



Prepared by group 8

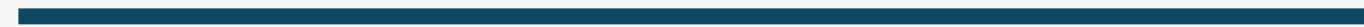
HEIF

HEIF (High Efficiency Image Format): How HEIF works, its use of HEVC compression for images, and its applications in mobile photography and storage efficiency.

15 February, 2024



Introduction



The High Efficiency Image Format (HEIF) is an efficient image format based on the High Efficiency Video Coding (HEVC) standard. It uses intra-frame compression to reduce file sizes while maintaining image quality. HEIF supports storing single images, image sequences, and additional data like thumbnails or captions in a compact container format.



ISOBMFF

The ISO Base Media File Format is the foundation of HEIF. Its box-based structure stores data hierarchically and has the following characteristics:

- **Modularity:** Separates storage for image data, metadata, and auxiliary data.
- **Flexibility:** Supports single images, sequences, and complex metadata for features like HDR, non-destructive edits, and AR.
- **Efficiency:** Avoids redundancy by referencing shared data instead of duplicating it, resulting in smaller file sizes.
- **Extensibility:** New features can be added without breaking compatibility, ensuring future adaptability.
- **Fast Access:** Specific data, like thumbnails or metadata, can be retrieved without scanning the entire file.



HEVC (H.265 / MPEG-H Part 2)

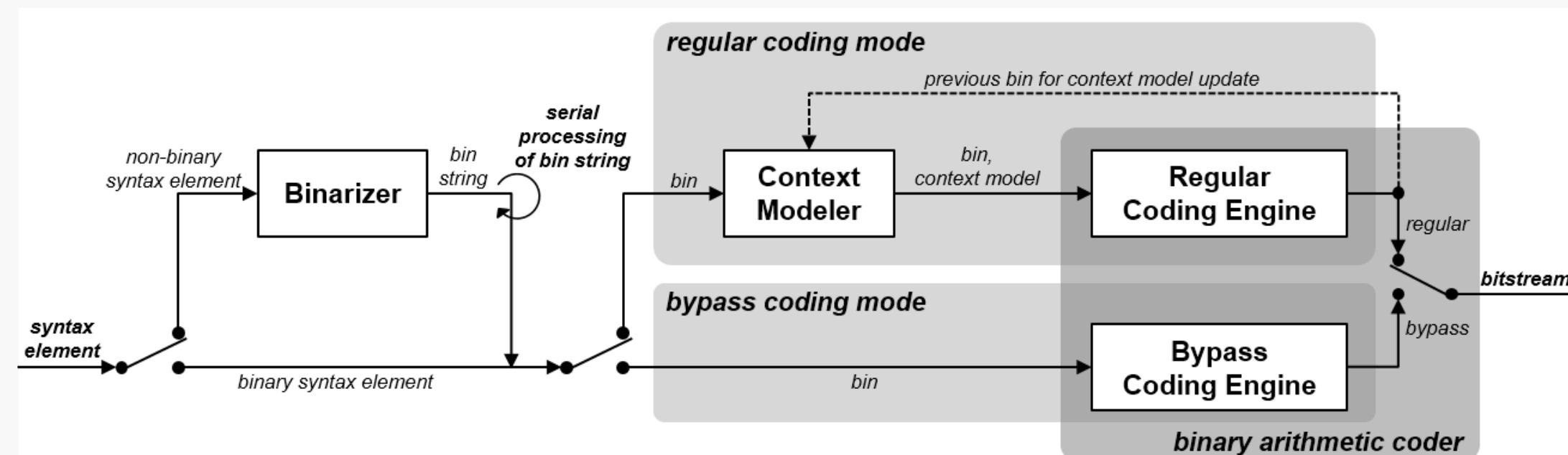
Application in still images

- **HEVC's Block-Based Structure for Compression**
 - Enabling more efficient representation of both large flat areas and detailed textures.
- **Intra-Prediction within HEVC for Still Images**
 - For images, intra-prediction works by analyzing color and brightness gradients in neighboring pixels.
 - HEVC offers up to 35 intra-prediction modes, such as:
 - Planar mode
 - DC mode
 - Directional mode
- **Transform and Quantization**
 - HEVC applies a transform (often a discrete cosine transform) to residuals, converting spatial data into frequency components, which are then quantized to reduce file size.

