CSc 461/561
Multimedia Systems
Multimedia Streaming

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Streaming applications

- Usually multimedia streams, e.g.,
  - video on demand (stored streaming)
  - web-cast (live streaming)
- But can involve
  - streaming server(s), e.g., CDN
  - (potentially many) streaming clients
- Challenges
  - performance (at client), scalability (at server)

Unicast streaming

- One streaming channel per client
  - no client waiting
    - except buffering delay to absorb network jitter
  - independent operations (high interactivity)
- Server overhead
  - proportional to the number of clients
    - e.g., the number of channels
  - does not scale well w/ a large number of clients

* e.g., VoD on airplane or in hotel

Batch streaming

- Approach: aggregate client requests
  - e.g., preprogrammed regular pay-per-view
  - appear to be “fewer” client requests
  - have to wait for other clients (for how long?)
- Technique: multicast to the client group
  - or broadcast to all clients with a key
  - reduced server overhead
    - proportional to the number of client groups

* e.g., premier PPV/cable TV channels

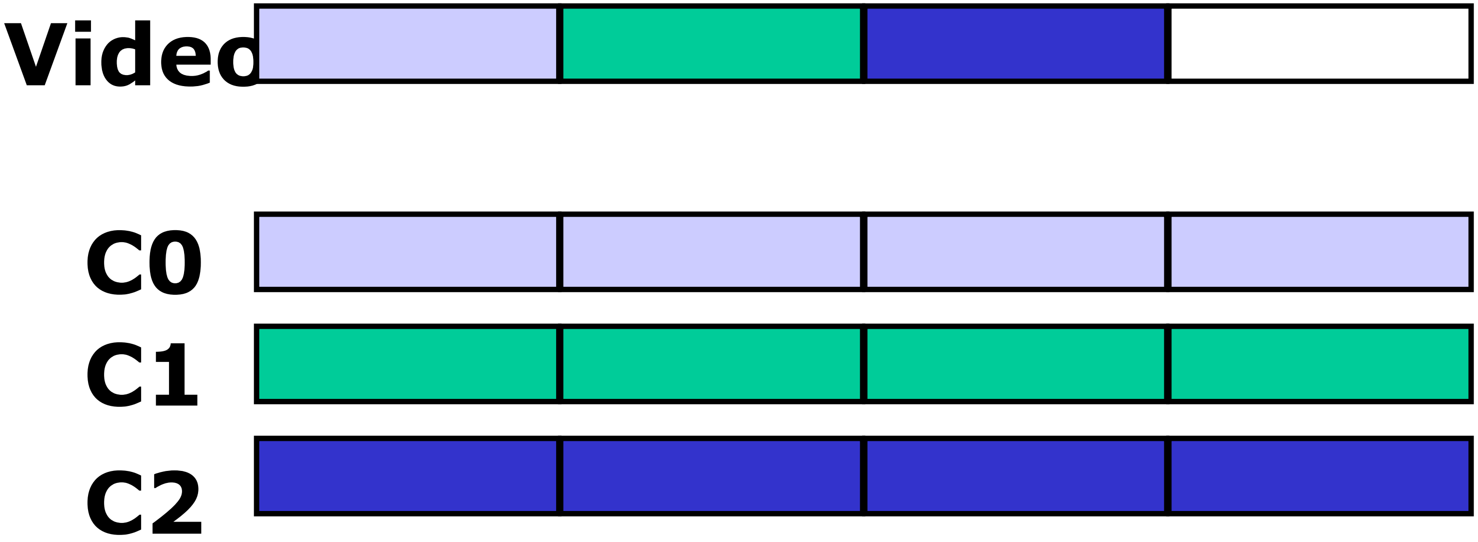
Staggered broadcast

- Data centric approach
  - staggered broadcast in different (sub)channels
  - repeated broadcast in one (sub)channel
- Technique
  - clients: pick the (earliest-to-start) channel
    - bounded waiting time
  - server overhead: # of (sub)channels
    - proportional to the number of channels

