Grid, Cloud & High Performance Computing in Science (ROLCG)
28–30 October 2015
Cluj-Napoca, Romania

Milestones of complex computing facility assembling

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ROLCG 2012 :
5th Romania Tiier 2 Federation Grid, Cloud & High Performance Computing Science

When Oct 25, 2012 - Oct 27, 2012
Where Cluj-Napoca, Romania

University of Latvia biggest in Baltic States:
In the academic year 2014/ 2015, the total number of students enrolled at the University of Latvia (UL) comprises 17,790

Institute of Mathematics and Computer Science,
Non profit research organization
established by University of Latvia

Staff ~ 200
Turnover 4 – 5 MEUR/year

Main research fields in IMCS are:

- *Computer Science*
  - Mathematical foundations of computer science
  - Complex systems modeling languages and development tools
  - Graph theory and visual information processing
  - Semantic web technologies
  - Real time systems, embedded systems
  - Computational linguistics
  - Bioinformatics
- *Mathematics*
  - Mathematical modeling for technologies and natural sciences
  - Theoretical problems of mathematical methods .
- *State delegated resposibility*
  - CERT.lv
  - National domain name .lv management .

IMCS UL International research projects 2014, 2015.

- Share-PSI 2.0 (Shared Standards for Open Data and Public Sector Information, Nr.621012);
- DEWI (Dependable Embedded Wireless Infrastructure, Nr.621353);
- R5-COP (Reconfigurable ROS-based Resilient Reasoning Robotic Cooperating Systems, Nr.621447) (ARTEMIS kopīgā tehnoloģiskā ierosmes projekts).
- EEZ projekts:"Latvian language in monolingual and bilingual acquisition: tools, theories and applications"
- EGI-InSPIRE (Integrated Sustainable Pan-European Infrastructure for Researchers in Europe – RI, Nr. 261323);
- GN3+ (Multi-gigabit European Research and Education Network and Associated Services Gn3plus, Nr. 605243);
- SmartOpendata (Linked Open Data for environment protection in Smart Regions, Nr.603824).
- CAGEKID (Cancer Genomics of the Kidney, Nr. 241669);
- EEZ projekts: Nr. NOR-R-PV/2013/004 "Metožu un rīku izstrāde biomedicīnas datu apstrādei un analīzei"
- GEANT 2020
- Software for Real Time Application, Telos Group Ltd.

Main international research partners

- European Bioinformatics institute (UK)
- University of Gothenburg (Sweden)
- NATO Cooperative Cyber Defence Centre of Excellence (https://ccdcoe.org/)
- European Union Agency for Network and Information Security (ENISA)
- Lithuanian Cybercrime Center of Excellence for Training, Research and Education (L3CE)
- Warsaw University of Technology (Poland)
- GÉANT Association
- Telos Group Ltd.(US)
- ARTEMIS JU

Project
about witch management we are speaking

Project:
Research infrastructure Development project that meet IMCS research development needs 3 385 000Euro

Main complexity of the project –

upgrade of 2008 year Cloud computing facility, including
- architectural design,
- selection of components from e-Catalogue,
- purchasing and installation.

The most complicated task in project management-
procurement procedures implementation

Our experience, solutions, conclusions as computer scientists and project managers

Scientific cloud services

Built as **cloud computing** system
(OpenStack + custom innovations
2 level hypervisors: VMs and containers):

Provides 3 most common cloud services:

- ✓**IaaS** – Linux or Windows virtual machines w/ choice of resource and access configurations
- ✓**PaaS** – SQL, HTTP, Hadoop
- ✓**Storage and File services** – FTP/FTPS and online NFS services, ownCloud

More services:

- ✓MaaS
- ✓High Throughput Computing (HTC)
- ✓GPU/SMP computing

Big Data services

- ✓**HDFS** distributed filesystem
- ✓**MapReduce** distributed computing service
- ✓**Hive** data warehouse and HiveQL query engine
- ✓**Oozie** job scheduling service

