6 Multimedia Content Production and Management

Literature:

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

Outline

Types of Multimedia Content for Streaming

- Dynamic Text
  - Low bandwidth
  - Proprietary formats (e.g. by RealNetworks)
- Audio
  - Bandwidth unproblematic in modern broadband networks (e.g. DSL access), but still an issue in older network technologies (e.g. 28 kBit/s modem)
  - Proprietary and standard formats (e.g. MP3, MPEG-4 AAC)
- Video
  - Bandwidth is still a serious issue, except very high-speed links (e.g. VDSL2)
  - Proprietary and standard formats (e.g. MPEG-1/2/4, H.264)
- Vector animations
  - Bandwidth mainly unproblematic
  - Proprietary formats (mainly Shockwave Flash SWF)
  - Download & play approach is sufficient

Supporting Good Video Compression

- Already when capturing a video source, good later compression can be prepared:
- High-quality capturing and storing equipment with low *video noise*
  - Noise (grain) may disturb compression algorithms (high frequencies)
- Simple pictures with little detail
  - No total views of large scenes
  - Few objects in large scale
- Little movement
  - Camera movement, object movement, zoom lead to worse compression
- Good lighting
  - Sharp edges and high contrast assist the compression algorithms
- No fine-grain patterns
  - High picture frequencies are problematic in compression
  - E.g. Uni-colour clothes instead of patterned ones

Supporting Low Audio Bandwidth

- Preparing audio content with low bandwidth requirements, a set of tips by Chris Priestman
- Halve your data by using mono unless stereo is really important.
- Halve it again by cutting the sample rate to 22.05 kHz for streams of 28.8 kbps and less.
- Lose the very top of the hearing range (above 10 kHz).
- Preserve detail across the tonal range by keeping resolution at 16 bits (unless for speech at less than 16 kpbs)

Video Capturing

- Modern standard computer interfaces (e.g. USB, FireWire)
  - Enable import of video data in compressed raw format with limited quality (e.g. DV standard)
  - Capturing is computing-intensive, CPU has to be shared between capturing and compression (e.g. MPEG)
  - Live streaming only with low-quality input (e.g. WebCam)
- Specialized video capturing hardware for PCs (card or external device)
  - Enable real-time encoding with less CPU load
  - Support various physical video connection standards
  - Limitations in quality (picture size, frame rate)
- Professional video capturing/encoding systems
  - Expensive
  - Able to deal with uncompressed or only mildly compressed video
  - Live compression, often in hardware (e.g. MPEG-4, H.264)
- Possible trend:
  - Video surveillance mass market leads to affordable high-quality encoders

Futuristic Trends in Image&Video Capture

- Automation of cost/ and personal intensive tasks in capturing
  - Direction
  - Quality control
- "Active capture"
  - Intelligent feedback loops
    - » Emit stimuli for people to be recorded
    - » Check quality and possibly repeat
  - M. Davis: Active Capture - Integrating Human-Computer Interaction and Computer/Vision Audition to Automate Media Capture, 2003 IEEE Multimedia Conference

    http://fusion.sims.berkeley.edu/GarageCinema/pubs/pdf/pdf_DDF5B875-781C-443F-8ED9D972AD37AB97.pdf
- Applied image analysis / computer vision
  - Automated checks for quality like contrast, sharpness etc.
  - Recognition of objects, faces, …
  - Layout assessment

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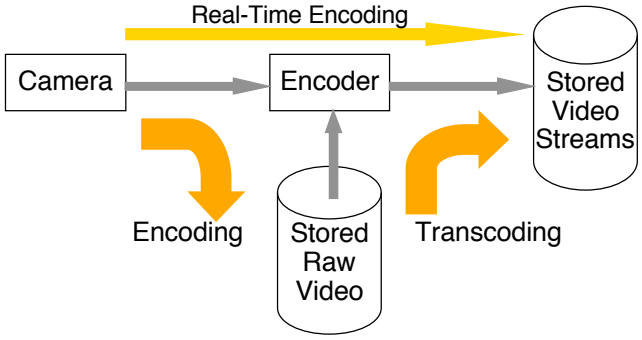
Gregory C. Demetriades: Streaming Media, Wiley 2003

