Computing / The DESY Grid Center
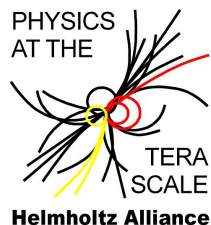
Developing software for HEP

- dCache

- ILC software development

The DESY Grid Center

- NAF, DESY-HH and DESY-ZN Grid overview

- Usage and outcome

Yves Kemp for DESY IT & DESY DV
70. DESY PRC
DESY Zeuthen 14.10.2010

HELMHOLTZ | ASSOCIATION

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dCache: Status

dCache as a project:

> Eight people at DESY

- Management, infrastructure, testing
- Development: NFS 4.1, Webinterface, main part

> Two people at Fermilab

- Development: SRM, gPlazma, Res. Manager

> Two people at NDGF

- Development: Specific NDGF needs

FTE Funding:

Legend:
- Fermi
- NDGF
- DESY (IT)
- HGF@DESY
- D-Grid@DESY
- EMI @ dCache.org
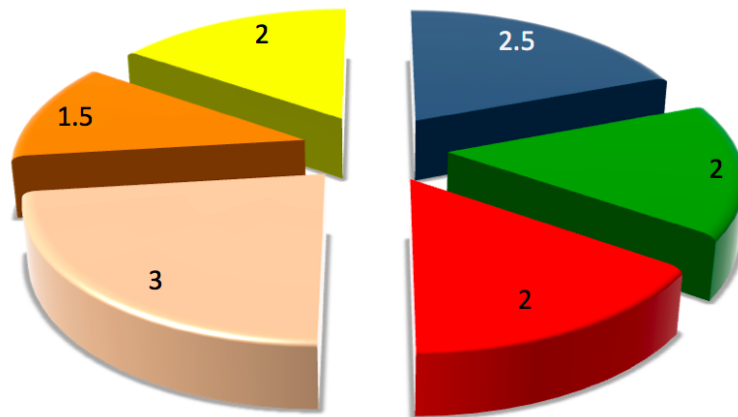
The current situation:

> Originally, developed at DESY for HERA

> Now massively used in WLCG

- More than ½ of all LHC data on dCache SE
- In about 40 Tier 2 and 8/11 Tier 1
- Total data stored in dCache (WLCG) ~20 PByte

> One of the four middlewares in EMI

- EMI: European Middleware Initiative
- dCache project leader also EMI Data Area Leader

"DESY pays two developers and gets 10 in return"

dCache, Future

Future of dCache

1) ## New customers

   - CFEL, European XFEL,…

   - LOFAR: LOw Frequency ARray in the Netherlands and Europe

   - SNIC: Swedish National Infrastructure for Computing, many branches of Science will use a dCache system distributed over many Swedish CC

2) ## New developments

   - Focusing on standard access protocols: Be competitive with industry solutions and benefit from their developments (e.g. WebDAV & NFS 4.1, also of interest in WLCG)

   - EMI + HGF imposing extended code quality control

3) ## Sustained funding for next three years through EMI + HGF is guaranteed

ILC software development

> Software support of ILC detector development:

- core software tools
- reconstruction software
- Grid production
- data storage
- software releases

> People at DESY IT:

- two scientists, one engineer
- Working in close collaboration with DESY FLC group and KEK, SLAC, CERN, LLR,...

> Recent activities:

- improve realism in detector simulation
- develop new tracking package
- develop Grid production system
- improvement of core tools (persistency, EDM, Conditions data,...)

> Projects involved:

- **EUDET - (ends 2010):**

  task leader "ANALYSIS"

- **AIDA – starts 02/2011:**

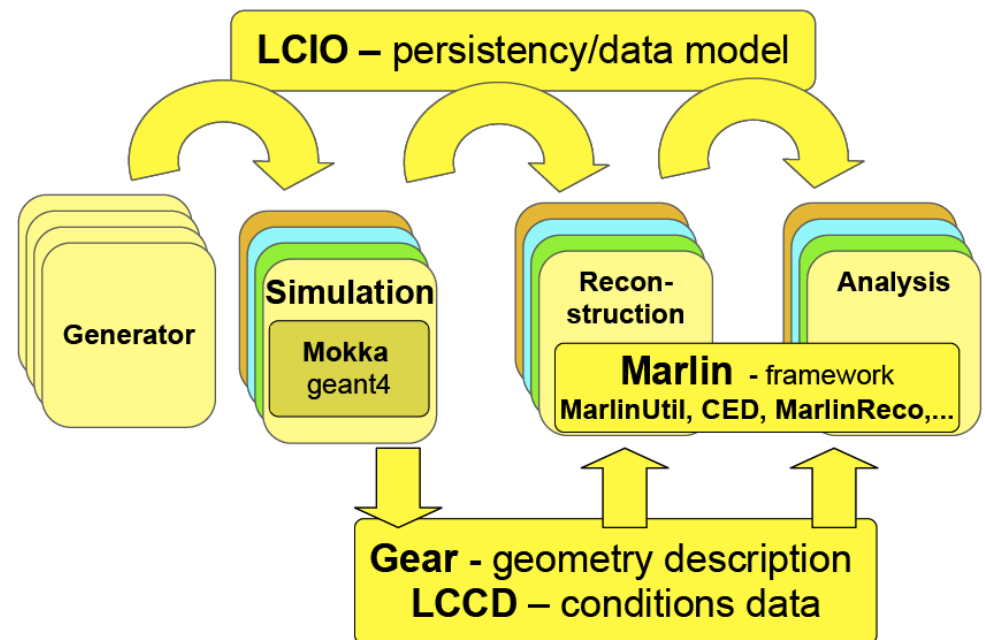 coordination of WP2 "Common Software"

