Media

#WWDC15

# What's New in Core Audio

Session 507

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Torrey Holbrook Walker Senior New Feature Salesperson

# Agenda

AVAudioEngine

- Recap
- What's New

Inter-device Audio

AVAudioSession

- What's New

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Audio Unit Extensions — Nob Hill — Thursday 11:00 AM

# AVAudioEngine

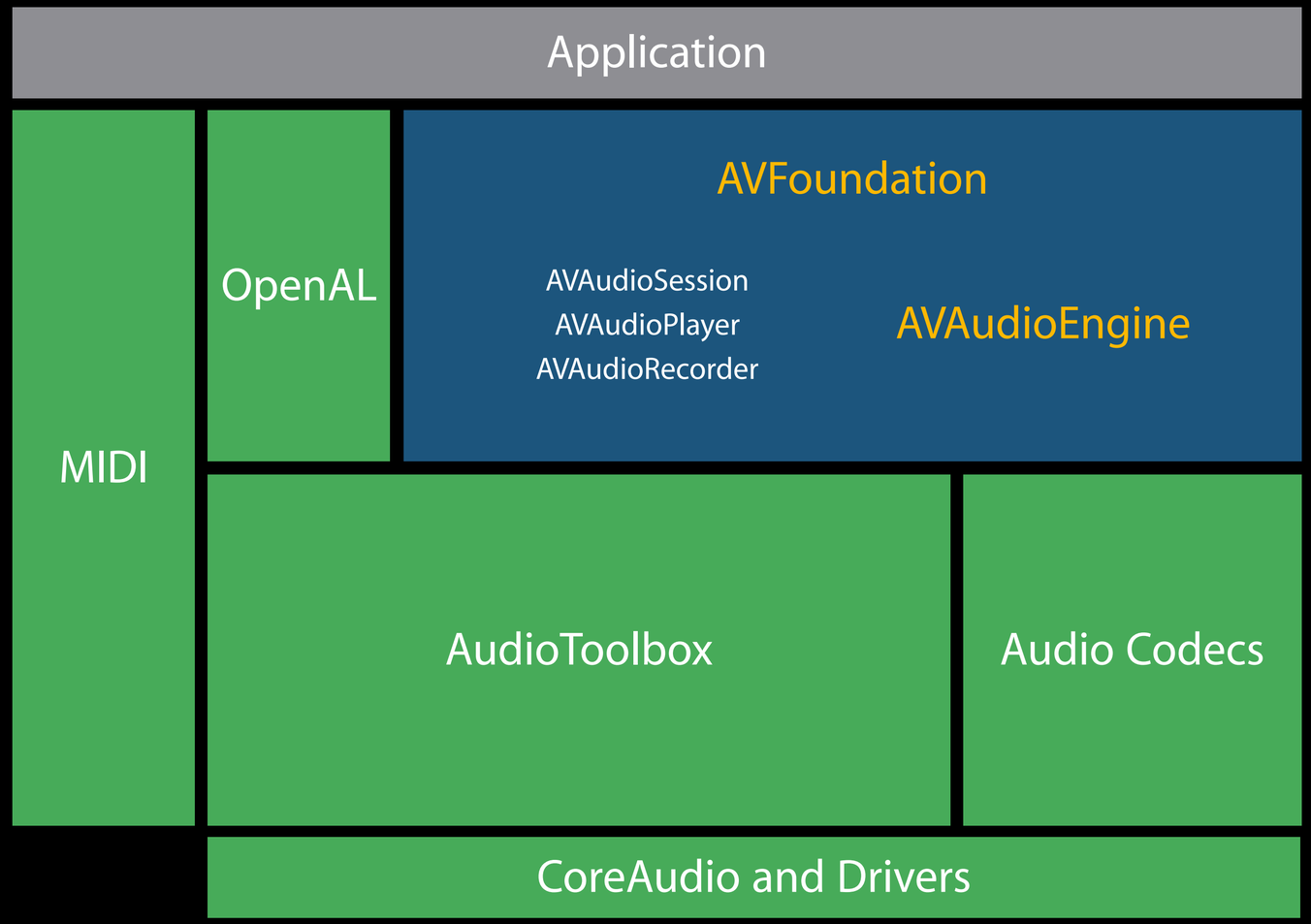
## Recap

# Core Audio Stack

## iOS and OS X

AVAudioEngine

- Introduced in iOS 8.0/OS X 10.10
- Refer to WWDC14 session 502
  AVAudioEngine in Practice



# AVAudioEngine

## Goals

Provide powerful, feature-rich API set

Achieve simple as well as complex tasks

Simplify real-time audio

# AVAudioEngine

## Features

Objective-C / Swift API set

Low latency, real-time audio

Play and record audio

Connect audio processing blocks

Capture audio at any point in the processing chain

Implement 3D audio for games

# AVAudioEngine

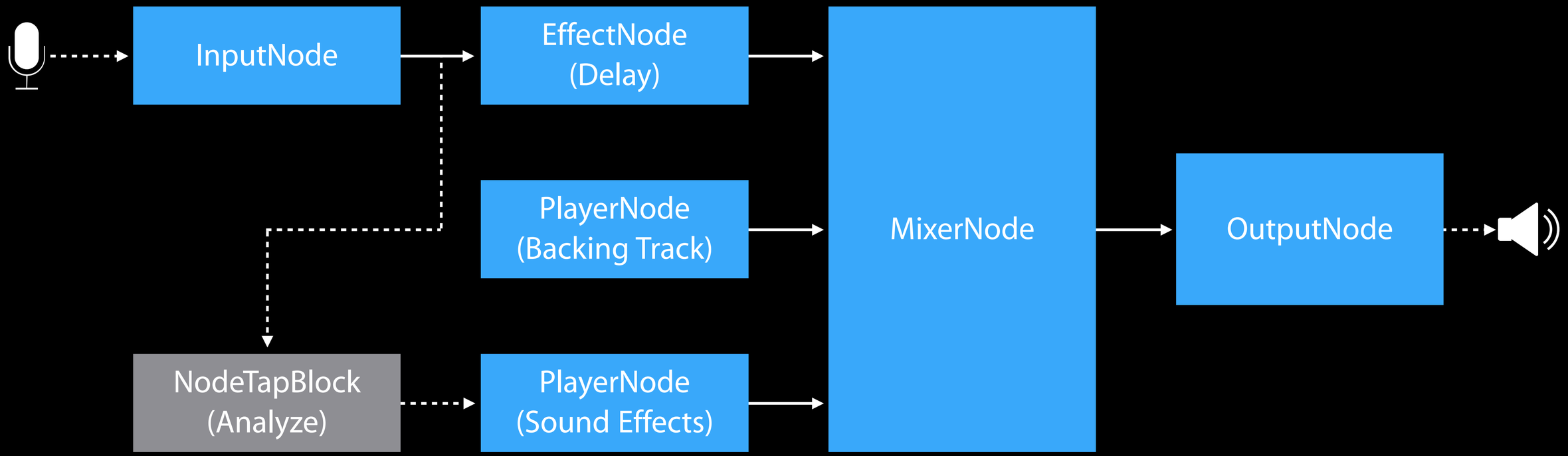
## Building blocks

Node-AVAudioNode

- Source nodes: Provide data for rendering
- Processing nodes: Process data
- Destination node: Terminating node connected to output hardware

# Sample Engine Setup

## Karaoke



# Sample Engine Setup

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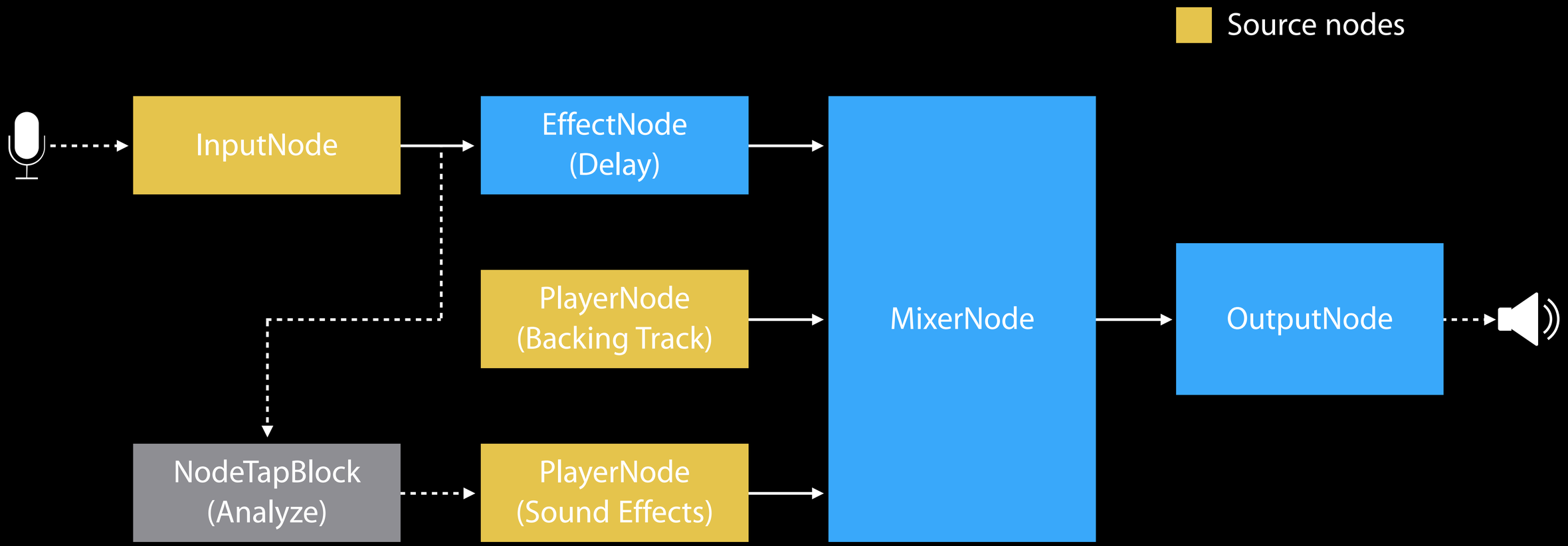

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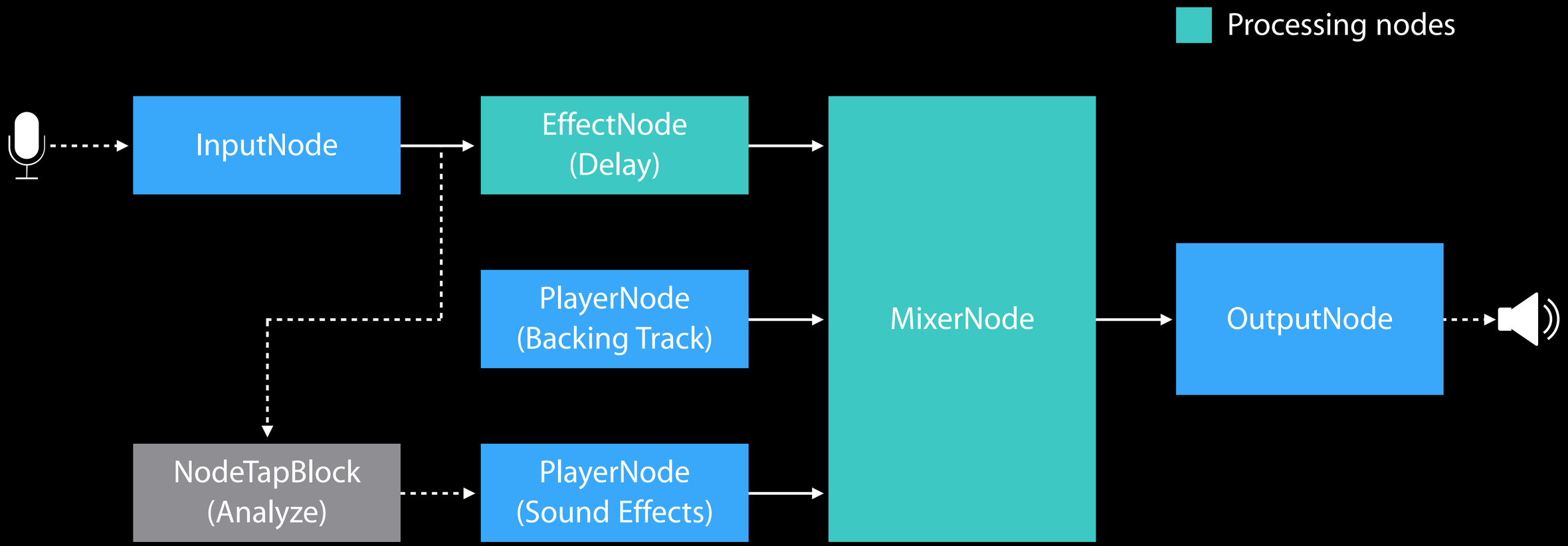

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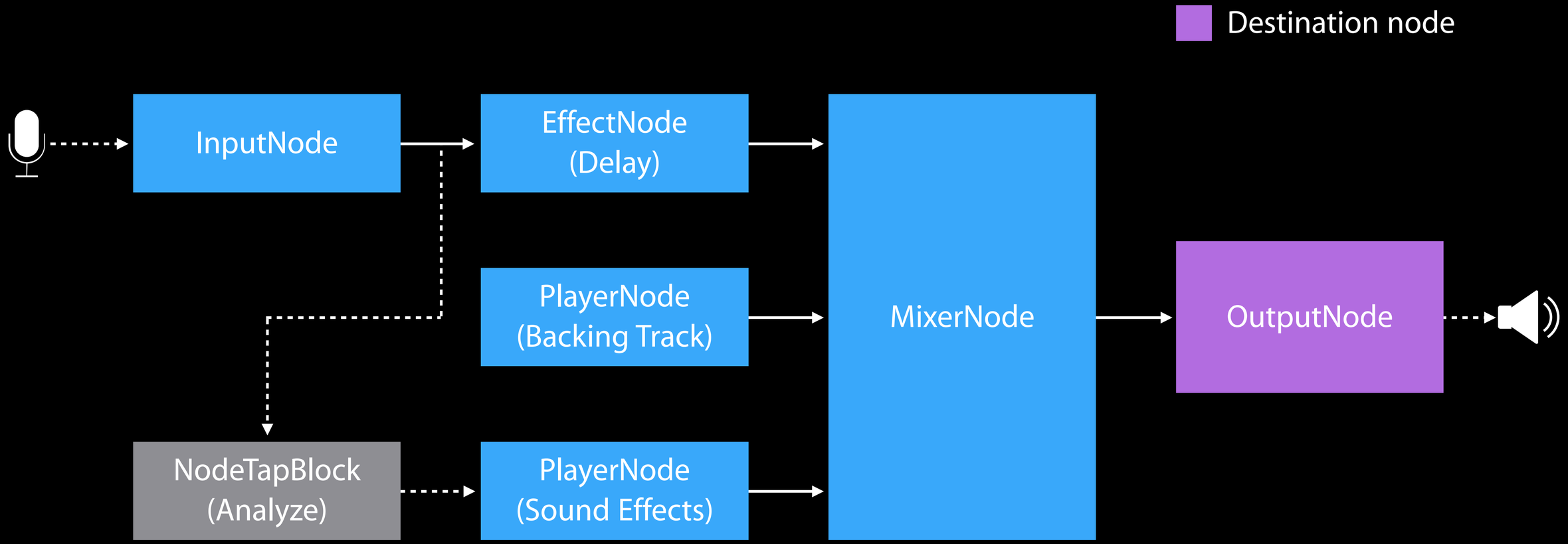
## Karaoke



# Mixer Nodes

AVAudioMixerNode

- Performs sample rate conversion, up/down mixing of channels
- Supports mono, stereo and multichannel inputs

AVAudioEnvironmentNode

- Simulates a 3D space (listener is implicit)
- Supports mono and stereo inputs
- Spatializes only mono inputs

# AVAudioMixing Protocol

Defines properties for a mixer input bus

Source nodes conform to this protocol

- Properties cached when not connected to a mixer
- Properties applied on connection to a mixer

# AVAudioMixing Protocol

## Properties

Common (all mixer nodes)

- volume - `player.volume = 0.5`

Stereo (AVAudioMixerNode)

