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# Unit 1 Multimedia

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# Unit 2 Graphics

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# Unit 3 Audio

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# Unit 4 Animation

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# Unit 5 Video

## 5.1 Different Video Attributes

### 5.1.1 Video Standards

**Different countries in the world have been using different video standards for broadcasting.** That is why we need a multi-system TV[[1]](#footnote-1) set to be compatible with different video standards. In Hong Kong, PAL (Phase Alternate Line) is the default television display standard while NTSC (National Television Standards Committee) is used in other countries like the US and Japan. The following table shows some common color television system and the countries that use them.

|  |  |  |
| --- | --- | --- |
| **TV display standard** | **Full name** | **Countries** |
| PAL | Phase Alternate Line | United Kingdom, Europe, Hong Kong, Mainland, China, Singapore, Australia |
| NTSC | National Television Standards Committee | United States, Japan, Taiwan |
| SECAM | SEquential Couleur avec Memoire | France, Russia |

### 5.1.2 Frames and Frame Sizes

**Digitized video** is similar to movie film in concept, which **consists of sequence of frames** (which differs only slightly from the previous frame) **accompanied with an audio track**. When slightly different successive frames are displayed on the computer screen very rapidly, such as 24 frames per second, our brains interpret these as a continuous motion. This phenomenon is known as the "persistence of vision".

Among different multimedia elements, video consumes the most computer resources. **The larger the frame size of a digitized movie, the more image details involved, and the more computer storage is needed.** Figure 5-4 shows some common video frame size used in multimedia productions. The ratio of the video width to its height is called "aspect ratio".

### 5.1.3 Frame Rate

**The frame rate is the number of frames or images that are projected or displayed per second, usually measured in frames per second (fps).** The higher the frame rate (above 24 fps), the smoother the video motion will be. Videos with low frame rates (below 12 fps) are usually jerky. The following table shows some common frame rates.

|  |  |
| --- | --- |
| **Frame rate (fps)** | **Multimedia systems** |
| 29.97 | NTSC TV |
| 25 | PAL TV |
| 24 | Movie films |
| 15 | Computer video or animations  (such as Flash movies) |
| 12 |

### 5.1.4 Bit Rate (Bandwidth)

**The bit rate (measure in bps, bit per second) determines the amount of information allocated per second (bandwidth) during video encoding.** As long as the frame size and frame rate remain unchanged, the higher the bit rate, the better the video quality will be. However, the overall video file size increases with encoding bit rate.

The use of various encoding bit rate is to cater for audience with different network connection speeds (from 56 K modem to broadband connections).

### 5.1.5 Codec

**Codec** (pronounced as "cold"-"deck") **stands for compression/decompression. It is an algorithm, or specialized computer program, that reduces the number of bytes consumed by large files and programs.**

Consider a 24-bit colour depth 720 x 576 video file displayed at 25 fps, the amount of information displayed on screen per second would be:

720 x 576 pixels/frame x 24 bit/pixel x 25 frame/second ÷ 8 bytes/bit = 31104000 bytes ≈ 29.7 MB/second

Such high demand for bandwidth probably overload an ordinary hard disk. Even a 10 GB hard disk can only store around 5 minutes of video. **Compression can reduce the amount of data needed to reproduce video. It can save storage space, increases access speed.**

**The contents of a compressed video file cannot be displayed without the appropriate codec installed** at the audience computer. Sometimes certain video clips downloaded from the web cannot be played in Windows Media Player because of the absence of corresponding codec.

Different codecs use different algorithms to compress video. Most codec are lossy which include a quality factor or encoding bit rate to govern the final video file size. Common codecs include Cinepak, Intel Indeo(R), Microsoft Video, Microsoft RLE, MPEG, Real Video and DivX. Although the differences in video quality within different codecs are not great, their compression ratios differ much.

|  |  |  |  |
| --- | --- | --- | --- |
| **360 x 90 24 bit still video** | **Codec** | **File size (1-second)** | **Compression ratio** |
|  | None | 2411 KB | - |
|  | Cinepak Codec by Radius (Quality 100%) | 68 KB | 35.5 : 1 |
|  | Intel Indeo(R) Video R3.2 (Quality 100%) | 65 KB | 37.1 : 1 |
|  | Microsoft RLE (Quality 100%) | 102 KB | 23.6 : 1 |
|  | Microsoft Video 1 | 67 KB | 36.0 : 1 |
|  | Microsoft MPEG 4 Video Codec V2 | 49 KB | 49.2 : 1 |
|  | Real Video (450 Kbps) | 3 KB | 803.7 : 1 |
|  | DivX (450 Kbps) | 50 KB | 48.2 : 1 |



**Fig.5-1** Using video conferencing so that visitors can "see and talk" with SARS patients without close contact.



**Fig.5-2** Video in educational use Talks and presentations can be digitally recorded, stored in servers and delivered to the audience through the web.

## 5.2 Common Video File Formats

### 5.2.1 Audio Video Interleaved (AVI)

**An AVI (Audio Video Interleaved) file is a sound and motion picture file format for Microsoft's Video for Windows standard.** AVI files (which end with an avi extension) with little or no compression capability. The format is interleaved such that video and audio data are stored consecutively in an AVI file.

