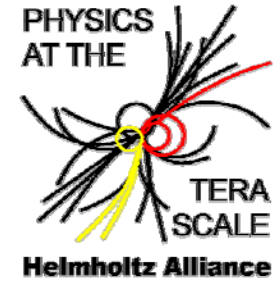


Grid Computing and the National Analysis Facility

**Günter Duckeck, Volker Gülzow, Andreas
Heiss, Thomas Kress, Günter Quast,
Christian Zeitnitz**

Outline



- 1. Computing for LHC in Germany**
- 2. The Terascale Alliance Grid Program**
- 3. The National Analysis Facility**
- 4. Conclusion**

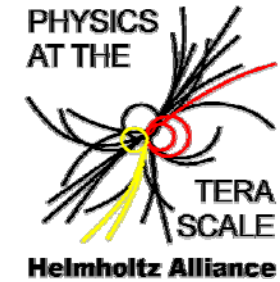
DESY

1. Computing for LHC in Germany



DESY

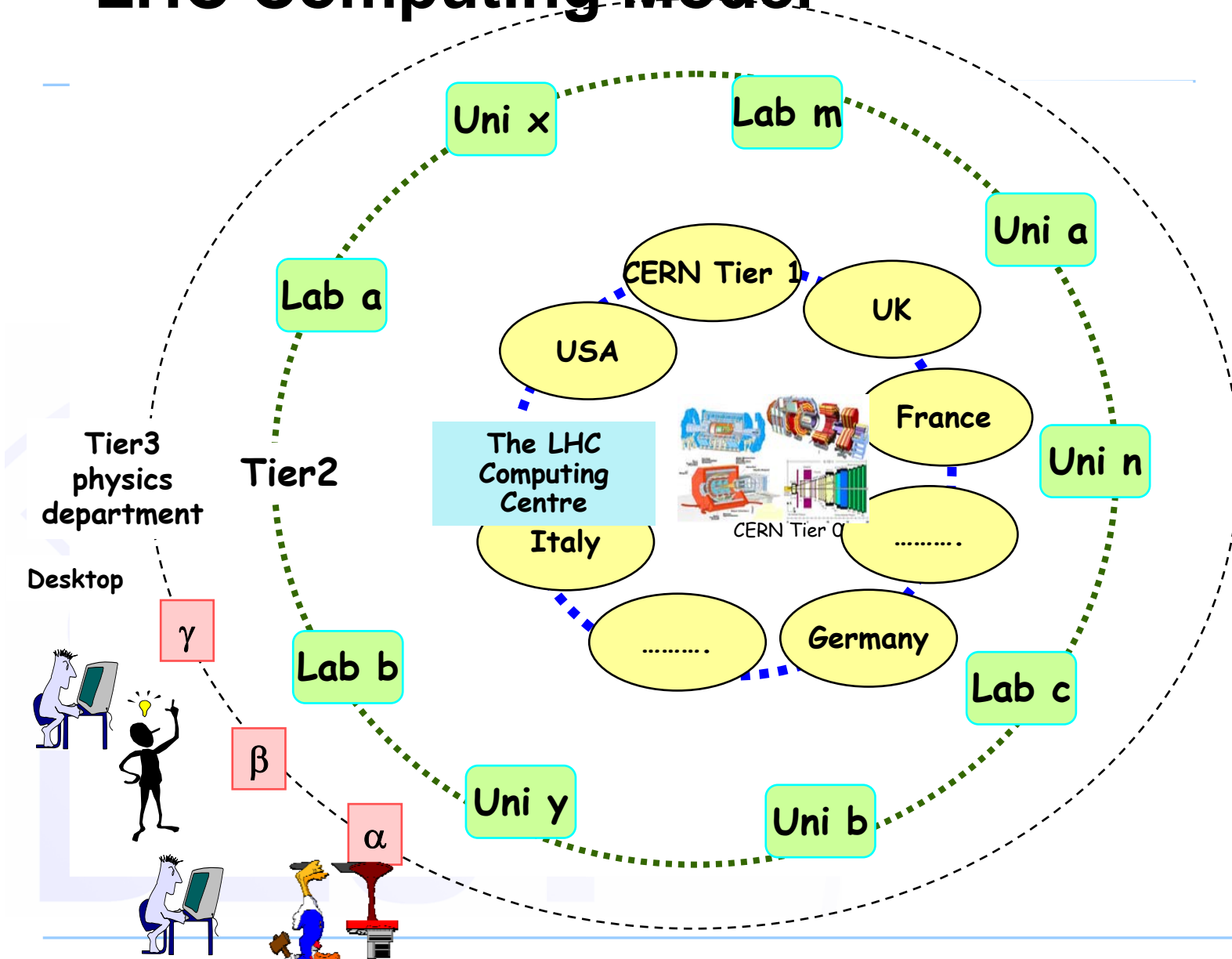
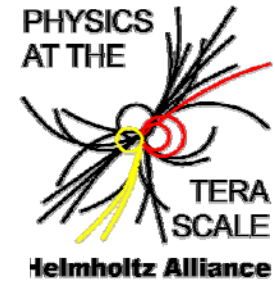
The Eventflow



	Rate [Hz]	RAW [MB]	ESD rDST RECO [MB]	AOD [kB]	Monte Carlo [MB/evt]	Monte Carlo % of real
ALICE HI	100	12.5	2.5	250	300	100
ALICE pp	100	1	0.04	4	0.4	100
ATLAS	200	1.6	0.5	100	2	20
CMS	150	1.5	0.25	50	2	100
LHCb	2000	0.025	0.025		0.5	20

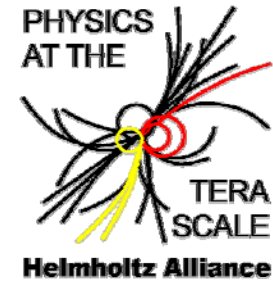
10⁷ seconds/year pp from 2008 on → ~10⁹ events/experiment
10⁶ seconds/year heavy ion

