iPhone Application Programming
Lecture 10: Multimedia and WatchOS

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http://hci.rwth-aachen.de/iphone

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Overview

Overview

	Photos	Audio	Video
User Libraries	UIImagePicker Controller	iPod Library Access	UIImagePicker Controller
Create	UIImagePicker Controller	AVAudioRecorder	UIImagePicker Controller
View	UIImage	AVAudioPlayer SysSound	AVPlayer
Edit	Core Image	Core Audio OpenAL	Core Image

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Images and Movies

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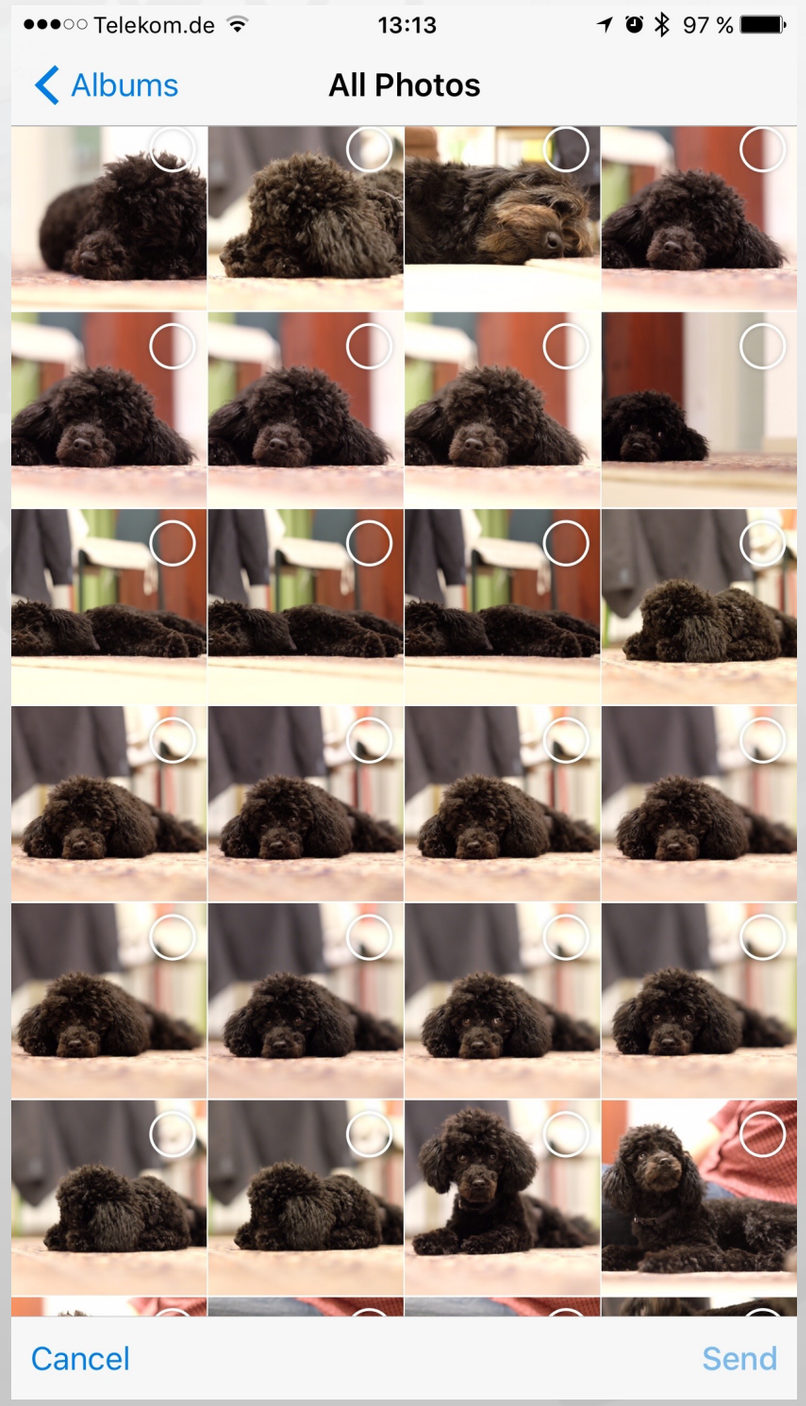
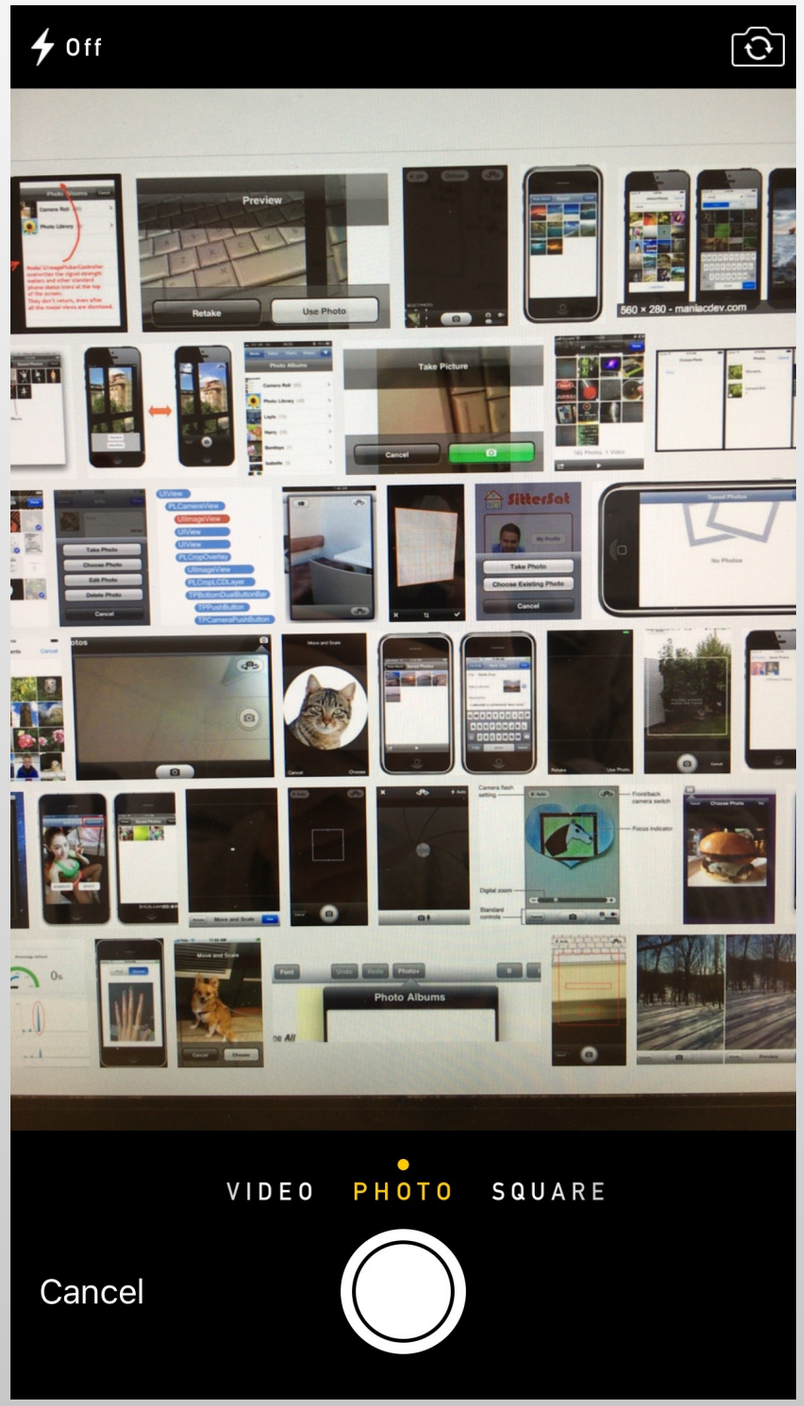
Select or Create





UIImagePickerController

1. Check if source type is available

```
UIImagePickerController.isSourceTypeAvailable(.Camera)
```

2. Check which media types are available

```
UIImagePickerController.availableMediaTypesForSourceType(.Camera)
-> [“public.image", "public.movie"]
```

