Dead Trees

A PUBLICATION OF QUESTIONABLE VALUE FROM William Blinn COMMUNICATIONS

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Making the Web safe for colors (or vice versa)

You've probably heard of "Web-safe colors" but there is confusion and disagreement over what that means and whether it's important to use colors that are "Web safe". The first disagreement is how many colors really are "Web safe".

Many think the number is 256 because early computers had video systems that would create 256 colors. But that's wrong.

Those who have studied how computers make colors know that both Windows and the Mac OS reserve about 20 colors each for use by the operating system. Unfortunately, most of these 40 colors (20 for each OS) aren't the same even though they're within the base 256 colors. So maybe the correct number of "Web safe" colors is really 216. But that's wrong, too.

In fact, because of the various standards in use for producing colors, the true number of "Web safe" colors is really somewhat smaller. The folks at Webmonkey claim the real number is 22.

Right. Just 22. Now while one might design a text-based website with just 22 colors, any attempt to reproduce a photograph with 22 colors (even 22 colors optimized for the image) would be hideously ugly.

So nobody is going to design for the "Web-safe 22 color palette". Nobody.

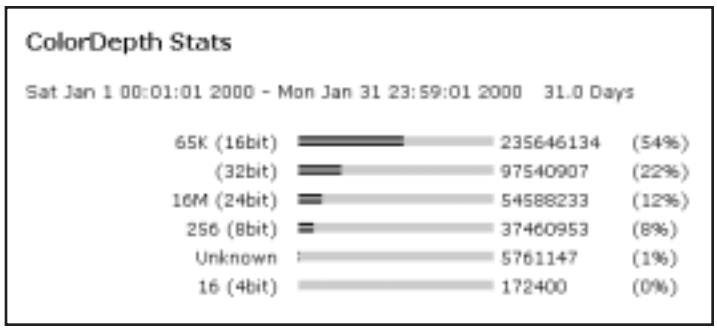
To understand why this problem still exists requires examining a small amount of the history of personal computers.

Producing color

Creating color on a computer monitor is an optical illusion. Only 3 colors exist inside the monitor: red, green, and blue (hence, "RGB monitor"). Each "pixel" is made of 1 red cell, 1 green cell, and 1 blue cell. Turn all the cells off and you get black. Turn them all on and you get white. Turn red and green on full, with blue off, and you have yellow.

Early color monitors offered only 16 colors. Any attempt to create intermediate colors resulted in "dithering", which was both ugly and, if text was involved, unreadable. The next step was a monitor that could display 256 colors: 8 possible shades for red, 8 for green, 8 for blue – 8x8x8=256. While that may seem like a lot of colors, it's far from adequate for photographic images. The eye can see millions of subtle variations and when a photograph is reduced to 256 colors, the result is "color banding": similar colors are all rendered as a single color, resulting in visible bands of color.

For a brief time, computers were sold with a "High Color" option – 65,536 colors (maybe). Some manufacturers chose to use 5 bits for each cell. Raise 2 to the 5th power and you'll get 32. 32x32x32 is 32,768. But I said 65,536 colors. That's because most manufacturers opted to double the number of colors by using an extra bit on the green cell – red and blue got 5 bits while green got 6. That's 32x64x32=65,536. This decision is still haunting us.



In January 2000, most computer users who visited websites monitored by *The Counter* had monitors that displayed "High Color".

Nearly every computer sold today comes with a monitor that can display 16,777,216 colors. Each red, green, or blue cell can be set to one of 256 possible shades (0 is off 255 is full on) and 256x256x256=16,777,216. Creating 256 numbers in binary requires 8 bits (0=00000000 and 255=11111111) so each pixel consumes 24 bits of data. You'll see this referred to as 24-bit color or 24bpp (bits per pixel). This is also called "True Color".

You'll also see some cards that claim 32bpp, but this extra processing capability is used to generate purer colors and faster displays. The result is still 24bpp.

Unfortunately, many of the people who manufacture computers seem to be clueless when it comes to setting them up. Computers arrive in homes and offices set to display just 256 colors. Or worse. Some come set to "High Color", which is probably the worst possible choice.

I recently had to reload the operating system on my Apple iBook and was reminded that even Apple's default is "High Color". It appears that Windows XP will automatically select "True Color", but users should check these settings.

The trouble is, most users don't. They'll use the computer just the way it came out of the box, never knowing that they could make the display a lot easier on their eyes by increasing

What the heck is this?

