

# Understanding Video Compression

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**Adobe, Apple, Avid**

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JGreenberg Consulting

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Animation  
Apple Intermediate Codec  
Apple Pixlet Video  
Apple ProRes 422  
Apple ProRes 422 (HQ)  
Apple VC H.263  
Avid 1:1x  
Avid DNxHD Codec  
Avid DV  
Avid DV100 Codec  
Avid Meridien Compressed  
Avid Meridien Uncompressed  
Avid MPEG2 50 mbit  
Avid Packed Codec  
DV - PAL  
✓ DV/DVCPRO - NTSC  
DVCPRO - PAL  
DVCPRO HD 1080i50  
DVCPRO HD 1080i60  
DVCPRO HD 1080p25  
DVCPRO HD 1080p30  
DVCPRO HD 720p50  
DVCPRO HD 720p60  
DVCPRO50 - NTSC  
DVCPRO50 - PAL  
H.264  
HDV 1080i50  
HDV 1080i60  
HDV 1080p24  
HDV 1080p25  
HDV 1080p30  
HDV 720p24  
HDV 720p25  
HDV 720p30  
HDV 720p50  
HDV 720p60

JPEG 2000  
MPEG IMX 525/60 (30 Mb/s)  
MPEG IMX 525/60 (40 Mb/s)  
MPEG IMX 525/60 (50 Mb/s)  
MPEG IMX 625/50 (30 Mb/s)  
MPEG IMX 625/50 (40 Mb/s)  
MPEG IMX 625/50 (50 Mb/s)  
MPEG-4 Video  
None  
Photo - JPEG  
PNG  
REDCODE  
Uncompressed 10-bit 4:2:2  
Uncompressed 8-bit 4:2:2  
XDCAM EX 1080i50 (35 Mb/s VBR)  
XDCAM EX 1080i60 (35 Mb/s VBR)  
XDCAM EX 1080p24 (35 Mb/s VBR)  
XDCAM EX 1080p25 (35 Mb/s VBR)  
XDCAM EX 1080p30 (35 Mb/s VBR)  
XDCAM EX 720p24 (35 Mb/s VBR)  
XDCAM EX 720p25 (35 Mb/s VBR)  
XDCAM EX 720p30 (35 Mb/s VBR)  
XDCAM EX 720p50 (35 Mb/s VBR)  
XDCAM EX 720p60 (35 Mb/s VBR)  
XDCAM HD 1080i50 (35 Mb/s VBR)  
XDCAM HD 1080i60 (35 Mb/s VBR)  
XDCAM HD 1080p24 (35 Mb/s VBR)  
XDCAM HD 1080p25 (35 Mb/s VBR)  
XDCAM HD 1080p30 (35 Mb/s VBR)  
XDCAM HD422 1080i50 (50 Mb/s)  
XDCAM HD422 1080i60 (50 Mb/s)  
XDCAM HD422 1080p24 (50 Mb/s)  
XDCAM HD422 1080p25 (50 Mb/s)  
XDCAM HD422 1080p30 (50 Mb/s)  
XDCAM HD422 720p50 (50 Mb/s)  
XDCAM HD422 720p60 (50 Mb/s)



New Play

View Cudirs Themes Masters

Text Box Shapes Table Charts Comment

Share

Mask Alpha Group Ungroup Front Forward Backward Back

Inspector Media Colors Fonts

Understanding Video Compression

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117 THANK YOU!

# Housekeeping

- **Ask anything you want!**
- **URL of Notes @ JGreenbergConsulting.com**
- **my email @ Jeff @ J Greenberg Consulting .com**



# Overview

- **Basic Rules**
- **Types of Compression**
- **Data Rates**
- **Codec types**
- **Formats**
- **Preparation**
- **Tools**



**Cool Tip:**  
**Always Watermark your**  
**video - until your client**  
**pays you**



**Getting to know you**



# Survey - Primary Tool

- **Apple Compressor**
- **Sorenson Squeeze**
- **Adobe Media Encoder**
- **Telestream Episode**
- **MPEG Streamclip**
- **FFmpeg**
- **Other?**



# Primary Job

- **Editor**
- **Producer**
- **I do it all**
- **New to the field**
- **I have no idea what I'm doing and I need to do it better**

# Primary Editorial Tool

- **Final Cut 7**
- **Adobe Premiere Pro**
- **Avid Media Composer**
- **Something else?**



