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Resource Allocation in Cellular Network with Device to Device Communication

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***Abstract:** As advanced cellular technologies headway, more than one component carrier can now be jointly utilized in a base station. In this model the base station (BS) can utilize secondary carrier component (CC) which is D2D when the traffic is relatively high. In this paper , we study resource allocation in cellular network with device to device communication , which is deemed as a promising technique to improve the spectrum usage efficiency and alleviate the heavy burden on backhaul links Most previous works ignored user mobility, thus having limited practical applications. Here we utilize the user mobility pattern by the inter contact times between the users and propose a time - efficient greedy algorithm which has an approximation ratio as 1/2 .*

***Keywords:** caching, resource allocation, data offloading ratio, inter contact times, OFDMA*

I. INTRODUCTION

The efficient power saving scheme for downlink transmission was proposed in orthogonal frequency division multiple access based multi CC systems, where the frame structure followed that of the LTE-A system that is the scheduling process proceeds sub frame by sub frame in [1]. The objective of this paper aims to minimize the total energy consumption in each sub-frame for the BS transceivers of OFDMA - based multiple CCs, while maintaining certain quality of service (QoS) minimum required levels and the fairness among users . This paper focuses on the downlink transmission and supports both the real time and the non-real time traffics simultaneously .The presented scheme includes necessary scheduling and admission control mechanisms. This paper even includes an effective mobility aware caching strategy in device-to-device caching networks to offload traffic from the cellular network. The carrier component switches from base station to D2D if the traffic is high.

II. SYSTEM MODEL

A. Basic Assumptions

In this model, the BS can jointly utilize two CCs that are classified into primary CC (PCC) and secondary CC (D2D)

The PCC acts as the main CC for transmission, while the SCC is utilized when the traffic is relatively heavy. Assume that the two CCs are consecutively located in the same band and each has bandwidth B Hz.

The LTE-A frame structure , the scheduling process is performed sub frame by sub frame .In each sub frame there are J sub channels and two time slots . The resource block (RB) which consists of seven OFDM symbols in one time slot and 12 subcarriers in one sub channel, is set as the smallest allocation unit.

The considered system model in the form of block diagram is shown in Fig.1. The model is assumed to have session level transmission. Assume that the maximum number of sessions allowed is constant denoted as S .When a session arrives the classifier it classifies the session into RT and NRT.

And then it is forwarded to the scheduling queue which follows admission control mechanism used to determine whether to block the session request in the scheduling queue and further which CC should be assigned to the session if it is allowed to access the network.

The mechanism is to assure the system not being heavily congested. Moreover, in this model, let CRT and CNRT be the minimum required data rate for the RT and NRT sessions, respectively. For convenience, the PCC and the SCC are indexed as k =1 and 2, respectively, and RT and NRT users are indexed as z = rt and NRT, respectively.

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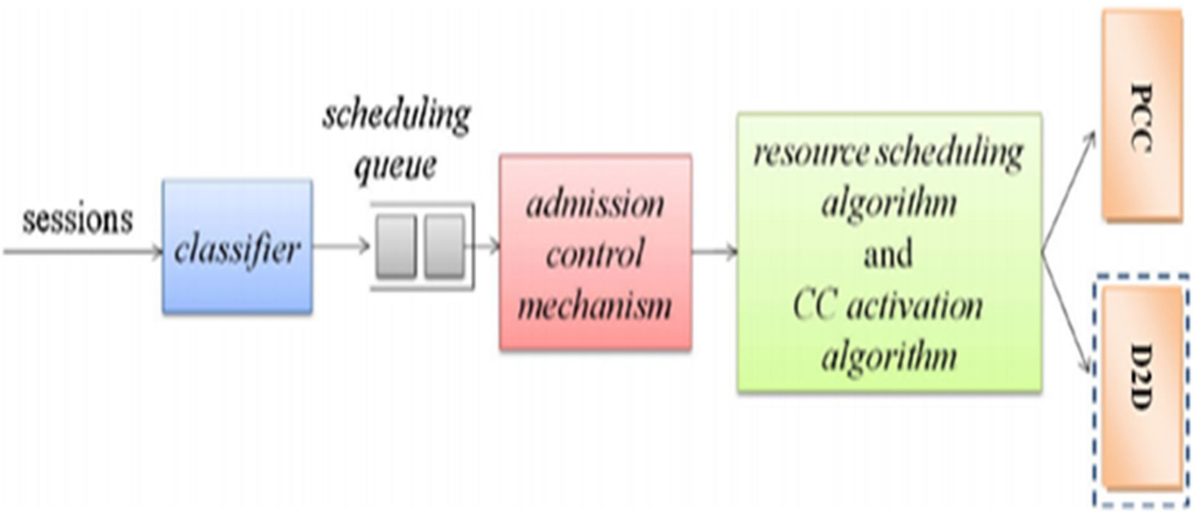

