Error Handling Best Practices for HTTP Live Streaming

Session 514

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Introduction to HLS Error Handling

Introduction to HLS Error Handling

Multiple complex delivery scenarios

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Multiple complex delivery scenarios

Possibly millions of simultaneous viewers

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Bound to run into errors

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Multiple complex delivery scenarios

Possibly millions of simultaneous viewers

Bound to run into errors

Best practices for handling errors for both server and app

Overview of HLS Delivery

Overview of HLS Delivery

Master Playlist

Overview of HLS Delivery

Master Playlist

Video 6Mbit

Overview of HLS Delivery

Master Playlist

Video 6Mbit   Video 2Mbit

Overview of HLS Delivery

Master Playlist

Video 6Mbit	Video 2Mbit

Audio English

Overview of HLS Delivery

Master Playlist

Video 6Mbit	Video 2Mbit
Audio English	Audio French

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Video 6Mbit	Video 2Mbit
Audio English	Audio French
Subtitles English	

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Overview of HLS Delivery

Master Playlist

Video 6Mbit	Video 2Mbit
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**Media Playlists**

Subtitles English
Subtitiles French
Audio English
Audio French
Video 2Mbit
Video 6Mbit

Overview of HLS Delivery

Master Playlist

Video 6Mbit	Video 2Mbit
Audio English	Audio French
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Media Playlists

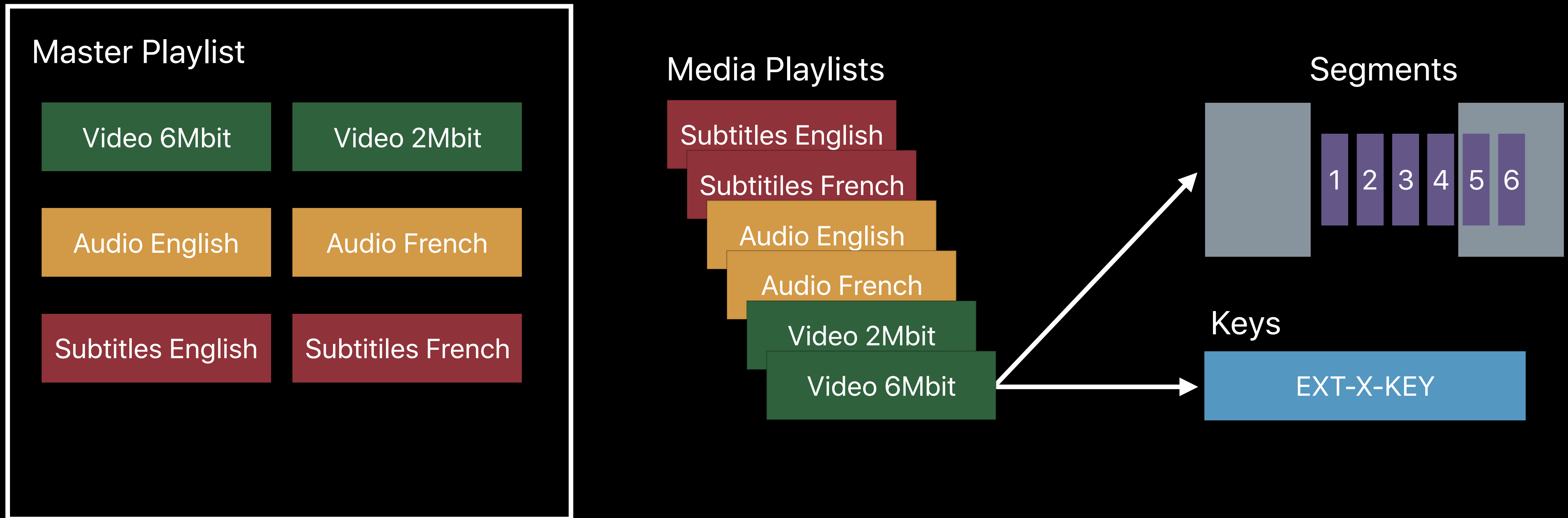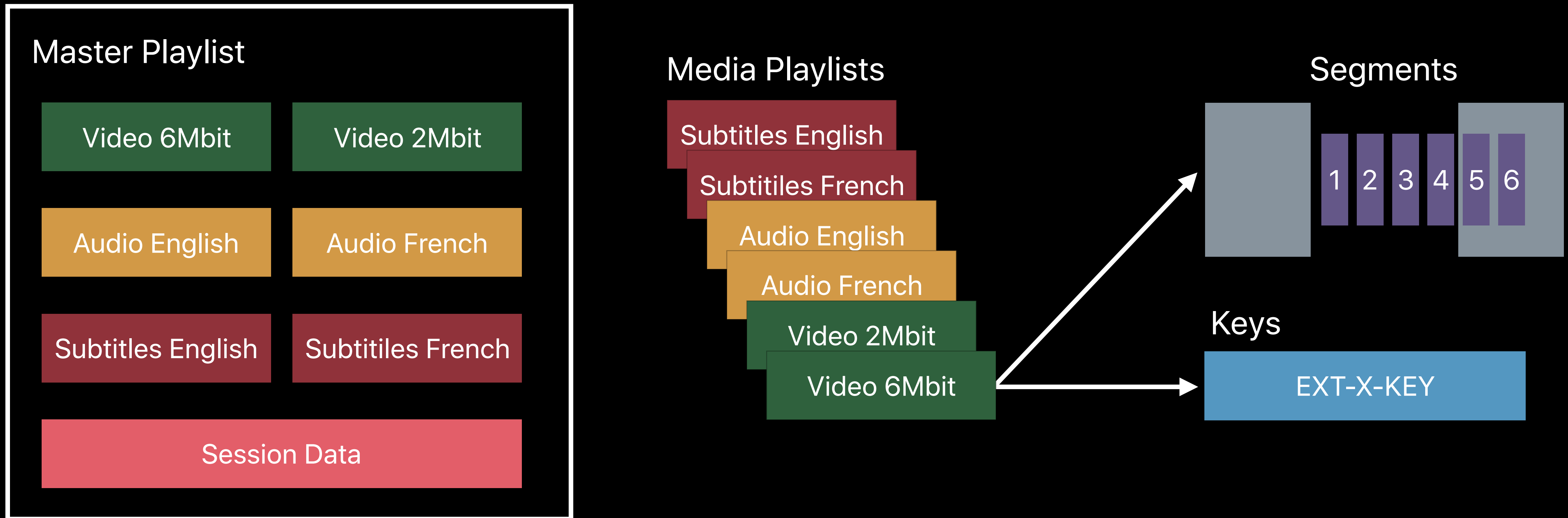- Subtitles English
- Subtitiles French
- Audio English
- Audio French
- Video 2Mbit
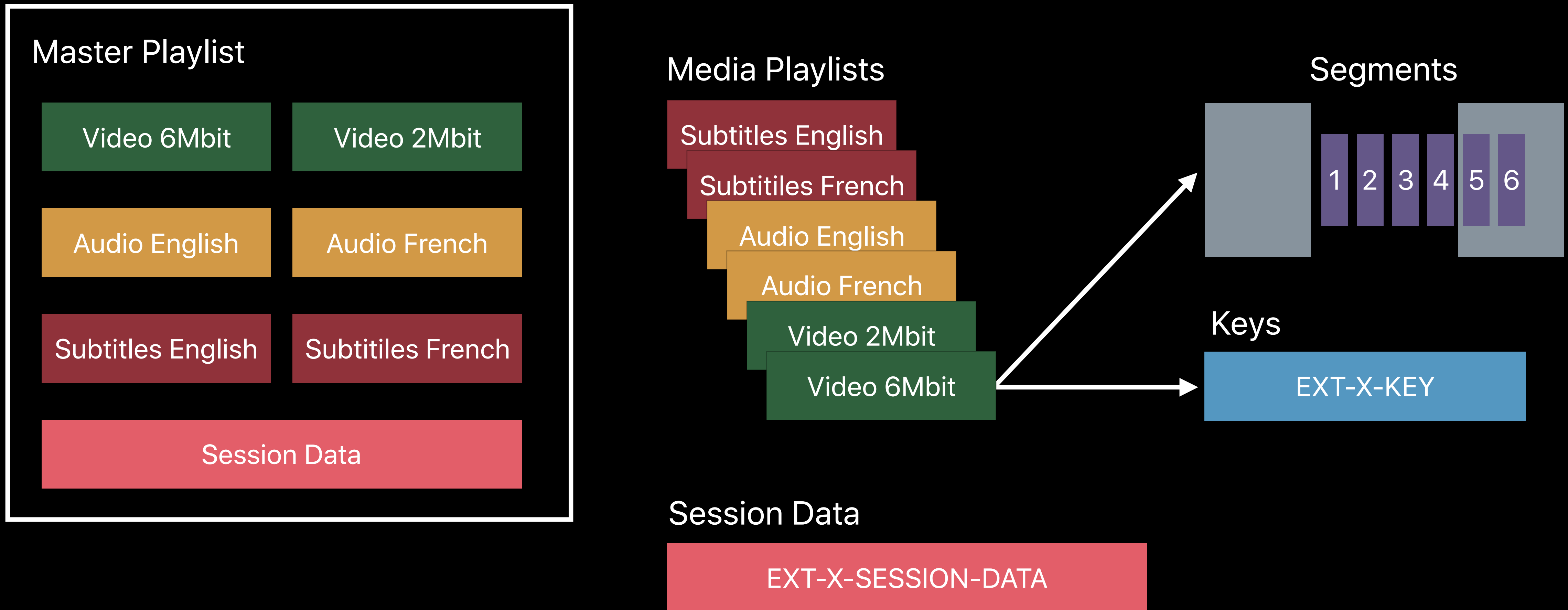- Video 6Mbit

