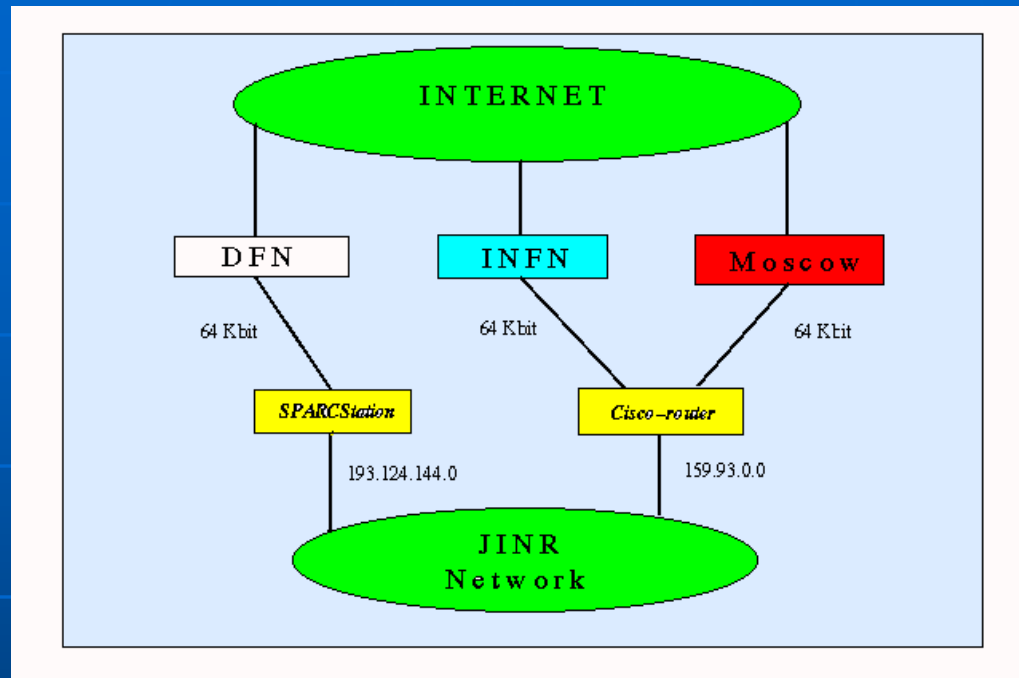# GRID Activity at Russia and JINR

Korenkov Vladimir (LIT,JINR)

Dubna, 19.12.2009
Round Table Italy-Russia@Dubna

Some history

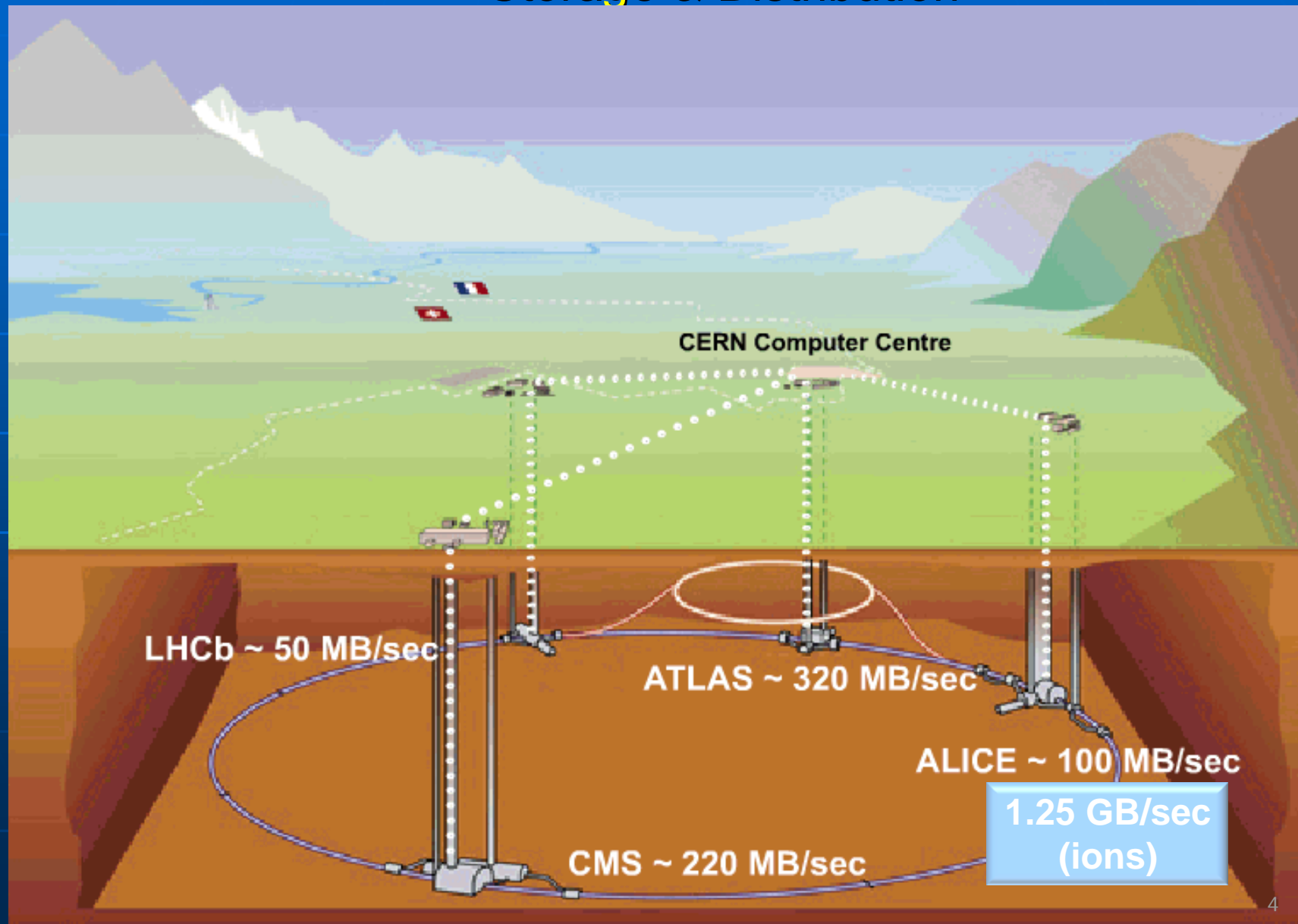- **1992 – satellite link JINR-RSCC-Intelsat- Gran Sasso-INFN-HEPNET**

1994-2004 APE –
The Array Processor Experiment
APE-100, APEMille, APEnext
   with INFN (Italy), DESY (Germany)
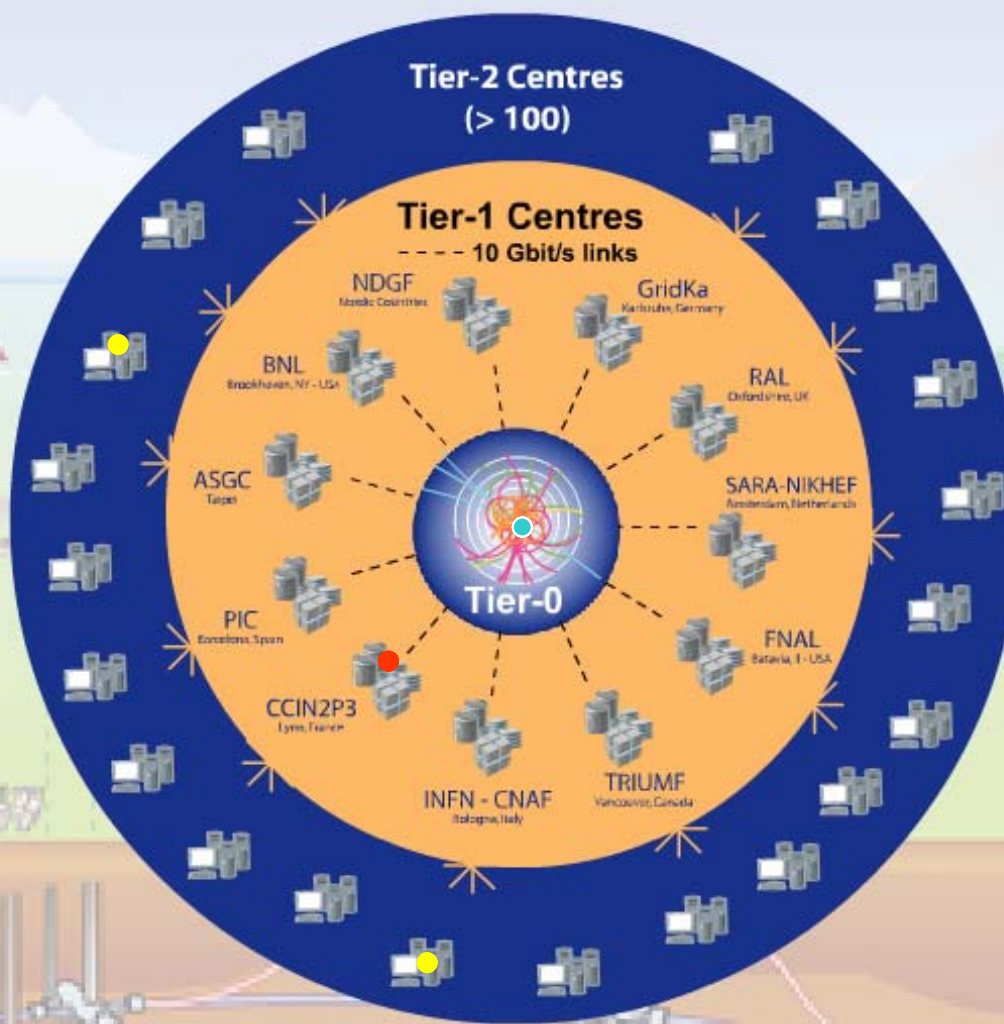**(Menshikov A., Lukyanov M., Ponomarev S.)**

