

# Encoding for Flash, Mobile and HTML5

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## Agenda

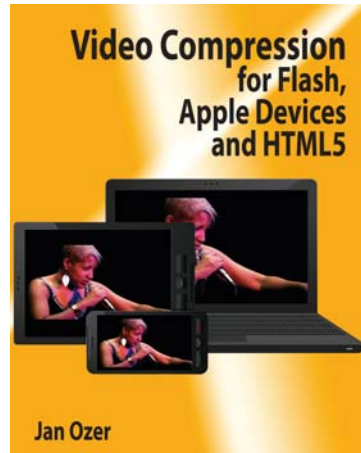
- Terms and terminology
- Producing H.264
- Producing WebM
- Encoding for adaptive streaming
- Comparing H.264 encoders
- If you see red, pay attention

## For Additional Reference



The material in this presentation was derived from Jan Ozer's book, *Video Compression for Flash, Apple Devices and HTML5*.

For further explanation of the concepts presented in this presentation, check out the book at [bit.ly/ozerbook1](http://bit.ly/ozerbook1)



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## Terms and Terminology



- Codec/compression
- Bandwidth
- Resolution
- Data rate
- Bitrate control
- Container formats, program and transport streams

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## Compression/Codec



- Compression
  - Used to shrink the size of video/audio still images
  - Common codecs
    - Video - H.264, MPEG-2, WMV
    - Audio - MP3, AAC, WMV
    - Still image - JPG, PNG, GIF
- Codecs - all of the above
  - Any technology that **CO**mpresses in the studio, then **DEC**ompresses in the field

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## Why is Compression Important?



- To achieve the target data rate, you have to compress
- Compression is “lossy,” the more you compress, the more you lose
  - This is immutable

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## About Bandwidth



- What is bandwidth?
  - Viewer's connection speed
- Why is it important?
  - Controls your viewer's ability to retrieve and play video smoothly
  - Higher delivery bandwidths mean higher data rates, which means better quality

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## Bandwidth



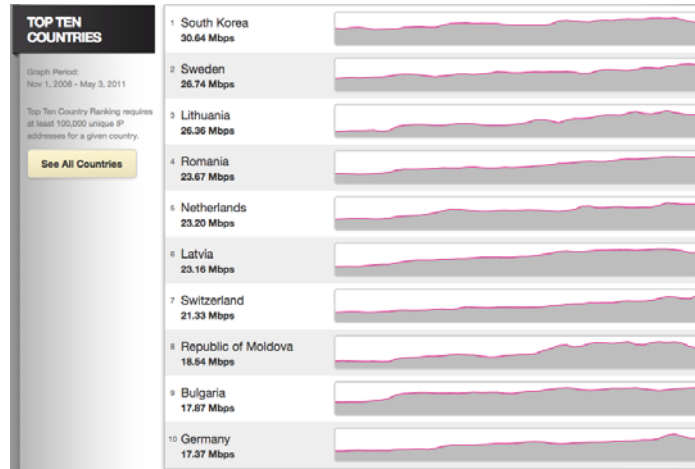
- Viewer's connection speed to the Internet
  - Increasing dramatically
  - [www.speedtest.net](http://www.speedtest.net)



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## Bandwidth



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## Paradigm Shift

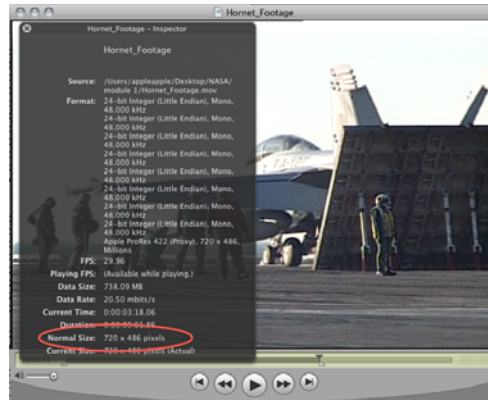
- Modem connection speeds (28.8/56 kbps)
  - Make the video fit
- Broadband
  - Make it good enough
  - Make it affordable
    - CNN/ESPN around 900 kbps combined; not to fit pipes, but because it's "good enough" and affordable
- Cellular
  - Make it fit

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## About Resolution

- What is it?
  - Actual pixels in the file



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## Resolutions That We Know and Love

### Acquisition

- DV - 720x480
- 720p - 1280x720
- 1080i/p - 1920x1080

### Distribution

- DVD - 720x480
- Streaming - 720p or smaller
- iPod - 320x240 - 720p

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## Why is Resolution So Important



- Most video starts life at 720x480 or higher
- Most video is scaled down for streaming
  - 320x240 is the general minimum
  - Ranges up to 720p and sometimes higher
- Resolution is key quality factor
  - At a set bit rate, increasing resolution degrades quality because you must compress more pixels
  - Can't say that 300 kbps is "adequate" without knowing resolution

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## What is Data Rate?



- Every time you produce a streaming file, you have to choose a data rate
  - Considerations - quality, cost, viewer bandwidth
- Uncompressed video is very, very large, to bulky to efficiently deliver - so you have to compress a lot!

Method: I-Pass ASP  
Data Rate: 468 Kbps  
Frame Size: 320 W x 240 H

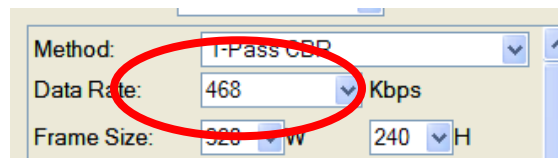
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## Why is Data Rate Important?



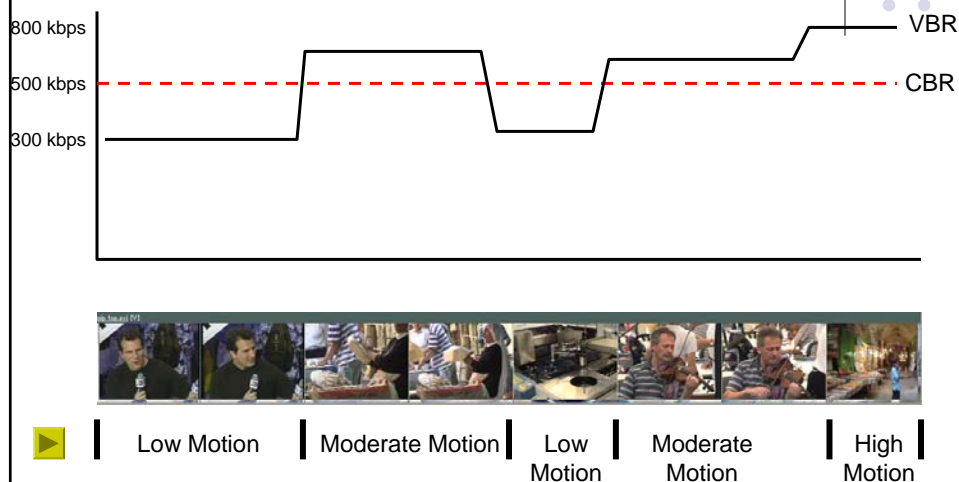
- Largely determines video quality
  - At static resolution and frame rate, increasing bit rate increases quality
- Because we have to pay for it



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## Constant vs Variable Bit Rate



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## Constant vs Variable Bit Rate



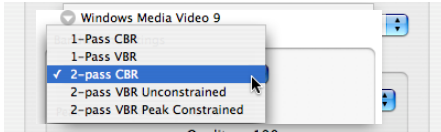
- Constant Bit Rate (CBR)
  - One bit rate applied to entire video, irrespective of content
- Pros:
  - Computationally easy
  - Fast - one pass will do it
- Cons: Doesn't optimize quality

## Constant vs Variable Bit Rate



- Variable Bit Rate (VBR)
  - Dynamic bit rate matches motion in video
- Pros: Best quality
- Cons:
  - Need two or more passes
  - Can produce stream with significant variability

## How do I Produce the Best Quality CBR?



- Use 2-pass CBR when available
  - Scans file (like VBR), but packs data into a consistent stream
  - Best of both worlds when available
- 1-pass of live or draft work

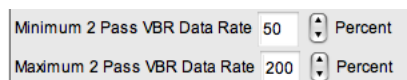
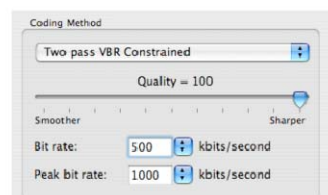
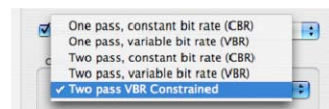
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## How Do I Produce the Optimal VBR File?



- 2 passes or more
- Use “Constrained”
  - Constrains to data rate to specified max
- Set Target and Max/Min
  - Overall target – 500 kbps
  - Max/Peak bit rate – how high rate can go when varying
    - Rule of thumb is 1.5 - 2X of target
    - If minimum setting, use .5x



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## When Should I Use VBR/CBR?



