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Clustering Based Dynamic Bandwidth Allocation in HC-RAN

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Abstract— A wireless network is composed of several independent nodes or gadgets that communicate mutually through a wireless link. The most destructive challenge encountered in a wireless network is bandwidth allocation because it defines the amount the network will cost and how effectively it will function. The most cutting-edge network architecture in the present wireless communication system, cluster-based heterogeneous cloud radio access networks (HC-RANs), is what powers cloud computing in heterogeneous networks. In this research, we proposed an HC-RANs that may optimize energy consumption for wireless data transfer in the multi-hop device to device scenario. The proposed scheme offers bandwidth allocation in wireless environments where there are concerns about significant user mobility over the course of a given time. The above design, we used clustering with joint beam formation for the down link of heterogeneous cloud radio access network (HC-RAN), developed design to improved amount of FBS. Result outcomes helped in calculating Critical bandwidth usage (CBU).

Keywords- WSN, CRAN, Heterogeneous, HC-RAN, Cluster, CSI

I. INTRODUCTION

Basically, our earth rotated with four different forces such as gravitation, electro magnetism (spectrum), weak interaction and strong interaction. The spectrum designed to use different way in our day to day life (spectrum is nothing but light), there are two types of light: one is visible (colour lights) and invisible (waves or electromagnetic waves) already fixed and use many places with depends on the different range of frequency, wavelength and energy. When start to generate continues forces in particular area, they form different frequency and wavelength until stop the force also based on forces only they create frequency and wavelength (if you generate more energy they create high frequency and low wavelength). So low wavelength wave cannot be use mobile communication due to do able to travel long distance for example ultra violet, x-rays, gamma rays depended on frequency. If low energy very suitable for mobile communication due to high wavelength and low frequency, possible to travel long distance communication (radio waves) eg. Radio, TV broadcasted, mobile communication and satellite communication. Today broadly used in 5G version (enhanced from fourth generation) networks implemented without issues because spectrum allocation especially designed for telecommunication in overcoming low and high data issues because of separate frequencies for all users due to avoided interference between users [1].

Latest updated version of 5G (fifth generation) network especially used for IoT (Internet of Things) wonderful communicating model, very great to support to solve many negative issues like delay, delivery performance and conjunction also support multi applications in all the fields with high speed and low complexity [2]. Current model using MIMO (Multiple Input Multiple Output) technology and one of broadly cloud design called CRAN (Cloud Radio Access Networks) [3]. Different types of cell and layer are used in HetNets (Heterogeneous Networks) such as femtocell, microcell, pico cell and macro cell, macro cell also classified three different layers macro cell 1, macro cell 2 and macro cell 3 as shows in figure 1 heterogeneous networks.

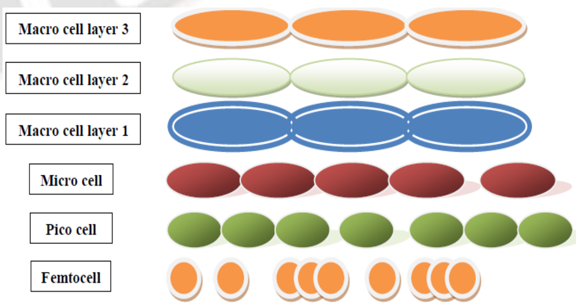

Fig 1 Heterogeneous Networks

Radio access network broadly classified in two types are open radio access network (opens up these interfaces giving operators faster, much flexible deployment options while

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enabling new functionalities like network automation, analytics and network slicing) and closed radio access network (uses proprietary interfaces between the radio and baseband units). 5G CRAN high power internet access scenarios are: enhanced mobile broadband is CMBB, massive machine type communications and ultra-reliable low latency communications this techniques also designed to future development strategies also we, require important parameter for telecommunication cost of ownership [4]. Today all IT field very hot topic is cloud based information technology, CRAN (Cloud Radio Access Network) or centralized radio access network designed is high data services because of HSPA (High Speed Packet Access) & LTE (Long Term Evaluation) they have increasing demand of data services and users [5].

