RESEARCH COMPUTING & DATA SERVICES AT USC

CENTER FOR ADVANCED RESEARCH COMPUTING (CARC)

VITERBI SCHOOL OF ENGINEERING
NEW FACULTY ORIENTATION AUGUST 17, 2023

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 supports USC's mission by providing advanced research cyberinfrastructure and the computational expertise necessary to enable cutting-edge scientific research.
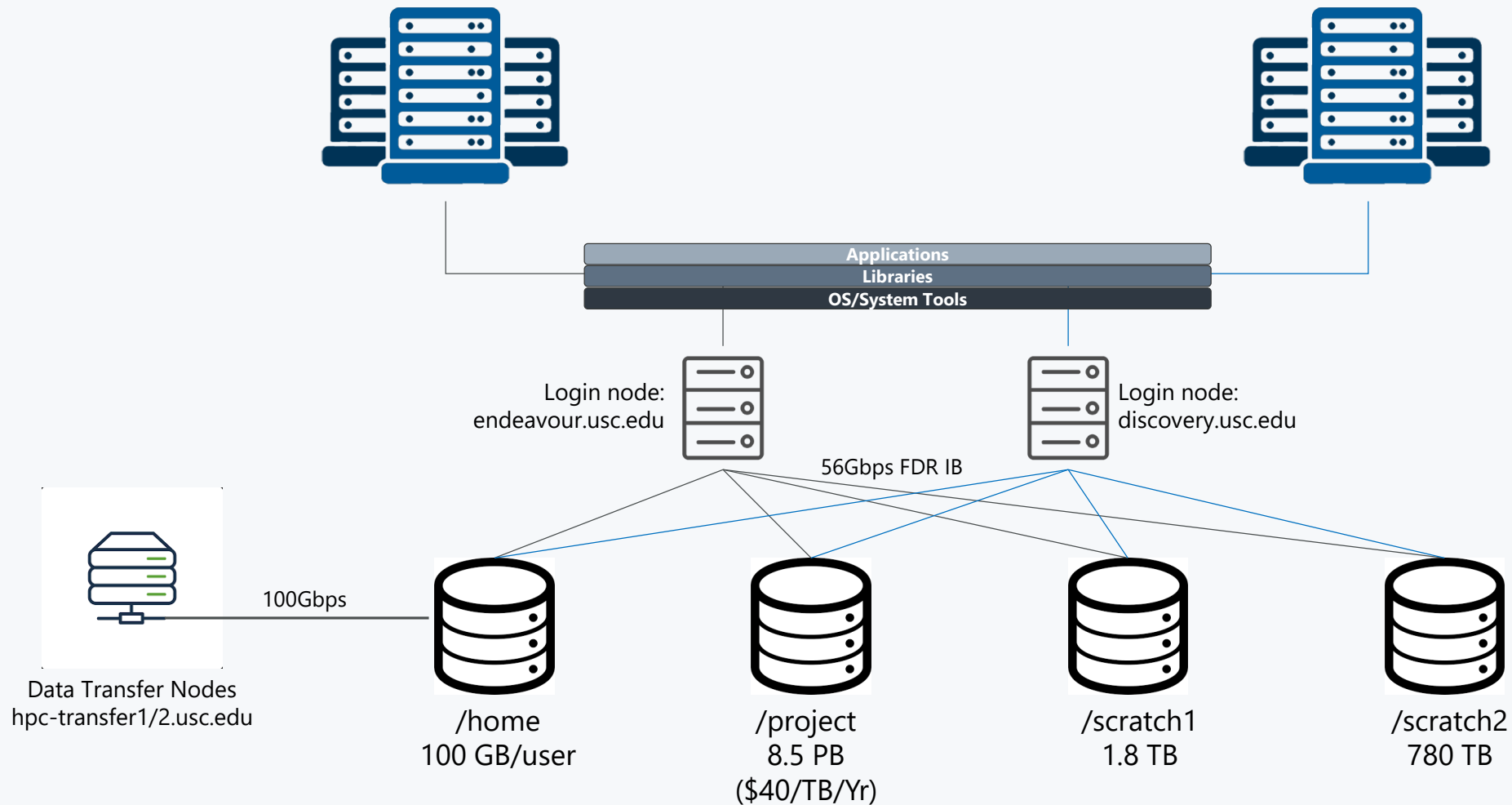
HPC RESOURCES

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	~600 nodes, totaling ~22,000 cores
	GPUs	~360 GPUs (A100, A40, K40, 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 FDR (56 Gpbs) – Soon to be upgraded to NDR
	Science DMZ	DTN w/ perfSONAR
Storage file systems	/home1	280TB total, 100 GB/user ZFS/NFS parallel file system
	/project	9PB 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.

