

# Achieving Better Image Optimization

Billy Hoffman

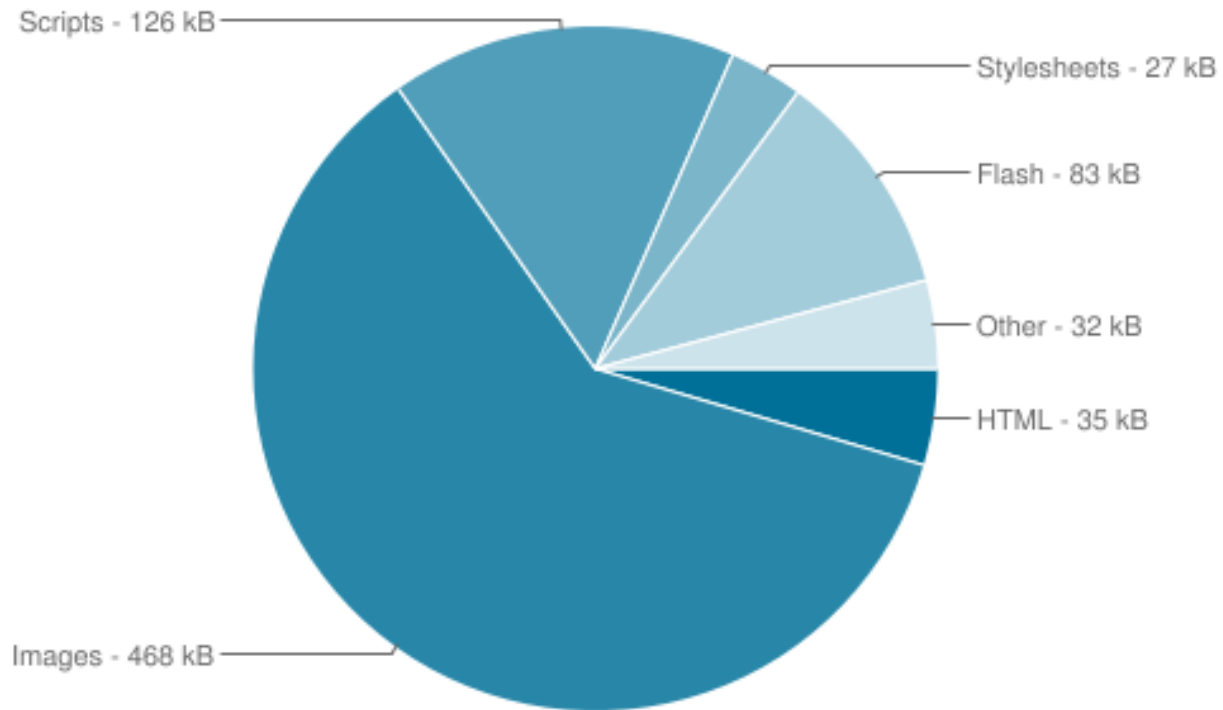
[billy@zoompf.com](mailto:billy@zoompf.com)

