The Austrian Grid -
and its use for High Energy Physics

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Outline

- HEP in Austria
- GRID for HEP in Austria
- Austrian GRID general
- Austrian GRID HEPHY
- Tier - Structure
- Connectivity
- Outlook

HEP in Austria (1)

(Schrödinger, Pauli, Hevesy, Hess, Meitner, Thirring, …)

Austria became CERN-member in 1959

Participation in High Energy Physics Experiments:
mainly 2 Institutions

1. Inst.f. High Energy Physics , Austrian Academy of Science, Vienna

founded in 1966, 60 staff
CERN Bubble Chamber Expts – UA1, DELPHI, CMS

(New opening for Chair for exp. HEP at Technical University + Directorate of the HEP Institute of the Academy)

HEP in Austria (2)

2. Leopold-Franzens- University Innsbruck

Inst.f. Experimental Physics $\rightarrow$ Inst. f. Astro- and Particle Physics
Long tradition: Victor Franz Hess CR Nobel-Price 1936

Small Bubble-Chamber Group 1967 started in close collaboration with Vienna, independent since LEP

Staff today: 12, 4 permanent
CERN Bubble Chamber Expts, ALEPH, ATLAS
…+ GRID

GRID for HEP in Austria

Attempts since 2000 …

FA (=Ministry): no funds for dedicated HEP – Grid

but: Austrian Hephy representative in CERN-WG for EGEE I proposal, …
GUP Linz involved! (Data Grid, Cross Grid 02 - 05):
strong allies with common goal starting from different motivations:

• GUP Linz (+IT- Inst. Vienna, Salzburg) : Parallel, high performance Computing and Grid itself

• UIBK (also in the name of Vienna): Application of Grid for HEPHY

Pilot-Project for HEPHY in Innsbruck

First kick-off *(Austrian Council for Research and Technology Development)*

80 k€ for 2 years 2002 - 04

Started work on minimal LCG-Configuration (3 Worker Nodes)

since April 04 in ATLAS IS

Participation in DC 2

Smooth transition to our work in WP A-2 of Austrian Grid

…. And in EGEE II !

Austrian GRID Consortium (2002)

Broader Basis: Unite all research fields with potential benefit from Grid-computing for common request for funding, resulted in

- IT itself
- Medical Sciences
- High Energy Physics
- Astrophysics
- Meteorology and Geophysics
- Environmental Applications

Austrian Grid Project: http://wiki.austriangrid.at
Funded by Federal Ministry for Education, Science and Culture (bm:bwk)
1st tranche 2004 – 06 with 2.7 M€ (200 k€ for Hephy)

Objectives

- Deployment of a national (prototype) Grid infrastructure in Austria
- Improvement and extension of existing Grid middleware by high level extensions
- Development and deployment of grid-enabled applications for various problem domains
- Inviting potential users to use grid technology and supporting them
- A stepping stone for intended future international and European Union projects
- Establishing of a contact point for future partners interested in every aspect of Grid computing:

  Industry, Scientists, Developers Users
- Establishing a platform for discussion of existing and future Grid/eScience structures in Austria
- Dissemination & Training

Involved Institutions

Johannes-Kepler Universität Linz

Universität Wien
Technische Universität Wien

Medizinische Universität Wien

Universität Salzburg

Leopold-Franzens Universität Innsbruck

Medizinische Universität Innsbruck

Karl Franzens Universität Graz

Austrian Academy of Sciences

Federal Environment Agency

AKH Allgemeines Krankenhaus Wien

HITT Health Information Technology Tirol

Tilak Tiroler Landeskrankenhaus

Krankenhaus der Barmherzigen Brüder Linz

Strucuture of the Austrian Grid:

Set of Workpackages:

WP 0: Coordination, Dissemination and Exploitation

+ three layers:

- Infrastructure Layer
- Middleware Layer
- Application Layer

Basic considerations:

Facilitate life of Application Domains VO by providing special extensions + general extensions (visualisation) for heterogenous users community,

common support modules to be provided by IT experts

Infrastructure Layer

:

WP I-1: Hardware and Infrastructure Services

Responsibility for whole AG infrastructure in one hand:

Central Computing Department (ZID) of the Johannes Kepler University Linz

… relieves middleware and application developers from time-consuming and tedious maintenance activities.

ZID Innsbruck: ZID-Grid!

Middleware Layer

WP M-1: Security and Authentication
WP M-2: Visualization and Interfaces
WP M-3: Multimedia and Compression
WP M-4: Databases, Data Mining and Data Retrieval
WP M-5: Self-adapting Computational GRID Software
WP M-6: Programming Paradigms and Methods for the GRID
WP M-7: Mobility Support in the GRID

Application Layer

WP A-1: Medical Sciences

WP A-2: High-Energy Physics

WP A-3: Applied Numerical Simulation

WP A-4: Astrophysical Simulations and Solar Observations

WP A-5: Meteorological Simulations

WP A-6: Environmental GRID Applications

Infrastructure layers

Grid applications

Grid visualization | Interactivity
GVK | GVid | glogin | ... | High level extensions

Globus Toolkit | gLite
MDS | GRAM | ... | VOMS | Grid middleware

Grid-specific

Non grid-specific

Batch queue systems | Compilers | Libraries | Others
PBS | Torque | ... | icc | gcc | ... | MPI | Math | ... | JDK | Ganglia | NWS | Basic infrastructure fabric

