

# H.265 (HEVC): OVERVIEW OF H.265 AND ITS IMPROVEMENTS OVER H.264

Information and Coding

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# Overview

- 01 Introduction to H.264 and H.265
- 02 Technical Improvements in H.265
- 03 Compression Efficiency and Quality
- 04 Technical Details on Encoding/Decoding
- 05 Use Cases and Benefits (4K, HDR)
- 06 Challenges and Considerations





# What are H.264 and H.265 codecs?

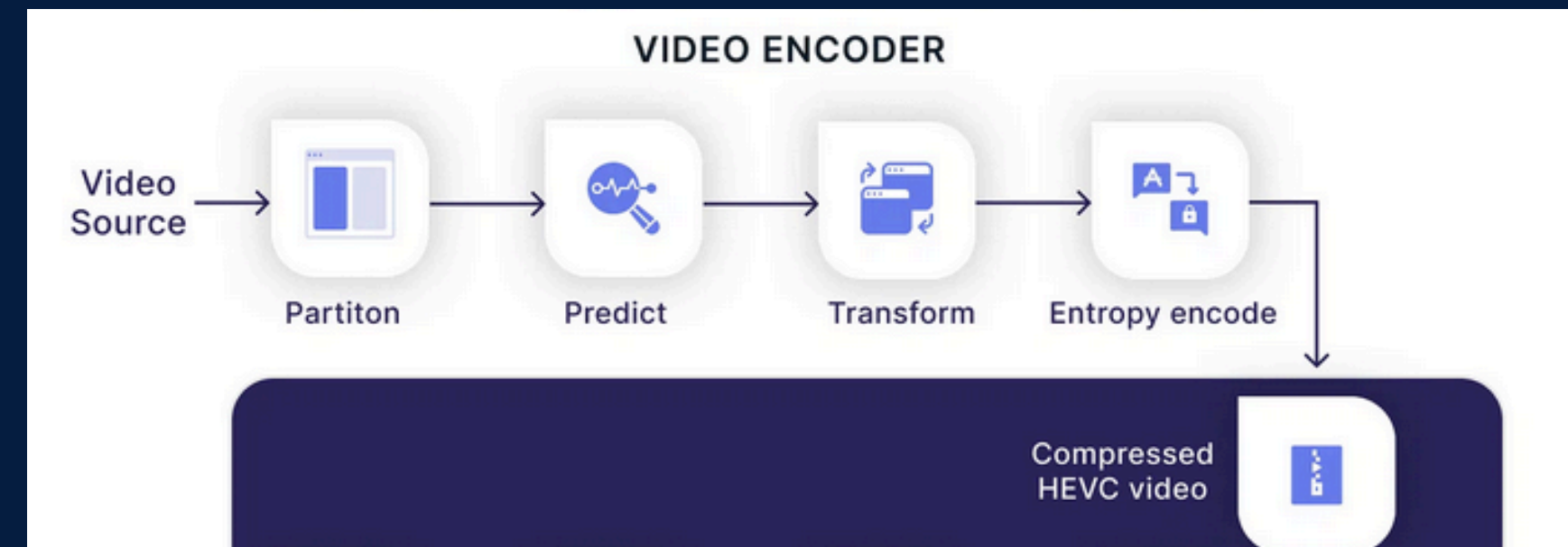
H.264 is one of the most widely used codecs for video compression. It's commonly used for Blu-ray Discs, online streaming platforms like YouTube, and video conferencing.

H.265 is the successor of H.264. It offers improved compression efficiency, allowing it to maintain high quality at half the bitrate required by H.264.

