IMI ASM & RENAM & USM

National, regional and European Grid infrastructures; participation of Moldova in EGI-Inspire project

www.math.md

www.renam.md

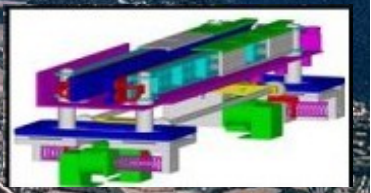
Nicolai Iliuha, Petru Bogatencov

e-infrastructure

CERN. LHC - the Large Hadron Collider
4 Detectors

CMS

LHCb

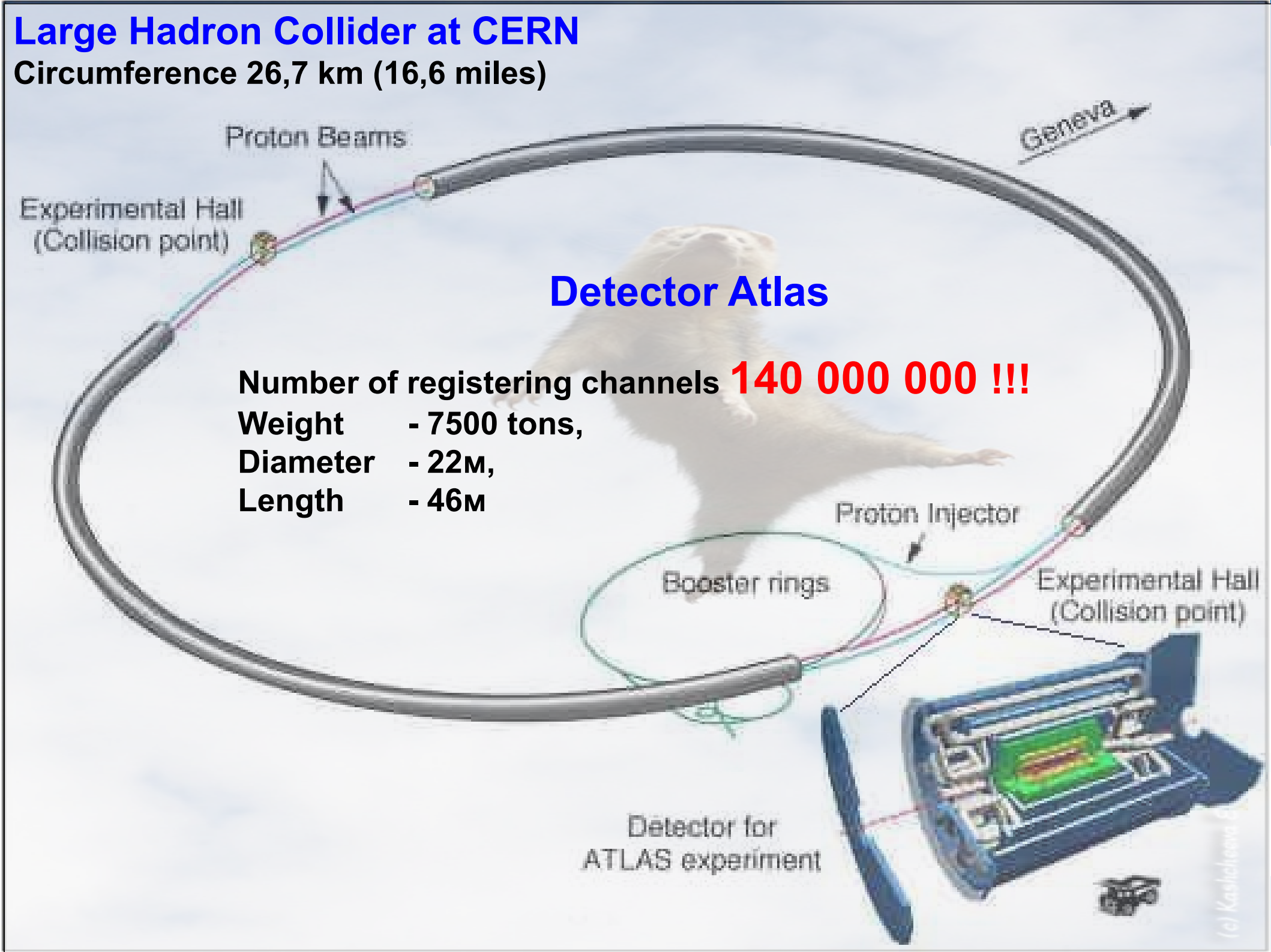


Alice

Atlas

Large Hadron Collider at CERN

Circumference 26,7 km (16,6 miles)



Detector Atlas

Number of registering channels 140 000 000 !!!

Weight - 7500 tons,

Diameter - 22м,

Length - 46м

Trigger / data acquisition (DAQ) architecture

CERN Computer Center

SDX1 dual-CPU nodes

6 ~1800 ~100 ~ 500

