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Min-Max and Limited Knowledge Algorithmic Approach for Load Balancing

Rishikesh B. Pansare[1*] and I.R.Shaikh[2]

[1*, 2]*Department of Computer Engineering, SND COE & RC, Yeola, Savitribai Phule Pune University*

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***Abstract*—** Network overload is one of the key challenges in wireless LANs. This goal is typically achieved when the load of access points is balanced. Recent studies on operational WLANs, shown that access point's load is often uneven distribution i.e. it will be a crucial task to handle the load of overloaded server. To identify such overloaded server many kind of techniques like load balancing have been proposed already. These methods are commonly required proprietary software or hardware at the user side for controlling the user-access point association. In this proposed system we are presenting a new load balancing method by controlling the size of WLAN cells, which is conceptually similar to cell breathing in cellular networks. This method does not require any modification to the users neither the IEEE 802.11 standard. It only requires the ability of dynamically changing the transmission power of the AP beacon messages. We have develop a set of polynomial time algorithms which find the optimal beacon power settings which minimizes the load of the congested access point. We have also considered the problem of network-wide min-max load balancing. Simulation results show that the performance of the proposed method is comparable with or superior to the best existing association-based method.

***Keywords*—** Load balance in wireless LAN, Power reduction, assign access point assign to Wireless LAN

I. INTRODUCTION

A wireless LAN connects two or more devices using some wireless distribution method and usually provides a connection through an access point to the wider Internet. This gives users the mobility to move around within a local coverage area and so that user will remained connected to the network. Most modern WLANs are based on IEEE 802.11 standards, marketed under the Wi-Fi brand name. Wireless LANs have become popular in the home due to ease of installation, and in commercial complexes offering wireless access to their customers; Large wireless network projects are being put up in many major cities.

1.2 Types of Wireless LAN (WLAN):

A) Peer-to-peer:-An ad-hoc network which is also known as Wi-Fi Direct network is a network where stations communicate only peer to peer. There is no base and no one gives permission to talk. This is accomplished using the Independent Basic Service Set (IBSS). A peer-to-peer (P2P) network allows. Wireless devices to directly communicate with each other.

Wireless devices within range of each other can discover and communicate directly without involving central access points. This method is typically used by two computers so that they can connect to each other to form a network. If a signal strength meter is used in this situation, it may not read the strength accurately and can be misleading, because it registers the strength of the strongest signal, which may be the closest computer.

Corresponding Author: *Rishikesh B. Pansare*

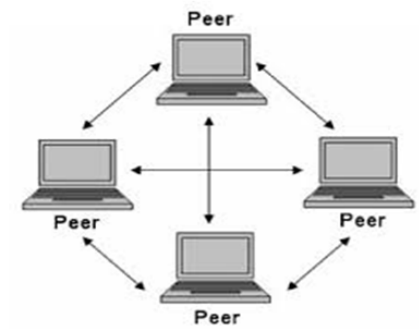

Fig. 1.1 : Peer-to-Peer network

B) Bridge:

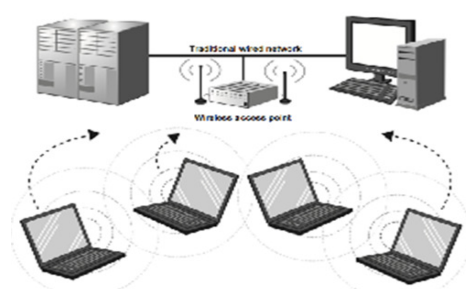

Fig 1.2: Wireless network

A bridge can be used to connect networks, typically of different types. A wireless Ethernetbridge allows the connection of devices on a wired Ethernet network to a wireless network. The bridge acts as the connection point to the Wireless LAN.

C) A Wireless Distribution System:

A Wireless Distribution System enables the wireless interconnection of access points in an IEEE 802.11 network. It allows a wireless network to be expanded using multiple access points without the need for a wired backbone to link them, as is traditionally required. The notable advantage of WDS over other solutions is that it preserves the MAC addresses of client packets across links between access points.

Wireless technologies opened the way to seamless and ubiquitous service delivery. In recent years, network bandwidth and quality has been extremely improved in a speed even much faster than the enhancement of computer performance. Numerous communication and computing tasks in the fields can be integrated and applied in a distributed system in now a days. However, those resources are heterogeneous and dynamic in distributed systems connecting a broad range of resources. This method has proposed a hybrid load balancing policy to maintain performance and stability of distributed system. Load balancing is found to reduce significantly the mean and standard deviation of job response times, especially under heavy and/or unbalanced workload.

Fig 1.3: Wireless connectivity

Network overload is one of the main challenges in wireless LANs (WLANs). This goal is classically achieved when the load of access points (APs) is balanced. Modern studies on operational WLAN have shown that AP load is often uneven allocation. To rectify such overload, more than a few load balancing schemes have been proposed.

