envivio.

MPEG-4 : A Solution for Interactive Digital Television

Olivier Avaro (France Telecom R&D),
Eric Deniau (Envivio)

143th SMPTE conference
New-York, 11/6/2001

Presentation overview

- MPEG-4 Systems
  - A standard for interactive rich media
- Application to Broadcast
  - A standard for interactive digital television
  - Examples of interactive MPEG-4 services
- Conclusion
  - MPEG-4 is the solution for interactive multimedia broadcast

envivio.

MPEG-4 Systems :

A standard for interactive rich media

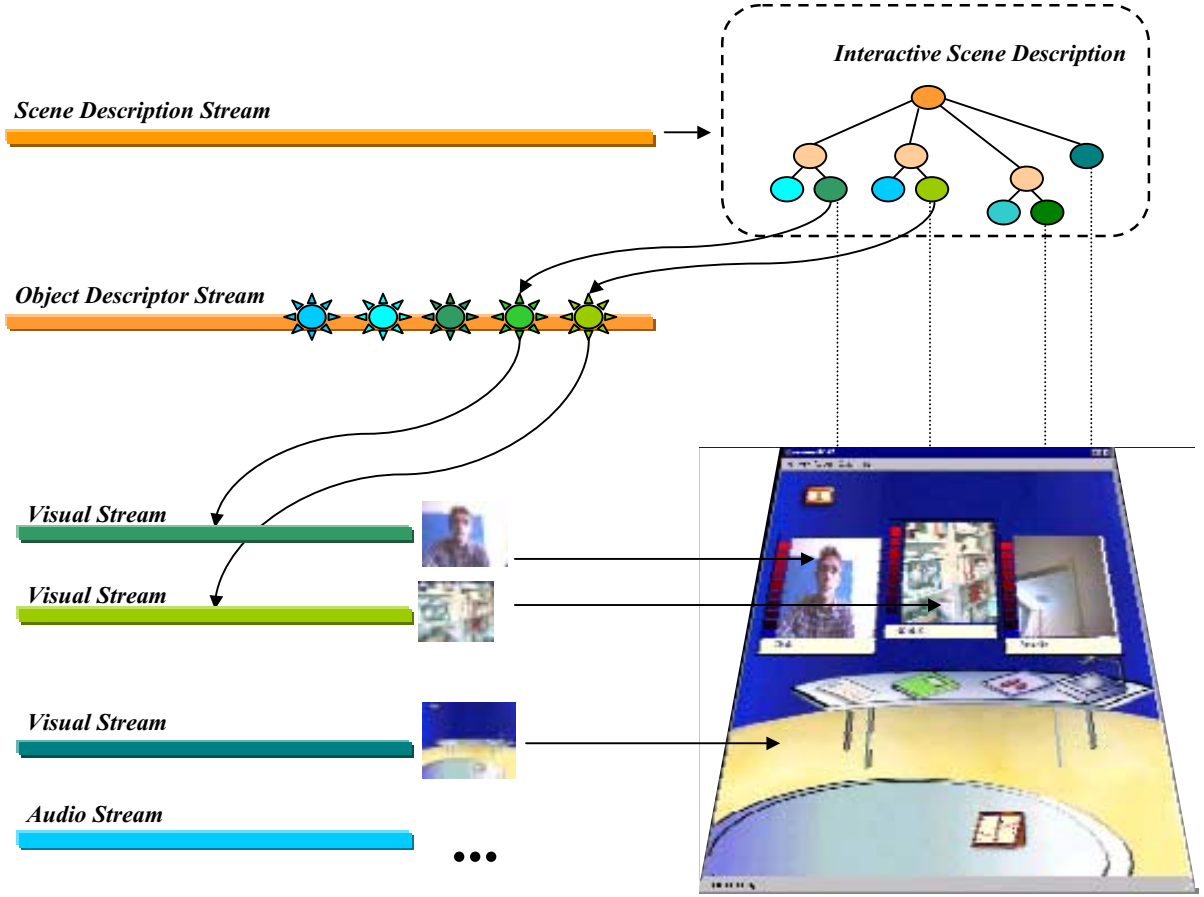
MPEG-4 Systems Principles

- Key concept :
  - Audio-visual scenes made of audio-visual objects composed together according to a scene description :
    - allows interaction with elements within the audio-visual scene
    - coding scheme can differ for individual objects
    - allows easy re-use of audio-visual content
- Audio-visual objects :
    - audio (single or multi-channel) or video (arbitrary shape or rectangular)
    - natural (natural audio or video) or synthetic (text & graphics, animated faces, synthetic music)
    - 2D (Web like pages) or 3D (spatialized sound, 3D virtual world)
    - streamed (video movie) or downloaded (audio jingle)

MPEG-4 Systems Principles

- Scene Description :
  - Spatial/temporal relationships between objects
    - 2D, 3D, mixed 2D and 3D scene description
  - Behavior and interactivity of the audio-visual objects and scenes
    - Scripting and optional Java APIs
  - Protocols to modify and animate the scene in time.

