Introducing HEIF and HEVC

Session 503

Gavin Thomson, Photos Manager
Athar Shah, CoreMedia Manager

It’s happening!

Media today

HEVC

HEIF

Ecosystem adoption and best practices

Media today

HEVC

HEIF

Ecosystem adoption and best practices

Today’s Environment

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Proliferation of movie and image assets (capture, cloud storage, sharing, etc.)

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Higher resolution and frame rate content (4K and beyond)

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H.264 and JPEG are limiting

Media today

HEVC

HEIF

Ecosystem adoption and best practices

HEVC (High Efficiency Video Coding)

Standardized and approved by ITU-T in 2013

- ISO/IEC: MPEG-H Part 2
- ITU-T: H.265

Follow on to H.264

Delivers significant compression improvement over H.264

Adopted in the industry

HEVC Coding Improvements

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	H.264	HEVC

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Coding Block	MB: 16x16	CTU: 64/32/16/8, quad-tree

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Transform	8x8 or 4x4 DCT	32/16/8/4, DCT/DST

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Intra Prediction Directional Modes	Up to 9	Up to 35

HEVC Coding Improvements

		H.264	HEVC
Coding Block		MB: 16x16	CTU: 64/32/16/8, quad-tree
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Inter	luma half-pel	6-tap filter	8-tap filter
	luma quarter-pel	Bilinear	7-tap filter
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Inter	luma half-pel	6-tap filter	8-tap filter
	luma quarter-pel	Bilinear	7-tap filter
	chroma sub-pel	Bilinear	4-tap filter
Loop Filter		Deblocking	Deblocking, SAO

Up to 40%

Better compression than H.264 in general use case

Up to 2x

Better compression than H.264 in iOS camera capture

Apple HEVC Support

Apple HEVC Support

Profiles	Main, Main Still Picture, Main 10

Apple HEVC Support

Profiles	Main, Main Still Picture, Main 10
Codec Type	hvc1

Apple HEVC Support

Profiles	Main, Main Still Picture, Main 10
Codec Type	hvc1
File Formats	QuickTime Movie (.mov), ISO MPEG-4 (.mp4)

Benefits of HEVC

Industry and Apple support

Works with industry file formats

Ideal codec for movie and photo compression

Media today

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Ecosystem adoption and best practices

Key Requirements for New Image File Format

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Compression codec support (HEVC in particular)

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Alpha channel and depth support

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Animation support (animated GIF, Live Photo)

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Partitioning of image into rectangular tiles

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ISO standard: ISO/IEC 23008-12 (June 2015)

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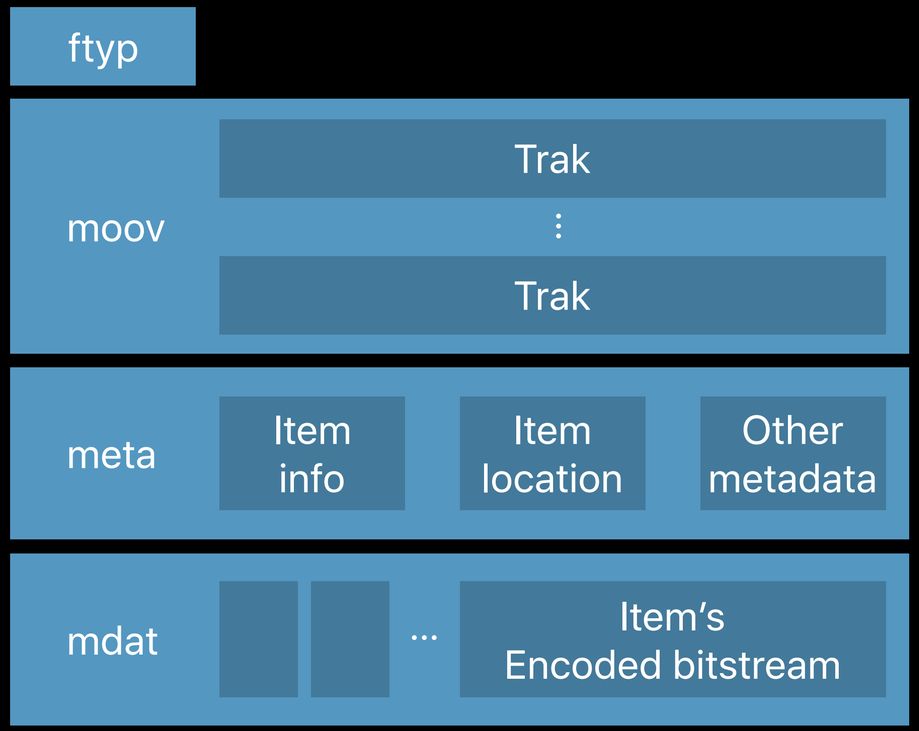
Container format based on ISO Base Media File Format



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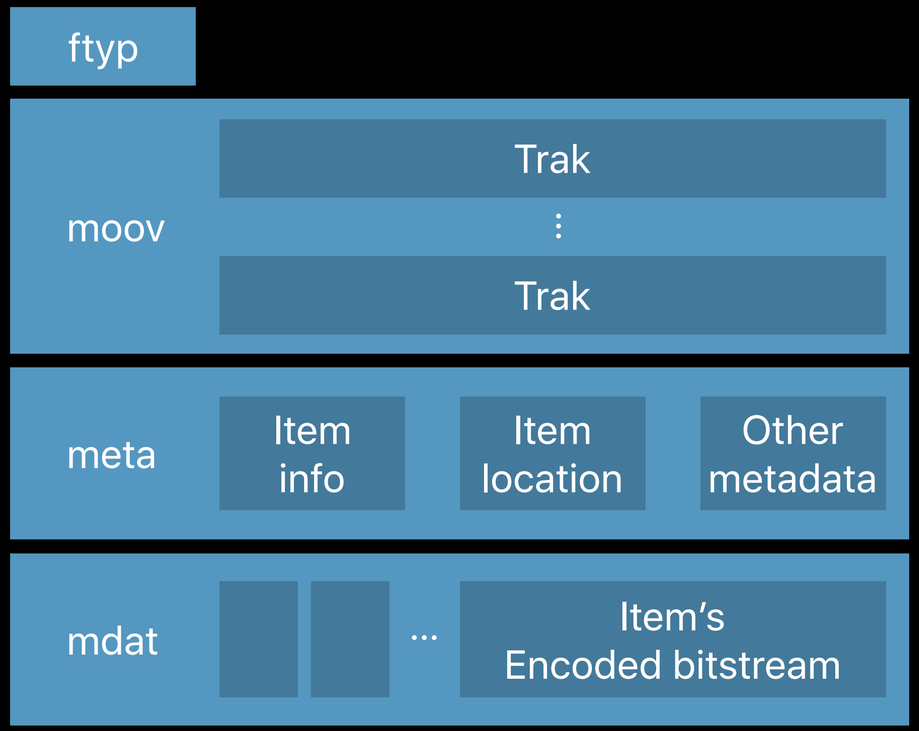
Supports individual images and sequences



