Computing & Networking infrastructure at JINR: status and plans

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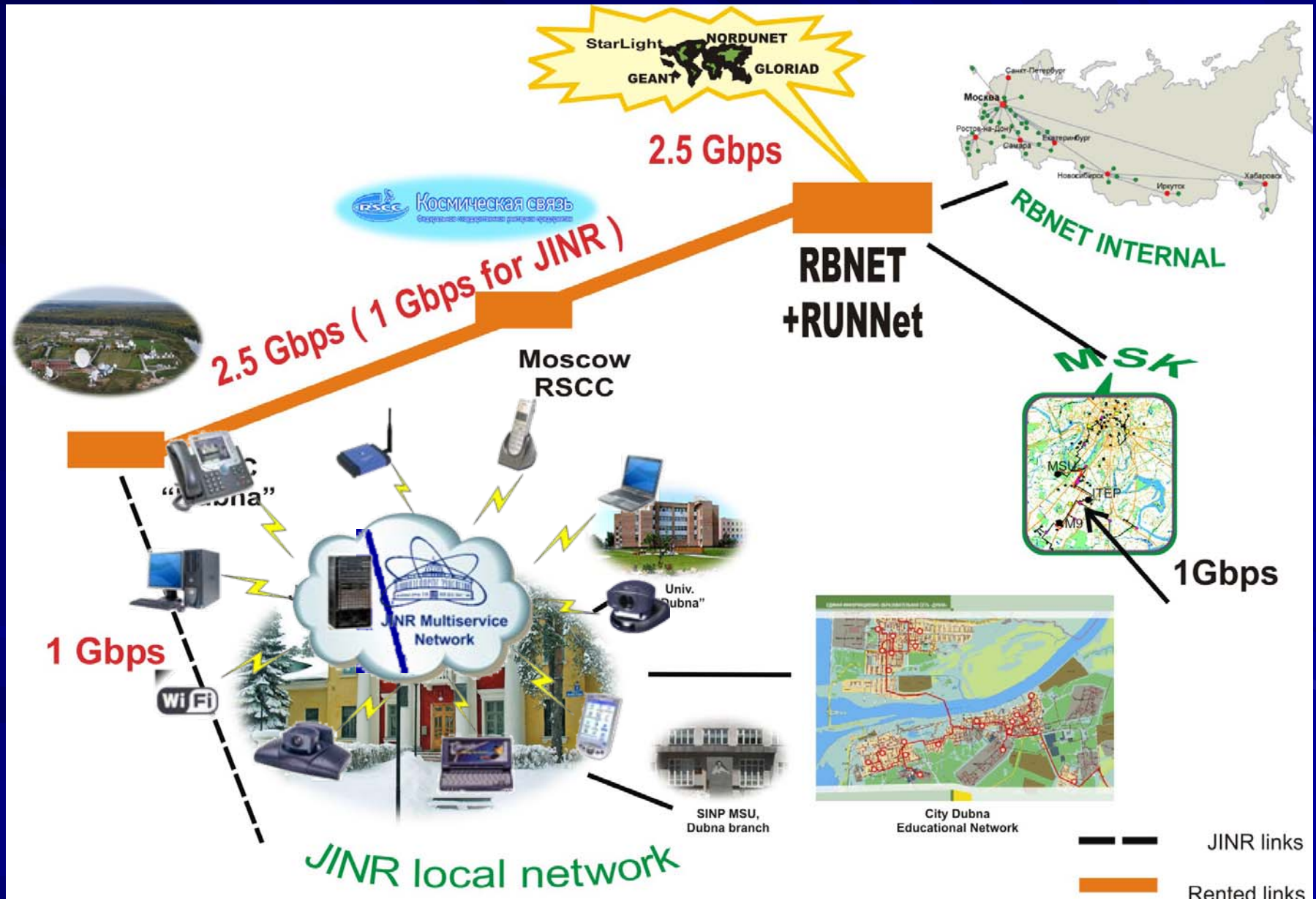
Neutrino physics at accelerators
Dubna 24 January, 2008

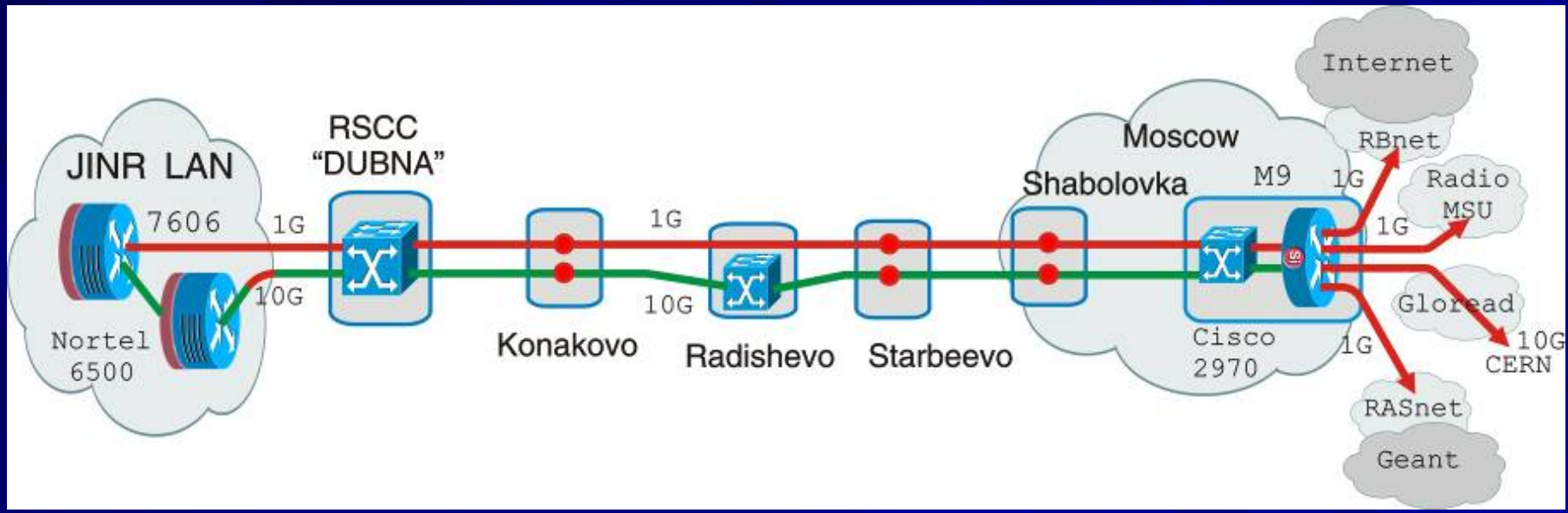
A necessary level of all the elements of the JINR telecommunication, network and information infrastructure should be provided:

- High-throughput telecommunication data links,
- JINR local area network (LAN) backbone,
- Central computer complex and Grid segment,
- Software support of experiments.

Current Status of External Network Communications at JINR

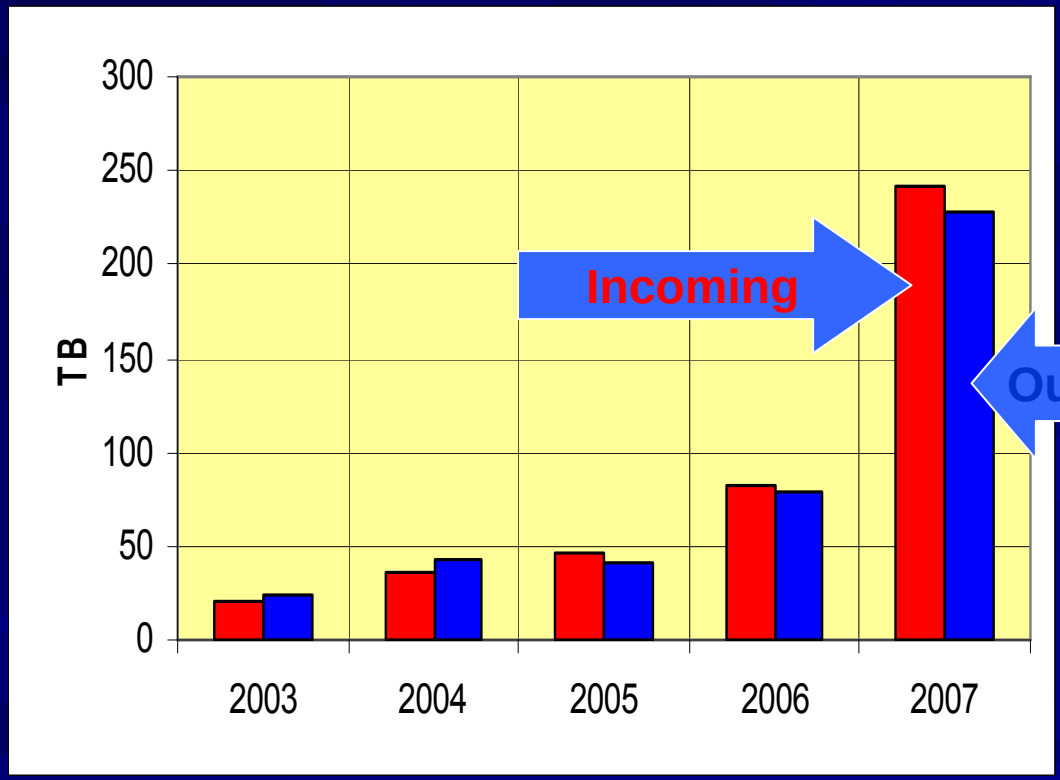


Telecommunication channels N*10 Gbps construction



Upgrade of Dubna-Moscow data link up to 10 Gbps in 2007 and up to 40 Gbps in 2010.