LHC Computing Model



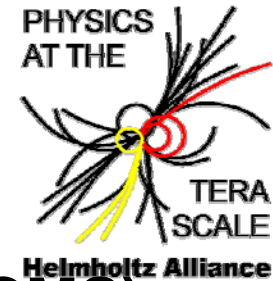
Hamburg, Dec 4th. 2007

The Hierarchical Model



- **Tier-0 at CERN**
 - Record RAW data (1.25 GB/s ALICE)
 - Distribute second copy to Tier-1s
 - Calibrate and do first-pass reconstruction
- **Tier-1 centres (11 defined)**
 - Manage permanent storage – RAW, simulated, processed
 - Capacity for reprocessing, bulk analysis
- **Tier-2 centres (>~ 100 identified)**
 - Monte Carlo event simulation
 - End-user analysis
- **Tier-3**
 - Facilities at universities and laboratories
 - Access to data and processing in Tier-2s, Tier-1s
 - Outside the scope of the project

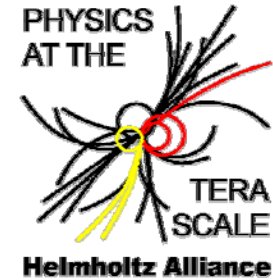
T2 Centres in Germany



- 3 average Tier 2's (Atlas), 1.5 average Tier 2 (CMS), 1 Tier 2 (LHCb) and 1 Tier 2 (Alice) are requested for Germany
- Desy: ~1 av. Tier 2 for CMS
 - - " - ~1 av. Tier 2 for Atlas
 - - " - 1 av. Tier 2 for LHCb
- Federations with Aachen and Göttingen
- Aachen commitment: ~0.5 average Tier 2 (CMS)
- Uni. of Freiburg, Wuppertal, LMU Munich & MPIfP 0.5 Tier 2 each (Atlas)
- GSI commitment: 1 av. Tier 2 for Alice



Memorandum of Understanding



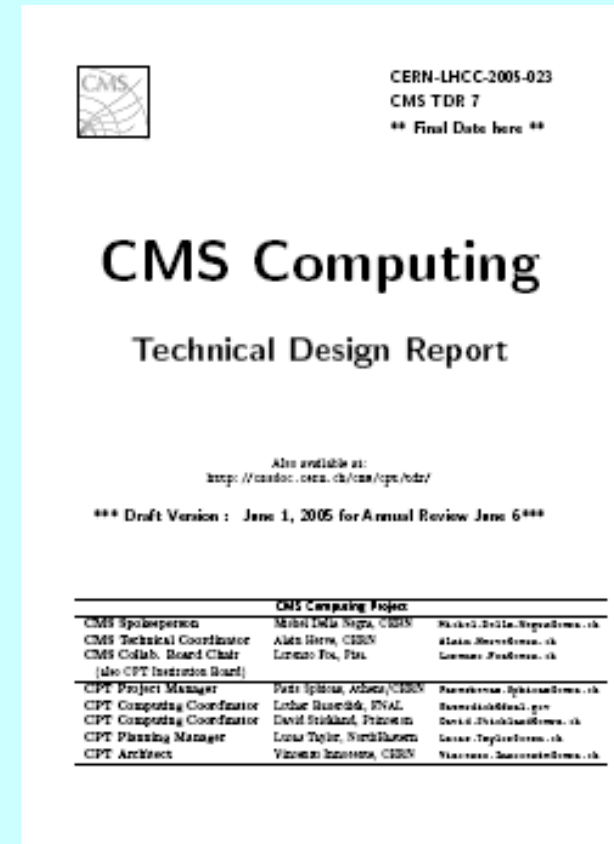
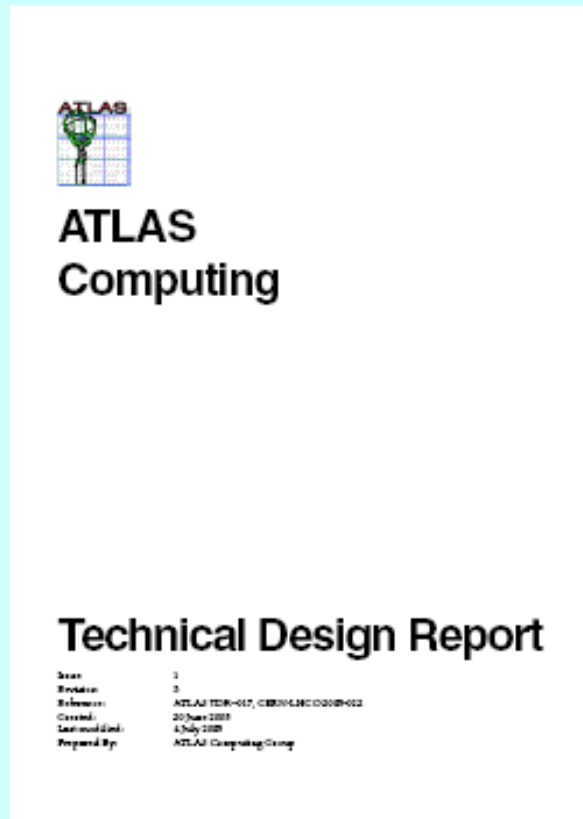
for Collaboration in the Deployment and Exploitation of the LHC Computing Grid between

The EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (“CERN”),
an intergovernmental Organization having its seat at Geneva, Switzerland, as the Host
Laboratory, the provider of the Tier0 Centre and the CERN Analysis Facility, and as the
coordinator of the LCG project, on the one hand,

