

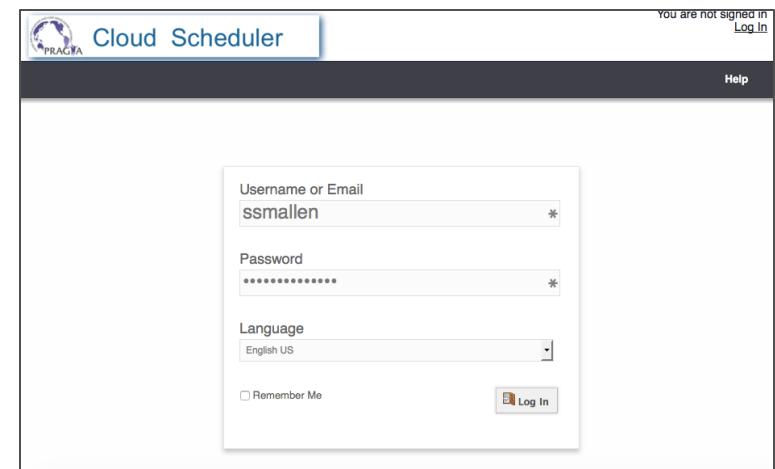
Building a persistent PRAGMA Cloud Testbed

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Nadya Williams, Serena Pan,
Weicheng Huang, Philip Papadopoulos

January 29, 2016
PRAGMA30

PRAGMA Cloud Testbed

- Biosciences and other working groups have requested a persistent Cloud Testbed
- Prototype of Lightweight Cloud Scheduler introduced in PRAGMA28 and enhanced in PRAGMA29.
- Migration from prototype to (very) early users

