



University of Luxembourg

# GreenCloud Simulator

User Manual

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## Introduction

GreenCloud is a sophisticated packet-level simulator for energy-aware cloud computing data centers with a focus on cloud communications. It offers a detailed fine-grained modeling of the energy consumed by the data center IT equipment, such as computing servers, network switches, and communication links.

GreenCloud can be used to develop novel solutions in monitoring, resource allocation, workload scheduling as well as optimization of communication protocols and network infrastructures. It can simulate existing data centers, guide capacity extension decisions as well as help to design future data center facilities.

GreenCloud, released under the General Public License Agreement, is an extension of the well-known NS2 network simulator. About 80 percent of GreenCloud code is implemented in C++, while the remaining 20 percent is in the form of Tool Command Language (TCL) scripts.

GreenCloud has been elaborated in the context of ECO-CLOUD and GreenIT projects.

## Getting Started: download and installation

GreenCloud simulator is an extension of NS-2 network simulator. It comes as an archived source tree, or as a [pre-configured VM](#), which works with VirtualBox and VMWare Player. The VM also includes a pre-configured Eclipse environment, so it is the easiest way to download GreenCloud and start running simulations and/or modifying the source code.

If you are building GreenCloud on a non-VM machine, here are the basic instructions:

1. [Download GreenCloud](#)
2. Unpack the downloaded software. It comes already integrated into NS-2 source code.
3. Navigate to the extracted directory.
4. Run `./install.sh` to do a full installation (it should work on any Debian-based system with a 3.2+ kernel, i.e. Ubuntu 12.x and higher).
5. Execute the simulation script by running `./run`.
6. View the dashboard by opening `show-dashboard.html`.

## Simulation Setup

The simulation is setup using TCL files located in `./src/scripts/` directory. The main file `main.tcl` determines the data center topology and simulation time. It also calls a set of the following simulation scripts:

- `setup_params.tcl` contains general configuration of servers, switches, tasks, monitoring and migration
- `topology.tcl` creates the data center network topology
- `dc.tcl` creates the data center servers and VMs

- `user.tc1` defines behavior of cloud users
- `record.tc1` sets up runtime results reporting procedures
- `finish.tc1` calculates and reports simulation statistics.

The simulation is run by executing the `./run/` script. It contains the following three simulation parameters:

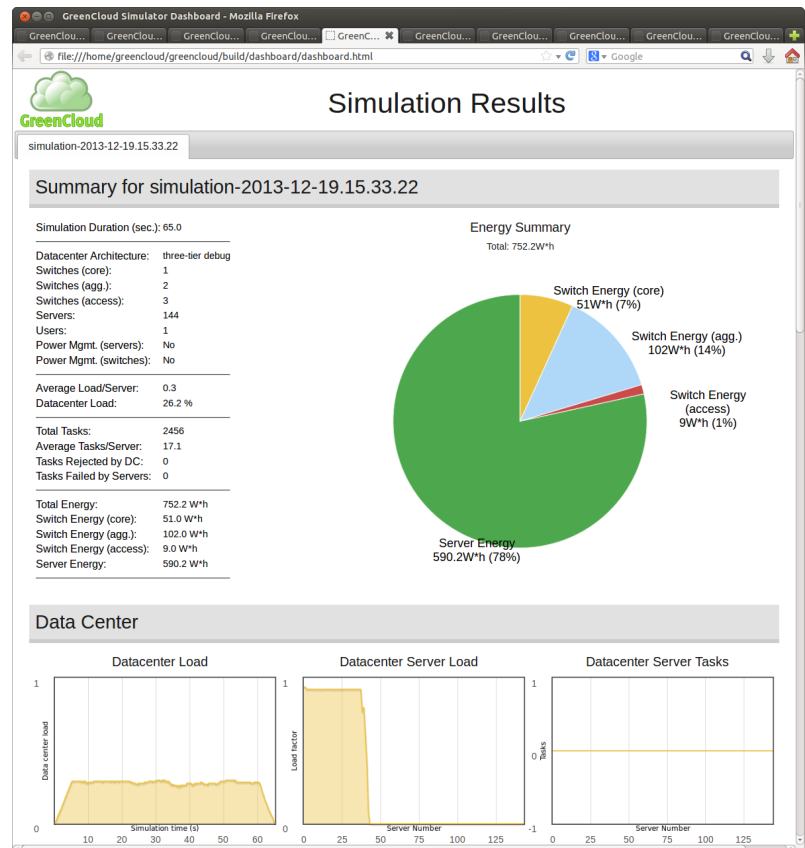
- Data center load defines the number and computing requirements of incoming tasks with the respect to the data center capacity. Usually the load should be between 0 and 1. The load close to 0 represents an idle data center, while the load equal or greater than 1 would saturate data center.
- Simulation time shows the maximum time allowed for task execution, while tasks deadlines have impact on the timesharing behavior of tasks. Longer deadlines allow more tasks to be executed in parallel on a single host or a VM.
- Memory requirement defines the maximum size of the simulated memory resource that can be used in multi-tasking.

## Simulation results

Output results can be accessed as raw values in trace files (`./traces/`) or the form of a dashboard generated from the raw values. The first section of the dashboard presents the summary for simulation, identified by the time it was executed. The summary includes a text overview and a pie chart which presents the total energy consumed by different data center IT systems.

The Data Center section presents the status of the data center components. It consists of the three main indicators: load, submitted tasks and failed tasks. The load is presented as a value between 0 and 1 and plotted against the simulation time (for the average data center load) or server/VM number (id). The plots for submitted tasks and failed tasks per server/VM number are presented in a similar manner.

The Data Center Network section describes link loads and queue sizes of data center networking links. The Uplink and Downlink statistics are



grouped in the respective subsections. The plots against time present the status of single links selected in `setup_params.tcl`.

The last section presents the Energy Consumption statistic as the total consumption per server and switch.

## Tips and tricks

Multiple simulations can be run from a single run script. In such case, the results of different runs are accessible by tabs in the top of the dashboard.