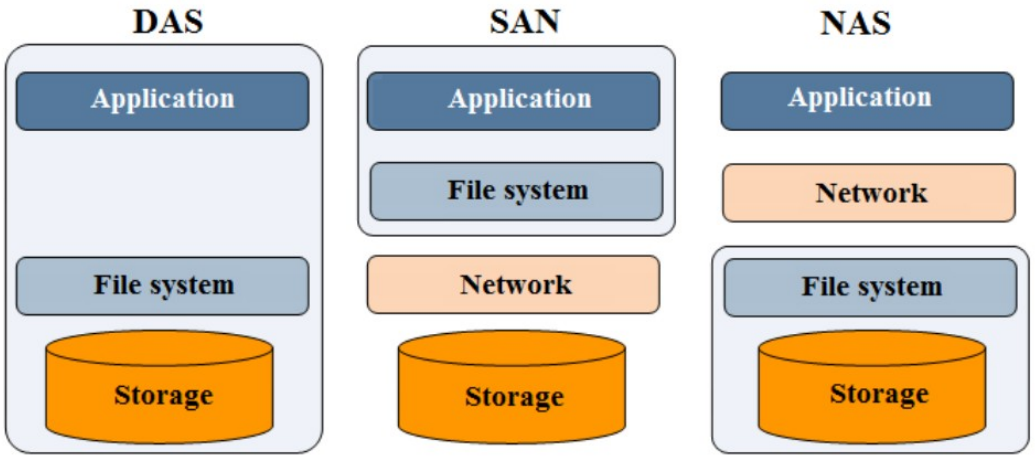
Content storage architectures

- DAS: Directly Attached Store
  - allocates storage resources only to the computer it is attached to
- SAN: Storage Area Network
  - network storage provides a common pool of storage that can be shared by many servers
- NAS: Network Attached Store
  - NAS is a device/equipment/server attached to TCP/IP network, that shares its own storage with other's.
  - It uses Ethernet connection for sharing files over the network and so it is accessible over the network through an IP address.



Content storage architectures

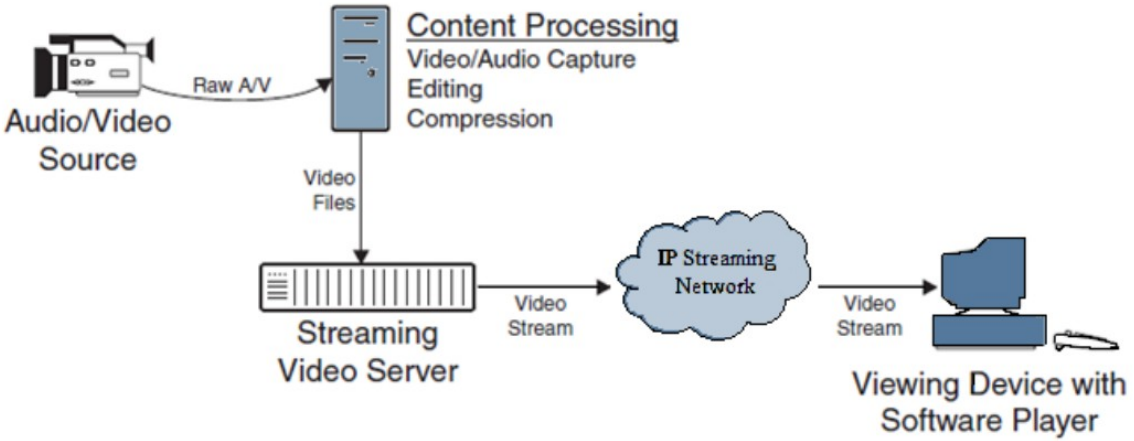
SAN	NAS
Block level data access	File Level Data access
Fiber channel is the primary media used with SAN	Ethernet is the primary media used with NAS
SCSI is the main I/O protocol	NFS/CIFS is used as the main I/O protocol in NAS
SAN storage appears to the computer as its own storage	NAS appears as a shared folder to the computer
It can have excellent speeds and performance when used with fiber channel media	It can sometimes worsen the performance, if the network is being used for other things as well
Used primarily for higher performance block level data storage	It is used for long distance, small read and write operations

The Common Internet File System (CIFS) is the standard way that computer users share files across corporate intranets and the Internet. An enhanced version of the Microsoft open, cross-platform Server Message Block (SMB) protocol, CIFS is a native file-sharing protocol in Windows 2000.