Segments

1 2 3 4 5 6
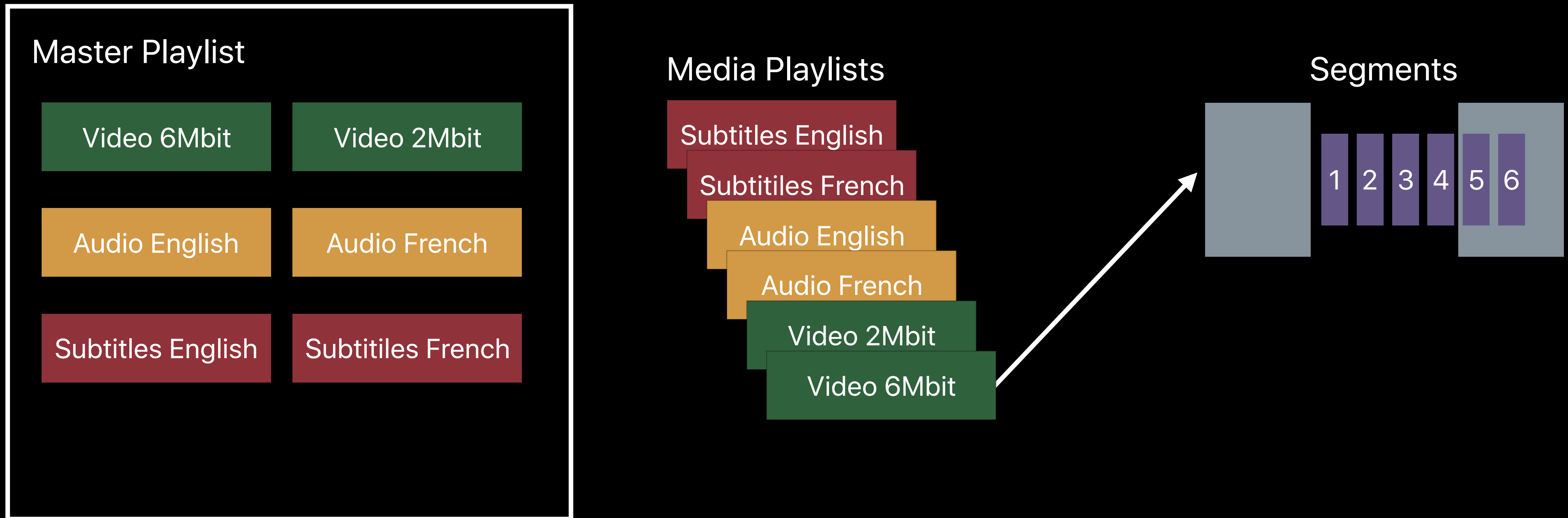
Overview of HLS Delivery

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Server Error Handling

How to handle content and delivery errors

Server Goals

General expectations

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Should deliver the expected resources in time

