NTUU "KPI" 1898

DEVELOPMENT OF GRID-INFRASTRUCTURE FOR EDUCATIONAL AND RESEARCH SEGMENT OF INFORMATION SOCIETY IN UKRAINE WITH FOCUS ON ECOLOGICAL MONITORING AND TELEMEDICINE

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Plan of presentation

- ► GRID technology
- ►Educational and research segments of information society in Ukraine
- ► Available computational resources (in 1952 Ukraine was the third after USA and Great Britain to build up the computer !)
- ► Examples of ecological monitoring and telemedicine support for the Chernobyl nuclear power plant

What is GRID ?

►GRID, geographically distributed infrastructure, compels existing in a network computers (thousand of PC, work stations and super-computers) to work how a sole enormous and mighty computer is, uniting the great number of resources of different types (processors, large memories, data depositories and data bases, networks), access to which users can get from any points, regardless of place of their location.

What do encourage scientists to build GRID?

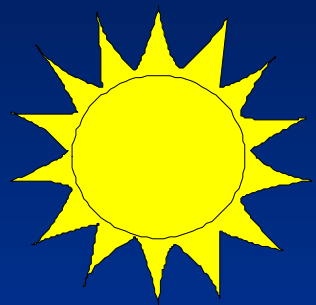
▼ *At first*, a necessity to process *the huge number of data*, that are saved in different organizations (possibly, placed in different parts of the world);

▼ *Secondly*, a necessity to execute *the huge number of calculations*;

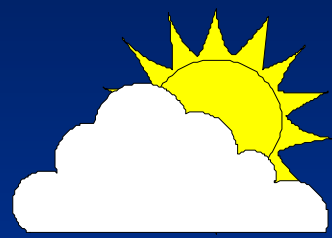
▼ *Thirdly*, wishes of scientific teams, the members of which work in different parts of Earth, *jointly use large data arrays, quickly and interactive to carry out their complex analysis and, here, discuss results in videoconferences*.

Who are interested in Distributed Supercomputing ?

Ecology

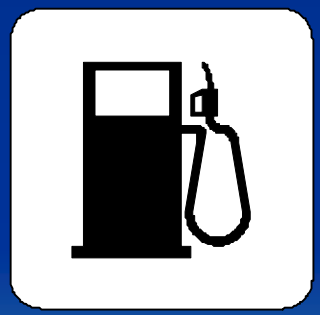


Astronomy



Meteorology

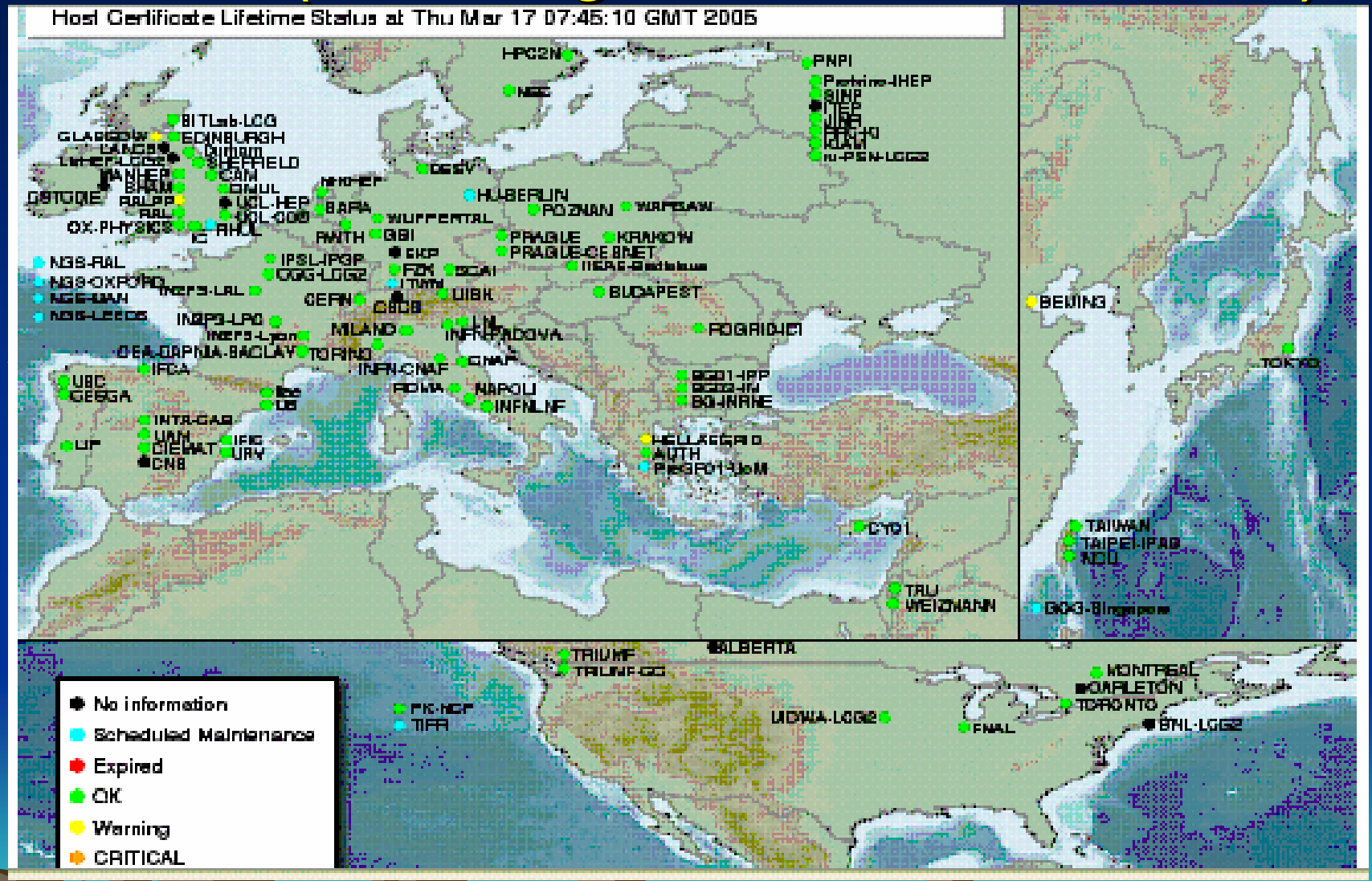
Atomic energy



Oil and Gas industry

Bioinformatics

EGEE (Enabling Grids for E-sciencE)



BalticGRID Project

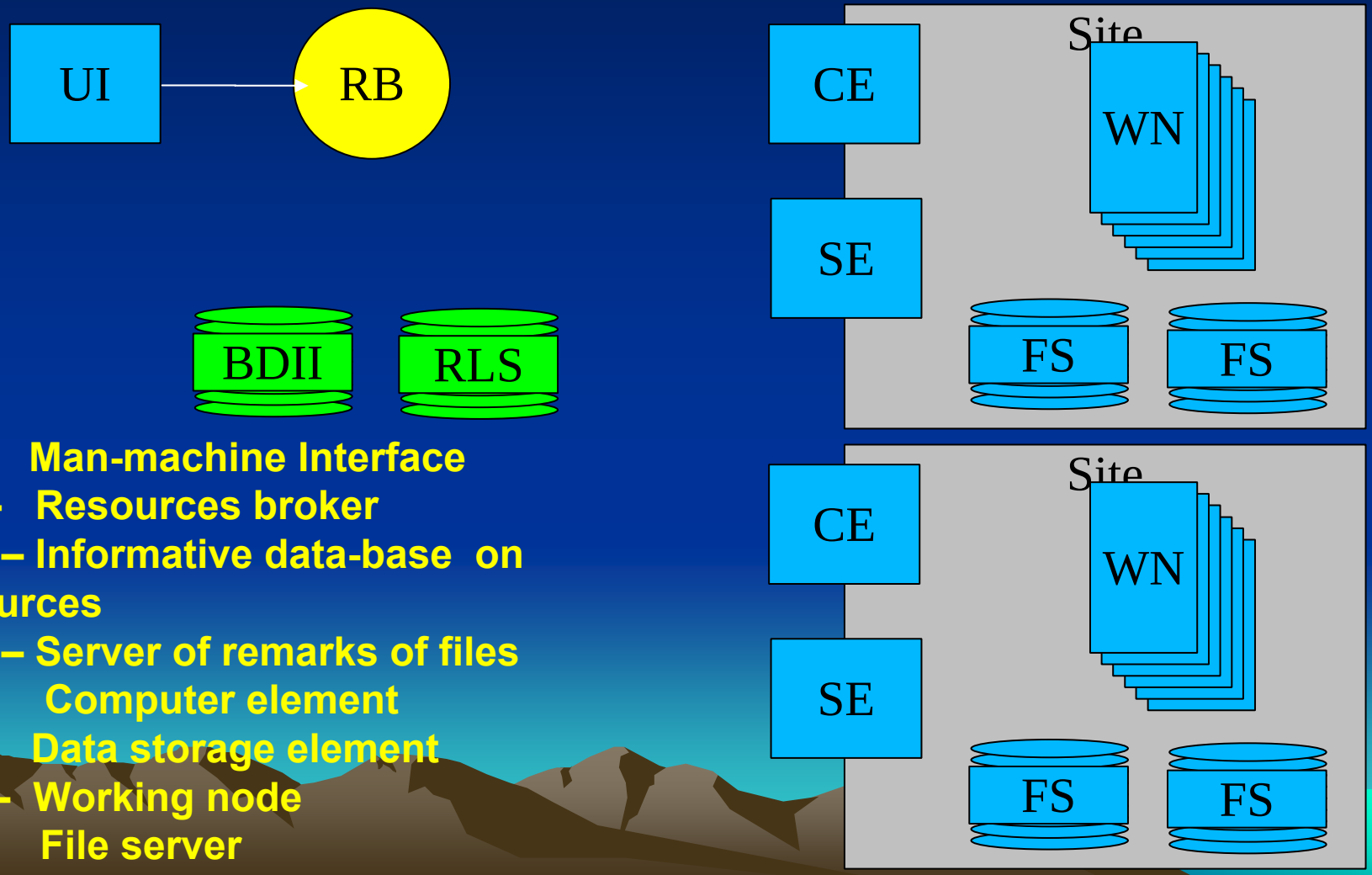
Goals:

