Lightweight Scheduling for the PRAGMA Cloud Testbed

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PRAGMA Cloud Testbed

- **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.
  - **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 install and configure their resource
- **Easy to use**
  - Provide a simple web interface for users to see the available resources and sites, construct their virtual cluster, and manage their images.
- **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
- **Other testbeds**
  - Grid 5000', GENI, PlanetLab
- **Open source web-based calendar 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:

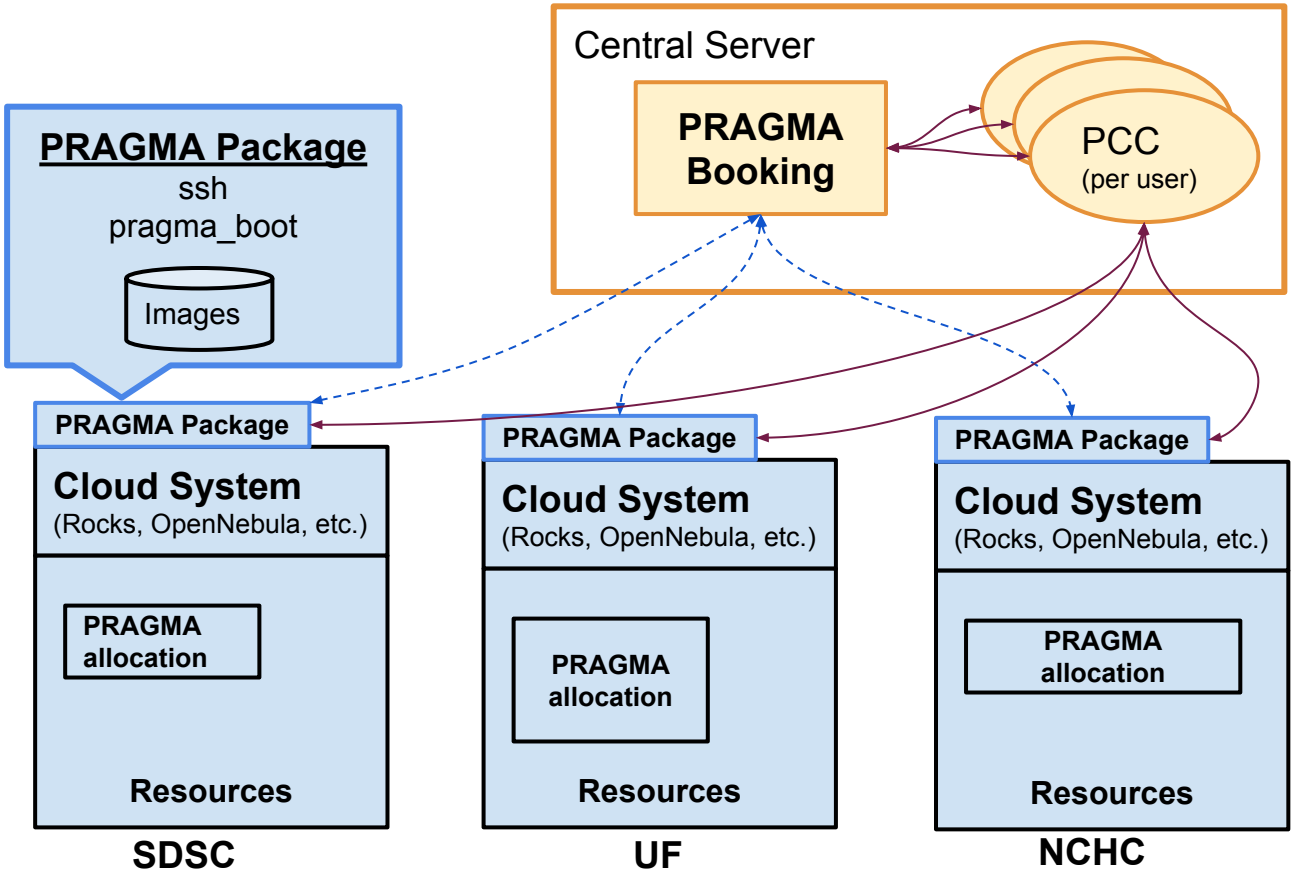
- ✓ Open source
- ✓ Easy to setup
- ✓ Nice GUI interface
- ✓ Usage reporting
- ✓ REST API
- ✓ Customizable-ish
- ✓ LDAP and Active Directory support.
- ✓ Fine tuned roles and permissions.
- ✓ User and group quotas.

