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MECHANISM OF RESOURCE ALLOCATION IN 5G NETWORK USING EDGE BASED PARTICLE SWARM OPTIMISATION (E-PSOA)

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Abstract:

It is becoming increasingly difficult to distinguish between devices as they shrink in size, and integrated circuits are assisting us in tracking the rise of the Internet of Things (IoT) as it grows in scope. The majority of IoT services and devices necessitate the use of an Internet connection, which must meet the bare minimum processing, storage, and networking requirements in order to adequately handle a service request. Quality of Service (QoS) requirements in a range of application scenarios is one of the most critical goals for 5G networks, and this is one of the most difficult objectives to achieve. The procedures for allocating computational resources to the services are widely regarded as being highly complex. In this paper, ParticleSwarm Optimization (PSO), a meta-heuristic optimization approach, is introduced as a means of distributing and controlling resources in 5G networks, and it is discussed further in the following sections. The system determines how to allocate edge resources in order to meet the needs of the user. In addition to decreasing the blocking ratio, the suggested solution increases the number of services it can provide at the same time by balancing its load during resource allocation.

Keywords:Mobile Edge Computing, Resource Allocation, 5G Network, Particle Swarm Optimisation.

1. Introduction

The mobile technologies we use in general are growing day by day. And the mobile devices we use are being upgraded to the next level due to technological advancements.The functionality of mobile technology thus enhanced also varies from generation to generation. For example, we are currently using high-speed fourth-generation (4G)network.

The telecommunication companies have introduced many advances in the technology in fourth generation (4G) networks. That is to say, the speed of the internet is increasing very high. The bandwidth used there was low, due to the small size of that spectrum in second and third generation network usage. Due to this the amount of data available to us was small and its speed was low. But with the large amount of spectrum available in current fourth generation technology, more data travel is possible. The data thus travelled will be much faster. Thus, high bandwidth usage is mandatory.

In general, resource allocation is the process of providing the required resources to all users on a network on time without any interruption.The particular user will continue to be connected to that network as the resource will continue to be provided without any interruption. If a user on a network does not have the required number of resources, he or she will switch to that resource or block his or her service to the available resource network. Thus, this resource allocation is the main focus of most of the networks that provide telecommunication service.

The spectrum commonly used in most mobile applications is not fully utilized. Spectrum that is not fully utilized by a user remains useless. The amount of this unused spectrum varies from user to user. And its application time will vary depending on their location. And their use will vary depending on the time and location. To enhance the spectrum usage, the mobile networks are utilized dynamic spectrum allocation concept [1].Currently, this 5G technology has only been introduced in a few places in the world. Even in our country this technology has not yet come into practice except that research has been conducted. But the technology is expected to be implemented in India between 2025 and 2027.

In this paper, Particle Swarm Optimization (PSO), a meta-heuristic optimization approach, is introduced as a means of distributing and controlling resources in 5G networks, and it is discussed further in the following sections.

2. Related works

Lagkas et al. [2] introduced a Spectral Resource Optimization technique for classified the primary and secondary user management in 5G communication network environment. In that the primary users of a network getting higher priority compare then the secondary users. Because the primary users have license to use the spectrum band and the secondary users are utilize the spectrum band in the random time manor. So, the primary users are getting more priority level.

YuanAi et al. [3] provided a smart mechanism of Joint resource allocation. Here the radio resource of the network can allocate both the primary and secondary users without any connection lost. So, the user groups (both primary and secondary users) are unable to suffer the resource utilization problem. Then the authors include here an admission control technique to the user groups. This controls the secondary user occupancy of the spectrum.

Khumalo et al. [4] proposed a Reinforcement Learning-based Computation Resource Allocation technique to separate the specific resources to the user group of a network. There the primary user attributes are registered and the secondary user group's attributes are not registered. So, the entry of primary users can register in a sequential manner and the entries of secondary users are in random manner.

Y. Wanget al [7] analysed the traffic issues between the user groups of the network. The conjugation occurs when the primary users and secondary usersare tried to come the network at the same time. At that time, more emphasis will be placed on the primary users and they will be allowed to enter. Meanwhile, the secondary user will then have to wait. As the waiting time were increases, then the chances of exiting the network increase [8] [13].

L.Huang et al [9] provided an energy efficient approach between the primary and secondary users. If the bandwidth allocation was increased, then the spectrum utilization automatically increased. In a cut-off range, the number of secondary users utilized more energy of the network shows the inefficiency of the network. Because the primary users are utilizing very low energy.