Fig.1. SYSTEM MODEL The dotted line for D2D means that D2D can be turnoff based on the traffic.

B. Admission Control Mechanism

In the first place define $(m, j)_{RB}$ as the RB on the mth schedule opening and the jth sub channel. At that point define the perfect transmission rate of the $(m,j)_{RB}$ on CC k for supporting client session n as r(k) m,j n. In view of [2], $r^{(k)}_{m,j\_n}$ can be inferred by means of

$$r^{(k)}_{m,j\_n} = \Box \log 2 \left(\frac{1+(K\,P(k)m,j\,|H(k)j_n}{\beta N0} \right) \quad \_\_\_\_\_\_\_\_\_\_ (1)$$

Note in (1) that N0 is the noise power spectral density, H(k) j n is the channel pick up between sub channel j and client session n on CC k, β = 12 · 15000 is the data transfer capacity in Hz for a RB, since one sub channel ncorporates 12 subcarriers and each subcarrier is defined to have 15000 Hz, K = −1.5log(5BER), where ER is the coveted (consistent) piece blunder rate, and P(k) m,j is the required transmission energy to accomplish $r^{(k)}_{m,j\_n}$ under the plan structure in (1).

In view of (1), the transmission energy of (m, j) RB on CC k would thus be able to be communicated as

$$P^{(k)}_{m,j} = \frac{\beta N0}{K||H(k)j\_n|}(2^{r(k)}{}_{m,j\_n}/\Box\Box\Box\Box\Box \qquad (2)$$

As needs be, the total energy consumption thus considered in the sub frame on CC k meant as Ek is given to be

$$E_K = \frac{tsub\_frame}{2} \sum\nolimits^{n}_{(m,j)R,B€\Omega K} P^k \qquad \_\_ (3)$$

Where tsub frame is the duration of each sub frame in seconds and Ω_k is the set of all RBs in each sub frame of CCk. Fig. 2 demonstrates the detailed flow chart of the call admission mechanism. At the point when another session arrives, the system will first do the vitality check by looking at Ek and ρEmax, where Emax implies the greatest accessible vitality in each sub frame and ρ is the upper minimal factor. In the event that permitted, the component will additionally check the SCC status to recognize if the SCC can be utilized. Notice that the PreOnFlag is a marker speaking to whether the new client session can get to the SCC. To be more detail, if PreOnFlag==0, the new session can't get to the SCC even if the SCC is still active and the new session can only use PCC if N1 < S, where Nk represents the number of user sessions in the system on CC k. In the other case, if PreOnFlag==1, CC k* that has the minimum Ek will be selected. Following that, the mechanism will check whether Nk∗ < S. If yes, CCk* will be assigned to the new session; otherwise, the mechanism will further check whether Nk < S and Ek < Emax to determine if the new session can access CC k. Notice that the operation and calculation of the mechanism is executed at the beginning of every sub frame.

