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Revenue Based Call Admission Control and Dynamic Channel Allocation Using Optimization Tool

SATHYAPRIYA.R, MALATHY.S, AMSAVENI.M

Abstract- Nowadays the advanced services in cellular networks efficient bandwidth management and channel availability increase the problem in data and voice. Dynamic channel allocation (DCA) strategy is used for supporting the data and video with Quality of Service (QoS) by using the parameters such as call handoff probability and call blocking probability. DCA has been used to avoid traffic modeling of audio/video conference. Call Admission Control (CAC) mechanism with Genetic which makes decisions on the possible acceptance of a video call into the network is not only based on the fulfillment of user's bandwidth prediction, but also it based on the revenue that the provider will make when degrading current users in order to accommodate new ones. Providers need to use the resource management schemes effectively in order to keep existing users satisfied and attract new users, so that they can increase their revenue. Genetic algorithm is an optimization tool, by this optimization tool the best match can be found out. Genetic algorithm is used for time management and for predicting accurate result here it is used with two stages one with regular interval assignment and another with genetic algorithm assignment. This methodology will provide high QoS to wireless Audio and video users.

Index Terms- Dynamic channel allocation, Genetic algorithm, call admission control, pricing.

1 INTRODUCTION

The area chosen for this proposed work is mobile communication, it is the fastest way to communicate all over the world, and it is the essential part of daily life. Compared to population growth mobile users are greatly increasing day-by-day. In such case, by accommodating as many calls as possible in the network and maintaining a reasonably high level of network utilization will lead to congestion so that traffic will occur. To overcome this problem an efficient call admission control is proposed which will limit the number of call connections in the network in order to reduce congestion. By using DCA traffic modeling can be avoided and it will provide high QoS (Quality of Service). DCA is to avoid traffic modeling for an audio/video conference. In the implementation of a new DCA of CAC mechanism which makes decisions on the possible acceptance of a video call into the network not only based on the revenue that the provider will make when degrading current users in order to accommodate new ones. In this society, mobile communication has become the backbone of their life. The way of life is improved by all the mobile system technologies. It's main plus point is that it has privileged a common mass of society.

- *R.Sathyapriya is currently pursuing masters degree program in Communication Systems in RVS college of engineering and technology, Coimbatore, India, E-mail: priyaramme@gmail.com*
- *S.Malathy is currently working as associate professor in the department of electronics and communication engineering in RVS college of engineering and technology, Coimbatore, India, E-mail: joymalaty@gmail.com*

A cellular network or mobile network is a radio network distributed over land areas called cells; each cell is served by one fixed-location transceiver, and the fixed location transceivers are known as cell site or base station In a cellular network, to avoid interference and provide efficient bandwidth each cell uses a different set of frequencies from neighboring cells; these cells provide radio coverage over a wide area. This will accommodate a large number of portable transceivers (e.g., mobile phones, pagers, etc.). The admission control aim is to use the precious bandwidth efficiently. The main difference is that in traditional communication networks, is that the service is unique. The system services become versatile. In general, call admission control processes at an access point are in the channel allocation and admission algorithm. The channel allocation controls the bandwidth usage in a cell to ensure that the resource is shared fairly. The main purpose of the admission algorithm is used to prioritize the calls. The problem of providing efficient CAC is especially important in wireless cellular networks, where the traffic conditions in the cells can change very quickly due to user mobility. Fixed resource channel allocation schemes use an assignment strategy as like Fixed Channel Assignment (FCA) [4], Dynamic Channel Assignment (DCA) [5], and Hybrid Channel Assignment (HCA) [6]. FCA, channels are assigned to each cell permanently based on a predefined channel demand. In DCA, channels are dynamically assigned to each cell based on the channel requests. HCA, as the name implies, is a combination between FCA and DCA.

2 LITERATURE SURVEY

(Bourgeois et al., 2006) [1] Present a new heuristic algorithm that consists of three stages to achieve lower bound solutions for certain instances. The best fitness gives 3% of the maximum population size. (Polychronis Koutsakis, 2010) [2] Proposed precomputed traffic scenarios for a single cluster cell, which makes the decision on acceptance or rejection of a new call. Ghosh et al. [3] proposed hyper-heuristic methodology is used to find out the minimum frequency bandwidth given in different traffic demand distribution within the mobile network and the minimum channel reuse distance in order to avoid the effect of call interference within the same cell or adjacent cells. Yeung et al. [4] proposed six channel assignment heuristic algorithm to obtain frequency span Sajal et al. [5] proposed dynamic multi-channel assignment (DMCA) algorithm, this algorithm is based on the concept of network flows, and DMCA algorithm performs under heavy traffic conditions and handles different traffic classes gracefully. Zhang and Salari [6] proposed hybrid channel allocation scheme, we first obtain the stationary distribution of each cell when there are i calls connecting to the system and j calls holding on in the buffer. We then derive new and handoff call blocking probabilities, the average number of borrowed channels, and the average delay period of handoff calls.

