Network Selection and seamless mobility in Heterogeneous Wireless Network Based on Type of User Preference

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***Abstract*— *The trending factor for next generation wireless networks will be heterogeneity of access networks, various networks are brought together to form an heterogeneous wireless network environment. Mobile users are now equipped with multimode capabilities that has the ability to select more than one type of network. In such type of heterogeneous network the mobile users may be having more than one access point to select for seamless service delivery and service continuity across the network environment. Selecting the optimal network among available networks and seamless mobility is a challenging task. Therefore a selection method is required that can facilitate seamless handoff between heterogeneous wireless access networks and selects the optimal among them.*

The proposed system architecture explicitly takes into account the user preference and context data for selection of optimal network. The system is based on IEEE 802.21 MIH (media independent handoff) framework. It best meets the need of user and ensures the selection of optimal network to perform handoff in heterogeneous wireless network environment.

***Keywords*— Mobility management, Next generation wireless networks, Media independent handoff, Vertical handoff, Horizontal Handoff.**

I. INTRODUCTION

There has been tremendous changes taking place in concern to network landscape, recently most of the homogeneous networks are changed to heterogeneous networks. The reason behind this is, due to the innovation of multimodal terminal devices that has the ability to support more than one type of network with multiple interface capability. Handoff is the mechanism by which a mobile node can move seamlessly within the network environment without any interruption.

Fig.1 shows heterogeneous wireless network environment. Achieving seamless handoff between heterogeneous networks requires taking into account many considerations such as continuity of service, the type of application running on the network, quality of service (QoS), discovery and selection of networks, security, and management of the energy consumption of the mobile system. The IEEE 802.21 working group has created an architecture that defines a basic media-independent handover function (MIHF) that will help mobile systems do seamless handover between heterogeneous networks such as IEEE 802.3 (wired LAN), IEEE 802.11x (wireless LAN), IEEE 802.16e (mobile WiMAX network), GPRS and UMTS (3G mobile).

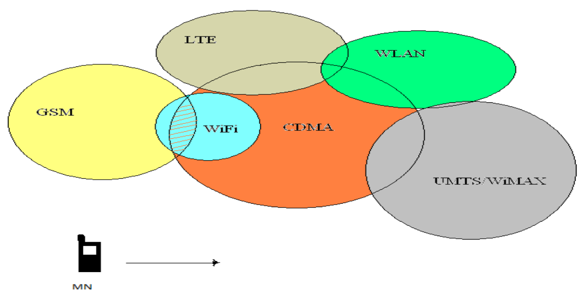

Fig.1. Heterogenous wireless network

Handoffs are classified as two types with respect to the behavior of a mobile terminal for allowing itself for a new connection. They are hard handoffs and smooth handoffs. A handoff in which a mobile terminal releases its existing connection with a base station before allowing itself connect to a new base station is considered as hard handoff. A mobile terminal connecting itself with a new base station before releasing its already existing connection is treated as soft handoff. Handoffs are classified as four types with respect to 'who controls the handoff decision'. Fig.2 depicts classification of various types of handoffs. If the control agent for handoff decision resides on the network side then it is called as network controlled Handoff (NCHO), if it resides On the mobile terminal then it is called as mobile controlled handoff (MCHO). If the mobile terminal assists the control agent, who is on the network side, in giving the primary information then it is called as mobile assisted handoff (MAHO). In case, if the network assists the

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control agent who is on the mobile terminal side then it is called as network assisted handoff (NAHO).In addition to the classifications given above, based on the kind of initiation, handoffs can be classified as forced handoffs and user handoffs. Forced handoffs are mandatory handoffs which are initiated due to potentially inconvenient network conditions. User handoffs are initiated due to user preferences. Handoff decision algorithms are essential components of the next generation heterogeneous wireless networks that are needed to satisfy the requirement of seamless roaming across the networks. These algorithms helps us gain a good Quality of Service(QoS) at a wide range of networks and help improving the Efficiency by selecting the best network among different available networks by applying

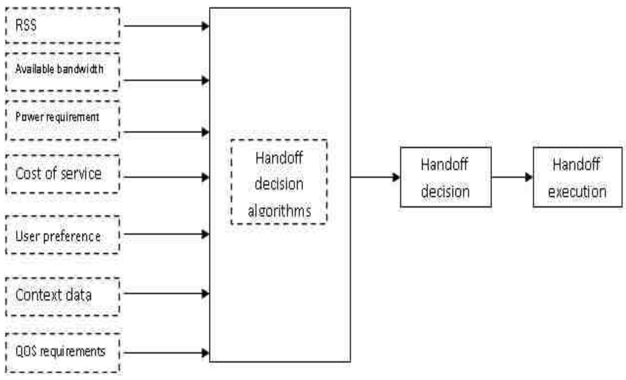

Fig.2 Handoff decision making criteria's

some parameters for selection. Fig.2 shows the different criteria's used by handoff algorithms for decision making.

