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Content Delivery Network

(CDN) for OTT

Abstract

With the world on our fingertips, we are just a click away from exploring various horizons, thanks to the internet! In the attempt to retain maximum users on a particular page, the website speed is all that counts. And this is where Content Delivery Network (CDN) comes into consideration. With its availability spanning across geographical boundaries, CDN comes handy in providing a fast loading speed to deliver web content to the users.

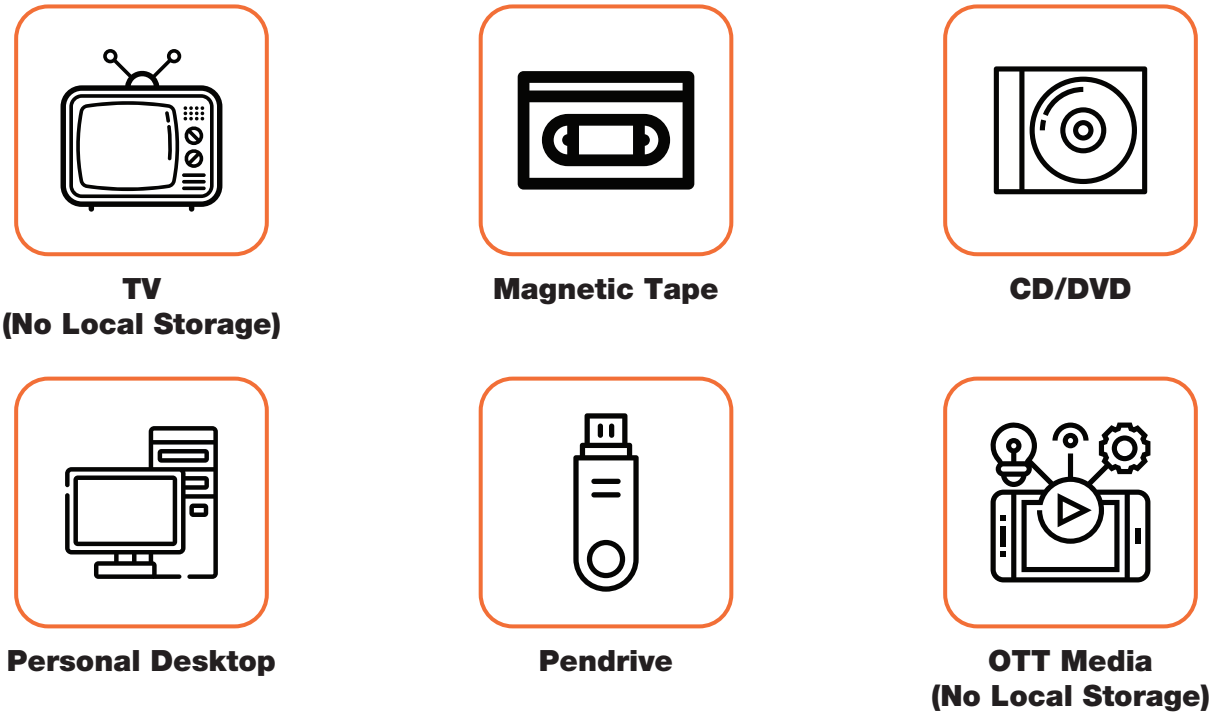
Not only does the server protect the master server from the local servers, but also handles the incoming traffic on a site by speeding up the website loading time. CDN provides a rich OTT experience to the end-users by placing remote services in various parts of the world, providing fast-paced content delivery. CDN forms the backbone of OTT platforms in defining the latency of the video streaming services.

In the connected world of the internet, when everything is running smoothly, sometimes it is difficult to differentiate between being connected to the internet and working on a local storage. Gone are those days where a good amount of local storage was dedicated to favorite songs or movies that people used to preserve like treasure. Nowadays we can connect seamlessly to service providers like Spotify or YouTube Music for an endless list of songs without being worried about storage space being taken up. In simple terms, this is OTT (Over-the-Top), where end users connect to a provider to consume audio or video media streamed over the internet. Some providers allow downloading of the media for offline usage, but the majority of users simply stream the content.

Storage required to store the audio/video content is called –a Content Delivery Network (CDN). A CDN is a geographically-distributed network of proxy servers and their data centers. The goal is to provide high availability and performance to end-users . In OTT media CDN selection and placement strategy have a huge impact on the end-user experience of clients. A wisely-chosen CDN can give an experience so smooth that there is no major difference between favorite songs played locally and on OTT streaming service.

