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"Performance analysis of QOS parameters in wireless multimedia mesh network using MultiMate, multichannel algorithm."

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Abstract: Devices in wireless mesh networks can operate on multiple channels and automatically adjust their transmission rates for the occupied channels. This shows how to improve performance-guaranteed multicasting transmission coverage for wireless multi-hop mesh networks by exploring the transmission opportunity offered by **M**ultiple **R**ates (MR) and **M**ultiple **C**hannels (MC). Based on the characteristics of transmissions with different rates, we propose and analyze **P**arallel **L**ow-rate **T**ransmissions (PLT) and **A**lternative **R**ate **T**ransmissions (ART) to explore the advantages of MRMC in improving the performance and coverage trade off under the constraint of limited channel resources. We then apply these new transmission schemes to improving the WMN multicast experience. Combined with the strategy of reliable interference-controlled connections, a novel **L**ink-**C**ontrolled **M**ulti-**R**ate **M**ulti **C**hannel multicast algorithm (LC-MRMC) is designed to make efficient use of channel and rate resources to greatly extend wireless multicast coverage with high throughput and short delay performance. Our NS2 simulation results prove that ART and LC-MRMC achieve improved wireless transmission quality across much larger areas as compared to other related studies.

Keywords: Wireless multicasting, multiple rates, multiple Channels, wireless mesh networks.

Introduction

Multicast in wireless mesh networks (WMN) is promising in efficiently utilizing wireless resources to provide flexible and reliable wireless connections to a group of multimedia receivers (e.g., video conferencing users) with consecutive transmissions on the same multi-hop WMN paths. Due to the nature of wireless broadcast multiple transmission comfits to occupy the same channel which degrades the performance of all channels. Also parallel delivery of multicast data on paths that have at least one interfering hop then in that case interference to parallel transmission path again degrades the performance especially for multimedia traffics.

By attaching orthogonal channels to different radio interfaces, the non-interfering capacity of a WMN may be increased. However, with current wireless technology, there is a limited number of orthogonal channels that are not sufficient for multihop WMN multicast because interference caused by the rich connectivity is substantial. Hence, it is difficult to gain significant improvement in extending performance-guaranteed multicast coverage by only efficiently using orthogonal channels.

Multimedia multicast may easily cause a very complicated interference topology. This is because different transmission rates have different coverage - an adaptive change of a transmission rate may incur new interference on a structured multicast tree.

Literature survey

Wanqing Tu in"Efficient Wireless Multimedia Multicast inMulti-rate Multi-channel MeshNetworks" proposed about devices in wireless mesh networks can operate on multiple channels and automatically adjust their transmission rates for the occupied channels. This paper shows how to improve performance multicasting transmission coverage for wireless multi hop mesh networks by exploring the transmission opportunity offered by multiple rates (MR) and multiple channels (MC). A novel link-controlled multi-rate multichannel multicast algorithm is also designed to extend wireless multicast coverage with high throughput. NS2 based simulation results show the improved multicast quality of LC-MRMC in much larger wireless areas as compared to current studies. [1]

Shreeshankar Bodas, Sanjay Shakkottai, Lei Ying, and R. Srikant in "Scheduling in Multi-Channel Wireless Networks:Rate Function Optimality in the Small-Buffer Regime" discussed the problem of designing scheduling algorithms for a multichannel (e.g., orthogonal frequency division multiplexing based) wireless downlink network. The classic Max Weight algorithm, although throughput-optimal, results in a very poor per-user delay performance in such systems. Hence, an alternate class of algorithms called iterated longest queues first (iLQF) is proposed for overcoming this issue. The iLQF class algorithms are analyzed in a number of different system configurations. A particular algorithm in this class, called iLQF with pull-up, is shown to be rate function optimal for the problem in an appropriate large deviations setting, and is shown to result in a strictly positive value of the rate function for a number of modifications to the basic system model[3].

Peng-Jun Wan, Yu Che, Zhu Wangand Frances Yaoin "Multiflows in Multi-Channel Multi-Radio Multihow Wireless Networks." studies maximum multiflow (MMF) and maximum concurrent multiflow (MCMF) in muliti-channel multi-radio multihop wireless networks under the 802.11 interference model or the protocol interference model. Practical polynomial approximation algorithms for MMF and MCMF with constant approximation bounds regardless of the number of channels and radios, is indicated. Under the 802.11 interference model, their approximation bounds are at most 20 in general and at most 8 with uniform interference radii; under the protocol interference model, if the interference radius of each node is at least $c$times its communication radius. In addition, it has been shown that if the number of channels is bounded by a constant (which is typical in practical networks), both MMF and MCMF admit a polynomial-time approximation scheme under the 802.11 interference model or under the protocol interference model with some additional mild conditions.[4]

Guokai Zeng , Bo Wang , Yong Ding and Matt W. Mutka in "Efficient Multicast Algorithms for MultichannelWireless Mesh Networks"proposes two multicast algorithms: the Level Channel Assignment (LCA) algorithm and the Multichannel Multicast (MCM) to improve the throughput for multichannel and multi-interface mesh networks. The algorithms build efficient multicast trees by minimizing the number of relay nodes and total hop count distances of the trees. The algorithms use dedicated channel assignment strategies to reduce the interference to improve the network capacity. Using partially overlapping channels can further diminish the interference. Additional interfaces help to increase the bandwidth, and multiple gateways can further shorten the total hop count distance. Results show that MCM achieves better throughput and shorter delay while LCA can be realized in distributed manner.[5]

Methods:

The LC-MRMC method handles the multicast traffic without degrading throughput performance. The LC-MRMC is consisting of two techniques as follows,

1. **Parallel Low Rate Transmission (PLT):**

In this method mesh node is equipped with multiple channels transmitting at a rate lower than the maximum available rate in parallel. As such, an aggregated throughput higher than that of the maximum available rate can be achieved across greater distances.

