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Enhancement of the Back-To-Back Throughput Performance of IEEE 802.11 by Routine Fine-Tuning of the Channel Access Probability

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Abstract: We propose a fully distributed contention window adaptation (CWA) mechanism, which adjusts the channel access probability depending on the difference between the incoming and outgoing traffic at each node, in order to equate the traffic forwarding capabilities among all the nodes in the path to improve the throughput of multihop wireless networks, The following issues are to be considered, how to estimate the traffic forwarding capability at each node, how to differentiate the contention window size depending on the traffic forwarding capability and how to increase the end-to-end throughput by regulating the throughput of traffic relayed at each hop in a distributed and scalable manner.

Key words: Multihop Wireless Network · Traffic · Window Adaption

INTRODUCTION

Problem Statement

Back to Back: Measures the maximum number of frames received at full line rate before a frame is lost. Fine Tuning: Fine tuning refers to the process of making small modifications to improve or optimize the outcome. Generally, fine tuning seeks to [1] increase the effectiveness or efficiency of a process or function. 802.11 specify an over-the-air interface between a wireless client and a base station or between two wireless clients. The traffic forwarding capability of each node varies according to its level of contention, simply a node should not transmit more packets to its relay node than the corresponding relay node can forward. Each node should yield its channel access opportunity to its neighbor nodes so that all the nodes can evenly share the channel and have similar forwarding capability. BEB algorithm have fixed value of Cwmin is not sufficient to improve the end-to-end throughput of a multihop path. In order to resolve this issue and further improve the network throughput.

Relative Work:

- Contention Control for High End-to-End Throughput Performance of Multihop Wireless Networks.

If the incoming rate of a node is larger/smaller [2] than its outgoing rate, the forwarding capability of that node should be increased/decreased so as to match the outgoing rate with the incoming rate.

The basic access method of IEEE 802.11 DCF is carrier sense multiple access with collision avoidance (CSMA/CA). Furthermore, to resolve contention among competing nodes, the binary exponential back-off (BEB) algorithm is adopted in IEEE 802.11 DCF [3].

A node that intends to transmit first senses the channel and defers its transmission while the channel is sensed busy. When the channel is sensed idle for a specific time interval, called distributed inter-frame space (DIFS), the sender chooses a random back-off timer, which is uniformly distributed in [0, CW - 1] where CW is the contention window size[4].

The node transmits its frame when the back-off timer becomes zero. After the data frame is received without errors, the receiver sends an acknowledgment frame to the sender after a specified interval, called the short inter-frame space (SIFS) [4] that is less than DIFS.

If an acknowledgment frame is not received, the data frame is presumed to be lost [5] and a retransmission is scheduled. Retransmissions for the same data frame can be made up to a pre-determined retry limit, L, times. Beyond this limit, the pending frame will be dropped.

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- Dynamic Tuning of the IEEE 802.11 Protocol to Achieve a Theoretical Throughput Limit.

Develop an analytical model of a p-persistent IEEE 802.11 protocol. [6] p-persistent version closely approximates the standard protocol, if the average back off interval is the same.

Analytically derive the average size of the contention window that maximizes the utilization [7].

Show the current binary exponential backoff algorithm operates far from the theoretical limit.

Propose an IEEE 802.11+ protocol that on-line dynamically tune the contention window [8].

- Kalman Filter Estimation of the Number of Competing Terminals in an IEEE 802.11 Network

To estimate n, based on an extended Kalman filter coupled with a change detection mechanism.

Shows both high accuracy as well as prompt reactivity The 802.11 standard is designed to allow both Basic Access and RTS/CTS access.

RTS threshold which maximizes the system throughput [9] is not a constant value, but significantly depends on the number n of competing stations.

Clearly, this operation requires each station to be capable of estimating n.

- A Novel Mac Protocol With Fast Collision Resolution For Wireless Lans.

A novel and efficient contention-based MAC protocol for wireless local area networks, namely, the Fast Collision Resolution (FCR) algorithm. To speed up the collision resolution, redistribute the backoff timers for all active nodes, to reduce the average number of idle slots,use smaller contention window sizes for nodes with successful packet transmissions and reduce the backoff timers exponentially fast when a fixed number of consecutive idle slots are detected.