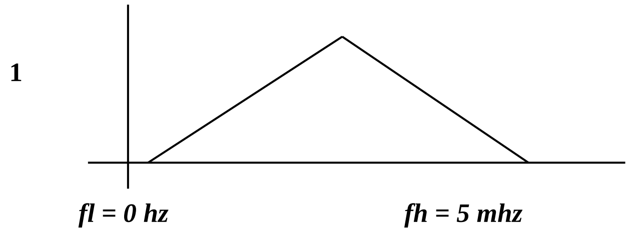
Traditional radio access network having some characteristics: RAN is part of second, third and fourth generation network such as each base station connects to fixed number of antennas, antenna cover small area handle TX/RX within area and capacity is limited by interference but, they have some challenges: large number of base station required (investment, site support, management rental etc.), base station utilization rate is low, base station processing unit power cannot be shared among other and for data services is faster (upgrade network). Future radio access network is provide mobile broadband internet access to wireless users, low bit cost (reduce total bit cost), high spectral efficiency, support multiple standards and platform for additional revenue generating services [6]. As smaller numbers of broadband unit are required in out-dated circuits has a capability to reduce the network operation cost by dropping energy and power consumption [7] The initial rollout of the 5G system is scheduled for 2020 [1]. It is anticipated to offer wireless area capacity that is about 100 times higher than the existing 4G system and to use up to 90% less energy per service, the predicted benefits of 5G systems include more than 1000 Gbit/s/km2 area spectrum capacity in congested metropolitan contexts, 10 times longer connected device battery life [2, 3]. Fifth generation network is significant advancements in baseband and radio frequency (RF) are necessary. A substantial and progressive baseband calculation is essential to happen the complex necessities of novel resolutions is efficient operation of the ultra-dense radio nodes, nevertheless, depends on recent advances in the integrated access node and heterogeneous convergence [4].

A. H CRAN

H-CRAN (Heterogeneous Cloud Radio Access Network) designed for both positive outcomes of cloud computing network and heterogeneous network, this effective network achieve better spectral and energy efficiency. A geologically dispersed antenna are used to collect radio frequency signals using by radio head in remotely transferred in to broad over front haul links. As a result, SE and EE performances are significantly enhanced to compare those of current HetNets and C-RANs, this updated technology is expectations and limitations of wireless communication. Main key technologies of heterogeneous cloud based radio access network is large scale co-operative multiple antenna processing and cloud computing based co-ordinated multipoint transmission they challenging some of open issues: performance analysis with stochastic geometry and performance optimization of constrained front haul. Multiple base stations with various transmitting power like high power node for macro cell and low power node for micro, pico and femto base stations (low power node utilized to provide additional area capacity within dense traffic regions like underlying cells

B. Bandwidth Allocation

There are three types of spectrum allocation such as no one may transmit (only for research propose cannot use no one), anyone may transmit (this type for power generation like normally ac power) and third types only licensed users/organizations transmit (particularly for telecommunication, TV broadcast or radio) this type of spectrum approved by government of all country [14]. In 1994 Indian government very first will be decided to sale spectrum allocation for 900 MHZ, after 1997, 2000, 2001, 2012 continuously sale, now in year of 2020 government will decided for 5 generation estimation for spectrum allocation is nearly 5 lakes crore approximately due to very high data rate speed 100 Gbps because they support 100 times better then 4G users under controlled by DRDO [15]. Bandwidth is important parameter of wireless communication spectrum, classified there are two types of spectrum allocation: significant signal (signal pass between starting and ending point like fixed frequency eg. normal video), insignificant signal (signal pass between starting and settled point like non fixed frequency eg HD video), further classified channel bandwidth and signal bandwidth [16].



