Recherche & Développement

EDF
Electricité de France

Le Monde change, nous aussi

Le Monde change, nous aussi

Le Monde change, nous aussi

Collaborative Scientific Visualization & Extensible 3D (X3D)

March 2005

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Collaborative Scientific Visualization Extensible 3D (X3D)

- **Plan**
  - Scientific Visualization
    - *calculation codes*
    - *visualization*
    - *applications*
    - *tools*
    - *collaborative visualization*
    - *visualization at EDF*
  - X3D / Xj3D
    - *X3D Standard*
    - *Xj3D application*
  - Extending X3D for scientific visualization
    - *new format for calculation code*
    - ***SciViz** component*
    - *using SAI*

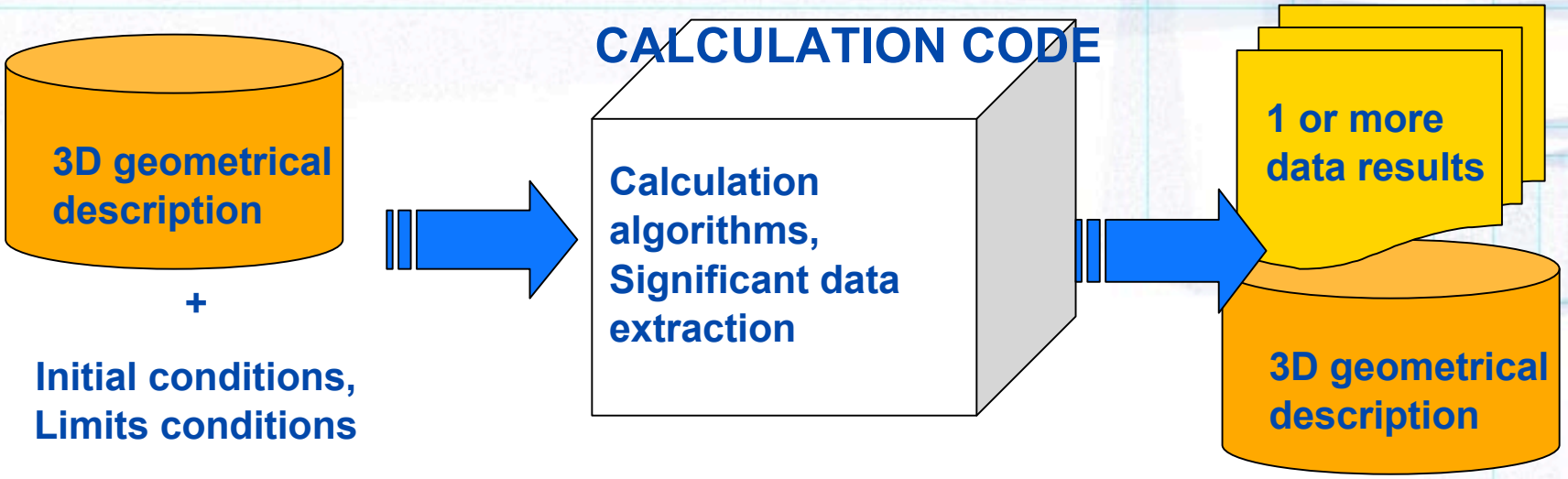
Scientific Visualization (SciViz)

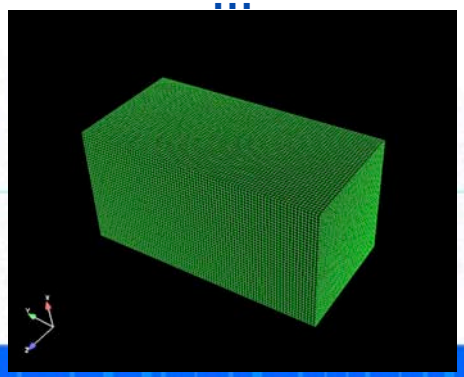
Scientific Visualization

- ***Calculation code*** **:**
  - encoded **mathematical expressions** in order to **simulate the evolution** of a simplified representation of **a system**