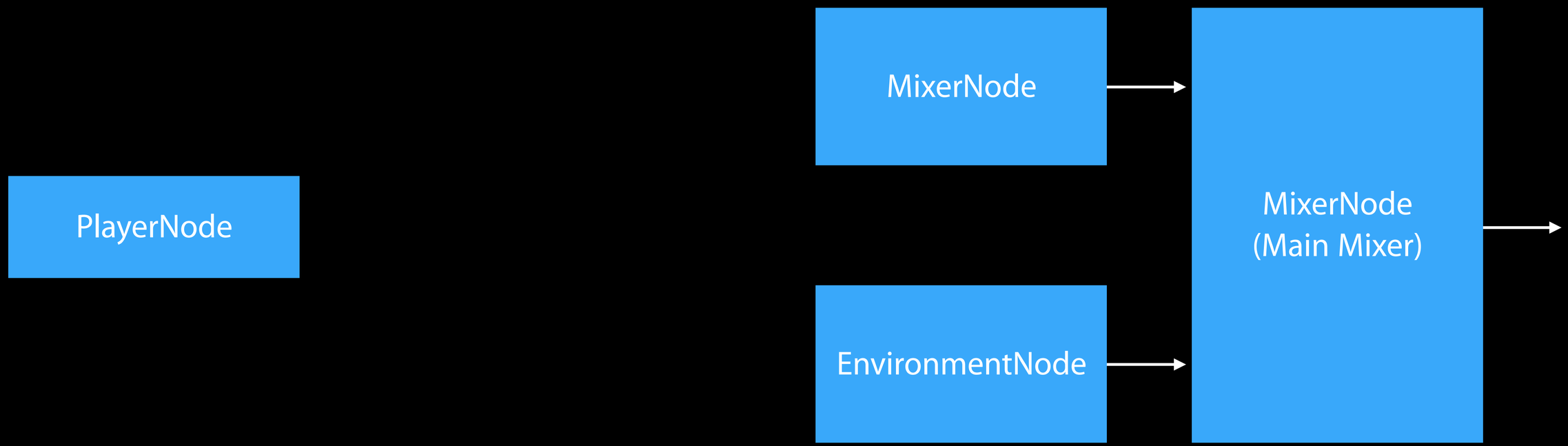
- pan - `player.pan = -1.0`

3D (AVAudioEnvironmentNode)

- position - `player.position = AVAudioMake3DPoint(-2.0, 0.0, 5.0)`
- obstruction, occlusion, renderingAlgorithm and more…

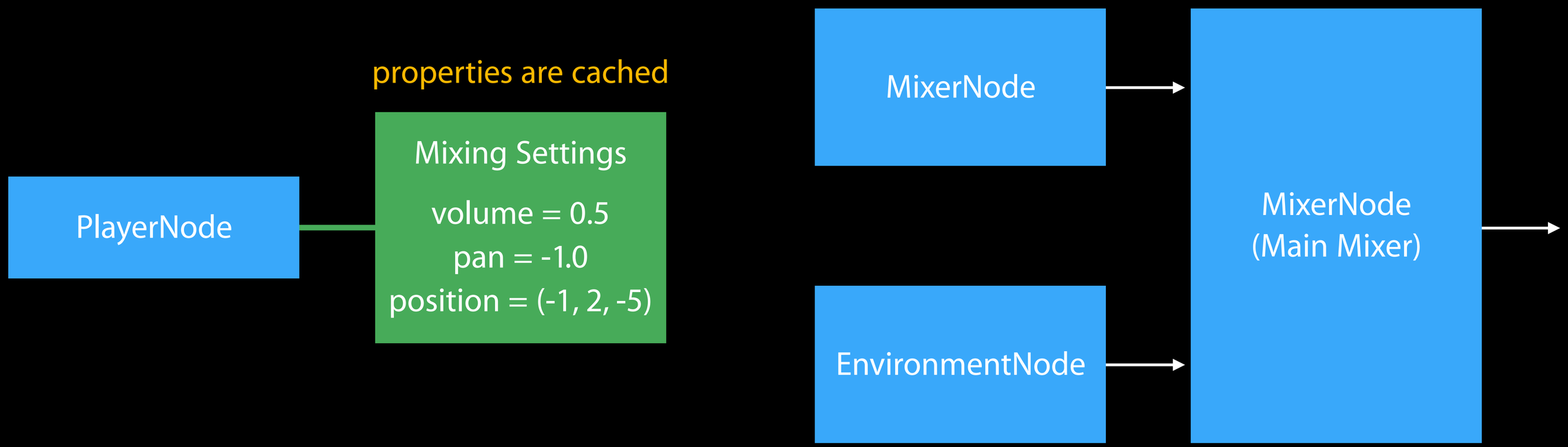
# AVAudioMixing Protocol

## Sample setup



# AVAudioMixing Protocol

## Sample setup



# AVAudioMixing Protocol

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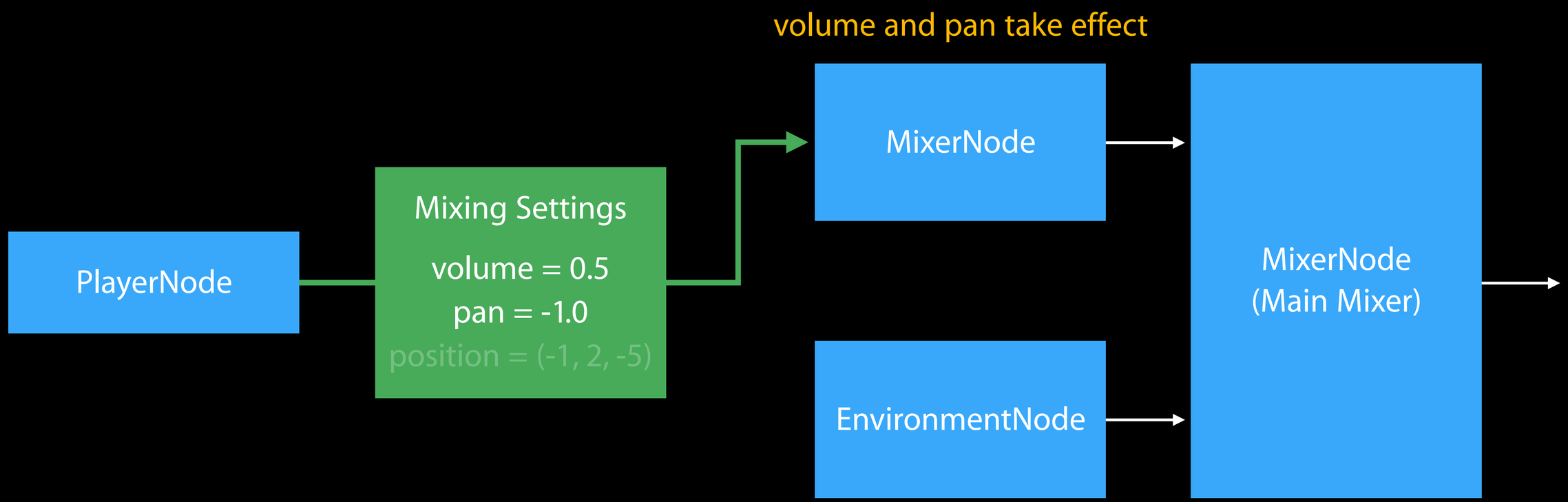

# AVAudioMixing Protocol

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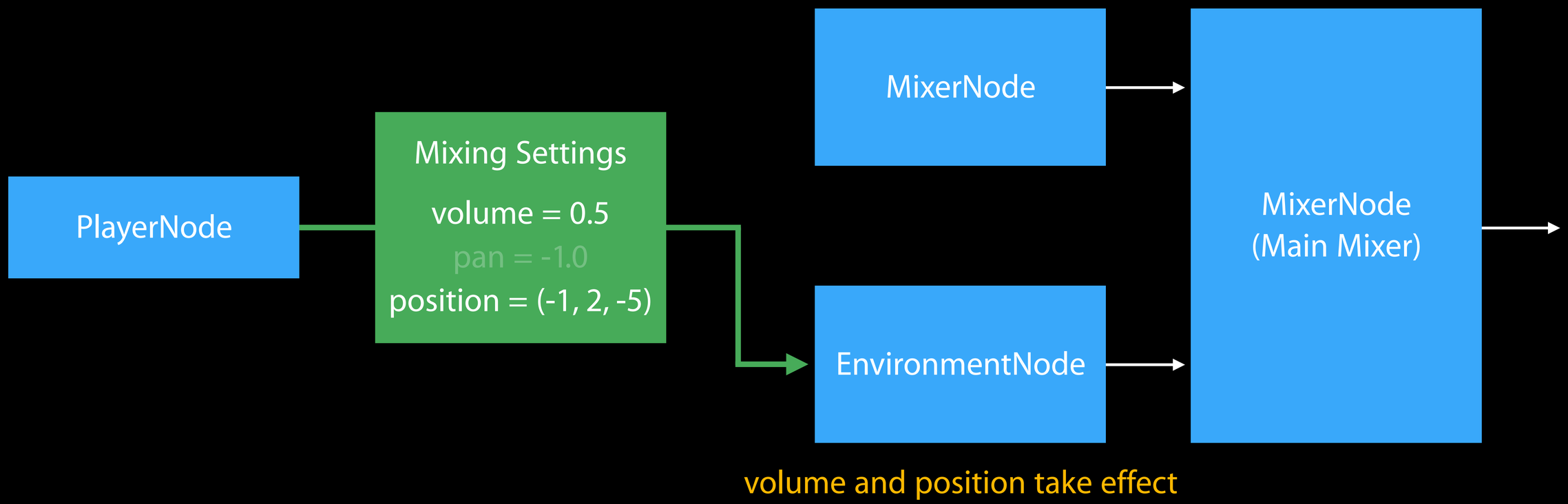


# Handling Multichannel Audio

Hardware setup

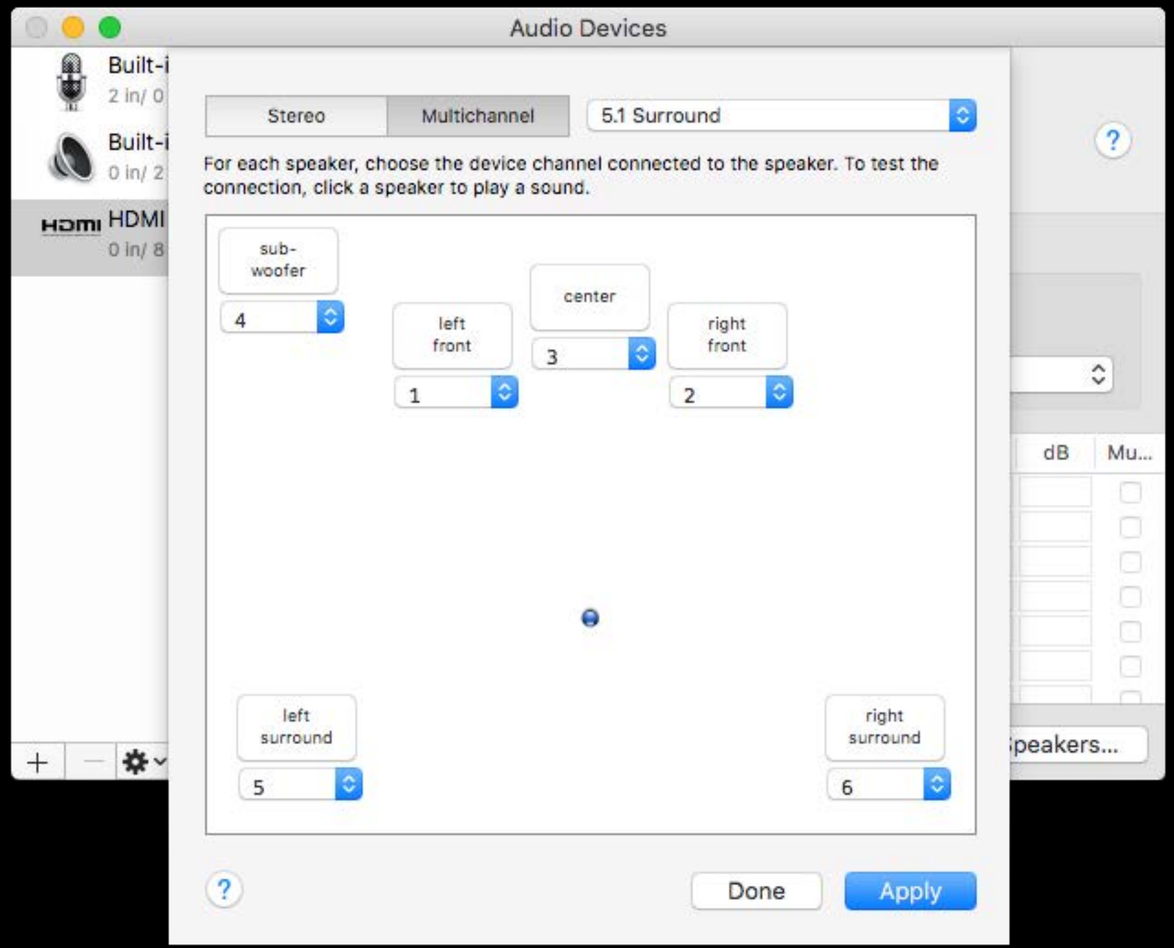
- OS X
- iOS

AVAudioEngine setup

# Handling Multichannel Audio

## Hardware setup: OS X

User can configure the hardware through Audio MIDI Setup



# Handling Multichannel Audio

## Hardware setup: iOS

Configure AVAudioSession

- Playback use case:
  - Activate audio session
  - Check maximumOutputNumberOfChannels
  - Set preferredOutputNumberOfChannels
  - Verify actual outputNumberOfChannels

# Handling Multichannel Audio

## Hardware setup: iOS-code example

```
// example: audio playback use case
do {
    let desiredNumChannels = 6 // for 5.1 rendering

    let audioSession = AVAudioSession.sharedInstance()
    let category = AVAudioSessionCategoryPlayback
    try audioSession.setCategory(category)
    try audioSession.setActive(true)

    // check maximum available output number of channels
    let maxChannels = audioSession.maximumOutputNumberOfChannels
```

# Handling Multichannel Audio

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    // check maximum available output number of channels
    let maxChannels = audioSession.maximumOutputNumberOfChannels
```

# Handling Multichannel Audio

## Hardware setup: iOS-code example

```
if maxChannels >= desiredNumChannels {
    // set preferred number of output channels
    try
    audioSession.setPreferredOutputNumberOfChannels(desiredNumChannels)
}
    let actualChannelCount = audioSession.outputNumberOfChannels

    // adapt to the actual number of output channels
    ..
} catch {
    // handle errors
}
```

# Handling Multichannel Audio

## Hardware setup: iOS-code example

```
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# Handling Multichannel Audio

## AVAudioEngine setup: iOS / OS X

Multichannel content

- AVAudioMixerNode

Spatialized content (games)

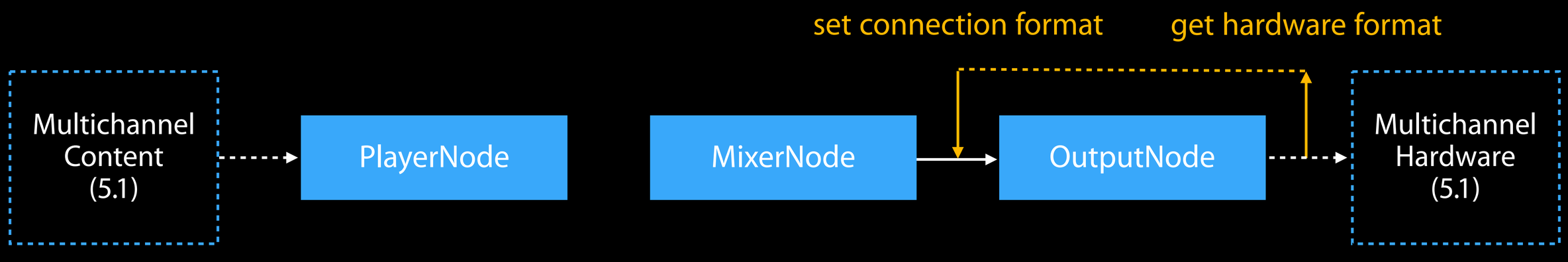
- AVAudioEnvironmentNode

# Handling Multichannel Audio

## AVAudioEngine setup: multichannel content

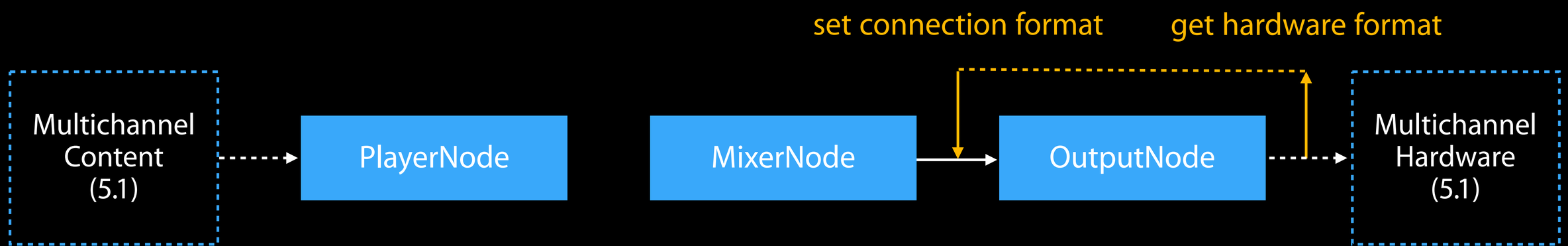
# Handling Multichannel Audio

## AVAudioEngine setup: multichannel content



# Handling Multichannel Audio

## AVAudioEngine setup: multichannel content

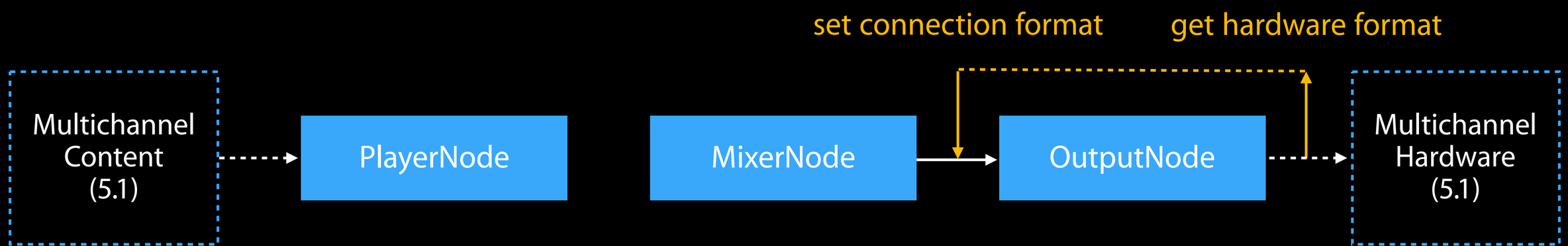



```
// get output hardware format
let output = engine.outputNode
let outputHWFormat = output.outputFormatForBus(0)

// connect mixer to output
let mainMixer = engine.mainMixerNode
engine.connect(mainMixer, to: output, format: outputHWFormat)
```

