Optimization of Resource Allocation By Efficient Offloading For Mobile Edge Computing in 5G

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Abstract- *Mobile edge computing (MEC) is a latest standard which provides network-edge cloud infrastructure resources, such as storage and computing. MEC has the potential to combine computer-intensive programs such as virtual and augmented reality. It is an important component of the Internet of Things (IoT) and 5G architecture that provides a major reduction in latency and energy consumption for mobile devices. MEC is identifying as one of the crucial technologies for 5G along with NFV (Network function virtualization) and SDN (Software Defined Network). The focal point of NFV is different functions of the network, and various applications can run at the edge because of the MEC framework. MEC is beneficial for both service providers and customers. The main challenges faced in MEC are task offloading, Resource allocation, security and privacy issue, mobility and standardization .Our work mainly focus on offloading based resource allocation and analysing the network We introduce a novel optimization technique called as Genetic Bee colony updated with monitoring and trace back procedures, to decrease the energy consumption and optimize the computing resource allocation as well as improve computing capability.*

Keywords- MEC, Offloading, NFV and Resource allocation.

I. INTRODUCTION

The telecommunications industry is bracing itself for the arrival of the latest generation of wireless technology: 5G, or fifth generation mobile networks. 5G is expected to have much higher speeds and capacity, and much lower latency (the lag between initiating an action and getting a response), than 4G. Because 5G can send and receive signals almost instantaneously, it is expected that 5G will offer mobile internet speeds of more than 10 gigabits per second (Gbps), approximately a hundred times faster than 4G. The latency will be less than a millisecond with 5G. Mobile edge computing (MEC) is a latest standard which provides network-edge cloud infrastructure resources, such as storage and computing. MEC sinking of cloud resources for the edge deployment of 5G virtualization network elements. MEC has the potential to combine computer-intensive programmes such as virtual and augmented reality. It is an important component of the Internet of Things (IoT) and 5G architecture that provides a major reduction in latency and energy consumption for mobile devices. MEC is an evolving technology that removes the limitations of conventional cloud computing.

II. LITERATURE SURVEY

A literature search was performed to identify and review the critical factors of the Optimization of Resource Allocation by Efficient Offloading for Mobile Edge Computing in 5G. There are various streams of research that have been taken by researchers while exploring about progressive collapse. We can broadly group them in some categories like literature review of existing, resource allocation, and offloading and energy efficiency. For instance, Sabayasachi Gupta propose the maximization of Life time of the MEC Networks [2]. Other side Computational off-loading and Energy efficiency are proposed with various mechanism on MEC Networks [4], [6], [7], [10], [11], [13], [14], [15] [16]. Some category are analyse and do case study of the existing literature and architecture for the Mobile Edge Computing [1], [3], [12], [17], [18], [19], [20]. In some other papers has proposal over Latency minimization [5], Privacy and authentication [8] and genetic algorithm for optimization [9].

III. DEPLOYMENT

The MEC application server can be deployed at the macro base station EnodeB that is part of an LTE cellular network, or at the Radio Network Controller (RNC) that is part of a 3G cellular network and at a multi-technology cell aggregation site. The multi-technology cell aggregation site [clarification needed] can be located indoors or outdoors.

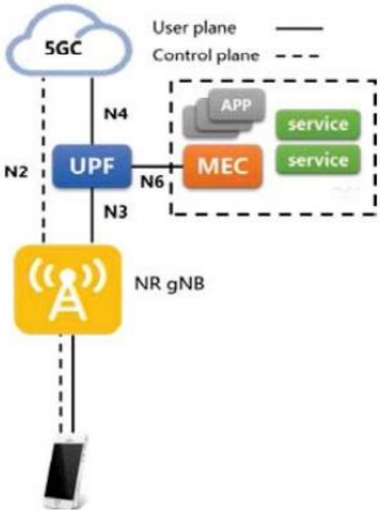

Fig 3.1: 5G Network Architecture.

IV. BLOCK DIAGRAM

In our proposed system, Mobile Edge Computing Cloud storage are created at eNode B, which called as Virtual machines. we made several mobile devices as in the name of cloudlets. The Cloudlets are having data like audio, text, videos that are send to the Data centres. In Telecom network data centres are called as BSS (Base Station Subsystem).
Then Virtual Machines are MEC cloud storage which are located in Data centre itself on BSS. Which is our objective to achieve by simulating all nodes.