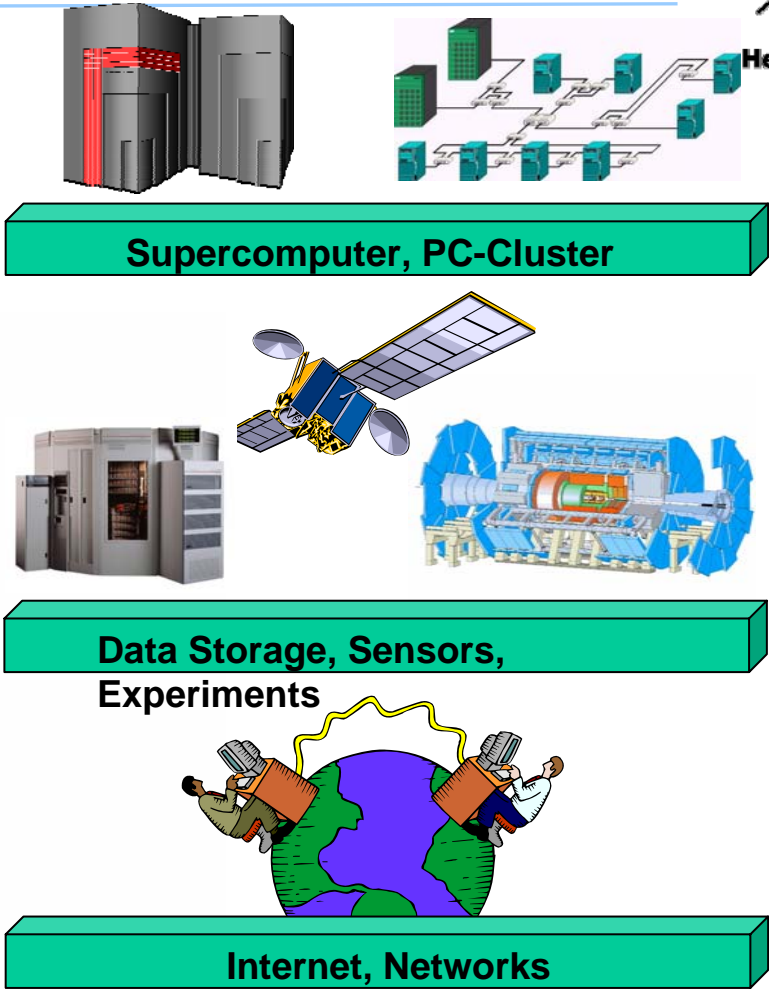
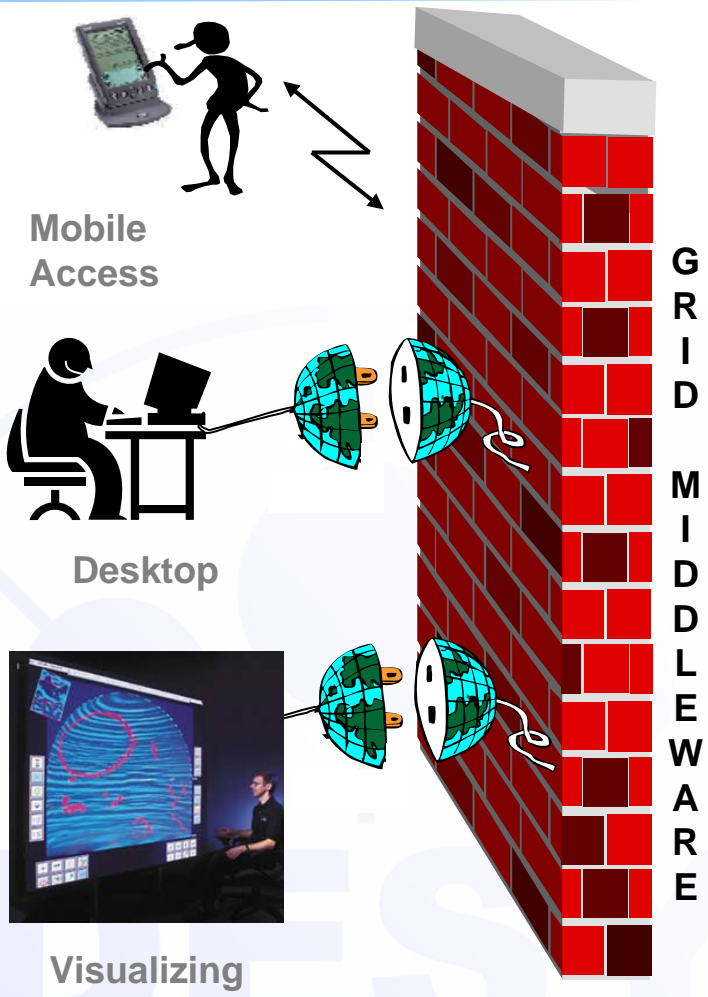
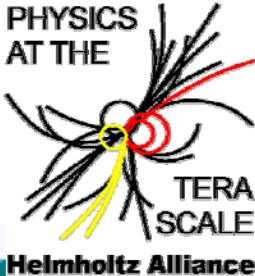
and

all the Institutions participating in the provision of the LHC Computing Grid with a Tier1
and/or Tier2 Computing Centre (including federations of such Institutions with
computer centres that together form a Tier1 or Tier2 Centre), as the case may be,
represented by their Funding Agencies for the purposes of signature of this
Memorandum of Understanding,
on the other hand, (hereafter collectively referred to as “the Parties”).