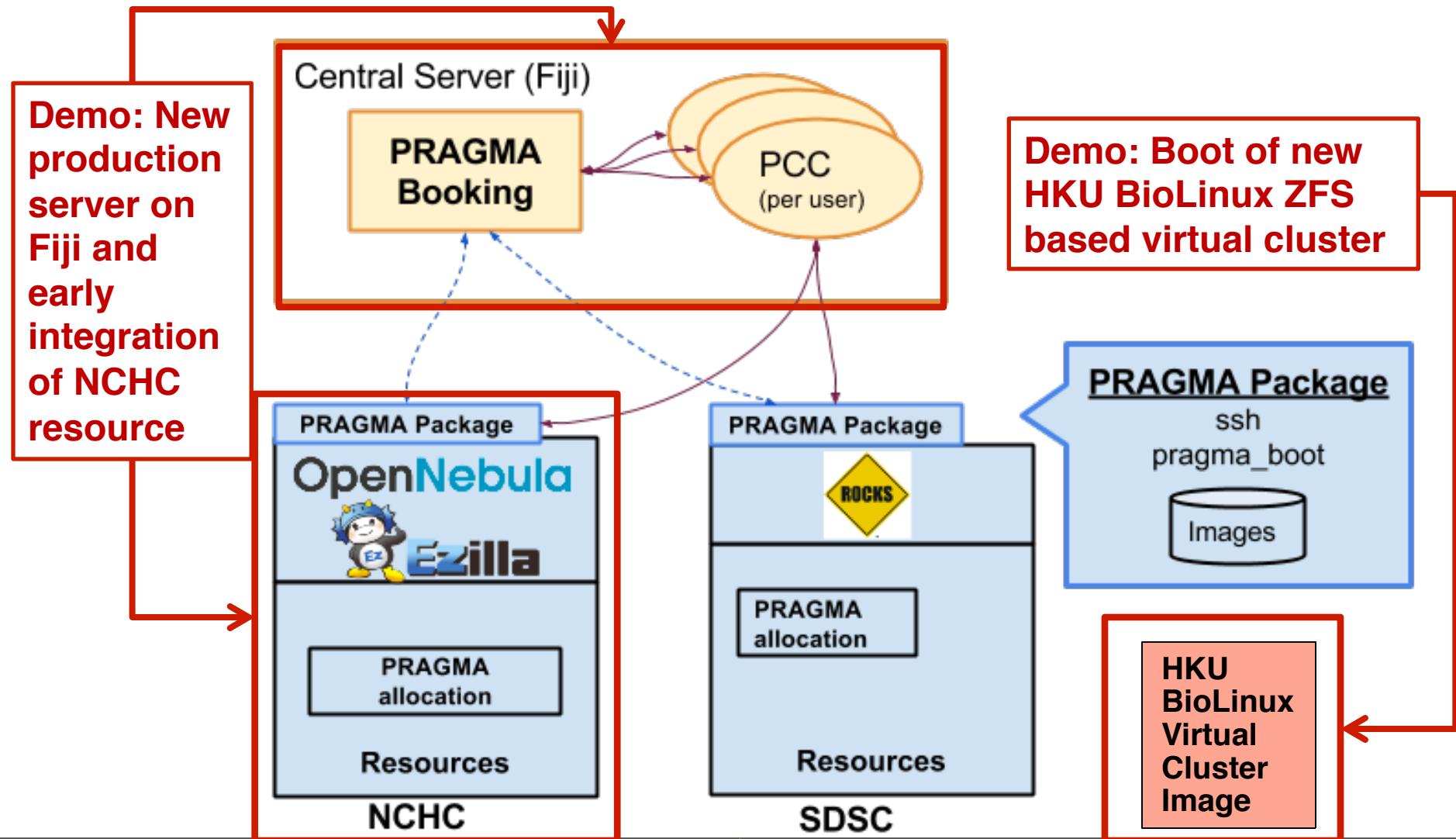


Login screen for PRAGMA lightweight scheduler

PRAGMA Cloud Scheduler

- **Goal: Low participation overhead and easy to use**
 - Sites only have to install a small package (SSH and `pragma_boot`) to participate
 - Users have convenient web interface to start up and manage their virtual clusters
- **Leverages the following tools:**
 - **Booked**: Open source room reservation software from Twinkle Toes
 - **`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.

Architecture Overview



Building Cloud Testbed Server (Fiji)

- **Step 1:** Catalogued Fiji configuration, backed it up, and developed detailed upgrade plan
- **Step 2:** Consolidated some machines (used some nodes to upgrade memory and disk
 - 10 nodes, each node with 16 CPUs and 32 GB memory
- **Step 3:** Upgraded Fiji to Rocks 6.2 and re-configured virtual clusters
- **Step 4:** Installed cloud-scheduler, pragma_boot, and img-storage rolls

<http://fiji.rocksclusters.org/cloud-scheduler>

Integrating NCHC Ezilla Resource **NARLabs**

(work with Serena Pan and Weicheng Huang)

承諾・熱情・創新

- **Step 1:** Installed pragma_boot from Github
- **Step 2:** Configured opennebula driver
- **Step 3:** Copied over virtual cluster image repository
- **Step 4:** Made bug fix to add wait for image to complete copying before generating template to launch. Still having issues with networking config.
- **Todos:**
 - Rewrite driver to leverage multi-cloud library like boto3 and integrated with new version of pragma_boot
 - Add automated shutdown and cleaning



X

Log into Cloud Scheduler as ssmallen Show NCHC resource



Show UCSD resource

Pragma_boot version:
-
Temporary directory:

Username:

Available CPUs:

Available Gb Memory:

Deployment type:
-
ENT-enabled:
-
Site hostname:

Filter

Tuesday, 2016-01-26 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]

Wednesday, 2016-01-27 00:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
UCSD/SDSC cloud
NCHC cloud
UCSan Diego
Description Rocks 6.2 KVM.
Hosting Virtual clusters and virtual machines
Notes (no notes)
Contact admin@address
Location UCSD/SDSC
Resource Type (no resource type set)

Thursday, 2016-01-28 00:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
NCHC cloud

