

## bwGRiD – A computing grid for Baden-Württemberg

### **Sven Hermann**

STEINBUCH CENTRE FOR COMPUTING - SCC



KIT – University of the State of Baden-Wuerttemberg and National Research Center of the Helmholtz Association

www.kit.edu



- bwGRiD partners
- bwGRiD the infra structure
  - infra structure
  - hardware at the sites
- What is (not) "grid" on bwGRiD?
- bwGRiD from a user's view
  - Webpage
  - User groups
  - bwGRiD-VO
  - future: User portal (Ulm)
- bwGRiD as a project
  - course of the project
  - bscw ("Basic Support for Cooperative Work")
  - successes & publicity
  - upcoming tasks 2011/2012
- bwGRiD technical features as "grid"
  - Jobs, CPUh & efficiencies
  - grid usage & cross site computing
- Summary







# bwGRiD partners

- bwGRiD the infra structure
- What is (not) "grid" on bwGRiD?
- bwGRiD from a user's view
- bwGRiD as a project
- bwGRiD technical features as "grid"
- Summary





### **bwGRiD** Partners





Baden-Württemberg





Bundesministerium für Bildung und Forschung



Karlsruhe Institute of Technology







### Universität Stuttgart



JNIVERSITÄT Mannheim

ALBERT-LUDWIGS-

UNIVERSITÄT FREIBURG

RUPRECHT-KARLS-UNIVERSITÄT HEIDELBERG



Eberhard Karls

Universität Tübingen





Hochschule Esslingen University of Applied Sciences









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### bwGRiD infrastructure (1/2)

- 9 sites (•) with ca. 1680 nodes á 8 cores in total  $\rightarrow$  13450 Cores
- 510 TB storage accessible via grid middleware (Lustre system)
- Current middleware for all clusters: Globus 4.0.8









### **bwGRiD** infrastructure (2/2)

- German Federation payed for hardware
- MWK Baden-Württemberg payed for personal ressources
- Grid: transparent aggregation of computing units in Baden-Württemberg









Site	Freiburg, Heidelberg, Karlsruhe, Mannheim, Tübingen	Stuttgart	Ulm	Esslingen
Number of nodes (IBM Bladeserver HS21 or rather in Esslingen type Appro gB222X)	140	434	280	180
Number of Blade-Chassis (IBM BladeCenter H, or rather Appro 5U)	10	31	20	18
CPU-Cores per node	8	8	8	8
Main storage per node [GB]	16	16	16	24
Local disk storage per node [GB]	120	0	120	0
Number of InfiniBand- Switches (Voltaire Grid Director ISR 2012)	1	2	1	1
Number of ports (InfiniBand)	168	576	288	192
Number of Frontend und Backend Server (IBM xServer x3650)	2	2	2	2







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### What is Grid on bwGRiD?



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- ✓ combination of computer resources from multiple administrative domains to reach a common goal
- ✓ a distributed system with non-interactive workloads that involve a large number of files
- ✓ is more loosely coupled, heterogeneous, and geographically dispersed than cluster computing
- common that a single grid will be used for a variety of different purposes
- ✓ often constructed with the aid of general-purpose grid software libraries known as middleware.
- ✓ Parallel computing locally at each site
- ✓ Very similar architecture at all sites (OS, software modules)

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### What is not Grid on bwGRiD?



- X no meta scheduling (like gLite WMS) but cross site computing possible
- X no "super virtual computer" is composed of many networked loosely coupled computers acting together to perform very large tasks, but large clusters per site
- X no across site parallel computing







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### bwGRiD Webpage: www.bw-grid.de



### powered by Uni Konstanz

🕘 BW-Grid: Standorte - Mozilla Firefox	Marrie Service of Contents					
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	Allgemeine Informationen	Benutzerinformation	Projekte	Portal		
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► Standorte	Auf diana Caitan fa	den eich enerifische Toform		Chandenten Diese Teferre		
▶ Esslingen	Aut diesen Seiten finden sich spezifischer Informationen zu den einzeinen Standorten. Diese Informationen umfassen allgemeine Informationen zu den im Rahmen der AD-Grid Initiative bereitgestellten Ressourcen wie Zugriffsmöglichkeiten					
▶ Freiburg	und installierter Software.					
Heidelberg	Im Rahmen von bwGRiD sind folgende Compute Ressourcen auf den folgenden Standorten verfügbar.					
Karlsruhe	• Stuttgart					
Storage	• Karlsruhe					
Konstanz / Ulm	Ulm/Konstanz     Tübingen					
Mannheim	• Heidelberg					
Stuttgart	Mannheim     Freiburg					
Tübingen	<ul> <li>Esslingen</li> </ul>					
Daneben sind im Rahmen von bwGRiD Storage Ressourcen vorhanden:						
	• Karlsrube					
	- Kanorano					







### Users in bwGRiD

Discipline (# of projects):

