Leveraging Open Source for Geographically Dispersed Workflows

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The VPH Approach

- Estimate future outcomes by simulating personalized physiological models
- Personalization mostly comes from imaging, but demographics and lifestyle are considered, too

- Typically, in a study:
  - the same *procedural* workflow needs to be repeated for all the subjects
  - the workflow is carried out by researcher that are either more technically minded or with a more marked clinical-background
  - specialized clinicians oversee the final quality of the results

A Common Denominator

- A common characteristic of the projects to be presented is that

each of them assembles

open-source or open-source-derived components

to deliver innovative services

The sum is bigger than its components

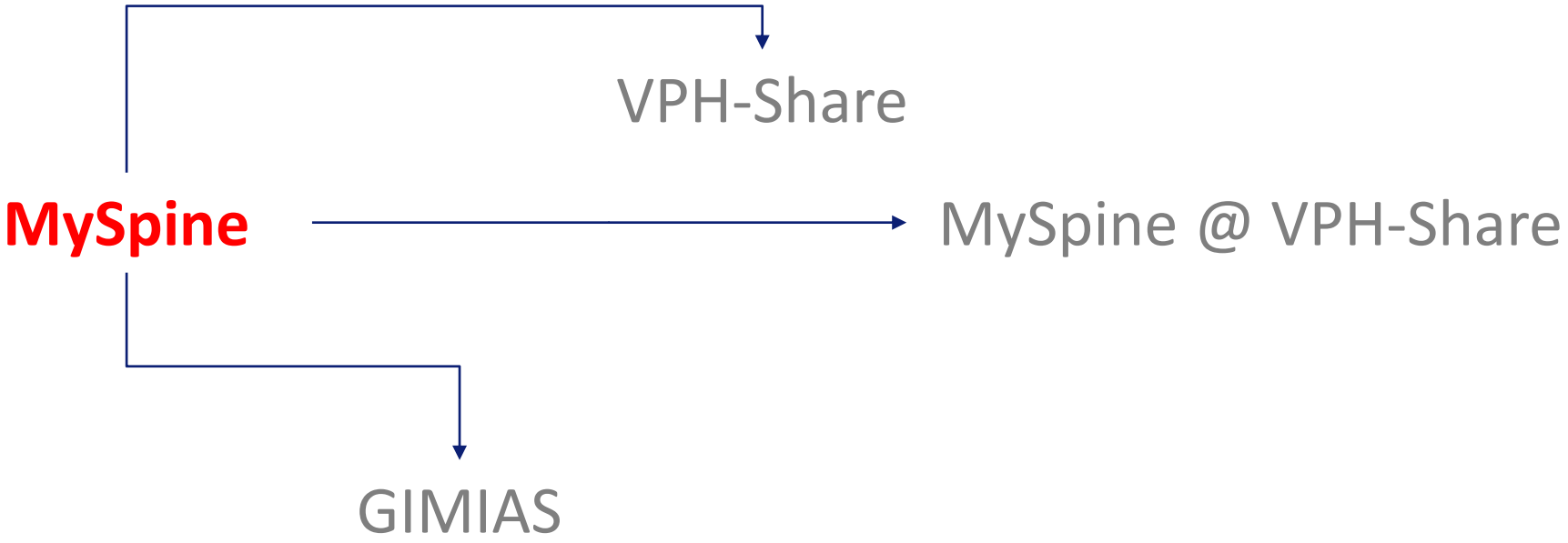
the orchestration of the three projects
exemplifies
a template of a new way to provide
access to advanced solutions

MySpine

VPH-Share

GIMIAS

*** Route Information ***



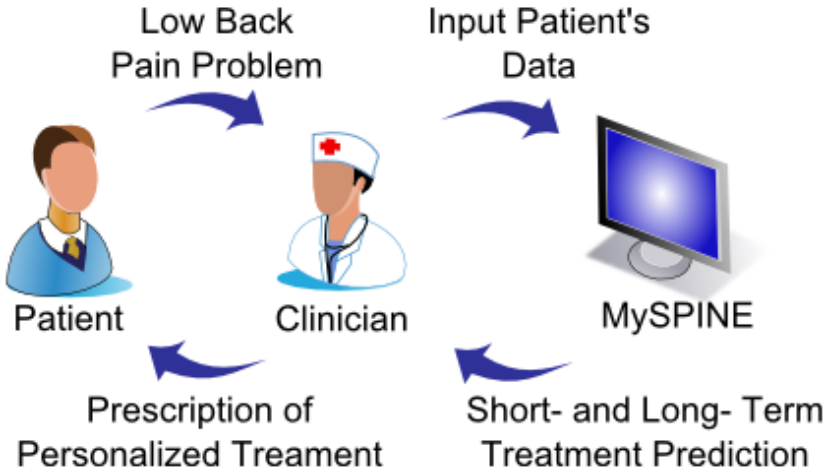
MySpine Motivation

- Low back pain is a well-known and widely spread illness.
- Prevalence estimates for chronic low back pain between 6 and 11% (and annual direct cost of low back pain of 7.000 € per person)
- Billions of Euro are spent each year in Europe on treating this disorder.

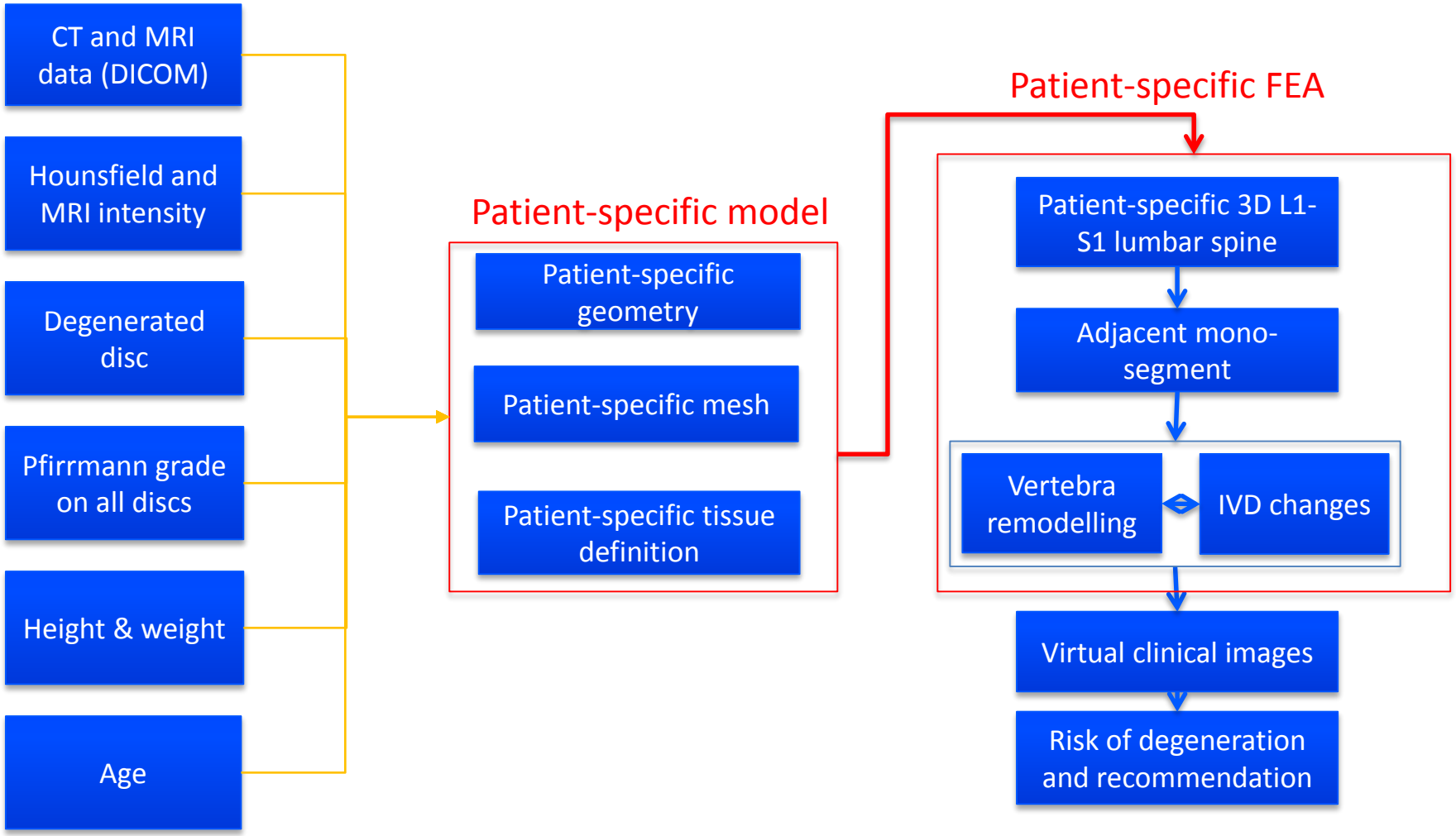
(Juniper et al. 2009)

MySpine Goals

- Aims to create a clinical predictive tool to provide clinicians with patient-specific biomechanical and mechanobiological analysis.
- This tool will help to determine the best patient specific treatment for low back pain.
- The project will focus on disc degeneration pathology although the developed prototype system may be able to analyze other spinal pathologies as well.



MySpine Data Flow



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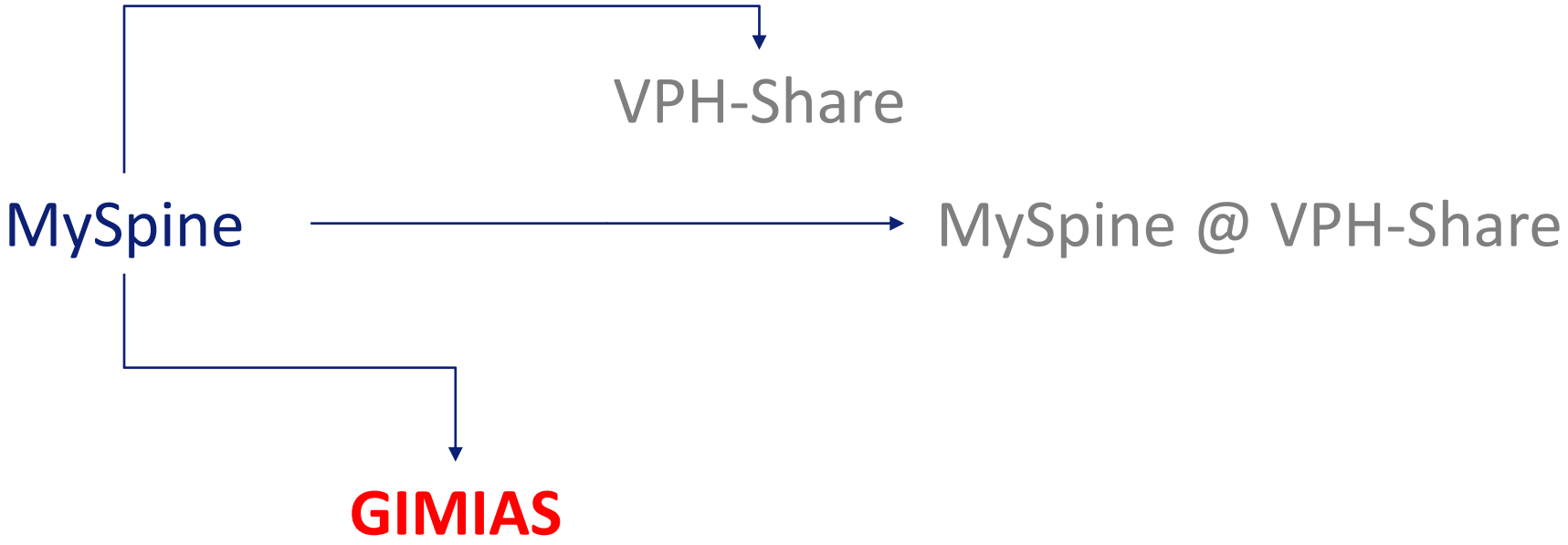

