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SINR CALCULATED USING THE UPLINK POWER CONTROL TECHNIQUES OF FEMTOCELLS

Madapati D H krishna*1 Boppana Ramu2
*1Department of Electronics and Communication Engineering, Swarnandhra College of Engineering and Technology, Narsapur, (West Godavari), Andhra Pradesh, India.
2Department of Electronics and Communication Engineering, Swarnandhra College of Engineering and Technology, Narsapur, (West Godavari), Andhra Pradesh, India.

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ABSTRACT
Femtocells are relied upon to expand system limit, broaden macrocell scope, and present new administrations. Since Femtocells offer the same recurrence band with macrocells by and large, the femtocell base station (BS) must moderate the obstruction with macrocells additionally guarantee scope in client premises. Be that as it may, ordinary femtocell BS transmit force setting have not satisfactorily represented the impedance with neighboring macrocell versatile stations (MSs), prompting little femtocell client all through. In the paper, we portray a versatile force level setting plan i.e. Disseminated Power Control calculation to relieve the impedance of MSs in the premise of the got force levels. In DPC, every pair of transmitter (e.g., a MS) and recipient (e.g., the BS) does not have to know the transmit power or channel nature of whatever other pair. At every time opening, everything it needs to know is the real SIR it right now accomplishes at the beneficiary. At that point, by taking the proportion between the settled, target SIR and the variable, genuine SIR worth measured for this time opening and increasing the current transmit power by that proportion, we get the transmit power for whenever space. This redesign happens at the same time at every pair of transmitter and recipient. This is the way DPC gives versatile nature to Femtocell.

INTRODUCTION
Unlicensed range nowadays is turning out to be progressively rare[1], particularly those underneath 3 GHz. The Federal Communications Commission (FCC's) measurements demonstrates that numerous recurrence groups are being designated to different clients, covering one another[2]. The two noteworthy constraints of remote correspondence are extent and limit. Beforehand, cell frameworks were intended for a solitary application, voice, yet shortly with the entry of third-era (3G) cell frameworks, clients foresee better nature of voice, continuous voice calls, clear video pictures and speedy downloads[3]. Femtocells give a decent answer for overcome indoor scope issues furthermore to manage the activity inside of Macro cells. They give solid and high caliber of administration to all clients[4]. The limit issue is discriminating issue of any Mobile Communication Networks. Indeed, even Long Term Evolution (LTE) is called as the fourth Generation of the Mobile Cellular Communication Network it couldn't make a spot for the Capacity Issue. Most profitable approach to build the Capacity is to part the Macro cell, in other word to utilize Femtocells in Macro cells[5]. Femtocell is the home base station that any endorsers can purchase and set it without anyone else's input effortlessly. Versatile administrators just need to consider the radio system participation in the middle of Femtocell and Macrocell and between Femtocells[6].

There are couple of principle elements that cause the limit debasement. One of them is Radio Signal Interference. There are two sorts of Interference in Orthogonal Frequency Division Multiple Access (OFDMA) framework. Between cell Interference and Intra-cell Interference[7]. Furthermore, Inter-cell Interference is more basic than Intra-cell Interference[8].

In this paper, utilizing versatile force control as a part of Femtocells we focus the proper transmit force level to accomplish worthy connection execution Femtocells and relieve Intra-cell and Inter-cell obstruction to give suitable SINR. The impedance level can be controlled by transmit force of the reference signal in light of the fact that it is corresponding to the most extreme transmit power[6]. Routine transmit force level setting plan that we connected in this paper is force level setting taking into account uplink gathering force from Macrocell(M.S) utilizing Distributed Power Control(DPC) calculation[8].

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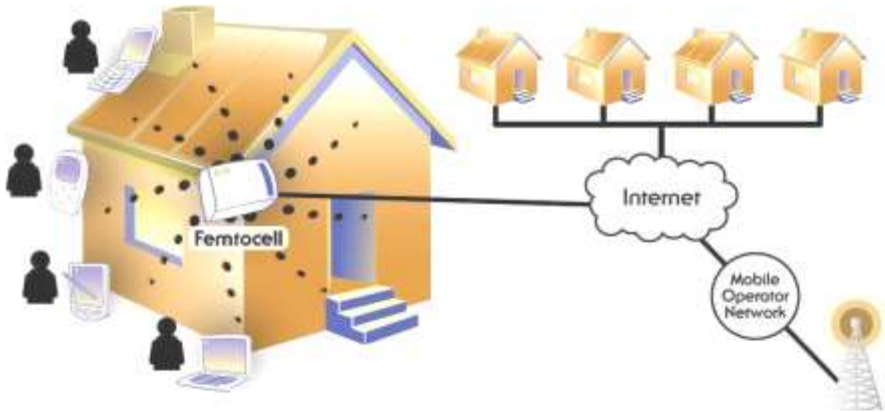

