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Energy aware-RSS based Vertical Handover decision algorithm

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ABSTRACT

Advances in communication system have lead to increase in services provided by various network technologies, to satisfy increasing user demands. Users want to access their varying services to remain connected to best service, which is achieved through handover. In this paper, we have discussed various network selection parameters, used to initiate the handover process, various network selection techniques and network selection algorithms which use network selection techniques to select the best network for handover. We have proposed an MADM based network selection algorithm taking RSS, bandwidth and network power dissipation as main network selection parameters. The proposed algorithm reduces the handover delay and number of handovers. It provides us with improved and efficient handover algorithm.

Keywords: Bandwidth, Multiple attributes, Power dissipation, Received Signal Strength, Terminal battery, Vertical handover.

1. INTRODUCTION

Fourth generation wireless networks are expected to support the heterogeneous environment. A Heterogeneous network (HetNet) consists of several Radio Access Technologies (RATs) working together to provide better services to the users. In heterogeneous network to provide the best connectivity to the user a process called handover is used, which switches the user between different RATs depending on his requirements to maintain the Quality of Service. Handover is classified into two categories – horizontal handover and vertical handover. When handover takes place between same types of RATs (e.g. CDMA to CDMA) it is termed as Horizontal Handoff (HHO) or intra-technology handover and when it takes place between different RATs (LTE to Wi-Max) it is called Vertical Handover (VHO) or inter-technology. VHO takes place in heterogeneous environment i.e. HetNets. [1, 2]

2. VHO PROCESS

VHO is executed in four stagesas depicted in the figure below. [3-5]

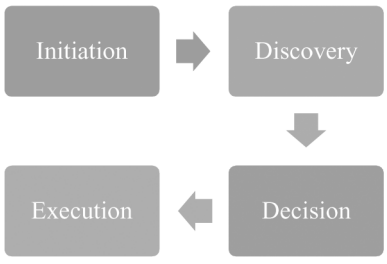

Figure 1: VHO process

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Handover initiation phase checks for any drop from the threshold value of the network section parameters. Network discovery phase discovers the available network present as the alternative to the current network and information regarding the same is exchanged. In handover decision phase VHO decision algorithm is used to select the best alternative among the candidate networks available. And finally connections are transferred and resources are reallocated to the new network by handover execution phase.

3. NETWORK SELECTION PARAMETERS

In VHO, the mobile terminal decides whether to handover to the new network or to continue with the current network. This decision depends on a number of parameters, known as network selection parameters. [6-9]

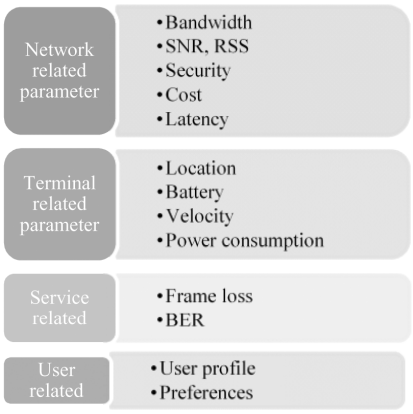

Figure 2: Network selection parameters

4. VHO DECISION ALGORITHM

VHO decision algorithm helps the mobile terminal to select the best alternative among the candidate networks available for handover. The VHO decision algorithms are categorized into following categories as shown in figure 3.

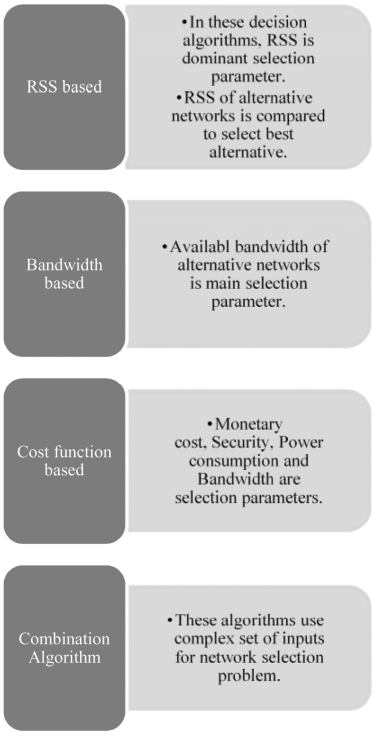

Figure 3: Network selection algorithm

5. VHO PERFORMANCE EVALUATION MATRICES

VHO performance evaluation matrices [4]