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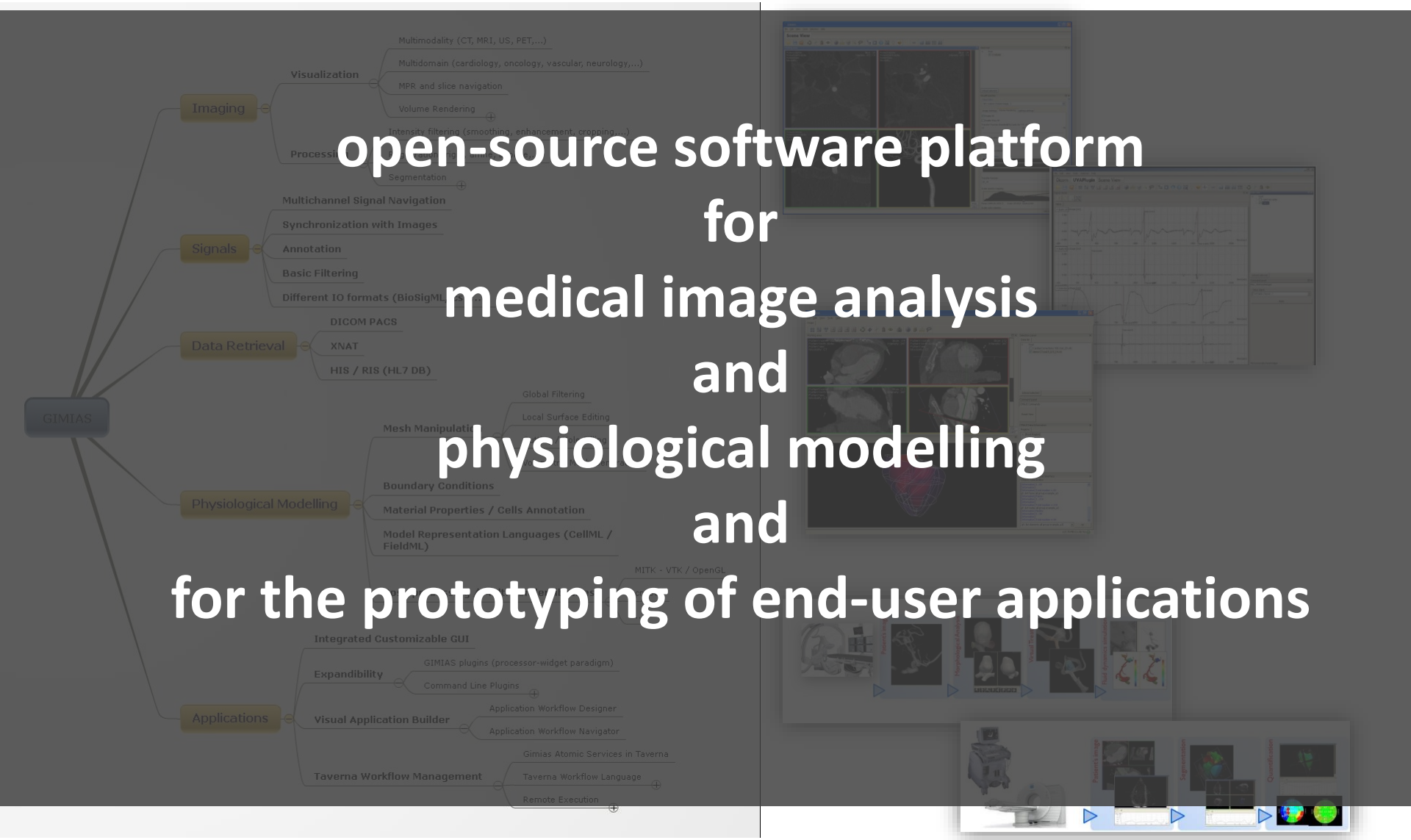
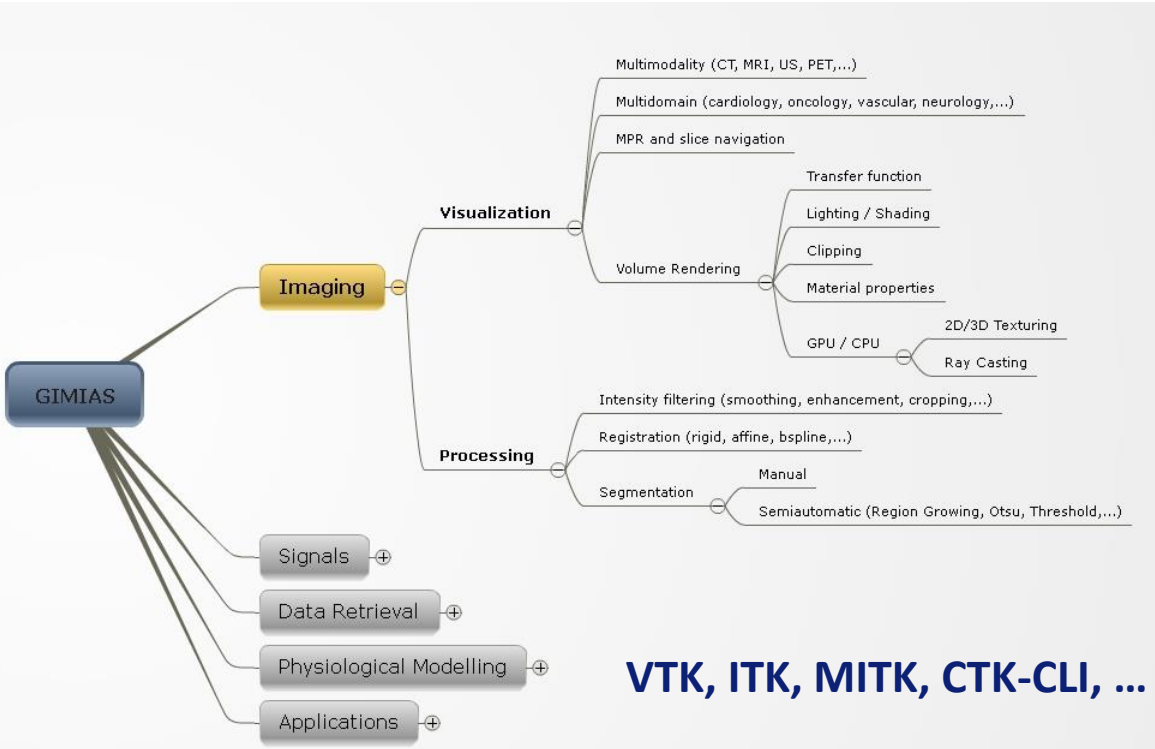


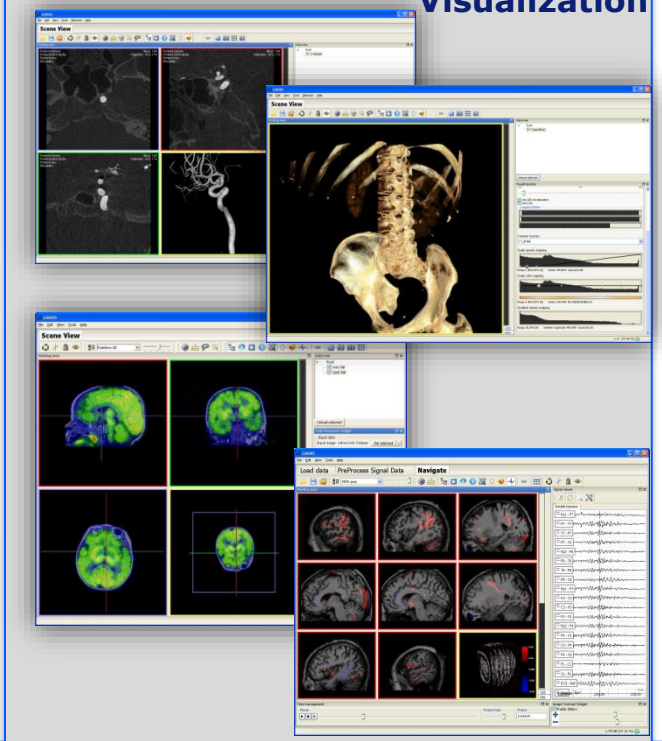
open-source software platform
for
medical image analysis
and
physiological modelling
and
for the prototyping of end-user applications

