Distributed Chess AI Computation through RT-BOINC

- Sangho Yi, Emmanuel Jeannot, Derrick Kondo -

Related work #1: **Towards Real-Time, Many Task Applications on Large Distributed Systems** (Euro-Par 2010)
Related work #2: **RT-BOINC: A Massive Parallel Real-Time Computing Platform using Volunteered Resources** (will be submitted to FGCS)

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Introduction to RT-BOINC

RT-BOINC

is

a

Real-Time

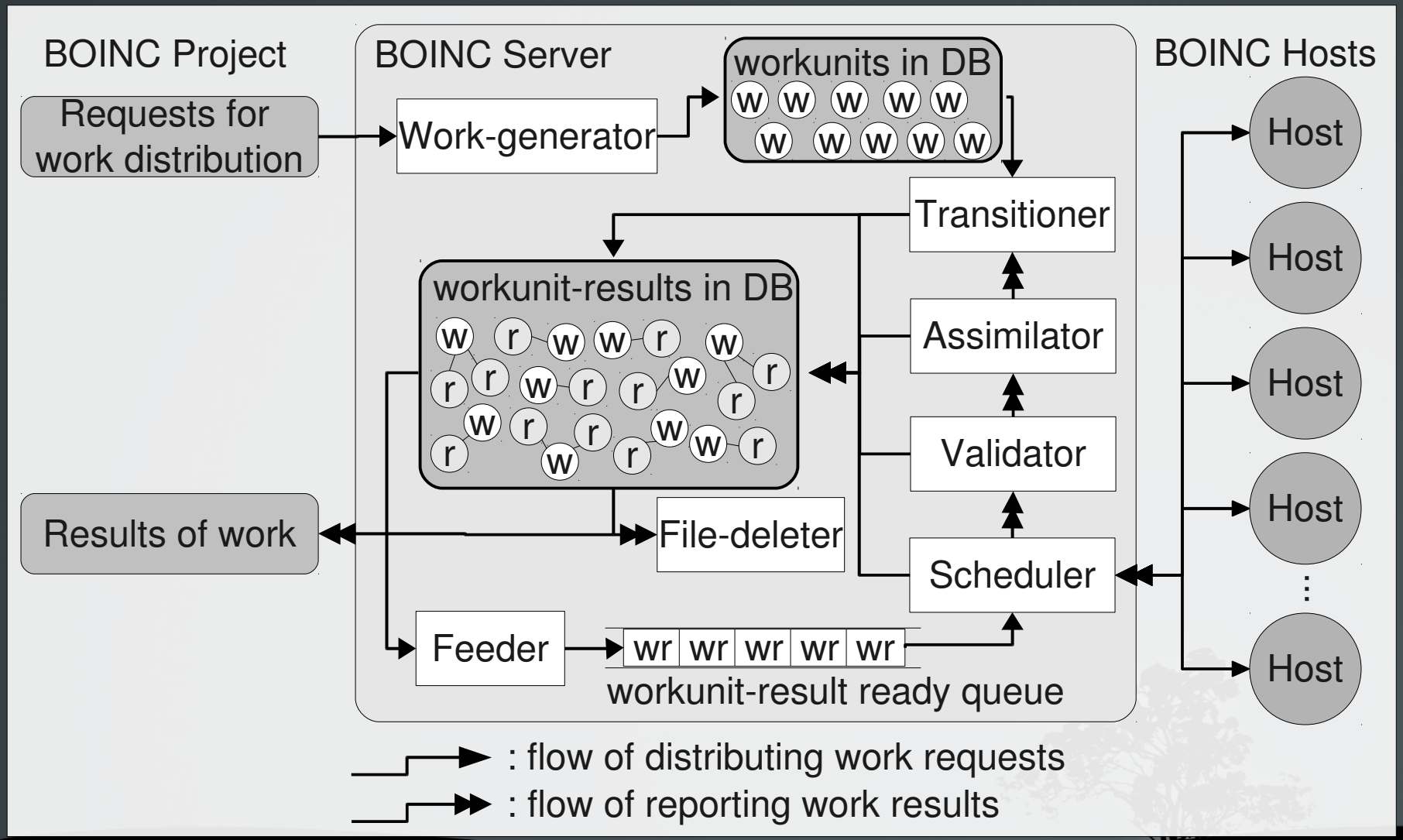
BOINC.

