MPEG-4 BIFS
BInary Format for Scenes

MPEG-4 BIFS Overview

- **First Scene Description language of MPEG**
  - First version standardized in 1999
  - Based on another ISO standard (VRML'97)
- **Builds on VRML (3D language) and adds**
  - 2D Vector Graphics
  - Improved Text handling
  - Improved Media Management
  - Binarization
  - Streamability
  - XML formats: XMT
  - Access with Java Code (MPEG-J)

MPEG-4 BIFS/VRML Principles

- **A BIFS Scene is**
  - a tree made of nodes
  - And a set of ROUTEs
- **Each BIFS node has**
  - A type
    - Graphical nodes (2D, 3D)
    - Audio nodes
    - Grouping, Transformation nodes
    - Interactivity nodes
    - Animation nodes
  - An optional ID
  - A set of properties
    - Single value or multiple values

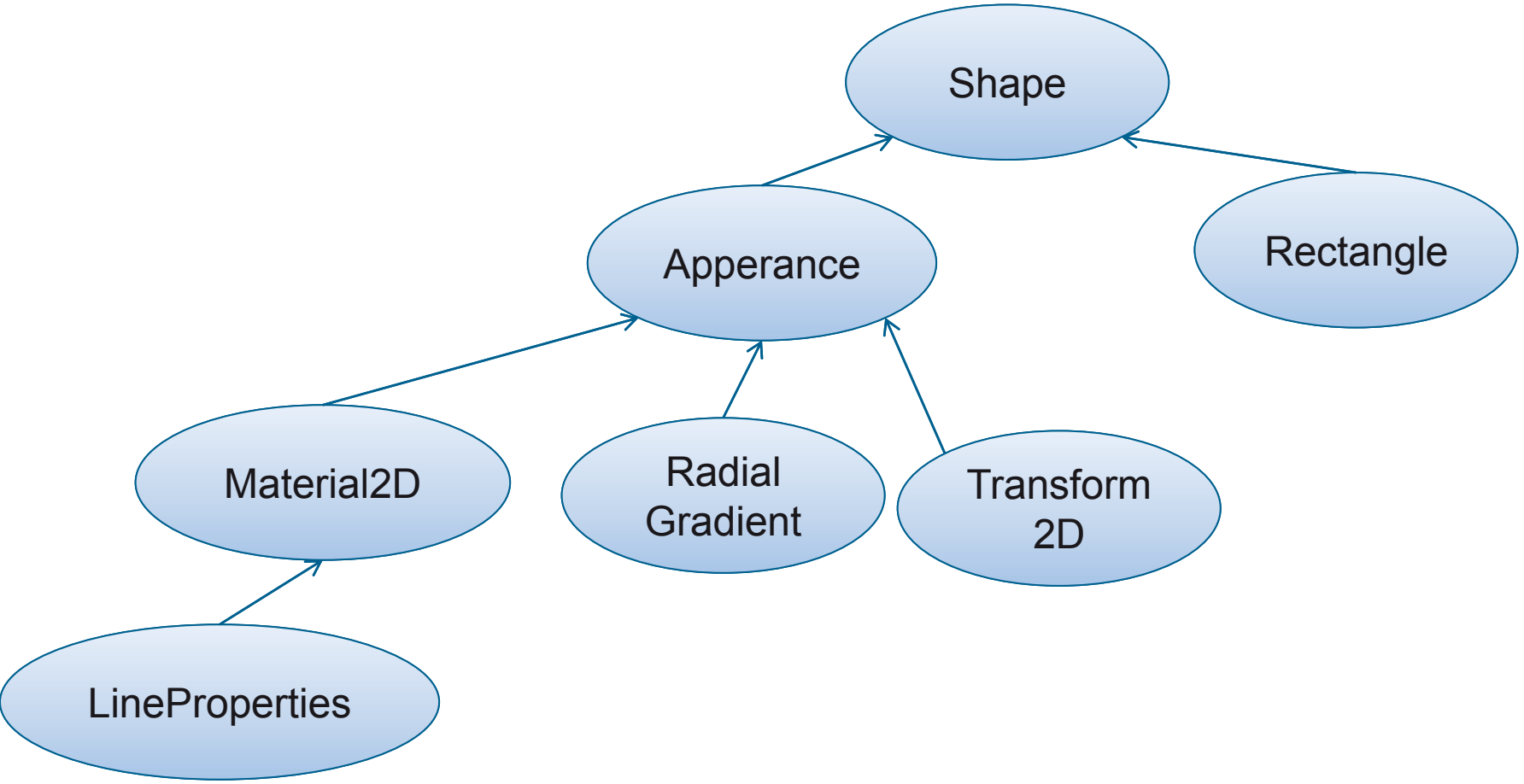
MPEG-4 BIFS/VRML Value Types

- **A BIFS Value is a typed values**
  - Simple Types
    - Booleans, Integer, Decimals (Single, Pair, Triplet), Color (R,G,B) $\in [0,1]^3$, Times, Strings
  - Complex Types
    - Nodes, BIFS Commands, ECMAScript Code