BW = positive high frequency – positive low frequency

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$$\mathbf{BW = 5\ MHZ - 0 = 5\ MHZ}$$

Minimum loss and maximum performance fulfill the following condition

$$\textbf{channel bandwidth} > \textbf{signal bandwidth}$$

Dynamic bandwidth allocation: High speed wireless broadband create new use causes using multi homing futures and they specially designed called dynamic bandwidth with number of wireless access network ports (one access network port for one broadband in wireless), the router fixed speed for load balancing algorithm.

fixed speed $\boldsymbol{f}\ (\boldsymbol{t})$

pay as you use $\boldsymbol{p}(\boldsymbol{t})$

it provide 8 ports for 8 YES dongles to achieve the dynamic bandwidth and availability, dynamic fourth generation network they achieve better network performance like delivery ration and throughput when they inserted multi number of YES dongles, this is novel evaluation of MIMO (multiple input and multiple output) technology.

$$\boldsymbol{Wbw} = \boldsymbol{frequency\ of\ input\ before\ system\ response\ drops\ 3db\ from\ DC\ gain}$$

Velocity of linear system $\text{Gv (S)} = \frac{\emptyset(s)}{Vs\ (S)}$

This types of bandwidth are varied for different hours of the day and different days of week, they have much better for the benefits of sufficient bandwidth and quality of service with availability and mobility requirement, available solution for existing problem like multi homing multi IPS, load balancing and virtual server mapping etc.

II. BACKGROUND WORK

In this segment, we discuss and analysis the prevailing developed work and find research gaps, Joint user's selection and beam forming in downlink millimetre-wave NOMA based on users positioning was taken by mahmoud mohamed (2020). A joint angle and distance based user pairing strategy for millimeter wave NOMA networks was discussed by X. Lu et al (2020). Impacts of imperfect SIC and imperfect hardware in functioning on AF non-orthogonal multiple access networks were proposed by D. Do et al (2019). FEBA: a bandwidth allocation algorithm for service differentiation in IEEE 802.16 mesh networks was suggested by C. Cicconetti et.al (2009). Bandwidth Allocation Based on Traffic Load and Interference was designed by Sanjeev Jain et.al (2013). Analyzing the performance of centralized clustering techniques for realistic wireless sensor network topologies was tested by Raval et.al (2015). Fuzzy based clustering and energy efficient routing for underwater wireless sensor networks was taken by Souiki et.al (2015).

A survey of rate-optimal power domain NOMA with enabling technologies of future wireless networks was developed by O. maraqa et.al (2020). Full duplex non-orthogonal multiple access cooperative overlay spectrum sharing networks with SWIPT was proposed by Q. N. Le et.al (2021). Matching theory based spectrum utilization in cognitive NOMA-OFDM systems was analysis by X. Li et.al (2017).

A novel compressed sensing based non-orthogonal multiple access scheme for massive MTC in 5G systems was discussed by K. He et.al (2018). Sub channel assignment for SWIPT-NOMA based HetNet with imperfect channel state information was suggested by I. Budhiraja et.al (2019). Resource allocation in NOMA enhanced backscatter communication networks for wireless powered IoT was measured by G. Yang, X. Xu, and Y.-C. Liang (2020). Energy efficiency maximization in NOMA enabled backscatter communications with QoS guarantee was powered by Y. Xu et.al (2021). On the application of quasi-degradation to MISO-NOMA downlink was talked by Z. Chen et.al (2016). Massive MIMO, non-orthogonal multiple access and interleave division multiple access was tested by C. Xu et.al (2017) very deeply surveyed the above research works achieved more advantages but cluster based bandwidth allocation network still not suitable for above designs.

III. PROPOSED ALGORITHM

In this section we discussed our developed new design called heterogeneous based cloud radio access network with cluster head node based energy efficient wireless network in efficient allocated for bandwidth. This efficient bandwidth allocation shared to different nodes, clustering design avoids noise conjunction control is designed for wireless nodes, this wireless network very stabilize with minimized overload to manage the target of the cluster heads.