RT-BOINC in a Nutshell

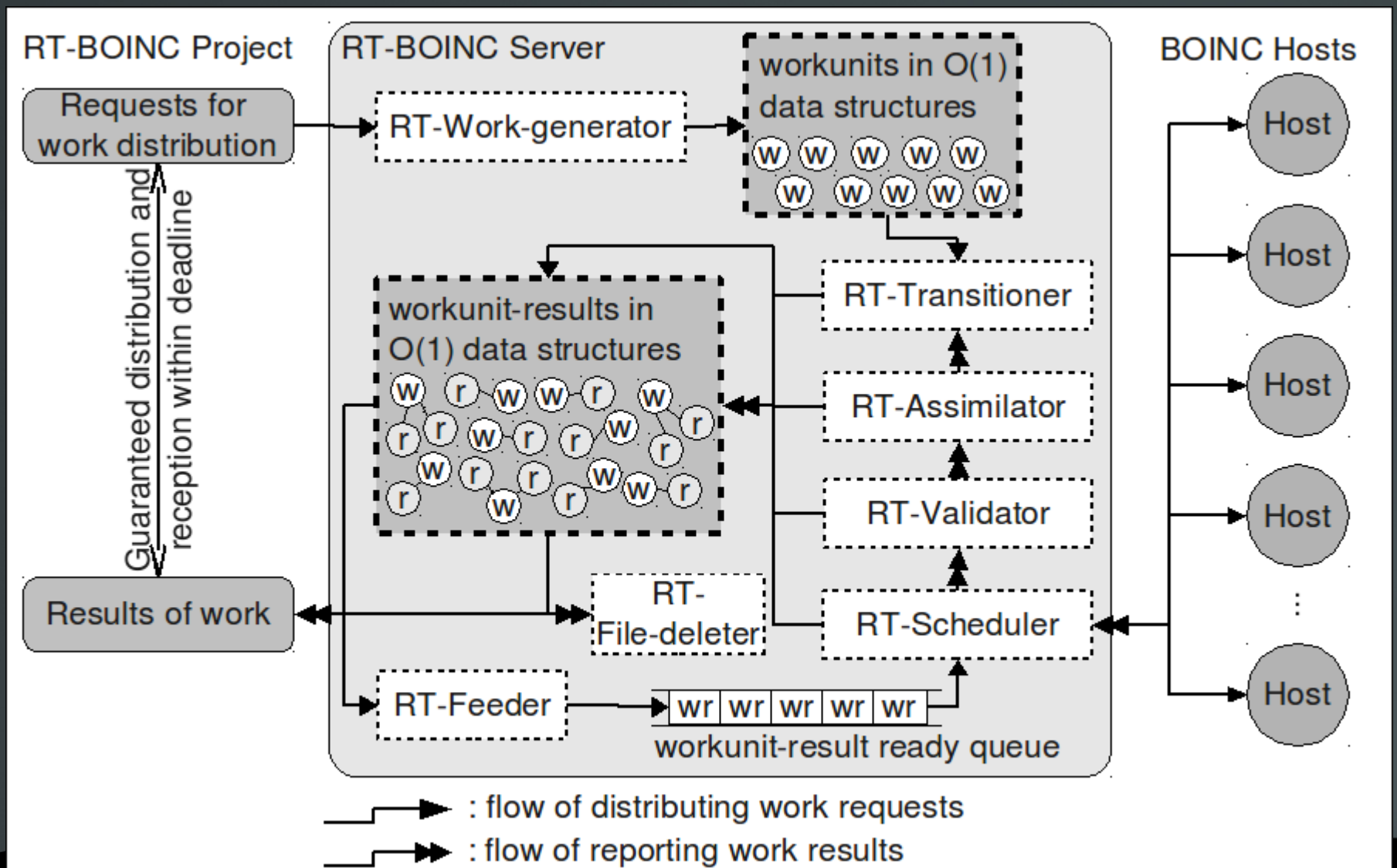
- RT-BOINC features
  - Low WCET (worst-case execution time) for all server-side operations (300~1,000 times faster)
  - No database operations at run-time
  - O(1) interfaces for data structures
  - Reduced complexity for server daemons
    - Almost O(1) (up to ~ O(n))

BOINC, RT-BOINC, what's the difference?

