

# CloudSim

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Hugo Boyer, Carlos Agüero, Brian Gerkey

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# Introduction

# Introduction

## OSRF

To support the development, distribution, and adoption of open source software for use in robotics research, education, and product development.

## Hugo Boyer

Senior software engineer

## Carlos Agüero

Senior software engineer

## Brian Gerkey

Chief executive officer

## Steffi Paepcke

UX

## Brant Revill

Web

# Introduction



# Introduction

**CloudSim** Settings

bramrevit@gmail.com

HOME

- Console
- Settings
- Source
- OSRF
- Logout

CloudSim Version: 1.4.0  
Open Source Robotics Foundation

### OSRF CLOUD CREDENTIALS

NAME:

API KEY:

[Override](#)

Set new credentials. These changes will be used for each new constellation.

### AMAZON WEB SERVICES CREDENTIALS

ACCESS KEY:

SECRET ACCESS KEY:

AVAILABILITY ZONE:  [Override](#)

Set new AWS credentials and availability zone. These changes will be applied on the new constellations.

### CLOUDSIM USERS

User Email	Role	Actions
bramrevit@gmail.com	admin	
hugo@osrfoundation.org	admin	

NEW USER'S EMAIL ADDRESS:

USER'S ROLE:  [Add user](#)

Do not remove the last remaining administrative user!

### SSH KEY DOWNLOAD

[DOWNLOAD KEY](#)

# Introduction

The screenshot displays the CloudSim web console interface. The top left corner features the CloudSim logo and the user's email address, brantrevil@gmail.com. The main header is labeled "Console". A navigation menu on the left includes "HOME", "Console", "Settings", "Source", "OSRF", and "Logout". Below the menu, it indicates "CloudSim Version 1.4.0" and "Open Source Robotics Foundation".

The main content area is titled "LAUNCH A MACHINE CONSTELLATION". It contains a "CONSTELLATION" dropdown menu set to "AWS CloudSim". Below this, it states "1 machine for starting a CloudSim on the cloud: A micro instance web app clone" and includes a "Launch" button.

The "CONSTELLATIONS" section shows a single constellation with ID "cx786e9e4a" and name "AWS CloudSim", launched by brantrevil@gmail.com at 2013-05-08 18:38:23. The constellation is in a terminated state, with a "Download Keys" button and a "Terminate" button. The console displays two error messages: "Launch terminated" and "Machine state terminated". Below these messages is a graph titled "RTT latency to its parent CloudSim" with a y-axis from 0 to 600 ms and an x-axis from 30 to 0 seconds. The graph area is currently empty.

# Introduction

**Task properties**

Task title  
VRC task 1, run 1

**Simulation parameters**

ROS package  
atlas\_utils

Launch file  
atlas.launch

Maximum time (sec)  
1800

Arguments

**Network parameters**

Minimum latency (ms, round trip)  
0

Uplink cap (bits for each s of run time)  
1000000

Downlink cap (bits for each s of run time)  
1000000

Update

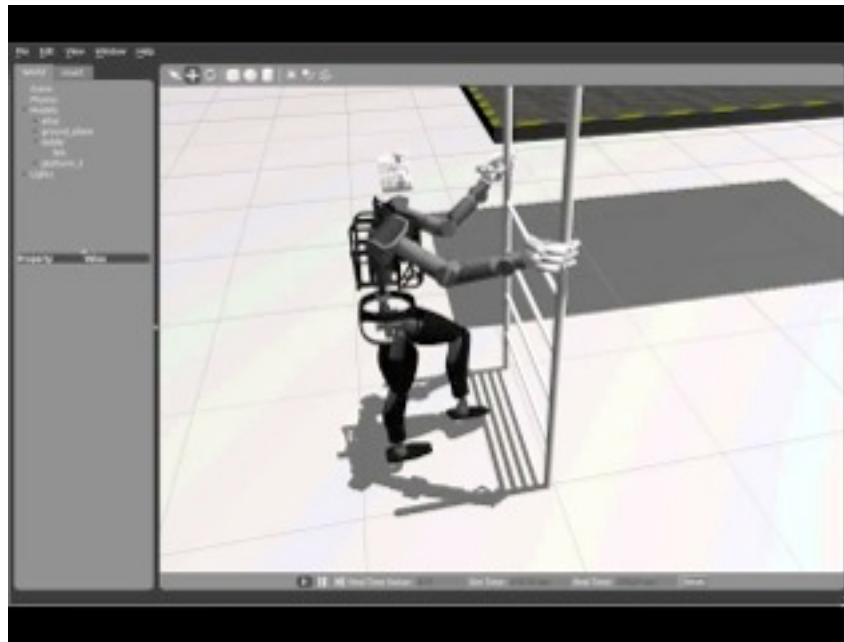
**Simulation tasks**

Create task... Stop current task...

