



THE GAME CHARACTER OF COLLABORATION in VC COMMUNITY

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Goal

To study the emerging type of online scientific research.

The questions to be answered are:

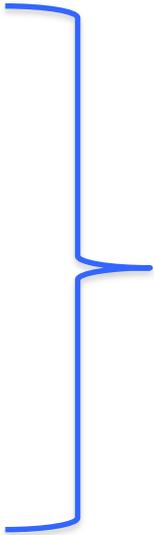
- Is there any collaboration in volunteer computing?
- What is the form of the collaboration in VC?
- Is it possible to consider VC community as a collaborative community?

Collaboration: «catchwords»

Google ~ about 797 000 000 results (0,46 seconds)

Collaboration – the action of working with someone to produce something (*Oxford University Press, 2015*).

- ❖ collaborative networks
- ❖ collaborative filtering
- ❖ collaboration community
- ❖ virtual collaboration
- ❖ adversarial collaboration



Has turned into a buzzword

Collaborative community

A simple combination of professional association of Internet users with a network platform does not turn it into a collaborative community.

A community formed in a virtual environment for joint collective activities, to achieve a common goal.

The presence of meta-goal of community activities.

What is volunteer computing?

Volunteer computing (VC) – a type of a *distributed computing* in which unskilled computer owners (**> 4,5 mln.**) can *donate* their spare computer resources *to perform a computation* of one or more large-scale research projects; *dispersed* “grid” system of volunteer desktops, notebooks, mobile phones can be connected to form equivalent of a single, huge and super-power supercomputer; **>24,032 Teraflops**

VC is based *on two pillars*:

- *Technical task* (computational): slicing a problem into thousands of tiny pieces which are then allocated (with a help of downloading project software) to a large number of individuals who volunteer their PC (notebooks, etc.) to scientific computing;
- *Social task* (participation): recruiting and retaining a large number of individuals to volunteer their computer resources (+ time, energy) to the project, and facilitating their continuous contribution.

Basic principles of VC-project organization

The technical challenge (computational task)

depends on slicing a scientific problem into tiny pieces and collecting the results

The social problem (participative task)

lies in involving and retaining the participants/maximum resources

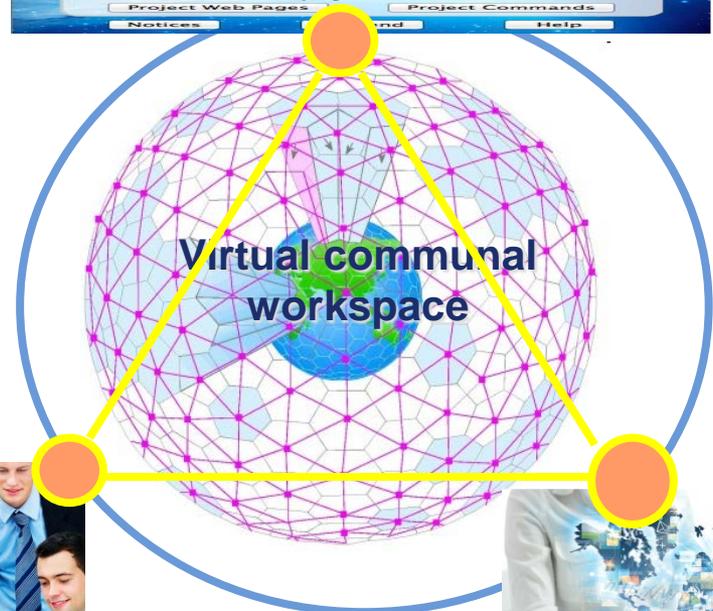
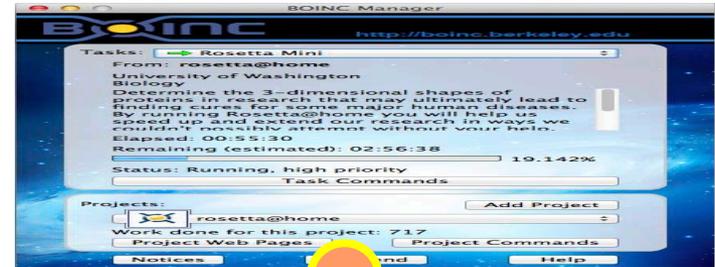
**Implementation of
VC project = computation
large scientific task**

Knowledge of the motives and behavior patterns of participants in VC projects.

