Chapter XIII

Constraint Allocation on Hierarchical Storage Systems

Introduction

Multimedia objects are stored on hierarchical storage systems (HSS). The objects are large in size but the access latency of HSS is high. It is necessary to provide high throughput in delivering data from the storage system. In addition to the statistical placement and striping methods in the two previous chapters, constraint allocation can also improve the throughput of HSS.

Multimedia streams should be displayed with continuity. Depending on the data migration method, the whole object or only partial object is retrieved prior to the beginning of consumption. Thus, it may need to retrieve the parts of the object within guarantee times.

The maximum access time depends on the storage locations of the object. If the parts of the object are freely stored on any media units, it may take the longest exchange time to exchange a media unit. If the parts of the object...
are freely stored on any locations of the media units, it may take the longest reposition time to reposition the media unit. The maximum access time needs to include both the longest exchange time and the longest reposition time. As a result, the guarantee times should not be shorter than the maximum access time in the worst case. The long guarantee time results in a small number of acceptable streams to the hierarchical storage system.

The constraint allocation methods limit the freedom to place data on media units so that the worst case would never happen. They reduce the longest exchange time and/or the longest reposition time in accessing the objects. Two approaches to provide constraint allocations have been proposed on different types of media units. The interleaved contiguous placement limits the storage locations of data stripes on optical disks and it is described in the next section. The concurrent striping method that limits the storage locations of data stripes on tapes is described.

### Interleaved Contiguous Placement

The interleaved contiguous placement method reduces the maximum overheads in accessing the objects concurrently. It maintains the separation between consecutive data stripes so that the maximum reposition time and the maximum access time are bounded above.

Some multimedia streams have some correlations. These multimedia streams may be more likely to be played at similar times. The objects that are accessed by these streams are more likely to be accessed at similar times. For example, the audio data and video data of a movie may be created on separate objects. The multimedia stream that accesses one object would likely be initiated at the same time as the stream that accesses another object. These two objects thus have a high probability of being accessed together. The interleaved contiguous placement method stores these objects on the optical disk in a way that they can be accessed efficiently.

The interleaved contiguous placement method merges the data stripes of the objects that are likely to be accessed concurrently. It interleaves the data stripes on the same optical disk by maintaining the distance in separation between consecutive data stripes. Thus, the optical disk moves only the distance between consecutive data stripes to serve a request on the object. As
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