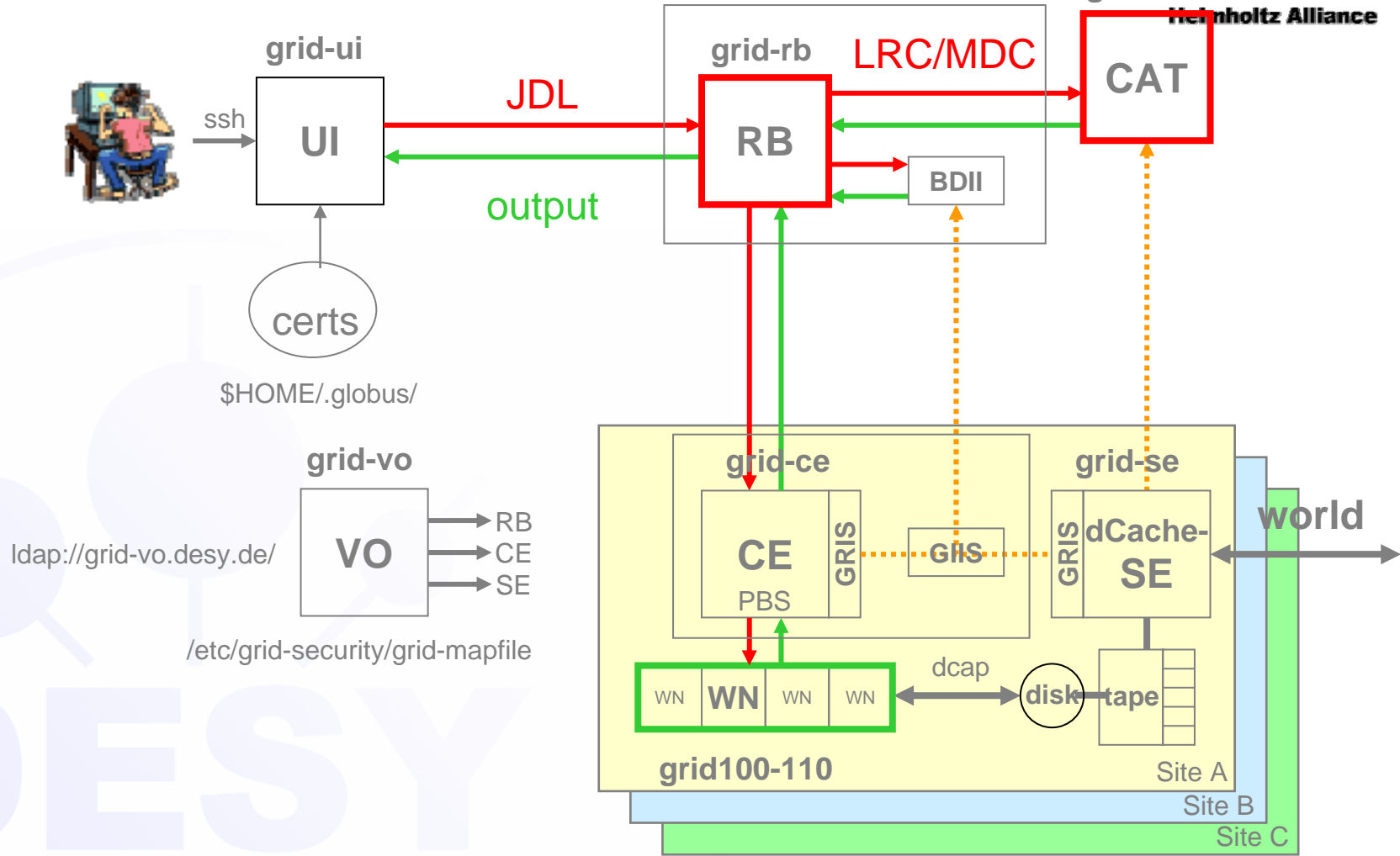
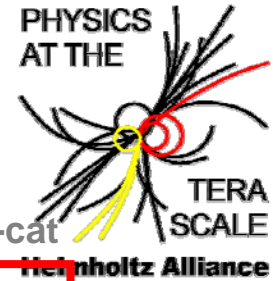
Where are the requirements stated?



Grid-Computing, a proper method for HEP



Grid Schema

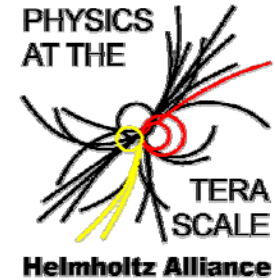


The Terascale Alliance Grid Program



DESY

Partners:



- **DESY**
- **Research Centre Karlsruhe (FZK)**
- **LMU Munich**
- **RWTH Aachen**
- **University of Freiburg**
- **University of Karlsruhe**
- **University of Wuppertal**

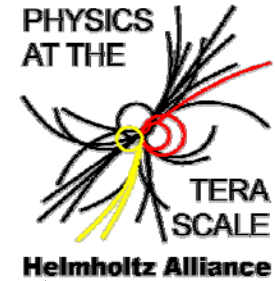
Physics at the Terascale

Scientific Goals

Work Packages

	Physics Analysis	Grid Computing	Detector Science	Accelerator Science
Scientific Goals	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 			
	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"> • Computing resources Tier 2 • National Analysis Facility • High performance network • User friendliness • Grid-based mass storage 	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			
	Training and Exchange	Grid Training	R&D Projects	
Backbone Activities Management – Young Investigator Groups - Fellowships – Equal Opportunities – Outreach – Interim Professorships				

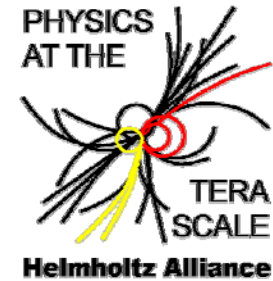
Primary Objectives



- **To allow German Institutes/Universities to participate in WLCG**
- **To provide a outstanding computing infrastructure to the German particle physics community**
- **To become a major contributor to Grid technology**

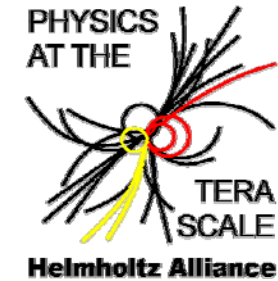
DESY

Objectives



- **Develop the needed GRID infrastructure**
- **Establish a National Analysis Facility to provide the needed computing resources for batch and interactive analysis by individual physicists**
- **Form a Virtual Computing Centre to optimize the utilisation of the available resources (Tier-1, Tier-2, Tier-3) in a coherent and efficient way and allow for an optimal access of all partner institutes to the computing resources and data**
- **Set up a high performance network between all collaborating institutes**
- **Further development of GRID structures and tools in order to optimize the reliability and utilization of the computing resources**
- **Provide Training, workshops and schools in order to train GRID users and site administrators.**

