Editing Movies in AV Foundation

Session 506

Tim Monroe AV Foundation Engineering

What You Will Learn

Editing movies in AV Foundation

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AV Foundation provides new classes for editing QuickTime movie files:

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AV Foundation provides new classes for editing QuickTime movie files:

- Perform range-based editing on movies and tracks

What You Will Learn

Editing movies in AV Foundation

NEW

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- Add and remove tracks

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- Add and remove tracks
- Set track associations between tracks
- Add or modify movie and track metadata

What You Will Learn

Editing movies in AV Foundation

AV Foundation provides new classes for editing QuickTime movie files:

- Perform range-based editing on movies and tracks
- Add and remove tracks
- Set track associations between tracks
- Add or modify movie and track metadata
- Create movie files and URL sample reference movie files

Session Outline

Editing movies in AV Foundation

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Introduce new classes for creating and editing QuickTime movie files

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Survey the new movie- and track-editing methods

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Editing movies in AV Foundation

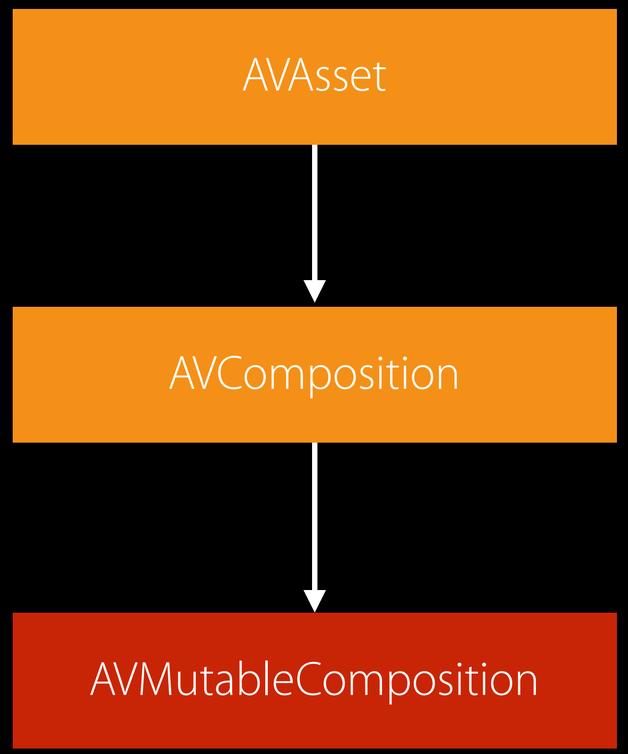
Introduce new classes for creating and editing QuickTime movie files

Survey the new movie- and track-editing methods

Describe a personal project that will benefit from these new capabilities

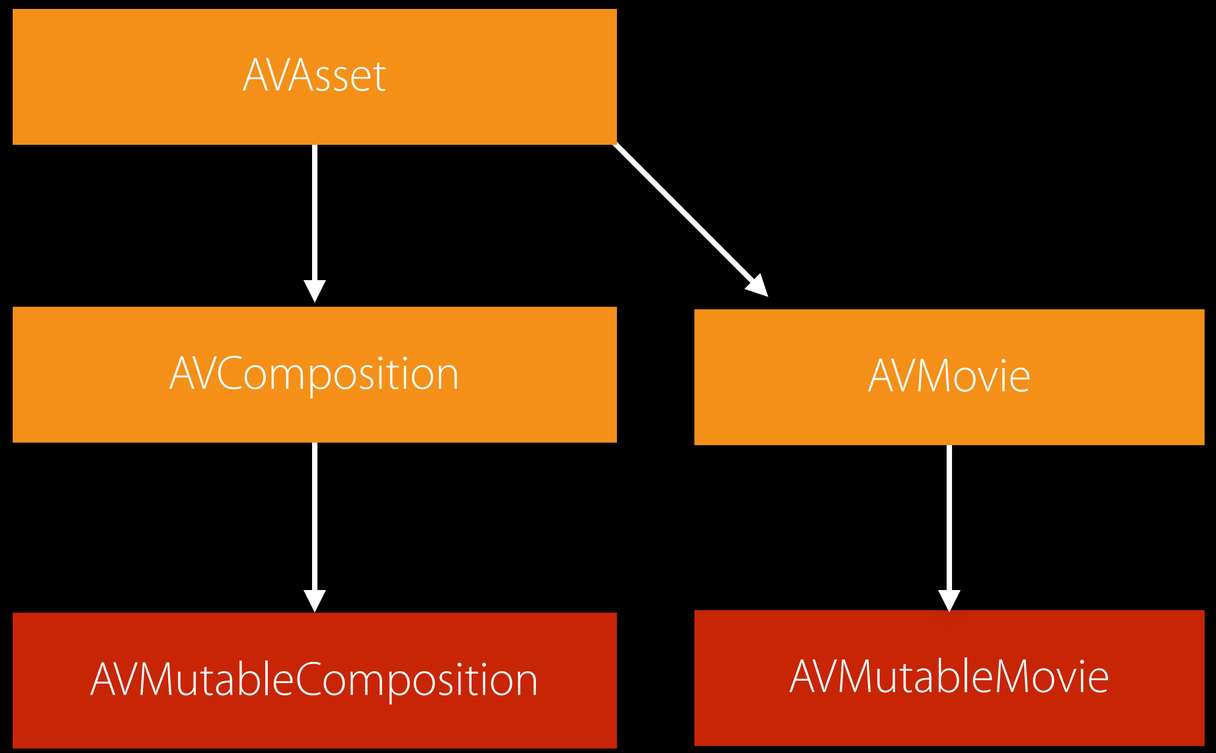
AV Foundation Editing Classes

AVAsset and Its Editing Subclasses

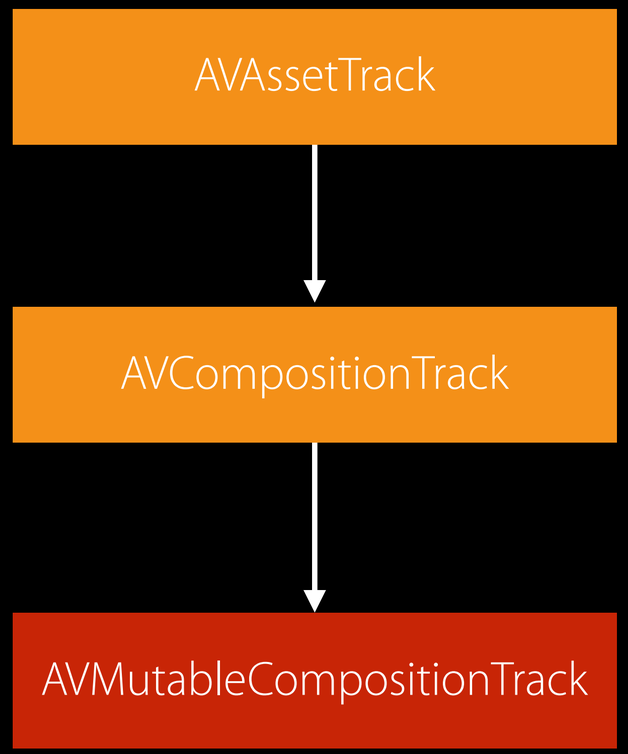


AVAsset and Its Subclasses

NEW



AVAssetTrack and Its Subclasses



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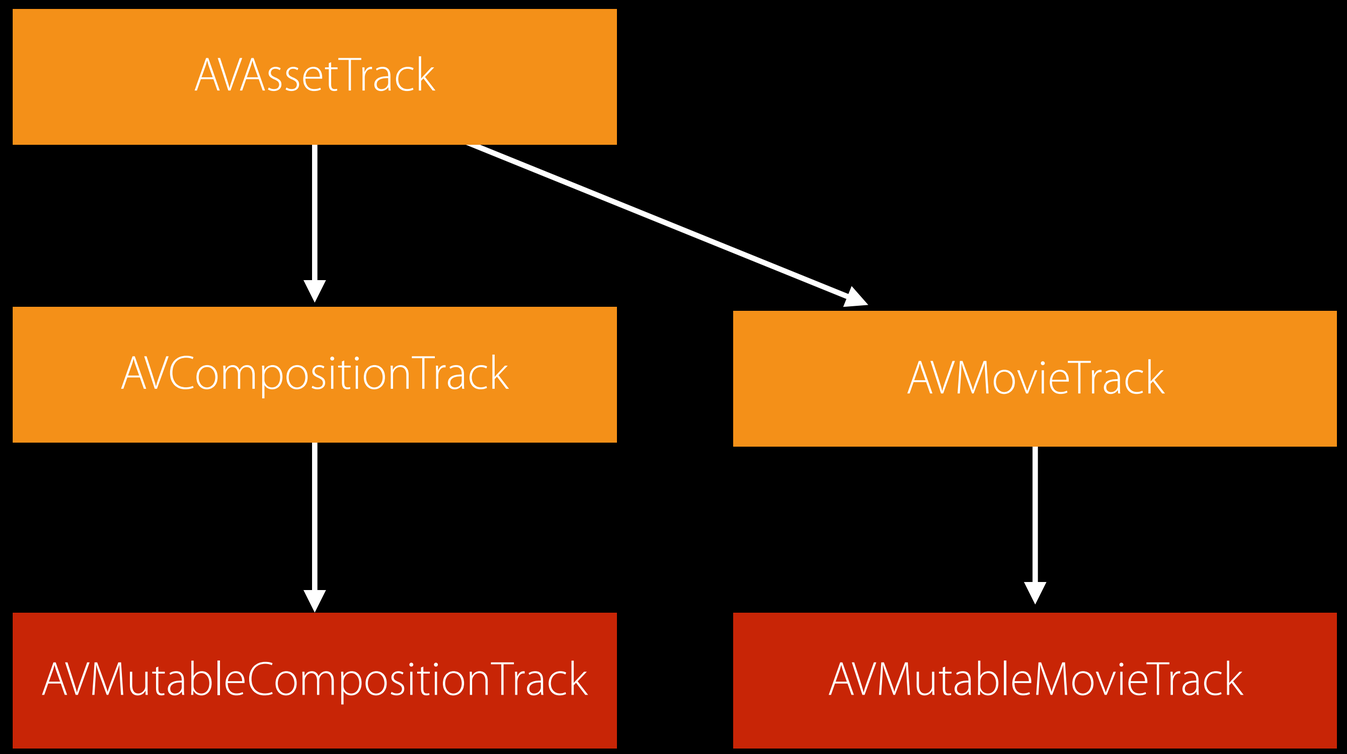