The Clients and mobile devices are remote and mobilize part of our proposed system. The data from the client are Transfer to Data centre, Data centre are BSS which create data brokers or agents which we used to find the optimised neighbour Data centres and Virtual machines. After finding Virtual machines and data stored in data centres are virtualize to all virtual machines (MEC Cloud Storages) with best routed table. Then data stored in all Virtual machines, Data broker are deactivated. Client mobile devices can access data from any of virtual machines of the data centres.

4.1 CLOUDLET:

In our proposed system, the cloudlets are considers are movable and remote mobile or offloading devices like , PDA, health monitor band, CCTV cameras and all other application front ends. Where

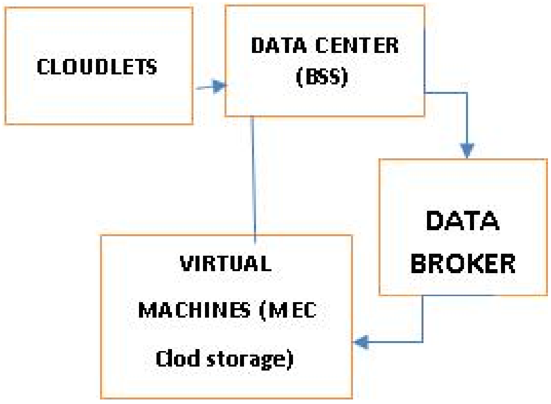

Fig 4.1 Block Diagram.

data are observed or created from the client or mobile users.

4.2 DATA CENTRE (BSS)

The base station subsystem (BSS) is the section of a traditional cellular telephone network which is responsible for handling traffic and signalling between a mobile phone and the network switching subsystem. The BSS carries out transcoding of speech channels, allocation of radio channels to mobile phones, paging, transmission and reception over the air interface and many other tasks related to the radio network.
The base transceiver station, or BTS, contains the equipment for transmitting and receiving radio signals (transceivers), antennas, and equipment for encrypting and decrypting communications with the base station controller (BSC). Typically, a BTS for anything other than a Pico cell will have several transceivers (TRXs) which allow it to serve several different frequencies and different sectors of the cell.In our proposed system, we configure the BSS as Data Centres which is medium and controller of the enter data flow of the Mobile Edge Computing Architecture.

4.3 DATA BROKER

The Data broker is an agent which temporarily created by Data centre to perform optimization algorithmic functions. This agent perform genetic algorithm to find the best routed Virtual machines between each and every VM in our networks. These data broker carries the data packets of the cloudlets to the VM to store and it retrieve the same data packets from VM to datacentres. It is main objective to optimize our proposed system by efficient resource allocation and reduction routed. Which improves our proposed system data speed and Execution time.

4.4 VIRTUAL MACHINE

Virtual Machine are the Mobile Edge Cloud Storage space which allocated at BSS in optimized manner. Each VM has their own security and privacy authentication by creating its own VM id. With this it provides the security and authentication improvements in our proposed system. Several VM are located in same BSS to separate the user or Allocation of resource to MNO, MVNO and 3rd Party applications individually to perform their own concern. This separated resource allocation and VM id is add-on of the security and authentication of the Mobile Edge Computing Architecture.

V. ARTIFICIAL BEE COLONY (ABC) ALGORITHM

The Artificial Bee Colony (ABC) algorithm is a swarm based meta-heuristic algorithm for optimizing numerical problems. It was inspired by the intelligent foraging behaviour of honey bees. The model consists of three essential components: employed and unemployed foraging bees, and food sources.

The first two components, employed and unemployed foraging bees, search for rich food sources, which is the third component, close to their hive. The model also defines two leading modes of behaviour which are necessary for self-organizing and collective intelligence: recruitment of foragers to rich food sources resulting in positive feedback and abandonment of poor sources by foragers causing negative feedback.

