Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
July- December- 2023 4(2), 1189–1198

SELECTION USING ENHANCED NORMAL FORM GAME THEORY BASED OPTIMIZATION APPROACH IN WSN

Dr. S. Ponlatha[1], P. Sowmiyaa [2]

[1] PhD, Associate Professor., Department of Electronics and Communication Engineering in Mahendra Engineering college at Salem- Tiruchengode Highway, Mahendhirapuri, Mallasamudram, Namakkal(Dt)- 637503
[2] B.E., M.E- Communication Systems (Student of Mahendra Engineering College)
Dr. D. CHITRA Ph.D., Professor., Department of Electronics and Communication Engineering in Mahendra Engineering college at salem- Tiruchengode Highway, Mahendhirapuri, Mallasamudram, Namakkal(Dt)-637503

ABSTRACT

Heterogeneous network is a network connecting mobile station (MS) with different kinds of wireless network. It will provide an efficient network connection for mobile users. When considering various wireless access technologies, it's difficult to search out reliable criteria to pick out the most effective offered wireless heterogeneous network. . Game theory techniques have been receiving growing attention in recent years as they can be adopted in order to model and understand competitive and cooperative scenarios between rational decision makers.In this paper, our aim is to develop an economical wireless network choice algorithm which is optimized using enhanced Normal Form Optimization Algorithm which follows game theory based procedure . This algorithm is proposed for optimizing the heterogeneous wireless environment comprising universal mobile telecommunication system (UMTS) and long term evaluation (LTE). Further, within optimization algorithm resource allocation is considered as an objective function. The incorporated optimization algorithm is involved in the optimal computation process for reducing channel complexity through optimal solution estimation. The computation complexity of proposed Normal Form Optimization Algorithm with TOPSIS method (NFOA-TOPSIS) measured in terms of running time and network utilization is measured in terms of the Packet Delivery Rate (PDR), throughput, simulation time, end-to-end delay and Power consumption. The simulation results expressed that the proposed NFOA provides reduced running time and increases PDR rather than conventional MADM (i.e., Hybrid Fuzzy Analytic Hierarchy Process (FAHP)& Technique for Order Preference by Similarity to an Ideal Solution -Hybrid FHAP-TOPSIS) method. The reduce in running time implies reduced complexity of proposed scheme. Also, the increase in PDR and throughput leads to reduced end-to-end delay and power consumption resulted in efficient utilization of available channels in heterogeneous networks.

Keywords: Heterogeneous Network, Optimization, Handover, Long Term Evolution (LTE), TOPSIS, Weight

DOI
10.29121/shodhkosh.v4.i2.2023.2305

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

1. INTRODUCTION

With the continuous evolution of wireless technology, a large number of wireless access technologies have been applied and overlap each other to form heterogeneous networks. These technologies have their own unique advantages, so users need to adopt the appropriate algorithm to select the best network. The traditional algorithm is the one based on the received signal strength (RSS) [1], this algorithm is vulnerable to the external environment and other factors, decision results often have a degree of randomness. The heterogeneous network selection algorithm based on multiple attribute decision making(MADM) [2] takes into account the influence of various factors such as user preferences, applications, networks, and terminals in the selection of the network. The analytic hierarchy process (AHP) and technique for order preference by similarity to ideal solution (TOPSIS) [3] are

commonly used in MADM. Since some network parameters cannot be given specific values in practical situations, in order to enable users to make accurate decisions, fuzzy logic theory to measure network parameters, and propose the algorithm based on fuzzy logic to select wireless networks [4]. A heterogeneous network selection algorithm based on game theory can balance the interests between users and users, users and networks, making network resource utilization more efficient and user satisfaction more higher. The above algorithms are classical methods to solve the problem of heterogeneous wireless network selection, but these algorithms consider the case that the terminal runs only a class of service. In real life, terminals tend to run multiple services, such as voice communications, web browsing and file downloading, therefore the terminal should consider QoS requirements of all services simultaneously when selecting networks, making all the services in the process of selecting or switching networks not be interrupted [5].
The Media Independent Handover (MIH) standarddefined in the IEEE 802.21 specification supports verticalhandovers across heterogeneous networks. The 802.21standard (MIH) aims to facilitate the integration ofheterogeneous networks by making link layer intelligenceand other associated information available to upper layersin order to help the handover decision [6]. This standarddefines the tools required to exchange information, eventsand commands to facilitate handover initiation andhandoverpreparation.The MIH framework covers three main elements: (i)MIH function (MIHF), (ii) Service Access Points (SAPs),and (iii) MIH users [7].The MIHF is a logical entity,provides cross layer abstract services to the upper layersof the protocol stack via a media independent interface(MIH_SAP) and gets information from the lower layersof the technology that uses the MIH services via mediaspecific interfaces [8]. This informationis used by the upper layers to make decisions forhandover. The MIH user is the entity that uses the MIHFservices. In addition, the MIH user could also be thehandover decision module (handover policy engine) thatactually fires the handover execution [9].
In this paper, focus is on network selection inheterogeneous network and providing good quality of service.Different wireless network may consist of different kinds of wireless technology. The goal of optimization is to find best fitness values forthe users that minimize objective function. The Normal Form Optimization Algorithm is anartificial intelligence technique that can be used to findapproximate solution to minimize or maximize the objectivefunctions. The users move from one location to anotherlocationwith an initial velocity, as well as a communicationchannel between the networks.