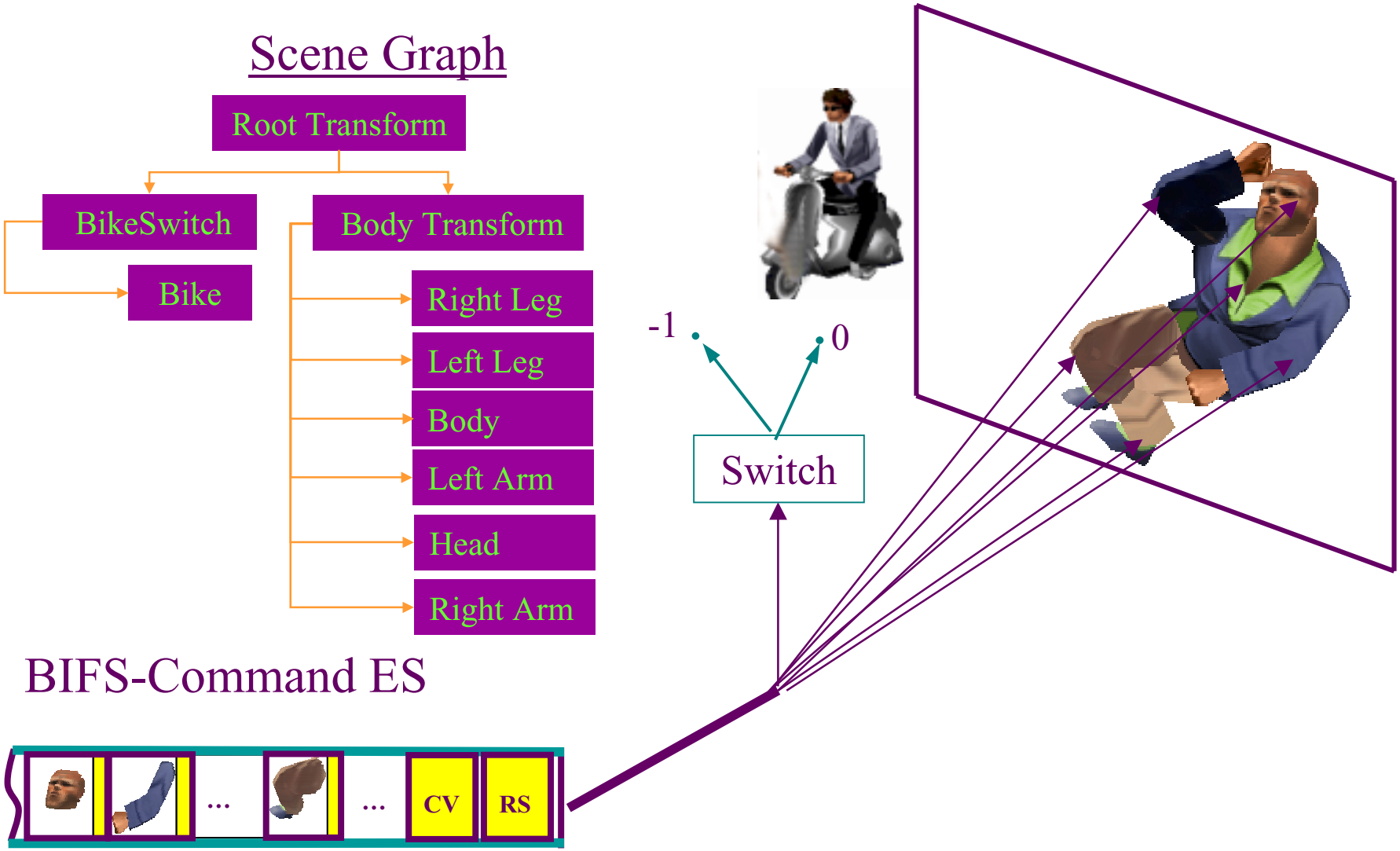
MPEG-4 Systems Principles



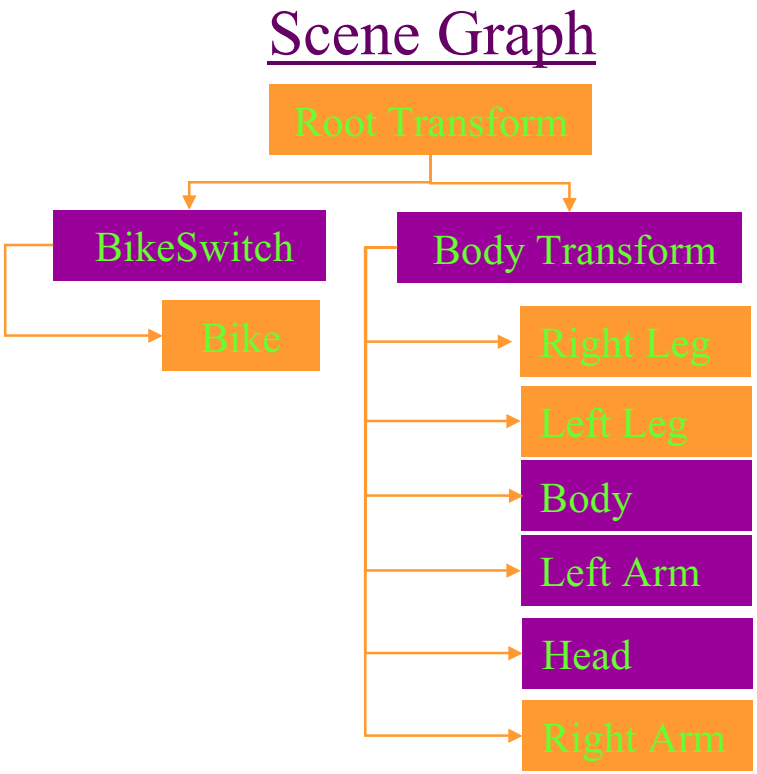
Scene Composition

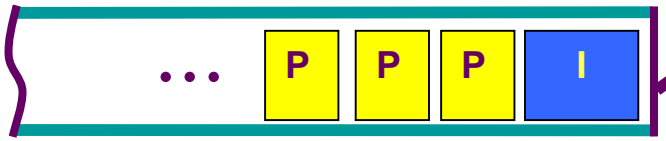
- Object Descriptors as signaling framework
- BIFS for scene composition & simple interactivity
  - VRML concepts : set of nodes to represent the primitive scene objects to be composed, the scene graph constructs, the behavior and interactivity through routes and scripts (Ecma script)
  - + Integration of streams
  - + 2D capabilities
  - + Integration of 2D and 3D
  - + Advanced Audio Features (ex : environmental spatialization)
  - + Timing model
  - + BIFS-Command and BIFS-Anim protocols to modify and animate the scene in time
  - + Upstream protocol
- XML based version of BIFS
  - XMT (eXtensible MPEG-4 Textual format)

BIFS-Command



BIFS-Anim


Scene Graph
Root Transform
BikeSwitch
Body Transform
Bike
Right Leg
Left Leg
Body
Left Arm
Head
Right Arm


