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COEN 233 (Computer Networks)

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Streaming Technology

Audience

This document provides an overview, technical definitions, benefits, cost analysis and different platforms used by users around the world for data streaming. At the end of this essay, an in-depth research was also done on how to choose a streaming technology based on several parameters.

A very basic knowledge of high-level languages used in streaming technologies such as Python and SQL, service architectures, commercial applications of data streaming, business needs and return on investment(RoI) fundamentals are required to understand the contents of this material.

This article can be used by students, tech enthusiasts, authors, software developers, software engineers, academicians, researchers and anyone who wants to learn about streaming technology and streaming real-time data.

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1. Introduction

In order to understand streaming technologies, it is essential to first know the meanings of the terms used in the jargon of streaming technologies. **Data** refers to text, images, music, video, and multimedia files. The term "**streaming**" refers to a continuous, endless stream of data with no beginning or end, providing a steady stream of information that can be used or edited without first being downloaded. Similarly, data streams are produced by many sources and come in a variety of sizes and formats.

Streaming data (also called event stream processing) is a constant flow of data generated from multiple sources. Streams of data can be processed, stored, analyzed, and manipulated in real time as they are produced using stream processing technology. The hardware and software that enable live or on-demand streaming of video and audio over the Internet are collectively referred to as "**streaming technologies**."

Today's enterprise applications rely on a variety of dynamic data sources. Enterprise data architectures are becoming increasingly sophisticated with access to a wide variety of sources. Because today we don't just want to store data, we need to analyze it and make it available to our applications as soon as possible. The core of this problem is the constant movement of data. Data flows through your organization and must provide immediate value to every business-related decision.

1.1 – Background

In the early stages of internet, it used to take hours to download a video from a website. This during the turn of the 20th century, when dial-up Internet was cutting edge and the word "smartphone" was not yet a common term. It goes without saying that video streaming was just getting started, but the foundation for what was to come was already laid. In fact, video delivery still uses many of the new technologies of that era. The concept of having to wait for a video to download instead of watching it right away is like a horse-drawn carriage ride to work.

Video streaming, both live and on demand (VOD), has become a part of everyday life. Zoom is used for company meetings, doorbell cameras are used to yell at pirates on the porch, and workout routines run on connected gym machines during workouts. Real-time streaming capabilities are already built into robot vacuums, wearables, and medical devices. Binge-watching Netflix has become a popular pastime, but facetime is listed as a verb in the Oxford Languages Dictionary. These events show how important data streaming has become in today's world.

1.2 – Objective

The purpose of this research project is to provide an overview of streaming technology, how it works, insights into the many streaming platforms used by consumers around the world, and criteria for choosing a streaming platform. This research paper draws on several articles published online as well as previous work in the IEEE Xplore and ACM Digital Library.

1.3 – Structure of Thesis

This thesis is divided into seven chapters. The first chapter emphasizes on understanding the basics of streaming technologies. This chapter also includes a description of a video streaming architecture, batch, stream and real time processing techniques and their architectures. The second chapter contains information on streaming platforms, their importance and popular streaming platforms used in the tech industry today and how they compare with each other. The third chapter is on video streaming technologies. It discusses topics like streaming protocols, codecs, video players and content delivery networks and their role in video streaming. The fourth chapter discusses ten criteria(real time and live streaming capabilities, video

storage, security, monetization, streaming costs of optimization, compatibility with all devices despite poor internet connection, usability and statistics tools) used to choose an optimum streaming platform. The fifth chapter discusses what the future holds for streaming technologies. The final chapter contains a summary of all the chapters of this document.

2. What is Streaming Technology?

Streaming data processing is beneficial in most situations where new dynamic data is constantly being generated. Applicable to most business domains and big data use cases. Businesses typically start with simple applications such as collecting system logs and basic operations such as performing minimum and maximum calculations. These applications will eventually evolve into more complex near real-time processing. Applications can first process the data stream to generate simple reports and take simple actions in response. This includes triggering alarms when key metrics cross predetermined thresholds. Finally, these apps perform more complex data analysis like leveraging machine learning techniques to derive more comprehensive insights from your data. Sophisticated algorithms for interpreting streams and events.

Recent developments in computing, compression, high-bandwidth storage, and high-speed networks have made it possible to deliver real-time multimedia services over the Internet. As the name suggests, real-time multimedia is time sensitive. For example, audio data and video data must play consecutively. Any delay in the data will stop the playback process, irritating the human ear and eyes.

A major component of real-time multimedia is real-time transmission of stored or live video. This white paper describes video streaming, the real-time transmission of pre-recorded video. Download mode and streaming mode are two methods of transmitting stored video over the Internet (that is, video streaming). When downloading, it usually takes an unacceptably long transmission time. In contrast, in streaming mode, only part of the video content needs to be downloaded in order to play it. The rest is played while the content is received and decoded. Since video streaming is a real-time format, it often has bandwidth, delay, and loss requirements. However, there are currently no Quality of Service (QoS) guarantees for online video streaming on the Best Effort Internet model. In addition, effectively supporting multicast video while maintaining service flexibility to meet her QoS requirements of different customers is also a challenge. Therefore, creating a system and standard for Internet streaming video poses great challenges.

Extensive research has been done to solve these problems. For example, in video streaming, the six major areas of streaming video are: video compression, application QoS control, continuous media distribution services, streaming servers, media synchronization mechanisms, and protocols for streaming media. Each of the six categories serves as a basic building block from which you can build your streaming video architecture. Figure 1 shows the relationships between the six basic building blocks.

