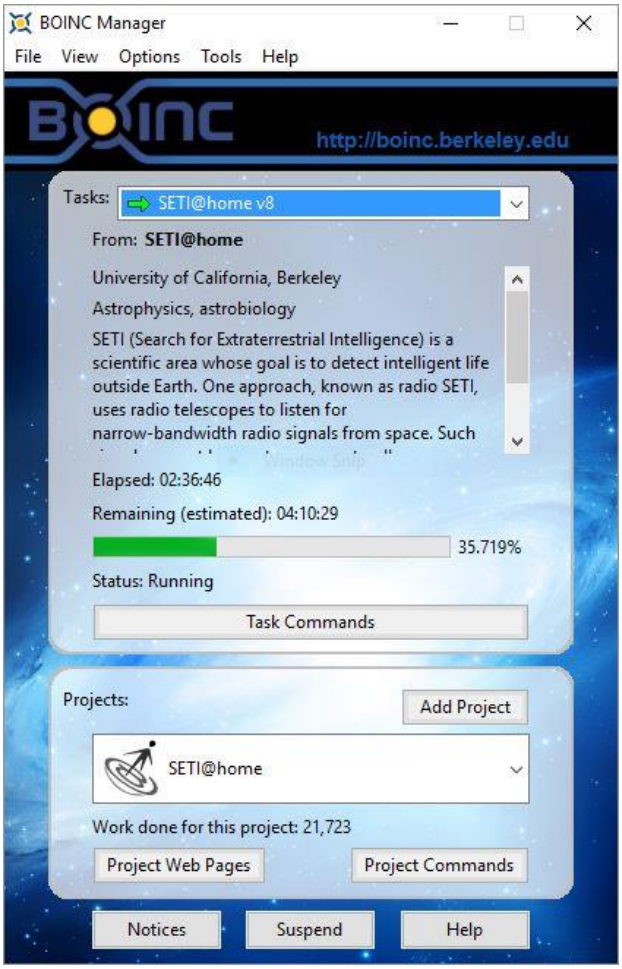
Peer-to-Peer Systems/ Grid Systems

Berkeley Open Infrastructure for Network Computing (BOINC)

The topic I chose to cover is the peer-to-peer networking / grid middleware system. Peer-to-peer and grid middleware share similar application uses but approach large data loads differently. I wanted to review the Berkeley Open Infrastructure for Network Computing (BOINC) middleware application that provides large-scale problem-solving computations through peer-to-peer and grid implementations. There are many community projects that utilize the BOINC middleware application I chose to cover three of these projects as real-world applications: World Community Grid, Climateprediction.net and SETI@home.

