

DIGITAL VIDEO STREAMING

DASAR MULTIMEDIA

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Platform:

Youtube & Netflix

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Group Assignment

- Research on digital video streaming (minimal 2 video streaming platforms)
 - Minimum and maximum video specification supported (resolution, bit depth, frame rate, audio specification, etc)
 - Calculate minimum and maximum bandwidth needed (without compression) theoretically
 - Experiment on real bandwidth use, for example stream a video for some duration and then check data usage.
 - Find some information about the compression on the chosen video streaming platform.

Answer

1. Minimum and maximum video specification supported (resolution, bit depth, frame rate, audio specification, etc)

YouTube

a. Resolution

Minimum = 144p Maximum = 8K (4320p)

Recommended resolution & aspect ratios

For the default 16:9 aspect ratio, encode at these resolutions:

- 4320p (8k): 7680x4320
- 2160p (4K): 3840x2160
- 1440p (2k): 2560x1440
- 1080p (HD): 1920x1080
- 720p (HD): 1280x720
- 480p (SD): 854x480
- 360p (SD): 640x360
- 240p (SD): 426x240

Note: In 2022, we started removing support for playback at resolutions between 4K and 8K. For example, we may no longer support playback at 5K.

b. Bit Depth

Standard: 8-bit

HDR: 10-bit

c. Frame Rate

Standard = 24 fps sd. 30fps. Maximum = 60fps

Common frame rates include: 24, 25, 30, 48, 50, 60 frames per second (other frame rates are also acceptable).

d. Audio Specification

Channels: Stereo or Stereo + 5.1

Sample rate 96khz or 48khz

Netflix

a. Resolution

Resolution (detail):

4K

4K: The highest resolution available on Netflix currently. Also called Ultra HD or 4K Ultra HD.

Minimum = 144p Maximum = 8K (4320p)

b. Bit Depth

Standar: 8-bit

HDR: 10-bit

c. Frame rate

Netflix offers limited high frame rate content (50fps or 60fps), but the majority of our catalog and viewing hours can be attributed to members watching 23.97 to 30fps content. This essentially means that most of the

d. Audio Specification

Mono audio is acceptable if the program's original source is mono and no stereo and/or 5.1 mix exists. Mono audio must be duplicated on channels 1 & 2 and delivered as 2-channel.

5.1 surround sound, 2.0 stereo (jika 5.1 tidak tersedia), dan mono

2. Calculate minimum dan maximum bandwidth needed (without compression) theoretically

$$\text{Bandwidth (bps)} = \text{Resolution width} \times \text{Resolution height} \times \text{Frame rate} \times \text{Bit depth} \times 3$$

YouTube

Minimum (144p, 24 fps, 8-bit)

Resolution: 256 x 144

Frame Rate: 24 fps

Bit Depth: 8-bit

$$\begin{aligned} \text{Bandwidth} &= 256 \times 144 \times 24 \times 8 \times 3 \\ &= 212,336,640 \text{ bps} \\ &= 0.212 \text{ Mbps} \end{aligned}$$

Maximum (8K, 60 fps, 10-bit)

Resolution: 7680 x 4320

Frame Rate: 60 fps

Bit Depth: 10-bit

$$\begin{aligned}\text{Bandwidth} &= 7680 \times 4320 \times 60 \times 10 \times 3 \\ &= 59,719,680,000 \text{ bps} \\ &= 59.72 \text{ Gbps}\end{aligned}$$

Netflix

Minimum (480p, 24 fps, 8-bit)

Resolution: 640 x 480

Frame Rate: 24 fps

Bit Depth: 8-bit

$$\begin{aligned}\text{Bandwidth} &= 640 \times 480 \times 24 \times 8 \times 3 \\ &= 1,768,857,600 \text{ bps} \\ &= 1.77 \text{ Mbps}\end{aligned}$$

Maximum (4K, 60 fps, 10-bit)

Resolution: 3840 x 2160

Frame Rate: 60 fps

Bit Depth: 10-bit

$$\begin{aligned}\text{Bandwidth} &= 3840 \times 2160 \times 60 \times 10 \times 3 \\ &= 14,929,920,000 \text{ bps} \\ &= 14.93 \text{ Gbps}\end{aligned}$$

3. Experiment on real bandwidth use, for example stream a video for some duration and then check data usage.

a. **Youtube (1440p, 3:32 Menit, 24 fps, Data Usage 138 MB):**

- i. **Durasi video dalam detik** : 3 Menit x 60 detik = 180 + 32 = 212 s

ii. **Bitrate** : $\frac{\text{Data Usage}}{\text{Duration}} = \frac{138 \text{ MB} \times 8 \text{ bits}}{192 \text{ s}} \approx 5.2075 \text{ Mbps}$

b. **Netflix Mobile (Auto Resolution, 23:38 Menit, 24 fps, Data Usage 172 MB):**

The Netflix app selects a setting that balances data usage and video quality.

i. **Durasi video dalam detik** : 23 Menit x 60 detik = 1380 + 38 = 1418 s

ii. **Bitrate** : $\frac{Data\ Usage}{Duration} = \frac{172\ MB \times 8\ bits}{1418\ s} \approx 0.9704\ Mbps$

4. Find some information about the compression on the chosen video streaming platform.

a. **YouTube** uses three main codecs: H.264, VP9, and AV1.

- i. H.264: Standard codec for low to mid-range quality and viewership.
- ii. VP9: Utilized for higher resolutions and more popular videos.
- iii. AV1: Advanced codec used for very high view counts and resolutions, offering better compression efficiency.

b. **Netflix**

i. **H.264/AVC Main Profile (AVCMain)**

- A widely-used video compression format supported on many devices, including web browsers, TVs, and mobile devices.

ii. **H.264 High Profile (AVCHi-Mobile)**

- This codec is more compression-efficient than the baseline and main profiles but requires greater decoding capabilities.

iii. **VP9 (Profile 0)**

- This codec has broad decoder support on Android OS and offers better codec efficiency on mobile devices.

iv. **HEVC (High Efficiency Video Coding)**

- Used for streaming video in 4K HDR on some TVs.

v. **AV1**

- This codec is reportedly 20–40% more efficient than HEVC, offering higher video quality at any given bitrate. Netflix began delivering AV1 to compatible Android devices in 2020 and has since expanded its use for 4K streams.

Referensi

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