
Recent and Future Activities in HPC and Scientific Data Management

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<http://www.par.univie.ac.at>

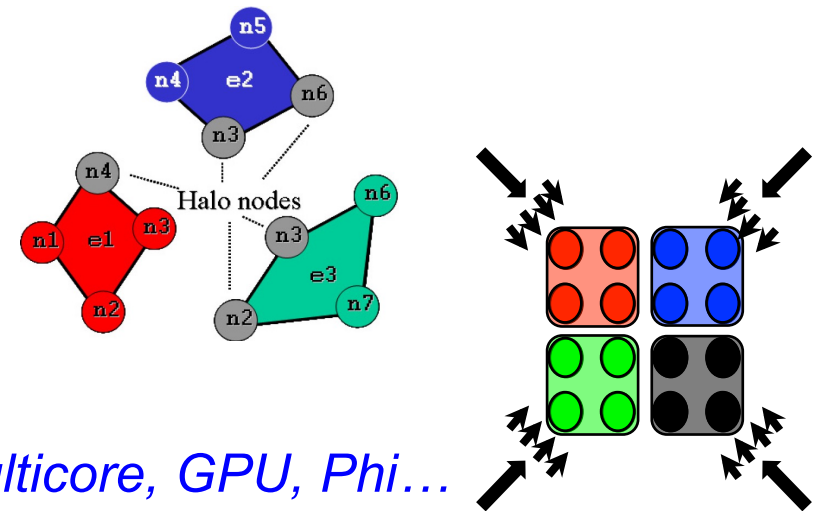


Research Group Scientific Computing

One of twelve research groups at the Faculty of Computer Science, University of Vienna.

Parallel Computing / HPC

- Programming Models and Languages
- Compiler and Runtime Technologies
- Programming Environments and Tools

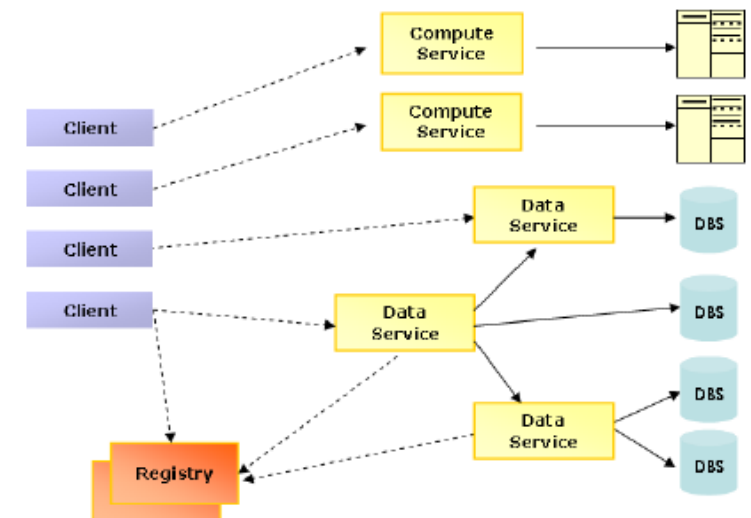


Vienna Fortran, HPF+, Hybrid Programming, Multicore, GPU, Phi...

Grid/Cloud/Big Data

- Compute and Data Services
- Semantic Data Integration
- Big Data and HPC

Vienna Cloud Environment, VPH-Share, ...