2. LITERATURE SURVEY

Yu et al., (2019) introduced an efficient network selection method for transmitting multimedia messages in wayof heterogeneous mode by considering the attributes for users and service purpose with respect to various distinctiveness . Then, Entropy and Fuzzy Analytic Hierarchy Process (EFAHP) was included by determining the weights based on priority level [10].
Liang et al., (2019) designs an algorithm for joint access selection and bandwidth allocation in Heterogeneous Wireless Networks (HWNs). Taking into account the environment in which worldwide interoperability for microwave access, long term evolution, and wireless local area network may co-exist, the algorithm uses received signal strength, network load, and user rate requirements as input decision parameters and adjusts the parameters of the membership function in the five-layer fuzzy neural network structure through supervised learning to obtain the score and bandwidth allocation value for each candidate network[11].
Bazrafkan et al., (2017) suggested normalization methods in network selectionby taking user preferences and application needs into account.Based on the proposed normalization method, a new decision process is suggested which is based on ELECTRE II algorithm. Our proposed method considers the dynamic nature of wireless networks and the uncertainty in the collected network performance metrics. Simulation results show that using the proposed handover decision process, the probability of ranking abnormality, which is a common drawback of MADM methods, is reduced significantly compared to other methods such as SAW, GRA and TOPSIS and the decision algorithm is more stable in terms of sensitivity to change in the amounts of decision criteria [12].
Almutairi et al., (2016) investigates the optimum pairing of attribute weighting techniques used with Distance to Ideal Alternative (DIA) selection in Multi-Attribute Decision Making (MADM) applied to wireless network vertical handover. The paper findings provide guidelines for selecting weighting techniques for each traffic class in order to achieve ideal network selection with minimal ranking abnormality [13].
El Helouet al.,(2015) propose a network-assisted approach. The network provides information for the mobiles to make more accurate decisions. By appropriately tuning network information, user decisions are globally expected to meet operator objectives, avoiding undesirable network states. Deriving network information is formulated as a semi-Markov decision process (SMDP), and optimal policies are computed using the Policy Iteration algorithm. Also, and since network

parameters may not be easily obtained, a reinforcement learning approach is introduced to derive what to signal to mobiles. The performances of optimal, learning-based, and heuristic policies, such as blocking probability and average throughput, are analyzed [14].

Lahby et al., (2013) proposes a new validation approach based on group MADM methods. This approach takes into account the weighting algorithms and allows to select the most valid ranking algorithm which can be used in specific traffic classes for network selection decision. Simulation results are presented to illustrate the effectiveness of our new validation approach for the network selection algorithm [15].

3. METHODOLOGY

3.1 SYSTEM MODEL

In this section we show the wireless network model used for network selection algorithm with the consideration if two heterogeneous network such as Long Term Evolution (LTE) network and UMTS network, It is assumed that the mobile user has to travel form base station of UMTS towards the base station of LTE at the straight line along with constant speed, with distance D between mobile stations and another. When a User is switched or turned ON, different carriers of various operators Public Land Mobile Network (PLMN) are scanned by the user, then with the aid of the International Mobile Subscriber Identity (IMSI), which comprises of the Subscriber Identity Module (SIM) and user helps to define the home network. The PLMN can be selected either manually or automatically but in most cases, these are done automatically. The user state in LTE are specified to be idle or connected mode, to avoid unwanted signaling cell selection and reselection happens when the UE is in idle mode using S-Criteria.

