Int. J. Nonlinear Anal. Appl. 13 (2022) No. 1, 1253–1267
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2021.24719.2807

A call reservation scheme for channel allocation using predication approach (CAPA) in wireless networks

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(Communicated by Madjid Eshaghi Gordji)

Abstract

The uncommitted bandwidth of the spectrum must be expeditiously employed by the mobile users, since nowadays the mobile users are rising step by step. The major aim of the channel reservation process is to minimize the probability of call dropping and an effective channel assignment approach can significantly minimize such probability of call dropping. There is several channel allocation and assignment approaches has been presented. In our paper, the Channel Allocation using Prediction Approach (CAPA) algorithm is presented. The CAPA algorithm appropriates the channel reservation for mobile users in the destination cell before the mobile user travels into that particular cell. The channels are pre-reserved while the mobile users are travelling inside some distance of the novel cell bound. Channel Adoption approach and Queuing approach are employed in our CAPA algorithm for apportioning the channel to predict permanent and temporary mobile users. In channel Adoption approach, free channels choose from the fundamental pool and optimally apportioned to permanent user. For temporary user, queuing approach is implemented and these approaches are employed

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Received: June 2021 *Accepted:* October 2021

to minimize the probability of call dropping and apply the available channel bandwidth efficiently. Hence, the Performance of CAPA algorithm is improved while compared to other existing channel reservation algorithms.

Keywords: Channel Allocation, Qos, CAPA, Call Management, Call Dropping.

1. Introduction

Generally, some of the process like channel allocation, handoff and access control are comes under the Channel Reservation Establishment (CRE)[[6],[17]]. In order to get a better performance, a CRE approach is used with integrated radio, which is essential for constructing trade-off among the individual aims of these tasks. The Call Admission Control (CAC)[1] scheme is based on Channel Reservation approaches that reserves channels in some of their neighboring cells with an eminent probability of obtaining handoff traffic from another neighboring cell which is predicted by employing mobility information of novel users. While a novel user comes, the reservation of bandwidth is assured in the home cell and in entire adjacent cells and the reservation based call access control is established with information of mobility of the mobile users. In such approach, cells required to be imposed in the future by a novel mobile user gains the reserved spectrum of bandwidth by the amount of necessitated bandwidth of the novel mobile user. This reservation established CAC is primarily utilized to minimize the handoff failures.

The available bandwidth is appropriated in each cell utilizing the information of user mobility and directionality in a neighboring cell. The reservation established CAC renders better Quality of Service (QoS) in Wireless ad hoc networks [11]. The condition of admission for the mobile users is established on the resource accessibility such that the entire system is within the schedulable area in terms of arrival rate and the number of mobile users. Handoff calls are dropped if it has lower priority. There are various prioritization approaches employed in a cellular communication network and the approaches concentrate on channel reservation. Channel Adopting, Reservation and Call Queuing approaches are more significant schemes in prioritization approaches. In our paper, the CAPA algorithm utilizes the channel adopting, reservation and queuing approaches for attaining the better QoS and minimizing the call dropping probability.

The channel adoption is one of the significant proficiencies of prioritization scheme. In channel adoption approach, the mobile user can adopt the free channels from fundamental pool. If the adopted channel is not interfering with living calls, the free channel can be adopted by a cell. There are various channel adoption approaches are present in cellular communication networks. In our paper, the CAPA algorithm is employed for channel reserved for the predicted mobile users. The permanent users are eminent priority users, so the probability of call dropping is lesser when compared to the temporary mobile user by employing channel adoption approach.

The call queuing approach is implemented for temporary users in CAPA algorithm. While there is no free channel present in the network, then the call is assigned into that queue. If entire channels in the destination cell concerned, the mobile call is queued. If any one of the channels is freed, it is allotted to the succeeding handoff call waiting in that queue and the queue can be categorized into a finite queue and infinite queue. The finite queue schemes are more naturalistic and infinite queue schemes are more commodious for analysis. First in First out (FIFO) queuing approach is employed in our analysis. The queuing approach is required to enhance the performance of that scheme. The significant factor of the queuing approach is time for call waiting. The priority established queuing approach affords the eminent priority to handoff calls throughout novel calls waiting in that queue to increase access to uncommitted channels [20].

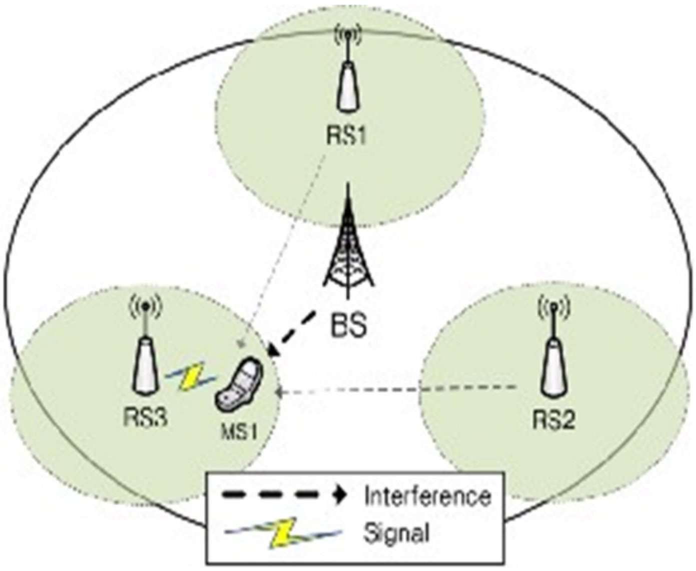

Figure 1: Channel Adoption Scheme

The total number of channels available in the network is the significant parameter in channel reservation approach. The primary aim of the channel reservation approach is reducing the probability of call dropping and the probability of call blocking as well. The static channel reservation approach results in poor utilization of resource. In order to figure out such problem, various dynamic channel reservation approaches were presented. In dynamic reservation approach, the optimum numbers of network channels are adapted dynamically established with the arrival of user. The reservation parameters are reservation level, user arrival and completion or rejection of calls. Future cases are prefigured in prediction schemes and the parameters are corrected in progress to keep unsuitable degradations of QoS. The predictive scheme approximates the global province of the ad hoc network by employing prediction approach based on locally available information.

