

# Handover forecasting in 5G using machine learning

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## Abstract

Communication plays a major role in human's life. Without network communication can't be done, to achieve proper and effective communication different generations of networks are introduced. Each generation has its own features and perspective of communication, but till now there is no network properly makes people to communicate. Many researches says 5G network will rule the network world as it satisfies all the effective network goals. This paper is proposed to obtain all the goals of a communication network by making proper handover with the help of machine learning.

Here we have used two main algorithms to make our 5G handover process by clustering and classifying. Clustering is a process of making the datasets into single units of every users and classification is a process of classifying user's clustered datasets into common path using prediction and forecasting. For clustering we are using K-means and for classification we are using Random Forest algorithm. By using the algorithms the datasets which is being predicted and forecasted is stored in the cloud. Here cloud technology is used as a platform for developing datasets associated with internet. 5G network adapts to any form technology easier and here we have used all the essential technologies under machine learning. This paper deals with all the above methodologies effectively with newer combinations of algorithms along with proper solutions.

## 1. Introduction

Communication plays an important role in everyone life's .Networking is a construction design and uses of a network which includes the physical (cabling, hub, bridge, router, and so forth),the selection and uses telecommunication protocol by managing the networks .It also gives the establishment of operation policies and procedures related to the network [1]. 5G networking is a wireless board band technology which supports all formats of networking devices. An important goal of 5G is to erase the differences between wire line and wireless networking .It will provide better speed and coverage than the current 4G by providing qualified and better handover.5G network incorporates all newer technologies with higher range of frequency ,proper antenna configuration along with deployment of ultra-dense device to device communication [2]. Handover is a bit difficult process even though lots of newer technologies were introduced .Handover consist of two form 1.vertical Handover 2.Horizontal Handover. Vertical Handover refers to a networking changing the type of connection to access a supporting infrastructure. It refers to automatic switching to communicate from one to other technology. It enables the exploitation of higher bandwidth and lower for networks like local area networks. It also provides extended coverage for cellular networks. The vertical handover process imposes important technical challenges. Horizontal handover a network always occurs in same radio access technology handover process occurs in different networks. Horizontal handover is a mobile terminal changes its point of connection within the same type of networks. In this paper we are using vertical handover as it uses automatic mapping of the target handover channel. Once the required handover is given definitely the network becomes more effective and qualified. Vertical handover helps in giving handover to different systems were it

expands the bandwidth capacity of this system. Mainly higher bandwidth systems have more users' occupancy.

5G network support MIMO for improving energy efficiency by radiating which gives 100 times better capacity system than the other generation networks. It also uses spectral sharing where the target broadband network can be easy identify and gives a centralized solution for all the mapping of networks centralized sharing spectrum techniques is used to map the database using geo- location ,were the database of the users can be stored and retrieved anywhere in the world. In this paper we have proposed a system which uses all the 5G properties with the help of machine learning. Handover using machine learning gives more quality of services by mapping to the required target services. By using machine learning we can predict and forecast the user's path while establishing handover [3].and it can store huge amount of data under a single handover service. In this paper we will consider three main aims along with machine learning 1. Quality of service 2.mobility 3.bandwidth.Quality of services is used to refer the ability of a network to provide improved service to select network technologies. Quality of service is a single network element, which includes queuing, scheduling, and traffic shaping features. In this paper QoS mainly focuses on user's side by giving required handover of specified bandwidth capacity. Mobility of services is a concept that aims to combine all modes of transport. A quality or capability which permits them to move from place to place while retaining the ability to fulfill their primary mission .These devices provides several benefits to users and in this paper mobility plays an important role as 5G network always finds a better solution for this problem. While the user is in handover proper handover switch is made by using two algorithms namely K-means and Random Forest algorithm. The bandwidth is defined as a link for communication [4] higher bandwidth capabilities will make a better system.

