Jetstream2: Accelerating cloud computing via Jetstream

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What is “the” Jetstream?

- Fast moving air currents
- Hot/Cold air boundaries
- An NSF-funded cloud environment
- A project that brought new resources to US researchers via the national cyberinfrastructure, continuing into Jetstream2
What worked?

• Allowing API access and full control (root privileges)
• “Indefinite workflows” – allowing instances to run continuously – providing PIs renew their allocations
• Development of trial allocations

What didn’t work?

• Forcing small allocations into the research allocation process
• Lack of multi-year allocations
• Lack of shared data set storage
Lessons learned

Challenges -> Inspired changes

• Storage capacity -> Larger HDD pool and new flash storage

• Homogeneous hardware -> Inclusion of NVIDIA GPUs (w/MIG or vGPU) and memory diversity

• Separate OpenStack domains -> Unification of “Atmosphere” domain

• Virtual networking architecture/maintenance -> Increase offload capabilities via Cumulus Networks software and Mellanox hardware (NAT & simulation)

• Acceptance & integration into national CI ecosystem -> Changes to our metrics/KPIs & accounting processes

• Deployment diversity -> Leverage single technology for config management
Big Memory, Larger Instances, GPUs

- 128 core nodes – AMD EPYC Milan
- Smallest node has 512GB of memory
- 32 Larger 1TB memory nodes*
- A100 GPUs sliced and diced
XSEDEnet
Advanced Layer 2 Services (AL2S) platform

Indiana University Cyberinfrastructure

Primary
- Compute
  - 416 Nodes
  - 53,248 Cores
  - 224 TB RAM

- Storage
  - 96 Nodes
  - 14 PB

- Accelerators
  - 90 Nodes
  - 45 TB RAM
  - 360 GPUs

TACC Cyberinfrastructure

- Compute
  - 8 Nodes
  - 1,024 Cores
  - 4 TB RAM

- Storage
  - 768 TB

- Accelerators
  - 2 Nodes
  - 1 TB RAM
  - 8 GPUs

University of Hawai‘i Cyberinfrastructure

- Regional
  - Compute
    - 8 Nodes
    - 1,024 Cores
    - 4 TB RAM

- Storage
  - 768 TB

- Accelerators
  - 2 Nodes
  - 1 TB RAM
  - 8 GPUs

Arizona State University Cyberinfrastructure

- Regional
  - Compute
    - 8 Nodes
    - 1,024 Cores
    - 4 TB RAM

- Storage
  - 768 TB

- Accelerators
  - 2 Nodes
  - 1 TB RAM
  - 8 GPUs

Cornell University Cyberinfrastructure

- Regional
  - Compute
    - 8 Nodes
    - 1,024 Cores
    - 4 TB RAM

- Storage
  - 768 TB
Jetstream2 Capabilities

Enhancing IaaS model of Jetstream:
• Improved orchestration support
• Elastic virtual clusters
• Federated JupyterHubs
• Ease storage sharing (CephFS w/Manilla)

Commitment to >99% uptime
• Critical for science gateway hosting
• Hybrid-cloud support

Revamped User Interface
• Unified instance management
• Multi-instance launch

>57K cores of next-gen AMD EPYC processors
>360 NVIDIA A100 GPUs will provide vGPUs via NVIDIA’s MIG/vGPU feature
>17PB of storage (NVMe and disk hybrid)
100GbE Mellanox network
Startup Allocations

• Primary cloud (IU) only
  • Jetstream (CPU Only) – 200,000 SU (core hours)
  • Jetstream LM (1TB Large Memory nodes) – 400,000 SU
  • Jetstream GPU (NVIDIA A100 GPU nodes) – 600,000 SU
  • Jetstream Storage (requires one of the compute resources) – 1TB

• Reference: [https://docs.jetstream-cloud.org/general/resources/](https://docs.jetstream-cloud.org/general/resources/)

