LHC GRID computing in Poland

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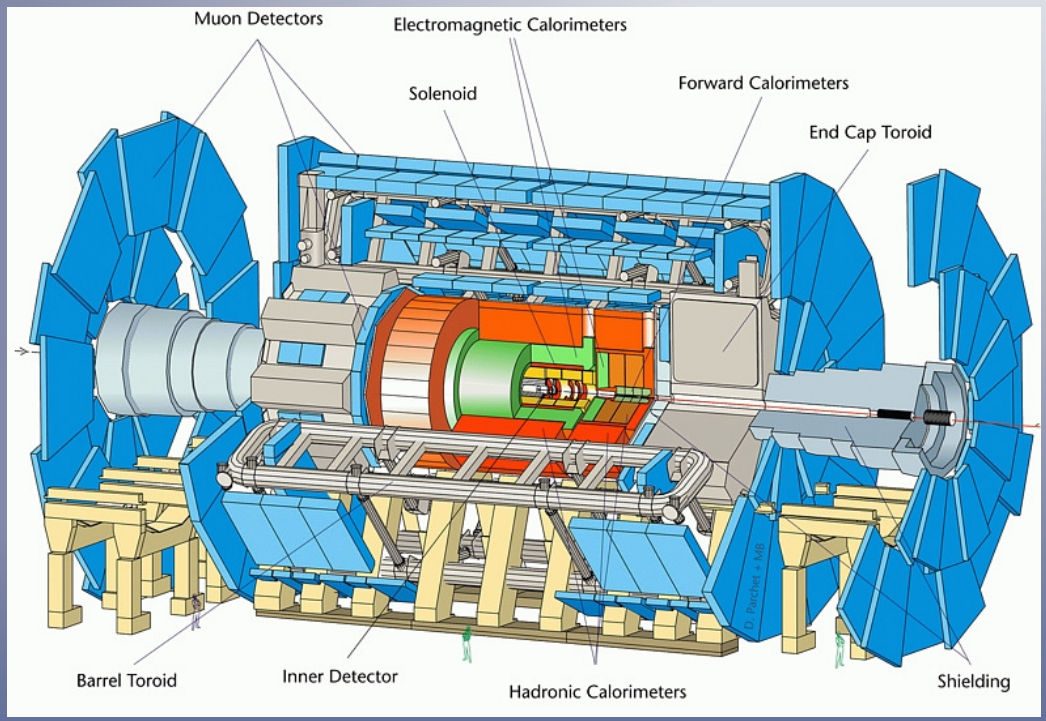
Polish Particle Physics Symposium, Warszawa, 21.04.2008

Outline

- Computing needs of LHC experiments
- WLCG - World Wide LHC Computing Grid
- Polish participation in WLCG
- Long term perspectives
- Conclusions

Computing needs of LHC experiments



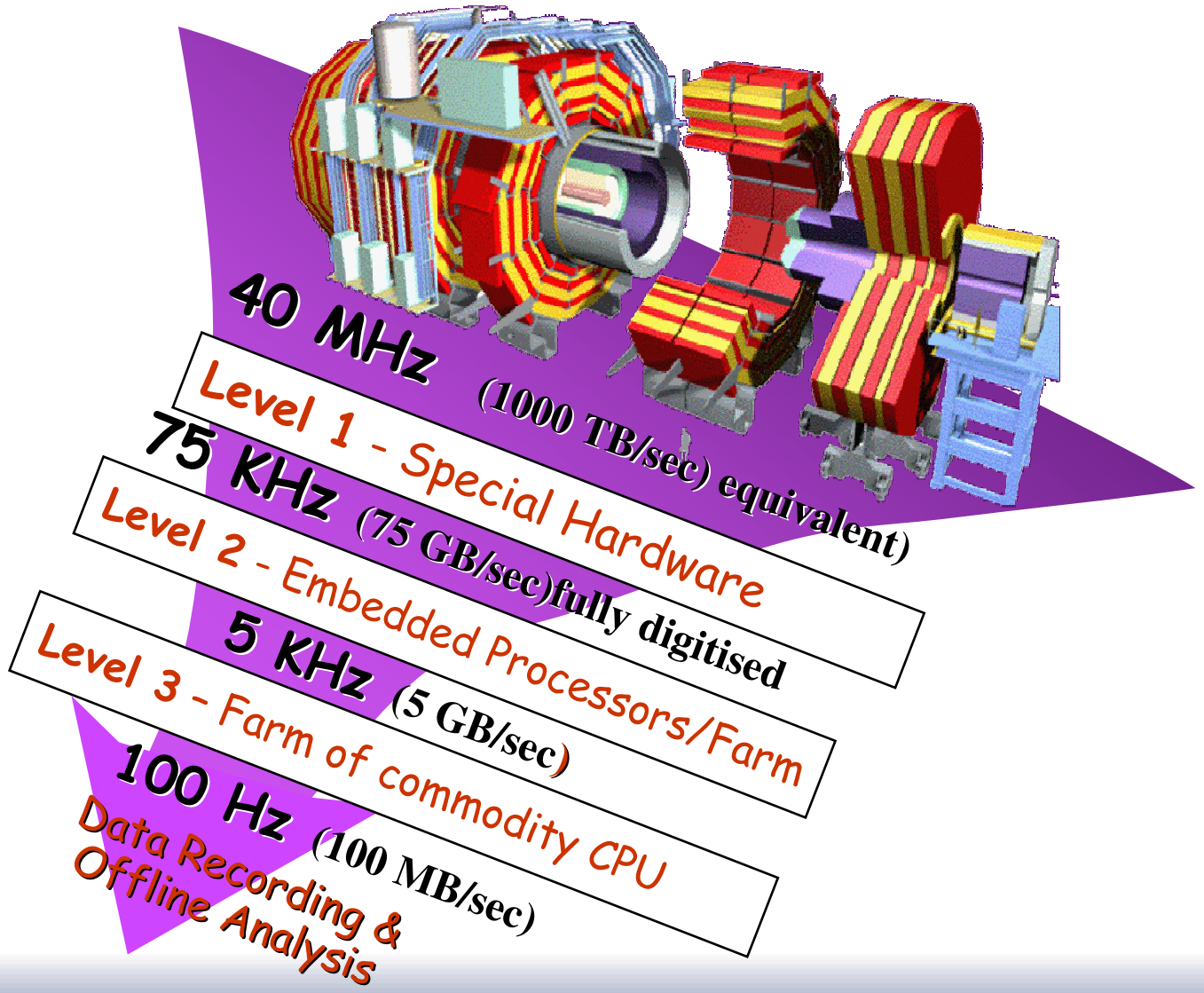
Challenges of LHC experiments

- High radiation (radiation resistance)
- Complex events (high granularity of detectors, long processing time)
- Very rare events (preselection)
- Huge volume of data (registration, storage)
- World-wide access to the data (networking)
- Large, distributed collaborations (coordination)
- Long-lasting experiments (documentation)

LHC data preselection

Data preselection in real time

- many different physics processes
- several levels of filtering
- high efficiency for events of interest
- total reduction factor of about 10^7



Data rate of LHC experiments

	Rate [Hz]	RAW [MB]	ESD Reco [MB]	AOD [kB]	Monte Carlo [MB/evt]	Monte Carlo % of real
ATLAS	200	1.6	0.5	100	2	20

For LHC computing, 100M SpecInt2000 or 100K of 3GHz Pentium 4 are needed!

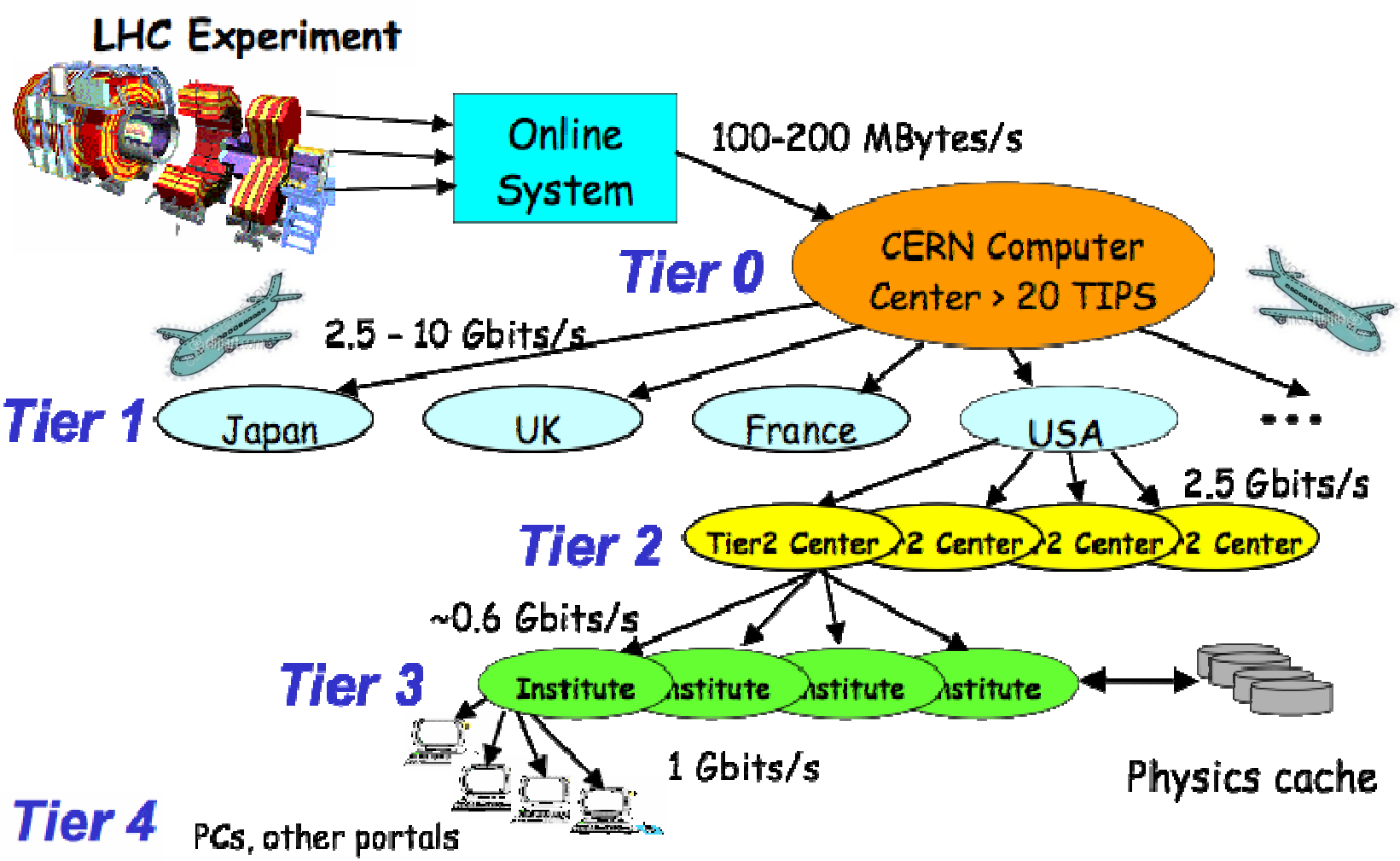
For data storage, 20 Peta Bytes or 100K of disks/tapes per year is needed!

First data in 2008
10^7 seconds/year pp from 2009 on → ~10^9 events/experiment
10^6 seconds/year heavy ion

ICFA Network Task Force (1998): required network bandwidth (Mbps)

	1998	2000	2005
BW Utilized Per Physicist (and Peak BW Used)	0.05 - 0.25 (0.5 - 2)	0.2 – 2 (2-10)	0.8 – 10 (10 – 100)
BW Utilized by a University Group	0.25 - 10	1.5 - 45	34 - 622
BW to a Home Laboratory Or Regional Center	1.5 - 45	34 - 155	622 - 5000
BW to a Central Laboratory Housing Major Experiments	34 - 155	155 - 622	2500 - 10000
BW on a Transoceanic Link	1.5 - 20	34 - 155	622 - 5000

