Decision Techniques for Vertical Handoffs -An Overview

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Abstract: Several heterogeneous networks in today’s wireless communication world has the access technologies, which varies in terms of network capacity, bandwidth, power consumption and data rates, coverage areas and received signal strength to a large extent. Coverage to the mobile users are provided by overlapping of these networks whose characteristics are integrated together, this produces many interesting research opportunities to bring omnipresent connectivity to the users. Vertical handoff is the technology that provides best of the varying characteristics of the networks. It is a seamless transfer of on processing session between these networks and provides best availability of service and uninterrupted connection in the network. Handoff decision is as chosen so as to avoids unwanted handoffs and on the other hand should not miss making an handoff. This increases computational load of the network and packet loss respectively. Several literature and algorithms are been developed about vertical handoff, these algorithms are based on parameters effecting them. This research paper provide s the various policies that are developed on the decision making handoffs.

I. INTRODUCTION

Integration of various wireless access technologies are required at a very high rate in order to provide the demand of the best wireless availability at that time at that place. Wireless communication derives its importance to provide connectivity while on the move. Global roaming of the next generation is to be provided by using current technologies and varying the parameters such as bandwidth, access methods, latencies and frequencies. Thus there should be an uninterrupted transfer of mobile device terminal link to access the best network amongst all available heterogeneous networks at that particular moment and at that particular place without having an interruption to the ongoing call. End-to-end optimization can be provided by taking into account parameters like routing optimization, economic profitability, throughput optimization and delay profiles. Practically, overlapping coverage and complementary wireless technology is integrated together to provide expected performance of service and to get the always best connected (ABC) concept. A host of network is chosen by enabling a user which is dictated in the always best connected (ABC) concept. This provides the best suit to his or her needs and to make better availability of the network. A framework is needed that provides the selection, authentication, mobility management, profile server, security and access discovery.

A vertical handoff decision (VHO) technique is called for this framework, which includes a tradeoff over several handoff parameters like system performance, quality of service, node conditions, user preferences, security costs, power requirements and application types. In the decision making task, the mentioned parameters will have different levels of importance [3]. The solution provided by this method should be network-layer-transparent, i.e. is applicable to any level of the network, as well as it should be modification-free, so that any new modifications does not affect the system parameters and output. This helps the internet servers and client applications to upgrade themselves in the fast changing and upgrading technologies[7].
There are two main streams of handoffs, Horizontal Handoff (HHO) and Vertical Handoff (VHO). Figure 1 illustrates horizontal and vertical handoff. Symmetry of Handoffs is used to distinguish between Vertical Handoff (VHO) and Horizontal handoff (HHO). The table bifurcating the VHO and HHO in terms of QoS parameters, network interface and connection, access technology and IP addresses is shown in Table 1.

<table>
<thead>
<tr>
<th>QoS Parameters</th>
<th>Horizontal Handoff (HHO)</th>
<th>Vertical Handoff (VHO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Interface</td>
<td>Not changed</td>
<td>May be changed</td>
</tr>
<tr>
<td>Network Connection</td>
<td>Single connection</td>
<td>More Than one connection</td>
</tr>
<tr>
<td>Access technology</td>
<td>Not Changed</td>
<td>Changed</td>
</tr>
<tr>
<td>IP Address</td>
<td>Changed</td>
<td>Changed</td>
</tr>
</tbody>
</table>

Table 1: Difference between Vertical and Horizontal Handoff.
Both the handoff techniques are defined on the basis of its symmetry and on bases of its process. VHO (vertical handoff) is inter-technology based process or asymmetric in nature and HHO (Horizontal handoff) is intra-technology based process or symmetric in nature [5]. The vertical handoff is sub divided into three phases such as execution phase, decision phase and discovery phase [6][9].

At first system discovery phase, the available network is founded by the mobile terminal device for forming link between network and mobile terminal device, and several parameters like QoS parameters and data rates etc are covered by this phase. If mobile terminal device is used for communication then this phase is used as periodically. On the basis of different parameters like cost, transmit power, minimum bandwidth available type of application, user preferences and delay constraints, the continuation of connection between network and mobile terminal device depends until it is handover to another network. This fundamental is covered in decision phase. In execution phase, in a perfect way a new network connection is established between mobile terminal and network through handed over also it covers transfer of user information, authentication and Authorization. There is an overlapping is possible in decision, discovery and handover so to overcome this handover delay there are some different fundamentals. First one is discovery time (T_d). A new wireless network range is realized by the mobile terminal device by trigger-based router solicitation or by getting after waiting a router advertisement in the visited network and after tacking its router advertisement from new access router.

