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Audio and Video Editing

Resolution Standards in Digital Video (HD, FHD, 2K, 4K, 8K)

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What is HD Video

- HD stands for high-definition video and represents the standard that succeeded video in SD resolution.
- Initially, HD was reserved for television systems and Blu-Ray, but mass production and falling equipment prices allowed it to expand into both semi-professional and amateur use.
- The HD format is recognizable by a greater amount of detail in the image, stronger contrast, a wider color palette, and the ability to reproduce multi-channel audio (surround). One of the biggest initial problems was the high price of HD cameras, monitors and recording media, but this has changed over time due to market demand and serial production.
- Today, HD video represents the minimum quality in professional and semi-professional production, and in many fields it has become a standard below which one no longer goes.

HD Resolutions and Frame Rate

- HD formats exist in two most common resolutions:
    - **1280 x 720 pixels (known as 720p)**
    - **1920 × 1080 pixels (known as 1080p or 1080i)**
- The resolution is always accompanied by the number of frames per second (fps), so HD formats end in 24p, 25p, 30p, 50p or 60p.
- The letter "**p**" stands for progressive image scanning, while "**i**" stands for interlaced scanning, where fields are displayed instead of the full frame.
- There is no interlace variant for 720p formats, all 720 formats are progressive. The most used frame rates in HD video are: 24p (film look), 25p (European TV standard), 30p (internet video), 50p and 60p (sports and fast content).

HD Resolutions and Frame Rate

Type		Resolution	Frames per second	Scan type
720	24p	1280 x 720 pixels	23,976	Progressive
	25p		25	
	30p		29,97	
	50p		50	
	60p		59,94	
1080	24p	1920 x 1080 pixels	23,976	Progressive
	25p		25	
	30p		29,97	
	50p		50	
	60p		59,94	
	50i		25 (50 fieds per second)	Interlaced
	60i		29,97 (59,94 fieds per second)	

FPS	**Usage today**
24p	Film, Netflix, “cinematic look”
25p	Europe, PAL TV standard (Serbia, EU)
30p	YouTube, streaming, social media, USA
50p	Sports TV broadcasts, HD broadcast
60p	Gaming, sports, high-motion YouTube content

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HD vs SD

- Compared to SD video (576 visible lines in PAL format), HD format brings multiple times higher resolution and higher image clarity.
- The standard SD video 720×576 has been replaced by HD formats 1280×720 and 1920×1080, with a 16:9 aspect ratio that has become the global widescreen standard.
- Higher image quality requires more attention to set design, lighting and framing, because HD reveals details that SD could not display.
- Due to the wider frame format, especially in sports broadcasting, a change in framing mode is required – less zooming, more tracking of the action in the width of the image.
  In the USA, the development of HDTV systems was the fastest precisely in the domain of sports broadcasting, because HD enabled a much more realistic display of live events.

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HD in the Film Industry

- High definition on film uses formats even higher than standard HD video, with more extensive color processing per channel (e.g., 4:4:4).
- The most well-known digital film formats are **2K (2048 pixels horizontally)** and **4K (4096 pixels horizontally)**, which provide a image quality comparable to 16 mm and 35 mm film stock.
- The HDV 1080p format in the 24p version became especially popular because it preserves the structure of film motion that audiences are accustomed to seeing in cinemas.
- Almost all HD formats intended for film use are recorded in 24p, because that frame rate provides a natural, film-like motion appearance and long-term compatible archival material.
- Digital HD in film not only introduces higher image quality but also simplifies post-production, because it allows working without scanning film stock and without quality loss.

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HD on Computers

- Computers represent a natural environment for working with HD video due to the ability to display high-resolution images on monitors. If the computer screen is the same resolution as the video file, the display is completely accurate without additional scaling.
- However, HD video can burden the computer when working with compressed formats, so conversion to a less compressed format is sometimes required for stable editing.
- For easier work with HD material, the use of faster hard drives (min. 7200 rpm) is recommended, as well as RAID systems that provide high data throughput. Laptops with slower drives (5400 rpm) often have problems working with higher HD bitrates, so the solution is to use external drives connected via USB 2.0, FireWire 400/800 or eSATA ports.
- Processor speed and GPU acceleration also play a significant role in real-time playback and rendering of HD video.