New Movie Editing Classes

NEW

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AVMovie and AVMutableMovie

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AVMovieTrack and AVMutableMovieTrack

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AVMovie and AVMutableMovie

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AVMediaDataStorage

QuickTime Movie Files

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AVMovie represents the data in a file that conforms to the QuickTime movie file format or to one of the related ISO base media file formats (such as MPEG-4)

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AVMovie represents the data in a file that conforms to the QuickTime movie file format or to one of the related ISO base media file formats (such as MPEG-4)

These formats impose a strict separation between the sample data and the information that organizes that sample data into tracks and movies

QuickTime Movie Files

A sequence of boxes

QuickTime Movie Files

A sequence of boxes

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A sequence of boxes

QuickTime Movie Files

A sequence of boxes

Movie Box

Stores global settings, metadata, and track information

Global Settings

Movie Metadata

Track Boxes

Movie Box

Stores global settings, metadata, and track information

Global Settings

Movie Metadata

Track Boxes

- Track count
- Duration
- Creation date
- Preferred rate

Movie Box

Stores global settings, metadata, and track information

Global Settings	Movie Metadata	Track Boxes
• Track count • Duration • Creation date • Preferred rate	• Copyright statement • Author • Title • Custom metadata	

Movie Box

Stores global settings, metadata, and track information

Global Settings

- Track count
- Duration
- Creation date
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Movie Metadata