The rest of the paper is organized as follows. Section 2 describes the related work. Section 3 consists of proposed system. Section 4 presents the algorithm flow. Section 5 does the results analysis and section 6 consists of conclusion.

II. RELATED WORK

Sharing of connection by different types of wireless networks is called vertical handoff. It has different phases such as: handoff initiation, discovering networks, decision making and execution of handoff. The MN acquires the neighbor networks information like: bandwidth available cost of service, network security, delay and packet loss in discovering the network. During the decision making, by using this information obtained, the node will decide the connection network. Later in execution of handoff the node will carry out its connection with the targeted network.

Various network selection algorithms can be classified [8] as Traditional (Received signal strength), Bandwidth based, Functional-based, Multi-criteria, Computational intelligence and context aware.

RSS based traditional VHD algorithms in [21] compares the RSS of the current point of attachment against the others to make handoff decisions. The author has classified the RSS based algorithm into different sub-categories on vertical as well as horizontal handoff. The complexity of RSS based algorithms is simple, which is followed by bandwidth based algorithms.

Bandwidth based algorithm as in [21] it is also shown that, SINR based handoffs has the ability to provide with higher overall throughput than RSS based handoffs to users since the throughput that is available, will depend on the SINR, and the resultant algorithm is capable of balancing the loads between the WLAN and the WCDMA networks. But such an algorithm may also tends to unnecessary handoffs with variation to signal to interference and noise ratio (SINR) that causes the mobile node to handoff forth and back between two networks, this situation is referred as the Ping-Pong effect, this algorithm reduces the wrong decision probability and traffic load balancing where, Received signal strength isn't considered. A handoff to a selected network with more bandwidth and weak strength of signal received is not required as those results into breakdown of the connection.

Multiple criteria based handoff decisions making are made using multiple criteria's such as cost, network security, network coverage area and signal strength. These all criteria's are combined together for selecting the best access network. Weighted Sum Model (WSM) or Simple Additive Weighting (SAW), Weighted Product Model (WPM) or Multiplicative Exponent Weighting (MEW), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Analytic Hierarchy Process (AHP), and Grey Relational Analysis (GRA) are the algorithms that uses multiple criteria's.

Handoff decision making based on the Computational intelligence based algorithms uses an available network for making handoff by applying a computational intelligence technique, such as Fuzzy Logic (FL), Fuzzy Multiple Attribute Decision Making (FMADM), Neural Networks (NNs), and Genetic Algorithm.

In Context-aware handoff decision making the terminal governs its surroundings and saves context information that is relevant for making handoff. Context aware decision making governs and uses information of device, network, and user and try to improve the connectivity, QoS and by maintaining user's satisfaction. In [22] a context-aware vertical handoff decision strategy is used that combines the fuzzy logic technique and the AHP technique for selecting the best network. Imprecise data during handoffs are also handled and addressed.

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Vertical handoff scheme in [22] requires functions in addition for discovering the available networks, best link selection, user's authentication, and a mechanism for making quick handoff for real-time services for example video and voice services.

IEEE 802.21 Media Independent Handoff (MIH) approach [15] allowed a common primitive for heterogeneous network environment for central abstraction of control and information querying that acts as a common interface for exchange messages by providing functionalities such as event service, command service and information service of MIH.

The author in [7] proposed handoff architecture for heterogeneous networks. This architecture was an extension to the IEEE 802.21MIH. The proposed architecture considered the user's needs and resources that are available of IEEE class for making the decision for best network selection.

In [9], the author accepted a mathematical model that is based prediction approach that considered UE velocity, RSS, cost per user bandwidth and load. The performance of the system is enhanced accordingly to preferences of user by weight adjustments. Developed a new generalized vertical handoff scheme which considers the practical constraints such as velocity, RSS, load balancing and cost optimization using an objective function. Thus unnecessary handoffs are reduced and thereby achieving improved users QoS level and system capacity.

