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# Co-tier and Co-channel Interference Avoidance Algorithm for Femtocell Networks

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***Abstract*****—**Femtocells are regarded as a milestone for next generation cellular networks. As femtocells are deployed in an unplanned manner, there is a chance of assigning same resource to neighboring femtocells. This scenario may induce co-channel interference and may seriously affect the service quality of neighboring femtocells. In addition, the dominant transmit power of a femtocell will induce co-tier interference to neighboring femtocells. Thus to jointly handle co-tier and co-channel interference, we propose an interference-free power and resource block allocation (IFPRBA) algorithm for closely located, closed access femtocells. Based on neighboring list, inter-femto-base station distance and uplink noise power, the IFPRBA algorithm assigns non-interfering power and resource to femtocells. The IFPRBA algorithm also guarantees the quality of service to femtouser based on the knowledge of resource requirement, connection type, and the tolerable delay budget. Simulation result shows that the interference power experienced in IFPRBA algorithm is below the tolerable interference power and hence the overall service success ratio, PRB efficiency and network throughput are maximum when compared to conventional resource allocation framework for femtocell (RAFF) algorithm.

***Keywords*****—**Co-channel interference, co-tier interference, femtocells, guaranteed QoS, power optimization, resource assignment.

## I. INTRODUCTION

THE necessity for any-time, any-where wireless service has urged the cellular network towards 3GPP-LTE standard. Even though cellular network plays an inevitable role in telecommunication, it sometime fails to provide a high quality voice and data service to indoor users [1]. The growing traffic burden, superior indoor coverage necessity and the potential demand for spectrum have paved way for smallcell technology.

Femtocell, the last member of smallcell family is a low power user deployed base station which brings the network closer to the users. This plug and play base station extends voice and multimedia service to network users who are at indoor, coverage holes, shadow, and edge regions. Femtocell network also provides backward network compatibility, resource reuse, better connectivity and insignificant greenhouse gas emission.

Network operators prefer to assign same uplink frequency to geographically apart femtousers. This improves the spectral efficiency and network capacity. Frequency reuse scenario in-turn leads to severe co-channel interference when spatially close femtousers operate at same frequency [2].

In addition to co-channel interference, co-tier interference between two neighboring femtocells is encountered when two coverage overlapping femtocells operate at dominant power. Co-tier interference degrades the quality of service (QoS) of non-associated femtouser [3]. Thus co-channel and co-tier interference becomes severe on account of unplanned and exponential femtocell deployment, access mode selection, proximity of co-channel and co-tier users and their dominant transmit power. To handle such interferences between femtocell networks, centralized femtocell management system (FMS) must be capable of flexibly assigning the uplink power and resource to interfering femtocell. Many literatures have proposed solutions to handle femtocell interference.

Neighboring cell interference avoidance technique proposed by [4] mitigates the co-tier and co-channel interference in femtocell network. However, this technique suffers with unbearable bit error rate. Yun and Shin [5] suggested a transmit power control technique to reduce the co-tier interference. Even though this technique alleviates the interference, abrupt reduction in transmission signal strength may degrade the uplink communication.

The framework presented in [6] assigns different subcarriers to different femtousers of same cluster. Inter-tier mobility is also highlighted in this work. Nonetheless this framework attains better performance at the cost of spectral wastage. Wei Wang et al. [7] proposed an interference coordination scheme which senses the spectrum and statistically analyzes the radio propagation path loss between femtouser and macrouser. Based on this, interference coordination is investigated through spectrum sharing approach. This approach is not straight forward in handling interference as it may make wrong decision on weak received signal. Graph based flexible resource allocation algorithm developed in [8] exploits the graph coloring technique to avoid co-tier interference. However, vertices of the graph remain un-utilized as they are assigned with single color.