- Copyright statement
- Author
- Title
- Custom metadata

Track Boxes

- Track type
- Sample data location
- Track metadata
- Track associations

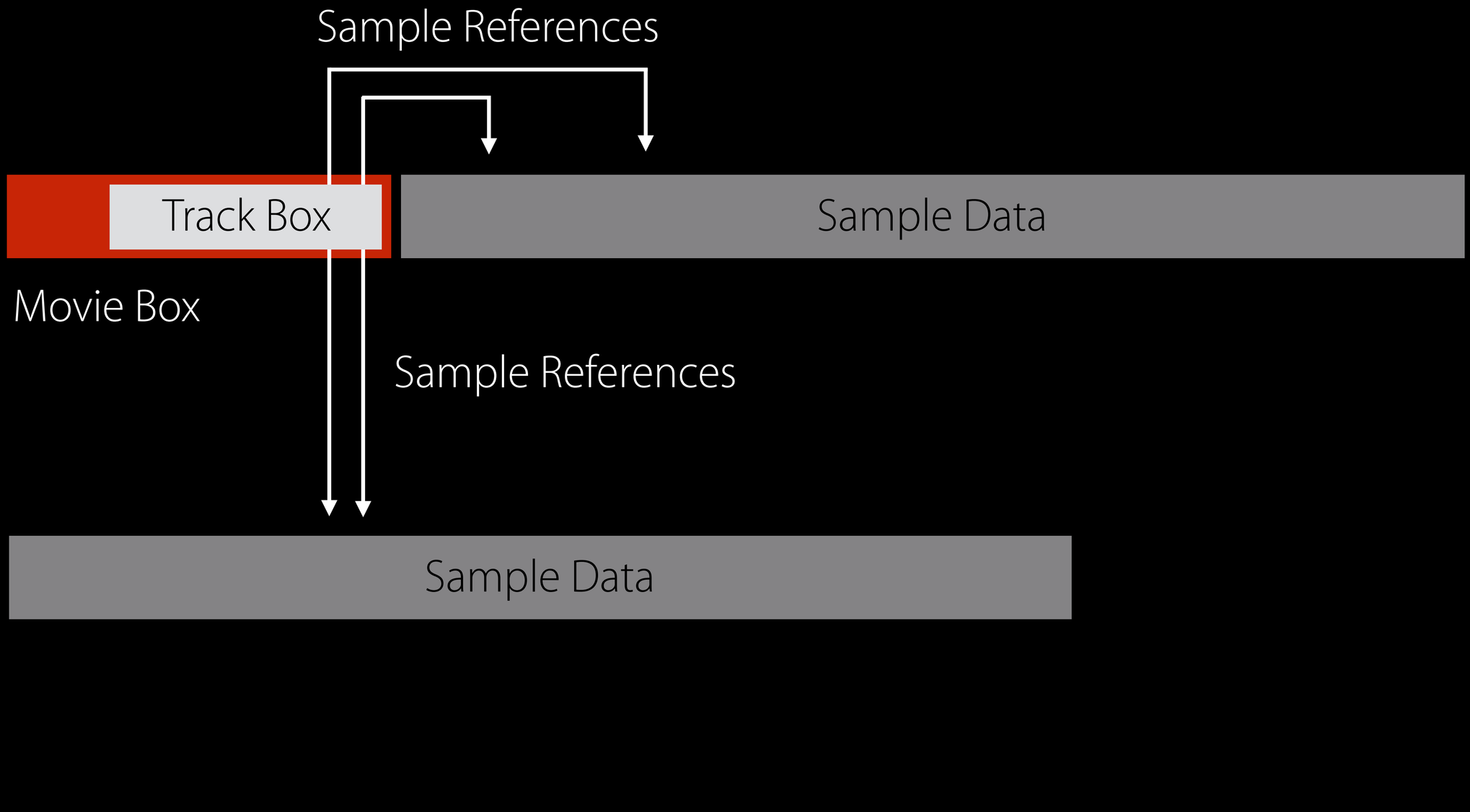
Track Box

Organizes the sample data into tracks

Movie Box

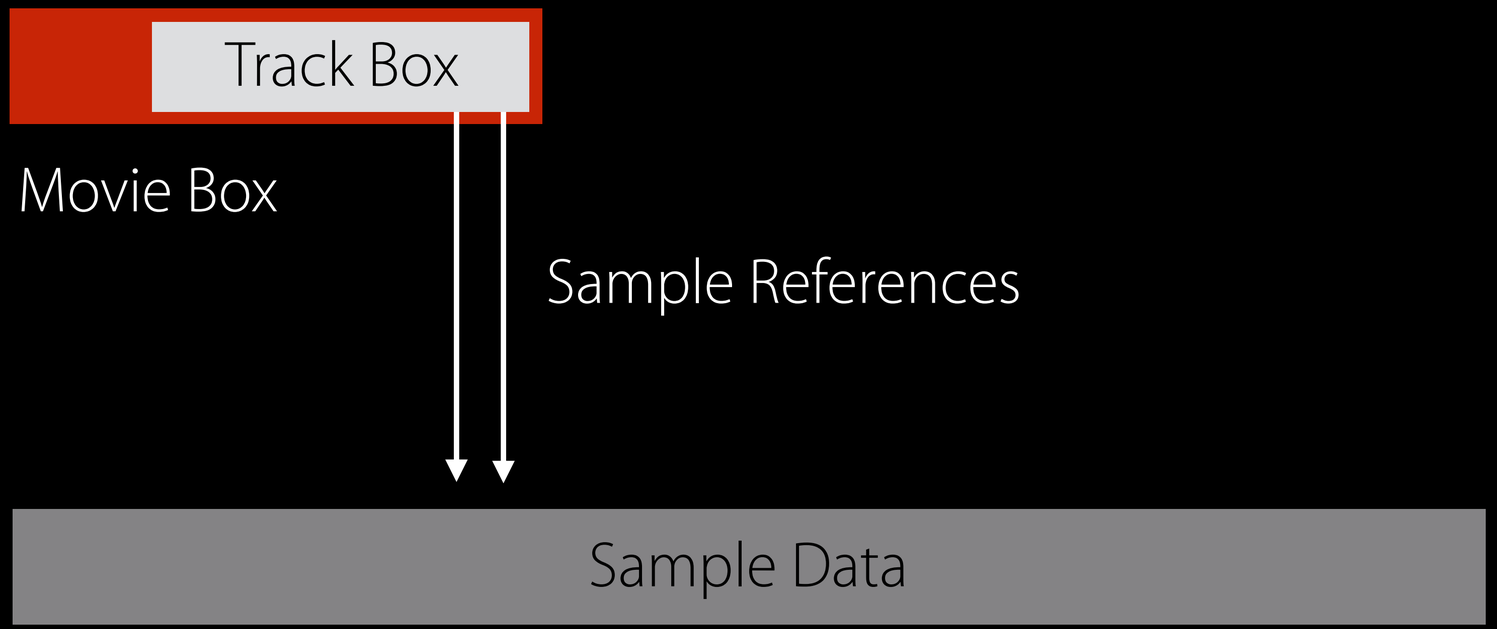
QuickTime Movie Files

Track box can point to external sample data



QuickTime Movie Files

Track box can point to only external sample data



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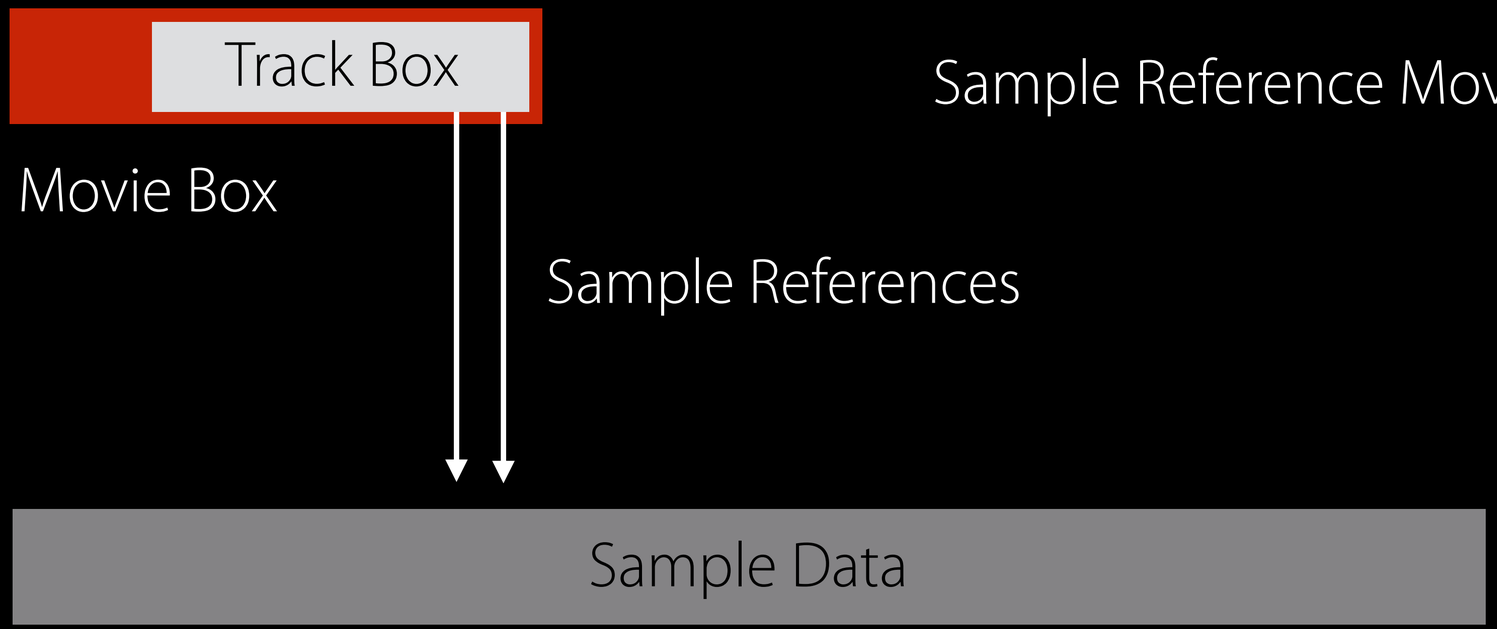

Sample Reference Movie File

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Provide a powerful workflow tool

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But sample reference movies are inherently fragile

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To help reduce that fragility, use relative URLs

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When it's time to deliver content, export it using AVAssetExportSession

Movie Editing API

AVMovie

Inspecting QuickTime movie files

AVMovie

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AVMovie provides inspection and header-writing methods:

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Inspecting QuickTime movie files

AVMovie provides inspection and header-writing methods:

- Get a list of tracks in the movie
- Retrieve the movie header from an existing file
- Write a movie header into a new file

AVMovie

Initializing AVMovie objects

AVMovie

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```
let movie = AVMovie(URL: inputURL, options: nil)
```

AVMovie

Initializing AVMovie objects

```
let movie = AVMovie(URL: inputURL, options: nil)

let movie = AVMovie(data: inputData, options: nil)
```

AVMovie

Creating a sample reference movie file

```
let movie = AVMovie(URL: inputURL, options: nil)
let options = AVMovieWritingOptions.TruncateDestinationToMovieHeaderOnly

try movie.writeMovieHeaderToURL(outputURL,
                                fileType: AVFileTypeQuickTimeMovie,
                                options: options)
```

AVMovie

Movie header writing options

```
let movie = AVMovie(URL: inputURL, options: nil)
let options = AVMovieWritingOptions.TruncateDestinationToMovieHeaderOnly

try movie.writeMovieHeaderToURL(outputURL,
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```

AVMovie

Movie header writing options

```
let movie = AVMovie(URL: inputURL, options: nil)
let options = AVMovieWritingOptions.AddMovieHeaderToDestination

try movie.writeMovieHeaderToURL(outputURL,
                                fileType: AVFileTypeQuickTimeMovie,
                                options: options)
```

AVMutableMovie

Modifying QuickTime movie files

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AVMutableMovie adds editing methods:

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let movie = AVMutableMovie()
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AVMutableMovie

Segment editing

```
func removeTimeRange(timeRange: CMTimeRange)

func insertEmptyTimeRange(timeRange: CMTimeRange)

func scaleTimeRange(timeRange: CMTimeRange, toDuration: CMTime)

func insertTimeRange(timeRange: CMTimeRange,
                     ofAsset: AVAsset,
                      atTime: CMTime,
                copySampleData: Bool) throws
```

AVMutableMovie

Segment editing

```
func removeTimeRange(timeRange: CMTimeRange)

func insertEmptyTimeRange(timeRange: CMTimeRange)

func scaleTimeRange(timeRange: CMTimeRange, toDuration: CMTime)
```

```
func insertTimeRange(timeRange: CMTimeRange,
                     ofAsset: AVAsset,
                      atTime: CMTime,
                copySampleData: Bool) throws
```

AVMediaDataStorage

Setting the container for movie's new sample data

AVMediaDataStorage

Setting the container for movie's new sample data

```
movie.defaultMediaDataStorage = AVMediaDataStorage(URL: movURL, options: nil)
```

AVMutableMovie

Creating and removing tracks

```
func addMutableTrackWithMediaType(
                    mediaType: String,
        copySettingsFromTrack: AVAssetTrack?,
                     options: [String : AnyObject]?) -> AVMutableMovieTrack
```

```
func removeTrack(track: AVMovieTrack)
```

AVMutableMovie

Use case: updating an existing movie file

```
let movie = try AVMutableMovie(URL: url, options: nil)


perform some edits on the movie

let options = AVMovieWritingOptions.AddMovieHeaderToDestination
try movie.writeMovieHeaderToURL(url,
                    fileType: AVFileTypeQuickTimeMovie,
                     options: options)
```

Track Editing API

AVMutableMovieTrack

Modifying tracks in QuickTime movie files

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AVMutableMovieTrack

Segment editing

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func removeTimeRange(timeRange: CMTimeRange)

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AVMediaDataStorage

Setting the container for a track's new sample data

AVMediaDataStorage

Setting the container for a track's new sample data

```
track.mediaDataStorage = AVMediaDataStorage(URL: movURL, options: nil)
```

AVMutableMovieTrack

Use case: silencing a track segment

```
if let track = movie.tracksWithMediaType(AVMediaTypeAudio).first {
    let range = CMTimeRangeFromTimeToTime(start, end)
    track.removeTimeRange(range)
    track.insertEmptyTimeRange(range)
}
```

AVMutableMovieTrack

Working with track associations

```
func addTrackAssociationToTrack(movieTrack: AVMovieTrack,
                                type: String)

func removeTrackAssociationToTrack(movieTrack: AVMovieTrack,
                                   type: String)
```

AVMutableMovieTrack

Use case: using relative URLs to reference data

AVMutableMovieTrack

Use case: using relative URLs to reference data

```
let url = NSURL(fileURLWithPath: “/Users/monroe/tristo_boston/movies“)

for track in movie.tracks {
    track.sampleReferenceBaseURL = url
}
```

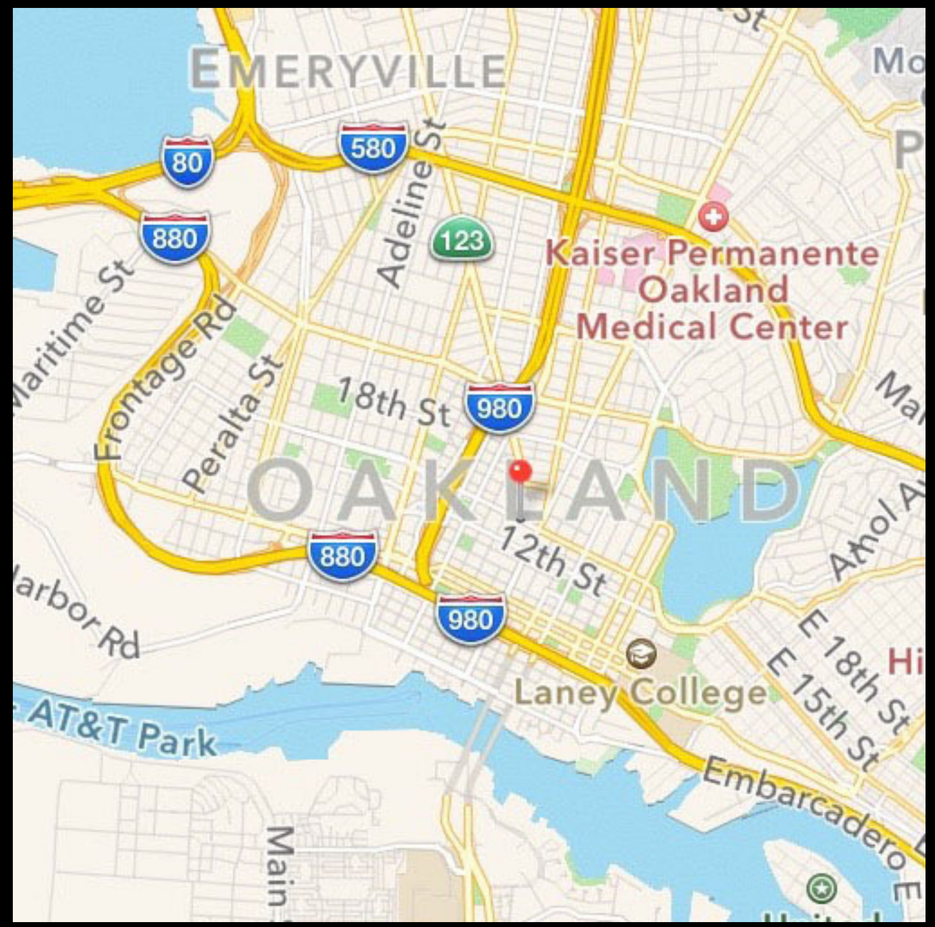
A Study in Scarlet (and Gray)