Recent Research Projects

- **PEPPHER**, Performance Portability and Programmability for Heterogeneous Many-core Architectures
European Commission, FP7, 2010-2014, **Coordinator**
- **VPH-SHARE**, Virtual Physiological Human - Sharing for Healthcare,
European Commission, FP7, 2011-2015
- **AutoTune** - Automatic Online Tuning,
European Commission, FP7, 2011-2015
- **RETIDA** - Real-Time Data Analytics for the Mobility Domain,
FFG, 2014-2017

EU Project PEPPHER

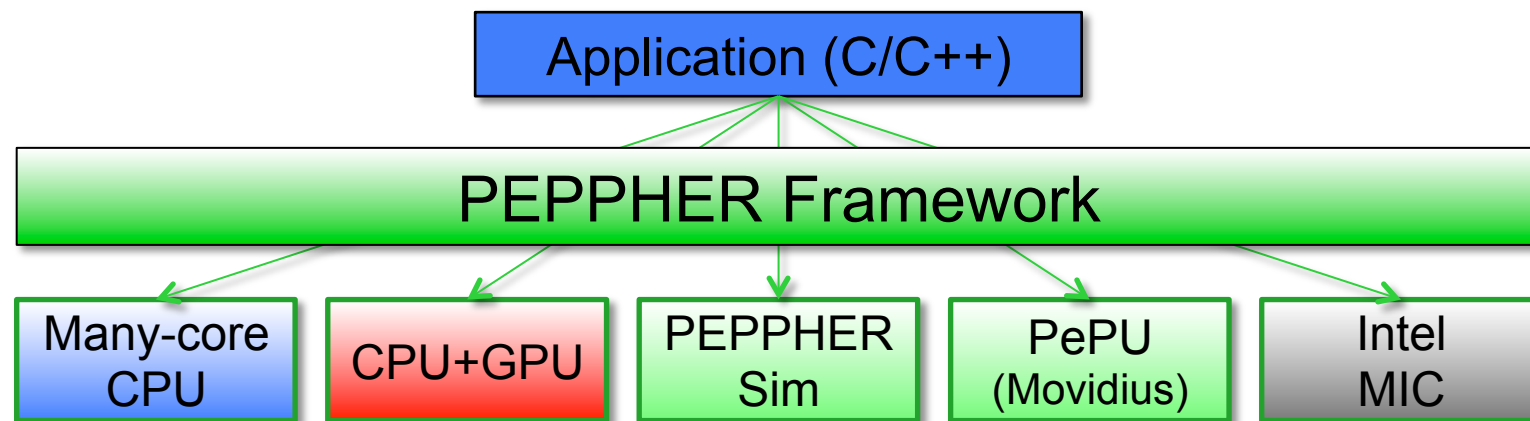
<http://www.peppher.eu>

Performance Portability & Programmability for Heterogeneous Many-Core Architectures

- FP7 ICT, Computing Systems; 2010-2014
- Partners: UNIVIE, INRIA, LIU, Intel, Movidus, Codeplay, KIT, Chalmers, TUW

