ROSPACEGRID

ANNUAL REPORT 2008

project: “Romanian GRID middleware repository for Space Science Applications”,
Contract No 98050

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Bucharest • May, 2009

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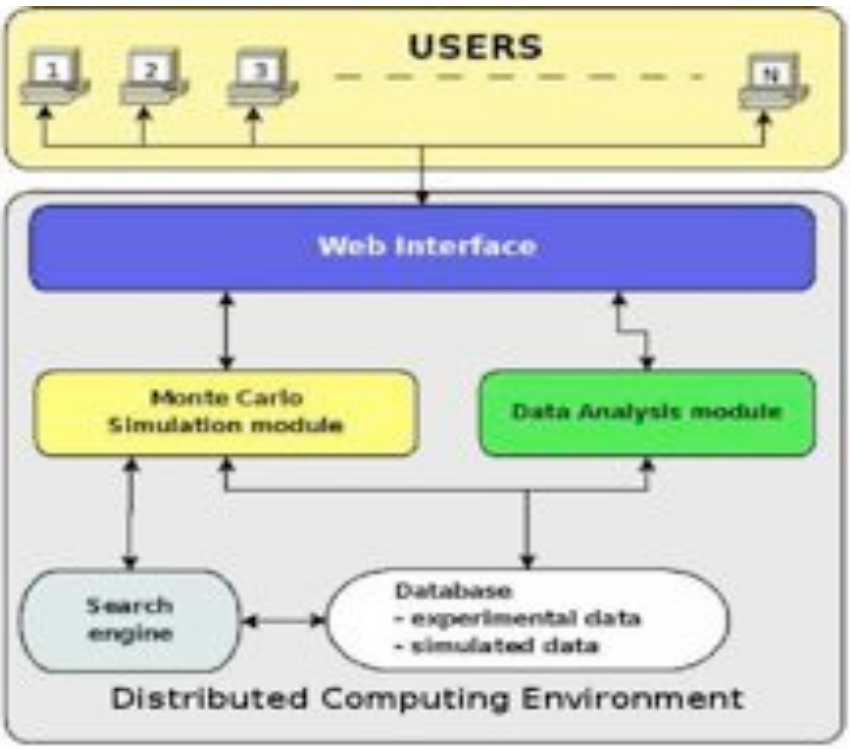
Technical objectives planned for the reporting period

Descriptions of the Work Package 2.

WP 2.a. Create Middleware

The middleware created is an integrated system for online Monte Carlo simulations in Space Science and High Energy Physics. Several Monte Carlo simulations codes are implemented: PYTHIA and HIJING accessed via a versatile and easy to use web interface. This system is structured in several basic modules, providing scalability. As a consequence of its accessibility and functionality, the system can be used as a powerful educational tool.



1. Introduction

During the last years, the increasing complexity of scientific experiments brought up the need of a new application that can handle differentMonte Carlo simulation codes. This application must facilitate its use both in scientific research, to obtain

descriptions as close of reality as possible of the natural phenomena, and in education, for making the students acquainted with advanced instruments for scientific research. In this paper we present an advanced integrated system, easy to use, with applications in science and education, system that will offer quick access to experimental data and their analysis.

2.*System Overview*

This system is structured in several basic modules for several reasons. First of all, a system composed of basic modules provides scalability. New features can be implemented without affecting the whole functionality of the system(i.e adding new simulation codes, new types of analysis, new features for the web interface, etc). First module ensures the system's web interface and the access to the other modules.

Another module is made of several Monte Carlo simulation codes. This module is a scalable one, allowing further addition of other codes. A third module contains analysis algorithms in order to obtain scientific results from simulated data or from experimental data. The last module has the necessary API for the management of the connections and data in databases: experimental data and simulated data. Due to the large hardware resources requirements that are specific to Monte Carlo simulation codes and the data analysis, the system is implemented in a distributed computing environment.

3. The Web Interface Module

First module will ensure the system's web interface, the access to the other modules and allows the logging of users at the same time. In order to develop this interface we used Open Source technologies as: GNU/Linux operating system[1], web file server Apache[2], the database runs the popular database server MySQL[3], and for the server-scripting part we used the script language PHP[4]. Using these technologies, the system benefits from an easy to use graphical interface and simultaneous connections from users, necessary prerequisite especially for proper e-learning conditions. For the user, the time spent to write a simulation or an analysis program is used to set the parameters of the simulation and of the data analysis.

Practically, the beginning of a simulation/data analysis will take place in a few minutes, the results being obtained faster.