BIFS-Anim ES
...
P
P
P
I

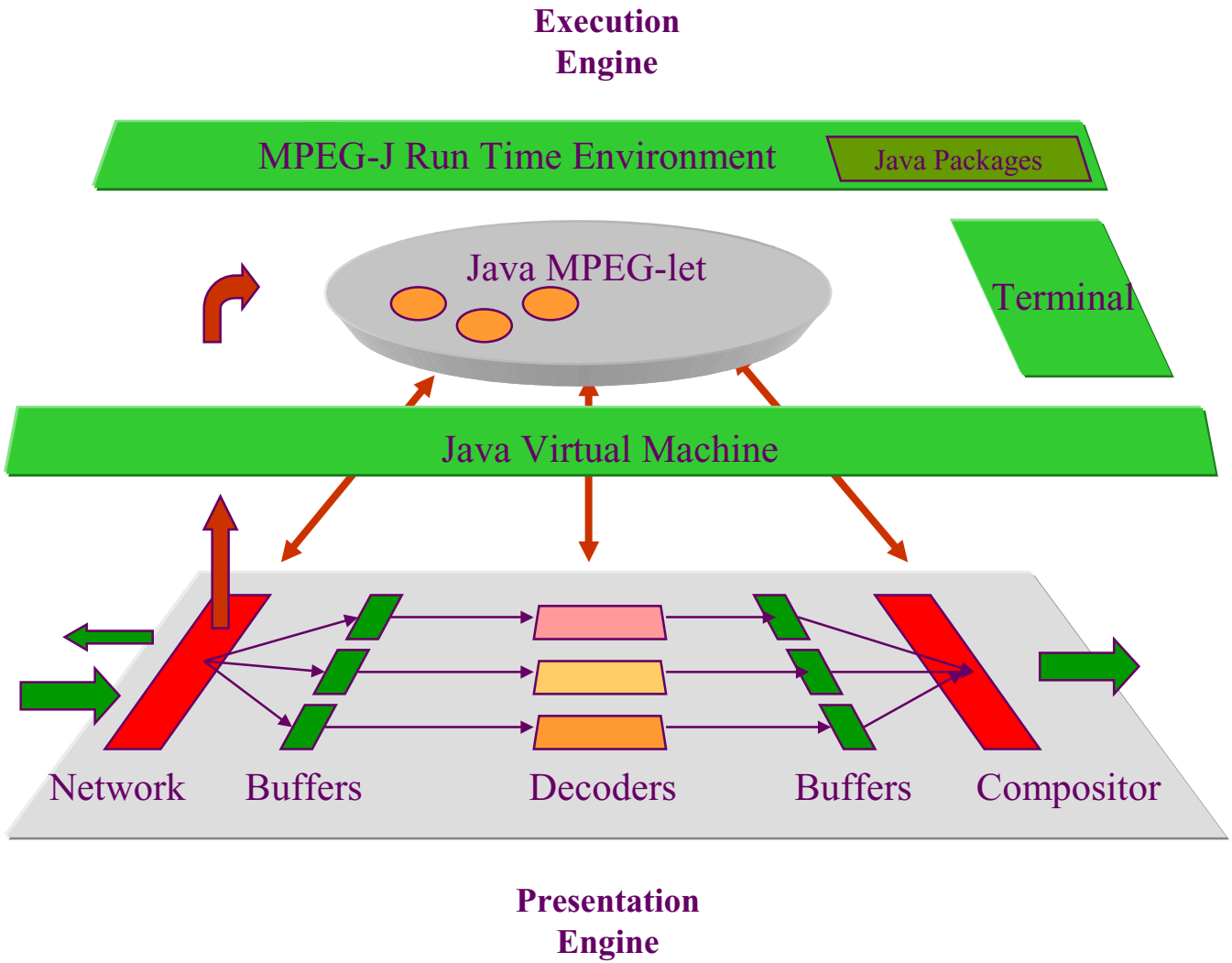
BIFS Binary Representation

- BIFS-Command
  - Compression factor of 10 to 25 compared to textual description
    - Context dependency
    - Hierarchical, linear quantization of scene data
    - Differential multiple fields coding and mesh coding integration
- BIFS-Anim
  - Compression factor of 15 to 30 compared to textual description
    - Linear quantization and predictive coding (including rotation and normals)
    - Adaptive arithmetic encoding

