

8 Commercial Streaming Systems – An Overview

8.1 RealNetworks

8.2 Apple QuickTime

8.3 Windows Media

Literature:

Tobias Künkel: Streaming Media – Technologien, Standards, Anwendungen, Addison-Wesley 2001

David Austerberry: The Technology of Video & Audio Streaming, Focal Press 2002

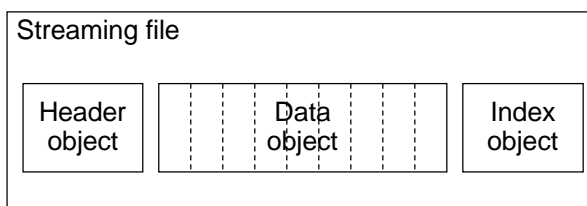
Actual Usage of Streaming

- Media Metrix report 2000/2001 (according to streamingmedia.com):
 - 99% of U.S. home computers (Windows & Mac) had media player installed
 - Only 47% of users used media player, only 40% used streaming
- AccuStream iMedia research report 2004:
 - Total number of video streams served/viewed rose 104% in 2003, following two years of consecutive growth
- Market shares:
 - A: Players November 2000 (percentage of all U.S. home computer users) according to streamingmedia.com
 - B: Servers June 2001 (according to Nielsen NetRatings/quicktiming.org)
 - RealPlayer: A 28% B 16%
 - Windows Media: A 22% B 14%
 - QuickTime: A 4% B 7.5 %
- Collecting media usage data on streaming has become a profitable business
 - See e.g. www.comscore.com (ComScore took over “Media Metrix”)
 - Therefore recent numbers are difficult to obtain...

History of RealNetworks

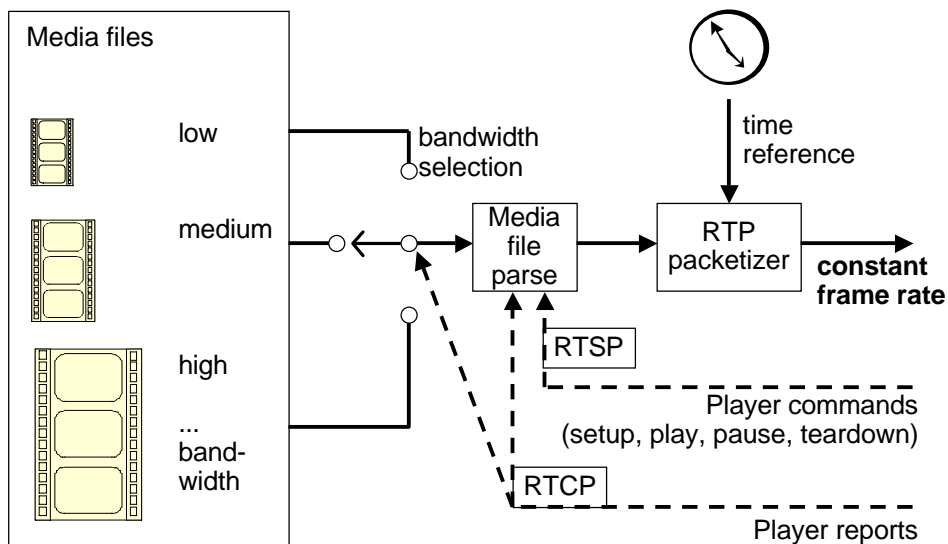
- 1994: Rob Glaser, former Vice President for Multimedia and Consumer Systems at Microsoft, founds *Progressive Networks*
- April 1995: First RealPlayer, RealAudio 1.0 codec
- February 1997: RealVideo 1.0
- September 1997: *Progressive Networks* is renamed into *RealNetworks*
- 1998: RealNetworks buys *Vivo Software*
- 1998: RealSystem G2 (=6.0) (SureStream, RTSP, SMIL, support of various foreign formats)
- 1999: RealNetworks takes over *Xing Technologies* (MP3 developer)
- 2000: RealSystem 8, player becomes similar to a multimedia Web browser, narrowband audio streams up to TV quality video
- 2002: RealOne Player (version 9)
- 2002: "Helix" open source project provides client, encoder and server for Real compatible platform
- 2004: RealPlayer 10, plays also other file formats, integrated Web browser, CD burning, media search, ...
 - » same quality at 30% lower bitrate than RealVideo 9
 - » same quality at 30 80% lower bitrate than MPEG-2