- Constrained VBR (usually 2X) for most streaming applications
  - Broadband has sufficient headroom to handle spikes
- Constrained VBR for virtually all progressive delivery
- Constrained VBR for most cellular connections, though not universally
- CBR for live, particularly when constrained
- CBR or constrained VBR for adaptive

## Container Formats, Transport Streams, Program Streams



- Container format:
  - A meta-file format whose specification describes how data and metadata are stored
  - Examples: MPG, MP4, MOV, F4V, WMV, FLV
- Transport stream:
  - Transport stream specifies a *container format* encapsulating packetized elementary streams, with *error correction* and *stream synchronization* features for maintaining transmission integrity when the signal is degraded (e.g. - broadcast)
  - Examples: .ts,

## Container Formats, Transport Streams, Program Streams



- Program stream:
  - *Container format* with multiplexed audio and video
  - Examples: .ps, VOB, EVO

## Why Do We Care?



- When producing for single file delivery or streaming, you have to choose the right container format/transport stream for your application
  - Streaming
    - Flash - MP4, FLV, F4V, MOV - H.264
    - HTML5 - MP4 - H.264, WebM - VP8
    - iDevices - MP4, MOV - H.264
  - Adaptive - HTTP Live Streaming - .ts

## H.264 Specific Parameters



- Introduction to H.264
  - The MPEG-4 specification
  - The MPEG-4 codec
  - MPEG-4 spec audio options
  - The H.264 codec

## MPEG-4 Specification

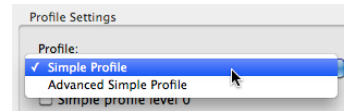


- Introduced in 1998 by ISO/IEC Moving Picture Experts Group
- 28 “Parts” within specification
  - Part 2 - MPEG video codec (the MPEG-4 codec)
  - Part 3 - MPEG-4 audio (AAC, etc)
  - Part 10 - Advanced Video Coding (AVC/H.264)
  - Part 14 - container format (MP4)

# The MPEG-4 Video Codec



- Used only for low power devices: Two profiles:
  - Simple Profile - very low power, low bandwidth applications
  - Advanced Simple Profile - Simple plus:
    - Support for "MPEG"-style quantization
    - Support for B pictures (a.k.a. B-frames)
    - Motion compensation

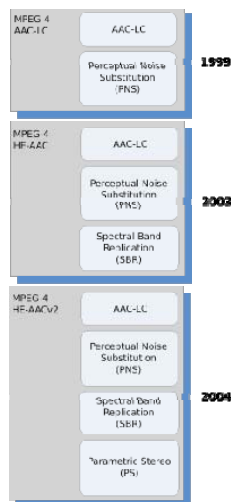


- Check specs on target devices
  - Will refer to MPEG-4 encoding only in mobile segments
  - Never use for computer playback

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# MPEG-4 Audio

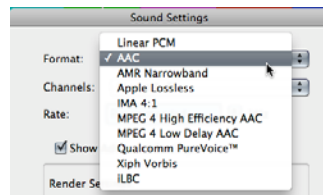


- AAC-Low Complexity (AAC-LC)
  - The most basic and most broadly compatible
- High Efficiency AAC (2003)
  - Also called AAC+, aacPlus and
- High Efficiency AACv2 (2006)
  - Also called enhanced aacPlus, Enhanced AAC+, aacPlus v2 and eAAC+

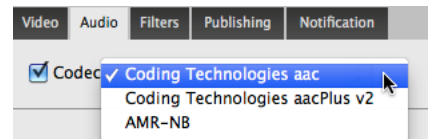
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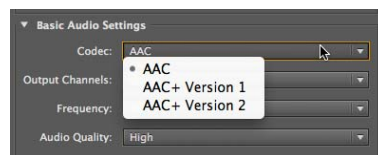
# MPEG-4 Audio Presentation



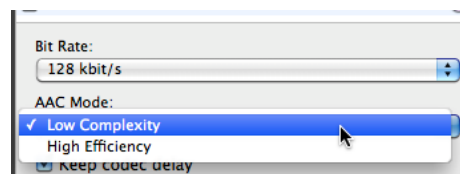
Compressor



Squeeze



Adobe Media Encoder



Episode

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# MPEG-4 Audio Summary



- Presentation varies by encoding tool
  - Some let you choose audio codecs that are not MPEG-4 compatible
  - Usage dictated by specs of target device
  - When in doubt, choose Plain Jane AAC
    - Most compatible on the playback side
    - Universally available on MPEG-4/H.264 encoders

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## What is H.264?



ITU – International Telecommunications Union Telephone, Radio, TV		ISO – International Standardization Organization Photography, Computer, Consumer Electronics	
1984	H.120		
1990	H.261 – Video Conferencing		
1993		MPEG-1 – Video CD	
1994	(H.262)	MPEG-2 – Digital Cable and Satellite TV	
1995	H.263 – Improved Video Conferencing		
1997		ATSC – U.S. HDTV	
1999		MPEG-4	
2002	AVC (H.264)	AVC (MPEG-4 Part 10)	

- Adapted by ISO and ITU
  - Telephony/cellular
  - TV - consumer electronics
  - Computer electronics
- Only codec adopted by top three streaming providers (Apple, Adobe, Microsoft)

Streamcrest Associates  
<http://www.streamcrest.com/SDF%20Final1.pdf>

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## What's MPEG-4/H.264 Cost?



- For free Internet video (e.g. no subscription or pay per view), free in perpetuity
  - Still technically a licensing obligation, but there are no teeth and no motivation to enforce
- For subscription or PPV, there may be a royalty obligation
- Check [www.mpeg-la.com](http://www.mpeg-la.com)

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## What is an MP4 file (and what are the variants)?



- .MP4 - official MPEG-4 wrapper
- .M4V - Apple's variant for iTunes and devices
- .MOV - H.264 file for editing or QuickTime delivery
- .F4V - H.264 for Flash
- .3GP - (not shown) - phone
- .MPG - H.264 in MPEG-2 transport stream

File Format:	MPEG-4	Extension:	mp4	<input checked="" type="checkbox"/> Allow Job Segmenting
File Format:	H.264 for Apple Devices	Extension:	m4v	<input checked="" type="checkbox"/> Allow Job Segmenting
File Format:	H.264 for DVD Studio Pro	Extension:	mov	<input checked="" type="checkbox"/> Allow Job Segmenting
Stream Type	F4V	Video-Basic	MPEG-2 Transport Stream	MPEG-4 System
Width	F4V	Height	Raw H.264 Stream	

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## H.264 Encoding Parameters



- The basics
- I, B and P-frames
- Search related options
- Miscellaneous options

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## H.264 Encoding - Basics



- Profiles and Levels
- Entropy encoding

## What are H.264 Profiles?



- “Define a set of coding tools or algorithms that can be used in generating a bitstream”

	Baseline	Extended	Main	High
I and P Slices	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes
Multiple Reference Frames	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes
8x8 vs. 4x4 Transform Adaptivity	No	No	No	Yes
Quantization Scaling Matrices	No	No	No	Yes
Separate Cb and Cr QP control	No	No	No	Yes
Separate Color Plane Coding	No	No	No	No
Predictive Lossless Coding	No	No	No	No
	Baseline	Extended	Main	High

## Which Profile?



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## Which Profile?



- Critical to know your target profile before encoding
  - Device
    - iPod/iPhone - Baseline (iPhone 4/iPod touch 4 – Main)
    - iPad - Main
  - Computer playback - High for all targets
- Issues to consider
  - iPad/iPhone/iPod Touch – one file for all, use Baseline
  - Computer/iPad - use Main

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# What are H.264 Levels?



- “Constrains key parameters in the bitstream”

Level number	Max video bit rate (VCL) for Baseline, Extended and Main Profiles	Max video bit rate (VCL) for High Profile	Examples for high resolution @ frame rate (max stored frames in Level)
1	64 kbit/s	80 kbit/s	128x96@30.9 (8) 176x144@15.0 (4)
1b	128 kbit/s	160 kbit/s	128x96@30.9 (8) 176x144@15.0 (4)
1.1	192 kbit/s	240 kbit/s	176x144@30.3 (9) 320x240@10.0 (3) 352x288@7.5 (2)
1.2	384 kbit/s	480 kbit/s	320x240@20.0 (7) 352x288@15.2 (5)

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## H.264 Levels



- Primarily an issue when encoding for devices
  - Devices may not load file encoded beyond max supported level
  - So, job #1 – making sure encoding parameters don't exceed (most templates do this)
- For computer playback,
  - Flash/QuickTime/SL/HTML5 will attempt to play ALL levels of ALL supported profiles – so level isn't a concern
  - Rather, it's can the computer play the file as configured
    - A netbook will try to load a 1080p file encoded for Flash
    - Flash Player won't complain
    - But playback won't be pretty

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## H.264 Levels – Bottom Line



- With devices, choosing the right profile and level is critical
- With computers, profiles and levels don't determine whether the file will load or play well
- Rather, you have to choose a resolution and data rate that will play smoothly on your targets

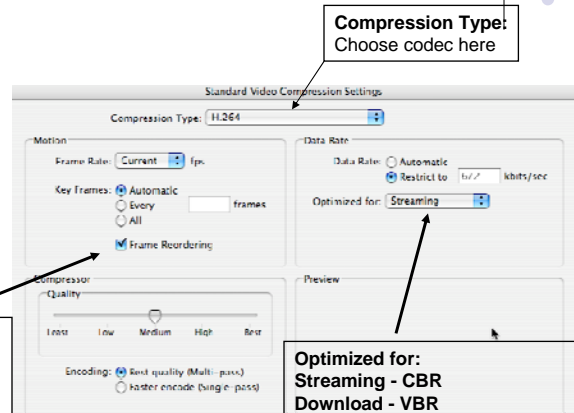
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## Apple Compressor - Compression Settings



- Available options and presentation varies by encoding tool
- Apple's is very simple



### Frame Reordering:

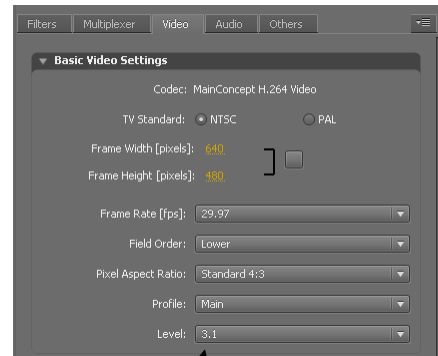
- Checked or unchecked produces Main Profile
- Frame reordering is Main with 1 B-frame (always)
- Must use iPod preset to produce Baseline profile for iPod

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## AME - Compression Settings

- Adobe lets you choose Profile and level directly
- If level too low for selected encoding parameters, you'll see an error message
  - If encoding for devices; reduce parameters
  - If encoding for computers, increase the level until the error message goes away

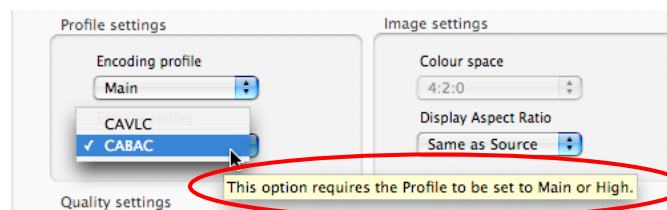


Profile/Level:

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## Entropy Encoding



- CABAC (Context-adaptive binary arithmetic coding)
  - More efficient (e.g. better quality), but harder to decode
- CAVLC (Context-adaptive variable-length coding)
  - Less efficient, easier to decode
- Big question - does quality improvement outweigh increase in required CPU horsepower

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## CABAC vs CAVLC Quality



CABAC

CAVLC

- In challenging scenes at low data rates, CABAC was noticeably better
- Most authorities place quality advantage at 10-15%

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## CABAC vs CAVLC Performance



Playback 720p files	CABAC	CAVLC
HP 8710w - Core 2 duo (% of both CPUs)	31.1%	30.5%
PowerMac - Dual 2.7 GHz PPC G5 (% of 1 processor)	71.17	67.34


- Does increase playback requirements slightly on lower power computers
- My recommendation:
  - Always enable CABAC **when available (Main & High profiles)**

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## What Would YouTube Do?

