CS 414 – Multimedia Systems Design

Lecture 29 – Media Server (Part 3)

Klara Nahrstedt

Spring 2008

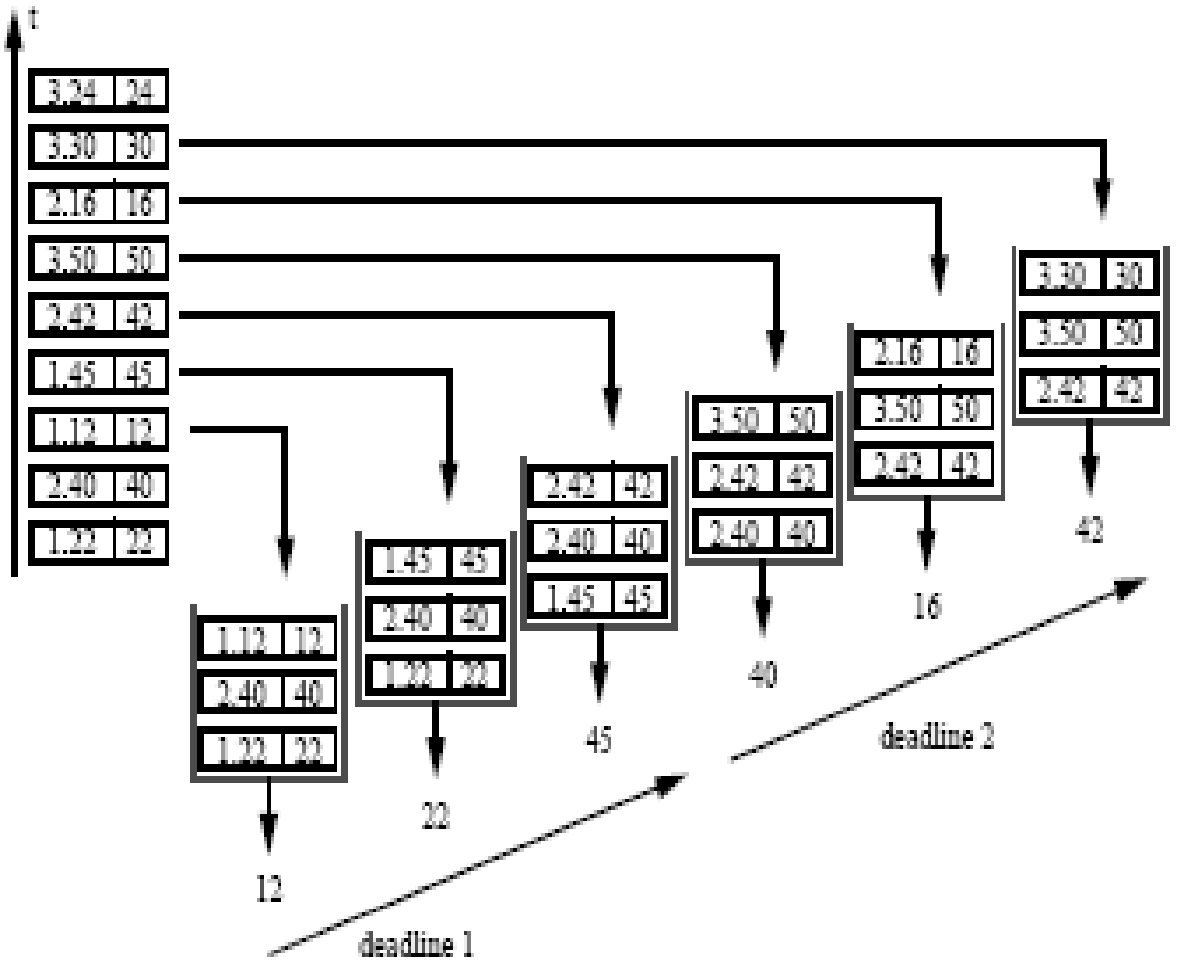
Administrative

- MP3 is out – deadline April 4
- Discussion Section – Monday, March 31, 7pm, 3405 SC

Outline

- Disk Scheduling
  - SCAN-EDF
  - Group Sweeping
  - Mixed Scheduling
- Admission Control
- File System Metadata/Indexing
- Block Size Issues

SCAN EDF Example (N_{max} = 100)