1984

TRISTO Oakland

Tim's Radical Inline Skate Tour of Oakland

Continued from 1985 to 2005

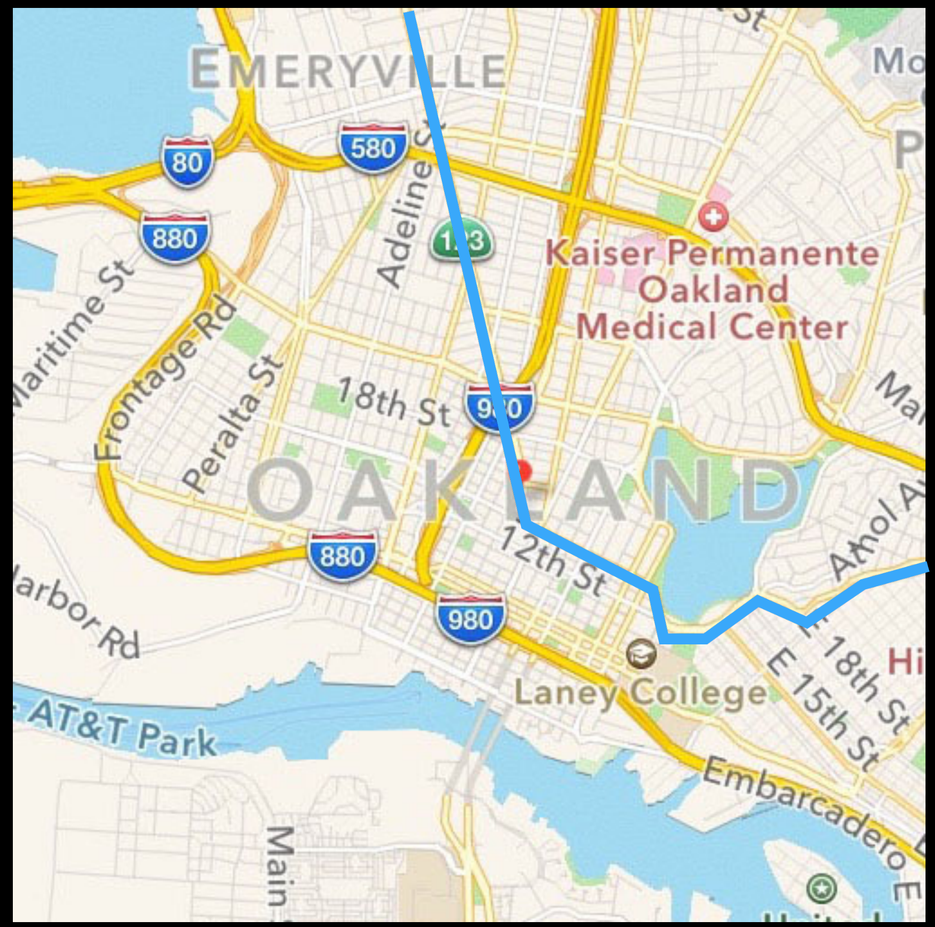


TRISTO Oakland

Tim's Radical Inline Skate Tour of Oakland

Continued from 1985 to 2005

800+ miles of roadways



TRISTO Oakland

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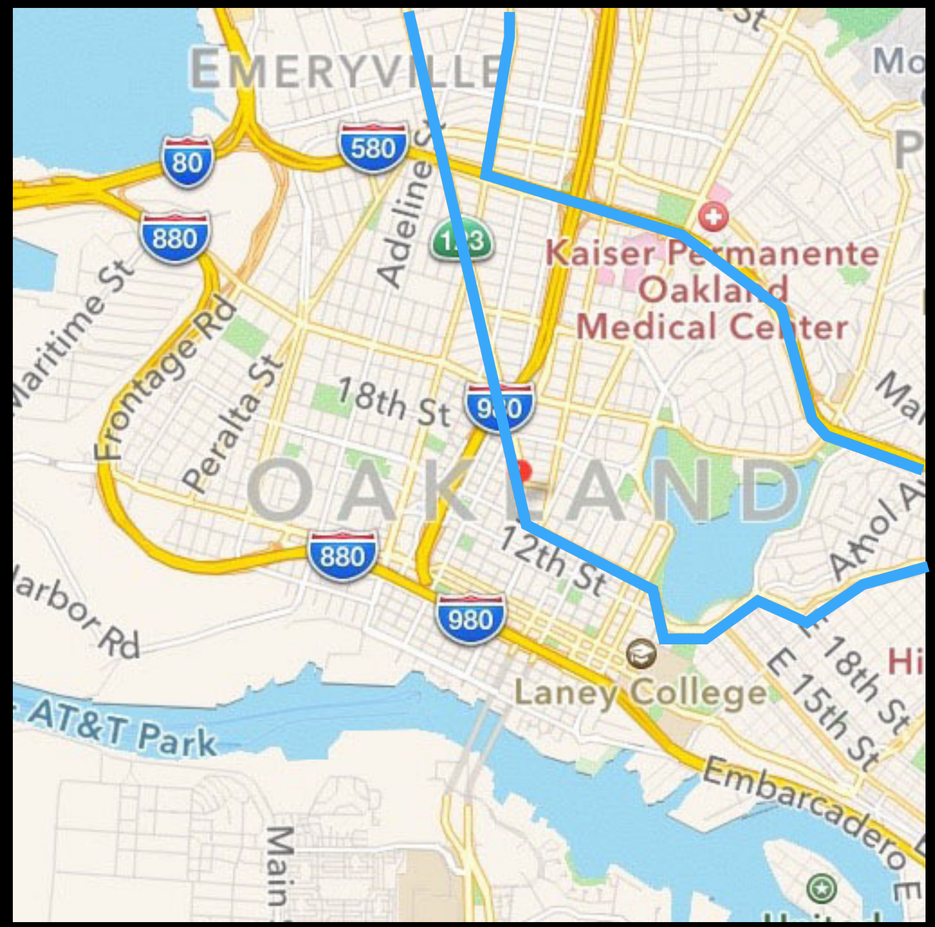
No location data



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Continued from 1985 to 2005

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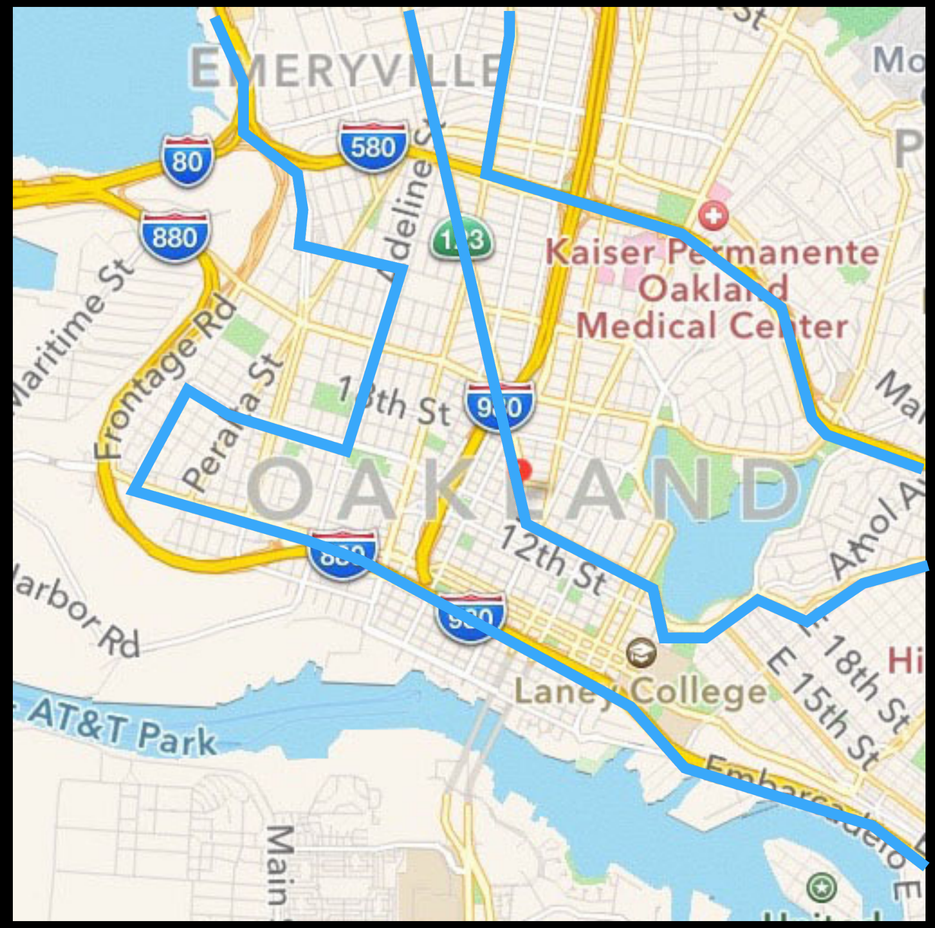
No location data

