Augmented Reality & Video Service Emerging Technologies

Video Streaming & MPEG-DASH

Prof. Jong-Moon Chung

Video Streaming & MPEG-DASH

Streaming Networks and Technologies

Streaming Networks and Technologies

❖ Managed Networks

- Cable TV and IPTV services
- Use multicast transport
- Uses controlled QoS functions
  - QoS: Quality-of-Service

Streaming Networks and Technologies

❖ Unmanaged Networks

- Content delivery to the viewer using a unicast connection
- Delivery from a Server or CDN
  - CDN: Content Delivery Network

Streaming Networks and Technologies

❖ Unmanaged Networks

- Streaming Methods
  - Proprietary streaming protocol running on TCP (or UDP)
  - HTTP over TCP (Progressive Download)

- Conventional Streaming vs. Adaptive Streaming technology

Streaming Networks and Technologies

❖ Unmanaged Networks

1. Conventional Streaming Services
   - Streaming Service Types
     - Microsoft Windows Media
     - Apple QuickTime
     - Adobe Flash
   - Progressive Download
     - HTTP over TCP
     - Video playout can start as soon as the necessary amount of data is retrieved and buffered

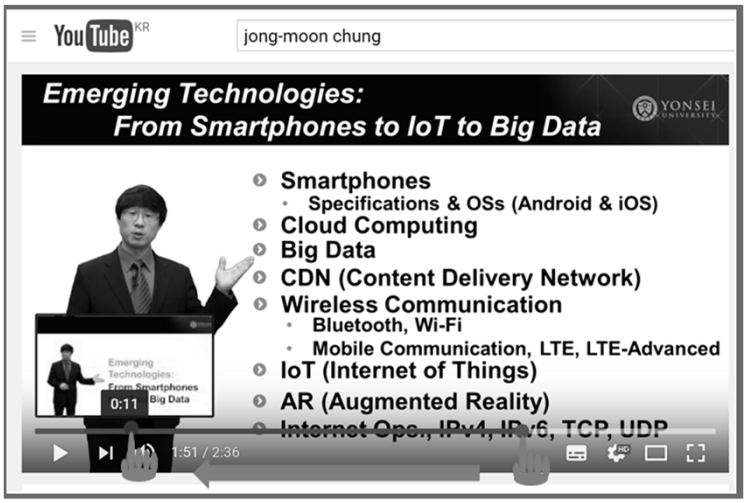
Streaming Networks and Technologies

❖ Unmanaged Networks

1. Conventional Streaming Services
   - Progressive Download
     - Pros
       - Easily supports Freezes and Rebuffering
       - Easily supports Trick mode (e.g., Fast-Forward Seek/Play, Rewind, etc.)
     - Cons
       - Server must have multiple resolution versions of the same video

Streaming Networks and Technologies

❖ Trick Mode example



Streaming Networks and Technologies

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2. Adaptive Streaming
   - Viewer device monitors its Replay Buffer & Network conditions (e.g., bandwidth, error rate, delay, etc.) to choose the most appropriate version of the video and uses Progressive Downloading

Streaming Networks and Technologies

❖ Unmanaged Networks

2. Adaptive Streaming
   - Adaptive Streaming service examples
     - MPEG DASH (Dynamic Adaptive Streaming over HTTP)
     - Microsoft Smooth Streaming
     - Apple HTTP Live Streaming
     - Adobe HTTP Dynamic Streaming

Streaming Networks and Technologies

❖ Unmanaged Networks

2. Adaptive Streaming
   - HTTP for Adaptive Streaming Benefits
     - HTTP has ubiquitous connectivity (almost all devices support HTTP connections)
     - HTTP is a Pull protocol

Streaming Networks and Technologies

❖ Unmanaged Networks

2. Adaptive Streaming
   - Pull Streaming Benefits
     - Easily traverses middleboxes (e.g., Firewall, NAT (Network Address Translation) device, etc.)
     - Pull streaming supportive servers keep only minimum device state information
       - Much more scalable compared to Push streaming servers

Media Streaming

❖ Push based Media Streaming

- Server streams packets to the client until the client stops or interrupts the session
- Server maintains a session state with the client and listens for commands from the client regarding session-state changes

Media Streaming

❖ Push based Media Streaming

- RTSP (Real-time Streaming Protocol)
  - IETF standard RFC 2326
  - SCP (Session Control Protocol) commonly used
- RTP (Real-time Transport Protocol)
  - IETF standard RFC 3550
  - UDP (User Datagram Protocol) commonly used

