Streaming delay challenges in video delivery applications

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ABSTRACT

The world today constantly leaps forward in terms of innovation and technology. Recreation and entertainment always remains a priority for one and all. This paved the way for live streaming and video on demand services. The main objective of these services is to deliver multimedia content to cater to a wide audience. This study aims to compare and assess the performance of five such highly competent applications based on a set of predefined parameters. We shall also delve deeper into the analysis and critically examine the root causes of the delay challenges faced thereby helping in finding appropriate solutions for the same. We also get an understanding of the various pros and cons of the different applications which aids users in making accurate choice of video apps.

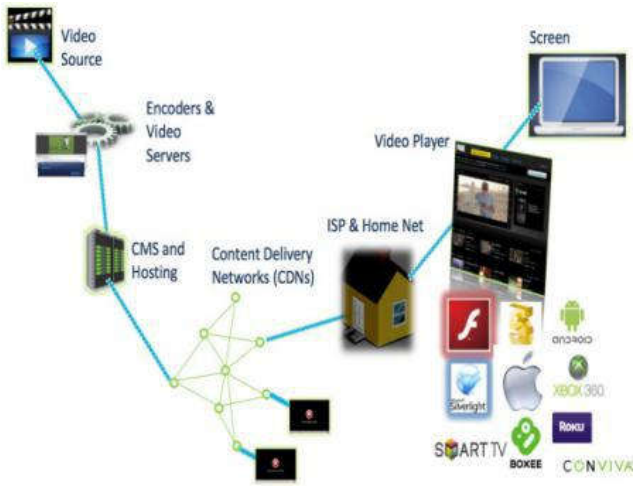
Keywords: CDN, video streaming ,delay, Video on demand.

1) INTRODUCTION

The ever progressing advancements in technology and global connectivity throughout the world, has made possible the timely delivery of live content to the large number of end users and provide them the capability to play, pause, forward and rewind the media provided by Video On Demand. Different models are used for the content delivery. One is the Client-Server model where in the client makes the request to the video server which in turn processes the request and depending on the availability of the content on the server the client is provided with the stream. Another method is the CDN (Content Delivery Network) which is based on the Client-Server Model. In this model, multiple servers are deployed rather than a single video server. This enables users to make requests to the nearest server available

1.1) THEORY OF THE RESEARCH:

The fig below depicts the VOD Architecture.



1.1.1) Ingestion : A complex step which takes care of the Migration of thousands of videos along with all the data and collections that come with it ensuring that they are put in the right buckets, and all play out without issue with respect to the user settings.

1.1.2) Encoding: It involves the transition from a pixelated, grainy video to a really high quality HD video. What actually happens is the switching of video files. Each of these copies is called a Rendition and it changes accordingly for HD, 720p along with different formats for different devices. Based on the Adaptive Bitrate (ABR) and type of network connection, OS, browser and device the video platform optimizes the video.

1.1.3) Content Management and Meta data: This essentially consists of the description, keywords and actors. Meta data focuses on the coordination of different kinds of media across social, TV, movies, marketing, government, education, faith and organize it into one perfect system along with the management of resources with respect the genre like Adventure, Comedy, Kids etc.

1.1.4) Delivery (push the video out to different places all over the world*):* this is one of the complex pieces of the value chain and centers around the CDN.

1.1.5) Players: The device playing the video. These devices can range from Smart phones by iOS, Android and devices like PlayStation and Smart TVs.

2) LITERATURE SURVEY

The following are the leading applications in the realm of video delivery apps.

2.1) NETFLIX: Netflix has 125 million members worldwide and is one of the leading brands in the video streaming industry. According to the comparative study the pros include excellent selection of video content. The web series with highest ratings are broadcast. thus giving user an attributed tuned experience. The graphical user interface is also highly optimized giving a broader sense of understanding for new customers as well. Netflix has built a very efficient and ultra-precise recommendation system, which recommends user new content based on their history. The cons might say a bit less than the pros. Netflix is observed to be a more expensive service. Although the new content is available but the quantity is limited by the number.

2.2) HULU: Hulu is an American entertainment company, available only in the US which offers great selection of current TV like Brooklyn 99, Power, Empire, etc. As compared to other streaming services it is less expensive. It offers original quality programming.It carries current and past episodes of many series from its respective television networks and other content partners (The Walt Disney Company and 21st century fox).Hulu spun out its free and massive content into a joint venture
with Yahoo called as Yahoo view. The cons might include the frequent commercials and cumbersome interface. Users need to get used to it after dedication certain period of time to get the ease.