3. Setup an ImagePickerController for your needs

```
let imagePickerController = UIImagePickerController()
imagePickerController.sourceType = sourceType
imagePickerController.mediaTypes =
    [UIImagePickerControllerOriginalImage]
```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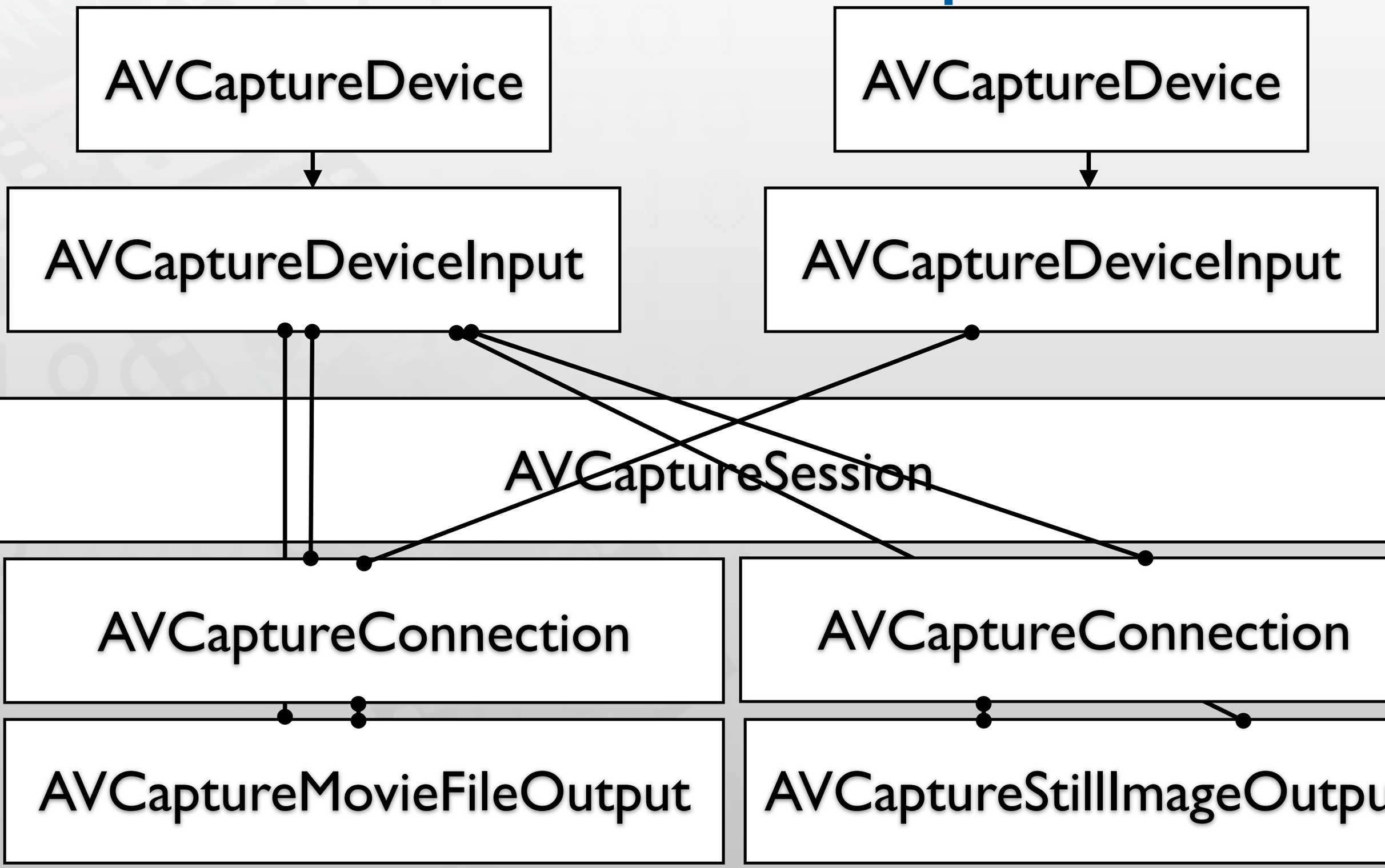
UIImagePickerController

4. Get Results

```
func imagePickerController(picker: UIImagePickerController,
didFinishPickingMediaWithInfo info: [String : AnyObject])
{
    if let image = info[UIImagePickerControllerOriginalImage] as? UIImage {
        self.imageView.image = image
    }
}
```

AVFoundation Capture



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Video Playback

```
let playerViewController = AVPlayerViewController()
    playerViewController.player = AVPlayer(URL: NSURL(string: "")!)

    self.presentViewController(playerViewController, animated: true) {
        playerViewController.player!.play()
    }
```

For PIP:

1. Link to iOS 9
2. Add Audio Background Mode
3. Configure AudioSession for Background Playback

For Airplay:

```
playerViewController.player!.allowsExternalPlayback = true
```


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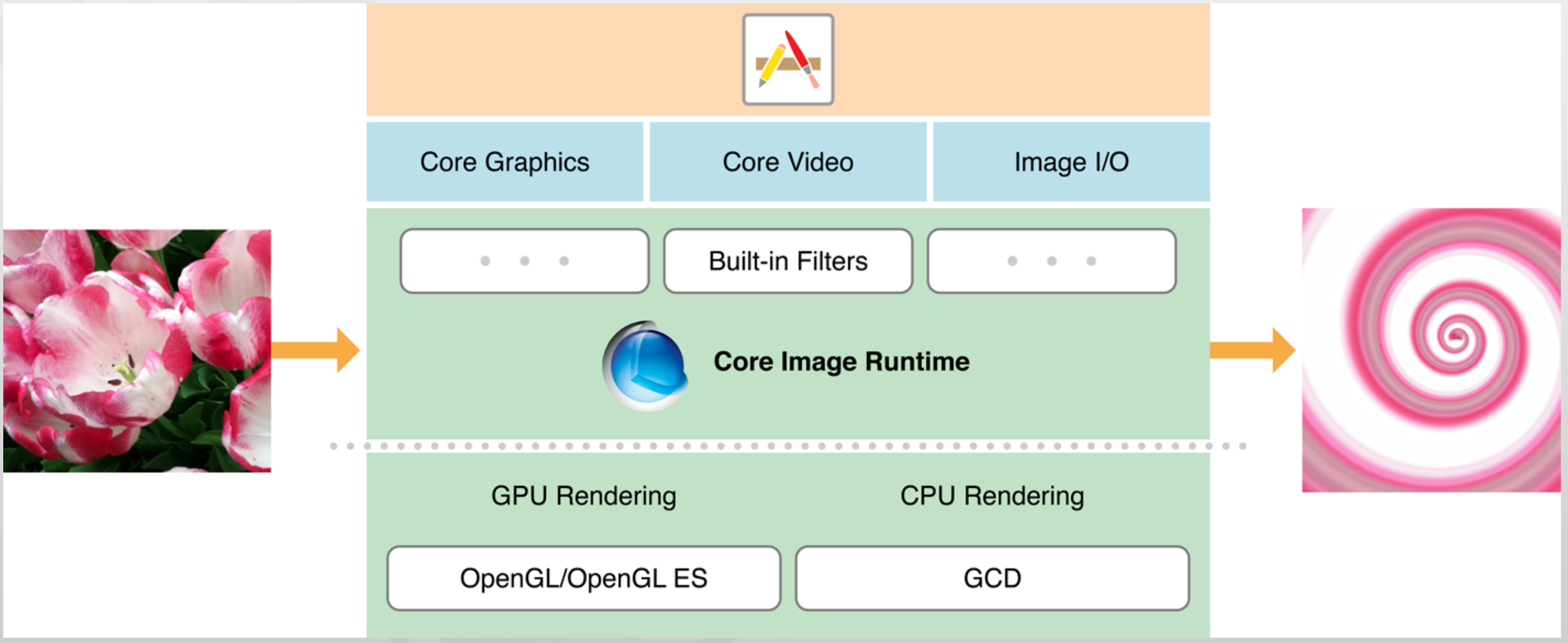
Core Image


Core Graphics
Core Video
Image I/O
Built-in Filters
Core Image Runtime
GPU Rendering
CPU Rendering
OpenGL/OpenGL ES
GCD

Core Image

1. Create a CIContext

```
let context = CIContext()
```

2. Load an Image

```
let ciimage = CIImage(image: image)
```

3. Setup Filters

```
let filter = CIFilter(name: “CIExposureAdjust")
filter.setValue(0.3, forKey: kCIInputEVKey)
```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Core Image

4. Setup filter chain

```
filter.setValue(ciimage, forKey: kCIInputImageKey)
filter2.setValue(filter.outputImage, forKey: kCIInputImageKey)

let result = filter2.valueForKey(kCIOutputImageKey) as! CIImage
```

5. Transform to UIImage

```
let cgimage = context.createCGImage(result, fromRect: result.extent)
let image = UIImage(CGImage: cgimage)
```

Core Image for Video

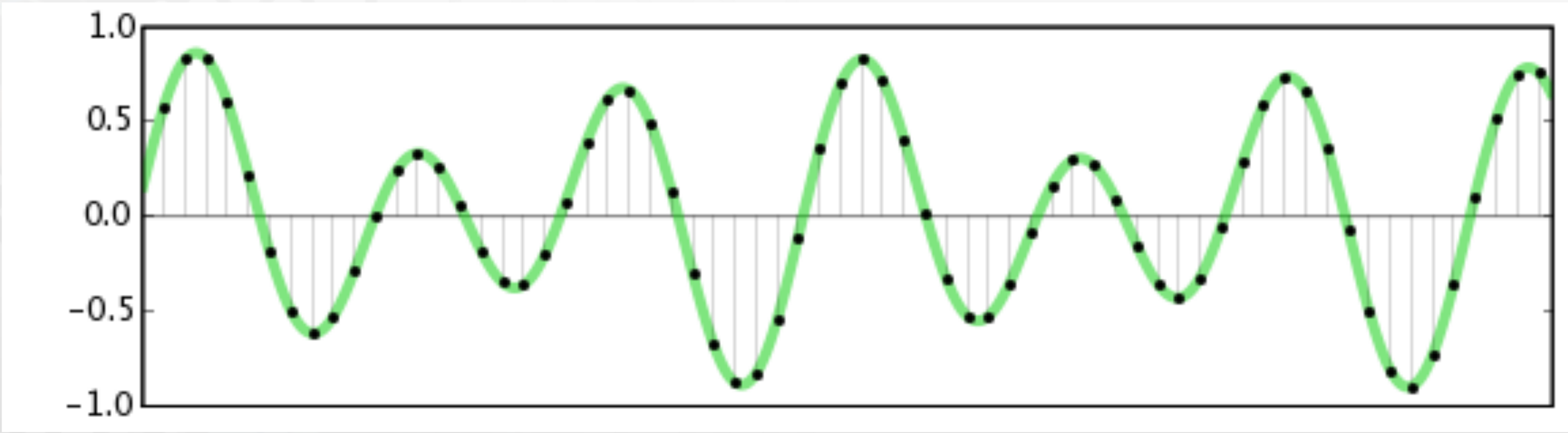
- Use AVPlayer for decoding
- Output to CVPixelBuffer
- Convert to CIImage
- Render CIImage in an OpenGL ES-backed CIContext