National users –
Users from more than 10 research institutions (universities), Latvia University, Riga Technical University, IMCS UL , Irbene radiotelescope data processing

Roles:

- User requirements
  according to needs in international projects,
- Achieve project results and

Also

- test and promote system,
- attract and train users,
- introducing new services

VO:

Bioinformatics,
natural language processing,
organic synthesis,
physics,
material science,
space,
mathematical modeling

Scientific Cloud Project 2008

SAN network
Redundant FC paths, 6 controllers, 624 SATA + 16 FC disks
468 TB storage (IBM DS 4700)
384 GB RAM (8*48)
64 Xeon cores (8xIBM x3650, Intel E5430)

Scientific Cloud Project realization in 2015

Much more powerful computing

Virtualization area

✦**Virtualization**

- 720 Xeon cores (45xHP Proliant DL380 gen9, 2*8cores Intel E5-2630 v.3, 256GB), 12TB RAM
- 4*HP Blade c7000 Platinum 16*BL460c gen9 2*10cores Intel E5-2660 v3 256GB)

✦**10/40GE low latency core networking**

- each server: 2x10GE SFP+ access to swhitch, 1Gbps management net
- each storage Cluster 2X 10 GE SFP+ , mutually 8Gbps FC
- 3XHP 5900AF-48XG, mutually 40GE QSFP

Area backbone 40/10 Gps

✦ **Maintenance switching and Campus connectivity**

- HP 1910 10/100/1000Base-T
- HP 5406 zl 10G SFP+, 1G-T

✦**Storage** (data archive, space data streaming, Big Data pre-processing, Data Backup + Scientific Cloud 2008) ...)

- 1.1PB IBM Storwize V7000 v7.3 , cluster with 2 nodes, Real Time Compression – up to 1.8x, SSD tiered (30%)
- IBM Flash V9000 32TB

Storage 1.1 PTB with Flash

✦**HPC, Info Graphics, Analytics, graphics on picture processing**

- In Memory Computing 2X (HP Proliant DL380 gen9, Intel E5-2630 v.3, 768GB RAM)
- 2X (HP Proliant DL380 gen9, Intel E5-2630 v.3, 256GB, 2X Intel Xeon Phi5110P Coprocessor+ GPU, HP, Graphics)
- 2X (HP Proliant DL380 gen9, Intel E5-2630 v.3, 256GB, 2X NVIDIA Tesla K40C 12GB Computational Accelerator+ GPU, HP, Graphics)

HPC and in Memory computing

✦**Research groups outside computing**

- 3X (IBM System x3650 M4 (Intel Xeon E5-2680, DDR3 256, SAS 900GB 6Gbps)
- HP Store Easy 1450 Storage
- 2X Supermicro SuperStorage Server 5018A-AR12L, 32GB, 12X5TB
- 3X iMAC 27” Retina 5K QC i5 3.5GHz/8GB/1TB
- 5X Mac Pro 2.7GHz 12-Core Intel Xeon/64GB/1TB Flash
- 6X iMAC 27” Retina 5K QC i7 4GHz/32GB/SSD1TB
- 14*Workstation HP Z1 G2
- 2*Alto X23 Intel i7-5820K 32GB DDR4 Video 12GB GDDR5 3072 CUDA

Outdoor computing in research laboratories

Procurement in project managament (*requirements in EU)*

◆ Critical path in project management

Procuring goods and services from external suppliers can be a critical path for many government institutional projects as well as state research institutions In EU and in Latvia as Member state of EU Directive 2014/24/EU on public Procurement.

◆ Change time to time

Procurement methods and legislation change time to time, now Fifth generation Directives on Public Procurement, Utilities Procurement and Concessions adopted by the European Council on 11 February 2014.The EU Member States (Latvia) have until April 2016 to transpose the new rules into their national laws, except with regard to e-procurement, where the deadline is September 2018. The new Directives make the use of e-procurement progressively mandatory in time to 2018

◆ Specification of needed goods

Traditionally General specification (full procurement document package) for Procurement is written in natural language and consists of draft contract, technical requirements for goods (hardware, software, third partner services), pricing requirements, technical specification of goods.

