Producing Video for the Web
Streaming Media West, 2011

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Agenda

- Production
  - Setting the scene (background and clothing)
  - Lighting
  - Shooting for streaming
- Editing/Preprocessing
  - Choosing your targets
  - Avoiding/correcting aspect ratio issues
  - De-interlacing
- Encoding

11:10 – 12:00

Setting the Scene

- What's different b/t streaming and analog?
- Key objectives for choosing a background
- Conclusion and checklist

Background - What's Different?

- Contrast issues:
  - Very similar between analog and streaming - need to separate subject from background
- Other issues:
  - Backgrounds with motion can degrade compressed video quality
  - Poorly chosen backgrounds (well lit, reflective blank walls) can "create" noise

What do I Care About When Choosing a Background?

- Provide contrast with talent
  - Obviously relates to clothing worn by talent
- Avoid color and contrast extremes
- Choose one that compresses well
  - No motion
  - Low detail
  - No wide open spaces (embrace clutter)
  - No highly saturated colors

Contrast

- Good contrast
  - Classic - brown coat/blue shirt
  - Gray shirt - yellow back
  - Apple super white
  - Green shirt/gray back
  - Black background
- Bad contrast
  - Black on black
  - White on white

Contrast

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Avoid Color/Contrast Extremes

- Brightness extremes hard for camera/codecs to preserve
- Color extremes make it tough to maintain contrast
- So – avoid color and brightness extremes in background/clothing

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Avoid Wide Open Spaces

- DON'T - Use flat, well-lit, light color backgrounds without some "clutter.
- DO
  - Add "clutter" to the background to contain artifacts

If You Had to Pick One Color

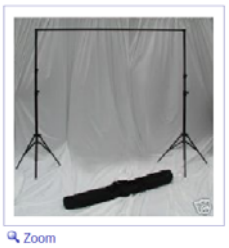
- Make it blue

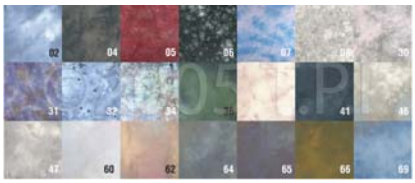
Backgrounds for people of color

- Significant diversity in actual color
- Rules seem about the same
- Light tans, light and dark blues
- Soft background
- Good backlight cures most problems

Building the Perfect Background - Office

- 1 stand (~ $100 US)
- 2-3 backgrounds (~$130 US)
  - Flat black
  - Dark grey
  - Light blue
- Under $250, you're set





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Building the Perfect Background - On Location

- Need "on location" feel
  - Curtains and portable backdrops out
- How to create compressible set?

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Building the Perfect Background - On Location

- Trend appears to be “make it work”
  - Backlighting increasingly used
  - Blur background if too much detail
- When all else fails, shoot against something solid

Background Checklist

- Does the background provide contrast with subject's face, clothing and hair?
- Are there extremes in contrast and/or color
- Is there extraneous detail in lighting or pattern?
- Is it moving?
- Are the colors highly saturated (rich reds and blues)?
- Are there well lit, wide open spaces?
- Are there any light sources like lights or windows?
- Have you tried compressing the footage and viewing the results?

What Should Talent Wear?

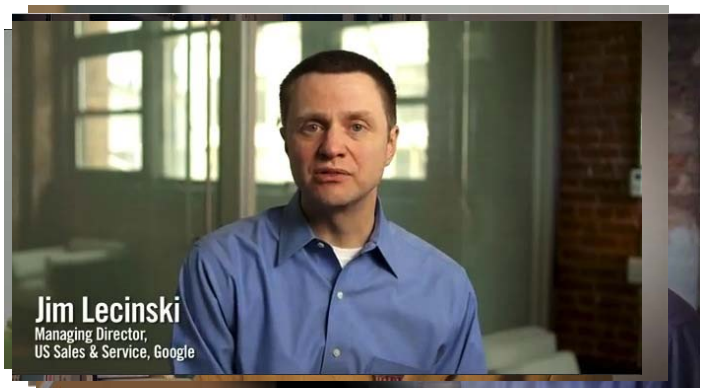
- What's different between streaming and analog production?
- Feng Shui in clothing and backgrounds
  - Avoid contrast extremes
  - Other issues
- Clothing checklist

Clothing - What's Different?

- Must be more sensitive to detail that can produce compression artifacts (jewelry, glasses, hair)
- Similar in other aspects, though compression exacerbates issues
  - Contrast (no black and white)
  - Increased data rates enable codecs to compress more detail effectively

Poor Clothing Choices

- We still prefer solids



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Poor Clothing Choices

- Avoid blacks and whites (as mentioned)

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Clothing Checklist

- Clothing
  - Solid colors - dark blues, grays or browns
  - Avoid white and light blue (which looks like white on camera)
  - **Advise in advance to contrast with background, and to bring alternatives (or lighter shirt/darker coat)**
- Hair
  - Pulled back (Loose ends get messy after compression)
- Jewelry
  - Some OK, large bling is additional detail and reflective
- Glasses may require special lighting (generally from the side) to avoid glare

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Lighting - Theory, Practice and Application

- What's different between streaming and analog production
- Overview
- Fundamentals
- Decision time - flat lighting or shadows

s/b 9:30

Lighting - What's Different?