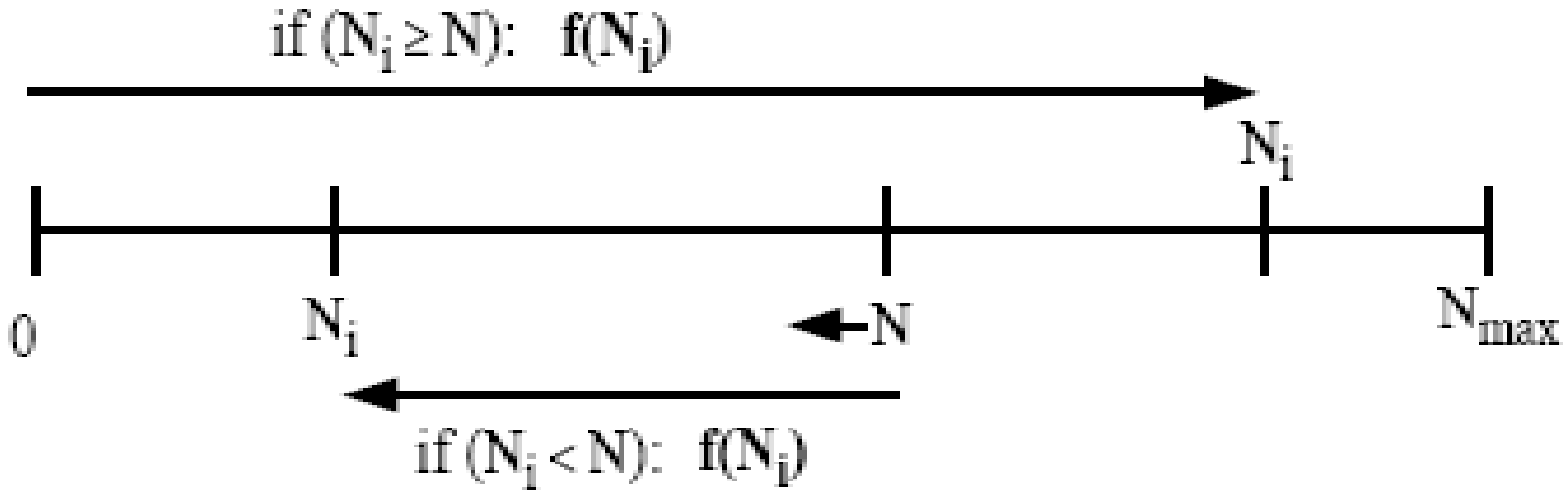


Enhanced SCAN-EDF (3)

