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An Analysis on Call Admission Control and Particle Swarm Optimisation

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Abstract: *The cellular networks remain the major telecommunication infrastructure in the existent and succeeding generation wireless networks. Radio Resource Management (RRM) has a very crucial part in Quality of Service (QoS) eqquiping for remote correspondence frameworks. The execution of RRM procedures directly affects every client's individual execution and on the general system execution. Because of the high demand of wireless networks ,Call Admission control (CAC) is providing the solution of the limited resources problem in these networks as the main function of CAC is to improve the quality of the signals and working according to the conditions that whether the call should be accepted or dropped. The Approval and denial of the the calls is decided by the predefined critera. This article gives an exhaustive study of CAC algorithms in present day remote systems during which it is found that there is Bandwidth utilization problem in CAC algorithms, so further algorithms like Particle Swarm Optimistaion are studied which can be used to solve this problem and provide efficient networks with minimum call drop rates.*

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I. Introduction

Call Admission Control:-

A cellular network is divided into small service area called cells which are connected to the users by base stations of the cells. The Channel frequencies are separated by the guard channels to avoid interference.With the development in mobile communication, the types of services in wireless networks has evolved from voice service to multimedia. Due to this development in the wireless communication network issues related to the congestion of bandwidth and quality has arrived because of high data traffic on network. The increased requirement of bandwidths for multimedia services in wireless cellular networks, increased the demand to provide Quality of Service (QoS) to the users.Traffic on the network has increased due to high multimedia data transfer. To provide better QoS on network CAC method is being used,these algorithms ensures that the network meets the QoS of the accepted freshly arriving calls and ensures that the QoS of the existing calls does not degrade. CAC deals with the question of whether or not a network can accept a new connection. The decision to accept or reject a new connection is based on the following factors:

- Influence of the new connection on the QoS of the previous connections.
- Level of QoS requested by the new connection?

Call admission control (CAC) algorithms help to check dropping probability of handover calls and blocking probability of new calls and helps to determine whether the call should be accepted or rejected at the base station. Call admission algorithm affects the blocking probability of new calls and the dropping probability of handover calls are affected. The priority should be given to the handover calls over new calls by the call admission algorithms. Call Admission Control is defined as the process of regulating the total number of calls on a network per unit time which helps to keep a control on the traffic of the network by keeping a track of the call details. It check the bandwidth when new call arrives if bandwidth is available it connects the call otherwise it terminates the call. CAC provides the quality of service and congestion control on the network.

Figure 1.1 Classification of Call Admission Control Schemes

The two basic operations performed by the CAC when establishing a connection:-

1) Establish a connection when resources are available.
2) If the connection is rejected in the absence of available resources a notification is sent back to the user.

Two types of CAC are defined below:

1) **Reservation based schemes:** In these schemes, a particular set of channels is reserved for exclusive use by handover calls.When the number of calls (new calls) exceeds a specific threshold, these schemes start rejecting new calls until the number of calls (new calls) decreases below the specific threshold.These schemes accept handover calls till the cell has idle channels.
2) **Call thinning schemes:** With the help of these schemes the no of new calls that will be accepted into the network depends on the probability of the no of ongoing calls.

Some of the subtypes of CAC Algorithms are furthur classified as follow:-

1) **Dynamic reservation**: Shadow cluster scheme is a type of dynamic call admission control. In this method current location of the mobile and adjacent location of the mobile is consider for the handoff method. This method is called as shadow method. Bandwidth utilization is very effective in this method. the cutoff priority scheme reserves some channels for handover calls. Whenever a channel is emptied, it is again added to the common pool of channels.
2) **Fractional dynamic reservation:**In the fractional guard channel scheme (the new call thinning scheme) a new call is admitted to the channels that depends on the certain probability depending on the number of busy channels.
3) **Static (fixed) reservation:** Guard Channel scheme is types of static call admission control which is used to avoid the problem of handoff. It reserves the number of guard channels for handoff. It uses the method of threshold which decides whether to accept a call or not according to the channels in the cell.All channels allocated to a cell are divided into two groups: one to be used by all calls and the other for handover calls only (the rigid division-based CAC scheme).
4) **New call bounding scheme:** This scheme limits the admission of number of coexisting new calls to the network.

Particle Swarm Optimisation:-

PSO was introduced by Dr.Eberhart and Dr.Kennedy in 1995, it is used extensively now a days because it has numberless applications. The nature inspired PSO algorithm helps in finding optimal values following the work of particles also known as the swarm intelligence technique. This algorithm deals with the problem for finding a best solution in an *n*-dimensional area.