Almost no video



TRISTO Boston

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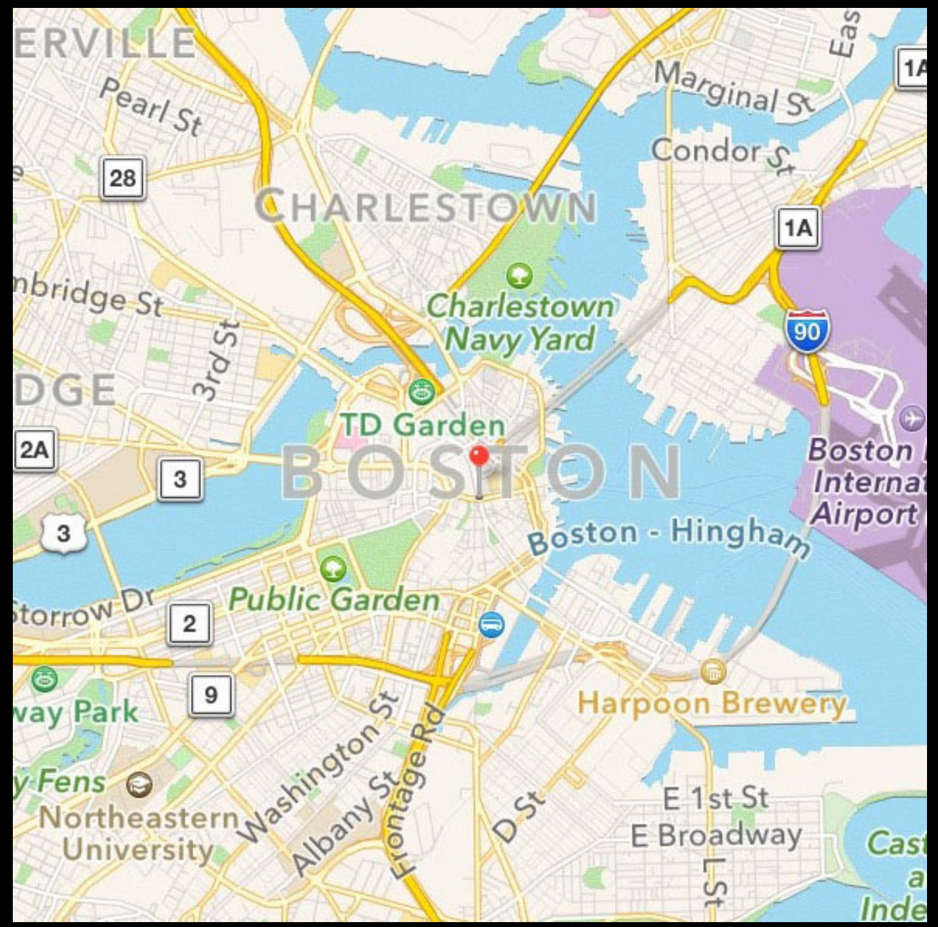
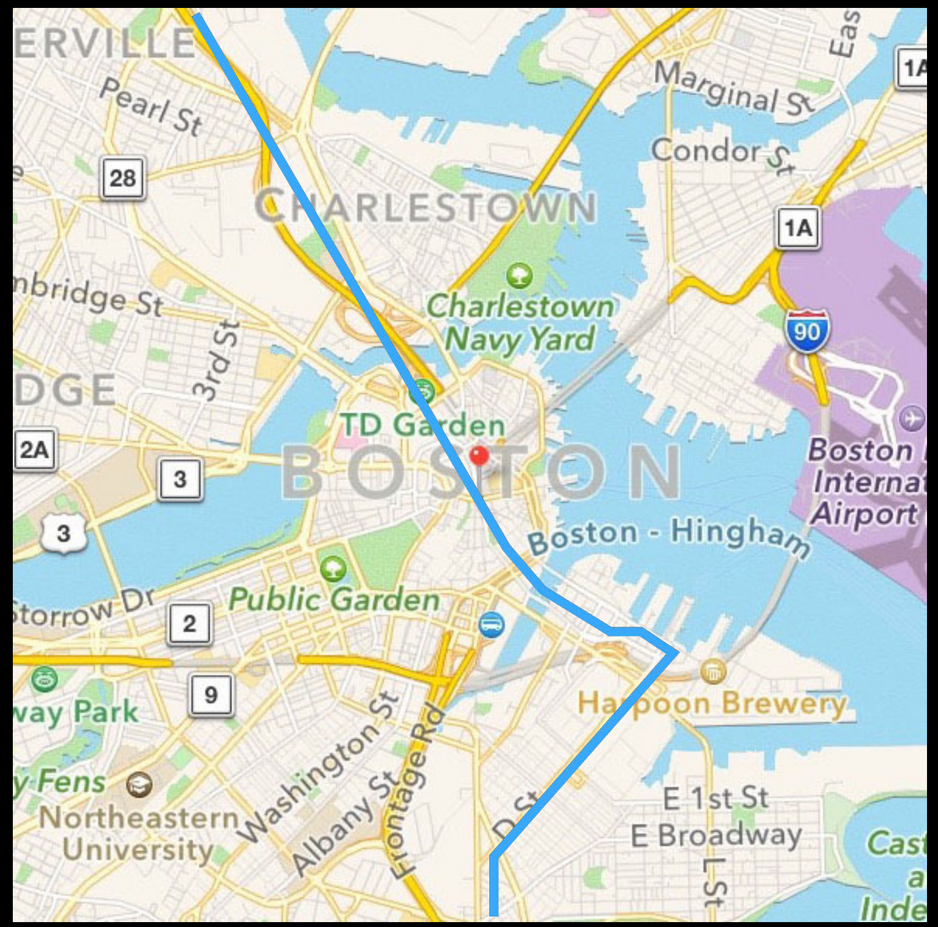


TRISTO Boston

Tim's Radical Inline Skate Tour of Boston

Began in 2011

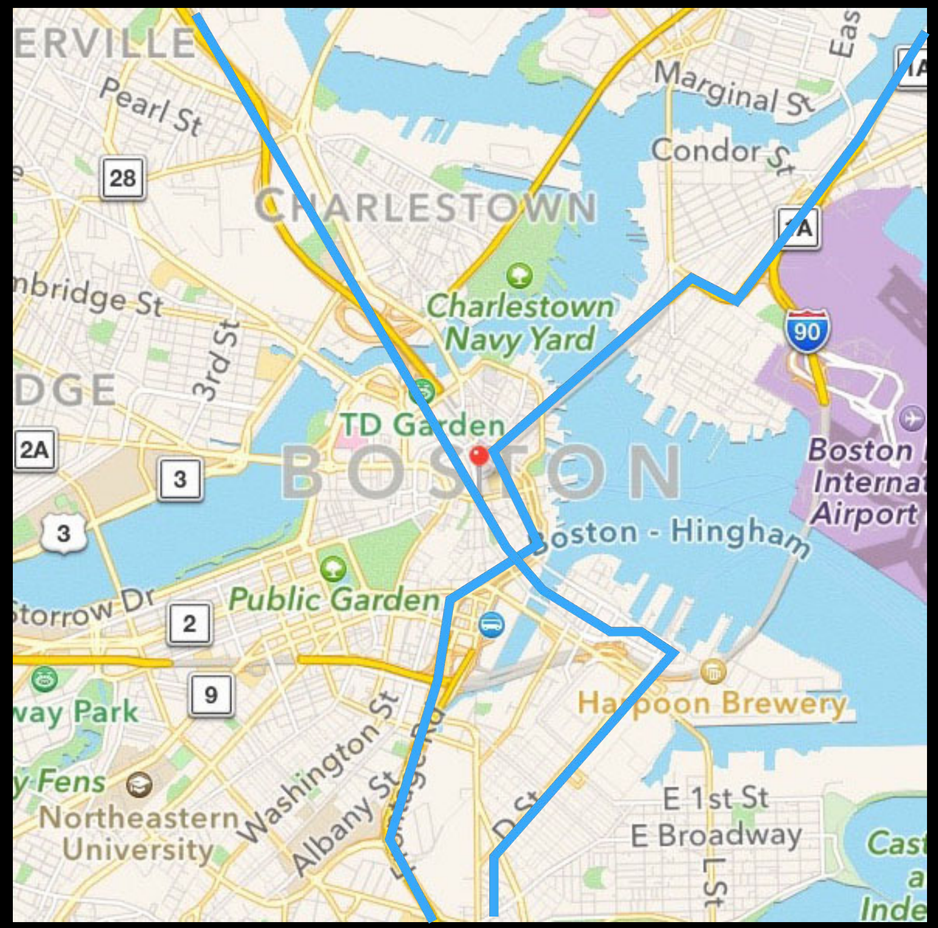


TRISTO Boston

Tim's Radical Inline Skate Tour of Boston

Began in 2011

Estimated 5 year project



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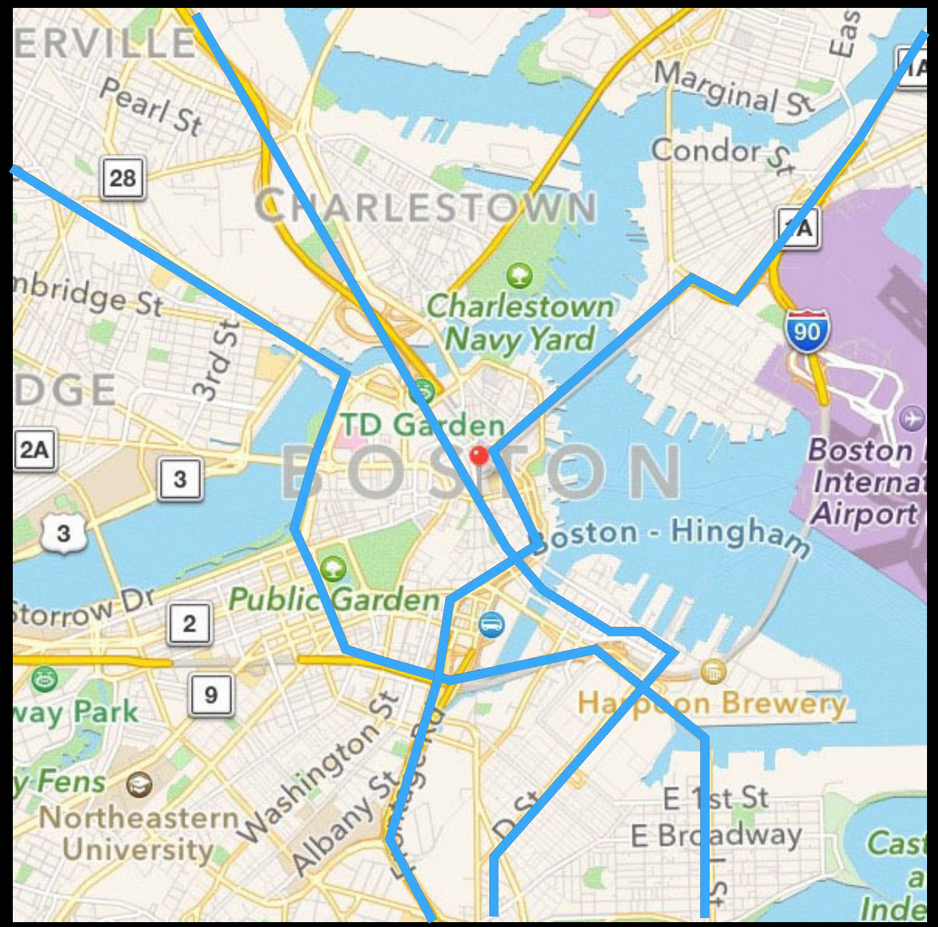

