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Cell Breathing Mechanism Using Networks with Load Balancing Approach

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Abstract:
In this paper, we establish a closed form formula of the other-cell interference factor f for omni-directional and sectored cellular networks. This objective is typically achieved when the load of access points is well-adjusted. Recent studies on operational WLANs, shown that AP load is often uneven distribution. To correct such overload, several load balancing schemes have been suggested. . Distance, arrival rate, bandwidth and non-orthogonality factor of the signal are considered for making the call acceptance decision. The paper demonstrates that fuzzy logic with the cell breathing concept can be used to develop a algorithm to achieve a better performance evaluation.

1.Introduction

In cellular systems, the geographical area covered by a base station is not constant. The size of a cell depends on the traffic managed by the base station: a cell shrinks when its load increases. Indeed, the higher is the number of users in the cell, the higher is the interference. As a consequence the lower the cell radius becomes. This is the phenomenon of cell breathing. This behaviour is particularly pronounced in CDMA networks and increases the complexity of network design. When coverage holes appear, the operator can for example sectorize existing omni-directional sites or densify the BS.

New researches are reported in implementing in IP based CDMA network . Multimedia applications are considered in Zhang et al. state that a fixed channel reservation scheme increases new call blocking probability and highlights the need of dynamic channel reservation . In , Ayyagari and Ephremides have developed some optimal strategies to maximize the throughput for multimedia traffic and thereby improving the capacity of the system. A CAC algorithm has been proposed for multimedia services by assigning different CAC thresholds to different call classes in . Kim and Han in proposed a CAC algorithm for multiple types of services using total received power as threshold taking into account cell load and SINR. Higher priority is given to voice traffic by setting higher threshold compared to data traffic.

2. System Model

2.1.WCDMA Network Model

M-Cell system model is used in evaluating the performance of the proposed scheme. Each cell is divided into N sectors . each is served by a controllable directional smart antenna. Sectors are virtually divided into L concentric supporting levels where each supporting level corresponds to a pilot channel transmission power level. These cells are connected to a single Radio Network Controller (RNC) which governors the radio resource management functionalities of WCDMA systems.

2.2.Mobile User Signal Model

The path loss calculation of the transmitted signals from users in the network has been modeled based on an outdoor pedestrian radio propagation model as defined in where PLMax is the maximum allowed path loss for a transmitted signal, d is the distance distance between transmitter and receiveand frequency is the system center frequency.

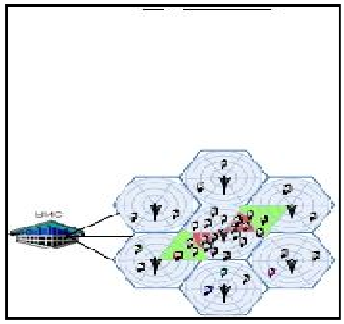

Figure 1 : WCDMA network model

2.3.Protocol Module

The Protocol Module contains the heart of the simulationprogram. It consists of 4 main functions namely“Generate”,“Propagate”, “Receive” and “Control”. These functions in turncontain numerous sub-functions.In general, the sequence of the program shall be top-downstarting (after “Initialize”) from “Generate” to “Propagate”,“Receive” and finally “Control”. Each main function will bestarted with a “Trigger” (a call) from the main controller. Uponcompletion of its task, it will response to the main controllerwith a status of “Ready” (a return).

Similarly, the sub-functionswithin each main function will be started and completed in thesame way. Fig. 3 shows the highest level data flow diagram ofthe protocol moduland shall explain the design clearer. Itshows the flow of data after “Initialize”. A description of thefunctions and its sub-function, ithe sequence of the flow of the simulation are decribed.