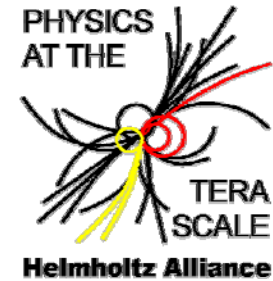
WP 1: Establishing a virtual Computing Centre



WP 1: Computing resources for the half Tier 2 centres (RWTH, LMU, Uni Freiburg, Uni Wuppertal)

		2007	2008	2009	2010	2011	2012
CPU Atlas	[kSI2k]	39	292	450	859	1152	1445
Disk Atlas	[TB]	21	129	219	369	518	668
CPU CMS	[kSI2K]	200	450	700	950	1200	1450
Disk CMS	[TB]	50	100	150	200	250	300

WP 1: Establishing a virtual Computing Centre



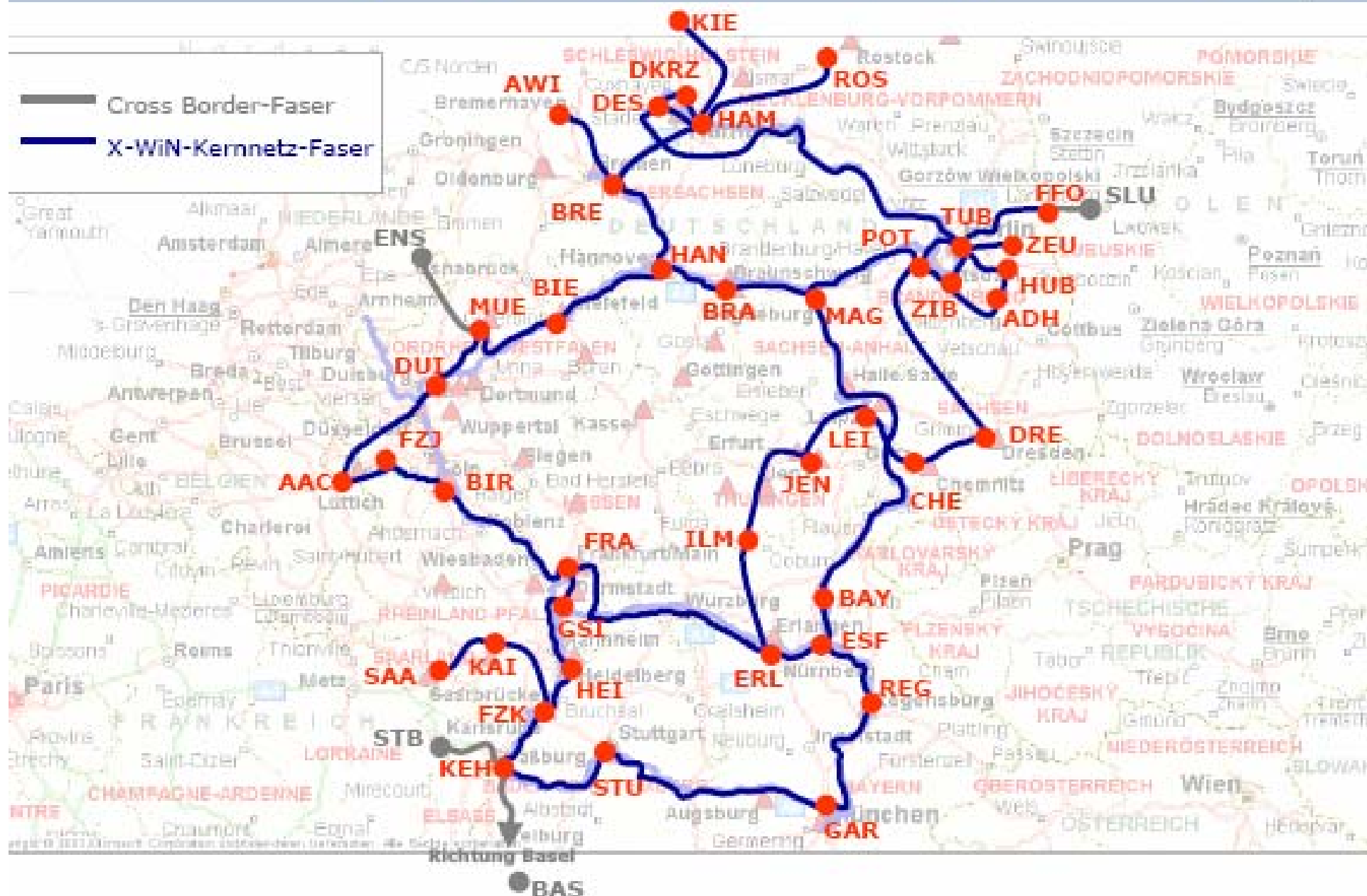
High Performance Networking

Idea:

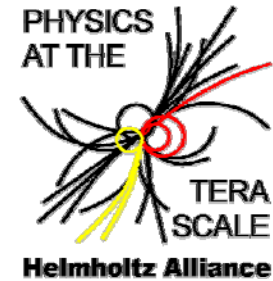
- Built up a national high bandwidth networking infrastructure for HEP-Labs/Universities
- Use existing DFN-Infrastructure and existing connections
- Allow fast access to data sources on Tier 1 and Tier 2's and the NAF

Coordinator: DESY, FZK

X-WiN: Topologie (Glasfasern)



WP 1: Establishing a virtual Computing Centre

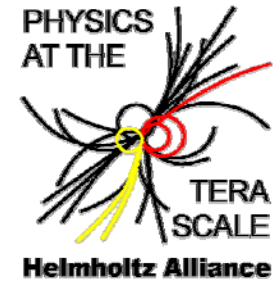


Operation and User friendliness of the virtual computer centre

- Redundancy
- Easy access to data
- Common user administration
- Support
- Resource scheduling and accounting
- Coordination and Management
- ...