BIFS Graphics Nodes

- **Every visual object requires a « Shape » node**
  - With 2 properties: appearance and geometry
- **The geometry property holds a Geometric node**
  - 2D geom. nodes: Rectangle, Ellipse, Curve2D…
  - 3D geom. nodes: Sphere, Box, IndexedFaceSet, …
- **The appearance property holds an Appearance node with the following properties**
  - material: Nodes describing painting (filling, stroking) …
  - texture and textureTransform: raster or vector graphics images and transformations

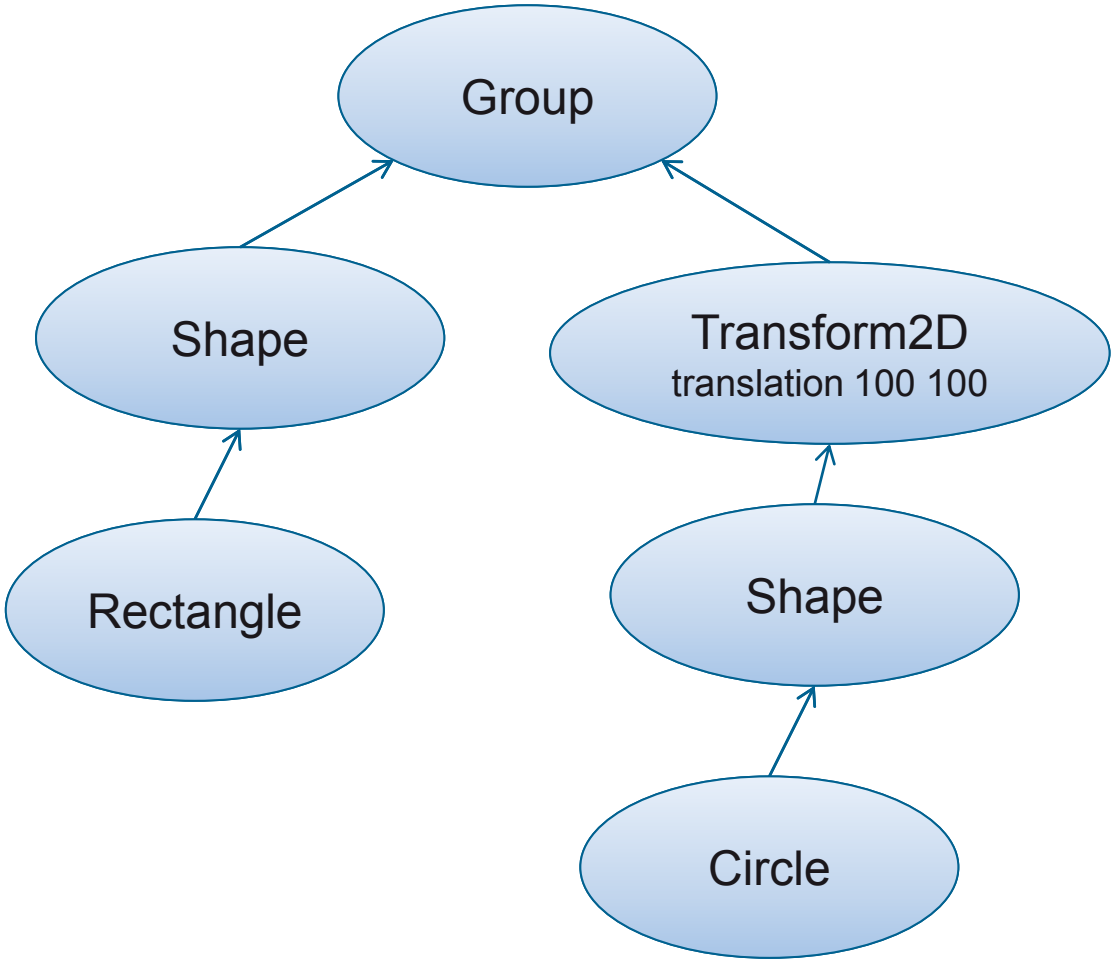
BIFS Shape Sub-Tree

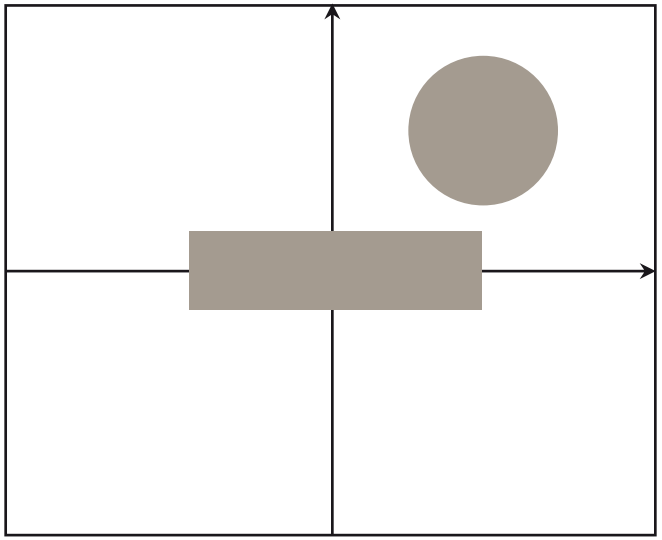


BIFS Positioning

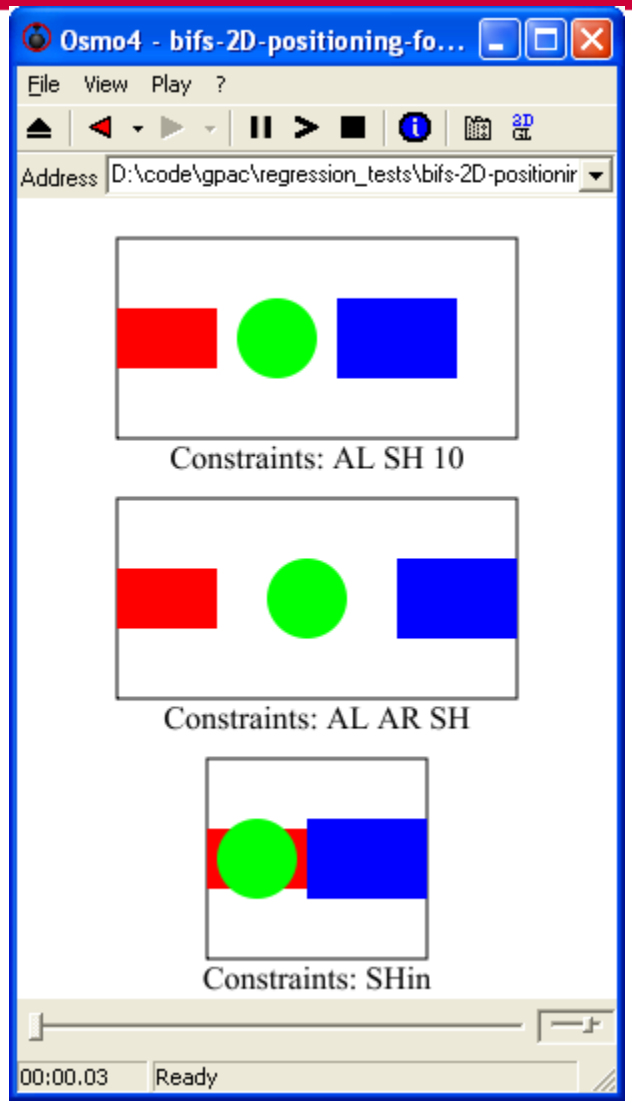
- **Global and Local Coordinate System**
  - Origin = Center of the Window or Graphical Object
  - Axis: X rightward, Y upward
- **Units**
  - Two units: pixel or meter (3D worlds)
- **Transformations**
  - Using intermediate nodes
  - Either with transformation matrices or complex layout algorithms

