

Building a Custom Streaming Video Player with Flash

Part 1 – Encoding Flash Video
Presented by Edward Apostol
Consultant, New Toronto Group
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Topics

- Understanding Flash Video (FLV)
 - What is a CODEC
 - About video encoding
 - About On2 VP6 & Sorenson Spark
 - Converting to FLV using the Flash 8 Video Encoder
 - Understanding bandwidth and data rate
 - Advanced encoding settings
 - Best encoding practices
-

Why You Need to Convert Media

- Audio and video needs to be **compressed** for distribution, especially on the Internet
 - Standard NTSC Video (North America) is uncompressed
 - VIDEO - 20 Mbytes per second (150 Mbits / sec)
 - AUDIO - 176 Kbytes per second (1.411 Mbits / sec)
 - Total - 20.2 Mbytes / sec (161.4 Mbits / sec)
 - Typical Home Internet Connection
 - Dialup - 50 kbps
 - DSL – 1.5 Mbps > 3.0 Mbps
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Audio and Video in Flash

- What does the Flash Player support?
 - Audio - MP3, includes adding metadata (ID3) support
 - Video – FLV - includes audio, video and video metadata
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Where is Digital Video?

- To deliver video images across various mediums, audio / video data needs to be *encoded*
- Encoded data is *compressed* while maintaining *quality*
- All digital delivery systems compress video, including:

• Digital satellite	• CD audio
• Digital cable	• Digital video cameras
• DVD video	• Digital still cameras
• ALL Internet video	

Understanding the Flash Video Format (FLV)

What is Flash Video (FLV)?

- Flash Video (FLV) is...
 - A binary file format for compressed digital video and/or audio
 - Encoded using On2 VP6 codec (Flash 8) or Sorenson Spark Codec (Flash 6.0.79+)
 - Playable from any Flash Player (version 6+) and any device that supports Flash
 - Is a "time-based" format
 - Can store embedded messages (metadata)
 - Supports streaming of media data
 - Can be played using progressive playback

About Flash Video

- Plays through (streams) and / or within (embedded) a Flash movie
- Flash Video can be played within a
 - Layer
 - MovieClip
- Flash Video can be
 - Scripted
 - Controlled just like any other object in a SWF file
 - Encoded with embedded cue points

A CODEC is a plan

- Video is compressed via a CODEC
- CODEC means CCompression/DECompression
 - Method of compressing audio and video data
 - Involves algorithms that compress data
 - Often removes redundant data
- Audio and video use different CODECs
 - Often compiled into a single file

A CODEC is a plan

- A client "media player" is required to watch a digital audio/video
- Media players often support multiple CODECs upon playback
- A CODEC in a media player DECompresses video on playback

Converting Video – Flash Encoder

- Macromedia Flash 8 Video Encoder
 - Stand-alone video encoding application
 - Lets you encode video in Macromedia Flash Video (FLV) format
 - Ships with
 - Macromedia Flash Professional 8 and
 - Macromedia Studio 8

Apps Supporting FLV Export

•The FLV format is supported as an export option by many commercial and consumer applications

- | | |
|---|---|
| <ul style="list-style-type: none"> <input type="checkbox"/> Consumer & Pro Apps supporting FLV Export: <ul style="list-style-type: none"> ■ Flix 8 Pro ■ Adobe After Effects 6+ & Adobe Premiere 6.5+ ■ Apple Final Cut Express & Final Cut Pro (3.x, 4.x) ■ Apple QuickTime Player Pro 6.3+ ■ Avid Media Composer, Xpress DV and DV Pro | <ul style="list-style-type: none"> <input type="checkbox"/> Batch Encoders supporting FLV Export: <ul style="list-style-type: none"> ■ Sorenson Squeeze ■ On2 Flix Exporter ■ Anystream Encoder ■ Canopus ProCoder ■ Discreet Cleaner XL |
|---|---|

Converting to Flash Video Using the Flash 8 Video Encoder

About Macromedia Flash 8 Video Encoder

- Flash 8 Video Encoder
 - Ships with Flash Professional 8 or Macromedia Studio 8.
 - Can be used as a stand-alone application
 - Can also be accessed through Flash Professional 8 using the Import > Video command
 - Enables FLV export from video software packages
 - Encodes video files in either On2 VP6 (Flash 8) or Sorenson Spark video (Flash 6 and 7) codec

