SP7
HIGH PERFORMANCE COMPUTING PLATFORM
Human Brain Project
The Human Brain Project (HBP) is a European Commission Future and Emerging Technologies Flagship that aims to achieve a multi-level, integrated understanding of brain structure and function through the development and use of information and communication technologies (ICT). These technologies will enable large-scale collaboration and data sharing, reconstruction of the brain at different biological scales, federated analysis of clinical data to map diseases of the brain, and the development of brain-inspired computing systems.
The HBP is working to achieve an integrated, multi-level understanding of brain structure and function through the development and use of information and communication technologies (ICT). The HBP’s ICT Platforms will allow neuroscientists, clinical researchers and information technology developers to perform diverse experiments and share knowledge, with a common goal of unlocking the most complex structure in the known universe. During the first two-and-a-half years (the Ramp-Up Phase), the HBP will collect strategic data, develop theoretical frameworks and perform the development work necessary to make the six ICT Platforms available for use by the scientific community in the Operational Phase. The HBP’s ICT Platforms are:

- **Neuromorphic Computing (ICT that mimics the functioning of the brain)**
- **Neuroinformatics (a data repository, and simulations of brains and brain components)**
- **Brain Simulation (building ICT models including brain atlases)**
- **Neurorobotics (testing brain models and simulations in virtual environments)**
- **High Performance Computing (this platform will support the other Platforms)**
- **Operational Objectives**

The HBP was launched in 2013 and brings together more than 100 academic and corporate Partners in more than 20 countries. HBP research is organised into twelve Subprojects (SP), each broken down into work packages (WP) and tasks (T), with well-defined goals and milestones. Six Subprojects are building the ICT Platforms, while the other six are gathering data, clarifying theory and controlling ethical aspects. An additional Subproject manages and coordinates the HBP.

With an unprecedented cross-disciplinary scope, the HBP’s goal is to catalyse a global collaborative effort to understand the human brain and its diseases and, ultimately, to emulate its computational capabilities.

The overall goal of the High Performance Computing Platform Subproject is to provide the Human Brain Project (HBP) Consortium with the broader European neuroscience community with supercomputing, big data and cloud capabilities at the exascale, as well as the system software, middleware, interactive computational steering and visualisation support necessary to create and simulate multi-scale brain models and address the hard-scaling challenges of whole-brain modelling. SP7 is using innovative High Performance Computing (HPC) technology as detailed in the Exascale Roadmap of the Strategic Research Agenda (SRA) of the European Technology Platform for High Performance Computing (ETP4HPC). In order to meet the specific challenging requirements of the HBP, the Subproject is performing additional specific research in hardware and software, thus contributing to path-breaking information and communication technology (ICT) research. Key research topics include the use of novel accelerator technologies to address highly scalable computational challenges, the use of hierarchical storage-class memory to increase available memory by more than an order of magnitude per core, and the realisation of interactive supercomputing at the exascale level—in particular, interactive computational steering, visualisation and big data integration.

The HBP hardware roadmap is aligned with the ETP4HPC roadmap and requires the exploitation of innovative energy-efficient technologies complemented by brain-inspired computing. The major objective of SP7 for the Ramp-Up Phase is to establish the HBP High Performance Computing Platform and make it available to the Consortium by Month 18, and to groups from outside the Consortium by Month 30.

In the Ramp-Up Phase, the HBP is negotiating with the PRACE Tier-0 organisations GCS and GENCI, which have expressed interest in adding in-kind support to the HPC Platform. The plan is to complement the resources for specific simulators as virtual robotics and conceptual brain models. A further high-priority goal is to establish a PRACE community access programme. This will allow access to the Tier-0 capability of the HPC Platform, reviewed by the HBP’s International Access Board, via PRACE services. Formal agreements with PRACE that will benefit both sides are being established during the Ramp-Up Phase.