It isalso called as the population based stochastic optimization technique which helps in simulating swarm behavior of birds flying in search of food. This technique computes the different parameters like position velocity etc providing random solution and doing optimisation by updating those parameters.PSO is very similarities to evolutionary computation techniques such as Genetic Algorithms (GA).

In PSO, the particles fly through the problem area by following the current optimum particles. Each particle has its own fitness value and velocity, and it follows the pattern of the swarm to search for the global optima. Every particle has its own velocity and position from where they start randomly . Every particle has to to maintain its best position.The self organisation technique is the best feature of PSO approach, this is the result of the feedback provided to promote the formation of structures, mutual communications help in scattering the data over the network.

PSO is a very simple algorithm, it just keeps the track of 3 parameters:-

1. Target Value
2. Global Best value
3. Stopping Value

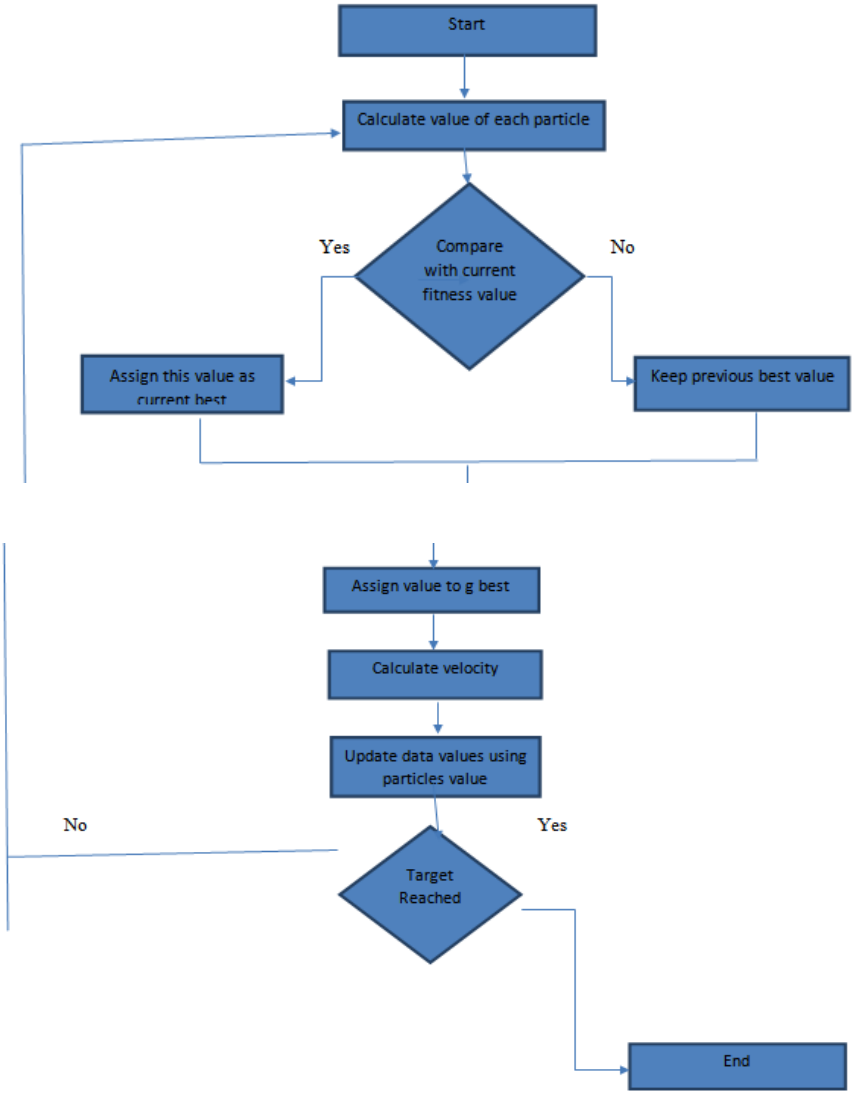

Figure 1.2 Flow diagram showing PSO process

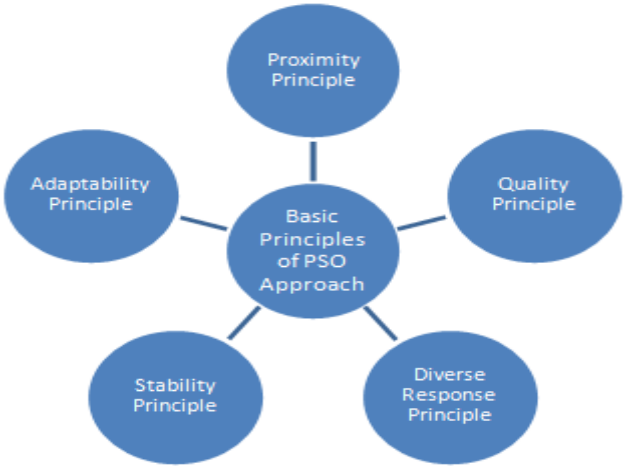

Figure 1.3 Basic Principles of PSO approach

PSO Based Routing Protocols:-

1) **Binary Particle swarm optimization**:- Kennedy and Eberhart proposed a binary version of PSO for binary problems. According to this model a particle will decide if its a "yes" or " no", "true" or "false", "include" or "not to include" etc. These binary values can be a representation of a real value in binary search

space. In the binary PSO, the particle's personal best and global best are updated as in real- valued version. The major difference between binary PSO and PSO is that velocities of the particles are defined in terms of bits i.e 0 or 1 , so the velocity gets restricted within the range [0,1] . All real valued numbers of velocity to the range [0,1] are therefore mapped on a Map.

2) **Wave of swarm of particles (WSOP**):-In this otimisation the particles change their direction from local minima to avoid collapse with other particles.
3) **Multicast routing based on particle swarm optimization(MSOP)**:-This protocol finds out the node that consumes low energy and then provide energy efficient and multicast routing.
4) **Particle Swarm Optimization based Lifetime Prediction(PSOLP)**:- The life of node is calculated using fuzzy rules and that infomation is transmitted to all the nodes while data transfer.
5) **Hybrid PSO and K-means clustering algorithm**:-The PSO clustering performance is improved using K-means clustering by improving the value of single swarm.
6) **Multi objective particle swarm optimization(MOPSO)**:-In this the resources are managed by finding the optimal nos of clusters improving the transmission power and battery power.