- Overall, TV/Movie and streaming are similar, except that:
  - We use cheaper cameras than film (usually)
  - Compression *decreases* overall contrast ratio, so lighting extremes are not well tolerated
  - Bottom line – highly stylized shadowed lighting may not work for streaming

Heirarchy of Lighting Concerns

- Lighting is the single most important determinant of video quality
  - Low lighting causes gain (noise) in the video, complicating compression
- Hierarchy of considerations
  - Ensure lighting is adequate to produce clear, easily compressible image
  - Then worry about style and mood

Fundamentals

- Color temperatures
- Hard vs. soft lighting
- Lighting styles
  - Three-point
  - Flat

Color Temperatures

WB to sunlight | WB to incandescent

- What's the problem?
- Key points:
  - All lights have different color temperature (sun/incand/fluor)
  - Don't mix

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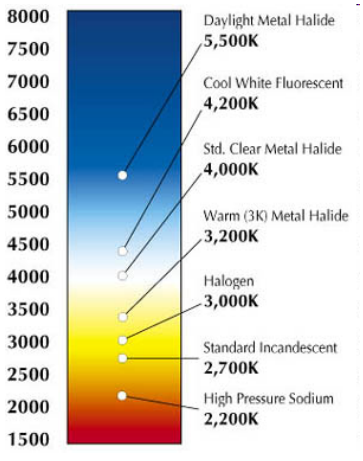
Common Color Temperatures



http://www.patmullins.com/img/colortempchartorig.jpg

- Big no-nos
  - Outdoor lighting with any indoor light
  - Fluorescent with any incandescent
- What to do?
  - Disable one light source (e.g. close shades, turn off lights)
  - Match existing lighting
  - Change color temperatures with gels

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Hard vs. Soft Lighting

- Hard lighting
  - Uses incandescent and halogen bulbs
  - Creates shadows and enhances detail
- Soft lighting
  - Minimizes shadows and detail - est for streaming
  - Diffused hard lights
    - Softbox/reflecter
  - Fluorescent and Compact fluorescent lights

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Know Your Lighting Styles

- Three-point
  - Useful for setting mood
  - Hard to set up
  - Heavy shadows tough to compress
- Flat
  - Visually neutral (e.g. boring)
  - Easy to set up
  - Easy to compress

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Flat or 3-Point - A Quick Survey

Category	Flat	3-Point
News	12	0
Corporate informational	6	5
Corporate case study	11	7

- News - takes the easy way out
- Others - can go either way, though trend is towards 3-point

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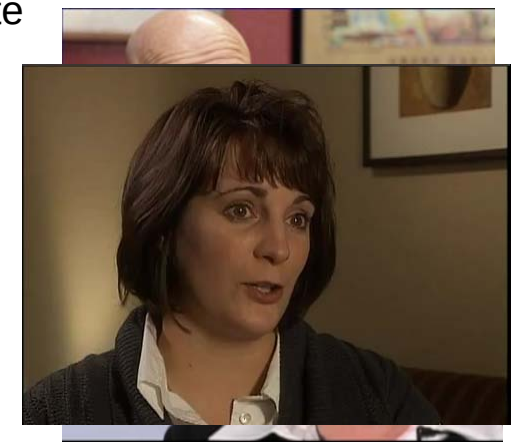
Using Flat Lighting

- Flat can still be quite distinctive
- But there are some risks
  - Overexposed and pasty (no contrast)
  - Reflections, if lights behind the camera
  - Too dark



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Using Three Point Lighting

- Match lighting to mood
  - Subtle modeling
    - Product videos
    - Informational videos
  - Setting dramatic tone
    - Case studies
- Watch for:
  - Gloomy
  - Under-lighted

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3-Point Rules

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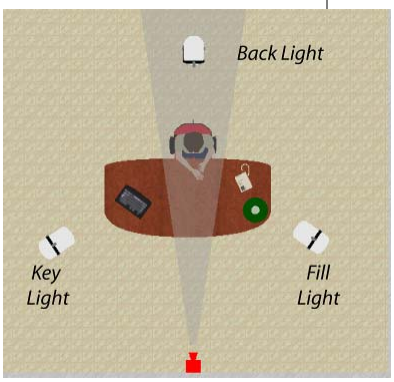
Setting up 3-Point Lighting

- Key-major light source
  - Strongest light
  - 45°angle from camera, pointing down at 20-45°
- Fill-moderates shadows
  - 50% power of key light
  - 45° angle from camera, pointing down at 20-45°
- Back light (or rim) creates contrast with background
  - "hard" light
  - Shining down from back on head and shoulders



Producing Flat Lighting

- Two approaches
  - Dual Key
  - Single Key
- Both use back light

Flat Lighting - Dual Key

- Two keys and a back light
  - Typically, 2 ***soft*** lights
  - 45° angle from camera, pointing down at 45°
- Back light-create contrast
  - Shining down from back on head and shoulders

- Setup issues:
  - No shadows on face
  - Minimize chin/nose shadows
  - Watch location of back shadows
  - Typical back light issues

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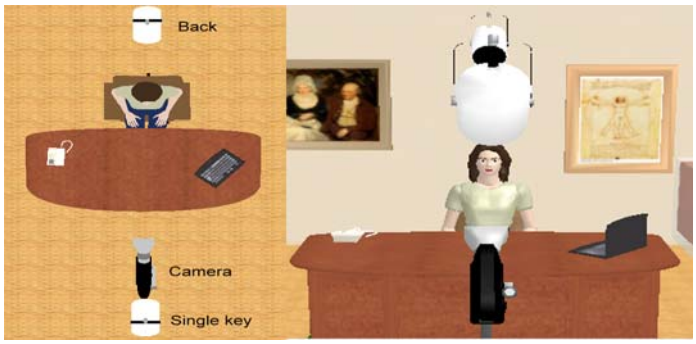
Flat Lighting - Single Key



- Single key above the camera
  - Typically, a ***soft*** light
  - As low as talent can stand it (to minimize chin/nose shadows)
- Back light-create contrast
  - Shining down from back on head and shoulders

- Key setup issues:
  - No hotspots on face
  - Watch chin and nose shadows
  - Watch back shadows
  - Typical back light issues

