

Multimedia Content

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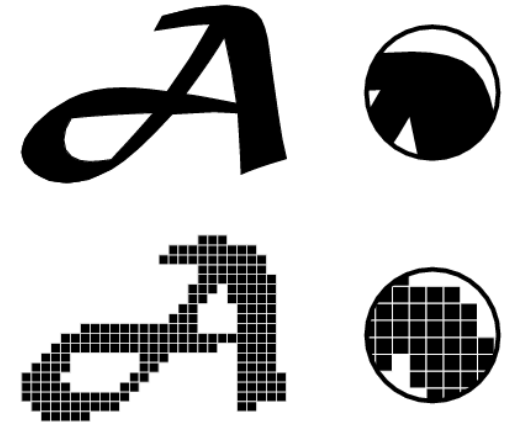
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Abstract (2)

Pictures are the only multimedia content on the Web that is widely supported by standardized formats. The most important picture formats are the *Graphics Interchange Format (GIF)*, the *Joint Photographic Experts Group (JPEG)* format, and the *Portable Network Graphics (PNG)* format. These picture formats target different application areas and depending on the picture material, choosing one format over the other can make a big difference. While audio and video are not supported by Web browsers, they also have become popular media types on the Web.

Images vs. Graphics (3)

- Pictures can be encoded in a [wide variety of ways](#)
[<http://en.wikipedia.org>]



[[/wiki/Comparison_of_graphics_file_formats](#)]

- *Images* are bitmaps of pixels
 - it takes *scanning/rendering* to produce images
 - images have a certain native *resolution*
 - *scanning* is done by a scanner, a fax, or a camera's [CCD](#) [http://en.wikipedia.org/wiki/Charge-coupled_device]
- *Vector Graphics* are composed out of graphic primitives
 - graphics can be searchable, stylable, and scalable
 - the format can have different capabilities (2D vs. 3D)
- Graphics preserve model-level information
 - this only makes sense if there *is* a model
 - rendering and styling can be an expensive process (e.g., video games)
 - images can be a snapshot of some specific "view" of graphics
- Today's Web supports images, but not graphics

Image Formats

Graphics Interchange Format (GIF)

Graphic Interchange Format (GIF) (6)

- [RFC 2046](http://dret.net/rfc-index/reference/RFC2046) [http://dret.net/rfc-index/reference/RFC2046] registers the oldest graphics format on the Web
- GIF was subject of a long patent debate
 - the compression technique of GIF ([LZW](http://en.wikipedia.org/wiki/Lzw) [http://en.wikipedia.org/wiki/Lzw]) had been patented by Unisys (1983)
 - Unisys wanted to get licensing fees from all commercial online uses of GIF
 - [Portable Network Graphics \(PNG\)](#) [Portable Network Graphics (PNG) (1)] was developed as an effort to develop a copyright-free format
 - in 1999, Unisys changed its tactics and wanted to collect one-time fees (\$5000-\$7500) from all users
 - all GIF-related LZW expired in 2003/2004, so GIF is freely available now
- GIF's poor features make PNG the better choice anyway
 - 8 bit color (requires dithering for photographs), binary transparency
 - GIF's animation feature is the only thing that is not available in PNG ...

Joint Photographic Experts Group (JPEG)

Joint Photographic Experts Group (JPEG) (8)

- [RFC 2046](http://dret.net/rfc-index/reference/RFC2046) [http://dret.net/rfc-index/reference/RFC2046] standardizes the second popular image format for the Web
 - [ISO 10918](http://dret.net/biblio/reference/iso10918) [http://dret.net/biblio/reference/iso10918] is the standard for the actual image format
- JPEG has been specifically designed for photographs
 - it always is lossy (it cannot preserve the complete information from a random bitmap)
 - it uses perception-based compression (for example, color precision is sacrificed for brightness)