Event rate ~ 200 Hz

Data storage

Local Storage SubFarm Outputs **SFO**s

Event Filter (EF)

Event Builder SubFarm Inputs (**SFI**s)

LVL2 farm

Second-level trigger

DataFlow Manager

Network switches

pROS stores LVL2 output

Network switches

LVL2 Super-visor

Requested event data

Event data requests

Delete commands

Gigabit Etherne

Regions Of Interest

USA15

~150 PCs

1600 Read-Out Links

Data of events accepted by first-level trigger

VME

Dedicated links

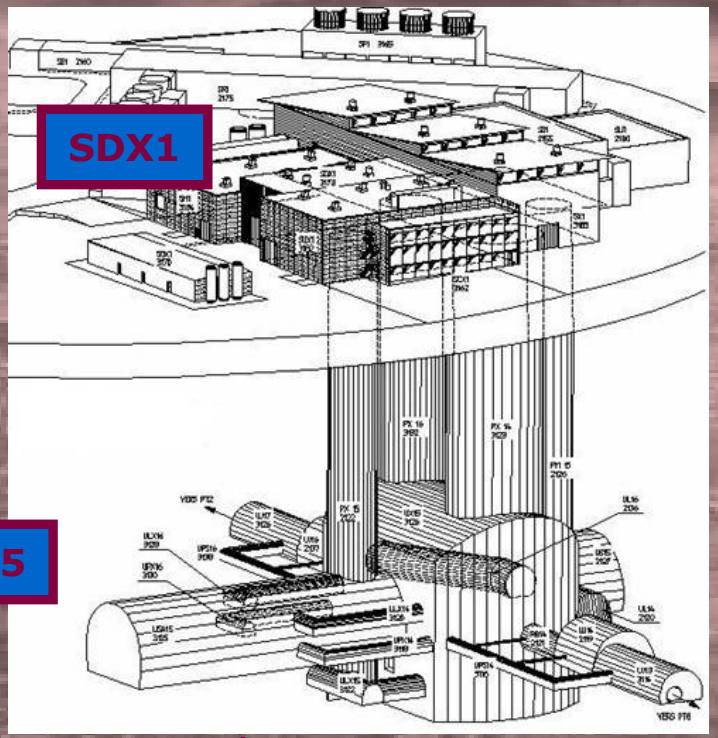
Read-Out Subsystems **ROS**

Read-Out Drivers **ROD**s

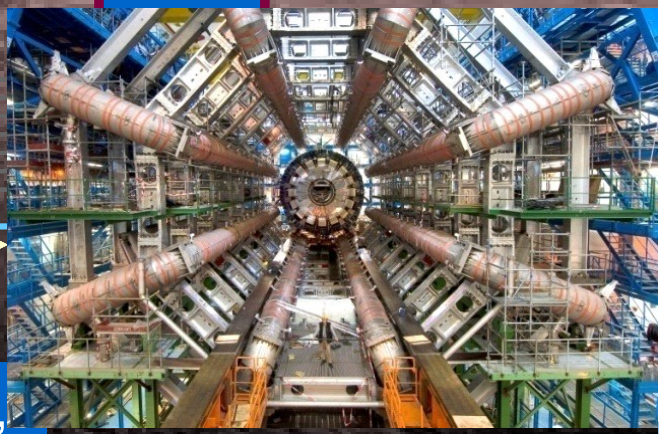
RoI Builder

First-level trigger

Timing Trigger Control (TTC)