Scientific Visualization

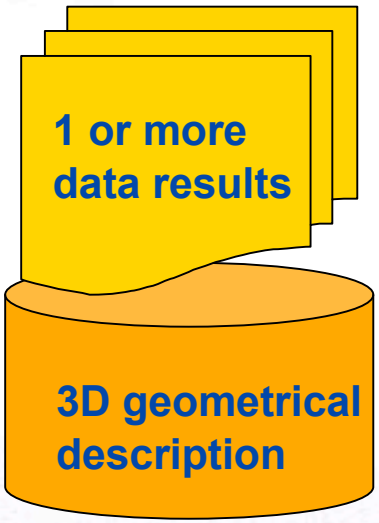
- Calculation code



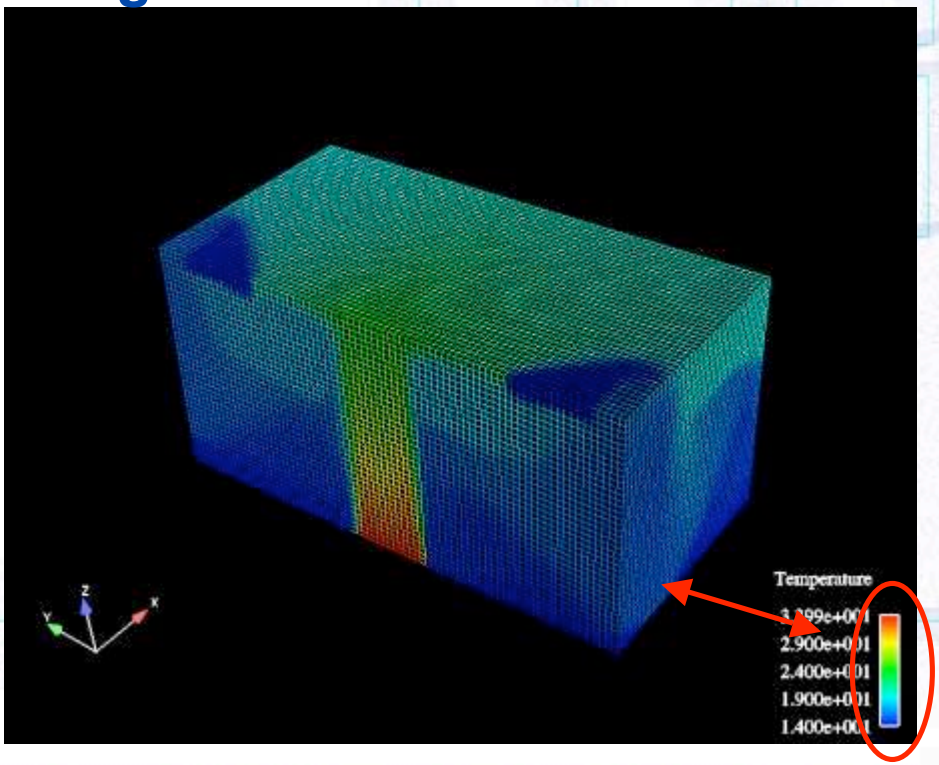


Scientific Visualization

- **Scientific visualization : process that converts raw numerical data to a visual representation of these data, as a support for understanding them**

