Journal of Theoretical and Applied Information Technology
15th January 2019. Vol.97. No 1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

BTS ALGORITHM: AN ENERGY EFFICIENT MOBILITY MANAGEMENT IN MOBILE CLOUD COMPUTING SYSTEM FOR 5G HETEROGENEOUS NETWORKS

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ABSTRACT

As of late, cell phones are turning into the essential stages for each client who dependably meander around and get to the distributed computing applications. Mobile Cloud Computing (MCC) consolidates the both portable and distributed computing, which gives ideal administrations to the versatile clients. In cutting edge versatile conditions, for the most part because of the immense number of portable clients in conjunction with the little cell measure and their convenient information's, the impact of portability on the system execution is reinforced. In this paper, we propose an energy efficient mobility management in mobile cloud computing (E2M2MC2) system for 5G heterogeneous networks. The proposed E2M2MC2 system use back track searching (BTS) algorithm for congestion prediction and selection of optimal routes to manage user mobility. The simulation results shows that the proposed E2M2MC2 system helps in minimizing delay, packet loss rate and energy consumption in a heterogeneous network.

Keywords: *Mobile Cloud Computing, Mobility Management, Heterogeneous Network, Best Route, Energy Efficient, Back Track Search, distributed follow me cloud controller*

1. INTRODUCTION

Cloud computing is for the most part utilizes for the processing assets which are circulated by the assistance of system. Assume, if the capacities and information are kept up on the web then it offering on-request get to [1]. Applications are ordinarily execute on a remote server. Subsequently, it is transmitted to the purchaser. Portable learning is generally occur if the masses are a long way from their workplaces or classrooms. After the school or office, a few masses are picked listen music, radio news, or games programs. Additionally, they want to learn cell phones, DVD/CD Players, tapes, PCs introduced by methods for learning programming or PCs with fast access to the Internet after they return home which are altogethers in light of e-learning [2]. For the most part, the cell phones are utilizes for interchanges with facilitate people, not for learning expectation. M-learning is regularly a creative innovation for adapting yet it doesn't swap ordinary learning [3]. Here, the cell phones are containing a small memory and capacity ability, which are confines the length of messages, the opening of connections, and the utilize of tabs or various windows [4].

As of late, the entrance of cloud servers through cell phone is considered as a general and stylish. In 2018, the cloud applications are experienced 90% of versatile information activity. For the most part, the cell phones are containing various reachable stockpiling administrations like Dropbox, iCloud, Google Drive, and Sky drive [18]. The basic innovation of distributed computing is utilized to unify the processing, administrations, and exact applications by the assistance of administration which is appropriated like water, gas or power to customer. Accordingly, the blend of ubiquities versatile system and distributed computing is utilized to cause a creative registering approach, which is known as MCC [5]. In present day PC areas, the versatility is end up being a stylish measurements. Ordinarily, the cell phones like Smartphone, PDA, GPS Navigation and workstations are

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

extended by different versatile registering, systems administration and security innovations [6]. Here, development rate of compound program is speedier than the extension rate of registering assets of cell phones which depend on the development of figuring concentrated applications [19]. Also, the surfing of Internet is ended up being less demanding by the extension of remote innovation like WiMax, Ad Hoc Network, and WIFI, however it not limited by methods for links. In this way, those cell phones are set up as their premier alternative of working and excitement in individuals lives [7]. In view of the investigation of Juniper, the distributed computing related portable programming and application are foreseen to increment 88% for every annum from 2009 to 2014. This development is additionally producing US 9.5 billion dollars in 2014 [8], [9].

The premier advantage of MCC is to vanquish challenges of versatile figuring which are related to the introduction, air, and insurance [20]. Mobile Computing is by and large gotten from three preeminent observations like equipment, programming and correspondence. The view of equipment is showing cell phones as PDA and workstation, or their versatile parts. The trouble of correspondence is essentially including the interchanges of versatile systems, conventions and information deliverance. A portion of the characteristics of versatile figuring are indicated as takes after [10]: In mobile computing network, the versatile hubs are utilized to make relationship with others. In addition, the foreordained hubs in wired system are occur by mobile support station (MSS) for the time of moving.

Regularly, the utilizing of mobile nodes in arrange isn't selective. Along these lines, this system can be a wired system through high-data transmission, low-transfer speed, or even in position of disengaged [11]. As indicated by confinement of battery control, charge of remote correspondence, arrange conditions and so forth, the portable hubs are not always keeping up the affiliation, but rather segregate and dependable through the remote system is occur as inertly or effectively [12]. Here, the servers, passageways, and encourage MSS are encouraging a solid send/get ability. This ability in portable hubs is fairly frail. In this manner, the correspondence data transfer capacity and overhead among downlink and uplink are irregularity [13]. A mobile computing network system is for the most part perceived from terminals, systems, database stages, and applications development for guard by reason of flag is helpless against hindrance and snooping.