UX15



Event data **pulled**: partial events @ ≤ 100 kHz, full events @ ~ 3 kHz

Event data **pushed** @ ≤ 100 kHz, 1600 fragments of ~ 1 kByte each

- How to manage data from 140 000 000 registering points ?
- Where to store and how to develope more than 10 petabytes/year (~10 Million Gbytes) ?

Grid was the Solution. Some history:

1999 – Monarc Project
Early discussions on how to organise distributed computing for LHC

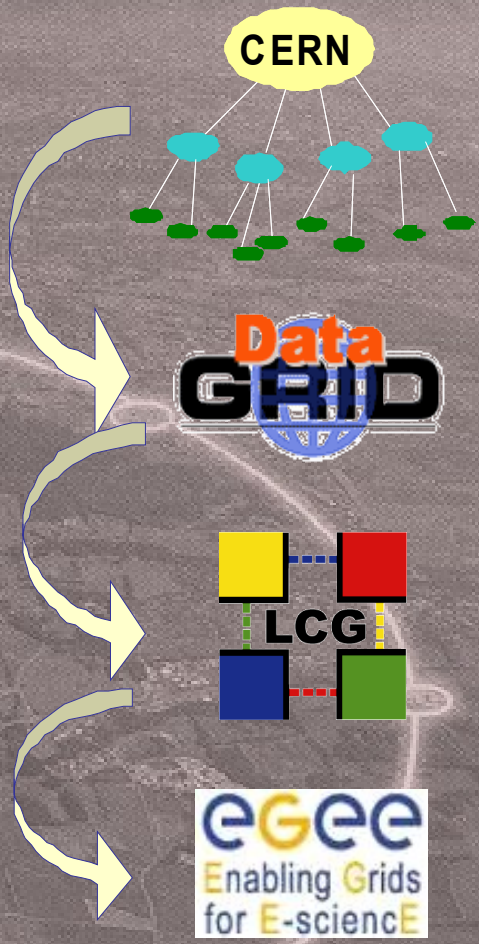
2001-2003 – EU DataGrid project
middleware & testbed for an operational grid

2002-2005 – LHC Computing Grid – LCG
deploying the results of DataGrid to provide a production facility for LHC experiments

2004-2006 – EU EGEE project phase 1
starts from the LCG grid
shared production infrastructure
expanding to other communities and sciences

2006-2008 – EU EGEE-II
Building on phase 1
Expanding applications and communities …

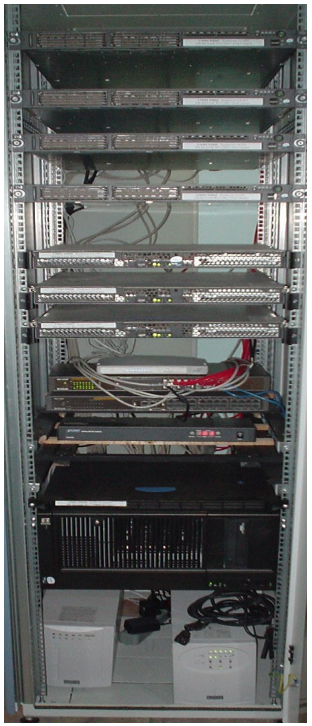
2008-2010 – EU EGEE-III



National, regional and European Grid infrastructures; participation of Moldova in EGI-Inspire project