According to the installed modules, the user has the possibility to choose between several types of monte carlo simulation codes and then make comparisons between the simulated data obtained and the experimental data provided by the Database and Search Engine module. Together with the
simulation, the system returns relevant documentation (articles, seminars, laboratories).

4. The Monte Carlo Module

The second module is made of several Monte Carlo simulation codes. The major advantage of the Monte Carlo simulation codes over other methods for solving the same problem (that is, analyticmethods that make use of algorithms) is their simple concept (they don't need to know the form of the solution or their analytical properties). Also, they are rather easy to implement on computers or on larger computing systems (parallel computing or distributed computing), mostly needing large computing power in order to obtain small errors - thousands to millions of numbers being needed to be simulated in order to obtain a significant result, the statistical error decreasing with the square root of the number of iterations.

We already implemented basic usage for PYTHIA[5] and HIJING[6] particle generators 2) but we intend to implement also transport simulation codes, mainly GEANT4[7] and FLUKA[8]. We are aware of the problems that will arise from using geometry applications with a web browser limited capabilities.

The main simulation codes that will be used are:

- PYTHIA - a standard simulation code for generating interactions of elementary particles at high energies,
- HIJING (Heavy Ion Jet INteraction Generator) - simulation code for heavy ion interactions
- GEANT a simulation framework for studying the interaction of elementary particles withmatter, used in nuclear physics, space sciences, chemistry, medicine,
-FLUKA - a simulator for particle physics used in experimental physics, study of cosmic radiation, dosimetry, medicine and radio-biology.

5. Database API and Search Engine

The last module has the necessary API(Application Programming Interface) for the management of the connections and of data in databases: experimental data and simulated data for comparative studies. This module allows the basic access of database, automatic management and indexing of data, for further data comparisons analysis's (called by the superior modules - the educational module or the analysis module). Due to the large hardware resources requirements that are specific to Monte Carlo simulation codes and to the fact that there will be many users running simultaneously the simulation codes and the data analysis, the system is implemented in a distributed computing network.

Conclusions

We presented a new tool that allows users to work with different monte carlo simulation codes in a fast and intuitive way. Although this system is flexible and we can add new features to the simulation and data analisys modules, we are aware that there is a limitation to the number and generality of system's features to satisfy all users. Another limitation this systemfaces are hardware resources (monte carlo algorithms are computing intensive). Because of this, the system will be a platform for developing educational applications for High Energy Physics and Space Sciences. This online monte carlo simulation and data analisys tool offers several key features for the users.

Basically the users don't need to install any software on a local machine(except a browser). Optionaly, users can download generated files and make offline analysis. Because users interact with the system through a web interface, they focus on phenomenology and not on developing the code for simulations/analysis. In other words, using the online documentation provided by the system you have quick access for different simulation parameters, experimental setups, or predefined analysis algorithms and users can create very fast custom simulations. Normally, if you want to make a simulation you have install and configure all the necessary libraries and applications. Further more, you have to search for the necessary documentation and then write your code. But this is no longer true if you use this type of system.

Future development of the system will include several new features. One of the most interesting feature that will be implemented is the posibility to work with transport particle simulation codes like GEANT4 with predefined geometries(specific to different experiments). The increasing complexity of astrophysics and high energy experiments will make this system to be more useful for the people new to these research fields.

References

[1] http://www.linux.org/

[2] http://www.apache.org/

[3] http://www.mysql.org/

[4] http://www.php.net/

[5] http://www.thep.lu.se/ torbjorn/Pythia.html

[6] http://www-nsdth.lbl.gov/ xnwang/hijing/index.html

[7] http://geant4.cern.ch/

[8] http://www.fluka.org/

[9] http://root.cern.ch

WP2.b.1. Hardware setup

The Data Center of Institute of Space Sciences migrated to the new room ICF (ISS Computing Facitily).

The room has 520 CPU computing elements and 25 TB storage elements. A part of them are dedicated to the ALICE Collaboration (http://alien.spacescience.ro). In this case, we had opportunity to test, deploy and run for space science applications.

ICF is in progress to be populated with computing elements and storage elements through ESA Office.