- If head **moves downwards** (towards 1), then

(a) $\forall N_i; N < N_i \leq N_{\max} : f(N_i) = \frac{N_i}{N_{\max}}$

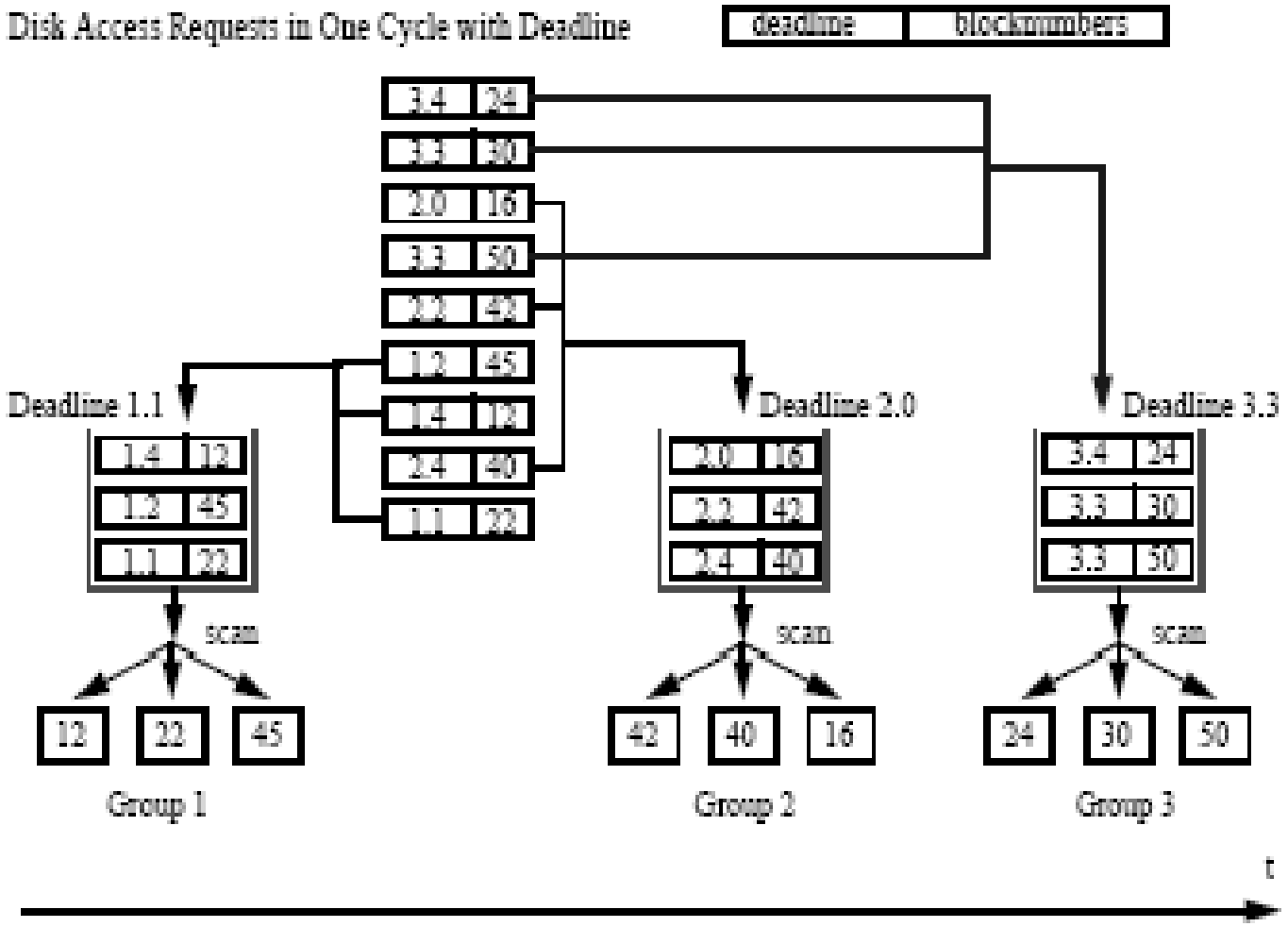
(b) $\forall N_i; 1 \leq N_i \leq N : f(N_i) = \frac{N - N_i}{N_{\max}}$



Group Sweeping Algorithms

- Policy:
  - Each Request consists of (Deadline, Block Number)
  - Disk Block Requests served in cycles
  - Requests served in Round-Robin manner
  - In one cycle, requests divided into groups
  - As we retrieve blocks, we may need smoothing buffers to ensure continuity