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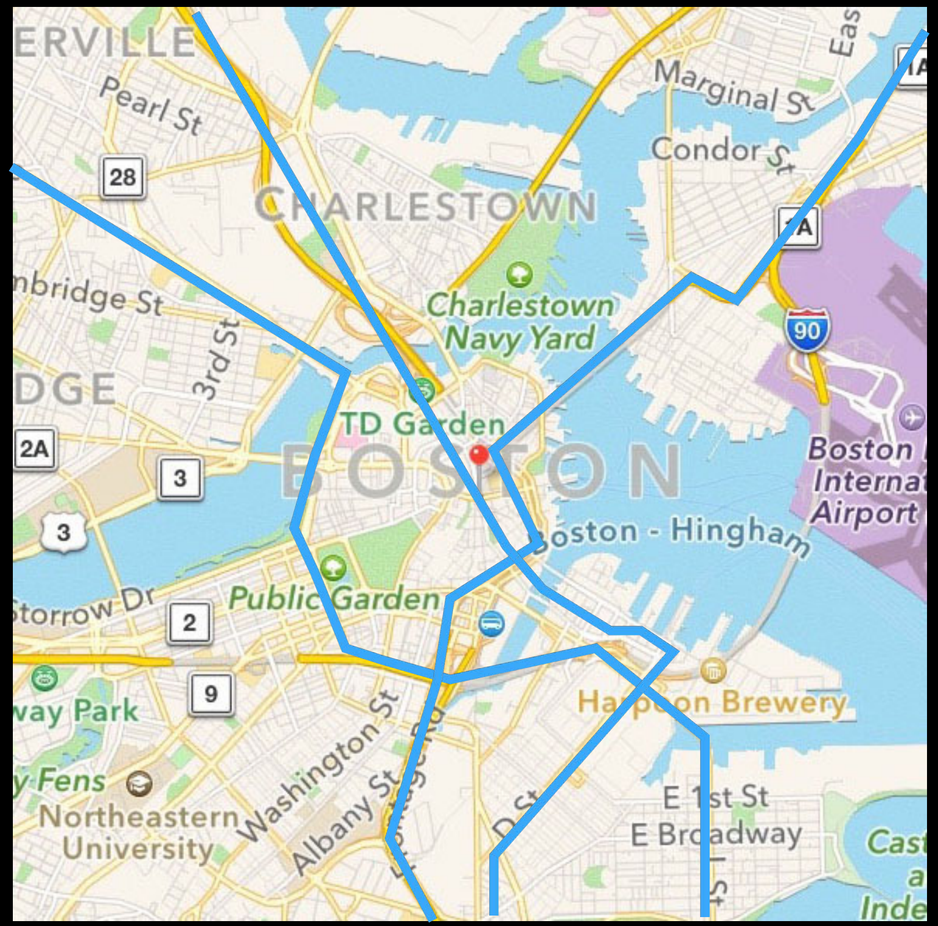
Completed May 2013



TRISTO Boston

Tim's Radical Inline Skate Tour of Boston

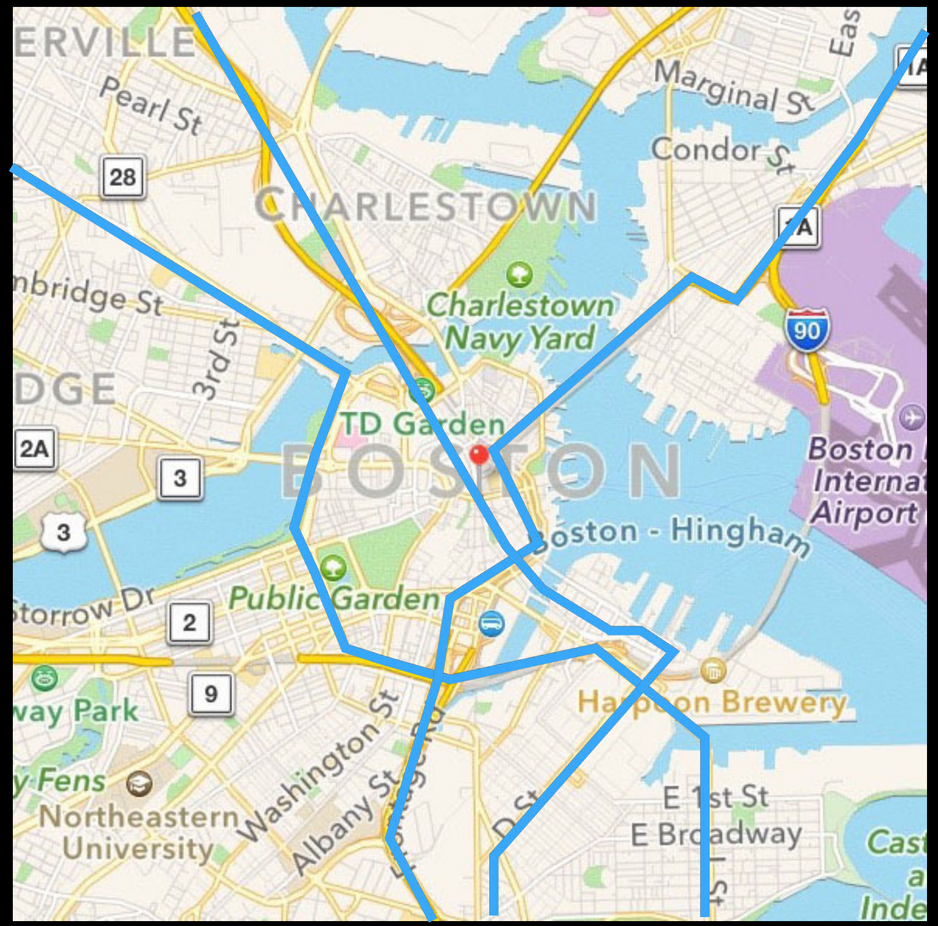
Began in 2011

Estimated 5 year project

800+ miles of roadways

Completed May 2013

Audio-video data: 490 MPEG-4 files covering about 200 sorties (1.5 terabytes)



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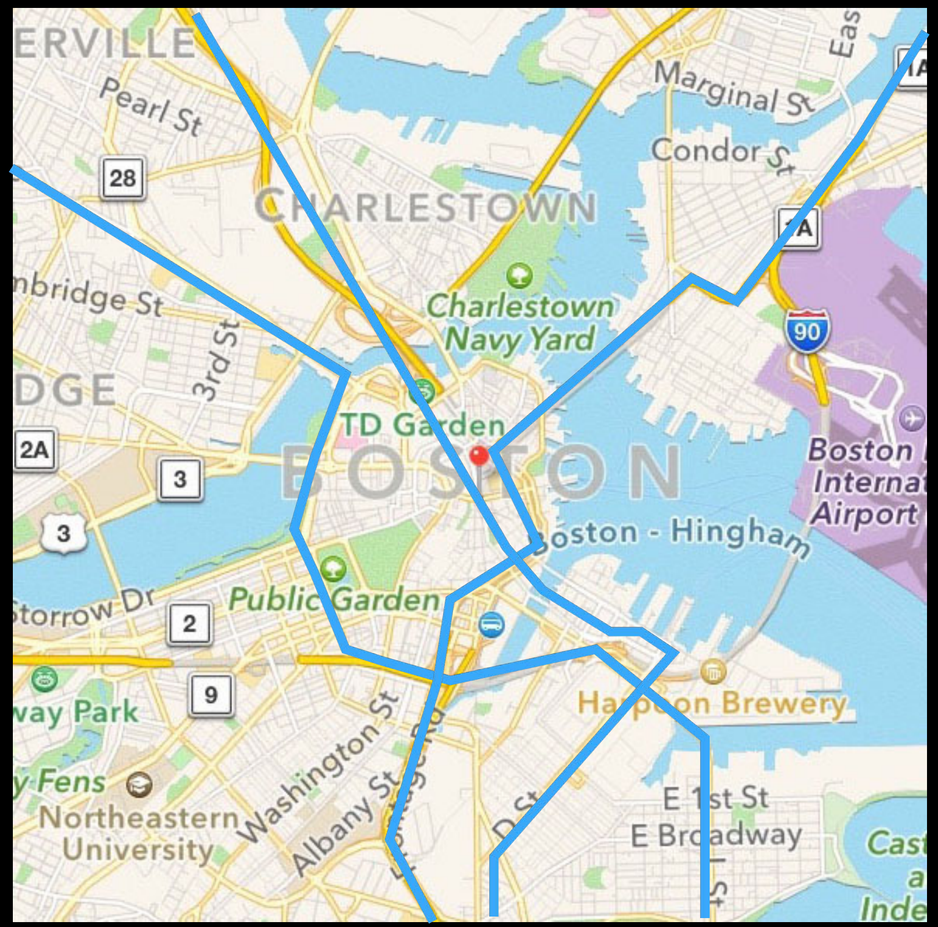
Completed May 2013

