

Multi Class Traffic Analysis of Single and Multi-band Queuing System

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Abstract: To facilitate higher bandwidth for multimedia traffic, modern routers support simultaneous multi-band communication, leading to less interference, higher capacity and better reliability. However, there is lack of quantitative evaluation to judge whether multi-band is better than single band router in realistic scenarios. Our objective is to propose a scheduling algorithm for multi-band routers and compare single band and multi-band system with different allocation policies. We have used different scheduling algorithms for multi-band routers which transmit different classes of traffic through different frequency bands, thereby achieving improved performance. By comparing multi-band and single band mobile router performances, we have found out that one of them is not always better than the other although multi-band is expected to have better performance.

Index Terms: Analytical modeling, scheduling algorithm, queuing system, real-time traffic, next generation mobile routers.

I. INTRODUCTION

In recent years, there have been explosive growth of users accessing large multimedia files (such as, high definition audio, video, images, etc.) over the Internet. Therefore, the bandwidth demand for mobile Internet access is increasing exponentially [1]. To satisfy such a higher bandwidth requirement, today wireless routers are available commercially with simultaneous multi-band support of 2.4 and 5 GHz. The benefit of using multi-band router is *less interference, higher capacity and better reliability*.

Current simultaneous multi-band MRs make use of 2.4 and 5 GHz for different types of devices in a home network. However, they do not attempt to exploit the under-utilized frequency band when other one is flooded with data. The multi-band router system is a heterogeneous multi-server system which means each server's service rate is different than the other. Hence, allocation policy, flexibility and priority of class of packets [2] in heterogeneity of a system must be taken into account since some of the traffic types (such as, real-time) have strict delay constraints [3]; some other signaling traffic (required for mobility management) [4] is crucial for maintaining Internet connectivity of the mobile users. Therefore, it is essential to propose an appropriate scheduling and queue management scheme for the multi-class traffic to ensure the maximum possible utilization of the system resources in multi-band mobile routers [5]. The *aim* of this work is to propose a scheduling algorithm for multi-band routers and compare single band and multi-band

system with different allocation policies and find out under which circumstances single band or multi-band performs better through the use of different router service rates and buffer sizes.

There have been several research works [1], [5]–[8] reported in the literature. Verma and Lee [8] explain possible Wi-Fi architecture with multiple physical and link layers to support multiple frequency bands simultaneously. Singh et al. [1] proposed a method to assign different frequency bands to end-devices based on their distances from the access router. In [6], [7], authors proposed the use of 60 GHz frequency band (having low range) to attain faster data transfer rate in wireless networks. However, none of these works [1], [5]–[8] propose any scheduling algorithm for multi-band system considering multi-class traffic, neither do they perform any comparison between multi and single bands.

To the best of our knowledge, there has been no earlier works on scheduling and queue management for multi-band mobile routers that attempts to maximize utilization of available bands. Moreover, Hossain et al. [9] is the only previous work exists that proposed the sharing of multiple bands to transmit different classes of traffic. In [9], we have compared the current multi-band scheduling with our proposed multi-band scheduling. However, it is essential to compare single band with our proposed scheduling for different allocations policies. This is a *novel work* that aims at attaining maximum possible band utilization with different allocation policies while comparing the performance of band sharing of multi-band and single band routers. The *objective* of this work is to determine whether such a multi-band router architecture performs better than single band architecture. The *contributions* of this work are: (i) proposing a band-sharing router architecture and a novel scheduling algorithm that aims at improved utilization of the system by using different allocation policies, (ii) comparing the performance of multi-band router with single band router with realistic simulations, and (iii) analyzing the results to make recommendations for choosing single or multi-band architecture and allocation policies based on traffic conditions, and their priority.

Results show the packet drop rate and throughput are significantly improved in proposed band-sharing architecture of the mobile router. Moreover, multi-band router can suffer low band utilization under light traffic.

The rest of the paper is organized as follows. In Section II,