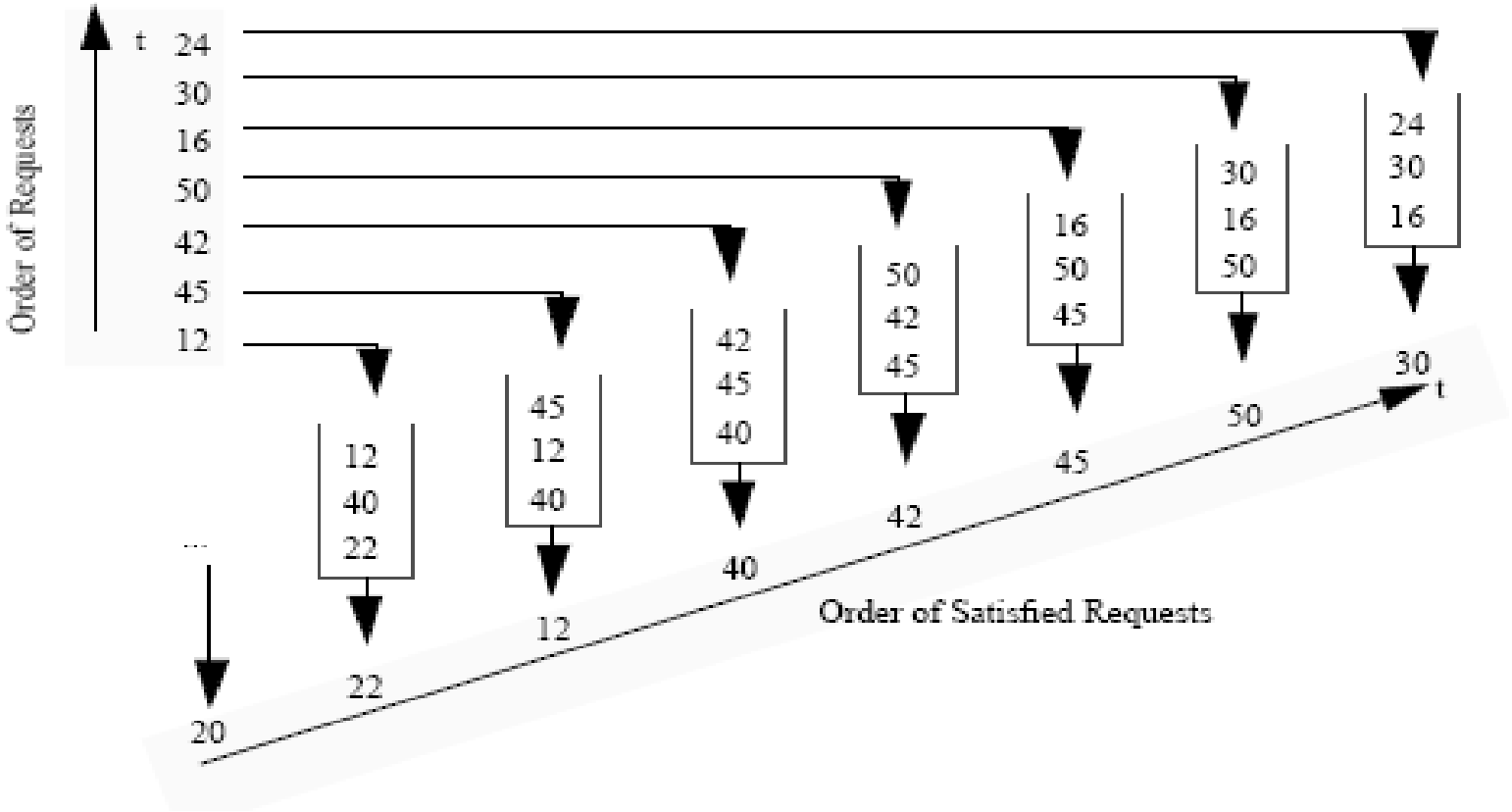
Group Sweeping Example



Mixed Scheduling