A second, equally important goal, is to prepare the procurement of the HBP pre-exascale-supercomputer. By 2017/18, Jülich plans to procure a pre-exascale supercomputer with a peak performance up to 50 petaFLOPS (floating point operations per second) and a memory capability of up to 20 petabytes (PB). The exascale and computational speed of the machine will be sufficient to simulate a realistic mouse brain and to develop first-draft models of the human brain. The rest of the hardware roadmap targets an exascale machine in 2021/2022 with a capability of 1 exaFLOPS and a hierarchical storage-class memory of 200 PB.
Finally, SP7 is researching and developing the system software and middleware needed for the Operational Phase. During the Ramp-Up Phase, these activities are being aligned with the ETP4HPC. Key research topics include the development of novel mathematical methods, programming models and tools, in situ analysis of multi-petabyte data sets, and real-time visualisation and visual computational steering of simulations. This novel kind of interactive supercomputing will become invaluable not just for brain simulation, but also for a broad range of other applications in the life sciences and elsewhere. The integration of hierarchical storage-class memory in software will boost big data analytics and will widely benefit the HPC community, providing resilience over millions of processing cores and communication devices. Mirror and checkpoint mechanisms exploiting the new capabilities will make it possible to move toward the final goal of system-wide virtualisation. The unprecedented scalability requirements of whole brain simulation will give a major boost to performance analysis and optimisation as well as to research into new numerical algorithms. Long-term, algorithmic research is expected to benefit from the novel capabilities of brain-inspired neuromorphic computing and communication.

As a general principle, HPC research in the HBP strives for Platform independence through the provision of high-level APIs for application codes, and for visualisation and steering middleware. This will be achieved through user-transparent programming paradigms, Platform-optimised libraries, and, in the long run, virtualisation of the entire system including the communication sub-systems. This approach will avoid the danger of technology lock-in.
Methodology

Building and simulating multi-level models of the complete human brain requires an exascale supercomputing infrastructure and a software environment with unprecedented capabilities for interactive computing and visualisation. It also requires a transparent, competitive Pre-Commercial Procurement (PCP) process for the HBP pre-exascale supercomputer.

The High Performance Computing Platform. The HBP High Performance Computing Platform consists of a production-scale HBP Supercomputer at Forschungszentrum Jülich (Germany), a smaller software development system at CSCS in Lugano (Switzerland), a system for molecular-level simulations at Barcelona Supercomputing Center (Spain), and a system for massive data analytics at CINECA in Bologna (Italy). The four systems are connected via a dedicated communication network, allowing the Partners to share massive data sets ranging from petabytes to exabytes of data. Data storage for models and simulation results is provided locally at the centres. Cloud storage resources are provided in-kind by Karlsruhe Institute of Technology, which also contributes R&D work to complement these resources later on using other academic and commercial providers.

The capability roadmap for the HBP will meet the data integration requirements of brain modelling, which are memory-constrained. The capability provided by the High Performance Computing Platform in the Ramp-Up Phase will allow the Project to perform cellular level simulations on the scale of the rodent brain, using 200-400 terabytes of memory per simulation. Capacity assessment depends on many factors, such as which part of the brain is modelled and at which level of detail, and ultimately the protocol that is being applied: learning experiments require the calculation of minutes and hours of brain activity per experiment, while the validation of brain activity will require seconds to minutes. The number of experiments that can be accomplished is thus limited by the available capacity, similar to the operation of a telescope.
Driving the development of interactive supercomputing for brain research. The HBP’s HPC requirements focus on technology specific to neuroscience simulations such as interactive supercomputing and large memory. To meet these extraordinary requirements, it is critical that the HBP has access to and builds upon the most advanced HPC technology development efforts in Europe and world-wide, as defined in ETP4HPC’s Strategic Research Agenda, and drives the R&D of the required specific technology on the supply side.

Pre-Commercial Procurement. Public procurers can drive innovation by acting as technologically demanding first buyers. The HBP therefore sees Pre-Commercial Procurement (PCP) as the ideal instrument to arrive at innovative solutions meeting the specific needs of the Project and laying the technological basis for the subsequent procurement of the new machine. During the first month of the Project, SP7 laid out the legal requirements for a PCP in line with relevant European and national legislation, assessed risks and provided risk mitigation plans. The detailed plan for the PCP was presented in Month 2, after an in-depth analysis of the process requirements and timeline.

The HBP PCP is being conducted in three phases, following the completion of the pre-commercial tender in Month 9. The requirements specified in the tender take into account the specific needs of the HBP. In phase 1 (“Solution Exploration”, Month 10-Month 15), up to five competing companies and/or consortia (selected through the pre-commercial tender) will describe their proposed solutions in a high-level design document. The solutions explored in phase 1 will be evaluated in a transparent and fair process. After phase 1, up to three companies and/or consortia will be selected to continue their work in phase 2 (“Prototyping”, Month 16 - Month 21). This second phase will end with another evaluation. In phase 3 (“Test Series”, Month 22-Month 36), up to two different consortia will develop test systems, demonstrating the readiness of the developed technologies and their integration into a scalable HPC architecture for a representative set of HBP use cases. This phase will last until the end of the HBP Ramp-Up Phase in Month 36.

