White Paper

HTTP Streaming for iPhone Best Practices

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Executive Summary

The consumption of mobile content around the globe is growing rapidly, thanks to the introduction of more open, Internet based smartphones like the iPhone. These devices expand the opportunity for content publishers to leverage the public internet (rather than closed-walled garden approach of carriers) to extend audience reach to new platforms.

Video capabilities on mobile handsets have increased significantly. According to a recent study, 75% of worldwide data-capable handsets are able to download video clips, and almost 50% support streaming video. Apple's iPhone represents a large and growing share of this market when measured by number of handhelds. But iPhone users are much more active on the network than others, generating a disproportionate amount of mobile web and application traffic.

In addition to screen size and ease-of-use, Apple's integral support of WiFi appears to be a big contributor to increased mobile internet usage. Apple products represent almost 80% of worldwide WiFi requests by handhelds, 50% from iPhones and another 30% from the iTouch.

The opportunity for mobile digital media and applications is growing as manufacturers add WiFi functionality to this leading edge of smartphones. With iPhones out in front, now is the time for your business to explore and plan a mobile content strategy.

Since the iPhone offers the optimal user video experience at this time, this guide will focus primarily on delivering content to iPhone users. However we will discuss other mobile devices in passing.

Step 1: Planning a Mobile Content Strategy

The iPhone has demonstrated that consumers are willing and able to download and view a wide variety of content and applications on their handsets. Windows of opportunity range from two to three minute breaks while waiting for something or someone, to an hour or more while commuting or other travel. Prior to the iPhone access to mobile content was primarily available through 'on-deck' services offered by the carriers. Carriers would determine which brands and content services are available to consumers from their mobile internet home pages. However, there is now a growing shift to 'off-deck' or 'direct-to-consumer' content through brand owned sites and applications. This has enabled new business models, revenue streams and delivery options for both 'on-deck' and 'off-deck' content.

Step 2: Deciding on a Business Model

There are three primary business models in today's mobile content market, those being;

1. Free content: if the content provides direct support for a product or service, then you might distribute it for free.
2. Paid for content: another model is to charge a fee directly to the customer for the content or the application. Variations on this include subscriptions, rental charges for viewing for a limited time, or an outright purchase.
3. Advertising supported content: supporting content distribution with advertising is a frequently considered business model. Advertising options include banner ads, 'pre-roll' of ads before the main video or more complex integration such as graphics overlays on the video content.

Choosing the appropriate business model for your content is the first step.

Step 3: Deciding on a Delivery Model

After choosing your business model, the next step is content delivery. 'On-deck' delivery requires partnership with the carrier, but can provide more details on user location, demographics, subscription, and billing options. 'Off-deck' delivers in two ways: using standard web protocols and browser; or with a custom application that gives you greater control over quality and user interaction.

A few examples highlight these choices.

Long-playing videos, such as movies or full TV episodes, have typically been downloaded to the handset and stored until the user is ready to play them. This involved a two-step process that goes first to a desktop and then to the handset when docked (for example, via iTunes). With the availability of WiFi enabled smartphones and faster wireless 3G data speeds, direct to handset streaming delivery over standard web protocols is becoming increasingly popular for full TV episodes. In this model, the video begins to play as soon as enough content has been received.

Short videos and time-sensitive video clips, such as sports or news highlights, are often delivered by streaming, which means they begin to play as soon as enough content has been received. These typically have to fit into brief windows of opportunity, with selection, download, ad display (if any), and main video completed in less than two or three minutes.

Simulcast of live sports, news and events to mobile handsets requires special considerations around scalability and performance of the delivery mechanism. Prior to the release of the iPhone 3.0 OS, live streaming required a custom proprietary solution. iPhone 3.0 OS now has built in support for live video streaming that dynamically adapt to available bandwidth, optimize full screen video playback and increase battery life.

This paper is intended as a guide to optimizing video streaming to the iPhone 3.0 OS.

Video Streaming for the iPhone

Video support

Full-screen video playback of movie files with the .mov, .mp4, .m4v, and .3gp filename extensions, using the following compression standards:

- H.264 video, up to 1.5 Mbps, 640 by 480 pixels, 30 frames per second, Low-Complexity version of the H.264 Baseline Profile with AAC-LC audio up to 160 Kbps, 48kHz, stereo audio in .m4v, .mp4, and .mov file formats
- H.264 video, up to 2.5 Mbps, 640 by 480 pixels, 30 frames per second, Baseline Profile up to Level 3.0 with AAC-LC audio up to 160 Kbps, 48kHz, stereo audio in .m4v, .mp4, and .mov file formats
- MPEG-4 video, up to 2.5 Mbps, 640 by 480 pixels, 30 frames per second, Simple Profile with AAC-LC audio up to 160 Kbps, 48kHz, stereo audio in .m4v, .mp4, and .mov file formats

Akamai recommends the use of H.264 encoding in an MP4 container file for iPhone video content. This combination has excellent compatibility and delivers higher quality at lower bitrates than MPEG-4.