@zoompf



# Images Dominate the Web

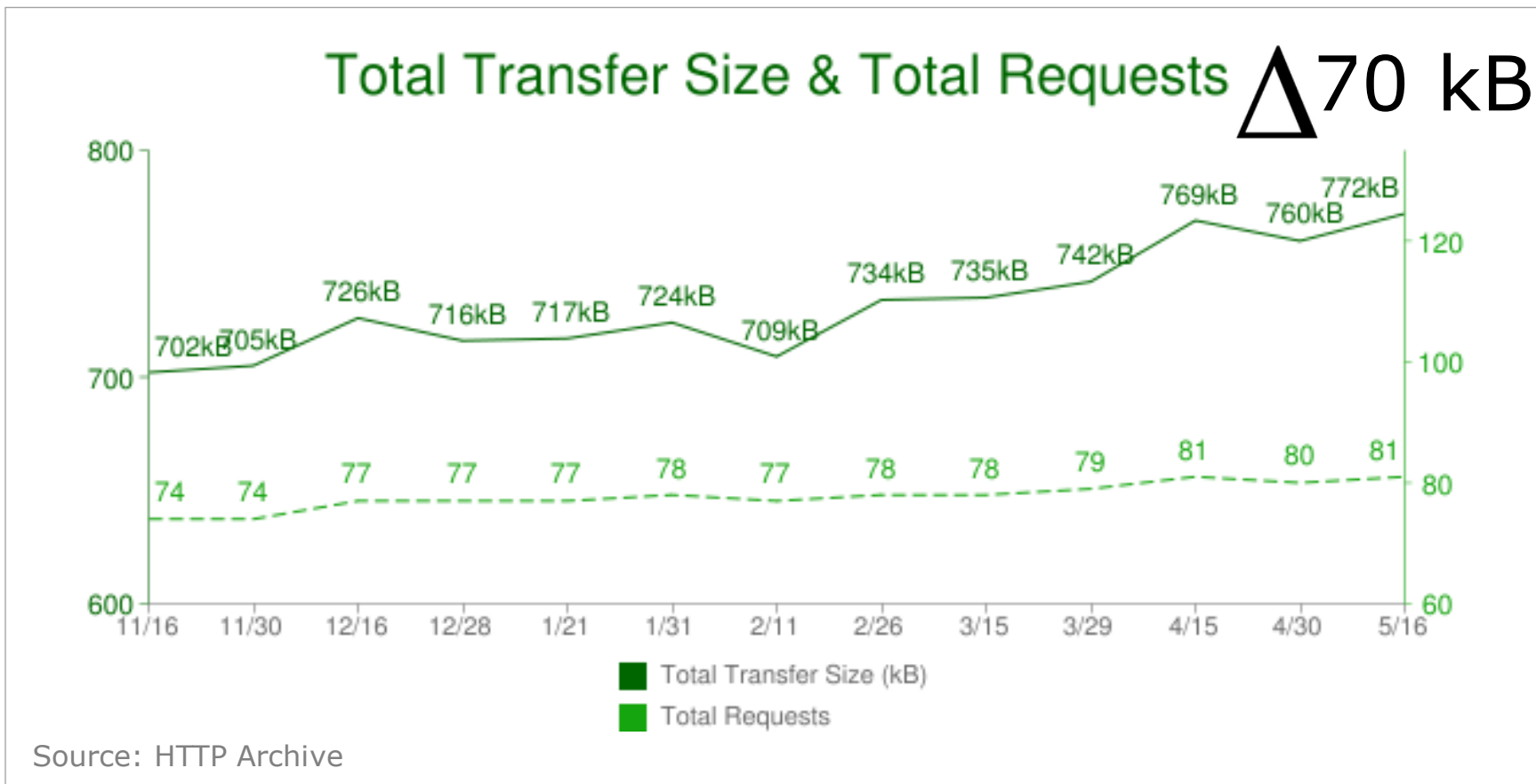
Average Bytes per Page by Content Type



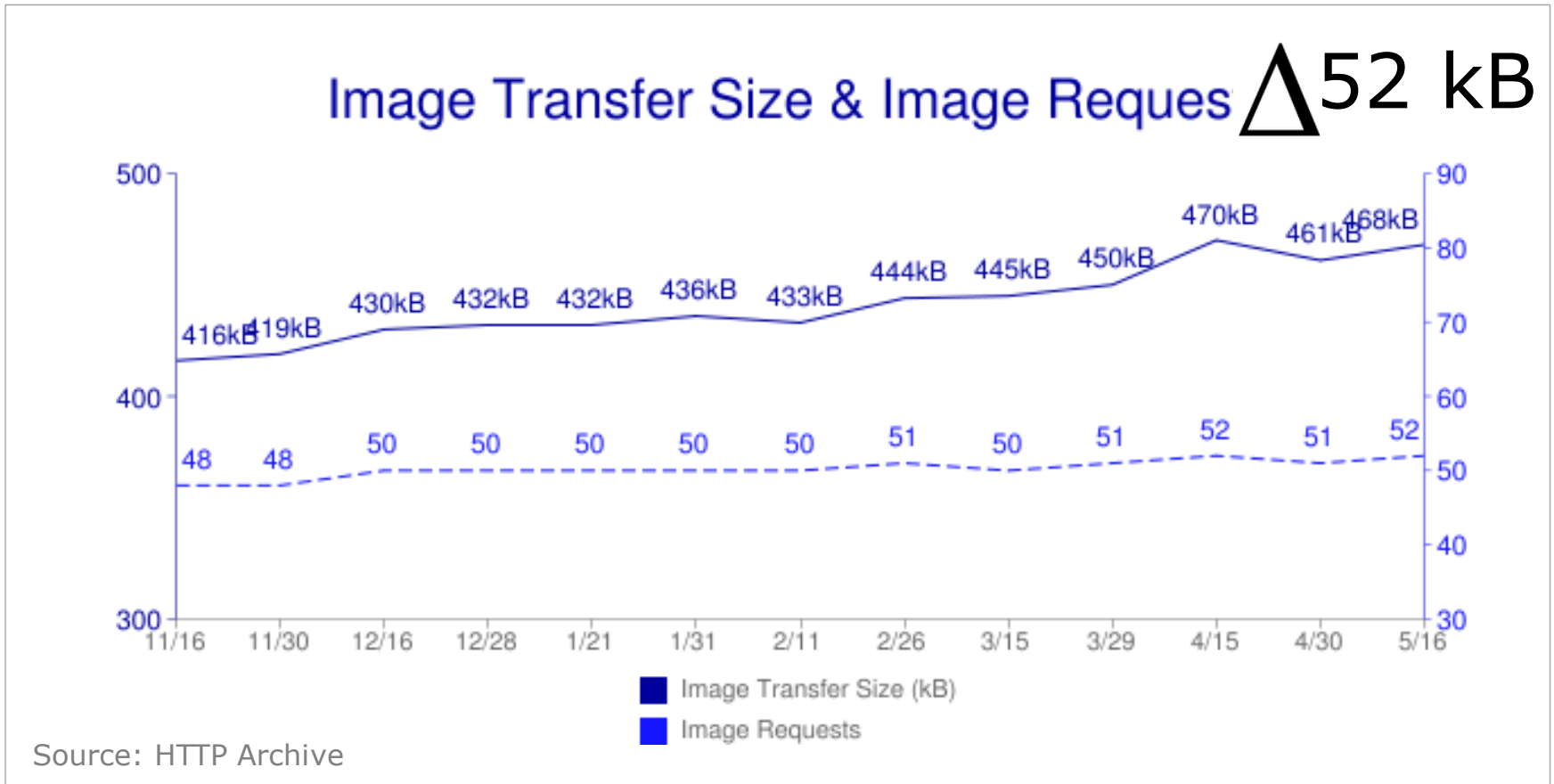
Source: HTTP Archive

total 772 kB

# Total Size is Increasing



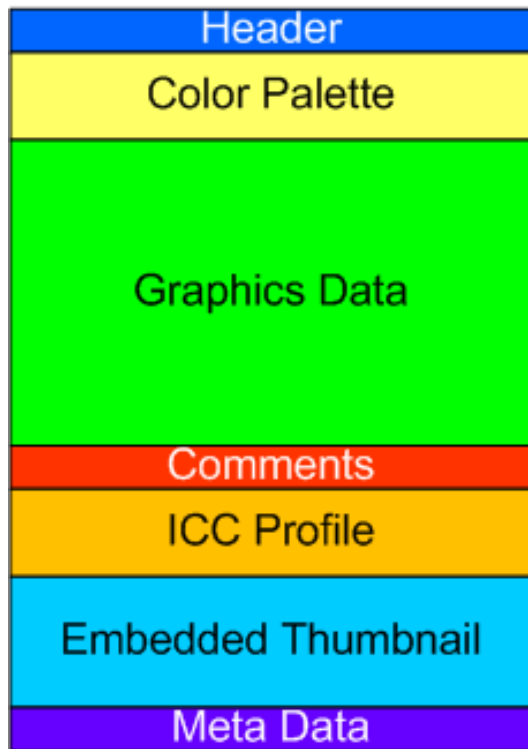
# Images Are 74% of the Increase



# Reducing Content Size

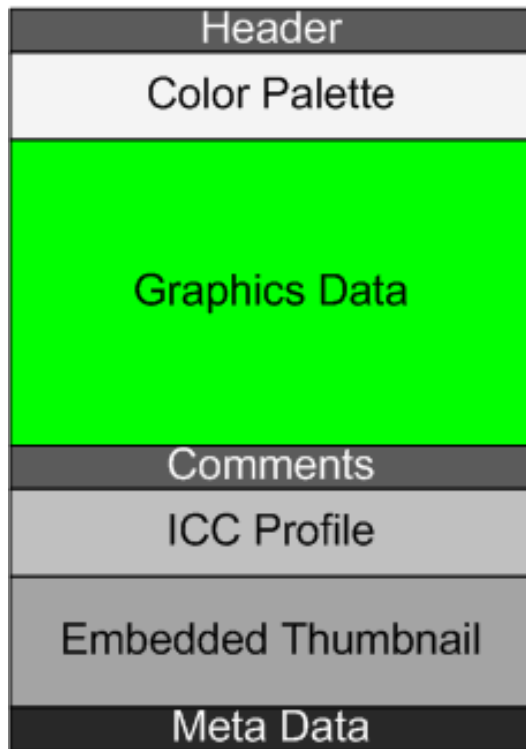
- **HTTP Compression isn't the king**
  - JS, CSS, HTML = 188 kB
