

VLAM-G: A Grid-based Virtual Laboratory

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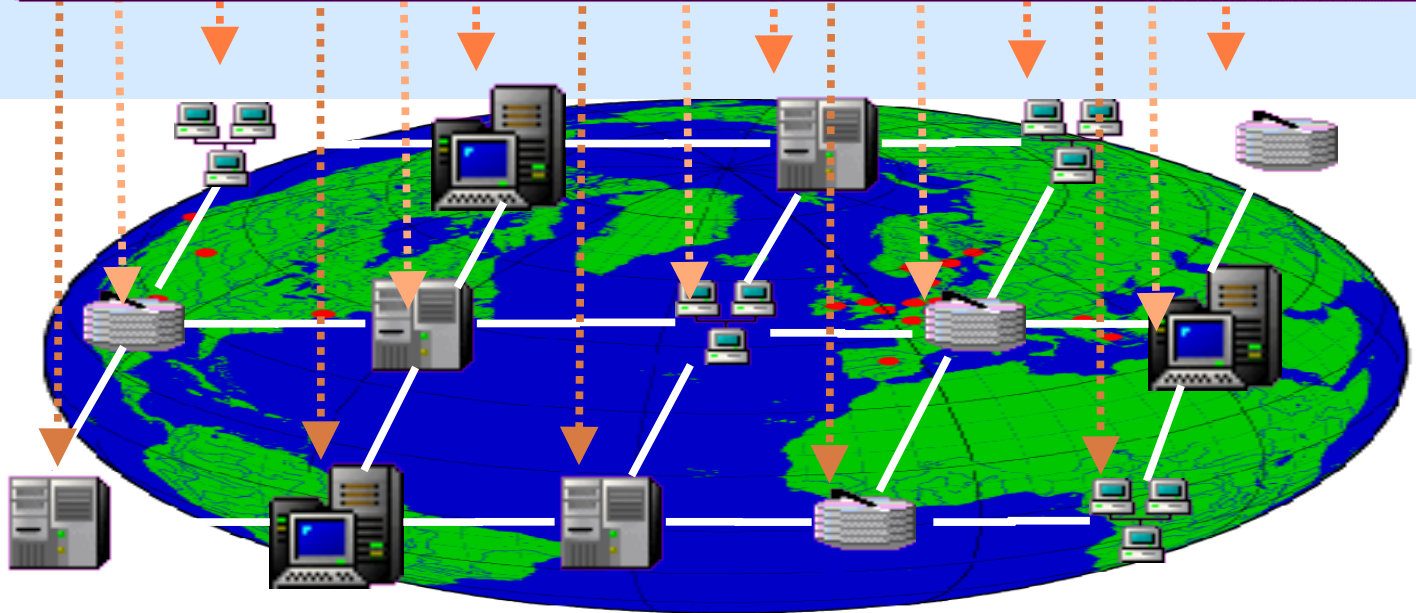
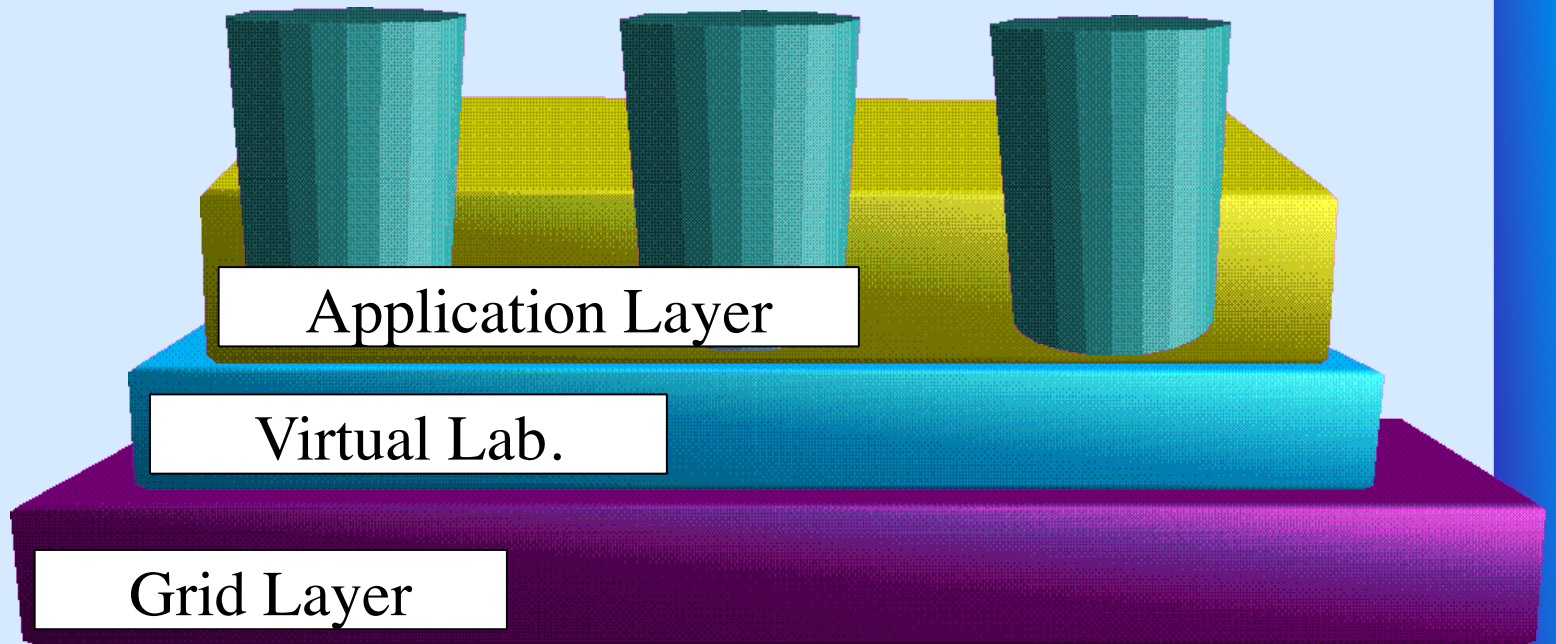
Outline