These methods are commonly required proprietary software or hardware at the end side for calculating the user-AP association. In this study we present a new load balancing method by controlling the size of WLAN cells (i.e., AP's coverage range), which is abstractly similar to cell breathing in cellular networks. This method does not require any modification to the users neither the wireless standard. It only requires the ability of dynamically changing the transmission power of the AP beacon messages. We have formeda set of polynomial time algorithms that locate the optimal beacon power settings which minimize the load of the most congested AP. We also judge the problem of network-wide min-max load balancing.

This study proposed a hybrid load balancing policy to maintain performance and stability of distributed system. Load balancing is found to reduce significantly the mean and standard deviation of job response times, especially under heavy and/or unbalanced workload. Network overload is one of the key challenges in wireless LANs (WLANs).

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Fig 1.4: wireless connection with AP

Load balancing is a computer networking method to distribute workload across multiple computers or a computer cluster, network links, central processing units, disk drives, or other resources, to achieve optimal resource utilization, maximize throughput, minimize response time, and avoid overload. Using multiple components with load balancing, instead of a single component, may increase consistency through redundancy.

This method does not require any modification to the users neither the wireless standard. It only requires the ability of dynamically changing the transmission power of the AP beacon messages. We build up a set of polynomial time algorithms that locate the optimal beacon power settings which minimize the load of the most congested AP. We also consider the problem of network-wide min-max load balancing.

II. RELATED WORK

Load balancing is a computer networking method to distribute workload across multiple computers or a computer cluster, network links, central processing units, disk drives, or other resources, to achieve optimal resource utilization, maximize throughput, minimize response time, and avoid overload. Using multiple components with load balancing, instead of a single component, may increase reliability through redundancy.

Recent studies [2], [3] on operational IEEE 802.11 wireless LANs (WLANs) have shown that traffic load is often unevenly distributed among the access points (APs). In WLANs, by default, a user scans all existing channels and associates itself with an AP that has the strongest received signal strength indicator (RSSI), while being oblivious to the load of APs. As users are, typically, not evenly distributed, some APs tend to suffer from heavy load, while their adjacent APs may carry only light load. Such load imbalance among APs is undesirable as it hampers the network from fully utilizing its capacity and providing fair services to users.

[1], Cell breathing is a mechanism which allows overloaded cells to offload subscriber traffic to neighboring cells by changing the geographic size of their service area. Heavily loaded cells decrease in size while neighboring cells increase their service area to compensate. Thus, some traffic is handed off from the overloaded cell to neighboring cells, resulting in load balancing.

[5], Cell breathing is the constant change of the range of the geographical area covered by a cellular telephone transmitter based on the amount of traffic currently using that transmitter. When a cell becomes heavily loaded, it shrinks. Subscriber traffic is then redirected to a neighboring cell that is more lightly loaded, which is called load balancing.

The load in a WLAN is rarely evenly divided among all access points. Most mobile nodes may be associated with one access point while neighboring access points could be lightly loaded or idle. Terminals associated with the overloaded AP will experience high rates of collision and large delays when contending for medium access. By redistributing some of the mobile nodes to neighboring AP's, the load on the network becomes more evenly distributed, allowing an increase in overall network throughput and a decrease in MAC delay. Load balancing can be a useful means of improving the network performance during congestion periods.

Several studies of [4], [6], [7], [8], [9], [10], In this proposed system, optimal load allocation strategies are proposed for a wireless sensor network which is connected in a star topology. The load considered here is of arbitrarily divisible kind, such that each fraction of the job can be distributed and assigned to any processor for computation purpose. Divisible Load Theory emphasizes on how to partition the load among a number of processors and links, such that the load is distributed optimally. Its objective is to partition the load in such a way so that the load can be distributed and processed in the shortest possible time.

The load contribution may be as simple as the number of users associated with an AP or can be more sophisticated to consider factors like transmission bit rates and traffic demands. Consequently, various load balancing and max-min fairness objectives can be achieved, such as bandwidth fairness, time fairness, and weighted fairness.

Our scheme does neither require any special assistance from users nor any change in the 802.11 standard. It only requires the ability of dynamically changing the transmission power of the AP beacons. Today, commercial AP products already support multiple transmission power levels, so we believe that this requirement can be relatively easily achieved. Depending on the extent of available information, we consider two knowledge models. The first model assumes complete knowledge, in which user-AP association and AP load are known a priori for all possible beacon power settings. Since such information may not be readily available, we also consider the limited knowledge model, in which only information on the user-AP association and AP load for the current beacon power setting is available.

Proposed system uses following algorithm:

1. Complete Knowledge Algorithm.
2. Limited Knowledge Algorithm.
3. Min-Max Algorithm

III. PROBLEM STATEMENT

A commonly used approach to evaluate the quality of a load balancing method is whether it generates a min-max load balanced solution. Informally, we say that a network state is min-max load balanced if there is no way to reduce the load of any AP without increasing the load of another AP with same or higher load. We define the load vector Y = {y1 . . . . y|A|} of a state S to be the |A|- tuple consisting of the load of each AP sorted in decreasing order.