Friday, 2016-01-29 00:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
NCHC cloud
HKU BioLinux cluster (Shava Smallen)
2016-01-25 12:00:00 - 2016-02-29 13:00:00
Status: Running
CPUs:16
Memory (GB):4
ENT-enabled:no
VC Name:hku_biolinux-zfs
Edit

Saturday, 2016-01-30 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 48 Available CPUs, 188 Available Gb Memory [Shava Smallen]

2016-01-24 - 2016-01-30

© 2014 Twinkle Toes Software
Booked Scheduler v2.5.13



Start ZFS Reservation

Create a new reservation

Shava Smallen (ssmallen@sdsc.edu) [Change](#)

Resources to be reserved

[SDSC cloud3](#) [More Resources](#)

Begin 00:00

End 00:00

Reservation Length 1 days, 0 hours

Repeat

Title of reservation
Demo rocks-zfs-basic reservation

Description of reservation

Accessories [Add](#)

Additional Attributes

CPUs: Memory (GB): ENT-enabled: VC Name:

Create Cancel



ZFS Reservation Confirmed

Create a new reservation

Shava Smallen (ss...
Resources to be re...
[SDSC cloud3](#) More F...

Begin 2015-10-04

End 2015-10-08

Reservation Length

Repeat Does Not

Title of reservation
Demo rocks-zfs-ba...

Description of reserv...

Additional Attribut...

CPUs: 32

Your reservation was successfully created!
Your reference number is 5611dc46c46f4966296376

2015-10-04

Resources: SDSC cloud3



Confirm ZFS Reservation



Login in as pragmac

Show users

Find User: Status: All Users All

| Name | Username | Email | Phone | Organization | Position | Created | Last Login | Timezone | Language | Status | Permissions | Groups | Reservations | Password | Delete |
|--|------------|--|-------|--------------|----------|-------------------------|-------------------------|---------------------|----------|------------------------|----------------------|----------------------|------------------------|-----------------------|-------------------|
| NCHC Admin | nchc-admin | ssmallen@icloud.com | | | | 2016-01-27 01:55:20 UTC | 2016-01-27 01:56:36 UTC | Asia/Taipei | en_us | Active | Edit | Edit | Search | Reset | X |
| Additional Attributes Edit | | | | | | | | | | | | | | | |
| Affiliation: NCHC SSH public key: d | | | | | | | | | | | | | | | |
| Jason Haga | jh | j.h.haga@aist.go.jp | | | | 2016-01-27 01:43:32 UTC | 2016-01-27 01:46:58 UTC | Asia/Tokyo | en_us | Active | Edit | Edit | Search | Reset | X |
| Additional Attributes Edit | | | | | | | | | | | | | | | |
| Affiliation: AIST | | | | | | | | | | | | | | | |
| SSH public key: ssh-rsa AAAAB3NzaC1yc2EAAAQABAAQDbuxjGQOYqWFSRSwugW47rDwDNWdRIWyUe3TpIAChcfppTKypqjCtoD/iKnmaV6IV/QR1cA8dkFlg3Q+GLBzfDlyDkeXZcW8Ujyslb9JecOlrfMAYl2gSUSI3vzmb3Odp/BZfFdWqYKLlaBjwMeDW7scsGhZ4GOLEp8jcsPhJKggCh2KkfSYUwH+948kjWNqJbUvEZNFUmXrSRGtMP0N1KJoXlaKcg4Nt877PshThqZ8FghcyGW+0UZdhl5ww8J0TMF2DC5PIWX6tpO1PM61F/yE8uYegwKcM/H9M/ahzcU9i4V9af9gqZULu13j+AjRZwrCgKERVs4zgrchRg2fp jh@Jhs-MacBook-Pro.local | | | | | | | | | | | | | | | |
| Serena Pan | serena | serenapanpan@gmail.com | | | | 2016-01-17 19:16:12 UTC | 2016-01-26 05:41:28 UTC | Asia/Taipei | en_us | Active | Edit | Edit | Search | Reset | X |
| Additional Attributes Edit | | | | | | | | | | | | | | | |
| Affiliation: NCHC SSH public key: please add | | | | | | | | | | | | | | | |
| pragmac pragmac | pragmac | root@fiji.rocksclusters.org | | PRAGMA Cloud | | 2016-01-12 18:56:17 UTC | 2016-01-27 01:59:01 UTC | America/Los_Angeles | en_us | Active | Edit | Edit | Search | Reset | X |
| Additional Attributes Edit | | | | | | | | | | | | | | | |
| Affiliation: SSH public key: | | | | | | | | | | | | | | | |
| Shava Smallen | ssmallen | ssmallen@sdsc.edu | | | | 2016-01-13 04:14:36 UTC | 2016-01-27 01:20:09 UTC | Asia/Manila | en_us | Active | Edit | Edit | Search | Reset | X |
| Additional Attributes Edit | | | | | | | | | | | | | | | |
| Affiliation: UCSD | | | | | | | | | | | | | | | |
| SSH public key: ssh-rsa AAAAB3NzaC1yc2EAAAQABAAQCbIXQg9zucGdIEQ0wVwPV5pWCtj3Uz/dvPpNa4IDusXB23Ryy6c/nhxSKOQIGsw2erPKR8Qr5p63oNNEsTjtLtv1cLL/cyIVtyL5dQ28+idcVbxLTK/2EUIsenUhG/WtGmPuATM51rG0yAQ/d+OtKc1Y08fCO502vQQgeqo0maS5hZgHgCQ2VAQ4FXQgnWP9/rcc1dPG0zmcHTME88gESAEO+Ixtt3R8i7P3BNuTR7Q0UTYj6aGvhrvfav1Z5ifTUn9iaKK4heKaGYDbgcM3kuXU9D2Q7g5lIZSkBAbbn6ac9mwOR03JVjzgizNeAv4sI04YYL2g3YBJAlcPAvgROT ssmallen@Shavas-MacBook-Air.local | | | | | | | | | | | | | | | |
| Rows: 1 - 5 (5) Page: 1 | | | | | | | | | | | | | | | |

