ON THE CELL BREATHING TECHNIQUE TO REDUCE CONGESTION APPLYING BANDWIDTH LIMITATION

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ABSTRACT

In order to effectively analyze or evaluate the performance of Wireless Local Area Networks (WLANs), it is important to identify what types of network settings can cause bad performance in the network when analyzing poor network performance, there is an important factor which is responsible for poor performance is when a number of users may obtain a much larger share of the available bandwidth in access point in a limited boundary as provided in the concept of cell breathing technique. In this paper, we proposed a new concept in which we can set bandwidth limitation so that no user can access data more than the specified limit for a particular access point. In this way the different users will get an efficient access over the network.

KEYWORDS

Access Point, Bandwidth, Bandwidth Limitation, boundary, Cell Breathing, Wireless Local area network.

1. INTRODUCTION

As according with the increasing demand of various services of wireless LAN, there are large number of users that rely on wireless network for many applications. Wireless networks are challenging systems because of the complex nature of signal propagation for both wired and wireless networks, they need to deal with links going up and down. However, in the wireless network, the frequency of link status changes is much higher than in today's wired network. wireless network architectures also plays an important role, the closer attention must be paid to link status changes and react faster to these changes. Wireless LAN administrators are often called upon to deal with the problem of sporadic user congestion at certain popular spaces (hot-spots) such as university campus within the network. In order to determine the performance of Wireless Local Area Networks (WLANs), it is important to identify what types of network settings can cause bad performance. The factors such as Low throughput, high packet loss rate, transmission delay for packets, increased retransmissions, and increased collisions, are the main attributes to look for when analyzing poor network performance. However,[1]According to IEEE 802.11 standard, the access point with the highest received signal strength indicator (RSSI) have large number of users associated with it, due to which the load is increased at this access point and the nearby access points either remain idle or contain very less number of users. The overall performance of the network degrades by this activity for which load balancing schemes have been applied to distribute load among different access points.

CSMA/CA (carrier sense with collision avoidance) is used as a medium access control scheme. The basic principles of CSMA/CA are listen before talk and contention. CSMA/CA is used as a medium access control scheme in delivering a best effort service, but no bandwidth and latency guarantee. The main advantages are that it is suited for network protocols such as TCP/IP, adapts quite well with the variable condition of traffic and is quite robust against interferences. CSMA/CA scheme is used for sending RTS/CTS frames which does not occur unless the packet size exceeds particular threshold. If the packet size of the node wants to transmit is larger than the threshold, the RTS/CTS handshake gets triggered. Otherwise, the data frame gets sent immediately. IEEE 802.11 RTS/CTS mechanism helps to solve this problem only if the nodes are synchronized and packet sizes and data rates are the same for both the transmitting nodes. When a node hears an RTS from a neighboring node, but not the corresponding CTS, that node can deduce that it is an exposed node and is permitted to transmit to other neighboring nodes. If the nodes are not synchronised (or if the packet sizes are different or the data rates are different) the problem may occur that the sender will not hear the CTS or the ACK during the transmission of data of the second sender.

2. COGNITIVE RADIO

The term cognitive radio is derived from "cognition".[6]Cognitive radio is an intelligent wireless communication system that is aware of its surrounding environment (i.e., outside world) and uses the methodology of understanding-by-building to learn from the environment and adapt its internal states to statistical variations in the incoming radio frequency stimuli by making corresponding changes in certain operating parameters (e.g., transmit power; carrier frequency, and modulation strategy) in real-time, with two primary objectives in mind, highly reliable communication whenever and wherever needed and efficient utilization of the radio spectrum.Cognitive radios are fully programmable wireless devices that can sense their environment and dynamically adapt their transmission waveform, channel access method, spectrum use, and networking protocols as needed for good network and application performance. According to Vanhatupa et al. [4], When there are large number of access points which had been installed near to each other then the interference occurs among these access points, To reduce this interference, adjustment of the transmission power is done. This work focuses on adjusting the AP's transmission power in order to dynamically modify the cell boundaries to improve load. There is a another problem which has been observed is that of a improper sharing of bandwidth in context of cell breathing technique. The number of user get increased in the same shrinked boundary dynamically due to which, rest of the users will have to suffer by facing many problems such as limited connectivity, delay, data loss, etc.

2.1 Types of cognitive radio

According to Dr. john M. Chaplin[7] Cognitive Radio(CR) is generally defined as a type of radio in which communication systems are aware of their environment and internal state that can make decisions about their radio operating behaviour based on that information and predefined objectives.

The three levels of CR systems:

A basic CR is a radio system that senses and adapts to its environment, but does not necessarily use explicit reasoning or learning techniques. A more sophisticated form of basic CR is a dynamic spectrum access network, where nodes exchange spectrum measurements and run a distributed algorithm to decide which channels are safe for secondary use.

A reasoning CR is system and that adds deductive inference to improve on a basic CR. for example, the DARPA XG radio automatically determines legal limits on secondary spectrum operation through deduction from rule sets and information about current conditions.

A Learning CR is a system that updates its system making based on the results of prior actions. standard AI techniques that may be used in learning cognitive radios include case based learning and knowledge based learning.