Machine learning is an effective newer technology which makes

handover using automatic prediction and forecasting. It is a relatively new discipline within computer science that provides collection of data techniques. Machine learning is an international forum for research on computational approaches. Here different algorithms were applied for different purpose like clustering and forecasting application. In this paper we will consider two main types of algorithm. 1. k means, 2.Random Forest. K-means clustering is an algorithm used to cluster the dataset into K clusters. Every cluster of k has a center point known as centroid, by using the center point it clusters all the related dataset into a single-single unit. In this paper we have used K-means for clustering different data types into single unit of related data. Random forest algorithm is used for classification of the clustered dataset; it makes the dataset into different tree like structures. As more number of trees will increase the accuracy of the system. The tree like structure is formed by using prediction of the dataset path by using training dataset. Machine learning system develops automatically and customizes themselves to the individual users. In this paper we uses cloud to store datasets were it can be retrieved, updated, added and removed easily.

## 2. Related works

Network handover is a tedious process in communication, for overcoming the difficulties in handover many researches using different generations of networks is done. This paper deals with 5G networking for establishing an effective handover. The following researches were made with the aim of improvised and effective handover implementation. The authors David Soldani and Antonio Manzalini[1] gives a solution for 5G infrastructure which will be converted into a 3D collaborative and immersive service. Here they use ultra low latency nerves system for supporting 3D. Authors Liang Gong, Bo Rong and KejieLu[2] proposed a system which uses software defined network(SDN) which is based on intelligent model in heterogeneous network. This paper is made to improve the system capacity and to achieve users demand dynamically. As a result of this system the network becomes scalable, reliable and positively implementable using SDN infrastructure.

In [3] this paper the author's uses call handling mechanism, conventional handling mechanism and different handover prioritization schemes for improving 5G handover. They use balancing scheme and cell overlap scheme for reducing traffic and system complexity while giving a handover. They also uses mathematical formulas for obtaining a better 5G system. Michele polese and Marco Giordani [4] are the authors proposed a connectivity of dual systems from 4G to 5G .First comprehensive end – to-end evaluation of handover mechanism in mm wave cellular systems was provided by this paper. It contains complete details of medium access control, radio link control and transport protocols. In [5] this paper the authors Marco Mezzavilla and Michele Zorzi use high directionality techniques to improve signal quality and extend area coverage. This paper proposed integrated LTE network architecture and mm wave radio access technologies to provide ultra-reliable services to mobile users and it provides alternatives for integration and shows how simulation can be used to assess and compare their performance. This[6]paper authors Le LuongVy and Li-Ping Tung told that handover is the important key for improving network quality and mobility performance in mobile networks. They implies that using of macro cells, small cells and ultra-dense networks make handover more complicated. Authors used more than 6000 cells of real networks for successfully identifying the separating handover behaviours, forecasting future number of handover attempts and detecting abnormal handover behaviours of cells.

In [7] this paper authors Teodora Sandra Buda and Haytham Assem explained about the limitations of current network and service management and completely explains the challenges that 5G faces from management perspective. The crisp thing of this paper is it presents number of use cases and scenario of 5G in

machine learning which can address their management challenges. The author's expectation in this paper is 5G network can bring more intelligent level in monitoring, managing networks and applications. UdiMargolin and Alberto Mozo[8] gives some technique to identify and solve the noisy neighbor in NFV infrastructure in 5G. They used simple and standard automated model to detect the noisy neighbor problem with an accuracy of more than 90%.

## 3. Proposed system

5G networks propose the next generation communication standards. 5G is an improved network which will be used in the future. Next generation wireless networks are expected to support extremely high data rates. Future smart 5G terminals expected to access the bandwidth which will impact entire mobile networks and it will transformed into 5G using technologies like NFV,SDN, enabling speed, agility and efficiency. Handover is a process which transfers upcoming data or ongoing data from one channel network to next channel. When a mobile terminal moves outside the coverage area of the base station it takes appropriate measures assumed by the network management. The quality of bandwidth is required to ensure the base station.