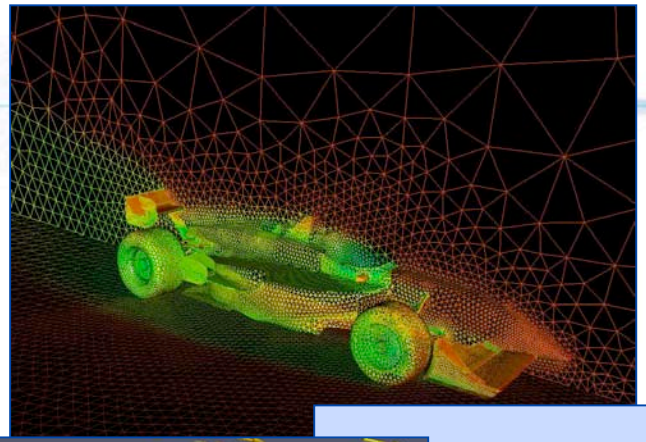


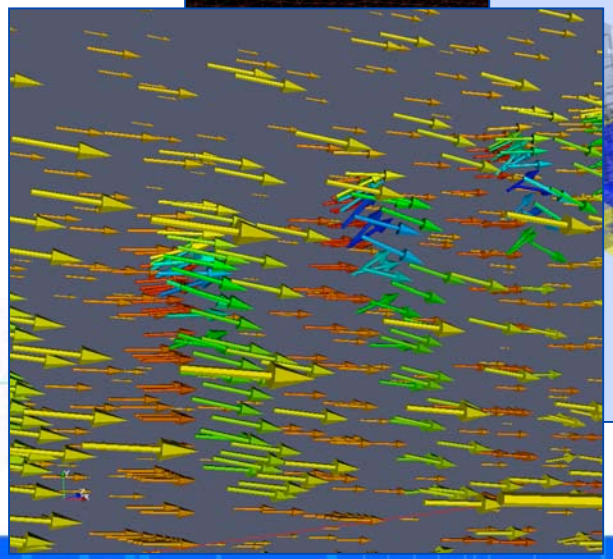
Scientific
visualization

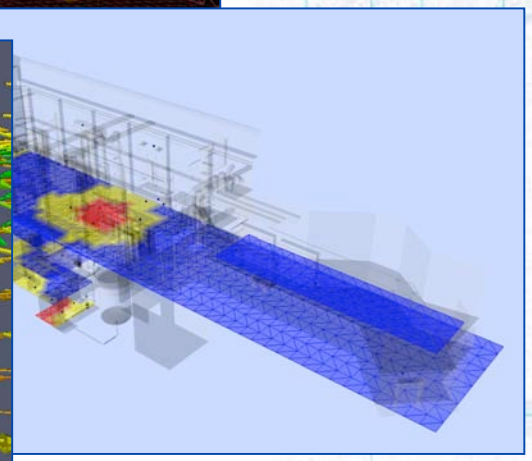


Scientific Visualization

- **Applications**
  - Mechanics
  - Fluid dynamics
  - Radiation
  - …





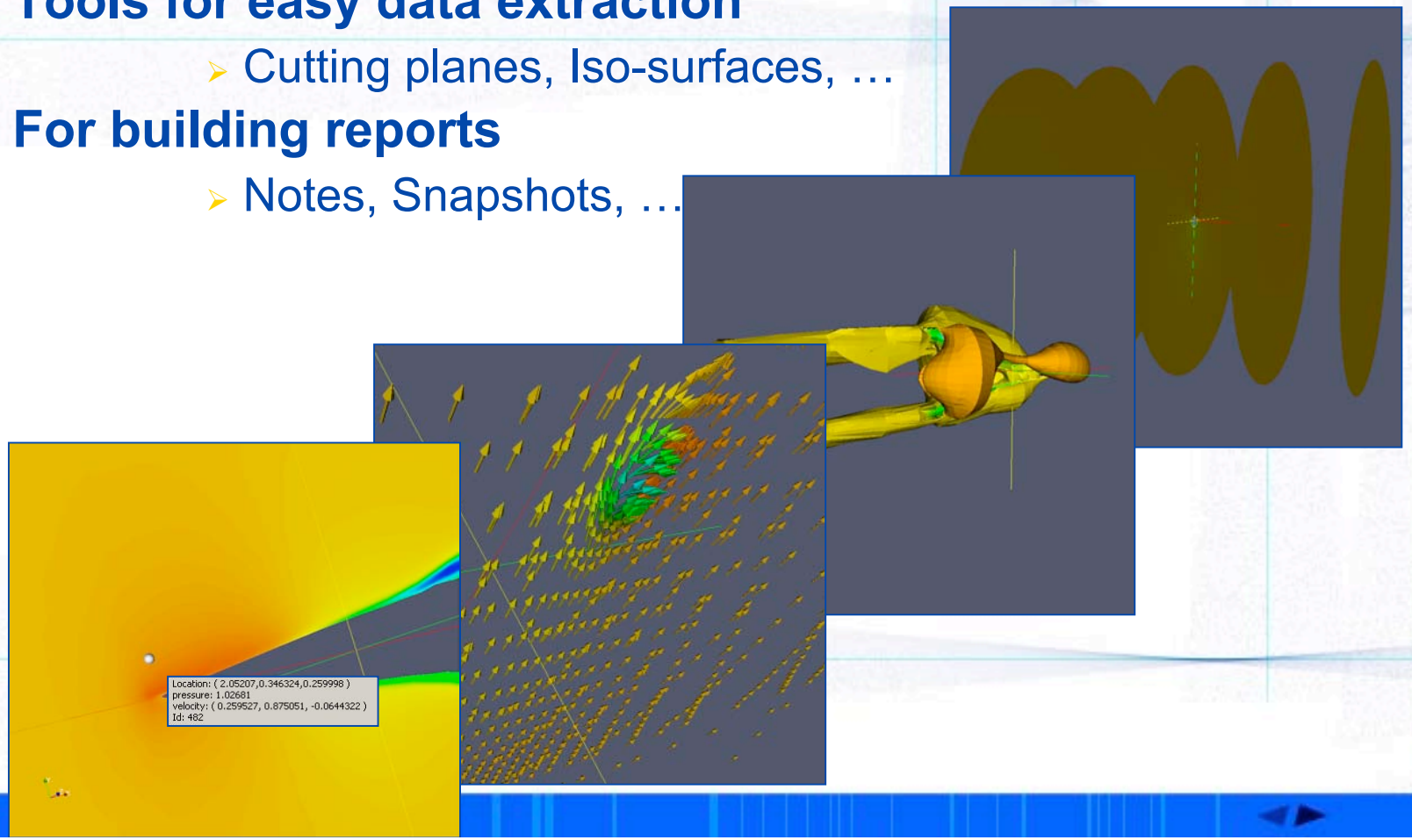


Scientific Visualization

- **User applications**
  - EnSight, Paraview, AVS, …
  - CoVise, OpenGL Vizserver, …