# How H.265 works

## H.265 encoder

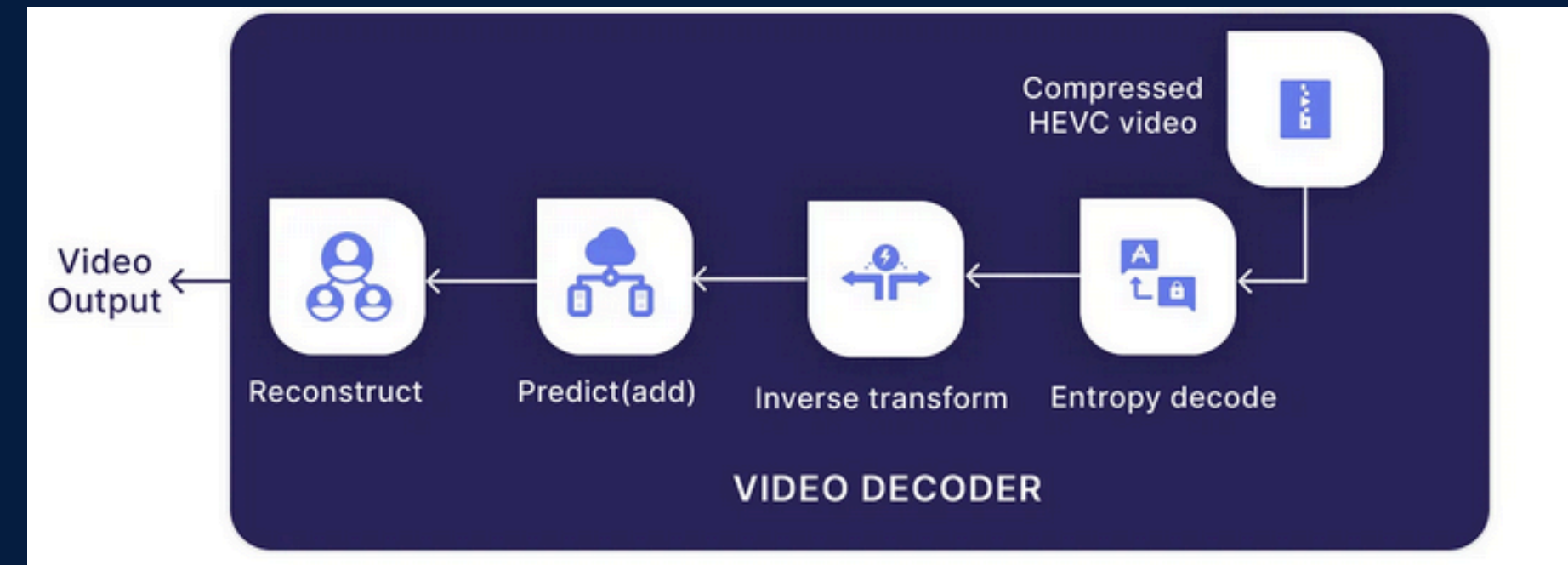
- 01** Splits the image into blocks.
- 02** Forms a prediction from the current frame or previously transmitted frames
- 03** Quantization and transforms the residual, using an approximate form of Discrete Cosine Transform (DCT), which outputs a set of coefficients relating to the weighting value of basic patterns. The initial residual is then combined.
- 04** Entropy encoding of the transformed output, mode information, prediction information, and headers.



# How H.265 works

## H.265 decoder

- 01** Entropy decoding - extracting the original elements from the sequence that was coded.
- 02** Inverting the transformations and rescaling.
- 03** Predicting each unit and adding it to the output of the inverse transform
- 04** Reconstructing the final decoded video image.