I will present a short descriptions of equipments:

CE Computing Element

Supermicro SYS-6015TW-TB TM

Equipment configuration:

- 4 x Intel Xeon Quad Core E5430

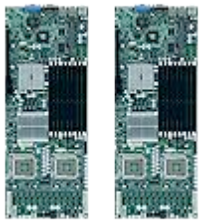
- Super X7DWT + Super X7DWT motherboard
- 16 x 2048 MB DDR2 FB-DIMM ECC
- 2 x 500 GB hdd
- SC808T-980V / 808T-980B case

Nr.	Products Tip	Specifications **Supermicro SYS-6015TW-T TM** **SUPERMICRO PROPRIETARY TRADE MARK**
1	**Processors**	**4 x** Intel® Xeon™ Quad Core **E5430 2.66GHz** Processor with 12MB L2 Cache 1333MHz 80W
2	**Chassis**	**Form Factor: 1U**, rackmountable/ Supports 2 proprietary 16" x 6.5 " (40.6cm x 16.5cm) motherboards **Model: SC808T-980V** (B)
3	**Dimensions**	27.75" (705 mm) Depth 1.7" (43mm) Height/ 17.2" (437mm) Width
4	**Mounting Rails**	Compatibil rack 19'"CSE-PT51L (1U Mounting Rail Kit)
5	**Processor/Cache (per Node)**	Dual 771-pin LGA Sockets Supports up to two Intel® 64-bit Xeon®processor(s) of the same type below: Quad-Core Intel®Xeon®Processor 5400/5300 sequence (Harpetown/ Clovertown processor) up to 3.20 GHz System Bus: 1600/ 1333 / 1066 MHz system bus
7	**Memory Capacity (RAM)**	**32 GB 667 FB-DIMM ECC DDR2 SDRAM 72-bit, 240 pin gold-plated DIMMS** **16 x 2 GB** DDR2 module DDR2 667 Mhz ECC FB Memory 72-bit, 240-pin gold-plated DIMMs Corrects single-bit errors/ Detects double-bit errors (using ECC memory) / Supports Intel® x4 and x8 Single Device Data Correc-tion (SDDC)
8	**Power Supply**	980W AC-DC power supply /AC Voltaj : 100-240 V, 60-50 Hz

9	**On-Board Devices (per Node)**	**Super X7DWT - Supermicro Proprietary** - Intel® 5400 (Seaburg) chipset / ESB2 6-Phase-switching voltage regulator with auto-sense from 0.8375V-1.60V 6x Cooling Fans -8 sloturi memorii/ DDR2 ECC FB-Dim up to 64 GB Memory - FSB 1600/ 1333/1066/667 SYSTEM BUS - 2 x Dual 771-pin LGA Sockets - 4x Hot-swap SATA 2 Drive Bays - 2Intel® (ESB2/Gilgal) 82563EB Dual-Port Gigabit Ethernet Controller - Enhanced Intel Speedstep Technology, - Intel Virtualization Technology, - RAID 0, 1, 5, 10 suport Windows/RAID 0, 1, 10 Linux, - 1 1 (x16) PCI-e Generation II slot - 4 USB 2.0 Compliant - clock generator CK410B - Intel® I/OAT support for fast, scaleable, and reliable networking/ Winbond 83627HF chip - 1 Fast UART 16550 serial port / 2 x RJ45 output - 8x fans with tachometer status monitoring - Status monitor for speed control - Monitoring for CPU and chassis environment - PSU I^2C temperature sensing logic
10	**Network Controller (per Node)**	Intel® (ESB2/Gilgal) 82563EB Dual-Port Gigabit Ethernet Controller Supports 10BASE-T, 100BASE-TX, and 1000BASE-T, RJ45 output Intel® I/OAT support for fast, scaleable, and reliable networking
11	**Graphics (per Node)**	ATI ES1000 controller with 32 MB of video memory
12	**Hard-disks (per Server)**	**2x500** GB Hdd WD 7200 rpm/ WD RE3 3GB/s 4 x 3,5” Hot-swap SATA Drive Bays
13	**USB ports (per Server)**	4x USB rear ports/ USB 2.0 Compliant 4x USB internal headers

14	**Software com-patibility**	**Linux 32 bit / 64 bit** **Other operating system compatibility**: MS Win 2000 Advanced Server + SP4, MS Win XP Pro + SP2(x64), MS Win 2003 Server Enterprise Edition(x64), Redhat Linux ES 3 (Update 7/8), Redhat Linux ES 4 (Update 2/3/4), SuSE Linux 10/10.1, SLES 10, Red-Hat Linux 3 (Update 8) x64, RedHat Linux 4 (Update 2/3/4) x64, SuSE Linux 10 x64,
15	**Power Supply**	PWS-981-1S/ 980W 1U Cold Swap 12V high eficiency Power : 100-240 V, 60-50 Hz, 14-6 Amp
16	**Keyboard & mouse**	Not included
17	**Case**	**SC808T-980V** (B), **Supermicro Proprietary** 1U, RACKMOUNT, black
18	**Warranty**	**60 months**