* e.g., movie X of 2 hours on channel 1 at 1am, 2 at 2am, 1 at 3am, etc

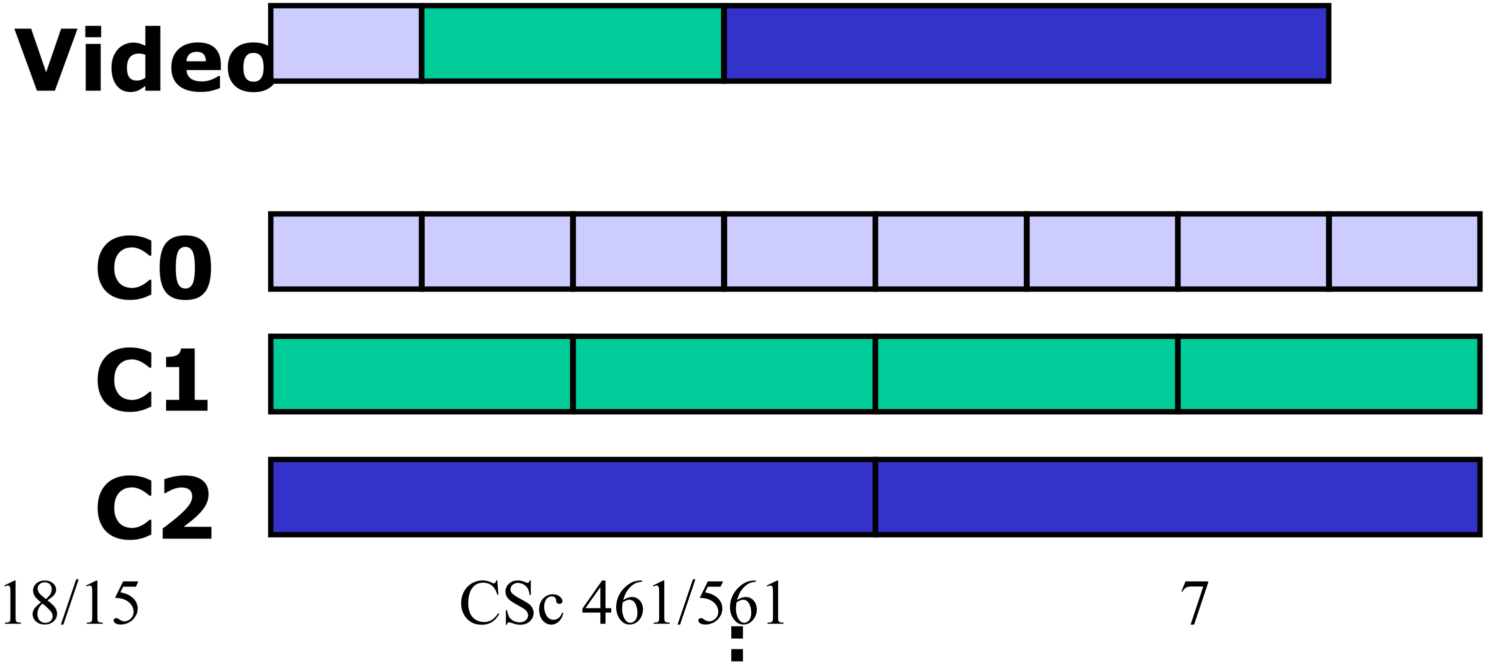
Periodic broadcast

- Approach
  - dealing with (smaller) segments
  - broadcast segments in different (sub)channels