2. RELATED WORKS

Mahesh, et al. [14] presented the model of channel reservation approach for Channel Admission Control at Next Generation Wireless Network (NGWN) which is based on the QoS requirement of various users. Various user classes of call blocking probabilities are demonstrated in the simulation results which are optimistic and obviously suggest that user classes of eminent priority possess very modest call blocking probability while compared to user classes of low priority owing to undivided channel reservation of eminent priority mobile users [5].

Dipti Varpe and Girish Mundada [21] were proposed the algorithm for dynamic channel allocation called Distributed Dynamic Channel allocation (DDCA) algorithm which is used for initiating calls. The proposed DDCA algorithm attains the probability of call dropping is 0.6. In such algorithm, the same channel demand is required by the uniform traffic distribution in each and every cell but the non uniform traffic distribution at each and every cell require dissimilar channel demand [18]. Hence the non uniform distribution of call blocking probability is less as compared with distribution of uniform calls. P.Jesu Jayarin and T.Ravi [7] proposed a channel assignment scheme with the aim of exploiting bandwidth with some fairness circumstance in order to equate the bandwidth appointment of packet flows. Here, they present an adaptive channel allocation approach for IEEE 802.11 networks that accepts into account the uncommitted bandwidth at each and every node and renders the throughput and the Quality of Service (QoS) to the wireless networks as well.

Arunita Jaekel, et al. [21] presented a new formulation called Integer Linear Programming (ILP) which is established on the Carrier to Interference Ratio and it also optimizes the channel allocation approach and incoming call power control. Such formulation assures that the entire power necessity for the chosen channel will be reduced as much as possible and there is no on-going calls may drop as a solution of accepting the novel call[17]. The experimental results show that such approach contributes to substantial advances throughout existing approaches.

Alioune Nagom, et al. [22] presented the two effective ILP formulation schemes which are employed for optimally apportioning a channel to an incoming call for a user. The beginning ILP1 does not appropriate channel reapportion of the former calls. The next ILP2 permits such reapportion and the ILP formulation scheme accomplishes probability of call dropping as 0.5 which also employed for optimally figuring out the hybrid channel assigning trouble. Kolate, et al. [20] presented a survey of admission control approaches and prioritization of handoff for cellular communication networks. In this paper, overall performance of handoff related system is improved by the handoff prioritization scheme [2].

Raj Kumar Samantaa, et al. [15] presented a mathematical model to approximate the call dropping probabilities of wireless cellular communication networks by handoff queuing rather than appropriating guard channels. Such approach with handoff queuing postulations can attain the impelled termination probability at the trusted level nearly as which received from the guard channel approaches where the call blocking probability of novel initiating calls minimizes significantly.

Muhammed Salamah and Hashem Lababidi, [[16],[10]] were presented the algorithm for Dynamically Adaptive Channel Reservation (DACRS) approach which is designed to amend the utilization of channel when meeting the call QoS. The DACRS exceeds current reservation approach and consequences in more powerful and statistical gain of channel utilization.

Jesu Jayarin et al. [8] proposed a novel Localization scheme is in order to locate the network nodes exactly with the assistance of Beacon Nodes present in the wireless network. This localization approach evoking the shortest path founded route establishment which is the most effective concept for quick and secure packet transmission and it enhances the Quality of Service (QoS) of the Wireless Sensor Networks in terms of accuracy and transmission speed. Without situating the network nodes and the exact distance, the shortest path determination is inefficient.

Sudarshan Subhashrao Sona wane [19] presented the D-LBSB approach which provides better performance than an overloaded system that contains a C-LBSB version. In such approach the mobile channels are borrowed through a high density network cell from desirable low density network cells. The suitableness of that low density cell as a loaner is decided by a function of optimization containing three parameters of cell such as the coldness degree, proximity and channel blockade of high density network cell. The solution of such approach is that, in an area with a great number of very high density network cells and the distributed approach for channel allocation provides better performance.

ZhongXu ZhenqiangYe et al. [23] presented the channel allocation scheme called Adaptive Channel Reservation (ACR) algorithm which utilizes Global Positioning System (GPS) measures to decide when the reservation is to be established. Such scheme is employed to reduce the consequence of false reservations approach and to enhance the channel usage of the cellular communication systems. Experimental results demonstrate that the ACR approach executes better in nearly complete distinctive scenarios than anterior schemes[12].

3. SYSTEM MODEL

The fundamental model of Channel Allocation Protocol [15] is employed to exemplify the system model for our proposed protocol under standard hexagonal cellular representation of mobile ad hoc networks. A set of 'Y' of 'm' discrete cells are presumed with number of cells as 0,1,2,...,m-1.Additionally, an exact vector E = (e_i), $1 \leq i \leq m$ is regarded to mention the total number of channels needed for network cell i as e_i . Then, a matrix for channel allocation (C_{Allo}) is determined with each and every component b_{ij} to specify the assignment of j^{th} channel in i^{th} cell of the channel, where,$1 \leq i \leq m$, $1 \leq j \leq y$. The reuse channel restraint is determined by the matrix of compatibility c_m , where each and every component of c_m is incurred as $|h_{ij} - h_{pq}| \forall i \not\equiv p, \ j \not\equiv q$.