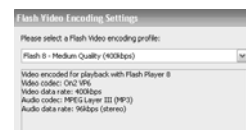
Exploring Encoder Options – Flash Video Encoding Profile

- Encoding profiles based on Flash Player version
- Flash 8 Video Encoder has default profiles
- Profiles determine the level of compression
- Encoding profile for Flash Player 8 uses the *On2 VP6* codec
- Encoding profile for Flash Player 7 uses *Sorenson Spark* codec



Encoder Options > Encoding Profile

- Settings are available based on default encoding profile
 - Flash Player version
 - Video codec
 - Video Bit Rate
 - Audio encoding



Exercise – Encoding Video with Flash 8 Video Encoder

- Encode video with the Flash 8 Video Encoder
 - Explore and change the settings required to convert the QuickTime movie file to a Flash Video file
 - Convert a video file to several Flash Video files of appropriate bandwidth
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Understanding Bandwidth and Data Rate

Understanding Bandwidth

- Bandwidth is the ultimate factor in online video regardless of platform
 - A bandwidth strategy is required for
 - Client
 - Server
 - Video
 - Server bandwidth must support the total peak users
 - Client bandwidth must support the stream plus other internet activities
-

Understanding Data Rate

- The **data rate** is a measure of *bandwidth*, *i.e.* how much data can be delivered through a medium
 - Data rate often measured in
 - Kilobits per second (Kbps/sec) ~ 1000 bits/sec
 - Megabits per second (Mbps/sec) ~ 1,000,000 bits/sec
 - Low data rates reduce quality
 - High data rates increase quality
-

Data Rates (1 / 2)

- Common data rates for the Internet from are:

Bandwidth Setting	Data Rate (Jan. 2005)
dial-up	~ 50 Kbps (kilobits per second)
DSL	~ 1.5 Mbps → 3.0 Mbps (megabits per second)
cable	~ 2 Mbps → 3.0 Mbps (megabits per second)
T1 and T3	~1.5 Mbps , ~43 Mbps (megabits per second)

Data Rates (2 / 2)

- Flash Player maximum data rate = **4 Mbps**
- Note these are the 'traditional' Conversions
 - 1 byte = 8 bits
 - 1 kilobyte (KB) = 1,024 bytes
 - 1 megabyte (MB) = 1,048,576 bytes
- But when it comes to streaming
 - 1 kilobyte (KB) ~ 1000 bytes or 8000 bits
 - 1 megabyte (MB) ~ 1,000,000 bytes

Bits and Bytes

- Bits per second
 - Data transfer of digital bits per second
 - Typically used in video / audio
 - Also known as bit rate
- Bytes per second
 - 8 bits in a byte
 - Data transfer of bytes (8 bits) per second
 - Measured (usually) in kilobytes (1024 Bytes)
 - Typically used in file storage
 - Web servers

Video Conversion: Quality / Data Rate

- Internet data rate
 - Amount of data transfer per second
 - Set Too Low: not enough information is processed for smooth video
 - Set Too High: wasted bandwidth with no quality increase
 - Sets minimum bandwidth required to play video
 - Measured in BITS per second (bps)
 - Calculated in BYTES per second (Bps)
 - Has direct results in the quality of your video
- General formula to calculate data rate

$$dR \text{ (bps)} = \frac{w \times h \times \text{color depth} \times \text{fps}}{\text{compression}}$$

$$dR = \frac{320 \times 240 \times 24 \times 15}{60} = 460,800 \text{ bits/sec} \quad (461 \text{ Kbps})$$

Data Rate Highs and Lows

- Low data rate
 - Reduced number of bits transferred per seconds
 - Lower quality
 - Available for low-bandwidth connections
 - Good for dial up access
 - Smaller file size
 - High data rate
 - More data is transferred
 - Higher quality
 - Not good for low-bandwidth connections
 - Broadband target audience
 - Larger file size
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Effect of Changing Data Rate