- High Profile
- CABAC



```
Video #0
Codec: AVC
Codec/Family: AVC
Codec/Info: MPEG-4 AVC
Codec profile: High@L3.1
Codec settings, CABAC: Yes
PlayTime: 1 mn 32s
Bit rate: 2002 Kbps
Width: 1280 pixels
Height: 720 pixels
Display Aspect ratio: 16/9
Frame rate: 29.970 fps
Chroma: 4:2:0
Interlacement: Progressive
Bits/(Pixel*Frame): 0.072
```

## Profile/CABAC in Squeeze and Episode



Pixel Aspect Ratio: Square Pixels

AVC Profile: High

Interlace Mode: Progressive

Field Order: Top Field First

Encoding Effort: Best

Entropy Coding Mode: CABAC

Use B-Pictures: 3

☐ Use B-Slices as Reference

Multiple Slices: 0

Reference Frames: 2

General Profile & Quality Advanced

Profile Settings

Encoder Profile: High

Context-Adaptive Variable-Length Coding (CAVLC)

☒ Context-Adaptive Binary-Arithmetic Coding (CABAC)

Level Signalling

Level: Auto (Recommended)

If a level that is too low for current configuration is selected, the lowest valid level will be used.



## I-, B- and P-frames

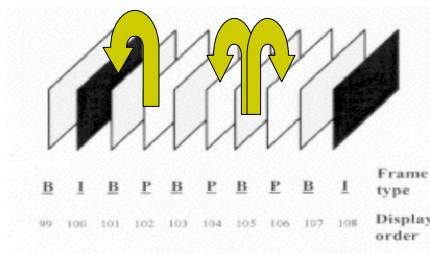


- Caveats:
  - Presented differently by each encoding tool
  - Will only cover most critical and most common parameters

## What are I, B and P Frames?



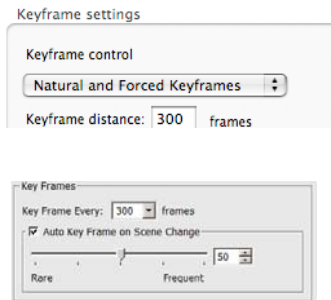
- I-Frame - encoded without reference to other frames (also called Key Frames)
- P - looks backward to I and P frames (predictive)
- B - looks forward and backward to previous I and P frames (Bi-directional interpolated)
  - No frames refer to B-Frame (most of the time)



## What do I Need to Know About Key Frames?



- Least efficient – so largest (which is bad)
- But, key frames enhance interactivity
  - All playback starts on a key frame
  - When seeking to random frame, must start playback at key frame
  - Maximum interval should be 5-10 seconds
- Key frames "reset" quality:
  - Useful at scene changes
  - Enable natural key frames or key frames at scene changes



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## What do I Need to Know About B Frames?

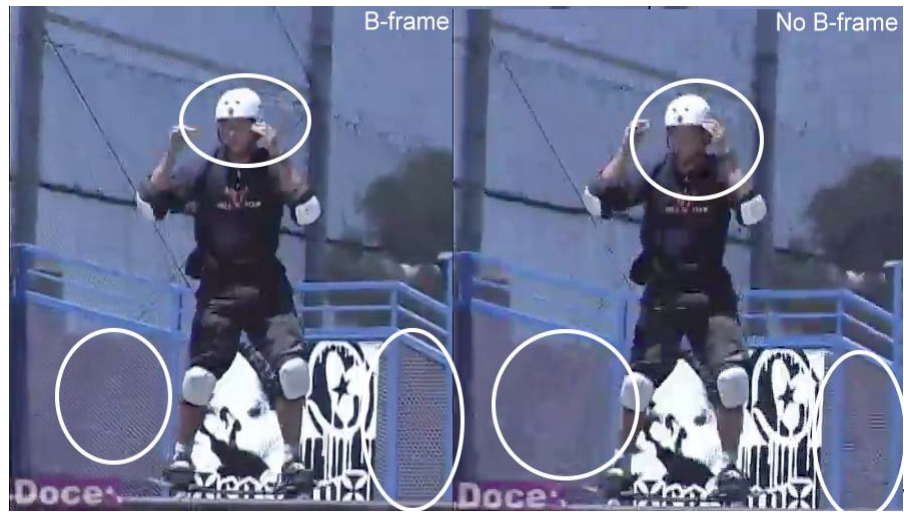


- The most “efficient” frame
  - So improves quality (comparisons to come)
- Hardest to decode
  - Decoder has to have all referenced frames in memory to decode B-frame
  - Frame usually delivered out of order, which also complicates playback

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## B-frames - Yes/No

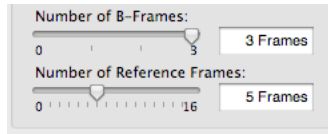


## B-frames - Yes/No



- Noticeable quality improvement
- 5-10% increase in decompression CPU load
- Recommend
  - Say “YES” to B-frames
  - 3 is a good number for real world video
  - Experiment with higher numbers with animations

## Typical B-Frame Encoding Parameters

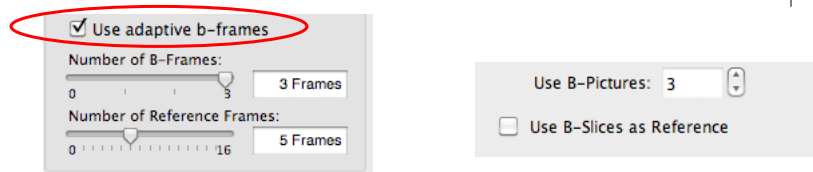


- Number is number of B frames between I and P-Frames; (IBBBPBBBBPBBBBPBBBBP)
  - 3 is recommended
- Reference frames (both P and B-frames)
  - Number of frames searched for redundancies
  - 5 is recommended setting

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## Advanced B-frame Options



- Adaptive B-frames -
  - Will change order if it will improve quality (e.g. insert an I-or P- frame to optimize quality)
- B-slice as reference
  - Allow B-frames to be reference frames for P-frames
  - Some quality improvement, can cause playback issues on low-power devices

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## More Advanced B-frame Options



- IDR frames
  - No frames look behind IDR frame
  - All key frames s/be IDR
- B-frames
  - Adaptive
  - Reference B-frames
    - P-frames can reference
  - Pyramid-B-frames
    - B-frames can reference

Minimum IDR interval	1
IDR frequency	1
Use adaptive B-frame placement	<input checked="" type="checkbox"/> Use adaptive B-frame placement
Reference B-Pictures	<input checked="" type="checkbox"/> Reference B-Pictures
Allow pyramid B-frame coding	<input checked="" type="checkbox"/> Allow pyramid B-frame coding

- Rhozet recommends:
  - IDR frequency - 1
  - Reference B-Pictures/ pyramid enabled

[http://www.rhozet.com/products\\_whitepapers.html](http://www.rhozet.com/products_whitepapers.html)

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## Search Related Options



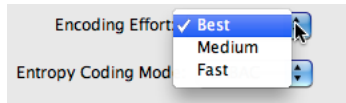
Search shape	8x8
Use fast inter and intra decisions	<input type="checkbox"/> Use fast inter and intra decisions
Use fast multi-reference frame mo...	<input type="checkbox"/> Use fast multi-reference frame motion estimation
Use fast sub-block motion estimat...	<input type="checkbox"/> Use fast sub-block motion estimation
Motion estimation subpixel mode	Quarter pixel

- Searching for redundancies; multiple factors
  - Search shape (8x8/16x16) – size of shape used for searching (smaller is more accurate)
  - Sub-pixel mode – (full/half/quarter pixel) – smaller is more accurate
  - Fast - trades encoding speed for quality

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## Sorenson Squeeze - Effort Matters



- Fast/Medium/Best settings controls unspecified search and other parameters
  - Substantial difference in time and quality
    - Fast - 8:10
    - Best - 18:37
- Use Fast for draft work
- Use Best for final unless time constrained

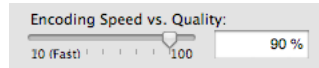
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## Sorenson Squeeze - Effort Matters



## Episode – Not so Much



- Help file: "In general, values over 50 yield very small improvements in visible image quality."
- My tests confirmed those results:
  - Encoding time at 50 - 3:33
  - Encoding time at 100 - 8:03
- Difference noticeable on only one video within test sequence

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## Search Related Options



- Other tools
  - Compressor/Adobe Media Encoder – no search related Options
  - High end tools – Inlet Fathom, others
    - Unique controls; check help file

## Slices



- Slices (Episode and Squeeze)
  - Divides frames into segments to speed encoding
  - Can't search between slices
  - Can reduce quality
  - Set to lowest value (either 0 or 1)





## Other Options



- Deblocking filter - always on
- Rate distortion optimization
  - Dynamic balance between quality and bit rate - as in - is the extra quality worth the bits necessary to achieve it?
  - Typically enable
- Hadamard Transform - enable

## What Resolution/Data Rate Should I Use? (11/2011 data)



Broadcast	Width	Height	Total Pixels	Data Rate	FPS	Audio Data Rate	Bits per Pixel
Conservative (4)	504	307	154,336	535	28	95	0.123
Midrange (17)	631	355	223,909	714	28	63	0.114
Aggressive (3)	768	432	331,776	1,026	28	NA	0.108