Kishor et al. [7] proposed blocking and dropping probability in wireless cellular networks with handoff strategy, this algorithm is used to determine the optimal number of guard channels and the optimal number of channels used to provide a performance analysis for cellular systems. Hamid et al. [8] Discussed a multi-threshold guard channel policy and limiting behavior under the stationary traffic. Channel assignment algorithm for finding the optimal number of guard channels that minimizes the blocking probability of calls with lowest level of Quality of Service (QoS) subject to constraints on blocking probabilities of other calls. Finally the result shows that a prioritized channel assignment algorithm for multi cells cellular networks to minimize the blocking probability of calls with lowest level of QoS. Muhammad Salamah [9] discussed the Dynamically Adaptive Channel Reservation Scheme (DACRS) assigns handoff-reserved channels to new calls depending on the locality principle in which the base station with the help of location estimation algorithms in the mobile location center predicts the position of the mobile terminal. This scheme is designed to improve channel utilization while satisfying the QoS of the calls

Robert et al. [10] designed a CAC algorithm for Code-Division Multiple Access (CDMA) networks with arbitrary call-arrival rates. The design of the CAC algorithm uses global information it incorporates the call-arrival rates and the user motilities across the network and guarantees the users' QoS as well as prespecified blocking probabilities. CAC algorithm guarantees QoS and blocking probabilities techniques and also calculates the network capacity, i.e., the maximum throughput for the entire network. Chatziperis [11] proposed to solve the bandwidth and QoS requirements for third and fourth-generation wireless networks, they built a Discrete Auto Regressive (DAR) model to capture the behavior of multiplexed H.263 videoconference from variable bit rate (VBR) coders. Kalpana Saha [12] proposed CAC protocol which provides videoconference traffic taking multiple services like voice, text and multimedia at a time for multiclass users. An adaptive scheduling scheme to allocate optimum rate for each traffic queue is proposed to minimize the scheduling delay. This protocol achieves optimum rate with reduced delay, maximum use of bandwidth and maximum QoS.

Tianshu Li [13] discussed about the interrelation between pricing and admission control in QoS-enabled networks and propose a tariff-based architecture framework that flexibly integrates pricing and admission control for multi-domain networks. Prihandoko [14] farmed a work on Adaptive Quality of Service (AdQos) to guarantee the QoS of multimedia traffic generally classified as real-time and non-real-time. The key feature bandwidth reallocation, when the system is overloaded bandwidth operation of ongoing connections is control. Fei Yu and Victor Leung [15] proposed the handoff dropping probability; statistically predict user mobility based on the mobility history of users. Their mobility prediction scheme is motivated by computational learning theory, which has shown that prediction is synonymous with data compression and their data achieves static-reservation and cell-reservation schemes. Leong and Zhuang [16] in this paper a survey on the existing literature related to the works on CAC for future wireless systems, especially in the wireless and combined wireless/wired domains were examined. As the concepts of the Virtual Connection Tree (VCT) and cell cluster have been proposed to handle user mobility, both centralized CAC policies for systems using static VCT static cell cluster and distributed CAC policies for systems using dynamic VCT dynamic cell cluster are discussed. Fang and zhang [17] investigated the call admission control strategies for the wireless networks. They point out that when the average channel holding times for new calls and handoff calls are significantly different.

From the above survey shown that CAC algorithm used the above said three assignments (FCA, DCA, and HCA) and pricing control were done by multi domain networks and adaptive scheduling scheme for traffic analysis. The present work proposed a traffic model for audio/videoconference traces encoded with the latest international audio/video coding standard, in order to propose a new DCA-CAC mechanism for wireless cellular networks. In this work, the mechanism makes decisions not only based on the system's ability to accommodate newly arriving users and handoff users in terms of the estimated bandwidth but also on the profit that can be made by the provider by choosing which users will be accepted and which will be degraded based on their willingness to pay for higher quality services, as stated in their contracts. Regular interval assignment assigns channels at regular intervals to the cell whose calls determine the lower bound on the total number of channels. This cell is the one with the largest demand of calls. Genetic is used to find an optimum call list in the unassigned cells in the first stages.

3 MATERIALS AND METHODOLOGY

In previous studies the CAC mechanism was achieved by using the channel allocation systems like DCA [4], HCA [6], and FCA [5]. Also the pricing strategy and genetic algorithm used to achieve this mechanism. The above said allocation systems and optimization tools are used separately. But in proposed methodology the channel allocation -DCA based on dynamic pricing with optimization tool GA is combined together to achieve the effective CAC mechanism. The drop tail queuing priority is assigned for handoff and new call users which is provided by using dynamic pricing. Pricing is a revenue parameter and it is provided for Audio and Video calls. In this work NS2 is used for simulating the parameters such as call blocking probability, call dropping probability, and long user call, by setting with and without priority. Network simulation is simulated by Tool command language. A genetic algorithm is used for time management function. By using this algorithm QoS can be provided efficiently. Due to the short term temporal and spatial variations of traffic in cellular systems, FCA schemes are not able to attain high channel efficiency. To overcome this, Dynamic Channel Allocation (DCA) schemes have been considered. Pricing is the revenue parameter which is based on successful call completion and based on CAC the priority is assigned. So that better priority leads to high revenue.