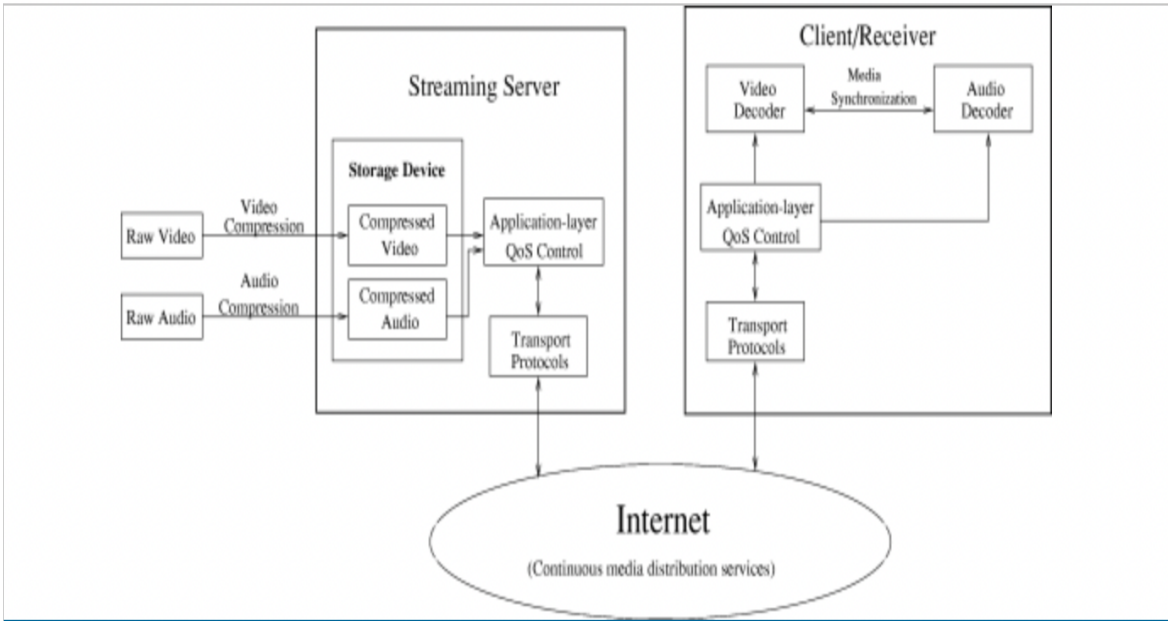

Figure 1 - Architecture for Video Streaming(Source)

An architecture for streaming video is shown in Fig. 1. In Fig. 1, pre-compressed video and audio data are stored in a storage device after being pre-compressed by a video compression and audio compression algorithm. A streaming server receives compressed video and audio data from a storage device upon client request, and an application-level QoS control module modifies the video and audio bitstreams according to network conditions and QoS specifications. The transport protocol packetizes the compressed bitstream after adaptation and sends the video/audio packets to the Internet. Internet congestion can cause packets to drop or slow down. On the Internet, continuous media delivery services such as caching are used to improve the transmission quality of video and audio. Once the packet is successfully delivered to the recipient, it first passes through the transport layer, then processed by the application layer, and finally decoded by the video/audio decoder. A media synchronization algorithm is required to achieve synchronization between video and audio presentations. The six domains are illustrated in Fig. 1 are closely related and are coherent components of the video streaming architecture.

2.1 – Video Streaming Architecture

A video streaming architecture typically consists of the following components:

1. Video Compression: Raw video must be effectively compressed before transmission.
2. Application Level QoS Control: An approach of variable application-level QoS control was presented to address changing network conditions and different user requirements for presentation quality. Techniques used at the application layer include congestion and error control.
3. Continuous Media Delivery Services: Proper network support is essential to creating high-quality multimedia presentations. In this way, network support can reduce packet loss and transmission delays.
4. Streaming Servers: A streaming server is essential to provide a streaming service. Streaming servers must process multimedia data within time limits and provide interactive control actions such as pause/resume, fast-forward, and rewind in order to provide quality streaming services.
5. Media Synchronization Mechanisms: A key feature that distinguishes multimedia apps from other traditional data applications is media synchronization. Receiving applications can deliver different media streams exactly as they were originally captured, thanks to media synchronization methods.

6. Protocols for Streaming Media: Protocols have been created and standardized to facilitate communication between clients and streaming servers. Network addressing, transport and session control are just a few of the features provided by streaming media protocols.

2.2 – Other Applications of Streaming Data

Data streaming is used in several other applications in everyday life. A few such applications are mentioned below:

1. Sensors in farm machinery, industrial machinery, and transportation vehicles provide data to a streaming application. In order to save equipment downtime, the application continuously monitors operation, identifies any defects before they occur, and automatically purchases a spare part.
2. Financial institutions monitor stock market volatility in real time, calculate value-at-risk, and automatically rebalance portfolios in response to stock price changes.
3. A real estate website collects some data from a customer's mobile device to provide real-time location-based real estate recommendations.
4. Solar power companies must continue to supply electricity for their customers. The company created a streaming data application that tracks all installed panels on site and arranges servicing in real time, minimizing the amount of time each panel experiences slow throughput and the resulting penalties suppressed.
5. A media publisher streams billions of clickstream recordings from online domains, aggregates and enriches the data with user demographics, and optimizes the layout of website content to create more relevant content. provide users with a satisfying experience.
6. Companies that offer online gambling collect real-time data on the player's interaction with the game and feed it into gaming platforms. Later, real-time data analytics is done, and interactive.

2.3 – Data Streaming

Processing streaming data benefits all industries that continuously generate data. Most use cases start with monitoring and reporting on internal IT systems such as: processing data streams from sensors, devices, data centers, and many other sources supports the operations of the company and its products. The ability to send, receive and process streaming data is becoming increasingly important as customers and partners alike. Its ability to apply machine learning and artificial intelligence to processing, analytics, and streaming data is critical as more organizations rely on it.

2.3.1 – Batch Processing

The processing and analysis of datasets already stored over time is done in batches or "**batch processing**". Examples of batch processing are payroll and payroll systems that need to be processed weekly or monthly. Processing huge amounts of data requires a large portion of storage and processing resources. Due to the large amount of data that needs to be processed, batch processing delays can range from minutes to days. Additionally, complex calculations and analyzes for longer timeframes are performed in batch processing. Batching data at rest is a typical big data scenario. In this case, the source application or orchestration procedure loads the source data into the data store. Parallelized jobs, which can also be started by orchestration workflows, process data locally. Before the modified findings are placed in the analytical data repository, the processing may involve several iterative steps accessible from the analysis and reporting components.

Batch processing is used in a variety of situations, from simple data transformations to more comprehensive Extract-Transform-Load (ETL) pipelines. Batch processing can be used in big data environments where very large data sets are involved and computations are time consuming. (See, for example, the Lambda architecture.) Batch processing typically produces data suitable for modeling and machine learning, or writes data to a data store suitable for analysis and visualization.

Consider an example of batch processing. A large collection of flat, illogical CSV or JSON files can be transformed into a structured, schematized format that can be further queried as an example

of batch processing. Binary formats store data in a columnar structure and often provide indexes and inline information about the data, resulting in better query performance than raw formats used for ingestion (such as CSV).