Network Monitoring:
Incoming and outgoing traffic distribution



- **Total:**

incoming in 2007 – 241.9 TB, outgoing -227.8;

- **Most of traffic:**

CERN (88.8%),

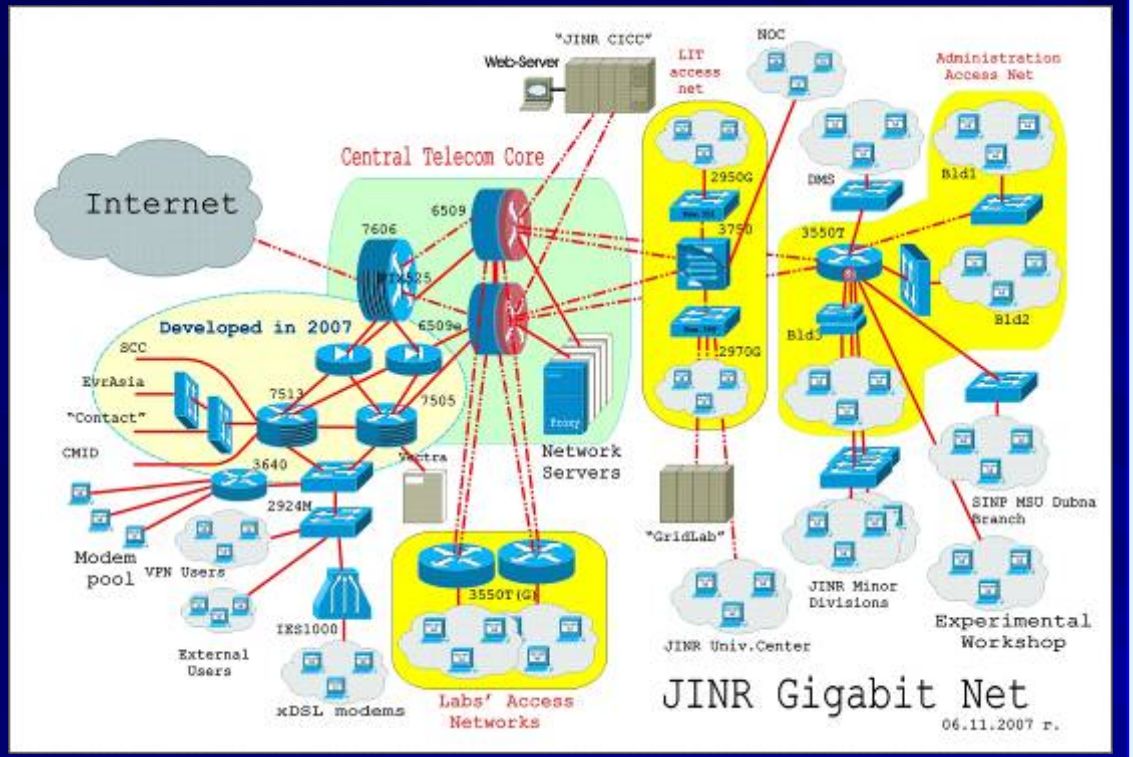
DESY, INFN, SARA, IN2P3

- 47 local sub-networks;
- Local traffic – 77.6 TB

Created in 2007:

- direct point-to-point data channel between JINR LAN and CERN as part of the JINR program of participating in LCG in CERN;
- Dubna-City Internet eXchange.

JINR Local Area Network Backbone (LAN)



- **Plans:**
- **Step-by-step modernization of the JINR Backbone – transfer to 10 Gbps**
- **Development and modernization of the control system of the JINR highway network**

- **Comprises 5880 computers and nodes,**
- **Users - 3322**
- **Modem pool users - 689**
- **Remote VPN users (Lanpolis, Contact, TelecomMPK) - 500;**
- **High-speed transport (1Gbps) (Min. 100 Mbps to each PC);**
- **Controlled-access (Cisco PIX-525 firewall) at network entrance;**
- **Partially isolated local traffic (8 divisions have own subnetworks with Cisco Catalyst 3550 as gateways);**
- **General network authorization system involves many services (AFS, batch systems, Grid, JINR LAN remote access, etc.**

JINR Central Information and Computing Complex (CICC)

670 kSi2K

100 TB Disk

The JINR Central Information and Computing Complex (CICC) is the element of Russian GRID Segment used for LHC computing and for the other applications.

Contract prepared in Dec 2007:
SuperBlade – 2 BOX
40 CPU Xenon 5430 2.66 GHz Quad Core ~ 400 kSi2K

Total expected in March, 2008 - 1070 kSi2K

JINR WLCG infrastructure

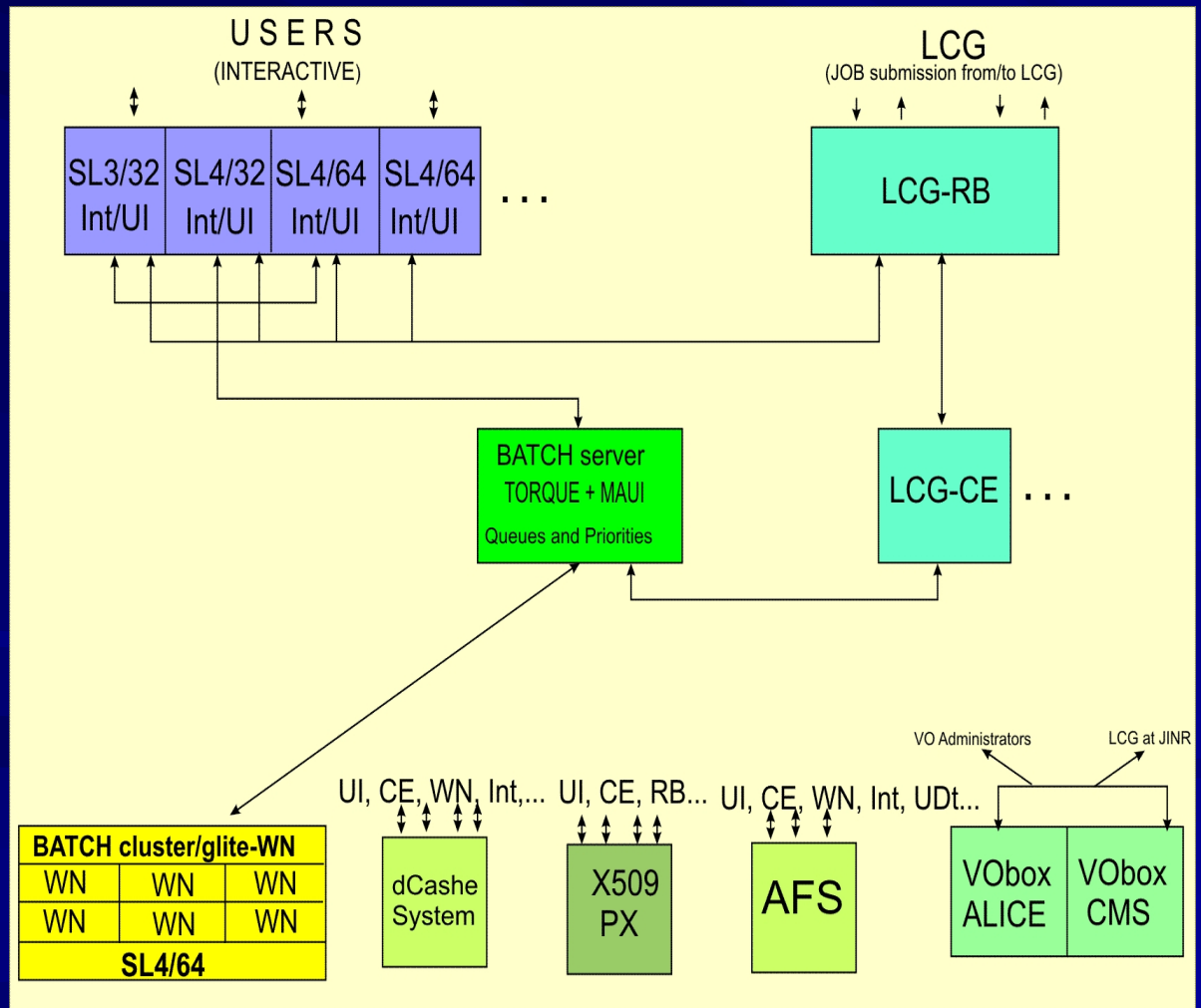
CICC comprises:

53 servers
7 interactive nodes
60 4-core computing nodes, Xeon 5150, 8GB RAM.
6 2-core computing nodes, Athlon , 2GB RAM, Mirynet.