Physical Views of CE

Supermicro SYS-6015TW-TB	
Case SM 808T	
Motherboard Super X7DWT + Super X7DWT	

2	**APC Smart-UPS RT 6000VA RM 230V**	
 	APC smart UPS RT, Rack mounting support 3U Output power capacity 4200Watts/ 6000 VA, Nominal voltaje 230 V, Efficiency at full load 92% Output connections 8 IEC 320 C13 backup + 2 IEC C320 C19, Typical recharge time: 2,5 hours Interface port DB-9 RS-232/ RJ-45 10/100 Base-T, Smart Slot Audible alarm distinctive low battery alarm Tipycal backup time: 15.8 minutes (2100 Watts), 5.3 minutes (4200 Watts) Filtering Full time multi-pole noise filtering 0,3% IEEE surge let-throught Web/SNMP Management card Regulatory approvals: C-tick, CE, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60650, en 61002, GOST, VDE Dimensions: 130x432x660 mm height x width x depth Net weight: 54.55kg **Warranty 2 years**	

3	**HP ProCurve Switch 2810 48G**	
	HP ProCurve rackmounting Switch 1U , J9022A 44 10/100/1000 ports (IEEE 802.3 Type 10Base-T, IEEE 802.3u Type 100Base-TX, IEEE 802.3ab 1000Base-T Gigabit Ethernet); 1 RJ-45 serial console port; 4 dual-personality ports - each port can be used as either an RJ-45 10/100/1000 port (IEEE 802.3 Type 10Base-T, IEEE 802.3u Type 100Base-TX, IEEE 802.3ab 1000Base-T Gigabit Ethernet) or an open mini-GBIC slot (for use with mini-GBIC transceivers), Switching capacity 86 Gbps, Mac address table size 8000 entries Memory and processor MIPS 264 Mhz, 16 MB flash, 64 MB sdram, packet buffer size 1,5 MB Management HP ProCurve Manager Plus, command line interface, web browser, configuration menu: out-of-band management Network management IEEE 802.1AB link layer discovery protocol (LLDP) RFC 2819 four groups of RMON/ RFC 3176 sFlow/ SNMPv1/v2/v3 Voltaje 100-127 VAC/ 200-240VAC/ Current 1,5 A Maximum power rating 92W Regulatory approvals: C-tick, CE, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60650, en 61002, GOST, VDE Net weight: 3,9kg **Warranty 3 years**	

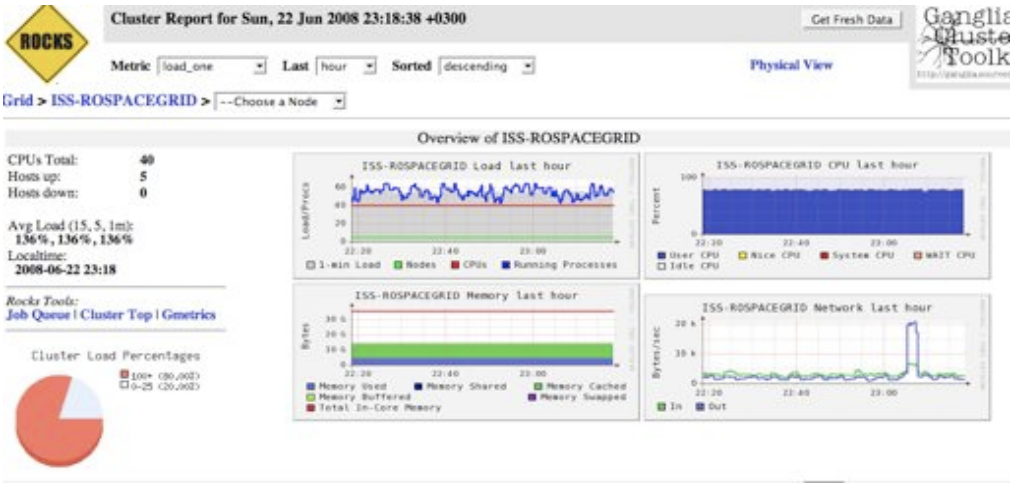
I started the procedure to launch the procurement. ESA sent the Purchase Order N. P109013 /20/04/2009 to the supplier.
The devices will be delivered around 13-14 may 2009.