II. Literature Survey

Gamage, Amila et al. [1] proposed a resource allocation system which enhances the throughput and satisfying quality of service. This networking is similar to hybrid coordination function. In this approach resources that are allocated to the user are power for transmission and subcarriers. This approach reduced the complexity of the network. **Nayak, Akshatha M., et al [2]** proposed a software defined approach which is used to control and manage the heterogeneous Radio Access technologies (RAT) in 5G networks. Network function virtualization is also used to enhance the performance of the network. This approach reduced the complexity of the network.

Younes, Sana et al. [3] Continuous-time stochastic logic is used to specify the quality of service by using steady state formulas. CSL is a language which is used for Continuous Markov Chain for providing flexibility to transient and steady state formulas. PRISM model checker is used for verify the proposed method.

Namwanta et al. [4] In this paper, the author proposed the call admission control algorithm to reduce the call dropping rate in the LTE networks. In LTE networks handover occurs frequently and some time it leads to call dropping. This algorithm is designed to avoid the problem of call dropping by accepting the calls on the basis of priority. QoS is increased if the number of call drops in reduced in the handover process.

Sigwele, Tshiamo, et al. [5] proposed a method for call admission control in 5G cloud radio access networks. Fuzzy logic method is used for call admission control. To avoid the delay in congestion period cloud bruiting technique is used with preempted algorithm. The simulation result of the proposed method provides high throughput, low energy consumption and low blocking probability.

Mamman, Maharazu, et al. [6] proposed a method of adaptive call admission control with bandwidth reservation for downlink LTE network. This method uses adaptive threshold value which is used to adjust the network resource in heavy traffic condition. This method works effectively when bandwidth is limited and users are more. The results of the proposed method show that it provides high resource utilization.

Shams, Rehan, et al. [7] introduced Genetic algorithm for the bandwidth allocation in wireless cellular network. This algorithm maintains the bandwidth for transmission of signals and field coverage. G.A provides the optimal solution to the problem by giving optimized results. This algorithm finds the free bandwidth on the cell and in neighbor cell if it is available then assigns the users. By using Genetic Algorithm all the bandwidth utilized properly and gives an effective Quality-of-service in wireless cellular network.