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

Encoding and Transcoding



- Audio and video needs to be converted for streaming delivery
  - Compression, proprietary formats
- *Transcoding*: Conversion of media files from one format to another
- *Repurposing:* Using existing content for new purposes
  - e.g. using TV ads as streaming content

Factors Determining Video Bandwidth

- Physical resolution (number of pixels)
  - Determines picture size in standard rendering resolution (e.g. 72 dpi)
  - Dependent on playback device
    - » "Set Top Box" for TV set requires full-screen TV signal
    - » Video window on PC can be adjusted in size
- Frame rate
  - Desirable: 25 fps
  - Over low-bandwidth links often only smaller rates possible (e.g. 10 fps)
- Colour (sub)sampling
- Audio quality
  - Sampling rate, resolution (e.g. speech vs. CD quality)
  - Mono, stereo, multi-channel
- Degree of compression
  - Determines appearance of compression artefacts

Network Limitations

- Bandwidth towards receiver is limited:
- Effective bandwidths for various access network technologies:
  - 28.8 modem: 20 – 23 Kbps
  - 56.6 modem: 32 – 35 Kbps
  - ISDN: 45 – 55 Kbps
  - Dual-ISDN: 80 – 100 Kbps
  - DSL: 1000 Kbps and more
  - VDSL 25 Mbps and more
  - Cable modem: 4 – 36 Mbps
  - LAN: 10 – 100 Mbps
- Compromise between bandwidth limitations and quality:
  - Picture format
    - » E.g. for 28.8 modem picture format 176 x 144 pixel (QCIF)
    - » E.g. for DSL picture format 360 x 288 pixel (CIF)
  - Plus other factors

Example: Multiple Bit Rate Encodings

	Video source	Broadcast (DVB)	DSL/ cable modem	Modem
Target data rate	(270 Mbit/s)	4 Mbit/s	500 kbit/s	35 kbit/s
Required data reduction		40:1	330:1	4700:1
Frame size	720 x 480 (CCIR 601)	720 x 480	192 x 144	160 x 120
Frame rate	30	30	15	5
Colour sampling	4:2:2	4:2:0	YUV12	YUV12
Uncompressed data rate (Mbit/s)	166	124	5	1.15
Fraction of original data rate		1:1.33	1:33	1:144
Required compression		30:1	10:1	30:1

From: D. Austerberry

Common Video Image Formats

Format	Resolution	Frame rate	Sub-sampling	Application
CCIR 601 (NTSC)	720 x 480	30 interlaced	4:2:2	Broadcast (DVB), DVD
CCIR 601 (PAL)	720 x 576	25 interlaced	4:2:2	
SIF (NTSC) Standard Interchange Format	352 x 240	30 progressive	4:2:0	CD-ROM
SIF (PAL)	352 x 288	25 progressive	4:2:0	
CIF Common Intc. Format	352 x 288	30 progressive	4:2:0	Videoconference, streaming
QCIF Quarter CIF	176 x 144	30 progressive	4:2:0	Videoconference, streaming

From: D. Austerberry

Multiple Bitrate Encoding

- In general, the same content has to be encoded in several qualities/bitrates
- File allocation:
  - One file multiplexing several qualities, or
  - Several files
- Selection of appropriate quality/bitrate:
  - Dependent on network access technology and dynamic network load
  - Manual selection: Through different alternatives on Web page, or
  - Automatic selection:
    - » Using streaming server software and adequate client
    - » Often access network type stored in user preferences for client software

Reminder: A Sample SMIL File

```
<smil xmlns="http://www.w3.org/2001/SMIL20/Language">
  <head>
     <layout>
        <root-layout width="356" height="356"
                backgroundColor="black"/>
        <region id="imgReg" width="256" height="256"
                left="50" top="50"/>
     </layout>
  </head>
  <body>
     <seq>
        <img region="imgReg" src="tiger.jpg" dur="4s"/>
        <img region="imgReg" src="elephant.jpg" dur="4s"/>
        <img region="imgReg" src="butterfly.jpg" dur="4s"/>
      </seq>
  </body>
</smil>
```