2. **Alternative Low Rate Transmission (ALT):**

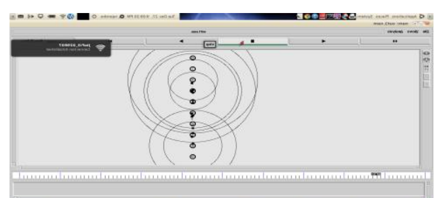
In case of implementation of PLT, channel allocation issue may arise due to less number of orthogonal channels availability in multimedia data transfer, and interference problem caused by multiple use of same channels. This can be solved by ALT by assigning minimum number of channels by classifying nodes in terms of normal and PLT nodes.

Methodology of analysis and exsisting results:

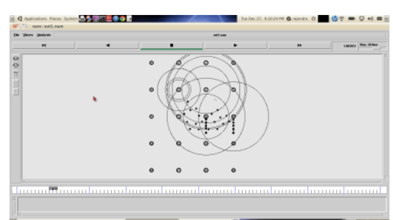
Throughput: Throughput for different scenarios are calculated and it can be calculated as, ratio of total number of packets received successfully to total time taken to reach all packets to receiver.

End to End delay: The average end-to-end delay is calculated by taking the time of the last packet received, subtracting the initial time of transmitting that packet, and then dividing by the total number of packets sent that sampling interval.

Simulation result:



Animated window for 10 Nodes.



Animated window for 20 Nodes.

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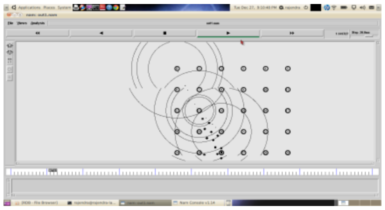
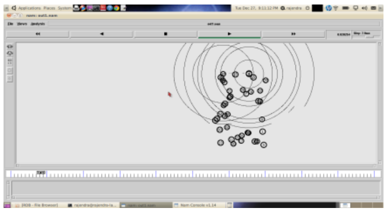
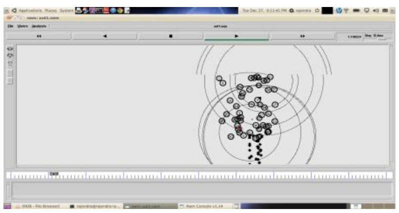


Animated window for 30 Nodes.



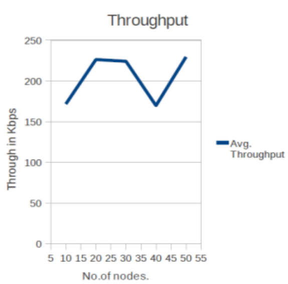
Animated window for 40 Nodes.



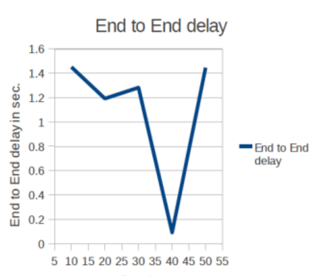
Animated window for 50 Nodes.

Graphical results for single transmission:

No. of nodes	Avg. Throughput in kbps
10	171.685461
20	226.102263
30	224.032004
40	169.753219
50	229.460683

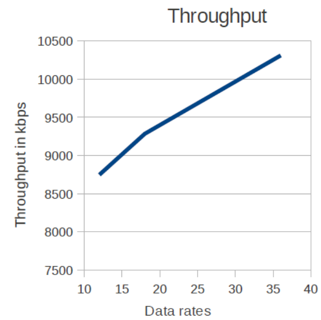


No. of Nodes	End to End delay in sec.
10	1.451273
20	1.192238
30	1.281575
40	0.092453
50	1.446178

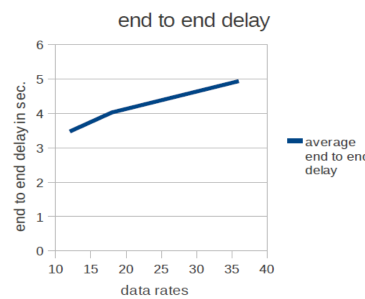


Graphical results for multirate-multichannel transmission:

Data Rates in mbps	Avg.throughput in mbps
12	8748.60944
18	9286.462641
36	10310.508522



Data Rates in mbps	End to end delay in sec.
12	3.474362
18	4.03185
36	4.942769



Conclusion

The results obtained show that performance in terms of throughput and end to end delay in case of multirate based network are optimum as compared to single rate based network. The performance evaluation is done for multiple scenarios consisting of varying number of nodes. Performance is optimum in multirate network even if number of nodes increase in the network.

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