Sdn in Edge Computing Based on Penguin Foraging Behaviour

Harikrishna Pydi, Allu Venkata Dattatreya Reddy, Chowdavarapu Jeevan Rupesh, Pothugunta Chandana, Chittamuru Bharath

Abstract: Over the years usage of computational devices have been increased rapidly. 3G and 4G network evolution has helped in seamless usage of the modern devices. As the users are increasing rapidly and 4G spectrum is been congested way too fast. These situations resulted in development of 5G Spectrum by unlocking the millimetre waves. Milli meter Waves are originally shortrange waves and cannot be passed through heavy objects for these solution Small Base station concept has been implemented which provides high coverage and less latency while using. A small cell is basically a miniature base station that breaks up a cell site into much smaller pieces, and is a term that encompasses pico cells, micro cells, femto cells and can comprise of indoor/outdoor systems. For this implementation the SDN plays an important role for maintaining the connection between Base stations. Penguin foraging behaviour can be taken as a reference for the search algorithm in edge computing for getting faster results. Usually a penguin population comprises of several groups. Each group contains a number of penguins that varies depending on food availability in the corresponding foraging region. They feed as a team and follow their local guide which has fed on most food in the last dive. Similarly we follow the same process in small cell base station. Edge computing supports all devices simultaneous for processing and getting accurate results. They can be used for platform development for storage centric, server centric or even hybrid(storage-server) workloads.
Related words: Edge computing, Software Defined Network, foraging behaviour, small cell base stations, Milli meter waves

I. INTRODUCTION

With the advancement of IOT devices and mobiles in the daily life the data generated is rapidly increasing and communication between them is becoming burden over the existing networks available. The currently used spectrum for 4G are below 6GHz whereas the 5G uses from 30GHz to 300GHz with shorter wavelengths. The 5G is termed as edge computing as it reduces the latency for computational process in heterogeneous network using the SCBS,MBS[1]. Initially the MBS are used to spread the spectrum all over the area.

Later on due to insufficient speed and bandwidths led to development of the Small cell Base stations(SCBS).

Energy consumption and several other factors led to limit the Macro Base station(MBS) concept and eventually led to small cell base stations(SCBS) which are of short range but effective at work along side with MEC server[7].
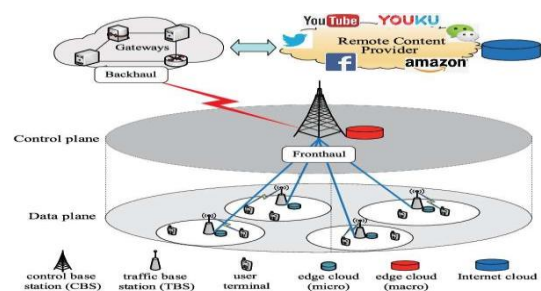
II. RELATED WORK:

Fig 1.

Intercommunication between the edge MEC servers is required to maintain by central controller to find out optimal destination in between them. Incase of required amount of data is small and real-time requirement is high the MEC servers could satisfy the needs without any turbulence of data transmission through central controller by offloading the most used data[6].

The communication taken place between these servers is depended on the software defined networks(SDN).SDN operates on data plane and control plane as mentioned in [9]. All the MEC servers are physically connected to the base stations. Every MEC server is linked to the central controller directly or indirectly using other MEC servers to maintain a uniformity. The huge network is formed using this architecture which allows much more wide area spread of the network and to maintain less disturbances among the data transmissions[4].

Penguin Foraging behaviour:

A meta-heuristic is a significant level issue autonomous algorithmic structure that gives a set of rules or techniques to create heuristic advancement calculations. Meta-heuristic calculations endeavour to locate the best arrangement out of every conceivable arrangement of an advancement issue.

A very dynamic region of research is the plan of nature-roused meta-heuristics. Nature goes about as a wellspring of ideas, systems and standards for planning of fake processing frameworks to manage complex computational issues. In this paper, another meta-heuristic calculation, roused by the conduct of penguins Optimization which is called Penguin Analyzer (PO), is proposed.

This calculation is constrained by the body heat radiation of the penguins and their winding like development in their state[5]. PeSOA is enlivened by the penguin's chasing conduct and it for the most part functions as pursues. The populace of penguins finds starting positions, every penguin at that point plunges and swims under the water for chasing fish while expecting its oxygen save. Various types of the correspondence between penguins are once in a while performed and the amounts of eaten fish increment. The procedure is rehashed until the predefined measure of fish is gotten or the greatest number of emphasis is come to. In the present work, the penguins are dispatched into a few bunches where each gathering is apportioned to a different area in the nourishment space. During the scavenging stage, the penguins of each gathering endeavour to chase a maximal number of fish around the apportioning area. The correspondence for sharing nourishment data happens between and intra- gathering, permitting to improve the best arrangement closed[5].

