VIDEO COMPRESSION, BANDWIDTH and STORAGE

Compression ratio relative to uncompressed HDTV	SDTV	Format	KB/frame (approx.)	MB/sec (@30fps)	Mbps (@30fps)	Storage/GB (min:sec)
100x		70mm IMAX (15-perf)	400,000			0:00.1
9x		35mm film (4-perf)	38,000			0:01
1:1		**Hi-def 1080i uncompressed**	4,050	120	950	0:08
2:1		Hi-def 720p uncompressed	1,800	53	420	0:19
		PAL	800	20*	160*	0:51
6:1	**1:1**	**NTSC** (480i) — UNCOMPRESSED "D1" or CCIR / ITU-601	680	20	160	0:51
	2:1	Digital Betacam	375	12	95	2:00
	3:1					
	4:1	M-JPEG: "AVR 77" — BetaSP				
	5:1	DV, MiniDV	125	3	25	4:30
	6:1					
50:1	8:1	MPEG-HDTV (1080i, 720p)	80	2.4	19	7:00
	12:1	S-VHS or Hi-8	50			11:20
	16:1	MPEG-SDTV/DVD (480i)	40	1.2	9.8	15:00
	20:1		30			19:00
	30:1	M-JPEG: "AVR 4" — VHS	20			28:00
	120:1	DSL / T-1	6	0.2	1.5	80:00
	500:1	STREAMING VIDEO — 300Kbps stream	1	0.04	0.3	450:00
	2500:1	56K modem	0.2	<0.01	0.05	2000:00

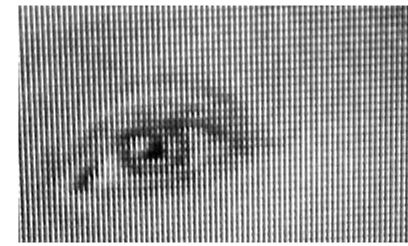
NOTES: This table represents compression on the vertical scale, **not image quality**. Picture quality varies depending on the compression scheme used, and not simply based on the resulting amount of data per frame; for example, MPEG looks better than Motion-JPEG at the same bit rate.

Formats listed in gray are approximate digital equivalents for analog media.

* PAL has more scan lines (and hence, more data) per frame than NTSC does. But with fewer of those frames per second (25 instead of 30), it amounts to the same overall data rate as NTSC.

PIXELS

"SQUARE" VS "NON-SQUARE"



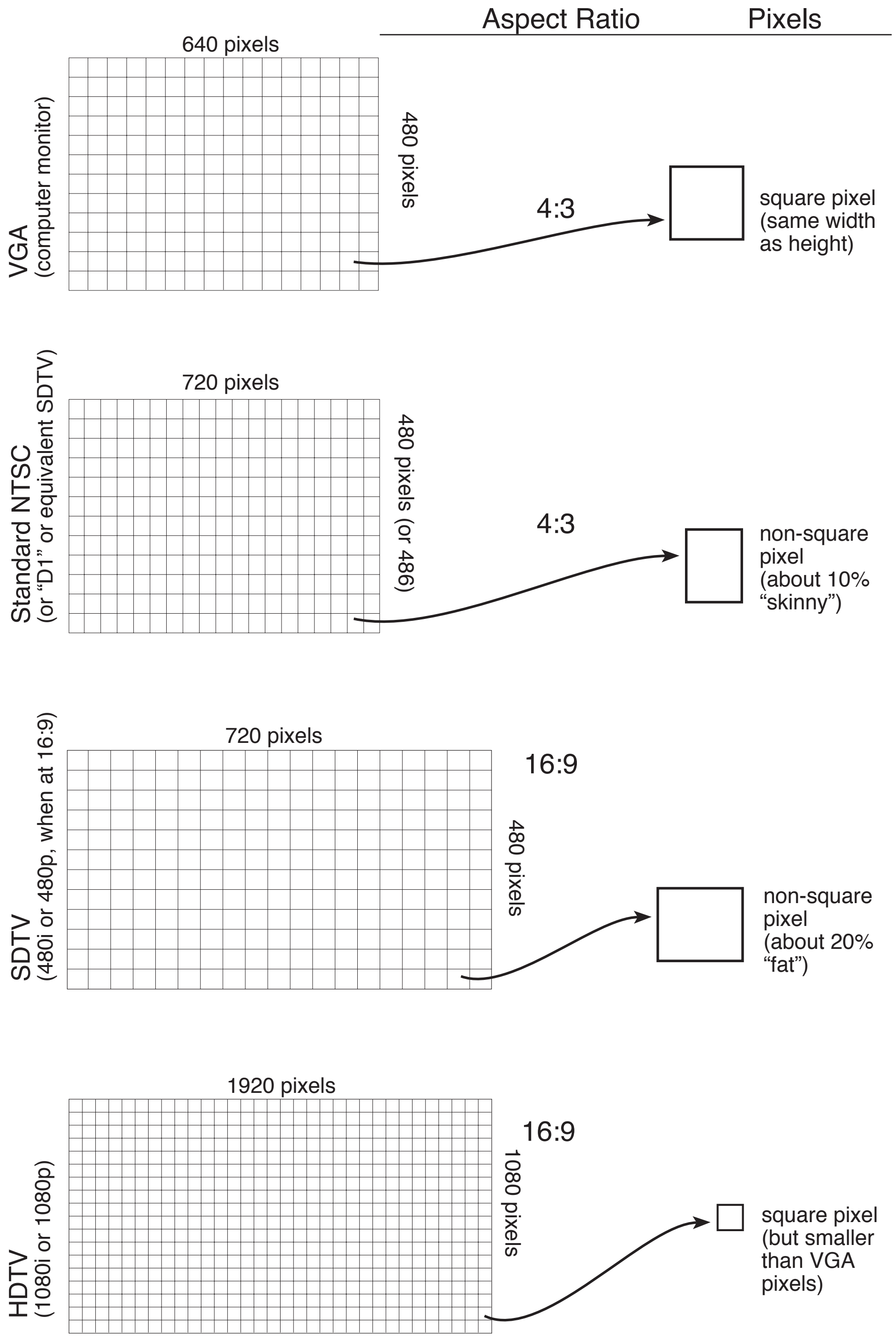
As you know, a pixel is the fundamental picture element of digital images. Analog TV monitors technically don't have pixels, but red, green and blue dots which, in groups of three, approximate a picture element. But for the moment, let's discuss both analog and digital displays as having pixels. This is, for all practical purposes, the case.

