# Decrease the Number of Base Stations without Hampering the Number of Channels per Unit Area

**Debabrata Sarddar, Utpal Ghosh, Rajat Pandit**

***Abstract:*** ***This paper presents a method which minimizes the cost of telecommunication service. In our previous work, we increased the number of channels per cell by reducing the bandwidth of Guard Band. In this paper, we remain fixed the number of channel per unit area and used our previous method. So here the handoff ratio remains the same. Hence, in our previous work the number of channels per cell is increased, so we have to increase the area of the cell without hampering the Handoff Initiation Ratio. So by using this technique The telecommunication companies have a chance to reduce the number of Base station with respect to the area is covered, as a result, their cost to provide telecommunication service is decreased.***

***Index Terms: Handoff, Channel distribution, Guard Band Principle,ChannelBandwidth, Telecommunication Company.***

## I. INTRODUCTION

### *A. CHANNEL DISTRIBUTION*

IEEE802.11b and IEEE802.11 g work within the 2.4GHz IS M band[2 ] and are compatible with 11 of the 14 most frequ ently offered channels by using the same frequency channels . The channels numbered from 1to14 are 5MHz apart with a bandwidth of 22MHz and 11MHz above the center of the channel.In addition, there is a 1MHz guard band on the underside to accommodate out -of-band emissions below 2.4GHz. Therefore, a channel-set transmitter transmits a signal from 2.401GHz to 2.423GHz and then offers the quality channel frequency distribution as shown in[Figure.1 ]. It must be noted that due to overlapping of frequencies there is vital interference between adjacent APs. Thus, in an exceedingly well-organized network,most of the APs can treat the non-overlapping channels[4] numbered 1, 6 and 11. The graph is shown in fig. 1:

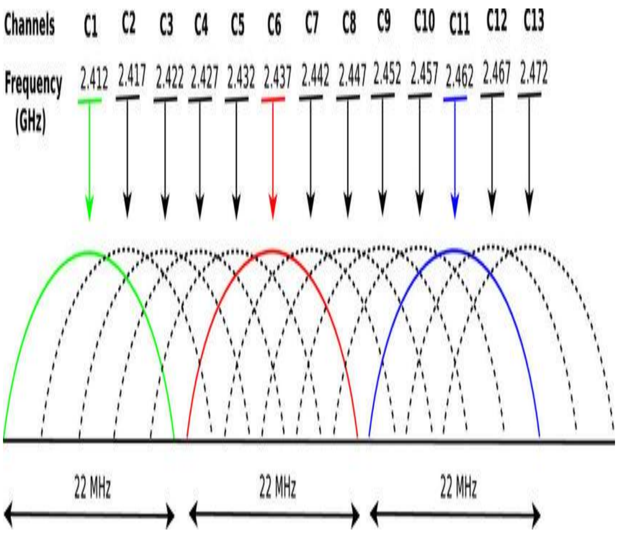


**Fig.1:Channel Distribution**

A guard band may well be a slim frequency range separating two wider frequency ranges[3]. A guard band for preventing interference is an unused part of the radio frequency spectrum among the radio bands. This ensures that communication channels used simultaneously do not interfere with expertise, so that the quality of every transmission can be reduced. Fig. 2 illustrates the position of the guard band:

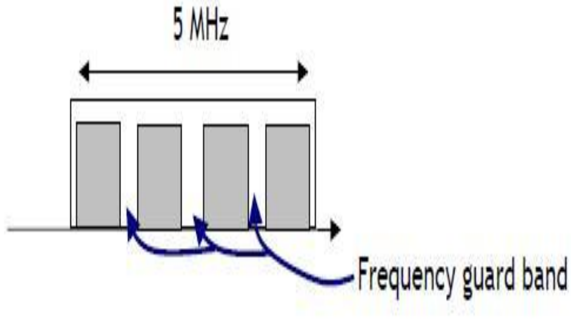


**Fig. 2: Frequency Guard Band**

Further, with regard to Guard Band[3] as such, the unused portion of the spectrum is intended to foreshadow crosstalk or interference from alternative modulated signals, such as the AM or FM radio, on the same transmission media. The bandwidth plan is for wired and wireless communications[3]. 10% of accessible bandwidth[3] has been described in the Guards Band. The technology offers, as is well known, several available bandwidth channels:

1. 1.4 MHz
2. 3 MHz

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3. 5 MHz
4. 10 MHz
5. 15 MHz
6. 20 MHz

This means that different channels bandwidth will have different Guard Band, as shown within the following Table[3].