Methodology & framework for development of performance portable code

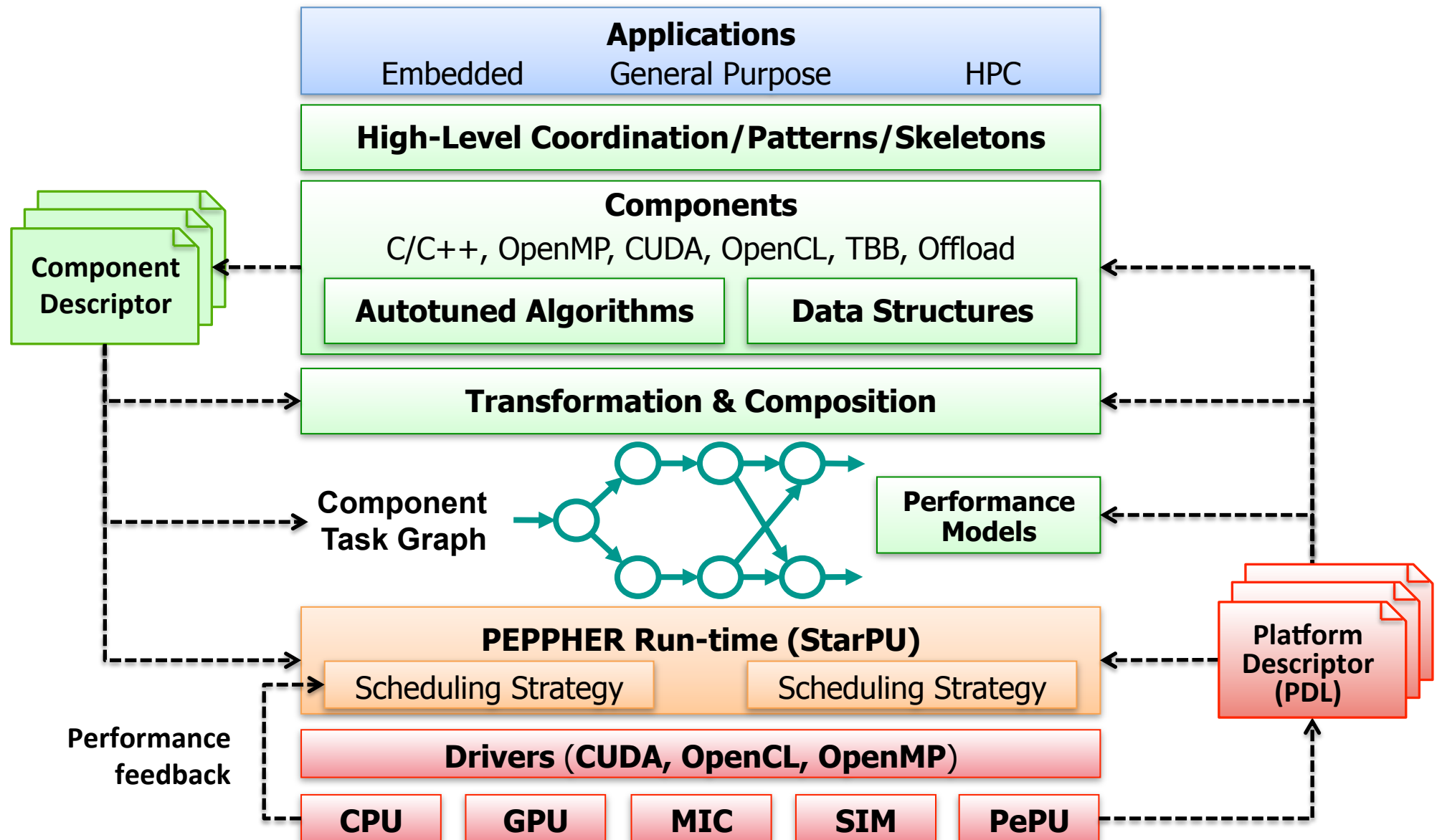
- Execute same application efficiently on different heterogeneous architectures
- Support real hybrid execution to exploit all available computing units



Focus: **Single-node** heterogeneous architectures