From: Digitale Medien

SMIL and Bandwidth Selection

- Example:

```
<smil>
  <body>
    <par>
      <switch>
        <audio src="http://www.providerxy.com/datei1.rm"
          system-bitrate="250000"/>
        <audio src="http://www.providerxy.com/datei2.rm"
          system-bitrate="100000"/>
        <audio src="http://www.providerxy.com/datei3.rm"
          system-bitrate="40000"/>
        <audio src="http://www.providerxy.com/datei4.rm"
          system-bitrate="1000"/>
       </switch>
    </par>
  </body>
</smil>
```

- RealPlayer supports SMIL
  - Selects first stream which is smaller than bandwidth from user preferences

Network-Based *Interactive* Video Delivery

- Using the advantages of interactivity and media composition
  - Making a difference between net-based media and traditional media
  - Leveraging the technical potential for better business opportunities
- Example:
  - User is interested in skiing and selects a skiing video from a Video on Demand repository
  - Show him or her in parallel or interleaved an ad for snowboards
  - Provide him or her with an option to enrol in a drawing for a ski-weekend getaway (and collect personal data for later advertising)
  - Allow him or her a one-click opportunity for lift tickets at a nearby resort
  - Provide him or her with links to further video material (e.g. skiing courses, travel guides to skiing regions), which cost a viewing fee

(from: Demetriades 2003, starts to become reality now with advertisement-driven video archives/exchange systems)

Combining Media Elements to Compound Media

- Combining video streams, audio streams, text captions, graphics, links to Web locations
  - In space on the screen (e.g. video with banner advertisement)
  - Temporally (e.g. “pre-roll advertisement” with video streams)
- Enhancing interactivity and flexibility
  - E.g. free navigation
  - E.g. language options
- Technological basis:
  - Spatio-temporally structured compound multimedia documents
  - with high degree of interactivity
  - Example technologies:
    - » SMIL in RealPlayer
    - » MPEG-4

Automated Media Composition and Repurposing?

- Sufficient metadata annotation enables automated semantic decisions
  - Combination of media elements
  - Repurposing, e.g. creating adequate still picture from video
  - Nack, F. (2004) The Future in Digital Media Computing is Meta. *IEEE MultiMedia, Vol 11, No. 2, pp. 10-13*
- Serious open research issue: *How to express the overall structure of a composed piece of media?*
  - Grammar-like system to express the semantic and aesthetic composition
    - » For movies
    - » For general multimedia productions
  - *"Applied media aesthetics"* (H. Zettl)
  - M. Davis: Media Streams - An iconic language for video representation, 1995

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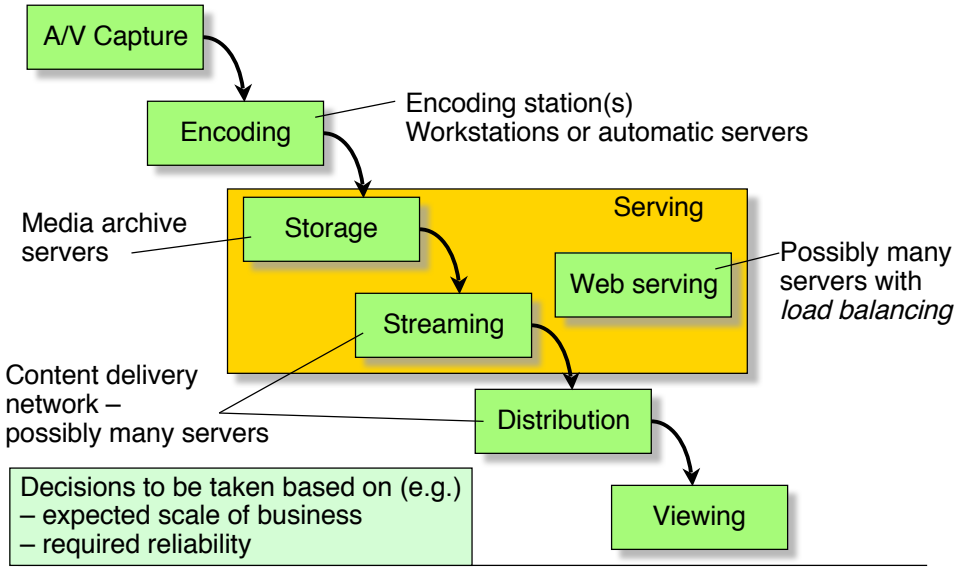
Jürgen Mayer (Hrsg.): streaming media - Internet bewegter, bunter, lauter. Markt&Technik 2001