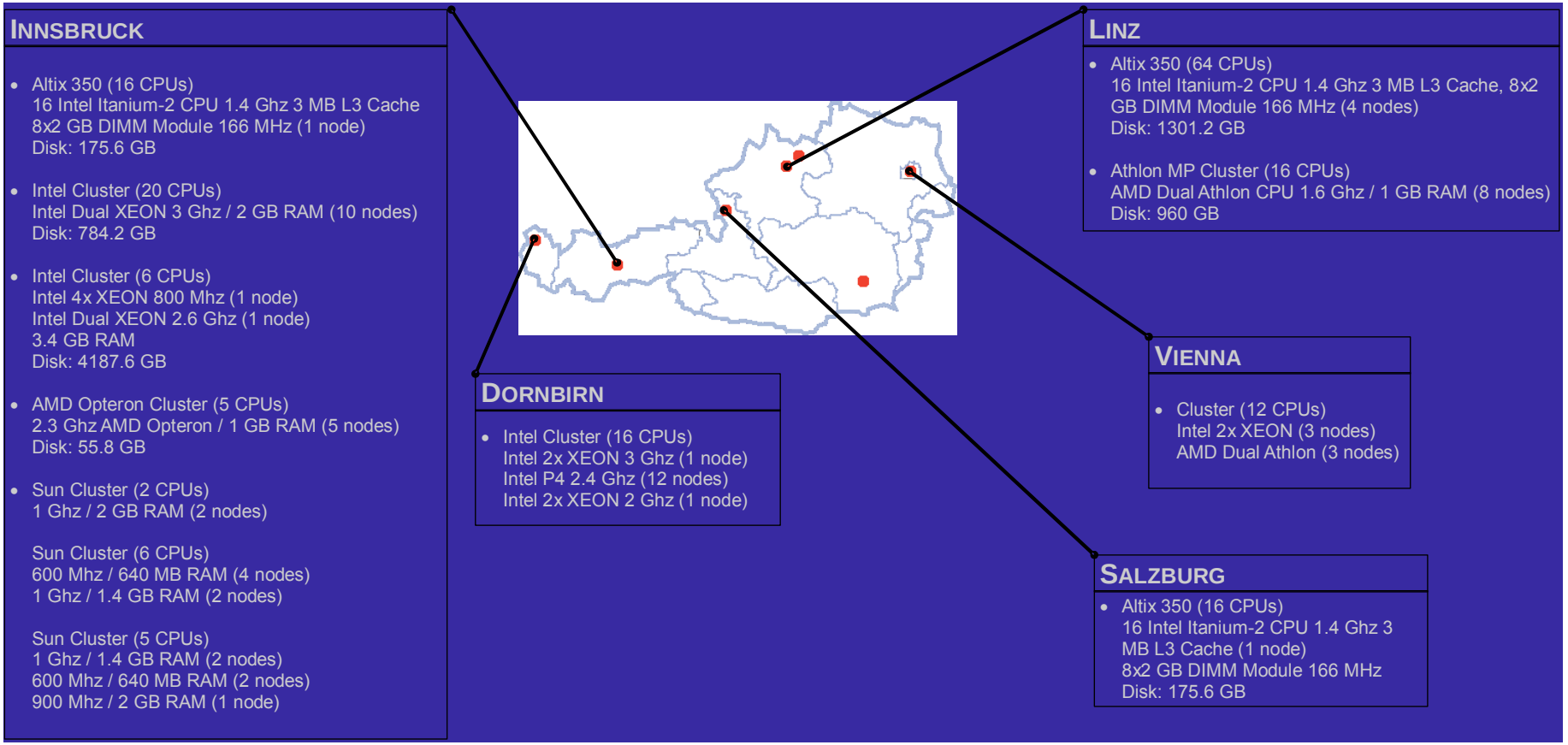
Software

SGI Altix SMPs | Clusters (IA32, AMD64, SPARC) | Student lab workstations | Grid resources

Hardware

Austrian Grid is a project funded by the bm:bwk (Federal Ministry for Education, Science and Culture) after recommendation by the Austrian Council for Research and Technology Development.

Infrastructure (at start of project)



Austrian Grid Information Index 2006-10-08 23:47

Site	Master	CPUs	Free	Jobs	RAM	SI00	SF00	LRM
AGRID-VMware	glitevm1.hostingcenter.uclv.net	0	0	0	503	801	761	pbs
ALTIX-UIBK	altix1.uibk.ac.at	16	16	0	15026	1078	1942	torque
FHV	grid.labs.fhv.at	12	12	0	3868	1223	1162	torque/maui
HEPHY-UIBK	grid.uibk.ac.at	32	32	0	1024	1100	1030	torque
Hephy-Vienna	hephygr.oeaw.ac.at	38	17	21	2048	1900	2100	torque
JKU	altix1.jku.austriangrid.at	64	64	0	61048	1078	1942	pbs
JKU	hydra.gup.uni-linz.ac.at	16	8	1	2025	578	648	Torque
SBG	schafberg.coma.sbg.ac.at	16	0	0	15026	1078	1942	pbs
astro-beowulf	astro-grid2.uibk.ac.at	2	2	0	3971	1048	998	torque/maui
astro-grid1	astro-grid1.uibk.ac.at	2	2	0	11986	1048	998	torque/maui
dps-prod	karwendel.dps.uibk.ac.at	56	56	0	15401	1499	1861	sge
hc-cluster	hc-ma.uibk.ac.at	194	155	52	3899	877	833	sge
Sum Austrian Grid		448	364	74				
Sum Innsbruck		302		52				

≈2/3 Innbruck, but only 7% Hephy so far … + ZID GRID

High Energy Physics in Austrian Grid (= LCG-Resources in Austria)

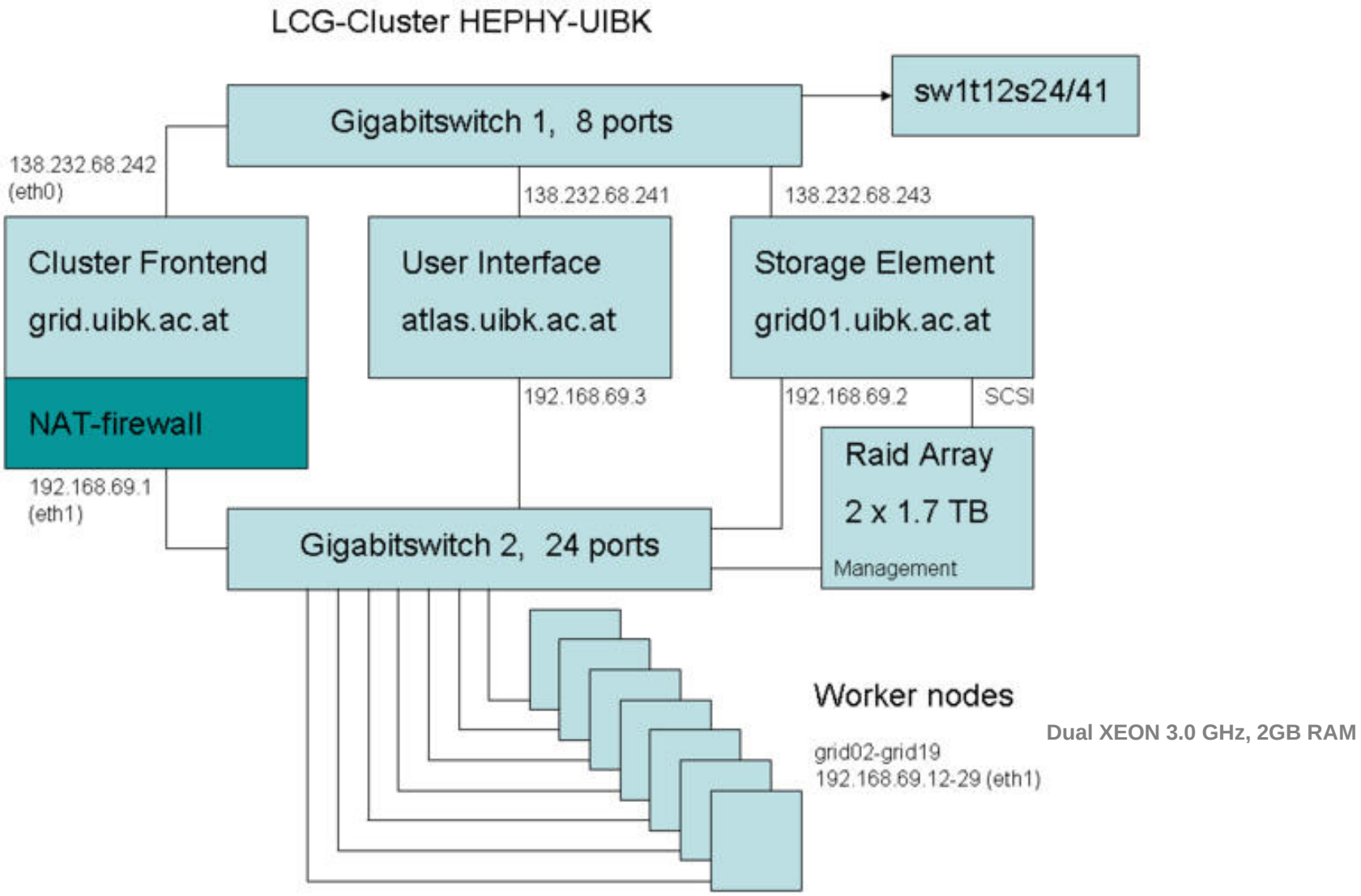
MoU's for LHC: Grid-Computing implicitely agreed …

