ITMO

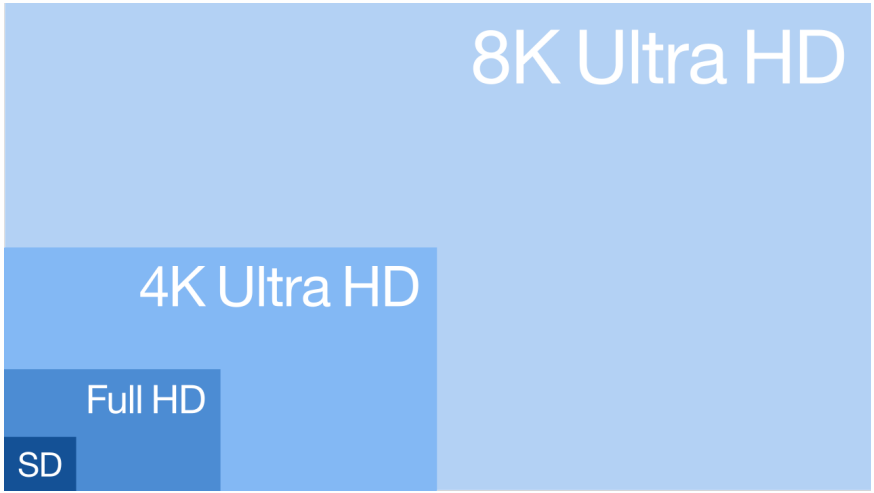
# Digital Video Sequences

## Image Processing

# Digital Video Sequences

# Digital Video Sequences and Video Formats

- EDTV PAL (576p) – 720x576 pixels,
- EDTV NTSC (480p) – 720x480 pixels,
- HD (720p) – 1280x720 pixels,
- Full HD (1080p) – 1920x1080 pixels,
- 4K UHDTV (2160p) – 3840 × 2160 pixels,
- 8K UHDTV (4320p) – 7680 × 4320 pixels,
- … .



# Digital Video Sequences and Video Formats

- Base ratio 4:2:2
- Minimum FPS for smooth movement: 16 FPS.
- Standard frequencies:
  - Full frame: 24, 25 (PAL / SECAM), 30 (NTSC) FPS;
  - Half frame: 50i, 60i FPS.
- Scan:
  - Progressive (frame DimX × DimY);
  - Interlaced (two half frames DimX × Dim(Y/2)).

# Digital Video Sequences and Video Formats

- Video streaming options:
  - Stream of digital images in standard formats: layered GIF and TIFF, stream of JPEG pictures (MJPEG).
  - Special video storage formats; the sequence of frames is encoded differently from static frames.
- Disadvantages of an image stream:
  - Redundancy:
    - Each image contains image headers (service information can take up to 10% of the size);
    - In slowly changing scenes, the difference between any two consecutive frames contains significantly less information than the original frame itself.
  - Impossibility of data aggregation, i.e. synchronization of various types data.

# Video Storage Formats: AVI

- An **AVI** (Audio Video Interleave) file is a container that contains a description of the content in a standardized way. Videos can be compressed with various algorithms.
- Disadvantage of AVI: audio and video clips do not contain timestamps or frame indices.
- Possible palettes (by color depth):
  - 8-bit black and white palette (256 shades of gray);
  - 8-bit RGB palette (256 colors);
  - 9-bit YUV9 palette;
  - 12-bit YUV (4:1:1);
  - 16-bit YUV2 (4:2:2);
  - 16-bit RGB (5 bits for red, 6 for green, 5 for blue);
  - 24-bit RGB (standard);
  - 32-bit RGB (with alpha channel).

# Video Storage Formats: MPEG

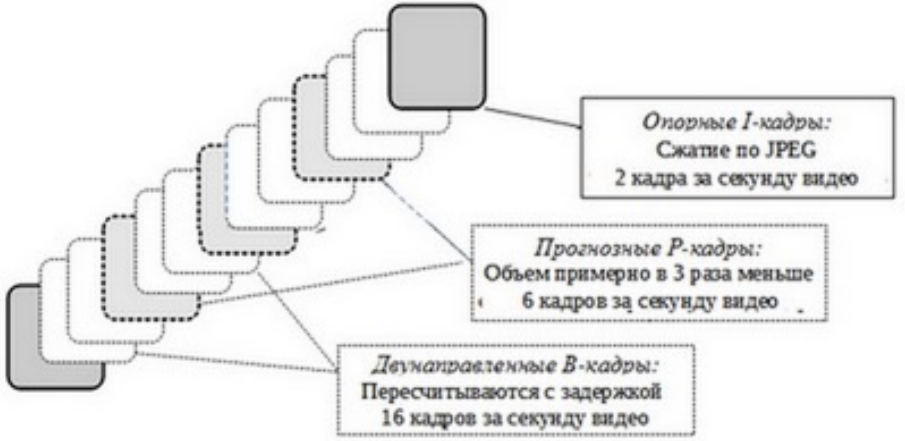
- **MPEG (Moving Pictures Experts Group)** – uses frame difference compression algorithms, i.e. uses a high redundancy of information in images separated by a small time interval, since only a small part of the scene changes between adjacent frames.
- For example: with a smooth displacement of a small object against a stationary background,
  - full information is saved only for reference images,
  - for the remaining frames, difference information is transmitted:
    - about the position of the object, the direction and amount of its displacement, new background elements that open behind the object as it moves.
  - Differences are formed both to the previous frames and to the following ones.

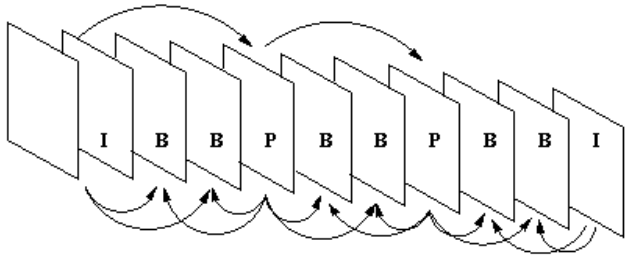
# Video Storage Formats: MPEG

- Key features:
  - Elimination of time redundancy;
  - Elimination of spatial redundancy (suppression of small details of the scene);
  - Elimination of some information about chromaticity;
  - Increasing the information density of the resulting digital stream.

# Video Storage Formats: MPEG GoPs

- Group of Pictures Sequence:
  - only **intra frames** are compressed (I-frames);
  - **predicted frames** will be included between I-frames (P-frames);
  - **bidirectional frames** are included between I- and P-frames (B-frames).
- GoP (Group of Pictures) – video sequence block: IBBPBBPBBPBB



# Video Storage Formats: MPEG Family

- MPEG-1
  - DCT is performed over the intra frames.
- MPEG-2
  - Higher coding speed due to the use of new compression algorithms and redundant information removal, allows you to choose the level of quantization.
- MPEG-4
  - Uses fractal compression of images (selection of contours (in the form of splines) and textures (in the form of DCT coefficients or wavelets)).
- MPEG-7
  - Describes information, incl. analog, presented in any form. Can compress MPEG-1, MPEG-2, MPEG-4.

# THANK YOU FOR YOUR TIME!

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