High-Level View of Media Production

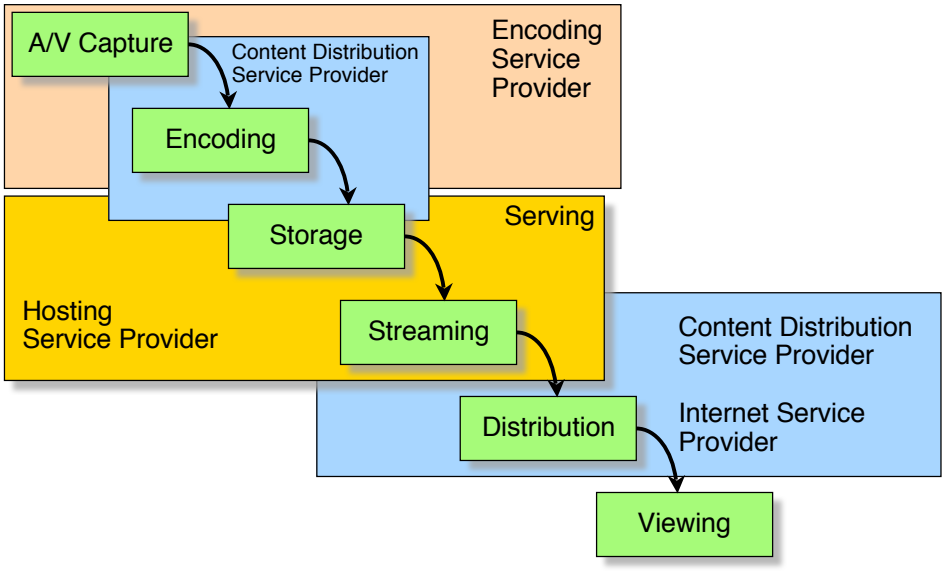
- Premeditate
- Capture
- Archive
- Annotate
- Query
- Message Construction
- Organise
- Publish
- Distribute

Lynda Hardman: Canonical Processes of Media Production, CWI Amsterdam, REPORT INS-E0512 SEPTEMBER 2005

Hardware in the Streaming Delivery Chain



Organisations in the Streaming Delivery Chain



Case Study: “Big Brother” 2000

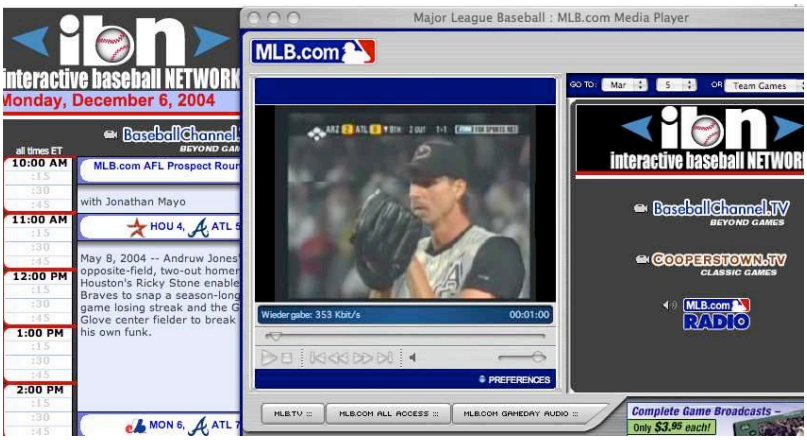
- Encoding: provided by TV1.de (10 encoding servers)
- Serving:
  - 50 million streaming requests...
  - World Online
    - » specially developed load balancing solution using global load balancing (based on BGP) and local load balancing among streaming servers
  - plus distributed server farm in the network of Deutsche Telekom
- Internet service provider: Nacamar

