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Jetstream2: Accelerating cloud computing via Jetstream

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Manager, Jetstream Cloud

ICICLE Webinar – July 18, 2022

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Is Jetstream2 a “testbed?”

- No, but it’s a great place to test!
- Ease-of-use focus, rapid on-ramp to XSEDE/ACCESS
- On-demand interactive computing and persistent services for science gateways
- Enables configurable environments; programmable cyberinfrastructure

Now with GPUs and large-memory!

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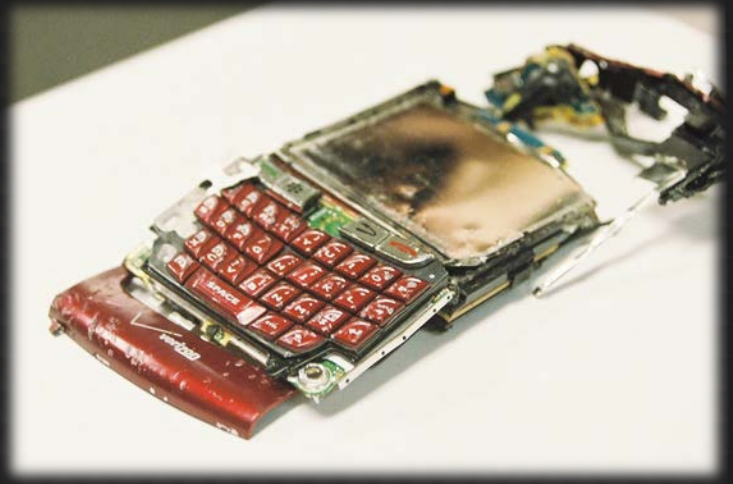
Jetstream1

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



Flickr user MattHurst – Broken Blackberry

What didn’t work?

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

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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

D.Y. Hancock – Castello di Nipozzano 2017

- 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

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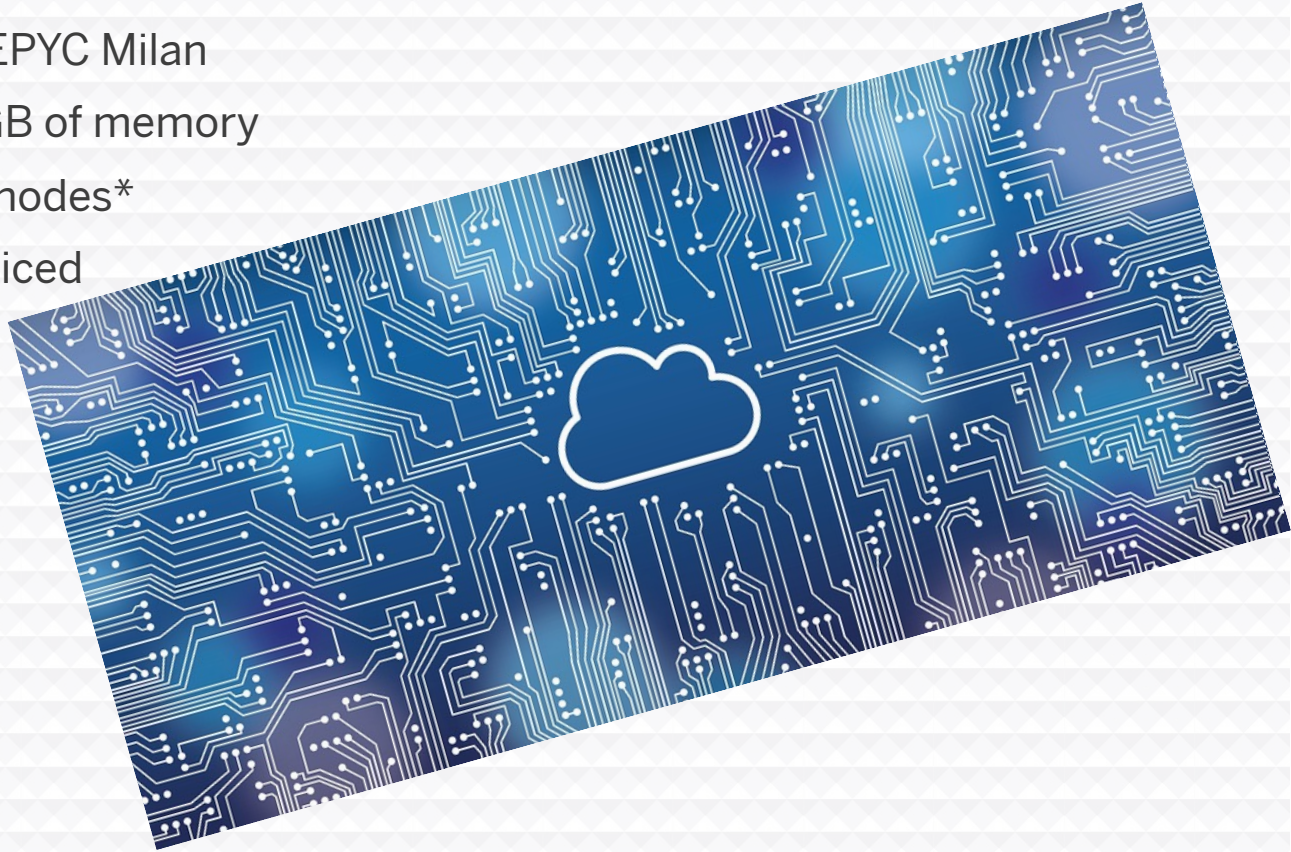
Big Memory, Larger Instances, GPUs

