The New MPEGs

What are they, and do they matter?

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In the Beginning

- MPEG-1
  - Developed 1988-1992
  - CIF (352x240) @ 30 Hz
  - Up to 1.5 Mb/s Video + Audio (1x CD rate)
  - Compare to audio CD, 2ch x 16 bits @ 44.1kHz
  - Better than 20:1 compression
  - Used DCT for spatial compression (similar to JPEG)
  - Motion estimation & compensation
  - No interlace tools
  - Defined tools, syntax & decoder (NOT the encoder)
  - Powerful syntax, extended for use with SDTV & HDTV for DirecTV and AD-HDTV (special decoders)

MPEG-1 Begat MPEG-2

- MPEG-2: Developed 1991-1994 (and continuing)
- Initially intended for broadcast TV (standard definition)
  - Improvements, but same basic algorithms as MPEG-1 for spatial and temporal compression (NOT a given!)
  - Tools for interlace
  - Scalable syntax
  - System layer for multiple program streams
  - Profiles & Levels
    - Vastly increased flexibility, including HDTV
    - Complexity/cost can be matched to application
    - Permitted addition of later extensions (4:2:2 profile etc.)

Profiles & Levels in MPEG-2

LEVEL \ PROFILE	SIMPLE	MAIN	4:2:2 PROFILE	SNR	SPATIAL	HIGH
HIGH		4:2:0 1920 x 1152 80 Mb/s I, P, B	*4:2:2* *1920 x 1080* *300 Mb/s* *I,P,B*			4:2:0, 4:2:2 1920 x 1152 100 Mb/s I, P, B
HIGH-1440		4:2:0 1440 x 1152 60 Mb/s I, P, B			4:2:0 1440 x 1152 60 Mb/s I, P, B	4:2:0, 4:2:2 1440 x 1152 80 Mb/s I, P, B
MAIN	4:2:0 720 x 576 15 Mb/s I, P	4:2:0 720 x 576 15 Mb/s I, P, B	4:2:2 720 x 608 50 Mb/s I, P, B	4:2:0 720 x 576 15 Mb/s I, P, B		4:2:0, 4:2:2 720 x 576 20 Mb/s I, P, B
LOW		4:2:0 352 x 288 4 Mb/s I, P, B		4:2:0 352 x 288 4 Mb/s I, P, B		

