

Large scale computing facilities at KIT and DESY

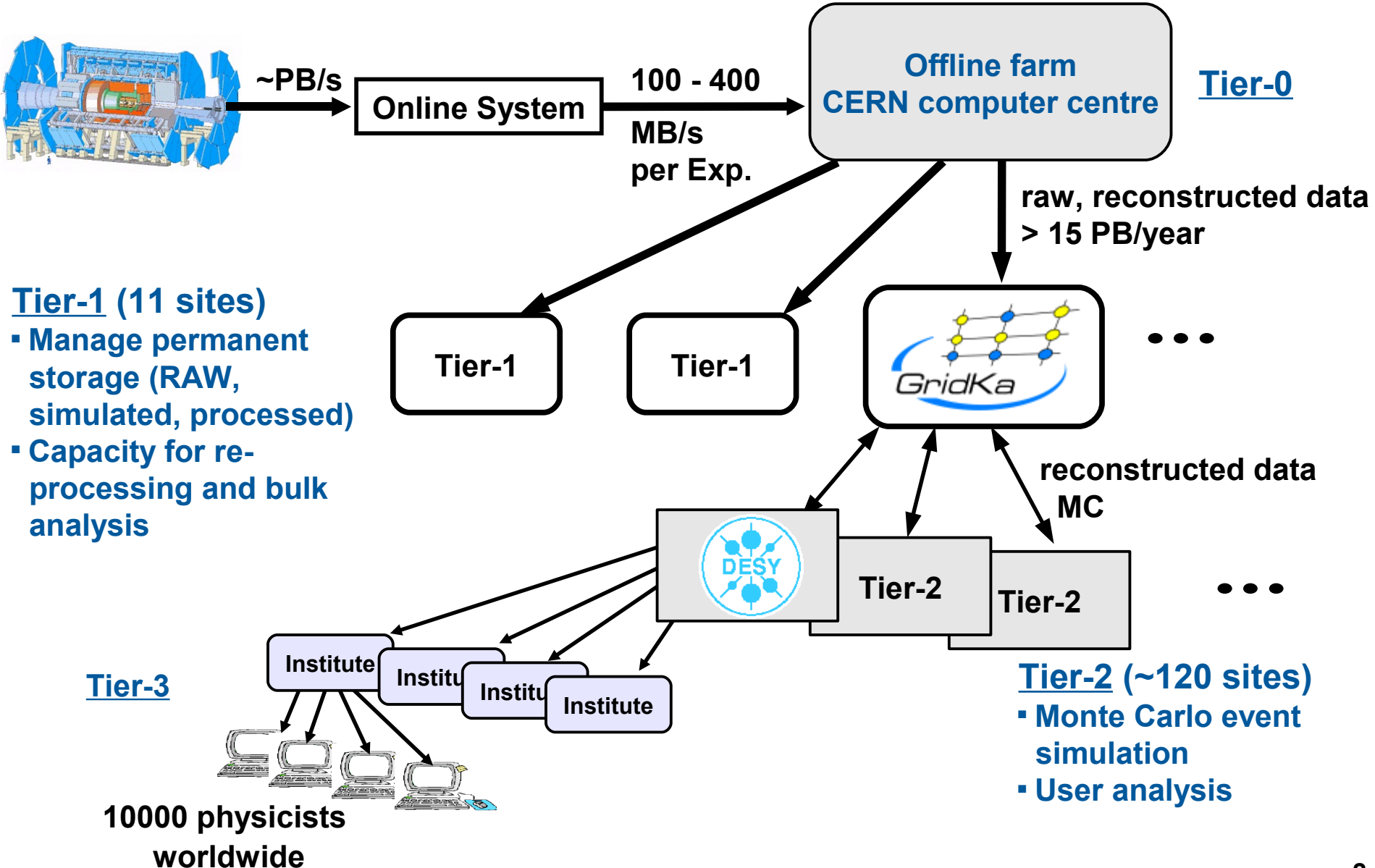
Volker Gülzow



Andreas Heiss



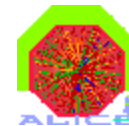
The Worldwide LHC Computing Grid (WLCG)



The Memorandum of Understanding (MoU) of the Worldwide LHC Computing Grid



- Members, aims and organisation of the WLCG collaboration
- Tier-1 and Tier-2 centres
 - Pledged resources (CPU, disk, tape)
 - Service levels
 - 24h x 7d operation
 - Response time on operational problems
 - Availability ($\geq 98\%$ for Tier-1 centres)
- Supported LHC experiments
 - GridKa supports all LHC experiments
 - DESY supports Atlas, CMS, LHCb



Tier-2 centres in Germany

3 average size Tier-2s for Atlas, 1.5 for CMS, 1 for LHCb and 1 for Alice have been requested for Germany.



DESY operates 1 average size Tier-2 each for:

- Atlas (federated with U Göttingen)
- CMS (federated with RWTH Aachen)
- LHCb

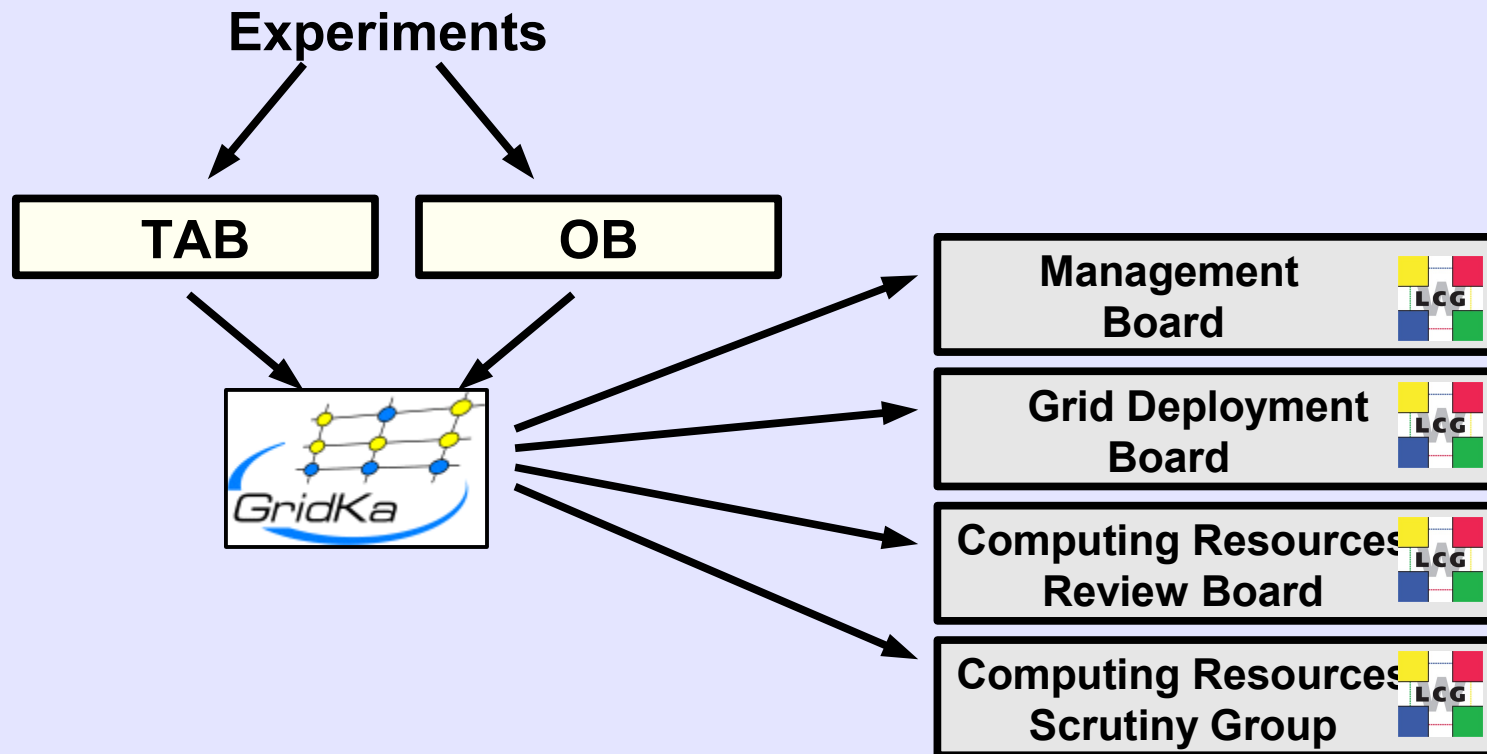


Other Tier-2 centres

- U Freiburg, U Wuppertal, LMU and MPIfP Munich :
0.5 av. Tier-2 for Atlas each.
- (GSI : 1 av. Tier-2 for Alice)

GridKa

- WLCG Tier-1: Alice, Atlas, CMS, LHCb
- non-LHC HEP: CDF, D0, Babar, Compass, Belle
- other VOs: Auger, Magic, ...