VC social structure

VC project website

- ✓ 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



Team home page



Online forums

What is the VC organization 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* (**57**, <http://www.boincstats.com>)

Individuals – Internet-connected low-powered computers = average person or organization (volunteers), not paid for their work, anonymous, working alone (**18,8%**, 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 (**81,3%**, 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 participates 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

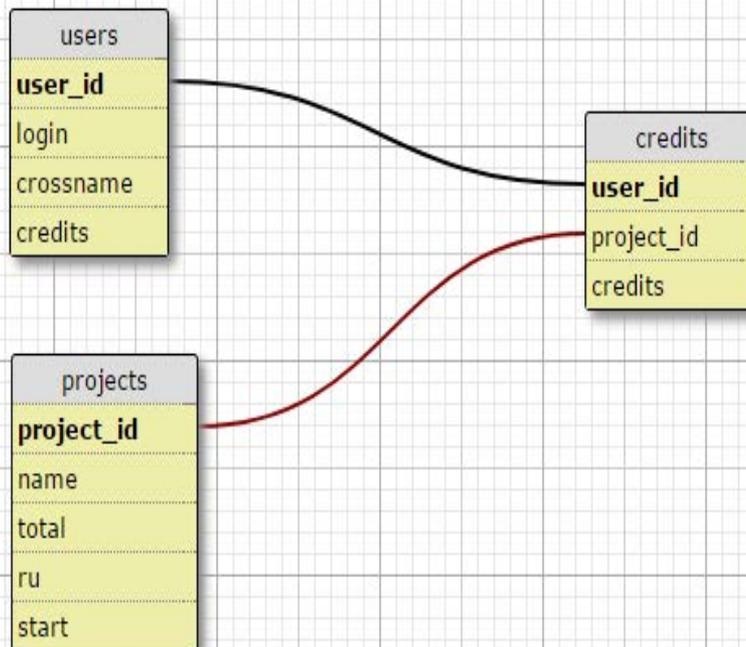
- Sense of involvement in scientific research, **co-ownership** (>92,2%)
- Sense of social interaction, **community identification** (32%)
- Sense (Demand) of struggle, competition, **sports spirit** (20,8)

[Holohan A. and Garg A., 2006; Nov O., et al., 2014; Andreev. A., 2014; Kurochkin et al., 2015]

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

Database “Community Boinc.ru”

To conduct a statistical analysis of the behavior of Russian participants in the VC, we used the data obtained with the websites www.boincstatistic.com and www.boinc.ru



Content of 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.

List of Russian VC teams

| last month | last week | last day | Rank | Team Name | Total credit | Credit /day | Credit /week | Credit /month | Average credit | Over take | Options |
|------------|-----------|----------|------|------------------------|----------------|-------------|--------------|---------------|----------------|-----------|--------------------------|
| 0 | 0 | 0 | 1 | Russia | 29,393,944,997 | 18,651,072 | 105,393,769 | 465,850,909 | 16,360,214 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 2 | Russia Team | 15,881,014,397 | 10,260,378 | 72,999,683 | 283,590,674 | 9,902,827 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 3 | Omsk | 9,823,119,725 | 20,095,917 | 105,382,656 | 462,802,453 | 15,959,625 | 365+ | <input type="checkbox"/> |
| 0 | 0 | 0 | 4 | TSC! Russia | 7,548,890,511 | 2,456,679 | 16,396,430 | 64,928,598 | 2,291,493 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 5 | Crystal Dream | 7,288,682,362 | 717,397 | 10,015,160 | 42,289,132 | 1,542,639 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 6 | DC Russian Union | 3,114,222,134 | 12,534,007 | 65,119,522 | 278,154,132 | 9,519,162 | 365+ | <input type="checkbox"/> |
| 0 | 0 | 0 | 7 | Astronomy.Ru Forum | 2,318,348,301 | 1,029,375 | 11,840,351 | 72,421,691 | 1,993,458 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 8 | BOINC RUSSIA | 1,971,881,842 | 520,391 | 5,396,872 | 28,021,375 | 803,579 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 9 | St.Petersburg | 1,916,191,047 | 238,046 | 1,685,838 | 9,185,137 | 266,180 | - | <input type="checkbox"/> |
| 1 | 0 | 0 | 10 | Sakhalin Russia | 1,800,875,704 | 41,242,046 | 191,420,242 | 700,472,689 | 27,321,402 | 5 | <input type="checkbox"/> |
| 1 | 0 | 0 | 11 | kvt.kurskstu | 1,180,670,781 | 455,708 | 4,531,967 | 19,143,704 | 682,314 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 12 | PolarSETI | 939,072,567 | 356,793 | 1,936,599 | 4,512,262 | 182,798 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 13 | BOINC SETI@home RUSSIA | 785,883,159 | 195,071 | 1,376,926 | 5,868,082 | 183,908 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 14 | kuegmi | 750,152,119 | 1,911,551 | 13,102,097 | 52,338,814 | 1,822,767 | 23 | <input type="checkbox"/> |
| 0 | 0 | 0 | 15 | MEPhI | 531,742,316 | 8,601 | 45,331 | 290,936 | 8,738 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 16 | RU-Team | 369,521,619 | 43,232 | 272,986 | 1,241,237 | 40,556 | 365+ | <input type="checkbox"/> |
| 0 | 0 | 0 | 17 | vtgt | 327,563,557 | 0 | 0 | 0 | 1 | - | <input type="checkbox"/> |
| 0 | 0 | 0 | 18 | RA3DOA | 266,843,369 | 154,057 | 840,102 | 1,933,693 | 94,127 | 365+ | <input type="checkbox"/> |