◆ Maximum widespread of open market

Technical parameters of goods in general specification must guarantee maximum openness for market, maximum possible contractors must be involved in procurement process. These technical parameters must retain customer obligatory requirements that mean, that technical parameters in general specification must be maximum widespread.

E-procurement

E-procurement means to conduct public procurement electronically.

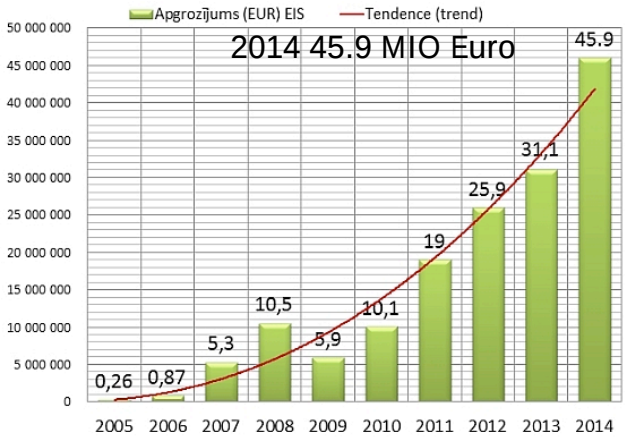
- E-Procurement contains several methods
  - Techniques and instruments for electronic and aggregated procurement;
  - Framework agreements;
  - Dynamic purchasing systems;
  - Electronic auctions;
  - Electronic catalogues (e-Catalogues);
  - Centralized purchasing activities and central purchasing bodies;
  - Occasional joint procurement;
  - Procurement involving contracting authorities from different EU Member States.
- In Latvia e-catalogue (e-procurement) starts from 2005
- We consider e-Catalogue Procurement method as very perspective in future.

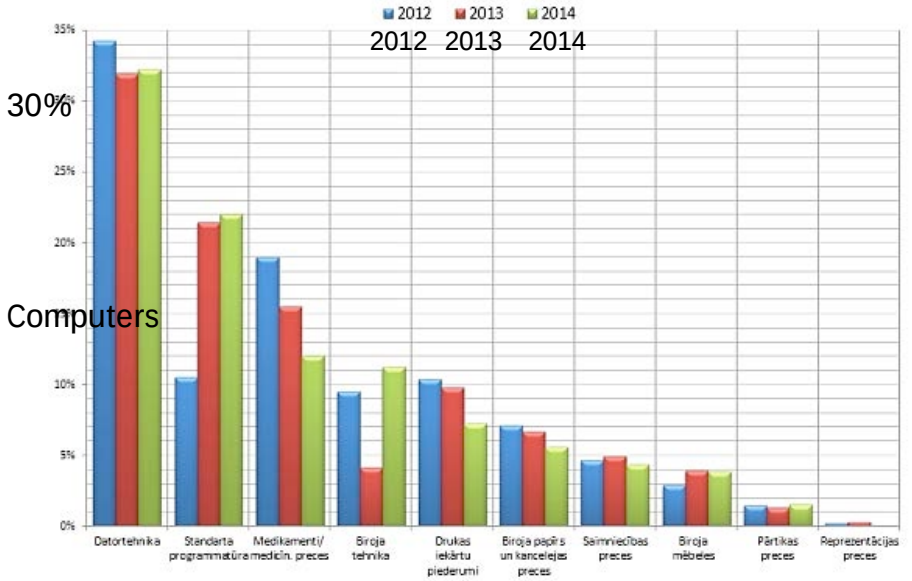
We must choose one of procurement legal method in Latvia today:

- traditional procurement procedure based on general specification;
- e-Catalogue system.