Complete Knowledge Algorithm

The algorithm starts with the maximal power state in which all APs transmit with the maximal power. Clearly, this state dominates all other state and, in particular, the optimal states. Based on the calculated set B, the algorithm determines whether it needs to apply another set power reduction operation or an optimal state is found. To this end, it utilizes two termination conditions.

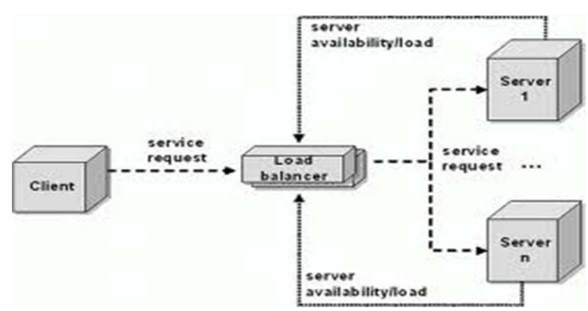

Fig 1.5: Architecture of server connection with client

The first condition checks if B = A, it follows that reducing the transmission power of all APs does not change the user-AP association. Consequently, it cannot reduce the maximal AP load. In reality, this condition is satisfied when the loads of all APs are balanced and any power reduction operation will cause some APs to be congested. The second condition checks if the bottleneck set B contains an AP that transmits with the minimal transmission power. In such case, the power level of all APs in B cannot be equally decreased and the algorithm halts. Such a case, typically, occurs when the AP load is not balanced and the algorithm attempts to reduce the maximal load by repeatedly reducing the power of the congested APs.

Limited Knowledge Algorithm

In limited knowledge algorithm, unlike the complete knowledge case, in this model, the algorithm cannot calculate bottleneck set in advance. According to it, as long as a network state is suboptimal and it dominates an optimal solution, a sequence of set power reduction operations of congested APs converges to the optimal state. Thus after each iteration, the algorithm updates the APs beacon power settings and evaluates the AP loads. This process raises the problem of determining a “termination condition” when an optimal solution is found. Without the termination condition, we may end up with a suboptimal solution. To this end, we use an optimal state recording approach that keeps record of the network state with the lowest congestion load found so far. We define two variables for recording. The first is S that keeps the recorded state and the second is Y that keeps the congestion load value of state S, termed the recorded congestion load.

The algorithm works as follows. It starts with the maximal power state and it initializes the recorded state S and the recorded congestion load Y accordingly. Then, the algorithm, iteratively, calculates the set D of congested APs and as long as the set D does not contain any AP with minimal power level, it performs a set D power reduction operation. After each iteration the algorithm evaluates the congestion load of the new state and if that load is lower than the recorded congestion load, then the algorithm updates its variables S and Y correspondingly. At the end, the algorithm sets the AP power levels according to the recorded network state.

Flow of Proposed System:

- First of all clients will initiate their requests towards the server
- We will initialize the capacity of server
- This capacity will decide the capability of server i.e. how many requests that server will handle
- Then we assume that serve is overloaded
- We will manage the overloaded server with the help of few algorithms like complete knowledge, limited knowledge, and min-max algorithm
- In this way we will manage the capacity of the server

IV. ALGORITHM USED FOR IMPLEMANTATION

In this Research Work, we are going to use following algorithms.

1. **Complete Knowledge Algorithm.**
2. **Limited Knowledge Algorithm.**
3. **Min-Max Algorithm**

Complete Knowledge Algorithm

The algorithm starts with the maximal power state in which all APs transmit with the maximal power. Clearly, this state dominates all other state and, in particular, the optimal states. Based on the calculated set B, the algorithm determines whether it needs to apply another set power reduction operation or an optimal state is found. To this end, it utilizes two termination conditions.

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Min-Max Algorithm

The algorithm iteratively finds a min max priority-load-balanced state that yields the optimal load vector Y. At any iteration m, m ε [1…|A|], we call a routine to calculate a network state that minimizes the priority load of the mth coordinate of the load vector. The routine needs to satisfy two requirements:

Requirement 1. The initial state of each iteration, m, must dominate the optimal state.

Requirement 2. The calculated network state at the mth iteration should not affect (increase) the load of the APs that their load have already been determined by the previous iterations.

To meet Requirement 1, the algorithm starts with the maximal power state in the first iteration and we need to ensure that each iteration ends with dominating state of the optimal solution. Moreover, to meet Requirement 2, we define a set of fixed APs, F, whose load have already been determined by previous iterations. Initially, the set F is empty and at each iteration, a new AP is added to it, until F contains all the APs. We refine the definition of the congestion load Y as the maximal load on any no fixed AP.

V. IMPLEMENTATION AND PERFORMANCE MEASURE

Dynamic Power Assignment

We inspect how to control power to optimize throughput based on given client demands. When clients' demands are usually changing, it is often desirable to find an assignment without requiring many clients to handoff to different APs, since the overhead of handoff is non-negligible.

VI. CONCLUSION

While current system directly use server APs the load wireless LAN server is increased. We are presenting our implementation for load balancing in wireless LAN by using Min-Max algorithm and Limited knowledge algorithm. Our system is balance the load by automatically assigning APs in separate group.

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