Show resources

Rows: 1 - 2 (2)
Page: 1

| Resource Details | |
|--|---|
| Name NCHC cloud Rename Delete Status Available Sort Order 0 Edit | Description OpenNebula. Hosting virtual machines Edit Notes (no notes) Edit Resource Administrator NCHC Group Edit Allow Subscriptions to this Calendar |
| Contact serenapan@nchc.narl.org.tw | |
| Additional Attributes Edit | |
| Pragma_boot version: 1 | Temporary directory: /home/shava/pcc Username: shava Available CPUs: 1 Available Gb Memory: 1 Deployment type: OpenNebula ENT-enabled: no Site hostname: 140.110.30.113 |

| Resource Details | |
|---|--|
| Name UCSD/SDSC cloud Rename Delete Status Available Sort Order 0 Edit | Description Rocks 6.2 KVM. Hosting Virtual clusters and virtual machines Edit Notes (no notes) Edit Resource Administrator (No Resource Administrator) Edit Allow Subscriptions to this Calendar |
| Contact admin@address | |
| Additional Attributes Edit | |
| Pragma_boot version: 2 | Temporary directory: /var/run/pcc Username: root Available CPUs: 64 Available Gb Memory: 192 Deployment type: Rocks KVM ENT-enabled: no Site hostname: fiji.rocksclusters.org |

Rows: 1 - 2 (2)
Page: 1



Login as nchc-hadmin

Available CPUs: Available Gb Memory: Deployment type: ENI-enabled: Site hostname:

Filter [Reset](#)

[Bulk Resource Update](#)

Rows: 1 - 1 (1)
Page: [1](#)

NARLabs
National Center for High-performance Computing

[Change](#) | [Remove](#)
Status Available
[Sort Order](#) [Edit](#)