GIMIAS – Imaging

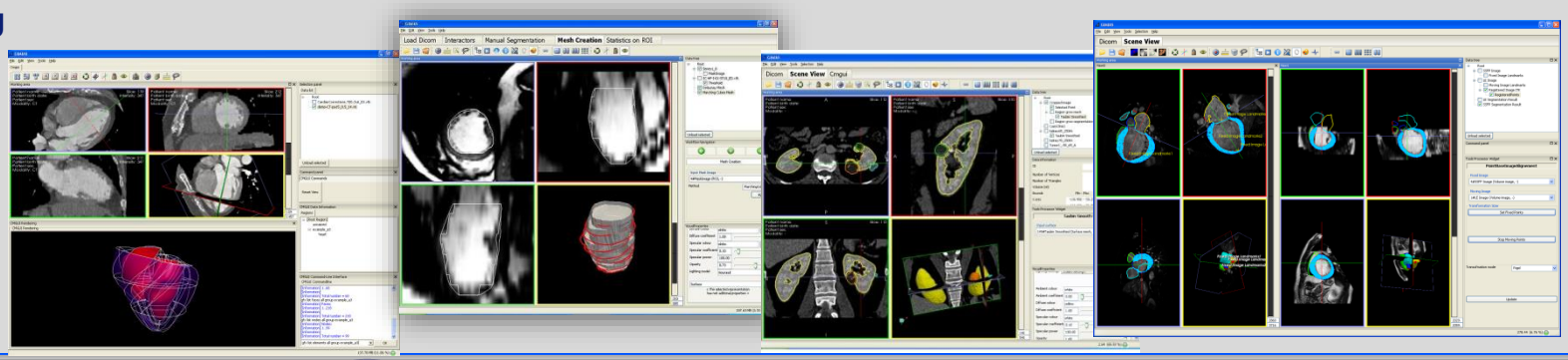


VTK, ITK, MITK, CTK-CLI, …

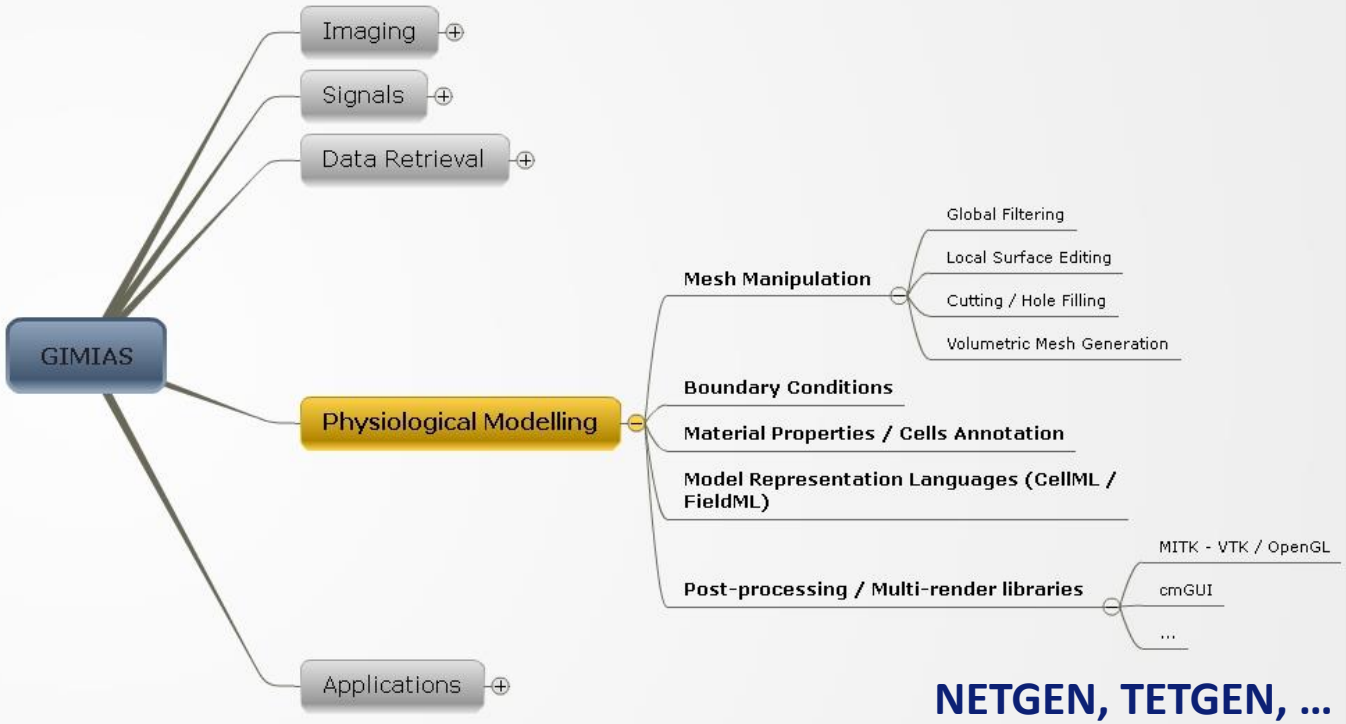
Visualization



Processing

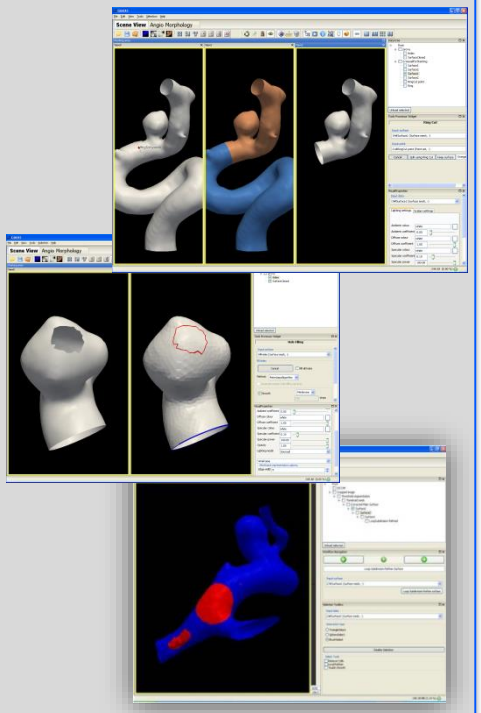


GIMIAS – Physiological Modelling

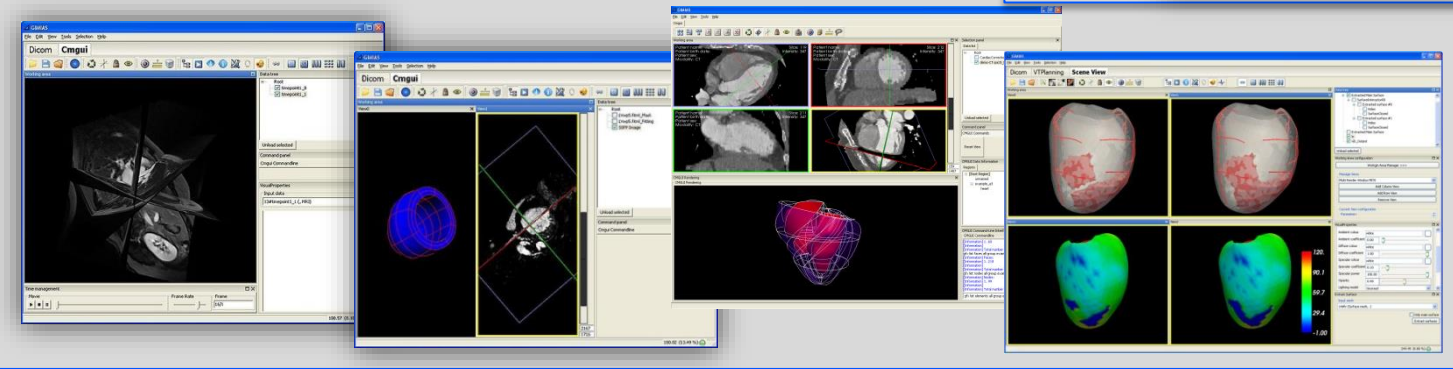


NETGEN, TETGEN, ...

Mesh Manipulation

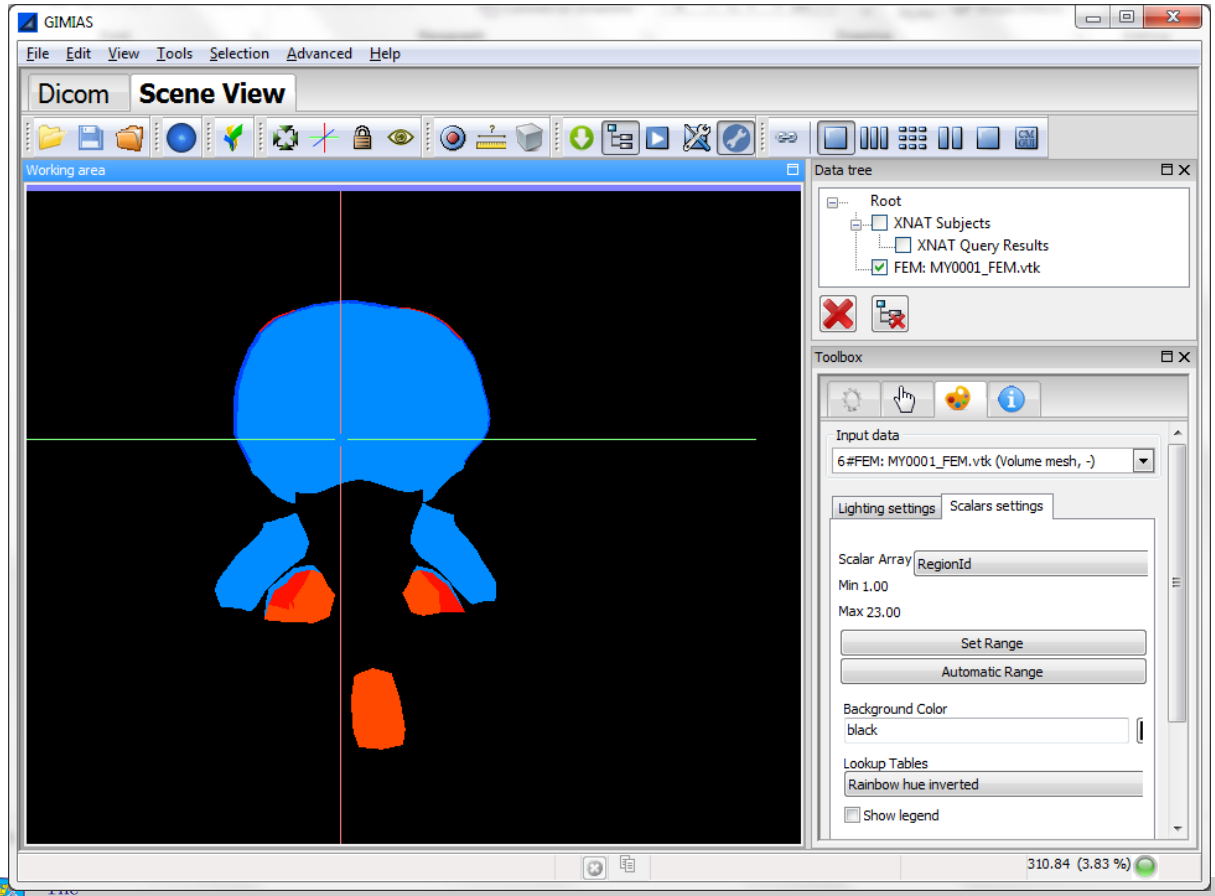


Post-processing
Multi-render libraries



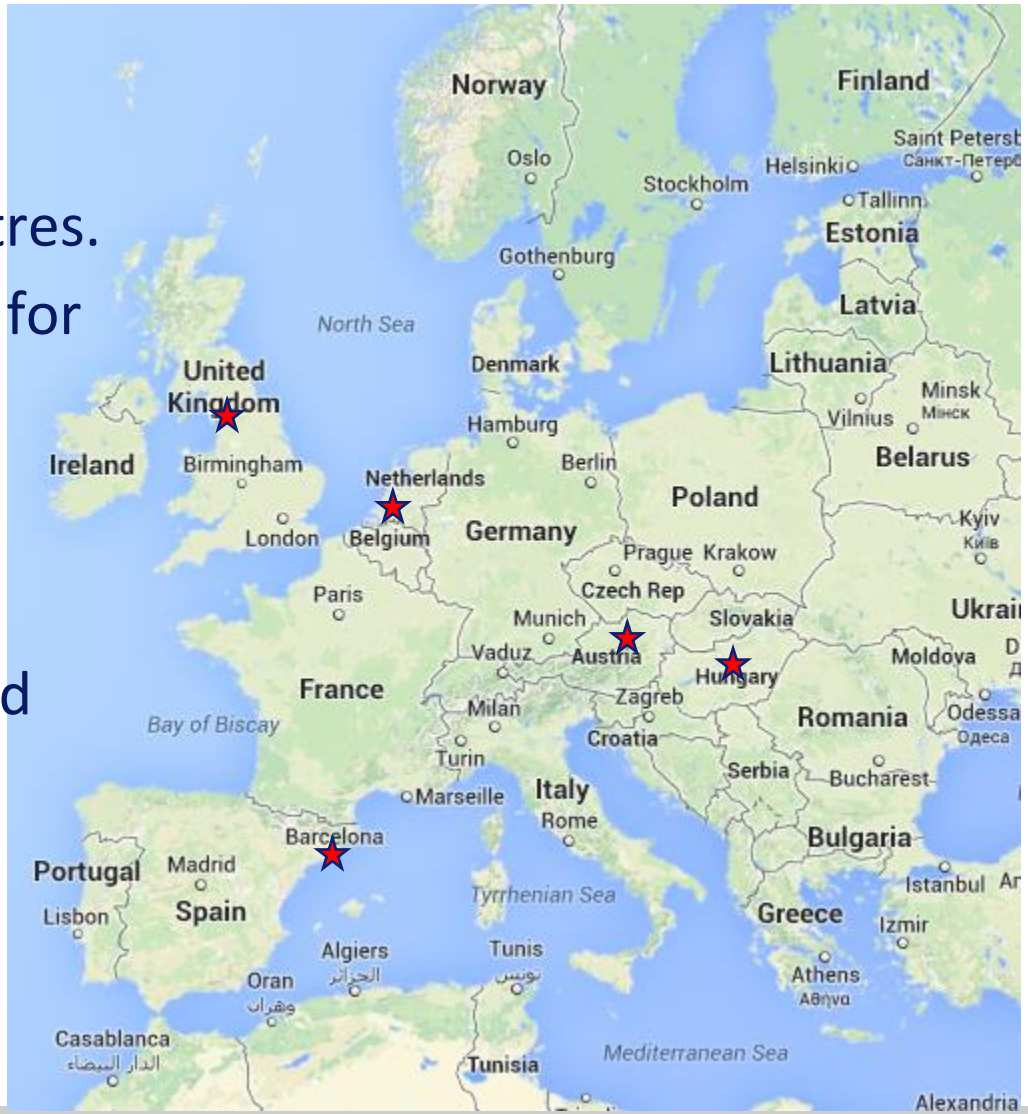
GIMIAS 4 MySpine

- Proper handling of unstructured grids
- Enhanced **XNAT** connectivity



MySpine goals & needs

- Run 250 lumbar spine reconstructions in 3 weeks involving 6 Partners, 4 HPC facilities and 2 Medical centres.
- Provide a clinical prototype for validation by the medical centres and the project advisory board.
- Facilitate continuous deployment of upgrades and fixes to the users