To abridge the perceptions from penguins rummaging conduct, the accompanying principles are introduced.

• Rule 1: A penguin populace involves a few gatherings. Each gathering contains various penguins that differs in relying upon nourishment accessibility in the comparing scavenging district.

• Rule 2: Each gathering of penguins begins scrounging in a particular profundity under the water as per the data about the vitality gain and the expense to acquire it.

• Rule 3: They feed as a group and pursue their neighbourhood manage which has benefited from most nourishment in the last jump. Penguins check the water for nourishment until their oxygen holds are exhausted

Rule 4: After various jumps, penguins return on surface to impart to its nearby members, by means of intra group correspondence, the areas and wealth of nourishment sources.

• Rule 5: If the nourishment support is less for the penguins of an offered gathering to live on, some portion of the gathering (or the entire gathering) relocates to somewhere else through intergroup correspondence.

Notations	Descriptions
N	Number of total penguins
K	Number of groups
f	Objective function of the problem
O_j^i	The oxygen reserve of the jth penguin of the ith group
$x_j^i(t)$	The position of penguin j allocated to the ith group at t^{th} instance
$x_{LocalBest}^i$	The best solution found by the ith group
$QEF^i(t)$	Quantity of eaten fish of the ith group at the tth instance
$P_i(t)$	Probability of existence of fish of gth group at t^{th} instance
rand()	A random number drawing from (0, 1)

Fig 2. Advantages of Edge computing:

Increasing usage of Internet, cloud services and many more IOT applications which are depending on computational capacities of cloud services will be benefited through edge computing as processing speeds would be increased much.With the increasing usage of IOT devices in Daily life huge amounts of data would be generated. So, for all these devices needs fast processing for better results which edge computing could provide way better than cloud computing.

III. CONTRIBUTIONS:

The main contributions of this paper are summarized as follows:

- This paper mainly focuses on the routing mechanism of the searching the result by adapting the penguin foraging behaviour which enhances the searching technique easily by creating local directories in each MEC server[6].
- MEC servers are periodically set into sleep position to maintain physical integrity of SCBS and the connectivity is maintained through discrete stochastic algorithm as mentioned in [1]. This algorithm also maintains the energy consumption for transmitting data in between the MEC servers.
- Each penguin cluster has a location in the deep sea to get the food as based on the previous hunting results and in case of any unavailability or abundance
- Each available resource MEC servers are shortlisted and probability is calculated based on factors like inactive cells, Central controller distance, load upon individual MEC servers. Final probabilities derived shall be compared and optimal path is used by MEC server.
- Implementing the edge computing is developed form of the fog computing which has three tire architecture edge has distributed node RED through three iterations[7].
- Another methodologies such METS also has researched early models of 5G to give high speed data services which categorized into levels[3].
- Many IOT devices applications can be accelerated using edge computing to navigate cars and real time sensing applications can be benefited as computation process moves to edge servers [9].

IV. PROPOSED MODEL

Every MEC server is connected via physical cables to central controller to maintain uniformity to provide a better user experience. All the MEC servers are directly or indirectly connected to each other.

Meta data of all the data transfers will be monitored by the central controller.

Based on the penguin foraging behaviour we would like to suggest a new methodology for communication between the Edge MEC servers and get the result as quick as possible. Each MEC server contains different data and they would get the data according to the user search results. Individual MEC server could serve the user with the available data.

Most common data like forex prices, trending topics in society and similar kind to data will be maintained according to priority based algorithm. All these data distributions and interconnectivity issues are monitored and maintained by the central controller only.When ever the user searches for the particular type of data it can be obtained from the nearest MEC server if any previous record is available form nearest server or else it should be able to contact the central controller and has to get form the cloud server. This methodology is based on the penguin foraging behaviour which is synchronized to current Edge servers methodology. With similar to the penguin hunting the fish in deep sea as they have previous information about the locations of food available. Similarly we focus on the previous data locations and search for the search result. This nature inspired meta heuristic algorithm will be able to search the requested result. Yet the methodology is inspired from a penguins foraging behaviour but some changes had been made to as penguins food groups are dynamic in the oceans but our destination MEC servers are fixed at certain locations and the directories are to be maintained in sync. The meta data containing directories will be acting as the pathways for getting the results and they will be able to get updated by the central controller only.
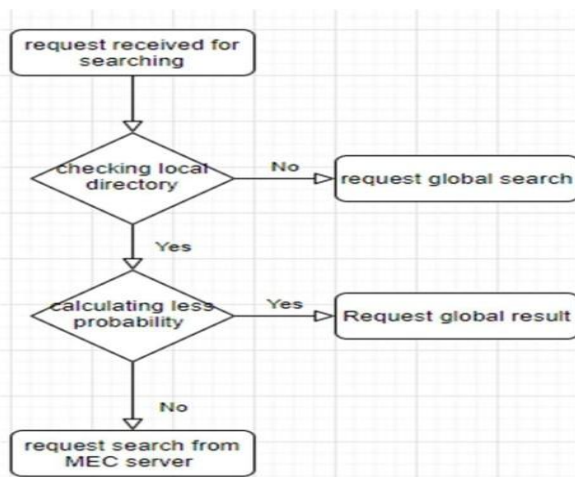

Fig 3.