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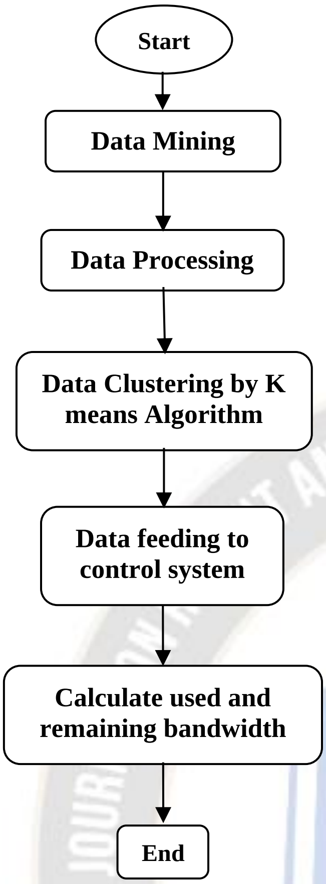

Fig 2 Proposed Algorithm

Data Mining: The extraction of data is the process of recovering the HC RAN data out of possible data sources.
Data Processing: The processing of data includes applying the essential calculation with dissemination of consumers that is time slots, the arithmetical information is converted from transformation steps, the predictable load of each node in HC-RAN network is determined.
Data Clustering: An arithmetical data analysis is the process of performing a processed consumer distribution of the following steps is to group consumers in clusters and mandatory properties to assign the finniest excellence of service to build the possible clusters is shown in figure 2, clustering algorithm denoted as 'K'.
Improving data quality using control system: The control system is improved by the data; the HC RAN system is the cluster to form empowers an allocated as each node of essential bandwidth.

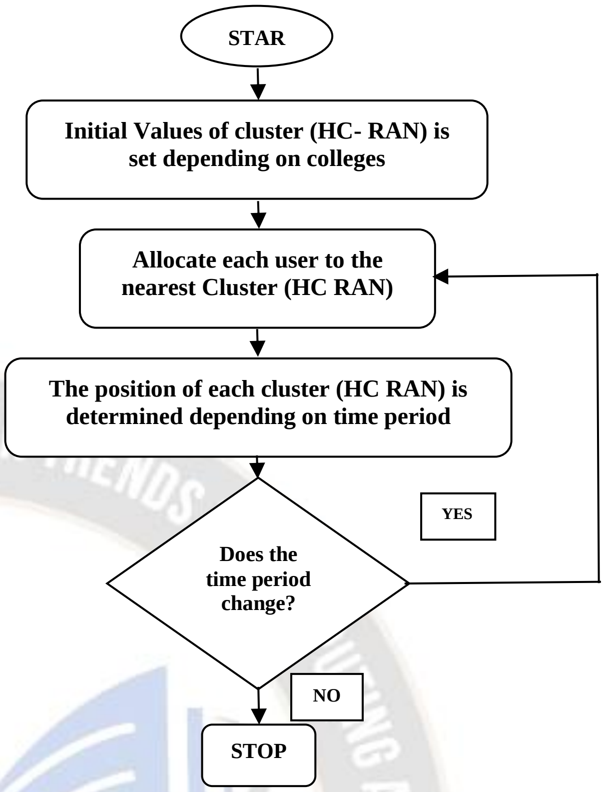

Fig 3 The Flow for data clustering in the HC-RAN

The recommended dynamic bandwidth allocation approach of the HC-RAN is installed in Creadco Solutions. The Creadco Solutions consists of nine department in which employees are grouped as shown in figure 3.
The schedule for each department is categorized as: The meetings for each department will be conducted on Monday, Wednesday and Friday (M, W & F) where each meetings will be of 40 minutes. The timing of company will be from morning 9'o clock to evening 6'0 clock, in between the meetings they allocated lunch break is 20 minutes. On Tuesday and Thursday (T & T) meeting will be of 60min starting at 9'0 clock to evening 6'0 clock with a lunch break of 20 minutes.
HC RAN designed is depending on dynamically allocated bandwidth, the position of the users at each department in proper time respectively: the employee's attendance report should be mentioned by mathematical order. The employee's distribution curve is denoted as a time period of HC RAN nodes, the bandwidth allocation is done by using load on nodes. The process of data extraction and its further refining comprises of the all the parameters like place and time in Credco Solutions campus for follow the steps:

1. If S_1 measured the employee working in particular period and department of company.

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2. If S_2 measured the following employee not enrolled at the time of interview, but they enrolled after the time of offered duration.
3. The enrolment of each department wise employee denotes S_3.
4. In S measures the government permitted strength of each department.
5. Number of predicted employee in specified time of department denotes S through the following formula.

$$S = S_1 + \frac{S_2}{8} + \frac{S_3}{2} \quad (1)$$

Note: Enrolled strength of agriculture is S_3.

Table I Model Statistical Information Of Time Slots In A Campus At Saturday 09:00 Am, In Each Department Building**.**

Department in company	Registered Employee at particular time slots (S1)	Registered employee at after time slots (S2)	Expected Strength (S)
Engineering	155	60	163
Research and Development	45	90	56
HR	101	41	106
Admin	64	81	74
Business Development	60	23	63
Marketing	44	33	48
Project Management	53	11	54
Media and corporate affairs	NA	NA	143

In the subsequent step, K-means clustering algorithm is employed for the purpose to classify the probable groupings of employee over the department. In HC RAN, links (nodes) are randomly distributed in the area of 100's of meter which is helpful to divide set of links (nodes) into subsets, which have lesser topographical closeness for the ease to reduce distance of transmission and result in energy saving, the process of group nodes acceding to number of users is clustering. The cluster receives the data, which depend on the number of users according to number of meeting in each department at company. The process of bandwidth allocation changes at instance of time as it depends on number of users in each Department at particular time. The Euclidian distance forms the basis of K-Means clustering algorithm. The formation of clusters depends on four steps, when k centroids are consistently distributed in the network K-means position starts, in accordance to the shortest path of the node amid is centroid, a node is assign to each centroid the average of x_i and x_j, the new position of centroid is determined. If the location of centroid variants K-means will run once again otherwise the process ends. Clustering, have k number of HC-RAN links or nods are useful for initiating the process. The Euclidean distance decides the assigning an input data point near clusters; the following pseudo code is used:

Algorithm

- ✓ **'K'** represents the no. of HC RAN **nodes**.
- ✓ ***Y*** represents the no. of users
  K_i
  i = 1,…,k
  k random in **Y**
- ✓ Selected active neighbour node (Clusters) for the entire user.
  if **y_t as a** subset of input data ***Y***.
  D_i ← 1
  if || y - K_i || = min_j || y - K_j ||
  D_i ← 0

Else

- ✓ The nearest node of the individual user is allotted new as *k* (Clusters).

For all ***K_i, i = 1,…,k***
K_i* ← *sum (D_i y) / sum (D_i)
End

HC-RAN Links or nodes $K (E_{i1}, E_{i2} \ldots E_{ik})$
Where,
E_{ik} is the value of the k^{th}
E_{ik} is the value of the i^{th} users

In the clustering algorithms, clustering represent 'k' it is to compute the Euclidean distance D by the following equation:

$$D_{ij} = \sqrt{\sum_{k=1}^{k} (C_{ik} - C_{jk})^2} \quad (2)$$

Where,
E_{ik} and E_{jk} is the value of the i or k users
E_{ik} and E_{jk} is the value of the *i or i* nodes

Each information origin plotted in the cluster is linked with the adjacent source point. The schedule of meeting is marked the information origin point of the new cluster mid point

Let us E_{ik} signifies the midpoint of k^{th}

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Let us E_{jk} signifies the midpoint of k^{th}, above procedure by the following expression:

$$C_{ik} = \frac{\sum_{j=1}^{n_i} C^*_{i,jk}}{n_i} \qquad 3$$

Where,

$E^*_{i,jk}$ is the k^{th} HC-RAN Links or nodes of j^{th} users are allotted to the i^{th} user in each clusters where, n_i denotes the number of data points of the cluster i.