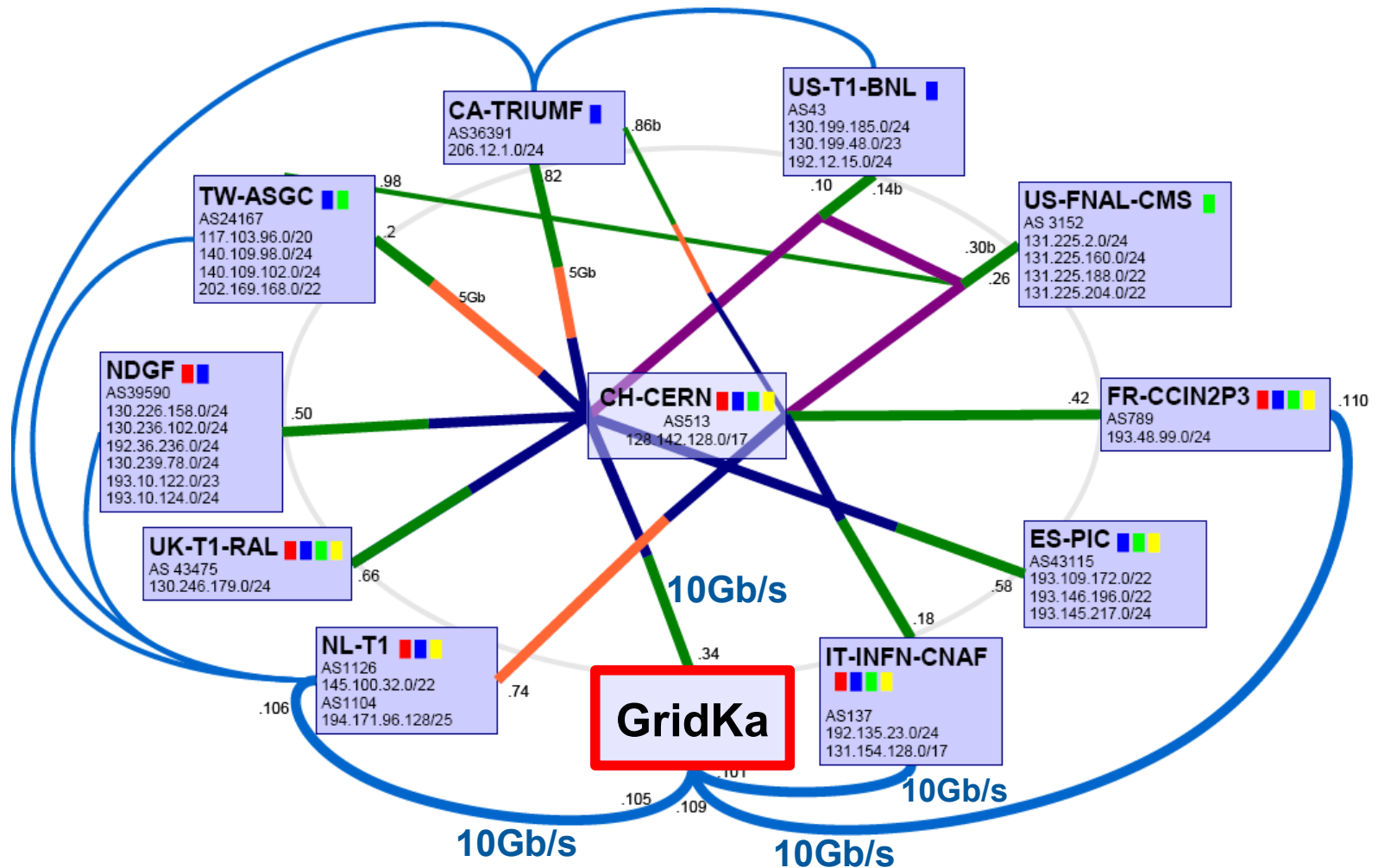
DESY

- **WLCG Tier-2:** **Atlas, CMS, LHCb**
- **non-LHC HEP:** **H1, Zeus, ILC, CALICE, ILDG**
- **other VOs:** **IceCube, XFEL, XRAY, Biomed, ...**

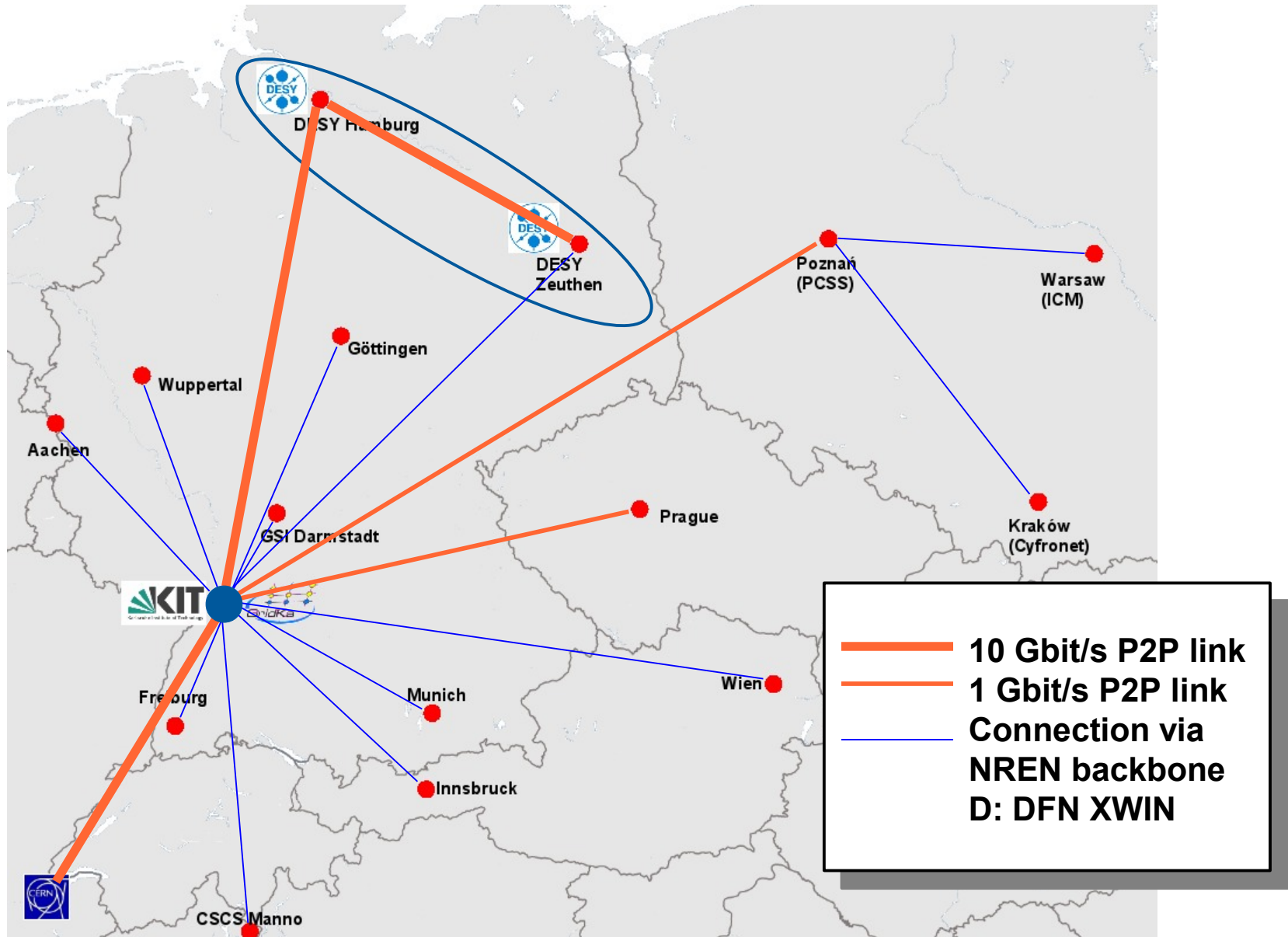
Example: Monte Carlo production for ILC detector design

- development of grid tools (job submission scripts, web based production database)
- >50 M events fully simulated (geant4) and reconstructed Standard Model 'background' and new physics (Higgs/SUSY)
- ~70 TByte of storage at DESY Grid ('T0')
- ~200 CPU-years
DESY and other EU Grid sites (UK, F, ...)