Demo

https://www.objc.io/issues/23-video/core-image-video/

Audio Basics

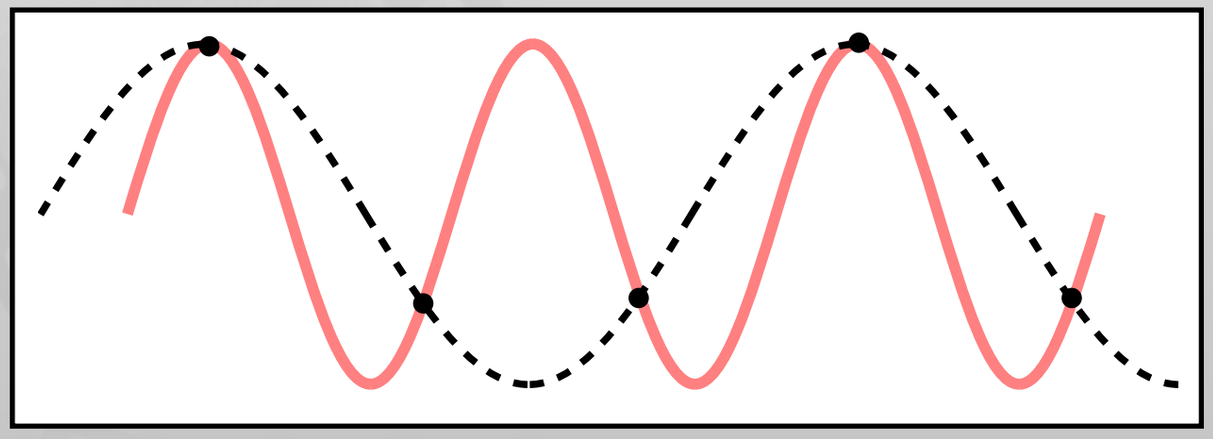
Digital Audio



X Axis Resolution: Sample Rate => min. $2f_{max}$

Y Axis Resolution: Bit Depth

typical: 44.1kHz, 16bit



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Audio Codecs

- Hardware codecs
  - Excellent performance (no CPU load)
  - No simultaneous playback
- Software Codecs
  - Decoding (playback) & encoding (recording)
  - Simultaneous playback

Audio Codecs

Audio decoder/playback format	HW-assisted decoding	SW-based decoding
AAC (MPEG-4 Advanced Audio Coding)	Yes	Yes
ALAC (Apple Lossless)	Yes	Yes
HE-AAC (MPEG-4 High Efficiency AAC)	Yes	
iLBC (internet Low Bitrate Codec, a format for speech)		Yes
IMA4 (IMA/ADPCM)		Yes
Linear PCM (uncompressed, linear pulse-code modulation)		Yes
MP3 (MPEG-1 audio layer 3)	Yes	Yes
µ-law and a-law		Yes

Audio Sessions

- Define the audio behavior of your app
- Express your app's audio intention
  - Should the audio be muted with the Ring/Silent switch?
  - Should the iPod playback continue when you app starts?
- Help to manage interruptions
- Route change notifications

Default Audio Session

- Playback is enabled and recording is disabled.
- The silence switch mutes your audio
- Your audio is silenced when the screen is locked
- Already playing audio (e.g., iPod) is silenced
- However, do not ship your app with the default audio session.

Audio Session Categories

Category	Silenced by the Ring/Silent switch and by screen locking	Allows audio from other applications	Allows audio input (recording) and output (playback)
AVAudioSessionCategoryAmbient	Yes	Yes	Output Only
AVAudioSessionCategorySoloAmbient	Yes	No	Output Only
AVAudioSessionCategoryPlayback	No	No (default) but override switch	Output Only
AVAudioSessionCategoryRecord	No	No	Input Only
AVAudioSessionCategoryPlayAndRecord	No	No (default) but override switch	Input and output
AVAudioSessionCategoryAudioProcessing	—	No	No input or output

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Audio Sessions

```
do {
    let session = AVAudioSession.sharedInstance()
    try session.setCategory(AVAudioSessionCategoryPlayback)
    try session.setActive(true)
} catch let e as NSError {
    print(e.localizedDescription)
}
```

Handling Audio Interruptions

- Interruption starts
  - Check wether resumption of audio process is supported
  - Save state and context
  - Update user interface
- Interruption ends
  - Restore state and context
  - Reactivate audio session
  - Update user interface

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Handling Interruptions

```
// Register for the interruption notifications

    NSNotificationCenter.defaultCenter().addObserver(self, selector:
"handleInterruption:",
name: AVAudioSessionInterruptionNotification,
object: AVAudioSession.sharedInstance())
```

Handling Interruptions

```
func handleInterruption(notification: NSNotification) {
    if let interruptionTypeInt = notification.userInfo?[AVAudioSessionInterruptionTypeKey]
as? UInt,
        interruptionType = AVAudioSessionInterruptionType(rawValue: interruptionTypeInt)
    {
        switch interruptionType {
        case .Began:
            print("Interruption Began")
        case .Ended:
            print("Interruption Ended")
        }
    }
}
```


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Reacting to Route Changes

- A route consists of ports
- Input ports (for example):
  - Wired microphone
- Output ports (for example):
  - Built-in speaker
  - Bluetooth A2DP output
- If the user plugs/unplugs a wired headset, the route changes and the app should react accordingly.

Reacting to Route Changes

```
Old outputs: (
"<AVAudioSessionPortDescription: 0x17800edb0, type = Speaker;
name = Speaker; UID = Speaker; selectedDataSource = (null)>"
)
New outputs : (
"<AVAudioSessionPortDescription: 0x17800ee50, type = Headphones;
name = Headphones; UID = Wired Headphones; selectedDataSource =
(null)>"
```

Audio Routes

- Route can be overridden
  - Output should remain on speaker
  - Input should be the device microphone (not the headset)
  - Input should be one specific microphone (on multi-microphone devices)

AVAudioPlayer

- Plays any supported file format
- Play sounds of arbitrary length
- Files or memory buffers
- Loop
- Simultaneous playback
- Volume level control
- Seek to a point in an audio file
- Audio power data

Audio Playback

```
player = try! AVAudioPlayer(contentsOfURL: url)
player.prepareToPlay()

self.player.play()
```

System Sounds

- File requirements
  - No longer than 30s
  - Linear PCM or IMA4
  - .caf, .aif, or .wav file

- Capabilities
  - Current volume, no programmatic control
  - Playback starts immediately
  - Only one sound at a time

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System Sound

```
//Setup
let url = NSBundle.mainBundle().URLForResource("tap", withExtension: "aif")!
AudioServicesCreateSystemSoundID(url, &systemSound)

//Play
AudioServicesPlaySystemSound(systemSound)

//Play and/or vibrate
AudioServicesPlayAlertSound(systemSound)

//Vibrate only
AudioServicesPlaySystemSound(kSystemSoundID_Vibrate)
```


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AVAudioRecorder

```
let session = AVAudioSession.sharedInstance()
let path = NSTemporaryDirectory() + "sound.caf"
self.recordURL = NSURL(fileURLWithPath: path)

try! session.setCategory(AVAudioSessionCategoryPlayAndRecord)
try! session.setActive(true)
```

