INTERFRAME MEDIA

QuickTime 7, H.264, and the revolution in digital video delivery

Ben Waggoner

Agenda

- QuickTime 7
- H.264
- ISMA 2.0
- Authoring tools

Defining QuickTime

- A media player
  - QuickTime Player
- An authoring tool
  - QuickTime Player Pro
- A media playback API
  - Used by QT Ameture, QuickTime GL Player
- An authoring API
  - Final Cut Pro, After Effects, Avid, iMovie, iDVD
- A file format
  - .MOV

A Quick History of QuickTime

- 1991: 1.0 Announced and Shipped
- 1992: 1.5 shipped, QT for Windows announced
- 1994: QuickTime 2.0 ships for Mac and Win
  - First with interactive features
- 1997: Long delayed QuickTime 3.0 released
  - Defined cross-platform API, features
  - First internet-focused release
- QuickTime 4 released - first with real-time streaming
- QuickTime 6 released - first with MPEG-4

QuickTime 7

- Biggest release since QuickTime 7
- H.264 codec
- Automatic bandwidth detection
  - Tests between media server and client each time
  - Still lacks stream switching for mid-stream changes
- Big performance improvements from CoreVideo
- Finally, out of order data support
  - Made H.264 possible
  - much better MPEG-1, MPEG-2, MPEG-4 possible
- Multichannel audio playback (but no codecs)

QuickTime isn't just .MOV!

- The QuickTime file format isn't critical to QT's success
  - QuickTime has built-in authoring and playback for other formats
    - .mp4, .3gp
  - Integrated 3rd party export for other formats
    - .wmv, .flv
  - Integrated 3rd party players for other formats
    - Divx, .wmv
- QuickTime the architecture is doing great
  - And will do great irrespective of how well .mov does

What happened with MPEG-4

- High expectation for MPEG-4 in late 90's
  - MPEG-1 and MPEG-2 were dominant in their markets
  - MPEG-4 promised internet support, compression
  - Very promising rich media
  - Universal playback promised
- The reality
  - Rich media features never widely implemented
  - MPEG-4 Part 2 codecs never were competitive
    - Barely better than best MPEG-2 implementations
  - Playback not universal, different subsets supported

Hence H.264

- Goal: Industry-leading compression efficiency
- The "next big thing" in codecs
- Lots of names
  - AVC (Advanced Video Coding)
  - MPEG-4 Part 10
  - H.26L (working ITU designation)
  - JVT (Joint Video Team)
- Joint MPEG/ITU standard
  - Replaces H.263 for videoconferencing
  - Replaces original MPEG-4 codec for video

Why H.264 rocks

- Much improved compression efficiency
  - Multiple reference frames
  - Generalized B-frames
  - Integer DCT
- Net effect: Best codec in the world for below 1 Mbps
  - WMV9/VC-1 does very well for HD
- Lots of vendors competing to build better, compatible encoders

H.264 limitations

- Somewhat slower to decode than equivalent codecs
  - Main Profile 4x CPU requirement versus MPEG-2
- Slow to encode to take full advantage
- Not widely distributed yet
  - QuickTime 7 first mass-market player for it
    - QT7 for Win released yet?
    - iTunes drives lots of QuickTime for Win installs
  - Some open source tools like VLC
- Not clear what "lowest common denominator" for compatible playback will be

Profiles and Levels

- Profile@Level define support needed for decode
  - Maximum support allowed for encoder
  - Minimum support required for decoder
- Profile
  - Defines tools that can be used
    - E.g., how many reference frames
- Levels
  - Maximum range of parameters
    - E.g. maximum data rate

H.264 Profiles

- Baseline (in QT7)
  - Simplest mode for simple devices
- Main (in QT7)
  - Adds more complex features for high quality file-based playback
- Extended (not in QT7)
  - Adds features for robust streaming
- High (not in QT7)
  - Adds features for very high video quality
  - Added after first three were defined

H.264 in HD DVD

- DVD Studio Pro 4
  - First shipping HD DVD format authoring tool
  - MPEG-2 and H.264 codec supported
    - VC-1 also in spec
  - Only Compressor 2 can make H.264 assets
- HD DVD playback requires G5 and DVD Player 4.6
- H.264 enables 2 hour HD movie to fit nicely on DVD-9

Tools for H.264 encoding

- QuickTime Player Pro
- Compressor 2
- Compression Master 3.1
- Squeeze 4.1

QuickTime Player Pro 7

- QuickTime Player 7 Pro BIG upgrade
  - Can now do background rendering!
  - Two-pass encoding
- Good H.264 implementation
- Decode-complexity constrained
  - Avoids some H.264 features that slow down decode
  - Does great job with quality anyway
- Multipass encoding for maximum quality
- Encodes in .mov, .mp4, 3gp

Compressor 2

- Same features as QuickTime Player Pro
- Plus it can make HD H.264 for DVDSP 4 HD DVD discs
  - Must use HD DVD preset
  - Only up to 720 formats
  - No 24p options
- Can split encodes across multiple machines with
  - Uses QMaster
  - Big speed gains good for H.264!
    - Several hours encoding per minute for HD

Squeeze 4.1

- H.264 in .mp4 only
- Need 4.1 (4.0 H.264 much worse, not QT7 compatible)
- Good quality
- Only 1-pass for CBR mode
- QT7 not compatible with Squeeze B-frames

Compression Master 3.1

- H.264 in .mov, .mp4, .3gp
- Much more flexible encoders
  - 1-100 slider for speed v. quality of encode
  - 1-10 reference frames
    - More improve quality
    - But slow down decode (and encode)
- Substantially higher quality than Apple's encoder

ISMA 2.0

- Internet Streaming Media Alliance
  - Founders include Apple, Cisco, IBM
  - Defines MPEG-4 for IP streaming applications
- ISMA 1.0 spec influential
  - Although even QT7 still doesn't support fully
- ISMA 2.0 same structure as 1.0, with new codecs
  - H.264
  - HE AAC
    - HE=High Efficiency
    - Near CD quality at 48 Kbps

ISMA Profiles

- ISMA "Profiles" define Profile@Level for different parts
- No Profile 1
- Profile 2: Small screens
  - Up to 384x288, 1.2 Mbps
- Profile 3: Standard Definition
  - Up to 720x576, 3.7 Mbps
- Profile 4: Standard Definition with HE AAC
  - Same video as Profile 3
  - But must decode HE AAC audio
  - Max 3.0 Mbps

Conclusions

- QuickTime 7 back in the running for web delivery
- QuickTime remains essential for content creation
- H.264 seeing wide adoption
- Variety of tools available

Q&A

- My email
  - ben@interframemedia.com
- My company
  - http://www.interframemedia.com
- My book
  - http://www.cmpbooks.com/compression
- My tutorials
  - http://www.classondemand.net/benwaggoner/