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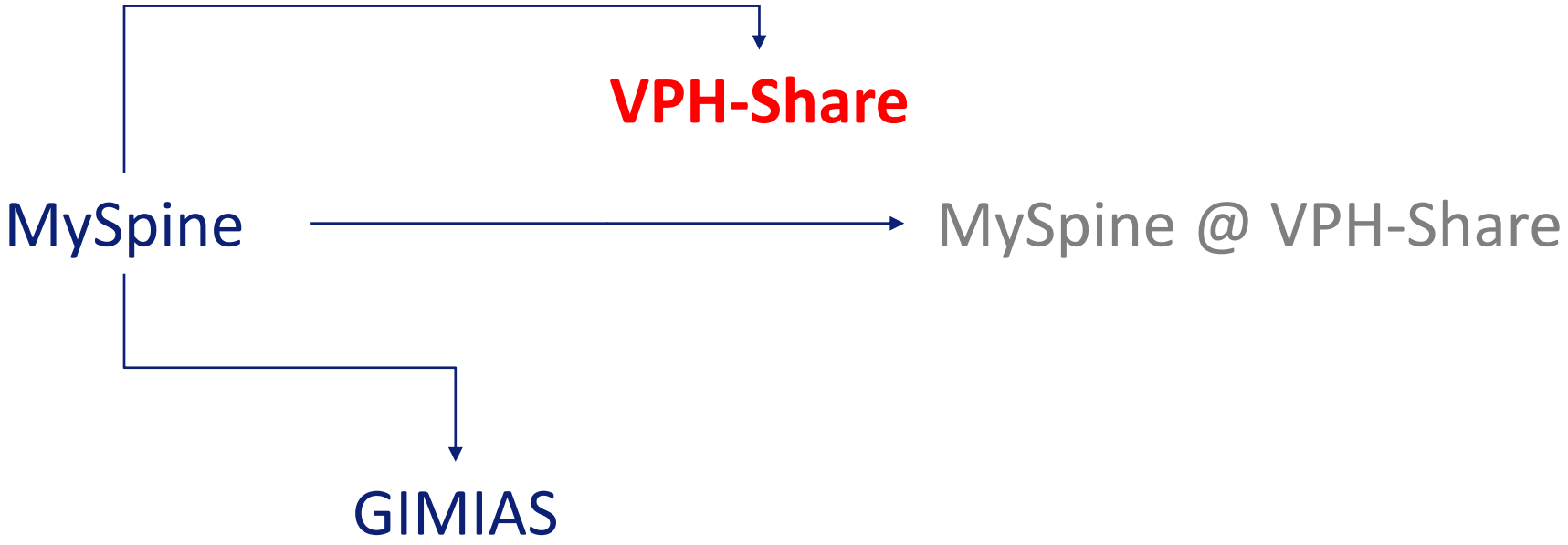
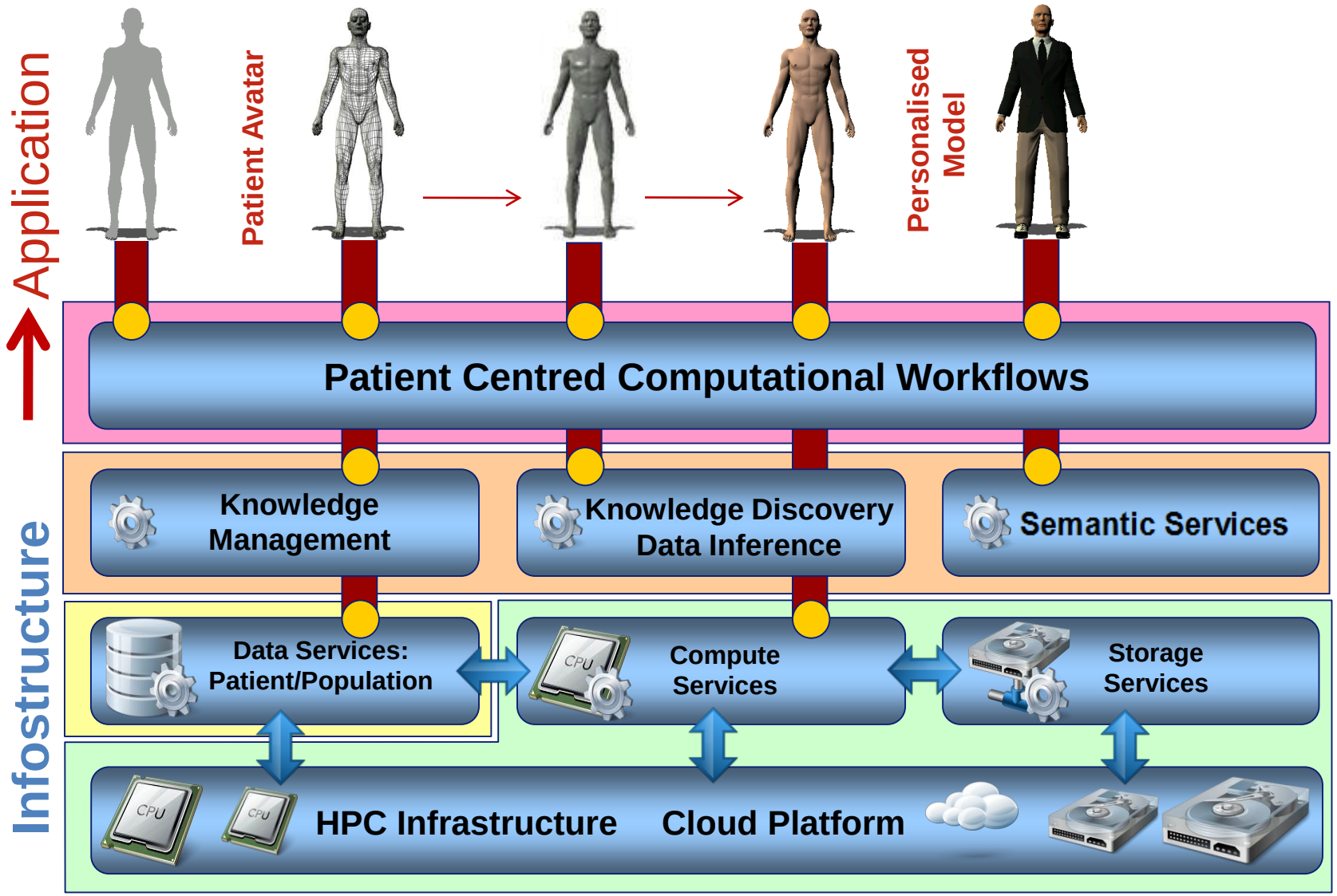
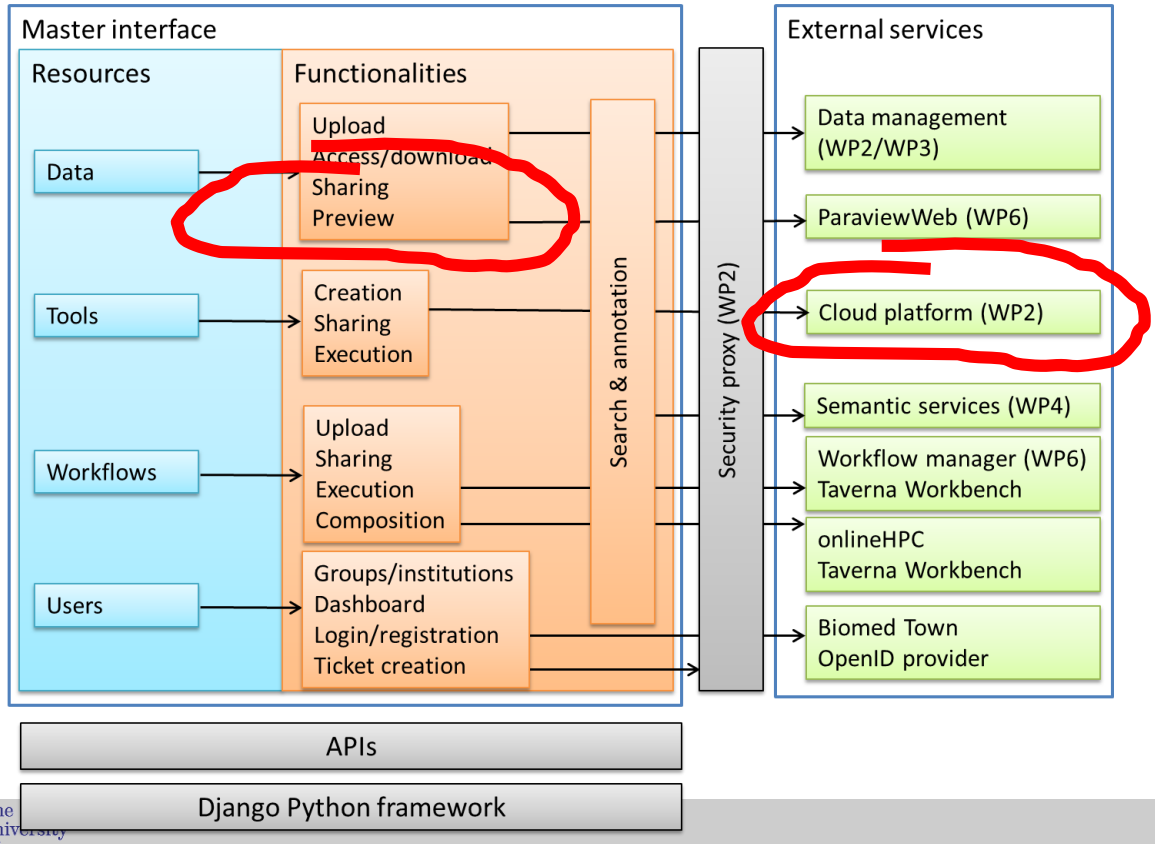


VPH-Share Overview

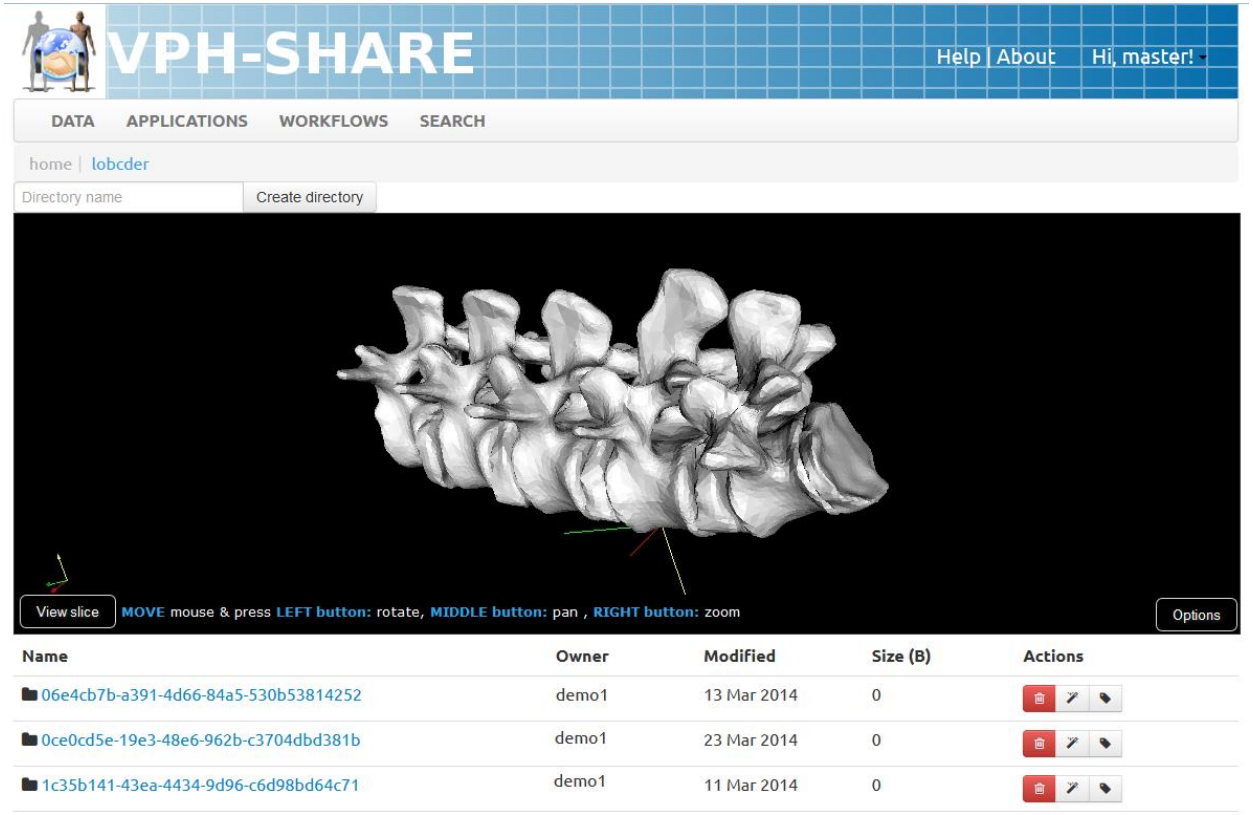


VPH-Share Infostructure

- VPH-Share flexibility comes from a rich support layer (the infostructure) where services are made accessible to user through the web-based Master Interface