Name NCHC cloud [Rename](#) | [Delete](#)
Location National Center for High-Performance Computing [Edit](#)
Resource Type (no resource type set) [Edit](#)
Schedule Default [Move](#)
Contact serenapan@nchc.narl.org.tw

Description OpenNebula. Hosting virtual machines [Edit](#)
Notes (no notes) [Edit](#)
Resource Administrator NCHC Group [Edit](#)
[Allow Subscriptions to this Calendar](#)

Additional Attributes [Edit](#)

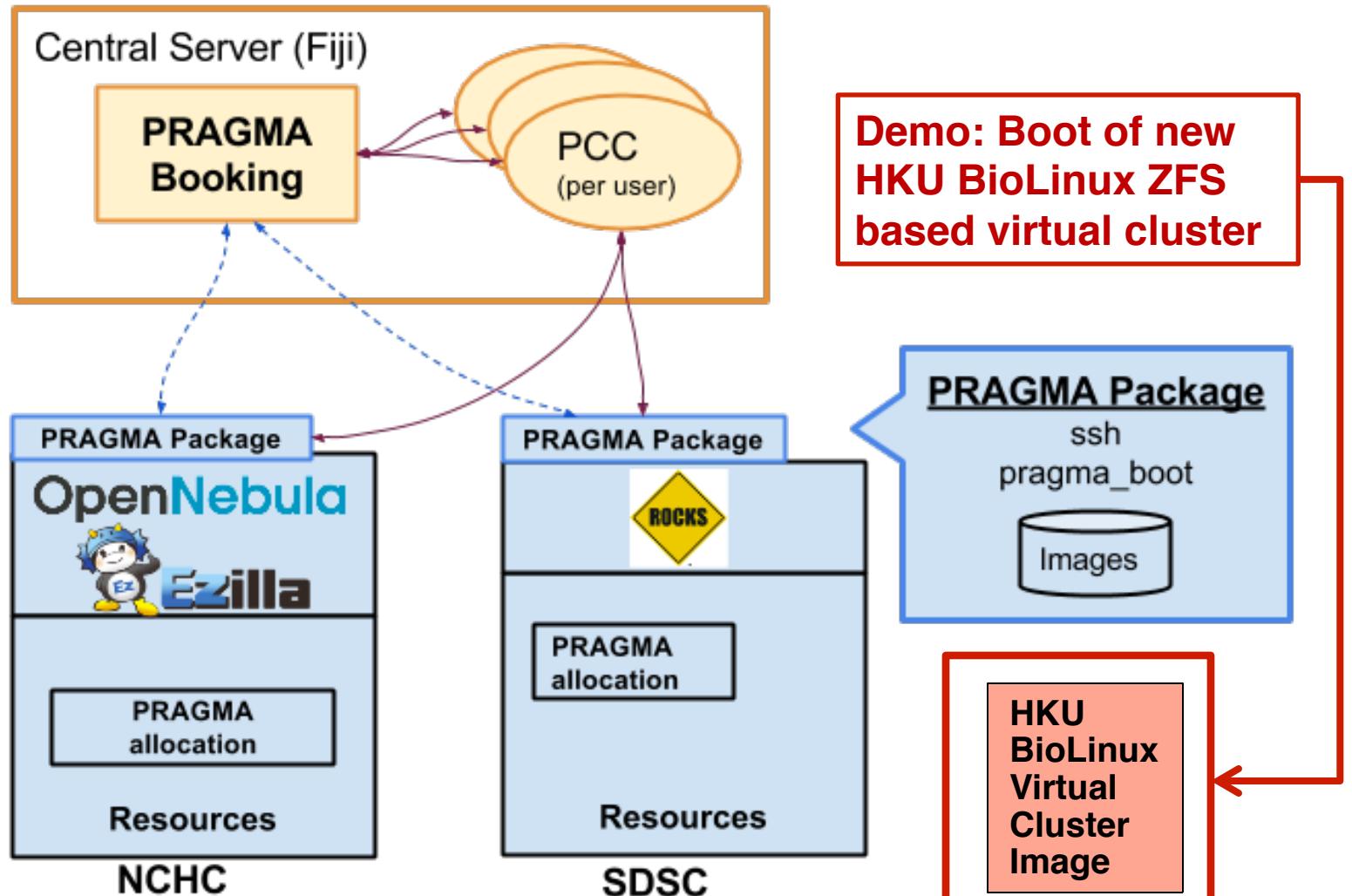
Pragma_boot version: 1 Temporary directory: /home/shava/pcc Username: shava Available CPUs: 1 Available Gb Memory: 1 Deployment type: OpenNebula ENT-enabled: no Site hostname: 140.110.30.113