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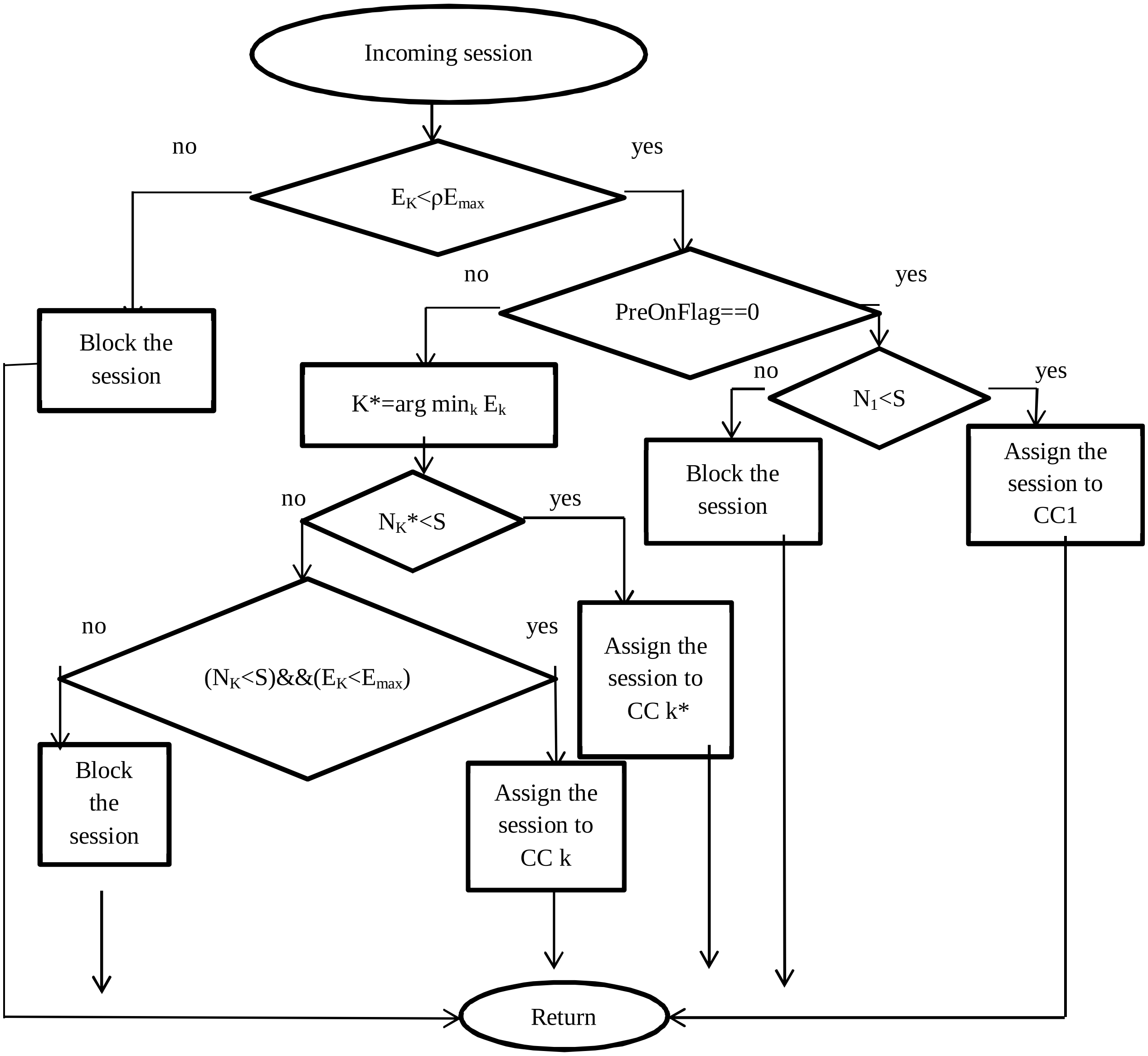

Fig .2.Admission Control Mechanism.

