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Role of Swarm Technology based Routing in UMTS-WLAN networks

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Abstract: Quality of service (QoS) is playing a vital role in communications system in emerging technologies. QoS means providing consistent and predictable data delivery service. QoS is dealt with providing real-time as well as non-real-time services. In this paper swarm based handover approach is proposed in UMTS /WLAN technologies. The proposed approach is used to evaluate the QoS Characteristics. The results obtained for proposed approach are found better and improved in minimizing the overheads to maintain QoS.

Keywords: Vertical Handover, Swarm Technology, WLAN, UMTS, QoS.

1 Introduction

Next generation mobile communication networks are intended to provide a variety of services with different Quality of Service (QoS) levels [1]. These networks are required to offer services such as video conferencing and e-commerce applications, which require a higher guarantee from the networks that the services can be continued uninterrupted during handover. For user perspective, quality of experience (QoE) and quality of service (QoS) are two key factors which are considered for observing and analyzing, the type of service and its response at user end, network utilization ,data delivery rate, data delivery time, user satisfaction etc . Different QoS monitoring parameters are used for different type of application such as for VoIP applications mean opinion score (MOS) [2]. During communication, when the user crosses the coverage area it is better to use the radio resources of the new nearby technology and is also called the target base station. This is required as the strength of signal in the preceding base station is weaker than the next one that is the target base station.

2 Related works

The integration of UMTS networks and WLAN will consist a new network that integrates the advantages of the two of them. UMTS and WLANs should be considered as complementary networks as UMTS could provide universal coverage and high mobility support while WLANs will be applied in hot spot areas offering high data rates. In cellular/WLAN integrated networks, to achieve better performance with respect to throughput and end-to-end delay a TCP-aware link layer agent, called VH agent, is proposed to resolve the packet reordering problem of downward vertical handover and the premature timeout and excessive transmission that occur during upward vertical handover [3]. A multimode mobile terminal software module is proposed to automatically monitor and switch the connection link for IEEE 802.21 compatible primitives in support for vertical handover in heterogeneous networks [4]. To meet the handoff latency demand in the upward vertical handoff, a novel link layer trigger mechanism based on IEEE 802.21 standard is proposed. It has been presented that selection of a suitable link layer trigger time is of particular importance for the minimization of handoff time difference and the improvement of handoff performance [5]. Optimal handover control is very important for investigating the possibilities of handover optimization by providing mobile terminals with additional information about the target system [6]. An ABC (always best connected) optimal handover solution of assigning N terminals to M access networks is proposed based on multi-PSO (particle swarm optimization) with optimum mutation [7].

3 Hardware schemes

Handover is performed based on parameters like received signal strength (RSS), bandwidth (BW) and velocity etc. In this section handover schemes analytically presented for data rate based approach and swarm based approach.

3.1 Data Rate based vertical handover (DR-VHDF)

The instantaneous parameter data rate is beneficial for vertical handover decision in UMTS and WLAN network. Good put, which refers to the data rate delivered to the mobile terminals on the network [8]. At time of mobile node (MN) connectivity and switching to different network the data rate gain D_R should be optimum from end user prospective. The D_g is measured with comparison of available data rate in UMTS and WLAN networks.

The signal to interference ratio (SINR) for WLAN network is given as:-

$$S_{nm}^{W} = \frac{g_{nm}^{W} P_{nm}^{W}}{P_B + \sum_{\substack{p\in W \\ p\neq n}} g_{pm}^{W} g_{p}^{W}} \qquad (1)$$

Where g_{nm}^{W} is channel gain between with mth MN and nth WLAN AP.

P_B= Back ground noise power

P_{nm}= Transmitting power of mth WLAN AP.

Similarly SINR for UMTS is given as:-

$$S_{nm}^{U} = \frac{g_{nm}^{U} P_{nm}^{U}}{P_B + \sum_{p=U} \left(G_{km}^{U} P_{Tp}^{U}\right) - \left(G_{mn}^{U} P_{nm}^{U}\right)} \qquad (2)$$

Where

P_{Tp}^{U} = Total Transmitted power of pth UMTS BS.

P_{nm}^{U} = Transmitted power of nth UMTS BS to the mth MN.

G_{mn}^{U} is channel gain between nth BS and mth MN.