In the Operational Phase of the Project this will be followed by a commercial tendering process, preferably as a Public Procurement of Innovative Solutions (PPI). This process should end with the installation of the pre-exascale system.

Numerical methods, programming models and tools. To support the efficient interactive simulation of brain models, the Project will start to develop new parallel and distributed programming models, performance analysis tools and numerical methods, adapted to the extreme parallelism of future exascale systems, and new middleware for workflow and I/O management. These activities will be carried out on top of activities planned in the roadmap of the ETP4HPC.
Interactive visualisation, analysis and control. During the Ramp-Up Phase, the Project will begin to develop a novel software framework, allowing interactive steering and in situ visualisation of simulations on future exascale systems. The development work will produce both general-purpose software and neuroscience-specific interfaces – virtual instruments allowing scientists to work with virtual specimens in the same way they work with biological specimens.

Exascale data management. HBP brain simulations will integrate and generate massive amounts of data (big data). In the Ramp-Up Phase, SP7 researchers are designing and implementing data management algorithms and tools, making it possible to manage, query, analyse and process these data, and to ensure that they are properly preserved. More specifically, SP7 is developing algorithms and tools that support scientists in building brain models, analysing models and most importantly, in storing and analysing the massive volumes of simulation results.

Users will access the Platform via a single point of access (a web portal) shared among all the Platforms.
Computer Resources

Development System
CSCS

Molecular Dynamics Supercomputer
BSC

Capacity

High-speed network

HBP Supercomputer
JUELICH

Capacity

Massive Data Analytics Supercomputer
CINECA

Cloud Storage
KIT

Cloud Storage

Use of computer resources by the High Performance Computing Platform

Deliverables

MONTH 2 — REPORT
PCP PLANNING DOCUMENT

This report provides a detailed specification of the PCP process, including the schedule, provisional requirements, and an analysis of related risks and contingency plans.

MONTH 6 — REPORT
HIGH PERFORMANCE COMPUTING PLATFORM V1 - SPECIFICATION DOCUMENT

This report provides a detailed specification of the High Performance Computing Platform v1. An annex provides a description of other work preparing for later versions of the platform. The report specifies indicators of progress and target values for the indicators.

MONTH 12 — REPORT
HIGH PERFORMANCE COMPUTING PLATFORM V1 – SET-UP DOCUMENT

This report will describe progress in the development of the platform.

MONTH 18 — PROTOTYPE
HIGH PERFORMANCE COMPUTING PLATFORM V1 – PRELIMINARY RELEASE FOR INTERNAL CONSORTIUM USE

This will be the first release of the platform, which will be available for use by members of the HBP Consortium.

MONTH 30 — PROTOTYPE
HIGH PERFORMANCE COMPUTING PLATFORM V1

This will be the first release of the High Performance Computing Platform, which, in the Operational Phase, will provide High Performance Computing capabilities and storage for all the other platforms.

MONTH 30 — REPORT
HIGH PERFORMANCE COMPUTING PLATFORM V1 — DOCUMENTATION

The prototype will be accompanied by technical and user documentation facilitating use of the platform by users within and outside the HBP Consortium and by a roadmap describing plans for future development in the Operational Phase of the Project.

MONTH 36 — PROTOTYPE
ASSESSMENT OF “TEST SERIES” PROGRESS (PHASE 3 OF PCP) AND DEFINITION OF FURTHER PROCESS FOR THE BIG DATA PRE-EXASCALE SYSTEM

This Deliverable will describe the assessment of the third phase of the Pre-Commercial Procurement process.
High Performance Computing Platform ready for community release

Exascale data analytics prototype completed

High Performance Computing Platform ready for internal release; PCP phase 3 participants selected

Algorithms, programming models, and architectures for interactive supercomputing and visualisation defined; PCP phase 2 participants selected

High Performance Computing Platform fully specified; supercomputer facilities at Jülich, BSC, CSCS, CINECA in operation, PCP phase 1 participants selected

MONTH 6
- Specifications and roadmap for parallel programming models
- Platform fully specified; supercomputer available for production-scale brain simulation at Jülich, for molecular level simulations at BSC, for massive data analysis at CINECA
- Requirements for user documentation and support for High Performance Computing, guidelines for establishing alliances
- Preliminary version of the PCP call and rationale ready for evaluation by EU Commission prior to publication of call