Figure 1 Femtocell Architecture

COMPATIBLE STANDARDIZATION OF THE TECHNOLOGY

The Standardization of the Femtocells these days is becoming fully compatible with the standard mobile devices and other devices working in the mobile range. Many standard protocols like UMTS, GSM, LTE, Mobile WiMAX, CDMA and other current and future mobile protocols standardized by 3GPP2, 3GPP and IEEE is also very harmonious with Femtocells. The Femto Forum, which is the organization to develop and implement Femtocells throughout the world is highly contributing for the standardization issues. Compatibility with above protocols and technologies can give a chance for Femtocells to give services with more than 3 billion existing devices in worldwide.

EFFECTIVE USE OF LIMITED SPECTRUM

The efficiency of limited spectrum is big issues of any operator company. Operating in licensed spectrum allows service providers to provide services with high quality and apart from the any kind of interferences which could worsen the capacity and quality of services.

RAISING CAPACITY AND INDEPENDENT COVERAGE FOR USERS

As pointed above Femtocells not only alleviates the capacity of the network, but also improve the coverage in the home which can allow them to have an independent coverage. Compare to the simple repeaters which are used just increase the coverage, Femtocells can provide a high data rate for limited number of users.

CONNECTION TO THE MOBILE OPERATOR NETWORK

As shown in Figure 1.1 Femtocells connect to the mobile operator network using standard residential broadband connections, including DSL and cable through the internet. The internet connection can be any type of network like dedicated or specific broadband line of mobile operator company or any other internet provider companies. That is the affability point of Femtocells.

FLEXIBILITY OF USAGE

Not only ordinary subscribers set up the Femtocells, but also mobile network operator companies could set up Femtocells purposely in the places where congested or distant areas. the usage of mobile phone at home is much larger than other places. A motivation of using mobile phone at home is high speed data and internet services using mobile phone. Only Femtocells can satisfy such requirements for the subscribers

EVOLUTION OF WIRELESS TECHNOLOGY

Characteristics	2G	3G	4G
Frequency Band	350-1900 MHz	1.8-2.5 GHz	2-8 GHz

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Bandwidth	200KHz	5-20 MHz	5-20 Mhz
Data Rate	56-115 Kbps	Upto 2 Mbps	Upto 20 MBps
Access	TDMA, CDMA	Wideband CDMA	Multi-carrier-CDMA or OFDM

Table 1

DISTRIBUTED POWER CONTROL

Before we move to a general discussion of the Distributed Power Control (DPC) algorithm, we must first define some symbols. Consider N pairs of transmitters and receivers. Each pair forms a (logical) link, indexed by *i*. The transmit power of the transmitter of link *i* is p_i, some positive number, usually capped at a maximum value: $p_i \leq p_{max}$ (although we will not consider the effect of this cap in the analysis of the algorithm). The transmitted power forces both the received power at the intended receiver and the received interference at the receivers of all other pairs. Now, consider the channel from the transmitter of link (i.e., transmitter receiver pair) *j* to the receiver of link *i*, and denote the **channel gain** by G_{ij} .So G_{ii} is the direct channel gain; the bigger the better, since it is the channel for the destined transmission for the transmitter- receiver pair of link *i*. All the other $\{G_{ij}\}$, for *j* not equal to *i*, are gains for interference channels, so the smaller the better. We call these channels "gains", but actually they are less than 1, so maybe a better term is channel "loss."This notation is visualized in Figure below for a simple case of two MSs talking to a BS, which can be thought of as two different (logically separated) receivers physically located together.

