Performance Analysis for Optimization of Vertical Hand-Off in Hetrogeneous Wireless

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ABSTRACT : Rapid growth of demand for various wireless communication services has led the industry and the researches to investigate on a new generation of telecommunication systems .One of the main objectives in designing and developing these systems is to provide the mobile user with a robust connection to different networks so that the users can move freely between heterogeneous networks while running their computing applications. Examples include cellular networks, metropolitan area networks, wireless local area networks and personal area networks. The combination of all these networks is usually called the beyond 3G (B3G) wireless networks. The B3G networking will enable mobile users to roam freely through heterogeneous networks on all-IP platform. Handoff is a process, which maintains a mobile users active connection as it moves within wireless networks and vertical handoff considers handoff between different types of networks or otherwise stated between different network layers. In this paper we show how performance analysis demonstrates significant improvement that can be achieved from the proposed technique and its optimization

I. INTRODUCTION

The Convergence of heterogeneous wireless access technologies has been envisioned to characterize the next generation wireless networks. Today there are various wireless networks around the world. Some of the examples are second and third generation of cellular networks. All these wireless networks are heterogeneous networks. They are heterogeneous in the sense that they are using different radio access technologies, communication protocols. Currently, the emerging mobile devices or mobile stations that we are using equipped with multiple network interfaces to access different wireless networks. These new mobile devices will provide the user with great flexibility for network access and connectivity but also generate the challenging problem of mobility support among different networks. User will expect to continue their connections without any disruption when they move from one network to another. This is referred to as handoff or handover

Fig. 1. Conventional handoff scheme.

Traditionally, the handoff process has been studied among wireless networks using the same access technology. This kind of handoff is defined as the horizontal handoff handoff scheme the mobile device monitors received power levels and periodically send this information to the MSC controller via their respective BS , which then decides whether a handoff should be performed and if yes, to which target BS. The Fig. (1) [2] shows how an conventional handoff is made. But now as we are going to use B3G wireless networks, the handover is a more complicated process and previous handover management techniques cannot be used [3]. The new handover process among networks using different technologies is defined as vertical handover (VHO). Vertical handover or vertical handoff refers to a network node changing the type of connectivity it uses to access a supporting infrastructure, usually to support node mobility. Vertical handovers refer to the automatic failover from one technology to another in order to maintain communication. This is different from a 'horizontal handover' between different wireless access points that use the same technology in that a vertical handover involves changing the data link layer technology used to access the network.
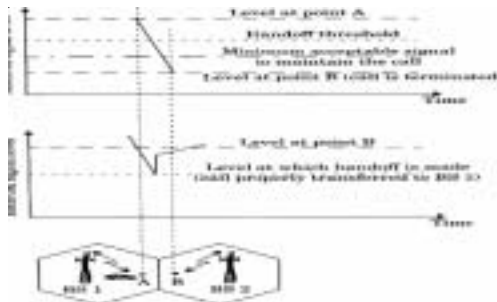
II. BENEFITS OF VERTICAL HANDOVER SYSTEM

The traditional handoff process is insufficient for the future generation wireless systems because of the following reasons.
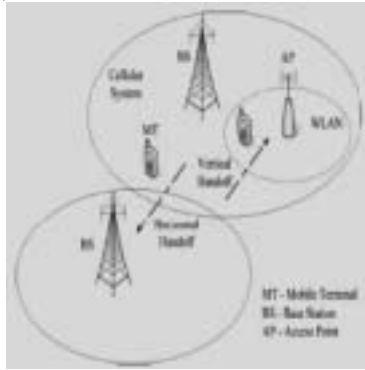
Fig. 2. Horizontal and vertical hand-off in heterogeneous network.

(*a*) Criteria

The use of the signal strength criteria for traditional handoff limits the ability of the network to initiate a Hand-off for control reasons (congestion control, change in data traffic, etc.)

(*b*) User Selection

Traditional hand-off does not allow users to select the network of different technologies with different networks, and with the corresponding protocols and standards.

(*c*) Interoperability

Traditional handoff protocols are developed for homogeneous systems that rely on a common signaling protocol, routing techniques and mobility management standard. In heterogeneous environments, mobile nodes and the network routers must be able to interoperate with different networks, and with the corresponding protocols and standards.

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III. CLASSIFICATION OF VERTICAL HANDOFF

The handoff's can be classified in many different ways for example horizontal and vertical handoffs. The VHO may be further classified as shown in Fig. 3.