B2C Brands	Width	Height	Total Pixels	Data Rate	FPS	Audio Data Rate	Bits per Pixel
Conservative (5)	504	304	153,456	843	25	96	0.212
Midrange (4)	651	395	258,036	1,125	27	91	0.189
Aggressive (7)	1,007	548	573,854	1,510	25	111	0.110

B2B	Width	Height	Total Pixels	Data Rate	FPS	Audio Data Rate	Bits per Pixel
Conservative (11)	573	320	186,432	764	28	112	0.166
Midrange (3)	814	455	372,320	1,875	27	128	0.194
Aggressive (5)	1,210	680	831,859	1,325	25	120	0.063

## H.264 Reference Configurations



	Width	Height	Codec	Data Rate	Bits per Pixel	Profile	CABAC
<b>Media</b>							
CNN - video library	640	360	H.264	671	0.097	Main	Yes
ABC - Castle	768	432	H.264	614	0.077	Main	Yes
<a href="#">NFL.com</a>	768	432	H.264	465	0.047	High	Yes
<b>Corporate</b>							
Deloitte	640	360	H.264	1072	0.194	Main	Yes
Apple	848	480	H.264	3174	0.325	Main	No
Starbucks	732	408	H.264	951	0.110	Main	Yes
Victoria's Secret	996	544	H.264	1300	0.100	High	Yes

## H.264 Specific Encoding Tutorials



- Understanding key H.264 Encoding Parameters
  - <http://www.vimeo.com/5377029>
- Apple Compressor
  - <http://vimeo.com/5462108>
- Adobe Media Encoder CS4
  - <http://www.vimeo.com/5118579>
- Sorenson Squeeze
  - <http://www.vimeo.com/5279015>
- Telestream Episode Pro
  - <http://www.streaminglearningcenter.com/articles/producing-h264-files-for-flash-distribution-with-telestream-episode-pro.html>

# Producing H.264 Video for Computer Playback



- Format specific considerations
  - Flash
  - HTML5
  - Mobile

## Flash and H.264



Flash Player	Playback Specifications
Video codec	H.264 ONLY, not MPEG-4
Profiles	Baseline, Main, High
Audio codec	AAC, AAC-LC, HE-AAC
Container formats	F4V (preferred), MP4, M4V, M4A, MOV, 3GP

## HTML5 and H.264



Flash Player	Playback Specifications
Video codec	H.264 ONLY, not MPEG-4
Profiles	Baseline, Main, High
Audio codec	AAC, AAC-LC, HE-AAC, HE-AACv2
Container formats	MP4 (otherwise, may call a different player)

- No published specs that I could find, but tested playback on Chromium, Safari and IE9

## Producing for HTML5



- All browsers have their own players, no specifications (that I could find)
  - Baseline, Main, High all supported up to 1080p
  - Ditto for AAC-LC, HE-AAC, HE-AAC v2
- Use MP4 file since F4V or MOV could trigger Flash or QuickTime players

## Producing for Devices



- Levels matter
- Supplied specs vary by vendor
  - Some are all over the map

## Encoding for iDevices



	Original iPod (to-5g)	iPod nano/ classic	iPod touch/ iPhone	iPhone 4 /iPod touch 4	iPad 1	iPhone 4S	iPad 2
<b>Device spec</b>							
Screen resolution	320x240	320x240	480x320	960x640	1024x768	960x640	1024x768
Aspect ratio	4:3	4:3	16:9-ish	16:9-ish	4:3	16:9-ish	4:3
<b>Codec spec</b>							
Video codec	H.264	H.264	H.264	H.264	H.264	H.264	H.264
Max video data rate	768 kbps	2.5 Mbps	2.5 Mbps	14 Mbps	14 Mbps	50 Mbps	50 Mbps
Max video resolution	320x240	640x480	640x480	720p	720p	1080p	1080p
Frame rate	30 fps	30 fps	30 fps	30 fps	30 fps	30 fps	30 fps
Profile/level	Baseline to Level 1.3	Baseline to Level 3.0	Baseline to Level 3.0	Main to Level 3.1	Main to Level 3.1	High to Level 4.1	High to Level 4.1
Audio codec	AAC-LC	AAC-LC	AAC-LC	AAC-LC	AAC-LC	AAC-LC	AAC-LC
Max audio data rate	160 kbps	160 kbps	160 kbps	160 kbps	160 kbps	160 kbps	160 kbps
Audio params	48 kHz, stereo	48 kHz, stereo	48 kHz, stereo	48 kHz, stereo	48 kHz, stereo	48 kHz, stereo	48 kHz, stereo

- 1080p playback unproven: use 720p
- These are maximum settings; not recommended

## Producing for iDevices



- Two scenarios
  - Podcasts (cable delivery, no bandwidth issues)
    - Covered next
  - Streaming to iDevices (Wi-Fi/cellular delivery)
    - Best done with HTTP Live Streaming, covered later

## Producing for iDevices



- Podcasts
  - Downloaded ~ 50 podcasts, mostly grouped into three resolutions
  - More detailed presentation at iDevice seminar on Wednesday

## Podcast Overview



	320x180 (or 240)	640x360 (or 480)	720p
<b>Video codec</b>	H.264 codec, Baseline profile	H.264 codec, Baseline profile	H.264 codec, Main profile
Data rate	528 kbps	1.319 Mbps	2.845 Mbps
Key frames	120	120	120
Frame rate	match source	match source	match source
<b>Audio</b>	AAC LC	AAC LC	AAC LC
Data rate	111 kbps/stereo	114 kbps/stereo	134 kbps/stereo
Extension	.m4v	.m4v	.m4v

- Bitrate control - use VBR constrained to less of max data rate or 2X
- Entropy encoding - **CABAC** when producing with Main Profile
- Otherwise, check your encoding presets - make sure they reasonably conform to these configurations

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## Android OS



Android OS	Playback Specifications
Video codecs supported in OS	H.263, MPEG-4 Simple Profile, H.264 Baseline (starting with Android 3.0)
Audio codecs	AAC, AAC-LC, HE-AAC up to 160 kbps
Container formats	3GP or MP4

<http://bit.ly/androidvideospecs>

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## Google Recommendations



- Lower quality video

Video codec	H.264 Baseline Profile
Video resolution	176 x 144 px
Video frame rate	12 fps
Video bitrate	56 Kbps
Audio codec	AAC-LC
Audio channels	1 (mono)
Audio bitrate	24 Kbps

- Higher quality video

Video codec	H.264 Baseline Profile
Video resolution	480 x 360 px
Video frame rate	30 fps
Video bitrate	500 Kbps
Audio codec	AAC-LC
Audio channels	2 (stereo)
Audio bitrate	128 Kbps

- Low is very conservative
- Check targeted hardware devices for additional capabilities

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## BlackBerry



- Defined at [bit.ly/blackberryvidspecs](http://bit.ly/blackberryvidspecs)
- However, there are 34 listed phones, each with different specs.

BlackBerry Devices	Lowest Common Denominator Specifications
Video specs	MPEG-4, Simple Profile, 320x240 resolution, 24 fps, @ max rate of 768 kbps.
Audio codecs	AAC-LC, HE-AAC and HE-AACv2
Container formats	MP4, M3A, 3GP, MOV

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## HP webOS - Max Settings



By Codec	H.264	MPEG-4
Profile	Baseline	Simple
Level	3	5
Resolution	640x480	640x480
Frame rate	30 fps	30 fps
Bit rate	1.5 Mbps	1.5 Mbps
Audio codec	AAC-LE, HE-AAC, HE-AACv2	AAC-LE, HE-AAC, HE-AACv2
Bit rate	1.5 Mbps	1.5 Mbps
Container formats	MP4, M4A, M4V, MOV, 3GP, 3G2	MP4, M4A, M4V, MOV, 3GP, 3G2

[bit.ly/webosvideospec](http://bit.ly/webosvideospec)

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## HP webOS - Recommended



- Defined at [bit.ly/webosvideospec](http://bit.ly/webosvideospec)

Protocol	Bandwidth	Recommended	Supported
HTTP progressive download	High	512 Kbps, H.264 Baseline Profile, 480 x 320 pixels, 30 fps. 64 Kbps, AAC+, 44 KHz, stereo.	All local formats are supported.
	Low	128 Kbps, H.264 Baseline Profile, 320 x 240 pixels, 20 fps. 24 Kbps, eAAC+, 44 KHz, stereo.	All local formats are supported.
Real time streaming protocol (RTSP)	Low	128 Kbps, H.264 Baseline Profile, 320 x 240 pixels, 20 fps. 24 Kbps, eAAC+, 44 KHz, stereo.	Video: H.264, MPEG-4, and H.263 Audio: AAC and AMR

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## Windows Phone 7



	H.264	MPEG-4	MPEG-4
Profile	Baseline/Main/High	Simple	Advanced Simple
Resolution/frame rate	720x480 @ 30 fps 720x576 @ 25 fps	800x600 (720p for HD capture devices) @ 30 fps	800x600 @ 30 fps
Average data rate	2 Mbps	2 Mbps	2 Mbps
Peak data rate	27 Mbps	27 Mbps	27 Mbps
Bit rate control	CBR/VBR	CBR/VBR	CBR/VBR
Audio codec	AAC-LC, HE-AAC v1, HE-AAC v2	AAC-LC	AAC-LC
Audio channels/samples	stereo/48 kHz	stereo/48 kHz	stereo/48 kHz
Audio bit rate	320 kbps	320 kbps	320 kbps
Container formats	.mp4, .m4v, .3gp, .3g2	.mp4, .m4v, .3gp, .3g2	.mp4, .m4v

- Some other codecs supported (like WMV)
- Details at [bit.ly/windowsphonevidspecs](http://bit.ly/windowsphonevidspecs)