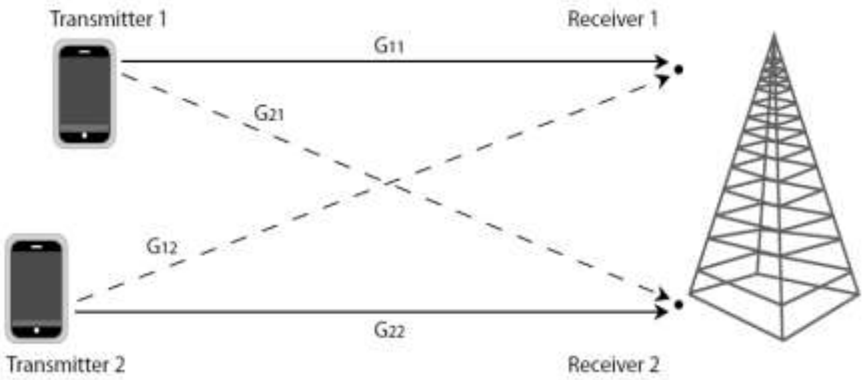

Figure 2: Uplink interference between two mobile stations at the base station. We can think of the base station as two (logically separated) receivers collocated. G_{11} and G_{22} are direct channel gains, the bigger the better. G_{12} and G_{21} are interference channel gains, the smaller the better.

Each G_{ij} is determined by two main factors: (1) location of the transmitter and receiver and (2) the quality of the channel in between. G_{ii} is also enhanced by the CDMA spreading codes that help the intended receivers decode more accurately.

The received power of the intended transmission at the receiver is therefore $G_{ii}p_i$. What about the interference? It is the sum of $G_{ij}p_j$ over all transmitters *j* (other than the intended one *i*): $\sum_{j\neq i} G_{ij}p_j$. There is also noise n_i in the receiver electronics for each receiver *i*. So we can write the SIR, a unit-less ratio, at the receiver of logical link *i* as

$$\mathrm{SIR}_i = \frac{G_{ii}\, p_i}{\sum_{j\neq i} G_{ij}\, p_j + n_i}$$

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For proper decoding of the packets, the receiver needs to keep up a target level of SIR. We will denote that as γ_i for link *i*, and we want $SIR_i \geq \gamma_i$ for all *i*. Clearly, increasing p_1 increases the SIR for receiver 1 but lowers the SIR for all other receivers.

As in a typical algorithm we will encounter throughout this book, we assume that time is divided into discrete slots, each indexed by [t]. At each timeslot t, the receiver on link *i* can measure the received SIR readily, and feeds back that number, $SIR_i[t]$, to the transmitter. The DPC algorithm can be described through a simple equation: each transmitter simply.

This algorithm is also simple in its computation: just one division and a single multiplication. And also it is simple in its parameter configuration: there are actually no parameters in the algorithm that need to be tuned. Simplicity in communication, computation, and configuration is a key reason why certain algorithms are widely adopted in practice.

Intuitively, this algorithm makes sense. First, when the iterations stop because no one's power is changing any more, i.e., when we have convergence to an equilibrium, we can see that $SIR_i = \gamma_i$ for all *i*. Second, there is hope that the algorithm will actually converge, given the direction in which the power levels are moving. The transmit power goes up when the received SIR is below the target, and goes down when it is above the target. Which proves that convergence will not happen easily. As one transmitter changes its power, the other transmitters do the same, and it is unclear what the next timeslot's SIR value is going to be. In fact, this algorithm does not converge if too many *i* are very large, i.e., when too many users request large SIRs as their targets.

Third, if satisfying the target SIRs is the only criterion, there are many transmit power configurations that can do that. If $p_1 = p_2 = 1$ mW achieves these two users' target SIRs, $p_1 = p_2 = 10$ mW will do so too. We would like to select the configuration that uses the least amount of power; we want a power-minimal solution. And the algorithm above seems to be lowering the power when a high power is unnecessary.

DPC AS AN OPTIMIZATION SOLUTION

In general, “will it converge?" and “will it converge to the right solution?" are the two prime questions that we would like to address in the design of all iterative algorithms. Of course, what “the right solution" means will depend on the definition of optimality. In this case, power-minimal transmit powers that achieve the target SIRs for all users are the “right solution." Power minimization is the **objective** and achieving target SIRs for all users is the **constraint**.

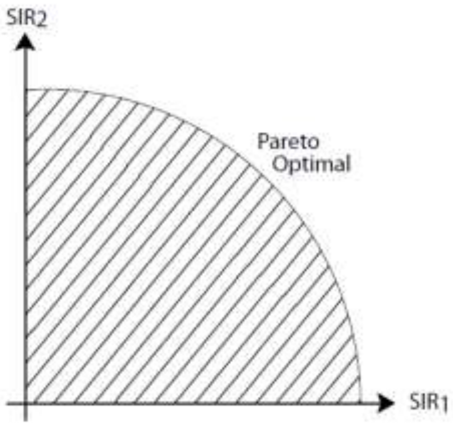

Figure 3: An illustration of the SIR feasibility region. It is a constraint set for power control optimization, and picture the competition among users. Every point strictly inside the shaded region is a feasible vector of target SIRs. Every point outside is infeasible. And every point on the boundary of the curve is Pareto optimal: you cannot increase one user's SIR without reducing another user's SIR.

