



AFRICAN
CENTERS
OF EXCELLENCE
IN BIOINFORMATICS &
DATA-INTENSIVE SCIENCE



UbuntuNet
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HPC Cyberinfrastructure in Resource Constrained Environments (RCE) – Challenges & Lessons Learned: Case of ACE Uganda and ACE Mali

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Outline

- Introduction
- What is ACE?
- Why HPC?
- ACE HPC Use cases
- Not Just HPC for R&E
- Lessons Learned
- HPC Challenges in RCE
- Key considerations for starters



Introduction

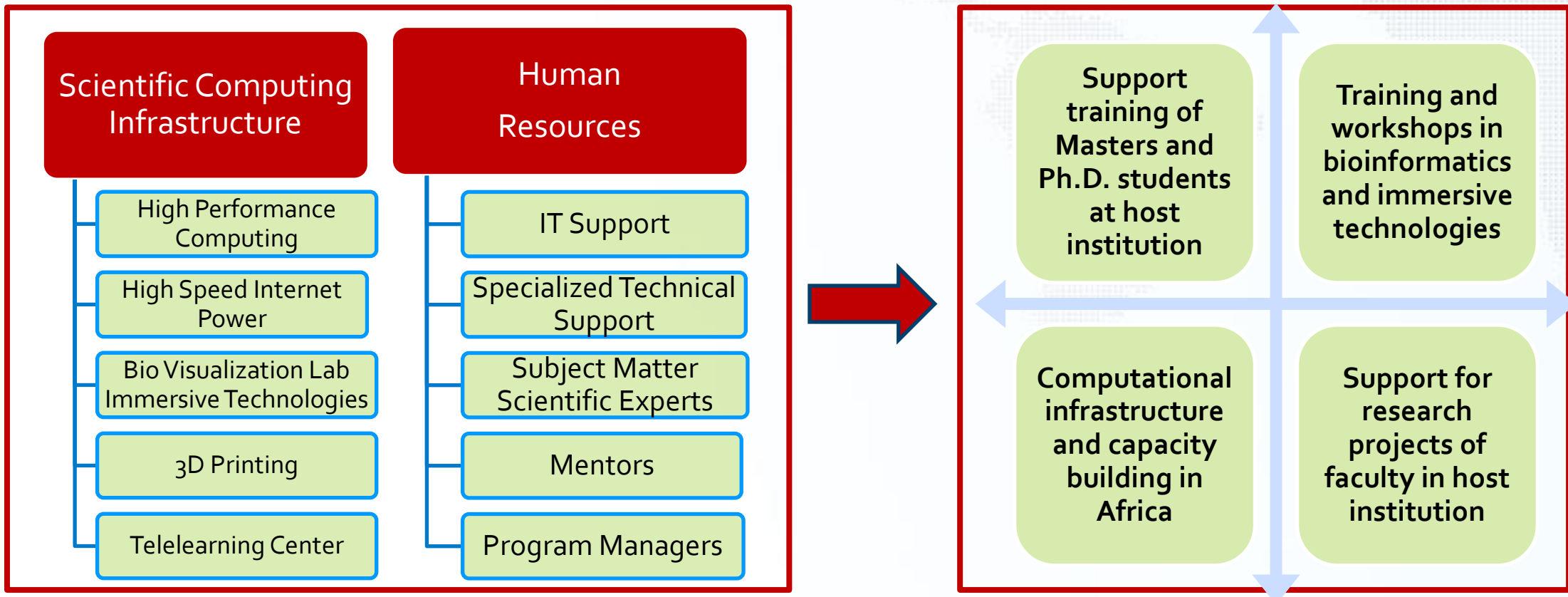


- 5 years ago, HPC Cyberinfrastructure facility at ACE Uganda, Makerere University.
 - Over the years, supported setup and configuration of HPC at ACE Uganda and ACE Mali
- Enormous HPC experience acquired concerning R&E
 - User and system Admin perspective
 - Resource utilization and management

African Centers of Excellence in Bioinformatics and Data Intensive Science



Consortium of research and training centers facilitated by National Institute of Allergy and Infectious Diseases/National Institutes of Health in collaboration with African research institutions, government (NIAID), and private sector companies, and the Foundation for NIH to support computational infrastructure and capacity and training in bioinformatics and data science to advance basic and translational research in Africa and reduce the threat of global infectious and non-communicable diseases.