3.2 NETWORK SELECTION

To estimate the channel allocation between LTE and UMTS three game models are considered for resource allocation. The available resources are stated as $i \in N$, the unlicensed space for each channel is denoted as S_i and the incoming channel is represented as U_i. Here, based on the decision-making elements game is deployed with maximizing resource utilization level. With consideration of players' situation strategy decisions are achieved. The space for strategy provides participants time and action. The layer player payoff is based on the utility level of resources to achieve a specified strategy. For the strategic decision of players income resources are optimized and action of criteria is achieved. The constructed normal form game theory is optimized for its resource utilization level based on the application of strategy. The developed NFOA model is deployed in network especially for Long Term Evolution (LTE) network. The functionality of NFOA is based on consideration of users and attributes which is deployed over the network model is stated as follows:

1. **USERS:** The participants of the game are LTE network and wireless Local Area Network (WLAN).
2. **ATTRIBUTES:** The strategy for the deployed game is based on the consideration of strategy adopted in LTE for achieving efficient bandwidth for the LTE coverage band. The WLAN bandwidth is allocated based on the WLAN coverage area.

3. **REVENUE/RESOURCES:** The resource availability in the LTE bandwidth for coverage area is provided. The coverage resource area of both LTE and UMTS in WLAN is defined in equation (1) and it is expressed as follows:

$$U = \alpha\left[N^{R1}\log\left(\beta\frac{B_{Ap1}^{R1}}{N^{R1}}\right) + N^{R2}\log\left(\beta\frac{B_{Ap2}^{R2}}{N^{R2}}\right) + \ldots\ldots + N^{Rm+1}\log\left(\beta\frac{B_{Apm+1}^{Rm+1} + B_{Ap1}^{Rm+1}}{N^{Rm+1}}\right)\right] \quad (1)$$

As stated, normal form game is similar to that of the cooperative game theory model which is defined by Nash equilibrium. To estimate the Nash equilibrium for NFOA following derivation is performed. Consider non-cooperative game stated as $G = \{P, S, U\}$ with n users /players. The players incorporated in game is denoted as $P = \{p_1, p_2, \ldots, p_n\}$, where each players have their own set of policies and elements of P, the each player strategy is defined as $S^* = \left(s_1^*, s_2^*, \ldots\ldots, s_n^*\right)$. The strategy of each payer is represented as s_i^* for i players. The strategy collected by each player is denoted as $S_{-i}^* = \left(s_1^*, \ldots, s_{i-1}^*, s_{i+1}^*, \ldots, s_n^*\right)$. The resource collected strategy of player can be stated in equation (2):

$$\mu_i\left(s_i^*, S_{-i}^*\right) \geq \mu_i\left(s_i, S_{-i}^*\right), \forall s_i \in S, i \in [1.n] \quad (2)$$

The player strategy characteristics are summarized to achieve the optimal strategy. The best player is identified based on the Nash equilibrium concept. The Nash equilibrium evaluates the dynamic relationship between players. When a player is identified, other players make a decision but that alone does not increase resources. For optimal resource allocation, Nash equilibrium adopts second-order derivatives stated in equation (3) as follows:

$$\frac{\partial^2 U}{\partial^2 B_{AP1}^{R2}} = -\frac{N^{R1}}{\left(B_{AP1} - \sum_{i=2}^{m*n+m+1} B_{AP1}^{R1}\right)^2} - \frac{N^{R2}}{\left(B_{AP1}^{R2} + B_{AP2}^{R2}\right)} < 0 \qquad (3)$$

It is observed that mixed partial derivatives are negative. Based on mixed partial derivatives Nash equilibrium is estimated using equation (4)

$$\frac{\partial^2 U}{\partial B_{AP1}^{R2} \partial B_{AP2}^{R2}} = -\frac{N^{R2}}{\left(B_{AP1}^{R2} + B_{AP2}^{R2}\right)} < 0 \qquad (4)$$

The application of second-order partial derivatives provides the utility function and mixed partial derivatives value of less than zero. It is known that the Nash equilibrium is unique for varying coverage areas and networks. By this means, resource allocation is optimized and resources are effectively optimized.

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is one of Multiple Attribute Decision Making (MADM) techniques which is utilized for finding the shortest path in the network by using efficient distance calculation using Euclidean formula which helps to finalize the non-ideal solution.

Step 1: Initially,find the transform units for all the attributes in the network with all maximized forms.

Step 2: Find the entropy for all the attributes by fixing the significant level.

