MPEG-4 &
Broadband Content Delivery

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What to expect

- Overview of MPEG-4 and its design principles

- Why using MPEG-4 makes sense

- Technical details if there is time, and on demand

- Ask any question anytime – even if they seem a little off-topic

What is MPEG-4 Anyway?

- Low bitrate video coding standard?
- Standard for Internet streaming?
- Successor of MPEG-2?
- Video coding method that requires extraction of objects?
- A newfound goldmine for MPEG-4 licensors?
  Or …
- An architecture and coding methods for representation multimedia content?
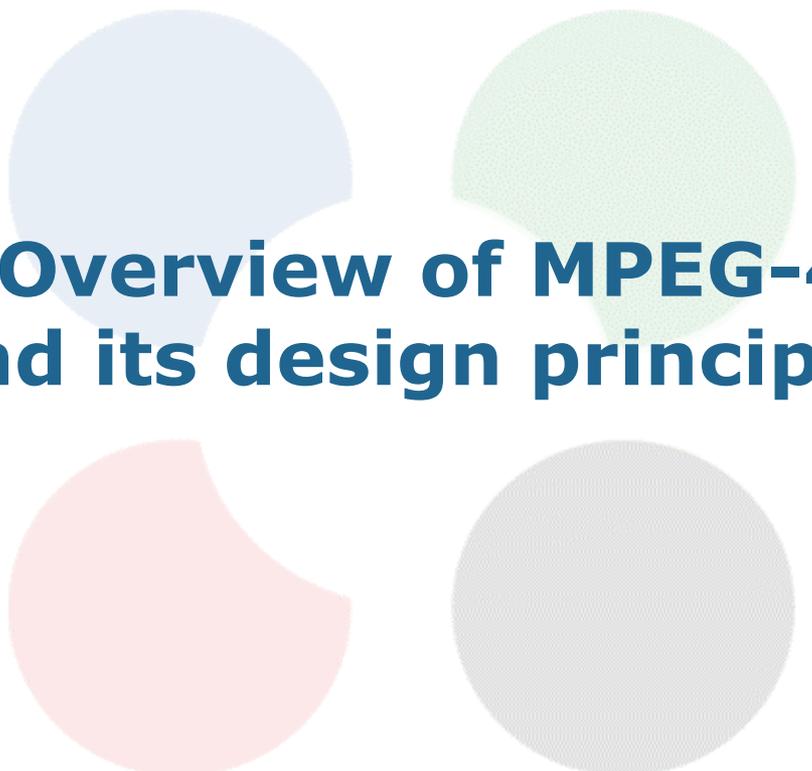
Overview of MPEG-4
# and its design principles

MPEG: Moving Picture Experts Group
Coding of Moving Video and Audio

- MPEG-1:	CD-i, (VoD trials), ... – 1992

- MPEG-2:	... + TV, HDTV – 1994

- MPEG-3:	*HDTV → merged into MPEG-2*

- MPEG-4: Coding of Audiovisual Objects –1998, 1999
	Extensions ongoing

- MPEG-7:	MM Description Interface – Fall 2001
	'Describing' audiovisual material

- MPEG-21: Digital Multimedia Framework – 1st parts ready
	'The Big Picture and The Glue'

A bit of history and background on MPEG-4

- 1993: started as 'Very Low Bitrate Audiovisual Coding'

- 1994: goal changed to 'Coding of Audiovisual Objects'

- Ready since 1999, being extended in backward compatible ways

- Now working on MPEG-4 part 10, the 'JVT Codec', Audio extensions and some Systems refinements

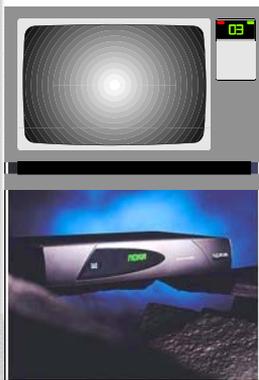*From the MPEG-4 Call for Proposals (drafted 1994)*
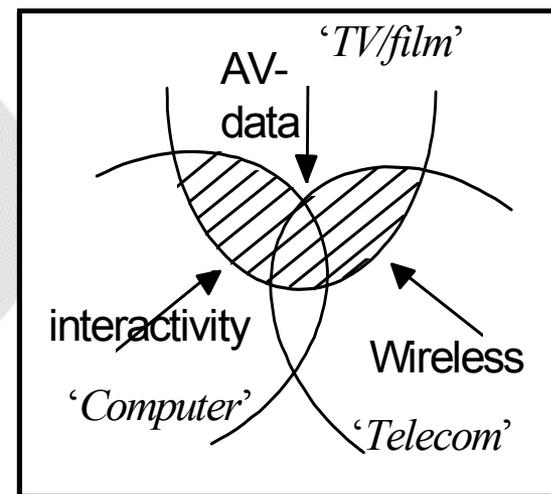
Vision from 1994