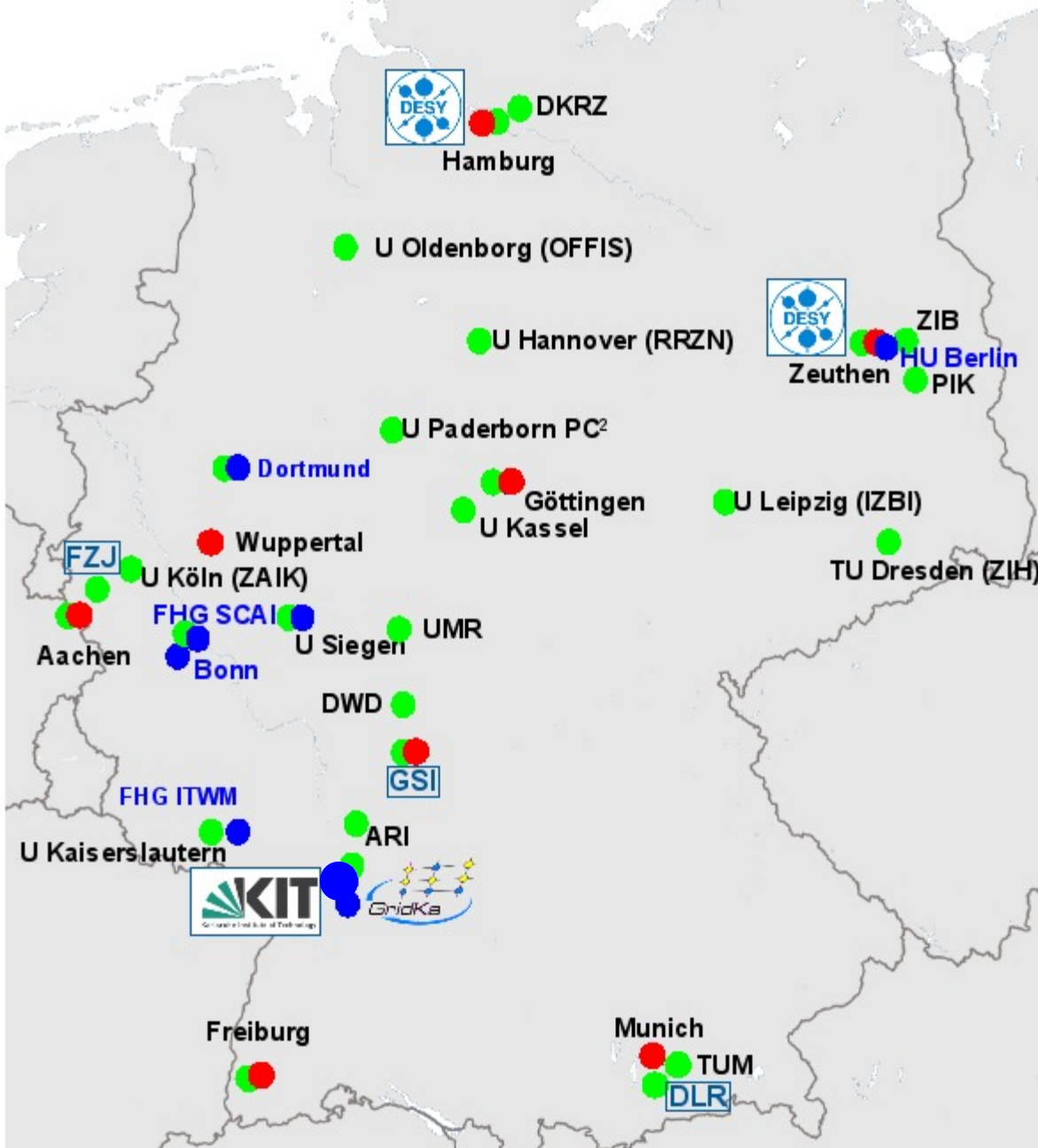
LHC Optical Private Network (OPN) Status



GridKa Tier-1 and associated Tier-2 sites



High visibility in national and international Grid projects

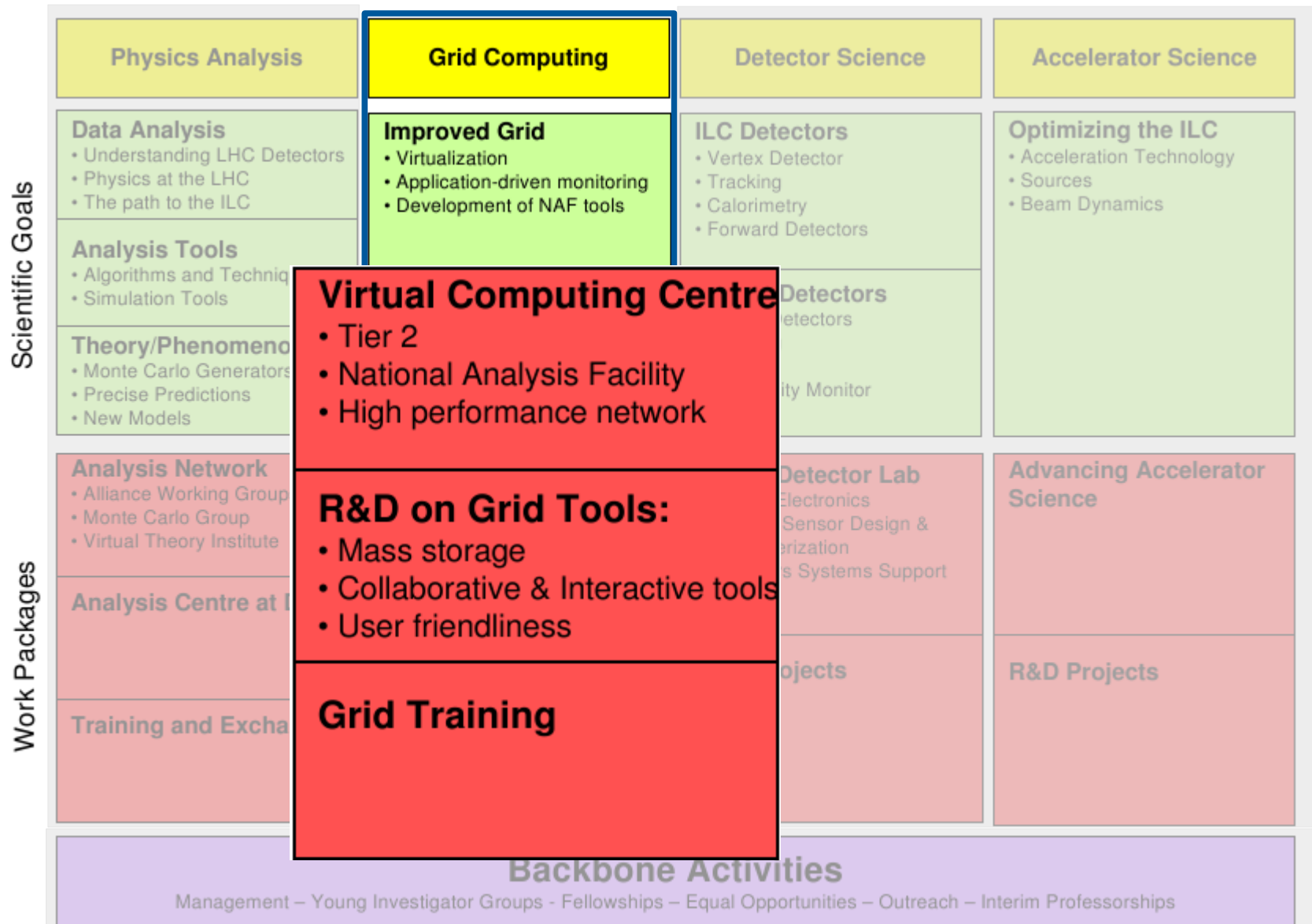


- Sites of the German national grid initiative D-Grid, funded by BMBF with Helmholtz sites as key players.
- EGEE site (non Tier-2)
- WLCG Tier-2 site (also EGEE)

Helmholtz Alliance 'Physics at the Terascale'

	Scientific Goals			
	Physics Analysis	Grid Computing	Detector Science	Accelerator Science
	Data Analysis <ul style="list-style-type: none"> Understanding LHC Detectors Physics at the LHC The path to the ILC 	Improved Grid <ul style="list-style-type: none"> Virtualization Application-driven monitoring Development of NAF tools 	ILC Detectors <ul style="list-style-type: none"> Vertex Detector Tracking Calorimetry Forward Detectors 	Optimizing the ILC <ul style="list-style-type: none"> Acceleration Technology Sources Beam Dynamics
	Analysis Tools <ul style="list-style-type: none"> Algorithms and Techniques Simulation Tools 	Data Storage + Retrieval <ul style="list-style-type: none"> Mass storage Data Access 	(s)LHC Detectors <ul style="list-style-type: none"> Vertex Detectors Tracking Trigger Luminosity Monitor 	
	Theory/Phenomenology <ul style="list-style-type: none"> Monte Carlo Generators Precise Predictions New Models 			
Work Packages	Analysis Network <ul style="list-style-type: none"> Alliance Working Groups Monte Carlo Group Virtual Theory Institute 	Virtual Computing Centre <ul style="list-style-type: none"> Tier 2 National Analysis Facility High performance network 	Virtual Detector Lab <ul style="list-style-type: none"> VLSI & Electronics Support Sensor Design & Characterization Detectors Systems Support 	Advancing Accelerator Science
	Analysis Centre at DESY	R&D on Grid Tools: <ul style="list-style-type: none"> Mass storage Collaborative & Interactive tools User friendliness 	R&D Projects	R&D Projects
	Training and Exchange	Grid Training		
Backbone Activities				
Management – Young Investigator Groups - Fellowships – Equal Opportunities – Outreach – Interim Professorships				