PEPPHER Framework

<http://www.peppher.eu>



The AutoTune Project

<http://www.autotune-project.eu>

- FP7 ICT, Computing Systems; 42 months, 2011-2015
- Partners: TUM, UAB, CAPS, LRZ, ICHEC, UVIE



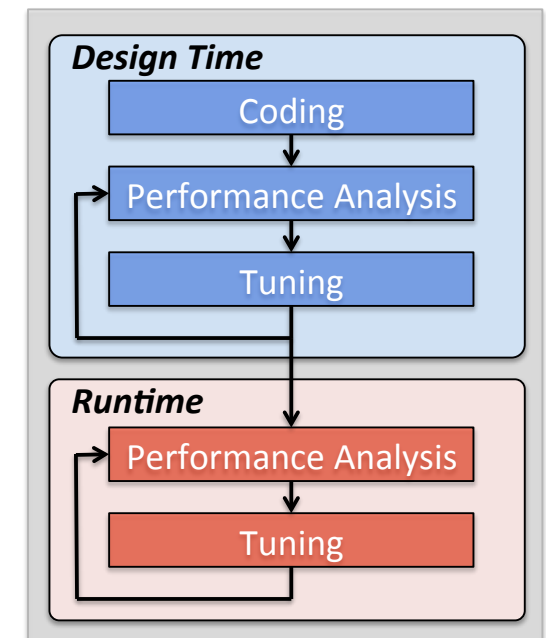
Combine performance analysis and tuning into single framework.