In ABC, a colony of artificial forager bees (agents) search for rich artificial food sources (good solutions for a given problem). To apply ABC, the considered optimization problem is first converted to the problem of finding the best parameter vector which minimizes an objective function. Then, the artificial bees randomly discover a population of initial solution vectors and then iteratively improve them by employing the strategies: moving towards better solutions by means of a neighbour search mechanism while abandoning poor solutions.
In the Artificial Bee Colony (ABC) algorithm that proposed the colony of the artificial bees is divided into three types of bees:

- The employed artificial bees,
- The onlookers' bees
- Scouts artificial bees.

VI. GENETIC BEE COLONY ALGORITHM

GBC is a new optimization algorithm which is designed by integrating the advantages of the Genetic Algorithms (GA) and Artificial Bee Colony (ABC) for optimizing the numerical problems. In the ABC algorithm that proposed the colony of the artificial bees is divided into three types of bees: the employed artificial bees, the onlookers' bees, and scouts artificial bees.

The integration of searching mechanism of the basic ABC algorithm and GA to the neighbourhood will be performed in the following four steps:

- In the neighbourhood of a food source (current), randomly we can select two other sources of food from the population and then can find a proposed solution;
- Apply the first operator and two-point crossover operator between the current two neighbourhoods, best and zero food sources to generate the sources of children food;
- Apply the second operator, swap operator, to the sources of children of food to find grandchildren sources of food;
- The best source of food can be selected as a neighbourhood source of food of the obtained solution among the children and grandchildren food sources.

The basic ABC has the following steps.

6.1 Setting ABC parameters

The main parameters of this algorithm should be first initialized. These parameters are the population size (PS) or solution, the number of bees that are supposed to be as twice of the size of PS, the (L) is the limit parameter.

6.2 Initialization of the population solutions

The solutions with size equal to PS are generated randomly by the following equation:

$$u = u_{i,j}^{min} + rand[0,1]\left(u_{i,j}^{max} - u_{i,j}^{min}\right) \quad ....(1)$$

Where i is the solution index, j is defined to be the decision variable, rand [0, 1] generate a random value between 0 and1, $u_{i,j}^{max}$ and $u_{i,j}^{min}$ denote the lower and upper limits of the j-th decision variable.

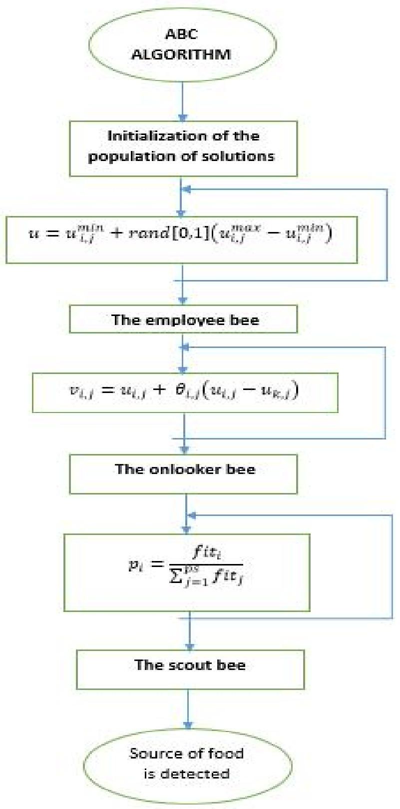

Fig 6.1 ABC Algorithm Flow Diagram

6.3 Evaluation of the population solutions

The objective functions can be used to determine the obtained generated solutions.

i. The employee bee

In this phase, each employed bee has a specific task to discover a new source of food in the surrounding area of its location. Then the employee bees move into candidate neighbour solutions, food sources, such that each employed bee has its food source in the surrounding environment. The nectar amount is evaluated of the detected food sources, and if the amount of the nectar of the detected source of food is greater than the amount of nectar of the current resources of food, then the detected food source is memorized. A neighbourhood solution, v can be obtained by the modification of the i -th solution, x is proposed as in the following equation:

$$v_{i,j} = u_{i,j} + \theta_{i,j}\left(u_{i,j} - u_{k,j}\right) \quad \text{......... (2)}$$

Where k is a solution which is selected randomly from PS and q is a randomly selected between [-1, 1].

