Chapter 1

Introduction

Priority inter-departure time processes have been studied more thoroughly since 1997 [7]. Stanford [7] considered the class-dependent waiting time and inter-departure time processes in single-server priority queues. Under the non-preemptive priority discipline, a customer's service time is not interrupted once it began. Under preemptive resume priority, a later arriving, higher priority customer displaces a customer of lower priority if it finds one in service. Service ultimately resumes at the point where the interruption occurred. Nain [8] determined the stationary distribution of the inter-departure time for each class via Laplace-Stieltjes transform for the preemptive priority single-server queue with Poisson arrival streams. Similar expressions for non-preemptive queues were obtained by Delbrouck [9] for the lowest priority class, and by Stanford [10] in the general case. Until recently, however, there was a dearth of waiting-time and inter-departure time results for priority queueing systems where one of the arrival streams is non-Poisson. In order to study priority queueing networks, more knowledge is needed about the departure process, as departures from one queue contribute to the arrival process elsewhere.

Our interest is to develop a model of characterizing priority inter-departure time in the system introduced in [3] and [6] with non-preemption discipline by conditional controls g_1 and g_2 of the Available Bit Rate (ABR). Following the description in [3], the system has a transmission link shared by an ABR application for non-real time traffic and a VBR application for real time traffic. The network access node is assumed to have a finite buffer of capacity C for the temporary storage of the ABR cells. They assumed no buffer for the VBR cells. There are two critical number g_1 and g_2 to characterize the congestion of the buffer of ABR, where $0 \leq g_1 \leq g_2 \leq C$. If the buffer is full, however, the ABR cells will be blocked and cleared from the system. They proposed a new feedback control method to control the flow of the ABR traffic. We investigate the two inter-departure times respectively. In the thesis, we present a method for calculating the departures of ABR and VBR based on a MMBP/G/1 queue with non-preemptive priorities. We successfully calculate the mean and variation for Variable Bit Rate (VBR) (or ABR). In the paper of Yue et al. [3], they focused on the problem of blocking probabilities and utilization of ABR by adjusting the values of g_1 and g_2. We study how the inter-departure times of ABR and VBR are affected by g_1 and g_2, deriving the mean and variance in comparison with the results obtained in simulation since ABR cells are only transmitted when the VBR buffer is empty. By our analysis, it shows two inter-departure times are functions of g_1 and g_2. However, simulation results show no significant difference when the mean and variance are computed in various test problems, and the sensitivity analysis is conducted. On the other hand, the mean and variance of the inter-departure times are more sensitive to the arrival process of VBR.

Probability distributions of the inter-departure time of ABR and VBR for the data packet delay are derived. We shall confine our discussion to a stationary queueing system that implies stationary inter-departure times which consists of a sequence of positive random variables $\{D_n\}$ with finite mean $E[D_n]$ and finite variation $V[D_n]$. Numerical results are compared among cases with different model parameters to analyze what affects on channel utilization and the loss probability. We have derived probability distributions of inter-departure time in a multi-traffic with control by extending the analytical technique in [4]. The analysis presented in this thesis can be applied to evaluate performance measures of other networks such as Head of Line (HOL) networks, cellular mobile radio networks and multi-hop wireless networks.

The remainder of this paper is structured as follows. In Chapter 2, we describe the system model. In Chapters 3, 4 and 5, following [3], we attain some formulas to compute mean and variation of inter-departure times of ABR and VBR. In Chapter 6, the numerical results of departure process are obtained in simulation and compared with the formulas. Conclusion are given in Chapter 7.