HEPHY-UIBK

- supports VO ATLAS
- currently 36 CPUs, 1.7 TB disk, 1 FTE (3 pttime admins)
  planned until 2007: 60 CPUs, 1.7 TB disk , 1.25 FTE

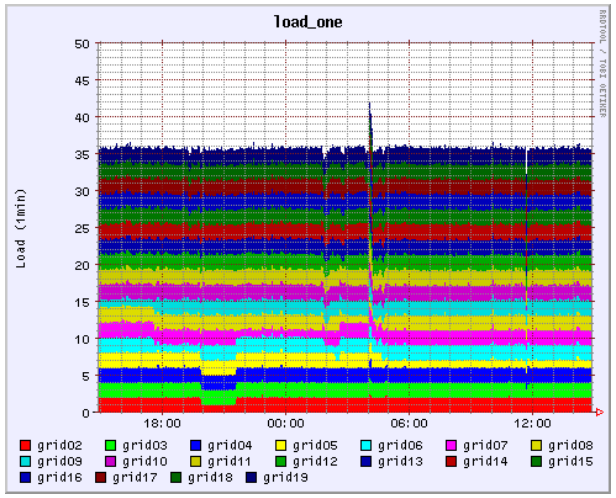
Hephy-Vienna

- supports VO CMS
  … and VOCE!
- currently 38 CPUs
- 10 → 40 TB disk
- 0.5 GB/s (GEANT)

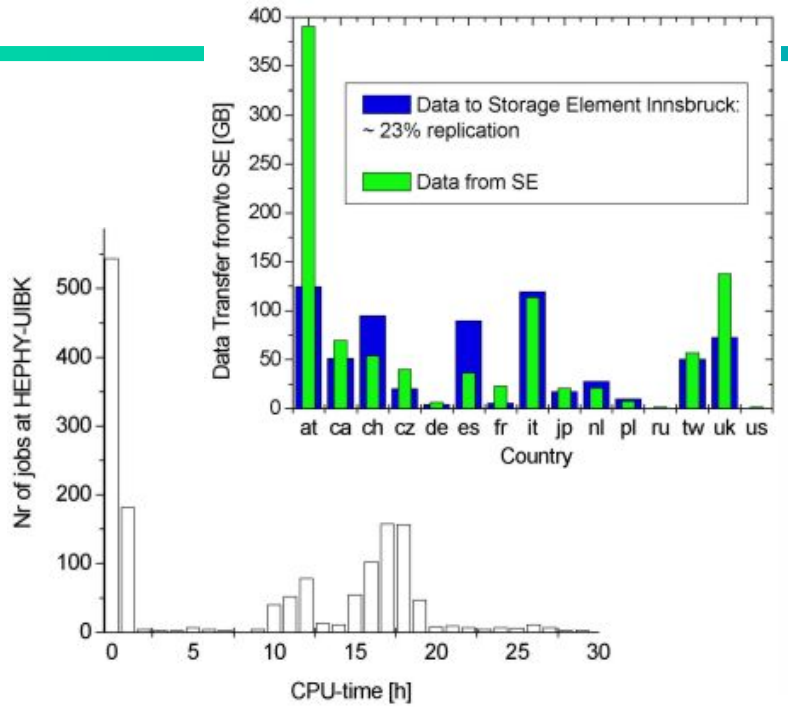

LCG-Cluster HEPHY-UIBK
sw1t12s24/41
Gigabitswitch 1, 8 ports
138.232.68.242
(eth0)
138.232.68.241
138.232.68.243
Cluster Frontend
grid.uibk.ac.at
User Interface
atlas.uibk.ac.at
Storage Element
grid01.uibk.ac.at
NAT-firewall
192.168.69.3
192.168.69.2
SCSI
Raid Array
2 x 1.7 TB
Management
192.168.69.1
(eth1)
Gigabitswitch 2, 24 ports
Worker nodes
Dual XEON 3.0 GHz, 2GB RAM
grid02-grid19
192.168.69.12-29 (eth1)

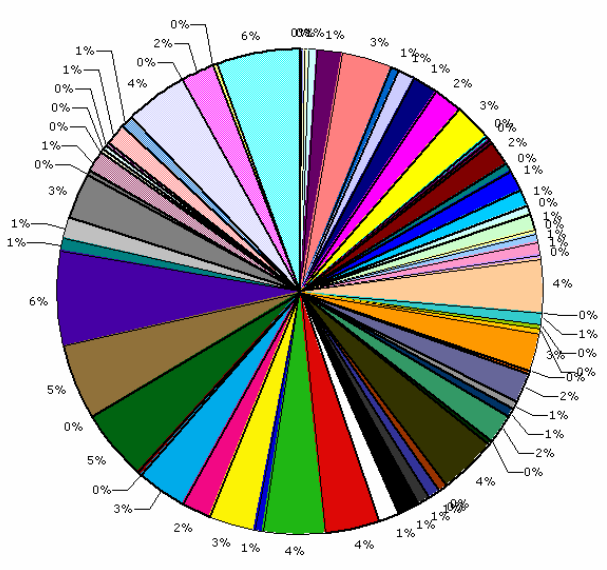
LCG-Site HEPHY-UIBK

- 18 worker nodes (36 CPUs) , each 2GB RAM, 80 GB disk
  SLC 3, gLite 3.02, RMS: torque with MAUI
- Storage Element 1.7 TB
- Small prototype for an ATLAS - Tier2
- Status: certified
- Participated in ATLAS Data Challenge 2 (2004) and
- production for the workshop in Rome 2005

