National Conference on Engineering Innovations and Solutions (NCEIS – 2018)
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 4 | Issue 6 | ISSN : 2456-3307

A Survey on Content Delivery Network Architecture Features And Their Benefits

Roja.S [1], Shilpa P[1], Suman Jayakumar[2]

[1] 6th semester students, Department of IS&E VidyaVikas Institute of Engineering and Technology, Mysore, Karnataka, India

[2]Assistant Professor, Department of IS&E VidyaVikas Institute of Engineering and Technology, Mysore, Karnataka, India

ABSTRACT

With the explosive increase in internet contents, the internet usage has shifted from host-to-host model to content dissemination model, e.g. video content accounts for the majority of Internet traffics. Content delivery networks (CDNs) can be seen as a solution to the problem and is one of the most important components of internet today. ISPs, content providers and other third parties have already deployed CDNs to improve user experience. In order to maximize the bandwidth, improve accessibility, maintain correctness through the content replication and bringing the content as close as possible to the clients system CDN's are proposed. CDN's web content is distributed to cache servers located to users resulting in fast, reliable applications and web services for the users. CDN maintains multiple point of presence (POP). As the Gateway network users and contents, POP's provide several key features for CDN's and they will be discussed in the paper. As the CDN architecture is evolving through the adoption of emerging paradigms, we make a survey on two general approaches to building CDN's one is the overlay model which replicates content to thousands of servers worldwide and another approach is network model which deploys code to routers and switches so that they can recognize specific application types and make forward decisions based of predefined policies. The benefit of each model has also been discussed. Layered architecture of CDN has been discussed in detail. Finally, we discuss potential avenues for further research aspects in CDNs.

Keywords: Content Delivery Networking, Content Centric Networking, Internet Architecture.

I. INTRODUCTION

Applications of content delivery networking are one of the hot topics in internet today. It is one of the biggest IP trends going on in internet right now. CDN's leveragehigh-layernetwork intelligences are managing the delivery of data which is multimedia in nature. They were initially built on top of public internet to accumulate website performance. The network engineers realized that the intelligent network tools could be applied in other beneficial and profitable ways [3].In order to meet the challenges of distributing massive amount of video data to users, almost all major video-streaming companies make use of content delivery network. CDN is a static web pages network optimized to deliver specific content, such as streaming video or audio.

The main goal of CDN is to distribute heavily requested contents from popular web servers, most of all image files.The purpose of CDN manages servers in multiple geographically distributed location, stores copies of video in it servers and attempts to direct each user request to CDN location that will provide the best user experience.

The CDN may be private CDN that is owned by the content provider itself or CDN may alternatively be a third party CDN that distributes content on behalf of multiple content providers.

CDN's already has a reasonable business case is in the website performance improvement. The CDN have a major goal to push contents as close to users as possible to minimize content latency and maximize available bandwidth speed. Hence in the next section we discuss on the approaches with respect to building CDN's.

II. APPROACHES TO BUILDING CDN'S

There are three approaches to building se CDN's.

1. Overlay model which replicate content to thousands of serversworldwide.The application caches are used to distribute the web graphics. The content delivery network are witnessing the outburst of video streaming where the video content, produced or accessed by the mobile phones, must be quickly transferred from a point to another of the network. Whenever a user request a video which is not directly available at the edge server ,the CDN network must
   1) Identify the best location in the network where the content is stored.
   2) Setup a connection.
   3) Deliver the video as quality as possible.
   For this reason, existing CDN's are adopting and overlay structure to reduce latency, leveraging the flexibility introduced by the Software Defined Networking (SDN) paradigm. In order to guarantee a satisfactory quality of experience (QOE) to users, the connection must respect several quality of services (QOS) constraint; our approach allows speeding up the transfer of video segments by finding minimum delay overlay path under constraints on hop count, jitter, packet loss and relay processing capacity [4].
2. Network model it deploys code to routers and switches so that they can recognize specific application types and make forward decision on the basis of predefined policies. Example of this approach include device that redirect content request to local cache or switch traffic coming into data centers to specific servers optimized to server certain content types .
3. CDN which uses both Network and overlay approach for example ,when a switch at a server farms front end redirect a hypertext transfer protocol request to an Akamai server located closer to end user. IP multicast is a good example of an early network -based approach to optimizing the delivery of specific content types.Conventional CDN's can be mainly classified into two subcategories, Commercial CDN's and Academic CDN's
   The commercial network are owned by corporate companies and generally follow centralized client - server architecture some of them have more than 20,000 servers around the globe to support their network[5].The Academics CDN's are non- profitable in nature and generally follow peer to peer architecture.

III. CDN ARCHITECTURE

In a CDN environment, specialized replicated web servers exist at the edge of the network to which end users are connected. The customer can sign up with CDN provider for service and to have their content placed on the content server. These contents are then been replicated in advanced or where the user request on demand. These users are served by the nearby replicated webserver. The user can end up communicating with a CDN and end users. CDN provider ensures the fast delivery of digital content.

