

Network Selection Scheme for LTE Systems using Multiple Parameters

Ramarajan. A, Thangadurai. N

Abstract--- Mobile communication standards are growing up day by day and improvements in the wireless technology environment leads to increase the number of user requirements. According to that many researches are going on to provide efficient and user friendly network to the end user. Network selection is the one to get the efficient network by the user, as per their needs. But, under the heterogeneous network environment of 4G systems, the network selection is somewhat difficult to perform. In this paper, various network selection schemes were discussed and the concept of network selection scheme using multiple parameters was proposed for the 4G systems. Here, Rank aggregation is performed for the available networks in the user environment to shortlist the networks in order. We are considering the Spearman foot rule method and Borda's method to perform the rank aggregation process. And considerably this network selection scheme provides the efficient communication to the user environment which has shown by simulation results done by network simulator.

Keywords--- Network selection scheme, Rank aggregation, QOS parameters, Heterogeneous network.

I. INTRODUCTION

IMPROVEMENT in the wireless technology, LTE Systems are employed for the purpose of providing the network which is user friendly and considerably providing better coverage, bandwidth availability, battery consumption. It provides a user centric system consist the abilities of user friendliness, user personalization, terminal heterogeneity, service personalization and network heterogeneity. Getting the benefit of heterogeneous network environment, it provides major benefits to the user. Anyway to use these benefits of LTE systems the devices used by the user should reconfigurable and could support multi-mode operation.[1] Various perspective of implementations were announced earlier and now at present, these LTE system is accepted as a 4th generation network worldwide. And the difference from the previous generation networks and LTE shown in table 1, which gives the basic technologies, data rates and the protocols used in these networks.

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The network standards from the beginning to the present 4G standard, various technologies were involved such as GSM, GPRS, EDGE, HSDPA, WCDMA and now LTE provides better data rates.

In order to provide best connected service Access discovery, Access selection, AAA support, Mobility management, Profile handling and Content adaptation are the basic things should be considered.[2] Network selection scheme is the one, notably a difficult one to perform the network selection under the heterogeneous network environment(Fig 1).

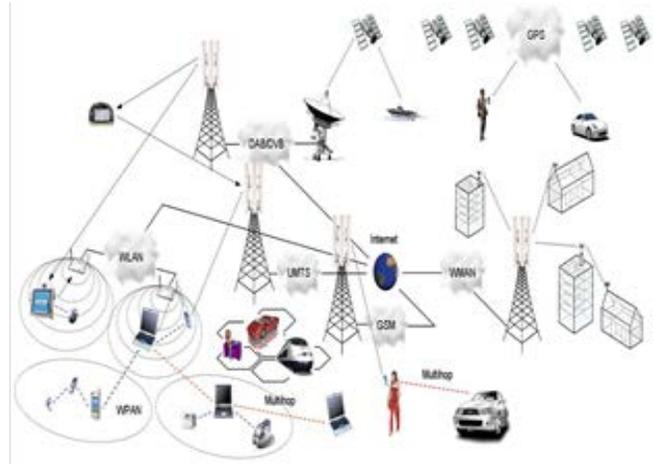


Fig 1. Heterogeneous network environment

Network selection schemes are the major technique to provide user friendly communication under heterogeneous environment. According to their requirement, they able to select the networks available, this is the task that network selection technique provides.

II. RELATED WORK

Various network selection schemes that were proposed earlier were discussed in this topic.

A. QOS Based Network Selection

QOS based network selection scheme is better one to provide the network to the user with their requirements. In this concept, the various qualities of service parameters like cost of service, Bandwidth, Call drop probability and power consumption are taken in to account and distance function is calculated for each parameters.

