Chapter 4
A Single Server Retrial Queueing System with Two Types of Batch Arrivals

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ABSTRACT

A retrial queueing system with two types of batch arrivals is considered. The arrivals are called type I and type II customers. The type I customers arrive in batches of size $k$ with probability $c_k$ and type II customers arrive in batches of size $k$ with probability $d_k$. Service time distributions are identical independent distributions and are different for both type of customers. If the arriving customers are blocked due to server being busy, type I customers are queued in a priority queue of infinity capacity whereas type II customers entered into retrial group in order to seek service again after a random amount of time. For this model the joint distribution of the number of customers in the priority queue and in the retrial group in closed form is obtained. Some particular models and operating characteristics are obtained. A numerical study is also carried out.

INTRODUCTION

Queueing models are the most powerful tool for modelling communication networks, transportation problems, production systems, computer networks, etc. Several queueing models have been defined and analyzed by adding additional characters to ordinary queueing models by researchers on the basis of real life situations. One such model is queue with retrials, called retrial queueing models. Retrial queueing systems are characterized by the fact that the arriving customer who find the server busy is to leave the service area and try his demand after a random period of time, called retrial time. Between trials, the blocked customers joins a pool of unsuccessful customers called orbits. This type of models has applications in web access, telecommunication networks, computer systems, pocket switching networks, etc.
In the last three decades, there has been a significant contribution in the area of retrial queueing theory. Cohen (1957) has published the first article on the retrial queueing system. Keelson et al. (1968) made some significant contribution to the retrial queue in the earlier stage. Some other notable works in the beginning stage are by Aleksandrov (1974), Choo and Conolly (1979) and Falin (1979). For detailed survey one can see Choi and Chang (1999), Falin and Templeton (1997), Falin (1990) and Yang and Templeton (1987), Artalejo and Falin (2002) have given a comparative study between the classical queue and retrial queue.

In modern telephone switching system, a server can serve incoming calls and outgoing calls, but the difference between the calls is that in the case of the server being busy, outgoing calls can be queued, whereas incoming calls get busy signals, returned to service. In computer and communication system, also we have the similar situation. This situation can be modelled using retrial queue with two types of customers.

Choi and Park (1990) investigated an M/G/1 retrial queue with two types of customers in which the service time distribution for both types of customers are the same. Khail et. al (1992) investigated the above model at Markovian level in detail. Falin et.al(1993) investigated a similar model, in which they assumed different service time distributions for both types of customers. In 1995, Choi et.al, studied an M/G/1 retrial queueing with two types of customers and finite capacity. Kalyanaraman and Srinivasan (2004), studied an M/G/1 retrial queue with geometric loss and with type I batch arrivals and type II single arrivals. In 2011 the author with Thillaigovindan analyzed a feedback retrial queueing system with two types of arrivals and the type I arrival being the batch arrival of fixed size $K$.

The Content of this Chapter is a retrial queue with two types of customers, in which both types of customers arrives in batches of variable size. First, the system with stability condition and notation have been and then we obtain the joint probability generating function for the number of customers in the priority queue and in the retrial group when the server is busy as well as idle. The expressions for some particular models are deduced and some operating characteristics are derived. Finally the numerical study is carried out. In the last section further research direction has been given.

**THE MODEL**

A retrial queueing system with two types of customers type I and type II, respectively has been considered in this paper. The type I customers arrives in batches of size $k$ with probability $c_k$ and type II customers arrives in batches of size $k$ with probability $d_k$ according to two independent Poisson processes with rates $\lambda_1 = k_c = \sum_{k=1}^\infty k c_k$ and $\lambda_2 = k_d = \sum_{k=1}^\infty k d_k$ respectively. If type II customers upon arrival finds the server busy, they enter into an orbit of infinite capacity in order to seek service again after a random amount of time. All the customers in the retrial group behave independent of each other. The retrial time is exponentially distributed with mean $1/\alpha$. The type I customers are queued in a priority queue of infinite capacity after blocking, if the server is busy. As soon as the server is free, the customers in the priority queue are served using FCFS rule and the customers in the retrial group are served, if there are no customers in the priority queue.