Step 3: After finding the entropy, find the threshold level

Step 4: Find the weight for all the threshold coefficients

Step 5: After the determination of weighted coefficient, , the weights are computed for the requested service using the following equation

Weight of estimation of requested service = (weight of combination of QOS parameters initialized through entropy)× (threshold values of attributes of the requested services) (5)

After criteria weights inference, in common, normalized matrix can be changed into the weighted matrix

vij= (vj.vij) (6)

Here, Vij indicates the updated weight matrix, i.e., the multiplication of the weight coefficients matrix is produced by the entropy method and the weight obligation algorithm with the normalized weight matrix is given as follows.

Thus, the ideal solution is the set:

I = {(maxi vij (j±i(n=5))} (7)

The non-ideal solution is the set:

I = {(mini vij (j±i(n=5))} (8)

The distance between each option, from the positive ideal (pos) and negative ideal solution(neg), are definite as follows

$$(pos)=\sqrt{\sum_{j=1}^{n}(vij - vj(pos)^2}$$

$$(neg)=\sqrt{\sum_{j=1}^{n}(vij - vj(neg)^2}$$

Finally, the position of networks is performed by considering the qualifiedproximity to the ideal solution, expressed as

$$D\ (total) = \frac{D(neg)}{D(neg)+D(pos)} \qquad (9)$$

Where, the best network is the one with the largest relative closeness to the ideal solution

3.3 ENHANCEDNFOAOPTIMIZATION MODEL

The available resources are optimized for the fair allocation of resources to both LTE and UMTS. Normal form game theory focused on two factors such as cooperation and defect between players or channel resources. Here, the user coverage area is estimated for analyzing the network layer to the bandwidth region. The resource estimation between a channel with normal form game is calculated with consideration of various region bandwidth. For analysis, the total bandwidth of the channel is stated as B^{R_i} and coverage area is defined as*Ri.* The total bandwidth B^{R_i} is calculated using following equation (10) as follows:

$$B^{R_i} = \begin{cases} B_{AP_j}^{R_i} & j \in \{1\}, i \in \{1\} \\ B_{AP_1}^{R_i} + B_{AP_j}^{R_i} & \text{i}, j \in \{2, \ldots.m+1\}, i = j \\ B_{AP_1}^{R_i} + B_{AP_j}^{R_i} + B_{AP_k}^{R_i} & \text{i}, k \in \{m+2, \ldots.m \times n+1\}, j \in \{2, \ldots.m+1\} \end{cases} \quad (10)$$

The number of users available within the network and its demand is estimated using the queuing model. This model uses a queuing window for estimation of connection distribution within a specified area, the user blocking rate P^{R_i} is calculated using equation (11) stated below:

$$P^{R_i} = \frac{\left(V^{R_i}\right)^{N_i} / N_i!}{\sum_{j=0}^{N_i} \left(V^{R_i}\right)^j / j!} \quad (11)$$

In above equation, *Ni* represents number of connections available within allocated system *Ri.* V^{R_i} provides details about amount of resources utilized within coverage area *Ri.* The total channel is stated as N_i and total number of users are represented as *j*.The channel utilization rate *Ei*is calculated using equation (12):

$$E_i = \frac{V^{R_i}\left(1 - P^{R_i}\right)}{N_i} \quad (12)$$

The key indicator for effective allocation of network communication is the blocking rate, this varies between users. To minimize the blocking rate of channel resources need to be allotted statistically for the number of connections. The first resource*Ri*utilized within region N^{R_i} is calculated based on the distribution model with consideration of bandwidth B^{R_i} . The average connection bandwidth is calculated using equation (13):

$$\bar{b} = \left[\frac{B^{R_i}}{N^{R_i}}\right] \quad (13)$$

In algorithm 1, game theory applied in heterogeneous network allocation between LTE and UMTS is presented.

ALGORITHM 1: NORMAL FORM GAME THEORY

```
Input: the threshold of the blocking rate, the increase of the regional user K;
Output: connection request acceptance
 for j=1:k
P_curentCalCurrentBlockingProbability();
            admissionConnection();
                areaNumberOfUserAdd();
           end if
       time 0;
     while(time<=adjustmentThreshold)
         addAreaBandwith();
             getAreaConn();
                    P CalCurrentBlockingProbability();
              if(P <Ri)
              admissionConnection();
             areaNumberOfUserAdd();
             break;
          end if
       time++;
  end while
 if(time==adjustmentThreshold)
            return admissionUser;
          end if
     end for
```

Based on the above mentioned algorithm network time complexity factor and change in user is calculated. The stated algorithm adjusts the resources with respect to LTE and UMTS.