(a) Vertical handoff
- Upward
- Downward
- Imperative
- Alternative

(b) Vertical handoff
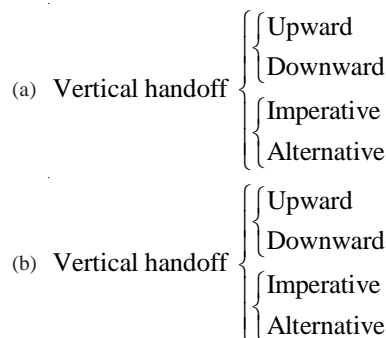- Upward
- Downward
- Imperative
- Alternative

Fig. 3. Classification of handoff's in wireless mobile systems.

The first classification for vertical handoff is upward and downward. An upward VHO occurs from a network with small coverage and high data rate to a network with wider coverage and lower data rate. Whereas a downward VHO occurs in the network with wider coverage and lower data rate to a network with small coverage and high data rate. As an example for this classification let's consider the case of two most important wireless technologies: cellular networks and WLAN's. The WLAN system can be considered as the small coverage network with high data rate while the cellular system is one with wider coverage and lower data rate. The second classification is: imperative and alternative [8]. An imperative VHO occurs due to low signal from the base station (BS) or access point (AP). It can be considered as an HHO. The execution of an imperative VHO has to be fast in order to keep on going connections. On the other hand, a VHO initiated to provide the user with better performance is considered to an alternative VHO. This VHO can occur when a user connected to cellular network goes inside the coverage of a WLAN, even if the signal of the connection to the cellular network does not lose any signal strength, the user may consider the connection to WLAN a better option.

IV. VERTICAL HANDOFF DECISIONS IN HETEROGENEOUS NETWORK

The vertical handoff process can be divided into three main steps [2] namely system discovery, handoff decision, and handoff execution. The function of each step is described below :

(*a*) System discovery

During this step, the mobile terminals equipped with multiple interfaces have to determine which networks can be used and the services available in each network.

(*b*) Handoff decision

In this step, the mobile device determines which network it should connect to. The decision may depend on various parameters or handoff metrics Algorithm

V. RELATED WORK

Several mobility management techniques have been proposed for next generation heterogeneous wireless networks. Regarding the second step, various VHO decision algorithms have been proposed recently. The decision algorithms use handover metrics to decide which the best network to use is. It is usually referred to as the target network. For example, in the VHO decision mechanism is formulated as an optimization problem. Each candidate network is associated with a cost function. The decision is to select the network which has the lowest cost value. The cost function depends on a number of criteria, including bandwidth, delay, and power requirement. Appropriate weights are assigned to each criterion to account for its importance. In the VHO decision is formulated as a fuzzy

MADM (Multiple Attribute Decision Making) problem. Fuzzy logic is used to represent the imprecise information of some attributes and user preferences. Two classical MADM methods are proposed SAW (Simple Additive Weighting) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution). In the network selected is based on Analytic Hierarchy Process (AHP) and Grey Relational Analysis (GRA). AHP decomposes the network selection problem into several sub-problems and assigns a weight value for each sub problem. GRA is then used to rank the candidate networks and to select the one with the highest ranking. In a context based handover decision procedure is proposed for WLANs and CDMA systems. Information parameters such as call dropping probability, call blocking probability, grade of service, the number of handover attempts and velocity are used for the handover decision. A velocity threshold is calculated to optimize the performance of the wireless system. In the authors propose an Autonomic Handover. Manager (AHM) based on the autonomic computing concept to decide the best network interface to handover in B3G wireless networks. The AHM decides the best policy for the specific service or application without the intervention of the user and using the context information from the mobile terminal, the network and the user. The context information is classified into static, static in a cell and dynamic depending on its evolution over time. Recently, in the use of ELECTRE, a type of MADM algorithm, in proposed for network selection in heterogeneous wireless networks. ELECTRE performs pair-wise comparisons amongst the alternatives, to select the best network. The original ELECTRE algorithm is modified to able to provide a complete ranking of networks even in scenarios where the utility is no monotonic.