- Introduction
- Objectives
- VLAM-G Components
- VLAM-G Experiments
- VLAM-G RunTime System
- Conclusions

VLAM-G

Virtual Laboratory AMsterdam

A collaborative analysis environment
for applied experimental science



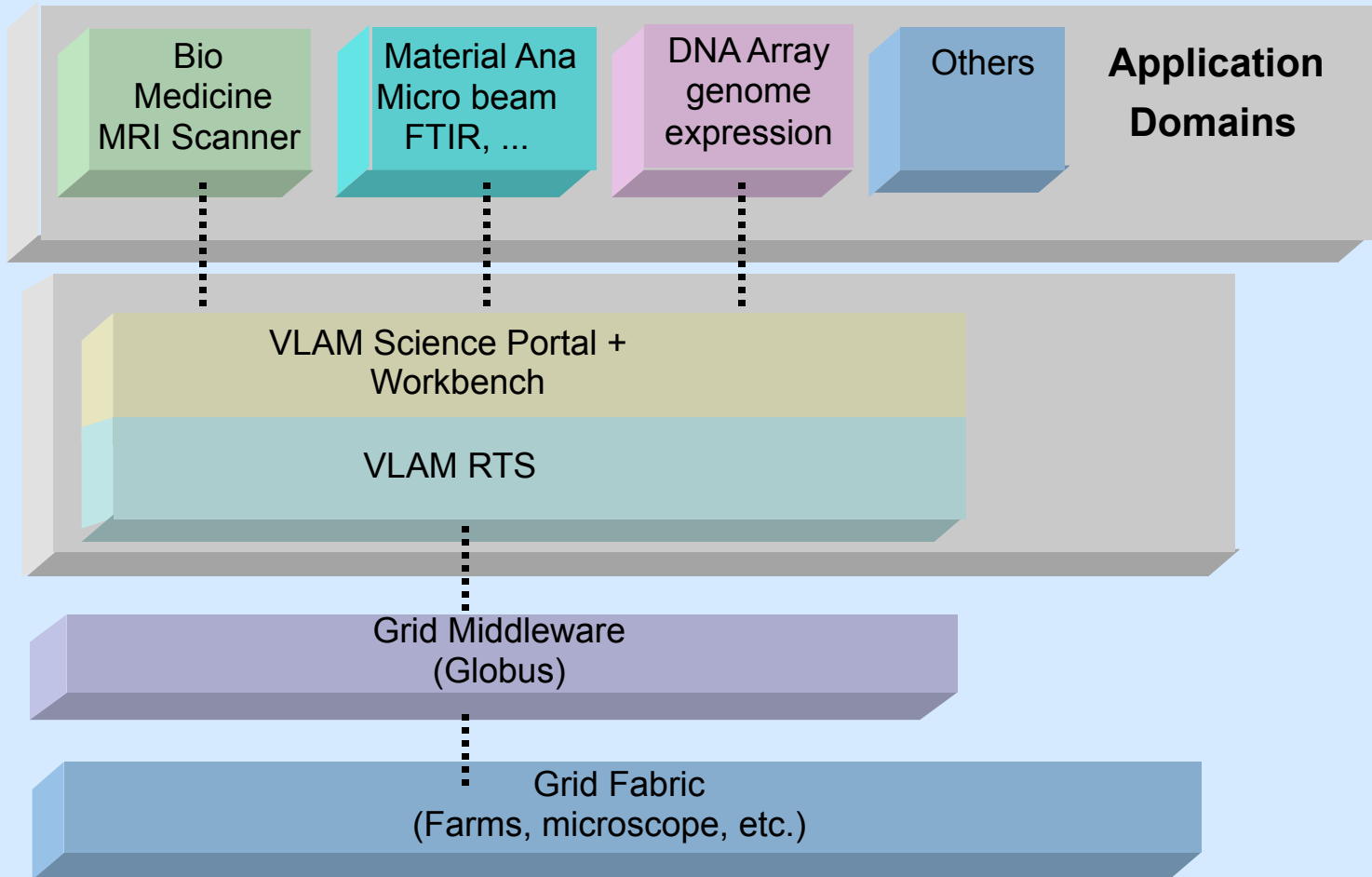
Objectives

- Designing **middleware**:
bridge gap between **Grid-** and **application-layer**
- Enable VLAM-G users to **define, execute, and monitor** their experiments
- Provide to VLAM-G users:
location independent experimentation,
familiar experimentation environment
assistance during their experiments
Easy way to bring new applications to the Grid

Why the VLAM-G project?

- The Grid deals only with raw data
 - A large number of potential applications require the manipulation of more than just raw data
- The Grid is just a bag of tools
 - The development of grid enabled applications require extensive knowledge in programming