3. Proposed System

This currently proposed algorithm which is shown in Fig 1 and the proposed flow graph is shown in Fig 2, mainly is designed to be used by both primary and secondary users. But it will be more for the primary user. According to this method the spectrum band is first divided into modules.

Step 1	Start the process
Step 2	Phase initialization

Step 3	Check the spectrum band
Step 4	If (PU = available)
Step 5	Then check the spectrum hole
Step 6	If (Spectrum hole = available)
Step 7	Then assign the location for Secondary user (SU)
Step 8	Else (assign the SU to waiting state)
Step 9	Else (assign the spectrum to the SU)
Step 10	If (PU = arrive)
Step 11	Then move to Step 5
Step 12	End the process

Fig 1: Proposed Algorithm

They are then passed on to the primary user for use. If the secondary user is currently logged in, the spectrum band will be tested first. If the test confirms that the spectrum band has not been used by the primary user then the spectrum band will be allocated to the secondary user.

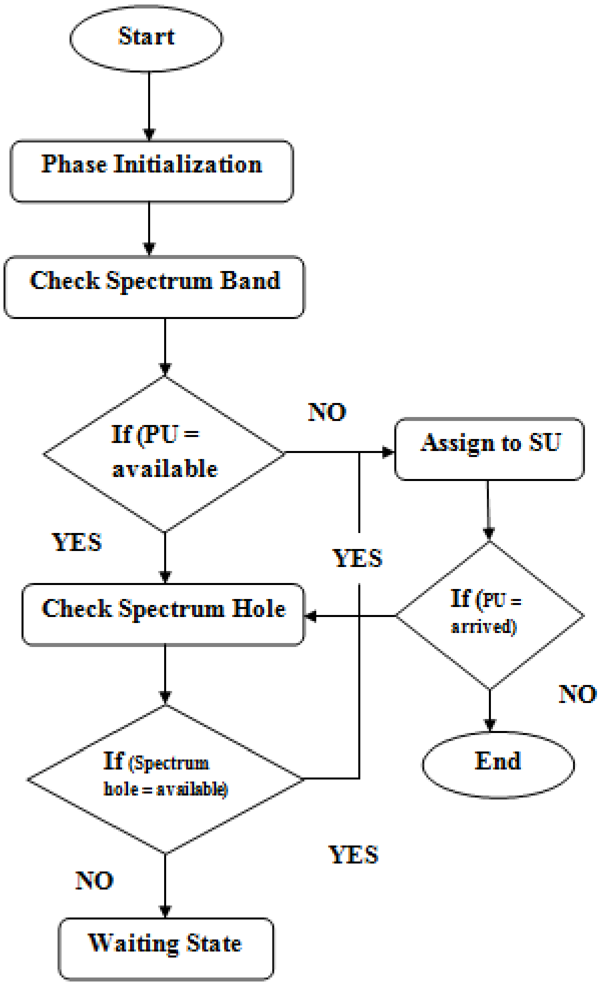

Fig 2: Proposed algorithm – Flow chart

If it is confirmed that the primary user is probably there during the test, that spectrum band will not be allocated. Immediately the system will start searching for spectrum holes. Here the spectrum hole will be checked based on the data already in our database. The spectrum hole is the spectrum band used by a primary user to remain empty until he or she reconnects. That intervening time is called the spectrum hole. In this method the spectrum hole is detected and allocated to the secondary user.

Maybe the primary user re-enters that spectrum band, then again, the secondary user has to be transferred to another spectrum hole. This method is called spectrum switching. In this mode the secondary user will be transferred back to another spectrum band in the database. Thus, the holes in the spectrum band will be filled by switching the secondary user. In this process the spectrum bandwidth will continue to be used without wastage. Thus, his proposed algorithm is more efficient.

4. Results and Discussion

The proposed system design algorithm is evaluatedamong the active algorithms withvarious performance metrics like resourcesblocking, resourcedropping, and utilization of bandwidth, of the network. Every performance measurements of the proposed system is confirmed for its value with the active techniques such as FUE-sub-channel matching algorithm (FSMA), and Joint sub-channel and power allocations algorithm (JSPA). The Network Simulator (NS-2) used for the simulation with the following parameters. In graphical representation, the blue and red indicates existing FSMA and JSPA whereas, green indicates the proposed E-PSOArespectively

Table 1: Simulation parameters

Parameter	Value
Simulation period	2000 frames
Preamble length	10ms
Discovery Connectivity	0.3
Frame Length	100ms
Primary user Active State	8
Primary User on Idle State	6
Maximum Interference Ratio	0.5
Permission Connectivity	0.6

4.1.Resource Blocking (%)

Normally the usage of spectrum was calculated by the number of primary user used the resources of the network. If the primary users of the network are in active state, then the secondary users are unable to enter the network. After the primary users are away from the network, its shows the spectrum is in idle state. When the spectrum is in idle state the secondary user will be allowed to use it. The process of blocking secondary user, while the primary user in active state, is called the Resource Blocking of a network.