As opposed to the traditional wired system, the portable processing system is incorporating assorted troubles and difficulties in unique highlights like flag interference, insurance, hand-off delay, confined power and low registering ability [14]. Three principal belonging are considered for the constrained properties of versatile systems: there is a necessity for joining belonging from various gadgets since cell phone is enveloping limited asset than ordinary wired systems [15]. Physical uniqueness of system is important to consolidated like stable courses, and so forth [16]. Vitality impediments are huge in versatile system on the grounds that the ongoing applications are requiring extra battery [17]. Then again, the trait of versatility is additionally containing the disservice of quickly vitality decrease and unequal strategy [12-17].

For this reason, the proposed energy efficient mobility management in mobile cloud computing (E2M2MC2) system is required for next generation 5G heterogeneous networks. The main of proposed E2M2MC2 system is to compute the user mobility is managed by the back track searching (BTS) algorithm with congestion control also.

The remainder of this paper is organized as follows. Section 2 discusses recent related work. In Section 3, we present the problem methodology and system model of proposed work. Section 4 describes the working function of proposed E2M2MC2 system in detail with proper mathematical models. Section 5 provides the simulation results and performance analysis with proper test scenarios. The paper concludes in Section 6.

2. RELATED WORKS

Sardis et al. [21] have offered a conceivable situation for to produce travel blockage troubles on the Internet by reason of lifted transfer speed media administrations and customer versatility. Here, the sensible structure is utilizes to inspect the element which concern the Quality of Experience (QoE) and QoS for VoD benefits in a portable environment. The cloud-related administrations are by and large giving sensible and brought together processing assets

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

and cell phones. Besides, it is additionally requiring brought together assets for to produce their need of handling power. A while later, the examination of administration deliverance structure is utilized to vanquish a trouble through the utilize of administration populating methodology and Cloud administrations.

Qi et al. [22] have foreseen an administration responsive position technique which is utilizes to distinguish the event and position of cell phone without customary cyclic enlistment refresh. Internet Protocol (IP) in multi media subsystem (IMS) is predominantly used to procure the position and conditions data of cell phones by the assistance of enlistment movement. Here, a coupling was framed by methods for serving-call session control function (S-CSCF) which is gotten from starter enlistment among open purchaser personality and IP address of cell phone. The S-CSCF and intermediary call session control function (P-CSCF) is for the most part used to keep up the purchaser enlistment position like the clock which is indicating the 'terminates' constraint.

Gani et al. [23] have foreseen a topical scientific categorization which is utilized for the characterization of existing interworking and portability strategy of remote information systems. Here, the suggestion and critical highlights of existing impeccable network systems are analyzed as adequately. In heterogeneous remote information organizes, the considered two critical units of flawless availability are interworking and versatility techniques. Here, the interworking system is utilized to consolidate different remote information systems for unique OSI layers which are encouraging hub portability in heterogeneous remote information systems for holding availability. In the movement of portability, various systems are utilizing proactive versatility to ascertain the conceivable give up for to avoid bundle disappointment and affiliation disappointment. Also, the further techniques are putting forth receptive versatility for lesser flagging straightforwardness handover. The first expectation of technique is to lessen the inertness, bundle disappointment, and multimodal. Here, QoS is keeping up flagging straightforwardness and mobility for the streamlining trouble.

Chen et al. [24] have foreseen mobility driven network (MDN) which is gotten from the examination of improvement stages. Here, the versatility association is delegated three sections, for example, one property in an exact system, portability in a typical ability of systems and portability. Assume, if the versatility is supporting the earth then possible portability innovation is representing the issue of undertaking excess, framework entanglement, deficiency, and adaptability. MDN is for the most part utilizes the outline of perspective, assignment introduction portrayal, and convention introduction portrayal for an abnormal state idea of key errand, arrange elements, and logical qualities.

Hu et al. [25] have mostly centering the portability issue in the cloud server farm which is utilized to gather various necessities of Internet administrations to supply upgraded customer encounter. For the most part, the virtual machines are equipped to exchange starting with one position then onto the next. The premier trouble of IP versatility was a migration of virtual machine (VM) in IP subnets. It is exhibiting the versatility based cloud server farm arrange at auxiliary outline which is gotten from the plan of MDN. Here, the Entity-character/Location-identifier is decoupling to build up a position official to design the Entity-personality at the current position of VM. In addition, the mapping table is utilized to adjust the VM for perfect administration which is offered by methods for cloud server farm.

Junior et al. [26] have offered the mobile offloading system (MOSys) which is for the most part utilizes to hold and keep up the capacity of versatile hubs. The essential framework basic outline is predominantly used to help the software defined network (SDN) for the portability association errand. The operational circumstance of store related association framework is dependent on the off-stack response time. The movement of middleware is utilizes to save the information off-stack, profiling administrations, cloud identification, and application utilization. The framework was evaluated by methods for versatility affect constraint on the off-stack introduction at the execution game plan in the ensuing generation cell phones. The MOSys versatility association framework is mostly used to control the hoisted thickness of portable hubs through the accumulation of low use and vitality equipped transformation starting with one position then onto the next position.

