Co-opetition in BOINC community

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Terminological digression

Co-Opetition = Competition & Cooperation

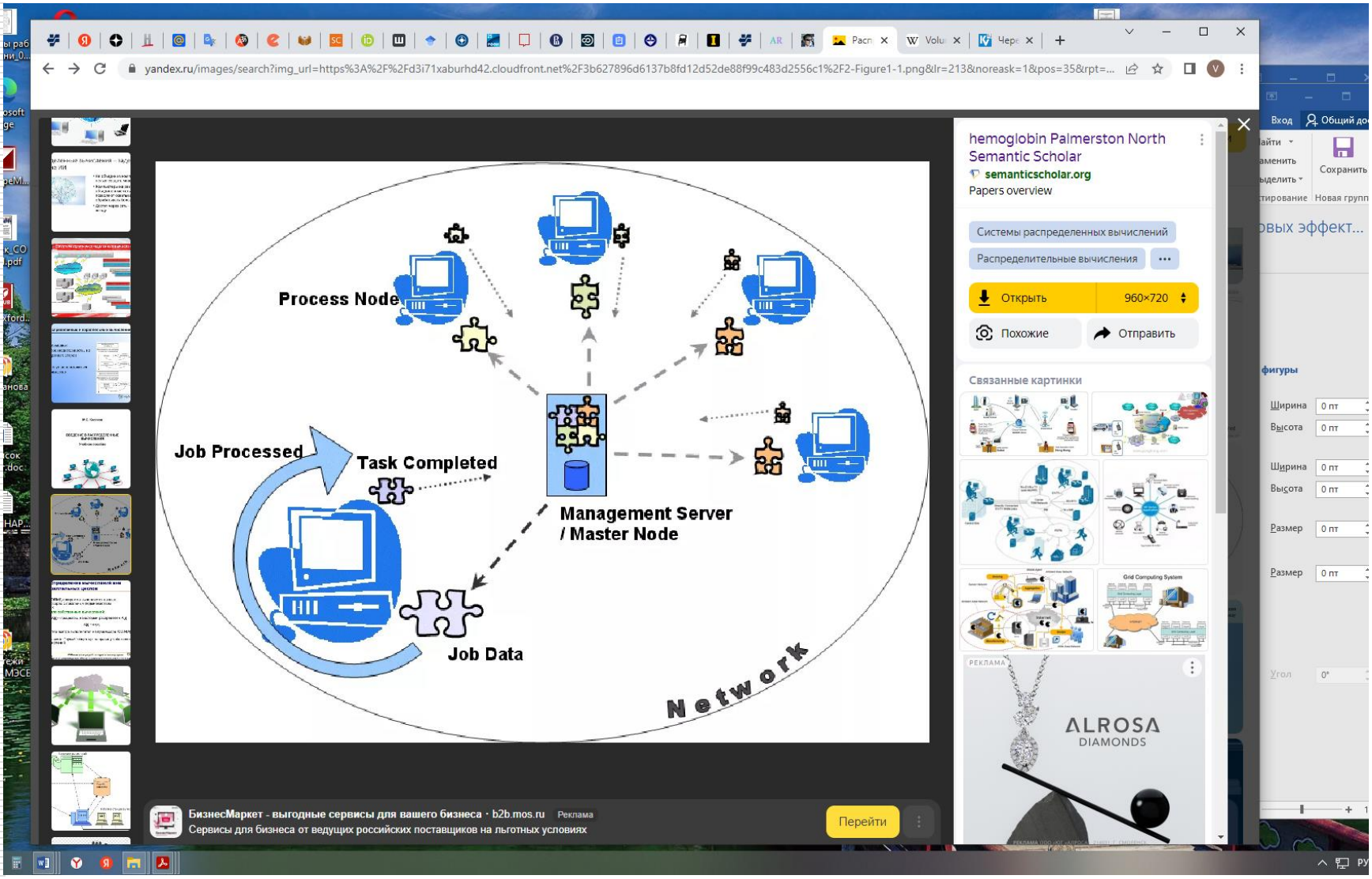
The hybrid behavior comprising competition and co…operation has been named co-opetition. Brandenburger, A.M. & Nalebuff, B.J. (1996).

HEADLINES

- **The BOINC-concept.**
  Free market model *(Anderson)***.**
- **The Decline of BOINC.**
- **The Coordinated model.**
- **Behavior patterns of volunteer.**
  Co-opetition model

The goal – to show the collaboration of members of the BOINC community as an alternative to «*United Science*».