In [14], author considered the design of the MIH mechanisms, and proposed his base design. Author also introduced the IEEE 802.21 Media Independent Handoff standard services, highlighted the nature of MIH and its cross layer design by showing how the entities in MIH communicates by using different SAPs and there services .An enhanced Mobility Management entity is presented in [15] that focus on heterogeneous network environment and this mobility management entity is based on IEEE802.21 standard. The proposed entity is able to perform terminal based handoff; it was deployed in a real heterogeneous environment with HSPA, WiMAX and Wi-Fi using an Android smart phone. Author had also demonstrated an Enhanced Mobility Management (EMM) with support for heterogeneous environments using the IEEE802.21 framework. The proposed EMM proved that the IEEE 802.21 framework can result into optimized the handoff procedures by providing exchange of messages between different types of networks.

An enhanced handoff functionality for integrated Wi-Fi , WiMAX networks, based on the IEEE 802.21 standard is described in [16] that serves to glue together heterogeneous wireless access technologies. The proposed architectures and the IEEE 802.21procedure for making handoff try to optimize handoff operations. The key features such as the resource query considerations, the practical implementation, and the reservations of the resources, and proper management of power are currently not covered by the IEEE 802.21 MIH standard.

To enable the MIH functionality and enabling accepting of multiple hop mode to operate in heterogeneous wireless network environments by effectively using the services provided by MIH framework an extended MIH model for Multi hop mode operation was proposed in [18]. The proposed techniques proved to be vital in multi-hop seamless handoff when it comes to consider in the personal environments. This model presents and evaluates the message exchange functionality to enhance the MIH services. The results show that user experiences seamless mobility in both single model and multimodal hop networks scenarios.

In [19] the author combined the smart triggers of 802.21 MIH with SIP mechanism and provided a fast handoff solution. Author has also shown that a combination of SIP handoff and the MIH services being proposed in IEEE 802.21 can meet the criteria such as to support real-time services, and offer seamless handoffs that are both fast and lossless. Some simulation results shown by author also proved that the proposed system gains the benefit of MIH Event triggers in predicting a connection loss that may happen in future; this can result in a reduced delay in handoff and early preparation for making handoff.

III. PROPOSED SYSTEM

The proposed system architecture is shown in fig. 3 The mobile terminal(MT) with multiple interfaces have the capability to operate in 3GPP LTE, WiMAX and Wi-Fi interfaces, and use the services supplied by the MIHF to provide an integrated architecture. We also assume that all entities networks are equipped with MIH functionalities. The core network (MIIS server) is assumed to be able to connect a variety of different access systems, and access selection derived from a mixture of user preferences, access network conditions.

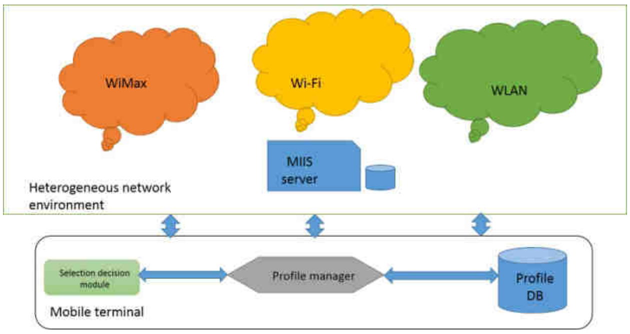

Fig.3. Proposed architecture

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1. Profile Database (PD): It maintains all the required information that is required to assist the selection decision algorithm when it makes the best network selection decisions. The following data are stored in the PD:

-Data related to user preferences and operator constraints such as preferred and forbidden access networks, the weights affected by different parameters participating in the selection decisions as policies. Therefore, we specify for each application the more important goal by providing the suitable values for the selection of goal parameters.

-Data related to applications QoS requirements. It contains mainly the QoS level required by each application. For example, the useful parameters from the application QoS requirements could be: Minimum necessary bit rate (kb/s), supported bit error rate, required security level and maximum tolerated delay.

-Data related to the available networks performance such as the mean bit rate, the maximum packet size, the packet error rate, the bit error rate, and the average latency to send a packet.