Partners: All

WP 1: Establishing a virtual Computing Centre



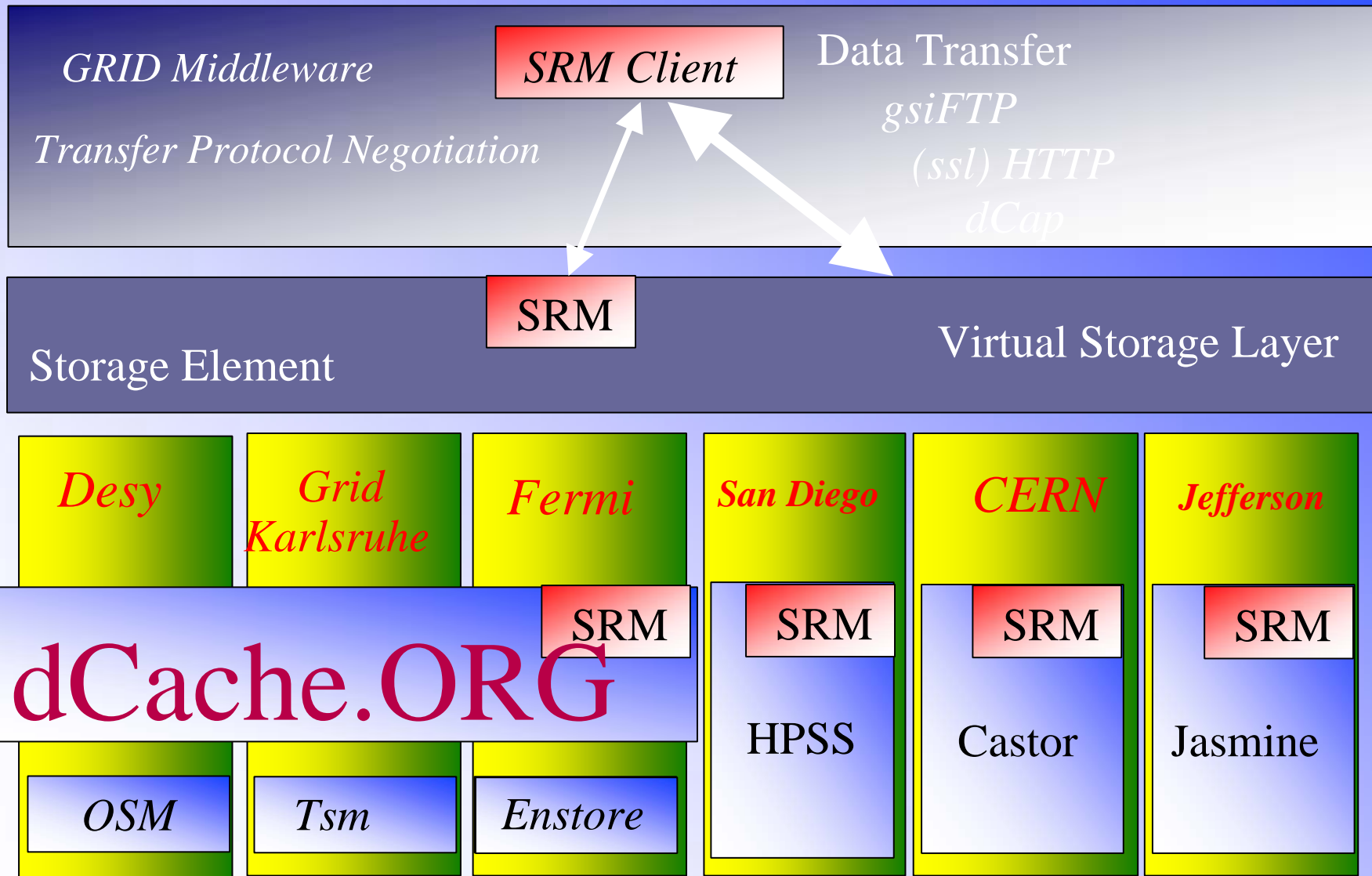
Development and deployment of a Grid-based mass storage system

dCache development for

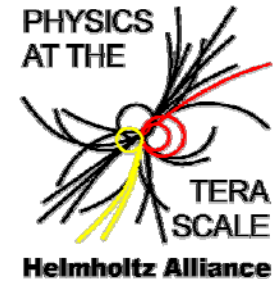
- Performance issues
- Scalability issues
- Ease of use
- Operational issues

Partners: DESY, FZK, LMU, RWTH

Grid Storage Fabric Abstraction



WP 2: Development of Grid Tools & Optimization of Grid Components



Virtualization of resources

Idea: Grid-Services on minimal hardware resources based upon virtualization techniques

Partner: FZK, Uni. Karlsruhe

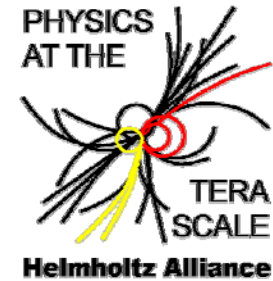
Application driven monitoring

Development, Integration and deployment of HEP-related monitoring tools for the whole Grid

Partners: FZK, Uni. Karlsruhe, Uni. Wuppertal

DESY

WP 3: Training, Workshops and Schools

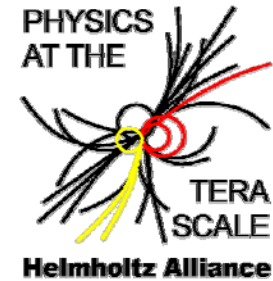


- Training lectures for users, admins, ...
- Data management courses
- documentation
- Schools (GridKa school, higher level schools, ...)

Partners: all participants

DESY

WP 2: Development of Grid Tools & Optimization of Grid Components



Improved Data Access Management

Idea:

- Manage physical data on the Grid by user criterias like access frequency/probability, management of replicas, management of metadata catalogs.