Kim et al. [27] have offered an activity association process by methods for versatile edge cloud. The mobile edge cloud is for the most part arranged in the mobile edge network for to watch

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

the situation of mobile terminals. Hence, it ends up being plausible for control the movement of mobile terminals effectively through the system. This procedure is ordinarily controls the video movement from content server in the Internet which depends on the edge arrange position and mobility of a mobile terminal. Additionally, it offers the video movement to the mobile terminals. This procedure is utilizing the mobile edge cloud for to build up the QoE of mobile video consumer.

Seo et al. [28] have foreseen the cloud interchanges for ubiquitous computing environment mobile application (CI-UCEMA), which envelops three layers like cloud service layer (CSL), M2M service layer (MSL) and ubiquitous service layer (USL). The M2M is including IoT services layer (MSL) for to lessen the difficulty of both the improvement and support of IoT frameworks. It is fundamentally exhibited by methods for improved interoperability and the utilize of standard process. Insurance is additionally proficient by methods for gadget administration and provisioning. The MSL was trustworthy for keeping the buyer from basic intricacy and irregularity in self-alteration environment by the assistance of mobility and adaptation at CDPS and CIMS.

3. PROBLEM METHODOLOGY AND SYSTEM MODEL

3.1 Problem Methodology

Aissioui et al. [29] have foreseen a versatile technique which is gotten from SDN/Open-Flow auxiliary outline and a control plane structure. They are for the most part altered for portable distributed computing frameworks and Follow Me Cloud (FMC)- related frameworks. The situation of 5G portable systems are for the most part utilizes to deal with the plane structure for MCC-related frameworks where versatile hubs and system administrations are showing restriction of exercises and movements. In addition, the divergence of unified strategy through single SDN controller is encouraging to apportion the SDN/Open-Flow control plane on a two-level progressive auxiliary outline which are containing first stage among a worldwide controller of G-FMCC and second stage among various nearby controller. The evaluation results are gained by methods for examination. Also, this clarification is ensuring the improved control plane association, introduction support, and system asset preservation. MCC is a focalized innovation included three foundation heterogeneous advances, in particular mobile computing, cloud computing, and networking. The up and coming heterogeneous 5G network accentuates on an emotional increment in the transmission rate of MCC movement. With more clients working at high rates, the kind of information shared over the system will be mind boggling and a greater part of it will incorporate video movement. Such perplexing structure of activity and substantial load over the parts of the system are hard to control. Further, the versatility of clients signifies this issue and makes it hard to oversee and work the system with no breakdown. Accordingly, it is essential to control activity and in addition deal with the versatility of clients to give effective correspondence, which can bolster video movement at high conveyance rates. Moreover, the fundamental parameters influence the execution of system as the immense assortment of cell phones with various operating systems (OSs), stages, and remote system principles. The forthcoming 5G systems go for giving rapid interchanges to clients regardless of their development. With an expansion in the quantity of gadgets and the system achieving its pinnacle estimate, because of thick arrangement, it winds up vital to oversee and control versatility for proficient correspondence. Versatility administration requires numerous tasks at a similar occasion, which incorporate ideal course determination, portable stay bolster, client design ID, and administration handoffs.

An energy efficient mobility management in mobile cloud computing (E2M2MC2) system utilizes the optimal route selection to obtain energy efficient mobility management. The main contributions of proposed E2M2MC2 system are summarized as follows:

- The back track searching (BTS) algorithm used to compute the congestion and select optimal routes between the serving terminals.
- Various parameters used for best route selection process are: packet loss, energy consumption, throughput, fairness index and delay.
- Finally, the performance of proposed E2M2MC2 system is compared with the existing simulation results shows that the proposed E2M2MC2 system helps in minimizing delay, packet loss and device lifetime in a heterogeneous network.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3.2 System Model Of Proposed E2m2mc2 System

The system model of proposed E2M2MC2 system is shows in Figure 1, which uses the follow me cloud (FMC) concept, which permits the migration of administrations gave to clients contingent upon their developments. Administrations are in this way dependably gave from server farm areas that are ideal for the present areas of the clients. This furnishes clients with enhanced QoS/QoE, in the meantime and it permits saving administrators' system assets by getting away system movement to server farms through the closest focuses contrasted and clients' areas. Another favorable position of FMC innovation is that movement of administrations is consistent and straightforward to clients. MCC system utilize both the data accumulating and the data dealing with occur outside of the mobile phone. Concerning definition, versatile applications move the handling power and limit from the cell phones to the Cloud. It may be thought the union of the distributed computing and versatile condition.