Live feeds

- 1. DVB-Satellite
  - The DVB-S (Digital Video Broadcasting — Satellite) prepares a digital MPEG transport for satellite transmission.
  - The standard for DVB-S is similar to the standard for DVB-T (Digital Video Broadcasting — Terrestrial), except from using different the modulation techniques.
  - The key features in DVB-S are: changing encoding parameters in real time, Variable Coding and Modulation (VCM) and Adaptive Coding and Modulation (ACM).
- 3. DVB-Terrestrial
  - In 1998 the terrestrial system was standardized. Due to harder environment, like multipath propagation and different noise characteristics, the terrestrial system needed to be more complex. It uses of the existing VHF (Very high frequency) and UHF (Ultra high frequency) spectrum allocation of the old analogue system.
- 5. DVB-Satellite 2nd Generation
  - DVB-S2 was developed in the DVB Project in 2003 and became the second generation specification for satellite broadcasting. It features better modulation and coding.
- 4. DVB-Handheld
- 2. DVB-Cable

Live feeds


Content Processing
Video/Audio Capture
Editing
Compression
Raw A/V
Audio/Video
Source
Video
Files
Streaming
Video Server
Video
Stream
IP Streaming
Network
Video
Stream
Viewing Device with
Software Player

Video transcoding

- Video transcoding is the process of converting compressed video signals to adapt video characteristics such as video bit rate, video resolution, or video codec, so as to meet the specifications of communication channels and endpoint devices.
- Video signals are compressed and decompressed with the techniques discussed under the term video coding, with compressed often denoted as enCOder and decompresser as DECoder, which collectively form the term CODEC.
- Therefore a CODEC is the collection of methods used to compress and decompress digital videos.

Media formats

- Digital video is a discrete representation of images sampled in spatial and
- temporal domain.
- In temporal domain samples are commonly taken at the rate of 25, 30, or more, frames per second.
- Each video frame is a still image composed of pixels bounded by spatial dimensions.
- Typical video spatial-resolutions are 1280 x 720 (HD) or 1920 x 1080 (Full HD) pixels.
- A pixel has one or more components according to a color space.
- Commonly used color spaces are RGB and YCrCb.
- RGB color space describes the relative proportions of Red, Blue, and Green in a pixel.
- RGB components are commonly measured in the range of 0-255, that is 8-bits for each component and 24-bits in total.
- In YCrCb color space, Y is the luminance and it is calculated as the weighted average (kr, kg, kb) of RGB: $y = kr * R + kg * G + kb * B$
- The color information is calculated as the difference between Y and RGB:
  - $Cr = R - Y$
  - $Cg = G - Y$
  - $Cb = B - Y$

Media formats

YCrCb frames could have pixels sampled with different resolution for luma and chroma.

These differences are noted in the sampling format as 4:4:4, 4:2:2, and 4:2:0.

In the 4:4:4 format, each pixel is sampled with equal resolution.

In the 4:2:2 format, chroma is at the half rate of luma.

In 4:2:0 format, chroma is recorded at the quarter rate of luma.

There are many choices for sampling a video at different spatial and temporal resolution. Standards are defined to support common

requirements of video formats.

Media formats

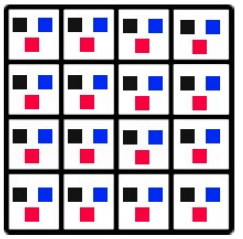
Let's pretend that we are looking at a small part of a frame – just a 4×4 matrix of pixels in an image

In this example, every pixel has a Y value, a Cb value, and a Cr value.

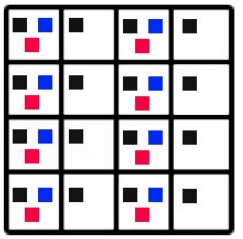
If you look at a line of pixels, and count how many Y, U, and V values, you'd say that there are 4 values of Y, 4 values for U, and 4 values of V. In color shorthand, we'd say that this is a 4:4:4 image.

4:4:4 color is a high quality standard for color. Since the human eye doesn't really notice when color is removed, most of the higher-end devices output something called 4:2:2.

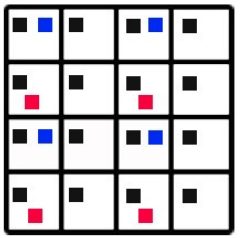
4:2:0, is used very frequently in MPEG encoding schemes



4:4:4 format



4:2:2 format



4:2:0 format

Media formats

W: width

H: height

P: Pixels per frame: WxH

B: Bits per pixel: eg 24 (3 bytes)

F: frames per second (eg 25)

BR: bit rate:

BR=WxHxBxF

Bit rates are huge: this is why compression is needed

Format	Luminance resolution	Pixels per Frame
CIF	352 x 288	101,376
4CIF	704 x 576	405,504
720p	1280 x 720	921,600
1080p	1920 x 1080	2,073,600
2540p	4520 x 2540	11,480,800

Coding/compression

Different video coding standards have been developed to satisfy the requirements of various applications.

