Live Streaming Platform

1. Requirement Gathering
    a. Functional
    b. Non-Functional
2. Process of Live Streaming
3. What are the technique we can use for live streaming.
4. while Network protocol is widely use
5. We can also talk about OSI model
6. HTML5 video player and why ?
7. We can talk about encoding, transcoding and CDN
8. Accessibility

Functional

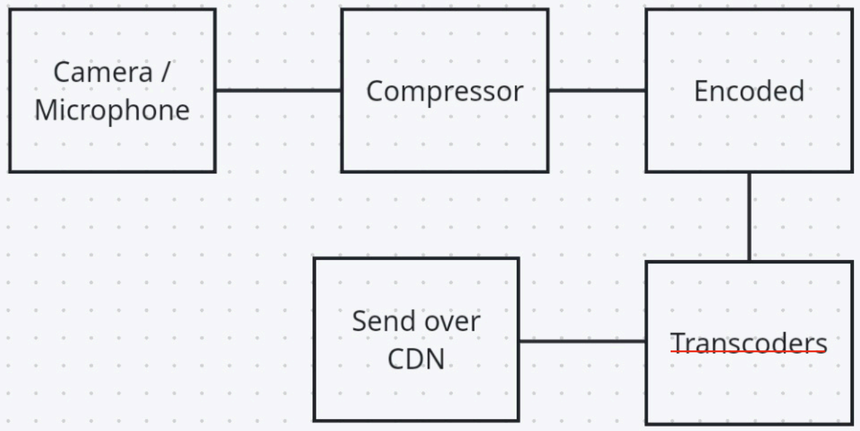
1. User should be able to see the video in application.
2. Latency should be very low
3. It should be secure.

Non-Functional

1. We can talk about WebVitals.
2. It should support variety of devices.
3. It should be responsive.
4. Localization / Internationalization

How Does Live Streaming Technology Work?

the streaming session starts with a video or audio input device capturing data. This is then compressed, encoded, segmented, and sent to a CDN for distribution.



RTMP is based on TCP protocol

1. Intiate connection in 3-way
2. It maintain the order
3. Congestion Control

Compressor

It compress the video files size get reduced and also maintain the quality

Encoder

It takes the video file and convert it into streamable format

RTMP
Real time messaging protocol

Streaming Server

CDN

HLS / DASH

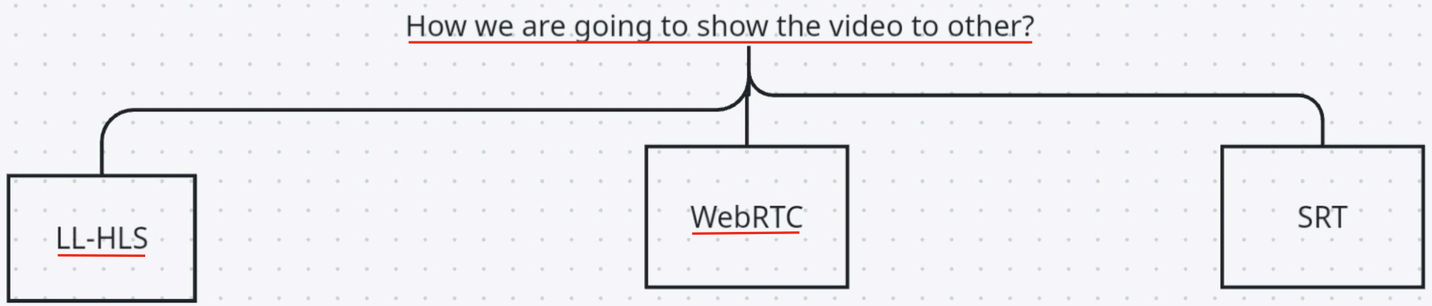
Transcoder

On the server, the incoming stream is **transcoded** into multiple resolutions (e.g., 1080p, 720p, 480p) to support adaptive bitrate streaming.