Site name: JINR-LCG2
Internal CICC network – 1Gbit/sec
Operating system - Scientific Linux 4.4,
Scientific Linux CERN 4.5;
Middleware version GLITE-3.1
File Systems – **AFS** (the Andrew File System) for user Software and home directories is a world-wide distributed file system. AFS permits to share easily files in an heterogeneous distributed environment (UNIXes, NT) with a unique authentication scheme (Kerberos).
dCache- for data.
User registration system – **Kerberos 5** (AFS use Kerberos 5 for authentication)

JINR Central Information and Computing Complex (CICC)

June 2007, the CICC resources and services have been integrated into a unified information and computing structure



SL3/32 Int/UI - Interactive nodes/User Interface at 32-bit architecture with SL3,
SL4/32 Int/UI - Interactive nodes/User Interface at 32-bit architecture with SL4,
SL4/64 Int/UI - Interactive nodes/User Interface at 64-bit architecture with SL4,
LCG-RB - LCG Resource Broker,
LCG-CE - LCG Computing Elements,
WN - Worker Nodes,
X509 PX - Proxy,
VObox - special node where experiments (ALICE, CMS, etc.) or Virtual organizations (VO) can run specific agents and services to provide a reliable mechanism to accomplish various tasks specific for VO,
AFS - AFS servers,
dCashe - dCashe servers (**82 TB**)

JINR WLCG infrastructure

JINR provides the following services in the WLCG environment:

***Basic services* - Berkley DB Information Index (top level BDII); site BDII; Computing Element (CE); Proxy Server (PX); Resource Broker (RB); Workload Management System + Logging&Bookkeeping Service (WMS+LB); RGMA-based monitoring system collector server (MON-box); LCG File Catalog (LFC); Storage Element (SE), dCache 82 TB;**

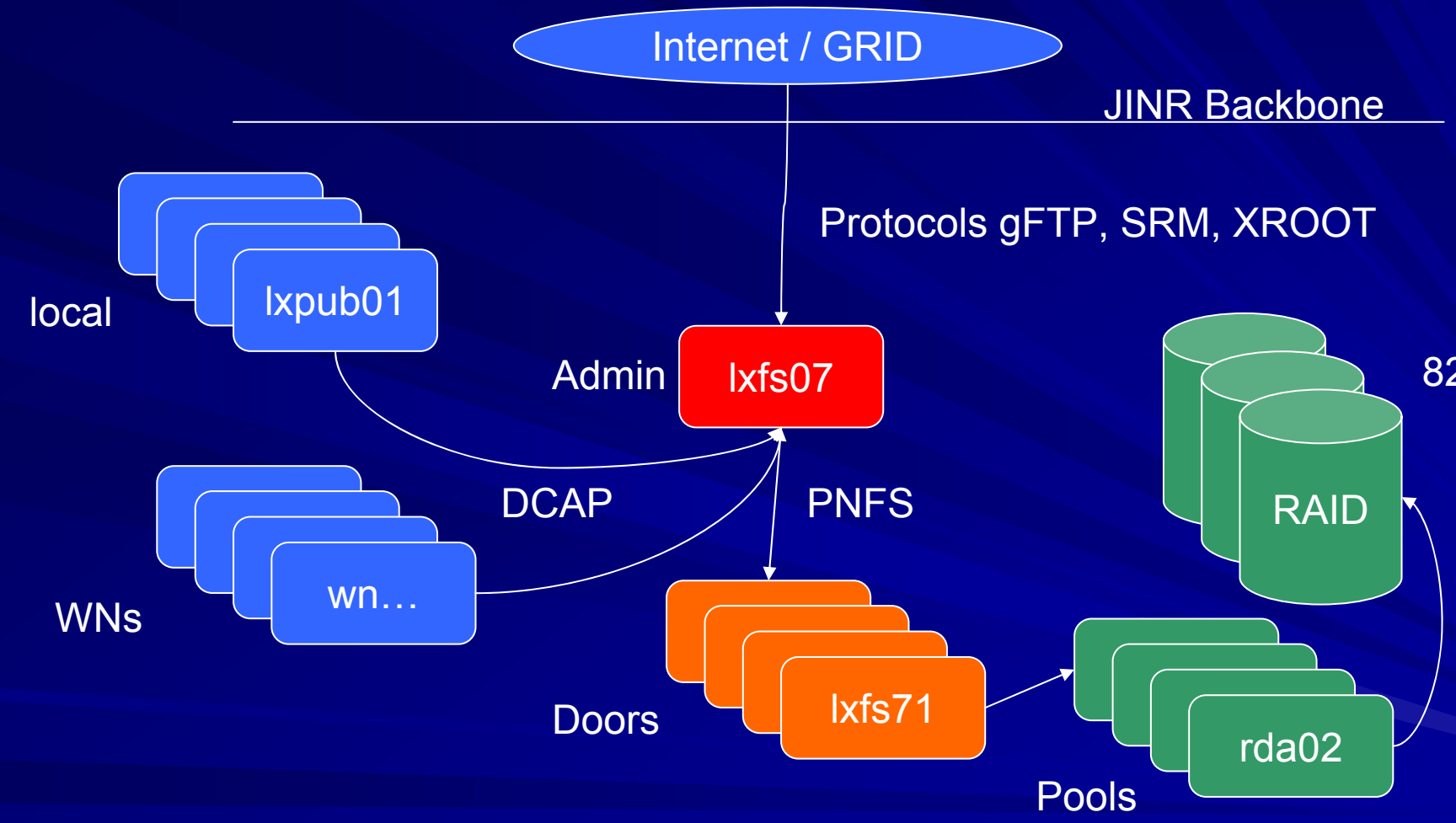
***Special Services* - VO boxes for ALICE and for CMS; ROCMON;**
***PPS and testing infrastructure* - Pre-production gLite version;**

Software for VOs: dCache xrootd door, AliROOT, ROOT, GEANT packages for ALICE; ATLAS packages; CMSSW packages for CMS and DaVinchi, Gauss packages for LHCb.

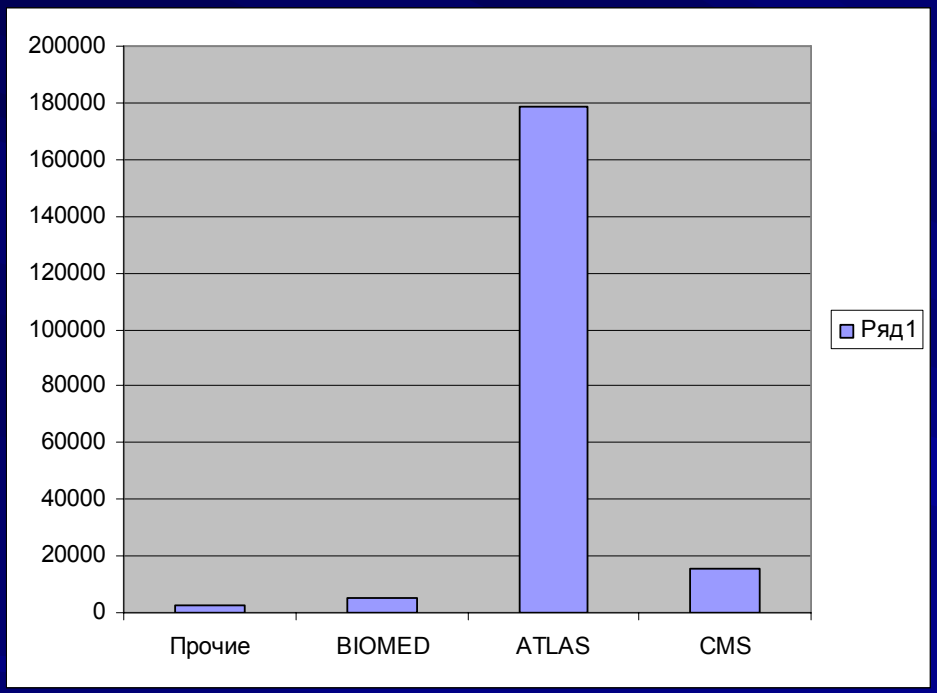
Grid Virtual Organizations at JINR CICC: June-December 2007