* Establish a production quality Grid infrastructure with high-quality services in the Baltic States, Poland and Ukraine

* Enable scientists to efficiently participate in the European Research Area and contribute to the European knowledge based economy

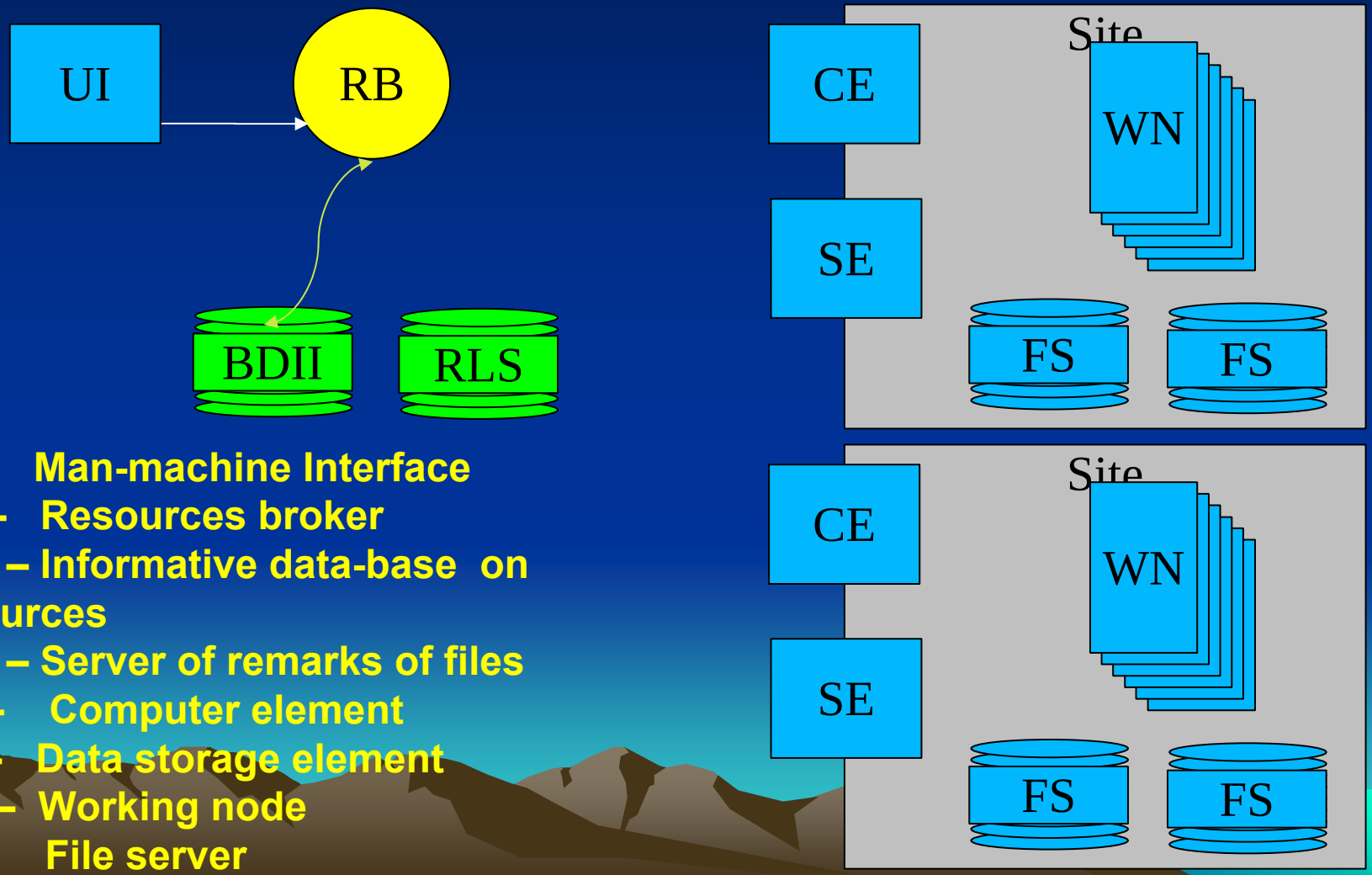
* Establish Special Interest Groups in significant application areas

Task processing in GRID (eLife)



UI – Man-machine Interface
RB – Resources broker
BDII – Informative data-base on resources
RLS – Server of remarks of files
CE – Computer element
SE – Data storage element
WN – Working node
FS – File server

Task processing in GRID (eLife)



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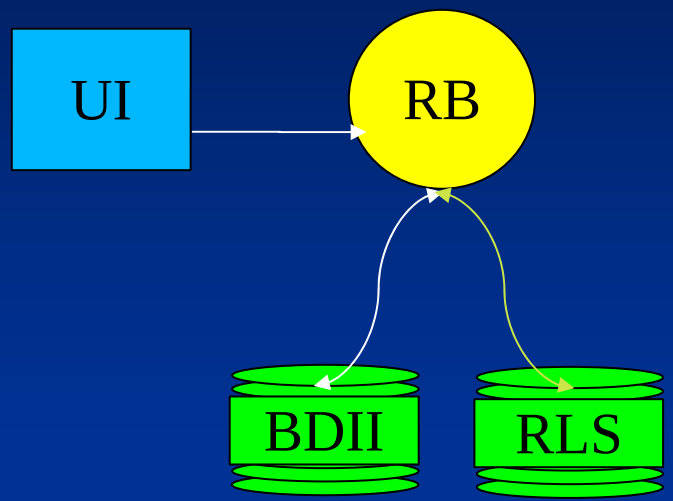