In address configuration interval (T_c), the routing table is updated by the mobile terminal device after getting router advertisement. The prefix of new router advertisement affects the new-care-of-address. Network Registration Period (T_r): This is the period of Binding Update. A Binding Update is the association of home address with a care of address. Binding update to the home agent and correspondent node is sent and the packet from the correspondent node is received. This is the first packet sent. Here the binding acknowledgement of the correspondent node is elective. When optimizing IP-level, vertical handoff delay minimizes the discovery time and network registration time. In VHO, the decision phase is the most important phase and it signify that handoff is very important to the user. This paper shows the effect of parameters and policies on VHO and also there is a brief survey of decision making methods.

II. Characteristics of VHO.
[10] Shows technical properties of VHO. There are three main categories of vertical handoffs, they are:-
1. Resource management
2. Service management
3. Mobility Engineering.

**Resource Management:** The QoS (Not end-to-end QoS) is directly based on resource allocation. Resource management is again divided into direct resource and indirect resource. The direct resource allocation is the allocation of channel and bandwidth whereas indirect resource allocation is the allocation of network capacity and performance optimization. The end-to-end QoS needs other management such as header compression on wireless networks, packet priority in routers and packet buffering in routers and terminals.

**Service Management:** Interactive mobile applications, service life cycle over the air, mobile services and location management are provided under service management.

**Mobility Engineering:** This consists of heterogeneous networks and services for example: mobility management, middleware solution in OSI protocol stack layer and design an implementation of multiple protocol [10].

### III. Working Description

The three phases which are available for performing handoff in heterogeneous networks have already been discussed. There are several networks through which a mobile terminal (MT) can connect to. The decision making of VHO is affected by parameters such as received signal strength, available bandwidth battery power status of MT, cost, etc. These parameters decide the connection made to a particular network. The signal strength between a mobile terminal and access point (AP) determines the network bandwidth available along the connection. Horizontal decision process greatly depends upon received signal strength (RSS) due to its compatibility between candidate attachment points and current attachment points. The heterogeneous networks are asymmetric in nature, so the RSS is incomparable in VHO. The availability and the condition of different networks is identified by this. On the availability of more than one wireless network as horizontal handoff the mobile terminal device handover itself on that network which has maximum RSS.

In the research several parameters are introduced as decision parameters that are used in decision process in VHO. The vertical handoff decision (VHD) has been proposed, the VHD algorithm is used to maximize the overall battery life time of the MT in the same coverage area. It also aims in equally distributing the traffic load in the network. VHD algorithm can also be implemented in multiple vertical handoff decision controllers (VHDC). VHDC located in access network can provide the VHD function for region covering more than one access point or base station. The performance result which are based on detail simulation using MAT Lab or otherwise perform comparatively better. Signal strength in this algorithm is considered important as it decides the Quality of Service. The probability of number of unnecessary handoff is studied and thus call dropping is reduced. A decision method called adaptive lifetime based vertical handoff (ALIVE-HO) is proposed on the basis of received signal strength [8]. The method used is to estimate coverage of wireless network, the best network is selected using vertical handoff algorithms. The mobile terminal device is in network ‘when on the basis of availability of bandwidth’ an adaptive handoff is considered. The mobile terminal velocity is adopted dynamically by the ALIVE-HO algorithm to reduce the number of unnecessary handoff and ping pong effect but a increase in handoff probability with distance from the access point. In the traditional RSS hysteresis the number of unnecessary handoff is more than the ALIVE-HO algorithm. By increasing the transmit power ‘to increase receive signal strength’ is the simplest way but the interference in the service is increased though this method which also affects the QoS of network. This method ‘to resolve network problem in open area’s’ is used but in urban areas, is not used due to clutters but additional parameters are used in decision process. To select best handoff algorithm by comparing some selected parameters like bit-error-rate, bandwidth, jitter and delay such as GRA (Gray relational analysis), TOPSIS (Technique for order preference by similarity to ideal solution), SAW (simple additive weighting), and MEW (Multiplicative exponent weighting). The vertical handoff decision algorithm has obtained a good performance of SAW and GRA, TOPSIS, MEW and SAW techniques performance is similar but GRA provides a lower delay and higher bandwidth.
The parameters which are considered as decision parameters are available bandwidth and delay encountered. During the handoff process, the algorithm performance against unnecessary handoff and throughput is evaluated. The capability of reacting to roaming events proactively and accurately with short handoff delays are the special feature of this work. This system maintains the continuation of connection and seamlessly and also reacts to roaming events accurately and proactively. The use of power consumption, financial cost for finding the performance of the work with respect to the handoff latency, cost function and involving bandwidth is employed by the working description of [19]. The requirement of manual user input must in the algorithm which employs cost function. If the algorithm needs to supply the user request as an input parameter thus poor handoff result is possible in the faulty event result and it could be the disadvantage for the system. In the dynamic model proposed by [17] it is consideration to tackling handoff decision, static factors like power consumption of the mobile terminal, cost, bandwidth and dynamic factors like received signal strength and velocity of the mobile are involved. The three phases like decision phase normal phase and priority phase are modeled to develop this model. In the priority phase the best selection of network is done on the basis of dynamic factor. The priority is based on RSS difference and threshold. The recording of the cost function for each static parameter which is based on their weight factor is done in the normal phase. Then the highest weight factor network selection is done. In the decision phase, by getting a score function which is the multiplication of first phase priority and the cost function of normal phase for every candidate network, decision for handoff is done for the best network. The candidate network is the highest score function network. In this soft vertical handoff model the aim is, by combining both the static and dynamic parameters, the handoff selection is done also number of handover terms is decreased. So the calculation of mobile velocity and the received signal strength interval, elaboration is needed.