Financial Summary of the Equipment purchased via PECS Office

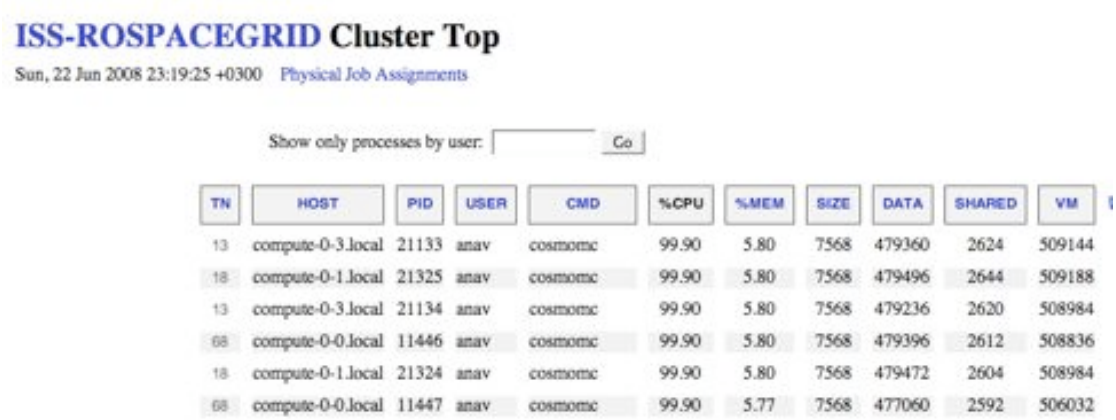
No	Products	No items	Price per item(EURO)	Total price (EURO)
1	CE Computing Element Supermicro SYS-6015TW-TB TM	20	7180	143600
2	APC Smart-UPS RT 6000VA RM 230V	3	2894	8682
3	HP ProCurve Switch 2810 48G	2	1988	3976
Total cost without VAT	156258			

WP2b2. Software setup:

The Operating System for cluster is Rocks Clusters 4.3 (Red Hat Enterprise flavor). The registered site http://rospacegrid.spacescience.ro is frontend of the GRID cluster



RoSpaceGRID Front-End



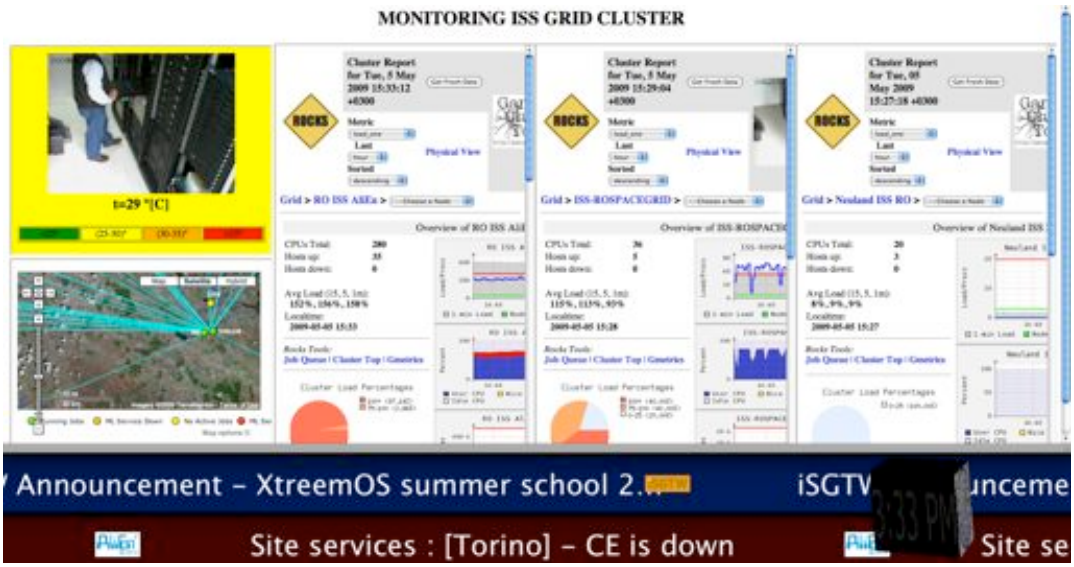
TN	HOST	PID	USER	CMD	%CPU	%MEM	SIZE	DATA	SHARED	VM
13	compute-0-3.local	21133	anav	cosmomc	99.90	5.80	7568	479360	2624	509144
18	compute-0-1.local	21325	anav	cosmomc	99.90	5.80	7568	479496	2644	509188
13	compute-0-3.local	21134	anav	cosmomc	99.90	5.80	7568	479236	2620	508984
68	compute-0-0.local	11446	anav	cosmomc	99.90	5.80	7568	479396	2612	508836
18	compute-0-1.local	21324	anav	cosmomc	99.90	5.80	7568	479472	2604	508984
68	compute-0-0.local	11447	anav	cosmomc	99.90	5.77	7568	477060	2592	506032