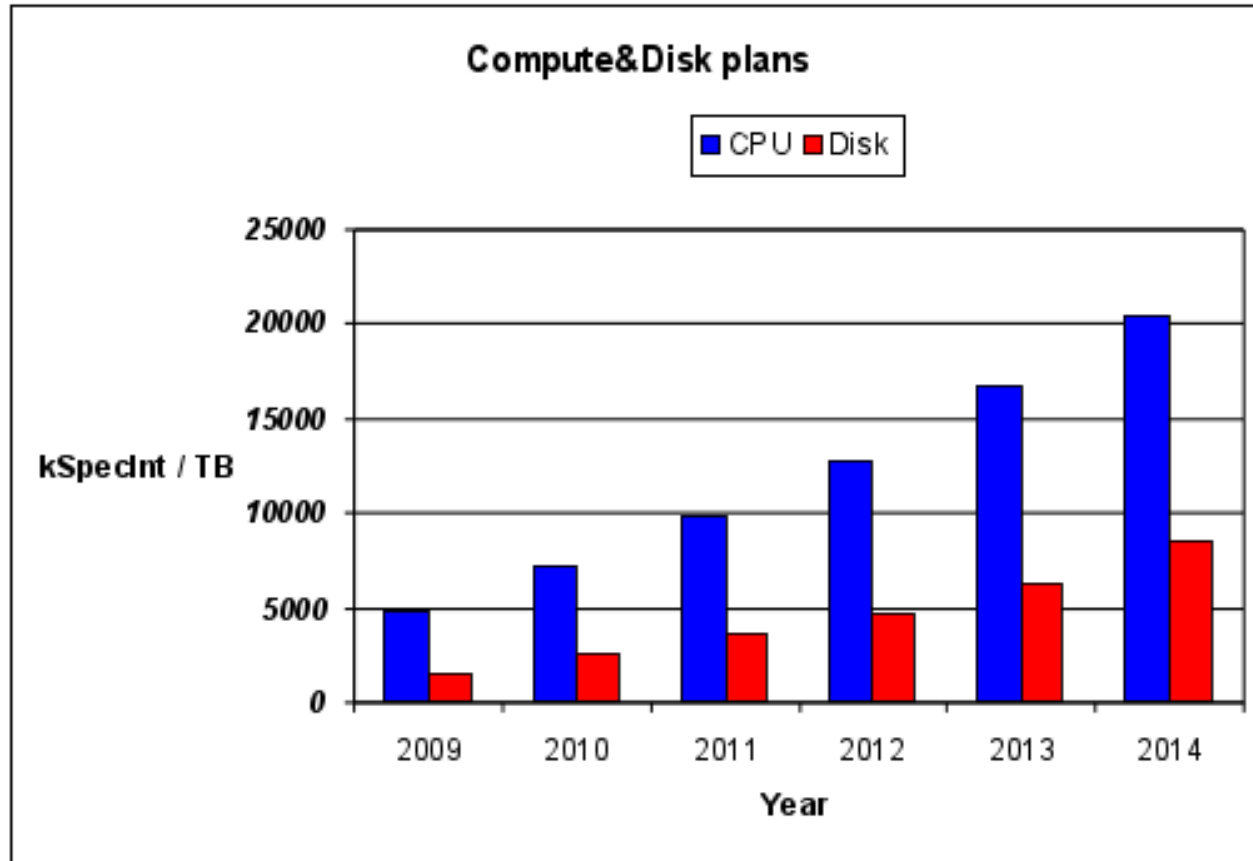
Helmholtz Alliance 'Physics at the Terascale'



The National Analysis Facility (NAF)

- Part of the Helmholtz Alliance 'Physics at the Terascale'
→ <http://naf.desy.de>
- Built according to requirements from German Atlas, CMS and LHCb groups
- Accessible by German research groups for LHC, Hera, Theory and ILC tasks
- Size of ~ 1.5 average Tier-2 centres with extra storage
- Interactive analysis to improve scientific harvest
- Provides interactive PROOF farm request by physics groups
- Locality of analysis data is required → core facility at DESY
 - .. intended to be distributed.

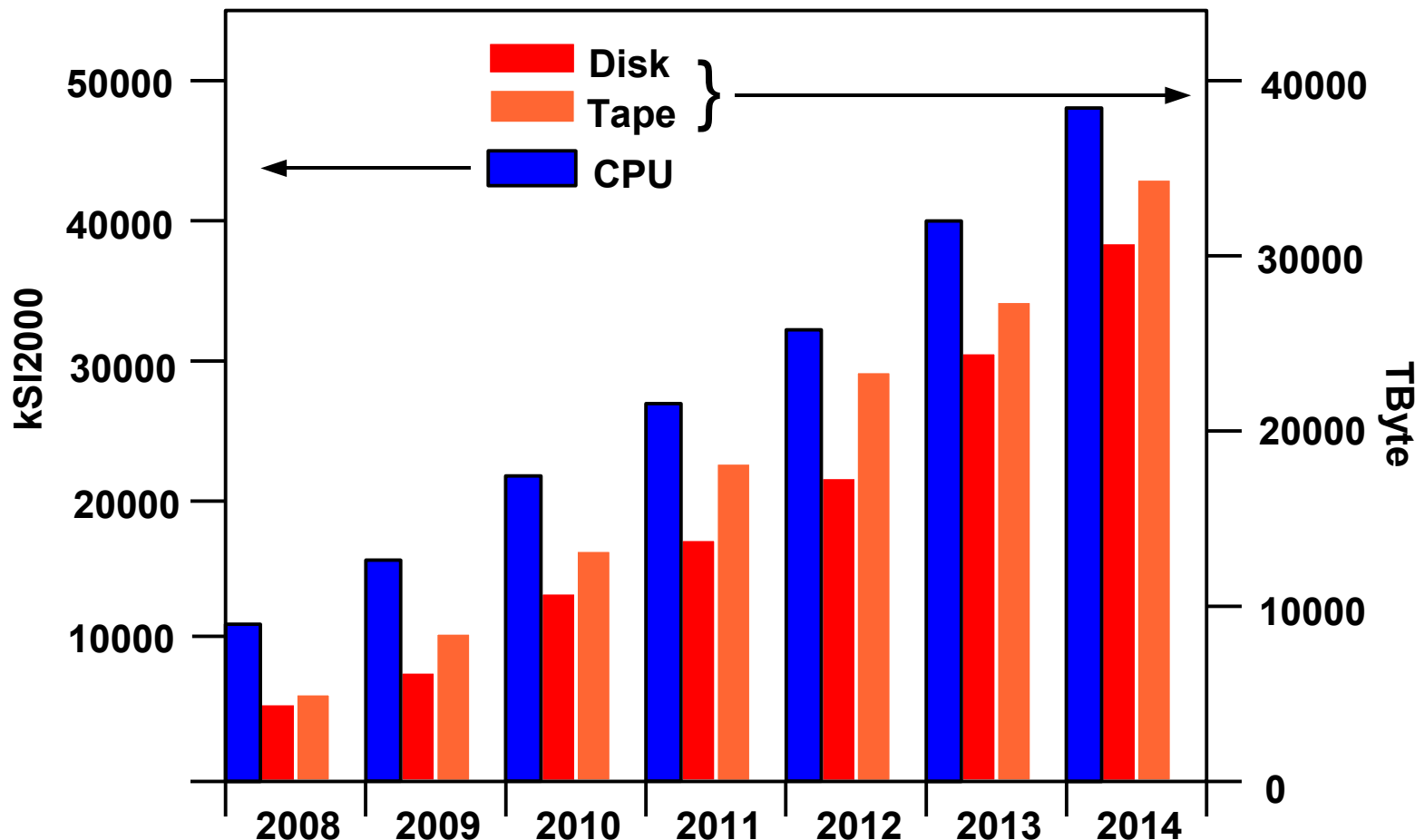
DESY storage and computing resources



numbers
correct for
2008?