Dynamic pricing makes adjustments often, according to the congestion level and demand pattern in a network in order to influence the way users utilize network resources, especially to allocate limited resources to those who value them most. Dynamic pricing also enhances network operators' ability to recover costs and make profits to finance capacity expansions. By influencing the demand patterns, operators could avoid the costly need to provision a network so that it can always meet its peak demand. Time-based pricing is recommendable for utilities both in regulated or market based environment. The time-based pricing is limited in the case of difference between peak- and off-peak demands, unavailability of adequate time-of-use metering. In a real-life scenario, call admitting decision or rejecting decision of a new call in the network will be made by the provider not only based on the capacity needed to accommodate the new call, but also on the revenue bases that the admission of the new call will provided. If the admission of a new call and increase in the bandwidth utilization can only be made with the degradation of a higher-paying customer who enjoys higher QoS, the CAC module should compute whether this is a profitable decision. One of the most important advantages of dynamic pricing[17] is that it will decrease call blocking probability and increase quality of service during congestion period and depending upon the need it will provide prioritized channel access to the user's urgency and willingness to pay for dynamic pricing. Percentage analysis can be done in dynamic pricing.

$$R=\sum_i N_i*W_i \qquad . (1)$$

N_i - total number of users call.

W_i – Revenue from each users.

Call dropping can be reduced by allocating sufficient guard channels for handoff calls and thus ensure improved QoS to users. A network will generate higher revenue because of higher utilization of system and a high tariff during peak period is used to prioritize important and urgent calls and boost demand will be provided during low tariff off peak period. In dynamic pricing, high demand during peak period is spread over to off peak period which results in improving overall utilization of system.

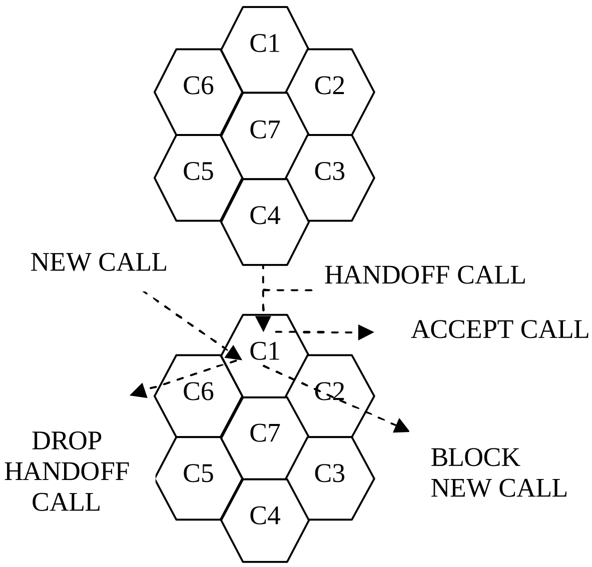

Fig.1. CAC with Priority

Dynamic pricing gives the user the freedom to use the network at a price they are willing to pay. Users are discouraged by high price during high network utilization and vice versa, resulting to reduction in congestion and hence high quality of service.

Genetic algorithm is encounter with mutation, population and crossover. Existing user is referred as parent and call transfer i.e. handoff is known as child. Call transfer from one zone to another is known as mutation. If new user's mutation value is above the offspring value then the call is forwarded. Less privilege is known as mutation and high privilege is known as transformation .In GA, 1. Population- No. of Users, 2.Transformation- New Call, 3.Crossover Mutation- Handoff Call are considered.

4 MODULES

These modules are used to simulate the proposed work, these scenarios' are as followed by,

Cellular Environment, Channel Allocation , DAC-CAC Mechanism, Priority Scheduling, Pricing Value, Performance evaluation.

The steps for evaluating the method,

1. Set 100 nodes for this environment.
2. The cell radius for this environment is 1000*1000m.
3. Arrival of call is specified with Handoff call and new call.
4. According to the call arrival rate channel allocation is evaluated.
5. For handoff call, audio call and video call is evaluated by using the pricing scheme.
6. The identification of handoff and new call is done by GA.
7. After the call arrival process genetic algorithm is implemented, GA is a generalized process.
8. GA is concern with interaction of genes on a chromosome.
9. The enlargement set of genetic operators such as crossover i.e. reproduction and inversion, procedure for GA is followed as,
10. The population is initialized first and it is evaluated, if the termination is not satisfied then the parents are selected for reproduction.
11. After selecting the parents it will perform recombination and mutation, then population is evaluated.
12. For example the representation of calls based on GA is given by,

Parent 1- 000|1101|001 Child 1- 000|0000|001

⇨

Parent 2- 110|0000|010 Child 2- 110|1101|010

Before crossover the string value is 1100000010, after crossover the string produces the value is 1101101010

13. By showing this, after crossover the string value produces high fitness function this will perform by reproduction and inversion.
14. In such a way if the strings are mutated then it will be a handoff call and if the string are transformed then it is a new call. Example for mutation,

101001
↓
101011

15. Mutation operators will inverse the binary bits if the bit is 1 and it will flip it in to 0 and vice versa, this operator will replace the bits in upper bound or lower bound randomly.
16. Admission control will make the decision of admitting the call handoff or new call process.

