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The HTTP-Live-Streaming Success Guide

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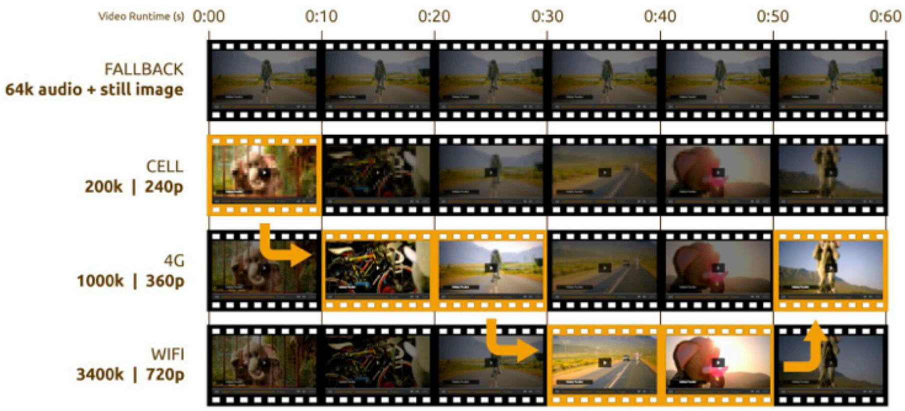
Background

HLS (HTTP Live Streaming) is an established standard for adaptive bitrate video. Adaptive bitrate video delivery is a combination of server and client software that detects a client's bandwidth capacity and adjusts the quality of the video stream between multiple bitrates and/or resolutions. The adaptive bitrate video experience is superior to delivering a static video file at a single bitrate, because the video stream can be switched midstream to be as good or bad as the client's available network speed (as opposed to the buffering or interruption in playback that can happen when a client's network speed can't support the quality of video).

> "HLS has rapidly become the standard for adaptive bitrate technology for mobile/tablets, OTT, and desktop."

With HLS emerging as a standard, and major players like Apple's iOS & Google's Android OS leading the way, Encoding.com wanted to provide video distributors and developers with a complete guide to the standard's evolution, architecture and device compatibility. We are all increasingly familiar with the issues surrounding video delivery to multiple devices, and HLS has rapidly become the standard for adaptive bitrate technology for mobile/tablets, OTT, and desktop. With this resource, we wanted to bring to light the ever-present confusion within the industry regarding the origin of HLS, its technical specifications, device support, and many other variables.

HLS provides midstream quaility adjustments for variable mobile bandwidth speeds



Apple adopted the HLS standard in 2009 to solve the problem of delivering video to mobile devices over varying bandwidths. They developed a system using adaptive streaming which enables delivery of audio and video to supported devices from a standard HTTP web server as opposed to a specialized streaming server. One of the key benefits of HLS is that all data is passed using HTTP, so no accommodations for firewalls or protocols need to be made.

While HLS was initially developed for playback on iOS-based devices 3.0 and higher—including iPhone, iPad, iPod touch, and Apple TV—and on desktop computers (Safari on OS X), its use has expanded to OTT devices as well as other mobile and tablet devices. In addition to iOS, it has also become the adaptive bitrate standard for Android devices.

HTTP Live Streaming supports both live broadcasts and pre-recorded content (video on demand) and multiple alternate streams at different bitrates and resolutions. HLS allows for the client to dynamically switch between streams depending on bandwidth availability. HLS also provides for media encryption and user authentication over HTTPS, allowing publishers to protect their work. HLS is a step up from progressive downloading, which just enables the playback of a video prior to completing the full download.

The Challenge

HLS is a widely adopted and leading standard for multi-screen delivery. Because of this, HLS transcoding solutions are offered by every leading media processing service provider. As with most technical solutions, the devil is in the details, and once you look under the hood at various HLS transcoding solutions, it's clear that all HLS solutions are not created equal. We've completed an in-depth analysis of our HLS transcoding solution with a direct comparison to the competition on a feature-by-feature basis.