MONTH 12
- Algorithms and programming models for interactive supercomputing
- Architecture of software applications for interactive visualisation
- Identification of potential alliances on HPC

MONTH 18
- Algorithms and programming models for multi-scale supercomputing
- Neuroscience-specific visualisation methods
- Requirements for data provenance and preservation
- Links established to other Platforms, High Performance Computing Platform released for internal use
- Agreements with GENCI and GCS, start of user support and training, guidebook - initial release
- Solution exploration (phase 1 of PCP) completed, participants for phase 2 selected

MONTH 24
- Specifications and roadmap for numerical algorithms
- Exascale data analytics prototype

MONTH 30
- Integrated framework for multi-scale interactive visualisation
- Initial set of tools for querying peta- and exascale data
- High Performance Computing Platform released for community use
- Unified model for secure access, Acceptable Use Policy (AUP) guidebook for the use of the High Performance Computing Platform
Key Personnel

Subproject Co-Leaders

Thomas LIPPERT, Thomas SCHULTHESS

WP7.1 Pre-commercial procurement of HPC system

Analysis of HBP requirements
Thomas SCHULTHESS - ETHZ
Pre-commercial procurement
Thomas LIPPERT - JUELICH
Evaluation of PCP phases
Dirk PLEITER - JUELICH

Mathematical methods, programming models, and tools

Parallel programming models for interactive brain modelling and brain simulation
Jesus LABARTA - BSC
Workflow and distributed programming models for brain modelling
Rosa M. BADIA - BSC
Middleware for resource and I/O management
Jesus LABARTA - BSC
Tools for performance analysis and prediction
Bernd MOHR - JUELICH
Numerical algorithms for neuroscientific high performance computing
Andreas FROMMER - BUW
Gabriel WITTUM - UFRA
Michael GRIEBEL - FG

Interactive visualisation, analysis and control

Visualisation and analysis component execution framework
Torsten KUHLEN - RWTH
Neuroscience-specific visualisation and interfaces
Benjamin WEYERS - RWTH
Hardware technology, benchmarking and optimisation for visualisation and rendering towards the exascale
Felix SCHÜRMANN - EPFL
Integrative visualisation and analysis tools for the HBP cockpits
John BIDDISCOMBE - ETHZ
Luis PASTOR - URJC
Vicente MARTIN - UPm
Torsten KUHLEN - RWTH
Benjamin WEYERS - RWTH

WP7.4 Exascale data management

Scalable querying of peta to exascale data sets
Anastasia AILAMAKI - EPFL
Exascale data analytics
Minos GAROFALAKIS - TUC
Data provenance and preservation
Peter BUNEMAN - UEDIN
Array-based data processing models
Martin KERSTEN - CWI
Data platform dissemination and integration
Anastasia AILAMAKI - EPFL
Martin KERSTEN - CWI

WP7.5 High Performance Computing Platform: integration and operations

The HBP supercomputer for brain modelling and simulation
Klaus WOLKERSDORFER - JUELICH
The HBP development system
Colin MCMURTRIE - ETHZ
The HBP supercomputer for molecular dynamics
Javier BARTOLOME - BSC
The HBP supercomputer for massive data analytics
Giovanni ERBACCI - CINECA
HBP cloud services
Marcus HARDT - KIT
Diana GUDU - KIT
Supporting infrastructure - networking, storage and monitoring
Ralph NIEDERBERGER - JUELICH
HPC Platform website construction and maintenance
Daniel MALLMANN - JUELICH

SP7 Objective

“To provide supercomputing, Big data and Cloud capabilities at the exascale, as well as the system software, middleware, interactive computational steering and visualisation support necessary to create and simulate multi-scale brain models and to address the hard-scaling challenges of whole brain modelling.”

WP7.3 Intergrative visualisation, analysis and control

Felix SCHÜRMANN - EPFL
John BIDDISCOMBE - ETHZ
Luis PASTOR - URJC
Vicente MARTIN - UPm
Torsten KUHLEN - RWTH
Benjamin WEYERS - RWTH

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The High Performance Computing Platform provides supercomputing capabilities for multi-scale brain modeling, simulation and data analyses.
Thomas Lippert, the head of the Jülich Supercomputing Centre, is also the Director of the Institute for Advanced Simulation (IAS), the managing director of the John von Neumann-Institut für Computing and director of the Jülich-Aachen Research Alliance, section JARA-HPC. Prof. Lippert holds the chair for Computational Theoretical Physics at the Bergische Universität in Wuppertal, Germany. He is a member of the Gauß Centre for Supercomputing e.V., and the coordinator of the EU-funded PRACE implementation projects 1IP and 2IP. Prof. Lippert is Co-Leader of the HBP High Performance Computing Subproject.