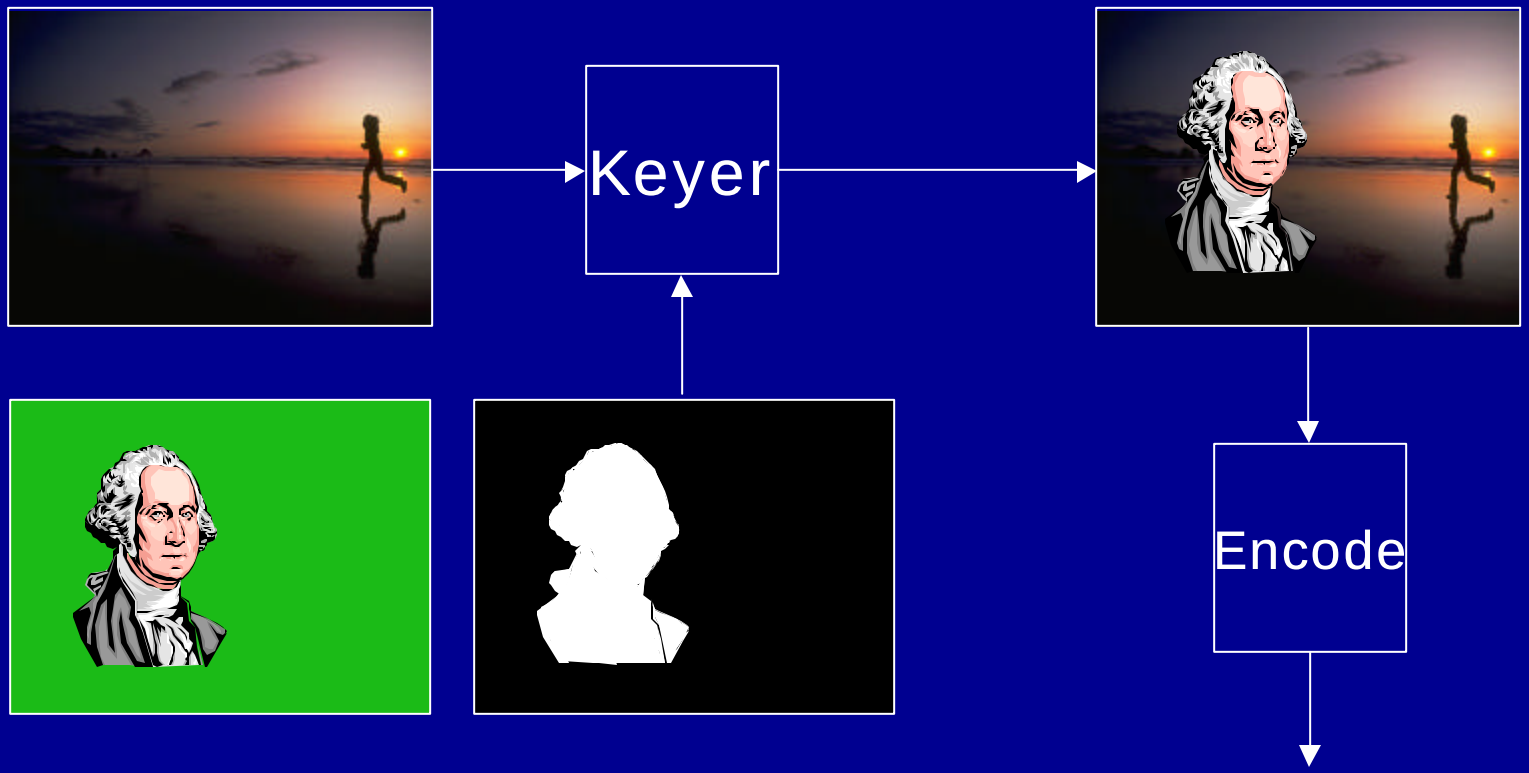
And on the Third MPEG, Leonardo Rested

- MPEG-3
  - Started 1992 to provide HDTV capabilities (1920x1080 @ 30 Hz; 20-40 Mb/s)
  - Abandoned in 1993 when it was realized that MPEG-2 would do the job!

And Then There Was MPEG-4

- Started 1993
  - Initial focus—"Very low bit rate audiovisual coding"
    - Below 64 kb/s
    - 64 to 384 kb/s
    - 384 kb/s to 4 Mb/s
- Changed in 1994 to "Coding of Audiovisual Objects"
- Evolved into "something for everyone"

Conventional Coding (Compositing First)