Workload on RoSpaceGRID

Monitoring Tools

We create and integrate specific tools to monitoring the cluster and GRID activities. We touch few software flavors. All of them are open source software and middle-ware.

One of them is EMIS (Extended Monitoring and Information System)



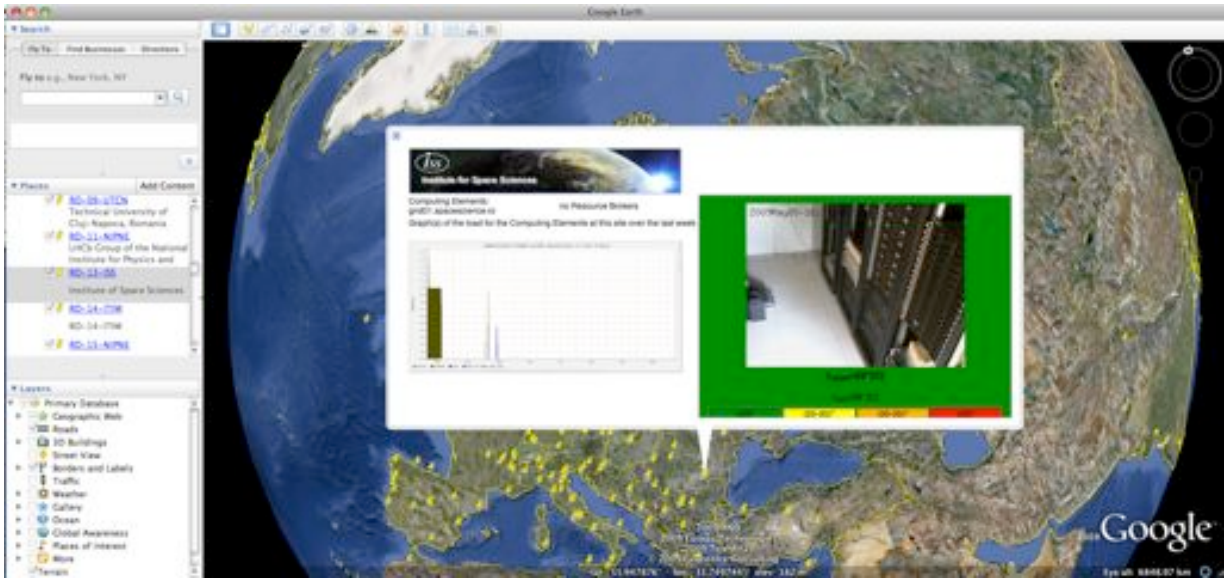
i) EMIS offers the following informations:

- monitoring local clusters frontends: alien.spacescience.ro, rospacegrid.spacescience.ro, neuland.spacescience.ro;
- monitoring in real time the Data Center from ICF (ISS Computing Facility);
- crawling rss news feed GRID related;

