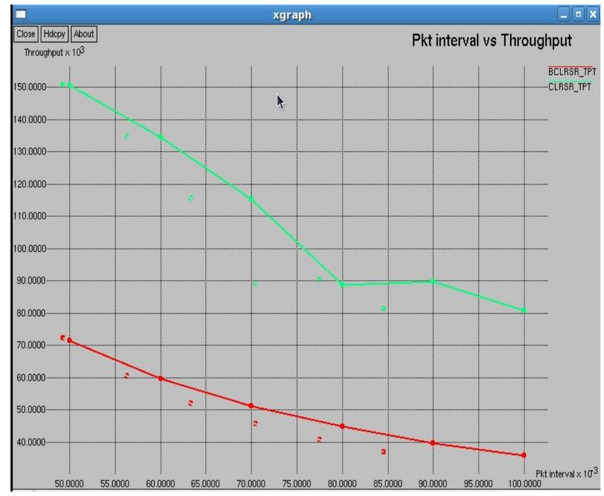


Graph 1: Packet Interval vs. Packet Delivery ratio

The parameter throughput shows total data delivery in specified amount of time.

Here for X-axis: Packet interval (data rate) in Mbps

Y-axis: Throughput in Mbps

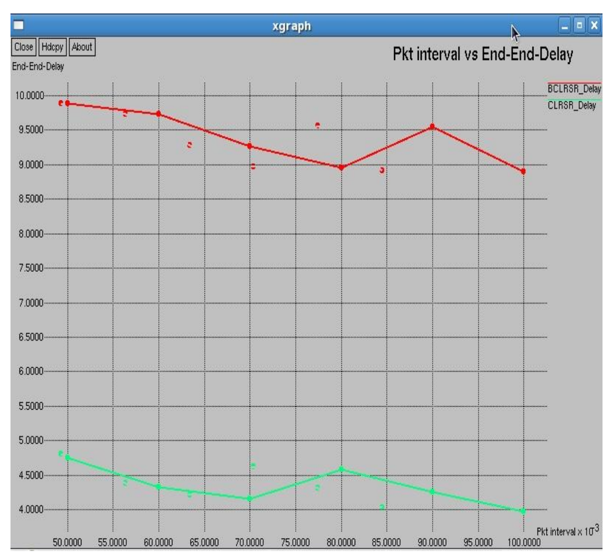


Graph 2: Packet Interval vs. Throughput

The delay parameter refers to the time taken for a packet to be transmitted across a network from source to destination.

For X-axis: packet interval (data rate) in Mbps.

Y-axis: Delay from source to destination in millisecond.



Graph 3: Packet Interval vs. Delay

6. Conclusion

In the WMNs the bandwidth guarantee is one of the most important requirement need. In our paper the goal is to maximize the bandwidth utilization by channel assignment subject to fairness constraints.

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