Scientific Visualization

- **Tools for easy data extraction**
  - Cutting planes, Iso-surfaces, …
- **For building reports**
  - Notes, Snapshots, …



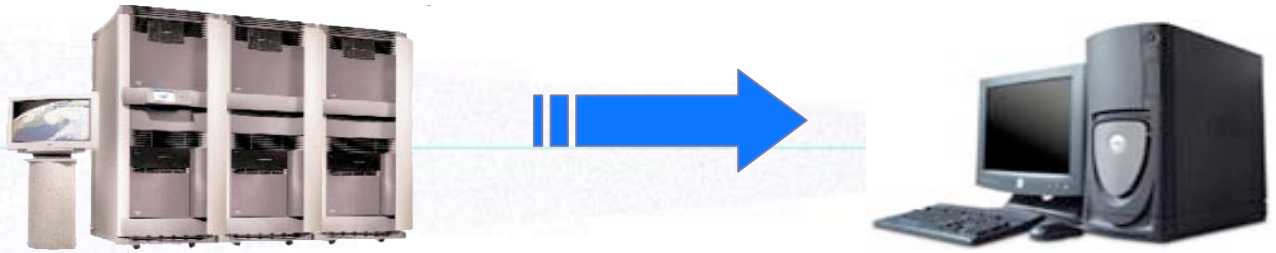
Scientific Visualization : adding collaboration

- **New technologies = New ways of working**
  - Shorten the distances between experts
  - Resolve problems
  - Sharing the workload

- **Example of use**
  - Medical
  - Automobile / aeronautic engineering
  - Oil & Gas exploration

Scientific Visualization

- **At EDF**
  - Needs
    - *Theorical researches (physical, numerical simulations)*
    - *Industrial studies, maintenance*
    - *Calculation codes co-development projects (EDF-CEA)*
  - Tools
    - *EnSight (CEI), 10 years of partnership with EDF*
  - Equipment
    - *PC with Windows / Unix / Linux, keyboard, 3-Buttons mouse*

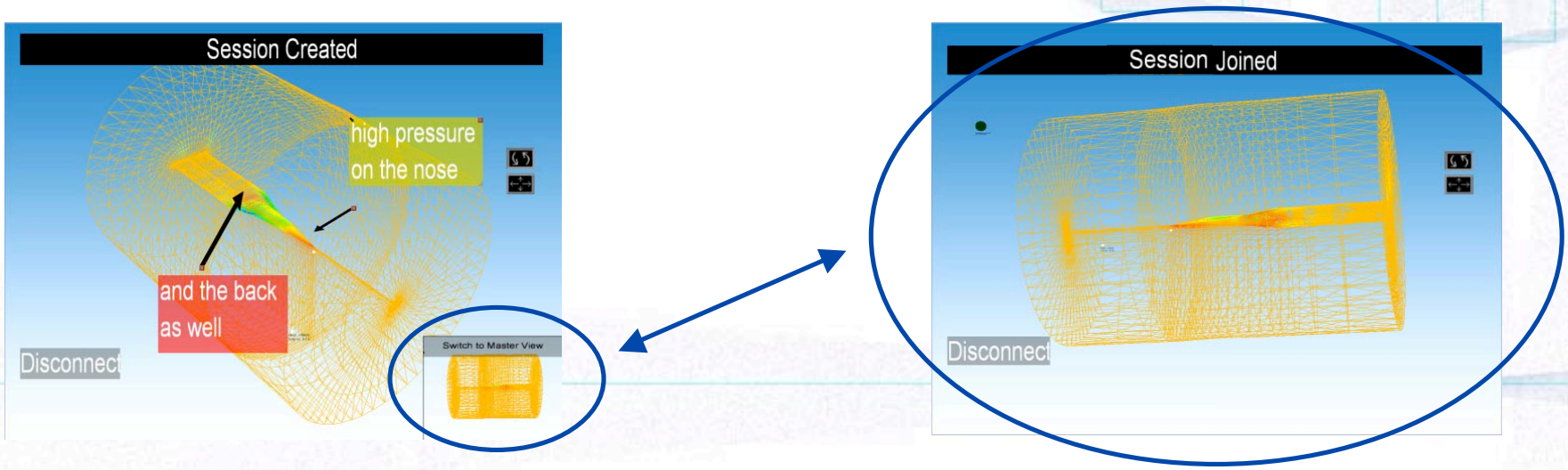


Scientific Visualization : adding collaboration

- **At EDF**
  - Research activities :
    - *Distant communication between experts, results consultation*
  - Industrial studies :
    - *Data validation*
    - *Distant and interactive consultation of the results*
    - *Enhanced presentation to the customer*
  - Co-development projects :
    - *Same as above*