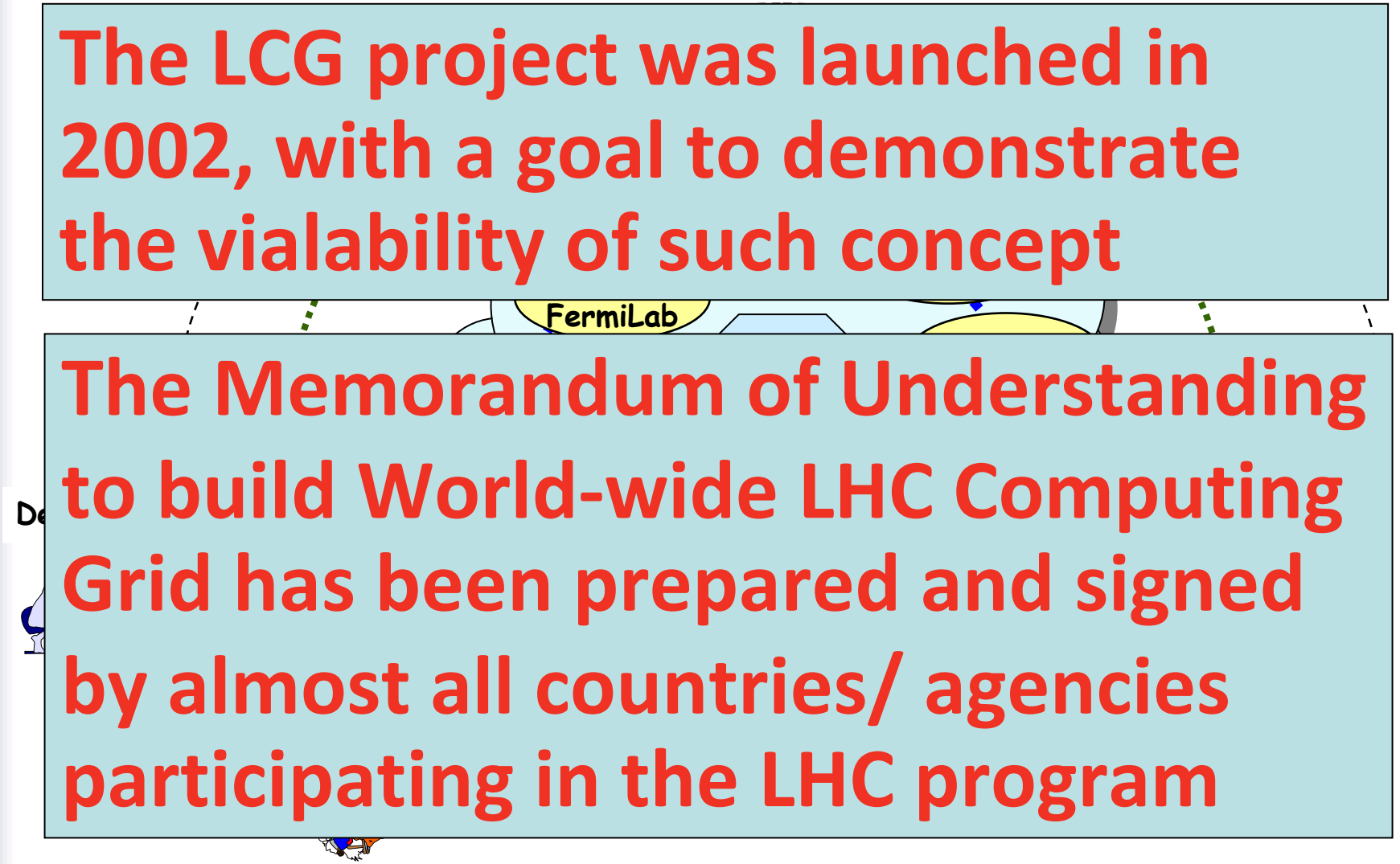
LHC computing model 1998



World Wide LHC Computing Grid

LHC Grid computing model

The LCG project was launched in 2002, with a goal to demonstrate the vialability of such concept



The Memorandum of Understanding to build World-wide LHC Computing Grid has been prepared and signed by almost all countries/ agencies participating in the LHC program

Required networking

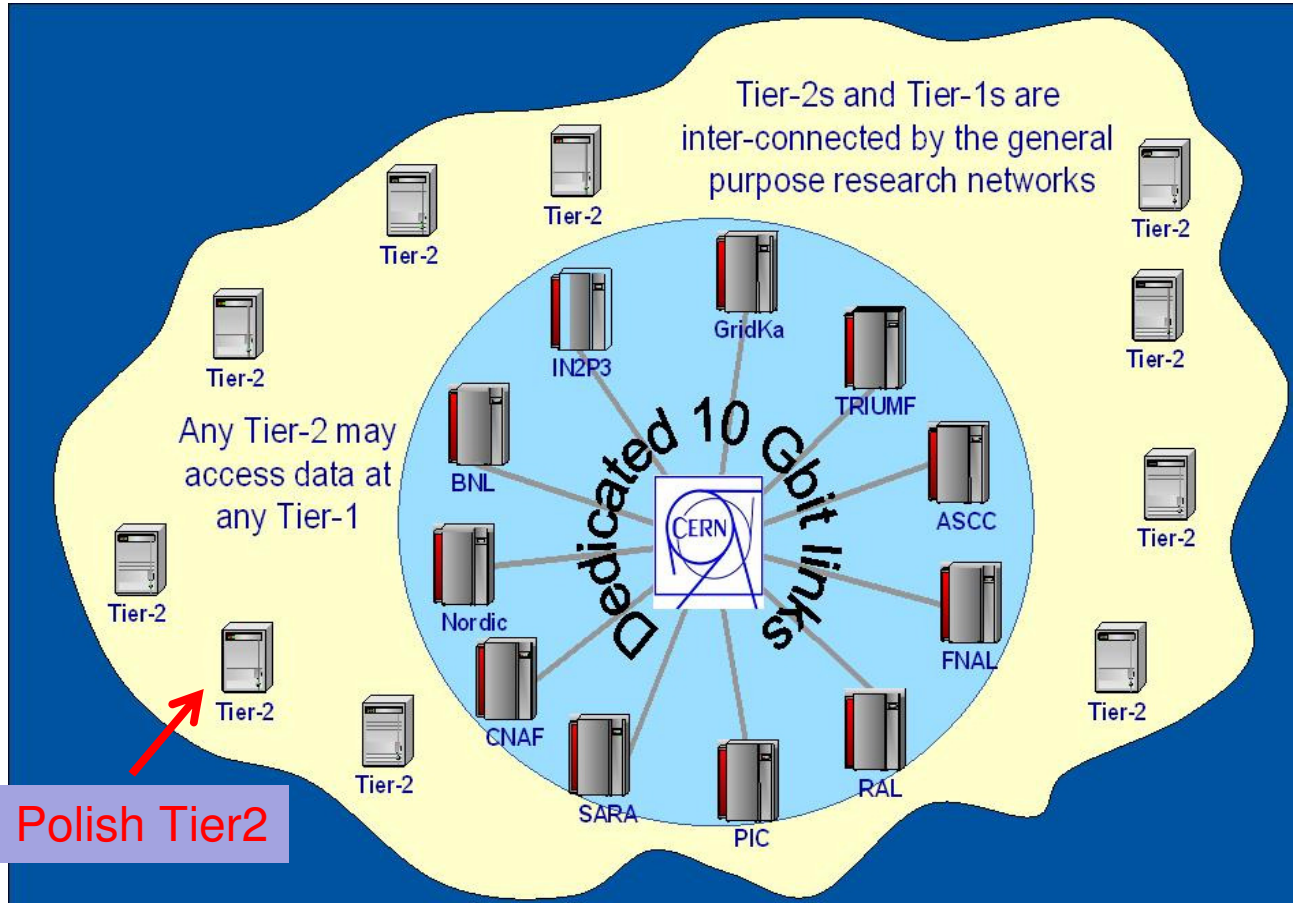
National Reasearch Networks (NRENs) at Tier-1s:

ASnet
LHCnet/ESnet
GARR
LHCnet/ESnet
RENATER
DFN
SURFnet6
NORDUnet
RedIRIS
UKERNA
CANARIE

For Tier-2s

GEANT

NRENs



LHC computing needs

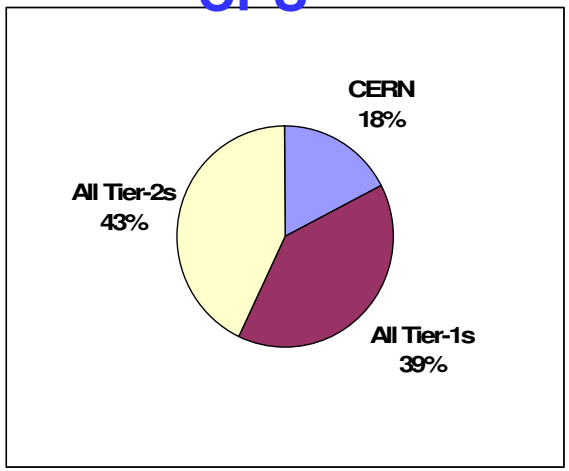
Summary of Computing Resource Requirements

All experiments - 2008

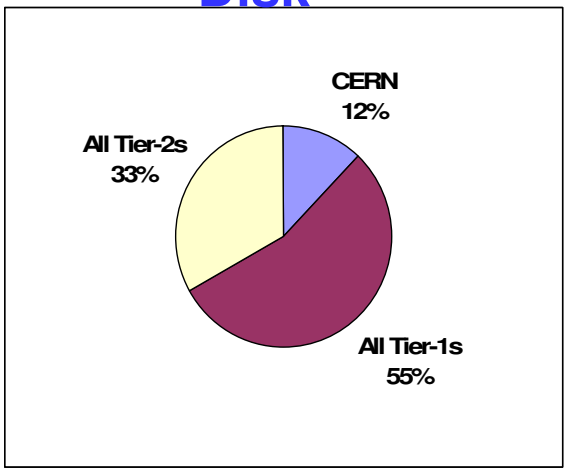
From LCG TDR - June 2005

	CERN	*All Tier-1s*	*All Tier-2s*	*Total*
CPU (MSPECint2000s)	25	56	61	142
Disk (PetaBytes)	7	31	19	57
Tape (PetaBytes)	18	35		53

