CHAPTER IV

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QoS ENHANCEMENT BY USING CHANNEL RESERVATION TECNIQUE

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In order to provide committed QoS to the users, telecommunication service providers use different channel allocation schemes. One of such schemes is the adaptive bandwidth allocation scheme. QoS is improved by minimizing the probability of call dropping (Pcd) and the probability of call blocking (Pcb) and by allocating channels, optimally. This chapter being with introduction of the Fixed Channel Allocation (FCA), Dynamic Channel Allocation (DC) and Hybrid Channel Allocation (HCA) as well as cell overlapping technique to enhance the capacity of HAP. It also introduces the basic theory of blocking and dropping probabilities

In this chapter, reserved channel technique has been proposed for HAP based communication services deployment. Then, the performed analysis of reservation channel technique has considered for hand-off calls and new requested calls. It is shown that the proposed reservation channel technique improve the Pcb a new call and Pcd of an hand-off calls, by varying the value of reserved channels for new request calls and reserved channels for hand-off calls.

4.1. Introduction

Recently, wireless mobile networks have become one of the brightest areas of growth in telecommunication industry [168, 169]. On one side, the total number of concurrent users of such networks is grown enormously while on the other side, there are limited numbers of channels available for providing user services [105]. Therefore, efficient management and sharing of bandwidth among the users become very important to enhance system performance, which is done using various channel allocation techniques [169].

Cellular networks are comprised of cells. The cells in the cellular network are allocated frequency channels from the available bandwidth. These frequency channels are responsible for communication between the mobile users. The number of available channels in a cell is limited and, due to this limitation if traffic in the cell is high, users may face call terminations and may be blocked by the cell completely. Such users are needed to be allocated permanent channels so they never face dis-connectivity due to unavailability of channels in the cell.

A mobile network is created by deploying BS which cover a small geographic area, by dividing it in multiple smaller cells, called BS coverage area [128]. Higher performance and capacity of a mobile system is obtained by exploiting frequency reuse in cells [112, 170]. Each cell is allocated a portion of the total available frequency band [171]. A user can make a call, when he is inside a mobile cell. Also, during a call, when he moves from one cell to another, his call is continued in the next cell, using hard hand-off or soft hand-off [172]. Further, when the call traffic inside a cell increases beyond the capacity, the cell gets overloaded and the QoS is degraded drastically [169, 173].

In HAP, the geometry of each cell is defined as an ellipse. The elliptical cell is dependent on the beam direction and elevation angle. Hence, the radius coverage of the HAP cell is approximately $30\,Km$ at $20\,Km$ altitude [128]. The entire coverage of HAP is then divided into 127 smaller cells [128]. HAP is capable of providing all types of mobile services and therefore, if any part of terrestrial mobile communication is affected, same area could also be serviced by using HAP.

Inside any such mobile cell, users communicate with each other by using wireless channels that are allocated to various users, as per the channel allocation scheme used. There are three types of channel allocation schemes viz Fixed Channel Allocation (FCA), Dynamic Channel Allocation (DCA) and Hybrid Channel Allocation (HCA) [174, 175]. Channel allocation focuses on the efficient utilization of bandwidth and how to divide the same between cells [176]. Considering that the bandwidth in wireless networks is a limited resource, the system needs to block/drop any request for a new/hand-off call, if all channels within that category, have already been allocated. Dropping call is more annoying than blocking call [177]. Furthermore, increasing traffic load in a cell leads to increase in blocking and dropping call probability [178]. Therefore, FCA and DCA are not suitable for providing high QoS for some reasons. FCA is not efficient in using channels and increase dropping rate. On the other hand DCA, it required for exohosive channel, need for keeping tracking channels, and more delay for assign channels.

Efficient channel management is therefore very important in order to provide high QoS. To provide high QoS, reducing the Pcb and Pcd is essential [179]. The high priority is assigned to higher QoS [180].

Currently, this reservation channel technique are being used for WiMAX [181]. On the other hand, reservation channel technique has reserve channels for hand-off and remaining are used for mobile calls as presented in cell [182]. Accordingly, in a HAP based mobile system deployment, when, fixed users within a single mobile HAP cell are served using permanent channels and when the number of hand-off call drops are minimized by provisioning reserved channels, the QoS is enhanced significantly as shown in Figure 4.1.

In this chapter, we have considered different techniques of ‘channel allocation’ and ‘channel reservation’ so that the probability of availability of channels, both for a new call admission and success of a hand-off call, could be improved in each mobile cell. Accordingly, we have discussed the concept of Poisson distribution with the help of Markov Chain to measure the probability of call blocking (Pcb) and probability of call dropping (Pcd). Consequently, in this contribution, we have proposed an algorithm for efficient channel reservation technique for reducing the probability of call blocking and call dropping. In this technique, we have created three exclusive channels pools: one for ‘new call requests’, second for ‘hand-off calls’ and the third cannels pool is a ‘buffer pool’. It is the buffer pool, which allocates additional channels, both to the ‘new call’ pool as well as to the ‘hand-off’ pool, typically when there are no channels available in either of these pools. By distributing total number of channels in these three pools, we have created different scenarios and analyzed different states of channel availability, by using Markov Chain and calculated the Pcb of a new call and Pcd of a new hand-off call.