Rows: 1 - 1 (1)
Page: [1](#)

Add New Resource

| Name | Schedule | Resource Permissions | Resource Administrator |
|----------------------|-------------------------|-----------------------------|---|
| <input type="text"/> | Default | Permission is not automatic | None + Add Resource |

Architecture Overview



Creating pragma_boot virtual cluster images

[http://sdlab.naist.jp/~ichikawa/data/
hku_biolinux.img.tar.bz2](http://sdlab.naist.jp/~ichikawa/data/hku_biolinux.img.tar.bz2)

- **Step1: Make image reconfigurable**
 - Installed vc-out-parser (Redhat) and modified to work on Ubuntu
- **Step 2: Make frontend image**
 - Setup IP forwarding and Iptables NAT rules
- **Step 3: Create vc-in.xml file**

Step 4: Add to Pragma_boot repository

- **Repository directory**

- vcdb.txt
- hku_biolinux
 - vc-in.xml
(based on libvirt XML syntax)
 - hku_biolinux_frontend.img
 - hku_biolinux_compute.img

```
<vc type='Local Beowulf'>
...
<frontend> ...
  <devices> ...
    <disk type='file' device='disk'>
      <source file='hku_biolinux_frontend.img' />
      <target dev='vda' bus='virtio' />
    </disk> ...
  </devices>
</domain>
</frontend>
<compute> ...
  <devices> ...
    <disk type='file' device='disk'>
      <source file='hku_biolinux_compute.img' />
    </disk> ...
  </devices>
</domain>
</compute>
...
</vc>
```

(Takes about 40 minutes to launch a 2-node cluster)

```
$ bin/pragma boot hku_biolinux 16
```

Leveraging ZFS and img-storage roll

- **Step 5: Create a ZFS volume and dd image into volume (39.5 GB)**
 - Boots within 6 mins but takes 2.5 hours to sync images behind the scenes