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## Producing WebM



- Overview
- Survey of encoding tools
- Live WebM encoding options

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## WebM Overview



- What is WebM
  - VP8 video codec (purchased from On2)
  - Open source Vorbis audio codec
  - WebM container format based on Matroska container
- Open source and royalty free
- Browser support:
  - Native - current versions of Chrome, Opera, FireFox
  - Via plug-in - Internet Explorer 9, Safari

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## Producing WebM



- Many tools, few are worthwhile
- *Streamingmedia* review - [bit.ly/webmencoderreview](http://bit.ly/webmencoderreview)
  - Performed 12/2010
  - Updated 4/2011 for book
- Basic workflow
  - Google encoded files for a presentation at StreamingMedia West (11/2010)
  - I encoded and compared results to Google output

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# Miro Video Converter

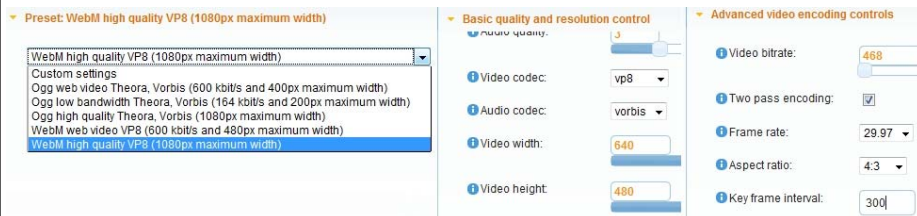


- Verdict
  - Good for experimentation but not production
- Issues
  - Can't configure presets
  - Presets use 160 kbps/audio, which is too high
  - Serious dropped frames during encoding

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# Firefogg

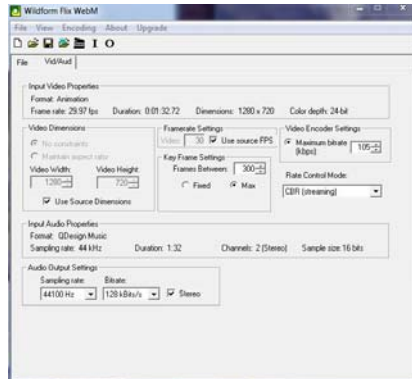


- Verdict
  - Best free alternative, but has issues
- Issues
  - Output didn't match configuration input
- Issues (con'd)
  - No data rate config for audio

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# Wildform Flix WebM

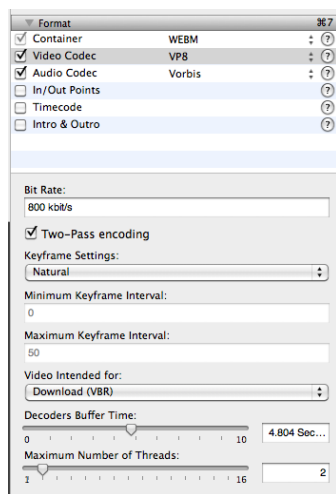


- Verdict
  - Awful (and withdrawn after the review)

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# Telestream Episode



- Verdict
  - Easy to use, fast, very good quality, but few VP8 config options
- Issues
  - Originally had issues playing back in Chrome; resolved in version 6.1
  - Minimal VP8 config options
    - Not a bad thing if you don't like to tinker

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## Sorenson Squeeze 7



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- Verdict
  - Fast, very good quality, highly configurable
- Issues
  - About 18% slower than Episode on same system for single file encoding, but can encode in parallel

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## Producing WebM



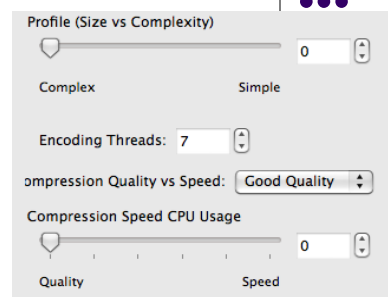
- Common parameters addressed by some encoders, like Squeeze, or via command line
  - Will explore those exposed by Squeeze
  - Will discuss most relevant parameters
- Complete list available at:  
<http://www.webmproject.org/tools/encoder-parameters/>



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## WebM Options - 1

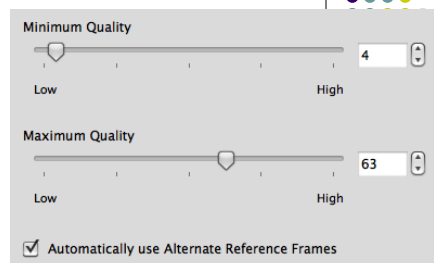


Parameter	Recommended	Description
Profile	0	Non-zero values makes content easier to decode. Use only with HD content targeted towards low power playback
Encoding Threads	Number of cores - 1	Lets you efficiently use multi-core system
Quality vs Speed	Good	Good/O configuration should match Best quality but will encode twice as fast
Quality/speed slider	0	

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## WebM Options - 2



Parameter	Recommended	Description
Minimum quality	0-4	Allow user to set minimum and maximum quality limits. Will override data rate setting, though, so be careful
Maximum quality	50-63	
Reference frames	Enabled	Use of --auto-alt-ref can substantially improve quality in many situations (though there are still a few where it may hurt).

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## WebM Options - 3



Lag in frames: 15  
 Maximum Buffer Size: 6 Seconds  
 Starting Buffer Level: 4 Seconds  
 Optimal Buffer Level: 5 Seconds

☐ Rate Control Resizing  
 Rate Control Resizing Up Threshold: 0  
 Rate Control Resizing Down Threshold: 30  
☐ Drop Frames to Maintain Data Rate  
 Drop Frames Threshold: 70

Parameter	Recommended	Description
Lag in frames	16 (Squeeze only goes to 15)	Relates to alt-reference frame
Buffer sizes	As shown	Recommend buffer settings
Rate Control Resizing/Dro Frames	Disabled	"These are specializet parameters and are not generally recommended"

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## WebM Options - 4

Sharpness Filtering: 0  
 Smoothest Sharpest  
 Noise Filtering Level: 0  
 Low High  
 Static Region Threshold: 0  
 Clean Noisy  
 Expected CPU Cores for Playback: 2  
☒ Error Resilient

Parameter	Recommended	Description
Filtering	As shown	"There are better filtering options available in specialist pre-processing products"
Static region threshold	As shown	"Any non zero value runs the risk of introducing artifacts caused by regions of the image not being updated"
Expected CPU cores for playback	2	Squeeze specific option, not WebM
Error Resilient	On when Alt-Ref-Frames enabled	

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## Other WebM Encoding



- Command line options - multiple are available
  - Check [www.webmproject.org](http://www.webmproject.org) for links and command line arguments
- Live Options
  - Broadcast International - Head End
  - Entropy Wave E1000
  - Flumotion WebTV
  - AFAIK, none of the majors have live WebM encoding yet

## Encoding for Adaptive Streaming



- Introduction
- Transmux strategies
- Flash
  - RTMP
  - HTTP
- HTTP Live Streaming to iOS/Android

# Adaptive Streaming - Introduction



- Concept
  - Customize experience for viewer device and bandwidth
    - High power/high bandwidth – great experience
    - Lower power/low bandwidth – lesser experience, but it plays
  - Adapt to changing conditions
  - All transparent to the viewer

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## Major League Baseball



- Example
  - MLB offers 11 streams in subscription service
  - Intelligent player
    - Monitors CPU
    - Monitors buffer level
  - System adjusts speed to ensure optimal quality stream



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## Advantages of Adaptive Streaming



- Enables highest quality viewing experience
  - Can create very high quality streams because the system will shift to lower quality if required
  - Rewards high performance/high bitrate consumers while still serving those at the other end of the spectrum

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## How it Works



- Streams switched to adapt to factors like:
  - Changing delivery bandwidths (avoid hard stops)
  - CPU utilization at client (avoid frame drops)
- Information is gathered by player
  - Server-based systems (RTMP Flash) *deliver* a different stream when change is required, switching at key frame
  - HTTP-based systems (HTTP Flash, iOS) use 2-10 second file chunks
    - Player *retrieves* chunk from different source file to effectuate stream switch (more later)

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## Encoding for Adaptive Streaming



- How to configure streams to:
  - Optimize playback experience across all served devices and bandwidths
    - How many streams, what resolutions, what data rates
  - Work within requirements of adaptive streaming technology
    - Key frame interval, VBR vs. CBR, audio parameters

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## Transmuxing Technologies

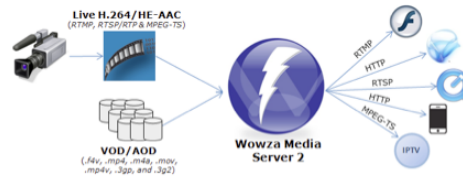


- Most producers must serve two clients
  - Flash (or Silverlight)
  - iOS (and now Android)
- In the past, that meant two separate encoding and delivery workflows
- Now, multiple technologies for:
  - “Transmuxing” H.264 stream
  - Using correct protocol to distribute to target

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# Transmuxing Technologies



- Options
  - Technology providers - Wowza, Microsoft, Adobe
  - Service providers - Akamai ("in the network" repackaging)
- Key point:
  - If serving multiple targets, you must produce using lowest common denominator H.264 encoding parameters

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# Inputs for Analysis



- Multiple case studies (Harvard, Turner, MTV, NBC, Indiana University)
  - *StreamingMedia* here: [bit.ly/ozeradaptive](http://bit.ly/ozeradaptive)
- White papers and other guides as identified throughout
- Several consulting projects

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## RTMP Flash - Overview



- Server driven system
  - Uses files as encoded (no chunking)
  - Server switches as necessary at key frame

## Sources



- Abhinav Kapoor, "Live dynamic streaming with Flash Media Server 3.5," ([adobe.ly/kapoorlivefms](http://adobe.ly/kapoorlivefms))
- Maxim Levkov, "Video encoding and transcoding recommendations for HTTP Dynamic Streaming on the Flash Platform," ([adobe.ly/Levkovhttp](http://adobe.ly/Levkovhttp))
- Larry Bouthillier, "How to do Dynamic Streaming with Flash Media Server," website ([bit.ly/fmsdynamic](http://bit.ly/fmsdynamic))
- "Tutorial: On-demand HTTP Dynamic Streaming," Adobe website ([bit.ly/ondemanddynamic](http://bit.ly/ondemanddynamic))
- "Encoding Guidelines Dynamic Streaming for Flash over HTTP," Akamai website ([bit.ly/akamaiwhitepaper](http://bit.ly/akamaiwhitepaper))