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HD Recording Formats (Basic Overview)

- HD video can be recorded on different media: tapes, memory cards, professional discs, or higher-capacity hard drives. The most well-known HD recording formats are: **HDV, XDCAM HD, XDCAM EX, DVCPRO HD** and **AVCHD**.
- HDV is a format that uses miniDV tapes and is suitable for semi-professional equipment, while XDCAM and DVCPRO HD use discs and memory cards, which enable faster material transfer.
- Professional HD formats mostly use higher bitrates (e.g., 50–100 Mbps), less compression, and better color quality (4:2:2 or 4:4:4).
- Amateur and consumer HD formats, such as AVCHD, are based on stronger compression (H.264), which allows smaller file size but requires a more powerful computer for editing. The recording medium also affects the workflow – tape requires real-time transfer, while cards and disks enable instant import into editing software.

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HDV Format

- The HDV format was developed as an affordable HD solution for semi-professional and amateur equipment, based on miniDV tapes.
- Recording is done in MPEG-2 format, at a bitrate of 19 Mbps for 720p or 25 Mbps for 1080i/p, which provides relatively good quality with a small file size.
- The HDV format is designed for cameras that work in real time and allows you to transfer the footage via a FireWire connection directly to your computer. This format still uses tape as a medium, so importing material takes as long as the recording itself.
- Although it is considered to be the initial HD format, HDV has had a great impact as it has enabled an affordable entry into HD production without major investments.
- It was most commonly used in documentary production, educational videos, weddings and TV shows of lower budget.

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XDCAM HD and XDCAM EX

- XDCAM HD is Sony's professional HD format that uses a 23GB optical disc (PFD) as a recording medium.
- Recording is done in MPEG-2 format at bitrates up to 35 Mbps, which enables better image quality compared to HDV.
- The later version of XDCAM EX uses SxS memory cards, which allow much higher write speeds and faster workflow without real-time transmission.
- These formats are intended for professional television and documentary production and have become the standard in many TV companies.
- Due to recording stability, reliable media, and metadata storage, XDCAM was the dominant broadcast format for a decade.

DVCPRO HD Format

- DVCPRO HD is Panasonic's professional HD format developed based on DVCAM and DVCPRO formats.
- t uses a 1.67:1 compression ratio and 10-bit color recording, with 8 audio channels, which makes it stable and visually high-quality.
- DVCPRO HD provides color subsampling at 4:2:2, suitable for color correction and keying in post-production.
- Recording is done in resolutions 960×720, 720p, 1280×1080 or 1080i, using image decimation (downsampling).
- The most common media used are P2 memory cards, and material is transferred to a computer via FireWire or USB faster than real time.
- This format was a long-time favorite in television production and field ENG cameras due to reliability and fast transfer.

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AVCHD Format

- The AVCHD format was developed jointly by Sony and Panasonic, as an HD solution for amateur and semi-professional use.
- It uses the MPEG-4 AVC/H.264 codec, which allows high compression and significantly smaller file size compared to HDV and XDCAM.
- Audio is most often recorded in Dolby AC-3 format, while professional models also support linear PCM audio.
- AVCHD is compatible with Blu-ray discs, standard DVD, external hard drives and various types of memory cards.
- Due to the high compression, this format requires a significantly more powerful processor and graphic acceleration during editing.
- Although it belongs to the consumer class, AVCHD is also used in serious productions when long-hour recording is required with minimal storage space.

HD and Full HD

- **HD (720p)** has a resolution of 1280×720 pixels and is considered a basic high-definition format.
- **Full HD (1080p)** has a resolution of 1920×1080 pixels and has largely replaced HD in modern production.
- Full HD offers about **twice as many pixels as HD**, making the image sharper and the details more visible.
- Most TVs, monitors, phones and streaming platforms today use Full HD as the minimum quality.
- However, 720p is still used in live streaming, sports broadcasts, and situations where a lower bitrate is more important than maximum resolution.

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Full HD, 2K, UHD, 4K and 8K

- After Full HD, resolutions with an even higher number of pixels appear – 2K, UHD, 4K and 8K.
- **2K** is a film resolution standard of 2048 px width and is used in cinemas (DCI standard).
- **UHD (Ultra HD)** has 3840×2160 pixels and is often referred to as “4K for TV”, since it is used in streaming services (YouTube, Netflix, etc.).
- **True 4K (DCI 4K)** has 4096 px width and is used in professional film production.
- **8K** is the format of the future, with a resolution of 7680×4320, but in practice it is rarely used due to the enormous file size and editing requirements.
- Higher resolution means more detail, but also larger files, a more powerful computer, more memory and longer render time.