- Convergence is a hype. There will not be one single network or terminal

- Rather, we will see a proliferation of multimedia services over different networks, terminals.

- Therefore, we need is a common multimedia technology that supports the three main service paradigms:
  - Broadcast
  - Communication
  - Retrieval (online, on-media)

Israel attacks Syria in ...

Israel attacks Syria in Lebanon

Help | Feedback | Preferences

For more video, visit

CNN videoselect

Common technology for ...

The most important objectives

- Common technology for many types of services:
  interactive, broadcast, conversational
- Allowing more & different interactivity - not just stop/play/slow, but interactivity involving elements within the 'scene'
- Integrating natural and synthetic content
- Covering a wide range of access conditions
  - Includes low bitrates, error resilience, scalable coding
- Helping to manage and protect Intellectual Property

The Nature of MPEG-4

- MPEG-4 is an object based multimedia content representation standard

- Many innovations come from the Systems Layer

- Stat-of-the art coders, responsibly upgraded

- It's got Intellectual Property Management and Protection ('IPMP') hooks deeply built into it

- Profiles and Levels to restrict complexity

mp4

An MPEG-4 Scene

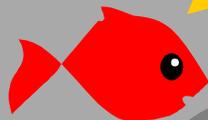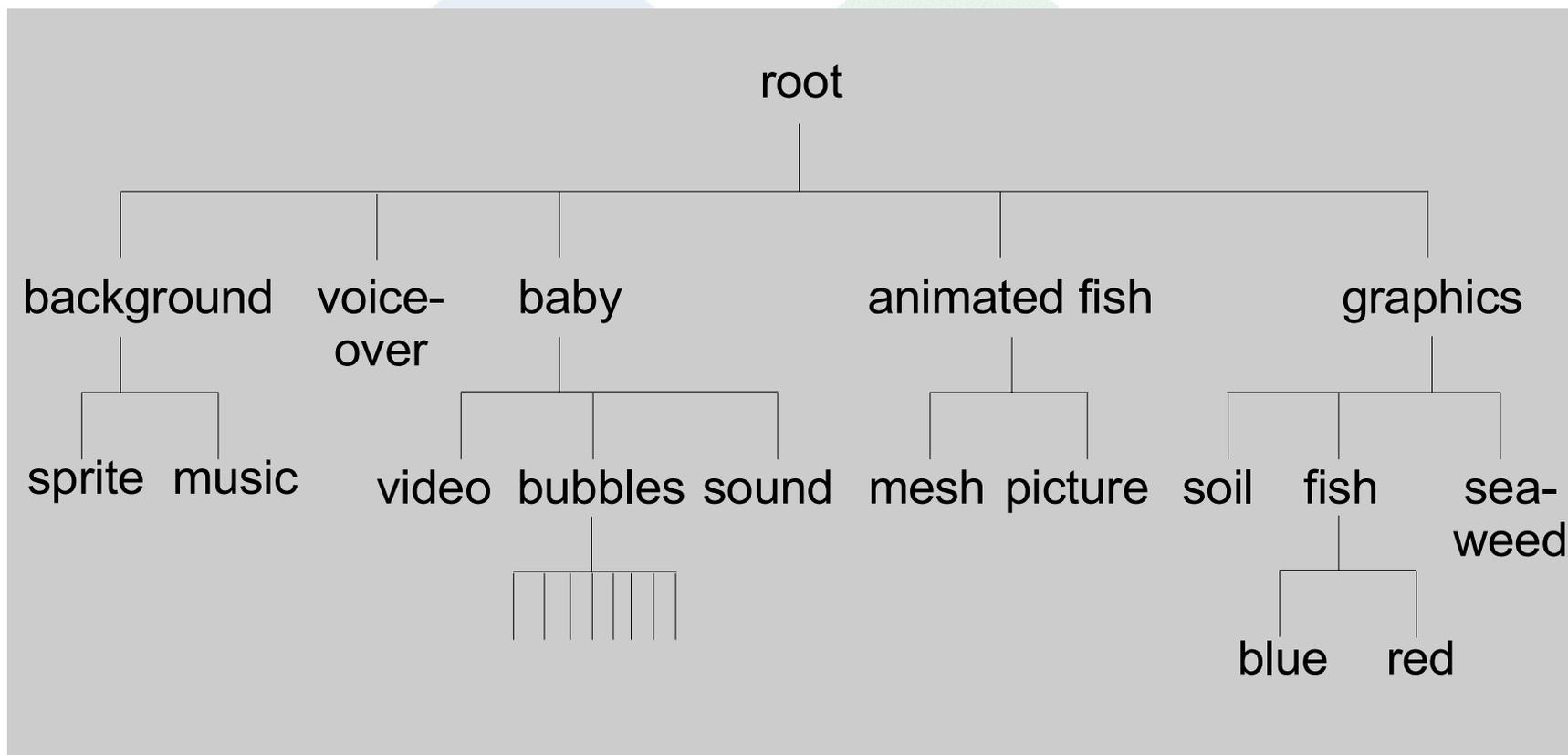**Animated 2D photo / mesh**
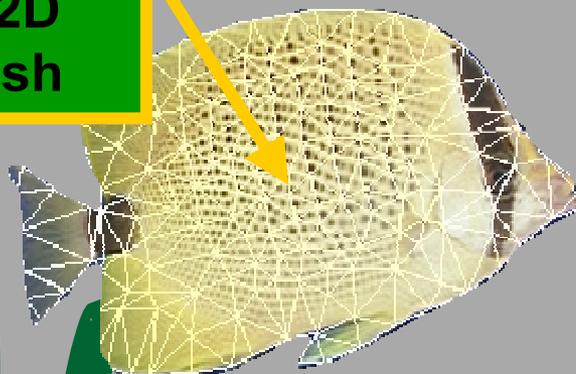
Graphic objects
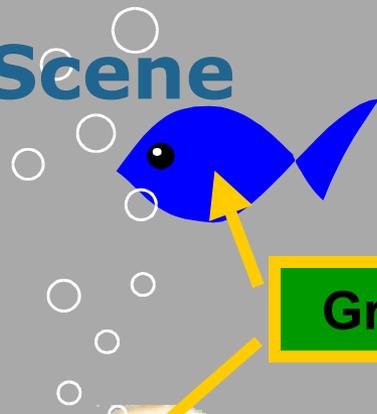
Background with music

'Natural' audiovisual object

The Scene Tree

MPEG-4: Coding of Audiovisual Objects