2.3) AMAZON PRIME: Despite the quality offerings that Netflix has, it makes more sense to go for Amazon Prime. Prime is way cheaper than Netflix. Amazon Prime is a bundled service. Prime has more wide range of regional content than Netflix. You will find Tamil, Telugu, Marathi & more regional movies on Prime but not on Netflix. Netflix has a rich & vivid content library of international data series but regional content is still low-hanging. Prime also offers music streaming services with its Prime Music subsidiary. It has a music library across 12 different languages including regional ones. Prime for now is not available on some platforms. And having an A la carte content would cost more to the customers.

2.4) HBO NOW: HBO shows are some of the best around in town. Game of Thrones, Sopranos, Silicon *Valley, True Blood, and Deadwood* are some of the series available on HBO Now. It has some Award-winning original programming and top- tier movies broadcast. HBO Now is exclusively available in the US. The only hurdle that we observed was the pricing structure which is much costly than the other service providers. It provides best channel-specific streaming services.

2.5) SHOWTIME : Amazing service is provided by Showtime to catch up on the latest content. It has series like Dexter, Weeds and Homeland. Though it has a very small library of just 57 series, they have high quality. It is very similar to HBO Now as it also started out in the form of premium networks for paid cable subscriptions.

There are three factors that drive their marketing. One is the huge range of content available on such platforms, their access to broader content. The second factor is technology and user interface: How well performing their recommendation engines are, how better they are able to anticipate what the user wants, and how you represent the relevant content to the consumer in an effortless and easy fashion. The third factor is the generation of harmony between the e-commerce and content management business. Creating a string of balance between all these is the real deal breaker.

3) METHODOLOGY

3.1) Collecting Viewership Data

Just like the smart phone sector, the video streaming arena in the country is witnessing a powerful fight.The video streaming industry is gaining a stronger stand in the domestic market.

Rate of Growth in Video Streaming as per surveys conducted by different media evaluating companies.

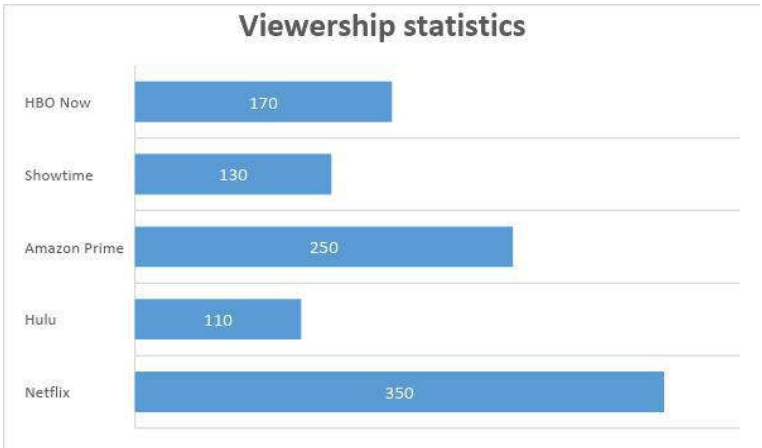
3.1.1) According to newteevee ,In 2008 13% of Internet traffic was video streaming and in 2009, 27% was video streaming.

3.1.2) According to ComScore, in July 2009 81% of Internet users watched streaming videos in the US. This number increased to 84.4% in October 2009.

3.1.3) According to websitegear, in July 2009, Internet users spent an average 8.3 hours/month watching streaming video in the US. By 2009, it significantly increased to 10.8hours/months.

3.1.4) According to masternewmedia, the streaming video advertisement revenue is increased from 1.37 billion dollars in 2008 to a 4.5 billion in 2011.

3.1.5) According to a recent study, the number of users have increased significantly. Netflix has the highest number of users closely followed by Amazon Prime. HBO Now, Showtime and Hulu follow suit.



3.2) Subscription of the various services:As an initiating step we obtained a subscription for the five video delivery applications namely Netflix, Hulu, Amazon Prime, Showtime and HBO Now.

3.3) Choice of parameters: We chose parameters which guide us to assess the delay in streaming namely connection time(the time it takes to connect to the server and load the content), number of requests(the number of requests it can accept a time) and page speed score(the efficiency with which

the fetching and querying of the results and content happen).We also chose parameters considering Usability like HDR,Chrome-cast and Airplay Support, Picture-in-Picture,Video Quality, Downloading Capability and Advertisements.

