Algorithm for Selection of Best Network for Handover based on GRC

Siddhartha Goutam
Operations & Research and Business Analytics (RBA)
Prin.L.N.Welingkar Institute of Management Development and Research(PGDM)
Mumbai, India
sgoutam07@gmail.com

ORCID 0000-0001-6780-9080

***Abstract*— As of today, multiple heterogeneous wireless networks have been deployed across geography. This has become possible due to developments & growth in the areas of Information & Communication Technologies. Considering the simultaneous existence of multiple Radio Access Technologies (RATs), the problem pertaining to the selecting the best n/w, all the time & place, has become crucial. The smart mobile phone user, based on his requirements and priorities, should get latched to the best network among the available set of various candidate n/w. The issue of network selection can be resolved by effective Vertical Handover (VHO). The choice of the best network can be made by applying the multi attribute decision making technique called as Grey Relational Coefficient (GRC). This research paper presents an algorithm for network selection based on GRC. The scores of the networks are calculated basis GRC and then the handover is happens to the best network. The main criteria considered for network selection are RSS, bandwidth, cost & user velocity.**

Keywords—Vertical Handover (VHO), Grey Relational Coefficient (GRC), Received Signal Strength (RSS), Heterogeneous Networks (HetNets)

I. INTRODUCTION

There is presence of HetNets across geography due to implementation of RATs. Figure 1 describes the presence of HetNets [1] [2] [3] [4].

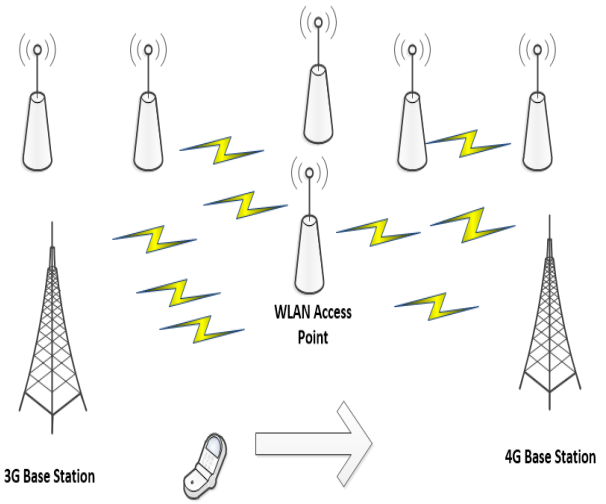

Fig. 1. Presence of Heterogeneous Networks Across Geography

II. THEORECTICAL BACKGROUND

A. *Grey Relational Coefficient (GRC)*

In this Multi Attribute Decision Making (MADM) technique, the analysis of relational grade for multiple discrete sequences can be performed and the best one is choosen.

The following are the steps followed.

Step 1: VHO decision is captured into a matrix in which each row denotes available networks and columns represents the multiple n/w attributes.

No. of N/ws : r

No. of criteria for decision : k

Each network is represented in ith row

Each decision making criteria is represented in jth column

Accordingly the under-mentioned matrix form is formed [5] [6] [7] [8]:

$$T_{rxk} = \begin{pmatrix} t_{11} & \cdots & t_{1k} \\ \vdots & \ddots & \vdots \\ t_{r1} & \cdots & t_{rk} \end{pmatrix} \quad (1)$$

Step 2: Each and every element of above matrix is normalized as under :

$$c_{ij} = \frac{t_{ij}}{\sqrt{\sum_{i=1}^{i=r} t_{ij}^2}} \quad (2)$$

while j is varying from 1 to k

Step 3 : Analytic Hierarchy Process (AHP).

The weights pertaining to the attributes are computed using AHP.

GRA score will be calculated using these weights [5][9][10][6] . Figure 2 shows the Analytic Hierarchy Process (AHP)

Algorithm ; Analytic Hierarchy Process (AHP)

Input(s) :
- Number of parameters
- RSS
- Bandwidth
- Cost
- Velocity of User

Calculated Data:
- Consistency Index (CI), Consistency Ratio (CR)

Output :
- Weights of the parameters

Steps to be followed :

1. Construct the pairwise matrix for parameters
2. Calculate the normalized matrix
3. Calculate the weights of the parameters wj
4. Calculate the Consistency Index and Consistency Ratio
5. Check the consistency of comparison
6. Is CR < 0.1 ?
7. If Yes . Move to Step No 9
8. If No. Modify the pair-wise comparison. Go to 1
9. The pairwise comparison is correct. Weights of the parameters to be used for further calculations.