- Audiovisual **Scene** is composed of '**Objects**' (A&V)

- '**Compositor**' puts objects in scene (A&V, 2&3D)

- Objects can be of different nature
  - natural or synthetic A&V, text & graphics, animated faces, arbitrary shape or rectangular

- **Coding** scheme can differ for individual objects

- Principle is **independent** of bitrate!
  - from low bitrates to (virtually) lossless quality

Why using MPEG-4 makes sense

Status of adoption

- The standard for low bandwidth multimedia on 3G mobiles

- Internet Streaming Media Alliance choose MPEG-4 as the single standard that will permit cross-vendor interoperability for video on the Internet

- It is being actively discussed by DVB, the world's leading digital television standards drafting body, for the transport of video over IP

# Increased operating profits

- Content businesses save money
  - More efficient use of bandwidth
  - Re-purpose existing content
  - Avoid duplication when adding value to assets
- Content businesses make money
  - Leverage existing content and infrastructure in new ways
  - Allows new dimension of content

Revolution in functionality, Evolution in infrastructure

- Smooth evolution from MPEG-2
  - Can integrate into hard-working MPEG-2 environments
  - Extension to MPEG-2 Systems: how to transport MPEG-4 objects and complete scenes and interactive material over MPEG-2 Transport Stream
  - MPEG-2 audio and video coding ('objects') can be used in MPEG-4 Systems
- 100% Agnostic to transport so allows all types of casting
  - Can use existing infrastructure such as IP networks
- Will be used on all types of networks
  - No new networks or transports need to be developed