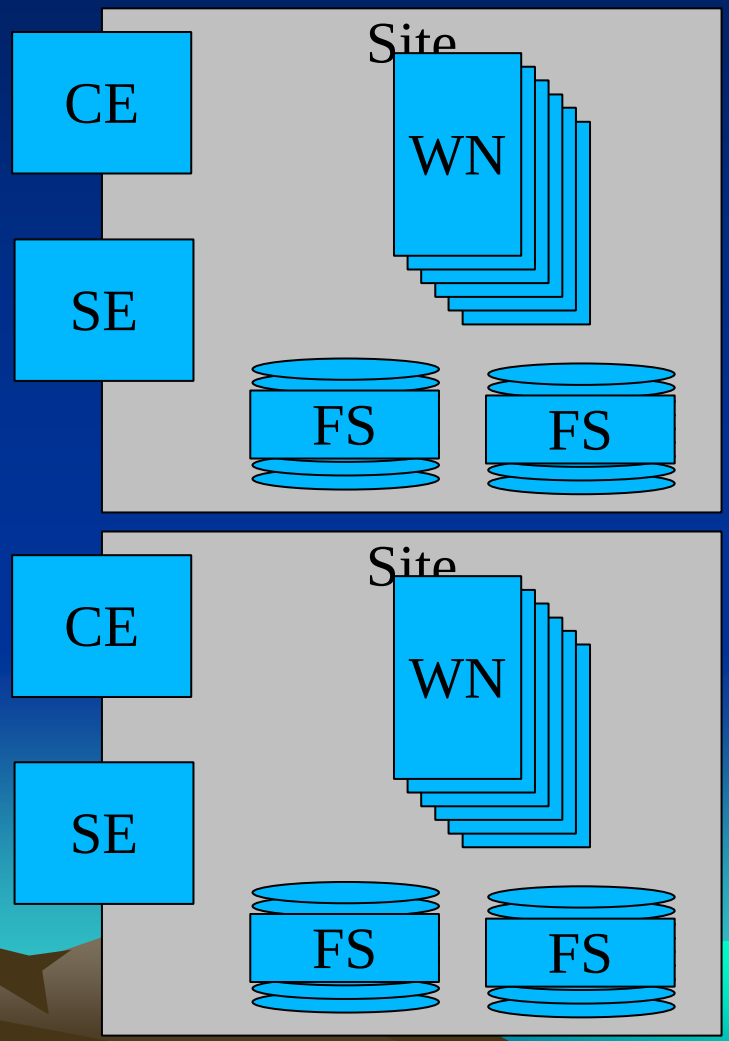

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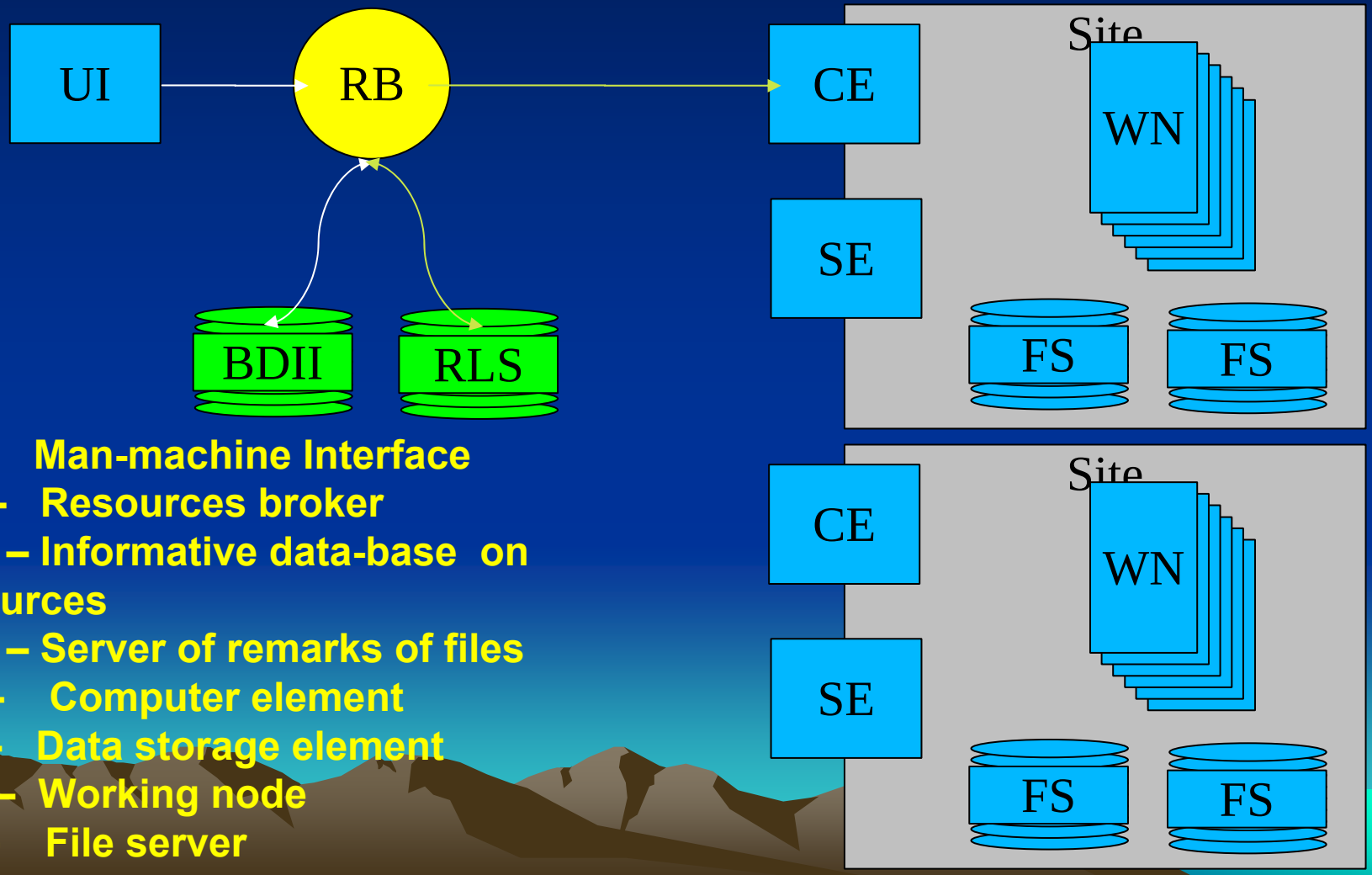

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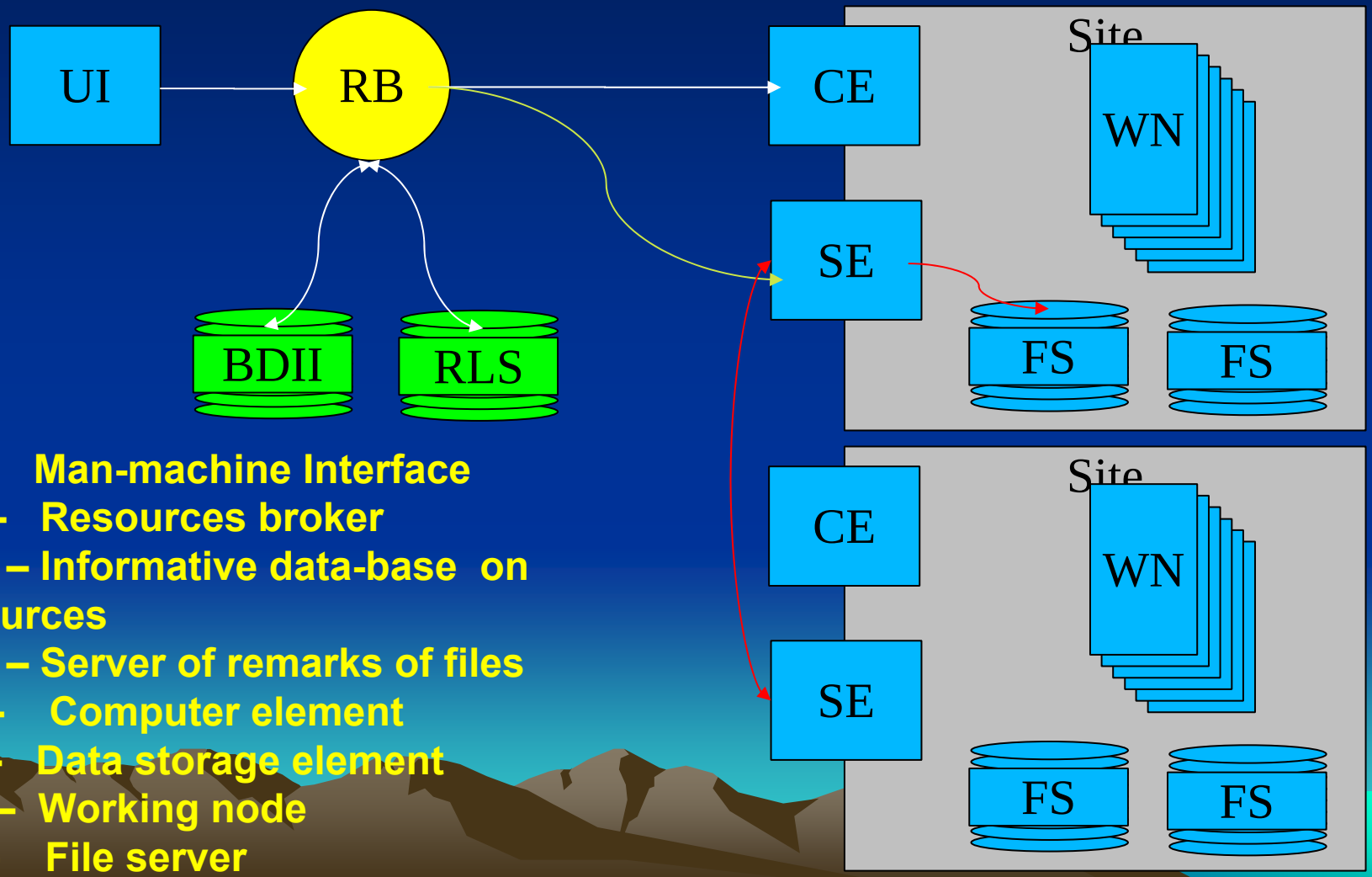

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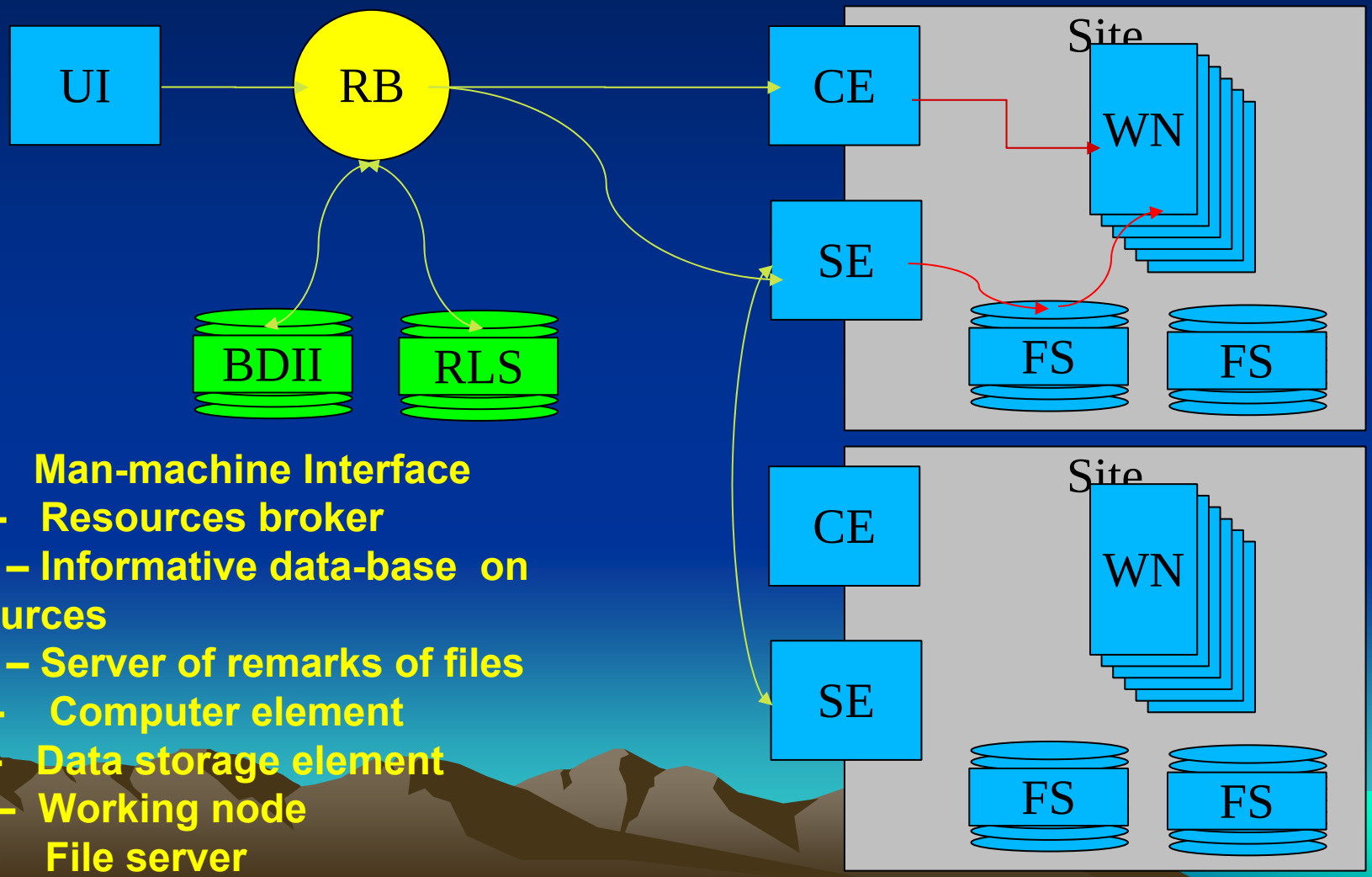