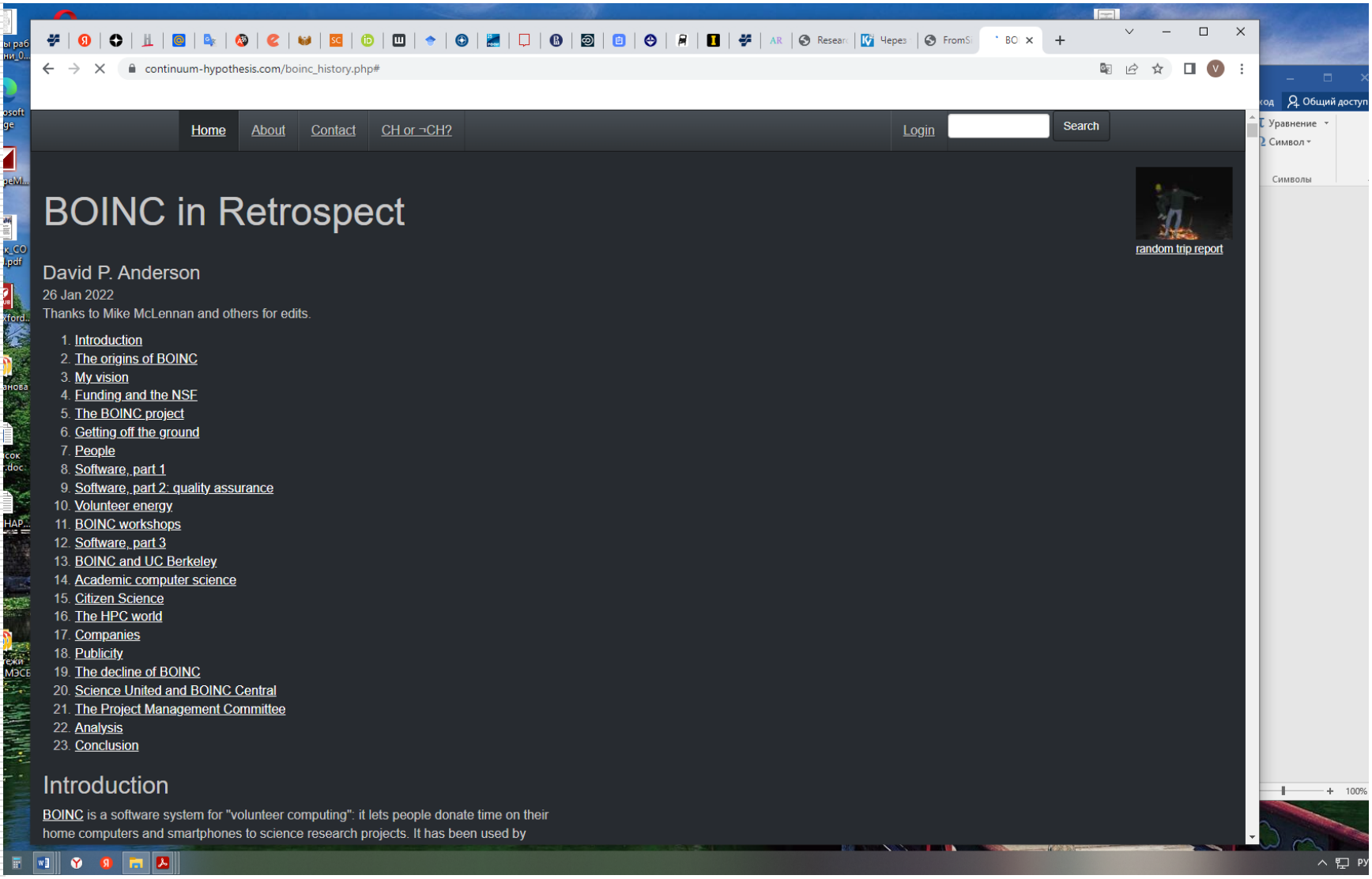
BOINC – Virtual Ecosystem



Volunteer computing (VC) – BOINC (The ***B***erkeley ***O***pen ***I***nfrastructure for ***N***etwork ***C***omputing) is a software system for «volunteer computing» (https://boinc.berkeley.edu)

- a type of a *distributed computing* in which unskilled computer owners can donate their spare computer resources to perform a computation of one or more large-scale research projects;
- **4,18 mln** from **250 country**; **active = 48.365** (on June, 20, 2023);
- Cumulative computer performance > **100 petaflops**
- **> 50 projects** in many areas of science, and has run on millions of computers
- BOINC-based computing contributed to over 400 research papers (https://boinc.berkeley.edu/pubs.php).

BOINC in Retrospective (26 Jan 2022)



Volunteer computing paradigm

The VC paradigm is based on 3 main pillars:

✓David Gedye's idea of using the integral resources of distributed personal computers in the form of voluntary computing to analyze signals («technosignatures») received by a radio telescope from space (David Gedye, 1994; SETI@home project);

✓Ideas about virtual interactions of desktop computers as a network and a Networked Society as a whole(M. Castells, 1996);

✓A software solution for connecting many computers of Internet users into a virtual network on a special platform(David P. Anderson, 2004)