They host third party content including static content (examples: static HTML ,pages ,images),streaming media(audio, real time video), user-generated videos(UGV).The end users can interact with the CDN by specifying the content/service request through cellphone, smartphone/PDA, laptop and desktop[6].

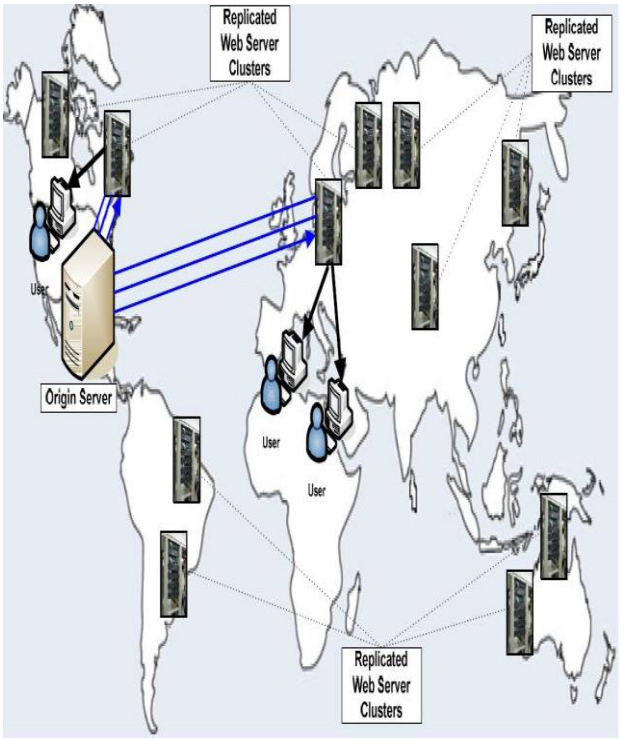

Figure 1: Abstract architecture of a Content Delivery Network (CDN) [1]

Layered approach in building the CDN's:

The layered architecture of the CDN is as follows:It consists of the basic fabric, communication and connectivity, CDN and end users.M.Pathan et al define the layers in the bottom up approach[7]. It constitutes of:

1. Basic fabric
2. Communication and connectivity layer
3. CDN layer
4. End User

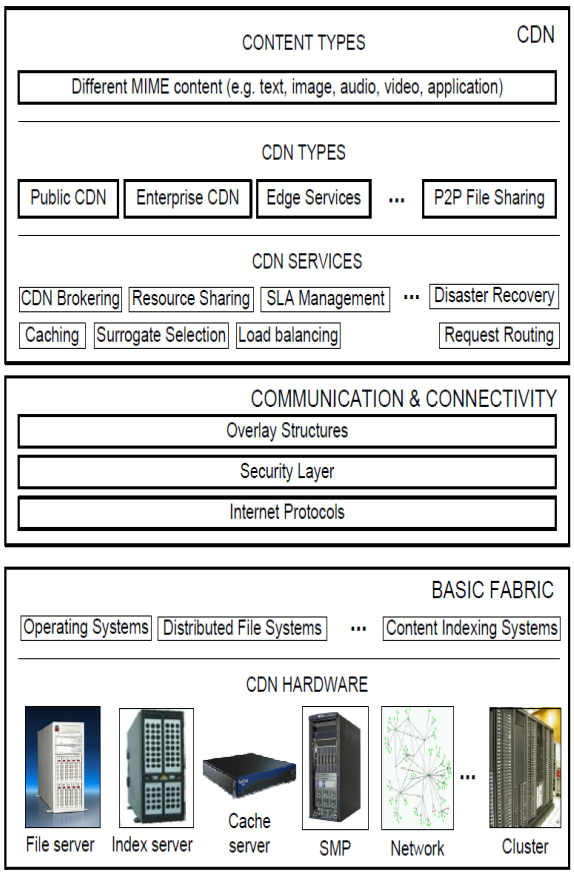

Figure 2: Layered architecture of CDN [1][7] Basic

fabric: It is a base layer of the CDN. It provides the infrastructure resources.This layer consists of the distributed computational resources such as symmetric multiprocessing servers(SMP),clusters,file servers,index servers,and basic network infrastructure connected by high bandwidth network.SMP is the processing of programs by multiple processor that shares a common operating system and memory.A single copy of the operating system is in charge of all the processor.SMP also known as "shared everything" system.