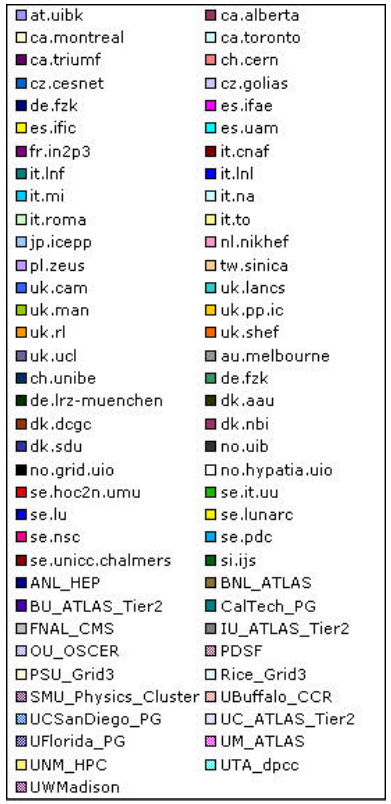


HEPHY-UIBK Participation in DC2





HEPHY-UIBK



Start 2004

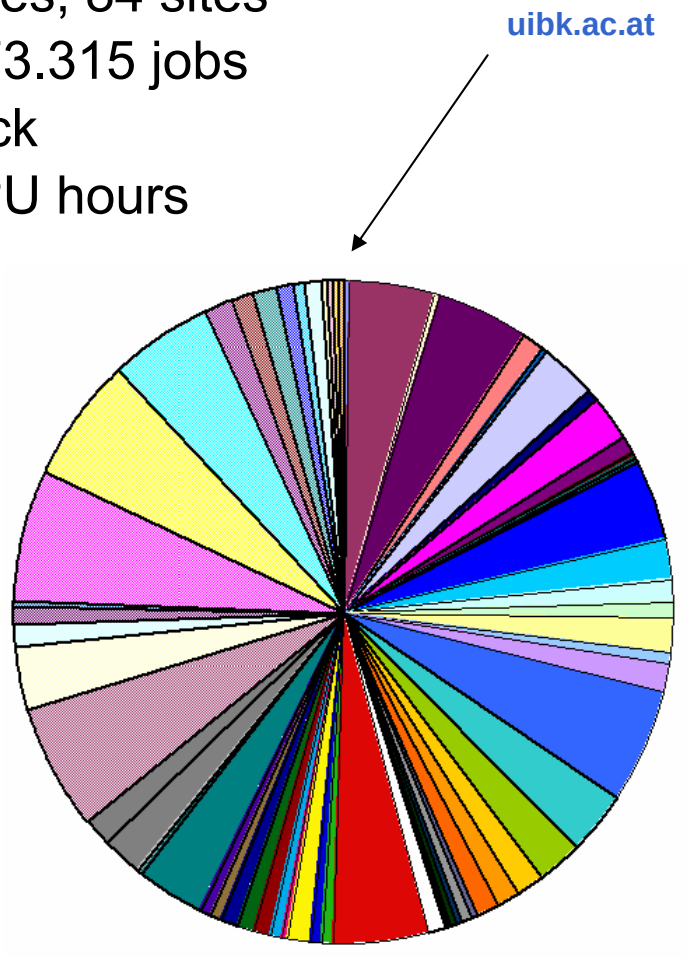
Event-production, G4-Simulation und Digitization, ca. 260.000 jobs in total

HEPHY-UIBK: 733 simulationa jobs, 11890 CPU- hours

Survey of jobs: http://physik.uibk.ac.at/hephy/grid/project/dc2.txt

ATLAS Rome-Production 2005

22 countries, 84 sites
4800 of 573.315 jobs
in Innsbruck
34.000 CPU hours



uibk.ac.at
umomtreal.ca
cern.ch
csvs.ch
skurut.cz
atlas.fzk.de
benedict.dk
morpheus.dk
ft.uam.es
marseille.fr
clrece.in2p3.fr
isabella.gr
cnaf.it
roma1.it
ba.it
lnf.it
to.it
ct.it
fe.it
roma2.it
pi.it
nikhef.nl
hypatia.no
lip.pt
hagrid.se
sigrid.se
chalmers.se
savka.sk
sinica.tw
shef.uk
ucl.uk
lancs.uk
ed.uk
BNL.us
UC_ATLAS.us
FNAL.us
OU.us
Hamptom.us
UCSanDiego.us
SMU.us
ANL.us
UC.us
Unknown
triumf.ca
utoronto.ca
unibe.ch
golias.cz
gridka.fzk.de
lcg-gridka.fzk.de
nbi.dk
ific.uv.es
ifae.es
cclcgcdli.in2p3.fr
cea.fr
kfki.hu
lnl.it
mi.it
pd.it
na.it
fi.it
ca.it
pd.it
bo.it
sara.nl
uio.no
zeus.pl
msu.ru
bluesmoke.se
pdc.se
brenta.si
ihep.su
ral.uk
ox.uk
ic.uk
man.uk
UTA.us
BU.us
PDSF.us
IU.us
PSU.us
UNM.us
Uflorida.su
CalTech.us
UWMadison.us
Rice.us

Vienna

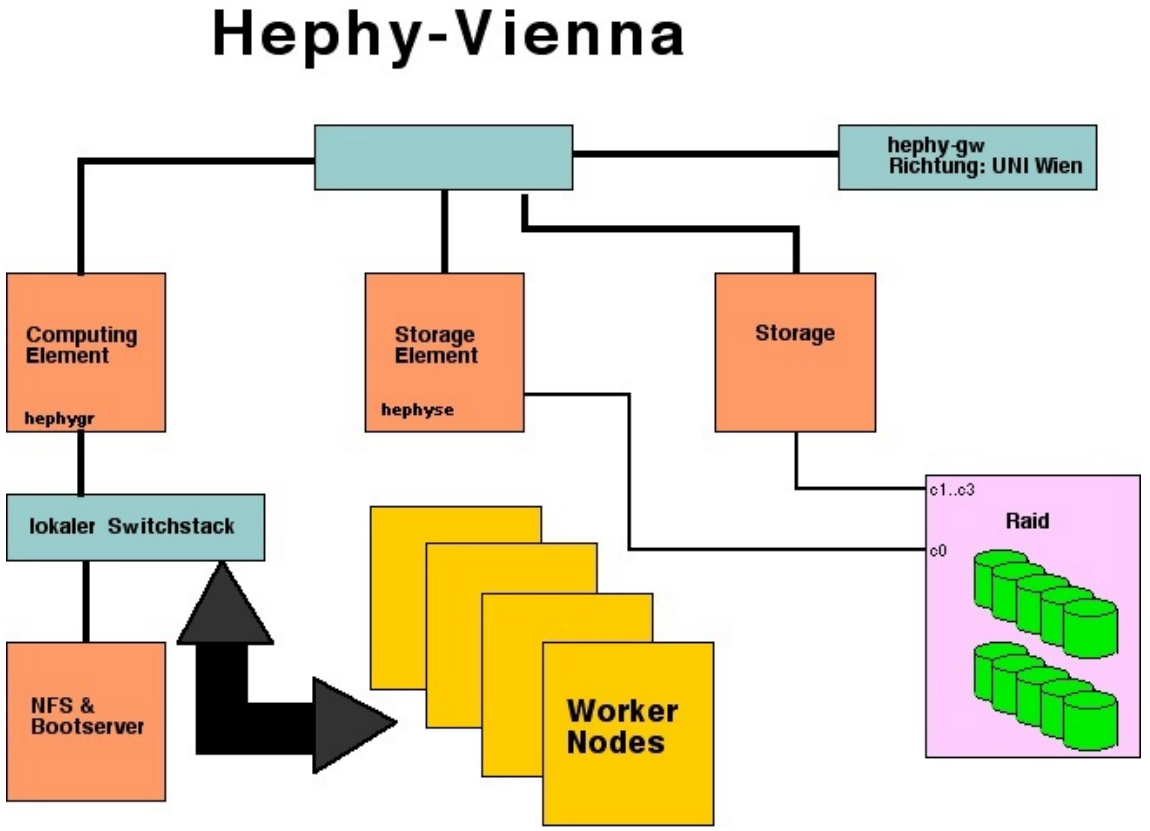
CMS (+BELLE)