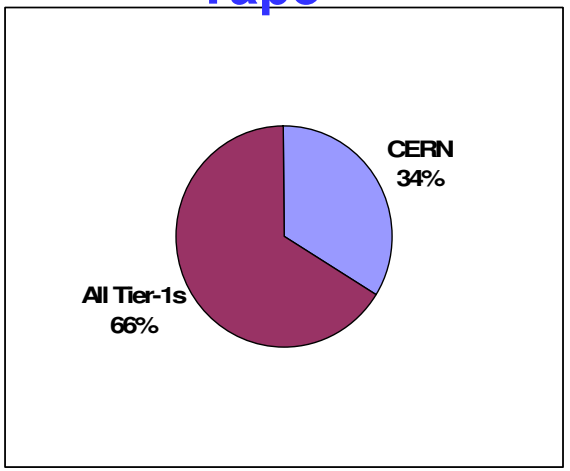
CPU



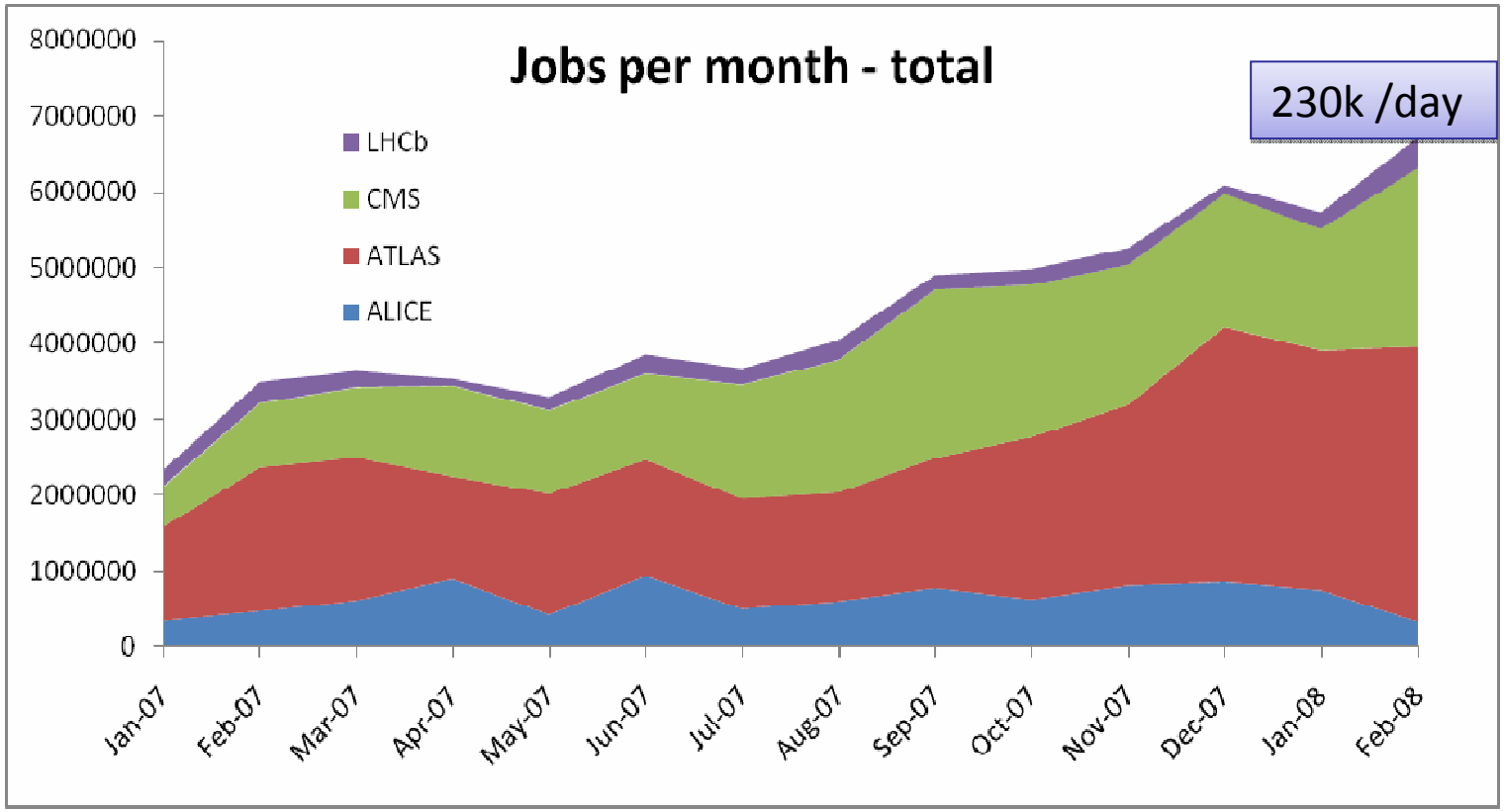
Disk



Tape



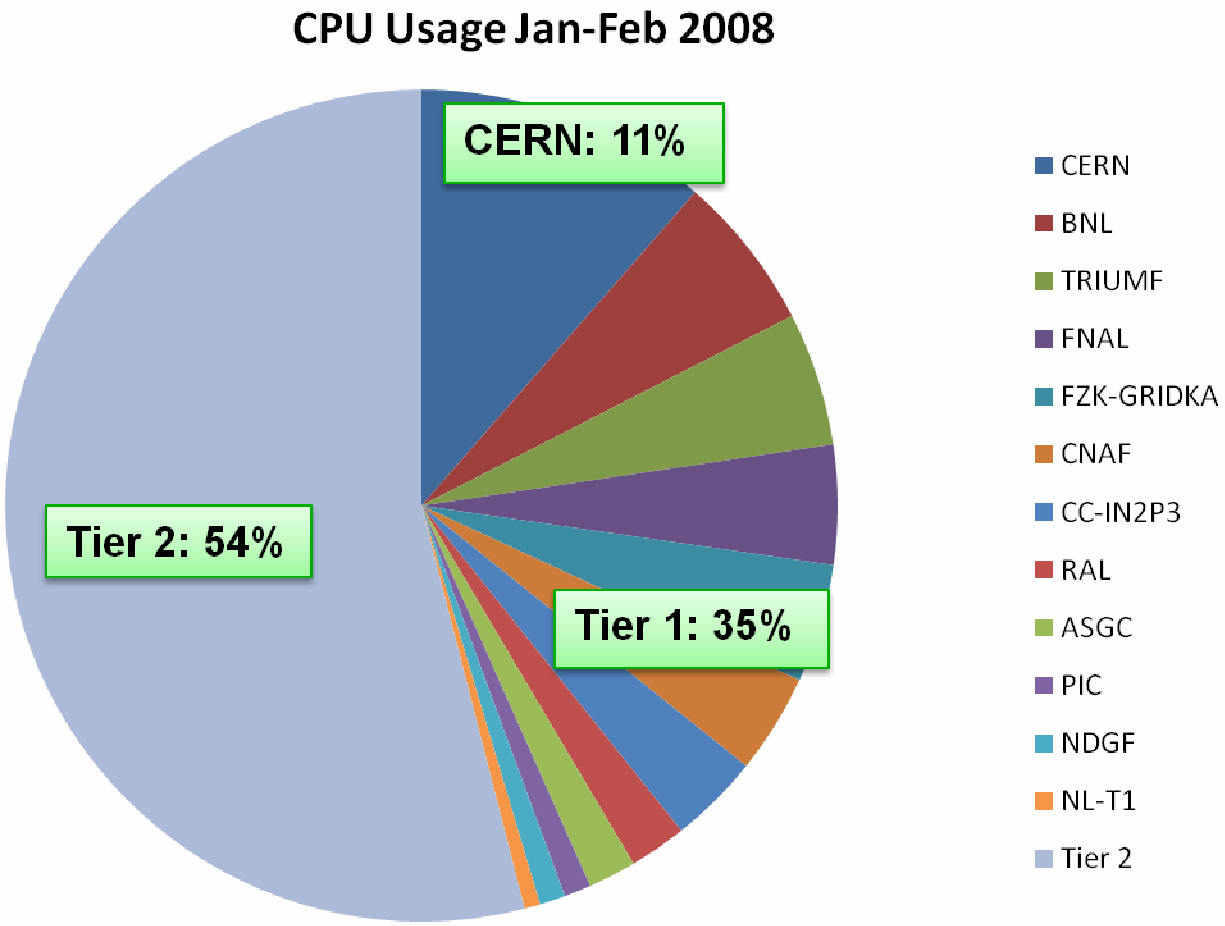
Grid activity



- These workloads (reported across all WLCG centres) are at the level anticipated for 2008 data taking

from I. Bird, April 2008

CP usage

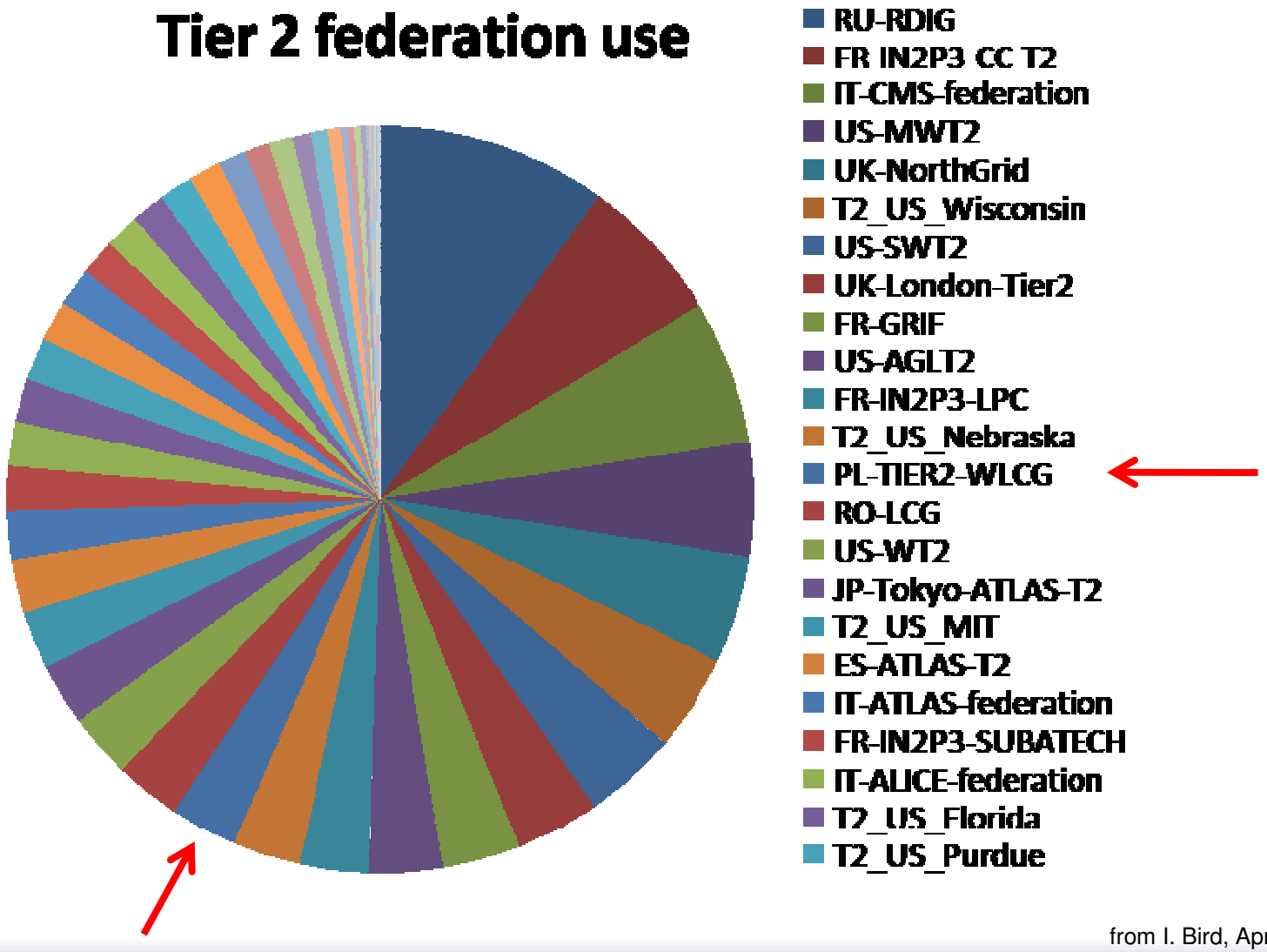


~ 90% of CPU Usage is external to CERN

(not all external resources taken into account)