- Blocky / blurry image
 - Decreased Data Rate
 - Data rate: 100 Kbps**
 - higher quality
 - Increased data rate
 - Data rate: 384 Kbps**
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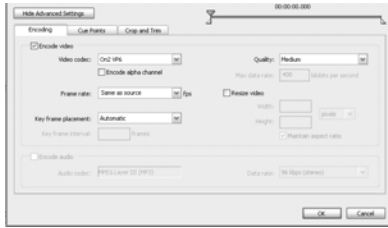
Advanced Encoding Settings

Advanced Flash 8 Video Encoder Settings

- No video is the same
 - Different videos have different
 - Movement
 - Color
 - Edits
 - Effects
 - Audio
 - Preset Settings are not always the ideal settings
 - Some video requires a higher data rate
 - Some video does not require as high of a data rate
 - Each video needs to be tweaked differently
-

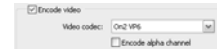
Exploring Encoder Options – Advanced Settings

- Clicking on Show Advanced Settings reveals additional options



Encoding Tab > Video Codec

- When checked, allows choice of either
 - Sorenson Spark (Flash 6+)
 - On2 VP6 (Flash 8+)
- Also selects **alpha channel support**
 - Stores transparency information
 - Video source must be Quicktime or equiv.



Encoding Tab > Frame Rate

- Frame rate – number of frames appearing per second
- Can choose pre-defined or enter value



Encoding Tab > Frame Rate

How Frame Rate affects video



- Quality improves up until a certain point (human eye discern ability)
- Also may be negated by end-user CPU and bandwidth limits
- Increase file size



- Quality generally lowers (movie appears to stutter)
- May be balanced by end-user CPU and bandwidth limits
- Lowers file size

Encoding Tab > Keyframe Placement

□ Keyframe Placement

- Identifies baseline frames that are used for comparing differences with other frames within video
- If difference is significant then new frame is conveyed to user

□ Keyframes can be automatic or custom

- Custom means enter own value for sampling



Exploring Key Frame Placement

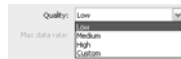


frame rate (fps)
X
key frames/sec
=
key frame every...frames

- Key frame interval 0 to 100 frames
- Auto mode: one key frame every two (2) seconds
- Dependent on the frame rate as well (FPS)
- Key frames can be manually set
- Increase motion in source, increase key frames
- The higher the key frame rate, the better the image quality
- Affects the seeking forward / pausing of streamed video

Encoding Tab > Quality

- The quality value influences the *data rate* and the *audience that can view the video*
- Recall - *Data rate* is the rate which the data is streamed to a client system (per unit time)
- Choose one of low, medium, high, or custom
- For custom, enter value based on formula
- Increasing data rate may increase quality
 - But take into account real-time bandwidth changes and end-user's CPU usage



How Data Rate values affects Compression

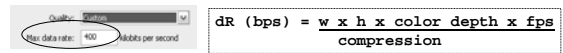
- High DR – 60 to 1
- Med DR – 120 to 1
- Low DR – 360 to 1
- Override with manual settings



Exploring Data Rate (1 / 3)

- Data (or *bit*) rate is ideally constant when streamed
- Data rate is influenced by encoding process
- Encoding can be done using variable rate or constant rate encoding
- 3rd party tools, such as Sorenson, may also support variable-rate encoding
 - Data rates may fluctuate within a range
 - Determined by amount of activity in footage
- 3rd party tools may also offer one or two-pass encoding – gains increased compression at expense of increased encoding time
- Flash Encoder encodes using *one-pass variable* rate encoding

Exploring Data Rate (2 / 3)



$$dR \text{ (bps)} = \frac{w \times h \times \text{color depth} \times \text{fps}}{\text{compression}}$$

- Max. Data Rate (MDR) sets the upper limit that the video can be streamed in kilobits / sec
- The MDR utilizes general formula to help determine how to best
 - Ex. If you set max rate to be 512 kbps (High DSL)
 - You can have the following settings:
 - $512000 \leq (320) \times (240) \times (24) \div (15)$
 - $512000 \leq (461000)$

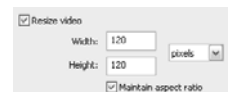
Exploring Data Rate (3 / 3)

- Understand bandwidth of your target audience

Connection	Connection Rate(kbps)	Recommended Maximum Bit Rate
DSL	1024	800 kbps
DSL	512	450 kbps
DSL	384	350 kbps
DSL	256	225 kbps
Dialup	56.6	40 kbps