  & task leader "Reconstruction"

http://ilcsoft.desy.de/

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ILC detector studies: Core Tools

User community diverse:
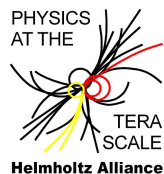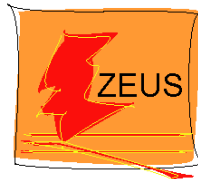
> **ILD/CLIC** detector studies

> **Calice** calo testbeam

> **LC-TPC** testbeam

> **EUDET** - Pixel Telescope

Overview of the different components and their interactions:

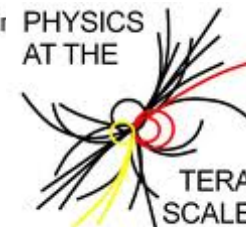➔ **Synergies between testbeam & global detector optimization**

DESY GridCenter
combining Grid / LHC Tier-2
and the National Analysis Facility

Which communities?

> **HERA** experiments: H1, Zeus, Hermes, HERA-B

> **LHC** experiments: ATLAS, CMS, LHCb

> **Future** HEP experiments: ILC, CALICE

> **Astro**: IceCube, CTA

> **Theory**: ILDG

> DESY **photon science** (CFEL, XFEL, …)

> Monitoring and training VOs

> DESY Grid Center platform for many diverse DESY activities.

> Many different services needed … see next slide

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Which services?

> Providing **Data storage**

> Providing **Computing power**

> Providing additional services to **DESY, national and global community**:

- Grid User interface on AFS: Used at different institutes in Germany, no need for them to deploy and maintain an own version of it.

- Grid Workload Management Systems (WMS): Largest WMS resource in Germany with ~6000 jobs/day, approx. 1/3 DESY, 1/3 Germany, 1/3 World

> **Central VO services** for (among others) HERA, IceCube & ILDG

- VOMS registry server, LFC file catalogue, …

> **Additional VO-specific** site services, like SQUID server, PHEDEX-Server, …

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Special NAF services

> **Access to experiment data on the Grid Storage Element**

> CPU cycles for analysis: interactive and local batch

  ▪ Complement the Grid resources

  ▪ New techniques like PROOF

> Additional storage: Lustre parallel file system

> Home directories on AFS, accessible from everywhere
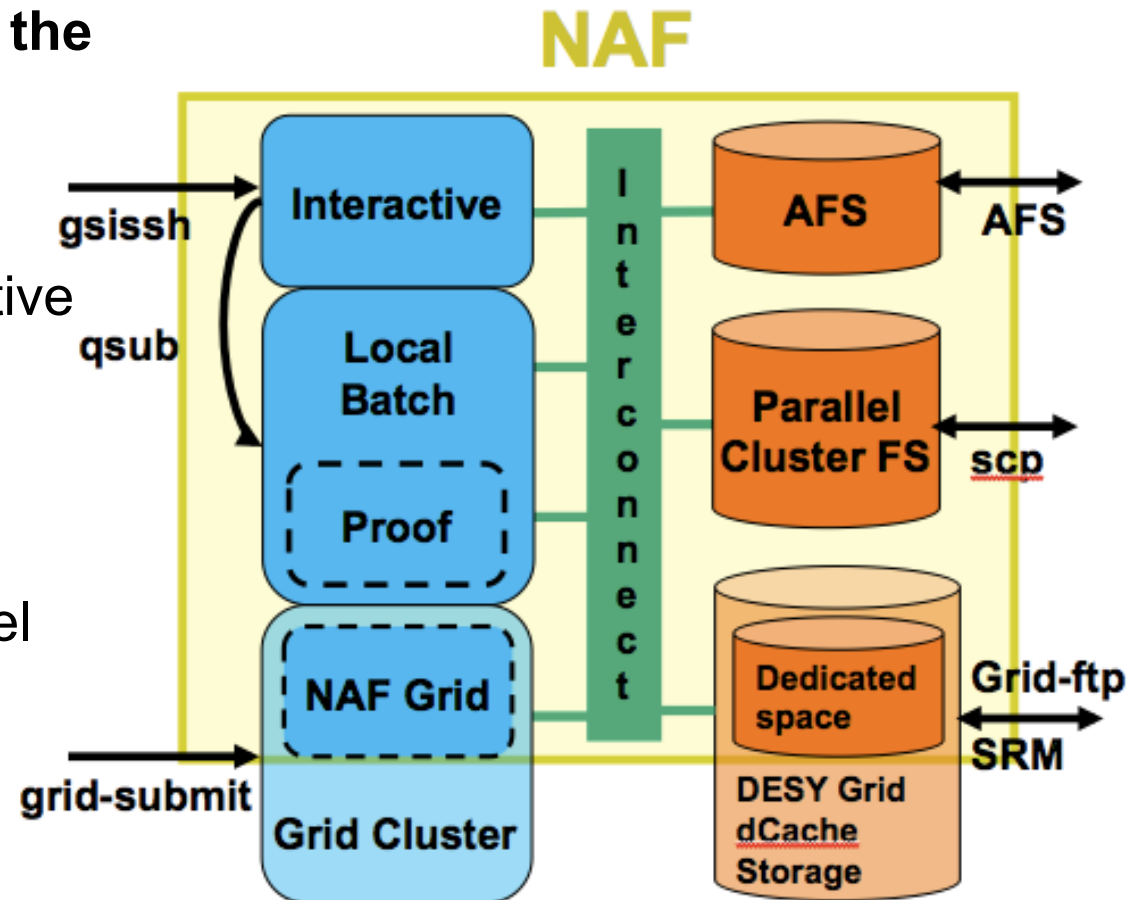
NAF CPU