CARC SYSTEM USAGE STATUS

Discovery HPC cluster usage status in a quick glance

# OF PROJECTS	# OF NODES ON DISCOVERY	FY23 COMPUTE PURCHASE
900+	**600**	**$0**

On Discovery

- 1000+ PI's
- 5,000 users
- 300M SU's have been allocated
- 160M SU's used on the system since inception

System Specs

- Total 22K cores
- 300+ applications
- 360 GPUs
- 148 old compute nodes will be decommissioned in FY24

New System Purchase: None

HPC Network Upgrade

- Current: FDR (56Gbps)
- Upgrading to:
  - NDR (200Gbps)

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 and storage resources on a yearly basis
- Compute resources 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

STATE OF THE NEW CONDO CLUSTER PROGRAM

Current usage for CARC's Endeavour condo cluster

# OF PROJECTS:	# OF NODES IN USE:	FY21-22 PURCHASE:
61	**900**	**$660K**

Contributions:

- Viterbi: 15 PI's, 393 nodes
- Dornsife: 26PI's, 256 nodes
- Keck: 13 PI's, 131 nodes
- Others: 2 PI's, 3 nodes

- Not including subscription nodes

System utilization:

- 22K cores
- 180 GPUs
- 42 subscription nodes
- 257 old compute nodes will be decommissioned in FY24

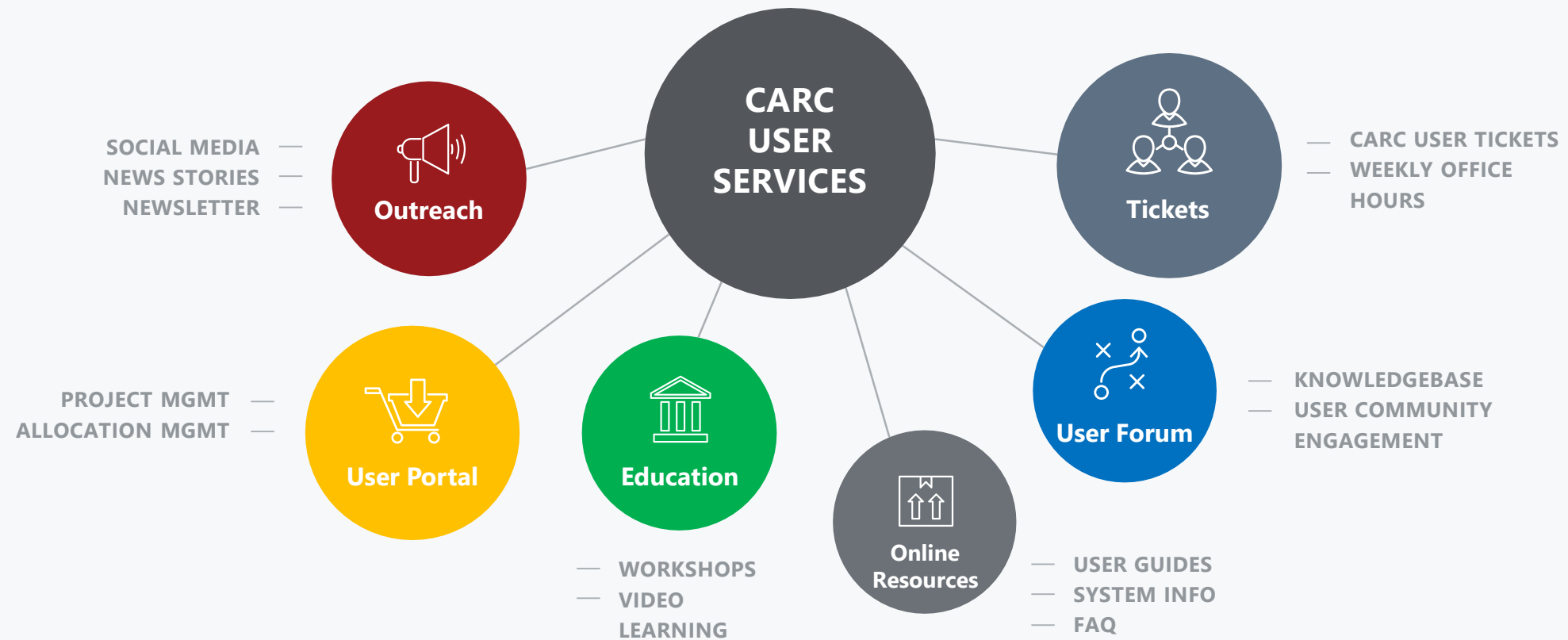**New nodes purchased:**

- 18 CPU nodes
- 9 GPU nodes (12 x A40 / 12 x A100)
- DOE cluster (18-node)