**B.*GUARD BAND AND USED BANDWIDTH CALCULATION***

From table1[3] Clearly, the guard band does not correspond to 10% exclusively with the 1.4 MHz bandwidth. Actually, 320 kHz is suitable or 22.85%[3]. It is sufficient. Therefore, evidence concerning this distinction between 1.4 MHz and other channels can be searched afterwards. For a channel of LTE, we will think about the Guard Band which can handle 20% of the accessible bandwidth, distributed to 10% at the lower limits and 10% at the upper limits. Therefore, the used Bandwidth that is available isCalculated for 1.4 MHz as shown below:

Bu = 1.4 MHz - (140 kHz * 2)
= 1.4 MHz - 280 kHz
= 1120 kHz

The effective range of the Resource Block assigned to the current Channel can be calculated because the associated RB(Ressource Block)[3] contains 180 kHz of speed.

The units in LTE must be resource elements, RB and channel bandwidth prompt. Therefore, we tend to change to the nearest number to calculate the correct number of RBs:

RBs for 1.4 MHz = LBu / 1 RB ⌋
= L 1120 kHz / 180 kHz ⌋
= L 6.22 ⌋
= 6

Now, we have associate oddment of 0.22[3], that means:
180 kHz * 0.22 = 39.6 kHz = 40 kHz.
Therefore, the guard band for to 1.4 MHz channel is equal to:

$B_G = 280\ kHz + 40\ kHz = 320\ kHz \Leftrightarrow 160\ kHz + 160\ kHz$

which is up to 22.85% of 1.4 MHz[3].
Finally, the effective useful Band is[3]:
B´u = 1.4 MHz - 320 kHz = 1080 kHz
These are pointed in fig. 3:

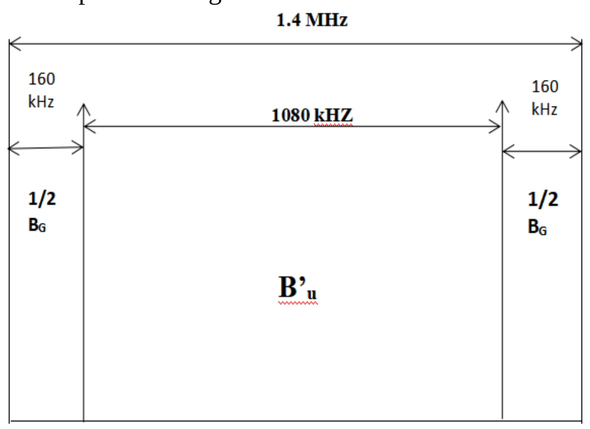


**Fig.3: Used Bandwidth and Guard Band for channel Bandwidth of 1.4 MHz**

Guard Band calculation for all different bandwidth channel. currently it ought to be clear that usingthe on top of formula altogether different bandwidth cases, the number of RB is an integer.

***table1:channel bandwidth(mhz),resource block(rb) number, used bandwidth and guard band length in each side***

| Channel Bandwidth(MHz) | 1.4 | 3.0 | 5.0 | 10.0 | 15.0 | 20.0 |
|---|---|---|---|---|---|---|
| Number of RB in Frequency Domain | 6 | 15 | 25 | 50 | 75 | 100 |
| Used Bandwidth(KHz) | 1080 | 2700 | 4500 | 9000 | 13500 | 18000 |
| Guard Band in each side(Kh=Hz) | 160 | 150 | 250 | 500 | 750 | 1000 |

Itmeans that thebandwidth could be a multiple of RB and the Guard Band (10%).

***C. GUARD BAND PRINCIPLE***

The guard band principle [5] for continuous data wants that the traditional distribution is valid. as luck would have it, there's ample proof that this could be a reasonable assumption. Throughout this paper, the applying of this principle is primarily to chemical-based experimenting and not process analytical technology or biological computations. it is necessary to evaluate a reportable value at or preparing to a restrictive or specification limit in terms of the inherent measure uncertainty. the thought is summarized in Fig.4[5]:

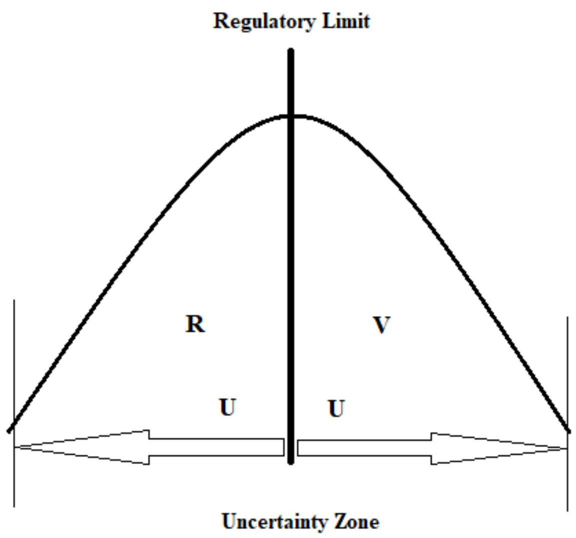


**Fig. 4: Guard band (±U) around a limit. Where RV stands for Reportable Value.**

The difficulty comes in decide however best to calculate the guard band (±U) [5] for the reportable value derived from associate analytical procedure. In theory, the overall variance of an analytical procedure( $s^2_{AP}$ ) is calculated from the individual variance components using Equation 1[5]:

$S^2_{AP} = S^2_W + S^2_B + S^2_{SM} + S^2_{RS}$ ---------- (1)

Where $S_W^2$ is that the inside assay variance because of measurement method itself, is that the between assay variance due to instrumental and operator effects, $S_B^2$ is that the assay variance because of the number of replicate samples, and $S_{RS}^2$ is that the variance introduced by the reference normal used.

## II. RELATED WORKS

In recent research days, a large quantity of analysis is done based on handoff technologies of cellularnetworks. In [1] Dr. Debabrata Sarddar et. al. Proposes a way of reducing the bandwidth of guard band, same quantity of bandwidth that reduced from the guard band are added to the effective useful band.So, by doing this the bandwidth of effective useful band is raised. every channel includes a fixed size bandwidth, that the increased bandwidth could happen some additional channels.Hence, by using this the quantity of channel during a cell is increased, which decreases the handoff failure chance.If there are accessible free channel then handoff initiation rate is raised and in this way may reduce handoff failure and can improve the probability of handoff rate. In reference, [7] and [8], for handoff management authors use GPS based access point maps.

## III. PROPOSED WORK

In our Previous work[1], we introduced a technique that helps to raised the quantity of channels by reducing the bandwidth of Guard Band. Where,We assume that, There is a total n number of channels. So, it implies that there are ***(n + 1)*** numbers of Guard band are out there. Suppose, total spectrum allocation of n channel is = ***L***

Hence, bandwidth of one channel or the channel per unit space is = ***L / n***

Again assume that the bandwidth of every Guard band of a channel is = ***Bg,*** Say. Shown in fig. 5. From earlier discussion[1], we all know that guard band takes 20 % of bandwidth from out there bandwidth of the channel, distributed to 10% on the lower limit and 10% on the upper limit.

So the expression of Bg is expressed as,

$$Bg = (L / n * (20 / 100)) \text{ or}$$

$$Bg = ((L / n )*2 *(10/100))$$

So, we are able to say that, the effective useful band of a channel (Bu) is = ***(L/n - Bg ).***

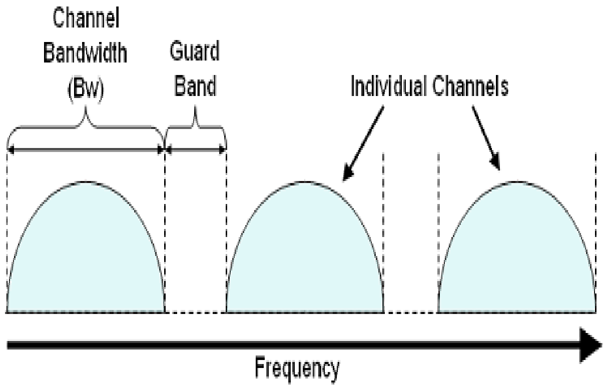


**Fig. 5: Guard Band and and useful Bandwidth of channel**

We all know that a **Guardband** is an unused part of the radio spectrum between radio bands, for the purpose of preventing interference. It has a risk factor which is 1:6. But in our Proposed work we make it half of 20 %, distributed to 5 % on the lower limit and 5 % on the upper limit.In other word we can say that, the risk factor is reduced from 1:6 to 1:3 i.e. half of the previous bandwidth of guard band. .So the bandwidth of each Guard band is reduce to became ***(Bg / 2)***. Shown in figure 6, And the effective useful band of a channel is increased.

which became $=(L / n - Bg + B_g / 2)$.