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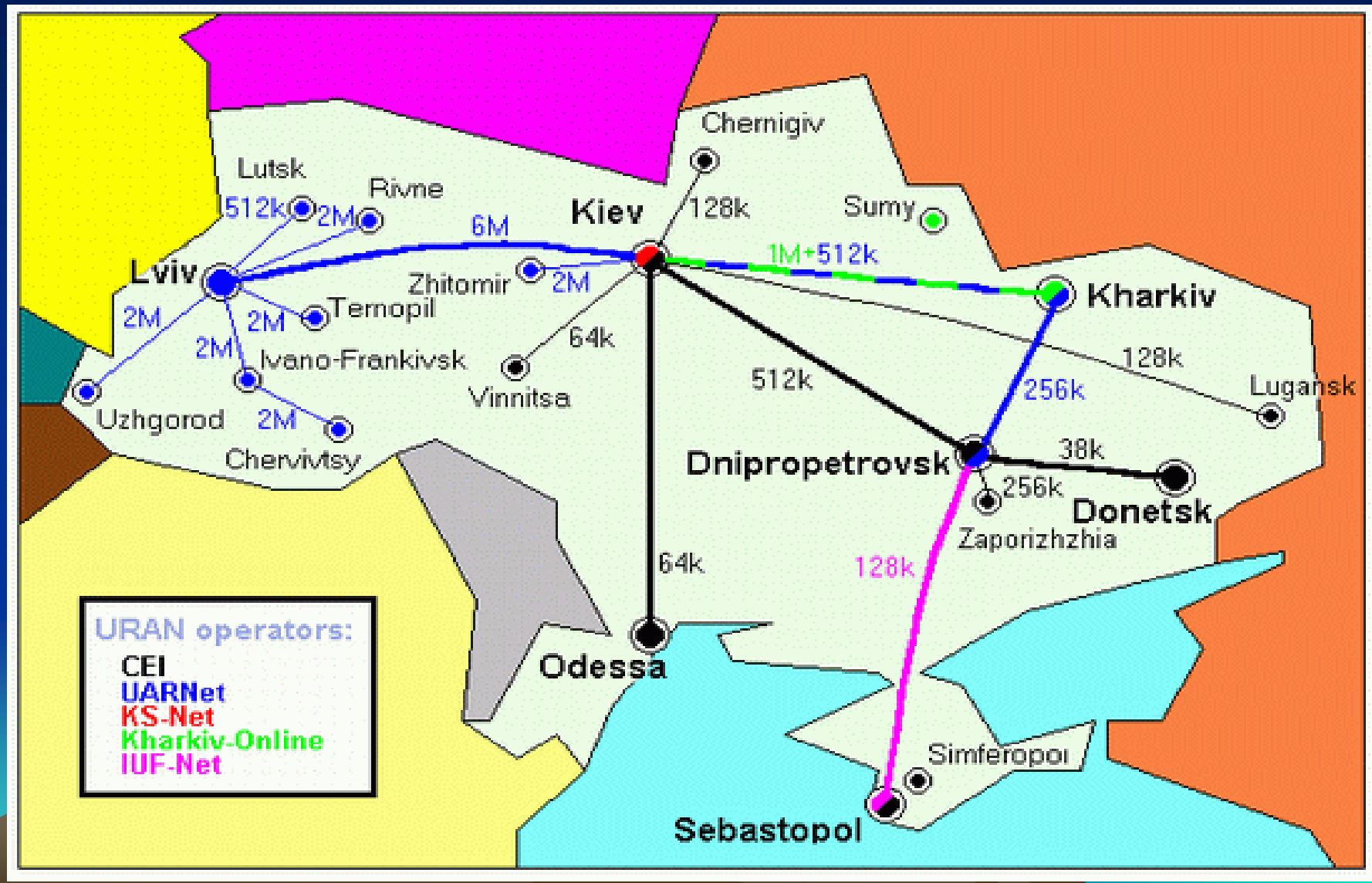
The Government decision about National Grid development

The President of Ukraine	Parliament	Cabinet of Ministers
Order "On the priority objectives of introduction of innovative information technologies" (October 20, 2005)	**Laws** (>30): • "On the Concept of the National information development program"; • "On electronic documents and electronic documents circulation";	**The State program** "Information and communication technologies in education and science for 2006-2010"

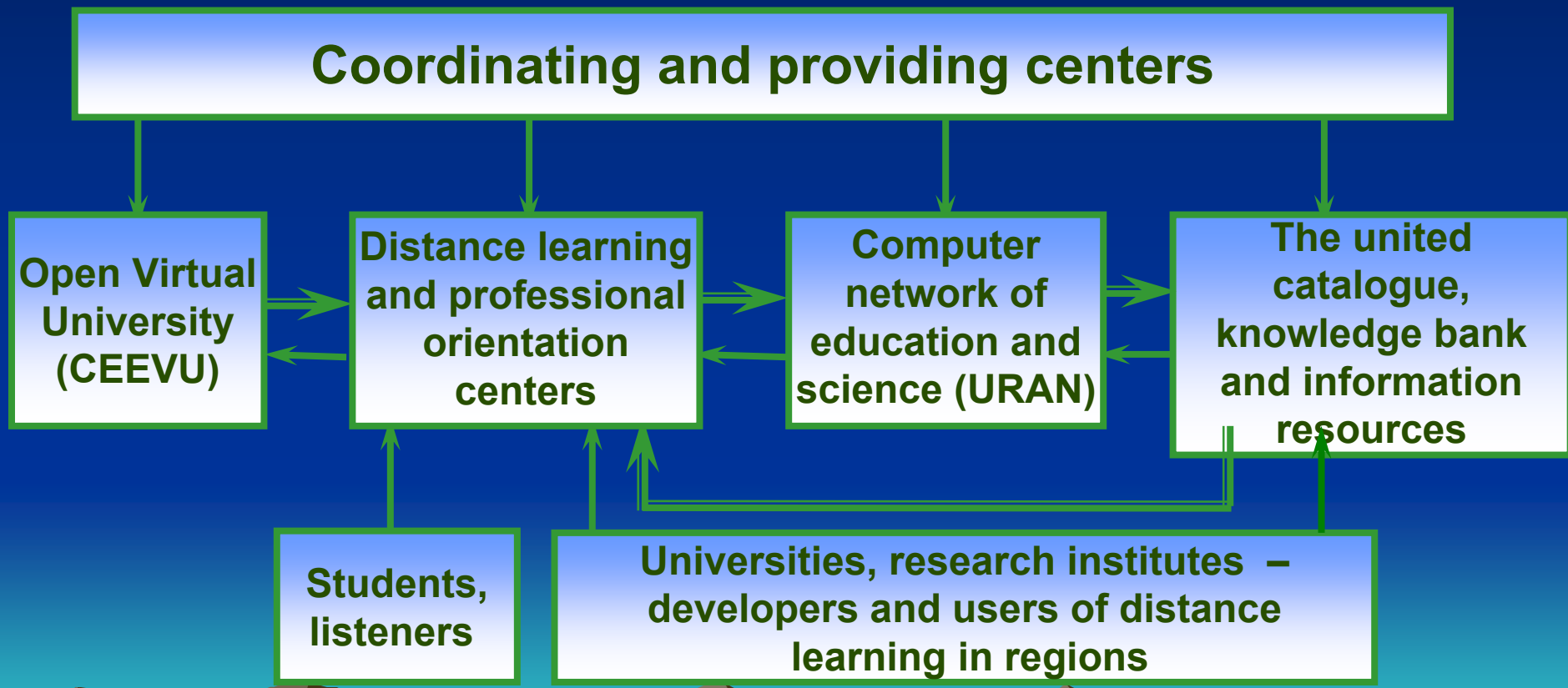
Segment 1. The Ukrainian research and academic network (URAN)



URAN facilities

- The total open access traffic of URAN has Increased 50 times within the last 5 years, and today it constitutes 1.5 Tb (terabyte) per a month
  - In every region both the optic fiber and satellit communication segments are developed, which ensure the rate of data transfer up to 1 Gb/s.
  - A selected way of the URAN infrastructure development is based on the dark optic fiber cables.