Communication and connectivity layer: It provides the core internet protocols such as TCP, UDP, FTP as well as CDN specific internet protocols called Internet Cache Protocol (ICP), Hypertext Caching Protocol (HTCP) and Cache Array Routing Protocols (CARP). Where ICP is a UDP based protocol used for coordinating web caches.Its purpose is to find out the most appropriate location to retrieve a requested object where in multiple cash is use at single site.HTCP is used for discovering,managing and

monitoring the HTTP caches and caste data.It permits full request and response headers to be used in cash management and expands the domain of cash management to include monitoring a remote cash addition and deletion.CARP is also used in load balancing. Connectivity layer also contains authentication protocols such as Public Key Infrastructure (PKI) or Secure Socket Layer (SSL) for communication,caching and delivery of content or service in an authenticated manner.Policies and procedure are needed in order to create,manage,distribute, use,store and revoke digital certificates to manage public key encryption.Application specific overlay structures provide efficient search and retrieved capabilities for replicated content by maintaining distributed indexes.

CDN layer: It consists of the core functionalities of CDN.It can be divided into three sub layers:

1. CDN services,
2. CDN types
3. Content types.

A CDN provides core services such as surrogate selection,request routing, caching and geographic load balancing and user specific services for Service Level Agreement (SLA) management,resource sharing and CDN brokering.The SLA is defined as an official commitment that prevails between a service provider and client.Particular aspects of service-quality,availability, responsibilities are agreed between service provider and service user.

End users: End users are at the top of the CDN layered architecture.In this layer,we have the web users who connect to the CDN by specifying the URL of content provider's website,in their web browsers.

The main goal of server replication in a CDN is to avoid large amount of data repeatedly traversing possibly congested link on the internet.Valkali et.al states are variety of ways and scale such as local area and wide area,in which content networks may be implemented.The local area contains webcluster that typically hosts single site and web forms. The wide area contains multiple sites. The distributed web server system is used to host single or multiple sites [9]. A cooperative proxy cache network is a service infrastructure to reduce latency in downloading web objects and content delivery network will be there.It is used to can deliver the content to the specific host.

M.Pathan et.al lists the main issues for CDN taxonomy are:

- CDN composition
- Contentdistribution and management
- Request routing
- Performance measurement

IV. MERITS AND DEMERITS OF USING CDN

There are several uses of hosting the web content using CDN. Few advantages are listed below:

- Decrease server load
- Faster content delivery
- 100 percent availability
- Increase in the number of concurrent users
- More control of asset delivery

Decrease Server Load

The strategic placement of content and surrogates can decrease the server load on interconnects, backbones and public and private peers, which frees up overall capacity and decreases delivery costs..

Faster Content Delivery

Since CDNs place servers as close to a group of users as possible, latency and packet loss are minimized due to a shorter distance traveled. Theoretically, the closer the content is to the user, the faster the delivery. Therefore, users will experience less jitter when streaming, fewer network spikes, and an overall improved streaming quality. Due to the reliability, operators can deliver high quality content

with a high level of service, low network server loads, and thus, lower costs.

Additionally, many CDN providers offer TCP acceleration technology which boosts performance, thus improving user experience. Since CDNs decrease latency, the acceleration working in conjunction with an already high-performing network results in explosive content.

100 Percent Availability

Due to the distribution of assets across many regions, CDNs have automatic server availability sensing mechanisms with instant user redirection. As a result, CDN websites experience 100 percent availability, even during massive power outages, hardware issues or network problems.

Increase in the number of Concurrent Users

Strategically placing the servers in a CDN can result in high network backbone capacity, which equates to a significant increase in the number of users accessing the network at a given time. For example, where there is a 100 GB/s network backbone with 2 TB/s capacity, only 100 GB/s can be delivered. However, with a CDN, 10 servers will be available at 10 strategic locations and can then provide a total capacity of 10 x 100 GB/s.

Control of Asset Delivery

Another beneficial feature of CDN technology is that more control of asset delivery and network load is awarded. Operators have the ability to deliver real-time load statistics, optimize capacity per customer, display active regions, indicate which assets are popular, and report viewing details to their customers. These details are extremely important, since usage logs are deactivated once the server source has been added to the CDN.

Unfortunately, there are several disadvantages to CDNs, which include:

- Impractical for many organizations
- Cost
- High cost per GB
- Support
- Maintenance
- Verification of the best locations

Impractical for many Organizations

Due to the inherent nature of the Internet being global, websites receive hits from across the world. Therefore, it is impractical for most organizations to maintain duplicate servers around strategically positioned around the world.

Cost

As a result, organizations must rely on support from third-party CDN vendors. Therefore, another one of the greatest limitations of a CDN are the fees associated with the service. Many of the larger CDN have high setup fees and other hidden fees. The high fee structure could potentially be to keep away smaller clients, focusing only on large business entities.

In many instances, the pricing structure is hidden, not readily available or can be difficult to understand all the moving parts – one of which is the limitation of high cost per GB or storage and data transfer. Therefore, it is critical to understand every aspect of the terms and conditions prior to entering into a contract.