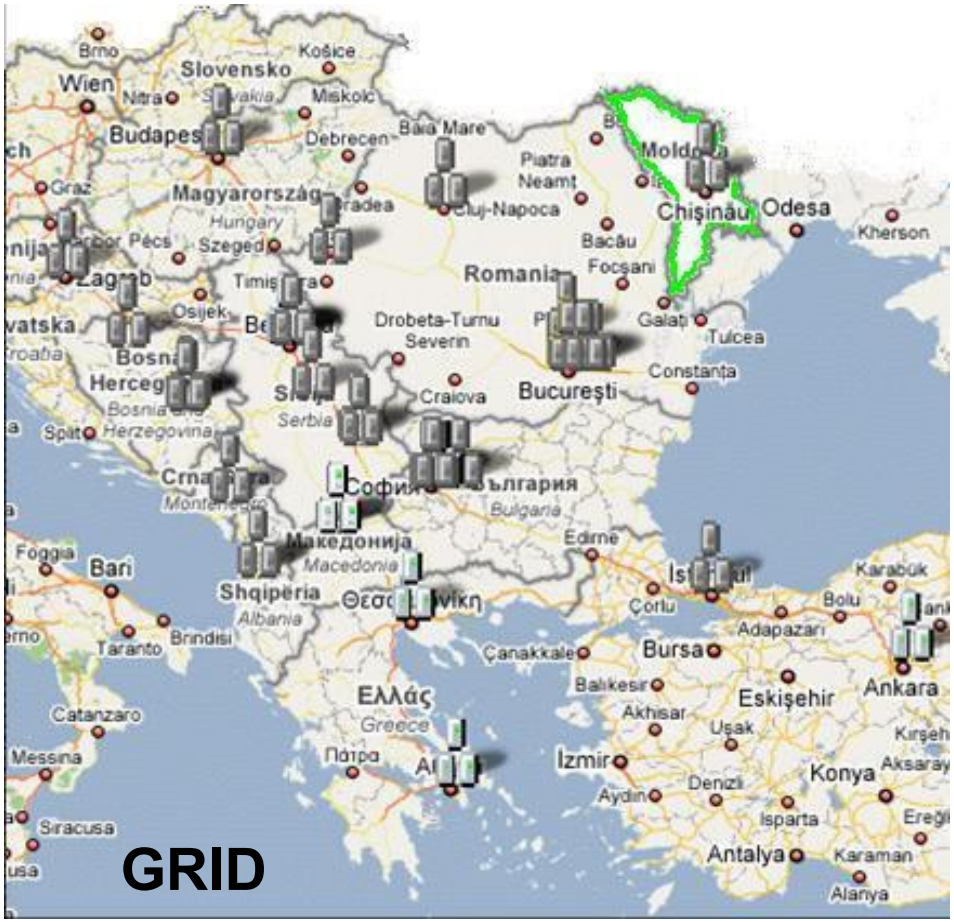
+ Software-Middlware

+...+
+
InterNet



+ Software-Middlware

=



Grid is a computational infrastructure that provides access through Internet to computing power and storage resources distributed across the globe.