2

Some history

- **2001-2003 - EU DataGrid project (F. Gagliardi)**
  - **middleware & testbed for an operational grid**
- **2002-2005 – LHC Computing Grid – LCG (L. Robertson)**
  - **deploying the results of DataGrid to provide a production facility for LHC experiments**
- **2004-2006 – EU EGEE project phase 1 (F. Gagliardi)**
  - **starts from the LCG grid**
  - **shared production infrastructure**
  - **expanding to other communities and sciences**
- **2006-2008 – EU EGEE-II (B. Jones)**
  - **Building on phase 1**
  - **Expanding applications and communities** …
- **2008-2010 – EU EGEE-III (B. Jones)**

- **Cooperation with F. Gagliardi , M. Mazzucato, M. Lamanna, F. Carminati, L. Mapelli, S. Citolin, …**

3

CERN Computer Centre

LHCb ~ 50 MB/sec

ATLAS ~ 320 MB/sec

ALICE ~ 100 MB/sec

1.25 GB/sec (ions)

CMS ~ 220 MB/sec

4

Tier 0 – Tier 1 – Tier 2

Tier-0 (CERN):
- Data recording
- Initial data reconstruction
- Data distribution

Tier-1 (11 centres):
- Permanent storage
- Re-processing
- Analysis

Tier-2 (>200 centres):
- Simulation
- End-user analysis

EGEE & OSG
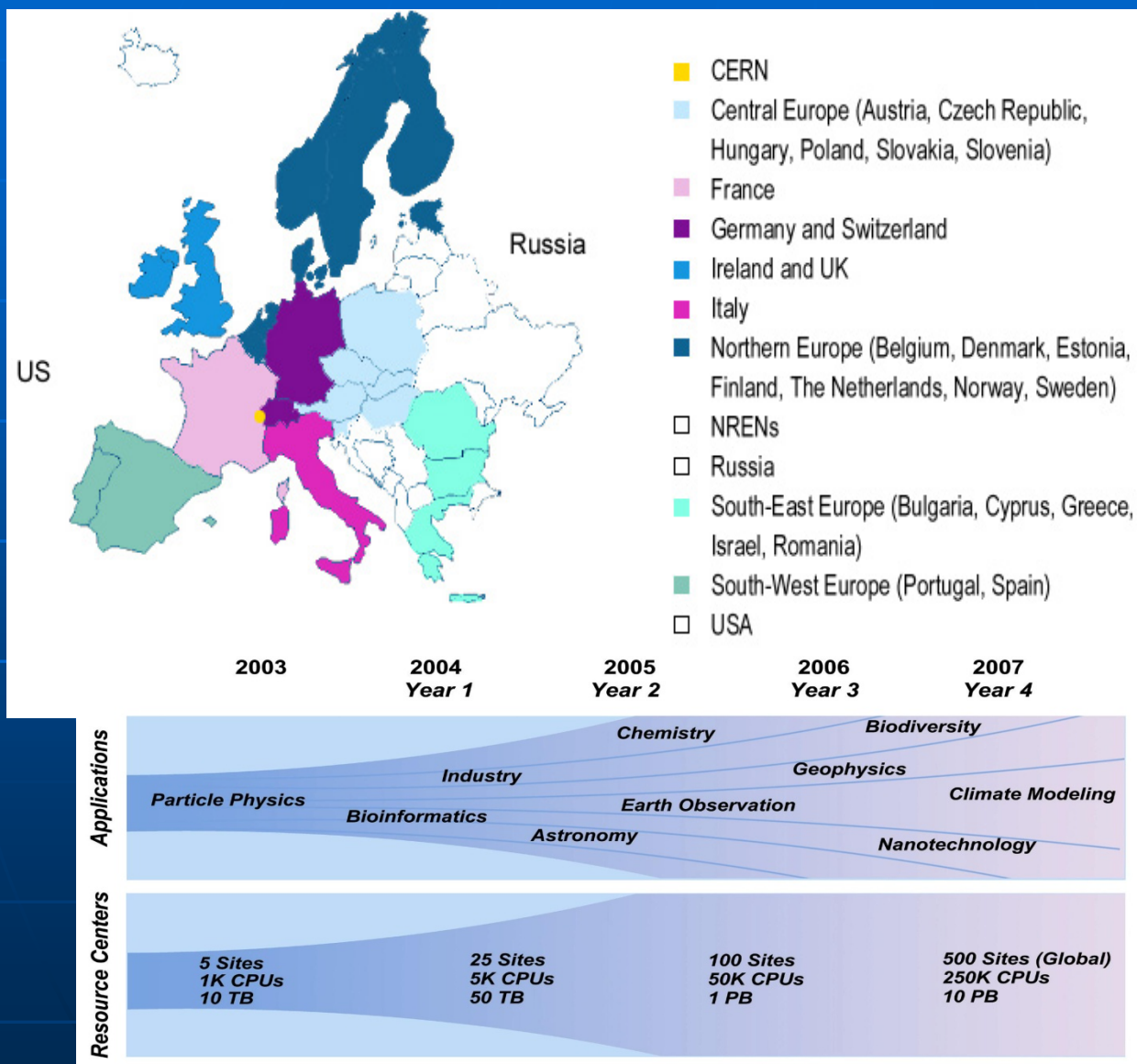
WLCG depends on two major science grid infrastructures
    EGEE   - Enabling Grids for E-Science
    OSG   - US Open Science Grid


eGee
Enabling Grids
for E-sciencE

Open Science Grid

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

Russia

US

The aim of the project is to create a global Pan-European computing infrastructure of a Grid type.
 - Integrate regional Grid efforts
 - Represent leading grid activities in Europe
10 Federations, 27 Countries, 70 Organizations

2003	2004 Year 1	2005 Year 2	2006 Year 3	2007 Year 4

Applications

Particle Physics · Bioinformatics · Industry · Astronomy · Chemistry · Earth Observation · Geophysics · Biodiversity · Nanotechnology · Climate Modeling

Resource Centers

5 Sites 1K CPUs 10 TB	25 Sites 5K CPUs 50 TB	100 Sites 50K CPUs 1 PB	500 Sites (Global) 250K CPUs 10 PB

T.Strizh   (LIT, JINR)

EGEE Enabling Grids for E-sciencE

350 sites
55 countries
150,000 CPUs
26 PetaBytes (Disk)
40 PetaBytes (Tape)
>15,000 users
>300 Vos
12 mln jobs/month
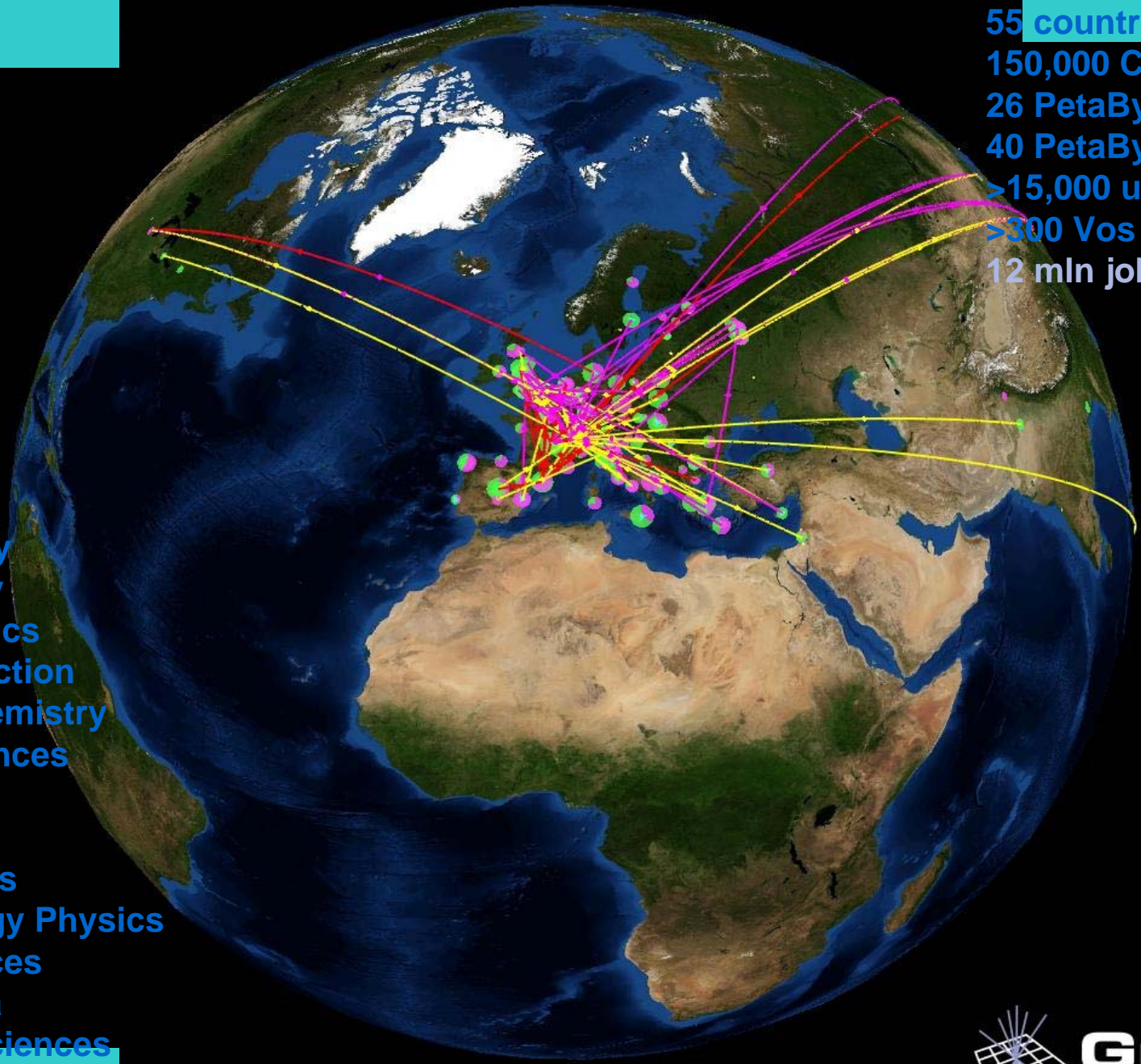
Archeology
Astronomy
Astrophysics
Civil Protection
Comp. Chemistry
Earth Sciences
Finance
Fusion
Geophysics
High Energy Physics
Life Sciences
Multimedia
Material Sciences
…