The proposed FCR algorithm provides high throughput performance [10] and low latency in wireless LANs.

FCR algorithm could significantly improve the performance of the IEEE 802.11 MAC protocol if efficient collision resolution algorithm is used to increase the throughput performance of a distributed contention-based MAC protocol, an efficient collision resolution algorithm is needed to reduce the overheads to this end.

For example, Backoff algorithms -to adjust the increasing and decreasing factors of the contention window size and the randomly chosen backoff values;[8]

The out-band busy-tone signaling -used to actively inform others of the busy channel status and the contention information appended on the transmitted packets can also help in the collision resolution

Exsiting System: The traffic forwarding capability of each node varies according to its level of contention, simply a node should not transmit more packets to its relay node than the corresponding relay node can forward.

Each node should yield its channel access opportunity to its neighbor nodes so that all the nodes can evenly share the channel and have similar forwarding capability [11].

BEB algorithm have fixed value of CWmin is not sufficient to improve the end-to-end throughput of a multihop path. In order to resolve this issue and further improve the network throughput.

Proposed System: We proposed a fully distributed contention window adaptation (CWA) algorithm for each node to independently and adaptively determine the minimum contention window size CWmin.

The proposed adaptation rules are:

- Needs neither the status information of neighboring nodes nor the topology information of the multihop path such as the total number of hops and the hop-count from the source.
- Each node periodically executes the algorithm and updates its CWmin at every ◎◎ seconds. The updated CWmin affects only new packet relays that start after its update. This means that this window adaptation scheme does not interference the ongoing BEB process.
- There are several points that are worthy of mentioning. In that first, in order to measure the rates of incoming and outgoing traffic, the number of packets are counted for the time interval ◎◎.

We have to consider two special cases:

- When a node receives packets whose destination is itself [12].

- When a node transmits packets whose source is itself. Whether or not to consider these cases may result in a large discrepancy between the amount of the incoming and outgoing traffic. Because these cases do not affect the forwarding capability (and hence the adaptation of CWmin), when an upper bound is placed on the rate of outgoing traffic.

Even if there are no incoming packets, the packets accumulated in the buffer can be transmitted. For a short interval of time, the outgoing rate could be higher than the incoming rate depending on the buffer size and it may lead to a false decision in updating CWmin [13].

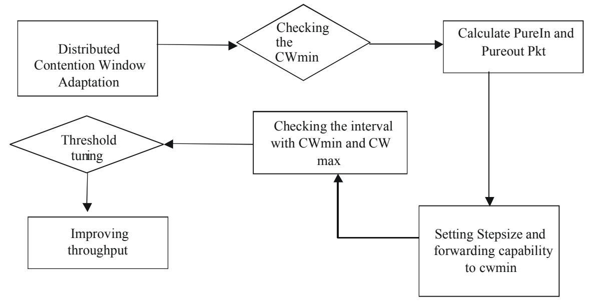
This is the reason that we limit the rate estimate of outgoing traffic up to that of incoming traffic the traffic load is sufficiently low and does not incur any packet loss,

Cumin has the tendency to be in maximum value with the use of the adaptation rule possible that a node cannot reach the target forwarding capability even though it eventually reduces CWmin to 1.

Algorthim:

1: // InPackets: the number of all the incoming packets for ◎◎
2: // DstPackets: the number of outgoing packets whose destination
is itself.
3: PureInPackets = InPackets - DstPackets
5: // OutPackets: the number of all the outgoing packets for ◎◎
6: // SrcPackets: the number of incoming packets whose source is
itself.
7: Pure Out Packets = Out Packets - Src Packets
9: if Pure Out Packets > Pure In Packets then
10: Pure Out Packets ← Pure In Packets
11: end if
13: CWmin ← CWmin +◎◎/◎◎. (Pure Out Packets – ◎◎. Pure In Packets)
15: if CWmin >◎◎◎◎◎◎◎◎◎ then
16: CWmin ← ◎◎◎◎◎◎◎◎◎
17: else if CWmin < ◎◎◎◎◎◎◎◎◎ then
18: CWmin ← ◎◎◎◎◎◎◎◎◎
19: end if