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The Net/Net on Lighting

- No one ever got fired for using flat lighting
  - Easier to setup and compress, but can be boring
- 3-Point Variations
  - Subtle - to create modeling
  - Dramatic - to create mood
    - Good for case studies and interviews
    - Questionable for fact oriented business video
    - Best when lighting matches environment
    - Watch contrast ratio issues

Lighting Resources

- Setting up three point lighting
  - http://www.streaminglearningcenter.com/articles/lighting-for-streaming-tutorials-released.html
  - http://en.wikipedia.org/wiki/Three-point_lighting
  - http://www.3drender.com/light/3point.html
  - http://www.5min.com/Video/Video-Lighting-Tutorial--Three-Point-Lighting-164812181
- Setting up flat lighting
  - http://www.streaminglearningcenter.com/articles/lighting-for-streaming-tutorials-released.html
  - http://www.streaminglearningcenter.com/articles/setting-up-flat-and-three-point-lighting.html

Shooting for Streaming

- Basics
- Progressive vs interlaced source
- Getting proper exposure
- Blurring the background

s/b 10:00

Basics

- At identical encoding parameters, which source video compresses to better quality – low motion or high motion
  - Low motion
- Why? Interframe compression, which relies upon interframe redundancies

What's this Mean?

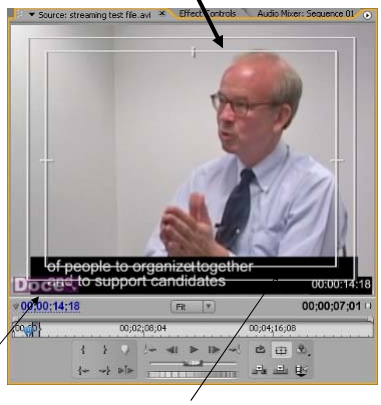
- Motion is the enemy of interframe compression
  - The more motion, the less redundancy
  - At lower bitrates, you have to eliminate extraneous motion in shooting, content and editing
- Overall, though, with better codecs (H.264) and higher bitrates, no longer need totally locked down videos to look good post compression
  - Shooting for streaming is getting inexorably closer to shooting for TV, DVD or film

Eliminating Extraneous Motion

- Camera - shooting techniques – for low bit rate distribution
  - Use a tripod
  - Minimize panning and zooming
    - Shoot in HD - cut from medium shot to close-up
    - Use multiple cameras
- Limit on-screen motion
  - Talent – consider sitting, and advise against excessive motion (better to frame wide than follow around)
  - Background – limit motion
- Editing
  - No goofy 3D effects
  - Dissolves/cross fades should be very fast, .25 - .5/sec.

Framing - No Safe Zone

- Safe zone
  - Outer 10-15% eliminated as overscan
  - All pixels show in streaming
- So:
  - Can zoom in a bit tighter b/c more room for other content



Should I Shoot Progressive

- Progressive vs. Interlaced
- The tests
  - Low detail/low motion
  - Low detail/high motion
  - High detail/variable motion
- Conclusion

Progressive vs. Interlaced

- Many SD cameras capture interlaced video
  - 60 fields per second, not 30 frames
  - Fields are captured 1/60th of a second apart
- All streaming class codecs are frame based
- Converting from fields to frames can cause a stair step or Venetian blind artifacts which deinterlacing can resolve
- Progressive cameras shoot 30 fps and divide into fields if necessary for NTSC viewing
  - Fields match up perfectly for streaming production

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Overview - Theory

- Traditional camcorders are interlaced (shoot in fields, 1/60 of a second apart)
- Streaming media is FRAME based

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Overview - Theory

- Shooting in progressive mode eliminates that problem and is vastly superior to interlaced
- But!
  - Most editors/ encoding programs have deinterlacing filters that take you from here:
  - To here.

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Overview - Theory

The moral of the story: Deinterlacing never delivers the same quality as a progressive frame

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Overview - In Practice

Little Miss Sunshine Trailer

Wal-Mart online video

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The Big Questions

- Does a progressive camcorder deliver better quality than interlaced?
  - If so, how much?
  - If so, when does it matter most?
- Implications:
  - If you're buying new, should you buy a progressive unit?
  - If your camcorder is interlaced, should you buy a new one for streaming?
  - If your camcorder has progressive and interlaced, which mode should you use?

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Test Description

- Shoot same scenes with two cameras simultaneously
  - One progressive - Canon XH A1
  - One interlaced - Sony HDR-FX1
- Scenes
  - High speed sports
  - Low contrast talking head
  - Real world (uncontrolled) shoot

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Conclusions - Sports

- Even at relatively slow shutter speeds (like 60)
- If you have sharp edges, you have a problem

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Conclusion - Talking Head

- In those instances where:
  - Minimum sharp detail
  - Relatively slow shutter (like 60)
- Not much distinguishable difference

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Conclusion - Talking Head

- Even when there's moderation motion, no major difference unless lots of detail in the frame

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Conclusion - Real World

- If you can't control the detail in the scene, go progressive
  - Swords - :47
  - Background - 1:07

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Conclusions

- Progressive delivers noticeably better quality in all but the most controlled shoots
- Especially with
  - Sharp edges
- So:
  - If you're buying for streaming, buy progressive
  - If you have progressive, use it
  - If your camcorder doesn't have progressive, and you shoot lots for streaming under uncontrolled circumstances, consider new camcorder

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Assessing Exposure at the Shoot

- Rule #1: Some sets (with too much contrast) are challenging to light - get the set right first
- Rule #2: Zebra stripes are your best friend
- Rule #3: Scopes are your other best friend
- Rule #4: When in doubt, check auto
- Rule #5: It's better to be underexposed than overexposed