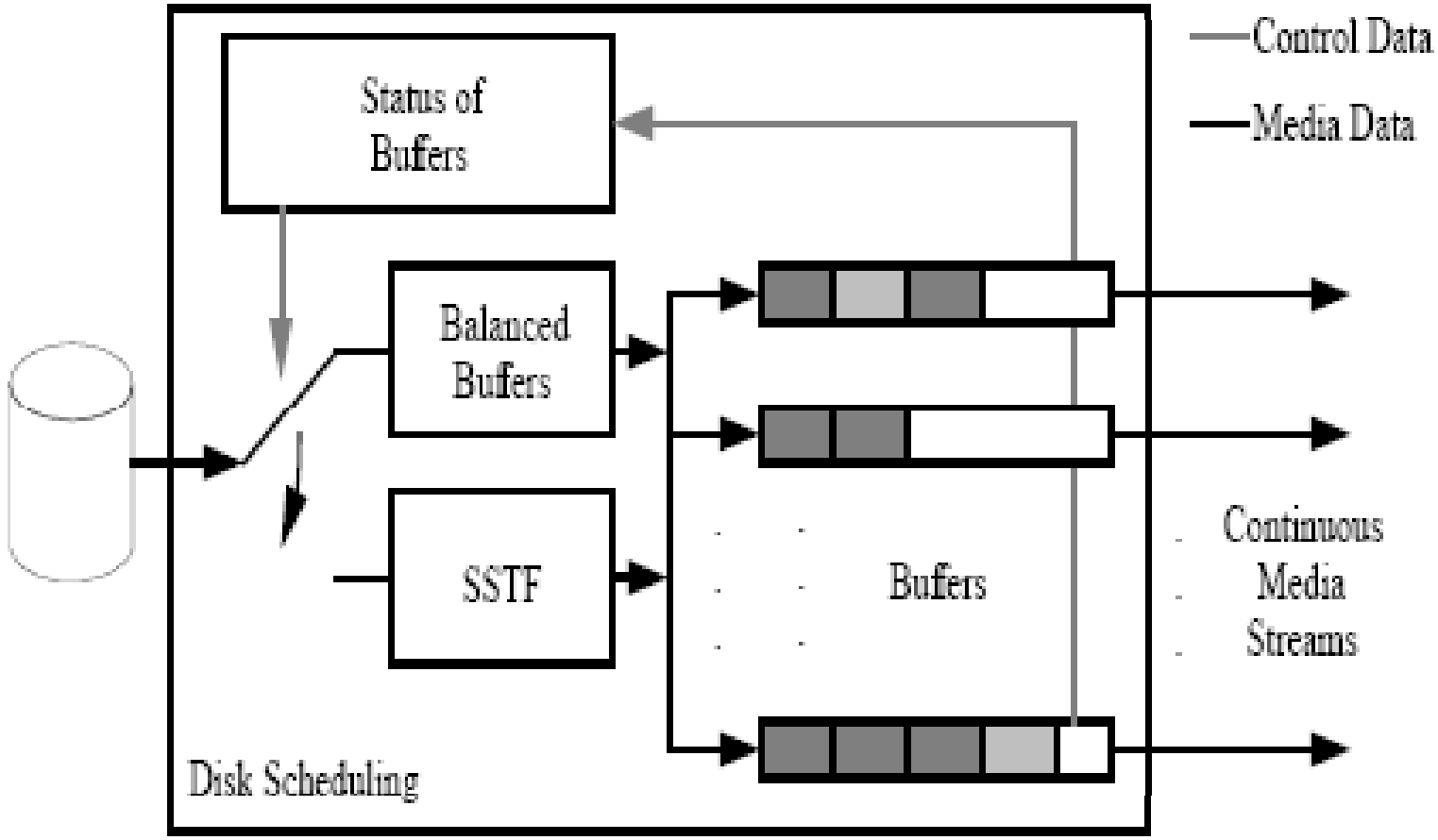
(uses SSTF – Shortest Seek Time First)

