Virtual Institute – High Productivity Supercomputing

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.)

Arm Ltd.
- Allinea Software

Barcelona Supercomputing Center
- Centro Nacional de Supercomputación

Lawrence Livermore National Lab.
- Center for Applied Scientific Computing

Leibniz Supercomputing Centre

Technical University of Darmstadt
- Laboratory for Parallel Programming

VI-HPS partners (cont.)

Friedrich-Alexander-Universität
- Erlangen Regional Computing Center (RRZE)

Technical University of Munich
- Chair for Computer Architecture

University of Oregon
- Performance Research Laboratory

University of Stuttgart
- HPC Centre

University of Versailles St-Quentin
- Li-Parad

Productivity tools

- **MUST & Archer**
  - MPI & OpenMP usage correctness checking
- **PAPI**
  - Interfacing to hardware performance counters
- **Periscope Tuning Framework**
  - Automatic analysis and Tuning
- **Scalasca**
  - Large-scale parallel performance analysis
- **TAU**
  - Integrated parallel performance system
- **Vampir**
  - Interactive graphical trace visualization & analysis
- **Score-P**
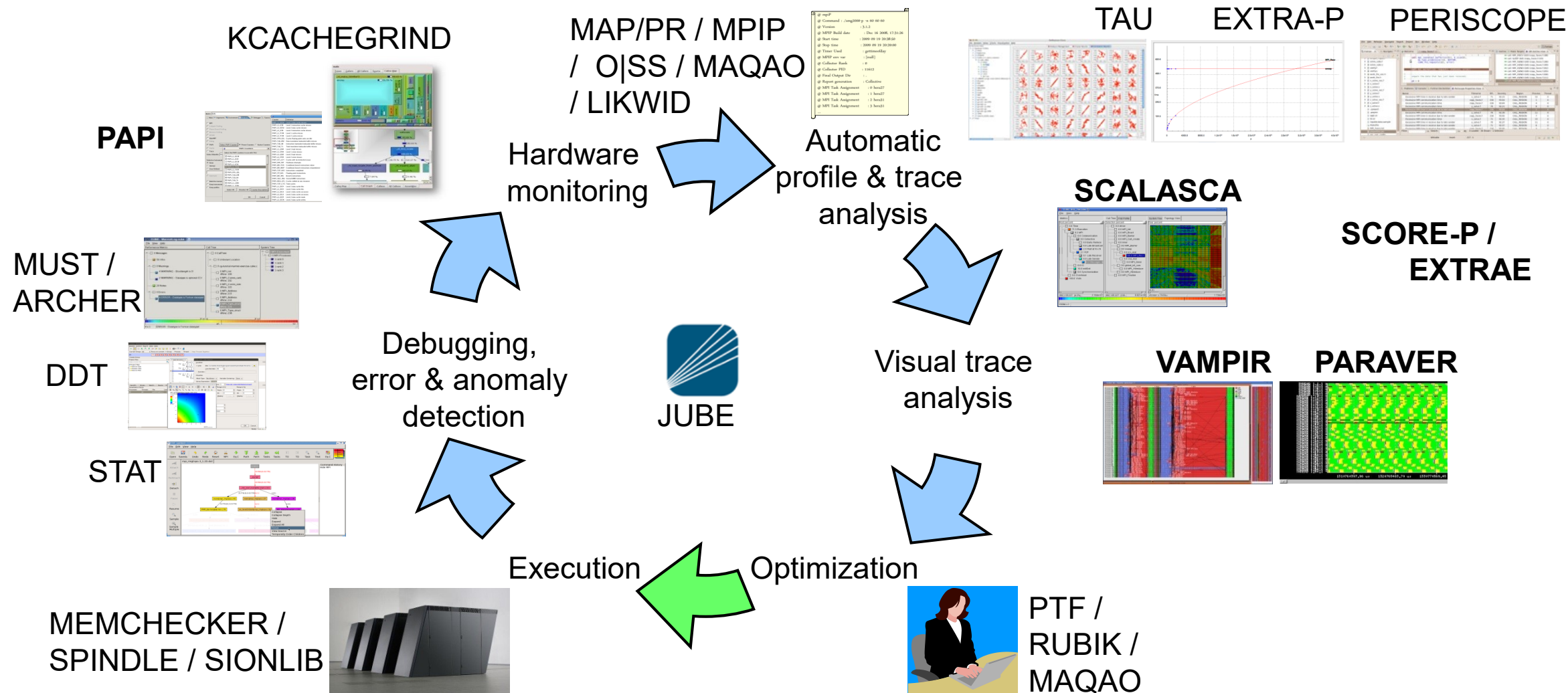 - Community-developed instrumentation & measurement infrastructure

For a brief overview of tools consult the VI-HPS Tools Guide:

VI-HPS VIRTUAL INSTITUTE – HIGH PRODUCTIVITY SUPERCOMPUTING

Tools Guide
November 2020

Productivity tools (cont.)