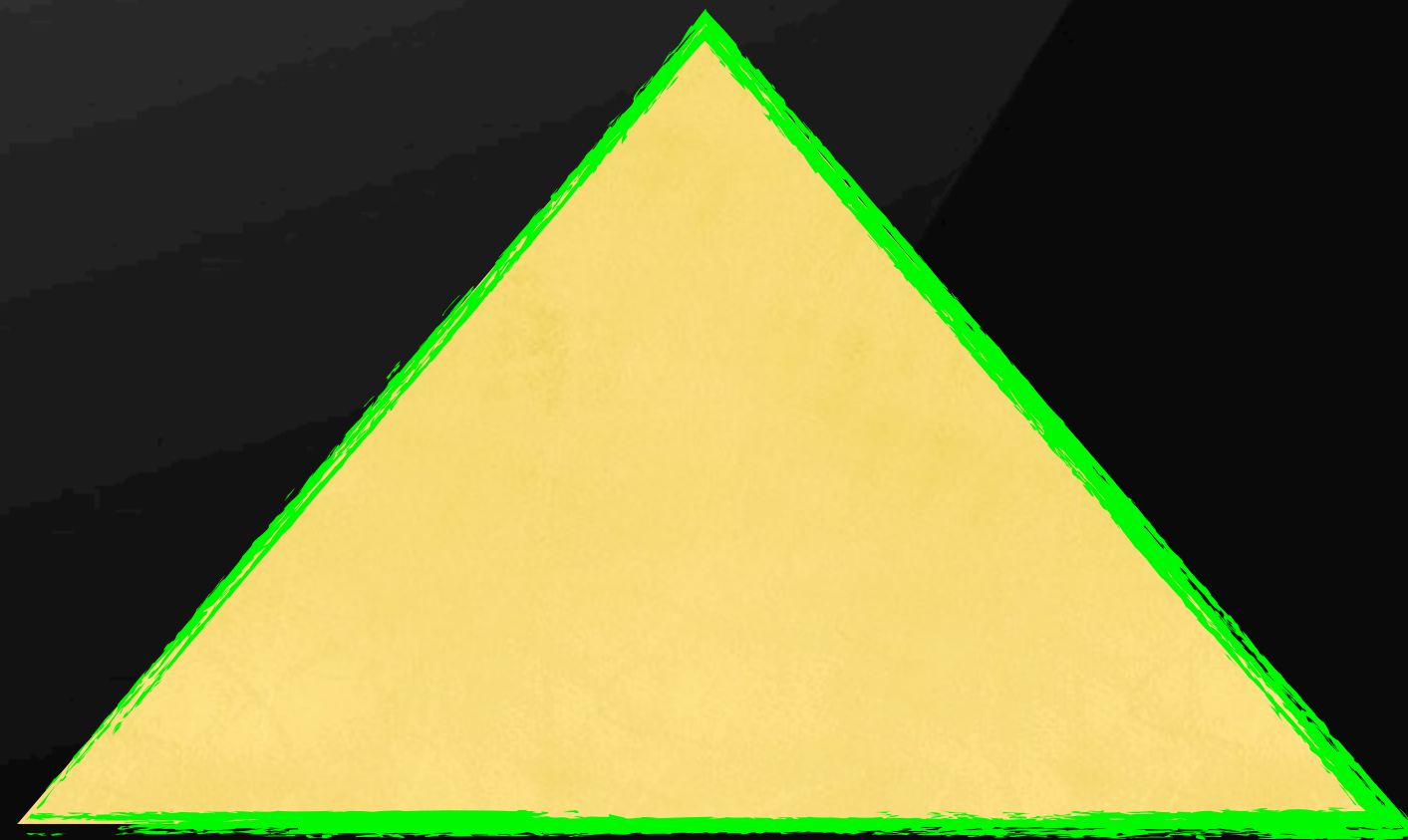
# General Thoughts

# Good, Fast, Cheap: Pick

2

Good

Fast

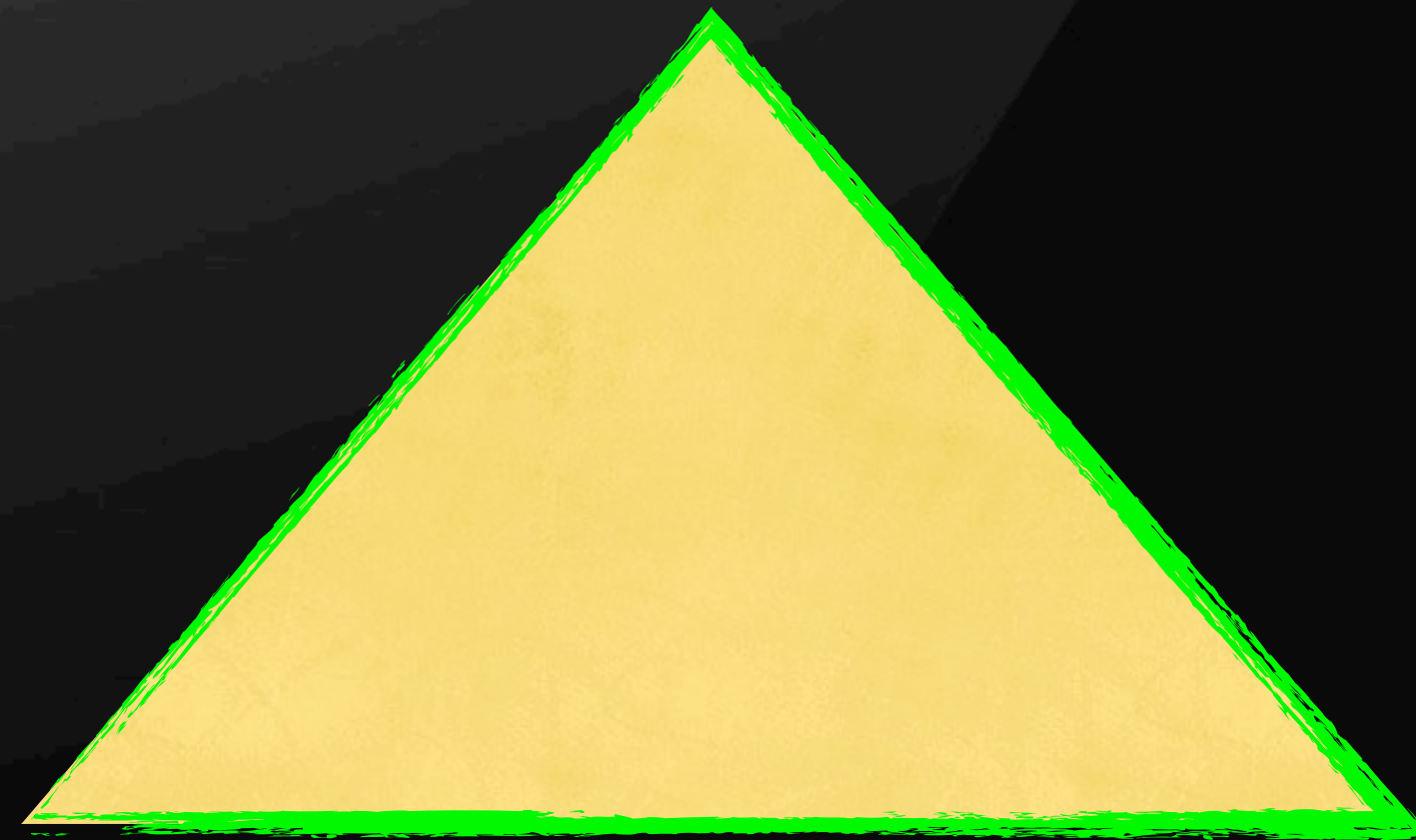


Cheap



# Good fast small Pick 2

Good



Fast

Small

# Pick 2

- **Good & Fast (not small)**
- **Good & Small (not fast)**
- **Small & Fast (not good)**



# TETO

**Finding the 'sweet'  
spot given your  
needs**

**Lots of testing =  
Quality**





# GIGO

**Film**

**Red**

**HD**

**Captured how?**

**Cleanest starting point =  
cleanest ending point**





**Recompression of  
compressed material is  
the 'Great Sin' to avoid**

# Three questions

- **What do I have?**
- **What do I want?**
- **What tools do I have?**

**You're smarter  
than you know**

**Types of compression**



# **What is Zip compression?**

**How is JPEG different  
from zip compression?**

# Lossless vs. Lossy

- **Zip = Lossless**
- **No data missing**
- **Works great on text...not so much on complex graphics**
- **Must be able to recover everything**
- **JPEG = Lossy**
- **Throws out information that your eye just can't see**
- **Once compressed, it can never be recovered**



**You're smarter  
than you know**

**Data Rates**

**How fast is Firewire?**

**How fast is USB 2.0?**



**How fast is your cable  
connection to the  
internet?**

**How fast is 802.11n?**

**miniDV is also known  
as DV\_ \_**



# These are all Data Rates

- **FireWire 400/800**
- **USB 2.0 480**
- **My Cable is 25 down / 5 up**
- **802.11n maximum is 104**
- **miniDV is 25**

# Megabits per second

- **People Glaze over with Megabits per second.**
- **Wires, Drives, Networking, codecs are all described in Mb/sec**

# Think about that

- **If a video's "Number" is bigger than your connection to it it cannot play back in real time**
- **An uncompressed clip can not be played over the Internet for this reason**



# Think about this

- **All video is described as Megabites per second.**
- **It's a marketing term.**
- **More = Better.**
- **Sexier: 56k modem or 7K modem?**

# Megabytes per second

- **Remember video is described in Megabits per second**
- **C'mon, if it were MegaBytes per second, you'd multiply the numbers and know how big a file would be.**
- **Take any # associated with a codec and divide by 8 and you get how many megs per second it will take up.**
- **Multiply that by the number of seconds and you get the size of the file**

# **Understanding Data Rates**



# Understanding Data Rates

- **Measurement of how much data per second the video receives**
- **Larger is generally better**
- **Uh...oh....numbers**

# **Math doesn't have to be scary**

- **Quit apologizing for being 'bad with math'**
- **Go read Innumeracy**
- **John Allen Paulos**