OR

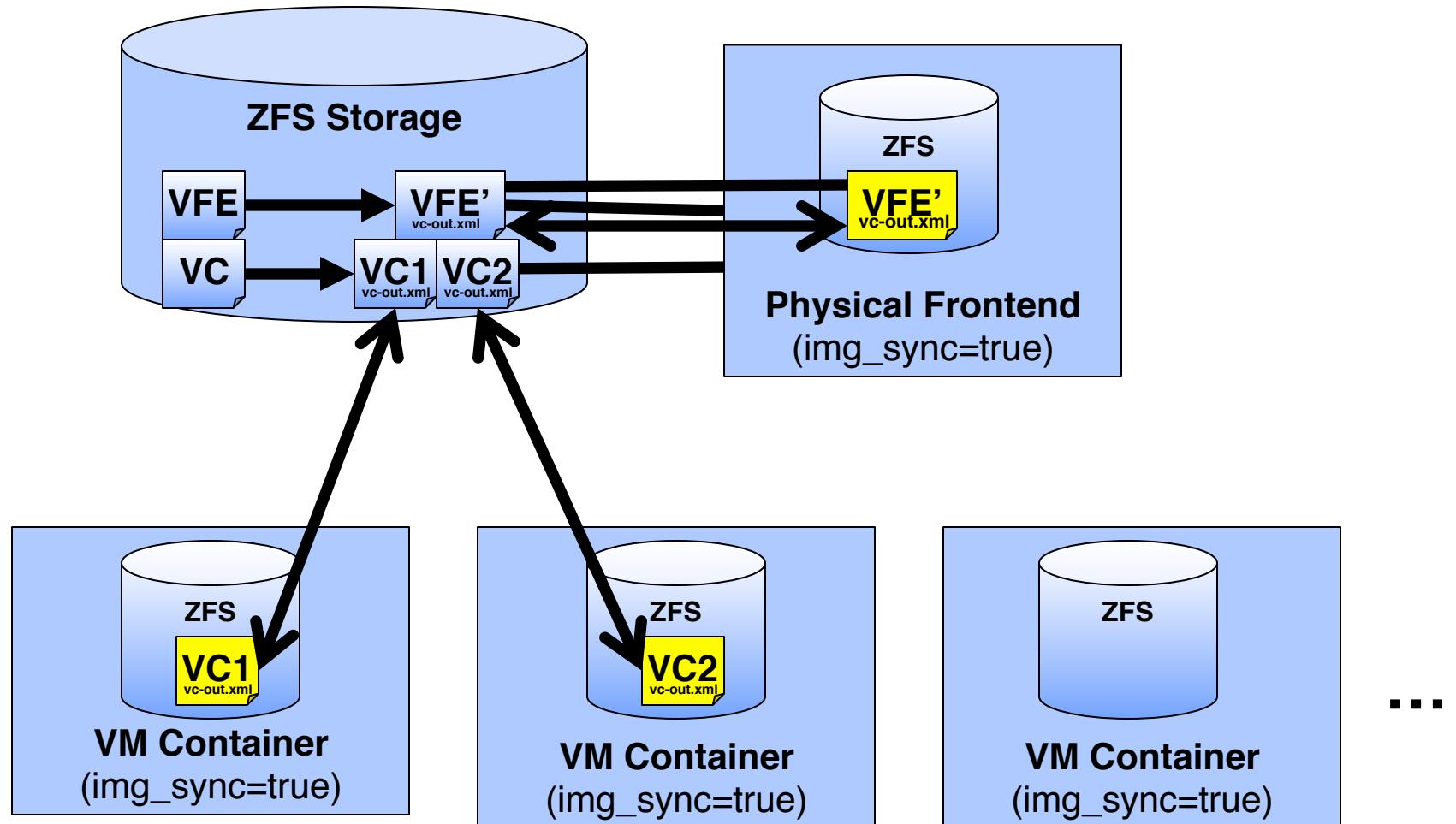
- **Step 5: Use Clonezilla to create ZFS volume (10.7GB)**
 - Boots within 6 mins but takes 25 mins to sync images