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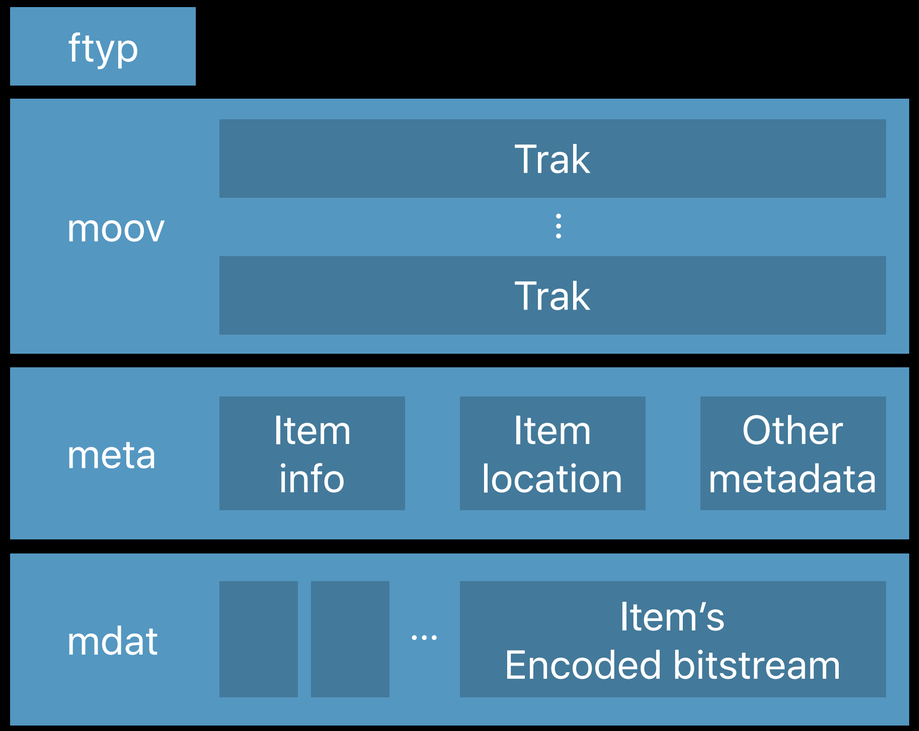

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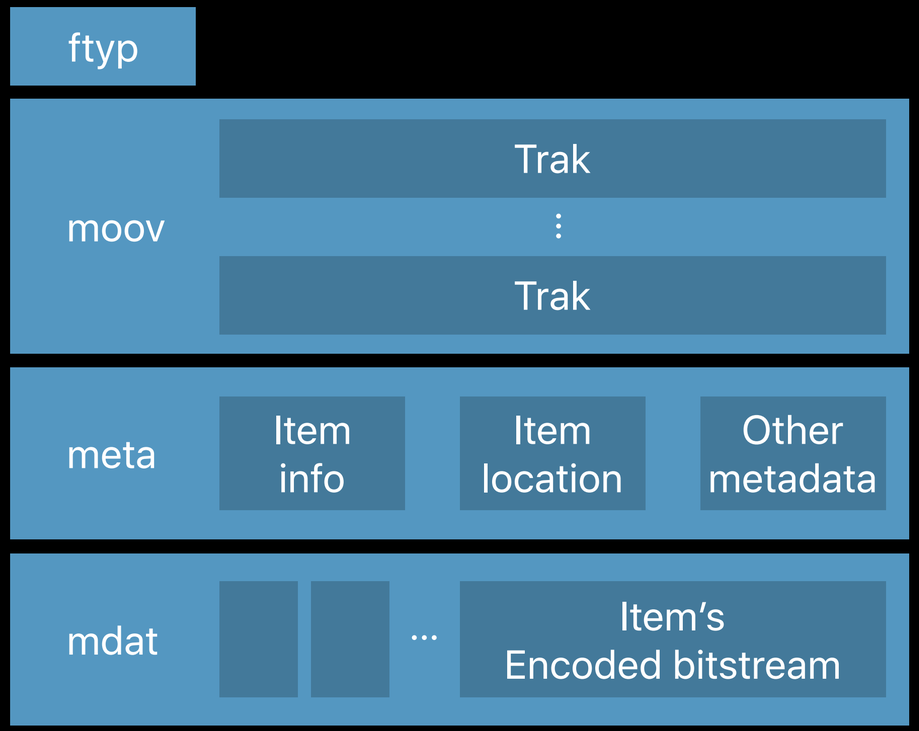
Typically uses HEVC for compression



Up to 2x

Better compression than JPEG

HEIF File Extension

Payload	Extension
HEVC	.heic
H.264	.avci
any codec	.heif

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HEIF/HEVC Ecosystem

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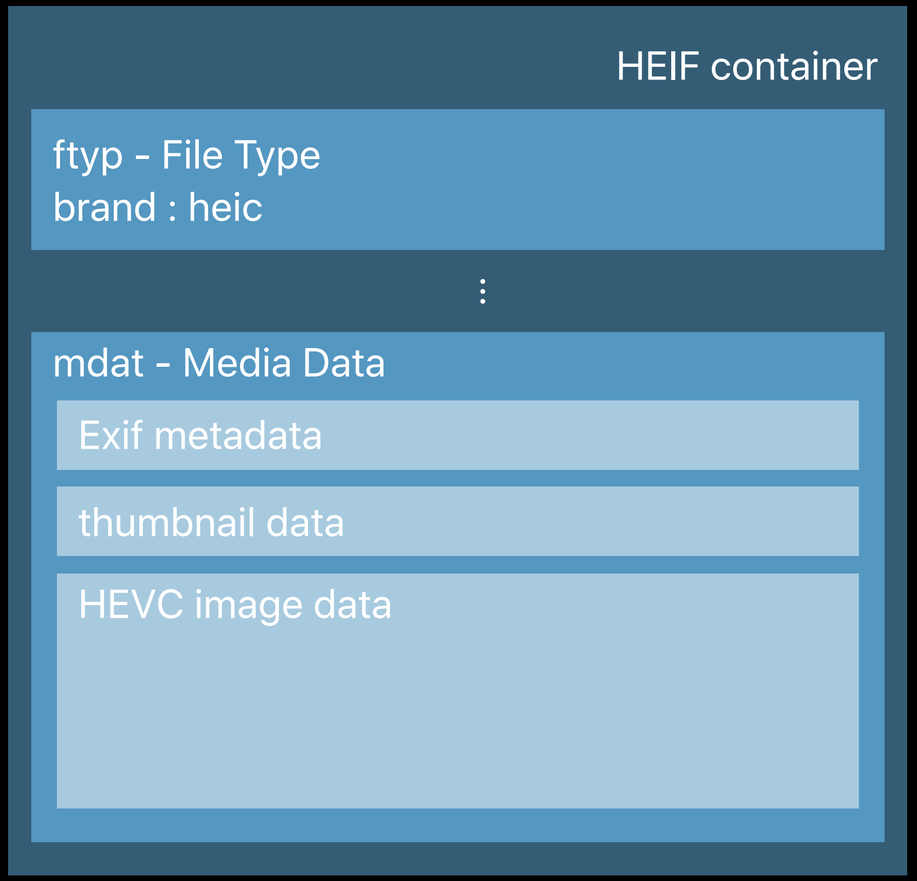
Apple HEIF