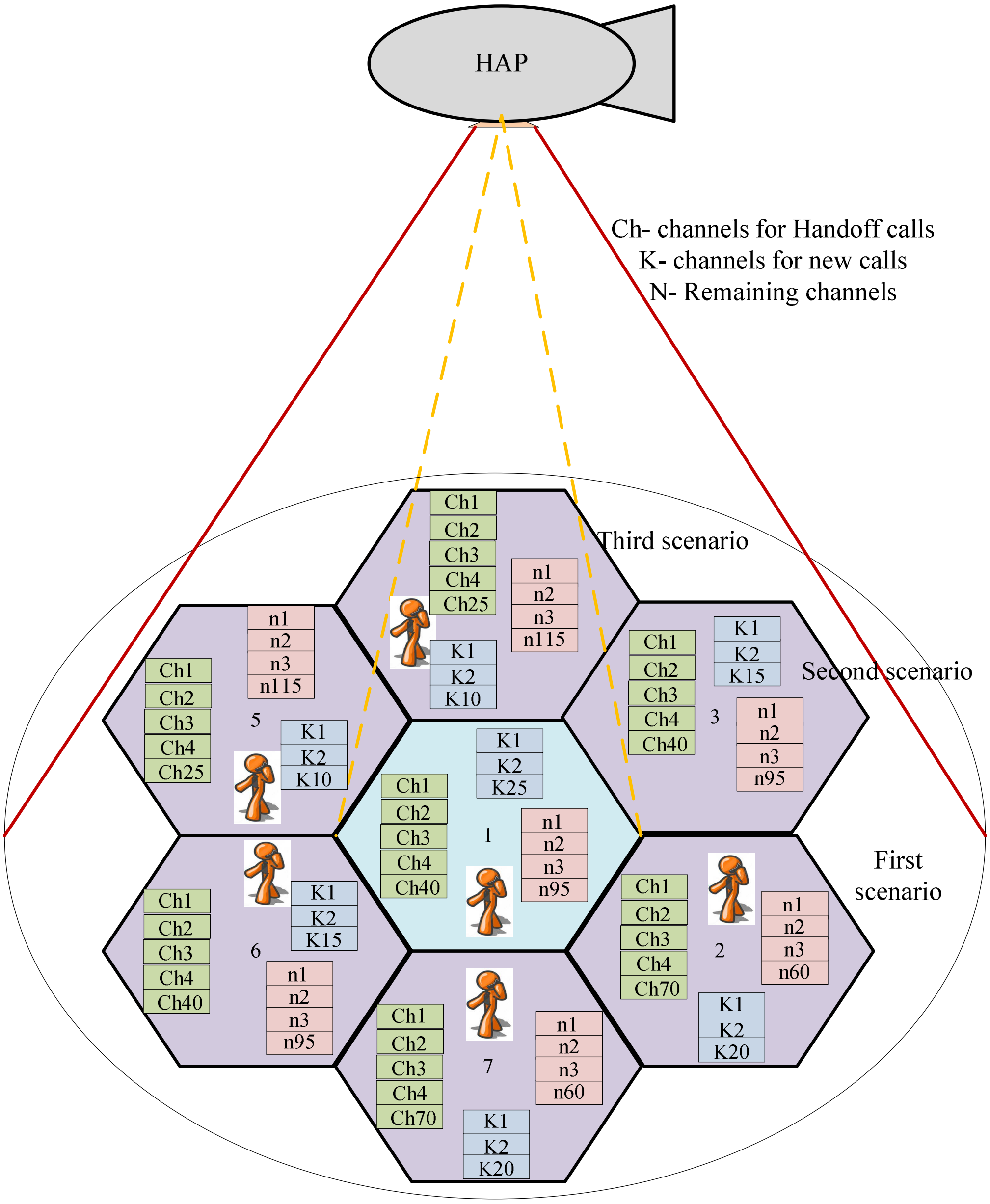

Figure 4.1 Reservation Channel Technique in HAP Cells and Scenarios

4.2. Channel Allocation Techniques

In wireless cellular networks, channel allocation techniques deal with the allocation of channels to various mobile cells. A call drop occurs when the user moves from one cell to another cell and there is no spare channel in next cell during his movement. On the other hand, user in the same cell may request for a new call and the new call request will be blocked if all the channels are occupied.

Channel distribution to various cells and subsequent channel allocation can be done centrally or in a distributed manner [174]. In the centralized distribution, all calls are monitored centrally while deciding which channel should receive the call (hand-off or new call). In the case of centralized scheme, the status of the system is known as globally and it is more likely to maintain a good configuration of the system [174]. On the other hand, distributed schemes allow each BS to decide and allocated channels based on the local cell knowledge [174]. This distributed subset of cell knowledge is then shared with other BS. The channel allocation technique inside a cell will then require the information about the neighboring cells only. Therefore, more distributed the scheme is, the less global knowledge is required while, in more centralized schemes, greater amount of cell information will be required [174].

The aim of channel allocation is to manage the channel distribution between the BS such that the interference is kept minimal and at the same time the traffic demands are fulfilled [141]. Channel allocation technique deals with the allocation of channels to cells. Dropping call occurs only during inter cell hand-off. This subscriber moves from previous cell which it has empty channels to cell where not sufficient channels to accept this call. Managing the channels can be done on a centralized or distributed basis. In the case of a centralized system, the BS is required to communicate with a central controller. This gives the advantage of being able to monitor the whole system while deciding which channel and it should be used.

On the other hand, the distributed schemes allow each BS to decide and allocated channels based in the local cell knowledge. Distributing knowledge among all BS is distributed subset. Dominating set of BS could be identified, and each dominating BS could coordinate its own basin. The channel allocation strategy is requiring only information about surrounding cells. So that the more distributed scheme is the less global knowledge is required and the more centralized scheme is the greater is the mount of signaling required.

HAP provides a line of sight communication in various cells, as formed on the ground and there will be less obstacles between users and the platform. HAP can centrally keep track of all cells and respective channels that are being used within its coverage area. Channel allocation techniques have also been configured for HAP by exploiting cell overlap [105]. In HAP, all the BS are co-located and central management and control becomes easier [183]. Considering all eventualities at this stage help to address the conflicts, which might cause dysfunction of the communication services, in various cells. Several radio resource allocation management techniques are developed for a broadband multi-beam HAP architecture [105]. These are based on fixed channel assignment at the HAP and distributed dynamic channel assignment at the user end of the link, allowing the inherent cell overlap to be exploited [105]. Channel allocation can be mainly divided into the following three categories based on the manner in which channels are allocated inside a cell or within a group of cells [174].

Channel allocation focuses on the bandwidth and how to divide between cells. Bandwidth can be ideally divided into a set of channels. These channels are separated by a redefined guard band to avoid interference with each other. The bandwidth is very expensive and limited resource so that it is required to minimize the guard bands between channels and increase the number of channels. The balance between maximizing capacity and minimizing interference is the aim of channel allocation.

Channel allocation techniques can be divided mainly into three categories based on the manner in which co-channels are separated. The first one and the most basic is FCA and the second one is the DCA as shown in Figure 4.2. Resource Allocation Techniques (RATs) consist of channel allocation, power control, and adaptive modulation and coding techniques.

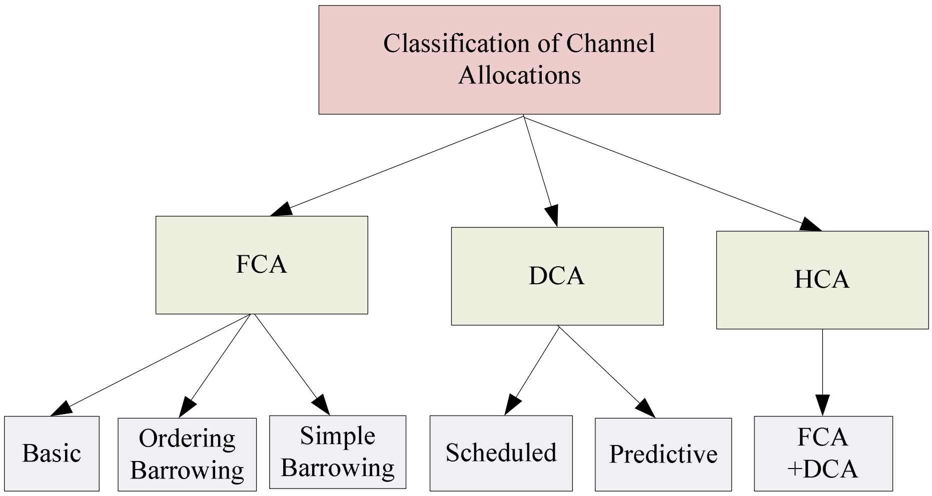

Figure 4.2 Classification of channel allocations

4.2.1. Fixed Channel Allocation (FCA)

Here, each cell is assigned as a fixed pool of channels as shown in Figure 4.3. If all the channels as assigned are in use, the new call request shall be rejected. The purpose of this type of channel allocation is to maximize frequency reuse. In HAP, this technique is easy to implement and works well in high traffic conditions and becomes inefficient when some cells are more loaded than others. Further, improvement in FCA based schemes has also been obtained by using cell overlap [105]. This technique improves the QoS further, in terms of Pcb and Pcd because of the higher trunking efficiency within such overlapping areas [112].