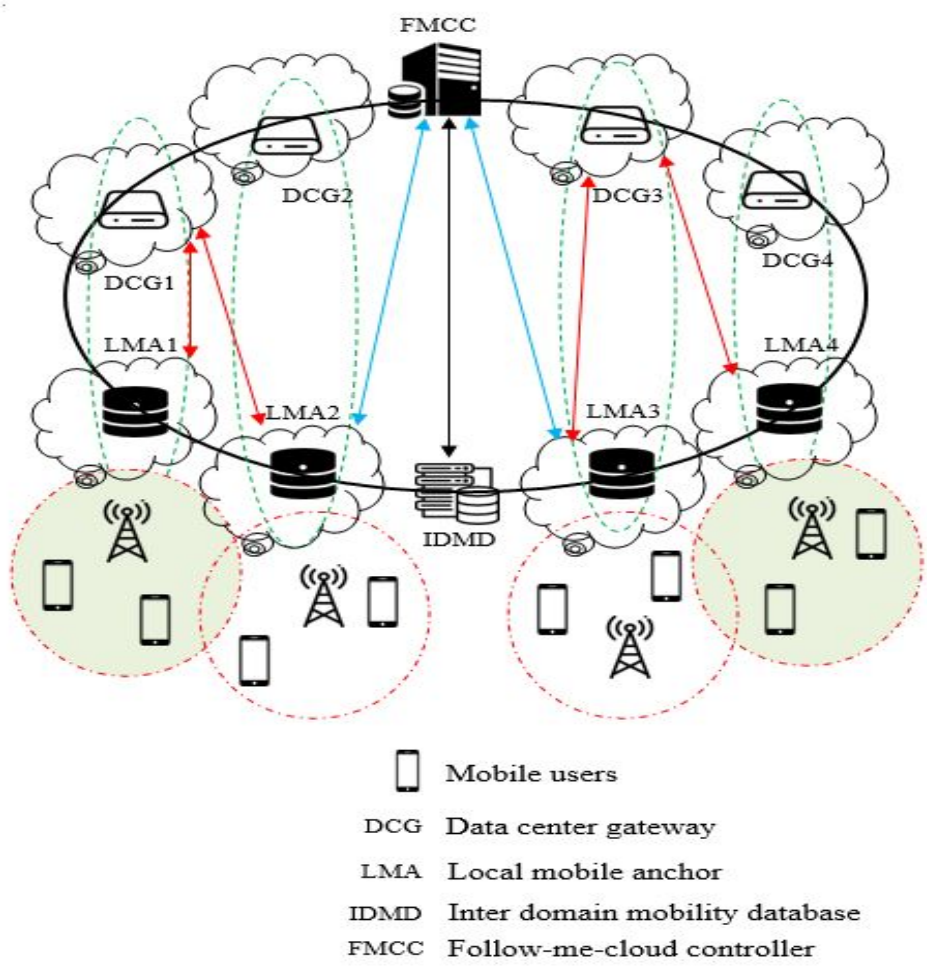

Figure 1: System model of proposed E2M2MC2 system

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

4. ENERGY EFFICIENT MOBILITY MANAGEMENT IN MOBILE CLOUD COMPUTING (E2M2MC2) SYSTEM

4.1 Optimal Route Selection Using Back Track Searching Algorithm

New challenges of cloud service selection are raised when combing the cloud computing with mobile systems. And thus an optimal cloud-path selection method is needed when choosing the best suited cloud provider for their applications. The selection process can be a hard task since a variety of data needs to be analyzed and many factors should be considered. Service selection, whether single or multi-criteria, falls with the preview of decision making since the mobile device has to make a decision to select a service from amongst candidate cloud services. The cloud routing is achieved by a back track search (BTS) algorithm is a beginning late profited however much as could be expected from transformative to deal with the streamlining issues. The four stage game plan of NS algorithm is introduction, request, change, and crossbreed. There are two processes, for example, the progress and trial individuals. The trial process made of some chronicled data with respect to the additional information, and an intrigue course framework is worked by the two processes to fortify the spots of the far reaching gathering. There is just a specific control parameter, to be specific the blend rate, which controls the measure of individual bits that will be changed in a trial. The system tries of BTS algorithm depicted as takes after: The initial population and history population of NS algorithm are initialized by,

$$P_{x,y} \approx \cup(L_y, U_y); \quad x = 1,2,\ldots,n;\ y = 1,2,\ldots,m \tag{15}$$

$$P^{-1}_{x,y} \approx \cup(L_y, U_y); \quad x = 1,2,\ldots,n; y = 1,2,\ldots,m \tag{16}$$

where n is the population size, m is the dimension size of control variables, $\cup$ is the uniform distribution, and L_y and U_y are the low and up boundaries of variables. In pre-selection process, the history population $P^{-1}_{x,y}$ is introduced in NS algorithm as,

$$P^{-1}_{x,y} = \begin{cases} P_{x,y}; & if\ (a < b/a, b \sim \cup(0,1)) \\ P^{-1}_{x,y}; & otherwise \end{cases} \tag{17}$$