Yu-Shan Liang et al. [9] addressed a resource allocation framework for femtocell (RAFF) in which resource blocks are assigned through greedy algorithm. Even though RAFF algorithm handles co-channel interference through alternate resource assignment, it is unaware about the co-tier interference experienced between neighboring femtocells. As inter-femto-base station distance and femtocell's transmit power are not weighed by RAFF algorithm, a coverage overlapping femtocell may tend to operate at higher transmit power thereby causing co-tier interference to its neighbors.

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To jointly avoid co-tier and co-channel interference in overlapping femtocell networks, we derived an interference free power and resource block allocation (IFPRBA) algorithm. Co-tier interference is avoided through femtocell power optimization and co-channel interference is mitigated through non-interfering resource block assignment. The requested number of PRBs is assigned to the femtocells through IFPRBA algorithm thereby guaranteeing the quality of service. With the neighboring list knowledge, the resource is completely utilized and also efficiently reused. At the outset, the aforementioned factors improve the spectral efficiency. When compared to the existing RAFF algorithm, our IFPRBA algorithm can accommodate more number of users over limited spectrum thereby leading to multiuser diversity.

The rest of this paper is organized as follows. Section II presents a brief overview on system model. Section III elaborates on IFPRBA algorithm, while Section IV analyzes the simulation results. Section V exhibits the conclusion.

## II. SYSTEM MODEL

The general femtocell network architecture is depicted in Fig. 1, where each femtocell or femto base station (FBS) can serve 3-4 femtouser (FU) concurrently. FUs are connected to operator core network through FBS and femtocell management system (FMS).

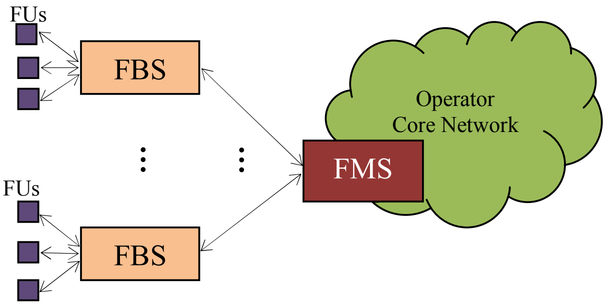

Fig. 1 Femtocell Network Architecture

The FMS, an integral part of operator core network, is a centralized coordinator where connection establishment, resource scheduling and power optimization take place. Due to random femtocell deployment, the coverage area of neighboring femtocells under an FMS may overlap. Extreme care should be taken in allocating resource and power to such coverage overlapping femtocells. Also, as femtocells are exponentially growing networks, the FMS reuses the scarce resource which is already assigned to spatially apart femtouser. This frequency reuse scenario may end-up with co-channel interference. Thus an FMS must be equipped with more robust resource and power allocation algorithm to handle both co-tier and co-channel interferences. As femtocell owners prefer to deploy their FBS in *selfish but safe* - closed access mode, we formulate the IFPRBA algorithm for closed access femtocells. In conventional resource allocation algorithms [6] and [7], complete subcarrier is allotted to a user. This way of dedicated subcarrier allocation leads to inefficient resource utilization.

TABLE I
QCI AND THEIR CHARACTERISTICS [11]

| QCI | Connection priority | Number of PRBs | GBR type | Tolerable delay ($d_{QCI}$) |
|---|---|---|---|---|
| 1 | 2 | 1 | GBR | 100 ms |
| 2 | 4 | 3-24 | GBR | 150 ms |
| 3 | 3 | 3-17 | GBR | 50 ms |
| 4 | 5 | 5-13 | GBR | 300 ms |
| 5 | 1 | 5-13 | Non GBR | 100 ms |
| 6 | 6 | 5-24 | Non GBR | 300 ms |
| 7 | 7 | 1-110 | Non GBR | 100 ms |
| 8 | 8 | 1-110 | Non GBR | 300 ms |
| 9 | 9 | 1-110 | Non GBR | 300 ms |

On the other hand, simultaneous assignment of same PRB to spatially apart femtousers will lead to multiuser diversity. Hence, to enjoy spectral efficiency with multiuser diversity, the proposed system considers the resource assignment in terms PRB instead of subcarriers.