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17. Allocating the process into different type of channel such as audio, video in an cellular network.
18. Allocating these channels for different type of user such as long term users and new users.
19. By allocating channel in network environment they can schedule different type of users.
20. Static acts as fixed users in cellular environment.
21. Dynamic acts as mobile user in cellular environment.
22. DCA (Dynamic channel allocation) for Call Admission Control mechanism which makes decisions on the possible acceptance of a audio call and for video call into the network.
23. All channels are kept in a central pool and they are assigned dynamically to the cells as new calls arrive in the system. After a call is terminated, the channel is returned to the common pool.
24. The arrived call is a new call then it will check the availability of the channel, in this case if the channel is free then it will assign the channel and the call will be admitted else the call is forwarded to buffer.

Then it will check for buffer status, if the buffer size is full then the call will be blocked, else the call will be hold. For example the buffer block is Buffer size- 10 calls, Buffer time- 1sec, lapsed time- 20 sec.

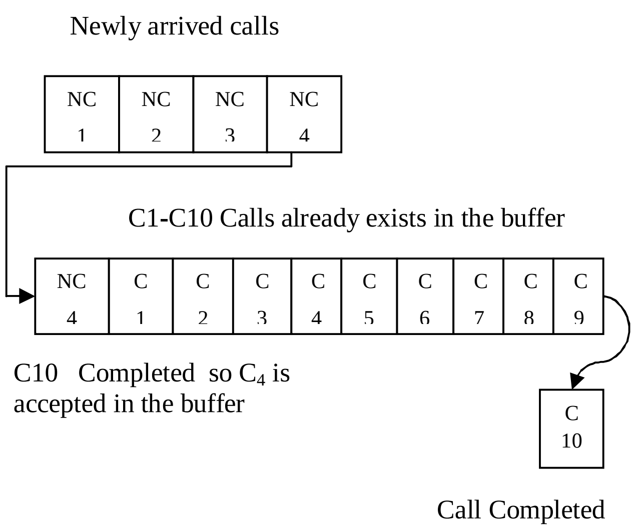

Fig.2. New call scenario for normal condition.

25. The above process is repeated until the lapsed time gets over.
26. After the mutation process the handoff call will check the availability of the channel if it is free then the channel is assigned and call will be accepted.

Fig.2 shows that when a call is arrived in the network if the channel is not free it will put it into buffer, if the buffer status is full then the call will be blocked else it allows the call to the lapsed counter. The buffer size is 10, when C10 completed newly arrived call NC_4 is accepted in the buffer. If the call C10 is not completed then the newly arrived calls will be put into lapsed counter.

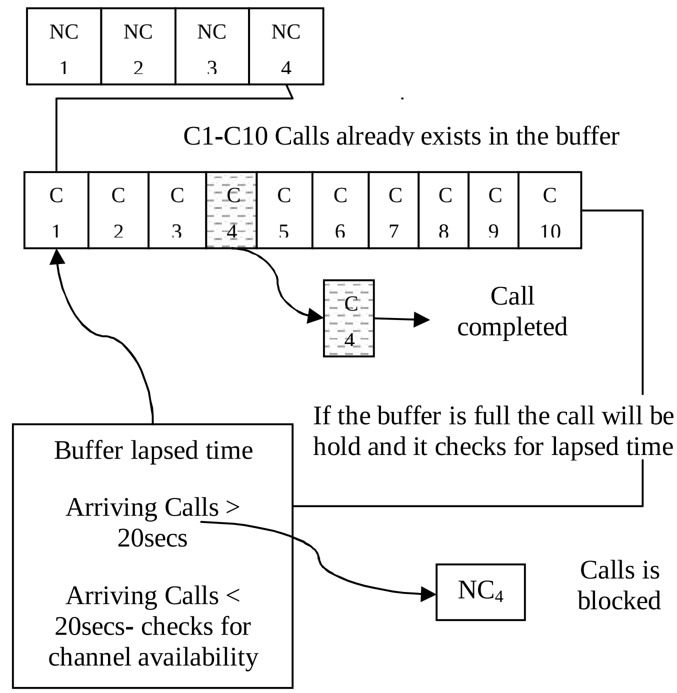

Fig.3. New call scenario for buffer condition.

The channel is full, newly arriving calls will checks the buffer status, if the buffer status exceeds its limit then the call will be blocked, else the call will be hold and checks the lapsed time of the buffer and waits for channel availability. If the lapsed time exceeds 20seconds the call NC_4 will be blocked, else NC_1-NC_4 will again check the channel availability and the process are repeated. If the callC4 completed then the buffer will be free so that newly arrived call will be accepted it is shown in fig.3.

27. The holed call will checks the lapsed time if the lapsed time over the call will be blocked, else it will check for the availability of channel if it is free then call is accepted
28. The priority will checks the audio and video quality based on revenue, by using dynamic pricing scheme priority will perform.