> "HLS is a step up from progressive downloading..."

The Features

We compared 22 supported features against the competition, and they are broken down in the grid below. When looking through this lens the differences between various solutions becomes clear. In addition, we define each feature and explain its importance in delivering seamless HLS playback to the broadest range of devices.

	FEATURES	ENCODING.COM	ZENCODER	AWS
AUDIO	He-AACv2 Support	YES	YES	YES
	Audio only HLS Streams	YES	YES	YES
	HE-AAC Support	YES	YES	YES
	Multiple audio bitrates in a single stream	YES	NO	NO
	Still image	YES	YES	NO
VIDEO	h.264 profile	YES	YES	NO
	Caption support WebVTT or CEA 608	YES	YES	ONLY WEBVTT
	Advanced H.264 parameters	YES	REDUCED	REDUCED
	Keyframes	YES	YES	YES
	Format identifiers (CODECS attribute)	YES	YES	YES
WORKFLOW	Per stream audio overlay	YES	NO	NO
	Nielsen ID3 tags support	YES	NO	NO
	Still Image configuration (Time & Size)	YES	NO	NO
	Encryption	YES	YES	NO
	Tar and Zip options	YES	YES	NO
	I-Frame Playlist	YES	NO	YES
	Byte-Range support for segments	YES	NO	YES
	Alternate media	YES	NO	NO
	Per stream watermarking	YES	YES	YES
	Per stream overlay and text overlay	YES	NO	YES
	Reduced TS structural overhead	YES	YES	NO
	Multiple resolutions	YES	YES	YES
	Segment duration	YES	YES	YES

AUDIO

Audio only HLS Stream

The audio only option for HLS will produce a single low bitrate (64K) audio stream. In a situation in which the device cannot support the bandwidth of the lowest video bitrate, the device will fall back to the audio only stream to maintain the audio track of the video during playback until bandwidth levels increase to the point where video playback can resume. The audio fallback is a much better video playback experience than the common alternative of the video and audio freezing, or stuttering, during playback during a temporary mobile bandwidth latency. A 64k audio fallback is a requirement for videos to be submitted within the Apple App Store approval process.

Multiple Audio Bitrates within a single stream

Although HLS specifies the presence of a 64k audio stream, this bitrate is often not sufficient when you intend to create a single HLS stream for mobile devices as well as set top boxes, like the Apple TV or Roku. In playback situations in which the set top box is connected to a home audio receiver, it is desirable to serve not only a higher bitrate audio stream along with the HD 1080p HLS stream, but also a different audio codec, for example Dolby 5.1 audio. Configuration control should exist to step up audio quality and codecs, along with resolution and bitrate. For example the 480x320 stream would be paired with the 64k audio only stream, where the 1136x640 stream would be paired with 128k audio stream and the 1920x1080 steam would be paired with Dolby 5.1 audio.

> "Configuration control should exist to step up audio quality and codecs, along with resolution and bitrate."

Audio only still image

In the low bandwidth situation where the audio only stream is invoked, a custom still image can be presented to the user to help inform them of the latency they are experiencing. For example, "Your device is is not receiving sufficient bandwidth. Please stand by or switch to a higher speed mobile or WiFi network." You can also choose to pull the custom image from a specified time stamp within the source video content.

DOLBY®
DIGITAL • PLUS

Dolby HE-AAC and HE-AACv2 Support

Sound compression is critical within the HLS required audio only 64k stream. Within such a low bitrate parameter, audio codecs like the open source libbfaac process far inferior sound quality. Support for Dolby's HE-AAC and HE-AACv2 provides the highest possible audio quality at low bitrates, including extreme dynamic range.

> "This level of granular control will allow a single stream to successfully serve all OS versions of iOS or Android."