> Different contributions:

- Core contribution (DESY, BMBF, D-Grid, Alliance…)

- DESY ATLAS group

- LHCb contribution

- CMS Uni-Hamburg
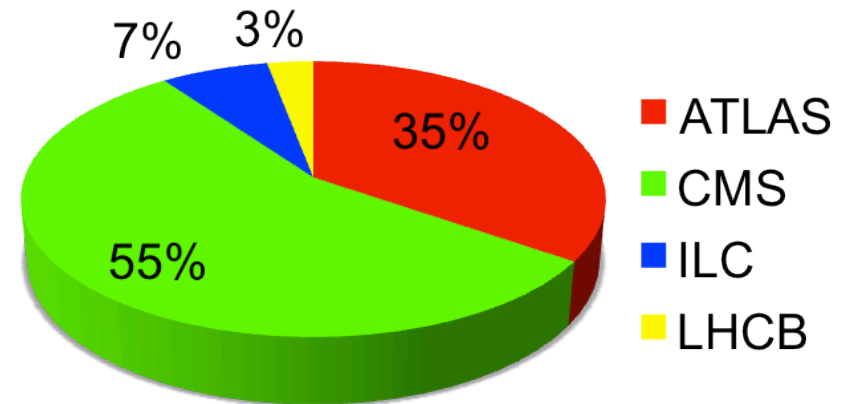
- … each contributing to the same infrastructure.

> **Concept: Sharing infrastructure works**

NAF CPU usage 1.4.-30.9.2010
All participants within ~10% of contribution

- 7%
- 3%
- 35% ATLAS
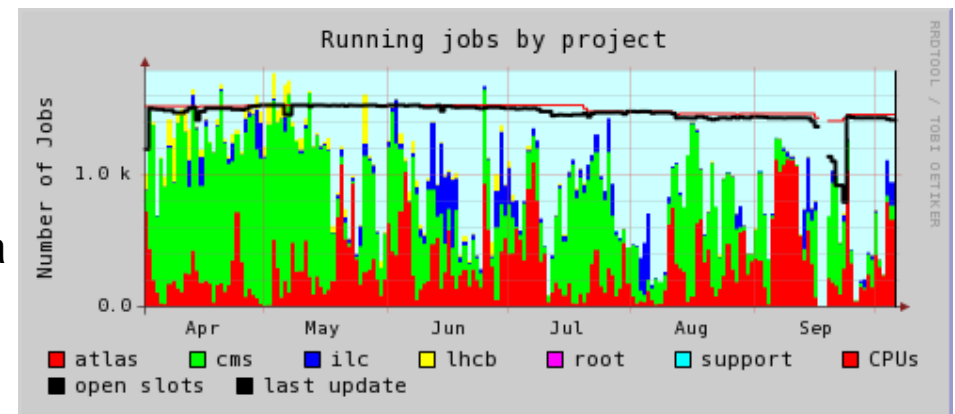- 55% CMS
- ILC
- LHCB

> Different expectations

- Financers want good occupation

- Users want many resources and (probably more important): no/small waiting time

- Experiment and users want fast access to data

> **Meet different expectations**

1.4.2010 – 30.9.2010: 66% Occupancy

Running jobs by project

atlas cms ilc lhcb root support CPUs
open slots last update

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NAF CPU usage by institutes

> The NAF is well accepted among the German user community

> DESY plays a big part, but not the biggest one

> UniHH have invested hardware in NAF, and using it extensively

> Some non-German researches invited by experiments to fully complete their analysis chains

5%
15%
41%
39%

■ UniHH ■ German ■ DESY ■ HUB

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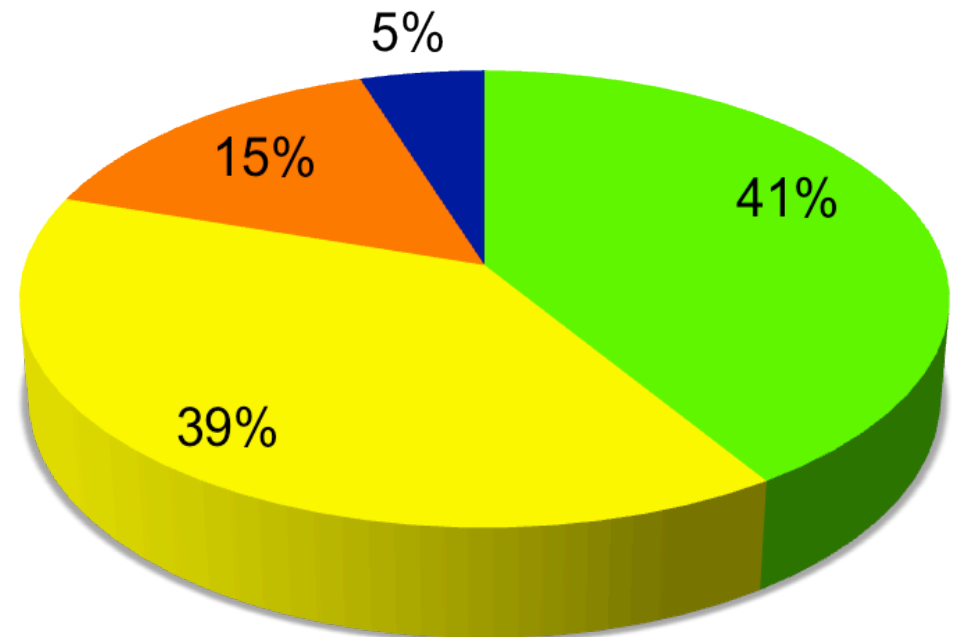
DESY

The best metric for NAF success:

> First CMS analysis explicitly mentioning the NAF: **CMS PAS QCD-10-005**

Measurement of the Underlying Event Activity with the Jet Area/Median Approach at 0.9 TeV

Acknowledgements

We would like to thank Matteo Cacciari, Gavin Salam and Sebastian Sapeta for their precious help in understanding the theory and their useful suggestions. We also thank the National Analysis Facility (NAF) administrators and WLCG for providing the excellent and reliable computing infrastructure necessary to carry out this analysis.