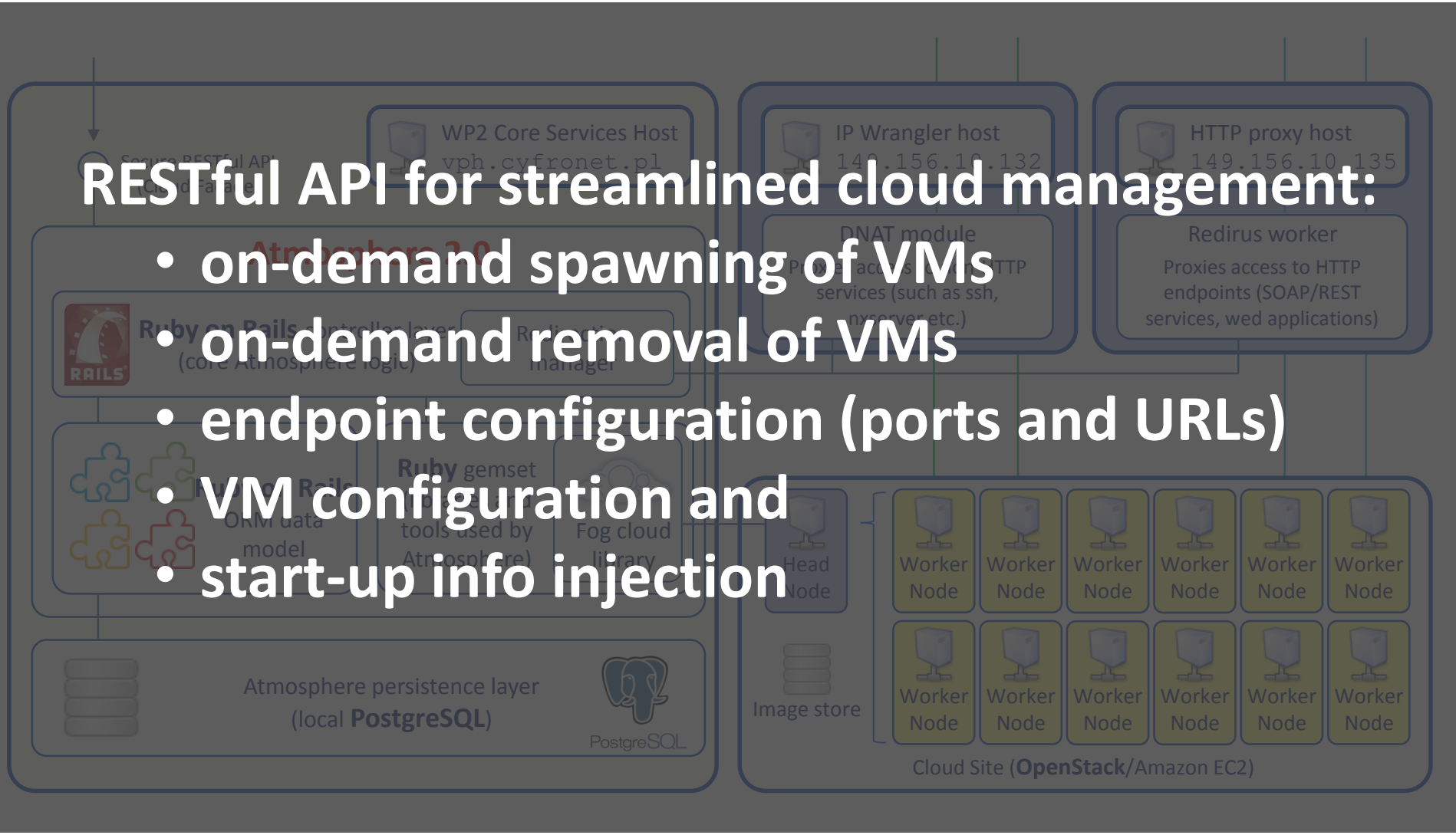


VTK File Preview in LOBCDER



ParaView Web

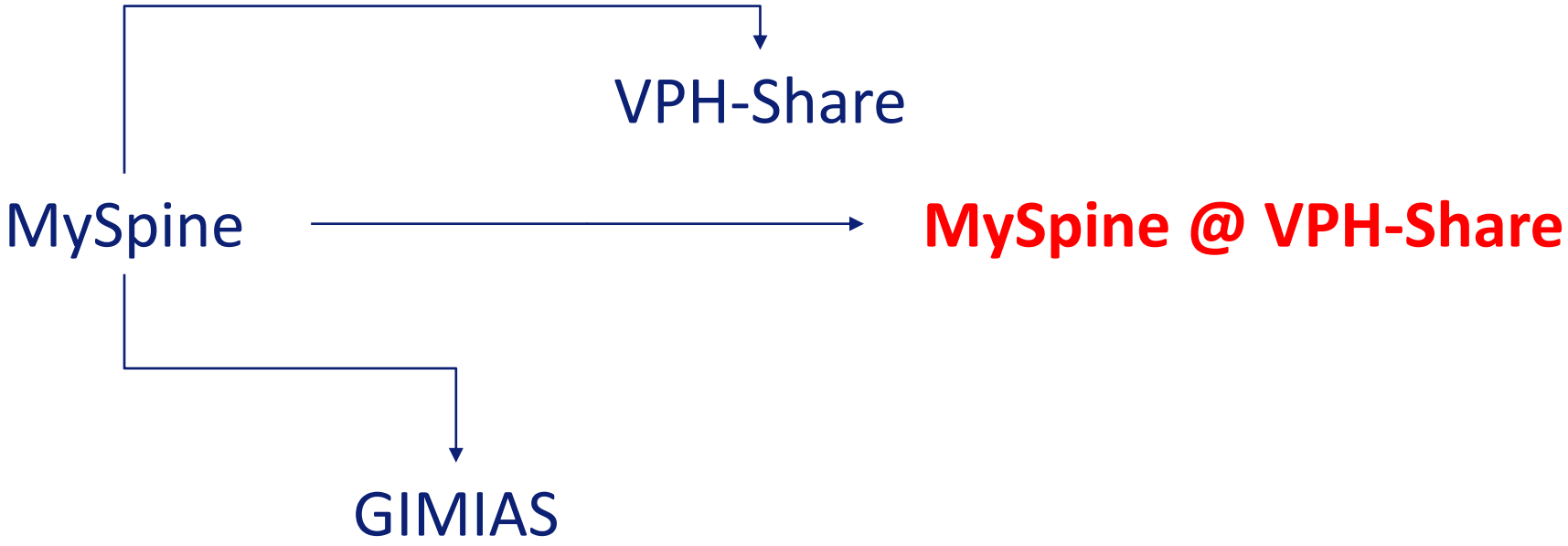
VPH-Share Cloud Services



RESTful API for streamlined cloud management:

- **on-demand spawning of VMs**
- **on-demand removal of VMs**
- **endpoint configuration (ports and URLs)**
- **VM configuration and**
- **start-up info injection**

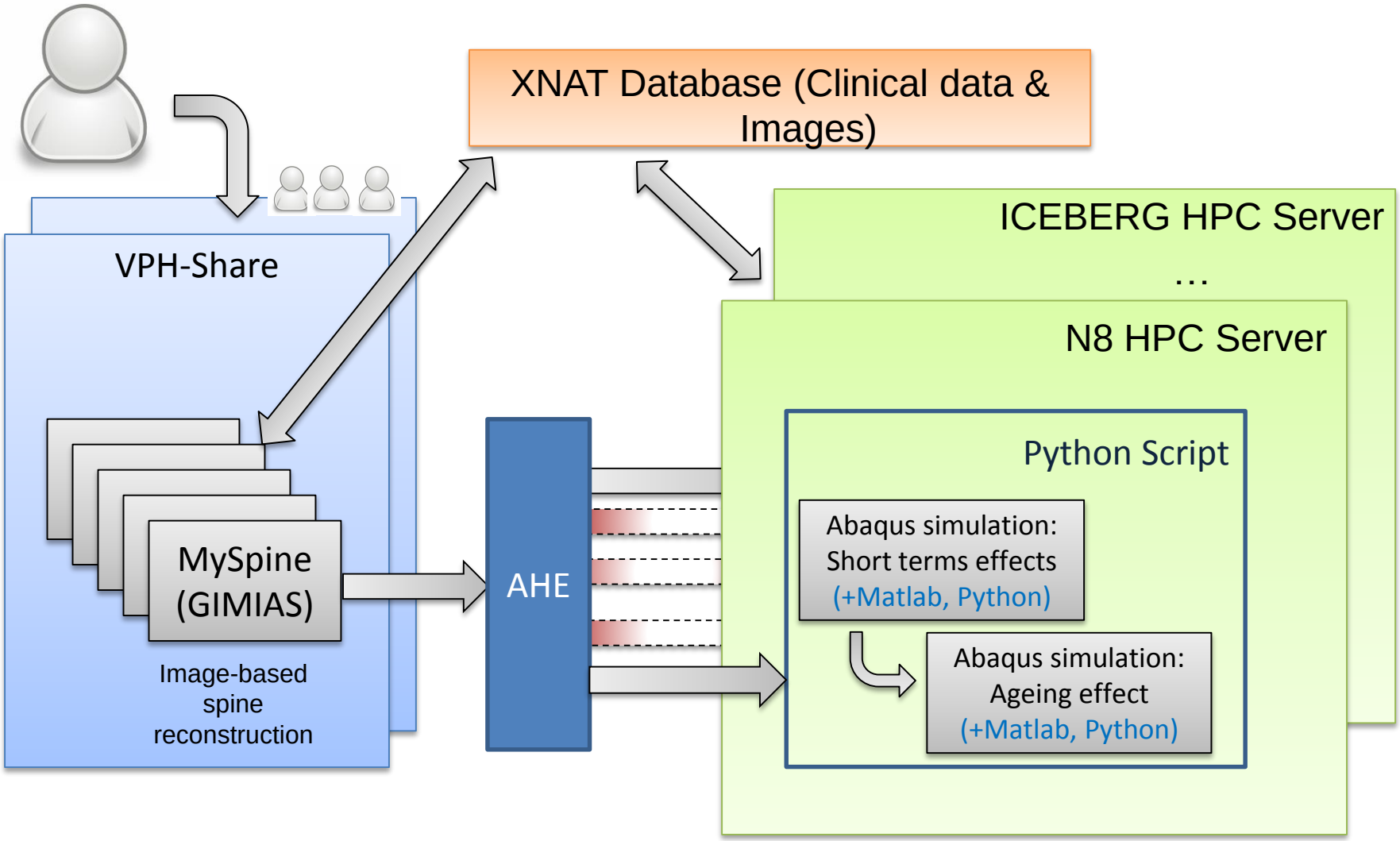
Route Information



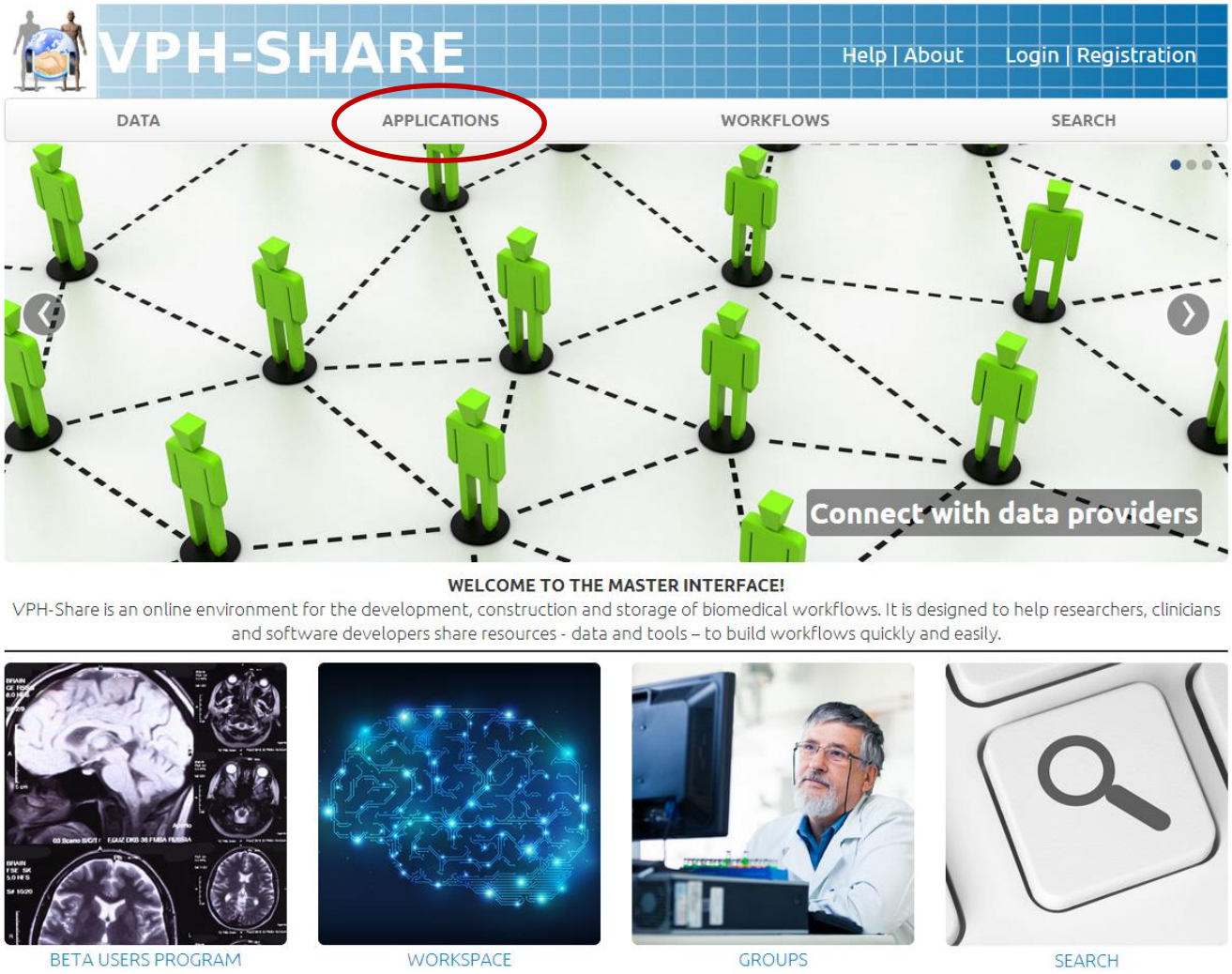
Expected Outcomes of MySpine in VPH-Share

- MySpine workflow made available at anytime, in anyplace to all partners
- Deployment of software upgrades automatically accessible to all partners
- Facilitate connectivity between MySpine software platform and HPC facilities