Newton, P. Calduwe et al. [8] the author proposed an algorithm for call admission control called Analytic Hierarchy Process. It increases the number of admission on network and decreases the compressed calls. This work can be performed by using various codecs like AMR, EVRC, iLBC. AHP is mainly used to take right decision and it provides the proper ranking. By using ranking method throughput of the network is increased. Throughput is based on the bandwidth, packetization delay and compression ratio of each codecs. The proposed method provides better quality of service and increase the throughput of the system.

Kim, Seung-Yeon [9] proposed a call admission control method to improve the performance of coordinated multipoint transmission (CoMP) with the joint transmission scheme.2 D markov chain model is used for traffic analysis and approximation of power sum of lognormal random components in multi cell environment. This method measures the resource utilization and call blocking probability in downlink resources. Results show that throughput of the system is effective.

Belghith, Aymen, et al. [10] explained a method of flexible call admission control with preemption in LTE networks. In this method calls are classified into two types that are real time or non-real time it depends on their Received signal strength. On the basis of this classification it decides it is new call or handoff call. Preemption method is used for resource allocation at high bearer requests. This method increases the throughput of the System and provides a better quality of channel.

Kumar, Sumit et al. [11] introduced the concept of probabilistic broadcasting in the MANET using Particle swarm optimization approach. In the proposed approach RREQ broadcast depends on the output of fuzzy controllers. It also considers the node density, energy and available bandwidth of the nodes. Results of the proposed approach clearly show that it is reliable and efficient than existing approaches.

Alsamhi et al. [12] Modified call admission control method is proposed which used two schemes in it that are bandwidth reservation and degradation scheme to provide the quality of service. This method allocated the bandwidth to the each cell. When new request comes on the network and there is no free cell then it performs the degradation scheme in it. In degradation bandwidth of all the channels are reduced to create the bandwidth for new call request. This method provides improved result in blocking probability and dropping probability.

Dhurandher, Sanjay Kumar, et al. [13] proposed a new protocol Rate Adaptive Routing on Cliques Admission Control protocol (so-called RA-RCAC) for wireless mesh networks. This protocol works on the application layer and also able to handle the congestion of the networks. This method also combined the Interference-Aware Admission Control distributed admission control protocol. It increases the throughput of the network and reduces the end to end delay, packet delivery ratio and loss ratio.

Kaur, Simrandeep [14] proposed a joint call admission control mechanism in LTE network. It is mainly used to balance the loads on the network and provides the quality of service. Performance of the system is measured by using interfaces, system throughput and delay. These metrics are based on the services and load on networks. This method is also called as radio resources management.

Zarai, Faouzi, et al. [15] described a method of hand off probability reduction in 3G networks. In this work the reduction is based on the adaptive call admission control scheme that provides quality of service and gives a priority of handoff over a new call in admission. The result of the proposed method shows the reduction in dropping probability and call blocking probability.

Norshidah Katiran [16] analyzedCoMP LTE-Advanved network performance by using two different opttimisation tools. The particle swarm optimisation and subgradient methods were compared to find the diffrence between different level of complexity and convergence rate . In the comparison it came out that PSO is far better than the other method because of less complexity and high finding strengths.

Shidrokh Goudarzi [17] presented a vertical handover decision algorithm which is based on hybrid intelligent handover decision composed of artificial bee colony and particle swarm optimisation . The numerical results when applied on IEEE 802.21 shows that this ABC-PSO algorithm has low cost and delay with high bandwidth and less handovers.

J.Preethi [18] proposed a hybridzed algorithm using PSO to improve the results and select the most accurate Radio Access Network . A constriction coefficient and hybridized multi objective decisison algorithm has been introduced in this paper which improves the results and provided better results.

Surbhi Jawa [19] presented the solution to routing problems in the network by avoiding re routing and repairing broken link to provide efficient network which is congestion free and safe by using a path selction based PSO.