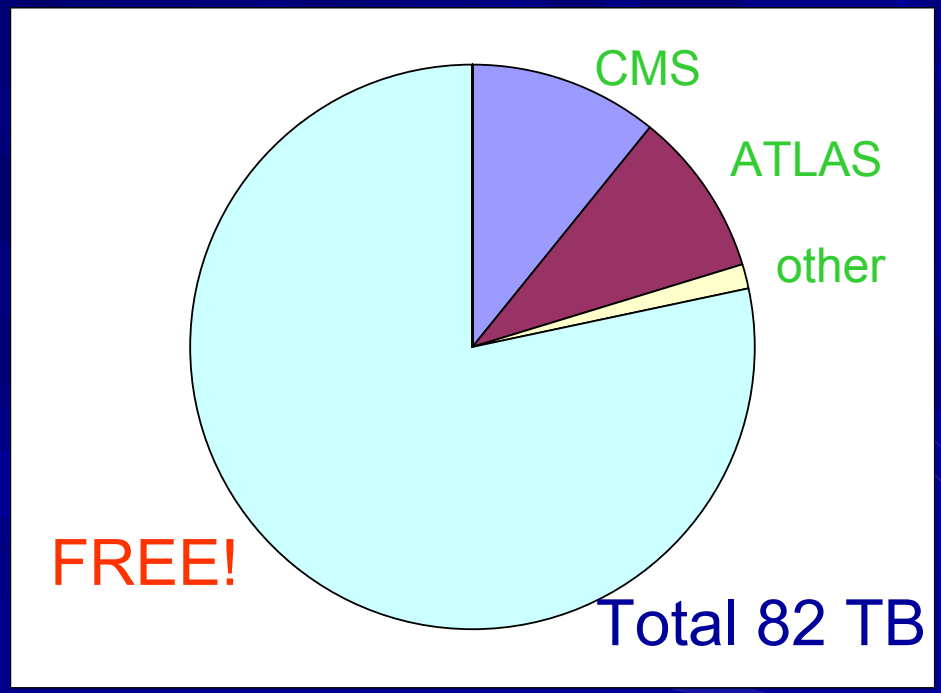
Grid VO	Jobs number	CPU time (kSi2k*hours)
ALICE	90 441	1 370 820.40
ATLAS	15 643	48 980.43
CMS	52 249	51 883.18
LHCb	10 484	6 604.50
BIOMED	25 103	164 102.07
FUSION	9 208	145 053.80
Others (ops, dteam, hone)	17 665	47 022.10
TOTAL	220 793	1 834 466.49

dCache in JINR



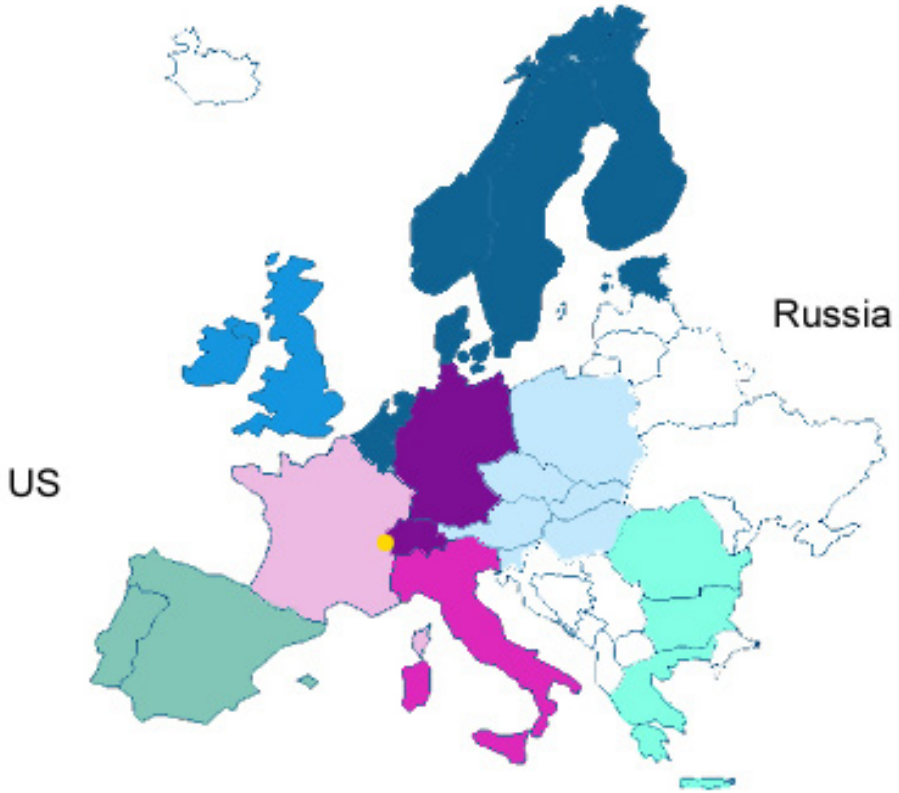
dCache: Files, VO, Discs





Files

EGEE (Enabling Grids for E-sciencE)



- CERN
- Central Europe (Austria, Czech Republic, Hungary, Poland, Slovakia, Slovenia)
- France
- Germany and Switzerland
- Ireland and UK
- Italy
- Northern Europe (Belgium, Denmark, Estonia, Finland, The Netherlands, Norway, Sweden)
- NRENs
- Russia
- South-East Europe (Bulgaria, Cyprus, Greece, Israel, Romania)
- South-West Europe (Portugal, Spain)
- USA

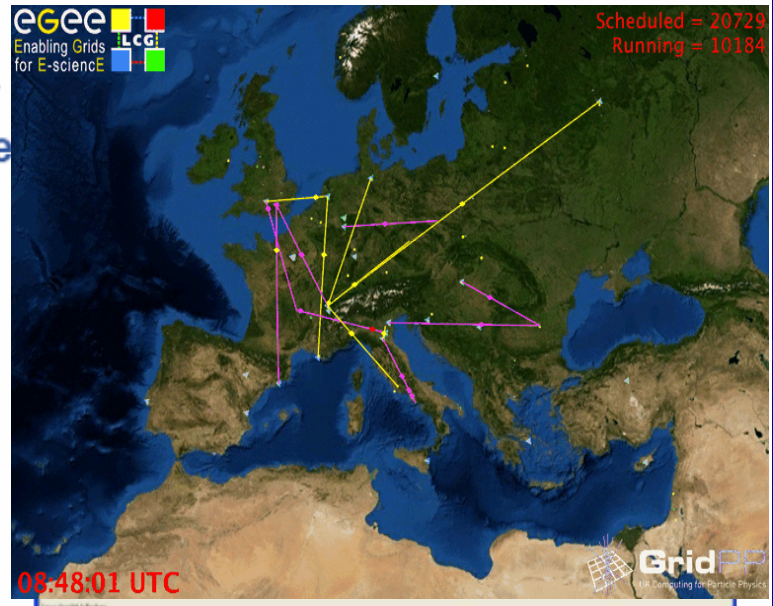
EGEE

Enabling Grids for E-sciencE

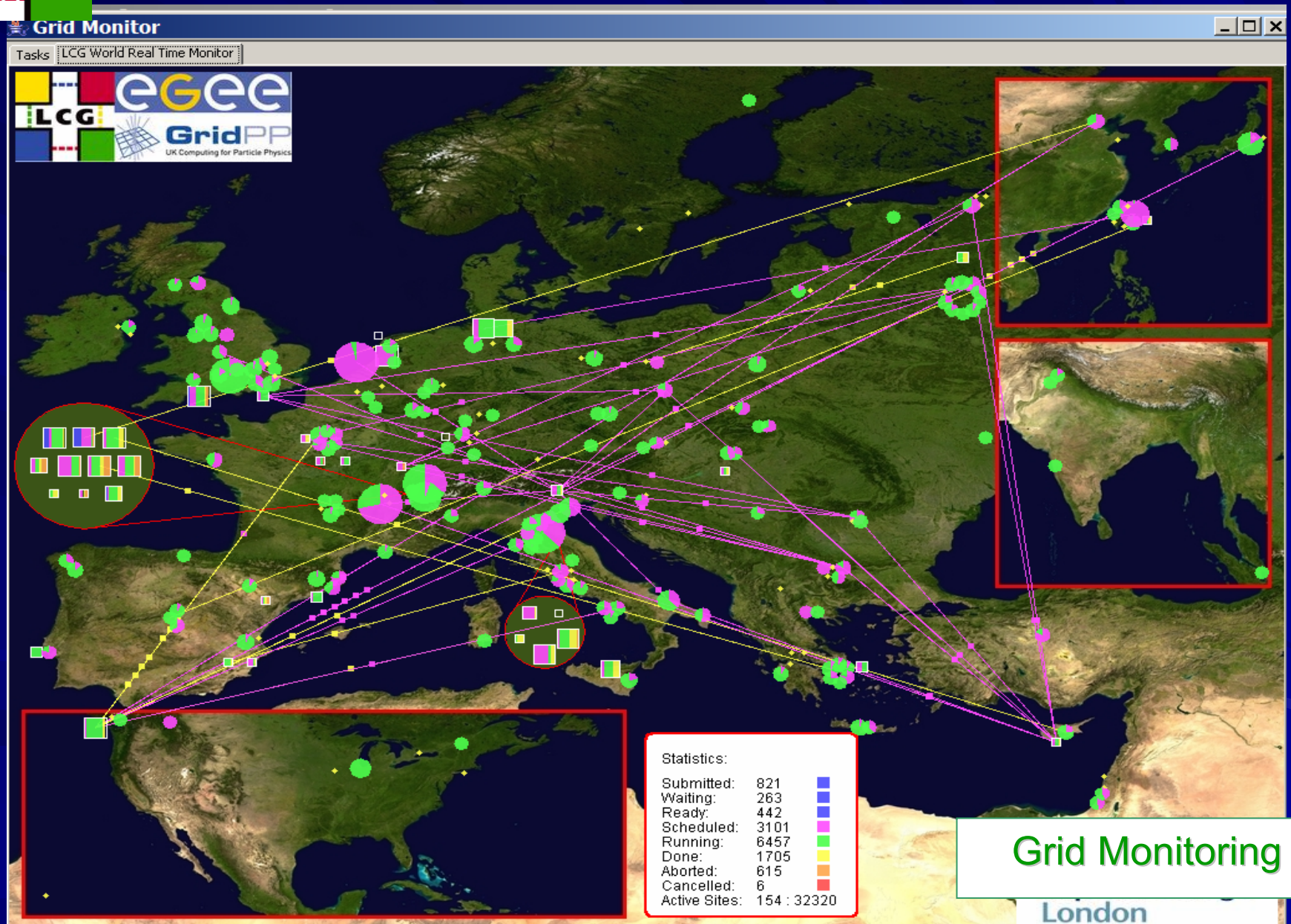
- Flagship European grid infrastructure project
- Now in 2nd phase with 91 partners in 32 countries