Thomas Schulthess has been the Director of the Swiss National Supercomputing Center (CSCS) and a Visiting Distinguished Professor in the Computer Science and Mathematics Directorate of the Oak Ridge National Laboratory (CSMD/ORNL) since 2008. He has held several senior research positions with CSMD/ORNL, including Group Leader of Computational Materials Sciences, and Group Leader of the Nanomaterials Theory Institute. He was appointed Professor of Computational Physics at ITP, ETH Zurich, in 2008. Schulthess has been awarded three Gordon Bell prizes for developing major improvements in the execution of algorithms on supercomputers. He co-directs the HBP High Performance Computing Subproject.

Anastasia Ailamaki is a Professor of Computer Sciences at the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. She earned her Ph.D. in Computer Science from the University of Wisconsin-Madison in 2000. Her research interests are in database systems and applications, specifically in strengthening the interaction between the database software and the underlying hardware and I/O devices, and in automating database design and computational database support for scientific applications. She has received a Finmeccanica endowed chair from the Computer Science Department at Carnegie Mellon (2007), a European Young Investigator Award from the European Science Foundation (2007), an Alfred P. Sloan Research Fellowship (2005), six best-paper awards at top conferences (2001-2006), and an NSF career award (2002). Ailamaki co-directs the HBP Medical Informatics Subproject.

Rosa M. Badia holds a PhD in Computer Science (1994) from the Technical University of Catalonia (UPC). Since 2008 she has been a Scientific Researcher from the Consejo Superior de Investigaciones Científicas (CSIC) and manager of the Grid Computing and Cluster group at the BSC since 2005. She was an Associated Professor at the UPC from 1997 to 2005. From 1999 to 2005, she was also involved in research and development activities at CEPBA. Her current research interests cover the programming models for complex platforms (from multicore to the Grid/Cloud) and interoperability in Clouds. She has participated in several European projects. Dr. Badia has been the PI of project SIENA, and is currently the PI of project EU-Brazil OpenBIO, a member of the HIPEAC2 NoE. She is the main investigator for other projects for which BSC was not the coordinating Partner, such as OPTIMIS, TERAFLUX, VENUS-C, TransPlant and ScalaLife.
JOHN BIDDISCOMBE — ETHZ

John Biddiscombe graduated from Warwick University in 1989 with a BEng in Electronic Engineering and worked at the Rutherford Appleton Laboratory on Digital Signal Processing methods for altimetry and remote-sensing radar. Following this he implemented 3D algorithms for cellular radio propagation, in particular, modelling signals around buildings and trees. He also designed a propagation toolkit derived from the VTK library for these simulations. This work led to an interest in visualisation algorithms, and since 2004 he has worked as a Computational Scientist at the Swiss National Supercomputing Centre (CSCS) with a specialisation in parallel visualisation and supercomputing. Recent work has focused on interactive visualisation and analysis of running supercomputing applications using distributed resources, and implementing communication middleware to enable the sharing of data between applications.

JAVIER BARTOLOMÉ — BSC

Javier Bartolomé earned his degree in Computer Science from the Technical University of Catalonia (UPC). In 2001, he began working for the European Center for Parallelism of Barcelona (CEPBA) in the System Administration Group. Bartolomé joined Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC) in 2005 as the head of the Systems Management Group. He is currently responsible for Hardware and Software Operations of MareNostrum in addition to supporting the BSC organisational infrastructure. He has expertise in UNIX multi-processor systems and storage systems and is currently involved in National and European projects (HPC-Europa and DEISA). He is also responsible for the coordination of the systems deployment and operations for the Spanish Supercomputing Network (RES).

PROF. PETER BUNEMAN — UEDIN

Peter Buneman is a Professor of Database Systems in the University of Edinburgh School of Informatics. His work focuses mainly on databases and programming languages; specifically, database semantics, approximate information, query languages, types for databases, data integration, bioinformatics and semistructured data. He has worked on important scientific database issues such as data provenance, archiving and annotation and made contributions to graph theory and to the mathematics of phylogeny. He has served on numerous programme committees, editorial boards and working groups, and has been programme chair for all the leading database theory and systems conferences including ACM SIGMOD, ACM PODS, VLDB and ICDT. A Fellow of the Royal Society, the Royal Society of Edinburgh, and the ACM, Buneman is the recipient of a Royal Society Wolfson Merit Award.