Fig. 2. Analytic Hierarchy Process (AHP)

III. Design & Implementation

There are two networks considered for implementation. The first network is 4G while the other network is Wireless Local Area Network (WLAN).

The parameters which have been taken into consideration for designing of the algorithm are as depicted in Figure 3. [11][12][13][3][14][15].

Figure 3 shows the parameters for VHO.

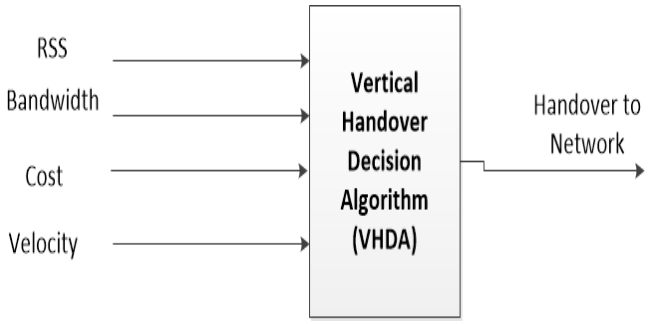

Fig. 3. Parameters for VHO

Figure 4 depicts the phases of Handover. Figure 5 & 6 shows the handover execution process considering the two networks 4G & WLAN and decision making process respectively[16][17][18][19][21]-[25].