Scientific Visualization : adding collaboration

- **Functionalities needed :**
  - same scene, own view, view of the others, highlight objects, put notes



Scientific Visualization

- **LASCO (LArge Scale COllaborative visualization) project :**
  - Leaders : Guillaume Thibault, Christophe Mouton
  - Contributors : 8 engineers (XML, perception, visualization algorithms, functional analysis, network, …)

- **Objective :**
  - visual support for the scientific community :
    - *Multiplatform, MultiUser, Ergonomic, Interactive,Access from the web, Large data sets (10-100M points)*

Scientific Visualization

- **Guest scientist at Institutt for Energiteknikk in Halden (Norway):**
  - evaluation of the X3D standard for supporting collaborative scientific visualization
    - *X3D : ISO/IEC FDIS 19775, ISO/IEC FCD 19776-19777*
  - provide a feasibility prototype

X3D / Xj3D

Scientific visualization and X3D/Xj3D

- **What is X3D ?**
  - Web3D consortium ***open standard*** for describing 3D content
  - Successor of ***VRML 2.0*** or VRML97
    - *Enhancements : XML, well-specified, componentized, extensible, binary format*
    - *Open Source implementation : Xj3D*
  - www.web3d.org

Xj3D - Overview

- **Overview**
  - Web3D Consortium ***open-source*** project to create a toolkit for VRML97 and X3D content written completely in Java (www.xj3d.org)
  - Official toolkit for validating the specification
  - Developed by Yumetech, Inc

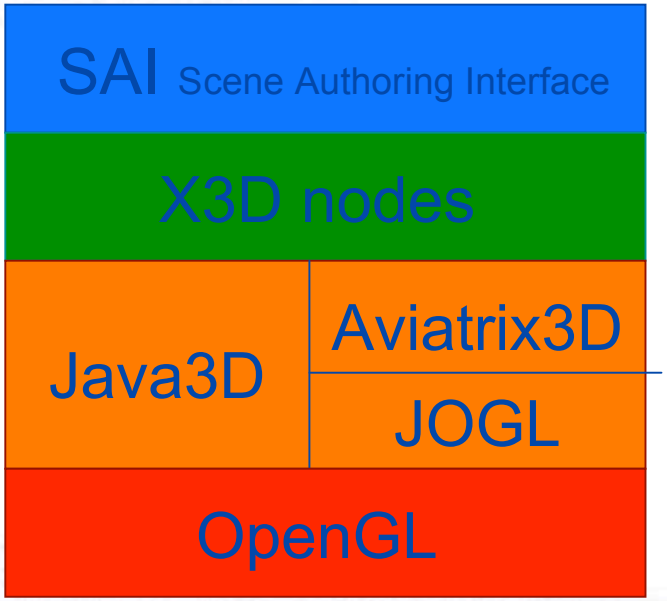
Yumetech, Inc. 夢

- **Features**
  - Multi-platform support (Windows, Linux, Mac)
  - Multiple renderers: Java3D, OpenGL, Mobile

Xj3D

Xj3D - Overview

- **Xj3D : architecture**



Extending X3D / Xj3D for scientific visualization purposes

Extending X3D – Xj3D

- File format for calculation codes : existing ones are numerous
- Need a file format for general purpose, that is easy to export data to : XML

Geometry

```
<sciviz>
    <vertices number="">
        <vertex id="" position=""/>
        ...
        <vertex id="" position=""/>
    </vertices>

    <meshes number="">
        <mesh id="" type="" vertices=""/>
        ...
        <mesh id="" type="" vertices=""/>
    </meshes>

    <part name="">
        <meshID=""/>
        ...
        <meshID=""/>
    </part>

    ...

    <part name="">
        <meshID=""/>
        ...
        <meshID=""/>
    </part>
</sciviz>
```

Data

```
<sciviz>

        <dataset name="Pressure" type="scalar">
                <timeStep id="1" >
                <data id="" value="" />
                ...
                <data id="" value="" />
                </timeStep>
        </dataset>

        <dataset name="Pressure" type="scalar">
                <timeStep id="2" >
                <data id="" value="" />
                ...
                <data id="" value="" />
                </timeStep>
        </dataset>

</sciviz>
```

