Introduction to VI-HPS

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Virtual Institute – High Productivity Supercomputing

- **Goal**: Improve the quality and accelerate the development process of complex simulation codes running on highly-parallel computer systems
- Start-up funding (2006–2011) by Helmholtz Association of German Research Centres
- Activities
  - Development and integration of HPC programming tools
    - Correctness checking & performance analysis
  - Academic workshops
  - Training workshops
  - Service
    - Support email lists
    - Application engagement

http://www.vi-hps.org

VI-HPS partners (founders)

Forschungszentrum Jülich
- Jülich Supercomputing Centre

RWTH Aachen University
- Centre for Computing & Communication

Technische Universität Dresden
- Centre for Information Services & HPC

University of Tennessee (Knoxville)
- Innovative Computing Laboratory

VI-HPS partners (cont.)

Barcelona Supercomputing Center
- Centro Nacional de Supercomputación

Lawrence Livermore National Lab.
- Center for Applied Scientific Computing

Technical University of Darmstadt
- Laboratory for Parallel Programming

Technical University of Munich
- Chair for Computer Architecture

University of Oregon
- Performance Research Laboratory

University of Stuttgart
- HPC Centre

## University of Versailles St-Quentin
- LRC ITACA

Allinea Software Ltd

Productivity tools

- **MUST & ARCHER**
  - MPI usage correctness checking & OpenMP race detection
- **PAPI**
  - Interfacing to hardware performance counters
- **Periscope**
  - Automatic analysis via an on-line distributed search
- **Scalasca**
  - Large-scale parallel performance analysis
- **TAU**
  - Integrated parallel performance system
- **Vampir**
  - Interactive graphical trace visualization & analysis
- **Score-P**
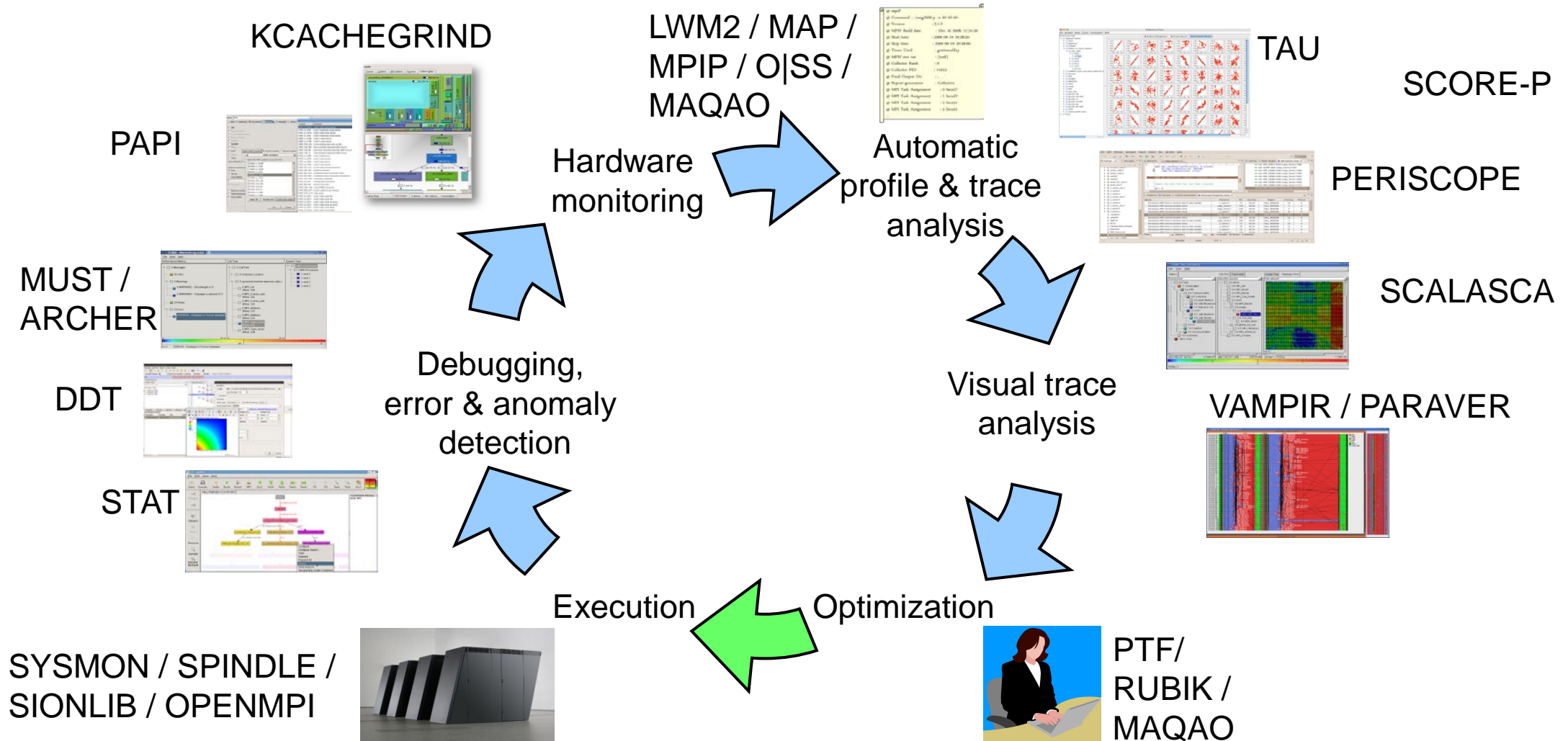 - Community-developed instrumentation & measurement infrastructure