# Handling Multichannel Audio

## AVAudioEngine setup: multichannel content

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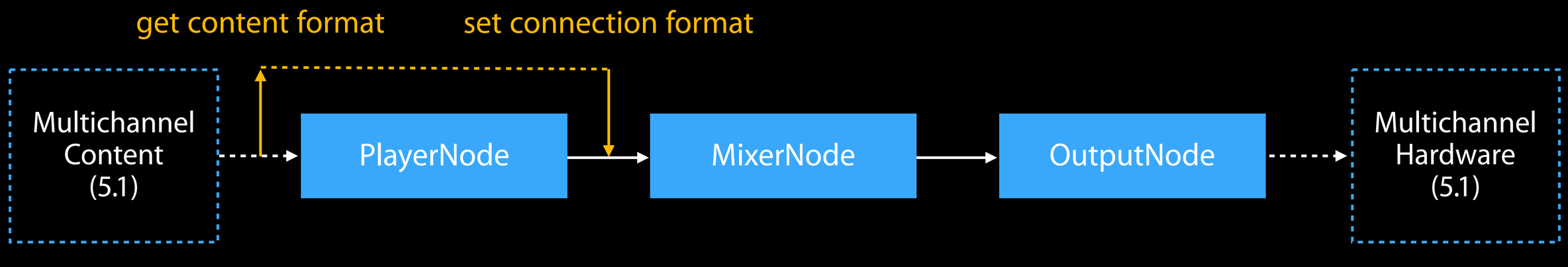
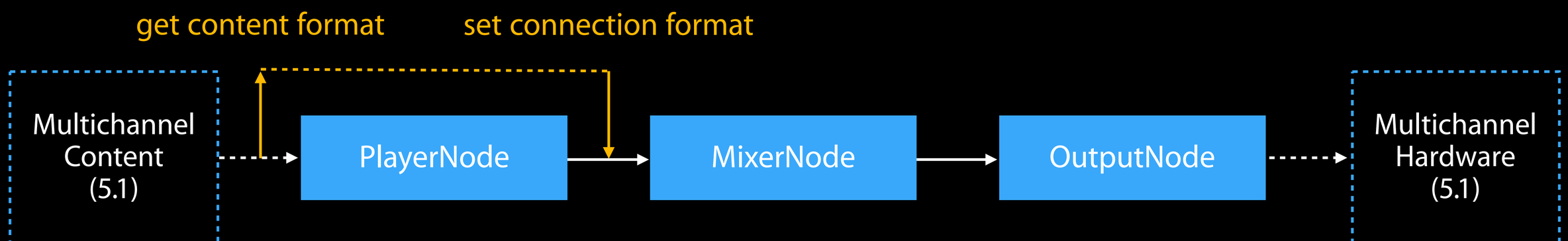


# Handling Multichannel Audio

## AVAudioEngine setup: multichannel content




```
do {
    // open multichannel file for reading
    let mcFile = try AVAudioFile(forReading: fileURL)

    // connect player to mixer
    engine.connect(player, to: mainMixer, format: mcFile.processingFormat)
} catch { ..
}
```

# Handling Multichannel Audio

## AVAudioEngine setup: multichannel content


```
// schedule file on player
// start engine
// start player
```

# Handling Multichannel Audio

## AVAudioEngine setup: spatialized content

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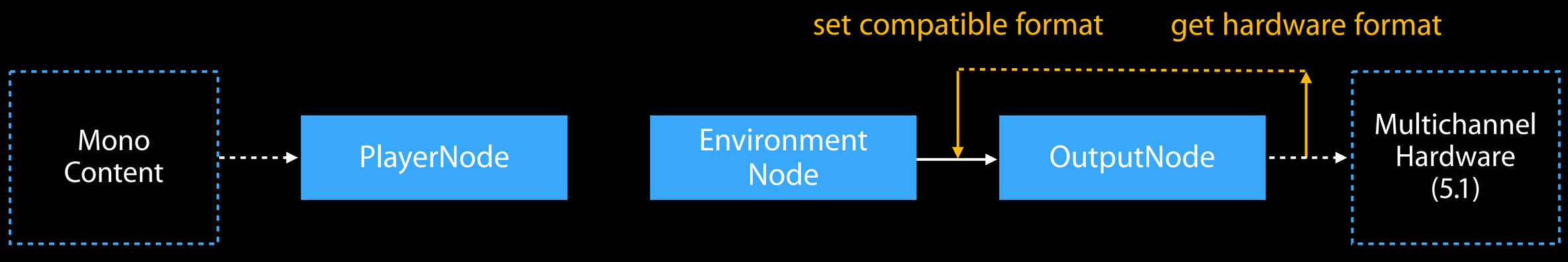

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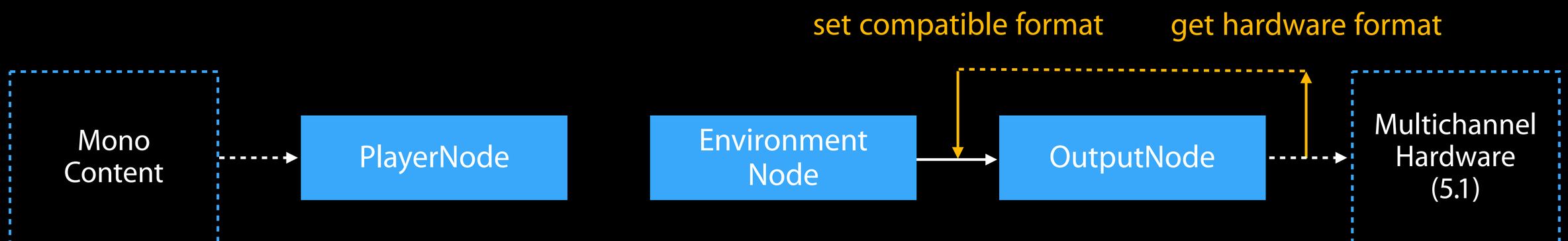
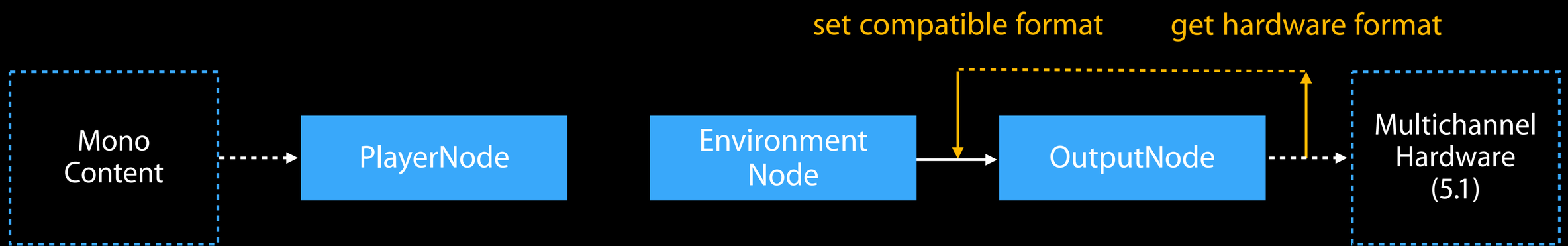



```
// map output hardware channel layout to a compatible layout
let layoutTag = kAudioChannelLayoutTag_AudioUnit_5_0 // for 5.1 HW layout
let layout = AVAudioChannelLayout(layoutTag: layoutTag)
let envOutputFormat = AVAudioFormat(
    standardFormatWithSampleRate: outputHWFormat.sampleRate,
    channelLayout: layout);

engine.connect(envNode, to: output, format: envOutputFormat)
```

# Handling Multichannel Audio

## AVAudioEngine setup: spatialized content

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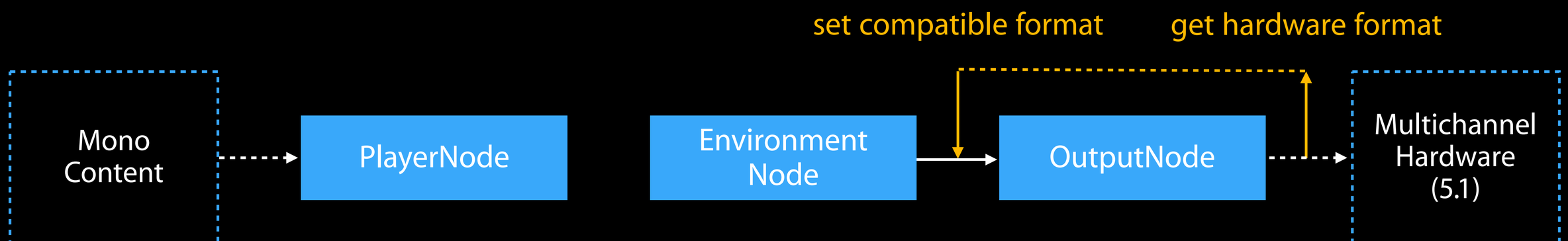


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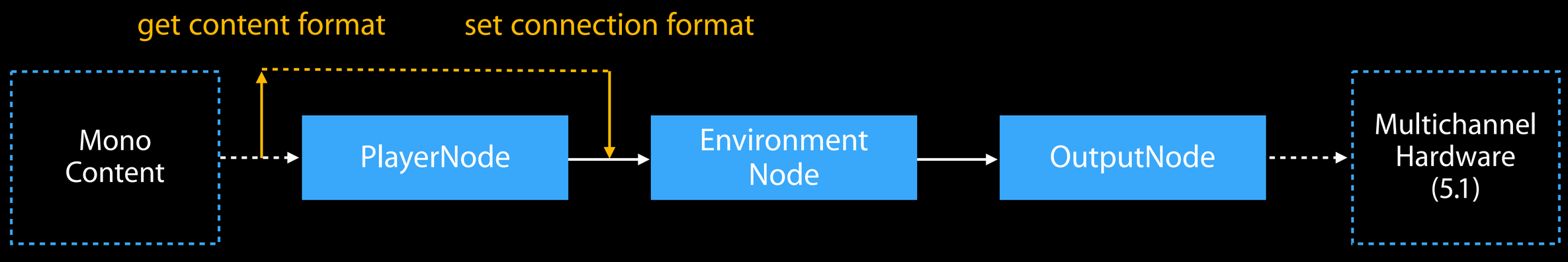

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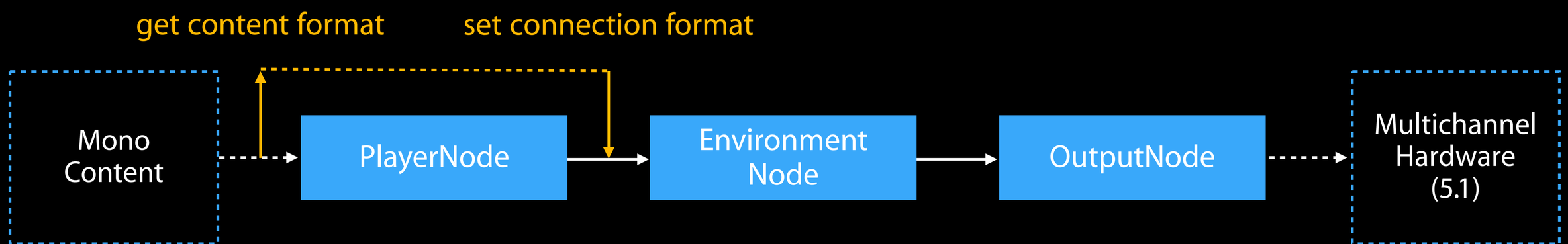
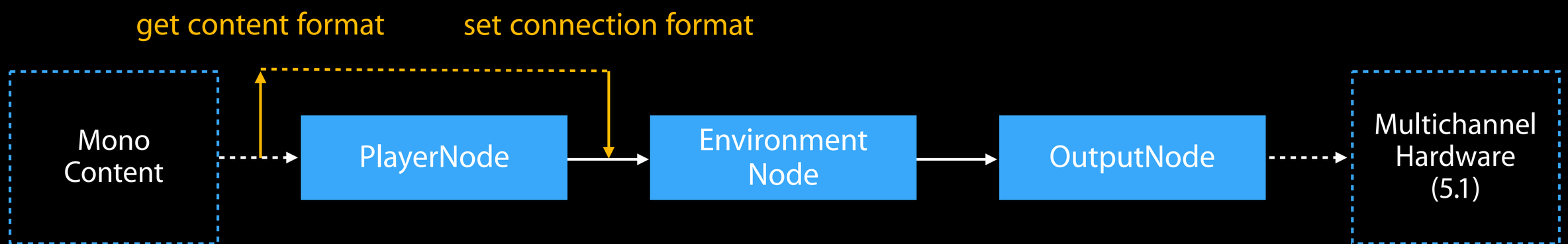



```
let file = try AVAudioFile(forReading: fileURL)
engine.connect(player, to: envNode, format: file.processingFormat)

// set multichannel rendering algorithm
player.renderingAlgorithm = AVAudio3DMixingRenderingAlgorithm.SoundField
```

# Handling Multichannel Audio

## AVAudioEngine setup: spatialized content

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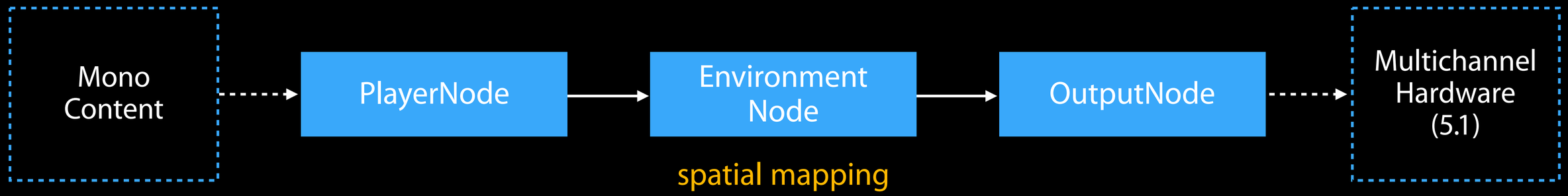


```
// schedule file on player
// start engine
// start player
```

