**Introduction to Computer Network Essay Assignment 1**

team：14

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**1.Introduction**

YouTube is an American video-sharing website which is also the world’s second largest searching engine and second most visited site after Google.There are a wide variety of videos being available in YouTube, including video clips, music videos, TV shows, vlogs, short original videos, live streamings, and etc. Nowadays, many people spend more time watching videos on YouTube than on live TVs, especially for the teenagers and young adults.[2]

The reasons why we choose “YouTube” as our topic of is not only because its popularity among the world and its potential in the future, but also both of us are YouTube-lovers and pretty curious about how it actually works, such as how the video are transmitted via Internet, or what happens after we upload a video on YouTube, etc.

**2.Video Uploading**

How to make the video with different resolutions or formats be playable among various devices is challenging. The reason why not just let the users watch original video is that once a user uploads a 4k resolution video which is really big, most of the users may constantly stuck in loading state because Internet bandwidth is not enough. Therefore, after video is uploaded to YouTube, the system will do something called “processing”.

The first thing “processing” do is making the video smaller. By examining the resolution and frame rate of the video, the system can generate a high-quality copy of original video called “mezzanine”. This copy will be carved up into five-second chunks, and then they will be sended to different machines to be compressed. This happens again and again, making the resolution of these chunks become lower. Afterward, all these corresponding chunks get stitch back together. This process will generate about 25 versions of outputs depending on the resolution of the input. That’s why we can select the resolution when we are watching video on YouTube.

And what compression actually does? In fact, the camera usually capture too many details than human can perceive. Video codec deletes these unimportant data. In addition, there are bunches of pixels similar to each other within a video, e.g. background that never changes. Thus, these unchanging pixels don’t need to be refreshed in new frame. Above methods shrink the file size. However, “blocking” and “banding” often appears in video after compression. To find out which codec algorithm makes the least distortion, YouTube teams also run experiments by asking people to watch video and rate which video look best.[4]

**3.Video Downloading**

About 10 years ago, we used to watch YouTube’s video by downloading the whole file. Nowadays YouTube breaks down videos into smaller and more manageable pieces, which web browsers can handle it more easily.

YouTube also uses “Adaptive Bitrate” for streaming, which means that the size of the video slices can be changed when the video is playing. This helps the videos be played more smoothly because the Internet bandwidth is frequently changing. How it works is when the client starts playing a video, YouTube will measure the situation such as current throughput or buffer level, and then choose chunks of video adaptively. For example, if the network condition is good, you may download high-resolution slices. In contrast, when your bandwidth is constrained, YouTube would download the video slices in lower quality instead to make sure that the video you’re watching won’t lag too long.

Another method YouTube adopts to speed up video downloading is Content Delivery Networks (CDNs), “a geographically distributed network of proxy servers and their data centers [3]”. When a customer requests a video that is popular in his/her living area, it will first send a request to local ISP server to see whether the requested content is cached there before requesting Google data center. If the local ISP doesn’t have that file, it will ask the upstream. CDN largely enhances the performance of streaming by delivering local frequently accessed content to hosts quickly.

**4.Review & Discussion**

Because of the page limitation of this essay, we mainly focus on the technique of uploading and downloading of YouTube. After studies, we find plenty of technique details behind what we are used to. To provide the best experience to every users, Youtube team shows that both theories and experiments are crucial. Meanwhile, how they deal with such big data is also marvelous. No wonder that YouTube is one of the most successful products in the world. By the way, learning YouTube from YouTube is interesting!

Although nowadays Youtube’s video playing mechanisms seem to be fine, we found some papers say that there are still a lot of improvement possible for YouTube. As “YouTube Can Do Better: Getting the Most Out of Video Adaptation”[7] mentions that YouTube players often discard currently buffered contents in order to re-download it in a higher quality version. It makes the users be able to watch video with better quality but the overall efficiency decreases. Another issue is that sometimes video are viewed regionally; thus, if we can accurately predict the geographic regions where the videos will become popular, then we could integrate the local bandwidth statistics to do a better job with them.

**5.Reference**

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[7] Christian Moldovan, YouTube Can Do Better: Getting the Most Out of Video Adaptation, <https://mediatum.ub.tum.de/doc/1415917/1415917.pdf>