

CSc 461/561

Multimedia Systems

MPEG-1/2/4

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MPEG

- Motion Picture Experts Group
 - MPEG-1: VCD (VCR-quality)
 - MPEG-2: DVD & HDTV
 - MPEG-3: aborted due to MPEG-2
 - MPEG-4: content-based
 - (future compression standards)
 - MPEG-7: meta-data
 - MPEG-21: DRM (21st century)

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MPEG-1

- MPEG-1 (1991): VCD (VCR+CD quality)
 - 352x240, 1.2Mbps video CBR, 256Kbps audio
 - progressive scan only (1x CD-ROM)
- MPEG-1 video compression
 - similar to H.261, with a few differences
 - more formats, flexible *slices*, quantization table
 - I-frame: JPEG-like compression
 - P-frame: prediction-based; B-frame

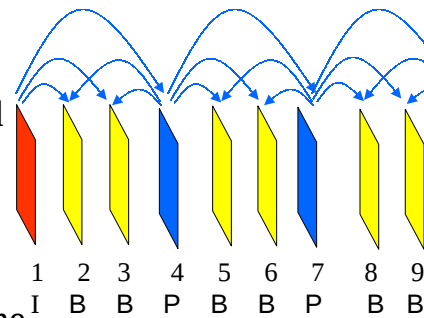
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MPEG-1: more

- Bi-directional search
 - search both previous and next frames for *similar* macro-blocks
- MPEG-1 GOP
 - I-frame, P-frame, B-frame
 - display order: IBBPBBPBBPBBPBB (M=3, N=15)
 - coding order: IPBBPBBPBBPBBIBB; timestamps
 - D-frame: for search through the video, DC only



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MPEG-2

- MPEG-2 (1994): DVD, HDTV, etc
 - also adopted as ITU-T H.262
 - many video formats and data rates; better audio
 - profiles: simple (4:2:0, I/P), main (+B), SNR (+variable quality), spatial (+variable resolution), high (+4:2:2)
 - levels: low (352x288), main (720x576), high 1440 (1440x1152), high (1920x1152)
 - support interlaced video (broadcasting!)

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LEVELS and PROFILES	Simple Profile	Main Profile	SNR Scalable Profile	Spatial Scalable Profile	High Profile
	No B-frames	B-frames	B-frames	B-frames	B-frames
	4:2:0	4:2:0	4:2:0	4:2:0	4:2:0 or 4:2:2
	Not Scalable	Not Scalable	SNR Scalable	SNR Scalable or Spatial Scalable	SNR Scalable or Spatial Scalable
High Level 1920 pixels/ line 1152 lines		≤ 80 Mbit/s			≤ 100 Mbit/s
High-1440 Level 1440 pixels/ line 1152 lines		≤ 60 Mbit/s		≤ 60 Mbit/s	≤ 80 Mbit/s
Main Level 720 pixels/ line 576 lines	≤ 15 Mbit/s	≤ 15 Mbit/s	≤ 15 Mbit/s		≤ 20 Mbit/s
Low Level 352 pixels/ line 288 lines		≤ 4 Mbit/s	≤ 4 Mbit/s		

MPEG-2
profiles
and
levels

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MPEG-2 scalability

- Layered encoding
 - base layer: independent for basic quality
 - enhancement layer: dependent on the base layer
- E.g., SNR scalability
 - base: low SQNR (coarse quantization)
 - enhance: high SQNR (fine Q on actual-base)
- E.g., spatial scalability
 - base: low resolution; enhance: high resolution