So ,the effective useful band is increased

$$= (L / n - B_g + B_g / 2) - (L / n - B_g)$$
$$= B_g/2$$

*L/n is bandwidth of = 1 channel*

*So, Bg/2 is bandwidth of = 1* $(B_g/2)$ channel*

*So now the total number of channel became = n +* $B_g/2 = N$

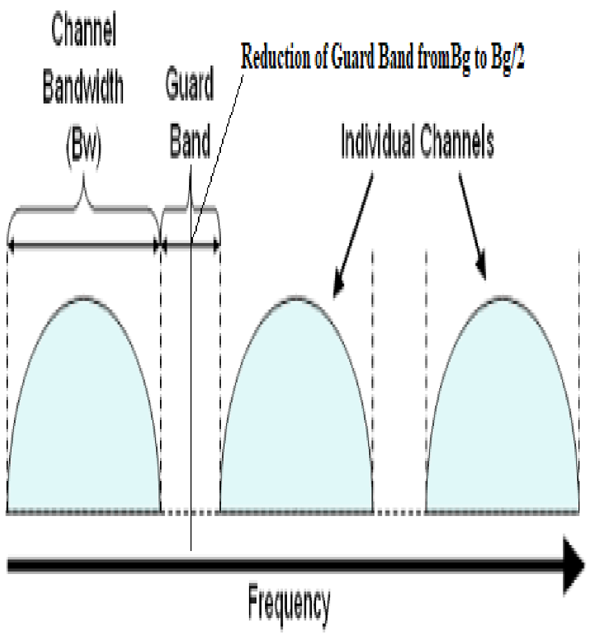


**Fig. 6: Reduction of Guard Band from Bg to Bg / 2**

So, Here the number of channels increases the area of a cell. We can use this increased number of channel in a different way.

**Case 1:** Here we fixed the bandwidth of each channel or the number of channels per unit area of the cell. So, in this case, we can increase the area or coverage of cells. By doing this we can increase the signal strength or coverage area of a base station. Here we increased the area based on the number of channels increased. That means,

Bg / 2 = Area of a base station increased, say A'.

**Case 2:** Each telecommunication company has a fixed particular area, so here we make constant the boundary area. Due to the fixed area, the number of increased channels increased the area of each base station. So, to cover the whole particular area there is less number of base station required.

**Let me give an example,**

***(i)Suppose, here the number of channels of a cell before reducing the bandwidth of Guard Band is =700***

***(ii)The number of channels after increasing the useful bandwidth by reducing the bandwidth of Guard Band is= 800.***

So, the number of channel per unit area of a cell is increased from 1/700 to 1/800.

Now, for the first case the number of channels per unit area of a cell remains constant, the number of channel per unit area of a cell is 1/800. Here we remain fixed the number of channel per unit area. We do the ratio from 1/800 to 1/700. We can do it by increasing the area of the cell with respect to the number of channels that are increased. So, by doing this coverage area of the base station should be increased. By using this concept, we may increase the coverage area of the base station and also can able to connect more people with the base station without handoff initiation, so it reduces call drop. Let me discuss it by an example, Suppose, a telecommunication company installs ten base station in a particular area which covers the whole area, say 400 acres. Suppose there are in a total number of 50000 channels. After increasing the number of channels by reducing the bandwidth of guard band extra 10000 channels are added, so now the total number of channels is 60000. Here, the number of channel per unit area is remain constant. That means 400 acres area is covered by 50000 channels, then the extra 10000 channels are used to cover another some extra area.

**In the second case,** The total coverage area remains constant. Because each telecommunication company occupies a particular area, not more than that. So here after increasing the number of channels we also increase the channel bandwidth or the number of channel per unit area. By doing this we can increase the cell size. So, each base station needs fewer cells and also handoff is avoided by this. We apply the same technique to the base station, so the total number of base station also decreased. As a result, the cost of installing the base station is reduced.