To detect whether user relies within BSS, for every time slot *t* energy detector is deployed. The probability of user within BSS is defined using equation (14):

$$P\gamma^{i}_{\det,k} = e^{-\frac{\alpha_{ik}}{2}} \sum_{b=0}^{B-2} \frac{1}{b!}\left(\frac{\alpha_{i,k}}{2}\right)^{b} + \left(\frac{1+\overline{\gamma_{ki}}}{\overline{\gamma_{ki}}}\right)^{b-1} \times \left[e^{-\frac{\alpha_{ik}}{2(1+\overline{\gamma_{ki}})}} - e^{-\frac{\alpha_{ik}}{2}} \sum_{b=0}^{B-2} \frac{1}{b!}\left(\frac{\alpha_{i,k}\overline{\gamma_{ki}}}{2(1+\gamma_{ki})}\right)^{b}\right] \quad (14)$$

Where,

b - time product of bandwidth;

α_{ik} - Energy detection threshold in k-th channel

γ_{ki} - PU average signal SNR, this is computed as $\gamma_{ki} = P\gamma^{i}_{\det,k}$ with transmitter channel consumption of Pk, with Gaussian noise variance as σ^2. The false probability of PU within SBS within k^{th} channel is computed using equation (15):

$$P\gamma^{i}_{f,k} = \frac{\Omega\left(b, \frac{\alpha_{i,k}}{2}\right)}{\Omega(b)} \quad (15)$$

Ω(, .,) represents gamma function. To improve performance spectrum are computed for varying channel condition of channel, using equation (16):

$$\alpha^{-k}_{i,j} = \alpha_k \tau^{k}_{ij} \quad (16)$$

In above equation ,i represented number of users within the channel and j relies on SBS as j ∈ S. The PU trust availability within PU is represented as τ. Based on trust computation ideal state of PU is computed using equation (17) as follows:

$$\tau^{k}_{ij} = P\gamma\left(i = C^{k}_{o} \middle| j = C^{k}_{o}\right) = \frac{P\gamma\left(C^{k}_{o}\right) j = C^{k}_{o}}{P\gamma\left(j = C^{k}_{o}\right)} \quad (17)$$

$P\gamma\left(i = C^{k}_{o} \middle| j = C^{k}_{o}\right)$ denotes probability of SBS lies within k channel. The channel are estimated based on the consideration of two players PU and SU with partitions of S_1 and S_2∈ N with $_1$ &i∈ S_2 f $_i(S_1)$ ≥ f $_i(S_2)$. The PU within SBS within network with game theory is defined in equation (183):

$$S_1 \geq_i S_2 \Leftrightarrow f_i(S_1) \geq f_i(S_2) \quad (18)$$

Where, S1 and S2 represents normal form game theory scenario wit preference function of f without any collision as defined in equation (19):

$$\omega_i = \begin{cases} \alpha_i(S) & if\left(a_j(S) \geq a_j(S\{i\})\right), \forall_j \in S\{i\} \\ \infty & Otherwise \end{cases} \quad (19)$$

4. PERFORMANCE ANALYSIS

In this section, we will test and evaluate our proposed scheme through extensive simulation experiments and the results obtained for the proposed NFOA is presented. The proposed scheme adopts Normal form game theory integrated with an optimization algorithm for handover process between LTE and UMTS in heterogeneous network. For analysis, the simulation setup consists of 10 relay stations deployed within the are 800 × 800m^2. The number of frequency bands considered is 8 with 6 channel availability. The selected bands operate with 10MHz with a maximal channel transmission capability of 10W in every band. The maximal transmission range of PU is stated as 250m with maximal 500m interference. Total optimization iteration is considered as 1000 with a buffer size of 8k bytes.On the other hand, compare the proposed method with the three existing hybrid MADM methods (i.e., Hybrid Fuzzy Analytic Hierarchy Process (FAHP)& Technique for Order Preference by Similarity to an Ideal Solution -Hybrid FHAP-TOPSIS), by the repeated network selection experiments in the dynamic simulation environment.

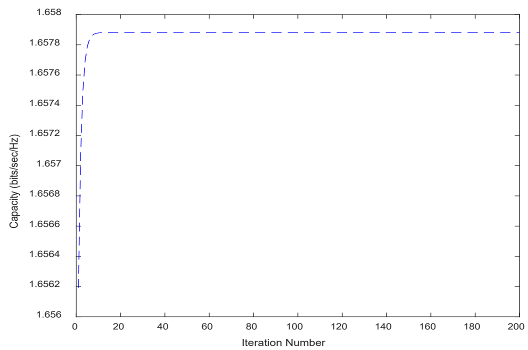

Figure 3: Allocated Channel for Assigned Frequency

From figure 3, it is observed that with the increase in traffic volume blocking rate is increased. The proposed NFOA significantly reduces the channel blocking rate with an increase in the volume of resources and an increase in the number of connections within the network. This implies that the proposed NFOA significantly reduces the blocking probability.