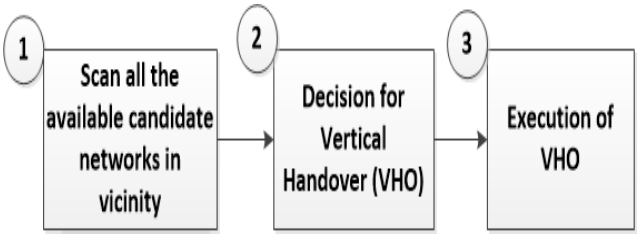

Fig. 4. Phases of Handover

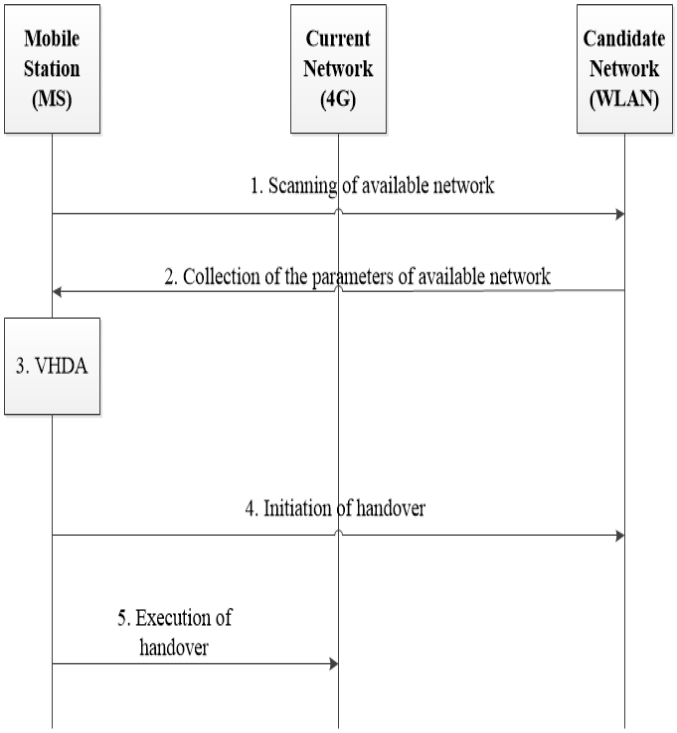

Fig. 5. Handover Execution Process

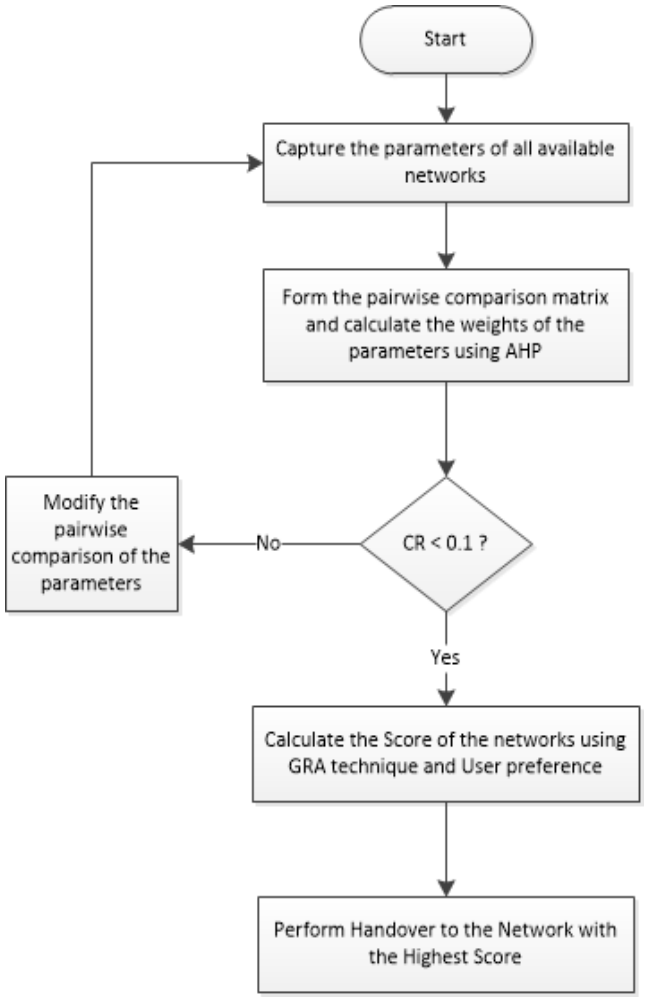

Fig. 6. Flowchart for Decision Making for Network

IV. Experimental Scenario

A. *Scenario*

In the experimental scenario considered, the mobile user (4G user) entering at Café. The café has WLAN for the customer.

The mobile user has the option of continuing to be latched on to 4G or be handed over to WLAN.

4G : current N/w & WLAN : available candidate N/w.

Figure 7 describes the scenario.

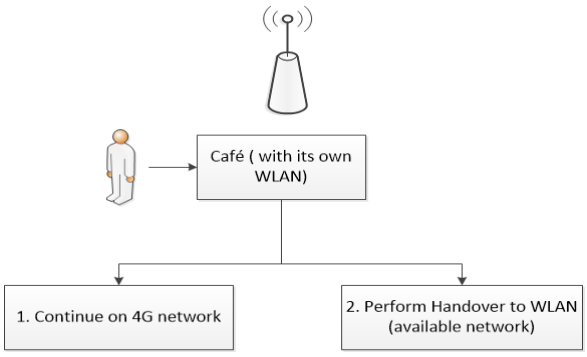

Fig. 7. Experimental Scenario

B. *Simulation Parameters*

Figure 7 & 8 represents the practical value of bandwidth and RSS value for 4G respectively.

Similarly, the values for other networks are measured practically.

Fig. 8. Measurement of Bandwidth for 4G

Fig. 9. Measurement of RSS for 4G

C. *Results*

We have measured the values practically for both the networks and have normalized the values on the scale of 0 to 1.

The Score value has been calculated using GRC.

Figure 10 shows the Score value of both networks.

- Score Value for 4G: 0.25
- Score Value of WLAN: 0.0833

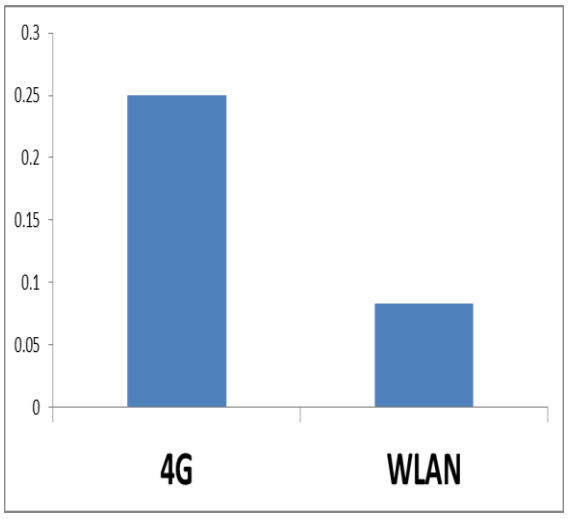

Fig. 10. Score Value for two networks

Since we have observed that

Score Value $_{WLAN}$ < Score Value $_{4G}$

the mobile user should continue on 4G.

It can be observed that the preference of the user towards WLAN can be low due to security parameters. WLAN is considered to be less secure than 4G. From the below mentioned equation , we infer that

Security $_{WLAN}$ < Security $_{4G}$ (3)

Using WLAN at Public place may not be preference of the user.

V. Conclusion & Future Work

. In this research paper, we have designed and simulated an algorithm for Vertical Handover based Grey Relational Coefficient. The values considered for the implementation have been measured practically and normalized.

In future, we intend to make the algorithm more dynamic and robust by including more number of criteria that can be user specific, increasing the number of simultaneously available candidate networks and testing in multiple network scenarios.

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