Audio Support

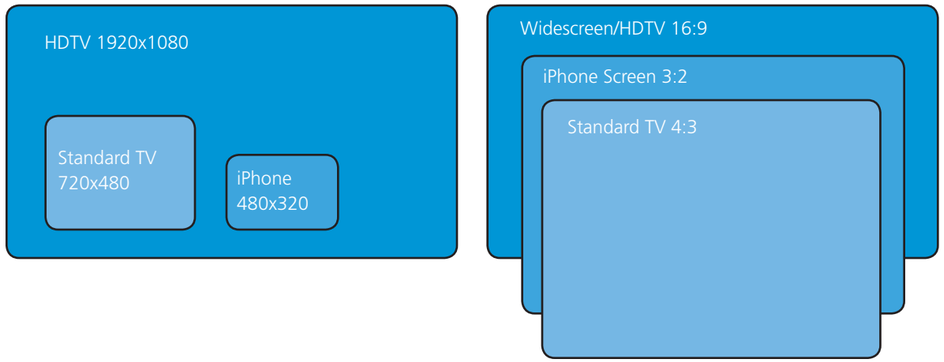
Audio capabilities available in iPhone OS are designed to provide a rich audio experience. Audio formats supported: AAC, Protected AAC, MP3, MP3 VBR, Audible (formats 2, 3, and 4), Apple Lossless, AIFF, and WAV

Resolution

The native video display format of the iPhone is 480 x 320 pixels, or about half the resolution of standard TV. When viewed sideways the aspect ratio of the screen is 3:2, which is slightly wider than standard TV, and narrower than widescreen/HDTV.

This means that images in unmodified standard-aspect videos will appear slightly squashed (shorter and wider). Widescreen videos will either display with black bars on the top and bottom, or the picture will have the left and right sides clipped

Video content in unmodified standard-aspect videos will appear slightly squashed (shorter and wider). Widescreen video will either display with black bars on the top and bottom, or the picture will have the left and right sides clipped.



Delivery

All media delivery to the iPhone is over HTTP. The iPhone does not natively support streaming protocols such as RTSP/RTMP, although custom applications can add this capability. Connectivity is available through EDGE, 3G, and Wi-Fi networks — optimal encoding takes available bandwidth into account, with 2 to 4 bit-rates that are optimized to different connections.

User Experience

The iPhone OS uses its built-in Media Player application to play media; even when video is embedded in a webpage. Video automatically expands to the size of the screen and rotates when the user changes orientation. The controls automatically hide when they are not in use and appear when the user taps the screen.

iPhone OS Version 3.0 — New Streaming Capabilities

Introduction

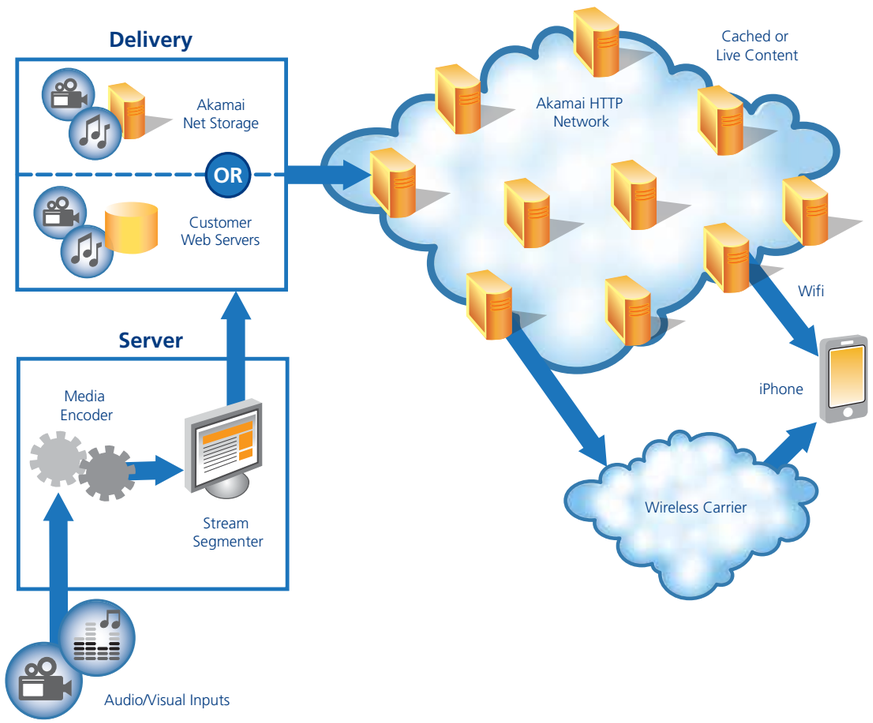
Starting with iPhone OS version 3.0 and QuickTime X, you can send streaming audio and video over HTTP from an ordinary web server for playback on iPhone, iPod touch, or other devices, such as desktop computers, without the limitations of Progressive Downloads.

