Jetstream2: Accelerating cloud computing via Jetstream

Jeremy Fischer – Indiana University
Manager, Jetstream Cloud

RT Infoshare – August 4, 2022
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

Regional
- Compute: 8 Nodes, 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

University of Hawaii CyberInfrastructure

Regional
- Compute: 8 Nodes, 1,024 Cores, 4 TB RAM
- Storage: 768 TB
- Accelerators: 2 Nodes, 1 TB RAM, 8 GPUs

Jetstream2
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
Some sample use cases

- Science gateways
- Research-supporting infrastructure / Infrastructure as a service
- Education support – compute and desktops for courses, workshops, tutorials
- Domain science interactive compute
- Domain science long running compute
  - Small core counts, “pleasingly parallel”, etc
- Jupyter notebooks and Hubs
- Research software development
- Machine learning – training and workflow development and data analysis
- [Your use case here]
Advanced capabilities

- Focusing on enabling several advanced capabilities:
  - "Push button" virtual clusters (Slurm-based)
  - Using Terraform for programmable cyberinfrastructure (infrastructure as code)
  - Simplifying container orchestration with Kubernetes
Allocations

• Primary cloud (IU) only Startup Limits
  • 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/

• Who can get an allocation?
  • Applying: https://docs.jetstream-cloud.org/alloc/startup/
  • For courses/workshops: https://docs.jetstream-cloud.org/alloc/education/
### 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>
</tr>
</thead>
<tbody>
<tr>
<td>m3.tiny</td>
<td>1</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>m3.small</td>
<td>2</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>m3.quad</td>
<td>4</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>m3.medium</td>
<td>8</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>m3.large</td>
<td>16</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>m3.xl</td>
<td>32</td>
<td>125</td>
<td>60</td>
</tr>
<tr>
<td>m3.2x1</td>
<td>64</td>
<td>250</td>
<td>60</td>
</tr>
<tr>
<td>m3.3x1</td>
<td>128</td>
<td>500</td>
<td>60</td>
</tr>
</tbody>
</table>

### VM GPU Instance Configurations

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

*5 GPU slices = 1 NVIDIA 40GB Ampere A100 GPU
**5 Slices max per GPU

### Large Memory Instance Configurations

<table>
<thead>
<tr>
<th>Instance Type</th>
<th>vCPUs (128 total)</th>
<th>RAM (10000GB available)</th>
<th>Ephemeral Storage (in GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>r3.large</td>
<td>64</td>
<td>500GB</td>
<td>60</td>
</tr>
<tr>
<td>r3.xl</td>
<td>128</td>
<td>1000GB</td>
<td>60</td>
</tr>
</tbody>
</table>
How do I access Jetstream2?

[Image of a web interface for 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 ends operations on July 31 for XSEDE
• JS1 hardware will live on for internal usage
• Jetstream2
  • Early operations started in February 2022
  • Production pending NSF approval
Acknowledgements

NSF Awards 1053575 & 1548562 (XSEDE), 1445604 (Jetstream) and 2005506 (Jetstream2)

This document was developed with support from the National Science Foundation. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

Special thanks to contributors & Jetstream2 partners
• PI David Y. Hancock, J. Michael Lowe, Therese Miller, Maria Morris, Winona Snapp-Childs, and George Turner
Jetstream2 partners