III. RESOURCE SCHEDULING ALGORITHM

The resource scheduling algorithm includes two proposed algorithms. A) Energy adaptive rate control algorithm (EARCA). B) Radio resource allocation algorithm (RRAA). The RRAA algorithm is again divided into two sub algorithm types. B.1) bandwidth assignment algorithm (BAA) and B.2) resource block allocation algorithm (RBAA).

EARCA is designed to adjust non real-time user's allocated capacity based on his/her path loss feedback and the current used in energy. After setting the nonreal-time user's data rate, BAA checks how many resource blocks should be assigned to each user in the session, while RBAA is used to further determine the set of resource blocks for those sessions. After the completion of both EARCA and RRAA in sequence with each transmission run, the available resource blocks for user session are determined. Then the required data rate is distributed equally over the resource blocks that the user session obtains the energy for each resource block and it is determined accordingly to required capacity.

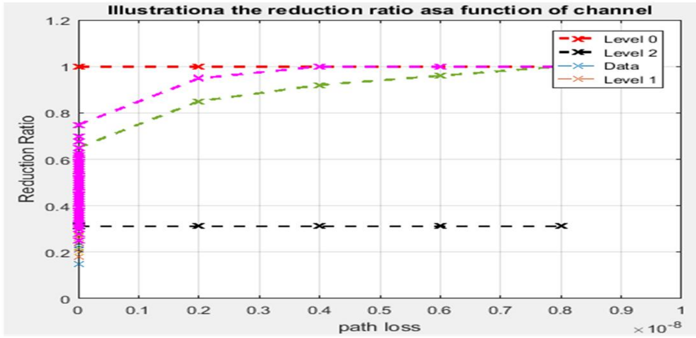

Fig. 3 The reduction ratio to determine the allocating capacity for nonreal-time user

IV. USER MOBILITY MODEL

The inter-contact model can catch the availability data in the client portability design, and has been broadly examined in wireless networks [3], [4]– [5]. Along these lines, it is embraced in this paper to show the versatility example of portable clients. In this model versatile clients may contact with each other when they are inside the transmission go. Correspondingly, the contact time for two portable clients is defined as the time that they can contact with each other, i.e., they may trade files amid the contact time. At that point, the between contact time for two cell phones is defined as the time between two continuous contact times

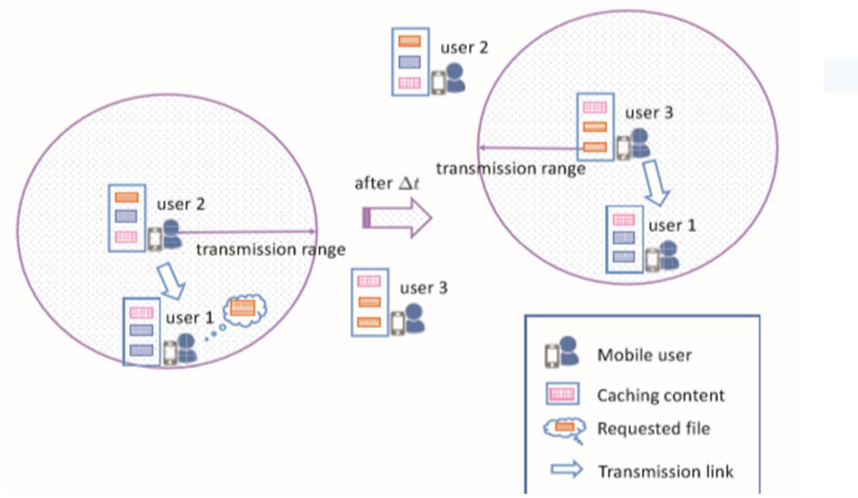

Fig 4 User Mobility Model.

V. GREEDY ALGORITHM

In an algorithm design there is no 'silver bullet' that is to cure computational problems .Different techniques are required to solve different problems. Based on the type of problem, all these techniques are used.