2.3.3.1 – Batch Processing Architecture

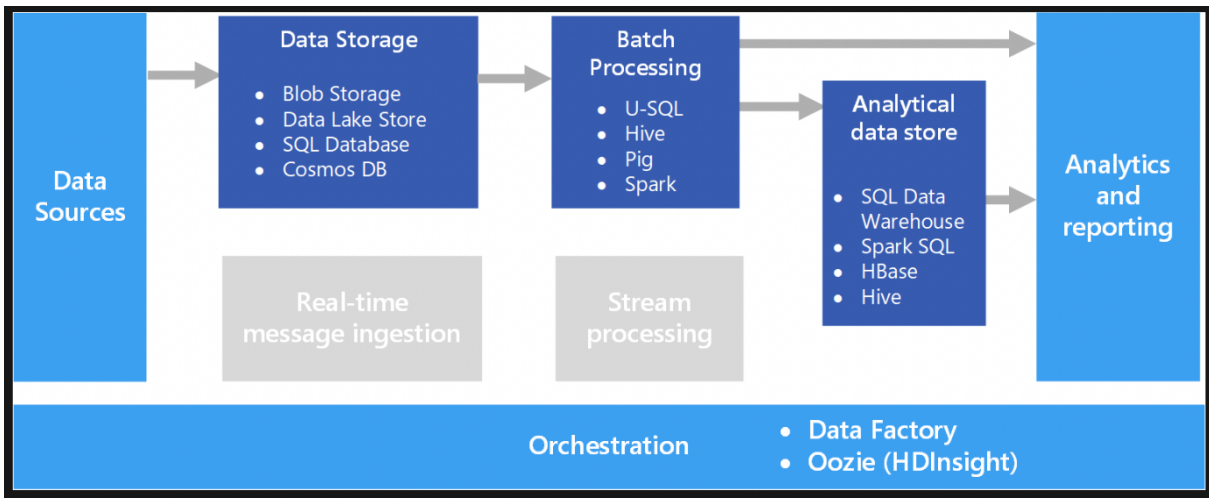

Figure 2 - Architecture for Batch Processing(Source)

2.3.2 – Stream Processing

Performing actions when records are created is called stream processing. Data that is processed as often as needed for a particular use case has historically been called "real-time processing" by data experts. However, "**stream processing**" has evolved into a more specific term as a result of the development and spread of stream processing tools and frameworks. Stream processing allows many jobs to run serially, in parallel, or both against a set of incoming data (a "stream"). Stream data creation, data processing, and data delivery to a destination are all part of this workflow, often referred to as the "stream processing pipeline."

The actions that stream processing performs on data include aggregation (such as summing, averaging, and standard deviation), analysis (such as predicting future events based on patterns in the data), and transformation (such as converting numbers to date format). change, etc.), enrichment (e.g. combining data items with other data sources to provide more context and meaning), and ingestion (e.g. inserting data into a database).

Stream processing can be used to process data from IoT sensors, payment processing systems, server and application logs, and more. Source/sink and publisher/subscriber (often called pub/sub) are two common paradigms. Data and events are produced by publishers or sources and passed to stream processing applications. There it is augmented, fraud-detection tested, or otherwise modified before being sent to subscribers or sinks. Technically, the most common sources and sinks include Apache Kafka, Hadoop, TCP connections, and in-memory data grids.

2.3.3.2 – Stream Processing Architecture

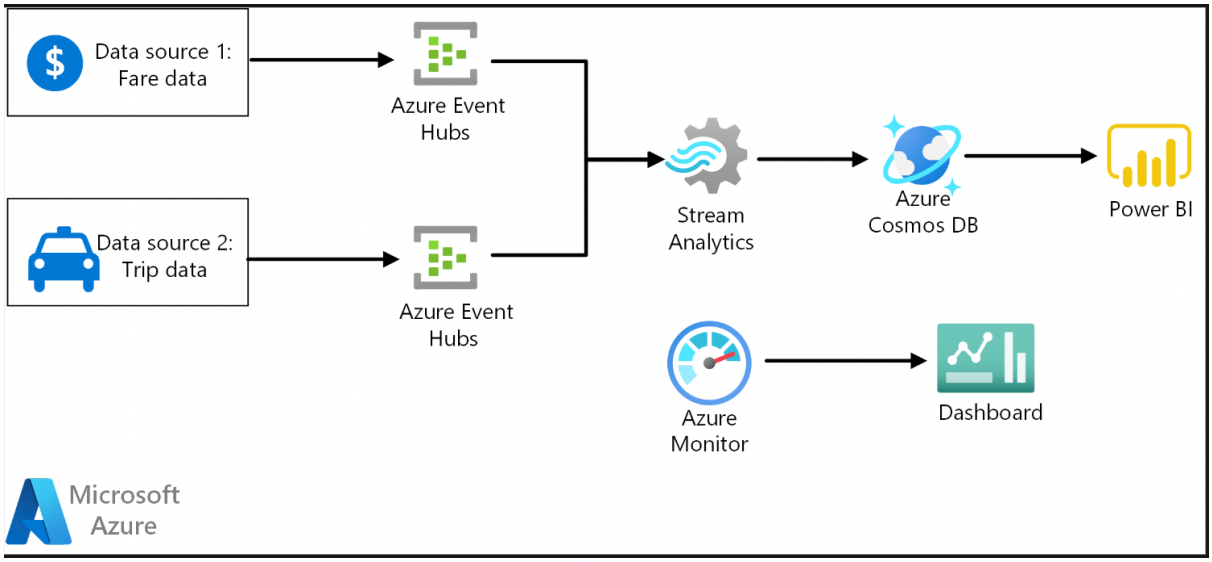

Figure 3 - Architecture for Stream Processing(Source)

2.3.3 – Real-Time Data Processing

Real-time data processing enables you to quickly act in response to real-time data. B. Milliseconds executed. An example is a real-time application that buys a stock within 20ms of reaching its desired price. Real-time data processing systems can input rapidly changing data and provide results almost instantaneously, making it easy to observe changes over time in such systems. For example, radar systems rely on constant input data streams. This data is processed by a computer to locate various aircraft flying within radar range and display it on the screen. This allows us to provide the exact position of the aircraft at that exact time.

There are several benefits of real-time data processing:

1. **Aids finer decision-making** - Being able to make better decisions faster is one of the key benefits of real-time analytics for your business. Simply put, it enables you to quickly and accurately extract insightful information from your data. These companies can implement new strategies, operational procedures, and concepts to improve operations based on data. Additionally, with real-time access to insights, organizations can take advantage of market opportunities they otherwise would not have been able to. Ultimately, access to these latest insights serves as the basis for making smart business decisions that impact both the success and bottom line of the company.

2. **Ability to quickly identify and fix problems** – It is very important for companies to be as productive and effective as possible in a crowded market. It all depends on whether your company has streamlined workflows and business processes. Real-time data and event processing enable organizations to gain near-instant insights. You can now identify business process and workflow issues much faster than before. And because you can find these issues more quickly, you can fix them before they completely disrupt operations. This helps businesses maintain their ability to generate revenue and protect their reputation from being damaged.

3. **Competitive Benefit** - Businesses can understand market performance, what is working and what is not, and keep up with industry trends through real-time data processing and analysis. For example, when competitors change their business, pricing, or marketing methods, companies can now react more quickly. This gives you the flexibility and agility you need to quickly adapt to changing market conditions and differentiate yourself from your

competitors. They have the competitive edge to ensure their continued success through their ability to outperform the competition and capitalize on trends.

4. **Better Customer Service** - Businesses can monitor customer behavior when they have real-time insights at their disposal. This helps us understand our customers better and how to serve them. For example, businesses can monitor consumer patterns and other factors that influence consumer purchases through real-time data processing and analytics. Armed with this knowledge, you can put major customer-facing initiatives into action. They can sell their products better, which allows them to sell more and increase their sales. However, real-time information can greatly improve customer service and help businesses attract new customers. Businesses can therefore use real-time insights to determine if customers have concerns or issues with their goods and services.