Controlling Exposure via Zebra Stripes

- IRE values and the waveform monitor
- Zebra stripes
  - What they are
  - How to set them
  - Optimum values/usage strategies

IRE Values and the Waveform

- Waveform shows brightness on IRE scale (0-100)
- Matches horizontal location in frame

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Zebra Stripes Show IRE Values on the Camera

- Face should be exposed between 70-80 IRE
- With zebras set to 75, you want the hot spots on face bathed in zebras
- Adjust:
  - Iris/shutter/lighting/gain until zebras appear where you want them

http://www.thedvshow.com/faq-pro/?action=article&cat_id=002&id=2&lang=

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More on Zebras

- Generally configurable
  - Either 70/100 (VX2000)
  - Totally configurable in menu
- Common settings
  - 100 - pure white
  - 95 - white with a safe zone
  - 70-80 - face

Waveform Values to Care About

- Blacks should be 0
  - Otherwise look faded
- Whites should be no higher than 100
  - Otherwise detail gets lost
- Faces should be in the 70-80 range

Zebra Strategies

- When faces aren't prominent, set zebras to 95+
- Zebras alert you're exceeding 100
- Small regions of zebras are OK, too much translates to lost detail

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What's so great about OnLocation?

- Two levels of Zebras (check faces and whites)
- Waveform monitor

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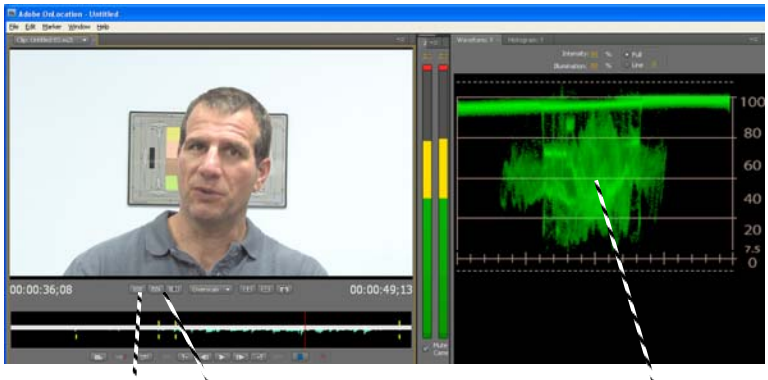
Adobe OnLocation



Zebra 1 zebra 2

waveform monitor

Working with OnLocation

- Get camera connected
- Get zebras/waveform configured
  - IRE isn't default waveform setting
- Adjust camera controls until
  - Face in 70-75 range
  - Whites aren't too high
  - Blacks are at or close to zero

When in Doubt, Check Auto

- Shoot using manual controls over gain, shutter speed and iris for reasons discussed
- Once you've reached optimal settings
  - Switch into automatic mode
  - Investigate significant differences
- Caution
  - Auto lights the entire frame, you care primarily about the face

Blurring the Background

- Why so popular?
- How to produce

Why so Popular

- Looks cool
- Focuses attention
- Makes back ground easier to compress

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Soft Background - with Camcorder

- The larger the CCD, the easier this is to do
  - Not all camcorders can do this in all situations
  - Easiest when background is far away
- Need widest aperture setting (lowest f-stop)
  - Control exposure manually
  - Control lighting with ND filters, higher shutter speed or by moving light further from the subject

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Soft Background - with Camcorder

Procedure

1. Subject max distance from background
2. Camera max distance from subject
3. Use zoom for framing
4. Open aperture to max setting (lowest f-stop)

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Blur Background - in Close

- Need very expensive camera, or
- DSLR, or
- 35 mm adapter

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Editing/Pre-processing

- Choosing your targets
- Producing the correct output resolution and aspect ratio
- Deinterlacing

s/b 10:40

What Output Parameters Should I Use?

- Codec
- Resolution
- Frame rate
- Audio bit rate

About the Survey

- Targets
  - Informal survey of 60+ web sites
  - Two categories, media and corporate
- Files chosen
  - Media – video from multiple areas, both preview and episode replay
  - Corporate – Top 20 B2C brands plus high-profile B2B

About the Survey

- Media (partial)
  - ABC, CBS, Fox, CNN, ESPN, The Golf Channel, WSJ, NY Times, E-Online, Accuweather, Forbes, MSNBC
- Corporate (partial)
  - Deloitte, Cisco, Accenture, E&Y, GE, Intel, McDonalds, Nike, Nokia, Apple
  - Converse, Coke, Red Bull, Zara, Disney, Victoria's Secret, Nike Football, Chevron

Codec Selection

	Total	H.264	VP6	Spark	Other
Media	25	18	7		
B2B	19	13	4	1	1
B2C	16	11	4		1
Total	**60**	**42**	**15**	**1**	**2**
Percent	100%	70%	25%	2%	3%

- Why move to H.264?
  - It's free for most uses, including free internet distribution
  - It can play on iDevices
  - It's accelerated in Flash Player 10.1
  - It's higher quality than VP6

Analysis

- Broadcast channels almost all Flash
  - Some Silverlight for live events (Olympics, etc)
  - Continuation of a very long term trend
  - No HTML5 usage to date in high profile sites
- Apple is the only site using QuickTime
- Microsoft xBox site is only site using VC-1

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

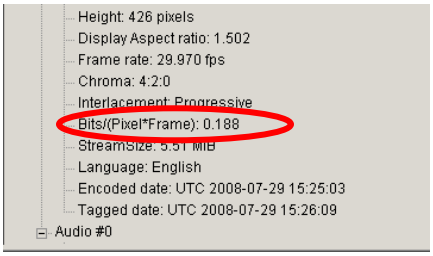
B2B	Width	Height	Total Pixels	Data Rate	FPS	Audio Data Rate	Bits per Pixel
Conservative (11)	573	320	186,432	764	28	112	0.166
Midrange (3)	814	455	372,320	1,875	27	128	0.194
Aggressive (5)	1,210	680	831,859	1,325	25	120	0.063