## RTMP Flash: How Many Streams?



- Considerations
  - Sufficient to cover a broad spectrum of bandwidths
  - Not so many that changing is frequent
  - Number of window sizes served
    - At least one for each relevant window size

## RTMP Flash: How Many Streams?



- Considerations
  - Number of window sizes served

Scenario	Format	Frame Size	Total Bitrate	Audio Bitrate	bits/pixel *frame @ 30 fps	bits/pixel *frame @ 24 fps
Mobile & constrained (low)	baseline, mono, 10 fps	448x252	150	48	0.09	0.09
Mobile & constrained (high)	baseline, mono	448x252	450	48	0.12	0.15
Sidebar placements	main profile, stereo	384x216	400	96	0.12	0.15
Small in-page	main profile, stereo	512x288	750	96	0.15	0.18
Medium in-page	main profile, stereo	640x360	1200	96	0.16	0.20
Large in-page	main profile, stereo	768x432	1700	96	0.16	0.20
Full size in-page	main profile, stereo	960x540	2200	96	0.14	0.17
HD 720p (full screen)	high profile, stereo	1280x720	3500	96	0.12	0.15

## RTMP Flash: How Many Streams?



- MTV Schema
  - Have at least one for each window size served (optimum quality when stream size=window size)
  - Never switch to quality higher than current viewing size
- Other considerations
  - Most if subscription service (MLB with 11)
  - More if entertainment
    - MTV with 8, though Turner (PGA golf) with 4
  - Fewer if education or corporate
    - Indiana - 3, Harvard, 5
- Overall - 3 - 8 for non-subscription

[MTV.com](http://MTV.com)

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## RTMP Flash: What Resolution?



- MTV - At least one for each window size
  - Don't shift to higher stream unless window size changes
    - Never send 720p stream to 768x432 window
  - Adobe white paper (right)
    - Cluster around window sizes
    - Switches least apparent w/in same window size

16x9				
Stream #	Picture Size	V	A	AV
1	256x144	150	64	214
2	256x144	250	64	314
3	512x288	450	64	514
4	512x288	600	64	664
5	512x288	800	64	864
6	512x288	1200	64	1264
7	768x432	1400	64	1464
8	1280x720	1700	64	1764
9	1280x720	2500	64	2564
10	1280x720	3500	64	3564
11	1920x1080	4200	64	4264
12	1920x1080	5300	64	5364

[bit.ly/Levkovhttp](http://bit.ly/Levkovhttp)

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## RTMP Flash: What Resolution?



- Adobe Media Encoder Presets
  - Where the rubber meets the road for Adobe producers

Preset	Resolution	Video bitrate (kbps)	Profile	Key frame	Audio bitrate (kbps)	Channels
Phone and Tablet, 3G, 16x9	512x288	300	Baseline	72	48	Stereo
Phone and Tablet, 3G, 16x9	512x288	450	Baseline	72	48	Stereo
Phone and Tablet, 3G, 16x9	512x288	650	Baseline	72	48	Stereo
PC &TV, SD, Med, 16x9	768x432	1,140	Main	72	64	Stereo
PC &TV, SD, High 16x9	768x432	1,740	Main	72	64	Stereo
PC &TV, HD, Med, 16x9	1280x720	2,440	High	72	64	Stereo
PC &TV, SD, High 16x9	1280x720	3,440	High	72	64	Stereo

<http://bit.ly/adaptivepresets>

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## RTMP Flash: What Resolution?



- Other considerations
  - Never encode at larger than source
    - Scaling upwards degrades quality
  - Match size to display window
    - If you have to scale during display, scale up, not down
    - Scaling down uses 40% more CPU
  - Very few producers adhere to mod-16 (where height/width are divisible by 16)
    - But all favor at least mod-8, all at least mod-4

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## RTMP Flash: What Data Rates?



- Considerations
  - Must be sufficiently far apart to avoid constant switching
  - Will vary with stream size
    - Smaller gaps at lower bandwidths
    - Larger gaps at higher bandwidths

## RTMP Flash: What Data Rates?



- MTV Schema

Scenario	Format	Frame Size	Total Bitrate	
Mobile & constrained (low)	baseline, mono, 10 fps	448x252	150	
Mobile & constrained (high)	baseline, mono	448x252	450	
Sidebar placements	main profile, stereo	384x216	400	350 kbps
Small in-page	main profile, stereo	512x288	750	450 kbps
Medium in-page	main profile, stereo	640x360	1200	500 kbps
Large in-page	main profile, stereo	768x432	1700	500 kbps
Full size in-page	main profile, stereo	960x540	2200	1300 kbps
HD 720p (full screen)	high profile, stereo	1280x720	3500	

## RTMP Flash: What Data Rates?



- <http://alexzambelli.com/WMV/MBRCalc.html>
  - For Smooth Streaming, but good starting point
  - Enter parameters, calculates rez/data rate for you
  - Attempts to keep quality consistent at all data rates

Max Width: 1280 Max Height: 720 Frame Rate: 29.97 Aspect Ratio: 16 9 Force mod-16? ☐ GO!

Min Bitrate (kbps): 400 Max Bitrate (kbps): 3000 Number of levels to generate: 6

Suggested Max Bitrate: 2962

Bitrate: 3000;	Width: 1280;	Height: 720;	Actual AR: 1.777:1
Bitrate: 2005;	Width: 968;	Height: 544;	Actual AR: 1.779:1
Bitrate: 1340;	Width: 732;	Height: 412;	Actual AR: 1.776:1
Bitrate: 896;	Width: 556;	Height: 312;	Actual AR: 1.782:1
Bitrate: 599;	Width: 420;	Height: 236;	Actual AR: 1.779:1
Bitrate: 400;	Width: 312;	Height: 176;	Actual AR: 1.772:1

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## RTMP Flash: How should H.264 encoding parameters change?



- Computer playback
  - High profile/CABAC enabled
  - Adobe switches profile with streams
    - Small streams – Baseline
    - Mid – Main
    - Large - Hit
- Mixed computer and device
  - Streams must match lowest common denominator targets

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## In General - Key Frame Parameters

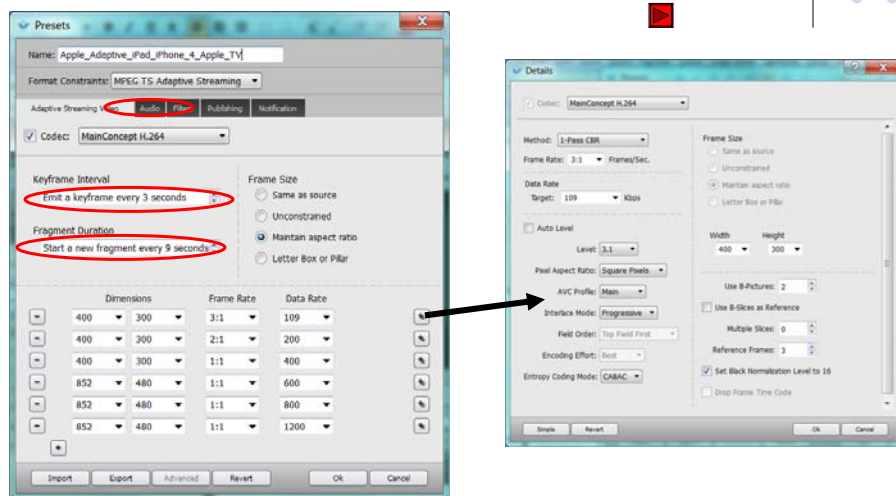


- Key frame interval must be consistent across all files
  - no scene change detection
- All key frames s/b IDR frames
- Intervals shorter (2-5 seconds) so stream switching is more nimble
- For chunk-based technologies, should divide equally into chunk duration
  - If eight second chunks, use 1, 2 or 4 seconds

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## Presentation in Squeeze 7



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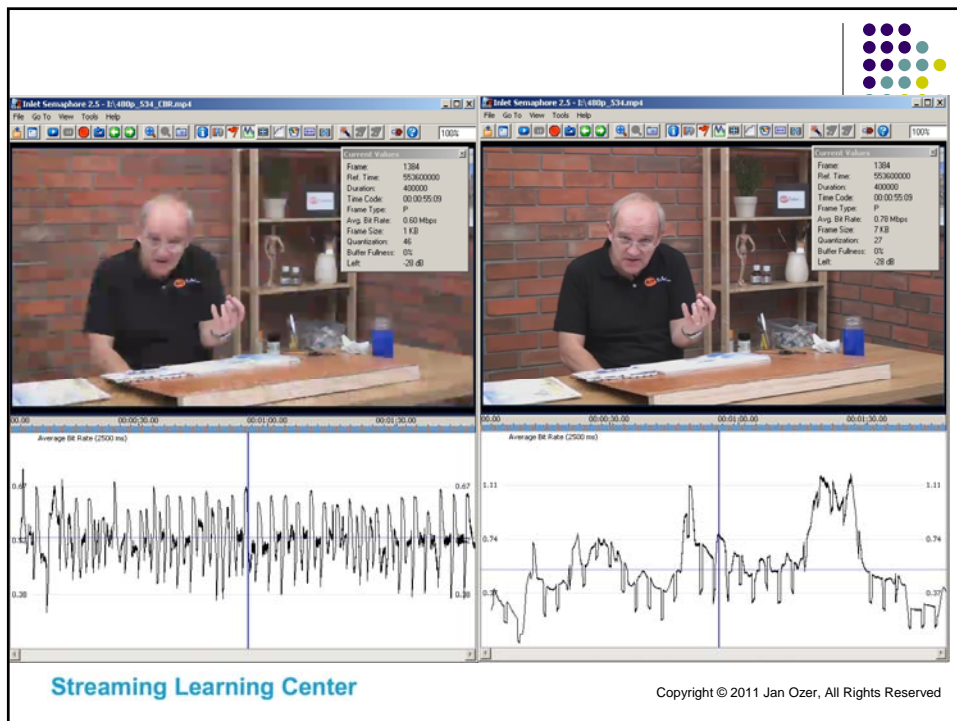
## In General - VBR vs CBR