  - Only 24% of total content size
  - Reducing 24% of web content by 66% is not great
- **Images**
  - Reduce image size by 25% results in more total savings than text optimizations

# Lossless Optimization (Bloat)



- Removes anything not needed to draw the image
- Optimized image is pixel perfect copy
- Saves 5-20%
- Occasionally 70-80%

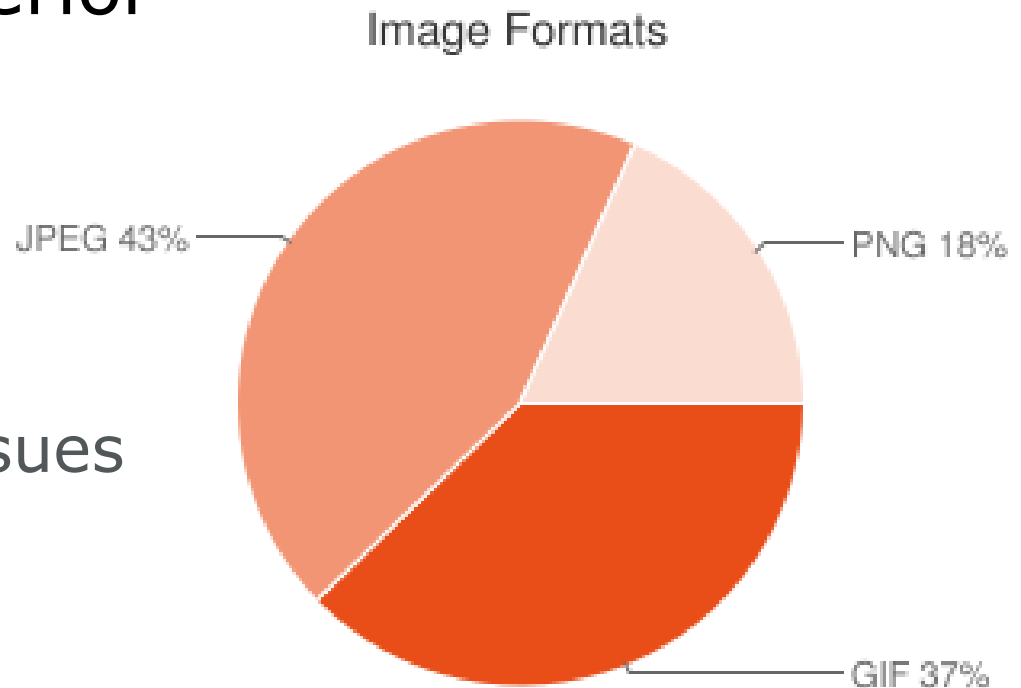
# Lossless Optimization (Efficiency)