From equation (1) & (2), data rate can be calculated as $D_{nm}^{W,U}$, which shows that for mth MN.

$$D_{mm}^{W,U} = W \log_2 \left[1 + \frac{S_{nm}^{WU}}{F} \right] \qquad (3)$$

Where F is channel coding loss factor for two different Handover gain D for same coding is given by

$$D_{nm}^{W} \geq D_{nm}^{U} + D_{g}^{W} \qquad (4)$$

Where D_{nm}^{U} represents the data rate gain for Handover for UMTS to WLAN

$$D_{nm}^{U} \geq D_{nm}^{W} + D_{g}^{U} \qquad (5)$$

So, in both cases handover occurs the network switching after a gain of data rate

3.2 Proposed Swarm Based vertical handover (S-VHDF)

In this paper, we propose a swarm based vertical handover in WLAN and UMTS networks. The MN performs handover based on the Received Signal Strength Indicator (RSSI) and Load. As soon as handover initiation starts, the swarm based route discovery is started. The new routes require the use of a forward Ant (FA) and Backward Ant (BA) for information upgrade. The FA visits each BS or AP and collects bandwidth and distance. When the destination AP or BS is reached, the BA inherits the FA and once again collects good put, battery life and distance parameters of the visited AP or BS. The BA follows the route in reverse. Once the source MN receives the BA, it collects the information about all APs and BSs along each path. The MN starts the goodput estimation [9].

GP(n) can be expressed as

$$GP(n) = \sum_{i=n-k}^{n} \frac{gi}{K} \qquad (6)$$

Assuming that g_i=0, i<0, it follows that GP(n)=0, n<0. If ESA filtering is considered, then the average goodput can be computed as follows:-

$$\begin{cases} GP(n) = w_1 g_n + w_2 GP(n-1) + w_3 GP(n-2) \\ w_1, w_2, w_3 \in [0,1] \\ \sum_{i}^{3} wi = 1 \end{cases} \qquad (7)$$

To select the target network, the network with high goodput is chosen for in-elastic (RT) applications. For elastic applications (NRT), the network with good distance parameters are chosen.

The format of pheromone table is given in table 1 below:-

Table 1 – Format of Pheromone Table

Source MN ID	Destination BS (or AP) ID	Good put (GP)	Battery life (B)	Distance (D)

3.3 Proposed Architecture

Figure 1 demonstrates the proposed architecture. The WLAN coverage zones are enclosed within UMTS coverage zone. Initially, MNs are present only in the UMTS coverage zone. The vertical handoff controllers (C_{VH}) are located in ANs that offers vertical handoff decision.

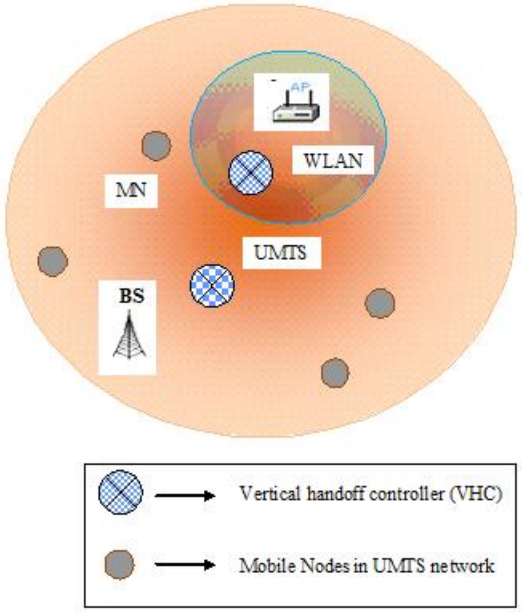

Fig 1: Proposed Architecture

4 Simulation Environment

The simulation is performed using 802.21for QoS analysis between WLAN and UMTS networks [10].A network topology consisting of one UMTS BS , one WLAN AP and a variable number of MNs was created. Choosing for a variable number of MNs allows us to measure the performance of QoS parameters such as Throughput and delay for real and non real type of application in simulating 802.21 scenarios. Fig. 2 presents the network topology, and Table 2 presents values for the most relevant variables. UMST has 1 km radius. Inside macrocell UMTS, two WLANs is located, with 100m radius. The transmit power of BSs is 1 Watt and the transmit power of APs is 100 mWatt. A MN is provided with dual- network interface capability.

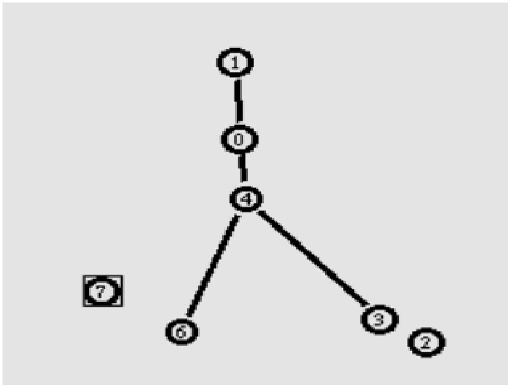

Fig. 2 Handover network topology

The simulation settings and parameters are summarized in table 2.

Table.2: Simulation Settings and Parameters

Area Size	1000mts X 1000mts
Base stations/AP	2
Users	10
Simulation Time	50 sec
Routing Protocol	SWARM
Traffic Source	CBR and Video
No. of CBR Flows	2
No. of Video Flows	2

5 Result & Discussion

To evaluate the QoS parameters (i) throughput and , (ii) delay in the system is measured and compared with respect to simulation time.In Fig. 3, average Delay responses of NRT application traffic are presented as a function of the simulation run time. The delay response obtained for proposed S-VHDF approach represents the better and minimized results with respect to simulation time in comparison to DR-VHDF approach.