IV. EXPERIMENTAL RESULTS

The developing procedure using HC-RAN of the Credco Solutions campus for the HC RAN nodes dispersed in the campus. It is assumed that the one node will be used in each department, and the four points of procedure are implemented. In this section, we assume simulation configure to perform the proposed wireless network in open environment is evaluated via network simulator (NS 2.34). The wireless network is simulated using this simulator by varying the time with department. The below table 2 simulation parameters are given.

Table II Simulation Parameters

Parameters	Values
Simulation area	1000m * 1000m
Average speed of nodes	0–25 m/sec
Mobility model	Random Waypoint
Transmission range	250m
Constant bit rate	2 (Packets/Second)
Packet size	512 Bytes
Initial energy/node	100 joules
Antenna model	Omni directional
Simulation time	500sec

The expected load on bandwidth for one of the department is shown in figure 4, which clearly shows that, the load is medium in the morning hours, peak in the afternoon, and low in the evening. The results express the smart allocation of HC-RAN bandwidth of the department shows the below steps to create the link of every employee are much stable and fast.

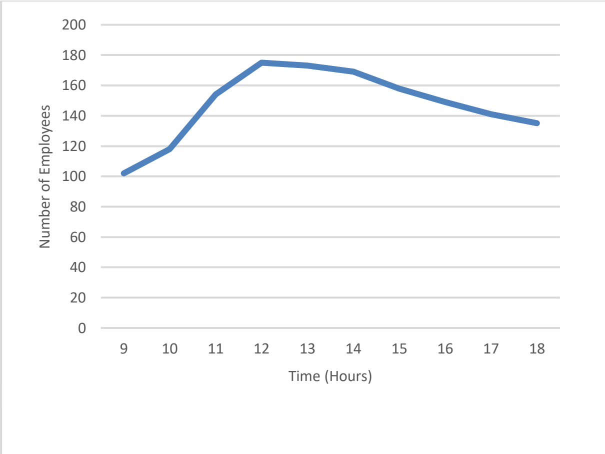

Fig 4 Expected Load on bandwidth for an Engineering department on Monday**.**

Developed methodology performance distribution in the company, in each department time at the time period of day starts, in between and ends depends on three classification the following schedule ([M, W & F] & [T & T]). The below figure 5 shows a time period of employee in a sample distributions 9 to 9.40 AM with M, W & F and 9 to 9.50 T & T of forenoon respectively

Table III Employee attendance time slot 9 to 9.40 (M, W & F) and 9 to 9.50 (T & T) in forenoon

Departments	Expected Distribution(M, W & F)	Expected Distribution (T & T)	Expected Distribution of bandwidth (mbps)
Engineering	185	164	49
Research and Development	49	41	95
HR	121	115	81
Admin	105	125	60
Business Development	71	61	83
Marketing	61	57	90
Project Management	58	37	92
Media and corporate affairs	143	130	56

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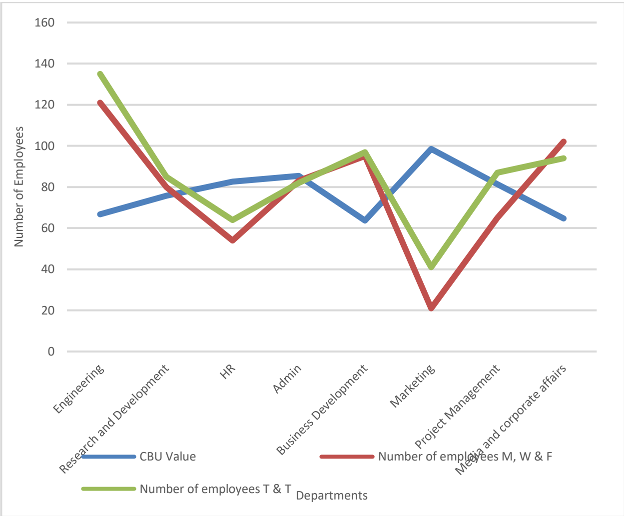

Fig 5 Employee time slot for 9 to 9.40 (M, W & F) and 9 to 9.50 (T & T) in forenoon.