DPC AS A GAME

Power control is a competition. One user's received power is another's interference. Each player searches for

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the right “move" (or, in this case, the right transmit power) so that its “payoff" is optimized (in this case, the transmit power is the smallest possible while providing the user with its target SIR γ_i). We also expect that the whole network reaches some desirable equilibrium as each player strategizes. The concepts of “players," “move," “payoff," and “equilibrium" can be defined in a precise and useful way.

We can model competition as a game. The word “game" here carries a technical meaning. The study of games is a branch of mathematics called game theory. If the competition is among human beings, a game might actually correspond to people's strategies. If it is among devices, as in this case among radios, a game is more like an angle of interpretation and a tool for analysis.
In the formal definition, a game is specified by three elements:

1. a set of **players** {1, 2,…,N},

2. a **strategy space** Ai for each player i, and

3. a **payoff function**, or utility function, Ui for each player to maximize (or a **cost function** to minimize). Function Ui maps each combination of all players' strategies to a real number, the payoff (or cost), to player i.

Now consider the two-player game in Table 1.1. This is the famous prisoner's dilemma game. The two players are two prisoners. Player A's strategies are shown in rows and player B's in columns. Each entry in the 2 X 2 table has two numbers, (x; y), where x is the payoff to A and y that to B if the two players pick the corresponding strategies. As you would expect from the coupling between the players, each payoff value is determined jointly by the strategies of both players. For example, the payoff function maps (Not Confess, Not Confess) to -1 for both players A and B. These payoffs are negative because they are the numbers of years the two prisoners are going to serve in prison. If one confesses but the other does not, the one who confesses gets a deal to walk away free and the other one is heavily punished. If both confess, both serve three years. If neither confesses, only a lesser conviction can be pursued and both serve only one year. Both players know this table, but they cannot communicate with each other.

If player A chooses the strategy Not Confess, player B should choose the strategy Confess, since 0 > -1. This is called the best response strategy by player B, in response to player A choosing the strategy Not Confess.

If player A chooses the strategy Confess, player B's best response strategy is still Confess, since -3 > -5. When the best response strategy of a player is the same no matter what strategy the other player chooses, we call that a **dominant strategy**. It might not exist. But, when it does, a player will obviously pick a dominant strategy.Clearly, this equilibrium is undesirable: (Not Confess, Not Confess) gives a higher payoff value to both players: -1 instead of -3. But the two prisoners could not have coordinated to achieve (Not Confess, Not Confess). An equilibrium might not be **socially optimal**, i.e., a set of strategies maximizing the sum of payoffs $\sum_i U_i$ of all the players. It might not even be Pareto optimal, i.e., a set of strategies such that no player's payoff can be increased without hurting another player's payoff.

UMTS LTE UPLINK POWER CONTROL

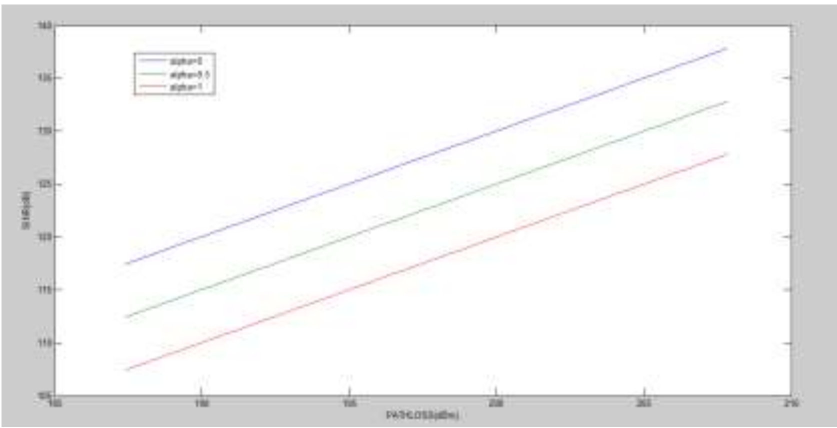

Figure 4: SINR vs. Path Loss

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INFERENCE: The SINR of the different path loss is calculated using the both power control techniques. If the slope parameter α equals to 1 in the LTE power control formula, that is the same as conventional power control. And if α equals to 0, then there will be no path loss compensation and there will be high interference in the FBSs. That means, α should get the value of $0< \alpha<1$ for compensation of path loss and good SINR at the FBS. From the simulation result, the received SINR at the FBS is compensated according to slope parameter that has good result when α equals $0< \alpha<1$.