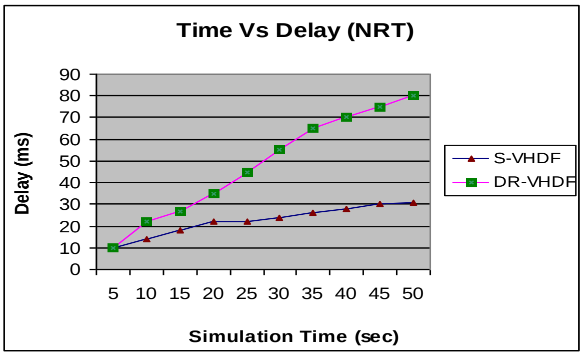

Fig 3: Time Vs Delay for NRT application

Throughput refers to the total number of bits transferred over the network in a given time. Throughput should be the maximum or should have a greater value so that we can send the maximum no. of bits in a given time [12].Fig. 4 illustrates the throughput response for swarm based handover and data rate based handoff decision algorithm for a NRT application. The throughput response for proposed approach is found to be better than the DR-VHDF approach.

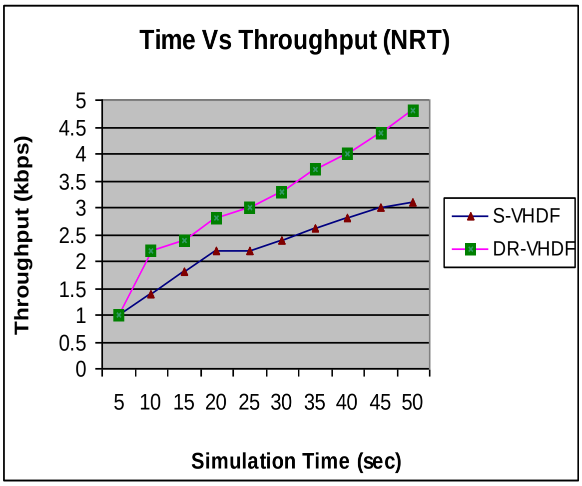

Fig 4: Time Vs Throughput for NRT application

Fig. 5 illustrates the throughput response for swarm based handover and data rate based handoff decision algorithm for a RT application. The dealy response for proposed approach is found minimized and optimum than the DR-VHDF approach.

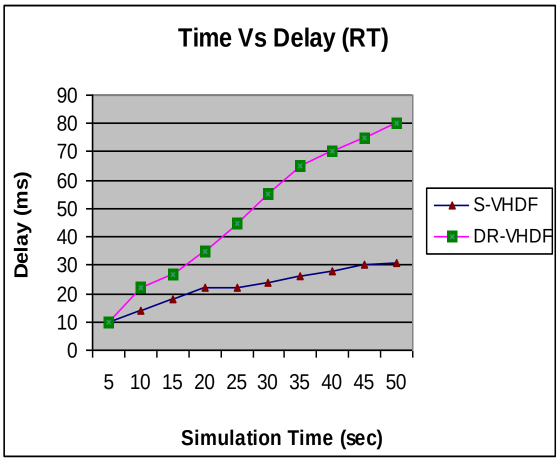

Fig 5: Time Vs Delay for RT application

Fig. 6 illustrates the throughput response for swarm based handover and data rate based handoff decision algorithm for a RT application. The throughput response for proposed approach is found better than the DR-VHDF approach.

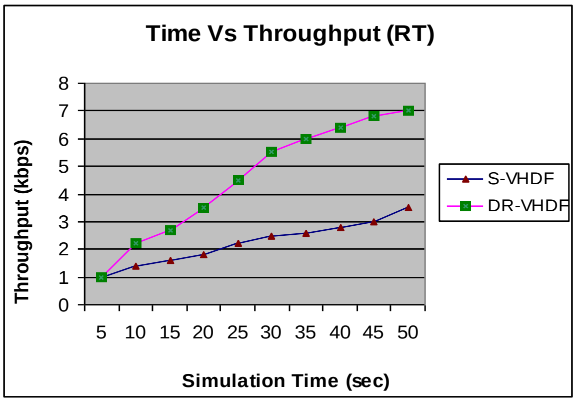

Fig 6: Time Vs Throughput for RT application

6 Conclusions and future work

This is important to choose the correct VHO criterion in order to achieve an optimum load balancing and QoS. Both handover schemes S-VHDF and DR-VHDF exhibited convergence according to QoS issue. We have proposed Swarm based Vertical handover algorithms(S-VHDF) .The proposed S-VHDF had the best performance for QoS parameters for elastic and in-elastic applications as compared to the data rate based handover function (DR-VHDF) scheme.

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