GridPP
UK Computing for Particle Physics
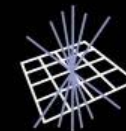
European e-Infrastructure

Need to prepare permanent, common Grid infrastructure

Ensure the long-term sustainability of the European e-infrastructure independent of short project funding cycles

Coordinate the integration and interaction between National Grid Infrastructures (NGIs)

Operate the European level of the production Grid infrastructure for a wide range of scientific disciplines to link NGIs
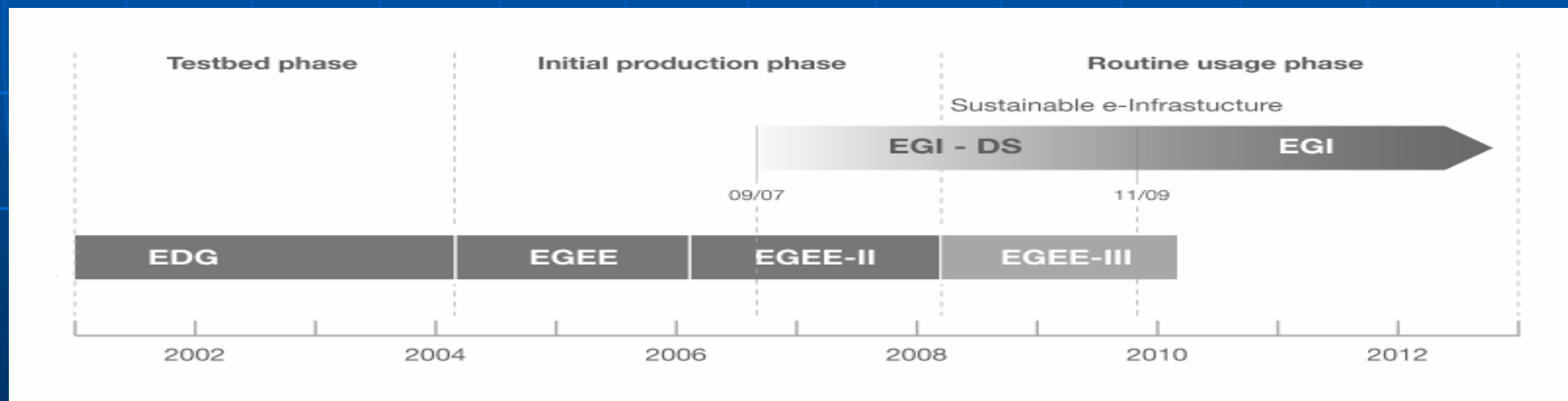
European Grid Initiative

JINR in the Russian Data Intensive Grid infrastructure (RDIG)

The Russian consortium RDIG (Russian Data Intensive Grid), was set up in September 2003 as a national federation in the EGEE project. Now the RDIG infrastructure comprises 15 Resource Centers with > 7000 kSI2K CPU and > 1850 TB of disc storage.
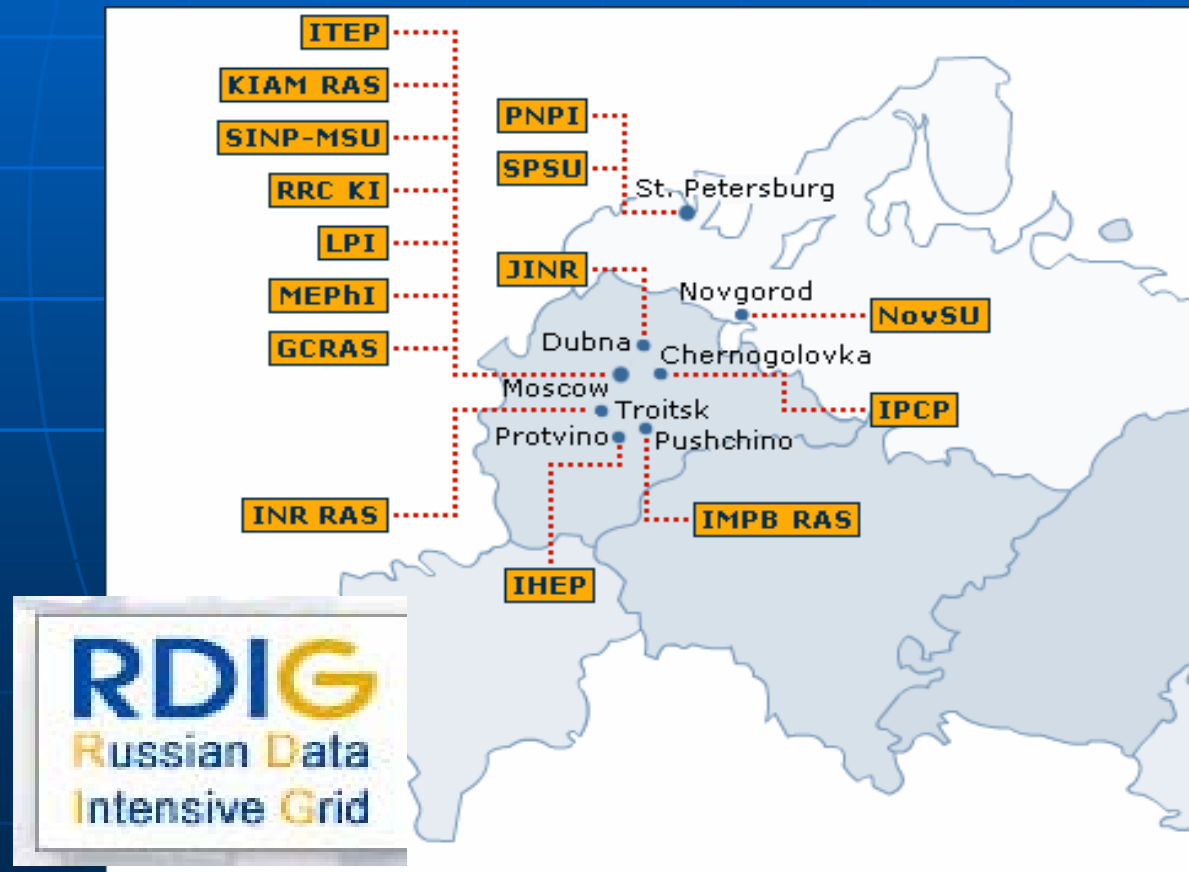
RDIG Resource Centres:
- **ITEP**
- **JINR-LCG2**
- **Kharkov-KIPT**
- **RRC-KI**
- **RU-Moscow-KIAM**
- **RU-Phys-SPbSU**
- **RU-Protvino-IHEP**
- **RU-SPbSU**
- **Ru-Troitsk-INR**
- **ru-IMPB-LCG2**
- **ru-Moscow-FIAN**
- **ru-Moscow-GCRAS**
- **ru-Moscow-MEPHI**
- **ru-PNPI-LCG2**
- **ru-Moscow-SINP**

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Development and maintenance of RDIG e-infrastructure

- - support of basic grid-services;
- - Support of Regional Operations Center (ROC);
- - Support of Resource Centers (RC) in Russia;
- - RDIG Certification Authority;
- - RDIG Monitoring and Accounting;
- - participation in integration, testing, certification of grid-software;
- - support of Users, Virtual Organization (VO) and application;
- - User & Administrator training and education;
- - Dissemination, outreach and Communication grid activities.

RDIG Certification Authority

Russian Data-Intensive Grid Certificate Authority - Microsoft Internet Explorer

File   Edit   View   Favorites   Tools   Help

Back   Search   Favorites

Address http://ca.grid.kiae.ru/RDIG/

Google   Search   3 blocked   Check   AutoLink   AutoFill   Options

egee
Enabling Grid
for E-SciencE

RDIG Certification Authority

RDIG
Russian Data
Intensive Grid

| сертификаты | — корневой | — действительные | — CRL | — политика выдачи |

| как | — получить сертификат | — узнать своего RA | — работать с сертификатом | — получ |

Карта сайта

- **Пользователям**

  - Получение нового сертификата.
  - Перерегистрация сертификата в виртуальной организации.
  - Корневой сертификат RDIG CA для загрузки в броузер.
  - Корневой сертификат RDIG CA в формате PEM.
  - Список действительных сертификатов.
  - Список отозванных сертификатов (CRL) для загрузки в броузер.
  - Список отозванных сертификатов (CRL) в формате PEM.
  - Политика выдачи сертификатов.
  - Различные манипуляции с вашим сертификатом.
  - Иногда задаваемые вопросы. Может быть ваша проблема уже известна и решена — взгляните.