Segment 2. Distance learning system at the national level



CEEVU Members

Nettuno (Roma, Italy)

Central and Eastern European Networking Association (CEENet) (Poland)

Technical University of Sofia (Bulgaria)

Brno University of Technology (Czech Republic)

University Politehnica of Bucharest (Romania)

Kaunas University of Technology (Lithuania)

State Engineering University of Armenia

Tallinn University of Technology (Estonia)

Ukraine:

National Technical University of Ukraine “Kyiv Polytechnic Institute”

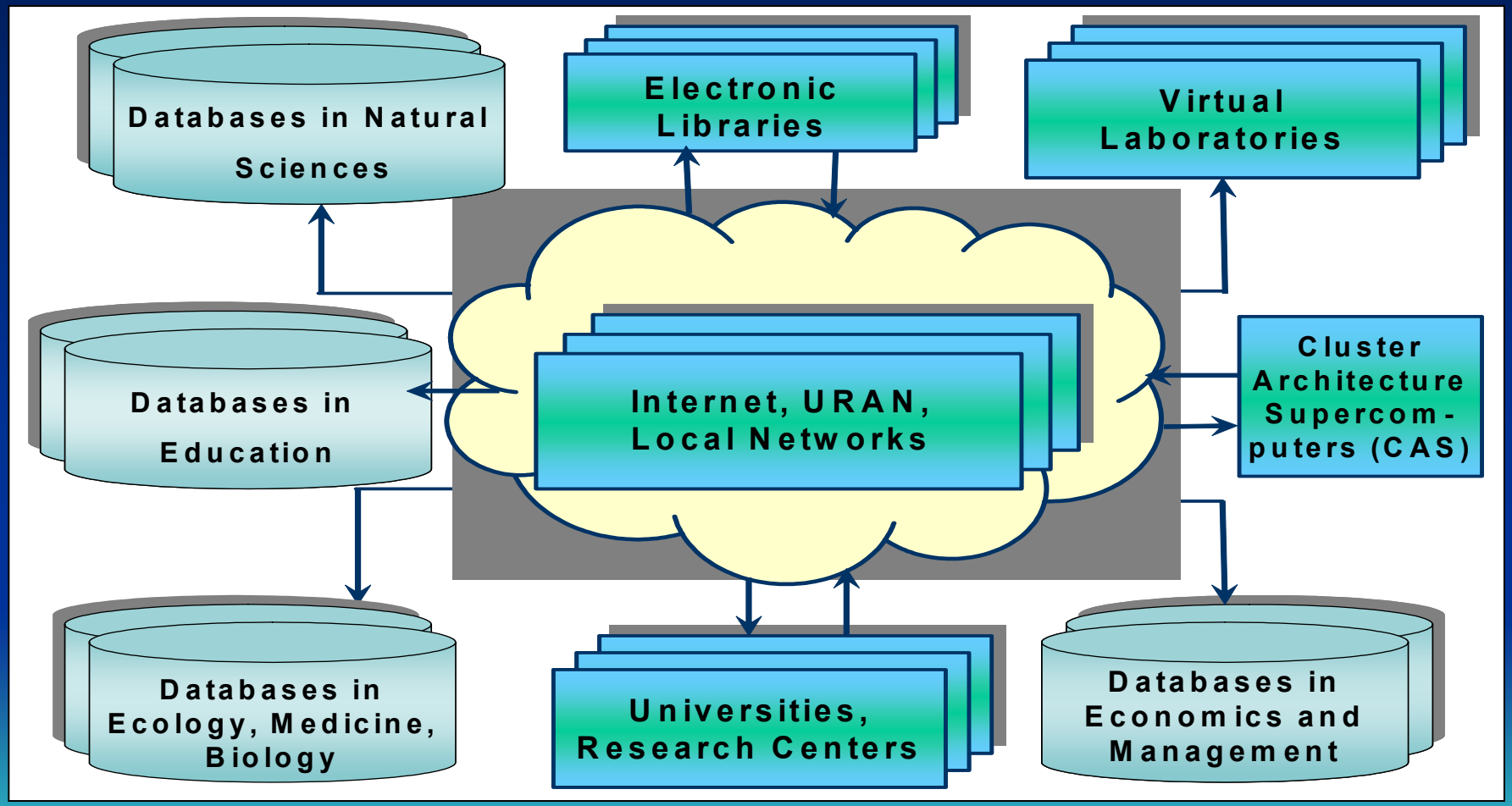
Lviv Polytechnic National University

National Technical University "Kharkiv Polytechnic Institute"

International University of Finances

Donetsk National Technical University

Segment 3. Distributed information resources and network computational facilities



200 electronic libraries in the field of education and science

Early printed books

"Dream of Scipion, Saturnalion"
Macrobius 1550 y. 18 pages.

"Naprestolnoe Evangeliye"
(The Enthrone Gospel)
Macrobius 1575 y. 396 pages.

200 electronic libraries in the field of education and science

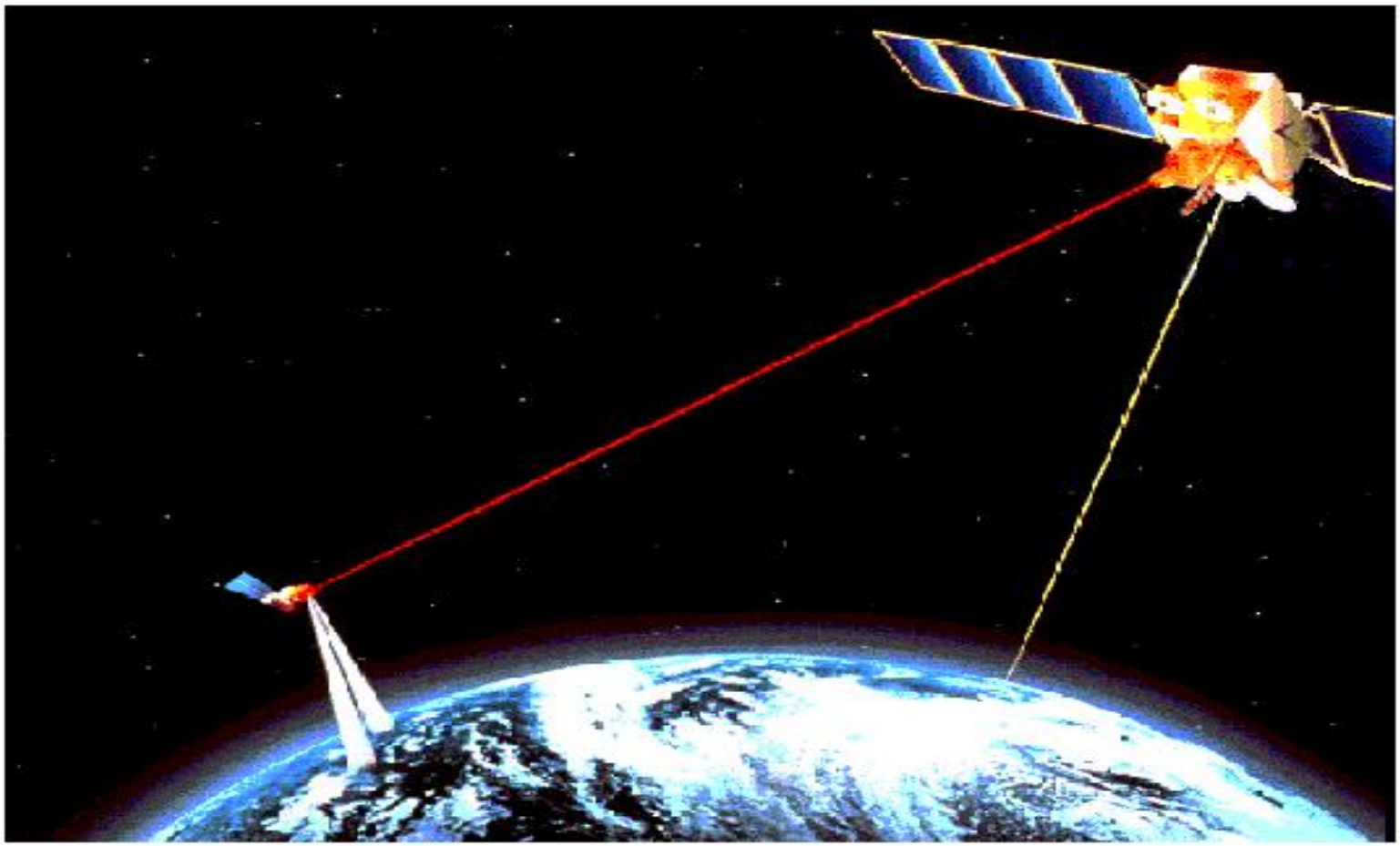
Ainsient icons

Mother of God
2 half of XV sentury.

Old Testament Whitsun
1422-1427 y.

Archangel Mikhail 2 half XVI sentury.