Object Coding

Texture Encode

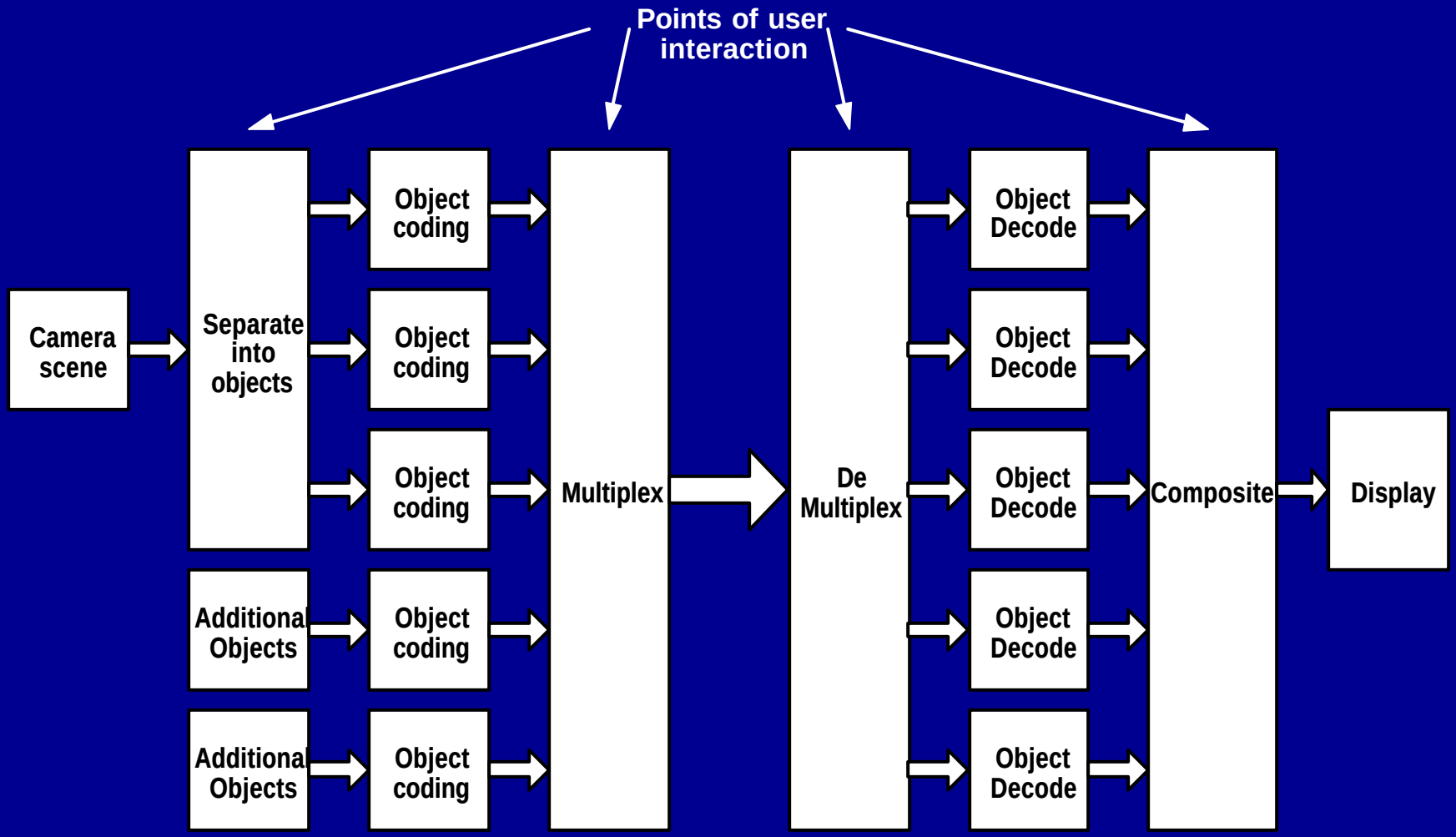
Texture Encode

Shape Encode

Multiplex

Bounding Box

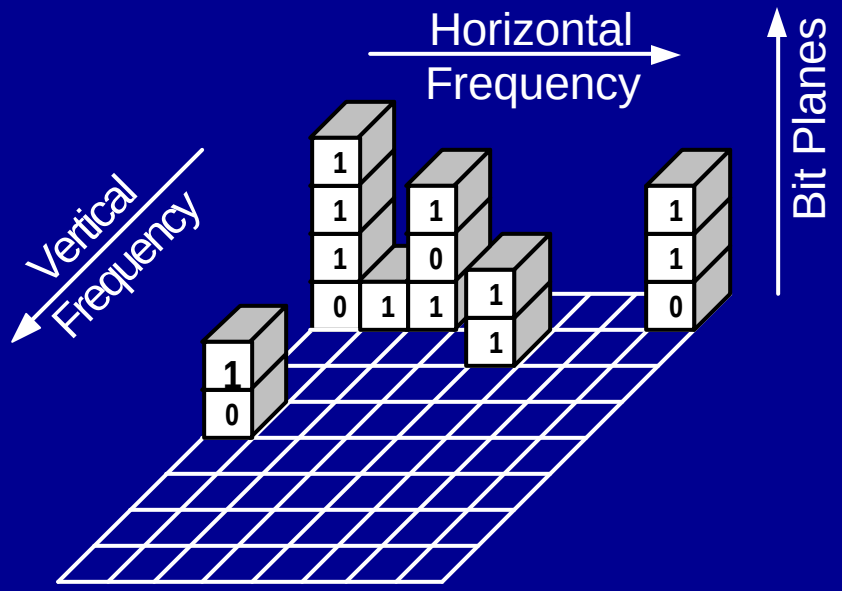
Object Coding in MPEG-4



Types of Objects

- Video Objects
  - Natural and/or synthetic
  - Backgrounds
  - Sprites
  - Other “video” components (foreground objects etc.)
  - Text
  - Graphic elements (2-D & 3-D)
  - Facial animations
  - Body animations
- Audio Objects
  - Natural & Synthetic
- Data Objects

