

# Project Settings, resolution, aspect ratios

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Hi. Love the software. I use it to render DVDs and it works wonderfully. However, as Blu-Ray expands and other video delivery methods do as well I think it's time to sort out a major flaw and misunderstanding which results in limited and sometimes erroneous profile settings. This is a TRIVIAL fix to perform but NOT trivial to workflow. I cannot contribute since I can't code. Apologies.

I've read through as much DVD material you can get without subscribing to the DVD forum and scoured forums of videographers, editors, broadcasters, Adobe, Sony, et al. I've pored over the materials for H.262/MPEG-2 (used by DVD), and H.264/AVC and ITU Rec 601 (SDTV) and Rec 709 (HDTV), the Blu-Ray specifications, and more. They use Sampling Aspect Ratio (SAR) in the terminology.

Many DVDs and MPEG-2 demand either a SAR of 1:1, a DAR of 4:3, a DAR of 16:9, or a DAR of 2.21:1. DVDs only subscribe to DAR 4:3 and DAR 16:9. Since only 720x480 resolution is widescreen compliant (why oh why!) this means that you must use a DAR of 16:9 exactly.

MPEG-2 does not allow for horizontal blanking at the edges; all horizontal pixels must be used.

This created a conflict with broadcasting and D-1 and ITU Rec. 601. Rec. 601 defined a sampling rate of 13.5 MHz. This meant that 525-line 60 Hz systems collected 720 samples per line and 625-line 50 Hz systems collected 720 samples per line, too.

The active line length is 53.33 microseconds This meant that, of those 720 samples, only 711 samples had video data in them under 525/60 systems and 702 samples under 625/50 systems. 525/60 systems ceased using the top three and bottom three "visible" lines. Latter-day NTSC only used 480 lines, cropping the top 3 and bottom 3 (though DV systems usually cropped the top 4 instead). To maintain a 4:3 aspect ratio, only the center 702 pixels were used. Hence an "active" image area of 702 horizontal pixels. The actual NTSC broadcast of 480i is still 711x486 sampled at 13.5 MHz with a 59.94 HZ refresh, but the leftmost 5 pixels, the rightmost 4 pixels, the top 3 lines, and the bottom 3 lines are all blank.

Why capture at 720x480 and 720x576 under D-1? Because the systems were not always centred perfectly. It was best to capture too much and crop later. Whether or not those padding pixels were cropped before transmission, the pixel aspect ratios were roughly 10:11 (and not 8:9) for 525/60 systems. If you did not crop the pixels before analog transmission on a 13.5 MHz signal, then the TV would simply ignore them since they were transmitted in a "dead" zone after the sync pulse but before the TV would accept video signals and begin scanning.

DVDs sourced from DigiBeta or analog were sampled at 13.5 MHz had about 702 horizontal pixels of active area and 18 pixels of near black. These DVDs would ideally get a SAR of 10:11 or 40:33 and a DAR of 15:11 or 20:11. The picture would be cropped during analog transmission if the output card's signal ran at 13.5 MHz. If the signal were digital, the monitor could display an image with a DAR that was slightly wider than "normal" with thin dark bars at the sides or the monitor could crop those bands. DVDs sourced from film usually used all 720 horizontal pixels upon resize. These DVDs would ideally get an SAR of 8:9 or 32:27 and a DAR of 4:3 or 16:9.

MPEG-2 only permitted DARs of 4:3 and 16:9 and 2.21:1 exactly or a SAR of 1:1, and DVDs didn't allow anything other than 720x480 to be available in widescreen, so we got 720x480 with a DAR of 4:3 or 16:9 exactly (PAR of 8:9 or 32:27 or 16:15 or 64:45).

ATSC's implementation of MPEG-2 has side-stepped the whole issue by using 704 horizontal pixels. This meant no horizontal blanking at the edges of the signal. A straight resize of DAR of 4:3 or 16:9 results in 640x480 or 854x480. A faithful SAR of 10:11 also resulted in 640x480 or 854x480.

For H.264/AVC the ITU and ISO got their stuff together and looked at the original ITU Rec. 601 again. They decided that NO DAR would be used. From now on, it was SAR only. The available choices included 1:1, 10:11, 40:33, 12:11, 16:11 and others to accomodate for other resolutions (like 20:11 and 24:11 for 352 pixel images, and 4:3 for 1920x1080 downsampled to 1440x1080).

This meant that 704 pixel wide images would have a SAR of 10:11 or 40:33 resulting in happy 640x480 and 854x480. 720 pixel wide images and 480 pixel wide images are explicitly labelled in the handbook as having "horizontal overscan" (actually horizontal sampling). This means that when these get stretched out, they result in 654x480 and 874x480.

This ratio for SVCD is in H.264 and in Kdenlive. Hurray! Kdenlive acknowledges that 480x480 with a Sampling Aspect Ratio of 15:11. This results in an image with DAR of 15:11 and the wizard lists it as 4:3 exactly, but no matter, the project is at 480x480 with the correct Sampling Aspect Ratio.

So... why can't I make videos with 720x480 with a SAR of 10:11 and 40:33 under H.264 in the Project Settings? Why can't I make a MPEG-2/H.264/ATSC compliant project with 704x480 resolution?

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SOLUTION: Add project settings for

- + ATSC-SD that is 704x480 with an SAR of 10:11 and DAR of 4:3 (Rec 601 Color)
- + ATSC-SD Wide that is 704x480 with an SAR of 40:33 and DAR of 16:9 (Rec 601 Color)
- + Blu-Ray NTSC that is 720x480 with an SAR of 10:11 and DAR of 15:11 (Rec 601 Color)
- + Blu-Ray NTSC Wide that is 720x480 with an SAR of 40:33 and DAR of 20:11 (Rec 601 Color)
- + Blu-Ray PAL that is 720x576 with an SAR of 12:11 and DAR of 15:11 (Rec 601 Color)
- + Blu-Ray PAL Wide that is 720x576 with an SAR of 16:11 and DAR of 20:11 (Rec 601 Color)
  
- ~ SVCD NTSC that is 480x480 with an SAR of 15:11 \*and a DAR of 15:11\* (Rec 601 Color)
- ~ SVCD PAL that is 480x576 with an SAR of 59:36 \*and a DAR of 15:11\* (Rec 601 Color)

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Also, none of this has anything to do with overscan. That is a phenomenon caused not by analog sources but by the Cathode Ray Tube. All TVs too could be adjusted to "zoom" out, but that created an ugly pincushion effect as the light bent inward on dark scenes and so was not adopted. Sampling 720 pixels is about oversampling. An analogue transmission is not nonstop waveforms. There are gaps. The CRT or the LCD TV or whatever will ignore any noise or waves that appear in these windows (measured in micro seconds). Overscanning is simply zooming in "too far". Shooting title safe and action safe meant that directors would put important stuff in the middle 400 lines out of 480 since the CRTs would cause some minor distortion at the edges or the bezel would hide the corners.

PiTiVi has sort of acknowledged this. Though the author ascribes it to being a difference between progressive and interlaced systems.

If I've explained this all too poorly, check out <http://lipas.uwasa.fi/~f76998/video/conversion/> [2] and anything by "edDV" on <http://videohelp.com> [3]. If you check out the Adobe Premiere forums, there was a bit of confusion about this among users when it finally got corrected in CS4 and there was also some confusion when they sorted out the 601 and 709 colour spaces in CS 5.5.

## Project Settings, resolution, aspect ratios

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[1] <http://kdenlive.org/forum/users-forums/bug-reports>

[2] <http://lipas.uwasa.fi/~f76998/video/conversion/>

[3] <http://videohelp.com>