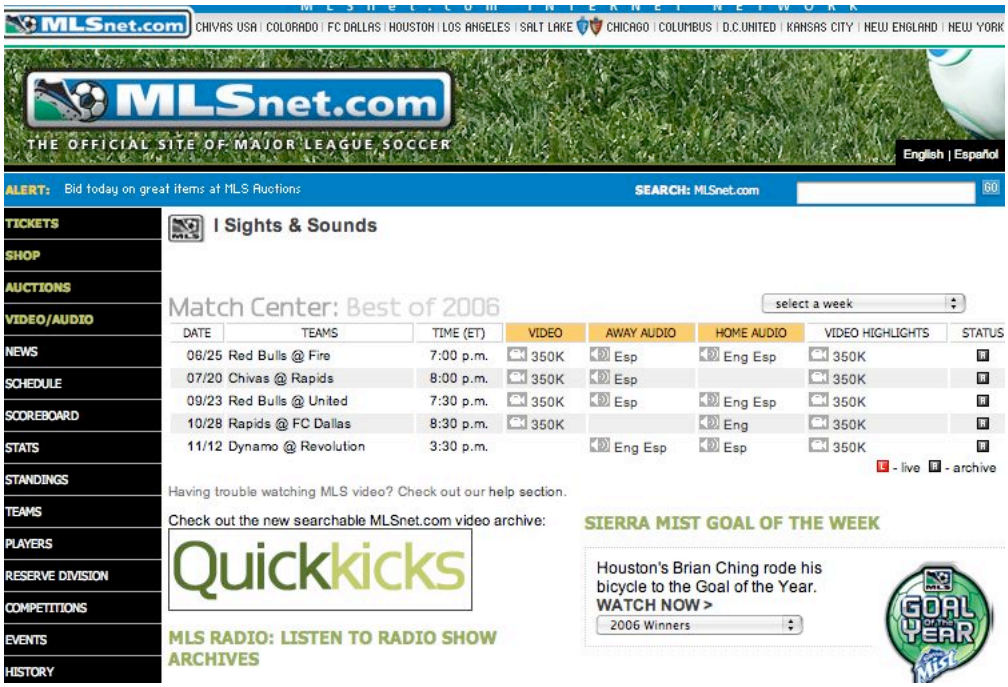
Automated Transcoding

- Example 1: Publishing Multiple Formats
  - Broadcaster is creating 8 hours of content per day
  - Repurposing into streaming media for Web-based Video-on-Demand
  - Live capturing, encoding (e.g. MPEG)
  - After program end: transcoding to different bitrates, delivery to streaming server
- Example 2: Flipping on Demand
  - Media archive for a cable channel to be made available through Web
  - Media kept in single, high-quality format
  - On demand (request), files are transcoded, watermarked, streamed
- Example 3: Collaboration Distribution
  - Large company working on marketing materials
  - One rough cut of a new commercial to be distributed to 100 clients with varying quality expectations and platforms
  - *Content distribution service* transcodes according to client requirements
- Example product: Telestream FlipFactory (www.telestream.net)

Case Study: Major League Baseball

- Major League Baseball Advanced media (MLBAM)
  - Audio and video indexing techniques
  - Searchable interactive video database (see MLB.com)