Original BOINC Internal



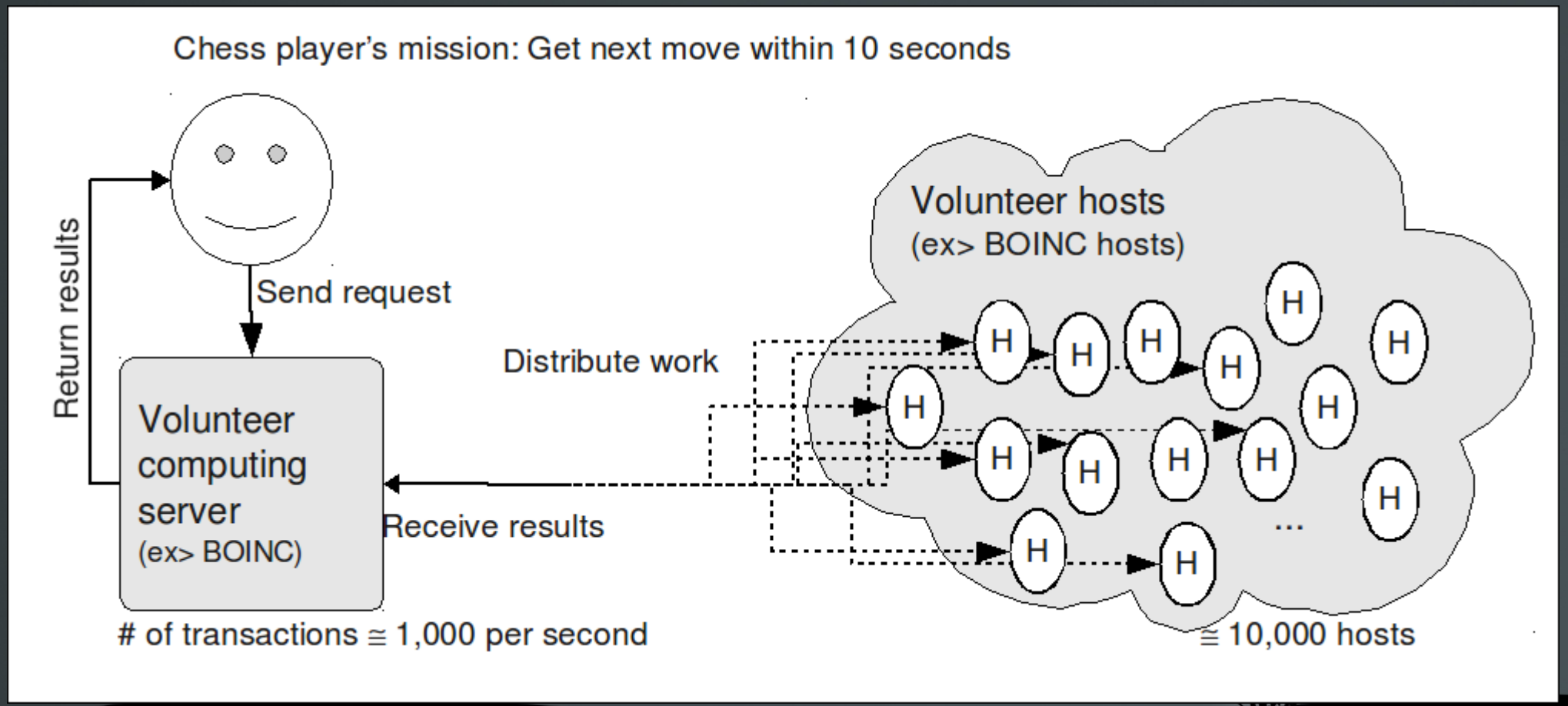
RT-BOINC Internal



When do we need a RT-BOINC?

Short-term, real-time applications

- An example: "10-second-completion." - in a "Chess game"



Why cannot BOINC work?

Actually, BOINC …

- BOINC is tailored for maximizing throughpht, not minimizing latency.
- BOINC does not support real-time task management in order of seconds.
- BOINC supports only the order of days, or hours of deadline management.
- BOINC normally handles <100 transactions per second

But, BOINC can be tuned to support short-term, real-time tasks, isn't it?

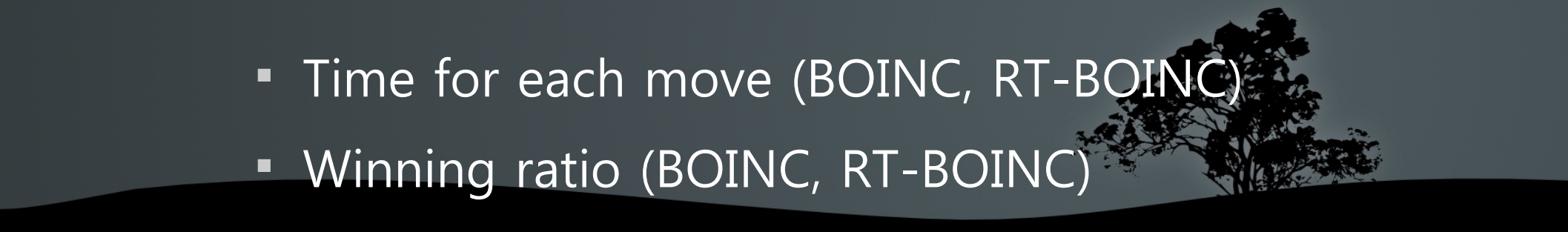
Maybe Yes, Maybe No.

- BOINC has at least O(log n) ~ O(n) complexity for handling internal data records. (up to polynormials)
  - BOINC may work with small number of volunteers.
  - BOINC may **NOT** work more than a few hundreds cores of volunteered resources.

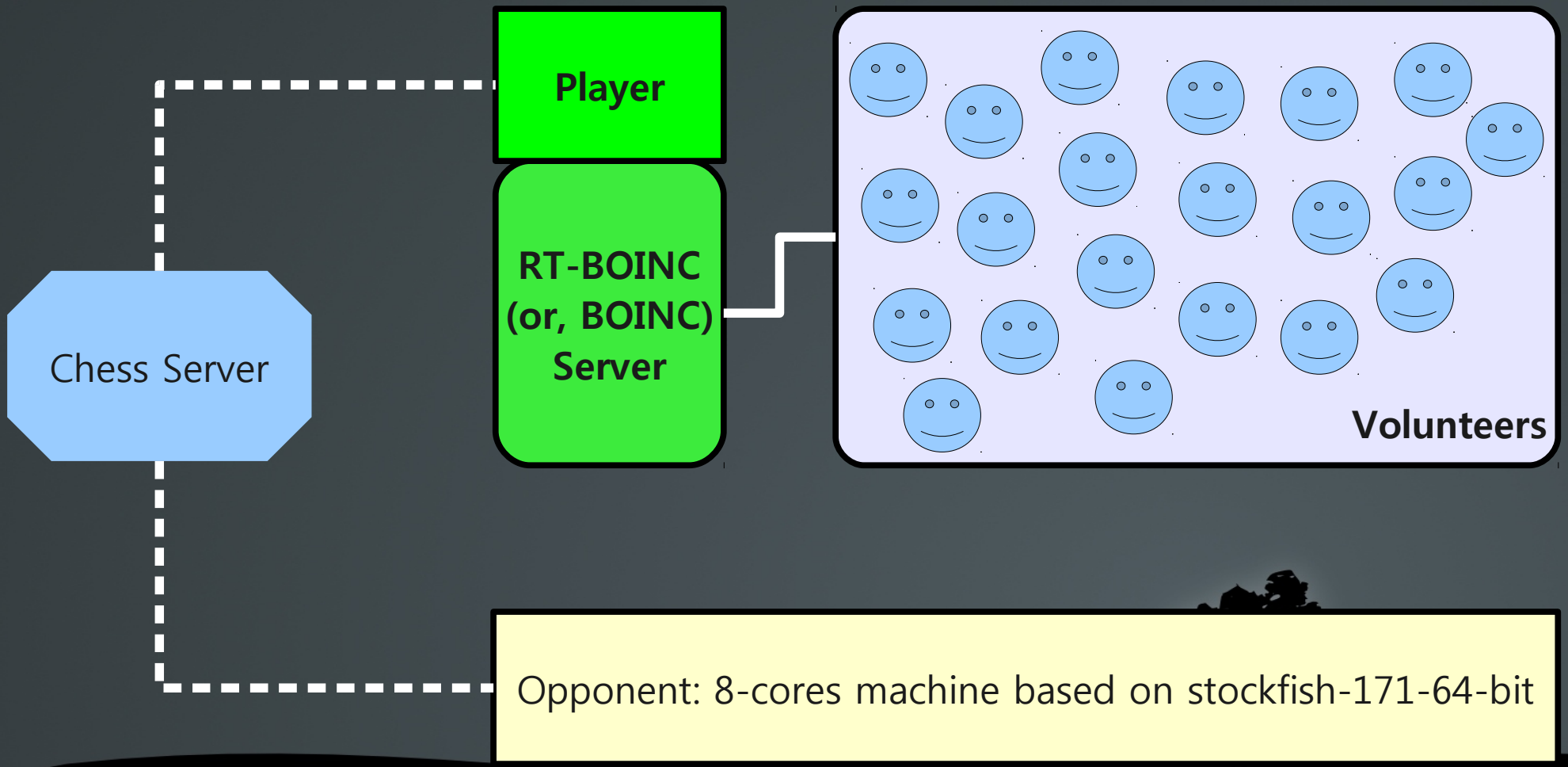
OK, show me the evidence!