- **Организациям и институтам**

  - Добавление нового Registration Authority для вашей организации.

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GGUS (ITEP from RDIG)

Portal www.egee-rdig.ru

VOs

- **Infrastructure VO's (all RC's):**
  - dteam
  - ops
- **Most RC support the WLCG/EGEE VO's**
  - Alice
  - Atlas
  - CMS
  - LHCb
- **Supported by some RC's:**
  - gear
  - Biomed
  - Fusion
- **Regional VO's**
  - Ams, eearth, photon, rdteam, rgstest

Flagship applications:
LHC, Fusion (toward to ITER), nanotechnology
Current interests from: medicine, engineering

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LHC Computing Grid Project (LCG)

The protocol between CERN, Russia and JINR on a participation in LCG Project has been approved in 2003.

The tasks of the Russian institutes in the LCG have been defined as:

✓ LCG software testing;

✓ evaluation of new Grid technologies (e.g. Globus toolkit 3) in a context of using in the LCG;

✓ event generators repository, data base of physical events: support and development.

LHC Computing Grid Project (LCG)

The tasks of the Russian institutes & JINR
in the LCG (2009 years):

- Task 1. MW (gLite) Testsuit
  (supervisor O. Keeble)
- Task 2. LCG vs Experiments
  (supervisor I. Bird)
- Task 3. LCG monitoring
  (supervisor J. Andreeva)
- Task 4/5. Genser/ MCDB
  (supervisor A. Ribon)

Worldwide LHC Computing Grid Project (WLCG)

The protocol between CERN, Russia and JINR on participation in LCG Project was approved in 2003. MoU on Worldwide LHC Computing Grid (WLCG) signed by JINR in October, 2007

The tasks of the JINR in the WLCG:

- WLCG-infrastructure support and development at JINR;
- participation in WLCG middleware testing/evaluation,
- participation in Service/Data Challenges,
- grid monitoring and accounting tools development;
- FTS-monitoring and testing;
- participation in ARDA activities in coordination with experiments;
- JINR LCG portal support and development;
- HEP applications;
- MCDB development;
- support of JINR Member States in the WLCG activities;
- User & Administrator training and education.

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Russian NGI is e-ARENA

The national association of research and educational e-Infrastructures «e-ARENA» has been established in August 2009 as a legal body for coordinating efforts of different organizations in Russian Federation in creating and developing the e-infrastructures, including networking and grids, to serve science and higher education.

The e-Arena Association is recognized by the Ministry of Communications as a legal body for coordination of the e-infrastructure efforts at national level.

In scope of the EGI stream the Russian NGI include five organizations, actively participated in the EGEE/EGEE-II/EGEE-III projects:

RRC KI (Moscow), SINP MSU (Moscow), JINR (Dubna), PNPI RAS (Gatchina) and ITEP (Moscow).

Development of the JINR Grid - environment

support

APPLICATIONS

Algorithms and Methods

Virtual Organizations

ATLAS
ALICE CMS
LHCb HONE
Biomed
etc.

"Gridification"

Adaptation to Grid
New VO
creation

support

Centre of
Primary
Grid
Services

RESOURCE LEVEL

JINR CICC

Computing clusters
and
data storage
systems

extension

JINRLIB
WWW/FTP
Progr.Lib.

support, upgrade

Telecommunications
channels
JINR-Moscow

NETWORK LEVEL

JINR LAN

JINR High-speed
Backbone

JINR Member-states connectivity

RBNet
RUNNet
RASNet
RUHEP
GEANT2

20 Gbps ⇨ 800 Gbps

M9-IX

Internet
RBnet
Radio MSU
Gloriad
RASnet
Geant

JINR LIT Router
OME CPL 6500
CPL Amplifier
CPL
Moscow Light OME6500
RBNet GNAP

JINR Dubna
Radishevo
Moscow

T.Strizh (LIT, JINR)

JINR – Moscow telecommunication channel

Collaboration with RSCC, RIPN, MSK-IX, JET Infosystems, Nortel

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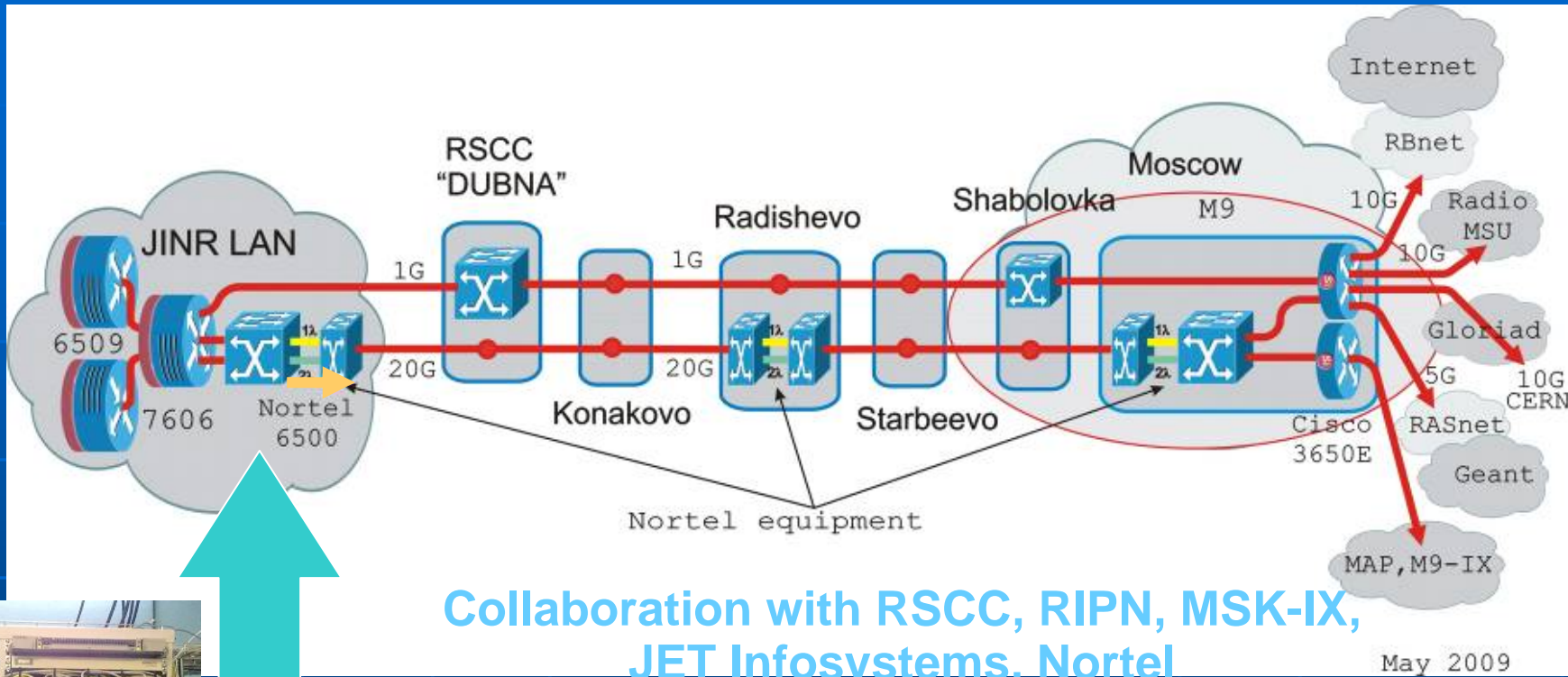
JINR Local Area Network Backbone (LAN)

