Determining loss of Packets in Wireless Network by Dissecting Collision from Weak Signal

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Abstract— we know that to detect exact cause of packet losses in wireless environment is quite difficult. It is well known that this can happened because of collision or because of weak signal. To identify exactly collision from weak signal is also a difficult task. In this paper we focused on the wireless packet loss problem in 802.11 and also analyses of the promising technique suggested earlier called COLLIE. COLLIE achieves loss analysis by means of newly designed metric that examine error patterns within a physical layer symbol for revealing difference between collision and weak signal based losses.

Keywords- *CSMA, Collision, Packet Loss, COLLIE, Weak Signal, Congestion Window (CW).*

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I. INTRODUCTION

IEEE 802.11 is the most popular WLAN system in the world today and it is likely to play an important role in the next generation of wireless and mobile communication systems. Slotted-Aloha is updated to CAMA or Carrier-Sense Multiple Access in the early 1970, has become the de-facto mechanism for implanting distributed access to shared communication medium, which is commonly used by the Ethernet class for both wired and wireless environment. Proper implementation of CSMA method we identify that, it is being able to detect simultaneous admittance of the media by two or more objects which reasons collision.

In 802.3 network environment, transmitting stations continuously searching for incoming collision and if it is present then it produces a jamming signal to inform all other stations if a collision is spotted, [1]. This introduces accurate and timely feedback to the CSMA protocol by resolving the concurrent access. As in 802.11 network environment i.e. in wireless media the strongest signal always dominates the receiver circuitry, such detection is hard to realize, So 802.11 network environment implements CSMA with Collision Avoidance. The receipt of data packet is confirmed through an explicit acknowledgement from the receiver.

A packet loss also caused by means of weak signal i.e. signal is unable to give the sufficient data rate for packet module at. The data-rate adaptation algorithm attempt to operate wireless link al the greatest rate possible to get maximum throughput and system capacity cause this frequently. In wireless media the exact cause of packet loss is important to known, as they have to perform the various choices for data transfer, [11].

Losses of packet in 802.11 wireless environments are very much difficult. But it has been observed by previous researches if we have a receiver that could provide detailed diagnostic information on the reception properties of a packet, then by analyzing the bit-level error patterns in received data and other physical layer metric we can determine the cause of packet loss between collision and weak signal.

After determining the exact cause of packet loss the transmitting stations have to perform several operations on link layer, once we know the exact cause the station would perform an exponential back off for collision and for weak signal the rate-adaptation algorithm would be invoked,[11].

Once we find the specific reason of packet loss, different actions should be taken at link layer as follows:

1) In case of collision realted loss, the congestion Window parameter should be double as determined by the Bainary-Exponential Backoff algorithm used in wireless environment.

2) In case of weak signal, adaptation of data rate and transmit power parameters must be performed a dictated by specific data-rate adaptation algorithm used in wireless environment.

A biased approach of assuming collision as the default cause for packet loss works well for the dominant laptop based usage scenarios where a user is static most of time while using the network. However, such usage patterns are increasingly changing [4] [5] as certain emerging class of applications such Voice or Video over Wi-Fi allow a user to be mobile while communicating with network. This creates new situations where constant adaptation of link parameters becomes necessary in order to operate the link at the 'best' setting. In such high mobility usage scenarios, packet losses are more likely to occur due overly optimistic settings for data rate/ transmit power parameters rather than due to collision. Therefore, the biased approach used by 802.11 could incur severe performance penalties by incorrectly attributing initial packet losses to collision, [11].

In 802.11 network environment it is increasingly important to be able to diagnose the cause of packet loss at the link layer and apply the exact method adaptation in real-time. In RRAA [6], the station does not conclude that the cause of packet loss is due to collision or weak signal before finding it on RTS test i.e. in Real-Time System test. In this it performs certain test to identify whether the packet loss occurred is due to weak signal strength or due to collision. (CARA [7] also uses this approach to handle a slightly different problem.) However, the philosophy employed in RRAA and also mimicked in 802.11 is to conduct active tests or experiments (by retransmitting or sending an RRTS) to estimate collision probabilities, [11].

The rest of paper is organized as follows. In section second mechanism which helps to identify packet loss and separate collision is analyzed. In third section detail overview of COLLIE is analyzed. In forth section an appropriate set of metrics used for loss diagnosis is analyzed. In fifth section use of COLLIE in link adaptation is analyzed. Sixth section concludes the paper.

II. Analysis Of Mechanism Used For Packet LOSS DETECTION

In this section we are going to see the useful mechanism which is contributed in detection of packet losses in wireless network.

A. Design of symbol level metric to study wireless errors :

COLLOE explore new metric that study error properties at level of a physical layer symbol. In Orthogonal Frequency Division Multiplexing (OFDM) employed by 802.11a/g standards, a symbol refers to the collection of bits modulated in single unit of time synchronously across 48 sub-carriers which constitute a channel.