# 4 numbers to understand

1

25

125

880



# 4 numbers to understand

1

480i SD

Uncompressed

**125** Megabits/sec

1 min ~ 1 gig

1 hr ~ 60 gigs

25

880

# 4 numbers to understand

1

Mini DV  
DV25

25 Megabits/Sec

5 min ~ 1 gig

1 hr ~ 12 gig

480i SD  
Uncompressed  
125 Megabits/sec  
1 min ~ 1 gig  
1 hr ~ 60 gigs

880

# 4 numbers to understand

1

Mini DV  
DV25

25 Megabits/Sec

5 min ~ 1 gig

1 hr ~ 12 gig

480i SD

Uncompressed

125 Megabits/sec

1 min ~ 1 gig

1 hr ~ 60 gigs

1080 HD

Uncompressed

**880 Megabits/Sec**

**1 min ~6 gigs**

**1 hr ~ 600 gigs**



# 4 numbers to understand

**Youtube SD**

**640x360**

**1 megbits/sec**

**2 hrs ~ 1 gig**

**1hr ~ 500 megs**

**Mini DV**

**DV25**

**25 Megabits/Sec**

**5 min ~ 1 gig**

**1 hr ~ 12 gig**

**480i SD**

**Uncompressed**

**125 Megabits/sec**

**1 min ~ 1 gig**

**1 hr ~ 60 gigs**

**1080 HD**

**Uncompressed**

**880 Megabits/Sec**

**1 min ~6 gigs**

**1 hr ~ 600 gigs**

# 4 numbers to understand

Youtube SD

640x360

1 megabits/sec

2 hrs ~ 1 gig

1hr ~ 500 megs

Mini DV

720x480

25 Megabits/Sec

5 min ~ 1 gig

1 hr ~ 12 gig

480i SD

Uncompressed

125 Megabits/sec

4 min ~ 1 gig

1 hr ~ 60 gigs

1080 HD

Uncompressed

88.8 Megabits/Sec

4 min ~ 1 gig

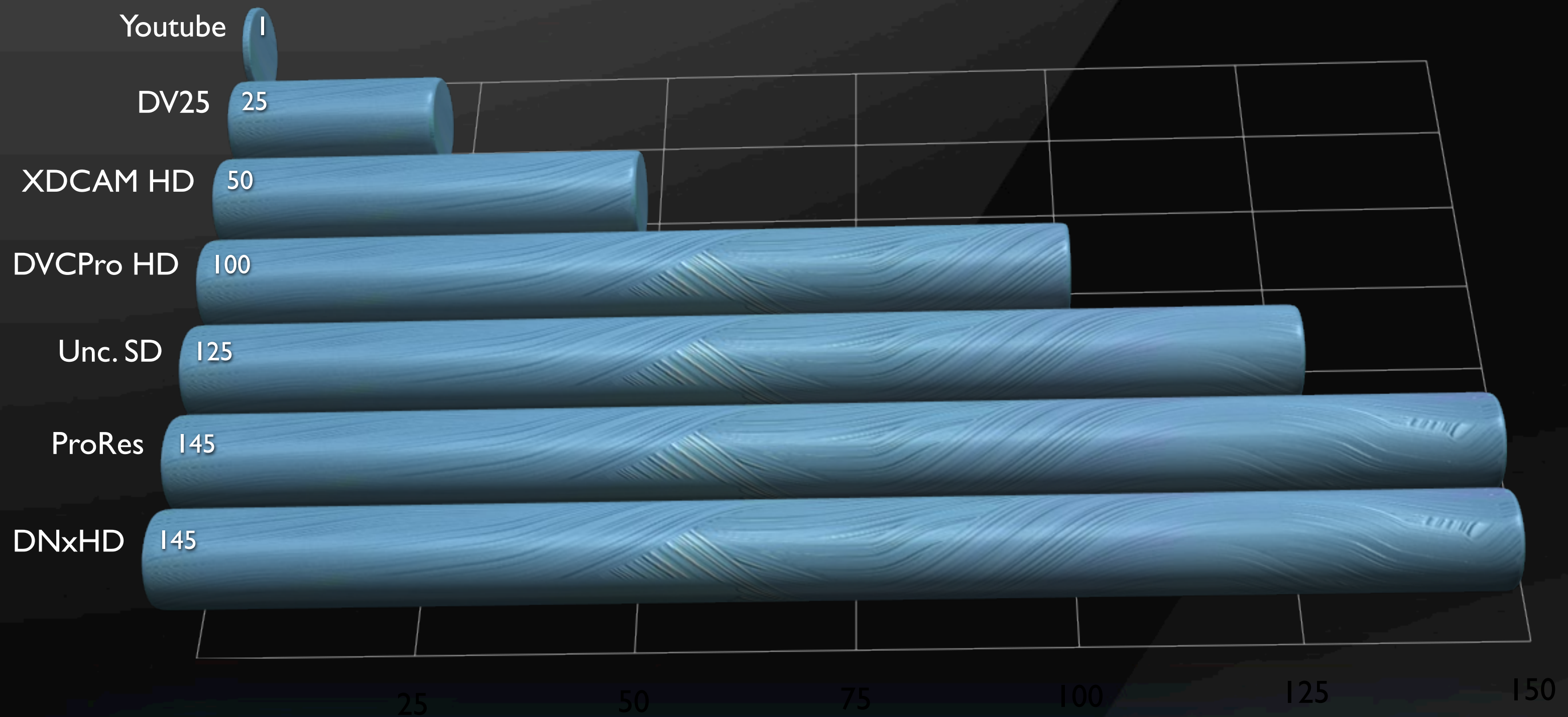
1 hr ~ 600 gigs

**Don't be scared by  
numbers**



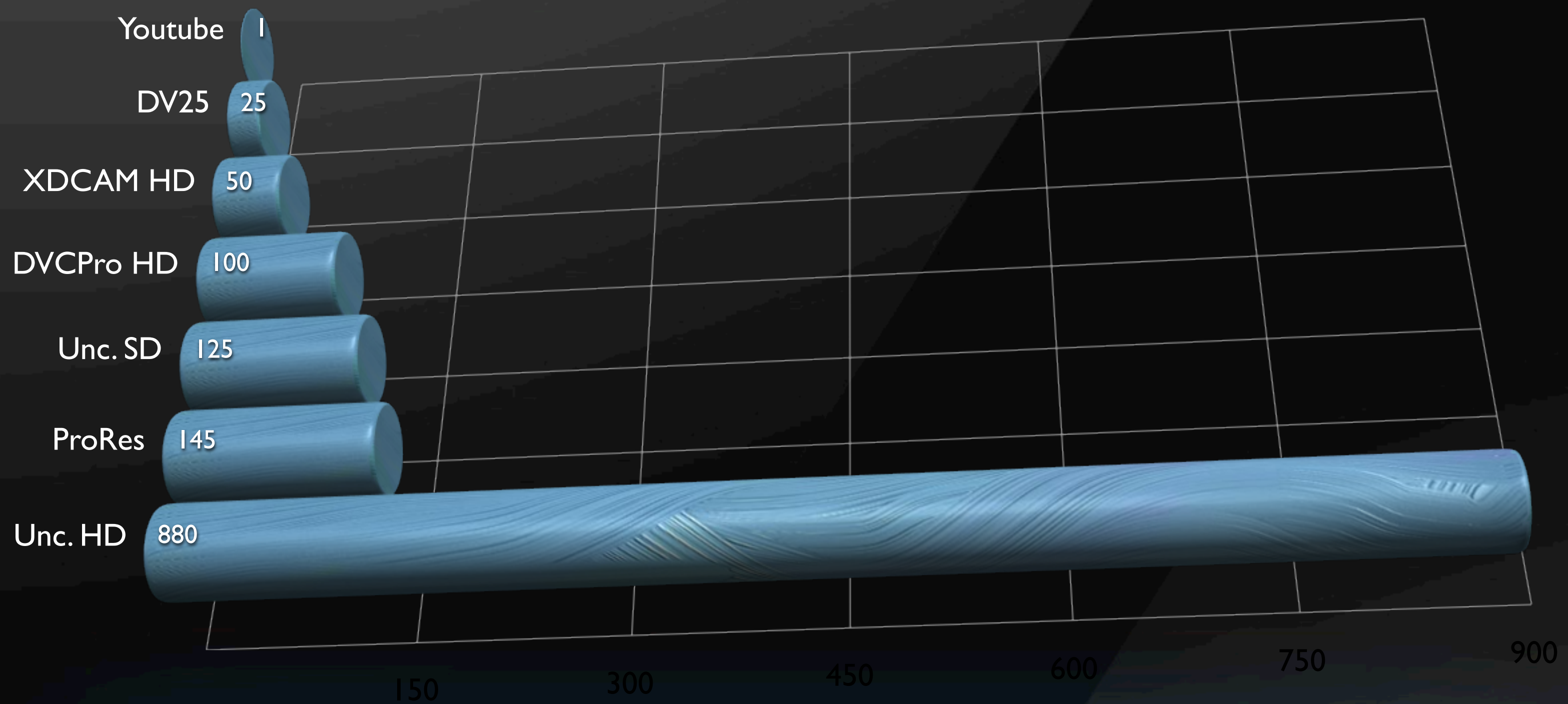
|                |                         |              |
|----------------|-------------------------|--------------|
| dialup         | 0.058 Mb/s              |              |
| youtube        | 0.6                     | 30:1         |
| cable          | 4 Mb/s                  |              |
| p-jpeg offline |                         | 30:1         |
| 15:1s          |                         | 30:1         |
| miniDV         | 25 Mb/s                 | 5:1          |
| HDV            | 25 Mb/s                 | 30:1         |
| Most DSLRs     | 17/45 Mb/s              |              |
| XDCam HD       | 25/35/50                |              |
| DVCPro 50      | 50 Mb/s                 | 2.5:1        |
| 802.11g        | 54 Mb/s                 |              |
| Ethernet       | 100 Mb/s                |              |
| AVC Intraframe | 100 Mb/s                |              |
| DVCPro HD      | 100 Mb/s                | 6:1          |
| UNC SD         | 125 Mb/s                | 1:1          |
| ProRes         | 35/100/145/220/330 Mb/s | 4:1 or less  |
| FireWire       | 400/800 Mb/s            |              |
| DNxHD          | 145/220 Mb/s            | 4:1 or less  |
| Red One        | 224/288/336             | 12:1 or less |
| UNC HD         | 880 Mb/s                | 1:1          |
| Ethernet       | 1000 Mb/s               |              |

# Graphs mean more





# Unc. HD is huge



# 4 numbers to understand

1

25

125

880



# Codecs

# Two things to know

- **A COmpressor/DECompressor refers to the math formula used to make video smaller**
- **Video (and audio) are stored in Architectures (which may be easier to think of as a bucket)**

# Three (four) types of codecs

- **Camera - DV25**
- **Post - Apple ProRes**
- **Distribution - WMV**
- **Hybrids - a distribution codec that's used somewhere else in the chain - h.264 is a great example.**