Bits Per Pixel

- In general
  - Broadcast sites have it right:
    - .18 - 2.0 for high motion (ESPN @ ~ .2)
    - .12 for low motion (CNN @ .12
    - Decrease as video gets larger
      - ABC Episode replay - 768x432@614 kbps (.077)

Bits Per Pixel

- To calculate:
  - Data rate/(fps*pixels)
- Or, get MediaInfo
  - Calculates for you, plus lots of other file details
- Free, Mac/Windows utility
  - Installed on every one of my computers



mediainfo.sourceforge.net/en

Bottom Line

- You should know the bits/pixel for each video that you produce
  - If too low – quality suffers
  - If too high, may not stream smoothly and bandwidth costs (if a factor) may be unnecessarily high

Summary

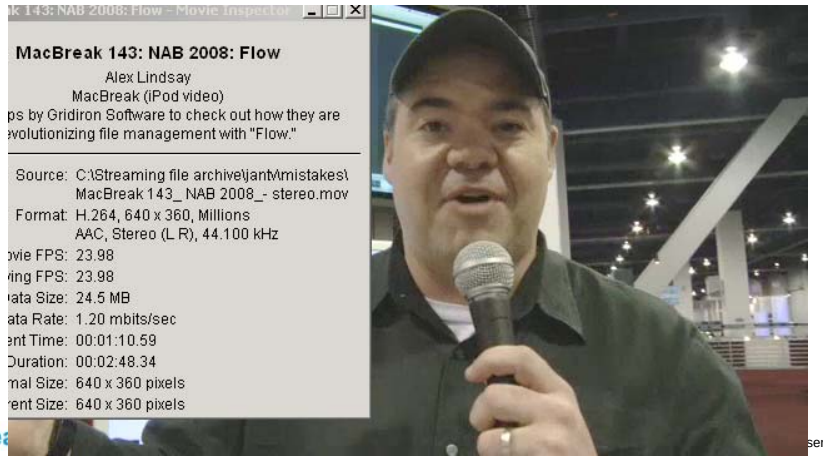
- Compare your media size/data rate to the various groups
- If in the conservative range, identify why
  - Design considerations?
  - Just haven't focused on it lately?
- Clearly, you no longer have to stream at 300 kbps to reach your target and play smoothly
  - Unless bandwidth costs are a factor, consider an upgrade

What Frame Rate?

- 57/60 either 24, 25 or 30
  - Golf Channel: 15 fps
  - McKinsey & Co 15 fps
  - Oreo: 17 fps (?)
- For single file streaming, use full frame rate
- For lowest bitrates in adaptive streaming range, drop frame rate to meet data rate targets

How Much Audio

- What's wrong with this picture?



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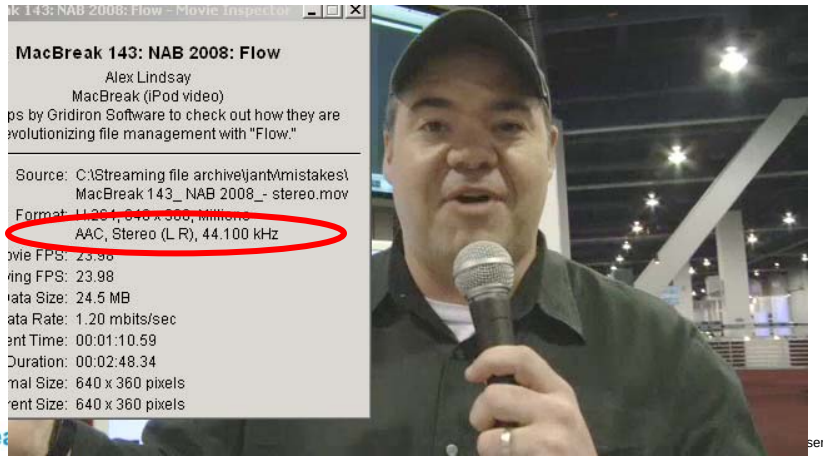

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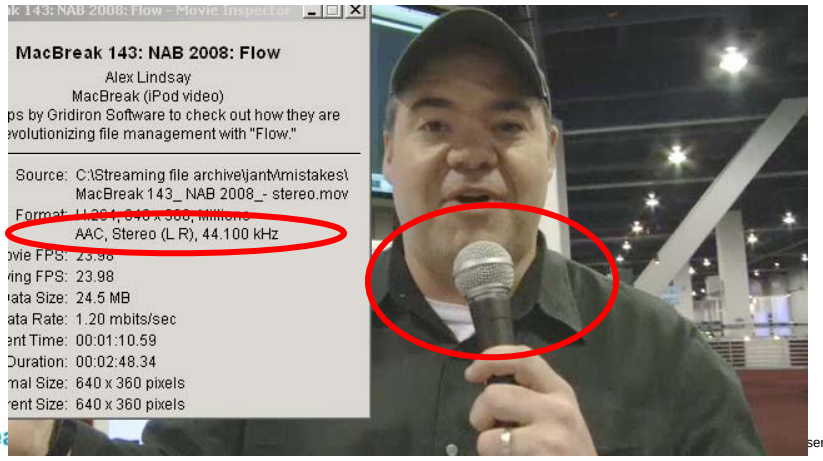

How Much Audio?