DR. GIOVANNI ERBACCI — CINECA

Giovanni Erbacci holds a laurea in Computer Science from the University of Pisa. Today, he is responsible for the Division for the Academic and EU HPC Projects in the CINECA’s Supercomputing Application and Innovation Department. He has vital experience in promoting HPC activities and methodologies, and is also involved in CINECA’s training and education activities. He has been actively engaged in PRACE projects since the beginning of the initiative and leads the HPC Eco-System WP in PRACE-IIP. He is also a member of the PRACE-2IP Executive Board, where he leads the Applications Pillar.
MINOS GAROFALAKIS received MSc (1994) and PhD (1998) degrees in Computer Science from the University of Wisconsin-Madison. He has worked as a Member of the Technical Staff at Bell Labs, Lucent Technologies (1998-2005); as a Senior Researcher at Intel Research Berkeley (2005-2007); and as a Principal Research Scientist at Yahoo! Research (2007-2008). Since October 2008, Prof. Garofalakis has been a Professor of Computer Science at the Department of Electronic and Computer Engineering of the Technical University of Crete; he has been Department Chair since 2011. Prof. Garofalakis' research interests include database systems, centralised/distributed data streams, and big-data analytics and data mining. He has published over 120 papers and has made 35 US Patent filings (27 patents issued). He is a PI for LIFT (FP7-ICT-FET Open project, 2010-2013) and LEADS (FP7-ICT-STREP project, 2012-2015). Prof. Garofalakis is an ACM Distinguished Scientist and a Member of the IEEE. He is the recipient of the Bell Labs President’s Gold and Teamwork Awards, as well as an FP7 Marie-Curie International Reintegration Fellowship.

SERGI GIRONA is the Chair and Managing Director of the Partnership for Advanced Computing in Europe (PRACE) Board of Directors, as well as the Director of the Barcelona Supercomputing Center (BSC) Operations Department. Dr. Girona holds a PhD in Computer Science from the Technical University of Catalunya. In 2004, he joined BSC for the installation of MareNostrum supercomputer. MareNostrum was the largest supercomputer in Europe at that time, and Girona was responsible for the site preparation and coordination with IBM for the system installation. Currently, he manages the Operations group and is responsible for User Support and System Administration of the different BSC HPC systems.

MICHAEL GRIEBEL has a Ph.D. (Dr. rer. nat.) in computer science from Technische Universität München, and a Habilitation (Dr. rer. nat. habil.) from the same institution. Since 1996, he has been a professor of Scientific Computing and Numerical Simulation at the University of Bonn. Since 2003, he has been the Director of the Institute for Numerical Simulation at the University of Bonn.
DIANA GUDU — KIT

Diana Gudu is a doctoral researcher at the Karlsruhe Institute of Technology. Diana received her BSc in Computer Science from the Polytechnic University of Bucharest in 2010 and went on to earn an MSc with Honours degree from the Technical University of Munich in 2012, majoring in high performance computing. Her research interests include distributed systems, HPC and highly scalable data storage. Her PhD work is focused on scheduling strategies that exploit data locality in data-intensive computing. At the HBP, she contributes to SP7’s cloud storage infrastructure.

DR. MARCUS HARDT — KIT

Marcus Hardt received his diploma in physics from RWTH Aachen in 2001. Between 1999 and 2002, he worked as a founding member of WebSmart Technology GmbH and as an IT freelancer. Since 2002, he has been a scientist in SCC’s Research Group on Cloud Computing. As a member of the CrossGrid and int.eu.grid integration teams, he managed software deployment and configuration on the Europe-wide DCI and was responsible for automated release builds. He was also responsible for KIT activities in the EU FP7 project “Ultrasound Computer Tomography,” where he contributed simulations of ultrasound waves in medical devices. In the last 10 years, he has published more than 20 conference and journal papers.

PROF. MARTIN KERSTEN — CWI

Martin Kersten has devoted most of his scientific career to the development of database systems. The latest is the open-source system MonetDB (http://www.monetdb.org), which demonstrates the viability of the column-storage approach in an efficient SQL and XQuery database engine. The system was developed by the CWI Database Architectures group, which Prof. Kersten established in 1985 and which hosts a strong group of experimental scientists. Prof. Kersten heads the Information Systems department of CWI and is a full professor at the University of Amsterdam. He is the author of more than 170 papers and the recipient of many national and international research grants for multi-media and scientific database research. He is a member emeritus of the VLDB Endowment.