Case Study: Chess AI on RT-BOINC

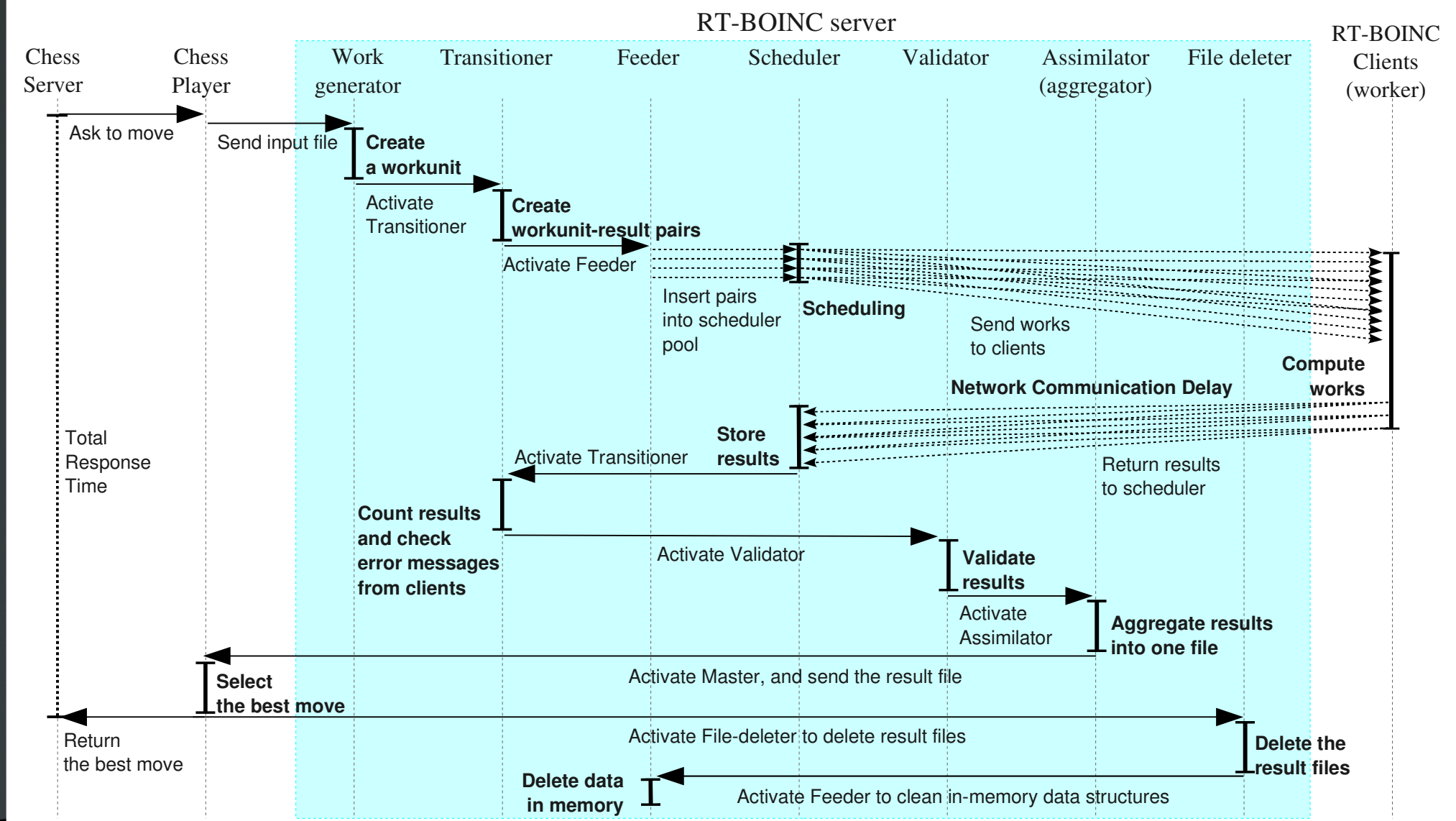
- Chess AI:
  - Emmanuel Jeannot's Distributed Chess AI (based on stockfish-171-64-bit version)
- Evaluation Method:
  - RT-BOINC (or, BOINC) plays Chess against one machine.
- Evaluation Criteria:
  - Time for each move (BOINC, RT-BOINC)
  - Winning ratio (BOINC, RT-BOINC)



How does it work?