Objectives

- Large-scale, production-quality grid infrastructure for e-Science
- Attracting new resources and users from industry as well as science
- Maintain and further improve gLite Grid middleware



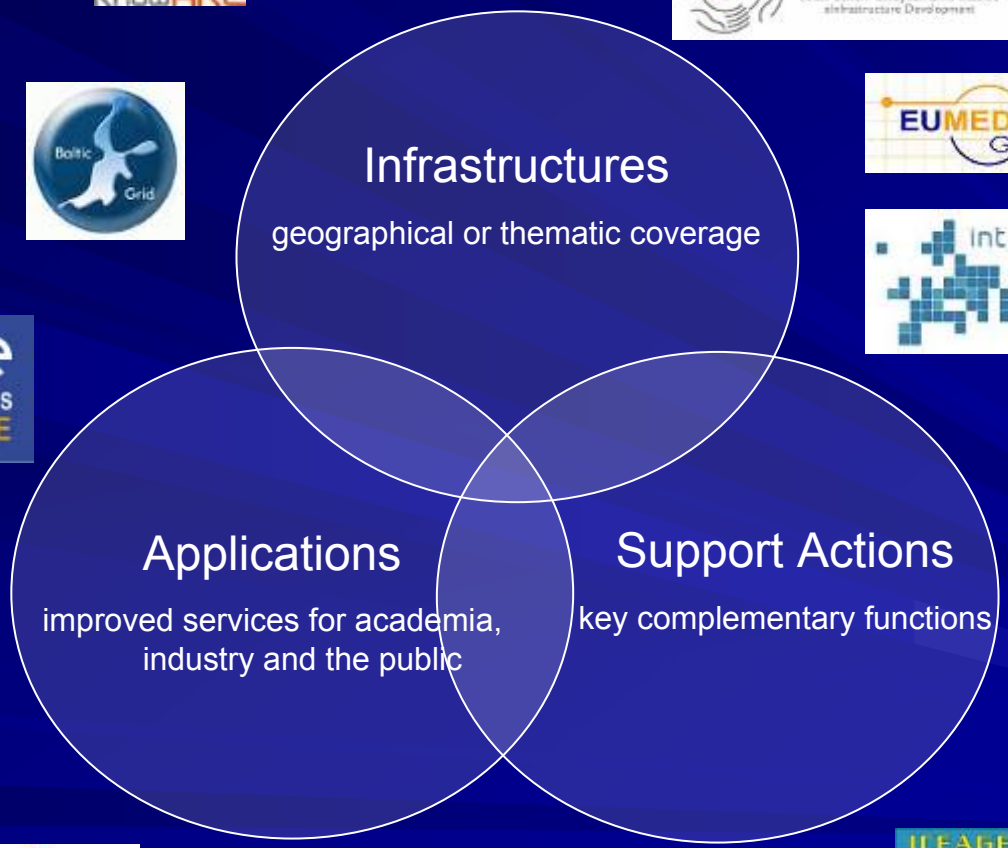
LCG/EGEE Grid infrastructure



Grid Monitoring

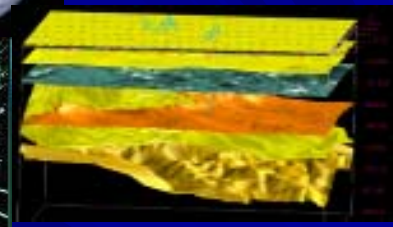
25 projects have registered as on June 2007

Registered Collaborating Projects

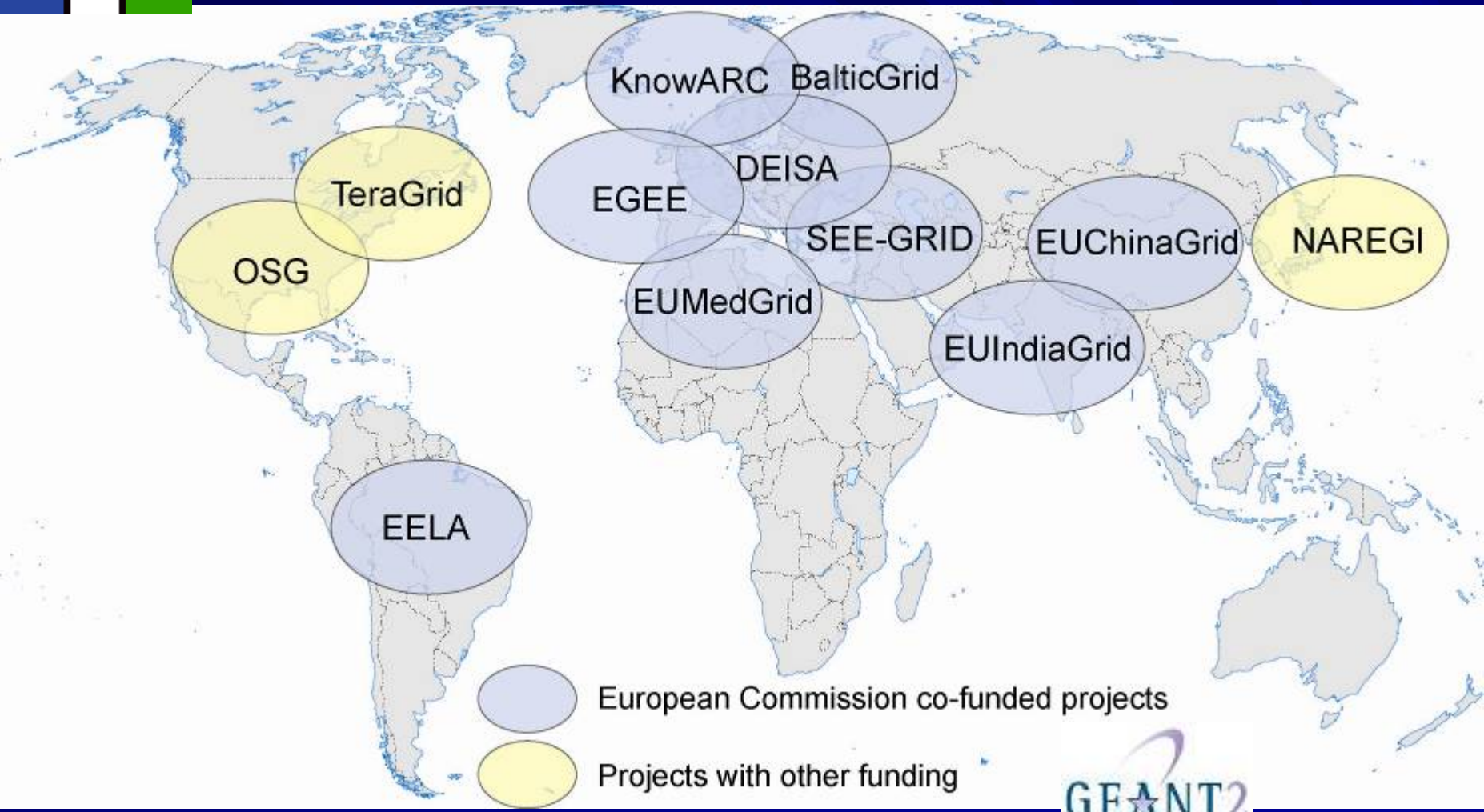


Applications on EGEE

- Multitude of applications from a growing number of domains
  - Archeology
  - Astronomy & Astrophysics
  - Civil Protection
  - Computational Chemistry
  - Earth Sciences
  - Financial Simulation
  - Fusion
  - Geophysics
  - High Energy Physics
  - Life Sciences
  - Multimedia
  - Nanomaterials
  - …