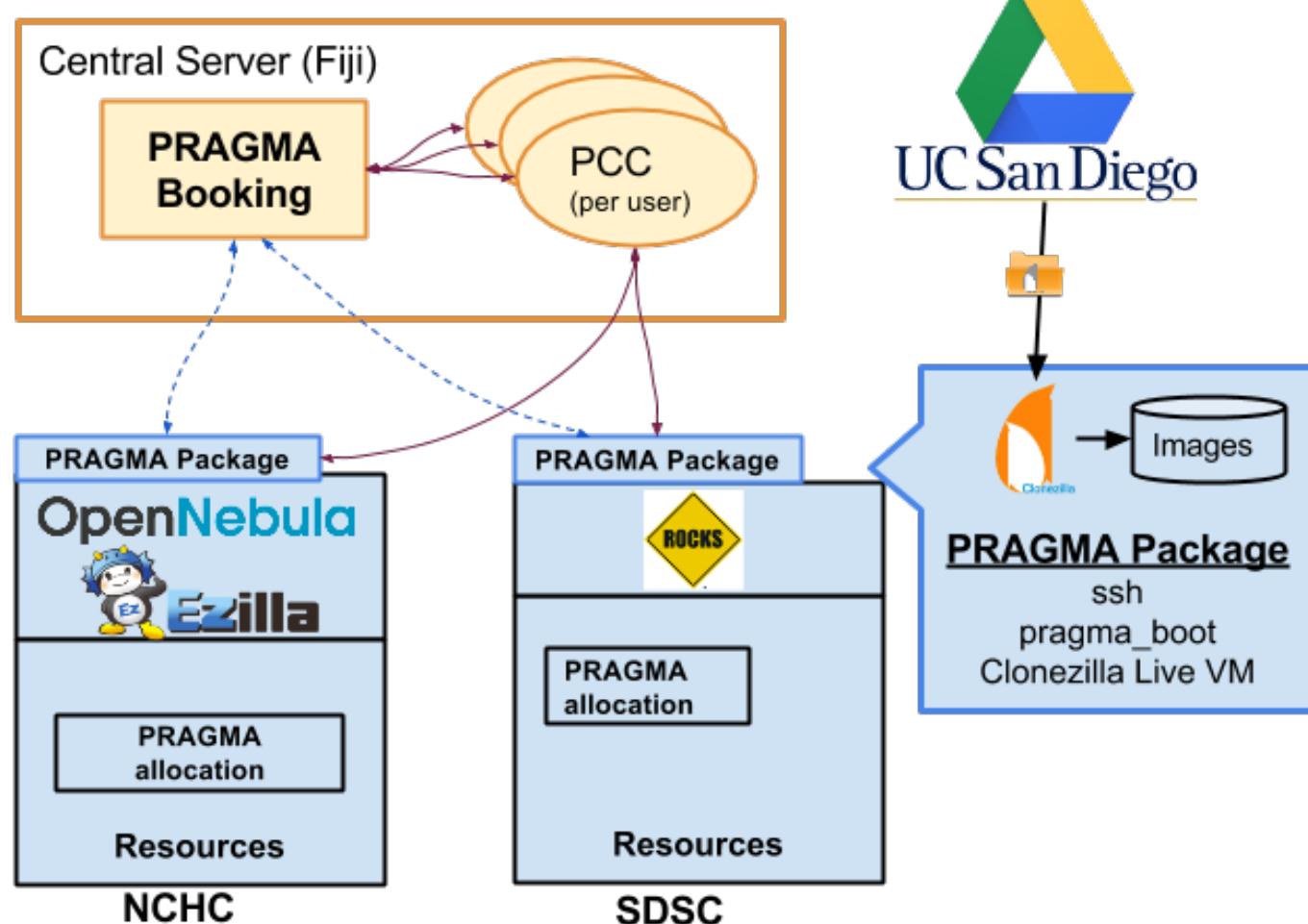
Step 6: Modify vc-in.xml

```
<vc type='Local Beowulf'>
...
<frontend> ...
    <devices> ...
        <disk type='volume' device='disk'>
            <source volume='state/hku_biolinux_fe'
                  pool='state' host='nas-0-0' />
            <target dev='vda' bus='virtio' />
        </disk> ...
    </devices>
</domain>
</frontend>
<compute> ...
    <devices> ...
        <disk type='volume' device='disk'>
            <source volume='state/hku_biolinux_compute'
                  pool='pragma' host='nas-0-0' />
            <target dev='vda' bus='virtio' />
        </disk> ....
    </devices>
</domain>
</compute>
...
</vc>
```

VFE Virtual FE Zvol
VC Virtual Compute Zvol



Revised Cloud Scheduler Architecture



Goals for PRAGMA 31

- Integrate 6 additional sites: AIST, NAIST, Thammasat / Kasetsart, IU, UF, CNIC
- Integrate PRAGMA-ENT
- Integrate more virtual cluster images and get feedback from early users (Jason, others?)
- Integrate 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
- Website
 - <http://fiji.rocksclusters.org/cloud-scheduler>
 - https://github.com/pragmagrid/pragma_boot



We welcome early users ☺

Thank you!