Write once - Play everywhere
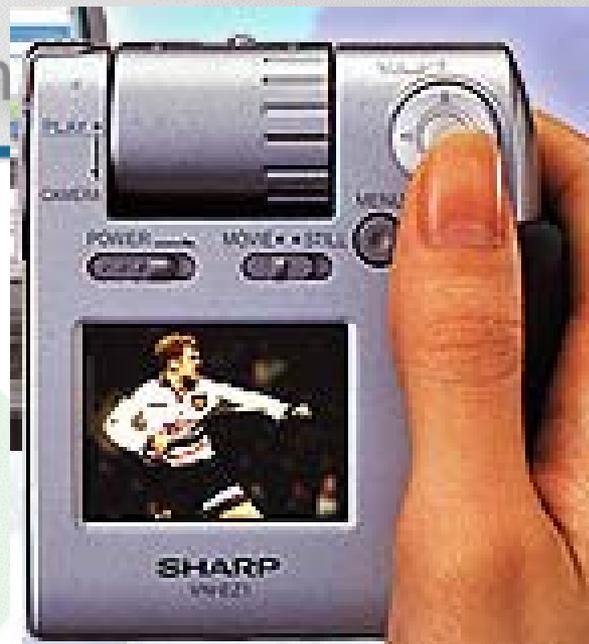
Applications of MPEG-4

- Mobile devices
  - Requires low datarates, error resilience, some scalability
- Streaming services
  - Require scalability, low to medium datarates, interactivity, IPMP
- On-disk distribution (DVD)
- Broadcast
  - Starting with 'individual' bandwidth
  - But not too much later
  - 'MPEG-4 over MPEG-2'
  - Coders being considered in DVB

Minimal capital expenditure

- Existing infrastructure will be adequate
- Open standard creates an ecosystem
    - Market-based price control mechanisms
    - Second sourcing of equipment
    - Different providers make what they excel in
    - No monopoly = compliance issues monitored by non-profit organisation (M4IF)
- Licensing Announced for Visual
    - Encoders / Decoders much cheaper than MPEG-2
    - Use fee (2 cts/hr) controversial but still under discussion
        - Not for 'free' content
        - Unknown for broadcast

Are other technologies cheaper or easier?

- Yes, there are "one stop shops"
  - Why does this make them cheaper?
- There are risks associated with doing business with a one stop shop
  - An open standard like MPEG-4 is not controlled by a single vendor
  - Competition in price AND quality
  - No vendor lock-in
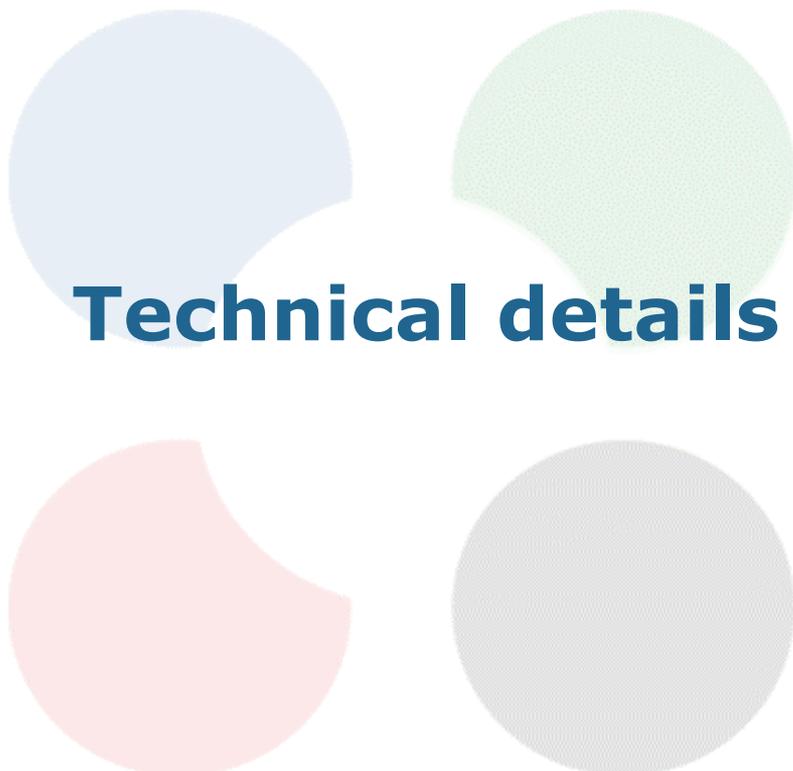
Major Risks of Proprietary Technology

- Hostage to third party business and pricing models

- Dependence on proprietary and confidential third party technology road maps

- Potential channel conflicts if supplier is also competitor Exploitative licensing terms, such as when the license includes many more "bundled features" than required, features that may lock you in

- "Classic" single sourcing problems with respect to pricing, competition, product-sourcing, new product versions, bug fixes.