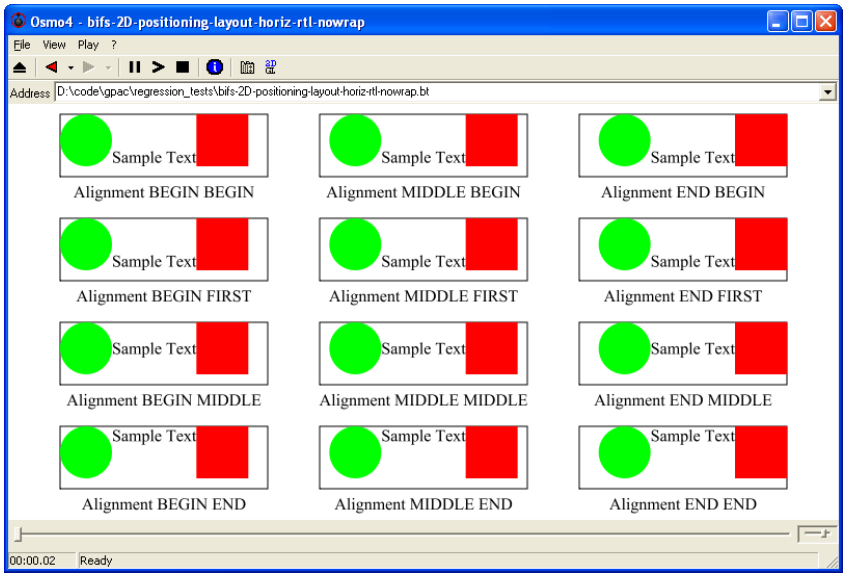
BIFS Grouping and Positioning Tree

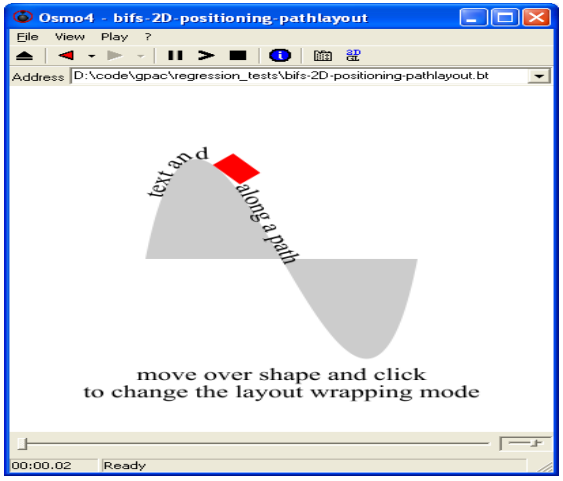




BIFS Complex Positioning







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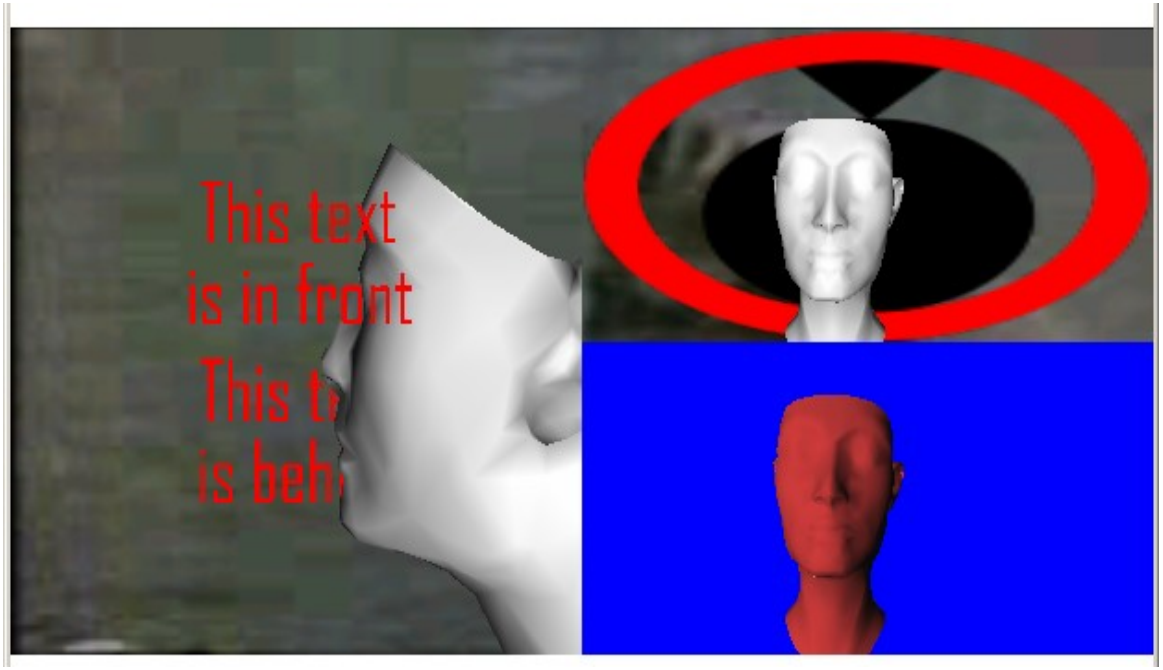
MPEG-4 BIFS 3D