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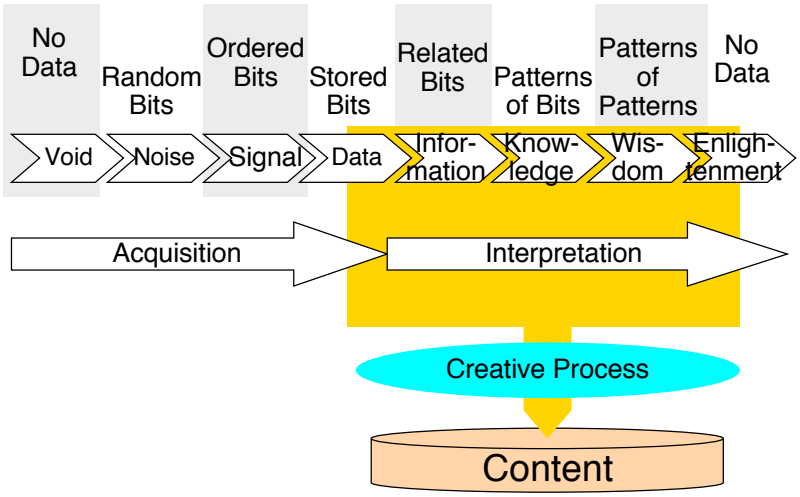
Rosenblatt et al., Chapter 10

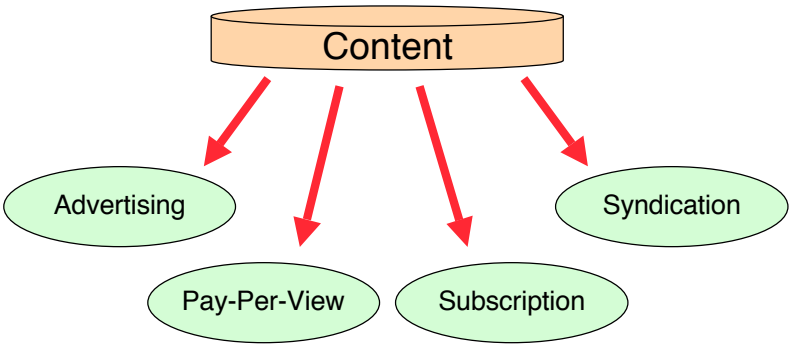
Information Progression and Content

- A holistic view according to Demetriades (p. 189) and Virage Inc.:



Content Monetization

- There are several traditional models for gaining a return on investment on content
  - Network-based media enable the integration of all models



Digital Asset Management

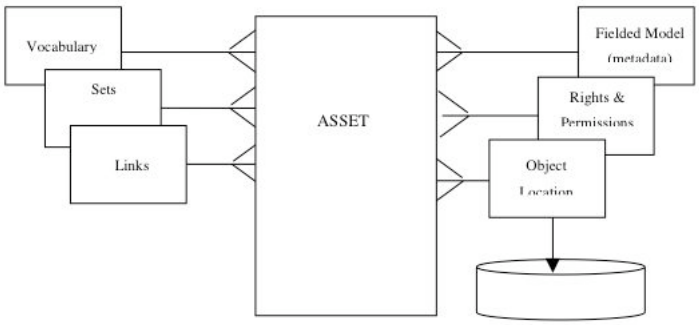
- Very similar acronyms:
  - Digital Asset Management DAM
  - Media Asset Management MAM
    - » Rich Media Asset Management RMAM
  - Digital Media Management DMM
- Basic idea:
  - To make the right media material *(media assets)* available for each specific use, in the right version and the right format
- Integration technology:
  - Workflow integration
  - Integration with various media processing tools
  - Integration with content management and syndication solutions
- Broad range of product offerings
  - From large IT companies (IBM, EMC) to niche vendors

Example: Artesia TEAMS

- Digital Asset Management product, see www.artesia.com
- Media ingestion:
  - Various import tools, e.g. hot folders, email
- Media file storage, access and delivery
- Complete workflow coverage:
  - Individual activities of team members
  - Group projects
- Individual view:
  - “Inbox” – What are the tasks I am assigned to, which dates, which assets
- Project view:
  - Participants, status, associated assets, events (milestones, new versions)
- Asset management view:
  - Asset-centric, navigation to various projects
  - History: “where used”, “who used”, “how used”

Asset Management, Rights and Metadata

- Quotations from Artesia White Paper “The Essential Characteristics of Enterprise Digital Asset Management”:
  - “The defining characteristic of a digital asset is that it is an asset.”
  - “There is general agreement that an asset is the asset’s content plus metadata (or data about the content). Metadata include information about ... rights and permissions ...”