# AVAudioEngine

## What's new

# AVAudioEngine

## What's new

NEW

Splitting support

Audio format conversion support

- AVAudioCompressedBuffer
- AVAudioConverter

AVAudioSequencer

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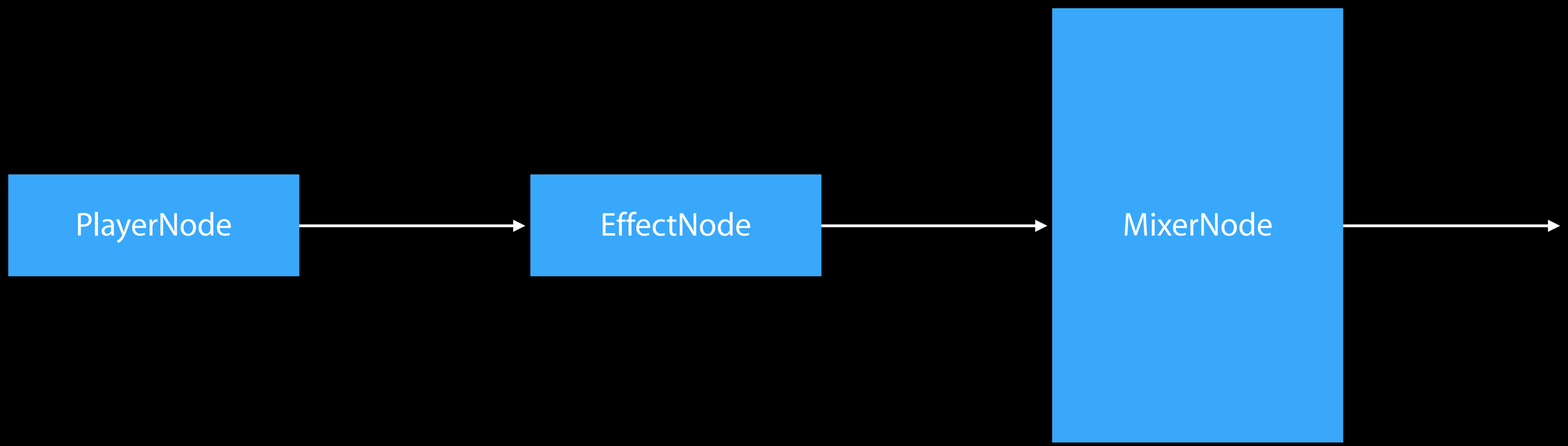
# Splitting Support

## Sample setup



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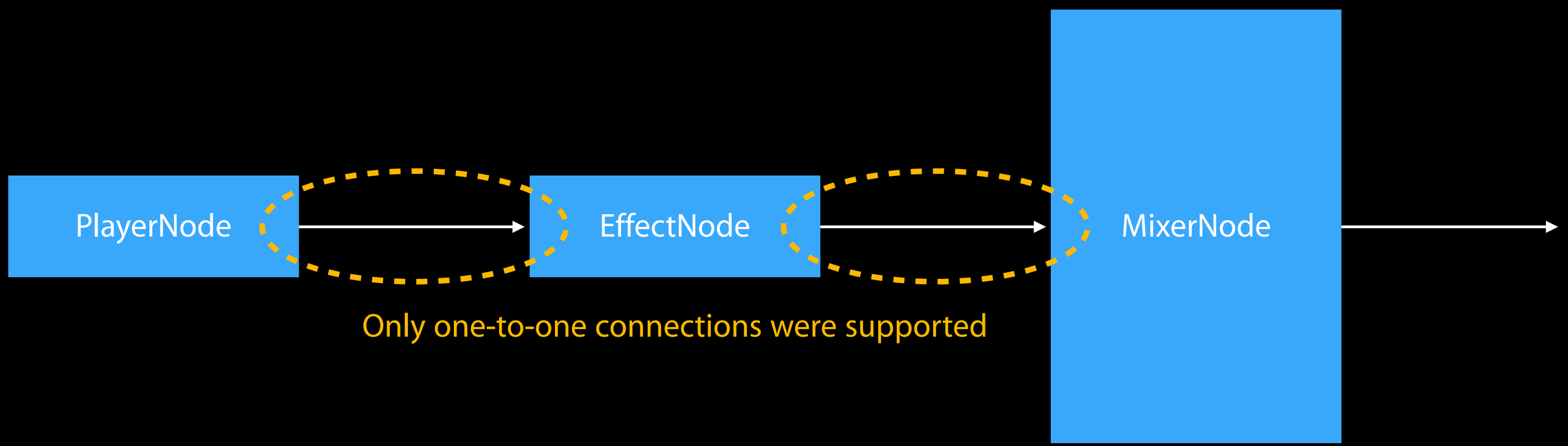

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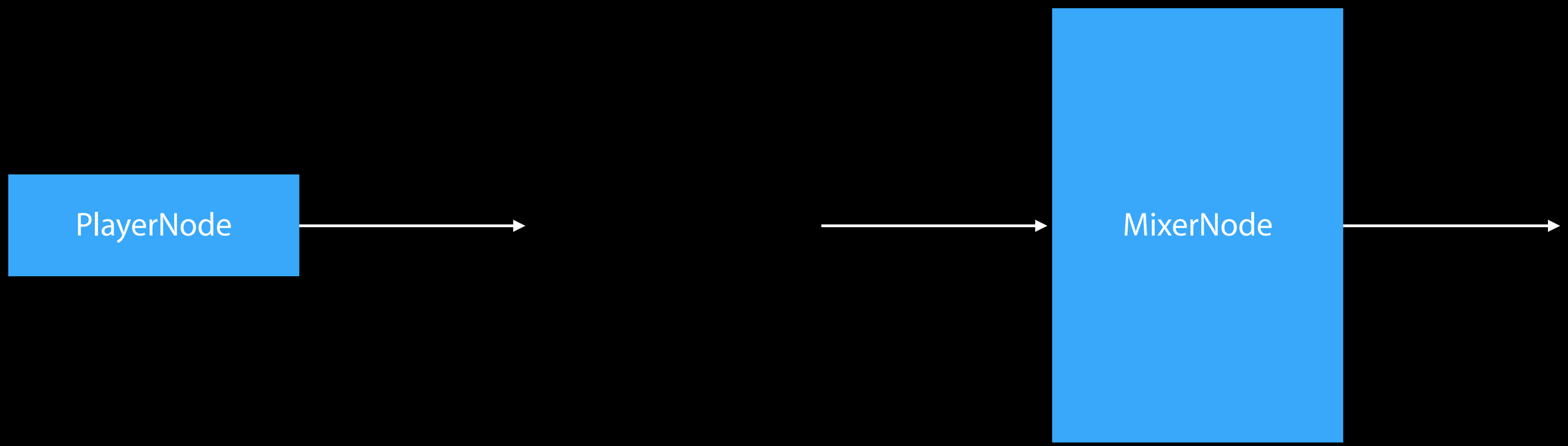
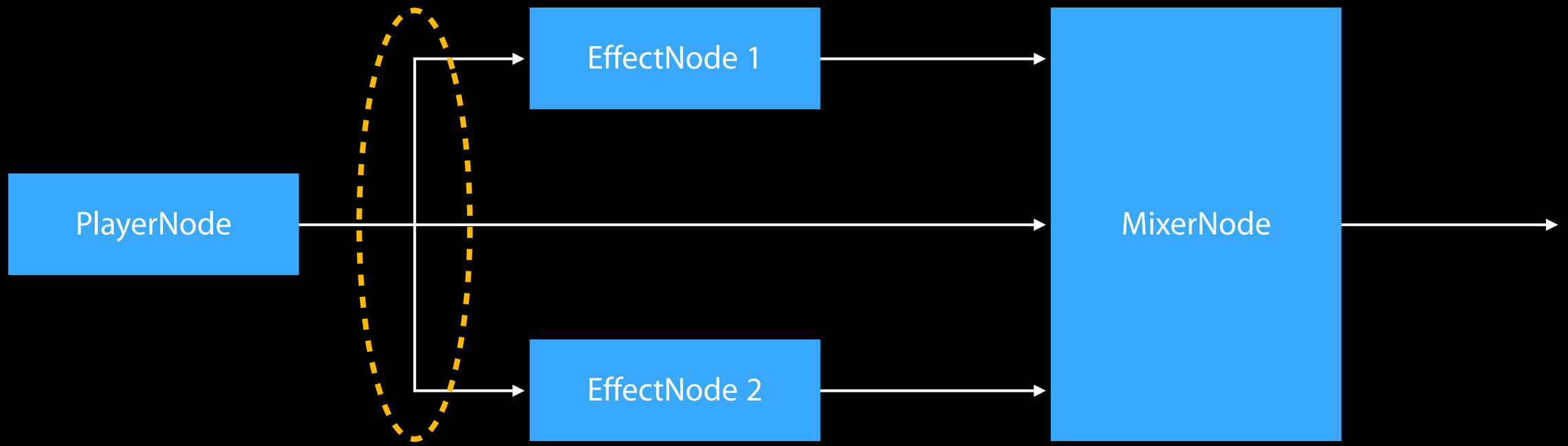


# Splitting Support

## Sample setup

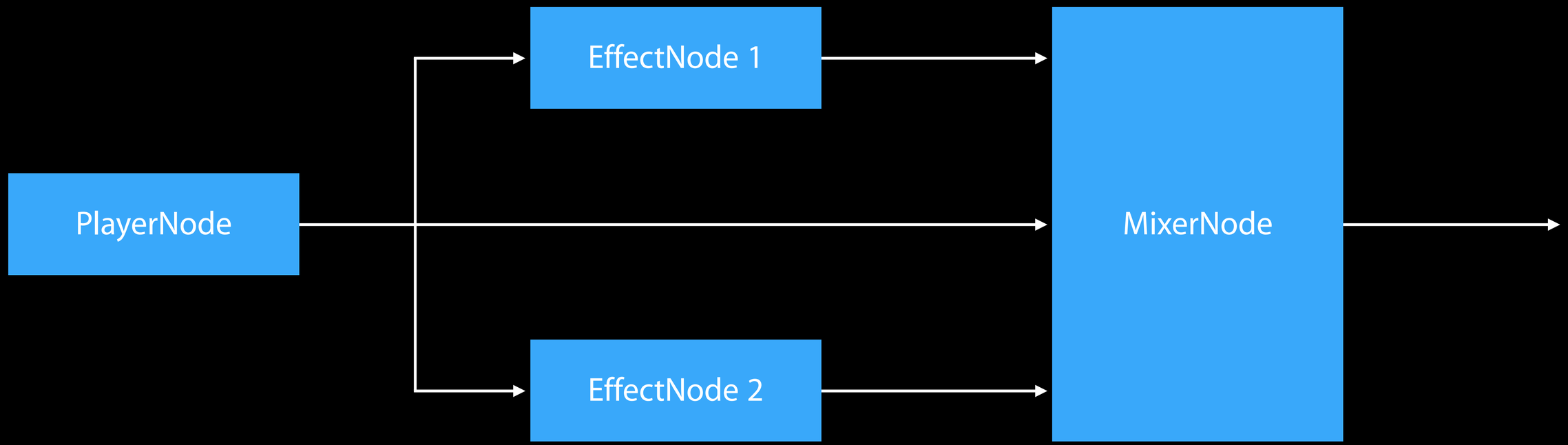
NEW



# Splitting Support

## Code example

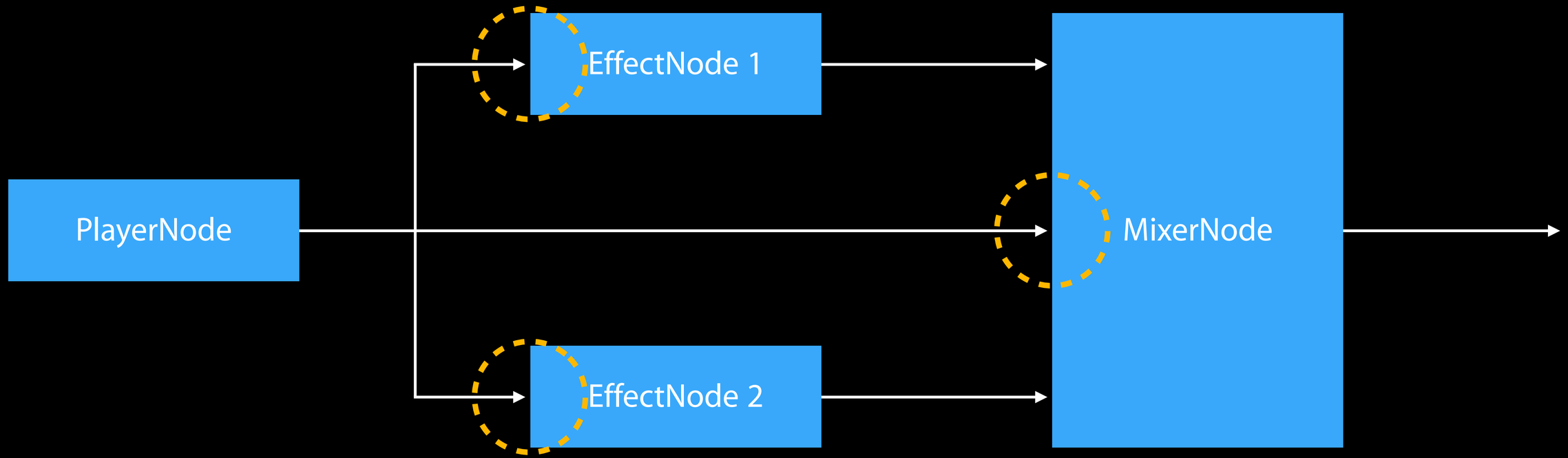
NEW



# Splitting Support

## Code example

NEW




Connection points—AVAudioConnectionPoint [node, bus]

# Splitting Support

## Code example

NEW

```
// Create an array of player connection points
let connPoints = [
    AVAudioConnectionPoint(node: effect1, bus: 0),
    AVAudioConnectionPoint(node: mixer, bus: 1),
    AVAudioConnectionPoint(node: effect2, bus: 0)]
```

# Splitting Support

## Code example

NEW

```
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    AVAudioConnectionPoint(node: effect1, bus: 0),
    AVAudioConnectionPoint(node: mixer, bus: 1),
    AVAudioConnectionPoint(node: effect2, bus: 0)]

// Make player connections
engine.connect(player, toConnectionPoints: connPoints, fromBus: 0,
    format: playerFormat)

// Make effect nodes to mixer connections
..
```
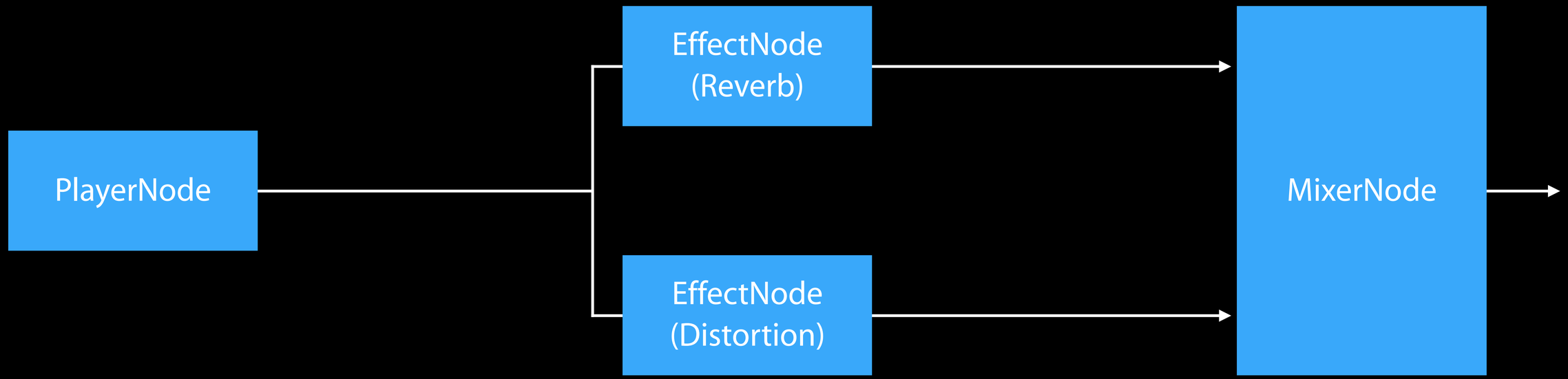