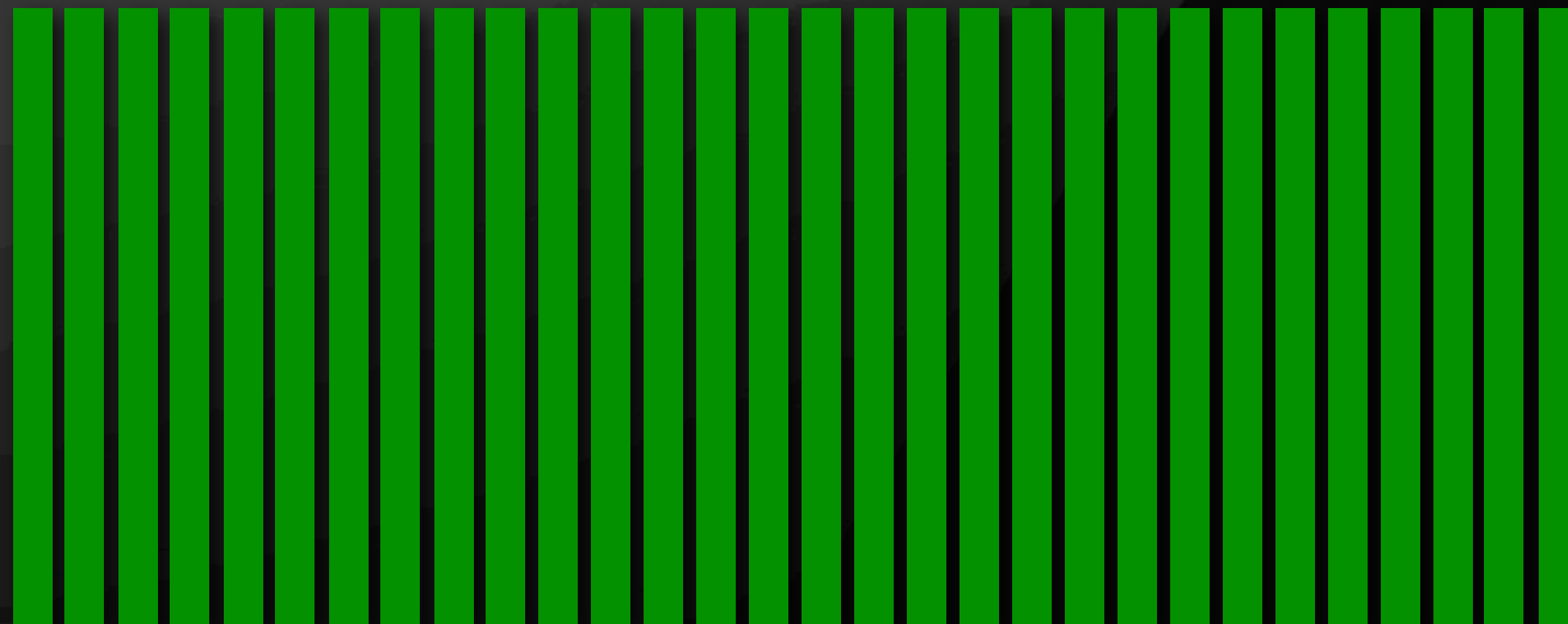
# Camera Codecs

- **Have to be able to encode/decode in real time**
- **Should be as 'least' compressed as possible**
- **Therefore - a “Constant” bit rate**



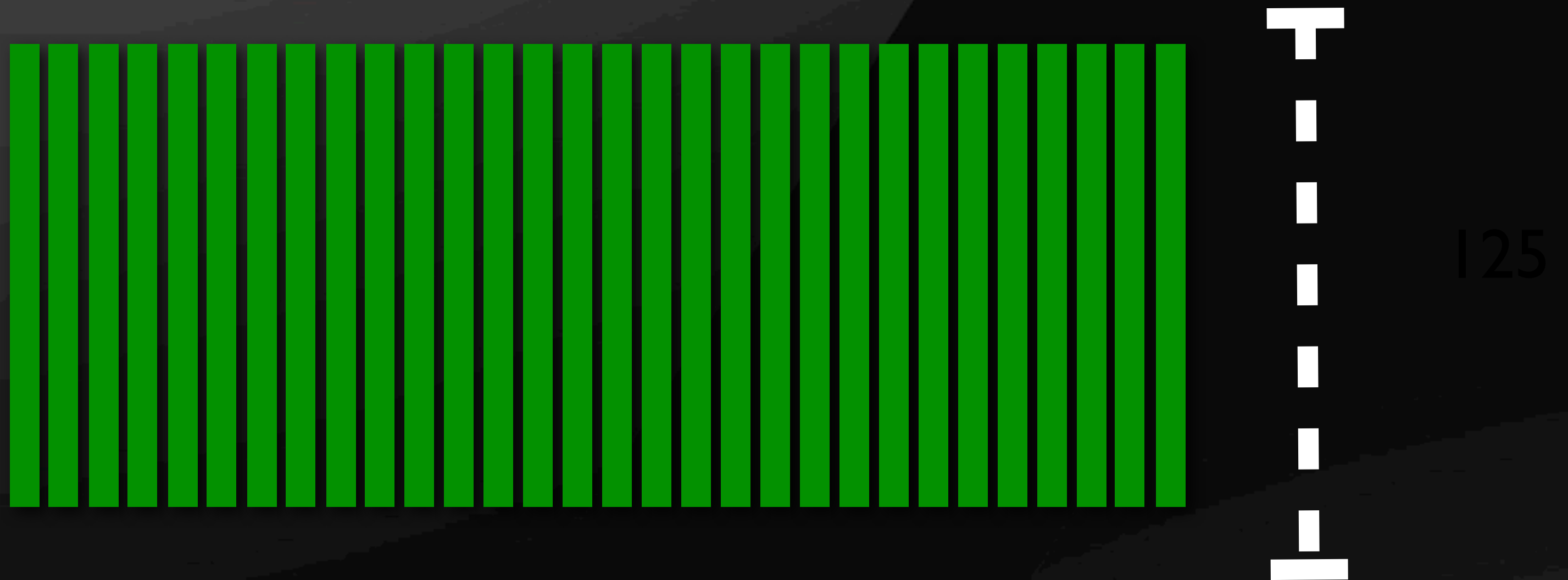
# Constant Bit Rate

(every frame gets the same amount of data)



# Constant Bit Rate

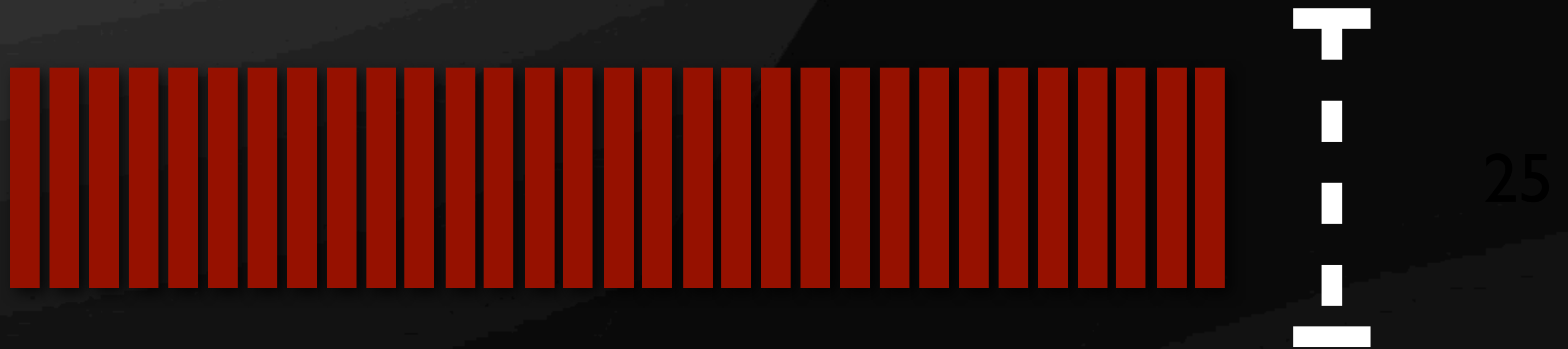
(every frame gets the same amount of data)



Uncompressed = easy for camera  
(no compression/decompression)

# Constant Bit Rate

(every frame gets the same amount of data)



DV = each frame gets JPEG  
Compression.