AVAudioRecorder

```
session.requestRecordPermission { (success) -> Void in
    if (!success) { return }
    if let existingURL = self.recordURL {
        let settings: [String:AnyObject] = [
            AVSampleRateKey: 44100.0,
            AVFormatIDKey: Int(kAudioFormatAppleLossless),
            AVNumberOfChannelsKey: 1,
            AVEncoderAudioQualityKey: AVAudioQuality.Max.rawValue
        ]

        if let recorder = try? AVAudioRecorder(URL: existingURL, settings: settings) {
            self.recorder = recorder

            recorder.delegate = self
            recorder.prepareToRecord()
            recorder.record()
        }
    }
}
```

iPod Library Access

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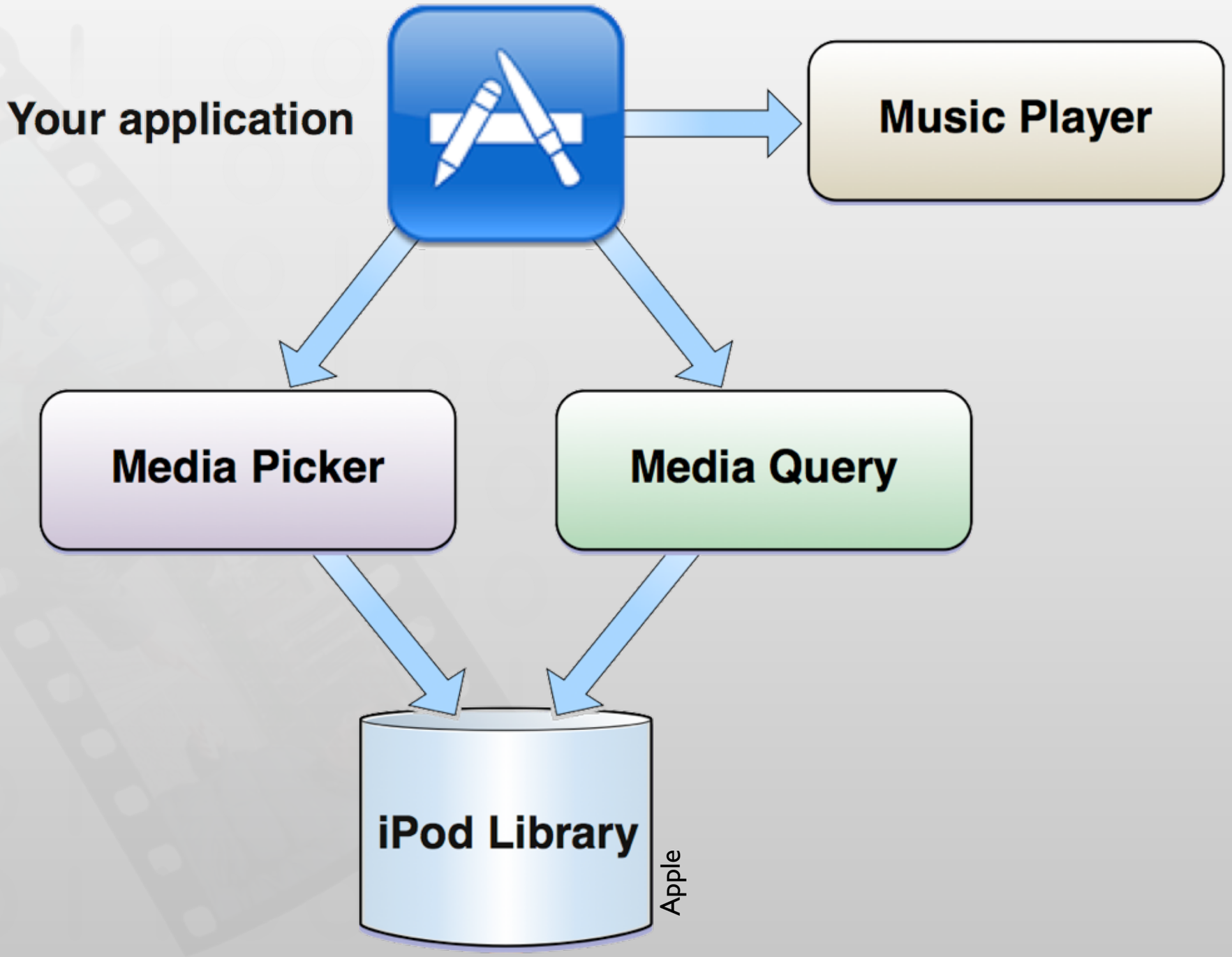
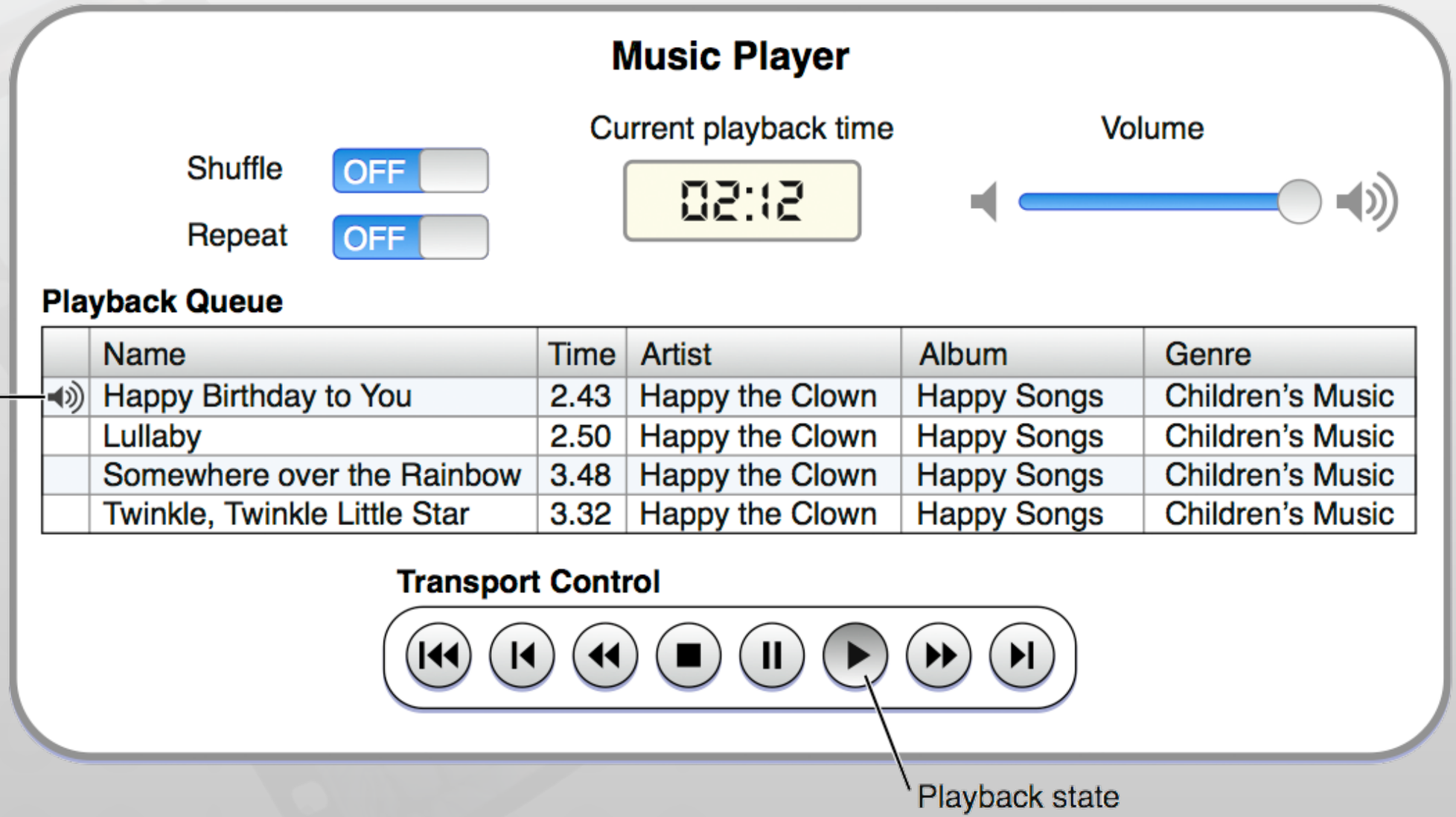
iPod Library Access



Music Player Terminology

- Music player is an object that plays media items
- A playback queue is a list of media items to play
- A media item is a song, audio podcast or an audio book
- The set of media items is called the iPod library

Music Players



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Music Player Basic Example

```
@IBAction func pickTracks(sender: AnyObject) {
    let picker = MPMediaPickerController(mediaTypes: .Music)
    picker.allowsPickingMultipleItems = true
    picker.delegate = self
    self.presentViewController(picker, animated: true, completion: nil)
}

extension ViewController : MPMediaPickerControllerDelegate {
   func mediaPicker(mediaPicker: MPMediaPickerController, didPickMediaItems
mediaItemCollection: MPMediaItemCollection) {
    self.dismissViewControllerAnimated(true, completion: nil)

    let player = MPMusicPlayerController.systemMusicPlayer()
    player.setQueueWithItemCollection(mediaItemCollection)

    player.play()
   }
}
```