Audio-video data: 490 MPEG-4 files covering about 200 sorties (1.5 terabytes)

Location data: GPS data as .gpx files (150 megabytes)



Some Movies


Alvin


MPEG4
2013_11_28_1.MP4
alias


MPEG4
2013_11_28_2.MP4
alias


ScreenCap


Alvin


MPEG4
2013_11_28_1.MP4
alias


MPEG4
2013_11_28_2.MP4
alias


ScreenCap


Hertz
Hertz


Hertz
Hertz

The Task

Manage 1.5 terabytes of data

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Step 1: Combine each sortie's MPEG-4 files into one sample reference movie file

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Step 2: Add indexing metadata as movie metadata

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Step 3: Add GPS data as a timed metadata track

The Task

Manage 1.5 terabytes of data

Step 1: Combine each sortie's MPEG-4 files into one sample reference movie file

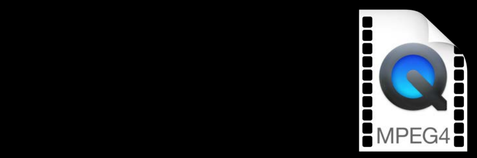
Step 2: Add indexing metadata as movie metadata

Step 3: Add GPS data as a timed metadata track

Do this all without modifying the original files and minimizing data copying

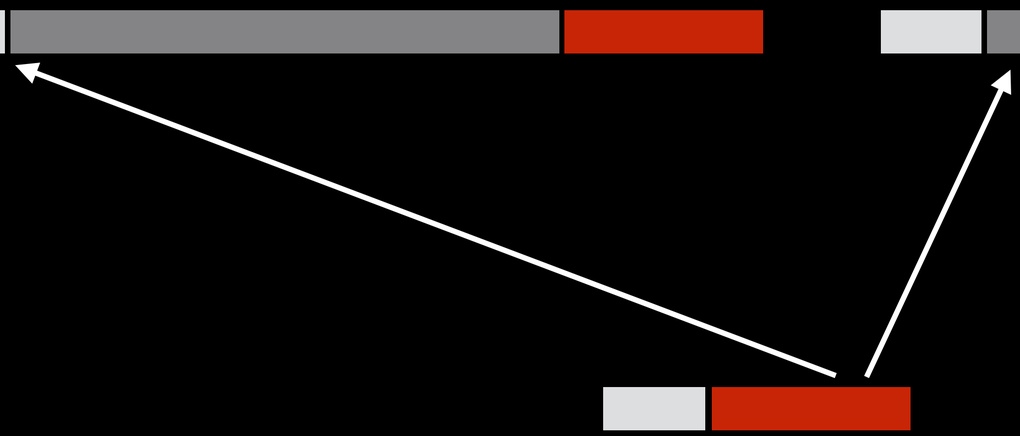
The Solution: Step 1

Combine camera files into a sample reference movie file



2013_11_28_1.MP4

2013_11_28_2.MP4



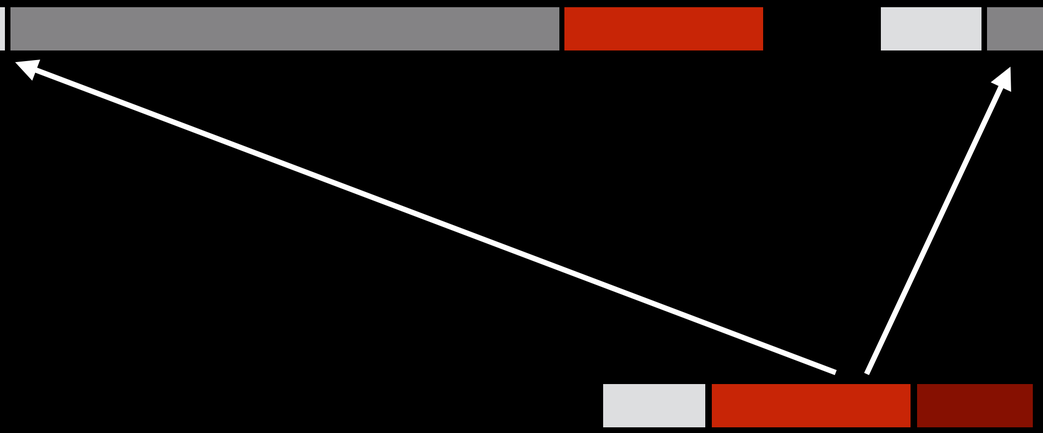
2013_11_28.MOV

The Solution: Step 2

Add custom metadata

2013_11_28_1.MP4

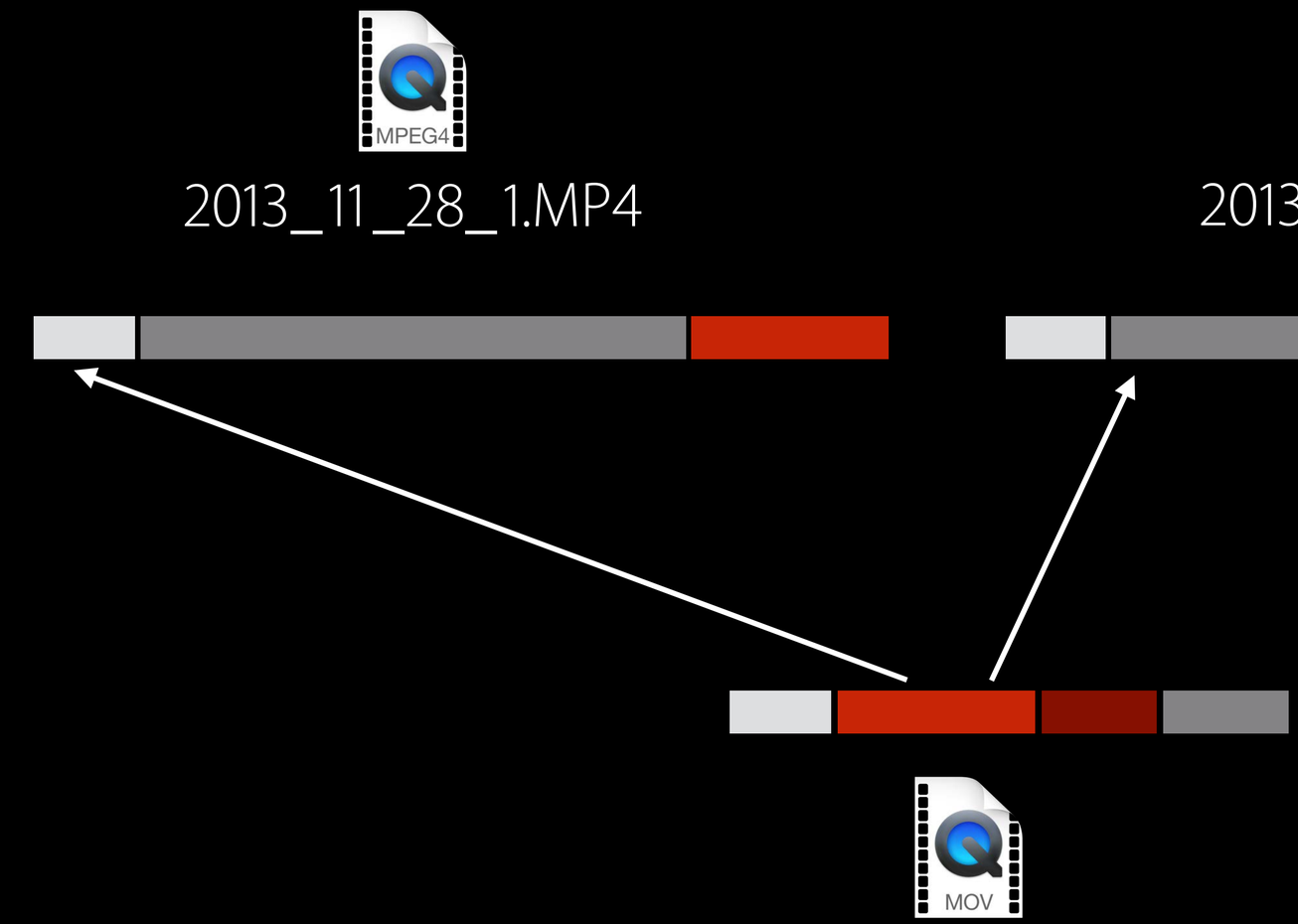
2013_11_28_2.MP4



2013_11_28.MOV

The Solution: Step 3

Add a timed metadata track for location data



Step 1

Combine camera files into a sample reference movie file

```
let movie = AVMutableMovie(URL: url1, options: nil)  // *_1.MP4
let asset = AVURLAsset(URL: url2, options: nil)      // *_2.MP4

let range = CMTimeRangeMake(kCMTimeZero, asset.duration)

try movie.insertTimeRange(range,
                  ofAsset: asset,
                   atTime: movie.duration,
             copySampleData: false)

try movie.writeMovieHeaderToURL(dstURL,
                 fileType: AVFileTypeQuickTimeMovie,
                  options: AVMovieWritingOptions.AddMovieHeaderToDestination)
```

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```

Some Demos

Alvin: an AV Foundation-Based Linear Indexer

Untitled

No Movie File Loaded

No GPX File Loaded

Load Movie File... | Save As... | Add GPS Metadata | Add Street Metadata | Add Weather Metadata

Load GPX File... | Load Street Names | Load Weather Data

Date and Time

Date: --/--/-- Start Time: --:--:-- Duration: -.- Day: -- Events: --

Annotations

Set In Point | Set Out Point | Add Annotation

Search | Add Annotation Metadata

Course

Distance: -.- Waypoints: -- Avg. Speed: -.-

Track: Date:

Cities and Streets

City: -- Street Count: -- Avg. Length: -.-

Weather

Max. Temperature: -.- Rain: -.- Avg. Wind Speed: -.-

Source: Date:

US Standard Units | Metric Units

Untitled

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No GPX File Loaded

Load Movie File... | Save As... | Add GPS Metadata | Add Street Metadata | Add Weather Metadata