Media Streaming

❖ Push based Media Streaming

- RTP on UDP lets the Server push packets to the Client
- Server bitrate (bits/s = bps) determining factors
  - Application QoS requirements
  - Client & Server characteristics

Media Streaming

❖ Push based Media Streaming

- Cons
  - Server has too much to do ➔ too burdening
  - Playing device's status is hard to track
  - Many Firewalls will block RTP packets
  - Many Internet service networks have been replaced with CDN which do not support RTP
    - CDN : Content Delivery Network

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

- Media Client (e.g., smartphone, PC) sends a HTTP Request to the server to quickly receive (pulling) content packets in Burst Mode
- After the minimum required buffer level is filled at the Media Client, the Media Client will begin to play the media

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

- Server transmits at the media encoding bitrate that matches the media consumption rate
- If the client buffer level remains stable then the network resources will be efficiently used
- If network packet loss or transmission delays occur, buffer underflow (emptying) will occur, and playback will be interrupted

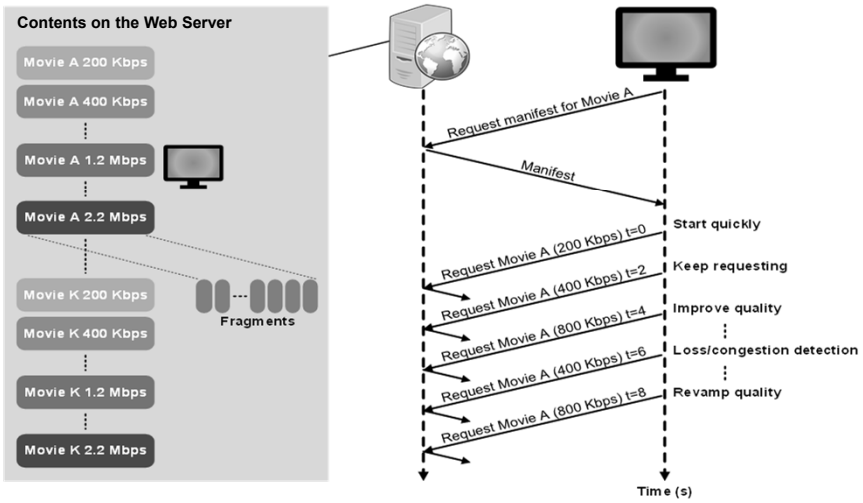
Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

- Server will dynamically switch to a lower bitrate stream to prevent buffer underflow
- To avoid noticeable visual quality degradation, gradual bitrate stream reductions will be used
- If network conditions improve, the server switches to a higher bitrate stream until the media encoding bitrate is recovered

Adaptive Media Streaming

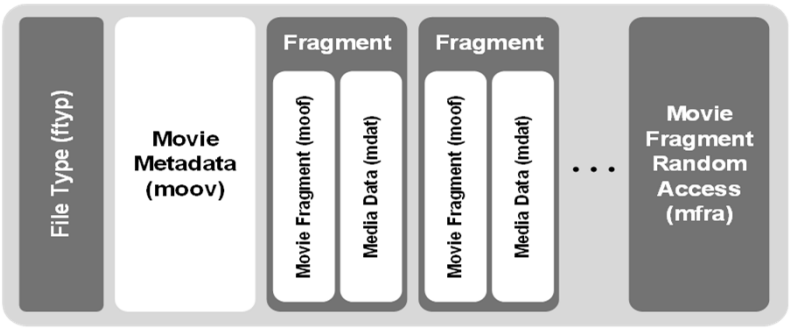
❖ Pull based Adaptive Media Streaming



Pull based adaptive streaming bitrate adaptation example under varying network conditions

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming



Fragmented MP4 file format structure

- Audio and video data are in the mdat boxes
- mdat boxes & metadata form a fragment
- Fragments are retrieved in an HTTP GET request

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

- HTTP request message (example)