Characteristics of Apple-generated HEIF images



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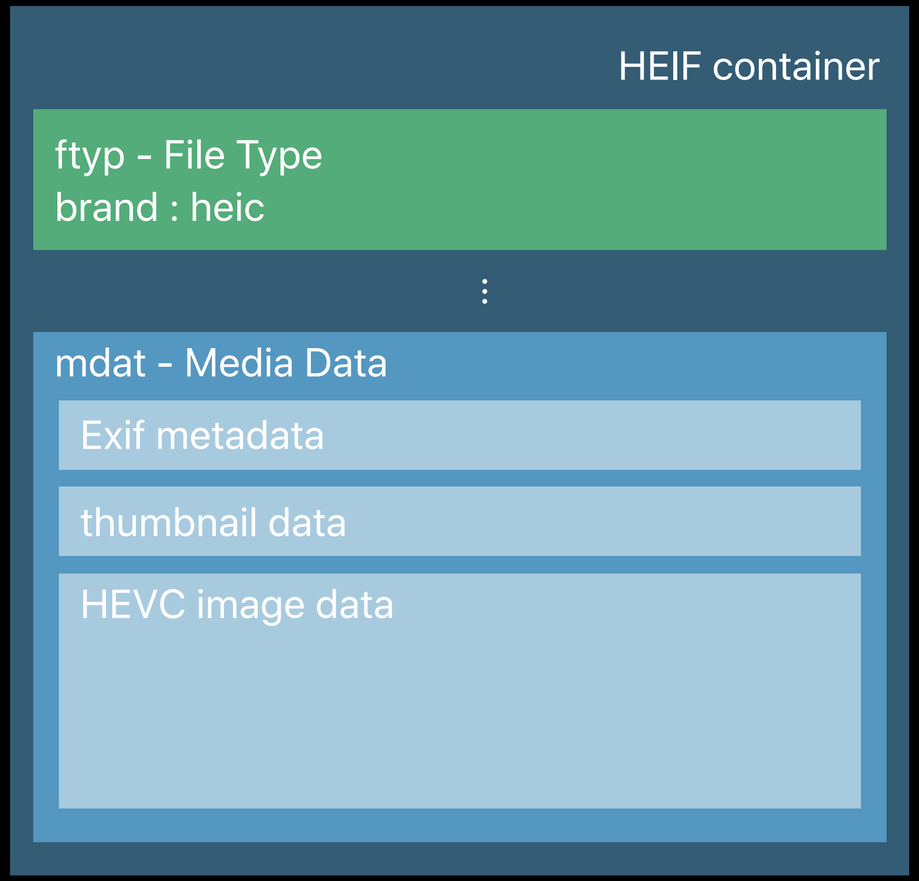
ISO base media file format



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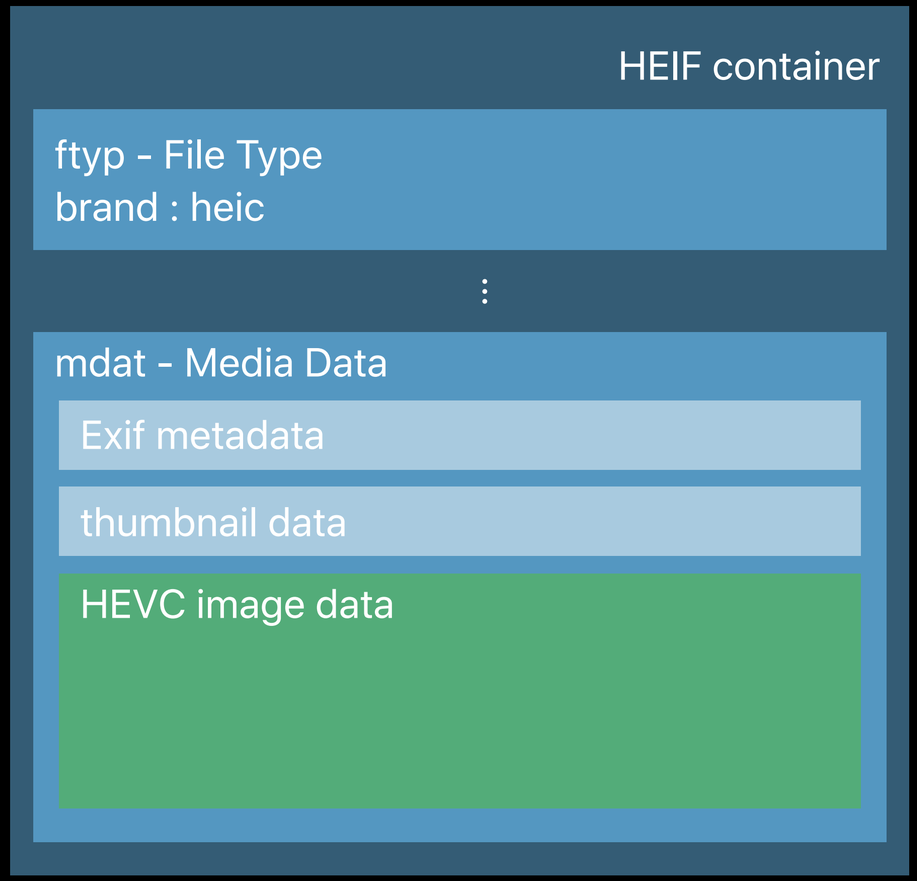
ISO base media file format