Block Diagram:

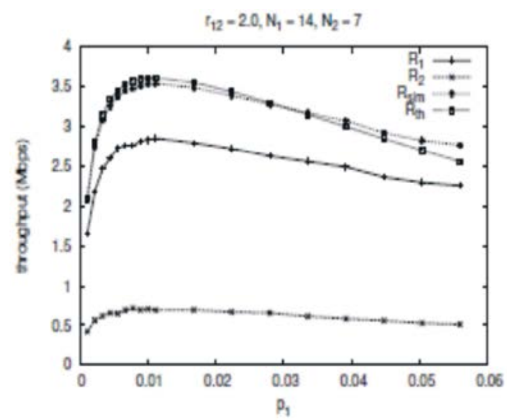


Advantages of Proposed System: Intra-flow interference provides consecutive packets in a single flow.

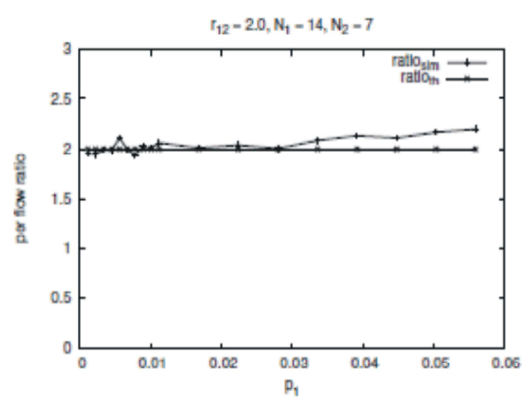
The traffic forwarding capability needs neither the status information of neighboring nodes nor the topology information of the multihop path such as the total number of hops and the hop-count from the source to destination.

Whether or not to consider these cases may result [14] in a large discrepancy between the amount of the incoming and outgoing traffic.

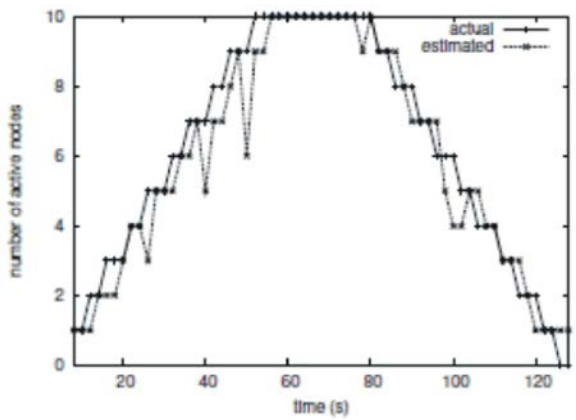
RESULTS



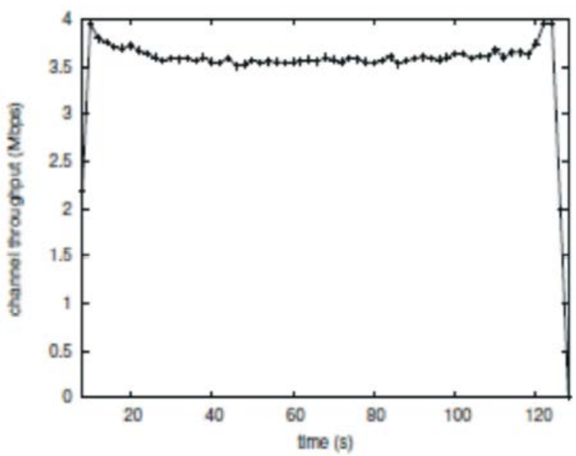
(a) Throughput



(b) Throughput ratio



(a) Number of active nodes



(c) System throughput

CONCLUSION

This paper focused on the use of contention resolution algorithms This paper have proposed a fully distributed contention window adaptation (CWA) scheme for tuning the minimum contention window size. The proposed CW adaptation scheme attempts to reduce unnecessary packet drops due to inter-flow interference and to improve the end-to-end throughput performance by differentiating the contention window sizes of relay nodes belonging to a same multi-hop path.

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