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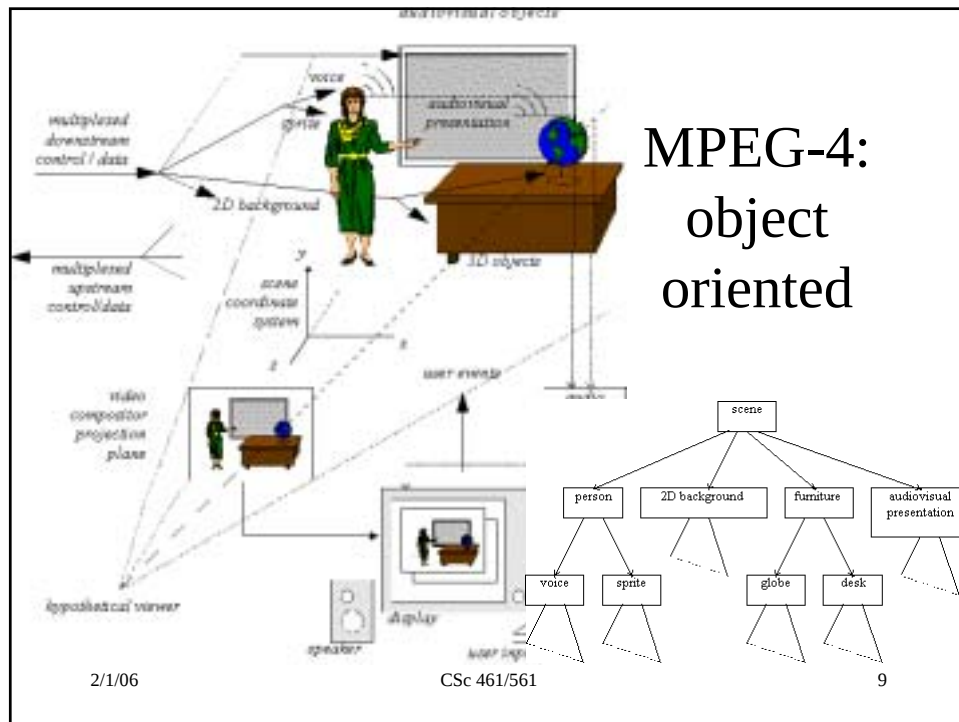
MPEG-4

- MPEG-4 (1999): content-based, object-oriented
 - based on H.263, initially for low bit-rate apps
 - video sequence: a collection of media *objects*
 - objects: still image, moving object, audio, etc
 - how to decompose is NOT specified (encoder)
 - VOP: video object plane
 - GOV: I-VOP, P-VOP, B-VOP
 - VOP is divided into many macro-blocks
 - motion estimation: bounding box; padding

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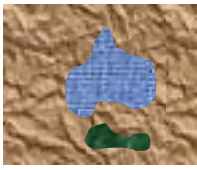
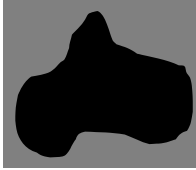
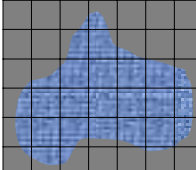
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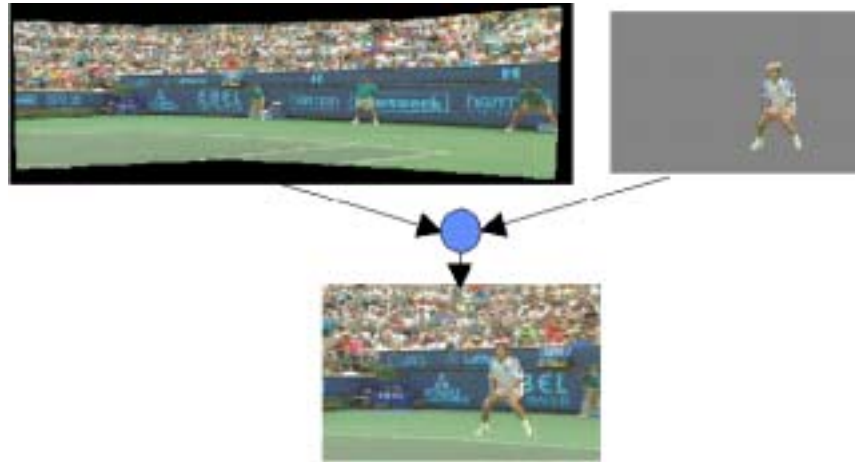
Object coding

- Texture coding
 - DCT-based
 - SA-DCT: shape adaptive
- Shape coding
 - binary shape; grayscale (transparency) shape
- Static texture coding
 - wavelet-based (good for scaling)
- 2-D and 3-D mesh coding


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Sprite coding



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MPEG-4: more

- Fine gain scalability
 - spatial scalability
 - temporal scalability
 - quality scalability
- MPEG-4 audio
 - general audio (2~64Kbps)
 - speech (2~4Kbps: HVXC; 4~24Kbps: CELP)
 - synthesized (e.g., MIDI, TTS)

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H.264

- H.264 (2003)
 - also as MPEG-4 AVC (advance video coding)
 - initially: low data rate for high picture quality
 - now a wide variety of bit-rates, applications, systems
 - enhanced motion estimation and compensation
 - multi-picture, variable block-size, quarter-pixel precision, weighted prediction, etc
 - profiles: baseline, main, extended; 15 levels
 - fidelity range extension: high, 10, 4:2:2, 4:4:4

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This lecture

- Video compression standards
 - MPEG-1: GOP
 - MPEG-2: scalability
 - MPEG-4: content-based, object-oriented
 - H.264: AVC
- Explore further
 - H.264

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Next lecture

- Multimedia delivery
 - multimedia networking
 - review on data networking