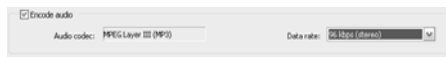
Encoding Tab > Resize Video

- Resize video
 - Adjust size of video in either pixels or percentage
- Maintain Aspect Ratio
 - Maintain aspect ratio of original clip
 - Video may become distorted if frame size is changed and Maintain Aspect Ratio is not selected
- If you resize video change your data rate

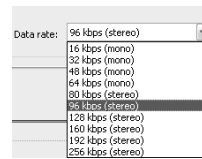


Encoding Tab > Audio Settings

- Audio settings (re)compress the sound portion of your video into the FLV format
- Audio is encoded with a different CODEC than video
- Only audio type currently supported is MP3 format (at this time)



Encoding Tab Data Rate (Audio)



- Data rate
 - Can be adjusted
 - Is a measure of transmitted data
- Sample rate
 - Is a measure of how frequently audio data is recorded
 - Cannot be adjusted after audio is recorded
- Automatic bit rate selections are optimized for FLV playback
 - The lower the data rate the lower the quality
- Audio data rate is added to the video data rate

Additional FLV Encoder Notes

- All settings are encoded into the file
- Settings cannot be changed after encoding
- Always keep your source file
- Multiple FLV files are required to support multi-bit-rate delivery
- Custom settings
 - Create an "ideal" quality stream and provides compromise between data rate and quality
 - Ensure you get the most out of your video

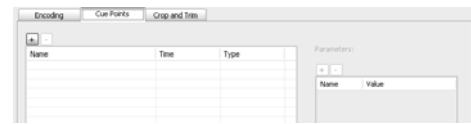
Exercise 1.1 - Flash 8 Video Encoder Advanced Settings

- Use the Flash 8 Video Encoder
- Explore and change the settings required to convert the QuickTime Movie File to a Flash Video File.
- Explore the Advanced Encoding Settings.

Introducing Cue Points, Cropping and Trimming

Additional Encoder Options – Cue Points

- Cue points can be encoded into an FLV
- Cue points are stored as *metadata* **within** the FLV file
- Cue points can be used to trigger actions within a Flash movie (discussed later)



Exploring Cue Point Options

- To add/remove cue points click the plus (+) or minus (-) button

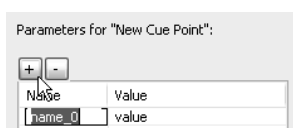


Name	Time	Type
New Cue Point	00:00:00.000	Event

- Name** – identifies cue point
- Time** – time in video for cue point
- Type** – navigation or event
- Custom parameters** can be entered for each point

Cue Point Parameters

- Parameters allow you to add extra information into the video
- Values could be Title, Author, Copyright
- Enter *Parameters* for each cue point (click on (+) button to add, (-) to remove)



About Event and Navigation Cue Point Types

- **Event** cue points
 - Trigger ActionScript methods
 - Synchronize playback to other events
- **Navigation** cue points
 - Used in navigation, seeking, and triggering ActionScript methods when a cue point is reached
 - Inserts a keyframe at the point in time in the video clip



Additional Encoder Options – Crop and Trim

- Cropping and Trimming alters the dimensions of the video clip
- **Cropping** eliminates areas of the video to emphasize a particular focal point
- **Trimming** edits the beginning and end points (in and out points) of a video



About Cropping

- **Cropping**
 - Enter values for right, left, top and bottom edges of video
 - Guidelines indicates cropped area
- **In and out points**
 - Drag triangles below scrubber until video clip is trimmed to desired length
 - Video preview visually identifies start and end frames
 - Elapsed time counter can locate specific points in time to trim clip.



