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An Efficient Algorithm for Nodal Distribution Using 5G

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Abstract: Today wireless services are the most preferred services of the world and the ultimate goal become to communicate any type of information with anyone, at any time, from anywhere, with no need of conductors or wires. In this paper, hybrid algorithm is developed for the distribution of 'n' network nodes in a defined area, which is used closely with the Small Cells (SCs), allowing to alleviate mobile network congestion in peak hours, and allow users to enjoy gourmet bandwidth services. Providing network connectivity to mobile users is a key requirement for cellular wireless networks. User mobility impacts network performance as well as user perceived service quality. To get an overall idea about the race between the services offered by mobile networks and the increasing flow demand by users, we made an overview on the various mobile networks from generation (1G to 5G) to show the importance of caching techniques to provide a better quality of service and better throughput.

Keywords: Small Cells (SCs), hybrid algorithm, 5g networks, throughput.

Introduction

The fifth-generation (5G) mobile communication networks are envisioned to support massive connectivity (millions of devices per sq. km), higher data rates, lower transmission delays (around 5 ms) in user plane and (around 10 ms) for control plane, and devices with very high mobility speeds (~ 500 kmph) [1], [2]. 5G networks will support ultra-reliable low latency communication (URLLC), enhanced Mobile BroadBand (eMBB) communication and massive machine type communications (mMTC) for a wide variety of applications such as augmented/virtual reality, ultra-high-definition video, cloud storage, Internet of Things (IoT), Internet of Vehicles (IoV), smart home, and smart cities. In the sequel, 5G networks will utilize ultra-dense deployment of access points, higher frequency bands (e.g., mm-wave, free-space optics [FSO], visible light, and Tera Hertz) via carrier aggregation or dual connectivity, and massive antennas to overcome higher path loss and blocking associated with such high frequencies. Further, technologies enabling device-to-device communications (D2D), cognitive radios, inter-vehicular (V2V), vehicle-topedestrian (V2X), vehicle-to-infrastructure (V2I), drone-toinfrastructure (D2I), and drone-to-user (D2X) communications are expected to be integral parts of future 5G/B5G wireless networks. The key features of 5G/B5G cellular networks include spatial randomness of network tessellation, heterogeneity of base-stations (BSs), dense/ultra-dense nature of network deployment, and diversified mobility patterns of users/devices and network nodes.

In this paper, an hybrid algorithm is developed for the distribution of 'n'

network nodes in a specific region in the network.

Literature Survey

Based on the benefits of the handover process, in [3], Qiu et. al. proposed a unique innovative method to implement the virtualized network functions and fog computing cases. The research indicates the benefits of virtualizing the network functions. These benefits play an important role to enhance the flexibility and the robustness of the network. The study was carried out by utilizing fog-computing based APs and X2- based handover design.

[4] that is written by Yang et. al., addresses the usage of wireless communication networking for the case of everyday situations. A handover operation for specific cases is presented in the study. The cases about that UE has weak connections with eNBs because of the surrounding buildings and the distances. These obstacles are handled by forwarding the signals from a relay station. By this way, coverage area and communication range increases, which eliminates the interference signal.

Arshad et. al., discusses about enhancement of spectral efficiency and resource allocation operations in a case involved multiple subscribers, in [5]. It is stated that, spectral efficiency can be improved by considering the BS footprints. The handover operation is utilized to increase the 5G network performance. Also, it is stated that handover rate is a significant element that has notable impacts on the network performance and it is needed to be considered appropriately. Moreover, the difficulties suffered while operating handover process in 5G networks are stated and discussed explicitly. A method that minimizes the unnecessary handover rate is proposed in the article, which is stated as topology aware handover approach. This proposed method is verified for single and two-tier networks for downlink connections.

In [6], Barua et. al., proposes a new way to yield better networking performance by utilizing D2D communication method. The proposed D2D method does not need any BS for communication between the UEs. Since mobility management processes are real challenging tasks in D2D communications, a few methods are stated to handle these tasks. The new approach proposes to utilize Time Division Duplex in LTE-A systems. By this way, it becomes possible to implement wellknown power control algorithms for Time Division Duplex. However, latency, complexity, and the power issues still go on as important challenges.

Wu et. al., in [7], studies on optimization of the handover parameters in small-cell deployed 5G multi-tier cellular networks. Initially, the article states that present methods used for enhancing QoS are based on former information and the network procedures. And, in case of insufficient information, the mentioned currently used methods are unsuccessful to fulfill the QoS and performance requirements. In purpose of handling this problem, dynamic fuzzy Q-Learning algorithm is proposed as a novel and unique method that ensures continuous D2D communication, lower latency, and lower signaling overhead.

Choi et. al., in [8], stated that, one of the main purposes for architectures is to provide seamless mobility management service by correlating the core network with multiple APs properly. In the paper, approach of MAPDU (Multiple Access Protocol Data Unit) session to manage the data communication in 5G cellular network, and a dynamic mobility management process between various APs are presented. The dynamic anchoring MM method is proposed with End Marker to ensure the connection while UE is moving.

Lastly but not least, in [9], Calabuig et. al. states that traditional mobility and resource management methods like increasing spectral efficiency are inapplicable in 5G networks due to the high capacity. They analyze the most promising methods that are defined in METIS project. They utilize context information in their structure to provide a reliable and power efficient mobility management service. Although the proposed solutions seem to enhance mostly resource management, the combination of the methods provide robustness to unplanned cell deployments, mobility for users and cells.