Author's Name	**Year**	**Technology Used/Algorithm Used**	**Desciprtion**
1.Gamage, Amila et al	2018	Resource Allocation for Cellular	• In This approach resources that are allocated to the user are power for transmission and subcarriers. This approach reduced the complexity of the network.
2Nayak, Akshatha M., et al	2018	Software defined network and Network function virtualization	• Control and manage the heterogeneous Radio Access technologies (RAT) in 5G networks. Network function virtualization is also used to enhance the performance of the network.
3 Younes, Sana et al.	2017	Continuous-time Stochastic logic and Probabilistic Model	• Continuous-time stochastic logic is used to specify the quality of service. • CSL is a language which is used for Continuous Markov Chain for providing flexibility.
4Namwanta et al.	2017	Call Admission Control Algorithm	• In this paper, the author proposed the call admission control algorithm to reduce the call dropping rate in the LTE networks. • QoS is increased if the number of call drops in reduced in the handover process.
5 Sigwele, Tshiamo, et al.	2017	Fuzzy logic based CAC	• To avoid the delay in congestion period cloud bruiting technique is used with preempted algorithm. • Fuzzy logics are also used on network with preemption.
6 Mamman, Maharazu, et al.	2017	Uses adaptive threshold value	• This method uses adaptive threshold value which is used to adjust the network resource in heavy traffic condition. This method works effectively when

			bandwidth is limited and users are more.
7 Shams, Rehan, et al.	2017	Genetic algorithm for the bandwidth allocation	• Genetic algorithm for the bandwidth allocation in wireless cellular network. • This algorithm maintains the bandwidth for transmission of signals and field coverage. • G.A provides the optimal solution to the problem by giving optimized results.
8 Newton, P. Calduwe et al.	2017	Analytic Hierarchy Process	• Proposed Analytic Hierarchy Process (AHP) for call admission control. • AHP is mainly used to take right decision and it provides the proper ranking. By using ranking method throughput of the network is increased.
9 Mamman, Maharazu, et al.	2017	2 D markov chain model	• Co-ordinated multipoint transmission (CoMP) with the joint transmission scheme.2 D markov chain model is used for traffic analysis and approximation of power sum of lognormal random components in multi cell environment.
10 Belghith, Aymen, et al.	2016	LTE networks.	• In this method calls are classified into two types that are real time or non-real time it depends on their Received signal strength. On the basis of this classification it decides it is new call or handoff call. • Preemption method is also used in this work.
11 Kumar, Sumit et al	2016	Particle swarm optimization approach.	• MANET used PSO method for call admission control. • In the proposed approach RREQ broadcast depends on the output of fuzzy controllers. It also considers the node density, energy and available bandwidth of the nodes.
12 Alsamhi et al	2016	HAP for enhanced QoS	• Modified call admission control method is proposed. • This method allocated the bandwidth to the each cell. When new request comes on the network and there is no free cell then it performs the degradation scheme in it.
13 Dhurandher, Sanjay Kumar, et al.	2015	Rate Adaptive Routing	• Rate Adaptive Routing on Cliques Admission Control protocol (so-called RA-RCAC) for wireless mesh networks. • This protocol works on the application layer and also able to handle the congestion of the networks.
14 Kaur, Simrandeep	2014	LTE-UMTS networks.	• Joint call admission control mechanism in LTE network. It is mainly used to balance the loads on the network and provides the quality of service.
15 Zarai, Faouzi, et al.	2014	3GPP LTE networks	• In this work the reduction is based on the adaptive call admission control scheme that provides quality of service and gives a priority of handoff over a new call in admission.
16 Norshidah Katiran		Performance Comparison of Optimized Resource Allocation in CoMP LTE-A using Iterative Subgradient Method and PSO	• PSO and subgradient method compared and the results showed that PSO has better performance.
17 Shidrokh Goudarzi	2017	ABC-PSO for vertical handover in heterogeneous wireless networks	• Hybrid ABC-PSO algorithm used on IEEE 802.21 to get better optimisation of networks.
18 J.Preethi	2012	Hybrid Modified Particle Swarm Optimization for Heterogeneous Radio Access Technology (RAT) Selection	• In this new constriction coefficient is introduced to get better results .
19 Surbhi Jawa	2015	PSO Approach for the Structuring of Optimal Route in Mobile Ad-Hoc Network	• In this a path based PSO is used to provide efficient network. and provide efficient and reliable network.

III. Conclusion

CAC in remote systems has been accepting a lot of consideration amid the most recent two decades because of the developing fame of remote correspondences and the focal part that CAC plays in QoS provisioning the signal quality, call blocking and dropping probabilities, bundle postponement ,misfortune rate, and transmission rate. In the first and second era of remote frameworks, CAC has been created for a solitary administration condition. In the third era and past remote frameworks, interactive media administrations voice, video, information, and sound are to be offered with different QoS profiles. Henceforth, more complex CAC plans are created to adapt to these progressions.Furthur the quality of CAC can be improved by using particle swarm optimisation , which will of great help in these algorithms.

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