☞ Periscope Tuning Framework (PTF)

Extend Periscope with automatic tuning plugins for **performance** and **energy efficiency** tuning.

Execute whole tuning process **online** (performance analysis and tuning during single application run).

Use **expert knowledge** to guide search for performance properties and tuned versions.



Periscope Tuning Framework (PTF)

Parallel architectures

- Multicore servers
- Supercomputers (SuperMUC)
- Accelerated systems (GPU, Xeon Phi)

Programming paradigms

- MPI, MPI/OpenMP
- OpenCL/CUDA
- Parallel Patterns (PEPPHER)

Tuning (at) Different Layers of SW Stack

- High-level language (directives/annotations)
- Compilers / Transformation systems
- Runtime systems and libraries
- Operating system

Developed Tuning Plugins

- MPI Parameter Tuning
- Pipeline Patterns for CPU/GPU
- DVFS Plugin
- Compiler Flags Selection
- MPI Master/Worker Tuning
- OpenCL Worksize Tuning

PTF available as open source:

- <http://periscope.in.tum.de/releases/latest/tar/PTF-latest.tar.bz2>



Virtual Physiological Human: Sharing for Healthcare

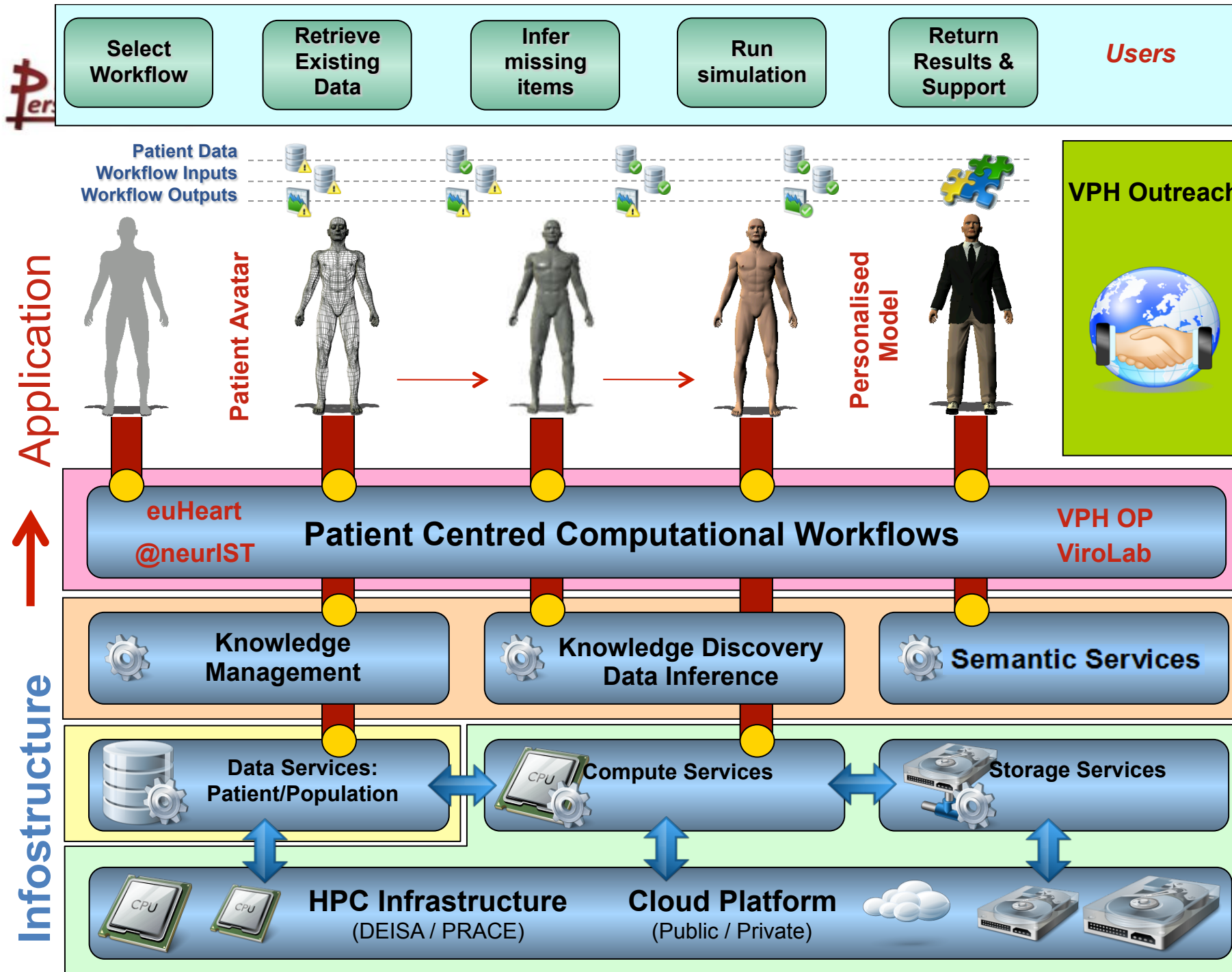
(European Commission, FP7, 2011-2015, Coordinator: The University of Sheffield)