# Data Rate Redux

**DVCPProHD 100**

**Camera data rates vary  
(more on this later)**

| 1   | 25  |
|-----|-----|
| 125 | 880 |



# Post Codec

- **Should be large - maybe larger than camera codecs**
- **Might contain an alpha channel**
- **Should be easy/quick to encode & decode**
- **Again, a 'constant' bit rate**

**Which is better - a  
camera or a post  
codec?**

# Data Rate Redux

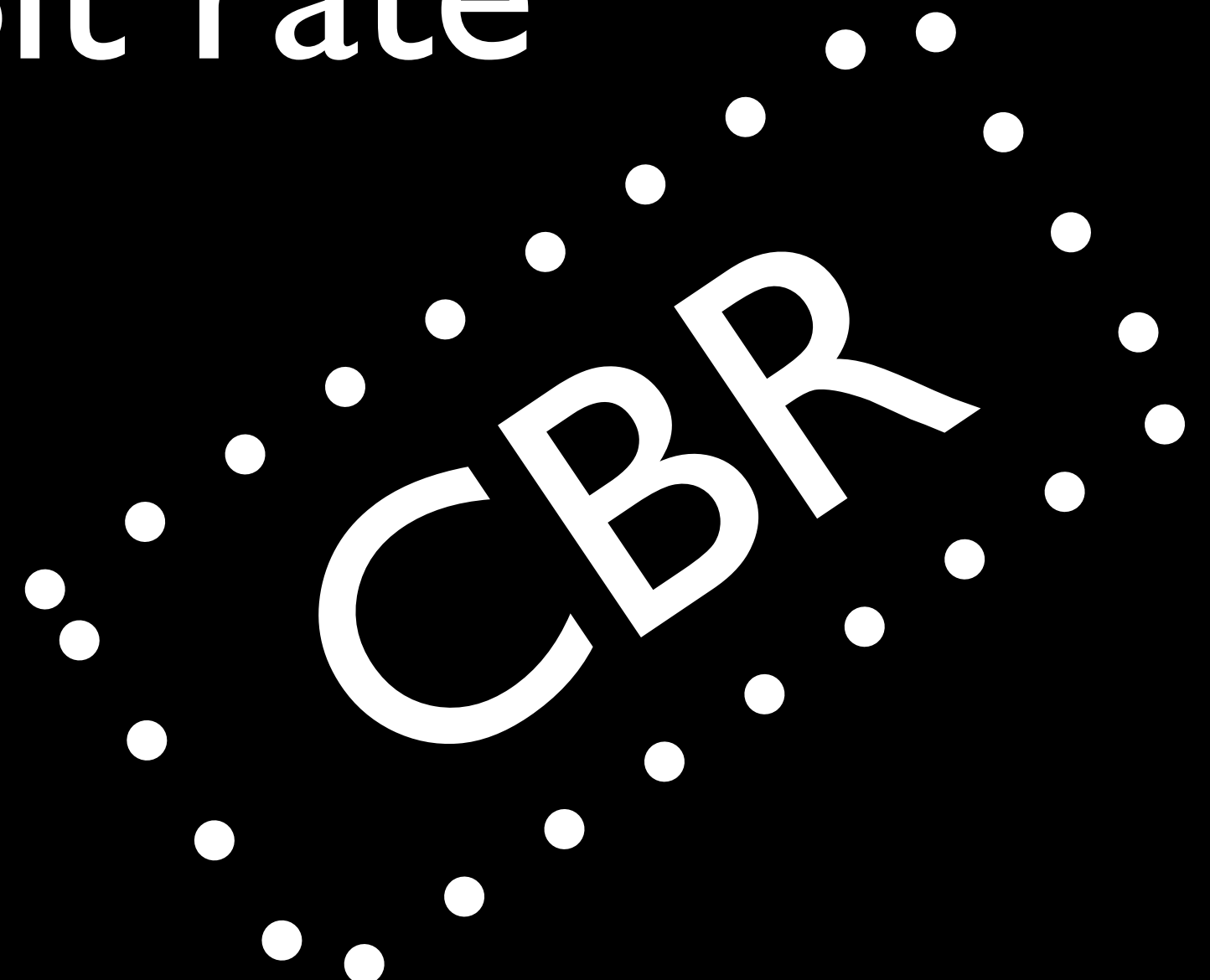
**ProRes 422 ~ 140**

**DNxHD 145**

| 1   | 25  |
|-----|-----|
| 125 | 880 |

# Constant Bit rate

- How cameras work
- Fast, fast, fast
- Don't make small files
- Every frame gets the same amount of info
- ex:  $3000 \text{ units} / 30 \text{ frames} = 100 \text{ units per frame}$





# Distribution Codecs

- **GOAL: SMALL, small, small**
- **Uses 'jpeg' on each frame**
- **Only sends pixels that change**
- **Can have 100:1 compression**

**Variable  
Bit Rates  
or  
Robbing Peter  
to pay Paul**

# How low can we go?

- **At some data rate, the quality becomes unacceptable.**
- **Unique for any type of footage**
- **but some footage has lesser demands**