3. Load Balancing

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

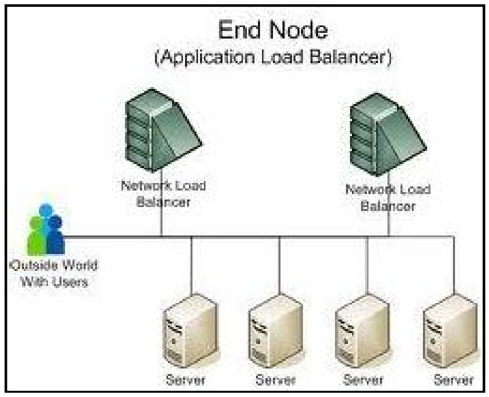

Figure 2: Network load balancing load

A variety of scheduling algorithms are usedby load balancers to determine which backend serverto send a request to. Simple algorithms includerandom choice or round robin. More sophisticatedload balancers may take into account additionalfactors, such as a server's reported load, recentresponse times, up/down status (determined by amonitoring poll of some kind), number of activeconnections, geographic location, capabilities, or how much traffic it has recently been assigned.

3.1.Load Balance Problem

One AP may support many WS, while some neighbor AP may support few or no stations. This asymmetry in load between AP causesa high probability of packet loss in AP 1 and thus and overall network degradation compared to AP 2, 3. Whether applying a WS distribution algorithm resultsin a load balance for each AP depends on the natureof the wireless LAN Problem becomes more difficultdue to dynamic network topology changes when theWS are roaming around.As according with the increasing demand ofvarious services of wireless LAN, there are large numbers of users that rely on wireless network for many acess points .Wireless systems are the challenging systems because of the complex nature of the signal propagation for both wired and wireless networks they need to deal with links going up and down.

4. Cell Breathing

During the dimensioning process, the cell radius is determined by taking into account

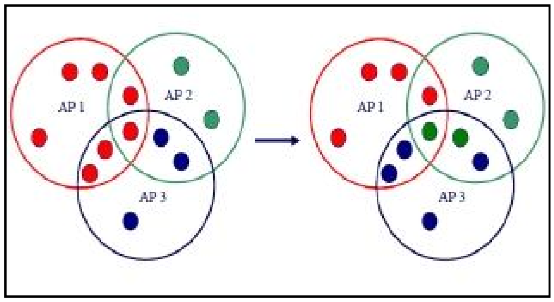

Figure 3: Various access points in load balancer

Indeed, the provider defines the maximum outage probability it accepts for his network, and then he calculates the number of base stations needed to cover a given zone. Considering a maximum value of the outage probability, we determine the decrease of cell radius when the load of the cell increases (i.e. the number of mobiles increases).

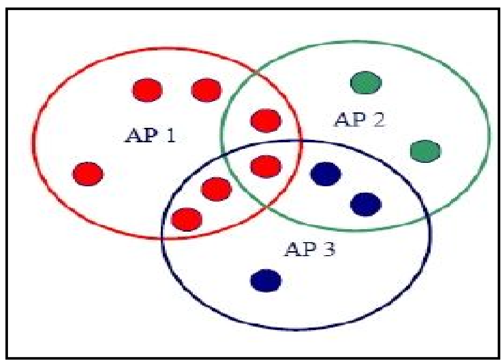

Figure 4: Load balance Problem before Balancing

4.1.Effect Of Cell Breathing And Sectorization

Numerical values in Figure shows the kind of results we are able to obtain instantaneously thanks to the simple formulas derived in this paper for voice service ($\gamma u*$ = −16 dB), ϕ = 0.2, α = 0.7, η = 3 and Rc = 1 Km in a CDMA network.Antenna gain pattern is G(θ) = −min 12[(θ3θdB)2, Am] ,with Am = 20 [19], where θ3dB is the angle for which the

received power is divided by 2 and characterizes the beam width.