ACE Public-Private Partnership



ACE-Mali



Training,
Research, Space,
Local Admin

Equipment,
Software,
Training &
Consulting

Connectivity

Management,
Training,
Infrastructure,
Technical Support

ACE-Uganda



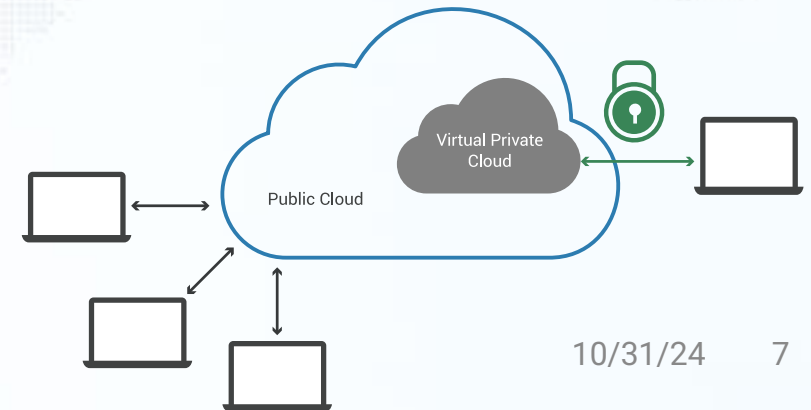
Why HPC?

- Most protocols in Biomedical research require high computation
- Most researchers have computational needs HPC to analyze their data
- Large data sets have been generated over time
- New Biomedical research trends require high computation

ACE HPC Use Cases



- Large-scale data analysis
- Hosting of reference databases
- Scientific Research such as
Climate and molecular modeling,
Disease modeling.
- Healthcare and Life Sciences
including Genomic Sequencing



Researchers need more than just HPC



- Virtual Machines and containers
 - Integrates software-defined storage and networking, high-availability clustering.
 - Support automated deploying, scaling and management of containerized applications
 - Kubernetes + dockers
- Proxmox
 - Open-source tool that manages both VM hypervisors and Linux Containers
 - R&E Community need this to create and deploy apps faster and more securely