For further improvement of QoS, in FCA, another technique called 'channel borrowing' is also used and has been shown in Figure 4.4.

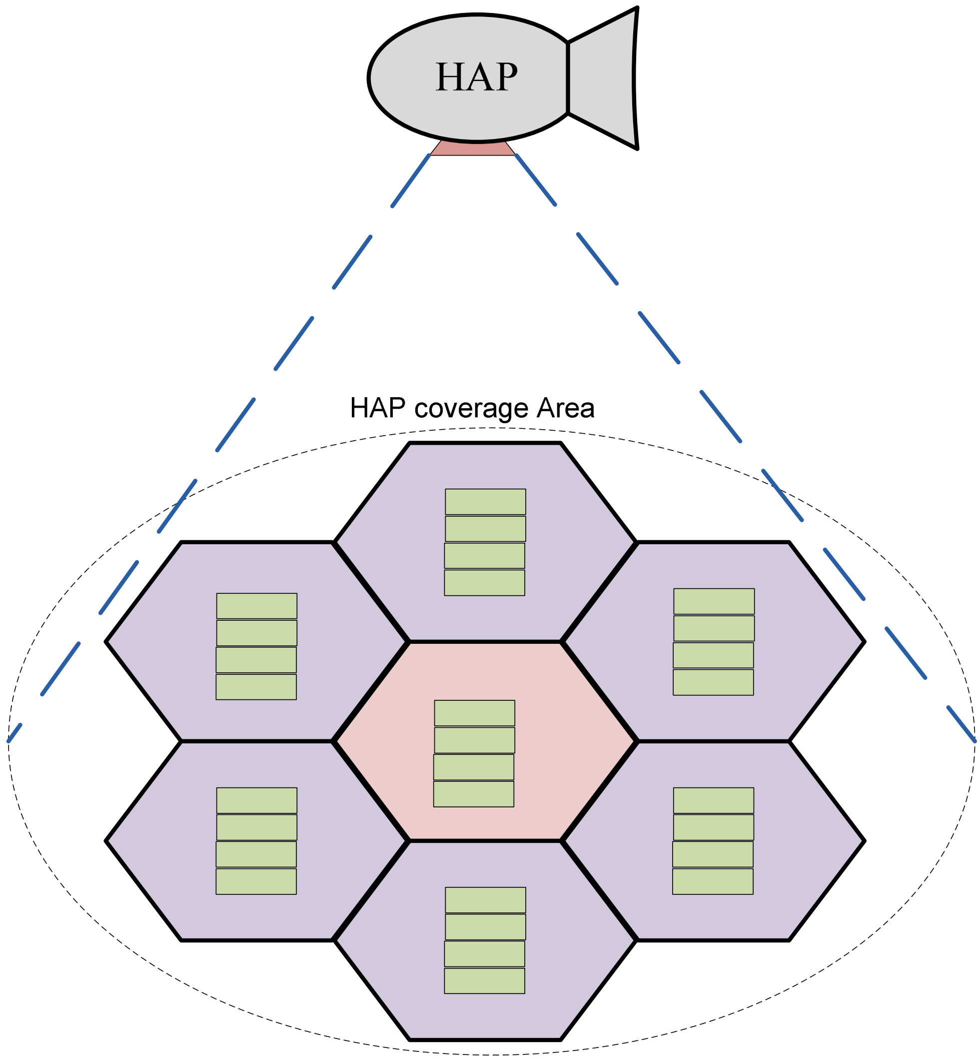

Figure 4.3 Fixed Channel Allocation

In channel borrowing, besides the routine pool of channels, a cell can borrow additional channels from its neighbor cell, while ensuring that it will not cause interference with channels that are in use in other cells. It is also ensured that as long as the channel is in use with the borrower cell, it will not be used by the owner cell [174]. In the Figure 4.4, borrowing of channels is shown in white, using directed arrows. Therefore, this technique makes FCA more flexible and minimizes Pcb and Pcd.

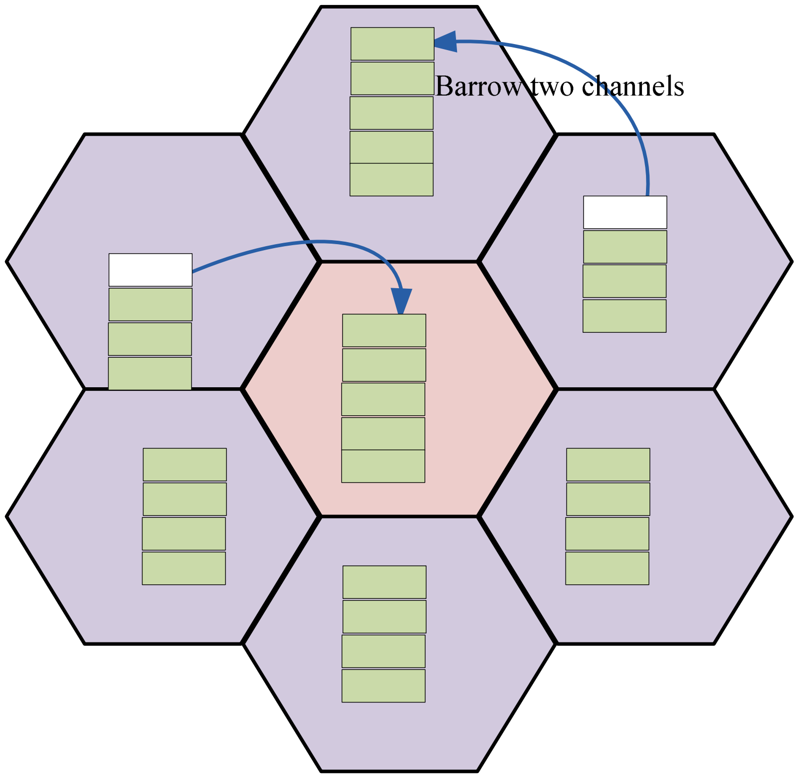

Figure 4.4 Borrowing Channel Technique

4.2.2. Dynamic Channel Allocation

DCA technique tries to address the problem faced in FCA technique, especially when the cell traffic is dynamically fluctuating and cannot the estimated crisply. In this technique, all channels are placed in a common pool while addressing to the requirements of each cell. On receiving a channel request from a cell, it is provided dynamically from the common pool. It is done, on a call by call basis, for all the cells and the frequency reuse requirements are also ensured [174]. After the requested call is finished, the channel comes back to the central pool. Further, more channels can be assigned to the cells which are carrying heavier traffic. This technique is shown in Figure 4.5.