PROF. TORSTEN KUHLEN — RWTH

Torsten Kuhlen is the founder of the Virtual Reality Group at the Center for Computing and Communication of RWTH Aachen, where he is also a professor of virtual reality (VR) in the Department of Computer Science. Before taking up this position, he was a research assistant at the Institute of Technical Computer Science, where he focussed on innovative human-computer interfaces and VR. For his doctoral thesis at the Faculty of Electrical Engineering, he developed VR-based methods for research on the sensorimotor organisation of the human brain. He is a spokesperson for the German Computer Science Society’s Special Interest Group on Virtual and Augmented Reality, and is a co-author of about 150 peer-reviewed publications. He has served as programme chair, committee member, and reviewer for numerous international conferences on VR, computer graphics and visualisation.
Jesus Labarta has been a full professor in the Computer Architecture Department at UPC since 1990. Since 1981, he has lectured on computer architecture, operating systems, computer networks and performance evaluation. His research interests are centred on parallel computing, covering areas from multiprocessor architecture, memory hierarchy, parallelising compilers and programming models, operating systems, parallelisation of numerical kernels, metacomputing tools and performance analysis and prediction tools. He has led the technical work of UPC in some 15 industrial R+D projects. Significant performance improvements were achieved in commercial codes owned by partners with whom he has cooperated. Since 1995 he was director of CEPBA and currently he is director of the Computer Sciences research department at BSC.

Vicente Martin is the director of CeSViMa, where he leads the UPM Quantum Information and Computation Group as well as the centre’s effort to prototype a metropolitan area QKD network. He is an associate professor of computational science, with a Ph.D. on the numerical simulation of quantum systems from the Universidad Autónoma de Madrid. He has taught scientific computing and parallel programming for more than ten years, has directed or participated in more than twenty projects, has co-authored more than 40 papers, holds several patents and has contributed to standardisation. He is a member of the European Telecommunications Standards Institute (ETSI) Industry Specification Group (ISG) on QKD.

Colin McMurtrie is a mechanical engineer with more than 14 years’ IT experience in the academic sector including more than seven years in HPC. At CSCS since 2009, he managed the National Systems group for four years and recently became group leader of the newly formed Systems Integration group. He has extensive project management experience, is a PRINCE2 Registered Practitioner and has ITIL certification.

Bernd Mohr started to design and develop tools for performance analysis of parallel programs with his diploma thesis (1987) at the University of Erlangen, and continued this in his Ph.D. work (1987 to 1992). During a three-year postdoc position at the University of Oregon, he designed and implemented the original TAU performance analysis framework. At the Jülich Supercomputing Centre, which he joined as a senior scientist in 1996, he leads the Programming Environments and Performance Optimization group. Besides being responsible for user support and training in the area of performance tools, he leads the KOJAK and Scalasca performance tools efforts in collaboration with Prof. Felix Wolf of GRS Aachen. Since 2007 he has been the deputy head of the JSC’s Application Support division. In 2012, Bernd Mohr joined the International Supercomputing Conference (ISC).
Dr. Boris Orth
— Juelich

Boris Orth leads the High Performance Computing in Neuroscience division of the Jülich Supercomputing Centre (JSC) at Forschungszentrum Jülich, Germany. Orth studied physics at the University of Edinburgh and the University of Bonn, from which he received his diploma in theoretical physics in 1998. He worked with supercomputers intensively during his doctoral studies in computational particle physics at the University of Wuppertal, from which he received his Ph.D. in 2004. He also worked with supercomputers as an HPC applications consultant at the JSC, where he organised and taught courses in parallel programming for scientific applications. Between 2007 and 2011, he was the managing director of the German Research School for Simulation Sciences, a joint graduate school of Forschungszentrum Jülich and RWTH Aachen University. Today, he coordinates the JSC’s activities at the intersection between HPC and neuroscience. At the HBP, he is the project manager for the High Performance Computing Subproject.

Prof. Luis Pastor
— URJC

Luis Pastor holds a Ph.D. in Electrical Engineering from the Polytechnic University of Madrid and is a professor of Computer Science/Engineering at the Universidad Rey Juan Carlos in Madrid, where he heads the Research Group on Modelling and Virtual Reality. In recent years, he has worked on virtual reality, visualisation, and interaction, particularly in neuroscience, where he has made major contributions to the Blue Brain and Cajal Blue Brain projects. In addition, he researches high performance computing and its application to graphics and imaging. He has led 33 European and Spanish-funded research projects and has co-authored some 60 peer-reviewed publications. He holds several patents on imaging and VR-based surgical simulators, some of which have been exploited commercially (Simbionix ARTHRO VR).