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In case of error, communicate the correct error code

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Server errors when it fails to fulfill a valid request

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General expectations

Should deliver the expected resources in time

In case of error, communicate the correct error code

Server errors when it fails to fulfill a valid request

• Encountered an error

• Incapable of performing the request

Expected Failures and Error Codes

Failure	Error Code
Authentication failures	401 Unauthorized
Client doesn't have permissions	403 Forbidden
Resource unavailable but may become available in the future	404 Not Found
Resource unavailable and will never become available in the future	410 Gone
Internal server errors	500 Internal Server Error
Invalid response from gateway	502 Bad Gateway
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GAP Tag

NEW

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-VERSION:2
#EXT-X-MEDIA-SEQUENCE:0
#EXTINF:10,
fileSequence0.ts
#EXT-X-GAP
#EXTINF:10,
fileSequence1.ts
#EXT-X-GAP
#EXTINF:10,
fileSequence2.ts
```

GAP Tag

Applied to one or more segments

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Put this tag in sample timeline to indicate gap

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AVPlayer could switch down to a variant without gap if possible

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GAP Tag

NEW

Applied to one or more segments

Put this tag in sample timeline to indicate gap

AVPlayer could switch down to a variant without gap if possible

Play silence if nothing else available

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Expected Error Codes and Behavior

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Send 404 to indicate stale playlist

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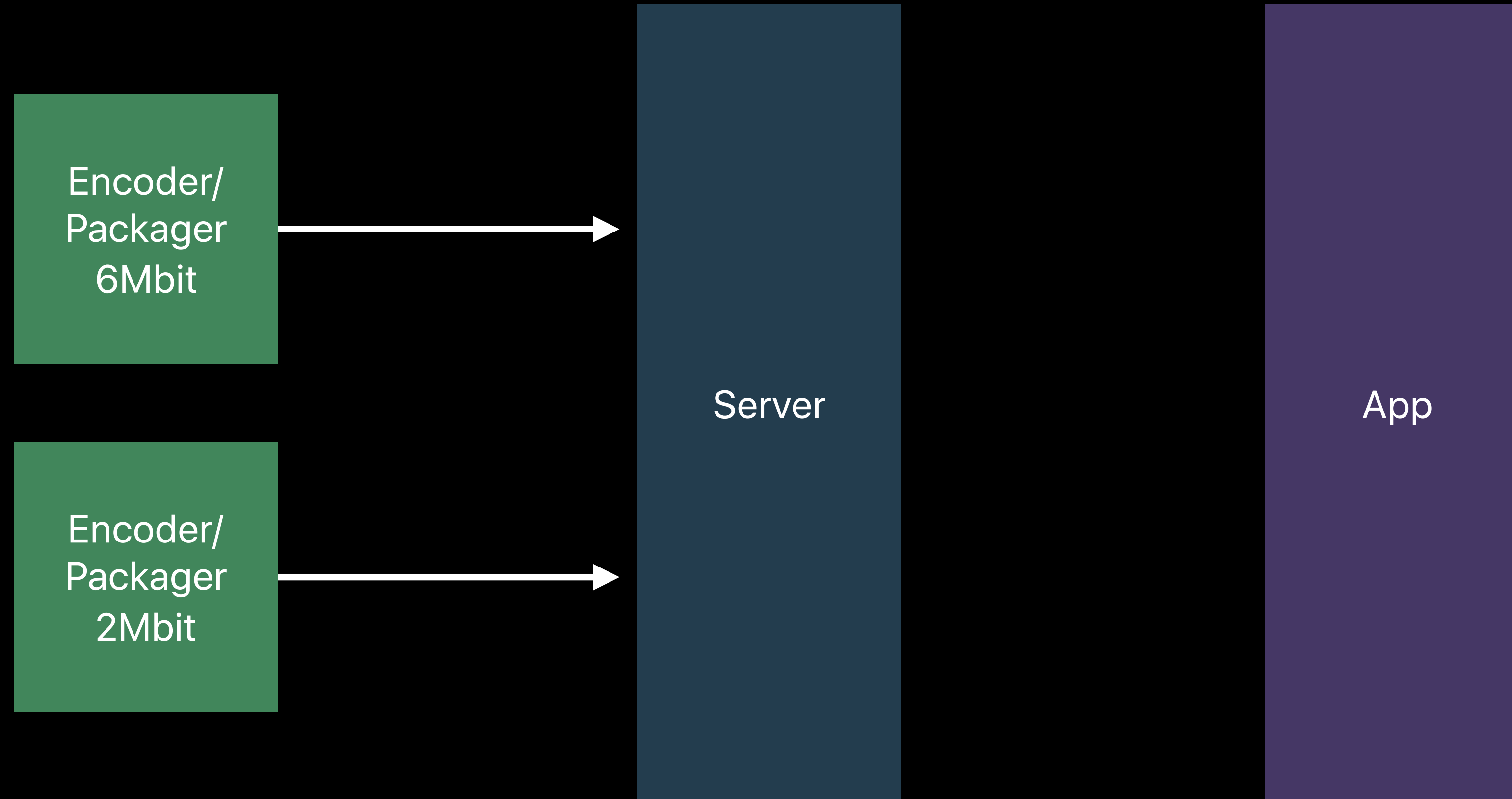Send 501 for Unsupported features for example BYTE-RANGES not supported

Expected Error Codes and Behavior
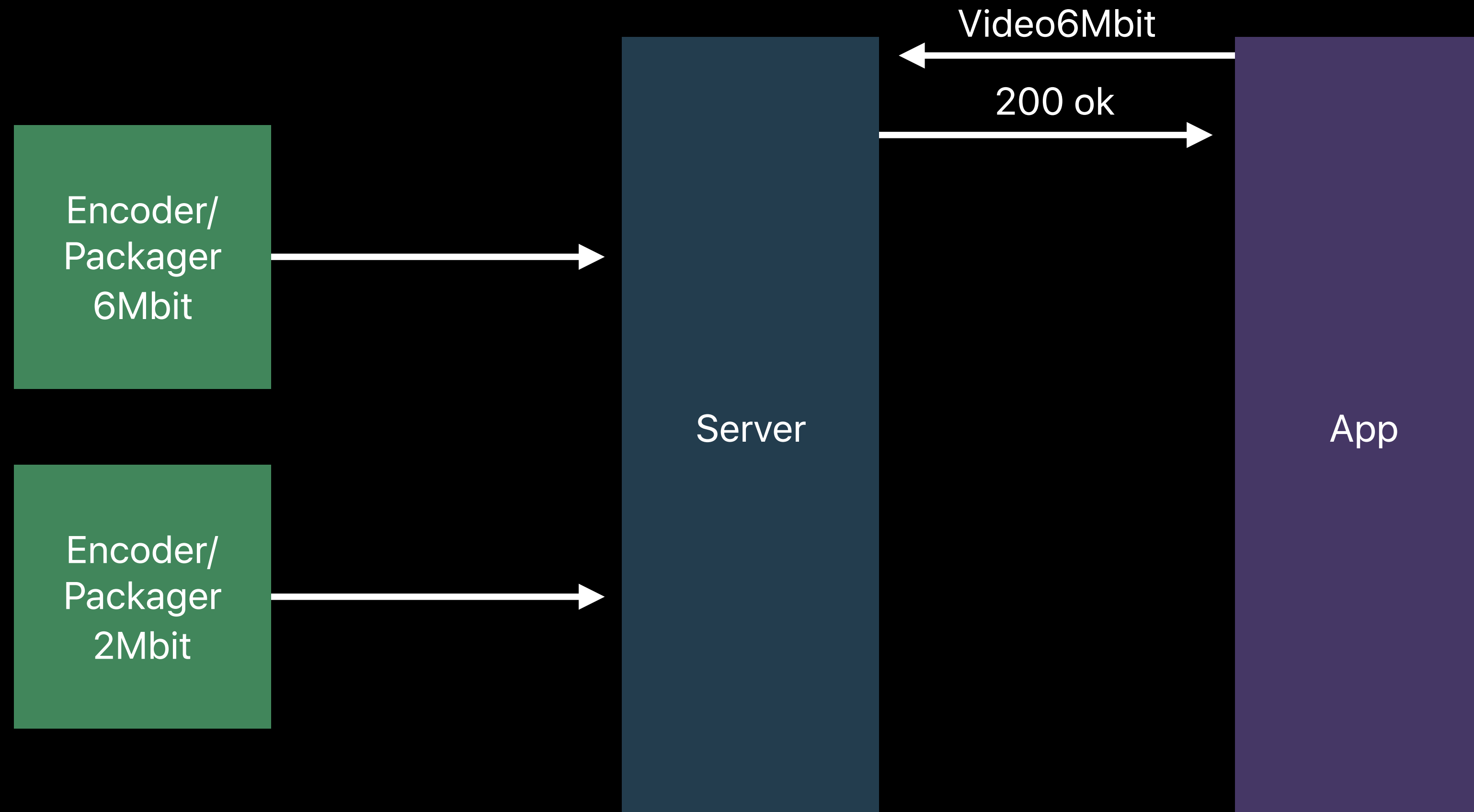
Send 404 to indicate stale playlist

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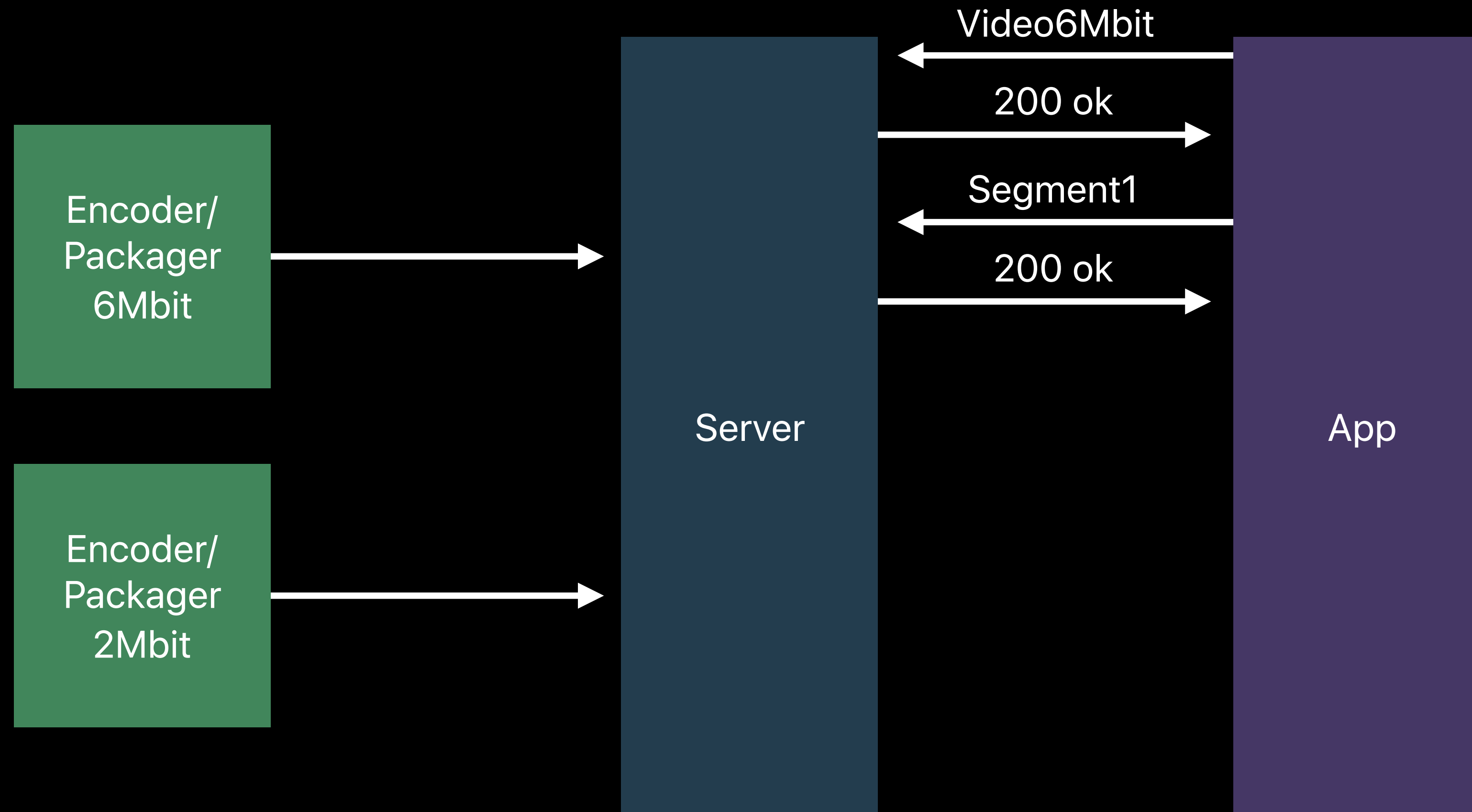
Send 401 for authentication failures
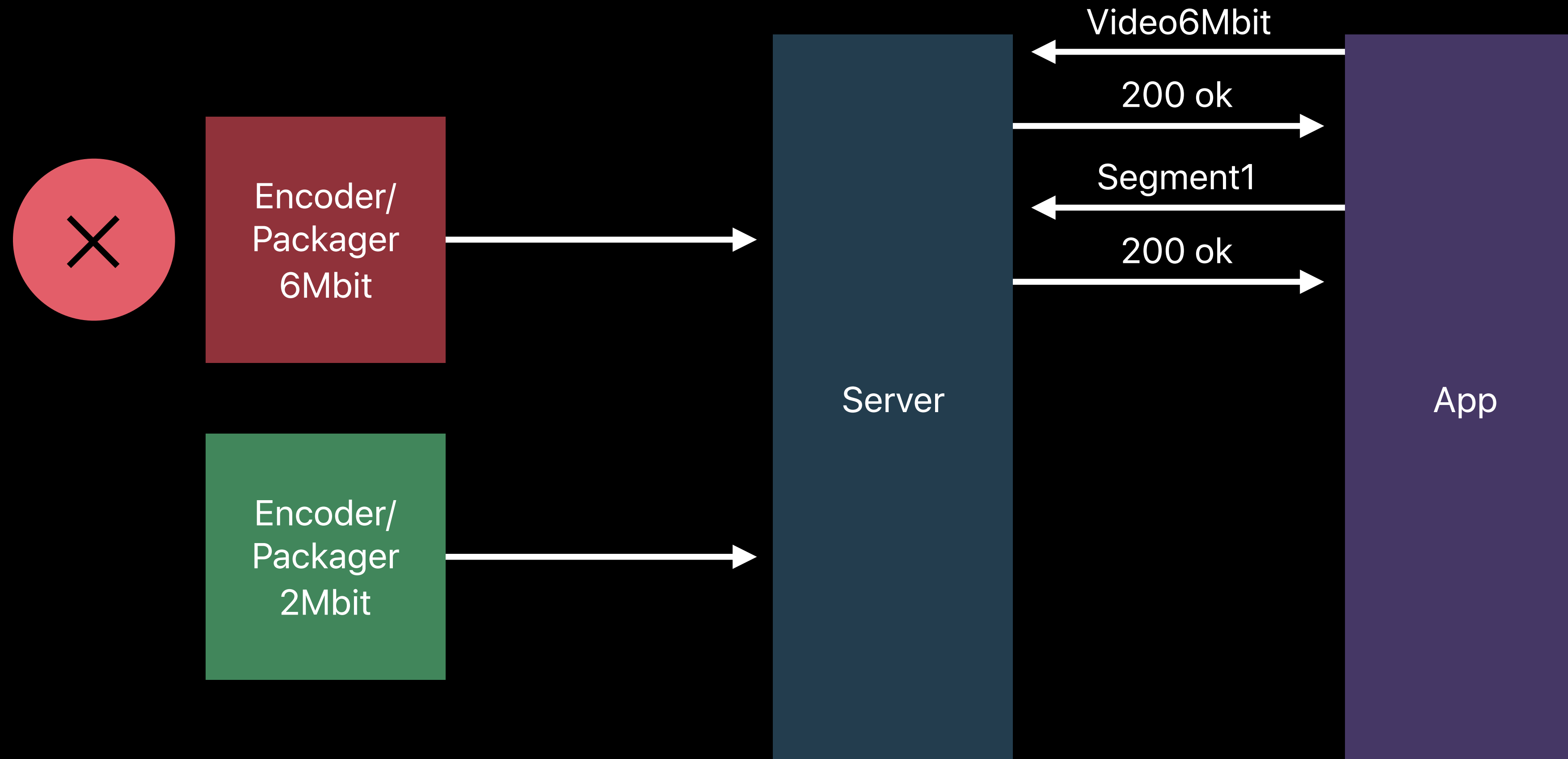
Example Scenario Live Playback

Encoder/
Packager
6Mbit
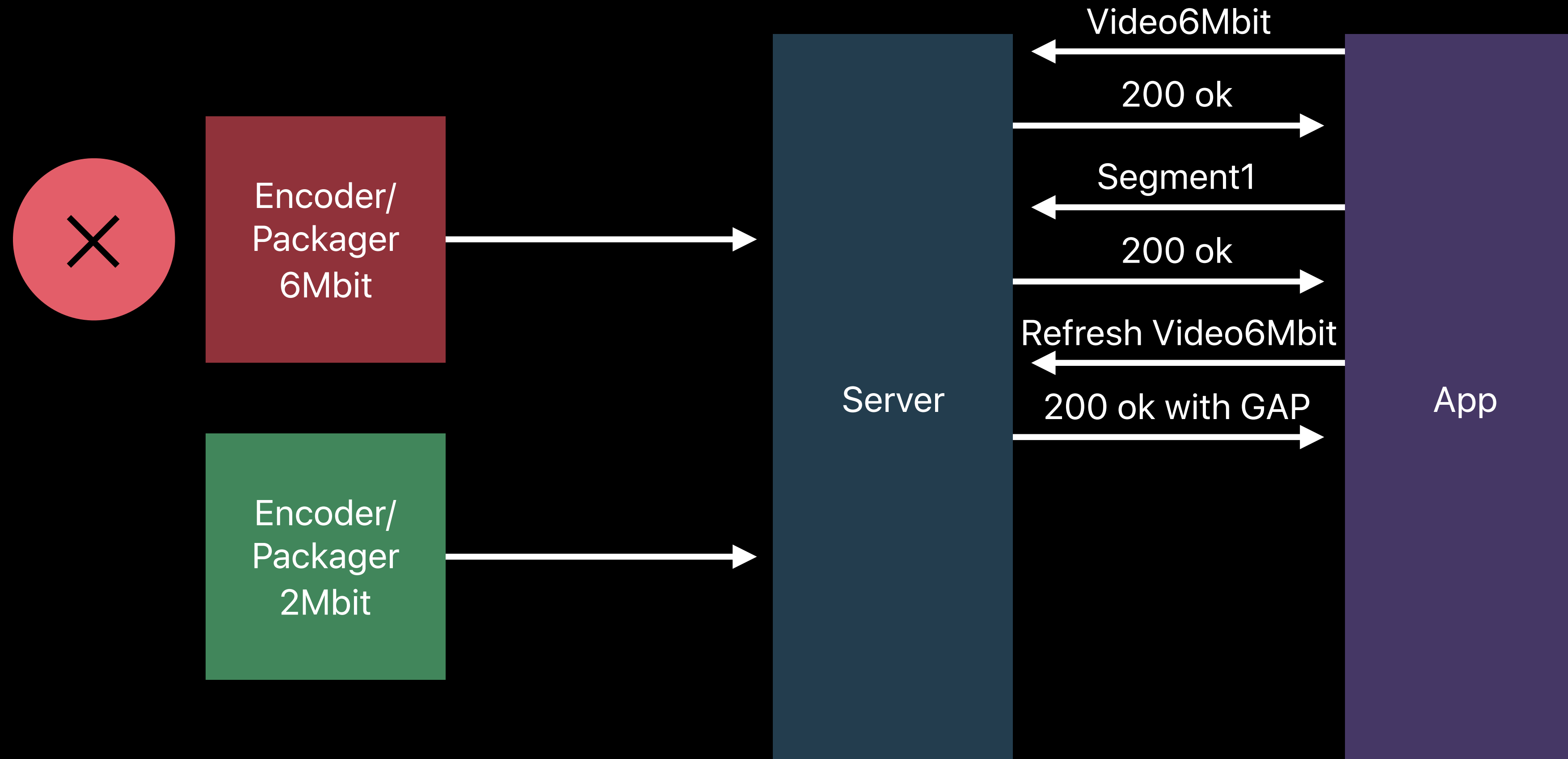
Encoder/
Packager
2Mbit

Server
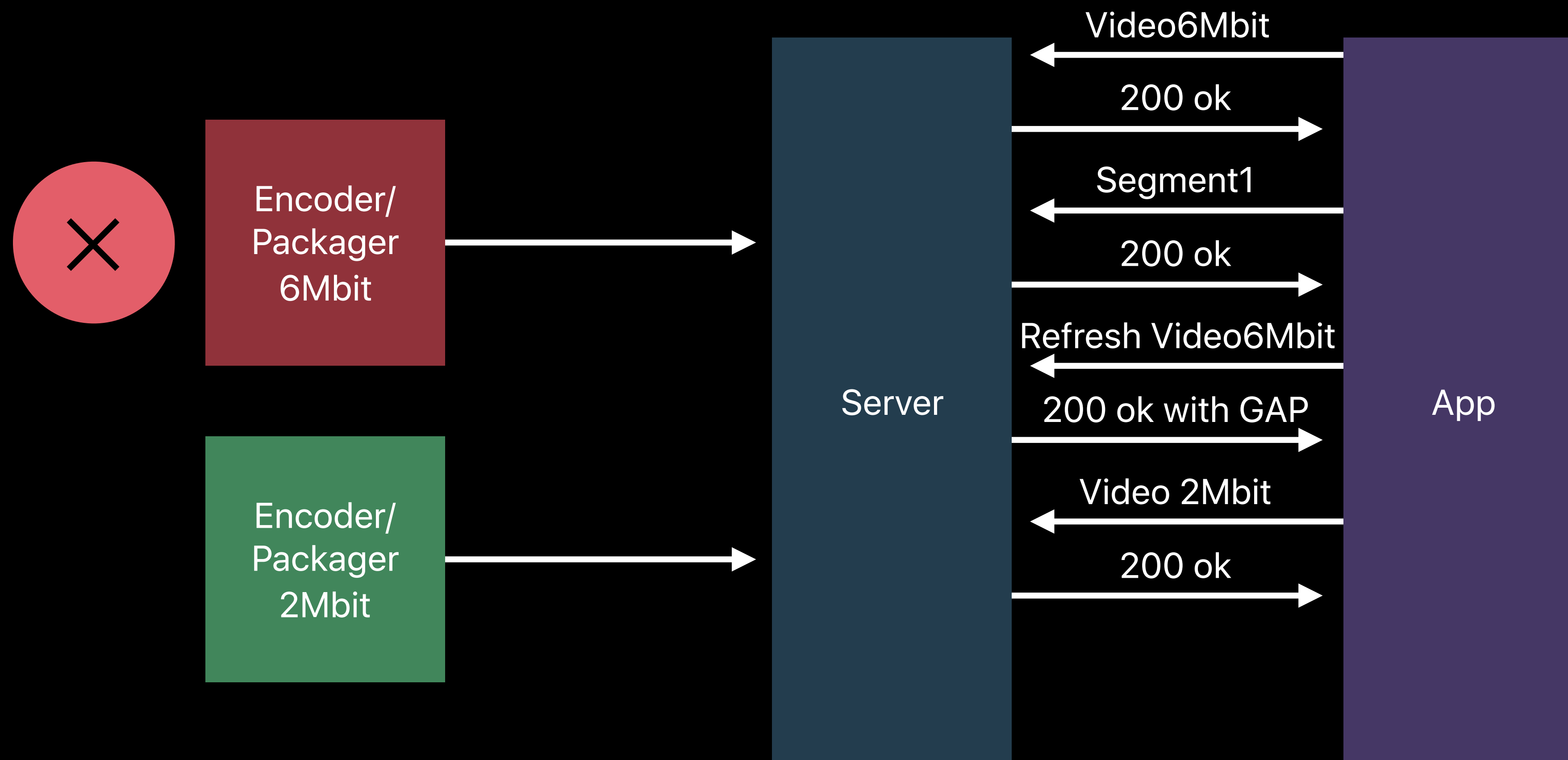
App

Example Scenario Live Playback
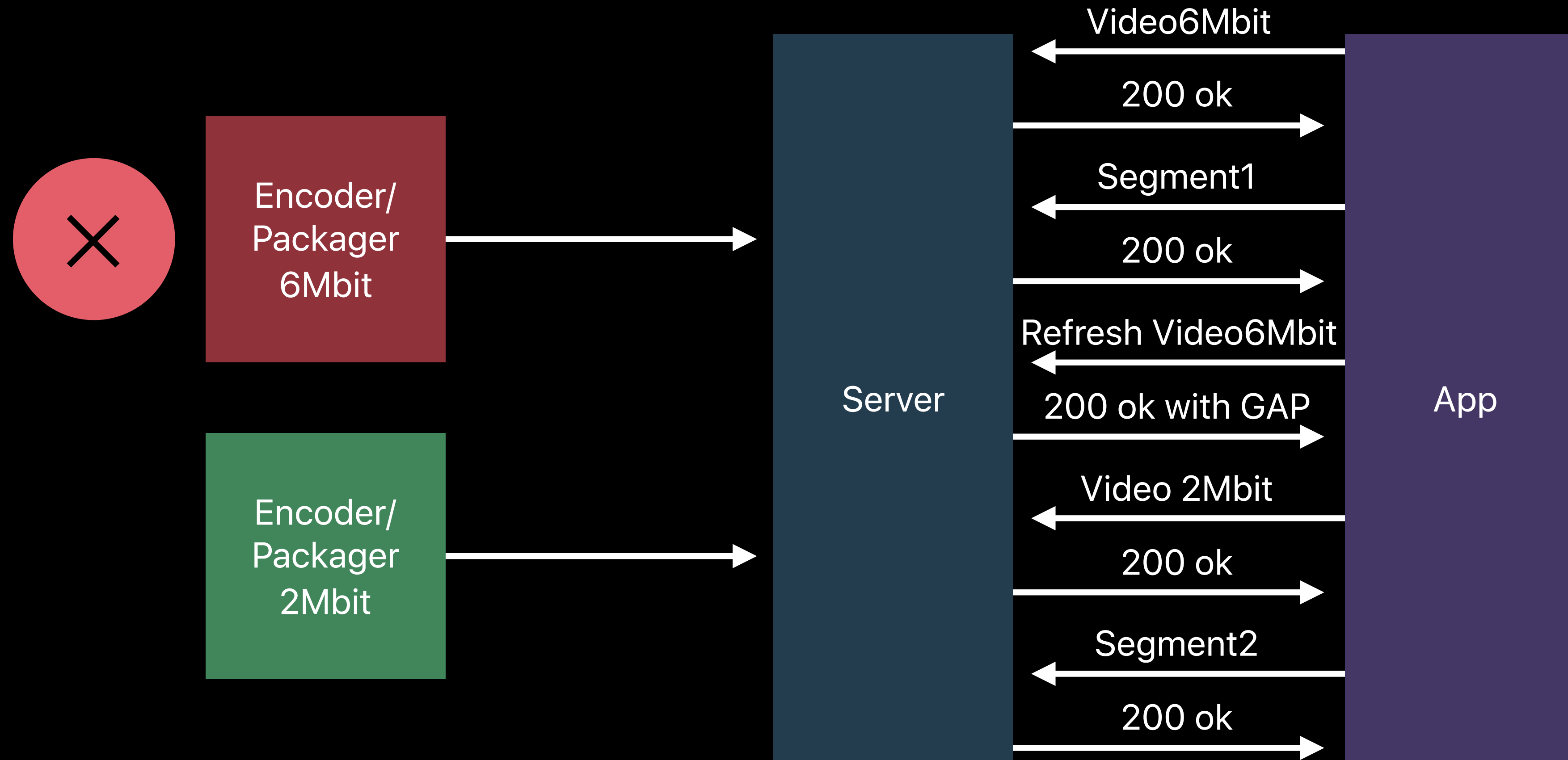
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Failover