Q = 50, filesize 15,138 bytes

Q = 10, filesize 4,787 bytes

Q =

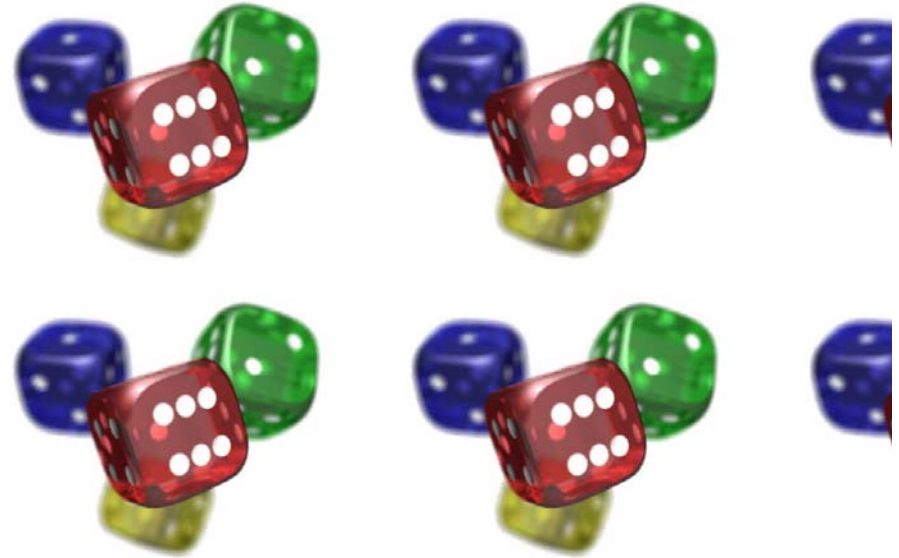
Portable Network Graphics (PNG)

Portable Network Graphics (PNG) (10)

- PNG is registered as image/png and is the third major image format
 - PNG was intended to be a royalty- and copyright-free replacement of [GIF](#) [Graphics Interchange Format (GIF) (1)]
 - image formats need to be supported by browsers and thus take a long time until they are established
 - IE6 implements PNG in a very rudimentary form, IE7 handles PNG correctly
- PNG has some advantages over GIF and JPEG
 - lossless, compressed palette, grayscale, or true color images
 - 8 bit alpha channel for gradual opacity (blending into the background)
- JPEG still is the preferred format for photographic pictures
- GIF still is the preferred format for animated images



Alpha Channel Effects (11)

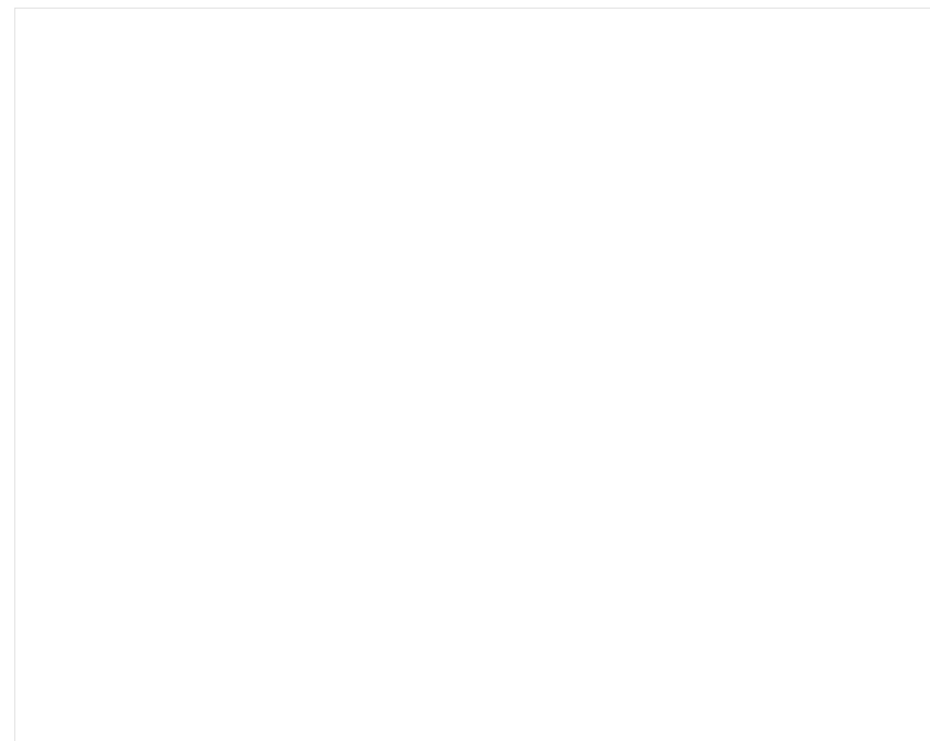


Video and Audio

Download vs. Streaming (13)

- Web resources usually are downloaded
 - browsers may choose to implement incremental rendering (e.g., HTML or images)
 - the resource is completely downloaded and stored
- [Streaming](http://en.wikipedia.org/wiki/Streaming_media) means that there is no complete download
 - TV and phone calls are classical examples of streaming
 - any navigable media type can use streaming ([iPaper](http://www.scribd.com/tools/ipaper) is "streamed PDF")
 - some data sources cannot be downloaded (e.g., a security camera)
- Streaming often is also used because of security issues
 - downloads make it easy to get content and redistribute it
 - streaming makes redistribution much harder (content must be [destreamed](http://en.wikipedia.org/wiki/Destreaming))
 - the data formats for streaming are often undisclosed

Streamed Paper (14)