The origins of VC concept

"Big Science" –

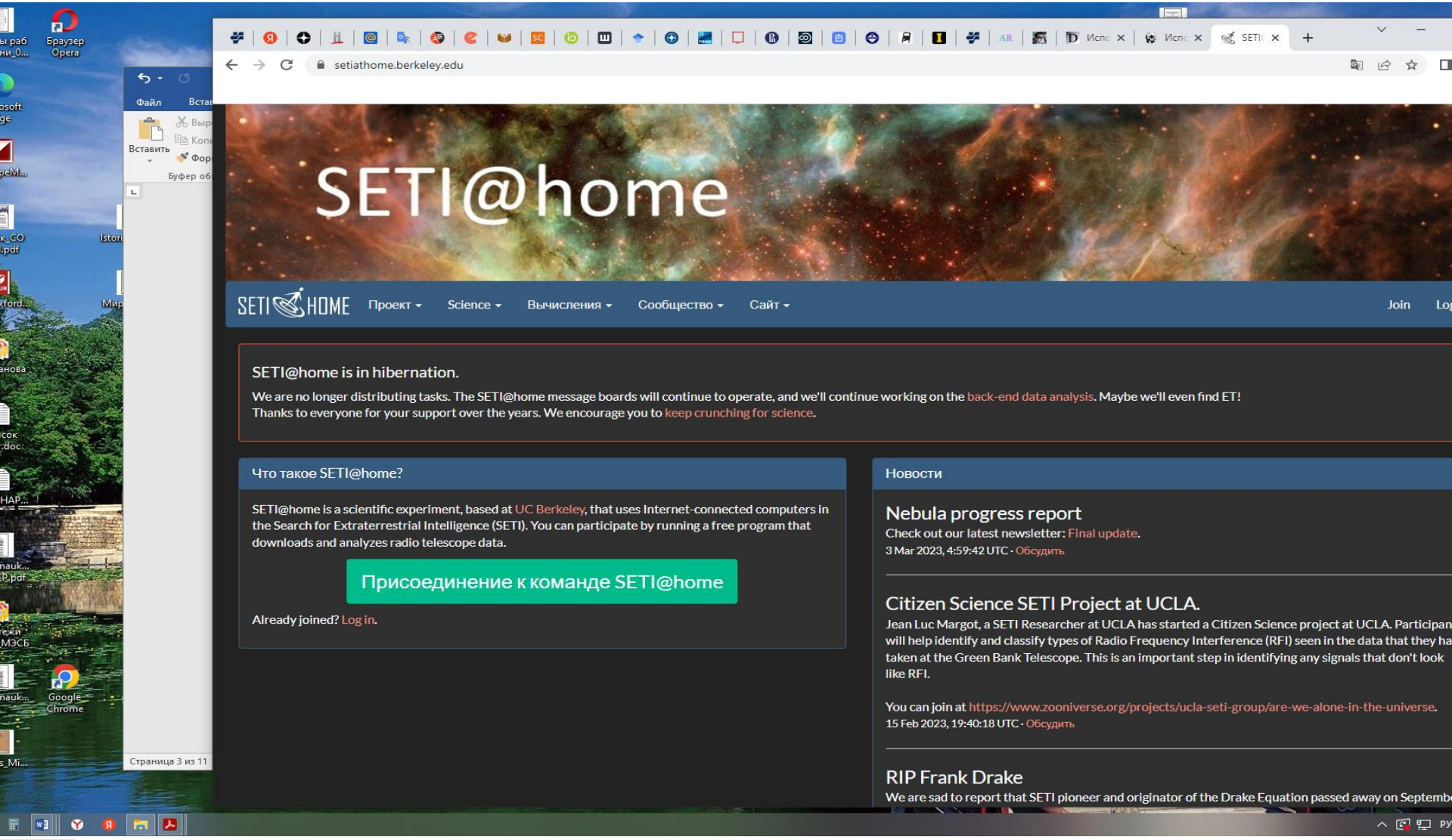
coordinate volunteer computing

- Gedye conceived of the idea of volunteer computing, and he shared it with Anderson in early 1995.
- Together with Woody Sullivan and Dan Werthimer we formed SETI@home (https://setiathome.berkeley.edu), with the goal of using volunteer computing to analyze radio telescope data: synthetic signals coming from space.

SETI@home creators

Дэн Вертимер, Вудрафф Т. Вудрафф Т. Салливан III, Дэвид Андерсон, Дэйв Геди на 10-й годовщине SETI@home в 2009 году.

Проект SETI@home

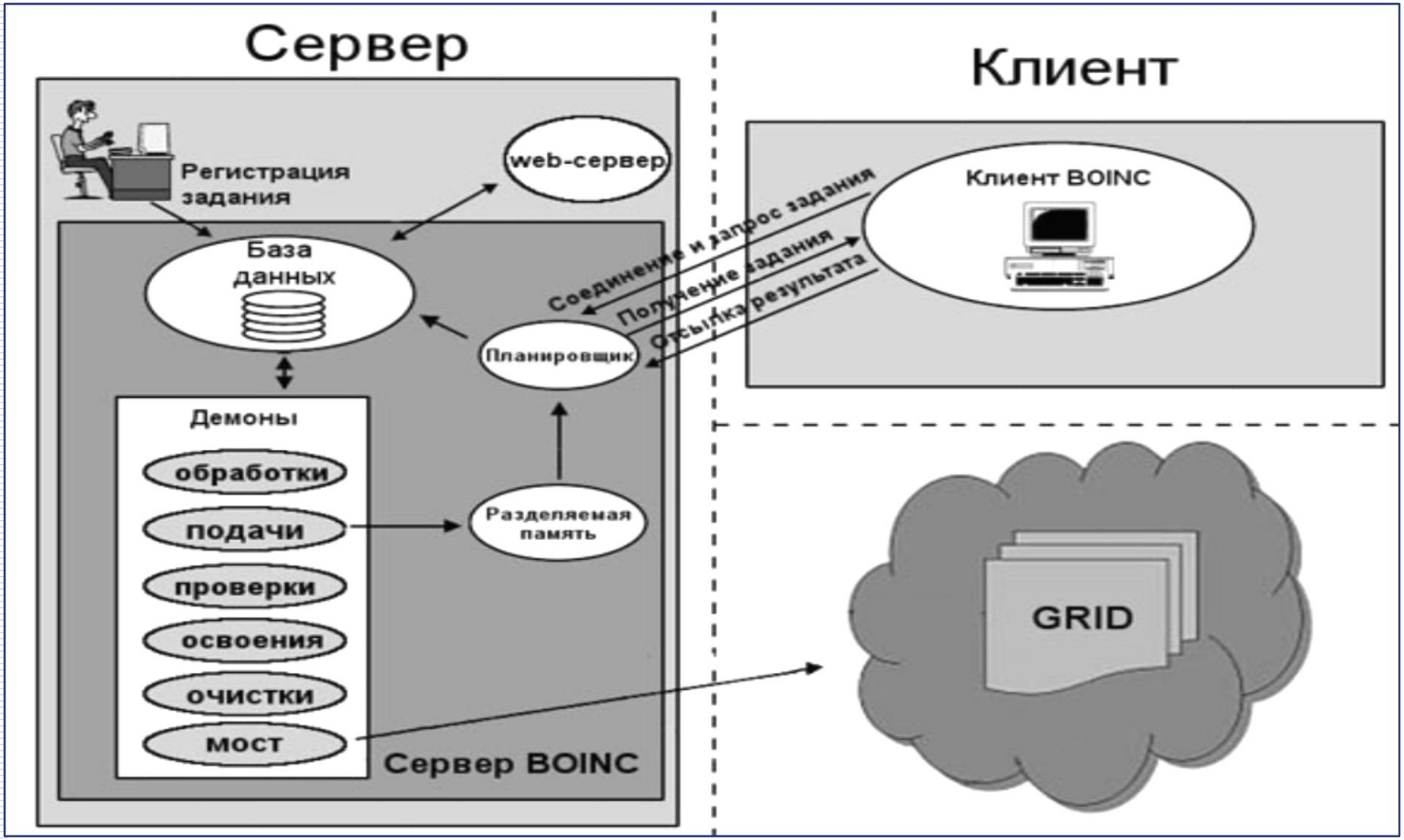


The origins of BOINC

- ✓ SETI@home was a single program, which included both the infrastructure part (network communication, fetching and returning jobs, working invisibly in the background) and the science part (the data analysis)
- ✓ Each time the science part changed, all the volunteers had to download and install a new version of the program

