

HOW NETFLIX STREAMING WORKS

An Overview of Adaptive Streaming, Multi-Device Encoding, and Advanced Codecs



Requisites

- Global Accessibility: Serving diverse regions with varying internet speeds and device capabilities.
- Content Variety: Delivering everything from low-resolution mobile streams to high-definition and 4K Ultra HD content.
- Scalability: Ensuring uninterrupted service for millions of simultaneous users.
- Efficiency: Minimizing bandwidth usage while maintaining high video quality.



ADAPTIVE STREAMING

01

- Adaptive Streaming is a technology that optimizes the transmission of video and audio over the internet
- Automatically adjusts the content quality in real-time based on the user's connection speed and stability.

02

- The content (video/audio) is encoded at multiple quality levels and resolutions, creating multiple versions of the same content.
- These versions are divided into small chunks (e.g., 2-10 seconds long).

03

- A manifest or index file lists all available quality levels and URLs for the corresponding chunks
- The player's software analyzes the user's device capabilities, screen size, and current network conditions.
- It selects the highest-quality stream the network can handle without buffering.

CODECS

- Codecs (compressor-decompressors) are tools for encoding and decoding data, enabling efficient storage and transmission.
- Reduce file sizes while maintaining acceptable quality, balancing compression and fidelity.
- Types:
 1. Lossy - Compress data by discarding some information (e.g., MP3, JPEG).
 2. Lossless - Preserve all original data (e.g., FLAC, PNG).
- Used in audio, video, and image processing for streaming, storage, and transmission.

H.264

KEY ASPECTS

- Minimal computational requirements
- Most supported codec for video
- Reliable

LIMITATIONS

- Only up to 8-bit footage
- Less efficient
- Higher data usage to maintain quality

H.265 (HEVC)

KEY ASPECTS

- 50% bitrate savings compared to H.264
- Higher quality
- Optimized streaming performance
- 4K playback support

LIMITATIONS

- High licensing costs
- Higher computational requirements
- Reduced compatibility
- Leads Netflix to rely on other codecs



AV1

KEY ASPECTS

- Latest codec in Netflix's lineup
- Up to 30% better efficiency than HEVC
- Open-source
- Beneficial in low-bandwidth environments

LIMITATIONS

- Higher computational requirements
- Lack of support on older equipments



AV1

CHALLENGES

- What's the best AV1 encoding recipe?
- How do they guarantee smooth playback on TVs?
- How do they deploy AV1 encoding at Netflix scale?
- How do they continuously monitor AV1 streaming?



PRE-PROCESSING

MULTI-RESOLUTION ENCODING

- Scales videos to SD, HD, 4K resolutions
- Enables adaptive streaming for optimal quality on any device

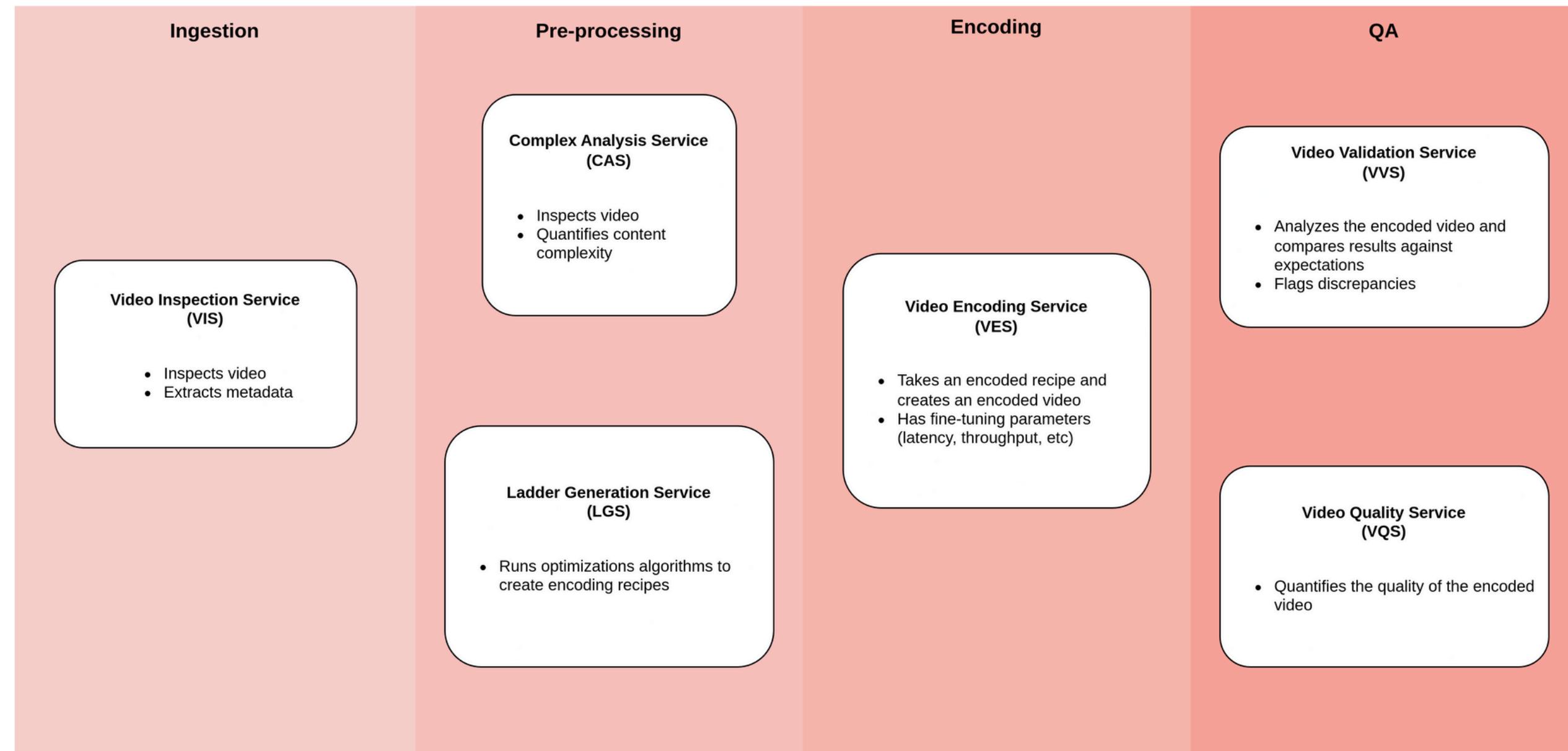
PER-TITLE ENCODING

- Customizes encoding settings for each title
- Accounts for content type (animation vs. live-action)
- Delivers better quality for complex content at lower bitrates

PER-CHUNK OPTIMIZATION

- Analyzes each chunk to determine optimal encoding parameters
- Creates unique bitrate ladders for each chunk

PROCESSING PIPELINE



REFERENCES

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THANK YOU