HEVC coded images



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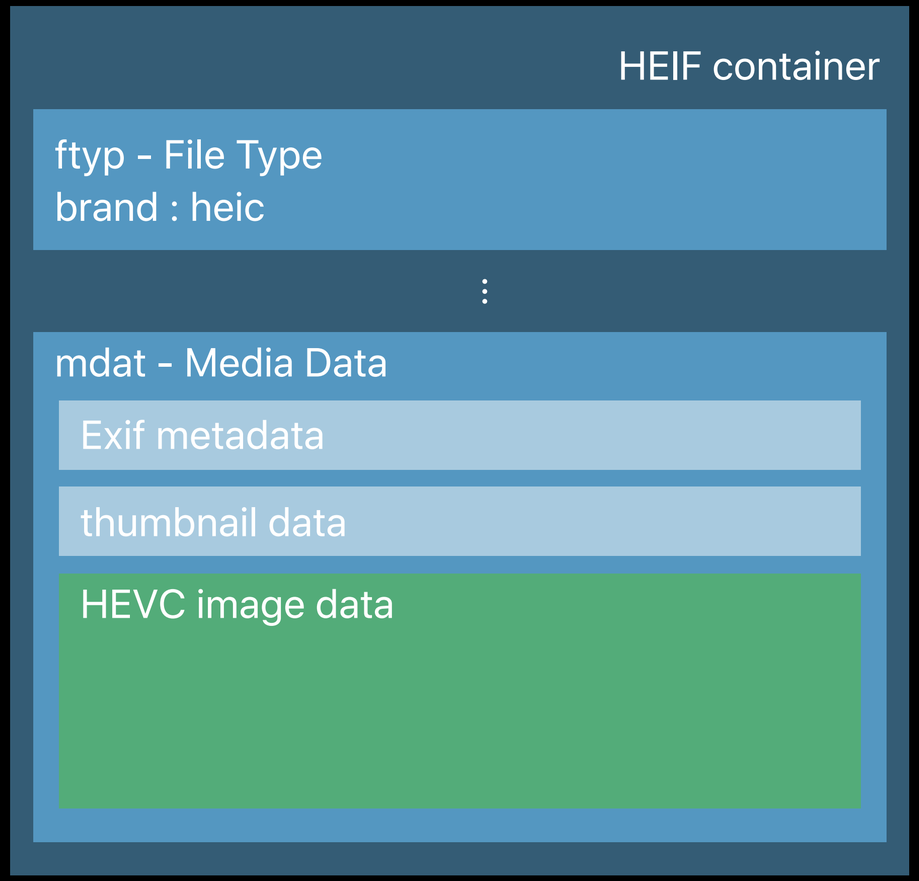
ISO base media file format

HEVC coded images

Encoded as tiles



Apple HEIF

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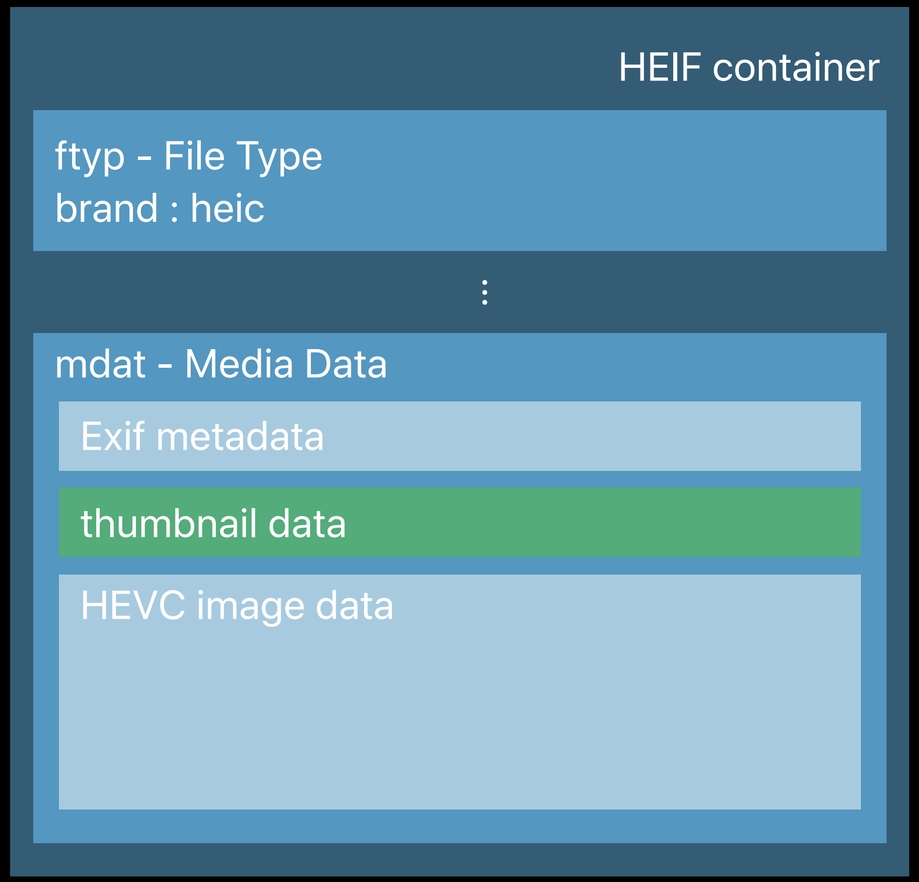
ISO base media file format

HEVC coded images

Encoded as tiles

320 x 240 embedded thumbnail



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ISO base media file format

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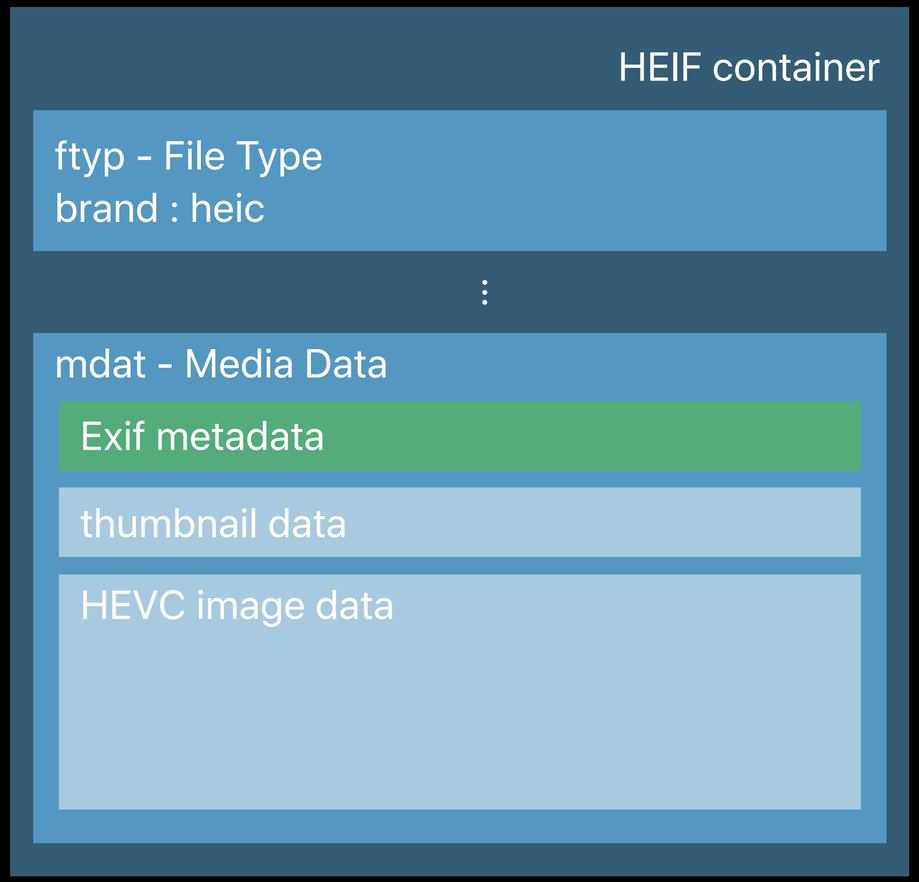
Encoded as tiles