This meant separating the infrastructure from the science

BOINC System Architecture



The free-market model

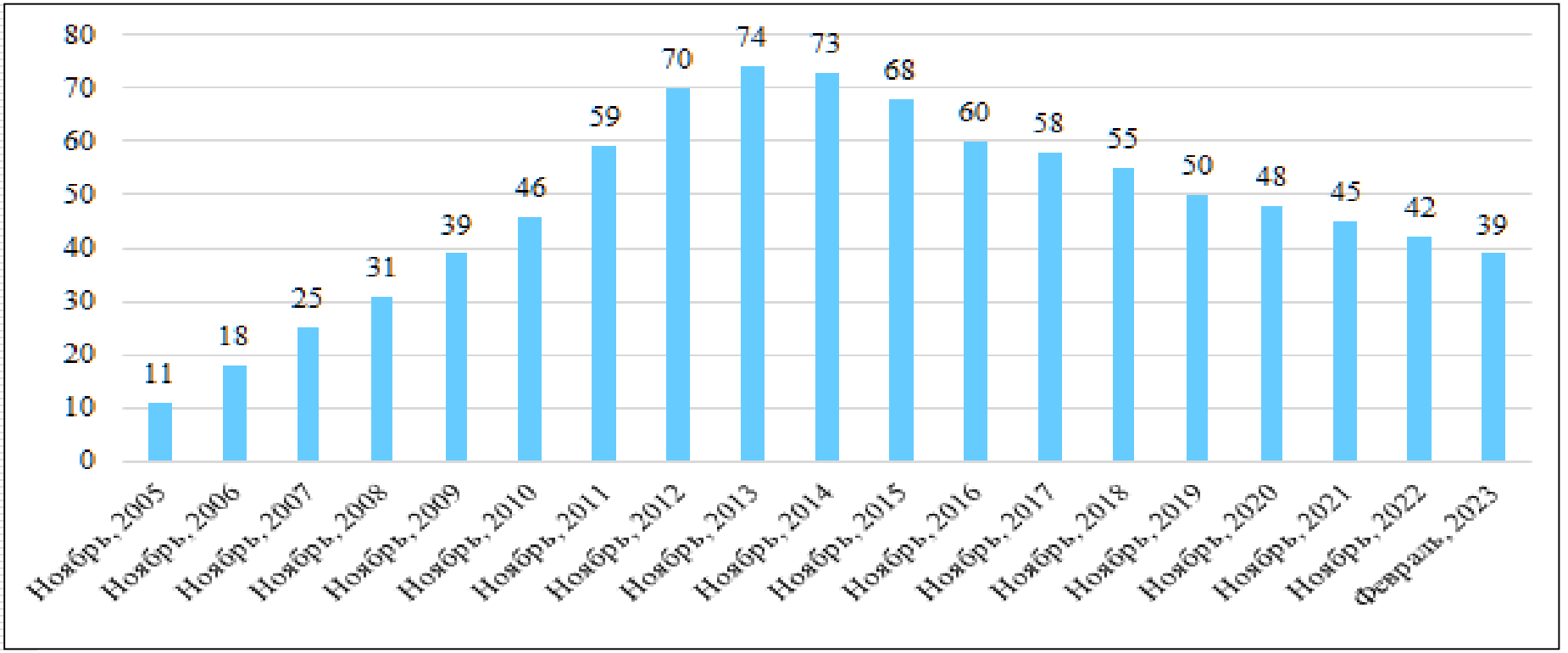
«The intention of this model was to create

- a *«market»* of projects that compete for computing power by promoting themselves and their research,
- a *population of volunteers* that periodically evaluate the set of projects and make informed decisions, based on their personal values and opinions, about how to allocate their computing resources.» (Anderson David, 2021)

The goal – volunteer computing can democratize science funding

The decline of BOINC

It appears – conjunction volunteers with technological platform ≠ virtual ecosystem for large-scale scientific computing