Uncompressed AVI files are exceptionally large in size, however AVI gains strong support from video editing software since it is one of the earliest video formats in Windows. It is usually used in video editing, but AVI files are usually further compressed using other codecs (such as Intel Indeo, MPEG 4 or DivX) for output and delivery.

### 5.2.2 Motion Picture Experts Group (MPEG)

**MPEG** (pronounced as "M" - "PEG") stands for Moving Picture Experts Group, which **develops standards for digital video and audio compression under the International Organization for Standardization (ISO)**. MPEG is remarkable for preserving video quality while supporting high compression ratio. MPEG is efficient enough to deliver full screen and full motion video but generally requires much more intensive computing power for encoding and decoding than AVI.

**MPEG achieves high compression rate by storing only the changes from one frame to another, instead of each entire frame.** The video information is then encoded. MPEG uses a type of lossy compression, since some data is removed. However the diminishment of data is generally imperceptible to the human eye.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Standard** | **Originally developed for …** | **Maximum**  **resolution** | **Common**  **encoding bit rate** | **Remark** |
| MPEG-1(1992) | Video CDs and interactive CD-ROMs | 352 x 288 (PAL)  352 x 240 (NTSC) | 1.5 Mbps | Video slightly better than  VHS with near-CD audio quality |
| MPEG-2(1994) | DVD, digital TV broadcast | 720 x 576 (PAL)  720 x 480 (NTSC) | Variable bit rate up to  4 Mbps | Full screen video with broadcast quality |
| MPEG-3 | High Definition TV (HDTV) | - | - | Obsolete and have merged with MPEG-2 standard |
| MPEG-4(1998) | Specifying a  description of digital AV scenes in the form of "AV objects" that have certain relations in space and time. | - | From 64 kbps up to 4  Mbps depending on available bandwidth | MPEG-4 goes beyond MPEG-1 and MPEG-2 which works with "framebased video" and audio.  MPEG-4 is also commonly  used as codec for AVI  files. |

### 5.2.3 Real Video (RV) and Video Streaming

**Real Video** is originally developed by Real Networks, Inc. It **aims at providing smooth delivery of video on the web with tailor-made quality. Real Video supports video streaming so that a user does not have to wait to download the whole video file before watching it**. Instead, the video is sent in a continuous stream and played as it arrives.

Video can be encoded as Real Video format using proprietary tools such as "Helix Producer". Real Video can only be played by RealOne Player from Real Networks, Inc.

### 5.2.4 QuickTime (MOV)

**QuickTime is a popular audio, video and even virtual reality (VR) formats** in Macintosh computers. QuickTime movies and audios can be played by QuickTime Player from Apple computer. QuickTime also supports VR format which can display 360 panoramas of scenic.

## 5.3 Balancing between File Size and Video Quality

In general, **the larger the video file size, the better the video quality will be.** However, various video attributes including frame size, frame rate, codec and codec bit rate (quality) are the primary factors that affect video quality.

## 5.4 Making Video Elements Fit Our Needs

Whether a video is to be delivered from the computer local hard disk, over a local area network or the web, channel bandwidth is the greatest concern among all factors. The following table is about the recommended video bandwidth and file type of different scenarios.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Recommended Video Format (Codec)** | | | | | |
| **Situation** | **Video Delivered from** | **Channel**  **Bandwidth** | **Real Video** | **MPEG-1** | | | **MPEG-2** | **AVI** |
| Presentation | Local hard disk of notebook or desktop computer | From 6 MB/s to  over 100 MB/s | ✔ | | ✔ | ✔ | | ✔ |
| Network video | Network video server distributed over a local area network | 10 Mbps | ✔ | | ✔ |  | |  |
| 100 Mbps | ✔ | | ✔ | ✔ | | ✔  (DivX, MPEG-4) |
| Web video | Web video server distributed over the web | From 56 Kbps  (dial-up) to 3  Mbps  (broadband) | ✔ | | ✔ |  | | ✔  (DivX, MPEG-4) |

In addition, recent streaming video technology provides even more choices on video file formats such as Windows Media Video (WMV) and Advanced Streaming Format (ASF). Both formats are developed by Microsoft and can be played by Windows Media Player.

## 5.5 Capturing Video

**With a video capture card or device, analogue video tapes (such as VHS tapes) can be converted to digital format for use in presentations.** Some capture cards can capture digital video directly from digital video cameras using high speed connection known as IEEE 1394 (also called "Firewire" or "i-link"). Data transfer speed can reach up to 400 Mbps and signal loss is minimal. Other capture cards can receive standard analogue signals (composite video or S-video) from video cassette recorder or camcorders, and then convert them to digital data with some signal loss.

## 5.6 Converting Video Elements from One File Type to Another

**Video files can be converted to different formats to suit different requirements.** AVI files are easy to edit while MPEG produce high compression ratio and is the standard of VCD and DVD. QuickTime and Real Video are tailor-made for streaming and web broadcast.

## 5.7 Editing and Processing of Videos

**Video files captured from various sources such as digital video cameras or network cameras can be edited and processed for multimedia production or web posting.** However, video editing software such as Ulead MediaStudio Pro and Adobe Premiere generally consumes more computer resources than other ordinary software. Common video editing techniques such as trimming, adding transitions, still images and background music will be discussed.

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1. TV = Television [↑](#footnote-ref-1)