320 x 240 embedded thumbnail

Exif image metadata



Apple HEIF

Characteristics of Apple-generated HEIF images

ISO base media file format

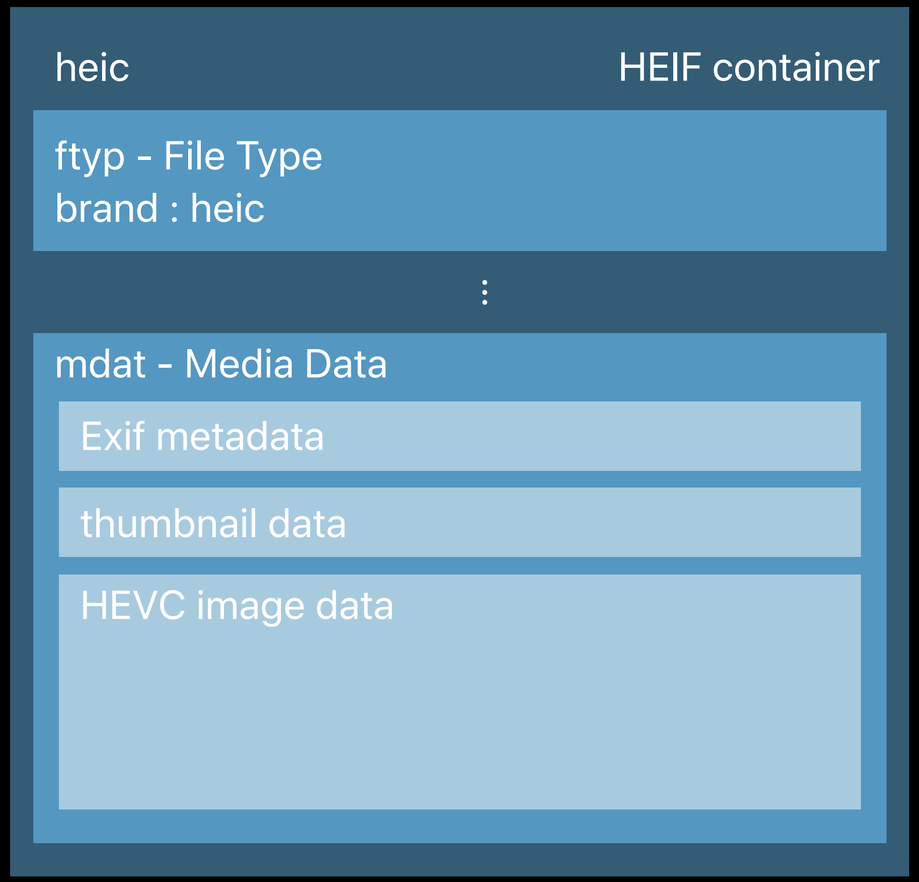
HEVC coded images

Encoded as tiles

320 x 240 embedded thumbnail

Exif image metadata

"heic" file extension



HEIF Image Decode Support

Minimum configurations

	iOS	macOS
Hardware Decode	A9 Chip	6th Generation Intel Core
Software Decode	All iOS Devices	All Macs

Accessing HEIF

HEIF image support

Accessing HEIF

HEIF image support

ImageIO—supported image source

Accessing HEIF

HEIF image support

ImageIO—supported image source

Core Image—supported image source

Accessing HEIF

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PhotoKit—image, resources, and edit

Accessing HEIF

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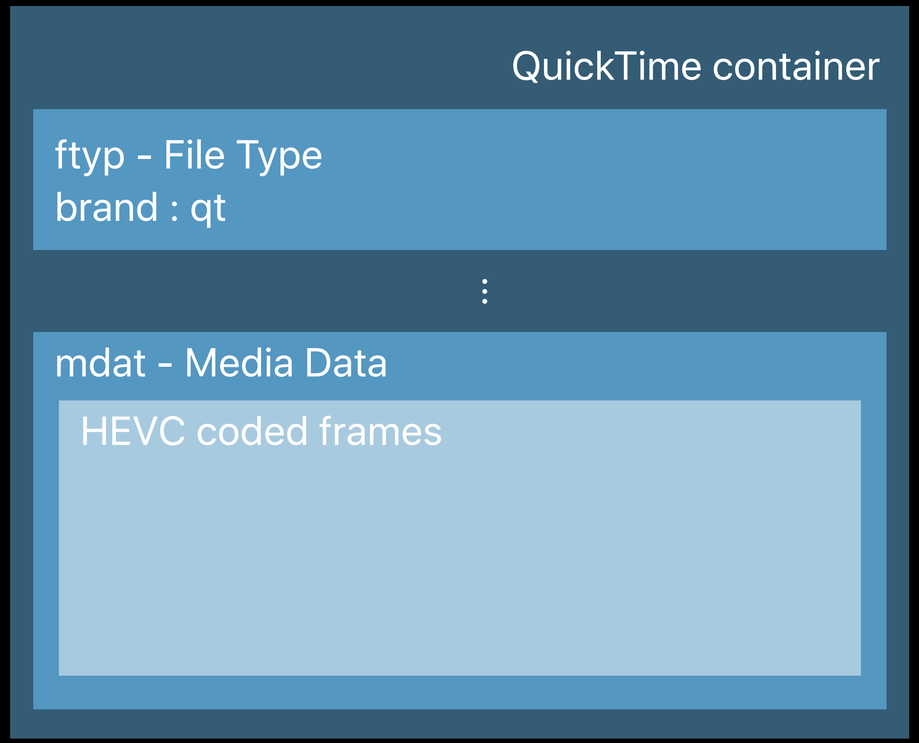
Apple applications

Apple HEVC

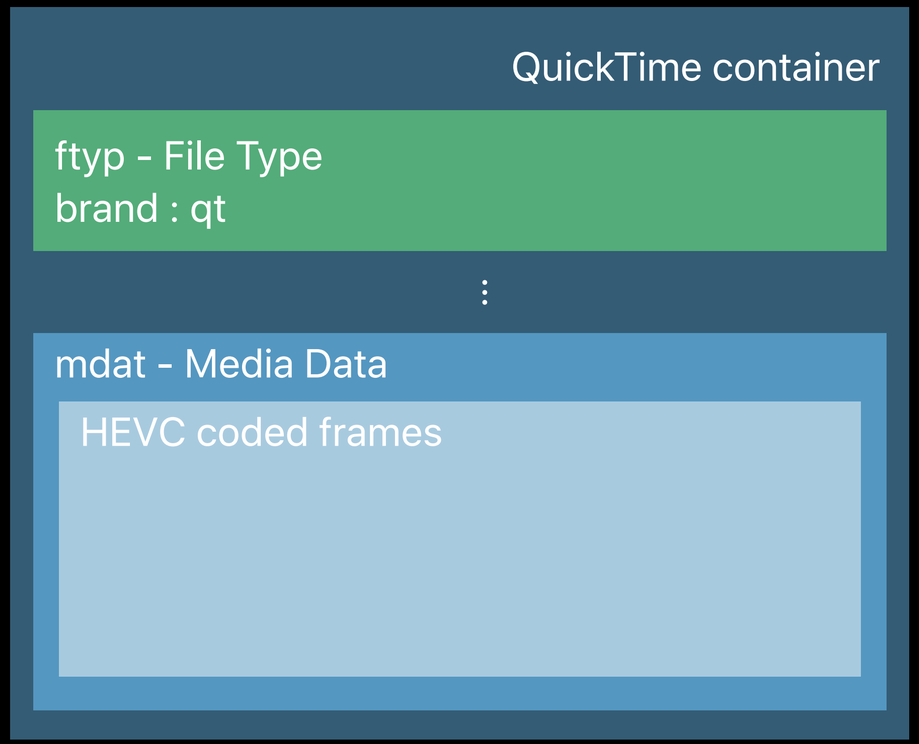
Characteristics of Apple-captured HEVC movie