Example of SSTF

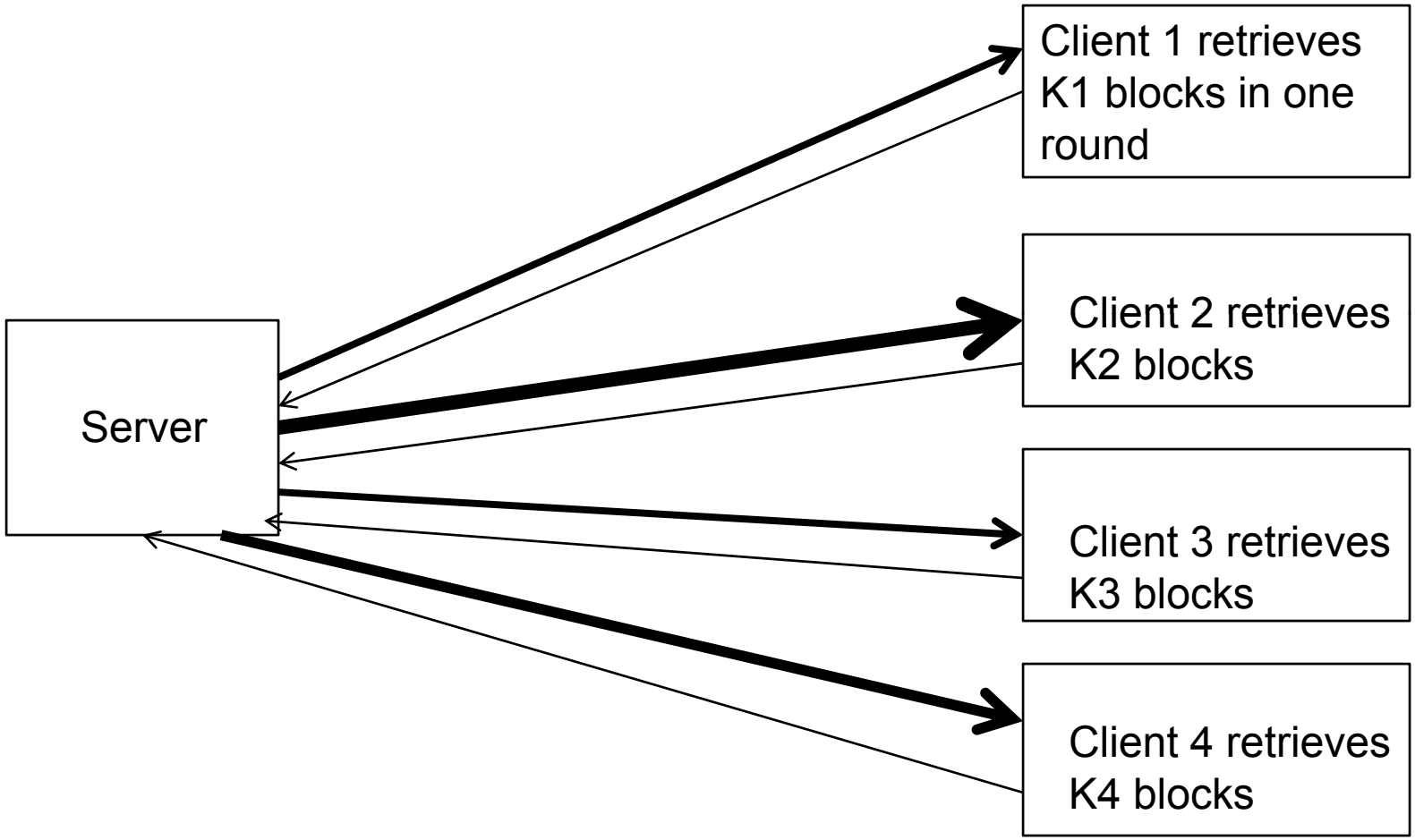


Mixed Scheduling

SSTF (Shortest Seek Time First) + Balanced Strategy



Admission Control



Admission Control

$$\sum_{i}(\alpha+\beta) \le \min_{i}(K_i \times (\eta^i) / R^i_{pl})$$

α – overhead switching from one round (‘j-1’)
To another round (j), and the transmitting the
First block of the ‘j’ round
β – transmission time of (Ki-1) blocks in ‘j’ round, i=1,..4
K_i – number of blocks retrieved by client ‘i’
η^i – Block granularity retrieved for client ‘i’
R^i – playback rates of client ‘i’

Admission Control

- Disk block requests are timed
  - Media server must determine
    - admit a stream
    - serve (schedule) a stream without having negative effect on other streams already serviced.
- Deterministic Guarantees
  - Admission control considers worst case scenario when admitting new stream
  - Constrained Disk Placement Example: *M* - size of blocks, *G* – size of gabs, r_{dt} – data transfer of disk

$$T_{play} \geq \frac{M(\text{sectors}) + G(\text{sectors})}{r_{dt}(\text{sectors}/s)}$$

Admission Control

- Statistical Guarantees
  - Deadlines are guaranteed with certain probability
  - Admission control considers statistical behavior of the disk system while admitting new stream (average performance)
- Best effort Service
  - No guarantees