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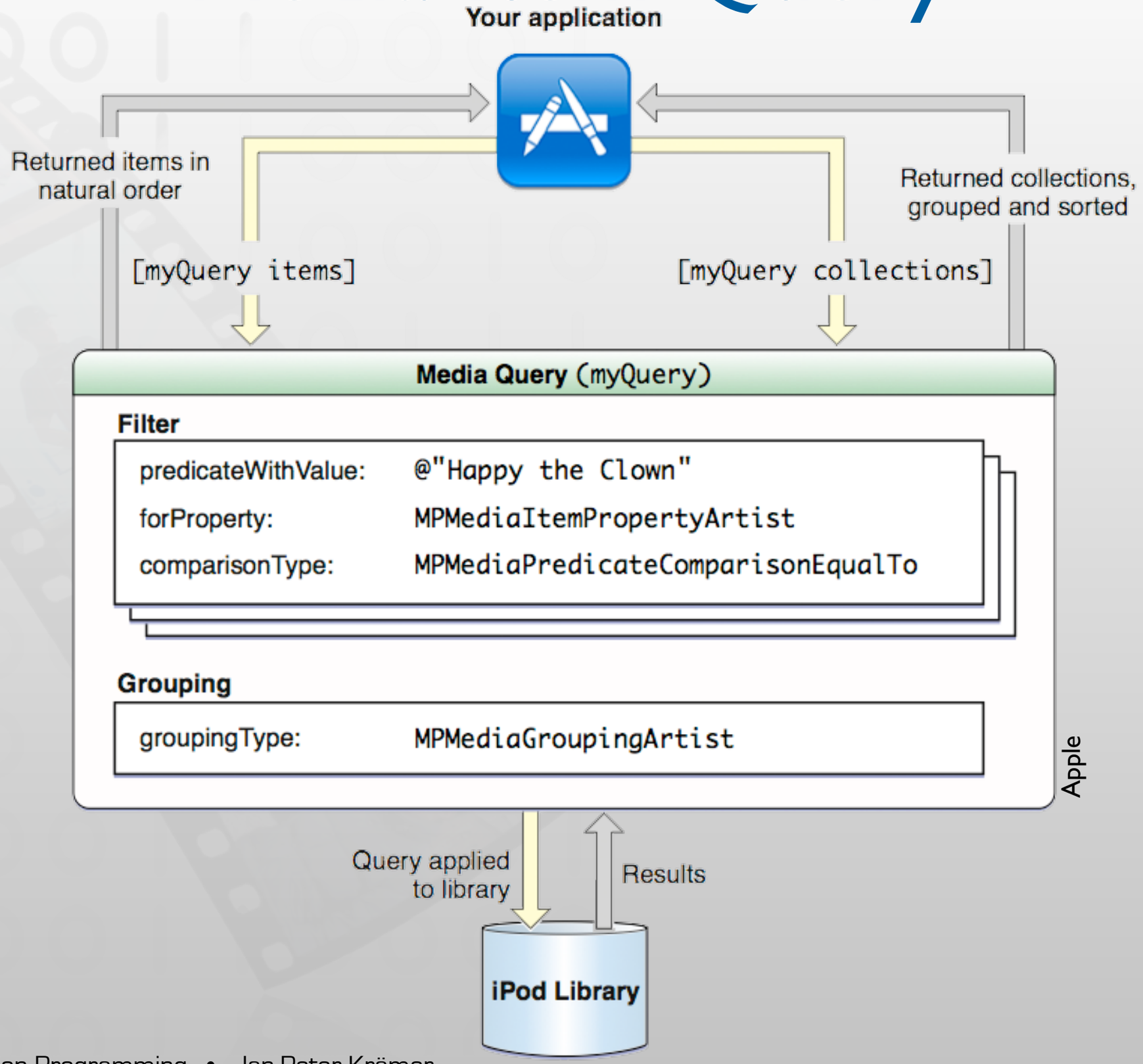
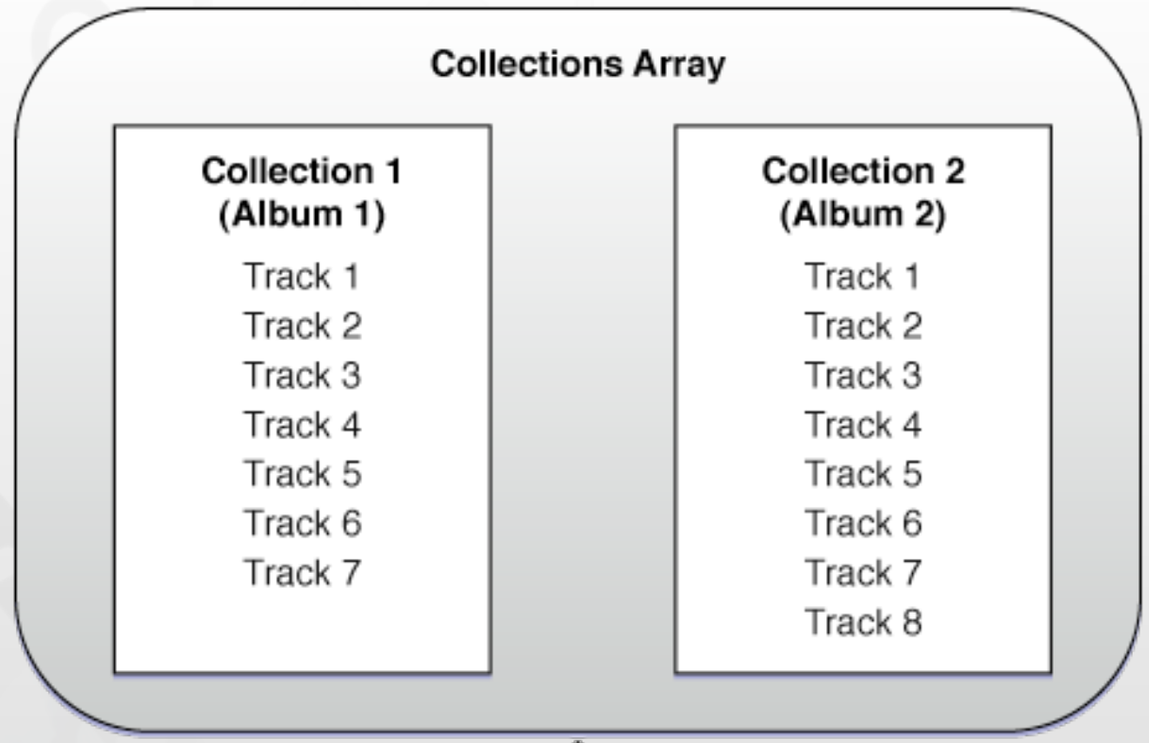
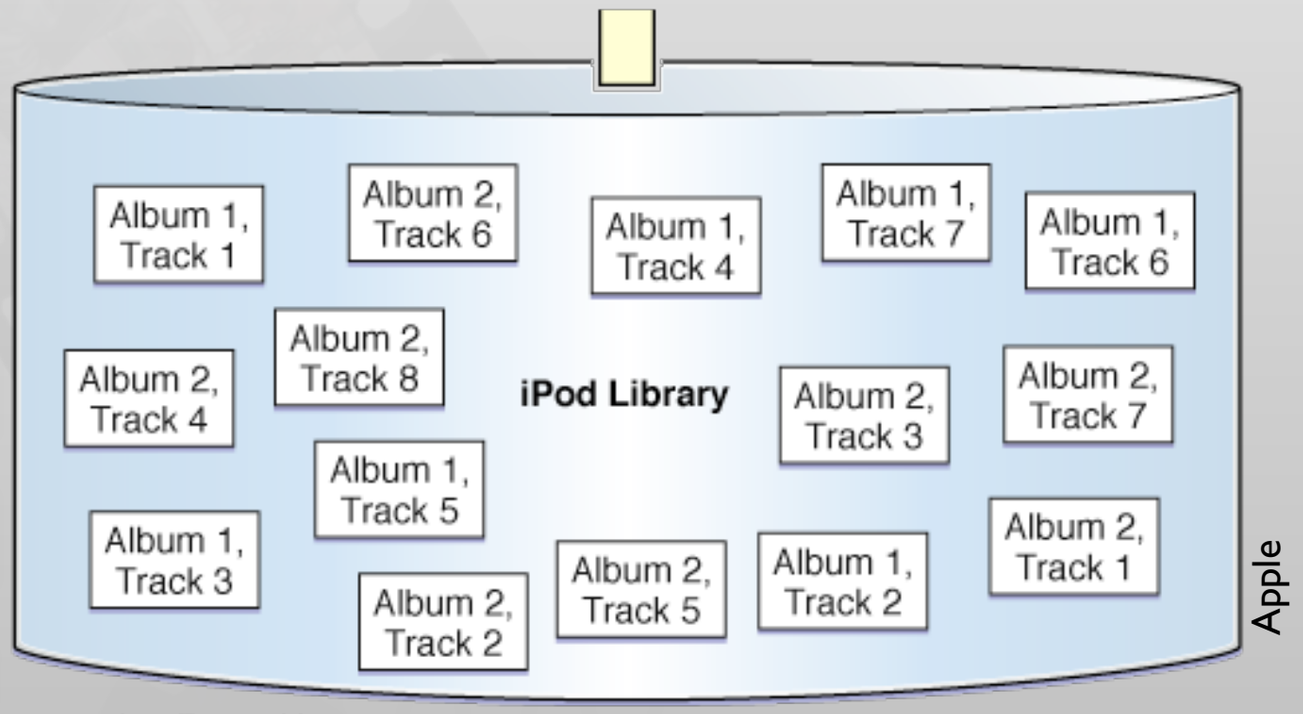
Media Item Query






```
MPMediaQuery *myQuery = [[MPMediaQuery] alloc] init];
[myQuery setGroupingType: MPMediaGroupingAlbum];
NSArray *myCollections = [myQuery collections];
```



Advanced Audio

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AVAudioEngine

- Powerful API for real-time audio
- Read and write audio files
- Play and record using files and buffers
- Audio processing
- Spatial audio