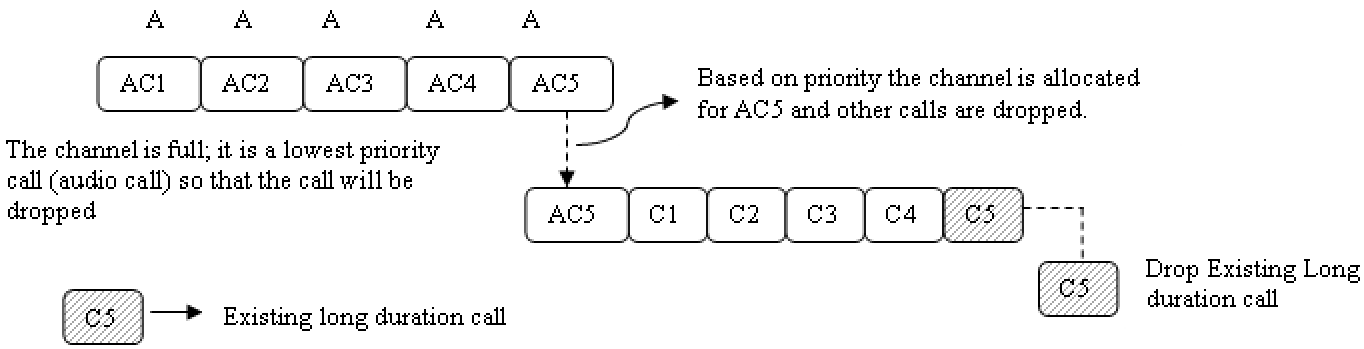

Fig.4. Handoff call scenario for audio call arrival.

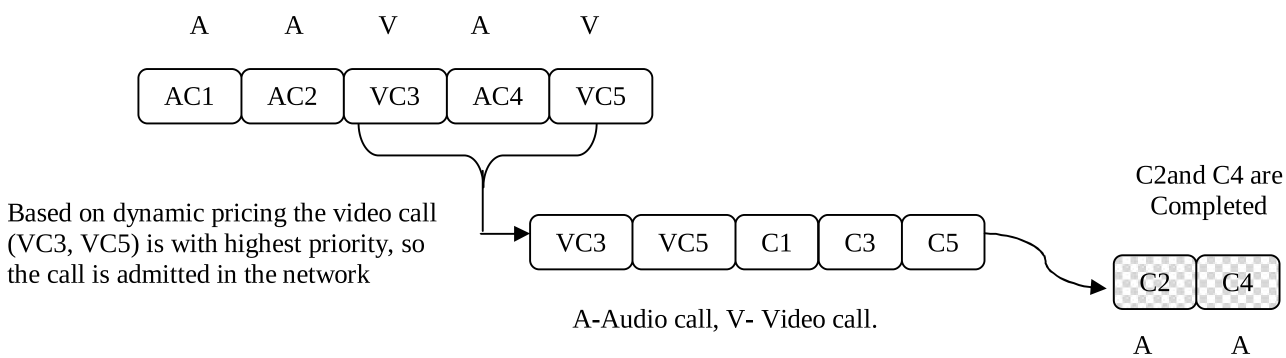

Fig.5. Handoff call scenario for audio and video call arrival.

The calls AC1-AC5 are the newly arrived calls and C1-C5 is already existing calls in the channel. The newly arrived calls are audio calls and it will check for the channel availability, based on priority (revenue) the audio call will have low priority, though it is an low priority call the existing long duration user will be dropped andAC5 is accepted then the other calls will be dropped, by this the dropping rate will be decreased it is shown in fig.4.

Based on pricing the calls VC3 and VC5 are video calls though it is a newly call it will allocated the channel for it because it is a high priority call. The calls C2 and C4 are completed else if it is a long duration call it will be dropped, and the network will give 1st priority to the video call so the channel will be allocated for those calls. This scenario is shown in fig.5.

29. The priority is assigned for audio call and video call, these will choose with the highest preference.
30. If the call produces lowest value then it will be dropped from the network.
31. If the call produces highest value then it will assign the channel and admit the call in to the network.

In the cellular environment 100 nodes are implemented, totally the 100 users are consider, the call is arrived in the network, it will check whether the arrived call is a handoff call or new call by using genetic algorithm. By mutating, 10 calls are assigned for handoff call and another 90 calls are assigned for new call. After admitting the call it will check for channel availability, the network can allocate channel for 88calls then remaining two calls will put it into buffer, the buffer size is 10 and it will accommodate only 10 calls into it if the arriving calls exceeds 10 that call will be blocked otherwise the buffer allows the call to behold, if the buffer lapsed time exceeds 20 seconds the call will be blocked else the 2calls will again check for availability of channel the above process will repeat until the channel availability criteria meets and lapsed time gets over. And for handoff call if the channel is free then channel is assigned for 8 calls and it will be accepted. The other two calls are meant for audio and video. Here it is consider 1 call is for audio and 1 call is for video by using dynamic pricing the network will choose the highest preferred call in this case the audio call will be dropped and for video call the channel is allocated, then the call is admitted in the network.