The central kind of the trial is made by Mutation operation with player thought. The coacher passes on the data for all players in the social event, and the players revive their positions as appeared by the coacher and the mean position of the present party. The player with the best prosperity is been the coacher. Here, the development issue portrayed the position of the N-th player be

$$N_i = \{x_{i,1}, x_{i,2}, \ldots, x_{i,M}\} \tag{18}$$

The N-th player updates its position according to the difference between the coacher and mean position as follows:

$$M = P_{x,y} + 3rand(0.5(P^{-1}_{x,y} - P_{x,y}) + 0.5rand(\bullet)(B - P_{x,y})) \tag{19}$$

where B is the best individual of the present age, $rand(\bullet)$ is the unique number in the range [0,1]. The playing technique contains two sections: First, every individual increments from a subjective individual from the present masses. At any supplement, z^{th} player is discretionarily picked as the learning object of the x^{th} player. The method for learning is x^{th} player can mathematically expressed as follows:

$$M_{x,y} = \begin{cases} P_{x,y} + R(P_{x,y} - P_{z,y}) + R(B_{1,y} - P_{x,y}); & if\ x > y \\ P_{x,y} + R(P_{z,y} - P_{x,y}) - R(W_{1,y} - P_{x,y}); & otherwise \end{cases} \tag{20}$$

where $P_{x,y}$ is the y^{th} bit of the x^{th} individual and the value of the y^{th} bit of the z^{th} individual, which is randomly chosen from the population and is different from the x^{th} individual. $M_{x,y}$ is the value of the y^{th} bit of the x^{th} individual after the mutation operator is applied. In addition, B and W are the best and worst positions of the current generation, respectively. The initial value of the trial population comes from the mutation process, and the trial individuals with better fitness are used to compute the target population individuals. A binary integer-valued matrix (m) of size N • M guides the crossover process and is expressed as follows:

$$C_{x,y} = \begin{cases} P_{x,y} & if\ m_{x,y} = 1 \\ M_{x,y} & otherwise \end{cases} \tag{21}$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

In post-selection, the population of next generation is generated according to a greedy selection mechanism. The working flow of entire proposed E2M2MC2 system illustrates in Figure 2.

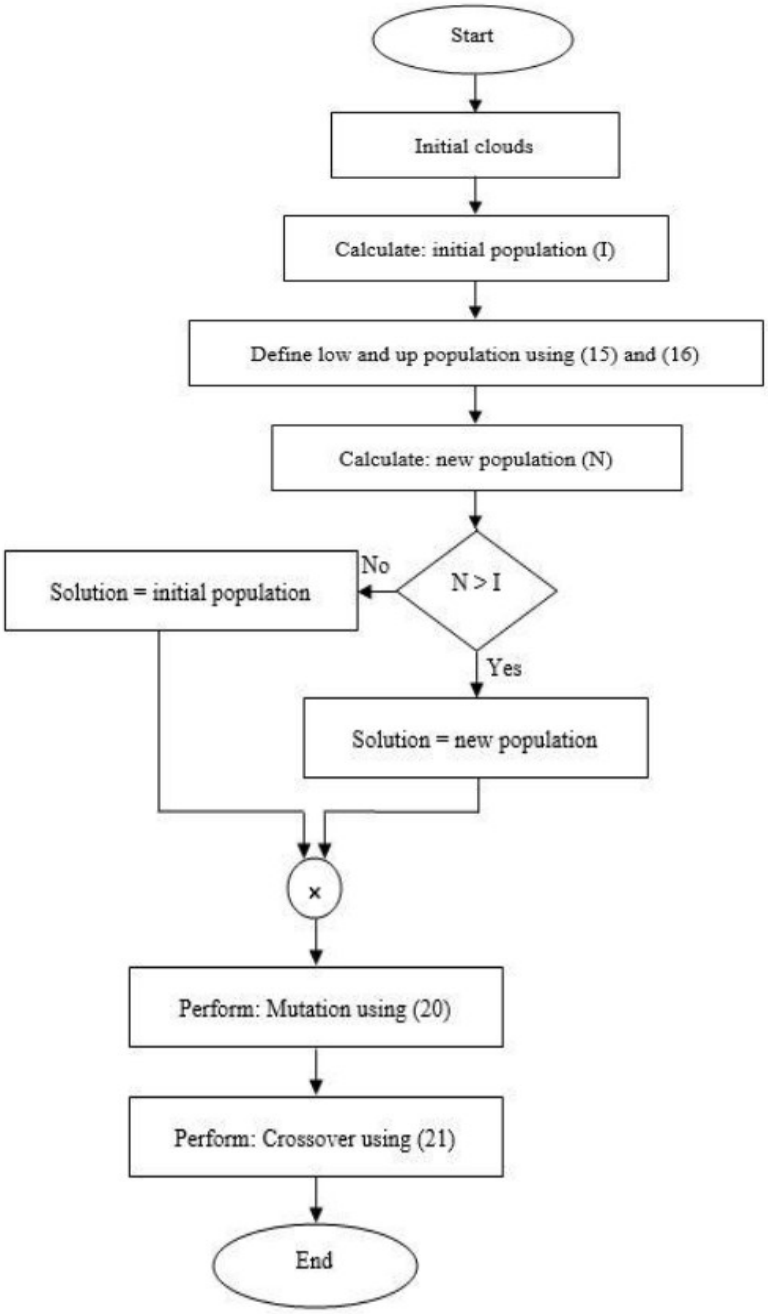

Figure 2: Working flow of proposed E2M2MC2 system route selection using back track searching algorithm