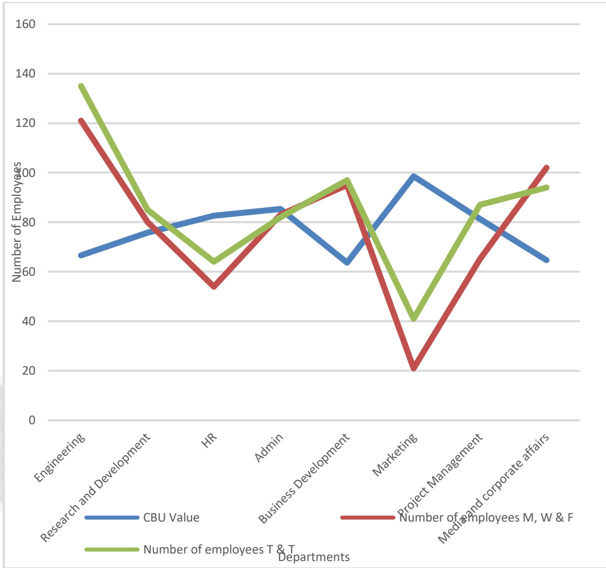

Fig 6 Employee time slot for 12 to 12.40 (M, W & F) and 12 to 12.50 (T & T) in afternoon

Table IV Employee attendance time slot 12 to 12.40 (M, W & F) 12 to 12.50 (T & T) in afternoon.

Departments	Expected Distribution (S) M, W & F	Expected Distribution (S) T & T	Expected Distribution of bandwidth (mbps)
Engineering	175	171	164
Research and Development	44	50	198
HR	115	95	154
Admin	91	85	170
Business Development	65	63	190
Marketing	68	62	192
Project Management	79	75	190
Media and corporate affairs	149	134	140

Table V Employee attendance time slot 15 to 15.40 (M, W & F) and 15 to 15.50 (T & T) in afternoon

Department	Expected Distribution (S) M, W & F	Expected Distribution (S) T & T	Expected Distribution of bandwidth (mbps)
Engineering	94	91	154
Research and Development	89	79	156
HR	81	71	169
Admin	48	41	175
Business Development	112	105	138
Marketing	41	39	188
Project Management	24	21	194
Media and corporate affairs	117	107	135

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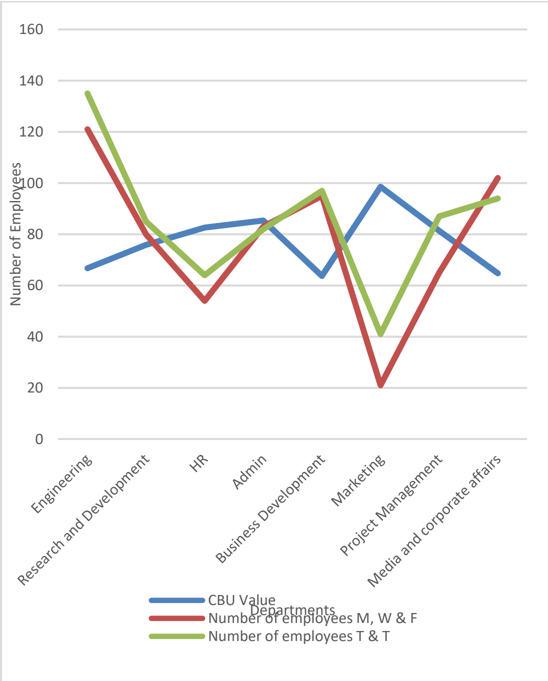