The new streaming protocol supports Multiple Bitrates and automatically switches to the optimal bit-rate based on network conditions for a smooth quality playback experience. This implementation also provides for media encryption and user authentication over HTTPS, allowing publishers to protect their work. Both Live and On demand content can be delivered using the 3.0 specification.

Architecture Overview

The encoder (or a separate segmenter process) will produce H.264/AAC content in a sequence of small content segments, in MPEG-2 TS format (.ts). There is also an M3U8 index file that references the segments; in the case of live content the M3U8 is continuously updated to reflect the latest content.

Content is served to the iPhone over HTTP. This makes Akamai NetStorage an ideal place to ingest the content, making it available to the Akamai HTTP delivery network.



Best Practices

Video Encoding and Bit-Rates

User's accessing content on the iPhone and iPod touch have widely varying download speeds depending on whether they accessing the content over Edge, 3G or WiFi. These settings are applicable to both live and on-demand content.

Delivery	Dimensions	Frame Rate	Total Bit Rate	Video Bit Rate	Audio Bit Rate	Audio Sample Rate
Aspect 4:3						
Edge	360x270	1/2 Current	112	85	32	16
3G (Low)	360x270	Current	314	250	64	32
3G (High)	360x270	Current	514	450	64	32
WiFi	360x270	Current	864	800	64	32
Aspect 16:9						
Edge	400x224	1/2 Current	112	85	32	16
3G (Low)	400x224	Current	314	250	64	32
3G (High)	400x224	Current	514	450	64	32
WiFi	400x224	Current	864	800	64	32

Note that the bit rates are general suggestions, and should vary depending on target audience, content subject matter, and specific encoder behavior.

H.264 Encoding should be single-pass Baseline Profile, frame re-ordering disabled. Key frames are suggested every 5 seconds, ideally an even divisor of the chosen segment length.

Stream Segmenter

Apple has created the Media Stream Segmenter, a command-line tool that segments Live MPEG-2 content for delivery, and also creates the associated M3U8 index. The Segmenter receives an MPEG-2 transport stream over UDP or can read from an existing file. The index file and media files can then be deployed using common web server infrastructure. The Media Stream Segmenter can also encrypt the segments using AES-128 encryption.

This approach should work with many encoders, as MPEG-2 transport stream support is wide-spread. Some encoder vendors are building this functionality into their product, so no separate segmentation process is needed.

At minimum the segmenter requires the URL base path, file output path, and address:port of the encoder. For more options, see the Apple Media Stream Segmenter user guide. A simple example:

```
mediastreamsegmenter -b http://myserver.com/mycontent1
  -f /mycontent1  224.0.0.1:27000
```

When configuring the segmenter please take into account best-practices as discussed in the next section.

Content Origin

As this content is delivered over standard HTTP, it can be served from nearly any origin web server, including Apache or IIS. The segmenter can be run locally, or configured to output content to a shared folder on the web server, or you can use a variety of methods suitable to your OS to move the content.

Akamai also supports serving content from NetStorage, a scalable cost-effective storage solution. NetStorage is transparently replicated across the globe, making it the best option for managing and delivering high-demand content.

Ingest to NetStorage

Akamai NetStorage is an ideal place to ingest the content, making it available to the Akamai HTTP delivery network. This section will outline the best practices for ingesting content to NetStorage. The focus is on Live, where the mechanism is more critical.

NetStorage supports several ways of ingesting content: HTTP POST/ DELETE, File Transfer Protocol (FTP), rsync, Secure Copy (SCP), and SSH File Transfer Protocol (SFTP)

Of these mechanisms HTTP is the preferred protocol for live ingest, as it is a simple protocol with low overhead, wide support, and compatibility with most firewalls and network configurations. Akamai is working with encoding partners to enable their products to directly transfer live content. For On-demand content, customers typically choose FTP for transferring files to NetStorage.

Storage Considerations

Dealing with many small files can be a challenge for any storage system. Apple and Akamai both recommend 10 second segments as the best length for balancing performance and user experience. Shorter chunk sizes will incur additional transfer overhead and result in more file entries. It is also recommended that each content item is stored in its own sub-directory, making performance issues from excessive file entries less likely. For long-running events consider rolling to a new folder periodically, file entries should be kept to 2,000 or less per folder.