We consider LTE-OFDMA system of 10 MHz bandwidth. The available bandwidth is divided into 50 resource blocks, each with 12 subcarriers. In time domain, each subcarrier is viewed as a radio frame of length 10 ms. A radio frame has 10 subframes, where each subframe can carry 14 symbols in 2 time slots. A PRB is a time frequency resource block of 180 KHz frequency band and 0.5 ms time length.

In OFDMA aspect, a PRB is viewed as a smallest radio resource unit that can be assigned to a user. Each user may require different number of PRBs depending on the connection type. As each type of connection has different QoS requirement, the connections are classified under QoS class identifier (QCI). Table I lists the QCI type and their characteristics. FMS assigns the requested number of PRB to the femtouser based on service request priority, guaranteed bit rate (GBR) type and tolerable delay budget as mentioned in Table I.

We consider femtocell architecture with self-organizing feature, where femtocells configure themselves into under-laid macrocell network. When an FBS is powered on, it registers to the network operator through its unique Femtocell_ID. Network operator, in return authenticates the femtocell registration by assigning the radio parameters to femtocell. After initial configuration process, femtocell broadcasts the unique Femtocell_ID to notify the neighbors and successively constructs the neighboring list by scanning the radio.

Femtocell updates the neighboring list periodically and forwards the same to FMS. Based on neighbor list, inter-femto-base station distance and uplink noise power experienced by each femtocell, IFPRBA algorithm instantaneously allocates the non-interfering power and resource to the service demanding femtocells. In addition, the transmit power of closely placed femtocells is optimized using Karush-Kuhn-Tucker (KKT) optimization [10]. This way of resource and power assignment avoids co-channel and co-tier interference between macro-femtocell networks.

## III. IFPRBA ALGORITHM

The interference-free power and resource block allocation (IFPRBA) algorithm is modeled using five femtocells connected to an FMS. Each femtocell is equipped with single femtouser who can demand different type of connections with unique QoS class identifier (QCI). After femtocell configuration process, the femtouser forwards the connection requisition to FMS. The requisition message bears QCI type, neighboring list, required number of PRB and other environment related radio parameters. The proposed IFPRBA algorithm at FMS assigns non-interfering resource and power based on received radio parameter information. Let a group of neighboring femtocell under a single FMS be represented as $FC = i, j \dots z$. The complete FMS resource $R$ is viewed as the collection of PRBs. The resource $R$ can be represented as

$$R = \{ r_{11}, r_{12}, r_{13}, \dots r_{mn}\} \tag{1}$$

where $r_{mn}$ is a PRB that can be assigned to any femtocell under a FMS. The subscripts $m$ and $n$ represents time and frequency slot respectively. The assignment of PRB to a femtocell is described as $r_{mn}^{FC}$. The resource block assignment status is given as

$$r_{mn}^{i} = \begin{cases} 1 & if\ r_{mn}\ is\ assigned\ to\ i \\ 0 & otherwise \end{cases} \tag{2}$$

At FMS, the overall resource efficiency $\delta_R$ can be determined as

$$\delta_R = \sum_{FC=i}^{z} r_{mn}^{FC} \tag{3}$$

To maximize the overall resource efficiency, the straight forward way is to determine the resource utilization factor $(u)$.

$$u = \frac{\sum_{m,n \in R} r_{mn}}{|R|} \tag{4}$$

The resource utilization factor indicates the capability of FMS to effectively utilize the resource. The value $|R|$ denotes the total number of PRB in a frame. The resource utilization factor $(u)$ takes a value between 0 and 1. Hence, the overall resource efficiency $(\delta_R)$ reaches maximum when the PRB utilization factor tends to 1.