For a brief overview of tools consult the VI-HPS Tools Guide:
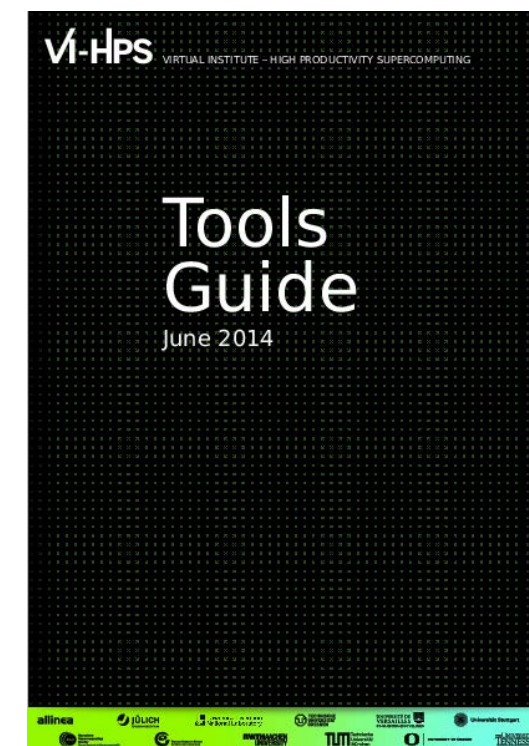
Productivity tools (cont.)

- **DDT/MAP/PR**: Parallel debugging, profiling & performance reports
- **Extra-P**: Automated performance modelling
- **Kcachegrind**: Callgraph-based cache analysis [x86 only]
- **MAQAO**: Assembly instrumentation & optimization [x86-64 only]
- **mpiP/mpiPview**: MPI profiling tool and analysis viewer
- **Open MPI**: Integrated memory checking
- **Open|SpeedShop**: Integrated parallel performance analysis environment
- **Paraver/Dimemas/Extrae**: Event tracing and graphical trace visualization & analysis
- **Rubik**: Process mapping generation & optimization [BG only]
- **SIONlib/Spindle**: Optimized native parallel file I/O & shared library loading
- **STAT**: Stack trace analysis tools
- **SysMon**: Batch system monitor plugin for Eclipse PTP