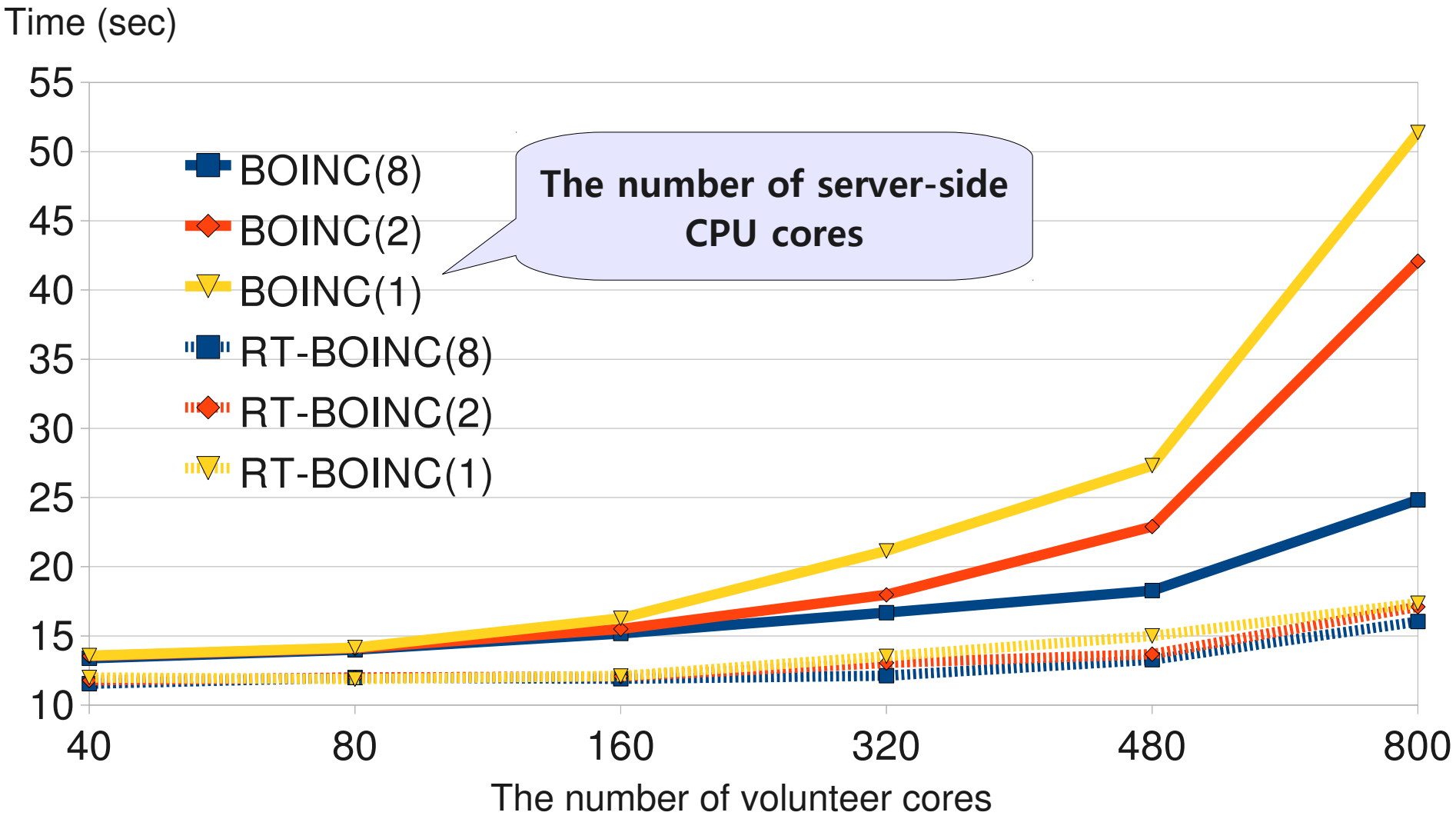
How does it work in the server?