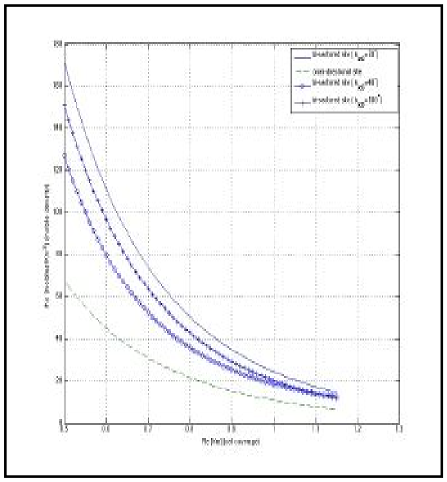

Figure 5: Mobile density as a coverage function

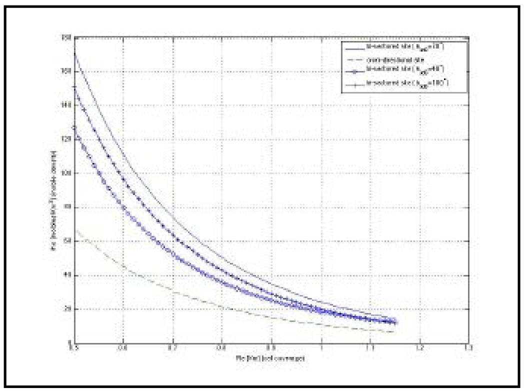

Figure 6: Beam width in BS density

Figure shows the mobile density as a function of the coverage range of base stations for both omni-directionnal and sectored sites, and, in the latter case, for different antenna beam width In this figure, the BS density is supposed to be constant, i.e., the inter-BS distance 2Rc is constant. The curves show that the coverage range shrinks when the traffic increases. We observe that for omni directional cells the maximum density of mobiles is 10 mobiles/Km2 for a coverage range of Re = 1 Km, and when the density is 20 mobiles/Km2 the coverage range reaches only 0.8 Km. As a consequence since the inter-BS distance is constant (= 2Rc), the zone is not completely covered.

5. Simulation with one cell

The program that developed is next used to illustrate the cell breathing effect. For the studies of cell-breathing effect, RPCAC will only be active during the transient state of the simulation. This is to ensure that steady state has been reached

before any simulation results are taken. RPCAC will make inactive upon the system reaching stability and when the

location and arrival of MS is to be manipulated to show cell- breathing, i.e., in other words, all newly generated calls are

allowed into the system. For simplicity, we also consider only single class (conversational real time) service.

6. Scenario

In this simulation, the coverage area recorded is specific on the downlink for call-type of 12.2kbps. A single cell is locatedat the centre of the simulation area, which is a 100□□ 100 grid square. Each grid division corresponds to a distance of 120m.MS and its class of service are distributed randomly throughout the whole simulation area. The total number of MS involved in the test is 500. The purpose of having this large number of MS which a single cell certainly cannot handle is to ensure that there is a definite possibility of overloading the network such that cell-breathing can take place.

As the average call durationfor voice calls is estimated to be 120s, we assume stability of the system to be reached by then. Upon the system reaching stability, all MS will move towards the BS at a speed of 12m/s. Cell-breathing can then be observed and analyzed. Here,coverage is defined as the maximum distance from a BS where SIR is above the required threshold and hence reliable service can be provided.

Table below shows a summary of the simulation condition.

Parametres	**Values**
No.of BS	1
No.of MS	500
Simulation time step	10ms per step
Map scale	120m per division

