Jetstream Overview
Gateways Conference

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What is Jetstream and why does it exist?

- NSF’s first production cloud facility, part of the NSF eXtreme Digital (XD) program
- Focus on ease-of-use, broad accessibility
- Encourage collaboration and community development
- User-selectable library of preconfigured virtual machines
- Provides on-demand *interactive* computing and analysis or persistent services such as gateways (e.g. SEAGrid, Galaxy, GenApp, and others)
- Enables *configurable* environments and *programmable cyberinfrastructure*
- Reproducibility: Share VMs and then store, publish via IU Scholarworks (DOI)
Who uses Jetstream?

- The researcher needing a handful of cores (1 to 44/vCPU)
- Software creators and researchers needing to create their own customized virtual machines and workflows
- Science gateway creators using Jetstream as either the frontend or processor for scientific jobs
- STEM Educators teaching on a variety of subjects
What Jetstream isn’t…

• It’s not traditional HPC
• There’s no shared filesystem (think cloudy!)
• There’s no high-end interconnect fabric (keep thinking cloudy!)
• There aren’t GPUs (yet…stay tuned)
• It isn’t Amazon, Azure, or GCE (similar, but…)
Jetstream and way of the cloud…

- **Cloudy Technologies**: clouds are more than just virtual machines (VM)
  - **Old way**: robust (expensive) infrastructure, weak (cheap) software
    - You expect the hardware to not fail
    - State in maintained in volatile data structures
  - **Cloudy way**: commodity infrastructure, robust software
    - Expect & plan for infrastructure to fail
    - Put intelligence into the software to handle infrastructure failure
- **And my favorite…**
Thinking about VMs…

Cattle, not pets: pets take great amount of care, feeding, and you name them; cattle you intend to have high turnover and you give them numbers.

-- Mike Lowe (Jetstream architect)

** Some caveats for gateways, but…
Jetstream System Overview

IU Cyberinfrastructure

Jetstream (production)

<table>
<thead>
<tr>
<th>Compute</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>320 Nodes</td>
<td>960 TB</td>
</tr>
<tr>
<td>7,680 Cores</td>
<td></td>
</tr>
<tr>
<td>40 TB RAM</td>
<td></td>
</tr>
<tr>
<td>640 TB local disk</td>
<td></td>
</tr>
</tbody>
</table>

TACC Cyberinfrastructure

Jetstream (production)

<table>
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</tbody>
</table>

U of Arizona Cyberinfrastructure

Jetstream (development)

<table>
<thead>
<tr>
<th>Compute</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Nodes</td>
</tr>
<tr>
<td>2 TB RAM</td>
</tr>
<tr>
<td>384 Cores</td>
</tr>
<tr>
<td>32 TB local disk</td>
</tr>
</tbody>
</table>

http://jetstream-cloud.org/

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Award ACI-1445604
Platform Overview

Web App

Globus Auth
Atmosphere API
Atmo Services
XSEDE Accounting

OpenStack
Ceph

Indiana University
TACC
Hardware and Instance ”Flavors”

VM Host Configuration
- Dual Intel E-2680v3 “Haswell”
- 24 physical cores/node @ 2.5 GHz (Hyperthreading on)
- 128 GB RAM
- Dual 1 TB local disks
- 10GB dual uplink NIC
- Running KVM Hypervisor

- Short-term *ephemeral* storage comes as part of launched instance
- Long-term storage is XSEDE-allocated
- Implemented as OpenStack Volumes
- Each user can get 10 volumes up to 500GB total storage*

<table>
<thead>
<tr>
<th>Flavor</th>
<th>vCPUs</th>
<th>RAM</th>
<th>Storage</th>
<th>Per Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>m1.tiny</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>46</td>
</tr>
<tr>
<td>m1.small</td>
<td>2</td>
<td>4</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>m1.medium</td>
<td>6</td>
<td>16</td>
<td>60</td>
<td>7</td>
</tr>
<tr>
<td>m1.large</td>
<td>10</td>
<td>30</td>
<td>60</td>
<td>4</td>
</tr>
<tr>
<td>m1.xlarge</td>
<td>24</td>
<td>60</td>
<td>60</td>
<td>2</td>
</tr>
<tr>
<td>m1.xxlarge</td>
<td>44</td>
<td>120</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>s1.large**</td>
<td>10</td>
<td>30</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>s1.xlarge**</td>
<td>24</td>
<td>60</td>
<td>240</td>
<td>2</td>
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<tr>
<td>s1.xxlarge**</td>
<td>44</td>
<td>120</td>
<td>480</td>
<td>1</td>
</tr>
</tbody>
</table>

** s1.* based instances are not eligible to be saved into a customized image
The Jetstream Atmosphere web interface

Getting Started

- Launch New Instance:
  Browse Atmosphere’s list of available images and select one to launch a new instance.
- Browse Help Resources:
  View a video tutorial, read the how-to guides, or email the Atmosphere support team.
- Change Your Settings:
  Modify your account settings, view your resource quota, or request more resources.