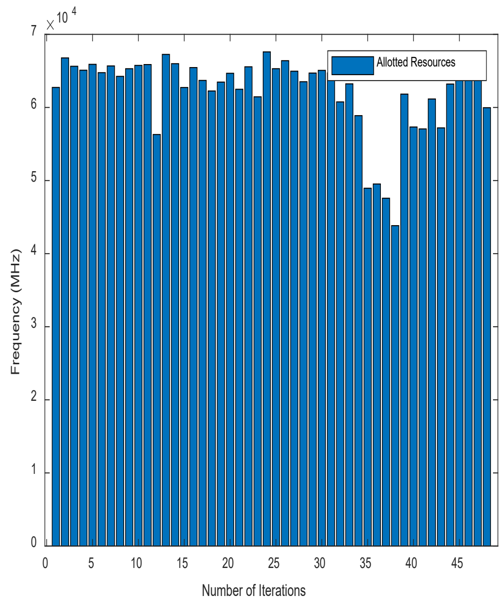

Figure 4: Number of Allotted Channels

In figure 4, it is observed that for a varying number of iterations for the assigned channel frequency range of 0.07 MHz is utilized for data transmission between LTE and UMTS. Further, it is stated that frequency variation is obtained for every iteration this implies the variation in data traffic.

In table 2 comparative analysis of the proposed NFOA game theory with existing Hybrid Fuzzy Analytic Hierarchy Process (FAHP)& Technique for Order Preference by Similarity to an Ideal Solution -Hybrid FHAP-TOPSISare presented in terms of computation timeis presented.

Table 2: Comparison of Running Time and End-to-End Delay

Number of Users	Running Time (ms)		End-to-End Delay (ms)		Jitter (ms)	
	Hybrid FHAP-TOPSIS	Proposed NFOA	Hybrid FHAP-TOPSIS	Proposed NFOA	Hybrid FHAP-TOPSIS	Proposed NFOA
50	1126	1020	21	15	34	17
100	1260	1178	29	23	27	13
150	1903	1605	47	36	41	23
200	1978	1745	55	43	35	20

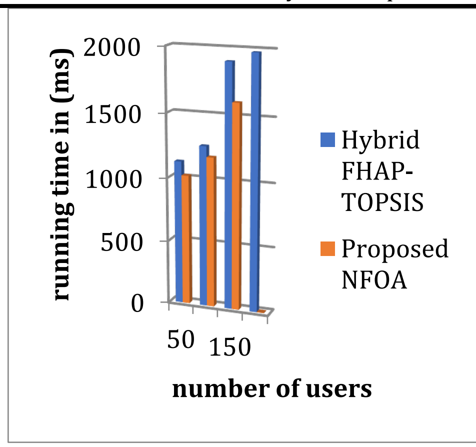

Figure 5: Comparison of running time

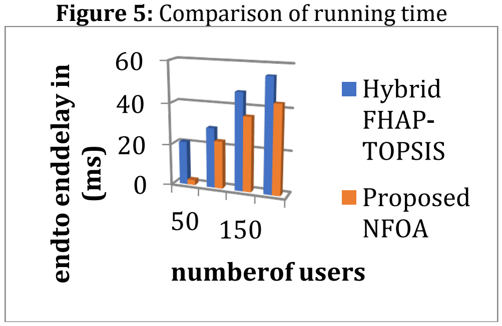

Figure 6: Comparison of end to end delay

From figure 5 and 6, it is observed that for a varying number of users, running time is significantly increased. Moreover, with the application of optimization, data were significantly transmitted over the network which decreases the end-to-end delay.

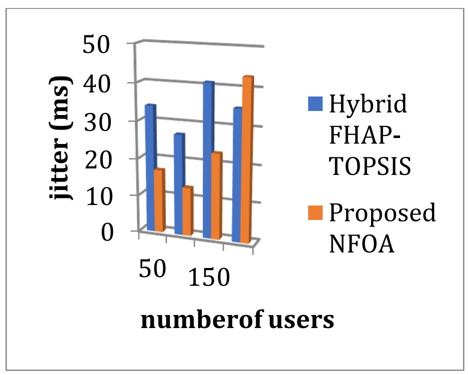

Figure 7: Comparison of end to end delay

From figure 7, it is observed that for a varying number of users, jitter is significantly decreased. Moreover, with the application of optimization, data were significantly transmitted over the network which decreases the jitter.