A. Divide and Conquer algorithm(D&C)
B. Dynamic Programming(DP)
C. Greedy Algorithm

The greedy algorithm gives a viable arrangement, and has been demonstrated to document a 1 2-estimation [6], i.e., the most pessimistic scenario is no less than half of the ideal arrangement. Also, it has been seen to give near ideal execution in bunches of cases. A randomized calculation was proposed in [7], which accomplishes a higher guess proportion. Be that as it may, with the size of the ground set as Nu×Nfile×Kmax, the randomized calculation is computationally inapplicable. In the reproduction, we will demonstrate that the greedy algorithm performs near the optimal caching strategy. The greedy algorithm firstly sets the reserving position Y as a void

set, and after that, it adds a component as indicated by the need esteems while fulfilling the matroid constraint. The procedure proceeds until the point that no greater component can be included

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1) Set $Y = \emptyset \Leftrightarrow$ set $x_{j,f} = 0, \forall j \in D$ and $f \in F$.
2) $S^r = S$.
3) Initialize the priority values $\{g^d_{j,f,k} | j \in D, f \in F, 1 \leq k \leq K_f\}$.
4) while $|Y| < N_u \times C\ d$
5) $y_{j*,f*,k*} = \arg\max g^d_{j,f,k}$.
6) Set $Y = Y \cup \{y_{j*,f*,k*}\} \Leftrightarrow$ add $x_{j*,f*}$ by 1.
7) $S^r = S^r - \{y_{j*,f*,k*}\}$.
8) if $|Y \cap S_{j*}| = C$ then
9) $S^r = S^r - S_{j*}$
10) end if
11) Update the priority values $\{g^d_{j,f*,k}(Y) | j \in D, 1 \leq k \leq K_{f*,yj,f*,k} \in S^r\}$.
12) end while

Fig .5 Greedy Algorithm.

VI. RESULTS

Simulation brings about the calculation demonstrate the vitality utilization of various control levels against standard plan with OFDMA innovation. For each period, vitality utilization is calculated. Regardless of the dynamic fluctuating burden ,the pattern conspire is to bar CC actuation algorithm .Primarily for the distinctive thought about data sources, a yield at various arrangement of modules were thus been given out

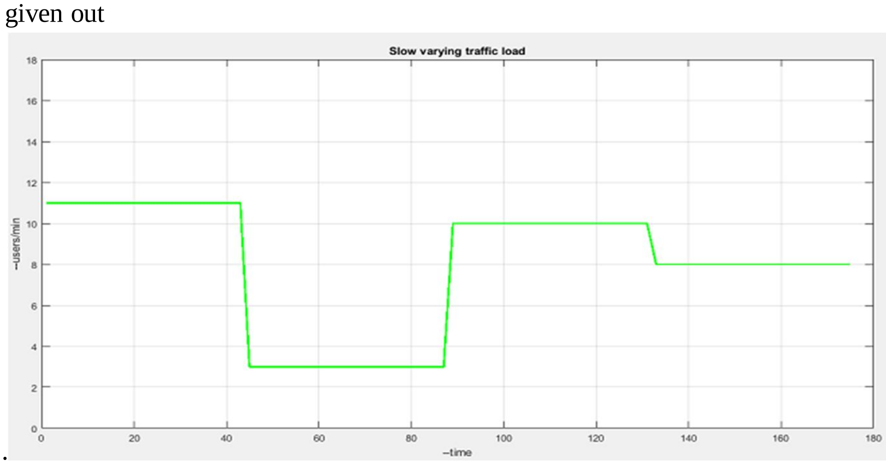

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Fig .6 Slow varying traffic load