VPH-Share developed a **Cloud *infrastructure*** to facilitate integration of/ access to...

- **Patient data** across different systems, hospitals, countries ...
- **Information/models** related to various parts and processes of human body
- **Knowledge** (guidelines, standards, protocols in research and clinical practice)

Specific requirements

- **Complex, distributed, heterogeneous data** (multi-scale, multi-modal)
- **Sensitive data** (security, privacy, legal issues, data quality)
- **Specialized analytics** to integrate bioinformatics and systems biology information with clinical observations



VPH-Outreach

Project No: 269978

Co-ordinator:
University of
Sheffield, UK
Partners:

CYFRONET, PL
Sheffield Teaching
Hospitals, UK
ATOS Origin, ES
Kings College
London, UK
Universitat Pompeu
Fabra, ES
Empirica, DE
SCS SRL, IT
NHS IC, UK
INRIA, FR
IOR, IT
Open Univ., UK
Philips Elec., NL
TU Eindhoven, NL
Univ. Auckland, NZ
Uv Amsterdam, NL
UCL, UK
Univ. Vienna, AT
AATRM, ES
FCRB, ES

VPH Outreach



European Commission
Information Society and Media



VPH-Share Data Management

Data Publication Suite

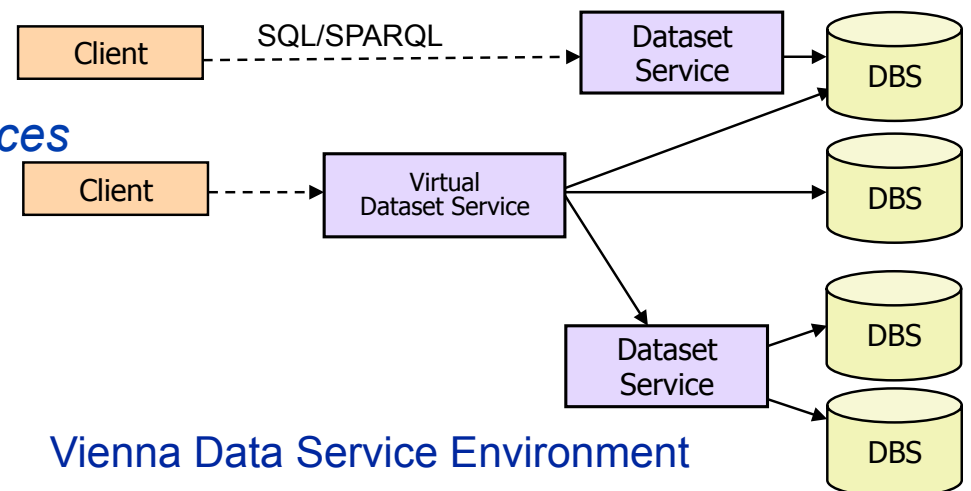
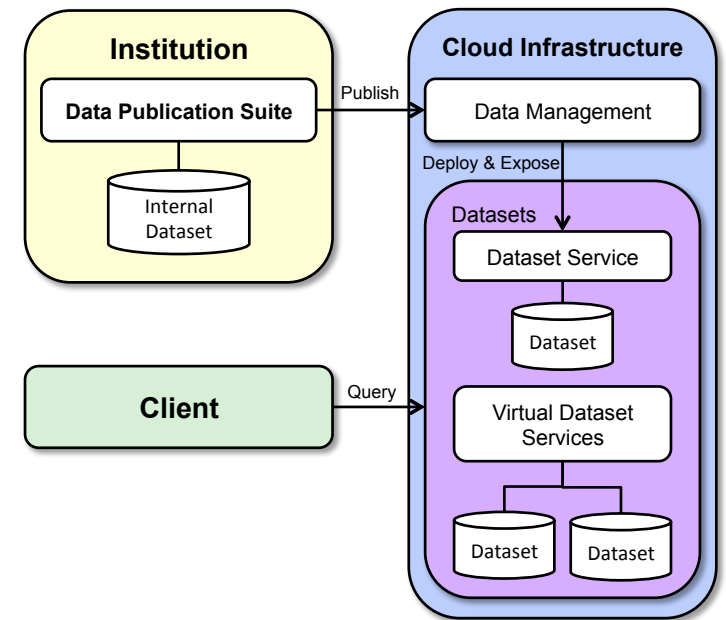
- select & annotate data with semantic concepts,
- de-identify selected data items
- expose data as Cloud services

Data Service Environment (VDSE)

- based on Vienna Cloud Environment (VCE)
- provision of data sets (RDBs) as Cloud services
- access via SQL or SPARQL
- provide on-demand *customized views*
- federation across multiple data sets
- preserve *autonomy of underlying data sources*