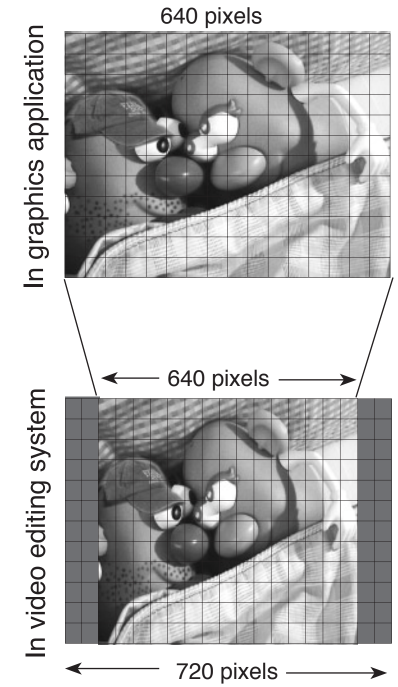
If you design a bitmapped graphic (for example, in a desktop application like Photoshop), and then import it into your video editing application, the image will generally end up looking "squished." The problem represents one of the fundamental differences between computer video and broadcast video—each uses pixels that are different shapes.* Why? It's because the two types of video come from different pedigrees—computer display resolutions (640x480, 800x600, *etc.*) use nice, round numbers that are even multiples of 4x3. NTSC and PAL video gear, on the other hand, is based on the different "D1" (or "ITU-R BT.601") standard for professional video, which uses awkward numbers like 720x486 (for NTSC) and 720x576 (for PAL) that aren't really multiples of anything.**

Some savvier graphics applications (After Effects, for example) understand these "non-square" pixels and will handle the conversion work for you, but many don't. In that case, you'll need to compensate somehow, either when exporting from the graphics application, or when importing into the nonlinear editing system. Since the particulars will vary depending on the system in question, you'll want to check the documentation for your software, or ask a knowledgeable user. Knowing that there is such a difference in the first place, though, means you're already halfway to mastery of pixel nightmares; it also will give you an appreciation for the

* OK, technically, pixels aren't really shapes at all, but infinitesimally small points spaced evenly across the screen. But since the practical upshot is the same, we're going to overlook this little detail.

** 720 pixels across was chosen as a middle-of-the-road compromise, in order to create a single standard that could be used to handle both NTSC and PAL using similar digital hardware. The result? A number that's pretty non-intuitive in both cases.





work being done on your behalf by those developing standards for digital television.

The organizations and individuals who created DTV were keenly interested in a truce between the computer and the broadcast video worlds (the much-used rallying cry is "convergence!"), so they've simplified things once again by using nice, square pixels for HDTV.

If you take a closer look at HDTV, notice how much smaller those pixels are, as compared to standard TV pixels. That's precisely the idea, of course: smaller pixels mean finer detail.

The other issue with regard to pixels is that size measurements cannot be made based on absolute dimensions (inches, points, *etc*.) on a display because the actual dimensions are in pixel units. 24-point type in a word processing program may be some other size on a VGA display; it depends mostly on the size of the display and its resolution. Another time this is particularly noticeable is in frame sizes for video when played on different computer monitors. A 640x480 video window (a professional resolution for broadcasting or graphics) may fill a TV monitor, but on a typical 1024x768 pixel computer monitor, it only takes up about 60% of the window; it is even smaller on a high-resolution monitor. At right are two examples of 4:3 displays; notice the significant discrepancy in the relative "size" of a 640x480 window. Also realize that streaming web video that plays on computer displays is often small: 320x240 would be a quarter of these imbedded windows. The impact of these variations on framing, titles, and even editing itself is important.