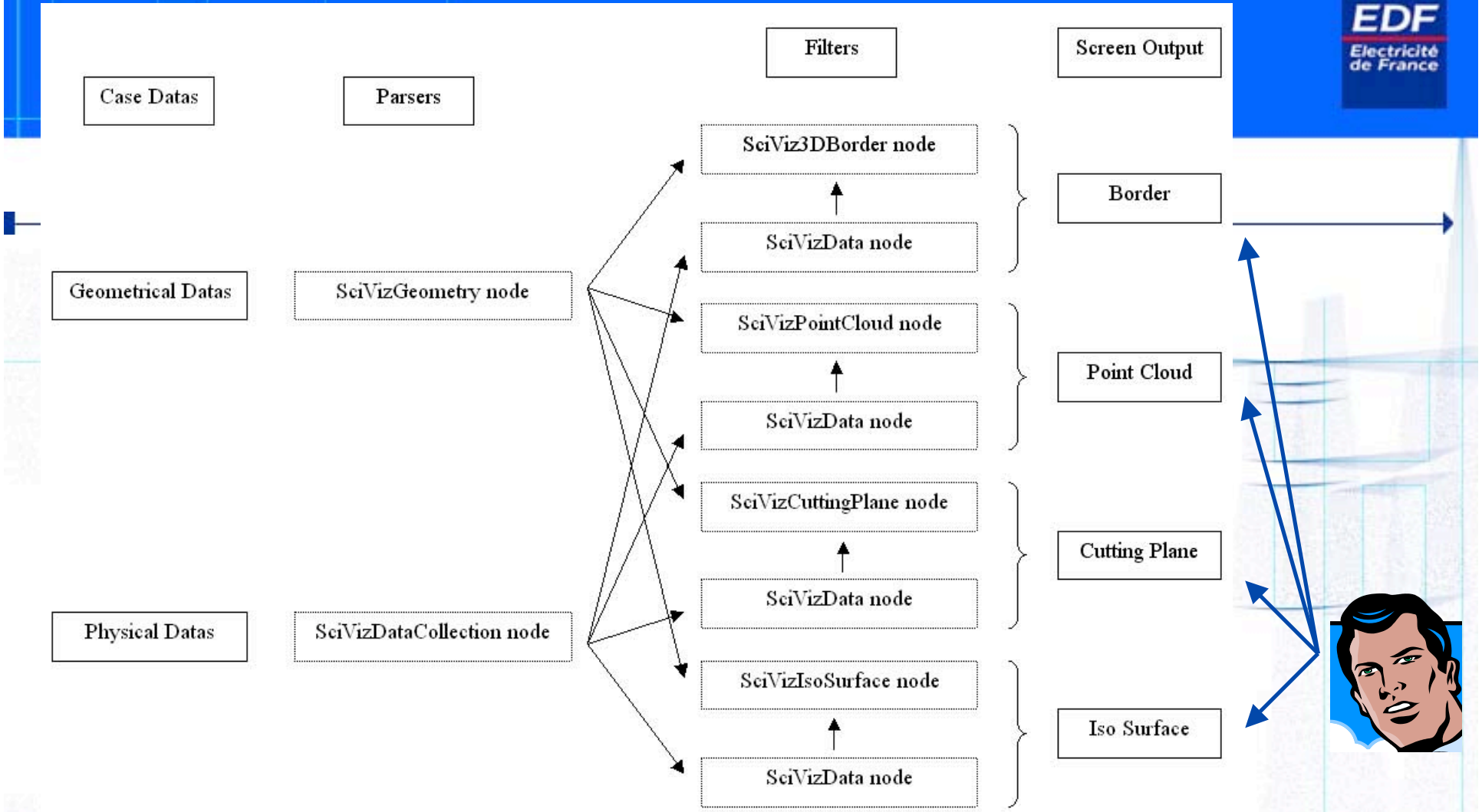
Extending X3D – Xj3D

- **X3D base components : Geometry, Shape, Text, Time, Networking, Humanoid Animation, Geospatial …**

- **New component, "SciViz", containing the nodes :**

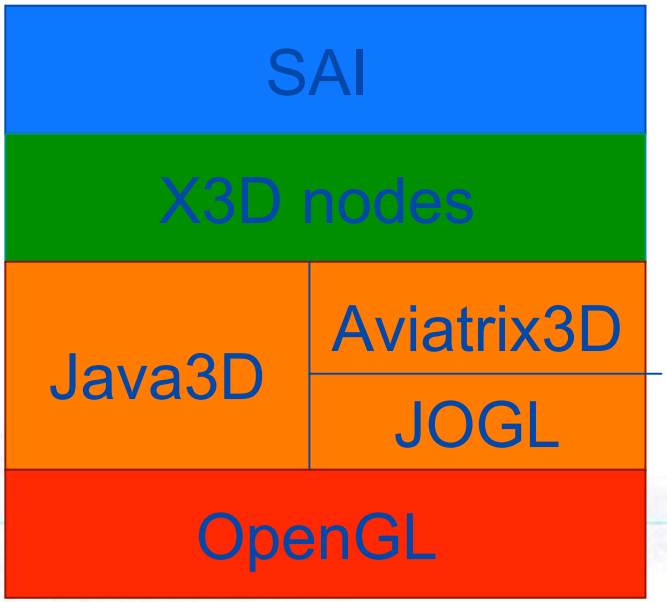
  - Input data nodes:
    - *SciVizGeometry*
    - *SciVizDataCollection*

