Simple Additive Weighted Algorithm for Vertical Handover in Heterogeneous Network

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***Abstract*— 5G mobile communication is not only promising very high data rate but ubiquitous connectivity and very small latency along with many other extreme performance parameters. Additionally, 5G is also expected to provide seamless connectivity to the users and ensure smooth handover across heterogeneous networks. There are various decision-making algorithms to carry out the handover process. The paper describes the simple additive weighting algorithm to select the best network for handover.**

Keywords—Heterogeneous networks, vertical handover, decision making algorithms, simple additive weighting.

I. Introduction

As the present, frequency spectrum saturates with increasing users. The demand for better service in terms of traffic, speed, connectivity, accessibility area coverage is shifting the entire frequency spectrum to Giga Hertz range to meet the high expectations for mobile broadband services especially towards fifth generation (5G) networks [1]. 5G guarantees higher data rates, more connected devices, enhanced wireless capability and enhanced support for the Internet of Things (IoT), multimedia and cloud computing environment [2]. As, the current and next generation is expected to consist of various radio access networks, vertical handover [3] techniques become crucial for seamless mobility management which provides good connectivity to the users during switching between networks.

An optimized vertical handover management system will be beneficial in minimizing the signalling overhead in the network and avoid the unnecessary handovers taking place between the neighbouring cells [4]. The complete handover procedure has three phases: (i) Handover Initiation- collects all required information like the RSS, mobile speed, latency, from available networks. (ii) Handover Decision - uses decision making algorithms to analyze the collected information and select the target network to which the call will be handover; and (iii) Handover Execution - takes care of connecting to the selected network.

For seamless handover, various vertical handover decision making algorithms have been proposed which are based on traffic environments and network scenario [5]. In a heterogeneous network, the use of single criterion for deciding handover makes the handover process inefficient as each network has its own characteristics. Hence, multicriteria decision making algorithms are preferred for efficient handover; involving RSS, SNR, bandwidth, latency, traffic class, speed, and network occupancy [6]. The multicriteria methods are:

a) ***Simple additive weighting (SAW):*** The taget network for handover is selected by comparing the network score of the available candidate networks which can be calculated by adding the normalized parameters and then multipling each of the values by a predefined weight [5].

b) ***Technique for order preference by similarity to ideal solution (TOPSIS*** The network which is closest to the ideal solution is selected from the available candidate network for carrying out the handover procedure [6]. The ideal solution is determined by taking the best parameter values from each of the input parameter metric.

c) ***Grey relational analysis (GRA)****:* a list of available networks is created in the descending order of assigned weights. The highest weight network will be placed on the top of the list [7]. After this, GRC is calculated for each network which gives a network score where the highest score gives the target network.

d) **Multiplicative exponent weighting (MEW):** The handover decision problem is represented in matrix form, with the rows representing the candidate networks and the columns representing the corresponding network parameter. Network score for each network is calculated based on the weighted product of this parameters and compared with ideal network [7]. The network with the best score gets selected as the targeted network for the handover.

II. Proposed Method

The main objective is to combine various decision-making criteria, compare them to provide seamless handover. Present work consists of simple additive weighting (SAW) algorithm. The multicriteria parameters considered are RSS, SNR and bandwidth signals received from different candidate networks. The flowchart of the work is as shown in Fig.1.

Each of the mobile input to this algorithm is the normalized values of each of the parameters RSS, SNR and bandwidth. The normalization of each of the values of the matrix is done by using the equation 1 as shown.

$$Xij(normalized) = Xij/Xmax(of\ each\ parameters) \quad (1)$$

Where $Xmax$ is the maximum value of each of the parameters. After normalization, weights are assigned to each of the parameters based on which priority matrix is

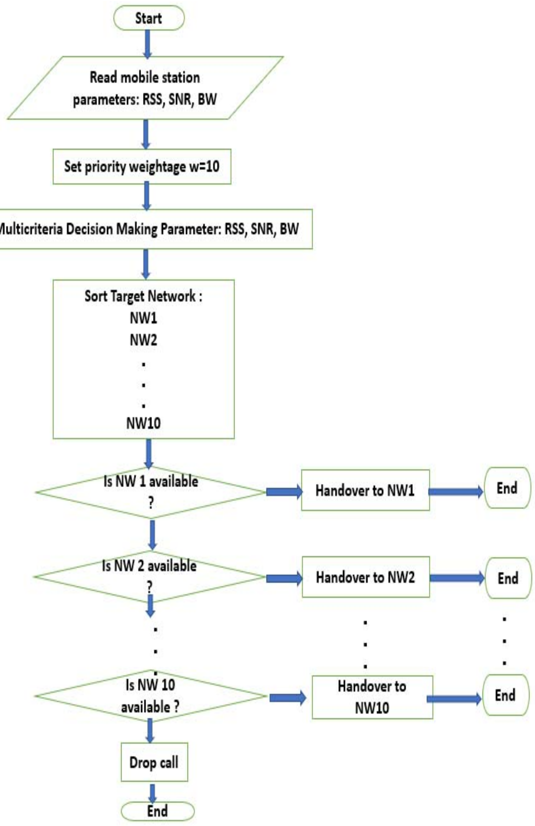

Fig 1: Flowchart of the proposed work

calculated and the network score is calculated based on equation 2:

$$Network\ Score = w * RSS + w * SNR + w * BW \quad (2)$$

Where, w is the assigned weight, RSS is received signal strength, SNR is signal to noise ratio and BW is bandwidth of the received signal. The algorithm calculates the network scores for each of the networks. At present, ten networks are selected and three mobile parameters of each network are considered which are RSS, SNR and BW, which are normalized and multiplied with a predefined weight W of 10 and network score is calculated. This is repeated for all the available candidate networks so that each candidate network has a network score. The network having the maximum score is considered as the target network for handover process.

III. Results

The simple additive weighting algorithm is simulated in MATLAB and a network score table is shown in Table 1. In the present work, 10 networks are considered which are Nw1, Nw2, …. Nw10. c1, c2 and c3 are the three mobile input parameters RSS, SNR and bandwidth BW. The weight $\boldsymbol{w}$ is considered as a constant value of 10 for each of the parameters. This weight can be changed based on the priority of each of the parameters. The best candidate network selected for handover procedure is network 9 Nw9.

As the mobile input parameters are randomly generated, each time the program runs a different network would be selected as the best network.

TABLE 1. Network Score table of the SAW algorithm

Network Score	**Mobile Input Parameters**		
	RSS	***SNR***	***Bandwidth BW***
Nw1	15.761	65.574	70.605
Nw2	97.059	3.5712	3.1833
Nw3	95.717	84.913	27.692
Nw4	48.538	93.399	4.6171
Nw5	80.028	67.874	9.7132
Nw6	14.189	75.774	82.346
Nw7	42.176	74.313	69.483
Nw8	91.574	39.223	31.71
Nw9	79.221	65.548	95.022
Nw10	95.949	17.119	3.4446

IV. Ongoing Work

In the next phase real time data transmission can be collected and analyzed, to decide on the target cell to carry out handover. Different networks like LTE, WiFi, WiMax, etc. can be considered and the SAW algorithm can be used to decide on the best network for vertical handover. Also, to enhance the decision making, more parameters like jitter, power consumption, bit error rate and data-rate can be considered. The four traffic classes conversational, streaming, interactive, and background. can also be considered.

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