• Who can get an allocation?
  • Applying: [https://docs.jetstream-cloud.org/alloc/startup/](https://docs.jetstream-cloud.org/alloc/startup/)

• What might be the best practice for SC22 reproducibility?
## VM flavors

### Table 1. VM CPU Instance Configurations

<table>
<thead>
<tr>
<th>Instance Type</th>
<th>vCPUs (128 total)</th>
<th>RAM (500GiB available)</th>
<th>Ephemeral Storage (in GB)</th>
<th>Instances/Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>m3.tiny</td>
<td>1</td>
<td>3</td>
<td>20</td>
<td>128</td>
</tr>
<tr>
<td>m3.small</td>
<td>2</td>
<td>6</td>
<td>20</td>
<td>64</td>
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<tr>
<td>m3.quad</td>
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<td>15</td>
<td>20</td>
<td>32</td>
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<tr>
<td>m3.medium</td>
<td>8</td>
<td>30</td>
<td>60</td>
<td>16</td>
</tr>
<tr>
<td>m3.large</td>
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<td>60</td>
<td>60</td>
<td>8</td>
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<tr>
<td>m3.xl</td>
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<td>125</td>
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<td>4</td>
</tr>
<tr>
<td>m3.2xl</td>
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<td>250</td>
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<td>m3.3xl</td>
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<td>500</td>
<td>60</td>
<td>1</td>
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</table>

### Table 2. VM GPU Instance Configurations

<table>
<thead>
<tr>
<th>Instance Type</th>
<th>vCPUs (128 total)</th>
<th>vGPUs (7 slices)*</th>
<th>RAM (500GiB available)</th>
<th>Ephemeral Storage (in GB)</th>
<th>Instances/Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>g3.small</td>
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<td>1 / 5gb</td>
<td>15</td>
<td>60</td>
<td>28**</td>
</tr>
<tr>
<td>g3.medium</td>
<td>8</td>
<td>2 / 10gb</td>
<td>30</td>
<td>60</td>
<td>16</td>
</tr>
<tr>
<td>g3.large</td>
<td>16</td>
<td>3 / 20gb</td>
<td>60</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>g3.xl</td>
<td>32</td>
<td>7 / 40gb</td>
<td>125</td>
<td>60</td>
<td>4</td>
</tr>
</tbody>
</table>

*7 GPU slices = 1 NVIDIA 40GB Ampere A100 GPU
** [https://docs.nvidia.com/datacenter/tesla/mig-user-guide/#a100-profiles](https://docs.nvidia.com/datacenter/tesla/mig-user-guide/#a100-profiles) - 7 slices max

### Table 3. Large Memory Instance Configurations

<table>
<thead>
<tr>
<th>Instance Type</th>
<th>vCPUs (128 total)</th>
<th>RAM (1000GB available)</th>
<th>Ephemeral Storage (in GB)</th>
<th>Instances/Node</th>
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<tbody>
<tr>
<td>r3.large</td>
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<td>128</td>
<td>1000GB</td>
<td>60</td>
<td>1</td>
</tr>
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</table>

Reference: [https://docs.jetstream-cloud.org/general/vmsizes/](https://docs.jetstream-cloud.org/general/vmsizes/)
How do I access Jetstream2?

https://docs.jetstream-cloud.org/overview/overview-doc/
Using and preserving VMs

• You can install just about anything*
  • But generally limited to Linux**
• Snapshots are fairly simple and easily shared with your allocation
• One general practice is often to pull from Git(hub/lab) or pull a container

* Standard warnings about licensed software here.
** Here there be dragons.
Timeline

- Jetstream now in 5th year of operations
- Jetstream extension granted by the NSF through November 2021
- Extension through end of March 2022 in process
- Jetstream2
  - Early operations in progress as of February 2022
  - Production operations by end of March 2022/early April 2022
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Jetstream2 partners

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- TACC
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http://jetstream-cloud.org/
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