E-Catalogue in Latvia

- Content of e-Catalogue is fulfilled by State Regional Development Agency based on traditional procurement process separately for every group of goods, for example, servers.
- Such Procurement process is renewed annually.
- In this Procurement phase rules of equivalent goods are defined, for example, manufacturer of product can be changed during auction.
- Use of e-Catalogue





Situation in Latvia

◆ Traditional Procurement proces

Supervised by
Procurement Monitoring Bureau (PMB)

Disputation under civil law (Cort)

Client

Procurement procedure

Signed contract

Contract settlment

Delay based on Complaint up to 1.5 Year

Procurement, purchasing and use of goods in time

Problems ,for example,
Complaint in PMB or followed cort- won competitor

Complaint for not suitable goods or services

◆ E-Procurement (e-Catague) proces

Supervised by State Regional Development agency

No Delay of Procurement

Disputation under civil law (Cort)

Client

Use of e-Catalogue

E-Contract

Purchasing of goods

Receipt of Goods

Use of Goods

Procurement, purchasing and supply in time

Complaint only in Sate Audit Office
about strange behaviour of Client

Results

Procurement way for our Cloud Computing Facility set up

- It is not possible to find in e-Catalogue goods with exact compliance to goods described in the general specification.
- General specification of traditional procurement method must be split in more additional purchasing steps which are necessary.
- Required goods must be assembled from separately purchased goods.
- Finally we must add complimentary traditional procurement step without use of e-Catalogue for remaining part of required technologies.

- Latvian e-Catalogue system is very simple, structured Meta data are not defined and formal analyzing methods are not used.
- Purchasing process of gods is strictly controlled according realized model in the e-Catalogue system.
- E-Catalogue process includes Auction Phase. 5-7 companies usually participate in the Auction and the Auction process is done electronically and duration time is approximately 15-30 minutes. The best result – we have received discount ≈50% from fixed price

Project realization step by step

STEP 1 STORAGE

1.1PB IBM Storwize V7000 v7.3 , cluster with 2 nodes, Real Time Compression

STEP 2 VIRTUALIZATION AREA

720 Xeon cores (45xHP Proliant DL380 gen9, 2*8cores Intel E5-2630 v.3, 256GB), 12TB RAM

STEP 3 10/40GE low latency core networking

3XHP 5900AF-48XG

STEP 4 Maintenance switching and Campus connectivity

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STEP 5 HPC, Info Graphics, Analytics, graphics un picture processing

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STEP 7 Virtualization

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STEP 8 Storage

- IBM Flash V9000 32TB

Additional tools for procurement in EU

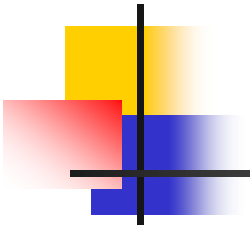
To support procurement process many tools are developed for customers, government audit institutions, controlled procurement management process, for open market participants:

- portals in EU (TED (Tenders Electronic Daily), e-Certis, ...);
- E-Procurement support tools, e-Catalogues;
- search engines and linked data technologies based tools,
- semantic web formal methods;
- structured data, data structure standardization, data interoperability,
- specific specifications language, multilingual processing tools.

Conclusions

Procuring goods and services can be a critical path for many projects. E-Catalogue method reduces half of purchasing time.

- Utilizing simple e-Catalogue procurement system is possible to assemble and set up modern complicated computer facility of Scientific Cloud.
- Use of e-Catalogue procurement system need deeper technical competence from contracting authority as traditional Procurement method.
- Centralized (EU) vs decentralized (national) procure process management system is under discussion. We appoint two benefits from our situation (national): 1) we receive high price discounts 2) important is contract fulfillment – locally is easily to control.
- Linked data technologies and formal procurement methods may be used for single EU market, nationally have no practical needs.
- Compatibility of computing components from various manufacturers is main technical problem for assembling Scientific Cloud Facility from purchased technologies.



Thanks for your attention!

Questions?