5. **Cost-Efficiency** - As mentioned earlier, real-time data processing can consume fewer resources than batch processing. Real-time processing can also reduce costs in several ways, but this alone can reduce costs. As mentioned above, businesses can improve operations, increase employee productivity, improve marketing, and increase sales. This ultimately leads to a more efficient business overall. As a result, you can generate more income with less money. Real-time data processing and analytics is the technology every business needs if they want to increase productivity, reduce costs, understand their customers better, and increase sales. And enjoying the benefits is the perfect time for businesses of all sizes to take advantage of real-time computing without having to deal with the inherent complexity.

Having learnt how batch processing, stream processing and real-time data processing work, we can tabulate the critical distinctions between the three types of processing.

	Batch Data Processing	**Real-Time Data Processing**	**Stream Processing**
Hardware	Processing huge amounts of data requires a large portion of storage and processing resources	Less storage space is required to process the latest or current collection of data packets. Reduced amount of computation	Less storage space is required to process the current data packet. Ensuring real-time processing requires more computing power to "wake up".
Performance	Delays of minutes, hours, or days can occur	It should be measured in seconds or milliseconds.	You must guarantee millisecond latency
Dataset	Huge amount of data	Some or latest data packages	A continuous stream of data
Analysis	Complex timeframe analysis and calculations	Simple calculations or reports	Simple calculations or reports

Table 1 - Comparison of Data Processing Techniques(Source)

3. Data Streaming Platforms

Through automation, easy-to-use workflows, and standards, data streaming platforms enable buyers and sellers to complete processes faster and easier. It is important to ensure that buyers and sellers always have the upper hand, even if the underlying operations can be completed more quickly. The development of more advanced data in-house has created the data streaming platforms category. Many companies have seen an opportunity to buy data to supplement their current datasets or monetize their current data to create new revenue streams when it becomes a strategic asset. This insight led to the idea of collecting and monetizing data, but it proved difficult to implement due to lack of knowledge, disjointed environments, and problems with the data itself. Companies needed a system of record to easily manage their data strategy without relinquishing control.

3.1 – Popular Data Streaming Platforms

Some of the popular data streaming platforms are:

1. **Amazon Kinesis** - Real-time streaming data can be easily collected, processed, and analyzed by Amazon Kinesis, allowing you to respond quickly to new information and gain timely insights. With the freedom to choose the tool that best fits your application needs, Amazon Kinesis provides the essential capabilities to economically process streaming data at any scale. You can use Amazon Kinesis to ingest real-time data for machine learning, analytics, and other applications such as video, audio, application logs, website clickstreams, and IoT telemetry. Rather than waiting for all the data to be collected before processing can begin, Amazon Kinesis allows data to be processed and analyzed as soon as it is received. Amazon Kinesis allows you to ingest, buffer, and analyze streaming data in real time, delivering insights in seconds or minutes instead of hours or days. It runs streaming applications without the need to manage infrastructure. And with extremely low latency, Amazon Kinesis can process massive amounts of streaming data and analyze information from myriad sources.

2. **Confluent** - Confluent is a full-featured data streaming platform that makes it easy to access, store, and manage data as a continuous real-time stream. Developed by the original developers of Apache Kafka®, his Confluent enhances the benefits of Kafka with enterprise-class features while making Kafka easier to manage and monitor. Today, over 80% of the Fortune 100 companies use data streaming technology, most of which use Confluent. With Confluent, you can easily build entirely new categories of modern event-driven applications, maintain universal data pipelines, and unlock powerful new use cases with full scalability, performance, and reliability. It does this by consolidating historical and real-time data into one centralized source of truth.

3. **Apache Kafka** - Many companies use Apache Kafka, an open-source distributed event streaming platform, for mission-critical applications, high-performance data pipelines, streaming analytics, and data integration. Deliver messages using a cluster of devices with latency as low as 2ms with network-limited throughput. Large production clusters can handle up to 1,000 brokers, billions of messages per day, petabytes of data, and hundreds of thousands of partitions. Storage and processing should be flexible in size. Store data streams securely in fault-tolerant, distributed, and durable clusters. Clusters can be efficiently stretched across Availability Zones and interconnected across geographic regions. Process event streams with joins, aggregations, filters, transformations, and more using event-driven, one-time processing. Hundreds of event sources and sinks are built into the Connect interface, including Kafka's fresh ideas Postgres, JMS, Elasticsearch, AWS S3, and more. Event streams can be read, written, and processed in a variety of computer languages. Large open source tool ecosystem : Leverage a wide variety of community-driven tools. Supports mission-critical use cases with efficient exactly once processing, guaranteed ordering, and no message loss. Kafka is used by thousands of companies, including stock exchanges, car

manufacturers, and internet giants. Lifetime tally of over 5 million unique downloads. With hundreds of meetups worldwide, Kafka is one of the five most active projects within the Apache Software Foundation. In-depth guides, online training, step-by-step guides, videos, example projects, Stack Overflow, and more.

4 **Google Cloud DataFlow** - Unified stream and batch data processing that's serverless, fast, and cost-effective. New customers get $300 in free credits to spend on Dataflow. Google Cloud DataFlow has fully managed data processing service, automated provisioning and management of processing resources. There is a provision of horizontal autoscaling of worker resources to maximize resource utilization and OSS community-driven innovation with Apache Beam SDK. Two important features of Google Cloud DataFlow is reliability and exactly-once processing feature.

The table below shows a summary of the key features of all these platforms:

	Apache Kafka	Confluent	Amazon Kinesis	Google Cloud Dataflow
Scalability	Can handle scalability in all four dimensions	It is fully scalable	Amazon Kinesis is scalable. It also has the on-demand capacity mode	Processing is exactly once kind of processing
High-Volume	Can work with high volumes of data	Can work with high volumes of data	Amazon Kinesis can work with high volumes of data	Can process high volume live streams of data
Data Transformations	Can derive new data from producer data	Confluent had data transformation capability	Kinesis uses firehose for data transformation	Can uses beam transforms for data transformation
Fault Tolerance	Can tolerate failures with masters and databases	Confluent is fault tolerant	Kinesis is fault tolerant	Google Cloud Dataflow is fault-tolerant
Reliability	Kafka is reliable because it is fault tolerant and distributed	Confluent is reliable like Apache Kafka	Amazon Kinesis is highly reliable	Google's Cloud Dataflow is committed to attaining an uptime of 99.99% or higher. It is highly reliable

Table 2 - Key Features of Different Streaming Platforms(Source)

Figure 4 - Amazon Kinesis Data Stream Flow Diagram(Source)