Partners: RWTH Aachen, Uni. Wuppertal

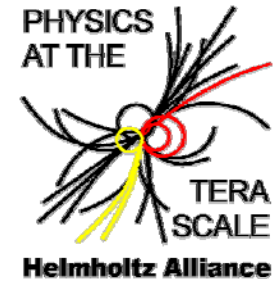
DESY

WP 1: Establishing a virtual Computing Centre

The National Analysis Facility (NAF)

DESY

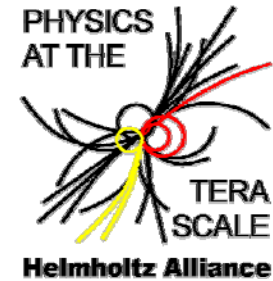
The National Analysis Facility (NAF)



The need for the NAF:

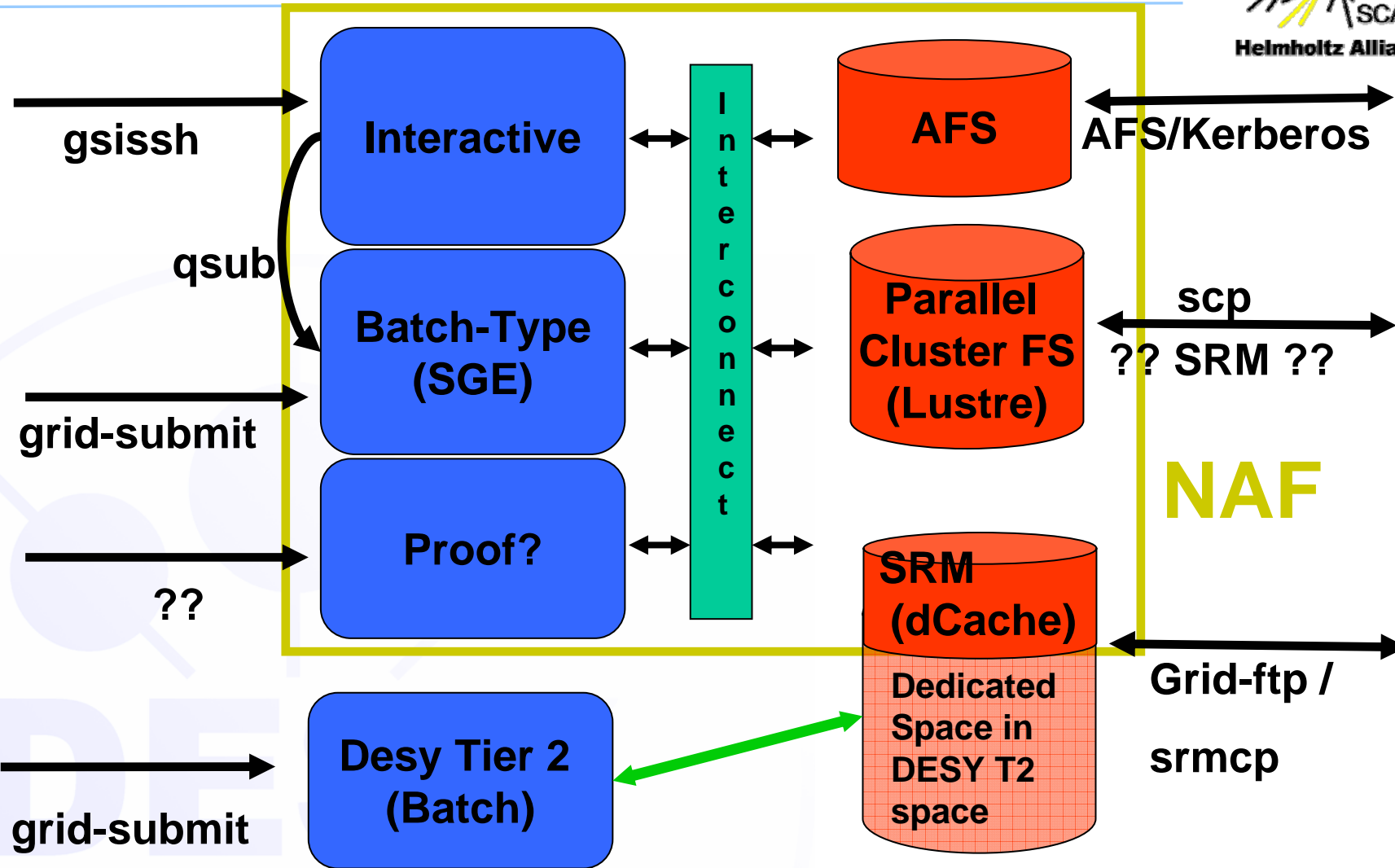
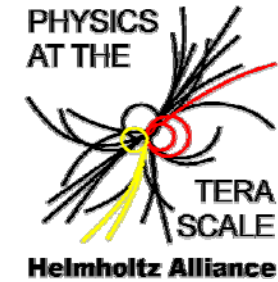
- Tier 2 resources are mainly for the international collaboration
- Tier 2 resources are by design for batch
- No interactive analysis facility available (except on Tier 3's)
- Tier 3 resources are not ready and not always well managed
- Competing countries do have a NAF

The National Analysis Facility

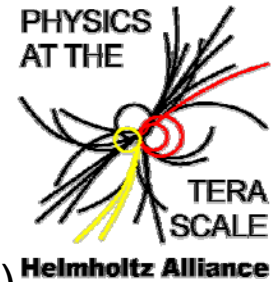


- Part of the Helmholtz Alliance
- Only accessible by german research groups for LHC/ILC tasks
- Used for batch and interactive usage
- Planned for a size of about 1.5 av. Tier 2, but with more data
- Starting as joint activity @ DESY, adding more sites later
- Requirements papers received from Atlas and CMS, input from LHCb expected
- Prototype design until Dec., discussion tomorrow afternoon
- Key points:
 - Fast and easy access to data
 - A more personalized environment than Grid
 - Large home directories
 - Easier job submission and debugging
 - Interactive usage