# AVAudioMixing Protocol

## With splitting

NEW



# AVAudioMixing Protocol

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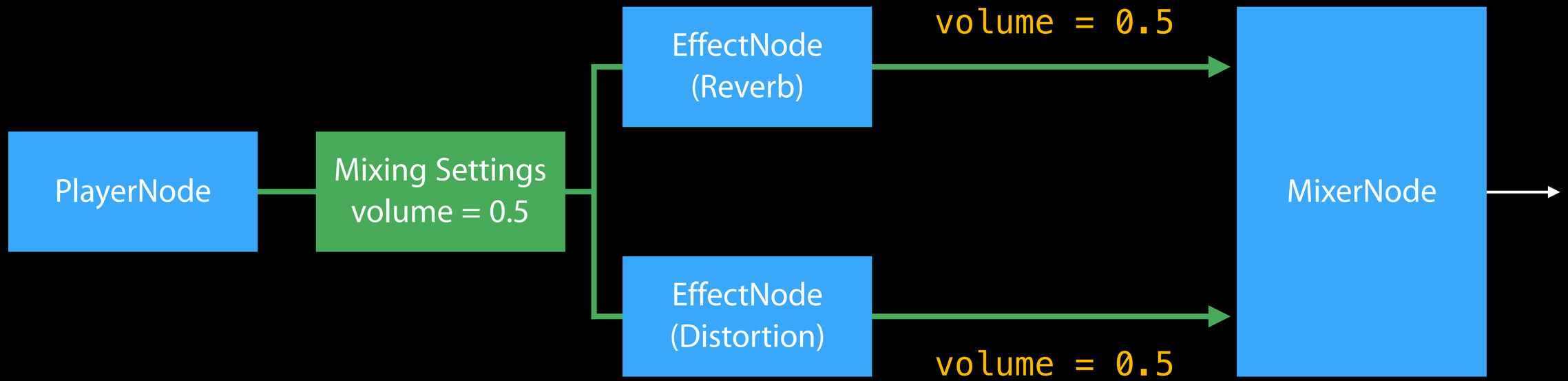
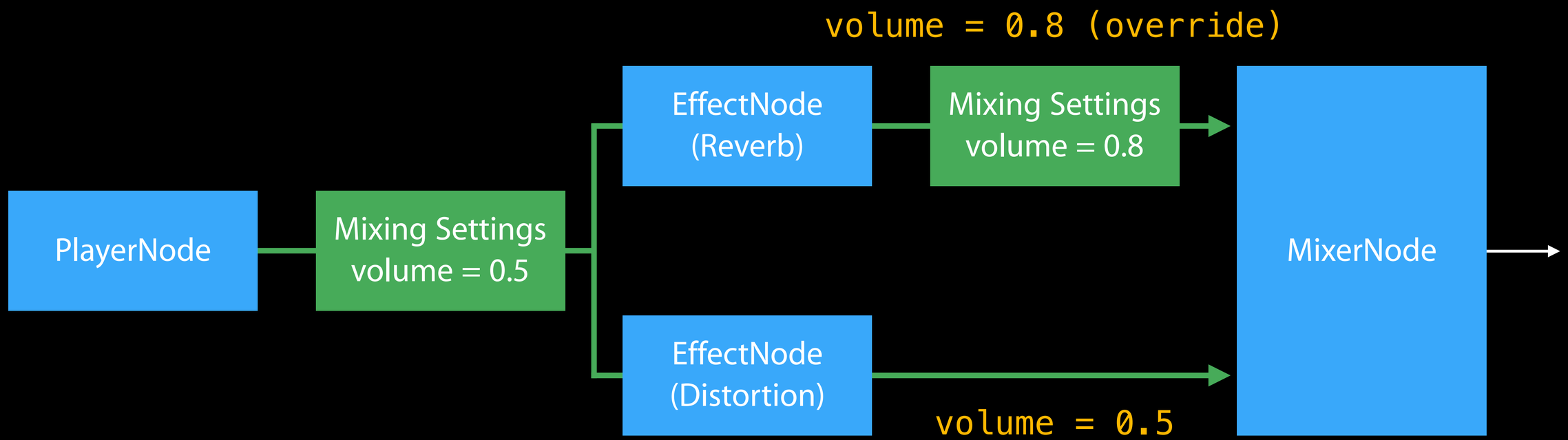



```
// set player’s global mixing setting
player.volume = 0.5
```

# AVAudioMixing Protocol

## With splitting

NEW

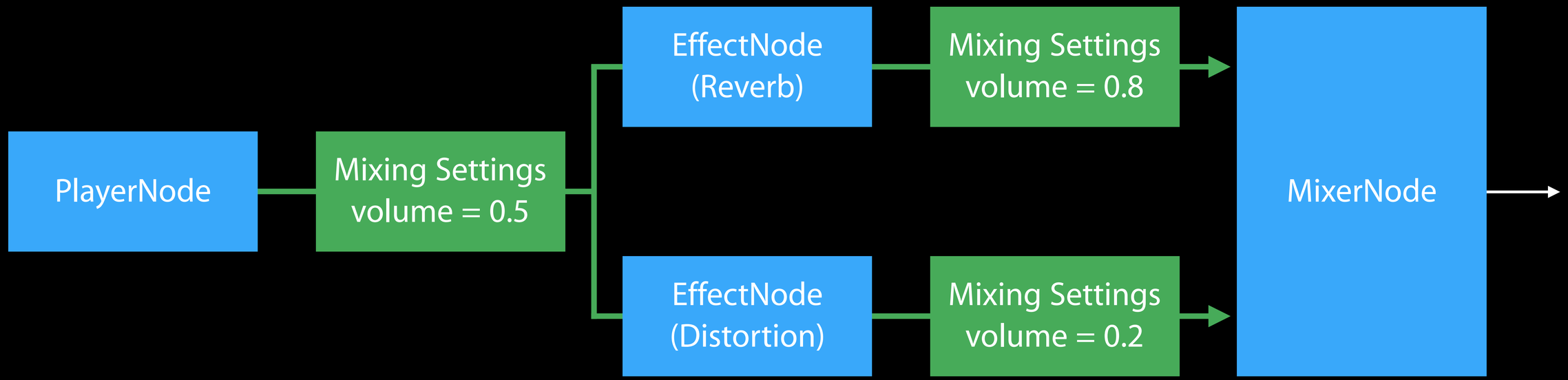



```
// override mixing settings of mixer bus0
if let mxDest0 = player.destinationForMixer(mixer, bus: 0) {
    mxDest0.volume = 0.8
}
```

# AVAudioMixing Protocol

## With splitting

NEW



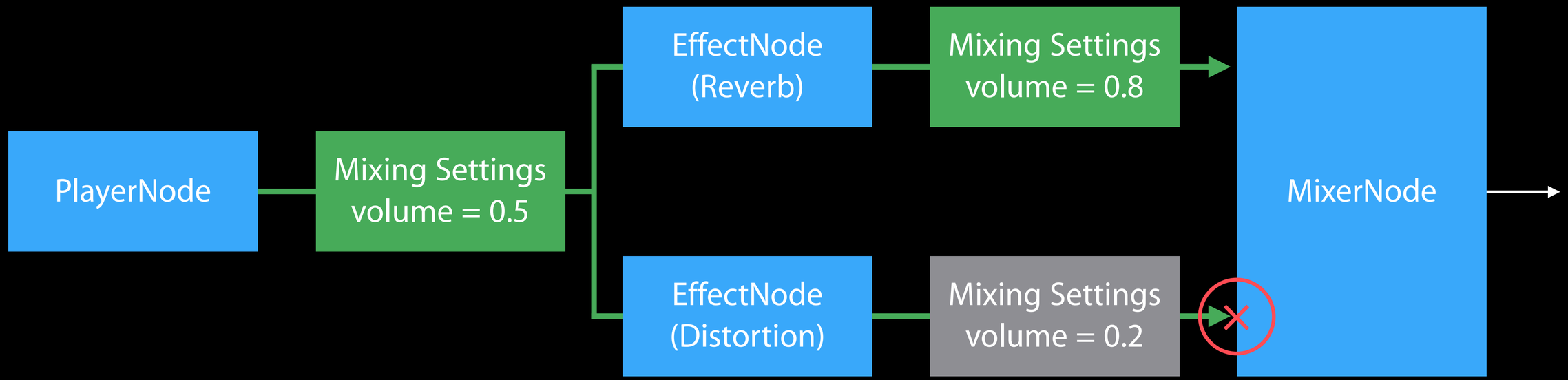

```
volume = 0.2 (override)
```

```
// override mixing settings of mixer bus1
if let mxDest1 = player.destinationForMixer(mixer, bus: 1) {
    mxDest1.volume = 0.2
}
```

# AVAudioMixing Protocol

## With splitting

NEW



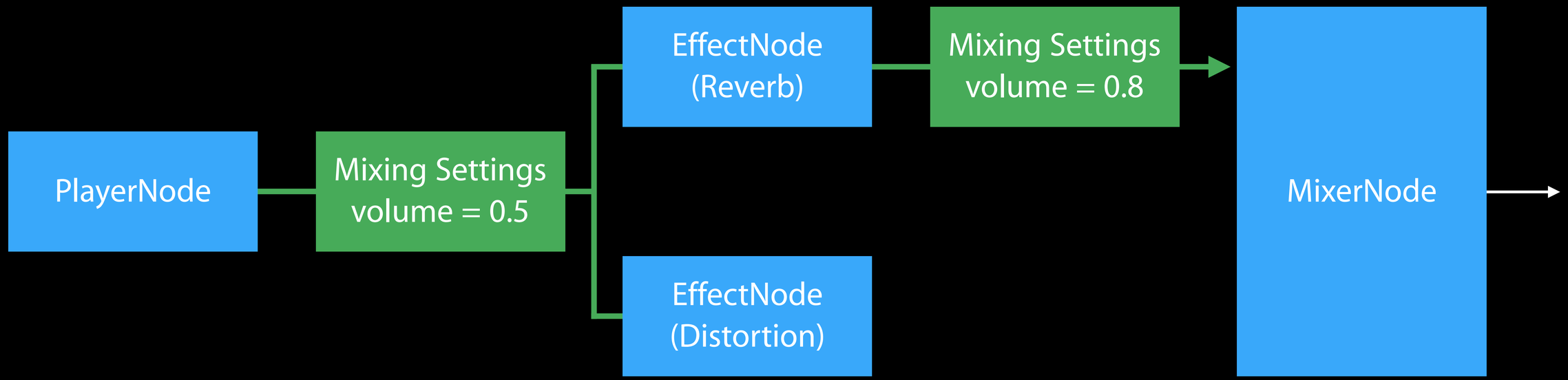

settings lost

```
// disconnect mixer bus1 input, corresponding mixing settings are lost
engine.disconnectNodeInput(mixer, bus: 1)
```

# AVAudioMixing Protocol

## With splitting

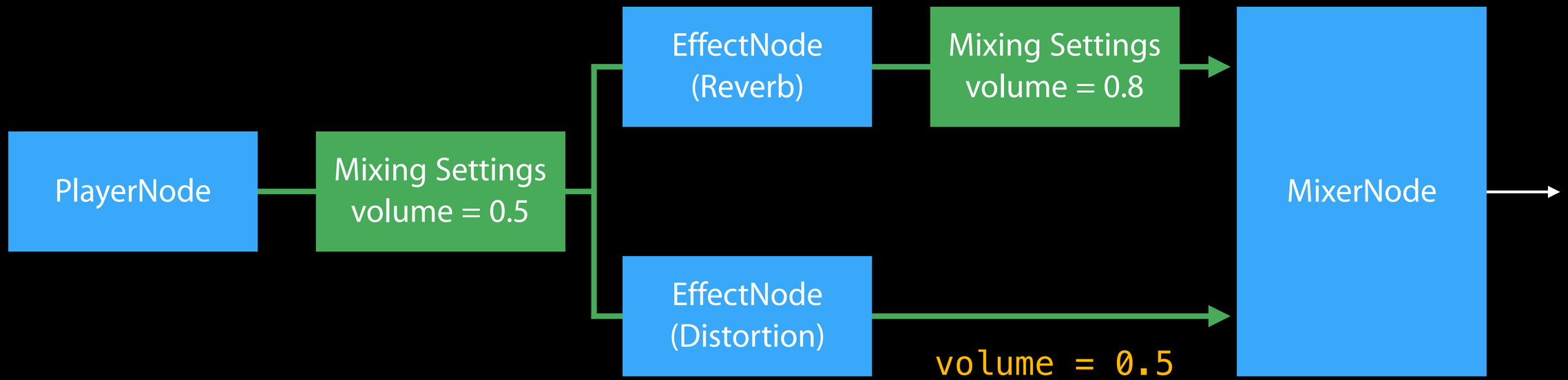
NEW



# AVAudioMixing Protocol

## With splitting

NEW




```
// make a new connection, player’s global mixing settings take effect
engine.connect(effect2, to:mixer, fromBus: 0, toBus: 1, format: format)
```

# AVAudioMixing Protocol

## With splitting

NEW

Source node with multiple mixer connections

- Properties changed on source node
  - Applied to all existing/new mixer connections
- Properties on individual mixer connections
  - Can be overridden
  - Not preserved on disconnections

# Splitting support

## Restrictions

NEW

From the split node to the mixer where all split paths terminate:

- Cannot have AVAudioUnitTimeEffect
- Cannot have any rate conversion

# AVAudioEngine

## What's new

NEW

Splitting support

Audio format conversion support

- AVAudioCompressedBuffer
- AVAudioConverter

AVAudioSequencer

# AVAudioBuffer

AVAudioPCMBuffer

- Uncompressed (PCM) audio data

AVAudioCompressedBuffer (new in iOS 9.0 / OS X El Capitan)

- Compressed audio data
- Used with AVAudioConverter

# AVAudioConverter

NEW

Utility class, higher-level equivalent for AudioConverter

Audio format conversion

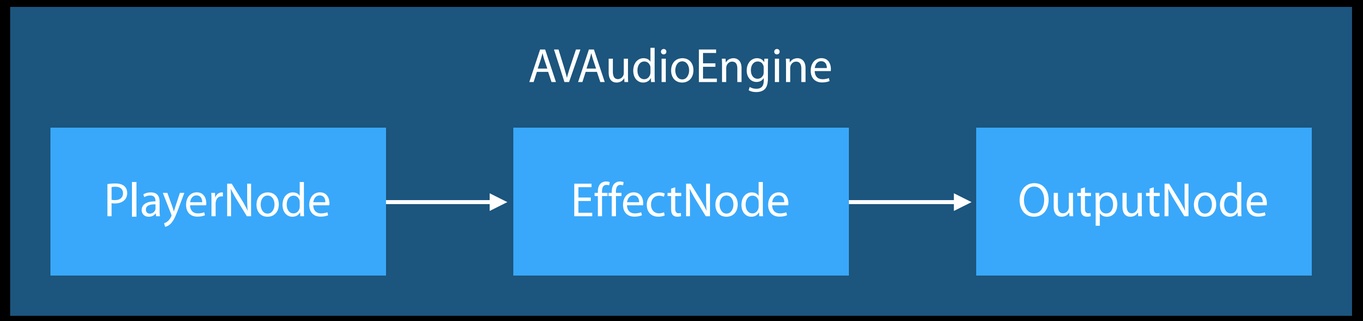
- PCM to PCM
  - Integer/float, bit depth, interleave/deinterleave, sample rate conversion
- PCM to/from compressed
  - Encoding
  - Decoding