● Task 1 run 1 Start View X



# Introduction



# DARPA Robotics Challenge

# DARPA Robotics Challenge

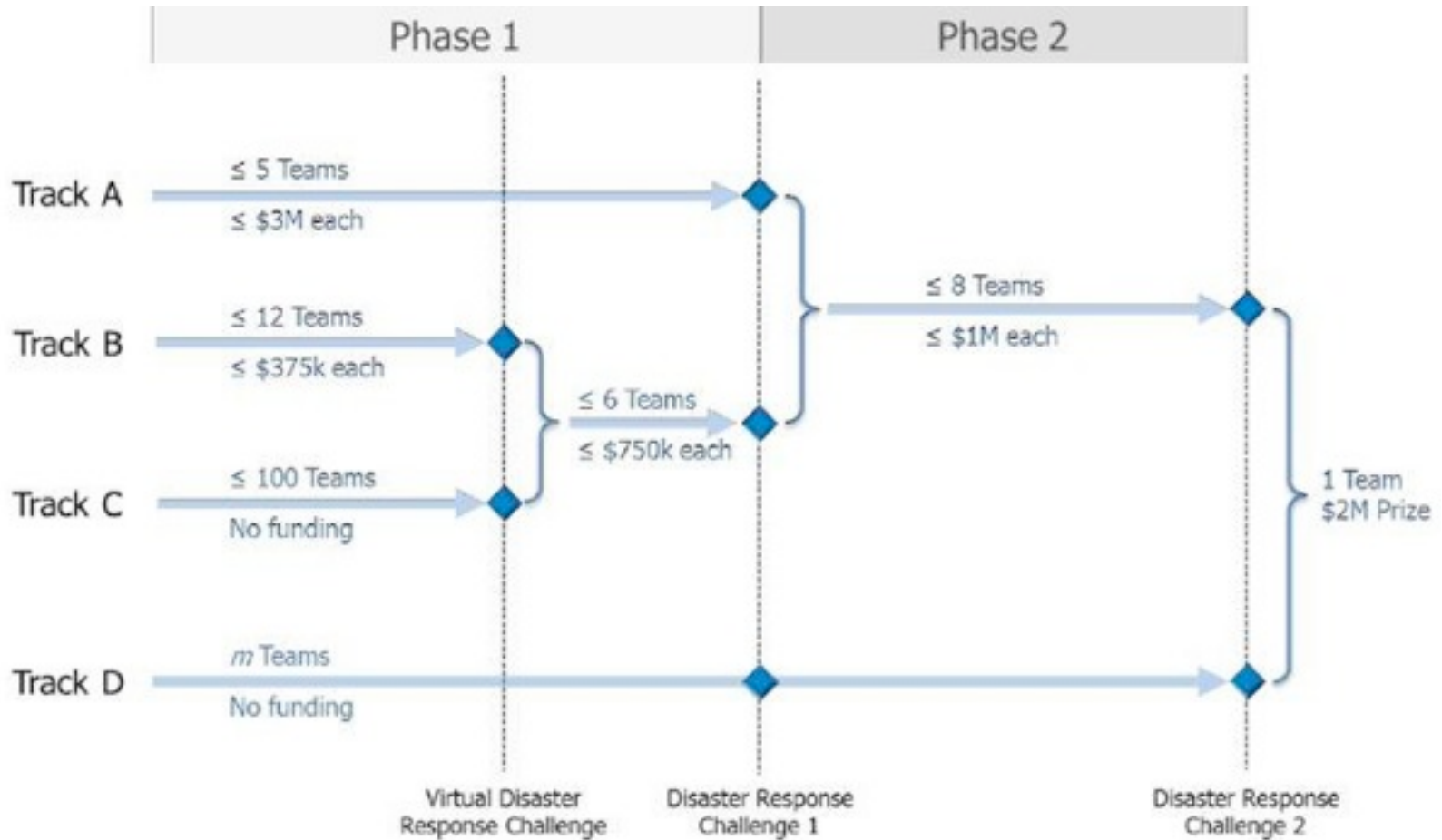
Disaster



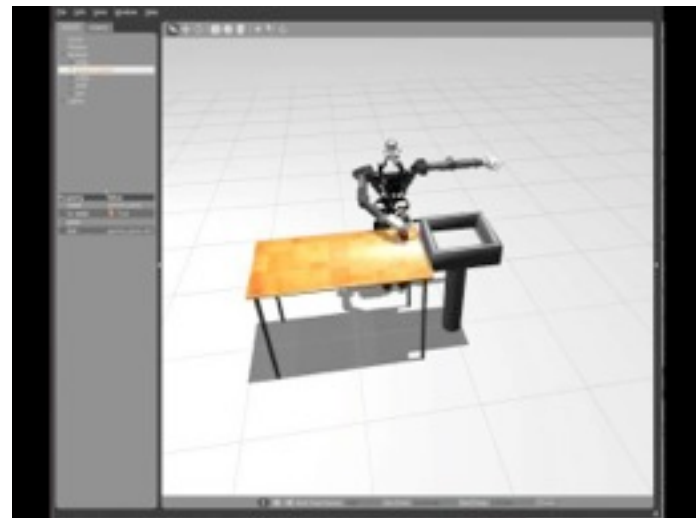
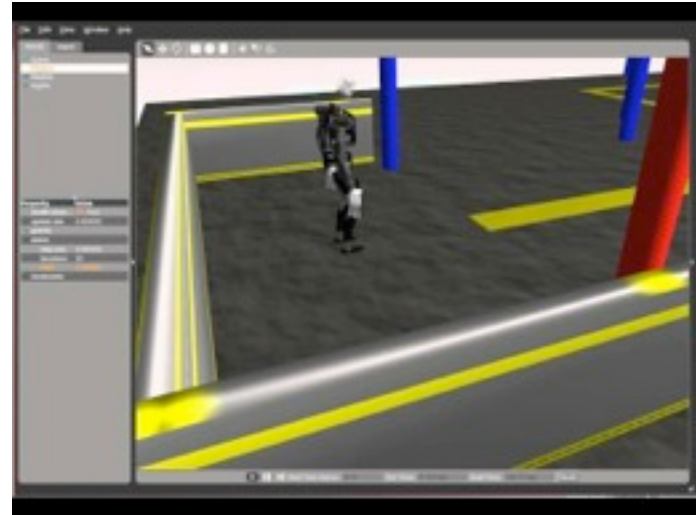
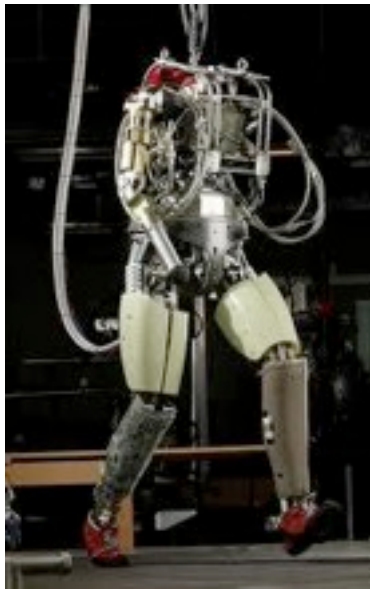
Response



# DARPA Robotics Challenge



# DARPA Robotics Challenge



# DARPA Robotics Challenge

## Map-reduce the best robotics teams in the world

Map: simulated arenas vs

- Operator skills
- Cutting edge software

Reduce: best score of

- Time
- Task completion
- Bandwidth utilization

15 tasks, 3 days.