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HD, Full HD, 2K, UHD, 4K and 8K

Label	Resolution (px)	Common Name	Typical Use
HD (720p)	1280 × 720	HD	YouTube, live streaming, TV sports
Full HD (1080p)	1920 × 1080	1080p	TV, online video, smartphones, DSLR
2K (DCI)	2048 × 1080	Cinema 2K	Film projection
UHD (4K TV)	3840 × 2160	4K UHD	Streaming, TV production
4K (DCI)	4096 × 2160	DCI 4K	Cinema cameras, film mastering
8K	7680 × 4320	8K	Experimental, high-end VR

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Codec and File Format

- Many beginners think that the video file is "one thing", but Premiere Pro makes a clear distinction between containers (.mp4, .mov, .mxf) and codecs (H.264, ProRes, DNxHD).
- If Premiere “stutters” during playback, the problem is usually not the resolution, but the codec that is too compressed (H.264, HEVC).
- One .mp4 file may work smoothly, while another may completely overload the system – even though they have the same extension.
- Therefore, in professional editing, material is often converted into “editing codecs” such as ProRes, DNxHD or Cineform.
- Understanding the difference between format and codec helps you know whether import, transcode or proxy is the better choice.

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Compressed vs Editing Formats

- Formats such as H.264, AVCHD or HEVC are ideal for recording, but poor for editing because each frame must be “unpacked” during playback.
- Premiere does this in real time, which heavily loads the CPU and leads to frame drops, audio glitches or image freezing.
- Therefore, transcoding is often done into a format that is easier to edit — ProRes, DNxHD or Cineform (less compression, but much more stable playback).
- If color correction, stabilization, keying or effects are used in the project, compressed formats decompose quickly and lose quality.
- In simplest terms: *“Record in what you must, edit in what works best.”*
  Premiere Pro does not have a problem with large files – it has a problem with "heavy" codecs.

Bitrate and File Size

- Bitrate determines how much data is processed in one second of video — and this directly affects how much storage the material will take and how hard Premiere will be loaded during work. Examples from practice:
    - 1h HDV = ~13 GB
    - 1h XDCAM = ~50 GB
    - 1h ProRes 422 = ~70–80 GB
- If the learner has, for example, 4 hours of recordings, this can mean from 50 GB to over 300 GB - depending on the format.
- Premiere does not copy the video to the project, but works directly with the original files, so the organization of the disk and folder is crucial.
- If files are moved or deleted, Premiere loses the links — this is the most common beginner mistake. Practically: before editing, always check the format, bitrate and available space — it saves hours of trouble.

Color Sampling (4:2:0 vs 4:2:2)

- 4:2:0, 4:2:2 and 4:4:4 indicate how much color information is stored in relation to luminance (brightness).
- If you are making a simple video without heavy effects — 4:2:0 is completely sufficient (DSLR, phone, YouTube).
- If you are doing chroma key (green screen), color correction or broadcast quality — 4:2:2 is the preferred minimum.
- 4:4:4 and RAW are used in the film industry, but they require enormous data throughput and memory space.
- Premier Pro can edit all these formats, but the quality of the grading depends on the input signal — the software cannot "invent" a color that does not exist. Practically: *if you know you're going to be doing heavy color grading* — record *in 4:2:2 or* RAW*, not 4:2:0.*

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Framerate and Timeline

- If a video is recorded at 25 fps, it must be placed in a 25 fps timeline — otherwise the image stutters and motion looks unnatural.
- Premiere Pro will not "magically fix" framerates; conversion to 30fps or 24fps always has consequences (duplication of frames, drop-frame, motion blur).
- Therefore, the framerate is not adjusted "along the way", but before the editing begins — when the sequence is created.
- If the project has multiple framerates (e.g. 25fps + 50fps), slow motion in 50fps can be perfectly smooth in a 25fps timeline.
- The most important rule: *timeline fps should match the majority of the footage, not the other way around.*
- Mixed Recording Solution: Use “Interpret Footage” in Premiere.

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Sequence Settings in Premiere Pro

- Properly set sequence settings prevent problems that later become hard to fix.
- The three most important parameters are: resolution, framerate and pixel aspect ratio.
- If the timeline is created automatically via the “drag & drop” method, Premiere will take the format of the first clip dropped in — which is often not the intended setting.
- The audio sample rate (48 kHz) must be aligned with the video material in order to avoid problems in the export.
- The rule always applies: *Project settings are not the same as Sequence settings.*
- Before starting work, it is best to manually create a sequence with the correct parameters and only then import the material.

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Questions & Answers

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