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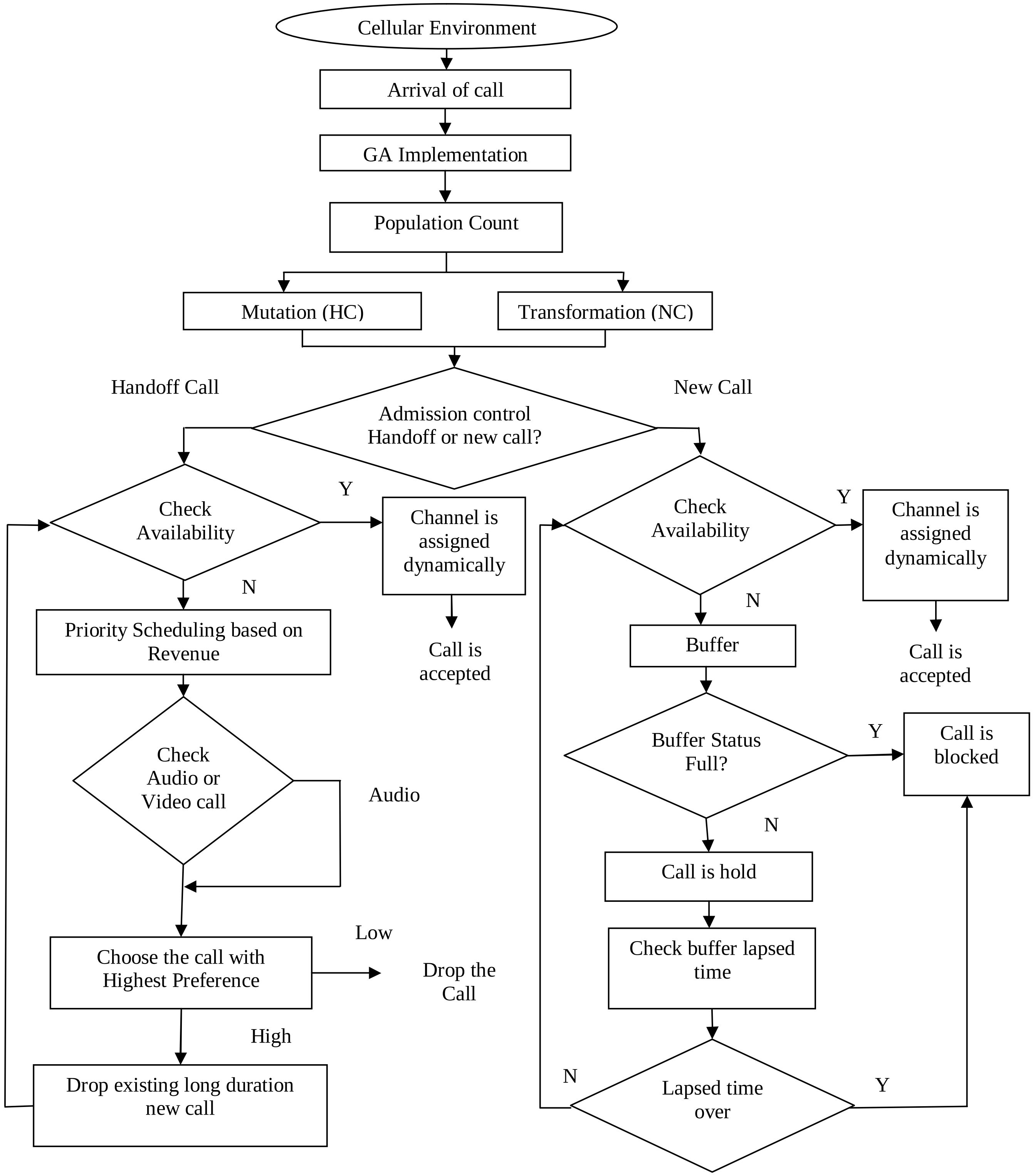

Fig.6. Flow chart for proposed method

5 RESULTS AND DISCUSSION

INPUT PARAMETERS	VALUES	DESCRIPTION
Cell type	Hexagonal	Usually the cells used for cellular structure is hexagonal.
Channel	Wireless	Here UDP protocol is used since it is a wireless channel.
Priority	Drop tail-Priority Queue	For pricing analyses drop tail queuing priority is fixed.
Cell radius	1000*1000m	The radius of the cell is 1000 meters; the distance of each cell is 100 meters.
No. of Users	100	In the cellular environment 100 users are considered.
No. of Channels	38 (1 slot)	2 channels for control signals, 30 channels for voice. For analyzing purpose 6channels are considered.
Threshold Value	0.75	Threshold value can be set between 0.60 t 0.75.
No. of Handoff Calls	10 calls	According to the call arrival it is defined.
No. of New calls	90 calls	According to the call arrival it is defined.
Buffer Time & size	1 sec, 10 calls	Buffer size is allocated only for 10 calls and the time take for it to allocate is 1second.

Table.1. Simulation Environment

S.N	Status	No. of Users (Peak time)	Audio (%)	Video (%)
1.	Call Blocking Probability-Priority	70	42	21
2.	Call Blocking Probability-No Priority	70	52	47
3.	Call Dropping Probability-Priority	70	47	21
4.	Call Dropping Probability-No Priority	70	26	24

Table.2. Results for the methodology

i. Simulation Environment

The environment setting of this simulation is wireless. The dimension of the cell's X and Y direction is 1000*1000.

ii.Simulation Parameters

The simulation parameters used in this methodology are dropping probability, blocking probability, bandwidth, Revenue of the network provider.