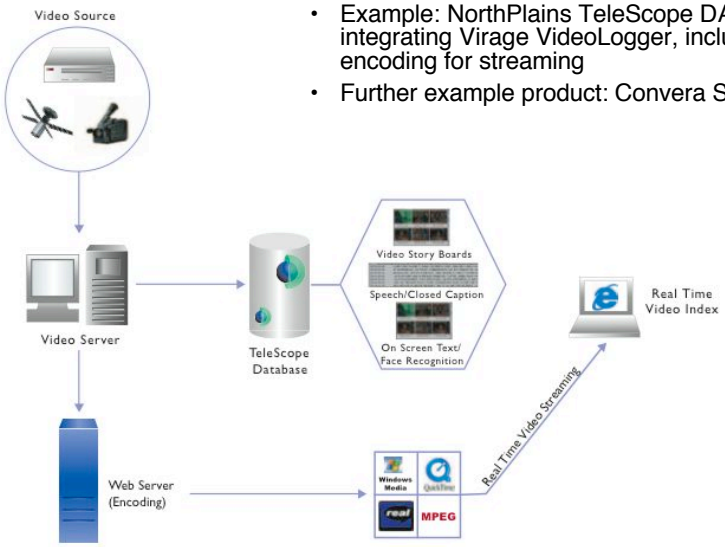


The Generality of Digital Asset Management

	Video	XML	Quark
Ingest	Encode and log	Parse and validate	Decompose
Index	Metadata and closed captions	Structure, attributes and content	Extracted content
Store	Media-server and HSM support	Fragments	de-binerize
Metadata	Format and codex dependent	Semantic web, RDF and industry specific DTD support	Extract
Model	Clips, tracks, key frames and storyboard	DTD or schema	decompose
Search	Visual search, frame accurate, offsets, metadata	Contextual within DTD structure, and metadata	Content and metadata
Navigate	Storyboard, low resolution versions	Xlink, Xpointer	component
Preview	Clip sequencing	XSLT, CSS styles/gist generation	page preview
Export	SMIL, play decision lists	Transform via XSLT, DOM, etc.	re-assemble
Distribute	Transcode, stream	Metadata wrappers	Insert into production workflow

Source: Artesia

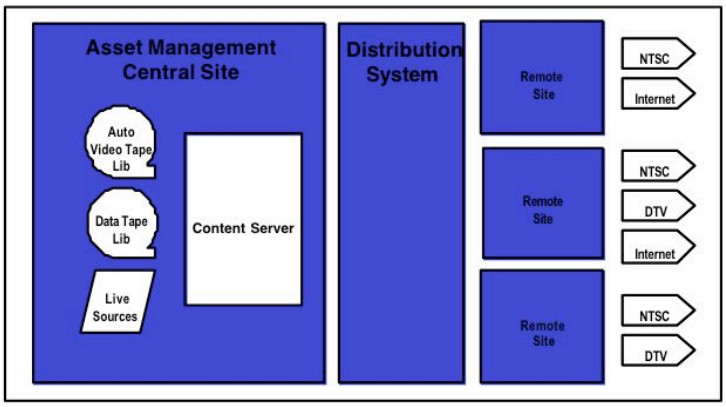
Integration of Metadata Extraction and DAM



- Example: NorthPlains TeleScope DAM product integrating Virage VideoLogger, including direct encoding for streaming
- Further example product: Convera ScreeningRoom

Centralcasting

- Production of various programmes on various distribution channels out of a central content server
- Source: Artesia Technologies



Semantic Gap in Content/Media Management (1)

C. Dorai, S, Venkatesh: Bridging the Semantic Gap in Content Management Systems: Computational Media Aesthetics, In Proc. Conf. on Computational Semiotics for Games and New Media, 2001.

"... An approach that goes beyond representing what is being directly shown in a video or a movie, and aims to understand the semantics of the content portrayed and to harness the emotional, visual appeal of the content seen."

$$P(n) = \alpha(W(s(n))) + \frac{\beta(m(n) - \mu_m)}{\sigma_m}.$$

Pace flow function
n = shot number
s = shot length
m = motion magnitude
μ, σ mean and standard deviation of m

Semantic Gap in Content/Media Management (2)