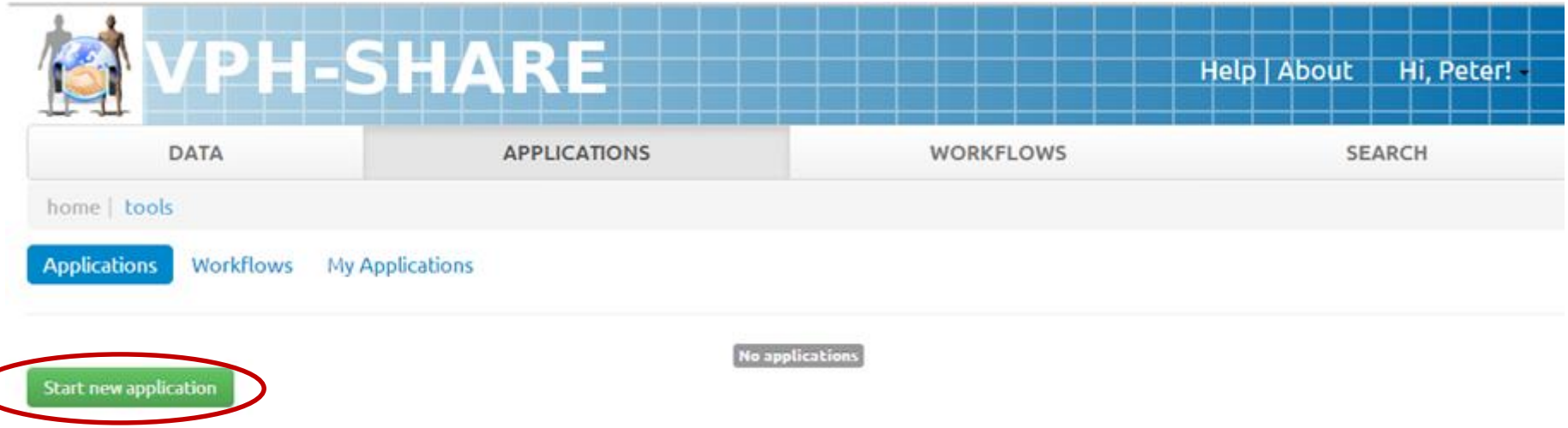
MySpine@VPH-Share Main Components



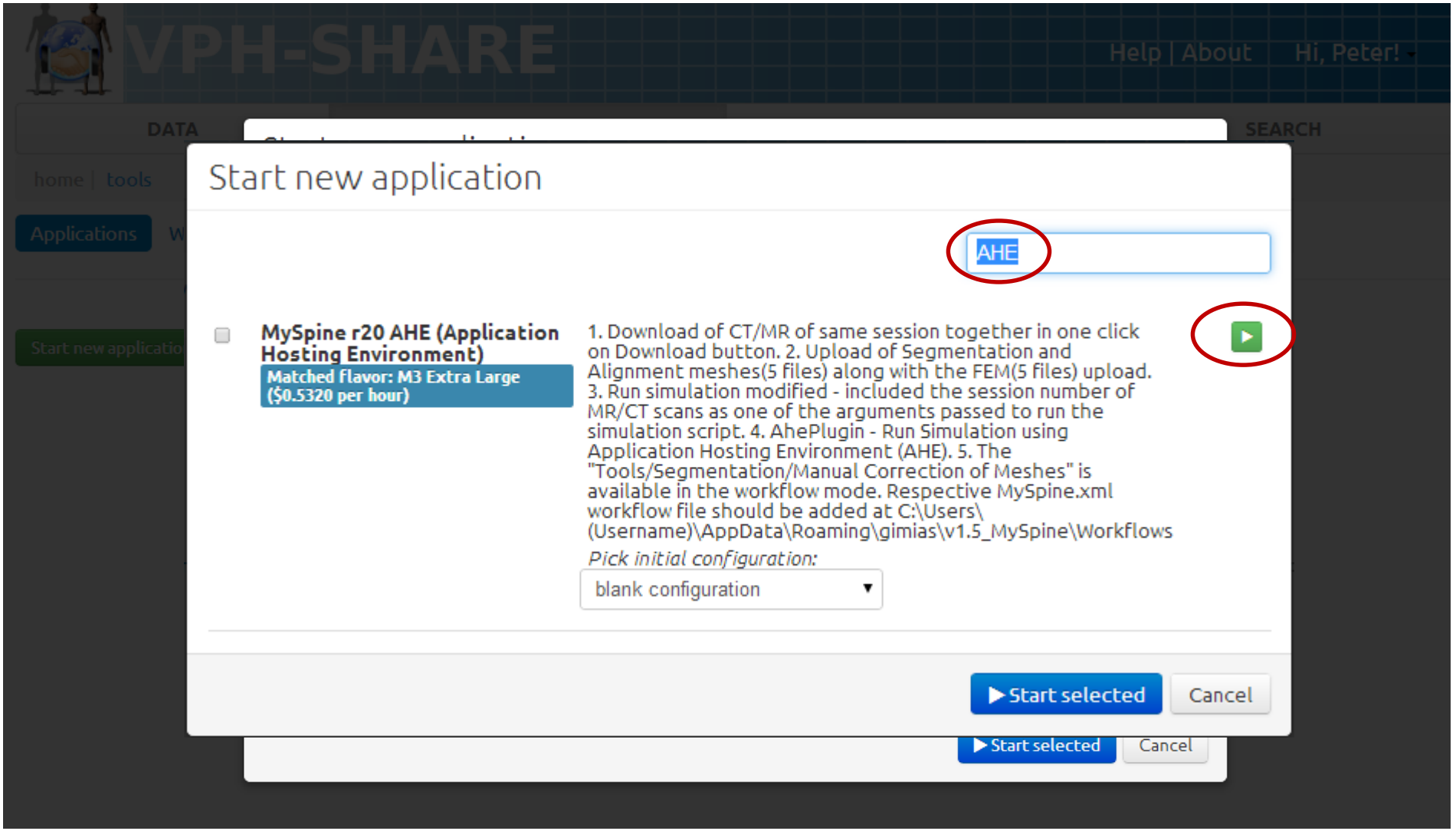
Starting MySpine@VPH-Share: application selection (1/3)



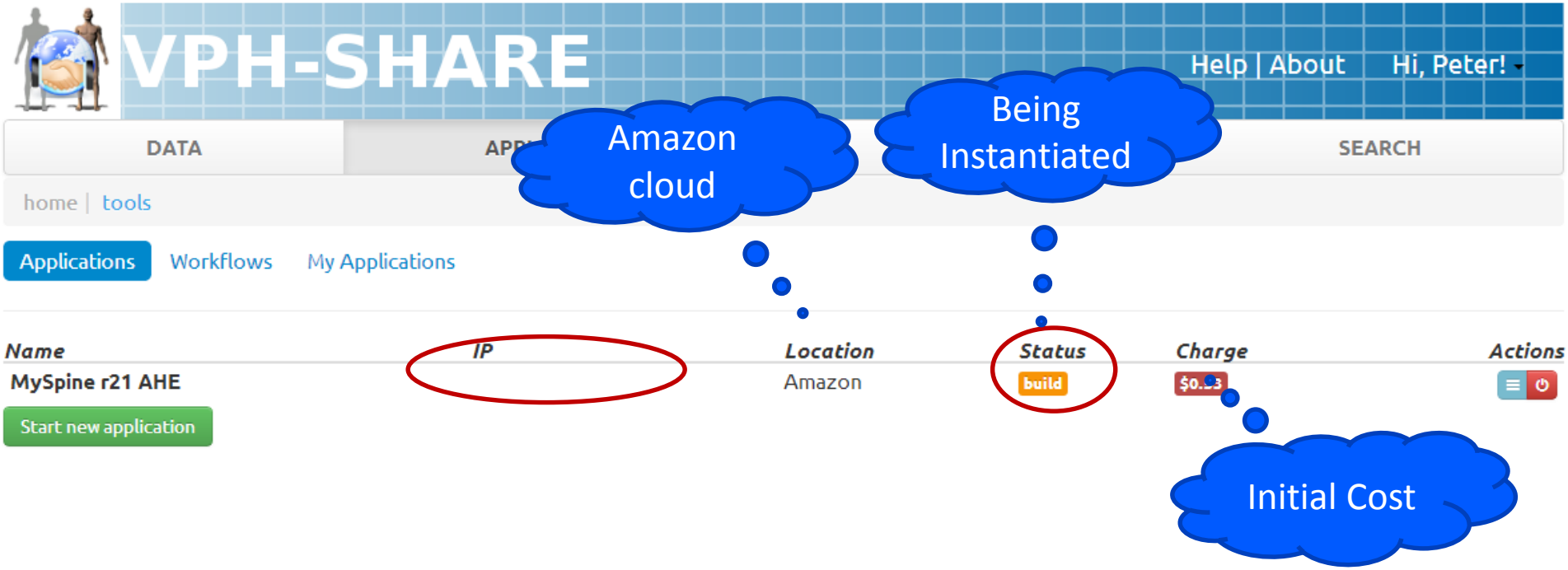
Starting MySpine@VPH-Share: application selection (2/3)



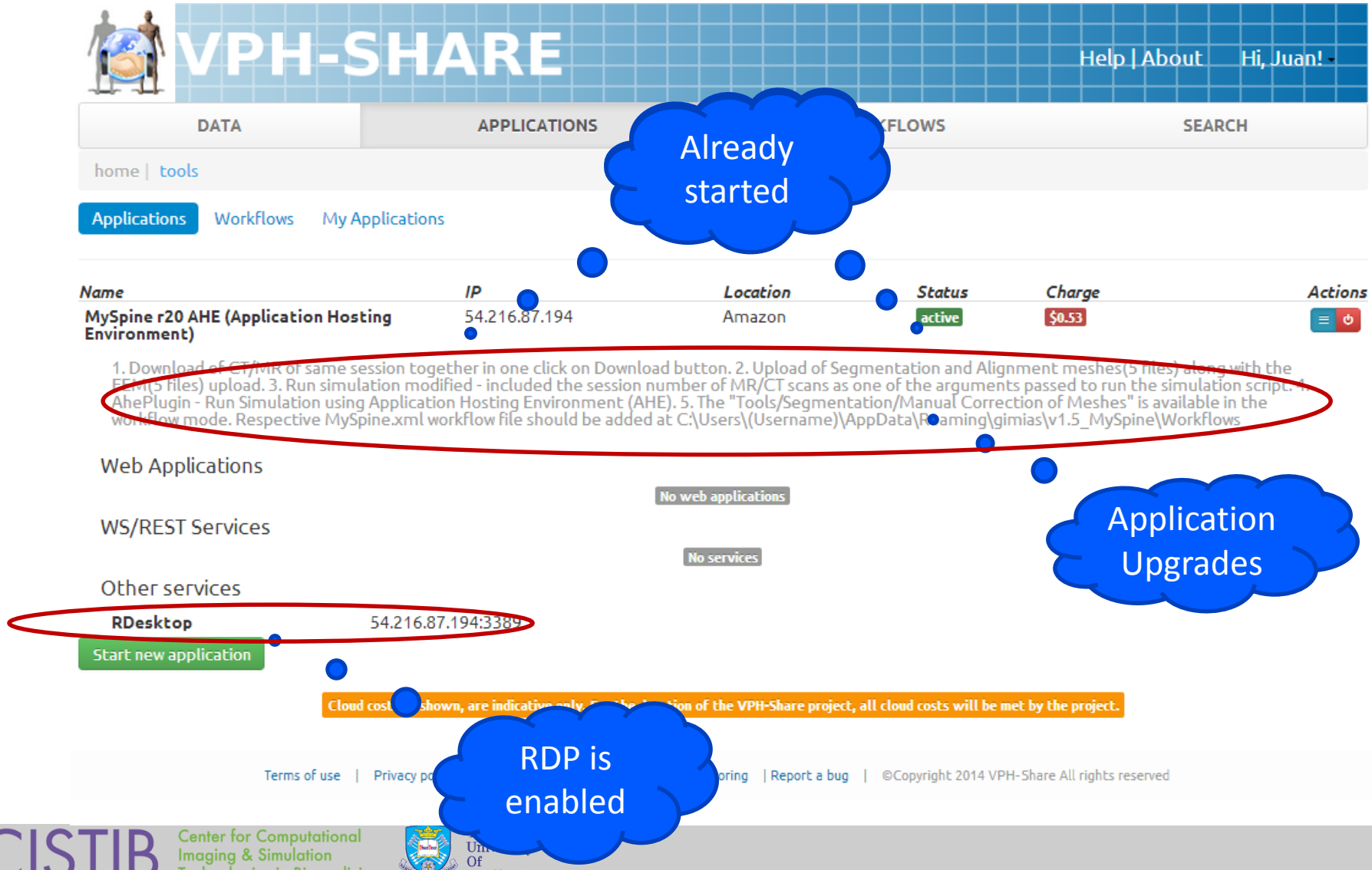
Starting MySpine@VPH-Share: application selection (3/3)