- **FORGE DDT/MAP/PR**: Parallel debugging, profiling & performance reports
- **Extra-P**: Automated performance modelling
- **Kcachegrind**: Callgraph-based cache analysis [x86 only]
- **JUBE**: Workflow execution environment
- **LIKWID**: Command-line performance tools suite
- **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, 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

Technologies and their integration

KCACHEGRIND

MAP/PR / MPIP / O|SS / MAQAO / LIKWID

TAU   EXTRA-P   PERISCOPE

PAPI

Hardware monitoring

Automatic profile & trace analysis

SCALASCA

SCORE-P / EXTRAE

MUST / ARCHER

Debugging, error & anomaly detection

JUBE

Visual trace analysis

VAMPIR   PARAVER

DDT

STAT

Execution   Optimization

MEMCHECKER / SPINDLE / SIONLIB

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'08-11/13/14/15/16/17/19, ICCS'09, Cluster'10, EuroMPI'12/14, XSEDE'13, ISC-HPC'15-19
- VI-HPS Tuning Workshop series
  - 2008 (x2), 2009 (x2), 2010 (x2), 2011 (x2), 2012 (x2), 2013 (x2), 2014(x4), 2015(x3)
  - 2016 (Kobe/Japan, Garching/Germany, Cambridge/UK, Livermore/USA)
  - 2017 (Southampton/UK, Aachen/Germany, Bruyères-le-Châtel/France)
  - 2018 (Garching/Germany, London/UK, Reims/France)
  - 2019 (Barcelona/Spain, Knoxville/USA, Bristol/UK, Jülich/Germany)
  - 2020 (EPCC/Scotland / Online, HLRS/Germany / Online, CINECA/Italy / Online, CSC/Germany / Online)