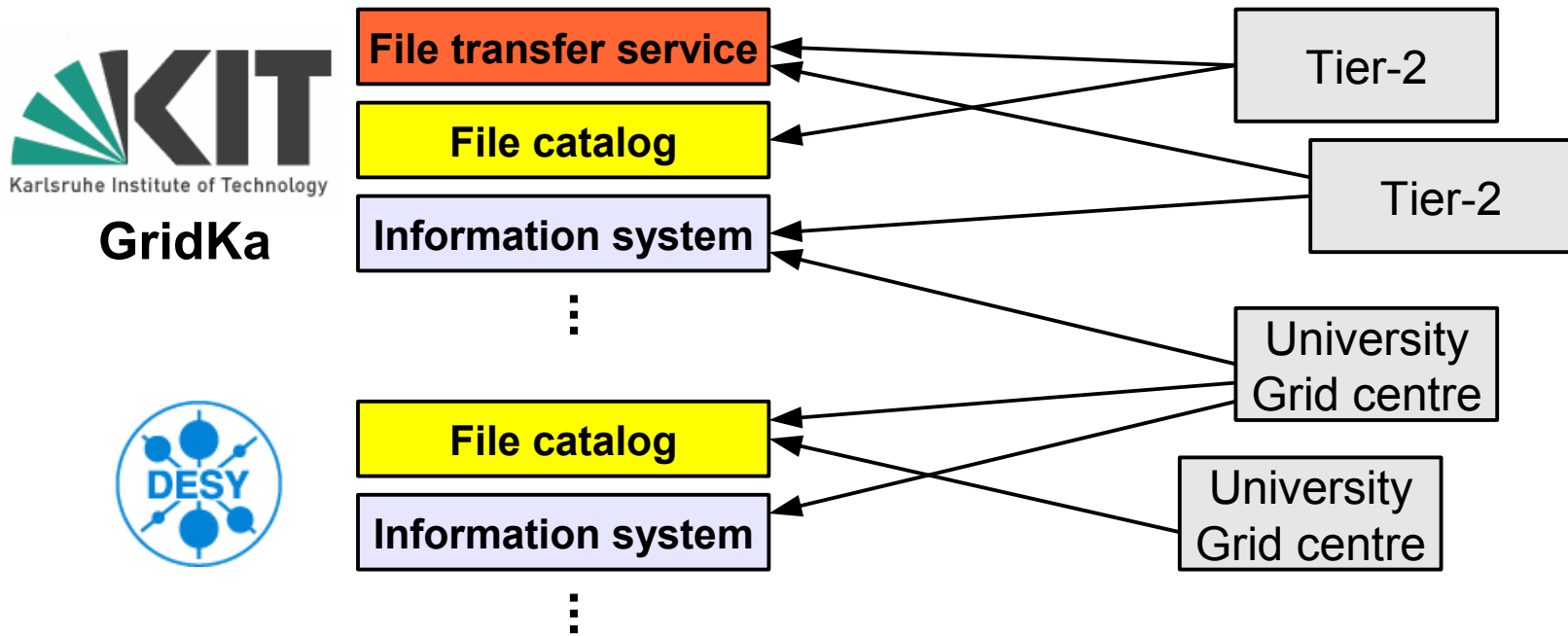
2008	Grid Hamburg (Tier-2, NAF, other HEP)	Grid Zeuthen (Tier-2, NAF, other HEP)	NAF non-Grid (batch/interactive)
CPU [kSI2k]	3000 (2000 cores)	700 (500 cores)	1200 (868 cores)
Disk [TB]	1350	460	

GridKa storage and computing resources



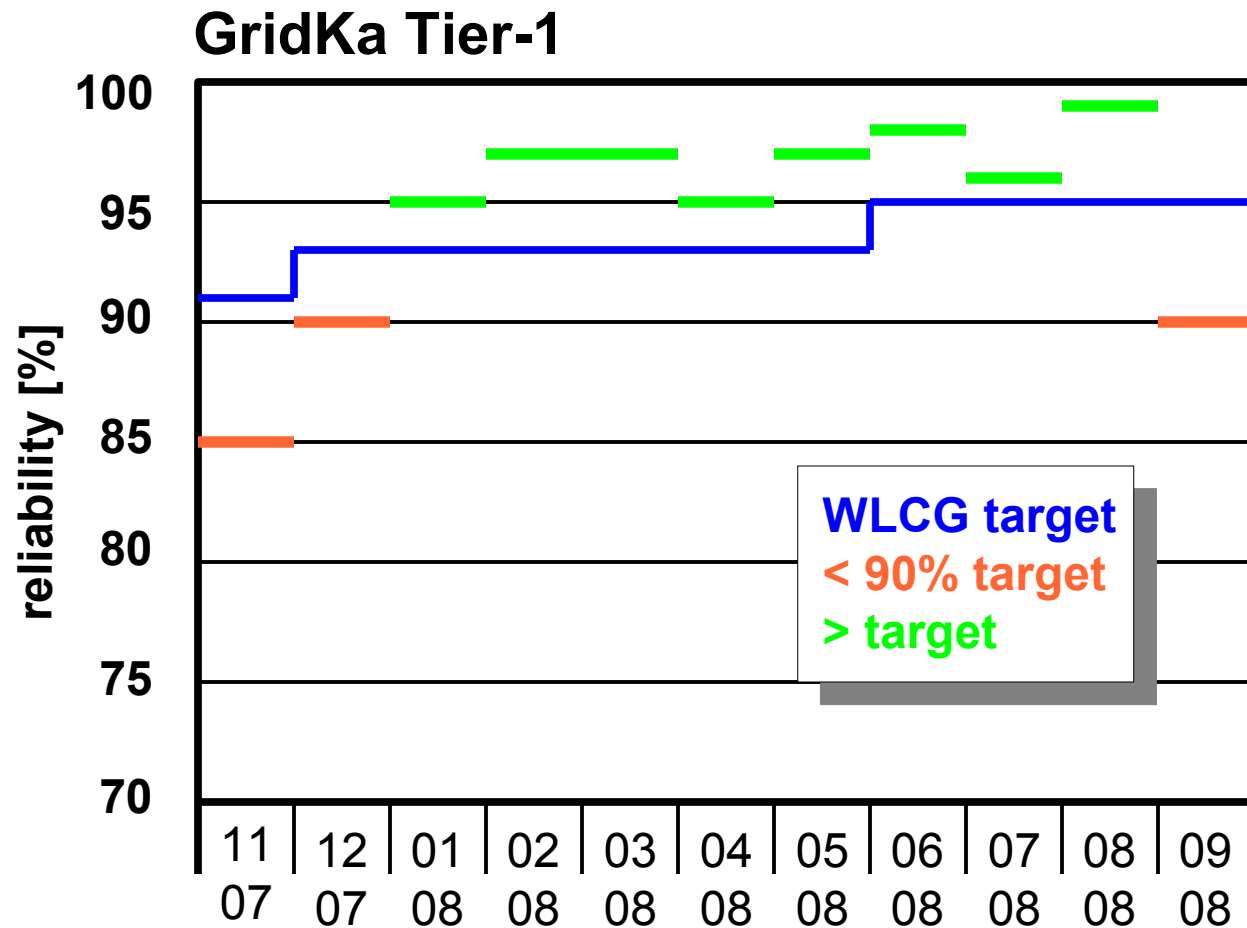
2008	Total		HEP	non-HEP (incl. D-Grid)
CPU [kSI2k]	10800	(6100 cores)	7700	3100
Disk [TB]	4300		3890	410
Tape [TB]	4880		4500	380

Fundamental Grid services provided for the whole HEP community



- Used by Tier-2 and university Grid centres
- LHC Computing in Germany and Europe depends on regional core services
- Highest reliability necessary

Service reliability measured by WLCG



Service reliability measured by WLCG

DESY Atlas and CMS Tier-2

DE-DESY-ATLAS-T2 (Germany ATLAS Federation, DESY)						
DESY-HH	2,018	97 %	97 %	97 %	94 %	98 %
DESY-ZN	450	100 %	100 %	100 %	98 %	100 %
DE-DESY-RWTH-CMS-T2 (Germany, CMS Federation)						
DESY-HH	2,018	97 %	97 %	97 %	94 %	98 %
DESY-ZN	450	100 %	100 %	100 %	98 %	100 %
RWTH-Aachen	2,024	86 %	86 %	77 %	90 %	95 %