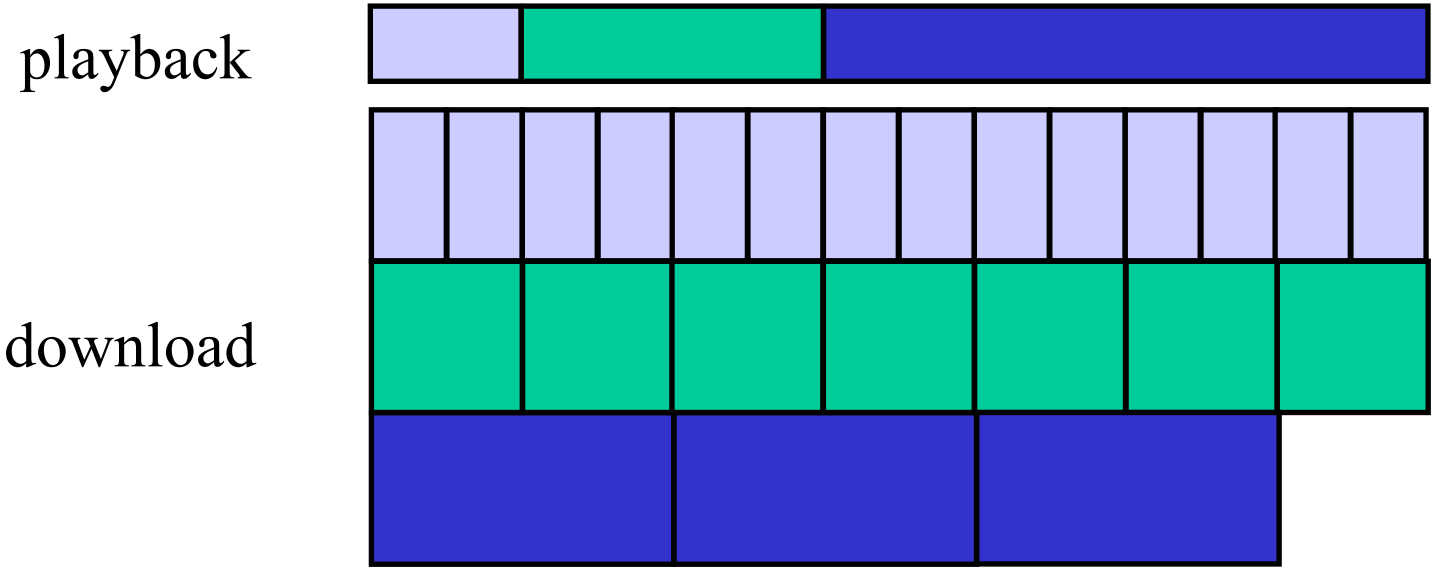
Pyramid broadcast

- Approach
  - segments of increasing sizes
  - (smaller) initial waiting time



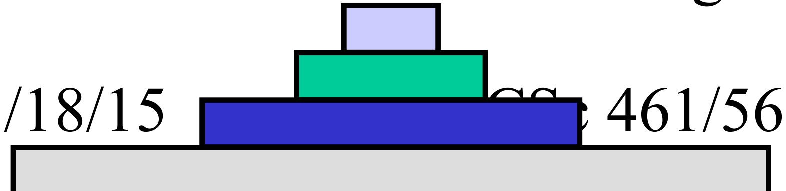
Pyramid broadcast: more

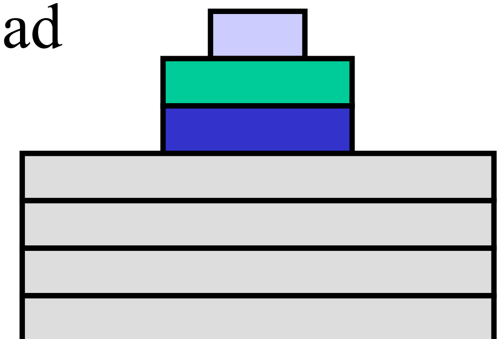
- Client technique
  - playing while further buffering (how much?)
    - playback rate vs download rate



Periodic broadcast: more

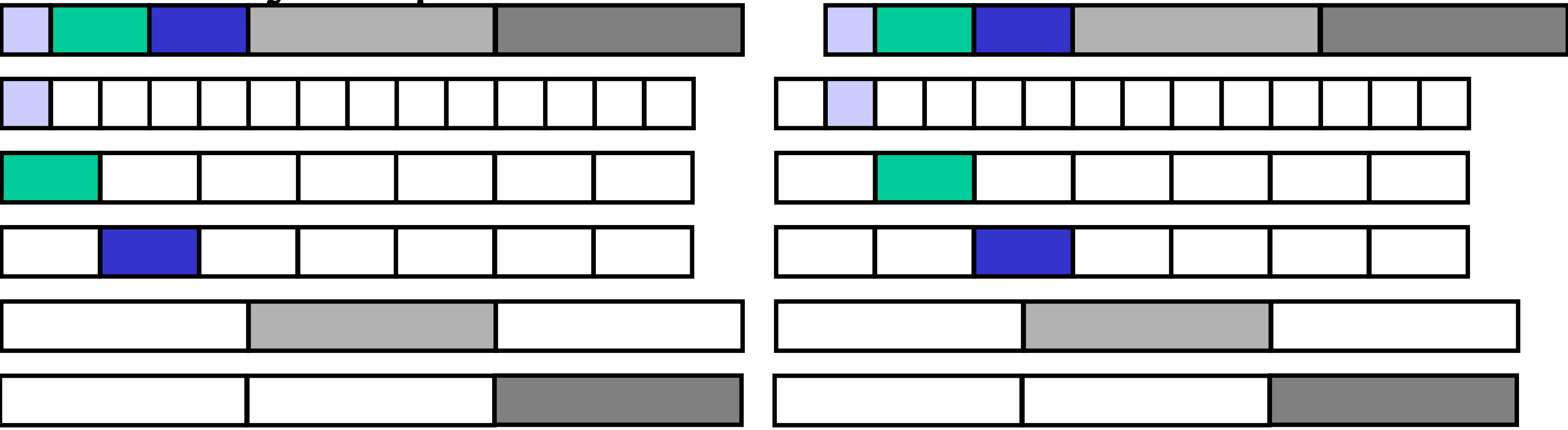
- Permutation-based pyramid broadcast
  - lower client storage requirement (~20%)
    - at the cost of (slightly) higher server overhead
- Skyscraper
  - e.g., segment size: 1, 2, 2, 5, 5, 12, 12, 25, …
  - even lower client storage requirement (~10%)
    - without much server overhead
    - limited client storage