VI-HPS Tuning Workshop series
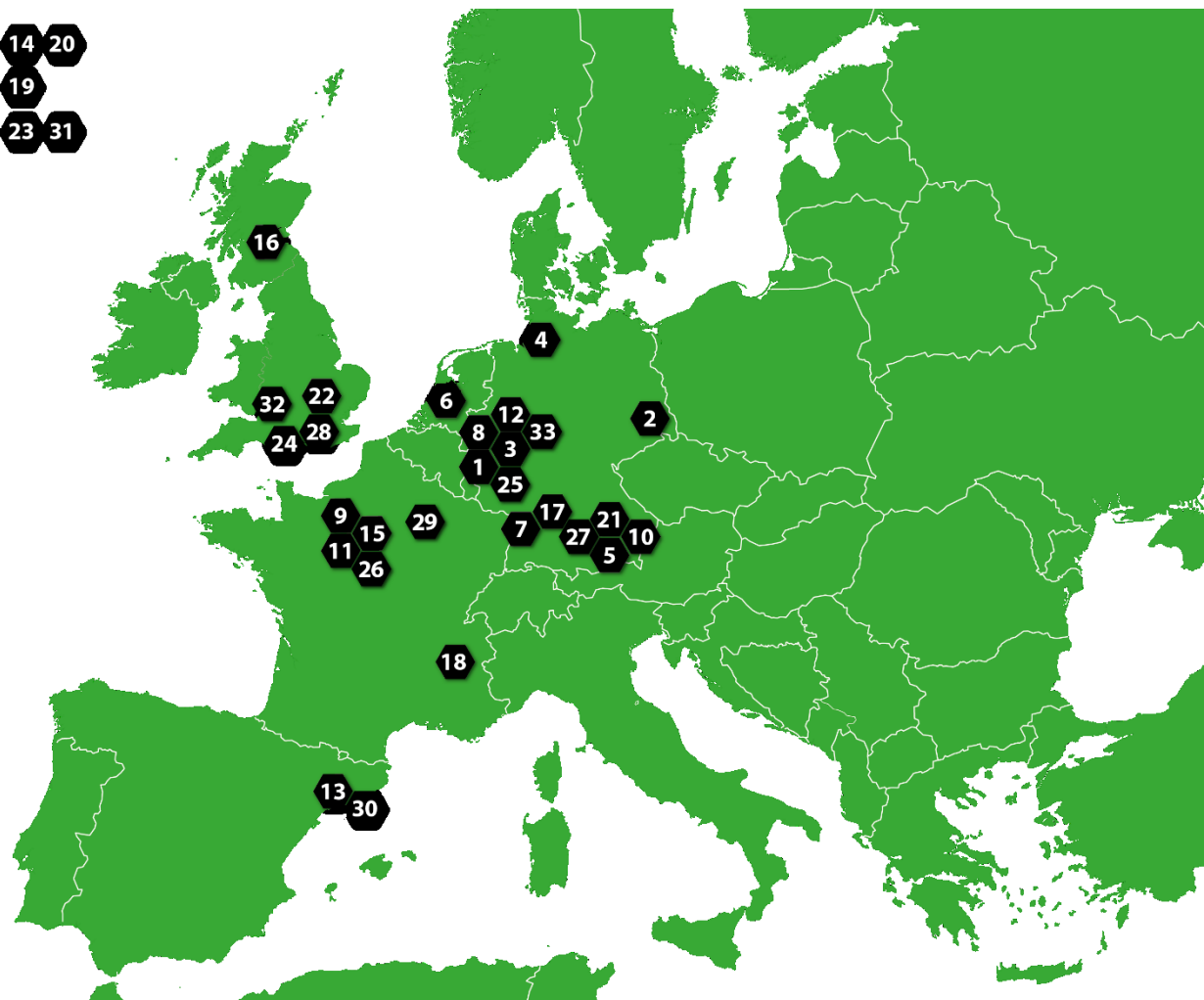
1.	2008/03/05+3:	RWTH, Aachen, Germany
2.	2008/10/08+3:	ZIH, Dresden, Germany
3.	2009/02/16+5:	JSC, Jülich, Germany
4.	2009/09/09+3:	HLRN, Bremen, Germany
5.	2010/03/08+3:	TUM, Garching, Germany
6.	2010/05/26+3:	SARA, Amsterdam, Netherlands
7.	2011/03/28+3:	HLRS, Stuttgart, Germany
8.	2011/09/05+5:	GRS, Aachen, Germany
9.	2012/04/23+5:	UVSQ, St-Quentin, France
10.	2012/10/16+4:	LRZ, Garching, Germany
11.	2013/04/22+4:	MdS, Saclay, France
12.	2013/10/07+5:	JSC, Jülich, Germany
13.	2014/02/10+5:	BSC, Barcelona, Spain
14.	2014/03/25+3:	RIKEN AICS, Kobe, Japan
15.	2014/04/07+4:	MdS, Saclay, France
16.	2014/04/29+3:	EPCC, Edinburgh, Scotland
17.	2015/02/23+5:	HLRS, Stuttgart, Germany
18.	2015/05/18+5:	UGA, Grenoble, France
19.	2015/10/27+3:	NLHPC, Santiago, Chile
20.	2016/02/24+3:	RIKEN AICS, Kobe, Japan
21.	2016/04/18+5:	LRZ, Garching, Germany
22.	2016/07/06+3:	Uni. Cambridge, England
23.	2016/07/27+3:	LLNL, Livermore, California, USA
24.	2017/02/08+3:	Uni. Southampton, England
25.	2017/03/27+5:	RWTH, Aachen, Germany
26.	2017/10/16+5:	Lab. ECR, Ter@tec, France
27.	2018/04/23+5:	LRZ, Garching, Germany
28.	2018/06/21+3:	UCL, London, England
29.	2018/10/15+5:	ROMEO, Reims, France
30.	2019/01/21+5:	BSC, Barcelona, Spain
31.	2019/04/09+4:	UTK-ICL, Knoxville/TN, USA
32.	2019/04/24+3:	Uni. Bristol, England
33.	2019/06/24+5:	JSC, Jülich, Germany
34.	2020/07/28+3:	EPCC, *Scotland* / ONLINE
35.	2020/09/14+5:	HLRS, *Germany* / ONLINE
36.	2020/09/30+3:	CINECA, *Italy* / ONLINE
37.	2020/12/07+5:	CSC, *Germany* / ONLINE
38.	2021/03/01+3:	NHR@FAU, *Germany* / ONLINE

Upcoming events

- Tuning Workshop (14-18 June 2021, LRZ, Germany – ONLINE)
- Hands-on tutorial at ISC-HPC'21 digital conference (27 June 2021, Frankfurt/Main, Germany)
- Tuning Workshop (TBD, JSC/RWTH, Germany - ONLINE)
  - Focus on GPU

- 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 a training event