HEVC

The techniques it uses

- **Entropy Coding Techniques (CABAC)**
 - An advanced entropy coding technique that compresses data more efficiently than traditional methods like Huffman coding by exploiting context and probability in binary encoding.
- **Support for Lossy and Lossless Compression**
- **Advanced Features in HEVC Used by HEIF for Improved Image Quality**
 - HEVC in HEIF leverages advanced compression features like flexible prediction modes and block partitioning, optimizing image quality and file size.



HEVC

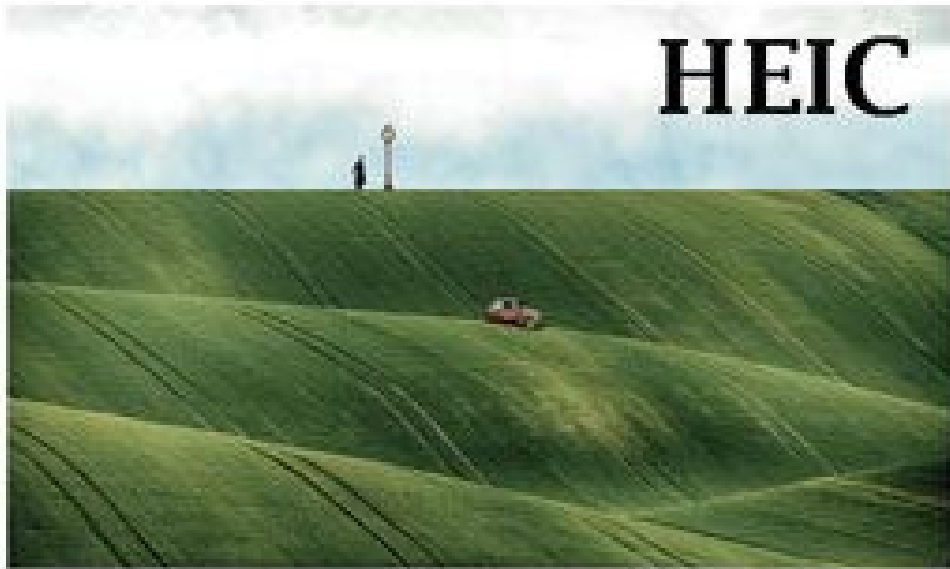
Significant contribution to storage and quality

- **HEVC for Image Sequences and Burst Photos**
 - HEVC in HEIF allows for efficient storage of burst photo sequences and image sequences, making it ideal for mobile photography and live photo features.
- **High Compression Efficiency for Mobile and Cloud Applications**
 - High compression efficiency reduces storage and bandwidth requirements, which is critical for cloud-based services and mobile devices with limited storage.
- **Support For HDR (High Dynamic Range) and WCG (Wide Color Gamut)**