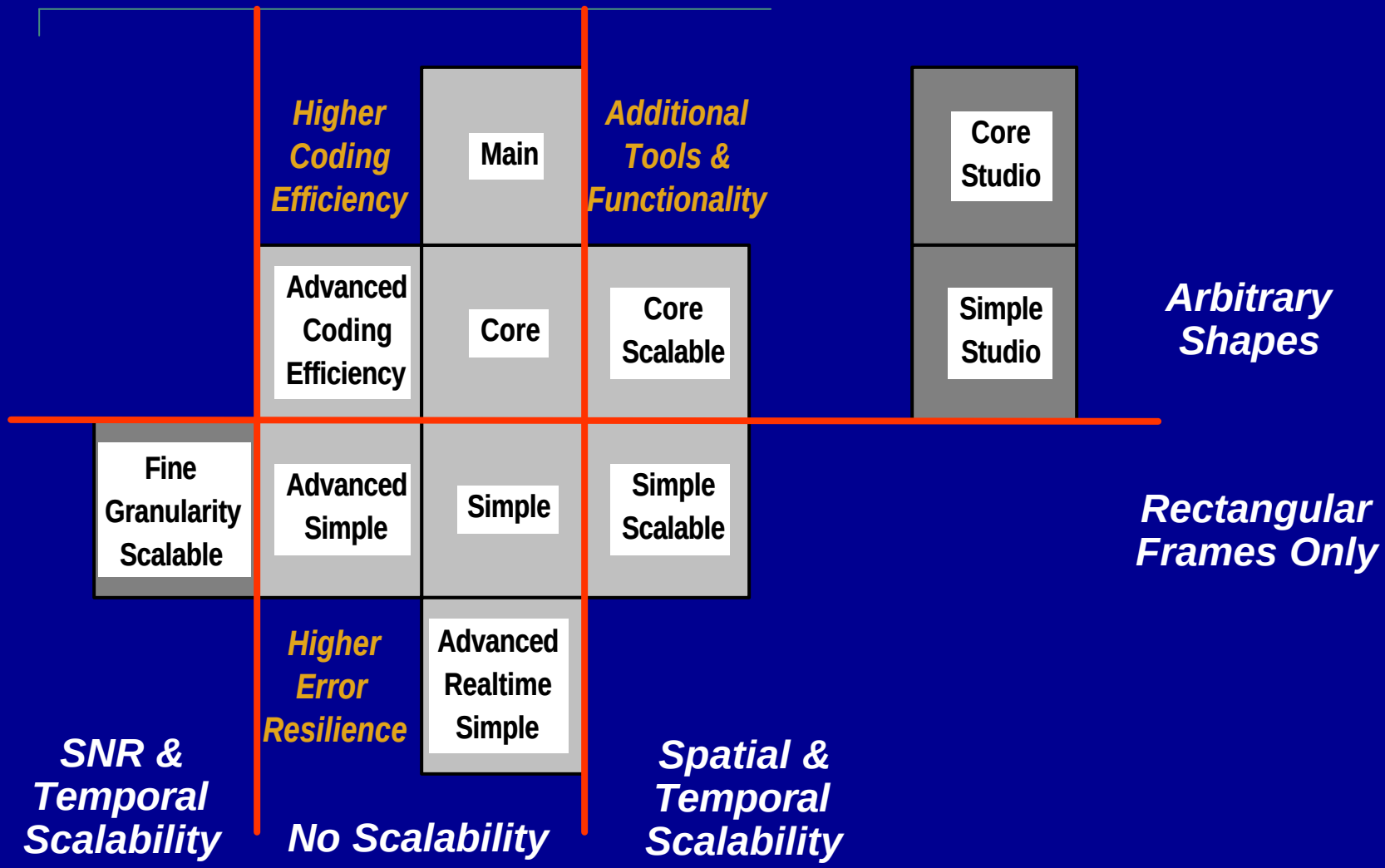
Fine Grain Scalability



Applications of MPEG-4

- Games
- Games
- Games
- Internet streaming
- Almost anything else
- MPEG-4 is vast, and getting even bigger!