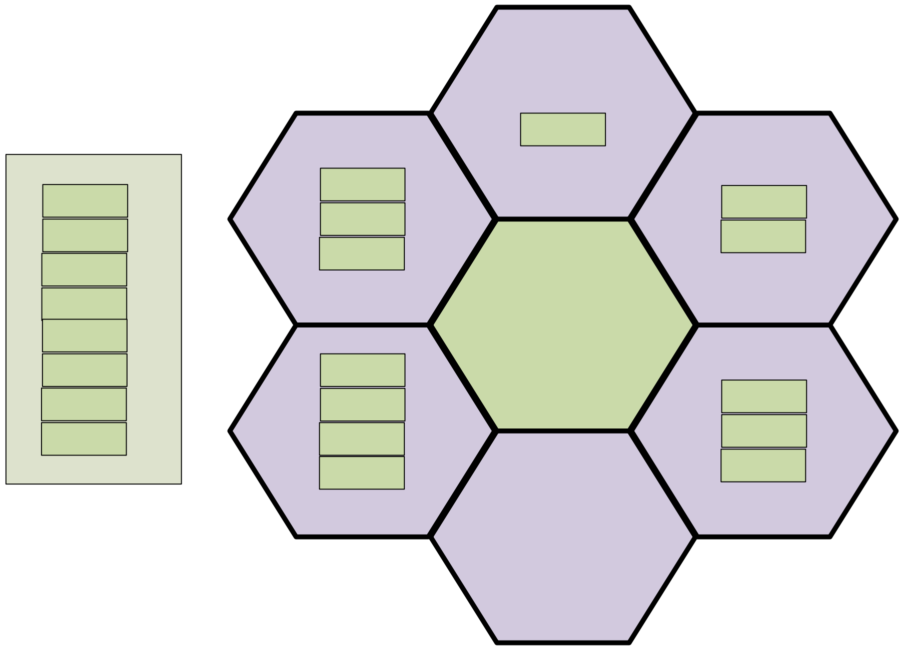

Figure 4.5 Dynamic Channel Allocation

Table 4.1 Difference between FCA and DCA

FCA	DCA
Perform better under heavy traffic	Perform better under high moderate traffic
Low flexibility in channel assignment	Flexible allocation channel
Maximum channel reusability	Not always maximum channel reusability
Sensitive to time and special changes	Insensitive to time and special changes
Not stable grade of services per cell in an interference cell group	Stable grade of services per cell in an interference cell group
High forced call termination probability	Low forced call termination probability
Suitable for large cell environment	Suitable in micro cellular environment
Low flexibility	High flexibility
Independent channel control fully centralized to fully distribute	Control depend on the scheme
Low computational effort	High computational effort
Low setup cell delay	Moderate cell setup delay
Low implementation complexity	Moderate implementation complexity
Low signaling load	Moderate signaling load
Centralized control	Centralized and decentralized

4.2.3. Hybrid Channel Allocation

An HCA is a mixture of the FCA and DCA techniques so that channels are divided into fixed and dynamic sets. Fixed set contains a number of channels which are assigned to cells. On the other hand, the dynamic set is shared by all users in the system to increase flexibility. When a call is a required service from a cell, but all of its nominal channels are busy, the dynamic set is assigned to the call [174, 184].

4.2.4. Exploiting Cell Overlapping

Channel allocations are very important for improve system capacity, enhance bandwidth, then improving QoS. Therefore, cell overlaps are required to ensure that not only the blocking and hand-off calls are kept minimal. However, the fairness QoS is measured in term of blocking and dropping levels. Reducing the Pcb and Pcd may be reduced by cell overlapping as shown in Figure 4.6.

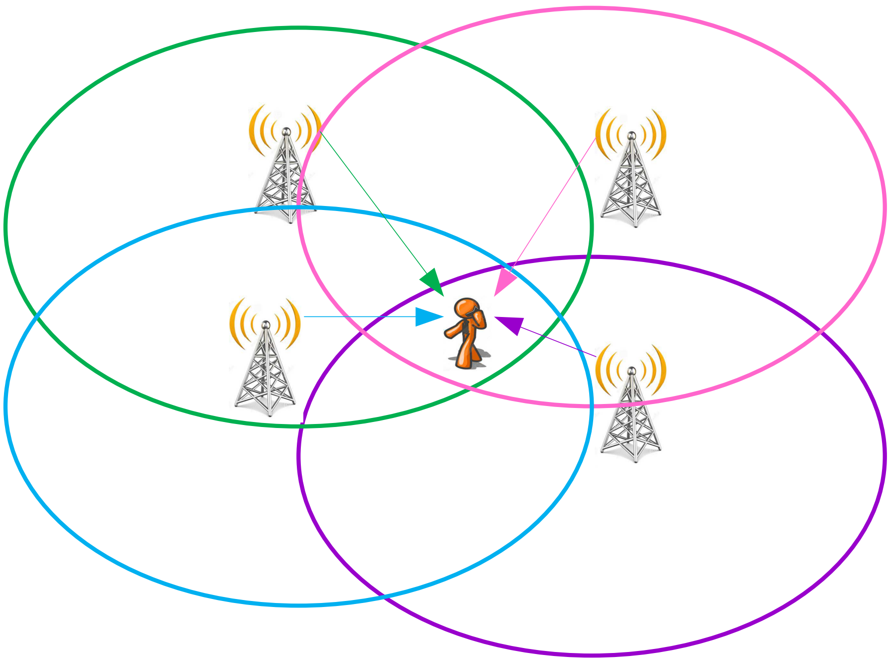

Figure 4.6 User in Overlapping Cell

Therefore, cell overlapping can improve the performance of system and give more flexible allocation for channel cells. Exploiting the overlap region is proven to be beneficial for a cellular communication system when the system capacity increases.

The users which request calls in the overlapping area may be redirected to another cell if all channels are occupied in the primary cell. The characteristics of the antenna main lobe of each cell can generate cell overlapping as well as determination of cell overlapping depend on channel interference ratio and minimum received power. Reducing the QoS variation through some CAC can possible for improvement in the overall service quality.

The most important features over wireless terrestrial systems made the practical problems that terrestrial communication systems face are not applicable HAP, because of the nature of HAP system. Naturally, in HAP all transceiver are co-located on the platform as well as the line of sight which platform provides with the stations on the ground. So that, there will be only fewer obstacles between stations in the ground and platform and cell overlap can be used in all of the system cells [105] as shown in Figure 4.7.