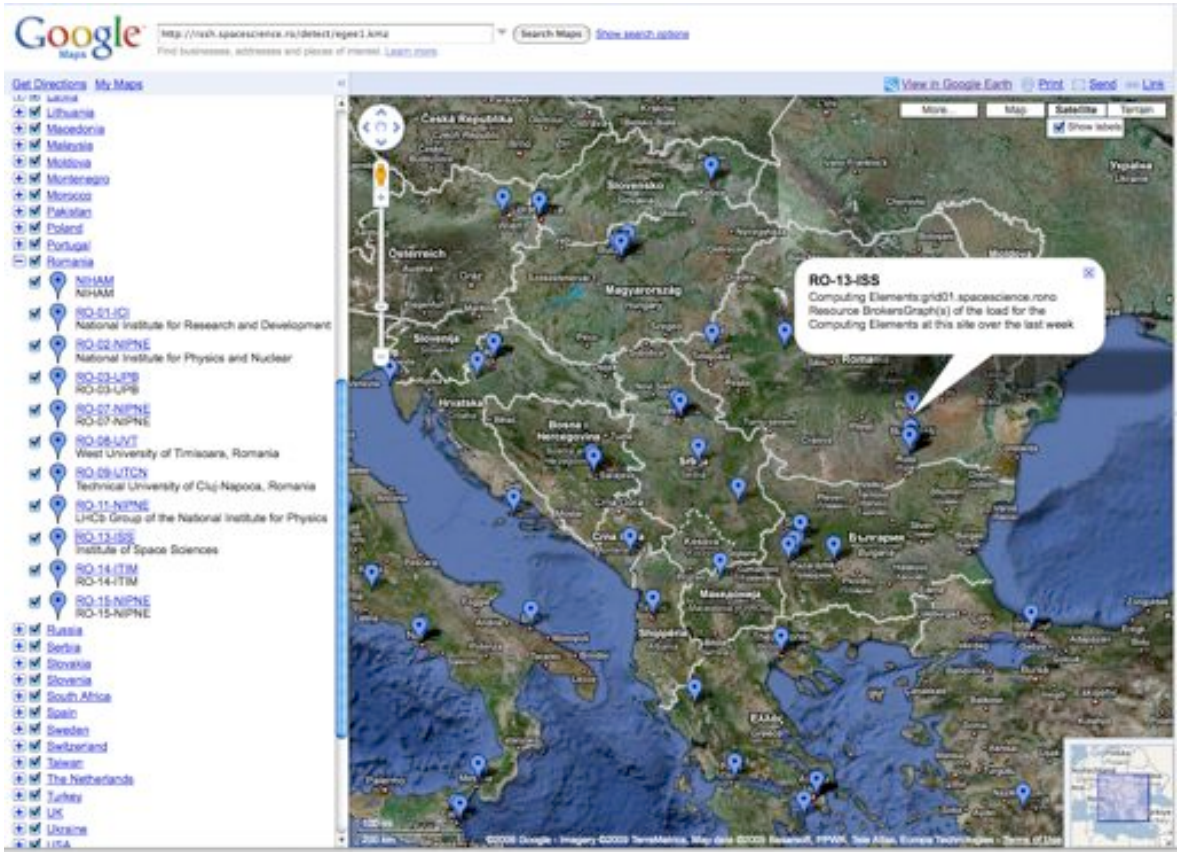
ii) GMIS (Google Monitoring and Information System)

GMIS is KML oriented application. KML is a file format used to display geographic data in an Earth browser such as Google Earth, Google Maps, and Google Maps for mobile. KML uses a tag-based structure with nested elements and attributes and is based on the XML standard.

GMIS is avaible for Google Earth and Google Maps, aslo.