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Date and Time

Date: --/--/-- Start Time: --:--:-- Duration: -.- Day: -- Events: --

Annotations

Set In Point | Set Out Point | Add Annotation

Search | Add Annotation Metadata

Course

Distance: -.- Waypoints: -- Avg. Speed: -.-

Track: Date:

Cities and Streets

City: -- Street Count: -- Avg. Length: -.-

Weather

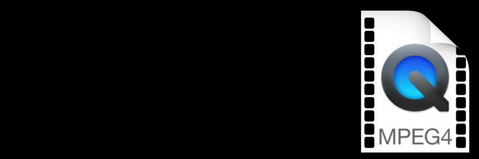
Max. Temperature: -.- Rain: -.- Avg. Wind Speed: -.-

Source: Date:

US Standard Units | Metric Units

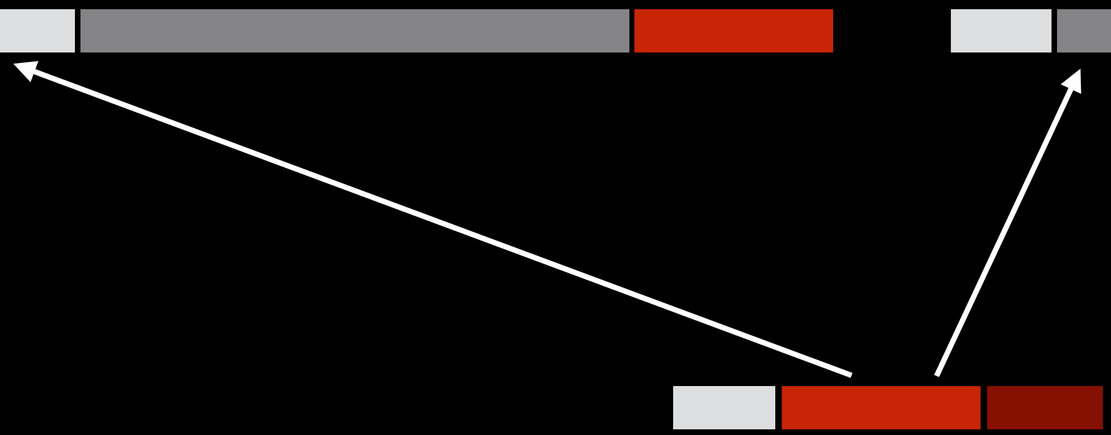
The Solution: Step 2

Add custom metadata



2013_11_28_1.MP4

2013_11_28_2.MP4



2013_11_28.MOV

Step 2

Add custom metadata

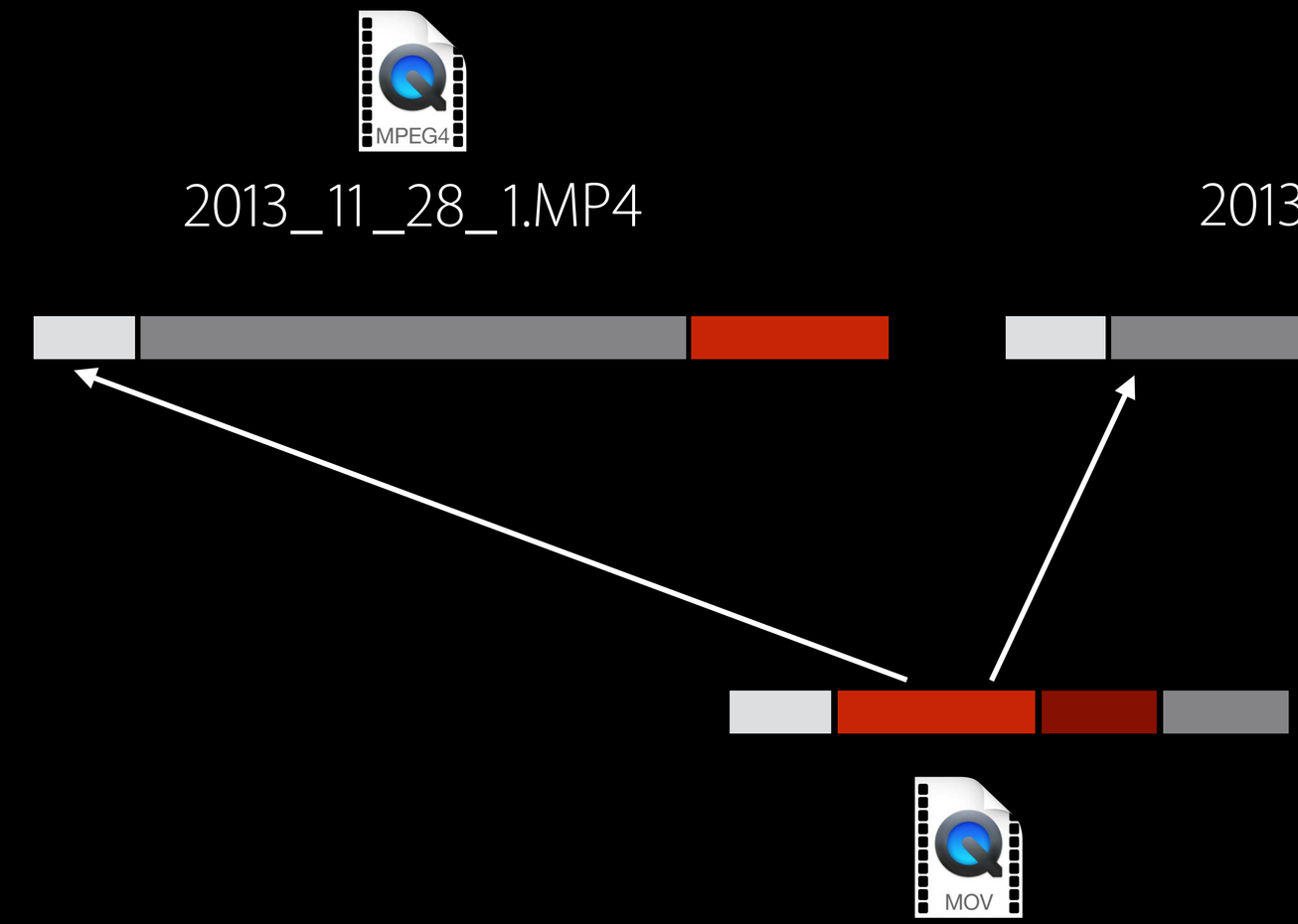
```
var metadataArray = movie.metadata

var newItem = AVMutableMetadataItem()
newItem.identifier = "mdta/com.example.weather.wind"
newItem.locale = NSLocale.currentLocale()
newItem.value = averageWindSpeedValue
newItem.extraAttributes = nil

metadataArray.append(newItem)
movie.metadata = metadataArray
```

The Solution: Step 3

Add a timed metadata track for location data



Step 3, Part 1

Create a movie file containing location timed metadata

See "Harnessing Metadata in Audiovisual Media", WWDC 2014

Sample code: AVCaptureLocation and AVTimedAnnotationWriter

Step 3, Part 2

Add a timed metadata track for location data

```
let gpsAsset = AVURLAsset(URL: gpsURL, options: nil)

if let gpsTrack = gpsAsset.tracks.first {
    let newTrack = movie.addMutableTrackWithMediaType(gpsTrack.mediaType,
                copySettingsFromTrack: gpsTrack,
                              options: nil)

    let range = CMTimeRangeMake(kCMTimeZero, gpsAsset.duration)
    try newTrack.insertTimeRange(range,
                              ofTrack: gpsTrack,
                               atTime: kCMTimeZero,
                        copySampleData: true)
}
```

Step 3, Part 2

Add a timed metadata track for location data

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let gpsAsset = AVURLAsset(URL: gpsURL, options: nil)

if let gpsTrack = gpsAsset.tracks.first {
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                       copySampleData: true)
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Step 3, Part 2

Add a timed metadata track for location data

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                              options: nil)

    let range = CMTimeRangeMake(kCMTimeZero, gpsAsset.duration)
    try newTrack.insertTimeRange(range,
                            ofTrack: gpsTrack,
                             atTime: kCMTimeZero,
                       copySampleData: true)
}
```

Step 3, Part 3

Add a track association

```
let vidTrack = movie.tracksWithMediaType(AVMediaTypeVideo).first
let type = AVTrackAssociationTypeMetadataReferent

newTrack.addTrackAssociationToTrack(vidTrack, type)
```

AVMutableMovie

Best practices

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However, to do these operations on a changing AVMutableMovie, make a copy of it:

AVMutableMovie

Best practices

An AVMovie or AVMutableMovie is an AVAsset, so you can

- Play it using an AVPlayerItem
- Grab an image using AVAssetImageGenerator
- Export it using AVAssetExportSession

However, to do these operations on a changing AVMutableMovie, make a copy of it:

```
let playerItem = AVPlayerItem(withAsset: mutableMovie.copy)
```

AVMutableMovie

Best practices

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Best practices

When opening assets to insert into an AVMutableMovie,

AVMutableMovie

Best practices

When opening assets to insert into an AVMutableMovie,

- set `AVURLAssetPreferPreciseDurationAndTimingKey` to true

Summary

NEW

New editing features provide access to QuickTime movie file format

Allows simplified editing workflows, especially when handling large amounts of data

Sample code: `AVMovieEditor`

More Information

Documentation and Videos

Documentation

http://developer.apple.com/

Technical Support

Apple Developer Forums

http://developer.apple.com/forums

Developer Technical Support

http://developer.apple.com/support/technical

Related Sessions

AVKit and AV Foundation Lab	Graphics, Games, and Media Lab B	Thursday 11:00AM
AVKit and AV Foundation Lab	Graphics, Games, and Media Lab B	Friday 1:30PM
Editing Media with AV Foundation	Session 407	WWDC10
Harnessing Metadata in Audiovisual Media	Session 505	WWDC14

WWDC15