- Astrophysics (5)
- Biology (21) -
- Chemistry (27) –
- Economic science (9)
- Informatics (7)
- Mathematics (1)
- Physics (17) —
- Political science (2)
- Social science (2)





e.g. quantum chemical analysis:



e.g. neuro science:



### **User authorization (bwGRiD-VO)**





**Computing ressource** 





### bwGRiD CPUh usage - H210











### **bwGRiD User Portal 1/3**

... from the users point of view:

- meta submit system
- login
- file browser

😢 Chemistry Portal Ulm - Mozilla Firefox 🎐	
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### **bwGRiD User Portal 2/3**



GridProxyManager / MyProxy Portlet
 job monitoring portlet

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### **bwGRiD User Portal 3/3**

- ... and most important: portlets for applications
  - Gatlet (Bash-Scripts)
  - Math

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About Introduction Documentatio	n Tools Step-by-Step	
Tools		
their respective manuals in the documentation Pre-processing	FLUENT analysis	Post-processing
		4 107 m
First, the modeling goals are specified. Th the model geometry as well as the mesh created. Thereto a geometry modeler and mesh generator are required. Within the development environment ANSYS Workbe	In the next step, the initialization of the solver (density based, pressure based, unsteady etc.) and of the physical models (turbulence, combustion, multiphase etc.) is to be made. Then, the computation and the monitoring of the	During post-processing, the numerical results of a CFD-simulation are analysed. Thereto, different tools can be used. These are for example graphical analysis tools or animations. Within the ANSYS Workbench,





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### course of the project Jan 2010 - Apr 2011

- Bi-weekly regular video conference (Thursday)
- On 1.1.2010 the project leadership of bwGRiD was handed over from HLRS to KIT

- End of April 2010: outstanding technical report has been delivered
- Mid May 2010: HS Esslingen joined with 180 Nodes
- March 2011: successful F2F Meeting bwGRiD @KIT





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**bwGRiD BSCW** 

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### **Successes and publicity**

- bwGRiD Poster for D-Grid AHM 2010 in Dresden
- Monitoring with "webmds" was working for all sites (but current outage ③) http://webmds.lrz-muenchen.de:8080/webmds/xslfiles/csm/



- Lustre upgrades since Jan 2010  $\rightarrow$  more stable than before
- bwGRiD wide initiative for unification of all bwGRiD clusters successfully finished in Sept 2010
  - Since then users have got an standard environment at the different sites
  - Continuous improvement ongoing (e.g. Software modules with common versions)

### Upcoming tasks 2011/2012 1/2



- Careful coordination of update to Globus 5
- further **middleware**? E.g. Unicore and/or gLite
- Improved transparency for users
- Workshops & training for users'
  - acquisition , access, promotion
- BW wide user support (1st-Line) with link to NGI-DE Support-Portal (<u>https://helpdesk.ngi-de.eu</u>)





### Upcoming tasks 2011/2012 2/2



- **Simplified login** to the grid (e.g. with Shibboleth?)
- elaborated accounting for more detailed statistics: Which user group computes what in bwGRiD?
- overall cluster scheduling
  - **Loadbalancing** (MOAB or Alternative?)
  - Transfer of user data among sites?
- Hedge against outages
  - maintenance contracts for several hardware components needed!
  - new contracts (e.g. infiniband switches, front server)







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### Used MCPUh/month (whole bwGRiD)









### Used MCPUh/month (whole bwGRiD)









percentaged CPUh used by different sites (per site)



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## Site Tübingen: CPUh Sept 2010 – Feb 2011



bG

Ri





## Site Karlsruhe: CPUh Sept 2010 – Feb 2011



GRI



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### Site Esslingen: CPUh Sept 2010 – Feb 2011





bG

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### **Correlation #Jobs – CPUh (per site)**





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### Summary

### bwGRiD

- ... is strong collaboration group of 9 specialized sites
- makes 13500 CPUs and 500 TB storage accessible to BW users
- ... has been grown together since years
- ... has reached production quality (e.g. high efficiency)
- ... is unique in German Federation
- ... makes communities profit of strong
  - inter site collaboration
  - inter site usability
- ... is preparing for upcoming tasks







### Thank you! ... Questions?

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### 1,2 **Efficiency/month** <sup>0,0</sup> <sup>0,4</sup> Х Ess Х ♦ Frei $\times$ **K**A XMa/Hd Ж ▲ Stutt Ж **×Tüb** +Ulm 0,2 0 100 1000 10000 100000 1000000 **#Jobs/month**

**G**Ri

### **Correlation # jobs – efficiency (per site)**



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### Half-year performance bwGRiD per site (H210)





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b

### Site Freiburg: CPUh Sept 2010 – Feb 2011

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### Site Stuttgart: CPUh Sept 2010 – Feb 2011







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### Site Ma/Hd: CPUh Sept 2010 - Feb 2011