Table 1

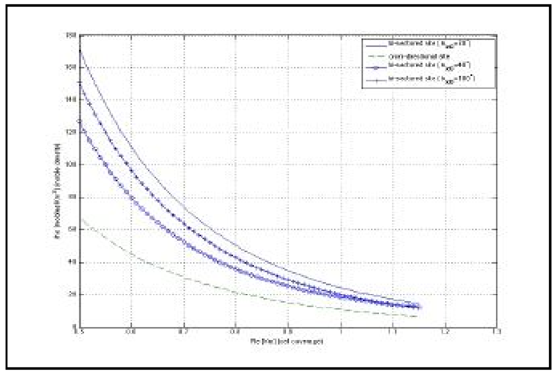

Figure 7: Graph showing simulation condition

7. Results and discussion

It shows the graphical plots of coverage distance with simulation time steps. upon reaching steady state after the start of the simulation, the radius where reliable signals can be provided by the BS is approximately 3100m. It can be seen that with the onset of convergence of MS towards the BS, there is generally a decline in the radius of reliable coverage. A drastic decline in the reliability is observed when all MS have moved within 1800m (each simulation time step in the figure is 20ms) from the BS. This sharp drop in radius shows that the system requires a significant number of MS, active at the same time, to trigger off cell-breathing which in this case is a great drop in area where reliable signals can be provided. The resulting radius where reliable signals can be provided by the BS is then approximately 2775m, which corresponds to a 10% decrease in radius.

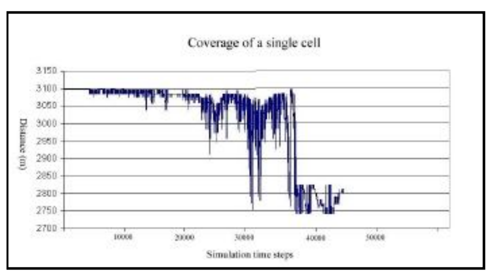

Figure 8 :Coverage plot for 1 single cell

The low percentage of successful calls by MS stems from the fact that there is only 1 BS supporting such a large number of MS. One would not expect to see this in practice because we purposely overload the system to observe the cell breathing impact. In practice, proper cell planning would require more BS to support the number of MS and service requests.

8. Implementation Issues For Proposed System

8.1.Various Issues To Be Discussed

- Finding the suitable power assignment at APs to routinely achieve load balancing is a stimulating problem.
- When client demands are same we can always calculate such a power assignment, we can set the powers of all APs in such a way that, after all the clients choose their AP.
- We only assume that the received power isproportional to the transmission power, but do not assume any relationship between the received power and the distance. best power configuration resulting from iterative.
- We start by setting the powers of all APs to thehigh
- est value and then we choose the ly decreasingthe power of overloaded APs. This approach is intuitive and easy to implement.
- It only requires knowledge of the APs' Load,which is easy to obtain. We show that if there exists apower assignment such that each AP has capacity toaccommodate the demands assigned to it, our algorithm can find the solution in a polynomial time.

8.2.Load Balancing Using Cell Breathing

Under heavy load conditions, the rate of collisions and hence the number of retransmissions escalates. This causes a serious or at least notable decrease in network throughput and hence reduced QoS because more and more bandwidth is consumed for frame retransmissions. Overloading at an AP also has an affect on the delays experienced at the MAC layer.A high number of collisions result in a high number of retransmission attempts and hence longer off periods.It will result in the deterioration of the QOS delayed by this sensitive application

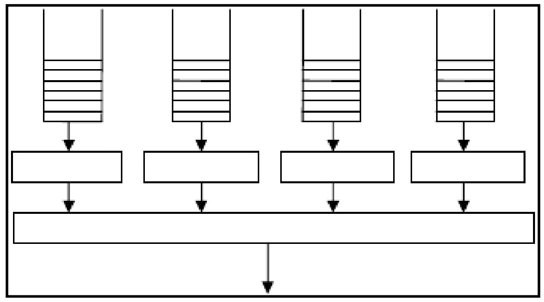

Figure 9: Each AC has its own transmit queue and contends for the independently of other the ACs

If the load becomes too high in one BSS and QoS degrades to an intolerable level, then the AP attempts to shed users by reducing it's transmit power, causing adecrease in the cell size. . Reducingthe transmit power will have the effect of shrinking coverage area of the AP. On the other hand, if the transmit power is increased then the cell breathing technique, if applied to WLAN, gives network ability .

9. Conclusion

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.

10. Future Work

It gives the network the ability to adapt to dynamically changing load conditions in a distributed fashion. Such a property is most desirable, particularly in the case of nomadic users whose mobility pattern is highly variable and causes hotspot movement throughout the network. Another benefit of this scheme is that load balancing is transparent to network users.They are completely unaware of the transmit power changes and resulting procedures with acess points.

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