2.2. Cell Breathing Technique in Cognitive Radio

In CDMA cellular networks, the coverage and capacity of a cell are inversely related with each other[9]. The increase of the number of active users in a cell causes the increase of the total interference sensed at the base station. Therefore, in congested cells, users need to transmit with higher power to maintain a certain signal-to-interference ratio at the receiving base station. As the users in a congested cell increase their transmission power, they also increase their interference to the neighbouring cells since all cells use the same frequency band in CDMA networks. As a result, the overall network capacity may decrease[11]. Furthermore, since the maximal transmission power of the users is bounded, the users who are far from the base station may experience poor services. This so-called near-far problem may result in imbalanced cell handoff boundaries for reverse and forward links, as the latter is determined by the strength of the pilot signal of the base stations, independent of the interference[12]. In other words, the cell handoff boundary of the reverse link is tighter than that of the forward link. To overcome these problems the cell breathing approach was proposed by Togo et al [11] and Jalali [12], independently. This approach shrinks the cell size of congested cells and balances the forward and reverse link handoff boundaries by reducing the pilot signal transmission power of the corresponding base stations.The technique known as cell breathing in cognitive radio in which we have large number of users, According to Rafiza Ruslan[1] transmission power adjustment which affect the cell boundaries which is decided by the cognitive radio as it has the intelligent capability to decide under what and which conditions transmissions takes place. If the transmission power is Increased it will enlarge the cell boundaries and if the transmission power is reduced it will make the boundaries shrink or compress. Decreasing the transmission power of an AP(access point) reduces the load of a basic service set (BSS).Cell-breathing is used for Controlling the size of the cell which is one of the method that been proposed by other researchers.[26]According to Olivia Brickley, Susan Rea, A high number of collisions results in a high number of retransmission attempts and hence, longer backoff periods.The network attempts to handle user service requests by readjusting the load across all AP's.If an AP cannot accommodate the new session request, the network suggests a location in the network where the request can be satisfied. In [27], three possible AP states: under-loaded, balanced and overloaded, are defined. The throughput per AP is used as a load metric in deciding the AP state. The node uses this information when choosing an AP to associate with.Cell breathing technique is explained in the following figure 1,where we have large number of users and access points associated with them.

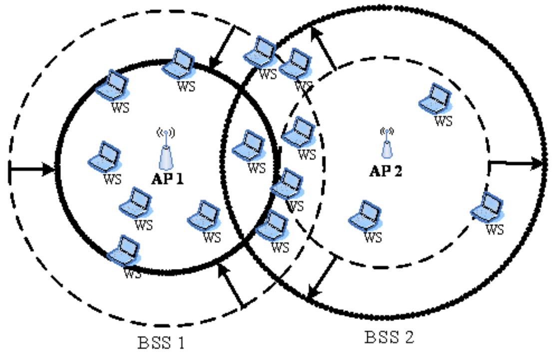

Figure 1. Cell breathing technique

As with this technique the number of users are being controlled by the adjustment of power level that will effectively change the load of the APs as shown in the figure 1, AP1 and AP2 are two different access points and there are number of wireless stations trying to access these access points, there are two boundaries one with dotted circle and another with darked circle, for example, In access point A1,There are 11 wireless stations inside the dotted boundary so to reduce strength of wireless stations the boundary has been shrinked shown by dark circle in the figure 1. By doing this the users are being shifted from heavily load access point AP1 to the another access point AP2 which is not that much loaded which will lead to load distribution of the access points. Similarly with interference matter, if there are less number of active Wireless Stations, the interference will also be less. Cell breathing technique reduces congestion But still there exist a problem which has not been resolved i.e proper utilization of bandwidth by every user, if we have large number of users even after shrinking the boundary in the the same area which are trying to access the same access point due to which the network may get choked. As with leaky bucket algorithm, we have a bucket filled with water and there is a hole in the bucket, if we increase the pressure of water then there comes a problem of overflow because water is flowing at constant rate from the hole but the pressure has been increased. This sudden increase in pressure of water will lead to overflow which resembles with the problem of network congestion. In the very similar manner different users are requesting for bandwidth more than the bandwidth of a particular access point then these large number of users are not being respond properly because there is no more bandwidth available and due to increase in traffic the users starts receiving message like reload page, page not found, No Internet Connection etc. The user even under connectivity behaves like, it is not connected to the network. To avoid such kind of problems, we have a method to resolve this problem.This method is used for sharing of bandwidth in an efficient and intelligent manner so that there may not be any adverse effect on the network performance .