# Data

Complex material

Cherry Blossoms  
falling in DC

Simple material

Talking heads



# What if we could steal data for where it's needed?

Complex material

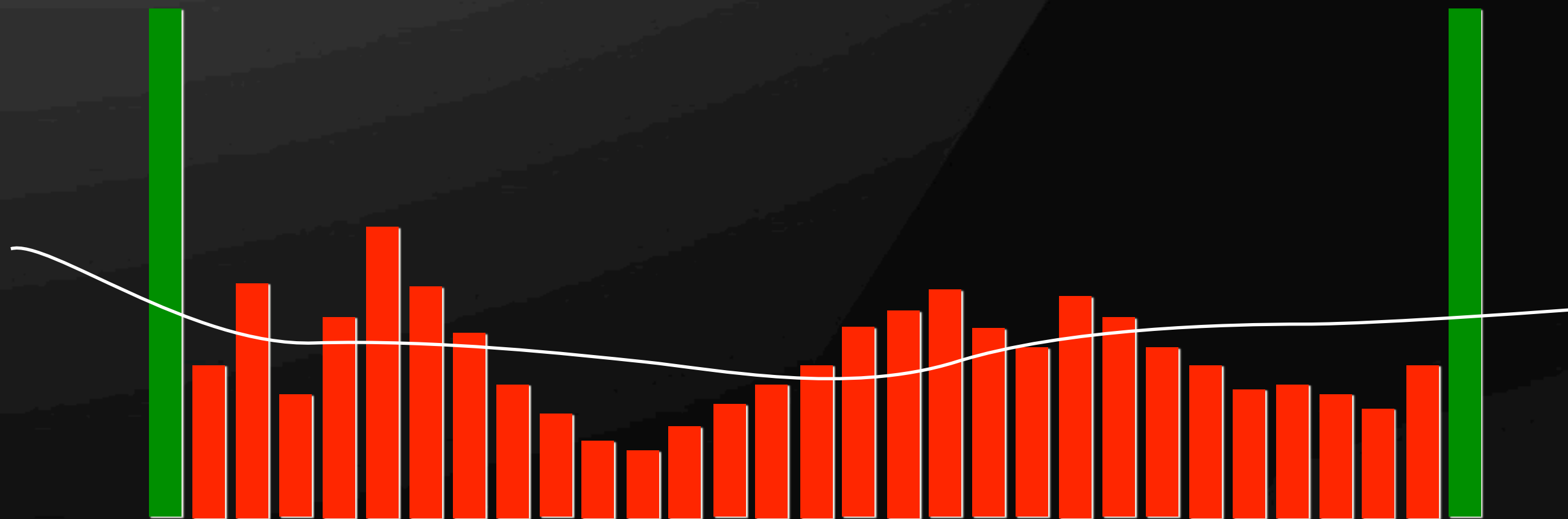
Cherry Blossoms  
falling in DC

Simple material

Talking heads



# Variable data rates



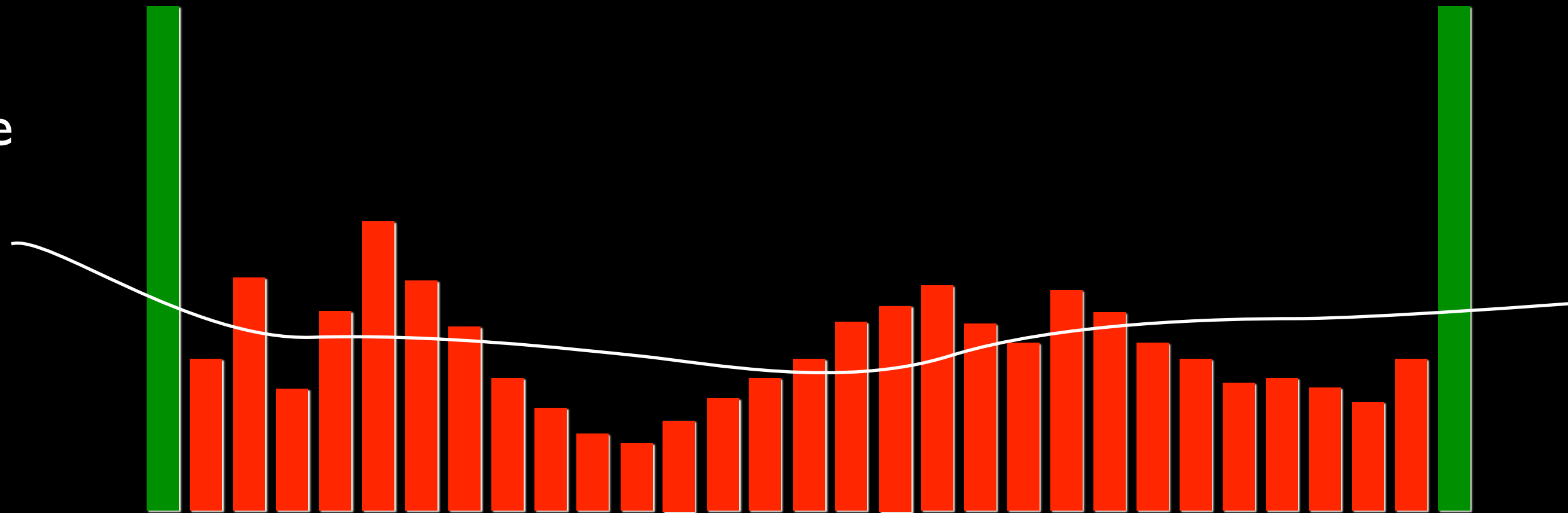
# Variable data rates



Focus on the average

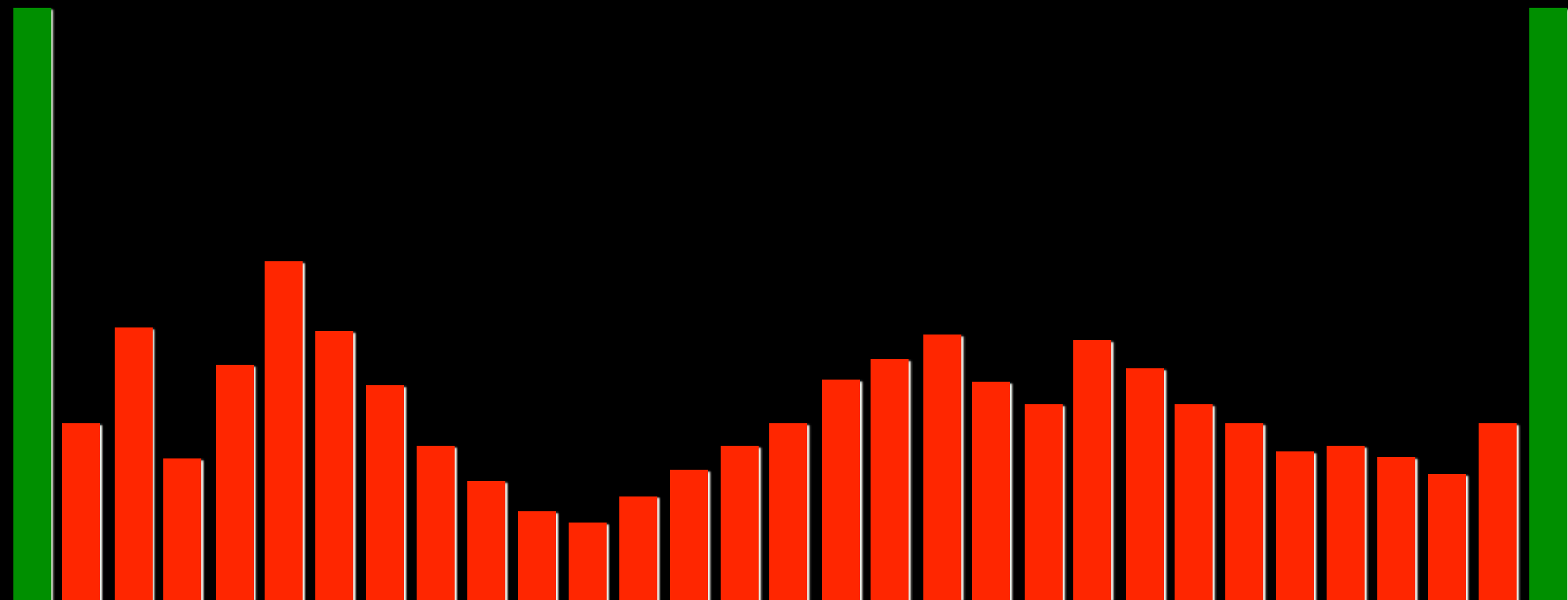
CBR or VBR, same  
data rate = same size  
file

Difference is where  
the data goes



# Lousy for editing

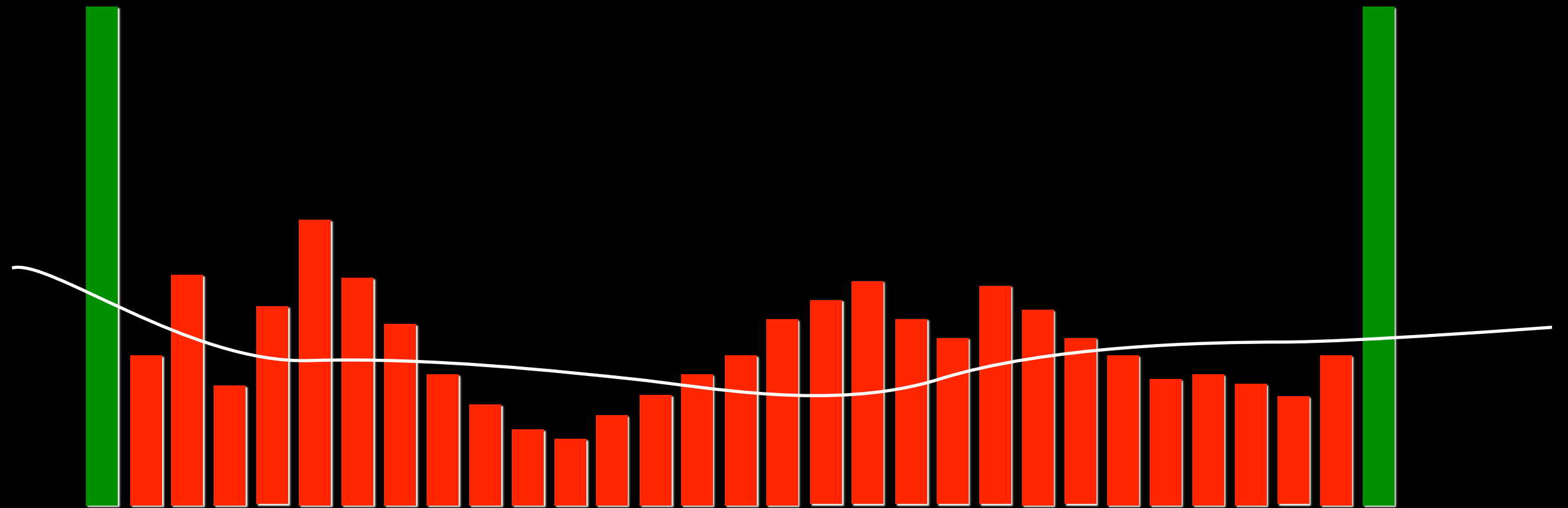
- Has to compute since last full frame
- “Why” you shouldn’t use formats like DVD for sources