Programming languages

- Programmatic Control of the “Presentation Engine” of MPEG-4 Systems through
  - Scripting : ECMAscript
  - Java : MPEG-J
- MPEG-J
  - Optional feature
  - Java APIs enabling access to the scene, network, decoders
  - local or streamed applications (MPEGlets)
  - Optionally allows compression and archiving of Java classes

MPEG-J Architecture



IPMP

- IPMP (Intellectual Property Management and Protection) is prerequisite for publishing serious, valuable content in digital form
- IPMP support integrated deeply into MPEG-4 systems
  - Hooks are already included
  - On-going developments on IPMP extension will support broader interoperability

Profiles and Levels

- Profiles define subsets useful for a large class of applications/services
- Profile types
  - Audio (natural and synthetic): types of objects
  - Visual (natural and synthetic): types of objects
  - Scene description (e.g. behaviour)
  - Object Descriptor (mainly timing models)
  - MPEG-J
  - Graphics
- Levels limit the number of objects and complexity

envivio.

Application to Broadcast :

A standard for interactive digital television

MPEG-4 network tools

- MPEG-4 is fully compatible with MPEG-2
  - Includes tools adapted to MPEG-2 networks
  - MPEG-4 and MPEG-2 media can coexist
  - MPEG-4 can easily be integrated in DVB & ATSC
- MPEG-4 provides a natural evolution path towards IP networks
  - Includes tools adapted to IP networks
  - ISMA selected MPEG-4 tools and uses IETF-defined transport
- MPEG-4 provides tools for error-prone networks (wireless)

MPEG-4 terminal playback

- MPEG-4 is fully compatible with MPEG-2
  - Can take advantage of MPEG-2 hardware legacy (MPEG-2 streams as MPEG-4 media)
- MPEG-4 provides a natural evolution path towards multi-network access
  - Terminal playback can combine media accessed via several access networks in a single user experience
- MPEG-4 provides terminal-based composition
  - Deterministic representation allowing to control the look and feel and the playback behavior
  - Natural framework for media push based services
  - Allows media personalization

MPEG-4 adaptability

- MPEG-4 allows a seamless migration / coexistence of streaming & broadcast services
  - Online and broadcast services can be designed consistently, taking advantage of their complementarities
- MPEG-4 quality can be scaled to the transport channel
  - Broadcast (e.g. satellite) channels can afford high (MPEG2-like) quality
  - Broadband (e.g. ADSL) channels get down-sized (streaming) quality
  - Non-guaranteed bandwidth channels can use scalable streams
- MPEG-4 profiles allow for a gradual increase in media complexity as playback devices scale-up

MPEG-4 interoperability

- MPEG-4 defines an interoperable binary format for interactive multimedia content
- MPEG-4 defines the minimal level of interoperability
  - OS and terminal independent
  - Authoring tool independent
    - interoperability at the authoring level (XMT)
- MPEG-4 interoperability groups (MPEG-4, M4IF, ISMA) are currently very active

envivio.

MPEG-4 service examples

MPEG-4 service examples

- Media on-demand
- Corporate TV channel
- Live music promo

Conclusion

- MPEG-4 is THE solution for interactive multimedia broadcast
  - Rich:
    - fully featured interactive media
  - Broadcast oriented:
    - meets broadcast quality and network requirements
  - Multi-vendor:
    - open standard, interoperability on the way
  - Network opportunistic:
    - can take advantage of any combination of transport networks
  - Economically viable:
    - scales with network / terminal capacity, at a cost equivalent to competing technologies

A little about Envivio

- MPEG-4 Broadcast software
  - Authoring, Server, Client
- Partnerships

SIGMA *Designs* INTERTRUST THOMCAST

Avid wavexpress sgi

NetworkAppliance nCUBE