MPEG-4 Industry Forum

- Doing the things that ISO cannot do
- Bootstrapping licensing pools
  - But real work is independent of M4IF
  - Studying alternative licensing schemes
- Interoperability testing
- Marketing
  - Trade shows, tutorials, papers
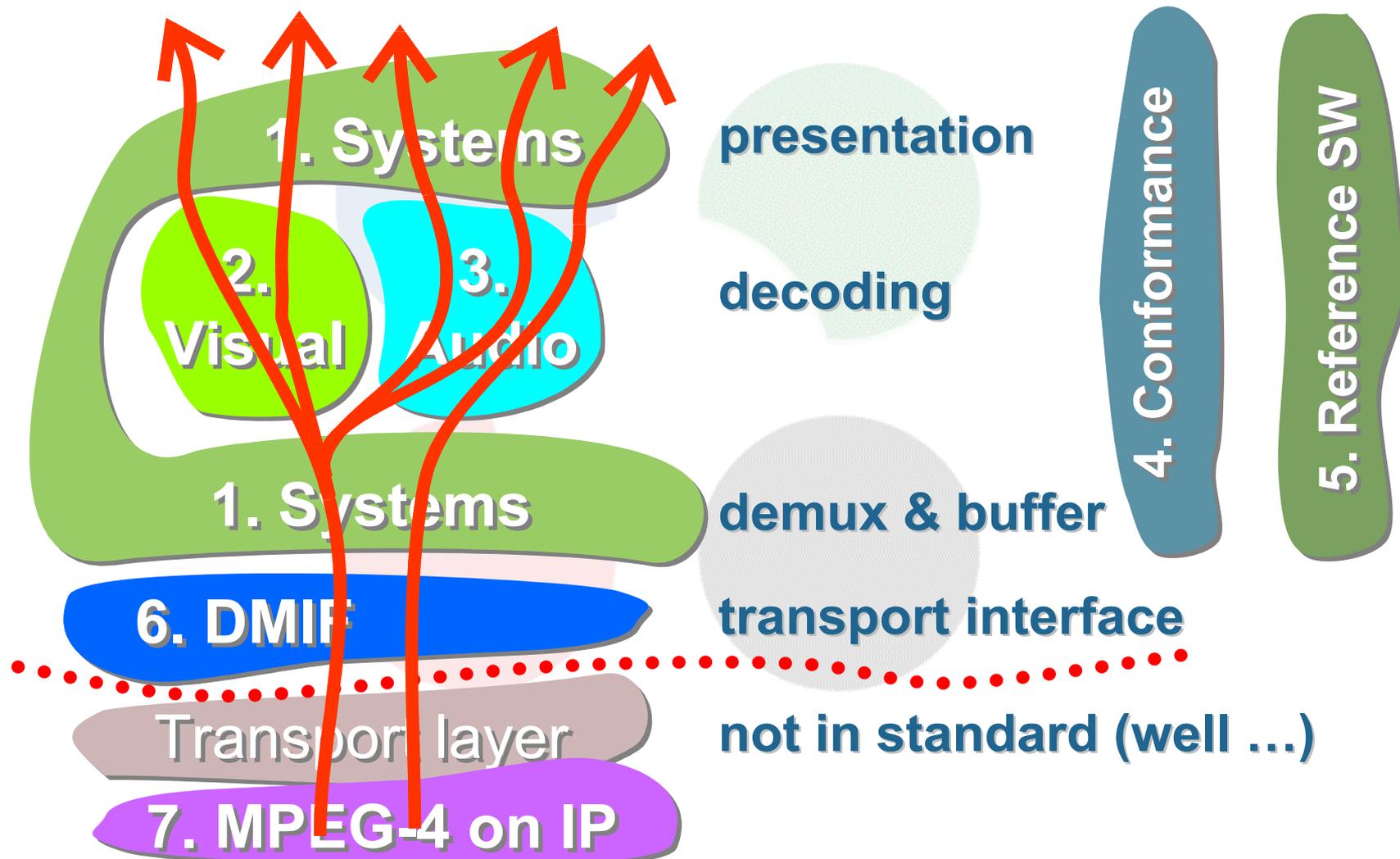- Information clearing house
- Logos for conformant Products