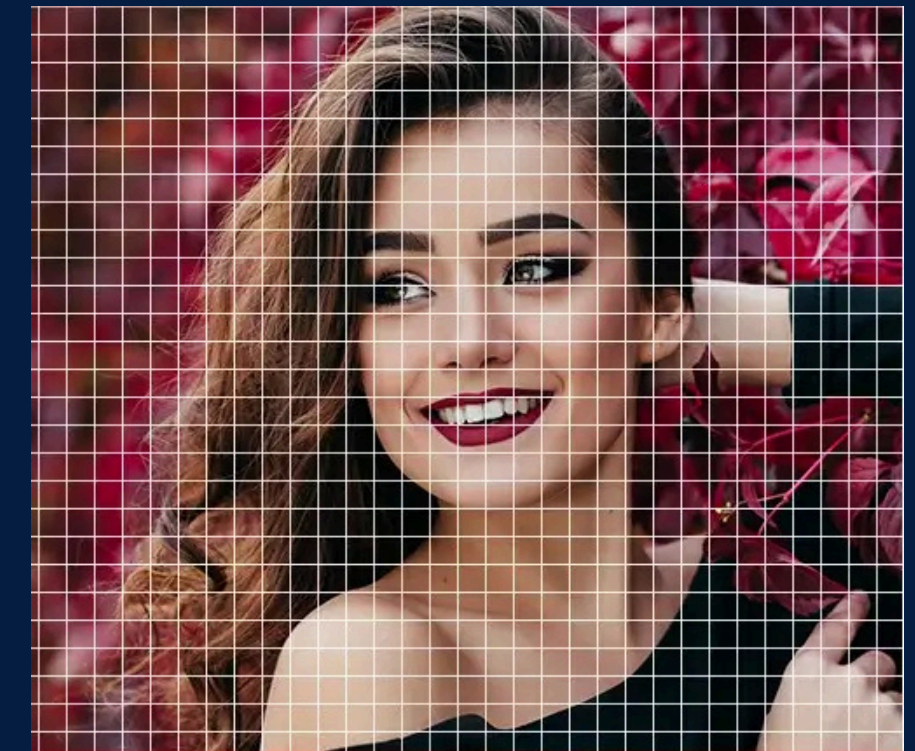
# Compression and Block Partitioning

## Macroblocks (H.264)

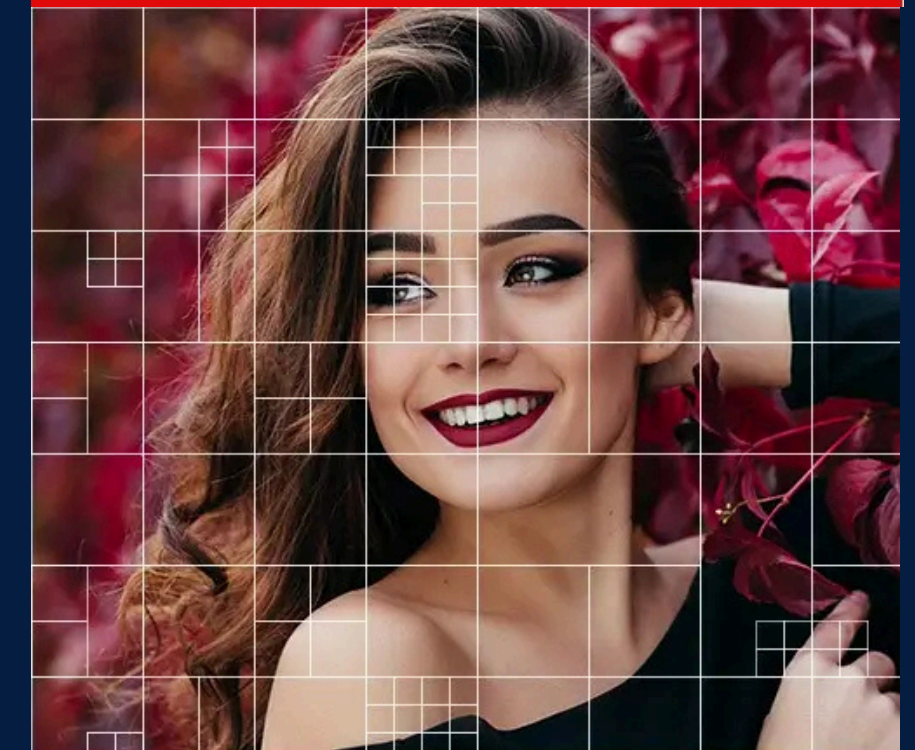
- Fixed size of 16x16 pixels
- Smaller, more granular units for processing video frames
- Less efficient for high-resolution or complex scenes