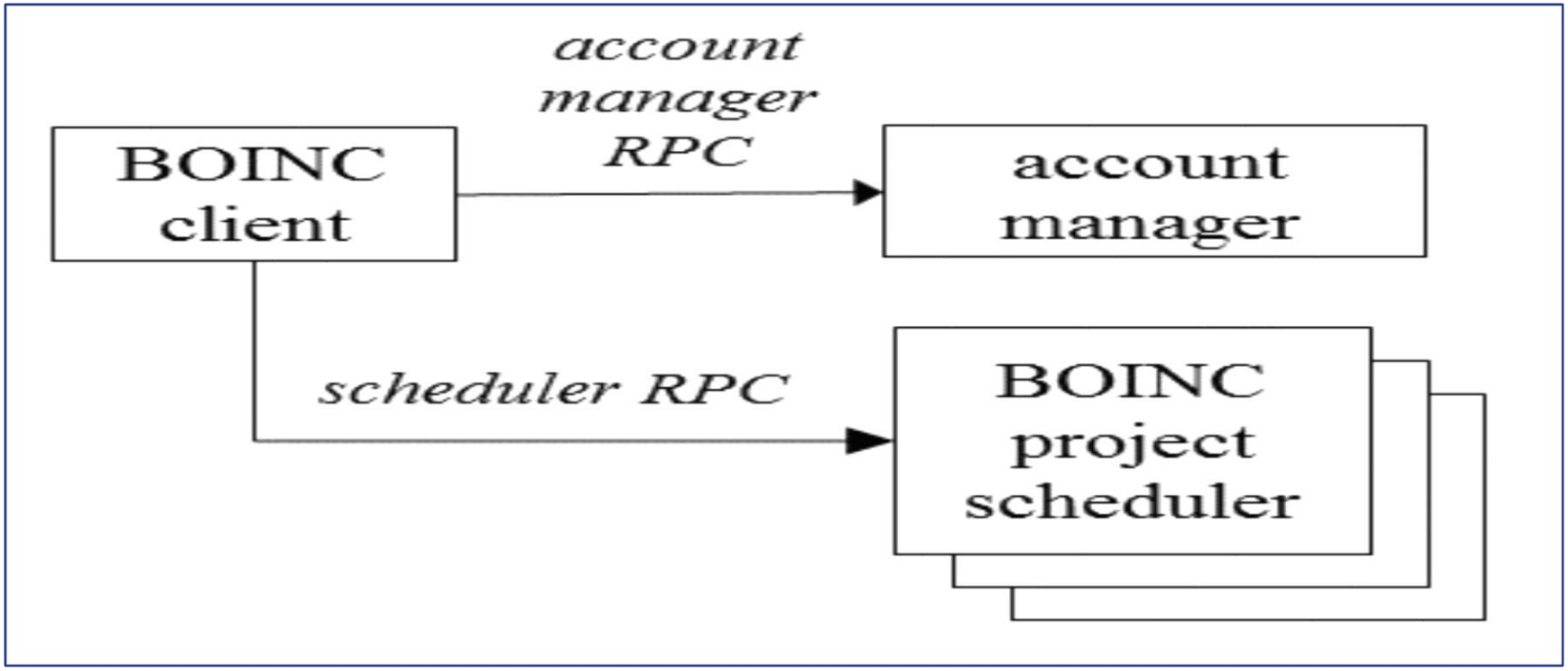


Source of diagram – V. Ivashko, E. Ivashko, 2023

«United Science» Concept (*Anderson, 2016*)

- ✓ The BOINC "free market" model doesn't make any sense: creating a new BOINC project requires a large investment, with no guarantee of any return. That's why there are no new BOINC projects
- ✓ We needed a way to guarantee scientists some level of computing power. This led to the idea of «Science United» (https://scienceunited.org)

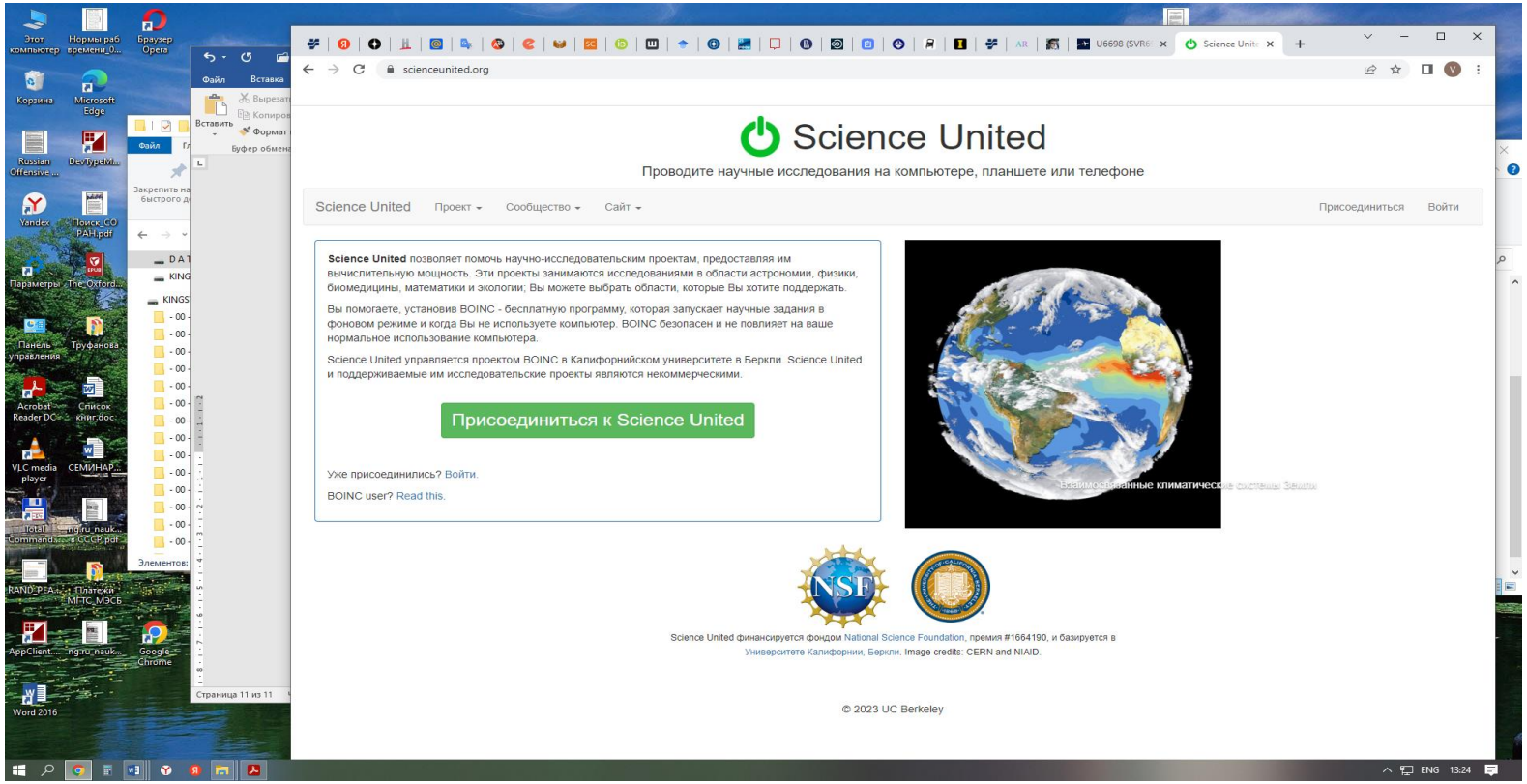
The Coordinated model



BOINC Account Manager Architecture

The model involves a central «coordinator», implemented as an account manager. The coordinator allocates computing power among a set of “vetted” projects, and may divide power non-uniformly among these projects;
eliminates scientists’ financial risk in creating BOINC projects,

A unified brand for VC



The committee may include representatives
of the U.S. and European scientific funding agencies,
leaders of the coordinator project, and members of the volunteer community.