The number of PRBs that can be assigned to a user is dependent on the type of requested connection. The QCI categorizes all type of connections into GBR and non-GBR based services as given in Table I. Let the number of PRBs requested by a femtouser be represented as $r_{\tilde{m}\tilde{n}}$ and the number of PRBs granted to a femtouser be represented as $r_{mn}$. If a request connection $(C)$ of a femtouser is of GBR type, the required number of PRBs will be offered to a femtouser. That is,

$$r_{\tilde{m}\tilde{n}} = r_{mn}, \quad if\ \{C \in GBR\} \tag{5}$$

As GBR based connections are error intolerant services, the FMS supplies the requested number of resource to femtouser. On the other hand, if the requested connection $C$ is of non-GBR type, only minimum number of PRB will be assigned. This is due to the reason that the non-GBR based connections are delay intolerant one.

$$r_{\tilde{m}\tilde{n}} \leq r_{mn} \quad if\ \{C \in non\_GBR\} \tag{6}$$

The delay to offer a connection $C$ is regarded as connection waiting period or service waiting period $d_w$. This waiting period may vary based on traffic associated with the network. To guarantee the QoS, any requested connection must be offered within the tolerable waiting period $d_{QCI}$. This can be represented as

$$d_w \leq d_{QCI} \tag{7}$$

The waiting period of any requested service must be maintained below the QCI delay budget as specified in Table I. Besides, the FMS should allocate resource to its associated femtocells in such a way that no two neighboring femtocells are assigned with same resource. The aforementioned statement can be modeled as

$$I_{ij} \sum_{i,j \in FC} r_{mn}^{i} . r_{mn}^{j} = 0 \tag{8}$$

The term $I_{ij}$ represents the interference experienced by two neighboring femtocells $i$ and $j$ due to resource similarity (say $r_{mn}$) between the associated femtouser. Such interference can be described as

$$I_{ij} = \begin{cases} 1 & \text{if } r_{mn} \text{ is assigned to neighbors } i\ and\ j \\ 0 & otherwise \end{cases} \tag{9}$$

When the resource similarity between two neighboring femtocells becomes nil, the chance of acquiring co-channel interference will become zero.

### A. Power Optimization

The two metrics that worsens the co-tier interference are distance between two neighboring femtocells and their dominant transmit power. Hence it is crucial to take care of these co-tier interference inducing parameters. If the inter-femto-base station distance $(D_{ij})$ between neighboring femtocells $i$ and $j$ is greater than the diameter of a femtocell $(x)$, their coverage will not intersect. Hence, the threat for co-tier interference becomes nil and the optimization of transmit power is not crucial but cautionary.

Initially, the network operators assign a threshold power $P_t$ to femtocells during cell-configuration process. Femtocells are supposed to maintain their actual transmit power $P_a$ within that threshold power $P_t$.

Hence, for a non-overlapping femtocells $i$ and $j$, the power optimization $P_o$ is carried out as

$$P_o = \min(P_a, P_t) \quad if \quad D_{ij} \geq x \tag{10}$$

On observing the non-intersecting femtocells, the optimized power is termed as the minimum value among $P_a$ and $P_t$. On the other hand, if two neighboring femtocells $i$ and $j$ are close enough such that their inter-femto-base station distance $D_{ij}$ is lesser than a femtocell diameter ($x$), their coverage will overlap and will lead to co-tier interference. Hence to protect such femtocells from co-tier interference, the Karush-Kuhn-Tucker (KKT) framework is utilized to optimize the femtocell's transmit power. The optimized power for a coverage overlapping femtocell can be represented as

$$P_o = \left[\frac{w_n}{(\lambda+\mu\tilde{I})ln2} - \frac{1}{\gamma_n}\right] \quad if \quad D_{ij} < x \tag{11}$$

where $\lambda$ and $\mu$ are the dual variables of Lagrange multipliers, $w_n$ is the resource frequency, $\gamma_n$ is the SINR of the channel and $\tilde{I}$ is the interference factor.

### *B. Flexible Resource Block Assignment*

Co-channel interference occurs when two neighboring femtocells are assigned with same set of PRBs. It is remarkable that the plug and play femtocells can travel with its user. This unplanned deployment nature will lead to a chance of being assigned with same set of resources. To prevent such conflict in resource assignment, IFPRBA algorithm takes an extra measure by examining the noise power experienced over the uplink resource of interest.