## Coding Tree Units (H.265)

- Larger and adjustable size up to 64x64 pixels
- More flexible and efficient for various resolutions and content types
- Allow for better compression of high-resolution videos and complex scenes



**H.264 (AVC)**  
Macroblocks up to 16x16 px



**H.265 (HEVC)**  
CTUs up to 64x64 px



# Quality comparison



**H.264 (AVC)**  
**@ 2.5 MBPS**



**H.265 (HEVC)**  
**@ 2.5 MBPS**

# Bandwidth and Storage Savings

## Bandwidth Savings

H.265 offers the same video quality as H.264 but at roughly half the bitrate.

This translates to reduced bandwidth consumption, making streaming smoother and more accessible.

	H.264 (AVC)	H.265 (HEVC)
Recommended bandwidth for video encoding	480p — 1.5 Mbps	480p — 0.75 Mbps
	720p — 3 mpbs	720p — 1.5 mpbs
	1080p — 6 Mbps	1080p — 4 Mbps
	4K — 32 mbps	4K — 15 mbps

## Storage Efficiency

Videos encoded with H.265 occupy significantly less storage space due to improved compression.

Aspect	H.264 (AVC)	HEVC (H.265)
File Size	~20 GB for 2-hour 4K movie	~10 GB for 2-hour 4K movie
Quality	Good quality; some artifacts in high-motion scenes	Better quality; fewer artifacts in high-motion scenes