HAP can provide large coverage area so that it keeps all of channel tracks in use within its coverage area. The size of footprint has to be large enough for keeping all of users attend inside the coverage area. The user can select which BS to be connected to by distance and minimum received power threshold or RSS. By any way, the cells are still set to overlapping with each other to ensure full coverage area. Thus, exploiting the overlapping regions possible to accomplish fairness and improve QoS. Significant gain can be distinguished through balancing the QoS through the service area [185].

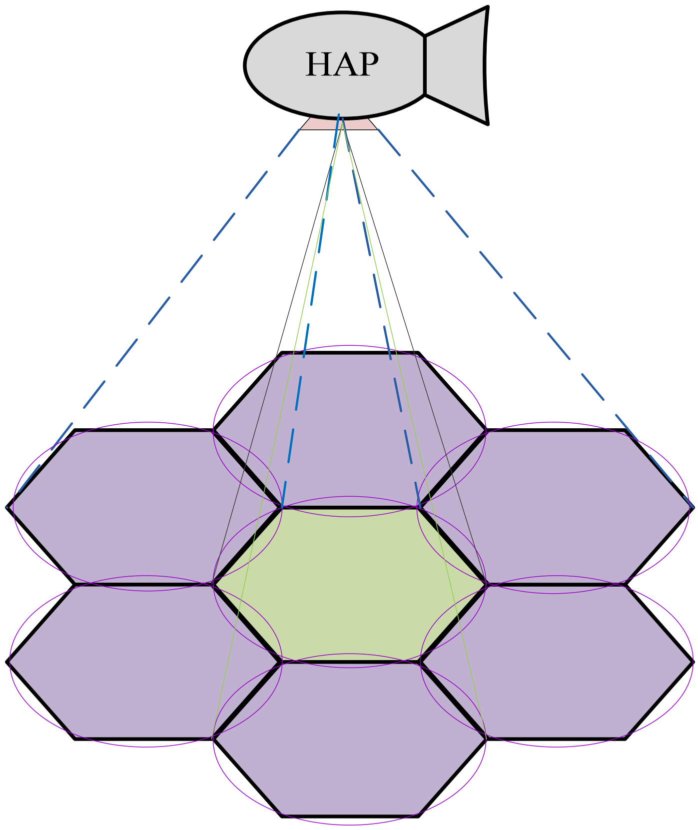

Figure 4.7 HAP Cells and Overlapping

4.3. Probability of Call Blocking and Dropping

Available bandwidth in each cell is channelized and focused on call-level QoS measured. Therefore, QoS is measured and evaluated based on term of Pcb and Pcd which are considered [186]. Blocking call occurs when all channels in a cell are busy and there is no channel available in the cell to entertain a new user. So the user will be rejected to make new connection. On the other hand, dropping call occurs when the user in during goes connection enters the cell and its call dropped because the channels at that time are busy. New arriving call and unavailable channels lead to dropping call.

The new call blocking refers to blocking of new calls, and the dropping call refers to blocking of ongoing calls due to the mobility of the users. Distinguishing the difference between two kinds of calls are measured terms is shown in Figure

4.8. By using channel reservation based channel technique, we can assign groups of channels to a group of users according to call duration. So, short duration calls will not be blocked due to long duration calls.

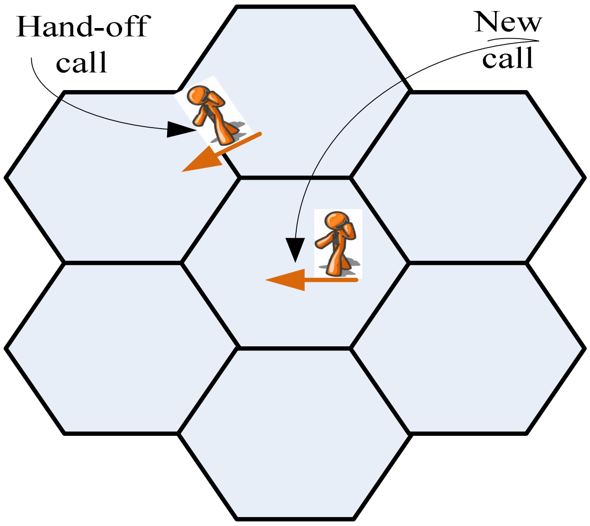

Figure 4.8 New Call and Hand-off Call

4.4. The Proposed Reservation Channel Technique

Under the assumption that each cell has been allocated certain number of channels, QoS can now be improved by the channel's effective allocation and utilization. Accordingly, two different conditions have been considered viz (i) when a user intends to initiate a new call, while being in the cell itself; and (ii) when a user moves from one cell to another typically when a call is already in progress. For the condition at (i) a call-block will occur when all the channels are already occupied and (ii) a call-drop will occur when there is no channel available to receive this hand-off call, in the next cell of movement.

Accordingly, to reduce the rate of call-block and call-drop i.e. to improve the QoS, we have proposed a novel channel reservation technique for implementation in HAP. As per this technique, the total channels (Tc) as allocated to each cell have been divided in three pools. Pool 1 ($Cp1$) comprises of channels which will be used by users who initiate new calls. Pool 2 ($Cp2$) comprises of channels for the user's hand-off calls (seeking entry in this cell). Remaining channels (m) are placed in Pool 3 ($Cp3$), as per Equation (4.1).

$$\mathrm{Cp3} = Tc - (\mathrm{Cp1} + \mathrm{Cp\ 2}) \qquad \text{Equation (4.1)}$$

$$\mathrm{Rc} \equiv \mathrm{Cp3} \qquad \text{Equation (4.2)}$$

Under heavy traffic conditions, additional channels may be provided from Pool 3 to Pool 1 i.e. $\Delta\, Cp1$ and/or Pool 2 i.e. $\Delta\, Cp2$, in order to reduce the Pcb and Pcd.

4.4.1. Procedures and Algorithm

We have Tc as the total number of channels allocated to a cell. For this cell, Tc is further divided in to $Cp1$, $Cp2$ and $Cp3$. Generally, at any particular point of time, the condition when $k \leq Cp1$, where k is the number of channels being used for calls and $k = 1{:}\,Cp1$, delivers the desired QoS. When $k > Cp1$, a channel is borrowed from $Cp3$, if available else the new-call request is blocked and the desired QoS considered degraded.

Similarly, in case of any hand-off call request, generally, at any particular point of time, the condition when $l \leq Cp2$, where l is the number of channels being used for hand-offs and $l = 1{:}\,Cp2$, the hand-off succeeds and the desired QoS is delivered. When $l > Cp2$, a channel is borrowed from $Cp3$, if available, else respective hand-off call request is dropped and the desired QoS gets degraded. Further, m is defined as the number of channels that are available for allocation in the pool $Cp3$. The proposed algorithm is shown in Figure 4.9.