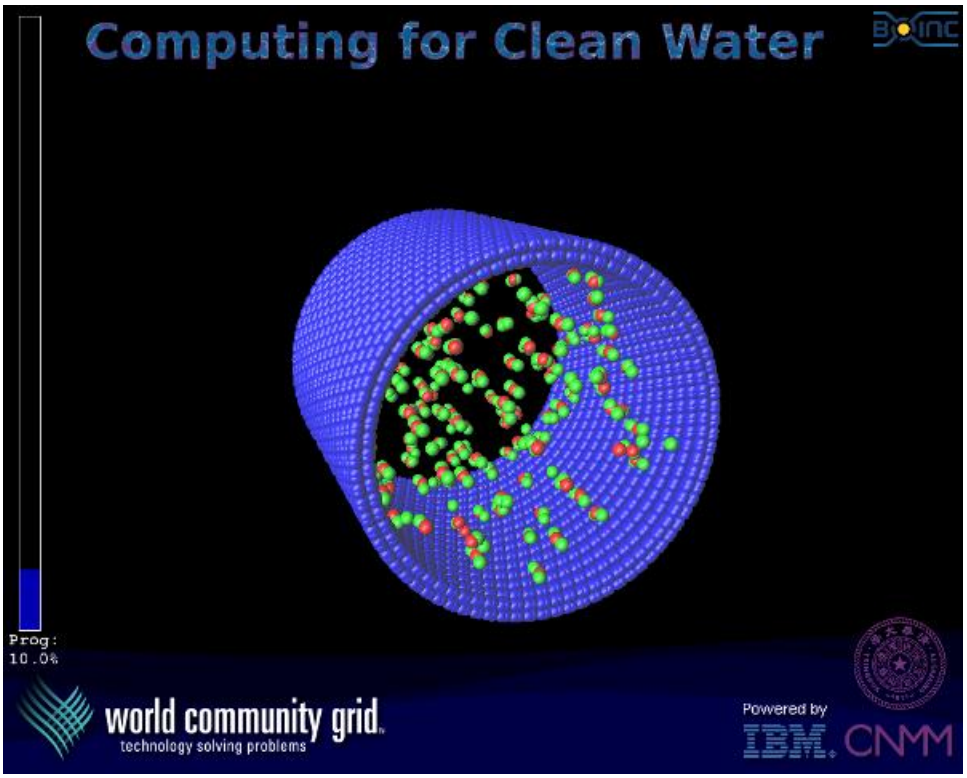


BOINC is “an open-source middleware system, supports volunteer and grid computing. Originally developed to support the SETI@home project, it became generalized as a platform for other distributed applications in areas as diverse as mathematics, linguistics, medicine, molecular biology, climatology, environmental science, and astrophysics, among others. BOINC aims to enable researchers to tap into the enormous processing resources of multiple personal computers around the world.” (6) BOINC places the results of the public projects in the public domain allowing researchers worldwide to contribute and discuss the results of the projects. This also allows the public communities on a global scale have the power to shape the course of a project.

BOINC can run its client software over a heterogeneous collection of computers and networks thanks to the implementation of virtual machine layers on client machines. A main concern of peer-to-peer networks and grid computing is users (clients) should not notice a performance issue due to the implementation of the peer-to-peer server system. BOINC ensures this by only utilizing clock cycles of the CPU and GPU during times that the client computer is considered idle.

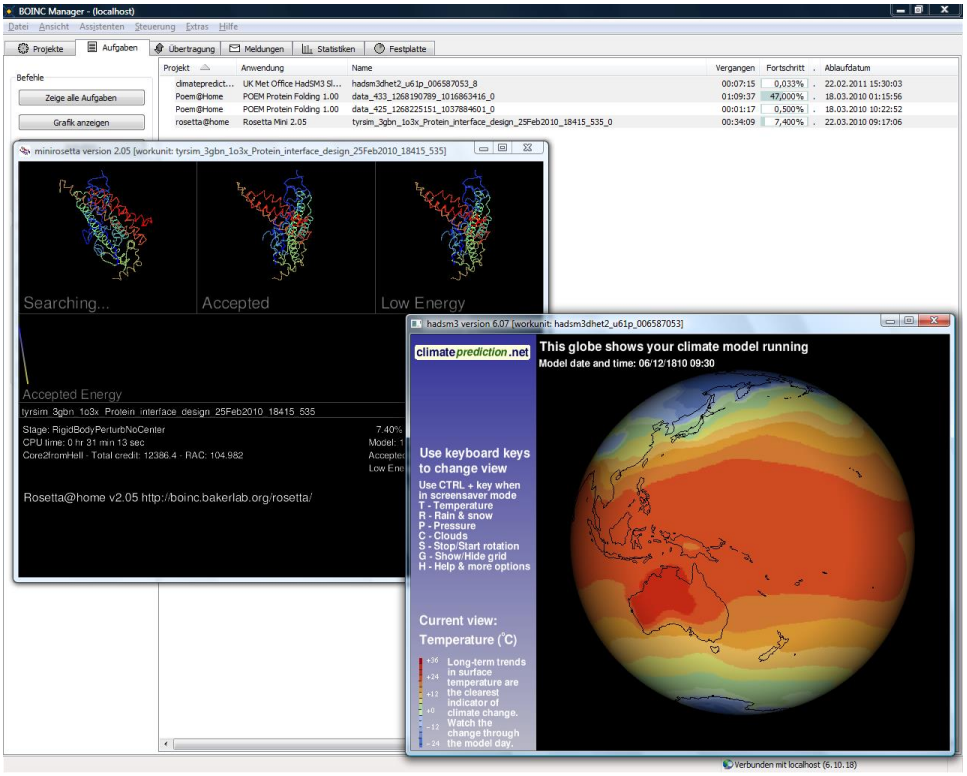
BOINC can scale easily from one to many server machines to handle the workloads of various projects utilizing the server software. This server uses two Common Gateway Interfaces (CGI) to interact with requests from client applications for workload requests and completed computation submissions. (7) The scheduler CGI handles requests from clients for work to compute and forward received work to various daemons