Video Profiles in MPEG-4



MPEG-7

- Why “7” ???
  - 1, 2, ~~3~~, 4, 5, ...
  - 1, 2, 4, 8, ...
  - 1, 2, 4, 7, ...

MPEG-7 is NOT About Compression

- MPEG-7 is about describing digital objects
- MPEG- is about *metadata*
  - The content (video, audio, etc.) is called digital *essence*
  - Metadata is data that *describes* digital essence
  - The “bits about the bits”
    - Title, owner, actors, format, color-space, …
    - Shooting location, time, zoom angle, …
    - Names, events, transcripts, …
    - Objects, faces, …
    - Colors, textures, shapes, …

The Archive Dilemma

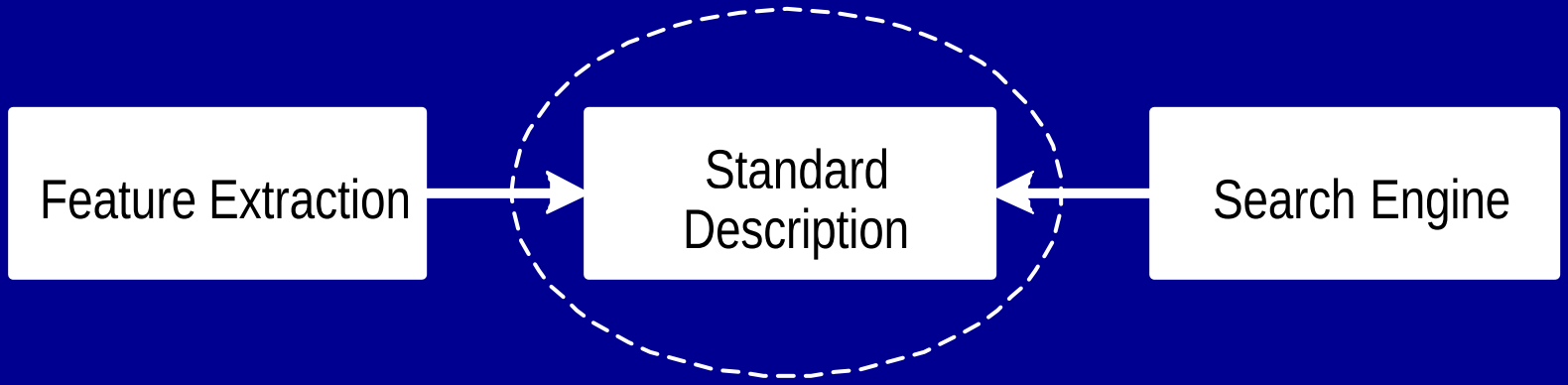
- “Once the journalist who worked on the story has forgotten what footage is on what tape, the archive is practically valueless.”
- Meaningful availability is timely availability
- Computer Systems Offer Excellent Search Tools
- But what do we search?

Some Example Applications

- Music: Play a few notes on a keyboard and get in return a list of musical pieces containing (or close to) the required tune or images somehow matching the notes, e.g. in terms of emotions.
- Graphics: Draw a few lines on a screen and get in return a set of images containing similar graphics, logos, ideograms, ...
- Find all clips on record showing both Liz Taylor and Richard Burton

Scope of MPEG-7

The technology will come!



MPEG-21

- “21” ???!!
  - Never mind!
- MPEG-21 seeks to create a complete structure for the management and use of digital assets, including all the infrastructure support for the commercial transactions that must accompany this structure.
- Vision Statement: “to enable transparent and augmented use of multimedia resources across a wide range of networks and devices”

Elements of MPEG-21

- Digital item declaration
- Digital item representation
- Digital item identification and description
- Content management and usage
- Intellectual property management and protection
- Terminals and networks
- Event reporting

Conclusions

- The deployment of millions of MPEG-2 decoders (DVD players, digital TVs, etc.) Will ensure the continued relevance of MPEG-2
- MPEG-4 Will become a major force in the computer world, and may appear in set-top boxes, etc. Don't ignore it!
- MPEG-7 should become a vital tool in the use of digital assets
- MPEG-21—Let's find out what it really is first (but MPEG has an enviable track record!)

Finally ...

- Presentation available at www.symes.tv