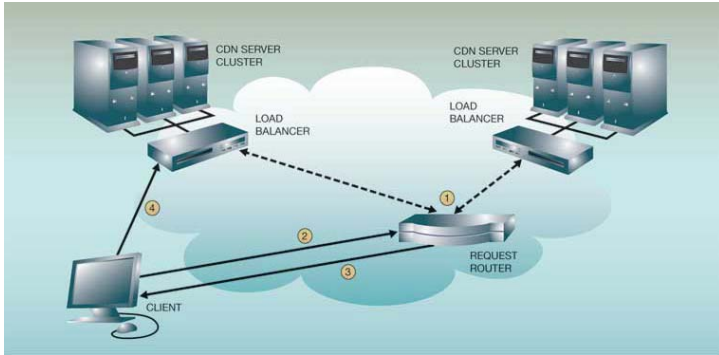
Video and Audio on the Web (15)

- [Internet Protocols](#) [Internet Architecture] only provide *best-effort connections*
 - *Quality of Service (QoS)* requires end-to-end QoS provisioning
 - QoS was never implemented on the Internet for economic reasons
- Data types and expectations co-evolve with the infrastructure
 - faster processors and graphics chips can handle high-resolution video
 - faster networks and better compression make high-resolution feasible
- Almost all data traffic will eventually move to an Internet
 - TV and telephony are two very popular examples
 - almost all telephony is handled on “a” Internet today anyway
- The *public Internet* and *an Internet* are not the same thing
 - companies and the military often have separate networks
 - using Internet technologies for building a network is cost-efficient
 - security and economics decide how Internets are connected

Content Delivery Networks (CDN) (16)

- High-volume traffic is better not routed from one place
 - [Google](#) [http://www.google.com/] and [YouTube](#) [http://www.youtube.com/] only look like a “a site”
 - sophisticated routing and load balancing helps handling traffic
- [Content Delivery Networks \(CDN\)](#) [http://en.wikipedia.org/wiki/Content_Delivery_Network] are designed for high-volume low-latency delivery
 - clients in different parts of the world will be served by different servers
 - the internal data distribution and management is handled by the CDN
- CDNs are required when sites start handling large traffic volumes
 - CDN services can be bought by site/service owners
 - [Akamai](#) [http://www.akamai.com/] and [Limelight](#) [http://www.limelightnetworks.com/] are two popular services
- CDNs are usually hidden by other technologies
 - DNS responses for CDN hostnames are returned based on the request
 - prepackaged video codecs for Flash/Silverlight have built-in CDN support

CDN Request Routing (17)



Audio on the Web (18)

- Audio is not very popular on the Web
 - the Web is mostly visually oriented
 - audio content without playback controls is not user-friendly
 - most sites using multimedia use [video](#) [Video on the Web (1)] instead of audio
- Internet radios such as [Pandora](http://www.pandora.com/) [http://www.pandora.com/] often use Flash
 - they are standalone applications running in a browser
 - content is often delivered via HTTP to circumvent firewalls
- Audio formats exist in many different variations
 - [MPEG1 Layer 3 \(MP3\)](http://en.wikipedia.org/wiki/MP3) [http://en.wikipedia.org/wiki/MP3] was the first widely supported audi format
 - [Advanced Audio Coding \(AAC\)](http://en.wikipedia.org/wiki/Advanced_Audio_Coding) [http://en.wikipedia.org/wiki/Advanced_Audio_Coding] is [Apple's preferred format because of DRM](http://en.wikipedia.org/wiki/FairPlay) [http://en.wikipedia.org/wiki/FairPlay]
 - audio streaming formats often use much less bandwidth

Video on the Web (19)

- Video formats have been evolving quickly for a while now
 - video signals have a lot of redundancy that is hard to compute
- Depending on the application, algorithms ideally behave differently
 - for playback of recorded content, encoding can be very expensive
 - symmetric scenarios (such as video conferencing) better use symmetric codecs
- Handling video in [Plug-Ins](#) [Web Browsers; Plug-Ins (1)] effectively implements dynamic codecs
 1. [YouTube](http://www.youtube.com/) [http://www.youtube.com/] started [serving better quality a while ago](http://news.cnet.com/8301-10784_3-9817732-7.html)
 2. the servers and the Flash plug-in have to be updated
 3. browsers reload the Flash code every time they load a YouTube page
- Video encoding combines time-enabled [Image Formats](#) [Image Formats (1)] and [audio](#)
[Audio on the Web (1)]
 - both signals must be carefully synchronized
 - sophisticated encodings use variable bitrates and even vary between video/audio rates

Conclusions (20)

- Images are the only supported media types on the Web
- Video and audio are not really “Web Media Types”
- Image formats serve different purposes on the Web
- PNG for graphics and JPEG for photographic images
- GIF should be avoided (still required for animated images)