A. *Handover delay:* It is the time required to execute handover process.

B. *Number of Handovers:* Vertical handover algorithm should avoid unnecessary handovers to save resources.

C. *Handover failure probability*: It should be minimum so as to provide quality of service to the users.

D. *Throughput:* The network selected should provide users with greater throughput as compared to the current network.

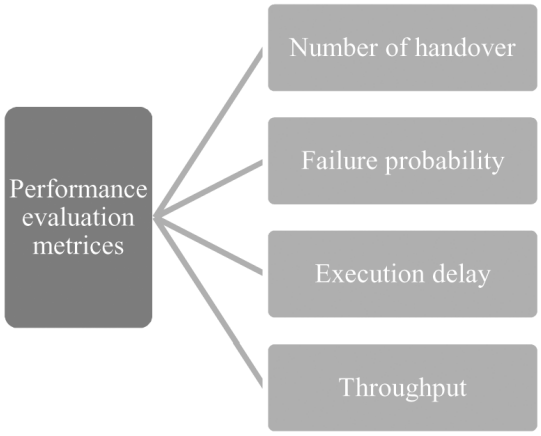

Figure 4: Performance evaluation matrices

6. TECHNIQUES FOR NETWORK SELECTION

Various network selection techniques have been designed for network selection when provided with multiple networks to choose the best network from. These techniques have been used by many researchers for designing the network selection algorithm and are stated below. [5]

A. Multiple Attribute Decision Making (MADM), involve ranking of the alternative present in the heterogeneous environment. Several MADM methods for networks selection have been proposed. MADM methods consist of GRA (Grey Relational Analysis), TOPSIS (technique for order preference by similarity to ideal solution), MEW (multiplicative exponent weighting) and AHP (Analytic Hierarchy process). MADM techniques are most popular and are most widely used for network selection algorithm design. [10]

B. Fuzzy Logic based network selection: Fuzzy logics deals with imprecise data. The aim of fuzzy logic is to convert physical measurementsinto fuzzy concepts. [11] The aim of fuzzy logic is is to design a computerized method for network selection. These methods rely on human intelligence. Network with highest fitness rank is selected for handover.

C. Game theory based network selection: Game theory presents a mathematical model for network selection. Game theory can be categorized into co-operative and non-cooperative techniques. A game theory model consists of 3 parameters which are players, strategies and payoffs. [12]

D. Utility theory based network selection: In this technique, utility function (cost) associated with each network is considered. the network having the largest overall sum and which satisfies the user requirements is selected for handover.

*E. Combining multiple methods for network selection:*Multiple network selection techniques can be merged to design a new, network selection algorithm for selection of the best network for handover. Table

1 compares different network selection techniques. the designer can choose network selection technique depending on his requirements and features of the network selection algorithm.

7. PROPOSED METHODOLOGY

The prime objective of the proposed methodology for network selection is to improve the decision making efficiency for Vertical handover. Purpose of the proposed technique is to efficiently use network selection algorithm to perform handover to network which consumes less energy, satisfies user preferences. RSS and terminal battery are considered as network selection parameters, which initiate the handover process when fall below threshold values. The handover decision is made by MADM based techniques. Various parameters under consideration are given in table 1.

Table 1
Parameters

General parameters	*Number of candidate networks*
Network related parameters	Threshold bandwidth Threshold Received Signal Strength (RSS) Threshold terminal battery Available bandwidth Received Signal Strength Power dissipation Number of candidate networks Connection time

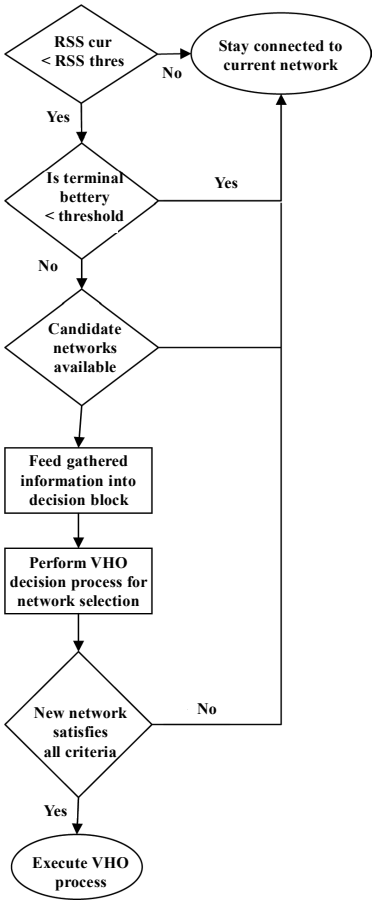

Figure 5: Flow chart of proposed methodology.

