

THE GAME CHARACTER OF COLLABORATION IN VOLUNTEER COMPUTING COMMUNITY

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The paper shows the emergence of a new form of online scientific collaboration, the collaborative networks of volunteer computing (VC) participants. And it examines what makes a collaborative VC-project successful and determines the formation of VC-community. We report on data from a statistic online study of volunteers' activities and an online survey of VC-participants on several online forums, and discuss and analyze the emerging type of collaboration network of VC-volunteers. The results can be significant for optimizing VC-management for solving problems that require large computational resources.

Keywords: volunteer computing, online collaboration, virtual communities

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1. INTRODUCTION

The notion of "collaboration" is nowadays a central issue in many fields including business, science and even everyday speech. In this paper it will be used to glean knowledge that will deepen our understanding of an emerging type of scientific distributed computing and online communication.

One of the forms of the distributed computing is the volunteer computing (VC) in which unskilled computer owners can donate their spare computer resources to perform a computation of one or more large-scale research projects.

The VC paradigm is divided into three main points:

The idea of using multiple integrated computers for distributed computing in scientific tasks; the network organization of communications; the distributed network of computers (>1,200,000) implemented in a BOINC software/platform [1].

As a whole VC-projects is based on two pillars:

At first, it is computational VC-space. So, in order to participate in a VC project, a user must download the project software from the VC project website and install it on their computer. Once installed, the project software contacts the project website and is assigned a task. Upon solving the task, the result is sent back to the project server and a new task is downloaded if the user so desires.

And the second, it is VC social structure. VC projects are by their nature decentralized and so, volunteer's communication through online form a *communal virtual place*. Participants in VC projects can either work alone or join a team and work together on the same project. Also all VC-projects have their own websites that are used to host the project software, disseminate information about performing the project and host a ranking table of volunteers' activity. Also there are discussion forums and online groups in social media where they can discuss different aspects and technical problems of distributed computing. So, we can say that VC is a dispersed network of individuals and teams, project and team sites, forums. And the VC organizational framework consists of *projects* – typically academic-based research assignments (there are 57 projects, <http://www.boincstats.com>); *individuals* – Internet-connected low-powered computers (just about 16,9%, survey, May, 2018); *VC teams* – a long-term strategic alliance formed by volunteers (just about 83,1%, survey, May, 2018); *Internet resources* – project websites with statistics in rank tables, discussion forums, etc

The implementation of VC project directly depends on the number of participants, PC (other machines) and time of their work. So, the main question of the project managers – Why do volunteers decided to participates in VC-projects? Most sociological studies of the motives of volunteers' behavior were based on the representation of the community as a set of participants and as a result, the research focuses only on the motivation of individual participants [2-5]. The background of such view is based on an idea that VC participants provide something for others (processing data for scientific projects) at their own cost (time, energy, opportunity costs, use of PC resources). E.g., factors which need for self-oriented motivations.

But we think that a motive of self-actualization is not enough to explain why millions of common people regular (day by day) participate in scientific computation. Our research indicates that the answer lies at the intersection of self-oriented motivation and the interactional and organizational possibilities emerging through the Internet. We suggest: online collaboration can capture people's motivation better than only intrinsic motives.

2. AIMS, OBJECTIVES AND METHODOLOGY

In the study as a metric (measuring the amount of computational time and resources/efforts donated by each volunteer/team), we use conditional points (crédits) that are charged by project managers in the team rating tables posted on the statistical website (www.boincstats.com). The object of the study was Russian VC-community (www.boinc.ru). The object of the study is a lot of participants in the BOINC.RU community. Out of 107,227 teams, uniting more than 4,5 million participants in the VC projects, there are 821 Russian teams. Of 57 active BOINC-projects using the BOINC platform, there are 11 Russian projects.

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". 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 the database were unique participant identifiers, participant names, unique project identifiers, project names, number of units (crédits) of participants/teams for the last week, month, year and all the time, participants' ownership of projects, unique team IDs, team names, team memberships.

3. THE COLLABORATIVE NETWORK'S EFFECT

As it was mentioned before participation in VC is voluntary and participants do not receive compensation for their work. So 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. And many of the projects create an environment for the competitors by volume computations are done, both individually and in the team event. Thus modus operandi of VC – is spirit of competition. 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.

As an example, we can cite the Russian project SAT@home [6], which is actively supported by national volunteers. For the period of each of these competitions the project's productivity increased by about 7,4 teraflops with the average value in 4,3.

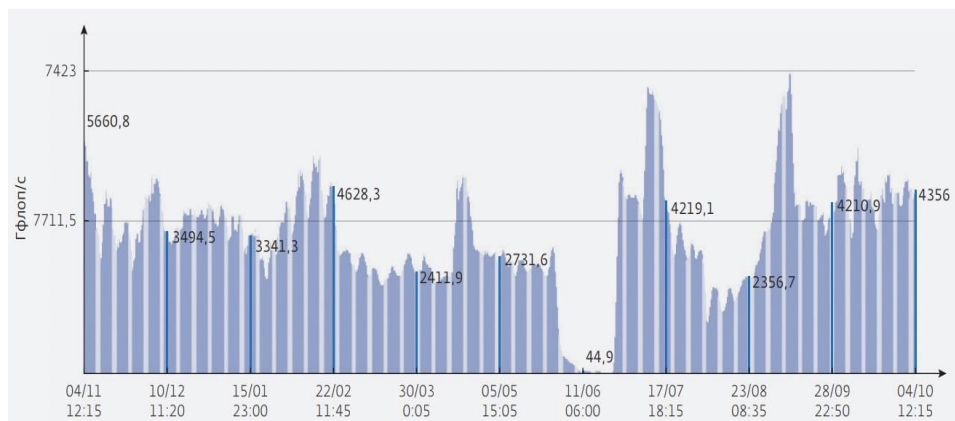


Figure 1. The performance of the SAT@home project. The peaks correspond to the moments of the competition among teams of volunteers

In order to highlight traces of collaborative networks we will allocate links between the active volunteers in a whole Boinc.ru community. For determining an 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.