  - Filtering nodes:
    - *SciViz3DBorder*
    - *SciVizPointCloud*
    - *SciVizCuttingPlane*
    - *SciVizIsoSurface*
    - *SciVizData*


Case Datas
Parsers
Filters
Screen Output
Geometrical Datas
SciVizGeometry node
Physical Datas
SciVizDataCollection node
SciViz3DBorder node
SciVizData node
SciVizPointCloud node
SciVizData node
SciVizCuttingPlane node
SciVizData node
SciVizIsoSurface node
SciVizData node
Border
Point Cloud
Cutting Plane
Iso Surface

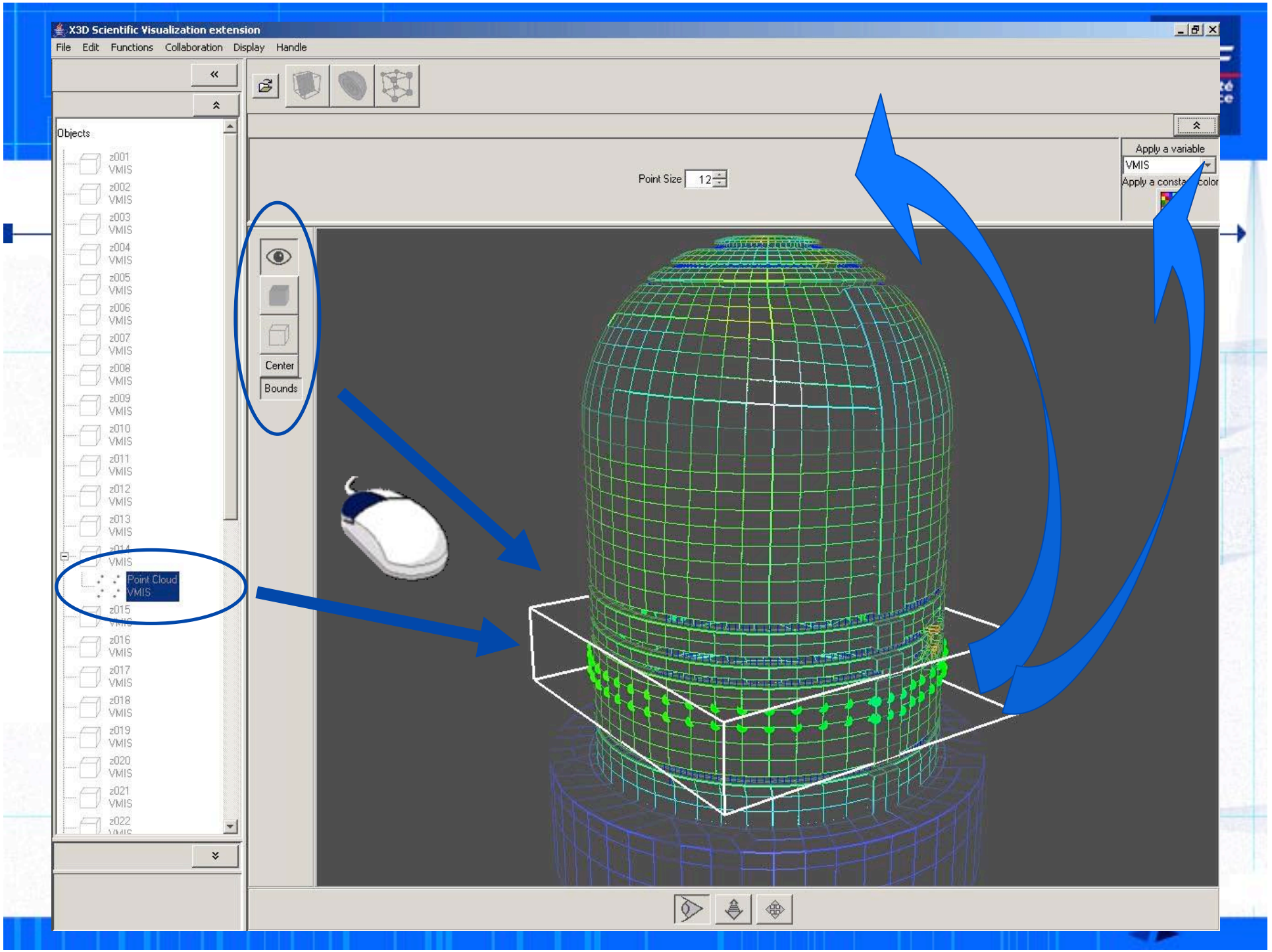
Extending X3D – Xj3D

- X3D : 3D content + how objects should interact with each other
- SAI, Scene Authoring Interface : how the user can interact with the 3D content