Mobility and handover are based on services, allows the user to move from one cell range to another or to switch to nearest cell for performance. The three main parameters considered in this paper are quality of services, bandwidth, and mobility. To increase these parameters by using machine learning, two algorithms are used. One is k-means for clustering and other is random forest algorithm for classification. The upcoming flow diagram will illustrated all the essential things to be done for constructing the system. In machine learning, Clustering is grouping of a set of observation into subsets called cluster. The unsupervised procedure is known as clustering, which involves grouping of data into categories based on similarity, example grouping of all calls, texts, videos, audio, and media from every users. In this paper we have used K-means to cluster different data types into single- single unit of datasets.

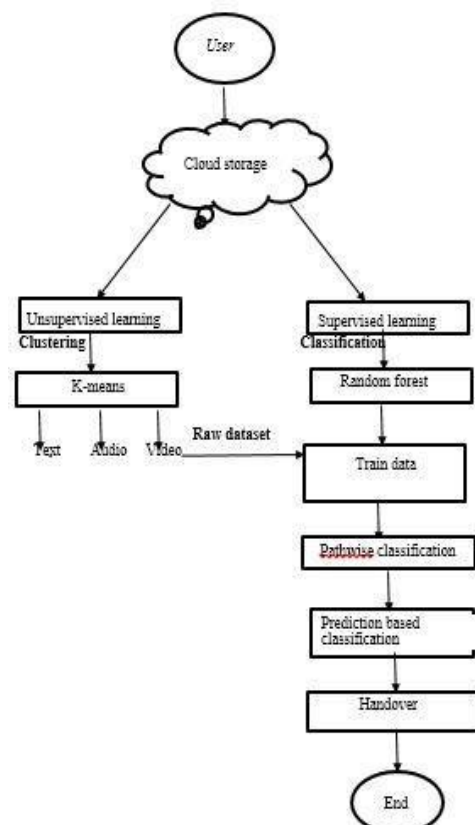


Figure 1: Flow diagram of ML system

K-means uses three main steps 1. K centroid initialization 2. finding nearest centroid and clustering them into unit 3. using arithmetic notations finding newer closest clusters, finally repeat step 2 and 3 for making newer and effective clusters. The centroid initialization is making centre of node which covers all the raw dataset around them. Once centroid is fixed the nearest dataset is founded out and marked. After marking by using notation the datasets were clustered. Once clustering is completed the clustered dataset is sent to the training face for prediction and forecasting. The prediction and forecasting is done using Random Forest algorithm. Dataset training plays an important role for prediction and forecasting. When the phone is moving away from the area covered by one cell and entering into the area covered by another cell and the call is transferred to second cell to avoid call termination when the phone gets outside the range of first cell. In order to avoid the interference, the cell is transferred to a different channel in the same cell or to different channel in another cell when the channel used by the phone becomes interfered. To reduce the interference to smaller neighboring cell due to near-far effect when phone still has an excellent connection to its current cell. When a fast travelling user stops then the call may be transferred to smaller macro cell for fast travelling users, this works in reverse to reduce the potential interference to other cells or users.

Random forest algorithm is used to do all above mentioned things with high efficiency. This algorithm makes tree like structure by using the training dataset which searches and finds the next handover target easily. In this paper this algorithm is mainly used to find the prediction path and to makes the dataset moved in the right way. The dataset training is made using the regular watching of the dataset path. Once the dataset is trained under a specified path all the nearest network which comes under path is allocated to the dataset users. All the trained datasets will fall under their own trained path, when the user from one trained path wants to get joined in another trained dataset due to change in path. In that situation forest algorithm pays way to the newer dataset to be added in the required trained dataset. For each and every user proper handover is fixed by seeing their path to the nearest network by prediction. By mapping to the required bandwidth network service quality of service is more. This is the way were we provide an effective handover using K-means and Random Forest algorithm under machine learning.