- 128 core nodes – AMD EPYC Milan
- Smallest node has 512GB of memory
- 32 Larger 1TB memory nodes*
- A100 GPUs sliced and diced



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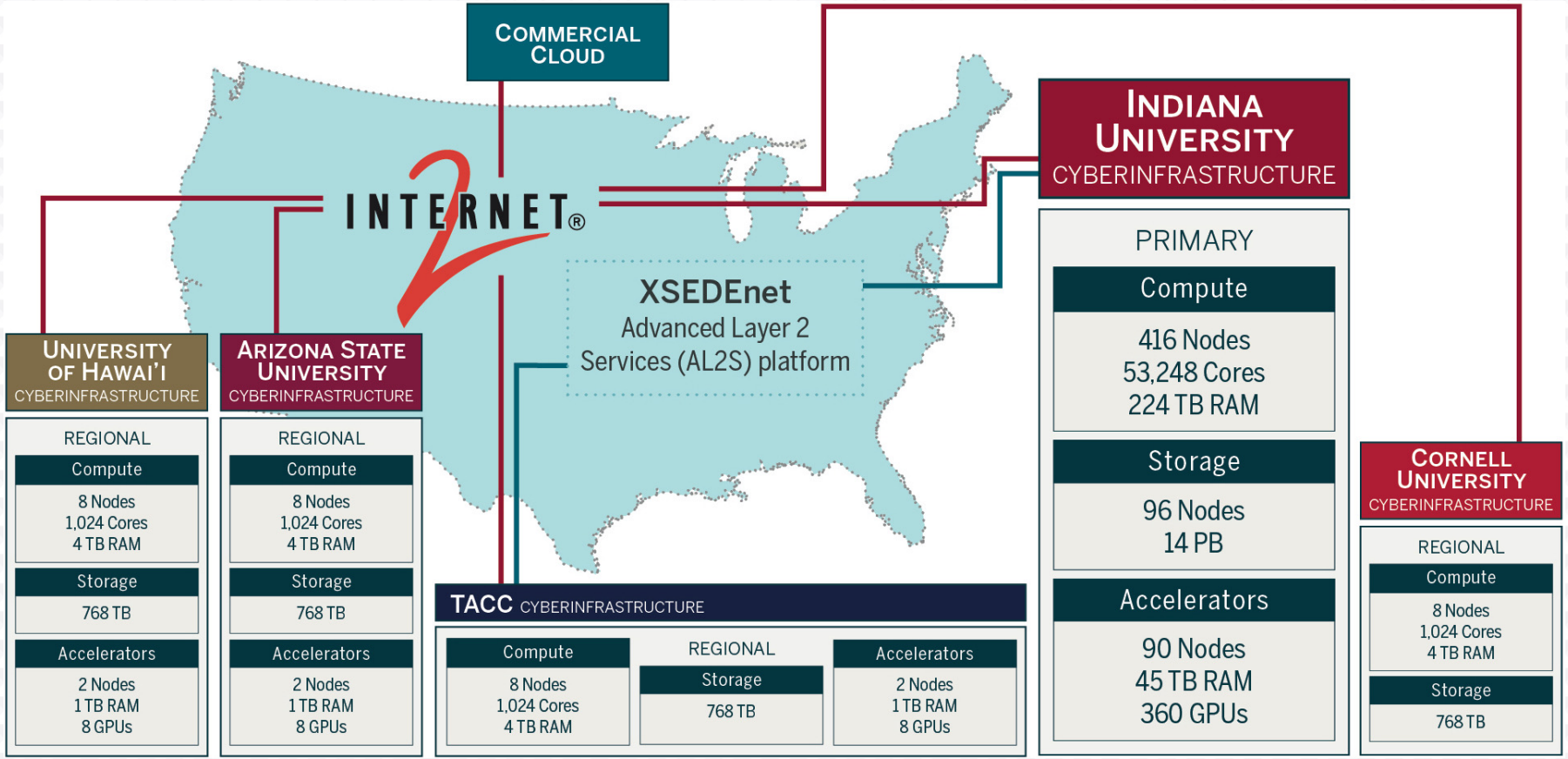
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CYBERINFRASTRUCTURE
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224 TB RAM
Storage
96 Nodes
14 PB
Accelerators
90 Nodes
45 TB RAM
360 GPUs
UNIVERSITY OF HAWAI'I
CYBERINFRASTRUCTURE
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Compute
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1,024 Cores
4 TB RAM
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Accelerators
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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

Feb 12, 2019 – Jet stream region called "Jet N6"
NASA/JPL-Caltech/SwRI/MSSS/Kevin M. Gill

- >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

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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]

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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