Semantic mechanisms

- to discover, link and search data



Vienna Data Service Environment

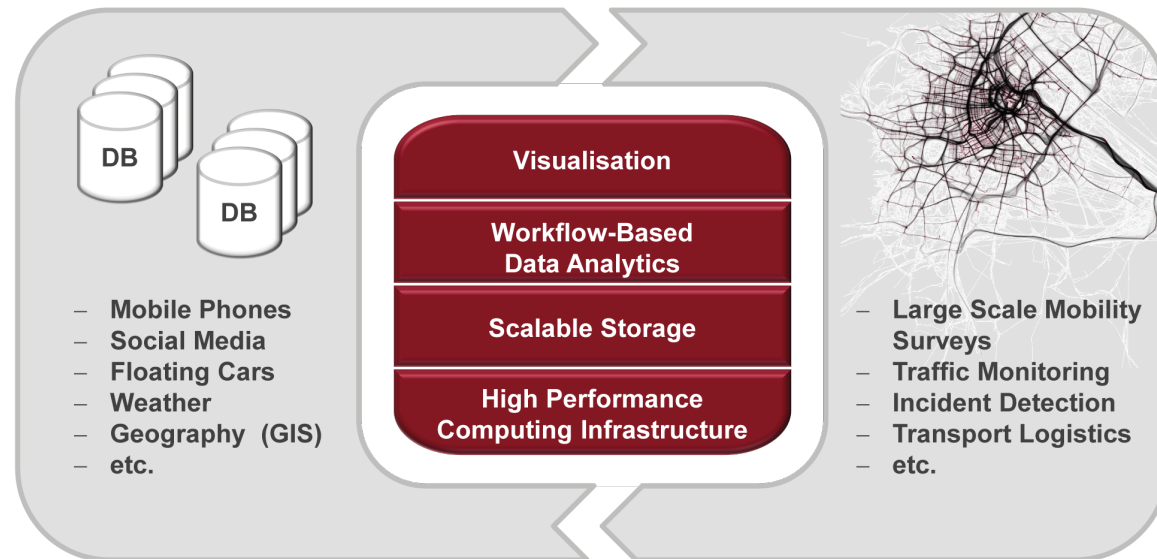
VPH-Share Data Publication Suite

The screenshot displays the VPH-Share Data Publication Suite interface, which is a web-based application for managing and publishing clinical data. The interface is divided into several main sections:

- Top Menu:** Includes "File", "Window", and "Help" options.
- Sources Panel (Left):** Contains a tree view of data sources under the "PVP" category. The sources listed are: SF36 (Medical outcomes stud), tblAnalgesiaScore (Pain Ther), tblOswestryDisability (Oswestr), tblPatientData (Patient), tblPatientNotes (Note), tblProcedure (Procedure), tblRecall (Patient recall proces), tblReferral (Referral), tblSymptoms (Symptoms), and tblSymptomsRef.
- Destinations Panel (Left):** Contains a tree view of data destinations under the "PVP" category. The destinations listed are: SF36, tblAnalgesiaScore, tblOswestryDisability, tblPatientData, tblPatientNotes, tblProcedure, tblRecall, tblReferral, tblSymptoms, and tblSymptomsRef.
- tblSymptoms - Relationships Panel (Center):** Displays a diagram showing the relationships between data tables. The tables shown are:
 - tblReferral:** Contains attributes: Osteoporosis, OtherSymptoms, OtherSymptomsNotes, OtherSymptomsOnsetDate, PatientType, PatSerial, PercentPredicted, ReferralID, ReferralStatus, ThoracicCollapse, Treatment, VertebraPlanaSite1, VertebraPlanaSite2, VertebraPlanaSite3, and Weight.
 - tblSymptoms:** Contains attributes: PatSerial, ReferralID, SymptomID, and SymptomRefID.
 - tblSymptomsRef:** Contains attributes: InUse, Symptom, SymptomID, and Type.Relationships are indicated by lines connecting the tables, with cardinalities (1, 1) shown at the ends of the lines.
- Ontology Search Panel (Right):** Includes a search bar with the text "patient" and a "Search" button. Below the search bar, it shows the results: "Returned results: 553 (71.7 seconds)". The search results are displayed as a list of ontology entries, each with a title and a description:
 - Patient:** Health Level Seven
 - patient:** Health Level Seven. Description: A Role of a LivingSubject (player) as a recipient of health care services from a healthcare provider (scoper).
 - Patient:** Health Level Seven. Description: A specimen that has been collected from a patient.
 - Patient:** Health Level Seven. Description: The recipient for the service(s) and/or product(s) when they are not the covered party.
 - Patient:** NCI Thesaurus. Description: A person who receives medical attention, care, or treatment, or who is registered with medical professional or institution with the purpose to receive medical care when necessary.