- **MPEG-4 BIFS V1**
  - VRML + Facial Animation + Mesh Compression
- **MPEG-4 BIFS V2**
  - Body Animations
- **MPEG-4 AFX = Animation Framework Extension**
  - Subdivision Surfaces, Nurbs, Wavelet Compression, …
  - Interpolator Compression, Skeleton based animation
  - Improved texturing
- **See http://www.mpeg-3dgc.com/**

Integration 2D / 3D

- **Specific nodes for creating 2D/3D context**
  - 3D: « Layer3D », « CompositeTexture »
  - 2D: « Layer2D », « CompositeTexture2D »

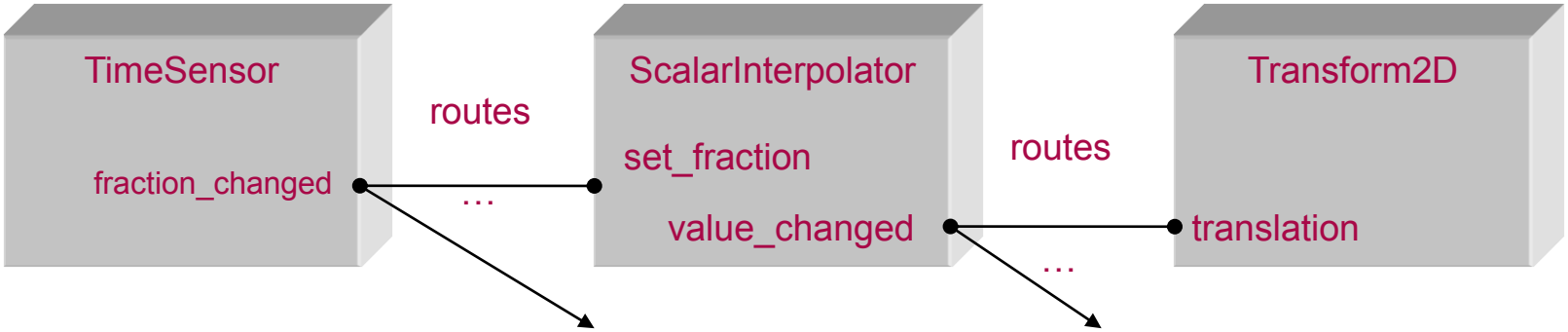


BIFS Interactivity and Animations

- **Each property has a interactive type**
  - eventIn – can receive events (write-only)
  - eventOut – can emit events (read-only)
  - field – cannot receive or emit event (constant)
  - exposedField – can emit and receive (read/write)
- **Two properties can be connected by a ROUTE**
  - Emitting node + eventOut
  - Receiving node + eventIn
  - Requires the same value data type (e.g. Booleans)

BIFS Animation Principle

- **Requires 3 nodes and 2 routes**
  - Timer node = TimeSensor
  - Interpolation node = ScalarInterpolator, ColorInterpolator, CoordinateInterpolator …
  - Animation target node = any node



MPEG-4 BIFS Update

- **Update = declarative description of scene modifications**
  - Using a node identifier (target)
  - A property of this node to modify (e.g. color, position…)
  - The index of the value of the property to modify (for arrays)
- **Update types**
  - Insertion of a value, a node, a route
  - Replacement of a value, a node, a route
  - Deletion of a value, a node, a route
  - Replacement of the whole scene
- **Examples**
  - REPLACE M.emissiveColor BY 1 0 0
  - DELETE ROUTE R1
  - INSERT AT MonPolygone.point[0] -50 -50

MPEG-4 BIFS Streams

- **BIFS Command Stream**
  - All access units are BIFS updates (not necessarily related)