Fourth segment: the Ukrainian branch of International Centers of Data (UB ICD)

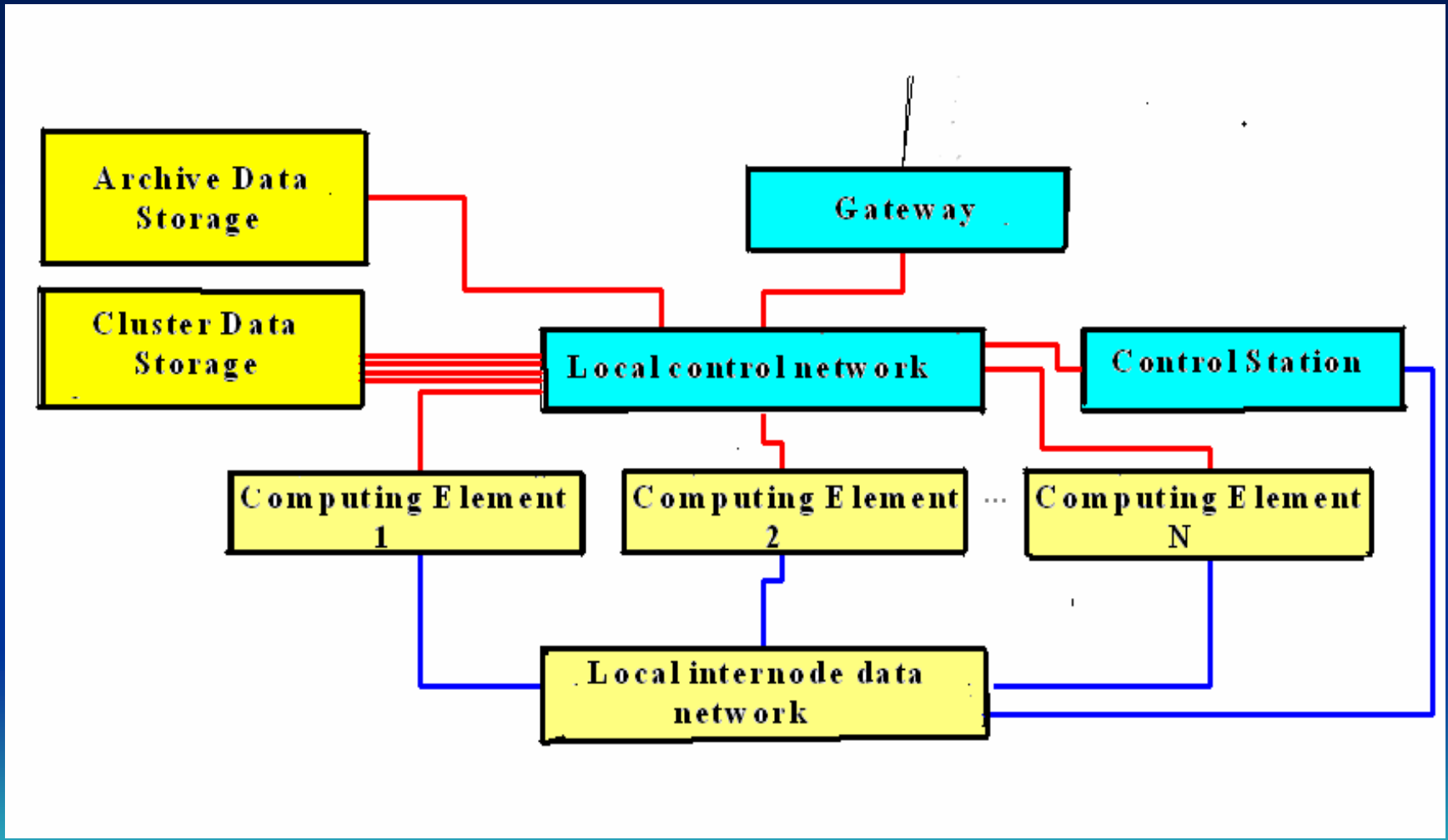


Artemis SILEX optical link

Clusters in Ukraine

Description	Characteristics		
	CAS-1	CAS-2	CAS-3
Processors number	16	32	168
Peak performance per A processor (Ghertz)	2,67	1,4	3.0
Operations with floating point (FLOPS))	$5,34 \cdot 10^{9}$	$5,6 \cdot 10^{9}$	$1.2 \cdot 10^{10}$
Total peak perfo rmance			
Operations with floating point (FLOPS)	$1,7 \cdot 10^{11}$	$3,58 \cdot 10^{11}$	$2.016 \cdot 10^{12}$
Speed of the system bus (Gb/s)	4,2	6,4	8.0
The cluster real perfo rmance at Linpack test (FLOPS)	$1,125 \cdot 10^{11}$	$2,8 \cdot 10^{11}$	

Supercomputer structure



Basic supercomputer components

- Computing Elements **(CE)** and Control Station uSystem ErgoLAN 455 being built on Intel Xeon 3,0GHz Dual Core, FSB 1333MHz, 80W, 65 nanometer, Cache 4MB,
- Cluster Data Storage uSystem ultraStorage 12TB with Seagate Storage Edition Hard Drive;
- Archive Data Storage uSystem Archive Storage 20TB (8+12) with disks and tapes;
- APC InfraXtructure system of trouble-free supply; ARS InRow 32kW system of microclimate adjusting ; 42U APC RACK w/Accessories for equipment assembling,
- System network – Infiniband 4x SDR ;
- Network switchboards – ProCurve Switch 2848 ;
- OS Linux;

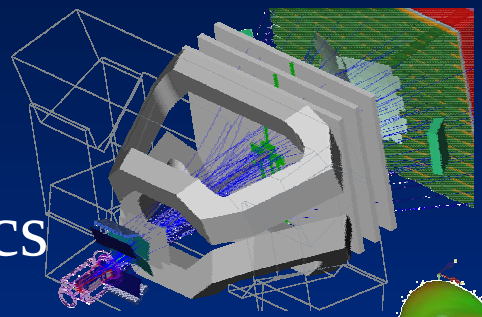
CLUSTER SOFTWARE

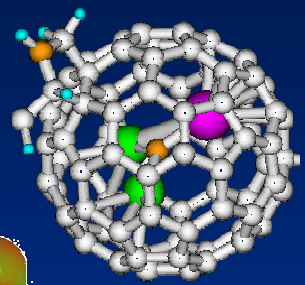
- Common system software (Linux CentOS-4.3);
- Test software, monitoring software;
- Software of collective access to the resources of the cluster;
- VTune –the program productivity analyzer
- MPI – OpenMPI (library for the parallel programming), Compilers – GCC (C/C++, Fortran-77, Fortran-95, etc.
- Libraries for the parallel calculations in linear algebra (ATLAS, GotoBLAS, ScaLAPACK,etc..

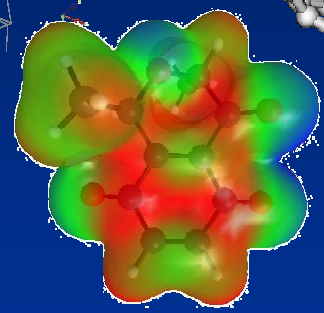
Clusters in SIC countries

N	Place	CPU numbers	Architecture	Peak performance	Ptoducer
	Moscow МСЦ РАН **2005 г**	**1148**	**Nodes: 574 (2xPowerPC 970 2.2 GHz 4 GB RAM)**	**6680/ 10102.4**	**"Квант", ИПМ РАН, МСЦ**
2	**Minsk** ОИПИ НАНБ 2004 г.	**576**	**Nodes : 288 (2xOpteron 248 2.2 GHz 4 GB RAM)**	**2032/ 2534.4**	**СКИФ**
3	**Kiev** НТУУ-КПІ **2006 г.**	**168**	**Nodes : 42 (2x3,0 GHz Dual Core Xeon 4 GB RAM)**	**2000**	**NTYY"KPI" "USTAR"**
4	**Moscow** МСЦ РАН 2005 г.	**256**	**Nodes : 128 (2xItanium 2 1.5 GHz 2.048 GB RAM)**	**1293/ 1536**	**Hewlett-Packard**

UGRID priorities







- Pilot Applications
  - High-Energy Physics
  - Materials Science
  - Bioinformatics
- Special Interests Groups
  - Modelling of the Chernobyl eco system
  - 3D field tasks simulation
  - MEMS and VLSI design

Chernobyl Telemedicine Project

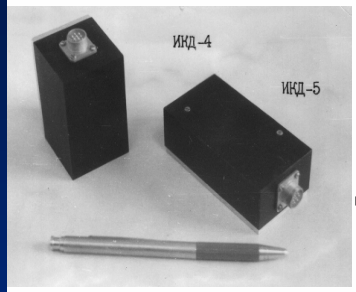
NTUU "KPI" – National Technical University of Ukraine "Kiev Polytechnic Institute"