3.4)Tools and Techniques used:
3.4.1) In order to assess the video quality and track advertisements we played a total of 10 movies with a 2.5 hr duration and 30 episodes of 5 television sitcoms. This helped compare the video quality in terms of 4K or 1080p and also classify the advertisements with respect to Base Tier and Branded.

3.4.2) We tested the usability parameters by manually exploring the five applications. We downloaded the some of the content, checked for Airplay, HDR and Chrome-cast Support and Picture-in-Picture facility. This helped us gain information regarding the ease of use and availability of the applications.

3.4.3) We used the website analyzer known as GTMetrix which served as our catalyst to record the connection time in milliseconds, page-speed score in terms of percentage and number of requests as whole numbers. These played an important role in gauging the performance of the different applications.

3.4.4) To obtain a more precise result to give a wholesome perspective the Quality Control Tool Histogram was used. The same experiment was carried out 10 times to help give us a better picture of the performance.

4)RESULTS AND FINDINGS

The table below enlists the recorded information for one observation in accordance to the various parameters considered.

Assessment Parameters	Netflix	Hulu	Amazon Prime	Showtime	HBO Now
HDR Support	Yes	No	Yes	No	No
Ability to Download	Yes	No	Yes	Yes	No
Video quality	4K	1080p	4K	1080p	1080p
Advertisements	None	Base tier only	Amazon Branded	Showtime Branded	HBO Now Branded
Chrome cast Support	Yes	Yes	No	Yes	Yes
Picture-in-Picture	Android 8.1	No	No	No	No
Connection Time	1ms	27ms	2ms	110ms	167ms
Airplay support	iOS	iOS	iOS	iOS	iOS
Number-of requests	51	130	160	67	5
Page-speed score	79%	55%	53%	82%	92%

Despite of the numerous pros delay challenges continue to persist in the video delivery applications.

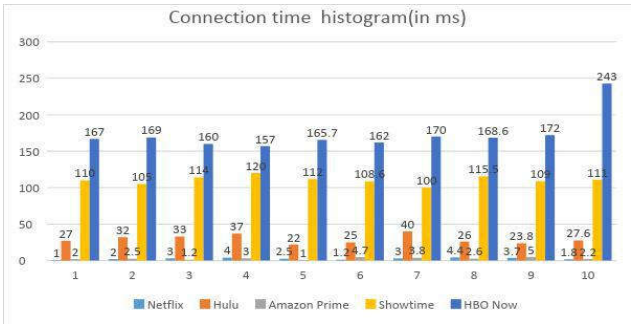
The reasons are due to the following:

4.1) Bandwidth: It refers to the range of frequencies that lie within a band particularly used for transmitting a signal. The bandwidth changes with respect to the video quality.This means an High Definition (HD) will have a higher bandwidth in comparison to a normal video.

4.2) Computational Requirements: In VOD the user or the clients need to be authenticated and authorized before streaming. It needs conditional access to whatever the content is being subscribed by the end user. As the destination device through which the content will be consumed is unknown it is a must that the decryption process have less computational complexity in order to meet the real time requirements.

4.3) Memory Consumption: Due to immense growth in the multimedia storage and reduced cost for the storage, there are huge number of videos available in the video repositories. This serves as a difficult task in retrieving the relevant videos from huge video repository pertaining to the user's interest. The querying and fetching the required video adds to the delay.

It can be inferred that the major contributor to all the delay challenges faced is the Connection Time. If the connection time is improved, the other problems can be easily tackled. Taking it into account, the histogram below shows the number of tasks with respect to connection time of the five applications. It is observed that Netflix has the lowest connection time and coincidentally is the most used application by the public. The values here depict the number of tasks that the application can perform and it is clear that the lesser the connection time greater is the number of tasks that can be performed.



5) RECOMMENDATIONS

It is evident that each of these services have their own pros and cons but thrive to meet customers' satisfaction. With significant research conducted at all layers of networking stack: Application, Transport, Network, MAC and Physical.This will help us get an overall understanding of the system.

6) CONCLUSION

In adherence to the observations above, we can conclude that Video on Demand (VOD) services are the trending applications these days over the internet as the user base is increasing rapidly and along with it the bandwidth consumption is also increasing. A comparative study is done on the global players of streaming applications i.e. Netflix, Hulu, Amazon prime, Showtime, HBO Now.In this paper we have assessed the performance of most frequently applications used by the public. We have also found that Bandwidth, Memory and Computation are root causes for the delay and that prioritizing the enhancement of connection time will help alleviate the challenges to a great extent.

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