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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/

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VM flavors

VM CPU Instance Configurations

Instance Type	vCPUs (128 total)	RAM (500GiB available)	Ephemeral Storage (in GB)
m3.tiny	1	3	20
m3.small	2	6	20
m3.quad	4	15	20
m3.medium	8	30	60
m3.large	16	60	60
m3.xl	32	125	60
m3.2xl	64	250	60
m3.3xl	128	500	60

VM GPU Instance Configurations

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

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

Large Memory Instance Configurations

Instance Type	vCPUs (128 total)	RAM (1000GB available)	Ephemeral Storage (in GB)
r3.large	64	500GB	60
r3.xl	128	1000GB	60

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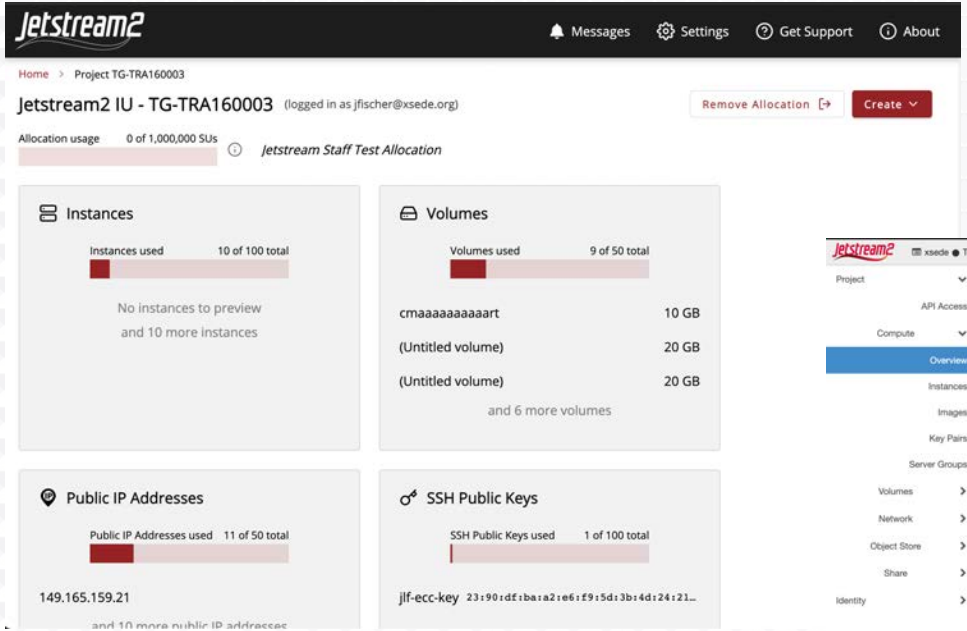
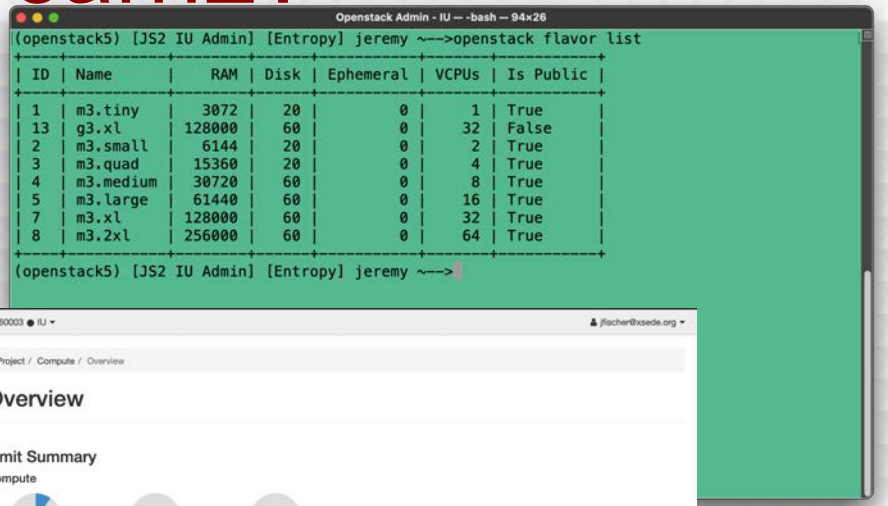
Reference: https://docs.jetstream-cloud.org/general/vmsizes/

How do I access Jetstream2?





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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.

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Making the jump to Jetstream2

- Almost 12,000 users over the span of Jetstream1
- Early Jetstream2 invitations out to PIs February 2022
- First projects added 7-February-2022
- July 1 2022: 265 projects and 1102 individuals
- Followed push for all projects to migrate in May – July.
- Includes multiple science gateways and education/training allocations

"Bike Exchange - 2009 IU Women's Little 500" by Indiana Public Media
Flickr CC BY-NC 2.0

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Timeline

- Jetstream ends operations on July 31 for XSEDE
- JS1 hardware will live on for internal usage
- Jetstream2
  - Early operations started in February 2022
  - Migrating from Jetstream1 now!
  - Production pending NSF approval

Flickr user Oiluj Samall Zeid - Lejos de Yulín

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