Streaming File Formats



- Header, Data: As in other audio/video formats
- Additional timing control information (here: Index Object)
 - Used to manage flow rate
 - Aid for client navigation
- Main streaming file formats:
 - Microsoft: Advanced Streaming Format (ASF), Windows Media Video (WMV), Windows Media Audio (WMA)
 - RealNetworks: RealMedia (RM), RealAudio (RA)
 - Apple: QuickTime Hinted Movie (MOV)

Adapting to Network Congestion



Realisations for Rate Adaptation

- Multiple bit rate files
 - RealNetworks "SureStream", Windows Media "multiple bit rate"
 - Several bit rates in one file
 - Compatible only with streaming servers, not with Web servers
 - Adaptation by change of picture size not supported
- Alternate movies (QuickTime)
 - Player receives pointers to assemble the actual program
 - Usable for adapting bit rate and other parameters
 - Usable also for different language versions and other applications
- MPEG-4 Scalable Streams
 - Similar to "progressive" technique in picture compression
 - Basic low-resolution stream transmitted
 - Additional "helper" streams can add more detail and improve quality

RealVideo Codecs

- Fully proprietary, compression algorithms kept secret
- Since version 8.0 probably using wavelet or fractal compression
- RealVideo G2: Still popular?
- RealVideo G2 SVT (*Scalable Video Technology*)
 - Dynamic control of transmission rate by client player
- Variable Bitrate Encoding
 - (See next slide)
- Two-Pass Encoding
 - First pass: Analyses video clip before encoding, collects statistical information
 - Second pass: Optimized encoding with parameter settings derived from information obtained in first pass
 - Not applicable for live streams
- Loss Protection
 - Adds information for error correction and additional key frames

Constant and Variable Bit Rate

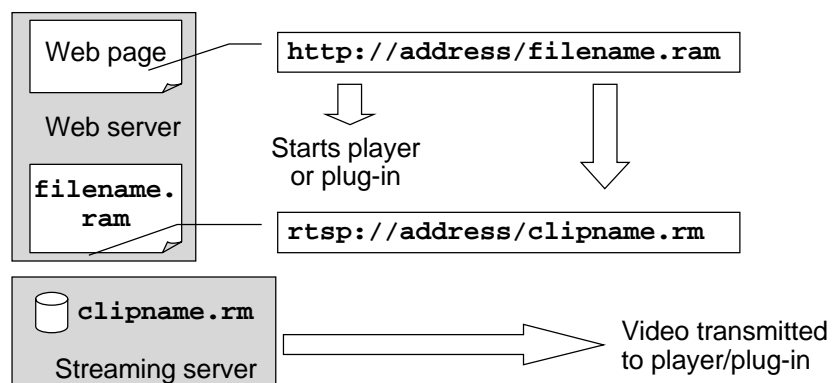
- Constant Bit Rate (CBR)
 - Fixed bit rate (of decoded data stream) independent of content
- Variable Bit Rate (VBR)
 - Low bit rate for simple scenes (e.g. no movements)
 - High bit rate for complex scenes (e.g. quick changes)
 - Average bit rate can be optimized: Scenes “borrow” bandwidth from others
 - » Still an average bit rate limit is obeyed
 - » “Instantaneous bit rate” can be limited
 - Leads to increase of buffer lengths and buffering times
 - Optimal effect in combination with two-pass encoding
- Quality-Based Encoding
 - Maintains steady visual quality of output
 - No limit to average bitrate
 - » “Instantaneous bit rate” can be limited

RealAudio Codecs

- **Voice**
 - Between 5 Kbps (4 kHz frequency range, 8 kHz sampling rate) and 64 Kbps (20 kHz frequency range, 44.1 kHz sampling rate)
- **Music**
 - Starting from 6 Kbps (3 kHz frequency range, 8 kHz sampling rate)
 - Sophisticated intermediate settings like “20 Kbps Music High Response” (10 kHz frequency range, 20.05 kHz sampling)
 - Up to 64 Kbps
- **Stereo Music**
 - From 16 Kbps to 96 Kbps (using differential stereo encoding)
 - “Broadband Codecs” with Sony ATRAC technology
 - » From 105 Kbps up to 352 Kbps (almost identical to CD quality)

Indirect Web Links

- Web link goes to small file containing the actual media file link
 - Real: “Real Audio Metafile” (RAM)
 - Microsoft: “Stream redirector” (ASX)
- Metafile may contain list of files (playlist)