> 53,000 participants united in 821 Russian teams, 11 VC projects

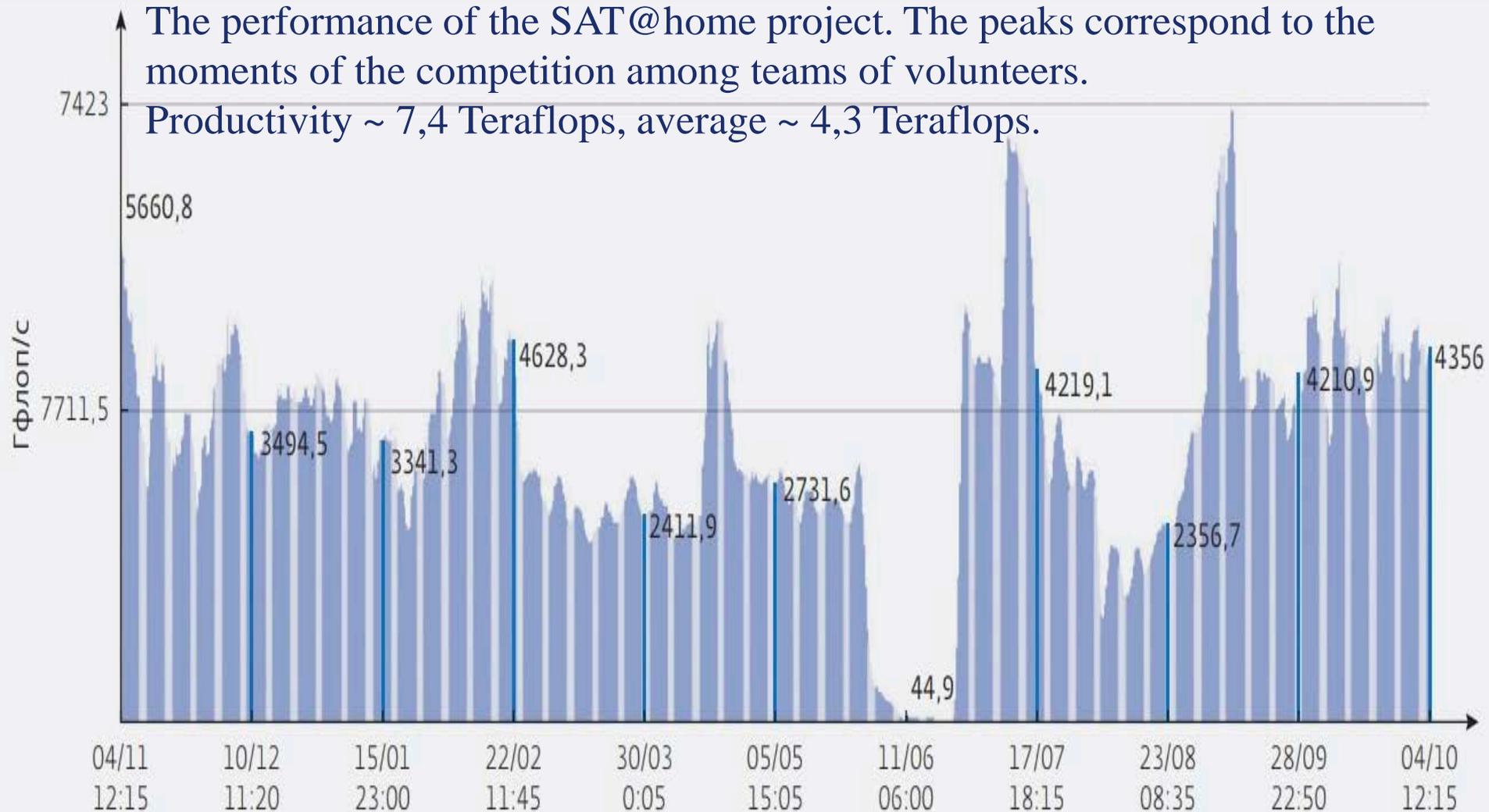
Social underpinning of VC-projects

- ❑ 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 teams of volunteers.