> "Constraining SUSY models with Fittino using measurements before, with and beyond the LHC" (arXiv:0907.2589v1 [hep-ph]) also mentions NAF.

> Many more analyses going on on the NAF:

   > ATLAS Minimum bias

   > …

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DESY Grid Occupancy
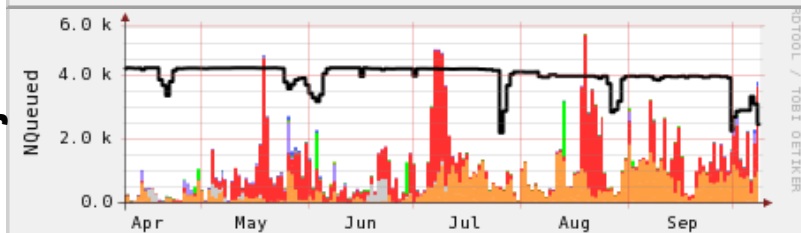
> DESY CPU Grid: Shared by many VOs

> … and many different job profiles

- CPU intensive

- Network/Storage intensive

- Local RAM or local HD intensive

- …

> Plots below are job-centric – not taking into account other used resources

> Sharing of resources works

> Both DESY-HH and DESY-ZN fulfilling 2010 T2 MoU pledges.

April-now DESY-HH
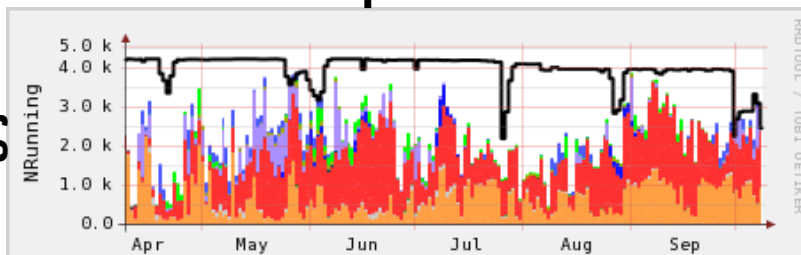
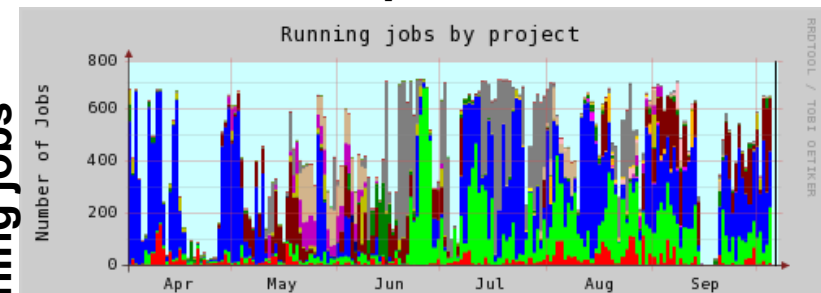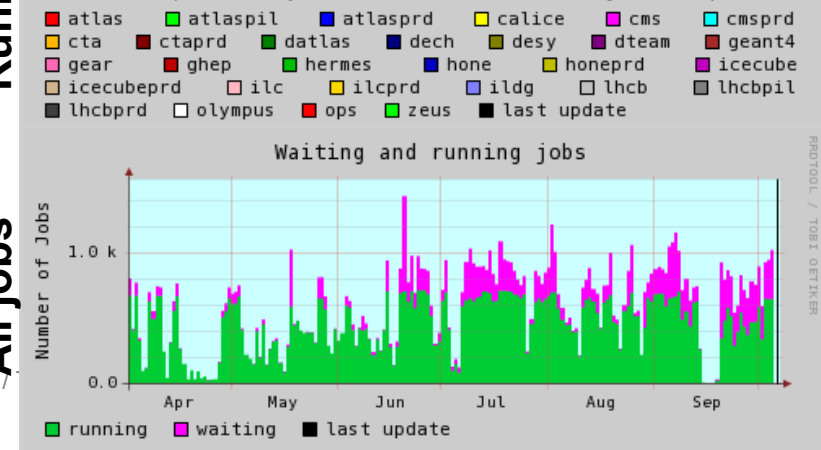**April-now DESY-ZN**

dCache storage:

> Central data store for all experiments

> Used from the Grid CPU and NAF CPU cluster

> LHC VOs have enormously raised volumes of data available

> Data availability key aspect of the NAF

  ▪ Focus on storage capacity

  ▪ … and available bandwidth

> T2 MoU Pledges:

  ▪ ATLAS: 740 TB @ 1.4.2010

  ▪ CMS: 400 TB @ 1.4.2010

> **Additional space for NAF usage!**

Used space | **Free space**
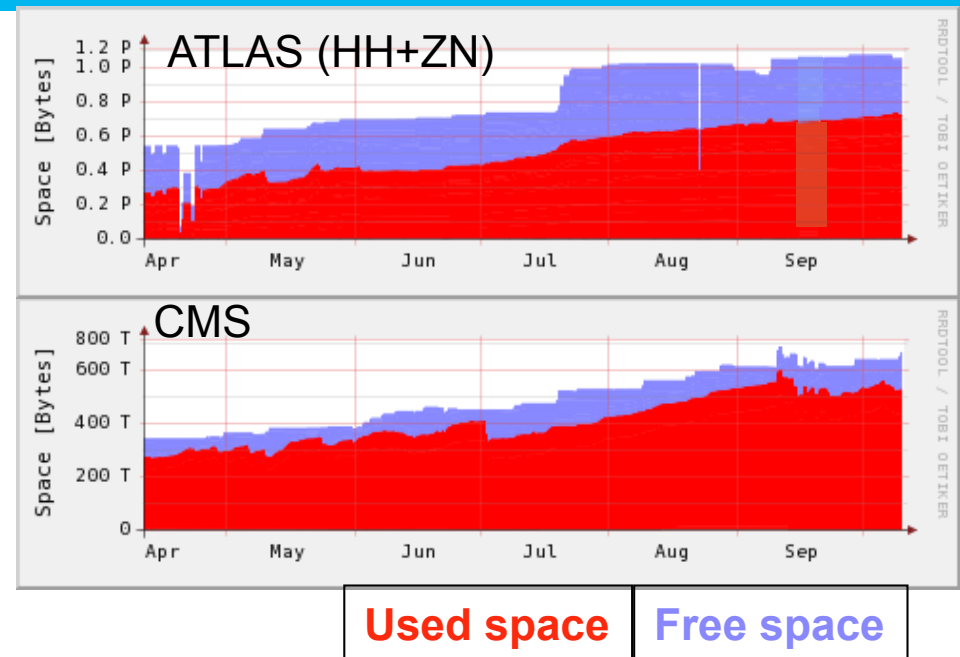
> ToDo next month: (Experiments and providers)

  ▪ (re)evaluate needs for NAF additions

  ▪ (re)evaluate needed bandwidth

  ▪ Develop tools to prevent "cold data"

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ATLAS TAG DB

> **Idea:** Have a database with a very condensed event format (~1kB/evt)

> a very fast pre-selection of events as input for data analysis

> DB at CERN, PIC, BNL, TRIUMPF and DESY (not Tier-2 duty!)

> Based on Oracle, knowledge at DESY

> Currently: ~9 TB used, 18 TB available

  ▪ CPU&DB resources sufficient for the moment

> **DESY service for global ATLAS!**

  ▪ DE users all directed to DESY

  ▪ MC only at DESY, serving **all** requests
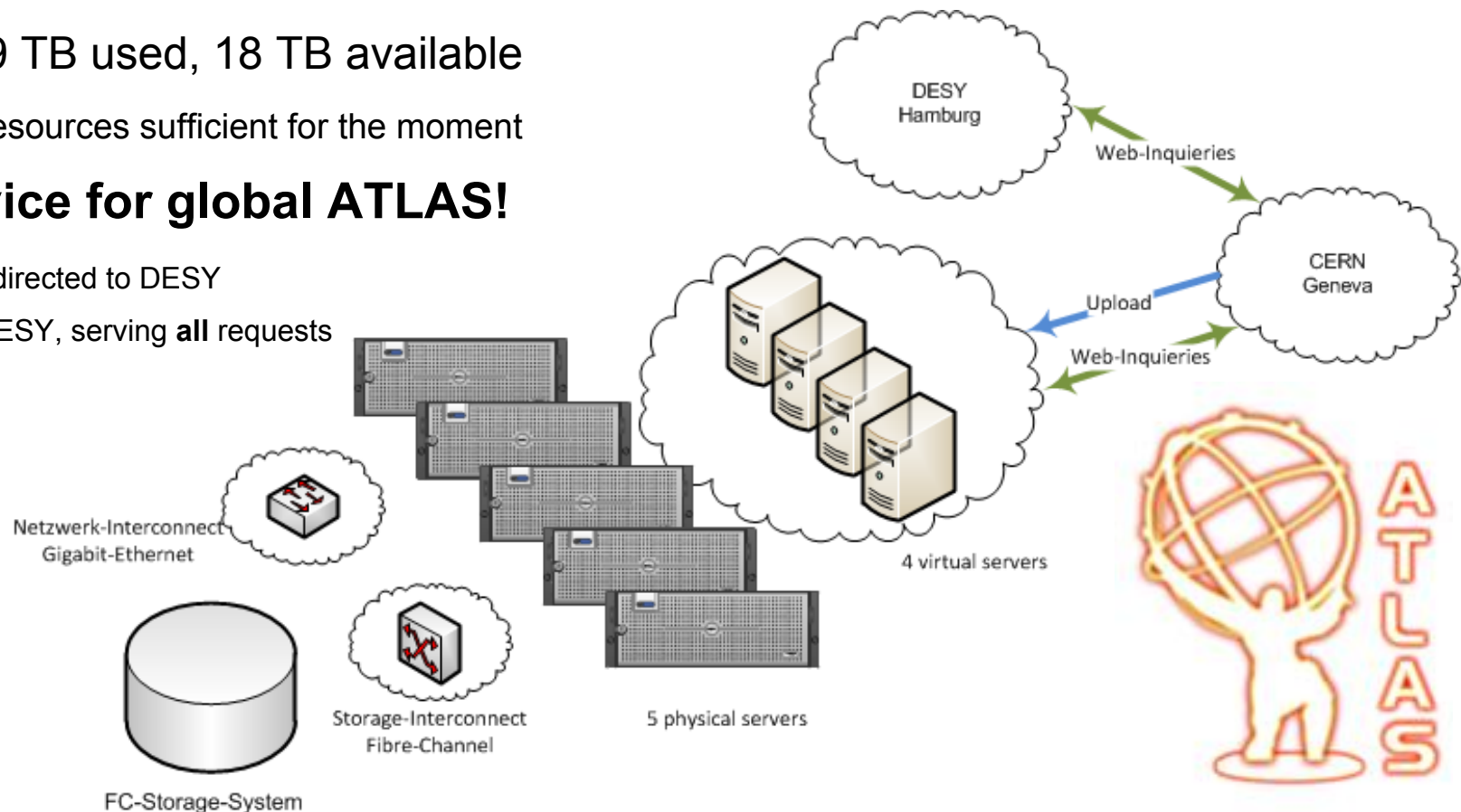
Reliability & Availability