For any femtouser, the tolerable noise power over the assigned resource $r_{mn}$ be $\sigma_{tol}$. Let the uplink noise power experienced by a femtouser (in femtocell $i$) due to a co-channel deployed neighboring femtouser (in femtocell $j$) be $\sigma_{ij}$. The uplink noise power experienced by the victim $i$ due to the aggressor $j$ can be formulated as

$$\sigma_{ij} = P_a.\tilde{I} \tag{12}$$

If the experienced uplink noise power ($\sigma_{ij}$) is greater than the tolerable noise power ($\sigma_{tol}$), it is evident that there exist another co-channel user operating at the same resource. Hence an alternate resource should be assigned to the victim femtouser. In other words, the resource assigned to neighboring *co-channel* user should not be same on experiencing higher uplink noise power.

$$r^i_{mn} \neq r^j_{mn} \qquad if\ \sigma_{ij} >> \sigma_{tol} \tag{13a}$$

$$r^i_{mn} = r^j_{mn} \qquad if\ \sigma_{ij} < \sigma_{tol} \tag{13b}$$

Accommodating the aforementioned constraints, the proposed IFPRBA algorithm is formulated as follows:

**IFPRBA Algorithm**

```
BEGIN: Service request from femtocell $i$
Input: QCI type, noise power and neighboring list.
Output: $r^i_{mn}$, $P^i_{opt}$
Constraints:
   1:  $\delta_R = max$
   2:  $u = \frac{\sum_{m,n \in R} r_{mn}}{|R|} \Rightarrow max$
   3:  $d_w \leq d_{QCI}$
   4:  $\sum r^i_{mn} \leq R$
   5:  $R \leftarrow r^i_{mn}, r^j_{mn}$
   6:  $I_{ij}$  $\sum r^i_{mn}.r^j_{mn} = 0$
   7:  $P^i_a \leq P_t$
Connection based resource assignment
   8:  if $\{C \in GBR\}$ then
   9:          $r_{\tilde{m}\tilde{n}} = r_{mn}$
  10:  else
  11:          $r_{\tilde{m}\tilde{n}} \leq r_{mn}$
  12:  end
Checking for the threat of co-tier interference
  13:  if $D_{ij} > x$ then
  14:          $P^i_o = \min(P^i_a, P_t)$
  15:  else
  16:          $r^i_{mn} \neq r^j_{mn}$ (Precautionary)
  17:          $P^i_o = \left[\frac{w_n}{(\lambda+\mu\tilde{I})ln2} - \frac{1}{\gamma_n}\right]$
  18:  end
Checking for the threat of co-channel interference
  19:  if $\sigma_{ij} >> \sigma_{tol}$ then
  20:          $r^i_{mn} \neq r^j_{mn}$
  21:  else
  22:          $r^i_{mn} = r^j_{mn}$(resource reuse)
  23:  end
END
```

The FMS executes the IFPRBA algorithm for each and every femtouser based on their request reception priority. The neighboring list is periodically updated at FMS as femtocells would enter or leave the network at any time. The buffer associated with FMS will queue-up the request from femtousers and corresponding service will be provided to them based on first-in first-out priority. Initially, the FMS makes sure that the constraints mentioned in IFPRBA algorithm (line no.: 1-7) are met at network level. Also the resources already assigned will not be reused in current assignment strategy so as to withstand IFPRBA algorithm (line no.: 6). After this resource segregation, FMS grants the service to a femtouser associated with femtocell $i$. Based on service requirement (QCI type), the number of PRBs that can be assigned will be selected as in IFPRBA algorithm (line no.: 8-12). On deciding the number of PRBs, the IFPRBA algorithm checks for the threat of interference. With the neighboring list metrics like inter-femto-base station distance ($D_{ij}$) and the uplink noise power ($\sigma_{ij}$), the FMS will allocate non-interfering resource and power to a femtouser associated in femtocell $i$ (as in IFPRBA algorithm line no.: 13-23). This ensures a safe femtocell uplink without the threat of co-tier and co-channel interferences.