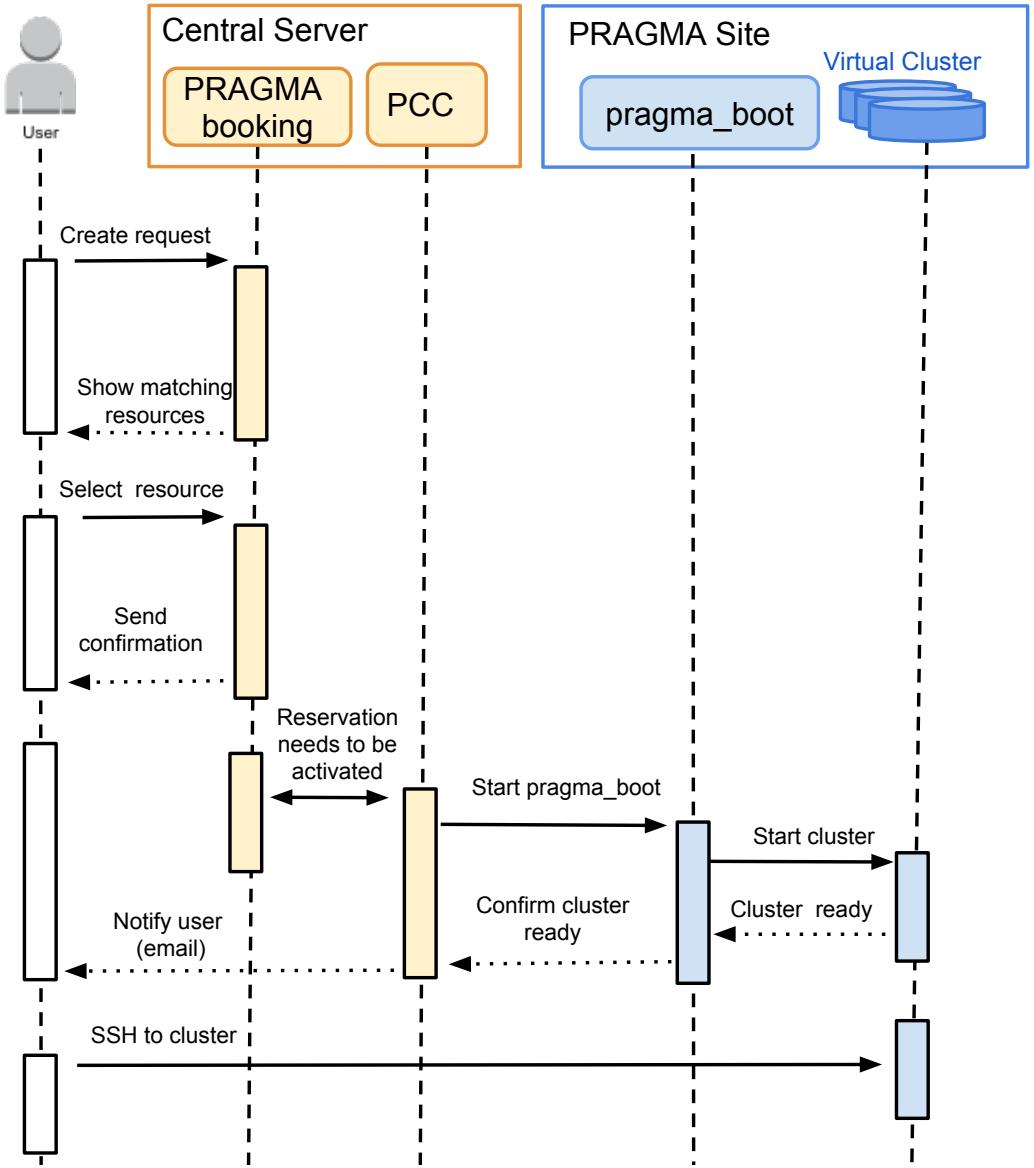
http://www.bookedscheduler.com

Cons:

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

PRAGMA Cloud Scheduler Architecture




User
Central Server
PRAGMA booking
PCC
PRAGMA Site
Virtual Cluster
pragma_boot
Create request
Show matching resources
Select resource
Send confirmation
Reservation needs to be activated
Start pragma_boot
Start cluster
Cluster ready
Confirm cluster ready
Notify user (email)
SSH to cluster

Temporary Assumptions For Pilot Implementation

- ~~Only one reservation can be made per resource~~
- Virtual cluster images are already available at each site
- Developed and used a PCC stub
- Only single site virtual clusters can be launched

Customizations to Booked

- **Added custom fields**
  - **User**:
    - Public SSH key - Single line textbox
  - **Reservation**
    - CPU count – Count
    - Memory – Count
    - Virtual cluster image name – Select list
    - ENT-enabled – Select list (yes/no)
  - **Resource**
    - CPU count – Count
    - Total memory – Count
    - Deployment type – Select List
    - ENT-enabled – Select list (yes/no)
    - Site hostname - Single line textbox
- **Added the PRAGMA logo to the header.**

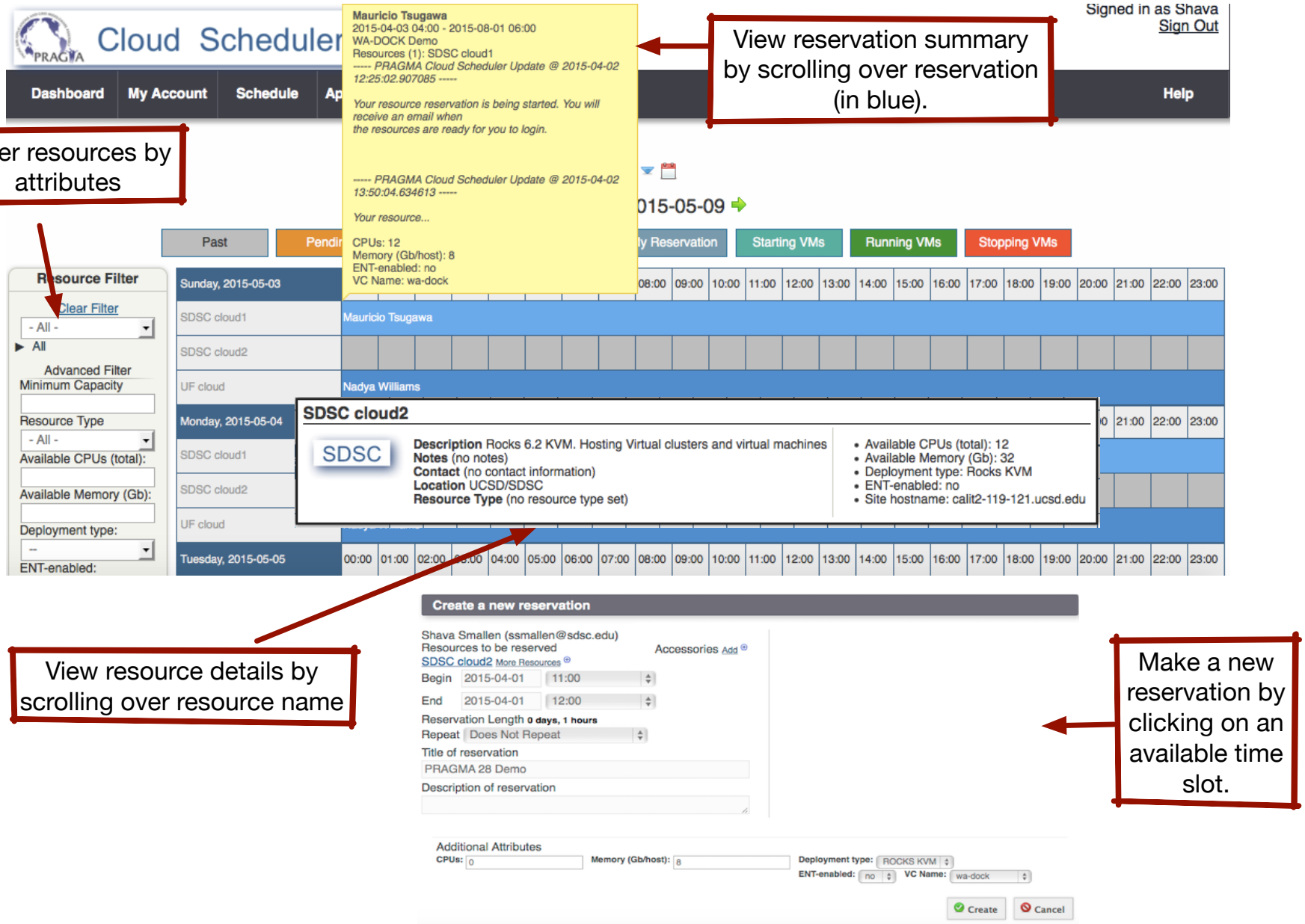
Customizations to Booked (cont.)