VLAM Functional View



Experimental Workflow



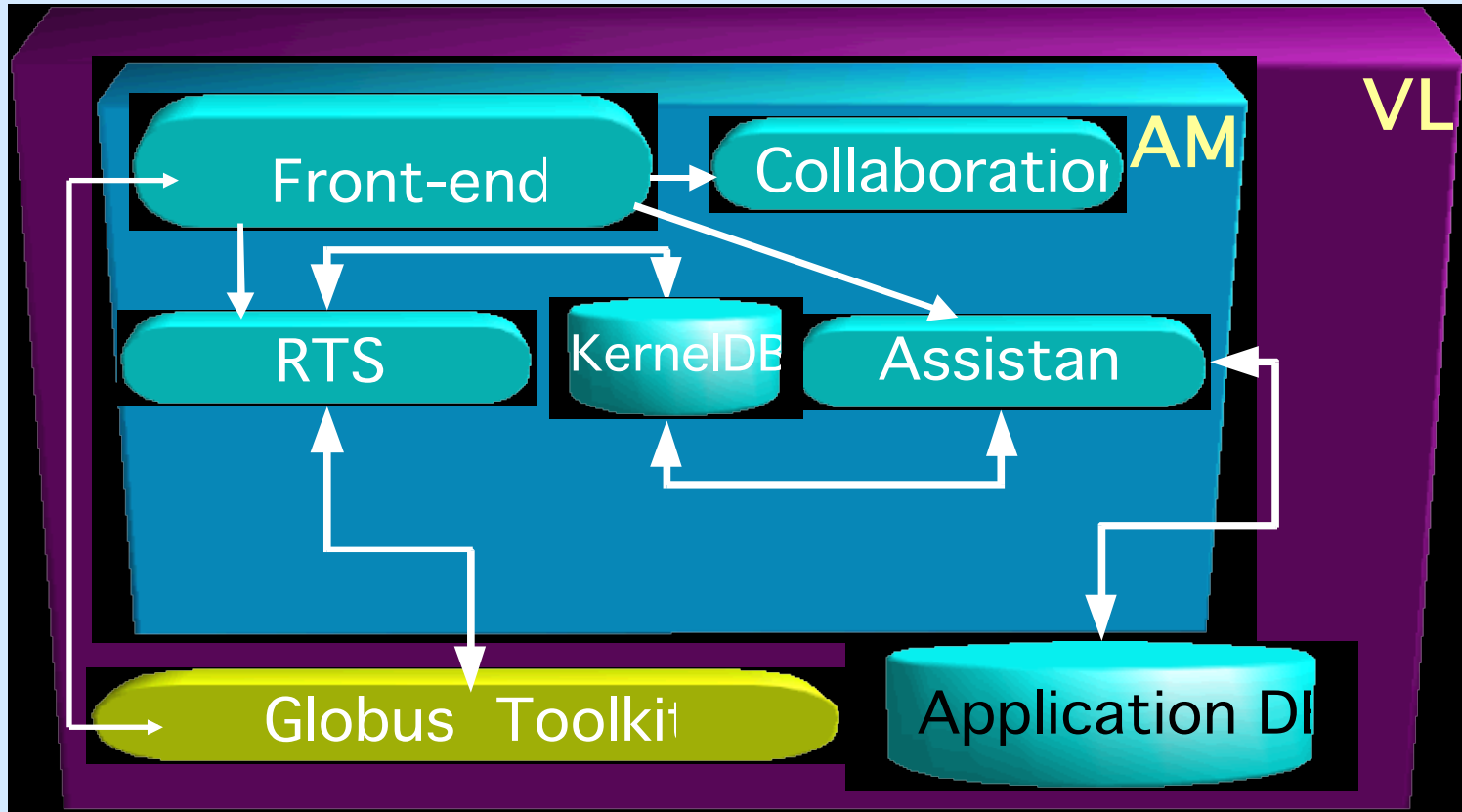
Access to devices

Access to data

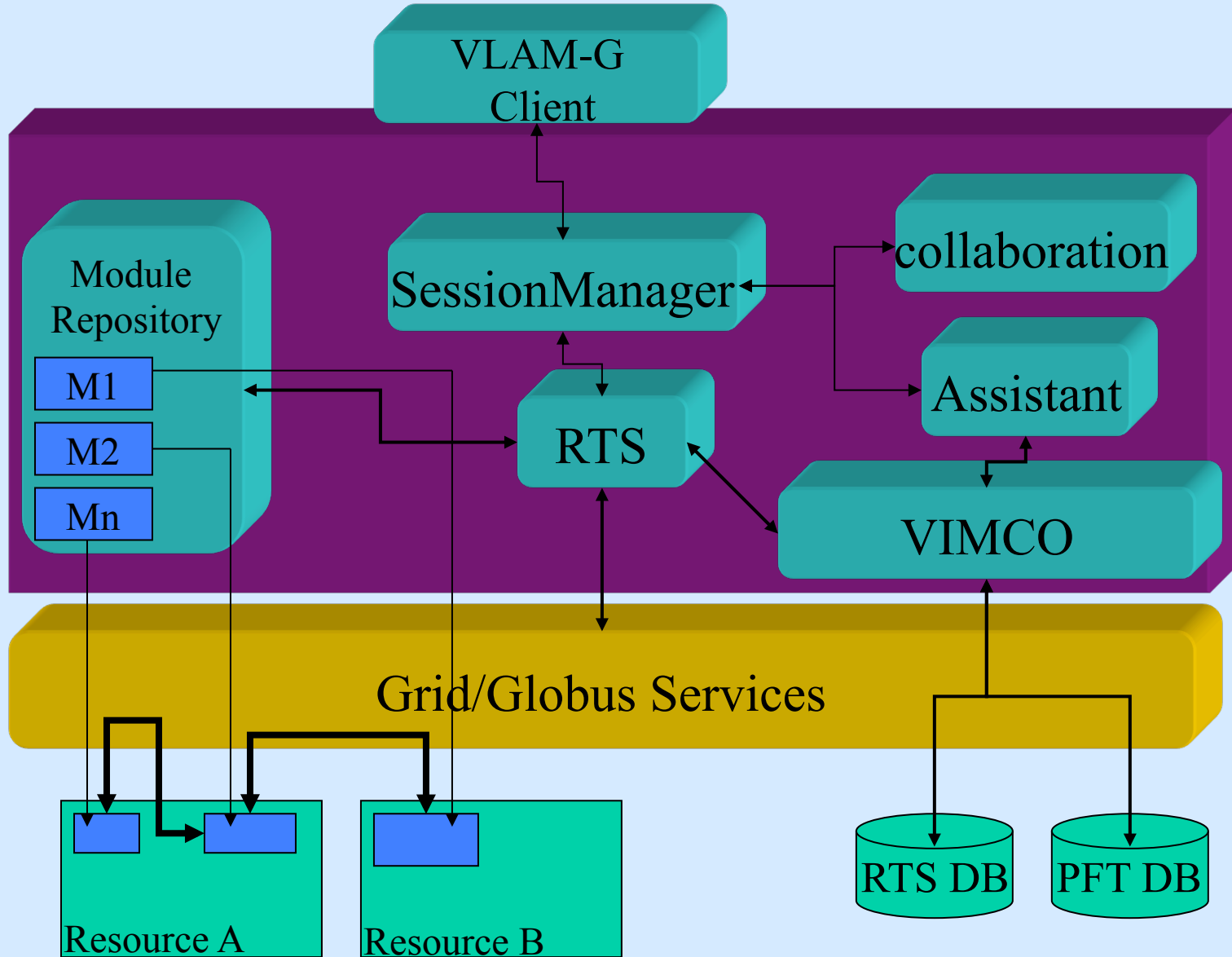
Access to information

Grid accessible infra: apparatus, systems, network

The VLAM Architecture



VLAM-G Architecture



RTS DB

- Stores user support information:
 - experiment topology definitions
 - module descriptions
 - user information
- Provides cross-links to application annotations
- Based on object-oriented database technology
- Extends resource directories now used in Grid

Application Domain DB

- **Characteristics of typical application**

Scientist(s) performing the experiment on:

objects and **preexisting information & data** on which **processes** operate, using **apparatus** with specific properties

➤ Resulting in **new data** and **information**

A domain-specific **flow of processes**



Examples:
Expressive, MACS, EFC, ...

Application Domain DB

- Characteristics of typical application

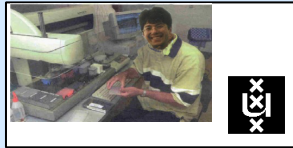


- A domain-specific **flow of processes**

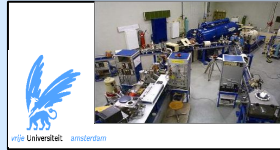


Examples:
Expressive, MACS, EFC, ...

VLAM-G Experimentation Environment Data Model



DNA micro-array experiment

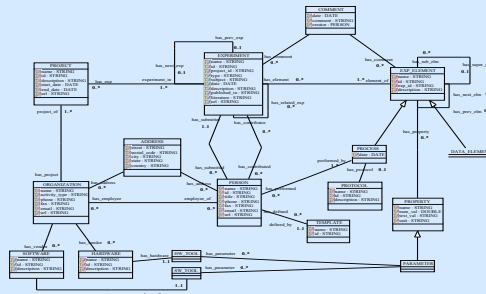
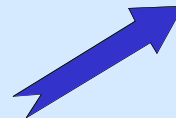