What is the VC community framework?

Projects – typically academic-based research assignments, e.g. *search for "Extra-Terrestrial Intelligence", understand of protein folding and related diseases, learn global warming, discover pulsars* (**> 50**, http://www.boincstats.com)

Individuals – Internet-connected low-powered computers = average person or organization (volunteers), not paid for their work, anonymous, working alone (**16,9%,** survey May, 2018)

VC team – a long-term strategic alliance formed by volunteers, individual users of PC, in order to participate in solving large scientific computational task (**83,1%,** survey in May, 2018).

Internet resources – project websites with statistics in rank tables, discussion forums, etc.

Basic behavioral patterns of VC community

The main question of the project managers – Why do volunteers decided to participate in VC-projects?

Sociological studies were based on the representation of VC community as a set of participants >>>>
self-oriented motivations = providing smth. to others at their own cost

- Sense of involvement in scientific research, **co-ownership**
- Sense of social interaction, **community identification**
- Sense (Demand) of struggle, competition, **sports spirit**.

[Holohan A. and Garg A., 2006; Nov O., et al., 2014; Andreev. A., 2014; Kurochkin et al., 2015; Tishchenko V., 2017; Якимец В. Н., Курочкин И. И., 2018]

We suggest: online collaboration can capture people`s motivation better than only intrinsic motives???

Aims, objectives and methodology

- The object of the study is Russian VC-community (www.boinc.ru)

> 53,000 participants united in 821 Russian teams, 11 VC projects (> 22`277 in Russian projects, 20 June, 2023)

- The Data were collected in online survey, statistic analysis; assembled in database; network of Boinc.ru community was visualized with a help of “Gephi” and “Force Atlas 2”

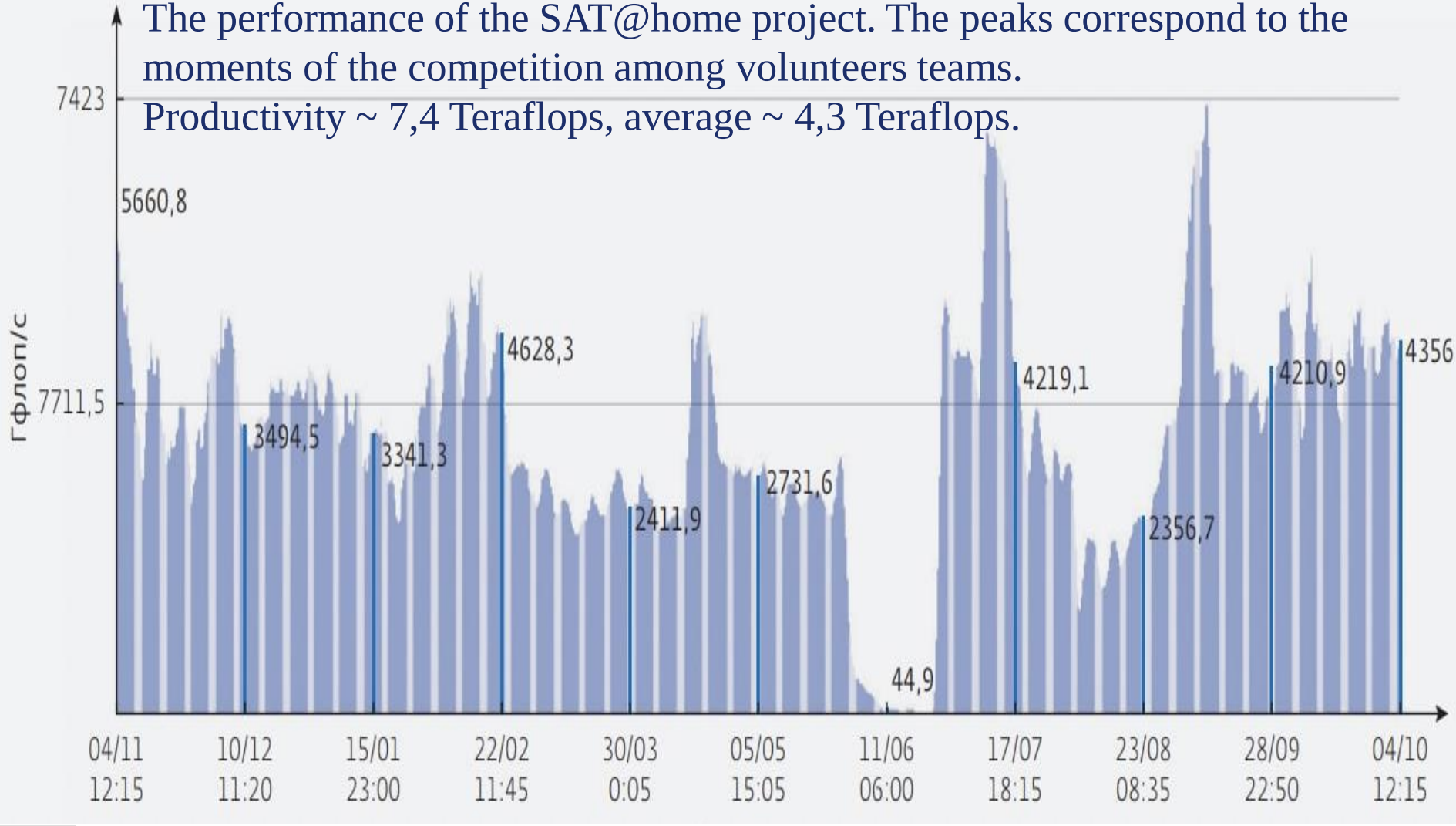
- Database: participants IDs, names; project IDs, names, number of units (credits) for the last week, month, year and all the time; unique team IDs, names, team memberships