They include providing better picture quality, higher coding efficiency and higher error robustness.

The Moving Picture Experts Group (MPEG) and Video Coding Experts Group (VCEG) are two major teams collaborating to develop digital video coding standards.

The MPEG is a working group of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

It aims at developing standards for compression, processing and representation of moving pictures and audio. MPEG-1 and MPEG-2 standards allow wide adoption of commercial products and services.

Coding/compression

The VCEG is a working group of the International Telecommunication

Union Telecommunication Standardization Sector (ITU-T).

It develops a series of essential standards for video communications over telecom-

munication networks and computer networks.

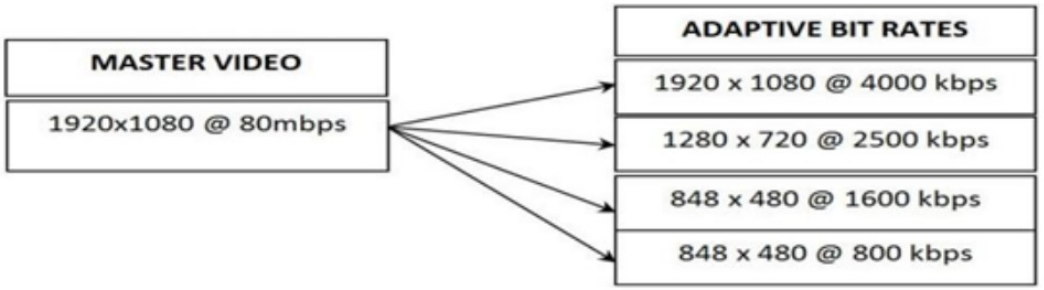
H.261: videoconferencing standard coding.

The following H.263 standard was created to improve the coding efficiency.

H.264 which is also known as MPEG-4 Part 10 delivers the same quality as MPEG-2 at a third to half the data rate, and when compared to MPEG-4 Part 2, H.264 provides up to four times the frame size at a given data rate.

Transcoding

Transcoding allows us to obtain good-quality video streams with a significantly lower bit rate than the master video



Group of pictures and I-frame interval

When transporting files via the Internet, the files need to be fragmented in order to fit into packets.

Hence, it seems like a good idea to fragment a video of for instance one minute into multiple parts of some seconds each.

Thus, the video/audio source is cut into many short segments with an encoding of the desired delivery format.

These segments are typically 2 to 10 seconds long.

The length of the segmented chunks are usually organized as group of pictures (GOP).

GOP is a group of successive pictures within a coded video stream.

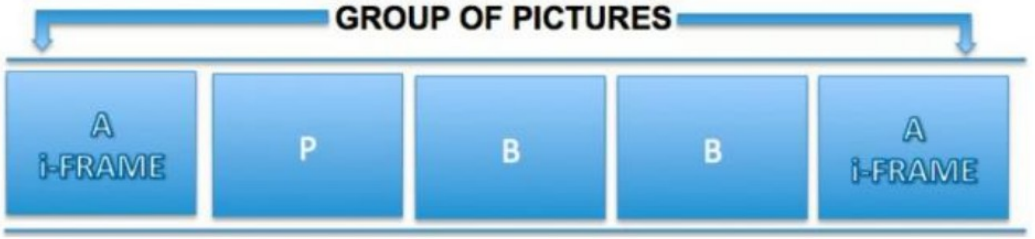
When compressing large video sources for transport, a usual technique is to reduce redundancy information in the images the video resource is made of.

GOP consists of different kind of picture frames, for example MPEG-2 uses three frame types I, P, and B frames [14].

GOP always begins with a reference picture, an I-frame interval.

Essentially it refers to the need for a reference frame from which guesses can be made about the subsequent frames.

Every video segment contains at least one I-frame. The I-frame is the only MPEG-2 frame type which can be fully decompressed without any reference to frames that precedes or follows it. It is also the most data-heavy, requiring the most disk space



Group of pictures and I-frame interval

The frames in between Key frames are called P-Frames (predictive coded picture) and B-Frames (bi-directionally

predictive).

The P-frames are forward predicted from the last I-frame or P-frame, means that it is impossible to reconstruct them without the data of another frame (I or P).

B-frames are additional reference frames, that help to improve the quality of P-Frames and the overall look of the stream.

The B-frames are both, forward predicted and backward predicted from the last/next I-frame or P-frame, means that there are two other frames necessary to reconstruct them. P-frames and B-frames are referred to as inter coded frames.