VI. CONTRIBUTION

As mentioned in the previous section, there are several VHO decision algorithms recently proposed, but to the best of our knowledge there is no performance comparison among them. Based on this fact, we compare the performance of four decision algorithms proposed for VHO.SAW and TOPSIS from GRA and the Multiplicative Exponent Weighting (MEW) are compared. A B3G scenario where four wireless networks are available for VHO International Journal of Future Generation Communication and Networking 556 Vertical Handover in B3G Wireless Networks is simulated by using stochastic models and several kinds of traffic (i.e., conversational, streaming, interactive, and background). Handover metrics such as available bandwidth, packet delay, jitter, and bit error rate are considered. The results show that although the performance of the four algorithms is very close, in some situations, GRA is able to provide a slightly better performance than SAW, TOPSIS and MEW. Finally,

the simulation results show that MEW, SAW and TOPSIS select the same network for VHO more than 90% of the time and the four algorithms select the same network more than 70% of the time. A mobile device in a B3G wireless network environment has to make a decision about the target network either periodically or every time that a new network is discovered. This kind of sequential decision problems can be modeled as a Markov decision process (MDP). In [16], we formulate the VHO decision problem as an MDP. Suitable and flexible reward and cost functions are introduced to capture the tradeoff among the network resources utilized by the connection (i.e., QoS in terms of available bandwidth and delay) and the signaling and processing load incurred in the network when the VHO is executed. The objective of the MDP Formulation is to maximize the expected total reward per connection. Such optimization problem is formulated as:

$$v(s) = \max \prod \pi \in A\{r(s,a) + \Sigma s' \in \lambda p[s'][s,a]v(s')\}$$

Where $v(s)$ is the expected reward, A is the set containing the possible actions (i.e., which network to use), $r(s, a)$ is the reward function, and $P[s' \mid s, a]$ the state transitions probabilities of the B3G system. The MDP optimization problem is solved using the value iteration algorithm and a stationary optimal policy is obtained. The optimal MDP vertical handover policy indicates which is the optimal network to use based on the state of the B3G system. The performance of the MDP handover algorithm is compared to other VHO decision algorithms such as SAW and GRA and also to a couple of heuristic policies. The results show good improvement in a wide range of conditions. Fig. 4 shows the expected total reward per connection for all the decision algorithms when the switching cost of executing a VHO is increased. The switching cost represent the signaling cost (*i.e.*, procedures, re-routing of packets, etc.) generated in the networks when the VHO is executed. We can see that the proposed MDP algorithm achieves the largest expected reward per connection. Fig. 5 shows an example of the MDP handover policy for a B3G scenario of 2 networks. In the figure, the mobile device is currently connected to network 2. The presence of cube represents the action switch the connection to network 1 (*i.e.*, execute a VHO to network 1), while the absence of cube represents the action reaming using the network.

VII. HANDOFF EXECUTION STEP

In this step, the connections need to be re-routed from the existing network to the new network in a seamless manner. This step also includes the authentication, authorization and the transfer of the user's context information among networks.
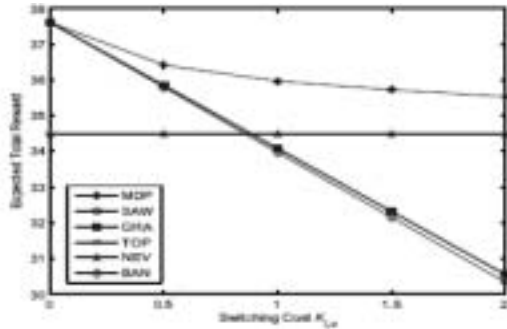
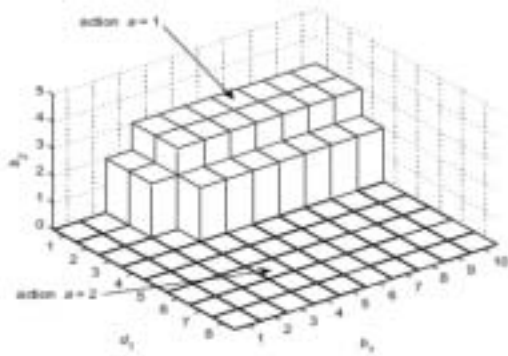Fig. 4. Effect of the switching cost in the expected reward per connection.

Fig. 5. Example of the optimal MDP VHO policy.

VIII. CONCLUSION AND FUTURE WORK:

This paper presents the vertical handoff as important elements in the emerging heterogeneous wireless networks. In this we classified vertical handoff, limitation of the traditional handoff and various steps for vertical handoff decisions. Handover can be classified as imperative and alternative handovers. By studying the paper we can develop an intelligent handover management system for the future generation networks and finally it was shown that performance analysis for optimization of vertical hand- off in heterogeneous wireless networks is dominant. Then, when minimal handoff delay is enabled, the optimal handoff instant should be considered.

Future work includes further considerations of connectivity that takes into considerations further aspects of the cross-layer approach rules for mobility and multiple radio network environments.

ACKNOWLEDGMENT

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