ii. The onlooker bee

The information that has gained from the previous phase from the employed bees is used to detect the new source of food in the neighbourhood of the selected food source by onlooker bee and then other qualified sources of food can be chosen in the exploitation process. The onlooker bees and employee bees try to improve their current solutions with exploring their neighbourhood using equation (2). The (fit) values can be exploited by onlooker bees select the solutions according to the following equation:

$$p_i = \frac{fit_i}{\sum_{j=1}^{ps} fit_j} \quad \text{........................ (3)}$$

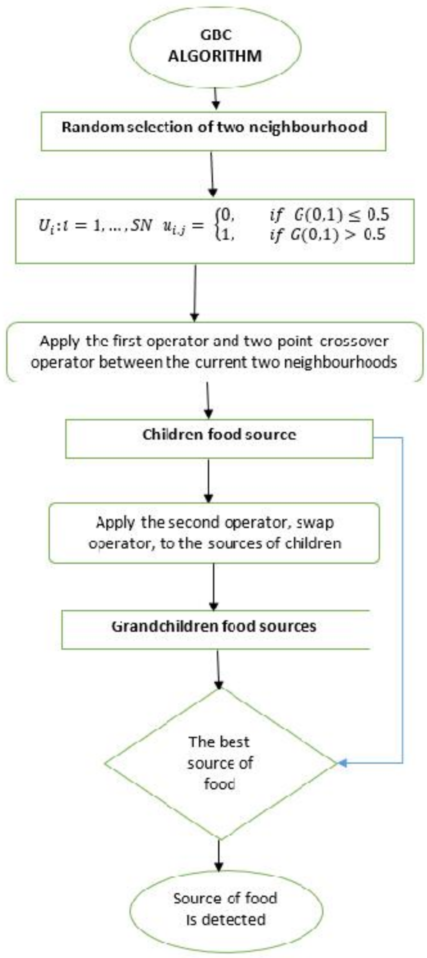

Fig 6.2GBC flow diagram

iii. The scout bee

When the source of food is detected, the employee bee becomes a scout to find the new source of food in the space of solutions. To control the number of scout bees, a parameter called limit can be used to represent the number of trials. Then, the new source of food needs to be randomly determined when the source of food cannot be improved. In this case, exploitation and exploration processes in the search space have to be carried out together.

6.4 Genetic operators

Since the basic structure of ABC is not preferred for the binary optimization; therefore, there is in proposed a new binary version of ABC algorithm by using some genetic operators such as swap and crossover to find the solution binary optimization problems. For this reason, the previous equations (1) and (2) of ABC algorithm should be modified, and then the initial solutions can be generated by the following equation (4) instead of equation (1);

$$U_i: i = 1, \dots, SN \quad u_{i,j} = \begin{cases} 0, & if \ \ G(0,1) \le 0.5 \\ 1, & if \ \ G(0,1) > 0.5 \end{cases}$$

…………….. (4)

Where G (0; 1) is a generated uniformly value.

The integration of searching mechanism of the basic ABC algorithm and GA to the neighbourhood will be performed in the following four steps:

(i) In the neighbourhood of a food source (current), randomly we can select two other sources of food from the population and then can find a proposed solution;
(ii) Apply the first operator and two-point crossover operator between the current two neighbourhoods, best and zero food sources to generate the sources of children food;
(iii) Apply the second operator, swap operator, to the sources of children of food to find grandchildren sources of food;
(iv) The best source of food can be selected as a neighbourhood source of food of the obtained solution among the children and grandchildren food sources.

Therefore, the performance of the basic ABC algorithm can be improved in binary optimization problems

VII. OUTPUT

From the comparison graph we can observe the execution time is reduced which shows that our system is optimized and increased in data speed access of the cloud storage. It achieve because of the efficient allocation of resource and optimized algorithmic approach in the network improve our data access speed and Throughput.