Table 2
Comparison between different network selection techniques.

Technique	*Objectiveof technique*	*Execution Speed*	*Algorithm complexity*	*Efficiency*	*User-preferences consideration*
MADM	Combines multiple attributes	Fast	Less	High	Yes
Game Theory	Equilibrium management in multiple entities	Moderate	High	Moderate	No
Utility Theory	Utility evaluation	Fast	Less	Moderate	Yes
Fuzzy logic	Imprecise data handling	Fast	Less	High	Yes

8. RESULTS

The results have been obtained, considering the input parameters. Simulations have been performed for 10 networks, considering threshold values for RSS and terminal battery level.

Experiment 1. The values of general parameters and individual network parameters are stated in the table 3 and table 4 below, and the graphs depict the results thus obtained. The results thus obtained by the proposed algorithm are represented in figure 6 and 7. The results show that the proposed algorithm helps to reduce call blocking probability during handover process and is also reduces number of handover as the number of networks available for handover increases.

Table 3
General parameter values.

Number of candidate networks	10
Threshold RSS	-350
Threshold Bandwidth	100
Threshold terminal battery	25

Table 4
Network related parameters.

Network	*Parameter values in sequence*
1	-300,150,0,1,1
2	-300,200,1,1,2
3	-300,160,0,2,2
4	-300,120,1,2,2
5	-300,120,1,2,2
6	-300,125,2,2,1
7	-300,160,2,1,1
8	-300,250,1,1,1
9	-300,120,0,1,2
10	-300,150,0,2,1

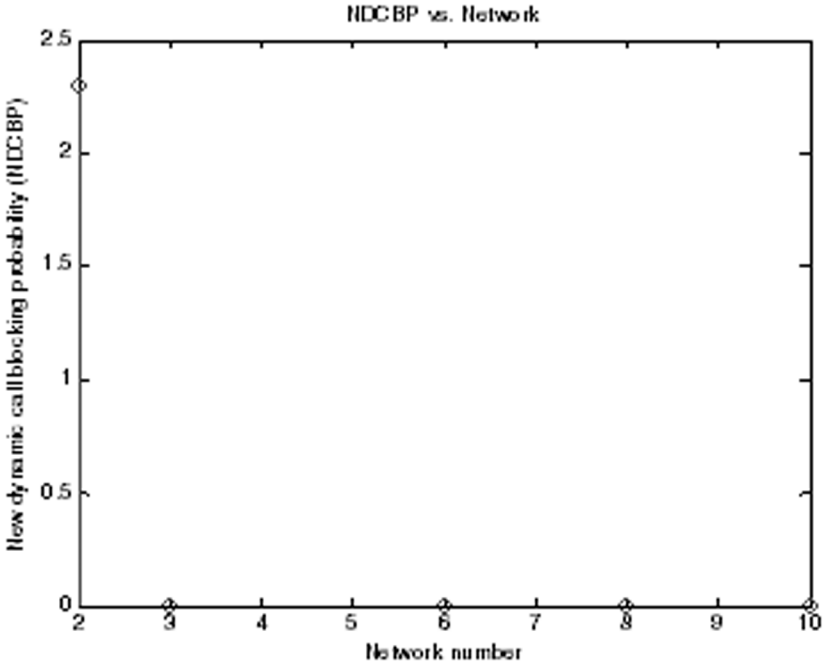

Figure 6: Call blocking Vs. Network Number for 10 Networks.