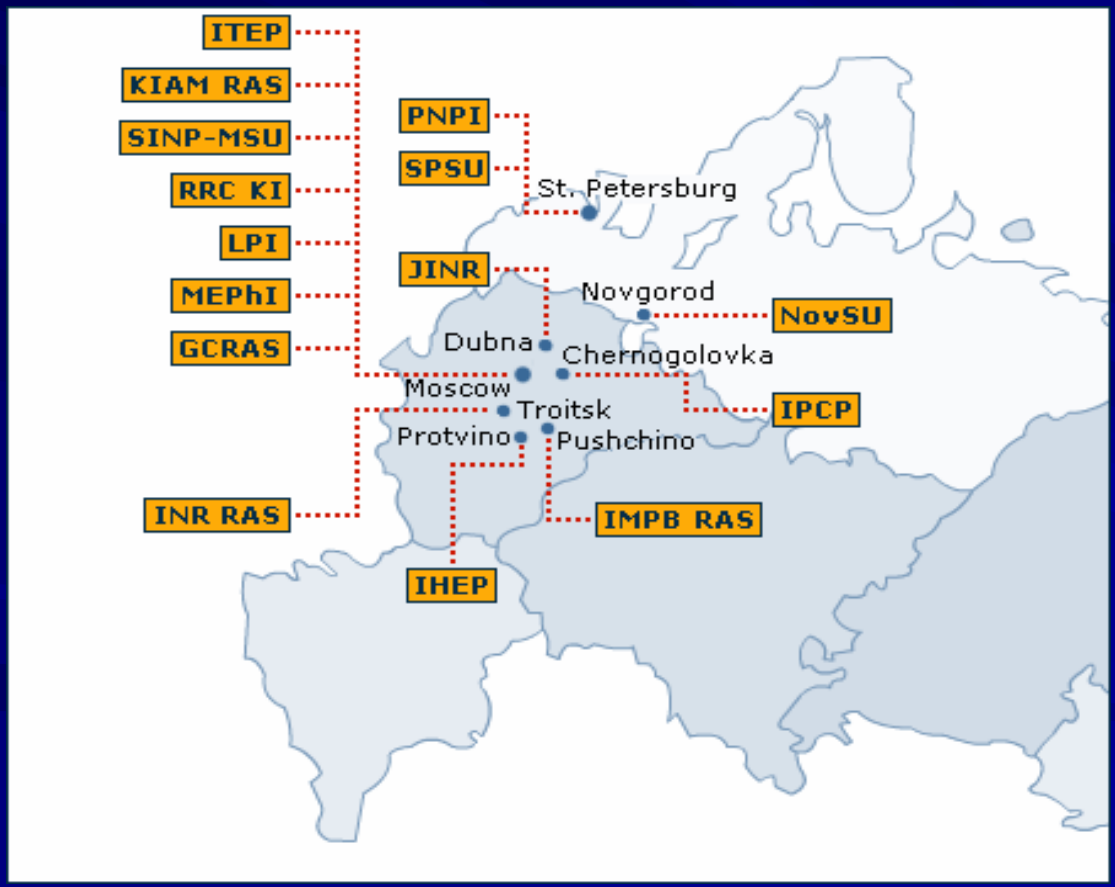
Collaborating e-Infrastructures



Potential for linking ~80 countries by 2008

JINR in the RDIG infrastructure

Now the RDIG infrastructure comprises 15 Resource Centers with more 1500 CPU and more 650 TB of disc storage.



RDIG Resource Centres:

- ITEP
- JINR-LCG2
- Kharkov-KIPT
- RRC-KI
- RU-Moscow-KIAM
- RU-Phys-SPbSU
- RU-Protvino-IHEP
- RU-SPbSU
- Ru-Troitsk-INR
- ru-IMPB-LCG2
- ru-Moscow-FIAN
- ru-Moscow-GCRAS
- ru-Moscow-MEPHI
- ru-PNPI-LCG2
- ru-Moscow-SINP

RDIG monitoring&accounting
http://rocmon.jinr.ru:8080

Monitored values

CPUs - total /working / down/ free / busy

Jobs - running / waiting

Storage space - used / available

Network - Available bandwidth

Accounting values

Number of submitted jobs

Used CPU time

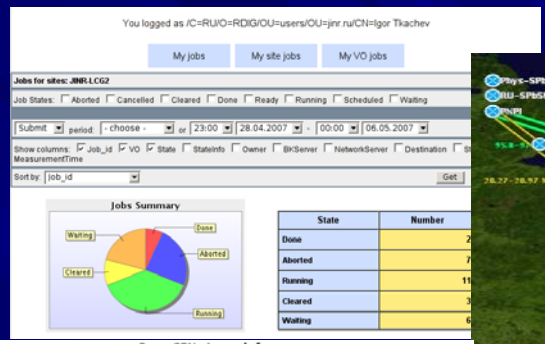
- Totally sum in seconds
- Normalized (with WNs productivity)
- Average time per job

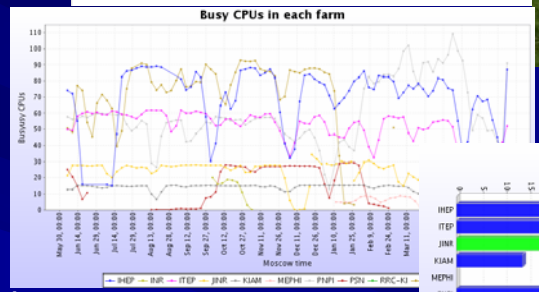
Waiting time

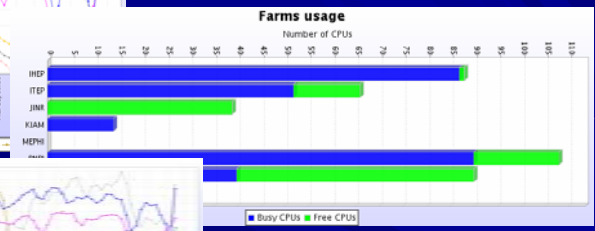
- Totally sum in seconds
- Average ratio waiting/used CPU time per job