AVAudioEngine

- Works on a processing graph
- The graph consists of connected AVAudioNodes
  - AVAudioOutputNode
  - AVAudioMixerNode
  - AVAudioPlayerNode
  - AVAudioUnit
- The engine sets up the graph by connecting the nodes
- Start/stop the engine to control playback

AVAudioNode

- Source
  - Player, microphone
- Process
  - Mixer, effect
- Destination
  - Speaker

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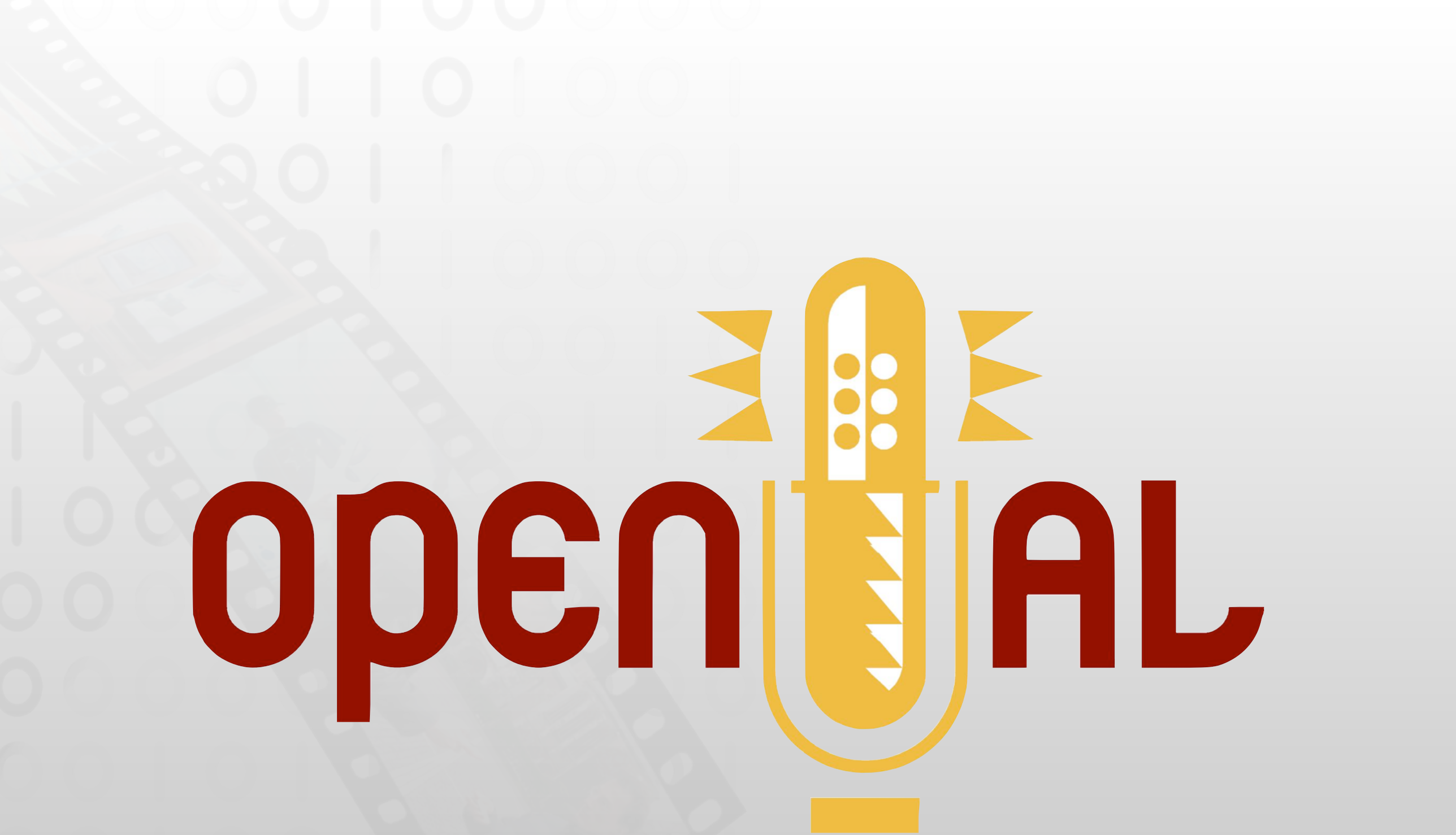
Effect nodes

- Effect
  - Delay
  - Distortion
  - EQ
  - Reverb
- Time effects
  - Varispeed
  - TimePitch

AVAudioEnvironmentNode

- Rendering algorithms
  - Equal power panning
  - Spherical head
  - HRTF
  - Sound field
- Input
  - Position
  - Orientation
  - Obstruction, occlusion
  - Distance attenuation
  - Reverberation