JINR Gigabit Net

- **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**
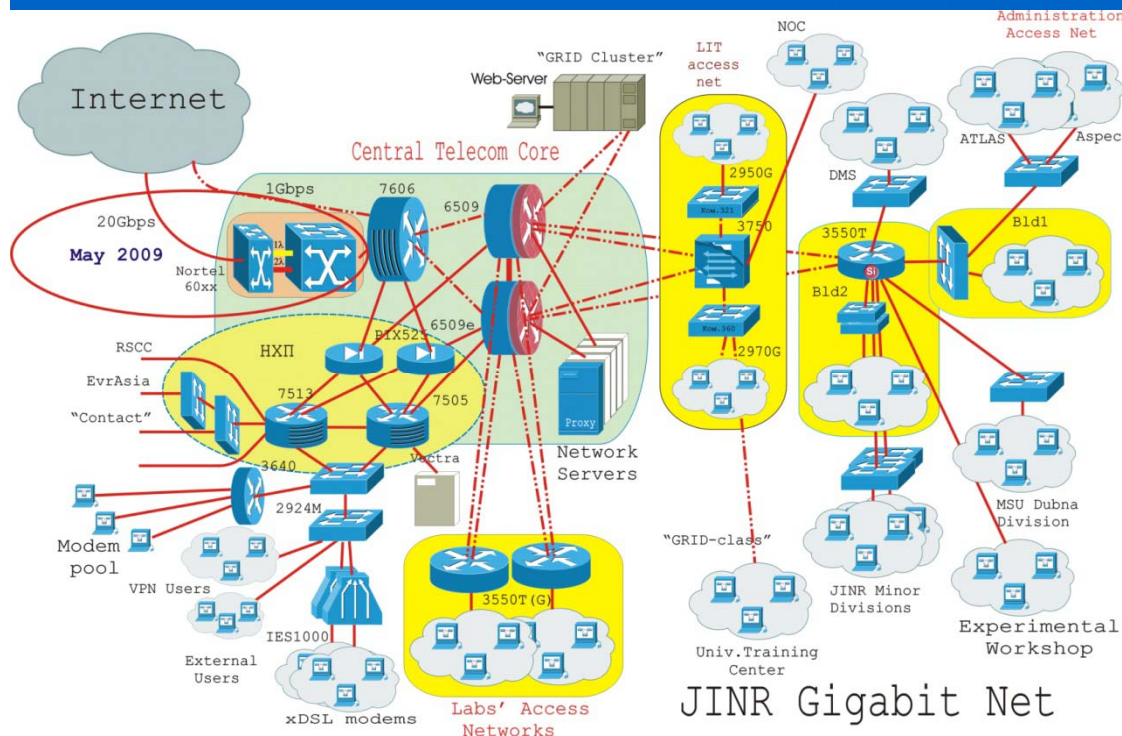
- **Comprises 6579 computers and nodes,**
Users – 3593,
IP – 7633,
Remote VPN users (Lanpolis, Contact, TelecomMPK) - 1248;
- **High-speed transport (1Gbps) (Min. 100 Mbps to each PC);**
- **Controlled-access (Cisco PIX-525 firewall) at network entrance;**
- **Partially isolated local traffic (8 divisions have own subnetworks with Cisco Catalyst 3550 as gateways);**
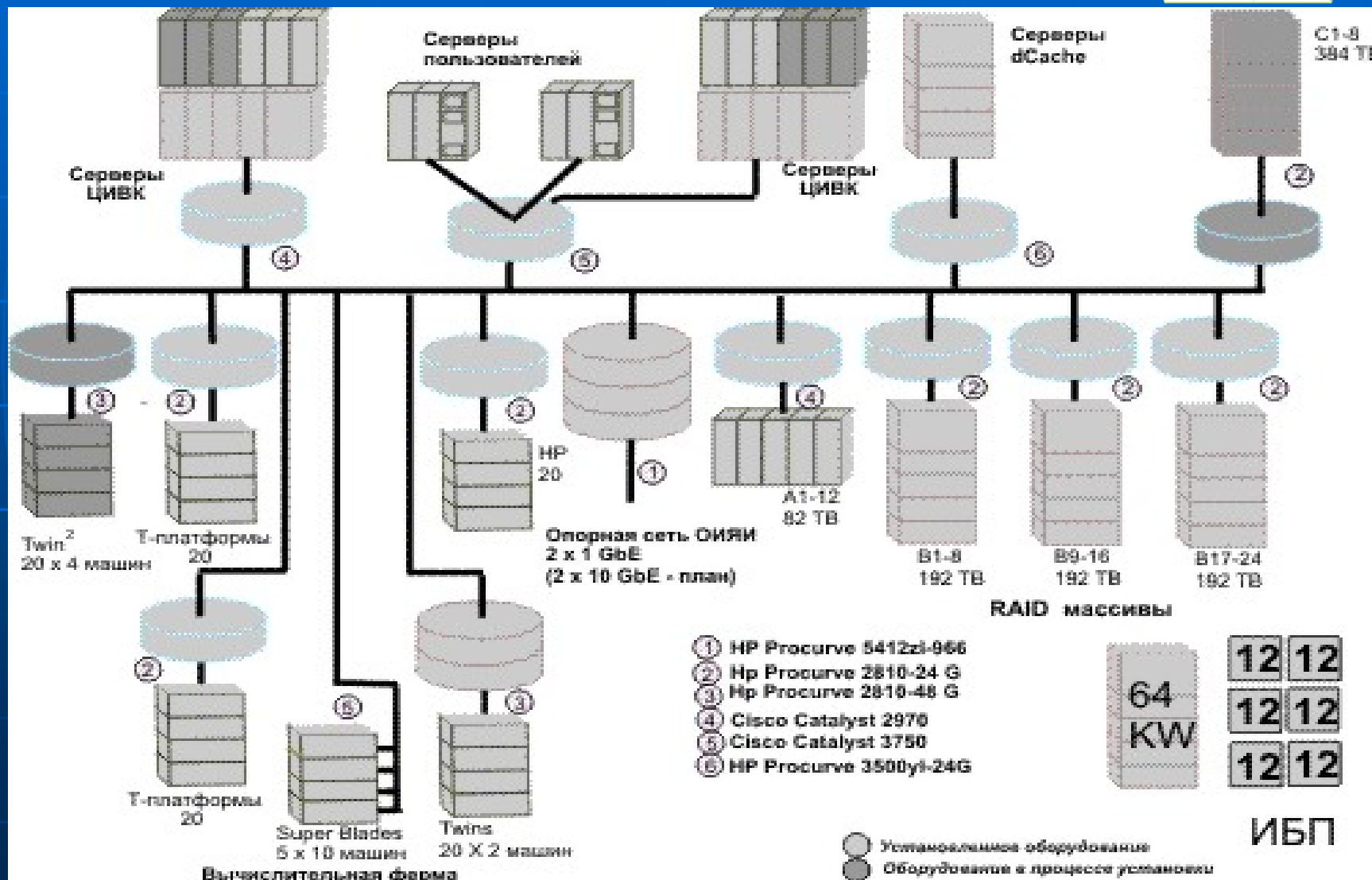- **General network authorization system involves many services (AFS, batch systems, Grid, JINR LAN remote access, etc.)**

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JINR Central Information and Computing Complex

JINR CICC structural scheme
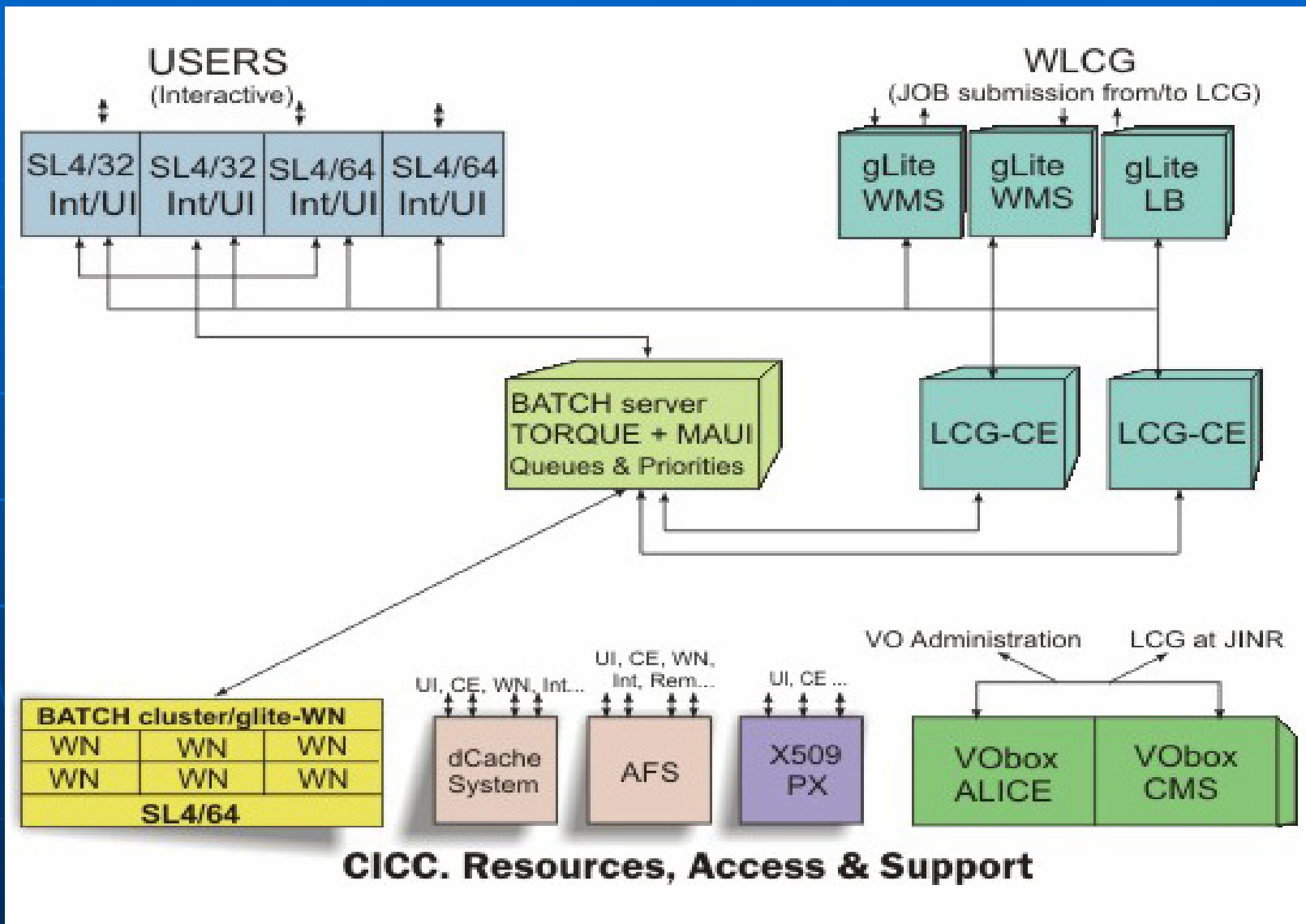
JINR Central Information and Computing Complex

At present, the CICC performance equals **2300 kSI2K** and the disk storage capacity 500 TB

SUPERMICRO
SUPER MICRO COMPUTER INC.

