Chapter VIII

Constraint Allocation on Disks

Introduction

Most existing storage servers store data stripes on magnetic hard disks. These magnetic hard disks are accessed by moving the disk heads to random disk tracks. A significant amount of overhead is spent in moving the disk heads across the disk tracks. The access time of a request would be significantly reduced if the seek time is reduced.

In the normal placement of data stripes on disks being described in the two previous chapters, data stripes can be placed on any tracks with free space. There is not much consideration on the distance among data stripes of concurrent streams. Separation distances between data stripes of an object are not sufficiently constrained. Thus, the only guarantee on the upper bounds of access times is very high.
Constraint allocation methods limit the available locations to store the data stripes. This helps to control the access time within media playback requirements. The data stripes are also evenly spread across the surface of the storage media. This reduces the overheads of serving concurrent streams from the same storage device. Therefore, the maximum overheads in accessing data from the storage devices, such as seek time, become lowered.

In this chapter, we shall describe two constraint allocation methods that are designed for magnetic hard disks. These methods may also be applicable to other storage media that use the disk format. When many streams access the same hot object, the phase based constraint allocation supports more streams with less seek actions. We shall describe the phase based constraint allocation method in the next section. The region based allocation limits the longest seek distance among requests. After that, we describe the region based allocation method.

### Phase Based Constraint Allocation

Multimedia objects are stored on and accessed from storage systems. The concurrent streams send requests to access data stripes. If the disk heads serve all the requests of one stream before another, the latter stream waits for a long time before it can start. If the disk heads serve requests of streams in an interleaving manner, the disk heads move across the disk heads many times. The storage locations of these objects could be very far away. Thus, the disk heads take a long time to seek the required tracks of each request. The overheads in serving concurrent streams are heavy, and the storage system cannot retrieve the objects efficiently.

When the overheads are heavy, the upper bounds on the access time are high. The maximum access time to serve a stream becomes very long. Thus, the storage system can only accept a small number of streams to be served. Other streams have to be rejected from being served.

Özden, Biliris, Rastogi, and Silberschatz (1994) proposed the phase based constraint allocation method to serve multiple concurrent streams efficiently (Özden et al., 1994; Özden, Rastogi, & Silberschatz, 1996). It shares the seek time overheads among the requests of concurrent streams. Instead of storing the data stripes belonging to an object on nearby locations, the phase based constraint allocation stores together the data stripes that are accessed...
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