Extending X3D – Xj3D

- **SAI, Scene Authoring Interface**
  - defined in ISO/IEC 19775
  - allows :
    - *sending events*
    - *reading values*
    - *getting notified when events occur*

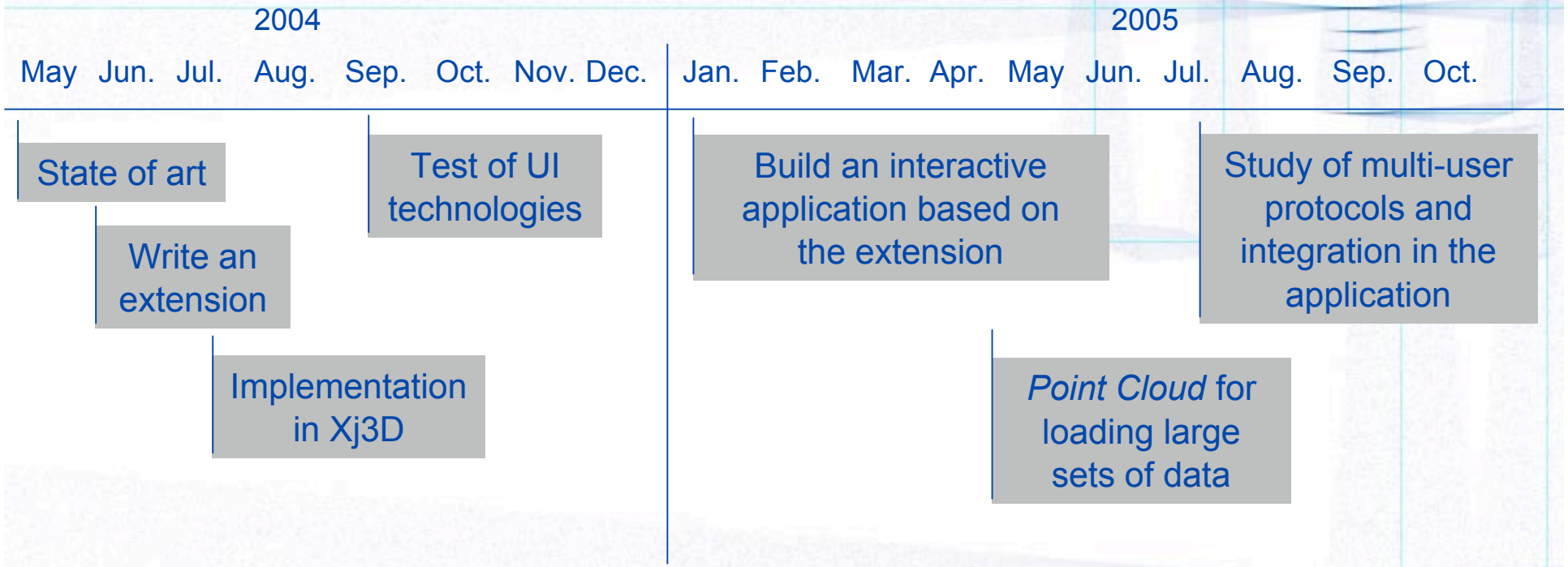

X3D Scientific Visualization extension
File
Edit
Functions
Collaboration
Display
Handle
Objects
z001 VMIS
z002 VMIS
z003 VMIS
z004 VMIS
z005 VMIS
z006 VMIS
z007 VMIS
z008 VMIS
z009 VMIS
z010 VMIS
z011 VMIS
z012 VMIS
z013 VMIS
z014 VMIS
Point Cloud VMIS
z015
z016 VMIS
z017 VMIS
z018 VMIS
z019 VMIS
z020 VMIS
z021 VMIS
z022
Point Size
12
Apply a variable
VMIS
Center
Bounds

Extending X3D – Xj3D

- **Collaboration**
  - Which architecture ?
  - Which techno ? DIS or other ?

Extending X3D – Xj3D

- **Project planning**



Thank you for your participation
Any questions ?