## IV. Simulation Result

We can reduce the bandwidth of Guard band, and use this extra bandwidth as useful band by increasing number of channels. So, by increasing channel number of a cell we can reduces handoff failure or call drop. Here is the graph is shown in fig. 7:

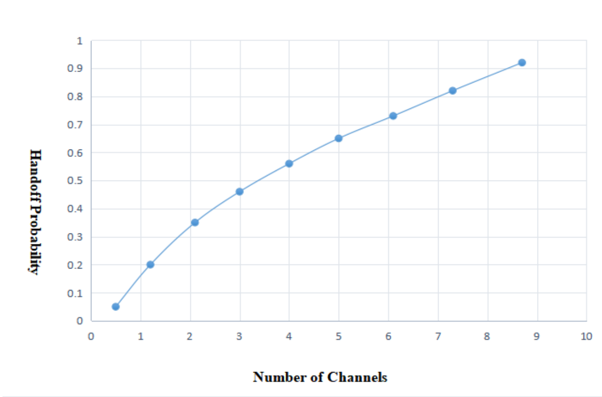


**Fig. 7: Number of channels vs. Handoff Probability**

If the number channel is increased then then the coverage area of Base station is also increased. Because here the channel number per unit area is remain same. So the extra increased channels are used to cover more cell area as compared to previous.So, we can say that, number of channels are directly proportional to the area of base station. The figure is shown in fig. 8:

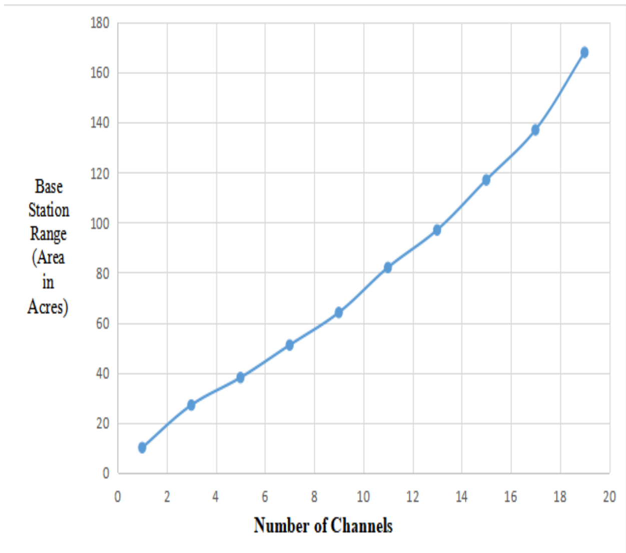


**Figure 8: Number of Channels vs. Base station Area**

When number of channels increased, the area of cell is also increased. But when the area of telecommunication network is fixed, then only cell size is increased and for that less number of cells are required to cover a base station. As the same way also the range of base station is also increased by increasing battery power, so less number of base station is needed to cover the particular telecommunication area. As a result the cost of installing base station is reduced. So, the increasing number of channels are inversely proportional to the number of Base station required. The graph is shown in fig. 10:

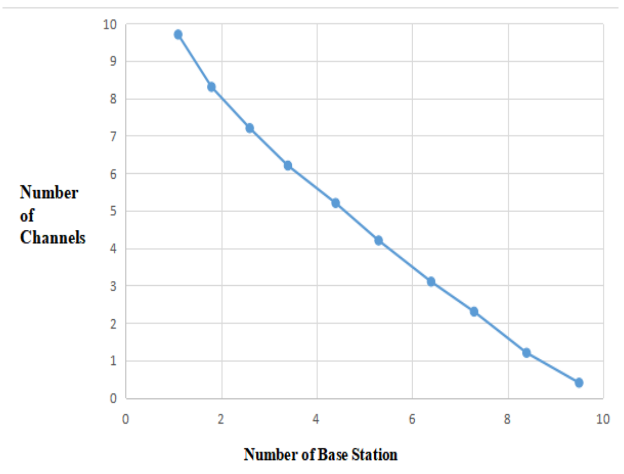


**Figure 10: Number of Channels vs. Number of Base station needed to install**

## V. CONCLUSION

In this paper have introduced the distribution of channels. Here we also discuss about Guard band and the occurance of Guard band between channels, including their usages. In our proposed work we have introduced a novel technique by reducing the bandwidth of the Guard band and increasing the effective useful band with the same ratio. By doing this, we may reduce the failure probability of handoff by avoiding the call drop. Here we introduce two cases, one is remain the channel number per unit area is fixed. So that the increased number of channels are used in to increase the coverage area of base station. Another is where we remain fixed the particular area of a telecommunication company, so that here we increase bandwidth of channel and for this reason the cell and also the coverage area range of base station is increased. That means to cover the constant communication area we need less base station.

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