- Store graphics data more efficiently
  - Convert GIF to PNG (LZW vs. DEFLATE)
  - Beyond stock zlib DEFLATE implementation
- Optimized image is pixel perfect copy
- Saves 5-20%

## Aside: Always Use PNG

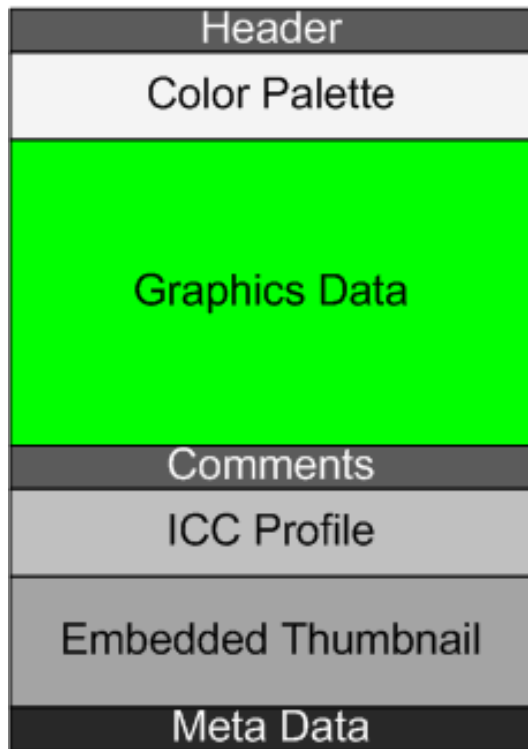
- DEFLATE is superior to LZW
- All browsers support PNG
  - Those with transparency issues are near dead
- Only keep animated GIFs



Source: HTTP Archive



# Losing Graphics Data?



If 80-95% of the bytes in an image are graphics data...

... perhaps we should look at reducing the size of the graphics data

**Lossy** Optimizations!

# “Do Not Touch My Art!”



- Lots of push back
- “Losing” data is scary
- “Won’t that look bad?”
- “We spent a long time to make it look like this.”

# Everything is Lossy!

- Telephone calls (8kHz w/ 8bit Samples)
- CDs (44kHz w/ 16 bit samples)
- Conversion to Color Television
  - Eye more sensitive to brightness than color
  - Chroma Sub-sampling (Y'CbCr 4:2:2)
  - 33% less bandwidth, no perceivable difference
- MP3 files
  - Frequency Masking

## ... In the Eye of the Beholder



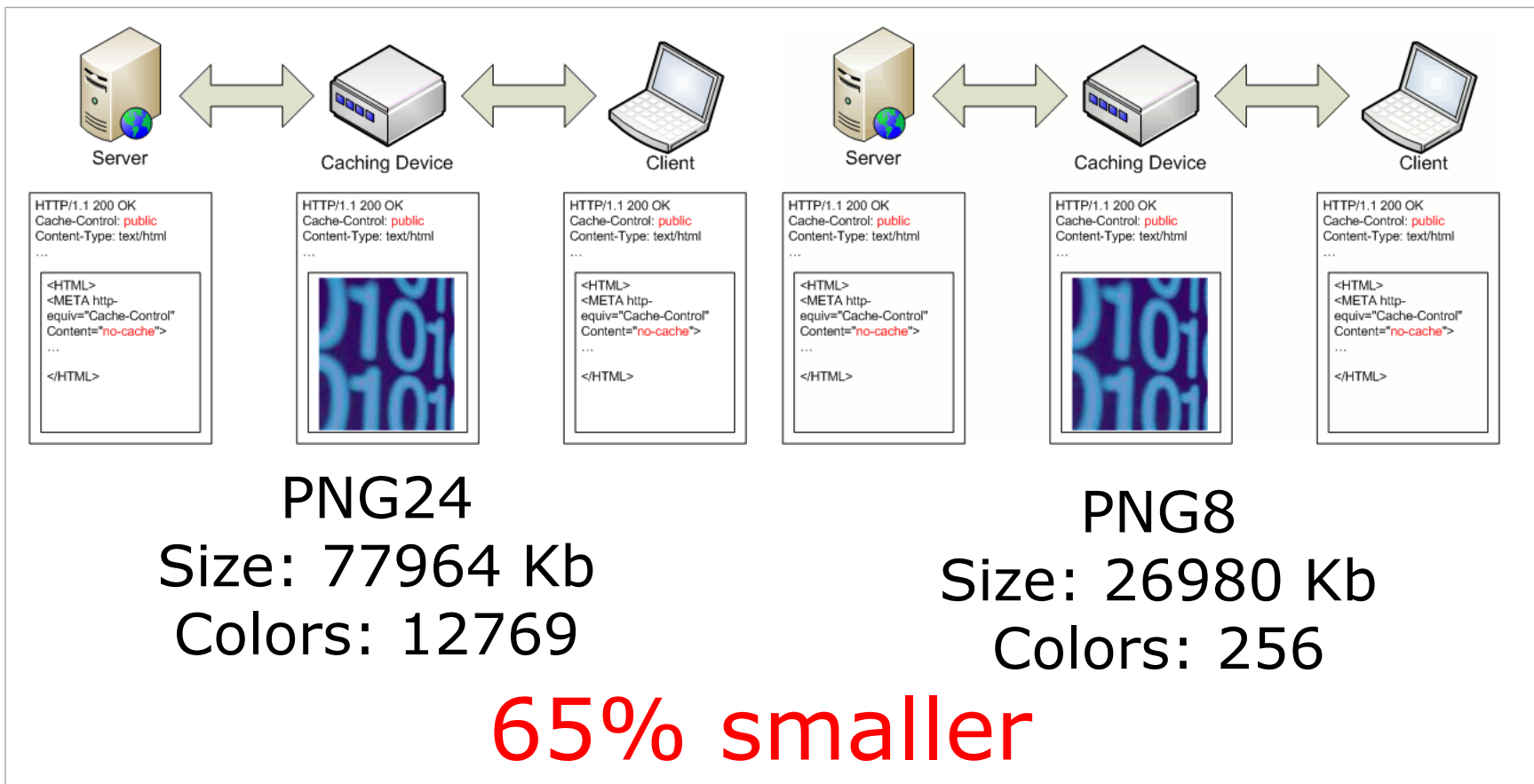
- This is all subjective!
  - “Noticeable”
  - “Perceptible”
  - “Nearly the same”
- Beware \*philes
  - CDs vs. Vinyl
  - MP3 vs. FLAC
- Find a middle ground for average viewer