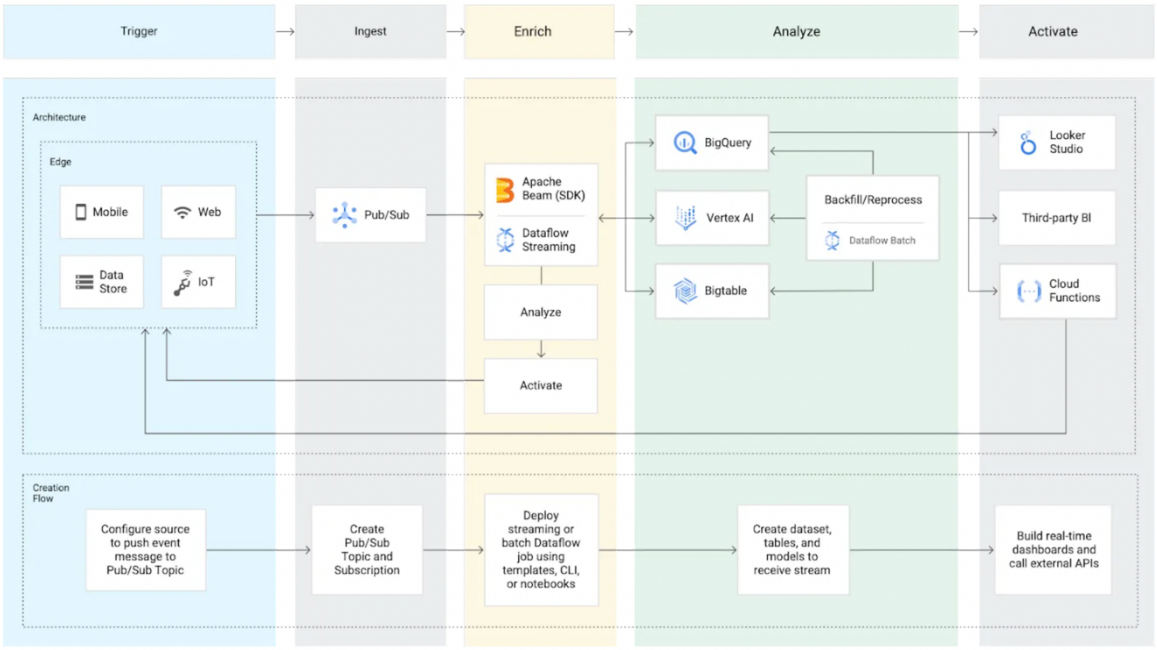

Figure 5 - Google Cloud DataFlow Architecture(Source)

4. Video Streaming Technologies

All the software and hardware required to deliver real-time video to your audience is collectively referred to as live streaming technology. Video files are huge and live video transmission requires special streaming equipment and techniques.

Using video streaming technology is one way to send video over the Internet. Thanks to streaming technology, music and video distribution over the Internet can reach tens of millions of people using PCs, PDAs, mobile phones, and other streaming devices. Video streaming protocols follow established rules and techniques to decompose a video file, deliver it to the end user, and reconstruct it for display. Files must be compressed for transmission. This is done using a "codec" which is the most common H.264. Files must be saved in a "container format" such as .mp4 or .avi before being transferred. The source of the video files for live streaming can be directly from the

broadcaster's cameras, or static files (VoD) for video on demand. Downloading and streaming videos are completely different concepts. Streaming is real-time, so it's more efficient than downloading media files. When you download a video file, a copy of the entire file is saved on your device's hard drive, so you must download the entire file to view the movie.

Instead of copying and saving movies, the browser simply plays them as they stream. The video loads in sections rather than all at once, and the data your browser loads is not stored locally. We can move on to the different types of video streaming technologies.

4.1 – Streaming Protocols

A standardized technique for transmitting media over the Internet is a streaming protocol. Small chunks of data are required to be portable across different internet connections. Protocols are important for transfers because they transfer content from one place to another during the video streaming process. Many video streaming protocols are essential for live streaming. Let's take a look at some of the most commonly adopted ones at the moment.

4.1.1 – HLS

One of the most important protocols in modern video streaming technology is the HTTPS Live Streaming (HLS) protocol. Apple set this protocol to work with HTML5 video players. Used to push media from the content delivery network to the player for the user to watch. HLS can be used to ingest media from encoders to online video platforms, but HLS encoders are still not very common, so RTMP ingest is more commonly used.

4.1.2 – RTMP

Another important protocol used by broadcasters today is the Real-Time Messaging Protocol (RTMP). Flash has taken on a new role in streaming since the demise of Adobe's Flash player, which was meant to play videos. RTMP ingest now uses this protocol. That means moving your video from your encoder to an online video platform or directly to your content delivery system. Low-latency streaming and low-cost RTMP encoders are two advantages of RTMP.

4.1.3 – RTSP

A little-known protocol called Real-Time Streaming Protocol (RTSP) is actually very important. Although not the same, it is often confused with RTMP. RTSP is used to send commands from the user to the video player. For example, notifying a video player when the user clicks controls such as play, pause, or fast forward on the player. The ability to access video content before the viewer has fully downloaded it also makes RTSP useful. It enhances the viewing experience by not having to wait for the selected content to play.

4.1.4 – MPEG-DASH

An open-source streaming protocol called MPEG-DASH has an organizational structure like HLS. This standard is notable for being the first to offer adjustable bit rate streaming. This allows viewers to instantly get the stream at the best resolution for their internet bandwidth. This prevents excessive lag and buffering for users with slower connections. MPEG-DASH is sometimes categorized as a streaming protocol, but it actually relies on another protocol, TCP, to function. Compatibility with this standard will increase over time as related technologies begin to support it. A key component of video streaming technology that enables efficient data transfer over the Internet is the streaming protocol.

4.2 – Codecs

A RAW video file created when a camera captures video is made up of hundreds of still images that are combined to create a smooth motion that is perceived as video. However, due to the size of these files, they cannot be streamed. In order to be able to stream it, it must be converted to a digital format. Still images deemed duplicate and redundant are discarded or compressed and sent, and video is converted to digital files. The technology that does this is called a codec, a portmanteau of "coder/decoder". There are two types of codecs: audio codec and his visual codec. Basically, a

codec batches and transfers incoming video data from one point in the streaming process to the next. Keep your content small to make it easier to send over the Internet. An "encoder" is a device that uses a codec. There are both hardware encoders and software encoders. We will discuss these tools in more detail later.

4.3 – Video Players

To reach the widest possible audience with HTML5, broadcasters should choose a video player that is widely supported. A user-side technology called a video player allows viewers to watch video streams. Adobe's Flash player used to be the standard, but has been superseded due to incompatibilities with mobile streaming. Since then, the industry has adopted HTML5 video players as a standard. Apple developed this video player to support mobile video streaming. Almost every internet-enabled device imaginable, including smartphones, tablets, smart TVs, and game consoles, is compatible with HTML5 video players. Most browsers and operating systems are also HTML5 compatible. Fig. 5 shows the home screen of Dacast video player.