TABLE I
COMPARISON TABLE FOR COMMUNICATION STANDARDS

	0G	1G	2G	3G	4G
TECHNOLOGY	ANALOG	DIGITAL	DIGITAL	DIGITAL	DIGITAL
PERIOD	1970S	1980S	1995+	2006+	2010+
DATA RATE	-	14.4 KBPS	144-200 KBPS	250 KBPS- 14.4 MBPS	100 MBPS- 1 GBPS
SWITCHING	-	CIRCUIT	PACKET	PACKET	BROADBAND
PROTOCOLS	PSTN	NMT, AMPS, TACS	GSM, GPRS, EDGE	DECT, HSPA, WIMAX	OFDMA, MIMO

The rank lists for each network can be computed using the parameters. From that, the networks are ordered in a list from highest score to lower one. The higher the value of network is the best one to select by the user environment. From this approach, the user can able to select the network with their requirement and considering more number of parameters instead of performing with single parameter is the major advantage in QOS based network selection scheme.[3]

B. QOE Based Network Selection

Since LTE network consist of available networks and service providers, the parameters based selection may not be accurate. Then, it is required to go further from the above scheme. In this scenario, [4] the packet switched network can be evaluated with some parameters and it can be compared with the available networks and the better one from those networks can be selected. Here, Analytical hierarchy process (AHP) and Grey relational analysis (GRA) methods are used to select the network by ranking those networks in ordered list. This method of network selection gives the better results but it is considering the network performance individually, so we proceed further to another network selection scheme.

C. Open Resources Based Network Selection

Resources considered in the network aspects are coverage of area, power consumption, expandability, memory and the devices and so on. Here, according to the requested services by the end user, the resources based things are considered to provide the best network. The concept of this process is to eliminate the networks which are not suitable with the all required resources. The process in the network is done by sending the request to networks with required resources, the networks which suits the maximum number of requests can be the one which the user is looking for. If two or more networks suits for the selection, extra weight is added to those network as per the user requirement. Otherwise no network suits the requirement of the user means, the network which is matching to the user requirement highly, that can be selected. Since it doesn't have

much calculation, it is not up to the level of previous schemes discussed in the efficiency wise.

D. User Requisite Based Network Selection

This type of selection scheme [5] provides the good one under user requirements. Scheme uses the parts of user agent, network agent and client side image. Here, cost functions are proceeded to get the service cost, network availability, bandwidth utilization and power consumption parameters. This system hides the complexity from the end user than the other selection schemes. Even though, the complexity of the system is high like mathematical calculations and in the lower layers, it provides the best network selection scheme to the user environment.

E. Network Selection Scheme as a Game

This type of network selection schemes are performed by a game approach. Networks available the user environment competes with each other like a game to provide the best one. [6] The components used in these systems are players, strategies, payoffs and resources. Payoff is the major one which provides the ordered network. Resources consist of coverage area, bandwidth, power consumption, security and so on. The competition done on the network side itself, since user preferences are collected to perform the selection of network. The concept of competition between the networks provides the high quality of service when they are automatically finds out the better one from the available LTE networks.

F. Ranking Based Network Selection

This scheme [7] performed by the combining techniques of network selection by user preference and network resources. Operation of the system done by initializing the networks available which are eligible for the services that required from the user end. Weighted matrix can be added with the available networks obtained through classifying things like speed, cost and some QOS parameters. Then the ranking algorithm can be implemented to get the network which provides the good services to the user as per their requirements. This system is the one to implement easy and it gives high efficiency also. But it consists of some major calculations to get the ranks of the networks.

G. Utility Theory Based Network Selection

Utility based system [8] provides good network selection among all. The theory for fundamental utility by Von Neumann defines that a set of $U(w,x)$. Where, x is the observation on product by the user and w is the set off user preferences, these two values are rounded off to whole real numbers. Already stated in the introduction, this service concentrates to give the “Always best connected” service from the available “Always connected” scenario. Here, dissimilar network values can be created after the numerical analysis of utility functions and it overcomes from the shortcomings of them. Efficient network selection is possible from this network selection scheme but for the simple services this amount of complex mathematical operations is the drawback.

H. Agent Acuity Based Network Selection

This network selection scheme approaches the concept of cognitive networks which functions constant perception and actions based on the data acquired. By the individual cognitive terminals, network selection provides the improved technique among other network selection schemes [10]. It also looks for efficient resource utilization of the system. In this system, the action depends upon the previous adaptation of the action. To find out the optimum action, the objective function is executed. Since the system is providing continuous connectivity and effective network selection, vertical handover issues may affect the adaptation process.

III. PROPOSED SCHEME

Many of the network selection schemes provide the concepts using single parameter values, but here we propose using multiple parameters. In 4G, Each user has their unique requirements. They will look for the network selection as per their needs. So, the proposing method gives approach to select the networks depends on usage of applications. Here, we are taking three applications voice, video and security that the end-user performing.