Failover

A method of protecting systems from failure, in which standby system takes over when the main system fails

Failover

Master Playlist

| Video 6Mbit | Video 2Mbit |

| Audio English | Audio French |

| Subtitles English | Subtitles French |

| Session Data |

Failover

Have variants on different servers with same bandwidth and include them in master playlist

Master Playlist

Video 6Mbit

Video 2Mbit

Audio English

Audio French

Subtitles English

Subtitiles French

Session Data

Failover

Have variants on different servers with same bandwidth and include them in master playlist

Master Playlist

Video 6Mbit	Video 2Mbit
BackupVideo 6Mbit	
Audio English	Audio French
Subtitles English	Subtitiles French
Session Data	

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Video 6Mbit	Video 2Mbit
BackupVideo 6Mbit	BackupVideo 2Mbit
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Failover

Have variants on different servers with same bandwidth and include them in master playlist

Backup alternate will be tried before switching down

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Have variants on different servers with same bandwidth and include them in master playlist

Backup alternate will be tried before switching down

Send 404 to trigger a failover

Master Playlist

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Summary of Server Best Practices

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Prefer gap tag in case of temporary resource/server unavailability

Summary of Server Best Practices

Notify the client of error with correct error code

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Update the playlist in time as specified by the HLS Spec

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App Error Handling

How to handle AVFoundation errors

Identifying Error

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AVPlayer.status and AVPlayerItem.status

Changes to AVPlayerStatusFailed, AVPlayerItemStatusFailed

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AVPlayerItemFailedToPlayToEndTimeNotification

Dig Deeper

AVPlayerItem.errorLog the snapshot of error log

What do the errors mean ?

Possible Error Events

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Network errors

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Timeouts

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Format errors

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Live playlist update errors

Possible Error Events

Network errors	4xx errors, 5xx errors
	TCP/IP, DNS errors
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Live playlist update errors	

Possible Error Events

Network errors	4xx errors, 5xx errors TCP/IP, DNS errors
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Format errors	Playlist format error Key format error Session data format error
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Corresponding AVFoundationDomain Errors

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Corresponding AVFoundationDomain Errors

Network errors	4xx errors, 5xx errors TCP/IP, DNS errors	AVErrorContentIsUnavailable AVErrorNoLongerPlayable
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Format errors	Playlist format error Key format error Session data format error	AVErrorFailedToParse
Live playlist update errors	Must update live playlist in time as per HLS Spec	AVErrorContentNotUpdated

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- Played out what ever buffer we have

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Switch to a different variant or retry on temporary server errors (i.e. 500, 502, 503, 504, 401, 403, 404)

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On permanent failures (i.e. 410) playback is stopped only if there are no other viable variants

All session data errors are not fatal and are ignored

