Achieving Better Image Optimization

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Images Dominate the Web

Average Bytes per Page by Content Type

- Images: 468 kB
- HTML: 35 kB
- Flash: 83 kB
- Other: 32 kB
- Stylesheets: 27 kB
- Scripts: 126 kB

Total: 772 kB

Source: HTTP Archive
Total Size is Increasing

Source: HTTP Archive
Images Are 74% of the Increase

Source: HTTP Archive
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

PNG24
Size: 77964 Kb
Colors: 12769

PNG8
Size: 26980 Kb
Colors: 256

65% smaller
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

<table>
<thead>
<tr>
<th>PNG24</th>
<th>PNG8</th>
</tr>
</thead>
<tbody>
<tr>
<td>100x100</td>
<td>100x100</td>
</tr>
<tr>
<td>Size: 19772</td>
<td>Size: 8734</td>
</tr>
<tr>
<td>Colors: 9138</td>
<td>Colors: 256</td>
</tr>
</tbody>
</table>

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

JPEG
Size: 52015
Colors: 72060

89% smaller
Logos/Icons/Buttons

PNG24
Size: 35503
Colors: 728

55% smaller

JPEG
Size: 16123
Colors: 12224
<table>
<thead>
<tr>
<th>Format</th>
<th>Size</th>
<th>56% smaller</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNG24</td>
<td>1623x967</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Size: 76,135</td>
<td></td>
</tr>
<tr>
<td>JPEG</td>
<td>1623x976</td>
<td>smaller</td>
</tr>
<tr>
<td></td>
<td>Size: 33663</td>
<td></td>
</tr>
</tbody>
</table>
PNG is supposed to be better than JPEG

- PNG24
  1623x967
  Size: 76,135

- JPEG
  1623x976
  Size: 33663

56% smaller
• Transition artifacts are remarkably low impact
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.JPG`
- 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 != 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

46% smaller

JPEG 100x100
Size: 2159
Quality: 50
Real Life: Facebook

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

<table>
<thead>
<tr>
<th>URL</th>
<th>Original Size</th>
<th>Optimized Size</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://static.ak.fbcdn.net/rsrsrc.php/v1/zX/r/4Plot2bO7ET.jpg">http://static.ak.fbcdn.net/rsrsrc.php/v1/zX/r/4Plot2bO7ET.jpg</a></td>
<td>398</td>
<td>349</td>
<td>12.312%</td>
</tr>
<tr>
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<td>8,938</td>
<td>6,729</td>
<td>24.715%</td>
</tr>
<tr>
<td><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></td>
<td>2,515</td>
<td>1,122</td>
<td>55.388%</td>
</tr>
<tr>
<td><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></td>
<td>2,584</td>
<td>1,079</td>
<td>58.243%</td>
</tr>
<tr>
<td><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></td>
<td>2,544</td>
<td>1,121</td>
<td>55.936%</td>
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<tr>
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<td>2,712</td>
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<tr>
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<td>2,784</td>
<td>1,242</td>
<td>55.388%</td>
</tr>
<tr>
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<td>2,694</td>
<td>1,177</td>
<td>56.310%</td>
</tr>
<tr>
<td><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></td>
<td>2,349</td>
<td>1,003</td>
<td>57.301%</td>
</tr>
<tr>
<td><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></td>
<td>2,703</td>
<td>1,201</td>
<td>55.568%</td>
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<td><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></td>
<td>2,567</td>
<td>1,106</td>
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<td>7,441</td>
<td>5,413</td>
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<td><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></td>
<td>2,549</td>
<td>1,100</td>
<td>56.846%</td>
</tr>
</tbody>
</table>

**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
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