In table 3 overall comparison of proposed NFOA with different parameters in terms of simulation time, PDR, throughput, and Average transmission power are presented.

Table 3: Comparison of Parameters

Number of Users	Throughput (%)		Average Transmission Power in dBm		PDR (%)		Bandwidth (bps)	
	Hybrid FHAP-TOPSIS	Proposed NFOA	Hybrid FHAP-TOPSIS	Proposed NFOA	Hybrid FHAP-TOPSIS	Proposed NFOA	Hybrid FHAP-TOPSIS	Proposed NFOA
50	64	87	46.63	39.76	97.56	98.76	76.8	89.3
100	70	83	51.78	40.07	93.45	97.83	67.4	79.4
150	74	79	56.78	41.67	91.5	95.67	67.9	87.2
200	78	81	63.67	42.87	89.45	91.84	78.9	98.3

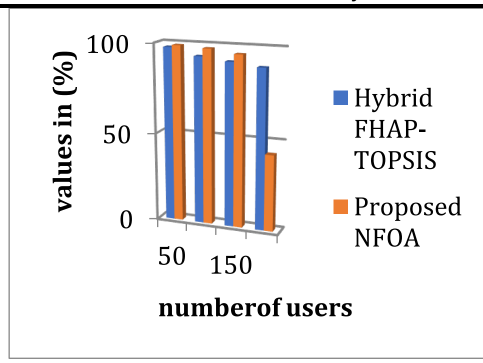

Figure 6: Comparison of packet delivery ratio

The PDR expresses the successful transmission of data for the allotted channel. The PDR analysis exhibits the successful reception of data from source to destination. From the analysis, it is observed that the proposed approach offers higher PDR rather than an existing technique

5. CONCLUSION

This paper focused on improving the performance of heterogeneous to meet the major challenge as it is needed to ensure seamless mobility across different radio air interfaces. . However, a vast range of techniques are incorporated in handover decision process between LTE and UMTS are a challenging task. This research developed a novel technique NFOA with TOPSIS method for better handover decision with transmission process. An optimization search algorithm is applied to reducing the complexity and obtaining the optimal global solution. The simulation results show the improved performance in terms of PDR and throughput with decreased end-to-end delay, simulation time and power consumption. The increase in the running time stated that data were effectively transmitted through the available nework. Also, the increase in PDR rate implies that through effective utilization of channel, data are transmitted significantly from LTE and UMTS.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCE

F. Kaleem, A. Mehbodniya, A. Islam, K. K. Yen,F.Adachi, "Dynamic target wireless network selection technique using fuzzy linguistic variables ,"China Communications, vol.10, no.1, pp.1-16,2013

Y. Sun, Y. M. Ge, H. Stephen, D. W. Eryk, "Research on multimode terminal service flow distribution in heterogeneous networks,"Computer Science, vol.33, no.6, pp.1004-1013,2010.

Y. T. Ling, L. L. Liu, J. B. Wu, "Multi-service wireless access selection method based on group decision-making," Mobile Communications, no.3, pp.119-124,2014.

Niyato, E. Hossain, "Dynamics of network selection in heterogeneous wireless networks: an evolutionary game approach,"IEEE Transactions on Vehicular Technology, vol.58, no.4, pp.2008-2017,2009

J. S. Wu, S. F. Yang., B. J. Hwang B.J., "A Terminal-Controlled Vertical Handover Decision Scheme in IEEE 802.21-Enabled Heterogeneous Wireless Networks", International Journal of Communication Systems, vol. 22, 819-834, 2009.

K. Savitha, and C. Chandrasekar, "Vertical Handover decision schemes using SAW and WPM for Network selection in Heterogeneous Wireless Networks," *Global Journal of Computer Science and Technology,* Vol. 11, No.9, pp. 1-7, May 2011

K. Savitha, C. Chandrasekar, "Grey Relation Analysis for Vertical Handover Decision Schemes in HeterogeneousWireless Networks," *European Journal of Scientific Research,* Vol. 54, No. 4, pp. 560-568, 2011.

V. A. Narayanan, A. Rajeswari and V. Sureshkumar, "An Intelligent Vertical Handover Decision Algorithm for Wireless Heterogeneous Networks," *American Journal of Applied Sciences,* Vol. 11, No. 5, pp. 732-739, 2014.

R. Verma and N. P. Singh, "GRA Based Network Selection in Heterogeneous Wireless Networks," *International Journal of Wireless PersonalCommunications,* Vol. 75, No. 2, pp. 1437-1452, September 2013.