VIDEO

Multiple Resolutions

Configuring multiple resolutions is a requirement for optimal playback of a single HLS stream to multiple screen sizes across smartphones, tablets, and HD capable set up boxes like the the Apple TV or Roku. The Encoding.com HLS Pro preset recommends 9 individual resolutions ranging from 416x234 to 1920x1080; however configuration control exists to customize based on individual requirements.

Multiple H.264 profiles in a single stream

Configuration control should be present when building a new HLS job to allow for multiple H.264 profiles within a single stream. This level of granular control will allow a single stream to successfully serve all OS versions of iOS or Android. Within the Encoding.com HLS Pro template you can find our recommended pairing of H.264 profile with resolution.

We encode to the following resolutions: 416x234, 480x270, 640,360, 960x540, 1280x720, 1920x1080

Advanced H.264 parameters

Configuration of advanced H.264 parameters allows fine tuning of a handful of specific H.264 parameters to ensure compatibility with a range of iOS and Android devices.

Format identifiers (CODECS attribute)

You can configure the CODECS attributed to your HLS playlist to allow the client to filter, based on the codec and the particular profile and level of encoding supported by the device. This is especially important when trying to target different generation iOS devices within a single HLS stream; as the iPhone 3GS will only support Baseline H.264 profile, the iPhone 4 and iPad 1 will support Main H.264 profile and the iPhone 4S+ and iPad 2+ will support the High H.264 profile.

Caption Support WebVTT or CEA 608

The HLS standard supports both the legacy CEA 608 or the more modern WebVTT standard. Encoding.com supports a broad closed caption feature set that allows closed captions in all popular legacy formats SRT, SCC, DFXP to be extracted from source content or side car files and converted into the CEA 608 or WEbVTT standard within your HLS stream at the time of encoding. Encoding.com also supports caption to caption conversion outside of a video processing job which enables preparation of legacy caption files prior to encoding into HLS.

Keyframes

Configuration of keyframes on a per HLS stream basis is critical to meeting the HLS spec and ensuring playback on a wide variety of mobile devices. In general, keyframes should generally be 3x the frame rate. For low resolution bitrate HLS streams with low framerates between 12-15 fps we recommend 36-45 keyframes. At higher resolutions where the frame rate is 29.97 fps keyframes can be set to 90.

WORKFLOW

HLS Compression Options (Tar and Zip)

The HLS architecture will produce a master playlist (.m3u8), playlists for each individual bitrate, as well as individual 9 second segments(. ts) in each bitrate. This means that an output from a single HLS job can produce hundreds if not thousands of files which need to be delivered to your CDN or storage location after processing is complete. Transport of many small files is far slower and less efficient than transport of a single larger file. Compression options of .tar or .zip can reduce overall job time significantly by reducing delivery time and reducing chances of transport failure. Compressed HLS output can be automatically decompressed for playback at the storage location within an automated HLS workflow.

> "..an output from a single HLS job can produce hundreds if not thousands of files which need to be delivered to your CDN or storage location after processing is complete."

HLS Encryption

Although not considered a complete DRM solution, the HLS spec offers a baseline of video encryption technology to provide the first level of defense against unauthorized playback of sensitive source content. Currently HLS supports AES-128 encryption using 32-octet keys. There are three ways in which encryption can be applied: using an existing key, using a randomly generated key, or using a new key that's generated for every X number of video segments. The more video segments that have unique encryption, the greater the overhead and the less the performance. Keys can be served over SSL for an added layer of encryption. Encoding.com HLS Pro supports providing an encryption key manually at the time of job submission or a hosted url of the encryption key to support the random key generation workflow.

Segment Duration

Segment duration will specify the time interval for which your source media is segmented into during conversion to HLS. The long standing standard has been 10 seconds. However, Apple recently revised the spec to 9 seconds. During playback of HLS content, the segment duration is the minimum amount of time a video plays at the current bitrate before switching to the next bitrate.