T.Strizh   (LIT, JINR)
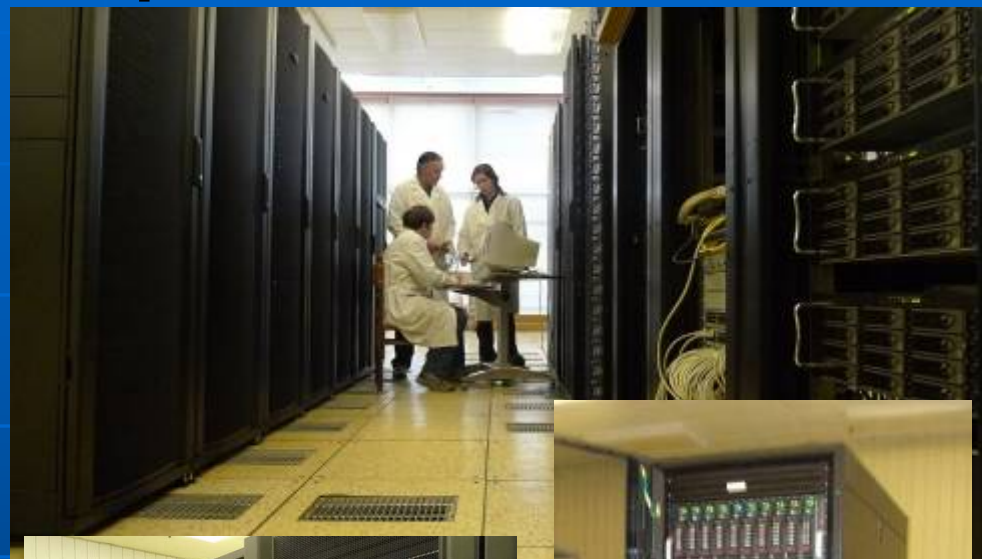
RDIG monitoring&accounting http://rocmon.jinr.ru:8080

- **Monitoring – allows to keep an eye on parameters of Grid sites' operation in real time**

- **Accounting - resources utilization on Grid sites by virtual organizations and single users**