Proposed Approach

Hybrid is the dynamic and geographic routing approach that selects the nodes dynamically. The selection of paths can be done by analyzing the traffic and density of the vehicles in the junctions to select reliable routes in the network. The maps are used to find the actual positions of the nearest junctions. Based on the score given by the density of vehicles in traffic and distance among the metric curves are used to selects the next destination, then the junction is selected. This works better on dense traffic platforms. The efficient selection of path is selected based on the packet travels. Every node in the network gives the information to the server (gateway) if it goes to its communication range. The gateway develops a various set of paths among itself and each node.

The algorithm is focused on various factors such as route discovery, route recovery, dynamic routing and maintaining the constant power at all the vehicles. The hybrid develops the route by using the request of the route from the base stations (BS). The BS gives the route reply by using the messages. To find the efficient route, the distances between two vehicles are to be calculated. Distance factor plays the main role to measure the distance among the nearest vehicles are measure by using Euclidean distance is represented in (1).

$$\text{Dist} = \sqrt{(a1 - a2) + (b1 - b2)} \quad (1)$$

Equation-1 (a1, b1) represents the neighbor nodes, and (a2, b2) represents the spatial region of the destination node. The data is sent to the destination node from source to find the accurate route. Various factors shows the huge impact on finding the route such as constant, lifespan and availability of buffer are measured. These factors are merged with reply packets to other general information. Hybrid is adopted with fitness function improves the more constant route, this results in increasing data PDR. This will also reduce the packet loss and more routes are added.

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Algorithm 1: Distribution function
getUeRandomVectorPosition (double gNB_X, double gNB_Y, double ue_height, double R, double r_m)
{
double r = (R-r_m) * sqrt((double)(rand())/RAND_MAX) + r_m;
double theta = (double)(rand())/RAND_MAX * 2 * M_PI;
double x = gNB_X + r * cos(theta);
double y = gNB_Y + r * sin(theta);
Vector res = Vector (x, y, ue_height);
return res;
}

The interference pattern should be changed when the subscribers move. The effect of reducing the SINR indicator should appear when an object moves away from the base station and when it is near other objects in the system. It indicates a deterioration in communication performance. On this basis, the packet loss increases and, consequently, the BLER parameter increases. A solution, where subscribers moved in a straight line away from the base station, was implemented to observe this event. The function describing the trajectory of subscribers' movement is shown in Figure 2. The linear function (Function 1), set by the positions of the subscriber and the base station, is used to determine the trajectory.

$$f(x) = \frac{Y_1 - Y_0}{X_1 - X_0}(X - X_0),$$

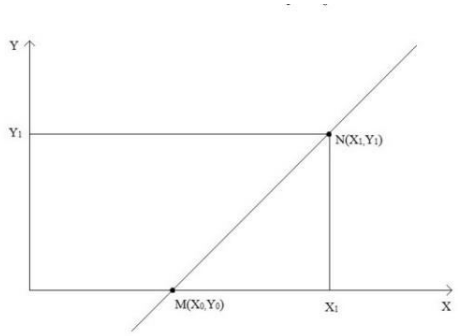

Figure: Function of describing the trajectory

Algorithm : Performance evaluation shortest path of hybrid LTE system

S= sorted based on the increasing value of the nodal degree
for h ϵ H do
Compute value of combined degree ∀ j ϵ C
for ∀ i ϵ S∫ do
T= ϵ
for ∀ q ϵ C do
if # hops shortest path between i and q <= h then
T += q
end if
end for
T0 = T sorted based on the decreasing value of the combined degree
Cmin = infinity

for ∀ k ϵ T0do

for node m ϵ T0 − k do

set node k as the primary node i
set node m as the backup node i

evaluate shortest path between node i and node k, and between node i and node m
evaluate total cost of Ck,m where shared backup resources
if Ck,m < Cmin then
Set k as the primary node i
Set m as the backup node i
Cmin = Ck,m
end if

end for
end for
end for
end for

Experimental Results

NS3 is a network simulator for discrete event simulation. It is free software under the GNU GPLv2 license. This tool is directed to research applications, as well as for educational purposes [11, 12]. NS3 has the flexibility and speed of simulation scenarios due to the using C ++ as a master programming language. At the same time, it supports the Python language, which gives a lower learning curve for new users using this simulator. Each of these programming languages allows describing the behavior of telecommunication systems.

The NS3 gives the opportunity to developers to build models of any topology and complexity. Along with this, a simulator gives an opportunity to implement, modify and supplement both existing models and modules with the user's own developments. Disadvantages of the NS3 are missing of a fully supported IDE and also missing a built-in graphical interface. However, there are ready-made third-party implementations for visualizing the behavior of models.

Table 1: Performance of Table

Algorithms	PDR	Throughput
Existing System	80.34%	84.34%
Hybrid Algorithm	88.98%	91.21%

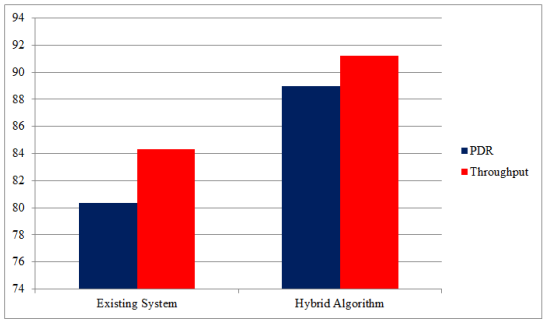

Figure 1: Performance Graph

Conclusion

In the last decades, there has been a rapid increase in demand for wireless communication that cellular communication is seen the major part of. And, the latest cases in communication need throughput with the best performance. Because of the innovative differences in 5G technology, it becomes inapplicable to utilize previous traditional mobility management strategies that are used in LTE systems. Therefore, in order to handle the mobility issues in 5G wireless networks, various techniques have been developed. In this study, mobility management in 5G networks is presented after discussing the evolution of wireless networks and mobility management process are increase the performance of hybrid nodal distribution.

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