ACE HPC Configurations Tools



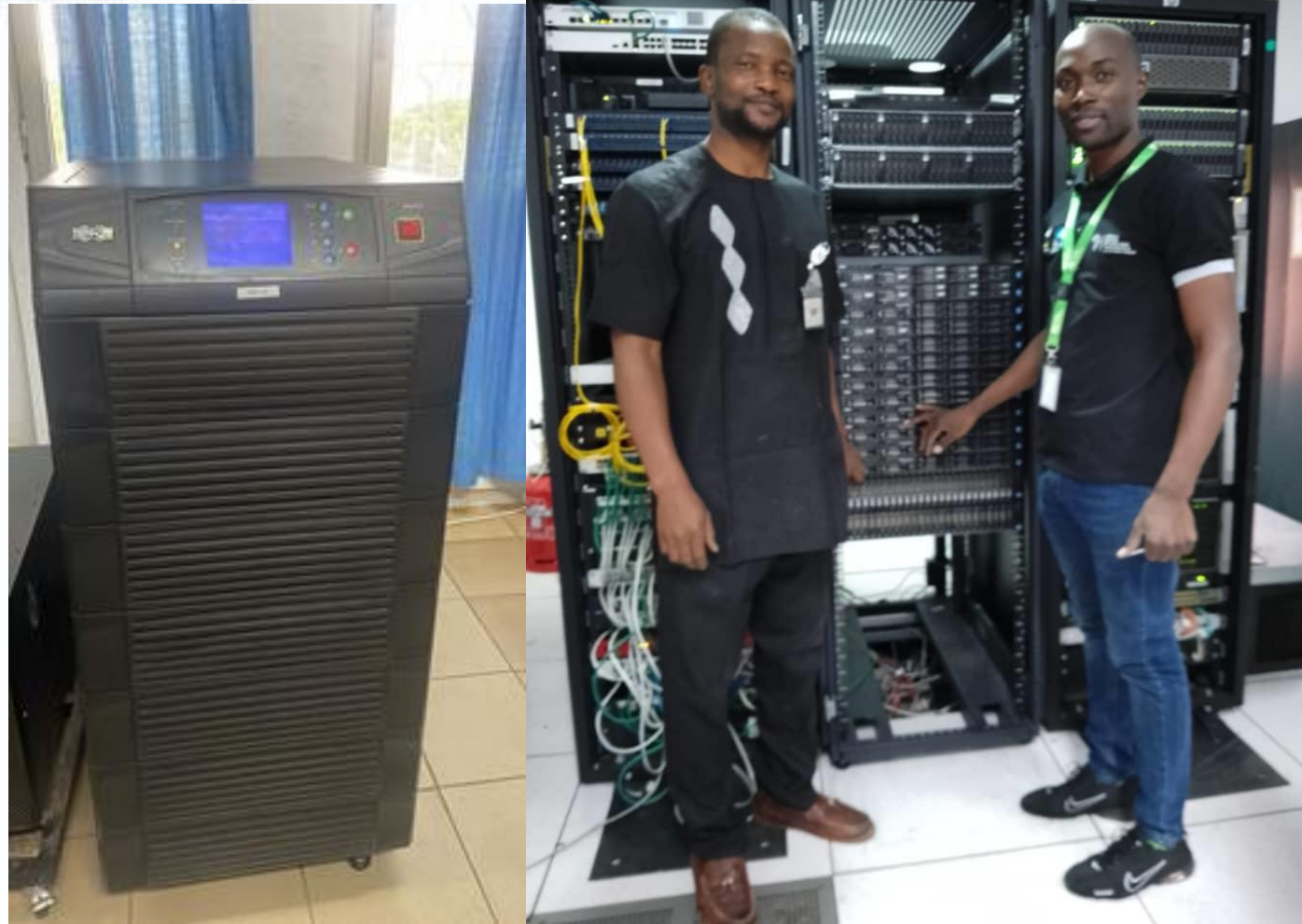
Spack
Package manager tool



ACE Mali HPC Configurations



- 16 Stampede 2 nodes
(donated by TACC).
- Total Memory: 1,792 GB
- Storage: Synology NAS
126TB (Donated by NIAID)
- Total Cores: 2,560
- 20 KVA Online UPS