2. Profile Manager (PM): The PM includes two entities:

I. Handoff Control Manager (HCM): HCM has the abilities to support MT controlled handoff.

II. Context Aware Manager (CAM): CAM identifies information of MT and generates trigger events to HCM. HCM supervises all the available entities that are responsible for the optimal network selection decision (network, user, application, and terminal) and stores the necessary information in the PD.

The HCM also determines when it is necessary to trigger the Selection Decision Module (SDM) and assists in making the choice of the best access. Indeed, the HCM triggers the SDM in the following cases:

- A modification of network interface status.
– An application been created or deleted.
– Flow monitored parameters values modification.
– User preferences or operator constraints change.
– Network performance modification.

HCM has the ability to make the automatic selection of an access network. It does the selection by keeping all the required information for selecting proper interface configuration.

3. Selection Decision Module (SDM): Selection decision module is called when trigger event is generated from the profile Manager to selection of optimal network among available network only when the HCM fails to select the network.

IV. PROPOSED ALGORITHM

This section presents the steps in proposed algorithm. Following are the steps of proposed algorithm:

1. Event occurs: The mobile terminal enters into the radio access technology and makes a call for list of available networks.
2. The context information of the available networks and the mobile terminal is collected by using the IEEE 802.21 MIH SAPs (system access points).
3. Relevant applications and services requirements are checked for delivery of data.
4. Provide this data to the application.
5. Provide event data, relevant parameters from different available radio access technologies to the mobile terminal for further calculation by using MIH SAPs.
6. Finalize the handoff decision by using AHP (Analytic Hierarchy Process), where the available data is broke up into a hierarchy of choices and criteria, the data is then synthesized to find comparative ranking of the available choices.
7. Execute the handoff and establish the connection with the resultant optimal network.