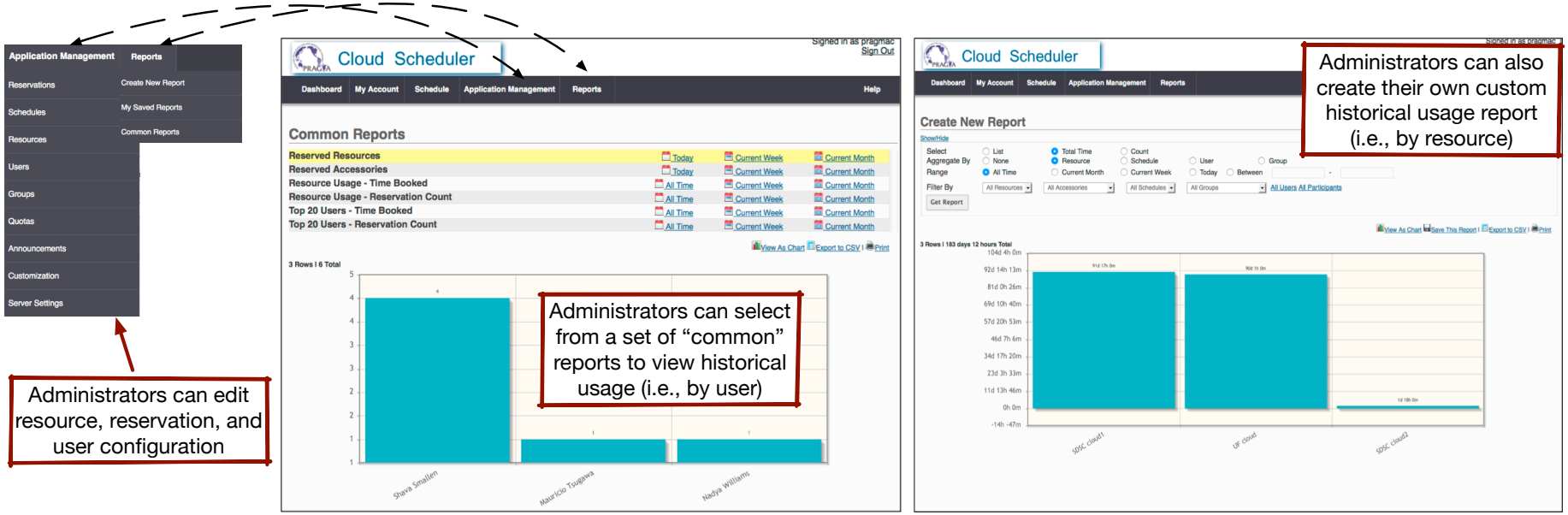
Code Enhancements

- 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.
- Packaged it as a Rocks roll.