- Live - use CBR
- On-Demand
  - CBR more conservative but can cost you quality
  - Unconstrained VBR - can cause unnecessary stream switches
    - Large packet of high bandwidth VBR that takes too long to deliver can make player think that buffer is low
  - Constrained VBR
    - Highly constrained at low data rates (1.2x)
    - Less constrained at high data rates, where difference in bandwidths is great (MTV uses 2X constrained)
    - But, CBR is safer and more conservative

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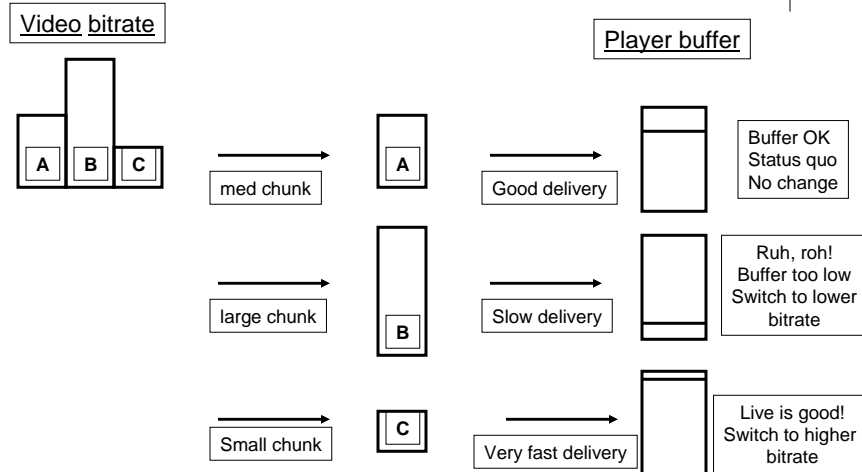
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## VBR vs CBR



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## In General - Audio Parameters

- Most conservative - use same parameters for all files
  - Popping can occur if audio parameters change
  - But, doesn't optimize experience at higher bit rates
- If you do switch audio parameters
  - Switch from stereo to mono at same per channel sampling rate and bit rate
    - From 128 kbps/44 kHz/16-bit/stereo to 64 kbps/44 kHz/16-bit/mono
  - Test to ensure no artifacts when switching streams

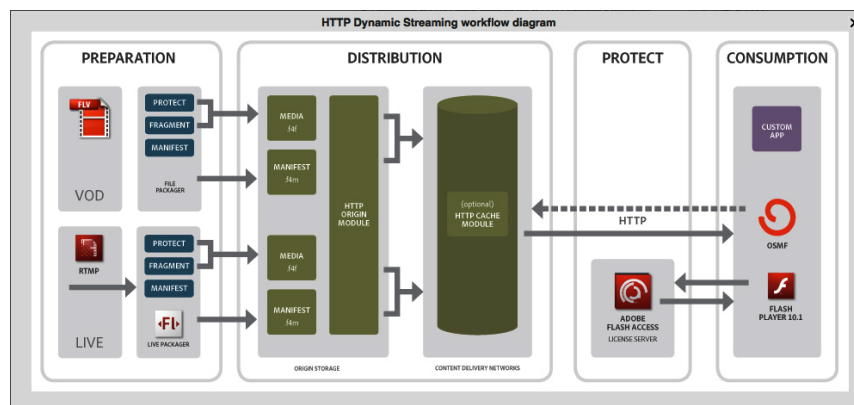
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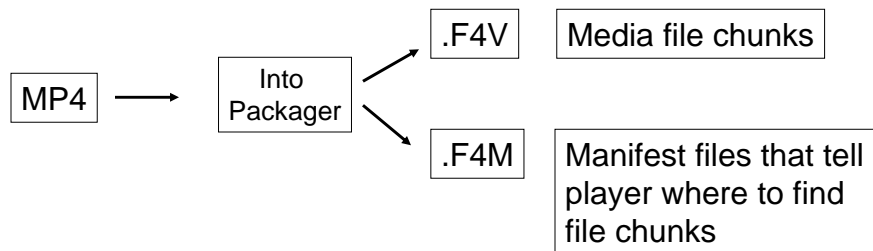
# HTTP Flash

- How it works
- How encoding is different from RTMP

## HTTP Flash - How it Works



## To Boil it Down



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## HTTP Flash - How it Works



- Encoding
  - Encode files as normal
  - Insert into file packager, which:
    - Creates manifest file that tells the player where to look for files at different bit rates (F4M)
    - Divides encoded files into chunks (F4F files)
  - All files uploaded to HTTP server
- Meanwhile, at the player
  - Player retrieves manifest file first
  - Player monitors bandwidth/CPU/other heuristics
    - Retrieves chunks from different locations as necessary

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## HTTP Flash: How Encoding is Different



- Number of files/req/data rate – as discussed
- Key frame, bitrate control, audio, make modifications previously discussed
  - 2-5 second key frame, evenly divisible into chunk size
  - CBR or highly constrained VBR
  - Audio – same or test to make sure no artifacts
- Best sources:
  - Maxim Levkov - Adobe - very detailed recommendations
    - [adobe.ly/Levkovhttp](http://adobe.ly/Levkovhttp)
  - Akamai - White paper: "Encoding Guidelines for Dynamic Streaming for Flash over HTTP"
    - [bit.ly/akamaiwhitepaper](http://bit.ly/akamaiwhitepaper)

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## Apple HTTP Live Streaming



- Primary technology for iOS devices
  - Also supported in Android 3.0
- How it works
- How to customize your encoding

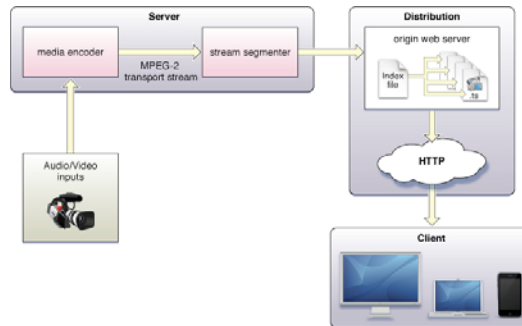
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# Apple HTTP Live Streaming: How it works



- Encoding
  - Encode as normal, send to segmenter
  - Files chunked, inserted into **MPEG-2** transport stream (.ts extension)
  - Manifest file (M3U8) created
  - Uploaded to server
- Client
  - Monitors **buffer**
  - Changes retrieved file as necessary



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# Encoding for HTTP Live Streaming



- Sources
  - Apple Tech Note: “Best Practices for Creating and Deploying HTTP Live Streaming Media for the iPhone and iPad,” ([bit.ly/bestpracticehttplive](http://bit.ly/bestpracticehttplive))
  - Apple Tech Note: “HTTP Live Streaming Overview,” ([bit.ly/httpliveoverview](http://bit.ly/httpliveoverview))
  - Apple Tech Note: “Using HTTP Live Streaming,” ([bit.ly/usinghttplive](http://bit.ly/usinghttplive))

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# HTTP Live Streaming



16:9 Aspect Ratio						WORKS ON		
	Dimensions	Total Bit Rate	Video Bit Rate	Keyframe	Restrict Profile to:	iPod Touch Gens 2, 3, 4 iPhone 3G 3GS	iPhone 4 iPad 1, 2	Apple TV 2
CELL	480x320	64	na	na	na	*	*	*
CELL	416x234	150	110	30	Baseline, 3.0	*	*	*
CELL	416x234	240	200	45	Baseline, 3.0	*	*	*
CELL	416x234	440	400	90	Baseline, 3.0	*	*	*
WIFI	640x360	640	600	90	Baseline, 3.0	*	*	*
WIFI	640x360	1240	1200	90	Main, 3.1		*	*
WIFI	960x540	1840	1800	90	Main, 3.1		*	*
WIFI	1280x720	2540	2500	90	Main, 3.1		*	*
WIFI	1280x720	4540	4500	90	Main, 3.1		*	*

4:3 Aspect Ratio						WORKS ON		
	Dimensions	Total Bit Rate	Video Bit Rate	Keyframe	Restrict Profile to:	iPod Touch Gens 2, 3, 4 iPhone 3G 3GS	iPhone 4 iPad 1, 2	Apple TV 2
CELL	480x320	64	na	na	na	*	*	*
CELL	400x300	150	110	30	Baseline, 3.0	*	*	*
CELL	400x300	240	200	45	Baseline, 3.0	*	*	*
CELL	400x300	440	400	90	Baseline, 3.0	*	*	*
WIFI	640x480	640	600	90	Baseline, 3.0	*	*	*
WIFI	640x480	1240	1200	90	Main, 3.1		*	*
WIFI	960x720	1840	1800	90	Main, 3.1		*	*
WIFI	960x720	2540	2500	90	Main, 3.1		*	*
WIFI	1280x960	4540	4500	90	Main, 3.1		*	*

\* Frame Rate: Assumes current frame rate is 29.97. For other frame rates see below:

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[Bit.ly/bestpracticehttplive](http://Bit.ly/bestpracticehttplive)

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## HTTP Live - Encoding Parameters



- Apple gives very good guidance
- Filling in the blanks
  - Profile/level - optimize for target
    - M3U8 can be device sensitive - won't send older iPods to iPad/iPhone 4 stream
  - VBR/CBR
    - As discussed
  - Key frame - chunked technology, optimal if key frame divides evenly into chunk duration

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## WebM-based Adaptive Streaming



- Nascent market;
  - Some technology providers
    - Anevia
    - Quavlive
  - HTML5 standard coming in a DASH
    - Dynamic Adaptive Streaming over HTTP (DASH)
    - [http://mpeg.chiariglione.org/working\\_documents.htm](http://mpeg.chiariglione.org/working_documents.htm)
  - No encoding recommendations at this point

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## Comparing H.264 Encoding Tools



- Test Description
- Mac, then Windows. In each:
  - Meet the participants
  - Quality
  - Performance
  - Features