ADVANCED RESEARCH COMPUTING USER SERVICES

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

CARC USER SERVICES

Outreach
- SOCIAL MEDIA
- NEWS STORIES
- NEWSLETTER

Tickets
- CARC USER TICKETS
- WEEKLY OFFICE HOURS

User Portal
- PROJECT MGMT
- ALLOCATION MGMT

Education
- WORKSHOPS
- VIDEO LEARNING

Online Resources
- USER GUIDES
- SYSTEM INFO
- FAQ

User Forum
- KNOWLEDGEBASE
- USER COMMUNITY ENGAGEMENT

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

CARC HIGHLIGHTS

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

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 USC & Amgen –Development of Computational Ecosystem

Education & Outreach:

- More than 20 workshop classes and summer bootcamp
- ITP 450: High-Performance Computing for Applied Machine Learning
- NSF CyberTraining proposal ($300K) development with AME faculty

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
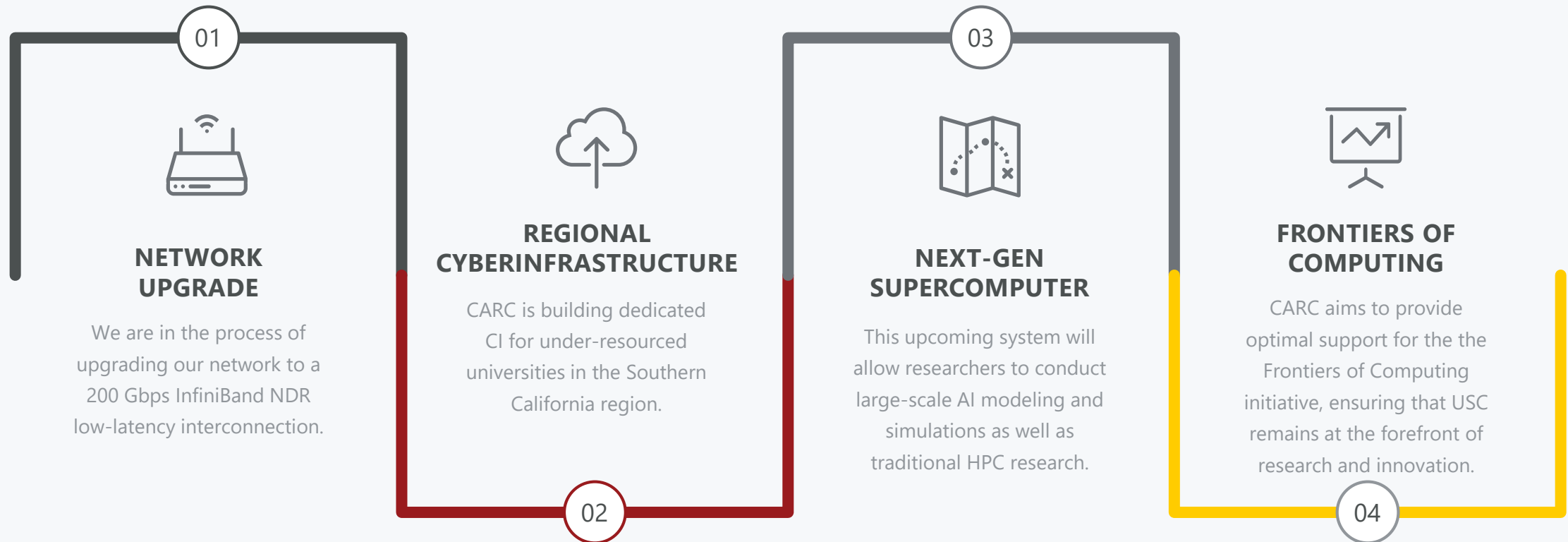- 10+PB data storage capacity

Industry Partnership:

- Samsung Semiconductor, Inc. – Full NVMe storage solution (2+PB)
- VAST Data – Advanced FS testbed
- Nvidia – Early access to Grace-Hopper next-gen system design & NSF proposal

USC RESEARCH COMPUTING & DATA ROAD MAP

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

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NETWORK UPGRADE

We are in the process of upgrading our 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.

02

03

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.

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THANK YOU
& FIGHT ON!

USC University of
Southern California