V.   RESULTS:

Fig 4.

Accuracy Evaluation Results :

Average System Accuracy (%)	98.44
System Error (%)	8.89
Precision (Micro) (%)	88.89
Recall (Micro) (%)	93.02
Fscore (Micro) (%)	90.91
Precision (Micro) (%)	88.89
Recall (Micro) (%)	94.44
Fscore (Micro) (%)	91.58

Fig 5[Result]

VI.   CONCLUSION:

Implementing the penguin based meta-heuristic approach in interconnectivity of many MEC servers can simplify the data requests handling procedure. We have obtained the minimal distance in the form of probability which is easier to classify individual and similar ones and select optimal one based on other influencing factors. Yet it can be improvised and polished much by further work and implications to even simplify the work.

REFERENCES:

1. T. Han, S. Li, Y. Zhong, Z. Bai and K. Kwak, "5G Software-Defined Heterogeneous Networks With Cooperation and Partial Connectivity," in IEEE Access, vol. 7, pp. 72577-72590, 2019.
2. C. Sonmez, A. Ozgovde and C. Ersoy, "EdgeCloudSim: An environment for performance evaluation of Edge Computing systems," 2017 Second International Conference on Fog and Mobile Edge Computing (FMEC), Valencia, 2017, pp. 39- 44.
3. H. Droste et al., "The METIS 5G Architecture: A Summary of METIS Work on 5G Architectures," 2015 IEEE 81st Vehicular Technology Conference (VTC Spring), Glasgow, 2015, pp. 1-5.
4. A. Wang, Z. Zha, Y. Guo and S. Chen, "Software-Defined Networking Enhanced Edge Computing: A Network-Centric Survey," in Proceedings of the IEEE, vol. 107, no. 8, pp. 1500-1519, Aug. 2019.
5. PeSOA: Penguins Search Optimisation Algorithm for Global Optimisation Problems.
6. X. Wei et al., "MVR: An Architecture for Computation Offloading in Mobile Edge Computing," 2017 IEEE International Conference on Edge Computing (EDGE), Honolulu, HI, 2017, pp. 232-235.
7. N. K. Giang, R. Lea, M. Blackstock and V.
8. C. M. Leung, "Fog at the Edge: Experiences Building an Edge Computing Platform," 2018 IEEE International Conference on Edge Computing (EDGE), San Francisco, CA, 2018, pp. 9-16.
9. K. Dolui and S. K. Datta, "Comparison of edge computing implementations: Fog computing, cloudlet and mobile edge computing," 2017 Global Internet of Things Summit (GIoTS), Geneva, 2017, pp. 1-6.
10. R. Jain and S. Tata, "Cloud to Edge: Distributed Deployment of Process-AwareIoT Applications," 2017 IEEE International
11. Conference on Edge Computing (EDGE), Honolulu, HI, 2017, pp. 182-189.
12. D. Loghin, L. Ramapantulu and Y. M. Teo, "Towards Analyzing the Performance of Hybrid Edge-Cloud Processing," 2019 IEEE International Conference on Edge Computing (EDGE), Milan, Italy, 2019, pp. 87-94.

AURTHOR PROFILE

Harikrishna Pydi, received B.Tech and M.Tech degrees from JNTU, Hyderabad, India in 2006 and 2010 respectively.

He is currently pursuing Ph.D in Computer Science and Engineering. His research interests include edge computing and machine learning.

Allu Venkata Dattatreya Reddy, is pursuing final year B. Tech of CSE Department in Koneru Lakshmaiah Education Foundation. His research area is Edge Computing & Data Analytics.

Chowdavarapu Jeevan Rupesh, is pursuing final year B. Tech of CSE Department in Koneru Lakshmaiah Education Foundation. His research area is Edge Computing & Data Analytics.

Pothugunta Chandana, is pursuing final year B. Tech of CSE Department in Koneru Lakshmaiah Education Foundation. Her research area is Big Data & Data Analytics.

Chittamuru bharath, is pursuing final year B. Tech of CSE Department in Koneru Lakshmaiah Education Foundation. His research area is Big Data & Data Analytics.