Reduced TS structural overhead

Format overhead is often overlooked when comparing commercial HLS output. The MPEG-TS format includes by default a lot of unnecessary padding when compared with the MP4 container, and majority of the commercial HLS muxers on the market include this overhead in their HLS output. Encoding.com has built a proprietary low structural overhead TS muxer within their HLS solution that minimizes TS overhead by as much as 25%. Low overhead is a significant consideration when deploying HLS on a large content library, as it will translate proportionally into TeraBytes of storage and CDN delivery savings.

Nielsen ID3 tags support

Nielsen has developed an industry standard for measurement of content broadcast on television and has launched new technologies that allow Nielsen tagged broadcast content to be translated to HLS content to ensure inclusion of all mobile and tablet views. Encoding.com has integrated the Nielsen SDK into our platform to allow tags to be extracted from source content and placed within the IDS tags of the HLS output. Encoding.com can also embed Nielsen tracking tags into MP4 files directly to support a workflow in which HLS segmenting is performed by the CDN provider.

I-Frame Playlist

iOS 5 now supports Fast Forward and Reverse Playback. However, you don't need to produce special purpose content to support Fast Forward and Reverse Playback. All you need to do is specify where the I-Frames are. I-Frames, or Intra frames, are encoded video frames whose encoding does not depend on any other frame. To specify where the I-Frames are, iOS 5 introduces a new I-Frame only playlist.

> "In iOS 5+, you can now specify a media segment as a byte range of a larger URL. This allows you to consolidate your media segments into larger files or a single large file."

Byte-Range support for segments

An HLS .m3u8 playlist provides the client with each URL of the segmented files. Each media URL refers to a media file which is a segment of a single contiguous stream. If you have 1000 media segments in your content, you will have 1000 files on your CDN or web server.

In iOS 5+, you can now specify a media segment as a byte range of a larger URL. This allows you to consolidate your media segments into larger files or a single large file. The primary benefit of this is when a client is playing your media, rather than downloading each successive segment file from a different location, it is actually walking through a larger file in sequence.

This also allows proxy caching servers to get a much better idea of what needs to be prefetched in order to ensure that the segment you will need is in the cache at the time you want it. An additional benefit is there are far fewer files to manage. If you have many video variants in a long movie, you can have thousands of individual segment files. With byte range support, you only have a few.

Alternate media

Available in iOS 5+ is support for alternate media. This feature allows a provider to specify one of a set of variant playlists as an "override" of the main content. In practice, this allows you to offer an alternate video angle (e.g view of sports event) or audio track (multiple foreign language) within a single HLS stream. The client will only play the override media (audio or video) and suppress any media of the same type from the main presentation, if present. This allows a presentation to offer multiple versions of the media without requiring you to store duplicate media or requiring the client to download all variants when it only needs one. It also allows additional media to be offered subsequently without remastering the original content.

Per stream watermarking, text overlay, or audio overlay

Encoding.com offers configuration control to not only add watermarks, custom text or custom audio overlays to the entire HLS output, but also allows customizing these features on a per stream basis. For example a video's watermark on a 416x234 video will likely need to be a different size when placed on a 1920x1080 stream.

CONCLUSION

When comparing various HLS solutions in the market we've outlined the features and controls to look for.

Maximum Compatibility

We provide HLS presets engineered, tested, and Apple reviewed to serve all screen resolutions and maximize compatibility across the top 30 smartphones and tablets for both iOS and Android.

Maximum Control

Customize all encoding parameters on a per-stream basis. Leverage HE-AAC for the highest quality audio at the lowest bit rates. Package output as .tar or .zip files for most efficient delivery.

Lowest Overhead

Encoding.com's proprietary HLS segmenter has the lowest overhead in the industry which equals tremendous storage savings.

Fastest Processing

Parallel dedicated 16-core processing of all individual streams ensure that even the largest libraries targeting complex 12 bitrate HLS outputs are completed in a fraction of real-time.

For more information on how to guarantee success with HLS, we recommend the following:

Contact our sales team for a free consultation: sales@encoding.com

Signup for a free trial: http://www.encoding.com/signup/