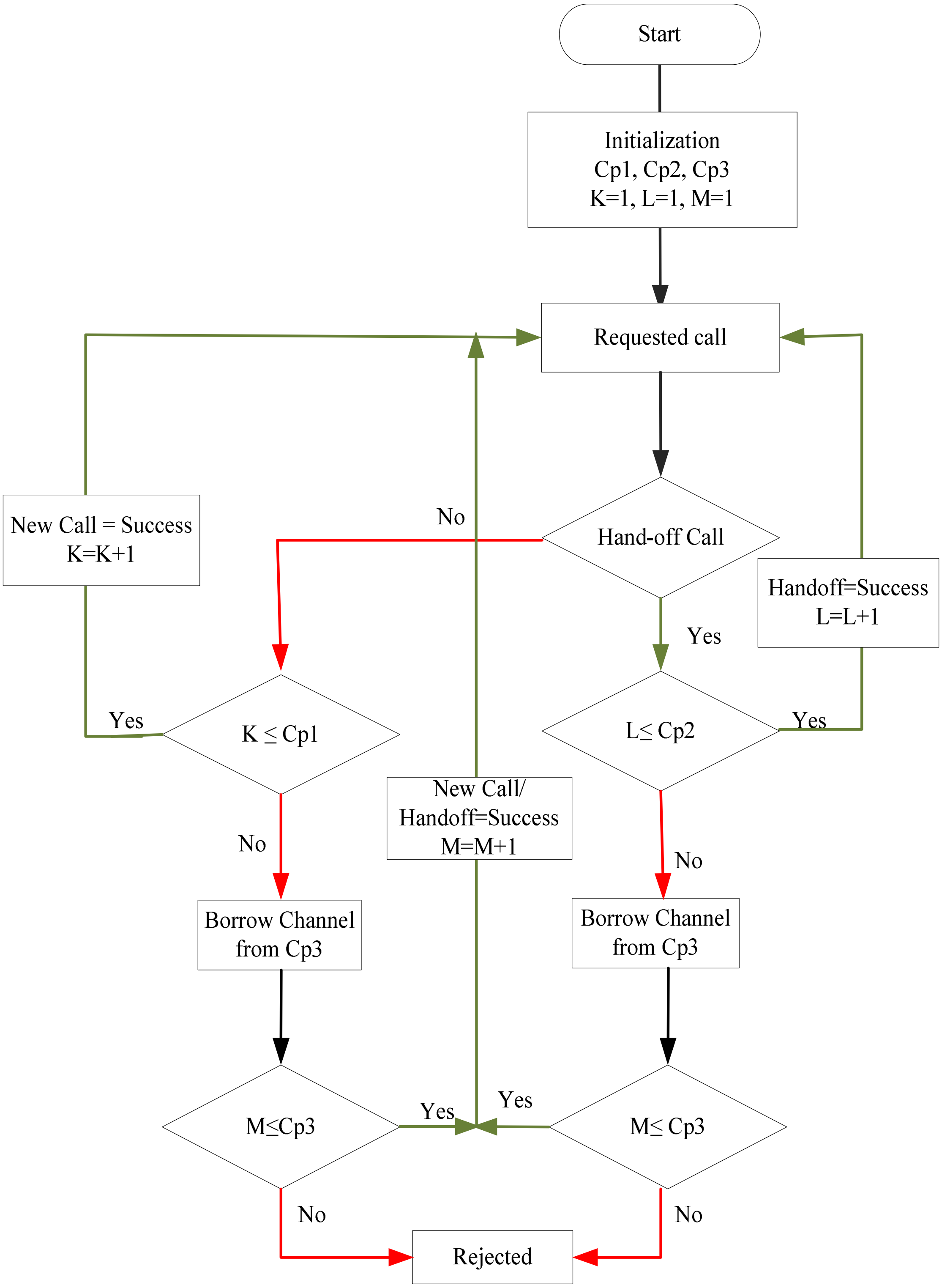

Figure 4.9 Reservation Channels Algorithm

4.4.2. Probability Model of the Proposed Technique

In this mode, the arrival of a 'new-call request' and the 'hand-off call request' has been assumed to follow the Poison distribution [122]. The new-call arrival intensity is represented by λ_k while hand-off call arrival intensity is represented by λ_l. The total call intensity (λ_t) is therefore calculated as the sum of hand-off call arrival intensity (λ_l) and the new-call arrival intensity (λ_k) i.e. $\lambda_t = \lambda_0 + \lambda_l + \lambda_k$, where λ_0 is initial intensity (at $t = 0$), before we begin our test time interval. Here, we also represent λ_0+λ_l=λ_s, for the sake of clarity and convenience.

We consider the total number of calls in this mobile cell as j, and p_{j1} is the probability of success of a new-call arrival request. We also define that p_{j2} is probability of success that a hand-off call request is successful. Lastly, at the start of this experiment event, initial probability of a new-call arrival request and a new hand-off call request is p_{01} and p_{02}, respectively.

There are basically two possible states of a mobile caller, during a particular test time (Δt): operational state (i.e. the user is busy in a talk) and it is represented by μ; and free state (i.e. the user has completed the talk and the handset is set free) and it is represented by η.

The sum of number of above two states per unit test time is called 'service intensity'$(\mu + \eta)$. This is our main criteria for sample space in probability.

The total number of states is defined by Markov process i.e. s+1 states and $s = cp1 + cp2 + cp3$. Figure 4.10 shows the state diagram for reservation channel technique. It is shown that both the arrival intensities λ_k and λ_l move till the last state's' and both are independent of each other. The probabilities are given by the following equations:

$$p_{j1} = \frac{(\lambda_k)^k (\lambda_0+\lambda_l+\lambda_k)^{j1-k}}{j1!(j2-l)!\,(\mu+\eta)^{j1+j2-l}} p_{01}$$ Equation (4-3)

$$p_{j2} = \frac{(\lambda_s)^l (\lambda_0+\lambda_l+\lambda_k)^{j2-l}}{j2!(j1-k)!\,(\mu+\eta)^{j1+j2-k}} p_{02}$$ Equation (4-4)

$$p_{01}= \sum_{j1=0}^{k} \frac{(\lambda_k)^k(\lambda_0+\lambda_l+\lambda_k)^{j1-k}}{j1!(\mu+\eta)^{j1}} / [\sum_{j1=0}^{k} \frac{(\lambda_k)^k(\lambda_0+\lambda_l+\lambda_k)^{j1-k}}{j1!(\mu+\eta)^{j1}} + \sum_{j2=0}^{l} \frac{(\lambda_l)^l(\lambda_0+\lambda_l+\lambda_k)^{j2-l}}{j2!(\mu+\eta)^{j2}}]$$ Equation (4-5)

$$p_{02}=\sum_{j2=0}^{l} \frac{(\lambda_l)^l(\lambda_0+\lambda_l+\lambda_k)^{j2-l}}{j2!(\mu+\eta)^{j2}} / [\sum_{j1=0}^{k} \frac{(\lambda_k)^k(\lambda_0+\lambda_l+\lambda_k)^{j1-k}}{j1!(\mu+\eta)^{j1}} + \sum_{j2=0}^{l} \frac{(\lambda_l)^l(\lambda_0+\lambda_l+\lambda_k)^{j2-l}}{j2!(\mu+\eta)^{j2}}]$$ Equation (4-6)