- That logic aside, most sites use stereo:
  - 10 of 25 in media use mono
  - 3 of 35 in corporate use mono
- Pop quiz: What happens when you use mono audio?
  - A: Only hear out of one ear
  - B: Same signal sent to both ears

Bottom Line

- With mono source audio:
  - 64 kbps mono provides ***exactly*** the same quality as 128 kbps stereo (at half the data rate)
  - That extra 64 kbps is better allocated to video quality
- Prime-time TV shows and other highly produced shows contain stereo cues in the audio (gunshot from the left)
  - Use stereo for these

How Do I Produce the Right Aspect Ratio?

- What's wrong with this picture?
- Producing aspect ratio correct video (the short answer)
- Explanation (bonus)

s/b 10:50

Hosing the Aspect Ratio

Video grab - 5/2010 (now, finally, fixed)

Picture on web site

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Hosing the Aspect Ratio - CNN

Tiger on CNN

Tiger on ESPN

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Hosing the Aspect Ratio - PWC

Price Waterhouse Coopers Website

Publicity digital photo

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Hosing the Aspect Ratio - Travel Channel

Fixing the Problem

- Recognize there's a problem
  - Just because you shoot in widescreen doesn't mean that the video should look stretched when streaming
  - Video frames should look like a digital picture

SD Source - You have to Change the Aspect Ratio

- Display aspect ratio of SD video is different from computer
  - e.g. – 4:3 SD video has a display aspect ratio of .9, so it's squeezed when displayed on a TV Set
  - That's why we use 640x480 rather than the native 720x480 on a computer

SD Source - You have to Change the Aspect Ratio

DV Frame Same Frame on TV

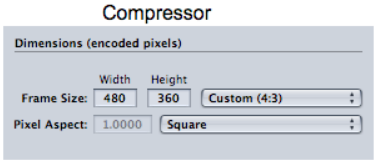
- If you don't change the display aspect ratio, the video will look distorted

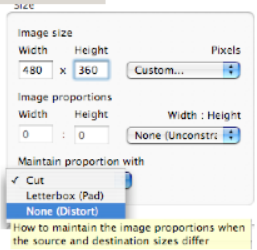
Getting it Right (4:3 DV Input)

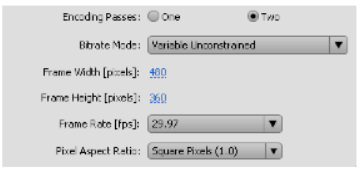
Squeeze

Squeeze

Compressor

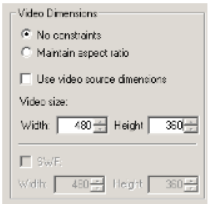






Adobe Media Encoder

Flix Pro



Episode

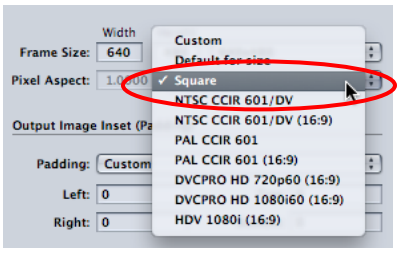
Doceo Publishing, Inc.

How Do I Get it Right?

- Always output Square Pixel (1:1)
  - Irrespective of input PAR
- When square not available, “distort”
  - You want to change aspect ratio from analog to square
  - Never choose “maintain aspect ratio” unless encoding from square pixel source
- Easiest (but not essential) when output resolution matches display aspect ratio
  - 4:3 - 640x480, 480x360, 400x300, 320x240
  - 16:9 - 640x360, 480x270, 320x180

HD Source - You *Don’t* Have to Change Aspect Ratio

- All HD videos have a 1:1 display aspect ratio
  - Should look ***the same*** on computer and TV
- You get into trouble when you try to match pixel aspect ratio with HD source
  - Always square



What is deinterlacing?

- About deinterlacing
- Why it's important

s/b 11:00

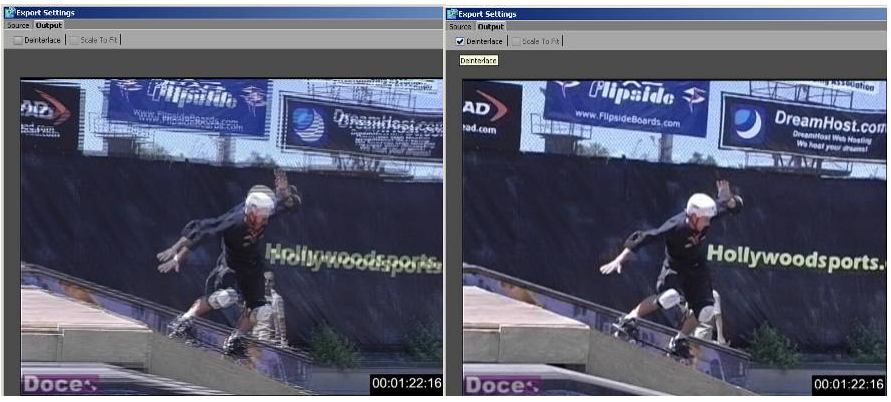
Streaming Learning Center

What is Deinterlacing (Take 2)?