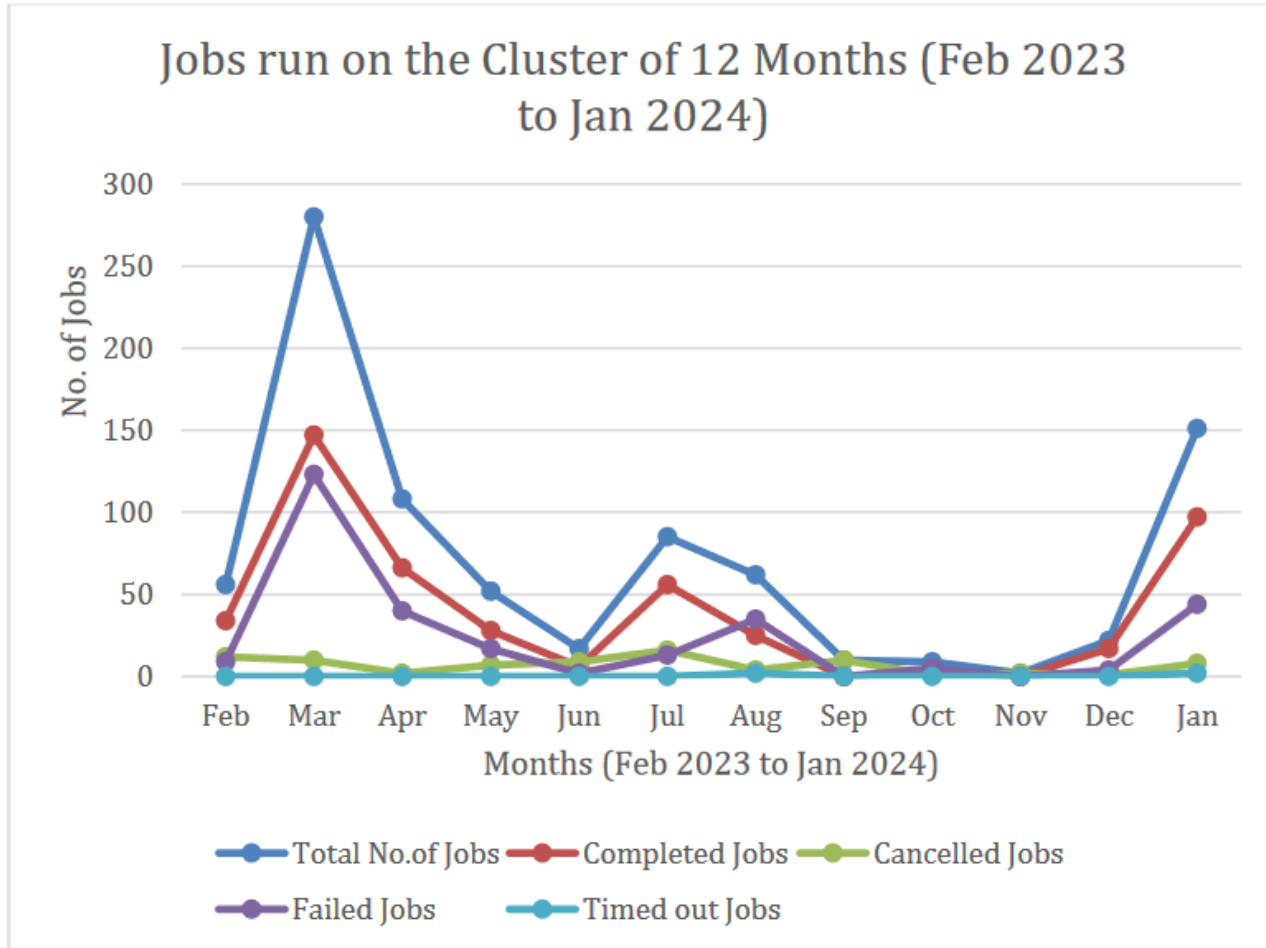
ACE Uganda HPC Configurations



- 56 Stampede 2 nodes (donated by TACC)
- Total Memory: 5.25TB
- Total Cores: 3,808
- Storage: 160TB Synology NAS & 0.5PB NetApp (Donated by NIAID)
- 40 KW Sinusoidal Online Inverter



HPC Usage Statistics – ACE Uganda



- 93 MSC & 22 PhD Bioinformatics students trained since accreditation by Makerere University in 2019
 - Cohort 1 (2019): 34 = 6 PhDs, 28 MSC
 - Cohort 2 (2020): 17 = 1 PhD, 16 MSC
 - Cohort 3 (2021): 15 = 3 PhDs, 12 MSC
 - Cohort 4 (2022): 18 = 5 PhDs, 13 MSC
 - Cohort 5 (2023): 31 = 7 PhDs, 24 MSC
 - Cohort 6 (2024): 12 = All PhDs



Lessons Learned: The Admin Perspective



- Working with Donated equipment is challenging
- HPC Administration requires various skills
- User training in HPC management is necessary

Lessons Learned: The User Perspective

- Limited exposure of users to Linux systems
 - Inclined to stand alone servers
 - Job scheduling (SLURM) was completely a new concept
- Absence of user policies
 - Access to the infrastructure
 - Storage utilization

HPC Challenges in RCE

- Not many staff with the required specialized skills and training to manage HPC
 - SLURM Workload manager
 - HPC resource monitoring
 - High Performance storage solutions
 - Parallel programming
- Heat and cooling Challenges
- Storage management
- Internet limitations

Key Considerations for Starters



- Implementation of storage Quotas
- Exploring web-based access options such open on demand
- Training System Admins and Users
- Partnering with NRENs for connectivity
- Optimizing HPC Networking to use distributed storage

Acknowledgements

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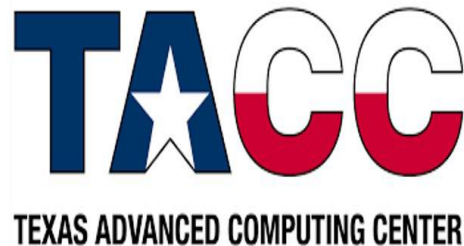
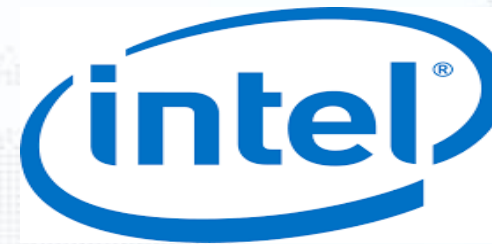
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Thank you



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