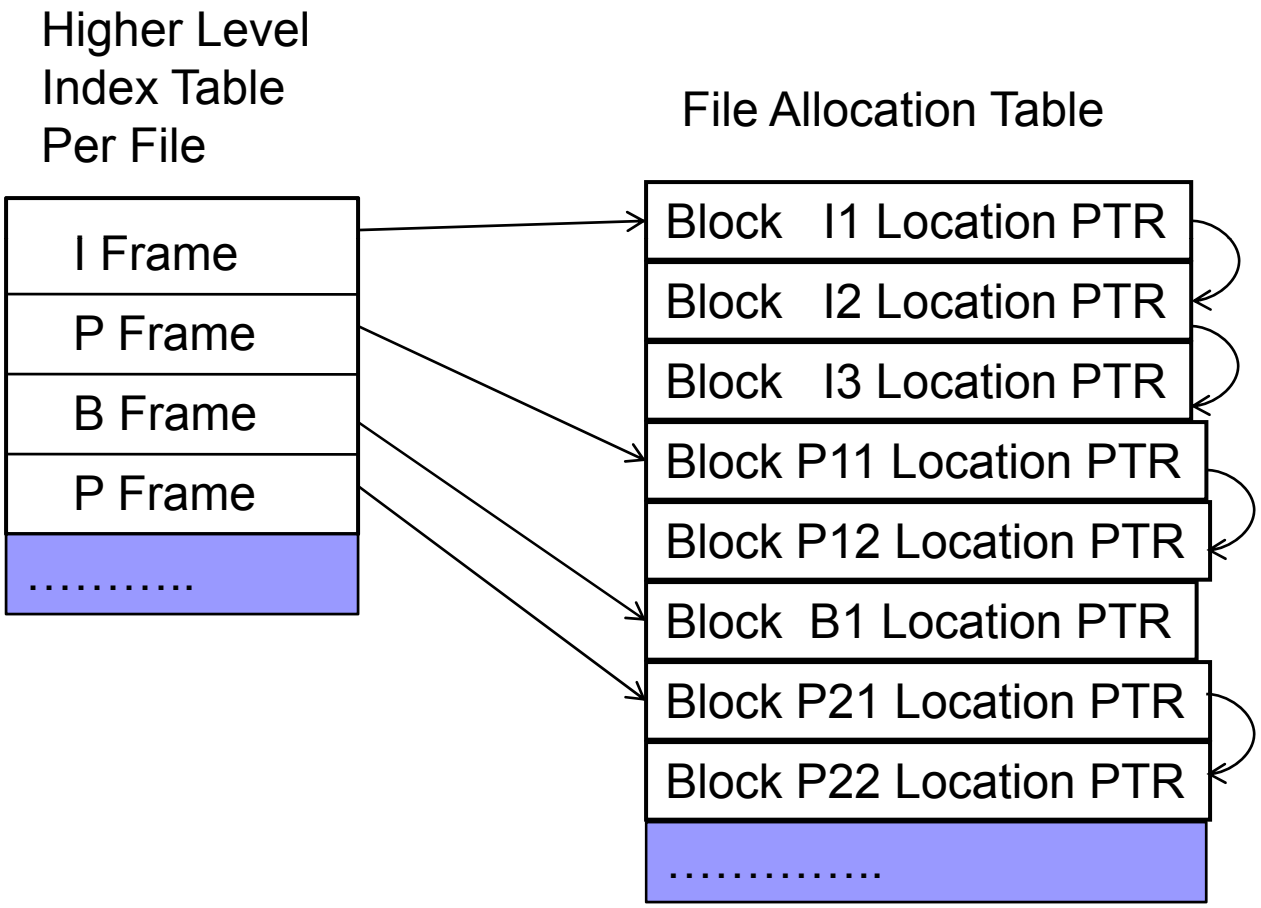
Multimedia File Systems

- Real-time Characteristics
  - Read operation must be executed before well-defined deadline with small jitter
    - Additional buffers smooth data
- File Size
  - Can be very large even those compressed
  - Files larger than 2^{32} bytes
- Multiple Correlated Data Streams
  - Retrieval of a movie requires processing and synch of audio and video streams

Placement of Mapping Tables

- Fundamental Issue: keep track of which disk blocks belong to each file (I-nodes in UNIX)
- For continuous files/contiguous placement
  - don’t need maps
- For scattered files
  - Need maps
    - Linked lists (inefficient for multimedia files)
    - File allocation tables (FAT)

Indexing and FAT



Constant and Real-time Retrieval of MM Data

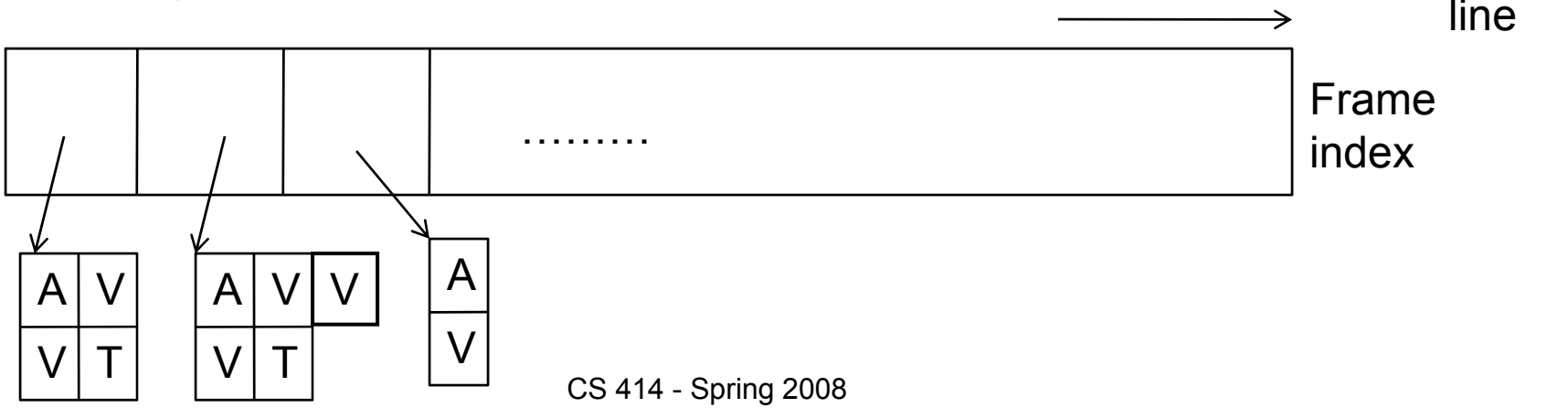
- Retrieve index in real-time
- Retrieve block information from FAT
- Retrieve data from disk in real-time
- Real-time playback
  - Implement linked list
- Random seek (Fast Forward, Rewind)
  - Implement indexing
- MM File Maps
  - include metadata about MM objects: creator of video, sync info