10 →38 (~40 CPU's end of 2006)

10 → 20 TB

GEANT 0.5 GB/s

Participated in SC3



EGEE I: 1.2 FTE to Austria, 0.5 fdd. to Ibk – Informatics

EGEE II: 26 PMS for Ibk hephy (13/13 funded/ unfunded)

SA1 (Grid operations, Support & Management)
NA4 (Applications, Identifications & Support)

Aim: complete autonomous data production and analysis within LCG for specific reaction channels in the ATLAS-Experiment

In preparation for LHC- startup in 2007

Austrian LCG - Tier – Structure

Tier-2
Planned (″full″) distributed Tier-2
VO ATLAS (Innsbruck) and VO CMS (Vienna)
Distributed installation management /administration

Tier-1
Innsbruck: accepted in 2004 by FZK!
Included into KFZ Tier-2 cloud

Vienna: Not yet decided

Austrian Grid Phase II (2007 – 2009)

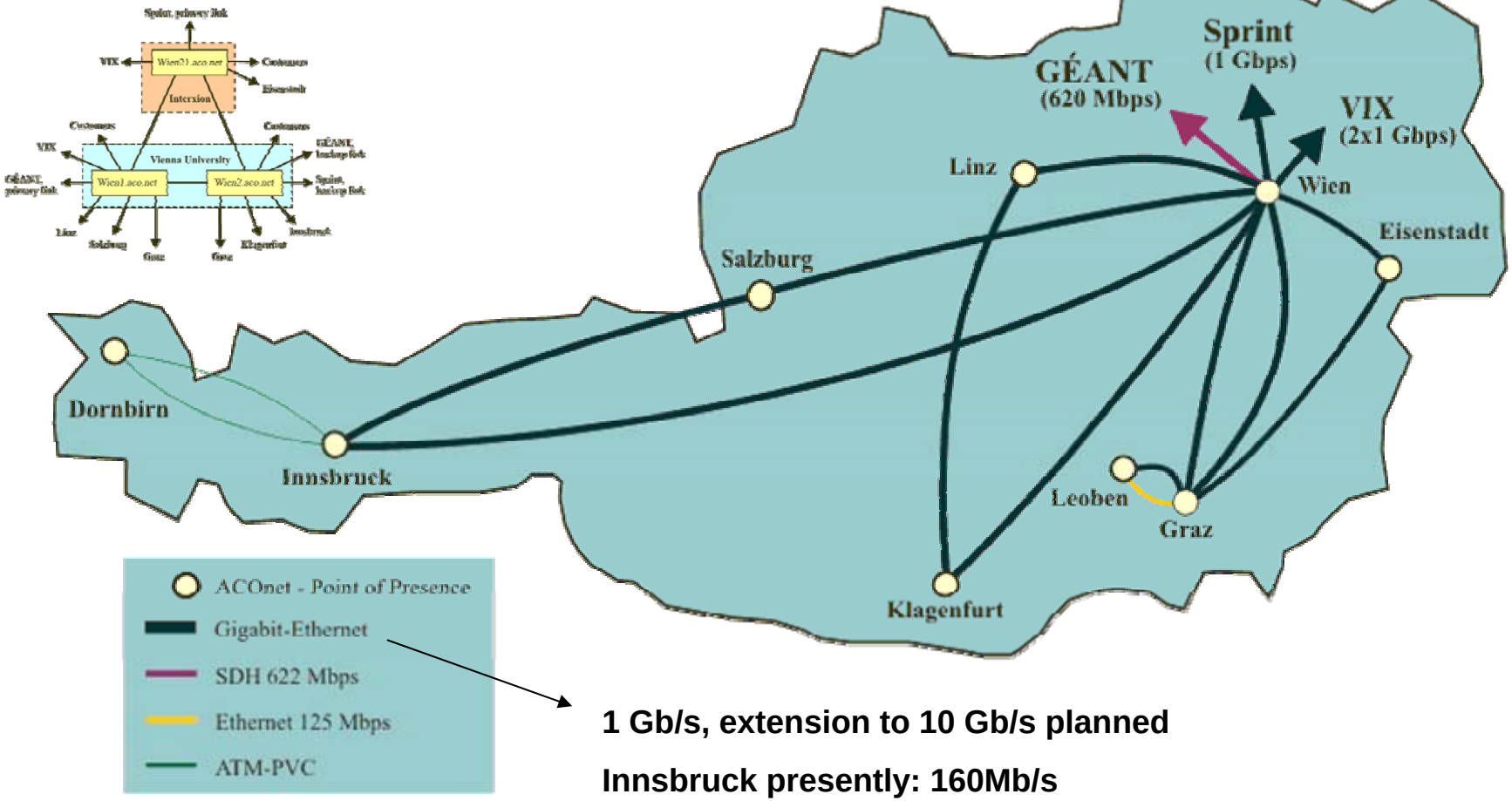
light at the end of the tunnel:
Proposal for such a national distributed Tier-2 (ATLAS+CMS) submitted

	2007	2008	2009	2010	total
CPU (kSI2k) Vienna	**400**	**100**	**100**	**100**	**700 kSI2k**
CPU (kSI2k) Innsbruck	**20**	**20**	**20**	**0**	**60 kSI2k**
HD (TB) Vienna	**80**	**10**	**10**	**0**	**100 TB**
HD (TB) Innsbruck	**10**	**10**	**0**	**0**	**20 TB**
Bandwidth (Gb/s)	**1**	**-**	**-**	**-**	**1 Gb/s**