4. CHANNEL ALLOCATION TO THE NODES

At first, the network channels are spitted into number of groups required by the mobile network and are allotted to Base Stations based on the principle called 'Mutual Exclusion' in which few channels are appropriated for call hand-off process. The persisting channels are denoted to, as usual channel that can be employed for both the initiating calls and the handoff calls. When a call is originated by a user, the concerned base station analyzes the user type whether it is regular or irregular user. If the base station identifies the user as a regular user then it checks the channel status and if the channel is free it allot the channel, otherwise it borrows a channel. If the identified user as irregular then it checks the channel status and if the channel is free it assign the channel for that user, otherwise it put the request into the queue. When the length of the queue is so long then the call is automatically dropped. The channel allocation procedure is given below.

(a) Channel Allocation Procedure

Inputs:

- Total number of groups
- Total number of BS (Base Station)
- Number of network channels
- Channel request

Steps:

Begin
Group Assignment process
Channels are splitted into number of groups required by the network.
In which some channels are allotted for handoff.
User group identification
Regular user, $(i > 45)$
Irregular user,$(i < 45)$
For Regular user
if channel is free
Allot the channel for user
else
Borrow a channel For Irregular user
if channel is free
Allot the channel for user

else
Put into queue
if queue is free
Allot channel for user
else
Drop the call
End

5. PROPOSED PROTOCOL

In a cellular communication network, several channels are present to satisfy various users to improve the performance of the network. The CAPA algorithm provides better performance than the existing channel reservation algorithm and our proposed algorithm utilizes the scheme called hybrid channel assignment. Distributed Dynamic Channel Allocation (DDCA) and Dynamic Load Balancing (DLB) approaches are combined in our CAPA algorithm. Here, the Channel Borrowing and Queuing Schemes are required in which channel borrowing is applied under DLB based Dynamic Channel Allocation Scheme and the queuing approach is employed under DDCA Scheme. The Channel Borrowing scheme is employed for Regular Users of the network and Queuing is applied for Irregular users of the network. This CAPA algorithm attains better Quality of Service by reducing the call dropping and call blocking probabilities and efficiently uses the bandwidth of the channel. In this algorithm, we use the total number of channels as 75, total number of users as 110 and total number of new arrival users as 25.The CAPA algorithm executes various steps to assign the channel for the users. At first, the user groups are analyzed to identify whether the user is regular user or irregular user. The network assigns threshold value for every user. If the threshold value is less than 45 the user is irregular user and if it is greater than 45 the network identify the user as regular user. If the network identifies the arrived user is a regular user, it checks the channel availability status and if a channel is available the network provides the channel to that user. Otherwise, the network checks the reservation status. If the reservation status is full, the network borrows a channel for regular user. Since, the regular user can play a vital role in cellular communication network. In channel borrowing approach, the available free channels are obtained from the fundamental or central pool and in each cellular communication networks a central pool is situated at the MTSO which is known as Mobile Telephone Switching Office. Entire Base Station free channels are placed in the central pool and while the user need free channels to improve quality of the call of the users, the channels are borrowed from the central pool. Then the borrowed channels are returned to the pool after completion of the user call. This CAPA algorithm functions priority wise to all of the users. If the network identifies the user is irregular, it checks the availability of the channel. If a channel is available, it is assigned to that user. If all channels are busy, the reservation status of a channel is checked. Whether the reservation status of channel is full, then the irregular user is put into the queuing process. Otherwise, the free channel is allotted for user. The status of the queue is checked and if the queue status is full, then the call is dropped. Otherwise, the call request is waiting till the channel becomes free. Our proposed CAPA algorithm is so simple and extremely reliable to the network.

6. ALGORITHM OF CHANNEL ALLOCATION USING PREDICTION APPROACH

1. Total number of channel = 75
2. Total number of user = 110

New user Arrival = 25
Step 1:
Channel Available = C_k
Queuing Process = q_i
Users are = A_i, B_i, C_i
A_i = Regular User
B_i =Irregular User
C_i =New User
Step 2:
For $(i > 45)$
{
A_i <= Regular User check Reservation Stat
If($A_i < -\ C_k$) available
{
$A_i < -$ allot channel
Else
{
$A_i < -$ Borrow Channel(queue is full)
$A_i = A_i + q_i$
}
}
}
Step 3:
For $(i < 45)$
{
B_i¡= Irregular User check Reservation Status
If($B_i < -\ C_h$) available
{
$B_i < -$ allot channel
Else
{
$B_i < -$ Borrow Channel (queue is full)
B_i=B_i +q_i
}
}
Step 4(New User Arrival)
if $C_i < 45$
{
$A_i < -\ C_i$ (Regular user) Step 3 Repeated Process
Else
{
$B_i < -\ C_i$ (Irregular user) Step 4 Repeated Process
}
}

SINR is generally employed measure to characterize the quality of the link among the nodes.

SINR is denoted by $x\left(.\right)\epsilon P$ at moment $g\left(.\right)\epsilon Y$ between the source and destination is defined as

$$x(g) = 10log\left(\frac{h(g)q(g)}{\alpha(g)}\right) \tag{6.1}$$

Where $\alpha\left(.\right)\epsilon P$ is the destination noise, $h\left(g\right)\epsilon P$ is the power during transmission and $h\left(.\right)\epsilon P$ is the gain of the channel which is defined as

$$d(.) = h_{d_0}\left(\frac{P(k)}{d_0}^{-k}\right)10^{0.1\delta(k)}\left|X(k)\right|^2 \tag{6.2}$$

Where $d\left(.\right)\epsilon P$ is the length among the nodes, $\beta\left(.\right)\epsilon P$ is the approach called log-normal shadowing, P is the power and h_{d_0} is the close node given by,

$$h_{t_0} = \frac{H_t H_\gamma \lambda^2}{(4\pi)^2 d_0^2 D}, \quad d_e \leq d_0 \leq d(g) \tag{6.3}$$

Where H_t= Source antenna Gain,
H_γ= Destination Antenna Gain
λ^2=Wave Length
D=Distance Between

$$\frac{\Delta y(k)}{Q_s} = \frac{Y(k+1)-Y(k)}{Q_s} = \frac{1}{Q_s}\left[10log\left(\frac{a(k+1)}{a(k)}\right) + 10log10log\left(\frac{b(k+1}{b(k)}\right) + 10log\left(\frac{\alpha(k+1)}{\alpha(k)}\right)\right] \tag{6.4}$$

Where, Q_s is the sampling time of the network.