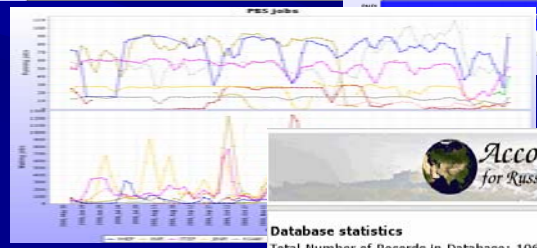
Physical memory

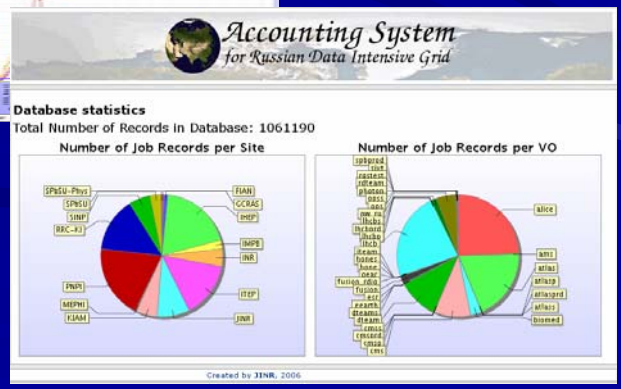
- Average per job



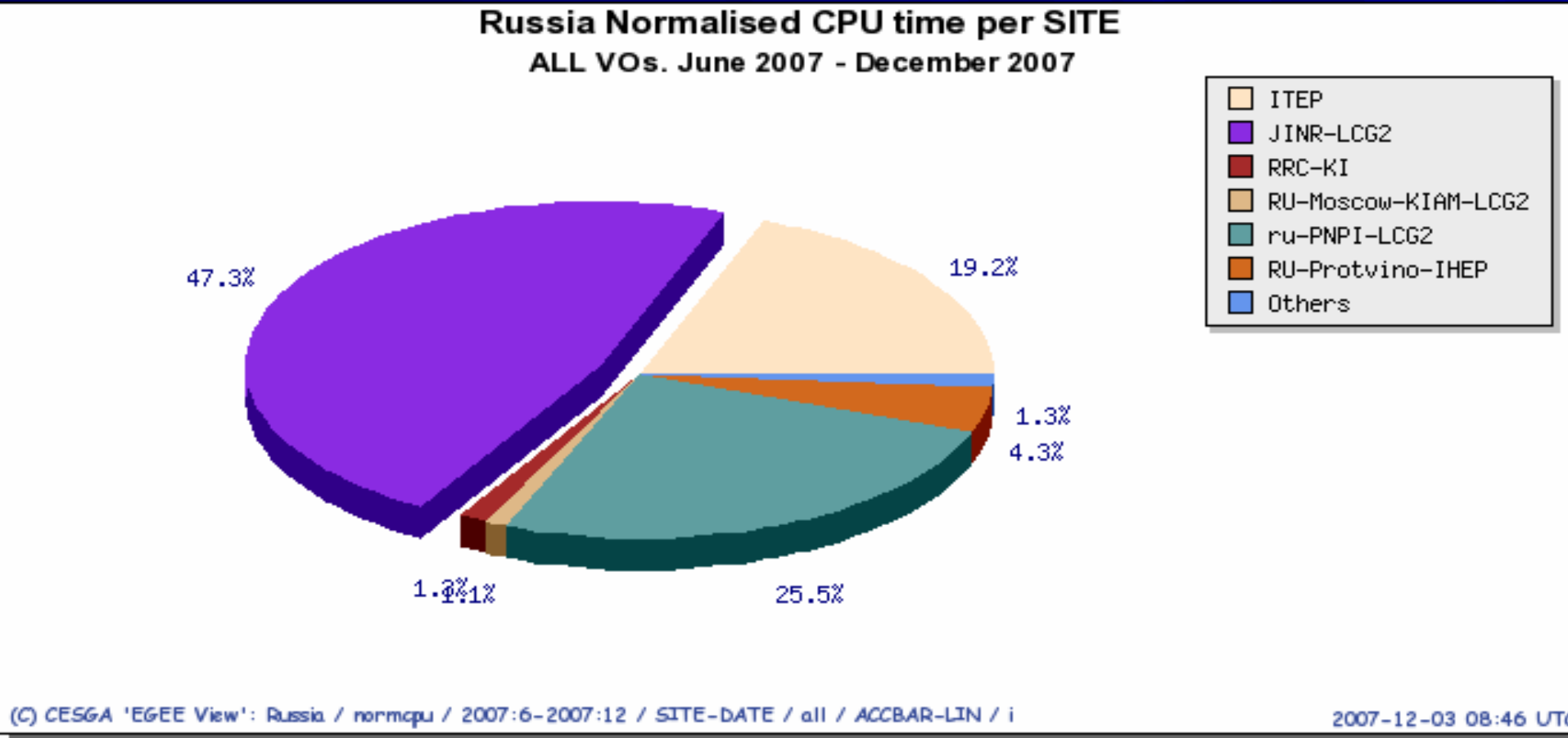








Russia and JINR Normalized CPU time per SITE (June 2007 - December 2007)

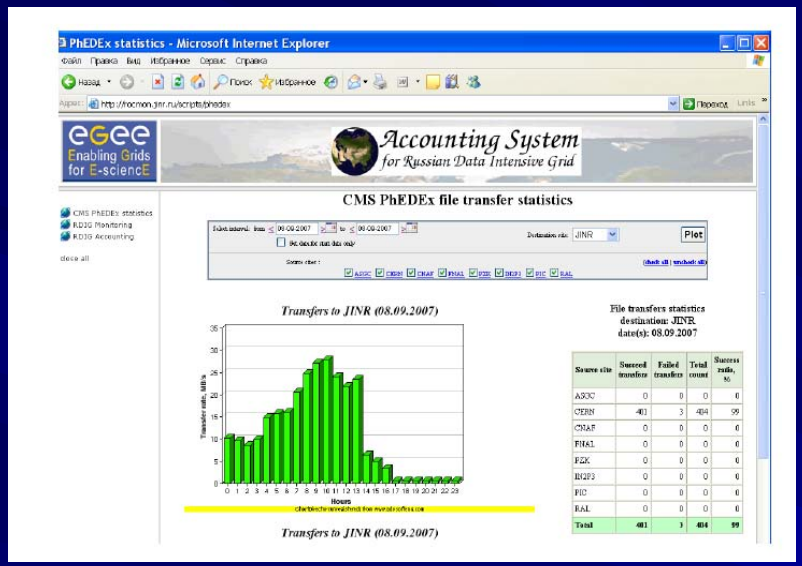


	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec07	Total	
JINR	103,238	244,393	136,615	320,041	365,456	341,876	11,258	**1,522,877**	**47.26%**

RDIG LCG2-sites: statistics on CPU usage, data transfers and site reliability

RDIG SITES	CPU Usage KSI2K Oct.2007 – Jan. 2008	Reliability			Data transfers from CERN (TeraBytes) Oct.-Nov.2007
		Oct.2007	Nov.2007	Dec.2007	
FIAN	336	51	94	43	-
IHEP	75203	71	72	84	25
INR	40620	79	93	35	-
ITEP	380164	63	93	84	11
JINR	1008105	93	93	94	37
MEPHI	479	92	95	44	-
Phys-SPbSU	-	96	97	92	-
PNPI	366723	44	85	0	5
RRC-KI	120	86	0	0	6
SINP	92068	25	0	49	3
SPbSU	3556	86	83	88	-
Totals	1967374				87
Average		71	73	56	

Network bandwidth and reliability of data transfers

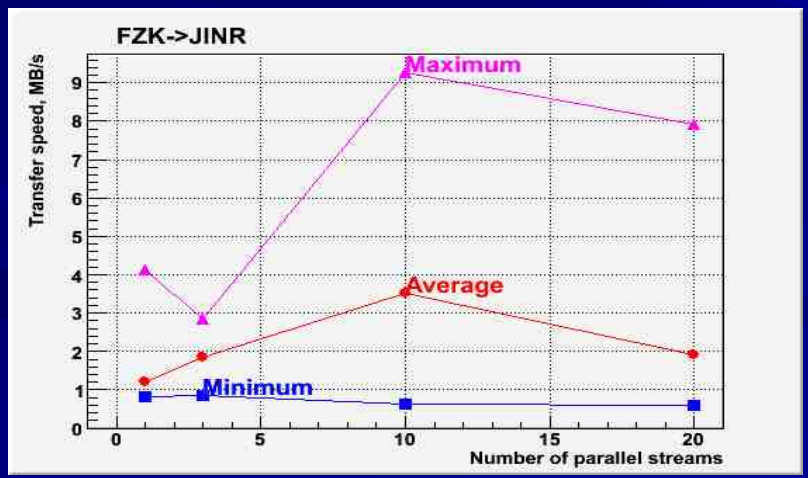


The following LHC computing centers serve as Tier1 centers for RDIG:

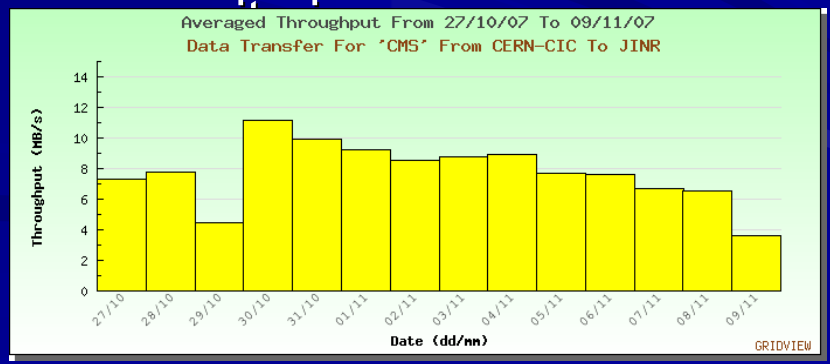
FZK (Karlsruhe) – for ALICE,

SARA (Amsterdam) – for ATLAS,

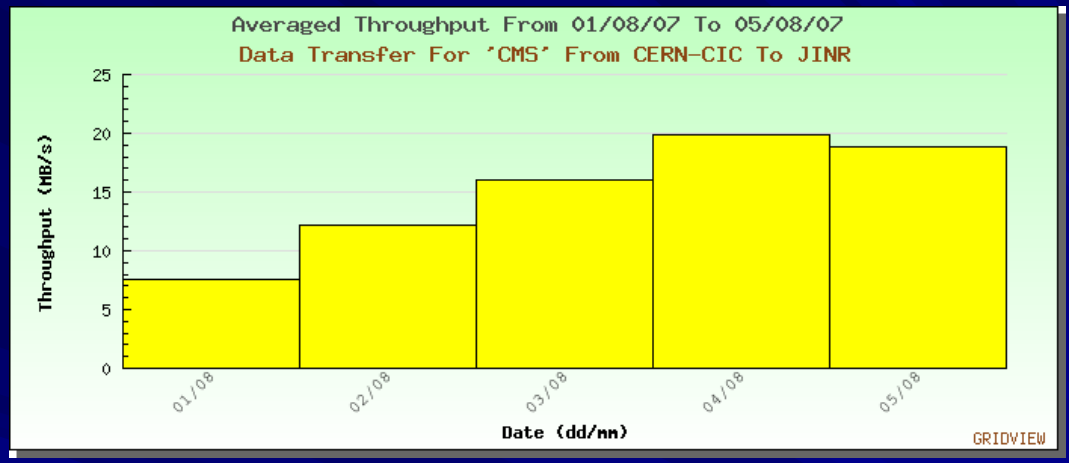
CERN – for CMS (CERN-PROD) and LHCb.