Cost estimate: 1.060 M€

Infrastructure and manpower to be provided by CIS of participating Institutions

Connectivity



1 Gb/s, extension to 10 Gb/s planned

Innsbruck presently: 160Mb/s

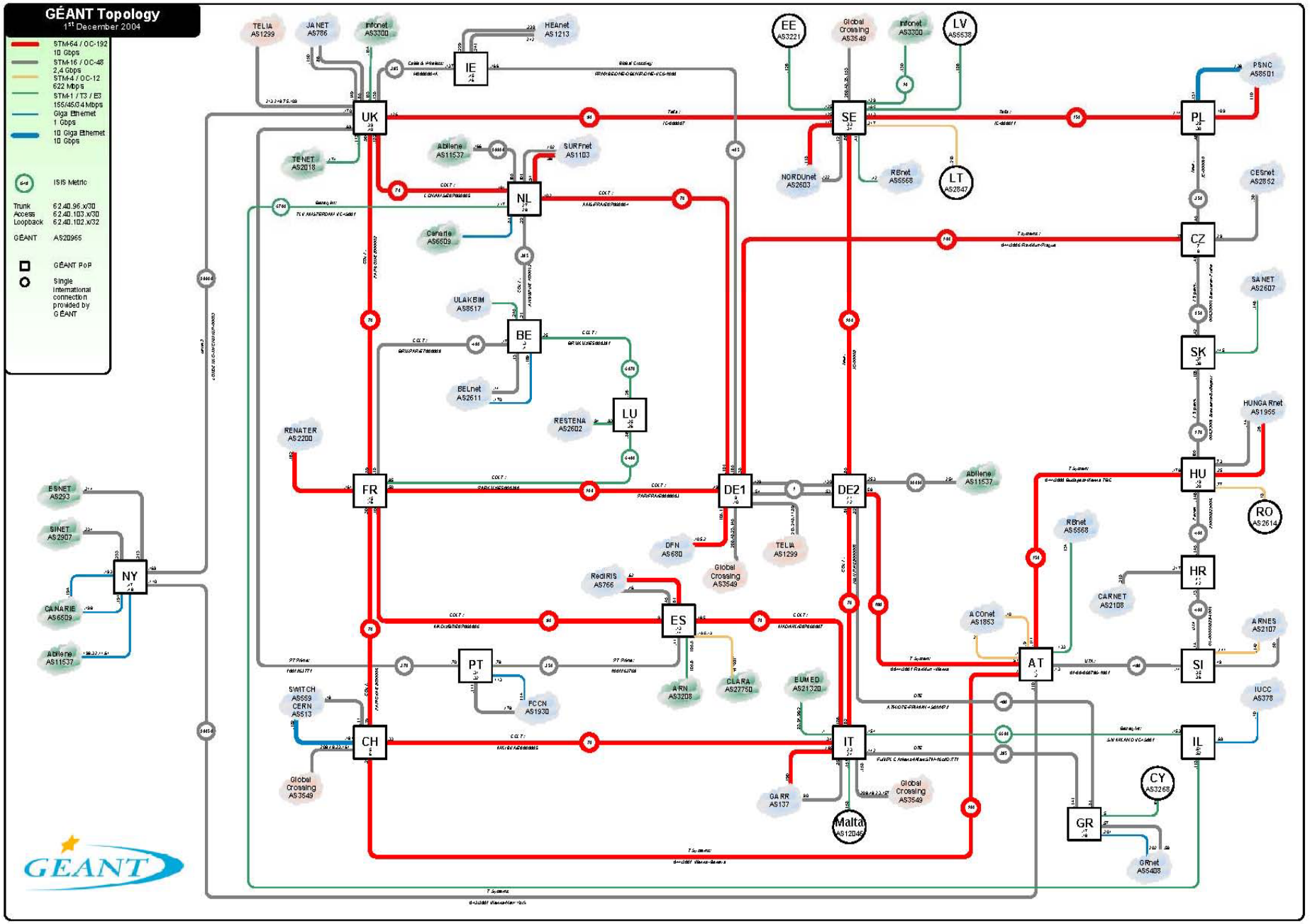
For improved bandwith management (packet shaper):

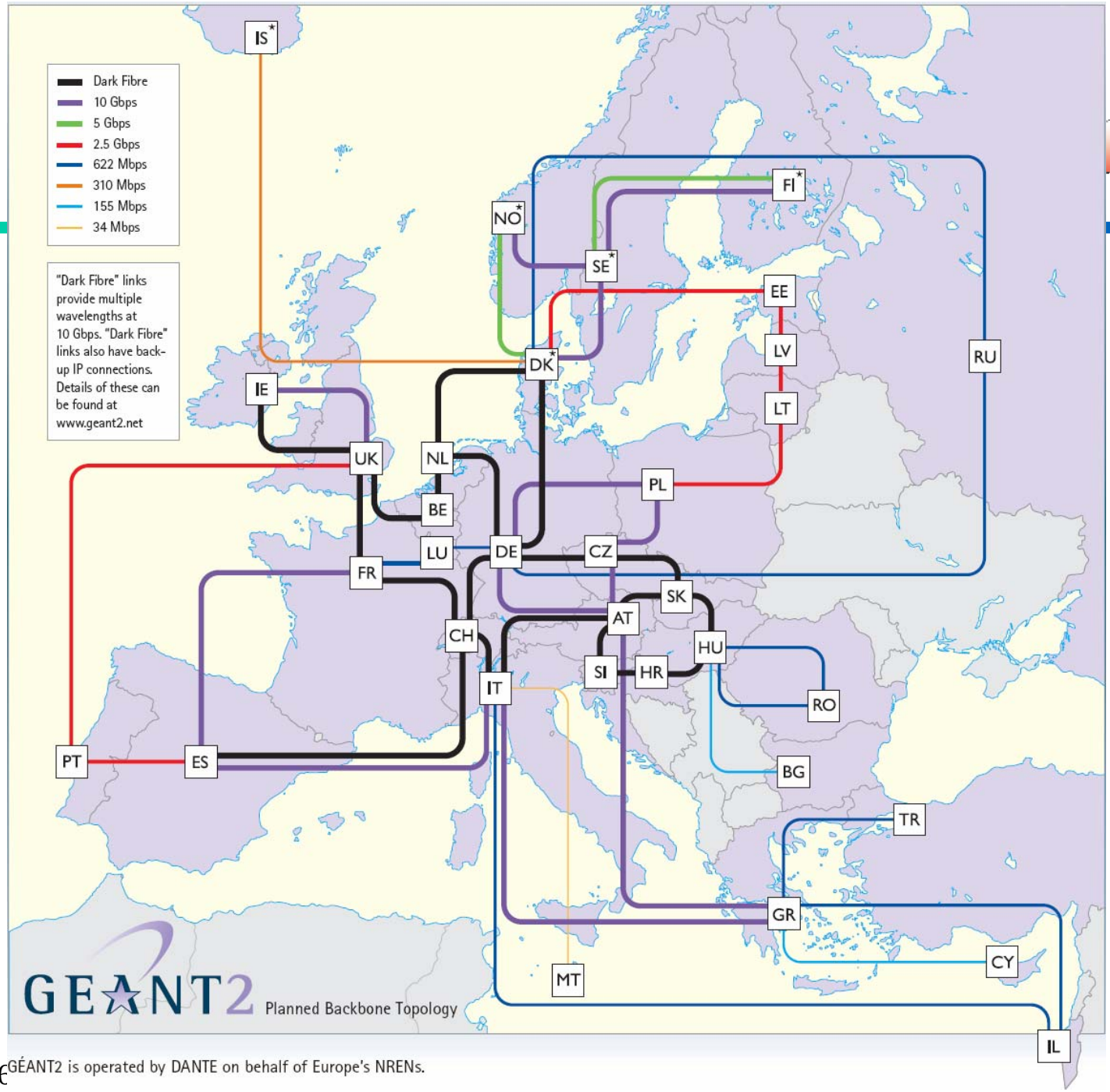
real need has to be proven first (e.g. full Tier2)

Connectivity ctd.