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

5. PERFORMANCE ANALYSIS

The mobile cloud computing models is dissected for the execution perspective. Portable cloud engineering builds asset accessibility by utilizing expansive number of close-by cell phones in broad daylight places like shopping center, film, and air terminal administration accessibility is expanding perceptibly. It additionally improves security as a result of the dynamic parceling of the correspondence divert in the between cell phone and cloud server. In this section, we exhibit the assessment of our energy efficient mobility management in mobile cloud computing (E2M2MC2) system and it compared with the existing distributed follow me cloud controller (DFMCC). The performance of proposed E2M2MC2 system is investigated by the diverse testing situations: effect of versatile client thickness and their speed. The quantity of versatile clients is fluctuated from 30 to 110 in first test and the portable client speed is changed from 20 to 100 ms in the second situation. For this testing, we use four DCG and LMA, one IDMD and one FMCC with high density mobile users. Both tests are implemented in Network Simulator (NS2) tool with 1000×1000 m^2 network size. The simulation parameters are summarized in Table 1.

Table 1: Simulation parameters

Parameters	*Values*
Number of mobile users	30, 50, 70, 90, 110
Mobile user speed (ms)	20, 40, 60, 80, 100
Number of DCG	4
Number of IMA	4
Number of IDMD	1
Number of FMCC	1
Network size	1000×1000 m^2
Traffic model	Constant bit rate
Simulation time (s)	100

5.1 Impact of mobile user speed

In this scenario, we varying the mobile user speed from 20 to 100 ms with fixed mobile user as 110 and the performance of proposed E2M2MC2 is compared with the existing DFMCC system. Figure 1 shows the packet loss rate of proposed E2M2MC2 and existing DFMCC system. The plot clearly depicts the packet loss rate of proposed E2M2MC2 system is very low in terms of 32% less compared to existing DFMCC system. Figure 2 shows the energy consumption of proposed E2M2MC2 and existing DFMCC system. The plot clearly depicts the energy consumption of proposed E2M2MC2 system is very low in terms of 31% less compared to existing DFMCC system. Figure 3 shows the throughput of proposed E2M2MC2 and existing DFMCC system. The plot clearly depicts the throughput of proposed E2M2MC2 system is very high in terms of 37% high compared to existing DFMCC system. Figure 4 shows the fairness index of proposed E2M2MC2 and existing DFMCC system. The plot clearly depicts the fairness index of proposed E2M2MC2 system is very high in terms of 29% high compared to existing DFMCC system. Figure 5 shows the delay of proposed E2M2MC2 and existing DFMCC system. The plot clearly depicts the delay of proposed E2M2MC2 system is very low in terms of 32% high compared to existing DFMCC system.

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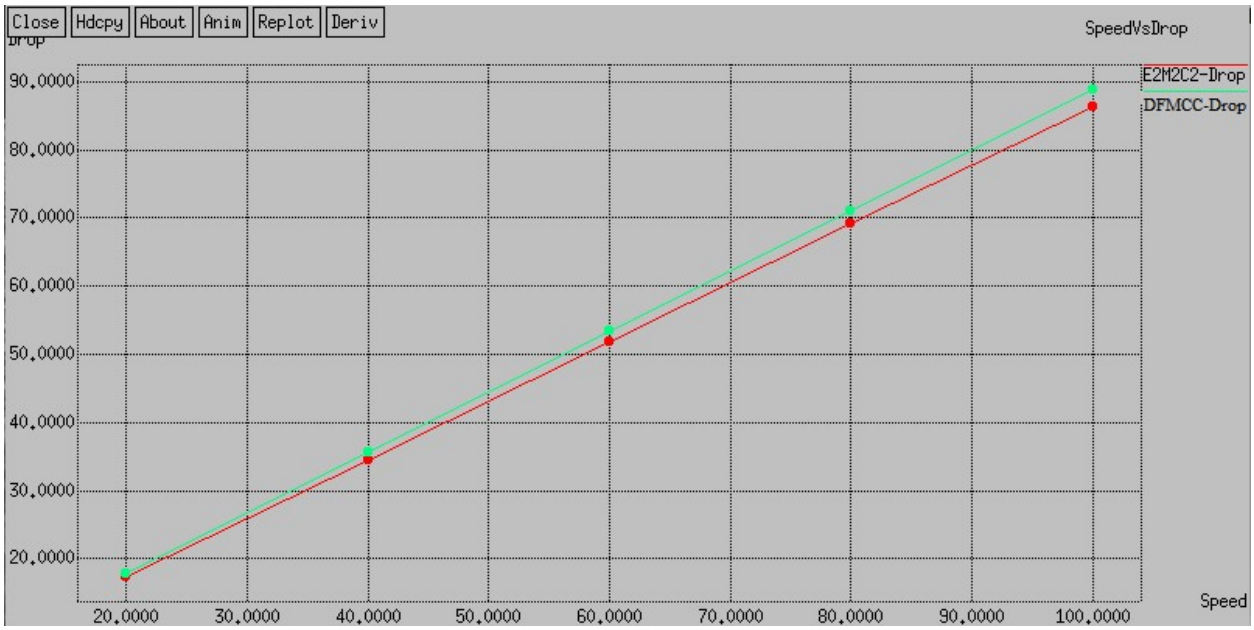