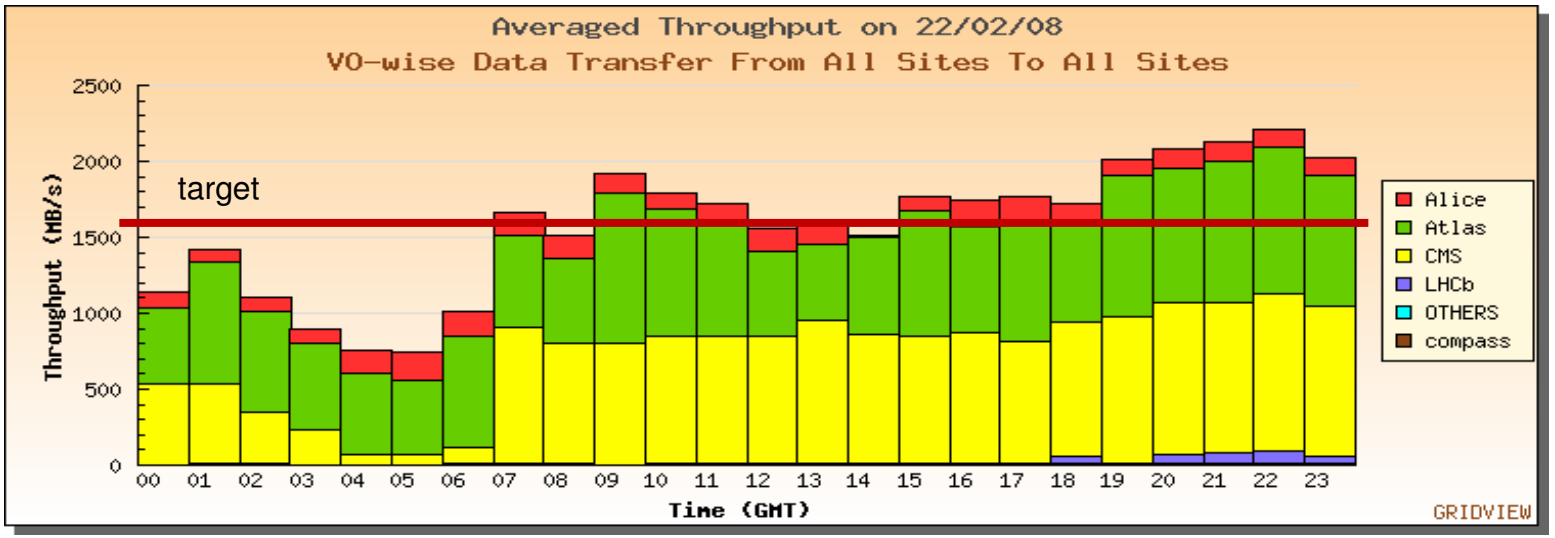
from I. Bird, April 2008

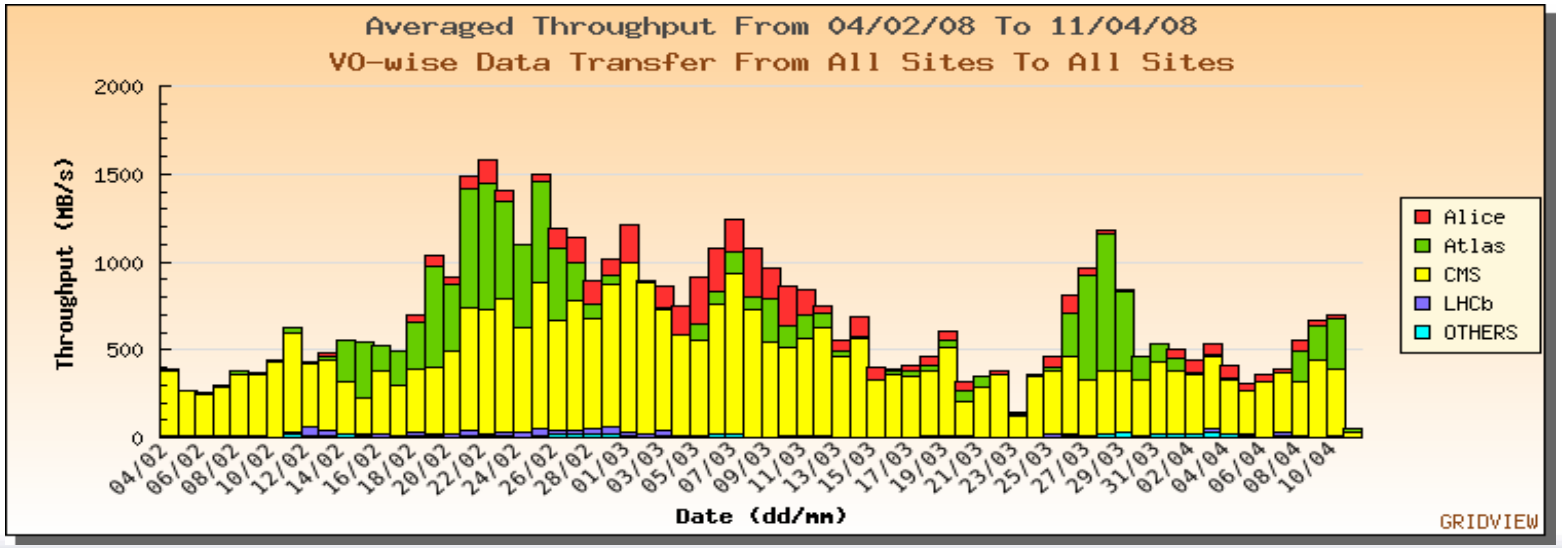
Tier2 sites – recent usage



from I. Bird, April 2008

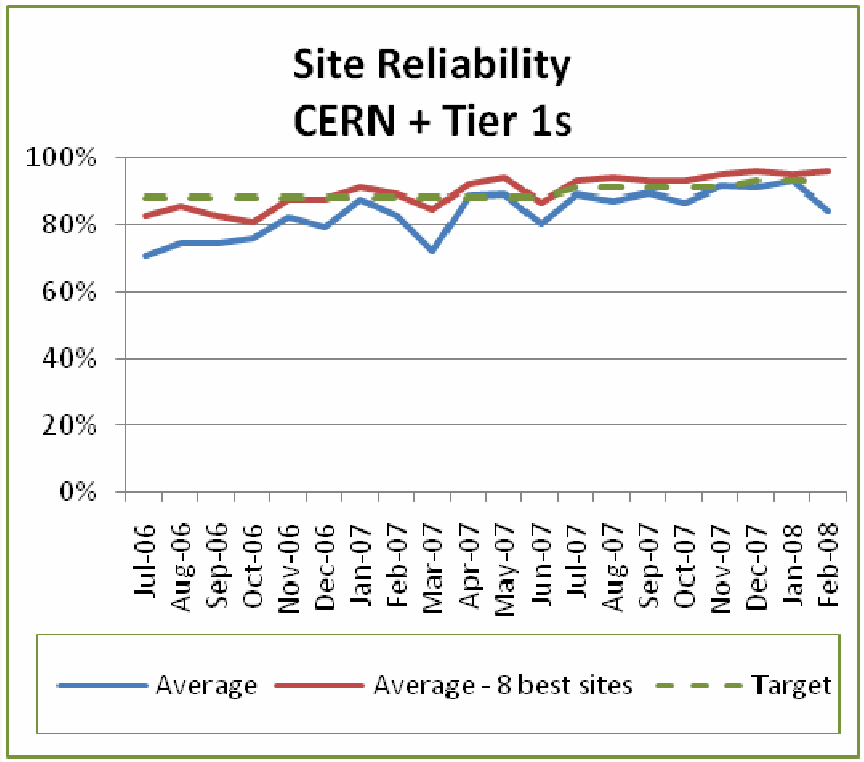
CERN data export

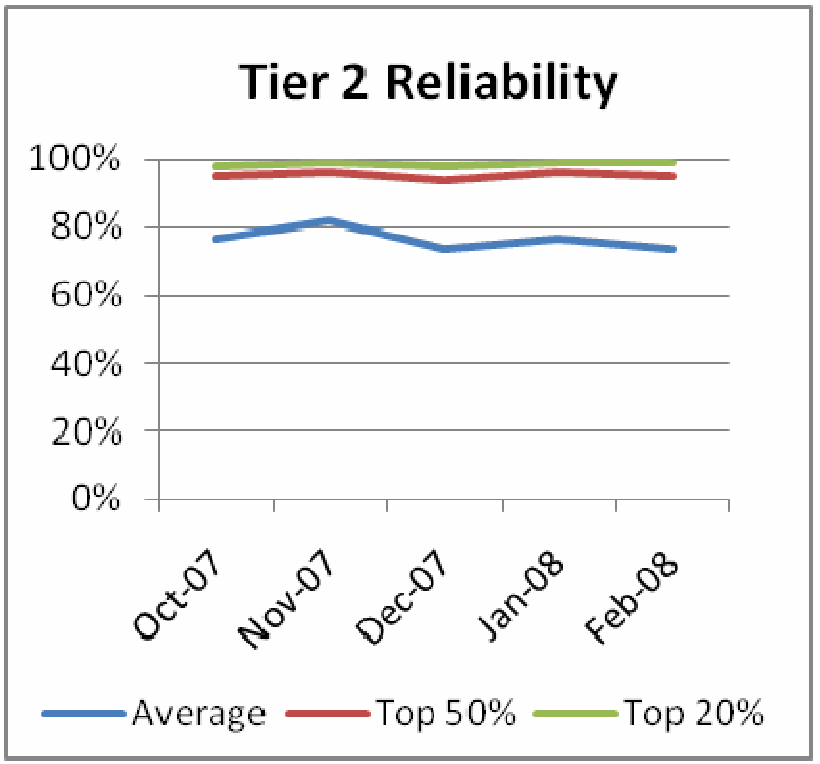




from I. Bird, Apr. 2008

Reliability

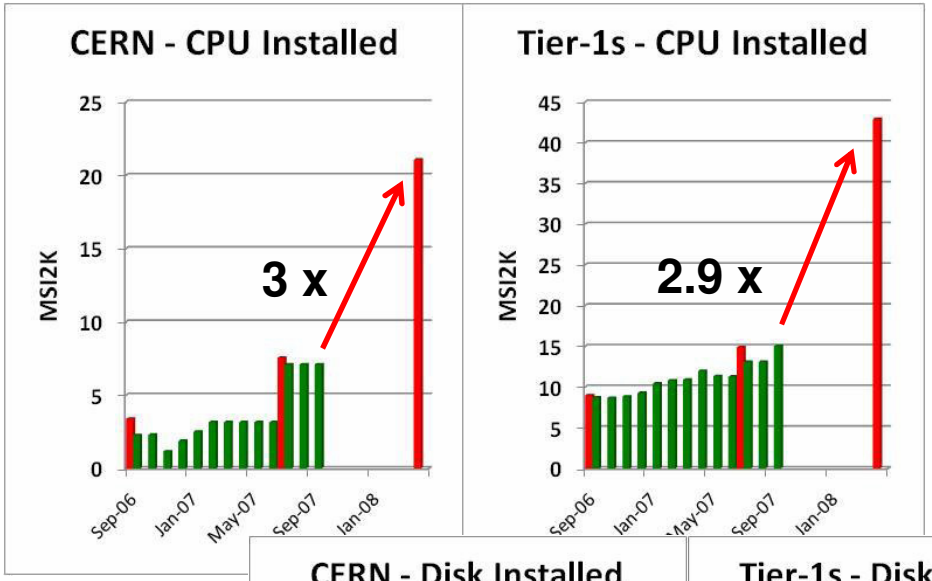


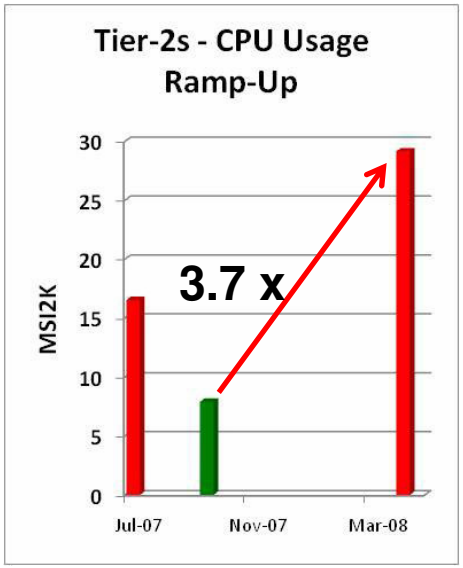


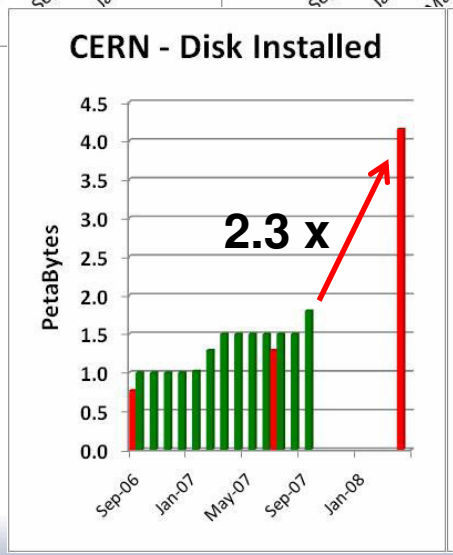
In February 2008 All Tier 1 and 100 Tier 2 sites reported reliabilities