Having constructed a connectivity table, where a_{ij} – the number of general projects for two volunteers we construct a graph.

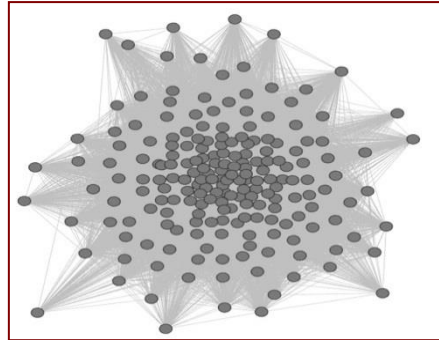


Figure 2. Visualization of links in group `active volunteers` (>50 000 credits, 2176 projects)

Increasing the participation threshold in the project to 100 000 crédits, followed by up to one million crédits hardly changes the picture evaluation of the participation of the 200 most active volunteers. In spite increasing the threshold the form of graphs does not change. It means that almost all active users are connected with some projects.

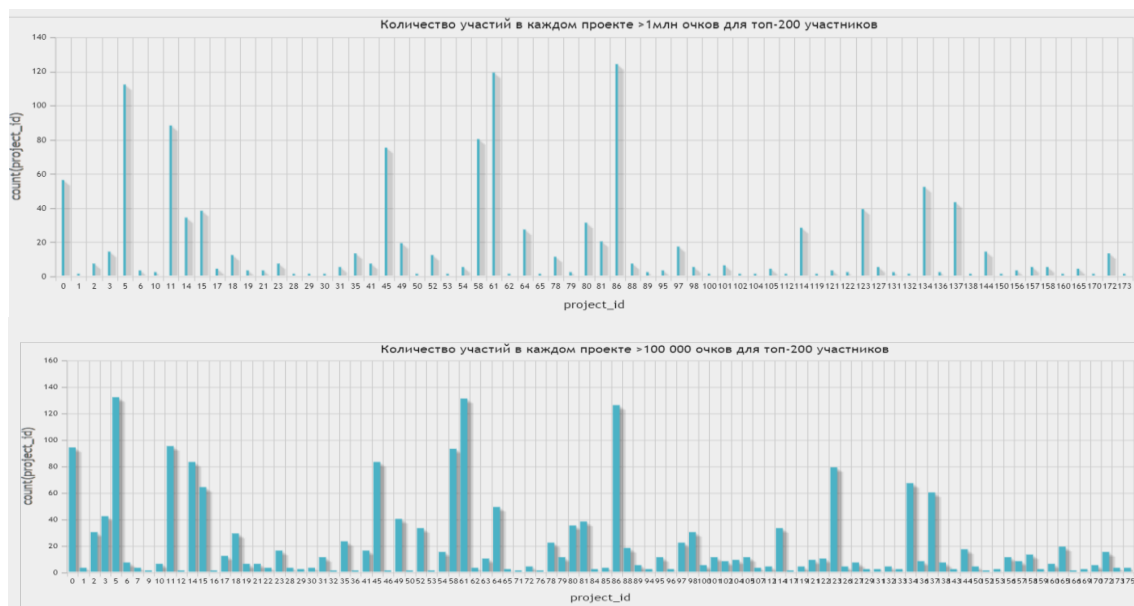


Figure 3. Distribution of active participants in the projects

In spite increasing the threshold the distribution of the participants in the projects are very similar. And as can be seen from the distribution and height of the peaks, which corresponds to the number of participants in the projects, these active volunteers participate in almost the same projects. The most active users are not inclined to participate in projects "on trial", they thoroughly approach the choice of the project and actively participate in the accruals.

If we look for the communication between participants of the largest team in Russian projects, ("Russia Team") and construct a graph, we see the graph of the links (participation) of volunteers in 7 projects (orange cluster is dedicated to the collaborative community).

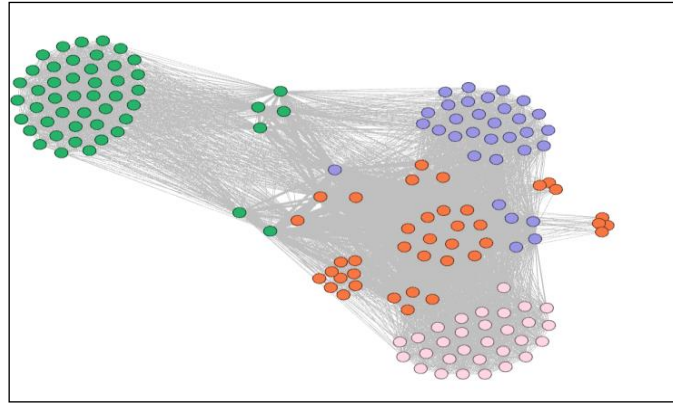


Figure 4. Collaborative network

The unification of volunteers into this group, without a provocation, shows that these are not only active, but also interested community members who follow the BOINC space, analyze the information and agree on the preference for new projects. Such behavior of the community members testifies, very likely, about their interaction with each other on third-party network resources.

4. Acknowledgement

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5. Conclusion

The most active and productive participants in VC are exemplify “co-competition” [7], 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

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