Micro-beam experiment

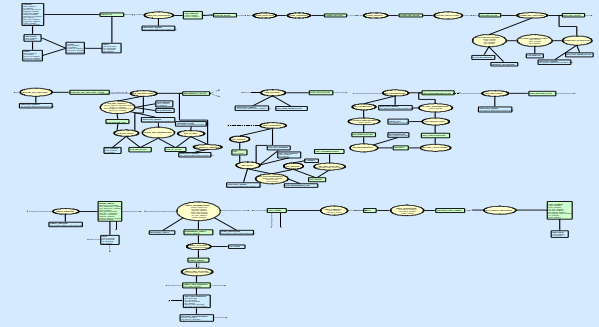
Common aspects of an experiment



Process and data flow in an experiment



Experimentation Environment Data Model



Process Flow Template

Annotations on an experiment

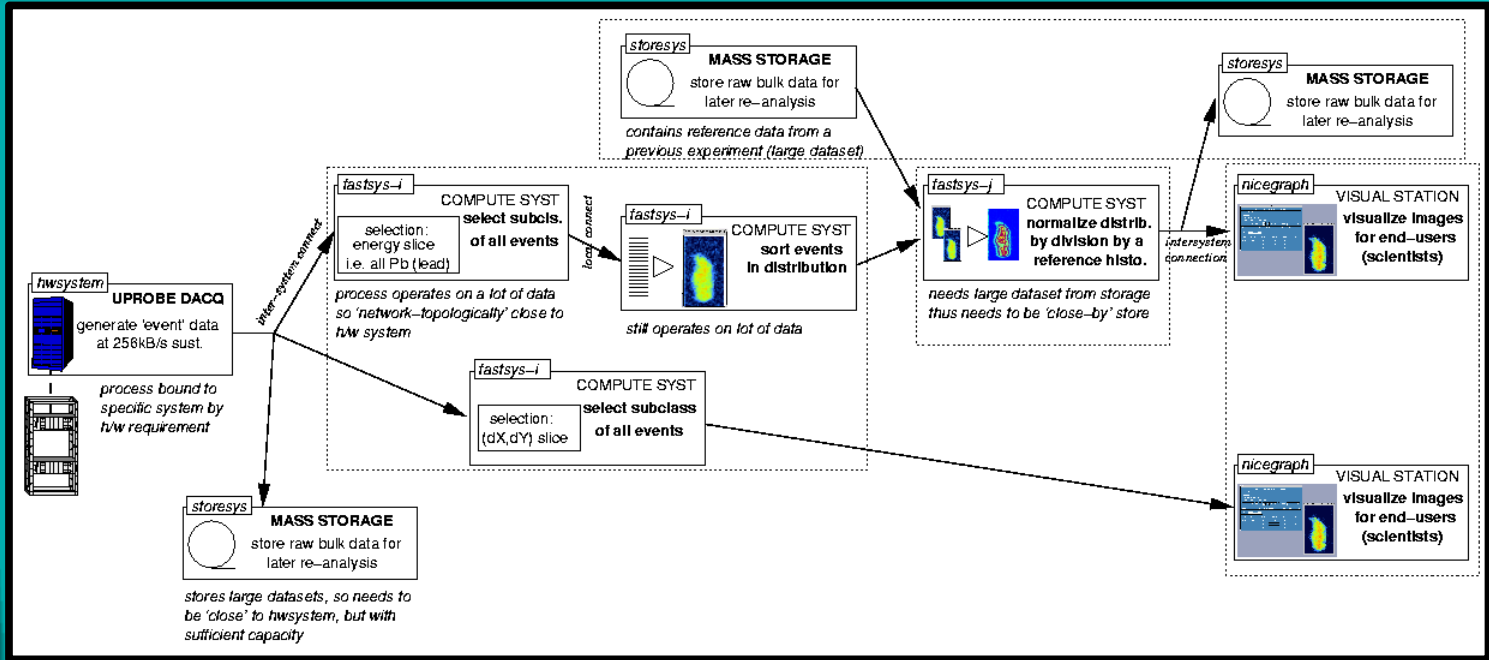


Application databases

Process Flow Template (PFT)

- Used as a blueprint for a specific type of experiments
- PFT is designed offline by the experts in each scientific domain
- It is the main interface used by the VLAM-G users to perform a specific experimentation in the VLAM-G environment.
- It Guides the user while performing the experiment.

Macslab Experiment



VLAM-G Run Time System

- Features:
 - Data-flow-like experiments with modules
 - Control parameters & read state
 - Interact with the Grid layer
- Interaction with VLAM-G RTS?
 - Module developers: API
 - End-users: None (transparent)

Status of the VLAM-G Prototype

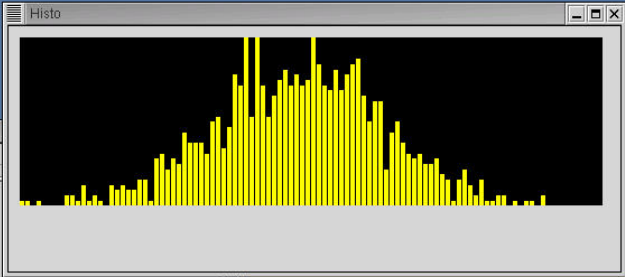
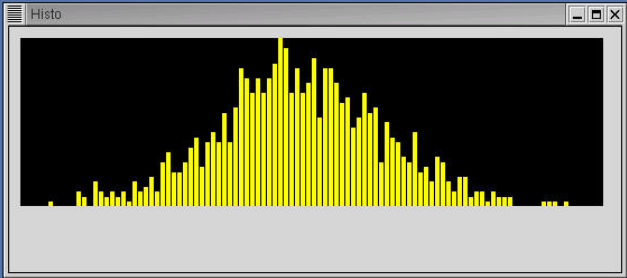
- VLAM-G RunTime System
 - Module skeleton and manager available
 - Parameter control available
 - Communication via GridFTP
- VLAM-G FrontEnd/GUI
 - Experiment topology editor
 - Process flow template editor