MPEG-4 Industry Forum Members

See Website

Technical details

The Parts of the MPEG-4 Standard

1. Systems — presentation

2. Visual

3. Audio — decoding

1. Systems — demux & buffer

6. DMIF — transport interface

Transport layer — not in standard (well …)

7. MPEG-4 on IP

4. Conformance

5. Reference SW

Recent additions

- Part 8: optimized video **en**coder
- Part 9: VHDL description of MPEG-4 (tentative)
- Part 10: JVT Coder
  - New video coder, built jointly with ITU-T
  - H.26L was starting point
  - Ready end 2002

Visual Media Object Types in MPEG-4

- Video from 10 – 1,000,000 Kbit/s
  - Multiple rectangular or arbitrary shape objects in the scene
  - Scalable – Interlaced and Progressive
- 'Sprites' (e.g. backgrounds): send once, then warp
  - Matshushita chip for mobile devices uses this
- Computer-generated visual information
  - Face ad body animation,
  - animated 2-D meshes with moving texture,
  - Synchronized graphics & animated text

Audio Media Objects in MPEG-4

- Audio from 4 kbit/s to 64 kbit/s/channel
  - Arbitrary number of objects in the scene
  - Extended AAC, TWINVQ
  - > 4kbit/s: Harmonic and Individual Lines plus Noise' (HILN)
- Voice from 2 kbit/s to 24 kbit/s
  - 2-4 kbit/s: HVXC (Harmonic Vector eXcitation Coding)
  - 4-24 kbit/s: CELP:
- Large step + Fine Grain Scalability
  - 1 kbit/s steps through Bit-Sliced Arithmetic Coding

MPEG-4's Synthetic Audio Objects

- Structured Audio
  - SAOL (SA Orchestra Language)
  - SASL (SA Score Language)
  - Great 'music' at very low bitrates
- Coded form of MIDI
- Wavetable synthesis for simple decoders
  - Including effects
- Text-To-Speech (interface!)
  - To complement face/body animation

MPEG-4 Systems

- Binary Scene Description
  - VRML concepts + Streaming + Real Time + Efficiency
  - Content in same scene can come from different sources
  - Allows interaction (local/remote)
  - 2D and 3-D
  - Dynamic (continuous) scene updates and scene animation
- XMT: Textual format for BIFS
  - Includes some SMIL harmonization

MPEG-4 Systems

- Predictable behavior of a decoder and decoded content:
  - Tight synchronization of A, V, synthetic, graphic elements
  - Buffer management
- Flextime
  - Spring-like timing model
- IP management and protection
- File format MP4 (based on Quick Time)

MPEG-4 Systems (cntd.)

- ## MPEG-J
  - API for complicated content behavior,
  - API's to network / terminal / UI resources
  - 'Application Engine'

- ## Audio Rendering
  - Specify downmix from arbitrary number of channels
  - Environmental spatialization
    - modeling of environment for spatial sound reproduction
    - Physical and perceptual

Profiles & Levels

- MPEG-4's Conformance points are Profiles@Levels
    - A bit like in MPEG-2
- Profiles determine tool set
    - E.g. B frames, ¼ pel Motion Compensation
- Levels limit complexity
    - E.g. MBs/sec, max # objects, Complexity Units (Audio)

- Profiles will be convergence point for Industry Standards built on MPEG-4
    - They will be the vehicle for market decisions and uptake

Profile Dimensions:

- Visual (natural, synthetic, natural + synthetic)
- Audio (natural, synthetic, natural + synthetic)
- Graphics

Media Profiles

- Scene Description (Scene Graph)
  - Tools to describe an manipulate scene
- MPEG-J (Main and Personal)
- Object Descriptor (Synch and Buffers)

- MPEG does not prescribe how to combine these

Thank you

Further info:
www.m4if.org (Website M4IF)
mpeg.telecomitalialab.com (website MPEG)