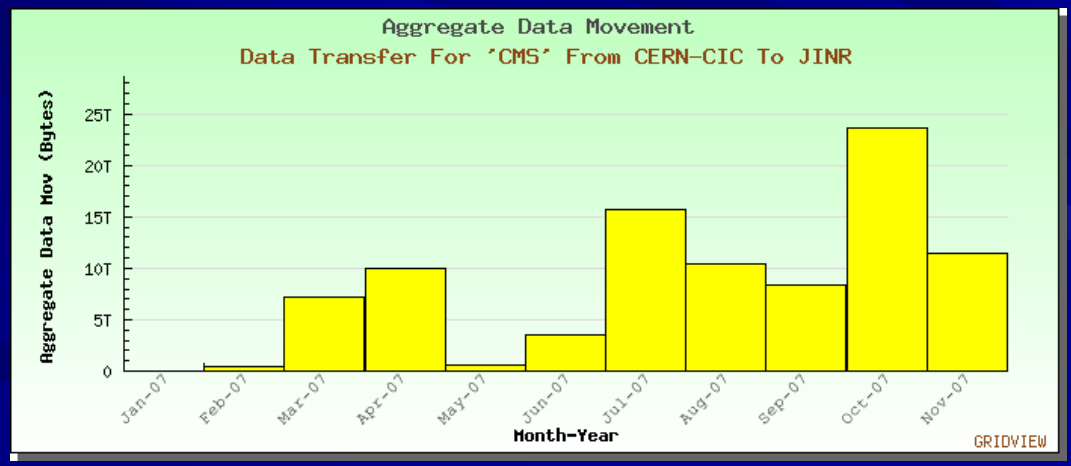
The quality of the JINR – Tier1s connectivity is under close



FTS Monitoring: CERN-JINR transfers



Best transfer-test results for CERN - JINR 01.08.2007-04.08.2007
Average throughput 20 MB/s during the whole 04.08



Average data movement from CERN to JINR 01.2007-11.2007

EGEE SITES:
LHC VOs (ALICE, ATLAS, CMS and LHCb)
Normalised CPU time by SITE
June 2007 - December 2007

1.	IN2P3-CC	4 731 732
2.	CERN-PROD	4 393 875
3.	FZK-LCG2	3 432 919
4.	TRIUMF-LCG2	3 358 117
5.	INFN-T1	2 244 936
6.	IN2P3-LPC	1 705 242
7.	INFN-PISA	1 438 029
8.	UKI-NORTHGRID-MAN-HEP	1 369 207
9.	GRIF	1 368 942
10.	RAL-LCG2	1 306 579
11.	JINR-LCG2	1 217 267

Statistics obtained from the EGEE Accounting Portal:
http://www3.egee.cesga.es/gridsite/accounting/CESGA/egee_view.html

EGEE SITES:
LHC VOs (ALICE, ATLAS, CMS and LHCb)
Normalised CPU time by SITE
September 2007 - January 2007

SITE	Sep 07	Oct 07	Nov 07	Dec 07	Jan 08	Total
TRIUMF-LCG2	624,019	1,258,052	1,229,198	729,033	377,204	**4,217,506**
IN2P3-CC	1,386,891	1,121,041	466,991	436,611	122,955	**3,534,489**
FZK-LCG2	643,124	612,975	598,618	645,248	384,200	**2,884,165**
CERN-PROD	483,517	869,397	504,751	598,155	302,715	**2,758,535**
INFN-T1	217,179	387,501	358,604	910,196	365,699	**2,239,179**
NDGF-T1	354,620	705,382	478,403	405,428	0	**1,943,833**
IN2P3-CC-T2	0	445,528	696,033	638,411	160,448	**1,940,420**
GRIF	266,099	342,961	248,369	271,297	194,211	**1,322,937**
IN2P3-LPC	263,765	394,922	312,387	241,328	79,836	**1,292,238**
JINR-LCG2	**228,648**	**280,674**	**278,157**	**268,371**	**171,503**	**1,227,353**

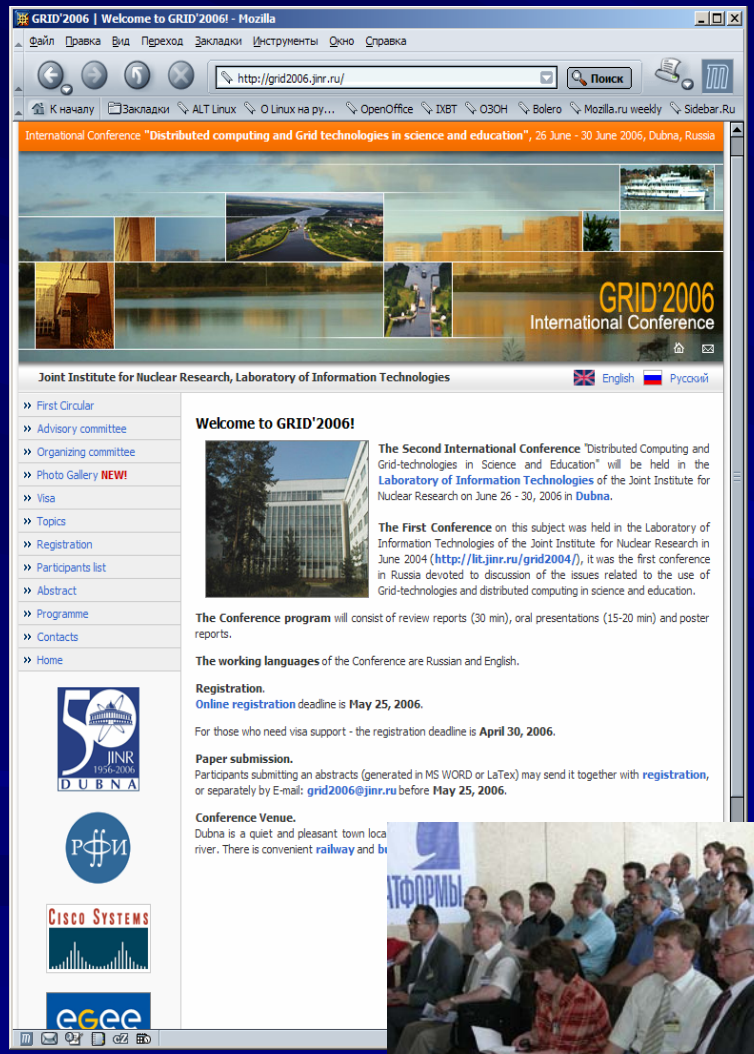
The XXI International Symposium on Nuclear Electronics and Computing (NEC'2007) Bulgaria, Varna, 10-17 September, 2007.

The main topics of the symposium are:

- Detector & Nuclear Electronics
- Computer Applications for Measurement and Control in Scientific Research
- Triggering and Data Acquisition
- Accelerator and Experiment Automation Control Systems
- Methods of Experimental Data Analysis
- Information & Data Base Systems
- Computer Networks for Scientific Research
- Data & Storage Management
- GRID computing

2-nd International Conference "Distributed Computing and Grid-technologies in Science and Education“

LABORATORY OF INFORMATION TECHNOLOGIES
26 - 30 June, 2006



The first conference, organized 2 years ago by LIT, became the first forum in Russia in this field. The second conference was attended by more than 200 specialists from 17 countries and from 46 universities and research centers.

The scientific program included 96 reports covered 8 topics: 1) creation and operating experience of Grid infrastructures in science and education; 2) methods and techniques of distributed computing; 3) distributed processing and data storage; 4) organization of the network infrastructure for distributed data processing; 5) algorithms and methods of solving applied problems in distributed computing environments; 6) theory, models and methods of distributed data processing; 7) distributed computing within LHC projects and 8) design techniques and experience of using distributed information Grid systems.

In the framework of the conference two tutorials on Grid systems gLite and NorduGrid were organized.

In general opinion of the conference attendees, such conference should be continued. This will allow one to extend the dialogue of leading experts from Europe, USA and Russia.

3-nd International Conference "Distributed Computing and Grid-technologies in Science and Education“ will be on 30 June – 4 July, 2008

JINR CICC

	2007	2008	2009	2010
CPU (kSI2K)	670 (1070)	1250	1750	2500
Disk (Tbytes)	100	400	800	1200
Active Tapes (Tbytes)	0	0	100	200

JINR – cooperation in Grid

- Worldwide LHC Computing Grid (WLCG);
- Enabling Grids for E-sciencE (EGEE);
- CERN-INTAS projects;
- **BMBF grant** “Development of the GRID-infrastructure and tools to provide joint investigations performed with participation of JINR and German research centers’
- “Development of Grid segment for the LHC experiments” was supported in frames of JINR-South Africa cooperation agreement in 2006-2007;
- NATO project "DREAMS-ASIA“ (Development of gRid EnAbling technology in Medicine&Science for Central ASIA);
- JINR-Romania cooperation Hulubei-Meshcheryakov programme
- LIT team participate in project "SKIF-GRID" - A Program of the Belarussian-Russian Union State.
- We work in close cooperation and provide support to our partners in Ukraine, Belarus, Czech Republic, Romania, Poland, Germany, South Africa, Bulgaria, Armenia, Uzbekistan, Georgia.
- protocols of cooperation with INRNE (Bulgaria), ArmeSFo (Armenia), FZK Karlsruhe GmbH (Germany), Wroclaw University (Poland), IHEPI TSU (Georgia), NC PHEP BSU (Belarus), KFTI NASU (Ukraine), etc