Can be used in conjunction with AVAudioEngine

# AVAudioConverter

## With AVAudioEngine: sample use case

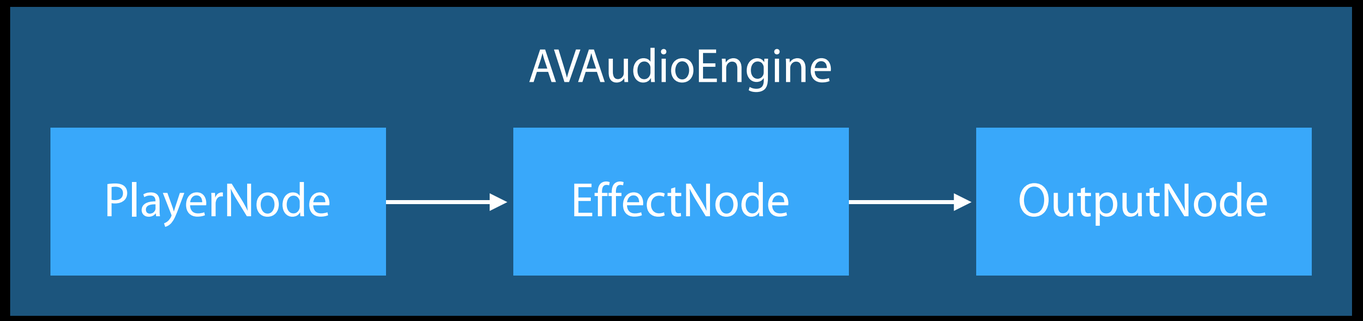
NEW



# AVAudioConverter

## With AVAudioEngine: sample use case

NEW

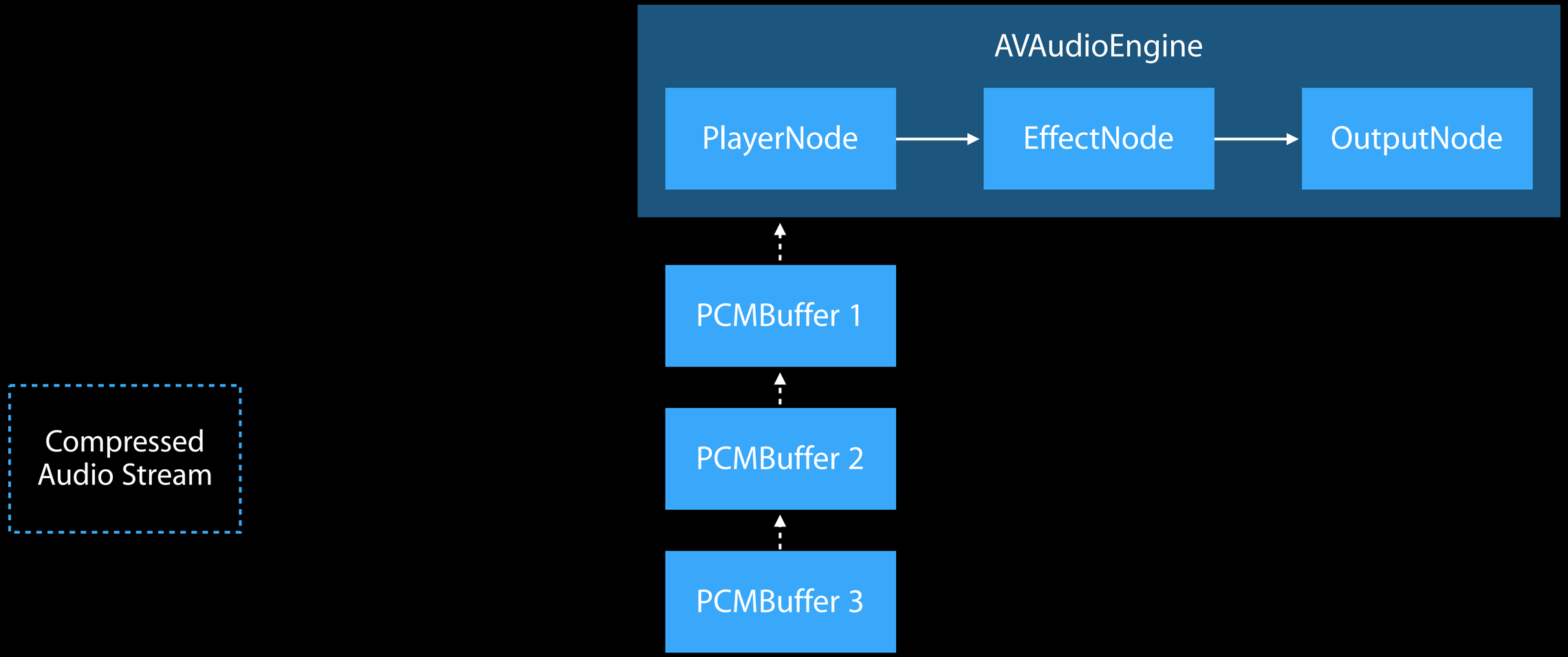



Compressed
Audio Stream

# AVAudioConverter

## With AVAudioEngine: sample use case

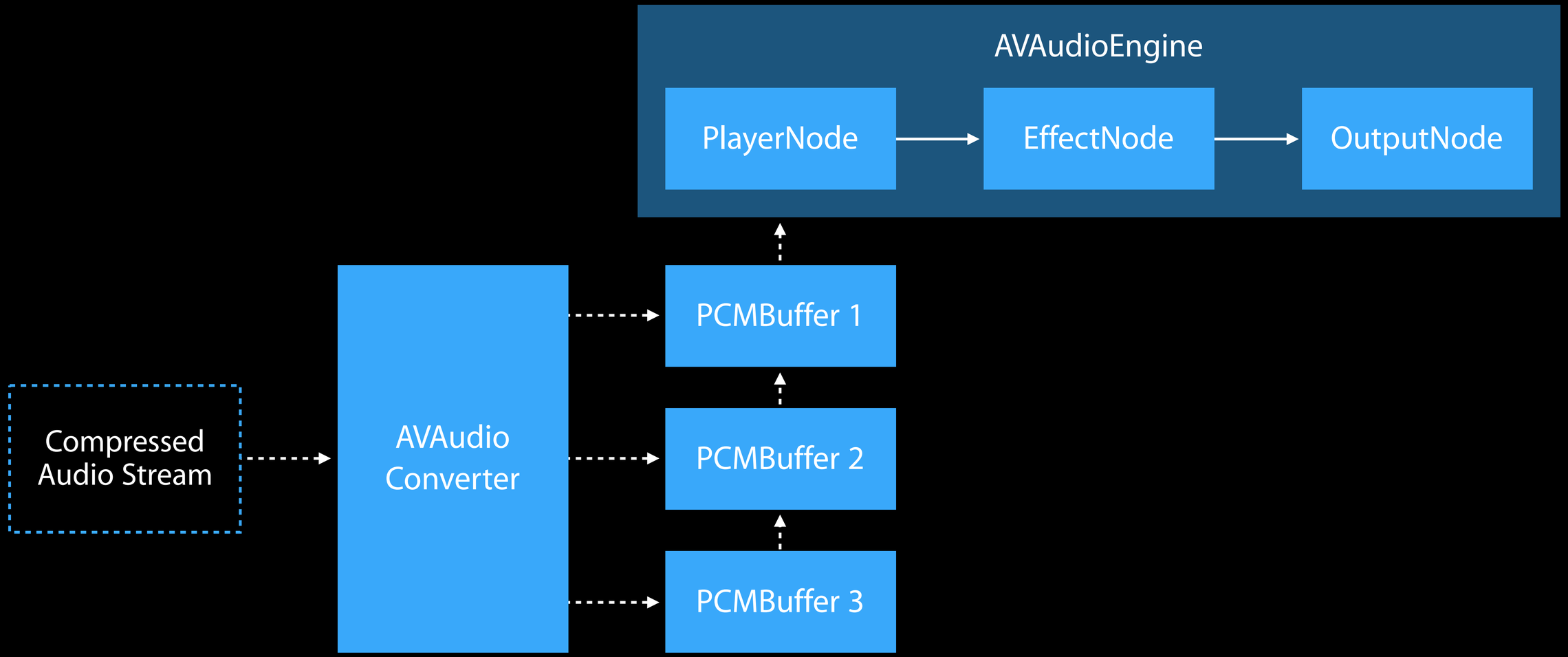
NEW



# AVAudioConverter

## With AVAudioEngine: sample use case

NEW



# AVAudioConverter

## Code example: encoding

NEW

```
// Input format: 44.1 kHz, 2 channel, non-interleaved, 16-bit signed integer
let inFormat = AVAudioFormat(
    commonFormat: AVAudioCommonFormat.PCMFormatInt16,
    sampleRate: 44100, channels: 2, interleaved: false)

// Output format: 44.1 kHz, 2 channel, AAC
var outDesc = AudioStreamBasicDescription(
    mSampleRate: 44100, mFormatID: kAudioFormatMPEG4AAC, mFormatFlags: 0,
    mBytesPerPacket: 0, mFramesPerPacket: 0, mBytesPerFrame: 0,
    mChannelsPerFrame: 2, mBitsPerChannel: 0, mReserved: 0)

let outFormat = AVAudioFormat(streamDescription: &outDesc)
```

# AVAudioConverter

NEW

## Code example: encoding

```
// Input format: 44.1 kHz, 2 channel, non-interleaved, 16-bit signed integer
let inFormat = AVAudioFormat(
    commonFormat: AVAudioCommonFormat.PCMFormatInt16,
    sampleRate: 44100, channels: 2, interleaved: false)

// Output format: 44.1 kHz, 2 channel, AAC
var outDesc = AudioStreamBasicDescription(
    mSampleRate: 44100, mFormatID: kAudioFormatMPEG4AAC, mFormatFlags: 0,
    mBytesPerPacket: 0, mFramesPerPacket: 0, mBytesPerFrame: 0,
    mChannelsPerFrame: 2, mBitsPerChannel: 0, mReserved: 0)

let outFormat = AVAudioFormat(streamDescription: &outDesc)
```

# AVAudioConverter

NEW

## Code example: encoding

```
// Create a converter
let converter = AVAudioConverter(fromFormat: inFormat, toFormat: outFormat)

// Allocate an input PCM buffer
let inBuffer = AVAudioPCMBuffer(PCMFormat: inFormat, frameCapacity: 1024)

// Allocate an output compressed buffer
let outBuffer = AVAudioCompressedBuffer(
    format: outFormat,
    packetCapacity: 8,
    maximumPacketSize: converter.maximumOutputPacketSize)
```

# AVAudioConverter

NEW

## Code example: encoding

```
// Create a converter
let converter = AVAudioConverter(fromFormat: inFormat, toFormat: outFormat)

// Allocate an input PCM buffer
let inBuffer = AVAudioPCMBuffer(PCMFormat: inFormat, frameCapacity: 1024)

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let outBuffer = AVAudioCompressedBuffer(
    format: outFormat,
    packetCapacity: 8,
    maximumPacketSize: converter.maximumOutputPacketSize)
```

# AVAudioConverter

## Code example: encoding

NEW

```
// Create an input block that’s called when converter needs input
let inputBlock : AVAudioConverterInputBlock = {
    inNumPackets, outStatus in
    if (<no_data_available>) {
        outStatus.memory = AVAudioConverterInputStatus.NoDataNow; return nil;
    } else if (<end_of_stream>) {
        outStatus.memory = AVAudioConverterInputStatus.EndOfStream; return nil;
    } else {
        ..
        outStatus.memory = AVAudioConverterInputStatus.HaveData;
        return inBuffer; // fill and return input buffer
    }
}
```

# AVAudioConverter

## Code example: encoding

NEW

```
// Create an input block that’s called when converter needs input
let inputBlock : AVAudioConverterInputBlock = {
    inNumPackets, outStatus in
    if (<no_data_available>) {
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# AVAudioConverter

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        outStatus.memory = AVAudioConverterInputStatus.EndOfStream; return nil;
    } else {
        ..
        outStatus.memory = AVAudioConverterInputStatus.HaveData;
        return inBuffer; // fill and return input buffer
    }
}
```

# AVAudioConverter

## Code example: encoding

NEW

```
// Conversion loop
outError = nil
while (true) {
    let status = converter.convertToBuffer(outBuffer, error: outError,
    withInputFromBlock: inputBlock)
    if status == AVAudioConverterOutputStatus.EndOfStream ||
       status == AVAudioConverterOutputStatus.Error {
       break
    }
    // outBuffer contains output data
    ..
}
```

# AVAudioConverter

NEW

## Code example: encoding

```
// Conversion loop
outError = nil
while (true) {
    let status = converter.convertToBuffer(outBuffer, error: outError,
    withInputFromBlock: inputBlock)
    if status == AVAudioConverterOutputStatus.EndOfStream ||
       status == AVAudioConverterOutputStatus.Error {
       break
    }
    // outBuffer contains output data
    ..
}
```

# AVAudioConverter

NEW

## Code example: encoding

```
// Conversion loop
outError = nil
while (true) {
    let status = converter.convertToBuffer(outBuffer, error: outError,
    withInputFromBlock: inputBlock)
    if status == AVAudioConverterOutputStatus.EndOfStream ||
       status == AVAudioConverterOutputStatus.Error {
        break
    }
    // outBuffer contains output data
    ..
}
```

# AVAudioEngine

## What's new

NEW

Splitting support

Audio format conversion support

- AVAudioCompressedBuffer
- AVAudioConverter

AVAudioSequencer

# AVAudioSequencer

NEW

Plays MIDI files

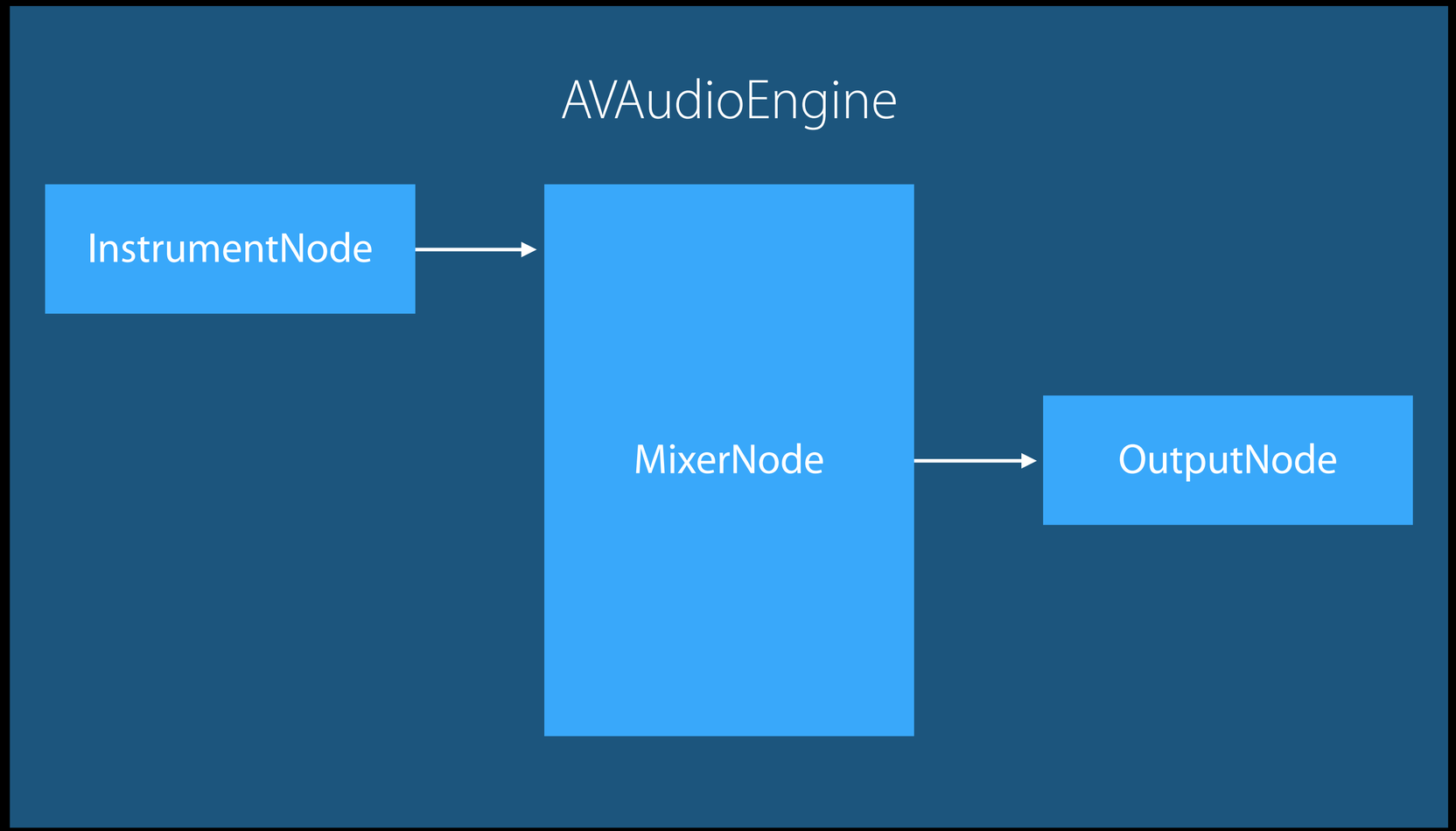
Associated with an AVAudioEngine during instantiation