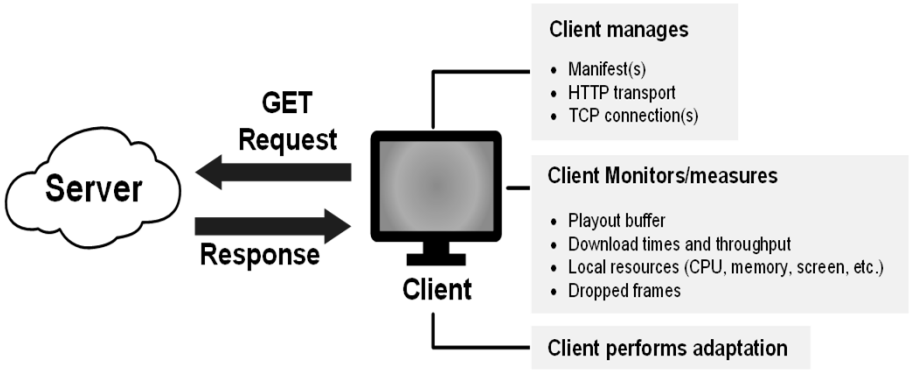
```
GET /sample/v_720p.Ism/QualityLevels(1500000)/Fragments(video=160577243) HTTP/1.1
```

- Each fragment is downloaded based on a unique HTTP request-response pair
- HTTP request message header contains two pieces of information
  - Bitrate & Time Offset of the requested fragment

Adaptive Media Streaming

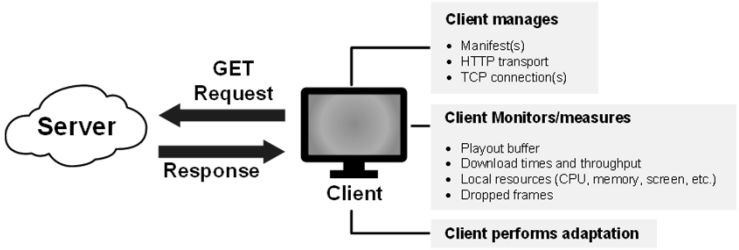
❖ Pull based Adaptive Media Streaming

- Generic client side pull-based adaptive streaming implementation example



Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

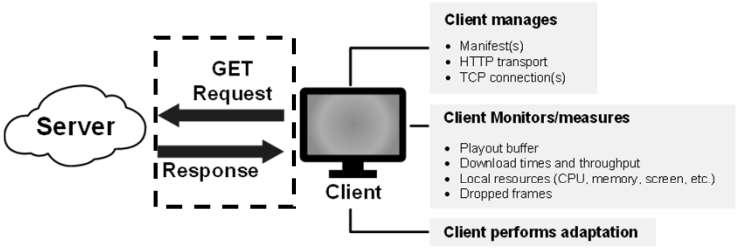


A client-side pull-based adaptive streaming implementation

- Client acquires media from fragments of a file over one or more connections according to the playout buffer state and other conditions

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

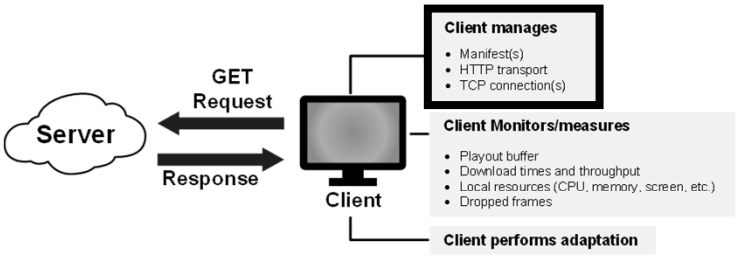


A client-side pull-based adaptive streaming implementation

- At minimum, the server provides standard responses to the HTTP GET request
- Client gets a manifest file that identifies files containing media presentations at alternative bitrates

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming

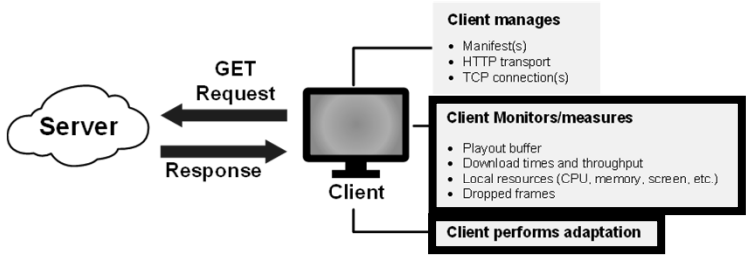


A client-side pull-based adaptive streaming implementation

- Client needs a Client-side Manifest or Playlist file to map fragment requests to specific files or to map byte ranges or time offsets to files
- In some adaptive streaming schemes, a similar file on the server translates client requests

Adaptive Media Streaming

❖ Pull based Adaptive Media Streaming



A client-side pull-based adaptive streaming implementation

- Playout buffer management selects fragments from a file at a particular bitrate in response to buffer state and other variables
- Adaptive streaming client keeps a playout buffer of several seconds (between 5 and 30 s)