Apple HEVC

Characteristics of Apple-captured HEVC movie

QuickTime movie file format



Apple HEVC

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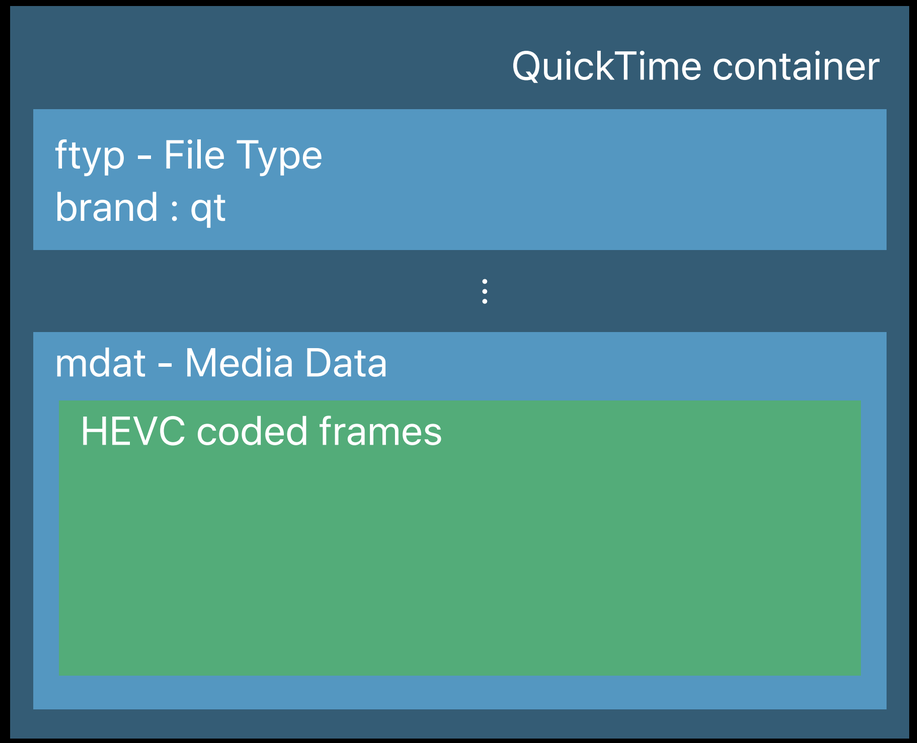
QuickTime movie file format

HEVC coded video frames



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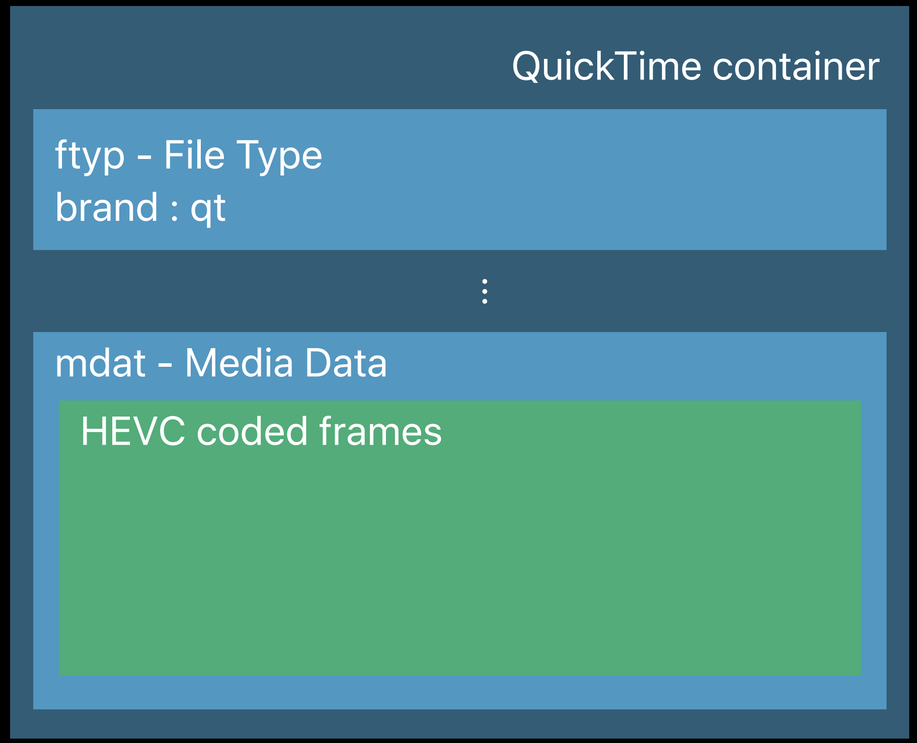
HEVC coded video frames

8- and 10-bit encoding



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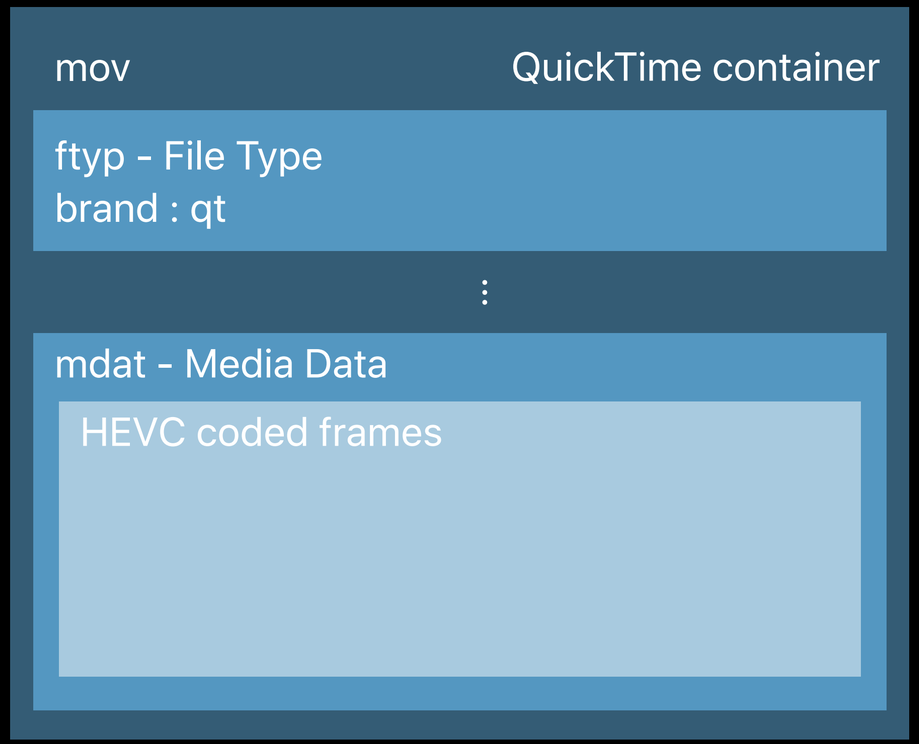
Characteristics of Apple-captured HEVC movie