- Most SD cameras capture interlaced video
  - 60 fields per second, not 30 frames
  - Fields are captured 1/60th of a second apart
- All streaming codecs are frame based
- Converting from fields to frames can cause a stair step or Venetian blind artifacts which deinterlacing can resolve

Streaming Learning Center

Deinterlacing – Why it's Important



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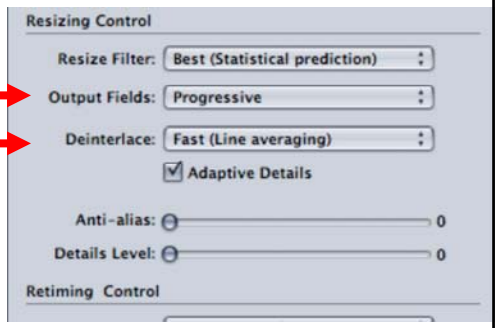
Deinterlacing - Rules of the Game

- Always deinterlace when producing with interlaced input
- Editors have different controls, but you may need to :
  - Select deinterlacing (and technique), AND
  - Output a progressive file



Apple Compressor

Streaming Learning Center

Deinterlacing - Rules of the Game

- Deinterlacing artifacts are easy to spot; once seen and recognized, you can resolve
- Obviously, don't de-interlace when working with progressive input

Encoding

- Terms and techniques
- Working with H.264
- Working with VP6
- Working with Windows Media Video

s/b 11:10

Terms and Techniques

- Bitrate control
  - Constant and variable bit rate encoding

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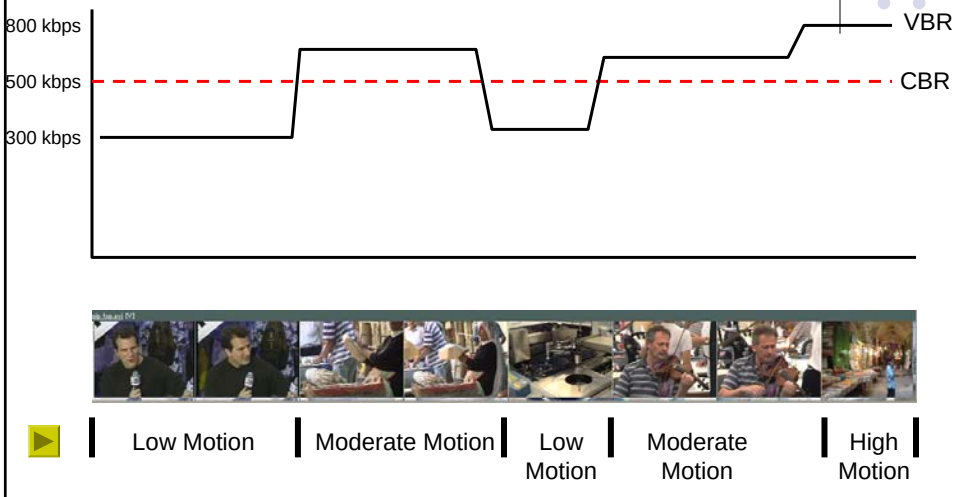
Constant vs Variable Bit Rate



Streaming Learning Center

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

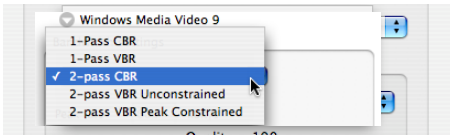
Streaming Learning Center

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 signficant variability

Streaming Learning Center

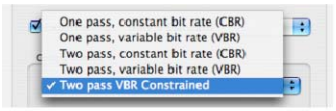
How do I Produce the Best Quality CBR?

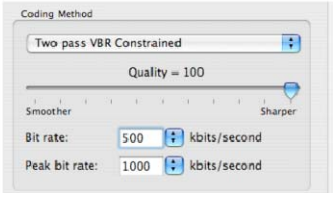


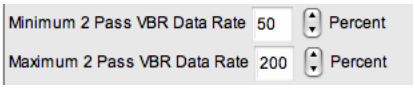
- Use 2-pass CBR when available
  - Scans file (like VBR), but packs data into a consistent stream
  - Best of both worlds when available
- 1-pass of live or draft work

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







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

Codec Specific Controls

- H.264
- Flash
- Windows Media

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)

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

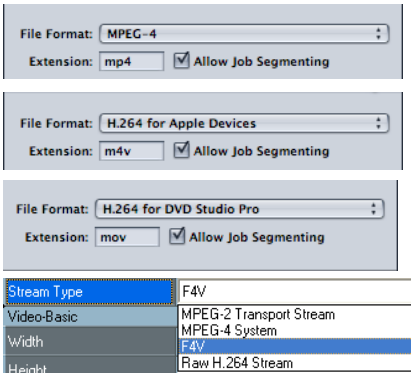
- Adapted by ISO and ITU
  - Telephony/cellular
  - TV - consumer electronics
  - Computer electronics
- Only codec adopted by top three streaming providers (Apple, Adobe, Microsoft)

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

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



H.264 Encoding - Basics

- Profiles and Levels
- Entropy encoding
- I and B-frame settings

Profiles and Levels

- Profiles and levels
  - Define sets of encoding techniques to be used in a bitstream
  - Lets hardware producers support H.264 on low power devices
  - Three profiles for computers and devices:
    - High - best quality, hardest to play back
    - Main - very good quality, easier to play back
    - Baseline - lowest quality, easiest to play back

Profiles and Levels

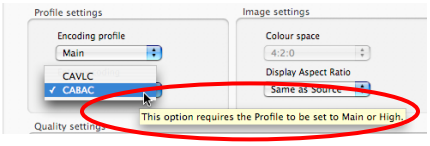
- General Rule - use highest supported profile and level on target
  - Use High profile for computer playback; use level that matches target output parameters
  - For devices, use device limit for profile and level

Encoding for iDevices

	Original iPod (to-5g)	iPod nano/ classic	iPod touch/ iPhone	iPhone 4 /iPod touch 4	iPad 1	iPhone 4S	iPad 2
Device spec							
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
Codec spec							
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

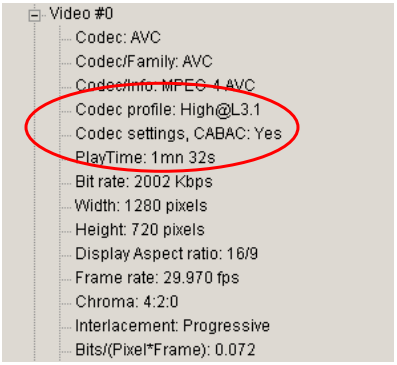
Entropy Encoding



- Two options:
  - 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
- General rule:
  - Use CABAC when available (Main, High profiles)

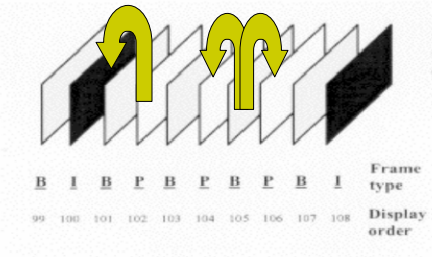
What Would YouTube Do?