ADAPTIVE SOLUTION USING DPC: Suppose we have four (transmitter, receiver) pairs. Let the channel gains $\{G_{ij}\}$ be given in below. We can also represent these gains in a matrix. You can see that, in general, $G_{ij} \neq G_{ji}$ because the interference channels do not have to be symmetric.

DPC OUTPUT

Plot for SIR vs Iteration

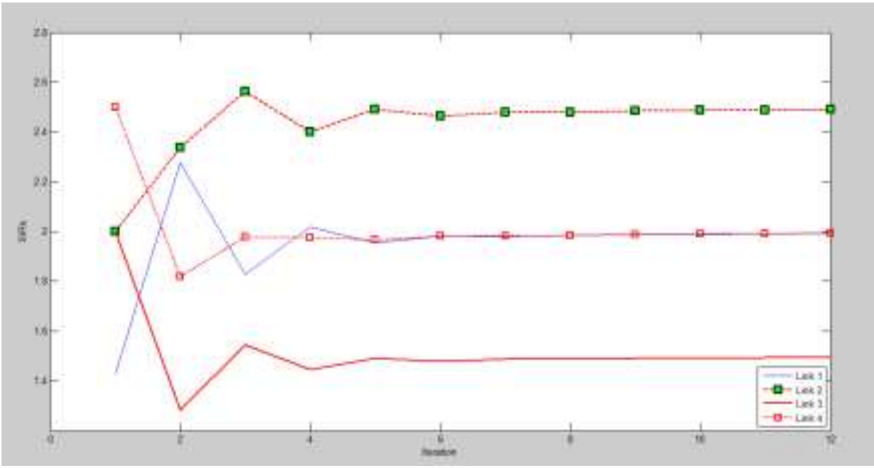

Figure 5: SINRs Vs Iteration

PLOT FOR POWER VS ITERATION

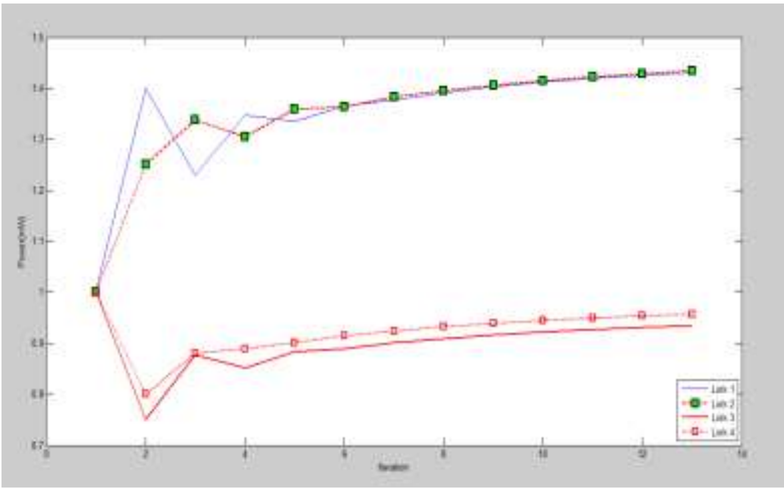

Figure 6: Power vs iteration

INFERENCE: All the SIRs are now within 0.05 of the target. The power levels keep iterating, taking the SIRs closer to the target. Figure 1.5 shows the graph of power level versus the number of iterations. After about 20 iterations, the change is too small to be seen on the graph; the power levels at that time are
p1 = 1:46 mW; p2 = 1:46 mW; p3 = 0:95 mW; p4 = 0:97 mW:

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The resulting SIRs are shown in above Figure. We get very close to the target SIRs, by visual inspection, after about 10 iterations.

CONCLUSION

The above recreation gives an authoritative perspective about the scope of a Femtocell which is 40-50m.The SINR of the distinctive way misfortune is computed utilizing the Uplink influence control systems. Diverse clients' signs meddle with one another noticeable all around, prompting a doable SIR district with a Pareto-ideal limit. Obstruction coordination in Femtocell systems can be accomplished through circulated force control with understood input. It takes care of an enhancement issue for the system as straight programming. By taking the proportion between the settled, target SIR and the variable, real SIR quality measured for this timeslot, and increasing the current transmit power by that proportion, we get the transmit power for the following timeslot. This overhaul happens at the same time at every pair of transmitter and collector.

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