

# **A "Room Scheduler" for running experiments across the PRAGMA multi-cloud environment**

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# PRAGMA

- Pacific Rim collaboration founded in 2002 to enable **scientific expeditions** in areas of computational chemistry, telescience, biodiversity, and lake ecology
- Original Grid testbed infrastructure was hard for sites to maintain
- In 2011, began to simplify infrastructure by migrating to Cloud and application virtual machines and then to **application virtual clusters**

# PRAGMA Cloud Tools

- **Leverages the following tools:**
  - **pragma\_boot**: Boots virtual clusters for users across PRAGMA institutions using local VM provisioner. Currently supports Rocks and OpenNebula.
  - **Personal Cloud Controller**: Manages startup, status monitoring, and shutdown of a virtual cluster. Built on top of pragma\_boot and HTCondor. Uses IPOP to enable multi-site virtual clusters.
  - **Software-Defined Networking**: Creates private network for multi-site virtual clusters and to protect access to sensitive datasets.

# Scheduler Requirements

- **Low participation overhead**
  - Minimal effort and expertise for a site to add their cloud deployment to the list of resources available for scheduling
- **Easy to use**
  - Provide a simple web interface for users to see the available resources and sites, select their virtual cluster image, and run and monitor its status.
- **Scale to tens of users**
  - Prioritize simplicity over scalability and give higher priority to the requirements of low participation overhead and ease of use.

# Related Scheduling Work

- **Open source batch schedulers**
  - Slurm, Torque, HTCondor
- **Related testbeds**
  - Grid 5000', GENI, PlanetLab
- **Open source web-based room reservation systems**
  - How easy is it to manage resources, reservations, and users as well as to add new parameters and features?
  - How intuitive is the GUI interface was with respect to menus and navigation and if it had a clean, modern, and uncluttered look
  - How easy is it to install and setup a prototype instance.

# Booked Scheduler

## Pros:

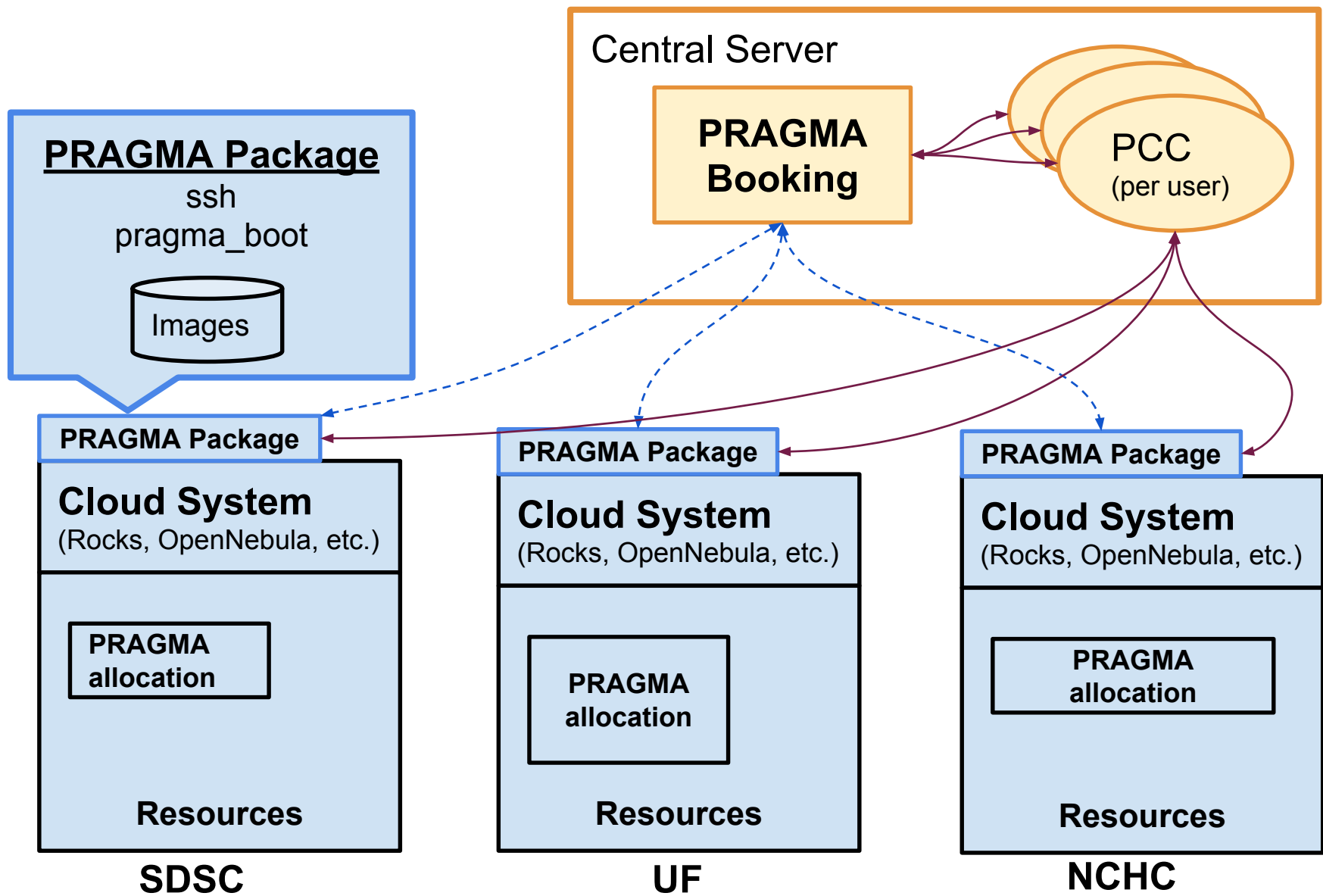
- ✓ Open source
- ✓ Easy to setup
- ✓ Nice GUI interface
- ✓ Usage reporting
- ✓ REST API
- ✓ Customizable-ish
- ✓ LDAP and Active Directory support.
- ✓ Fine tuned roles and permissions.
- ✓ User and group quotas.