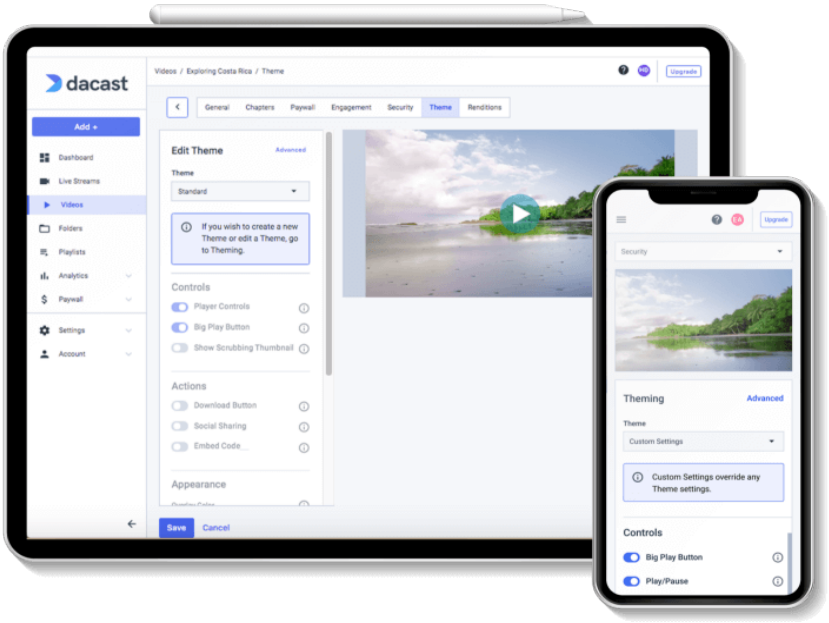

Figure 6 - Dacast Video Player(Source)

4.4 – Content Delivery Networks(CDNs)

A network of servers, known as a content delivery network (CDN), is strategically placed to deliver high-quality content to locations remote from the source of the stream. Streaming CDN pushes content to a network of servers to work. Users select the content they want to watch through a video player connected to an online video platform. From there, the CDN serves the cached material by redirecting the request from the origin site's server to a server within the CDN that is closest to the user. Content can be delivered significantly faster by placing servers closer to the source and destination.

Many broadcasters use relationships created by their favorite online video platforms to access CDNs. For example, Dacast works with leading CDNs like Akamai, Limelight, etc. to deliver fast, high-quality streaming to audiences around the world. For more information on the best available solutions, see Video CDN Comparison for Streaming Video. Content Delivery Networks are

a key component of video streaming technology, making it easy to deliver content to viewers wherever they are.

5. Criteria for Choosing the Best Streaming Platform

There are a few important features to consider when it comes to choosing the best streaming platform. We will discuss them in the following sections.

5.1 – Real Time and Live Streaming Capabilities

If you plan to host a live broadcast, consider the broadcasting capabilities your streaming platform offers. What protocols is it compatible with? Does it support SRT and RTMP/RTMPS streams? Streaming service platforms provide features such as live broadcast (DVR) rewind, video footage recording and rebroadcasting to social networks It is highly recommended to check if they offer Additionally, the platform should be able to reduce latency when streaming live video.

Currently, all types of broadcasts follow the trend of reduced latency. Major streaming services are making every effort to meet consumer demand for real-time video viewing. In addition to low-latency streaming, many companies also offer ultra-low-latency streaming. The price of ultra-low latency streaming is higher. Therefore, you should understand the difference between low-latency and ultra-low-latency streaming before deciding. Only then can you decide if your project requires it.

According to the concept of "low-latency streaming", broadcast delay should not exceed 4 seconds. Our platform does this using chunked CMAF technology. The video is split into bite-sized pieces or chunks and delivered in segments. Ultra-low latency streaming latency is less than 1 second. Usually, he uses WebRTC technology to achieve this. Thanks to this communication standard, video material can be delivered directly between browsers without the need for additional add-ons or applications. If you are making a video call, holding a meeting or hosting a webinar - i.e. communicating with your audience or event attendees in real time - you should select a delay option of no more than 1 second. If your online event doesn't require real-time communication with your audience, choose a 4 second delay.

Streaming Service and CDN Integration When talking about low-latency streaming, it's important to address CDN integration. A CDN (Content Delivery Network) consists of a number of interconnected servers or "points of presence". End users cache and deliver data received from origin servers. Whether you have 1 user, 1,000, or over 1 million, a CDN allows you to deliver your content to a large number of consumers as quickly and easily as possible. No matter where in the world you are, with a CDN you get your material at the same speed for all your audience. Streaming requires a CDN if your target audience is far away from your origin server.

5.2 – Video Storage

A modern streaming platform should offer more than a live broadcast. It should also be able to deliver and store VOD (video on demand). Even if online broadcasting is more important to your project, being able to record, archive and distribute your stream online is always a plus. Consider how many video recordings you can store, how easy it is to publish your videos to the platform, and what file types are accepted.

Emulating live streaming with pre-recorded video (VOD to Live) is a very useful feature. Choose a start time and upload your ready-made video to the platform. The viewer watches the video at a specific point in time and cannot fast-forward. The recording is therefore interpreted as an internet transmission.

5.3 – Security

Put time and effort into your project to create original and helpful content. The results of your painstaking work should not be exposed to malicious users. Copy protection of your content becomes more important if you decide to sell your movie. Let's say you create useful professional video content and sell it for a significant profit. Shortly after the project has been published, you will notice that the video has been published online. Users will love free access to your material. Your

sales are down and your project isn't generating the revenue you wanted. They put a lot of effort into this project to no avail. To avoid this, you need to protect your belongings properly. Meetings and video calls also need reliable security. For example, if you're hosting an onsite meeting to discuss important issues, you don't want outsiders to be able to join and intercept the video chat. Protection is also important for unrestricted transmissions. You work hard to produce top-notch video footage and want your audience to understand that this is what you have to offer.

5.4 – Monetization

If you want to monetize your paid ads with free video access, check out our platform's monetization options. A comprehensive checklist for choosing a streaming service. Check the possible ad serving options, the technology used and the provider's guarantee that the ad will not be blocked by his AdBlock. Ads interfere with the demo. Traditional Client-Side Ad Integration (CSAI) strategies require client-side ad insertion and allow player-side ad rendering. Ideally, the service should be able to use all four techniques above. This gives you the chance to test many options and choose the one that works best for your audience. It's also important to think about the advertising protocols your company uses. Choose a solution that allows you to track audience reactions to your ads and easily insert them into your videos. This allows you to see how many people have seen your ad, which ones they tend to skip, and which ones stayed the last. You can also determine if this depends on the placement of ads within the video.