QuickTime movie file format

HEVC coded video frames

8- and 10-bit encoding

“mov” file extension



HEVC Movie Decode Support

Minimum configurations

	iOS	macOS
8-bit Hardware Decode	A9 chip	6th Generation Intel Core processor
10-bit Hardware Decode	A9 chip	7th Generation Intel Core processor
8-bit Software Decode	All iOS Devices	All Macs
10-bit Software Decode	All iOS Devices	All Macs

Accessing HEVC

HEVC movie support

Accessing HEVC

HEVC movie support

AVFoundation—supported media source

Accessing HEVC

HEVC movie support

AVFoundation—supported media source

PhotoKit—movies, resources, and edit

Accessing HEVC

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AVFoundation—supported media source

PhotoKit—movies, resources, and edit

WebKit—hardware support and macOS desktops

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HTTP Live Streaming

Accessing HEVC

HEVC movie support

AVFoundation—supported media source

PhotoKit—movies, resources, and edit

WebKit—hardware support and macOS desktops

HTTP Live Streaming

Apple apps

Accessing HEVC

Decodable vs. playable

Accessing HEVC

Decodable vs. playable

No hardware acceleration on some older devices

Accessing HEVC

Decodable vs. playable

No hardware acceleration on some older devices

All movie formats are decodable

Accessing HEVC

Decodable vs. playable

No hardware acceleration on some older devices

All movie formats are decodable

AVFoundation “isPlayable” provides distinction

Accessing HEVC

Decodable vs. playable

No hardware acceleration on some older devices

All movie formats are decodable

AVFoundation “isPlayable” provides distinction

Apple captured 4K30 playing in software

Accessing Photo APIs

HEIF/HEVC support through Photo APIs

Accessing Photo APIs

HEIF/HEVC support through Photo APIs

	HEIF/HEVC
PhotoKit (iOS + macOS)	Supported

Accessing Photo APIs

HEIF/HEVC support through Photo APIs

	HEIF/HEVC
PhotoKit (iOS + macOS)	Supported
AssetLibrary (iOS)	Supported

Accessing Photo APIs

HEIF/HEVC support through Photo APIs

	HEIF/HEVC
PhotoKit (iOS + macOS)	Supported
AssetLibrary (iOS)	Supported
Media Library (macOS)	Transcoded

Accessing PhotoKit

Direct access to HEIF/HEVC content through PhotoKit

Accessing PhotoKit

Direct access to HEIF/HEVC content through PhotoKit

Requesting Images	PHImageManager

Accessing PhotoKit

Direct access to HEIF/HEVC content through PhotoKit

Requesting Images	PHImageManager
Requesting Video Objects	PHImageManager

Accessing PhotoKit

Direct access to HEIF/HEVC content through PhotoKit

Requesting Images	PHImageManager
Requesting Video Objects	PHImageManager
Requesting Asset Resources	PHAssetResourceManager

Accessing PhotoKit

Direct access to HEIF/HEVC content through PhotoKit

Requesting Images	PHImageManager
Requesting Video Objects	PHImageManager
Requesting Asset Resources	PHAssetResourceManager
Editing Assets	PHContentEditingInput

Accessing HEIF/HEVC

Transparent for on-device workflows

Accessing HEIF/HEVC

Transparent for on-device workflows

ImageIO

Accessing HEIF/HEVC

Transparent for on-device workflows

ImageIO

AVFoundation

Accessing HEIF/HEVC

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Core Image

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Transparent for on-device workflows

ImageIO

AVFoundation

Core Image

UIKit

Accessing HEIF/HEVC

Transparent for on-device workflows

ImageIO

AVFoundation

Core Image

UIKit

PhotoKit

Accessing HEIF/HEVC

Transparent for on-device workflows

ImageIO

AVFoundation

Core Image

UIKit

PhotoKit

Working with HEIF and HEVC | Hall 2 | Friday 11:00AM

HEIF/HEVC Ecosystem

HEIF/HEVC Ecosystem

HEIF Image Encode Support

Minimum configurations

	iOS
Hardware	A10 Fusion chip

Creating HEIF

How HEIF Images are created

Creating HEIF

How HEIF Images are created

ImageIO—supported image destination

Creating HEIF

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ImageIO—supported image destination

AVFoundation—photo capture output

Creating HEIF

How HEIF Images are created

ImageIO—supported image destination

AVFoundation—photo capture output

Camera

Creating HEIF

How HEIF Images are created

ImageIO—supported image destination

AVFoundation—photo capture output

Camera

Only heic

HEVC Movie Encode Support

Minimum configurations

	iOS	macOS
8-bit Hardware Encode	A10 Fusion chip	6th Generation Intel Core processor
10-bit Software Encode		All Macs

Creating HEVC

How HEVC movies are created

Creating HEVC

How HEVC movies are created

AVFoundation—export destination

Creating HEVC

How HEVC movies are created

AVFoundation—export destination

AVFoundation—video capture session

Creating HEVC

How HEVC movies are created

AVFoundation—export destination

AVFoundation—video capture session

Camera

HEIF/HEVC Ecosystem

HEIF/HEVC Ecosystem

Transferring HEIF/HEVC

Strategies for moving HEIF/HEVC media off the creation device

Transferring HEIF/HEVC

Strategies for moving HEIF/HEVC media off the creation device

The options to consider

Transferring HEIF/HEVC

Strategies for moving HEIF/HEVC media off the creation device

The options to consider

- Always transcode

Transferring HEIF/HEVC

Strategies for moving HEIF/HEVC media off the creation device

The options to consider

- Always transcode
- Capabilities exchange

Transferring HEIF/HEVC

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Transferring and Always Transcoding