Bug Fixes

- Fixed bug that allowed users to make reservations for past time frames.
- Fixed a time conversion bug that was preventing updates to existing reservations.
- Fixed bug where the username was getting set to a blank value when a reservation was updated via the REST API.
- Fixed bug that would not recognize zero as a valid value (e.g., specifying a virtual cluster with just a frontend and 0 compute nodes).


Cloud Scheduler
Signed in as Shava
Sign Out
Dashboard
My Account
Schedule
Help
Mauricio Tsugawa
2015-04-03 04:00 - 2015-08-01 06:00
WA-DOCK Demo
Resources (1): SDSC cloud1
----- PRAGMA Cloud Scheduler Update @ 2015-04-02 12:25:02.907085 -----
Your resource reservation is being started. You will receive an email when the resources are ready for you to login.
----- PRAGMA Cloud Scheduler Update @ 2015-04-02 13:50:04.634613 -----
Your resource...
CPUs: 12
Memory (Gb/host): 8
ENT-enabled: no
VC Name: wa-dock
View reservation summary by scrolling over reservation (in blue).
Filter resources by attributes
015-05-09
Past
Starting VMs
Running VMs
Stopping VMs
Resource Filter
Clear Filter
- All -
All
Advanced Filter
Minimum Capacity
Resource Type
Available CPUs (total):
Available Memory (Gb):
Deployment type:
ENT-enabled:
Sunday, 2015-05-03
SDSC cloud1
SDSC cloud2
UF cloud
Mauricio Tsugawa
Nadya Williams
Monday, 2015-05-04
Tuesday, 2015-05-05
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
SDSC cloud2
SDSC
Description Rocks 6.2 KVM. Hosting Virtual clusters and virtual machines
Notes (no notes)
Contact (no contact information)
Location UCSD/SDSC
Resource Type (no resource type set)
Available CPUs (total): 12
Available Memory (Gb): 32
Deployment type: Rocks KVM
ENT-enabled: no
Site hostname: calit2-119-121.ucsd.edu
View resource details by scrolling over resource name
Create a new reservation
Shava Smallen (ssmallen@sdsc.edu)
Resources to be reserved
Accessories Add
SDSC cloud2 More Resources
Begin 2015-04-01 11:00
End 2015-04-01 12:00
Reservation Length 0 days, 1 hours
Repeat Does Not Repeat
Title of reservation
PRAGMA 28 Demo
Description of reservation
Additional Attributes
CPUs: 0
Memory (Gb/host): 8
Deployment type: ROCKS KVM
ENT-enabled: no
VC Name: wa-dock
Create
Cancel
Make a new reservation by clicking on an available time slot.


Application Management
Reports
Reservations
Schedules
Resources
Users
Groups
Quotas
Announcements
Customization
Server Settings
Create New Report
My Saved Reports
Common Reports
Cloud Scheduler
Dashboard
My Account
Schedule
Application Management
Reports
Help
Common Reports
Reserved Resources
Reserved Accessories
Resource Usage - Time Booked
Resource Usage - Reservation Count
Top 20 Users - Time Booked
Top 20 Users - Reservation Count
Today
All Time
Current Week
Current Month
Create New Report
Administrators can also create their own custom historical usage report (i.e., by resource)
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)

Summary

- Pilot implementation of a scheduler for the PRAGMA cloud testbed that prioritizes ease of use and low installation and maintenance overhead
- Server has an intuitive web GUI frontend based on the Booked web reservation system software.
- **Future Work**
  - Integrate IPOP and PRAGMA-ENT
  - Rework PCC and integrate HTCondor so it's used in personal mode
  - Leverage CloudFront option in pragma_boot to manage application virtual cluster images and staging them to each of the sites.
  - Package and document software

Demo at PRAGMA29 on Friday will show multiple reservations per resource and ZFS integration with pragma_boot