openAL

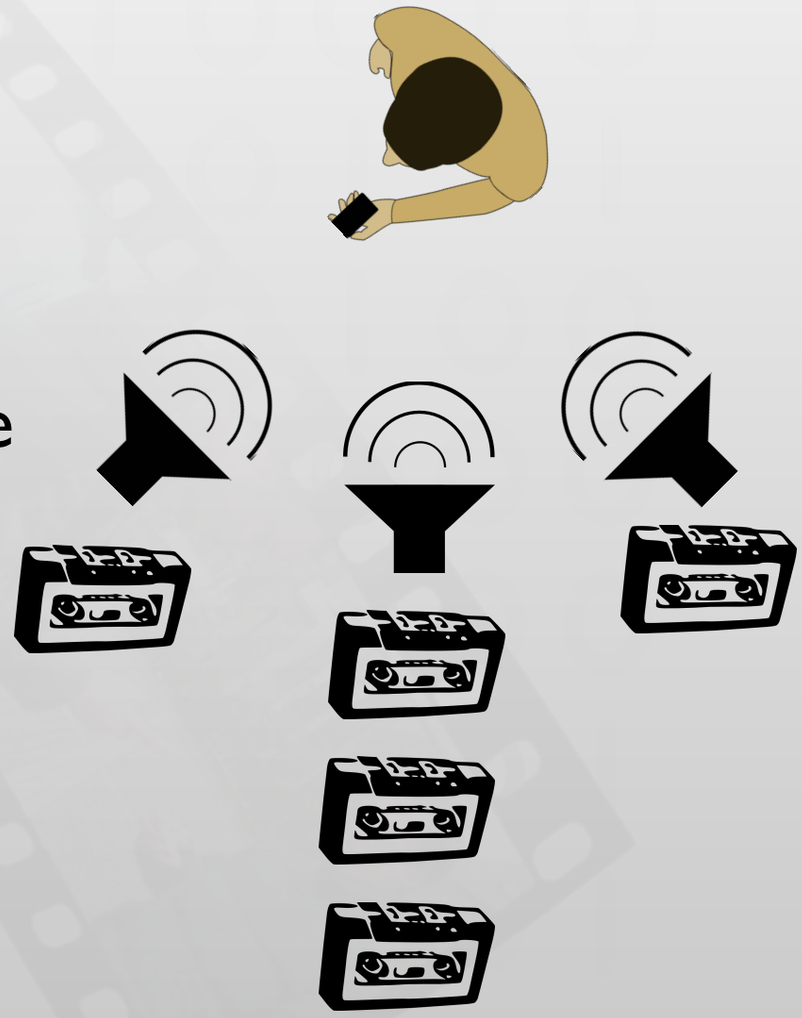
Demo

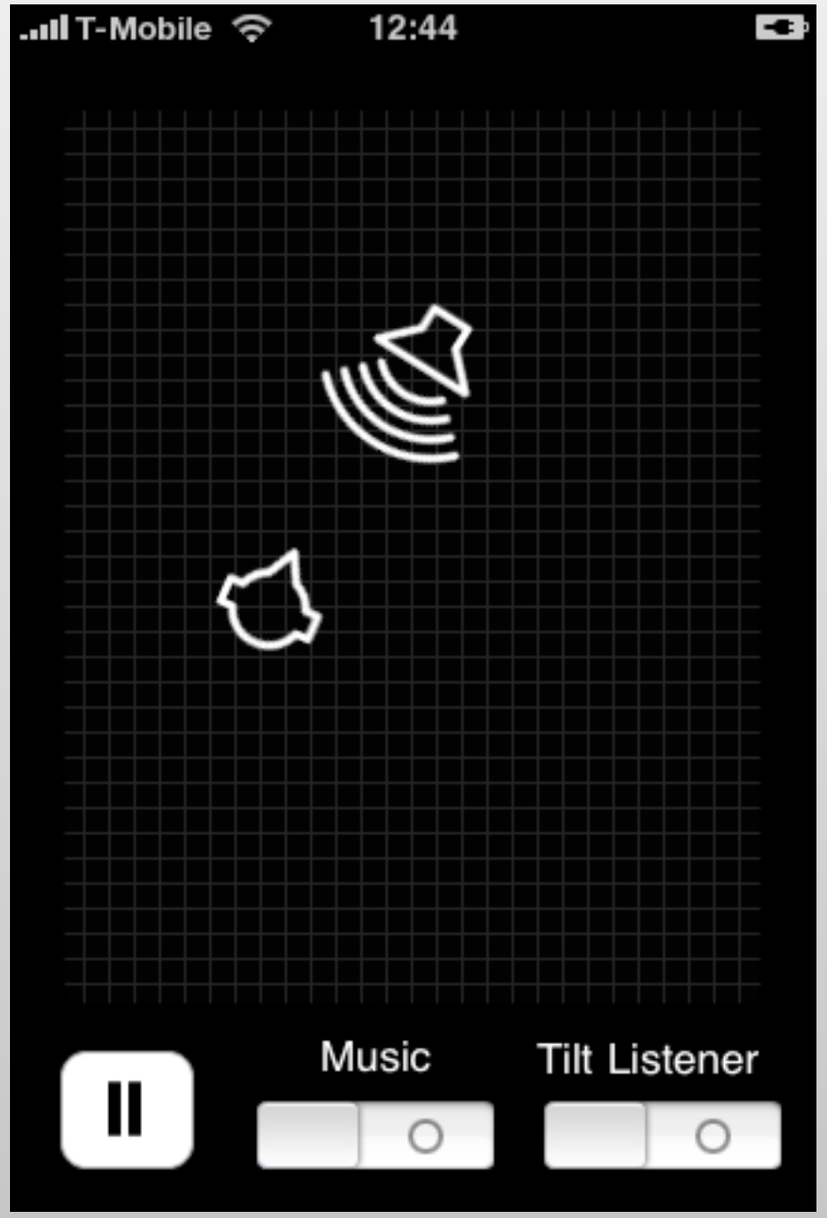
OpenAL

- Spatial audio rendering framework
- Similar to OpenGL
- Define the scene, let the system do the rest
- Simultaneous playback of several sources

OpenAL Primitives

- Listener
- Sound Source
- Sound Buffer





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More Audio

- Audio Units
- Inter-App Audio
- Audio queue services
- Core MIDI

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WatchOS

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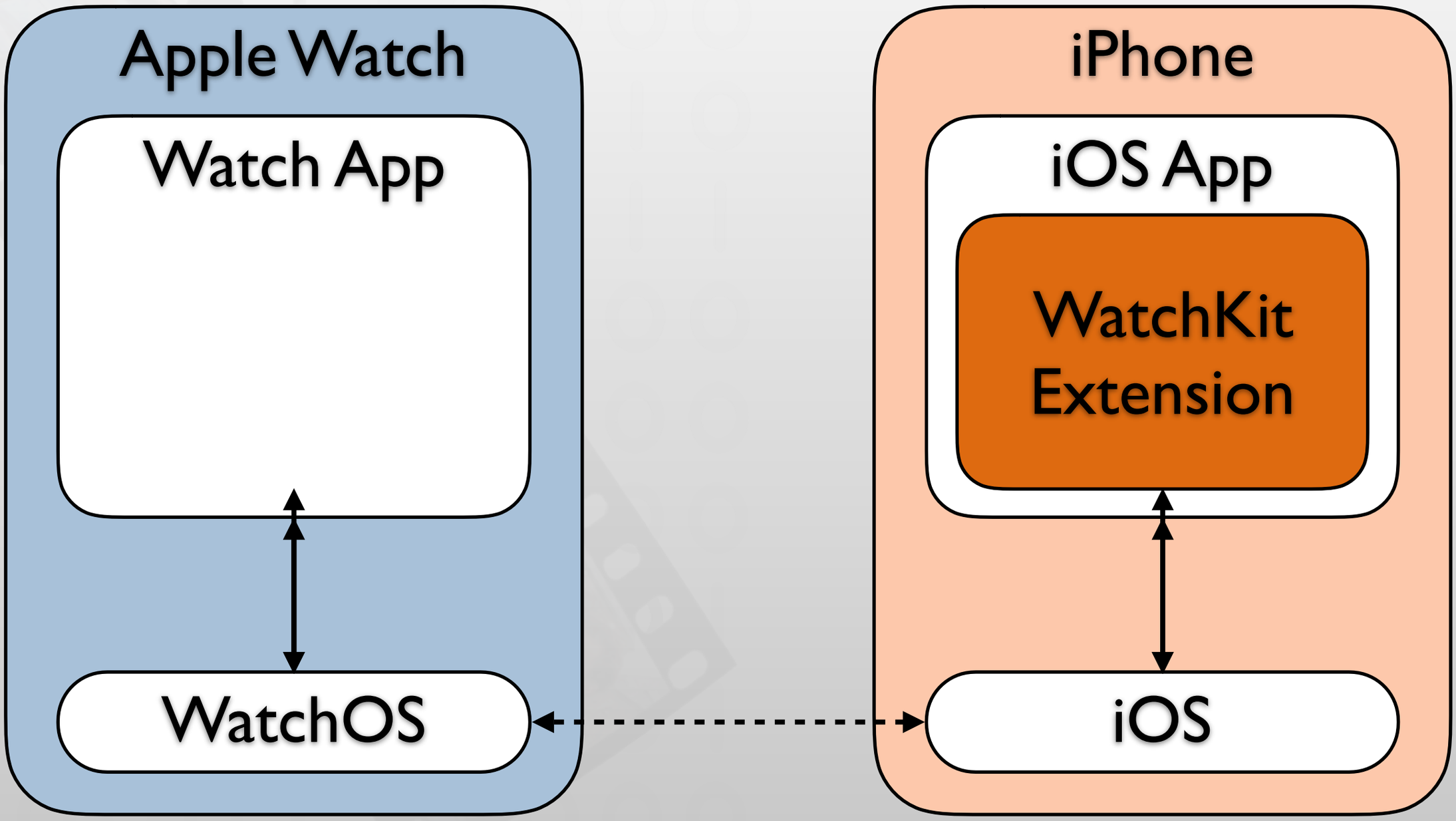
Architecture