This publication is an answer to a question in the form of how, why, and what in the context of CDN. Though Content Delivery Network (CDN) is a generic term for any content on the internet, this publication is focused on OTT video/audio streaming version.

Rise of Media Storage



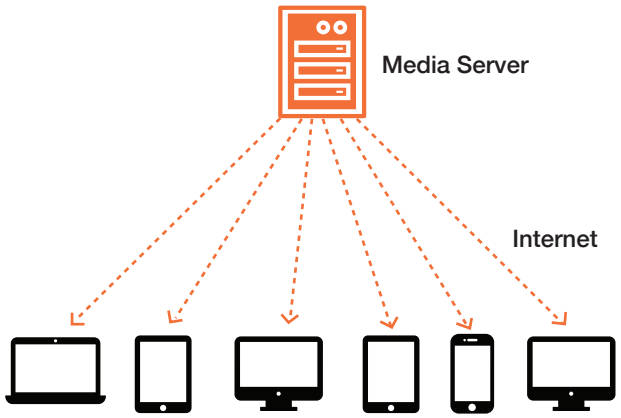
In decades past, the media viewing experience was run by TV. Antennas were placed in the direction of the TV station to catch a signal, and hence, there was no need for local storage. All storage complexity was handled by relaying interconnected TV stations.

Then came the era of magnetic tapes, where media was stored and distributed on tapes. Individuals could buy or rent these tapes and there was no need for storage.

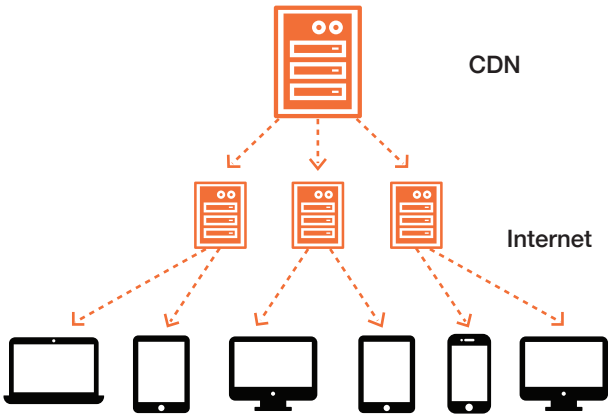
Followed by this, the world was introduced to CDs (Compact Discs). Now it was easy for end-users to store and access media on their personal desktop's memory. Moving further, personal portal memory devices like pen drives were used to store favorite media.

OTT has has revolutionized the media business. No one needs to save their favorite movie or songs locally as everything is on the cloud. End-users can now have a world media to explore without being worried about running out of storage size.

CDN in Simple Words



Overloading single media server



Distribution of load with CDN

Imagine that there is only one burger store in the city and everyone wants to eat burgers almost daily. Burger lovers from every corner of the city will try to reach the store, and eventually everyone will get into a traffic jam. The solution should be to have various franchises created in locations/corners of the city which serve the same burger. The need for CDN can be understood in the same way. Everyone can access a final episode of the season for their favorite show and hence to serve everyone. Instead of having one central media server, various strategic cache servers are created. This complete system with distributed cache servers and related attributes are termed as Content Delivery Network or CDN.

In general, CDN can have three kinds of servers:

- **Master/Origin:** This is the source for all the media content. All other servers rely on this to get the desired content.

- **Master/Origin Shield:** This server acts as a shield and protects the master server from heavy request load from remote servers. This server is placed close to the origin server. If any remote server makes a request, the content shield server checks for local cache. If not available locally, it sends a request to the master server. This acts as one more level of caching.

- **POP (Point of Presence):** This is a remote cache server placed at strategic location. POP can consist of many caching and streaming servers to provide low latency to the end-user.

CDN Impact on OTT

In any OTT service, as the number of subscribers increases, there is a need to invest in more hardware. But investing on hardware at one location will not solve the purpose as users connected from Asia need to hop on various routes to reach the source server in the USA. This poses a risk of congestion on the route, or ending up on a bad route and the packet getting lost. This will impact end-user experience and may lead to customer churn. The solution is to put additional remote servers in various parts of the world. These servers will reduce the hops, hence reducing latency and complexity of long-distance routing. This will help in increasing QoS(Quality of service) with quick and reliable content delivery.