Current VLAM-G FrontEnd

The screenshot displays the VLAM-G FrontEnd interface, which is divided into several windows and panels:

- Virtual Laboratory Entry Point:** A window with a navigation bar containing "VL Members", "To subscribe to VL", "VL admin Only", and "Stop here". The main content area contains a welcome message: "***** Welcome the Virtual Laboratory prototype *****". Below this, there are two paragraphs of text: "The Virtual Laboratory for experimental science you are about to enter is the prototype of a research project developed by the University of Amsterdam and its partners." and "The Virtual-Laboratory project aims at developing a platform allowing Scientists working at distributed sites to use all the resources (hardware and software) available at all sites to perform their experiments." A third paragraph thanks the user for choosing the Virtual Laboratory and provides contact information: "Thanks for Choosing to use the Virtual Laboratory for your experiment. Please report any troubles, bugs to vlam.support@science.uva.nl". At the bottom, it says "Welcome to the Virtual Laboratory ...".
- Virtual Laboratory for Experimental Science:** A window with a navigation bar containing "Connection", "Science Portals", and "Help".
- AMTApp:** A window with a navigation bar containing "Experiment", "Grid Resource", and "Run Exp.". The main content area shows a list of modules (module5, module4, module3, module2, module1) on the left and a diagram of a network topology on the right. The diagram consists of five yellow square nodes connected by blue lines. A status bar at the bottom of this window reads "Drag Operation Completed: the Module No 4 has been".
- VIKernelDbMgrXX From MATISSE:** A window titled "Kernel DB Store ...". It has a "File" menu and "Store", "Retrieve", and "Remove" buttons. The main content area contains a form for adding a new entry into the VLAM Kernel DB. The form fields are: "Name of the module:" (value: module8), "Description:" (value: A short description of the module8), "Status:" (value: Alpha), "Developer:" (value: Foo1), "Manual:" (value: /home/module8/doc/manual), and an image field (value: /home/module8/icon/module8icon.gif). At the bottom of the form, there are buttons for "Add port", "CPU requirement", "Memory & storage Requirements", and "Clear".

Demo1: histogram



Experiment Grid Resource. Run Exp.

- VisualNetCDFCAVE
- VisualNetCDF
- HeadSlice
- MRItNetCDF
- MRIScanner
- ballctr
- ball
- DataWriter
- viewer
- fft
- histogram
- apodization
- slider

Drag Operation Completed: the Module No 3 has been moved to 518, 213

Demo2: Floating Ball

Demo3: MACSLab Exp

The screenshot displays the MACSLab experimental environment with several key components:

- Top Left Panel:** A netCDF Datafile window showing a 2D heatmap of data from `/home/demo/vi-matlab-distr/data/B146_01p1-10-650-64x64.nc`. The plot shows a grid of bright spots on a dark background. Controls include Channel (1), Colormap (hot), Viewmode (interp), and Spectrum (Start: 1, End: 1).
- Top Right Panel:** A netCDF Datafile window showing a 2D heatmap from `/home/demo/vi-matlab-distr/data/fastfourier-out.nc`. The plot shows a color gradient from blue to yellow. Controls include Channel (1), Colormap (jet), Viewmode (interp), Perform FFT, Apodization (None), and Spectrum (Start: 1, End: 1).
- Bottom Left Panel:** An Experiment Grid window titled "Experiment Grid Resource. Run Exp." containing a list of modules: VisualNetCDFCAVE, VisualNetCDF, HeadSlice, MRitoNetCDF, MRIScanner, ballctr, ball, DataWriter, viewer, fft, histogram, apodization, and slider. A workflow diagram shows a sequence of modules: DataWriter, apodization, fft, and a Net Viewer viewer.
- Bottom Right Panel:** A spectrum plot showing the magnitude of the fast Fourier transform. The x-axis ranges from 0 to 600, and the y-axis ranges from 0 to 1800. A prominent peak is visible at approximately 150, with a value of 37.24 indicated at the start of the plot.