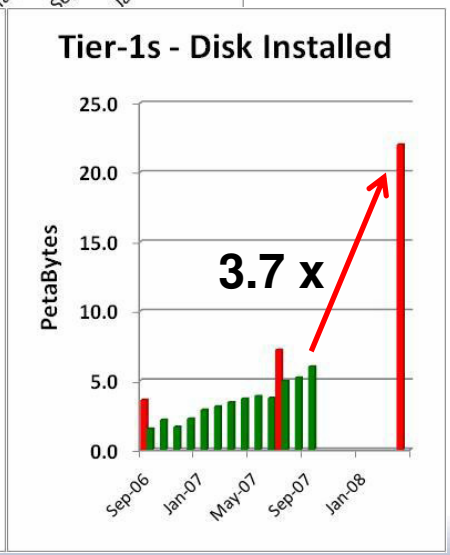
from I. Bird, Apr. 2008

Rump-up needed before LHC start









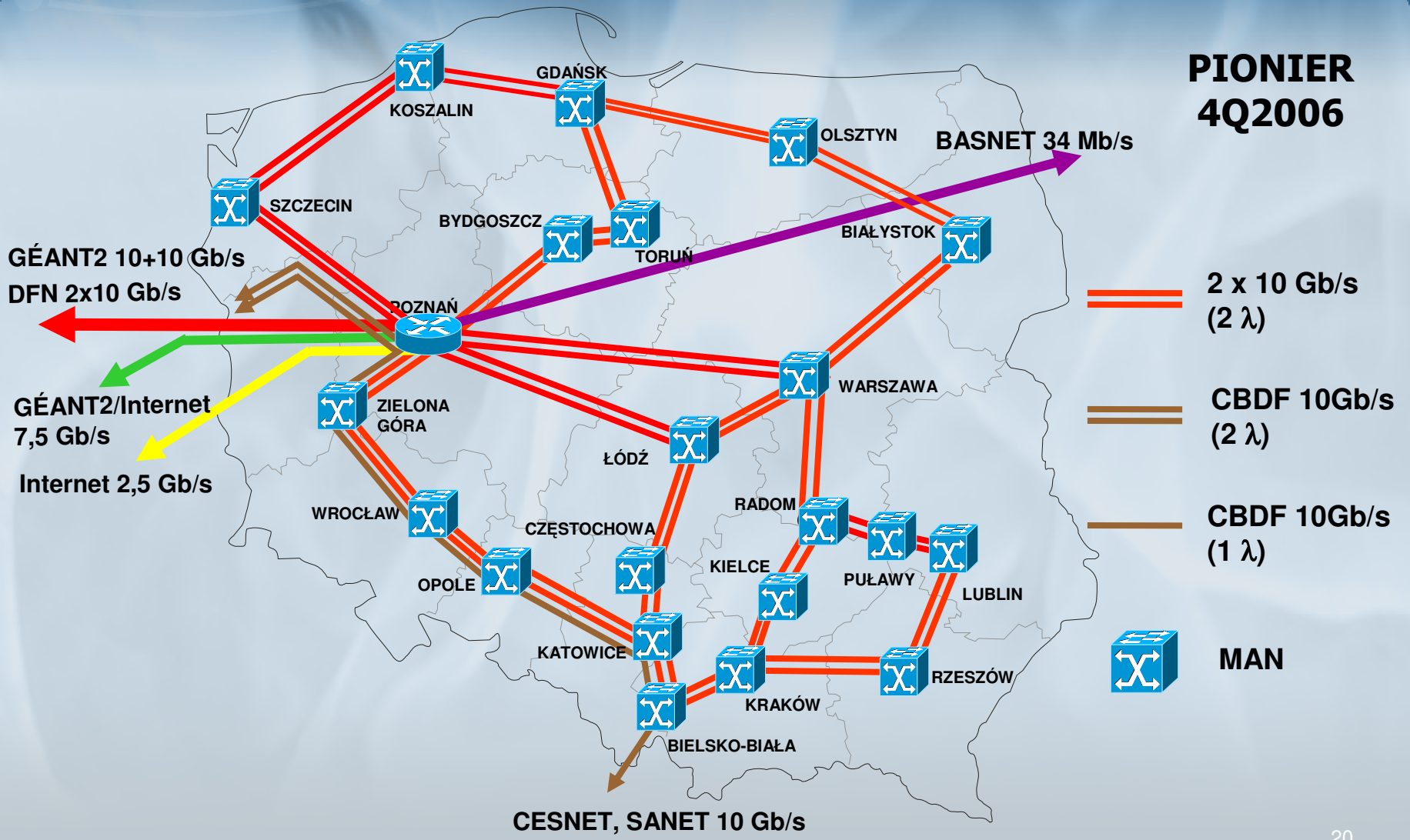
from L. Robertson
Oct. 2007

Poland in WLCG

Polish Particle Physics Symposium, Warszawa, 21.04.2008

INFRASTRUCTURE FOR e-SCIENCE

PIONIER - POLISH OPTICAL INTERNET

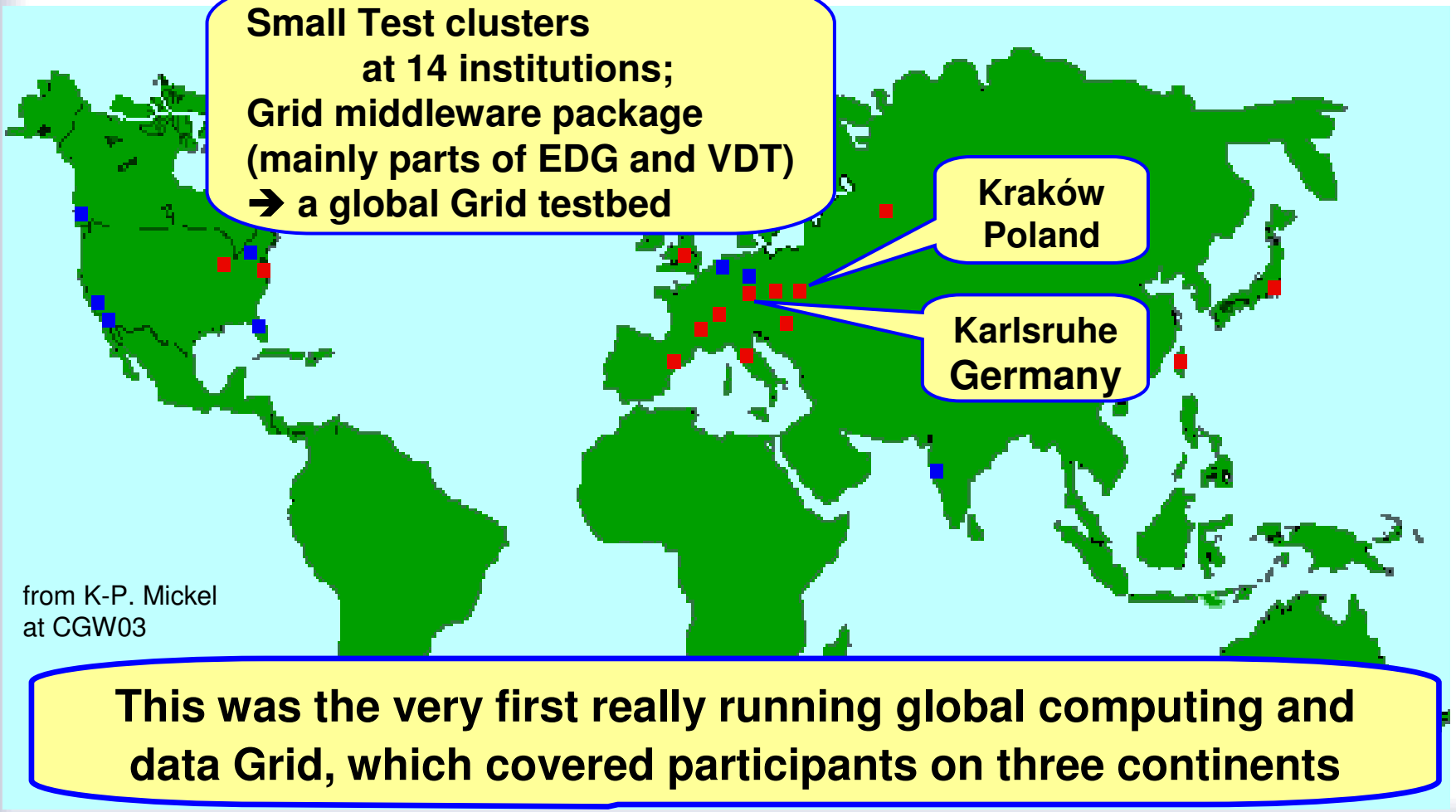


Polish participation in networking and grid projects

PIONIER, CrossGrid and EGEE were essential for the development of Polish WLCG infrastructure

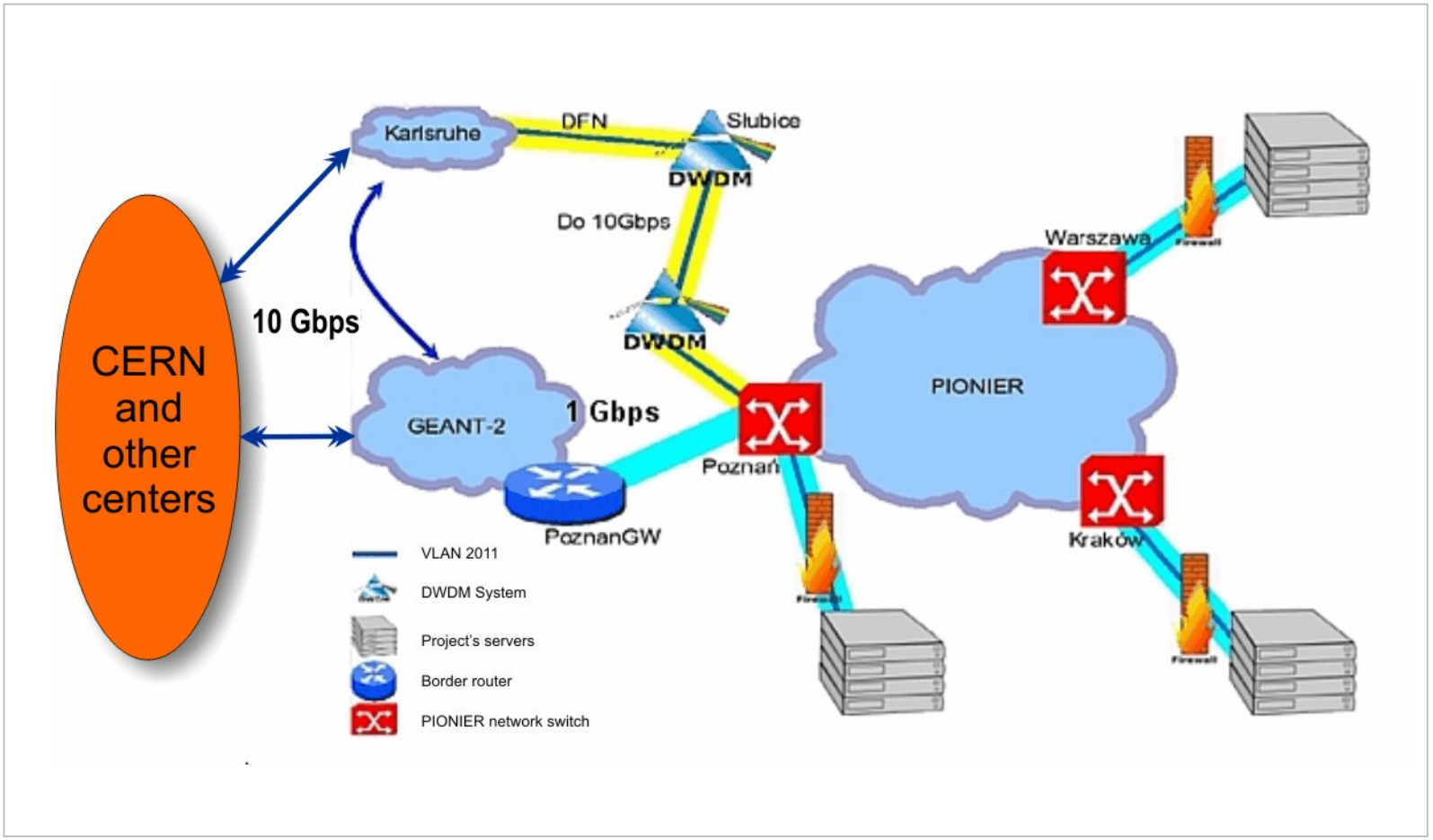
ACC Cyfronet AGH in LCG-1

Sept. 2003: Sites taking part in the initial LCG service (red dots)



This was the very first really running global computing and data Grid, which covered participants on three continents

Networking and computational infrastructure of Polish Tier2 for WLCG



Polish infrastructure for WLCG

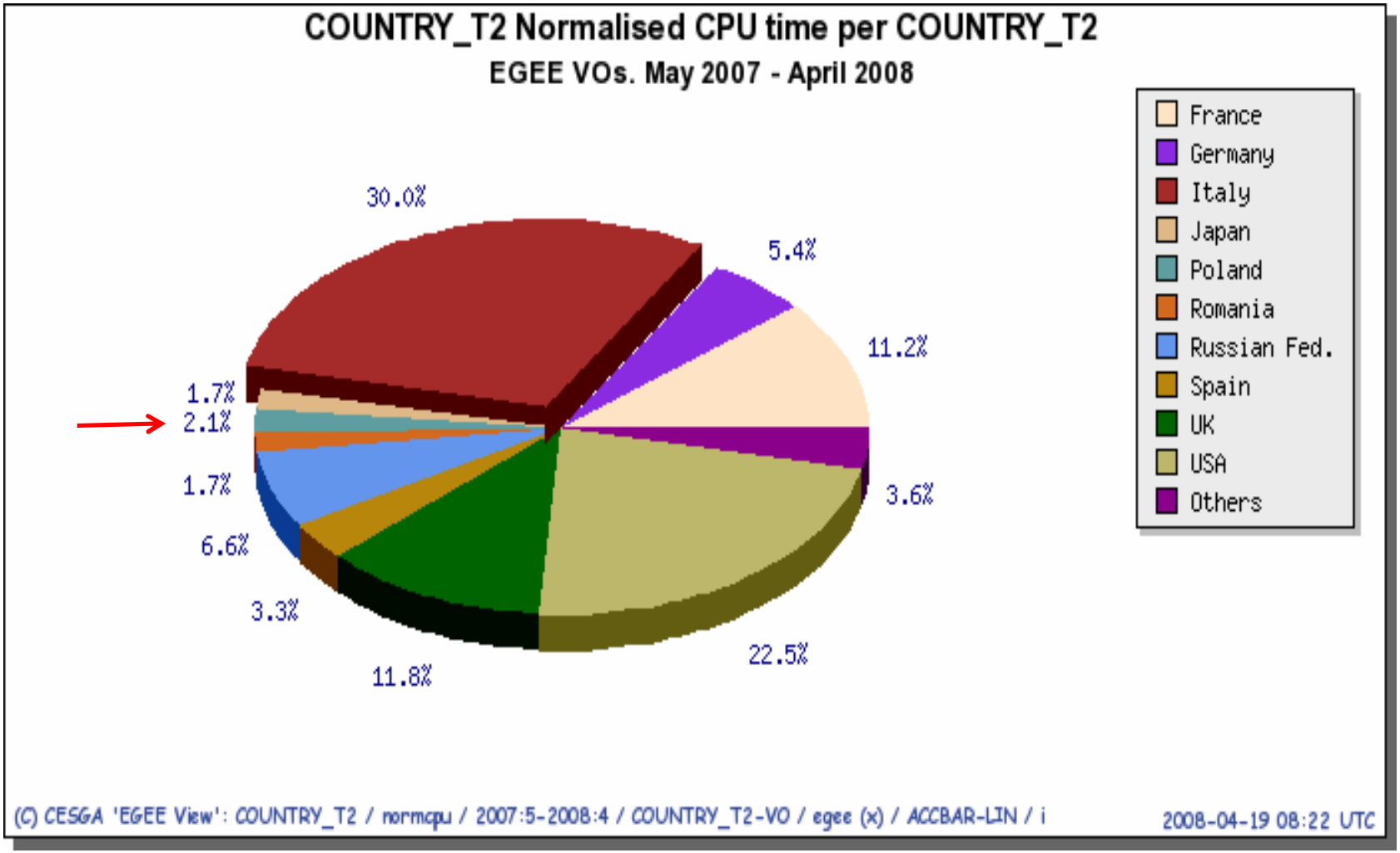
ACK Cyfronet AGH – Tier2
for LCG: 450 kSI2k, 50 TB

PCSS Poznań –Tier2
LCG ~400 kSI2k, 16 TB

ICM Warszawa – Tier2
for LCG: 350 kSI2k, 40 TB

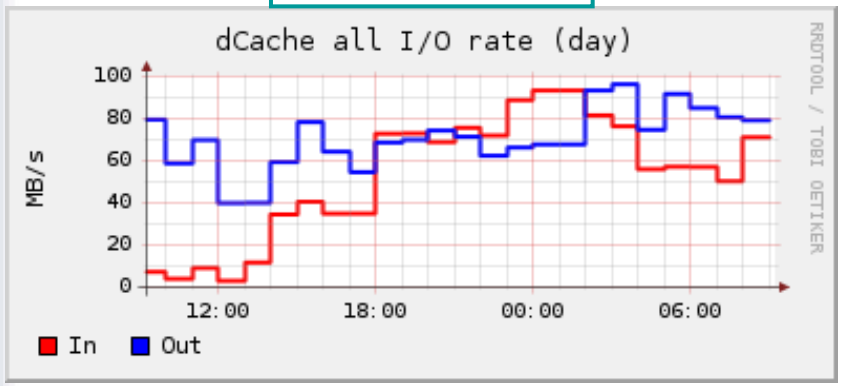
IFJ PAN Cracow – Tier3
at IPJ Warsaw – soon