World Community Grid is an attempt to create the world's largest computing grid to assist with calculations on scientific research projects. WCG's research projects include research topics such as the human genome, HIV, muscular dystrophy, cancer, influenza, and Ebola. (3) The WCG utilizes the idle time of internet connected computers via the middleware application BOINC. The WCG server sends out workunits, or blocks of computations to perform, to clients participating in the grid. In order to check for accuracy multiple copies of the same workunits are sent to various clients and the received completed results are compared against each other. The WCG uses idle CPU cycles to perform the calculations however the recent performance enhancement of newer CPU's can create overheating issues on systems using WCG. The BOINC middleware monitors CPU usage and throttles the usage to reduce overheating.



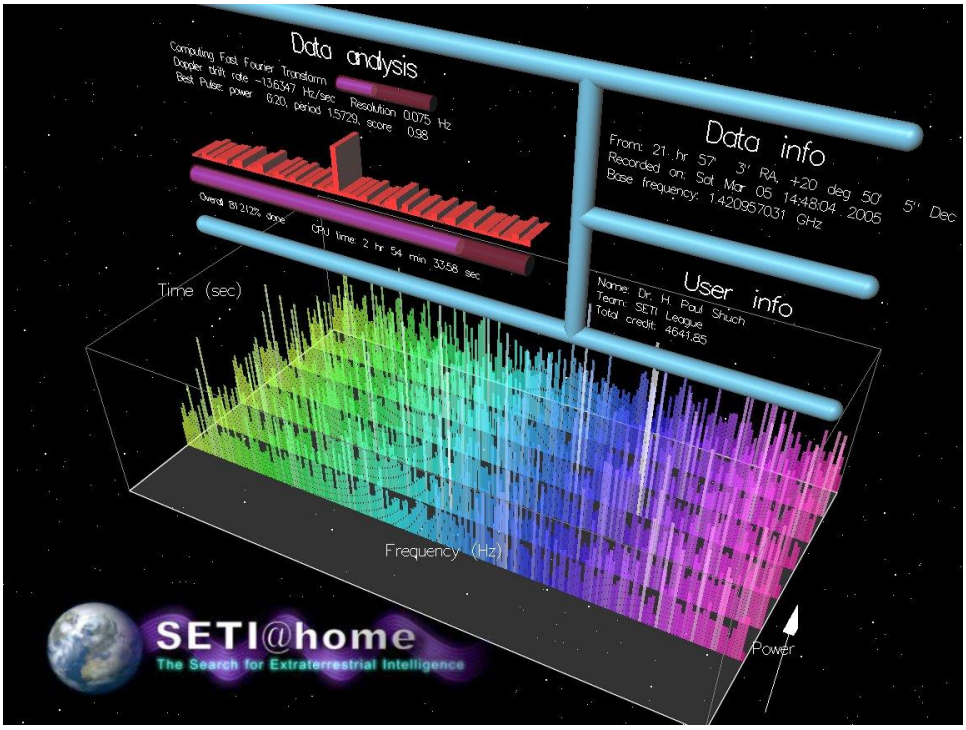
Climateprediction.net (CPDN) is another volunteer computer application that uses BOINC to harness the power of volunteer client computers to investigate and reduce

uncertainties in climate modeling. CPDN “aims to do this by running hundreds of thousands of different models using the donated idle time of ordinary personal computers, thereby leading to a better understanding of how models are affected by small changes in the many parameters known to influence the global climate.” (4) Similar to WCG and SETI@home client machines receive workunits from the CPDN server to perform calculations on and the results are sent back to the CPDN server.



No discussion of BOINC would be complete without mentioning the application and development of the BOINC middleware thanks to the research initiative SETI@home. “Its purpose is to analyze radio signals, searching for signs of extraterrestrial intelligence, and as such is one of many activities undertaken as part of the worldwide SETI effort.” (5) SETI servers send workunits for computation to clients with the BOINC software installed. Once completed the

client workstations send the results back to SETI servers where the dataset is cross-referenced and checked for validity.



I was curious to learn more about peer-to-peer middleware applications after learning about project SETI@home during a class discussion about peer-to-peer networking.

References

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