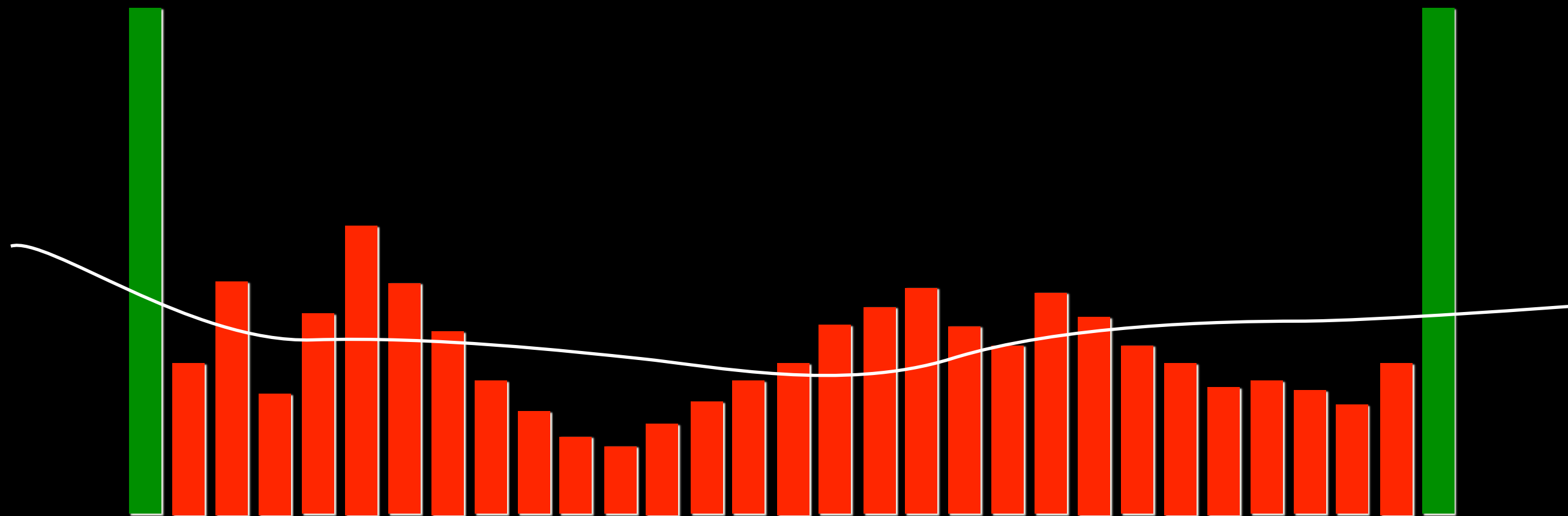


# Focus on the average

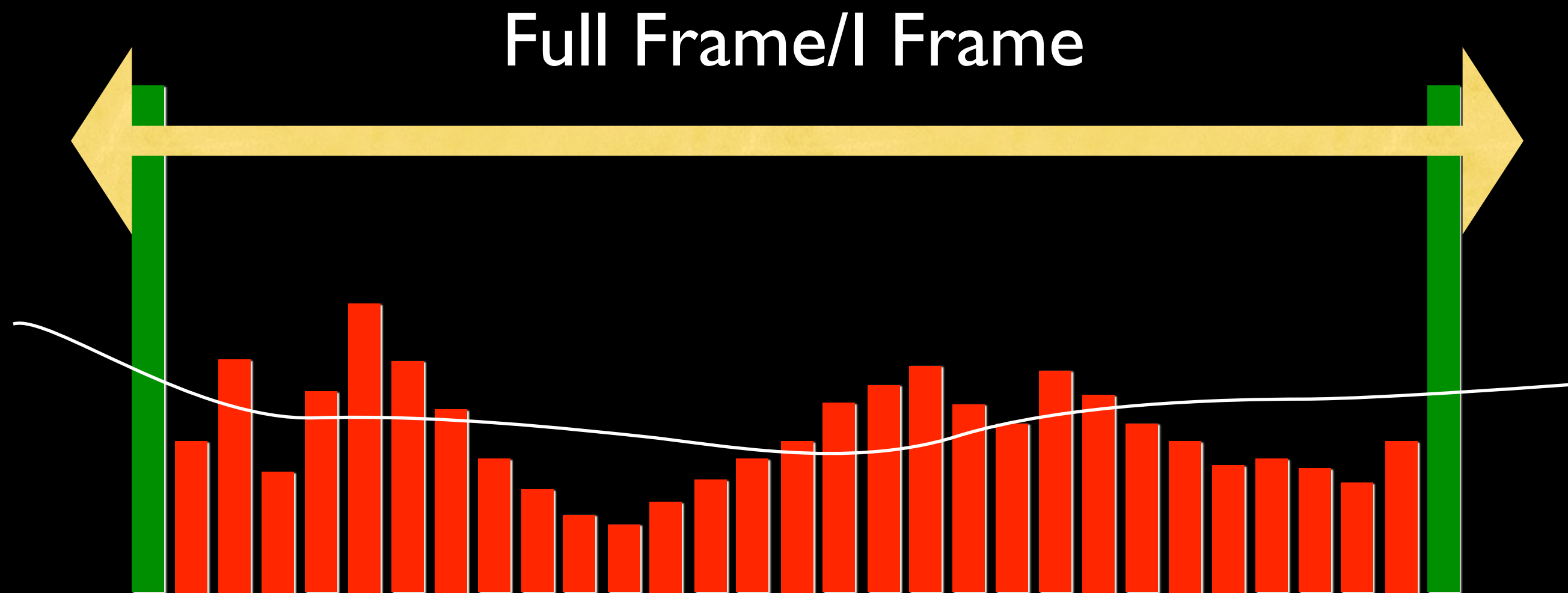
- A VBR or CBR file with the same data rate  
= same file size



# Distribution codecs throw out tons of information



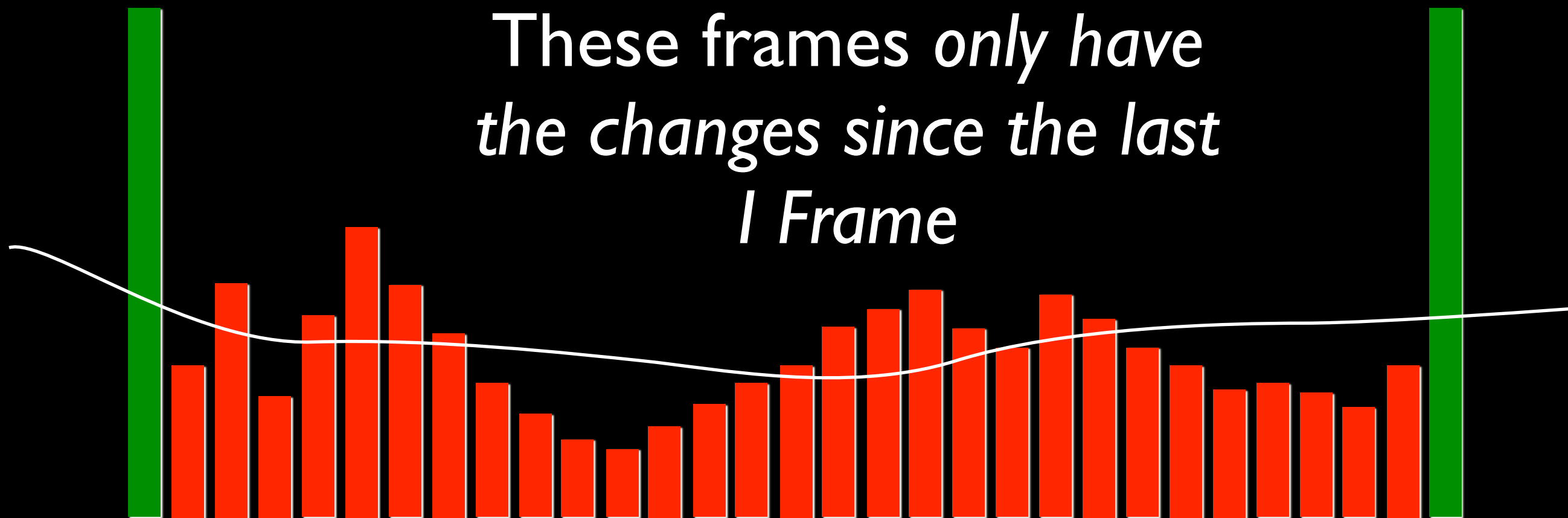
# A “Group” of pictures



# Delta Frames

B + P Frames

*These frames only have  
the changes since the last  
I Frame*





**1 pass vs. 2 pass**

# Data Rate Redux

**1080i apple devices ~  
10mbps**

**1080**

| 1   | 25  |
|-----|-----|
| 125 | 880 |

# **Quiz Question 1**

**Which will look better at  
a low data rate?**



**VBR**



# **Quiz Question 2**

**Which will look better at  
a HIGH data rate?**

**Codecs need room to  
breathe -  
at larger values it  
matters less**

# **Quiz Question 2.5**

**Which weighs more a  
pound of feathers or a  
pould of steel?**

# Quiz Question 3

**I encode CBR 100 Mbs**

**I encode VBR 100 Mbs**

**Which is larger?**



# Formats and Uses

**Don't confuse the  
architecture and a  
codec**

# Think of it as a bucket

Architecture

Codec

Codec

Codec

Architecture

Architecture

# Codecs



# Common Camera Codecs

- **DVCPRo**
- **XDCAM**
- **HDCAM**
- **\*h264 (big)**

# Common Post Codecs

- **Animation**
- **ProRes**
- **DNxHD**
- **Cineform**

# Common Distribution Codecs

- **h.264**
  - **Online, BluRay, iDevices, Android**
- **MPEG2 (DVD)**
- **WMV9 (VC1)**

# Architectures



# Common Architectures

- **Quicktime/MOV**
- **Audio Video Interleaved/AVI**
- **Motion Picture Expert Group 4 rev/MPEG4**
- **Flash Video/ FLV**
- **Video Compression 1/Windows Media Video/ WMV**
- **Materials Exchange Format/ MXF**

# Quicktime

- **Flexible, most codecs**
- **Deep non-video bonuses: timecode tracks etc**
- **Not on every PC**
- **Pro Version \$30 (dying) to do encodes**
- **Legacy codecs: qtdefaults write LegacyCodecsEnabled yes**
- **Very similar to MPG-4**
- **streaming options**
- **DRM**

# AVI

- **PC centric**
- **No way to encode info like pixel ratio/  
aspect ratio (non square pixels)**

# MPEG4

- **4th revision, Motion Picture Experts Group**
- **30+ parts; h.264 = part 10**
- **streaming options**



# Flash Video

- **Subsection of flash**
- **Only 3-4 codecs**
- **streaming options**
- **DRM**

# VC1/WMV

- **Windows Media Video**
- **(Advanced systems format - ASF)**
- **DRM**
- **WMV evolved into VC-1**
- **Blu Ray, Silverlight, Slingbox**

# MXF

- **Can contain “essence” metadata from a camera**
- **Avid/Sony/Panasonic**
- **AAF**