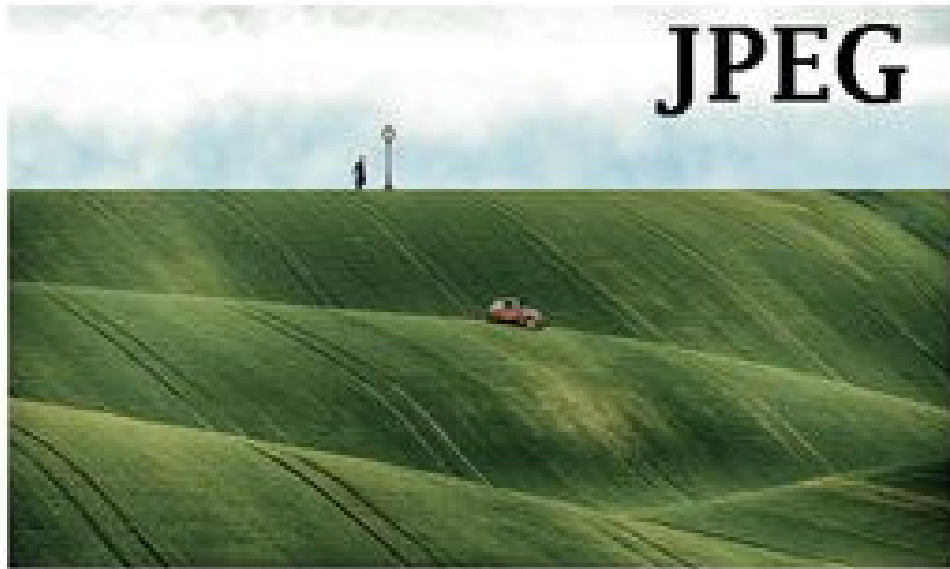


HEVC

Comparison: HEVC in HEIF vs. JPEG



130 KB



217 KB

- JPEG: larger file sizes and visible artifacts, especially under high compression.
- HEIC: up to 50% more compact files with higher image quality.

| Feature | JPEG | HEVC in HEIF |
|------------------------|-------------------------------|---|
| Compression Efficiency | Moderate, less efficient | High compression efficiency |
| Image Quality | Limited, visible artifacts | Higher quality, fewer artifacts |
| Block Size | Fixed 8x8 blocks | Variable block size (4x4 to 64x64) |
| Prediction | Simple DC and AC coefficients | Advanced intra-prediction with 35 modes |
| HDR and WCG Support | Limited | Full HDR and WCG support |
| Entropy Coding | Huffman Coding | CABAC, more efficient |
| Use of Animation | Not supported | Supported, with efficient storage for sequences |

Applications

Mobile photography and storage efficiency

Saving Storage Space Without Losing Quality:

- Photos have smaller file sizes compared to JPEG
- They keep the same, or even better, quality.

Improved Image Quality and Vivid Colors:

- HEIF supports 10-bit color (compared to 8-bit for JPEG).
- Photos look richer, with smoother color gradients and less banding, especially for HDR images.

Mobile photography and storage efficiency

Non-Destructive Editing:

- Edits like cropping, color adjustments, or filters can be saved as separate layers without altering the original image data.

Support for Animated Sequences and Bursts:

- HEIF supports image sequences and animations like burst photos and GIF-like animations.
- It saves those sequences in a single file and by using the HVEC, the file size is much smaller than a standard GIF file, retaining the same quality.

Mobile photography and storage efficiency

Support for Multi-Image Formats:

- Capable of storing both the still image and the short video clip captured before and after the photo in a single file.
- Used in features like Live Photos (Apple) and Motion Photos (Google) to enhance how you can view and share memories.

Depth Map Storage for Portrait Mode and Effects:

- HEIF can store depth information along with the image.
- This depth data can be used for post-processing effects, like:
 - adjusting the background blur intensity
 - applying different effects to the foreground and background (even after taking the photo).
- Used essentially for features like Portrait Mode or background blurring.

Mobile photography and storage efficiency

Faster Sharing and Uploading:

- Since HEIF files are smaller, uploading or sharing photos from a mobile device is quicker and uses less data.

Compatibility with Augmented Reality (AR) and 3D Imaging:

- HEIF's ability to store additional data layers, like depth and multi-angle views, makes it a great fit for AR applications.
- Example:
 - a HEIF image that contains depth information can be used in AR apps to apply 3D effects or for realistic object placement in the image, all from within a single photo file.

Conclusion

- HEIF is more efficient than JPEG
- It combines great image quality with smaller file sizes, making it perfect for modern devices and workflows.
- HEIF's capabilities extend far beyond simple photo storage.
- It's support for animations, depth maps, HDR, and AR applications makes it a powerful format for today's multimedia demands.



Thank you