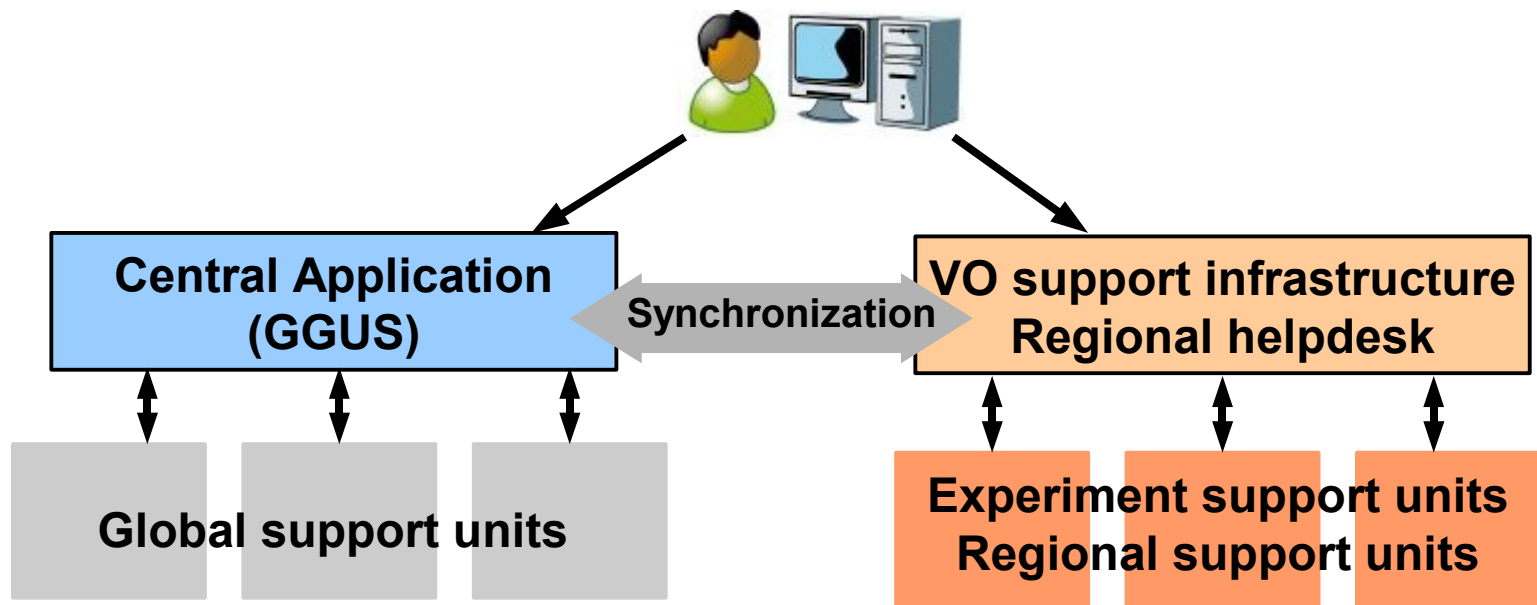
→ Excellent service quality by provided Helmholtz centres

dCache mass storage system



- Developed in collaboration between **DESY**, Fermilab, and the Nordic Data Grid Facility (NDGF)
- Close collaboration with GridKa (large dCache installation, testing)
- dCache will hold the largest share of LHC data outside CERN
- dCache is distributed by EGEE gLite and US Open Science Grid Virtual data tool (VDT)
- dCache is in production at **8** WLCG Tier-1 sites and **~40** Tier-2s
 - **High support effort**
 - DESY (international and national)
 - Helmholtz-Alliance 'Physics at the Terascale' (nat.)
 - D-Grid (nat.)

Global Grid User Support (GGUS)



- Central Grid helpdesk system developed at **KIT** for EGEE
- Adapted and extended to WLCG/HEP specific needs
- Single point of entry for all trouble tickets
- **59** support units , ~**1000** supporters on **5** continents
- **10** regional helpdesks connected and synchronized
- ~8000 tickets processed last year

Education and training activities

GridKa school

- 2003: 30 students
- 2008 in cooperation with the Helmholtz Alliance
- 2008: 170 participants (14 countries) from science and industry
- Highly visible, international event



dCache trainings

- strong involvement of DESY dCache experts and support people of the Helmholtz Alliance (KIT, LMU Munich, RWTH Aachen)

Summary

- **GridKa and the Desy Grid centre are crucial for Elementary Particle research in Germany and Europe.**
- **Support of Tier-2 centres and universities with Grid services.**
- **Important contributions to Grid development and training activities.**
- **The NAF is a key element for the data analysis at the universities.**

Challenges

- Immense increase of computing resources necessary during the coming years to fulfil the requirement of LHC data processing.
- Providing services with high level of quality and reliability.
- Support universities in grid computing for particle physics.
 - application / middleware support
 - education and training
- Support new communities in the Grid.
- Continue dCache / GGUS development, international support.
- Long term data preservation.
 - Keep data for 10 - 25 years

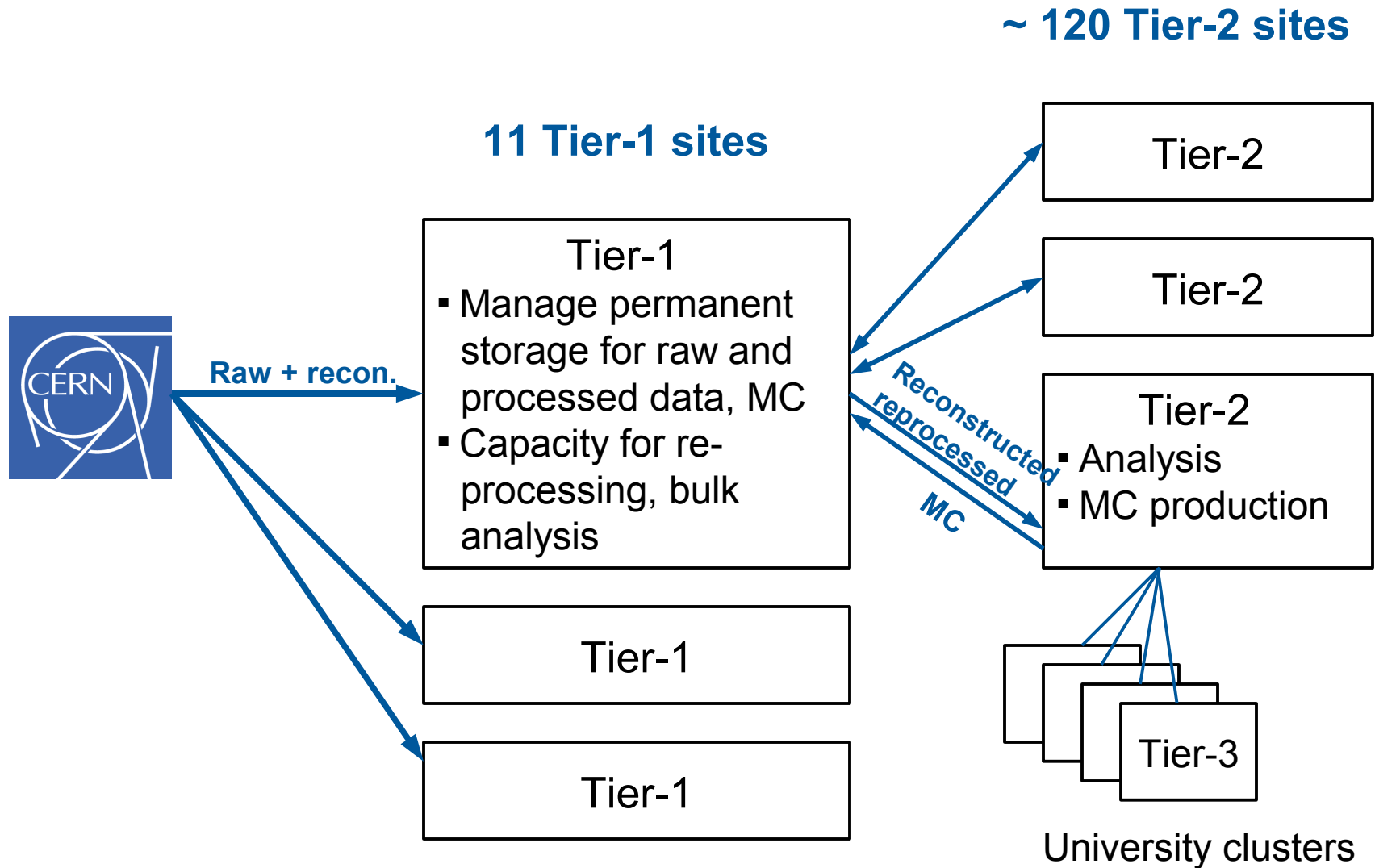
Waiting for collisions...