Fig. 2 also shows a worst case scenario in which the coverage of five overlapping femtocells is organized by FMS. Let the available time-frequency PRB at the FMS be $\{r_{11}, r_{12}, r_{13}, r_{14}, r_{15}\}$. The IFPRBA algorithm at FMS allocates resource to neighboring femtocell (FC:1-5) based on (8), such that no two closely located neighbors are assigned with same or adjacent frequency. Accordingly, the power of coverage overlapping femtocells is optimized. The flexible resource allocation along with power optimization strategy makes the IFPRBA algorithm more immune against co-channel and co-tier interference. Priority and QCI based resource assignment with better frame utilization factor builds the IFPRBA as a simple, yet robust algorithm.

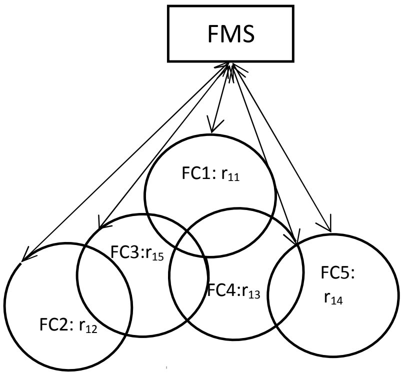

Fig. 2 Illustration of PRB ($r_{1n}$) allocation using IFPRBA algorithm

TABLE II
SIMULATION PARAMETERS

| Parameters | Values |
|---|---|
| Number of femtocells | 5 |
| Radius of femtocell | 5 meters |
| Deployment type/mode | Random/close access mode |
| Frame structure | FDD |
| Carrier frequency | 2.4 GHz |
| Bandwidth | 10 MHz |
| No. of PRB | 50 |
| Modulation | 64 QAM |
| Subframe duration | 0.5 ms |
| Transmit power of FU | 20 dBm |

## IV. SIMULATION RESULTS

In this section, we have studied the performance of IFPRBA algorithm through Matlab simulations. We modeled our IFPRBA algorithm under 3GPP-LTE standard and the corresponding simulation parameters are listed in Table II. The coverage area of randomly deployed femtocells is considered to overlap. All the femtocells, which are overlaid on a macrocell are coordinated by FMS. The algorithm is formulated under $10^4$ Monte Carlo simulations.

The resource assignment strategy plays an essential role in determining date rate and throughput of a femtocell networks. The number of PRBs that can be assigned to a user varies based on the service requirements. The existing resource allocation framework for femtocell (RAFF) algorithm assigns resource without considering the connection type that may belong to either delay tolerant or delay intolerant one. Hence RAFF algorithm may irrelevently assign more resource to delay insensitive, non-real time connections and limited resource to real time delay sensitive connections. This resource assignment stratergy will throttle the service success ratio of a femtouser which leads to the degration of throughput. To guarantee QoS and to assign resource based on femtouser's connection type, our IFPRBA algorithm formulates few constraints like maximizing utilization factor, offering connection based on priority and assigning non-interfering resource. Among this, QCI based resource assignment (IFPRBA algorithm line no.: 8-12) plays a promising role in maximizing the success rate of the femtouser service.

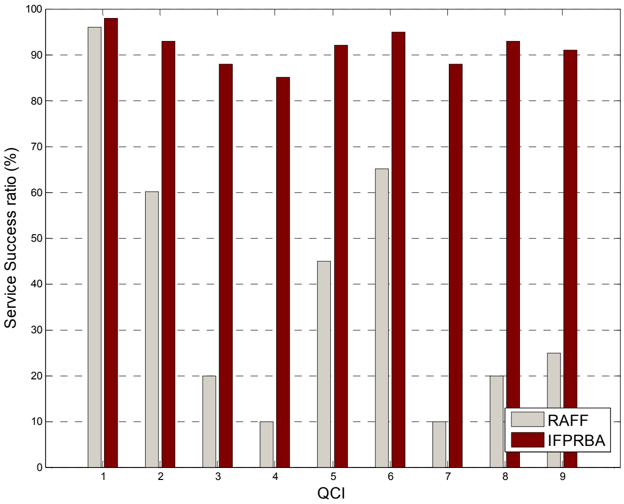

Fig. 3 Service success ratio comparison between existing RAFF and IFPRBA algorithm for various QCI