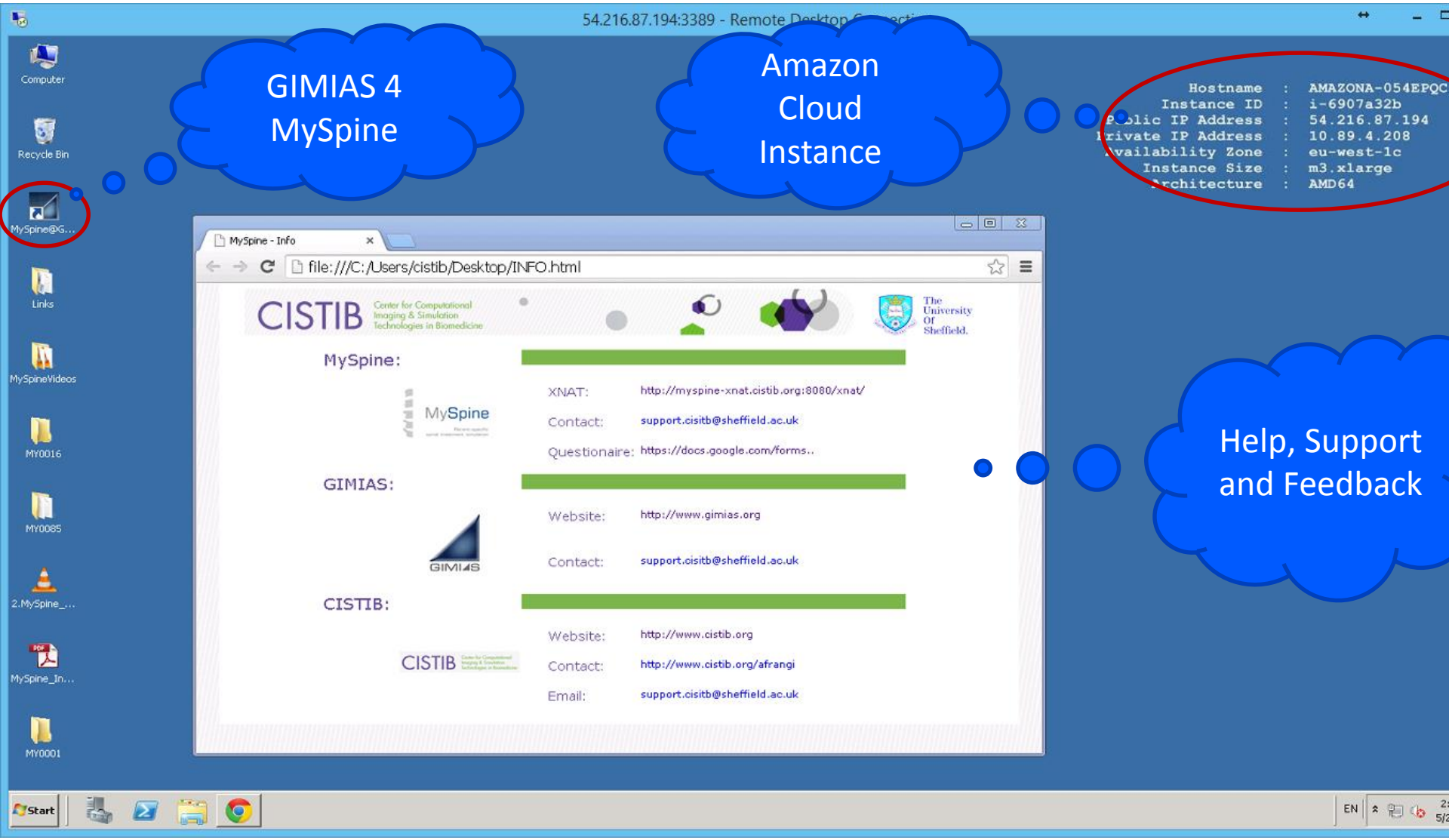
Starting MySpine@VPH-Share: cloud instantiation (1/2)



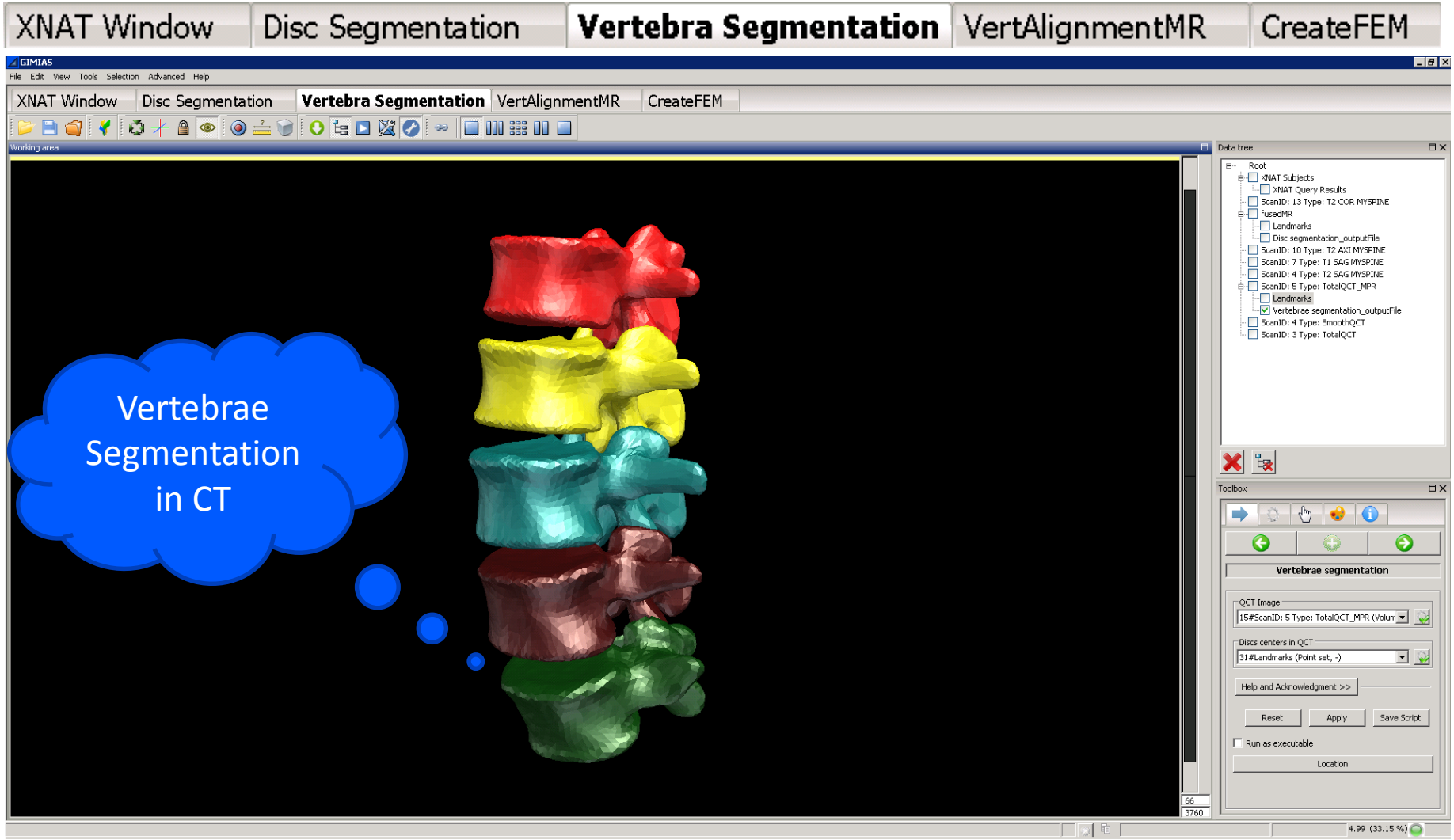
Starting MySpine@VPH-Share: cloud instantiation (1/2)