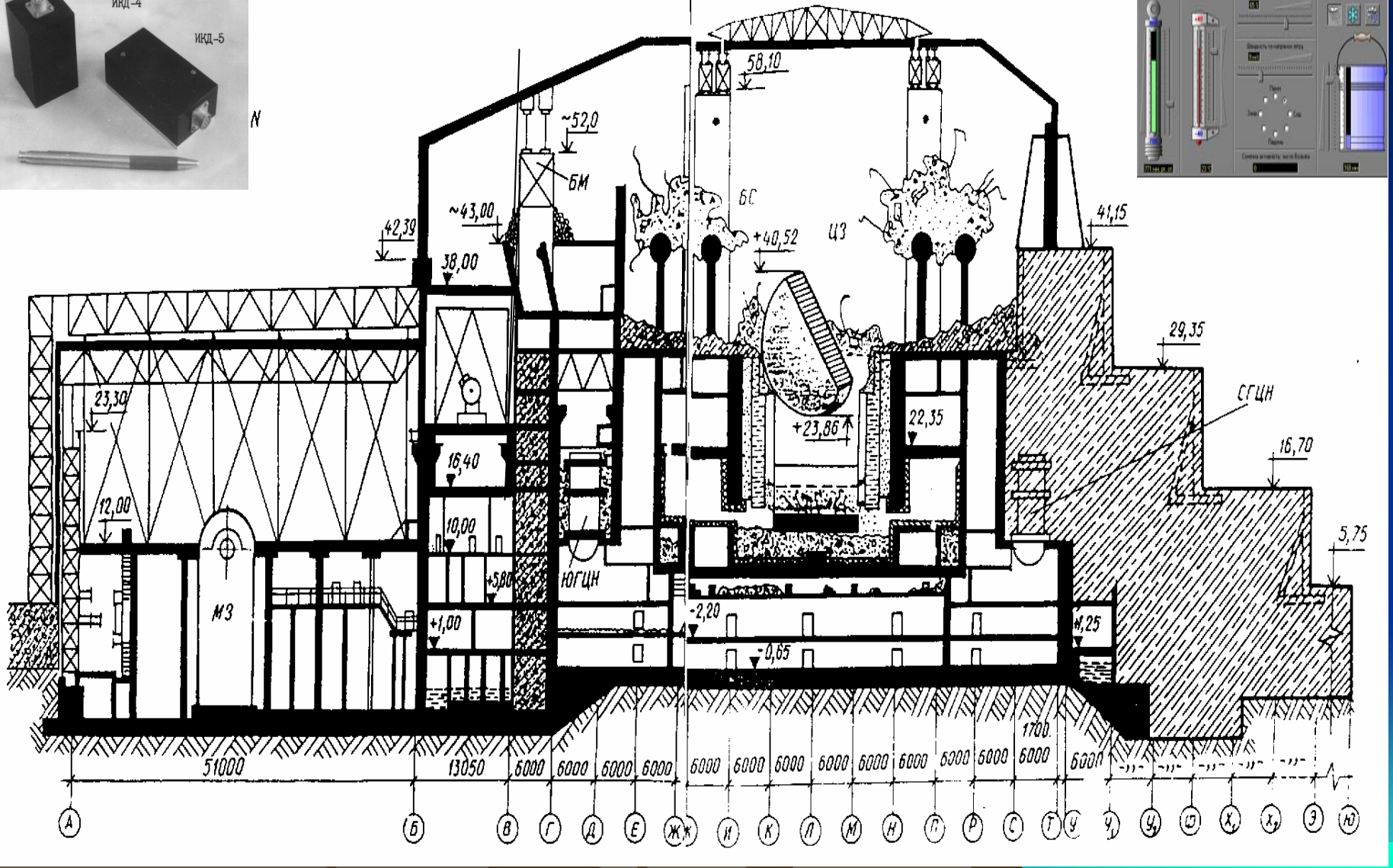
ICTM – International Center of Telemedicine

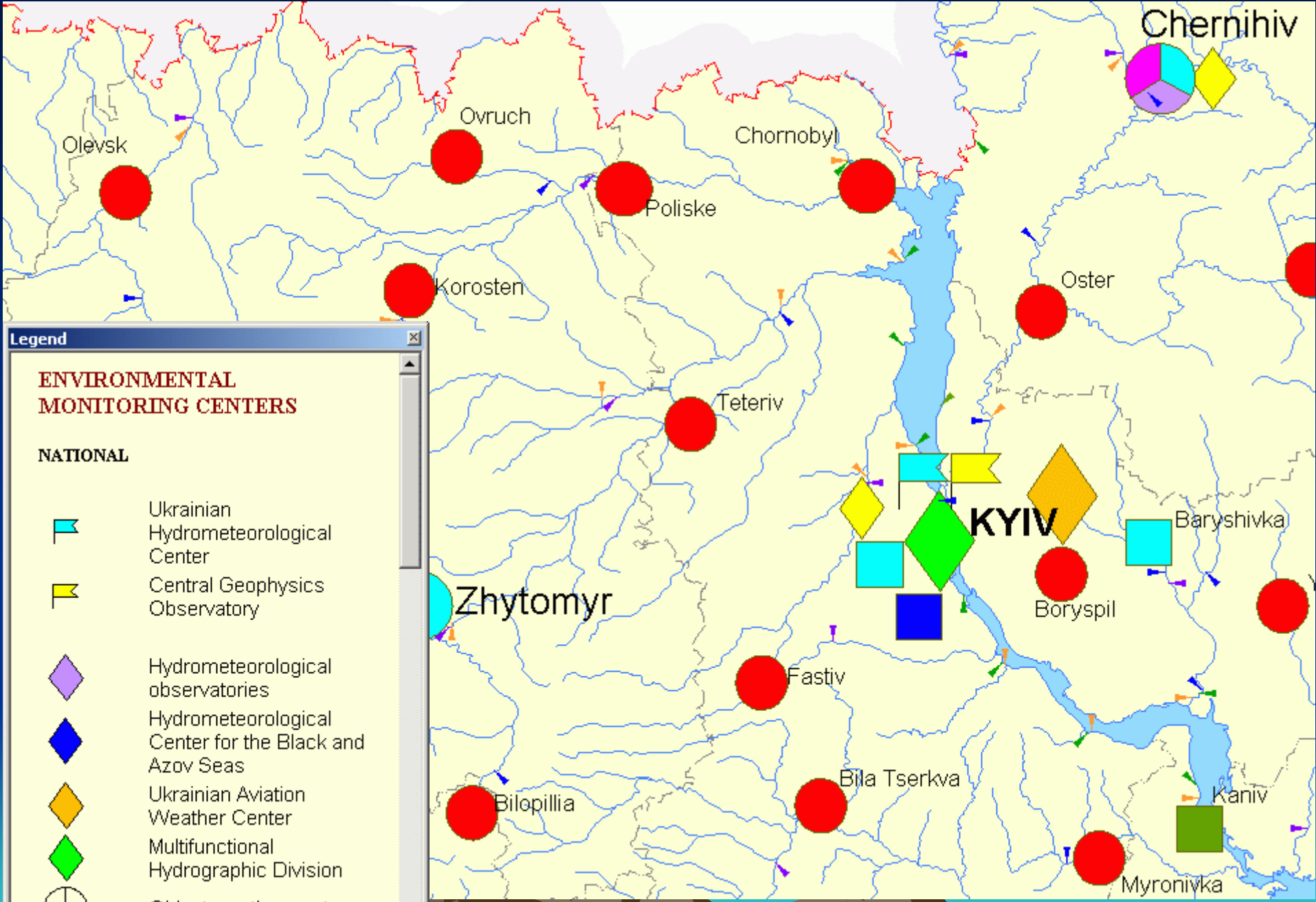
STMC – Slavutych Telemedicine Center

FP – Foreign Partner

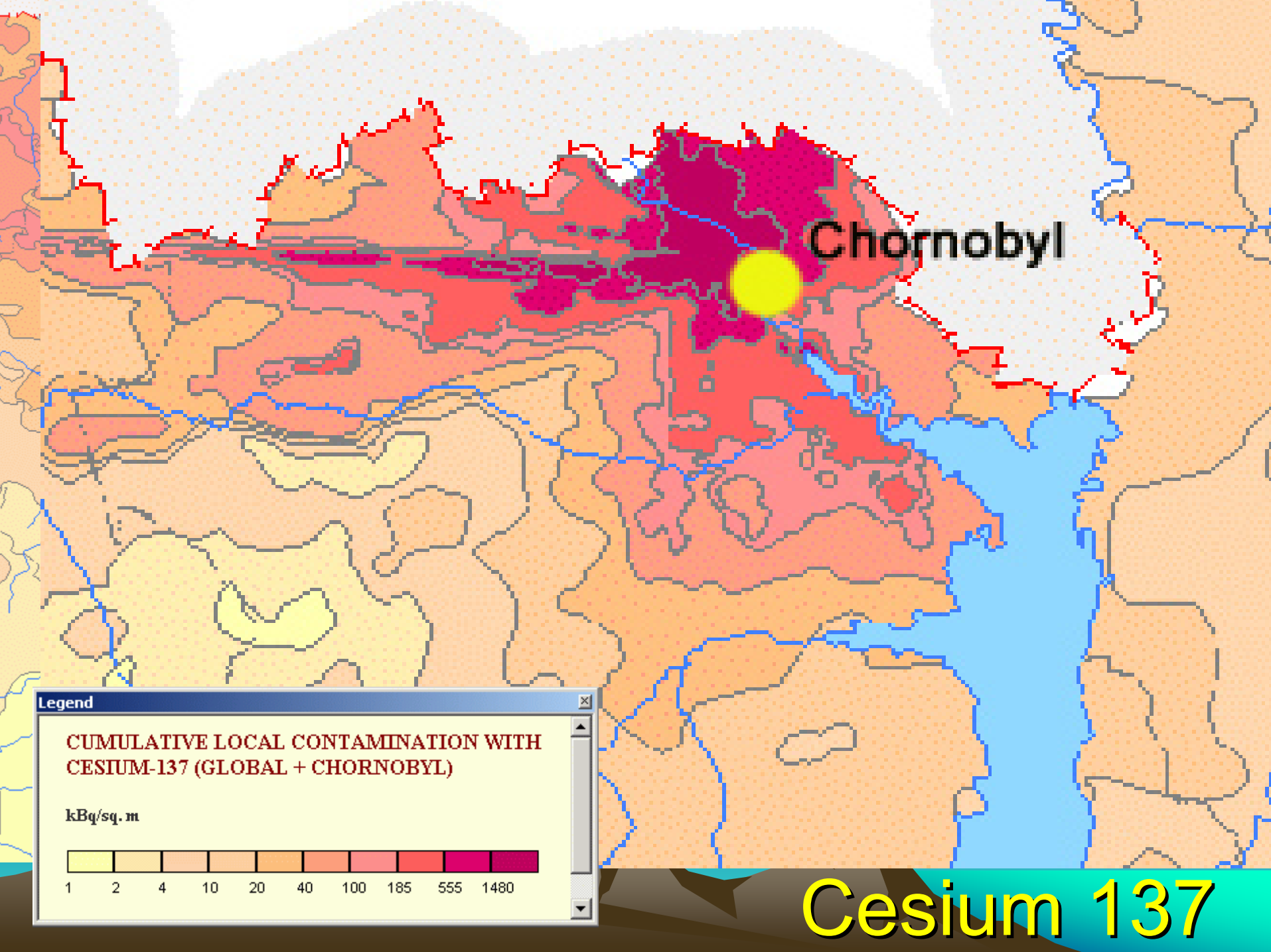
The internal part of the sarcophagus with the monitoring system