Real-time data analytics for the mobility domain

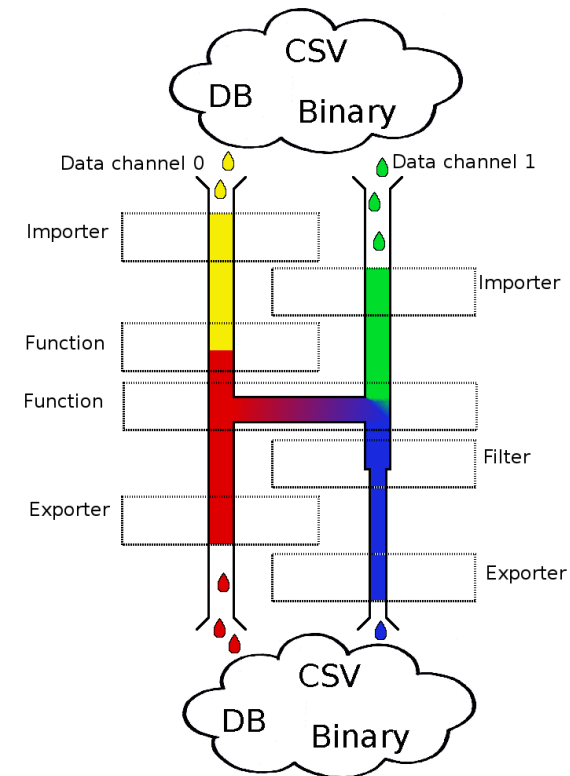
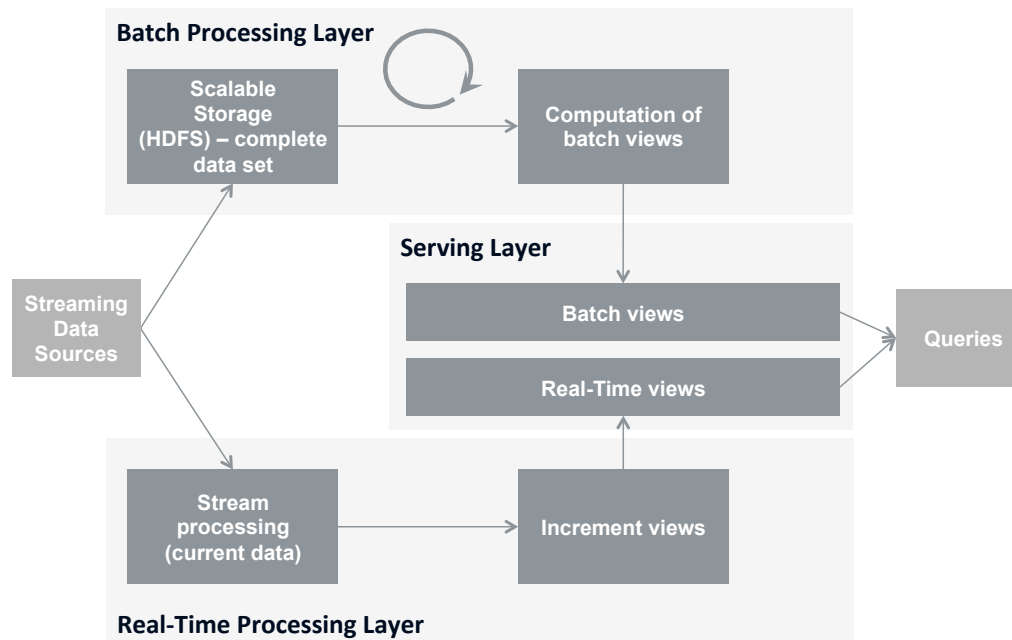
Austrian FFG, ICT of the Future, 2014-2016



- Real-time integration and analytics of large-scale heterogeneous data sources mobile phone data, floating car data, GIS, weather, social media, ...
- Massively parallel, adaptive execution of generic data analytics workflows support for heterogeneous architectures (GPUs, Xeon Phi, ...)
- Application-specific visualizations

RETIDA

<https://dts.ait.ac.at/projects/retida/>



Hadoop-based lambda architecture

- scalable and fault-tolerant processing
- real-time vs. batch

High performance data pipeline

- C++ re-configurable framework
- real-time processing capabilities

Future Research

- Programming Support for Big Data Applications
- Taking Advantage of Heterogeneous Architectures
- Streaming and Real-Time Support
- Runtime systems for Big Data Applications
- Cloud-based Scientific Data Management (VDSE)