Demo4: RMI Scan

The screenshot displays a Virtual Lab environment with several windows:

- Terminal (demo@lama:~):** Shows the execution of a script: `RSL: &(executable="module_starter.sh")(arguments= "VisualNetCDF"`. It lists instance details: Instance URL: `gsiftp://lama.demo.wtcw.nl:34743`, Instance ID: 1, Module ID: Mod_15, Module name: MRItNetCDF, Module location: MRItNetCDF, Hostname: lama, Environment: `DN: /O=dutchgrid/O=users/O=demo/CN=VL_Demo User`, and RSL: `&(executable="module_starter.sh")`.
- Visualization Toolkit - OpenGL:** Displays a 3D rendered model of a human head.
- Experiment Grid Resource. Run Exp.:** A window showing a list of resources and their connections:
 - VisualNetCDFCAVE
 - VisualNetCDF
 - HeadSlice
 - MRItNetCDF
 - MRIScanner
 - ballctr
 - ball
 - DataWriter
 - viewer
 - fft
 - histogram
 - apodization
 - slider
- HeadSlice:** Shows a cross-sectional slice of a head with a resolution of `64x64 [257x243], 8 bits , 256 colors`.
- HeadSlice Control Panel:** A control interface with a table for window levels and slice selection:

Window Level	Slice	
1000	800	26

Update
- Diagram:** A central `MRItNetCDF` node is connected to `MRIScanner`, `3D Viewer`, and `HeadSlice`.

Potential Research issues

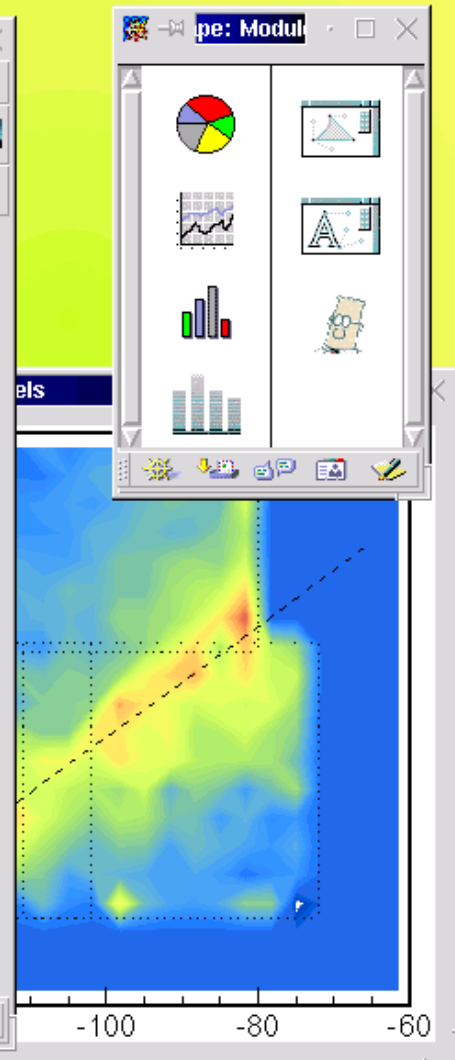
- Resource Management on the Grid
 - One Ph.D student is going to study this topic in detail
- Security issues on the Grid
- Federating Data on the Grid

Conclusions

- VLAM-G: a science portal for exp. analysis
- Workflow support for
Bio-informatics, Materials Science
and **Biomedical Simulation & Visualisation**
- Seamless access to distributed resources
- Resource Management: based on Globus
- Content Management: VLAM-G middleware
- **Current status: preparing the beta-release of the VLAM-G toolkit.**

VLAM-G Front End

The screenshot shows a Netscape browser window titled "Virtual Laboratory - Experiment #1". The address bar contains "http://www.vlam.nl/". The main content area displays a diagram of an experimental setup. On the left, a box labeled "µBeam" has three red arrows pointing to three boxes on the right: "Cutter", "Datastore", and "Processor". Below the diagram is a text area with the text "Welcome to the Virtual Laboratory Experiment Designer". The status bar at the bottom indicates "100%" zoom and "Applet ExpDesigner running".



People (not comprehensive)

- Adam Belloum
- David Groep
- Anne Frenkel
- Cees de Laat
- Toto van Inge
- Gert Eijkel
- Zeger Hendrikse
- Dmitry Vasunin
- Ersin Kaletas
- Vladimir Korkhov
- Robert Belleman
- Hakan Yakali
- Hamideh Afsarmanesh
- Timo Breit
- Peter Sloot
- Ron Heeren

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