Support

Since most organizations utilize third-party vendors to maintain the CDN, there is always the question of support availability. If a major issue arises, will the operator be able to fix it in a timely manner and prevent the same problem from occurring again?

Maintenance

Similarly, the CDN operator must also effectively maintain each server with the proper updates and patches without disrupting the client's content network. Placing a company's entire corporate network into the hands of an operator is a major step. Therefore, all factors must be considered and backup plans implemented prior to setup and usage. This also includes timely maintenance and application of updates.

Verification of the Best Locations

Additionally, organizations must research the location of the servers offered by each CDN and find those that best fit their customer's locations. It is pointless to utilize a CDN that is a significant distance from users, which will result in potential service disruptions, jittering streaming of video, downtime, low latency and thus low performance. Clients must completely verify the exact locations of all servers and determine if the CDN will be beneficial to its services and client base.

With the high number of products available on the Internet and the amount of money spent to purchase those items while checking information, reading, writing and conducting many other activities on the Internet, it is critical to have a system that delivers performance and reliability. CDNs maintain those tasks and do much more.

To overcome all the above issues Cloud Computing and Ad-Hoc networking can be a solution. Cloud Computing becomes a popular tendency in recent years. Content delivery network has been used for many years to distribute content over the world. The relative between Cloud computing and content delivery network is exciting.Thus Cloud-CDN and hybrid cloud will become the next generation of content distribution network. Vehicular Cloud networks give an opportunity for CDN to be implemented using ad hoc networking techniques.

V. CONCLUSION

Through more and more households purchasing high-speed access, it is obvious that the traffic volumes over CDNs will explode. The methods used for delivering content in CDNs today will not be suitable for the infrastructure load incurred as delivery of high-bitrate video content becomes commonplace. Technologies that offer better scalability and distribution should be used, such as high- throughput caching systems, content routing algorithms with global awareness and more efficient streaming systems. In conjunction with CDN peering, a CDN that will scale to future requirements is perceivable.

Content networking tools can be deployed in a variety of configurations that benefit everyone in the CDN and edge services supply chain: content owners, CDN network operators, service providers, equipment makers, and, ultimately, users. The same drivers that spawned content networking services in the public Internet are now pushing enterprises to build intranet CDNs as a way to reduce WAN costs while avoiding WAN performance bottlenecks—particularly as streaming applications, such as Web-based training and corporate communications, emerge.

Content networking technology is also beingexpanded to enable a whole new market area: edge services. These services include not only the traditional local distribution of cached content, but also create new opportunities for delivering services and applications specific to the user at the opposite end of the single-hop link. Localized and even personalized advertising, network services such as storage and security, and the delivery of regional and local content that pertains to a particular user become available through the use of content networking technologies.

Essentially, a CDN can peer with multiple others, thus being able to redirect end-users to a partner's POP instead of one's own if the content routing algorithm decides that this offers better performance. Of course, this isn't a simple prospect, since open protocols need to be developed to allow CDNs to communicate content location and availability to each other. Now different vendors produce different protocols. So it's time to standardize and adapt to advanced technology

VI. REFERENCES

[1] Vakali, A. and Pallis, G. Content delivery networks: Status and trends. IEEE Internet Computing 7, 6 (2003), 68–74.

[2] Content Delivery Networks (CDNs) – A Reference Guide, Matthew Liste from cisco

[3] M. Pathan. Content distribution networks (CDN) - research directory, May 2007.URL http://www.cs.mu.oz.au/~apathan/CDNs.html.

[4] Overlay routing for fast video transfer in cdnhttps://arxiv.org/pdf/1701.09011.pdf

[5] An Architecture of distributed Content delivery network http://ieeexplore.ieee.org/abstract/document/4444113/?reload=true

[6] A Taxonomy of content delivery network http://www.cloudbus.org/reports/CDN-Taxonomy.pdf

[7] Pathan, Mukaddim, and Rajkumar Buyya. "A Taxonomy of CDNs." Content Delivery Networks Lecture Notes Electrical Engineering: 33-7

[8] C. M. Chen, Y. Ling, M. Pang, W. Chen, S. Cai, Y. Suwa, O. Altintas, "Scalable Request-Routing with Next- Neighbor Load Sharing in Multi-Server Environments," In Proceedings of the 19th International Conference on Advanced Information Networking and Applications, IEEE Computer Society, Washington, DC, USA, pp. 441-446, 2005.

[9] S. Sivasubramanian, M. Szymaniak, G. Pierre, and M. Van Steen, "Replication of Web Hosting Systems," ACM Computing Surveys, Vol. 36, No. 3, ACM Press, NY, USA, 2004.

[10] F. Douglis, and M. F. Kaashoek, "Scalable Internet Services," IEEE Internet Computing, Vol. 5, No. 4, 2001, pp.36-37.