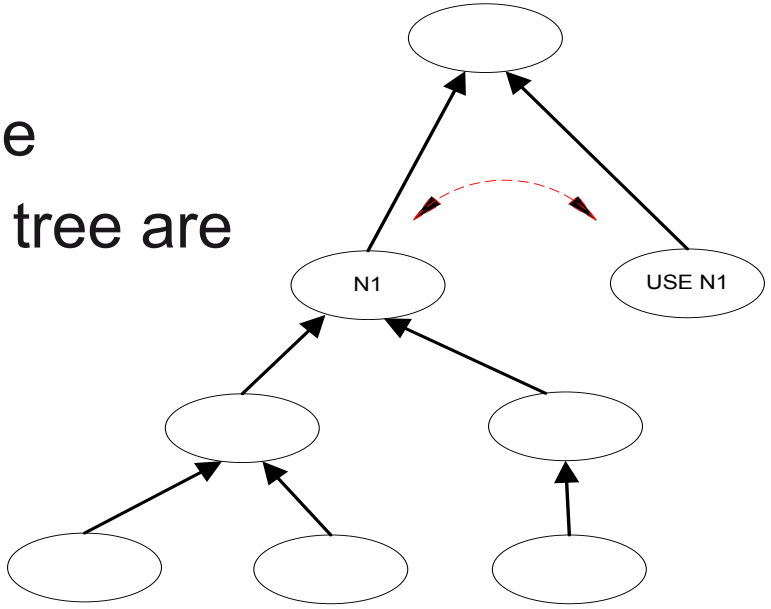
- **BIFS Animation Stream**
  - All access units are REPLACE Updates, modifying the properties of a global set of nodes/properties
  - Coded in a specific manner to exploit redundancy
    - Quantization / Prediction / Arithmetic Codind

BIFS Interactivity

- **Use of specific listener nodes**
  - TouchSensor, InputSensor, PlaneSensor, ProximitySensor …
- **Routing of events from the listener towards a target node**
  - Requires same type of property value (e.g. Boolean -> Boolean …)
  - Possible type castings using the « Valuator » node
- **Possible targets**
  - Any node
  - The « Conditional » node
    - Place holder for BIFS updates to be executed when needed
  - The « Script » node
    - Place holder for ECMAScript code

Advanced Scene Tree Management

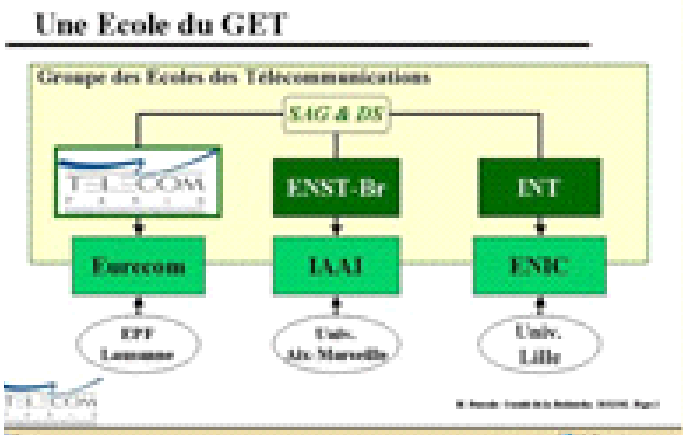
- **The USE concept**
  - Copy / Paste of scene tree
  - Used when 2 parts of the tree are the same
- **The PROTO concept**
  - Parametric copy / paste
  - Used when 2 parts of the tree are almost the same
- **The EXTERNPROTO concept**
  - PROTO outside the main scene
  - Library of Scene Components



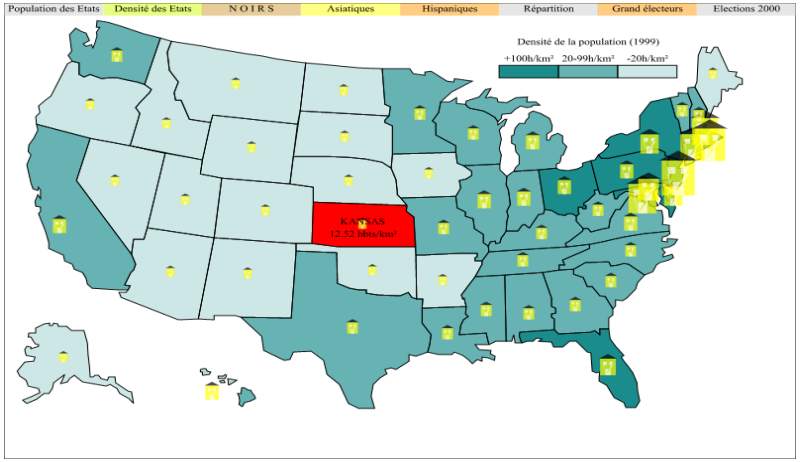
BIFS Examples

Cartoons

Animated 3D Worlds



PowerPoint Slides



Maps