ADVANCED RESEARCH COMPUTING & DATA AT USC

CENTER FOR ADVANCED RESEARCH COMPUTING (CARC)

VITERBI NEW FACULTY ORIENTATION

USC University of Southern California

ABOUT CARC

https://www.carc.usc.edu/

The computational expertise in high-performance computing of the USC Center for Advanced Research Computing (CARC) has been a vital resource in USC research community and contributes to improved research productivity and superior outcomes, driving USC's research excellence forward.

CARC aims to be an institutional resource enabling scientific breakthroughs at scale.

Main Service Areas:

1. High-Performance Computing
2. Data Solutions
3. Research Support
4. Education

CARC HIGHLIGHTS

The resources, services, and achievements that set us apart.

Advanced Cyberinfrastructure:

- Discovery shared HPC cluster system & Endeavour Condo cluster program
- Artemis: virtual computing platforms and cloud solution (NSF Funded)
- High-performance HPC network upgrade to 200Gbps
- 10+PB data storage capacity

Education & Outreach:

- More than 25 workshop classes and summer bootcamp
- ITP 450: High-Performance Computing for Applied Machine Learning
- DSCI 599: Advanced Computing for Data Science – Under Review
- NSF CyberTraining project – collaboration with AME faculty for development of computational science summer program

Research Collaborations:

- NSF Campus Compute ($400K) - Hybrid Computing System Development
- NSF Regional Network ($1M) - Science DMZ R&E Network Deployment
- NSF Regional Computing ($1M) – Leading Research Computing Alliance in SoCal
- Cryo-EM project for Dornsife & Viterbi –Development of Computational Ecosystem

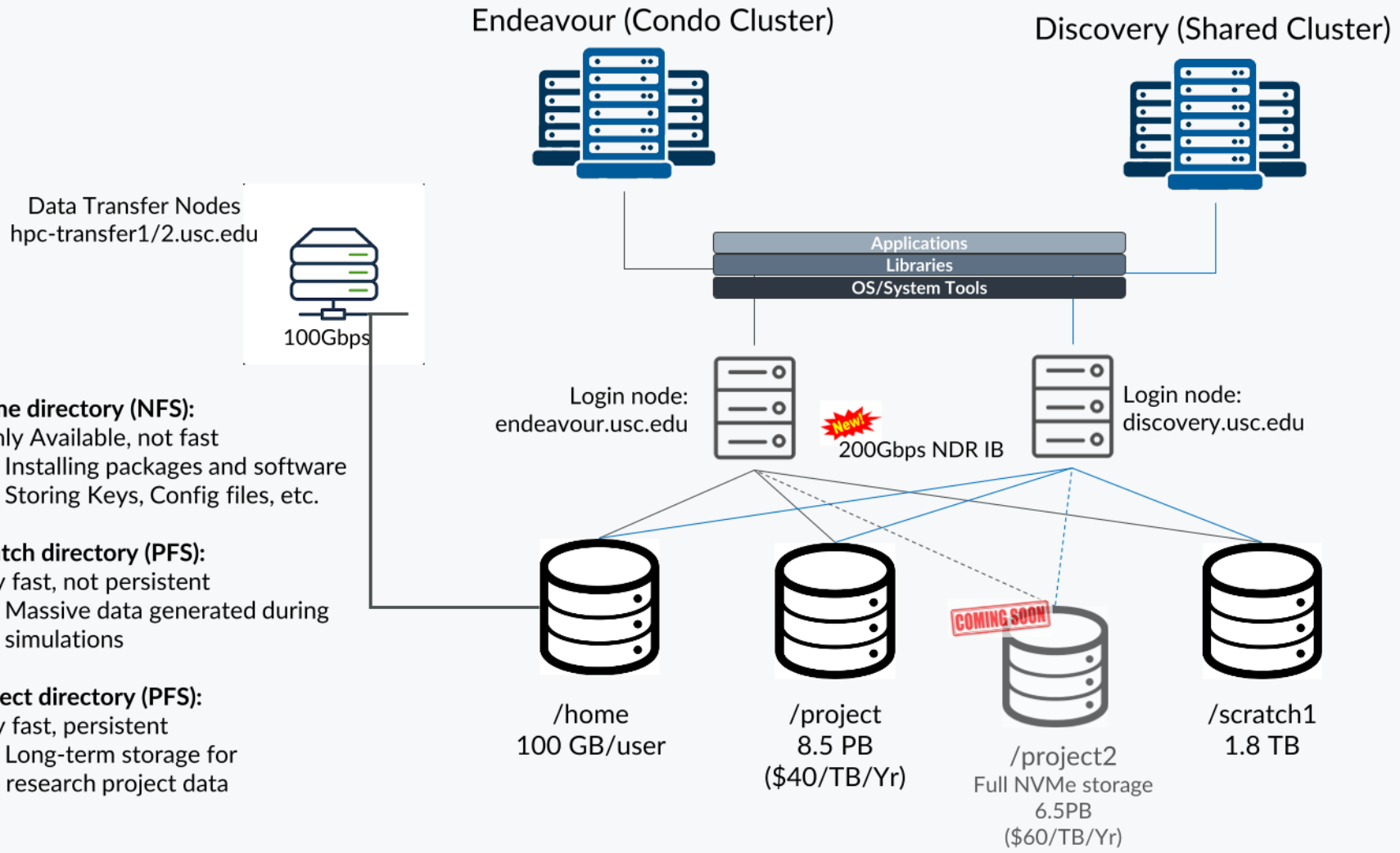
Industry Partnership:

- Samsung Semiconductor, Inc. – Smart Memory, Full NVMe storage solution
- VAST Data – Advanced FS testbed
- Nvidia – Early access to Grace-Hopper next-gen superchip, future collaboration for Frontiers of Computing

USC University of Southern California

CARC SYSTEMS OVERVIEW

CARC systems include the Endeavour condo cluster as well as the Discovery shared cluster



Home directory (NFS):
Highly Available, not fast
- Installing packages and software
- Storing Keys, Config files, etc.

Scratch directory (PFS):
Very fast, not persistent
- Massive data generated during simulations

Project directory (PFS):
Very fast, persistent
- Long-term storage for research project data

New in 2023

Artemis: Private Cloud
- Virtual computing platform
- DB, Web server, Docker, etc.
- In production since 09/23

Tape System for Data Preservation
- 20PB capacity
- Expandable up to 200PB
- Aiming for March for production

Secure Research Computing Enclave
- Federal compliances ready
- Under development

USC University of Southern California

HPC RESOURCES

The following table summarizes the resources at CARC.

Category	Function	Descriptions
Discovery general-use cluster	Login nodes	2 x 40 Gbps nodes
	Data transfer nodes	2 x 100 Gbps nodes running GlobusConnect
	Compute nodes	~500 nodes, totaling ~18,000 cores
	GPUs	~180 GPUs (A100, A40, V100, P100)
	Large memory nodes	4 nodes with 1 TB of memory
Endeavour condo cluster	Login nodes	2 x 40 Gbps nodes
	Compute nodes	~900 nodes, totaling ~22,000 cores
	GPUs	~180 GPUs (V100, A40, A100)
Network	Interconnection	InfiniBand NDR (200 Gpbs)
	Science DMZ	DTN w/ perfSONAR
Storage file systems	/home1	280TB total, 100GB/user ZFS/NFS parallel file system
	/project	8.5PB ZFS/BeeGFS parallel file system
	/scratch1&2	2.6PB total ZFS/BeeGFS parallel file system
Artemis cloud platform	Compute nodes	14 nodes, totaling 896 cores
	GPUs	6 x A40 GPUs

Recognizing the need for a significant upgrade in USC's current HPC infrastructure to meet the demands of future research, CARC is actively engaged in collaborative efforts with multiple departments across the university, focusing on planning and developing next-generation HPC systems that will deliver the necessary computing power to propel USC's research endeavors forward. These concerted efforts aim to provide optimal support for the the Frontiers of Computing initiative, ensuring that USC remains at the forefront of cutting-edge research and innovation.

USC University of Southern California

CCP: CONDO CLUSTER PROGRAM

The Center for Advanced Research Computing (CARC) launched the Condo Cluster Program (CCP) in December 2020 to allow researchers a flexible way to purchase computing resources for their own dedicated use.

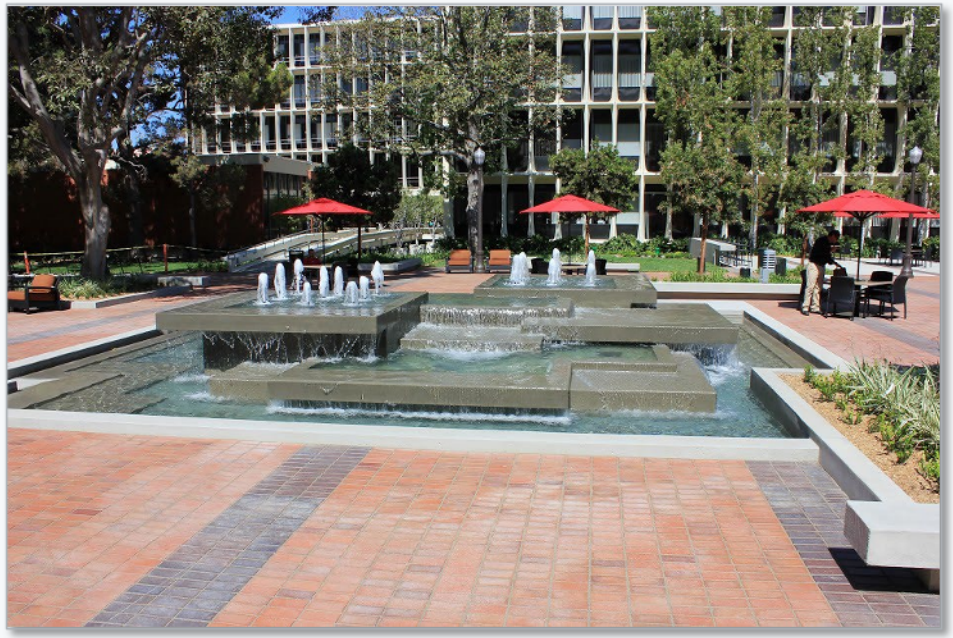
The CCP has two pricing models:

Annual Subscription Model

- Allows research groups to subscribe to their selected number of compute resources on a yearly basis
- Compute nodes can be requested via CARC User Portal
- Allocated nodes get provisioned automatically within a week

Traditional 5-year System Purchase Model

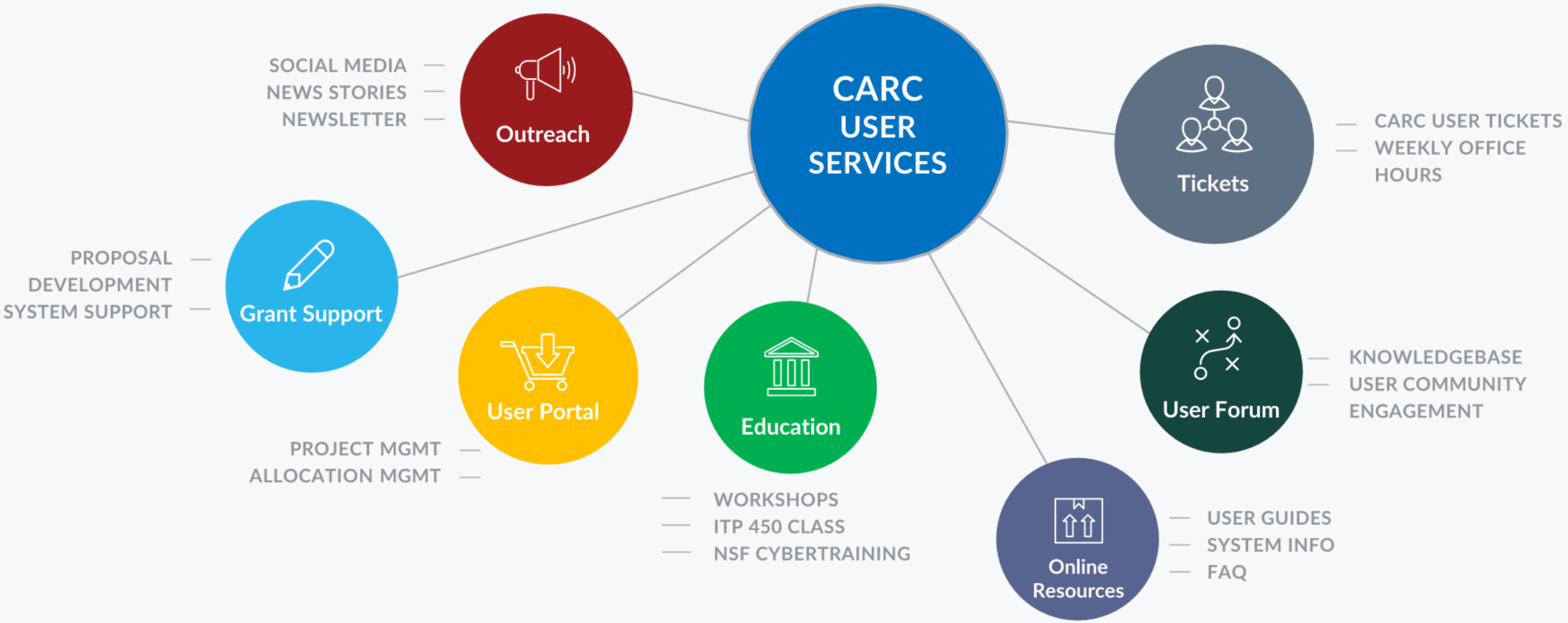
- A useful option when research groups need to make a bulk purchase using a research grant or departmental budget
- Compute/GPU system configurations by CARC
- System purchases can be requested via CARC User Portal



USC University of Southern California

ADVANCED RESEARCH COMPUTING USER SERVICES

The Center for Advanced Research Computing (CARC) offers comprehensive user support services



https://www.carc.usc.edu/

USC University of Southern California

USC RESEARCH COMPUTING & DATA ROAD MAP

The future of CARC looks bright with plans for future improvements, outreach, and collaborations.

‘23

NETWORK UPGRADE

We have upgraded our HPC network to a 200 Gbps InfiniBand NDR low-latency interconnection.

REGIONAL CYBERINFRASTRUCTURE

CARC is building dedicated CI for under-resourced universities in the Southern California region.

‘24

‘25

NEXT-GEN SUPERCOMPUTER

This upcoming system will allow researchers to conduct large-scale AI modeling and simulations as well as traditional HPC research.

FRONTIERS OF COMPUTING

CARC aims to provide optimal support for the the Frontiers of Computing initiative, ensuring that USC remains at the forefront of research and innovation.

& BEYOND


THANK YOU
& FIGHT ON!
USC University of Southern California