Fig. 3 shows the performance improvement of IFPRBA algorithm over existing RAFF algorithm. As our IFPRBA algorithm assigns PRB based on QCI of a service, the quality of service experienced by femtouser is uncomparably higher than the RAFF algorithm. The average success ratio of IFPRBA algorithm is 91% whereas it is only 40% in RAFF algorithm. It is also observed that the RAFF algorithm is capable of attaining higher success rate only for voice service (QCI=1) and success ratio of other services are not more than 65%. This is due to the reason that RAFF algorithm is not aware of the PRB requirement of individual services and hence it fails to attain higher success ratio. On the other hand, the IFPRBA algorithm yeilds a service success ratio from 86 to 97% for all 9 type of services.

Co-tier interference and co-channel interference are the two performance degradating factors which should be jointly handled in overlaid macro-femto heterogeneous networks.

To deal with such interferences, we combine two remedies namely power optimization and alternate resource allocation along with the knowledge of neighbouring list, inter-femto-base station distance and uplink noise power. The proposed IFPRBA algorithm not only avoids co-tier and co-channel interferences, but also guarentees the QoS to femtouser through service resource assignment. On the other hand, RAFF algorithm does not study the inter-femto-base station distance and uplink noise power experienced from corresponding femtocell neighbours. Fig. 4 depicts the interference power experienced by neighbouring femtocells in IFPRBA and RAFF algorithm. With the tolerable interference power of 3 mW over uplink, our IFPRBA algorithm assigns resource and power to coverage overlapping femtocells such that the interference power experienced over the uplink is within 3 mW. This implies that the overall interference power becomes nearly nil in IFPRBA algorithm whereas for the RAFF algorithm, the interference power increases with an increase in number of femtocells.