Fig 7 Employee at time slot 15 to 15.40 (M, W & F) and 15 to 15.50 (T & T) in afternoon

Critical Bandwidth usage for each cluster of employees of each department is used for the bandwidth allocation. It use values that helps in clustering for a particular time slot. The whole scenario is divided into number of division. For each and every minor division, the process divides the records of employee thus evaluating the complete time spent. These values are then used for calculation of the Critical Bandwidth Usage value for each division. Resulting in the single value of critical bandwidth usage is identified. Using the corresponding value of the value of CBU, the technique calculates the FBS value, the purpose of which is to allocate the bandwidth for the employee. Table 5 and figure 8 shows the CBU value calculated for employees at M, W, F and T & T. CBU Cumulative value is used to calculate FBS value which help in bandwidth allocation.

$$CBU = \frac{time\ spent \times 0.8}{total\ time\ spent} \times \frac{Number\ of\ action\ performed}{size\ of\ personalized\ log} \times \frac{Number\ of\ data\ download}{size\ of\ personalized\ log}$$

$$Cumulative\ CBS = {\sum CBU}/{Number\ of\ divisions}$$

Table VI. CBU value calculated for employees at M, W, F and T & T

Department	CBU Value	Number of employees M, W & F	Number of employees T & T
Engineering	66.67	121	135
Research and Development	75.8	80	85
HR	82.6	54	64
Admin	85.4	83	82
Business Development	63.68	95	97
Marketing	98.53	21	41
Project Management	81.3	65	87
Media and corporate affairs	64.74	102	94

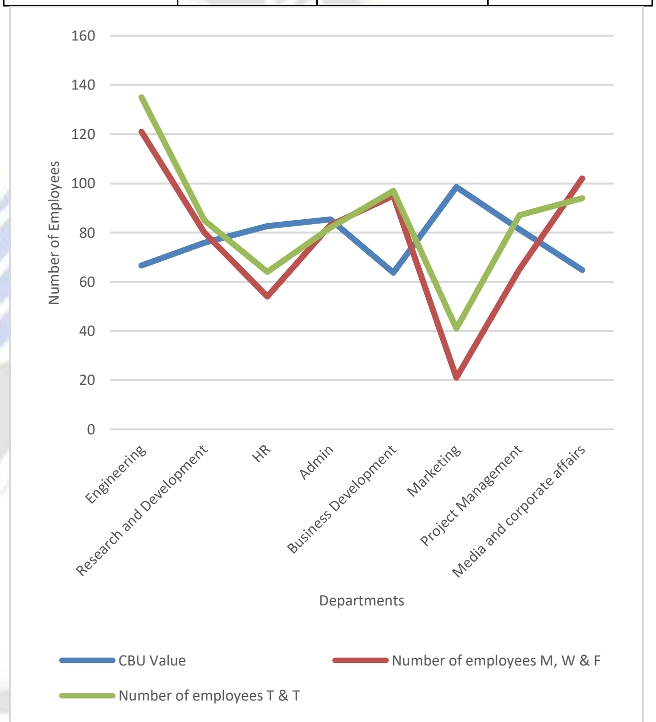

Fig. 8 CBU value for all departments according to number of employees in M, W & F and T & T.

V. CONCLUSION

With wireless technology in mind, our proposed architecture, entitled Cluster based Heterogeneous Cloud Radio Access Networks (HC-RANs), is accountable for the cloud computing in heterogeneous networks. The paper established bandwidth distribution for Credo Company employees working across several departments. The K indicates that clustering was performed, based on the number of employees present at a specific moment. For various outputs, the recommended HC-RANs were effective. The prospective user domain was mathematically analyzed in the article. In order to conduct this study, data from the meeting schedules of corporate personnel from various departments had to be extracted. K means clustering was used to determine the bandwidth demand. Later on in the study, critical bandwidth utilisation was calculated in order to allocate bandwidth. The suggested work includes smart bandwidth allocation among users even though there is always scope for future work.

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