```swift
// Extracting the Errors

let hlsAsset = AVURLAsset(URL: assetURL as URL)
let item = AVPlayerItem(asset: hlsAsset!)
let player = AVPlayer(playerItem: item)


// Add observer for player status
addObserver(self, forKeyPath: #keyPath(AVPlayer.status), options: [.new, .initial], context:
nil)
// Add observer for playerItem status
addObserver(self, forKeyPath: #keyPath(AVPlayer.currentItem.status), options:
[.new, .initial], context: nil)


// Listen to notification
NotificationCenter.default.addObserver(self, selector:"failedToPlayToEndTime:",
    name: NSNotification.Name.AVPlayerItemFailedToPlayToEndTimeNotification, object:
player.currentItem)
```

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```swift
// Observe If AVPlayerItem.status Changed to Fail

override func observeValue(forKeyPath keyPath: String?, of object: Any?, change:
[NSKeyValueChangeKey: Any]?, context: UnsafeMutableRawPointer?) {
    if keyPath == #keyPath(player.currentItem.status) {
        let newStatus: AVPlayerItemStatus
        if let newStatusAsNumber = change?[NSKeyValueChangeKey.newKey] as? NSNumber {
            newStatus = AVPlayerItemStatus(rawValue: newStatusAsNumber.intValue)!
        }
        else {
            newStatus = .unknown
        }
        if newStatus == .failed {
            NSLog("Error: \(player.currentItem?.error?.localizedDescription), error: \
(player.currentItem?.error)")
        }
    }
}
```

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override func observeValue(forKeyPath keyPath: String?, of object: Any?, change:
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    if keyPath == #keyPath(player.currentItem.status) {
        let newStatus: AVPlayerItemStatus
        if let newStatusAsNumber = change?[NSKeyValueChangeKey.newKey] as? NSNumber {
            newStatus = AVPlayerItemStatus(rawValue: newStatusAsNumber.intValue)!
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// Getting error from Notification payload
func failedToPlayToEndTime(_ notification: Notification) {
    let error = notification.userInfo!["AVPlayerItemFailedToPlayToEndTimeErrorKey"]
    NSLog("Error: \(error?.localizedDescription), error: \(error)")
}
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// Getting error from Notification payload
func failedToPlayToEndTime(_ notification: Notification) {
    let error = notification.userInfo!["AVPlayerItemFailedToPlayToEndTimeErrorKey"]
    NSLog("Error: \(error?.localizedDescription), error: \(error)")
}
```

Summary App Best Practices

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Monitor AVPlayer and AVPlayerItem status

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Monitor AVPlayer and AVPlayerItem status

Listen to AVPlayerItemFailedToPlayToEndTimeNotification

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Monitor AVPlayer and AVPlayerItem status

Listen to AVPlayerItemFailedToPlayToEndTimeNotification

Listen to AVPlayerItemNewErrorLogEntryNotification

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Monitor AVPlayer and AVPlayerItem status

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Notify user of errors

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Monitor AVPlayer and AVPlayerItem status

Listen to AVPlayerItemFailedToPlayToEndTimeNotification

Listen to AVPlayerItemNewErrorLogEntryNotification

Notify user of errors

Display meaningful messages/pop-ups when failures occur

More Information

https://developer.apple.com/wwdc17/514