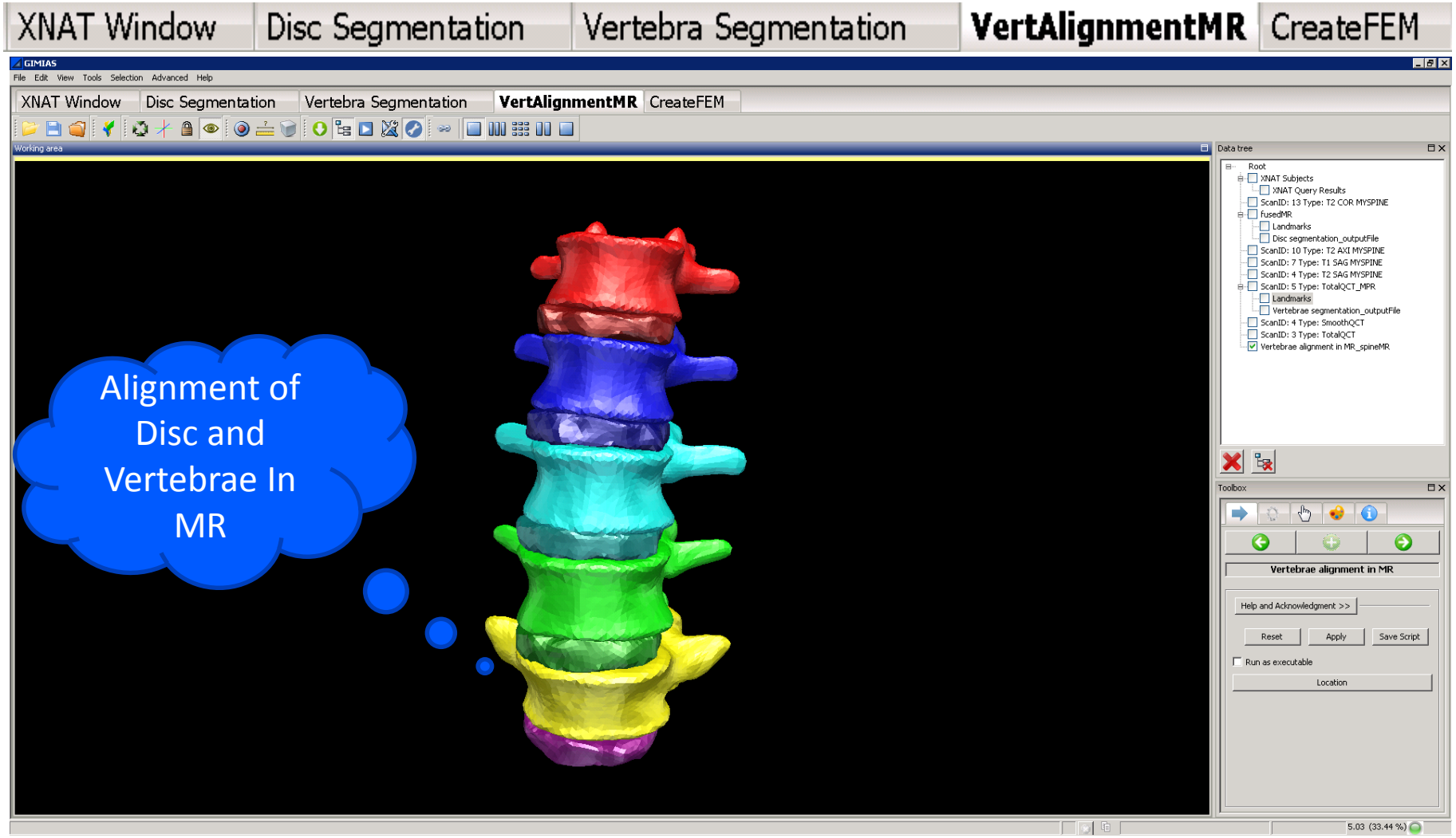
Connecting to MySpine@VPH-Share



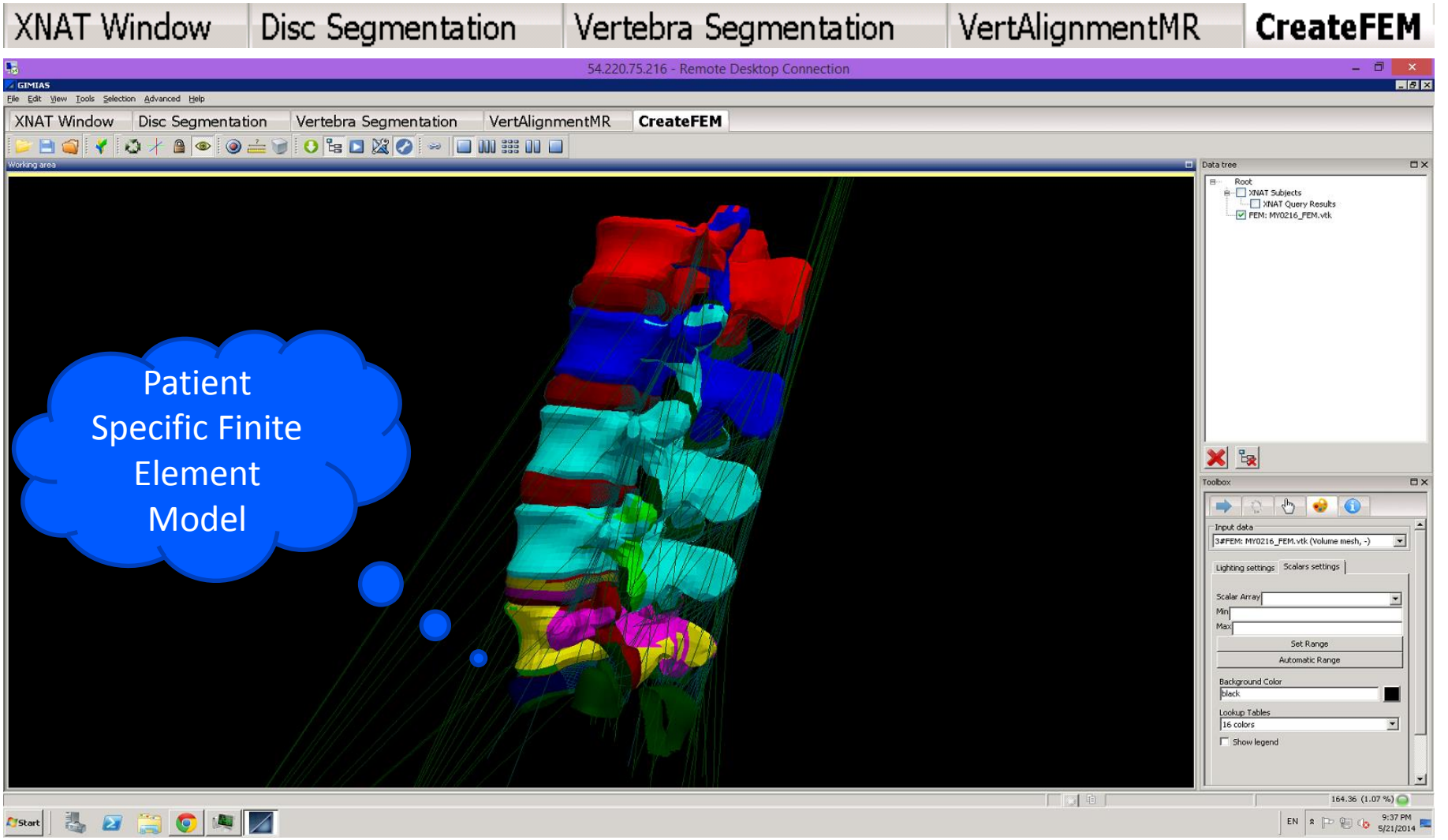
MySpine VM: Vertebra Segmentation



MySpine VM: MR/CT Alignment

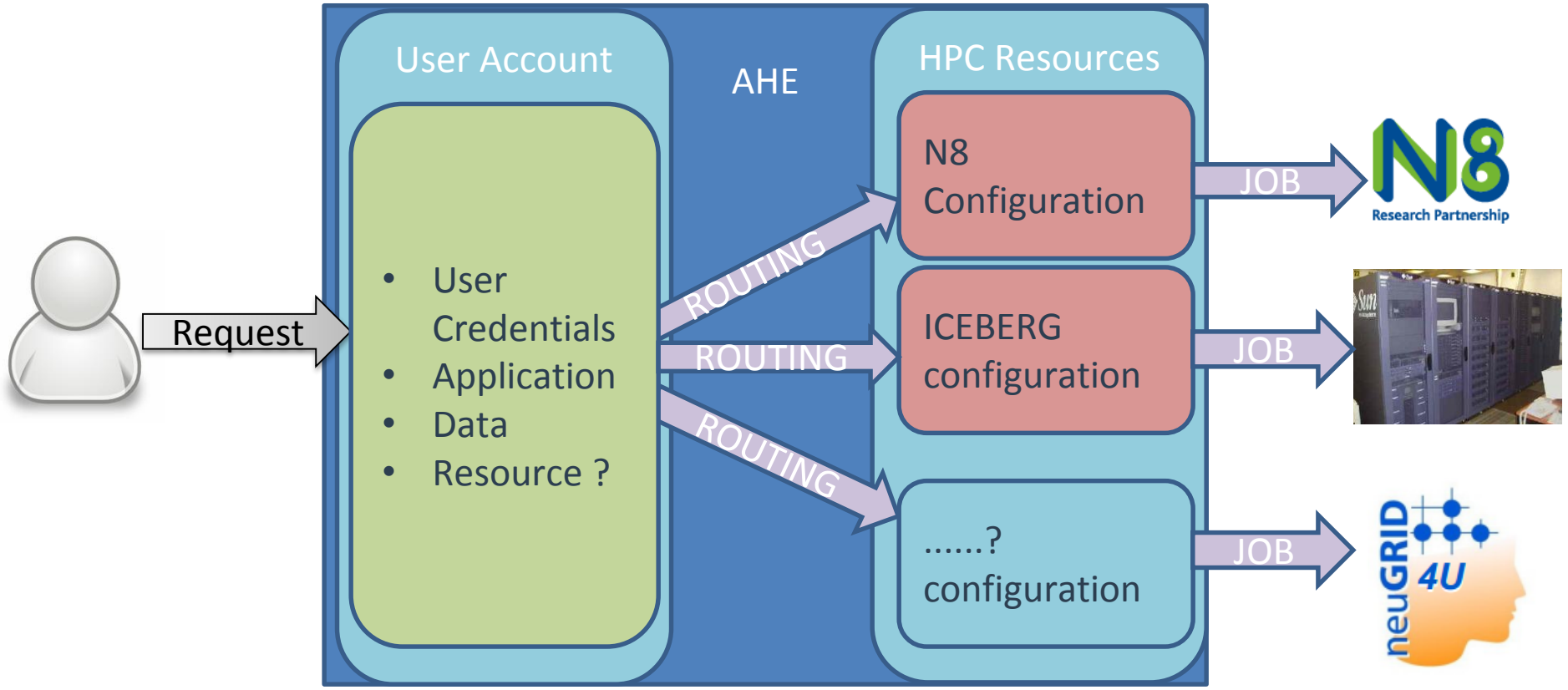


MySpine VM: FEM Generation



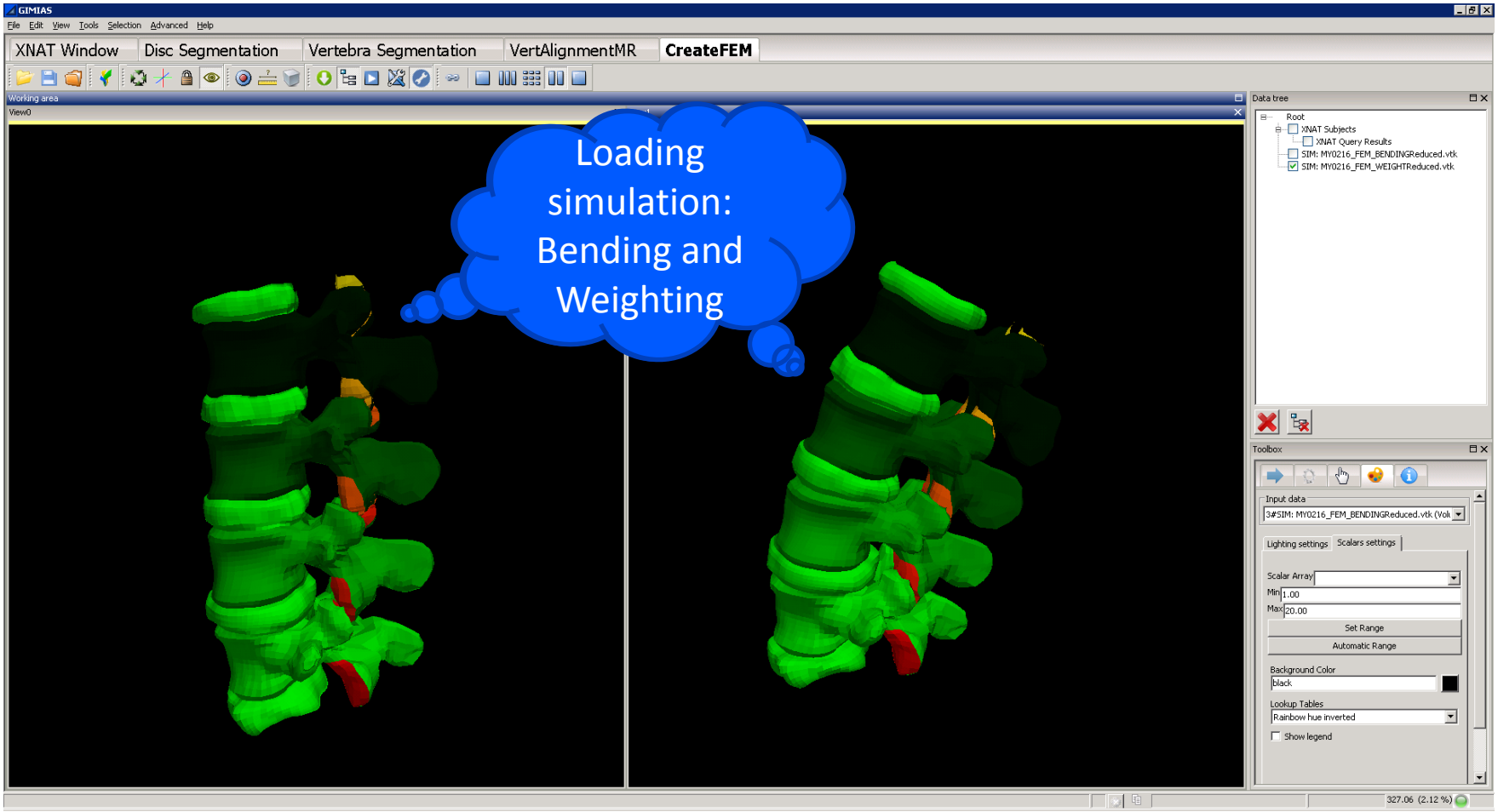
MySpine Workflow: Simulation on HPC

- Application Hosting Environment (AHE)



MySpine VM:

Visual Assessment of Simulation Outcomes



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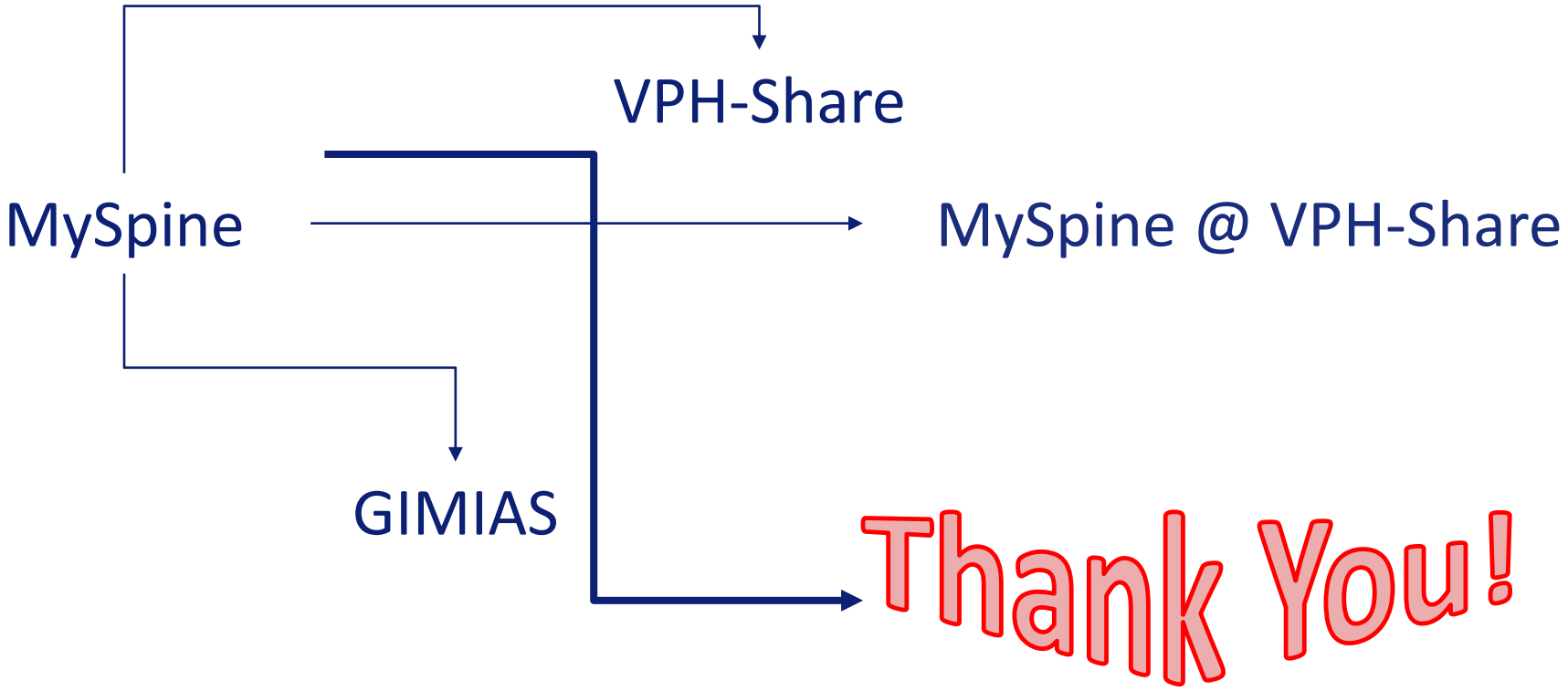

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