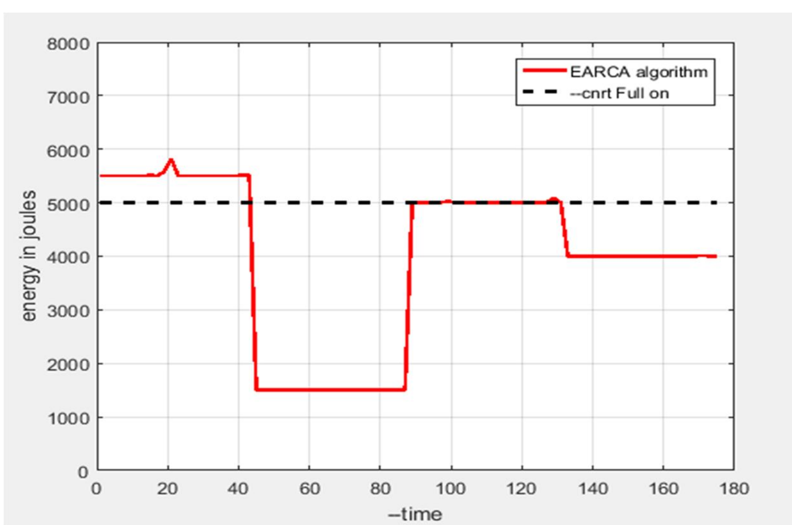

Fig.7 Comparison of energy consumption between the proposed scheme with EARCA, level 2

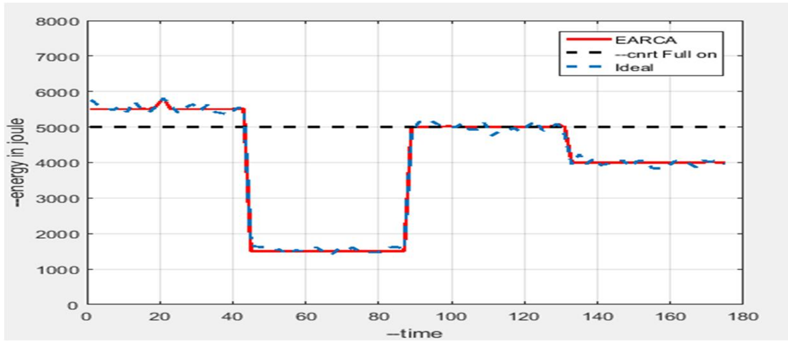

Fig 8: Comparison of energy consumption between the proposed scheme with EARCA, level 0

A. *Fairness index*

The data rates fairness index of all users under the proposed scheme is evaluated by fairness index formula. The fairness index maintained must be atleast greater than 0.8[8],[9].Fairness index is given by

$$= \frac{(\sum_{t=1}^{n} \mathrm{xi}\ )^2}{n \sum_{t=0}^{n} x_i^2}$$

Where Xi = normalized throughput ; n = number of connections.

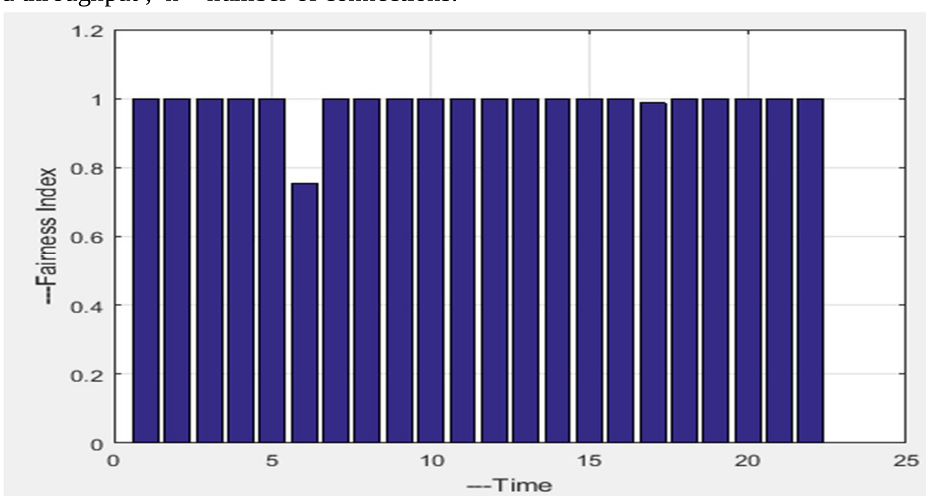

Fig .9 NRT users' average data rate every 10 minutes of the proposed scheme with EARCA