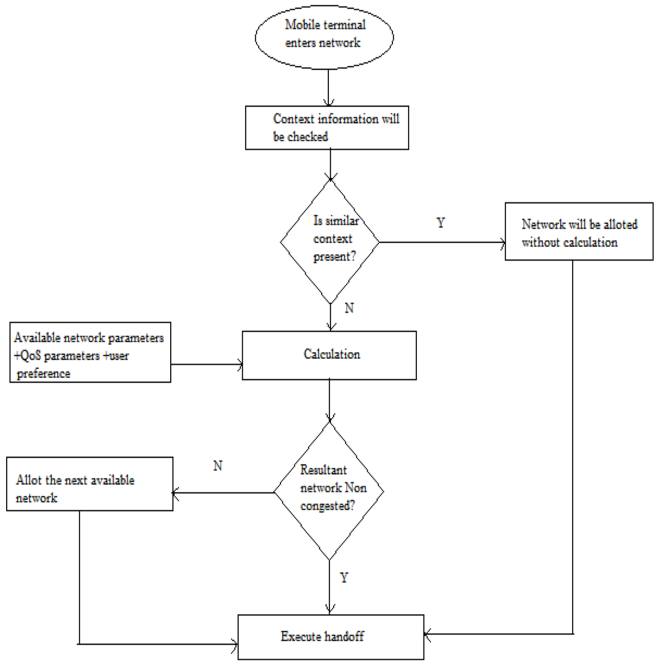


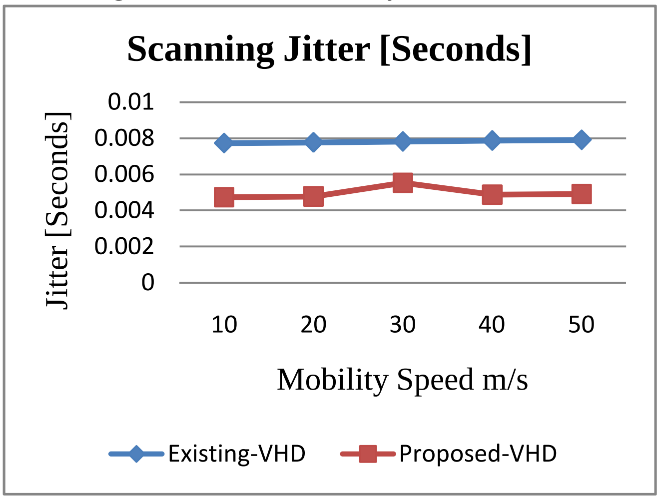
Fig.4. Algorithm flow

V. RESULTS ANALYSIS

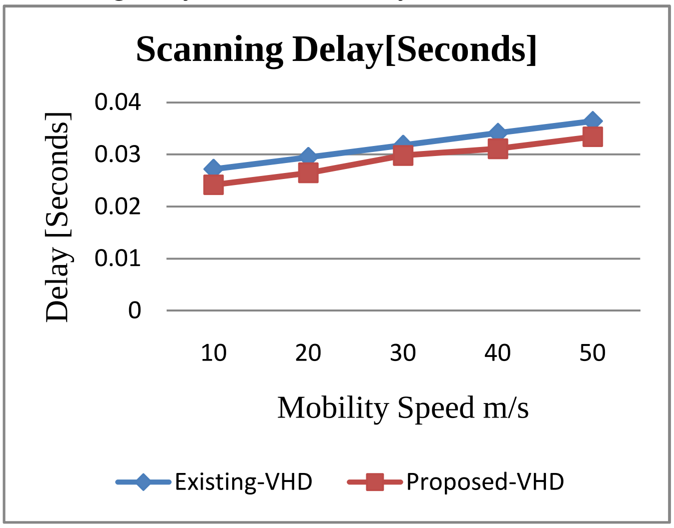
This section does the performance analysis of the system with the existing system that is presented in [1] and the performance is measured depending on varying speed of mobile node and increasing the number of mobile nodes and access points. It is observed that whenever there is change in speed of mobile node and increase in number of mobile and access point nodes, performance can be analyzed based on delay and jitter.

The performance analysis is shown with respect to varying mobile speed as follows:

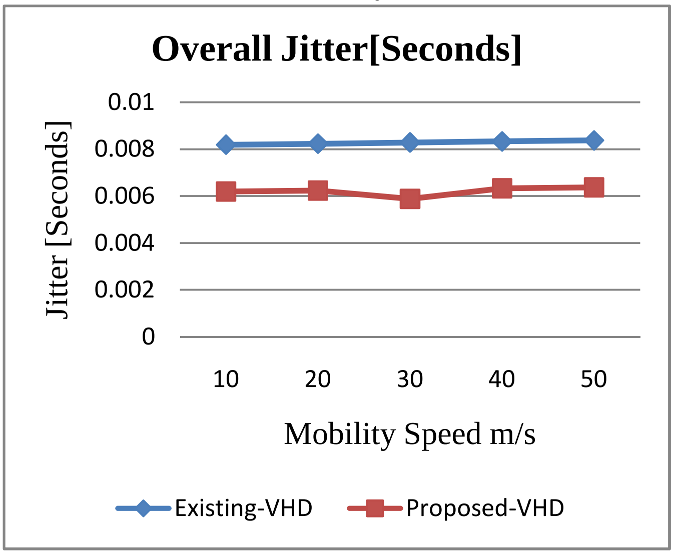
1. Scanning Jitter Performance Analysis



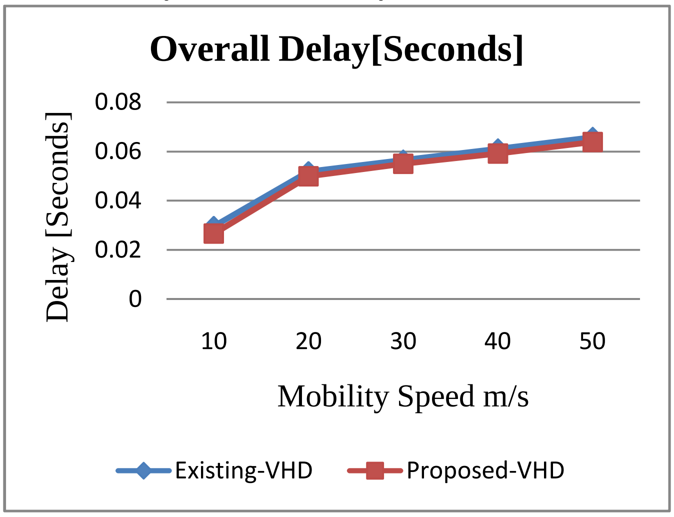
2. Scanning Delay Performance Analysis



3. Overall Jitter Performance Analysis



4. Overall Delay Performance Analysis



VI. CONCLUSION

The proposed system presents a new and efficient method with objective to determine the optimal network available under which handoff should be performed.

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