Productivity ~ 7,4 Teraflops, average ~ 4,3 Teraflops.



Active group selection in VC-community

In virtual collective projects (OSS projects) only a subset users contributes in significant ways (Weber S., 2004).

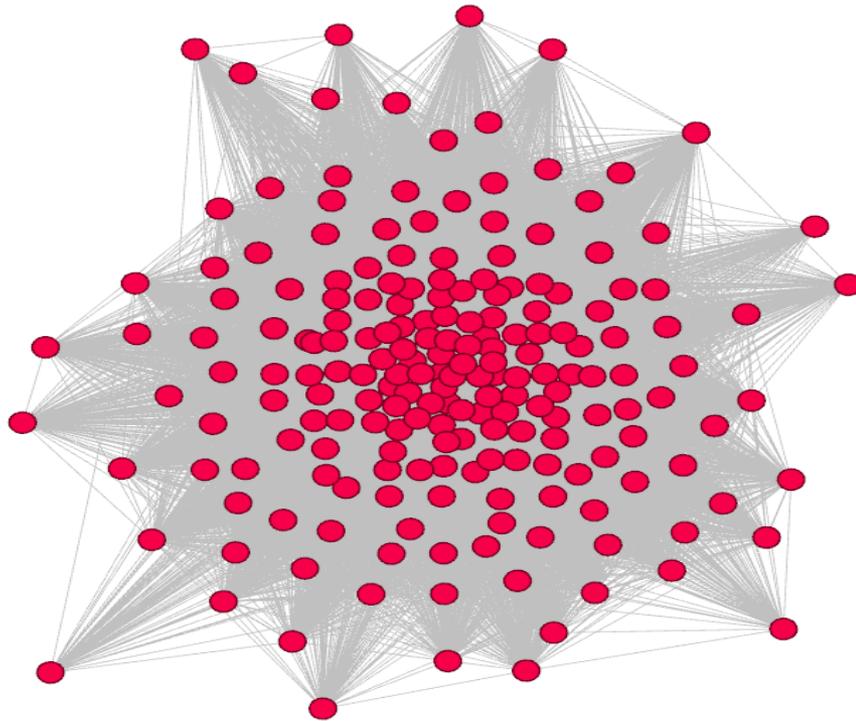
85-90% of the code (Apache server) was written by about 15 developers.

- ✓ For determining active group of participants in VC-projects in Boinc.ru community we have used the accrued credits, assumed that a person took part in the project if he *collected at least 50,000 points* in it
- ✓ 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

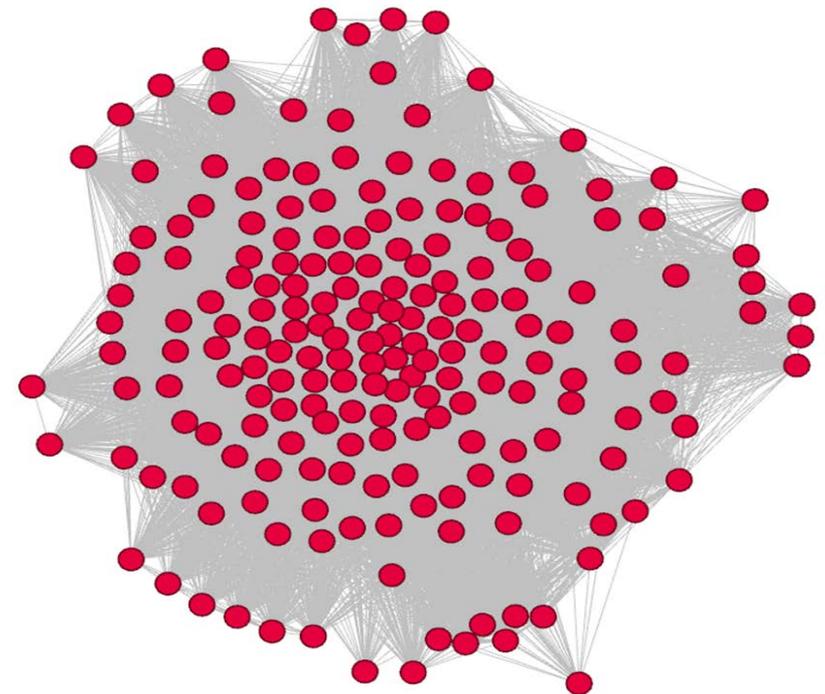
^xlink - simultaneous participation of two volunteers in a project