The result analyses of graphs are measured and it is shown in table.2

S.No	Status	No. of users	Priority	Non-Priority
1.	System Utilization	15	42	37

Table.3. System utilization

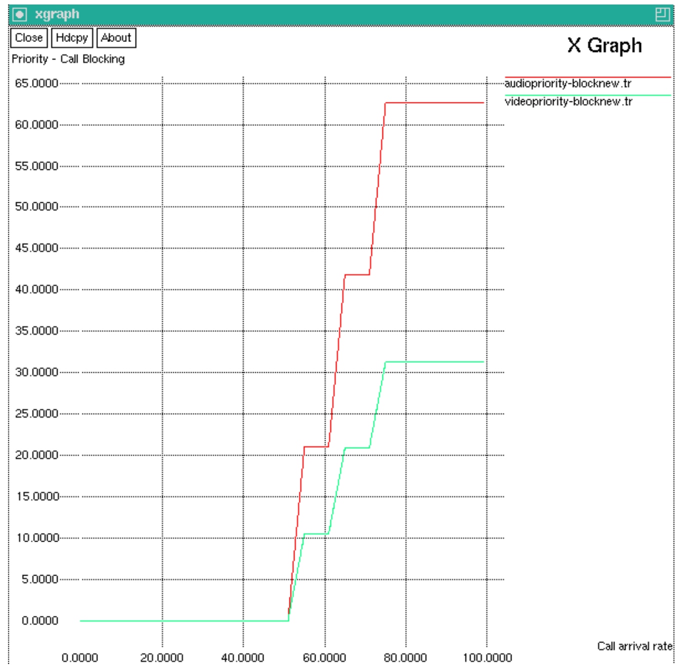

Fig.7. New User's Blocking Probability with Priority

The graph is drawn between call blocking rate vs. call arrival rate with priority setting. If 60 calls arrive in the network, the blocking probability of audio is 20% and for video the blocking probability is 10% and if 100 users arrives in the network, the blocking probability of video call is nearly 30% and audio call is nearly 60%. The result shows, blocking probability of the audio call users is much greater than video call users. By revenue bases it achieves low blocking rate for video call users it is shown in fig.7.

The graph is drawn between call blocking rate vs. call arrival rate without priority setting. The above Fig.8. is compared with blocking rate for audio and video. It shows if 60 users accommodate in the network then the audio rate will be 26% and for 100 users the audio rate is 79%.In video call for 60 users the blocking is 24% and for 100 users it is 70%.Without setting the priority the blocking in audio and video is higher compared with priority blocking. The

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blocking probability of audio call users is greater than video call users