Prof. Dirk Pleiter
— Juelich

Dirk Pleiter is research group leader at the Jülich Supercomputing Centre and a professor of theoretical physics at the University of Regensburg. At JSC he leads work on application-oriented technology development. During his career, he has played a leading role in several special purpose machine development projects. Currently, he is the principal investigator of the Exascale Innovation Center and the NVIDIA Application Lab at Forschungszentrum Jülich.

Ralph Niederberger is a Senior Research Associate at Forschungszentrum Jülich, deputy leader of the Communication Systems division, and leader of the operational security group. His main working areas are high-speed communication, IT Security, Network Management and Administration. He has been working in several regional, national and international network test-beds and projects concentrating on high-speed communications, optical networks, bandwidth on demand (BoD), Grid networking and Firewalls. Since 1996 he has lectured on data communications and network and security management at FH Aachen University of Applied Sciences. He leads the network operations group of the EU FP6 PRACE project, and is the deputy leader of the IT security activities in the EU FP7 EUDAT project. As an independent expert, Niederberger evaluates and reviews networking projects for the European Commission. At the HBP, he leads the “Supporting Infrastructures: Network, storage and monitoring” Task.
Felix Schürmann is adjunct professor at the École Polytechnique Fédérale de Lausanne and co-director of the Blue Brain Project. He studied physics at the University of Heidelberg, Germany, supported by the German National Academic Foundation. Later, as a Fulbright Scholar, he obtained his Master’s degree (M.S.) in Physics from the State University of New York, Buffalo, USA, under the supervision of Richard Gonsalves. During these studies, he became curious about the role of different computing substrates and dedicated his Master’s thesis to the simulation of quantum computing. He studied for his Ph.D. at the University of Heidelberg, Germany, under the supervision of Karlheinz Meier. For his thesis he co-designed an efficient implementation of a neural network in hardware. Now, at the Blue Brain Project, he oversees all computing-related aspects such as high performance computing, visualization, computing infrastructure and computational science and engineering processes.

Gabriel Wittum’s main research interest is the application of advanced numerical methods to complex realistic models, the development of simulation frameworks and tools incorporating these methods, and their efficient implementation on modern supercomputers. He has worked in many areas including computational fluid dynamics, environmental research, energy research, finance, neuroscience, and pharmaceutical technology. Another focus is on solvers for large systems of equations and in particular on multigrid methods. In his research, he has used these methods to predict pathways for the diffusion of molecules through human skin, which have subsequently been confirmed by two-photon microscopy. In neuroscience, he has been able to explain differentiation of the shapes of neuron nuclei in hippocampal neurons and the shape of synaptic boutons in the muscle cells of Drosophila melanogaster larvae. He is also the author of a detailed 3D model of electric signal transduction with subcellular resolution and of tools for the automatic reconstruction and classification of neurons.

Klaus Wolkersdorfer is the head of the High-Performance-Computing Systems division of the Jülich Supercomputing Centre (JSC) within the Institute of Advanced Simulation (IAS) at Forschungszentrum Jülich (FZJ). He is responsible for integrating the wide range of FZJ’s supercomputers into a production environment. His research areas are performance optimisation and tuning of large systems. He obtained a masters degree in mathematics and computer science at the University of Erlangen and worked on structured programming and programming languages. He participated in IBM’s World Trade Postdoctoral Program for one year at the IBM Thomas J. Watson Research Center, before moving to the operating system division at JSC, which he now leads.
The goal is exascale computing performance—sufficient for an initial simulation of the whole human brain.

The High Performance Computing Platform will provide HBP researchers—and eventually the larger scientific community—with the supercomputing capabilities required for multi-scale brain modeling, simulation and data analyses. By the end of the project, the platform will offer exascale performance: $10^{18}$ FLOPS (floating point operations per second), 50 times the speed of today’s fastest computer and sufficient for an initial simulation of the whole human brain. The platform builds on existing capabilities at Forschungszentrum Jülich in Germany, the Swiss National Supercomputing Centre (CSCS), the Barcelona Supercomputing Center (BSC Spain), and the Consorzio Interuniversitario del Nord Est italiano per il Calcolo Automatico (CINECA Italy).