Backup Slides

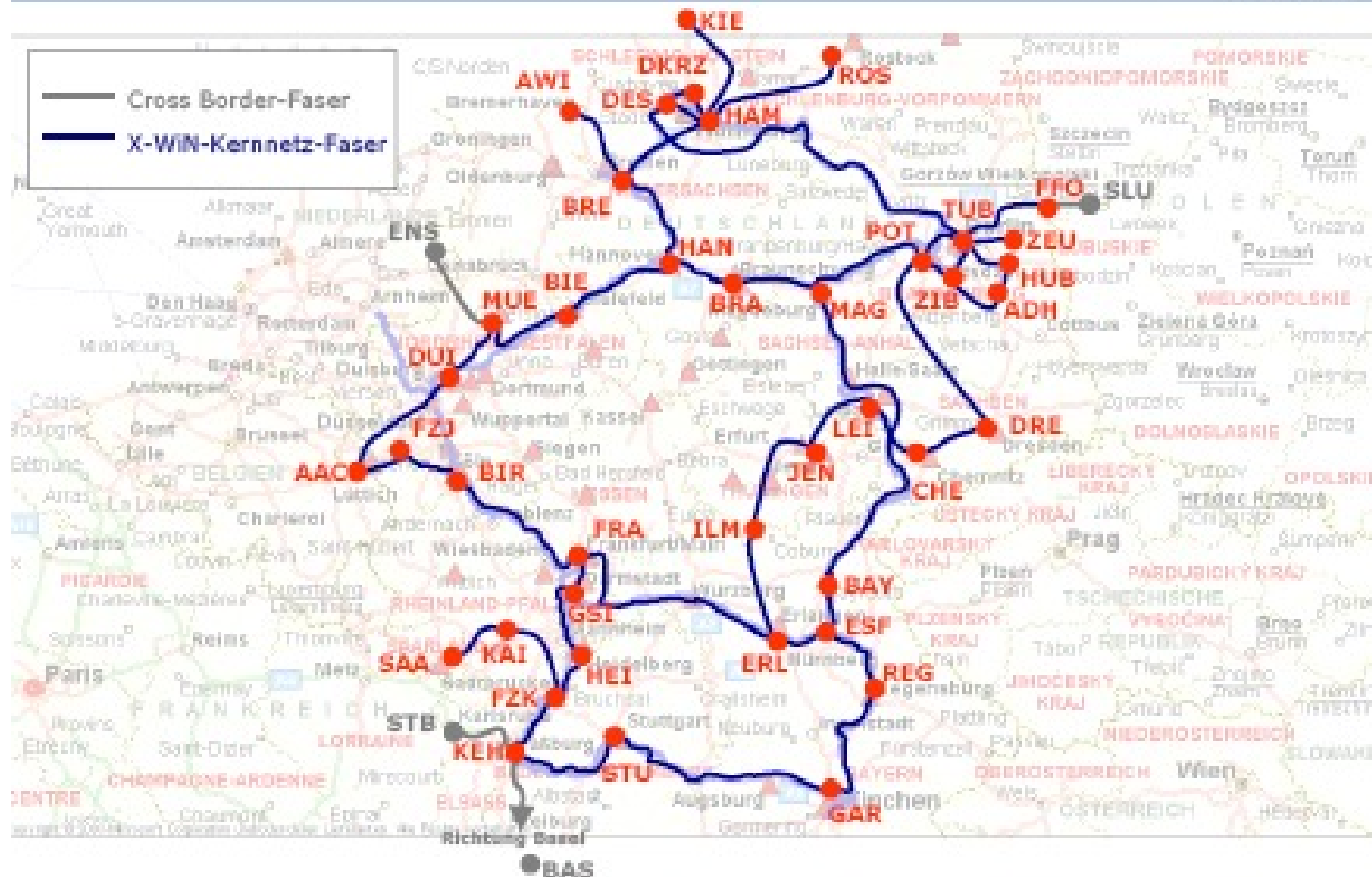
Alternative slides

The LHC computing model



German Science Network XWIN

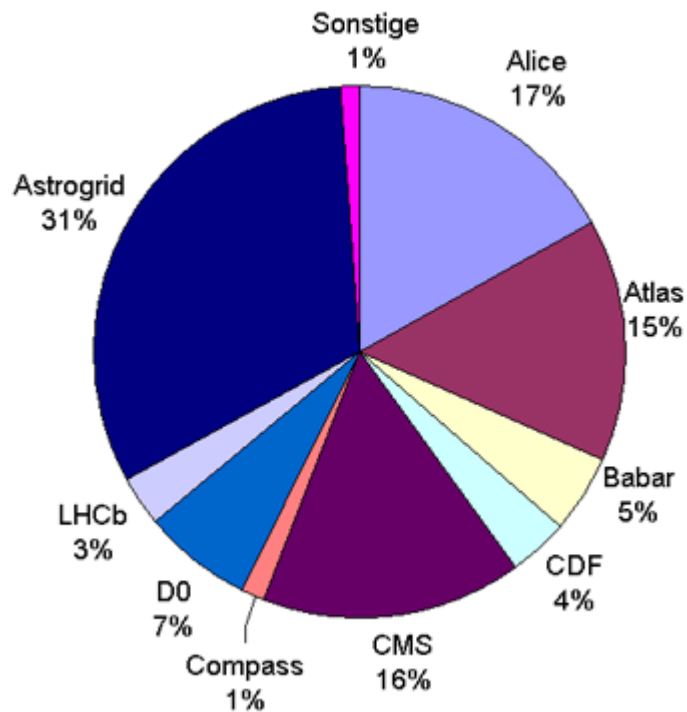
X-WiN: Topologie (Glasfasern)



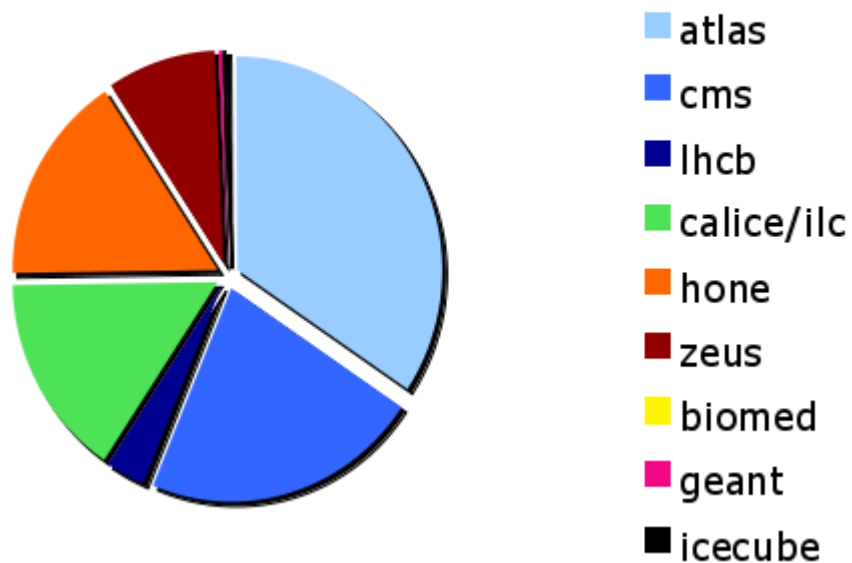
CPU utilization of GridKa and DESY Grid

GridKa 1.1. - 31.12.2008

3990500 CPU hours



CPU utilization DESY Grid (1.4.08-29.9.08)



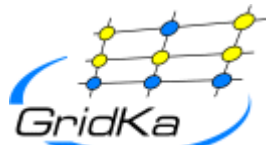
GridKa project organization

Technical Advisory Board (TAB)

- Discusses and reviews requirements of the VOs
- Discusses technical realization of GridKa
 - VO representatives
 - Tier-2 representative
 - DESY representative
 - KET, KHK (physics committees)
 - Project leader

Overview Board (OB)

- Discusses the project planning
- Discusses financial requirements
 - VO representatives
 - Tier-2 representative
 - TAB chairman
 - DESY representative
 - KET, KHK (physics committees)
 - BMBF representative
 - Head of the institute
 - Member of the FZK board of directors



- Planning
- Development
- Technical realization
- Operation



Management Board

Grid Deployment Board

Computing Resources Review Board

Computing Resource Scrutiny Group

Fundamental Grid services provided by FZK and DESY for the whole HEP community

Service	FZK/GridKa	DESY
Compute elements (CE)	X	X
Information systems (BDII)	X	X
Workload management systems (WMS)	X	X
File catalogs (LFC)	X	X
File transfer service (FTS)	X	
Storage elements (SE)	X	X
VO management (VOMS)	X	X
VO specific services (VOBox)	X	X