The equation for Pcb and Pcd is given respectively by Equation (4-7) and Equation (4-8):

$$Pcb = \sum_{j=0}^{s} p_{j1}$$ Equation (4-7)

$$Pcd = \sum_{j=0}^{s} p_{j2}$$ Equation (4-8)

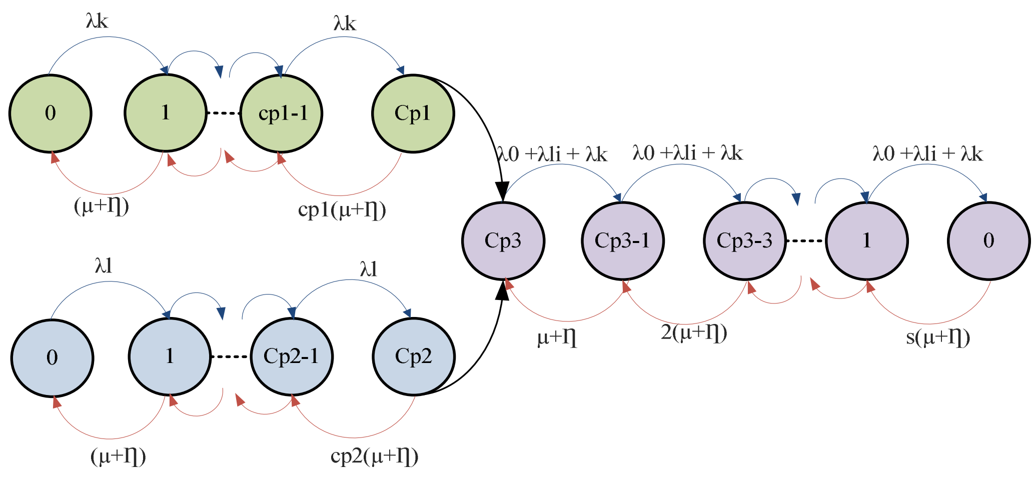

Figure 4.10 Reservation State Diagram for the Proposed Technique

4.5. QoS Analysis of the Proposed Technique

Three scenarios have been considered, for the considered mobile cell. For this cell, we have assumed that the total number of allocated channels (Tc) is 150. These channels are then re-distributed among three pools following the proposed scheme, viz $Cp1$, $Cp2$ and $Cp3$ for three different scenario. The probability of blocking of a new-call (Pcb) and the probability of dropping of a new-hand-off call has been then explored by varying the traffic intensity parameters i.e. the instantaneous value of new-call parameter k and new hand-off call parameter l. The QoS performance analysis has been done using MATLAB.

1. In the first scenario, we allocate 20 channels for new-call requests i.e. $Cp1 = 20$ while 70 channels for hand-off call requests i.e. $Cp2 = 70$, and the remaining channels are allocated to the reserve pool $\mathrm{Cp3} = 60$. Respective plots for Pcd and Pcb are shown in Figure 4.11.
2. In the second scenario, we allocate 15 channels for new-call requests i.e. $\mathrm{Cp1} = 15$ while 40 channels for hand-off call requests i.e. $\mathrm{Cp2} = 40$, and the remaining channels are allocated to the reserve pool $\mathrm{Cp3} = 95$. Respective plots for Pcd and Pcb are shown in and Figure 4.12.
3. In the third scenario, we allocate 10 channels for new-call requests i.e. $\mathrm{Cp1} = 10$ while 25 channels for hand-off call requests i.e. $\mathrm{Cp2} = 25$, and the remaining channels are allocated to the reserve pool $\mathrm{Cp3} = 115$. Respective plots for Pcd and Pcb are shown in Figure 4.13.

4.6. Results and Discussion

We have tested our proposed algorithm under three different channel distribution scenarios viz. Scenario 1, 2 and 3 and the probability of blocking of a new call and the probability of dropping of a hand-off call shows significant reduction. The reserved channels in for all scenarios is shown Table 4.2.

Table 4.2 Channel Reserved for all Scenarios

	First Scenario	**Second Scenario**	**Third Scenario**
k	20	15	10
l	70	40	25
***m* in case of reserved**	60	95	115