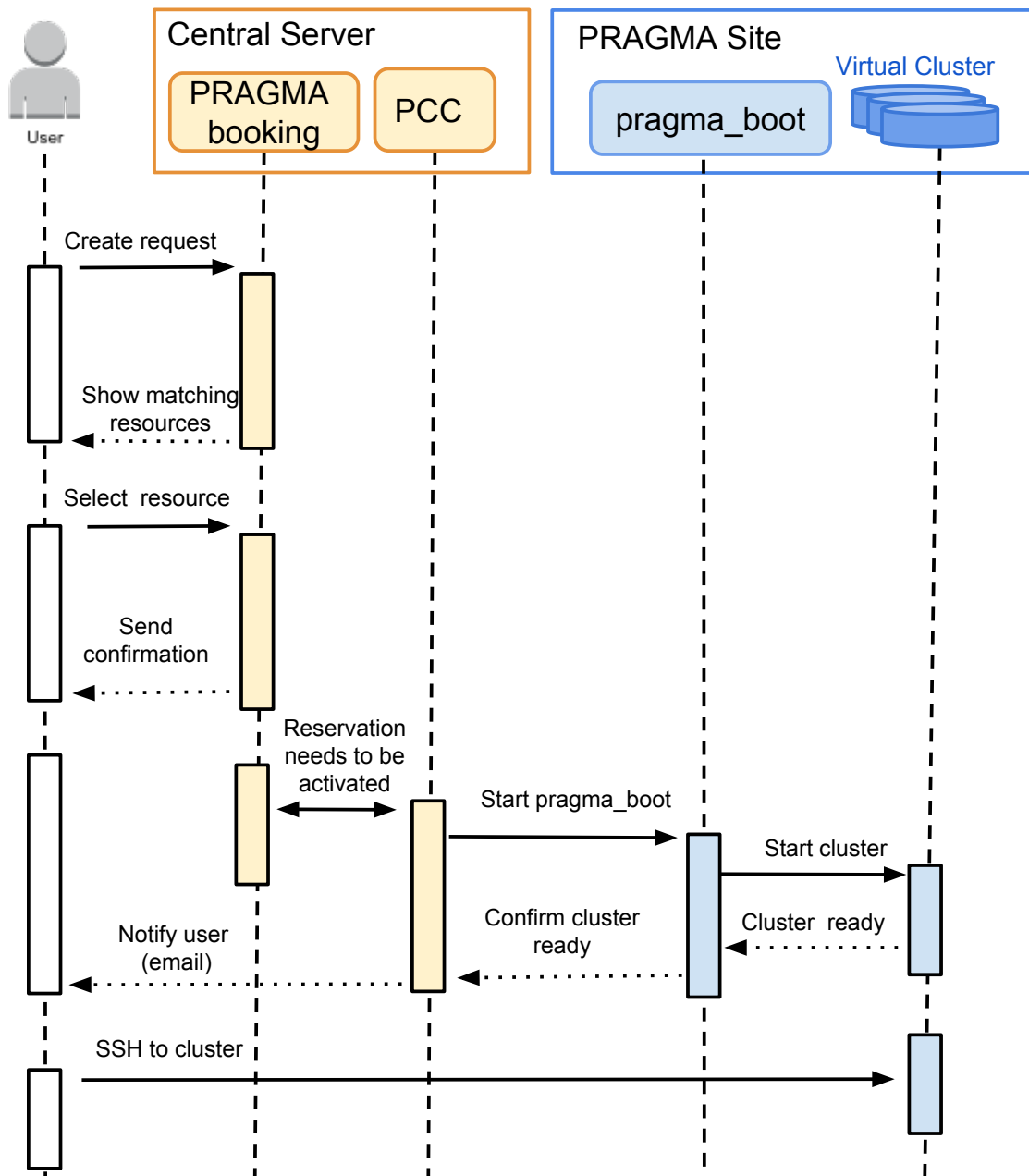
<http://www.bookedscheduler.com>



## Cons:

- ❖ Can only handle one reservation per resource at a time
- ❖ PHP changes can be painful (heavy OO makes it hard to find right files)
- ❖ Doc is sparse