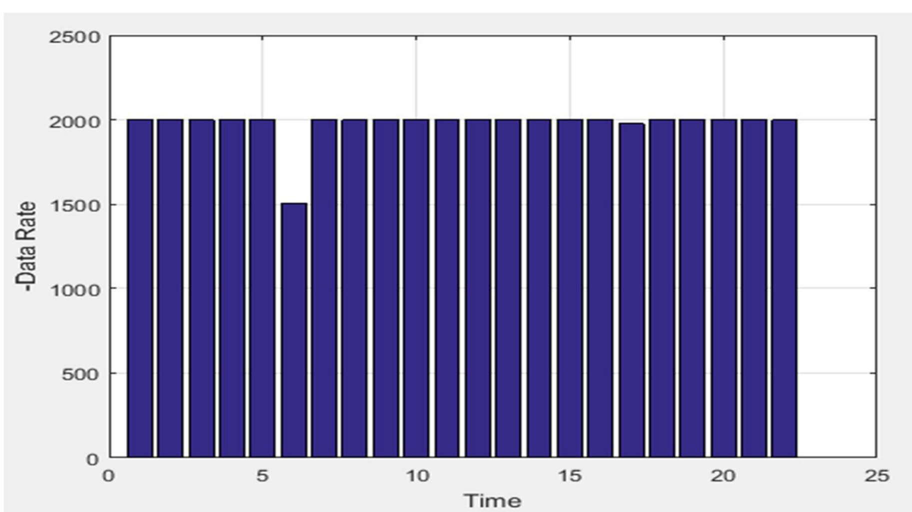

Fig .10 Comparison of different caching strategies based on optimal mobility and greedy mobility.

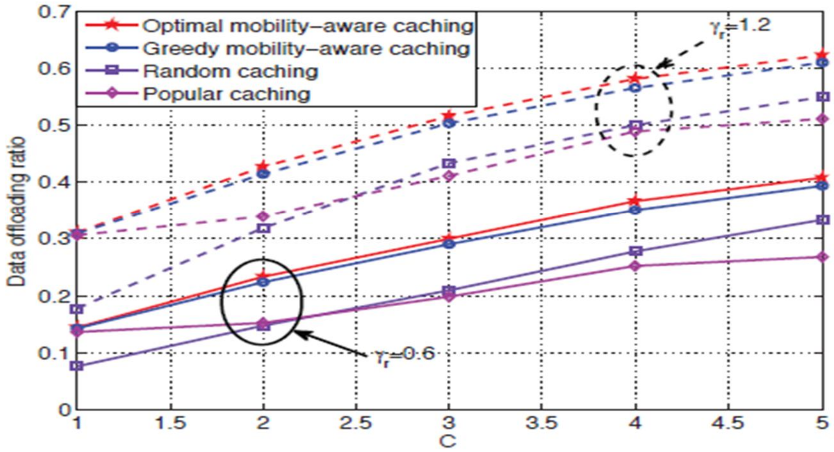

Fig .11 Comparison of different caching strategies with Nu = 5, Nfile = 20 ,Td =120 s, Bi,j = 2 and Kmax= 3

VII. CONCLUSION

We examined resource allocation in device- to device communications in cellular networks where we use a substituting progression strategy to execute reuse of increases and range capability for D2D coordinates by figure determined previously. Simulation comes to fruition watch that our proposed count can enhance the farthest point that is inconvenience on base station of cellular network.

VIII. FUTURE SCOPE

Device - to - Device communication indeed, even empowers clients to experience benefits with respect to tinier correspondence latency, increased data rate and decreased essentialness usage. Remembering the true objective to make profitable and flexible D2D development, recognizing verification and appraisal of potential increments and specific plans of framework controlled D2D, the cell framework controls and helps the capable assignment of D2D joins matching with cell correspondences.