5.5 – Streaming Costs of Optimization

By using a streaming platform, you should be able to minimize your streaming costs. Because we can leave all the technology to the provider and focus on creating content, without having to build our own infrastructure, develop our own solutions, add staff, or train our own staff. You can save money. However, the platform can help you optimize your costs only if you choose wisely. If you choose a service that doesn't suit your needs, you'll miss your goals and waste your money. Therefore, choosing a streaming solution requires careful consideration. This is the best way to determine how easy and practical a particular solution is. If your streaming service doesn't offer that option, it's better to leave it off the list. Consider the broadcasting platform your platform should offer. Do you need an advanced system that covers everything from video recording to playback, or have you already developed some yourself? Finally, consider: See if your provider offers other useful services (CDN, storage options, cloud, etc.) in addition to their streaming platform, and if they're all coordinated and easy to use. That's always a big advantage.

5.6 – Compatibility with All Devices Despite Poor Internet Connection

Any device should be able to display the video. The transcoding process eliminates the need to create multiple video streams for each device. This method converts the video to another format to meet the specifications of the playback device. Video quality or format may change. For example, modern smart TVs let you watch shows in 4K or 8K. Mobile internet connection on smartphone is irregular. This means that the video quality automatically adapts to the situation. The term for this is adaptive bitrate. Most streaming services can transcode videos. Ask your provider what devices can view the show and what the video quality will be. Transcoding also requires a lot of resources. The only way to not introduce latency is to use powerful servers. So check how your platform organizes the transcoding process and how your provider prevents latency.

5.7 – Usability

Any device should be able to display the video. The transcoding process eliminates the need to create multiple video streams for each device. This method converts the video to another format to meet the specifications of the playback device. Video quality or format may change. For example, modern smart TVs let you watch shows in 4K or 8K. Mobile internet connection on smartphone is irregular. This means that the video quality automatically adapts to the situation. The term for this is adaptive bitrate. Most streaming services can transcode videos. Ask your provider what devices can view the show and what the video quality will be. Transcoding also requires a lot of resources. The

only way to not introduce latency is to use powerful servers. So check how your platform organizes the transcoding process and how your provider prevents latency. Another important aspect to consider is the ease of installation and use of the platform. If it is too complicated and confusing, it may cause problems when using the service. Time is lost learning how to use and customize the platform instead of focusing on content. How easy is it to combine resources and platforms? Is customization and branding possible? Is it possible to integrate with zero code? How easy is it to create and use a personal account?

5.8 – Statistics Tools

By understanding how your audience is responding to your shows, what they like and dislike, and how popular your videos are, you can use video streaming to meet your business goals. This way you can get the best results and have a better understanding of what needs to be addressed. For that we need statistical data. Make sure the stats tools you need belong to your streaming platform. For example, when you choose our streaming platform, you'll always know your total views and unique users, peak viewers, and featured lists. We have access to data about the platforms where videos are being watched and where the viewers are.

5.9 – Technical Support

Even if you choose a reliable platform and set up procedures effectively, emergencies can still occur. In situations like this, you need reliable technical support. We need to consider a few points. When will technical assistance be available? Ideally, it should be accessible every day. You can broadcast your movies anytime, regardless of business hours. What communication channels (chat, email, phone) are available to contact the experts? The better and easier it becomes for you, the more channels are available. If you are unable to contact technical support using the first method, please choose another method. We offer a wide range of communication channels available for most tariffs and provide 24/7 technical assistance. The problem should be resolved by technical support as soon as possible. You can see how this works in user reviews of various providers. Detailed documentation and a knowledge base with detailed instructions on how to use the streaming platform should also be available from the provider. This eliminates the need to seek technical assistance in many cases. Another important factor to consider is that rather than outsourcing this service, we recommend using a company that offers its own technical support. This is very important for suppliers, but contractors are less interested in quickly resolving issues. There is always the possibility that a dissatisfied customer will choose a competitor.

5.10 – Price and Trial Period

There are basically two categories of streaming services: paid and free. Twitch, YouTube Live, Facebook Live, and Vimeo are some of the most popular instances of free platforms. They are incredibly user-friendly and offer content monetization opportunities, but are not as functional as commercial solutions. Professional end-to-end streaming solutions are offered through paid platforms. They offer more possibilities but have a more complex framework. Free platforms are great for bloggers and small media outlets. If you are interested in a business venture and expect to make a good profit out of it, you should opt for a premium solution. Reasons. Third-party advertising is allowed on our free platform. With millions of competing contents her creators can easily capture the attention of their customers on a free platform. You may not introduce paid access to Content if you are using the Free Service. Compared to free features and statistical tools. Technical support is provided on paid and free platforms. Paid services offer high quality movies and reduced wait times. Paid option allows you to personalize your player and embed your videos directly into the service. When choosing a paid high-end solution, compare plans from different providers and find the one that offers the most value for your business in terms of cost-effectiveness.

6. Future of Streaming Services

Recently, video distribution services have been enhanced, and their use at home is increasing. According to COMSCORE's State of Streaming webinar, households will watch an average

of 5.4 streaming services in March 2022, up from 4.7 over the past two years. According to the same source, Netflix leads him in hours watched per week, followed closely by YouTube and Hulu. The 4th, 5th and 6th place are Amazon Prime Video, HBO Max and Disney+ respectively. Netflix has previously said it would never add advertising but given that it is necessary and that COMSCORE data suggests consumers may want it, advertising could be added. Ad-supported streaming services are being adopted by Americans faster than ad-free, subscription-based services. Free or low-cost ad-supported streaming channels seem to be the norm amid recession fears.

The cost and engagement of streaming will determine its future. A piece of the jigsaw is making long-term investments in shows and brands, while another is reaching out to potential viewers. Collaborations, including influencer outreach, and advertising are anticipated to continue to be important in this. Figures 6 and 7 show some important trends in streaming services market growth. Franchised content appeals to influencer audiences especially well because fans are familiar with the characters, businesses, and themes. Emotions can be sparked, and preconceived assumptions challenged. It's a powerful way to connect businesses and people, and broadcast marketing can rely heavily on it. COMSCORE research shows that social media is the ideal platform for disseminating information, perspectives and anecdotes. Netflix dominates social media with uploads of clips, movies, images, and interactive content. This is how Disney+ drives engagement.

The way we watch feature films has also fundamentally changed as a result of the pandemic. HBO began showing all Warner Bros. theatrical releases on his HBO Max on the same day as the theatrical release. There are no additional costs for paying customers. Blockbuster movies that normally must be seen in theaters can now be seen in the comfort of your own home for a fraction of the cost of buying a movie theater ticket. Many believe that this move will forever change the entertainment sector, especially the film industry. As more people across the country get vaccinated and return to work, school, and other normal daily activities, watch TV and movies, especially as many believe the market is saturated there will be less time and potentially less subscriptions. As a result of the pandemic, the streaming and film industry has undergone major changes. Above all, because I had to adapt to the people at home. We are now facing another fundamental change as the world has opened again, and the entertainment industry will decide where it fits and how it will affect streaming service subscriptions.