Exercise 1.2 – Cue Points, Cropping and Trimming

- Add cue points using the Flash 8 Video Encoder
- Explore Cropping and Trimming using the Flash 8 Video Encoder

Getting the Best Video Encoding

Adjusting Video Properties to Gain the Best Quality

- How important are the following video properties?
 - Frame rate
 - Does your video need to have a full frame rate?
 - Is there a lot of detail in the motion of the screen contents (i.e. slow motion / time lapse)?
 - Frame size
 - Does your video need to be full size?
 - Is there a lot of detail that needs to be visible in the clip (i.e. logos / subtle expressions)
 - Quality
 - Does your video need to be 100% image quality?
 - Can your video suffer a small degree of "blurring" or reduced quality?
-

Video Conversion: Frame Size

- Frame size is the width and height (in pixels) of the frame
 - Frame size standards (width : height ratios)
 - NTSC / online video: 4:3 ratio
 - 640 x 480 | 720 x 480 (0.9 pixel aspect)
 - PAL
 - 768 x 576
 - Widescreen: 16:9 ratio
 - 720 x 576 (1.42 pixel aspect)
 - Flash Video does NOT have to adhere to any standards
 - Challenge the rectangle!
-

Effect of Frame Size

- Larger frame
 - More screen real-estate required
 - Higher resolution
 - Better quality of detail
 - Larger file size
 - Increased bandwidth required
 - Smaller frame
 - Less screen real estate
 - Lower resolution and less detail
 - Smaller file size
 - Less bandwidth required
-

Video Conversion: Frame Rate

- Frame rate is the number of frames per second (fps) displayed
- Typical frame rates
 - NTSC / widescreen: 29.97 fps
 - PAL / widescreen: 25.00 fps
 - Computer
 - 8 – 30 fps
 - Typically 12-15 fps
- The higher the frame rate, the larger the video file

Factors that Affect Encoding

- Encoder results are as good as the source footage
- Goal: Reduce the amount of pixel change frame over frame
- For the best source quality, use
 - Tripod
 - Good light
 - No light gain filters
 - No camera effects
 - High quality tape / film
 - Professional D1 video (not consumer DV)
 - No pre-compression

Factors that Affect Encoding: Frame Motion

- Little movement (characters)
- Static background (no trees blowing)
- No camera effects
 - Zoom / pans
- Post-production effects
 - Dissolves
 - Fades
 - Video effects
- No hand-held sources
- Too much motion
 - More key frames are required
 - More bandwidth required

Is the Extra Data Rate Required?



- | | |
|---|---|
| <input type="checkbox"/> Little frame motion | <input type="checkbox"/> Little frame motion |
| <input type="checkbox"/> Higher quality | <input type="checkbox"/> Higher quality |
| <input type="checkbox"/> Sharper image | <input type="checkbox"/> Sharper image |
| <input type="checkbox"/> DECREASED data rate | <input type="checkbox"/> INCREASED data rate |
| <input type="checkbox"/> Data rate: 100 Kbps | <input type="checkbox"/> Data rate: 384 Kbps |

Video Items to Remember

- As bandwidth decreases
 - Reduce the key frame rate
 - A more blurry image results
 - As motion increases
 - Increase the key frame rate
 - Increase the frame rate and (if possible) the data rate
 - Dial up connections
 - Require consumption of almost 100% of all available bandwidth
 - Frame rates
 - When reducing, they are calculated at half-rate, quarter-rate, & third-rate
 - Frame size
 - Reduce when bandwidth is limited
 - A 1:1 conversion of 720 x 486 D1 aspect ratio is 640 x 480
 - De-interlacing
 - If the video source you are encoding is straight from a video camera
 - Increase the performance of the video encoding and playback
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Summary

- FLV can store video, audio, and meta data
 - A CODEC is the encoding/decoding algorithm used to compress/playback digital video
 - Bit rate decreases when frame size and rate are decreased
 - Data rate (bit rate) affects the quality of the video and the playback performance
 - VBR is a fluctuating bit rate relative to the properties of the video
 - There are 8 bits in a byte
 - A key frame is an uncompressed frame in the video used to calculate the removed frames
 - Reducing frame size will produce better compression then reducing frame rate
 - Source footage is important for good compression (use tripod, good lights, good lens, and good media)
-

Review

- What three things are stored in an FLV?
 - Describe a CODEC; what is the video CODEC for Flash Video?
 - What happens to the bit rate when you reduce frame rate?
 - What does data rate affect?
 - What is variable bit rate (VBR)?
 - How many bits are in a byte?
 - What is a key frame?
 - What is better: reducing rate or size?
 - What qualities of the source footage make for good compression?
-