We are considering multiple parameters like cost, bandwidth and distance function as per the application. According to the different available networks, each network has unique cost values and bandwidth availability. Using this scheme we are shortlisting the available networks in an order as per the user interest. From that he/she can select the appropriate one.

Rank aggregation methods [12] are used to arrange the network parameters in an order. Various rank aggregation methods are available to arranging the networks. Here, we are considering spearman foot rule to show the difference between the parameter values of various networks. Before that we have to normalize the network values in the range from 0 to 1. The outcome we are getting from that is higher the value parameter

is the better one than the others. Spearman foot rule provides the difference between the each network according to the normalized values that they have. Then, Borda’s method of rank aggregation is used for shortlisting the network in an order.

As stated earlier, we are considering the operations like voice calls, video streaming and electronic transactions to be performed in a particular region of network. For that, according to network provided service, we are focusing on cost of service, Bandwidth availability and security features. In the testing of the proposed scheme, we are considering three networks called net A, net B and net C in a particular region. The user is moving towards the testing region and travelling through the region. Three networks have the unique parameter values. According to that, the users will select the network as per the requirement of application.

The proposed algorithm is performed by the following steps that are shown in Fig 2.

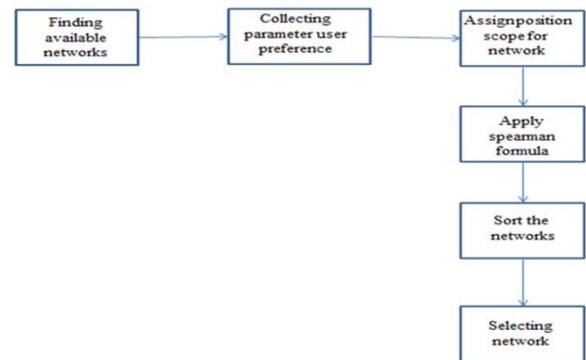


Fig 2. Steps involved in network selection scheme

TABLE III
FEATURES OF THE TEST NETWORKS

	Net A	Net B	Net C
Cost of service	Fixed	Fixed	Data based
BU Factor	High	Medium	Low
Call drop probability	Medium	Medium	Low
Security level	Medium	High	Low

The above table gives the features of the networks in the test region. According to the networks each has the unique properties. This network selection scheme performed using those parameter values that they possess.

VII. SIMULATION RESULTS

A. Test Area

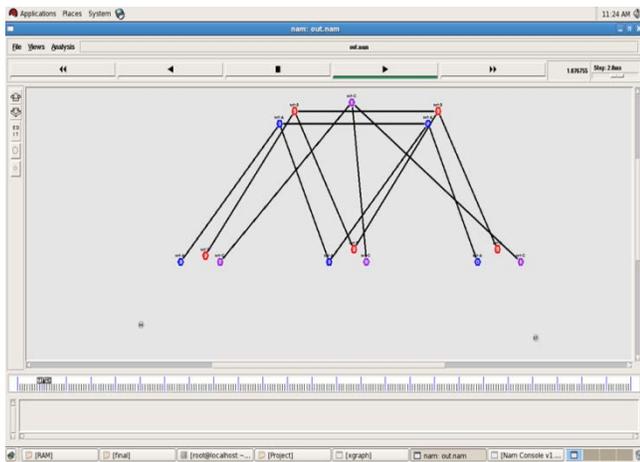


Fig 3. Representation of networks and the users in the test region.

As shown in Fig 3 two users are moving from one place to another in an opposite direction. The connected points denote the availability of networks net A, net B and net C in the region. At bottom of the result the two unconnected points are defining the two users moving in the test region.

B. Application Considered – Voice calls

In this case, we are considering that both users are looking for the voice communication. For voice communication, the main thing considered here is better connectivity through the network region, instead of looking cost of the service, bandwidth, etc.

As per the parameter values of the different kind of networks, net C is providing the better connected network according to the distance function value. So, both the users are connected with the net C in the process of voice communication. That is shown in Fig 5.