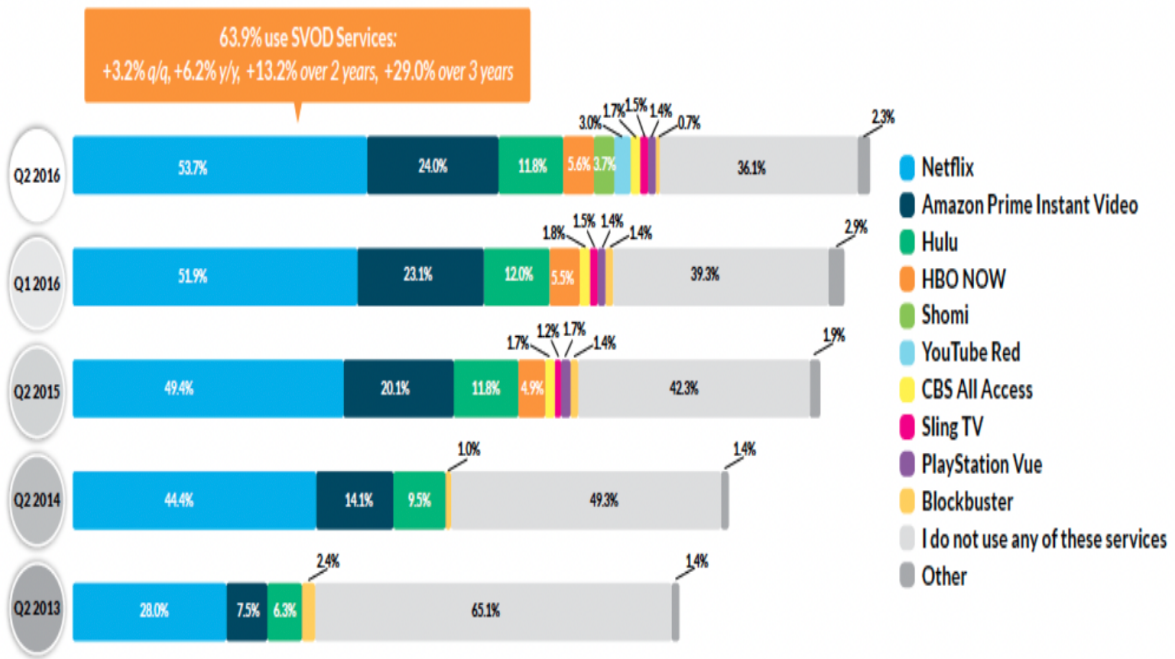

Figure 7 - Monthly subscription of OTT/SVOD services(Source)

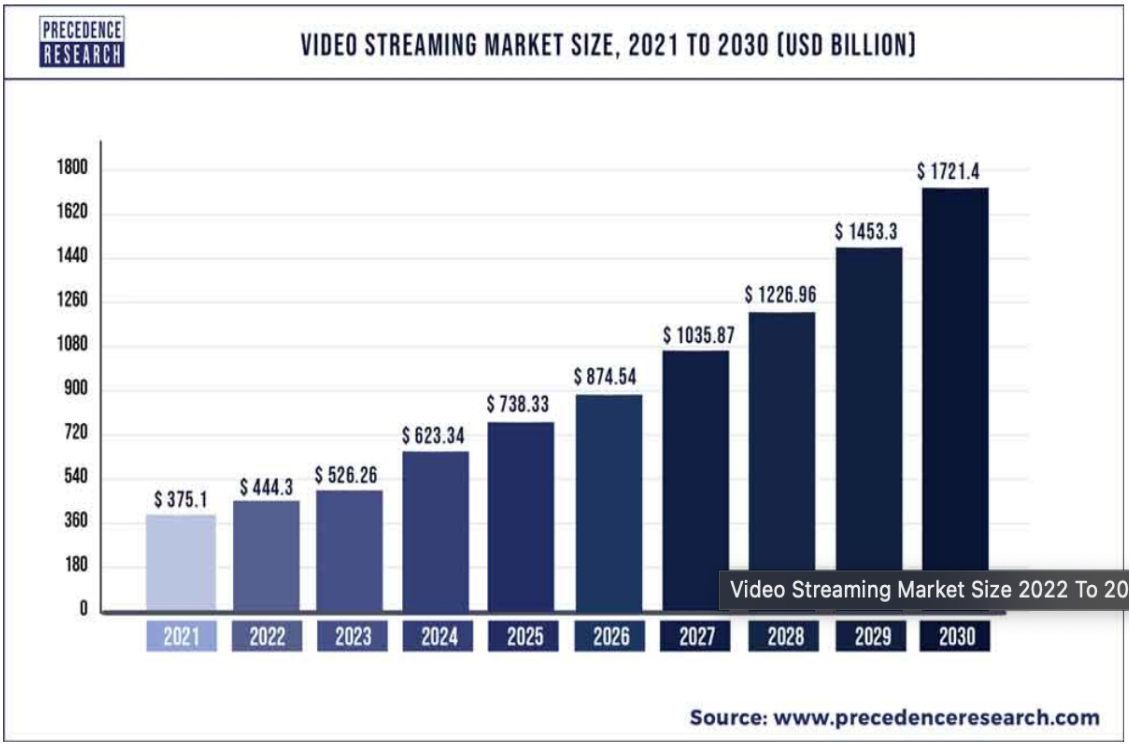

Figure 8 - Video Streaming Market Over the Years(Source)

7. Conclusion

The way people consume music has changed from attending live music venues to listening to records, cassettes, CDs and digital files. The market is currently dominated by digital music and streaming services. One of the biggest developments in the music industry to date is the advent of digital music. Thanks to digital music technology, consumers can now access millions of tracks from one place at low prices. Streaming acceptance has met with varying degrees of success. Hence, it can be concluded that the demand for streaming technology will increase in the future. As the demand for uninterrupted, seamless high-definition material increases, the future need for streaming technology is likely to increase. Many Internet multimedia applications, such as distance learning, digital libraries, online retail, and video on demand, rely heavily on streaming video. However, the design of streaming video systems faces many challenges due to the best-effort nature of the existing Internet. Building on Internet research, mobile multimedia apps have become the focus of modern Internet applications with the growth of streaming media technology and the development of mobile Internet and smartphones.

Acronyms

RoI – Return on Investment

QoS - Quality of Service

CODEC - Coder-Decoder

MPEG - Moving Picture Experts Group

RTSP - Real-Time Streaming Protocol

RTMP - Real-Time Messaging Protocol

VOD – Video On Demand

IEEE - Institute of Electrical and Electronics Engineers

ACM – Association for Computing Machinery

ETL – Extract, Transform, Load

CSV – Comma-separated Values

JSON – JavaScript Object Notation

PC – Personal Computer

PDA – Personal Digital Assistant

HLS – HTTP Live Streaming

CDN – Content Delivery Network

CSAI – Client-Side Ad Integration

HBO – Home Box Office

CD – Compact Disc

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