> Users expect to be able to always work on all subsystems

> As a Tier-2 DESY has committed to:

Service	Maximum delay in responding to operational problems		Average availability[5] measured on an annual basis
	Prime time	*Other periods*	
End-user analysis facility	2 hours	72 hours	95%
Other services[6]	12 hours	72 hours	95%

- Note: This is "responding to operational problems", not "solving them".

> From 1.4.-31.9: Both DESY-HH and DESY-ZN are **above Tier-2 requirements**

- Only includes Grid-CPU and dCache storage, for VO OPS (WLCG official accounting)

> What about NAF?

- More difficult to measure:

- More systems, more complex system

- E.g. also waiting time in queue is subjectively folded into perceived availability and reliability ➔ more complex metric

- Trying to evaluate using simple "user-like" test jobs

➔ **NAF successful 97.5% of the time**

NAF test jobs
July 2010, ATLAS
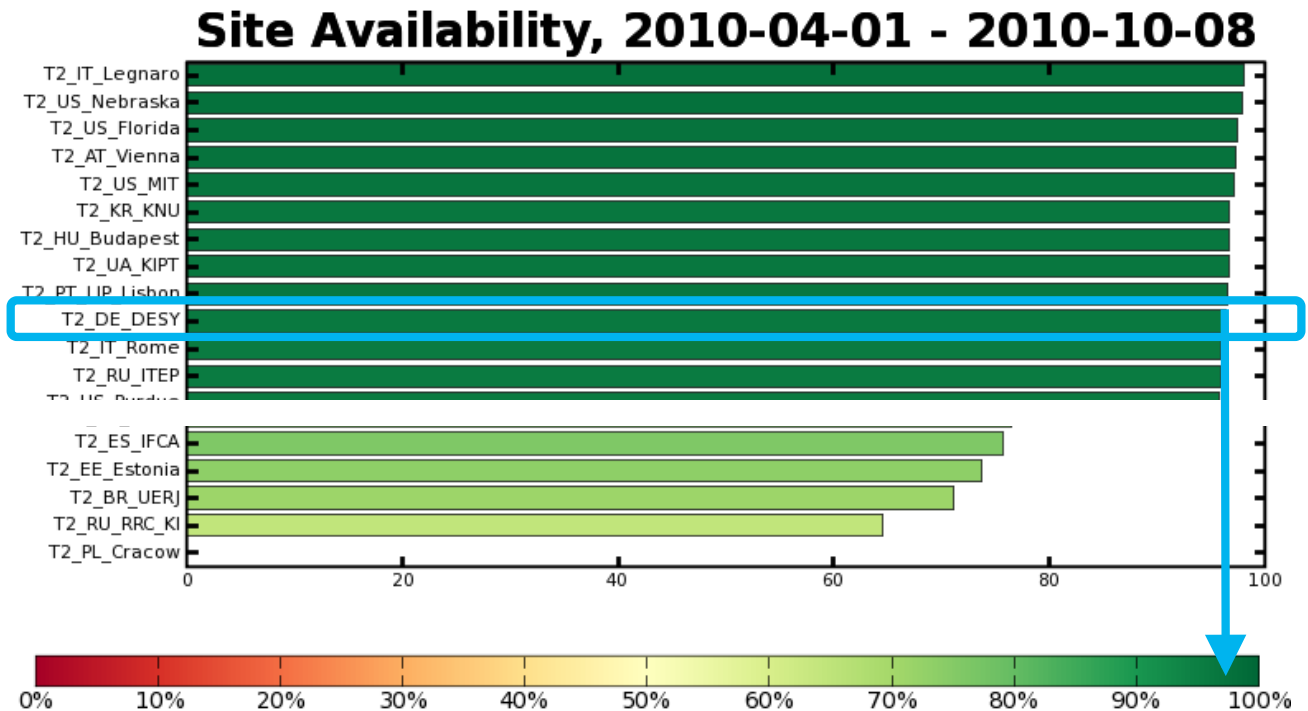
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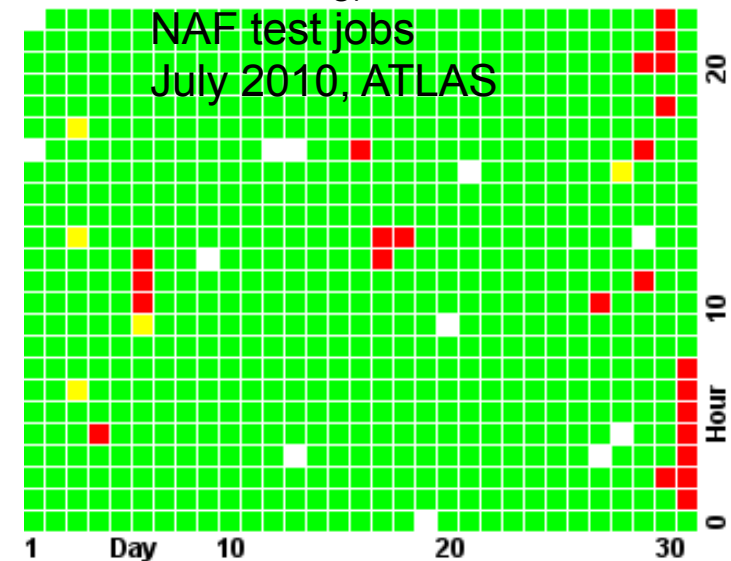
Experiment's view on availability might vary:

Example CMS

> Additional to official WLCG tests:

- Check availability of CMS SW
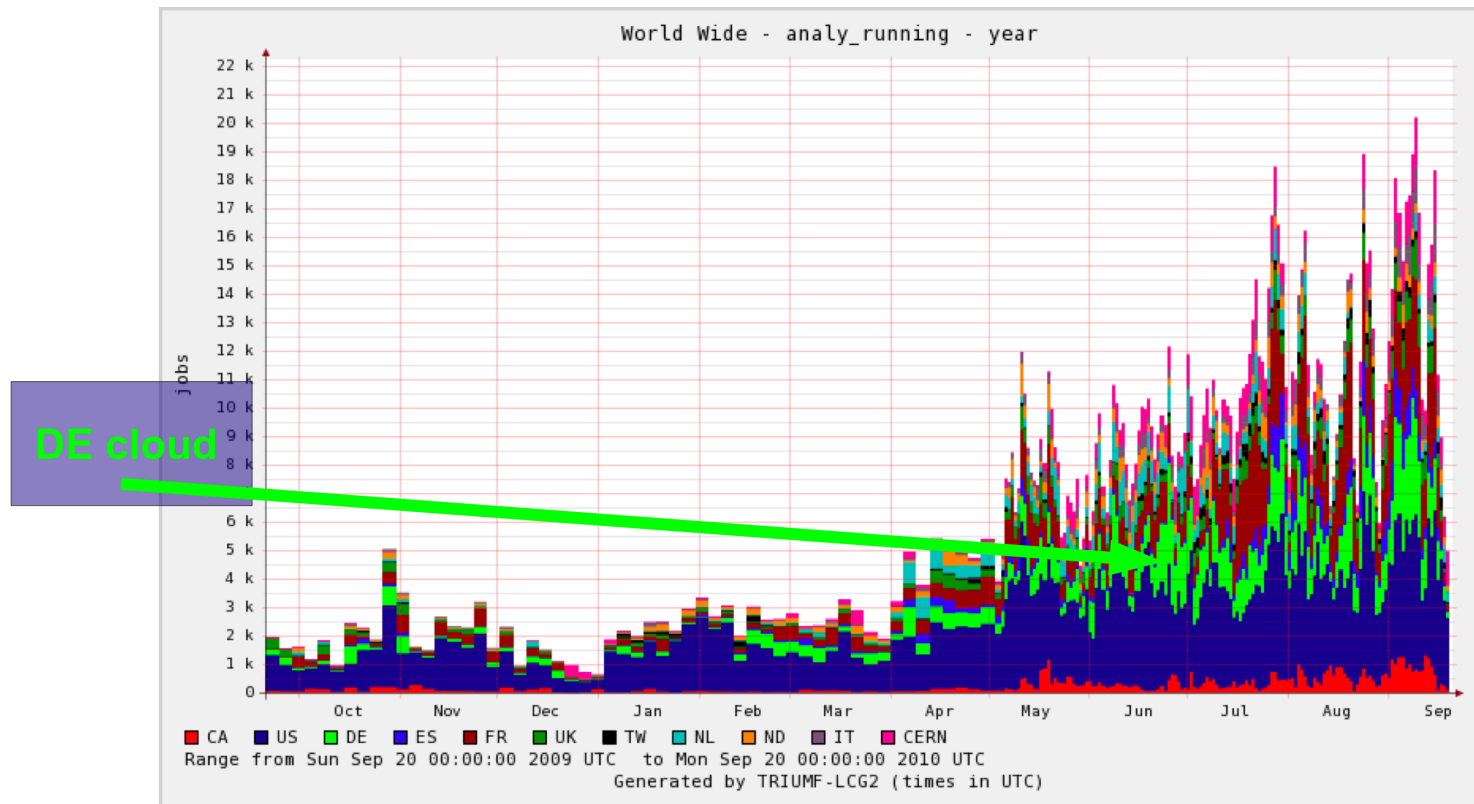
- Checking availability of CMS site services like Squid DB