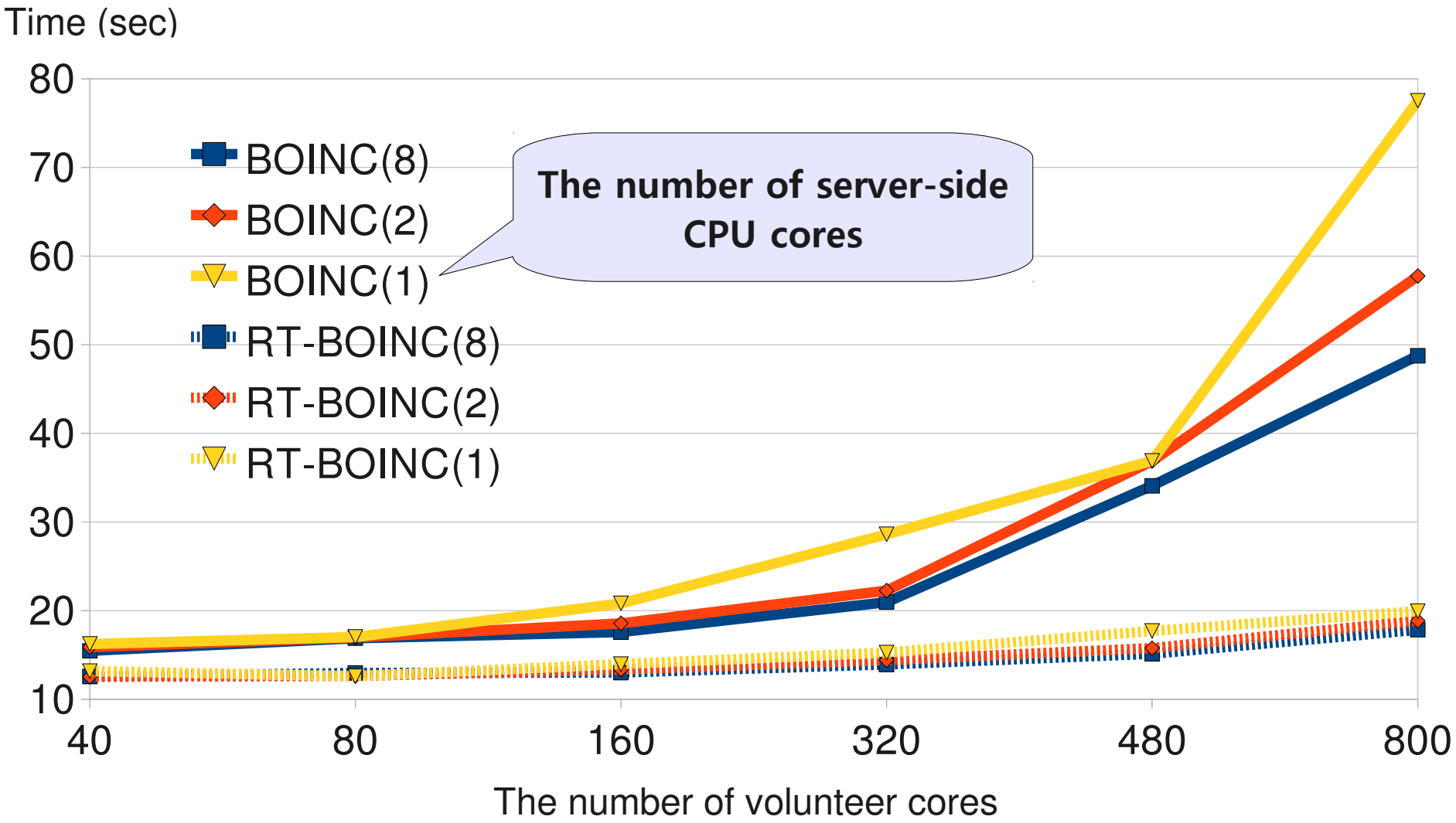
Parameters

- Number of volunteer CPU cores
  - 40, 80, 160, 320, 480, 800 cores (from G5K)
- Number of server-side CPU cores
  - 1, 2, 8 cores
- The amount of computation for each client
  - Fixed to 5 seconds