Benefits of a Grid system for LHC Project

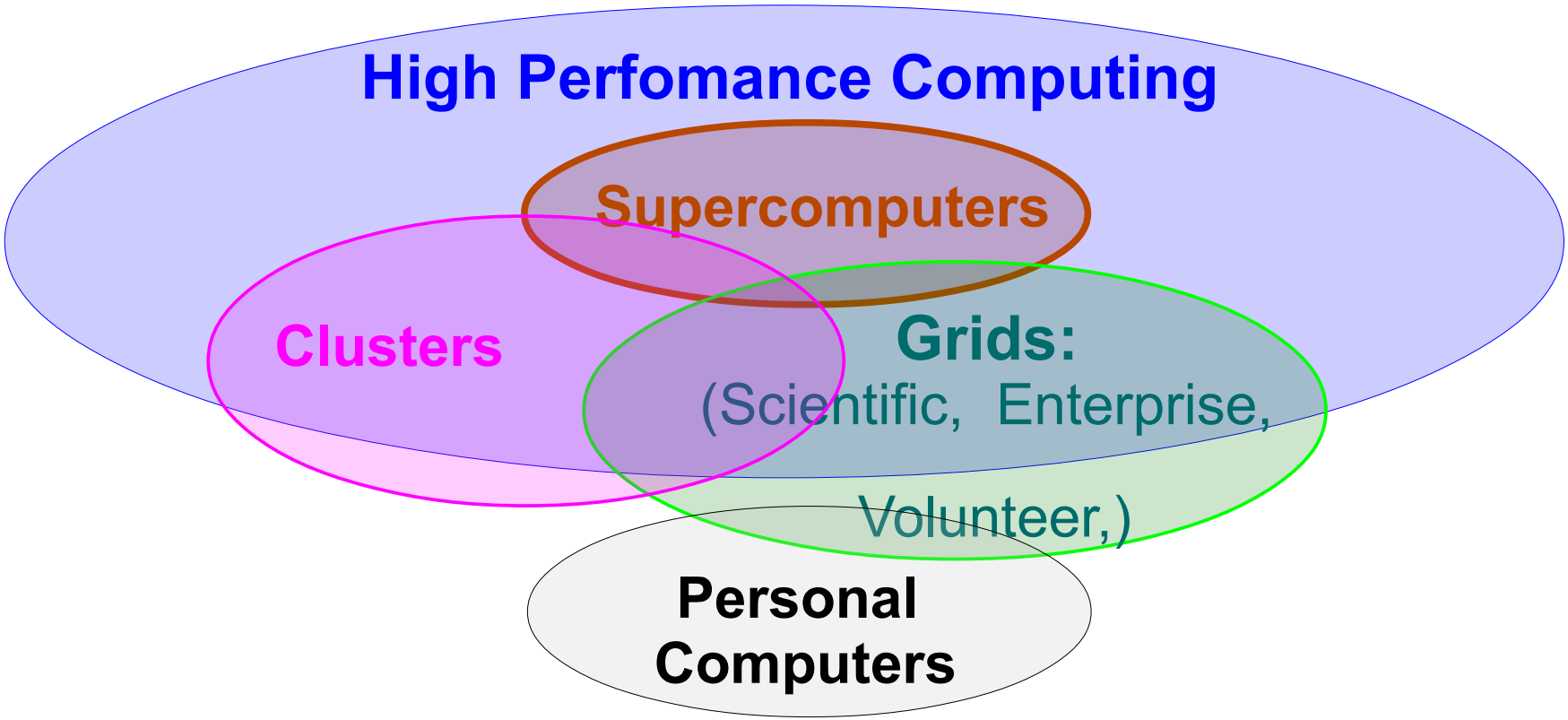
During the development of the LHC Computing Grid, many benefits of a distributed "grid" system became apparent:

- Multiple copies of data can be kept in different sites, ensuring access for all scientists involved, independent of geographical location;
- Allows optimum use of spare capacity for multiple computer centres, making it more efficient;
- Having computer centres in multiple time zones eases round-the-clock monitoring and the availability of expert support;
- No single points of failure. Refusal of one node does not stop work of the others;
- The cost of maintenance and upgrades is distributed;
- The system can be easily reconfigured to face new challenges, making it able to dynamically evolve throughout the life of the LHC, growing in capacity to meet the rising demands as more data is collected each year;
- Provides considerable flexibility in deciding how and where to provide future computing resources;

Virtual organizations

- Virtual organizations (VOs) are groups of Grid users (authenticated through digital certificates)
- VO Management Service (VOMS) serves as a central repository for user authorization information, providing support for sorting users into a general group hierarchy, keeping track of their roles,etc.
- VO Manager, according to VO policies and rules, authorizes authenticated users to become VO members
- Resource centers (RCs) may support one or more VOs, and this is how users are authorized to use computing, storage and other Grid resources
- VOMS allows flexible approach to **Authentication**&**Authorization** on the Grid

High-performance computing is a branch of applied computer science that is dealing with the finding of solutions to problems that require a large amount of computing resources.