Resources of EGEE for WLCG



Data transfer FZK-Cyfronet FTS

FZK dCache

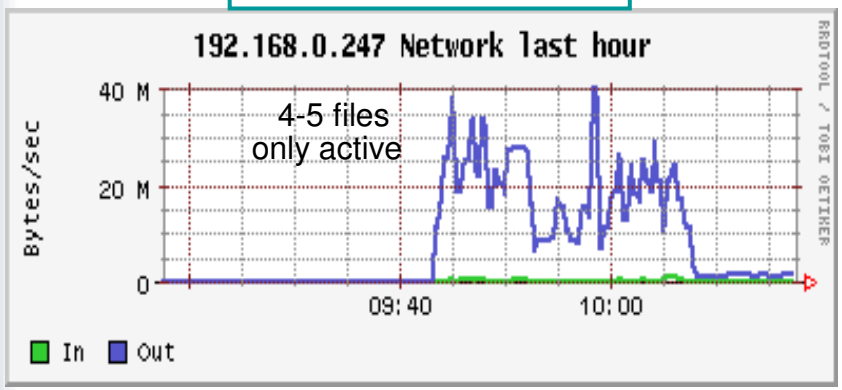


Star-FZK:
- Parallel streams: 10
- Parallel files: 10

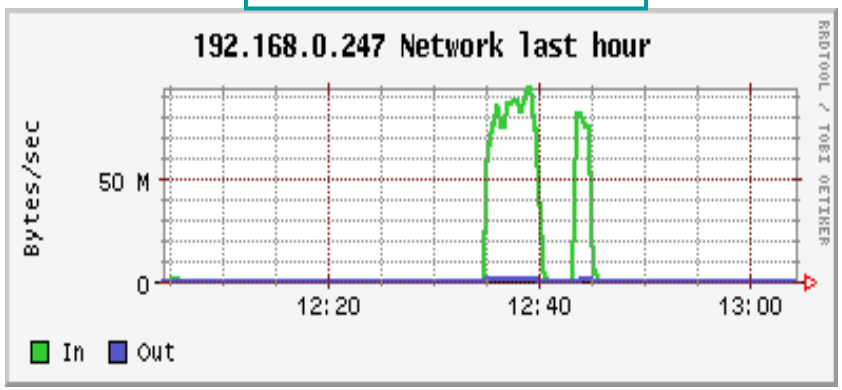
Star-CYFRONET:
- Parallel streams: 10
- Parallel files: 20

20 June 2007

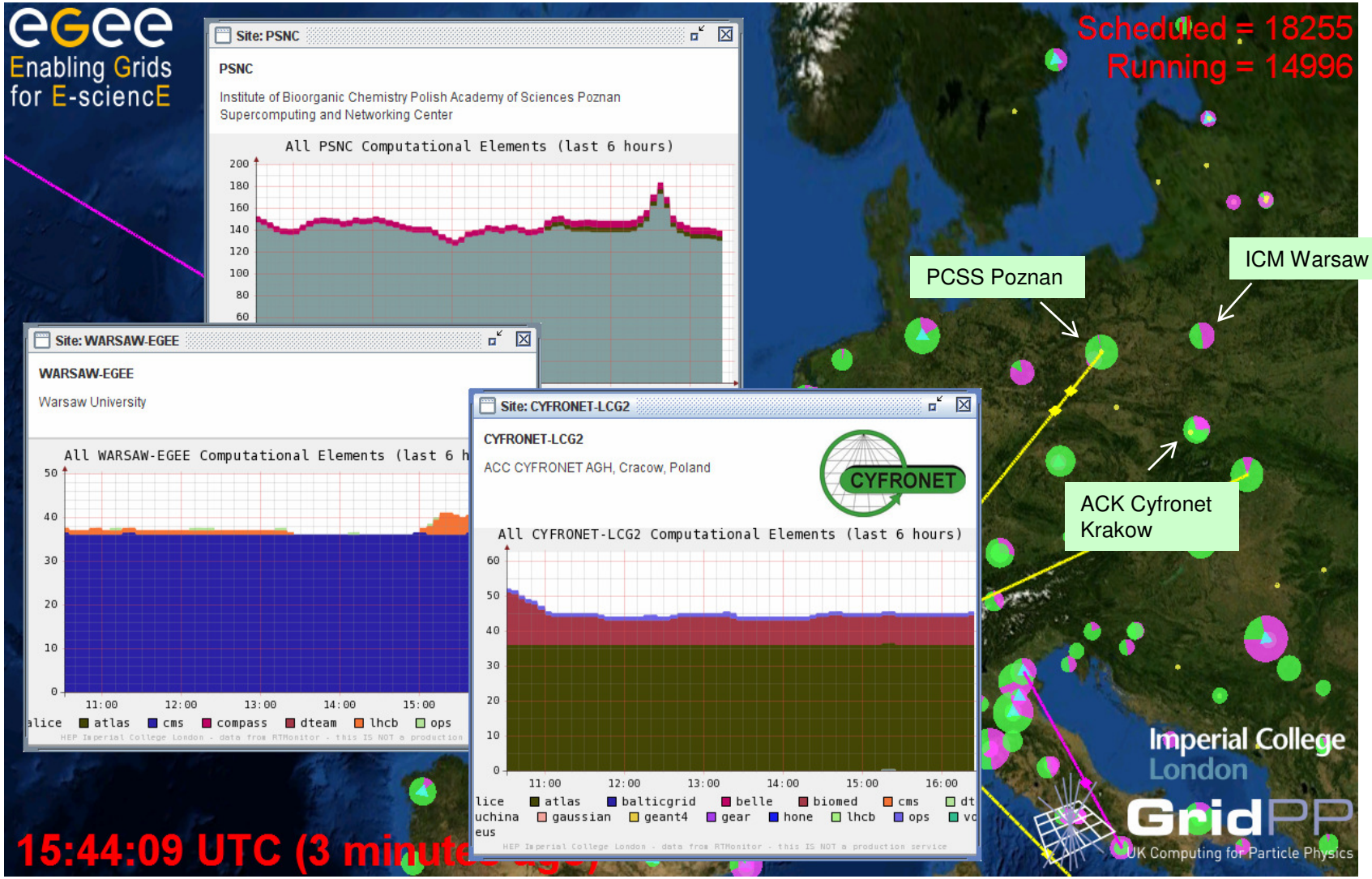
Kraków→FZK



FZK→Kraków



Polish CP usage



RTM snapshot of 15 Apr. 08.

Poland in WLCG

- In 2006 Poland has signed the Memorandum of Understanding (MoU) on the participation in the WLCG project as distributed Tier2, which includes computing centers of Cracow (ACK Cyfronet AGH), Poznan (PSNC) and Warsaw (ICM),
- According to this agreement in 2007 Poland should provide for LHC experiments about 650 processors and about 60 TB of disk storage; during 2008 these numbers should increase by about a factor of 2.
- From the WLCG accounting summary for January 2008

		Reliability	Availability	Oct.07	Nov.07	Dec.07
IT-LHCb-federation		64%	64%	64%	78%	65%
Japan, ICEPP, Tokyo	TOKYO-LCG2	99%	98%	99%	58%	100%
JP-Tokyo-ATLAS-T2		99%	98%	99%	58%	100%
Norway, UNINETT SIGMA Tier-2	NO-NORGRID-T2	0%	0%	0%	0%	0%
NO-NORGRID-T2		0%	0%	0%	0%	0%
Pakistan, Pakistan Tier-2 Federation	NCP-LCG2	2%	22%	0%	0%	39%
	PAKGRID-LCG2	0%	7%	0%	0%	0%
PK-CMS-T2		1%	14%	0%	0%	19%
Poland, Polish Tier-2 Federation	AMD64.PSNC.PL	93%	93%	85%	93%	91%
	CYFRONET-IA64	97%	97%	95%	97%	87%
	CYFRONET-LCG2	94%	94%	71%	84%	87%
	egee.man.poznan.pl	88%	88%	66%	78%	91%
	WARSAW-EGEE	97%	97%	93%	99%	99%
PL-TIER2-WLCG		94%	94%	82%	90%	91%
Portugal, LIP Tier-2 Federation	LIP-Coimbra	4%	44%	94%	98%	82%
	LIP-Lisbon	11%	35%	88%	98%	37%
PT-LIP-LCG-Tier2		7%	39%	91%	98%	60%
Romania, Romanian Tier-2 Federation	NIHAM	90%	92%	85%	91%	93%
	RO-02-NIPNE	48%	67%	93%	93%	89%
	RO-07-NIPNE	56%	66%	42%	82%	34%
	RO-11-NIPNE	78%	81%	67%	27%	45%
RO-LCG		68%	77%	72%	73%	65%

Future development

Tier1

Summary Ext. Tier1s	2007	2008	2009	2010	2011	2012
CPU (kSI2K)	14894	37563	61692	101737	126523	146130
Disk (Tbytes)	7221	20221	35222	60008	79875	93821
Tape (Tbytes)	6503	21298	40329	65438	88837	108775

Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
Offered	5541	19195	10291	2536	37563
Required	10100	18120	9600	1770	39590
Balance	-45%	6%	7%	43%	-5%
Offered	2395	10913	5546	1367	20221
Required	4000	10730	7200	1025	22955
Balance	-40%	2%	-23%	33%	-12%
Offered	2983	7692	9429	1194	21298
Required	5800	8070	9800	860	24530
Balance	-49%	-5%	-4%	39%	-13%

Tier2

Summary Tier2s with Split in 2008	2007	2008	2009	2010	2011	2012
CPU (kSI2K)	21986	45486	68432	106753	135970	153850
Disk (Tbytes)	4641	12125	21728	33187	42085	47703
Tape (Tbytes)	0	0	0	1500	2000	3000

Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
Offered	6693	17528	17042	4223	45486
Required	12500	17510	13400	4550	47960
Balance	-46%	0%	27%	-7%	-5%
Offered	1363	6314	4309	139	12125
Required	1700	7770	5100	9	14579
Balance	-20%	-19%	-16%	1443%	-17%

For ATLAS Disk/CPU=44%

Poland

Poland, Polish Tier-2 Federation	2007	2008	2009	2010	2011	2012
CPU (kSI2K)	650	1250	1780	2635	3265	3940
Disk (Tbytes)	60	202	340	599	808	1019
Nominal WAN (Mbits/sec)	1000	1000	2000	2000	2000	2000

Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
Offered	265	407	341	237	1250
% of Total	2%	2%	3%	5%	3%
Offered	15	113	74	0	202
% of Total	1%	1%	1%	0%	1%

For ATLAS Disk/CPU=27%

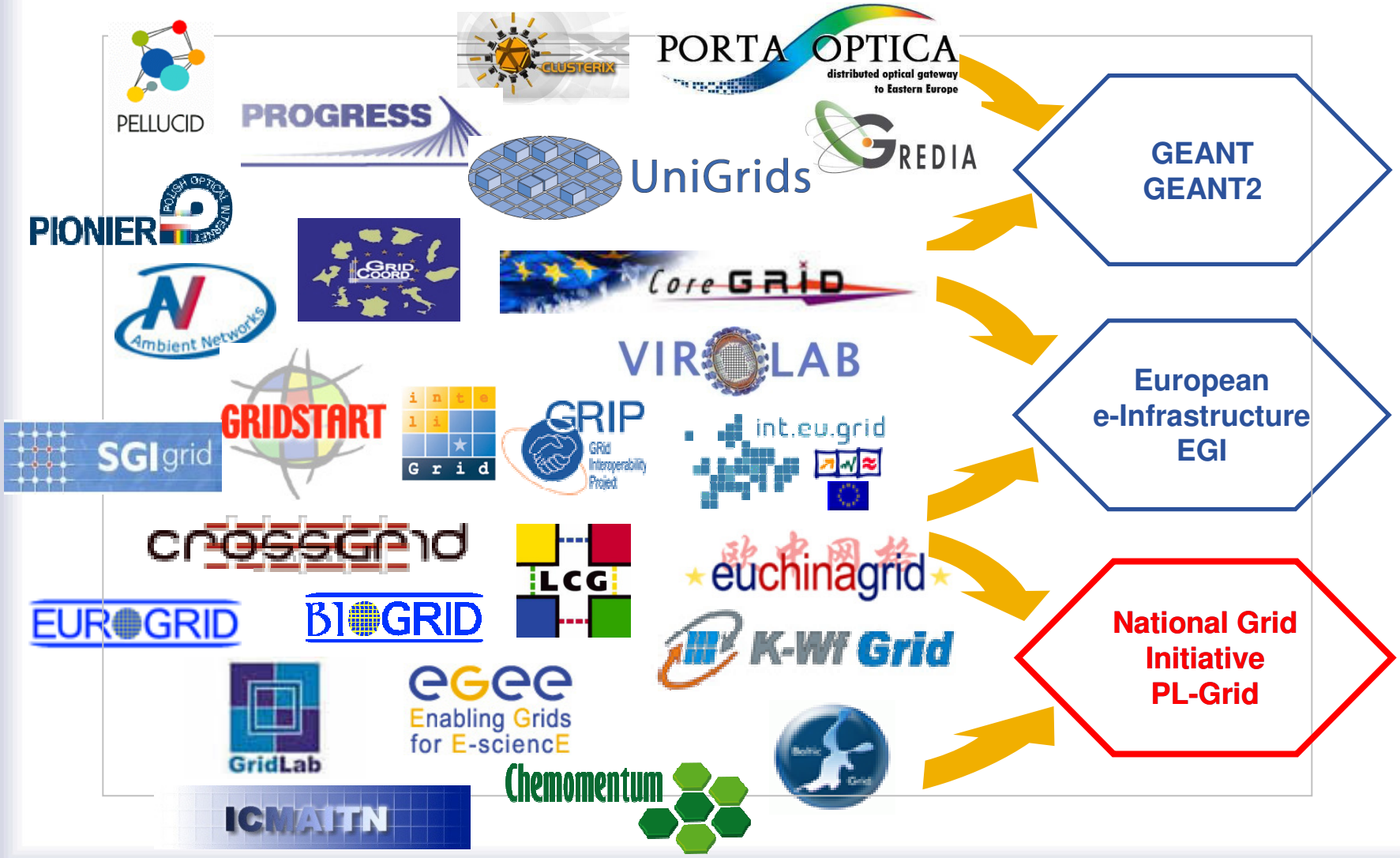
POLTIER – a national network on LHC computing

- Created in 2006 by 8 research institution: IFJ PAN, PK, UST AGH, UJ Krakow; PSNC Poznan; IFD UW, IPJ, PW Warsaw with IFJ PAN being a coordinator
- A main goal of the network is to coordinate Polish effort towards LHC computing, including coordination with relevant international bodies (CERN, LCG, GDB, FZK Karlsruhe, others)
- Several local meetings took place: Warsaw (2006), Poznan (2006), Krakow (2007), Warsaw (2007); participation to international meetings is limited due to lack of finding,
- Financial support is badly needed – first application of 2006 was rejected on formal grounds; the 2007 request awaits decision.