Visualization of links in group `active volunteers`

> 50,000 credits, 2176 projects



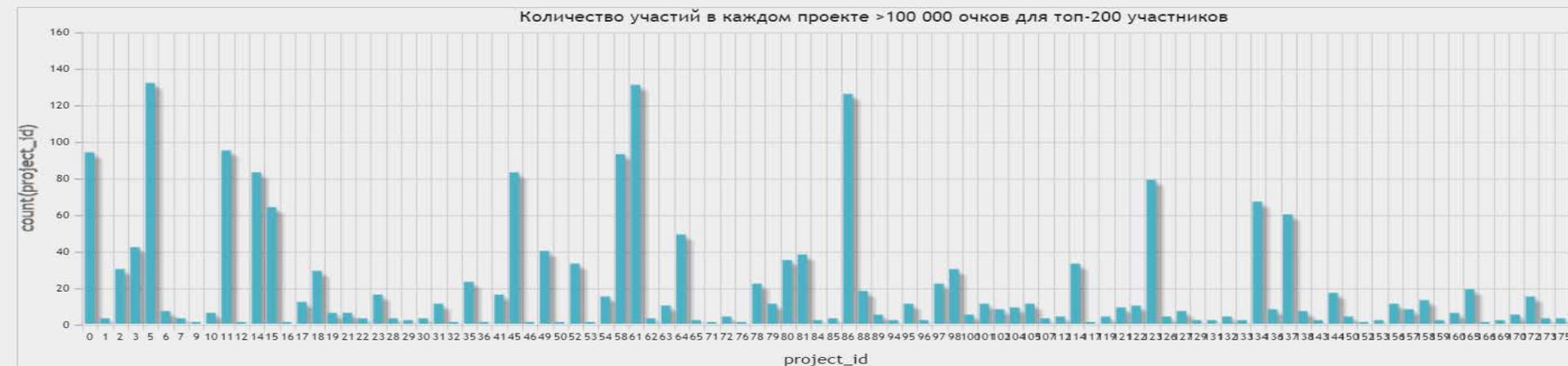
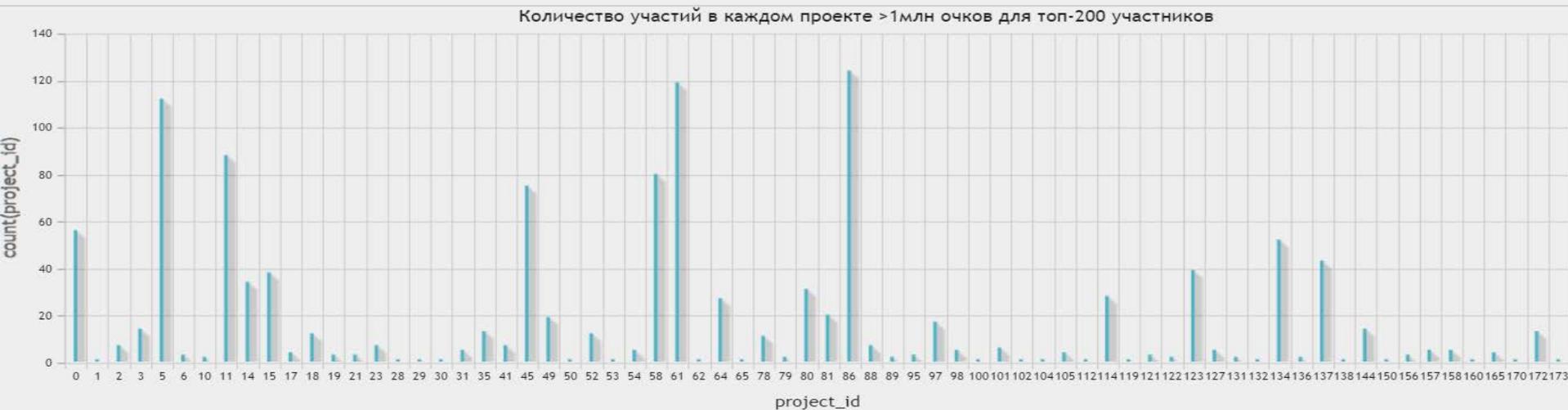
> 1,000,000,000 credits, 1217 projects