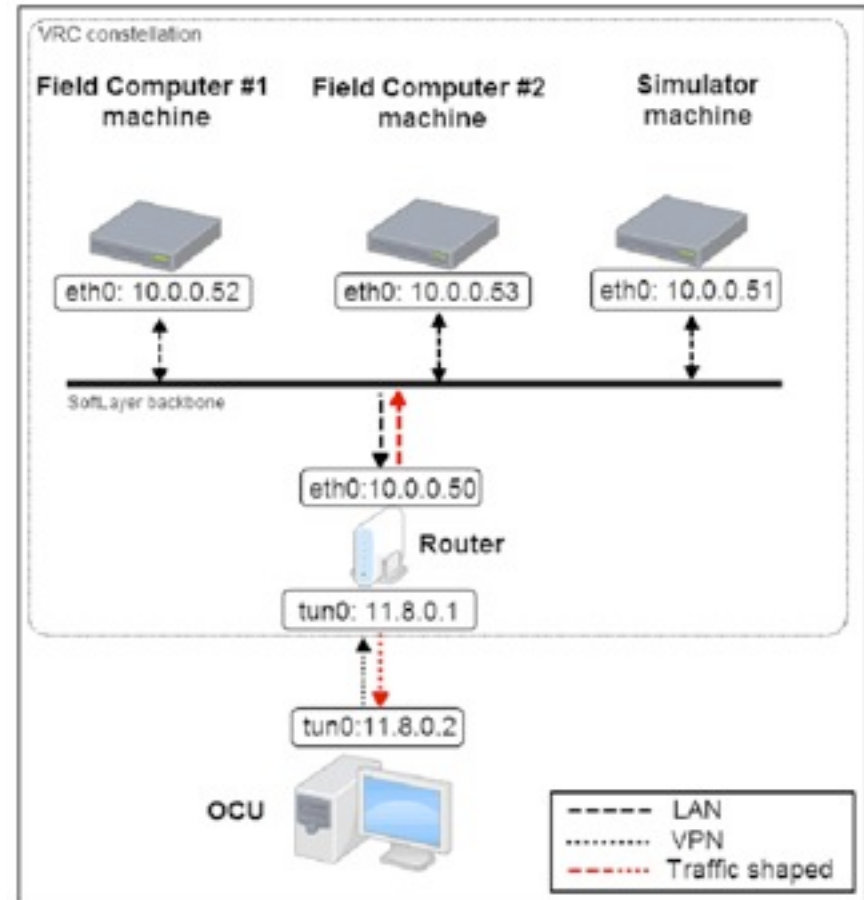
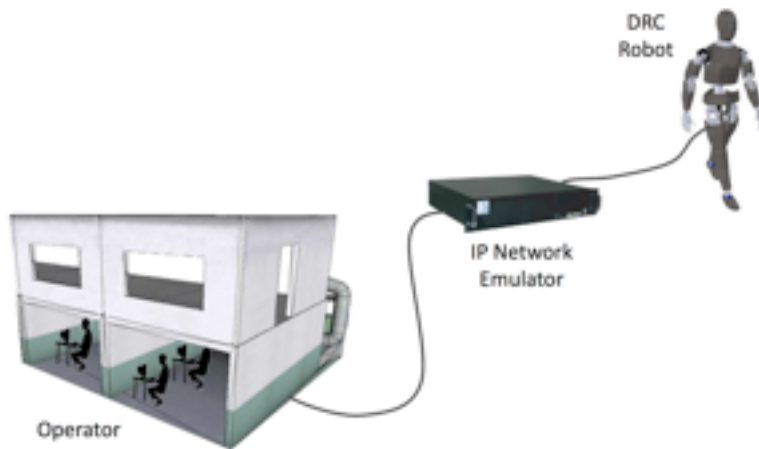


[theroboticschallenge.org](http://theroboticschallenge.org)

# CloudSim: design and overview

## Configuration

- Network routes
- Software, simulation configurations
- Security



Private instant network

# Evolution



# CloudSim evolution

September 2012 (2012-09)

Brian's prototype:

- Amazon gpu machine
- OpenID authentication
- Python thread that bring up a machine, setup ROS, X and Gazebo

December 2012

Version 1.0

- New front end
- push notifications (polling)
- REST API
- Redis backend

# CloudSim evolution

February 2013

## Constellations

- chaining VPNs does not scale
- virtual lans (AWS VPC)
- Constellation plugin (single thread):
  - launch, terminate
  - start task, stop task