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

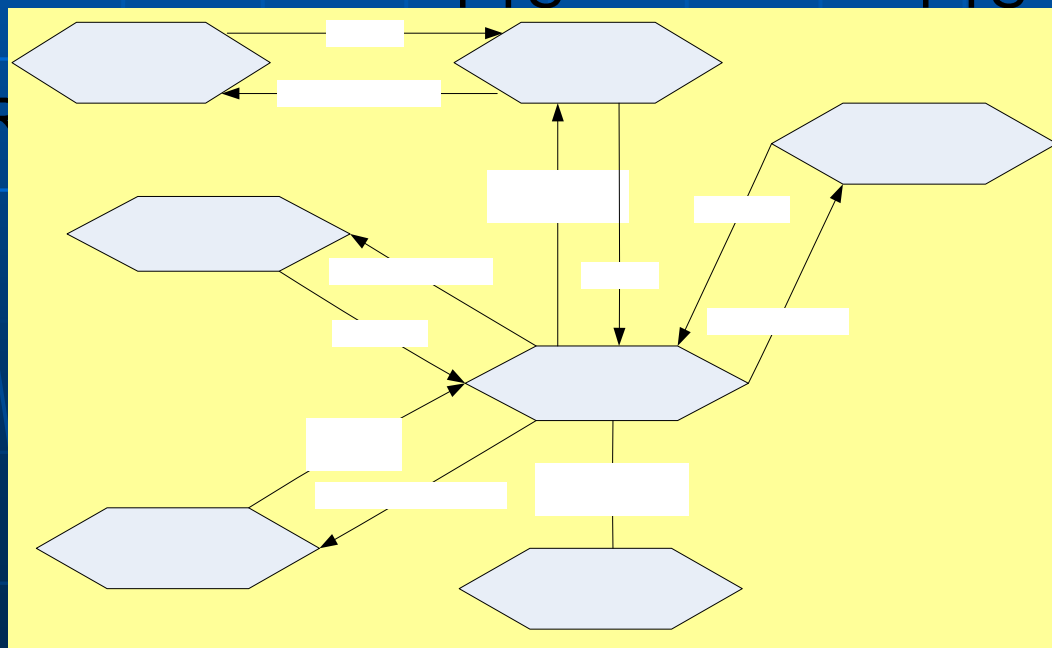**Physical memory**

    Average per job
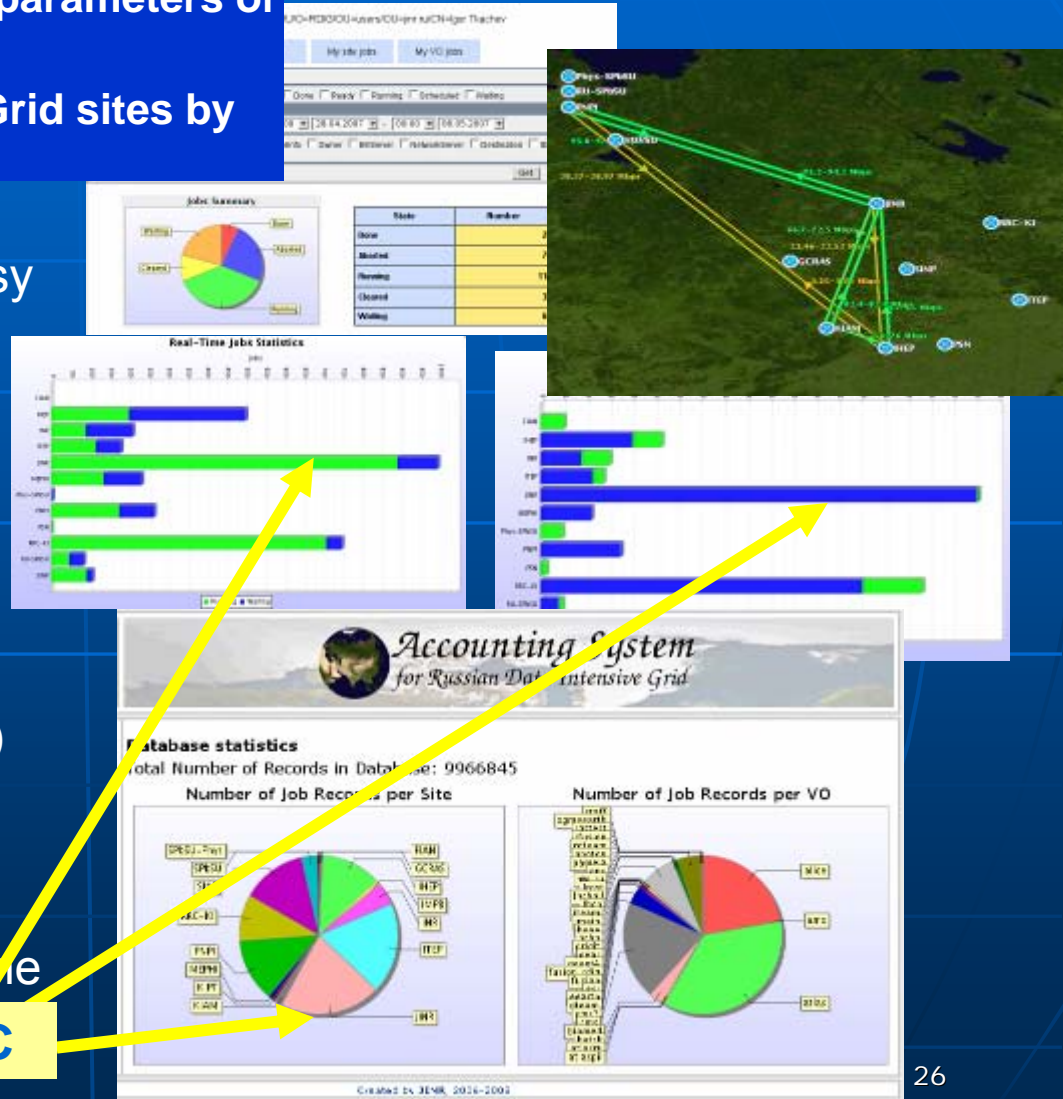
JINR CICC

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Site1

Storage System

FTS

FTS

CASTOR

dCache

DPM

GridFTP

27
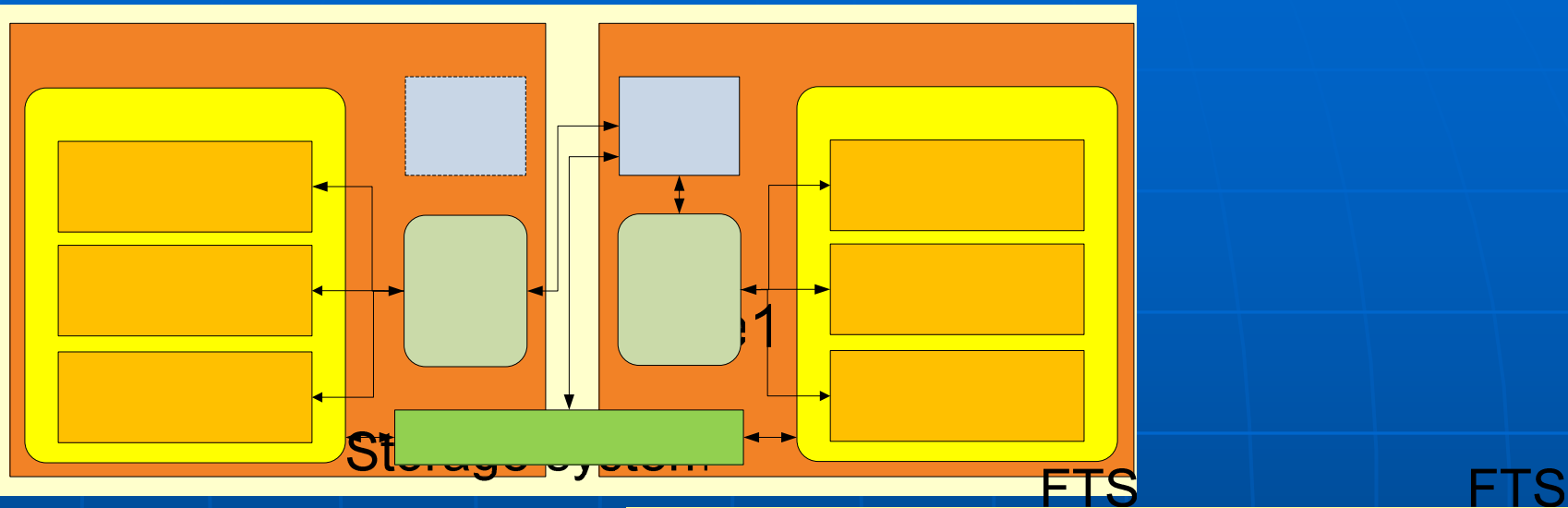
T.Strizh   (LIT, JINR)

Integration with Google Erath

(CERN, IT/GS)

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Production Normalised CPU time per EGEE Region (June-December 2009)

PRODUCTION Normalised CPU time per REGION
LHC VOs. December 2008 - July 2009

14.7% 6.3% 16.7% 6.9% 3.0% 8.6% 7.6% 6.2% 3.3% 5.6% 21.2%

Legend:
- AsiaPacific
- CentralEurope
- CERN
- France
- GermanySwitzerland
- Italy
- NorthernEurope
- Russia
- SouthEasternEurope
- SouthWesternEurope
- UKI
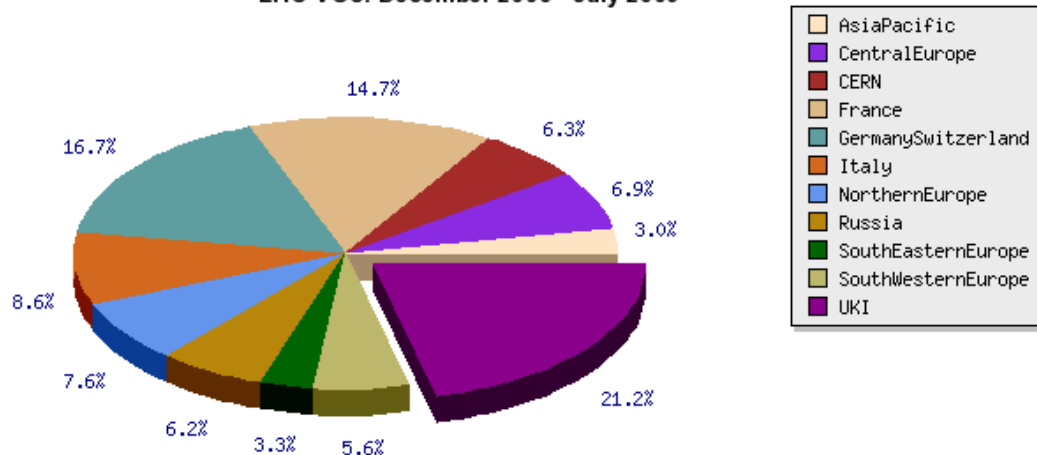
(C) CESGA 'EGEE View': PRODUCTION / normcpu / 2008:12-200

PRODUCTION Normalised CPU time per REGION
LHC VOs. June 2009 - December 2009

14.5% 2.3% 17.7% 7.2% 5.1% 8.4% 0.2% 8.2% 3.6% 5.6% 2.3% 6.9% 18.3%

Legend:
- AsiaPacific
- CentralEurope
- CERN
- France
- GermanySwitzerland
- Italy
- NorthernEurope
- ROC_Canada
- Russia
- SouthEasternEurope
- SouthWesternEurope
- UKI
- Others
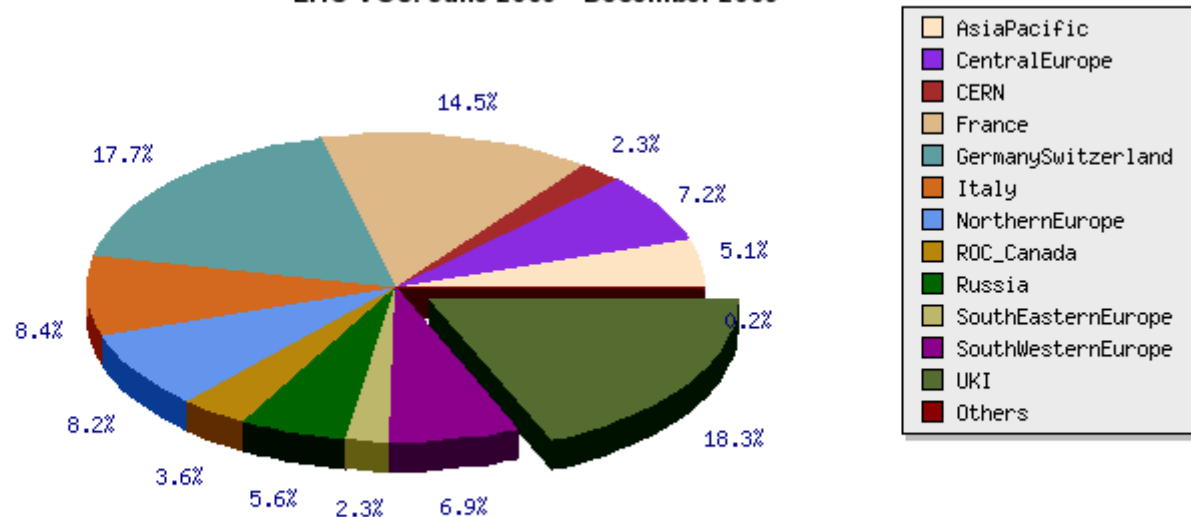
(C) CESGA 'EGEE View': PRODUCTION / normcpu / 2009:6-2009:12 / REGION-DATE / lhc (x) / ACCBAR-LIN / i

2009-12-17 17:31 UTC

Russia and JINR Normalized CPU time per SITE (June 2009 - December 2009)

Normalised CPU time (SpectInt2000*hour = 1000) per Site
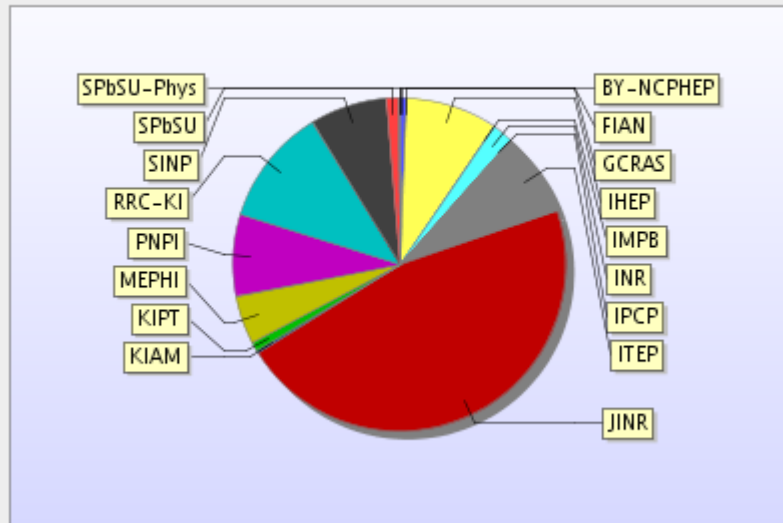
Normalised CPU time (SpectInt2000*hour = 1000)
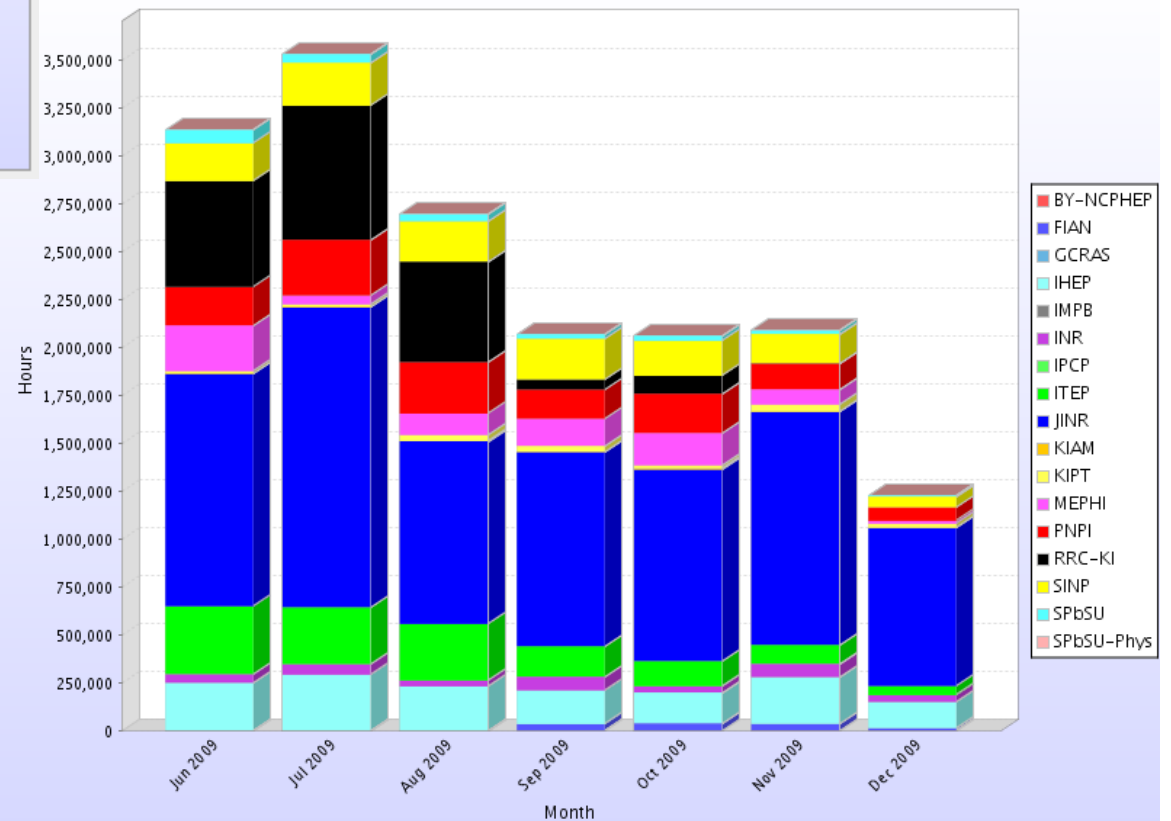
Production Normalised CPU time per EGEE site for VO LHC (June – September 2009)