7. PERFORMANCE EVALUATION

The channel reservation is essential for minimizing the call dropping and call blocking probabilities by the way we can increase the channel utilization rate and call arrival rate. In order to reduce the traffic, the number of channels for users is increased. Therefore, we increase the total number of channels in our approach. The call dropping and call blocking probabilities of regular user is very less while compared to the irregular user of the cellular network. By merging channel borrowing and queuing approaches, the efficient channel utilization is accomplished. The performance of the network is determined based on the channel bandwidth utilization and the performance of our proposed CAPA algorithm is improved when compared to the DDCA algorithm. The simulation parameters used in our research are number of users, channel utilization rate, traffic intensity, call arrival rate, call dropping probability and call blocking probability. Number of channels regarded in our system are 75 among which new arrival users are 20 and already present users are 110. The channel availability or the total number of channels is35. When compared to existing DDCA algorithms, our CAPA algorithm attains better call dropping and call blocking probabilities. The application of our CAPA algorithm demonstrates that while 20 users enters into the cell, the channels employed is less and when the total number of users increases theutilization of channels also increase respectively. Because the utilization of bandwidth is qualified on the total number of users, the available bandwidth is not unnecessarily wasted.

(a) Traffic Intensity (T_γ)
Traffic intensity isanevaluation of the average tenancy of a base station during a intended period of time, generally a busy hour and it is given in equation 7.1.

$$Traffic\ Intensity\ T_r = \frac{Average\ rate\ packet\ arrival * average\ packet\ length}{Transmission\ rate\ bits/sec} \tag{7.1}$$

(b) Channel utilization rate (C_μ)
Channel utilization rate reckons on the traffic intensity of the network, which is given in equation 7.2 and it is defined as the ratio of traffic intensity and total number of channels.

$$Channel\ utilization\ rate\ C_\mu = \frac{Network\ traffic\ intensity}{Total\ number\ of\ channels} \tag{7.2}$$

(c) Call Arrival Rate (A_r)
The call arrival rate is defined as the ratio of total number of ongoing calls and busy or total call duration and it is given in the following equation 7.3.

$$CallArrivalRate\ A_r = \frac{Total\ number\ of\ outgoing\ calls}{Busy\ calls/total\ call\ duration} \tag{7.3}$$

(d) Call Dropping Rate (C_r)
Call dropping rate is calculated from the equation 7.4.

$$CallDroppingRate\ C_r = \frac{Total\ number\ of\ Dropped\ calls}{total\ number\ of\ attempted\ calls} \tag{7.4}$$

(e) Call Blocking Rate(C_b)
It is defined as the ratio of total number of calls that is blocked onchannel unavailability in the network to the total number of originatingcalls in the network and it is given in the equation 7.5.

$$Call\ Blocking\ Rate\ C_b = \frac{Total\ number\ of\ Blocked\ calls}{total\ number\ of\ new\ originated\ calls} \tag{7.5}$$

By using the above formulae, we can calculate traffic intensity, channel utilization rate, call arrival rate, call droping and call blocking rate which are mentioned in Table 2.

8. EXPERIMENTAL RESULTS

Figure 2 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare Call arrival rate and Traffic intensity. Here, the call arrival rate is taken on the X axis and Traffic intensity is taken on the Y axis. Our proposed CAPA protocol uses a number of channels and increased channel utilization rate than the existing DDCA approach Figure 3 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare No. of channels and Channel utilization rate. Here No. of channels is taken on the X axis and Channel utilization rate is taken on the Y axis. Our proposed CAPA protocol has reduced call arrival rate and traffic intensity than the existing DDCA approach. Figure 4 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare Channel utilization rate and Call dropping probability. Here Channel utilization rate is taken on the X axis and Call dropping probability is taken on the Y axis. Our proposed CAPA