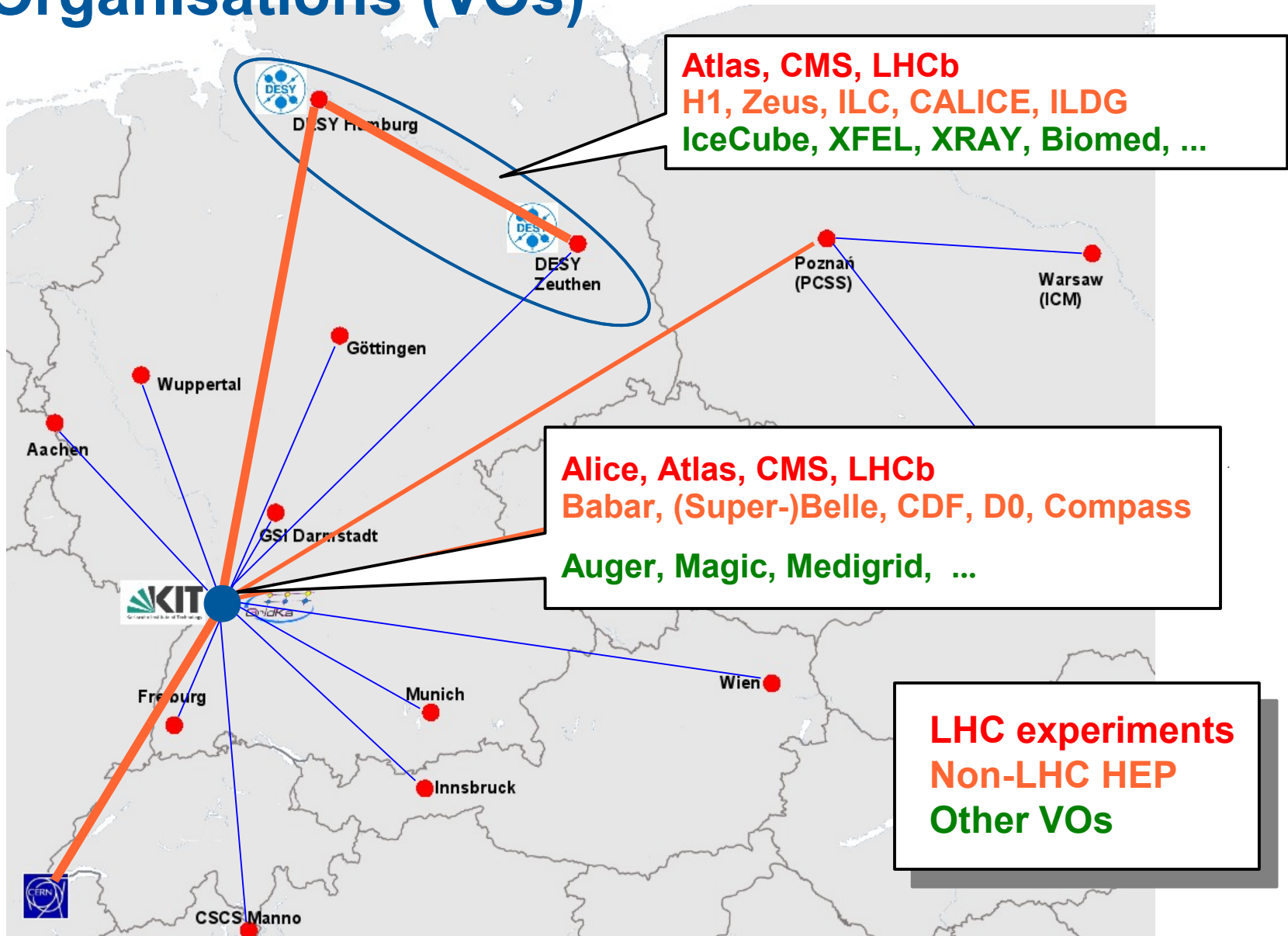
Very high reliability required for central (regional) services!

Service reliability measured by WLCG / EGEE

GridKa Tier-1

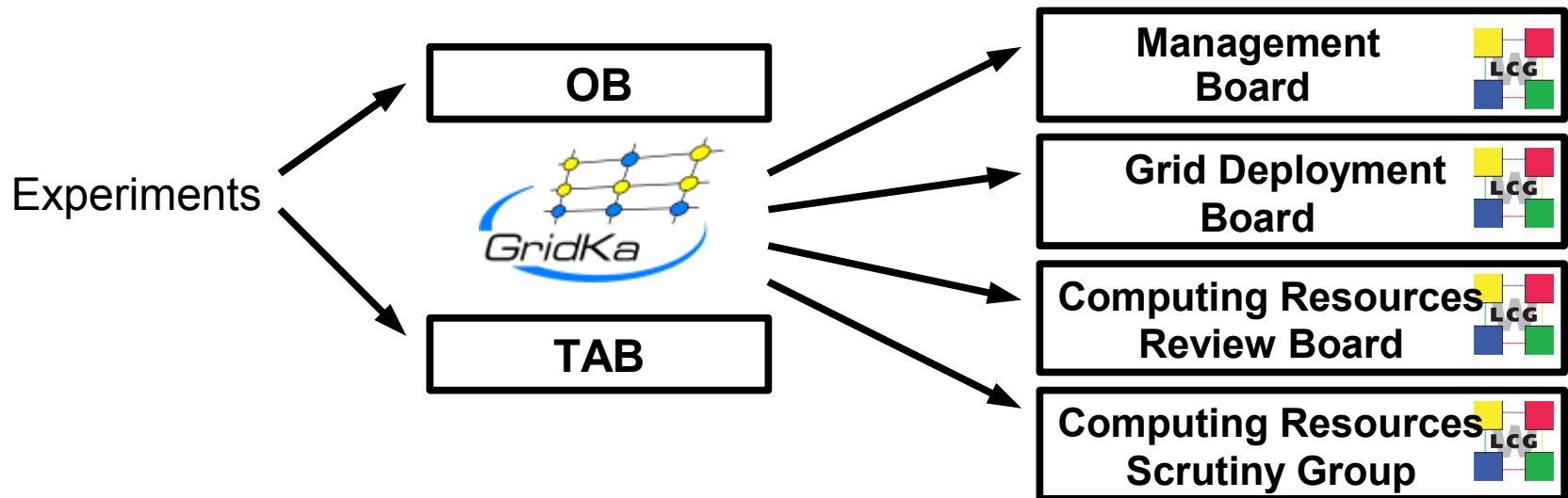
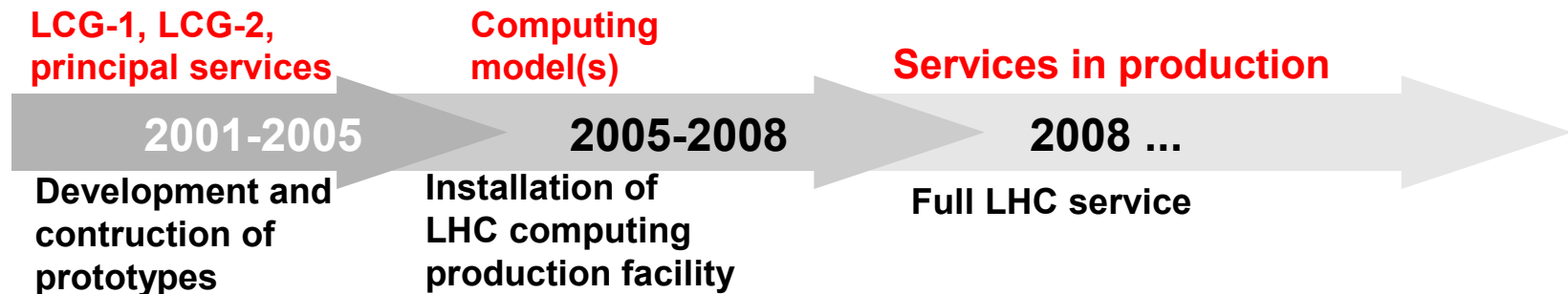
Milestone		ASGC	CC IN2P3	CERN	DE- KIT	INFN CNAF	NDGF	PIC	RAL	SARA NIKHEF	TRIUM F	BNL	FNAL
Tier-1 Sites Reliability - June 2008													
Tier-1 Sites Reliability above 95% Considering each Tier-0 and Tier-1 site	Jan 93%					70	92		92	57		91	
	Feb 93%					20	84			84		67	85
	Mar 93%					86		88				80	
	Apr 93%					76	84			90			92
	May 93%					88							
	June 95%					86							93
Average of Best 8 Sites above 97% Average of eight sites should reach a reliability above 97%						Averages of the 8 Best sites Jan-Jun 2008 Jan 96 - Feb 96 - Mar 96 - Apr 96 - May 98 - Jun 96							
Tier-1 Sites Reliability - Dec 2008													
Tier-1 Sites Reliability above 97% Considering each Tier-0 and Tier-1 site	Jul 95%		94			79	88			91			
	Aug 95%						43						

Supported experiments through Virtual Organisations (VOs)



GridKa

- Requirement by LHC and other international particle physics experiments
- Project proposed and started 2001
- Project planning oriented at the 3 phases (W)LCG timeline



Example: Grid for ILC

Monte Carlo production for ILC detector design

- development of grid tools (job submission scripts, web based production database)
- >50 M events fully simulated (geant4) and reconstructed Standard Model 'background' and new physics (Higgs/SUSY)
- ~70 TByte of storage at DESY Grid ('T0')
- ~200 CPU-years
DESY and other EU Grid sites (UK, F, ...)

Summary

- **The Helmholtz-Centres KIT and DESY build-up and operate large scale computing facilities which are crucial for elementary particle physics research.**
- **KIT and DESY strongly support the universities with Grid services.**
- **The NAF is a key element for the data analysis at the universities.**
- **Important contributions to Grid development and training activities.**