Then, the resource blocking of a network is given by

$$\boldsymbol{Resource\ Blocking} = \sum_{s=1}^{h} \boldsymbol{Bj}(1)$$

where,

B_j is dented here the total number of users in the spectrum

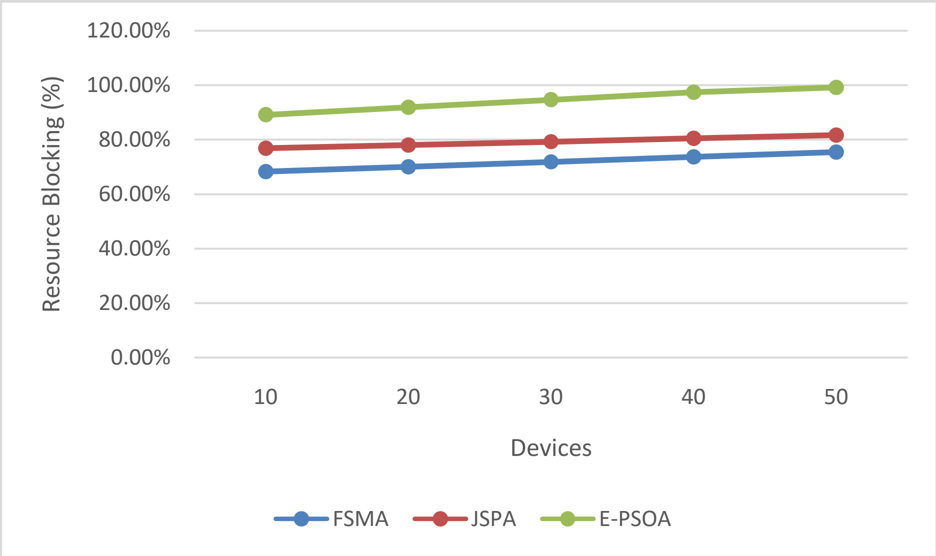

Figure 3 Comparison of Blocking Connectivity

The above figure 3 shows the resource blocking comparison. When compared with the existing algorithms, the proposed E-PSOA algorithm achieves high resource blockingbecause the primary user spectrum utilization was increased and the number of secondary user spectrum allocation was reduced.If the spectrum was in active state, then the primary user utilizes the spectrum and the secondary users of a spectrum are in waiting state.

4.2.Resource Dropping (%)

If a spectrum is in high usage, then the usage time of its users should be more. That is, the time used by the primary users should be calculated first and that spectrum should be passed on to the secondary users in their absence. If the secondary user logs in again at the time allotted to the secondary user, the secondary user should be immediately relocated. Thus,the effectively handling of both the primary user and the secondary user is called the resource management. Anyone who is unable to connect on the time of spectrum usage, and then they will leave the network without any intimation. This is called the resource dropping of a network.

$$\text{Resource Dropping } x(t) = \frac{\text{dropped users under the active state of spectrum } (x,t)}{nonblock\ \ user\ \ arrivalsundertime\ \ (x,t)} \quad (2)$$