National, regional and European Grid infrastructures; participation of Moldova in EGI-Inspire project

Many countries have launched National Grid Initiatives (**NGI**) to establish National grid infrastructures.

MD-Grid — **National Grid Initiative** of Moldova was officially inaugurated on the plenary session of RENAM "Users Conference – 2007" on **May, 14 2007**

Now the **European Grid Initiative** (**EGI**) is an organisation being developed to coordinate the European Grid Infrastructure, based on the federation of individual **National Grid Initiatives** (**NGI**), to support a multi-disciplinary user community.

EGI will unite the National Grid-organisations of Europe.

e-infrastructure

EGI-InSPIRE - European Grid Initiative:

Integrated Sustainable Pan-European Infrastructure for Researchers in Europe.

Supports „grids" of high-performance computing (HPC) and high-throughput computing (HTC) resources

Supports integration into a seamless production infrastructure of new Distributed Computing Infrastructures (clouds, supercomputing networks and desktop grids)

Continued support for current heavy users of the infrastructure in earth science, astronomy and astrophysics, fusion, computational chemistry and materials science technology, life sciences and high energy physics as they move to sustainable support models for their own communities

A 4-year project, started in 2010

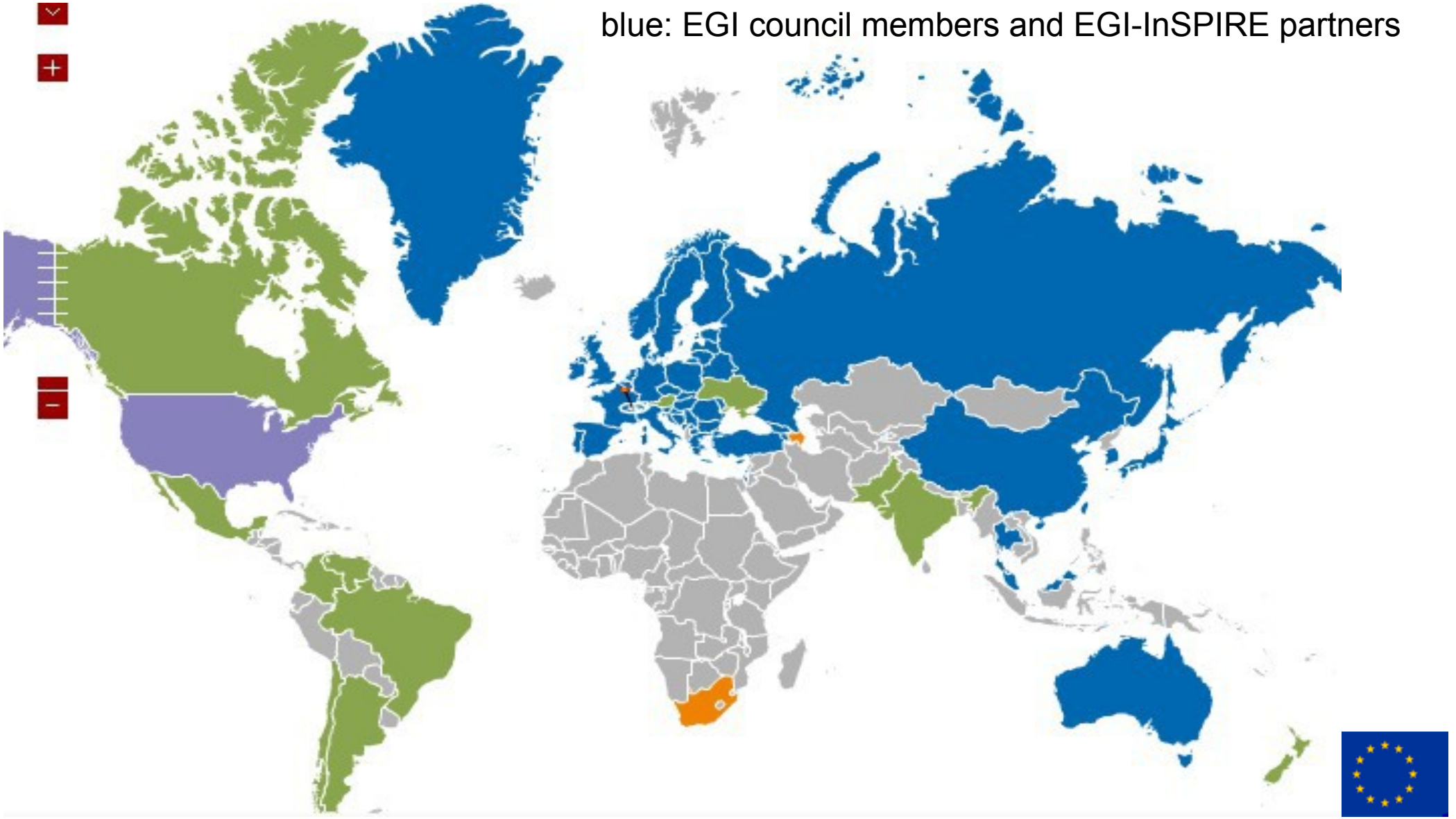
e-infrastructure

European Grid Initiative — the main goals and objectives:

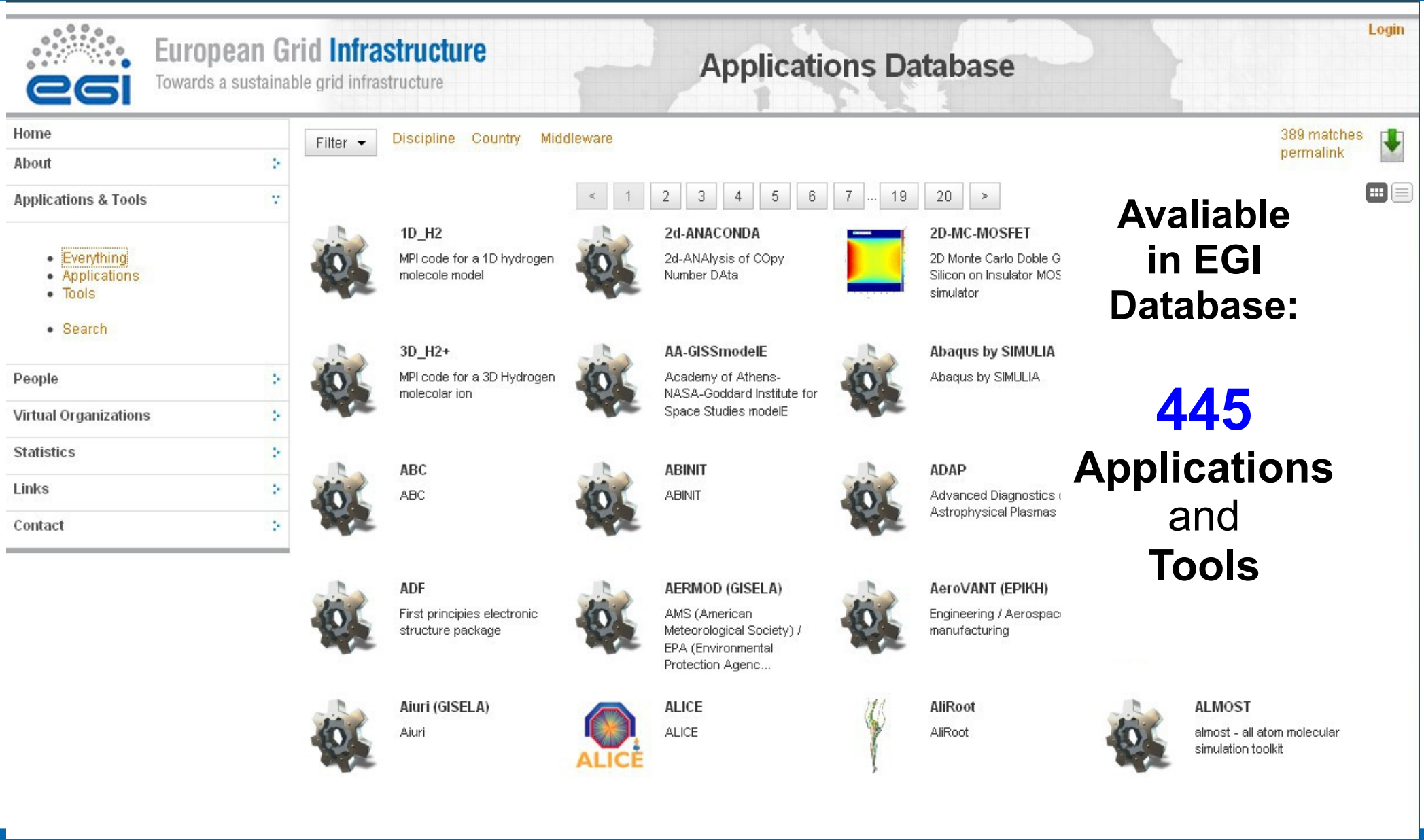
- Ensure the long-term sustainability of the European e-infrastructure;
- Coordinate the integration and interaction between National Grid Infrastructures;
- Operate the European level of the production grid infrastructure for a wide range of scientific disciplines to link National Grid Infrastructures;
- Integrate, test, validate and package software from leading grid middleware development projects and make it widely available;
- Take into account developments made by national e-science projects which were aimed at supporting diverse communities;
- Link the European infrastructure with similar infrastructures elsewhere;
- Collaborate closely with industry as technology and service providers, as well as grid users, to promote the rapid and successful uptake of grid technology by European Industry.