GRID-site	CPU time	Num CPU
FZK-LCG	8,095,787	8620
CERN-PROD	4,552,891	6812
INFN-T1	4,334,940	2862
GRIF	4,089,269	3454
JINR	3,957,790	960
CYFRONET-LCG	3,948,857	2384
PIC	3,921,569	1337
UKI-GLASGOW	3,860,298	1912
RAL-LCG2	3,793,504	2532
UKI-LT2-IC-HEP	3,752,747	960
IN2P3-CC	3,630,425	4544

Production Normalised CPU time per EGEE site for VO LHC (June – December 2009)

GRID-site	CPU time	Num CPU
FZK-LCG	22,348,420	8400
IN2P3-CC	11,572,577	4544
RAL-LCG2	9,808,557	4304
GRIF	9,291,364	3504
DESY-HH	8,506,052	2956
INFN-T1	8,028,802	2862
JINR	7,790,442	992
UKI-GLASGOW	7,765,457	1912
PIC	7,728,730	1329
IN2P3-CC-T2	7,742,571	4296
CYFRONET-LCG	7,476,269	2384

Frames for Grid cooperation of JINR

- Worldwide LHC Computing Grid (WLCG);
- Enabling Grids for E-sciencE (EGEE);
- RDIG Development (Project of FASI)
- CERN-RFBR project "Grid Monitoring from VO perspective"
- 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;
- NATO project "DREAMS-ASIA" (Development of gRid EnAbling technology in Medicine&Science for Central ASIA);
- JINR - FZU AS Czech Republic Project "The GRID infrastructure for the physics experiments"
- **NASU-RFBR project "Development and support of LIT JINR and NSC KIPT grid-infrastructures for distributed CMS (CERN) data processing during the first two years of the Large Hadron Collider operation"**
- Project "Elaboration of distributed computing JINR-Armenia grid-infrastructure for carrying out mutual scientific investigations"
- JINR-Romania cooperation Hulubei-Meshcheryakov programme
- Project "SKIF-GRID" (Program of Belarussian-Russian Union State).
- Project GridNNN (National Nanotechnological Net)

Distributed training infrastructure
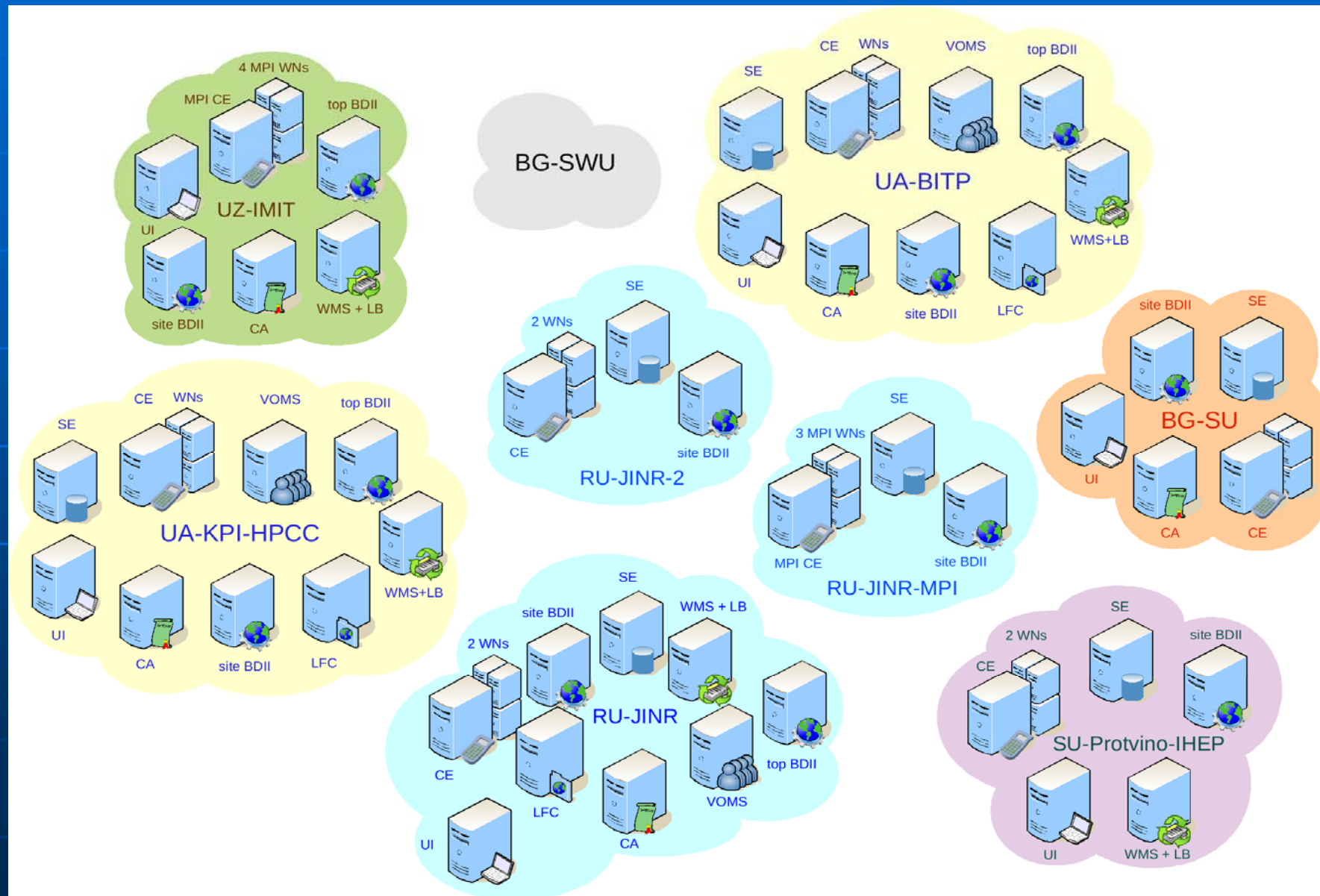
Present state and plans

- gLite user trainings for students of Dubna University and University Centre of JINR
- grid site admins trainings for JINR member-states
- testbed for grid developers
- testbed for middleware evaluation
- GILDA cooperation

User Training and Induction

Russian and JINR physicists participants of ATLAS experiment train and practise with Grid and the GANGA

COURSES   **LECTURES**   **PRACTICAL TRAINING** 36

T.Strizh (LIT, JINR)

3-rd International Conference
"Distributed Computing and Grid-technologies in Science and Education"
30 June – 4 July, 2008

126 reports, 211 participants

http://grid2008.jinr.ru

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Development of the JINR Grid-environment – 2010-2016

Network level:

links between Moscow and Dubna on the basis of state-of-the-art technologies DWDM and 10Gb Ethernet.

JINR Local area network :

JINR High-speed backbone construction – 10Gbps

Resource level:

requirements of the LHC experiments stimulate the development of a global Grid-infrastructure, together with the resource centers of all the cooperating organizations. First of all, this is of primary concern for such large research centers as the JINR. To reach effective processing and analysis of the experimental data, further increase in the JINR CICC performance and disk space is needed.

	2010-2011	2012-2013	2014-2015	2016
CPU (kSI2k)	3500	5000	8000	12000
Disk systems (TB)	1500	2500	4000	8000
Mass storage (TB)	1000	2000	5000	10000