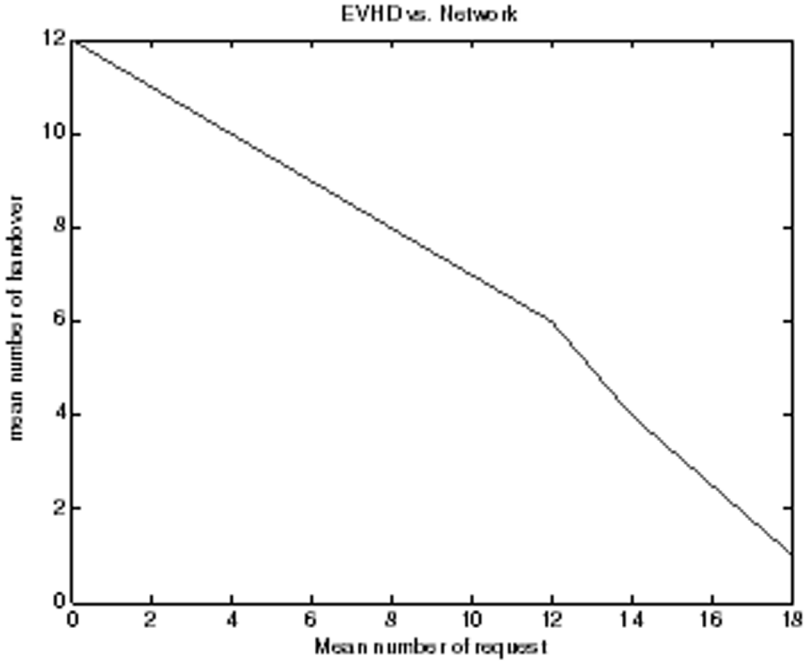

Figure 7: Number of handover v/s number of requests received by Network

Experiment 2. In second experiment we consider 5 networks for handover process. The general parameters and individual network related parameters are given in table 5 and table 6, followed by the results obtained from the algorithm in figure 8 and 9.

Table 5
General parameter values.

Number of candidate networks	5
Threshold RSS	-200
Threshold Bandwidth	75
Threshold terminal battery	20

Table 6
Network related parameters.

Network	*Parameter values in sequence*
1	-150,100,2,1,1
2	-150,120,2,3,3
3	-150,170,3,2,4
4	-160,100,4,1,3
5	-170,110,2,1,4

