Abstract. In this paper we propose a bandwidth adaptation scheme that release multi-level of bandwidth from the existing calls. The amount of released bandwidth is based on the priority of requesting traffic call. This priority scheme does not reduce the bandwidth utilization. Moreover, the bandwidth adaptation policy provides significantly reduced call blocking probability for the higher priority traffic calls.

Keywords: Bandwidth adaptation, traffic class, and call blocking probability.

1 Introduction

The quality of service (QoS) adaptability has been used by several schemes (e.g., [1], [2]) to reduce the call blocking probability. The adaptive QoS schemes [3], [4] proved more flexible and efficient in guaranteeing QoS than the guard channel schemes [1]. In this paper, we present a scheme which allows reclaiming some of the allocated bandwidth from already admitted bandwidth adaptive traffic calls, as to accept higher priority calls, when the system’s resources are running low. Consequently, the scheme can reduce the overall forced call termination probability significantly as well as provides significantly reduced call blocking probability for the higher priority traffic calls. Our scheme reserves some releasable bandwidth to accept higher priority calls by providing multi-level bandwidth adaptation.

2 Proposed Bandwidth Adaptation

The basic idea for the proposed scheme is shown in Fig. 1. A call of $m$-th class traffic can be allocated by different level of bandwidth. The bandwidth allocation scheme is characterized by bandwidth degradation factors $\gamma_m$ and $\gamma_{m,p}$, respectively, are defined for each class $m$ traffic, as: the fraction of the bandwidth that has been already degraded of an admitted call, the maximum fraction of the bandwidth of an admitted call that can be degraded to accept a call of class $p$ type ($p=0$ represents the handover calls of any types of traffic). Therefore, to accept $p$-th priority call, the existing $m$-th class traffic call can be degraded to the maximum limit of the $\gamma_{m,p}$ portion.
Requested bandwidth by a call of \( m \)-th class traffic

Allocated bandwidth for \( m \)-th class traffic

Maximum releasable bandwidth from each call to accept a call request of lowest priority call

Maximum releasable bandwidth from each call to accept a request of highest priority call

\[ \gamma_{m,0} \geq \gamma_{m,1} \geq \ldots \geq \gamma_{m,m} \geq \ldots \geq \gamma_{m,M} \geq 0 \]  

Equation (1) indicates that the proposed scheme offers more degradation of the existing \( m \)-th class bandwidth adaptive traffic calls to accept a higher priority traffic call compared to the lower priority traffic calls.

### 3 Performance Analysis

In this section we present the performance of our proposed scheme. The ratio of the number of requested calls (voice: web-browsing: video: background) is considered as 3:3:1:2. Considering the average call duration of 120 sec during condition of no bandwidth degradation, the average cell dwell time is found to be 240 sec. During the bandwidth degraded condition, we considered the average call duration is state dependent i.e., more than 120 sec. We assume that the system capacity is 6 Mbps. For \( p = 1 \) to 4, we consider \( \gamma_{m,p} = 0.95 \gamma_{m,p-1} \).

Fig. 2 shows that the proposed scheme provides negligible handover call dropping probability even for high call arrival rate. The provision of maximum level of bandwidth adaptation without the priority of calls cannot provide acceptable handover call dropping probability and new call blocking probability of the higher priority traffic calls. Our scheme provides almost equal forced call termination probability compared to the adaptive non-priority scheme. Therefore, our proposed scheme offers priority for the higher priority calls without reducing the resource utilization.
Fig. 2. A comparison of new call blocking probability, handover call dropping probability, and overall forced call termination probability.

4 Conclusions

The proposed scheme offers more bandwidth degradation of the calls to support higher priority traffic calls over lower priority calls. Therefore, our proposed scheme provides priority of traffic calls as well as bandwidth adaptation. As a result, to give the priority of traffic calls, the overall forced call termination probability is not increased significantly.

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References