Social underpinning of VC-projects

- The implementation of VC project depends on the number of connected («included») computers, their resources and the time of their work
- Project managers/organizers in search of a mechanism to encourage participation in VC-projects use conditional points accrual mechanism; the number of these points («credits») depends on the provided capacities, the time of participation in projects, and other characteristics of the activity of volunteers and their teams
- The availability of constant statistics for all projects, in addition to tracking various ratings, *provokes* various virtual competitions (“challenges”) between participants and teams
- If volunteers are members of a team, they are simultaneously competing with the other teams on the project on the more immediate goal of racking up the most contributions and coming out on top of the table of statistics documenting contributions
- This form of cooperation and competition demonstrates a new type of online scientific collaborative network

The collaborative network`s effect

The performance of the SAT@home project. The peaks correspond to the moments of the competition among volunteers teams.
Productivity ~ 7,4 Teraflops, average ~ 4,3 Teraflops.



Active group in VC-community

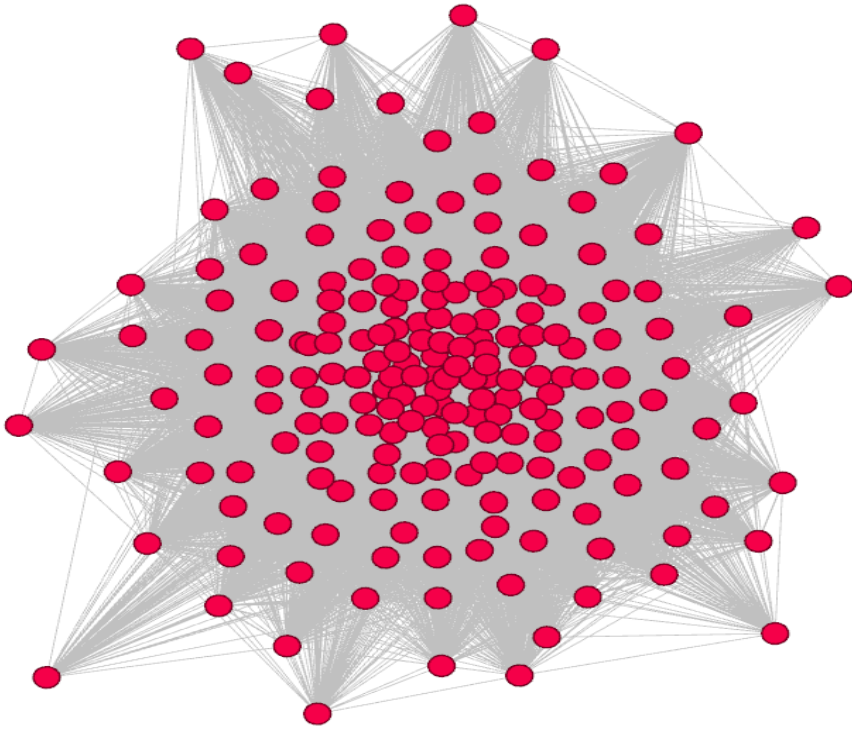
- ✓To highlight the traces of collaborative networks, we will highlight the connections between active volunteers
- ✓For determining active group of participants in VC-projects in Boinc.ru community – construct a graph
- ✓participation threshold at least 50,000 points
- ✓So it appeared – 200 volunteers, who participated in 2176 projects;

(To visualize and analyze links[X] between volunteers we use the Gephi software and the Force Atlas 2 algorithm)

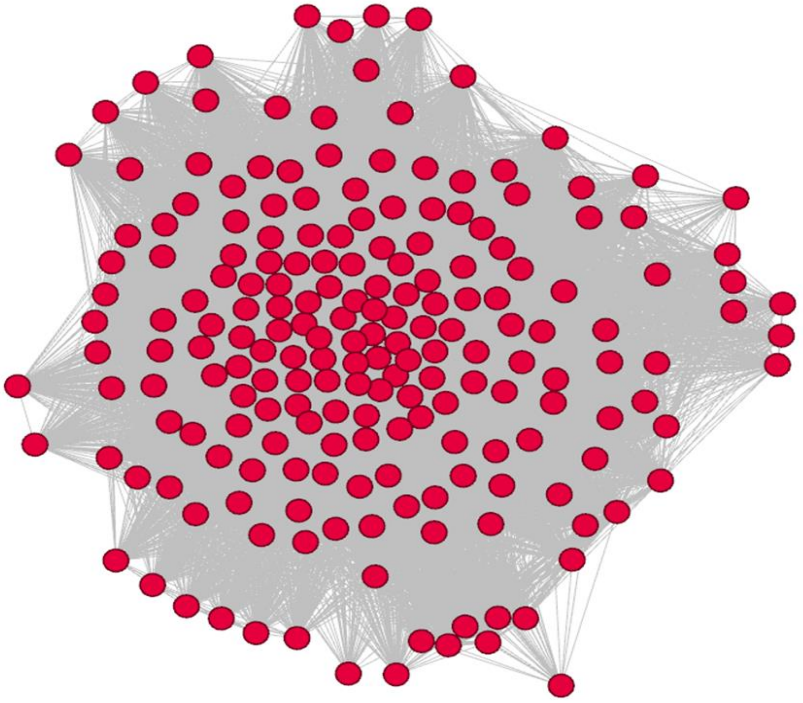
[X]link - simultaneous participation of two volunteers in a project