**4. Experiment and result**

The dataset is proposed into clustering and classification phases and finally the required target handover is switched. Here we are using matlab for implementing the two phases into an effective processing. First clustering is done then classification is made. Both these processes use user datasets.

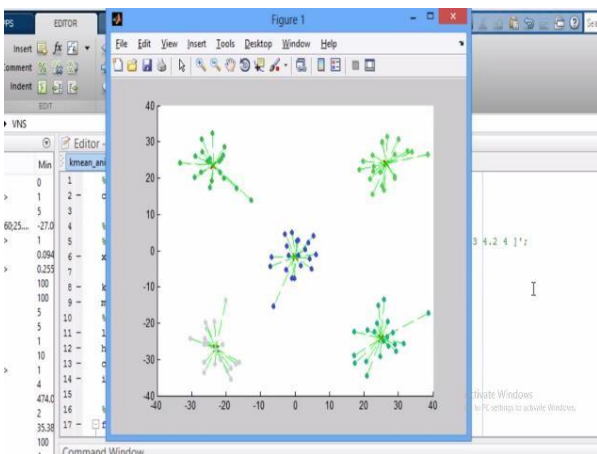


Figure 2: K-means clustering

Figure 2 shows that data is clustered using centroid and all the

related data were clustered into a single unit. Here blue colour represents centroid for global system and remaining were data. Locally each dataset has centroid and does clustering function of different data types.

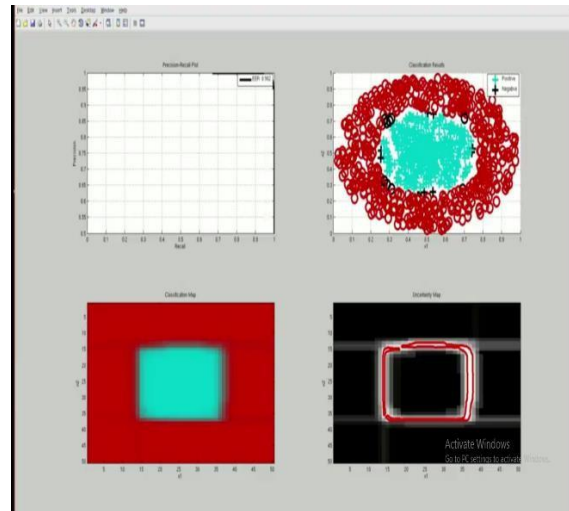


Figure 3: Random forest classifications 1

Figure represents that data after training is classified based on prediction in a circular tree way.

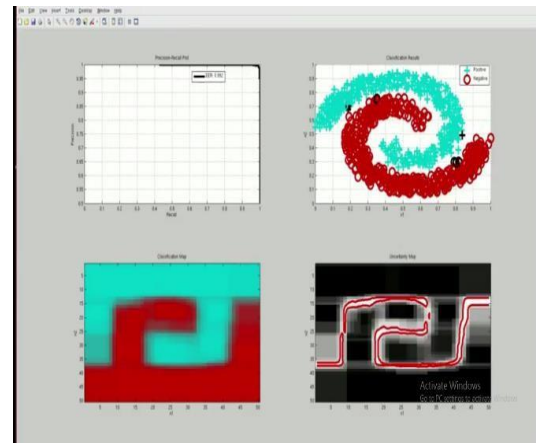


Figure 4: random forest classifications 2

The figure gives classification in linear order were dataset gets changed to another path from one predicted set to another set. The path changing does not affect the handover process because the changing dataset can go the required predicted path once it is changed

**5. Conclusion and future enhancement**

5G ML handover system using machine learning is an effective and qualified system to improved handover in 5G network. Here we have used more accurate algorithms to achieve handover without traffic and interception. Cloud storage makes this system even more effective for online usages. By using prediction and forecasting the handover in this system is easier than the other generation networks. This system can be enhanced by adding upcoming technology. This system can be also developed by using other core related algorithms such mm wave format and MIMO. Many researches were made to implement this formats into existence by using machine learning.

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