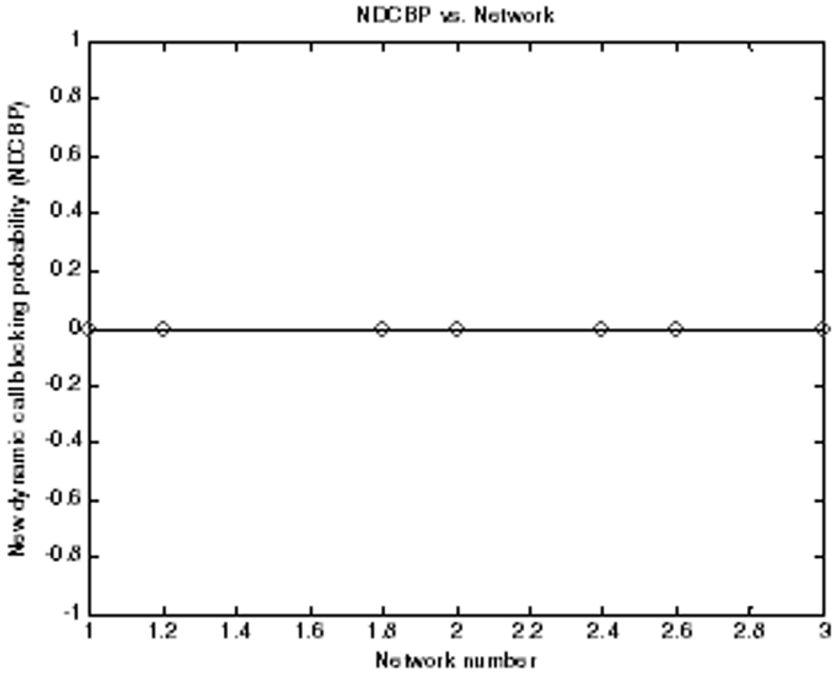

Figure 8: Call blocking Vs. Network Number for 5 Networks

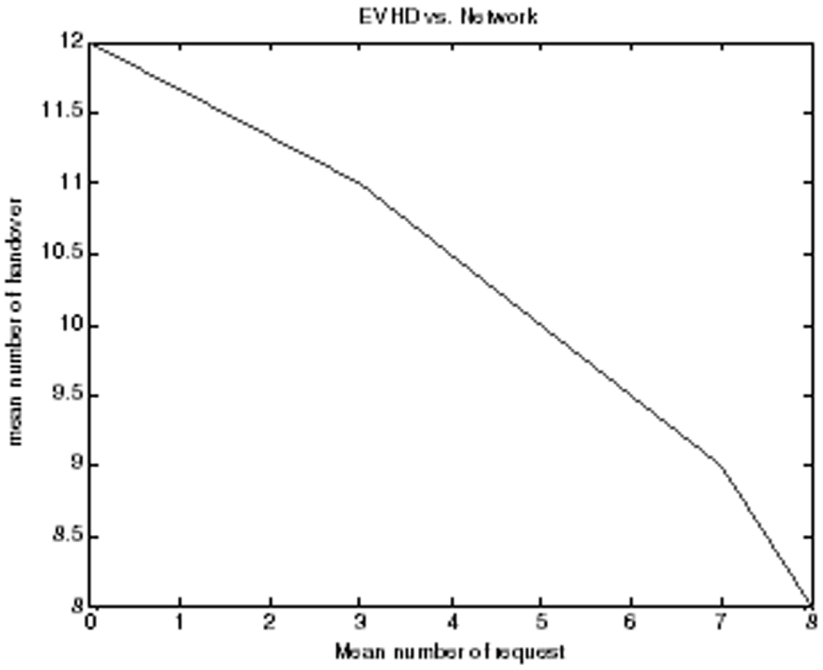

Figure 9: Number of handover v/s number of requests received by Network

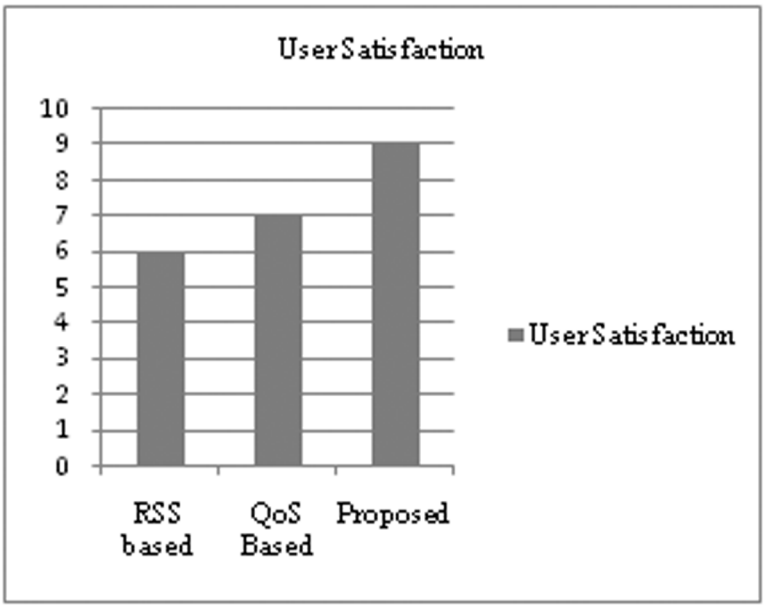

Figure 10: User satisfaction

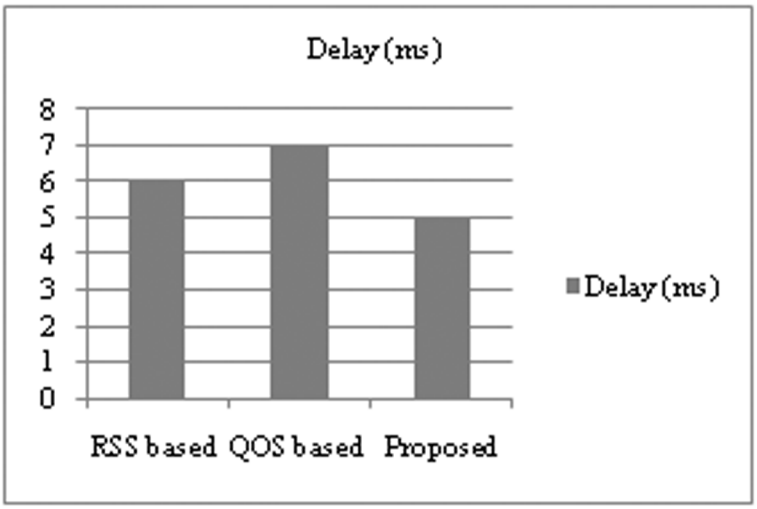

Figure 11: Delay

Graphs below depicts User Satisfaction and Delay provided by the proposed technique for execution of Vertical Handover in Heterogeneous environment.

9. CONCLUSION AND FUTURE WORK

In this research, we have presented an Energy aware VHO algorithm. We have improved existing algorithms by reducing the number of unnecessary handover. Network parameters are considered and simulated using MATLAB tool. The prime objective of the research is to design efficient VHO mechanism, so as to reduce unnecessary handover.

The proposed algorithm has enhanced the VHO decision making speed, by reducing the delay and number of handover which avoids the degradation of terminal battery. Handover algorithm is kept as simple as possible so as to reduce the decision algorithm execution time.

In future the proposed algorithm can be enhanced by merging two or more network selection techniques, so as to obtain optimum results, but this may increase the algorithm complexity and execution time. To overcome the existing limitations in the handover algorithms, the researcher may design a new handover procedure for execution of handover process.

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