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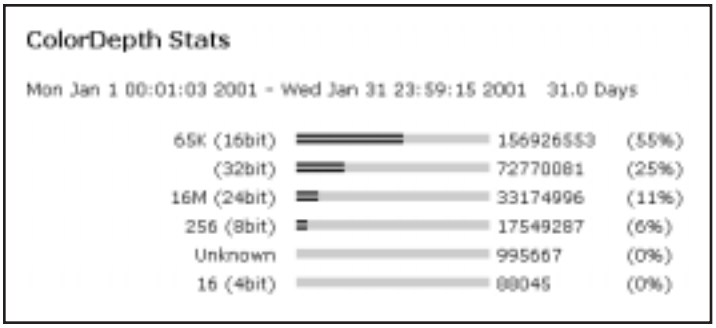
the refresh rate to 70 Hz or higher, but that's another story. They'll not investigate to learn whether they can set their 19-inch monitor to a resolution higher than 800x600. And they won't change the color depth to 24bpp.

Because of this, most users will come to your website with a monitor that's capable of displaying only 65 thousand colors while your website has photographs and graphics that contain nearly 17 million colors. If you assume this is no big deal and that your 17 million colors will somehow magically be mapped to the user's 65 thousand colors, you're wrong.

Do you want to know how many colors the 16bpp palette shares with the 32bpp palette? Two.



In January 2001, most computer users who visited websites monitored by *The Counter* had monitors that displayed "High Color".

Whaaaaaaaaaat!?

That's right. Just 2. Black. White. Nothing else is an exact match. Not even a nice shade of middle gray.

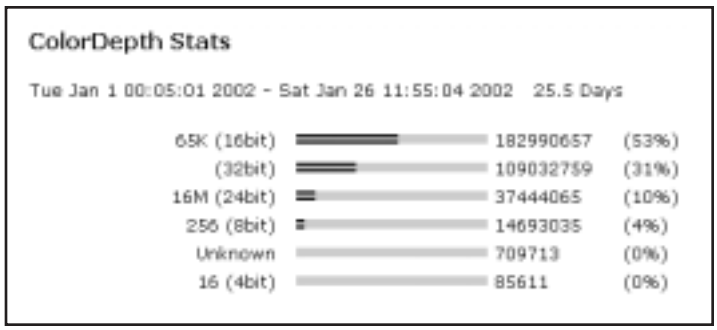
The reason is a bit (pardon) complicated. I'll make this as painless as I can, but read the following 3 points as many times as necessary because it's critical to understanding the problem.

- In the 16bpp palette, any displayable color will be one of 65,536 and these colors will be made up of evenly distributed values of red, green, and blue. If you express this as a percentage, the smallest percentage change of red and blue will be 3.226% while the smallest percentage change of green will be 1.587%.
- In the 24bpp palette, any displayable color will be one of 16,777,216 colors and these colors will be made up of evenly distributed values of red, green, and blue. If you express this as a percentage, the smallest percentage change will be 0.391%.
- With the exception of black and white, none of the percentage values will coincide. So for 16,777,214 of the 16,777,216-color palette, the 65,536-color palette will have to select either a close match or dither the color.

Depending on the video card, the result might be acceptable or horrible. **There's no good way to predict the result.**

How widespread is the problem?

I said that "most" website visitors are using "High Color" and I can back that up with numbers thanks to *The Counter,* an on-line service of Internet.com. Counter software is installed on tens of thousands of websites and The Counter routinely makes summary information available.



In January 2002, most computer users who visited websites monitored by *The Counter* had monitors that displayed "High Color". Do you see the same trend I do? The number of computers that display "High Color" doesn't seem to be changing much! Why?

For January 2002 (based on 392 million visits through the 25th), 53% of the people visiting sites monitored by The Counter were using High Color. 31% reported 32bpp and 10% reported 24bpp (both are True Color) and 4% have 8bpp (256 color) monitors. Less than 1% are still using ancient 16-color monitors.

In January 2001, 55% had 16bpp monitors and in January 2000, 54%. As long as manufacturers continue to ship computers with incorrect settings, this problem will not go away.

And the solution is ...?

Use black and white only? Stick with 22 colors? Use the 16bpp palette? Go with 24bpp colors?

The solution is to make your own decision. For my own website and for most of the websites I'm involved in today, I recommend using True Color, but sticking with the "Web safe" colors for any large areas of color that will have text over them. There are other solutions, equally valid. For a site that's aimed at graphic designers, for example, I would use True Color everywhere. The best solution is the one that most closely matches most of your site's visitors.

And don't even get me started on gamma ....

Friend and client Jim Vormelker had some problems upgrading his computer to MSIE 6, and I made the image at the right for him as desktop "wallpaper". Want a copy? Send me an e-mail (bill@blinn.com) and tell me your screen's resolution!