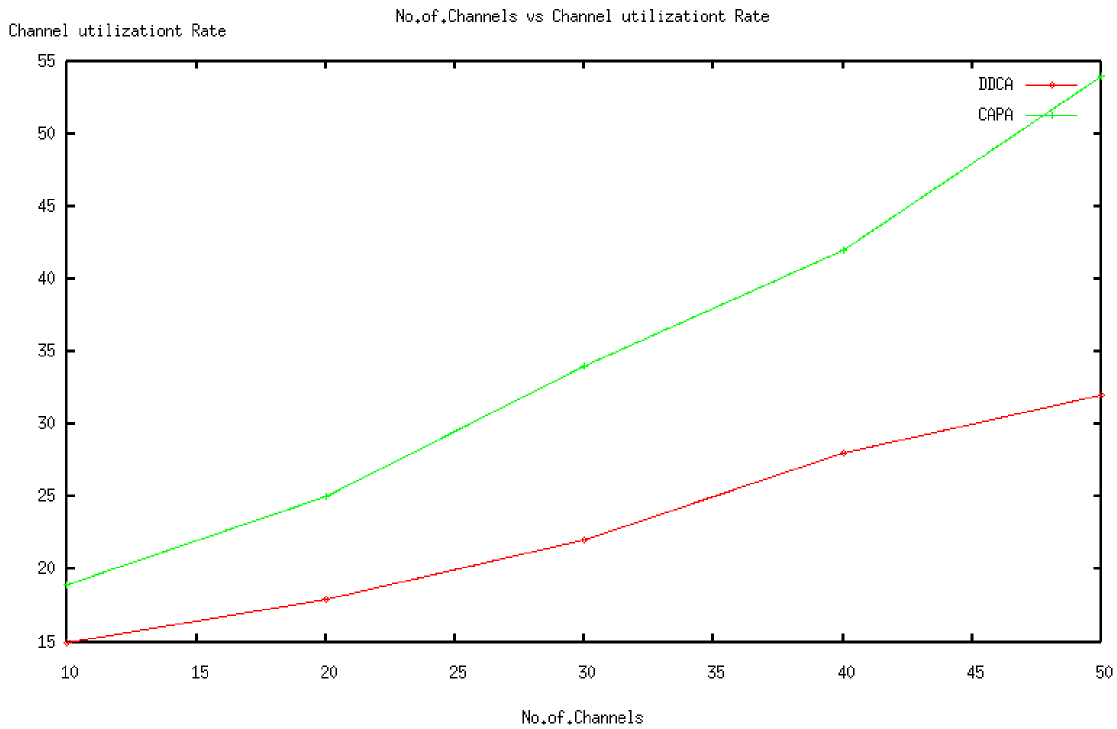

Figure 2: No. of Channel Vs Channel Utilization Rate

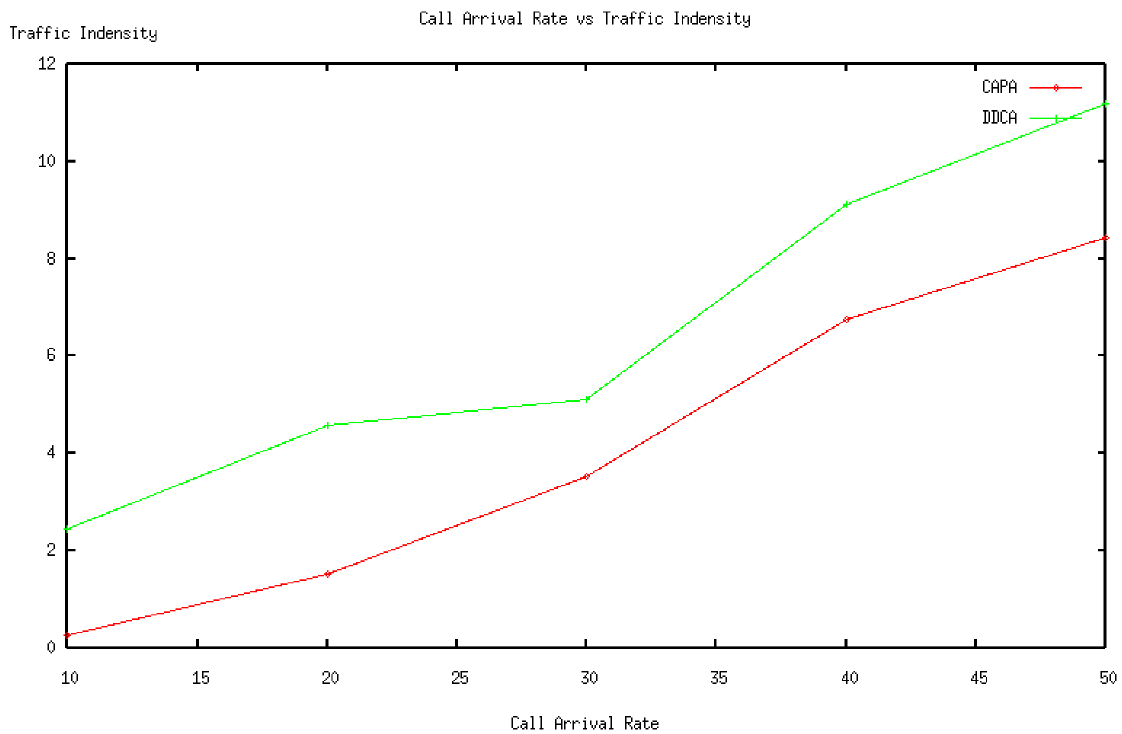

Figure 3: Call Arrival Rate Vs Traffic Intensity

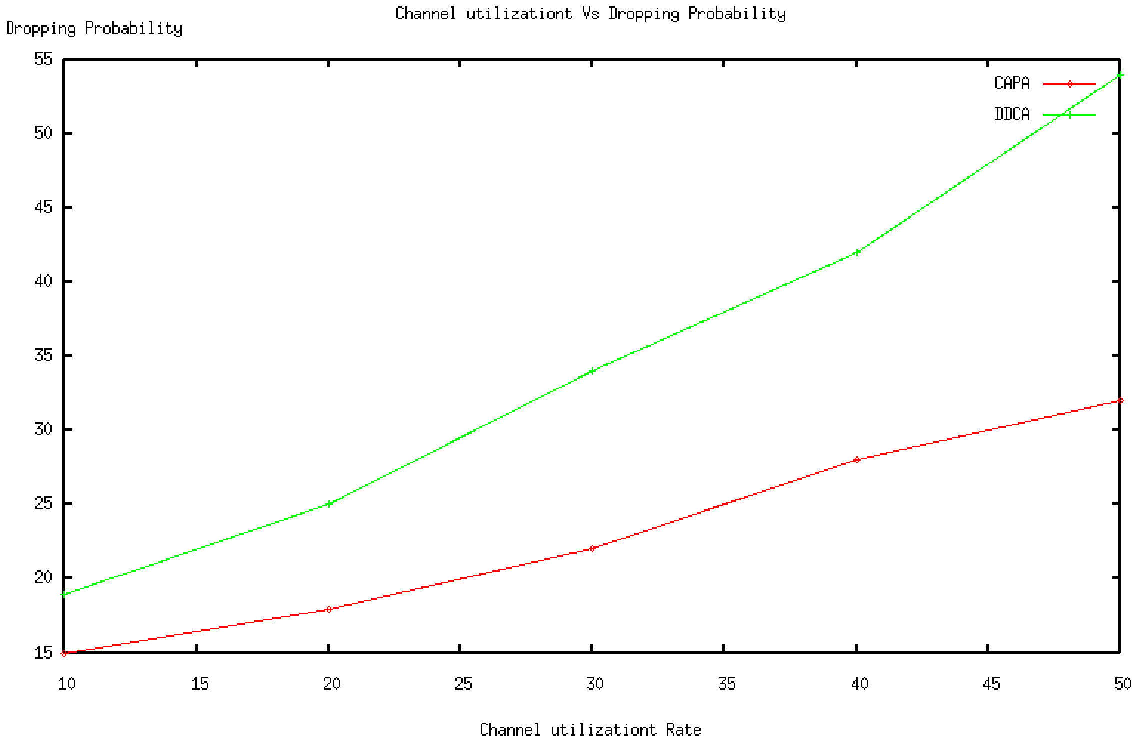

Figure 4: Channel Utilization rate Vs Dropping probability

protocol has increased channel utilization rate and reduced dropping probability than the existing DDCA approach.

Figure 5 (compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare the Call dropping probabilityand Number of channels. Here No. of channels is taken on the X axis and Call dropping probability is taken on the Y axis. Our proposed CAPA protocol employs the number of channels and reduced, dropping probability than the existing DDCA approach. Figure 6 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare Call Arrival rate and Channel utilization rate. Here Call Arrival rate is taken on the X axis and Channel utilization rate is taken on the Y axis. Our proposed CAPA protocol increases call arrival rate and channel utilization rate than the existing DDCA approach. Figure 7 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare Call Duration and Number of channels. Here Call Durationis taken on the X axis and Number of channels is taken on the Y axis. Our proposed CAPA protocol providesa number of channels by the way the call duration can be increased. Figure 8 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare Call Arrival rate and Call dropping probability. Here Call Arrival rate is taken on the X axis and Call dropping probability is taken on the Y axis. Our proposed CAPA protocol has increased call arrival rate and reduces the call dropping probability than the existing DDCA approach. Figure 9 compares the performance of networks that uses CAPA protocol and DDCA approach and here we particularly compare Call Arrival rate and Channel Utilization rate. Here Call Arrival rateis taken on the X axis and Channel Utilization rateis taken on the Y axis. Our proposed CAPA protocol increases the call arrival rate and channel utilization rate than the existing DDCA approach