Austrian Academic Computer Network ACOnet
3 DWDM- rings (Telecom Austria)
Etnernet-Switches (Vie,Lz,Sbg, Ibk,Klu, Le, E partly twice connected in ring)

Aconet since 2001 in GEANT (620 Mb/s),
since 2002 in Sprint Global IP Network (400 Mb/s),
VIX (Vienna Internet ExchangeThe Vienna Internet eXchange, a Service of the Vienna University Computer Centre for Austria and the Central and Eastern European Region), 6NET (finished 05)


GÉANT Topology
1st December 2004
STM-64 / OC-192
10 Gbps
STM-16 / OC-48
2.4 Gbps
STM-4 / OC-12
622 Mbps
STM-1 / T3 / E3
155/45/34 Mbps
Giga Ethernet
1 Gbps
10 Giga Ethernet
10 Gbps
ISIS Metric
Trunk 62.40.96.x/30
Access 62.40.103.x/30
Loopback 62.40.102.x/32
GÉANT AS20965
GÉANT PoP
Single International connection provided by GÉANT
UK
SE
NL
BE
LU
FR
DE1
DE2
IE
PL
CZ
SK
HU
HR
SI
AT
IT
CH
ES
PT
NY
IL
GR
TELIA AS1299
JANET AS786
Infonet AS3300
HEAnet AS1213
EE AS3221
Global Crossing AS3549
LV AS5538
PSNC AS8501
NORDUnet AS2603
RBnet AS5568
LT AS2847
CESnet AS2852
SANET AS2607
HUNGARnet AS1955
RO AS2614
Abilene AS11537
SURFnet AS1103
TENET AS2018
Canarie AS6509
ULAKBIM AS8517
BELnet AS2611
RESTENA AS2602
RENATER AS2200
DFN AS680
RedIRIS AS766
CARNET AS2108
ARNES AS2107
ACOnet AS1853
ESNET AS293
SINET AS2907
SWITCH AS559
CERN AS513
FCCN AS1930
ARN AS3208
CLARA AS27750
EUMED AS21320
GARR AS137
Malta AS12046
CY AS3268
GRnet AS5408
IUCC AS378
GÉANT


Dark Fibre
10 Gbps
5 Gbps
2.5 Gbps
622 Mbps
310 Mbps
155 Mbps
34 Mbps
"Dark Fibre" links provide multiple wavelengths at 10 Gbps. "Dark Fibre" links also have back-up IP connections. Details of these can be found at www.geant2.net
IS
NO
SE
FI
EE
LV
LT
RU
DK
IE
UK
NL
BE
LU
DE
PL
CZ
FR
SK
AT
CH
HU
SI
HR
IT
RO
BG
PT
ES
TR
GR
CY
MT
IL
GÉANT2
Planned Backbone Topology
GÉANT2 is operated by DANTE on behalf of Europe's NRENs.

ZID-Grid

ZID-GRID: ≈ 300 PCs in student's labs (more to follow soon)
Innsbruck HEP Group IHG in cooperation with the IT Central Informations Service (**Z**entraler **I**nformatik **D**ienst **ZID**) of the Innsbruck University

made available for AustrianGrid users out of the normal labs opening hours (i.e. over night, weekends and during holidays)

The PCs can easily be grouped into clusters as needed e.g. one large cluster for production and several small clusters as a development testbed for the middleware developers in the AustrianGrid project.

Similar small setup: ZID Technical University Vienna ca. 150 PCs
(http://www.zid.tuwien.ac.at/zidline/zl14/grid.html)

ZID-Grid (2)

The available clusters are advertised in the AustrianGrid Information Index (the setup of an IS similar to the LCG has been done by the IHG)

These resources have been used e.g.for

large scale productions for the Institute of Engineering Mechanics and Institute of Statistics (70.000 CPU hours) and middleware tests of the Distributed and Parallel Systems group.

an internal production for ATLAS: 10 k events for generation, detector simulation, digitization (no reconstruction: lack of RAM ….)

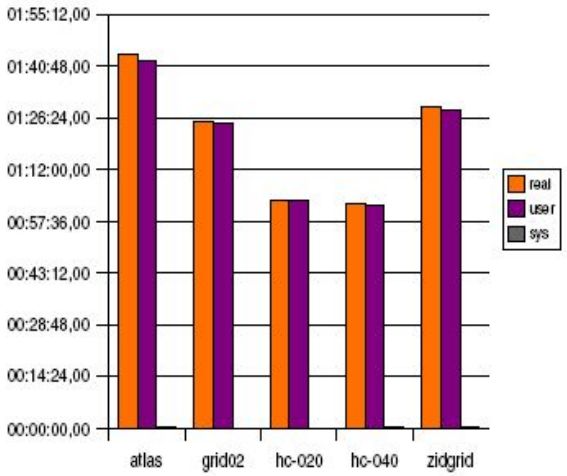
Jobs started by specific Web Interface (product of collaboration with Austrian Grid Infrastructure WP)

No official ATLAS production, since resources not permanent available

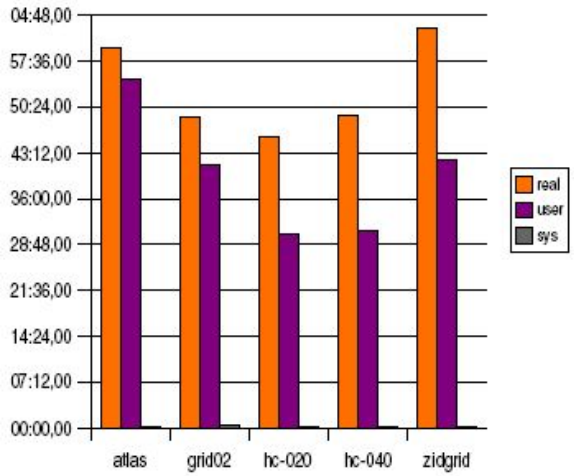
(AW: not all kind of jobs possible?)

http://agrid.uibk.ac.at/zidgrid

ZIDGrid: High Energy Physics



Simulation (10 events)