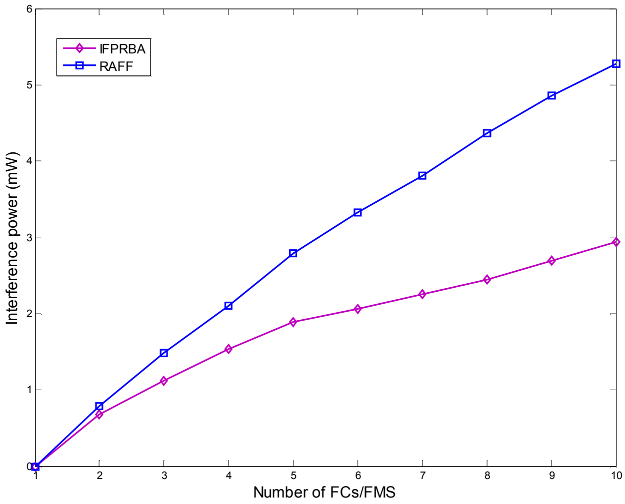

Fig. 4 Overall interference power experience by 10 femtocells/FMS

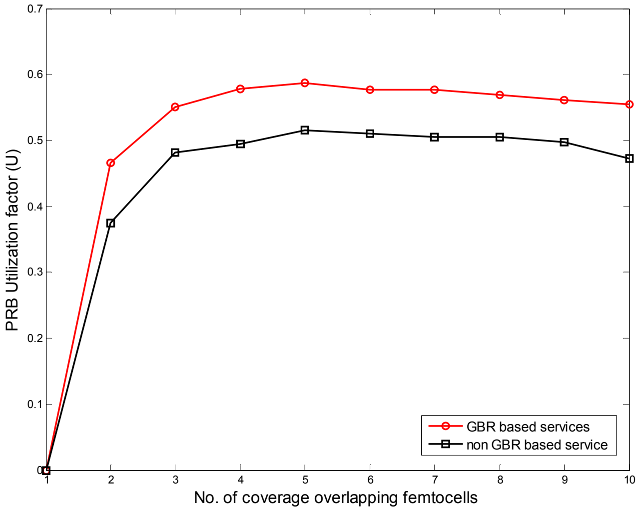

Fig. 5 PRB Utilization factor of IFPRBA algorithm for GBR and non-GBR services

The resource assignment algorithm residing in femtocell management system (FMS) is responsible for efficiently reusing the same resource among spatially apart femtocells. As RAFF algorithm does not focus on acquiring neighboring list and service requirement of femtouser, the chance of efficiently utilizing or reusing the same resource to non-overlapping femtocell becomes unquestioned. Whereas in the case of IFPRBA algorithm, the femtocell periodically communicates their dynamic neighboring list to FMS, based on which the centralized FMS reuses the same resource to spatially apart femtousers. It is inferred from Fig. 5 that the PRB utilization factor of both GBR and non-GBR based services in our proposed algorithm is appreciable. The reason behind this is the reuse of resource between spatially apart femtousers along with neighbor awareness.

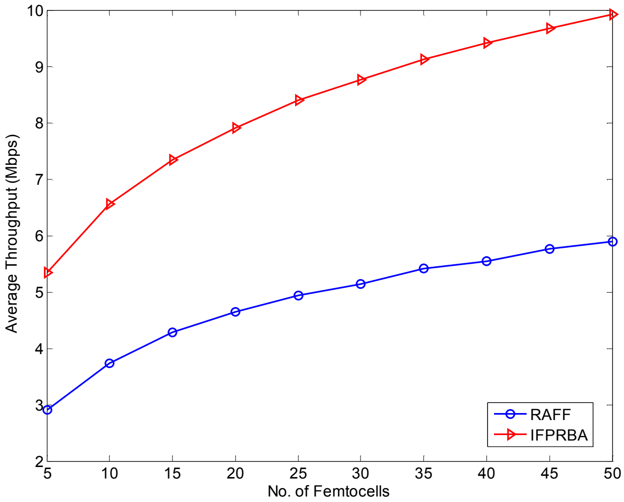

Fig. 6 Throughput comparison of IFPRBA and RAFF algorithm

The proposed IFPRBA algorithm yields 10% better PRB efficiency for GBR based services than that of non-GRB based services.

The increase in overall network throughput of our IFPRBA algorithm can be collectively reasoned as follows:

i. The self organizing feature of femtocell networks
ii. Flexible and proactive power and resource assignment with interference awareness.
iii. Exploitation of PRB based resource assignment instead of subcarrier assignment to femtocells.
iv. Centralized monitoring nature of FMS which instantaneously allocates resource based on neighboring list, connection type and delay budget.

On less femtocell deployment, the under-laid macrocell throughput of RAFF and IFPRBA algorithm, as illustrated in Fig. 6, are 3 Mbps and 5.2 Mbps respectively. With growing number of femtocells, the overall network throughput of IFPRBA algorithm increases by 4 times the throughput offered by RAFF algorithm.

At the outset, the IFPRBA algorithm has unwrapped the advantages like multiuser diversity, resource reusability, higher spectral efficiency, improvised network throughput and capacity.

## V. CONCLUSION

In this paper, we propose interference free power and resource block allocation (IFPRBA) algorithm to handle co-tier and co-channel interferences in femtocell networks. The IFPRBA algorithm efficiently avoids the interference through power optimization and flexible resource allocation. The proposed algorithm guarantees the QoS for all type of connections. Delay intolerant services are also taken care by

IFPRBA algorithm with best effort service. Precise self organization strategy, multiuser diversity over limited resource and GBR based service availability equip the IFPRBA algorithm to be robust against interferences. Performance analysis exemplifies that even with growing number of users and limited amount of resource, the IFPRBA algorithm attains higher PRB efficiency and lower interference power, whereas the conventional RAFF algorithm find harder to attain the same.

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