It is proven that error patterns appear differently for collision versus weak signal when isolated to within a single symbol, [11].

B. Diagnosing wireless packet :

In this paper, we analyzed bit patterns of received data for loss diagnosis in 802.11, specifically between collision and a weak signal. The Collision Inferencing Engine - COLLIE. COLLIE immediately determines the cause of a packet loss without requiring any additional transmission from the wireless client, but by using explicit feedback from the receiver. COLLIE performs intelligent analysis on received data through a combination of various metrics such as bit-level and symbol-level error patterns and received signal strength. It depend on two components: (i) algorithms which separate the cases of collision from weak signal through empirical analysis; (ii) a protocol which capitalizes on the judgment from the algorithms by aptly adjusting the correct link-level parameters for 802.11 This results in significant throughput and capacity improvements for high mobility usage scenarios,[11].

C. Appication of COLLIE :

It has been observed so far that the mechanism proposed in COLLIE can be used to enhance existing link adaptation mechanism, allowing them to make difference between collision and weak signal and based on this make decisions suited for packet transmission process. This can be done by enhancing the Auto Rate Fallback (ARF) [3] rate adaptation mechanism with collision inferencing component.

The issue of loss diagnosis does not arise in cellular networks as they use different centralized techniques TDM, FDM (Frequency Division Multiplexing) etc. to allow user data sharing for multiple users. This avoids the problem of collisions altogether, thus eliminating the need for any link-level inferencing and attributing any bit-level errors to weak signal, [11].

III. An Overview Of COLLIE

COLLIE can be used for determining the exact cause of packet losses in network. The mechanism behind COLLIE is employed by Ethernet. An Ethernet station easily detects a collision by comparing the transmitted data with the simultaneously received data.

It is proven already that even in 802.11 systems, given a copy of the originally transmitted packet and the received error packet, it is possible to identify the cause of transmission failure based on the error bit-patterns of this single packet. A number of different procedures are used to detect the cause, the most unique among them are the ones derived out of the constituent PHY-layer symbols of the packet. Once the cause of a packet loss is identified, this information is fed into link adaptation algorithms enabling them to more intelligently select the right set of transmission parameters for all subsequent communication, [11].

The method proposed for detection of exact cause of packet loss is having three main components, [11].

1) A supplicate module.
2) AP module.
3) COLLIE server.

The supplicate module is a wireless laptop, an AP module which exist in an access point, and an optional backend COLLIE server which implements some additional procedures. COLLIE places most of the optimization logic on the client device, and requires only a minimal support from the APs

A. Supplicate module:

The supplicate side COLLIE module works on the link-layer side and cooperates with link adaptation procedures. It has access to the physical layer and MAC layer limitations and metrics such as signal strength, packet receptions, etc. This module implements logic to discern the cause of a packet loss to either a collision or a weak signal. This process in the client is facilitated through specific feedback from the receiver, i.e., the AP, when the latter receives a packet in error. In particular, the AP relays the entire packet, received in error, back to the client for analysis.

This collision inference algorithm examines the data packet that was received in error and makes a cultured inference as to the cause of the packet loss. It practices a set of metrics such as received signal strength designs in bit-errors and their distribution, patterns in symbol errors and their distribution,

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etc. One exciting observation in this work is that symbol-level mistakes were quite useful in sensitive reason of packet losses.

B. AP module:

The AP-side application of COLLIE which includes a module, that implements the component to provide the kind of client feedback described above. Lastly, it optionally gears constructs that allow a chief COLLIE server to more accurately regulate the cause of a packet loss.

C. COLLIE server:

This is an optional component in our design. The COLLIE server implements a simple collision inference procedure that uses response from multiple access points in the network. It is perceived that the correctness of basic collision detection mechanisms can be importantly improved by using a COLLIE server in additional to the above two modules.

IV. COLLISION INFERENCE ON FEEDBACK

One of the critical components among the COLLIE is appeal side or client side module which takes response from receiver such as AP in WLAN in in order to infer the cause of a packet loss (weak signal versus collision). COLLIE gears most of the judgment on the client device demanding minimal support from the receivers. This inference algorithm is having two versions. [11]:

1) Single-AP, which requires minimal support from the AP to which the client is associated to. Which will be applied to surroundings where a single AP offers wireless access to the entire establishment, such as in hotspots – coffee shops, apartments, etc.

2) Multi-AP, which forms on topmost level of the basic version, by leveraging input from two or more APs to provide very high accuracy in detecting collisions. This method applies to enterprise WLANs where multiple

APs belong to the same administrative domain. As with the elementary case, APs here also instrument a very negligible transmitting of information that assists in collision inference.