Technologies and their integration

KCACHEGRIND

LWM2 / MAP / MPIP / O|SS / MAQAO

TAU

SCORE-P

PAPI

Hardware monitoring

Automatic profile & trace analysis

PERISCOPE

MUST / ARCHER

SCALASCA

DDT

Debugging, error & anomaly detection

Visual trace analysis

VAMPIR / PARAVER

STAT

Execution   Optimization

SYSMON / SPINDLE / SIONLIB / OPENMPI

PTF/ RUBIK / MAQAO

Disclaimer

Tools will *not* automatically make you, your applications or computer systems more productive.

However, they can help you understand *how* your parallel code executes and *when / where* it's necessary to work on correctness and performance issues.

VI-HPS training & Tuning Workshops

- Goals
  - Give an overview of the programming tools suite
  - Explain the functionality of individual tools
  - Teach how to use the tools effectively
  - Offer hands-on experience and expert assistance using tools
  - Receive feedback from users to guide future development
- For best results, bring & analyze/tune your own code(s)!

- VI-HPS Hands-on Tutorial series
  - SC'08/09/10/11/13/14/15, ICCS'09, Cluster'10, EuroMPI'12/14, XSEDE'13, ISC-HPC'15
- VI-HPS Tuning Workshop series
  - 2008 (Aachen & Dresden), 2009 (Jülich & Bremen), 2010 (Garching & Amsterdam/NL),
    2011 (Stuttgart & Aachen), 2012 (St-Quentin/F & Garching), 2013 (Saclay/F & Jülich)
    2014 (Barcelona/Spain, Kobe/Japan, Saclay/France, Edinburgh/UK)
    2015 (Stuttgart & Grenoble/France & Santiago/Chile)

Upcoming events

- 21st VI-HPS Tuning Workshop (LRZ, Garching/Munich, Germany, 18-22 Apr 2016)
  - Using *SuperMUC#2* Lenovo NeXtScale Xeon 'Haswell' Linux cluster
  - Tools from 9 partners, including first appearance of Extra-P & Open|SpeedShop
- 22nd VI-HPS Tuning Workshop (CINES, Montpellier, France, 23-27 May 2016)
  - Using *Occigen* Bull Xeon 'Haswell' Linux Cluster
  - Score-P, Scalasca, Vampir, TAU and MAQAO

- Further events to be determined
  - (one-day) tutorials: with guided exercises sometimes using a Live-ISO/OVA
  - (multi-day) training workshops: with your own applications on actual HPC systems

- Check **www.vi-hps.org/training** for announced events
- Contact us if you might be interested in hosting an event

VI-HPS Linux Live ISO/OVA

- Bootable Linux installation on DVD (or USB memory stick)
- Includes everything needed to try out our parallel tools
  on an 64-bit x86-architecture notebook computer
  - VI-HPS tools: Score-P, Periscope, Scalasca, TAU, Vampir*
  - Also: Eclipse/PTP, DDT*, MUST, PAPI, TotalView*
    * evaluation licences provided for commercial products
      (limited time/capability)
  - GCC (w/ OpenMP), OpenMPI
  - Manuals/User Guides
  - Tutorial exercises & examples
- Produced by U. Oregon PRL
  - Sameer Shende

VI-HPS Linux Live ISO/OVA

- ISO image approximately 5GB, OVA approximately 12GB
  - download latest version from website
  - **http://www.vi-hps.org/training/live-iso/**
  - optionally create bootable DVD or USB drive
- Boot directly from disk
  - enables hardware counter access and offers best performance, but no save/resume
- Boot within virtual machine (e.g., VirtualBox)
  - faster boot time and can save/resume state,
    but may not allow hardware counter access
- Boots into Linux environment for HPC
  - supports building and running provided MPI and/or OpenMP parallel application codes
  - and experimentation with VI-HPS (and third-party) tools