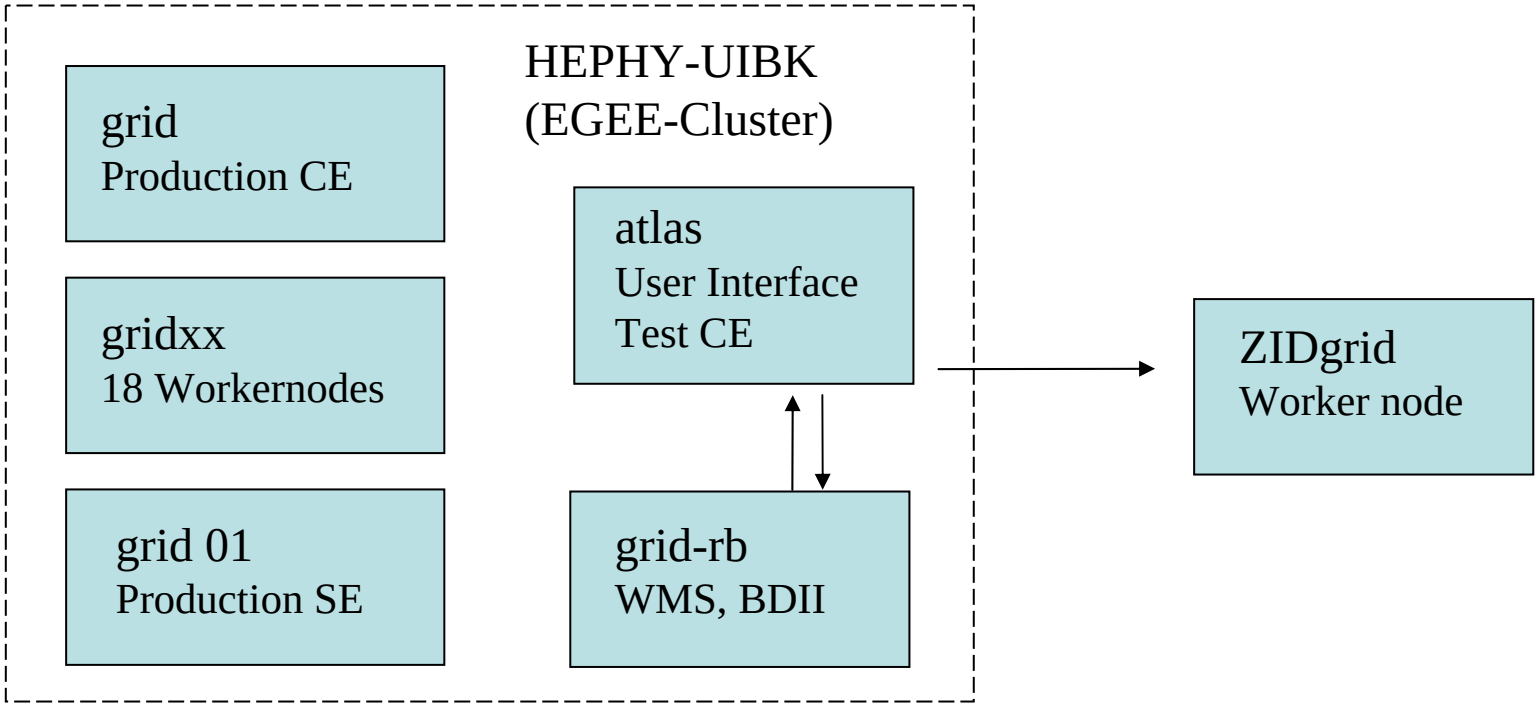


Reconstruction

Fastest ZIDGrid machines (50 CPUs) comparable to LCG-Cluster HEPHY-UIBK, but not available all the time, not enough RAM for all jobs and no server machines

ZIDGrid ongoing work: glite

Glite middleware installed on central file server for User Interface and Worker Node, Workload Management Server on grid-rb for job distribution (parametric jobs, one job description file for a lot of jobs)



Outlook

- Existing Austrian mini Tier-2‘s for ATLAS and CMS will grow and merge into a common national Tier2 over next 2 years

- Central Information Services of Universities/Academy are then expected to take over running of this Tier-2

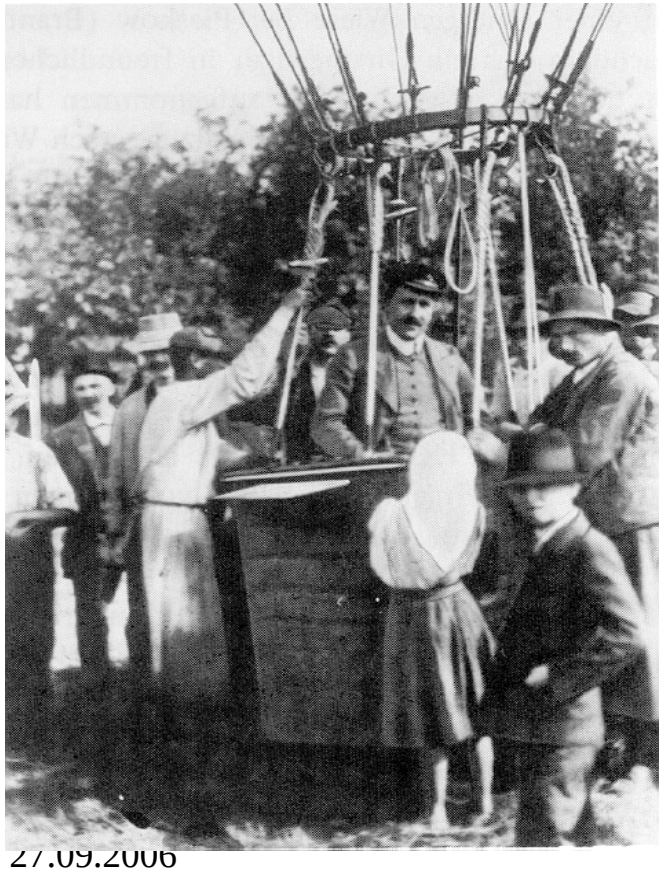
- It seems essential, that the Austrian Grid is accepted by the scientific community as useful and even necessary tool in order to ensure ist existence after its launch via the Consortium

… before coming to the end:

Leopold-Franzens- University Innsbruck

Inst.f. Experimental Physics

Long tradition: Victor Franz Hess CR Nobel-Price 1936



Data transfer from Station: film + monthly excursion:

AD-conv. By hand: 100 kB/year

Rate: ≈ mB/s

Compare to ATLAS‘ MB evts with 100 Hz, … PB/a !

Thanks to:

The members of the Innsbruck AustrianGrid-LCG-EGGE- Group:
Reinhard Bischof
Peter Oettl
Gabriel Esterhammer
Wolfgang Kausch
Wolfgang Jais
Katharina Nimeth
CMS Vienna:
Gerhard Walzel
… to many colleagues at CERN, FZK, …
and last but not least to our FA
Austrian Ministry of education, science and culture
Austrian Council for Research and Technology Development

… and thanks for your attention!