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

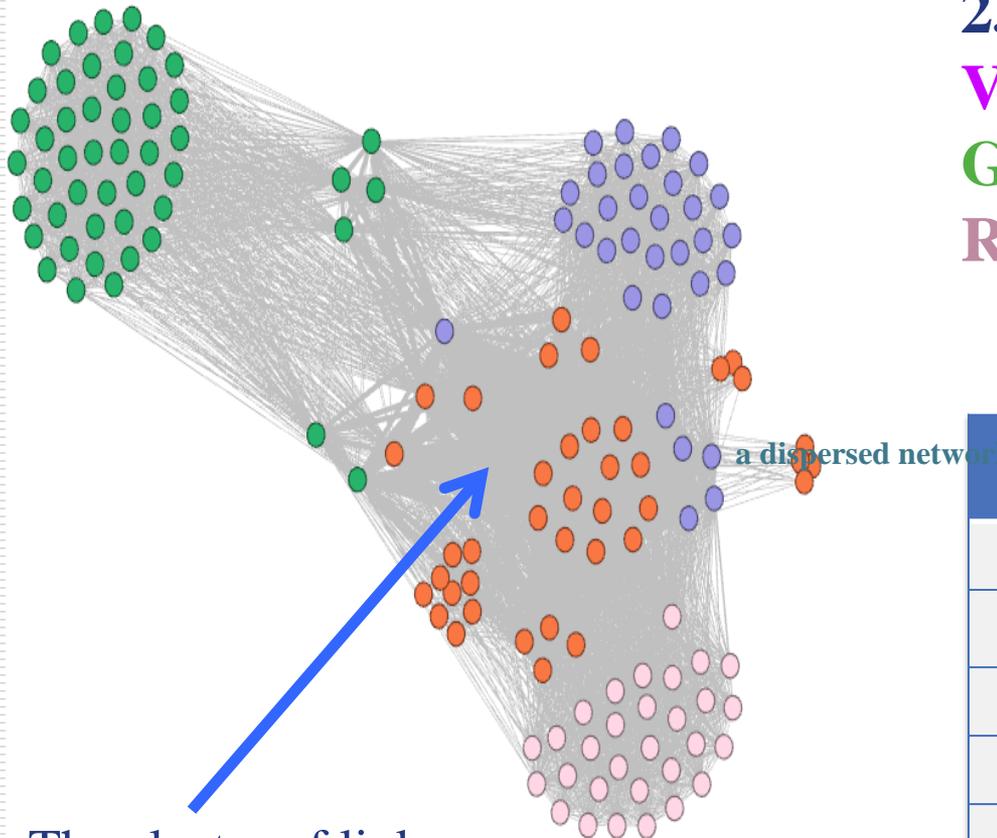


List of Russian BOINC-Projects

All projects «launched» recently, in 2016 – 2017,
«Russia Team» – 2,300 participants; `activity` rating > 500 credits

| Project | Participants |
|---------------------|--------------|
| Gerasim@Home | 557 |
| OPTIMA@HOME | 53 |
| SAT@home | 1528 |
| XANSONS for COD | 11 |
| AndersonAttack | 17 |
| Amicable Numbers | 58 |
| Stop@home | 32 |
| Acoustics@home | 54 |
| ODLK | 7 |

Collaborative network



230 links; 182 participants

Violet – Acoustics@home

Green – OPTIMA@HOME

Rose – Amicable Numbers

Orange

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

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

Game strategy

Importance of online communication – 86%

Team building and teamwork coordination – 67%

Feedback from project organizers – 60,3%

The lexicon (most used terms) in both sections of forum ("Main" and "Competitions Russia Team") - «КОМАНДА», «УЧАСТНИКОВ», «ОЧКИ», «ПРОЕКТЫ».

The “competition” lexicon -

- ❖ «AlexA», «krasbars», «citerra»;
- ❖ «SETI», «SAT», «Cosmology», «AlmereGrid», «Einstein@Home
- ❖ «разрыв», «вполне», «места», «время» (in the context of «ликвидации отрыва/победы/наращивания мощности»)

Conclusion

- ✓ The most active and productive participants in VC exemplify game, “co-opetition” strategy (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



Thanks for attention.

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