Development slows down

- 20 min

# CloudSim evolution

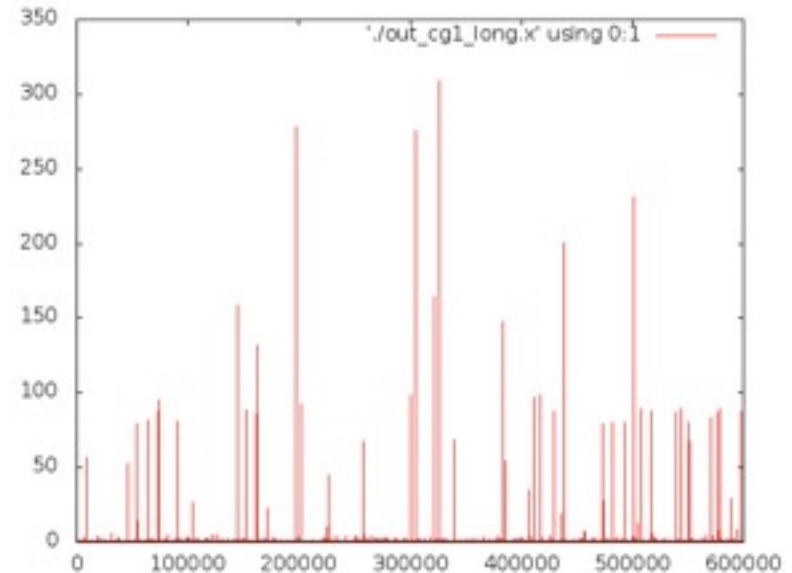
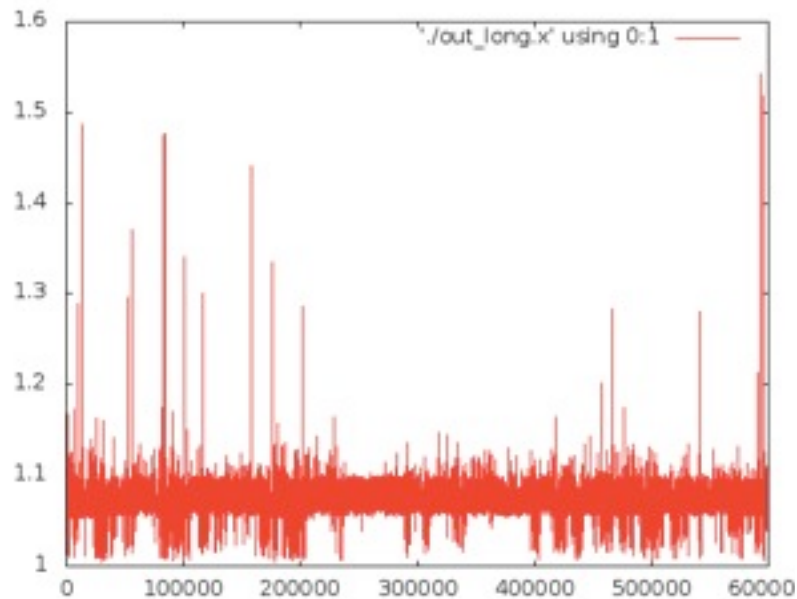
February 2013



# CloudSim evolution

Issues:

- not getting full 10 gbs bandwidth
- some strange behavior
- capacity
- jitter



# CloudSim evolution

SoftLayer

Pros

- up to date performance

  - NVIDIA K10 processor

  - 2x Intel Xeon-SandyBridge E5-2690-OctoCore [2.9GHz] CPU

- no hypervisor

- single tenancy

Cons

- monthly instead of hourly

- inflexible network topology and FW

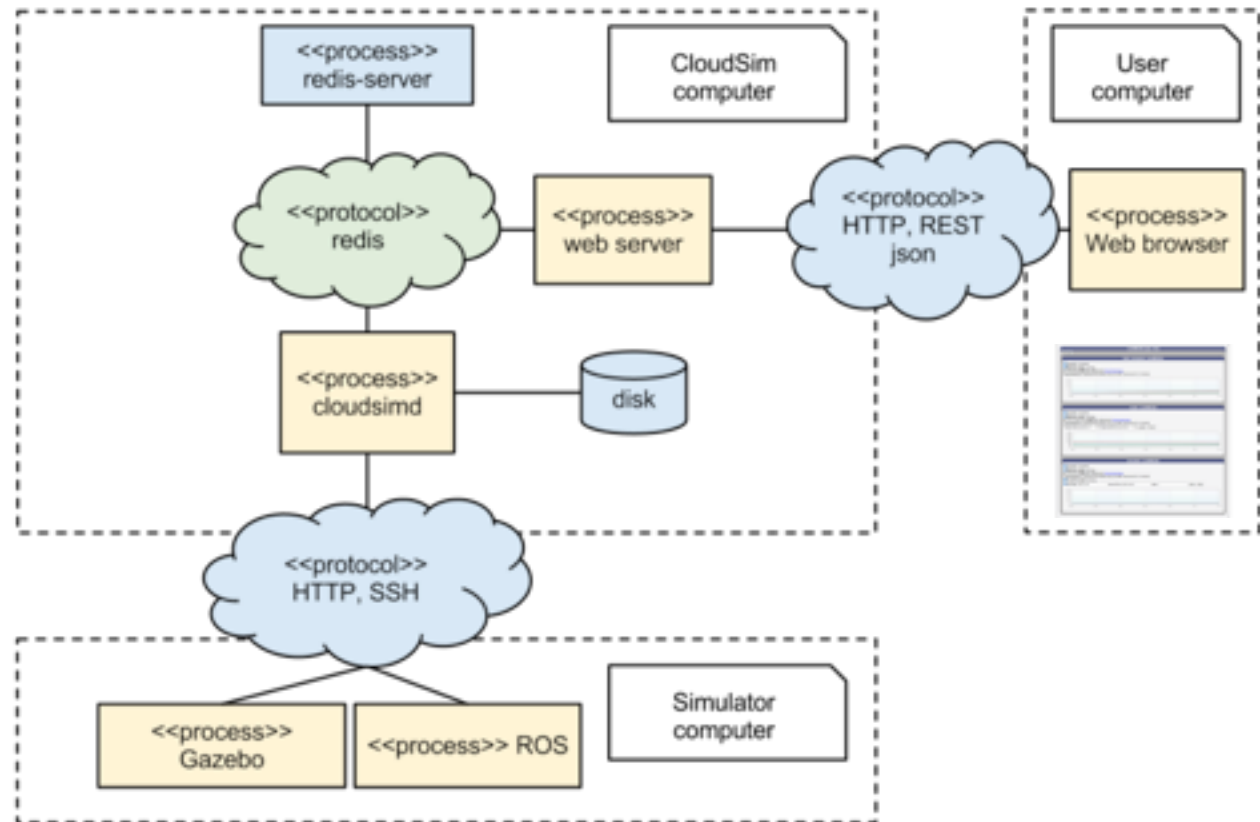
- 1h provisioning [with bugs]

# Status

# Status

## CloudSim architecture

- Thin web client
- Web server to process requests
- Daemon to launch cloud machines
- Simulation machines



CloudSim, Simulator and Web Client machines

# Limitations



# Limitations

## Latency

- Some extra ms. are required to reach the machines on the cloud
- The latency is not fixed and depends on the geographic location of user/provider

## Cost

- Pay on demand
  - Amazon \$2.10/h
  - SoftLayer \$1200.00/month
- Are we ready to pay for CPU cycles?

## Small range of GPU-based providers

- A wider selection of providers would reduce costs
- Mitigated by demand for game streaming



# Benefits

# CloudSim benefits

## ROS in a box

- curated selection of:
  - hardware
  - software (Groovy Precise Gazebo)
  - networking and routing
  - robotics (controllers, sensors)
  - simulation worlds

## Concurrent by design

- 1 or 100 machines, same time
- Open and extensible

## Low barrier to entry

- Thin client
- Platform for sharing

# Future possibilities

# Future possibilities

## Research and industrial

- Store of simulation experiments
- [Automatic] [parallel] Testing
- Design optimization

## Education

- Competition in the classroom
- Share simulations, data, benchmarks

## Other future lines

- Launch other open source robotics software
- Connect to data sets

## Expansion

- Deploy to real robots



Dream big

# Conclusion

# Conclusion

Motivated by specific requirements of the DARPA Robotics Challenge  
Contribute to the success of Gazebo  
Enables new workflows in robotics simulations  
Makes ROS and Gazebo more accessible  
Open Source, BSD license

*CloudSim could be to be to ROS/Gazebo what Android is to Linux*

<http://gazebosim.org/wiki/CloudSim>