Visualization of links in group `active volunteers`

> 50,000 credits, 2176 projects



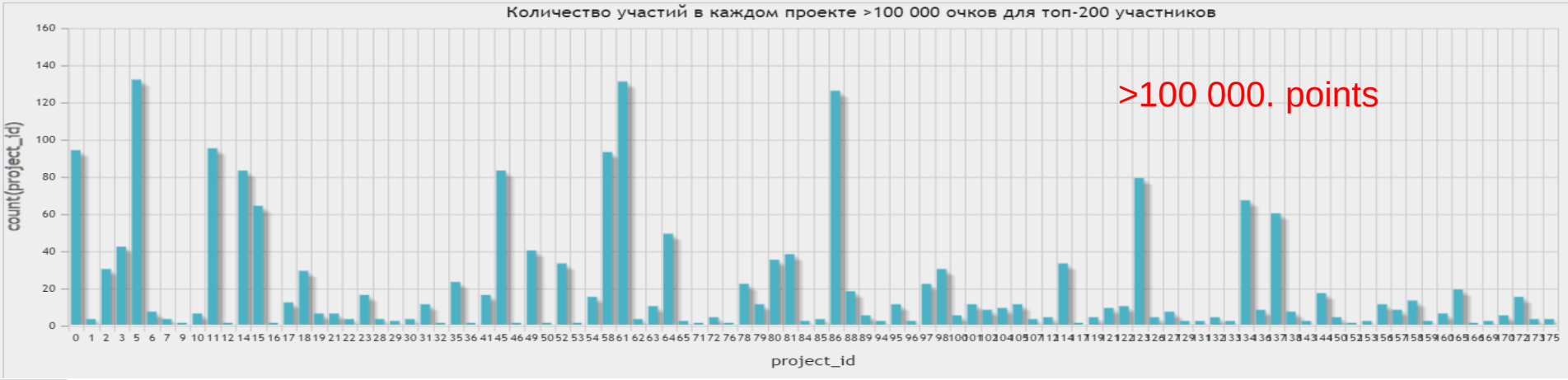
> 1,000,000,000 credits, 1217 projects



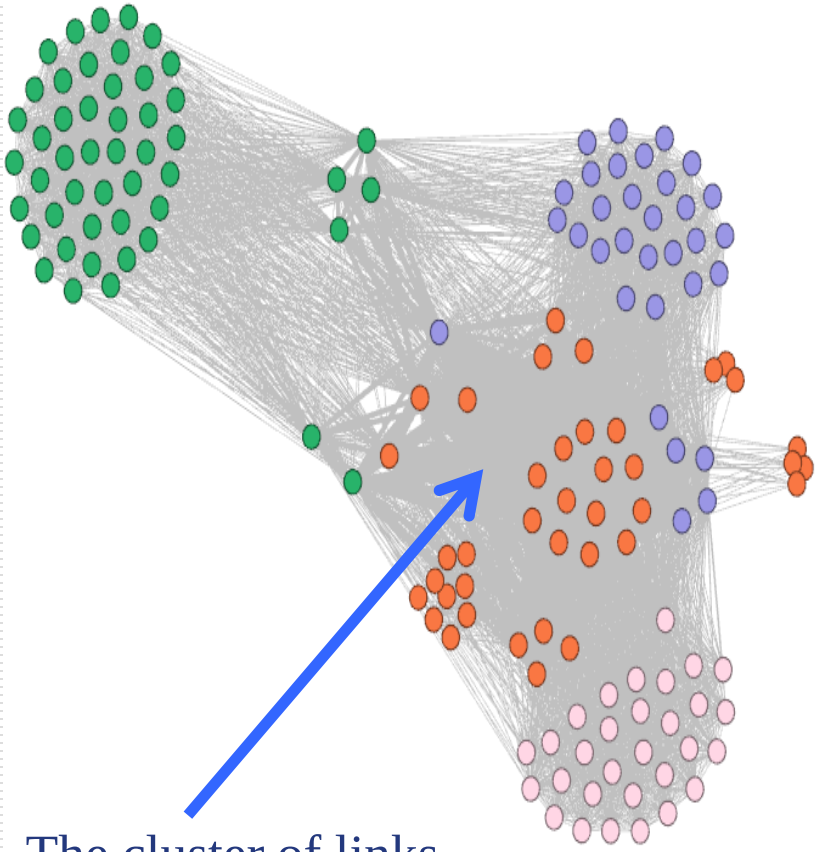
In spite increasing the threshold the form of graphs does not change.
It means that almost all active users are connected with some projects.

Distribution of participants in the projects

Active volunteers participate in almost the same projects



Collaborative network



The cluster of links
participation (links)
of volunteers in 7 projects

230 links; 182 participants

Violet – Acoustics@home

Green – OPTIMA@HOME

Rose – Amicable Numbers

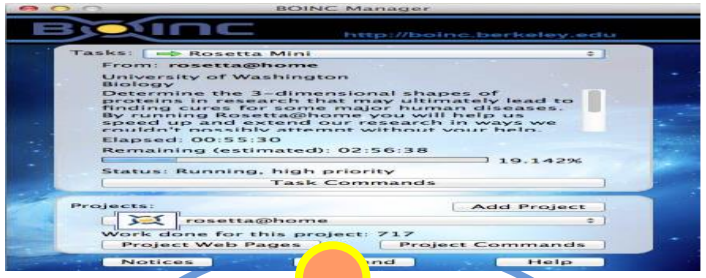
Orange

Remaining Projects	Participants
Stop@home	32
Amicable Numbers	58
Acoustics@home	54
AndersonAttack	17
XANSONS for COD	11
ODLK	7
OPTIMA@HOME	3

VC social structure

- ✓ **VC – a dispersed network of individuals and teams, project&team sites, forums**
- ✓ **VC – virtual community** (*formed through the teams, project sites, and online forums*)
- ✓ **VC – virtual communal workspace**
- ✓ **VC – new type of collaborative network**

VC project website



Team home page

Online forums

Conclusion

- ✓ The most active and productive participants in VC exemplify “co-competition” (Brandenburger & Nalebuff, 1996) – collaboration within the network organization of a VC project
- ✓ Our research indicates that the motivation of participation of millions of unskilled volunteers in VC-projects lies at the intersection of intrinsic motivation and the organizational possibilities emerging through the collaboration
- ✓ In providing the means for channeling participants' motivations to compete and cooperate, VC-projects provide powerful insights into a new type of collaborative network
- ✓ VC community model – collaborative network
- ✓ Co – opetition model – alternative to «United Science model»

Thanks for attention.

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