Client Playback

The iPhone 3.0 Media Player directly supports this segmented streaming approach and will launch when a user enters the M3U8 link into Safari. Publishers may also choose to write their own native iPhone apps that are able to seamlessly browse content, leveraging the Media Player for content rendering.

HTML 5 Video Support

HTML 5 is the latest revision of the HTML standard. Of relevance is the new video tag, which allows video content to be directly embedded into a page, without the need for proprietary runtimes or plug-ins. HTML 5 is considered in the last stages of the design process, however, some browsers are beginning to add support for it, starting with Apple's Safari 4 browser, which includes Safari on the iPhone 3.0. The next version of Firefox, 3.5, will also introduce partial support for HTML 5.

The video tag is used in a similar fashion to the image tag, with a source element that defines the content. A very simple example is as shown:

```
<video width="640" height="480" >
   <source src="content1/content1.m3u8" />
</video>
```


Like HTML object tags, the video tag has a 'fall-through' mechanism. If the video tag is not recognized, the browser will attempt to render the next child tag. This is extremely useful, allowing a runtime like Flash to handle playback on browsers that do not yet support HTML 5 video playback. The video tag can also fall-through across multiple sources, in the event that a browser does not support a particular file format or compression. The HTML 5 specification defines the syntax for the video tag, but it is up to the browser which media formats to support.

The below example has a link to the new segmented streaming format for iPhone 3.0, then rolls to a normal on-demand MP4 clip for Safari/iPhone 2.0, and then to an tag that would load the QuickTime plug-in to play the MP4 clip for other OS/browser combinations.

```
...
<html>
<head>
<script type="text/javascript">
    function isiphone(){
        return ((navigator.userAgent.match(/iPhone/i)) || (navigator.userAgent.
match(/iPod/i))) != null;
    }
    function init(){
        if (!isiphone()){
            document.getElementById("videotag").src = "content.mp4";
        }else{
            document.getElementById("videotag").src = "content.m3u8";
        }
    }
</script>
</head>
<body onload="init()" >

<video id="videotag" width="400" height="224" controls="controls" >

    <!-- Fall-through to Quicktime object -->
        <object width="400" height="224" type="video/quicktime" class="mov"
            data="content.mp4" >
        <param name="controller" value="true" />

        <!-- Fall-through to Install message -->
        <a href="[link to preferred runtime install..]">
            Click here to install support for this content.
        </a>
    </object>
</video>

</body>
</html>
...
```

Note: This example is provided for demonstration purposes, more HTML is needed for a complete page, values will need to be changed to meet your content, and all target platforms should be tested.

Detecting iPhone OS Version

If HTML 5 is not used, there is still an easy way to detect if the user can play this new format. A browser sends a special string, called a 'user agent', to websites to identify itself. The web server, or JavaScript in the downloaded webpage, detects the client's identity and can modify its behavior accordingly. Live streaming and Multiple Bit-Rates switching is available only with iPhone OS 3.0, the site can leverage the User Agent to provide user friendly messages for unsupported clients, redirect to a different site, or dynamically load a different type of content. On-Demand content is capable of a better experience with the segmented streaming approach, while Progressive Download is compatible with all iPhones and most other systems. If you choose to use this new format for On-Demand content you may consider also providing the content as Progressive Download to reach a wider audience.

UserAgent for iPhone OS Version 3.0:

Mozilla/5.0 (iPhone; U; CPU iPhone OS 3_0 like Mac OS X; en-us) AppleWebKit/528.18 (KHTML, like Gecko) Version/3.1.1 Mobile/XXXXXX Safari/525.20

Note: 'XXXXXX' is replaced by the build number, and for iPod Touch requests, iPhone is replaced by iPod

Getting Your Video Ready For Playback on the iPhone (http://developer.apple.com/mac/articles/quicktime/videocompressionoptimization.html)

H.264 (http://www.apple.com/quicktime/technologies/h264/)

Creating Amazing Video Content with H.264 (http://www.apple.com/quicktime/tutorials/h264.html)

Exporting Movies for iPod and iPhone (http://developer.apple.com/technotes/tn2007/tn2188.html)

Creating Video for Safari (http://developer.apple.com/safari/library/documentation/AppleApplications/Reference/SafariWebContent/CreatingVideoforSafarioniPhone/CreatingVideoforSafarioniPhone.html#//apple_ref/doc/uid/TP40006514-SW1)

Understanding Safari User Agent String (http://developer.apple.com/safari/library/documentation/AppleApplications/Reference/SafariWebContent/OptimizingforSafarioniPhone/OptimizingforSafarioniPhone.html#//apple_ref/doc/uid/TP40006517-SW3)

The Akamai Difference

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