## PNG24 to PNG8

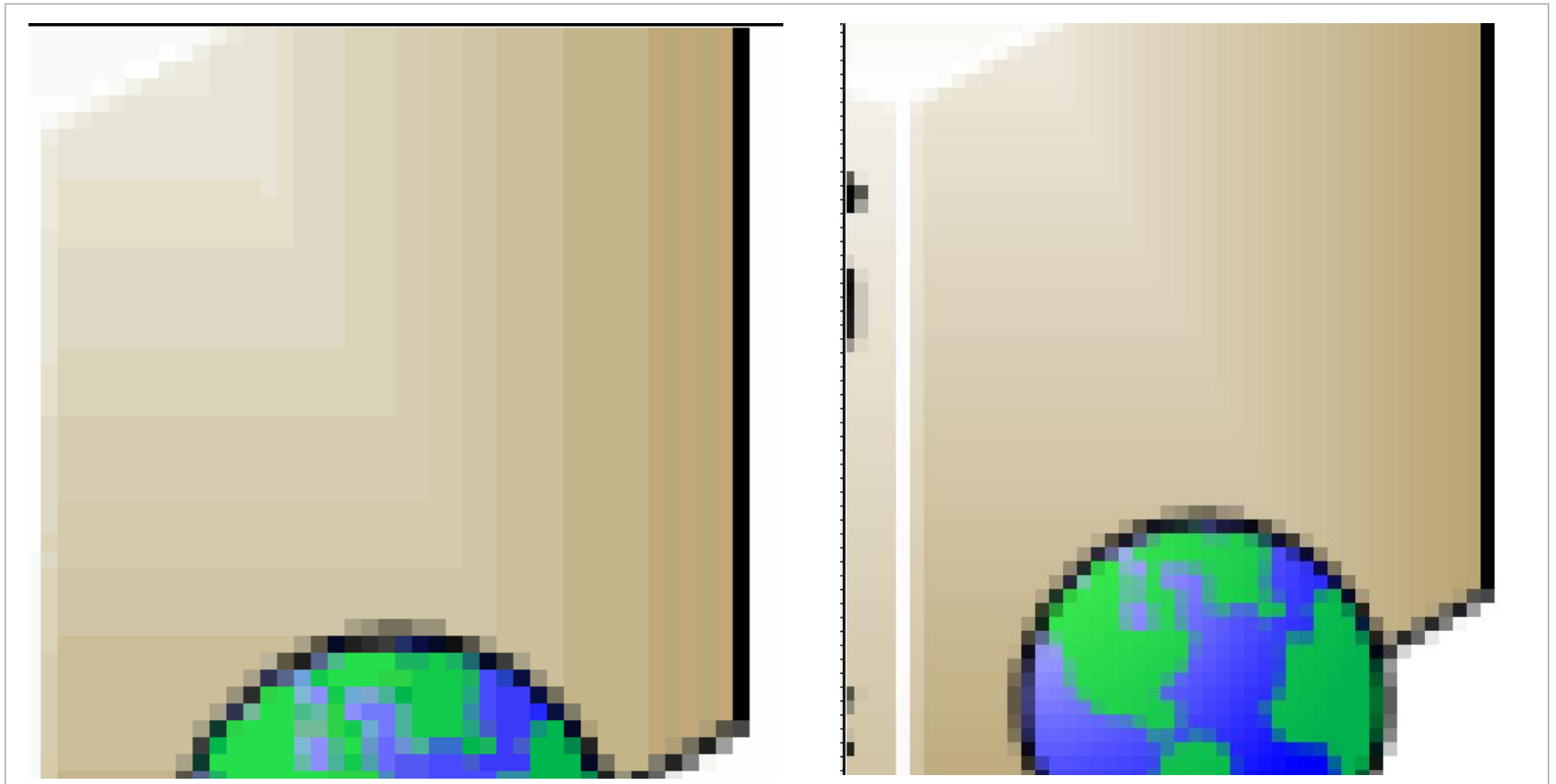
- From millions of colors to 256
- The human eye is not well suited to detecting subtle color changes
- Discard them!