Yu, H., Ma, Y., & Yu, J. (2019). Network selection algorithm for multiservice multimode terminals in heterogeneous wireless networks. *IEEE Access*, *7*, 46240-46260

Liang, G., Yu, H., Guo, X., & Qin, Y. (2019). Joint access selection and bandwidth allocation algorithm supporting user requirements and preferences in heterogeneous wireless networks. *IEEE Access*, *7*, 23914-23929.

Bazrafkan, A., &Pakravan, M. R. (2017, May). An MADM network selection approach for next generation heterogeneous networks. In *2017 Iranian Conference on Electrical Engineering (ICEE)* (pp. 1884-1890). IEEE.

Almutairi, A. F., Landolsi, M. A., & Al-Mashmoum, H. Q. (2016, September). Performance of different weighting techniques with DIA MADM method in heterogeneous wireless networks. In *2016 International Wireless Communications and Mobile Computing Conference (IWCMC)* (pp. 921-925). IEEE.

El Helou, M., Ibrahim, M., Lahoud, S., Khawam, K., Mezher, D., & Cousin, B. (2015). A network-assisted approach for RAT selection in heterogeneous cellular networks. *IEEE Journal on Selected Areas in Communications*, *33*(6), 1055-1067.

Lahby, M., Cherkaoui, L., & Adib, A. (2013, May). Novel validation approach for network selection algorithm by applying the group MADM. In *2013 ACS International Conference on Computer Systems and Applications (AICCSA)* (pp. 1-4). IEEE.

K.Nirmaladevi, Dr.K.Prabha, "An Efficient Energy of Mobile Pattern Ad-Hoc Networks in Reactive Routing Protocols", International Journal of Innovative Technology and Exploring Engineering, Issn – 2278 3078, Volume 8, Issue 9, July 2019.

J.Santhi, Dr.K.Prabha, "An MADM Algorithm for vertical Handover Decision in Heterogeneous Wireless Networks", International Journal of Recent Technology and Engineering, Issn – 2277 3878, Volume 8, Issue 1, May 2019.

Soja, Edward W. *Third space: Journeys to Los Angeles and Other Real-and-Imagined Places*. Blackwell Publishers, 1996

Shakespeare, William. *As You Like It*. Edited by H.J. Oliver, Oxford University Press, 1993

West-Pavlov, Russell. "Shakespearean Space in Contemporary Critical Theory." *Shakespeare Survey*, vol. 68, 2015, pp. 254-266

Bachelard, Gaston. *The Poetics of Space*. Beacon Press, 1994

Eagleton, Terry. *The Ideology of the Aesthetic*. Blackwell, 1990

Friedman, Susan Stanford. "Women's Autobiographical Selves: Theory and Practice." *Women's Studies: An Interdisciplinary Journal*, vol. 15, no. 1, 1988, pp. 5-19.

Harrison, G.B. *Forest of Arden in Drama: A Study of As You Like It*. The University of Michigan Press, 1963

Lynch, William F. "The Functions of the Forest of Arden in Shakespeare's *As You Like It*." *Studies in Philology*, vol. 50, no. 1, 1953, pp. 42-53

Norbrook, David. *Writing the English Republic: Poetry, Rhetoric and Politics, 1627-1660*. Cambridge University Press, 1999

Ogburn, Charlton. "Romantic Ideology and the Rural Tradition in *As You Like It*." *Shakespeare Quarterly*, vol. 38, no. 4, 1987, pp. 432-447.

Rutherford, Jonathan. *The Third Space: Interview with Edward Soja*. Sage Publications, 1996.

Smith, Neil. *Uneven Development: Nature, Capital, and the Production of Space*. Blackwell Publishers, 1984.

Tuan, Yi-Fu. *Space and Place: The Perspective of Experience*. University of Minnesota Press, 1977.

Zukin, Sharon. *Landscapes of Power: From Detroit to Disney World*. University of California Press, 1991.

Bakhtin, Mikhail. *The Dialogic Imagination: Four Essays*. University of Texas Press, 1981

Foucault, Michel. *The Archaeology of Knowledge*. Routledge, 2002.

Butler, Judith. *Bodies That Matter: On the Discursive Limits of "Sex"*. Routledge, 1993.

Hall, Stuart. "Cultural Identity and Diaspora." *Identity: Community, Culture, Difference*, edited by Jonathan Rutherford, Lawrence & Wishart, 1990, pp. 222-237.

Said, Edward W. *Culture and Imperialism*. Vintage Books, 1994.