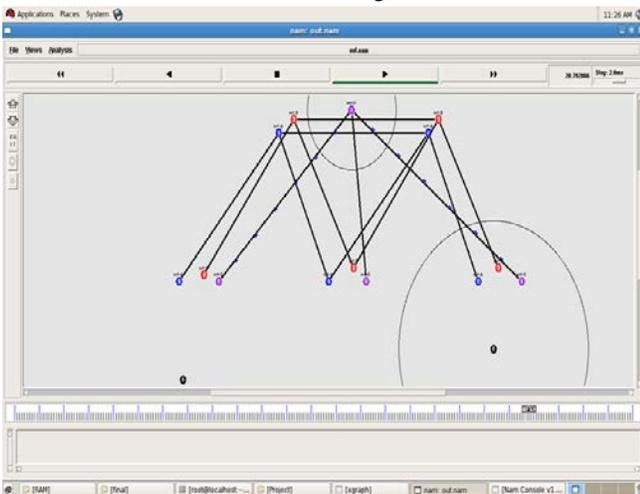


Fig 5. Network selection for voice calls.

C. Application Considered – Video Streaming

In this case, for video streaming applications we have to focus on the available bandwidth of different networks. From the networks taken in the test area, net A has the higher bandwidth to provide faster and efficient network to the user. This will available for the user to select the net A. It is shown in Fig 6.

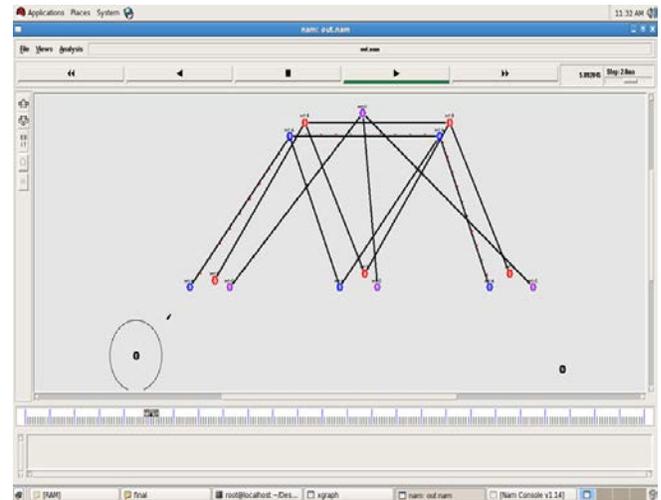


Fig 6. Network selection for video streaming

D. Results Obtained

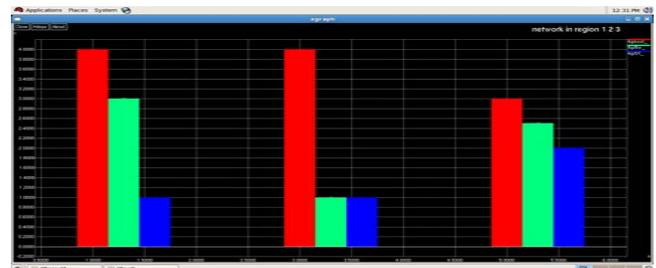


Fig 7. Comparison of three networks

The above graph gives the combined result of three networks available to the user environment according to the parameter values. As already stated, if the customer of the network searching for the better network for the voice communication, as per above result net C provides the better connectivity using distance function, which is shown in blue in the graphical result. If he/she needs a cost efficient network means, he can select net A or net B which are providing good cost efficient networks. Similarly, if the user is looking for video calls, video streaming requirement of bandwidth is more. According to the requirement they can select net A which is providing higher bandwidth. If the customer is performing any e-transactions he needs a continuous network connection without any disconnection. He/she can able to select the best one from this kind of network selection scheme.

VIII.CONCLUSION

In this paper we discuss the network selection schemes that were available for the 4G systems and the proposed scheme gives the concept using multiple parameters to select the network. Anyway to adopt with the facilities of network selection the devices should be reconfigurable and to support multi-mode operation. Network selection schemes that were proposed earlier were performed using limited parameters only. But, this scheme provides efficient one because the number of parameters involved is more. According to that, this scheme satisfies the user requirements easily. The proposed algorithm performed by using distance function values to create an ordered list of networks. The final results clearly show that the proposed scheme gives the efficient network selection to the users as per their interest.

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