# Reasonable Number of Colors



# Differences



# What About Lots of Colors?



PNG24  
Size: 512110  
Colors: 148279

**63%  
smaller**



PNG24  
Size: 188342  
Colors: 256



# Differences

- 99.82% less colors!
- Skin tone transition is not smooth...
- Only noticeable on larger images or extreme zoom



# Smaller Images



**PNG24**  
**100x100**  
**Size: 19772**  
**Colors: 9138**

**PNG8**  
**100x100**  
**Size: 8734**  
**Colors: 256**

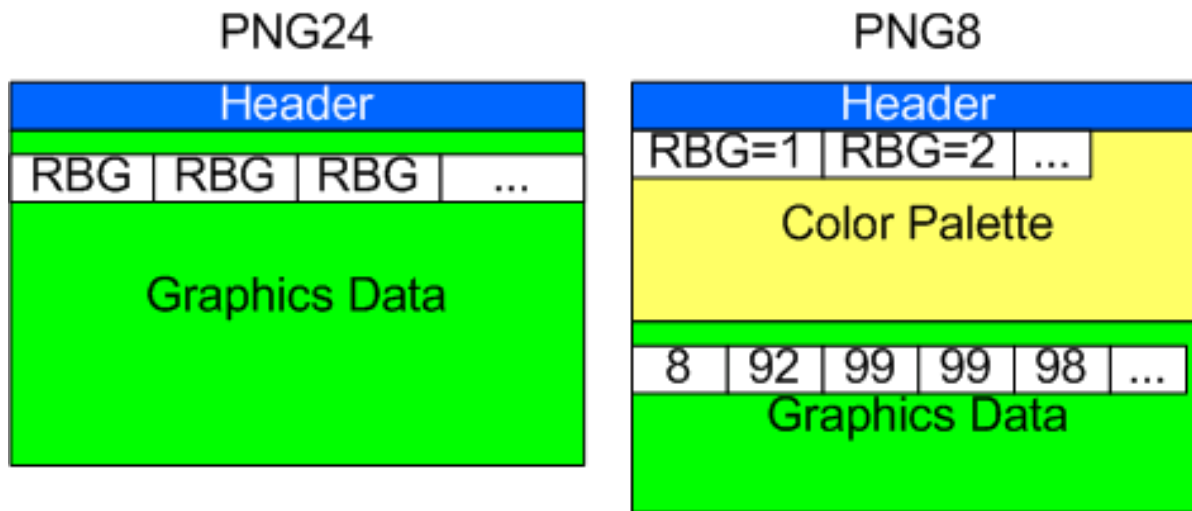
**55.8%**  
**smaller**

# PNG24 to PNG 8 Guidelines

- Convert images with low unique color counts and verify
  - identify `-format "%k" image.png`
  - Zoompf recommends  $< 5000$  colors
- Always convert small dimensional images
  - Zoompf recommends  $< 10,000$  pixel area
- You can push these limits
- Tools
  - Zoompf free scan/WPO

# PNG24 to PNG8: Caveats

- Tool support for alpha transparency
  - Online converter
- Not always smaller for small images



# Lossless to Lossy (PNG to JPEG)

- Lots of images are saved as lossless when lossy will work
  - Photos
  - Screen shots
  - Logos
  - Icons
  - Diagrams
- Changing formats reduces file size

