Dynamic Resource Allocation with network initiated Bandwidth Renegotiation (DRABR) protocol for Providing Seamless Handovers in Wireless ATM Networks

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ABSTRACT

With the ever increasing demand for easy portability and mobility of devices supporting diverse mobile multimedia applications, the need for the adaptation of broadband infrastructure to wireless scenario has arisen. Mobile multimedia networks like the wireless ATM are faced with challenges relating to user mobility management and channel access. In this paper the issue of handovers is addressed. We propose, simulate and present the relative performance appraisal of a handover strategy employing network-initiated bandwidth renegotiation and redistribution. The handover protocol is shown to perform better than static and dynamic handover schemes in terms of handoff connection drop probability.

I. INTRODUCTION

Mobility management is an important consideration in provisioning multimedia applications over wireless channel. Inter-cell handovers should be seamless vis-a-vis resource availability to the mobile hosts. This is crucial as the mobile hosts may support ATM traffic with stringent QoS requirements. As many multimedia applications can adapt to sporadic drops in bandwidth availability [2], network initiated bandwidth renegotiation can be employed to accommodate handover and new connection requests in a congested cell.

When a handover occurs, the destination cell should provide sufficient resources to the calls that have handed in. This is so because if the resources are not sufficient to meet the pertinent QoS needs, premature termination of the calls can occur. In resource allocation a base station should give priority to the handoffs requests over new connection requests as premature termination of a call is more detrimental to network performance than the rejection of new calls. This implies reservation of resources in each cell for handoff requests. Hence, a new connection request is accepted only if the vacant resources minus the resources reserved for handoff requests are sufficient to cater to the new call. Different handover strategies that have been proposed differ in the static, dynamic, or adaptive nature of the guard threshold, i.e., the bandwidth reserved to deal with handoff requests. In Fixed (f) strategy base station reserves f% of its capacity for handoff requests. The dynamic ExpectedMax strategy has been proposed in [1] wherein each base station dynamically adapts the guard threshold values based on current estimates of the rate at which mobiles in the neighboring cells are likely to incur hand-offs into this cell. The algorithm maintains a target probability for hand-offs request. The determination of guard threshold values is based on an analytical model, which relates the guard threshold values to the blocking probabilities for hand-offs and new connection requests. Each base station queries neighbouring base stations and computes an estimate of the rate at which calls are expected to hand-off in the next update period. The arrival of new connections is also estimated on the basis of local measurements. From these values the base station computes the minimum number of guard channels required to meet the target blocking probabilities for handoff requests.

II. THE DRABR PROTOCOL

By proposing the Dynamic Resource Allocation with network initiated Bandwidth Renegotiation (DRABR) strategy, we enhance call admission efficaciousness by introducing bandwidth renegotiation vis-a-vis the already existing connections. If a cell is too congested to accommodate a handoff connection request, a network-initiated renegotiation of the resources devoted to the connections currently present in the cell is done. The resource allocation to currently present connections is degraded in order of the decreasing priority of the pertinent traffic class type and the level of degradation acceptable to this traffic class connection. Successive permissible resource exemption is done till the resources so generated are sufficient to cater to an incoming request. Similar network initiated resource renegotiation is done in case the network lacks adequate resources to entertain a new connection request. Now some of the connections operate at a permissible degraded QoS. When a connection terminates, the network again initiates a resource renegotiation in order to distribute the resource vacated by the termination of this call. Hence the QoS available to the connections currently present in the cell is upgraded.

III. PROTOCOL SIMULATION

The simulations for the relative performance appraisal of the proposed DRABR strategy have been done via a C++ discrete event simulator developed for the purpose. The inputs to the simulator are characteristics/requirements of the traffic in the network, including the bandwidth requirement for peak QoS and acceptable bandwidth exemption. The output of the simulator includes the blocking probability of the new connection requests and the hand-off requests. The system model comprises of a topology consisting of a cell surrounded by six neighbouring cells. The central cell pertains to a main city region and the peripheral cell corresponds to the suburban areas located around the city centre. The simu-

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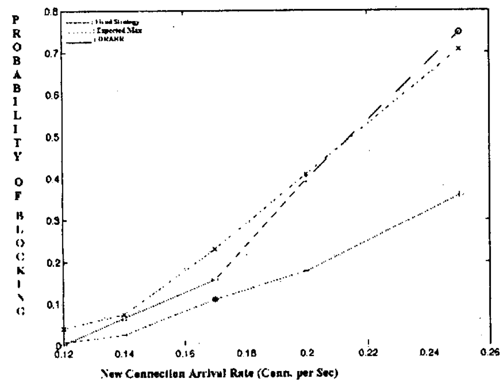

Fig. 1. :New Connection Blocking Probability Vs.New Connection Arrival Rate

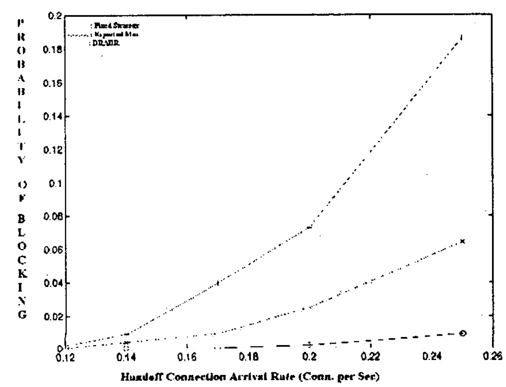

Fig. 2. :Handoff Connection Blocking Probability Vs. Handoff Connection Arrival Rate

lations have been done for a scenario typifying the morning rush hour traffic where the calls from the suburban areas are handed into the busy city area. E.g., the 8.00 a.m. to 9.00 a.m. Delhi mobile call traffic consists of a large number of mobile calls handing in from the peripheral areas like Noida.

A completely general topology can be visualized as the superposition of the "hotspot" topology employed in our simulations. Consider this set of a hotspot cell surrounded by six less active cells. Then in a network consisting of a large number of cells can be seen as the superposition of such hotspot windows centered at each cell of this network.

IV. RESULTS

Simulations have been done for the DRABR, EXPECTED-MAX, and the Fixed (5%) strategies. In Figure 1 and Figure 2 the blocking probability versus the handoff request arrival rate and new connection request arrival rate respectively is shown. These curves pertain to a traffic class having bandwidth requirement of 500 kbps and expected connection duration time of 1500 seconds. The DRABR strategy outperforms the other two handoff policies in terms of handoff call blocking probability. The new call blocking probability for Fixed(5%) strategy is the lowest as the resource reservation for dealing with handoffs is not adequate: this is manifested as the highest handoff call blocking probability for Fixed(5%). The performance curves for other traffic classes follow a similar trend.

V. CONCLUSION

In this paper we have addressed the issues of handovers in mobile multimedia networks The DRABR strategy proposed herewith is based on the consideration that multimedia connections can adapt to sporadic changes in bandwidth availability. The affect of a network initiated bandwidth renegotiation and redistribution on the performance of a handover protocol is analyzed. We show that the DRABR consistently performs better than a static and a dynamic handoff scheme. We further deliberate on medium access in wireless ATM networks. We conclude that bandwidth renegotiation can enhance the network performance in terms of number of handoff and new calls catered.

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