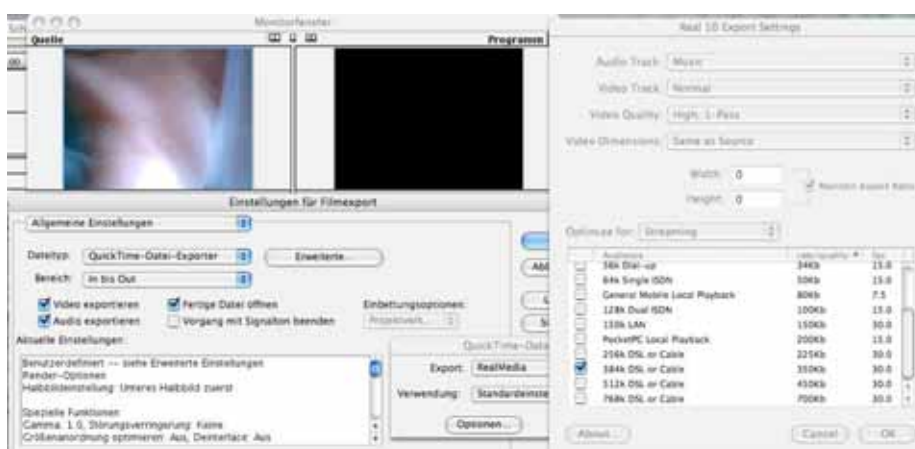


RealProducer



Real Plugin

- Plugin solution to embed production into many video editing applications on MacOS
 - Example: With Adobe Acrobat



Typical Video Filters

- Noise filter
 - Remove “snow” (often originating from antenna signals)
- Resizing filter
 - Quick or fast methods to compute a smaller version of the video
- Inverse-Telecine filter
 - For conversion of cinema formats to TV formats
 - In particular relevant for US standards (film 24 fps, NTSC 30 fps)
- De-Interlacing filter
 - Remove “jagged” contours resulting from overlaying two half-pictures

- General principle:
 - High picture quality leads to low encoding speed

Capturing in RealPlayer

- Recording of streamed content
 - Only in premium versions of player
- Restrictions during production
 - Streams have to be explicitly enabled for being recorded in the client
- Simple Model of Digital Rights Management

Content & Technology in one Business Model

- See website www.real.com and the *RealGuide*
 - 85% of all streaming content, 350,000 hours live content produced per week
 - One of the 25 most popular web sites
 - Clever combination with advertisement and content subscription systems



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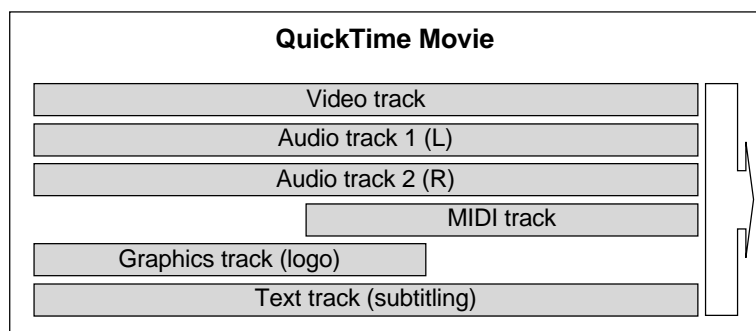
David Austerberry: The Technology of Video & Audio Streaming, Focal Press 2002

QuickTime

- Popularity (according to Apple)
 - QuickTime 5: more than 100 million downloads in one year
 - QuickTime 6: 175 million downloads in 18 months
 - 300,000 people per day use QT for receiving content
- Platform independence
 - QuickTime player available for Windows and MacOS
 - (Streaming server available only for MacOS)
- Digital cameras
 - Many photo cameras use QuickTime for recording small video clips
- Record on largest ever live Internet streaming event
 - Live Webcast of Steve Jobs' keynote speech at MacWorld 2002
 - 81,000 simultaneous viewers, 160,000 Web visitors
 - 11 TeraBytes of content served
 - Peak total serving bandwidth 16,5 Gbit/s

QuickTime Tracks

- Modular and flexible architecture
 - Multimedia files organized in tracks
 - Example:



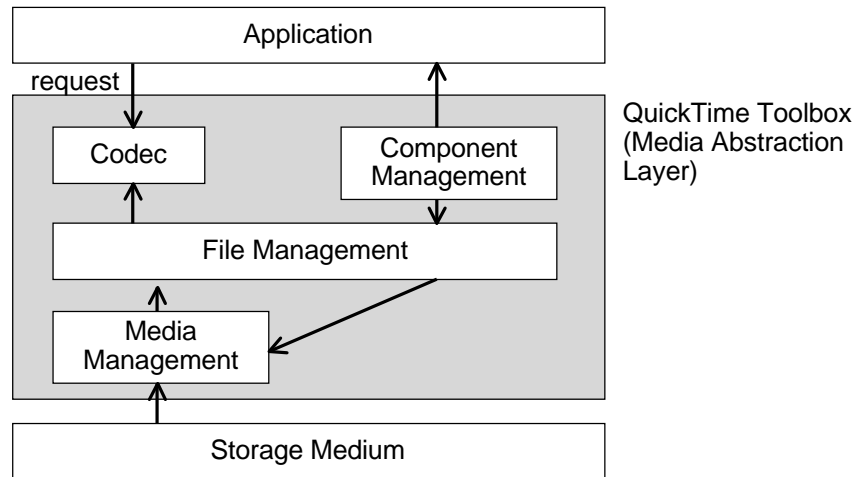
Types of QuickTime Tracks

- Movie track: Copyright info, annotations, ...
- Audio track(s)
- Text track: Titles, subtitles, credits, notes, ...
- Sprite track: Images with animatable, programmable behaviours
- Flash track: SWF animation
- QuickTime VR track: VR objects, panorama movies
- Video track: Digital video, 3D animation, ...
- Music track: MIDI
- Chapter track: Inserts addressable entry points
- 3D track: Contains QuickDraw 3D metafile objects
- Streaming track: References to streams from a server source
- Hint track: Additional information for streaming (see below)

Typical QuickTime Codecs

- Video
 - Animation: Specially for large coloured areas
 - BMP: High-quality import/export
 - Cinepak: Exchange format for other platforms and old versions
 - Component video (3:2 compression, YUV colour model)
 - » High quality capturing with low CPU load
 - DV Stream (10:1 compression)
 - » Specially for capturing from DV devices (over FireWire)
 - H.261, H.263, H.264
 - Sorenson Video: Excellent compression/quality rate
 - ...
- Audio
 - IMA 4:1 (CD music quality with 80 kbps)
 - QDesign Music (comparable to MP3)
 - QualComm PureVoice

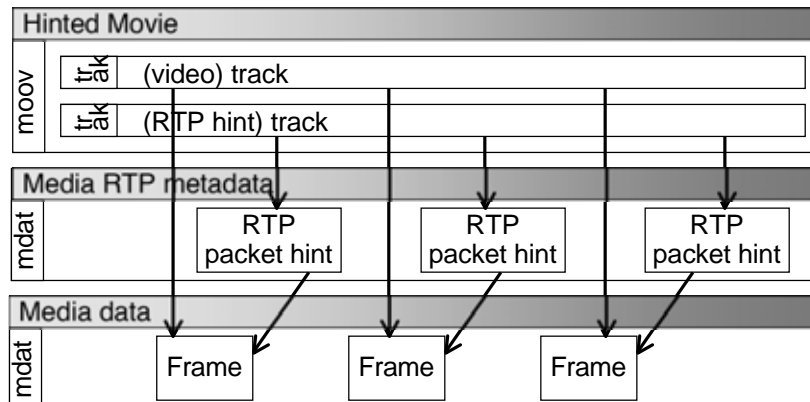
QuickTime Media Abstraction Layer



Interactivity in QuickTime

- Movies or video tracks as clickable links
 - “HREF tracks” allow dynamic change of target during runtime
- Sprites can react to system events (like mouse movement)
- Flash animations can be fully integrated
 - e.g. movie controllers developed in Flash
 - more efficient animations (vector-based)
- JavaScript support
- Full QuickTime API
 - Available also for Java (QuickTime for Java)

Hint Tracks in QuickTime and MPEG-4



- Hint track gives server software pointers to the RTP information to serve the relevant media chunks
- Concept from QuickTime, integrated in MPEG-4 (streaming)

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History of Windows Media

- 1991-1992: Multimedia extensions of Windows 3.0
 - Playback of AVI
- 1992-1996: Netshow 1.0
 - First experiments with OnDemand Streaming
- 1997-1999: Windows Media Technologies in Windows 98
 - Completely reworked version of NetShow
- Since 2000:
 - Strong emphasis on compression/quality ratios comparable to competitors Real and Apple
- Current version 2004: Windows Media 9.0

- General impression: Duplication of many concepts from Real
 - Few special features: E.g. screen capturing
- Digital Rights Management is intrinsic part into Windows Media

Windows Media and MPEG-4

- Windows Media MPEG-4 Video V3
 - MPEG-4 based Microsoft implementation
 - Probably used as a quick-start to catch up with competitors
- Windows media Video V7 and higher
 - No longer compatible with standard MPEG-4
- ISO MPEG-4 Video
 - Special, additional codec for MPEG-4 standard