# Obvious: Photographic Data



PNG24

Size: 512110  
Colors: 148279

**89%  
smaller**



JPEG

Size: 52015  
Colors: 72060

# Logos/Icons/Buttons



PNG24  
Size: 35503  
Colors: 728

**55%  
smaller**



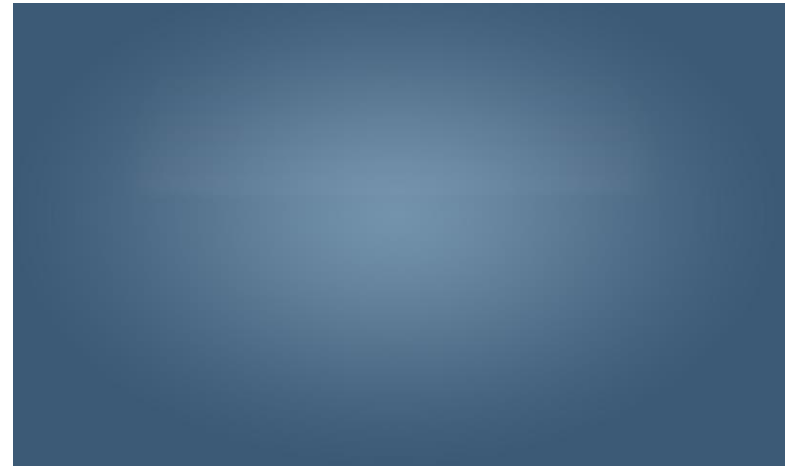
JPEG  
Size: 16123  
Colors: 12224

# Backgrounds



PNG24  
1623x967  
Size: 76,135

**56%  
smaller**

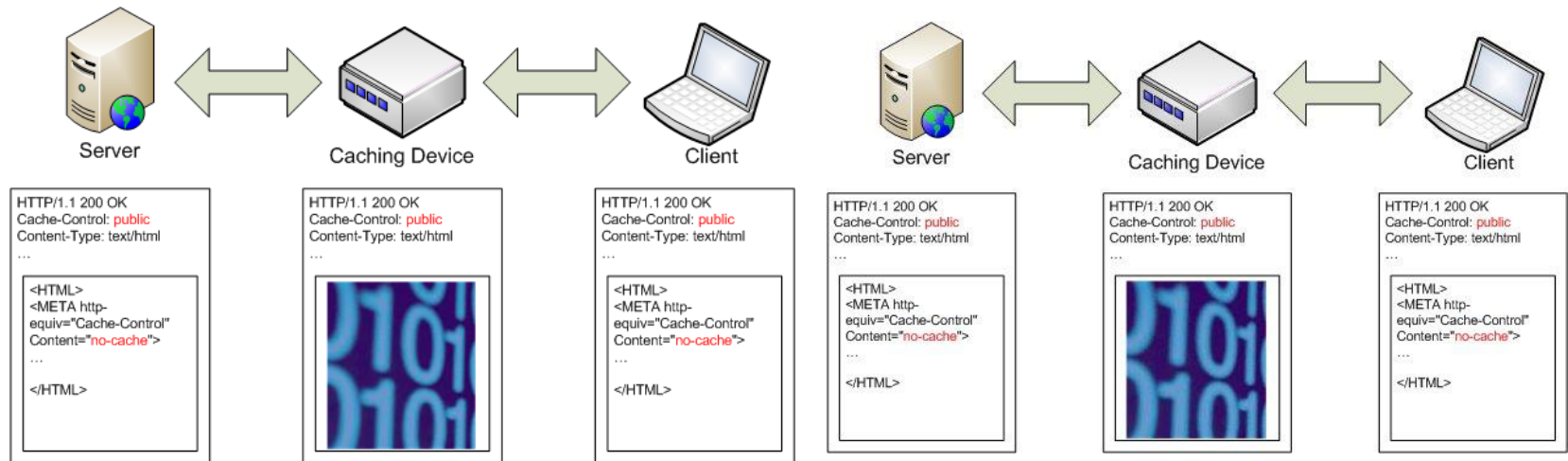


JPEG  
1623x976  
Size: 33663



# Figures/Line art?

- PNG is supposed to be better than JPEG



**PNG24**  
1623x967  
Size: 76,135

**56%**  
**smaller**

**JPEG**  
1623x976  
Size: 33663

## Figures/Line art?

- Transition artifacts are remarkably low impact

```
HTTP/1.1 200 OK
```

```
Cache-Control: public
```

```
Content-Type: text/html
```

# PNG to JPEG Caveats

- Different formats with different features
- Transparency
  - JPEG does not support it
  - Not as big of a deal as you think
  - Flatten onto background color
  - *convert input.png -background white -flatten output.JPEG*
- Generational losses
  - Don't keep editing the same JPEG...

# PNG to JPEG Guidelines

- Review images to discover what is PNG and what is JPEG
  - .jpg does not mean JPEG...
  - Imagemagick's *identify*, Linux/Unix's *file*
- Bulk convert and verify
  - Tedious
- Only consider when savings > 30%
  - Zoompf free scan/WPO flags these candidates

# JPEG Quality

- JPEG images have a “quality” setting
  - 1-100
  - 0-10
- Quality 90  $\neq$  discarding 10% of data
- Quality scale is purely arbitrary
  - it's not a percentage of anything
- Best Practices for web
  - 50-80, 75, depends on source

# Reducing JPEG Quality



JPEG  
Size: 52015  
Quality: 85

**29%  
smaller**



JPEG  
Size: 37121  
Quality 75

# Going Further



JPEG  
Size: 52015  
Quality: 85

**55%  
smaller**



JPEG  
Size: 23488  
Quality 50

# Differences

- Differences
  - Some blurring
  - Feather edges affected
  - Only visible when zoomed
- Quality 50:
  - little differences
- Quality 75:
  - Virtually no differences





# Smaller Images



JPEG  
100x100  
Size: 3964  
Quality: 85

JPEG  
100x100  
Size: 2159  
Quality: 50

**46%**  
**smaller**

# Real Life: Facebook

 Friends

Friends



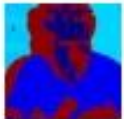
Elonka Dunin



Daniel Keeling



Karim Hijazi



Nathan Abraham



Victoria Oliver

- All those thumbnails?
- 95 Quality!
  - Seriously. 95!
- Reducing to 70?
  - 44% Savings!