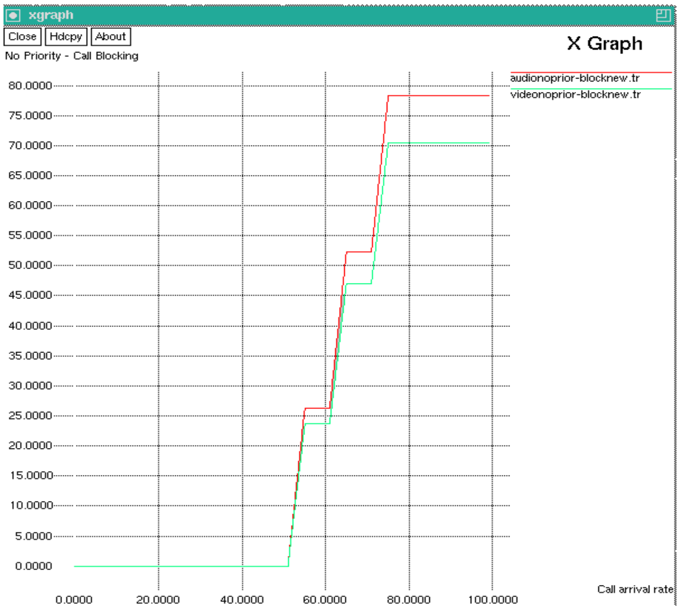

Fig.8. New User's Blocking Probability without Priority

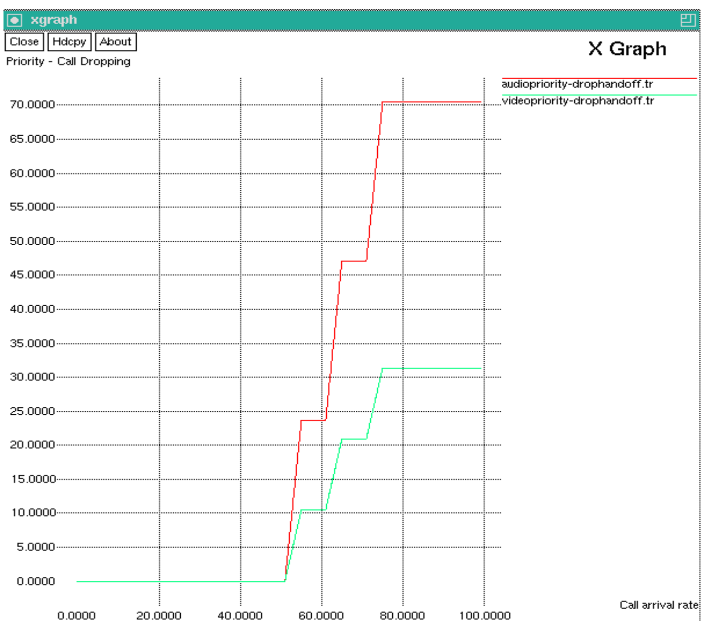

Fig.9. Handoff User's Dropping Probability with Priority

The graph is shown for Handoff user's call dropping rate vs. call arrival rate with priority setting. If 60 calls arrive in the network, the dropping probability of audio is 24% and for video the dropping probability is 10%.if 100 users arrives in the network, the dropping probability of video call is nearly 31% and audio call is nearly 70%. The result shows, dropping probability of the audio call users is much greater than video call users. By revenue bases it achieves low dropping rate for video call users it is shown in fig.9.

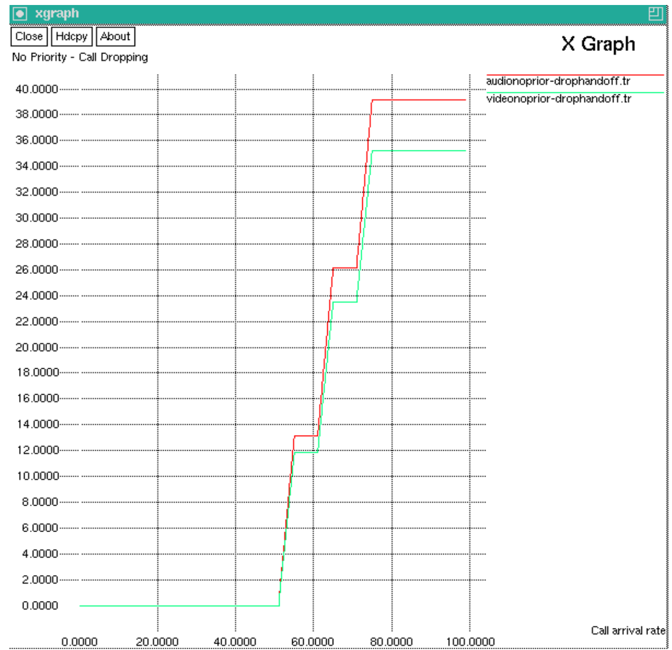

Fig.10. Handoff Users' Dropping Probability without Priority

The graph is drawn between call dropping rate vs. call arrival rate without priority setting. The above fig.10. is compared with dropping rate for audio and video. It shows if 60 users accommodate in the network then the audio rate will be 13% and for 100 users the audio rate is 39%.In video call for 60 users the dropping is 12% and for 100 users it is 35%.Without setting the priority the dropping in audio and video is higher compared with priority blocking. The dropping probability of audio call users is greater than video call users.

The graph is drawn between revenue and call arrival rate for priority and non priority classes if the priority is high then the revenue will be increased simultaneously if the priority is low then the revenue will be decreased. In the shown graph in 20 users arrives in the network the providers revenue will be 37% and it is a non priority value, and for priority the providers revenue will be 42 for 20 users. For 25 users the revenue obtained is 90%.

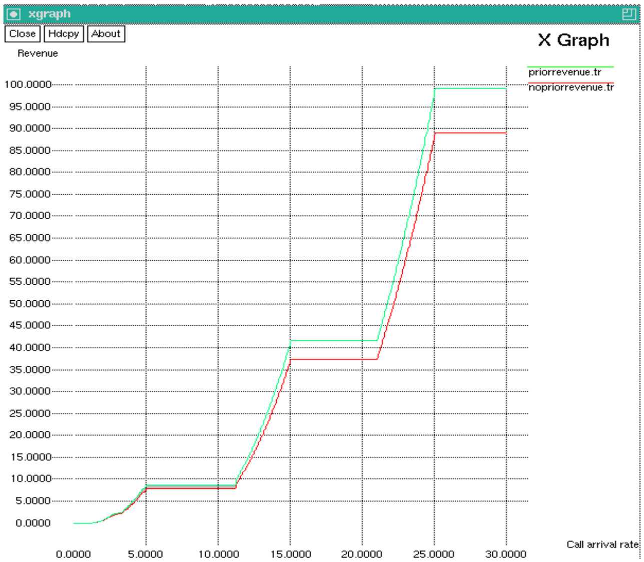

Fig.11. System utilization with and without Priority

6 CONCLUSION AND FUTURE WORK

Bandwidth management and channel utilization are the main problems in this field. In this work the proposed Dynamic Channel Allocation with Call Admission Control (DCA-CAC) is used. It will support to utilize bandwidth and channel effectively. DCA strategy is used for supporting the data and video with guarantee Quality of Service (QoS) such as reduced call dropping probability and call blocking probability. Providing the priority based on pricing the dropping and blocking probability is maximally reduced. Minimizing traffic in the cell, so that probability of rejecting users can be maximally reduced, Channel utilization will be increased, Provider profit will be increased, and User will be satisfied. In future, the proposed methodology will be analyzed with different optimization tools, the node analysis metrics consider in this work for 100 users that can be increased and implemented in future work.

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