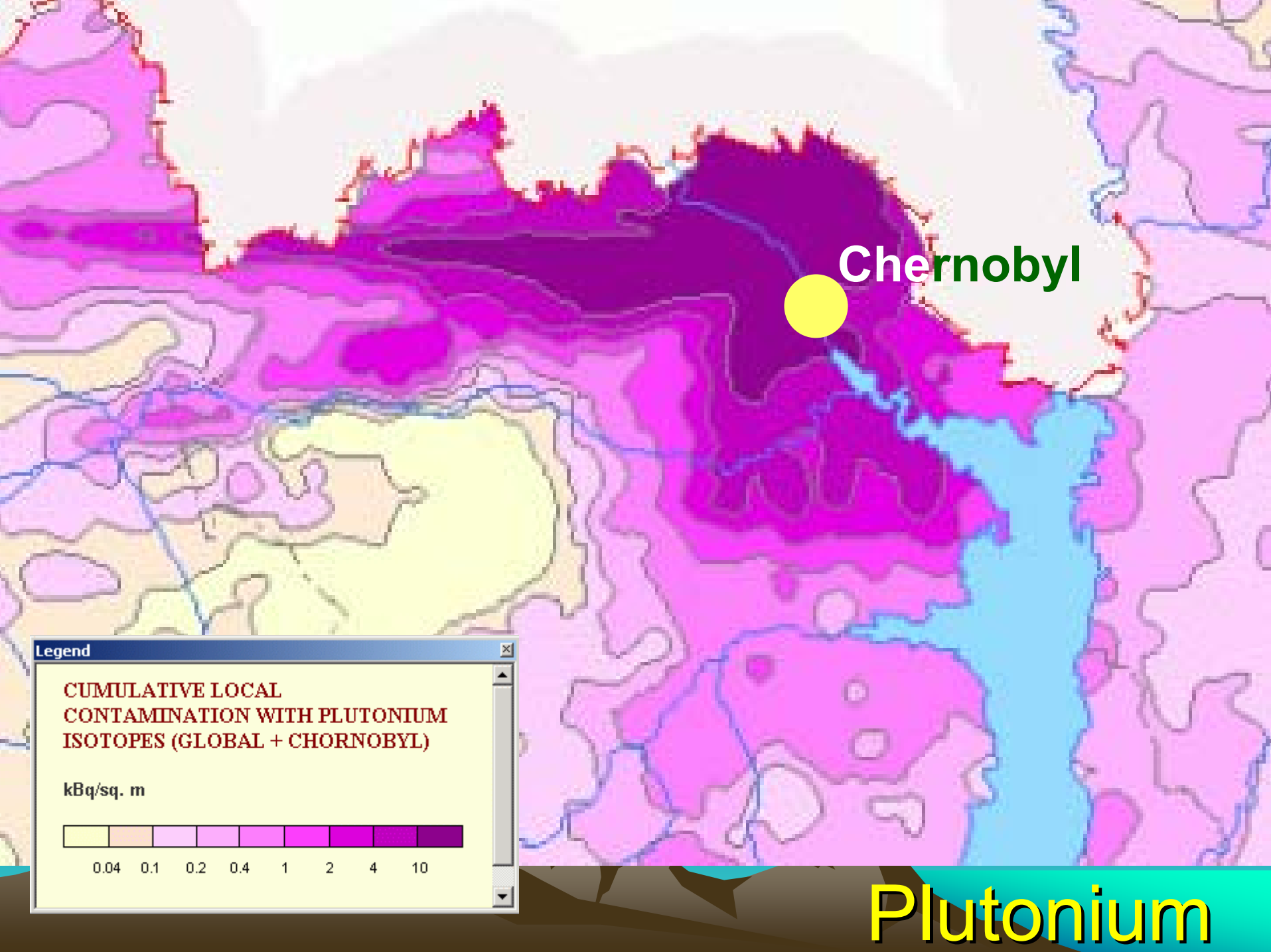






Environmental monitoring centers


Chornobyl
Legend
CUMULATIVE LOCAL CONTAMINATION WITH CESIUM-137 (GLOBAL + CHORNOBYL)
kBq/sq. m
1
2
4
10
20
40
100
185
555
1480
Cesium 137


Chernobyl
Legend
CUMULATIVE LOCAL
CONTAMINATION WITH PLUTONIUM
ISOTOPES (GLOBAL + CHORNOBYL)
kBq/sq. m
0.04
0.1
0.2
0.4
1
2
4
10
Plutonium

Exclusion zone

Slavutych

30 км

Specialized hospital № 5

Kiev

I C T M

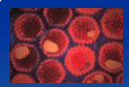
350 Children

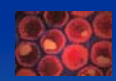
S T M C

Department of monitoring and prevention

Diagnostics Department

Department of medical and social examination





130 км

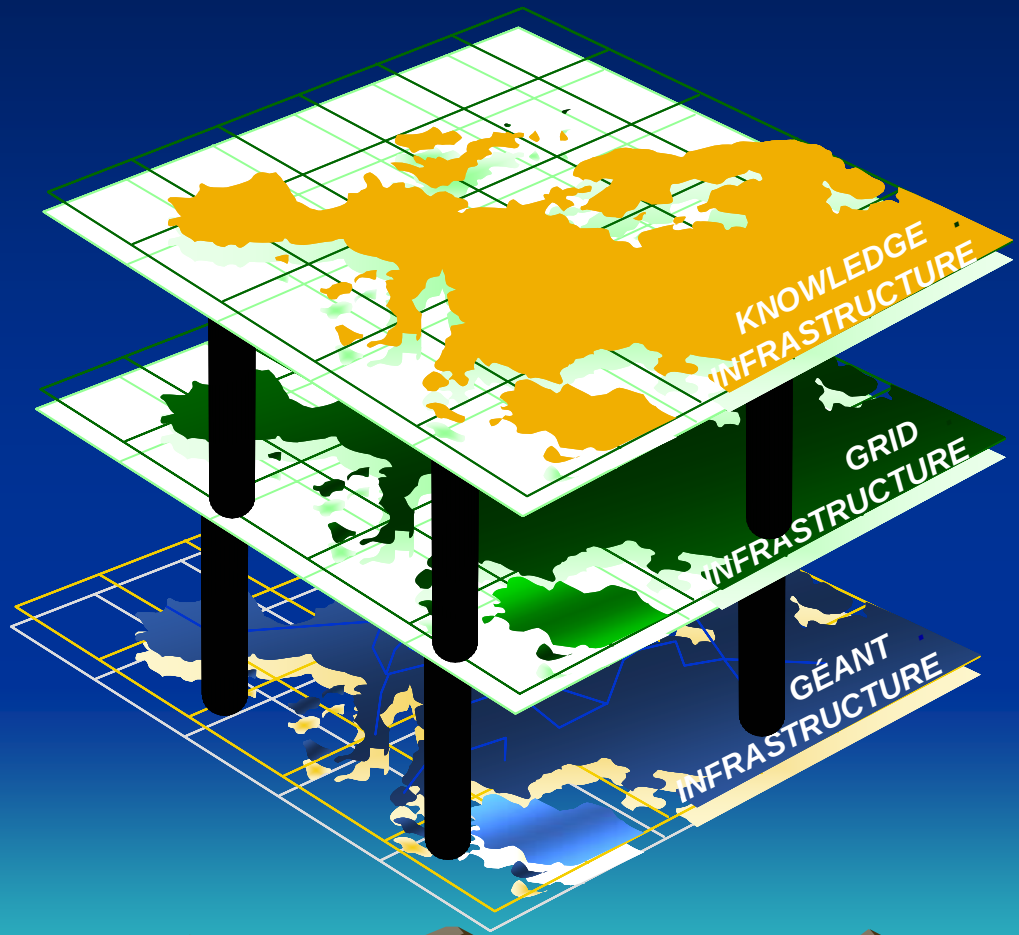
NTUU “KPI”

FP

caBIG pilot project

- New techniques in biomedical research create huge amounts of data greatly increasing the chance of scientific breakthroughs but making those advances difficult to achieve.
- The cancer Biomedical Informatics GRID Project is funded by the National Institutes of Health (USA) and helps scientists to accelarate progress in cancer prevention and treament by synthesizing standardising and analysing all that datd

GEANT and GRID in European knowledge infrastrusture



UGID will allow:

- Ensure the people's right of open access to important scientific and educational information.
- Solve the social problems connected with providing equal conditions for an access to education and science.
- Raise the efficiency of public administration of education and science.
- Promote Ukraine's integration into the global research and educational area.