Fast Forward and Rewind (Implementation)

- Play back media at higher rate
  - Not practical solution
- Continue playback at normal rate, but skip frames
  - Define skip steps, e.g. skip every 3rd, or 5th frame
  - Be careful about interdependencies within MPEG frames
- Approaches for FF:
  - Create a separate and highly compressed file
  - Categorize each frame as relevant or irrelevant
  - Intelligent arrangement of blocks for FF

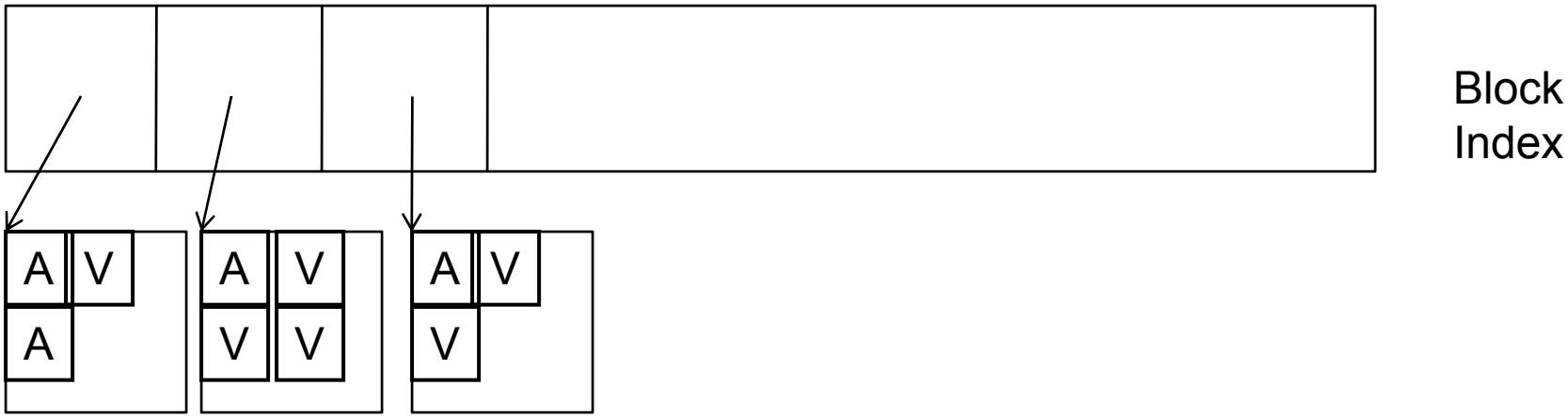
Block Size Issues in File Organization

- Small Block Sizes
  - Use smaller block sizes, smaller than average frame size
- Organization Strategy: Constant Time Length
- Need Metadata structure, called Frame Index
  - Frame means a time frame within a movie
  - Under the time frame read all blocks (audio, video, text) belonging to this time frame



Block Size Issues

- Large Block Size
  - Use large blocks (e.g., 256 KB) which include multiple audio/video/text frames
- Organization Strategy: Constant Data Length
- Need Metadata structure, called Block Index
  - Each block contains multiple movie frames



Tradeoffs

- Frame index : needs large RAM usage while movie is playing, however little disk wastage
- Block index (if frames are not split across blocks): need low RAM usage, but major disk wastage – internal disk fragmentation
- Block index(if frames are split across blocks): need low Ram usage, no disk wastage, extra seek times

Conclusion

- The data placement, scheduling, block size decisions are very important for any media server design and implementation.
- Still need to consider caching – next lecture