In [7] by minimum changes in infrastructure algorithms for both horizontal and vertical handoff is discussed, which needs deployment of handoff servers only on internet. A seamless handoff is provided by USHA (Universal seamless Handoff Architecture) instead of using new session transport protocol through the middleware design strategy. It is an upper layer solution. The soft handoff technique helps for handoff either for vertical or horizontal which takes place on overlaid network. If the overlapping of coverage fails which is due to the multiple access methods then USHA connectivity for upper layer applications can lose.

**IV. VERTICAL HANDOFF (Limitations)**

In the literature study of vertical handoff, it gives the expansion of networks with complementary features such as limited coverage area with high data rate or wide coverage area with low data rate. All these features give some limitations such are following:

1. The best one wireless interface is used on that instant when automatically transfer of TCP/IP connections form one interface to another is done.
2. In another way when same network interface is used and the DNS server and Mobile IP are easily got by Mobile nodes and peers then in that condition, the part of same Mobile IP and DNS infrastructure must use as all wireless interfaces.
3. Due to containing of nodes by the networks the loss of wireless diversity is enabled. SoThe peer to peer connection provides shortcuts for slow and expensive infrastructure which is efficient for network.
4. All the connections are handed in same manner by vertical handoff.

**V. VERTICAL HANDOFF DECIDING PARAMETERS**

The performance analysis of developed vertical handoff decision algorithms is based on the use of two or more parameters through which a constant value is maintained over a time period such parameters are power consumption, security features and access cost. The dynamic parameters are used by those vertical handoff algorithms which are work on the basis of contentiously changing values like received signal strength, bit error rate, available bandwidth and data rate. A more better performance is obtained when a combination of static and dynamic parameters is used. And Increase in decision time and algorithm complexity the tradeoff also increased. By considering fewer parameters there will be inaccurate decision and poor performance exists. In the study of handoff, there are few algorithms are present which works on probability principle to take handoff decision and to overcome the unnecessary handoffs to reduce the no of handoffs and increase service quality. Due to these requirements, call
for special algorithm is need which is not so complex and not so simple. There are so many algorithms are available which are base on several parameters which gives the reduced delay , deciding on the best algorithms whose practical implementation is difficult , reduced number of unnecessary handoff and decides the parameters to give disappear mobility. To maintain a good quality of service (QoS) it is the primary requirement to maintain received signal strength thus RSS is the major parameter for decision algorithm because RSS is changed with change the distance from base station.

VI. CONCLUSION

Vertical handoff is an essential feature of wireless communication which leads to further investigate in the direction of ability to roam in the available network via minimum changes in the system. It is more responsible for whole process of decision phase since in this process on basis of parameters along the optimum time that will allow to make decision. The efficient cost effective decision algorithm gives the improved QoS and system capacity. In this paper a survey of handoff techniques on the basis of decision parameters and the parametric effect on decision process has made. The vertical handoff implementation structure on the basis of several static and dynamic parameters used in VHO is taken special importance in this paper. Inclusion of the parameters to take better decision, many decision parameters employed.

REFERENCES