# Real-World Applications

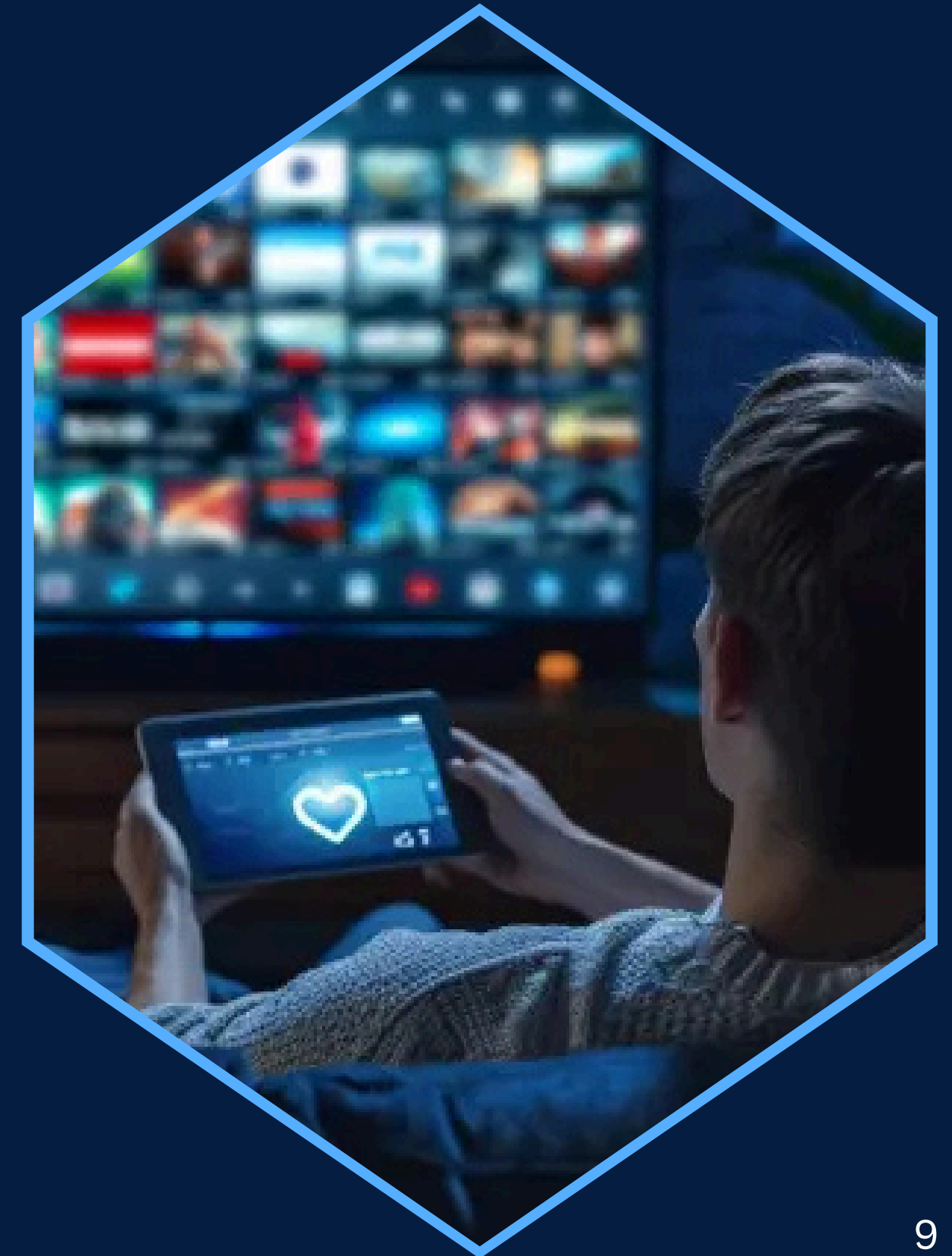
**Netflix**

**Youtube**

Benefit from H.265 due to lower bandwidth requirements

Many broadcasters are moving to H.265 for efficient 4K content distribution and better HDR support by supporting 10-bit color depth

Improved compression makes H.265 suitable for video conferencing apps and surveillance systems where bandwidth is limited.



# Challenges with H.265

- 01** Licensing Costs: Unlike H.264, H.265 has higher licensing costs, which has slowed its adoption in some markets
- 02** Encoding Complexity: Encoding with H.265 requires significantly more processing power compared to H.264, which means higher computational costs
- 03** Trade-Off: These limitations are balanced by the benefits of reduced storage and bandwidth.

# Market Analysis

This representation illustrates the transition from H.264 dominance to H.265 becoming the preferred codec over time. The actual adoption rates varied across industries and applications, but this gives a general idea of how the transition occurred.

Year	H.264 Adoption	H.265 Adoption
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2003	Introduced	N/A
2005	Growing	N/A
2007	Widely Adopted	N/A
2009	Dominant	N/A
2011	Near Universal	N/A
2013	Peak	Emerging
2015	Plateau	Rapid Growth
2017	Slow Decline	Widespread
2019	Legacy Status	Dominant
2021	Niche Uses	Near Universal



# H.264 VS H.265

Feature	H.264 (AVC)	HEVC (H.265)
Release Year	2003	2013
Compression Efficiency	Good	Better, ~50% more efficient than H.264
Block Size	16x16 pixels	Up to 64x64 pixels
Motion Compensation	Block-based, variable sizes	Larger blocks, advanced techniques
Entropy Coding	CAVLC, CABAC	CABAC, more advanced
Parallel Processing	Limited support	Better support
HDR Support	Basic	Improved
Hardware Support	Extensive, almost universal	Good, but not universal
Licensing Costs	Moderate	High, multiple patent pools

# Conclusion

- H.265 provides significant advances over H.264 in compression and efficiency.
- Offers the same video quality as H.264 at roughly half the bitrate.
- Supports higher resolutions (4K and 8K) and features like HDR for improved quality.
- Challenges include higher licensing costs and increased computational complexity.
- Impact on the Industry
- Future of Video Compression

# Closing thought

"Is H.265 ready to be the dominant codec in a future driven by 8K content and augmented reality?"