**h.264 can be: MOV,  
FLV, MP4**

**Which is best and  
why?**



# Buckets

QuickTime

h.264  
h.264  
h.264

QuickTime

QuickTime

MPEG - 4

h.264  
h.264  
h.264

MPEG - 4

MPEG - 4

Flash video

h.264  
h.264  
h.264

Flash video

Flash video

# Buckets

QuickTime

h.264  
h.264  
h.264

QuickTime

QuickTime

MPEG - 4

h.264  
h.264  
h.264

MPEG - 4

MPEG - 4

Flash video

h.264  
h.264  
h.264

Flash video

Flash video

# Preparation

# Production Tips



# Shooting tips

- **Tripod**
- **Soft Lighting**
- **Narrow DOF**
- **Tight shoots**
- **Avoid Complex Backgrounds**

# Post Tips

# Complicated=bad

- **Still motion/straght cuts**
- **Text 2x normal**
- **Blur good**
- **Rapid Cutting / Dissolves**
- **Complex graphics**
- **Rotations/Zooms**

# Common questions



**How can I get my video  
as small as possible?**

**2 pass VBR, h264...and  
reduce the data rate as  
low as you dare**

**What's the best file/  
format/size for YouTube**

**Easy: h.264 ~ 10 Mbps**

**Harder: your post codec**



**What can I do to make  
my video look better?**

**More data. Clean the  
video (filters).**

**Tools you can use**

# **“Big” hitters**

- **Adobe Media Encoder**
- **Apple Compressor**
- **Sorenson Squeeze**
- **Telestream Episode**



# Nice to have

- **QuickTime Pro**
- **Media Info**
- **VLC**
- **MPEG Streamclip**

**Closing**  
**(aka “Stuff you should**  
**know about”)**

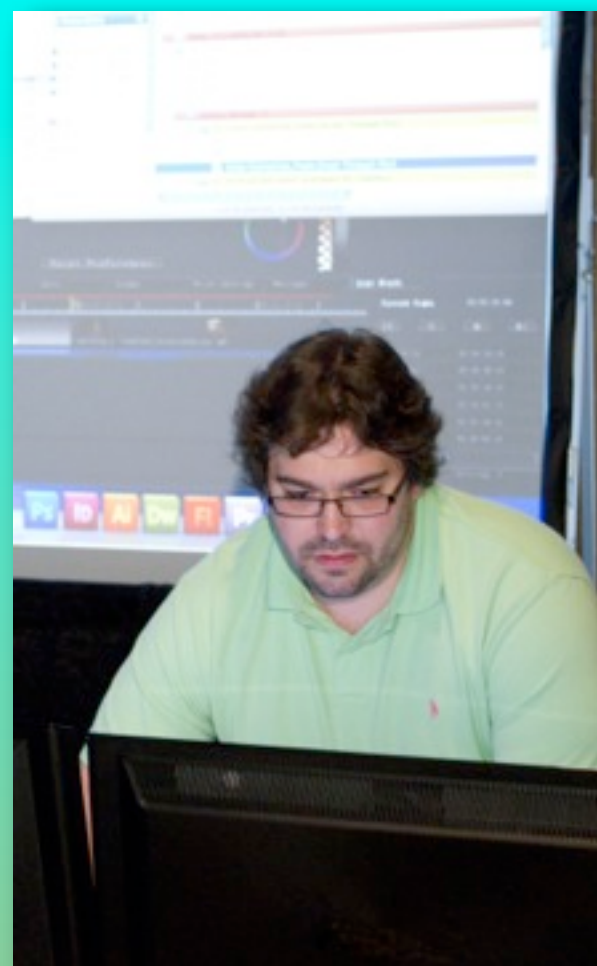
# Jeff @ J Greenberg Consulting . Com

Master Trainer



You **should** follow me on [twitter.com/filmgeek](https://twitter.com/filmgeek)





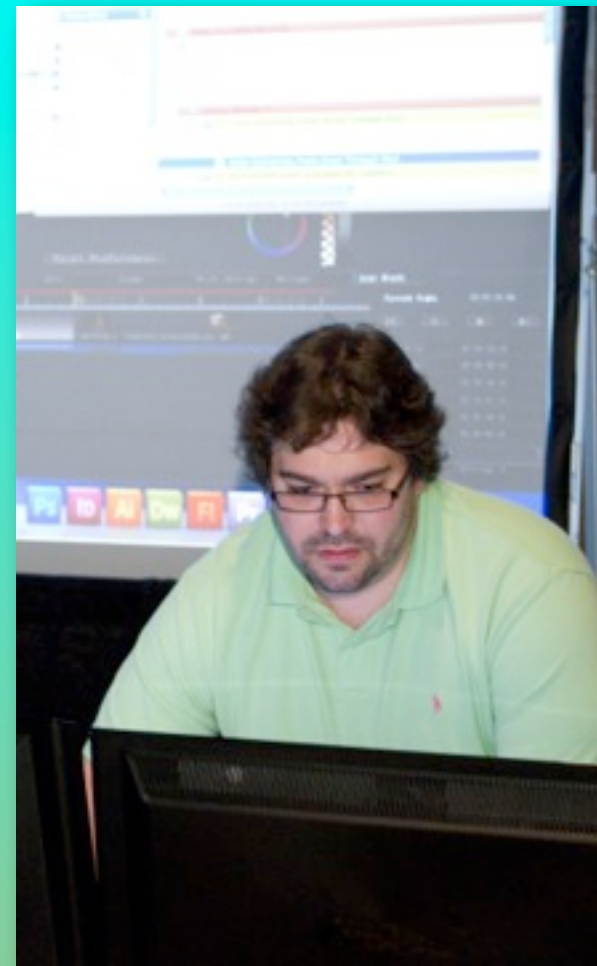
# EDITORS RETREAT

## 2013



[www.editorsretreat.com](http://www.editorsretreat.com)





# EDITORS RETREAT

## 2013



[www.editorsretreat.com](http://www.editorsretreat.com)

## **FOCUS Workshops at FMC**

Full-day, in-depth explorations of your favorite production topics

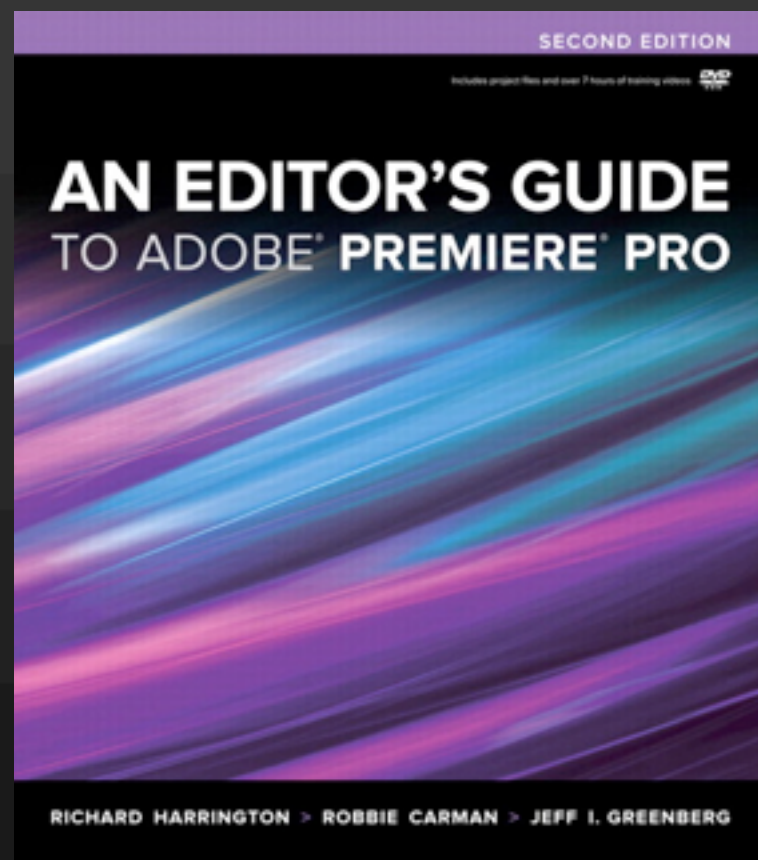
**One day HANDS ON**

**Color Correction in ANY NLE  
workshop**

**Video Compression workshop**



# Jeff @ J Greenberg Consulting . Com



Peachpit

Amazon.com

iBooks

Kindle

**macProVideo.com**

Comprehensive Media

Composer 6 Training

Premiere Pro and FCPX DSLR

workflow training

**Lynda.Com**

Compressor

Training

You should follow me on [twitter.com/filmgeek](https://twitter.com/filmgeek)

# THANK YOU!

Session Notes @ J Greenberg Consulting  
(along with my blog)

Contact me if you'd like to talk  
about me education/speaking to  
your group directly

Jeff @ J Greenberg Consulting . Com