Resources Used

- Allocation Source:
  - TG-STA1100245
  - TG-ASC160018
  - TG-CDA160007
  - TG-TBA160003
  - TG-TBA160027

- 10 Instances:
  - Active
  - Shorted

- Provider Resources:
  - Jetstream - Indiana University
  - Jetstream - TACC

http://jetstream-cloud.org/
The Jetstream Atmosphere web interface
Look! It’s more Jetstream web interface!
Even more Jetstream web interface...
Using Jetstream as a gateway developer

Manipulating Jetstream VMs:
• Direct API access via OpenStack CLI or Horizon access
• Log in via ssh (or gui if you install X and a VNC server— but that’s up to you)

Why:
• Programmatic access – Programmable cyberinfrastructure
• Reserved IP pools
• Ability for true cloud benefits like elastic computing are available via the API
The basics that Jetstream provides

- Base images to start from
- A basic network space (some DIY required)
- An IP pool
- Isolated project space for your team (on two clouds)
- A blank canvas (to some degree) – you can truly install just about anything you want – and you can BYOLicense if needed

http://jetstream-cloud.org/

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Jetstream storage

Storage built into the VM flavors = ephemeral (replicated, but…)

Volume storage = persistent (erasure coded, 4 data 2 recovery)

Valuable data should be on volumes (and backed up elsewhere)
Some of the possibilities on Jetstream…

- **True elastic computing**
  - OpenStack Heat
  - OpenStack Magnum
  - Your own creation?

- **Virtual clusters**
  - Several gateways using virtual clusters
  - Working on a bigger and better long-term solution
  - Workshop at PEARC17 – (link in the tutorial walkthrough)

- **Other possibilities**
  - [https://www.openstack.org/software/project-navigator/](https://www.openstack.org/software/project-navigator/)
  - Mistral (OSG) – cron as a service
  - Senlin (a coming attraction for making virtual clusters elastic-ness easier)
  - other additions like Manila (filesystems as a service), etc
Left Twix, Right Twix

- Having two clouds = some semblance of fault tolerance
- Making that work for your gateway
  - Fail over possibilities
  - Load distribution/performance
  - Maximizing simultaneous VMs (VM/IP limits per cloud)
But what about big data sets and such?

- At IU, Wrangler is nearby
- Jetstream wired to Wrangler’s switch and vice versa
- Dedicated NFS node(s) on Wrangler for Jetstream
- Dedicated vlan built for projects that need access (still in beta, but working!)
- Hoping to replicate at TACC soon-ish
Jetstream Fun: Happy cluster / Angry Cluster
Where can I get help?


User guides: https://portal.xsede.org/user-guides

XSEDE KB: https://portal.xsede.org/knowledge-base

Email: help@xsede.org

Campus Champions: https://www.xsede.org/campus-champions

Training Videos / Virtual Workshops (TBD)
Discussion -

• What images would gateway developers like to see?
  - Is there a distribution and standard set of packages that would benefit many gateway developers?

• What features would gateway developers like to see?

• Other things?
Questions?

Project website: http://jetstream-cloud.org/
Project email: help@jetstream-cloud.org  Direct email: jeremy@iu.edu

License Terms

- Jetstream is supported by NSF award 1445604 (Craig Stewart, IU, PI)
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And onward…
Cloud Computing Terms...simplified

**Image:** a file on a disk. It will be booted to create an...

**Instance:** a running virtual server; i.e. something you can log into.

**Running:** the *instance* is up & running

**Suspended:** the *instance* is memory resident but not running

**Stopped:** the *instance* is shutdown akin to powering down

**Shelved:** the *instance* is shutdown, backed up, and stored

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http://jetstream-cloud.org/
Cloud Computing Terms…simplified

Flavor: the size of a running instance; i.e. #core, RAM, disk

Hypervisor: the thing the instance runs on; something akin to a software defined hardware compute server.

Snapshot: the process of taking an instance and turning it to an image.

State: something worth remembering; i.e. the state of the system
Object store: a blob of bits; it has a starting address & a size. There may be metadata associated with the object. The data is consumed in a streaming manner.

Block store: a software defined entity akin to an unformatted hardware disk drive.

Filesystem: hierarchical in nature, directories & files, ability to open, seek, read, write.

Persistent storage: If you pull the plug, it will still exist when power is restored. Safe to store data or state here.

Ephemeral storage: If you pull the plug, it no longer exists. (Don’t put your data here!!!)
OpenStack Overview

- Client
- Keystone
- Nova
- Glance
- Ceph
- Cinder
- Compute

Token
Getting into the hands on part -

Open [https://goo.gl/8ke2fu](https://goo.gl/8ke2fu) in your browser

You’ll be connecting to a prepped host…but you might want to wait until I tell you something key first. 😊

ssh [trainXX@tutorial.jetstream-cloud.org](mailto:trainXX@tutorial.jetstream-cloud.org)