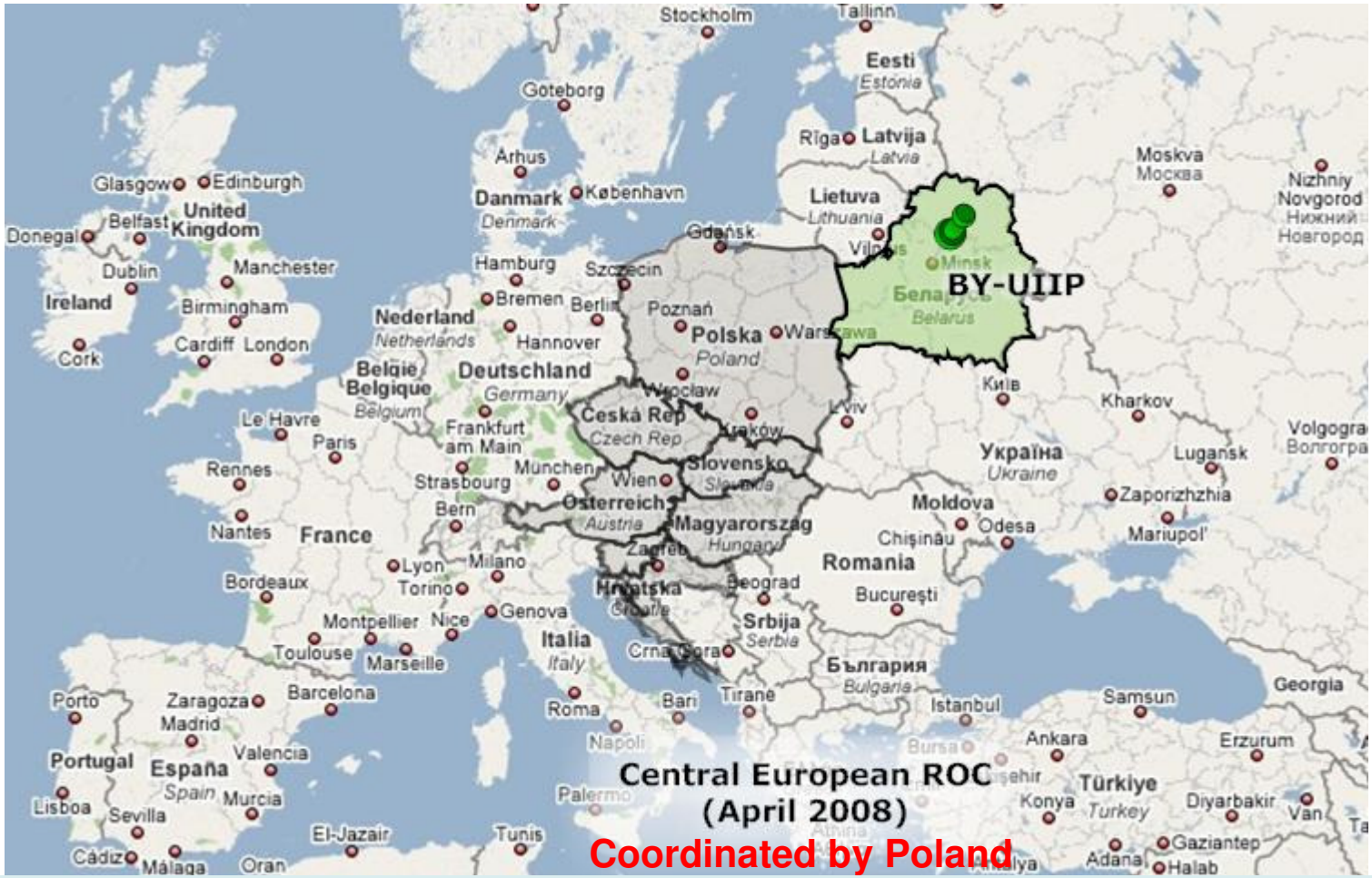
Polish National Grid Initiative

Polish Particle Physics Symposium, Warszawa, 21.04.2008

Polish participation in networking and grid projects



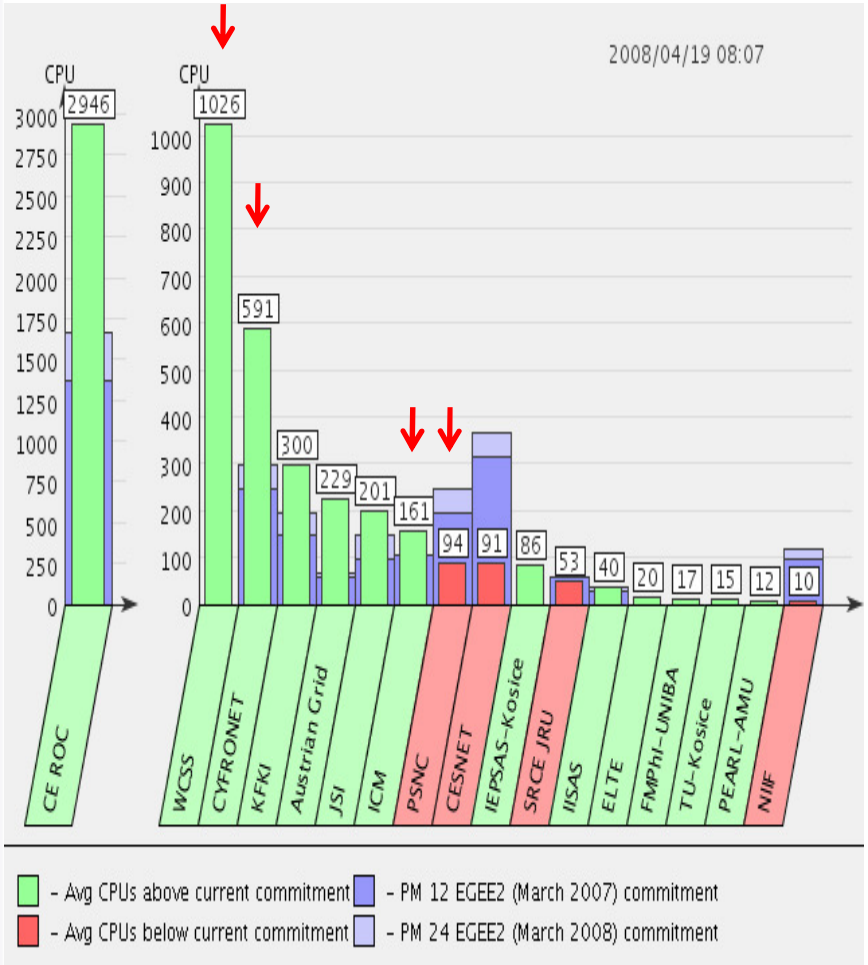
EGEE CEGC ROC

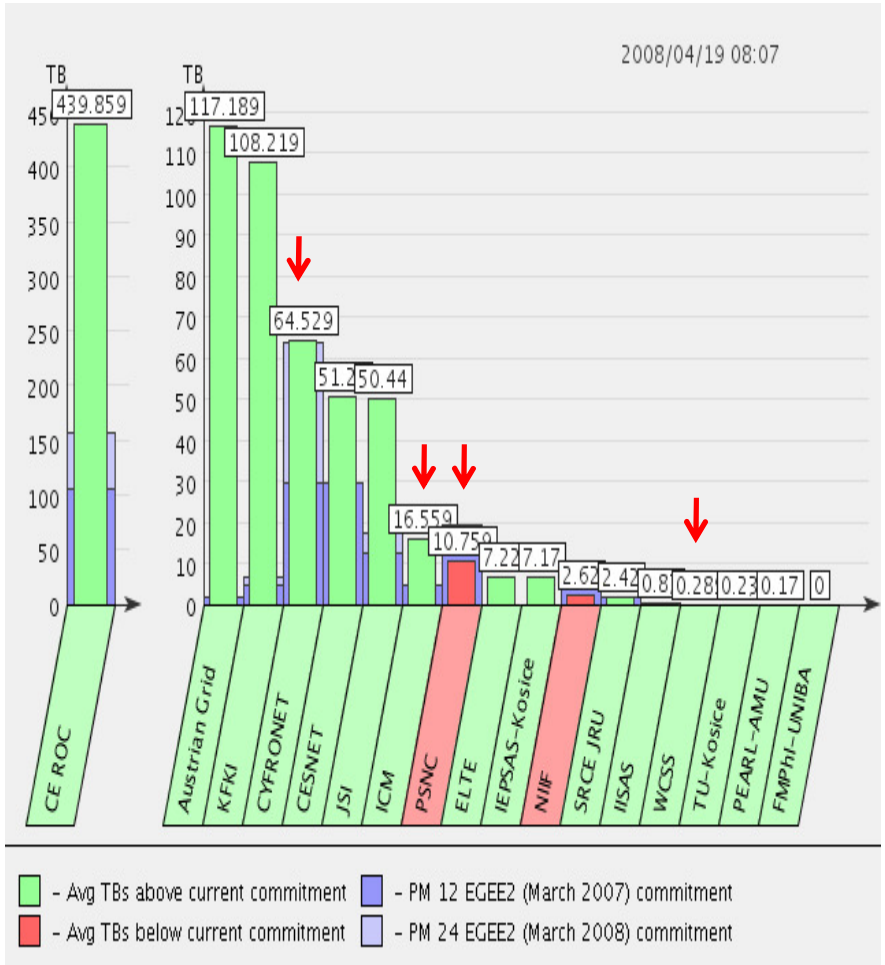


Very recently Belarussia become a new member of CEGC ROC

Poland is also a member of Baltic Grid projects, which includes Estonia, Lithuania and Latvia