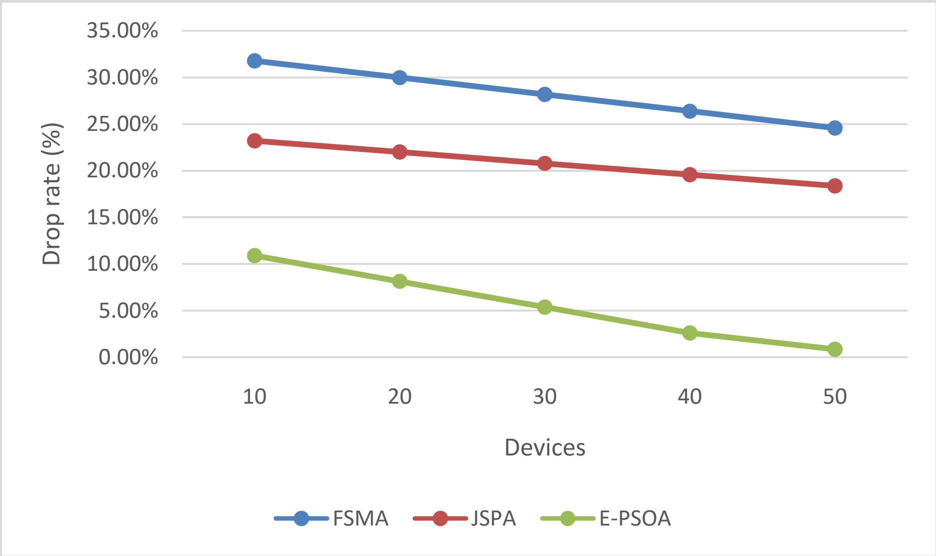

Figure 4 Comparison of Dropping Connectivity

The above Figure 4 depicts the resource droppingcomparison. When compared with the existing algorithms, the proposed E-PSOA algorithm achieves lowresource dropping because the user switching process effectively performed by the E-PSOA algorithm. The proposed algorithm was performing the dynamic spectrum allocation work very comfort. So the utilization of spectrum was high and the number of dropping user was low.

4.3.Utilization of Bandwidth

At a particular time, the highest amount of data packets over the spectrum transferred is called the bandwidth utilization of a network.

$$\text{BU (in \%)} = \frac{(Totalmessagestrasmittedandreceived\ \ )}{speedof\ \ transmission} \times\ 100 \quad (3)$$

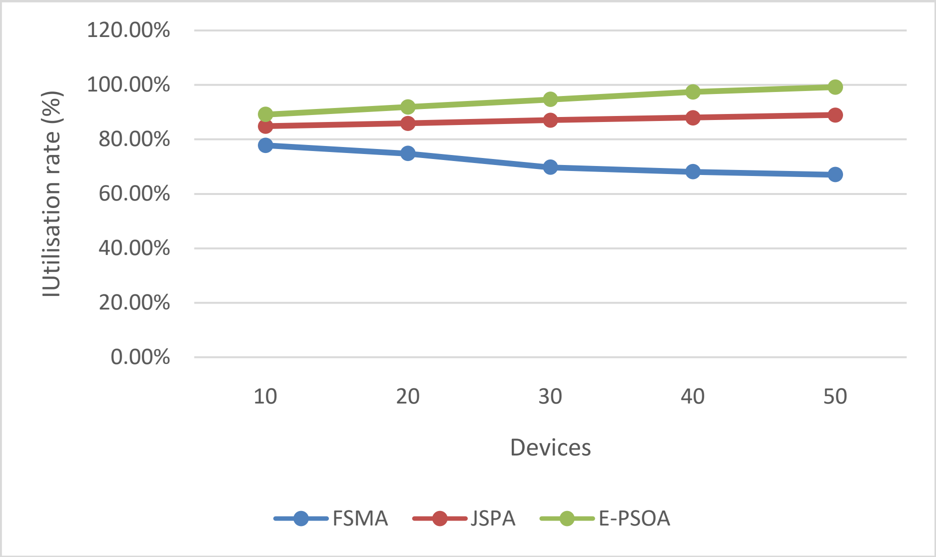

Figure 5 comparison of Bandwidth Utilization

The above Figure 5 shows the bandwidth comparison between existing and proposed systems. From Table-4, the primary users utilize the spectrum with highly efficient manner and they do not require any authentication to join the network. When the spectrum is in idle state, then the secondary users are allowed to use the spectrum. So, the maximum bandwidth was utilized by the primary and secondary users.

The proposed edge-based particle swarm optimisationalgorithm (E-PSOA) is compared with two existing methods such as FUE-sub-channel matching algorithm (FSMA), and Joint sub-channel and power allocations algorithm (JSPA), with the maximum 50 devices capacity and it is found that the proposed method achieves, 89/100 of blocking Connectivity, 11/100 of dropping Connectivity, 99.15 % bandwidth utilization.

5. Conclusion

This proposed edge-based particle swarm optimisationalgorithm (E-PSOA), prevents more secondary users than the other two methods. Thisalgorithm was allowing a lower number of primary users to exit the network. Also,this algorithm achieves maximum bandwidth utilization of the network by the primary and secondary user groups. Thus, the result the unnecessary conjuration was reduced. The major advantage of the proposed algorithm was the primary user and the secondary user get benefit. The efficient spectrum utilization was improved, and then the speed of the network automatically increased. The secondary can use the same speed as the effective manner. The secondary user may encounter minor connectivity issues when switching the spectrum. But that too will not give them much trouble as it will be fixed soon.

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