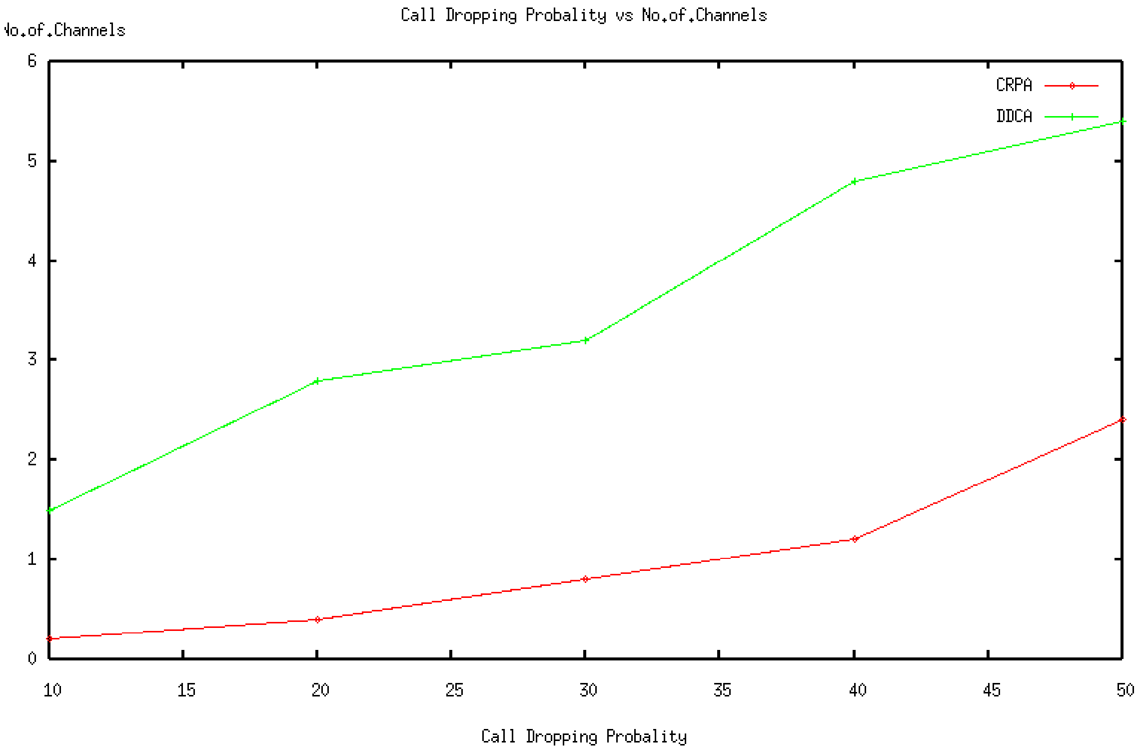

Figure 5: Call Dropping probability Vs No. of Channels

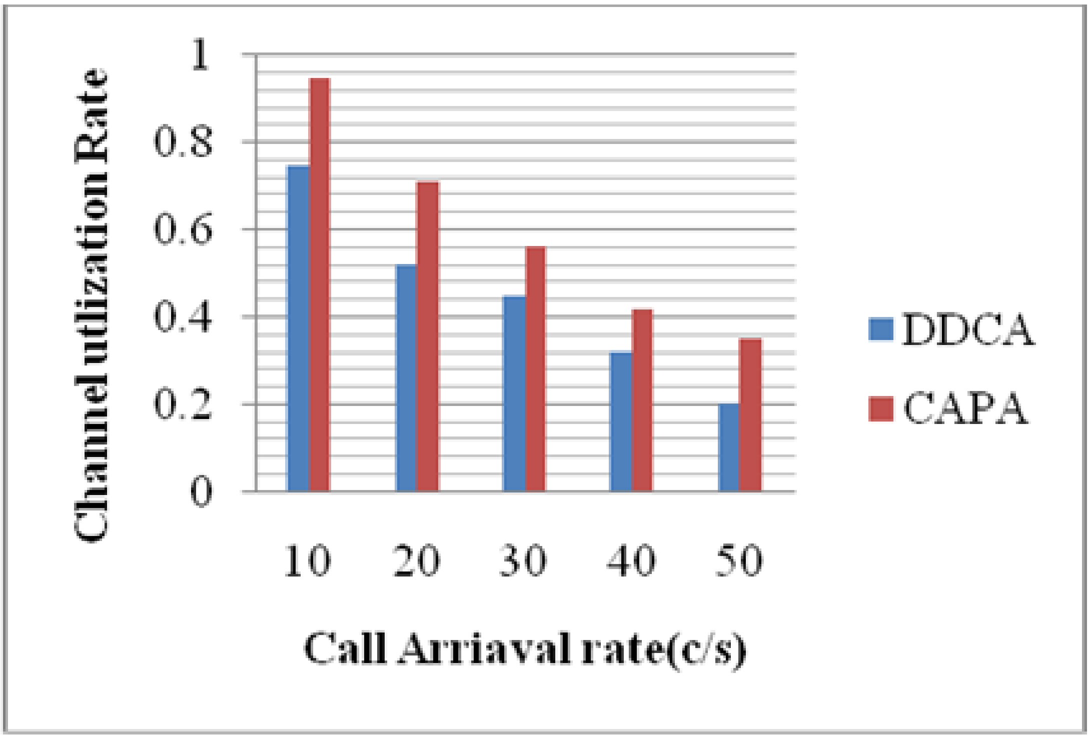

Figure 6: Call Arrival rate Vs Channel Utilization rate

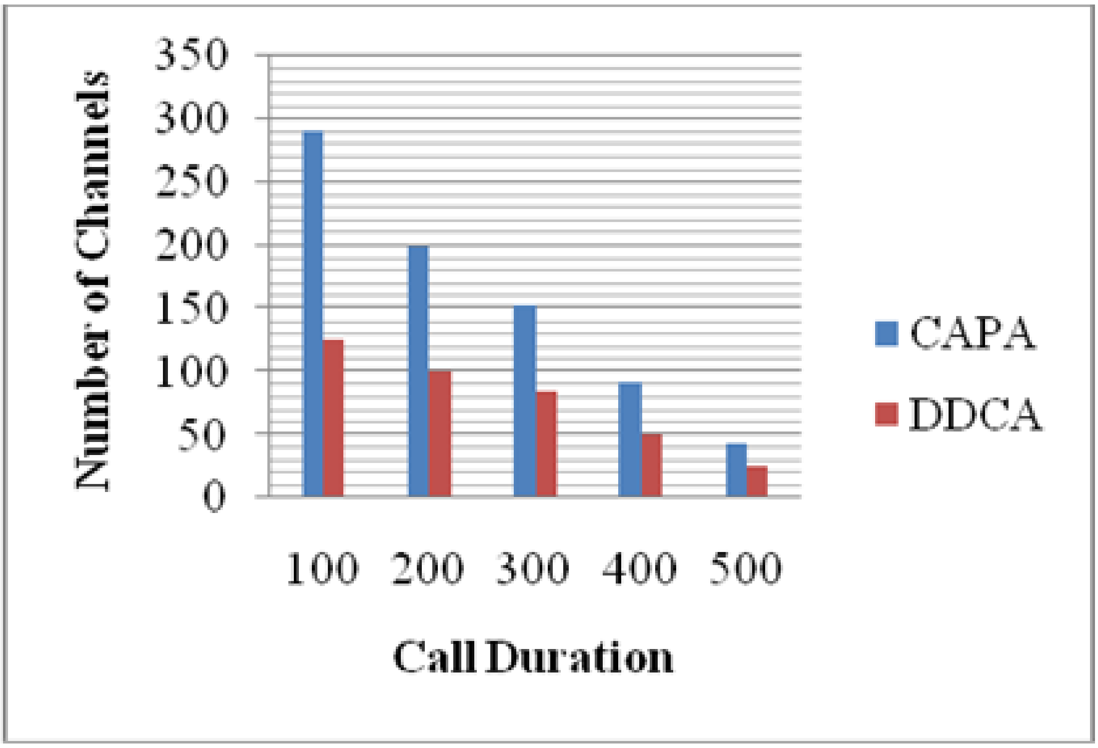

Figure 7: Call Duration Vs Number of Channels

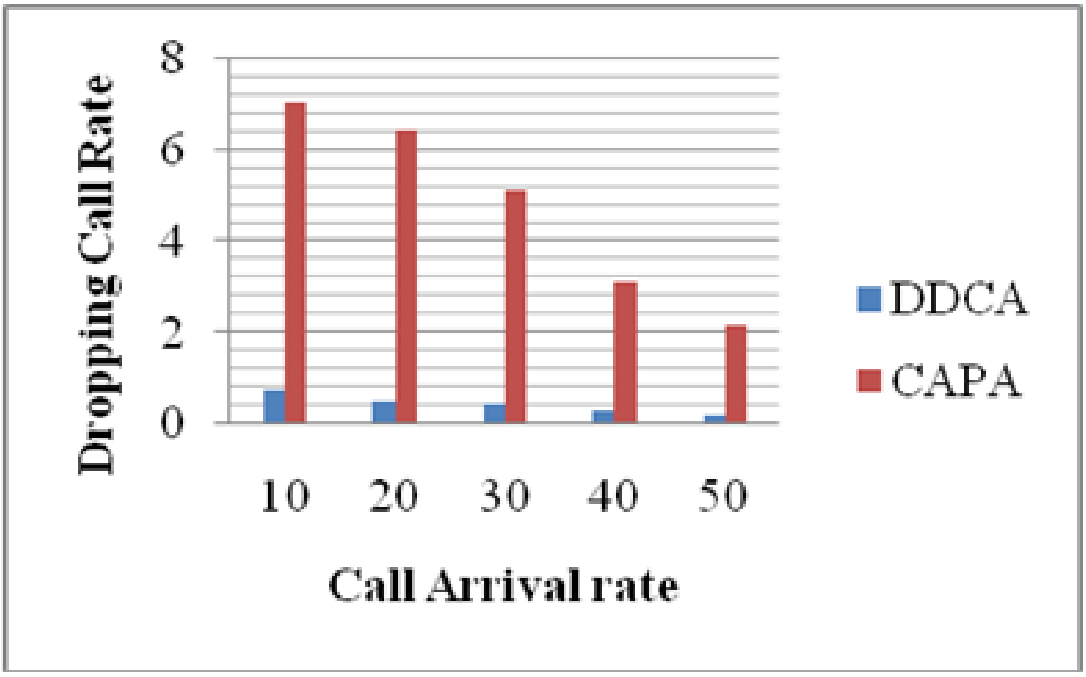

Figure 8: Call Arrival rate Vs Dropping Call rate

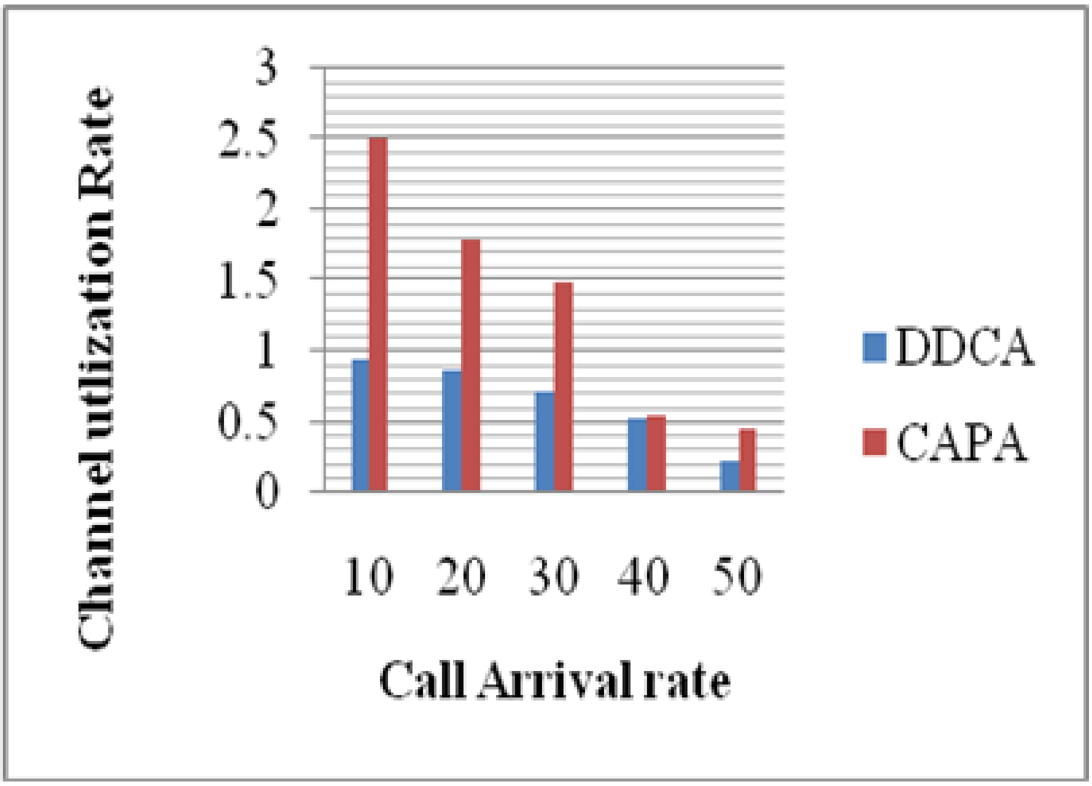

Figure 9: Call Arrival rate Vs Channel Utilization rate

9. CONCLUSION

Thus, the users are properly predicted by the way the vital bandwidth scarcity is possibly managed by proposing Channel Allocation using Prediction Approach (CAPA) protocol, which separates the regular user and irregular user and allots eminent priority to regular users. The network channels are apportioned among the both regular and irregular users in a rational manner and thus both users might not sense hard to have channels while they get across the boundaries of the cell. Therefore the regular users invariably experience the favor and the irregular users are predicted with a warrantee service. Because both users deal with priority level, the usable channels are apportioned efficiently and dropped calls are also decreased in a drastic manner. This channel allocation process consumes very few times by the way efficiency and life-time of the network can be increased.

10. FUTURE SCOPE

The challenges increase even more for those ad hoc networks that, like their conventional wireless counterparts, support both best effort services and those with QoS guarantees, allow different classes of service, and are required to interwork with other wireless and wire line networks, both connection-oriented and connectionless. Algorithms, policies, and protocols for coordinated admission Control, resource reservation, and routing for QoS under such models are only beginning to receive attention. QoS for ad hoc networks is a new area of research.

Conflict of Interest

The Authors having there is no conflict of interest to publish the article in this conference.

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