The procedure is estimated with the help of following metrics:

1) The chance of false positives – the cases where our procedure outputs a collision while the actual reason was weak signal.

2) The accuracy – the number of cases our procedure recognizes as collision over the total number of cases.

A. Single AP

This approach uses simply relaying back of data packet received in error. This transmitting is complete by the proposed receiver of the packet which is the AP to which the client is associated to. It is observed from previous study that due to receiver-synchronization by the physical-layer introduction, data that immediately follows the preamble is seldom found in error — this includes critical fields in the header such as the source and destination MAC addresses.

Thus, basically for all cases of packets received in error at the AP, it was possible to relay it back to the accurate associated client. By investigative these packets, we project an vital and satisfactory set of metrics including of bit-error rates (BER), error-per-symbol (EPS), symbol-error rates (SER), and joint distributions of these, which can act as strong pointers for packets suffering collision versus signal attenuation.

B. Multi AP

By using feedback from multi AP correctness of the basic method can be enhanced. This is achievable in an enterprise WLAN where APs operate in a synchronized style as a part of a sole network. Leadingly, we present a procedure that uses feedback from several APs to improve the accuracy of collision inference. Next, through trials, we show that such a method can yield good results in a practical setting

A procedure is presented by taking feedback from two or more APs, which detect such cases and improved the accuracy of collision inferensing. The COLLIE server implements a modest collision inference procedure that practices time-of-receipt information about packets acknowledged in the error at the Aps, and combines this with information about the data-rate of the packet received to make an inference.

V. USE OF COLLIE IN LINK ADAPTATION

In this section we are going to analyze the effective protocol used to enhance link adaptation mechanism based on Collie framework. The procedure implemented in this simple protocol is only to help as a reference implementation of COLLIE and is by no means is a best procedure. In short this analysis shows how COLLIE, [11] can be operative in building more intellectual link adaptation decisions leading to improvements in throughput.

This link adaptation protocol is used to utilize the collision inference results available from COLLIE in deciding how to best react to a packet loss and its consequent recovery. For e.g. if a client which transfers a packet to an AP, but the later accepts the packet in error. Using feedback mechanisms, the client can infer the cause of the packet error. Which, then, suckled into the link adaptation decision at the client. If collision cause the pack loss, then the precise adaptation mechanism is to perform exponential back off. In other case, if the packet loss is resolute to be due to a weak signal, then COLLIE mechanism can allow an existing rate adaptation algorithm to explore and find a better data rate to transmit future packets. In general, any existing rate adaptation algorithm, e.g., RRAA, AARF, Sample Rate, and ARF, can be used here to influence such feedback from COLLIE. It is explained in the Auto-Rate Feedback (ARF), which uses the history of previous transmission error rates to adaptively select the data rates used for future transmission. This means the sender attempts to transmit at a higher rate and if the delivery of this frame is unsuccessful after the number of consecutive successful transmission, it immediately falls back to previous supported mode, [11].

The response on the mistaken packet provides another occasion of optimization throughout re-transmission of an erroneously received packet at the AP selective retransmission of packet segments in error. By investigating the mistaken packet, the client distinguishes exactly the set of bits that were in error. If the amount of bits in error is little, then it is beneficial to create a Diff bitmap of these bits in error and to send only this Diff bitmap to the AP piggybacked with the next packet transmission. If the Diff bitmap is properly acknowledged, then the AP can rebuild the innovative packet thereby reducing the retransmission related costs associated with the client.

Table I summarizes the different implementation aspects of this protocol.

TABLE I. COLLIE -BASED LINK ADAPTATION TASKS IN DIFFERENT MODULES, [11].

COLLIE Module	Summary of tasks
Client	Collision inference, selective re-TX based on Diff
AP	Return packet in error, re-construct packet on Diff
Server	Facilitate multi-AP collision detection

The problem of loss diagnosis is a fairly difficult one, and there have been a few prior efforts in the wireless domain that have tried to address this problem. For example, Whitehouse [10] showed that if dualistic frames arrive at a receiver with certain timing characteristics (the second message arrives after the foreword and start bytes of the first message) and with certain levels of power (the second message has higher power level suggestively when compared to the first) then it was possible for the receiver to conclude that collision had, indeed, occurred.

VI. CONCLUSION

In this paper we have tried to analyze the issue present in packet losses in wireless network during transmission. Also the difficulties faced during the exact cause detection from collision and weak signal. From one of the previous mechanism we select COLLIE to analyze, also overview of COLLIE mechanism is analyzed. And conclude that this mechanism is proved accurate than any other mechanism in detecting packets in collision. We can also perform practical experiments for detecting the exact accuracy of Collie protocol.

We can use this in other problem domains for example, channel management, link adaptation, transmit power control etc., where understanding the link behavior is dangerous.

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