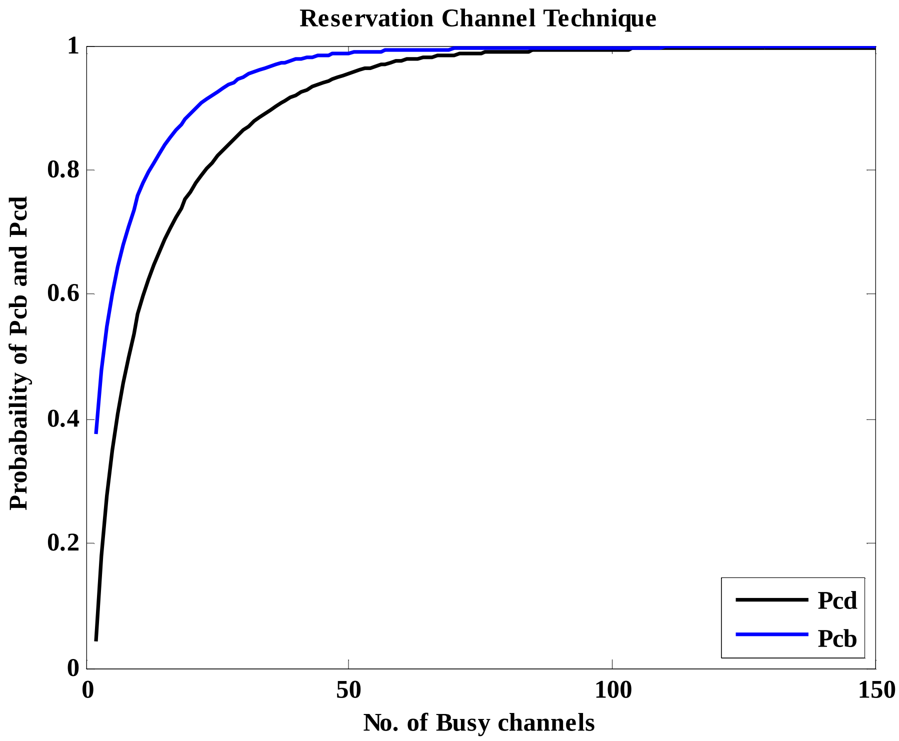

Figure 4.11 Probability of Call Blocking and Dropping in Scenario1

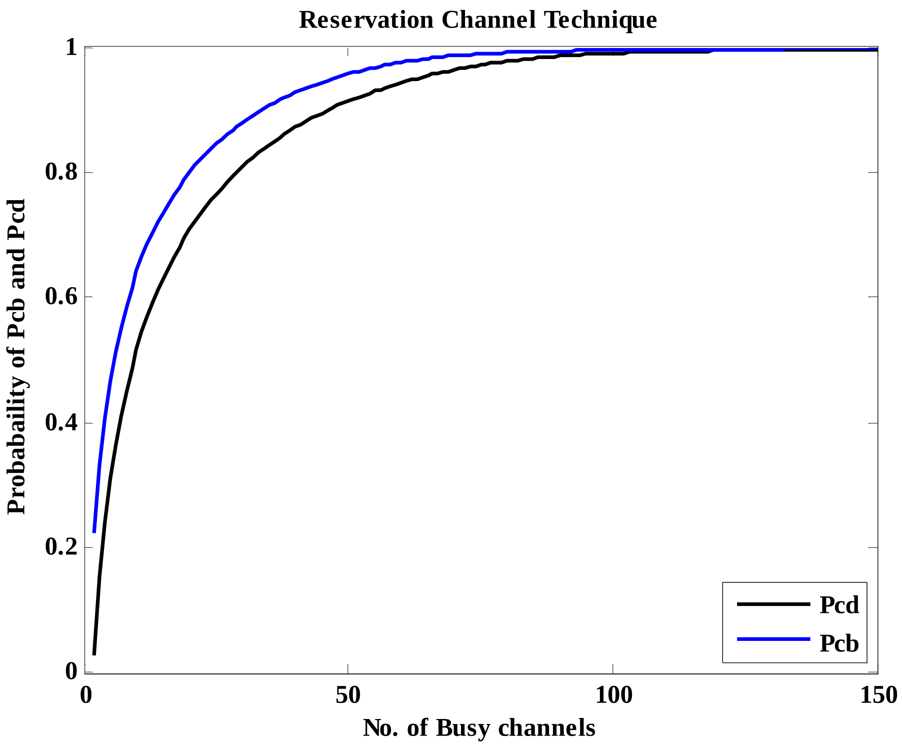

Figure 4.12 Probability of Call Blocking and dropping in Scenario 2

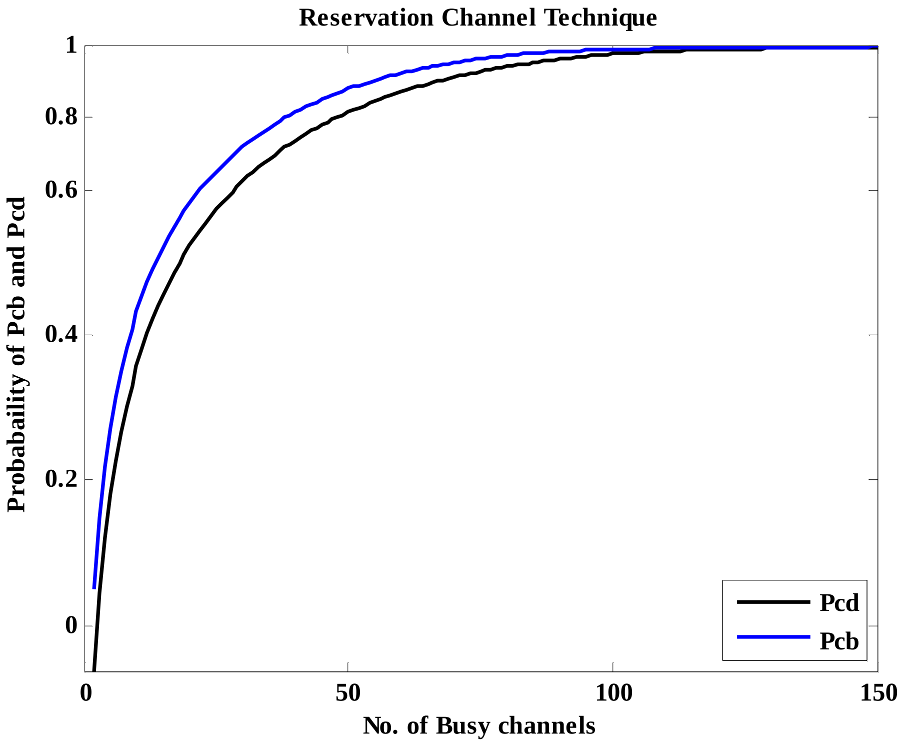

Figure 4.13 Probability of Call Blocking and Dropping in Scenario 3

In case of reserved channel, Figure 4.11, Figure 4.13 and Figure 4.12 are shown that, by reducing the number of l channel for hand-off calls, the Pcd is increased (i.e. probability of calls dropping Figure 4.11 < that of in Figure 4.12 < that of Figure 4.13). This increase in Pcd is caused by reducing number of l channels for hand-off calls. On the other hand, in case of l channels, (means, we have l channel for hand-off) if all of channels in cell are busy and any hand-off call requested arrives to the cell, it will be accommodated. Therefore, the Pcd in case of l channels is less than the Pcd in case of unreserved channels.

In case of reserved channel, Figure 4.11,Figure 4.12, and Figure 4.13 are shown that, by reducing the number of k channels for new call, Pcb is increased (i.e. probability of calls blocking Figure 4.11 > that of in Figure 4.12 > that of in Figure 4.13). The reasons behind that is reducing the number of k channel for new calls and increasing the number of l channels for hand-off. Pcb in case of unreserved channel for new call and hand-off calls, is greater than the Pcb in case of reserved channel for new call and hand-off calls. In addition, decreasing the number of available channels leads to higher Pcb, otherwise, the Pcb is low.

The results show that Pcd increases as the number of channels in Cp2 is reduced, in Scenario 1, 2 and 3. In first and second scenario Pcb increases as the number of channels in Cp1 is reduced, in Scenario 1, 2 and 3.

It has been observed that the Pcb shows a decreasing trend when we increase the number of reserved channels for new calls, in a HAP cell and vice-versa. Similarly, the Pcd also shows an increasing trend when we decrease the number of reserved channels for new hand-off calls, in a HAP cell and vice-versa.

Also, if the number of hand-off calls is very high, then the HAP cell requires to increase the number of reserved channels for accepting such new hand-off call requests, which can be done dynamically as well.

4.7. Conclusion

We have performed our analysis based on reserved channel for new calls and hand-off calls in HAP mobile cell. The comparison of results is done for enhanced QoS in terms of Pcb and Pcd. It is found that the Pcb decreases if the number of reserved channel for new call in a HAP cell increases and vice-versa. Therefore, the Pcd increases if we decrease number of reserved channel for hand-off calls in a HAP cell and vice-versa. For QoS enhancement, if the number of users inside the HAP cell is very high, then the HAP cell will require to increase the number of reserved channel for new calls. And, if the number of hand-off calls is very high, then the HAP cell requires to be increased the number of reserved channels to serve these hand-off calls. The results have reported that with our channels reservation technique, the Pcb and Pcd has been greatly improved.