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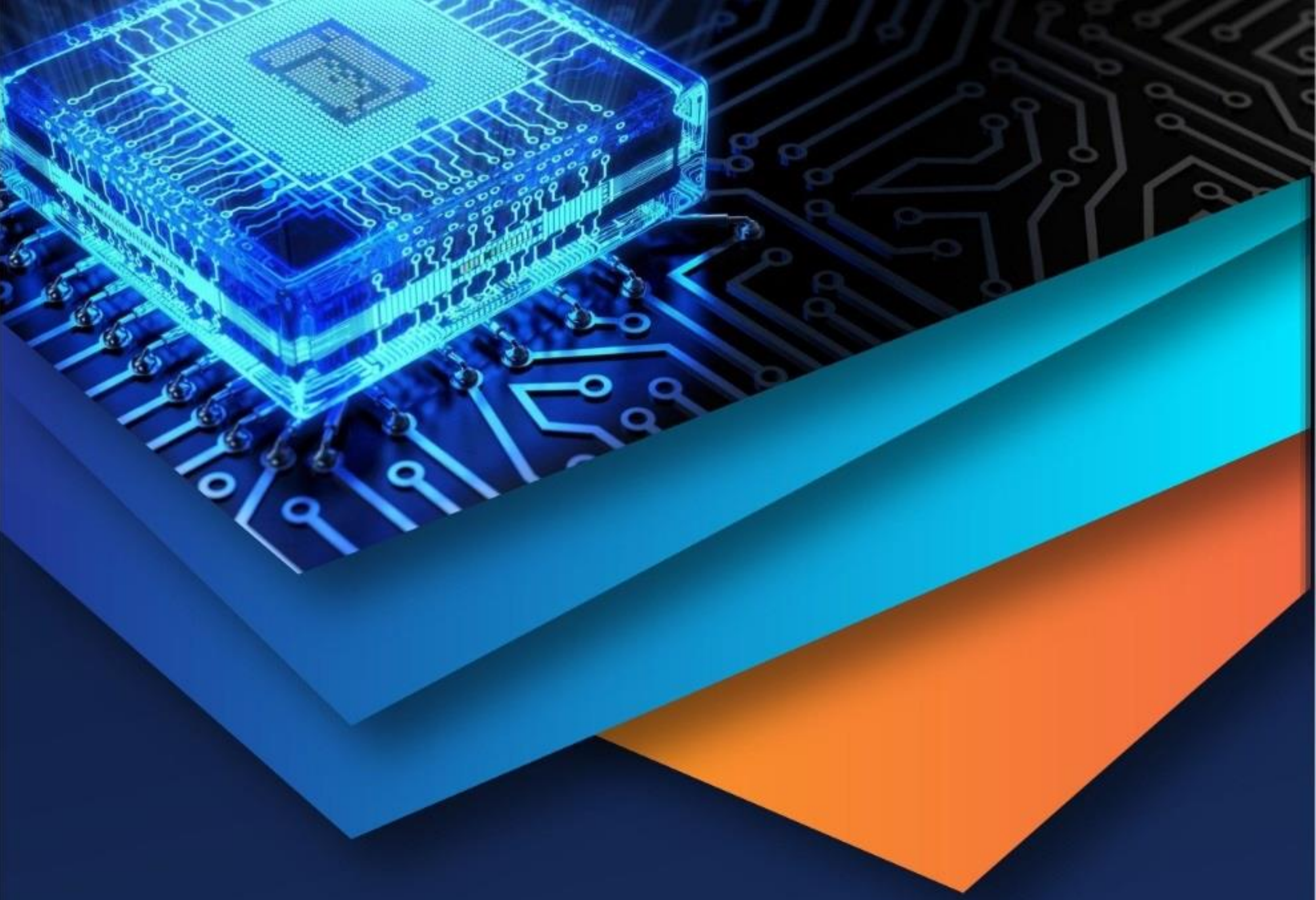

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