Figure 1: Packet loss rate comparison with impact of mobile user speed

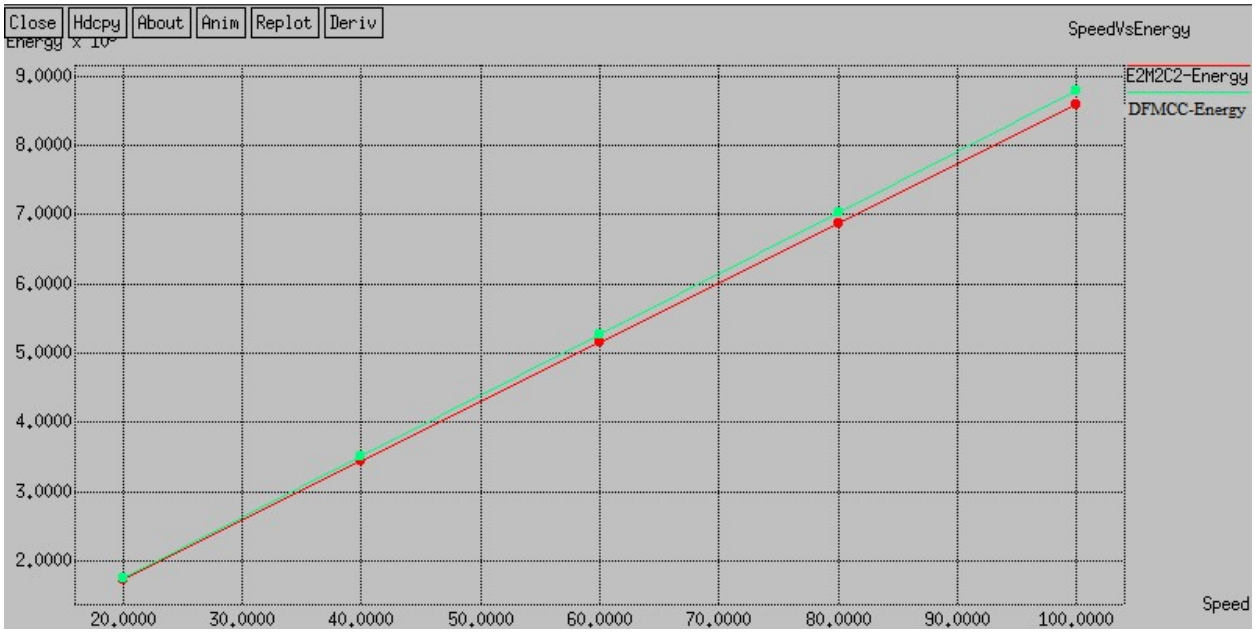

Figure 2: Energy consumption comparison with impact of mobile user speed

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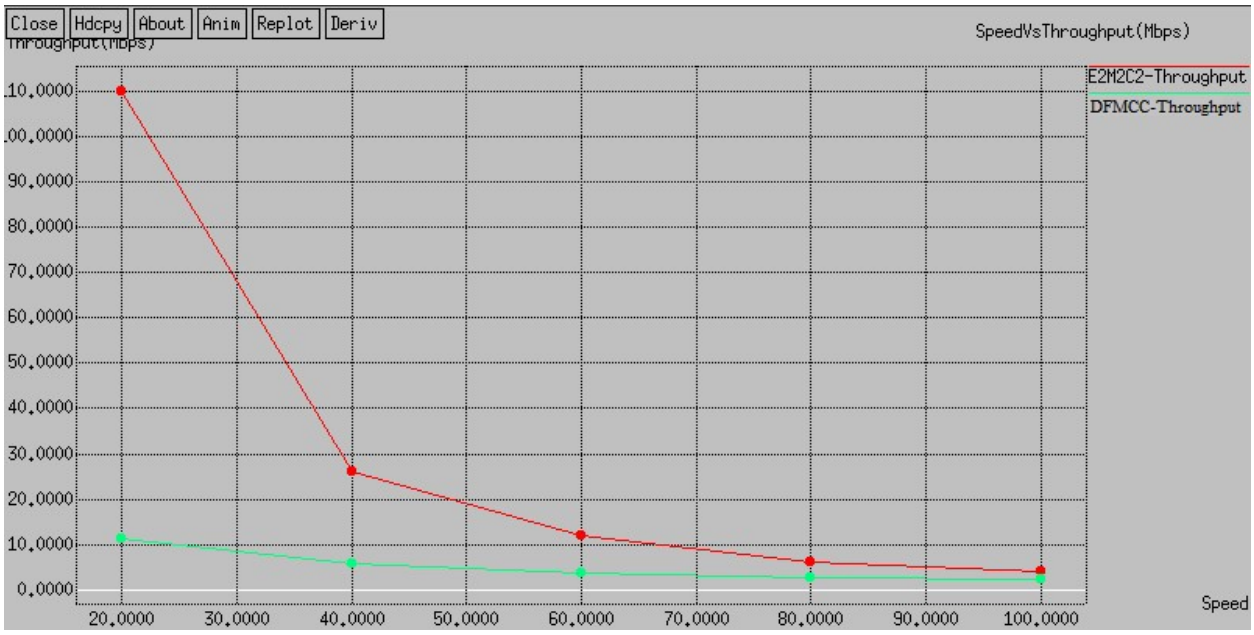

Figure 3: Throughput comparison with impact of mobile user speed

Figure 4: Fairness index comparison with impact of mobile user speed

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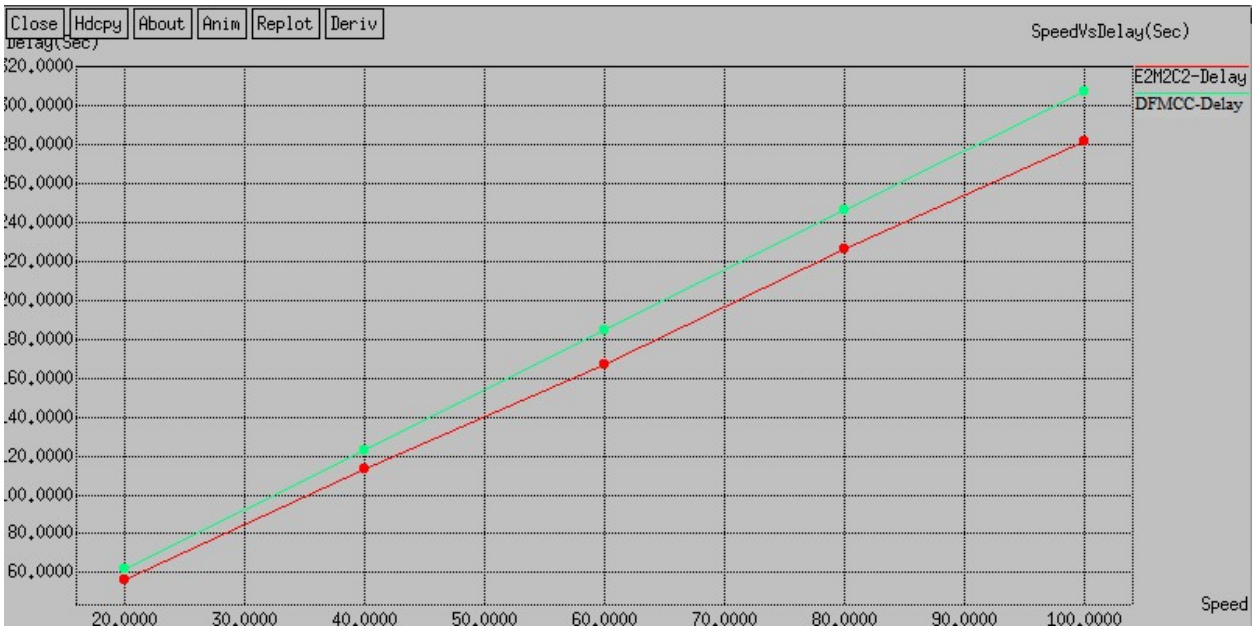

Figure 5: Delay comparison with impact of mobile user speed

6. CONCLUSION

Mobile cloud computing makes utilization of the assets from the cloud to build the computational capacities of cell phones. Portable clients can scale the accessible administrations to coordinate their needs, tweak applications and access cloud space from any area with a dynamic web association. In this paper, we have proposed energy efficient mobility management in mobile cloud computing (E2M2MC2) system. The main objective is route computation, which are achieved by back track searching (BTS) algorithm respectively. The simulation results prove the effectiveness of our E2M2MC2 system in terms of delay, packet loss rate, throughput, fairness-index and energy consumption.

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