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## Test Description



- Quality
  - SD - 640x480x29.97 @ 468 kbps video/32 kbps audio - highest quality encoding available
  - HD - [720p @ 29.97](#) @ 800 kbps/video/128 kbps audio - highest
  - Compared still frame and motion quality
- Encoding speed
  - Encode SD/HD Files
  - One to many (produce for adaptive)
  - Many to one (high volume encoding shop)

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## Mac H.264 Encoders



- Meet the participants

	Adobe Media Encoder (Mac/Windows)	Apple Compressor Mac Only	Apple Compressor with x264Encoder	Sorenson Squeeze	Telestream Episode Pro 6
Company	Adobe	Apple	My Comet 3G	Sorenson Media	Telestream
Platforms	Mac/Windows	Mac	Mac	(Mac/Windows)	(Mac/Windows)
Price as tested	Bundle-only	Bundle-only	Free	\$799	\$995
H.264 Codec	MainConcept	Apple	x264	MainConcept	MainConcept
Other Streaming Codecs Supported	VP6	None	None	VP6, WMV	VP6, WMV

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## Mac H.264 Encoders



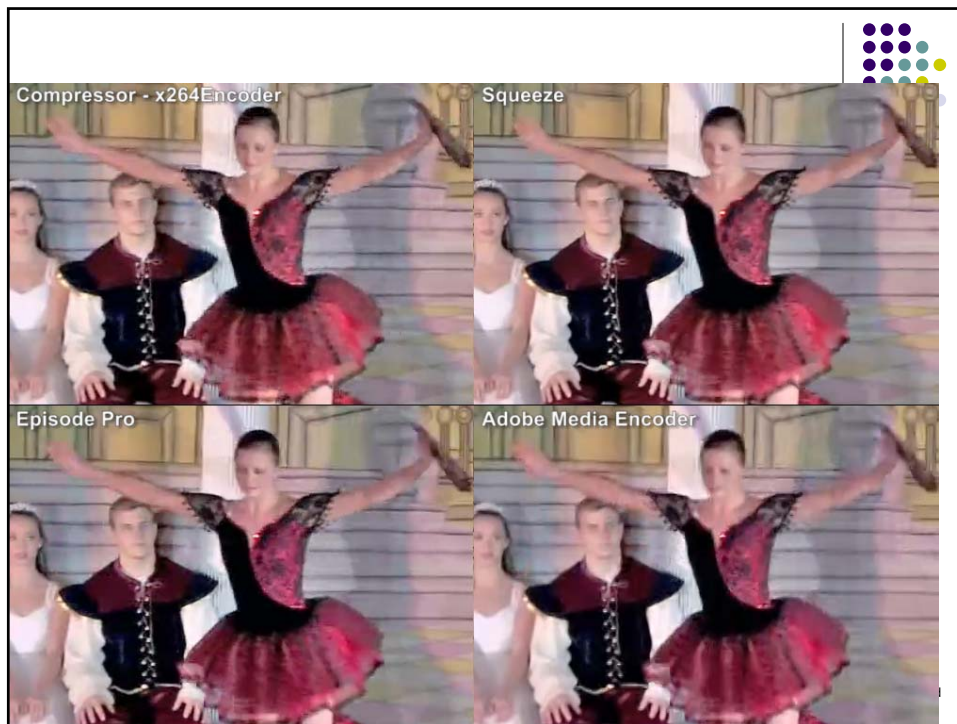
- Quality in a nutshell:
  - Don't encode in QT/Compressor using the Apple codec; Instead try the x264Encoder

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## Mac Quality - Apple





## Mac Quality Summary

	Adobe Media Encoder	Apple Compressor	Apple Compressor with x264Encoder	Sorenson Squeeze	Telestream Episode Pro 6
SD frame quality	Excellent	Fair	Very Good	Excellent	Excellent
SD motion quality	Excellent	Good	Very Good	Excellent	Excellent
HD frame quality	Very Good	Poor	Very Good	Excellent	Excellent
HD motion quality	Excellent	Fair	Very Good	Excellent	Excellent
Bottom line	Just a hair behind the leaders in HD quality	Avoid if possible	Very, very good, but verify compatibility	The standard by which others are judged	Version 6.1.1 brings parity with Squeeze

- Episode 6.1 resolved all issues with H.264 encoding quality; now on par with Squeeze
- AME is slightly behind in one category - s/be fine for most jobs
- Seems like bad vintage of x264 encoder - usually on par with others
  - Use that if locked into Compressor workflow

# Encoding Schemas



- Serial - one at a time
  - Adobe Media Encoder
- Parallel - multiple simultaneous encodes, usually up to number of cores in system
  - Compressor with Qmaster
- Hybrid parallel
  - Episode Pro - 2 at a time
    - Episode Engine - to number of cores
  - Squeeze
    - Many to many - to number of cores (shown on right)
    - But! One to many - serial



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# Mac Encoding Speed



	Adobe Media Encoder	Apple Compressor	Apple Compressor with x264Encoder	Sorenson Squeeze	Telestream Episode Pro 6
<b>Encoding: Serial or Parallel</b>	Serial	Parallel (with Qmaster)	Parallel (with Qmaster)	Parallel	Parallel (2 files max)
Single SD file to 500 kbps	2:47	8:21	5:30	7:28	3:17
Single HD file to 800 kbps	2:10	4:30	3:00	3:47	2:14
Single HD test file to 8 files	15:55	23:36	34:30	24:30	15:17
8 DV files to 500 kbps	2:48	3:29	3:02	5:20	2:27

- Overall; differences relevant only to very high volume shops
- AME very fast for serial encoder
- Episode - very fast
- Squeeze
  - Slow single file time
  - Encodes *multiple files* in parallel, not one
- Compressor - middle of the pack

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## Mac Encoding Features



	Adobe Media Encoder	Apple Compressor	Apple Compressor with x264Encoder	Sorenson Squeeze	Telestream Episode Pro 6
Baseline/Main/High profile selection?	Yes	Baseline/Main	Yes	Yes	Yes
CABAC entropy encoding	Automatic	No	Yes	Yes	Yes
B-frame/reference frame controls	Automatic	Automatic	Yes	Yes	Yes
Other H.264 controls	None	None	Very extensive	Minimal	Minimal
Adaptive streaming presets	Yes	No	No	Yes	No

- Who cares?:
  - Those who need to customize
  - Those who like to tinker

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## Windows H.264 Encoders



- Meet the participants

	Adobe Media Encoder	Microsoft Expression Encoder	Sorenson Squeeze	Telestream Episode Pro 6
<b>Company</b>	Adobe	Microsoft	Sorenson Media	Telestream
<b>Platforms</b>	Mac/Windows	Windows	Mac/Windows	Mac/Windows
<b>Price as tested</b>	Bundle-only	\$199.95	\$799	\$995
<b>H.264 codec</b>	MainConcept	MainConcept	MainConcept	MainConcept
<b>Other streaming codecs supported</b>	VP6, WMV	WMV	VP6, WMV	VP6, WMV

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## Windows



## Windows Quality Summary

	Adobe Media Encoder	Microsoft Expression Encoder	Sorenson Squeeze	Telestream Episode 6
SD frame quality	Excellent	Excellent	Excellent	Excellent
SD motion quality	Excellent	Excellent	Excellent	Excellent
HD frame quality	Very Good	Excellent	Excellent	Excellent
HD motion quality	Excellent	Excellent	Excellent	Excellent
Bottom line	Just a touch behind in some HD frames	A solid choice, particularly if you like to tinker	The standard by which others are judged	Version 6.1.1 brings parity with Squeeze

- All encoding tools use MainConcept codec, so no surprise quality is very similar
  - Episode 6.1 resolved all issues with H.264 encoding quality; now on par with Squeeze
  - AME and Expression Encoder perform well across the board
  - No meaningful quality differentiation

## Windows Encoding Speed



- Some encoders let you open multiple instances
  - Yes - Expression Encoder, Squeeze
  - No - Adobe Media Encoder, Episode
- Useful when encoding tool encodes serially
  - Expression Encoder

## Windows Encoding Speed



	Adobe Media Encoder	Microsoft Expression Encoder	Sorenson Squeeze	Telestream Episode Pro
<b>Encoding: serial or parallel</b>	Serial	Serial	Parallel	Parallel (2 files max)
Single SD file to 500 kbps	1:30	2:34	3:46	1:21
Single HD file to 800 kbps	1:33	1:19	2:42	3:26
Single HD test file to 8 files	12:16	7:40	16:59	10:53
8 DV files to 500 kbps	2:16	6:04	3:23	2:34
8 DV files - multiple instances	NA	5:55	NA	NA

- Overall; differences relevant only to very high volume shops
- AME very fast for serial encoder
- Expression Encoder was fastest in one to many encodes, which is adaptive streaming scenario
- Squeeze
  - Slowest in adaptive streaming scenario
- Episode Pro
  - Competitive in all tests

## Windows Encoding Features



H.264 Encoding Features	Adobe Media Encoder	Microsoft Expression Encoder	Sorenson Squeeze	Telestream Episode Pro
Baseline/Main/High profile selection?	Yes	Yes	Yes	Yes
CABAC entropy encoding	Automatic	Yes	Yes	Yes
B-frame/reference frame controls	Automatic	Yes	Yes	Yes
Other H.264 controls	None	Very extensive	Minimal	Minimal
Adaptive streaming presets	Yes	Yes	Yes	No

- Who cares?:
  - Those who need to customize
  - Those who like to tinker

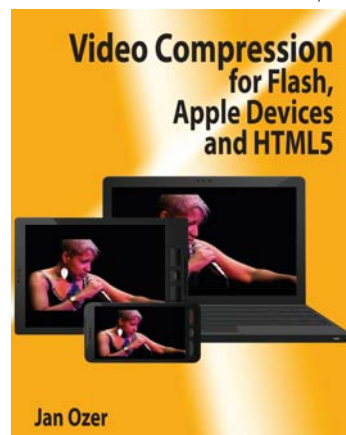
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## Questions?



- For more information, check out the book
  - Available on Amazon
  - Some copies available today



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