## Temporary Assumptions

- Virtual cluster images are already available at each site
- Developed and used a PCC stub
- Only single site virtual clusters can be launched



# User Interface

Filter resources  
by attributes

Available time  
slots

← 2016-01-24 - 2016-01-30 →

Past Pending Reservable Reserved My Reservation Starting VMs Running VMs Stopping VMs

Sunday, 2016-01-24 00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

NCHC cloud Unavailable[ Shava Smallen ]

UCSD/SDSC cloud

UCSD/SDSC cloud

Create Cancel

21:00 22:00 23:00

Create a new reservation

Shava Smallen (ssmallen@sdsc.edu)  
Resources to be reserved  
UCSD/SDSC cloud [More Resources](#)

Accessories [Add](#)

Begin 2016-01-26 00:00  
End 2016-01-27 00:00  
Reservation Length 1 days, 0 hours  
Repeat Does Not Repeat

Title of reservation  
My new reservation  
Description of reservation

Additional Attributes  
CPUs: 32 Memory (GB): 32 ENT-enabled: no VC Name: hku\_biolinux-zfs

Create Cancel

Friday, 2016-01-29 00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

View reservations in  
time slot. resources

View resource details by scrolling  
over resource name

Make a new reservation by clicking on an  
available time slot.

# Administrative Interface

The screenshot displays the Cloud Scheduler Administrative Interface. On the left is a sidebar with a tree view containing 'Application Management' and 'Reports'. Under 'Application Management' are 'Reservations', 'Schedules', 'Resources', 'Users', 'Groups', 'Quotas', 'Announcements', 'Customization', and 'Server Settings'. Under 'Reports' are 'Create New Report', 'My Saved Reports', and 'Common Reports'. The main content area is titled 'Common Reports' and lists several report categories: 'Reserved Resources', 'Reserved Accessories', 'Resource Usage - Time Booked', 'Resource Usage - Reservation Count', 'Top 20 Users - Time Booked', and 'Top 20 Users - Reservation Count'. Each category has links for 'Today', 'Current Week', and 'Current Month'. Below the list is a bar chart showing usage for three users: Shane Smullen, Maurice Toussaint, and Nadia Williams. A red box highlights the chart with the text: 'Administrators can select from a set of “common” reports to view historical usage (i.e., by user)'. To the right of the chart is a red box with the text: 'Administrators can edit resource, reservation, and user configuration'. On the far right is a 'Create New Report' section with various filters and a 'Get Report' button. A red box highlights this section with the text: 'Administrators can also create their own custom historical usage report (i.e., by resource)'. The bottom of the interface shows a bar chart for '3 Rows | 183 days | 12 hours Total' with data for 'SPSC-Cloud1', 'UP-Cloud', and 'SPSC-Cloud2'.

Administrators can edit resource, reservation, and user configuration

Administrators can select from a set of “common” reports to view historical usage (i.e., by user)

Administrators can also create their own custom historical usage report (i.e., by resource)

# Customizations to Booked

## Code Enhancements

- **Added ability to make multiple reservations per time slot**
- Added a numeric count as a custom field type.
- Added custom reservation statuses: "Starting", "Running", and "Stopping"
- Added the ability to retrieve and set the reservation status from the Booked REST API.
- Added the PRAGMA logo to the header.
- 5 bug fixes

## Added custom fields

- User:
  - Public SSH key
- Reservation
  - CPU count
  - Memory
  - Virtual cluster image name
- Resource
  - CPU count
  - Total memory
  - Site hostname
  - ENT capability

# Summary

- Lightweight scheduling for the PRAGMA cloud testbed using room reservation software that prioritizes ease of use and low maintenance overhead
- In the process of migrating from prototype to early users
- **Future Work**
  - Image management with Google drive and Clonezilla
  - Integrate Cloud Init and boto with pragma\_boot for greater portability
  - Package and document software

# More Information

- **Contact email**
  - [ssmallen@ucsd.edu](mailto:ssmallen@ucsd.edu)
- **Website**
  - <http://fiji.rocksclusters.org/cloud-scheduler>



**Thank you!**