e-infrastructure

National, regional and European Grid infrastructures; participation of Moldova in EGI-Inspire project



National, regional and European Grid infrastructures; participation of Moldova in EGI-Inspire project



Avaliable in EGI Database:

445

Applications and **Tools**

MD-Grid NGI technical resources

MD-GRID NGI site	Available CPUs	Available storage	Network
Existing equipment			
MD-01-TUM	5 Intel P-IV 3,0 GHz CPUs	320 GB on Storage Element	100 Mbit Ethernet
MD-03-SUMP	5 x CPU AMD Athlon 64 X2 6000+ (3.0GHz)	650 GB on Storage Element	100 Mbit Ethernet
MD-04-RENAM	6 Quad Core Xeon 5130 CPUs	2 TB on Storage Element	100 Mbit Ethernet
MD-02-IMI	12 Quad Core Xeon 5130 CPUs	3,5 TB on Storage Element	1 Gbit Ethernet
Planned to be integrated into MD-GRID NGI			
MD-05-SUM	4x2xAMD 275 Dual-Core 2.2GHz and 3x2xAMD 280 Dual-Core 2.4GHz CPUs	2x500GB 7.2k SATA and 4x80 GB 7.2k SATA	100 Mbit Ethernet

What types of tasks (Applications) can be run on a High Performance Resources ?

Sequential Application - application runs on one computer and it's run time (wall time) depends on the capacity of the computer

Parallel Application – Application runs on all cores of one processor or **on multiply processors (cores) of one or more computers**

Distributed Application (parametric sweep) – the same Application runs on several cores **on one or more computers.**

Task flow – several tasks (perhaps one and the same program with different inputs) are run in sequence **(automatically)**

Questions ?