7.1 DATA SPEED:

This shows, Data access speed is high which compared to the existing system

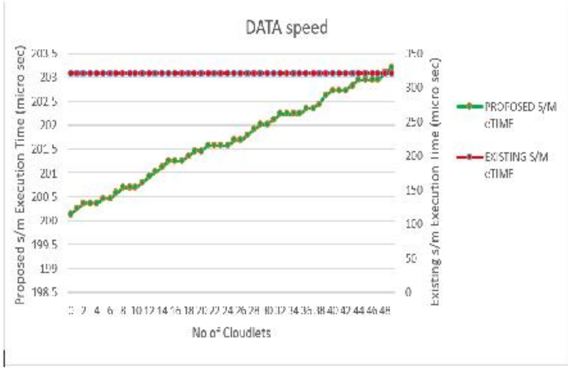

Fig 7.1 Data speed comparison

execution time. Cloudlet data access of the proposed system is maximum up to 203 msec and in existing system it will be 301msec.

7.2 RESOURCE ALLOCATION:

From the above graph we can observe the resource allocation of the proposed is well optimized than the existing system. It has improved to accessibility of more no of cloudlet to Virtual machine. By using our genetic optimal MEC network can create more Virtual Machine in single data centre.

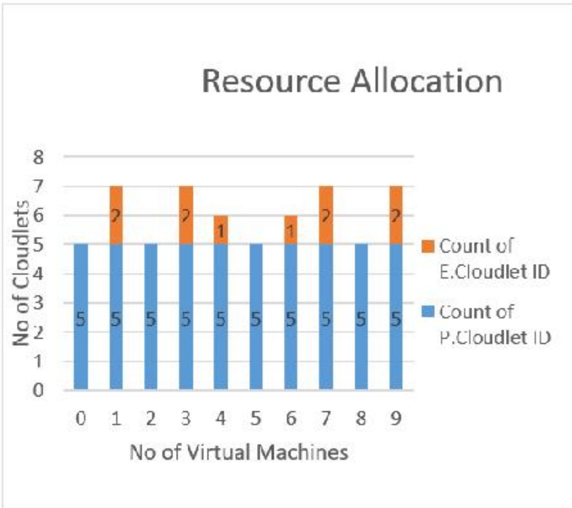

Fig 7.2 Resource allocation comparison

7.3 THROUGHPUT

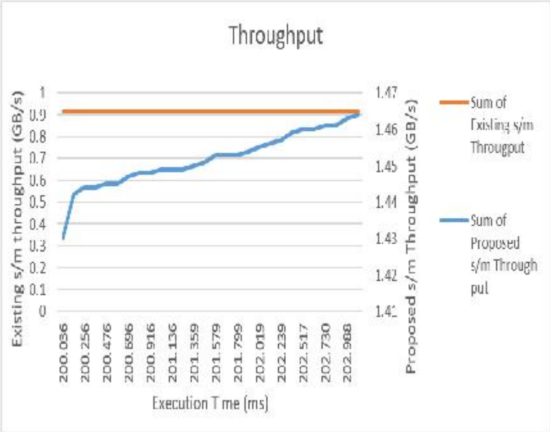

Fig 7.3 Throughput comparison

From the graph we can observe that throughput is increased in our proposed system,it is calculated by the data access with respect to the execution time depends on the transmission medium and packet rate in our network. In our proposed system we achieve maximum through put from 1.43 GB/s to 1.46 GB/s. In the existing system we have maximum throughput up to 0.9 GB/s.

VIII. CONCLUSION

In this paper, MEC offloading mechanisms in 5G heterogeneous networks, in order to improve the Data access speed of the offloading system, formulated a problem to minimize the delay of the computation task implementation together with that of the communication process. Simulation is also performed to prove the authenticity of the proposed algorithms and the behaviour of the algorithm for various inputs and situations. Evaluation of offloading performance is done using CloudSim simulator. The limitations of various available techniques are found and various techniques to overcome the limitations are adapted and materialised in the thesis. Overall the paper will be a big bridge to have the Resource allocation and data access principles by using cloud infrastructure. To solve the problem more efficiently, which jointly optimizes the computation offloading decisions and the radio resource allocation strategies to minimize the system delay constraints. In addition, conducted a simulation study, which clearly displays the efficient resource allocation and increase data speed.

IX. FUTURE WORK

This paper can also be scaled in such a way to better suit the need of the users with high performance and security measures at lower costs. Further improvements in terms of energy efficiency can also be addressed. This paper extends to include an IOT devices as mobile client and store different types of data such as videos, audios, images and text in cloud storage. Access the stored data from different virtual machines using same IOT device.

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