HLS - HTTP live streaming
DASH - dynamic adaptive streaming over http

Here is how the whole process works:

1. To capture the content, use a camera, microphone, or any other audio or video recording device.
2. The content is then sent to be compressed and encoded into a digital format that will be suitable for streaming.
3. If needed, a transcoder is used to transcode the content into multiple bitrates and resolutions before it's sent to a content delivery network (CDN) for distribution.
4. The CDN caches each data segment to prevent bottlenecks, saves streaming bandwidth, and then sends it to all users watching the stream.
5. When the user receives the stream, they access it through a media player on their device, which is almost always an HTML5 video player.
6. It decompresses, decodes, and converts the data back into video and audio information.



1. HLS - stand for HTTP live streaming
2. LL - low latency HLS
3. Breaks big video segments (6s) into **partial segments** (like 200ms–400ms).
4. Server pushes **partial video chunks** immediately.
5. Player can start playing **without waiting** for the full segment.
6. Using HTTP/2 protocol
7. It send chunks over the network, which handled at Application layers.

1. Designed for **real-time peer-to-peer communication**.
2. Very low latency, almost instant.
3. Mostly used for video calls.
4. It doesn't chunks the video.
5. It uses UDP protocol
6. It deals with packet, which handle over network layer.

1. SRT stand for secure reliable transport.
2. This is good for broadcasting.
3. Latency is around 2-3s.
4. It deals with packet, which handle over network layer.
5. It uses UDP protocol

✅ Proper way to explain Live Streaming Workflow:
"In a live streaming platform, the flow typically works like this:

STEP-1: Capture: The video is captured from a camera or webcam.

STEP2: Encoding: The raw video is compressed using a codec (e.g., H.264) to reduce size and make it streamable.

STEP-3: RTMP Upload: The encoded stream is sent to the streaming server using RTMP (Real-Time Messaging Protocol), which is based on TCP and is good for ingesting live video reliably.

STEP-4: Transcoding: On the server, the incoming stream is transcoded into multiple resolutions (e.g., 1080p, 720p, 480p) to support adaptive bitrate streaming.

STEP-5: Packaging: These variants are then packaged into HLS or DASH formats (which are chunk-based and use HTTP) for playback.

STEP-6: Delivery: Finally, the HLS/DASH segments are served via a CDN or origin server, and users fetch them over regular HTTP using their video players."

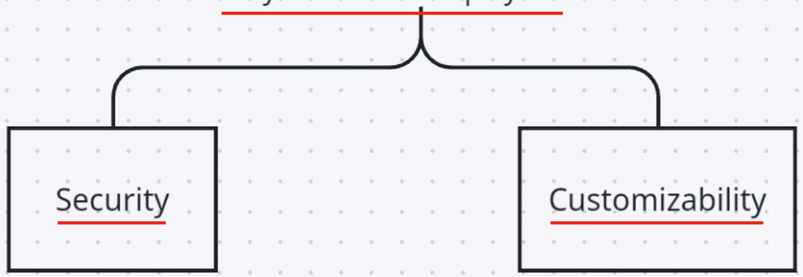
What is UPD ?

1. **UDP stands for user datagram protocol.**
2. It is a **transport layer protocol** (Layer 4 in OSI model).
3. Its main job: **Send data packets (datagrams) from one computer to another — FAST**.

OSI Model

1. Application Layer
2. Presentation Layer
3. Session Layer
4. Transport Layer
5. Network Layer
6. Data Link Layer
7. Physical Layer

Why HTML5 Video player ?



Because, It doesn't need any external plugins, So no one will interfare

It provides so many options like,

1. Muted
2. Loop
3. Height/Width we can change
4. We can add styles
5. Many other controls

What is Video Encoding ?

The RAW video files that cameras capture are very large and impossible to stream over the internet. Video encoders act as the “middleman” that solves this problem by converting these massive files into streamable digital files.

What is Video Transcoding ?

Video transcoding produces multiple renditions, or versions, of one video file in various qualities to enable multi-bitrate streaming. Many broadcasters prefer this streaming type because it allows users to access a rendition that works best for their internet connection.

What is a CDN (Content Delivery Network)?

A **CDN** is a **network of servers** that are **distributed across different locations** around the world to **deliver content faster** to users.

Suppose your website is hosted in **New York**, USA.
- A user from **India** visits it.
- Without a CDN: They must connect all the way to New York (slow!).
- With a CDN: They connect to a nearby **India CDN server** that has a cached copy of your website (fast!).