Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 2, Issue. 12, December 2013, pg.220 – 223

RESEARCH ARTICLE

Enhancement of Multi-Radio Multi-Channel with TCP Tuning For Mesh Networks

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Abstract - Wireless mesh network is a first step towards providing cost effective and dynamic high bandwidth networks over a specific coverage area. Multi-hop bandwidth degradation is major problem. Multi-Radio Multi-Channel (MRMC) approach is used to solve bandwidth contention and radio interference. In existing researchers multi TCP connections using MRMC approach cannot resolve the multi-hop TCP throughput degradation problem it caused increase in TCP Round Trip Time (RTT) when the number of hops increases. In this paper use multiple parallel TCP connections the wireless bandwidth can be fully utilized with a sufficient number of parallel streams. The use of multiple parallel TCP connections between the transmitter and receiver that are multiple hops away can better utilize the wireless bandwidth and boost the aggregated throughput. Parallel connections between any two nodes could be a potential solution for transmitting a large amount of data at high speed from one client to one server through the wireless mesh network.

Keywords: Wireless Mesh Network, MRMC, IEEE 802.11n, Multi-hop Throughput and Bandwidth

I. INTRODUCTION

Wireless mesh network has been conducting a lot of awareness from the study community and industry due to its low cost and readily deployable nature. A network topology where each node must not only capture and distribute its own data, but also serve as a relay for other nodes, that is, it must work together to propagate the data in the network. A mesh network can be designed using a flooding technique or a routing technique. When using a routing technique, the message is propagated along a path, by hopping from node to node until the destination is reached. To ensure all its paths' availability, a routing network must allow for continuous connections and reconfiguration around broken or blocked paths, using self-healing algorithms. A mesh network whose nodes are all connected to each other is a fully connected network. Mesh networks can be seen as one type of ad hoc network. Mobile ad hoc networks (MANET) and mesh networks are therefore closely related, but MANET also have to deal with the problems introduced by the mobility of the nodes. Previous researchers proposed the use of multiple radios and channels in wireless mesh networks. With multiple radios a node can receive and transmit at the same time on non overlapping orthogonal channels, and full duplex communication can then be achieved. The subtle channel allocation, orthogonal channels are assigned to mesh nodes with respect to the network topology to prevent radio interference and allow simultaneous transmissions in the network without any collisions. These proposals on channel assignment for multi-radio WMNs to maximize the network capacity. A joint channel assignment and routing scheme for maximizing the capacity subject to fairness constraints, proposes distributed and centralized load-aware channel assignment algorithms that make dynamic decisions on a per-flow basis. Multi-Radio Multi-Channel (MRMC) approach is a well-accepted solution in the research community to the multi-hop throughput degradation problem. The bandwidth delay is a useful quantity for analyzing network performance.

Multiple radios and channels solely is not enough to improve the multi-hop TCP throughput in an 802.11n based WMN. The multi-hop TCP throughput drop in MRMC 802.11n mesh networks is primarily due to the large RTT of multi-hop wireless communication path and the high bandwidth of 802.11n, resulting in a large bandwidth-delay product where protocol tuning or other remedies are required for achieving the peak throughput. Multi-hop bandwidth is limited by the TCP protocol, a wireless mesh network that supports many simultaneous TCP connections each with small bandwidth requirements should be achievable. These connections may be able to utilize the wireless bandwidth more efficiently. The aggregated throughput in a WMN with multiple parallel TCP connections simultaneously transmitting TCP streams. The use of multiple parallel TCP connections between the transmitter and receiver that are multiple hops away can better utilize the wireless bandwidth and boost the aggregated throughput. Parallel connections between any two nodes could be a potential solution for transmitting a large amount of data at high speed from one client to one server through the wireless mesh network. TCP tuning techniques such as the use of parallel streams and dynamic adjustment of the advertised window based on the measured behavior need to be enabled in commercial wireless networking.

II. SYSTEM MODEL

A. MESH NETWORK MODEL

A Creation of mesh network that supports many simultaneous TCP connections should be achievable. As a whole, these connections may be able to utilize the wireless bandwidth more efficiently. Then it would be interesting to study the aggregated TCP throughput in a wireless mesh network. A source node {S0, S1, S6}, and destination nodes {D0, D1, D6}, and relay nodes {R}. Each node has at most two relay and is assigned with the 5 GHz channels. Packets are transmitted from the source node Sx to the destination node Dx via the three intermediate relay nodes.

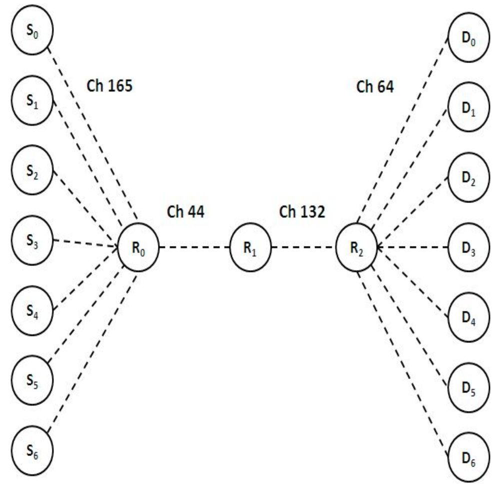

Fig 1. Mesh Network Model

B. MULTI-RADIO MULTI-CHANNEL APPROACH

Multi-Radio Multi-Channel (MRMC) approach is a well-accepted solution in the research community to the multi-hop throughput degradation problem, and a number of network planning and communication algorithms were proposed based on the multi-radio architecture. Multi-Radio Multi-Channel 802.11n, and MRMC 802.11a. First of all both the TCP and UDP throughput of single-channel 802.11n drop drastically when traversing the network, which is primarily due to radio interference and collision. For its TCP throughput, it is more than halved for every increase of hops. With the use of multiple radios and channels, the TCP and UDP throughput of 802.11a, and the UDP throughput of 802.11n can be sustained over five hops (a fluctuation of less than 10% could be due to the processing of routing overheads or of the wireless link quality and is considered to be normal).

C. PARALLEL TCP CONNECTIONS

Multi-hop throughput degradation is due to the large bandwidth-delay product of wireless path, then running multiple simultaneous TCP connections could further increase the aggregated throughput. This is because parallel streams take advantage of the fact that TCP tries to share the bandwidth equally among all flows along a path, and n parallel streams will have n times larger aggregated buffer (or advertised window) size. Therefore, parallel connections between any two nodes could be a potential solution for transmitting a large amount of data at high speed from one client to one server through the wireless mesh network. One way to implement multiple parallel TCP streams is to re-write the application with multiple sockets. Re sequencing of data segments at the receiver is also needed. There are a number of applications that can use parallel TCP streams.

D. MULTIHOP END-TO-END DELAY METRIC

The end-to-end delay over a path is the summation of delays experienced by all the hops along the path. For convenience, we also use EED to denote the delay metric at each link. The meaning of EED will be clear in the context. In order to compute the EED metric over a wireless channel, each node needs to monitor the number of packets buffered at the network layer waiting for MAC layer service, as well as measuring the transmission failure probability at the MAC layer.

III. CONCLUSION

A Multi-Radio Multi-Channel (MRMC) IEEE 802.11n mesh network have shown that although UDP throughput can be sustained after traversing multiple hops, the TCP throughput degrades dramatically even with the

MRMC approach. Results indicate that the use of multiple radios and channels is not enough to improve multi-hop TCP throughput performance in mesh networks.

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