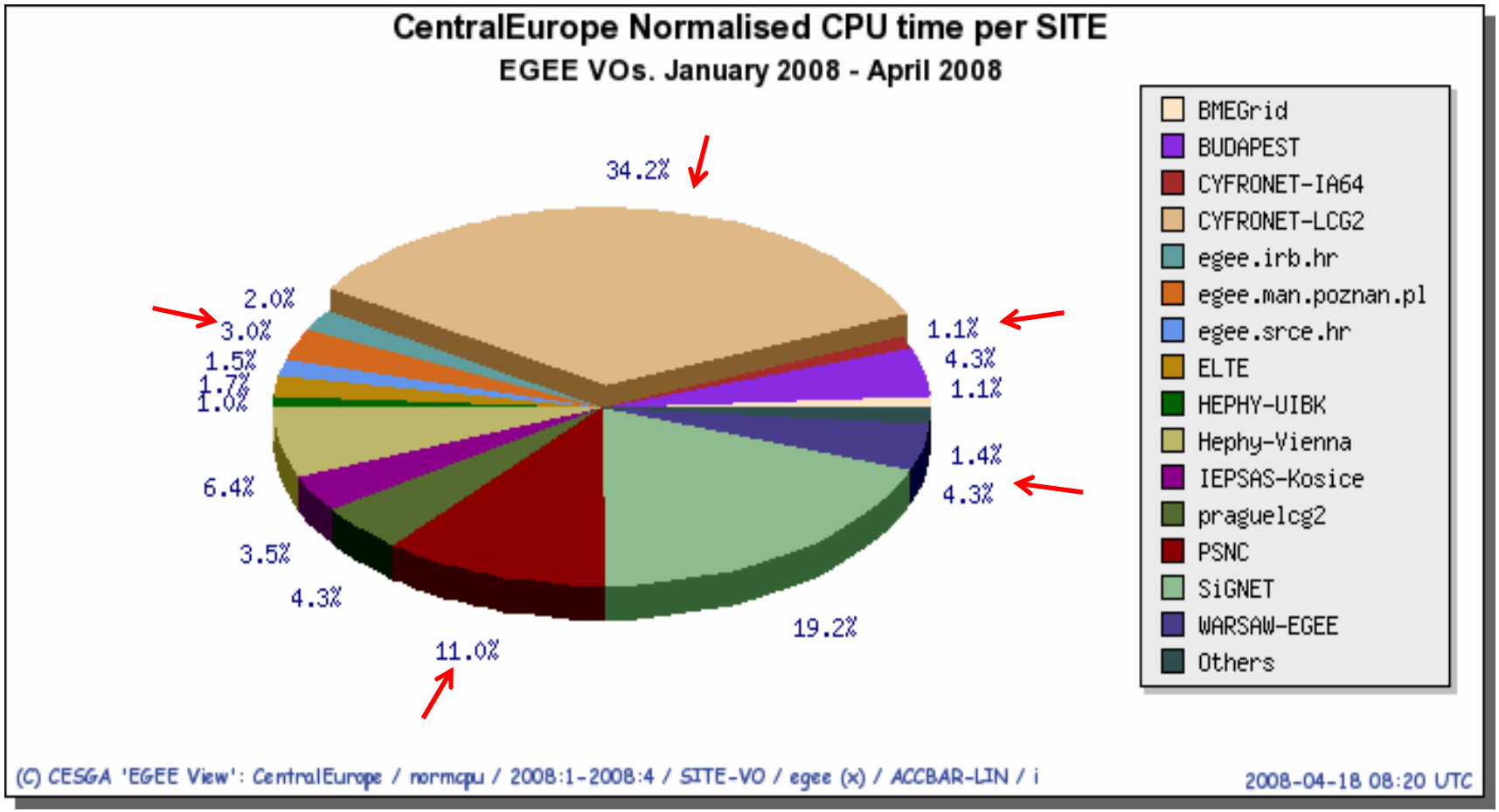
Resources of EGEE CEGC ROC





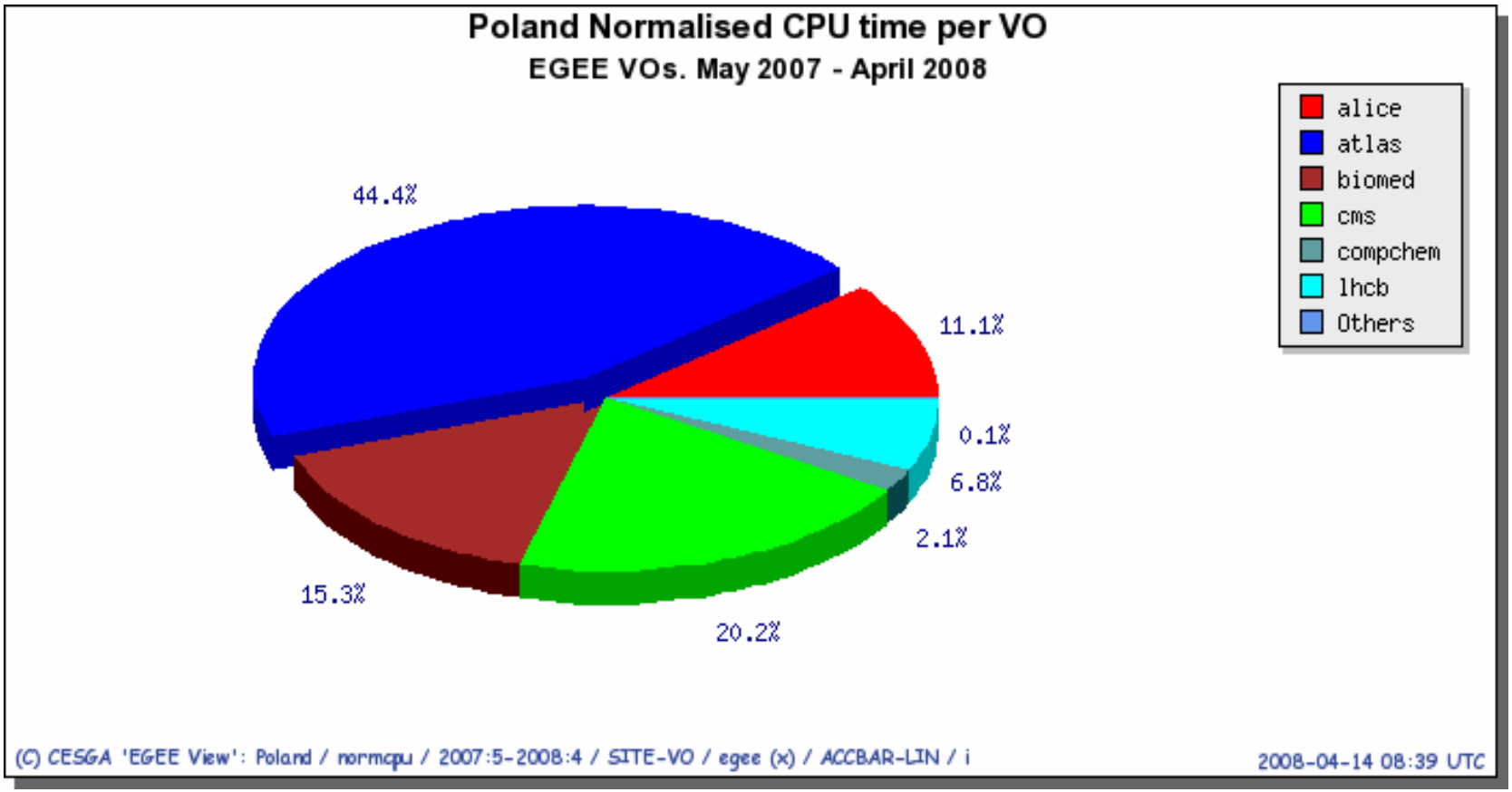
These resources are mainly used by physics, bioinformatics and chemistry

Resources of EGEE CEGC ROC



Large fraction of these resources is provided by the Polish computing centers

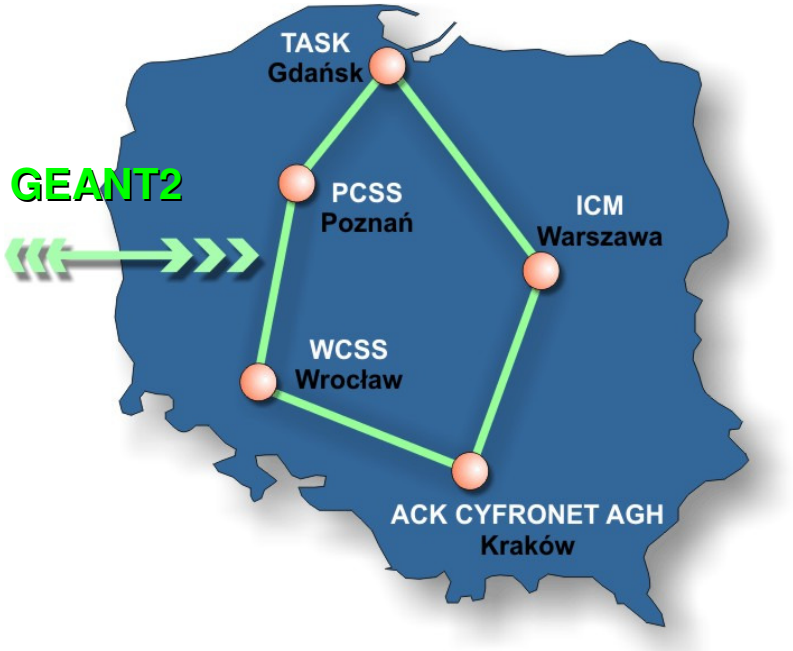
Users of the Polish EGEE Grid



- Physics, Biomedical, Chemistry…

PL-Grid Initial Phase

- Creation of Polish Grid (PL-Grid) Consortium
- Agreement signed in January 2007
- Preparation of PL-Grid Project (2008-2010, 2011-2013)
- Consortium made up of five largest Polish supercomputing and networking centers (founders):



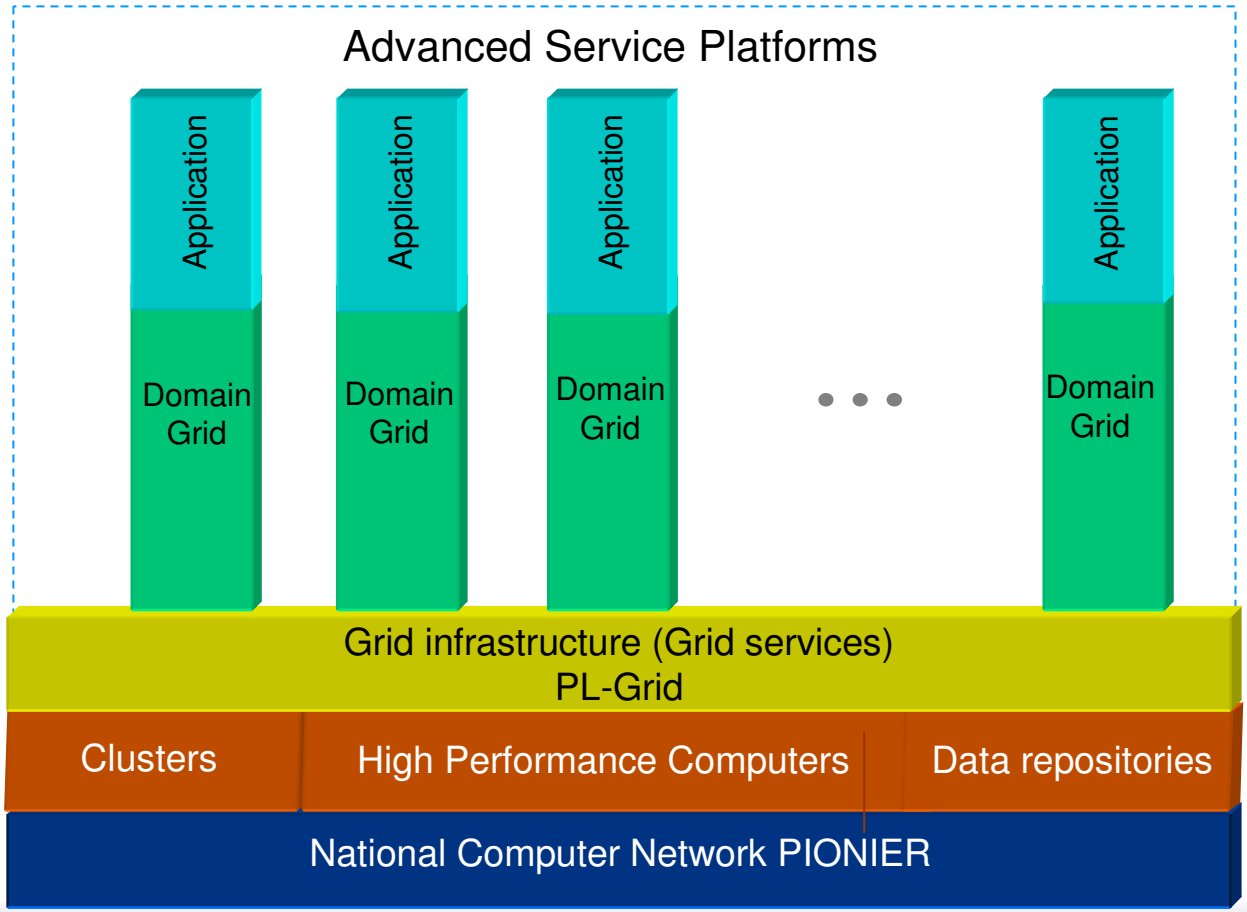
- Academic Computer Center Cyfronet AGH (**ACK CYFRONET AGH**) – Coordinator
- Poznań Supercomputing and Networking Center (**PCSS**)
- Wrocław Centre for Networking and Supercomputing (**WCSS**)
- Academic Computer Center in Gdańsk (**TASK**)
- Interdisciplinary Center for Math. and Computat. Modelling, Warsaw University (**ICM**)

PL-Grid Project Aims

- The main aim of the PL-Grid Project is to create and develop a stable Polish Grid infrastructure, fully compatible and interoperable with European and worldwide Grids.
- The Project should provide scientific communities in Poland with Grid services, enabling realization of the e-Science model in various scientific fields.
- Similarly to solutions adopted in other countries, the Polish Grid should have a common base infrastructure. Specialized, domain Grid systems – including services and tools focused on specific types of applications – should be built upon this infrastructure.

PL-Grid generic architecture

These domain Grid systems can be further developed and maintained in the framework of separate projects. Such an approach should enable efficient use of available financial resources.



PL-Grid Workpackages

- Project management (including PL-Grid architecture and dissemination) – *coordinated by ACK CYFRONET AGH (Krakow),*
- Planning and development of infrastructure – *TASK (Gdansk),*
- Operations Center – *ACK CYFRONET AGH*
- Development and installation of middleware – *PCSS (Poznan),*
- Support for domain Grids – *ICM (Warsaw),*
- Security Center – *WCSS (Wrocław)*

PL-Grid Project

- The Consortium has prepared a PL-Grid Project proposal, to be financed by national funds over a three-year period (2008-2010); it needs un update to satisfy requirements of the recent call,
- The Consortium plans to continue the Project (-s) in the years 2011-2013, however the next phase will depend on the results of the first one, as well as on user needs and international developments in this field.
- The PL-Grid Project is consistent with long term plans on the development of Polish IT infrastructure,
- The PL-Grid Initiative aligns well with the European Grid Initiative, towards creation in Europe a sustainable production Grid for e-Science

Conclusions

Conclusions

Poland is well placed in the framework of European networking and grid computing, which is used by local research groups (in particular by physicists, bioinformatics, chemistry....),

Polish physicists and computer scientists created distributed LCG Tier2, which availability and efficiency is high; the delivered computing power is in the range 2-3 % of the total, the disk storage needs an increase,

There is a systematic effort in Poland to develop national grid infrastructure for science, in particular the PL-Grid, to be able to participate efficiently in the forthcoming EU and other projects,

The networking and grid computing in Eastern European countries (in particular in the Baltic States) is improving with the help of EU and the neighbouring countries, including Poland; we would be ready to play a role of a regional EGI coordinator.

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