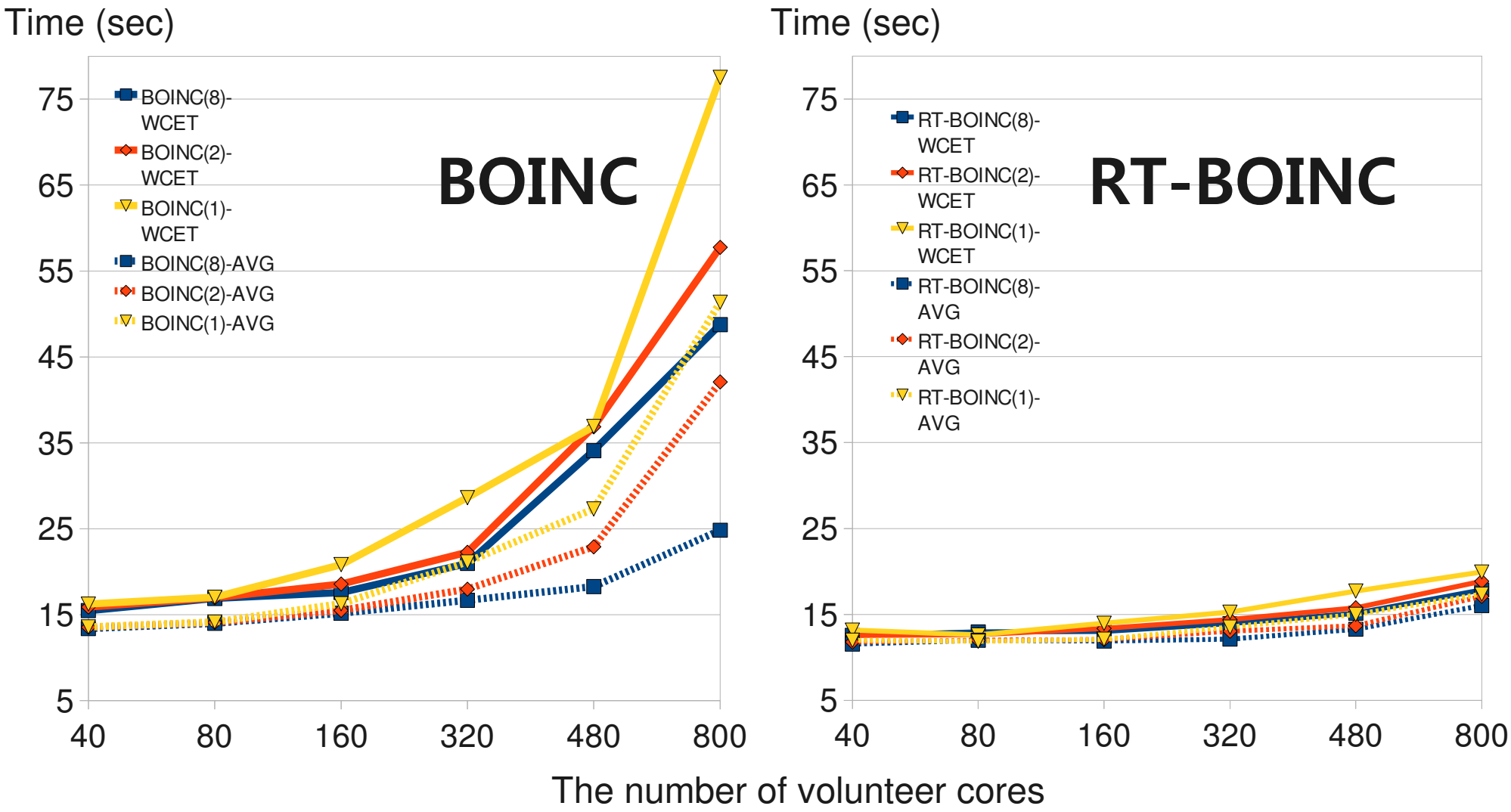
Average Response Time



Worst-case Response Time

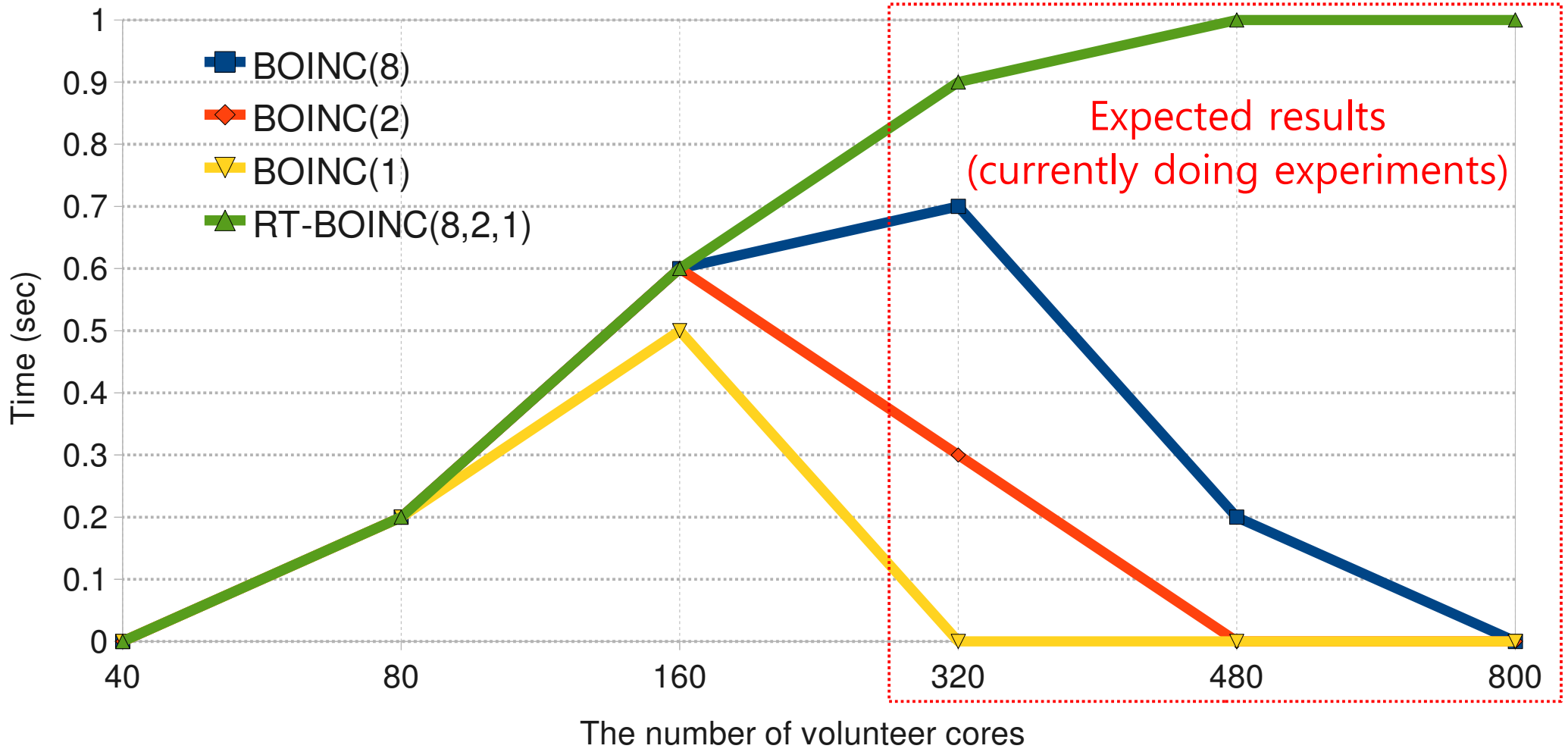


Performance Gap between Average and the Worst-case



Winning Ratio vs. Opponent

(where time constraint = 20s/move)



Can I get the source code of RT-BOINC?