- High Profile
- CABAC



What are I, B and P Frames?

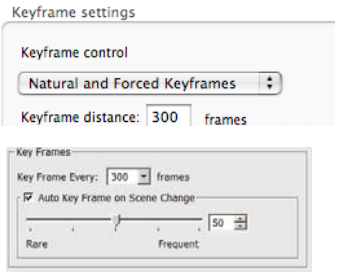
- I-Frame - encoded without reference to other frames (also called Key Frames)
- P - looks backward to I and P frames (predictive)



- B - looks forward and backward to previous I and P frames (Bi-directional interpolated)
  - No frames refer to B-Frame (most of the time)

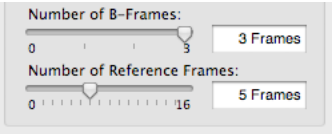
What do I Need to Know About Key Frames?

- Enable 1 key frame every ten seconds or so
  - Helps playback interactivity
- Enable key frames on scene changes
  - Optimizes quality



What do I Need to Know About B Frames?

- Use B-frames when available
  - Main and High profiles
- Use an Interval of 3 (number of B frames between I and P-Frames; (IBBBPBBBPBBBPBBBP)
- Reference frames (both P and B-frames)
  - Number of frames searched for redundancies
  - Use 5



H.264 Reference Configurations

	Width	Height	Codec	Data Rate	Bits per Pixel	Profile	CABAC
Media							
CNN - video library	640	360	H.264	671	0.097	Main	Yes
ABC - Castle	768	432	H.264	614	0.077	Main	Yes
NFL.com	768	432	H.264	465	0.047	High	Yes
Corporate							
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

Producing H.264 - Other Sessions I'm teaching

- Tuesday
  - 10:30 am - 11:15 am - How-To: Encoding for Adaptive Streaming
  - 11:30 am - 12:30 pm - How-To: Encoding Video for HTML5 (HTML5 summit)
  - 2:45 pm - 3:30 pm - How-To: Encoding Video for iDevices (HTML5 summit)

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 VP6

- File formats
- Codec options

Overview – the FLV

- FLV – Flash video file
  - VP6/Spark video codec
    - Can also be H.264, but moving towards F4V extension
  - MP3 audio
- Not accelerated by GPU in Flash Player 10.1
  - Will require substantially more CPU horsepower to decode on supported hardware

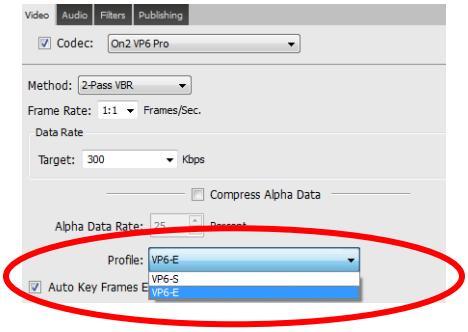
Which Codec?

- Sorenson Spark or On2 VP6?

- Always use On2 VP6
  - Much better quality
  - Universal compatibility

VP6-E and VP6-S

- What's the quality difference?
- What's the difference in playback?



VP6-E and VP6-S

- Quality difference is real, but not substantial
- Playback difference on some computers can be significant
  - Use VP6-S for HD video > 640x480
  - Use VP6-E for SD video
- If your encoder doesn't offer both options, it's VP6-E

VP6 Reference Configurations

	Width	Height	Codec	Data Rate	Bits per Pixel
Media					
Wall Street Journal	512	288	VP6	452	0.128
MSNBC News	596	336	VP6	434	0.072
NY Times - in library	600	338	VP6	725	0.149
Corporate					
PWC	480	270	VP6	400	0.103
National Cancer Institute	480	270	VP6	400	0.103
Dr. Pepper	612	344	VP6	2500	0.495
BP	768	432	VP6	704	0.085

What Do I Need to Know About Windows Media?

- What's VC-1 and how does it relate to WMV9?
- What are the relevant Windows Media profiles (and do I care)?

What's VC1 and How Does it Relate to WMV9?

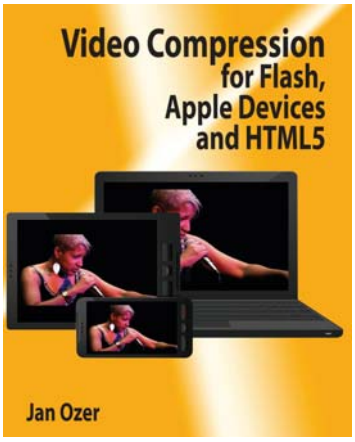
- From the mouth of Ben Waggoner, MSFT
  - "VC-1 is SMPTE's version of WMV 9. Windows Media Video 9 is Microsoft's brand for our VC-1 implementation."
  - "Basically, just think of "WMV 9" and "VC-1" in a WMV file as synonymous."

What are the Windows Media Profiles?

- Now two profiles
  - Main - backwards compatible, no codec update required
  - Advanced Profile
    - Supports interlaced video (for Blu-ray)
    - No real quality difference, not compatible with older WMV players (I use Main)

Questions?

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



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