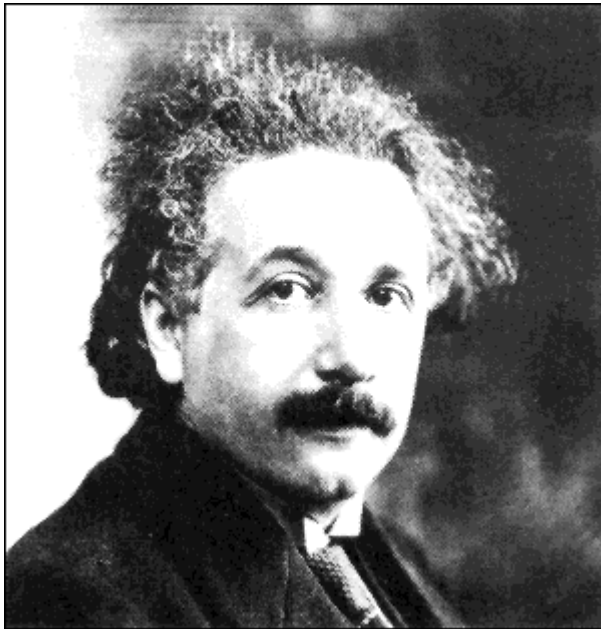
# Zoompf Savings Table

URL	Original Size	Optimized Size	Savings
<a href="http://static.ak.fbcdn.net/rsrc.php/v1/zX/r/4PIot2bO7ET.jpg">http://static.ak.fbcdn.net/rsrc.php/v1/zX/r/4PIot2bO7ET.jpg</a>	398	349	12.312%
<a href="http://static.ak.fbcdn.net/rsrc.php/v1/zs/r/1HX6ENG455b.jpg">http://static.ak.fbcdn.net/rsrc.php/v1/zs/r/1HX6ENG455b.jpg</a>	8,938	6,729	24.715%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/186810_1038056801_91485_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/186810_1038056801_91485_q.jpg</a>	2,515	1,122	55.388%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/212003_1016033580_5190845_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/212003_1016033580_5190845_q.jpg</a>	2,584	1,079	58.243%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/41636_706785383_7495_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/41636_706785383_7495_q.jpg</a>	2,544	1,121	55.936%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/186053_33007924_5970618_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/186053_33007924_5970618_q.jpg</a>	2,712	1,219	55.052%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/195319_729110379_2784779_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/195319_729110379_2784779_q.jpg</a>	2,784	1,242	55.388%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/211627_1503020179_2783745_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/211627_1503020179_2783745_q.jpg</a>	2,694	1,177	56.310%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/161431_874435458_1560599_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/161431_874435458_1560599_q.jpg</a>	2,349	1,003	57.301%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/41710_1602017253_3685_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/41710_1602017253_3685_q.jpg</a>	2,703	1,201	55.568%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/195552_5024573_2390878_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/195552_5024573_2390878_q.jpg</a>	2,567	1,106	56.915%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/49871_1205905151_492_n.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/49871_1205905151_492_n.jpg</a>	7,441	5,413	27.254%
<a href="http://profile.ak.fbcdn.net/hprofile-ak-snc4/49147_1093405517_3717837_q.jpg">http://profile.ak.fbcdn.net/hprofile-ak-snc4/49147_1093405517_3717837_q.jpg</a>	2,549	1,100	56.846%
		Average Savings:	44.221%

# JPEG Quality Guidelines

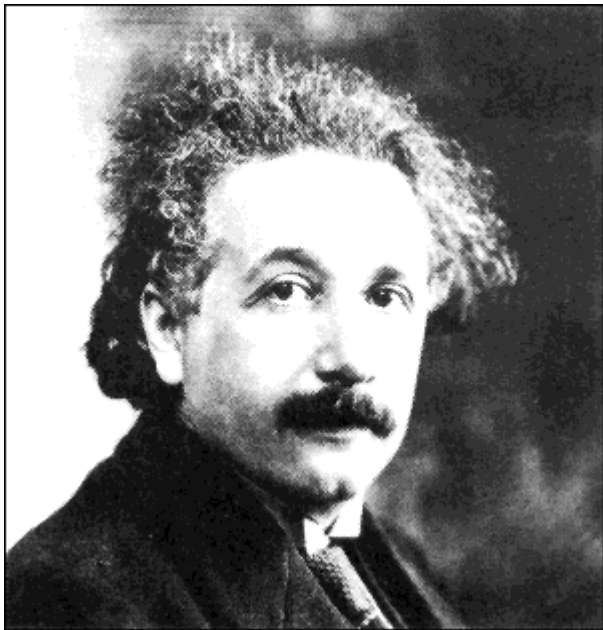
- if  $q > 85$ 
  - Reduce to 85 always ( $> 90$  has no benefits)
  - Consider Q 75 if it saves more than 30%
- If pixel area  $< 10,000$ 
  - Always reduce to 60. Lower if possible
- Consider tweaking
  - Blurs, softens, sharpens, etc
- Tools
  - WebPageTest, ZOOMPF, Imagemagick

# Conclusions



- Images dominate the web
  - In Size
  - In Count
- Image domination is growing larger
- Huge, untapped area, needs more attention

# Conclusions



- Don't be scared about lossy
  - Be intelligent about how you apply lossy
- Lossy achieves substantial savings
  - 40-60%, 80% spikes
- Lossy can be automated

# Lossy Guidelines Summary

- **PNG24 to PNG8**
  - When  $< 5000$  colors
  - When  $< 10,000$  pixel area
- **PNG to JPEG**
  - Per case, apply when  $> 30\%$  savings
- **JPEG Quality**
  - Target a 70-85 quality settings
  - Always 50-60 when for  $< 10,000$  pixel area


# Free Performance Assessment

- Free performance scan
- Finds lossy candidate images
  - And 380+ issues
- [zoompf.com/free](http://zoompf.com/free)

Performance Issues | Additional Analysis | Upgrade to Zoompf WPO

### Assessment Overview

Scan: [www.whitehouse.gov](http://www.whitehouse.gov) 5/24/2011 3:08:05 PM



**Zoompf Score**  
**75**

Conservative Bandwidth Savings  
**21.8%**

Aggressive Bandwidth Savings  
**67.1%**

Visited URLs	250
Pending URLs	0
Total Issues	715
Issues per URL	2.86
Start Time	5/24/2011 3:08:05 PM
End Time	5/24/2011 3:08:47 PM

### Summary of Issues

Severity	Issue Name	Affected pages
🔴	<a href="#">Content Served Without HTTP Compression</a>	5
🟡	<a href="#">Image Without Caching Information</a>	43
🟡	<a href="#">JPEG Candidate Image (GIF)</a>	13
🟡	<a href="#">JPEG Candidate Image (PNG)</a>	11
🟡	<a href="#">Single Color Image</a>	3
🟡	<a href="#">Unoptimized Image (Animated GIF)</a>	1
🟡	<a href="#">Unoptimized Image (GIF)</a>	60
🟡	<a href="#">Unoptimized Image (JPG)</a>	17
🟡	<a href="#">Unoptimized Image (PNG)</a>	60
🟡	<a href="#">Unoptimized Image (Progressive JPG)</a>	42



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