Social network client example

Supported Receiver

Social Network Client
HEIF Image

Server

Unsupported Receiver

Transferring and Always Transcoding

Social network client example

Can’t evaluate capabilities of all receiving devices

Supported Receiver

Social Network Client
HEIF Image

Server

Unsupported Receiver

Transferring and Always Transcoding

Social network client example

Can’t evaluate capabilities of all receiving devices

Always transcode

Social Network Client
HEIF Image

Server

Supported Receiver

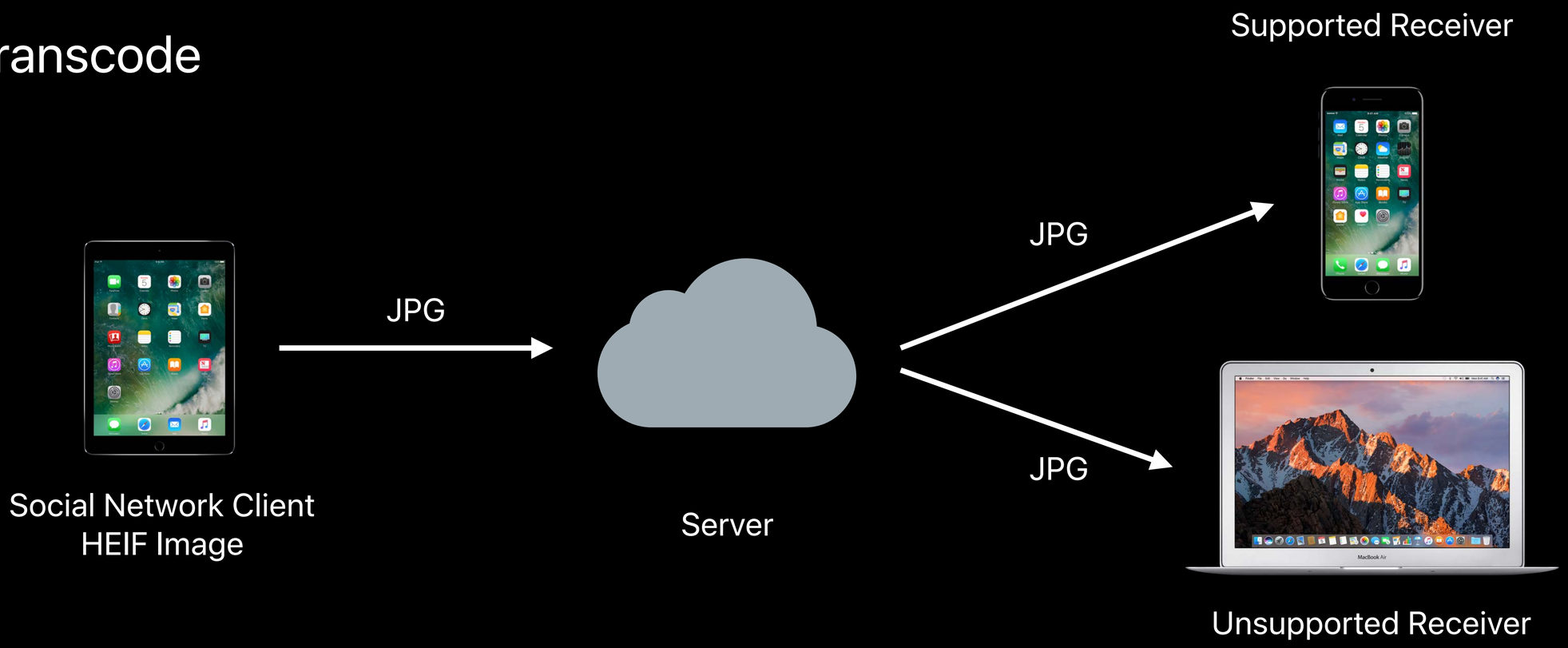
Unsupported Receiver

Transferring and Always Transcoding

Social network client example

Can’t evaluate capabilities of all receiving devices

Always transcode



Transferring HEIF/HEVC

Strategies for moving HEIF/HEVC media off the creation device

The options to consider

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Transferring HEIF/HEVC

Strategies for moving HEIF/HEVC media off the creation device

The options to consider

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Transferring with Capabilities

Multipeer Connectivity (P2P) example

Sender
HEIF Image

Receiver

Transferring with Capabilities

Multipeer Connectivity (P2P) example

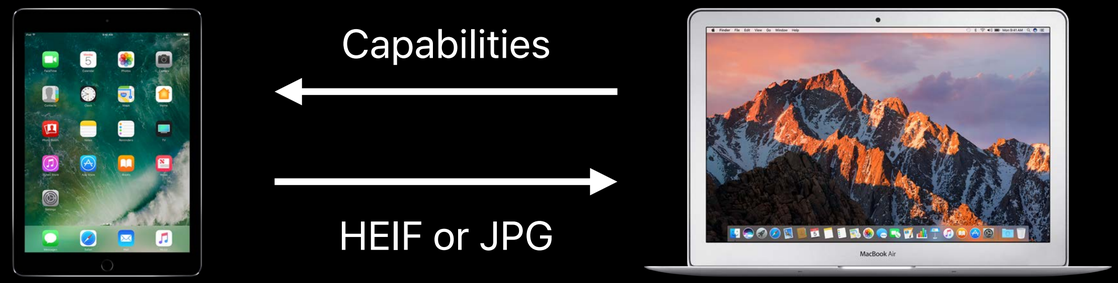
Receiver sends capabilities

Transferring with Capabilities

Multipeer Connectivity (P2P) example

Receiver sends capabilities

Sender evaluates capabilities to determines transcode policy



Transferring HEIF/HEVC

Apple transfer workflows

Transferring HEIF/HEVC

Apple transfer workflows

	Transfer Strategy
Mail, Share Extensions	Always transcode

Transferring HEIF/HEVC

Apple transfer workflows

	Transfer Strategy
Mail, Share Extensions	Always transcode
PTP, AirDrop	Capabilities exchange

Summary

Summary

HEVC is Apple’s next generation codec

Summary

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Adopting HEIF as an image file format

Summary

HEVC is Apple’s next generation codec

Adopting HEIF as an image file format

Transparent within the Apple ecosystem

Summary

HEVC is Apple’s next generation codec

Adopting HEIF as an image file format

Transparent within the Apple ecosystem

Developers should produce their own HEIF/HEVC content

More Information

https://developer.apple.com/wwdc17/503

Related Sessions and Labs

Advances in HTTP Live Streaming	Grand Ballroom B	Tuesday, 5:10PM
What's New in Photos APIs	Hall 2	Wednesday, 1:50PM
Capturing Depth in iPhone Photography	Hall 2	Wednesday, 5:10PM
Working with HEIF and HEVC	Hall 2	Friday, 11:00AM
High Efficiency Image File Format		WWDC17 Video
HLS Authoring Update		WWDC17 Video

Related Sessions and Labs

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HLS Authoring Update		WWDC17 Video

Labs

HEIF and HEVC Lab	Technology Lab A	Wed 9:00AM–11:00AM
AVFoundation Lab	Technology Lab G	Wed 11:00AM–1:00PM
AVFoundation Lab	Technology Lab F	Thur 12:00PM–3:00PM
HEIF and HEVC Lab	Technology Lab F	Fri 12:00PM–1:50PM
Photos Depth and Capture Lab	Technology Lab F	Fri 1:50PM–4:00PM


WWDC17