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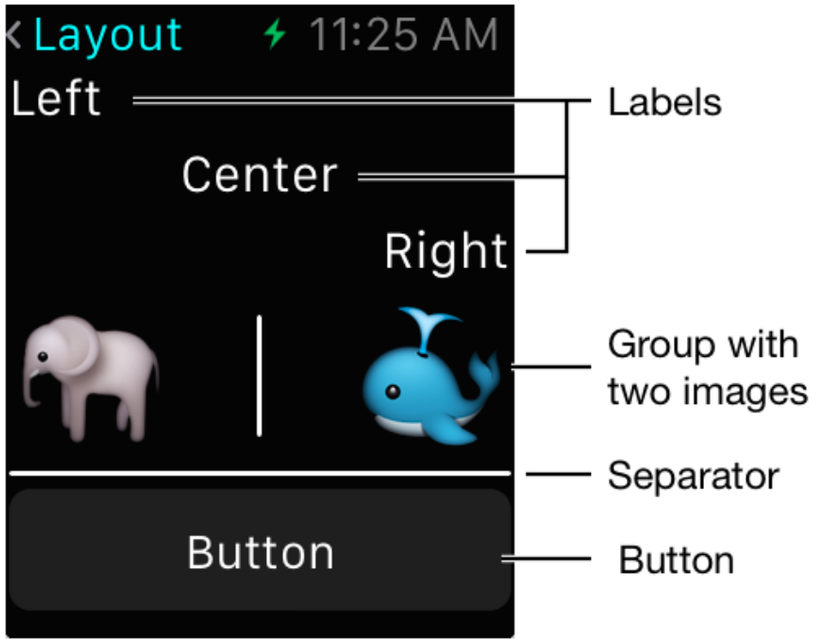
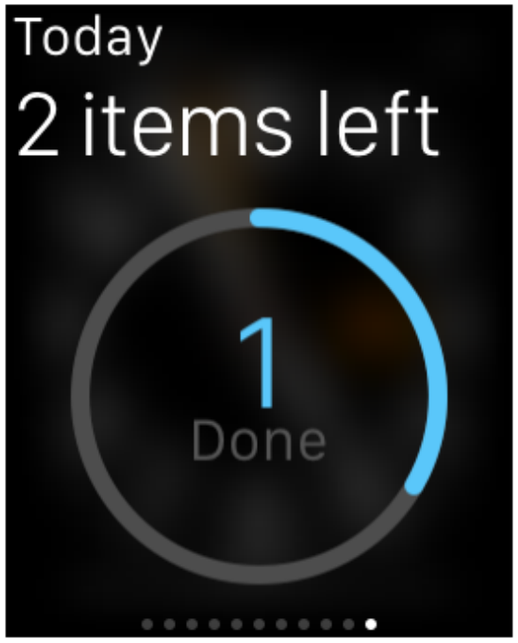
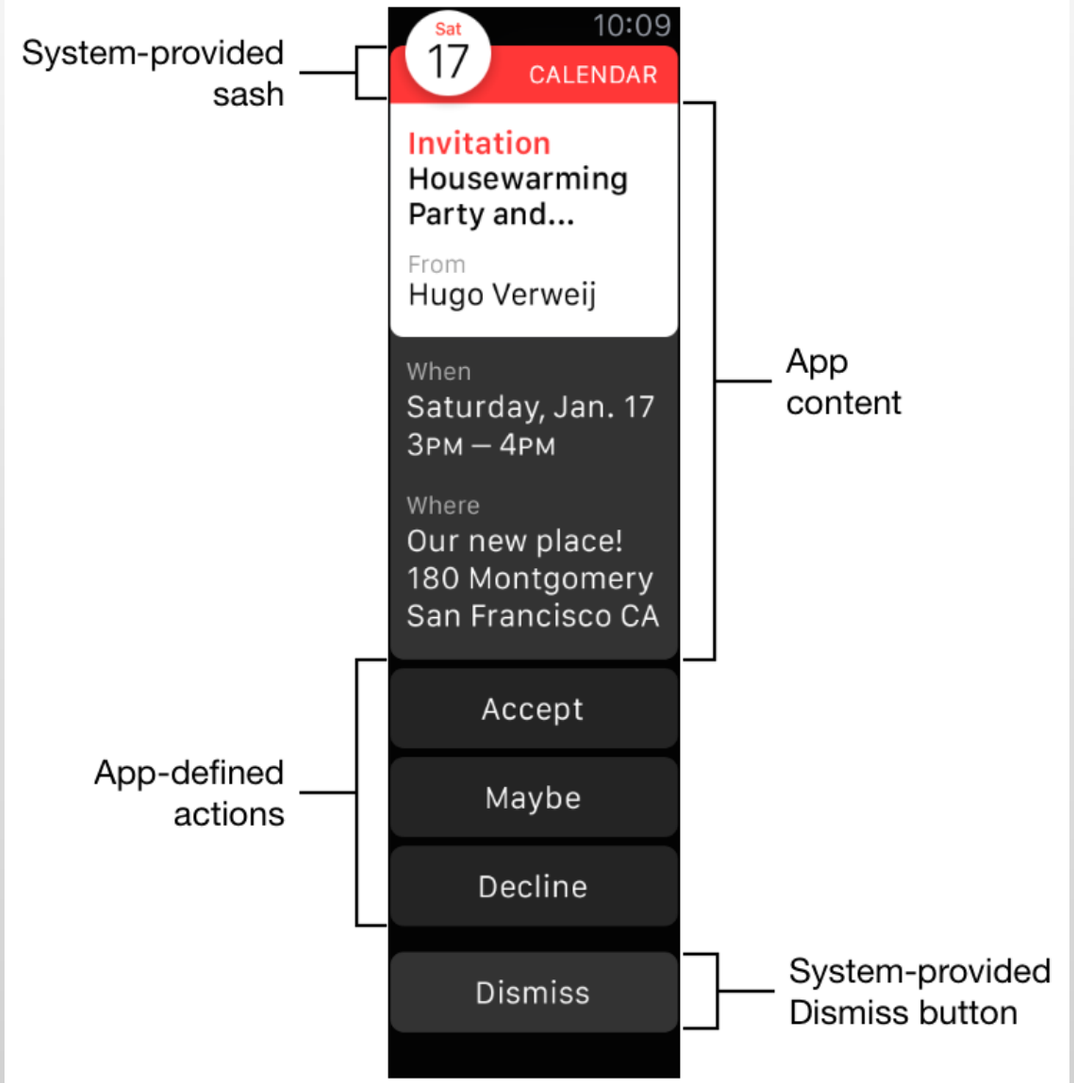
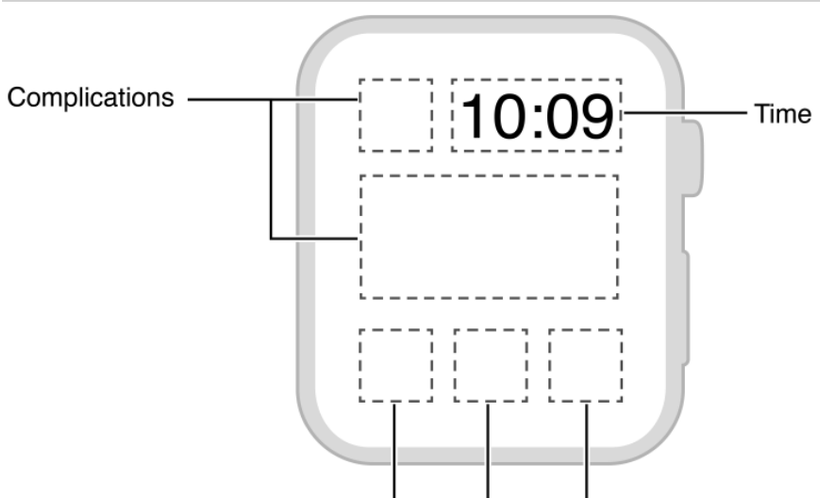
Parts of a WatchKit App









Communicate with iOS

- No Background execution
- Permission requests sometimes need to be answered on the iPhone
- Handoff long-running tasks to the iPhone

WatchConnectivity

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Watch Connectivity

1. Check if WC is available

```
WCSession.isSupported()
```

2. Activate Session

```
let session = WCSession.defaultSession()
session.delegate = self
session.activateSession()
```


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Watch Connectivity

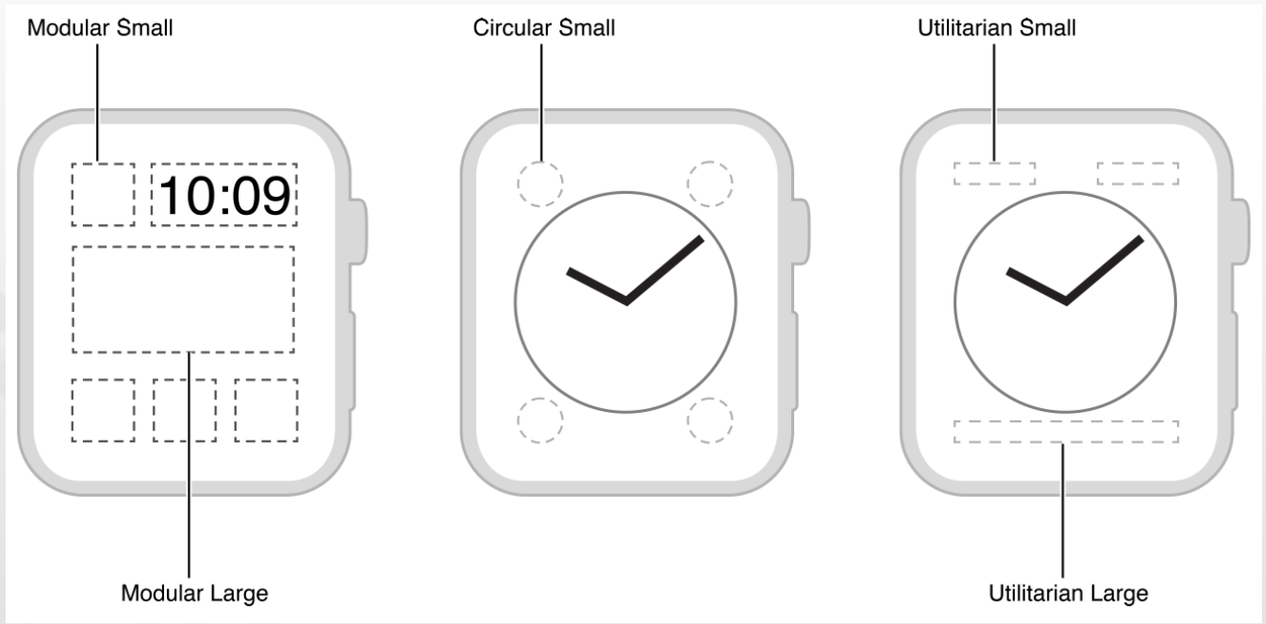
Send Messages

```
session.sendMessage(["info": "Hello"], replyHandler: {
    (response) -> Void in
    }, errorHandler: { (ErrorType) -> Void in
    })
```

Background transfer

```
session.transferUserInfo([String: AnyObject])
session.transferFile(url, metadata: [String: AnyObject])
session.transferCurrentComplicationUserInfo([String: AnyObject])
```

Complications



- Implement one class conforming to CLKComplicationDataSource
- Implement at least:

```
func getCurrentTimelineEntryForComplication(complication: CLKComplication,
withHandler handler: (CLKComplicationTimelineEntry?) -> Void)
func getSupportedTimeTravelDirectionsForComplication(complication: CLKComplication,
withHandler handler: (CLKComplicationTimeTravelDirections) -> Void)
func getTimelineEntriesForComplication(complication: CLKComplication, afterDate date:
NSDate, limit: Int, withHandler handler: ([CLKComplicationTimelineEntry]?) -> Void)
```

Complications show Entries on a Timeline

⚽ 11:00AM
Haight – Twin Peaks
Group D

⚽ 1:30PM
Bernal – Presidio
Group C

⚽ 4:00PM
SOMA – Castro
Group A

⚽ 6:00PM
Sunset – Marina
Group B

Complications show Entries on a Timeline

eaks

⚽ 1:30PM
Bernal – Presidio
Group C

⚽ 6:00PM
Sunset – Marina
Group B

Complications show Entries on a Timeline

Demo

http://www.raywenderlich.com/117298/watchos-2-tutorial-part-3-animation

Summary

- WatchOS apps comprised of
  - App
  - Glances
  - Notifications
  - Complications
- Further Reading
  - WatchKit Programming Guide
  - watchOS 2 Transition Guide
  - Watch Connectivity Framework Reference