Functions of CDN

Let's take look what are in important function/purpose of CDN infrastructure.

- **Availability:** With the presence of multiple remote caching servers or POP, availability of streaming service is assured. When one of the servers gets down, the load is directed to the nearest POP to prevent a downtime. In the worst case scenario, if the origin server is down, the majority of the service can run by the origin shield and POP server for a good amount of time based on available cache.

- **Scalability:** Building a scalable CDN is the core of the media OTT service. Scalability and performance are the parameters to measure the success of a video streaming service. With the possibility of adding on-demand servers, modern cloud-based CDN are built to handle peaks and lows of incoming traffic. There is no additional cost paid as cloud services can be configured for cost based on the number of bytes delivered. In the case of privately-built CDN, this advantage is not included, and there is a chance that servers might sit idle in low traffic conditions.

- **Performance:** Performance is the core objective of the CDN. POP located in required locations reduces the number of hops in the route, hence reducing the latency for the end-user cached content.

- **Security:** In every CDN, security is the highest priority. For this, security features like application firewalls, bot detection and mitigation, and requests limiting are added. The threat can never enter an origin as by design only the origin shield can access it. Also, higher numbers of nodes (i.e POP) are less susceptible to D-DOS attacks.

Types of CDN

Based on architecture, placement, ownership, route, and cache handling, CDN can be of following types:

Close Proximity CDN

This is public CDN, Consist of many POP places very close to clients

Pros:

- Good performance due to very low latency as POP exist in low proximity of client
- High number POP provides Protection against DDOS attacks

Cons:

- Need to maintain high number of POPs
- If POP choose to have small size cache then it generates many download request to other POPs, while larger size cache increase the expenses

Super-POP CDN

This is public CDN, consist of few large size cache POP places at very strategic locations with high bandwidth links to multiple ISP

Pros:

- Correctly place POP with high bandwidth connection gives good performance
- Less number of POP to maintain
- Due to large ache less download requests to other POPs

Cons:

- Careful planning and selection of POP location is required
- If POP fails, client are redireted to other POP further away leading to latency

Proprietary CDN

This is proprietary CDN, build by network owner or providers to handle their own traffic. Generally resides within owner's network or rented POP location

Pros:

- Owners have control of CDN in terms of technology, user statistis and usage data
- Can be build to solve a speific business problem for a traget group/location

Cons:

- Need to have a deep technology team to maintain the server
- Need to track the traffic fluctuation to keep check on scalability

Hybrid CDN

This is hybrid CDN between public CDN and proprietary DN. Build by taking pros from both to overcome cons

Pros:

- Solution allows to add private POP to handle VOD request in target region
- Enables control on coast and performance based on requirements

Cons:

- Careful designing and planning needs to be done for communication between public and private CDN
- Increase in maintenance complexity

Multi-CDN Strategy

Delivering faster content to the end-user located in different continents is the ultimate goal of the CDN network. To fulfil this goal, a multi-CDN environment is created, in this environment, instead of having a central CDN with a limited number of servers, the content is cached across various CDN located around the world.

Success or failure of a multi-CDN strategy is dependent on the selection of appropriate CDN switching strategies. CDN switching strategies are as follows:

DNS based switching

DNS based switching is done to select appropriate CDN based on the performance or availability, this is achieved by changing the DNS entries of the stream URL

Pros:

- Simple and reliable switching
- Video URL remains always same
- CDN selection is more granular which enables mid-stream switching

Cons:

- QoS can be hampered as switching may take time
- Quick mid-streaming switching increases DNS overhead traffic

Manifest rewrite switching

In Manifest rewrite-based switching content, manifest is rewritten with the video segment URL pointing to the most appropriate CDN

Pros:

- For live OTT stream, new manifests are continuously created
- Automatic switching to next URL in list by client when it detects segment download issue

Cons:

- Mid-stream switching is not seamless due to delay in getting CDN availability status

API based switching

In API based switching, at session startup client gives API call to serve in order to get details of most appropriate CDN to be used for this session

Pros:

- Client agnostic and control resides with server
- All CDN performance information and selection rules resides on server and hence can be easily updated

Cons:

- By default mid-stream switching is not supported

Client side switching

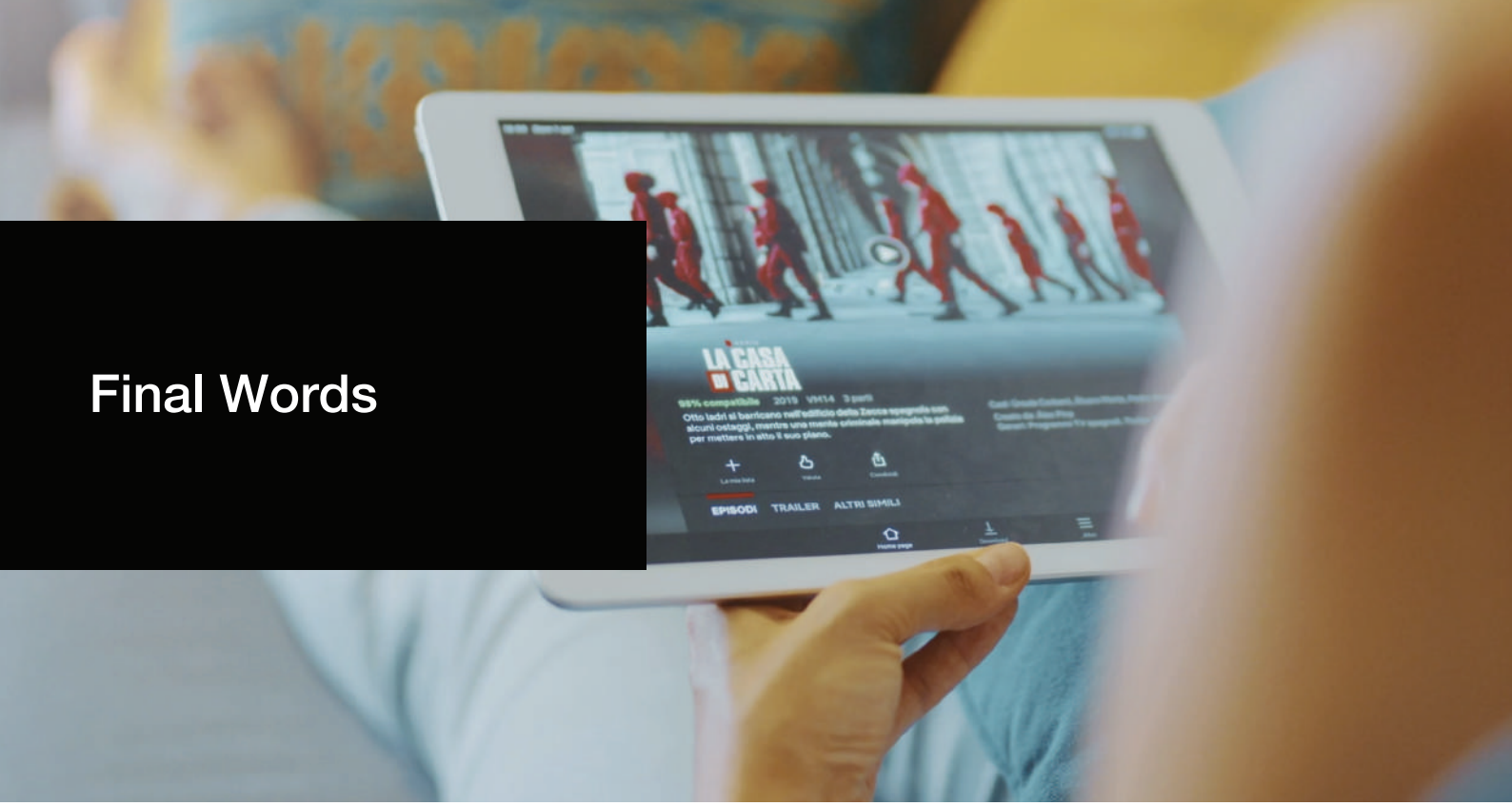
In Client side switching at start of session, client receives the information about available CDNs and their real time performance parameters. Client switches to appropriate CDN anytime based on the performance parameters

Pros:

- Accurate switching base on the real time performance parameters

Cons:

- Switching algorithms and rules resides on client and hence any update in algorithm or rules requires redistribution of client apps



Final Words

In today's world, QoS is the most important parameter to avoid customer churn. In OTT media, latency is considered a key QoS parameter. Since CDN defines the latency in video streaming service, success and failure of the OTT service provider is based on the CDN selection and implementation.

References

Online Resources

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