Sends MIDI events to AVAudioUnitMIDIInstrument nodes in the engine

# AVAudioSequencer

## Sample setup

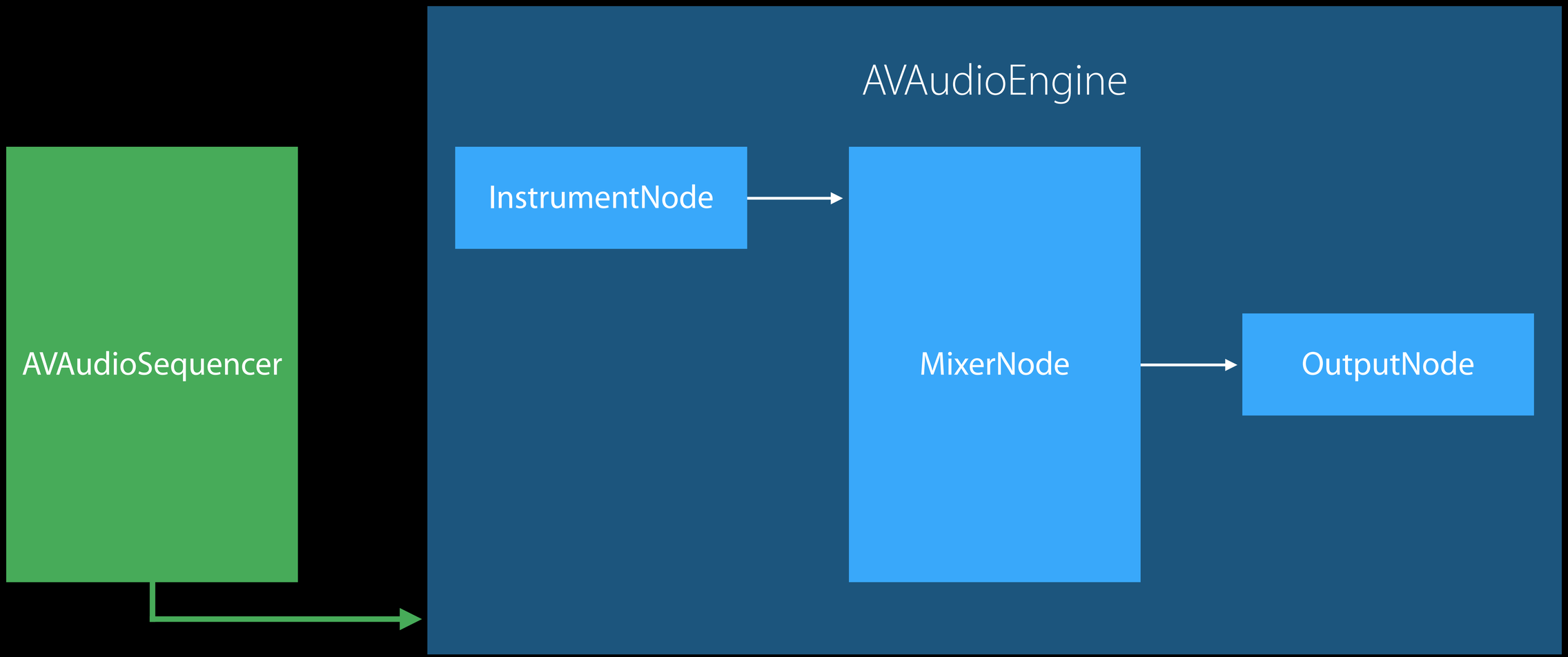
NEW



# AVAudioSequencer

## Sample setup

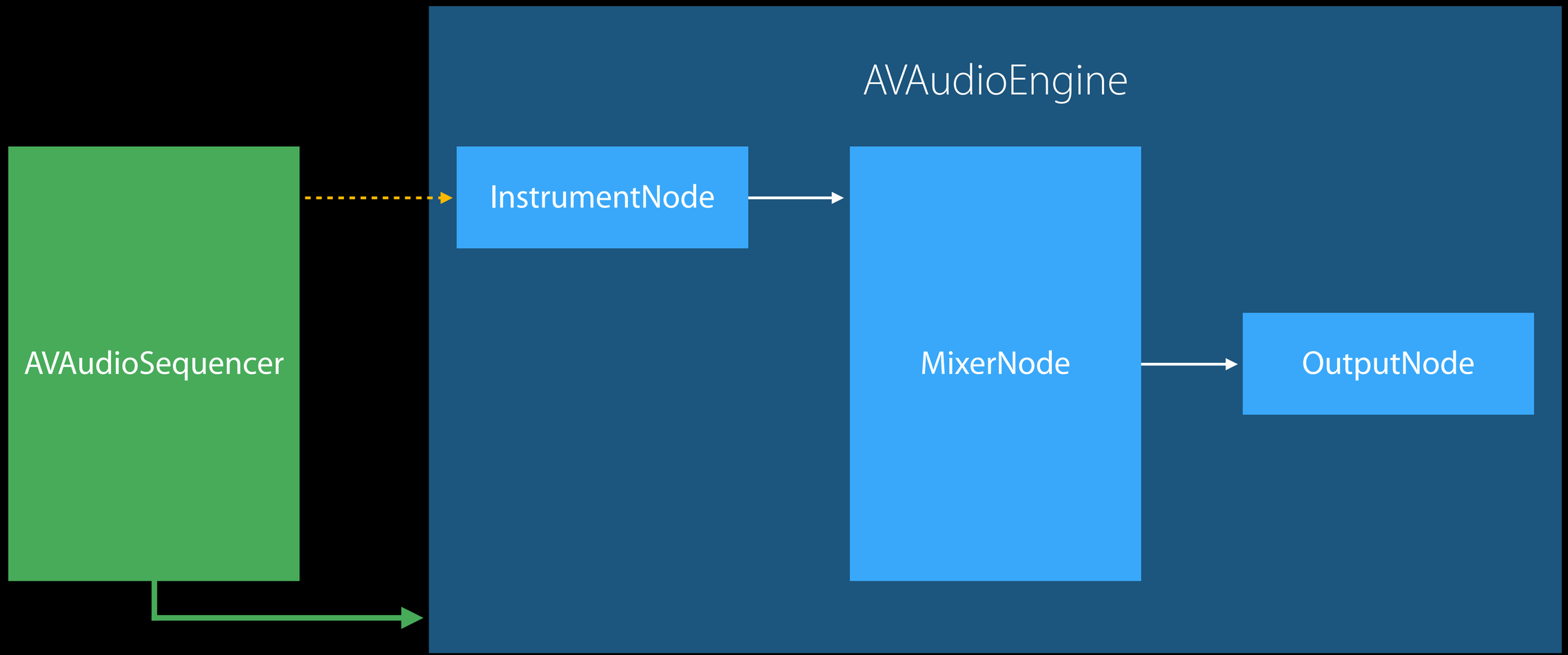
NEW



# AVAudioSequencer

## Sample setup

NEW



# AVAudioSequencer

NEW

## Code example: AVAudioEngine setup

```
do {
    // setup instrument node (e.g. sampler)
    let sampler = AVAudioUnitSampler()
    engine.attachNode(sampler)
    engine.connect(sampler, to: engine.mainMixerNode, format: format)
    try sampler.loadInstrumentAtURL(instURL)

    // start the engine
    try engine.start()
} catch {
    // handle errors
}
```

# AVAudioSequencer

NEW

## Code example: AVAudioEngine setup

```
do {
    // setup instrument node (e.g. sampler)
    let sampler = AVAudioUnitSampler()
    engine.attachNode(sampler)
    engine.connect(sampler, to: engine.mainMixerNode, format: format)
    try sampler.loadInstrumentAtURL(instURL)

    // start the engine
    try engine.start()
} catch {
    // handle errors
}
```

# AVAudioSequencer

NEW

## Code example: AVAudioSequencer setup

```
do {
    // create sequencer and associate with engine
    let sequencer = AVAudioSequencer(audioEngine: engine)

    // load MIDI file
    try sequencer.loadFromURL(fileURL,
        options: AVMusicSequenceLoadOptions.SMF_PreserveTracks)

    // start sequencer
    sequencer.prepareToPlay()
    try sequencer.start()
    // audio will start playing
} catch { // handle error
}
```

# AVAudioSequencer

NEW

## Code example: AVAudioSequencer setup

```
do {
    // create sequencer and associate with engine
    let sequencer = AVAudioSequencer(audioEngine: engine)

    // load MIDI file
    try sequencer.loadFromURL(fileURL,
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    sequencer.prepareToPlay()
    try sequencer.start()
    // audio will start playing
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}
```

# AVAudioSequencer

NEW

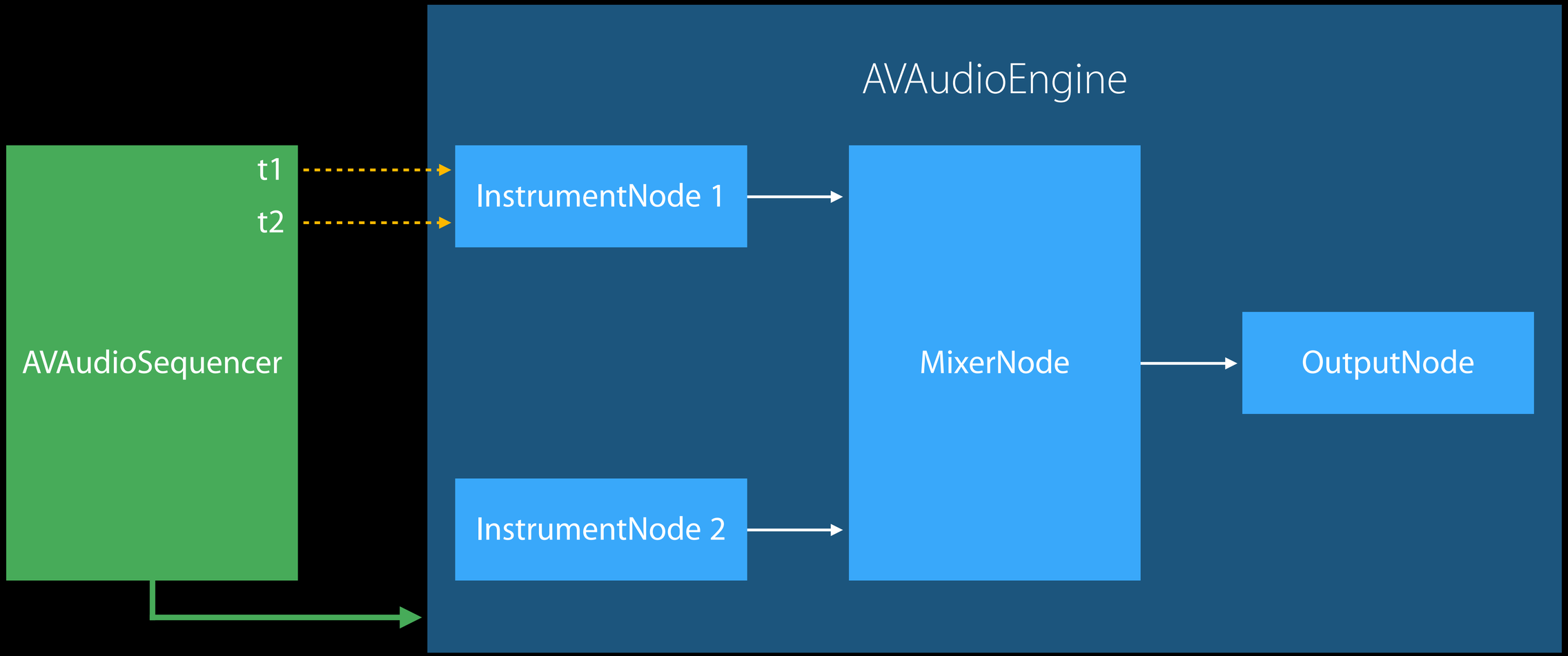
## Code example: AVAudioSequencer setup

```
do {
    // create sequencer and associate with engine
    let sequencer = AVAudioSequencer(audioEngine: engine)

    // load MIDI file
    try sequencer.loadFromURL(fileURL,
        options: AVMusicSequenceLoadOptions.SMF_PreserveTracks)

    // start sequencer
    sequencer.prepareToPlay()
    try sequencer.start()
    // audio will start playing
} catch { // handle error
}
```

# AVAudioSequencer

## Handling multiple tracks

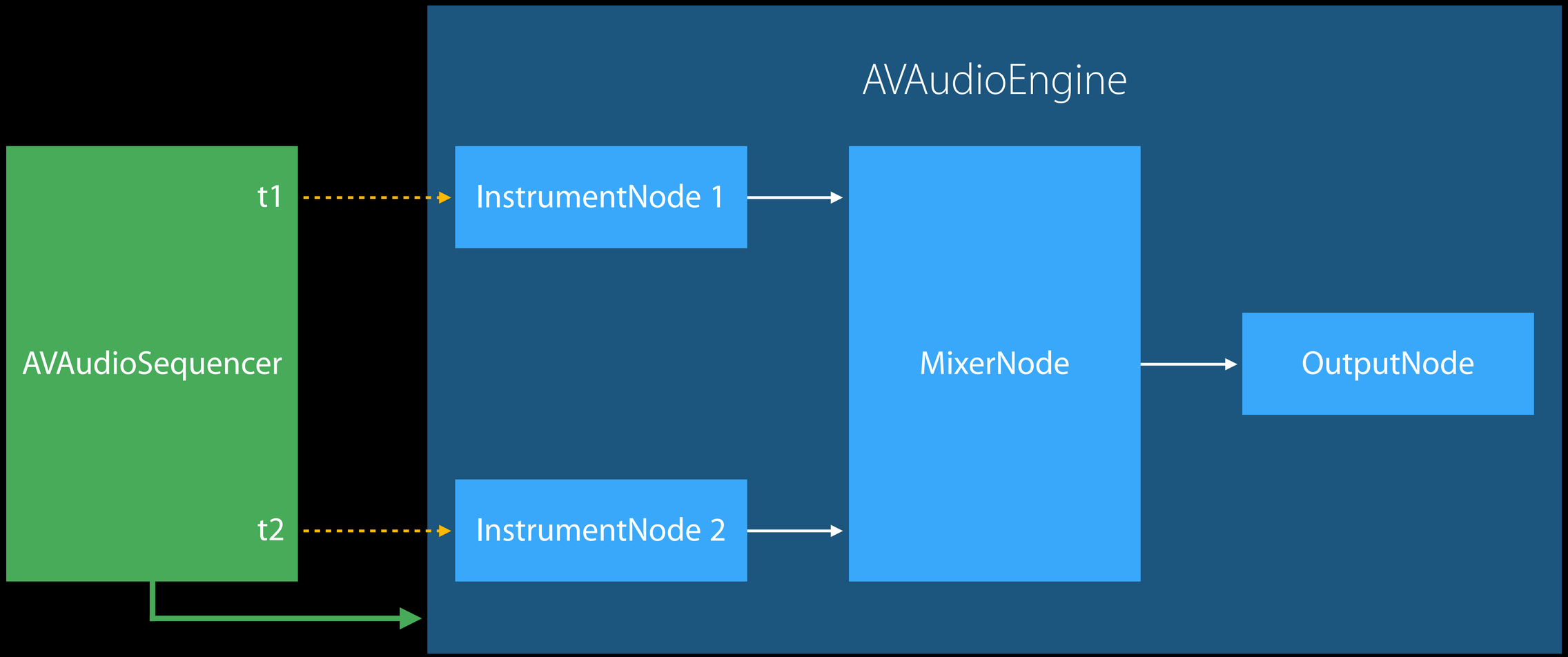
NEW



# AVAudioSequencer

## Handling multiple tracks

NEW



# AVAudioSequencer

NEW

## Code example: handling multiple tracks

```
// create and setup engine
// create sequencer
// load MIDI file
..
// send individual tracks to different instrument nodes in the engine
let tracks = sequencer.tracks
tracks[0].destinationAudioUnit = sampler
tracks[1].destinationAudioUnit = midiSynth

// start sequencer
..
```

# AVAudioSequencer

## Transport controls

NEW

Prepare to play, start, stop

Set playback position

- Seconds or beats

Set playback rate

# *Demo*

## AVAudioEngine

Akshatha Nagesh ‘AudioEngine’er
Torrey Holbrook Walker Senior New Feature Salesperson

# Summary

## AVAudioEngine

Recap

- Handling multichannel audio

What's new

- Splitting support
- Audio format conversion support
  - AVAudioCompressedBuffer
  - AVAudioConverter
- AVAudioSequencer

# Inter-device Audio Mode for iOS

Torrey Holbrook Walker
Senior New Feature Salesperson

# Recording From iOS Devices

# Recording From iOS Devices

# Recording From iOS Devices

Digital USB Audio

Digital USB Audio

# Recording Audio From iOS

Digital recording is possible with USB host mode and USB hardware

3rd party software/frameworks

Couldn’t this be simpler?