Documents on the Web

- http://rt-boinc.sourceforge.net

RT-BOINC stands for a Real-Time BOINC

It was designed for managing highly-interactive, short-term, and massively-parallel real-time applications. We designed and implemented RT-BOINC on top of BOINC server source codes.

Contact information: Sangho Yi and Derrick Kondo

For users

Download RT-BOINC files
Project detail and discuss
Get support
Donate money

For developers

Join this project:

To join this project, please contact the project administrators of this project, as shown on the project summary page.

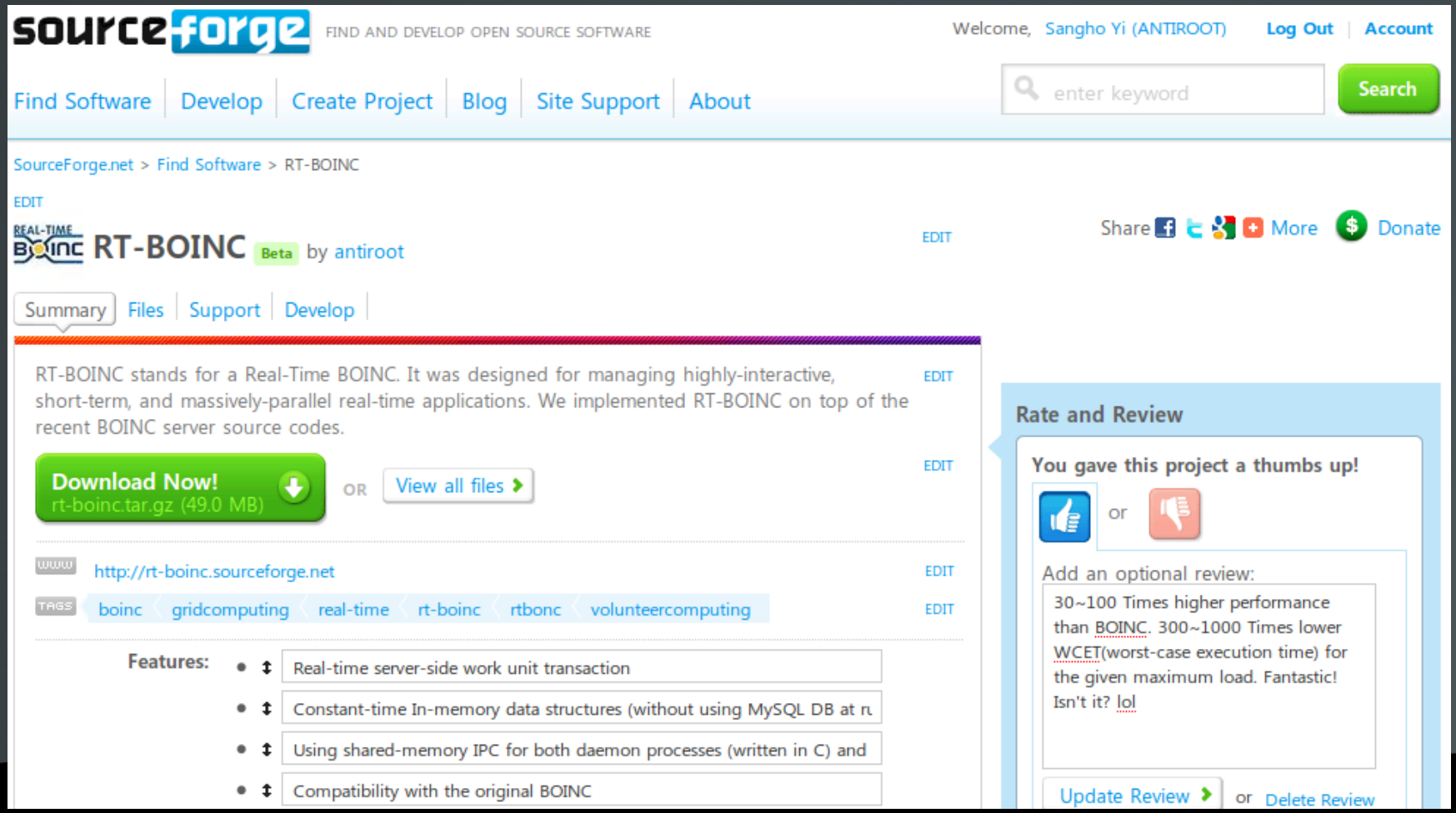
Get the source code:

Source code for this project may be available as downloads or through one of the SCM repositories used by the project, as
page.

About RT-BOINC

Source code on the Web

- http://sourceforge.net/projects/rt-boinc



Does RT-BOINC have some remaining issues for future work?

Remaining Issues (1)

- Trade-off between Space and Time
  - More memory usage → Lower WCET
  - Less memory usage → Higher WCET
- Memory Management
  - Current RT-BOINC manages data records on a (static) shared memory segment.
  - Static management = space-inefficient, simple, faster
  - Dynamic management = space-efficient, complicated, slower when reallocating shared memory segment

Remaining Issues (2)

- Resource-aware Scheduling Policies
  - Latency-aware Scheduling → Lower distribution of network communication delay
  - Availability-aware Scheduling → Lower # of deadline misses in the presence of unavailability
- Better O(1) data structure
  - To reduce memory space usage
  - To reduce WCET

Thank you!

(to be continued in the future...)