An art of segment size

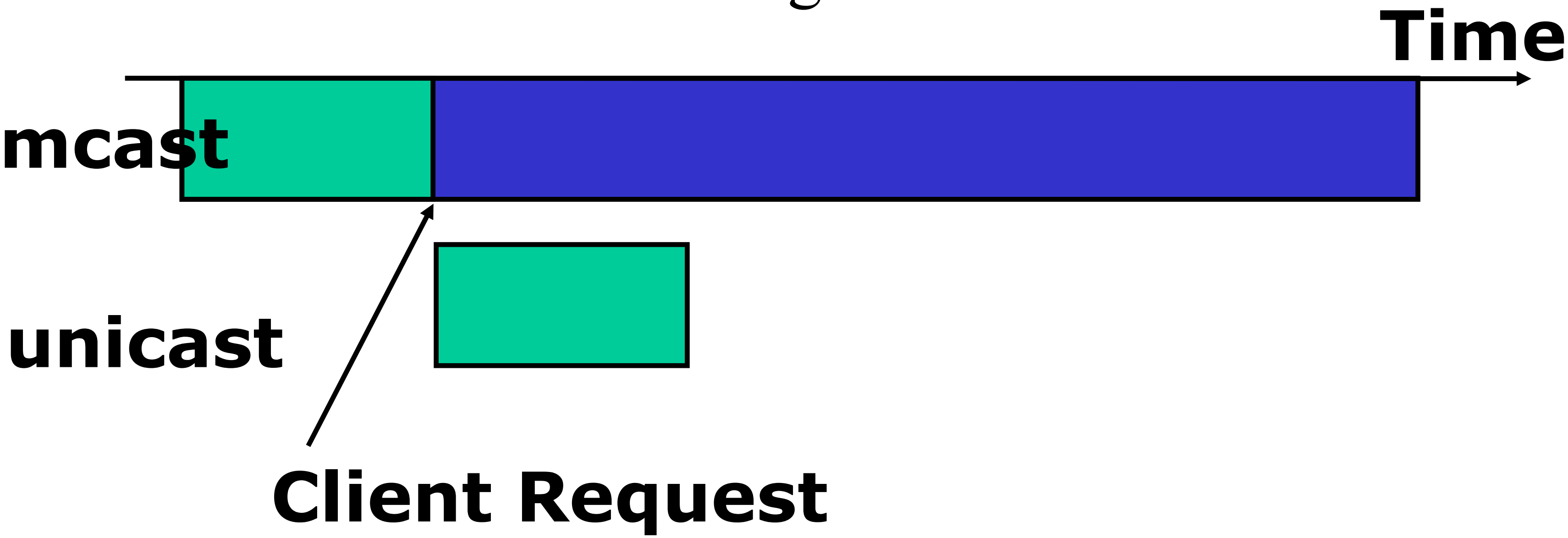
- Skyscraper



- Pagoda: 1, 3, 5, 15, 25, 75, 125, …
- Harmonic: equal segment size, variable bw

Patching

- The combination of multicast and unicast
  - multicast: what's still available
  - unicast: what's missing



Patch or not to patch

- When a client request comes
  - initiate a new multicast, or
  - join an existing multicast with a unicast
- Balance
  - overall (multicast+unicast) overhead
  - given a request arrival pattern
- Patch window
  - initiate a new mcast after the PW of the old one

Multicast support

- IP multicast
  - IGMP
  - multicast routing
  - M-Bone
- Application multicast
  - hosts act as multicast router
- Peer-to-peer streaming
  - clients also serve other clients

* e.g., Telus Optik IPTV

This lecture

- Multimedia streaming
  - streaming vs download-and-play
  - streaming techniques
    - unicast
    - broadcast
    - multicast