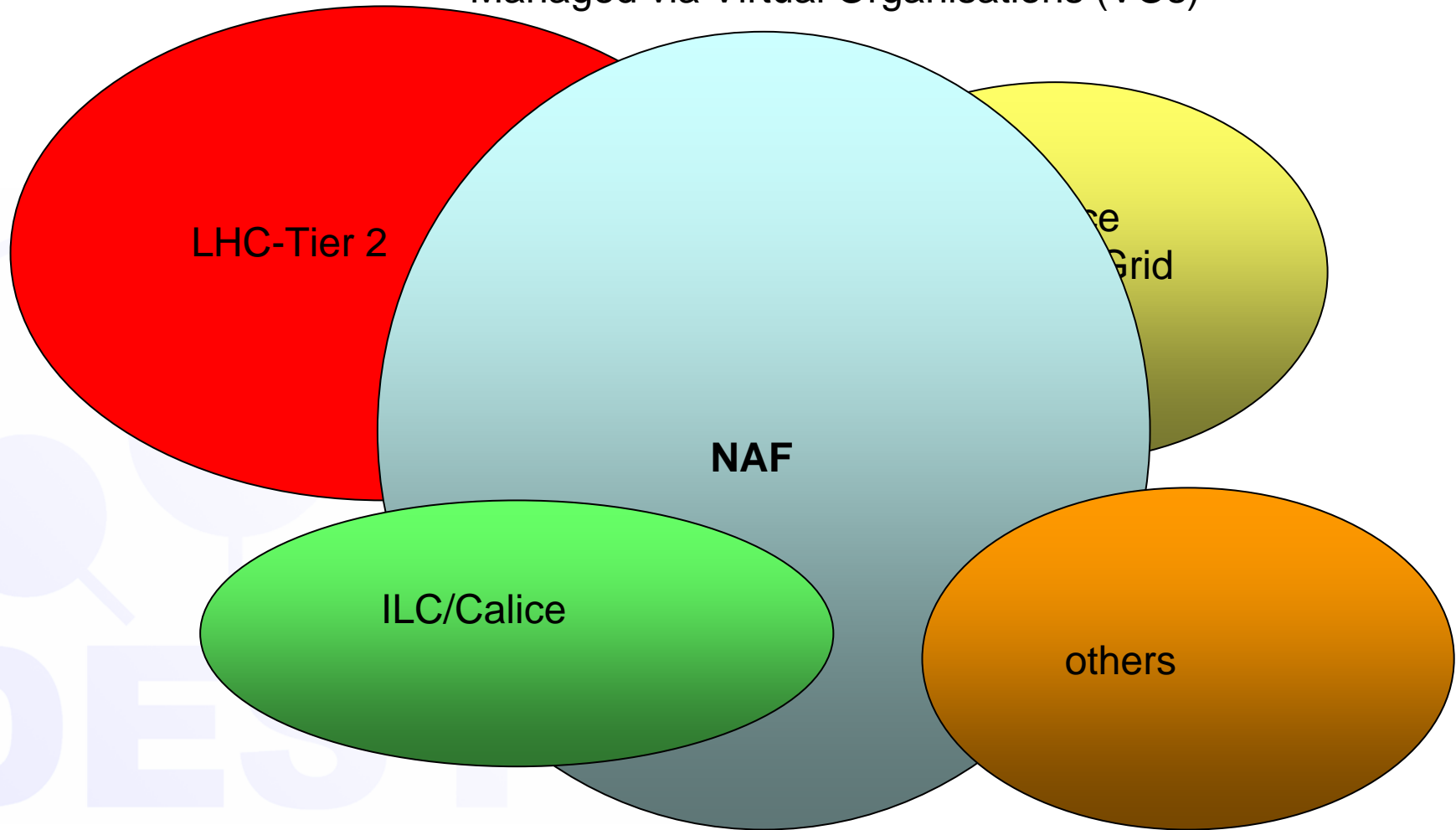
NAF: Schematic basic layout



The NAF is part of larger Grid



Managed via Virtual Organisations (VOs)



NAF Hardware Resources

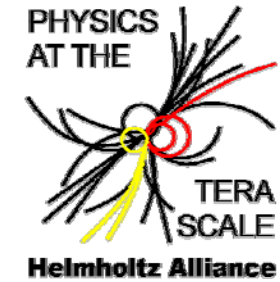
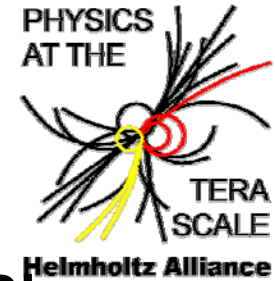


Table 2: Planned resource for the National Analysis Facility

	2007	2008	2009	2010	2011	2012
CPU [kSI2k]	110	280	540	800	1180	1720
Disk [TB]	70	180	360	580	920	1440
Tape [TB]	100	300	600	800	1200	1500



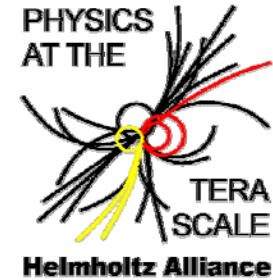
Status



- **Currently first hardware upgrades at the Tier 2's**
- **First positions (mainly dCache/virtualization) are taken**
- **More positions are announced**
- **Planning of networking under way (with DFN)**
- **Planning of workshops started**

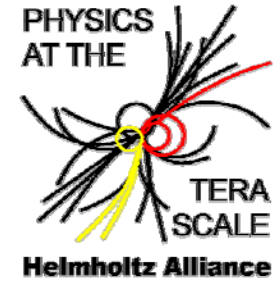
DESY

Summary



- **The whole idea of the Alliance Grid program is to set up a excellent computing infrastructure for LHC and ILC ...**
- **... and to help smaller groups**
- **We have a very ambitious program with very limited resources**
- **We try to cooperate with other projects (EGEE, D-GRID,...)**
- **We try to get as much as possible resources from other programs.**

links



<http://www.terascale.de>

<http://grid.desy.de>

<http://www-it.desy.de/physics/>

<http://www.dcache.org>

<http://cern.ch/lcg/>

<http://goc.grid-support.ac.uk/gridsite/accounting/index.htm>

dCache: Integration