> Also around ~97%

Site Availability, 2010-04-01 - 2010-10-08

Grid: Readiness for LHC data analysis

Global readiness: Example: ATLAS (slide from Guenter Duckeck)
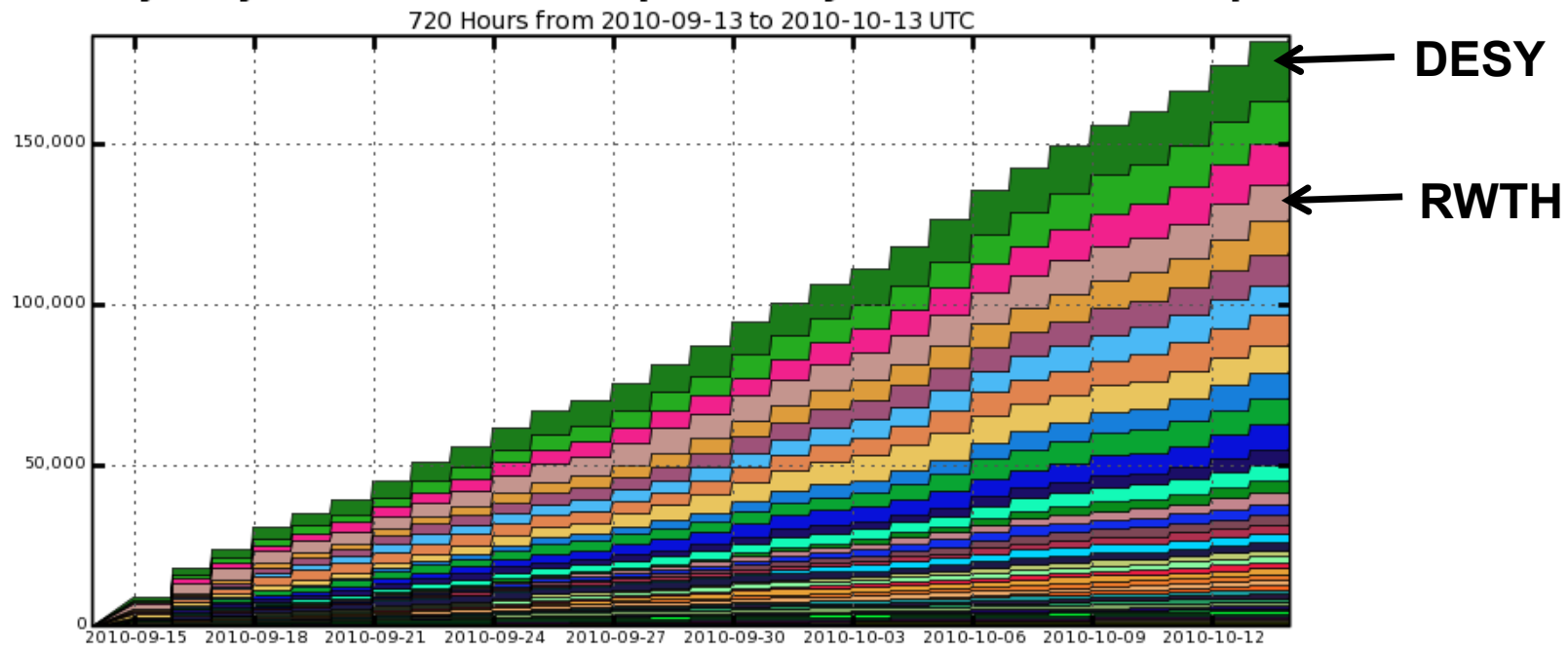
ATLAS worldwide analysis last 12 months

- strong increase of analysis jobs since LHC start, up to 20k jobs

Grid: Readiness for LHC data analysis

Tier-2 Readiness: Example: CMS analysis jobs (last month)
DESY Tier-2 #1 for analysis in CMS

days/day: Wall Clock consumptions All Jobs (Cumulative Graph)

The multiple faces of "support"

> ## Tier-2 / Grid

- Mainly contacted by **expert users**, usually via GGUS

- Direct contact with appropriate provider 2nd level support team

- Also consulting experts from (mostly) DESY VOs for their work on the Grid

> ## NAF facility problems

- **User knowledge level more diverse** – and not local to DESY.

- Contact naf-helpdesk@desy.de: General 1st level DESY support

- Either answers themselves … or asks appropriate 2nd level team

- Expert users ("VO admins") know 2nd level channels and can contact these directly

- **Majority** of first-level contacts **outside DESY**

> ## NAF VO related problems

- Is organized by the **experiments themselves**, usually via mailing lists

- Very **valuable work** done by the German experiment groups themselves
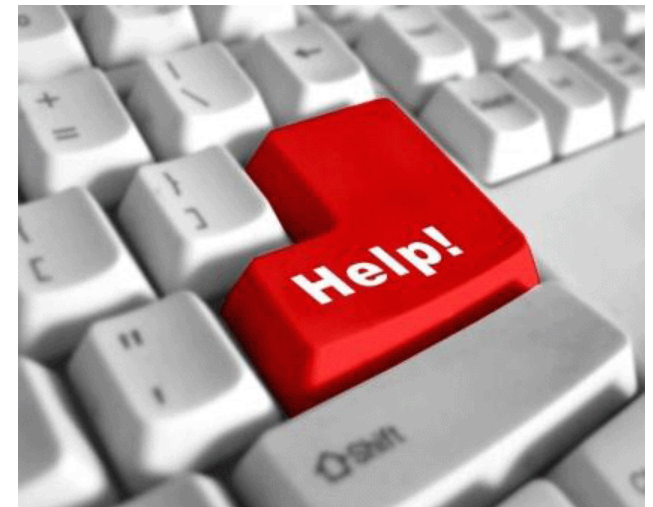
GridCenter Review Task Force

> FH director set up a task force to answer three questions:

- Critically assess the existing resources: Are they optimally set up and used?

- Which monitoring tools do we have for users, decision-makers and "non-experts"?

- What are the requirements and plans for 2011-2014

> The realm of the task force does not cover Tier-2 MoU numbers!

> Timeline: August 2010-December 2010

> Participants from ATLAS, CMS and IT/DV providers

- 7 members in total

- Liaison to Grid project board and NAF users committee

> Current status: bi-weekly meetings, helping preparation of this talk

Summary and outlook

> With dCache, DESY provides important pillar for HEP computing and the Grid.

> DESY IT software development plays important role for ILC

> Grid masters LHC analysis storm

> DESY GridCenter in good shape and well used

- DESY offering many services for **DESY, German and Global** communities

- **NAF** important element in **German HEP analysis** landscape.

- Most important metric**: First LHC analyses performed on the NAF!**

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