3. BANDWIDTH LIMITATION

The main factor we are focusing here is Bandwidth i.e data transfer rate . Bandwidth is the range In this way the bandwidth is shared properly with less problems.with cell breathing technique the boundary shrinks in case of large number of users and the boundary of nearby access point enlarge but there still exist a problem for example if within the same compressed area the number of users get increased as shown in the figure 1, as it can only shrink boundary but can not stop users to enter in that shrinked area so this leads a problem of congestion as shown in figure 2, in which we have dotted circle showing the original boundary of the access point A1 and A2 and the darked circle shows that the boundary is shrinked and enlarged. There are several workstations which entered into the same shrinked boundary which leads of frequencies used for transmitting a signal. In this approach, we have different access points in which, number of users are trying to access network. The performance of the network is enhanced by providing bandwidth limitation on each and every user so that it may not access more than the specified bandwidth, in this way large number of users can participate in the network, there will be no interference of other users, and the data transfer will be accurate and there will be very less chance of congestion in the network. The user with the more bandwidth requirement will not be allowed to get access over it,in case if the access point is having no more bandwidth to distribute. to congestion, so to avoid this problem of congestion we have set bandwidth limitation to users.

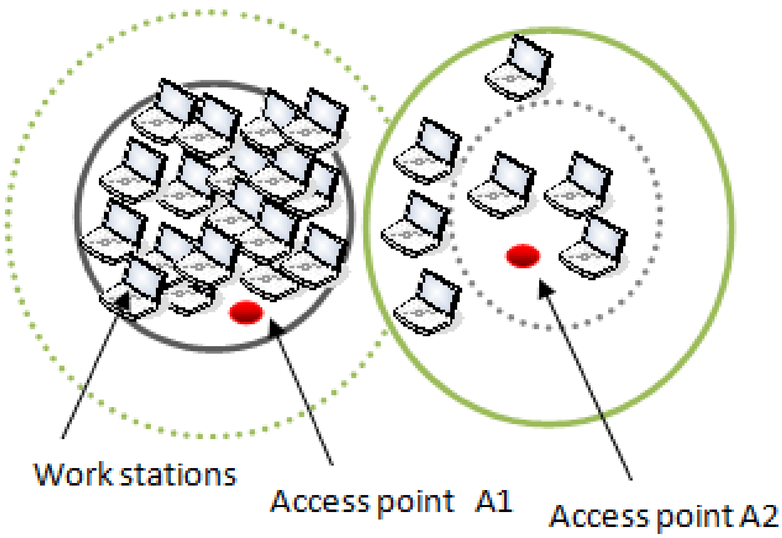

Figure 2. Large number of workstations within the shrinked access point A1

For example, if a particular access point have fixed bandwidth of 10MB,it will keep on allocating bandwidth until its bandwidth distribution leads to 9MB but as the stage comes when it has only 1MB left with it, it will stop new users to get access and the new users will not be allowed to get access over the network, the 1MB bandwidth is stored for users who are already in the network so that if any of the user among these already connected users have need of more bandwidth so that it may provide it, more probably this 1MB bandwidth is utilized for maintaining connectivity of those users who are already connected to the network as shown in the given figure, in which users are demanding for some bandwidth in and the access point should have intelligency about how to distribute bandwidth in a dynamic situation when there is a sudden increase in the network traffic in increased number of users. As the double cross symbol in the figure, is an indication to not to allow any new user as it does not have any more bandwidth to distribute. This is the way in which we can reduce congestion in a better manner. This approach is an improvement in the cell breathing technique as the entry of new users have been restricted for a particular access point in wireless LAN to avoid Congestion. In this way many problems such as packet loss, retransmission, limited connectivity, improper data transfer, delay and traffic can be minimized.

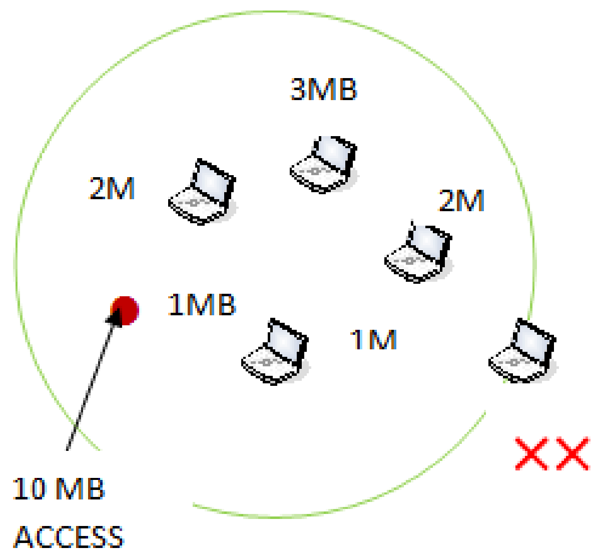

Figure 3. An example, showing how new user is restricted to enter into the network.

4. CONCLUSION AND FUTURE WORK

This paper presents a cell breathing technique with additional bandwidth limitation concept in cellular WLAN that performs load balancing with the aim to find an optimal solution for congestion control, limited connectivity, delay. The problems such as Low throughput, high packet loss rate, transmission delay for packets, increased retransmissions, and increased collisions loss, for wireless LAN is improved. This can be done by proper bandwidth sharing with cognitive radio techniques for decision making power adjustment level. This removes dynamic congestion problem which occur suddenly.We have highlighted concerns and opportunities for performance enhancement with bandwidth limitation used in WLAN. Future work will aim to perform more on cell breathing technique with another factors or parameter considerations according to the user requirements which can enhance network performance.

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