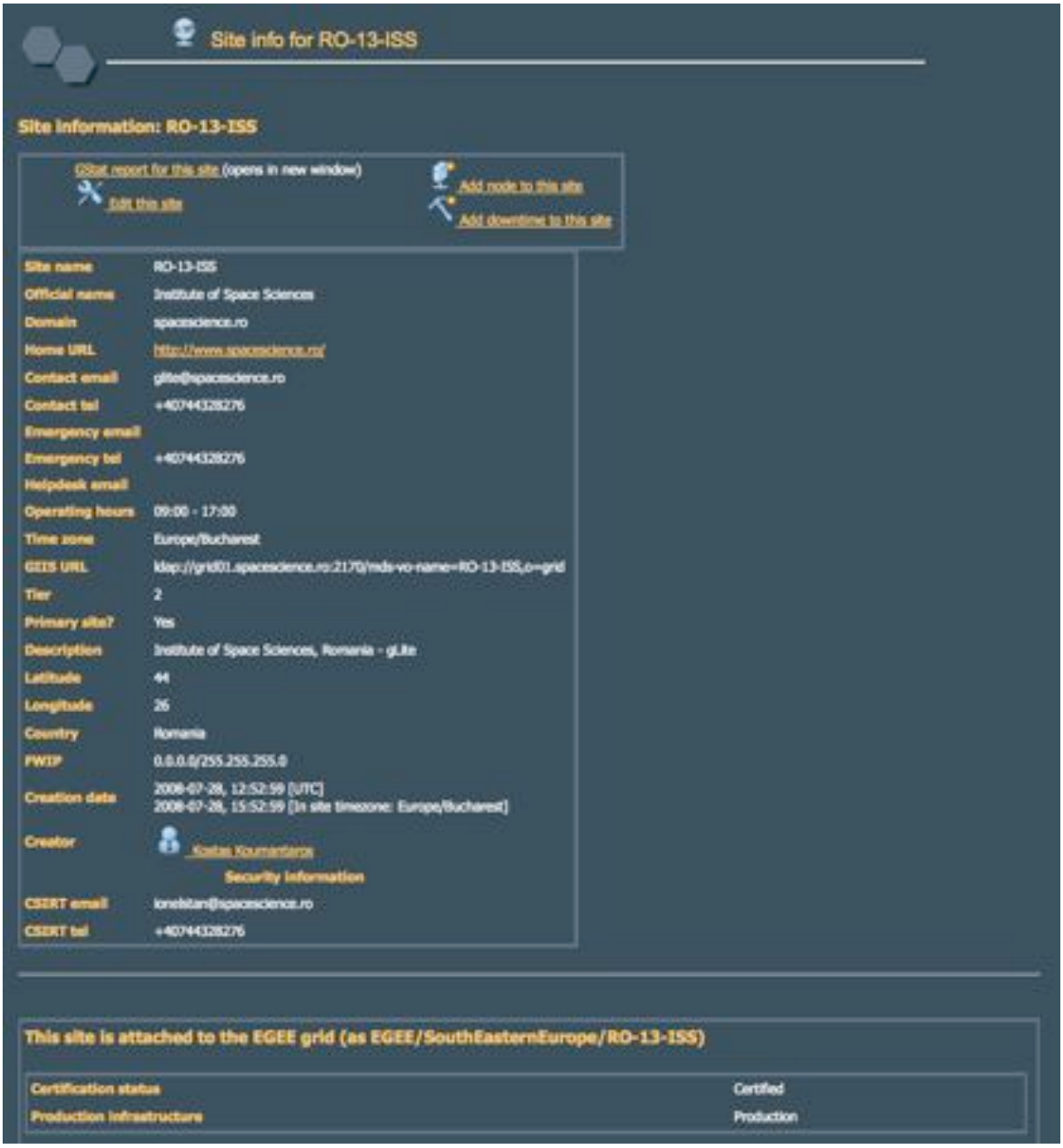
GMIS in Google Earth



GMIS in Google Maps

WP2b3. RoSpaceGRID site in EGEE infrastructure

The site RoSpaceGRID is certificated in EGEE infrastructure since 01 february 2009.



In present RO-13-ISS is member in OPS,DTEAM and ALICE VOs.

We are in contact with Claudio Vuerli from Istituto Nazionale di Astrofisica (INAF) Osservatorio Astronomico di Trieste, to configure our site to become VOBox in PLANCK VO.

Snapshot of the ICF (ISS Computing Facility)

Results achieved

The main results of the WP2 are training of the team to use the hardware and software (middleware) and to offer support to interested physics groups(Plack-ESA Mission) . We obtained a near 100% uptime.

As a by-product, team's activity contributed to the results:

1. Zgura I.S., Stanciu Al. Stan I. Banaru O. Sevcenco, A., Niculescu, M., "Management methods of data using GRID infrastructures based on digital certification technologies", ACAT 2008, XII International Workshop on Advanced Computing and Analysis Techniques in Physics Research, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Sicily, November 3-7, 2008
2. Jipa Al., Sevcenco A., Zgura S.I., Mitu C.M., Niculescu M., "Advanced online system for data analysis and Monte-Carlo simulations in High Energy Physics", ACAT 2008, XII International Workshop on Advanced Computing and Analysis Techniques in Physics Research, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Sicily, November 3-7, 2008
3. Zgura I.S., "RoSpaceGRID eInfrastructure", South East European Research Area for eInfrastructures, GRNET, Athens, Greece, 9.04.2009-10.04.200

Changes proposed for the next period

At this time the is no need to change the initial master plan of the WP3

Financial balance of the project against planned budget

	Institute cost	2007		2008		2008-2009
		Planned Jan-Dec (EURO)	Actual Jan-Dec (EURO)	Planned Jan-Sept (EURO)	Actual Jan-Sept (EURO)	Actual Oct 2008- Feb 2009 (EURO)
1	Salaries	102000.00	98750.15	102000.00	76500.00	42000
2	Consum-ables	15000.00	4456.09	10000.00	5308.65	6000
3	Travel	3000.00	0.00	10000.00	1847.60	8400
4	overhead	17550.00	17550.00	16800.00	12600.00	7100
	Subtotal	137550.00	120756.2	138800.00	96256.25	64000

Total:

Total ex-penses:	217012.49	EURO	281012.49
Advance payment	133152.00	EURO	