# Inter-device Audio Mode

NEW

Record audio digitally over the Lighting to USB cable

Stereo 24-bit @ 48 kHz stream format

USB 2.0 audio class-compliant implementation

# Inter-device Audio Mode

NEW

No additional hardware

No additional software

No need to modify OS X or iOS applications

No system sounds routed to USB

# Inter-device Audio Mode

NEW

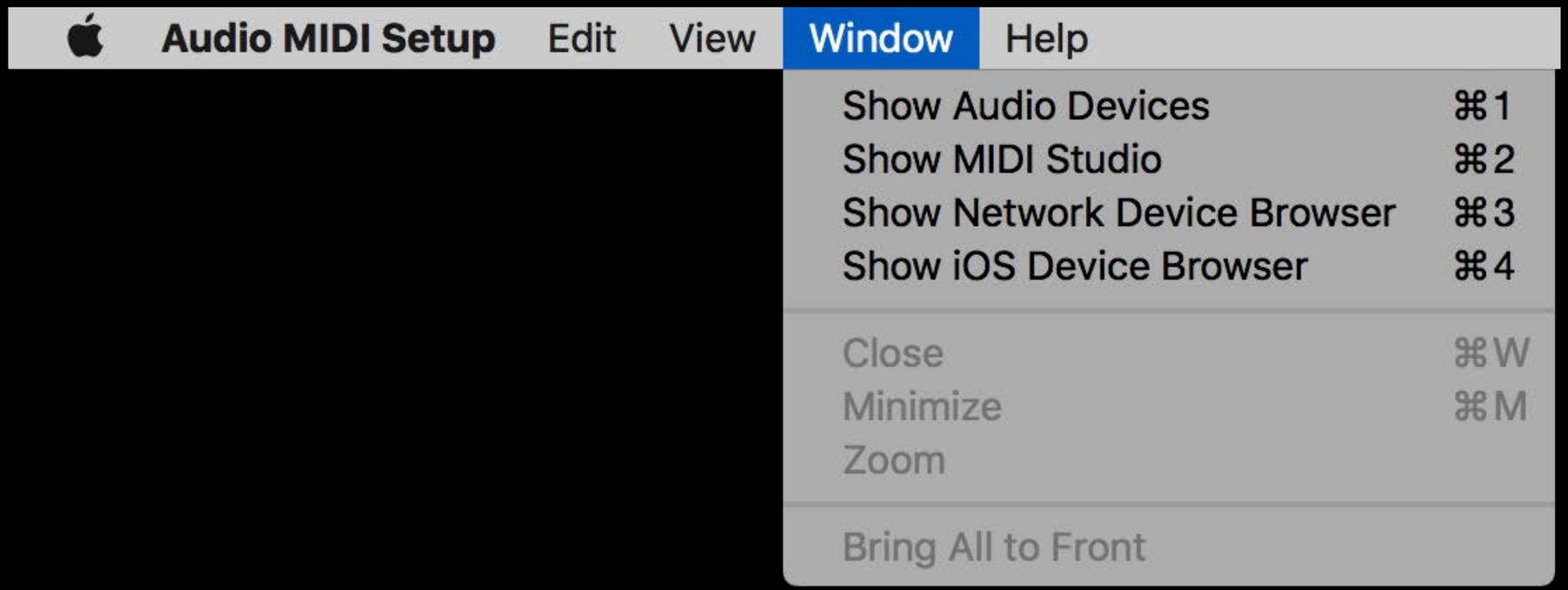
Device can charge and sync

Temporarily disabled functionality

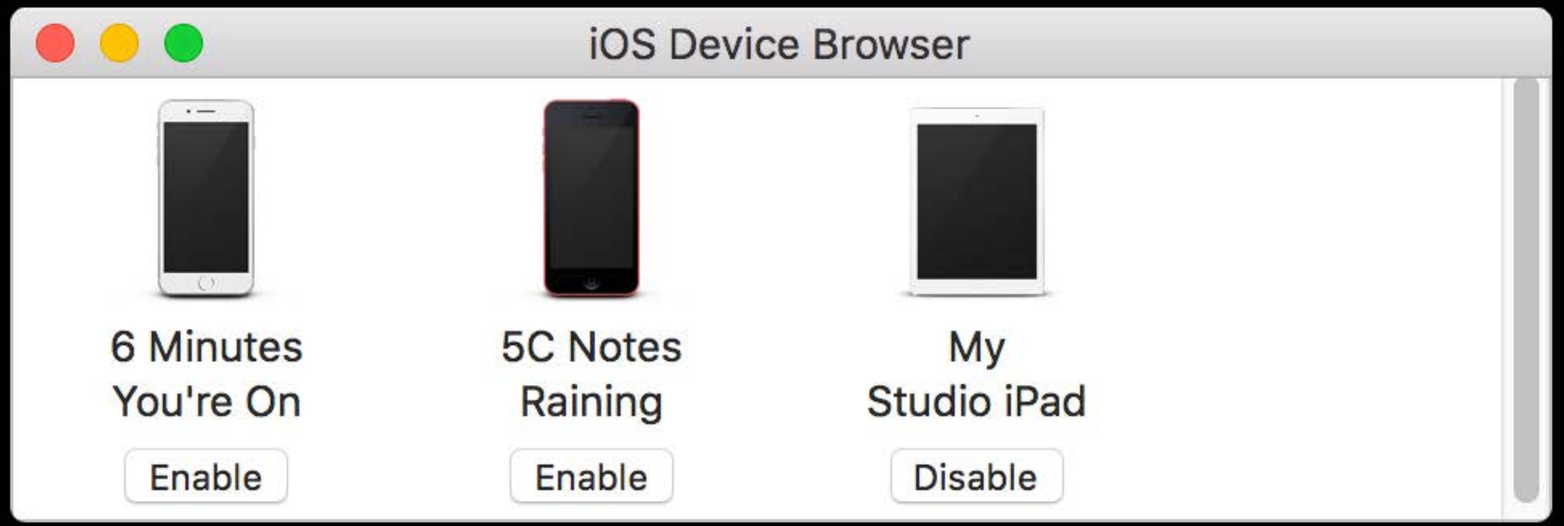
- Photo import
- Tethering
- QuickTime screen capture

# Inter-device Audio Mode

## Accessible via Audio MIDI Setup



# Inter-device Audio Mode



# *Demo*

## Inter-device audio mode

Torrey Holbrook Walker
Senior New Feature Salesperson

# Inter-device Audio Mode

Requires OS X El Capitan and iOS 9

Works on all iPhones with a lightning connector

Works on all iPads with a lightning connector except first-gen iPad mini

Supports multiple devices simultaneously (if you've got the hubs)

# CoreAudioKit View Controller

NEW

```
@IBOutlet weak var viewContainer: NSView!
weak var iOSDeviceView: NSView?
var controller : CAInterDeviceAudioViewController?

@IBAction func toggleIOSDeviceView(sender: NSButton) {
        if iOSDeviceView == nil {
            controller = CAInterDeviceAudioViewController()
                iOSDeviceView = controller!.view
                viewContainer.addSubview(iOSDeviceView!)
            } else {
                iOSDeviceView!.removeFromSuperview()
                iOSDeviceView = nil
                controller = nil
            }
    }
```

# More CoreAudioKit View Controllers

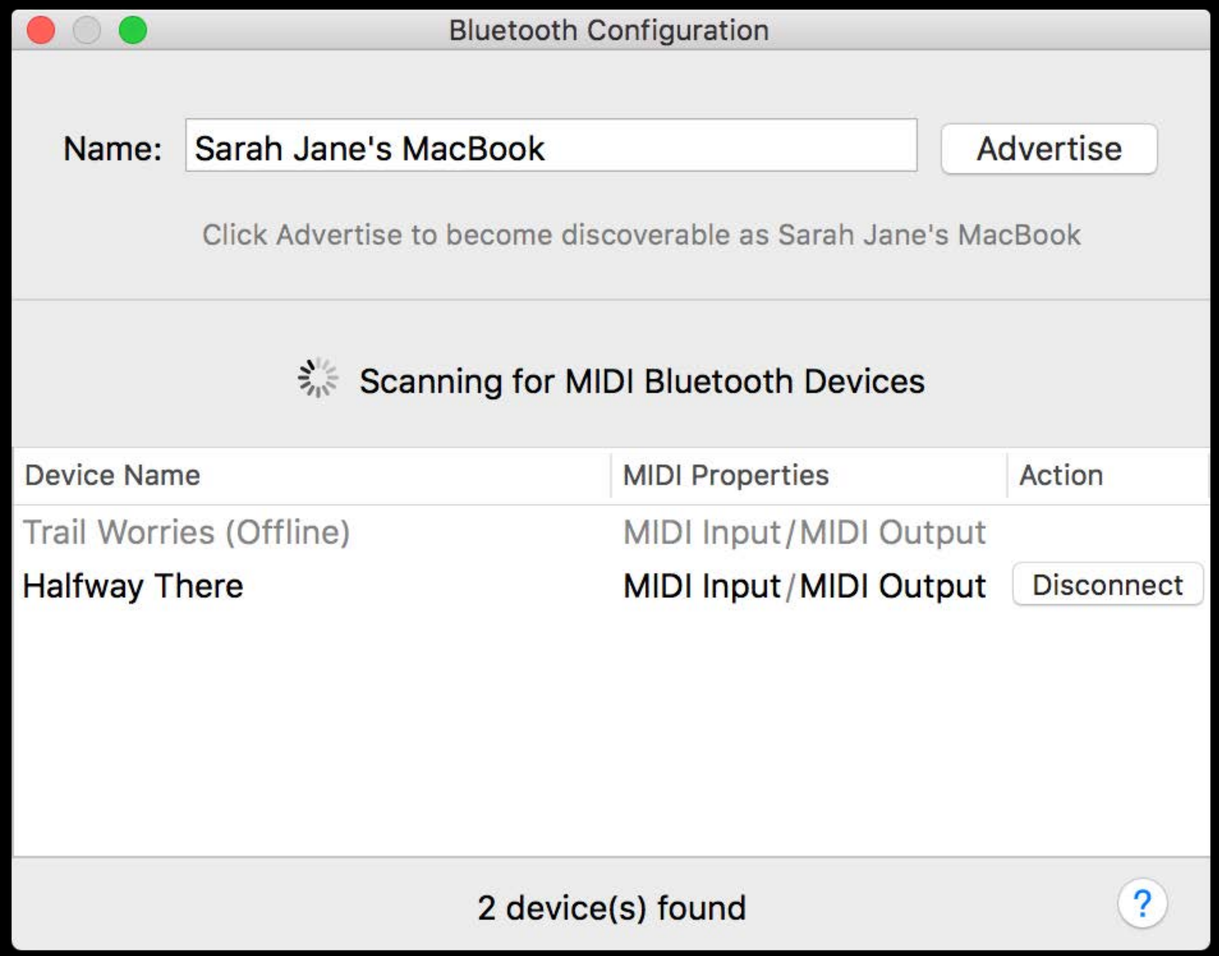
NEW

CABTLEMIDIWindowController

Displays UI for configuring Bluetooth LE MIDI devices

NSWindowController subclass

# CABTLEMIDIWindowController



# More CoreAudioKit View Controllers

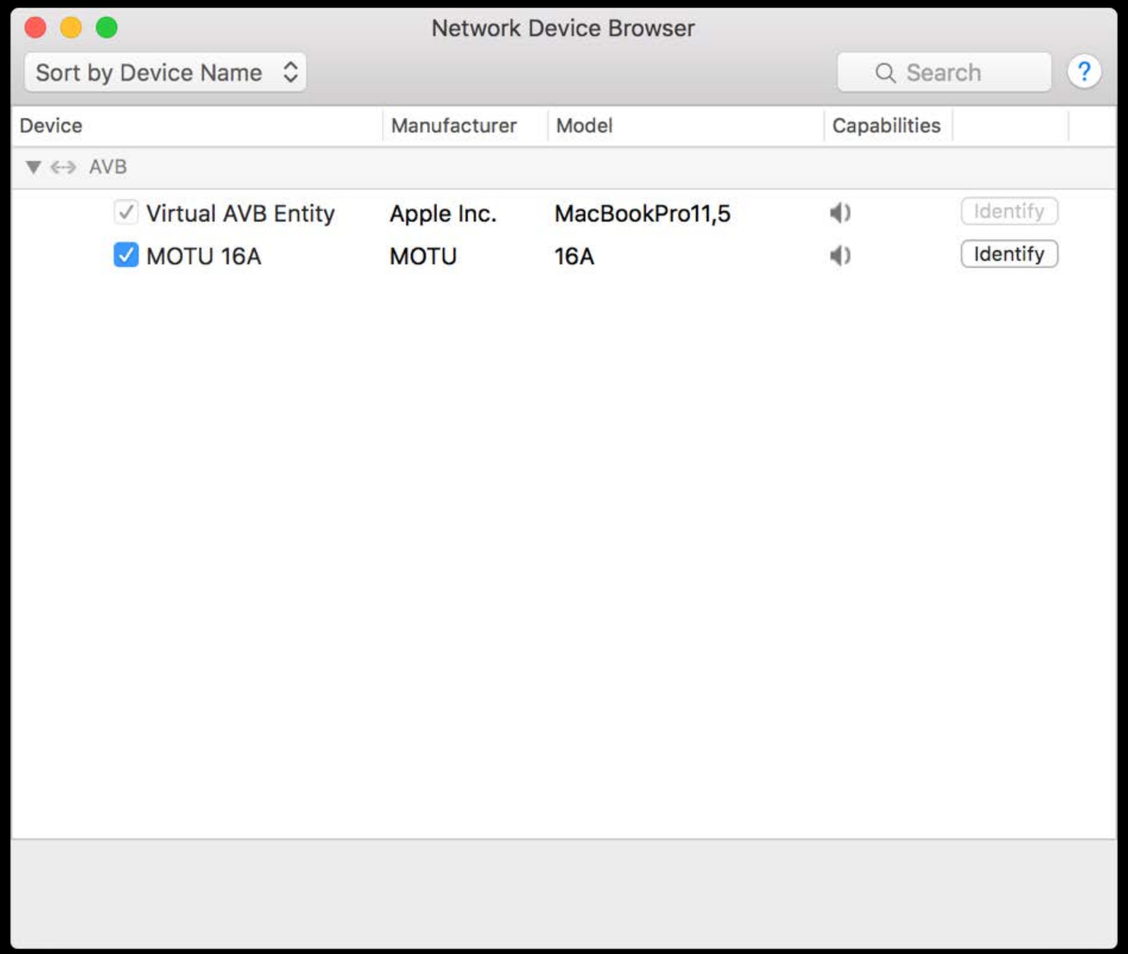
NEW

CANetworkBrowserWindowController

Displays UI for managing AVB audio devices

NSWindowController subclass

# CoreAudioKit View Controller (cont.)



# What's New in AVAudioSession

Torrey Holbrook Walker
Senior New Feature Salesperson

# Navigation Prompts and Podcasts

## Problem

Listening to podcast while driving

Navigation prompts duck podcast audio

—> Bad user experience!

# Navigation Prompts and Podcasts

NEW

## Solution

Podcast and audio book apps:

- Use AVAudioSessionModeSpokenAudio

Navigation and fitness apps:

- Use AVAudioSessionCategoryOptions.InterruptSpokenAudioAndMixWithOthers

1st party apps have opted in:

- Maps, Podcasts, iBooks

# Navigation Application

## Session setup

```
do {
  let audioSession = AVAudioSession.sharedInstance()
  let category = AVAudioSessionCategoryPlayback
  var categoryOptions = AVAudioSessionCategoryOptions.DuckOthers
  if #available(iOS 9.0, *) {
      categoryOptions.unionInPlace(.InterruptSpokenAudioAndMixWithOthers)
  }
  try audioSession.setCategory(category, withOptions: categoryOptions)
} catch {
  // handle errors ...
}
```

# Navigation Application

## Starting navigation prompts

```
func startNavPrompt(promptPath : NSURL) {
  do {
    let audioSession = AVAudioSession.sharedInstance()
    let player = try AVAudioPlayer(contentsOfURL: promptPath)
    player.delegate = self
    try audioSession.setActive(true)
    player.play()
  } catch {
    // handle errors ...
  }
}
```

# Navigation Application

## Completing navigation prompts

```
// AVAudioPlayerDelegate method
func audioPlayerDidFinishPlaying(player: AVAudioPlayer, successfully flag:
Bool) {
  do {
    let audioSession = AVAudioSession.sharedInstance()
    try audioSession.setActive(false,
                withOptions: .OptionNotifyOthersOnDeactivation)
  } catch {
    // handle errors ...
  }
}
```

# Podcast Application

## Session setup

```
do {
  let audioSession = AVAudioSession.sharedInstance()
  let category = AVAudioSessionCategoryPlayback
  var mode = AVAudioSessionModeDefault

  if #available(iOS 9.0, *) {
    mode = AVAudioSessionModeSpokenAudio
  }
  try audioSession.setCategory(category)
  try audioSession.setMode(mode)

...
```

# Podcast Application

## Session setup

```
...

  // add interruption handler
  NSNotificationCenter.defaultCenter().addObserver(self, selector:
"handleInterruption:", name:AVAudioSessionInterruptionNotification, object:
audioSession)

  // register for other important notifications

} catch {
  // handle errors ...
}
```

# Podcast Application

## Interruption handling

```
func handleInterruption(notification: NSNotification)
{
  let userInfo = notification.userInfo as! [String: AnyObject]
  let type = userInfo[AVAudioSessionInterruptionTypeKey] as!
AVAudioSessionInterruptionType

  switch type {
    case .Began:
    // update UI to indicate that playback has stopped
   if (state == isPlaying) {
     wasPlaying = true
     state = stopped
   }
...
```

# Podcast Application

## Interruption handling (cont.)

```
...
    case .Ended:
      if let flag = userInfo[AVAudioSessionInterruptionOptionKey] as?
AVAudioSessionInterruptionOptions {
        if flag == .OptionShouldResume && wasPlaying {
          // rewind the audio a little
          player.play()
          state = isPlaying
          // and update the UI to reflect that playback has resumed
        }
      }
  } // end switch
} // end func
```

# Recap

Enhanced AVAudioEngine

Inter-device audio mode

CoreAudioKit View Controllers for IDAM, BLE MIDI, and AVB

AVAudioSessionModeSpokenAudio

AVAudioSessionCategoryOptions.InterruptSpokenAudioAndMixWithOthers

# Related Sessions

| | | |
|---|---|---|
| Audio Unit Extensions | Nob Hill | Thursday 11:00 AM |
| What's New in SpriteKit | Mission | Wednesday 10:00 AM |
| Enhancements to SceneKit | Mission | Wednesday 2:30 PM |

# Related Labs

| | | |
|---|---|---|
| Audio Lab | Graphics, Games, and Media Lab A | Thursday 9:00 AM |
| Audio Lab | Graphics, Games, and Media Lab A | Thursday 1:30 PM |

# More Information

Technical Support

Developer Technical Support

http://developer.apple.com/contact

Apple Developer Forums

http://developer.apple.com/forums

Bugs

http://bugreport.apple.com

General Inquiries

Craig Keithley, Technologies Evangelist

keithley@apple.com

WWDC15